YUNEX TRAFFIC

A Siemens Business

SEPAC Actuated Signal Control Software

User/Reference Manual

SEPAC Actuated Signal Control Software

http://www.yunextraffic.com

User / Reference Manual

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- Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

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Danger

For the purpose of this manual and product labels, danger indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

Warning

For the purpose of this manual and product labels, warning indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Caution

For the purpose of this manual and product labels, caution indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Notice

This manual addresses the 5.3.0 version of the SEPAC software. The version represented in this book may not be the same as the software version you are using. Check the initial software screen to determine the date of the software on your system.

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1 Introduction

1.1 General

The Yunex Traffic SEPAC Actuated Signal Control Software is an advanced, powerful, easy-to-use intersection control package that runs on standard hardware platforms including:

- 2070 ATC units from all vendors on the CALTRANS Qualified Products List
- Yunex Traffic m60 series controllers
- ATC standard controllers

Installed in the above hardware, the Yunex Traffic SEPAC 5.3.0 Software controls all the following cabinet styles:

- NEMA TS-1 cabinets
- NEMA TS-2, Type 1 cabinets
- NEMA TS-2, Type 2 cabinets
- CALTRANS 332 cabinets
- ITS cabinet – v01.02.17b
- ATC cabinet – ATC 5301 v02.02

Because the Yunex Traffic SEPAC 5.3.0 Software is designed to operate in all the popular controller hardware and cabinet styles, the same familiar intersection programming screens are used for all cabinet and controller combinations. This greatly reduces training of personnel confronted with maintaining different cabinet and controller configurations.

A controller unit (CU) with Yunex Traffic SEPAC 5.3.0 Software provides operational capabilities in accordance with and exceeding the requirements of NEMA Standards Publication No. TS 1-1989 and TS 2-2016.

1.1.1   Modes of Operation

SEPAC operates in the following modes:

- One to four rings
- Full-, Semi-, and Non-Actuated Phases

1.1.2   Phase Timings and Functions

SEPAC provides the following timings and functions:

- Initialization
- Minimum Green
- Passage Time

- Maximum 1
- Maximum 2
- Yellow Change
- Red Clear
- Walk 1
- Walk 2
- Pedestrian Clear 1
- Pedestrian Clear 2
- Added Initial
- Maximum Initial
- Dynamic Maximum Step
- Dynamic Maximum Limit
- Time Before Reduction
- Cars Before Reduction
- Time To Reduce
- Minimum Gap
- Non-Act Response
- Vehicle Non-Locking Memory
- Vehicle Recalls
- Vehicle Recall Delay Timing
- Pedestrian Recalls
- Pedestrian Recall Delay Timing
- Dual Entry
- Last Car Passage
- Conditional Service
- Disable Simultaneous Gap
- Pedestrian Walk Offset
- Walk Offset Mode
- Programmable Detector Control
  - Phase Assignment
  - Operational Modes
    - Normal Vehicle
    - Normal Pedestrian
    - Vehicle 1 Call
    - Vehicle Stop Bar A
    - Vehicle Stop Bar B

- ▪ Protected-Permissive Left

- ▪ Protected-Permissive Through

- ▪ AND Call

- ▪ Red Protect

- ▪ Bicycle Call

  - ♦ Detector Switching

  - ♦ Extend and Delay Timing

  - ♦ Volume and Occupancy

  - ♦ Non-locking Detector

  - ♦ Call, Passage, Added Initial

  - ♦ Queue Detector and Limit

  - ♦ Detector Fail

- Selective Phase Omit

- Selective Yellow Omit

- Selective Call Omit

- Flashing Walk

- Extended Pedestrian Clear

- Actuated Rest In Walk

- Phase Copy

- Update Green

1.1.3   Unit Timings and Functions

Unit timings and functions include the following:

- Programmed Flash

  - ♦ Flash Entry Phase(s)

  - ♦ Flash Exit Phase(s)

  - ♦ Load Switch or CVM Control

  - ♦ Flash Alteration

- Ring Configurations (Up to four Rings)

- Sequences (16)

- Start-Up (Pre-Initialization)

  - ♦ Time

  - ♦ Flash (Volt Monitor Inactive)

  - ♦ All Red (Volt Monitor Active)

  - ♦ Red After Flash (Volt Monitor Active)

- Red Revert

- Automatic Pedestrian Clear
- Stop Time Reset
- Default Sequence
- Special Sequence
    - Standard NEMA
    - International Sequence
    - Standard NEMA With One Second Green
- Overlaps (16):
    - 4 Types of Overlaps
        - Standard
        - Flashing Yellow Arrow
        - Pedestrian
        - Transit Priority
    - Parent Phases
    - Minus Pedestrian Phase
    - Timed Trailing Green, Yellow, and Red
    - Preempt Trailing Green
    - Overlap Green/Yellow Omit
    - Permissive and Protected Phases
    - Permissive and Protected Overlaps
    - Walk 1
    - Walk 2
    - Pedestrian Clear 1
    - Pedestrian Clear 2
    - Auto Timing of Pedestrian Clear
- Peer to Peer Communication (NextPhase Compatible)
    - Peer Selection (Sources)
        - IP Address
        - Communication Timeout
    - Peer Functions
        - Source Functions and Index
        - Input Functions and Index
        - Failure Action
- Output Mapping
    - Phase, Pedestrian, Overlap, Pre-empt Active and Phase Status
    - Output to Load Switch

♦   Output Color to Load Switch Pin

1.1.4   Coordination Timings and Functions

Coordination timings and functions include the following:

- 256 patterns, each with
    - ♦ Cycle Length
    - ♦ Offset
    - ♦ Phase Times (Splits)
    - ♦ Coordinated Phases
    - ♦ Non-Coordinated Phase Modifiers
    - ♦ Dual Coordination
    - ♦ Operational Mode
    - ♦ Sequence Modifiers
    - ♦ Transit Priority Extensions and Reductions
- 6 Coordination Modes
- 5 Offset Correction Modes
- Transition Cycles
- Auto Permissive (Vehicle and Pedestrian)
- Sync Monitoring
- Manual Control
- Input Monitor (WRM, MCE, ST, and RF)
- Pattern Copy
- Master Line Driver Outputs

1.1.5   Time Base Timings and Functions

Time base timings and functions include the following:

- 255 Schedules, each defining:
    - ♦ Active Days of Week
    - ♦ Active Months of Year
    - ♦ Active Days of Month
    - ♦ Active Day Plan
- 255 Day Plans, each defining:
    - ♦ 15 Event Hours
    - ♦ 15 Event Minutes
    - ♦ 15 Event Actions
- 255 Actions, each with:

- Pattern/Flash/Free/Interconnect
- Phase Function Control
- Aux Function Control
- Special Function Control
- Dimming Control
- Detector Function Control

- 3 Auxiliary Outputs
- 8 Special Function Outputs
- Signal Dimming
- Alternate Detector Diagnostic Values
- System Detector Reporting
- Phase Function Mapping
- Special Function Mapping
- Day Plan Copy

1.1.6   Preemption Timings and Functions

Preemption timings and functions include the following:

- 12 Preempt Sequences with:
  - Preempt Detector Assignment including:
    - 6 Preempt Detectors
    - 64 Vehicle Detectors
    - 8 Pedestrian Detectors
    - 8 Special Detectors
  - Min Green Before Preempt
  - Min Walk Before Preempt
  - Extended Pedestrian Clearance Control
  - Lock/Non-Lock Memory
  - Delay, Extend, and Duration (Multiple Runs)
  - Railroad Gate Extension
  - Select and Return All Red
  - Track and Dwell Sequence
  - Vehicle R-G-FR-FY-DARK
  - Overlap R-G-FR-FY-DARK
  - Pedestrian DW-W-FW-DARK
  - Link to Another Preempt
  - Cycling Dwell

- ◆ Max Call Time
- ◆ Return-to-Coord on Exit
- ◆ Exit Phases
- ◆ Exit Calls
- ◆ Lockout
- Flash Override
- Transit Priority Override
- Priority of Preempts

1.1.7   Transit Priority Timings and Functions

12 Transit Priority Routines suitable for bus and light-rail, each with

- Detection

  Detectors may be selected from any of the 80 standard SEPAC detectors

  - ◆ 8 Approach Detectors
    - ▪ Toggling Preempt with Delay, Extension and Locking
    - ▪ 6 Advanced Detectors
    - ▪ Backup Detector
  - ◆ Check-out Detector
  - ◆ Cancel Detector
- Service
  - ◆ Priority Co-phase Selection
  - ◆ Exclusive Co-phase Mode
  - ◆ Queue Jump Phase Collection
  - ◆ Priority Minimum Walk
  - ◆ Priority Minimum Green
  - ◆ Priority Maximum Green
  - ◆ Lockout Inhibit
  - ◆ Self Lockout
  - ◆ Other Lockout
  - ◆ Free Pattern
- Transit Signal
- Level and Approach Timing
- Partial Priority
- Full Priority
- Full Priority Recovery

- Full Priority Queue Monitor

1.1.8   Other Timings and Functions

- 8 Special Detectors Inputs (Coordinator Inputs without System Address)
- Detector Diagnosis for Each Detector Input
    - No Activity Time
    - Max Presence Time
    - Erratic Output Count
- Assign Detectors to System Sampling Function
- Assign Detectors to Speed Trap Function
- Measurements of Effectiveness
    - Utilization (Sec of Green Used)
    - Delays (Time Waiting Sum)
    - Stops (Cars Waiting Sum)
    - Volume (Actuation Sum)
- Monitor and Log
    - Cycle Faults
    - Cycle Failure
    - Coordination Failures
    - Voltage Monitor
    - Conflict Flash
    - Local Flash
    - Automatic Flash
    - Preempt
    - Priority
    - Local Free
    - Power On/Off
- 6 Special Inputs
- 8 Special Outputs
- Respond to Remote Manual Overrides
- Revert to Local Time Base Control (TBC) On Loss Of Communications
- Upload to Remote Locations
    - Parameters
    - Logs
    - Real Time Status

- Download from Remote Locations
  - Parameters

1.1.9 Communication Configuration

Setting baud rates and IP addresses for various communication options

- RS-232 Compatible Serial Ports (2 Ports)
  - Baud Rate
  - Modem Control
  - Protocol
- IP Configuration (2 NICs)
  - Host Name
  - IP Address
  - Subnet Mask / CIDR
  - Gateway and Routing
- UTCS Configuration
  - Port Selection
  - SCOOT
  - Boston UTCS
- SCOOT Configuration
  - Stage Mapping
  - Detector Mapping
  - Phase Mode
- BTCS Coordinated Phases
- GPS Port Selection
- SPaT Addressing (16 targets)

1.1.10 Front Panel Indicators

An alpha-numeric display provides for easy visibility into program entries, timers, and the instantaneous status of current intersection operation. Front panel indicators include:

- Phase Control Indicators
  - Phase On
  - Phase Next
  - Phase Vehicle Call
  - Phase Vehicle Min, Max, and Soft Recall, and Front Panel Detector Calls

- ♦ Phase Pedestrian Call
- ♦ Phase Pedestrian Normal and Non-Act Recall
- ♦ Phase Hold
- ♦ Phase Omit
- ♦ Phase Pedestrian Omit
- ♦ Phase Bicycle Call
- Ring Status Indicators
  - ♦ Ring Walk Timer
  - ♦ Ring Pedestrian Clear Timer
  - ♦ Ring Walk Hold State
  - ♦ Ring Walk Rest State
  - ♦ Ring Advanced Walk Timer
  - ♦ Ring Delayed Walk Timer
  - ♦ Ring Min Green Timer
  - ♦ Ring Add Initial Timer
  - ♦ Ring Cars Before Reduction
  - ♦ Ring TBR Timer
  - ♦ Ring TTR Timer
  - ♦ Ring Max 1 Timer
  - ♦ Ring Max 2 Timer
  - ♦ Ring Passage Timer
  - ♦ Ring Effective Gap Time
  - ♦ Ring Last Car Passage
  - ♦ Ring Gap Out State
  - ♦ Ring Max Out State
  - ♦ Ring Force Off State
  - ♦ Ring Green Rest State
  - ♦ Ring Yellow Timer
  - ♦ Ring Red Clear Timer
  - ♦ Ring Red Revert Timer
  - ♦ Ring Red Rest State
  - ♦ Ring Stop Time State
- Overlap Status Indicators
  - ♦ Overlap Trailing Green Timer
  - ♦ Overlap Trailing Yellow Timer
  - ♦ Overlap Trailing Red Timer

- Overlap Walk Timer

- Overlap Pedestrian Clear Timer

- Miscellaneous Indicators

  - Sequence Number

  - Phase, Priority, Unit and System Bank Number

  - Change Pending

  - Operational Mode

1.1.11   Utilities

- User Access Code

- Data Manager

  - Load Default Configuration

    - Mode: Full Function or Texas Diamond

    - Software Option: FIO, TS 2, NYS, ITS, ATC, CBD

  - Load and Save Current Configuration

    - Datakey™

    - USB Flash Drive

    - Local File System

  - SPM File Management

    - Copy to USB Flash Drive

    - Move to USB Flash Drive

    - Delete Internal SPM Files

- Diagnostics

- Function Key Mapping

- Software Installation

  - USB Flash Drive

  - Local File System

  - Remote Automatic Update

1.2 Standard Features

- Standard features include the following:

  - Diagnostics

  - Data transfer

1.2.1   Diagnostics

A resident diagnostic program is standard. In addition to unit status, unit timing, and active timer countdown to aid in intersection setup, monitoring, and troubleshooting, the CU monitors its own operation automatically. It continually verifies memory and processor operation with additional capability to verify inputs, outputs, the keypad, and the display.

1.2.2   Unit to Central Server or Diagnostic PC

The CU timing and operational data, preemption data, priority routine data, coordination program data, time base data, and system data are individually transmitted to and from a central server or PC running the appropriate software. The transmissions do not interrupt normal CU operation except when ring structure data is changed. When the received ring structure data is different from that running, the receiving unit automatically reverts to the Start Flash interval. The receiving unit times the Start Flash Time and resumes normal operation in the programmed Initialization Interval.

The CU Active Status Events (Ring Timers, Coordination Timers, Preempt Timers, and Time Base Current) are individually transmitted to a central server or PC running the appropriate software.

The CU Log Reports (Local Alarms, Communications Faults, Detector Faults, System Detector Log, Measurement of Effectiveness [MOE] Report, and Speed Report) are individually transmitted to a central server or PC running the appropriate software.

The CU provides for Asynchronous Serial Data Communications with RS-232 signal levels as well as IP over Ethernet to transmit and receive configuration data.

1.3 Programming

The CU provides means to enter and view variable data, view current status, and view the event report.

The CU prevents the alteration of keypad-set unit variables prior to the user having entered a specific code. This access code is also user-programmable through the keypad.

There is a provision (user-entered code) to disable the requirement of entering an access code before alteration of keypad-set unit variables.

1.3.1   Entry

The following methods can be used to enter the CU variables:

- An integral keypad on the face of the unit
- An Ethernet or RS-232 interface and a central server or PC
- Datakey or USB Flash Drive

1.3.2   Display

The following methods can be used to view CU variables, current status, and the event report:

- Integral indication on the face of the unit

- An Ethernet or RS-232 interface and a central server or PC

The method provided includes a simultaneous display of up to 16 lines, 40 characters per line, of ASCII text (HEX 20 through HEX 7E).

1.3.3   Security

The CU maintains user-programmable variables in non-volatile memory to insure continued proper CU operation with return of power after power loss.

2 Front Panel

A CU with Yunex Traffic SEPAC software uses an alpha-numeric display and multi-position keypad to provide an interface between the user and the CU.

The CU display becomes active on power-up and remains active as long as power is applied to the unit.

2.1 Front Panel Summary

The CU display provides true visibility into program entries, timers, and the instantaneous status of intersection operation. Related parameters are visible simultaneously making verification straight forward and eliminating the need to write the data down or scan back and forth in order to remember what the parameters are.

Programming through the front panel keypad and display is easy and error free because of the English language menus with easy 1 digit selection and automatic forward and backward progressions. Within a menu, each parameter may be viewed, and changes may be made. If an error is made during programming, the operator will see a pop-up message such as OUT OF RANGE and the cursor remains at the entry parameter waiting for a valid entry. Attempts to enter parameters outside acceptable ranges are rejected on occurrence without destroying the existing values.

Context-sensitive help is available in each screen. The + key has been designated as the key to press for displaying Help text on the first 8 lines of the screen. Pressing the + key once will open the Help screen and once more will close the Help screen.

The Help screen provides information based on the field where the cursor is located when the Help is called. Closing the Help screen will return the user to the same field.

On Yunex Traffic m60 controller units the HELP key will display the Help screen on the bottom 8 lines of the 16-line display, corresponding to the field selected on the top 8 lines. See the Auto-Help Section (2.13.4) for more details.

2.1.1 Front Panel Entry

Data is entered or displayed by selecting from menus. The menus are arranged in a hierarchy consisting of a top-level menu made up of sub-menus that may or may not consist of more sub-menus. This section describes the key combination (input), the window display (output), and the purpose of each menu, sub-menu and screen.

The highest-level menus are discussed first and then each sub-menu is discussed. The Main menu (Figure 2-1) represents the highest-level menu from which the user can choose. Pressing the F or ESC key a minimum of four times will always return the user back to the top-level menu. The purpose of each menu and sub-menu is discussed along with the correct keypad selection.

Front panel entered data is cross checked on a priority basis. To enable the check to have maximum value and to minimize error messages during entry, it is suggested data be entered in a Unit, Phase, Coordination, Time Base, Preempt and System sequence.

2.1.2 Front Panel Timeout

There are 2 different types of time-outs associated with the front panel. Except when perpetual access is programmed, access is automatically turned off approximately 10 minutes after either:

- Access was gained

- The last change was entered

The front panel back light is automatically turned off approximately 10 minutes after the last front panel activity.

2.1.3 Main Menu

The Main menu (Figure 2-1) becomes active when power is supplied to the CU. It is the basic starting point for all data/status reviews and entry.

```
SEPAC # 5.3.0                    OCT 2020
            LINUX                     FIO
 1-ACTIVE STATUS     6-TIME BASE DATA
 2-UTILITIES         7-PREEMPT DATA
 3-PHASE DATA        8-PRIORITY DATA
 4-UNIT  DATA        9-SYSTEM DATA
 5-COORD DATA        0-REPORTS
 A-COPYRIGHT
```

Figure 2-1. Main Menu

The Main menu gives the date and revision number of the resident software along with providing menu options for the following:

- Active Status – For real time displays

- Utilities – For miscellaneous parameters, features and data management

- Phase Data – For phase parameters

- Unit Data – For unit parameters

- Coord Data – For coordination parameters

- Time Base Data – For time base data parameters and status

- Preempt Data – For preempt parameters

- Priority Data – For priority parameters

- System Data – For system parameters, status, and reports

- Reports – For viewing reports

- Copyright – For copyright and additional information

MAIN MENU

1-Active Status	2-Utilities	3-Phase Data	4-Unit Data	5-Coord Data
1-Ring Timers	1-Enable Access	1-Vehicle Data	1-Startup & Misc.	1-Setup Coord
2-Coord Status	2-Disable Access	2-Density Times+	2-Remote Flash	2-Manual Control
3-Preempt / Priority	3-Change Access	3-Pedestrian Data	3-Overlap Data	3-Pattern Data
4-Time Base	4-Data Manager	4-Init & NA Resp+	4-Peer-to-Peer	C-Copy Pattern
5-Communications	5-Diagnostics	5-NLock & Misc+	5-Ring Structure	D-Load Default
6-Detectors	6-Configure Ports	6-Spec. Sequence+	6- Sequences	
7-Intersection	A-Function Key Map	7-Detector Data	7-Port 1/ITS Data	
8-Port1/ITS Frames	B-Install Software	8-Phase Bank Copy	8-I/O Misc	A-Copyright
9-Input / Output		9-Sel. Phase Bank	9-Output Mapping	1-Build Info
0-MMU/CMU Mon			B-Bank Selection	
A- utcs* Status			C-Copy Bank	

6-Time Base Data	7-Preempt Data	8-Priority Data	9-System Data	0-Reports
1-View Current	1-Preempt 1	1-Priority 1	1-Communications	1-Comm Faults
2-Set Time/Date	2-Preempt 2	2-Priority 2	2-Traf Responsive	2-System Detector
3-Schedule	3-Preempt 3	3-Priority 3	3-Det Diagnostics	3-Detector Faults
4-Day Plans	4-Preempt 4	4-Priority 4	4-Local Alarms	4-Local Alarms
5-Actions	5-Preempt 5	5-Priority 5	5-Local MOEs	5-Local MOEs
6-Day Plan Copy	...	...	6-Speed Traps	6-Speed
7-Clear Memory	B-Preempt 11	B-Priority 11	B-Bank Selection	7-Cycle MOEs
8-Dimming	C-Preempt 12	C-Priority 12	C-Copy Bank	8-MMU/CMU Fault
9-Phs Func Mapping	0-Overrides	D-Load Default		9-System Message
0-Spc Func Mapping	D-Default Data			0-Peer-to-Peer
A-DST Entry				

*utcs** – 'SCOOT' or 'BTCS' depending on configuration. Option is available only when UTCS enabled.	variable	LEGEND	menu
			display

Figure 2-2. SEPAC Menu Structure

2.2 Active Status

The Active Status menu (Figure 2-3) allows the user to select which real time values will be displayed.

From the Main Menu (Figure 2-1), select **1-ACTIVE STATUS**.

```
ACTIVE STATUS

  1-RING TIMERS        6-DETECTORS
  2-COORD TIMERS       7-INTERSECTION
  3-PREEMPT/PRIORITY   8-PORT1/ITS FRAMES
  4-TIME BASE          9-INPUT / OUTPUT
  5-COMMUNICATIONS     0-MMU/CMU MONITOR
  A-SCOOT STATUS
```
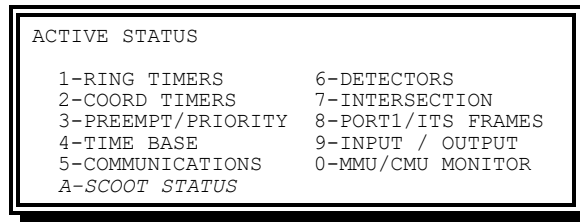
Figure 2-3. Active Status Menu

The Active Status menu includes the following options:

- Ring Timers – Provides viewing of the real time status of any 2 rings (timers and states) and phase data.

- Coord Timers – Provides viewing of the real time status of the coordination and permissive timers.

- Preempt/Priority Timers – Provides viewing of the real time status of the preemption timers and priority timers, phase utilization and queues.

- Time Base – Provides viewing of the time base time, date, and event status.

- Communications – Provides viewing of the communications status of Port 2, Port 3, IP Ethernet Ports 0 and 1, Peer-to-Peer, NTCIP, and the Ping Utility.

- Detectors – Provides viewing of the current detector status as determined by the detector diagnostics.

- Intersection – Provides viewing of the real time status of the phase, pedestrian, and overlap outputs as well as phase vehicle and pedestrian calls.

- Port1/ITS Frames – Provides viewing of the message content on TS 2 Port 1 or ITS/ATC frames.

- Input/Output – Provides viewing of the Field I/O and final input and output status.

- MMU/CMU Monitoring – Provides viewing of the NEMA TS 2 malfunction management unit (MMU) or ITS/ATC Cabinet Monitor Unit channel, fault, and status information.

2.2.1   Ring Timers

The Ring Timers menu (Figure 2-4) allows the user to select which pair of rings will be displayed.

From the Active Status menu (Figure 2-3), select **1-RING TIMERS**.

```
RING TIMERS MENU
             1-R1 + R2 TIMERS
             2-R1 + R3 TIMERS
             3-R1 + R4 TIMERS
             4-R2 + R3 TIMERS
             5-R2 + R4 TIMERS
             6-R3 + R4 TIMERS
```

Figure 2-4. Ring Timers Display

This display shows a selection of ring pairs. For example, selecting 1-R1 + R2 Timers from the Ring Timers display brings up the Ring Pairs display for Rings 1 and 2. (Figure 2-5).

```
RING TIMERS SEQ:00 B:1:1:1:1 CHG PENDING
RING 1    RING 2    PHS..12345678 90123456
MGRN 10   MGRN 10   O/N  .O. .O.  ........
WALK 05   WALK 05   VEH  CRCCCRCC ........
TBR  15   TBR  15   PED  .R.C.R.C ........
CBR  02   CBR  03   H/O  .HO..HO. ........
PASS  4   PASS  4   BACKUP  055       060
MAX1 25   MAX1 25        STOPTIME - 1/2
```

Figure 2-5. Ring Pairs Display

While this display is active, the user may place calls by pressing the following:

- A followed by 1 to 8 for phase vehicle 1 to 8
- B followed by 1 to 8 for phase vehicle 9 to 16
- C followed by 1 to 8 for phase pedestrian 1 to 8
- D followed by 1 to 8 for phase pedestrian 9 to 16

The call remains active until the key is pressed again, the user leaves the display, and the access timer times out (10 minutes after the last key press), or power is interrupted. Calls implemented this way will be denoted by a small c in the appropriate column.

Multiple calls may be placed or removed without pressing A, B, C, or D each time. To place vehicle calls on phases 1, 2, 3, and 4, press **A1234**. The A level remains active until the user presses B, C, or D, so pressing 1234 again would remove the calls placed on phases 1, 2, 3, and 4 for the A level.

In the first line of the display, the following fields are active:

- SEQ:## (where ## is a two-digit number) Sequence that is currently running.
- B:#:#:#:# (where # is 1-4) Bank that is currently running. Banks are listed in the following order: Phase, Priority, Unit and then System Bank.
- CHG PENDING: when present, indicates that configuration changes are being withheld until the top of the coordination cycle.

Ring status (active phase) indicators include the following:

- MGRN ** – Minimum Green
- AINI ** – Added Initial
- WALK1 ** – Standard Walk

- WALK2 ** – Alternate Walk
- PCLR1 ** – Standard Pedestrian Clear
- PCLR2 ** – Alternate Pedestrian Clear
- TBR ** – Time Before Reduction
- CBR ## – Cars Before Reduction (## count up)
- TTR ** – Time to Reduce
- EGAP ** – Effective Gap (gap in effect)
- PASS ** – Passage
- MAX1 ** – Maximum 1
- MAX2 ** – Maximum 2
- Overlap A-P:
  - O_x G ** – Overlap Trailing Green
  - O_x Y ** – Overlap Trailing Yellow
  - O_x R ** – Overlap Trailing Red
- OWALK1 ** – Standard Overlap Walk
- OWALK2 ** – Alternate Overlap Walk
- OPCL1 ** – Standard Overlap Pedestrian Clear
- OPCL2 ** – Alternate Overlap Pedestrian Clear
- OAWALK ** – Overlap Advanced Walk
- ODWALK ** – Overlap Delayed Walk
- GAP OUT – Gapped Out termination
- MAX OUT – Maxed Out termination
- FORCE – Forced Off termination
- LST CAR – Last Car Passage
- WLK HLD – Walk Hold state
- WLK RST – Walk Rest state
- GRN RST – Green Rest state
- YEL ** – Yellow change
- RED ** – Red clear
- RED RST – Red Rest state
- RRVT ** – Red Revert
- GDLY ** – Green Delay
- YDLY ** – Yellow Delay
- AWLK – Advance Walk
- DWLK – Delay Walk

** Interval timing with countdown

Phase status indicators include the following:

- O/N (Phase on/phase next)
    - O – On: Phase is active
    - N – Next: Phase will follow
- VEH (Vehicle Call/Recall)
    - C – A vehicle actuation call
    - c – Keypad initiated call
    - b – A bicycle actuation call or non-actuated transition
    - B – Bicycle recall
    - N – Non-actuated vehicle recall
    - R – Minimum vehicle recall
    - X – Maximum vehicle recall
    - S – Soft vehicle recall
- PED (Pedestrian call/recall)
    - C – A pedestrian call
    - c – Keypad initiated call
    - N – Non-actuated pedestrian recall
    - R – A pedestrian recall
- H/O (hold/omit)
    - H – Hold input active
    - O – Phase omit active
    - P – Pedestrian omit active

2.2.1.1   Operational Mode Indicators

One of the following, or a combination depending on the Operational Mode, may appear. The first item on the line is the Control Source. The second item on the line is the Control Plan. The third item, if available, on the line is the Pattern Timing.

Time base – 055 120

Interconn – 055 120

System – 055 120

Backup – 055 120

Manual – 055 120

Time base – FREE

Interconn – FLASH

System – FLASH

Standby – FREE

Other Operational Mode indicators include the following:

STRT FLASH – Startup Flash timing

STRT FLASH w/PREEMPT – Startup Flash and active Preempt routine

STOPTIME - 1/2 – Active Stop Time input(s)

PREEMPT - 1 – Active Preempt routine

PRI CONTROL -1 – Transit priority adjustments in progress

PRIORITY - 1 –Transit Priority in service

LOCK OUT – Coordination Omitted

QUE1 LVL1 - 055 120 – Local TR QUE1 LVL1 override

QUE1 LVL2 - 055 120 – Local TR QUE1 LVL2 override

QUE2 LVL1 - 055 120 – Local TR QUE2 LVL1 override

QUE2 LVL2 - 055 120 – Local TR QUE2 LVL2 override

DIAG FLSH – Diagnostic Fault Flash (Watchdog)

DIAG FLSH W/PREEMPT – Diagnostic Fault Flash and active Preempt routine

CAB DIAG FLSH – Diagnostic Fault Flash (MMU / CMU compatibility, MMU / CMU response, or TF BIU / SIU response)

DIAG FLSH - NO XIT – Diagnostic Fault Flash has occurred three times in a 24-hour period

CAB DIAG FLSH - NO XIT – A Cabinet Diagnostic Fault Flash has occurred three times in a 24-hour period

2.2.2 Coordination Status Menu

The Coordination Status Menu display (Figure 2-6) allows the user to view the real time status of coordination timers and parameters for the active pattern.

From the Active Status menu (Figure 2-3), select **2-COORD STATUS**.

```
COORD STATUS MENU
        1-COORD TIMERS
        2-PERMISSIVE TIMERS
        3-CAS STATUS
```
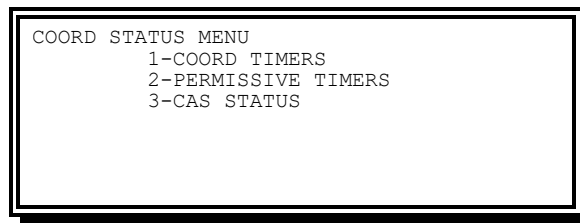
Figure 2-6. Coordination Status Menu Display

2.2.2.1 Coordination Timers

The Coordination Timers display (Figure 2-7) allows the user to view the real time status of coordination timers and parameters for the active pattern.

From the Active Status menu (Figure 2-3), select **2-COORD TIMERS**.

```
COORD TIMERS       SEQ: 01  CHG PENDING
TIME BASE   012   >  PRM/INH/BEG/PLN
  CYC   OFF   RING.....1....2....3....4
  090   011   SETTING   25   25   .   .
  060   001   ACTIVE    20   20   .   .
 -010  -010   ADJUST - 05 - 05   .   .
  SYNC: 090   PHSE   2-1  6-1   .   .
  CORR: SW+   PERM   3-P  7-P
```

Figure 2-7. Coordination Timers Display

In the first line of the display:

- The Sequence that is currently running is defined by SEQ: ## (where ## is a 2-digit number)

- CHG Pending – a change has been made to the current pattern, which will be introduced at the top of the cycle

Status indicators include the following:

- Time Base – Time Base is in control and the Mode is pattern, FREE, or FLASH.

- Interconn – Interconnect is in control and the Mode is pattern, FREE, or FLASH.

- System – System is in control and the Mode is pattern, FREE, or FLASH.

- Backup – Time Base is in control because of system or interconnect failure and the Mode is pattern, FREE, or FLASH.

- Manual – Manual Mode is in control and the pattern.

- Standby – System is in control and STANDBY FREE is the Mode.

- > – Denotes there is a command to change patterns.

- PRM/INH/BEG/CYC – Denotes the coordination/maximum/offset/and force-off modes currently running.

Coord modes include the following:

- PRM – Permissive

- YLD – Yield

- PYL – Permissive Yield

- POM – Permissive Omit

- SOM – Sequential Omit

- FAC – Full Actuated Control

Max modes include the following:

- INH – Max Inhibited

- MX1 – Max 1

- MX2 – Max 2

Offset modes include the following:

- BEG – Beginning of Green

- END – End of Green

Force-off modes include the following:

- PLN – Time in pattern
- CYC – Time in Cycle

Other modes include the following:

- AS – Adaptive Split

Pattern indicators include the following:

- CYC (Cycle Length)
    - SETING Line – Current pattern cycle length value
    - ACTIVE Line – Local cycle countdown
    - ADJUST Line – Adjustment this cycle
- OFF (Offset)
    - SETING Line – Current pattern offset value
    - ACTIVE Line – Offset at beginning of cycle
    - ADJUST Line – Adjustment this cycle
- RING #
- SETING Line – Current phase split
- ACTIVE Line – Phase countdown
- ADJUST Line – Adjustment this cycle (plus/minus)
- PHSE Line – Pattern Phase and Mode
    - Mode 0 – Actuated phase
    - Mode 1 – Coordination phase
    - Mode 2 – Minimum recall phase
    - Mode 3 – Maximum recall phase
    - Mode 4 – Pedestrian recall phase
    - Mode 5 – Maximum + pedestrian recall phase
    - Mode 6 – Phase omitted
    - Mode 7 – Dual coordination phase

PERM Line – Permitted phase and control

- Control > – Force
- Control H – Hold
- Control P – Pedestrian permissive
- Control V – Vehicle permissive
- Control Y – Permissive yield

CORR (Correction) – Correction mode in effect. Modes include the following:

- DW – Dwell
- MDW- Max Dwell
- SW – Shortway
- SW+ – Shortway add only.
- SW2-Shortway + correction

SYNC – System cycle count up

> **NOTE: When running multiple clusters, the CYC, SYN, OFF, and COR are for the Ring 1 cluster.**

2.2.2.2   Coord Permissive Status

The Coordination Timers Display also allows the user to view the real time status of the coord permissive status for the active pattern via the Coordination Permissive Status Display (Figure 2-8).

From the Coordination Status Menu display (Figure 2-6), press 2.

```
PERM RING 1-4 STATUS
            RING.....1....2....3....4
            PHSE   2-1  6-1    .    .
  CYC: 120  ACTIVE  20   20    .    .
            PERM   3-P  7-P    .    .
            P-TM    0    0     .    .
```

Figure 2-8. Coordination Permissive Status Display

Indicators on this display include the following:
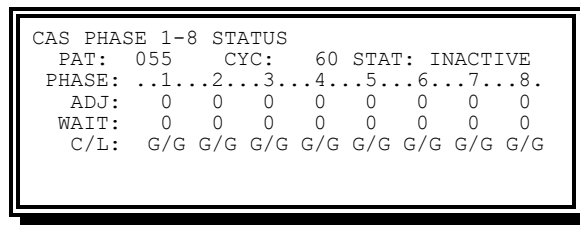
- PHSE – Pattern Phase and Mode (same as Coord Timers)
- ACTIVE – Phase Split countdown (same as Coord Timers)
- PERM – Permitted Phase and State
    - Control > – Force
    - State 0 – Coord Phase is held
    - State 1 – Coord Phase is timing but not held
    - State 2 – Timing Pedestrian Permissive
    - State 3 – Timing Vehicle Permissive
    - State 4 – Timing a no Permissive Period
    - State 5 – Period there is no Phase
    - State 6 – Leaving State 5
    - State 7 – Back to Coord Phase
    - State 8 – Period no Phase can be selected
    - State 9 – Perm Yield waiting for Gap Out
    - State A – Perm Yield period waiting to start

- ♦ State B – Perm Delay for Yield Operation
- P-TM – Permissive Timing (tenths)

2.2.2.3 Coordination Adaptive Split Status

The Coordination Timers display also allows the user to view the real time status of the Coordination Adaptive Split (CAS) status for the active pattern via the Coordination Adaptive Split Status Display (Figure 2-9).

From the Coordination Status Menu display (Figure 2-6), press **3**.

```
CAS PHASE 1-8 STATUS
  PAT:  055    CYC:   60 STAT: INACTIVE
 PHASE: ..1...2...3...4...5...6...7...8.
  ADJ:   0   0   0   0   0   0   0   0
 WAIT:   0   0   0   0   0   0   0   0
  C/L:  G/G G/G G/G G/G G/G G/G G/G G/G
```

Figure 2-9. Coordination Adaptive Split Status Display

Line 2 status and timing indicators include the following:

- PLAN – Running pattern
- CYC – Time in Cycle
- STAT – Adaptive Split Status
  - ♦ INACTIVE – CAS is not running
  - ♦ ACTIVE – CAS is running; no adjusts (for example, correction active)
  - ♦ APPLIED – CAS is running; adjustment is possible

Line 4 Phase Adjustments include the following:

- ADJ – Phase Adjustment this Cycle (plus/minus)

Line 5 Phase waiting indicators include the following:

- WAIT – Adjust Priority # (largest is highest)

Line 6 current/last Cycle Status indicators include the following:

- C/L – Current and last cycle termination status
- F – Forced
- G – Gapped
- N – Neutral (no adjustment)

2.2.3 Preempt / Priority Displays

From the Active Status menu (Figure 2-3), press **3-PREEMPT/PRIORITY**.

```
PREEMPT/PRIORITY DISPLAYS
 1-PREEMPT TIMERS
 2-PRIORITY TIMERS
 3-PRIORITY DETECTORS
 4-PRIORITY STATUS
 5-PRIORITY PHASE UTILIZATION
 6-PRIORITY VEH QUEUE-LRT/TSP
```

Figure 2-10. Preempt / Priority Menu

The Preempt / Priority menu includes the following options:

- Preempt Timers – Preempt Timers and Status are shown

- Priority Timers – Priority Timers and Status are shown

- Priority Detectors – Input Source and Status of Priority Detectors

- Priority Status – Reserved for future use

- Priority Phase Utilization – High resolution timer display of various phase states

- Priority Vehicle Queue – Running list of priority requests and approach timings

2.2.3.1   Preempt Timers

The Preempt Timers display (Figure 2-11) allows the user to view a real time status of Preemption Timers and Input Status for any active Preempt.

```
PREEMPT TIMERS
 PREEMPT 1 TRK GRN   5
PREEMPT.....1....2....3....4....5....6.
 STATUS...  DUR  CAL
 TIMING...  100
PREEMPT.....7....8....9...10...11...12.
 STATUS...  DEL  DEL
 TIMING...  000   25
```

Figure 2-11. Preempt Timers Display

Line 2 Status and Timing Indicators include the following:

- PREEMPT # – Preempt 1 to 12 is in control

- MIN GRN – Minimum Green/Walk is timing

- SEL PCL – Selective Pedestrian Clear is timing

- SEL YEL – Selective Yellow Change is timing

- SEL RED – Selective Red Clear is timing

- TRK GRN – Track Green is timing

- TRK PCL – Track Pedestrian Clear is timing

- TRK YEL – Track Yellow Change is timing

- TRK RED – Track Red Clear is timing

- DWL GRN – Dwell Green is timing

- RET PCL – Return Pedestrian Clear is timing

- RET YEL – Return Yellow Change is timing

- RET RED – Return Red Clear is timing

- ### – Interval Timing countdown

Lines 4 and 7 status indicators include the following:

- LOC – Global Lockout

- DEL – Delay timing

- DUR – Duration timing

- EXT – Extend timing

- CAL – Call active (not timing)

- MAX – Maximum Call time out occurred

Lines 5 and 8 timing indicators include the following:

- ### – Status Timing Countdown

2.2.3.2 Priority Timers

```
PRIORITY TIMERS
 PRIORITY 2
PRIORITY...1....2....3....4....5....6...
  STATUS.. DUR  CAL
  TIMING.. 100
PRIORITY...7....8....9...10...11...12...
  STATUS..
  TIMING..
```

Figure 2-12. Priority Timers Display

Line 2 Status and Timing Indicators include the following:

- Driving Priority Type

  - PRIORITY –Minimal priority

  - PART PRI – Partial priority

  - PART SWP – Partial priority with Sequence Swap

  - FULL PRI – Full priority

  - AUTO F2P – Full priority running as partial

  - FPF P4F – The FPF timer is timing. User has set PP4 FUL to 1

  - FPF 4NF – The FPF timer is timing. User has set PP4 FUL to 0

  - RCVRY2FP – Recovery interrupted by full priority

  - F2PEXT2F – Full priority demoted to partial had to be promoted again to full to complete extension

  - FP ABORT – Full priority aborted

  - P2F OVRD – Partial priority promoted to full priority

- Driving Priority Number (1-12)

- Primary Service Interval

- ◆ CYCLING – Preparing for co-phases
- ◆ WAITING – Co-phases active ahead of time
- ◆ DWL GRN – Co-phase service is being provided
- ◆ HBAR – Vehicle stop displayed (horizontal bar or red)
- ◆ FL HBAR – Vehicle pre-green displayed (flashing horizontal bar or red)
- ◆ VBAR – Vehicle right of way displayed (vertical bar or green)
- ◆ FL VBAR – Vehicle clearance displayed (flashing vertical bar or triangle or yellow)
- ◆ RECOVERY – Priority is ending
- Primary Service Interval Time
- Secondary Service Priority (SS=)
- Secondary Service Priority # (1-12)
- Secondary Service Interval (as above)
- Secondary Service Interval Time

Lines 3 and 6 display priority number columns 1-12

- #   – No priority service
- #=P – Primary service by the driving priority
- #=S – Secondary service is being hosted by primary service
- #LP – Locked primary service
- #LS – Locked secondary service
- #=R – Recall priority display service
- #BR – Backup recall priority service

Lines 4 and 7 display priority status text

- TSD – Time of service desired timing
- TED – Time of estimated departure timing
- TTL – Time to live timing
- MNG – Minimum green timing
- MXG – Maximum green timing
- CAL – Priority call received
- LOC – Priority currently locked out
- EXT – Extension timing
- E4C – Extension used
- G4C – Green time diverted
- GEC – Green time diverted plus extension time

- CHK – Checkout has been received

Lines 5 and 8 display priority status text

- ### - Current timer value

- Tmo – Timeout

- Tss – Secondary service expired

- Tsc – Timeout closest vehicle

- Tpo – Timeout due to preempt operation

- Ncc – No closest call

- GLB – Lockout source is global

- CYC – Priority cycle lockout

- WTG – Priority time lockout

- CAL – Priority call waiting for preempt

- INH – Maximum timeout inhibited

2.2.3.3 Priority Detectors

The Priority Detectors Display (Figure 2-13) allows the user to view a real time status of the Priority's eight Advance Detectors and two Control Detectors.

```
PRIORITY 1 DETECTORS: TSD FAR->NEAR
LOGICAL: .PE..1A..BU..2A..3A..4A..5A..6A
INP SRC: 248  65  66   0   0   0   0   0
STATUS : ...  ..F ..F ..N ..N ..N ..N ..N
TIMING :   0   0   0   0   0   0   0   0
     LOG INP STS TIM  LOG INP STS TIM
      C  67  ..F   0   X  68  ..F   0
 UP/DOWN - PREV/NEXT PRIORITY
```

Figure 2-13. Priority Detectors Display

- LOGICAL / LOG – The Advance Detectors are listed in order from far to near based on the time of service desired (TSD).

- INP SRC / INP – The Input Source is shown. Detectors are 1-80 and Preempt Inputs 1-6 are 248-253, respectively.

- STATUS / STS – The Detector Status Indicator as:

  - . (period) – Assigned detector is OFF

  - RCV – Detector is ON

  - B – Blocked detector

  - D – Timing detector delay

  - E – Timing detector extend

  - F – Failed detector diagnostics

  - N – Not assigned

- TIMING – Delay and extension timing in seconds
- The fields along the bottom provide similar information for the control detectors Checkout (C) and Cancel (X)

2.2.3.4 Priority Status

The Priority Status screen is not yet implemented.

2.2.3.5 Phase Utilization Timers

The Phase Utilization Timers displays show various configurations and timers critical to Priority operation.

```
PRIORITY 1 PAT055 SEQ01 PH.1PR.1UN.1SY.1
PHASE......1...2...3...4...5...6...7...8
CPHZ*10     0   0   0   0   0   0   0   0
USED*10     0   0   0 371   0   0   0 371
IMPC*10     0   0   0   0   0   0   0   0
PRED*10     0   0   0   0   0   0   0   0
PEXT*10     0   0   0   0   0   0   0   0
PPHZ*10   300 400 300 400 300 400 300 400
```

Figure 2-14. Phase Utilization Timers

Note: only phases 1 - 8 are available at this time.

All timer fields are shown in tenth seconds.

- Service Type – Priority Service type currently running:
  - PRIORITY – No Service Running (Default), Minimal Priority or Priority Recall
  - PART PRI – Partial Priority
  - PART SWP – Partial Priority Swap
  - FULL PRI – Full Priority
  - RCVRY2FP – Recovery to Full Priority
  - P2F OVRD – Partial to Full Priority Override
  - AF2P 2F – Auto Full to Partial to Full
- Active Priority – Active (driving) Priority whose data is being displayed
- PAT – Current Pattern if coordination is active
- SEQ## – Sequence number
- PH# – Active Phase Bank number
- PR# – Active Priority Bank number
- UN# – Active Unit Bank number
- SY# – Active System Bank number
- CPHZ*10 – Coordination Phase Time
- USED*10 – Accumulated Phase ON Time
- IMPC*10 – Impact of Priority action on the phase

- PRED*10 – Partial Priority Phase Reduction Time
- PEXT*10 – Partial Priority Phase Extension Time
- PPHZ*10 – Priority Base Phase Time

2.2.3.6   Priority Vehicle Queue

The Priority Vehicle Queue displays information about the nearest six vehicles that are to be given priority service.

```
VEH#..P.ST.TSD.TED.TTL.EXP-INVK.ACT-INVK
   5  2  6   0  76  54 321..... 32......
   2  1  9   0  18  83 128..... 12......
   4  1  9  75  32  97 128..... 12......



 PRIORITY VEH QUEUE-LRT/TSP
```

Figure 2-15. Priority Vehicle Queue Display

Each line of the queue represents an approaching vehicle. The lines are sorted from top to bottom by nearness, i.e., by increasing TSD. It displays the approach timers and the detectors activated as the vehicles get nearer.

- VEH# – Vehicle Number in the queue. Range 1-9999, then rolls over
- P – Priority Number to be served for that vehicle
- ST – State of the Priority
    - CODE 0 (Not Active) – Priority Control is not in effect for this approaching vehicle and may be cancelled. The vehicle is not close enough to require active management.
    - CODE 1 (Active) – Priority Control is in effect for this approaching vehicle but may still be cancelled. The intersection is being adjusted to accommodate this vehicle's approaching Priority Service.
    - CODE 6 (Serving) – Primary Priority Service is being provided to this vehicle.
    - CODE 7 (Cancel) – The Priority request has been cancelled and vehicle is timing down to be dropped from the queue.
    - CODE 9 (Committed) – The vehicle has passed the closest detector and may not be cancelled. Priority Service is imminent.
    - CODE 10 (Secondary) – Secondary Priority Service is being provided to this vehicle on the back of the Primary Service.
- TSD – Time of Service Desired in seconds. The time provided for the vehicle to travel from the detector to the point where the Priority Service is needed.
- TED – Time of Expected Departure in seconds. The time provided for the vehicle to travel from the detector to the point where it clears the intersection. This should typically cover about 75-90% of the expected cases. This value is primarily used to determine if a Partial Priority may be substitute for a Full Priority, thus preserving coordination.

- TTL – Time to Live in seconds. The time provided to keep the vehicle alive in the queue. For detectors other than the closest, the timing of TTL to zero causes the vehicle to be dropped from the queue. A vehicle cannot be dropped after passing the closest detector even if TTL times down.

- EXP-INVK – Expected Invocation Order. The order in which this vehicle is expected to trigger the approach detectors.

  - CODE 1 – Preempt detector

  - CODE 2-7 – Advance detectors 1-6, respectively

  - CODE 8 – Backup detector

- ACT-INVK – Actual Invocation. The detectors actually triggered and the order in which they were triggered.

2.2.4   Time Base Current

The Time Base Current Display (Figure 2-16) allows the user to view the current time base status and control modes.

From the Active Status menu (Figure 2-3), press **4-TIME BASE**.

```
TIME BASE - CURRENT
   MON   5/ 4/15  12: 4:37  DST TIME *
   SCH:   4   DAY PLAN:  4  ACTION:   1
------TRAFFIC------   ----AUXILIARY----
 PATTERN.: 055          A:***     DIM:N
                        D:***
 P:******** ********   S:********
CODES: (#)-ON  (.)-OFF  (*)-NOT DEFINED
```

Figure 2-16. Time Base Current Display

Line 2 status indicators include the following:

- Day of the Week – The current day of the week is displayed in an abbreviated English format (for example, SUN, MON, etc.)

- Date – The current date (month/day/year) is displayed

- Time – The current time (hour/minute/second) is displayed

- DST – The current programming and status for DST is displayed

NOTE: DST must be disabled if a time zone is set on the operating system. For example, when SafeSuite web is used to change the time zone. In such cases STD time will be displayed during daylight saving time.

Line 3 status indicators include the following:

- SCH (Schedule) – The active Schedule number. Prior to the first action time in a new Day Plan, this will show # > indicating a new schedule is appropriate but no action is defined before the current time

- DAY PLAN – The active Day Plan number. Prior to the first action time in a new day plan, this will show # > indicating a new day plan is appropriate but no action is defined before the current time

- ACTION – The active Action number. There are times when the active action will come from the day plan that started the prior day (when no action exists between midnight and the current time)

In the Traffic Event section, the current coordination pattern, flash, free, and phase function are displayed. Indicators include the following:

- PATTERN – Pattern (0-255)
- P: 123456789 0123456 – Phase Function (#) – On (.) – Off

In the Auxiliary Event Section, the current status of each Auxiliary, Special Function, Detector Diagnostic Parameters, System Detector Report, and Dimming Event Structure is displayed. Indicators include the following:

- A: 12*   Auxiliary Control   + or function num: On; . : Off; * : Not Defined
- D: .2.   Detector Control   + or function num: On; . : Off; * : Not Defined
- S: ********   Special Func Control   + or function num: On; . : Off; * : Not Defined
- DIM: N   Dimming Control   N - Off and Y - On

When the Time Base Current Display (Figure 2-16) is active and access is enabled, the user may activate the Auxiliary, Special Function, and Phase Function options by pressing the following:

- A, followed by 1 to 3 to turn on Auxiliary Function 1-3
- B, followed by 1 to 8 to turn on Special Function 1-8
- C, followed by 1 to 8 to turn on Phase Function 1-8
- D, followed by 1 to 8 to turn on Phase Function 9-16

The function will remain on until the key is pressed again, you leave the display, and the access timer times out (10 minutes after the last key press), or power is interrupted. Action implemented this way will be denoted by a plus sign (+).

Multiple Outputs may be turned on or off without pressing A, B, C, or D each time. To turn on Auxiliary 1, 2, and 3, **press A123**. Until the user presses B, the A level remains active, so pressing 123 again would turn off the outputs for the A level.

2.2.5   Communications Status Menu

The Communications Status Menu allows the user to view a variety of communication status related to the CU Operation.

From the Active Status Menu (Figure 2-3), press **5-COMMUNICATIONS**.

```
COMMUNICATIONS MENU

        1-SYSTEM COMM STATUS
        2-IP CONFIG STATUS
        3-PEER-TO-PEER STATUS
        4-NTCIP NETWORK STATUS
        5-PING UTILITY
```
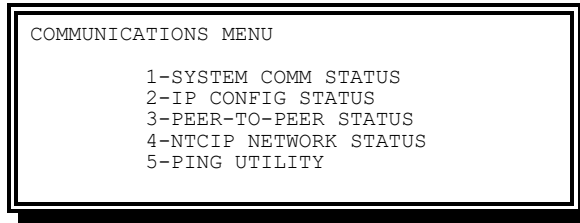
Figure 2-17. Communications Status Menu

The Communication Status Menu has the following options:

- System Comm Status – Provides viewing of current Serial Communications Status

- IP Config Status – Provides viewing of IP Configuration Status of the CU for all configured network interfaces

- Peer-to-Peer Status – Provides viewing of Peer-to-Peer Status

- NTCIP Network Status – Provides viewing of NTCIP Status

- Ping Utility – Provides for sending ICMP Ping messages to an IP Address

2.2.5.1 Communication Status

The Communication Status Display (Figure 2-18) allows the user to view the current status of communications on Port 2 (RS232 connector) and Port 3 (System Interface Connector).

From the Communications Status Menu Display (Figure 2-17), press **1-SYSTEM COMM STATUS**.

```
COMM STATUS
                ..ECOM 2..  ..NTCIP3..
  SETTINGS....: 1200,8N1    1200,8N1
  STATUS......: OFF LINE    OFF LINE
  CARRIER.....: ACTIVE      INACTIVE
  TRANSMITTING: DATA - ACK
  RECEIVING...: DATA-VALID
```
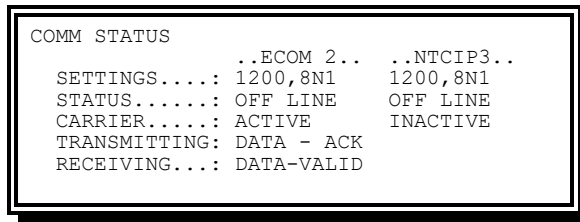
Figure 2-18. Communications Status Display

Information on this display includes the following:

- Settings – Denotes the Speed, Data Bits, Parity, and Stop Bits programmed for communicating through that port

- Status – Denotes the current communications status of both Port 2 and Port 3 communications link

  - Port 2

    - ON LINE – Data Carrier Detect (DCD) input is TRUE

    - OFF LINE – Data Carrier Detect input is FALSE

  - Port 3

    - ON LINE – Data Carrier Detect input is TRUE

- ONLN-NOSYS - Data Carrier Detect input is TRUE but a system address is not programmed

- FAILED - Data Carrier Detect input is TRUE, a System Address is programmed, but the unit has not been polled since power was applied or within the Backup Time

- OFF LINE - Data Carrier Detect input is FALSE

- Carrier – Denotes the current Carrier Status for that port (ACTIVE or INACTIVE).

- Transmitting – Denotes when the CU is Transmitting Data (DATA) through that port plus the response returned (ACK or NAK)

- Receiving – Denotes when the CU is Receiving Data (DATA) through that port plus the validity of that reception (VALID or ERROR)

2.2.5.2   IP Configuration Status

The IP Configuration Status Display gives an overview of the controller's IP network configurations.

From the Communications Status Menu Display (Figure 2-17), press **2-IP CONFIG STATUS**.

```
IP CONFIG STATUS

     INTERFACE: eth0
            IP: 10.227.27.142
       NETMASK: 255.255.0.0
DEFAULT GATEWAY: 10.227.1.1
      HOSTNAME: ATC2070-SIEMENS
 UP/DOWN TO SCROLL
```

Figure 2-19. IP Configuration Status Display

All active IP network interfaces may be displayed, including the loopback interface. Use UP and DOWN to scroll through and examine all of the interfaces.

2.2.5.3   Peer-to-Peer Status Menu

The Peer-to-Peer Status Menu allows the user to view Peer-to-Peer status for Sources, Functions, and Subscribers.

From the Communications Status Menu Display (Figure 2-17), press **3-PEER-TO-PEER STATUS**.

```
PEER-TO-PEER STATUS MENU

        1-SOURCE STATUS
        2-FUNCTION STATUS
        3-SUBSCRIBER STATUS
```

Figure 2-20. Peer-to-Peer Status Menu

The Peer-to-Peer Status menu includes the following options:

- Source Status – Provides viewing of Peer-to-Peer Source Status

- Function Status – Provides viewing of Peer-to-Peer Function Status

- Subscriber Status – Provides viewing of Peer-to-Peer Subscriber Status

2.2.5.3.1   Peer-to-Peer Source Status

The Peer-to-Peer Source Status Display allows the user to view the Peer Sources active status and Network statistics. They are displayed in the same order they were configured on the Peer-to-Peer Sources Display.

```
PEER-TO-PEER SOURCE STATUS
   PEER                    STATUS NET
01 WASHINGTON-MAIN         Active 100%
02 Peer68129               Active  99%
03 Fail03                  ConnEr  50%
04 Fail04                  Trying   0%
05 MLK-AND-FIRST           Active 100%
 UP/DOWN TO SCROLL         C-CLEAR NET
```

Figure 2-21. Peer-to-Peer Source Status Display

The Peer-to-Peer Source Status Menu includes the following options:

- Peer (Peer Name) – The Peer name for that configured peer

- Status (Peer Status) – The Peer's current status. See Table 2-1 below for more details

- Net (Network Percentage) – The percentage of successful Peer-to-Peer communication with this Source over the last hour. It accounts for missed heartbeats, disconnects, timeouts, and function publishes

The control key C allows the clearing of all the network percentages.

Table 2-1. Peer-to-Peer Source Status	
Status	**Description**
Active	Connected and Active
Trying	Trying to connect
Refuse	Connection was refused by the Peer
DstUnr	Destination was unreachable via the current network settings
ConnEr	Disconnected because of a network error or timeout
DupId	Peer responded with DupId, meaning it already has a Peer with the same System Address. Only reported by NextPhase CU's
SrvFul	Peer responded it is full of Subscriptions

2.2.5.3.2   Peer-to-Peer Function Status

The Peer-to-Peer Function Status Display allows the user to view the Peer Functions active status. They are displayed in the same order they were configured on the Peer-to-Peer Functions Display.

```
PEER-TO-PEER FUNCTION STATUS
   PEER      SRCFCN  IDX INFCN    IDX STAT
01 WASHINGT PhsGrn   10 PhsCall    1 On
02 Peer6812 PreAct    3 PreCall    3 Off
03 Fail03   PhsYel    6 PhsCall    1 Foff
04 Fail04   VehDet   45 PhsCall    1 Foff
05
 UP/DOWN TO SCROLL
```

Figure 2-22. Peer-to-Peer Function Status Display

The Peer-to-Peer Source Function Status Menu includes the following options:

- Peer (Peer Name) –The name for the Peer that the Peer Function is configured for. This will truncate to only the first 8 characters

- SRCFCN (Source Function) –The Source Function that is configured

- IDX (Source Function Index) – The Source Function Index that is configured

- INFCN (Input Function) – The Input Function that is configured

- IDX (Input Function Index) – The Input Function Index that is configured

- STAT (Function Status) – The active Status for the Function. See Table 2-2 below for more details.

Table 2-2. Peer-to-Peer Function Status	
Status	**Description**
Off	Source Function is Off and therefore the Input Function is Off
On	Source Function is On and therefore the Input Function is On
Foff	Peer is in failed state and therefore this function is in its programmed failed state of Off
Fon	Peer is in failed state and therefore this function is in its programmed failed state of On

2.2.5.3.3 Peer-to-Peer Subscriber Status

The Peer-to-Peer Subscriber Status Display allows the user to view the active Peer-to-Peer subscribers, the function(s) they are subscribing, and network statistics.

```
PEER-TO-PEER SUBSCRIBER STATUS
   PEER                 SRCFCN  IDX NET
1 WASHINGTON-MAIN       PhsGrn    2 100%
2 GREATOAK-MAIN         PhsGrn    2 100%
3 MLK-AND-FIRST         PreCall   1 100%
4
5
UP/DOWN TO SCROLL              C-CLEAR NET
```

Figure 2-23. Peer-to-Peer Subscriber Status Display

The Peer-to-Peer Source Subscriber Status Menu includes the following options:

- Peer (Peer Name) – The Peer name for the Subscriber

- SRCFCN (Source Function) – The Source Function that is being provided by the Local CU to this Peer

- IDX (Source Function Index) – The Source Function Index that is being provided by the Local CU to this Peer

- NET (Network Percentage) – The Percentage of Peer-to-Peer communication with this Subscriber over the last hour. It mainly accounts for missed heartbeats

The control key C allows the clearing of all the network percentages.

2.2.5.4   NTCIP Network Status

The NTCIP Network Status Display allows the user to view the current communications status and statistics for NTCIP.

```
NTCIP NETWORK STATUS
        ...SNMP PORT...  ...STMP PORT...
 IP..: 10.227.1.15      0.0.0.0
 TYPE: SNMP REQUEST     UNKNOWN REQ
 INP : 624              0
 OUTP: 624              0
 REQ.: snmpOutGetResp
```

Figure 2-24. NTCIP Network Status Display

Statistics for both SNMP and STMP protocols are reported:

- IP – The IP Address associated with the last NTCIP transaction

- Type – The Type of the last transaction

- INP – The total number of NTCIP messages received

- OUTP – The total number of NTCIP messages sent

- REQ – The current request being served

2.2.5.5   Ping Utility

The Ping Utility Display allows the user to send a series of three ICMP Ping messages to an IP Address to confirm network connectivity, update router tables, etc.

```
PING UTILITY

  IP: 192.168.  0.  1  PING: 1

  RESULT 1: NO RESPONSE
  RESULT 2: OK
  RESULT 3: WAITING FOR RESPONSE
```

Figure 2-25. Ping Utility Display

The Ping Utility Status Menu includes the following options:

- IP – The IP address to Ping

- PING – Any entry initiates the Ping

- RESULT 1/2/3 – The Ping is attempted 3 times, and this displays the result of each

2.2.6   Detector Status

The Detector Status Display (Figure 2-26) allows the user to view the current detector status as determined by the detector diagnostics.

From the Active Status menu (Figure 2-3), press **6-DETECTORS**.

```
SYSTEM – DETECTOR STATUS
VEH DET....1...2...3...4...5...6...7...8
  STATUS   0   0   0   0   0   0   0   0
VEH DET....9..10..11..12..13..14..15..16
  STATUS   0   0   0   0   0   0   0   0
CODES: 0-ON LINE..FAIL:.1-MP.2-NA.3-EC..
       4-NS.5-BIU.6-LWD.7-LO.8-LS.9-LC..
UP/DOWN - PREV/NEXT DISPLAY
```

Figure 2-26. Detector Status Display

The **UP** and **DOWN** arrow keys allow the user to page through all detectors.

To view the status for the remainder of the Vehicle Detectors (17–64), press **DOWN** from the initial Detector Status Display (Figure 2-26). There are a total of four screens for the vehicle detectors.

To quickly view Special and Pedestrian Detectors 1-8 (Figure 2-27), press **UP** from the initial Detector Status Display (Figure 2-26).

```
SYSTEM – DETECTOR STATUS
SPC DET....1...2...3...4...5...6...7...8
  STATUS   0   0   0   0   0   0   0   0
PED DET....1...2...3...4...5...6...7...8
  STATUS   0   0   0   0   0   0   0   0
CODES: 0-ON LINE..FAIL:.1-MP.2-NA.3-EC..
       4-NS.5-BIU.6-LWD.7-LO.8-LS.9-LC..
UP/DOWN - PREV/NEXT DISPLAY
```

Figure 2-27. Detector Status Display – Special and Pedestrian Detector

The status codes used on the Detector Status display include the following:

- Code 0 (ON LINE) – Denotes that the detector is operating within the parameters established for diagnostic faults
- Code 1 (MP) – Denotes that the detector failed the CU Maximum Presence Diagnostic
- Code 2 (NA) – Denotes that the detector failed the CU No Activity Diagnostic
- Code 3 (EC) – Denotes that the detector failed the CU Erratic Counts Diagnostic
- Code 4 (NS) – Denotes that the detector is Not Supported, i.e., FIO input is not available. The detector was assigned but:
  - Port 1 is disabled
  - Port 1 is enabled but BIU/SIU is not present
  - Port 1 is enabled but BIU/SIU is not enabled

- Code 5 (BIU) – Denotes that a Response Frame Fault occurred for the BIU

- Code 6 (LWD) – Denotes that the Detector BIU Channel Status Input for the detector is OFF. This may indicate:

  - The detector is NOT a TS 2 detector

  - The detector has failed

  - The detector watchdog time-out has occurred

- Code 7 (LO) – Denotes that the detector reported an Open Loop Fault to the detector BIU

- Code 8 (LS) – Denotes that the detector reported a Shorted Loop Fault to the detector BIU

- Code 9 (LC) – Denotes that the detector reported an Excessive Inductance Change Fault to the detector BIU

2.2.7   Intersection

The Intersection Display (Figure 2-28) allows the user to view the active status of all phase, pedestrian, and overlap outputs as well as vehicle and pedestrian calls.

From the Active Status menu (Figure 2-3), press **7-INTERSECTION**.

```
INTERSECTION     SEQ:00 B:1
 PHASE.....1234.5678.9012.3456
  V SIG..: RGRR YRRR .... ....
  P SIG..: DWDD DDDD .... ....
  V CALL.: C..C .C.C .... ....
  P CALL.: ...C .C.C .... ....
 OVERLAP...ABCD.EFGH.IJKL.MNOP
  V/P SIG: GtHR .... .... ....
```

Figure 2-28. Intersection Display

On the Intersection Display, the user may place calls by pressing the following:

- A, followed by 1 to 8 for phase vehicle 1 to 8 calls

- B, followed by 1 to 8 for phase vehicle 9 to 16 calls

- C, followed by 1 to 8 for phase Pedestrian 1 to 8 calls

- D, followed by 1 to 8 for phase Pedestrian 9 to 16 calls

The call remains in effect until the key is pressed again, the user leaves the display, and the access timer times out (ten minutes after the last key press), or power is interrupted. Calls implemented in this way are denoted by a small c.

Multiple calls may be placed or removed without pressing A, B, C, or D each time. To place vehicle calls on phases 1, 2, 3, and 4, press **A1234**. Until B, C, or D is pressed, the A level remains active, so pressing 123 again would turn off the outputs for the A level.

- In the first line of the display, the Sequence that is currently running is defined by SEQ: ## (where ## is a two-digit number)

The per-phase intersection indicators include the following:

- • V SIG – Vehicle output status:
  - ♦ [G] – Green [Y] – Yellow [R] – Red
- • OVERLAP – A-P Overlap Output Status:
  - ♦ [G] – Green [Y] – Yellow [R] – Red
  - ♦ [V] – Vert Bar [v] – Flashing Vert Bar [t] – Flashing Triangle
  - ♦ [H] – Horiz Bar [h] – Flashing Horiz Bar
  - ♦ [W] – Walk [w] – Flashing Walk
  - ♦ [D] – Don't Walk [d] – Flashing Don't Walk
- • P SIG – Pedestrian output status:
  - ♦ [W] – Walk [w] – Flashing Walk
  - ♦ [D] – Don't Walk [d] – Flashing Don't Walk
- • V CALL – Phase Vehicle Call Status
  - ♦ [C] – Phase Vehicle has a call
  - ♦ [c] – Phase Vehicle has a temporary call from screen
- • P CALL – Phase Pedestrian Call Status
  - ♦ [C] – Phase Pedestrian has a call
  - ♦ [c] – Phase Pedestrian has a temporary call from screen

2.2.8   Port 1/ITS Frames

The status screens provided are dependent on which type of cabinet is being used; NEMA TS 2 or ITS/ATC/CBD.

2.2.8.1   Port 1 Frames (TS 2)

The Port 1 Frame View Display (Figure 2-29) allows the user to view the data content of command and response frames that occur on Port 1.

From the Active Status Menu (Figure 2-3), press **8-Port1/ITS FRAMES**.

```
PORT 1 FRAME VIEW

 COMMAND FRAME:    0   9  10  11  12  13
                  24  25  26  27  42  43
RESPONSE FRAME: 129 131 138 139 140 141
148 149 150 151 152 153 154 155 158 169
- ENTER FRAME ### TO VIEW DATA:    0
TEES 2002 TIMER
```

Figure 2-29. Port 1 Frame View Display (TS 2)

See Chapter 15 for a complete list of all Command and Response Frames along with a definition of their content bit by bit.

Assuming 131 is entered above, a display like Figure 2-30 would be shown.

```
FRAME 131 DATA
BIT  01234567 01234567 01234567 01234567
009  01000010 00000000 00000000 00000000
041  10111101 00000000 00000000 00000000
073  00000000 00000000 ........ ........
105  ........ ........ ........ ........
137  ........ ........ ........ ........
A-UP B-DN C-NewData D-REVERSE E-FRME ###
```

Figure 2-30. Frame Data Display (TS 2)

When more than one page is required to display the data:

- Press DOWN ARROW or A to move forward through the data

- Press UP ARROW or B to move backward through the data

- Press C to display the next new occurrence of that message

- Press D to reverse the order of the bits in each byte of data displayed

- Press E and then three digits to display the next occurrence of the message for the three digits entered

2.2.8.2   ITS / ATC Frames

The ITS / ATC Frames displays (Figure 2-31 for ITS and Figure 2-32 for ATC) allows the user to view the data content of ITS command and response frames.

From the Active Status Menu (Figure 2-3), press **8-Port1/ITS FRAMES**.

```
ITS FRAMES.ITS DISPLAY & OPS
 1-INPUT ASSY DETECTORS
 2-CMU LOAD SW DRIVERS MSG 61/67 OUT
 3-CMU LONG STATUS      MSG 189 IN
 4-CMU CONFIG: DATAKEY MSG 193 IN
 5-CMU SHORT STATUS    MSG 195 IN
 C-REFRESH     0-RUN ONCE ITS/CBD SEEK
SIU:.....56..9A.... CMU:F.. IO:.. FMT:6
```

Figure 2-31. Frames Display for ITS Software Option

```
 ATC DISPLAY & OPS
 1-INPUT ASSY DETECTORS
 2-CMU LOAD SW DRIVERS MSG 81/67 OUT
 3-CMU LONG STATUS      MSG 209 IN
 4-CMU CONFIG: DATAKEY MSG 210 IN
 5-CMU SHORT STATUS    MSG 195 IN
 C-REFRESH     0-RUN ONCE ITS/CBD SEEK
SIU.1.......9A.... CMU:F... IO:.. FMT:15
```

Figure 2-32. Frames Display for ATC Software Option

Menu options for the ITS Frames display include the following:

- INPUT ASSY DETECTORS – Provides viewing of the Status of the Inputs (mostly detectors)

- CMU LOAD SW DRIVERS MSG OUT – Provides viewing of the load switch driver outputs (message 61/67 for ITS cabinet and message 81/67 for ATC cabinet)

- CMU LONG STATUS MSG IN – Provides viewing of CMU Long Status message responses (message 189 for ITS cabinet and 209 for ATC cabinet)

- CMU CONFIG STATUS MSG IN – Provides viewing of CMU Config Data Key message responses(message 193 for ITS cabinet and message 210 for ATC cabinet)

- CMU SHORT STATUS MSG 195 IN – Provides viewing of message 195 responses (CMU Short Status)

Line 7 options include the following:

- C-REFRESH – Press the C key while this menu is active to refresh the Line 8 status

- 0-RUN ONCE ITS/CBD SEEK – Press the 0 key while this menu is active to cause the program to reinitialize the ITS SDLC processing

Line 8 status indicators include the following:

- SIU – The SIU status based on Unit Data programming (see Section 2.5.8.2)
    - . (period) – In the relative position means the address is not active
    - # (number 0-9 and A-E) – In the relative position means the address is active and operating properly
    - P (upper case) – In the relative position means the address is active and experienced a problem during initialization
    - x (lower case) – In the relative position means the address is active and experienced one error (error = 2 consecutive Response Faults)
    - X (upper case) – In the relative position means the address has experienced two more consecutive response faults during the attempt to recover from a lower-case x condition

- CMU – the CMU status based on Unit Data Programming (see Section 2.5.8.2).
    - The status shown is and has the same meaning as noted above for SIUs. The only difference is the number shown when the address is active and operating properly (first position will show an F)

- IO – The AUX IO status based on Unit data programming (see Section 2.5.8.2).
    - J(upper case) – AUXIO by CABSIM
    - K(upper case) – AUXIO by FIO-2A

- FMT – The form of the Output Assemblies based on unit data programming (see Section 2.5.8.2 and Chapter 16 Section 16.1.2)
    - 1 – ITS Cabinet Output Assemblies 14-0-0-0
    - 2 – ITS Cabinet Output Assemblies 14-0-14-0
    - 3 – ITS Cabinet Output Assemblies 14-0-6-0
    - 4 – ITS Cabinet Output Assemblies 14-0-6-6
    - 5 – ITS Cabinet Output Assemblies 6-0-0-0
    - 6 – ITS Cabinet Output Assemblies 6-6-0-0

- ♦ 7 – ITS Cabinet Output Assemblies 6-6-6-0
- ♦ 8 – ITS Cabinet Output Assemblies 6-6-6-6
- ♦ 9 – ITS Cabinet Output Assemblies 6-0-14-0
- ♦ 10 – ITS Cabinet Output Assemblies 6-6-14-0
- ♦ 11 – CBD Cabinet Output Assembly
- ♦ 12 – CBDv2 cabinet output assemblies 14 channel output
- ♦ 13 – CBDv2 cabinet output assemblies 28 channel output
- ♦ 14 – CBDv2 cabinet output assemblies 32 channel output
- ♦ 15 – ATC cabinet output assemblies 16 channel output
- ♦ 16 – ATC cabinet output assemblies 32 channel output
- ♦ U – UNKNOWN (not programmed)
- ♦ S – SEEK. During initialization of ITS SDLC, while trying to validate the output format

2.2.8.2.1 Input Assembly Detectors

The status display provided depends on whether an ITS/ATC or CBD cabinet is used.

ITS/ATC Cabinet

The ITS Input Assembly Detectors Display (Figure 2-33) is described in this section.

From the ITS Frames display (Figure 2-31), press **1-INPUT ASSY DETECTORS**.

```
   ATC INPUT ASSY DETS & 1stOPTOS ----
SLOT#: 123456789012         123456789012
IN1 F: -----------1  IN1 W: -----------1
IN2 F: ------------  IN2 W: ------------
IN3 F: .......OFF..  IN3 W: .......OFF..
IN4 F: .......OFF..  IN4 W: .......OFF..
IN5 F: .......OFF..  IN5 W: .......OFF..
ITS Pass Delay-> Peak:0     Now:0
```

Figure 2-33. ITS/ATC Input Assembly Detectors Display (ATC Shown)

Information on this display includes the following:

- 1stOPTOS – Opto Isolator Inputs from the first Output Assembly
  - ♦ - (dash) – The SIU is enabled, and the input is NOT active
  - ♦ 1 (one) – The SIU is enabled, and the input IS active
  - ♦ The SEPAC follows the ATC ITSv1 2002 location for the 1stOPTOs to be in the first Output Assembly unless there are no Output Assemblies, wherein the location of the 1stOPTOs becomes the first Input Assembly
  - ♦ For ATC ITSv2 (ATC cabinet), the OPTOs in the primary output assembly are always used
- IN1 F – Input Assembly #1 Pin F; Channel 1 status
- IN1 W – Input Assembly #1 Pin W; Channel 2 status

- IN2 F – Input Assembly #2 Pin F; Channel 1 status

- IN2 W – Input Assembly #2 Pin W; Channel 2 status

- IN3 F – Input Assembly #3 Pin F; Channel 1 status

- IN3 W – Input Assembly #3 Pin W; Channel 2 status

- IN4 F – Input Assembly #4 Pin F; Channel 1 status

- IN4 W – Input Assembly #4 Pin W; Channel 2 status

- IN5 F – Input Assembly #5 Pin F; Channel 1 status

- IN5 W – Input Assembly #5 Pin W; Channel 2 status

    - \- (dash) – The SIU is enabled (Unit Data – F47) and the slot Pin F is NOT active

    - 1 – The SIU is enabled, and the slot Pin F IS active

    - Off Line – The SIU IS enabled but has not responded

    - OFF – The SIU is NOT enabled (Unit Data – F47).

- ITS Pass Delay-> – The delay in SB#1 (SDLC Serial Bus 1) relative to the tenth second task.

    - Peak – The largest Delay since reset

    - Now – The current Delay (expected delay is zero)

    This is a SB#1 Performance Indicator (press key E to reset the Peak Value)

CBD v1 Cabinet

The CBD Inputs Display (Figure 2-34) is described in this section.

From the ITS Frames display (Figure 2-31), press **1-INPUT ASSY DETECTORS**.

```
CBD INPUTS              SIU -> 1  ONLINE
VEH DET (01-12) ------------
PED DET (01-08) X.X.X.X.
STOP TIME .  LOCAL FLASH .
INTERVAL ADVANCE         .
MANUAL CONTROL ENABLE    .
WALK REST MODIFIER       .
ITS Pass Delay-> Peak:0      Now:0
```

Figure 2-34. CBD Inputs Display

Information on the CBD Inputs Display includes the following:

- SIU -> 1 – Status

    - SIU -> 1 ONLINE – The SIU is enabled and responding correctly

    - SIU -> 1 OFFLINE – The SIU is enabled and NOT responding

    - SIU -> ? OFFLINE – When the Unit Data Programming contains NO output format selection (see Section 2.5.8.2)

- VEH DET (01-12) – Vehicle Detectors 01 to 12

    - \- (dash) – The Input is NOT active

    - 1 (one) – The Input IS active

    The CBD vehicle detector order is:

Slot	1	2	2	4	5	6
Pin F	3	1	7	5	11	9
Pin W	4	2	8	6	12	10

Table 2-3. CBD Detector Order

- PED DET (01-08) – Pedestrian Detectors 01 to 08
    - . (dot) – The Input is NOT active
    - 1 (one) – The Input IS active
    - X – The Input is NOT available
- Stop Time– Denotes that the controller has been put into Stop Time either manually or by remote control
- Local Flash – Denotes that the cabinet has been put into Local Flash either through the Police Panel Switch or by remote control
- Interval Advance – Denotes that Manual Advance of the controller is activated, and that the controller is waiting for a Manual Interval Advance
- Manual Control Enable – MCE is active, and the controller is ready for Interval Advance Inputs
- Walk Rest Modifier – A Walk/Rest in Walk Modifier is applied to the controller
    - . (dot) – The input is NOT active
    - 1 (one) – The input IS active. For Local Flash, this represents the logical input as the physical input is false when in flash
- ITS Pass Delay-> – The delay in SB#1 (ITS SDLC Serial Bus 1) relative to the tenth second task
    - Peak – The largest delay since reset
    - Now – The current delay (expected delay is zero)
    - This is an SB#1 Performance Indicator (press key E to reset the peak value)

2.2.8.2.2 CMU Load SW Drivers Msg Out

The CMU Load SW Drivers Msg Out Data display is described in this section.

From the ITS Frames display (Figure 2-31), press **2-CMU LOAD SW DRIVERS MSG 61/67 OUT** when Software option is selected as ITS.

```
CMU MSG 61/67 OUT DATA      -> F OFFLINE
 LOAD SWITCHES & DARK MAP
CHNL=12345678 90123456 78901234 56789012
RED: -------- -------- -------- --------
YEL: -------- -------- -------- --------
GRN: -------- -------- -------- --------
 DARK MAP: 03=M#4
ITS Pass Delay-> Peak:104    Now:103
```

Figure 2-35. ITS CMU MSG 61/67 Out Data Display

And press **2-CMU LOAD SW DRIVERS MSG 81/67 OUT** when Software option is selected as ATC.

```
CMU MSG 81/67 OUT DATA      -> F ONLINE
 LOAD SWITCHES & DARK MAP
CHNL=12345678 90123456 78901234 56789012
RED: -111-111 1111---- -------- --------
YEL: -------- -------- -------- --------
GRN: 1---1--- -------- -------- --------
DARK MAP: 03=M#4
ATC Pass Delay-> Peak:104    Now:103
```

Figure 2-36. ATC CMU MSG 81/67 Out Data Display

- OUT DATA ->
    - F ONLINE – The CMU address is online
    - F OFFLINE – The CMU address is offline
- CHNL RED – Channel Red Status
- CHNL YEL – Channel Yellow Status
- CHNL GRN – Channel Green Status
    - - (dash) – The Output is NOT active
    - 1 (one) – The Output IS active
- DARK MAP – See CMU programming of the expected dark signals (for example, pedestrians during flashing)
    - 00 – Map 1 (SEPAC – normal operation)
    - 01 – Map 2 (SEPAC – internally generated preemption)
    - 02 – Map 3 (not assigned)
    - 03 – Map 4 (SEPAC – internally generated flashing)
- ITS Pass Delay-> – The delay in SB#1 (ITS SDLC Serial Bus 1) relative to the tenth second task
    - Peak – The largest delay since reset
    - Now – The current delay (expected delay is zero)
    - This is a SB#1 performance indicator (press key E to reset the peak value)

2.2.8.2.3   CMU Long Status Msg In

The CMU Long Status Msg RSP display is described in this section.

From the ITS Frames display (Figure 2-31), press **3-CMU LOAD STATUS MSG 189 IN** when Software option is selected as ITS.

```
CMU MSG 189 RSP
CMU STATUS - LONG FORMAT    View  1 of  5
  1> 189 000 00  00  00   00  ff  0f <  8
  9> 00  00  ff  0e  00   00  ff  0f < 16
 17> 00  00  00  00  00   00  00  00 < 24
 25> 00  00  00  00  00   00  7e  00 < 32
 33> 117 121 120 000 000 120 119 119< 40
ITS Pass Delay-> Peak:0       Now:0
```

Figure 2-37. ITS CMU MSG 189 RSP Display

From the ITS Frames display (Figure 2-31), press **3-CMU LOAD STATUS MSG 209 IN** when Software option is selected as ATC.

```
CMU MSG 209 RSP
CMU STATUS - LONG FORMAT    View  1 of  7
  1> 209 000 00  00  00   00  ff  0f <  8
  9> 00  00  ff  0e  00   00  ff  0f < 16
 17> 00  00  00  00  00   00  00  00 < 24
 25> 00  00  00  00  00   00  7e  00 < 32
 33> 117 121 120 000 000 120 119 119< 40
ATC Pass Delay-> Peak:0       Now:0
```

Figure 2-38. ATC CMU MSG 209 RSP Display

NOTE: A Help screen is available. Help is restricted to the current view (1-5).

Five screens are required to present a complete Message 189 (in ITS) and 209(in ATC) Response (use the A, B, Up, or Down arrow keys to cycle through the display). The display shows a byte-by-byte presentation of the SB#1 frame content.

Each line begins with a ##> that notes the Data Frame Byte Number of the first data in the line. Each line ends with a <## that notes the Data Frame Byte Number of the last data in the line.

- ITS Pass Delay-> – The Delay in SB#1 (ITS SDLC Serial Bus 1) relative to the tenth second task.
    - Peak – The largest Delay since reset
    - Now – -The current Delay (expected delay is zero)
    - This is an SB#1 Performance Indicator (press key E to reset the Peak Value)

2.2.8.2.4   CMU Config: Datakey Msg In

The CMU Config Datakey Msg RSP display is described in this section.

From the ITS Frames display (Figure 2-31), press **4-CMU CONFIG: DATAKEY MSG 193 IN** when Software option is selected as ITS.

```
CMU MSG 193 RSP
CMU CONFIGURATION        View  1 of 13
 1> 01  e0  00  00  80  38  00  00 <  8
 9> 00  07  00  00  80  03  00  40 < 16
17> 1c  00  00  70  00  00  00  00 < 24
25> 00  10  00  00  00  00  00  00 < 32
33> 00  00  02  00  00  00  00  00 < 40
ITS Pass Delay-> Peak:0      Now:0
```

Figure 2-39. ITS CMU MSG 193 RSP Display

From the ITS Frames display (Figure 2-31), press **4-CMU CONFIG: DATAKEY MSG 210 IN**
when Software option is selected as ATC.

```
CMU MSG 210 RSP
CMU CONFIGURATION        View  1 of 13
 1> 01  e0  00  00  80  38  00  00 <  8
 9> 00  07  00  00  80  03  00  40 < 16
17> 1c  00  00  70  00  00  00  00 < 24
25> 00  10  00  00  00  00  00  00 < 32
33> 00  00  02  00  00  00  00  00 < 40
ATC Pass Delay-> Peak:0      Now:0
```

Figure 2-40. ATC CMU MSG 210 RSP Display

NOTE: A Help screen is available. Help is restricted to the current view (1-13).

Thirteen screens are required to present a complete Message 193(in ITS) and 210 (in ATC)
Response (use the A, B, Up, or Down arrow keys to cycle through the display). The display
shows a byte-by-byte presentation of the SB#1 frame content.

Each line begins with a ##> that notes the data frame byte number of the first data in the
line. Each line ends with a <## that notes the data frame byte number of the last data in the
line.

- ITS Pass Delay-> – The delay in SB#1 (ITS SDLC Serial Bus 1) relative to the tenth
  second task
    - Peak – The largest Delay since reset
    - Now – The current Delay (expected delay is zero)
    - This is a SB#1 performance indicator (press key E to reset the peak value)

2.2.8.2.5   CMU Short Status Msg 195 In

The CMU Message 195 RSP display (Figure 2-41) is described in this section.

From the ITS Frames display (Figure 2-31), press **5-CMU SHORT STATUS MSG 195 IN**.

```
CMU MSG 195 RSP
CMU STATUS - SHORT FORMAT  View  1 of  1
 1> 195 003 ff  0f  00  00  ff  0f <  8
 9> 00  00  db  06  00  00  ff  0f < 16
17> 00  00  71  00  ff  00  000 000< 24


ITS Pass Delay-> Peak:0      Now:0
```

Figure 2-41. CMU MSG 195 RSP Display

NOTE: A Help screen is available.

This display presents a complete Message 195 Response. The display shows a byte-by-byte presentation of the SB#1 frame content.

Each line begins with a ##> that notes the data frame byte number of the first data in the line. Each line ends with a <## that notes the data frame byte number of the last data in the line.

- ITS Pass Delay-> – The delay in SB#1 (ITS SDLC Serial Bus 1) relative to the tenth second task
  - Peak – The largest Delay since reset
  - Now – The current Delay (expected delay is zero)
  - This is a SB#1 Performance Indicator (press key E to reset the peak value)

2.2.9   Input/Output

The Input/Output Displays allow the user to view the state of each Input and Output pin present on the connectors. These displays show the status of the Input and Output pin regardless of the function caused by alternate I/O Modes.

From the Active Status menu (Figure 2-3), press **9-INPUT/OUTPUT**.

```
I/O MENU
          1-ABC INPUT STATUS
          2- D  INPUT STATUS
          3-ABC OUTPUT STATUS
          4- D  OUTPUT STATUS
          5-FINAL INPUT STATUS
          6-SIGN CONTROL STATUS
```

Figure 2-42. I/O Menu

The status display provided depends on the software option (FIO, TS2, ATC, etc.). (See Section 2.3.4.1).

2.2.9.1   FIO (NEMA) and TS2

The status displays in this section appear when the software option is FIO or TS2.

2.2.9.1.1   ABC Input Status

From the I/O menu (Figure 2-42), press **1-ABC INPUT STATUS**.

```
ABC INPUT STATUS
  ES -.   TIB-.   ST -..   VDET-12...6.8
  MCE-.   ILC-.   ORC-..   PDET-.2......
  EMR-.   WRM-.   RR -..   OMIT-........
  NA2-.   IA -.   MX2-..   POMT-........
  NA1-.   TIA-.   FO -..   HOLD-........
  IOM-0   FM -.   PR -..   PMPT-X.X...
                  IMT-..
```

Figure 2-43. ABC Input Status Display – FIO and TS2 (NEMA)

An X in a field indicates the status is not provided.

The ABC input status indicators include the following:

- Unit Input displays a 1 next to the name when active (first two columns)
- Ring Input displays the ring number (1 or 2) next to the name when active (third column)
- Phase Input displays the phase number (1 to 8) next to the name for which the input is applied, such as the VDET above (fourth column)

Unit inputs

- ES – External Start Active
- MCE – Manual Control Enable
- EMR – External Minimum Recall
- NA2 – Non-actuated Two
- NA1 – Non-Actuated One
- IOM – Input/Output Mode Bits Value
- TIB – Test Input B
- ILC – Indicator Lamp Control
- WRM – Walk Rest Modifier
- IA – Interval Advance
- TIA – Test Input A
- FM – Free Mode

Ring inputs
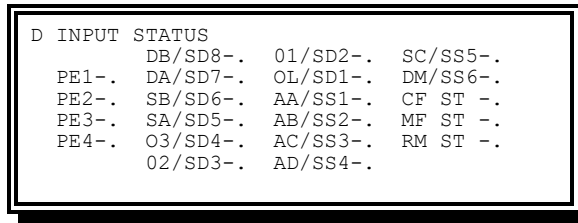
- ST - Stop Time
- ORC – Omit Red Clear
- RR – Red Rest Mode
- MX2 – Maximum Two
- FO – Force Off
- PR – Pedestrian Recycle
- IMT – Inhibit Maximum Termination

Phase inputs

- VDET – Vehicle Detector
- PDET – Pedestrian Detector
- OMIT – Omit
- POMT – Pedestrian Omit
- HOLD – Hold
- PMPT – Preempt

2.2.9.1.2 D Input Status

From the I/O Menu (Figure 2-42), press **2-D INPUT STATUS**.

```
D INPUT STATUS
         DB/SD8-.   01/SD2-.   SC/SS5-.
  PE1-.  DA/SD7-.   OL/SD1-.   DM/SS6-.
  PE2-.  SB/SD6-.   AA/SS1-.   CF ST -.
  PE3-.  SA/SD5-.   AB/SS2-.   MF ST -.
  PE4-.  O3/SD4-.   AC/SS3-.   RM ST -.
         02/SD3-.   AD/SS4-.
```

Figure 2-44. D Input Status Display – FIO and TS2 (NEMA)

This D Input Status Display (Figure 2-44) shows the status of all Connector D Inputs. Input displays a 1 next to the name when active.

- PE1 – Preempt One
- PE2 – Preempt Two
- PE3 – Preempt Three
- PE4 – Preempt Four
- DB/SD8: Dial B / System Detector 8
- DA/SD7: Dial A / System Detector 7
- SB/SD6: Split B / System Detector 6
- SA/SD5: Split A / System Detector 5
- O3/SD4: Offset 3 / System Detector 4
- O2/SD3: Offset 2 / System Detector 3
- O1/SD2: Offset 1 / System Detector 2
- OL/SD1: On Line / System Detector 1
- AA/SS1: Alt Sequence A / Special Status 1
- AB/SS2: Alt Sequence B / Special Status 2
- AC/SS3: Alt Sequence C / Special Status 3
- AD/SS4: Alt Sequence D / Special Status 4
- SC/SS5: Set Clock / Special Status 5
- DM/SS6: Dimming / Special Status 6
- CF ST / Conflict monitor status
- MF ST / Manual flash status
- RM ST / Remote flash status

2.2.9.1.3 ABC Output Status

From the I/O Menu (Figure 2-42), press **3-ABC Output Status**.

```
ABC OUTPUT STATUS
 PHSE 12345678 PHSE 12345678  OVLP ABCD
  RED-*.***.**  ON -.*...*..   RED-**..
  YEL-........  NXT-........   YEL-....
  GRN-.*...*..  CHK-...*...*   GRN-....
  DWK-********  FM -*          CS1-*..
  PCL-........  VM -*          CS2-*..
  WLK-........  FL -.
```
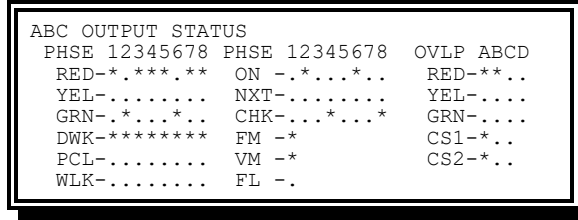
Figure 2-45. ABC Output Status Display – FIO and TS2 (NEMA)

The ABC Output Status Display (Figure 2-45) shows the status of all Connector A, B, and C Outputs. Outputs displays an asterisk (*) next to the name when active.

- Under PHSE 12345678
    - GRN – Phase Green
    - YEL – Phase Yellow
    - RED – Phase Red
    - DWK – Phase Don't Walk
    - PCL – Phase Pedestrian Clear
    - WLK – Phase Walk
    - ON – Phase On
    - NXT – Phase Next
    - CHK – Phase Check
    - FM – Fault Monitor
    - VM – Voltage Monitor
    - FL – Flash Logic
- Under OVLP ABCD
    - GRN – Overlap Green
    - YEL – Overlap Yellow
    - RED – Overlap Red
    - CS1 – Coded Status Ring 1
    - CS2 – Coded Status Ring 2

2.2.9.1.4   D Output Status

From the I/O Menu (Figure 2-42), press **4-D Output Status**.

```
D   OUTPUT STATUS

    A1-.   DA/SF7-.   SA/SF5-.   O1/SF2-.
    A2-.   DB/SF8-.   SB/SF6-.   02/SF3-.
    A3-.   FL/SF1-.              03/SF4-.
```
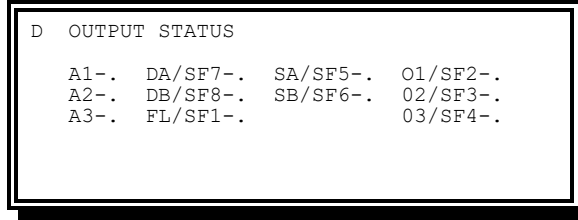
Figure 2-46. D Output Status Display – FIO and TS2 (NEMA)

The D Output Status Display (Figure 2-46) shows the status of all Connector D outputs.
Outputs display a 1 next to the name when active.

- A1 – Auxiliary 1
- A2 – Auxiliary 2
- A3 – Auxiliary 3
- DA/SF7: Dial A / Special Function 7
- DB/SF8: Dial B / Special Function 8
- FL/SF1: Flash / Special Function 1
- SA/SF5: Split A / Special Function 5
- SB/SF6: Split A / Special Function 6
- 01/SF2: Offset 1 / Special Function 2
- 02/SF3: Offset 2 / Special Function 3
- 03/SF4: Offset 3 / Special Function 4

2.2.9.1.5   Final Input Status

From the I/O Menu (Figure 2-42), press **5-Final Input Status**.

```
FINAL INPUT STATUS
V DET (01-16)  .2.4.6.8........ ST - .
V DET (17-32)  ................ IA - .
V DET (33-48)  ................ LF - .
V DET (49-64)  ................ MCE- .
SP DET(1-8)    ........        RR - .
PED DET (01-08).2...6..        WRM- .
PREEMPT (01-06)......
```
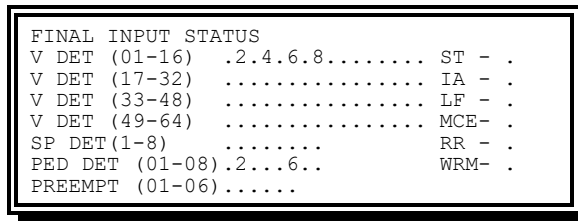
Figure 2-47. Final Input Status Display – FIO and TS2 (NEMA)

The Final Input Status Display (Figure 2-46) shows the state of the detector, Preempt, and
several other control inputs after all processing and I/O mapping has been completed.

- CODE . (period) – The input is not active
- CODE # – the input # is active. Number shown is the ones digit of the detector number
- ST – Stop Time
- IA – Interval Advance
- LF – Local Flash

- MCE – Manual Control Enable (Police Panel)
- RR – Red Rest
- WRM – Walk Rest Modifier

2.2.9.1.6 Sign Control Status

From the I/O Menu (Figure 2-42), press **6-Sign Control Status**.

```
SIGN CONTROL STATUS
         Phase State Timer Spc
LANE 1:    2   WTD2     0  1
LANE 2:    4   TD2    265  1
LANE 3:    6   WD2      0  1
LANE 4:    8   D1       1  1
```

Figure 2-48. Sign Control Status Display

The Sign Control Status Display (Figure 2-46) shows the states and transitions of the turn control signs. See Chapter 9 for more information.

- D1 – Display 1 is being presented
- WTD2 – Waiting to Begin Transition to Display 2; display 1 is still being presented
- TD2 – Transition to Display 2 is in progress; transitional display is being presented
- D2 – Display 2 is being presented
- WTD1 – Waiting to Begin Transition to Display 1; display 2 is still being presented
- TD1 – Transition to Display 1 is in progress; transitional display is being presented

2.2.9.2 FIO (Caltrans), ITSv1, ATC and CBD Options

The status displays in this section appear when the software option is FIO (Caltrans 2070-2A/-2E), ITS, ATC, or CBD.

2.2.9.2.1 ABC Input Status

From the I/O menu (Figure 2-42), press **1-ABC INPUT STATUS**.

```
ABC INPUT STATUS
  INPUT NUMBER ... 1234567890   CF - .
   VEH DET (01-10) .X.....X.X   ST - .
   VEH DET (11-20) .....X...X   IA - .
   VEH DET (21-30) .....XXX.X   LF - .
   VEH DET (31-40) .....X..XX   MCE- .
   PED DET (01-08) X.X.X.X.     RR - .
   PREEMPT (01-06) ......       WRM- .
```

Figure 2-49. ABC Input Status Display – FIO (Caltrans); ATC, ITS, CBD similar

An X in a field indicates the status is not provided, depending on FIO type.

- ABC Input Status Indicators include the following:
  - VEH DET - Vehicle Detector – Inputs display a 1 next to the name when active

      ♦   PED DET - Pedestrian Detector

      ♦   PREEMPT - Preemption

- Unit Inputs include the following:

      ♦   CF – Conflict Flash

      ♦   ST – Stop Time

      ♦   IA – Interval Advance

      ♦   LF – Local Flash

      ♦   MCE – Manual Control Enable

      ♦   RR – Red Rest

      ♦   WRM – Walk Rest Modifier

2.2.9.2.2   D Input Status

From the I/O Menu (Figure 2-42), press **2-D INPUT STATUS**.

```
D INPUT STATUS
  CF -.   DB/SD8-.   O1/SD2-.   SC/SS5-.
  SP1-.   DA/SD7-.   OL/SD1-.   DM/SS6-.
  SP2-.   SB/SD6-.   AA/SS1-.      AF -.
  SP3-.   SA/SD5-.   AB/SS2-.      FR -.
          O3/SD4-.   AC/SS3-.
          O2/SD3-.   AD/SS4-.
```
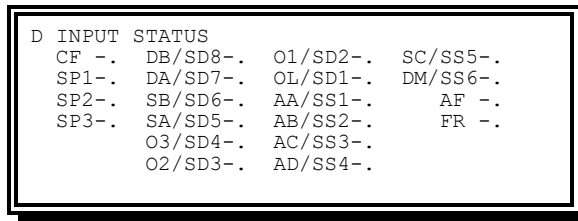
Figure 2-50. D Input Status Display – FIO (Caltrans), ITS, ATC, and CBD

This D Input Status display shows the status of all Connector D (C11S) inputs. Inputs display a 1 next to the name when active.

- CF – Conflict Monitor Status

- SP1 – Spare 1

- SP2 – Spare 2

- SP3 – Spare 3

- DB/SD8: Dial B / System Detector 8

- DA/SD7: Dial A / System Detector 7

- SB/SD6: Split B / System Detector 6

- SA/SD5: Split A /System Detector 5

- O3/SD4: Offset 3 / System Detector 4

- O2/SD3: Offset 2 /System Detector 3

- O1/SD2: Offset 1 / System Detector 2

- OL/SD1: On Line / System Detector 1

- AA/SS1: Alt Sequence A / Special Status 1

- AB/SS2: Alt Sequence B / Special Status 2

- AC/SS3: Alt Sequence C / Special Status 3

- AD/SS4: Alt Sequence D / Special Status 4
- SC/SS5: Set Clock / Special Status 5
- DM/SS6: Dimming / Special Status 6
- AF: Automatic (Remote) Flash Status
- FR: Free

2.2.9.2.3 ABC Output Status

From the I/O Menu (Figure 2-42), press **3-ABC Output Status**.

```
ABC OUTPUT STATUS
      PHSE 12345678      OVLP ABCD
       GRN-........        GRN-....
       YEL-........        YEL-....
       RED-........        RED-....
       DWK-........
       PCL-....X.X.       WD -.
       WLK-....X.X.       DR -.
```
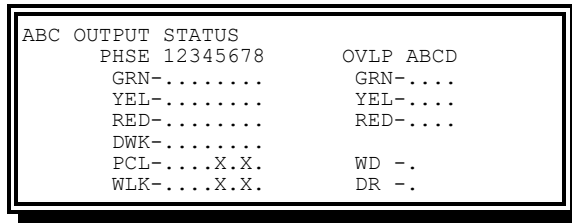
Figure 2-51. ABC Output Status Display – FIO (Caltrans), ITS, ATC, and CBD

The ABC Output Status Display (Figure 2-51) shows the status of all outputs. Outputs display an asterisk (*) next to the name when active. An X in a field indicates the status is not provided.

- Under PHSE 12345678
  - GRN – Phase Green
  - YEL – Phase Yellow
  - RED – Phase Red
  - DWK – Phase Don't Walk
  - PCL – Phase Pedestrian Clear
  - WLK – Phase Walk
- Under OVLP ABCD
  - GRN – Overlap Green
  - YEL – Overlap Yellow
  - RED – Overlap Red
  - WD – Watchdog
  - DR – Detector Reset

2.2.9.2.4 D Output Status

From the I/O Menu (Figure 2-42), press **4-D Output Status**.

```
D   OUTPUT STATUS

        DA/SF7-.          O1/SF2-.
        DB/SF8-.          O2/SF3-.
        SA/SF5-.          O3/SF4-.
        SB/SF6-.          FL/SF1-.
```
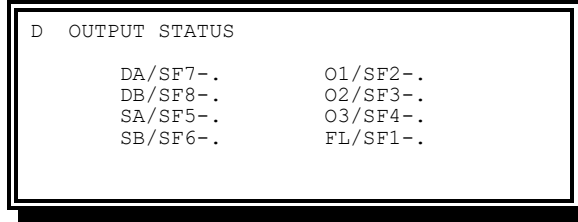
Figure 2-52. D Output Status Display – FIO (Caltrans), ITS, ATC, and CBD

The D Output Status display (Figure 2-52) shows the status of all Connector D (C11S) outputs. Outputs display a 1 next to the name when active.

- DA/SF7: Dial A / Special Function 7
- DB/SF8: Dial B / Special Function 8
- SA/SF5: Split A / Special Function 5
- SB/SF6: Split B / Special Function 6
- 01/SF2: Offset 1 / Special Function 2
- 02/SF3: Offset 2 / Special Function 3
- 03/SF4: Offset 3 / Special Function 4
- FL/SF1: Flash / Special Function 1

2.2.9.2.5   Final Input Status

See section 2.2.9.1.5

2.2.9.2.6   Sign Control Status

See section 2.2.9.1.6.

2.2.10   MMU/CMU Monitoring

The MMU/CMU Monitoring Display (Figure 2-53) allows the user to view the state of each MMU or CMU channel input and current fault and status information.

From the Active Status menu Figure 2-3), press **0-MMU/CMU MONITORING**.

```
MMU MONITOR
  CHANNEL.....123456789 0123456
    RED...:    101110111 1111111
    YELLOW:    000000000 0000000
    GREEN.:    010001000 0000000

    FAULTS:   ...
    STATUS:   .REN.
```
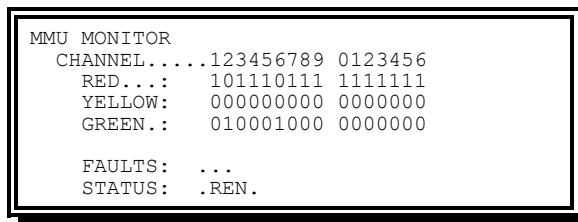
Figure 2-53. MMU Monitor Display (TS 2)

```
CMU MONITOR
 007=CU NFSA Flash (62)
CHNL=12345678 90123456 78901234 56789012
FLT:
RED: 11111111 ........ ........ ........
YEL: ........ .....1.. ........ ........
GRN: ........ ........ ........ ........
```
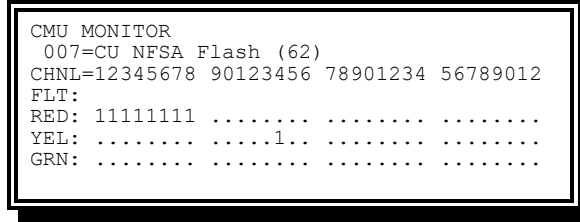
Figure 2-54. CMU Monitor Display (ITS/CBD)

The status displayed is reported to the CU through TS 2 Port 1 or ITS/ATC Serial Bus 1. When communications are not possible, one of the following messages will be displayed:

- PORT-1 NOT ENABLED
- FRAME-129 RFF (MMU response frame fault)
- MMU NOT ACTIVE
- CMU NOT ACTIVE

When communication is possible, the following status is displayed:

- The unit displays the following channel status indicators:
    - 1 – The respective input is active
    - 0 – The input is not active
- MMU Faults include the following:
    - CON – Conflict Fault
    - RED – Red Fault
    - FLD – Field Check Fault
    - DIN – Dual Indication Fault
    - BND – Blinking Noise Fault
    - WDG – Watchdog Fault
    - DIA – MMU Diagnostic Fault
    - MCL – Minimum Clearance Fault
    - P1T – Port 1 Time Out Fault
    - CVM – Controller Voltage Monitor Fault
    - VM1 – 24 Volt Monitor 1 Fault
    - VM2 – 24 Volt Monitor 2 Fault
- MMU status includes the following:
    - VMI – Volt Monitor Inhibit
    - RST – Reset
    - REN – Red Enable
    - ORT – Output Relay Transferred
    - IRF – Immediate Response to Fail
    - RSV – Reserved

- ◆ LFS – Local Flash
- ◆ SFC – Startup Flash Call
- CMU Faults include the following (ref. ITS v1.2.17b §4.4):
  - ◆ 000 – No Fault
  - ◆ 001 – CMU/AMU +24 VDC
  - ◆ 002 – CMU +12 VDC
  - ◆ 003 – Conflict
  - ◆ 004 – Serial Bus #1
  - ◆ 005 – Serial Bus #3
  - ◆ 006 – CU LFSA Flash (Type 62)
  - ◆ 007 – CU NFSA Flash (Type 62)
  - ◆ 008 – Diagnostic
  - ◆ 009 – Multiple
  - ◆ 010 – Lack of Signal Input
  - ◆ 011 – Short Yellow Clearance
  - ◆ 012 – Skipped Yellow Clearance
  - ◆ 013 – Yellow + Red Clearance
  - ◆ 014 – Field Output Check
  - ◆ 015 – Serial Memory Key Absent
  - ◆ 016 – Serial Memory Key FCS Error
  - ◆ 017 – Serial Memory Key Data Error
  - ◆ 018 – Local Flash
  - ◆ 019 – CB Trip
  - ◆ 020 – CMU/AMU AC+MainFlt
  - ◆ 021 – NRESET Active
  - ◆ 022 – HDSP Diagnostic
  - ◆ 023 – FYA Flash Rate Fault
  - ◆ 024 – CMU +48 VDC

2.3 Utilities

The Utilities function allows the user to display or change controller parameters to allow a user to:

- Gain access
- Disable access
- Enter a new personal access code
- Load, save, or restore parameters

- Run diagnostics
- Configure ports
- Install Software

The Utilities Menu (Figure 2-55) allows the user to select which utility feature to be addressed. From the Main Menu (Figure 2-1), press **2-UTILITIES**.

```
UTILITIES

 1-ENABLE ACCESS        5-DIAGNOSTICS
 2-DISABLE ACCESS       6-CONFIGURE PORTS
 3-CHANGE ACCESS
 4-DATA MANAGER         A-FUNCTION KEY MAP
                        B-INSTALL SOFTWARE
```
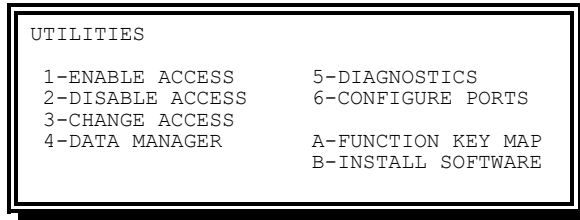
Figure 2-55. Utilities Menu (Linux shown)

The Utilities Menu (Figure 2-55) has the following options:

- ENABLE ACCESS – Provides for gaining Access
- DISABLE ACCESS – Provides for losing Access
- CHANGE ACCESS – Provides for changing the Access Code
- LOAD DEFAULT – Provides for loading Default Configuration Data, changing the Software Option or Mode, as well as Loading/Saving the current configuration from/to devices
- DIAGNOSTICS – Provides for running the Resident Diagnostic Routines
- CONFIGURE PORTS – Provides for viewing and changing Port 2 and Port 3 Configuration Data for communications or printer
- FUNCTION KEY MAP – Provides a reference for how Function Keys F1-F5 on 16-line displays have been mapped
- INSTALL SOFTWARE – Provides for installation of New Software onto the CU.

2.3.1   Enable Access

This function allows the user to gain access.

From the Utilities Menu (Figure 2-55), press **1-ENABLE ACCESS**.

```
ENABLE ACCESS

        .........................
        .........VARIABLE.........
        ..........MESSAGE.........
        .........................
```
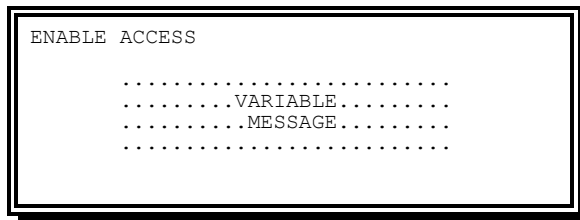
Figure 2-56. Enable Access Display

The variable message that appears can be any of the following:

```
               ‖       ACCESS IS ENABLED        ‖
                      NO CHANGE IS NECESSARY
```

Or

```
               ‖       ACCESS IS DISABLED       ‖

                      ENTER THE FOUR DIGIT CODE
                      AND PRESS "E" :   ....
```

Or

```
               ‖      IMPROPER ACCESS CODE      ‖
                      PRESS "E" TO CONTINUE
```

Figure 2-2-57. Enable Access Variable Messages

Code 0000 is the default access code. This requires any number of zeros to be entered before access is provided.

2.3.2   Disable Access

This function allows the user to lose access.

From the Utilities menu (Figure 2-55), press **2-DISABLE ACCESS**.

```
DISABLE ACCESS


        .........VARIABLE.........
        ..........MESSAGE.........


```

Figure 2-58. Disable Access Display

The variable message that appears can be any of the following:

```
               ‖       ACCESS IS DISABLED       ‖
                      NO CHANGE IS NECESSARY
```

Or

```
               ‖       ACCESS IS ENABLED        ‖
                      PRESS "E" TO DISABLE
```

Or

```
               ‖       ACCESS IS PERPETUAL      ‖
                      NO CHANGE IS POSSIBLE
```

Figure 2-2-59. Disable Access Variable Messages

When access is gained, it is automatically turned off approximately ten minutes after either access was gained or the last keystroke. When 9999 has been entered as the code, access cannot be turned off.

2.3.3   Change Access

This function allows the user to enter a new personal Access Code.

From the Utilities Menu (Figure 2-55), press **3-CHANGE ACCESS**.

```
CHANGE ACCESS CODE


        .........VARIABLE.........
        ..........MESSAGE.........
```
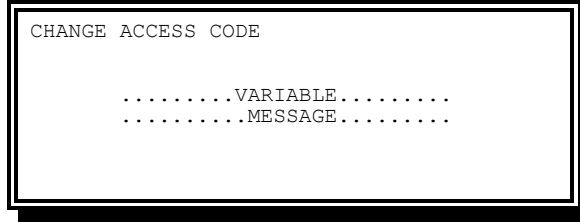
Figure 2-60. Change Access Code Display

The variable message that appears can be any of either of the following:

```
        ACCESS IS DISABLED
        NO CHANGE IS POSSIBLE
```

Or

```
        ENTER THE FOUR DIGIT CODE
        AND PRESS "E" :   ....
```
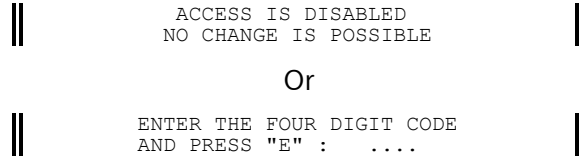
Figure 2-2-61. Change Access Variable Messages

The default access code 0000 will work until a specific personal access code has been entered.

Any number between 0001 and 9998 may be chosen as the new access code. The new access code replaces any previous access code. Note that the access code can only be changed after access has been gained.

An entry of 9999 as an access code sets the access to continually enabled (disables all access requirements until a number between 0000 and 9998 is entered as an access code).

> **CAUTION: Be sure to write your access code down and store it in a safe place. If you forget your code, the memory device on the unit will have to be re-initialized and all data will be lost.**

If units are returned for repair, the access code should be noted on the unit.

2.3.4   Data Manager Menu

The Data Manager Menu (Figure 2-62) allows the user to access various ways to load new operating data for SEPAC as well as save the current operating data to a device.

```
DATA MANAGER

        1-LOAD DEFAULTS CONFIG
        2-LOAD/SAVE DATAKEY CONFIG
        3-LOAD/SAVE USB CONFIG
        4-COPY/MOVE SPM FILES
```
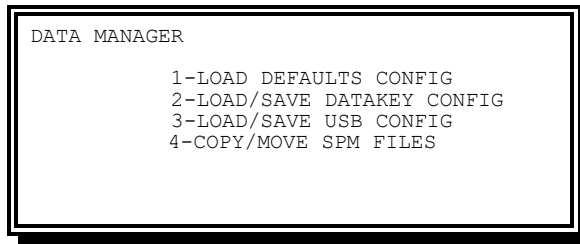
Figure 2-62. Data Manager Menu

The Data Manager Menu has the following options:

- Load Defaults Config – Provides for loading default data
- Load/Save Datakey Config – Provides for loading and saving data to a Datakey

- Load/Save USB Config – Provides for loading and saving data to a USB drive

- Copy/Move SPM Files – Provides for copying, moving, and deleting Signal Performance Measures (SPM) data files

2.3.4.1   Load Default Parameters

This function allows the user to load SEPAC's default parameter set into memory to become the active database.

From the Data Manager Menu (Figure 2-62), press **1-LOAD DEFAULTS CONFIG**. Based on the current Mode of your Software, either Figure 2-63 or Figure 2-64 will be displayed.

```
LOAD DEFAULT PARAMETERS

  CURRENT MODE: FULL FUNCTION SEPAC
  CURRENT SOFTWARE OPTION: FIO


PREV/NEXT TO CYCLE          E-LOAD DEFAULT
```
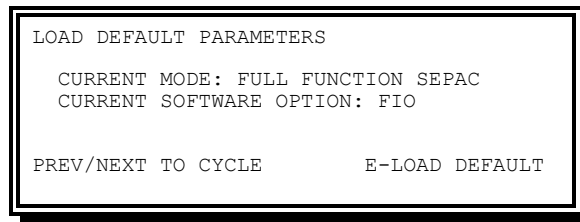
Figure 2-63. Load Default Parameters Menu – Full Function SEPAC

Or

```
LOAD DEFAULT PARAMETERS

  CURRENT MODE: TX DIAMOND CONTROL
  CURRENT SOFTWARE OPTION: FIO


PREV/NEXT TO CYCLE          E-LOAD DEFAULT
```
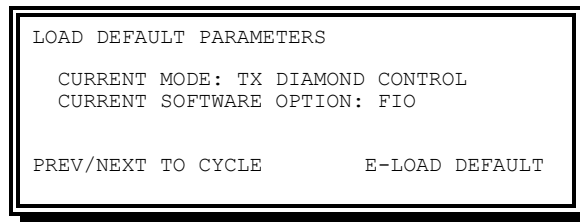
Figure 2-64. Load Default Parameters Menu – TX Diamond Control

For the Load Default Parameters screen, the user can use the PREV and NEXT keys to cycle through the options listed below for each field.

Current Mode:

- **Full Function SEPAC –** This function allows the user to configure phase and rings. Unless a sequence defined in Chapter 10 is needed, this is the Mode that should be used.

   Throughout this manual, parameters are simulated for examples. Each display includes the FULL FUNCTION SEPAC default data where default data is provided, unless otherwise stated. A note indicates if there is no default data available.

- **TX Diamond Control –** This function provides for the specialized phase and ring configurations required to operate the diamond intersection control sequences. See Chapter 10 for details on sequence, control, and default parameters.

Press Key E or ENTER to load defaults. Upon completion, line 6 shows DEFAULT PARAMETERS LOADED.

Current Software Option:

- **FIO** (STD -2A OR -8) – This option establishes defaults values specific to 2070 ATC units with 2070-2A/-2E or 2070-8 field I/O. 2070-8 field I/O also includes M50 or M60 units used for NEMA TS1 cabinet applications

- **TS2** (TYPE 1 OR 2) – This option establishes default values specific to NEMA TS 2 cabinet applications

- **NYS** [NCNY] (-2A FIO) – This option establishes defaults values specific to New York State 2070 ATC units with -2A field I/O

- **ITS v1** – This option establishes default values specific to ITS v1 cabinet applications

- **ATC** – This option establishes default values specific to ATC cabinet applications

- **CBD** – This option establishes default values specific to CBD cabinet applications

- **CBD v2** – This option establishes default values specific to CBD v2 cabinet applications.

When Key E or ENTER is pressed on this this field, Line 6 shows DEFAULT PARAMETERS LOADED.

2.3.4.2   Datakey Load/Store

This screen allows the user to manage the Configuration Data for the unit using a Datakey.

From the Data Manager Menu (Figure 2-62), press **2-LOAD/SAVE DATAKEY CONFIG**.

```
LOAD/SAVE CONFIGURATION DATA W/DATAKEY

   1-LOAD FROM DATAKEY
   2-SAVE TO DATAKEY
```
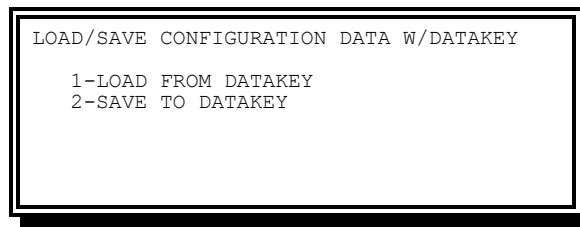
Figure 2-65. Datakey Load/Store Parameters Menu

The Load/Store Datakey Parameters menu (Figure 2-65) options include the following:

- LOAD FROM DATAKEY – Copies the contents of the Datakey into temporary storage, validates the structure and integrity of the Datakey. If the integrity of the Datakey is confirmed, Datakey version and date information will be displayed. If it is not confirmed an appropriate error message will be displayed.

```
LOAD FILE: DATAKEY

  VERSION: 5.3.0

FILE DATE: Thu Oct 21  07:51:36 2020

 ENT-CONTINUE LOAD        ESC-CANCEL
```
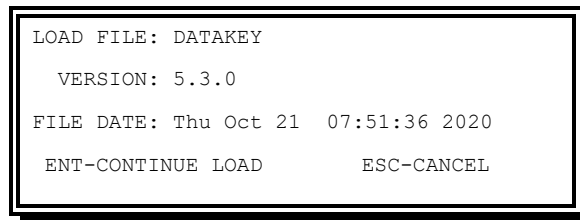
Figure 2-66. Datakey Load File Confirmation Menu

♦ If the user selects ESC, the load will be cancelled

♦ If the user selects ENT/ENTER, the user will be prompted to DEFAULT DATA PRIOR TO LOADING if desired

♦ The user will then be prompted to LOAD NETWORK SETTINGS FROM FILE if desired

♦ Upon successful completion, CONFIG FILE LOADED SUCCESSFULLY will appear. The user may then press ENT/ENTER to continue.

♦ In the event of parsing errors, the user will be notified with and appropriate error message

♦ Possible error messages include:

  o UNABLE TO READ DATAKEY

  o MISSING FILE HEADER INFORMATION

  o CONFIGURATION SIZE MISMATCH

  o CONFIGURATION CHECKSUM MISMATCH

  o MISSING FILE HEADER INFORMATION

  o ERROR READING HEADER INFORMATION

  o CONFIG DATA VALIDATION FAILED

  o DATA MEMBER VALUE OUT OF RANGE

  o ERROR LOADING CONFIG FILE

- SAVE TO DATAKEY – Copies the contents of the cfgdata for the unit to a blank Datakey

  ♦ If the DATAKEY ALREADY CONTAINS DATA, the user will be prompted to erase the Datakey before saving

  ♦ After erasing, data will be saved to the Datakey

  ♦ Possible errors include:

    o UNABLE TO READ DATAKEY

    o ERROR ERASING DATAKEY

    o ERROR SAVING CONFIG FILE

2.3.4.3   USB Load/Save

This screen allows the user to manage the Configuration Data for the unit using a USB Flash Drive.

From the Data Manager Menu (Figure 2-62), press 3-**LOAD/SAVE USB CONFIG**.

```
LOAD/SAVE CONFIGURATION DATA WITH USB

 1-LOAD FROM USB
 2-SAVE TO USB
```

Figure 2-67. Load/Save USB Config Menu

The Load/Save USB Config Menu (Figure 2-67) options include the following:

- LOAD FROM USB – Permits the user to select and load an appropriate configuration file from a USB flash drive or from /home/admin/sepac on the local file system. The contents of the file are checked for. If the integrity of the file is confirmed, the file version and date information will be displayed. If it is not confirmed an appropriate error message will be displayed.

```
USB LOAD FILE
1-[HOME] 5.3.0_SW 2 Ave & SW 7 St
2-[USB1] 5.2.0_ATC-TEST-CABINET
3-[USB1] 5.0.1 - NWARTERIAL
4-[USB1] 2241-SW 2 Ave & SW 7 St
5-[USB1] 5.3.0_DATA

 UP/DOWN TO SCROLL
```

Figure 2-68. USB Load File selection screen

```
LOAD FILE: 5.3.0_DATA

  VERSION: 5.3.0
   SOURCE: SEPAC
FILE DATE: Thu Oct 21  07:51:36 2020

 ENT-CONTINUE LOAD        ESC-CANCEL
```

Figure 2-69. USB Load File Confirmation Menu

- ♦ If the user selects ESC, the load will be cancelled
- ♦ If the user selects ENT/ENTER, the user will be prompted to DEFAULT DATA PRIOR TO LOADING if desired
- ♦ The user will then be prompted to LOAD NETWORK SETTINGS FROM FILE if desired
- ♦ Upon successful completion, CONFIG FILE LOADED SUCCESSFULLY will appear. The user may then press ENT/ENTER to continue.
- ♦ In the event of parsing errors, the user will be notified with and appropriate error message
- ♦ Possible error messages include:
    - o MISSING FILE HEADER INFORMATION
    - o CONFIGURATION SIZE MISMATCH
    - o CONFIGURATION CHECKSUM MISMATCH

- o   MISSING FILE HEADER INFORMATION

- o   ERROR READING HEADER INFORMATION

- o   CONFIG DATA VALIDATION FAILED

- o   DATA MEMBER VALUE OUT OF RANGE

- o   ERROR LOADING CONFIG FILE

- SAVE TO USB– Copies the contents of the cfgdata for the unit to a file on a mounted USB flash drive or to the local flash file system if no USB device is mounted.

    - The number keys may be used to alter the default file name, as shown below.

    - Only uppercase letters, digits and hyphen are available

```
USB CONFIGURATION FILE

File:  5.3.0_Data
         KEY: 1:-01   2:ABC2 3:DEF3
              4:GHI4  5:JKL5 6:MNO6
              7:PQRS7 8:TUV8 9:WXYZ9
              0:Backspace
ENT-CONTINUE SAVE        ESC-CANCEL
```

Figure 2-70. Save Configuration File

    - Possible errors include:

        - o   UNABLE TO READ FROM USB

        - o   ERROR SAVING CONFIG FILE

        - o   NULL FILE NAME

2.3.5   Diagnostics

WARNING: These diagnostics are for Bench Test only. They are not intended to be used while operating an intersection.

This allows the user to run the Resident Diagnostic Routines to check the CU hardware. See Chapter 4 for more details on diagnostics.

From the Utilities Menu (Figure 2-55), press **5-DIAGNOSTICS**. The warning message shown in Figure 2-71 is displayed.

```
DIAGNOSTICS

 WARNING....THE CONTROLLER UNIT SHOULD
 NOT BE IN CONTROL OF AN INTERSECTION
 WHILE RUNNING DIAGNOSTICS.
 - PRESS "E" TO CONTINUE
```

Figure 2-71. Diagnostics Warning Menu

When the user presses E, the Internal Diagnostic Results Display (Figure 2-72) is shown.

```
INTERNAL DIAGNOSTIC RESULTS

 SOFTWARE CLK:     WED  11/18/20 13:57:37
 RTC IC   CLK:     WED  11/18/20 13:57:37

 CFGDATA TEST: PASSED

                        PRESS "E" TO CONTINUE
```

Figure 2-72. Internal Diagnostic Results Display (OS-9 shown)

The Diagnostic Results display provides the following information:

- SOFTWARE CLK – Software Clock. Maintains the date and time data updating the real time IC clock as necessary
- RTC IC CLK – Real Time IC Clock. Read and used to initialize the software clock on power up

> NOTE: The software clock and real time IC clock should present the same data

- CFGDATA TEST – Indicates the results (failed or passed) of the CFGDATA Test

2.3.5.1   Diagnostics Menu

From the Diagnostics Menu (Figure 2-73), the user can select the Diagnostics Routine to be run.

```
DIAGNOSTICS

          1-KEYBOARD TEST
          2-STANDARD INPUT
          3-SPECIAL INPUT
          4-OUTPUT TEST
          5-LOOP BACK I/O TEST
          F-EXIT DIAGNOSTICS TO RESTART
```

Figure 2-73. Diagnostic Menu

The Diagnostics Menu (Figure 2-73) includes the following options:

- KEYBOARD TEST – Start the Keyboard Diagnostic
- STANDARD INPUT – Start the Standard Input Diagnostic
- SPECIAL INPUT – Start the Special Input Diagnostic
- OUTPUT TEST – Start the Output Diagnostic
- LOOP BACK I/O TEST – Start the Loop Back I/O Diagnostic
- EXIT DIAGNOSTICS – Return to normal traffic control after doing a restart

2.3.5.1.1 Keyboard/Display Diagnostics

To run the Keyboard Test, press **1-KEYBOARD TEST** on the Diagnostics Menu (Figure 2-73).

```
DIAGNOSTIC: KEYBOARD TEST

CHARACTER SET:0123456789abcdefghijklmnop
qrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ!@#$
%^&*()_+~`[]<>,./?|

KEYBOARD TEST:
```

Figure 2-74. Keyboard Test Display

The Keyboard/Display Diagnostic will begin with the display shown in Figure 2-74. It will automatically display all characters the display is capable of generating as shown in the top part of the display. The lower part of the display shows each key identity as the key is pressed. The F key will abort the routine and return to the prior menu.

2.3.5.1.2   Standard Input Test

To run the Standard Input Test, press **2-STANDARD INPUT** on the Diagnostics Menu (Figure 2-73).

```
INPUT DIAGNOSTIC STANDARD
  ES -.   TIB-.   ST -..   VDET-........
  MCE-.   ILC-.   ORC-..   PDET-........
  EMR-.   WRM-.   RR -..   OMIT-........
  NA2-.   IA -.   MX2-..   POMT-........
  NA1-.   TIA-.   FO -..   HOLD-........
  IOM-0   FM - .  PR -..   PMPT-X.X...
 ANY SPECIAL-.   IMT-..
```

Figure 2-75. Standard Input Test Display – NEMA FIO and TS 2

```
INPUT DIAGNOSTIC STANDARD      CF - ..
  VEH DET (01-10) .X.....X.X   ST - .
  VEH DET (11-20) .....X...X   IA - .
  VEH DET (21-30) .....XXX.X   LF - .
  VEH DET (31-40) .....X..XX   MCE- .
  PED DET (01-08) X.X.X.X.     RR - .
  PREEMPT (01-06) ......       WRM- .
     ANY SPECIAL -.
```

Figure 2-76. Standard Input Test Display – Caltrans FIO, ATC, ITS and CBD

If no inputs to the CU are active, the Standard Input Diagnostic will begin with the displays shown above.

- Dynamic Input Status includes the following:
  - Unit Inputs display a 1 next to the name when active
  - Ring Inputs display the ring number 1 or 2 next to the name when active
  - Phase Inputs display the phase number 1 to 8 next to the name when active, such as the VDET above
- Unit Inputs include the following:
  - ES – External Start Active
  - MCE – Manual Control Enable

- ♦ EMR – External Minimum Recall
- ♦ NA2 – Non-Actuated Two
- ♦ NA1 – Non-Actuated One
- ♦ IOM – Input/Output Mode Value
- ♦ TIB – Test Input B
- ♦ ILC – Indicator Lamp Control
- ♦ WRM – Walk Rest Modifier
- ♦ IA – Interval Advance
- ♦ TIA – Test Input A
- ♦ FM – Free Mode
- ♦ CF – Conflict Flash
- Ring Inputs include the following:
  - ♦ ST – Stop Time
  - ♦ ORC – Omit Red Clear
  - ♦ RR – Red Rest Mode
  - ♦ MX2 – Maximum Two
  - ♦ FO – Force Off
  - ♦ PR – Pedestrian Recycle
  - ♦ IMT – Inhibit Maximum Termination
- Phase Inputs include the following:
  - ♦ VDET or VEH DET – Vehicle Detector
  - ♦ PDET or PED DET – Pedestrian Detector
  - ♦ OMIT – Omit
  - ♦ POMT – Pedestrian Omit
  - ♦ HOLD – Hold
- Other Inputs include the following:
  - ♦ PMPT or PREEMT – Preempt 1-6
  - ♦ ANY SPECIAL – Displays a 1 when any Special Input is active while displaying this window

2.3.5.1.3   Special Input Test

To run the Special Input Test, press **3-SPECIAL INPUT** on the Diagnostics Submenu (Figure 2-73).

```
INPUT DIAGNOSTIC SPECIAL
          DB/SD8-.  01/SD2-.  ../SS5-.
  PE1-.   DA/SD7-.  OL/SD1-.  DM/SS6-.
  PE2-.   SB/SD6-.  AA/SS1-.  CF/ST -.
  PE3-.   SA/SD5-.  AB/SS2-.  MF/ST -.
  PE4-.   O3/SD4-.  AC/SS3-.  RM/ST -.
          02/SD3-.  AD/SS4-.
 ANY STANDARD  -.
```

Figure 2-77. Special Input Test Display – NEMA FIO and TS 2

```
INPUT DIAGNOSTIC SPECIAL
  CF -.   DB/SD8-.  O1/SD2-.  SC/SS5-.
  SP1-.   DA/SD7-.  OL/SD1-.  DM/SS6-.
  SP2-.   SB/SD6-.  AA/SS1-.    AF -.
  SP3-.   SA/SD5-.  AB/SS2-.    FR -.
          O3/SD4-.  AC/SS3-.
          O2/SD3-.  AD/SS4-.
 ANY STANDARD  -.
```

Figure 2-78. Special Input Test Display – Caltrans FIO, ATC, ITS and CBD

If there are no active inputs to the CU, the special input diagnostic will begin with the displays shown above. Inputs display a 1 next to the name when active.

Dynamic status inputs include the following:

- Special Inputs
  - PE1 – Preempt One
  - PE2 – Preempt Two
  - PE3 – Preempt Three
  - PE4 – Preempt Four
  - DB/SD8: Dial B – System Detector 8
  - DA/SD7: Dial A – System Detector 7
  - SB/SD6: Split B – System Detector 6
  - SA/SD5: Split A – System Detector 5
  - O3/SD4: Offset 3 – System Detector 4
  - O2/SD3: Offset 2 – System Detector 3
  - O1/SD2: Offset 1 – System Detector 2
  - OL/SD1: On Line – System Detector 1
  - AA/SS1: Alt Sequence A – Special Status 1
  - AB/SS2: Alt Sequence B – Special Status 2
  - AC/SS3: Alt Sequence C – Special Status 3
  - AD/SS4: Alt Sequence D – Special Status 4
  - SC/SS5: Set Clock – Special Status 5
  - DM/SS6: Dimming – Special Status 6

 ♦ CF ST or CF – Conflict Monitor Status

 ♦ MF ST – Manual Flash Status

 ♦ RM ST or AF – Remote or Automatic Flash Status

 ♦ SP1 – Spare Input 1

 ♦ SP2 – Spare Input 2

 ♦ SP3 – Spare Input 3

 ♦ FR – Free

- Other inputs include the following:

 ♦ Any Standard – Displays a 1 when any Standard Input is active while displaying this window

2.3.5.1.4   Output Test

To run the Output Test, press **4-OUTPUT TEST** on the Diagnostics Menu (Figure 2-73).

```
DIAGNOSTIC: OUTPUT TEST

      ACTIVE OUTPUT: RED,  PHASE 1

      NEXT OUTPUT:   YEL,  PHASE 1


   A-ADVANCE   B-PAUSE
```
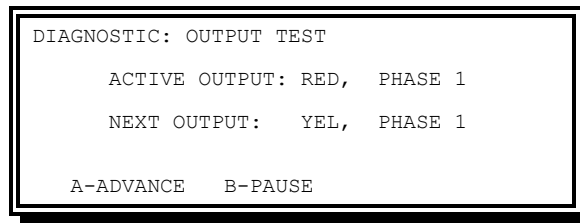
Figure 2-79. Output Test Display

The Output Diagnostic Test will begin with the display shown in Figure 2-79 with Phase 1 Red output is active. The display denotes which output is active and which will become active next. The routine will automatically sequence through all outputs one at a time, each being active for approximately one second to allow time for visual verification. The routine will repeat until interrupted by pressing the F key.

2.3.5.1.5   Loop Back I/O Test

To run the loop back I/O test, press **5-LOOP BACK I/O TEST** on the Diagnostics menu (Figure 2-73).

```
LOOP BACK I/O DIAGNOSTIC
     (REQUIRES SPECIAL CABLE)


               FAILED

```
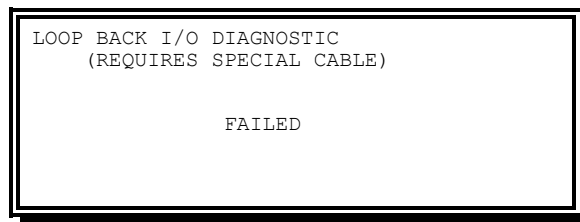
Figure 2-80. Loop Back I/O Test Display

The Loop Back I/O Diagnostic Test will begin with the display shown in Figure 2-80. After a few seconds, the message PASSED or FAILED will denote the results of the test.

- This test requires a special cable specific to the controller's FIO type; contact Yunex Traffic for more information.

2.3.6   Configure Ports

The Configure Ports Menu (Figure 2-81) allows the user to select the port and function parameters to view or edit.

From the Utilities Menu (Figure 2-55), press **6-CONFIGURE PORTS**.

```
CONFIGURE PORTS

1-PORT 1 COMM        5-NETWORK CONFIG
2-PORT 2 COMM        6-UTCS CONFIG
3-PORT 3 COMM        7-GPS CONFIG
4-IP ADDRESSING      A-SPAT ADDRESSING
```
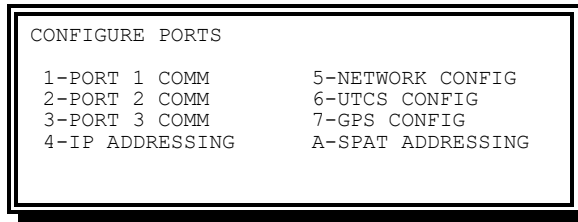
Figure 2-81. Configure Ports Menu

Configure Ports Menu options include the following:

- PORT 1 COMM – Allows the user to view or edit the Port 1 SDLC Parameters
- PORT 2 COMM – Allows the user to view or edit the Port 2 Comm Parameters
- PORT 3 COMM – Allows the user to view or edit the Port 3 Comm Parameters
- IP ADDRESSING – Allows the user to view or edit the IP Addressing Parameters
- NETWORK CONFIG – Allows the user to view or edit the Network Parameters
- UTCS CONFIG – Allows the user to view or edit the SCOOT or Boston UTCS Parameters
- GPS CONFIG – Allows the user to view or edit the GPS Parameters
- SPAT ADDRESSING – Allows the user to view or edit the SPaT Parameters

2.3.6.1   Port 1 Comm

The Port 1 Comm Display (Figure 2-82) allows the user to view or edit the parameter that enables and disables Port 1 communications.

From the Configure Ports Menu (Figure 2-81), press **1-PORT 1 COMM**.

```
PORT 1 COMM                 SDLC 153600
    DISABLE: 0 (0-NO 1-YES)
 YES: AS IF PIN 10 IS JUMPERED TO PIN 8
  BUT VALID ONLY UNTIL ACCESS TIMEOUT
```
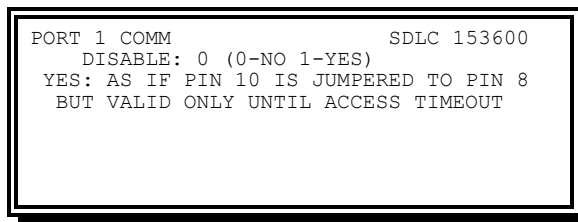
Figure 2-82. Port 1 Comm Display

NOTE: Default data is as shown in Figure 2-82.

2.3.6.2   Port 2 Comm

The Port 2 Comm Display (Figure 2-83) allows the user to display and enter the serial
communications parameters for Port 2:

From the Configure Ports Menu (Figure 2-81), press **2-PORT 2 COMM**.

```
PORT 2 COMM            [NTCIP] 1200,8N1
  BAUD RATE: 0 (0-1200  2-4800  5-19200)
             (1-2400  4-9600  6-38400)
  PROTOCOL.: 0 (0-NTCIP 1-ECOM)
  DCD FCONT: 0 (0-NO 1-YES)
  CTS FCONT: 0 (0-NO 1-YES)
```

Figure 2-83. Port 2 Comm Display

- Baud Rate – Defines the communications speed, it is often referred to as bps

- Protocol – Communications protocol expected on the port.

- DCD FCONT (Data Carrier Detect Flow Control) – When set for NO, the status of the
  DCD input will be considered always active

- CTS FCONT (Clear to Send Flow Control) – When set for NO, the status of the CTS
  input will be considered always active. When set to YES, transmissions will wait for
  the CTS input to become active.

2.3.6.3   Port 3 Comm

The Port 3 Comm display (Figure 2-84) allows the user to display and enter the serial
communications parameters for Port 3.

From the Configure Ports menu (Figure 2-81), press **3-PORT 3 COMM**.

```
PORT 3 COMM            [ECOM ] 1200,8N1
  BAUD RATE: 0 (0-1200  2-4800  5-19200)
             (1-2400  4-9600  6-38400)
  PROTOCOL.: 1 (0-NTCIP 1-ECOM)
  DCD FCONT: 0 (0-NO 1-YES)
  CTS FCONT: 0 (0-NO 1-YES)
```

Figure 2-84. Port 3 Comm Display

The definition for parameters is the same as for Port 2 Comm (Section 2.3.6.2)

- **NOTE – ECOM/UTCS only: When operating at 1200 or 1312 baud with CTS FCONT
  enabled, SEPAC ignores the CTS signal from the modem and uses a 12-18 ms
  wait between the assertion of RTS and the transmission of the first character.
  This applies to both Port 2 and Port 3.**

2.3.6.4   IP Addressing

The IP Addressing Display (Figure 2-85) allows the user to view or edit the parameters for IP
communications for the host unit.

From the Configure Ports Menu (Figure 2-81), press **4-IP ADDRESSING**.

```
IP ADDRESSING
  HOST NAME: ATC2070-SIEMENS

  INTERFACE: ETH0 (ENET1)
  IP ADDRESS:  10.227. 27.142 / 16 CIDR
  SUBNET MSK: 255.255.  0.  0
  BROADCAST :  10.227.255.255
```

Figure 2-85. IP Addressing Display

- Host Name – The DHCP Access requires an ASCII text identification (name) by which the host will be known to the Network Interface. The name for each host unit on the Network Interface must be different to avoid duplicates. The hostname must begin with an alpha character (A-Z). Within the hostname numbers (0-9) and hyphens (-) are allowed. The hostname is limited at 25 characters, but fewer may be used. The host name is not used with fixed IP Addressing, but may be entered for reference. It is reported to the CU's Peers when running Peer-to-Peer. The Default Host Name is shown.

- INTERFACE – The corresponding Ethernet interface associated with the IP Address and Subnet Mask below. Use PREVIOUS and NEXT to cycle between Enet1 and Enet2.

- IP Address – The IPv4 address of the controller. Networks using the TCP/IP protocol route messages based on the IP Address of the destination. The format of an IPv4 Address is a 32-bit numeric address written as 4 numbers separated by periods. Each number can be 0 to 255.

- CIDR – This entry allows the user an alternate method for entering the Subnet Mask. Instead of entering 255.255.0.0 for a CLASS B Subnet the user can enter the number 16 in the CIDR field to achieve the same effect.

- Subnet MSK – The subnet mask, used to determine what subnet an IP Address belongs to. This field may be automatically generated by the CIDR

- Broadcast – The broadcast address is a view-only field that is automatically generated based on IP Address and Subnet Mask entries.

2.3.6.5   Network Configuration

The Network Configuration Display (Figure 2-86) allows the user to view or edit the parameters for network configuration.

From the Configure Ports Menu (Figure 2-81), press **5-NETWORK CONFIG**.

```
NETWORK CONFIG: DESTINATION

 TYPE: 0 (0-NONE 1-NETWORK 2-HOST 3-GATE)
 DESTINATION:   0.  0.  0.  0
 GATEWAY    :   0.  0.  0.  0
 NETMASK    :   0.  0.  0.  0
 HOP COUNT [ 0] (0-16)
```

Figure 2-86. Network Config Display

TYPE (Destination Type)

- 0-NONE – This host does not require access to a network destination address outside of the local network to which this host is connected

- 1-Network – The Destination IP Address specified is a network end point

- 2-Host – The Destination IP Address is a host computer end point

- 3-Gate – The Gateway IP Address is DEFAULT (when a destination IP Address is not required)

- Destination – Used when TYPE is 1 or 2 to specify the IP Address to seek outside of the local network

- Gateway– The Gateway IP Address specifies an intermediate Host Address through which the destination may be reached. (Only used for TYPE 1 or 2)

- Netmask – This entry has the same concept as the Local Host Subnet Mask, but applies to the gateway IP Address

- Hop Count – This entry specifies the maximum number of different computer IP Address accesses, that are allowed when trying to reach the destination IP Address.

2.3.6.6   UTCS Configuration

The UTCS Configuration Menu (Figure 2-87) allows the user to configure the UTCS parameters.

```
UTCS CONFIGURATION MENU

 1-UTCS CONFIG    4-BTCS CONFIG
 2-SCOOT STAGES   C-CLEAR SCOOT DATA
 3-SCOOT MISC.    D-DEFAULT SCOOT DATA
```
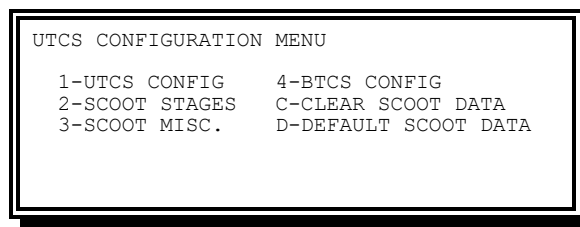
Figure 2-87. UTCS Configuration Menu

UTCS Configuration menu options include:

- UTCS COMM Config – Allows the user to view and modify UTCS type and communication parameters

- SCOOT Stage Config – Allows the user to view and modify SCOOT stage to phase mapping

- SCOOT Misc. Config – Allows the user to view and modify SCOOT detector and phase mode parameters

- BTCS Config - Allows the user to view and modify BTCS phase mode parameters

- Clear SCOOT Data – Allows the user to clear (zero-out) all SCOOT parameters

- Default SCOOT Data – Allows the user to default all SCOOT parameters

2.3.6.6.1   UTCS Communications

The UTCS Communications Display (Figure 2-88) allows the user to view or edit the UTCS type selection and in communication mode parameters.

```
UTCS COMM CONFIG                  DISABLED

MODE.....: 0 (0-DISABLE 1-ETH 2-P2 3-P3)
MSG TYPE.: 0 (0-AUTO 1-STD 2-ACA 3-BTCS)
```

Figure 2-88. UTCS Comm Display

The UTCS Comm Display (Figure 2-88) provides the following information:

- Mode – Defines the mode of communication, whether that is Disabled, or via Ethernet (IP), Port 2, or Port 3.
- MSG Type (Message Type)
  - 0-AUTO – The message type is defined by SPECIAL SEQ under STARTUP & MISC screen. If SPECIAL SEQ is set to 3-Boston Mode then the BTCS message handling will be used, otherwise STD message handling will be used
  - 1-STD – The original format SCOOT Comm Server message handling (limited to addresses 1-7)
  - 2-ACA – Extended format SCOOT Comm Server message handling (limited to addresses 1-15. Contains additional data transport.)
  - 3-BTCS – Boston UTCS message handling (limited to addresses 0-7)

2.3.6.6.2   SCOOT Stage Configuration

The SCOOT Stage Configuration Display (Figure 2-89) allows the user to view or edit the SCOOT Stage to phase mapping. This is applicable to Msg Type STD and ACA.

```
SCOOT STAGE CONFIG
        PHASES. 12345678 90123456
        STAGE A 01000100 00000000
        STAGE B 00100010 00000000
        STAGE C 00100001 00000000
        STAGE D 00010010 00000000
 UP/DOWN TO SCROLL
```

Figure 2-89. SCOOT Stage Config Display

STAGE x (Stage x Phase Mask) – The phase(s) included in this SCOOT Stage.

2.3.6.6.3   SCOOT Miscellaneous Configuration

The SCOOT Miscellaneous Configuration Display (Figure 2-90) allows the user to view or edit the SCOOT Detector and Phase Mode parameters. This is applicable to Msg Type STD and ACA.

```
SCOOT MISC. CONFIG

DET  12345678 90123456 78901234 56789012
RPLY 00000000 00000000 00000000 00000000

        PHASES 12345678 90123456
        PHSMODE 00000000 00000000
```

Figure 2-90. SCOOT Misc. Config Display

The SCOOT Misc. Config Display provides the following information:

- DET RPLY (Detector Reply) – The detectors to report via the SCOOT reply message. Msg Type STD can report up to 12 detectors, Msg Type ACA can report up to 32

- PHSMODE (Phase Mode) – The phase mode selected for the given phase. See Section 11.2.2 for more details

2.3.6.6.4   BTCS Configuration

The BTCS Configuration Display (Figure 2-91) allows the user to view and modify BTCS phase mode parameters.

```
BTCS CONFIG

        PHASES  12345678 90123456
      COORD PH: 01000100 00000000
```

Figure 2-91. BTCS Config Display

COORD PH – This feature defines the coordinated phases when running BTCS.

- Code 0 – This phase is not a coordinated phase.
- Code 1 – This phase is a coordinated phase.

2.3.6.6.5   Clear SCOOT Data

The Clear SCOOT Data Display allows the user to clear (zero-out) all SCOOT (STD and ACA) parameters.

```
CLEAR SCOOT DATA

 WARNING....THIS OPTION WILL ZERO OUT
 ALL CURRENT OPERATING DATA ..........
 - PRESS "E" TO CONTINUE
```

Figure 2-92. Clear SCOOT Data Display

Pressing 'E' on this display clears all data included on the SCOOT Stage Configuration and SCOOT Miscellaneous Configuration Displays.

2.3.6.6.6   Default SCOOT Data

The Default SCOOT Data Display allows the user to default all SCOOT (STD and ACA) parameters.

```
DEFAULT SCOOT DATA

WARNING....THIS OPTION WILL DEFAULT ALL
CURRENT OPERATING DATA ..............
- PRESS "E" TO CONTINUE
```

Figure 2-93. Default SCOOT Data Display

Pressing 'E' on this display defaults all data included on the SCOOT Stage Configuration and SCOOT Miscellaneous Configuration Displays.

2.3.6.7   GPS Configuration

The GPS Configuration Display (Figure 2-94) allows the user to view or edit the parameter for communications to a GPS device.

From the Configure Ports Menu (Figure 2-81), press **7-GPS CONFIG**.

```
GPS CONFIGURATION
GPS : 0 (0-NO 1-YES) PORT 8 (P2/3/8)

NOTE: The parameter 'GMT DIFF' on the
      F-6-2 screen defines the offset
      between the GPS provided and
      local time.
```

Figure 2-94. GPS Configuration Display

The GPS Configuration Display provides the following Information:

- GPS (Global Positioning)
    - Code 0 (No) – GPS is disabled
    - Code 1 (Yes) – GPS is enabled
- PORT – This entry defines which port the GPS device is connected to. The valid selections:
    - M50/M60-NEMA – 2 (Port 2) and 3 (Port 3[†])
    - M60-ATC Lite – 2 (Port 2 or C22S[‡]) and 3 (C21S[‡])
    - M60-ATC – 2 (Port 2 or C22S[‡]), 3 (C21S[‡]) and 8 (SP8)
    - 2070 ATC Linux – 2 (C22S[‡]), 3 (C21S[‡]), and 8 (C13S)

> **NOTE: The baud rate of the port must be set to match the GPS device.**
> **† – Port 3 expansion adapter required.**
> **‡ – 2070-7A required in slot A1.**

The usage of GPS on Port 2 prevents the use of IP ECOM on the CU.

2.3.6.7.1 Setting Time Using GPS

To set the time using a GPS device, do the following:

- From the Main Menu (Figure 2-1) press **2-UTILITIES**

- From the Utilities Menu (Figure 2-55) press **6-CONFIGURE PORTS**

- From the Configure Ports Menu (Figure 2-81) press **7-GPS CONFIG**

- From the GPS Config Display (Figure 2-94) press 1 to enable the GPS device

- Enter the port configured for the GPS unit. For example, Port 2 or Port 3, depending on the port configuration

- Connect the GPS unit to the controller. Refer to the instructions from the GPS user manual

The GPS time is synced to the top of the minute. It makes use of the GMT Time Zone Differential (GMT DIFF) which is automatically set by the Linux time zone (See 2.7.3). GPS is utilized to update the SEPAC time when:

- The two times differ by more than two seconds

- The SEPAC time is not within five seconds of the top of the minute

- The SEPAC time is not between midnight and 4AM local

- The GPS has a satellite lock

> **NOTE: When GPS is enabled, the user CANNOT set the time or date from the front panel. A range error will be displayed if user attempts this.**

This feature has been tested with Garmin GPS 17-HVS and 19-HVS marine devices. Any GPS that puts out the standard NMEA $GPRMC sentence at 4800 baud should work.
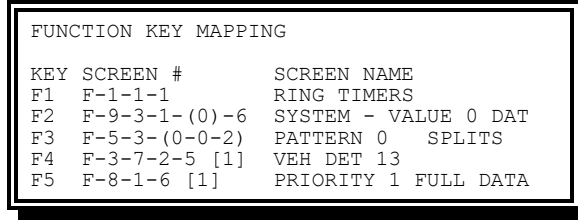
2.3.6.7.2 Display GPS Data Stream

To Display the GPS data stream, do the following:

- From the Main Menu (Figure 2-1), press **1-ACTIVE STATUS**

- From the Active Status menu (Figure 2-3), press **4-TIME BASE**

```
TIME BASE - CURRENT
   FRI  11/6/20  12:10:30  STD TIME
   SCH:   0 DAY PLAN:   0  ACTION: 0
------TRAFFIC------   ----AUXILIARY----
 PATTERN:  ICCONN      A: 12*    DIM:N
 GPS V  110620  181030 D: .2.
 P: ......... .......  S: .*******
CODES: (#)-ON  (.)-OFF  (*)-NOT DEFINED
```

Figure 2-95. Time Base Display – GPS Data Stream

2.3.6.8   SPaT Addressing

The SPaT Addressing Display (Figure 2-96) allows the user to view and edit the SPaT
Addressing parameters.

```
SPAT CONFIGURATION
    DESTINATION IP    DST PORT   ENABLED
01    0.  0.  0.  0      1034       0
02    0.  0.  0.  0      1034       0
03    0.  0.  0.  0      1034       0
04    0.  0.  0.  0      1034       0

 UP/DOWN TO SCROLL                   E-EDIT
```

Figure 2-96. SPAT Addressing display

This screen provides up to 16 entries.

- Destination IP – The IP Address to send SPaT Messages

- DST Port – The destination port number to send SPaT messages

- Enabled – Whether this destination is enabled or not

2.3.7   Function Key Mapping

The Function Key Mapping Display (Figure 2-97) shows the current mapping of the Function
Keys.

```
FUNCTION KEY MAPPING

KEY SCREEN #        SCREEN NAME
F1  F-1-1-1         RING TIMERS
F2  F-1-2-1         COORD TIMERS
F3  F-1-9-5         FINAL INPUT STATUS
F4  F-1-4           TIME BASE - CURRENT
F5  F-1-5-1         COMM STATUS
```

Figure 2-97. Function Key Mapping Screen

NOTE: Default mappings are shown above.

The first column (KEY) indicates the Function Key described on that row.

The second column (SCREEN #) describes the equivalent key presses it would take to get to
that screen. The letter 'F' is used to denote starting from the Main Menu. Parentheses are
used around key presses that are field inputs. Square brackets are used to denote the Priority
Bank or Phase Bank that that screen would display.

The third column (SCREEN NAME) is the Name of the Screen.

Below is an example of all possible Function Key Mapping Screen notations.

```
FUNCTION KEY MAPPING

KEY SCREEN #        SCREEN NAME
F1  F-1-1-1         RING TIMERS
F2  F-9-3-1-(0)-6   SYSTEM - VALUE 0 DAT
F3  F-5-3-(0-0-2)   PATTERN 0   SPLITS
F4  F-3-7-2-5 [1]   VEH DET 13
F5  F-8-1-6 [1]     PRIORITY 1 FULL DATA
```

Figure 2-98. Function Key Mapping Screen Example

2.3.8   Install Software

The Install Software Display allows the user to install new software files on the CU.

```
SOFTWARE INSTALLATION
1-[USB1] SEPAC_3.58a.99
2-[USB1] SEPAC_4.58a.1
3-[USB2] SEPAC_4.58aILL.32
4-[USB2] SEPAC_4.58.103
5-[USB3] SEPAC_4.59.54

UP/DOWN TO SCROLL
```

Figure 2-99. Install Software Display

The Install Software Display searches all inserted USB drives as well as the /home/admin/updates directory on the controller for software files.

If no software files are found, the following message will be displayed:

```
SOFTWARE FILE(S) NOT FOUND.
```

Figure 2-2-100. Software Files Not Found

After pressing 1-5 keys to select a software file the user will be presented with one of the following options.

```
            CORRUPT SOFTWARE FILE
             PRESS ESC TO RETURN
```

Figure 2-2-101. Corrupt Software File

If this occurs, there is something corrupted on the USB file. Re-transfer the files to the USB drive and try again.

OR

```
          INSTALL SCRIPT NOT PRESENT
             PRESS ESC TO RETURN
```

Figure 2-2-102. Install Script Not Present

If this occurs, the selected software file is not a valid software package that SEPAC can install.

OR

```
***INSTALL MAY REBOOT THE CONTROLLER***
    PRESS ENTER TO CONTINUE AND INSTALL
             PRESS ESC TO ABORT
```
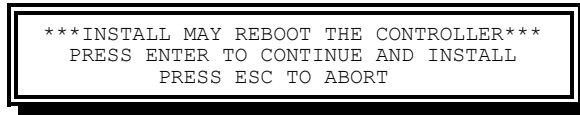
Figure 2-2-103. Install May Reboot the Controller

For this option, pressing ENTER will perform the installation and may reboot the controller.

NOTE: Software Installation should not be performed on a live intersection unless the cabinet has been put into flash state first.

If upgrading from older NTCIP-only versions (4.58x) the user may be prompted with the following message requesting a license key. This means the controller is not licensed for the version being installed. The user will need to enter a valid license key.

```
SEPAC 5.3.0   SOFTWARE LICENSE KEY

 MAC ADDR:    00.00.00.00.00.00

 ENTER LICENSE KEY:
```
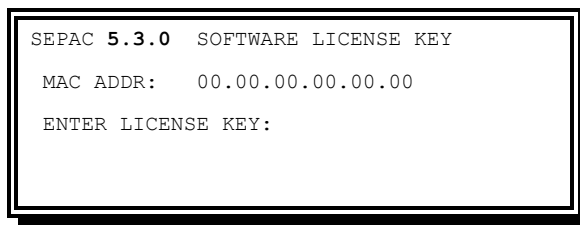
Figure 2-104. Software License Key Display

Enter the 32-character license key provided when the software was purchased, and press ENTER. The LEFT ARROW key performs the backspace function. If the updated license key hasn't been provided, the Distributor should be contacted. The user should provide the MAC Address of the controller and the SEPAC version number shown on the top line of the screen.

2.4 Phase Data

Phase data allows the user to display and enter controller parameters for:

- Vehicle times and controls
- Density times
- Pedestrian times and controls
- Initialization and non-actuated response
- Non-lock and miscellaneous vehicle controls
- Special sequence controls
- Detector controls

Phase and Detector Configuration Data (all the above except Initialization) is provided in a table that provides four instances (Banks) of each parameter used to configure all 16 phases in the Controller Unit. All the parameters of a Phase Bank are used concurrently.

User access is required to enter data for these parameters. See 2.3 for more information on gaining access.

2.4.1   Phase Data Menu

The Phase Data Menu (Figure 2-105) allows the user to select which phase parameter database area will be addressed.

```
PHASE MENU
 1-VEHICLE DATA      6-SPEC. SEQUENCE+
 2-DENSITY TIMES+    7-DETECTOR DATA
 3-PEDESTRIAN DATA   8-PHASE & BANK COPY
 4-INIT & NA RESP+   9-SELECT PHASE BANK
 5-N.LOCK & MISC+

'+' DENOTES BANKABLE DATA           [1]
```
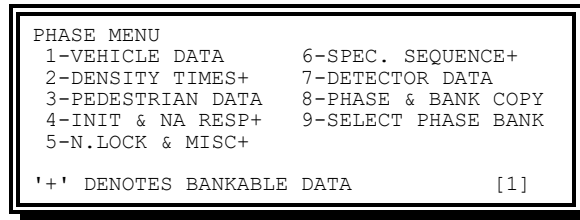
Figure 2-105. Phase Data Menu

Information for the Phase Menu Display includes the following:

- 1-Vehicle Data – Provides access to various displays for editing vehicle timing, bike timing, and recall parameters for all phases

- 2-Density Times – Provides viewing and editing of Vehicle Density parameters for all phases

- 3-Pedestrian Data – Provides access to various displays for editing Pedestrian times, Recalls, Offsets, and other related parameters

- 4-Init & NA Resp – Provides viewing and editing of Initialization states and Non-Actuated input responses for all phases

- 5-N.Lock & Misc – Provides viewing and editing of Non-locking Memory and other miscellaneous vehicle operational modes for all phases

- 6-Spec. Sequence – Provides viewing and editing of Sequence modification parameters for all phases

- 7- Detector Data – Provides viewing and editing of Vehicle, Pedestrian and Special Detector Assignment and operational parameters

- 8-Phase & Bank Copy – Provides an editing shortcut to equate Phase Data (for example, copy Phase Data to another Phase or copy data from Bank to Bank)

- 9-Select Phase Bank – Provides a shortcut to select the phase bank being editing on the other Phase Data displays

2.4.2   Vehicle Data

The Vehicle Data Menu (Figure 2-106) provides access to various displays for editing vehicle and bike times, as well as recall parameters.

From the Phase Data Menu (Figure 2-105), press **1-VEHICLE DATA**.

```
VEHICLE DATA

            1-VEHICLE TIMES+
            2-DYNAMIC MAX+
            3-RECALLS+
            4-BIKE & AWS TIMES+

                                    [1]
```
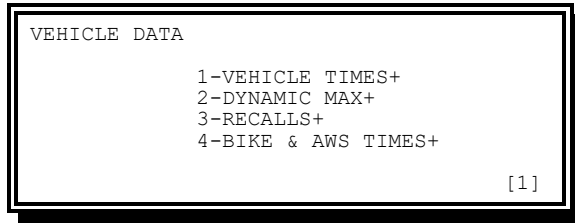
Figure 2-106. Vehicle Data Menu

Vehicle Data Menu options include the following:

- Vehicle Times – Provides viewing and editing of basic vehicle timing parameters

- Dynamic Max – Provides viewing and editing of Dynamic Max parameters

- Recalls – Provides viewing and editing of Vehicle Recall parameters

- Bike and AWS Times – Provides viewing and editing of Bike Timing and Advance Warning parameters

2.4.2.1   Vehicle Times

The Vehicle Times Display (Figure 2-107 and Figure 2-108) allows the user to view and modify the basic vehicle timings of all 16 Phases.

From the Vehicle Data Menu (Figure 2-106), press **1-VEHICLE TIMES**.

```
PHASE......1...2...3...4...5...6...7...8
 MIN GRN  10  15  10  15  10  15  10  15
 PASS/10  40  50  40  50  40  50  40  50
 MAX # 1  25  35  25  35  25  35  25  35
 MAX # 2  30  50  30  50  30  50  30  50
 YEL/10   40  40  40  40  40  40  40  40
 RED/10   10  10  10  10  10  10  10  10
                                    [1]
```
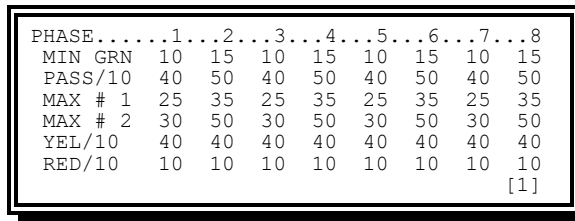
Figure 2-107. Vehicle Times Display – Phases 1-8

```
PHASE......9..10..11..12..13..14..15..16
 MIN GRN   0   0   0   0   0   0   0   0
 PASS/10   0   0   0   0   0   0   0   0
 MAX # 1   0   0   0   0   0   0   0   0
 MAX # 2   0   0   0   0   0   0   0   0
 YEL/10   30  30  30  30  30  30  30  30
 RED/10    0   0   0   0   0   0   0   0
                                    [1]
```
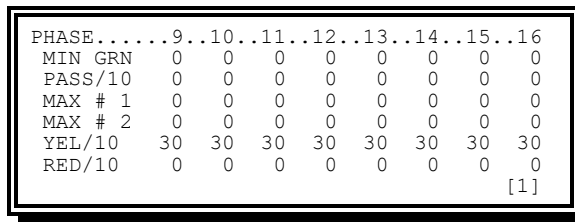
Figure 2-108. Vehicle Times Display – Phases 9-16

Default data for all phase banks is as shown.

The above displays are scrolling screens. Scrolling occurs in the first (top left) and last (bottom right) fields. Scrolling Functions include the following controls:

- Press Up in the first field to cause the screen to scroll left eight columns

- Press Left in the first field to cause the screen to scroll left one column

- Press Down in the last field to cause the screen to scroll right four columns

- Press Right in the last field to cause the screen to scroll right one column

Table 2-4. Vehicle Time Ranges		
Data Names and Ranges		
Abbreviation	**Data Name**	**Range**
MIN GRN	Minimum Green	0–255 Sec
PASS/10	Passage	0–255 Tenth Sec
MAX # 1	Maximum 1	0–255 Sec
MAX # 2	Maximum 2	0–255 Sec
YEL/10	Yellow Change	0–255 Tenth Sec
RED/10	Red Clearance	0–255 Tenth Sec

Changes to Minimum Green, Yellow Change, and Red Clearance parameters, will be held until the top of the next cycle. This provides for a positive release from one set of parameters, further entries, and an evaluation of the complete new set of parameters, prior to running coordination again.

2.4.2.2   Dynamic Max

The Dynamic Max Display (Figure 2-109) allows the user to view and modify the vehicle Dynamic Max Timings of all 16 Phases.

From the Vehicle Data Menu (Figure 2-106), press **2-DYNAMIC MAX**.

```
PHASE......1...2...3...4...5...6...7...8
DMAX       0   0   0   0   0   0   0   0
DSTP/10    0   0   0   0   0   0   0   0



                                   [1]
```

Figure 2-109. Dynamic Max Display

Default data for all phase banks is as shown. The above display is a scrolling screen. (See section 2.4.2.1)

Table 2-5. Dynamic Max Ranges		
Data Names and Ranges		
Abbreviation	**Data Name**	**Range**
DMAX	Dynamic Max	00–255 Sec
DSTP/10	Dynamic Step	00–255 Tenth Sec

2.4.2.3   Vehicle Recalls

The Vehicle Recalls Display (Figure 2-110) allows the user to view and modify the vehicle Recall Modes of all 16 Phases. These parameters may be changed without first Enabling Access.

From the Vehicle Data Menu (Figure 2-106), press **3-RECALLS+**.

```
PHASE......1...2...3...4...5...6...7...8
 VEH RCL   0   0   0   0   0   0   0   0
 VEH DLY   0   0   0   0   0   0   0   0

 CODES....0....1....2....3....4....5....
         NONE 1CALL MIN  MAX SOFT BIKE
                                    [1]
```

Figure 2-110. Vehicle Recalls Display (Phases 1-8 of 16 shown)

Default data for all phase banks is as shown. The above display is a scrolling screen. (See section 2.4.2.1)

Information provided in the Vehicle Recalls Display (Figure 2-110) can be edited without Enabling Access (see Section 2.3.1) and includes the following:

Vehicle Recalls:

- Code 0 (none) – The phase will operate as an actuated phase. It must, therefore, be connected to at least one detector

- Code 1 (Vehicle Call) – Places one momentary Vehicle Actuation

- Code 2 (Minimum Vehicle Recall) – Places a demand for vehicle service in memory each time the Phase leaves its Green interval

    ♦ This phase continually demands at least a minimum Green service even in the absence of actual vehicle or pedestrian calls

    ♦ The Green interval is extended by vehicle actuations during the green interval in the usual manner

    ♦ Pedestrian service is not provided in the absence of pedestrian actuations

- Code 3 (Maximum Vehicle Recall) – Places a demand for vehicle service in memory each time the Phase leaves its Green interval

    ♦ The Green interval is determined by the Maximum Time Setting

♦ The Green interval will not terminate on the basis of the maximum setting, but will continue until there is an actual serviceable conflicting call

♦ Pedestrian service is not provided in the absence of pedestrian actuations

- Code 4 (Soft Vehicle Recall) – provides the capability to recall a phase in the absence of serviceable calls (light traffic conditions). Places a demand for vehicle service in memory when:

  ♦ A conflicting phase is in Green or Red Dwell

  ♦ There are no serviceable conflicting calls

- Code 5 (Bike Recall) – Places a demand for bike service in memory each time the phase leaves its Green interval.

  ♦ This phase continually demands at least a Bike Green (BGRN) service even in the absence of actual Vehicle or Pedestrian calls

  ♦ The Green interval is extended by vehicle/bike actuations during the Green interval in the usual manner

  ♦ Pedestrian service is not provided in the absence of pedestrian actuations

Vehicle Recall Delay – 0-255 seconds

- The Recall operation will not occur until after the Recall Delay Time following the Phase termination

- The delay is applicable to Vehicle Minimum, Maximum, Soft Recall, and Bike Recall

- The delay begins the instant operation exits the Phase

- The timing continues regardless of demands on other Phases

2.4.2.4 Bike and AWS Times

From the Vehicle Data Menu (Figure 2-106), press **4-MISC**.

```
PHASE......1...2...3...4...5...6...7...8
 BGRN/10   0   0   0   0   0   0   0   0
 BPAS/10   0   0   0   0   0   0   0   0

 GDLY/10   0   0   0   0   0   0   0   0
 YDLY/10   0   0   0   0   0   0   0   0

                                    [1]
```

Figure 2-111. Bike and AWS Times (Phases 1-8 of 16 Shown)

- BGRN/10 (Bike Green) – 0-255 tenth seconds

  This parameter defines the ability to assign a Bike Lane Green time if a previous Minimum Green assignment is active.

  > ♦ **NOTE: In the case of NA phases or MAX Recalls the CU will use the larger of the MIN GRN and BGRN for the Vehicle Phase.**

- BPAS/10 (Bike Passage) – Bike Passage time in tenth seconds

- ◆ When a detector is assigned to this phase with a Mode of Bike Lane, the extensible portion of the Green is a function of Bike actuations that occur during the Green interval
- ◆ The Phase remains in the extensible portion of the Green interval as long as the Passage Timer is not timed out
- GDLY/10 (Green Delay) – 0-255 tenth seconds
  - ◆ SPECIAL SEQ is 1 (International Sequence): This parameter defines the time that the Green/Walk is delayed in order to provide a Red+Yellow transition
  - ◆ SPECIAL SEQ is not 1 (Advance Warning): This parameter defines the time that the Advance Warning output will remain on after onset of Green
  - ◆ YDLY/10 must also be non-zero to enable Advance Warning
- YDLY/10 (Yellow Delay) – 0-255 tenth seconds
  - ◆ SPECIAL SEQ is 1 (International Sequence): This parameter defines the time that Yellow is delayed in order to provide a Flashing Green transition
  - ◆ SPECIAL SEQ is not 1 (Advance Warning): This parameter enables the Advance Warning Output and defines the time that Yellow is delayed in order to provide Advance Warning prior to the termination of Green

2.4.2.4.1 Advance Warning Signals

Advance Warning Signals (AWS) can be used to provide drivers with information on the change in signal indication at approaching intersection. SEPAC provides the ability to drive AWS for each Phase through the Pedestrian Clear (Load Switch Yellow) Output.

The AWS sequence for a Phase is as follows:

Table 2-6. Advance Warning Sequence								
Signal		**Sequence**						
	1	**2a**	**2b**	**3**	**4**	**5**	**6**
Phase (#) Red	-	-	-	-	-	-	R
Phase (#) Yellow	-	-	-	-	-	Y	-
Phase (#) Green	G	G	G	G	G	-	-
Phase (#) Don't Walk	-	-	FD	D	D	D	D
Phase (#) PC (Yel)	ON	-	-	-	ON	ON	ON
Phase (#) Walk	W	W	-	-	-	-	-

The Advance Warning Sequence Intervals in the table above are timed as follows:

1. The GDLY (0-255 tenth seconds) value determines this interval length (amount of time the Advance Warning Output remains ON after the beginning of the Phase Green). This value may be set to zero
2. The Phase Walk (2a)/Pedestrian Clear (2b) values determine this interval length

3. The Phase Green values determine this interval length

4. The YDLY (0-255 tenth seconds) values determine this interval length (amount of time the Advance Warning Output turns ON before the end of the Phase Green). This value must be greater than zero (1-255 tenth seconds) for AWS operation to be enabled

5. The Phase Yellow values determine this interval length

6. The Phase Red Clearance values determine this interval length

> **NOTE: SEPAC turns AWS outputs ON during startup and Fault Flash even though standard cabinet wiring precludes the outputs from being visible to the driver. With a modification to standard cabinet wiring, the AWS could be made visible to the driver during these situations.**
>
> **SEPAC turns on AWS outputs when a transition to Preempt begins and maintains this ON condition for the duration of Preempt.**

2.4.2.4.1.1 Advance Warning Programming

This section shows an example of Advance Warning programming.

From the Unit Data Menu (Figure 2-140.), press **1-STARTUP & MISC**.

```
STARTUP & MISC
STARTUP TIME.:  5 (SEC) STATE: 0 (0-FL
RED REV/10...: 40 (TSEC)          1-RED
AUTO PED CLR.:  0 (0-NO 1-YES)    2-RAF)
STOP T RESET.:  0 (0-NO 1-YES)
ALT SEQUENCE.:  0 (0-18)
SPECIAL SEQ  :  0 (SEE HELP)
```

Figure 2-112. Startup & Misc Display

Special Sequence (SPECIAL SEQ) must not be 1 for SEPAC to provide the Advance Warning Operation.

From the Vehicle Data Menu (Figure 2-106), press **4-MISC**.

```
PHASE......1...2...3...4...5...6...7...8
 BGRN/10    0   0   0   0   0   0   0   0
 BPAS/10    0   0   0   0   0   0   0   0

 GDLY/10    0  60   0  60   0  60   0  60
 YDLY/10    0  40   0  40   0  40   0  40
 FLASH      0   1   0   0   0   1   0   0

                                      [1]
```

Figure 2-113. Miscellaneous Vehicle Display

- GDLY (Green Delay) value (0-255 tenth seconds) establishes the amount of time the Advance Warning Output remains ON after the beginning of the Phase Green. This value may be set to zero

- YDLY (Yellow Delay) value (0-255 tenth seconds) establishes the amount of time the Advance Warning Output turns ON before the end of the Phase Green. This value must be greater than zero (1-255 tenth seconds) for AWS operation to be enabled

- FLASH (AWS Flash) value (0-1)

  - CODE 0 (Steady) – AWS output is on steady for the duration of the AWS period. A flasher unit is required at the sign for flashing display.

  - CODE 1 (Flash) – AWS output flashes at 60 fpm for the duration of the AWS period. No flasher unit is required.

- When Special Sequence is zero and Yellow Delay is zero, the standard NEMA Sequence is provided

From the Unit Data Menu (Figure 2-140.), press **2-REMOTE FLASH**.

```
FLASH SETTINGS        TEST-A AS FLASH: 0

LDSW:123456789 0123456789 0123456789 012
FLSH:000000003 3330000000 0000000000 000
 ALT:000000000 0000000000 0000000000 000


0-DARK  1-RED  2-YELLOW  3-STEADY YELLOW
```

Figure 2-114. Remote Flash Display

- The Flash (FLSH) value must be zero when the Advance Warning Signals are to be dark during Remote Flash. Use two (flashing) or three (steady) when the Advance Warning Signals are to be ON during Remote Flash.

- The above example programming establishes AWS control on Phases 2-4-6-8 and that the AWS output will appear four seconds before the end of the respective Phase Green and stay on until six seconds after the Phase Green begins. Phases 2 and 6 are flashing; phases 4 and 8 are steady.

2.4.2.4.2   International Sequence

SEPAC includes the ability to provide the transition displays used by the international user.

The International Sequence for a Phase is as follows:

Table 2-7. International Sequence						
Signal	**Sequence**					
	1	**2**	**3**	**4**	**5**	**6**
Phase (#) Red	R	-	-	-	R	R
Phase (#) Yellow	Y	-	-	-	Y	-
Phase (#) Green	-	G	G	FG	-	-
Phase (#) Don't Walk	D	-	FD	D	D	D
Phase (#) PC (Yel)	-	-	On	-	-	-
Phase (#) Walk	-	W	-	-	-	-

The International Sequence Intervals in the table above are timed as follows:

1. The GDLY (0-255 tenth Seconds) values determine this interval length (amount of time the R->G transition lasts and the Green/Walk is delayed)

2. The Phase Green values and actuations determine this interval length

3. The Phase Pedestrian Clear values determine this interval length

4. The YDLY (0-255 tenth seconds) values determine this interval length (amount of time the G->Y transition lasts and the Yellow is delayed)

5. The Phase Yellow values determine this interval length

6. The Phase Red Clearance values determine this interval length

2.4.2.4.2.1 International Sequence Programming

The following is an example of International Sequence programming:

From the Unit Data Menu (Figure 2-140.), press **1-STARTUP & MISC**.

```
STARTUP & MISC
STARTUP TIME.:  5 (SEC) STATE: 0 (0-FL
RED REV/10...: 40 (TSEC)          1-RED
AUTO PED CLR.:  0 (0-NO 1-YES)    2-RAF)
STOP T RESET.:  0 (0-NO 1-YES)
ALT SEQUENCE.:  0 (0-18)
SPECIAL SEQ  :  1 (SEE HELP)
```

Figure 2-115. Startup & Misc Display

Special Sequence must be one (1) for SEPAC to provide International Sequence Operation.

From the Vehicle Data Menu (Figure 2-106), press **4-MISC**.

```
PHASE .....1...2...3...4...5...6...7...8
 BGRN/10    0    0    0    0    0    0    0    0
 BPAS/10    0    0    0    0    0    0    0    0

 GDLY/10   20   20   20   20   20   20   20   20
 YDLY/10   40   40   40   40   40   40   40   40
 FLASH      0    0    0    0    0    0    0    0
                                          [1]
```

Figure 2-116. Miscellaneous Vehicle Options Display

- The GDLY (Green Delay) value establishes the amount of time the Green/Walk outputs are delayed to provide the Red + Yellow transition display

- YDLY (Yellow Delay) value establishes the amount of time the Yellow output is delayed to provide the Flashing Green transition display

- FLASH value is not used for International Sequence

- The above example programming establishes International Sequence Control on all Phases (1-8) and that the International Sequence R->G transition (R+Y) will be two seconds and the International Sequence G->Y transition (FG) will be four seconds

> **NOTE: In current SEPAC operation, the International Sequence is not extended to Overlap Load Switches nor is operational in any transition to and within Preempt**

2.4.3   Density Times

The Density Times Display (Figure 2-117) allows the user to view and modify the Vehicle Density Timings of all 16 Phases.

From the Phase Data Menu (Figure 2-105), press **2-DENSITY TIMES**.

```
PHASE......1...2...3...4...5...6...7...8
 AINI/10    0   0   0   0   0   0   0   0
 MAX INI    0   0   0   0   0   0   0   0
 TIM BEF    0   0   0   0   0   0   0   0
 CAR BEF    0   0   0   0   0   0   0   0
 TIME TO    0   0   0   0   0   0   0   0
 MGAP/10    0   0   0   0   0   0   0   0
                                      [1]
```

Figure 2-117. Density Times Display (Phases 1-8 of 16 shown)

The above displays are scrolling screens. Scrolling occurs in the first and last fields (See 2.4.2.1)

Table 2-8. Density Time Ranges		
Data Names and Ranges		
Abbreviation	**Data Name**	**Range**
AINI/10	Added Initial	0–255 Tenth Sec
MAX INI	Maximum Initial	0–255 Sec
TB RED	Time B4 Reduction	0–255 Sec
CB RED	Cars B4 Reduction	0–255 Cars
TT RED	Time to Reduce	0–255 Sec
MGAP/10	Minimum Gap	0–255 Tenth Sec

Changes to Added Initial and Maximum Initial parameters will be held until the top of the next cycle.

2.4.4　　Pedestrian Data Menu

The Pedestrian Data Menu (Figure 2-118) provides access to various displays for editing Pedestrian times, Recalls, Offsets, and other related parameters.

From the Phase Data Menu (Figure 2-105), press **3-PEDESTRIAN DATA**.

```
PEDESTRIAN MENU

          1-PED TIMES+
          2-PED RECALL+
          3-PED OFFSET+
          4-MISC PED OPTIONS+
                                    [1]
```
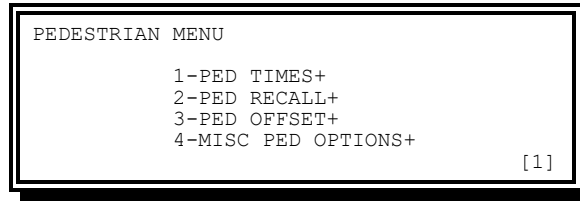
Figure 2-118. Pedestrian Data Menu

Pedestrian Data Menu options include the following:

- PED Times – Provides viewing and editing of Primary and Alternate Walk and Pedestrian Clear times

- PED Recall – Provides viewing and editing of Pedestrian Recall parameters

- PED Offset – Provides viewing and editing of Pedestrian Offsets and Offset directions

- Misc PED Options – Provides viewing and editing of Flashing Walk, Extended Pedestrian Clear and Actuated Rest in Walk parameters

2.4.4.1　　Pedestrian Times

From the Pedestrian Data Menu (Figure 2-118), press **1- PED TIMES**.

```
PHASE......1...2...3...4...5...6...7...8
 WALK1      0   5   0   5   0   5   0   5
 PEDCLR1    0   8   0   8   0   8   0   8

 WALK2      0   5   0   5   0   5   0   5
 PEDCLR2    5  10   0  10   0  10   0  10

                                    [1]
```

Figure 2-119. Pedestrian Times (Phases 1-8)

```
PHASE......9..10..11..12..13..14..15..16
 WALK1      0   0   0   0   0   0   0   0
 PEDCLR1    0   0   0   0   0   0   0   0

 WALK2      0   0   0   0   0   0   0   0
 PEDCLR2    0   0   0   0   0   0   0   0

                                    [1]
```

Figure 2-120. Pedestrian Times (Phases 9-16)

The above displays are scrolling screens. Scrolling occurs in the first and last fields (See 2.4.2.1). The parameters available on this screen are:

- WALK1: Pedestrian Walk time in seconds. This shall control how long the WALK indication is displayed when the pedestrian call is held for less than 1 second or for any call when the WALK2 time is 0.

- PEDCLR1: Pedestrian Clear time in seconds. This shall control how long the Flashing Don't Walk indication and the Ped Clear output are displayed when the Pedestrian call is held for less than 1 second, or for any call when PEDCLR2 time is 0.

- WALK2: Alternate Pedestrian Walk time in seconds. This shall control how long the WALK indication is displayed when the pedestrian call is held for 1 second or longer. If WALK2 is 0, WALK1 time is used

- PEDCLR2: Alternate Pedestrian Clear time in seconds. This shall control how long the flashing Don't Walk indication and the Ped Clear output are displayed when the pedestrian call is held for 1 second or longer. If PEDCLR2 is 0, PEDCLR1 time is used

A pedestrian movement is considered valid if either WALK1 or PEDCLR1 is non-zero. Thus, it is possible for a Pedestrian to have a zero second Walk time if PEDCLR1 is non-zero.

Table 2-9. Pedestrian Time Ranges		
Data Names and Ranges		
Abbreviation	**Data Name**	**Range**
WALK1	Walk 1	0–255 Sec
PED CLR1	Pedestrian Clear 1	0–255 Sec
WALK2	Walk 2	0–255 Sec
PEDCLR2	Pedestrian Clear2	0–255 Sec

2.4.4.2   Pedestrian Recall

From the Pedestrian Data Menu (Figure 2-118) press **2-PED RECALL**.

```
PHASE......1...2...3...4...5...6...7...8
 PED RCL   0   0   0   0   0   0   0   0
 PED DLY   0   0   0   0   0   0   0   0

CODES....0....1....2....3....4
         NONE 1CALL PED  NA   NA+

                                    [1]
```
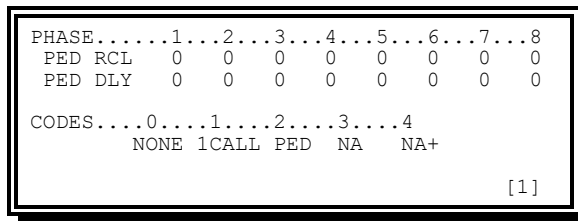
Figure 2-121. Pedestrian Recall Display (Phases 1-8 of 16 shown)

The above displays are scrolling screens. Scrolling occurs in the first and last fields. (See 2.4.2.1). The parameters available on this screen are:

Pedestrian Recalls

- Code 0 (none) – The Phase (Pedestrian Movement) will operate as an actuated phase. It must, therefore, be connected to at least one detector

- Code 1 (Pedestrian Call) – Places one momentary Pedestrian actuation

- Code 2 (Pedestrian Recall) – Places a demand for standard Pedestrian service in memory each time the phase leaves its Green interval

    - The Phase will continually demand Pedestrian service even in the absence of actual Pedestrian calls, but an actual Pedestrian call is required to recycle Pedestrian service during the Pedestrian service interval

    - Alternate Pedestrian Times are not invoked by this Code

- Code 3 (Non-Actuated) – The Phase will operate as a Non-Actuated phase

- Code 4 (Non-Actuated Plus) – The Phase will operate as a Non-Actuated Phase

    - On initial entry to a Phase, programmed in this way, the Walk Time will be set equal to the longer of the Walk Time parameter or the called Maximum Time parameter (Max 1 or Max 2)

    - A recycle of the Pedestrian within the Phase will result in the Walk Time being set equal to the Walk Time parameter.

    - An active call to a Non-Actuated input, for which the Phase is programmed to respond, will result in the Walk Time being set equal to the Walk Time parameter

    - Running Internal Coordination will result in Walk Time being set equal to the Walk Time parameter

- Recall Delay (0-255 seconds)

    - The Recall operation will not occur until after the Recall Delay time following the Phase Green termination

    - The Delay is applicable to Code 2 (Pedestrian Recall)

    - The Delay begins the instant operation exits the Phase Green interval

    - The timing continues regardless of demands on other Phases

2.4.4.3   Pedestrian Offsets

From the Pedestrian Data Menu (Figure 2-118), press **3-PED OFFSET**.

```
PHASE......1...2...3...4...5...6...7...8
 WOFF/10   0   0   0   0   0   0   0   0
 MODE*     0   0   0   0   0   0   0   0



CODES: * 0=ADVANCE 1=DELAY
                                     [1]
```

Figure 2-122. Pedestrian offset (Phases 1-8 of 16 shown)

The above displays are scrolling screens. Scrolling occurs in the first and last fields. (See 2.4.2.1). The parameters available on this screen are:

- WOFF/10 (Walk Offset) – 0-255 tenth seconds. This parameter defines the Offset between the start of the Phase Walk and the start of the Phase Green outputs in tenth seconds. Zero offset provides normal operation

- MODE (Walk Offset Mode) - This parameter defines the Mode (direction of Offset) for the Phase Walk from the Phase Green in the following way:
    - Code 0 (Advance/Leading Walk) – Phase Walk appears before the Phase Green
    - Code 1 (Delay/Trailing Walk) – Phase Green appears before the Phase Walk

2.4.4.4   Miscellaneous Pedestrian Options

From the Pedestrian Data Menu (Figure 2-118), press **4-PED MISC**.

```
PHASE......1...2...3...4...5...6...7...8
 *FL WK    0    0    0    0    0    0    0    0
 **EXT PCL 0    0    0    0    0    0    0    0
 *ACT RIW  0    0    0    0    0    0    0    0


CODES: * 0=NO 1=YES  ** SEE HELP
                                    [1]
```
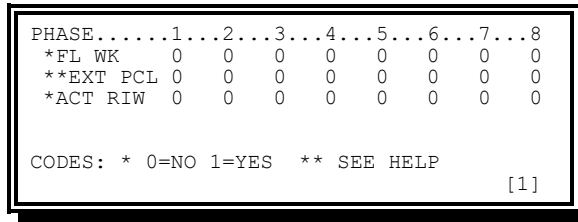
Figure 2-123. Misc Ped Options Display (Phases 1-8 of 16 shown)

The above displays are scrolling screens. Scrolling occurs in the first and last fields (See 2.4.2.1). The parameters available on this screen are:

- FL WK – (Flashing Walk)
    - Code 0 (Steady Walk) – The Walk output is steady during Walk timing
    - Code 1 (Flashing Walk) – The Walk output is flashing during Walk timing
- EXT PCL – (Extended Pedestrian Clearance)
    - Code 0 (Normal Pedestrian Clear) – This is the standard NEMA-defined Pedestrian operation with Flashing Don't Walk terminating no later than the start of Yellow Change
    - Code 1 (Extended through Red) – The Pedestrian Clearance Interval (Flashing Don't Walk), may appear concurrently with the vehicle change (Yellow Change + Red Clear) intervals
        - The end of the Pedestrian Clear (Flashing period) occurs earlier than the end of the Vehicle Clearance Intervals in the following conditions:
            - Min Green + Yellow + Red is greater than Walk + Pedestrian Clear
            - The Phase is extended
            - Pedestrian clear is less than Yellow + Red
        - When the Extended Pedestrian Clear (flashing period) occurs concurrent with the vehicle Yellow Change and Red Clearance display, the Red timing will not be omitted if the omit Red Clearance input becomes active
    - Code 2 (Extended through Yellow) – Similar to Code 1 except the flashing period (Pedestrian Clearance) may appear concurrently only with the vehicle Yellow Change interval.

♦ Code 3 (Extended with 3 Second Buffer) – Similar to code 1 except the flashing period (Pedestrian Clearance) must terminate at least three seconds prior to the end of Red Clearance. This is MUTCD 2009 compliant

Actuated Rest-In-Walk

♦ Code 0 (Actuated Rest-in-Don't) – This is the standard NEMA-defined actuated Pedestrian operation. The actuated phase rests in Don't Walk.

♦ Code 1 (Actuated Rest-in-Walk) – The CU design provides an alternate mode Pedestrian Dwell for actuated Phases. The actuated Phase rests in Walk when so programmed and there is no serviceable conflicting call at the end of the Walk timing

Changes to Walk, Pedestrian Clear and Extended Pedestrian Clear parameters will be held until the top of the next cycle

2.4.5 Initialization and Non-Actuated Response

The Initialization and NA Response Display (Figure 2-124) allows the user to view and modify the Initialization states and Non-Actuated Input Responses of all 16 Phases.

From the Phase Data Menu (Figure 2-105), press **4-INIT & N.A. RESP**.

```
PHASE......1...2...3...4...5...6...7...8
 INITIAL   1   3   1   1   1   3   1   1
 NA RESP   0   1   0   2   0   1   0   2
 UPDT GRN  0   0   0   0   0   0   0   0
CODES.....0....1....2...3...4...5...6
 INITL  NONE INACT RED YEL GRN DRK G/DW
 NA RSP NONE  NA1  NA2 1&2 --- --- ---
                                    ***
```

Figure 2-124. Initialization and Non-Actuated Display (Phases 1-8 of 16 shown)

Different values for INITIAL and UPDT GRN do NOT exist in each Phase Bank. Therefore, the display shows *** in the lower right of the window rather than the selected Phase Bank.

When the cursor is moved into a NA RESP field, the lower right of the window indicates the currently selected Phase Bank ([#]) as in other Phase windows.

The above display is a scrolling screen. Scrolling occurs in the first and last fields (See 2.4.2.1).

INITIAL (Initialization)

• Code 0 (None/No Phase) – The Phase is not used and will *never* appear in the sequence; the outputs will be Dark

• Code 1 (Phase Inactive) – The Phase will not be actively timing any interval and the outputs will be Red and Don't Walk

• Code 2 (Phase ON in Red Clear) – The Phase starts timing at the beginning of its Red Clearance interval and the outputs will be Red and Don't Walk

• Code 3 (Phase ON in Yellow Change) – The Phase starts timing at the beginning of its Yellow Change interval and the outputs will be Yellow and Don't Walk

- Code 4 (Phase ON in Green/Walk) – The Phase starts timing at the beginning of its Minimum Green and Walk intervals and the outputs will be Green and Walk

- Code 5 (Phase Dark and Omitted) – The Phase will not be active and will not *normally* appear in the sequence. No intervals will be timing and the outputs will be Dark

- Code 6 (Phase ON in Green/Don't Walk) – The Phase starts timing at the beginning of its Minimum Green interval and the outputs will be Green and Don't Walk

Code 5 (Dark) is like Code 0 (None) but with an important difference: it is the only way a user can get a dummy (Dark) Phase time to run in Coordination. A Dark Phase can cycle during Preempt.

All mutually exclusive active phases must be in the first ring.

Changes to Initialization parameters among Codes 1, 2, 3, 4 and 6 will be held until the top of the next cycle. Any entry that changes the Phase state between not having outputs (Codes 0 and 5) to having outputs (Codes 1, 2, 3, 4 and 6) causes an automatic restart of the CU. This prevents residual Phase Status for Phases that are no longer active from affecting the running configuration.

NA RESP (Non-Actuated Response)

- Code 0 (None) – The phase will not respond to the activation of either of the CALL TO NON- ACTUATED MODE inputs

- Code 1 (Responds to NA1 input) – The Phase responds to the activation of the CALL TO NON-ACTUATED MODE I input but not to the activation of the CALL TO NON-ACTUATED II input

- Code 2 (Responds to NA2 input) – The Phase will respond to the activation of the CALL TO NON-ACTUATED MODE II input but not to the activation of the CALL TO NON-ACTUATED I input

- Code 3 (Responds to NA1 and NA2 inputs) – The Phase responds to the activation of either of the CALL TO NON-ACTUATED MODE inputs

UPDT GRN (Update Green) – Determines at what point Remote Update may transition from the currently running version of SEPAC to a new version. Only one phase per ring may be selected and the phases must be compatible. At least one phase must be selected. It is recommended that a phase be selected to each active ring in most cases. If phases are not selected for all active rings, SEPAC will begin its transition when the selected phases are active regardless of the state of the other rings. It is the user's responsibility to ensure that this is a safe transition point. If no phases are selected, the Remote Update functionality is disabled.

- Code 0 – not selected
- Code 1 – selected Phase Green

Remote Update is done in conjunction with TACTICS™ and is not possible for a standalone controller. Remote Update is inhibited during cabinet flash, startup, preempt, priority and automatic flash. If remote update is requested during startup, preempt or priority, the request is kept pending for up to 2 cycles before returning an error. It will also return an error if the selected green phases do not come up for 2 cycles. If remote update is requested during automatic flash, the intersection is temporarily brought out of flash to execute the update then returned to flash.

2.4.6   Non-Locking and Miscellaneous Controls

The Non-Locking Miscellaneous Controls Display (Figure 2-125) allows the user to view and modify the non-locking mode and miscellaneous other vehicle operational modes of all 16 Phases.

From the Phase Data Menu (Figure 2-105), press **5-N.LOCK & MISC**.

```
PHASE......1...2...3...4...5...6...7...8
 NL MEM.   0   0   0   0   0   0   0   0
 2 ENTRY   0   0   0   0   0   0   0   0
 LC PASS   0   0   0   0   0   0   0   0
 CON SER   0   0   0   0   0   0   0   0
 NO SGAP   0   0   0   0   0   0   0   0
CODES........0-NO....1-YES..............
                                     [1]
```

Figure 2-125. Miscellaneous Controls Display (Phases 1-8 of 16 shown)

The above displays are scrolling screens. Scrolling occurs in the first and last fields. (See 2.4.2.1).

Information provided on the Miscellaneous Controls Display includes the following:
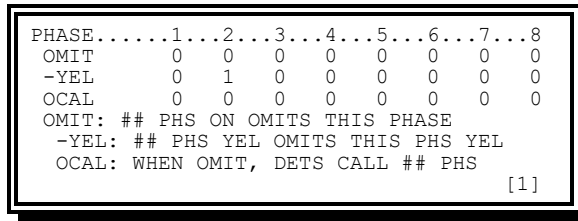
- NL MEM. (Non-locking memory)

    - Code 0 (Locking VEH memory) – The locking phase setting enables the memory storage of vehicle calls until the Phase is serviced

    - Code 1 (Non-Locking VEH memory) – The Non-Locking phase setting prevents the memory storage of vehicle calls. In this mode of operation, one or more of the assigned detectors must be continuously occupied in order to maintain a vehicle call for service

- 2 ENTRY (Dual Entry)

    - Code 0 (No) – Single entry is a mode of operation (in multiple ring CUs) in which a phase in one ring can be selected and timed alone if there is no demand for service in a non-conflicting phase in a parallel ring

    - Code 1 (Yes) – Dual entry is a mode of operation (in multiple ring CUs) in which one Phase in each ring must be in service (subject to compatibility where possible) at all times. If a call does not exist in a ring when it is committed to cross a barrier, a Phase is selected in that ring to be activated by the CU based on this entry

- LC PASS (Last car passage)

    - Code 0 (No) – This is the standard NEMA-defined actuated Green Termination operation

    - Code 1 (Yes) – Last Car Passage provides an alternate method of operation to control Green termination with Volume Density operation by an entry through the front panel

    - When Last Car Passage is active, each Phase operating in a Volume Density mode will retain the right of way for the unexpired portion of the Passage Time following a decision to terminate the Green due to a reduced gap

- ♦ This provides a full Passage Time for the last vehicle (car) which crossed the detector prior to the decision to terminate the Green
- CON SER (Conditional Service)
    - ♦ Code 0 (No) – This is the standard NEMA-defined actuated operation
    - ♦ Code 1 (Yes) – This Phase may Conditionally Service prior Phases, if two concurrent Phases are timing and a call exists on the other side of the barrier and one of the Phases is prepared to terminate due to Gap Out or Maximum Time out, the ring containing the timed-out Phase reverts to a preceding vehicle Phase if:
        - ▪ A call exists on a preceding vehicle Phase
        - ▪ The gapped/maxed phase is programmed for conditional service
        - ▪ There is sufficient time remaining before the maximum time of the other phase has elapsed
    1. The criterion for determining if sufficient time remains for conditional servicing is whether the gapped Phase vehicle clearance time plus the Minimum Green time of the Phase about to be Conditionally Serviced is less than the time remaining on the Maximum timer of the Non-Gapped/Maxed Phase
    2. Conditional Service applies to vehicle Phases only. For Phases with concurrent Pedestrian service, the Pedestrian display remains Don't Walk. Any Pedestrian calls placed prior to re-service or during the re-service will be stored until the Phase is serviced normally
    3. If a Conditionally Serviced Phase has been re-serviced, the ring containing that Phase remains in the Conditionally Serviced Phase until the Phase of the complementary ring has gapped out or reached its maximum time and the Phase of the Conditionally Serviced Phase Minimum Green time has been completed. The timed Phases then cross the barrier together. If all calls on the opposite side of the barrier are removed during the Conditional Service operation, the controller reverts to its normal Phase sequence operation
    4. The gap timer of the Conditional Serviced Phase does not extend the Green time of that Phase when it is being Conditionally Serviced
    5. A non-actuated phase will never receive conditional re-service.
- NO SGAP (No simultaneous gap out)
    - ♦ Code 0 (No) – This provides Simultaneous Gap operation
    - ♦ Code 1 (Yes) – This disables Simultaneous Gap operation on this Phase

2.4.7   Special Sequence

The Special Sequence Display (Figure 2-126) allows the user to view and modify the sequence modification parameters of all 16 Phases.

From the Phase Data Menu (Figure 2-105), press **6-SPEC. SEQUENCE**.

```
PHASE......1...2...3...4...5...6...7...8
 OMIT      0   0   0   0   0   0   0   0
 -YEL      0   1   0   0   0   0   0   0
 OCAL      0   0   0   0   0   0   0   0
OMIT: ## PHS ON OMITS THIS PHASE
 -YEL: ## PHS YEL OMITS THIS PHS YEL
  OCAL: WHEN OMIT, DETS CALL ## PHS
                                    [1]
```

Figure 2-126. Special Sequence Display (Phases 1-8 displayed)

The above displays are scrolling screens. Scrolling occurs in the first and last fields (See 2.4.2.1).

Information provided on the Special Sequence display (Figure 2-126) includes the following:

- OMIT
    - Code 0 (None) – This is the standard NEMA-defined actuated operation
    - Code # (Omit) – This phase will be omitted if the entered phase is already ON. I.e., this feature provides a per-Phase entry (Phase Number) that will Omit the Phase so programmed when the entered Phase is ON
- -YEL (Minus Yellow)
    - Code 0 (None) – This is the standard NEMA-defined actuated operation
    - Code # (-Yellow) – This phase's Yellow will be inhibited when the entered phase is Yellow. I.e., this feature provides a per-Phase entry (Phase Number) that omits the Phase programmed in this way from outputting a Yellow when the entered Phase is outputting a Yellow
    - This operation applies during all levels of operation (for example, normal, Preemption, etc.)
- OCAL (Omitted Call)
    - Code 0 (None) – An omitted call will not be placed
    - Code # (Omitted Call) – This feature provides a per-Phase entry (Phase Number) that will define the Phase to call when this Phase is omitted by the Omit programming above
    - If a Phase is currently omitted by Phase on omit logic and the Phase is not Green and one of the Phase detectors has a call and no conflicting call exists for the ON Phase, then operate as though a call exists on a user-entered Phase

2.4.8   Detector Data

The Detector Data Display (Figure 2-127) allows the user to view and modify the detector operational parameters of all detector inputs.

From the Phase Data Menu (Figure 2-105), press **7-DETECTOR DATA**.

```
DETECTOR CONFIG

 1-VEH  1- 8   6-VEH 41-48   A-ALL DETS
 2-VEH  9-16   7-VEH 49-56   B-OVERVIEW
 3-VEH 17-24   8-VEH 57-64   D-LOAD DEF
 4-VEH 25-32   9-PED  1-8
 5-VEH 33-40   0-SPC  1-8
                                    [1]
```

Figure 2-127. Detector Data Menu

The Detector Data Menu options provides access to detector configuration for all detector inputs as well as configuration that applies to all detectors.

2.4.8.1   Detector Configuration Data

From the Detector Data Menu (Figure 2-127), press **1-VEH 1-8**.

```
DETECTOR CONFIG DATA

 1-VEHICLE DET 1+    5-VEHICLE DET 5+
 2-VEHICLE DET 2+    6-VEHICLE DET 6+
 3-VEHICLE DET 3+    7-VEHICLE DET 7+
 4-VEHICLE DET 4+    8-VEHICLE DET 8+

                                    [1]
```

Figure 2-128. Detector Config Data Menu

The Detector Config Data Menu options provides access to per detector configuration parameters.

2.4.8.1.1 Detector Configuration

From the Detector Configuration Data Menu (Figure 2-128), press **1-VEHICLE DET 1**.

```
VEH DET 1     PHASE 12345678 90123456
 ASSIGNED PHASES....10000000 00000000
 SWITCH PHASES......00000000 00000000
   MODE   0    CALL  1    EXT/10   0
   VOLUME 0    PASS  1    DLY/10   0
   OCCUPY 0    ADDED 1    FAIL   255
   LOCK   0    QUEUE 0    QLIMIT   0
                                    [1]
```

Figure 2-129. Vehicle Detector Data Display

- Assigned Phases
    - Code 0 (Not Assigned) – The detector input is not assigned to this Phase
    - Code 1 (Assigned) – The detector input is assigned to this Phase

An active Phase without a means of being actuated (no detector assigned, or no recalls programmed) operates as though it had a continuous call. Each detector may be assigned to multiple Phases.

- Switch Phases – w/Mode of Non-Ped
    - Code 0 (Not Switched) – This is the standard NEMA-defined actuated vehicle detector operation
    - Code 1 (Switched) – This programming feature allows Phase detector actuations to be switched to another Phase when an assigned Phase cannot be serviced normally or is Yellow or Red and a compatible switched Phase is Green

Detector switching provides a per-detector entry identifying the Phases that will receive the switched actuations. Each detector may have multiple switch Phases.

When serviced normally the following conditions are true:

- An assigned Phase is active
- An assigned Phase is not omitted
- A compatible switch Phase is not Green

The detector programming may be used in any combination. That is to say, a vehicle detector may be programmed to Extend, Delay, and Switch.

NOTE: Detector switching is not provided during SCOOT or UTCS operation.

- Switch Phases – w/Mode of Ped establish Switched Pedestrian Phase as follows:
    - Code 0 (none) – No Switched Pedestrian Phase
    - Code 1 (Enabled) – Phase number of the second Phase to also drive the assigned Phase Pedestrian outputs (see Chapter 3, Section 3.2.2.1).

NOTE: When configuring a Switched Pedestrian Phase, SEPAC currently only supports one ASSIGNED PHASE and one SWITCHED PHASE per detector. Configuring more than one will result in undefined behavior.

- Mode – Operation Mode
    - Code 0 (VEH) – The detector input operates as a standard vehicle detector
    - Code 1 (PED) – The detector input operates as a standard Pedestrian detector

NOTE: If MODE is configured as PED, the following fields have no effect on detector operation: VOLUME, OCCUPY, LOCK, PASS, ADDED, QUEUE, EXT/10, DEL/10, FAIL, QLIMIT.

- Code 2 (ONE) – The detector input operates as a vehicle detector that is operational while the Phase is not Green until a call is received on the assigned Phase.
- Code 3 (SBA – Stop Bar A) – The detector input operates as a vehicle detector that operates normally (accepts calls) when the assigned phase is not Green.

- When a call is detected, it may be held into the Green until a gap occurs (detection area is empty) or the Green has been active longer than the extend time setting

- The extend timer begins with the Green

- When the extend timer times out or a gap occurs, the detector is disconnected until the Green terminates

- When the extend time setting is zero, a call is held into the Green until a gap occurs

- Delay time functions normally

♦ Code 4 (SBB – Stop Bar B) – The detector input operates as a vehicle detector that operates normally (accepts calls) when the assigned Phase is not Green

- When a call is detected, it may be held into the Green until a gap (detection area is empty) greater than the extend time setting occurs

- The extend timer begins with the Green

- If a call is received before the extend timer times out, it is reset

- Timer reset will continue to occur until a gap is large enough to allow the extend timer to time out

- When a time out occurs, the detector is disconnected until the Green terminates

- When the extend time setting is zero, a call is held into the Green until a gap occurs

- Delay time functions normally

♦ Code 5 (PPL - Protected/Permissive Left) – The detector input operates as a turn vehicle detector for the adaptive Protected/Permissive routine. See Chapter 8 for additional details

♦ Code 6 (PPT - Protected/Permissive Through) – The detector input operates as a through vehicle detector for the adaptive Protected/Permissive routine. See Chapter 8 for additional details

♦ Code 7 (AND) – All Mode 7 detector inputs assigned to the same Phase must be active to call the assigned Phase when it is not Green. Only the lowest numbered Mode 7 detector will extend the assigned Phase or switch Phase

♦ Code 8 (RDPR – Red Protect) – The detector input operates as part of the Red Protect Function. See Section 2.4.8.1.1.1

♦ Code 9 (BIKE – Bike Detector) – The detector input operates as a Bicycle detector. See Section 2.4.2.4

Only normal vehicle detectors (Mode 0) will accumulate a Measure of Effectiveness (MOE).

- Volume – Volume Detector

  ♦ Code 0 (No) – The detector is not a Volume detector

  ♦ Code 1 (Yes) – The detector is a Volume detector and Volume will be collected for this detector for the NTCIP Vol/Occ Report

NOTE: If MODE is configured as PED, then VOLUME has no effect on operation.

- Occupy – Occupancy Detector
  - Code 0 (No) – The detector is not an Occupancy detector
  - Code 1 (Yes) – The detector is an Occupancy detector and Occupancy will be collected for this detector for the NTCIP Vol/Occ Report

NOTE: If MODE is configured as PED, then OCCUPY has no effect on operation.

- Lock – Locking Detector
  - Code 0 (Non-Locking) – The detector will not lock an actuation for the assigned Phases
  - Code 1 (Red Lock) – The detector will lock a call to the assigned phases if an actuation occurs while that Phase is not timing Green or Yellow
  - Code 2 (Yellow Lock) – The detector will lock a call to the assigned Phases if an actuation occurs while that phase is not timing Green

NOTE: If MODE is configured as PED, then LOCK has no effect on operation.

- Call – Detector Call
  - Code 0 (No) – The detector will not place a call on the assigned Phases
  - Code 1 (Yes) – The detector places a demand (per MODE setting) for service on the assigned Phase when the Phase is not timing the Green interval
- Pass – Passage Detector
  - Code 0 (No) – The detector will not reset Passage times on the assigned Phases
  - Code 1 (Yes) – The detector resets the assigned Phases Passage timer for the duration of the detector actuation when the assigned Phases are Green

NOTE: If MODE is configured as PED, then PASS has no effect on operation.

- Added – Added Initial Detector
  - Code 0 (No) – The detector actuations do not count for use in Added Initial
  - Code 1 (Yes) – The detector actuation counts for use in the Added Initial calculations. Counts are accumulated from the beginning of the Yellow interval to the beginning of the Green interval

NOTE: If MODE is configured as PED, then ADDED has no effect on operation.

- Queue – Queue Detector
  - Code 0 (No) – The detector does not act as a Queue detector
  - Code 1 (Yes) – The detector extends the Green interval of the assigned Phase until a gap occurs (no actuation) or until the Green has been active longer than the QLIMIT time

NOTE: If MODE is configured as PED, then QUEUE has no effect on operation.

- Ext/10 – Detector Extension

  - Range of 0-255 tenth seconds

  - When the assigned Phase is Green, each detector actuation (input duration) is extended from the point of termination by this time

  - In Mutual Coord, this is the time to extend the remote Yellow Input Field information active time

NOTE: If MODE is configured as PED, then EXT/10 has no effect on operation.

- Dly/10 – Detector Delay

  - Range of 0-999 tenth seconds

  - When the assigned Phases are NOT Green, the start of each detector actuation is delayed by this time. Once the Delay has been satisfied, the detector remains actuated for as long as the input is present

  - In Mutual Coord, this is the OFFSET time from the remote Yellow Input Yield information until the actual Yield at this unit

NOTE: If MODE is configured as PED, then DLY/10 has no effect on operation.

- Fail – Detector fail time

  - Range of 0-255 seconds

  - When diagnostics indicate the detector has failed, a diagnostic call is maintained on the assigned Phase. The diagnostic call for the detector is removed during the Green after having been Green for this time
    - If FAIL is 255, a diagnostic call is placed on the assigned Phase (Max recall)
    - If the FAIL is 0, a diagnostic call is NOT placed on the assigned Phase (no recall)

NOTE: If MODE is configured as PED, then FAIL has no effect on operation.

- QLimit – Detector Queue Limit

  - Range of 0-255 seconds

  - The time an actuation from a Queue detector may continue into the assigned Phase Green. This time begins when the Phase becomes Green and when it expires any associated detector inputs are ignored

NOTE: If MODE is configured as PED, then QLIMIT has no effect on operation.

2.4.8.1.1.1 Red Protect – Detector Mode

SEPAC provides a detector mode (Red Protect – Operation Mode 8) to use smart sensors that have the ability to determine when an approaching vehicle will not clear the intersection by the end of the Red Clearance time and provides an output until the intersection will be clear.

SEPAC recognizes Red Protect calls during the Red Clearance only. A Red Protect call during the Red Clearance causes a Stop Time on the respective ring for as long as the input is active within the constraint of MX PRES diagnostic for that detector.

> **NOTE: The use of Stop Time as the means of extending the Red display must be used with caution in a coordinated system.**

The detector timing operations (Delay and Extend) are valid for this type of detector. A Red Protect call is delayed or extended based on the value entered for the detector.

The Detector Diagnostic operations (Maximum Presence, no activity and erratic count) are valid for this type of detector, with some changes.

A Red Protect detector classified as failed by the diagnostic operates as though no call is present. This is opposite that for other vehicle detector modes.

The timing for Maximum Presence is in seconds while for other modes it is minutes. Maximum Presence must be greater than zero for a Red Protect detector to be recognized and therefore cause a Stop Time.

> **NOTE: SEPAC stores all Diagnostic Values in seconds and, depending on the operation mode, converts that value for uploads and downloads or display. To ensure the value is appropriate for the desired operation mode, the mode should be set before the diagnostic value.**
>
> **As in other Vehicle Detector modes, any detector input assigned to a Phase programmed as non-actuated (Pedestrian Recall Code = 3) will not be tested for conformance to the specified parameters. Therefore, a Red Protect detector will not be recognized or cause a Stop Time.**

2.4.8.1.1.2 Red Protect Programming

This section provides an example of Red Protect programming. From the Detector Data Menu (Figure 2-127), press **2-VEH 9-16**, then from the Detector Config Menu (Figure 2-128), press **1-VEHICLE DET 9.**

```
VEH DET 9     PHASE 12345678 90123456
 ASSIGNED PHASES....01000000 00000000
 SWITCH PHASES......00000000 00000000
   MODE   8    CALL  1    EXT/10   0
   VOLUME 0    PASS  0    DLY/10   0
   OCCUPY 0    ADDED 0    FAIL   255
   LOCK   0    QUEUE 0    QLIMIT   0
                                   [1]
```

Figure 2-130. Red Protect Phase 2 Display

From the Detector Config Menu (Figure 2-128), press **2-VEHICLE DET 10.**

```
VEH DET 10    PHASE 12345678 90123456
 ASSIGNED PHASES....00010000 00000000
 SWITCH PHASES......00000000 00000000
   MODE   8    CALL  1    EXT/10   0
   VOLUME 0    PASS  0    DLY/10   0
   OCCUPY 0    ADDED 0    FAIL   255
   LOCK   0    QUEUE 0    QLIMIT   0
                                   [1]
```

Figure 2-131. Red Protect Phase 4 Display

From the Detector Config Menu (Figure 2-128), press **3-VEHICLE DET 11.**

```
VEH DET 11    PHASE 12345678 90123456
 ASSIGNED PHASES....00000100 00000000
 SWITCH PHASES......00000000 00000000
    MODE   8    CALL  1    EXT/10   0
    VOLUME 0    PASS  0    DLY/10   0
    OCCUPY 0    ADDED 0    FAIL   255
    LOCK   0    QUEUE 0    QLIMIT   0
                                      [1]
```

Figure 2-132. Red Protect Phase 6 Display

From the Detector Config Menu (Figure 2-128), press **4-VEHICLE DET 12.**

```
VEH DET 12    PHASE 12345678 90123456
 ASSIGNED PHASES....00000001 00000000
 SWITCH PHASES......00000000 00000000
    MODE   8    CALL  1    EXT/10   0
    VOLUME 0    PASS  0    DLY/10   0
    OCCUPY 0    ADDED 0    FAIL   255
    LOCK   0    QUEUE 0    QLIMIT   0
                                      [1]
```

Figure 2-133. Red Protect Phase 8 Display

The above example programming uses Vehicle Detectors 9-12 as Red Protect detectors for Phases 2-4-6-8 respectively.

From **VALUE 0 DIAGNOSTICS MENU** (Figure 2-244), press **2-VEH 9-16**.

```
SYSTEM - VALUE 0 DATA
VEH DET....9..10..11..12..13..14..15..16
 MX PRES   5   5   5   5   0   0   0   0
 NO ACTY   0   0   0   0   0   0   0   0
 ERR CNT   0   0   0   0   0   0   0   0
    - DATA = MINUTES OR COUNTS/MINUTE -
 - TIME BASE "DET 1" ENABLES VALUE 1 -
```

Figure 2-134. Vehicle Detector Diagnostics

- MX PRES (Maximum Presence) – Diagnostic value establishes the limit (Maximum time) a Red Protect detector may hold the Red (0-255 seconds). When the MX PRES time has expired, SEPAC will operate as though the detector was no longer activated.

- NO ACTY (No Activity) – Diagnostic value (0-255 minutes). When the no activity time has expired, SEPAC will NOT place a Red Protect call. For this application, this value should probably be zero to disable the diagnostic

- MAX CNT (Max Counts) – Diagnostic value (0-255 counts/minute). When the MAX CNT is exceeded, SEPAC will NOT place a Red Protect call

The above example programming establishes a limit of five seconds for Extension of the Red Clearance for Phases 2-4-6-8 respectively. A MX PRES value is required for all Red Protect detectors. A Ped Protect call is NOT placed on a Phase when MX PRES is zero.

2.4.8.2   All Detectors

The All Detectors Display (Figure 2-135) allows the user to view and edit parameters that apply to all detectors.

```
ALL DETECTORS


        VOL/OCC PERIOD:    0 SEC


                                      [1]
```
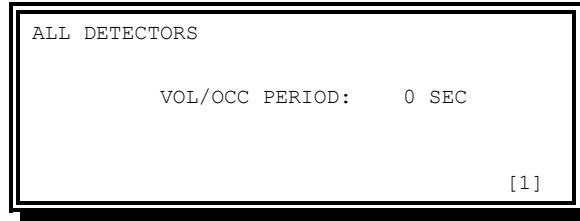
Figure 2-135. All Detectors Display

- VOL/OCC Period (Volume and Occupancy Period) – The duration (in seconds) for which Volume and Occupancy counts are accumulated.

2.4.8.3   Detector Overview

The Detector Overview Display (Figure 2-136) allows the user to easily view the overall detector configuration as well as navigating into the individual detector configuration.

```
DETECTOR CONFIG OVERVIEW
VEH DET...1...2...3...4...5...6...7...8
PHASE     1*  2   3   4   5   6   7   8
MODE      VEH VEH VEH VEH VEH VEH VEH
VEH DET...9..10..11..12..13..14..15..16
PHASE     --- --- --- --- --- --- --- ---
MODE      --- --- --- --- --- --- --- ---
                    E/ENT- DET CONFIG  [1]
```
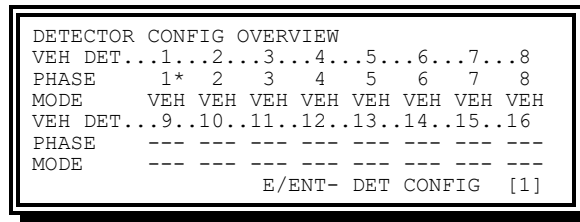
Figure 2-136. Detector Overview Display

- Phase (Assigned Phase) – The assigned Phase for the detector. If assigned to more than one Phase, the lowest numbered Phase will be displayed followed by an asterisk (*)
- Mode (Operation Mode) – The Operation Mode for the detector

If there is no assigned Phase, both fields will display "---" signifying the detector is not in use by a Phase.

The ARROW keys are used to navigate to each detector. Pressing ENTER will bring the user to the Detector Data Display (Figure 2-129) for that detector.

2.4.8.4   Detectors Load Default

The Detectors Load Default Display (Figure 2-137) allows the user to default all operating data of the detector configuration for all Phase Banks.

```
DETECTORS LOAD DEFAULT

 WARNING....THIS OPTION WILL DEFAULT ALL
 CURRENT OPERATING DATA ..............
 - PRESS "E" TO CONTINUE
```

Figure 2-137. Detectors Load Default Display

Pressing "E" will default all detector data.

2.4.9   Phase + Bank Copy

The Phase + Bank Copy Display (Figure 2-138.) allows the user to copy the total database for one or more Phases to another Phase.

```
PHSE+BANK COPY
  COPYING BANK.......FROM: 1  TO:   1
  COPYING PHASE......FROM: 1  TO:   1
 ENTER THE FROM & TO BANK/PHASE ##
 THEN ENTRY HERE INITIATES THE COPY>>>>0
  [A 0 IN ANY TO FIELD OR IN FROM PHSE
   COPIES TO ALL MATCHING GIVEN VALUES]
```

Figure 2-138. Phase+Bank Copy Display

The FROM Phase/Bank will be the source Phase data and the TO Phase/Bank will become the destination Phase data of the copy operation. Be sure to review the destination Phase data after a copy as all data in the copy may not be appropriate (for example, INITIALIZE data).

2.4.10   Select Phase Bank

The Select Phase Bank Display (Figure 2-139) allows the user to change the currently *editing* Phase Bank. This can also be done on all Phase Bankable screens by pressing the MINUS (-) key to cycle between them.

```
SELECT PHASE BANK

     CURRENTLY EDITING PHASE BANK  1
       [RUNNING PHASE BANK IS 1]


 SEE Help (+) FOR MORE INFORMATION
```

Figure 2-139. Select Phase Bank Display

- Currently Editing Phase Bank – The Phase Bank that will be displayed on all Phase Bankable screens

- Running Phase Bank – The actively running Phase Bank

2.5 Unit Data

Unit data allows the user to display and enter controller parameters for the following:

- Startup and miscellaneous controls
- Remote Flash parameters
- Overlap Data definition
- Peer-to-Peer Data
- Ring Structure parameters
- Sequences
- Port 1 Data
- Input/Output miscellaneous
- Output Mapping

User access is required to enter data for these parameters. See Section 2.3 for more information on gaining access.

2.5.1 Unit Data Menu

The Unit Data Menu (Figure 2-140.) allows the user to select which unit parameter database area will be addressed.

From the Main Menu (Figure 2-1), press **4-UNIT DATA**.

```
UNIT DATA
  1-STARTUP & MISC.    6-SEQUENCES
  2-FLASH              7-PORT 1/ITS DATA
  3-OVERLAP DATA       8-I/O MISC
  4-PEER-TO-PEER       9-OUTPUT MAPPING
  5-RING STRUCTURE     B-BANK SELECTION
                       C-COPY BANK
 '+' DENOTES BANKABLE UNIT DATA      [1]
```
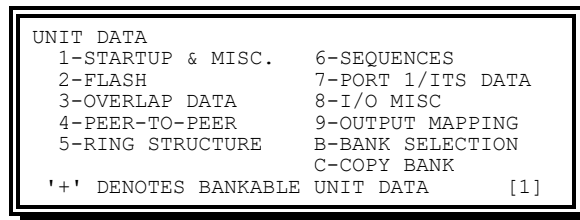
Figure 2-140. Unit Data Menu

Options on this menu include the following:

- Startup & Misc – Provides viewing and editing of startup and miscellaneous control parameters on the CU
- Flash – Provides viewing and editing of Remote Flash and Flash Jumper parameters for the CU
- Overlap Data – Provides viewing and editing of all Overlap definitions
- Peer-To-Peer – Provides viewing and editing of Peer-to-Peer parameters on the CU
- Ring Structure – Provides viewing and editing of basic ring structure of the CU
- Sequences – Provide viewing and editing of Sequences
- Port 1/ITS Data – Provides viewing and editing of Port 1 or ITS parameters

- I/O Misc – Provides viewing and editing of Input/Output mode and ring Input/Output select parameters

- Output Mapping – Provides viewing and editing of load switch pin parameters

- Bank Selection – Provides viewing and changing the Unit Bank being edited through the screen

- Copy Bank – Provides an editing shortcut to copy Unit Banks

2.5.2   Startup and Miscellaneous

The Startup and Miscellaneous Display allows the user to view and modify the startup and miscellaneous control parameters for the CU.

From the Unit Data Menu (Figure 2-140.), press **1-STARTUP & MISC**.

```
STARTUP & MISC
STARTUP TIME.:  6 (SEC) STATE: 0 (0-FL
RED REV/10...: 40 (TSEC)          1-RED
AUTO PED CLR.:  0 (0-NO 1-YES)    2-RAF)
STOP T RESET.:  0 (0-NO 1-YES)
SEQUENCE.....:  0 (0-18)
SPECIAL SEQ  :  0 (SEE HELP)
```

Figure 2-141. Startup & Misc. Display

Default data is as shown.

- Startup Time – 0-255 seconds

   ♦ Code 0 (None) – An entry of 0 eliminates the Start-Up State

   ♦ Code ## – This entry provides an adjustable timed period/state (Start-Up) prior to the Initialization routine when power is restored following a defined power interruption or Watchdog Restart. No output, other than AC power, prevents this state from completion or exit to the initialization routine. This is also the All-Red time for Red After Flash

- Startup State

   ♦ Code 0 (Flash) – This entry provides for cabinet flashing (Voltage Monitor & Fault Monitor inactive) during the Start-Up period. When Flash is programmed as the Start-Up State, no outputs are active except flashing logic and +24 VDC

   ♦ Code 1 (All Red) – This entry provides for a Start-Up State with the Voltage Monitor & Fault Monitor active, and an All-Red state on all vehicle, pedestrian, and overlap outputs regardless of initialization settings

   ♦ Code 2 (Red After Flash) – In addition to the functionality detailed in Code 1 (All Red), this entry provides an All-Red State after Local, Automatic, or Conflict Flash operations for the duration specified in STARTUP TIME.   This permits compliance with MUTCD guidance for a 6 second All Red State following flash operation (MUTCD 2009 section 4D.31 paragraph 02-03). Further, if cabinet flash jumper settings have been defined (see 2.5.3.3), a steady Yellow State will proceed the All-Red State if the output has been

jumpered for Yellow Flash. The Steady Yellow State will be equal to the programmed Yellow Change interval for that phase.

> **NOTE: SEPAC is unable to supply this operation for Local Flash in certain cabinet wiring configurations.**

- Red Rev/10 (Red Revert Time) – 20-255 tenth seconds
    - This parameter provides a Minimum Red indication following the Yellow Change Interval prior to the next display of Green on the same signal output driver group
- Auto Ped Clear
    - Code 0 (No) – This is the standard NEMA-defined operation. When manual control enable is active, the Pedestrian Clearance interval is terminated by the Interval Advance Input
    - Code 1 (Yes) – This entry provides for CU timing of Pedestrian Clearance interval when manual control enable is active
- Stop Time Reset
    - Code 0 (No) – This is the standard NEMA-defined operation
    - Code 1 (Yes) – The CU operation, upon release of a Stop Time input, will be conditioned by the timing/state active when the Stop Time input was applied. Some timing will be reset to the full time while others will be maintained status-quo
        - Minimum Green resets to the programmed value. Any calculated variable initial is maintained status-quo
        - Passage resets to the programmed value. Time Before Reduction, Time to Reduce, Effective Gap, and Last Car Passage are maintained by the status-quo
        - Maximum Green resets to the programmed value
        - Walk and Pedestrian Clear reset to the programmed value
        - Yellow change and Red clear reset to the programmed value
        - Overlap Trailing Green, Trailing Yellow Change, and Trailing Red Clear will reset to the programmed value
        - All other timings will be maintained status-quo. These timings include but are not limited to detector stretch and delay, Red Revert, all coordination timings, all time base timings, and all Preempt timings
- Sequence
    - Code ## – This entry (1 to 19) sets the default Sequence (typically phase pair reversal) as defined in the ring structure database. The entered DEF SEQ ## is active when hardware Sequence inputs are not active, and the active coordination pattern Sequence parameter is 0.
- Special Sequence (formerly International Sequence)

- ♦ Code 0 (STD) – Standard Advanced Warning Signals. See Section 2.4.2.4.1 for more information

- ♦ Code 1 (INT'L) – International Sequence. See Section 2.4.2.4.2 for more information

- ♦ Code 2 (1/G) – One Second Green

  - ▪ 1-second Green cycle after boot, Flash, and Preempts without programmed exit Phases. Overlaps will be Red during this cycle except FYA Overlaps. FYA Overlaps will be red during permissive movement and steady green during protected movement.

  - ▪ Standard Advanced Warning Signal timings do still apply, therefore Green timings could be longer than 1 second. See Section 2.4.2.4.1 for more information

- ♦ Code 3 (BOS) – Boston I/O mode validation

  - ▪ Standard Advanced Warning Signals

  - ▪ The Input and Output modes are validated against the ABC I/O mode pins. If they differ, an "INVALID ABC IO MODE" fault will occur, and the controller will go into CAB DIAG FLSH – NO XIT

  - ▪ Valid only for NEMA TS 1 (FIO) and TS 2-Type 2 cabinets

2.5.3   Remote Flash Menu

The Remote Flash Menu allows the user to select which Remote Flash parameters to configure.

```
FLASH

   1-REMOTE FLASH SETTINGS
   2-REMOTE FLASH ENTRY/EXIT PHASES
   3-CABINET FLASH SETTINGS
```
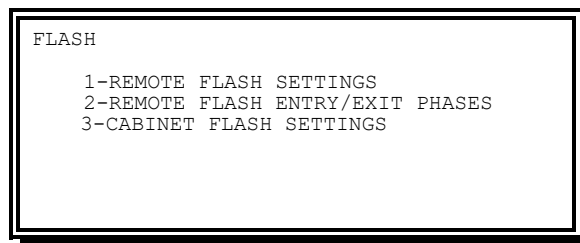
Figure 2-142. Remote Flash Menu

Options on this menu include the following:

- Flash Settings – Provides viewing and editing of load switch Flash configurations for the CU

- Entry/Exit Phases – Provides viewing and editing of Entry and Exit Phase parameters for Remote Flash on the CU

2.5.3.1   Remote Flash Settings

The Remote Flash Display allows the user to view and modify the Remote Flash Control parameters for the CU.

From the Flash Menu (Figure 2-142), press **1-REMOTE FLASH SETTINGS**.

```
REMOTE FLASH SETTINGS      TEST-A FLASH: 0

LDSW:123456789 0123456789 0123456789 012
FLSH:000000000 0000000000 0000000000 000
 ALT:000000000 0000000000 0000000000 000

0-DARK  1-RED  2-YELLOW  3-STEADY YELLOW
```

Figure 2-143. Remote Flash Settings Display

NOTE: Default data is as shown in Figure 2-143.

Flash definition is on a load switch basis.

- Test-A As Flash
  - Code 0 (No) – The CU will not recognize the Test A input as a Remote Flash request
  - Code 1 (Yes) – The CU will recognize the Test A input as a Remote Flash request
- Flash
  - Code 0 (No) – The load switch output will not flash when Remote Flash is called
  - Code 1 (Red) – The load switch output will flash Red when Remote Flash is called
  - Code 2 (Yellow) – The load switch output will flash Yellow when Remote Flash is called
  - Code 3 (Steady Yellow) – The load switch output will be Steady Yellow when Remote Flash is called
  - When all FLSH entries are 0, Remote Flash is implemented through the Controller Voltage Monitor output (CVM inactive)
- Alt
  - Code 0 (No) – The load switch output will flash (ON/OFF) when Remote Flash is called
  - Code 1 (Yes) – The load switch output will flash (OFF/ON) when Remote Flash is called

2.5.3.2 Remote Flash Entry/Exit Phases

The Remote Flash Entry/Exit Phases Display allows the user to view and modify the Remote Flash entry and Exit parameters for the CU.

From the Flash Menu (Figure 2-142), press **2-REMOTE FLASH ENTRY/EXIT PHASES**.

```
REMOTE FLASH ENTRY/EXIT PHASES

   PHASES: 12345678 90123456
    ENTRY: 00000000 00000000
     EXIT: 00000000 00000000
```

Figure 2-144. Flash Entry/Exit Phases Display

NOTE: Default data is as shown in Figure 2-144.

- Entry Phase
    - Code 0 (No) – The Phase is not the Remote Flash entry Phase. When there is no entry Phase, the CU will initiate Free (non-coordinated) operation based on a Remote Flash request
    - Code 1 (Yes) – The Phase is the Remote Flash entry phase. A Flash entry Phase must be serviceable for Remote Flash to occur
- Exit Phase
    - Code 0 (No) – The Phase is not the Remote Flash Exit Phase. When there is no Exit Phase, the CU will exit at the entry point
    - Code 1 (Yes) – The Phase is the Remote Flash Exit Phase

When the Remote Flash input becomes inactive, the CU moves immediately to the programmed Exit Phase(s) with a Green/Walk Display, puts calls on all the other vehicle Phases and Pedestrians, and ceases Flashing operation.

Upon exiting a Remote Flash wherein the Phase or Overlap vehicle load switch outputs flash, the CU provides a timed exit transition period when any flashing Yellow display is followed by a Red, Flashing Red, or Dark display. The load switch driver outputs during this period are Yellow for those that were Flashing Yellow and Red for those that were flashing Red or Dark.

- Exit Flash transition timing is as follows:
    - Yellow – Longest Phase Yellow change of Phases receiving a steady Yellow
    - Red – Longest Phase Red clearance of Phases receiving a steady Red

When no exit Phases are programmed, the Red will equal the Start Up time. This operation enables a longer All Red transition period to be operational prior to stop-and-go operation after Remote Flash.

When exit Phases are programmed, enabling Red After Flash (RAF) will cause all Phases to go Red for the Start Up time.

2.5.3.3 Cabinet Flash Settings

The Cabinet Flash Display allows the user to view and modify the Cabinet Flash Control parameters for the CU.

From the Flash Menu (Figure 2-142), press **3-CABINET FLASH SETTINGS**.

```
CABINET FLASH SETTINGS

LDSW:123456789 0123456789 0123456789 012
 CFG:121112110 0000000000 0000000000 000

          0-DARK  1-RED  2-YELLOW
```

Figure 2-145. Cabinet Flash Settings Display

NOTE: Example configuration is shown in Figure 2-143.

Flash definition is on a load switch basis.

- Load Switch / Output Flash Jumper Setting
    - Code 0 (Dark) – The output will be dark during cabinet flash and red after flash
    - Code 1 (Red) – The output will flash Red during cabinet flash
    - Code 2 (Yellow) – The output will flash Yellow during cabinet flash

2.5.4   Overlap Data

The Overlap Data Menu allows the user to view and modify the overlap types as well as enter the overlap configuration display.

From the Unit Data Menu (Figure 2-140), press **3-OVERLAP DATA**.

```
OVERLAP DATA

A: STD    E: FYA    I: PED    M: ---
B: STD    F: ---    J: ---    N: STD
C: ---    G: FYA    K: PRI    O: FYA
D: STD    H: FYA    L: ---    P: ---

PREV/NEXT TO CYCLE
```

Figure 2-146. Overlap Data Display

The above example is just to show a variety of settings. By default (in FULL FUNCTION SEPAC) all overlaps are set to "---".

The PREV and NEXT keys are used to cycle through the types of Overlaps described below.

- "---" – Overlap Not In Use
- STD – Standard Overlap
- FYA – Flashing Yellow Arrow Overlap
- PED – Pedestrian Overlap
- PRI – Priority Overlap

Press ENTER to confirm selection and/or go into that overlaps configuration.

When switching from one type to another, if there is non-default data entered for that overlap SEPAC will warn the user and confirm that the user does want to change the type.

2.5.4.1 Standard Overlap

The Standard Overlap Display (Figure 2-147) allows the user to view and modify the standard Overlap parameters.

From the Overlap Data Menu (Figure 2-146), press the PREV and NEXT keys until STD is displayed. Then press ENTER.

```
OVERLAP - A        12345678 90123456
          PARENTS: 00000000 00000000
  +GRN PHASES: 00000000 00000000
   -G/Y PHASES: 00000000 00000000
   -PED PHASES: 00000000 00000000
 TRAIL GREEN STANDARD:   0   YEL/10:  40
 TRAIL GREEN  PREEMPT:   0   RED/10:  20
```

Figure 2-147. Standard Overlap Display

NOTE: Default Data is as shown in Figure 2-147.

Information included in the Standard Overlap display includes timing control to trail Overlap load switch driver outputs to delay their Green termination. When the Overlap is no longer locked to a Phase timing, it must be provided a separate Yellow Change and Red Clearance.

Any Phase which may operate concurrently with an Overlap is not considered to be in conflict with the Overlap. Such a Phase is allowed to start while the Overlap is trailing.

Overlaps may be configured to trail differently during Preempt and Non-Preempt operation as described below.

- Parents
    - Code 0 (No) – The Phase is not part of the Overlap
    - Code 1 (Yes) – The Phase is part of the Overlap
- +GRN Phases (Plus Green Phases)

    This feature provides per-overlap Phase indications which perform as described below.

    - When TRAIL GRN is greater than 0 and there are one or more parent Phases, prevent the Overlap from performing a trailing operation when the indicated non-parent Phase is *selected as NEXT*. Only one +GRN phase can be selected, and it must not be a parent Phase.

        - Code 0 (No) – The Overlap will always trail
        - Code 1 (Yes) – The Overlap will not trail when this non-parent Phase is NEXT

                        OR

    - When TRAIL GRN equal to 0 – When there are multiple parent Phases, prevent the Overlap from starting until the indicated parent Phase is Green (i.e., when

Overlap is Red, Overlap Green is locked out until this Phase turns Green). This operation applies during all levels of operation (for example, normal, Preemption, etc.). Only one +GRN Phase can be selected, and it must be one of the parent Phases.

- Code 0 (No) – The Overlap will start with its parent
- Code 1 (Yes) – The Overlap will be delayed until this parent Phase is Green, then remain on until all parents terminate

- -G/Y Phases (Minus Green/Yellow Phases)

  This feature provides per-Overlap Phase indications which perform as described below.

  - When TRAIL GRN greater than 0 – When there are one or more parent Phases, prevent the Overlap from performing a trailing operation when the indicated non-parent Phase is *active*. Only one -G/Y phase can be selected, and it must not be a parent Phase.

    - Code 0 (No) – The Overlap will always trail
    - Code 1 (Yes) – The Overlap will not trail when this non-parent Phase is ON

      OR

  - When TRAIL GRN equal to 0 – When there are one or more parent Phases, prevent the Overlap from outputting a Green when the indicated Phase is outputting a Green, or outputting a Yellow when the indicated Phase is outputting a Yellow. Red is displayed instead of Yellow or Green. This operation applies during all levels of operation (for example, normal, Preemption, etc.). Only one -G/Y phase can be selected.

    - Code 0 (No) – The overlap will operate normally
    - Code 1 (Yes) – The overlap will display Red instead of Green or Yellow when this phase is Green or Yellow, respectively

- -PED Phases (Minus Pedestrian Phases)

  This feature provides per-Overlap indications of whether the Overlap is compatible with the given PED phase.

  - Code 0 (No) – The Overlap's compatibility with the Pedestrian Phase is not modified
  - Code 1 (Yes) – The Overlap is not compatible with the Pedestrian Phase. When selected, the Overlap will not begin until the programmed Pedestrian has completed to Solid Don't Walk. If the Overlap is already on when a Pedestrian Phase should be serviced, that Pedestrian service will be delayed until the conflicting Overlap is terminated.

- Trail Green Standard (Standard Trailing Green) –0-255 seconds

  - Value = 0 – The Overlap will not trail during *non-Preempt* operation. Trailing Yellow and Trailing Red times will not be used
  - Value > 0 – The Overlap will trail during *non-Preempt* operation using this Trailing Green time. Trailing Yellow and Trailing Red times will be used

- Trail Green Preempt (Trailing Green in Preempt) –0-255 seconds
    ◆ Value = 0 – The Overlap will not trail during Preempt operation
    ◆ Value > 0 – The Overlap will trail during Preempt operation using this Trailing Green time. Trailing Yellow and Trailing Red times will also be used. See Section 2.8.4.5 to complete trailing operation during Preempt
- YEL/10 (Trailing Yellow) –0-255 tenth seconds
- RED/10 (Trailing Red) –0-255 tenth seconds

If a Standard Overlap is configured with no PARENTS but with +GRN and –G/Y Phases, the Overlap will automatically be converted to an FYA Overlap upon exit.

2.5.4.2   FYA Overlap

The FYA Overlap Display (Figure 2-148) allows the user to view and modify the Flashing Yellow Arrow Overlap parameters.

From the Overlap Data Menu (Figure 2-146), press the PREV and NEXT keys until FYA is displayed. Then press ENTER.

```
FYA OVERLAP - A          DELAY/10:  50
        PHASES..12345678 90123456
  PERM PHASES: 00000000 00000000
  PROT PHASES: 00000000 00000000
  -PED PHASES: 00000000 00000000
     OVERLAPS..ABCDEFGH IJKLMNOP
PERM OVERLAPS: x0000000 00000000
PROT OVERLAPS: x0000000 00000000
```

Figure 2-148. FYA Overlap Display

NOTE: Default Data is as shown in Figure 2-148.

FYA Operation is defined in more detail in Chapter 8. In general, the following will apply:

  ◆ The Permissive operation may occur only when all PERM movements are ON, i.e., the PERM PHASES and PERM OVERLAPS are AND'ed together
  ◆ The protected operation will occur when any of the PROT movements are ON, i.e., the PROT PHASES and PROT OVERLAPS are OR'd together

- Delay/10 (FYA Delay) – 0-255 tenth seconds
- Perm Phases (Permissive Phases)
    ◆ Code 0 (No) – This is not a Permissive Phase
    ◆ Code 1 (Yes) – This is a Permissive Phase for FYA
- Prot Phases (Protected Phases)
    ◆ Code 0 (No) – This is not a Protected Phase
    ◆ Code 1 (Yes) – This is a Protected Phase for FYA
- -PED Phases (Minus Pedestrian Phases)

    This feature provides per-Overlap indications of whether the FYA Overlap is compatible with the given PED phase.

♦ Code 0 (No) – The Overlap's compatibility with the Pedestrian Phase is not modified

♦ Code 1 (Yes) – The Overlap is not compatible with the Pedestrian Phase

When selected, the Overlap will not begin until the programmed Pedestrian has completed to Solid Don't Walk. If the Overlap is already on when a Pedestrian Phase should be serviced, that Pedestrian service will be delayed until the conflicting Overlap is terminated. For FYA Overlaps the Overlap cannot shutdown without also shutting down the Permissive Phases of the Overlap. Therefore, the FYA shall not shutdown until the Permissive Phases have reached a Green Rest state.

- Perm Overlaps (Permissive Overlaps)

    ♦ Code 0 (No) – This is not a Permissive Overlap

    ♦ Code 1 (Yes) – This is a Permissive Overlap for FYA

- Prot Overlaps (Protected Overlaps)

    ♦ Code 0 (No) – This is not a Protected Overlap

    ♦ Code 1 (Yes) – This is a Protected Overlap for FYA

2.5.4.3   Pedestrian Overlap

The Pedestrian Overlap Display (Figure 2-149) allows the user to view and modify the Pedestrian Overlap parameters.

From the Overlap Data Menu (Figure 2-146), press the PREV and NEXT keys until PED is displayed. Then press ENTER.

```
PED OVERLAP - A

     PHASES: 12345678 90123456
    PARENTS: 00000000 00000000

    WALK1 :   0  WALK2 :   0
    PEDCLR1:   0  PEDCLR2:   0
```

Figure 2-149. Pedestrian Overlap Display

NOTE: Default Data is as shown in Figure 2-149.

- Parents

    ♦ Code 0 (No) – The Phase is not part of the Overlap

    ♦ Code 1 (Yes) – The Phase is part of the Overlap

- Walk1: Pedestrian Walk time (0-255) in seconds

    This shall control how long the WALK indication is displayed when the pedestrian call is held for less than 1 second or for any call when the WALK2 time is zero

- PedClr1: Pedestrian Clear time (0-255) in seconds

This shall control how long the Flashing Don't Walk indication and the Ped Clear output are displayed when the Pedestrian call is held for less than 1 second, or for any call when PEDCLR2 time is zero

- Walk2: Alternate Pedestrian Walk time (0-255) in seconds

  This shall control how long the WALK indication is displayed when the pedestrian call is held for 1 second or longer. If WALK2 is zero, WALK1 time is used

- PedClr2: Alternate Pedestrian Clear time (0-255) in seconds

  This shall control how long the Flashing Don't Walk indication and the Ped Clear output are displayed when the Pedestrian call is held for 1 second or longer. If PEDCLR2 is zero, PEDCLR1 time is used

Calls for Pedestrian Overlaps come from the parent Phases' Pedestrian detectors. The calls come to the Pedestrian Overlaps even if the parent Phase does not have a normal Pedestrian movement, as long as there are detectors set for PED mode and calling the parent Phase.

A Pedestrian Overlap is considered valid if it has at least one parent and either WALK1 or PEDCLR1 is non-zero. Thus, it is possible for a Pedestrian Overlap to have a zero second Walk time if PEDCLR1 is non-zero.

2.5.4.4 Priority Overlap

The Priority Overlap Display (Figure 2-150) allows the user to view and modify the Priority Overlap Clearance times used for Priority Transit routines.

From the Overlap Data Menu (Figure 2-146), press the PREV and NEXT keys until PRI is displayed. Then press ENTER.

```
PRI OVERLAP - B

           TRANSIT YEL/10:  40
           TRANSIT RED/10:  20

        NOT IN USE BY ANY PRI

```
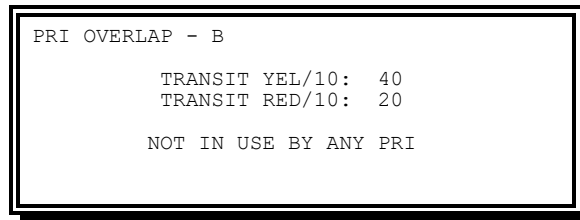
Figure 2-150. Priority Overlap Display

NOTE: Default Data is as shown.

- Transit Yel/10 (Transit Yellow Clearance) –0-255 tenth seconds
- Transit Red/10 (Transit Red Clearance) –0-255 tenth seconds

Line 6 will list all Priorities that use this Overlap

2.5.5 Peer-to-Peer Data

Peer-to-Peer data Menu (Figure 2-151) allows the user to display and enter controller parameters for the following:

```
PEER-TO-PEER DATA

          1-CONFIGURE SOURCES+
          2-ASSIGN FUNCTIONS+

          D-LOAD DEFAULT

                                [1]
```
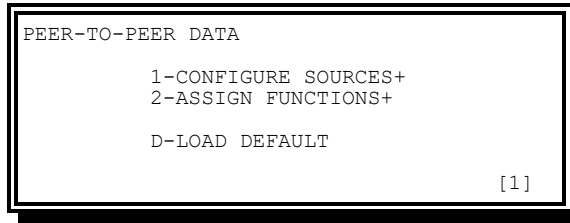
Figure 2-151. Peer-to-Peer Data Menu

- Configure Sources – Provides viewing and editing Peer-to-Peer Source Parameters

- Assign Functions – Provides viewing and editing Peer-to-Peer Function Parameters

- Load Default – Provides editing Source/Function Parameters back to Default Data

2.5.5.1 Peer-to-Peer Sources

The Peer-to-Peer Configure Sources Display allows the user to view and modify Peer-to-Peer Source parameters.

```
CONFIGURE SOURCES
   PEER        ID   IP ADDRESS     TOUT
01 5TH-AVE-     0 192.168.  0. 22    30
02                   0.  0.  0.  0    30


PEER NAME: 01-5TH-AVE-MAIN-ST
                            E-EXIT [1]
```
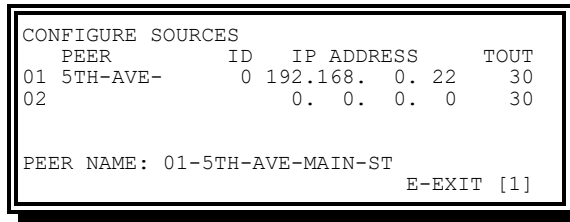
Figure 2-152. Peer-to-Peer Configure Sources Display (Edit Mode)

Peer-to-Peer Sources include the following parameters that will be automatically populated upon connection and only displayed for the running Unit Bank:

- Peer (Peer Name) – Auto-populated upon connection to the Peer

  - This parameter is read-only

  - This is the remote Peer's Hostname

  - If a connection cannot be made to the remote Peer the name shall be populated as "FailXX", where "XX" is the row in the parameter table it is configured in

  - If a connection is made but the Peer does not provide a name, the name will be populated as "PeerXXXXX", where "XXXXX" is the Peer ID that was provided by the Peer upon successful connection

- ID (Peer ID) – Auto-populated upon connection to the Peer, this parameter is read-only. This is the System Address for the SEPAC CU

Peer-to-Peer Sources include the following parameters that are user-configurable:

- IP Address (Peer IP Address) – Establishes the PEER's IP Address that is used to make the Peer Connection

  - "0.0.0.0" is considered un-configured

♦ A user can delete a Peer from the table by entering all zeroes into the IP Address parameter

♦ Upon entering all zeroes, if Peer Functions are configured the user will be prompted for confirmation that all corresponding Peer Functions will also be deleted

- TOUT (Peer Timeout) – Establishes the Peer's Timeout in seconds (0-255 seconds)

♦ If the CU does not receive a Peer-to-Peer message (heartbeat or function publish) from the remote Peer within the given amount of time the Peer will be marked as failed, and all Functions will go to their Fail state

2.5.5.2 Peer-to-Peer Functions

The Peer-to-Peer Assign Functions Display allows the user to view and modify Peer-to-Peer Function parameters.

```
ASSIGN FUNCTIONS
    PEER     SRCFCN  IDX INFCN   IDX FAIL
01 5TH-AVE- PhsGrn    1 PhsCall   1    0
02 Fail02   PhsGrn    1 PhsCall   1    0
03 Fail03   PhsGrn    1 PhsCall   1    0
04 Fail04   PhsGrn    1 PhsCall   1    0
PEER NAME: 01-5TH-AVE-MAIN-ST
PREV/NEXT TO CYCLE            E-EXIT [1]
```

Figure 2-153. Peer-to-Peer Assign Functions Display

Peer-to-Peer Functions include the following parameters:

- Peer (Peer Source Name) – Establishes the Peer Source to use for this function.

♦ The user can use the NEXT/PREV keys to cycle through sources in their Peer Source list

- Srcfcn (Source Function) – Establishes the Peer Source Function to subscribe to from the Peer Source.

♦ The user can use the NEXT/PREV keys to cycle through the Source Function list. See Table 2-10 for more details

- Idx (Source Function Index) – Establishes the Peer Source Function Index for this function. See Table 2-10 for more details

- Infcn (Input Function) – Establishes the Peer Input Function to enable on the Local CU when the Source Function is enabled.

♦ The user can use the NEXT/PREV keys to cycle through the Input Function list. See Table 2-11 for more details

- Idx (Input Function Index) – Establishes the Peer Input Function Index for this function. See Table 2-11 for more details.

- Fail (Failure Mode) – Failure Mode for this function if the Peer connection fails

♦ Code 0-FOFF – The function goes to an OFF state

♦ Code 1-FON – The function goes to an ON state

Table 2-10. Peer-to-Peer Source Functions			
Function	**Short Name**	**IDX Range**	**Description**
Phase Green	PhsGrn	1 - 16	Phase's Green Status
Phase Yellow	PhsYel	1 - 16	Phase's Yellow Status
Phase Red	PhsRed	1 - 16	Phase's Red Status
Ped Walk	PedWlk	1 - 16	Pedestrian's Walk Status
Ped Clear	PedClr	1 - 16	Pedestrian's Clearance Status
Ped Don't Walk	PedDw	1 - 16	Pedestrian's Don't Walk Status
Overlap Green	OvlGrn	1 - 16	Overlap's Green Status
Overlap Yellow	OvlYel	1 - 16	Overlap's Yellow Status
Overlap Red	OvlRed	1 - 16	Overlap's Red Status
Overlap Walk	OvpWlk	1 - 16	Overlap's Walk Status
Overlap Clear	OvpClr	1 - 16	Overlap's Clearance Status
Overlap Don't Walk	OvpDw	1 - 16	Overlap's Don't Walk Status
Phase On	PhsOn	1 - 16	Phase's ON Status
Phase Next	PhsNxt	1 - 16	Phase's NEXT Status
Overlap On	OvlOn	1 - 16	Overlap is in Green, Yellow, or Trailing Red
Phase Call	PhsCall	1 - 16	Phase's Call Status
Ped Call	PedCall	1 - 16	Pedestrian's Call Status
Overlap Call[1]	OvlCall	1 - 20	Overlap's Call Status
Overlap Ped Call	OvpCall	1 - 16	Overlap's Ped Call Status
Vehicle Det Call	VehDet	1 - 64	Vehicle Detector's Call Status
Ped Det Call	PedDet	1 - 8	Pedestrian Detector's Call Status
Preempt Call	PreCall	1 - 12	Preempt's Call Status
Preempt Active	PreAct	1 - 12	Preempt's Active Status
Preempt Track Green	PreTrk	1 - 12	Preempt's Track Green Status
Preempt Dwell	PreDwl	1 - 12	Preempt's Dwell Status
Preempt Exit	PreExit	1 - 12	Preempt's Exit Status
Special Function	SpcFunc	1 - 8	Special Function's Status
Aux Function	AuxFunc	1 - 3	Auxiliary Function's Status
Special Status	SpcStat	1 - 8	Special Status' Status
Pattern Active	PatAct	1 - 255	Pattern's Active Status (PlnAct in NextPhase)
Priority Active	PriAct	1 - 12	Priority's Active Status
Priority Det	PriDet	1 - 80	Priority Detector's Status
Queue/Level[2]	QueLvl	1 - 4	Active Traffic Responsive Queue Level Status 1=Q1L1, 2=Q1L2, 3=Q2L1, 4=Q2L2
Sequence[2]	Sequenc	1 - 20	Sequence Status
Special Detector[2]	SpcDet	1 - 8	Special Detector's Status
[1]Only supported by NextPhase Peer, [2]Only supported by SEPAC Peer NOTE: For ranges when connecting to a NextPhase CU see the NextPhase Manual. SEPAC allows for input of the greater of SEPAC and NextPhase ranges.			

Table 2-11. Peer-to-Peer Input Functions			
Function	**Short Name**	**IDX Range**	**Description**
Phase Call	PhsCall	1 - 16	Activates phase call on the given phase
Ped Call	PedCall	1 - 16	Activates ped call on the given phase
Vehicle Det Call	VehDet	1 - 64	Activates the given vehicle detector
Ped Det Call	PedDet	1 - 8	Activates the given pedestrian detector
Preempt Call	PreCall	1 - 12	Activates preempt call for the given preempt
Special Function	SpcFunc	1 - 16	Activates the given Special Function
Special Status	SpcStat	1 - 8	Activates the given Special Status
Hold	Hold	1 - 16	Activates a Phase Hold on the given phase
Omit	Omit	1 - 16	Activates a Phase Omit on the given phase
Omit Ped	OmtPed	1 - 16	Activates a Ped Omit on the given phase
Force	Force	1 - 16	Activates a Force Off on the given phase
Ped Recycle	PedRcyc	1 - 16	Activates a Ped Recycle on the given phase
Min Recall	MinRcl	1 - 16	Activates a Min Recall on the given phase
Walk Rest	WlkRst	1	Activates a Walk Rest Modifier on the CU
Free	Free	1	Activates Free Operation on the CU
Priority Detector	PriDet	1 - 80	Activates priority detection on the given detector
Special Detector	SpcDet	1 - 8	Activates the given special detector
Queue Level	QueLvl	1 - 4	Activates the given Traffic Responsive Queue Level for the CU. 1=Q1L1, 2=Q1L2, 3=Q2L1, 4=Q2L2 The Queue activated must have Enter/Leave Percentages set to zero but does need a Dial and/or Split that is non-zero. If the configuration does not meet those criteria this Peer-to-Peer function will be ignored in favor of local control of the Queue's.

2.5.6   Ring Structures

The Ring Structure Display (Figure 2-154.) allows the user to view and modify the basic ring structure of the CU.

From the Unit Data Menu (Figure 2-140.), press **5-RING STRUCTURE**.

```
RING STRUCTURES PHASE – 1

      RING: 1  NEXT PHASE: 2

     PHASES: 12345678 90123456
  COMPATIBLE: x0001100 00000000

UP/DOWN TO SCROLL            E-EDIT
```
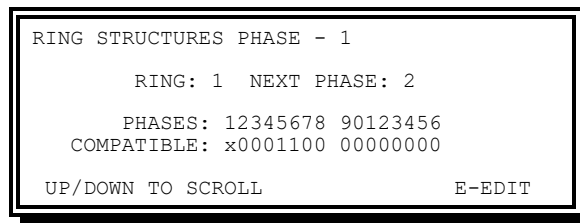
Figure 2-154. Ring Structure Display

NOTE: Default data is as shown in Figure 2-154..

- Ring (Ring number)
    - The Ring assignment for this phase (1-4)
    - When Ring = 0, the Phase is disabled
    - Each Phase must be assigned to a Ring to be serviced
- Next Phase – The Phase (1-16) to be serviced following this Phase in the Ring. Each Phase must have a Next Phase. When a Phase is the only Phase in a Ring, its Next Phase is the same as the phase number. In other words, the Phase points to itself as Next.
- Compatible (Compatible Phase) – The Phase(s) that may run concurrently with this Phase. Phases that are contained in the same Ring may NOT run concurrently.
    - Code 0 (No) – The Phase is not allowed to run concurrently with this phase
    - Code 1 (Yes) – The Phase is allowed to run concurrently with this Phase. A Phase is always concurrent with itself

Each Phase has the compatible Phase(s) defined. The CU automatically enters the reverse data (for example, if phase 8 is entered as a Phase 1 concurrent Phase, Phase 1 is automatically entered as a Phase 8 concurrent phase).

Changes to the Ring structure deletes Sequence data or re-initializes Sequence data and initializes the unit on exit from the display. This provides for a positive implementation of the new structure (initialization) and the unit to evaluate Sequence data based on new entries.

NOTE: Any Phase that has no concurrent Phases must be in Ring 1.

The sequence in a Ring should start with the lowest numbered Phase to be used.

2.5.7   Sequences

The Sequence Display allows the user to view and modify the Sequences to the basic Ring Structure sequence.

From the Unit Data Menu (Figure 2-140.), press **6- SEQUENCES**.

```
SEQUENCE  1
          PHASE SEQUENCE BY RING
PHSE ## ## ## ## ## ## ## ## ## ## ## ##
 R1-  1  2  3  4  0  0  0  0  0  0  0  0
 R2-  5  6  7  8  0  0  0  0  0  0  0  0
 R3-  0  0  0  0  0  0  0  0  0  0  0  0
 R4-  0  0  0  0  0  0  0  0  0  0  0  0
 UP/DOWN TO SCROLL                 E-EDIT
```

Figure 2-155. NTCIP Sequence Display (1 of 16 shown)

Sequence Display is a paging screen to enable viewing all 16 sequence definitions.

- Pressing UP or DOWN while E-EDIT is displayed on the bottom line will page up or down to the next screen
- Pressing E in any screen enables editing in that screen

- While in the editing mode, the bottom line will show E-EXIT indicating that pressing E will cause an exit from edit mode to display mode

The CU provides the capability of fifteen alternates to the standard sequence defined in the Ring Structure database and displayed for Sequence 1. These alternates are typically variations to the sequence based on groups of two Phases in a Ring being serviced in reverse order.

The Phase pair to be serviced in reverse order must be adjacent in the normal sequence, may not be separated by barriers, and a single Phase may appear in only one of the Phase pair definitions for an alternate.

The Sequence definitions must include all Phases assigned to all Rings.

Changes to the Sequence will be held until the top of the next cycle. This provides for a positive release from one set of parameters, further entries, and an evaluation of the new parameter set prior to running coordination again.

2.5.8 Port 1/ITS Data

The following screens provide data entry for NEMA TS 2 Port 1 as well as ATC, ITS and CBD cabinets. Address/Entry 101 – 128 are currently used for ATC, ITS and CBD cabinets.

2.5.8.1 TS 2 Port 1 Configuration Data

The Port 1 Data Display (Figure 2-156.) allows the user to view and modify the devices present (by Address) and devices to receive Frame 40 (by Address) parameters for the CU.

When Port 1 hardware does not exist, this programming should be all zeros to prevent the CU diagnostics from trying to take corrective action.

From the Unit Data menu (Figure 2-140.), press **7-PORT 1/ITS DATA**.

```
PORT 1 DATA - TS2              (0-NO/1-YES)
 ADDR DESCRIPTION............. ENA B F40
   0   T&F BIU #1 TS2            0   0   0
   1   T&F BIU #2 TS2            0   0   0
   2   T&F BIU #3 TS2            0   0   0
   3   T&F BIU #4 TS2            0   0   0
   4   T&F BIU #5 RESERVED       0   0   0
UP/DOWN TO SCROLL
```

Figure 2-156. Port 1 Data Display

Default data is all data fields are 0.

- ENA (Enable) – The data that controls whether the CU will allocate time for messages to and from that address

- B (Basic Detection) – The data that controls whether the CU will use only Basic detection from that address

    ♦ Basic detection ignores the millisecond resolution detection information from the BIU in favor of the Basic detection bit alone

    ♦ This reduces the timing resolutions to tenths of a second instead of milliseconds

♦ It is intended to provide compatibility with BIUs that are not fully TS 2 compliant

• F40 (Frame 40) – The data that controls whether the CU will allocate time for the Peer-to-Peer Frame 40 series to and from that address

When the cursor is in the ADDR (address) field, entry of a number causes the display to place that data for the address on the cursor line. This enables the user to jump to a specific data entry area.

```
ADDR DESCRIPTION............. ENA B F40
   0  T&F BIU #1 TS2            0   0   0
   1  T&F BIU #2 TS2            0   0   0
   2  T&F BIU #3 TS2            0   0   0
   3  T&F BIU #4 TS2            0   0   0
   4  T&F BIU #5 RESERVED       0   0   0
   5  T&F BIU #6 RESERVED       0   0   0
   6  T&F BIU #7 MFG USE        0   0   0
   7  T&F BIU #8 MFG USE        0   0   0
   8  DET BIU #1 TS2            0   0   0
   9  DET BIU #2 TS2            0   0   0
  10  DET BIU #3 TS2            0   0   0
  11  DET BIU #4 TS2            0   0   0
  12  DET BIU #5 RESERVED       0   0   0
  13  DET BIU #6 RESERVED       0   0   0
  14  DET BIU #7 MFG USE        0   0   0
  15  DET BIU #8 MFG USE        0   0   0
  16  MALFUNCTION UNIT          0   0   0
  17  DIAGNOSTIC (MSG 30)       0   0   0
  18  CONTROLLER UNIT           0   0   0
  19  MSG 0 BROADCAST           0   0   0
  20  UNDEFINED                 0   0   0
   |        |         |       |
 253  UNDEFINED                 0   0   0
 254  UNDEFINED                 0   0   0
```

Figure 2-157. Port 1 Data List

Jumper the Port 1 connector pins 8 and 10 to disable all Port 1 communications when Port 1 hardware exists.

The CU is also capable of Port 1 communications to detector BIUs or other devices in a NEMA TS 1 cabinet without having a NEMA TS 2 MMU attached to Port 1. This requires the proper terminating resistors on the Port 1 communications link.

Terminal and facilities BIU # 1 being programmed as present is the flag to inform the CU that it is being used in a Type 1 terminal and facilities. The use of any other terminal and facilities BIU without Terminal and Facilities BIU # 1 is considered a Fault and DIAG: INV. TS2-A1 CNF is logged plus Flashing as defined below is initiated.

NOTE: It is not recommended to enable address 17 (Diagnostic Msg 30) for normal operation. Address 18 (Controller Unit) should not be enabled unless BIUs are enabled for F40 (Message Frame 40). Msg 0 Broadcast is mutually exclusive with Malfunction Unit.

2.5.8.2   ITS Configuration Data

When the user presses 7 from the Unit Data Menu (Figure 2-140.), the TS 2 Port 1 Data Display is displayed. To jump to the ITS Configuration Data Display (Figure 2-158.), enter **101** in the 0 ADDR field. ATC, ITS and CBD cabinets are configured in this section.

```
ITS CONFIGURATION DATA      (0-NO/1-YES)
 ENTR DESCRIPTION.............. ACTIVE
101  OUT FORMAT  1: 14,0, 0,0  1
102  OUT FORMAT  2: 14,0,14,0  0
103  OUT FORMAT  3: 14,0, 6,0  0
104  OUT FORMAT  4: 14,0, 6,6  0
105  OUT FORMAT  5:  6,0, 0,0  0
UP/DOWN TO SCROLL
```

Figure 2-158. ITS Configuration Data Display

2.5.8.2.1   ATC Default Data

Default data for ATC mode is indicated below.

- ACTIVE – Entries denote the following:
    - 0 – Defines the format is NOT active
    - 1 – Defines the format as active

```
ENTR DESCRIPTION.............. ACTIVE
115  OUT FORMAT 15: ATC 16 Ch  1
116  OUT FORMAT 15: ATC 32 Ch  0
117  RESERVED                  0
118  RESERVED                  0
```

Figure 2-159. ATC Output Format List

All output formats (Entries 115-116) are mutually exclusive. Only one format may be active at a time (see Chapter 16, Section 16.1.2).

- 115 OUT FORMAT 15 – ATC 16 channel cabinets only (default)

- 116 OUT FORMAT 16 – ATC 32 channel cabinets only

```
ENTR DESCRIPTION.............. ACTIVE
119  INPUT ASSY 1: ADDR 9      1
120  INPUT ASSY 2: ADDR A      0
121  INPUT ASSY 3: ADDR B      0
122  INPUT ASSY 4: ADDR C      0
123  INPUT ASSY 5: ADDR D      0
```

Figure 2-160. ATC Input Assembly List

- ACTIVE – Entries denote the following
    - 0 – Defines the Input Assembly is NOT active
    - 1 – Defines the Input Assembly as active

All Input Assemblies (Entries 119-123) may be used at the same time. SEPAC does not provide the ability to use inputs from Input Assembly # 5 and some inputs from Input Assembly #4.

When an Input Assembly is defined as active but is not present in the ATC cabinet, the result will be Cabinet Diagnostic Flash.

```
ENTRY ..DESCRIPTION...........   ACTIVE
 124  RESERVED                   0
 125  CMU 1: ADDR F              1
 126  CMU 2: ADDR 10 RESERVED    0
 127  CMU 3: ADDR 11 RESERVED    0
 128  CMU 4: ADDR 12 RESERVED    0
```

Figure 2-161. ATC CMU List

- ACTIVE – Entries denote the following:
  - ♦ 0 – Defines the CMU is NOT active
  - ♦ 1 – Defines the CMU as active

SEPAC only supports CMU Assembly #1.

When the cursor is in the ENTRY field, entry of a number causes the display to place that entry data on the cursor line. This enables the user to jump to a specific data entry area.

2.5.8.2.2   ITS Default Data

Default data for ITS mode is indicated below.

- ACTIVE – Entries denote the following:
  - ♦ 0 – Defines the format is NOT active
  - ♦ 1 – Defines the format as active

```
ENTR DESCRIPTION.............. ACTIVE
101  OUT FORMAT  1: 14,0, 0,0  1
102  OUT FORMAT  2: 14,0,14,0  0
103  OUT FORMAT  3: 14,0, 6,0  0
104  OUT FORMAT  4: 14,0, 6,6  0
105  OUT FORMAT  5:  6,0, 0,0  0
106  OUT FORMAT  6:  6,6, 0,0  0
107  OUT FORMAT  7:  6,6, 6,0  0
108  OUT FORMAT  8:  6,6, 6,6  0
109  OUT FORMAT  9:  6,0,14,0  0
110  OUT FORMAT 10:  6,6,14,0  0
111  OUT FORMAT 11: CBD        0
112  OUT FORMAT 12: CBDv2 14Ch 0
113  OUT FORMAT 13: CBDv2 28Ch 0
114  OUT FORMAT 14: CBDv2 32Ch 0
```

Figure 2-162. ITS Output Format List

All out formats (Entries 101-114) are mutually exclusive. Only one format may be active at a time (see Chapter 16, Section 16.1.2).

- 101 OUT FORMAT 1 – ITS cabinets that use Output Assembly 14-0-0-0 (Default)
- 102 OUT FORMAT 2 – ITS cabinets that use Output Assembly 14-0-14-0
- 103 OUT FORMAT 3 – ITS cabinets that use Output Assembly 14-0-6-0
- 104 OUT FORMAT 4 – ITS cabinets that use Output Assembly 14-0-6-6
- 105 OUT FORMAT 5 – ITS cabinets that use Output Assembly 6-0-0-0
- 106 OUT FORMAT 6 – ITS cabinets that use Output Assembly 6-6-0-0
- 107 OUT FORMAT 7 – ITS cabinets that use Output Assembly 6-6-6-0
- 108 OUT FORMAT 8 – ITS cabinets that use Output Assembly 6-6-6-6
- 109 OUT FORMAT 9 – ITS cabinets that use Output Assembly 6-0-14-0

- 110 OUT FORMAT 10 – ITS cabinets that use Output Assembly 6-6-14-0

- 111 OUT FORMAT 11 – CBD cabinets only

- 112 OUT FORMAT 12 – CBDv2 14 channel cabinets only

- 113 OUT FORMAT 13 – CBDv2 28 channel cabinets only

- 114 OUT FORMAT 14 – CBDv2 32 channel cabinets only

```
ENTRY ..DESCRIPTION..   ITS ADDR  ACTIVE
 119  INPUT ASSY  1: ADDR 9       1
 120  INPUT ASSY  2: ADDR A       1
 121  INPUT ASSY  3: ADDR B       0
 122  INPUT ASSY  4: ADDR C       0
 123  INPUT ASSY  5: ADDR D       0
```

Figure 2-163. ITS Input Assembly List

- ACTIVE – Entries denote the following

  - 0 – Defines the Input Assembly is NOT active

  - 1 – Defines the Input Assembly as active

All Input Assemblies (Entries 119-123) may be used at the same time. SEPAC does not provide the ability to use inputs from Input Assembly # 5.

When an Input Assembly is defined as active but is not present in the ITS cabinet, the resultant operation will be Cabinet Diagnostic Flash.

```
ENTRY ..DESCRIPTION...........   ACTIVE
 124  RESERVED                    0
 125  CMU 1: ADDR F               1
 126  CMU 2: ADDR 10 RESERVED     0
 127  CMU 3: ADDR 11 RESERVED     0
 128  CMU 4: ADDR 12 RESERVED     0
```

Figure 2-164. ITS CMU List

- ACTIVE – Entries denote the following:

  - 0 – Defines the CMU is NOT active

  - 1 – Defines the CMU as active

All CMU assemblies (Entry 125-128) may be used at the same time; however, SEPAC only supports CMU Assembly #1.

When the cursor is in the ENTRY field, entry of a number causes the display to place that entry data on the cursor line. This enables the user to jump to a specific data entry area.

2.5.9   I/O Miscellaneous

The I/O Miscellaneous Display (Figure 2-165.) allows the user to view and modify the parameters for the CU.

From the Unit Data Menu (Figure 2-140.), press **8-I/O MISC**.

```
I/O MISC
RING I/O    RING..1..2..3..4  2070 AUX
 INPUT RESPONSE  1  2  0  0   SWITCH: 0
 OUTPUT SELECT   1  2  0  0
I/O MODES....INPUT..OUTPUT..BIT
 "ABC" CONN :    0       0      0
 "D" CONN   :    0       0      -
```

Figure 2-165. I/O Misc Display

2.5.9.1   Ring I/O – Input Response

The CU provides the capability to define 16 Phases into a structure of up to four rings while having only hardware inputs for two rings. This programming entry defines for each functional ring which, if any, hardware input set it responds to. From none to all rings may respond to one ring input set.

- Code 0 (None) – The programmed ring does not respond to either hardware ring input set

- Code 1 (Ring 1) – The programmed ring responds to hardware Ring #1 input set

- Code 2 (Ring 2) – The programmed ring responds to hardware Ring #2 input set

2.5.9.2   Ring I/O – Output Select

The CU provides the capability to define 16 Phases into a structure of up to four rings while having only hardware outputs for two rings. This programming entry defines for each hardware output set which, if any, functional ring will control it. Only one ring may control an output set.

- Code 0 (None) – The programmed ring does not control either hardware ring output set

- Code 1 (Ring 1) – The programmed ring controls Ring #1 output set

- Code 2 (Ring 2) – The programmed ring controls Ring #2 output set

2.5.9.3   Aux Switch

On controllers equipped with a front panel Aux switch (e.g., 2070 or M60 controllers), the Aux switch may be configured to perform the following functions, based on one of the following codes:

- Code 0 (No operation) – The Aux switch is ignored

- Code 1 (Stop time) – While the Aux switch is in the ON position, the CU behaves as though Stop time 1/2 inputs are active

- Code 2 (Interval advance) – Whenever the Aux switch is toggled from ON to OFF, the CU behaves as though an Interval Advance has been issued on its inputs.

This feature is provided as a convenience for bench testing only and is not to be used in on-street operation

Note that the Aux switch position is not read when the CU is powered on; it must be toggled after the CU is operational. On controllers not equipped with an Aux switch, this setting has no function.

2.5.9.4   ABC Conn – Input

See Chapters 13 and 14 for pin/function definitions. The following is a summary as applies to NEMA hardware. Only Input Mode 0 provides functions that are NEMA TS1-1983 compatible. A Terminal and Facilities wired to use Input Modes 6-19 may not be compatible with other manufacturer's CUs.

- Input Mode 0 – Provides Phase Hold, Phase Omit, and Phase Pedestrian Omit input functions. It provides input functions that are NEMA TS1-1983 compatible

- Input Mode 1 – Provides additional detector and coordination input terminations

- Input Mode 2 – Provides additional detector system input terminations.

- Input Modes 3-5 – Reserved for future definition and use by NEMA

- Input Mode 6 – This mode provides manufacturer-specific compatibility with Boston cabinets

- Input Mode 7 – Reserved for manufacturer-specific applications. This mode provides for 32 detector inputs

- Input Modes 10 and 11 – For manufacturer-specific applications

- Input Mode 18 and 19 – For manufacturer-specific applications

All other input modes are reserved for manufacturer-specific applications. These modes are not used by SEPAC at this time.

2.5.9.5   ABC Conn – Output

See Chapters 13 and 14 for pin/function definitions. The following is a summary as applies to NEMA hardware. Only Output Mode 0 provides functions that are NEMA TS1-1983 compatible. A Terminal and Facilities wired to use Output Modes 6-19 may not be compatible with other manufacturer's CUs.

- Output Mode 0 – Provides Phase On, Phase Next, and Phase Check output functions

- Output Mode 1 – Provides coordination output terminations

- Output Mode 2 – Provides system output terminations

- Output Modes 3-5 – Reserved for future definition and use by NEMA. These modes are not used by SEPAC at this time

- Output Mode 6 – Reserved for manufacturer-specific applications. This mode provides compatibility with Boston cabinets

- Output Mode 7 – Reserved for manufacturer-specific applications. This mode provides for load switches 21-28 via the On/Next/Check outputs

- Output Mode 10 – For manufacturer-specific applications. Output Mode 10 is like Output Mode 2 with the addition of an Any Preempt status output.

- Output Mode 11 – For manufacturer-specific applications. This mode provides 8 special function outputs.

- Output Mode 12 – For manufacturer-specific applications
  - Output Mode 12 is the same as Output Mode 10 except it provides Interrupted Sync Pulses on the active offset output
  - Interrupted Sync Pulses are provided at intervals equal to 20% and 25% of the cycle on alternate cycles
- Output Mode 13 – For manufacturer-specific applications. Output Mode 13 is the same as Output Mode 10 except it provides a Flashing output on the inactive Preempt Status outputs
- Output Mode 14 – For manufacturer-specific applications. Output Mode 14 is the same as Output Mode 11 except it provides a Flashing output on the inactive Preempt status outputs
- Output Mode 18 – For manufacturer-specific applications. This mode provides support for variable turn lane signs via the On/Next/Check outputs
- Output Mode 19 – For manufacturer-specific applications

All other output modes are reserved for manufacturer-specific applications. These modes are not used by SEPAC at this time.

2.5.9.6 ABC Conn – Bit Mode

The ABC Conn – Bit Mode displays the value of the ABC I/O Mode inputs. This value sets both the ABC connector input and output modes when both parameters above are zero.

2.5.9.7 D Conn – Input

See Chapters 13 and 14 for pin/function definitions. The following is a summary as applies to NEMA hardware. D connector input functionality depends upon the System Address. Zero and non-zero System Addresses typically swap the functionality between pairs of even and odd modes, e.g., 0 and 1.

- Input Mode 0 – Provides coordination and Alt Sequence inputs when no system address is programmed and special detectors and special status inputs when a system address is programmed
- Input Mode 1 – Provides input functions just opposite of standard input mode (coordination and Alt Sequence inputs when a system address is programmed and special detectors and special status inputs when no system address is programmed)
- Input Mode 2 – Provides input functions like Mode 0 except Preempt 5 and Preempt 6 inputs replace functions on pin 20 and pin 21
- Input Mode 3 – Provides input functions like Mode 1 except Preempt 5 and Preempt 6 inputs replace functions on pin 20 and pin 21
- Input Mode 8 – Provides input functions like Mode 2 except this input mode automatically modifies the output functions so the modifications to Pins 21 and 32 functions as defined above eliminating the Preempt 6 and TBC Auxiliary 3 capability
- Input Mode 9 – Provides input functions that may be used with a central computer system.

♦ The computer control input, when active, causes the coordinator Phase times to stop at dwell points when Dial 3 is in control, and the Dial 3 input is active

♦ For Permissive modes, the dwell points will occur just prior to the completion of the coordination Phase Pedestrian Hold and just prior to the completion of the Actuated Phase Pedestrian Permissive

♦ For Yield mode, the dwell points will occur 3.1 seconds into every Phase except the phase following the coordination Phase and 0.1 second into the Yield Period

♦ Force points are based on points in the Phase time countdown regardless of the force mode programmed

♦ On Phases that have no Phase time (0 seconds) allocated, the dwell points will not occur

♦ The interconnect mode, Free to Coordinated transition is not dependent on an offset input when the dial request is for Dial 3. Coordination pickup will begin after a Dial 3 request is active for 15 seconds

♦ When the coordinator Dial 3 is in control, all offset transition methods will be disabled

♦ The sync monitoring functions do not cause the unit to revert to Free mode when all offset inputs are inactive for 15 seconds

♦ When coordination has begun, the lack of an offset input will not cause the unit to revert to Free (the central system may not provide an offset for up to three cycles on a transfer from computer control to backup)

♦ The coordination cycle diagnostics are suspended when the coordinator is stopped at a dwell point

See Output Mode 9 in Section 2.5.9.8 for outputs that may be used with this input mode. Output Mode 9 is established automatically when Input Mode 9 is programmed.

This operation was established for systems that were designed for controlling pre-timed cycle units and has several limitations when attempting to control Dual Ring Actuated Controllers. The Dual Ring controller must look to the system like a single Ring controller That is to say, Ring-to-Ring timings must be the same and lead/lag operation is not possible. Also, Yield mode and Dual Ring configurations that have a non-coord Phase split timing at cycle zero are not compatible. There are more limitations, but it is best to say for this operation to be applicable to Dual Ring operation, the Dual Ring configuration must be very simple.

2.5.9.8   D Conn – Output

See Chapters 13 and 14 for pin/function definitions. The following is a summary as it applies to NEMA hardware. D connector output functionality depends upon the System Address. Zero and non-zero System Addresses typically swap the functionality between pairs of even and odd modes, e.g., 0 and 1.

• Output Mode 0 – Provides coordination outputs when no system address is programmed and system Special Function outputs when a System Address is programmed.

• Output Mode 1 – Provides output functions just opposite of standard output mode.

- Output Mode 2 – Provides output functions like Mode 0 except when any Preempt routine has control then it is like Mode 4 below.

  When Auxiliary #2 is not programmed for output as a TBC Auxiliary Function, it will become an Any Preempt active function. The Any Preempt output will become active when any Preempt routine is in control. This output may provide the control signal to correctly utilize these dual function outputs.

  Whenever an Auxiliary 2 event has been programmed and it is desired to again implement the Any Preempt output, the Clear Memory Function within TBC must be used to eliminate all TBC or all Auxiliary Events (Code 0 or Code 2).

- Output Mode 3 – Provides output functions like Mode 1 except when any Preempt routine has control then it is like Mode 4 below.

- Output Mode 4 – Provides Preempt Status outputs that are active whenever a Preempt routine is in control.

- Output Mode 5 – Provides output functions like Mode 0 (Address = 000) except Output Mode 5 provides Interrupted Sync Pulses on the active offset output. Interrupted Sync Pulses are provided at intervals equal to 20% and 25% of the cycle on alternate cycles

- Output Mode 6 – Provides output functions like Mode 4 except when a Preempt is active provides a flashing output on the inactive Preempt Status outputs

- Output Mode 9 – Provides output functions which are provided as status feedback for the central computer system control established with Input Mode 9. It is established automatically when Input Mode 9 is programmed.

  Cycle 0 – This output is operational during all coordination timing plans. Each time the background cycle passes through a point equal to local zero, the output will be inactive for a minimum of three seconds.

  R# Dwell – A per-ring output is operational when Dial 3 is in control and a dwell point is reached. See Mode 9 in Section 2.5.9.8 for a definition of dwell points.

2.5.10   Output Mapping

The Output Mapping Display (Figure 2-166.) allows the user to view and modify the output source to load switch map for the CU.

From the Unit Data Menu (Figure 2-140.), press **9-OUTPUT MAPPING**.

```
OUTPUT MAPPING            EDIT MODE: LDSW
                           E-TOGGLE MODE
LDSW ..1.. ..2.. ..3.. ..4.. ..5.. ..6..
RED  PH1   PH2   PD2   PH3   PH4   PD4
YEL   -     -     -     -     -     -
GRN   -     -     -     -     -     -
FIO   1     2     3     4     5     6
PREV/NEXT TO CYCLE        D-DISPLAY COMPAT
```

Figure 2-166. Output Mapping Display – Load Switch Mode
(Default Caltrans FIO data)

```
OUTPUT MAPPING           EDIT MODE: PIN
                        E-TOGGLE MODE
LDSW ..1.. ..2.. ..3.. ..4.. ..5.. ..6..
RED  PH1 R PH2 R PH3 R PH4 R PH5 R PH6 R
YEL  PH1 Y PH2 Y PH3 Y PH4 Y PH5 Y PH6 Y
GRN  PH1 G PH2 G PH3 G PH4 G PH5 G PH6 G
FIO   1     2     3     4     5     6
PREV/NEXT TO CYCLE    D-DISPLAY COMPAT
```

Figure 2-167. Output Mapping Display – Pin Mode
(Default NEMA FIO data)

The Output Mapping display presents a list of 32 load switches where each of the load switch outputs (pins) which may be assigned an output source. This may be done either collectively as an entire load switch or individually on a pin per source basis. Each load switch may also have a separate FIO mapping if applicable.

- LDSW – The logical load switch that is being mapped. This is also:
    - the SDLC Output Channel for TS 2 cabinets,
    - the SB1 Output Channel for ATC/ITS cabinets, and
    - the Output Channel for SEPAC Logic Builder.
- RED/YEL/GRN – The output source that is mapped to the output pin on the logical load switch.
    - Press PREV or NEXT keys to cycle through the various output sources.
    - Press the shortcut keys listed in Table 2-12 to jump to the beginning of the range for that Output Source type, i.e., pressing '1' will jump the current setting to PH1, '2' will jump to PD1, etc.
    - Press ENTER to accept the source configuration. The user is prompted on exit of the display to accept any changes before they are used by the CU
- FIO (FIO Routing) – The FIO Routing of this LDSW.
    - This allows rerouting a LDSW output (SDLC) to a different load switch on the FIO outputs.
    - The primary use of this field is for TS-2 Type 2 Cabinets where it is desired to have the same LDSW going out one spot over SDLC and another spot out the ABC Connectors.
    - This field also works with 2070-2 Field I/O's

There are two editing modes for this display, Load Switch (LDSW) mode and PIN mode. When first entering the screen, the user will begin in LDSW mode. Pressing E-TOGGLE MODE will toggle the display to PIN mode. Pressing again will toggle back to LDSW mode.

In LDSW mode the user can change all the pins for a load switch at once to match those of the corresponding source. For instance, if the user changes LDSW 1 RED to be PH1, then LDSW 1 RED will map to PH1 R, LDSW1 YEL to PH1 Y, and LDSW1 GRN to PH1 G. Only the RED entry indicates the source. The YEL and GRN pins are marked with a dash (–) to indicate that the RED entry shows the source.

In PIN mode the user can change each pin for a load switch individually, without affecting the other pins on that load switch. In this case, both the output source (say PH3) and the output "pin" (R, Y or G) are selected.

Table 2-12. Output Mapping Sources				
Output Source	**Short Name**	**Shortcut Key**	**Range**	**Pin Selection**
None	NONE	0	--	--
Phase (Red/Yellow/Green)	PH	1	1-16	R/Y/G
Pedestrian (DW/Clear/Walk)	PD	2	1-16	D/C/W
Overlap (Red/Yellow/Green)	OL	3	A-P	R/Y/G
Preempt Status	PRE/PR	4	1-12	n/a
Phase Status (On/Next/Check)	PS	5	1-16	O/N/C

NOTE: In LDSW mode the shortcut key '4' for Preempt is not allowed.

Pressing **D-DISPLAY COMPAT** will bring the user to the Output Compatibilities display.

NOTE: This display is provided for information purposes only. The display shows load switch compatibility.

```
OUTPUT COMPATIBILITIES
LDSW:1234567890 1234567890 1234567890 12
LS01:x000110000 1000000000 0000000000 00
LS02:.x00110010 1000000000 0000000000 00
LS03:..x0001100 0100000000 0000000000 00
LS04:...x001101 0100000000 0000000000 00
LS05:....x00010 0000000000 0000000000 00
 UP/DOWN TO SCROLL               ESC-BACK
```

Figure 2-168. Output Load Switch Compatibilities Display

Use the UP or DOWN keys to display the next or prior

- Load switch compatibilities
    - . (period) – Compatibility between these load switches is displayed under the lower number load switch
    - x – A load switch cross reference to itself
    - 0 –These load switches are not compatible
    - 1 – These load switches are compatible

Output Compatibilities are generated from the Green Pin of the load switch. The MMU Card programming can be less restrictive (more compatibility jumpers) but not more restrictive (less jumpers) than shown. This means the MMU must have all the compatibility jumpers SEPAC shows. The MMU may have more, but those shown must be present. When this is NOT true, an MMU UTILZATION CNFLCT Fault will cause Diag Flash (see Chapter 3, Section 3.7.1 and Chapter 4, Section 4.1.2.5).

```
LDSW:1234567890 1234567890 1234567890 12
LS01:x000110000 1000000000 0000000000 00
LS02:.x00110010 1000000000 0000000000 00
LS03:..x0001100 0100000000 0000000000 00
LS04:...x001101 0100000000 0000000000 00
LS05:....x00010 0000000000 0000000000 00
LS06:.....x0010 1000000000 0000000000 00
LS07:......x001 0000000000 0000000000 00
LS08:.......x01 0100000000 0000000000 00
LS09:........x0 1000000000 0000000000 00
LS10:.........x 0100000000 0000000000 00
LS11:.......... x000000000 0000000000 00
LS12:.......... .x00000000 0000000000 00
LS13:.......... ..x0000000 0000000000 00
LS14:.......... ...x000000 0000000000 00
LS15:.......... ....x00000 0000000000 00
LS16:.......... .....x0000 0000000000 00
LS17:.......... ......x000 0000000000 00
LS18:.......... .......x00 0000000000 00
LS19:.......... ........x0 0000000000 00
LS20:.......... .........x 0000000000 00
LS21:.......... .......... x000000000 00
LS22:.......... .......... .x00000000 00
LS23:.......... .......... ..x0000000 00
LS24:.......... .......... ...x000000 00
LS25:.......... .......... ....x00000 00
LS26:.......... .......... .....x0000 00
LS27:.......... .......... ......x000 00
LS28:.......... .......... .......x00 00
LS29:.......... .......... ........x0 00
LS30:.......... .......... .........x 00
LS31:.......... .......... .......... x0
LS32:.......... .......... .......... .x
```

Figure 2-169. Output Load Switch Compatibilities, Complete

2.5.11 Unit Bank Selection

The Unit Bank Selection Display allows the user to alter which Unit Bank is currently being viewed and edited by screens with Unit Bank data on them. This is in addition to the '-' key shortcut on those screens.

```
UNIT BANK SELECTION

      CURRENTLY EDITING UNIT BANK: 1
        (AVAILABLE BANKS = 1-2-3-4)

         [RUNNING UNIT BANK IS 1]
```
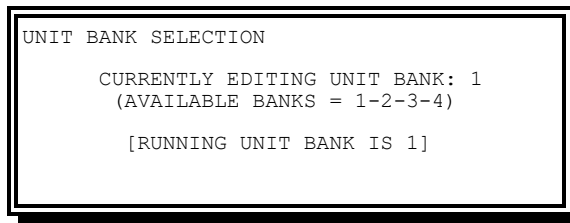
Figure 2-170. Unit Bank Selection Display

The Unit Bank that is selected for editing is shown and may be altered here. In addition, the currently running Unit Bank is also shown for informational purposes only.

2.5.12 Unit Bank Copy

The Unit Bank Copy Display allows the user to copy the complete Unit Bank data from one bank to another.

```
UNIT BANK COPY
  COPYING UNIT BANK FROM: 1 TO: 1

 ENTER THE FROM AND TO UNIT BANK ##
 THEN ENTRY HERE INITIATES THE COPY>>>>0
```
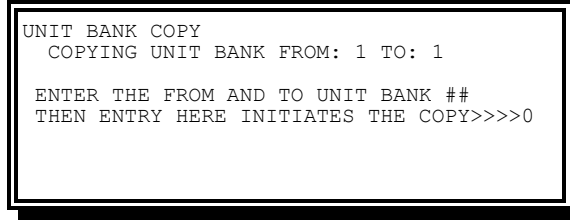
Figure 2-171. Unit Bank Copy Display

The FROM bank will be the source Unit Bank and the TO bank will become the destination Unit Bank of the copy operation.

2.6 Coordination Data

Coordination Data allows the user to display and enter controller parameters for the following:

- Setup (Mode/Correction) parameters
- Manual mode parameters
- Dial/Split parameters
- Dial/Split copy
- Coordination Data Clear

User access is required to enter data for these intervals. See Section 2.3 for more information on gaining access.

2.6.1   Coordination Data Menu

The Coordination Data Menu (Figure 2-172.) allows the user to select which coordination parameter database is to be viewed or modified.

From the Main Menu (Figure 2-1), press **5-COORD DATA**.

```
COORD DATA

            1-SETUP COORD
            2-MANUAL CONTROL
            3-PATTERN DATA
            C-COPY PATTERN
            D-LOAD DEFAULT
```
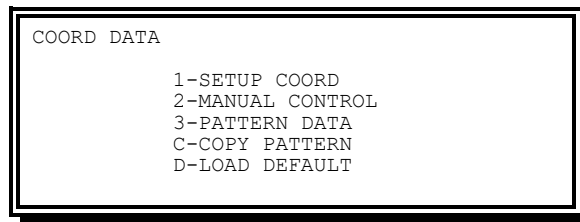
Figure 2-172. Coordination Data Menu

Coordination data menu options include the following:

- Setup Coord – Provides viewing and editing of the overall Coordination/Unit parameters
- Manual Control – Provides viewing and editing of the pattern to control in Manual mode

- Pattern Data – Provides viewing and editing of the pattern parameters for each of the 255 patterns
- Copy Pattern – Copies one set of pattern parameters to another pattern
- Load Default – Defaults all Coordination parameters

2.6.2   Coordination Setup

The Coordination Setup Display allows the user to view and modify the overall Coordination/Unit parameters.

From the Coordination Data Menu, press **1-SETUP COORD**.

```
COORD SETUP  .0. .1. .2. .3. .4. .5. .6.
 OPERATION:0 FRE AUT MAN --- --- --- ---
      MODE:0 PRM YLD PYL POM SOM FAC MUT
      MAX :2 INH MX1 MX2 --- --- --- ---
CORRECTION:0 DWL MDW SWY SW+ SW2 --- ---
    OFFSET:0 BEG END OF GREEN
     FORCE:0 PLN CYCLE TIME
        MX DWELL: 0 YIELD PERIOD: 0
```

Figure 2-173. Coordination Setup Display

NOTE: Default data is as shown in Figure 2-173.

Coordination data parameters include the following:

- Operation (Operation mode)
    - Code 0-FRE – Provides for Free operation without Coordination from any source
    - Code 1-AUT – Provides for Coordination operation, or Free, to be automatically determined by the possible sources (for example, Interconnect, Time Base, or System Commands)
    - Code 2-MAN – Provides for Manual Coordination operation running the pattern as defined in the Manual Control entries
- Mode (Coordination Mode)
    - Code 0-PRM – Permissive operation – Section 3.8.11.1

NOTE: This mode is compatible with Transit Priority operation

    - Code 1-YLD – Yield operation – Section 3.8.11.2
    - Code 2-PYL – Permissive Yield operation – Section 3.8.11.3

NOTE: This mode is compatible with Transit Priority operation.

    - Code 3-POM – Permissive Omit Mode operation – Section 3.8.11.4
    - Code 4-SOM – Sequential Omit Mode operation – Section 3.8.11.5
    - Code 5-FAC – Full Actuated Mode operation – Section 3.8.11.6

- ◆ Code 6-MUT – Mutual Coordination (aka, Yellow-Yellow or Non-Background Cycle Coordination) (Section 3.8.11.7)
- Max (Maximum Mode)
  - ◆ Code 0-INH (Inhibit) – Provides for the internal Maximum timing to be Inhibited while coordination is running a pattern
  - ◆ Code 1-MX1 (Maximum 1) – Provides for the Maximum 1 timing to be effective while coordination is running a pattern
  - ◆ Code 2-MX2 (Maximum 2) – Provides for the Maximum 2 timing to be effective while coordination is running a pattern
- Correction (Correction Mode)
  - ◆ Code 0-DWL (Dwell) – Provides an offset Dwell until correction has been accomplished
  - ◆ Code 1-MDW (Maximum Dwell) – Provides an offset dwell until correction has been accomplished with maximum dwell time establishing the dwell limit for a single cycle
  - ◆ Code 2-SWY (Shortway) – Provides an offset correction by shortening or dwelling based on a shortest way calculation. When going short, time is subtracted from all phases proportional to their split times. When going long, time is added to the coordinated phases only. Correction will not exceed 20% in a cycle and will automatically take into consideration Minimum times
  - ◆ Code 3-SW+ (Shortway Plus) – Provides an offset Dwell like MX DW except the Max Dwell time will be 20% of the cycle
  - ◆ Code 4-SW2 (Shortway 2) – Operates the same as SW Mode except when going long will add to all Phases proportional to their split time
- Offset (Offset Mode)
  - ◆ Code 0-Beg (Beginning of Green) – Provides an offset based upon the beginning of the first coordination Phase Green
  - ◆ Code 1-End (End of Green) – Provides an offset based upon the end of the first coordination Phase Green
- Force (Force mode)
  - ◆ Code 0-Pln (Plan)– Provides a floating force-off based upon the plan timing. Each phase will be forced a fixed time after it has become active

NOTE: This mode is compatible with Transit Priority operation

  - ◆ Code 1-Cycle – Provides a fixed force-off based upon the cycle timing. Each actuated phase will be forced at a fixed position in the cycle
- Mx Dwell (Maximum Dwell) – This value establishes the maximum time (0-255 seconds) that the unit may dwell for offset correction in a single cycle under Max Dwell coordination mode.
- Yield Period – This value establishes a time (0-255 seconds) for the Yield Period used by Yield and Permissive Yield coordination modes

2.6.3 Coordination Manual Control

The Coordination Manual Control Display (Figure 2-174.) allows the user to view and set the pattern to be in control under Manual coordination mode.

From the Coordination Data Menu press **2-MANUAL CONTROL**.

```
COORD MANUAL CONTROL

       PATTERN: 001      SYNC: 0

  TO SET CYCLE ZERO IN MANUAL CONTROL
          ENTER "1" FOR SYNC.
```
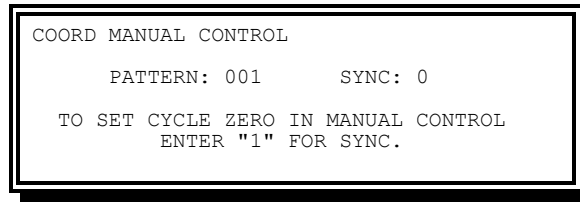
Figure 2-174. Coordination Manual Control Display

NOTE: Default data is as shown in Figure 2-147.

- Pattern – This entry establishes the Pattern that will run during manual mode.
- Sync – This entry (1) establishes the SYNC reference for the pattern that will control during Manual mode. When it is initiated, this reference will be automatically regenerated once a cycle for the duration of the Manual pattern

Absolute Sync Reference is a reference method in which each cycle is individually referenced to a single point in time through a keypad-initiated sync command or downloaded through the system interface or RS232C port. This operation will allow the CU to keep step with a free running cycle counter. Typically, this operation is required when the CU is running under Manual control.

To establish the absolute sync reference point for a Pattern, enter a 1 in the Sync field.

To clear the absolute sync reference point for a Pattern, enter a 0 in the Sync field.

When running coordination using Absolute Sync Reference Points, the active status for the coordination timers will show ASYN REF in place of the standard SYNC REF. When the active pattern has a valid Absolute Sync Reference, an exclamation point (!) will appear next to the sync timer value. For those periods when a valid Absolute Sync Reference does not exist, the CU will utilize 24:00 hours as the sync reference point.

2.6.4 Pattern Data

The Pattern Display allows the user to view and modify the Split Parameters and Pattern Parameters for each of the 253 Patterns .

From the Coordination Data Menu press **3- PATTERN DATA**.

```
PATTERN DATA

    PATTERN: 001   CYCLE LENGTH:   70
                   CYCLE - SPLITS:    0

        A - SPLIT PARAMETERS
        B - PATTERN PARAMETERS
```

Figure 2-175. Coordination Dial/Split Data Display

- Pattern – Pattern number for subsequent viewing or modifying
  - CODE A – Go to Split Parameters Data (See Section 2.6.4.1).
  - CODE B – Go to Pattern Parameters Data (See Section 2.6.4.2).
- Cycle Length – Establishes the cycle length of the timing plan (0-255 seconds) pointed to by the Split Parameters fields it. This value is automatically calculated by the device but may be increased by the user
- Cycle – Splits – A read only field displaying the difference between the Cycle Length and the sum of the split time values.

2.6.4.1   Pattern Split Time Data

The Coordination Phase Display (Figure 2-176) allows the user to view and modify the respective parameters for each of the Dial/Split combinations.

From the Coordination Pattern Split Time Display, select **Level A**.

```
PATTERN 001 SPLITS
PHASE......1...2...3...4...5...6...7...8
 TIME..:   0   0   0   0   0   0   0   0
 MODE..:   0   0   0   0   0   0   0   0
   MODE: 0-7=AP/CP/VR/XR/PR/XPR/PO/DCP
 P.RED.:   0   0   0   0   0   0   0   0
 P.EXT.:   0   0   0   0   0   0   0   0
```

Figure 2-176. Coordination Phase Display (Phases 1-8 of 16 Shown)

The Split Parameters available are:

- Time (Phase Time) – Establishes the time 0-255 seconds allocated to the Phase within the patterned defined
  - A zero value may be entered for an inactive Phase
  - Otherwise, this value must be adequate to service the Minimum vehicle requirements of the Phase except for some non-primary Phases when operating in Texas Diamond mode
- Mode (Phase mode)
  - Code 0-AP (Actuated Phase) – Operates without additional modifiers in the pattern
  - Code 1-CP (Coordinated Phase) – Operates as the COORDINATED PHASE for the ring in the pattern

- Code 2-VR (Minimum Vehicle Recall) – Operates as an actuated Phase with a modifier of MINIMUM RECALL in the pattern

- Code 3-XR (Maximum Vehicle Recall) – Operates as an actuated Phase with a modifier of MAXIMUM RECALL in the pattern

- Code 4-PR (Pedestrian Recall) – Operates as an actuated Phase with a modifier of PEDESTRIAN RECALL in the pattern

- Code 5-XPR (Max & Ped Recall) – Operates as an actuated Phase with a modifier of MAXIMUM RECALL and PEDESTRIAN RECALL in the pattern

- Code 6-PO (Phase Omit) – Operates as an actuated Phase with a modifier of PHASE OMIT in the pattern

- Code 7-DCP (Dual Coordinated Phase) – Operates as the DUAL COORD Phase for the ring in the pattern

Changes to the active Pattern will be held until the top of the next cycle. This provides for a positive release from one set of parameters, further entries to the same pattern, and an evaluation of the new parameter set prior to running same.

2.6.4.2   Pattern Parameters

The Pattern Parameters display allows the user to view and modify the respective parameters for each of the available patterns.

From the Pattern Parameters Display select **Level B**.

```
PATTERN 001 PARAMETERS
    COORD MODE: 0      TIME OFFSET:  0
      MAX MODE: 0        SEQUENCE:  0
     CORR MODE: 0
  COORD OFFSET: 0            R2 LAG:
    FORCE MODE: 0            R3 LAG:
     SPEC FUNC: 0            R4 LAG:
```
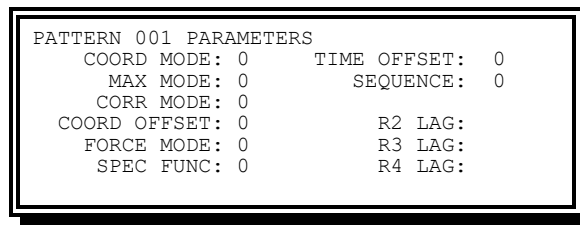
Figure 2-177. Pattern Parameters Display

- COORD MODE (Coordination mode) – Establishes the Coordination Mode (0-7) that will be in effect for the duration of the pattern defined. A non-zero entry overrides the default mode entered in the Coordination Setup display (see Section 2.6.2) for the duration of this pattern

- MAX MOD (Max mode) – Establishes the Max Mode (0-3) that will be in effect for the duration of the pattern defined. A non-zero entry overrides the default mode entered in the Coordination Setup display (see Section 2.6.2) for the duration of this pattern

- CORR MODE (Correction Mode) – Establishes the Correction Mode (0-5) that will be in effect for the duration of the pattern defined. A non-zero entry overrides the default mode entered in the Coordination Setup display (see Section 2.6.2) for the duration of this pattern

- COORD OFFSET (Coordination Offset) – Establishes the Coordination Mode (0-2) that will be in effect for the duration of the pattern defined. A non-zero entry overrides the default mode entered in the Coordination Setup display (see Section 2.6.2) for the duration of this pattern

- FORCE MODE (Force Mode) – Establishes the Force Mode (0-2) that will be in effect for the duration of the pattern defined. A non-zero entry overrides the default mode entered in the Coordination Setup display (see Section 2.6.2) for the duration of this pattern

- SPC FUN (Special Function)– This entry enables a Special Function to be turned on for the duration of this pattern

- TIME OFFSET (Time Offset) – Establishes the Offset time of 0-255 seconds for the local cycle zero that will be maintained during the pattern defined

- SEQUENCE (Sequence) – The entry establishes the Sequence (1-19) that will be in effect for the duration of the pattern defined. The Sequence needs to be in effect for this pattern. See Section 2.5.7 for the Sequence definition. When this value is zero, the DEF SEQUENCE defined in it is active.

- R2 LAG (Ring 2 Lag time) – When barriers do not lock Ring 2 to Ring 1, this establishes an offset time of 0-255 seconds for the Ring 2 first coord Phase from the Ring 1 first coord Phase for this pattern

- R3 LAG (Ring 3 Lag time) – When barriers do not lock Ring 3 to Ring 2, this establishes an offset time of 0-255 seconds for the Ring 3 first coord Phase from the Ring 1 first coord Phase for this pattern

- R4 LAG (Ring 4 Lag time) – When barriers do not lock Ring 4 to Ring 3, this establishes an offset time of 0-255 seconds for the Ring 4 first coord Phase from the Ring 1 first coord Phase for this pattern

Changes to the active Pattern will be held until the top of the next cycle. This provides for a positive release from one set of parameters, further entries to the same pattern, and an evaluation of the new parameter set prior to running same.

2.6.5   Coordination Copy Pattern

The Coordination Copy Pattern Display allows the user to copy the parameters from one Pattern to another within the CU.

From the Coordination Data Menu, press **C-COPY PATTERN**.

```
COORD COPY

    COPY FROM PAT: 001  TO  PAT: 001

 ANY ENTRY HERE INITIATES THE COPY >>>>0
```
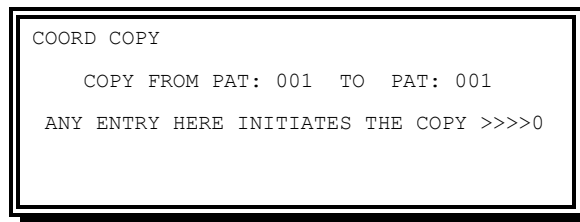
Figure 2-178. Coordination Copy Pattern Display

Information provided on this display includes the following:

- From Pat (Pattern) – This entry establishes the Source Pattern number for the copy function
- To Pat (Pattern)– This entry establishes the destination for the copy function
- Any Entry here initiates the copy – Executes the copy defined

Pattern copy operation will cause the unit to drop coordination for 15 seconds.

2.6.6 Coordination Load Default

The Coordination Load Default Display allows the user to default all coordination parameters.

From the Coordination Data Menu press **D-LOAD DEFAULT**.

```
COORD LOAD DEFAULT

 WARNING....THIS OPTION WILL DEFAULT ALL
 CURRENT OPERATING DATA ...............
 - PRESS "E" TO CONTINUE :
```
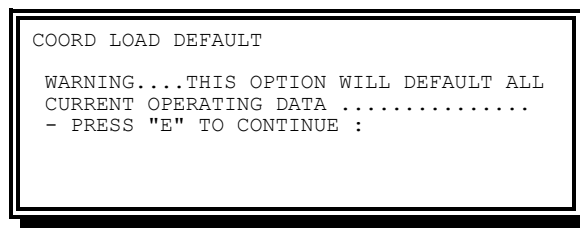
Figure 2-179. Coordination Load Default Display

2.7 Time Base Data

The Time Base Data Function allows the user to display and enter controller parameters for the following:

- View current
- Set time/date
- Schedules
- Day plans
- Actions
- Day plan copy
- Clear memory
- Dimming
- Phase Function mapping
- Special Function mapping

User access is required to enter data for these parameters. See Section 2.3 for more information on gaining access.

2.7.1 Time Base Menu

The Time Base Menu allows the user to select which Time Base parameter database to be addressed.

From the Main Menu press **6-TIME BASE DATA**.

```
TIME BASE DATA

 1-VIEW CURRENT       6-DAY PLAN COPY
 2-SET TIME/DATE      7-CLEAR MEMORY
 3-SCHEDULE           8-DIMMING
 4-DAY PLANS          9-PHS FUNC MAPPING
 5-ACTIONS            0-SPC FUNC MAPPING
```
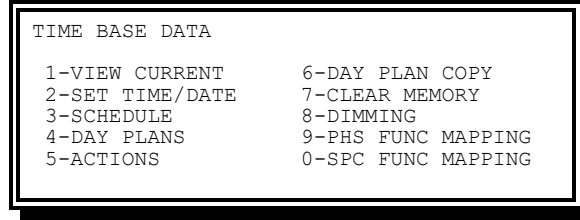
Figure 2-180. Time Base Data Menu

The Time Base Data Menu includes the following options:

- View Current – Provides viewing of the Time Base time, Date, and Event status
- Set Time/Date – Provides for setting the date, time, daylight savings, and cycle zero parameters
- Schedule – Provides viewing and editing of the Time Base schedule data
- Day Plans– Provides viewing and editing of the Time Base day plan data
- Actions– Provides viewing and editing of the Time Base action data
- Day Plan Copy– Provides for copying one Day Plan to another
- Clear Memory – Clears (zeros out) selective or all TBC event areas
- Dimming – Provides viewing and editing of the dimming parameters
- Phs Func Mapping – Provides viewing and editing of the phase function mapping parameters
- Spc Func Mapping – Provides viewing and editing of the special function mapping parameters

2.7.2   Time Base Current

The Time Base Current Display allows the user to view the current Time Base status and Control modes.

From the Time Base Menu press **1-VIEW CURRENT**.

```
TIME BASE - CURRENT
   FRI   1/ 8/21  13:37:51  STD TIME
   SCH:  1   DAY PLAN:  1  ACTION:   1
------TRAFFIC------   ----AUXILIARY----
 PATTERN.:  001        A:..*     DIM:N
 GPS A   221154 070621 D:..*
 P:******** ********   S:..******
CODES: (#)-ON  (.)-OFF  (*)-NOT DEFINED
```
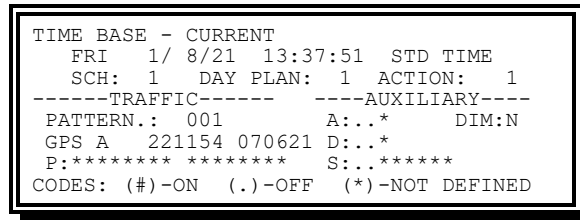
Figure 2-181. Time Base Current Display with Optional GPS

See Section 2.2.4 for details on this status screen.

2.7.3   Time Base Set Time/Date

The Time Base Set Time/Date display allows the user to modify and set the date and time within the CU.

From the Time Base Menu press **2-SET TIME/DATE**.

```
TIME BASE - SET TIME/DATE
 --DATE--  --TIME--  WEEK
 MM/DD/YY  HH:MM:SS  DAY
  6/ 9/15   9:25:39   3
 CYC ZERO:  0: 0   (00:00 HH:MM - EVENT)
 GMT DIFF:-21600   (- IS 1; CST=-21600)
```

Figure 2-182. Time Base Set Time/Date Display

The Time Base Set Time/Date Display provides the following information:

- Date MM/DD/YY – This entry establishes the current date from which the Time Base implements all Time of Year events

- Time HH:MM:SS – This entry establishes the current time from which the Time Base implements all Time-of-Day events

- Weekday – This entry displays the current day of the week from which the Time Base implements the proper Program Day. (Sunday is Day 01)

- CYC Zero (Cycle zero) – This entry establishes the Time of Day from which all Sync Reference (CYCLE ZERO,) for coordination, will be made. An entry of 24:00 establishes a midnight reference. When set at 00:00 the Sync Reference will be the time the event was initiated

- GMT DIFF (GMT Time Zone Differential) – This entry displays the differential (in seconds) between the local time and Greenwich Mean Time (GMT), also known as Universal Time (UTC)

Table 2-13. Time Zone Offsets in Seconds					
Standard Time					
Time Zones	**GMT**	**EST**	**CST**	**MST**	**PST**
Diff (hours)	0	-5	-6	-7	-8
Diff (seconds)	0	-18000	-21600	-25200	-28800

2.7.4   Schedule

The Time Base Schedule Display allows the user to view and modify the Time Base schedules programmed in the unit's Time Base database.

From the Time Base Menu press **3-SCHEDULE**.

```
TIME BASE SCHEDULE # 001
        SMTWTFS         JFMAMJJASOND
    DAY:0000000   MONTH:111111111111...
     123456789 0123456789 0123456789 01
DATE:111111111 1111111111 1111111111 11
PLAN:000

 UP/DOWN TO SCROLL              E-EDIT
```

Figure 2-183. Time Base Schedule Display

- Day – The day(s) of the week the schedule will be allowed.
    - Each field represents a specific day of the week
    - If the field is set to one, the schedule will be allowed
    - If the field is set to zero, the schedule will not be allowed
- Month – The month(s) of the year the schedule will be allowed
    - Each field represents a specific month of the year
    - If the field is set to one, the schedule will be allowed
    - If the field is zero, the schedule will not be allowed
- Date – The day(s) of the month the schedule will be allowed
    - Each field represents a specific day of the month
    - If the field is set to one, the schedule will be allowed
    - If the field is set to zero, the schedule will not be allowed
- Plan – The day plan number associated with this schedule

The CU supports 255 schedules.

The CU selects a schedule by comparing the current month (MONTH), day-of-week (DAY) and day of month (DATE) to the appropriate fields. The schedule that defines the most specific date is selected.

The CU selects the more specific schedule based on the MONTH settings. If the same, select the most specific DATE. If that is still the same, select the most specific DAY. If that is still the same, the first occurrence within the Time Base event table is selected.

Most specific means the least number of bits set within a category. All entries in the Time Base schedule table are expressed in local time and date. A schedule may be deactivated by setting the DAY, MONTH, DATE, or PLAN parameters to zero.
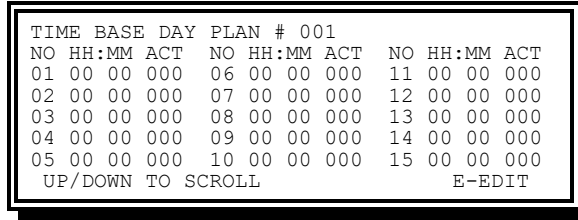
The above displays are paging screens to enable viewing all 255 schedule definitions

- Pressing UP or DOWN ARROW keys while the word E-EDIT is displayed on the bottom line will page up or down to the next screen
- Pressing ENTER in any screen enables editing in that screen
- While in the editing mode, the bottom line will note E-EXIT to note that pressing ENTER will cause an exit from edit mode to display mode

2.7.5   Day Plans

The Day Plans Display allows the user to view and modify the Day Plans in the unit's Time Base database.

From the Time Base Menu press **4-DAY PLANS**.

```
TIME BASE DAY PLAN # 001
NO HH:MM ACT   NO HH:MM ACT   NO HH:MM ACT
01 00 00 000   06 00 00 000   11 00 00 000
02 00 00 000   07 00 00 000   12 00 00 000
03 00 00 000   08 00 00 000   13 00 00 000
04 00 00 000   09 00 00 000   14 00 00 000
05 00 00 000   10 00 00 000   15 00 00 000
 UP/DOWN TO SCROLL                   E-EDIT
```

Figure 2-184. Time Base Day Plans Display

This display provides the following information:

- HH (Hour) – The Hour of the day the event will become active. Valid values for this object are 00-23
- MM (Minute) – The Minute of the hour the event becomes active. Valid values for this object are 00-59
- ACT (Action Number) – The Action Number associated with this Day Plan event

The CU supports 255 day plans.
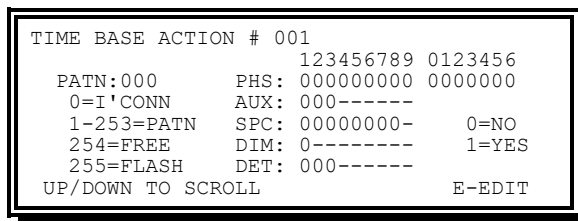
The above displays are paging screens to enable viewing all 255 day plan definitions

- Pressing UP or DOWN ARROW keys while the word E-EDIT is displayed on the bottom line will page up or down to the next screen
- Pressing ENTER in any screen enables editing in that screen
- While in the editing mode, the bottom line will note E-EXIT to note that pressing ENTER will cause an exit from edit mode to display mode

2.7.6   Actions Display

The Actions Display allows the user to view and modify the time base actions.

From the Time Base Menu press **5-ACTIONS**.

```
TIME BASE ACTION # 001
                123456789 0123456
 PATN:000      PHS: 000000000 0000000
  0=I'CONN     AUX: 000------
  1-253=PATN   SPC: 00000000-    0=NO
  254=FREE     DIM: 0--------    1=YES
  255=FLASH    DET: 000------
 UP/DOWN TO SCROLL               E-EDIT
```

Figure 2-185. Time Base Actions Display

This display provides the following information:

- PATN (Pattern) – The Pattern that is active when this action is selected

- ♦ The valid value is 000-255
- ♦ A Pattern of zero indicates that no pattern is being selected and the unit will respond to interconnect inputs
- ♦ A Pattern of 254 indicates that the unit will run Free, i.e., without coordination
- ♦ A Pattern of 255 indicates that the unit will run Remote (Automatic) Flash

- PHS (Phase Function) – The Phase Functions that are active when this Action is selected
  - ♦ Each field represents a specific Phase Function
  - ♦ If the field is set to 1, the Phase Function will be active
  - ♦ If the field is set to zero, the Phase Function will not be active
  - ♦ See Section 2.7.10 for detail on Phase Function mapping

- AUX (Auxiliary Function) – The Auxiliary Functions that are active when this action is selected
  - ♦ Each field represents a specific Auxiliary Function
  - ♦ If the field is set to 1, the Auxiliary Function will be active
  - ♦ If the field is set to zero, the Auxiliary Function will not be active

- SPC (Special Function) – The Special Functions that are active when this action is selected
  - ♦ Each field represents a specific Special Function
  - ♦ If the field is set to 1, the Special Function will be active
  - ♦ If the field is set to zero, the Special Function will not be active

- DIM (Dimming)
  - ♦ Code 0 – Establishes that Dimming will not occur
  - ♦ Code 1 – Establishes that Dimming will occur

- DET (Detector Function) – The Detector Functions that are active when this action is selected
  - ♦ D1 (Detector Diagnostic) relates to the diagnostic values found on the F-9-3-1 screens
    - Code 0 – Establishes that the Value 0 set of parameters will be used for Detector Diagnostics
    - Code 1 –Establishes that the Value 1 set of parameters will be used for Detector Diagnostics
  - ♦ D2 (System Detector Report)
    - Code 0 – Establishes that the System Detector Report will be stopped if running
    - Code 1 – This entry establishes that the System Detector Report will start. After the Start command. The report will begin at an even multiple of the

interval time (see 2.10.2.3) from 24:00 hours. The report will continue to log (repeat) until a Stop event is seen

♦ D3 (Not used)

The CU supports 255 Actions.

The above displays are paging screens to enable viewing all 255 action definitions.

- Pressing UP and DOWN ARROW keys while the word E-EDIT is displayed on the bottom line will page up or down to the next screen

- Pressing ENTER in any screen enables editing in that screen

- While in the editing mode, the bottom line will note E-EXIT to note that pressing ENTER will cause an exit from edit mode to display mode

2.7.7 Day Plan Copy

The Day Plan Copy Display allows the user to copy Day Plan events from one Day Plan to another.

From the Time Base Menu press **6-DAY PLAN COPY**.

```
TIME BASE DAY PLAN COPY

 FROM: 000   TO: 000 000 000 000 000 000

 AFTER ANY COPY, REVIEW & CHANGE THE
 NEW DAY PLANS FOR DESIRED OPERATION.
```
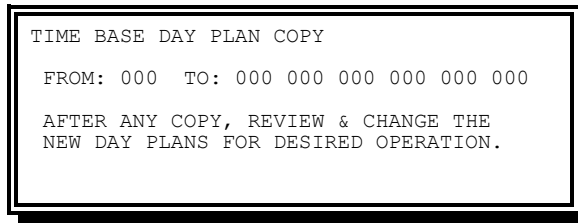
Figure 2-186. Time Base Day Plan Copy Display

NOTE: Default data is not provided.

Parameters on this display include the following:

- From – This entry (01-255) establishes the Source Day of the copy function
- To – This entry (01-255) establishes the Destination Day of the copy function
- (Clear) – To clear (delete) all events from a Day Plan set the FROM value to zero and the TO value equal to the Day Plan to clear

2.7.8 Clear Memory

The Clear Memory Display allows the user to clear (zero out) specific Time Base data.

From the Time Base Menu, press **7-CLEAR MEMORY**.

```
TIME BASE CLEAR

  CODE -     (0-ALL  1-SCHEDULE
              2-DAY PLAN  3-ACTIONS)
WARNING....THIS OPTION WILL REMOVE ALL
CURRENT OPERATING DATA................
```

Figure 2-187. Time Base Clear Display (NTCIP Only)

NOTE: Default data is not provided.

Information provided on this display includes the following:

- Code 0 (All) – Clears (sets default) all TBC data

- Code 1 (Schedule) – Clears Schedule data

- Code 2 (Day Plan) – Clears Day Plan data

- Code 3 (Actions) – Clears Action data

When Time Base starts running an event, it continues to run that event until it encounters a new event to run. Therefore, clearing the Time Base events will not stop Time Base from continuing to run the event which was in effect.

2.7.9   TBC Dimming

The TBC Dimming Display allows the user to view and modify the load switch outputs that are affected by the Dimming function.

From the Time Base Menu, press **8-DIMMING**.

```
TIME BASE DIMMING          (0-NO/1-YES)

LDSW:123456789 0123456789 0123456789 012
 RED:000000000 0000000000 0000000000 000
 YEL:000000000 0000000000 0000000000 000
 GRN:000000000 0000000000 0000000000 000
 ALT:000000000 0000000000 0000000000 000
```

Figure 2-188. Time Base Dimming Display

Information provided on this display includes the following:

- Dim Red

  - Code 0 (No) – Establishes the load switch Red output will not be dimmed

  - Code 1 (Yes) – Establishes the load switch Red output will be dimmed

- Dim Yel

  - Code 0 (No) – Establishes the load switch Yellow output will not be dimmed

  - Code 1 (Yes) – Establishes the load switch Yellow output will be dimmed

- Dim Grn

  - Code 0 (No) – Establishes the load switch Green output will not be dimmed

♦ Code 1 (Yes) –Establishes the load switch Green output will be dimmed

- Dim Alt

    ♦ Code 0 (No) – Establishes the load switch outputs will be dimmed by removing the positive half cycle

    ♦ Code 1 (Yes) – Establishes the load switch output will be dimmed by removing the negative half cycle

2.7.10   TBC Phase Function Mapping

The Time Base Phase Function Mapping Display allows the user to view and modify the Mapping of Function-to-Control.

From the Time Base Menu press **9-PHS FUNC MAPPING**.

```
TIME BASE PHS FUNC MAPPING
                 PHS FUNC SEL(0-OFF/1-ON)
 NUM..P-FUNCT NAME.....123456789 0123456
   1  PHS-01 MAX # 2   000000000 0000000
   2  PHS-02 MAX # 2   000000000 0000000
   3  PHS-03 MAX # 2   000000000 0000000
   4  PHS-04 MAX # 2   000000000 0000000
UP/DOWN TO SCROLL              E-EDIT
```

Figure 2-189. Time Base Phase Function Mapping Display

The above display is a paging screen to enable viewing all 192 functions that may be mapped to one or more of the Phase Functions. It is possible to map more than one function to the same logical control (for example, PHS-01 MAX # 2 through PHS-16 MAX # 2 may be mapped to the logical control of PHS FUNC 1). Enter a 1 to enable the respective function to become active when the control is requested.

- Pressing A or B while the word E-EDIT is displayed on the bottom line will page up or down to the next screen

- Pressing the UP and DOWN ARROW keys will move the cursor one line at a time

- Pressing E in any screen enables editing in that screen

- While in the editing mode, the bottom line will note E-EXIT to note that pressing E will cause an exit from edit mode to display mode

- While in the edit mode, an entry in the NUM field will cause the display to place that function on the cursor line

Coordination timing plans duplicate some TBC Phase Functions. Therefore, when coordination is running, the following TBC Phase Functions will not have an impact:

PHS-## MAX # 2   PHS-## MAX REC

PHS-## PHS OMT   PHS-## MIN REC

PHS-## PED OMT   PHS-## PED REC

The following list the available Phase Functions and their default programming.

2.7.10.1　　　　　　　　PHS-## MAX # 2

```
 1  PHS-01 MAX # 2    000000000 0000000
 2  PHS-02 MAX # 2    000000000 0000000
 3  PHS-03 MAX # 2    000000000 0000000
 4  PHS-04 MAX # 2    000000000 0000000
 5  PHS-05 MAX # 2    000000000 0000000
 6  PHS-06 MAX # 2    000000000 0000000
 7  PHS-07 MAX # 2    000000000 0000000
 8  PHS-08 MAX # 2    000000000 0000000
 9  PHS-09 MAX # 2    000000000 0000000
10  PHS-10 MAX # 2    000000000 0000000
11  PHS-11 MAX # 2    000000000 0000000
12  PHS-12 MAX # 2    000000000 0000000
13  PHS-13 MAX # 2    000000000 0000000
14  PHS-14 MAX # 2    000000000 0000000
15  PHS-15 MAX # 2    000000000 0000000
16  PHS-16 MAX # 2    000000000 0000000
```

Figure 2-190. PHS-## Max # 2

PHS MAX # 2 causes Maximum # 2 to be operational on a specific Phase (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track.

2.7.10.2　　　　　　　　PHS-## PHS OMT

```
17  PHS-01 PHS OMT    000000000 0000000
18  PHS-02 PHS OMT    000000000 0000000
19  PHS-03 PHS OMT    000000000 0000000
20  PHS-04 PHS OMT    000000000 0000000
21  PHS-05 PHS OMT    000000000 0000000
22  PHS-06 PHS OMT    000000000 0000000
23  PHS-07 PHS OMT    000000000 0000000
24  PHS-08 PHS OMT    000000000 0000000
25  PHS-09 PHS OMT    000000000 0000000
26  PHS-10 PHS OMT    000000000 0000000
27  PHS-11 PHS OMT    000000000 0000000
28  PHS-12 PHS OMT    000000000 0000000
29  PHS-13 PHS OMT    000000000 0000000
30  PHS-14 PHS OMT    000000000 0000000
31  PHS-15 PHS OMT    000000000 0000000
32  PHS-16 PHS OMT    000000000 0000000
```

Figure 2-191. PHS-## PHS OMT

PHS-## PHS OMIT prevents vehicle and pedestrian service on a specific Phase (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track.

2.7.10.3　　　　　　　　PHS-## PED OMT

```
33  PHS-01 PED OMT    000000000 0000000
34  PHS-02 PED OMT    000000000 0000000
35  PHS-03 PED OMT    000000000 0000000
36  PHS-04 PED OMT    000000000 0000000
37  PHS-05 PED OMT    000000000 0000000
38  PHS-06 PED OMT    000000000 0000000
39  PHS-07 PED OMT    000000000 0000000
40  PHS-08 PED OMT    000000000 0000000
41  PHS-09 PED OMT    000000000 0000000
42  PHS-10 PED OMT    000000000 0000000
43  PHS-11 PED OMT    000000000 0000000
44  PHS-12 PED OMT    000000000 0000000
45  PHS-13 PED OMT    000000000 0000000
46  PHS-14 PED OMT    000000000 0000000
47  PHS-15 PED OMT    000000000 0000000
48  PHS-16 PED OMT    000000000 0000000
```

Figure 2-192. PHS-## PED OMT

PHS-## PED OMIT prevents Pedestrian service on a specific Phase (01-16) when a TBC traffic event calls a Phase Function it is programmed to track.

2.7.10.4 PHS-## MAX REC

```
49  PHS-01 MAX REC   000000000 0000000
50  PHS-02 MAX REC   000000000 0000000
51  PHS-03 MAX REC   000000000 0000000
52  PHS-04 MAX REC   000000000 0000000
53  PHS-05 MAX REC   000000000 0000000
54  PHS-06 MAX REC   000000000 0000000
55  PHS-07 MAX REC   000000000 0000000
56  PHS-08 MAX REC   000000000 0000000
57  PHS-09 MAX REC   000000000 0000000
58  PHS-10 MAX REC   000000000 0000000
59  PHS-11 MAX REC   000000000 0000000
50  PHS-12 MAX REC   000000000 0000000
61  PHS-13 MAX REC   000000000 0000000
62  PHS-14 MAX REC   000000000 0000000
63  PHS-15 MAX REC   000000000 0000000
64  PHS-16 MAX REC   000000000 0000000
```

Figure 2-193. PHS-XX MAX REC

PHS-## MAX REC initiates a Maximum Vehicle Recall on a specific Phase (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track.

2.7.10.5 PHS-## MIN REC

```
65  PHS-01 MIN REC   000000000 0000000
66  PHS-02 MIN REC   000000000 0000000
67  PHS-03 MIN REC   000000000 0000000
68  PHS-04 MIN REC   000000000 0000000
69  PHS-05 MIN REC   000000000 0000000
70  PHS-06 MIN REC   000000000 0000000
71  PHS-07 MIN REC   000000000 0000000
72  PHS-08 MIN REC   000000000 0000000
73  PHS-09 MIN REC   000000000 0000000
74  PHS-10 MIN REC   000000000 0000000
75  PHS-11 MIN REC   000000000 0000000
76  PHS-12 MIN REC   000000000 0000000
77  PHS-13 MIN REC   000000000 0000000
78  PHS-14 MIN REC   000000000 0000000
79  PHS-15 MIN REC   000000000 0000000
80  PHS-16 MIN REC   000000000 0000000
```

Figure 2-194. PHS-## MIN REC

PHS-## MIN REC initiates a Minimum Vehicle Recall on a specific Phase (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track.

2.7.10.6 PHS-## PED REC

```
81  PHS-01 PED REC   000000000 0000000
82  PHS-02 PED REC   000000000 0000000
83  PHS-03 PED REC   000000000 0000000
84  PHS-04 PED REC   000000000 0000000
85  PHS-05 PED REC   000000000 0000000
86  PHS-06 PED REC   000000000 0000000
87  PHS-07 PED REC   000000000 0000000
88  PHS-08 PED REC   000000000 0000000
89  PHS-09 PED REC   000000000 0000000
90  PHS-10 PED REC   000000000 0000000
91  PHS-11 PED REC   000000000 0000000
92  PHS-12 PED REC   000000000 0000000
93  PHS-13 PED REC   000000000 0000000
94  PHS-14 PED REC   000000000 0000000
95  PHS-15 PED REC   000000000 0000000
96  PHS-16 PED REC   000000000 0000000
```

Figure 2-195. PHS-## PED REC

PHS-## PED REC initiates a Pedestrian Recall on a specific Phase (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track.

2.7.10.7   DET-## SW OMIT

```
 97  DET-01 SW OMIT    000000000 0000000
 98  DET-02 SW OMIT    000000000 0000000
 99  DET-03 SW OMIT    000000000 0000000
100  DET-04 SW OMIT    000000000 0000000
101  DET-05 SW OMIT    000000000 0000000
102  DET-06 SW OMIT    000000000 0000000
103  DET-07 SW OMIT    000000000 0000000
104  DET-08 SW OMIT    000000000 0000000
105  DET-09 SW OMIT    000000000 0000000
106  DET-10 SW OMIT    000000000 0000000
107  DET-11 SW OMIT    000000000 0000000
108  DET-12 SW OMIT    000000000 0000000
109  DET-13 SW OMIT    000000000 0000000
110  DET-14 SW OMIT    000000000 0000000
111  DET-15 SW OMIT    000000000 0000000
112  DET-16 SW OMIT    000000000 0000000
```

Figure 2-196. DET-## SW OMIT

DET-## SW OMIT (Detector Switch Omit) prevents an otherwise allowable switch operation from occurring on a specific vehicle detector (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track.

- During a DET SW OMIT period, the detector stays as an active input to its valid (can be serviced normally) assigned phase and no switch is done

- A DET SW OMIT period may not begin or end when the switched phase is Green

2.7.10.8   DET-## SW NOW

```
113  DET-01 SW NOW    000000000 0000000
114  DET-02 SW NOW    000000000 0000000
115  DET-03 SW NOW    000000000 0000000
116  DET-04 SW NOW    000000000 0000000
117  DET-05 SW NOW    000000000 0000000
118  DET-06 SW NOW    000000000 0000000
119  DET-07 SW NOW    000000000 0000000
120  DET-08 SW NOW    000000000 0000000
121  DET-09 SW NOW    000000000 0000000
122  DET-10 SW NOW    000000000 0000000
123  DET-11 SW NOW    000000000 0000000
124  DET-12 SW NOW    000000000 0000000
125  DET-13 SW NOW    000000000 0000000
126  DET-14 SW NOW    000000000 0000000
127  DET-15 SW NOW    000000000 0000000
128  DET-16 SW NOW    000000000 0000000
```

Figure 2-197. DET-## SW NOW

DET-## SW NOW (Detector Switch Now) causes the switch operation to occur immediately on a specific vehicle detector (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track.

- This function is disabled when SCOOT or UTCS are in control

- During a DET SW NOW period the detector stays as an active input to its valid (can be serviced normally) switched phase

- During a DET SW NOW period a switch is precluded if the assigned Phase is currently Green

- During a DET SW NOW period DET Delay timing is done only if both the assigned Phase and the switched phase are not Green.

- A DET SW NOW period may not begin or end when the switched phase is Green.

2.7.10.9 DET-## SW ALSO

```
129   DET-01 SW ALSO    000000000 0000000
130   DET-02 SW ALSO    000000000 0000000
131   DET-03 SW ALSO    000000000 0000000
132   DET-04 SW ALSO    000000000 0000000
133   DET-05 SW ALSO    000000000 0000000
134   DET-06 SW ALSO    000000000 0000000
135   DET-07 SW ALSO    000000000 0000000
136   DET-08 SW ALSO    000000000 0000000
137   DET-09 SW ALSO    000000000 0000000
138   DET-10 SW ALSO    000000000 0000000
139   DET-11 SW ALSO    000000000 0000000
140   DET-12 SW ALSO    000000000 0000000
141   DET-13 SW ALSO    000000000 0000000
142   DET-14 SW ALSO    000000000 0000000
143   DET-15 SW ALSO    000000000 0000000
144   DET-16 SW ALSO    000000000 0000000
```

Figure 2-198. DET-## SW ALSO

DET-## SW ALSO (Detector Switch Also) will cause the calls from a specific vehicle detector (01-16) to occur on both the assigned and switched phases simultaneously when a TBC Traffic event calls a Phase Function it is programmed to track.

- This function is disabled when SCOOT or UTCS are in control

- During a DET SW ALSO period, the assigned detector is processed as though no switch was programmed but the assigned phase call is placed on the Switched Phase Also

- A DET SW ALSO period may not begin or end when the switched phase is Green

- The hierarchy for the above detector options are:

  ♦ Detector Switch Omit

  ♦ Detector Switch Also

  ♦ Detector Switch Now

2.7.10.10 OVERLAP # OMIT

```
145   OVERLAP A OMIT    000000000 0000000
146   OVERLAP B OMIT    000000000 0000000
147   OVERLAP C OMIT    000000000 0000000
148   OVERLAP D OMIT    000000000 0000000
149   OVERLAP E OMIT    000000000 0000000
150   OVERLAP F OMIT    000000000 0000000
151   OVERLAP G OMIT    000000000 0000000
152   OVERLAP H OMIT    000000000 0000000
153   OVERLAP I OMIT    000000000 0000000
154   OVERLAP J OMIT    000000000 0000000
155   OVERLAP K OMIT    000000000 0000000
156   OVERLAP L OMIT    000000000 0000000
157   OVERLAP M OMIT    000000000 0000000
158   OVERLAP N OMIT    000000000 0000000
159   OVERLAP O OMIT    000000000 0000000
160   OVERLAP P OMIT    000000000 0000000
```

Figure 2-199. OVERLAP # OMIT

OVERLAP # OMIT causes a specific overlap (A-P) to remain Red (or Don't Walk) once it is Red (omit Green and Yellow) or in Don't Walk when a TBC Traffic event calls a Phase Function it is programmed to track.

- An Overlap omit period will start when the overlap is in an inactive Red state (not until Green and all Yellow and Red timing required by included phases is complete) or

for Ped Overlaps in an inactive Don't Walk state (when all Walk and Ped Clear timing required is complete). For a standard Overlap programmed for Minus Green operation, the Red during the Minus Green period does not constitute an inactive Red state

- Following an Overlap Omit period, an Overlap Green/Walk will be precluded until the start of an included Phase Green

- Overlap Omit precludes in-cycle Fast Flashing Green displays. Following an Overlap Omit period, an Overlap Fast Flashing Green or steady Green will be precluded until the start of an included Phase Green

- Overlap Omit precludes in-cycle Flashing Red displays. Following an Overlap Omit period, a Flashing Red is precluded until the start of a Phase Green, which would not produce a Flashing Red display

- During Preempt, overlaps that are part of cyclic operation process Overlap Omit during normal operation

- During Preempt, overlaps that are not part of cyclic operation provide displays as required by programming. However, if the Overlap Omit would be active upon exit from PE, the Overlap will clear to Red and be in the omitted state upon return to normal (even if the exit phase is an overlap included phase)

- During the Start Sequence (power on or external start), if an Overlap would be omitted in the phase(s) following start up, the Overlap will remain Red during the Start Up period

2.7.10.11　　　　　PHS-## BIK REC

```
161  PHS-01 BIK REC    000000000 0000000
162  PHS-02 BIK REC    000000000 0000000
163  PHS-03 BIK REC    000000000 0000000
164  PHS-04 BIK REC    000000000 0000000
165  PHS-05 BIK REC    000000000 0000000
166  PHS-06 BIK REC    000000000 0000000
167  PHS-07 BIK REC    000000000 0000000
168  PHS-08 BIK REC    000000000 0000000
169  PHS-09 BIK REC    000000000 0000000
170  PHS-10 BIK REC    000000000 0000000
171  PHS-11 BIK REC    000000000 0000000
172  PHS-12 BIK REC    000000000 0000000
173  PHS-13 BIK REC    000000000 0000000
174  PHS-14 BIK REC    000000000 0000000
175  PHS-15 BIK REC    000000000 0000000
176  PHS-16 BIK REC    000000000 0000000
```

Figure 2-200. PHS-## BIK REC

PHS-## BIK REC initiates a Bicycle Recall on a specific Phase (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track.

2.7.10.12   PHS-## CRD RSV

```
177  PHS-01 CRD RSV    000000000 0000000
178  PHS-02 CRD RSV    000000000 0000000
179  PHS-03 CRD RSV    000000000 0000000
180  PHS-04 CRD RSV    000000000 0000000
181  PHS-05 CRD RSV    000000000 0000000
182  PHS-06 CRD RSV    000000000 0000000
183  PHS-07 CRD RSV    000000000 0000000
184  PHS-08 CRD RSV    000000000 0000000
185  PHS-09 CRD RSV    000000000 0000000
186  PHS-10 CRD RSV    000000000 0000000
187  PHS-11 CRD RSV    000000000 0000000
188  PHS-12 CRD RSV    000000000 0000000
189  PHS-13 CRD RSV    000000000 0000000
190  PHS-14 CRD RSV    000000000 0000000
191  PHS-15 CRD RSV    000000000 0000000
192  PHS-16 CRD RSV    000000000 0000000
```

Figure 2-201. PHS-## CRD RSV

PHS-## CRD RSV initiates the Re-Service in Coordination Function for Sequential Omit coordination during on a specific Phase (01-16) when a TBC Traffic event calls a Phase Function it is programmed to track. See the Phase Re-Service in Coordination application note.

2.7.10.12.1   Application Note: Re-service in Coordination

<u>Designation of Re-service Phases</u>

Re-Service in Coordination is provided by a revision of Conditional Service but the existing designation of a phase as a Conditional Service phase has no impact in Coordination. The designation of candidates for Coordination Re-Service Select Phases is designated in an addition of 16 Phase Modes. These new Selectors are not selected via the standard Phase Mode Selectors but are only active when an applicable Special Function Selector is active. All Special Function Selectors yield the Re-Service Select Phases under the same numbered Phase Function Selectors.

The first page of the Coord Re-Service Phase selection of the TBC Phase Function mapping appears as follows:

```
TIME BASE PHS FUNC MAPPING
              PHS FUNC SEL(0-OFF/1-ON)
 NUM..P-FUNCT NAME.....123456789 0123456
 177  PHS-01 CRD RSV   100000000 0000000
 178  PHS-02 CRD RSV   000000000 0000000
 179  PHS-03 CRD RSV   100000000 0000000
 180  PHS-04 CRD RSV   000000000 0000000
UP/DOWN TO SCROLL                 E-EDIT
```

Figure 2-202. Phases 1 and 3 selected for Re-Service

Note: Phases 1 and 3 are selected as Re-Service Phases when Special Function 1 selector is active.

<u>Coordination Changes for Re-Service</u>

Because Coordination needs to restrict the phases available for Re-service, any Coord Mode which permits ready access to phases forward of the active phases is not suitable for Coord Re-Service. With this in mind, <u>*the availability of Re-Service is restricted to a modified operation of Sequential Omit Coord Mode*</u>. If Sequential Omit mode is selected as the active

Coord Mode either by its selection as the overall Coord Mode or as the active Coord Mode under the active Coord Plan's special Coord Mode selection, the operation of Sequential Omit Mode is modified by the any active Coord Re-Service phases.

When some phases are selected as Re-Service phases, Sequential Omit mode removes the Coord omits (opening phases for prospective service) by entire compatibility groups, rather than phase-by-phase. The exception to this is that the Coord Phases will not be "un-omitted" early.

A sample of what Coordination data changes might provide Re-Service is shown by the following Coord data screens:

```
COORD SETUP  .0. .1. .2. .3. .4. .5. .6.
 OPERATION:1 FRE AUT MAN --- --- --- ---
      MODE:4 PRM YLD PYL POM SOM FAC MUT
      MAX :2 INH MX1 MX2 --- --- --- ---
CORRECTION:0 DWL MDW SWY SW+ SW2 --- ---
    OFFSET:0 BEG END OF GREEN
     FORCE:0 PLN CYCLE TIME
        MX DWELL: 0 YIELD PERIOD: 0
```

Figure 2-203. The Mode Field Set to Sequential Omit

Note that this picture of the Coord Setup, the Mode field is set to SOM (Sequential Omit).

```
PATTERN DATA

    PATTERN: 001   CYCLE LENGTH:  100
                   CYCLE - SPLITS:  20

       A - SPLIT PARAMETERS
       B - PATTERN PARAMETERS
```

Figure 2-204. Extra Split Time

Note that in this screen, it indicates that there are 20 seconds extra time in the cycle (CYCLE – PHASES). This provides an additional 20 seconds which are distributed to the non-Coord Phases in the cycle in order to provide for the extension of the Coord Phases. This time allows additional time for the Re-Service operation but is not strictly required.

```
PATTERN 001 PARAMETERS
    COORD MODE: 0     TIME OFFSET:  0
      MAX MODE: 0       SEQUENCE:   0
     CORR MODE: 0
  COORD OFFSET: 0            R2 LAG:
    FORCE MODE: 0            R3 LAG:
     SPEC FUNC: 1            R4 LAG:
```

Figure 2-205. Special Function Set

Note that the plan Special Function Selector is 1 which will activate the selection of the odd phases (1, 3, 5, and 7) as available Re-Service Phases.

```
PATTERN 001 SPLITS
PHASE......1...2...3...4...5...6...7...8
 TIME..:  15  25  15  25  15  25  15  25
 MODE..:   0   1   0   0   0   1   0   0
   MODE: 0-7=AP/CP/VR/XR/PR/XPR/PO/DCP
 P.RED.:   0   0   0   0   0   0   0   0
 P.EXT.:   0   0   0   0   0   0   0   0
```

Figure 2-206. Generic Coordination Plan

Note that this is fairly generic Coord Plan phase data.

Return service to Re-Service Phases is only provided when Coordination is preventing service forward. In non-Coord Phases, this occurs when the last phase in a ring within a compatibility group has received service and no reason (e.g., GAP not expired) exists to keep the phase Green. In addition, there must be sufficient time before the application of a Force Off to accommodate leaving the current Green and serving the Minimum Green on the Re-Service Phase.

In Coord Phases, the extension of the Green provided under the "Yield" function of Sequential Omit must be active for the other ring to provide Re-Service. Only this extension of a Coord Phase's Green will prevent the servicing of the next phase in the sequence and thus prohibit Re-Service. Once a ring is engaged in providing Re-Service, the Gap Out of the phase whose extension made that Re-Service possible will allow that ring to begin a Re-Service.

An example of this follows using the Coord data shown above: Phases 2 & 6 (the Coord Phases) reach their yield points, but Phase 2 has an active vehicle call forcing the phase's extension. Phase 6 may provide Re-Service to phase 5 which has been designated as a Re-Service phase. Once the transition to Phase 5 begins, the call extending phase 2 is removed and the phase gaps out. Phase 1 then may be serviced via Re-Service.

Re-Service phases will only be provided their Minimum Green service. This might allow cycling between the last phase in a ring within a compatibility group and a designated Re-Service Phase if there is sufficient time in the Coord Plan and the Minimum Green times are small enough.

2.7.11   TBC Special Function Mapping

The Time Base Special Function Mapping display allows the user to view and modify the mapping of function-to-control.

Coordination timing plans duplicate some TBC Phase Functions. Therefore, when coordination is running, the following TBC Phase Functions will not have an impact:

PHS-## MAX # 2   PHS-## MAX REC

PHS-## PHS OMT   PHS-## MIN REC

PHS-## PED OMT   PHS-## PED REC

From the Time Base Menu, press **0-SPC FUNC MAPPING**.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
SPEC FUNCTION 1         10000000 00000000
SPEC FUNCTION 2         01000000 00000000
SPEC FUNCTION 3         00100000 00000000


 UP/DOWN TO SCROLL
```

Figure 2-207. Time Base Special Function Mapping Display

```
SPEC FUNCTION 1        10000000 00000000
SPEC FUNCTION 2        01000000 00000000
SPEC FUNCTION 3        00100000 00000000
SPEC FUNCTION 4        00010000 00000000
SPEC FUNCTION 5        00001000 00000000
SPEC FUNCTION 6        00000100 00000000
SPEC FUNCTION 7        00000010 00000000
SPEC FUNCTION 8        00000001 00000000
SYSTEM BANK 2          00000000 00000000
SYSTEM BANK 3          00000000 00000000
SYSTEM BANK 4          00000000 00000000
NON-ACTUATED 1         00000000 00000000
NON-ACTUATED 2         00000000 00000000
RESERVED               00000000 00000000
DISABLE PROT/PERM OMIT 00000000 00000000
PHASE 2 SIGN CONTROL   00000000 00000000
PHASE 4 SIGN CONTROL   00000000 00000000
PHASE 6 SIGN CONTROL   00000000 00000000
PHASE 8 SIGN CONTROL   00000000 00000000
TX DIAMOND - FOUR  PH  00000000 00000000
TX DIAMOND - THREE PH  00000000 00000000
TX DIAMOND - SEPARATE  00000000 00000000
QUE1/LVL1 CONTROLS     00000000 00000000
QUE1/LVL2 CONTROLS     00000000 00000000
QUE2/LVL1 CONTROLS     00000000 00000000
QUE2/LVL2 CONTROLS     00000000 00000000
OLI-P FL G 150f        00000000 00000000
OLI-P FL R PHS         00000000 00000000
RESERVED               00000000 00000000
COORD ADAPTIVE SPLIT   00000000 00000000
SPC 1-16>PHS FUNC 1-16 00000000 00000000
SPC 1- 8>PHS FUNC 9-16 00000000 00000000
PHASE BANK 2           00000000 00000000
PHASE BANK 3           00000000 00000000
PHASE BANK 4           00000000 00000000
PRIORITY BANK 2        00000000 00000000
PRIORITY BANK 3        00000000 00000000
PRIORITY BANK 4        00000000 00000000
OLI-P FL G 100f        00000000 00000000
UNIT BANK 2            00000000 00000000
UNIT BANK 3            00000000 00000000
UNIT BANK 4            00000000 00000000
```

Figure 2-208. Special Function Mapping Example

Note: Default shown.

Information provided in this display includes the following:

- Adaptive Protected/Permissive (See Chapter 8)
  - Disable Prot/Perm Omits
- Lane Usage Sign Control (See Chapter 9)
  - Phase 2 Sign Control
  - Phase 4 Sign Control
  - Phase 6 Sign Control

- ♦ Phase 8 Sign Control
- TX Diamond intersection control (See Chapter 10)
    - ♦ TX Diamond – Four Phase
    - ♦ TX Diamond – Three Phase
    - ♦ TX Diamond – Separate
- Queue/Level Traffic Responsive (See 2.10.2)
    - ♦ QUE1/LVL1 Controls
    - ♦ QUE1/LVL2 Controls
    - ♦ QUE2/LVL1 Controls
    - ♦ QUE2/LVL2 Controls
- In Cycle Flashing Signals (See Chapter 6)
    - ♦ Flashing Greens (150 fpm)
    - ♦ Flashing Greens (100 fpm)
    - ♦ Flashing Reds (60 fpm)
- Coordinated Adaptive Split (See Section 3.8.6.1)
    - ♦ Coord Adaptive Split
- Special to Phase function Mapping (See 2.7.11.1 below)
    - ♦ SPC 1-16>PHS FUNC 1-16
    - ♦ SPC 1- 8>PHS FUNC 9-16
- Phase Bank Control
    - ♦ Phase Bank 2
    - ♦ Phase Bank 3
    - ♦ Phase Bank 4
- Priority Bank Control
    - ♦ Priority Bank 2
    - ♦ Priority Bank 3
    - ♦ Priority Bank 4
- Unit Bank Control
    - ♦ Unit Bank 2
    - ♦ Unit Bank 3
    - ♦ Unit Bank 4
- System Bank Control
    - ♦ System Bank 2
    - ♦ System Bank 3
    - ♦ System Bank 4
- Non-Actuated Control

♦   Non-Actuated 1

♦   Non-Actuated 2

2.7.11.1   SPC 1-8 AS PHS FUNC #-#

This feature allows any Special Function control to also set a phase function control. Therefore, providing Phase Functions controls independent of pattern/free modes.

- SPC 1-16 AS PHS FUNC 1- 16 – Provides the capability of Special Function 1 through 16 controls also setting Phase Function 1 through 16 controls

- SPC 1-8 AS PHS FUNC 9- 16 – Provides the capability of Special Function 1 through 8 controls also setting Phase Function 9 through 16 controls

The above programming causes Phase Function 1 to be set every time Special Function 1 is set. Also, Phase Function 10 is set every time Special Function 2 is set.

TBC Traffic events that set Phase Function controls are assumed to occur at times other than when the event calls for a pattern (free mode modifiers).

TBC Auxiliary events that set Special Function controls are independent of pattern/free modes.

It is possible to map more than one function to the same logical control (for example, Spec Function 1 through Spec Function 8 may be mapped to the logical control of SPC FUNC 1). Enter a 1 to enable the respective function to become active when the control is requested.

2.8 Preempt Data

2.8.1   Preempt Data

Preempt Data allows the user to display and enter controller parameters for the following:

- Overriding Flash and other Preempts
- Preempt 1-12 parameters
- Load Preempt default data

User Access is required to enter data for these parameters. See 2.3 for more information on gaining Access.

2.8.2   Preempt Data Menu

The Preempt Data Menu (Figure 2-209.) allows the user to select which Preempt parameter database to be addressed.

From the Main Menu (Figure 2-1), press **7-PREEMPT DATA**.

```
PREEMPTS

1-PREEMPT 1  5-PREEMPT 5  9-PREEMPT  9
2-PREEMPT 2  6-PREEMPT 6  A-PREEMPT 10
3-PREEMPT 3  7-PREEMPT 7  B-PREEMPT 11
4-PREEMPT 4  8-PREEMPT 8  C-PREEMPT 12


   0-OVERRIDES       D-DEFAULT DATA
```
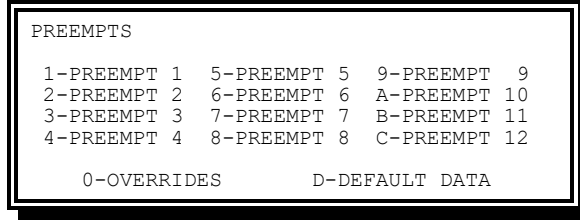
Figure 2-209. Preempt Data Menu

The Preempt Data Menu includes the following options:

Preempt 1-12 provides viewing and editing of Preemption 1-12 parameters respectively

Overrides – Provides viewing and editing of priorities of Preempts over Automatic Flash, other Preempts, and Priorities

Load Default – Provides for loading the Preempt default parameter set as the active database

2.8.3 Preempt Overrides

The Preempts Overrides Display (Figure 2-210.) allows the user to view and modify Preempt priority over one another as well as overriding Automatic Flash.

From the Preempt Data Menu (Figure 2-209.), press **0-OVERRIDES**.

```
PREEMPT OVERRIDES
 PREEMPT.....1.2.3.4.5.6.7.8.9.0.1.2
  OV FLSH:   1 1 1 1 1 1 1 1 1 1 1 1
  OV PE+1:   1 1 1 1 1 1 1 1 1 1 1 -
  OV  PRI:   1 1 0 0 0 0 0 0 0 0 0 0

      OV CODE: 0 - NO / 1 - YES
```
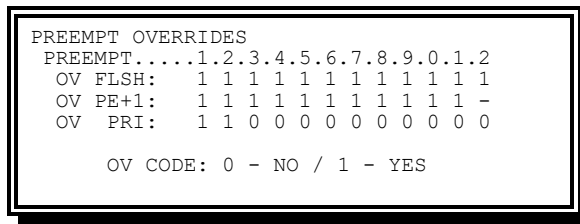
Figure 2-210. Preempt Data Display

The information provided on this display includes the following:

- OV FLSH (Override Flash)
    - Code 0 (No)
    - Code 1 (Yes) – This preempt overrides automatic flash
- OV PE+1 (Override Preempt # + 1)
    - Code 0 (No)
    - Code 1 (Yes) – This preempt overrides the next higher numbered Preempt
- OV PRI (Preempt Overrides Priorities)
    - Code 0 (No) – This Preempt will wait for any active Priority service to finish
    - Code 1 (Yes) – This Preempt overrides an active Priority service, serving Minimum times but Re-Servicing the Priority after the Preempt is over

Note: By default, preempts 3-12 will not override a running priority

2.8.4   Preempt # Menu

The Preempt # Menu (Figure 2-211.) allows the user to select which Preempt parameters to be viewed or modified.

From the Preempt Data Menu (Figure 2-209.), press **1-PREEMPT 1**.

```
PREEMPT 1

 1-MISCELLANEOUS        4-PEDEST. STATUS
 2-INTERVAL TIMES       5-OVERLAP STATUS
 3-VEHICLE STATUS
```
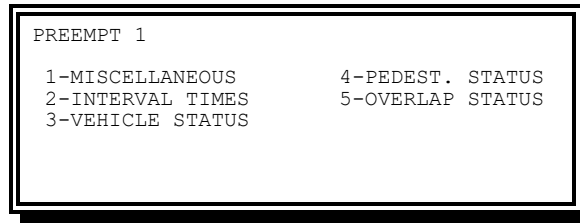
Figure 2-211. Preempt 1 Menu

Options provided on the Preempt # menu include the following:

- Miscellaneous – Provides viewing and editing of basic parameters
- Interval Times – Provides viewing and editing of interval times
- Vehicle Status – Provides viewing and editing of Phase vehicle load switch driver status parameters for the Track Green and Dwell intervals, and Vehicle Dwell Cycling
- Pedest. Status – Provides viewing and editing of Phase Pedestrian load switch driver status parameters for the Track Green and Dwell intervals, and Pedestrian Dwell Cycling
- Overlap Status – Provides viewing and editing of Overlap load switch driver status parameters for the Track Green and Dwell intervals, and Overlap Cycling

2.8.4.1   Preempt # Miscellaneous

The Preempt # Miscellaneous Data Display (Figure 2-212.) allows the user to view and modify the basic parameters for the Preempt.

From the Preempt # Menu (Figure 2-211.), press **1-MISCELLANEOUS.**

```
PREEMPT 1 MISC DATA           TEST : 0
DET: 248  DELAY:  0  MXCAL:  0  DB/10: 0
NLOCK: 0  EXTND:  0  L OUT:  0  SRMOD: 0
LINK#: 0  DURAT:  0  GATE :  0  R2C  : 0
PHASE....1.2.3.4.5.6.7.8.9.0.1.2.3.4.5.6
 EXIT     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 CALLS    0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```
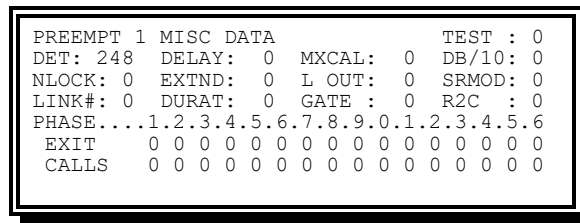
Figure 2-212. Preempt 1 Miscellaneous Data Display

Information provided on this display includes the following:

- Test (PE test) – This option is not allowed during Startup Flash
  - Code 0 (No)
  - Code 1 (Yes) – Provides a means to momentarily request a Preempt routine for testing of programming and operation

- DET (PE Detector) – Establishes the detector that this Preempt will use. Any Vehicle, Special, or Pedestrian detector may be used, or the standard Preempt detector inputs provided by the traffic cabinet by using the following codes:
    - Code 0 – No Detector assigned for this (may still be called by Preempt Linking or Peer-to-Peer Input Function)
    - Code 1-64 – Vehicle Detector 1-64
    - Code 65-72 – Special Detector 1-8
    - Code 73-80 – Pedestrian Detector 1-8
    - Code 248 – PE1 Input
    - Code 249 – PE2 Input
    - Code 250 – PE3 Input
    - Code 251 – PE4 Input
    - Code 252 – PE5 Input
    - Code 253 – PE6 Input
- NLock (PE Non-Locking Memory)
    - Code 0 (No)
    - Code 1 (Yes) – Establishes that the Preempt detector memory is Non-Locking
- Link# (PE Link to PE #) – Establishes the higher priority Preempt routine that is to be linked to this Preempt routine
    - This link provides an automatic call at the end of the Dwell time for the higher priority routine and will maintain that call for the demand of the original Preempt routine
    - When the link value equals this Preempt (Preempt 1 linked to Preempt 1), a constant input actuation will place a call for the Transit Priority routine
    - Any other entry that is not a higher priority preempt routine will be ignored
- Delay (PE delay) – 0-999 seconds
    - The time the Preempt input will be active prior to initiating any Preempt sequence. A non-locking Preempt input that is removed prior to the completion of this time will not cause a Preempt sequence to occur
- Extnd (PE Extend) – 0-999 seconds
    - The time the preempt actuation (call duration) is extended from the point of termination of the actuation
- Durat (PE Duration) – 0-999 seconds
    - The time this Preempt requires prior to a transition back to normal traffic operations can occur
- Mxcal (PE Maximum Call) – 0-999 seconds
    - The maximum time this Preempt call may remain active and be considered valid

- ♦ When this Preempt call has been active for this time, the CU will return to normal operation
- ♦ This Preempt call is considered invalid until such time as a change in state occurs (no longer active)
- ♦ When this value is 0, a preempt call will be considered valid without reference to time

- L Out (PE Lock Out) – 0-999 seconds

  The time following an exit from this Preempt routine that will occur prior to running coordination.

  - ♦ Value equals 0 – Unit will exit and cycle until all calls are serviced or a phase is Re-Serviced
  - ♦ Value equals 1 through 3 – No Lock Out will occur
  - ♦ Value is greater than 3 – Lock Out will last for the time entered

- Gate (PE Gate Extension) – 0-99 seconds

  - ♦ Gate Extension time in seconds
  - ♦ This is the time the Preempt actuation (Call Duration) is extended from the termination the extend timing
  - ♦ Re-actuation of the input during this period causes the Preempt to *restart from the beginning*
  - ♦ It is intended for use in situations where vehicles driving under a rising gate could be trapped if a second train caused the gates to reactivate

- DB/10 (PE Gate De-Bounce) – 0-9.9 seconds in increments of 0.1

  - ♦ This is the time the Preempt input is held steady state, on or off, before that state is recognized by the remainder of Preempt system.
  - ♦ This is intended for use when the interconnect to the railroad is noisy or is subject to intermittent spurious activations or dropouts.

- SRMOD (PE Selective/Return Mode)

  This affects All Red behavior upon entering and exiting this Preempt. One motivation for going to All Red while transitioning to or from a Preempt is to eliminate Yellow trap conditions

  - ♦ Code 0 (Full Auto) – When this Preempt is first activated, if any of the Track Green phases (or Dwell phases, if Track Green phases are not used) are already Green, Walk, Flashing Yellow, or Flashing Red; then they will stay Green, Walk, Flashing Yellow, or Flashing Red, respectively. Likewise, if any phases of the Return interval are Green, Walk, Flashing Yellow, or Flashing Red; they will stay Green, Walk, Flashing Yellow, or Flashing Red, respectively going out of this Preempt
  - ♦ Code 1 (Selective Red/Return Auto) – At the start of this Preempt, the intersection shall be taken to All Red before entering Track Green phases (or Dwell phases, if Track Green phases are not used), except if all Non-Pedestrian outputs for this Preempt are identical to current Phase and Overlap. On Return it shall behave as in the Full Auto Mode (Code 0)

- ◆ Code 2 (Selective Auto/Return Red) – At the start of this Preempt, the intersection shall behave as in the Full Auto Mode (Code 0). On Return it shall be taken to All Red before entering the programmed Exit Phases, unless all programmed Exit Phase Non-Pedestrian outputs are identical
- ◆ Code 3 (Full Red) – Takes the intersection to All Red at both the start and at the end of this Preempt. Again, All-Reds are omitted if corresponding Non-Pedestrian outputs are identical before and at the start of this Preempt, and/or during and after this Preempt
- R2C (Return to Coordination)
  - ◆ Code 0 (No) – The Preempt routine will run a Lockout after the return interval
  - ◆ Code 1 (Yes) – The Preempt routine will jump into step with the background coordination cycle after the return interval

NOTE: Currently not supported in TX Diamond mode. Undefined behavior may occur. Also not supported with Exit Phases.

- Exit (PE Exit Phase)
  - ◆ Code 0 (No)
  - ◆ Code 1 (Yes) – Establishes that the Preempt routine will exit to this phase

When exit phases are not programmed, the exit (Return) sequence will be to All Red (no phases Green) followed by phases with calls beginning with the initialization phase(s)

When phases are programmed in one ring as the exit phase and a possible concurrent phase is not programmed in another ring, the routine will allow any legal concurrent phase to occur with the exit phase(s) based on actual demand.

When non-concurrent phases are programmed as the exit phases, the routine will exit based on the lowest number phase programmed.

- CALLS (PE Exit Call)
  - ◆ Code 0 (No)
  - ◆ Code 1 (Yes) – Establishes that a call (Pedestrian) will be placed following the exit from the Preempt routine.

All calls present at the beginning of the Preempt routine will be present (subject to phase memory programming and detector status) and will be serviced with the entered exit calls.

2.8.4.2   Preempt # Interval Times

The Preempt # Interval Times Display (Figure 2-213) allows the user to view and modify the interval times for the Preempt.

From the Preempt # Menu (Figure 2-211.), press **2-INTERVAL TIMES.**

```
PREEMPT 1 INTERVAL TIMES
 MIN GRN: 10  MIN WLK: 10   DWL GRN: 10
              EXT PED:  0
--SELECT---   ---TRACK---   ---RETURN--
              GREEN  : 10
 PED CLR:  8  PED CLR:  8   PED CLR:  8
 YEL/10 : 40  YEL/10 : 40   YEL/10 : 40
 RED/10 : 20  RED/10 : 20   RED/10 : 20
```

Figure 2-213. Preempt 1 Interval Times Display

Data provided in this display includes the following:

- Min Grn (Minimum Green) – 0-255 seconds
  - A Preempt initiated transition will not cause the termination of an existing Green prior to its display for lesser of the Minimum Green time for the phase or this period

- Min Wlk (Minimum Walk) – 0-255 seconds
  - A Preempt-initiated transition will not cause the termination of an existing Walk prior to its display for lesser of the Walk time of the phase or this period

- Ext Ped (Extended Pedestrian Clear)
  - Code 0 - The active Ped's Extended Pedestrian Clearance configuration will be used throughout the Preempt routine
  - Code 1 - The active Ped's, Pedestrian Clearance will time only during the phase's Green time
  - Code 2 - The active Ped's, Pedestrian Clearance is allowed to time through the phase's Red interval
  - Code 3 - The active Ped's, Pedestrian Clearance is allowed to time through the phase's Yellow interval
  - Code 4 - The active Ped's, Pedestrian Clearance will time, finishing at least 3 seconds before a conflicting movement, as described in the MUTCD

- Select Ped Clr (PE Selective Pedestrian Clear) – 0-255 seconds
  - The time that is provided to clear a terminating Walk during the transition to Track Green
  - The lesser of this time or the Ped's requested (i.e., standard or alternate) Pedestrian Clear time will be used
  - When this time is 0, the terminating phase's requested Pedestrian Clear time will be used instead
  - PE Selective Pedestrian Clear is also known as PE enter Pedestrian Clear

- Select Yel/10 (PE Selective Yellow Change) – 0-255 tenth seconds
  - The time that is provided to clear a terminating Green during a transition to Track Green
  - The lesser of this time or the Traffic Yellow (i.e., phase or overlap Yellow) time will be used
  - When this time is 0, the Traffic Yellow time will be used instead

- Select Red/10 (PE Selective Red Clear) – 0-255 tenth seconds
  - ♦ The time that is provided to clear a terminating Yellow during a transition to Track Green
  - ♦ When this time is 0, the Traffic Red (i.e., phase or Overlap Red) time will be used instead

- Track GREEN (PE Track Green)
  - ♦ The time of 0-255 seconds will be provided for the Track Green interval
  - ♦ When this time is 0, the Track intervals will be skipped altogether and the Preempt will go directly to Dwell Green; Track Green, Track Pedestrian Clear, Track Yellow, and Track Red will not appear

- Track Ped Clr (PE Track Pedestrian Clear) – 0-999 seconds
  - ♦ The time that is provided to clear a terminating Walk during the transition to Dwell Green
  - ♦ The lesser of this time or the phase's requested Pedestrian Clear time will be used
  - ♦ When this time is 0, the phase's requested Pedestrian Clear time will be used instead

- Track Yel/10 (PE Track Yellow Change) – 0-255 tenth seconds
  - ♦ The time that is provided to clear a terminating Green during the transition to Dwell Green
  - ♦ The lesser of this time or the traffic Yellow time will be used
  - ♦ When this time is 0, the traffic Yellow time will be used instead

- Track Red/10 (PE Track Red Clear) – 0-255 tenth seconds
  - ♦ The time that is provided to clear a terminating Yellow during the transition to Dwell Green
  - ♦ When this time is 0, the traffic Red time will be used instead

- Dwl Grn (PE Dwell Green)
  - ♦ The Minimum time of 0-255 seconds will be provided Dwell Green interval

- Return Ped Clr (PE Return Pedestrian Clear) – 0-999 seconds
  - ♦ The time that is provided to clear a terminating Walk during the transition to normal operation.
  - ♦ The lesser of this time or the phase's requested Pedestrian Clear time will be used
  - ♦ When this time is 0, the phase's requested Pedestrian Clear time will be used instead

- Return Yel/10 (PE Return Yellow Change) – 0-999 tenth seconds
  - ♦ The time that is provided to clear a terminating Green during the transition to normal operation
  - ♦ The lesser of the traffic Yellow time or this time will be used

♦ When this time is 0, the traffic Yellow time will be used instead

• Return Red/10 (PE Return Red Clear) – 0-999 tenth seconds

♦ The time that is provided to clear a terminating Yellow during the transition to normal operation

♦ When this time is 0, the traffic Red time will be used instead

Table 2-14. Preempt Interval Ranges			
Data Names and Ranges			
Preempt Parameter	**Min Used[1]**	**Force Phase Time[2]**	**Range**
MIN GRN	Yes	—	0–255 sec
MIN WLK	Yes	—	0–255 sec
SELECT PED CLR	Yes	0	0–255 sec
SELECT YEL/10	Yes	0	0–255 tenth sec
SELECT RED/10	No	0	0–255 tenth sec
TRACK GREEN	No	—	0–255 sec
TRACK PED CLR	Yes	0	0–999 sec
TRACK YEL/10	Yes	0	0–255 tenth sec
TRACK RED/10	No	0	0–255 tenth sec
DWL GRN	No	—	0–255 sec
RETURN PED CLR	Yes	0	0–999 sec
RETURN YEL/10	Yes	0	0–999 tenth sec
RETURN RED/10	No	0	0–999 tenth sec
Notes: 1 – The lesser of the Traffic (i.e., phase or overlap) time or Preempt Parameter time will be used. 2 – This value or range of values will cause the Traffic time to be used in all cases.			

2.8.4.3 Preempt # Vehicle Status

The Preempt # Vehicle Status Display (Figure 2-214.) allows the user to view and modify the phase vehicle load switch driver status parameters for the Track Green and Dwell intervals.

From the Preempt # Menu (Figure 2-211.), press **3-VEHICLE STATUS.**

```
PREEMPT 1 VEHICLE STATUS
PHASE....1.2.3.4.5.6.7.8.9.0.1.2.3.4.5.6
 TRK GRN 0 0 0 0 0 0 0 0 4 4 4 4 4 4 4 4
 DWELL   0 0 0 0 0 0 0 0 4 4 4 4 4 4 4 4
 (0-RED.1-GRN.2-FLR.3-FLY.4-DARK.5-FLG)
 CYCLE   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
    (0-NO..1-ACT..2-MN REC..3-MX REC)
```

Figure 2-214. Preempt 1 Vehicle Status Display

NOTE: Default data is as shown above.

Information provided on this display includes the following:

- Track Green and Dwell Status

    - Code 0 – Phase vehicle will be Red

    - Code 1 – Phase vehicle will be Green

    - Code 2 – Phase vehicle will be Flashing Red

    - Code 3 – Phase vehicle will be Flashing Yellow

    - Code 4 – Phase vehicle will be Dark

    - Code 5 – Phase vehicle will be Flashing Green

- Cycle Status

    - Code 0 – Phase vehicle will not cycle

    - Code 1 – Phase vehicle will cycle based on demand

    - Code 2 – Phase vehicle will cycle on Minimum Recall

    - Code 3 – Phase vehicle will cycle on Maximum Recall

2.8.4.4 Preempt # Pedestrian Status

The Preempt # Pedestrian Status Display (Figure 2-215.) allows the user to view and modify the phase Pedestrian load switch driver status parameters for the Track Green and Dwell intervals.

From the Preempt # Menu (Figure 2-211.), press **4-PEDEST. STATUS.**

```
PREEMPT 1 PEDESTRIAN STATUS
PHASE....1.2.3.4.5.6.7.8.9.0.1.2.3.4.5.6
 TRK GRN 3 0 3 0 3 0 3 0 3 3 3 3 3 3 3 3
 DWELL   3 0 3 0 3 0 3 0 3 3 3 3 3 3 3 3
     (0-DONT..1-WALK..2-FL WK..3-DARK)
 CYCLE   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
           (0-NO..1-ACT..2-RECALL)
```

Figure 2-215. Preempt 1 Pedestrian Status Display

NOTE: Default data is as shown above.

Information provided on this display includes the following:

- Track Green and Dwell Status

    - Code 0 – Phase Pedestrian will be Don't Walk

    - Code 1 – Phase Pedestrian will be Walk

    - Code 2 – Phase Pedestrian will be Flashing Walk

    - Code 3 – Phase Pedestrian will be Dark

- Cycle Status

    - Code 0 – Phase Pedestrian will not cycle

    - Code 1 – Phase Pedestrian will cycle based on demand

    - Code 2 – Phase Pedestrian will cycle on recall

2.8.4.5   Preempt # Overlap Status

The Preempt 1 Overlap Status Display (Figure 2-216.) allows the user to view and modify the Overlap load switch driver status parameters for the Track Green and Dwell intervals.

From the Preempt # Menu (Figure 2-211.), press **5-OVERLAP STATUS.**

```
PREEMPT 1 OVERLAP STATUS
OVERLAP..A.B.C.D.E.F.G.H.I.J.K.L.M.N.O.P
 TRK GRN 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
 DWELL   4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
 CYCLE   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
(0-R.1-G.2-FR.3-FY.4-DK.5-FG|0-NO.1-ACT)
 TRAIL   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

Figure 2-216. Preempt 1 Overlap Status Display

NOTE: Default data is as shown above.

Information provided on this display includes the following:

- Trk Grn (Track Green) and Dwell status for Non-Pedestrian Overlaps
  - ♦ Code 0 – Overlap output will be Red
  - ♦ Code 1 – Overlap output will be Green
  - ♦ Code 2 – Overlap output will be Flashing Red
  - ♦ Code 3 – Overlap output will be Flashing Yellow
  - ♦ Code 4 – Overlap output will be Dark
  - ♦ Code 5 – Overlap output will be Flashing Green
- Trk Grn (Track Green) and Dwell status for Pedestrian Overlaps
  - ♦ Code 0 – Overlap output will be Don't Walk
  - ♦ Code 1 – Overlap output will be Walk
  - ♦ Code 2 – Overlap output will be Don't Walk
  - ♦ Code 3 – Overlap output will be Don't Walk
  - ♦ Code 4 – Overlap output will be Dark
  - ♦ Code 5 – Overlap output will be Flashing Walk
- Cycle Status
  - ♦ Code 0 – Overlap will not cycle
  - ♦ Code 1 – Overlap will cycle based on service to included phases
- Trail Operation
  - ♦ Code 0 – Overlap will not Trail during Preempt operation
  - ♦ Code 1 – Overlap will Trail only during the Select Interval
  - ♦ Code 2 – Overlap will Trail only during the Return Interval
  - ♦ Code 3 –Overlap will Trail during both the Select and Return Intervals

NOTE: Trailing during Preempt operation does not apply for Pedestrian Overlaps

2.8.5   Preempt Default Data

The Preempt Default Data Display (Figure 2-217.) allows the user to replace the current parameters with the program resident default parameters.

From the Preempt Data Menu (Figure 2-209.), press **D- DEFAULT DATA.**

```
PREEMPT LOAD DEFAULT

 WARNING....THIS OPTION WILL REMOVE ALL
 CURRENT OPERATING DATA ..............
 - PRESS "E" TO CONTINUE
```
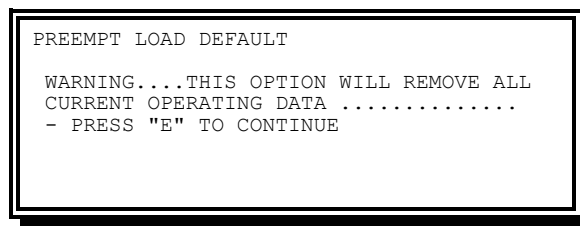
Figure 2-217. Preempt Default Data Display

2.8.6   Important Considerations for FYA During Preempt

The following are important considerations regarding Flashing Yellow Arrow Overlap operation during Preempt:

- Track Intervals

  - If the Protected Phase Green is provided, the associated Overlap must be set to FLASHING GREEN (5) to have proper clearances

  - If the Permissive Phase is provided and the associated Overlap is to display the Flashing Yellow Arrow at that time, set the associated Overlap to FLASHING GREEN (5).

  - If the associated Overlap is to display Red Arrow at that time, set the associated Overlap to RED (0)

- Dwell Intervals without cycling operation

  - Use the same rules as provided for Track Intervals

- Dwell Intervals with Cycling Operation

  - Set the associated overlap to RED (0)

- If the Protected Green phase is available during cycling, the associated Overlap must be set to 1-ACT in order to have proper clearances. If the Permissive Phase is also available during cycling, the Flashing Yellow Arrow display will appear and cannot be blocked out.

- If the Permissive Phase is available during cycling and the Protected Phase is not available during cycling, to provide the NCHRP Flashing Yellow Arrow display at that time, set the associated Overlap to 1-ACT. If the NCHRP signal is to display Red Arrow at that time, set the associated overlap to 0-NO

2.9 Priority Data

The Priority Data Display (Figure 2-218) allows the user to select which Priority parameter database to be addressed.

From the Main Menu (Figure 2-1), press **8-PRIORITY DATA**.

```
PRIORITY DATA

1-PRIORITY 1 5-PRIORITY 5 9-PRIORITY 9
2-PRIORITY 2 6-PRIORITY 6 A-PRIORITY 10
3-PRIORITY 3 7-PRIORITY 7 B-PRIORITY 11
4-PRIORITY 4 8-PRIORITY 8 C-PRIORITY 12

                        D-LOAD DEFAULT
```
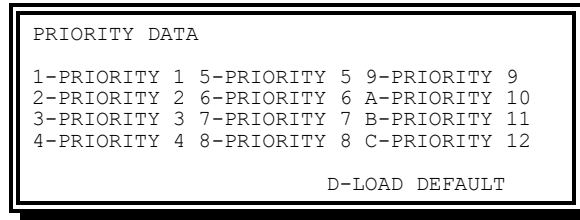
Figure 2-218. Priority Data Display

The Priority Data Menu includes the following options:

- Priority 1-12 provides viewing and editing of Priority -12 parameters respectively.

- Load Default – Provides for loading the default parameter set as the active database

2.9.1 Priority Menu

The figure below shows all the options available for each Priority.

```
PRIORITY 1

  1-DETECTION        6-FULL DATA+
  2-SERVICE          7-RECOVERY+
  3-TRANSIT SIGNAL   8-QUEUE MONITOR+
  4-LEVEL/MISC+      9-DATA BANK COPY
  5-PARTIAL DATA+    0-SEL DATA BANK
(+) 4 PRIORITY DATA BANKS
```
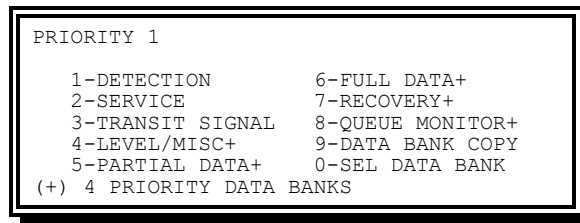
Figure 2-219. Priority Data Menu

The available options are:

- Detection – Provides viewing and editing of detector assignment parameters

- Service – Provides viewing and editing of Co-Phases, Queue Jump Phases, Min and Max Priority Green times, Min Walk times and various Lockouts

- Transit Signal – Provides viewing and editing of Transit Signal Type and Overlap assignment, Blankout Overlap assignment, Pre-Green times and Recalls

- Level/Misc – Provides viewing and editing of the Priority type (Level) and the various Advance detector timings

- Partial Data – Provides viewing and editing of Priority Sequences and exit calls to be used for Partial Priority service

- Full Data – Provides viewing and editing of parameters controlling Full to Partial downgrades and forced Omits for phases and Peds for Full Priority service

- Recovery – Provides viewing and editing of Full Priority recovery parameters and phases

- Queue Monitor – Provides viewing and editing of Full Priority Recovery Queues

- Data Bank Copy – Provides for Copying Priority and Priority Bank configurations

- Sel Data Bank – Provides for Selecting the Priority Bank to be edited

2.9.2 Detection

This section describes the Priority Detection Display.

```
PRIORITY 1 DETECTION
 PE DET                   N-LOCK:   1
   DELAY:  10 SEC         EXTEND/10:   0
 PR DET (DET=## FOR INPUT SOURCE)
           .1A...2A...3A...4A...5A...6A
  ADV DET: 65   66   67   68   69   70
     BDET: 71  CDET: 72  XDET: 73
```

Figure 2-209.. Priority Detection Display

The PE input has the ability to select Lock or Non-Lock for that input according to the value in N-LOCK in the individual Priority detection Display.

- N-Lock – PE Detector Non-Locking defines whether the Preempt detector will be Non-Locking when used as a Priority Detector
  - ♦ 0-No – Locking memory
  - ♦ 1-Yes – Non-locking memory

    When non-locking equals 1 and the activating request ends prior to the service engaging it, that request will not be retained

NOTE: The service engaging occurs immediately after the delay times out. Delay set to 0 defeats non-locking.

- Delay – Delay for Preempt Detector in seconds
  - ♦ The time in seconds that the Priority actuation through the PE Detector must be active before triggering service
  - ♦ Delay must be greater than zero for non-locking to be effective
- Extend – Extend for Preempt Detector in tenths of seconds, the time that each Priority actuation will be extended from the point the actuation terminated
- 1A-6A – Transit Advance Detector 1 through 6 assignments

  Assignment of a SEPAC detector to function as priority Advance Detector 1 through 6

NOTE: Phase Recalls (Min/Max/Soft/etc.) do not have any effect on Transit Priority operations. Transit Priority service can only be requested through detector inputs from devices in the field. A Transit Signal recall is available, but this is a display only service with no priority operation.

- BDET – Transit Backup Detector assignment

  Assignment of a SEPAC detector to function as the Backup Detector
- CDET – Transit Checkout Detector assignment

Assignment of a SEPAC detector to function as Checkout Detector

- XDET – Cancel Detector assignment

Assignment of a SEPAC detector to function as the Cancel input

> **NOTE: Each of the ten sources, PE, 1A, 2A, 3A, 4A, 5A, 6A, BACKUP, CHECKOUT, and CANCEL, has an independently programmable Delay and Extension. Except for the PE input, the detector's own Delay and Extension parameters are used.**

The physical input PE also known as Preempt or (Pulsing) Priority has Delay and Extension.

If the PE input is determined to control Preempt, that Delay and Extension is programmed in the individual Preempt menu selection 1-MISCELLANEOUS.

If the PE input is determined to control Priority, that Delay and Extension is programmed in the individual Priority menu selection 1-DETECTION where the physical input source is specified for the remaining nine detection inputs.

When a source detector number is assigned to any of the nine input sources that are NOT the PE, the Delay and Extension are programmed in the TIMING section of the data entry for the specific detector source number entered.

For example, the Delay and Extension for Detector 23 is entered in the screen accessed by the key sequence Main-3-7-3-7. For detector 23 enter the Delay and Extension value.

2.9.3   Service

This section describes the Priority Service Display.

```
PRIORITY 1 SERVICE
  PHASE...1234.5678.9012.3456
CO-PHASE: 0000 0000 0000 0000 <EXCL: 0
QJ-PHASE: 0000 0000 0000 0000
MIN WLK+:  0  N-LOUT:   0  FREE PAT: 253
MIN GRN:   0  LOUT A:   0 SEC
MAX GRN:   1  LOUT B:   0 SEC
                                    [1]
```

Figure 2-220. Priority 1 Service Display

The Priority 1 Service display provides the following information:

- Co-Phase – Priority Co-Phases compatible with Transit vehicle
  - ♦ Code 0 – Not compatible with Transit vehicle
  - ♦ Code 1 – Compatible with Transit vehicle
- Excl– Exclusive Co-Phase Service
  - ♦ Code 0 – Service the Co-Phase and any compatible phases
  - ♦ Code 1 – Service only the Co-Phase

> **NOTE: Exclusive Co-Phase may be used in conjunction with NO Co-Phases for All Red Priority service. This is only legal for Full Priority service of an LRT vehicle.**

- QJ-Phase– Queue Jump Phase

♦ Code 0 – Not a Queue Jump Phase

♦ Code 1 – Assigned as a Queue Jump Phase

NOTE: When selecting a Queue Jump Phase, the following rules apply:

1. **Queue Jump Phases must always immediately precede the Co-Phases in the ring structure**

2. **Queue Jump Phases will always be omitted until the Priority needs to jump to them**

3. **Queue Jumps Phases will not be satisfied if the Co-Phases are already on when the Priority call comes in**

MIN WLK – Minimum walk time in seconds (0 – 255)

This parameter applies to conflicting phases on entry and all phases on exit.

MIN GRN – Priority minimum green in seconds

Establishes the minimum time that the LRT white bar will display or the TSP DWL GRN interval will occur to service the transit vehicle.

MAX GRN – Priority right-of-way limit in seconds

♦ LRT – White Bar

♦ TSP – DWL GRN (traffic phase green)

Establishes the maximum time that the DWL GRN interval will occur to service the transit vehicle (other criteria may end service early).

N-LOUT – No Lockout - Global (GLB)

♦ 0 – No. Allows GLB lockout.

♦ 1 – Yes. Disallows GLB lockout.

Establishes whether this priority should disallow lockout of Ext Start, Auto flash, Stop time, Preemption, and Start flash.

NOTE: If N-LOUT = 0, then even a full priority will be downgraded to Minimal until the lockout has expired.

LOUT A – Lockout A in seconds

Lockout is applied by a priority to itself after it finishes its exit. Vehicle service during lockout is as Minimal priority is set.

♦ 0 – Lockout for one cycle

♦ 1-3 – No Lockout

♦ 4+ – Lockout for seconds entered

LOUT B – Lockout B in seconds

Lockout service to other priorities after exit from this priority. Vehicle service during lockout is as if Minimal priority is set.

♦ 0 – Lockout for one cycle

♦ 1-3 – No lockout

♦ 4+ – Lockout for seconds entered

FREE PAT – Free Pattern

Defines the timing plan that is the source for phase reduction/extension when running in (standard) free operation. Default pattern is 253.

> **NOTE: MAX GRN times for the co-phases must be greater than zero while the intersection is operating free.**

If the controller is operating as coord free mode by making the offset greater than the cycle length, the source for phase reduction/extension is dial/split of the timing plan producing the coord free request.

2.9.4 Transit Signal

This section describes the Priority Transit Signal display.

```
PRIORITY 1 TRANSIT SIGNAL
 OVERLAP.....: ABCD EFGH IJKL MNOP
 SIGNAL TYPE.: 0000 0000 0000 0000
 BLANKOUT SIG: 0000 0000 0000 0000

 PREGRN/10:   0 (0-255)
 RECALL...:   0 (0-NO 1-MIN 2-MAX 3-COP)
```

Figure 2-221. Priority 1 Transit Signal Display

The Priority 1 Transit Signal display provides the following information:

SIGNAL TYPE – Signal type on Overlap A–P for TSP signal

This entry establishes the overlap and selects the signal head type for a Transit Signal priority.

When the value under each overlap letter for Signal Type is set to 0 the set of 16 entries defines this priority as a non-Transit Signal priority.

Signal Type for A–P positions:

♦ 0 – This overlap is not used for TSP signal by this priority.

♦ 1 – Invalid, reserved.

♦ 2 – This overlap is used as a 2-section signal by this priority.

♦ 3 – This overlap is used as a 3-section signal by this priority.

The OVERLAP line identifies the association of the data entry on the next lines SIGNAL TYPE assigned.

Position the cursor under the desired letter on SIGNAL TYPE row and enter 2 to set that overlap for use by this priority as a 2-Section signal or enter 3 to set that overlap for use by this priority as a 3-Section signal. Any entry of 2 or 3 will be set at the cursor position and any other existing SIGNAL TYPE overlap entry with a 2 or 3 in the Overlap A–P group on this display will be automatically removed. An entry of 2 will set the BLANKOUT SIGN for the same overlap to 2 automatically.

NOTE: Different priorities cannot have a same overlap set to different signal head types.

2- Section signal head type uses Red and Green output of the overlap while 3-Section signal head type uses all three (i.e., Red, Yellow and Green) outputs of the overlap.

To remove an overlap association with this priority set A–P to 0. The direct method is to set the overlap having a 2/3 to 0 (which makes all other A–P be 0).

> **NOTE: If SIGNAL TYPE overlap is omitted for this priority, the Transit Signal vehicle will not be serviced.**

If SIGNAL TYPE overlap is omitted (by TOD or Preemption Cycling) the vehicle will enter the queue but will not be acted upon until the omit is removed. TSD, TED, and TTL timers will continue to countdown (with the exception of during Preemption) and the vehicle could be removed from the queue without service.

> **NOTE: To permit Transit Signal service during preempt dwell, the SIGNALTYPE overlap must be enabled in the cycle map.**

> **CAUTION: Running Transit Signal All-Red priority during preempt dwell could make it possible for the Transit Signal vehicle to run in conflict with the preempt vehicle in rare intersection configurations. In this case, the Transit Signal SIGNAL TYPE overlap MUST BE OMITTED from the preempt cycle map.**

BLANKOUT SIG – Blankout Signal on Overlap A–P for TSP signal

This entry establishes the overlap and sets the color for the Blankout Signal.

When the value under each overlap letter for Blankout Signal is set to 0 the set of 16 entries defines this priority as a non-Blankout Signal Transit Signal priority.

Blankout Signal for A–P positions:

♦ 0 – This overlap is not used for Blankout Signal.

♦ 1 – This overlap uses Red output to show Blankout Signal.

♦ 2 – This overlap uses Yellow output to show Blankout Signal.

♦ 3 – This overlap uses Green output to show Blankout Signal.

The OVERLAP line identifies the association of the data entry on the next lines BLANKOUT SIG. assigned.

Position the cursor under the desired letter on BLANKOUT SIG row and enter 1-4 to set the color of the Blankout Signal as mentioned above. Any entry of 1-4 will be set at the cursor position and any other existing BLANKOUT SIG overlap entry with a 1-4 in the Overlap A–P group on this display will be automatically removed.

An overlap set to use 2-Section signal head as a SIGNAL TYPE is by default set to 2 as Blankout Signal output. Any other value on BLANKOUT SIG than 2 for the same

overlap will cause a "Transit Overlap Conflict". Users are free to move the Blankout Signal output to any other overlap.

NOTE: Different priorities can have different overlaps set to different Blankout Signals outputs.

To remove an overlap association of BLANKOUT SIG with this priority set A–P to 0. The direct method is to set the overlap having a 1-4 to 0 (which makes all other A–P be 0).

> **NOTE: If BLANKOUT SIG overlap is omitted for this priority, the LRT vehicle will be serviced without Blankout Signal.**

When assigning either SIGNAL TYPE or BLANKOUT SIG, SEPAC will check to ensure that the overlap is configured as a PRI overlap. If it is not set to PRI, one of two things will happen:

1. If the overlap is not assigned a type or it only contains default data, SEPAC will silently change the type to PRI.

2. If there is non-default data configured in the overlap, SEPAC will prompt the user for permission to reallocate the overlap for Priority use. Upon confirmation, the Overlap Type will be changed to PRI and all previously configured data for the overlap will be defaulted, with the exception of YEL/10 and RED/10.

PREGRN/10 – Pre-green in tenths of seconds (0–255)

> This entry establishes the length of the Transit Signal pre-green signal interval. Transit signal display – Flashing Horizontal Bar

RECALL – Priority recall

- ♦ 0 – None: No Recall
- ♦ 1 – Min: Recall will service the priority for MIN GRN
- ♦ 2 – Max: Recall will service the priority for MAX GRN
- ♦ 3 – Cop   Recall will service the priority when the co-phases are green

> **NOTE: When using a recall with the priority, the green, yellow, and red for the transit vehicle must be less than the time to service the co-phases. Otherwise, the co-phase will rest in red and wait for the transit vehicle overlap to complete timing.**

2.9.5   Level/Misc

This section describes the Priority Level/Misc display.

```
PRIORITY 1 LEVEL / MISC
 LEVEL...: 2 (0-MIN 1-PART 2-FULL 3-DIS)
 PR.DET...PE..1A..2A..3A..4A..5A..6A..BU
 TSD..:    0  50  45  40  35  30  20   0
 TED..:    0  65  60  55  50  45  35  10
 TTL..:    0 100 100 100 100 100  40  60
SORTxTSD: 1A  2A  3A  4A  5A  6A  BU  ..
                                     [1]
```

Figure 2-222. Priority 1 Level/Misc Display

The Priority 1 Level/Misc display provides the following information:

LEVEL – Level of priority

Selects modifications used to reach co-phase(s) include the following:

♦ 0 – Min. No changes to the phase timing or phase sequence will take place to service the transit vehicle. However, Minimal will extend phase timings to the co-phase once service for the transit vehicle has started.

♦ 1 – Partial (Phase Reduction). Provides the ability for the controller to shorten conflicting phases, shorten conflicting walk timing, lengthen compatible phases, or modify phase sequences to service the transit vehicle as close to arrival time as possible.

♦ 2 – Full (Vehicle and Pedestrian Omit). Provides all the features of partial priority plus the ability for the controller to skip conflicting vehicle phases and/or pedestrian phases to service the transit vehicle as close to arrival time as possible.

♦ 3 – Disable. Detectors disabled. Only recall service allowed.

2.9.5.1 Advance Detector Timing Values

TSD – Time-of-Service-Desired in seconds for above priority detection

TED – Time-of-estimated-departure in seconds for above priority detection

TTL – Time-to-live in seconds for above priority detection

0 – Disables TTL processing for this detector, which will not timeout (Tmo, Tss, or Tpo) and will not be a factor for ending the priority service. Displays as TTL WTG.

2.9.6 Partial Data

This section describes the Priority Partial Data display.

```
PRIORITY 1 PARTIAL DATA
  SEQUENCE:   0   (SEQ # : 1-16, 17-19)


   PHASE....1234.5678.9012.3456
 EXIT CALL: 0000 0000 0000 0000 (1-YES)
                                    [1]
```

Figure 2-223. Priority 1 Partial Data Display

The Priority 1 Partial Data display provides the following information:

SEQUENCE – The sequence for priority entry.

Establishes the sequence the partial priority may use to facilitate priority entry. Only phase leading the co-phase will become lagging.

♦ Non-Diamond: 1-16

♦ Diamond: 17-19 = 4Ph, 3Ph, Separate

NOTE: Partial will not use sequences while the intersection is operating free.

EXIT CALL – Exit Call phases

Establishes which phases will receive a pedestrian call to insure service on exit from priority service.

- ♦ 0 – No exit call
- ♦ 1 – Exit call placed

2.9.7   Full Data

This section describes the Priority Full Data display.

```
PRIORITY 1 FULL DATA
  FP WAIT :   0   FPW LVL: 1   FPW OVR: 0
  PED SKIP:   0   FRC FUL: 0
     PHASE....1234.5678.9012.3456
  PHS OMIT:  1011 1011 0000 0000 <SKIP
  PED OMIT:  0001 0001 0000 0000

                                    [1]
```

Figure 2-224. Priority 1 Full Data Display

The Priority 1 Full Data display provides the following information:

FP WAIT – Full Priority Wait in seconds (0–999, 0=Disable). Full priority wait sets the number of seconds that full priority service will be treated as either Minimal or Partial as defined by FPW LVL.

FPW LVL – Full Priority Wait Level (0-No/1-Yes). If a FP WAIT block has been set, full priority wait level determines if Minimal or Partial should be used to service full priority calls during the full priority wait block.

FPW OVR – Full Priority Wait Override (0-No/1-Yes). If a FP WAIT block has been set, full priority wait override determines if the FP WAIT block can be overridden. For the FPW OVR to operate the full priority must be servicing without a checkout detector and the next full priority call must be for the same priority.

PED SKIP – Pedestrian skip in seconds (0–999, 0=Disable). With a pedestrian omit but no vehicle omit, this entry establishes the maximum time a pedestrian movement may be forced to wait for service. After the skip time is reached the pedestrian omit is ignored to allow the pedestrian service. When pedestrian is provided in this manner, there may be a delay reaching the co-phase on time due to the unplanned nature of the pedestrian service.

NOTE: Values 1–999 do not block the recover pedestrian wait time operations. Both operations are allowed within the same priority. Pedestrian skip is an entry function while pedestrian wait is an exit function. The two may actually apply for different pedestrian movements.

FRC FUL – Force Full (0-No/1-Yes). If set, force full will determine whether the transit vehicle full priority call must always use the full priority routines.

> **NOTE: If configuring a priority with co-phase that normally do not start in the ring sequence together (under standard 8 phase-quad: 1 & 6, 2 & 5, 3 & 8, 4 & 8) force full should be set to ensure both phases are green at TSD=0.**

PHS OMIT – Phase Omit (0-No/1-Yes). Phase omit determines whether a conflicting vehicle phase *must always* be omitted in order to cycle to the co-phase and service the transit vehicle during full priority.

- ♦ 0 –No. Phase may be served
- ♦ 1 – Yes. Phase always omitted

PED OMIT – Pedestrian Omit (0-No/1-Yes). Pedestrian omit determines whether a conflicting pedestrian movement *must always* be omitted in order to cycle to the co-phase and service the transit vehicle during full priority.

- ♦ 0 – No. Pedestrian movement may be serviced
- ♦ 1 – Yes. Pedestrian movement always omitted

> **NOTE: Setting the PHS OMIT or PED OMIT to 0 does not guarantee the vehicle or pedestrian movement receives service. The full priority routine may determine that a movement set to zero still needs to be omitted in order to service the transit vehicle as close to arrival time as possible.**

2.9.8   Recovery

This section describes Priority Recovery for full priority operation.

```
PRIORITY 1 RECOVERY (FULL)
  METHOD..: 0 (0-NORM 1-WAIT 2-RECOVERY)
  RETURN..: 0 (0-CYCL 1-JUMP)
  PED WAIT:   0 SEC   PED OVR: 0 (1-YES)
    PHASE....1234.5678.9012.3456
  RECOVERY:  0000 0000 0000 0000

                                      [1]
```

Figure 2-225. Priority 1 Recovery (Full) Display

The Priority Recovery (Full) display provides the following information:

Method – Each of the three values for method follows the setting of the return programming and sets what criteria apply to get there.

- ♦ 0 – Normal accesses return without special handling.
- ♦ 1 – Wait goes to the longest waiting phase(s).
- ♦ 2 – Recovery goes to a phase (or pair) following the co-phase(s) as programmed by the Recovery setting.

Return

- ♦ 0 – Cycle may retain coordination if the recovery can return to coordination and remain in sync. Otherwise, cycle drops coordination at the location provided by method. If the location is in the coordinated phases, the phases

will be required to end. The unit must cycle through phases in free until reaching the coordinated phase(s).

- ♦ 1 – Jump waits in coordination at the location provided by method. When the next coordinated permissive opens (or the drop is within an open permissive) the recovery process is complete for re-aligning the split phase timing with the traffic phase timing.

> **NOTE: Using 0-Normal and 1-Jump allows coordination to operate and recover full priority without offset correction. However, the phases that follow the co-phase may not be those expected. The next phases to be serviced depend upon when the priority ends and what is the next coordinated permissive. An example is priority ending just a few seconds into coordinated phases 2 and 6. The coordinated pedestrian and hold operations do not occur there because the recovery is not complete until the permissive opens to phases 3 and 7.**

PED WAIT – Pedestrian Waiting time. This entry establishes the minimum time a pedestrian demand waits before it defines the recovery phase.

- ♦ 0 – No action taken
- ♦ 1-999 sec – Minimum pedestrian wait time
- ♦ The PED WAIT value also applies to the longest traffic vehicle waiting time as the threshold that must be achieved for a phase vehicle waiting to be considered as a recovery phase candidate.

  Because the pedestrian has precedence over vehicle, the identical time waiting for each will result in selecting pedestrian (assuming that queue has not precluded both pedestrian and vehicle).

> **NOTE: Full priority PED SKIP VALUES 1-999 do not block these recover pedestrian wait time operations. Both operations are allowed within the same Priority. Pedestrian skip is an entry function while pedestrian wait is an exit function. The two may actually apply for different pedestrian movements.**

PED OVR – Pedestrian override

- ♦ 0 – Pedestrian wait does not override queue. Standard order of precedence is traffic queue, pedestrian, and vehicle.
- ♦ 1 – Pedestrian wait overrides queue. Override order of precedence is pedestrian, traffic queue, and vehicle

RECOVERY – (Define) recovery phases

- ♦ 0 – Phase is not a recovery phase
- ♦ 1 – Phase is a recovery phase

2.9.9   Queue Monitor

This section describes the Priority Queue Monitor display for full priority operation.

```
PRIORITY 1 QUEUE MONITOR (FULL)

  QUEUE....1....2....3....4....5....6
  PHS #:   0    0    0    0    0    0
  DET #:   0    0    0    0    0    0
  TIME.:   0    0    0    0    0    0

                                  [1]
```

Figure 2-226. Priority 1 Queue Monitor (Full) Display

The Priority 1 Queue Monitor (Full) display provides the following information:

> PHS # – Phase associated with above queue (0–16: 0 disables queue)

> DET # – Detector associated with above queue (0–80: 0 disables queue)

> TIME – Time in seconds (0–255: 0 disables queue)

>> This entry establishes the minimum occupancy time before queue overrides.

2.9.10   Priority Data Bank Copy

This section describes the Priority+Bank Copy display.

```
PRIORITY+BANK COPY
  COPYING BANK.......FROM: 1  TO:   1
  COPYING PRIOR......FROM: 1  TO:   1
 ENTER THE FROM & TO BANK/PRIORITY ##
 THEN ENTRY HERE INITIATES THE COPY>>>>0
  [A 0 IN ANY TO FIELD OR IN FROM PRIOR
   COPIES TO ALL MATCHING GIVEN VALUES]
```

Figure 2-227. Priority+Bank Copy Display

The Priority+Bank Copy display provides the following information:

> FROM BANK – Copy From - Bank Number

>> The source bank number of the copy. Allows the user to equate the data for one or more priority banks by copying from one bank to one or more banks.

>> Range of values from 1-4. Bank 0 is not allowed as a From bank.

> TO BANK – Copy To - Bank Number

>> The destination bank number of the copy.

>> Range of values from 0-4. Bank 0 allows copies from a source bank to all other banks.

> FROM PRIORITY – Copy From – Priority Number

>> The source priority number of the copy

>> Range of values from 0-12. Priority 0 allows copies all priorities of a bank.

> TO PRIORITY – Copy To - Priority Number

>> The destination priority number of the copy

>> Range of values from 0-12. Priority 0 allows copies to all priorities of a destination bank.

EXECUTE COPY – Copy Bank/Priority Data

Causes the copy to take place.

No data. The action of enter executes the copy according to the FROM and TO values entered above for bank and priority.

2.9.10.1   Copy Examples

Seven copy actions are described in this section.

The # is a Bank or Priority number as described above for the specific field.

The abbreviations used are:

- ♦ FB – From bank
- ♦ TB – To bank
- ♦ FP – From priority
- ♦ TP – To priority

Be sure to review the destination priority data after a copy as all data in the copy may not be appropriate.

This operation is like phase bank copy.

Copy Action 1

FB - # / TB - # / FP - # / TP - #

Copies data from the designated From priority in the designated From bank to the priority in the To bank.

Copy Action 2

FB - # / TB - # / FP - # / TP - 0

Copies data from the designated From priority in the designated From bank to ALL priorities in the To bank.

NOTE: TP is 0.

Copy Action 3

FB - # / TB - # / FP - 0 / TP - 0

Copies data from all priorities in the designated From bank to the like numbered priority in the To bank.

NOTE: FP and TP are both 0.

Copy Action 4

FB - # / TB - 0 / FP - # / TP - #

Copies data from the designated From priority in the designated From bank to the designated To priority in every bank.

NOTE: TB is 0.

Copy Action 5

>   FB - # / TB - 0 / FP - # / TP - 0

Copies data from the designated From priority in the designated From bank to all priorities in every bank.

NOTE: TB and TP are both 0.

Copy Action 6

>   FB - # / TB - 0 / FP - 0 / TP - 0

Copies data from all priorities in the designated From bank to the like numbered priorities in every bank.

NOTE: TB, FP, and TP all 0.

Copy Action 7

>   ... / ... / FP - 0 / TP - #

INVALID BANK COPY Operation Error. Copy from all priorities to a single priority is not allowed.

2.9.11   Select Editing Priority Bank

This section describes select editing the priority bank.

```
PRIORITY 1 DATA BANK

   CURRENTLY EDITING PRIORITY BANK: 1
     (AVAILABLE BANKS = 1-2-3-4)

     [RUNNING PRIORITY BANK IS 1]
SEE Help (+) FOR MORE INFORMATION
```

Figure 2-228. Priority 1 Data Bank Display

The Priority Data Bank display provides the following information:

Select editing priority bank – Selection of priority bank for the front panel.

- ♦ All priority data viewed or modified will be contained in the priority bank selected. Changes to data in the running priority bank will take immediate effect.
- ♦ The [1] [2] [3] [4] in the lower right corner of the data entry displays indicate the current editing bank.
- ♦ Use the - (minus) key to sequence through the [1] [2] [3] [4] editing banks. The Minus key equals placing the next number into the current editing bank.
- ♦ The - (minus) key may be used on any Priority screen displaying [+] to advance to the next priority bank for editing.

2.10   System Data

Although defined as system data, all of these capabilities are available and may be of value in the stand-alone controller (for example, Alarms, MOE, etc.).

System data allows the user to display or modify parameters for:

Communications

Traffic responsive data

Detector diagnostic data

Local alarm report

Local MOE report

Speed data

User access is required to enter data for these parameters. See Section 2.3 for more information on gaining access.

The System Data menu (Figure 2-229.) allows the user to select which system parameter database to be addressed.

From the Main menu (Figure 2-1), press **9-SYSTEM DATA**.

```
SYSTEM DATA

 1-COMMUNICATIONS      6-SPEED TRAPS
 2-TRAF RESPONSIVE
 3-DET DIAGNOSTIC
 4-LOCAL ALARMS        B-BANK SELECTION
 5-LOCAL MOEs          C-BANK COPY
                                   [1]
```
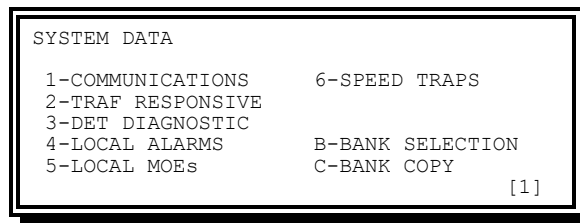
Figure 2-229. System Data Menu

Options for this menu include the following:

COMMUNICATIONS – Provides viewing and editing of communications parameters, status, and report.

TRAF RESPONSIVE – Provides viewing and editing of traffic responsive parameters and report.

DET DIAGNOSTIC – Provides viewing and editing of detector diagnostic parameters, status, and report.

LOCAL ALARMS – Provides viewing of local alarm report.

LOCAL MOE'S – Provides viewing of local MOE report.

SPEED DATA – Provides viewing and editing of speed trap parameters and report.

Note the [1] in the lower right corner indicting System Bank 1. All the traffic responsive fields are included in the system bank.

2.10.1   Communications Menu

The Communications menu (Figure 2-230.) allows the user to select which communications parameter database to be addressed.

From the System Data menu (Figure 2-229.), press **1-COMMUNICATIONS**.

```
SYSTEM - COMMUNICATIONS

1-ADDRESS          4-FAIL LOG
2-BACKUP           5-ENET/NTCIP
3-STATUS
```
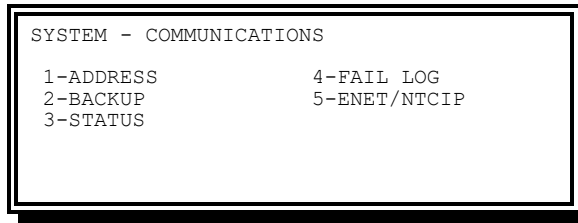
Figure 2-230. Communications Menu (NTCIP shown)

Options provided on this menu include the following:

ADDRESS – Provides viewing and editing of local system address.

BACKUP – Provides viewing and editing of time in minutes before reverting to local time base as a backup for system commands

STATUS – Provides viewing the current communications status.

FAIL LOG – Provides viewing the list of communications faults along with the date and time of occurrence.

ENET/NTCIP – Provides viewing NTCIP statistics.

2.10.1.1   Communications Address

The Communications Address display (Figure 2-231.) allows the user to view and modify the CU system address.

From the Communications menu (Figure 2-230.), press **1-ADDRESS**.

```
SYSTEM - COMM ADDRESS

  ENTER A 3 DIGIT ADDRESS & PRESS "E"
      ADDRESS: 000 - KEYPAD
      ADDRESS: 000 - T&F INPUTS
 WARNING....AN ADDRESS OTHER THAN "000"
 TRANSFERS I/O TO ITS SYSTEM DEFINITION
```
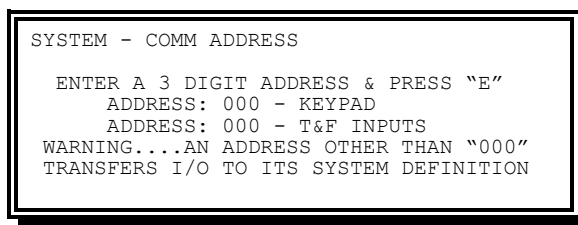
Figure 2-231. Communications Address Menu

NOTE: Default data is as shown above.

Information provided on this screen includes the following:

ADDRESS - KEYPAD – This program entry (000-999) overrides the TS2 terminal and facilities system address inputs and implements the address based on this program entry. If this data field is 0, the CU reads the terminal and facilities address inputs for the system address to make active.

NOTE: The system address must be non-zero for network communication (typically 1)

ADDRESS - T&F INPUTS – This display only field will show the address based on TS2 terminal and facilities address inputs.

Having address inputs allows the terminal and facilities to control. On the surface, this sounds like the best approach, but we believe that should a terminal and facilities address input fail, the CU would most likely operate with the wrong address, so we recommend the use of an address program entry.

2.10.1.2   Communications Backup

The Communications Backup display (Figure 2-232.) allows the user to view and modify the time after which the unit will revert to local time base as a backup for system commands when not being polled by the master.

From the Communications menu (Figure 2-230.), press **2-BACKUP**.

```
SYSTEM – COMM BACKUP

  ENTER THE TIME BEFORE THE UNIT IS TO
  REVERT TO BACKUP OPERATION ON LOSS OF
  COMMUNICATIONS
      TIME IN SECONDS:   900
```
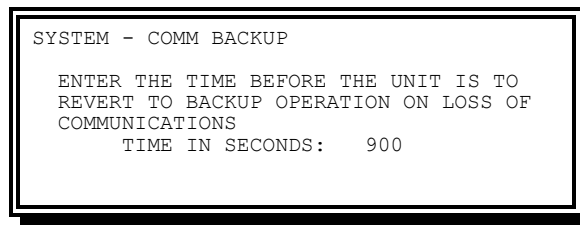
Figure 2-232. Communications Backup Display

NOTE: Default data is as shown above.

This value establishes the time (0-65535 **seconds**) the SEPAC software will wait for a master poll and continue operating with the last master pattern/mode prior to reverting to local time base as the backup control source.

An entry of 0 will prevent the SEPAC software from reverting to backup.

CAUTION: A small value can cause the SEPAC software to revert to backup when it should not. The normal setting would be some multiple of the polling frequency (for example, 5x to 15x). The Siemens MARC300 master polls each local approximately once every minute.

2.10.1.3   Communications Status

The Communications Status display (Figure 2-233.) allows the user to view the current communications status.

From the Communications menu (Figure 2-230.), press **3-STATUS**.

```
COMM STATUS
             ..ECOM 2..   ..NTCIP3..
  SETTINGS....: 1200,8N1    1200,8N1
  STATUS......: OFF LINE    OFF LINE
  CARRIER.....: ACTIVE      INACTIVE
  TRANSMITTING: DATA - ACK
  RECEIVING...: DATA-VALID
```

Figure 2-233. Communications Status Display (Linux NTCIP Shown)

See Sections 2.2.5.1 for details on this status screen.

2.10.1.4   Communications Fault Report

The Communications Fault Report display (Figure 2-234.) allows the user to view the list of communications faults along with the date and time of occurrence.

From the Communications menu (Figure 2-230.), press **4-FAIL LOG**.

```
SYSTEM - COMM FAULT REPORT
  MM/DD  HH:MM  --------STATUS-------
  09/20  10:20  RECV ERROR
  09/20  11:14  RECV FRAME ERROR



 UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 2-234. Communications Fault Report Display

This display provides the following information:

   MM/DD (Date) – This display denotes the date (month and month day) of the fault.

   HH:MM (Time) – This display denotes the time of day (hour and minute) of the fault.

   STATUS (Fault) – This display denotes a description in English of the fault. See Chapter 3 Section 3.12.7 for a list of possible report entries.

The Communications Fault report has the capacity to store up to 60 faults. Faults will appear in the order in which they occur, with the initial display showing the oldest. The cursor control keys A and B all the user to page through the report. The control key C allows clearing of the report log.

2.10.1.5   Ethernet / NTCIP Statistics

The Ethernet/NTCIP Statistics display (Figure 2-235) allows the user to view the current communications status and statistics for NTCIP.

From the Communications menu (Figure 2-230.), press **5-ENET/NTCIP**.

```
NTCIP NETWORK STATUS
        ...SNMP PORT...  ...STMP PORT...
 IP..: 10.227.1.15       0.0.0.0
 TYPE: SNMP REQUEST
 INP : 624               0
 OUTP: 624               0
 REQ.: snmpOutGetResp
```

Figure 2-235. Communications Status Display

Statistics for both SNMP and STMP protocols are reported:

IP – The IP address associated with the last NTCIP transaction.

TYPE – The type of the last transaction.

INP – The total number of NTCIP messages received.

OUTP – The total number of NTCIP messages sent.

REQ – The current request being served.

2.10.2   Traffic Responsive Menu

The Traffic Responsive menu (Figure 2-236.) allows the user to select which traffic responsive parameter database to be addressed.

From the System Data menu (Figure 2-229.), press **2-TRAF RESPONSIVE**.

```
SYSTEM - TRAFFIC RESPONSIVE

 1-ASSIGN SYS DET+    5-QUEUE ASSIGN+
 2-V+O PARAMETERS+    6-QUEUE SELECT+
 3-REPORT PARAMETERS+
 4-SYS DET REPORT

'+' DENOTES BANKABLE DATA        [1]
```

Figure 2-236. Traffic Responsive Menu

Options provided on this menu include the following:

ASSIGN SYS DET – Provides viewing and editing of the system detector assignments.

V+O PARAMETERS – Provides viewing and editing of the system detector parameters required by the master for traffic responsive pattern selection.

REPORT PARAMETERS – Provides viewing and editing of the system detector report parameters.

SYS DET REPORT – Provides viewing of the system detector reports.

QUEUE ASSIGN – Provides viewing and editing of the parameters required for local traffic responsive pattern selection.

QUEUE SELECT – Provides viewing and editing of the parameters required for local traffic responsive pattern selection.

Traffic Responsive Configuration Data (all the above except System Detector Reports) is provided in a table that provides four instances (System Banks) of each parameter used to configure local traffic responsive in the CU. All the parameters of a System Bank are used concurrently. See the 2.7.11 TBC Special Function Mapping, for information to change the System Banks by time of day.

2.10.2.1   System Detector Assignment

The System Detector Assignment display (Figure 2-237.) allows the user to view and modify the system detector assignments.

From the Traffic Responsive menu (Figure 2-236.), press **1-ASIGN SYS DET**.

```
SYSTEM - SYS DET ASSIGNMENT

SYS DET....1...2...3...4...5...6...7...8
 ASSIGNED  0   0   0   0   0   0   0   0
    TO ASSIGN:  VEH 01-64 enter #01-64
                SPC 01-08 enter #65-72
                PED 01-08 enter #73-80
                                     [1]
```

Figure 2-237. System Detector Assignment Display

NOTE: Default data is as shown above.

The System Detector Assignment display allows any vehicle, special, or pedestrian detector input to be assigned as a system detector.

2.10.2.2   Volume + Occupancy Data

The Volume + Occupancy Data display (Figure 2-238.) allows the user to view and modify the system detector parameters required by the master for traffic responsive pattern selection.

From the Traffic Responsive menu (Figure 2-236.), press **2-V+O PARAMTERS**.

```
SYSTEM – SYS DET V+O PARAMETERS

SYS DET....1...2...3...4...5...6...7...8
VPHR*100:  0   0   0   0   0   0   0   0
AVGT....:  0   0   0   0   0   0   0   0
CTFC/10.:  0   0   0   0   0   0   0   0
MVOL%...:  0   0   0   0   0   0   0   0
                                     [1]
```

Figure 2-238. System Detector Volume + Occupancy Data Display

NOTE: Default data is not provided.

Information provided on this display includes the following:

VPHR*100 – This entry (0-99) establishes the lane capacity (100 vehicles per hour) used in V+O preprocessing.

AVGT – This entry (0-99 minutes) establishes the averaging time used in V+O preprocessing.

CTFC/10 – This entry (0-99) establishes the occupancy correction factor used in V+O preprocessing. The value entered is internally divided by 10 to provide a real factor of 0-9.9. This allows the user to diminish the importance of real occupancy.

MVOL% – This entry (0-255) establishes the minimum volume required prior to using occupancy in V+O preprocessing. An entry over 250 prevents the addition of occupancy in the V+O reported to the master.

2.10.2.3   Report Parameters

The Report Parameters display (Figure 2-239.) allows the user to view and modify the system detector report parameters.

From the Traffic Responsive menu (Figure 2-236.), press **3-REPORT PARAMTERS**.

```
SYSTEM - REPORT PARAMETERS

 REPORT INTERVAL:   0  (00-99 MINUTES)


   TIME BASE "DET 2" ENABLES REPORTING

                                     [1]
```

Figure 2-239. Report Parameters Display (NTCIP shown)

NOTE: Default data is as shown above.

The REPORT INTERVAL entry (0-99 minutes) establishes the time period for the report. When the sample interval exceeds the time between report requests, the report in process will complete and the second request will not be honored.

2.10.2.4   System Detector Report

The System Detector Report display (Figure 2-240.) allows the user to view the system detector reports.

From the Traffic Responsive menu (Figure 2-236.), press **4-SYS DET REPORT**.

```
SYSTEM - SYS DET REPORT
BEGIN:  09/21  07:15  INT: 15  MULT: 10
DETECTOR...1...2...3...4...5...6...7...8
RAW VOL:
RAW OCC:
AVOL%..:
ACO%...:
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 2-240. System Detector Report Display

NOTE: Default data is not shown.

Information provided in this display includes the following:

BEGIN – The date (month and day) and time (hour and minute) the report began.

INT – The sample interval (0-99 minutes) the report data represents.

MULT – The multiplier (1, 10, 100 or 1000) for the RAW values below. This value is determined automatically. If any raw volume or raw occupancy is:

- ♦ Greater than 255, then the multiplier is 10

- ♦ Greater than 2550, then the multiplier is 100

- ♦ Greater than 25500, then the multiplier is 1000

- ♦ If the raw volume or raw occupancy is anything else the multiplier is 1

RAW VOL (Multiplier) – The raw volume count (0-255) for each system detector during the sample period.

RAW OCC (Multiplier) – The raw occupancy count (0-255) for each system detector during the sample period. The count is the number of full seconds of occupancy.

AVOL% – The average volume percent (0-250) for each system detector during the sample period.

ACO% – The average occupancy percent (0-100) for each system detector during the sample period.

The System Detector report collects volume and occupancy for the report period then calculates the averages. See Chapter 3, Section 3.12.8 for additional detail.

The System Detector report has the capacity to store up to 96 sample periods. Sample period data will appear in the order in which they were logged; the initial display will show the oldest. The cursor control keys A and B allow the user to page through the report. The control key C allows the clearing of the report log.

2.10.2.5   Queue Assignment

The Queue Assignment display (Figure 2-241.) allows the user to view and modify the parameters for the two Queue routines.

From the Traffic Responsive menu (Figure 2-236.), press **5-Queue Assign**.

```
QUEUE ASSIGNMENT
        ---- NO. 1 ----   ---- NO. 2 ----
DETECT...1...2...3...4  ..1...2...3...4
 SYSD    0   0   0   0    0   0   0   0
 WTFC    0   0   0   0    0   0   0   0
INPUT SELECT..:  0        0   (0-AV/1-HI)
FAILED LEVEL..:  0        0   (# TO FAIL)
                                    [1]
```

Figure 2-241. System Detector Queue Assignment Display

NOTE: Default data is as shown above.

Information provided on this display includes the following:

SYSD (System Detector number) – This entry (1-8) establishes the system detector number that inputs V+O data to this routine.

WTFC # (Weighting factor) – This entry (0-100) establishes the weighting factor to be used for V+O data received from this detector. The weighting factor represents a percentage 0-100 to be applied to the detected V+O data.

INPUT SELECT (Average or highest) – Establishes that the input will be an average of all operational assigned detectors.

- ♦ Code 0 – Establishes that the V+O input generated will be the average output of all operational assigned detectors.
- ♦ Code 1 – Establishes that the V+O input generated will be the highest output of all operational assigned detectors.

FAILED LEVEL (# to fail channel), Code # – This entry (0-4) establishes the number of assigned detectors that must fail to consider the queue failed.

2.10.2.6 Queue Select

The Queue Select display (Figure 2-242.) allows the user to view and modify the parameters for the two queue-select routines.

From the Traffic Responsive menu (Figure 2-236.), press **6-Queue Select**.

```
QUEUE SELECT
------- NO.1 --------  ----- NO.2 -----
LEVEL...........1...2  LEVEL......1...2
 % ENTER (UP) 000 000   % ENTER 000 000
 % LEAVE (DN) 000 000   % LEAVE 000 000
 PATTERN      000 000   PATTERN 000 000

                                    [1]
```

Figure 2-242. System Detector Queue Select Display

NOTE: Default data is as shown above.

Information provided on this display includes the following:

% ENTER (UP) – 0-255

The V+O percentage required to enter the level when it transitions up from a lower level.

Any number between 1 and 250 is valid. The controller automatically limits the V+O% to 250%. Any value over 250 will prevent the queue routine from ever attaining that level.

% LEAVE (DN) – 0-255

The V+O percentage required to leave the level when it transitions down to a lower level.

See the second paragraph under % ENTER (UP) above.

The routine will use the smaller of ENTER and LEAVE as the LEAVE parameter (ENTER is assumed to be larger than LEAVE).

Pattern – 1-255

The pattern or partial pattern that is operational when the V+O percentage for the routine matches that required to run or maintain the level.

2.10.3   Detector Diagnostics Menu

The Detector Diagnostics menu (Figure 2-243.) allows the user to select which detector diagnostic parameter database to be addressed.

From the System Data menu (Figure 2-229.), press **3-DET DIAGNOSTIC**.

```
SYSTEM - DETECTOR DIAGNOSTICS

       1-DIAGNOSTIC VALUES
       2-DETECTOR STATUS
       3-DETECTOR FAULT REPORT
```
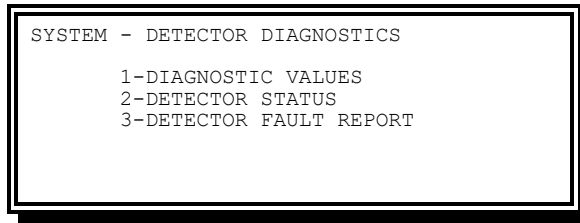
Figure 2-243. System Detector Diagnostics Menu

Options available on this menu include the following:

DIAGNOSTIC VALUES – Provides viewing and editing of the detector diagnostic parameters.

DETECTOR STATUS – Provides viewing of the current detector status as determined by the detector diagnostics.

DETECTOR FAULT REPORT – Provides viewing of the list of detector faults along with the date and time of occurrence.

2.10.3.1   Diagnostics Values

The Diagnostics Values Menu (Figure 2-244.) allows the user to view and modify the detector diagnostic parameters.

From the Detector Diagnostics menu (Figure 2-243.), press **1-DIAGNOSTIC VALUES**.

```
SYSTEM - VALUE 0 DET DIAGNOSTICS

 1-VEH  1- 8    5-VEH 33-40   9-PED 1-8
 2-VEH  9-16    6-VEH 41-48   0-SPC 1-8
 3-VEH 17-24    7-VEH 49-56
 4-VEH 25-32    8-VEH 57-64   A-VALUE 1
```
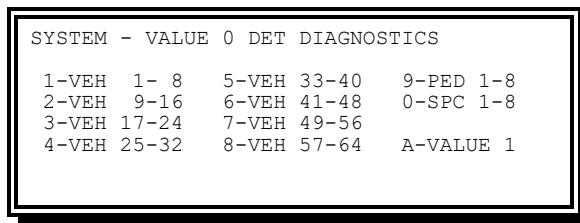
Figure 2-244. System Diagnostics Values Menu

Options on this menu include the following:

VEH ##-## – Provides viewing and editing of the selected vehicle detector value 0 diagnostic parameters.

PED 1-8 – Provides viewing and editing of the pedestrian detector value 0 diagnostic parameters.

SPC 1-8 – Provides viewing and editing of the special detector value 0 diagnostic parameters.

VALUE 1 – Provides for jumping directly to the Value 1 diagnostic menu. VALUE 0 and VALUE 1 entries provide two parameter sets for detector diagnostics on each detector. Time Base event Det 1 causes Value Set 1 to be in effect.

2.10.3.1.1 Detector Diagnostic Value Display

From the System Diagnostics Values menu (Figure 2-244.), press **1-VEH 1-8**.

```
SYSTEM - VALUE 0 DATA
VEH DET....1...2...3...4...5...6...7...8
 MX PRES   0   0   0   0   0   0   0   0
 NO ACTY   0   0   0   0   0   0   0   0
 ERR CNT   0   0   0   0   0   0   0   0
    - DATA = MINUTES OR COUNTS/MINUTE -
  - TIME BASE "DET 1" ENABLES VALUE 1 -
```

Figure 2-245. System Diagnostics Values VEH DET Display

NOTE: Default data is as shown in Figure 2-245.).

Information provided on this display includes the following:

MX PRES – This entry (0-255 minutes) establishes the maximum presence a detector can exhibit prior to being considered a maximum presence fault.

NO ACTY – This entry (0-255 minutes) establishes the no activity limit (maximum time between detector actuations) prior to being considered a no activity fault.

ERR CNT – This entry (0-255 counts) establishes the maximum actuations per minute that can occur prior to being considered an erratic count fault.

An entry of 0 into any routine (no activity, maximum presence, or erratic output) will omit the routine from the diagnostic evaluation for that detector.

2.10.3.2 Detector Status

The Detector Status display (Figure 2-246.) allows the user to view the current detector status as determined by the detector diagnostics.

From the Detector Diagnostics menu (Figure 2-243.), press **2-DETECTOR STATUS**.

```
SYSTEM - DETECTOR STATUS
VEH DET....1...2...3...4...5...6...7...8
  STATUS   0   0   0   0   0   0   0   0
VEH DET....9..10..11..12..13..14..15..16
  STATUS   0   0   0   0   0   0   0   0
CODES: 0-ON LINE..FAIL:.1-MP.2-NA.3-EC..
       4-NS.5-BIU.6-LWD.7-LO.8-LS.9-LC..
UP/DOWN - PREV/NEXT DISPLAY
```

Figure 2-246. System Detector Status Display

UP and DOWN may be used to cycle through groups of 16 detectors. Press UP to view the Pedestrian and Special detectors, or DOWN to see the next set of 16 detectors.

In general, detectors must be assigned to accumulate and report faults. The status codes which may be displayed are:

Code 0 (ON LINE) – denotes that the detector is operating within the parameters established for diagnostics faults.

Code 1 (MP) – denotes that the detector failed the CU MAXIMUM PRESENCE diagnostic.

Code 2 (NA) – denotes that the detector failed the CU NO ACTIVITY diagnostic.

Code 3 (EC) – denotes that the detector failed the CU ERRATIC COUNTS diagnostic.

Code 4 (NS) – denotes that the detector failed the CU NOT SUPPORTED diagnostic; it is assigned but the BIU is not enabled and a corresponding FIO Hardware Input is not available

Code 5 (BIU) – denotes that a Response Frame Fault occurred for the Detector Bus Interface Unit (BIU).

Code 6 (LWD) – denotes that the Detector BIU Channel Status input for the detector is "OFF" (Loop Watchdog Fault). This may indicate 1) the detector is NOT a TS 2 detector, 2) a detector failure occurred, or 3) a detector watchdog time-out occurred.

Code 7 (LO) – denotes that the Detector reported an Open Loop Fault to the Detector BIU.

Code 8 (LS) – denotes that the Detector reported a Shorted Loop Fault to the Detector BIU.

Code 9 (LC) – denotes that the Detector reported an Excessive Inductance Change Fault to the Detector BIU.

2.10.3.3 Detector Fault Report

The Detector Fault Report display (Figure 2-247.) allows the user to view the list of detector failures along with the date and time of occurrence.

From the Detector Diagnostics menu (Figure 2-243.), press **3-DETECTOR FAULT REPORT**.

```
SYSTEM - DETECTOR FAULT REPORT
  MM/DD  HH:MM   -------STATUS-------
  09/20  10:20   VEH 1 - FAIL ERR CNTS
  09/20  12:10   SPC 2 - FAIL MAX PRES
  09/20  13:15   VEH 1 - ON LINE
  09/20  23:55   SPC 3 - FAIL NO ACTY
  ../..  ..:..   ....................
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```
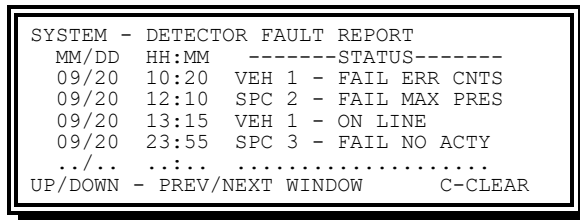
Figure 2-247. System Detector Fault Report Display

Information provided on this display includes the following:

MM/DD (Date) – Denotes the date (month and month day) of the fault.

HH:MM (Time) – Denotes the time of day (hour and minute) of the fault.

STATUS (Fault) – This display denotes description in English of failed detector and the fault detected as follows:

The Detector Fault Report has the capacity to store up to 60 diagnostic faults. Fault data will appear in the order in which it occurs; the initial display will show the oldest. The cursor control keys A and B allow the user to page through the report. The control key C allows the clearing of the report log.

2.10.4   Local Alarms Menu

The Local Alarms Report display (Figure 2-248.) allows the user to view the list of local alarms along with the date and time of occurrence.

From the System Data menu (Figure 2-229.), press **4-LOCAL ALARMS**.

```
SYSTEM - LOCAL ALARMS


        1 - ALARM SELECTION
        2 - ALARM REPORT
```

Figure 2-248. System Local Alarms Menu

2.10.4.1   Local Alarm Selection

From the Local Alarms menu (Figure 2-248.), press **1-ALARM SELECTION**.

```
SYSTEM - LOCAL ALARMS SELECTION
 ALRM.....DESCRIPTION.. (0-NO LOG/1-LOG)
    1 ON LINE                    1
    2 POWER ON                   1
    3 POWER OFF                  1
    4 NO COORD - CYCLE FAULT     1
    5 OFF LINE - CYCLE FAIL      1
```

Figure 2-249. System Local Alarms Selection Display

The entry 0 will disable the logging of a specific event into the alarm log. The entry 1 enables the logging of a specific event into the alarm log.

When the cursor is in the ALRM (Alarm) field, entry of a number will cause the display to put the data for that alarm on the cursor line. This enables the user to jump to a specific data entry area.

See Chapter 3, Section 3.12.3 for a definition of report entries.

```
ALRM ....DESCRIPTION.. (0-NO LOG/1-LOG)
    1 ON LINE                    1
    2 POWER ON                   1
    3 POWER OFF                  1
    4 NO COORD - CYCLE FALT      1
    5 OFF LINE - CYCLE FAIL      1
    6 NO COORD - COORD FALT      1
    7 NO COORD - COORD FAIL      1
    8 OFF LINE - VOLT MONIT      1
    9 OFF LINE - REMOTE FL       1
   10 OFF LINE - PREEMPT 1       1

   11 OFF LINE - PREEMPT 2       1
   12 OFF LINE - PREEMPT 3       1
   13 OFF LINE - PREEMPT 4       1
   14 SPECIAL STATUS 1 ON        1
   15 SPECIAL STATUS 2 ON        1
   16 SPECIAL STATUS 3 ON        1
   17 SPECIAL STATUS 4 ON        1
   18 SPECIAL STATUS 5 ON        1
   19 SPECIAL STATUS 6 ON        1
   20 SPECIAL STATUS 1 OFF       1
```

```
21 SPECIAL STATUS 2 OFF      1
22 SPECIAL STATUS 3 OFF      1
23 SPECIAL STATUS 4 OFF      1
24 SPECIAL STATUS 5 OFF      1
25 SPECIAL STATUS 6 OFF      1
26 OFF LINE - MONITOR FL     1
27 OFF LINE - LOCAL FL       1
28 ALARM 28 - RESERVED       1
29 RESERVED FOR FUTURE       1
30 WATCHDOG TIMEOUT          1

31 EEPROM WRITE ERROR        1
32 EEPROM WRITE COUNT        1
33 COORD ACTIVE              1
34 TRAFFIC TASK DELAYED      1
35 CYCLE ZERO PHASE FALT     1
36 NO SYSTEM - BACKUP        1
37 SYSTEM ACTIVE             1
38 CYCLE ZERO PED DELAY      1
39 NO SYSTEM - STANDBY       1
40 NO COORD - COMND FREE     1

41 NO COORD - COORD FREE     1
42 NO COORD - BAD P FREE     1
43 NO COORD - TRANS FREE     1
44 NO COORD - INPUT FREE     1
45 NO COORD - FAIL FREE      1
46 ALARM LOG FAULT           1
47 COMM LOG FAULT            1
48 TRAF RESP LOG FAULT       1
49 SPEED LOG FAULT           1
50 MOES LOG FAULT            1

51 DET LOG FAULT             1
52 DIALUP FAILED             1
53 DATA CHANGE - REMOTE      1
54 DATA CHANGE - KEYPAD      1
55 OFF LINE - PREEMPT 5      1
56 OFF LINE - PREEMPT 6      1
57 OFF LINE - PRIORITY 1     1
58 OFF LINE - PRIORITY 2     1
59 OFF LINE - PRIORITY 3     1
60 OFF LINE - PRIORITY 4     1

61 OFF LINE - PRIORITY 5     1
62 OFF LINE - PRIORITY 6     1
63 DIAG: BUS FAULT           1
64 DIAG: ADDRESS FAULT       1
65 DIAG: INVALID OPCODE      1
66 DIAG: DIVIDE BY ZERO      1
67 DIAG: SYSTEM FAULT        1
68 DIAG: FALSE INTERRUPT     1
69 DIAG: INVALID TRAP        1
70 DIAG: UNSPECIFIED         1

71 DIAG: IOP INIT            1
72 DIAG: RAM TEST            1
73 DIAG: VRTX FAULT          1
74 DIAG: IOP TIMEOUT         1
75 DIAG: IOP RAM TEST        1
76 DIAG: IOP CLOCK TEST      1
77 DIAG: IOP ROM TEST        1
78 INVALID PROM RESTART      1
79 INCOMPAT MEM RESTART      1
80 EEPROM CRC INITIALIZE     1

81 EEPROM INIT - KEYPAD      1
82 TIME CHANGE - REMOTE      1
83 TIME CHANGE - KEYPAD      1
84 COORD OFFSET FAULT        1
85 RTC CHIP FAILURE          1
86 RTC CHIP FAULT            1
87 RTC CHIP ADJUST           1
88 SOFTWARE CLOCK ADJUST     1
89 PROGRAM DAY 0             1
90 CRIT'L ALARMS CLEAR       1

91 DIAG: EEPROM CRC ERR      1
92 DIAG:  EPROM CRC ERR      1
93 DIAG: TRAFTASK XS DLY     1
```

```
 94 DIAG: TRAF TASK WDOG      1
 95 VOL COUNT LOG FAULT       1
 96 RAW ERR LOG FAULT         1
 97 MMU UNDETECTED CNFLCT     1
 98 MMU UTILZATION CNFLCT     1
 99 SDLC .1 SEC DLY FAULT     1
100 SDLC .1 SEC DLY FAIL      1

101 FRAME 128 FAULT          1
102 FRAME 128 ON LINE        1
103 FRAME 129 FAULT          1
104 FRAME 129 ON LINE        1
105 ALARM 105 RESERVED       1
106 ALARM 106 RESERVED       1
107 FRAME 131 FAULT          1
108 FRAME 131 ON LINE        1
109 ALARM 109 RESERVED       1
110 ALARM 110 RESERVED       1

111 ALARM 111 RESERVED       1
112 ALARM 112 RESERVED       1
113 ALARM 113 RESERVED       1
114 ALARM 114 RESERVED       1
115 ALARM 115 RESERVED       1
116 ALARM 116 RESERVED       1
117 ALARM 117 RESERVED       1
118 ALARM 118 RESERVED       1
119 ALARM 119 RESERVED       1
120 ALARM 120 RESERVED       1

121 FRAME 138 FAULT          1
122 FRAME 138 ON LINE        1
123 FRAME 139 FAULT          1
124 FRAME 139 ON LINE        1
125 FRAME 140 FAULT          1
126 FRAME 140 ON LINE        1
127 FRAME 141 FAULT          1
128 FRAME 141 ON LINE        1
129 ALARM 129 RESERVED       1
130 ALARM 130 RESERVED       1

131 ALARM 131 RESERVED       1
132 ALARM 132 RESERVED       1
133 ALARM 133 RESERVED       1
134 ALARM 134 RESERVED       1
135 ALARM 135 RESERVED       1
136 ALARM 136 RESERVED       1
137 ALARM 137 RESERVED       1
138 ALARM 138 RESERVED       1
139 ALARM 139 RESERVED       1
140 ALARM 140 RESERVED       1

141 FRAME 148 FAULT          1
142 FRAME 148 ON LINE        1
143 FRAME 149 FAULT          1
144 FRAME 149 ON LINE        1
145 FRAME 150 FAULT          1
146 FRAME 150 ON LINE        1
147 FRAME 151 FAULT          1
148 FRAME 151 ON LINE        1
149 FRAME 152 FAULT          1
150 FRAME 152 ON LINE        1

151 FRAME 153 FAULT          1
152 FRAME 153 ON LINE        1
153 FRAME 154 FAULT          1
154 FRAME 154 ON LINE        1
155 FRAME 155 FAULT          1
156 FRAME 155 ON LINE        1
157 ALARM 157 RESERVED       1
158 ALARM 158 RESERVED       1
159 ALARM 159 RESERVED       1
160 ALARM 160 RESERVED       1

161 FRAME 158 FAULT          1
162 FRAME 158 ON LINE        1
163 ALARM 163 RESERVED       1
164 ALARM 164 RESERVED       1
165 ALARM 165 RESERVED       1
166 ALARM 166 RESERVED       1
```

```
167 ALARM 167 RESERVED        1
168 ALARM 168 RESERVED        1
169 ALARM 169 RESERVED        1
170 ALARM 170 RESERVED        1

171 ALARM 171 RESERVED        1
172 ALARM 172 RESERVED        1
173 ALARM 173 RESERVED        1
174 ALARM 174 RESERVED        1
175 ALARM 175 RESERVED        1
176 ALARM 176 RESERVED        1
177 ALARM 177 RESERVED        1
178 ALARM 178 RESERVED        1
179 ALARM 179 RESERVED        1
180 ALARM 180 RESERVED        1

181 FRAME 168 FAULT           1
182 FRAME 168 ON LINE         1
183 FRAME 169 FAULT           1
184 FRAME 169 ON LINE         1
185 FRAME 170 FAULT           1
186 FRAME 170 ON LINE         1
187 FRAME 171 FAULT           1
188 FRAME 171 ON LINE         1
189 RESERVED FOR FUTURE       1
190 RESERVED FOR FUTURE       1

191 RESERVED FOR FUTURE       1
 |       |       |       |         |
355 RESERVED FOR FUTURE       1
356 RESERVED FOR FUTURE       1
357 DIAG: RESP FRAME FAIL     1
358 DIAG: RNG DNLOAD FAIL     1
359 DIAG: INV. TS2-A1 CNF     1
360 FRAME 18 FAULT            1

361 FRAME 18 ON LINE          1
362 FRAME 18 FAILURE          1
363 CYCLE MOE LOG FAULT       1
364 MMU LOG FAULT             1
365 INVALID ABC I/O MODE      1
366 PREEMPT INPUT MAX FLT     1
367 RESERVED FOR FUTURE       1
368 RESERVED FOR FUTURE
369 RESERVED FOR FUTURE       1
370 RESERVED FOR FUTURE       1

371 WD RESTART - FIELDIO      1
372 WD RESTART - 10THTSK      1
373 WDOG START - WDBCKUP      1
374 WDOG START - WDPRIME      1
375 WDOG START - PLAYER       1
376 WDOG START - PRINTER      1
377 WDOG START - TRIB 1       1
378 WDOG START - TRIB 2       1
379 WDOG START - F PANEL      1
380 WDOG START - LV1 DIAG     1

381 WDOG START - TBE          1
382 WDOG START - BACKGND      1
383 WDOG START - TBC          1
384 WDOG START - LED          1
385 WDOG START - KEYBOARD     1
386 WDOG START - DISPLAY      1
387 DIAG: FIELDIO FAIL        1
388 DIAG: PWRFAIL LOADFLT     1
389 DIAG: NO IP STACK         1
390 DIAG: FIO MAX RETRIES     1

391 DIAG: FIO RESET           1
392 DIAG: FIO EVENT OVRN      1
393 CFGDATA CRC INITIALZE     1
394 CFGDATA/SWOP INCOMPAT     1
395 HARDWARE/SWOP PROBLEM     1
396 CFGDATA INIT - KEYPAD     1
397 DIAG: CFGDATA CRC ERR     1
398 DIAG: PROGRAM CRC ERR     1
399 SIGNATURE INVALID         1
400 BBDATA CHG FAULT          1
```

```
401 CFGDATA CHG FAULT        1
402 CFGDATA INIT-EXT DEV     1
403 PRIORITY 1 FAULT         1
404 PRIORITY 2 FAULT         1
405 PRIORITY 3 FAULT         1
406 PRIORITY 4 FAULT         1
407 PRIORITY 5 FAULT         1
408 PRIORITY 6 FAULT         1
409 ALARM 409 RESERVED       1
410 ALARM 410 RESERVED       1

411 ALARM 411 RESERVED       1
412 ALARM 412 RESERVED       1
413 PRIORITY FAILURE         1
414 SEQUENCE FAULT           1
415 RESERVED FOR FUTURE      1
416 DIAG: ECOM DNLD FAIL     1
417 PERFLOG FAILED           1
418 OFF LINE - PREEMPT 7     1
419 OFF LINE - PREEMPT 8     1
420 OFF LINE - PREEMPT 9     1

421 OFF LINE - PREEMPT 10    1
422 OFF LINE - PREEMPT 11    1
423 OFF LINE - PREEMPT 12    1
424 SOFTWARE UPDATE-INIT     1
425 R2C WATCHDOG TIMEOUT     1
426 RED PROTECT - PH01       1
427 RED PROTECT - PH02       1
428 RED PROTECT - PH03       1
429 RED PROTECT - PH04       1
430 RED PROTECT - PH05       1

431 RED PROTECT - PH06       1
432 RED PROTECT - PH07       1
433 RED PROTECT - PH08       1
434 RED PROTECT - PH09       1
435 RED PROTECT - PH10       1
436 RED PROTECT - PH11       1
437 RED PROTECT - PH12       1
438 RED PROTECT - PH13       1
439 RED PROTECT - PH14       1
440 RED PROTECT - PH15       1

441 RED PROTECT - PH16       1
442 STOPTIME                 1
443 OFF LINE - PRIORTY 7     1
444 OFF LINE - PRIORTY 8     1
445 OFF LINE - PRIORTY 9     1
446 OFF LINE - PRIORTY 10    1
447 OFF LINE - PRIORTY 11    1
448 OFF LINE - PRIORTY 12    1
449 PRIORITY 7 FAULT         1
450 PRIORITY 8 FAULT         1

451 PRIORITY 9  FAULT        1
452 PRIORITY 10 FAULT        1
453 PRIORITY 11 FAULT        1
454 PRIORITY 12 FAULT        1
455 UPDATE FAILED            1
456 UPDATE SUCCESSFUL        1
```

Figure 2-250. Complete List of Local Alarms

2.10.4.2 Local Alarm Report

From the Local Alarms menu (Figure 2-248.), press **2-ALARM REPORT**.

```
SYSTEM - LOCAL ALARMS REPORT
  MM/DD  HH:MM   -------STATUS-------
   9/20  10:20  OFF LINE - CYCLE FALT
   9/20  10:22  OFF LINE - COORD FAIL
   9/20  10:24  ON LINE
   9/25  06:00  POWER OFF
   9/25  08:02  POWER ON
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 2-251. System Local Alarms Report Display

Options on this display include the following:

MM/DD (Date) – This display denotes the date (month and month day) of the fault.

HH:MM (Time) – This display denotes the time of day (hour and minute) of the fault.

STATUS (Fault) – This display denotes description in English of the fault detected. See Chapter 3, Section 3.12.3 for a definition of report entries.

The Local Alarms report has the capacity to store up to 120 alarms. Alarms appear in the order in which they occur. The initial display will show the oldest. The UP and DOWN keys allow the user to page through the report. The control key C allows the clearing of the report log.

2.10.5   Local MOE Report

The Local MOE Report display (Figure 2-252.) allows the user to view the pattern related MOE (Measures of Effectiveness) reports by beginning date and time.

From the System Data menu (Figure 2-229.), press **5-LOCAL MOE'S**.

```
SYSTEM - LOCAL MOE'S
BEGIN:  9/21  07:15           PAT: 001
PHASE......1...2...3...4...5...6...7...8
VOLUME.:  50 100  50 100  50 100  50 100
STOPS..:  40  20  40  70  40  20  40  70
DELAY..:  30  55  30  30  30  50  30  30
UTILIZ.:  15  35  10  30  10  40  15  25
UP/DOWN - PREV/NXET WINDOW      C-CLEAR
```

Figure 2-252. System Local Moe's Display

Options on this display include the following:

BEGIN – Denotes the date (month and day) and time (hour and minute) the report began.

PAT – Denotes the pattern the report is for.

VOLUME – Denotes the per-cycle average number of actuations (0-999) received on each phase.

STOPS – Denotes the per-cycle average number of actuations (0-999) received during the non-green time on each phase.

DLAY*10 – The displayed data times 10 denotes the per-cycle average time (0-999 Seconds) of the delay on each phase. Delay accumulates based on cars waiting and elapsed time.

UTILIZATION – Denotes the per-cycle average green time (0-999 Seconds) used on each phase.

The Local MOE report has the capacity to store up to 24 pattern sets of MOE. Pattern MOE sets appear in the order in which they occur. The initial display will show the oldest. The UP and DOWN keys allow the user to page through the report. The control key C allows the clearing of the report log.

2.10.6   Speed Trap Data Menu

The Speed Trap Data menu (Figure 2-253.) allows the user to select which speed parameter database to be addressed.

From the System Data menu (Figure 2-229.), press **6-SPEED DATA**.

```
SYSTEM - SPEED DATA

        1-ASSIGN DETECTORS
        2-RANGES
        3-REPORT
```
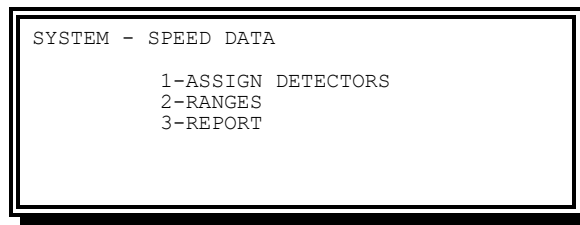
Figure 2-253. System Speed Trap Data Menu (NTCIP shown)

Options on this menu include the following:

ASSIGN DETECTORS – Provides viewing and editing of the speed trap detector assignments.

RANGES – Provides viewing and editing of the pattern related speed range parameters for each pattern.

REPORT – Provides viewing of the pattern related speed reports.

2.10.6.1   Speed Trap Assign Detectors

The Speed Trap Assign Detectors display (Figure 2-254.) allows the user to view and modify the basic speed trap parameters (detector assignments).

From the Speed Trap Data menu (Figure 2-253.), press **1-ASSIGN DETECTORS**.

```
SYSTEM - SPEED DATA
MEASUREMENT:  0     (0=MPH 1=KPH)
TRAP # 1  D1..D2     TRAP # 2  D1..D2
 ASSIGN   0   0       ASSIGN   0   0
 DISTANCE  1          DISTANCE  1
ASSIGN #: VEH=1-64, SPC=65-72, PED=73-80
DISTANCE CODES:..1=11 FT..2=22 FT....
```
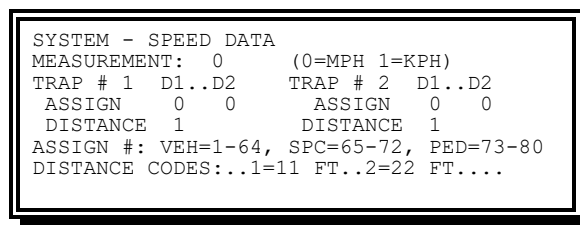
Figure 2-254. Assign Detectors Display

NOTE: Default data provided.

Parameters on this display include the following:

MEASUREMENT – This entry provides for speed to be measured and reported based on miles per hour (0 entry) or kilometers per hour (1 entry).

ASSIGN – These entries provide for assigning ANY vehicle, special, or pedestrian detector input as a speed trap detector.

DISTANCE – These entries provide for spacing of 11 feet (1 entry) or 22 feet (2 entry) for the speed trap detector sensors.

2.10.6.2 Pattern Speed Trap Ranges

The Speed Trap Ranges display (Figure 2-255.) allows the user to view and modify the pattern related speed range parameters.

```
SYSTEM - SPEED RANGES
 PATTERN: 001    LOW: 000    HIGH: 000
 PATTERN: 002    LOW: 000    HIGH: 000
 PATTERN: 003    LOW: 000    HIGH: 000
 PATTERN: 004    LOW: 000    HIGH: 000
 PATTERN: 005    LOW: 000    HIGH: 000
 UP/DOWN TO SCROLL
```

Figure 2-255. Dial 1-4 Speed Trap Ranges Display

NOTE: Default data is shown.

The LOW and HIGH entries provide a nominal speed range in MPH or KPH for the trap for each coordination pattern.

2.10.6.3 Speed Trap Report

The Speed Trap Report display (Figure 2-256.) allows the user to view the pattern related speed reports, as a percentage within, below, and above the specified range. The values are identified by beginning date and time of pattern implementation.

From the Speed Trap Data menu (Figure 2-253.), press **3-REPORT** .

```
SYSTEM - SPEED REPORT
  --- BEGIN --        PERCENT OF TOTAL
  MM/DD  HH:MM   PAT    LOWR   W/IN   HIGH
  09/21  07:15   023    10     80     10



 UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 2-256. Speed Trap Report Display

Details shown on this display include the following:

BEGIN (MM/DD HH:MM) – Denotes the date (month and day) and time (hour and minute) the report began.

PATTERN – This display denotes the pattern the report data is for.

PERCENT OF TOTAL

♦ LOWR – The percentage of vehicles that were slower (lower) than the range defined.

♦ W/IN – The percentage of vehicles that were within the range defined.

♦ HIGH – The percentage of vehicles that were faster (higher) than the range defined.

The Speed Trap report has the capacity to store up to 24 patterns of speed data. Pattern speed data appears in the order in which it occurs. The initial display shows the oldest. The UP and DOWN keys allow the user to page through the report. The control key C allows the clearing of the report log.

2.11   Reports Menu

The Reports Menu allows the user to display the following reports:

Communication fault

System detector

Detector fault

Local alarm

Local MOE

Speed

Cycle MOE

MMU/CMU fault

System Message

Peer-to-Peer

The Reports Menu (Figure 2-257.) allows the user to select which report to be viewed.

From the Main menu (Figure 2-1), press **0-REPORTS**.

```
REPORTS

  1-COMM FAULTS        6-SPEED
  2-SYS DET            7-CYCLE MOEs
  3-DET FAULTS         8-MMU/CMU FAULT
  4-ALARMS             9-SYS MSG
  5-MOEs               0-PEER-TO-PEER
```
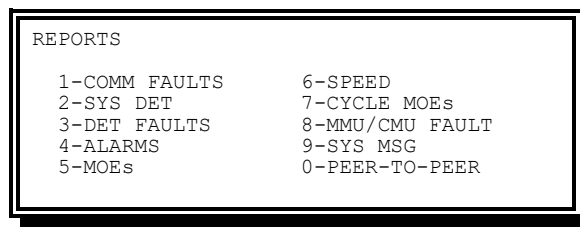
Figure 2-257. Reports Menu

Menu options on this display include the following:

COMM FAULTS – Provides viewing of Communication Fault report.

SYS DET – Provides viewing the System Detector report.

DET FAULTS – Provides viewing the Detector Fault report.

ALARMS – Provides viewing of Local Alarm report.

MOEs – Provides viewing of Local MOE report.

SPEED – Provides viewing the Speed Trap report.

CYCLE MOE – Provides viewing the Cycle MOE report.

MMU/CMU FAULT – Provides viewing of the MMU/CMU Fault report.

SYS MSG – Provides viewing of the System Message downloaded from the Central.

PEER-TO-PEER – Provides viewing of the Peer-to-Peer report.

2.11.1   Communication Fault Report

The Communication Fault Report (Figure 2-258.) allows the user to view the list of communications faults along with the date and time of occurrence.

From the Reports Menu (Figure 2-257.), press **1-COMM FAULTS**.

```
SYSTEM - COMM FAULT REPORT
 MM/DD  HH:MM  --------STATUS-------
  9/20  10:20  RECV ERROR




UP/DOWN - PREV/NEXT WINDOW     C-CLEAR
```

Figure 2-258. Comm Fault Report Display

See Section 2.10.1.3 for additional detail on this report.

2.11.2   System Detector Report

The System Detector Report (Figure 2-259.) allows the user to view the system detector reports.

From the Reports Menu (Figure 2-257.), press **2-SYS SET**.

```
SYSTEM - SYS DET REPORT
BEGIN:    /     :    INT:     MULT:
DETECTOR...1...2...3...4...5...6...7...8
RAW VOL:
RAW OCC:
AVOL%..:
ACO%...:
UP/DOWN - PREV/NEXT WINDOW     C-CLEAR
```

Figure 2-259. System Detector Report Display

See Section 2.10.2.4 for complete details on this report.

2.11.3   Detector Fault Report

The Detector Fault Report display (Figure 2-260.) allows the user to view the list of detector faults along with the date and time of occurrence.

From the Reports Menu (Figure 2-257.), press **3-DET FAULTS**.

```
SYSTEM - DETECTOR FAULT REPORT
  MM/DD  HH:MM   -------STATUS-------
   9/20  10:20  VEH 1 - FAIL ERR CNTS
   9/20  12:10  SPC 2 - FAIL MAX PRES
   9/20  13:15  VEH 1 - ON LINE
   9/20  23:55  SPC 3 - FAIL NO ACTY

UP/DOWN - PREV/NEXT WINDOW     C-CLEAR
```

Figure 2-260. System Detector Fault Report Display

See Section 2.10.3.3 for additional details on this report.

2.11.4   Local Alarm Report

The Local Alarm Report display (Figure 2-261.) allows the user to view the list of local events along with the date and time of occurrence.

From the Reports Menu (Figure 2-257.), press **4-ALARMS**.

```
SYSTEM - LOCAL ALARMS REPORT
  MM/DD  HH:MM   -------STATUS-------
   6/12  14: 4  CFGDATA INITIALIZE
   6/12  14: 4  POWER ON
   6/12  14: 4  NO COORD - COMND FREE
   6/12  14: 9  POWER OFF
   6/12  14:11  POWER ON
UP/DOWN - PREV/NEXT WINDOW     C-CLEAR
```

Figure 2-261. System Local Alarms Report Display

See Section 2.10.4.2 for additional detail on this report.

2.11.5   Local MOE Report

The Local MOE Report display (Figure 2-262.) allows the user to view the pattern related MOE reports by beginning date and time.

From the Reports Menu (Figure 2-257.), press **5-MOEs**.

```
SYSTEM - LOCAL MOE'S
BEGIN:  9/21  07:15         PAT: 003
PHASE......1...2...3...4...5...6...7...8
VOLUME.:  50 100  50 100  50 100  50 100
STOPS..:  40  20  40  70  40  20  40  70
DELAY..:  30  55  30  30  30  50  30  30
UTILIZ.:  15  35  10  30  10  40  15  25
UP/DOWN - PREV/NXT WINDOW      C-CLEAR
```

Figure 2-262. System Local Moe's Report Display

See Section 2.10.5 for additional detail on this report.

2.11.6 Speed Trap Report

The Speed Trap report (Figure 2-263.) allows the user to view the pattern related speed reports, as a percentage within, below, and above the specified range. The values are identified by beginning date and time of pattern implementation.

From the Reports Menu (Figure 2-257.), press **6-SPEED**.

```
SYSTEM - SPEED REPORT
  --- BEGIN --         PERCENT OF TOTAL
 MM/DD  HH:MM   PAT    LOWR   W/IN   HIGH
 09/21  07:15   005    10     80     10



UP/DOWN - PREV/NEXT WINDOW        C-CLEAR
```

Figure 2-263. System Speed Report Display

See Section 2.10.6.3 for additional detail on this report.

2.11.7 Cycle MOE Report

The Cycle MOE Report (Figure 2-264.) allows the user to view a cycle-by-cycle listing of green utilization for each pattern.

From the Reports Menu (Figure 2-257.), press **7-CYCLE MOEs**.

```
SYSTEM - CYCLE MOE
BEGIN: 15:45:00    DBASE        PAT: 002
PHASE......1...2...3...4...5...6...7...8
UTILIZ.:  20  20  20  20  20  20  20  20
PHASE......9..10..11..12..13..14..15..16
UTILIZ.:
FORCE..:
UP/DOWN - PREV/NXET WINDOW        C-CLEAR
```

Figure 2-264. System Cycle Moe Report Display

Information on this report includes the following:

BEGIN (HH:MM:SS) – Denotes the time (hour, minute, and second) the cycle began.

DBASE – This data denotes the status of coordination for the cycle. The following lists the possible status of the cycle:

- ♦ DBASE – A database reference for the following cycle data. A DBASE entry will be maintained for as long as any cycle data follows for a specific pattern which started at the specified time.
- ♦ TRANS – The first cycle for a coordination pattern.
- ♦ CORR+ – A cycle in which an offset correction extended the cycle.
- ♦ CORR- – A cycle in which an offset correction shortened the cycle.
- ♦ COORD – A cycle in which there was no offset correction.
- ♦ FREE – An entry to denote that coordination was terminated to operate in non-coordinated.

PAT – Denotes the pattern the report is for.

UTILIZ – Denotes the per-cycle phase utilization. This data will be a negative value when the phase uses less than the entered pattern time and positive when the phase uses more than the entered pattern time.

FORCE – Phase force mask.

The Cycle MOE report has the capacity to store up to 60 cycles of data. Cycle MOE data appears in the order in which it occurs. The initial display shows the oldest. The UP and DOWN keys allow the user to page through the report. The control key C allows the clearing of the report log.

2.11.8   MMU Faults Log

The MMU Faults Log display (Figure 2-265. and Figure 2-266.) allows the user to view a history of MMU or CMU reported faults. The MMU status logged is reported to the CU via TS 2 Port 1. The CMU status logged is reported to the CU via SB1.

From the Reports Menu (Figure 2-257.), press **8-MMU/CMU FAULT**.

```
LOGGING - MMU FAULT           MM/DD  HH:MM
  RED FAILURE                 06/12  14:57
CHNL=12345678 90123456 78901234 56789012
FLT:
RED: 01101110 11111111
YEL: 00000000 00000000
GRN: 00000000 00000000
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 2-265. MMU Fault Log Display (TS 2)

```
LOGGING - CMU FAULT           MM/DD  HH:MM
  007=CU NFSA Flash (62)      04/38  23:24
CHNL=12345678 90123456 78901234 56789012
FLT:
RED: 11111111 ........ ........ ........
YEL: ........ .....1.. ........ ........
GRN: ........ ........ ........ ........
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 2-266. CMU Fault Log (ATC/ITS/CBD)

This display provides the following information:

MM/DD (Date) – This display denotes the date (month and month day) of the fault.

HH:MM (Time) – This display denotes the time of day (hour and minute) of the fault.

STATUS (Fault) – This display denotes description in English of the fault detected.

The list of possible MMU faults for TS 2 cabinets is as follows:

- UNKNOWN FAULT (logged for MMU2 FYA Flash Rate Fault)
- CONFLICT FAULT
- RED FAILURE
- FIELD CHECK FAULT
- DUAL INDICATION FAULT

- BND FAULT (Recurrent Pulse)

- EXTERNAL WDOG FAULT

- MMU DIAGNOSTIC

- MIN CLEARANCE FAULT

- PORT-1 TIMEOUT

- CONTROLLER VOLTAGE MON

- +24 VOLT MONITOR I

- +24 VOLT MONITOR II

The list of possible CMU faults is:

- 000=No Fault

- 001=CMU/AMU +24 VDC

- 002=CMU +12 VDC

- 003=Conflict

- 004=Serial Bus #1

- 005=Serial Bus #3

- 006=CU LFSA Flash (Type 62)

- 007=CU NFSA Flash (Type 62)

- 008=Diagnostic

- 009=Multiple

- 010=Lack of Signal Input

- 011=Short Yellow Clearance

- 012=Skipped Yellow Clearance

- 013=Yellow + Red Clearance

- 014=Field Output Check

- 015=Serial Memory Key absent

- 016=Serial Memory Key FCS error

- 017=Serial Memory Key Data error

- 018=Local Flash

- 019=Circuit Breaker Trip

- 020=CMU/AMU AC+MainFault

- 021=NRESET Active

CHANNEL (Status) – The status of each channel input at the time of the fault.

The MMU/CMU Fault Log display has the capacity to store up to 24 events. Fault log data appears in the order in which it occurs. The initial display shows the oldest. The UP and DOWN keys allow the user to page through the report. The control key C allows the clearing of the report log.

2.11.9   System Message

The System Message display (Figure 2-267) allows the user to view a message downloaded via the Central System for viewing at this CU.

From the Reports Menu (Figure 2-257.), press **9-SYS MSG**.

```
DISPLAY OF SYSTEM MESSAGE




                              C-CLEAR
```
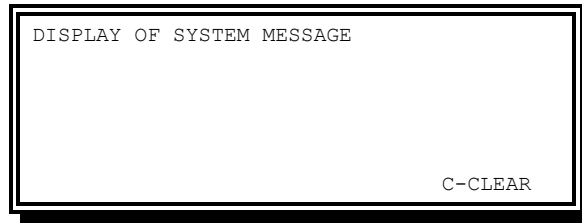
Figure 2-267. System Message Display

This screen can display six lines of 40 characters. The definition and download is through communications with a computer.

2.11.10   Peer-to-Peer Report

The Peer-to-Peer Report display allows the user to view a history of Peer-to-Peer Source connections. This display logs changes in a connection status, i.e., Active -> ConErr. It will also log new connections being made upon Unit Bank changes or configuration changes. It logs disconnects and the reason when the CU did not initiate the disconnect, i.e., a Unit Bank change will not log all of the previous Bank's peers becoming inactive.

```
PEER-TO-PEER REPORT
 MM/DD HH:MM  ----PEER----     -STATUS-
  1/14  0:36  Fail01           Active
  1/14  0:36  Fail02           Refuse
  1/14  0:36  Fail03           DstUnr
  1/14  0:36  Fail04           ConnErr
  1/14 22: 0  Unit Bank 3 Acti BankChg
UP/DOWN - PREV/NEXT WINDOW     C-CLEAR
```
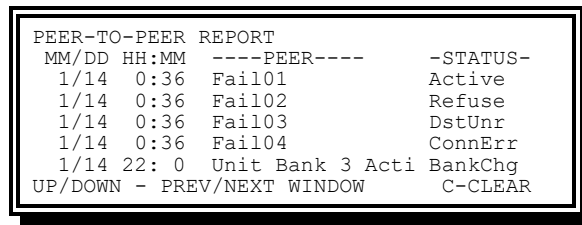
Figure 2-268. Peer-to-Peer Report Display

Information in this report includes the following:

MM/DD (Date) – Denotes the date (month and month day) of the entry.

HH:MM (Time) – Denotes the time of day (hour and minute) of the entry.

PEER (Peer Source Name) – Denotes the name of the Peer that caused the entry.

STATUS (Peer Status) – Denotes the status that caused the entry.

Table 2-15. Peer-to-Peer Report Status	
Status	**Description**
Active	Connected and Active
Refuse	Connection was refused by the Peer
DstUnr	Destination was unreachable via the current network settings.
ConnErr	Disconnected because of a network error or timeout.
DupId	Peer responded with DupId, meaning it already has a Peer with the same System Address. Only reported by NextPhase CU's.
SrvFul	Peer responded it is full of subscriptions.
BankChg	Unit Bank was changed. The PEER entry will be populated with a description of what Unit Bank became active.

2.12   Copyright

The Yunex Traffic SEPAC software that operates in SEPAC M50/M60 and 2070 ATC units is copyrighted. To read that notice and additional information about the unit:

From the Main menu (Figure 2-1), press A-COPYRIGHT.

```
COPYRIGHT (c) 1984-2021    SIEMENS ITS
          ALL RIGHTS RESERVED
 WARNING: This program is protected by
copyright law and international treaties


          1-BUILD INFO
```

Figure 2-269. Copyright Display

From the copyright display (Figure 2-269.), press **1-BUILD INFO**.

```
MVP TYPE: ATCnx                BUILD: 80
Sw OP: TS2                 Jan 25 2021
Linux: eInfoChips ATC8309 1.4.0


I/O MAP: NOT PRESENT
LAT  3018.9500 N TIME 192015
LON 09752.0926 W DATE 070621 LOCK=A
```

Figure 2-270. Build Information Display

NOTE: Display shown for CU with GPS enabled and running.

The Copyright more information display provides the following information:

MVP TYPE – Vendor hardware types:

- ♦ ATCnx – Yunex Traffic Linux CU (all types)
- ♦ UNKNOWN – Hardware vendor unknown
- ♦ ETCS – Yunex Traffic 2070 OS-9 CU
- ♦ ETCS-2 – Yunex Traffic NEMA OS-9 CU
- ♦ SAFETRAN
- ♦ NAZTEC
- ♦ ECONOLITE
- ♦ MCCAIN
- ♦ OTHER_2070

BUILD – Build number, to be used when reporting issues.

Sw OP – Software Options (FIO, TS2, ITS, ATC, NYS, CBDv1, CBDv2)

Build date

Linux – Linux hardware and BSP version

I/O MAP – Displays whether an iomap is present or not

- • NOT PRESENT – No I/O MAP is loaded
- • PERSENT – I/O MAP is present and running
- • ERROR – I/O MAP is present but invalid and is not running

GPS information:

- • LAT – Latitude North or South in degrees × 100 (0000.0000 – 9000.0000)
- • LON – Longitude East or West in degrees × 100 (00000.0000 – 18000.0000)
- • TIME – UTC time of day in hhmmss format
- • DATE – UTC date in MMDDYY format
- • LOCK – 'A' when GPS unit has acquired a lock, '*' when not acquired or not present

2.13 Function Key Usage

When using a 16-line display (i.e., 2070 ATC with a 2070-3D front panel or Yunex Traffic M60 unit) it is possible to program the bottom 8 lines to display any SEPAC screen. The primary way of navigating on the bottom 8-lines is using the Function Keys (F1, F2, F3, F4, and F5). Pressing a Function Key will bring up the corresponding screen on the bottom 8 lines of the display.

2.13.1 Yunex Traffic M60 Vendor Specific Keys

The Yunex Traffic M60 controller unit introduced some new keys to the front panel. These are F1, F2, F3, F4, F5, HELP, and PREV. These keys are mapped in hardware to be compliant with the ATC specified key codes as follows.

Table 2-16. Function Key to ATC Vendor Key Mappings	
Yunex Traffic M60 Key	**ATC Key Code**
F1	Vendor Specific Key 1
F2	Vendor Specific Key 2
F3	Vendor Specific Key 3
F4	Vendor Specific Key 4
F5	Vendor Specific Key 5
HELP	Vendor Specific Key 6
PREV	Vendor Specific Key 7

2.13.2   Default Mappings

The following are the default mappings for the Function Keys for SEPAC.

Table 2-17. Function Key Default Displays		
Key	**Screen #**	**Screen Description**
F1	F-1-1-1	Active Status for Rings 1&2
F2	F-1-2-1	Coord Timers
F3	F-1-9-5	Final Input Status
F4	F-1-4	Time Base Status
F5	F-1-5	Communication Status

2.13.3   Programming Function Keys

To program the Function Keys, go to the desired screen on the top half of the display, then press and hold the desired Function Key for 1 second. After that, the bottom half will duplicate the screen from the top half. This is confirmation that it has been programmed properly.

The only screens that cannot be programmed to the Function Keys are the Diagnostic screens.

Programming the Function Keys is only available Front Panel hardware compliant with ATC v6 or higher, as it needs to support the key polling Inquiry Command-Response code: **ESC [K n**. On hardware that does not support key polling, programming the Function Keys will be unavailable and a possible "n" artifact could display on the screen.

2.13.4   Auto-Help

The HELP key switches the bottom half of the screen to Auto-Help mode. This mode displays the help text for the field that is currently selected on the top half of the screen. The help

text updates when the cursor is moved on the top half of the screen and the cursor stops moving for more than 2 tenths of a second.

To navigate on the bottom half while in Auto-Help mode use the PREV and NEXT keys. To get out of Auto-Help mode either press HELP again or press a Function Key.

2.13.5 Alternate Key Sequences

For controllers that have a 16-line display but do not have F1-F5 keys, there is a second method for controlling the bottom half of the screen. Below is a table that lists the alternate key sequence that corresponds to each Function Key.

Table 2-18. Function Key Alternate Key Sequences	
Yunex Traffic M60 Key	**Alternate Key Sequence**
F1	* * 1
F2	* * 2
F3	* * 3
F4	* * 4
F5	* * 5
HELP	* * +
PREV	* * -

For the Alternate Key Sequence, each key press in the sequence must be within 1 second of the previous key press or else the sequence is aborted.

To program screens, use the alternate key sequence and hold the third key press of the sequence. This will be equivalent to long pressing the Function Key as mentioned in Section 2.13.3.

3 Function

A CU with SEPAC 5.3.0 software is one of the most advanced full featured, fully actuated traffic CUs specifically designed for the traffic controller market.

3.1 General

Inputs, outputs, functions, and programming controls are separated into the following three categories:

> Per phase
>
> Per ring
>
> Per unit

3.2 Per Phase

This section includes inputs, outputs, functions, and programming controls, which are provided on a per phase basis.

3.2.1 Time Settings

The following functions, with the associated minimum timing ranges and maximum increments, are provided:

Table 3-1. Phase Intervals and Ranges

Function	Range Seconds	Increments Seconds
Min Green	1-255	1
Passage Time	0-25.5	0.1
Maximum 1	1-255	1
Maximum 2	1-255	1
Yellow Change	0-25.5	0.1
Red Clearance	0-25.5	0.1
Dynamic Max Limit	0-255	1
Dynamic Max Step	0-25.5	0.1
Bike Lane Green Time	0-25.5	0.1
Bike Lane Passage	0-25.5	0.1
Green Delay	0-25.5	0.1
Yellow Delay	0-25.5	0.1
Walk1	0-255	1
Walk2	0-255	1
Pedestrian Clearance1	0-255	1
Pedestrian Clearance2	0-255	1
Walk Offset	0-25.5	0.1
Added Initial	0-25.5	Per actuation
Maximum Initial	0-255	1
Time Before Reduction	1-255	1
Time to Reduce	1-255	1
Minimum Gap	0-25.5	0.1

Zero is satisfied by any time between zero and 100 milliseconds.

3.2.2   Phase Intervals

Green interval – Actuated phase

- ♦ Without volume density – The green interval is a variable interval dependent upon vehicle actuations. The green interval time is limited by the maximum green time function which commences timing upon registration of a serviceable conflicting call. The minimum green time is not preempted by a maximum green termination.

♦ All green time after minimum green is considered the extensible portion of the green or part of the passage time period. Passage time times the time between successive vehicle actuations. If the passage time times out in the presence of a serviceable conflicting call, the phase is said to be gapped out, which is a condition for phase termination.

♦ Three time settings are provided for determination of green timing on an actuated phase without volume density.

   ♦ Minimum green – The first timed portion of the green interval that may be set in consideration of the storage of vehicles between the zone of detection for the approach vehicle detector(s) and the stop line.

   ♦ Bike Minimum green – The first timed portion of the green interval that may be set in consideration of the storage of bicycles between the zone of detection for the approach bicycle detector(s) and the stop line.

   ♦ Passage time (vehicle interval, preset gap) – The extensible portion of the green is a function of vehicle actuations that occur during the green interval. The phase remains in the extensible portion of the green interval as long as the passage timer is not timed out.

     The timing of this portion of the green interval is reset with each subsequent vehicle actuation and does not commence to time again until the vehicle actuation is removed from the CU. The duration of the green interval is subject to the limit of the maximum green.

   ♦ Bike Passage time (bicycle interval, preset gap) – The extensible portion of the green is a function of bicycle actuations that occur during the green interval. The phase remains in the extensible portion of the green interval as long as the passage timer is not timed out.

     The timing of this portion of the green interval is reset with each subsequent bicycle actuation and does not commence to time again until the bicycle actuation is removed from the CU. The duration of the green interval is subject to the limit of the maximum green.

   ♦ Maximum green – This time setting determines the maximum length of time this phase may be held green in the presence of a serviceable conflicting call. In the absence of a serviceable conflicting call the maximum green timer is held reset.

♦ With volume density – In addition to minimum green, passage time, and maximum green timing functions, phases provided with volume density operation includes variable initial timings and gap reduction timings.

The effect on the variable initial timing is to increase the timing in a manner dependent upon the number of vehicle actuations stored on this phase while its signal is displaying yellow or red.

The variable initial time is a computed value that is at least as large as the minimum green time and not more than the maximum initial time. With these boundaries observed the computed value is the product of the number of non-green actuations and the seconds/actuation time value.

The effect on the extensible portion is to reduce the allowable gap between successive vehicle actuations by decreasing the extension time in a manner dependent upon the time waiting of vehicles on a conflicting phase.

Variable initial – The variable initial timing period is determined by an interrelationship of two time settings as described below:

♦ Minimum green setting determines the minimum variable initial time period.

♦ Added initial setting determines the time by which the variable initial time period will be increased from zero with each vehicle actuation received during the associated phase yellow and red intervals.

♦ The maximum of the variable initial timing period is capable of being (on a per-phase basis) in the range of 0-255 seconds with increments of one second. The maximum initial setting is subordinate to minimum green time setting.

♦ Initial timing equals (added initial) multiplied by (number of actuations) within the constraint of maximum initial and is not less than minimum green.

♦ Gap reduction – The gap reduction function is accomplished by means of the following functional settings:

  ♦ Time before reduction

  ♦ Cars before reduction

  ♦ Passage time

  ♦ Minimum gap

  ♦ Time to reduce

The time before reduction period begins when the phase is green and there is a serviceable conflicting call. If the serviceable conflicting call is withdrawn while timing this period, the timer is reset and remains reset until the next serviceable conflicting call is received. During this time, the value that the gap timer must reach to cause a gapped-out status is equal to be the passage time.

The cars before reduction count begins in the green extensible portion to calculate the sum of the conflicting cars waiting. If the serviceable conflicting calls are withdrawn, the count is held reset until the next serviceable conflicting call is received. During the period until the count equals the cars before reduction setting, the value that the gap timer must reach to cause a gapped-out status is equal to the passage time.

Upon completion of the time before reduction period or cars before reduction, the linear reduction of the allowable gap from the passage time level begins. The time period in which this reduction occurs is called time to reduce.

The rate of reduction is based on the setting of the passage time, minimum gap, and time to reduce controls. This method reduces the allowable gap at a rate equal to the difference between the passage time and minimum gap setting divided by the setting of the time to reduce control.

The reduction of the allowable gap continues until the gap reaches a value equal to or less than the minimum gap as set on the minimum gap control after which the allowable gap remains fixed at the values set on the minimum gap control. In

the presence of a continuous vehicle actuation, the phase will not gap out even if the gap is reduced to zero (for example, minimum gap set at zero).

If at any time the serviceable conflicting call is withdrawn, the gap reverts to the passage time setting value, and the time before reduction period timer is reset and remains reset until the next serviceable conflicting call is received.

The CU has a provision that modifies the gap timing when a gap-out occurs. When programmed to enable last car passage and a gap-out occurs, the CU times a period equal to the difference between the passage time setting and the value of the gap-in-effect at the time of the gap-out before terminating the phase. The period is referred to as the last car passage interval.

Pedestrian timing, concurrent

Concurrent pedestrian timing is permitted in association with any mode of vehicle signal timing. Two time settings are provided:

◆ Walk1 – Controls the amount of time the primary walk indication will be displayed when the pedestrian call button is held for less than one second or during ped recall.

◆ Walk2 – Controls the amount of time the alternate walk indication will be displayed when the pedestrian call button is held for more than one (MUTCD §4E.06 ¶09).

◆ Pedestrian Clearance1 – Controls the duration of the primary pedestrian clearance output and the flashing period of the don't walk output when the pedestrian call button is held for less than one second or during ped recall.

◆ Pedestrian Clearance2 – Controls the duration of the secondary pedestrian clearance output and the flashing period of the don't walk output when the pedestrian call button is held for more than one second (MUTCD §4E.06 ¶09).

When a pedestrian call is stored in pedestrian memory and pedestrian indications are concurrent with an associated vehicle phase, the pedestrian sequence commences service when entering the vehicle green of that phase unless the pedestrian omit line is activated.

During the display of the walk and pedestrian clearance indications, a concurrent green vehicle indication is shown. It is possible to recycle the pedestrian indications in response to succeeding pedestrian calls for service subject to absence of serviceable conflicting calls (vehicle or pedestrian) and non-activation of the pedestrian omit line.

Actuated phase operating in the non-actuated mode

The actuated phases that are converted to non-actuated operation by activation of either the call to NA inputs have a permanent demand placed for vehicle and pedestrian service. Each such phase is equipped with pedestrian timing capability.

These phases are considered to have the four green states.

◆ State A is the minimum timing state. The duration of State A is equal to the walk time setting. Signal indications for State A is green and walk.

◆ State B is a state immediately following the minimum timing state. The CU dwells in this state in the presence of a hold input or when the walk rest

modifier is active, and no serviceable conflicting call exists. The signal indications remain in green and walk. The CU leaves this state when the hold input is not active; or when the hold input is active, a serviceable conflicting call exists, and the force off input is activated. If the phase hold is active and the force off is activated when the phase is active and a serviceable conflicting call does not exist, the CU continues to dwell in State B of the phase.

♦ State C is the pedestrian clearance state. During State C, the phase activates its pedestrian clearance output and flashes its don't walk output. The duration of the state is equal to the pedestrian clearance setting. The phase times the clearance and, upon completion of the timing, advance to State D.

The duration of the Green interval will not be less than the setting of the minimum green control. In those instances where the sum of the walk timing (State A), the hold state (State B), and the pedestrian clearance timing is less than the setting on the minimum green control, the CU will remain in State C until the phase has displayed a green indication for a time equal to the minimum green time setting and will display a steady don't walk.

♦ State D is a green dwell/select state from which the CU may select the next phases(s) to be serviced. During State D signal indications are green and steady don't walk. When a serviceable conflicting call does not exist and the pedestrian recycle input is active, or when a serviceable conflicting call does not exist and the walk rest modifier is active, the phase returns to State A and retime the walk interval. If the pedestrian recycle input is not active and the walk rest modifier is not active, the pedestrian movement does not recycle.

Each green interval will provide a response to the phase hold input. In those instances where the non-actuated State B (walk hold) has not appeared because of a transition to non-actuated during that green, the CU will hold in State D.

In the presence of external signals which may be used for coordination, the sequence of these states is as follows.

The green interval begins with the existence of State A. Upon the completion of this state the CU exits to State B. If the hold input is active at this point, the CU remains in this state. If force off is applied and if a serviceable conflicting call exists, the CU advances to State C; otherwise, State B exists as long as hold remains active. If hold is released while the CU is in State B, the CU advances to State C without regard to the presence of a serviceable conflicting call. If the CU advances to State C, it will advance to State D even in the presence of hold. When in State D, the CU terminates the phase if a serviceable conflicting call exists. If no serviceable conflicting call exists, the CU returns to State A of this interval if pedestrian recycle is active. If pedestrian recycle is not active and no serviceable conflicting call exists, the CU rests in State D. The hold function has no effect on the duration of State D.

The duration of the green interval is not less than the setting of the minimum green control. In those instances where the sum of the walk setting, the hold state duration, and the pedestrian clearance setting is less than the setting on the minimum green control, the CU remains in State C until the phase has displayed a

green indication for a time equal to the minimum green time setting and displays a steady don't walk.

Termination of green timing – Green timing termination occurs in response to one of the following conditions:

♦ Interval advance when timing the last portion of the Green interval.

♦ Interval advance with manual control enable activated.

♦ Initial including variable portion completed, the pedestrian service completed, a serviceable conflicting call, and one of the following:

   ♦ Passage time timed out without hold applied.

   ♦ Reduced gap timed out without hold applied.

   ♦ Maximum green termination without hold applied.

   ♦ Force off applied.

♦ Initial including the variable portion completed, the pedestrian service completed, red rest activated and passage time time-out without hold applied.

Green timing termination in multiple ring controller configurations, unless programmed otherwise, provide for simultaneous termination. Simultaneous termination, when timing phases concurrently with the next serviceable call on a phase that conflicts with more than one of the phases timing (about to cross a barrier), ensures that all phases which will terminate must simultaneously reach a point of being committed to terminate before green timing termination will begin (for example, gap out, max out, and force off). See Section 3.4.2.

Vehicle change and clearance intervals – Following the green interval of each phase the CU provides a yellow change interval that is timed according to the yellow change timing control for that phase.

Following the yellow change interval for each phase, the CU provides a red clearance interval which is timed according to the red clearance timing control for that phase. During this red clearance interval, no green indication will be shown to any conflicting phase. This red clearance interval is subject to omission in response to operation of the per ring omit red clearance input.

Pedestrian timing, exclusive – Exclusive pedestrian service is permitted. When servicing a pedestrian movement exclusively, no other phase will be active. It is not required in a dual ring CU to provide more than two phases in the second timing ring when exclusive pedestrian timing is employed in the other timing ring, neither of which can be employed on the same side of the barrier with the exclusive pedestrian phase.

It is not required in a four-phase sequential CU to provide more than three phases in addition to an exclusive pedestrian phase.

Two time settings will be required on the phase, walk and pedestrian clearance.

When a pedestrian call is stored in pedestrian memory, the exclusive pedestrian phase will be serviced with appropriate consideration of its order in the priority of phase sequencing.

The exclusive pedestrian phase rests with a steady don't walk indication displayed. It is possible to recycle the pedestrian indication in response to succeeding pedestrian calls for service, subject to absence of serviceable conflicting calls (vehicle or pedestrian) and non-activation of the pedestrian omit line.

Dynamic maximum – The CU provides an optional feature that provides a phase-by-phase adaptive max operation based on vehicle demand.

Adaptive protected/permissive – The CU provides an optional adaptive protected/permissive operation. This control measures the volume of turn vehicle traffic and available gap windows in the opposing through vehicle traffic to determine whether the turn should operate protected or permissive.

This operation is capable of being disabled through time base event or system command.

3.2.2.1 Switched Pedestrian Phases (Legacy Ped Overlap)

Switched Pedestrian Phase is defined here as the ability to program phase pedestrian outputs so that the pedestrian outputs are active with more than one phase. The programming is as follows:

If either phase is timing walk, the pedestrian outputs display walk. If the assigned phase is walk and the switched phase is next in the ring structure based on the active sequence and has a pedestrian call, the walk will remain walk until the switched phase completes it walk timing.

If neither phase is timing walk but one of the phases is timing pedestrian clear, the pedestrian outputs display pedestrian clear (FDW).

If neither phase is timing walk or pedestrian clear, the pedestrian outputs display Don't Walk.

If multiple pedestrian detectors have the same assigned phase entries but different non-zero switched phase entries, they will be used as additional pedestrian timings to be OR'd into the control.

When ALL assigned active (walk and pedestrian clear times <> 0) pedestrian detectors have the same switched phase entries, a concurrent/exclusive pedestrian operation is assumed. When this condition exists, the absence of a phase omit on the exclusive (switched phase) phase causes a continuous ped omit to occur on the assigned phase. When this condition exists, the exclusive (switched phase) phase will receive the assigned phase pedestrian calls regardless of pedestrian operation (concurrent/exclusive).

Exclusive pedestrian omits are subject to hardware inputs, TBC phase functions, and coordination phase omits.

3.2.2.2 Pedestrian Concurrent/Exclusive

The Switched Pedestrian Phase capability above makes it possible have pedestrian outputs that are concurrent or exclusive at different times of day.

Time-of-day (free) – Use a phase function to activate the exclusive phase omit at the appropriate time(s). Concurrent when true. Exclusive when false.

The Switched Pedestrian Phase capability above makes it possible have pedestrian outputs that are concurrent or exclusive based on pattern.

Due to the reliance on the servicing of an existing coordination phase pedestrian movement in the permissive and yield modes of coordination, those coordination modes do not support the exclusive pedestrian functionality. When one of these coordination modes is operational, the exclusive phase is omitted.

The exclusive pedestrian function is only compatible with those coordination modes that support an actuated pedestrian movement on the coordination phases (permissive yield, permissive omit, sequential omit and full actuated).

Pattern (coord) – When the exclusive phase mode equals phase omit, concurrent pedestrian operation will occur. When the exclusive phase mode <> phase omit, exclusive pedestrian operation will occur.

3.2.3   Phase Selection Points

The phase next to be serviced is determined at the end of the green interval of the terminating phase; except that if the decision cannot be made at the end of the green interval, it will not be made until after the end of all vehicle change and clearance intervals.

3.2.4   Provision for Storing a Demand

There is a provision for storing a call for vehicle service on each vehicle phase when that phase is not displaying a green indication. The vehicle memory feature is capable of being disabled through program entry. There is a provision for storing a call for pedestrian service on phases equipped with pedestrian time setting when that phase is not displaying a walk indication.

3.2.5   Placement of Vehicle Recall

Minimum vehicle recall – Means are provided, through program entry, to place a recurring demand for vehicle service on the phase when that phase is not in its green interval.

Maximum vehicle recall – Means are provided to place a call on a phase, through program entry, such that the timing of the green interval for that phase is extended to maximum green time.

When such a call is placed, the maximum timing commences to time as if there were always a serviceable conflicting call, but the phase does not terminate unless there is an actual serviceable conflicting call.

Soft vehicle recall – Means are provided to place a demand for vehicle service in memory only when:

- ♦ A conflicting phase is in green or red dwell and
- ♦ There are no serviceable conflicting calls.

Recall delay – Means are provided such that recall operation does not occur until after an adjustable period (0-255 seconds in increments of one second) following a phase termination. The delay is applicable to vehicle min, max, and soft recall, and

pedestrian recall. The delay begins the instant operation exits the phase. The timing continues regardless of demands on other phases.

3.2.6   Placement of Pedestrian Recall

Pedestrian recall – Means are provided to place a recurring pedestrian demand, through program entry, which functions in the same manner as an external pedestrian call except that it does not recycle the pedestrian service until a conflicting phase is serviced.

Pedestrian NA recall – Means are provided to force the phase to operate as an non-actuated phase.

Pedestrian NA+ recall – Means are provided to force the phase to operate as a non-actuated phase. On initial entry to a phase, so programmed, the walk time will be set equal to the longer of the walk time parameter or the called maximum time parameter (Max 1 or Max 2). A recycle of the pedestrian within the phase will result in the walk time being set equal to the walk time parameter.

An active call to non-actuated input, for which the phase is programmed to respond, will result in the walk time being set equal to the walk time parameter.

Running internal coordination will result in walk time being set equal to the walk time parameter.

Recall delay – Means are provided such that recall operation does not occur until after an adjustable period (0–999 seconds in increments of one second) following a phase termination. The delay is applicable to vehicle min, max, and soft recall, and pedestrian recall. The delay begins the instant operation exits the phase. The timing continues regardless of demands on other phases.

3.2.7   Placement of Call at Phase Termination

When a phase is terminated with time remaining in the passage time, a call is left on that phase. Disabling the vehicle call memory defeats this feature. If a phase is terminated with no passage time remaining, no call is left on the phase.

3.2.8   Conditional Service

Conditional service provides an optional method for phase selection. When timing phases concurrently with the next serviceable call on a phase that conflicts with more than one of the phases timing (about to cross a barrier), if one of the phases is prepared to terminate due to gap out or max time out, the ring containing the timed-out phase reverts to a preceding vehicle phase if all of the following conditions apply:

A call exists on a preceding actuated vehicle phase. (Non-actuated phases are not conditionally re-serviced).

The gapped/maxed phase is enabled for conditional service through program entry.

There is sufficient time remaining before max time out of the phase(s) not prepared to terminate.

The CU is not in coordinated mode.

3.2.9   Automatic Pedestrian Clearance

The CU design provides an alternate mode of operation to enable the CU timing of the pedestrian clearance interval when manual control enable is active.

When enabled, through program entry, this feature prevents the pedestrian clearance interval from being terminated by the interval advance input.

3.2.10   Flashing Walk

Means are provided to cause the walk output will be flashing during walk timing.

3.2.11   Actuated Rest-In-Walk

Means are provided to provide an alternate mode of pedestrian dwell for an actuated phase. The actuated phase will rest in walk when so programmed and there is no serviceable conflicting call at the end of the walk timing.

3.2.12   Walk Offset (Advance or Delay)

Means are provided to cause the start of walk output to be offset from start of the green output. The offset will be selectable to cause either an advanced or delayed walk output in respect to the phase green.

3.2.13   Inputs per Phase

The CU will provide the following input features on a per phase basis:

Hold (In the applicable mode) – Command that retains the existing green indications and has different CU responses depending on operation in the vehicle-actuated or non-actuated mode. The operation is as follows:

- It is effective in the non-actuated mode:

  - During the walk hold state.

  - During the green don't walk state if the walk hold state did not occur in the non-actuated mode.

- It is effective in the actuated mode:

  - During the green don't walk state.

For a non-actuated phase, activation of the hold input maintains the CU in the timed-out walk period (walk hold) with a green and walk indication displayed. activation of the hold input while timing the walk portion does not inhibit the timing of this period.

De-activation of the hold input and with the walk interval timed out causes the CU to advance into the pedestrian clearance interval (with walk rest modifier input inactive). Re-application of the hold input while timing the pedestrian clearance portion of the green interval neither inhibits the timing of this period nor termination of the phase.

The CU provides for transition to and from non-actuated mode immediately. This feature presents the possibility that a phase may become non-actuated without having the opportunity to respond to the hold input in a walk hold state. Therefore, a non-actuated phase will hold in the green don't walk state if the walk hold state did not occur in the non-actuated mode.

- ♦ For an actuated phase, activation and de-activation of the hold input is as follows.

  Activation of the hold input allows the CU to time normally but inhibits its advance into the vehicle change interval. Activation of the hold input inhibits the recycle of the pedestrian service unless the pedestrian recycle input is active and a serviceable pedestrian call exists on the phase. The rest state indication for that phase is green for vehicle traffic and don't walk for pedestrians.

  De-activation of Hold input allows the CU to advance into the green dwell/select state when all green periods are timed out.

  De-activation of hold input with all intervals timed out, allows the CU to recycle the walk interval if there is no conflicting demand for service and a pedestrian call exists for that phase. However, if there is any serviceable demand on a conflicting phase with the hold de-energized and with all intervals timed-out, the CU advances into the yellow change interval and will not recycle the Walk on that phase until those demands have been served.

Phase omit (In the applicable mode) – Input to cause omission of a phase, even in presence of demand, by application of an external signal. It affects phase selection. The omission will continue in effect until the signal is removed. The phase to be omitted will not present a conflicting call to any other phase but will accept and store calls. Activation of this input will not affect a phase in the process of timing.

Pedestrian omit (In the applicable mode) – Input to inhibit the selection of a phase due to a pedestrian call on that phase and to prohibit the servicing of a pedestrian call on the phase. This input when active prevents the starting of the pedestrian movement of that phase. After the beginning of the phase green, a pedestrian call will be serviced or recycled only in the absence of a serviceable conflicting call and with pedestrian omit on the phase non-active. Although it does not prohibit the servicing of a phase itself, it will not allow the pedestrian calls to be serviced. Pedestrian calls that are omitted, therefore, are not serviceable conflicting calls. Activation of this input will not affect a pedestrian movement in the process of timing.

3.2.14   Outputs per Phase

The CU will provide the following output features on a per phase basis:

Load switch drivers, basic vehicle (three per phase) – Provision for separate green, yellow, and red outputs for each basic vehicle phase. A circuit closure to logic ground is maintained at one of these three outputs at all times. The three outputs energize the appropriate vehicle signal load switching circuit to result in a green, yellow, or red indication for the required duration of such indication.

Load switch drivers, pedestrian (three per phase) – Provision of separate walk, pedestrian clearance, and don't walk outputs for each pedestrian movement. A circuit closure to logic ground is maintained on at least one of these three outputs at all times. The three outputs energize the appropriate pedestrian signal load switching circuit to result in a walk, pedestrian clearance, or don't walk indication. The don't walk output flashes only during the pedestrian clearance interval.

The don't walk flashing provides an alternating true/false output at 1 pulse per second repetition rate with 50 ±2 percent duty cycle.

Check (in the applicable mode) – An output to indicate call status (vehicle or pedestrian, or both) of the phase, activated when the CU is not in the green interval of that phase, which has a demand in that phase. Neither the phase omit nor pedestrian omit inputs affects the check output.

Phase on (In the applicable mode) – An output to indicate phase status. The phase on output of a particular phase is activated during the green, yellow, red clearance, and red dwell intervals/state of that phase.

Phase next (in the applicable mode) – An output of a particular phase activated when the phase is committed to be next in sequence and remains present until the phase becomes active. The phase next to be serviced is determined at the end of the green interval of the terminating phase; except that if the decision cannot be made at the end of the green interval, it will not be made until after the end of all vehicle change and clearance intervals.

3.3 Per Ring

The following inputs, outputs, functions, and programming controls are provided on a ring basis.

3.3.1   Inputs per Ring

The CU will provide the following input features on a per ring basis:

The NEMA definition of an actuated CU assumes the maximum number of rings utilized is two. The CU allows for user programming of phases within four rings. To enable maximum flexibility in the use of two sets of ring inputs, the controller provides user selection of which ring responds to each set of inputs. One or more rings may be assigned to each set of inputs.

Force off – Provision for termination of the green timing in the actuated mode or walk hold in the non-actuated mode of the active phase in the timing ring by application of this signal, such terminating subject to presence of a serviceable conflicting call. The force off function will not be effective during the timing of the minimum green, variable initial, walk, or pedestrian clearance. The force off input is effective only as long as the input is sustained.

Red rest – Input to require rest in red of all phases in the timing ring by continuous application of an external signal. Registration of a serviceable conflicting call results in immediate advance from red rest to green of the demanding phase. Registration of a serviceable conflicting call before entry into the red rest state, even with this signal applied, results in termination of the active phase and

selection of the next phase in the normal manner and with appropriate change and clearance intervals.

Inhibit maximum termination – An input to disable the maximum termination functions of all phases in the selected timing ring. The input does not inhibit the timing of maximum green.

Omit red clearance – An input to cause omission of red clearance interval timing(s).

Pedestrian recycle – An input to control the recycling of the pedestrian movement. The recycling operation is dependent upon whether the phase is operating in the actuated or non-actuated mode:

- When the phase is operating in the actuated mode, if a serviceable pedestrian call exists on the phase and the hold input is active, the pedestrian movement is recycled when the pedestrian recycle input is active, regardless of whether a serviceable conflicting call exists.

- When the phase is operating in the non-actuated mode, if the phase has reached State D (green rest), the pedestrian omit is not active on the phase and a serviceable conflicting call does not exist, the pedestrian movement is recycled when the pedestrian recycle input is active.

Stop timing – An input which when activated causes cessation of CU ring timing for the duration of such activation. Upon removal of activation from this input, all portions which were timing will resume timing from the point it was stopped.

During stop timing, vehicle actuations on non-green phases are recognized; vehicle actuations on green phase(s) resets the passage time timer in the normal manner; and the CU will not terminate any interval or interval portion or select another phase, except by activation of the interval advance input.

Operation of the interval advance with stop time activated clears any stored calls on a phase when the CU is advanced through the green interval of that phase.

A ring in red rest with stop time activated will not inhibit other rings in any manner.

During stop timing, the special detector programming will continue to function normally (for example, stretch, delay, and switch).

Maximum II selection – Input to allow the selection of a second maximum time setting on all phases of the timing ring.

This ring input, when active, selects the Maximum II time value or, when inactive, the maximum I time value. The time value is maximum green time interval. Both maximum timers will run concurrently. A change of the maximum timer in control during the green will be to a point within the new timing as though that new timing had been in effect for the entire green.

3.3.2   Outputs per Ring

The CU will provide the input features described in this section on a per ring basis:

The NEMA definition of an actuated CU assumes the maximum number of rings used is two. The CU allows for user programming of phases within four rings. To enable maximum flexibility in the use of two sets of ring status bits, the CU provides user selection of which

ring drives each set of status bit outputs. Only one ring may be assigned to each set of status bit outputs at a time.

3.3.2.1 Coded Status Bits

One or more of the coded status bit states shown in the following table might be omitted from a normal cycle of operation. Only one of the coded status codes is active when the following conditions are present in the CU:

Table 3-2. Coded Status Bits (1 Per Ring)				
Code #	**Bit States**			**State Names**
	A	**B**	**C**	
0	OFF	OFF	OFF	Min Green
1	ON	OFF	OFF	Extension
2	OFF	ON	OFF	Maximum
3	ON	ON	OFF	Green Rest
4	OFF	OFF	ON	Yellow Change
5	ON	OFF	ON	Red Clearance
6	OFF	ON	ON	Red Rest
7	ON	ON	ON	Undefined
Voltage levels: OFF = +24 V; ON = 0 V				

The active phase is in its green interval and operating in the actuated mode.

- ♦ Code 0 minimum timing – When timing in initial walk, or pedestrian clearance portions of the green interval.

- ♦ Code 1 extension timing – That portion of the green interval following the completion of the minimum timings (initial, walk, and pedestrian clearance) when timing an extension(s).

- ♦ Code 2 maximum timing – That portion of the green interval following the completion of the minimum timings, (initial, walk, and pedestrian clearance) when not timing an extension and the maximum green is timing (for example, when the hold input is active).

- ♦ Code 3 green rest – That portion of the green interval when the minimum timings (initial, walk, and pedestrian clearance) are complete, passage timer is timed out and the maximum green timer is either timed out or has not started.

The active phase is in its green interval and operating in the non-actuated mode.

- ♦ Code 0 walk timing – When timing the walk portion of the green interval (non-actuated State A).

♦ Code 1 walk hold – When the walk output is active, walk timing is complete and the hold input is active (non-actuated State B).

♦ Code 2 pedestrian clearance timing – When timing the pedestrian clearance interval or the remaining portion of minimum green (non-actuated State C).

♦ Code 3 green rest – When the timing of pedestrian and minimum green intervals are complete (non-actuated State D).

The active phase is not in its green interval.

♦ Code 4 yellow change – When timing yellow change.

♦ Code 5 red clearance – When timing Red clearance.

♦ Code 6 red rest – When timing is complete, and a red indication is displayed.

♦ Code 7 – Other (including preempt).

3.4 Per Unit

The inputs, outputs, functions, and programming controls described in this section are provided on a per unit basis.

3.4.1 Initialization

Initialization occurs under either of the following conditions:

Restoration of power after a defined power interruption. (See Section 3.7.1.1.)

Activation of external start input.

A program entry for initialization is provided to cause the CU to start at the beginning of the green, yellow, or red interval of any phase or non-conflicting phase pair.

As part of the initialization routine, vehicle and pedestrian calls are placed on all phases and retained until serviced.

3.4.2 Simultaneous Gap Out

Multi-ring CU configurations provide the capability of simultaneous gap out when servicing cross barrier calls.

When timing phases concurrently with the next serviceable call on a phase that conflicts with more than one of the phases timing (about to cross a barrier), simultaneous gap out, if enabled through program entry, will ensure that all phases which will terminate, must simultaneously reach a point of being committed to terminate before green timing termination will begin (for example, gap out, max out, or force off). When all phases have not yet reached such a point, any gapped-out phase will revert to the extensible portion and time passage intervals based on vehicle calls.

Under the conditions as defined above, simultaneous gap out, if disabled, will allow a phase to reach a point of being committed to terminate independently of any other phase and will not revert to the extensible portion from a gapped-out condition.

3.4.3   Dual Entry

Dual entry is a mode of operation (in multi-ring CUs) in which one phase in each ring must be in service, where possible subject to compatibility, at all times.

If a call does not exist in a ring when the CU is committed to cross a barrier, a phase may be selected, through program entry, in that ring to be active.

3.4.4   Overlaps

The CU includes sixteen internally generated overlaps.

Overlaps are designated alphabetically A to P.

Each overlap can be defined as one of the following types:

- ♦ STD – Standard Vehicle Overlap
- ♦ FYA – Flashing Yellow Arrow
- ♦ PED – Pedestrian
- ♦ PRI – Priority

3.4.4.1   Standard Vehicle Overlaps

The generation of control for standard vehicle overlap signal indications is programmable and provides green, yellow, and red load switch drivers for each of the overlap signals.

Change and clearance timing – The timing for yellow change and red clearance vehicle overlap signals is determined by either:

> The phase terminating the vehicle overlap, or
>
> An independent adjustment for each vehicle overlap signal.

Each vehicle overlap display is defined by a phase association entry through the keypad.

Each vehicle overlap is provided with timed trailing control to delay green termination. When the vehicle overlap is no longer locked to a phase timing due to the trailing green a separate yellow change and red clearance will control the vehicle overlap yellow and red display. Concurrent phase(s) for the overlap included phases are allowed to start while the overlap is trailing.

Each vehicle overlap is provided with special sequence controls for Plus Green, Minus Green/Yellow and Minus Ped. See Section 2.5.4.1 for more details on operation.

3.4.4.2   Flashing Yellow Arrow Overlaps

See Chapter 5.

3.4.4.3 Pedestrian Overlaps

Pedestrian overlaps provide a method for a walk and/or flashing don't walk indication to span multiple phases. Both standard and alternate timings are provided for the pedestrian overlap walk and clearance intervals.

Pedestrian overlaps receive calls from any parent phase's assigned ped detectors, even if one or more parent phases are not configured for a normal pedestrian movement.

A pedestrian overlap begins with the start of a parent phase if a call was present. Until the overlap has completed, the CU will not advance to the next phases if they do not include a parent phase or are incompatible with currently on parent phases.

The WALK and PEDCLR times are programmable in the overlap configuration, however there are some configurations that are inherited from the parent phases:

Table 3-3. Ped Overlap Configurations from Parents	
Configuration	**Behavior**
Advance/Delay Walk Time (WOFF, WOFF MODE)	Inherited from the parent phase in the lowest numbered ring that started with the PED Overlap.
Flashing Walk	Inherited from any parent phase. If any parent phase is configured for Flashing Walk, the PED overlap will use a flashing walk.
Actuated Rest in Walk	Inherited from any active parent. If any active parent phase is configured for ACT RIW, then the overlap will inherit that behavior. Calls will be considered conflicting if the call conflicts will all parent phases.
Extended Ped Clear	Inherited from the active parent phase in the lowest numbered ring, when the PED overlap is terminating.

The following lists the controls that the pedestrian overlap inherits from its parent phases.

Table 3-4. Ped Overlap Controls from Parents	
Control	**Behavior**
Walk Rest Modifier	Under FREE and CENTRAL/UTCS control, this is inherited from any active parent phase's ring. Under COORD, Walk Rest/Hold is not currently supported.
Ped Recalls	Inherited from any parent phase. If any parent phase has a recall on it, overlap will have a recall placed on it.
Non-Actuated	Inherited from any active parent phase.
Hold	Inherited from any active parent phase.

Additionally, under FREE operation pedestrian overlaps act as if the pedestrian recycle input is always on, so they will always recycle if there are no conflicting calls. Under coordination, pedestrian recycle it is controlled by the coordinator.

Under coordination control, if the pedestrian overlap contains a Coordinated Phase as a parent, the pedestrian overlap's time must fit into the summation of in-sequence parent phases' split times; if it does not, it will generate a Bad Plan Free. A pedestrian overlap will always be allowed to start at the beginning of a sequence of parent phases but will be omitted thereafter in that cycle unless the pedestrian overlap's time fits into the remaining splits. This will allow for an oversized pedestrian to start in the first parent phase of the sequence, but not after.

Pedestrian overlaps may be omitted by the overlap omits put in by Time Base Phase Functions.

3.4.4.4   Priority Overlaps

Overlaps may be allocated to be used by the Priority system. See Section 3.11 for more information.

3.4.5   Sequences

The CU provides the capability of 15 alternatives to the standard sequence. The alternates are assumed to be variations to the standard sequence based on groups of 2 phases (phase pair) being serviced in reverse order.

As a minimum, the 16 sequences provide every combination of lead-lag (phase pair reversal) for an 8-phase dual ring CU configuration. As viewed from NEMA the alternate sequence inputs, the variations could be as follows:

>   AS A – Phase 1 and Phase 2 reversed
>
>   AS B – Phase 3 and Phase 4 reversed
>
>   AS C – Phase 5 and Phase 6 reversed
>
>   AS D – Phase 7 and Phase 8 reversed

The alternate sequences may be selected by the Alternate Sequence external interface inputs (in the applicable mode) or the coordinator as a function of the pattern (timing plan/offset) in effect. When the internal coordinator is running, the external interface inputs for alternate sequences are ignored.

Alternate sequence inputs are interpreted as command requests in accordance with the following:

Table 3-5. Sequence Inputs				
Command Request	**AS A Input**	**AS B Input**	**AS C Input**	**AS D Input**
SEQ 01(Standard)	OFF	OFF	OFF	OFF
SEQ 02	ON	OFF	OFF	OFF
SEQ 03	OFF	ON	OFF	OFF
SEQ 04	ON	ON	OFF	OFF
SEQ 05	OFF	OFF	ON	OFF
SEQ 06	ON	OFF	ON	OFF
SEQ 07	OFF	ON	ON	OFF
SEQ 08	ON	ON	ON	OFF
SEQ 09	OFF	OFF	OFF	ON
SEQ 10	ON	OFF	OFF	ON
SEQ 11	OFF	ON	OFF	ON
SEQ 12	ON	ON	OFF	ON
SEQ 13	OFF	OFF	ON	ON
SEQ 14	ON	OFF	ON	ON
SEQ 15	OFF	ON	ON	ON
SEQ 16	ON	ON	ON	ON

Connector pins – In the applicable mode, input pin terminations are provided in accordance with the following:

Alternate sequence A

Alternate sequence B

Alternate sequence C

Alternate sequence D

3.4.6   Inputs per Unit

The CU will provide the following input features on a per unit basis:

AC line – Current protected side of 120 VAC 60 Hertz power source within the CU.

The m60 series CU has a front panel mounted over-current protection device in the 120 VAC input to the unit.

AC neutral – Unfused and unswitched side of 120 VAC 60 Hertz power source taken from neutral output of ac power source.

This input is not connected to logic ground or earth ground within the CU.

Earth ground – Terminal for connection to the chassis of the unit. earth ground is electrically connected to the shell of the connector(s) where applicable. This input is not connected to logic ground or AC neutral within the CU.

Vehicle detector – Provision to enter a vehicle call into the CU.

Vehicle detector inputs are provided as follows:

- Type A1 CU (TS 2) – 64 detectors
- Type A2 CU (TS-1) – 8 detectors (32 in the applicable mode)

Each vehicle detector input is enabled by assignment to one or more phases, through program entry. Each is capable of delay, extension, and switching as follows:

- Delay – The vehicle detector actuation (input recognition) is capable of being delayed, by an adjustable program entered time (0–255 seconds in increments of one second), when the phase is not green. When the actuation has been present for the delay time it is continued for as long as it is present. If an actuation is removed prior to delay timing out, no call is placed.

- Extension – The vehicle detector actuation (input duration) is capable of being extended from the point of termination by an adjustable program entered time (0–25.5 seconds in increments of 0.1 second), when the phase is green.

- Switch – The vehicle detector actuation is capable of being switched to another phase when the assigned phase is yellow or red and the program entered phase is green. Detector switching provides a per detector entry identifying the program entered phase that will receive the switched actuations.

The special vehicle detector functions are capable of being used in any combination.

Up to 8 vehicle detector inputs may be assigned a system detector function, through program entry.

Pedestrian detector (8 per unit) – Provision to enter a pedestrian demand for service into the appropriate phase of the CU.

Each pedestrian detector call input is enabled by assignment to any one phase, through program entry.

Interval advance – A complete on-off operation of this input causes immediate termination of the interval in process of timing. Where concurrent interval timing exists, use of this input causes immediate termination of the green, walk or pedestrian clear interval that would terminate next without such actuation. In most cases, the yellow change and red clearance intervals may not be interrupted.

The initial and walk timings are examples of intervals that can occur concurrently.

NOTE: Only a single interval advance is necessary to go from pedestrian clearance to yellow.

Phases without stored vehicle or pedestrian calls are omitted from the resultant phase sequencing of the CU unless external min recall or manual control enable inputs are activated.

The CU selects the next phase to service based on its normal sequence control method. If interval advance is activated during the green interval and no serviceable call exists, the CU does not advance beyond the green dwell/select state, except when red rest input is active.

If interval advance is applied when the CU is displaying green and walk indications, the unit advances to the state of displaying green and pedestrian clearance. If interval advance is applied when the unit is displaying green and pedestrian clearance, the unit displays a steady don't walk indication and advance to the green dwell/select state, from which it immediately selects a phase next and advances to the yellow subject to the presence of a serviceable conflicting call and the constraints of concurrent timing.

If no pedestrian provisions exist, application of the interval advance signal at any point in the green interval causes the unit to advance to the green dwell/select state from which it immediately selects a phase next and advance to the yellow subject to the presence of a serviceable conflicting call and the constraints of concurrent timing.

Interval advance may be used in conjunction with manual control enable to produce manual control of the CU with timed vehicle change and clearance intervals.

Interval advance may be used in conjunction with stop time to advance through all serviceable intervals except that the CU will not advance beyond the green dwell/select state without a serviceable conflicting call, except when red rest is active.

Manual control enable – An input to place vehicle and pedestrian calls on all phases, stop CU timing in all intervals except vehicle change and clearance intervals, and inhibit the operation of interval advance during vehicle change and clearance intervals. When this function is used in conjunction with interval advance, the operation of the CU is as follows:

- When concurrent pedestrian service is not provided, an activation of the interval advance advances the CU to green dwell/select, from which it will immediately select a phase next and advance to the yellow, subject to the constraints of concurrent timing.

- When concurrent pedestrian service is provided, an activation of the interval advance input terminates the walk interval. When automatic pedestrian clearance is enabled, the pedestrian clearance interval is timed internally by the CU. When automatic pedestrian clearance is not enabled, a second activation of the interval advance input is required to terminate the green interval, including the pedestrian clearance interval.

- All vehicle change and clearance intervals are timed internally by the CU. Actuations of the interval advance input during vehicle change and clearance intervals has no effect on the CU.

Call to NA (two per unit) – Two inputs are provided that, when activated, causes any phases(s) appropriately programmed to operate in the non-actuated mode.

The two inputs are designated call to NA I and call to NA II. When both inputs are active, all phases programmed for non-actuated mode operate in the non-actuated mode.

Each phase can be programmed individually to respond to one input, both inputs, or neither of the inputs.

The CU provides for transition to and from non-actuated mode immediately. When a transition from non-actuated to actuated mode occurs during the phase green, all actuated timing will operate as though actuated mode had been in effect for the entire green.

External minimum recall – Input to place a recurring demand on all vehicle phases for a minimum vehicle service.

This prevents any phase from dwelling in green, by creating a serviceable conflicting call. Control will pass from phase to phase with each phase receiving green time at least equal to minimum time.

Indicator lamp control – Input to disable CU indicators.

This input is not functional in the CU. The alpha-numeric display used in the CU is both a long life and low power display.

Test input (two or three per unit) – Test input, two or three per CU, for manufacturer's use only.

These inputs are for use by the manufacturer. The CU provides the capability for the user to assign one of the inputs (Test A) to be an automatic flash input. The other inputs are not used.

Caution: A facility wired to use automatic flash by activating Test Input A (Pin #n) of Connector A may not be compatible with the CUs of other manufacturers. Disconnect this input from the facility terminal block, where used, before placing any other manufacturer's CU in the facility.

External start – An input to cause the CU to revert to its programmed initialization phase(s) and interval(s) upon application. Upon removal of this input the CU commences normal timing.

Walk rest modifier – This input when true modifies non-actuated operation only. With this input active, non-actuated phase(s) remain in the timed-out walk state (rest in walk) in the absence of a serviceable conflicting call without regard to the hold input status. With this input non-active, non-actuated phase(s) will not remain in the timed-out walk state unless the hold input is active.

The CU recycles the pedestrian movement when reaching State D in the absence of a serviceable conflicting call.

System address bits – Five system address inputs are provided. The CU responds to the system address defined by the binary decoding of these five inputs.

Input/output mode (three per unit) – The Type 2 CU selects the input/output function of specific hardware I/O based on the current status of these three inputs.

Table 3-6. I/O Mode Bits (3 Per Unit)				
Mode #	**Bit States**			**State Names**
	A	**B**	**C**	
0	OFF	OFF	OFF	TS 1 Compatible
1	ON	OFF	OFF	Hardwire Interconnect
2	OFF	ON	OFF	System Interface
3	ON	ON	OFF	Reserved
4	OFF	OFF	ON	Reserved
5	ON	OFF	ON	Reserved
6	OFF	ON	ON	Manufacturer Specific
7	ON	ON	ON	Manufacturer Specific

Voltage levels: OFF = +24V; ON = 0V

- Mode 0 input/output functions
- Mode 1 input/output functions
- Mode 2 input/output functions
- Mode 3, 4, and 5 input/output functions

  Mode 3, 4, and 5 are reserved for future definition and use by NEMA. The CU will not recognize any mode dependent input as valid, nor will it provide a valid output on any mode dependent output when this input/output mode is active.

- Mode 6 and 7 input/output functions

  Mode 6 and 7 are for manufacturer specific applications.

  A terminal and facilities wired to use Mode 6 or Mode 7 may not be compatible with the CUs of other manufacturers.

3.4.7   Outputs per Unit

The CU provides the following input features on a per unit basis:

Logic ground – Voltage reference point and current return for CU input and output logic circuits. This output is not connected to AC neutral or earth ground within the CU.

Fault monitor – An open collector output that is maintained true (low state) as long as the voltages within the CU do not drop below predetermined levels required to provide normal operation.

The output will also be false (hi state) during CU-generated flash modes as defined elsewhere.

Voltage monitor (NEMA Type 2 only) – An open collector output that is maintained true (low state) as long as the voltages within the CU do not drop below predetermined levels required to provide normal operation.

The output will also be false (hi state) during CU generated flash modes as defined elsewhere.

This output operates concurrently with fault monitor output except during periods of no-fault flash (for example, automatic flash, and preempt flash).

24 VDC external (NEMA Type 2 only) – Positive 24 ±2 VDC is regulated over an AC line voltage variation from 89 to 135 volts from no-load to full-load. Current capability is 500 milliamperes continuous with less than 0.5 volts peak-to-peak ripple.

Flashing logic out (NEMA Type 2 only) – Alternating true/false logic output at one pulse per second repetition rate with 50 ±2% duty cycle. In its false state, this output is capable of providing 50 milliamperes of current. In its true state, this output is capable of sinking 200 milliamperes. This output will switch within five degrees of the zero crossover point of the AC line.

Load switch drivers, vehicle overlap (three per overlap) – Provision of separate green, yellow, and red outputs for each overlap when determined internal to the CU, four overlaps maximum. A circuit closure to logic ground is maintained at one of these three outputs at all times. The three outputs energize the appropriate overlap signal load switching circuit to result in a green, yellow, or red indication for the duration of such required indication.

3.4.8   Red Revert

A provision within the CU whereby an adjustable (0.0, 2.0-99.9 seconds in increments of 0.1 seconds) minimum red indication will be timed following the yellow change interval and prior to the next display of green on the same phase.

The red revert function prevents a vehicle movement (phase or overlap) from recycling back to green from yellow change, red clearance, or red rest without another phase becoming active prior to a time period equal to the red revert setting. This prevents a vehicle movement (phase or overlap) from terminating and being reactivated before a minimum period of red is shown (the red revert time has passed).

A serviceable conflicting phase call will be serviced before a call on the phase in the process of terminating (for example, in yellow change, red clearance, or red rest). Therefore, up to the point of reentry, a serviceable conflicting phase call will cause phase termination in a normal manner.

When an overlap is inhibited from returning to green because of red revert, any phase that is part of the overlap will also be inhibited from going green.

The red revert timing is concurrent with the red clearance timing and is unaffected by the omit red clearance input.

3.5 Priority of Input Functions

The priority of input functions is in the following order:

- Power-up
- External start
- Preemption
- Phase omit
- Pedestrian omit
- Interval advance
- Stop time
- Automatic flash
- Manual control enable
- Ring force off
- Phase hold
- Pedestrian recycle

Lower priority inputs condition those of higher priority as defined elsewhere.

3.6 Indications

Indications are provided on the display and appropriately identified to facilitate the determination of the operation of the CU. These indications are described in this section.

The indications provide for the simultaneous (concurrent) presentation, where concurrent states exists, of the following states/functions:

Phase

- Phase or phases in service
- Phase or phases next to be serviced
- Presence of vehicle call
- Presence of pedestrian call

The above information is displayed simultaneously for all phases.

Status of Active Phase in the Ring

- Initial
- Extension
- Yellow change
- Red clearance
- Walk
- Pedestrian clearance
- Reason for Green termination
    - Gap-out
    - Maximum time-out
    - Force-off

♦ Rest state (dwell).

The above information is presented simultaneously for two rings in a multi-ring CU.

3.7 Miscellaneous

3.7.1 Flash

3.7.1.1 Start-Up Flash

The CU has provisions whereby an adjustable time period/state (start-up flash – 0 to 999 seconds in increments of one second) occur prior to the Initialization routine.

During the start-up flash state, the fault monitor and voltage monitor outputs are inactive.

When power is restored following a defined power interruption, the start-up flash state becomes operational. No input, other than the lack of AC power, prevents this state from the completion and/or exit to the Initialization routine except as noted in this manual.

If a preempt input is active during start-up flash timing, the CU maintains the start-up flash state for the duration of the preempt demand and/or start-up flash time.

All flashing states that occur in response to a recognized fault are classified for convenience as forms of start-up flash. There are five start flash conditions based on severity of errors and the required (by TS2) flash state. These are:

Start flash – Normal flash timing to the start of traffic.

♦ Response to conditions – N/A

♦ Flash conditions – Normal flash output and all load switches dark.

♦ Exit path – Will exit after start-up flash time to running traffic if no preempt input is active.

♦ Active timer display – STRT FLSH or STRT FLSH - W/PREEMPT.

Diagnostic flash – There are two conditions which could cause this state to occur. This is a basic timed start flash that was caused by a (possibly) transient condition.

Response to conditions:

♦ Tenth second processing has consumed more than 250 ms without reaching a conclusion. This is referred to as a big tenth task delay watchdog. Alarm is DIAG: TRAF TASK WDOG

♦ An unanticipated watchdog caused by the hardware has been detected. This is referred to as a hardware watchdog. Alarm is WATCHDOG TIMEOUT.

Flash conditions – Normal flash output and all load switches dark.

Exit path – Will exit after startup flash time to running traffic if no preempt input is active.

Active timer display – DIAG FLSH or DIAG FLSH - W/PREEMPT.

TS 2 diagnostic flash – TS 2 required flash condition which can exit when the causal condition corrects itself. There are four conditions which can cause this flash.

Response to conditions:

- ♦ TS 2/Port-1 fault. The TS 2 SDLC device has failed to respond to the controller in five out of the last ten tenths of a second interactions. Alarm is SDLC .1 SEC DLY FAULT

- ♦ MMU response frame fault. Alarm is FRAME ### FAULT

- ♦ TF BIU response frame fault. Alarm is FRAME ### FAULT

- ♦ MMU compatibility programming is incompatible with controller phase configuration. Alarm is MMU UTILZATION CNFLCT.

Flash conditions – TS 2 flash: Flash output, fault monitor and all vehicle load switches flash red.

Exit path – Will exit to normal startup flash after the error condition no longer exists. See start flash above for continued processing.

Active timer display – TS2 DIAG FLSH in the display.

Diagnostic flash - no exit – This flash condition is a serious or repetitive fault and requires operator intervention for recovery. Conditions which would normally cause a diagnostic flash (see diagnostic flash above) but occur three times in a calendar day, will lock into diagnostic flash - no exit.

Response to conditions:

- ♦ Third time traffic task watchdog. Alarm is DIAG: TRAF TASK WDOG.

- ♦ Third time hardware watchdog. Alarm is WATCHDOG TIMEOUT.

- ♦ Synchronization between the tenth second processing and the real time has slipped more than two seconds (2083 ms) without the occurrence of a traffic task watchdog. This is referred to as an incremental watchdog. Alarm is DIAG: TRAFTASK XS DLY.

- ♦ Cycle fail – Alarm is OFF LINE - CYCLE FAIL.

- ♦ EEPROM check sum error. Alarm is DIAG: EEPROM CRC ERR.

- ♦ EPROM check sum error. Alarm is DIAG: EPROM CRC ERR.

- ♦ EEPROM write error. Alarm is EEPROM WRITE ERROR.

Flash conditions – Normal flash output and all load switches dark.

Exit path – Will exit to normal startup flash after an operator interaction (front panel or data download) occurs. See start flash above for continued processing.

Active Timer Display – DIAG FLSH - NO XIT.

TS2 diagnostic flash - no exit – This TS2 diagnostic flash condition is a serious or repetitive error and will require operator intervention for recovery. Conditions that would normally cause a TS2 diagnostic flash (see TS2 diagnostic flash above) but occur three times in a calendar day, will lock into TS2 diagnostic flash - no exit.

Response to conditions:

- ♦ Third time TS2 card fault is TS2 card failure. Alarm is SDLC .1 SEC DLY FAIL.

- ♦ Third time MMU response frame fault. Alarm is DIAG: RESP FRAME FAIL.

- ♦ Third time TF BIU response frame fault. Alarm is DIAG: RESP FRAME FAIL.

- ♦ MMU undetected conflict. Alarm is MMU UNDETECTED CNFLCT.

- ♦ Invalid TS2 Type A-1 configuration. This is caused by a TF BIU being enabled while SDLC communications is disabled. Alarm is DIAG: INV. TS2-A1 CNF.

Flash conditions - TS2 flash – Flash output, fault monitor and all vehicle load switches flash red.

Exit path – Will exit to normal startup flash after an operator interaction (front panel or data download) occurs. The Invalid TS2 Type A-1 configuration may clear if Port-1 becomes enabled but that is not anticipated. See start flash above for continued processing.

Active timer front panel display – TS2 DIAG FLSH - NO XIT.

As noted in the individual flash type entries under Exit path, most recovering error flash conditions exit by starting into the start flash sequence and timing out that condition to the subsequent normal start of traffic. Any existing preempt input will prevent the transition from start flash to traffic processing as usual.

3.7.1.2 Automatic Flash

The activation of the automatic flash input causes the operation described in this section to occur.

The CU will assure the completion of the minimum green or walk plus pedestrian clearance time on the current phase(s). Thereafter, if necessary, it will proceed to the vehicle clearance intervals followed by the programmed entry phases. After the entry phase's minimum green or walk plus pedestrian clearance, the CU will proceed to the vehicle clearance intervals. Upon completion of the vehicle red clearance interval, the CU initiates flashing operation. The CU will maintain this condition as long as the automatic flash input is active.

When no entry phases are programmed, requests will result in free (non-coordinated) operation.

When the automatic flash input becomes inactive, the CU will move immediately to the beginning of the phases programmed as the exit phases, with a green/walk display, calls on all phase vehicle and pedestrian, and will cease flashing operation.

Upon exiting a remote flash wherein the method is through load switch output flashing, the CU will provide a timed exit transition period when any flashing yellow display will be followed by a red, flashing red, or dark display. The load switch driver outputs during this period will be yellow for those that were flashing yellow and Red for those that were flashing red or dark.

Upon exiting remote flash (load switch output flashing), the exit flash transition timing is:

Yellow – Longest phase yellow change of phases receiving a steady yellow

Red – Longest phase red clearance of phases receiving a steady red

On exiting remote flash (load switch output flashing) when no exit phases are programmed, the red will equal the start up time. this operation enables a longer all red transition period to be operational prior to stop-and-go operation after remote flash.

The automatic flash output will only be active when the active program is flash. The automatic flash output is not active due to start-up flash or conflict flash.

The method by which flashing operation is accomplished is determined through program entry and will be either:

Voltage monitor output inactive

Load switch driver output flashing

Load switch driver output flashing provides an alternating true/false logic output at 1 pulse per second repetition rate with 50 $\pm$2 percent duty cycle. The selection, through program entry, of yellow flashing, red flashing, or dark for each vehicle load switch driver group (G/Y/R) is provided. All pedestrian load switch driver groups (W/PC/D) are inactive (DARK) in flash.

3.7.2   Dimming

The CU may be programmed to provide output dimming based on a time base auxiliary event and dimming enable input (both must be active to enable). The dimming function will be accomplished by controlling the load switch driver outputs with respect to the AC line voltage.

For a NEMA Type 1 CU, the dimming function is accomplished within the terminal and facilities.

For a NEMA Type 2 CU, the dimming function is integral to the CU.

The dimming function is accomplished by the elimination of alternate one-half wave segments from the AC sinusoid applied to the field indications. When dimmed by this method, the control transition from the on (low state) to off (high state) and vice versa occurs within 20º of AC line zero crossing.

Dimming control provides selection, via program entry (individual green, yellow, red, walk, pedestrian clear, and don't walk output), of which load switch driver has a dimmed output and which half cycle (+ or -) will be eliminated.

When the NEMA Type 2 CU is used in a cabinet that employs absence of red monitoring with a NEMA TS 1 monitor, the user may be required to make a choice between:

Absence of red monitoring

Dimming the red display

For additional information about this subject, reference is made to Federal Highway Administration Report No. FHWA-TS-85-213 entitled Traffic Signal Brightness: An Examination of Nighttime Dimming.

Some types of signals may not operate properly or may be damaged if dimmed.

3.8 Coordination

The CU includes provisions for an internal coordinator. the coordinator accepts timing plan (Pattern) and offset commands from traditional (pre-timed) interconnect systems, from a companion time base program, and/or an internal system interface.

Coordination is implemented by holding the CU in the programmed coordinated phase(s) until a specific point in the cycle and forcing-off non-coordinated phase(s) at predetermined points within the cycle.

Coordination controls (hold, omit, Force Ring 1, etc.) are internally applied while the CU inputs for these same functions remain active and may impact coordinator operation.

Coordination is capable of implementing sequence operations. It is possible to transfer from one sequence to another based on a change in pattern (timing plan plus offset). When the internal coordinator is running, external selection of sequences is ignored.

The CU internal coordinator provides 6 unique control strategies for coordination. Each of the strategies are capable of being selected on a pattern basis. The 6 strategies are termed:

1. Yield
2. Permissive
3. Permissive yield
4. Permissive omit
5. Sequential omit
6. Full actuated control

Each strategy has strengths and limitations and normally the coordination pattern highlights the application. Because of the nature of coordination, control techniques are normally present that allow one type of strategy to operate like another type of strategy. These controls must also be discussed since certain applications are not suitable to specific strategies. For example, a system would not always operate actuated pedestrians and some non-actuated pedestrians within the same pattern.

The CU internal coordinator allows selection of a sequence (phase rotation within a ring) and an alternate pattern mode (control strategy) for each pattern. The sequence is used to select a lead, lag reversal or selection from dual leading lefts to lead, lag left turns. 16 sequences are provided that include all possible combinations of leading, lagging or lead/lag sequences for an 8-phase intersection. The alternate pattern mode allows selection of any of the 4 control strategies to operate with a selected pattern selection. The application of the 4 strategies will be discussed under separate sections.

A coordination pattern allows the selection of time allocated for each phase and special conditioning of each phase as may be required to effect smooth progression. One of 253 Patterns (timing plans) may be selected. Pattern 254 is Free, and Pattern 255 is Flash.

Coordination parameters are entered through the CU keypad, downloaded through the system interface, or imported from a Datakey or a USB flash drive. Coordinator settings and activity can be monitored on the CU display (for example, hold, omit, and force off indication will denote when these functions are used). Coordination controls are internally applied (hold, omit, Force Ring 1, etc.) while the CU inputs for these same functions remain active and may impact coordinator operation.

The user will enter the phase times, phase modes, offsets, ring lags, and Sequence for each timing program. All timings are in seconds so there will be no conversion from seconds to percent and vice versa. The cycle length, yield points, permissive periods, and force off points are automatically calculated internally.

3.8.1   Patterns

The coordinator provides control for 253 patterns (timing plans). The coordinator selects the pattern to be used according to the current status of the pattern request. The first 48 patterns may be selected via the external Timing Plan and Offset inputs when the appropriate input mode is selected.

The coordinator is capable of providing one cycle length for each pattern. Each cycle is adjustable over a range of 30 to 255 seconds in one-second increments.

One set of splits is provided for each Pattern. Each split provides an adjustable time for each phase, each adjustable from 0 0 to 255 in one-second increments.

The cycle time of each pattern is normally equal to the sum of the phase times of the longest path between barriers for all rings in the CU. The user may include additional "slop" to the cycle time.

Patterns are evaluated prior to being set to control coordination. Valid patterns must have:

> A cycle length equal to or greater than the sum of Ring 1 phase times, and

> A coord phase in the first ring in each cluster and the other rings in the same cluster that have a compatible phase must also have a coord phase, and

> Phase times greater than the minimum service requirement that is:

> > ♦ On actuated (non-coord) phases equal to the vehicle minimum service

> > ♦ On coord phases as follows

> > > ♦ For perm yield, perm omit, seq omit, and full act modes equal to the vehicle minimum service

> > > ♦ For perm and yield modes equal to the pedestrian and vehicle minimum service

> Phase modes set to 6 (phase omitted) when the phase time equals 0 on active phases.

3.8.2   Offsets

Coordination includes one offset per pattern, each adjustable from 0 to 255 seconds in one-second increments.

The value determines the latest time that the starting point of the coordinated phase green, local time zero, lags the synchronization pulse, system time zero.

The coordinator recognizes when the sync reference and local offset in control indicate local zero is not correct. When establishing its offset based on the sync pulse, the coordinator references only the leading edge, regardless of the width of the sync pulse. The pulse width is a minimum of 3 seconds or 3% of the cycle.

Local time zero is the point when the first coordinated phase green begins/ends (user selected) in the cluster (rings locked together based on the ring structure concurrent definition) associated with Ring 1.

The offset value is adjustable in length from 0 to 255 seconds. The only restriction as to the value is that it must be less than the cycle time for the respective pattern to be considered valid.

In addition to the Free Pattern (254), it is possible to enact free mode as a function of the pattern in effect for a valid pattern. This is accomplished by setting the offset value equal to or greater than the cycle length for that pattern. During this period of free mode, any coordination pattern programmed sequence will be implemented.

When running coordination free and the pattern time is not equal to zero then Maximum 1 is set equal to the pattern time.

The coordinator has 5 methods of changing the actual offset (for example, shortway, shortway add only, infinite dwell, and dwell with interrupt).

Regardless of the method selected for offset correction, the coordinator recognizes when the master sync and offset in control indicate local zero is not correct, but the coordinated phases are on and waiting for local zero to begin the next cycle.

The coordinator uses this extra time to change the actual offset by restarting the local cycle. On an early return (coordinated phases are on), the cycle is restarted if the time is right to be in sync or if doing shortway correction (short) and time for being in sync is past.

This type of correction may only take place if the controller has returned to the coordinated phases early due to a phase or phases not requiring any or all of the phase time programmed.

> Dwell – When changing offset by dwell, the coordinator establishes a new offset by dwelling in the coordinated phase(s) green until the correction is made.
>
> Dwell transition contains provisions to operate in applications where the master contains an offset interrupter. An offset interrupter is a device that imposes a number of shifting interrupter pulses onto the interconnect line containing the real sync pulses for the purpose of smoothing the offset correction over several cycles. The maximum time the coordinator will dwell will be determined by the last sync separation.
>
> Max dwell – When changing offset by max dwell, the coordinator establishes a new offset by dwelling in the coordinated phases green. The maximum time the coordinator can dwell will be adjustable from 1 to 255 seconds. A value greater than the cycle time for the respective pattern will provide operation similar to infinite dwell.
>
> After the dwell, the coordinator releases and begins timing program phase times. The dwelling operation is repeated until the desired offset is reached. Only one dwell interval is timed between sync pulses.
>
> Shortway – When changing the offset by shortway, the coordinator establishes a new offset by the shortest route possible. This movement will never be over 50% of the cycle length and is accomplished by adding or subtracting to/from the program phase times in a manner to limit cycle change to a maximum of 18.75%.
>
> When adding time to change the actual offset, the time is added to the coordinated phase(s). When subtracting time to change the actual offset, the time is subtracted from all phases (subject to the available time. For example, program phase time versus minimum phase time).

When the shortest route to the correct offset requires subtracting time and the program/minimum phase time differential would preclude correction within five cycles, the routine changes the offset by adding time.

Shortway**+** – When changing offset by shortway+, the coordinator establishes a new offset by dwelling in the coordinated phase(s) green. The maximum time the coordinator can dwell will be 18.75% of the cycle length.

After the dwell, the coordinator releases and begins timing program phase times. The dwelling operation is repeated until the desired offset is reached. Only one dwell interval is timed between sync pulses.

Shortway2 – This correction mode operates the same as shortway except when going long will add to all phases proportional to their split time.

3.8.3   Absolute Sync

Absolute sync reference is a reference method in which each cycle will be individually referenced to a single point in time through keypad-initiated sync command or downloaded via the system interface or RS232 port. This operation will allow the CU to keep in step with a free running cycle counter, particularly one which does not divide evenly into 24 hours, such as a 70 second cycle.

Following a power outage, the CU will automatically update its absolute sync reference points. The CU is capable of updating its reference points following a power outage up to seven days without being reset.

Typically, this operation is required when the CU is running under manual control. It is possible to use these absolute sync reference points for TBC controlled or queue-controlled timing plans.

For those periods when a valid absolute sync Reference does not exist, the CU will use 24:00 hours as the sync reference point.

3.8.4   Ring Lag

The coordinator provides a means to establish an offset (lag) for each ring in the CU when the ring structure does not lock the ring to Ring 1 based on the ring concurrency definition (no barriers).

The coordinator controls rings which are locked together based on the ring structure concurrency definition as a single identity (cluster). The lowest numbered ring in a cluster will receive the lag time setting.

The ring lag is adjustable in length from 0 to 255 seconds. The only restriction as to the value is that it must be less than the cycle time for the respective pattern to be considered valid.

It is possible to enact free mode, for the cluster, as a function of the pattern in effect. This is accomplished by setting the ring lag value equal to or greater than the cycle length for that pattern. The Ring 1 cluster must be in a coordinated mode before other clusters may respond to this operational setting.

3.8.4.1 Ring Lag Applications

The CU can operate as four 2 phase controllers, as two 2 ring controllers (diamonds and offset tees), or as two single ring controllers in addition to the standard dual ring CU.

In the majority of installations are standard dual ring applications and programming of ring lag values are not necessary. However, if the application utilizes the controller as defined in the paragraph above, an offset adjustment for Rings 2 through 4 may be required. The term Ring 2 Lag refers to Ring 2 lagging (offset) the offset programmed for Ring 1. In operation the CU will sync.

3.8.5 Transition Cycles

The coordinator provides a smooth and orderly transition from free to coordinated operation and coordination program to coordination program.

Free to coordinated – The free to coordinated smooth and orderly transition is accomplished by enabling partial coordinated operation only after the offset has been determined to be valid (active for 18.75% of the cycle minus three seconds in the case of interconnect control, otherwise immediately). When this condition is met, the coordinator will:

♦ Transfer the coordinated phase(s) to non-actuated and allow normal service to continue until a coordinated phase is green. At the beginning of any coordinated phase green, complete coordination control commences. The cycle will begin timing when all coordinated phases are on. Normal offset correction will sync the controller to the system reference after the completion of the first cycle under full coordination control.

Or

♦ When all phases are programmed as non-actuated, normal service will continue until the first ring coordinated phase is green at which time complete coordination control commences. The cycle will begin timing when all coordinated phases are on. Normal offset correction will sync the controller to the system reference after the completion of the first cycle under full coordination control.

Pattern to pattern – The pattern-to-pattern smooth and orderly transition will be accomplished by limiting a program change to occur only at local zero time.

Normal offset correction will sync the controller to the system reference after beginning with the first cycle.

Pattern transitions that include a change in coordinated phase(s) or change in sequence which include coordinated phase(s) will drop the unit to free at which time it will perform the free to coordinated transition noted above.

Pattern transitions which find a traffic phase on or next that is not part of the new pattern (phase omitted in the new pattern) will cause the coordinator to drop free at which time it will perform the free to coordinated transition noted above.

The drop out of coordination on a change in coordinated phase(s) or sequence provides for a positive release from one set of conditions (phase holds, omits, etc.) prior to establishing another set.

3.8.6   Phase Times

The coordinator provides an adjustable time for each phase for each of the patterns. The program phase time is adjustable from 1 to 255 seconds. For the coordinated phase(s) this will become the minimum phase time and for the non-coordinated phases it determines the force off point (maximum phase times). Green time for a phase is the phase time minus the phase vehicle clearance (yellow and red) times.

In general, the time allocated to a phase must be longer (by at least one second) than the longest sum of one of the three conditions:

Table 3-7. Allocated Phase					
MIN GREEN	or	WALK	or	MAX INIT*	
		PED CLR			
YELLOW		YELLOW		YELLOW	
RED CLR		RED CLR		RED CLR	
* When Added Initial is greater than zero					

When calculating the yellow + red clear interval, if the CU is to permit termination of phases concurrently, the longest possible sum of yellow + red clear for the phases terminating must be used.

Example 1+6 terminate as lag left turn.

Table 3-8. Phase Timings				
Timings	**Phase 1**	**Use**	**Phase 6**	**Use**
MIN GRN	3	5	6	-
MAX INI	0	-	12	-
WALK	0	-	7	7
PED CLR	0	-	12	12
YELLOW	3.0	5.0	5.0	5.0
RED CLR	1.0	2.0	2.0	2.0
PLUS 1 SEC	1	1	1	1
MIN TIME	8	13	19	27

The MIN GRN for Phase 1 must assume five seconds because the coordinator will use five seconds in those cases where the actual traffic green times indicate less than five seconds.

Phase 6 must use the longer of MIN GRN, MAX INI, or WALK + PED CLR to determine the green time minimum service. The WALK + PED CLR may be removed from this calculation as explained later in this section.

The YELLOW + RED CLR for Phase 6 must be used for Phase 1 because the Phase 1 and Phase 6 may go to yellow at the same time and Phase 1 will dwell in a red display for the additional time necessary to terminate Phase 6.

Timing plans will normally have time allocated such that the time between barriers is equal ring to ring.

When all phases are active:

Table 3-9. Active Phases			
Phase 1	Phase 2	Phase 3	Phase 4
10	30	20	20
Phase 5	Phase 6	Phase 7	Phase 8
20	20	10	30

When all phases are not active:

Table 3-10. Not Active Phases			
Phase 1	Phase 2	Phase 3	Phase 4
10	30	20	20
Phase 5	Phase 6	Phase 7	Phase 8
X	40	X	40

The phase time for the coordinated phase(s) may not begin prior to its normal position relative to local time zero.

The force off point (user selected) may be based on when the phase begins (plan) or based on a position in the cycle (cycle).

> Plan – The green time (force off point) is based on when the respective phase is ON. This force mode assures the time allocated to any non-coordinated phase never exceeds that programmed, regardless of when it may appear in the background cycle because some other non-coordinated phase gapped out earlier than the limit set in the timing plan. This force mode is required for priority operation.

> Cycle – The green time (force off point) is based on a position relative to local time zero. This force mode provides for unused time from a non-coordinated phase gapping out early being given to the next phase that will take it based on traffic demand. This force mode is not compatible with priority operation.

> The phase yellow change and red clear calculation, for green time above, must accommodate the longest yellow and red that may be presented on concurrent terminating phases except when all phases are programmed as non-actuated.

- ♦ The phase time need not include provision to accommodate oversized pedestrian timings on phases where pedestrians do not operate non-actuated based on coordination operation mode.

  To accommodate oversized pedestrian timings, the pedestrian times are not evaluated for adequate service time.

  When a phase is about to be serviced that has an oversized pedestrian timing actuation, the coordination phase time (split) will be adjusted for the additional time required to accommodate the oversized pedestrian timing.

  This adjustment of the coordinated phase times may cause a late return to the first coordinated phase relative to the cycle time. The normal offset correction will re-sync the local cycle following an oversized pedestrian timing service.

- ♦ The phase time need not include provision to accommodate trailing overlaps timings.

  To accommodate a trailing overlap, the internal cycle length calculation will assume any trailing overlap will terminate once a cycle and will add to normal cycle length calculation any difference between the trailing overlap requirement and the shortest phase yellow and red clear time sum of the overlap included phases. Two trailing overlaps with the same definition will not bump the cycle twice.

  To satisfy trailing green applications where the basic assumptions in the coordination cycle length calculation is wrong, coordination allows the calculated coordination cycle length to be overridden and a value set by the user. It is suggested that this capability be used with caution because the automatic calculation is normally correct.

  When a trailing overlap is terminating, the coordinated phase timers will stop for the additional time required to accommodate the trailing overlap.

Lead/lag considerations – The CU internal coordinator differs from most, if not all, CUs when operated in a coordinated mode, lead/lag where pedestrian phases are selected as non-actuated. The CU design, under 2–4 ring operation, requires each ring to operate in an independent timing mode.

Some controllers delay the start of concurrent coordinated pedestrian walk intervals until both coordinated phase walks are concurrent. These controllers then time concurrent walk and pedestrian clear intervals before releasing the lag ring to commence timing the lagging left. Thus, the coordinator times three separate sequences 1+6, 2+6, and 2+5 or 2+5, 2+6, and 1+6. The concurrent sequence interval 2+6 must therefore be of sufficient duration to time concurrent walk and pedestrian clear intervals.

However, the Yunex Traffic CU's internal coordinator provides a totally independent ring timing capability. It does not require the 2+6 concurrent pedestrian operation and therefore can operate lead/lag sequences in the same time intervals as leading left sequences. This enhances selection of shorter cycle lengths.

The phase time need not include provision to accommodate oversized pedestrian timings on phases where pedestrians do not operate non-actuated based on coordination operation mode. Coordination operation modes that should be used in this situation are permissive

yield mode (PYM), permissive omit mode (POM), sequential omit mode (SOM), or full actuated control (FAC). More detail for these modes can be found in Section 3.8.11.

To accommodate oversized pedestrian timings, the pedestrian times are not evaluated for adequate service time.

When a phase is about to be serviced that has an oversized pedestrian timing actuation, the coordination phase time (split) will be adjusted for the additional time required to accommodate the oversized pedestrian timing.

This adjustment of the coordinated phase times may cause a late return to the first coordinated phase relative to the cycle time. The normal offset correction will re-sync the local cycle following an oversized pedestrian timing service.

3.8.6.1 Coordination Adaptive Split

The goal of Coordination Adaptive Split (CAS) is to achieve operation whereby a running pattern will automatically seek the most advantageous split possible for all non-coordinated phases (coordinated phases are not adjusted).

CAS is achieved by monitoring the termination of each phase and determining whether the phase gapped (terminated through a lack of demand) or was forced (terminated by action of coordinator in controlling the maximum service). If forced, the phase is a candidate for an increase in its split. If gapped, the phase is a candidate for a decrease in its split.

CAS will monitor the time usage of each phase under coordination. If, for two consecutive cycles, a phase is forced by coordination while not already set to terminate or in the process of termination (Yellow or Red), that phase is designated as a Wanting Phase (requesting an additional increment of split). If, in two consecutive cycles, a phase becomes ready to terminate with over one second left in its coordination force timer, it will be designated as a Giving Phase (capable of giving up an increment of split).

At the end of each cycle, the supply/demand situation is examined and, if a change is possible, the splits of impacted phases are changed.

When more phase(s) are wanting (forced) than are giving (gapped), then time will be distributed based on the number of cycles the phase has been wanting.

When more phase(s) are giving than are wanting, then time will be taken from the lowest number of giving phase.

When a phase has been a giving phase (has a negative adjustment) and becomes a wanting phase and no giving phase exists, any phase with a positive adjustment will be considered a giving phase. This assures that a wanting phase will return to at least its split time under saturated conditions.

Time will never be subtracted from a phase split except to give to another phase. Time will only be added to a phase split if such addition does not cause the cycle length to change.

If the phase gaps out in one cycle and is forced the next cycle or vice versa, the adaptive split will not change.

When a phase has not received service for a period equal to two times the cycle, the CU will operate as though the phase had gapped out twice in a row. Subsequently and until such

time as the phase receives service, the CU will operate as though a gap out occurred every cycle.

Any coordination operation which makes a negative adjustment to any split time will prevent the adaptive split adjustments being made that cycle (for example, shortway, permissive yield, etc.).

Maximum recall or a failed detector will disable adaptive split operation on a phase. When a detector fails or the phase placed on maximum recall, it will smoothly correct until its normal split is active then no further adjustments.

When interval advance terminates a phase, the CU will not consider it a force or gap in the adaptive split operation.

CAS will be enabled by local TBC or system command.

3.8.7 Implementing Coordination Adaptive Split

The entry of 1 under SPC FUNCTION 1 column denotes that coordination adaptive split will be enabled whenever Special Function 1 is called. Special Function 1 may be called by local or master TBC or local queue routines.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
COORD ADAPTIVE SPLIT  10000000 00000000
SPC 1-16>PHS FUNC 1-16 00000000 00000000
SPC 1- 8>PHS FUNC 9-16 00000000 00000000


 UP/DOWN TO SCROLL
```

Figure 3-1. Time Base Function Mapping Display

3.8.8 Phase Modes

3.8.8.1 Coord Phases

The coordinator provides for selecting in each of the 253 Patterns which phase(s) are to be the coordinated phase(s). The coordinated phase(s) operate as non-actuated when coordinated. When no phases have been selected as the coordinated phase(s), the controller will run free. When operating in multiple ring controller configurations, a phase in every other active ring (Rings 2, 3 or 4) must be selected as the coordinated phase for that ring except when compatibility does not exist within that ring to the coordinated phase in Ring 1.

NOTE: Ring 1 must contain a coordinated phase.

3.8.8.2 Dual Coord Phases

The coordinator provides for selecting in each of the 253 Patterns one or more dual coordinated phases in each ring. The dual coordinated phase operates as non-actuated when coordinated. The dual coordinated phase maintains a fixed position in the pattern cycle in relationship to the coordinated phase. It may begin early but will not terminate later than the allocated times would imply.

3.8.8.3   Non-Coordinated Phases

The coordinator provides for operation modifiers to be selected for each of the non-coordinated phases in each of the 253 Patterns. The non-coordinated phases operate as full-actuated when coordinated. These 5 modifiers are:

> Minimum vehicle recall
>
> Maximum vehicle recall
>
> Pedestrian recall
>
> Maximum vehicle recall and pedestrian recall
>
> Permanent phase omit

3.8.9   Sequences

The CUs provide the capability of fifteen alternates (Sequences 2-16) to the standard sequence (Sequence 1) defined in the ring structure database. These alternates are assumed to be variations to the sequence based on groups of two phases in a ring being serviced in reverse order. The phase pair must be adjacent in the normal sequence, may not be separated by barriers, and a single phase may appear only in one of the phase pair definitions for a single alternate. The sixteen total sequences offer every combination of lead-lag on an eight-phase quad application.

The coordinator provides a means to select one of the alternates or the standard sequence as a function of the pattern in effect.

The sequences may also be selected by the sequence external interface inputs. When the coordinator is running a pattern, the external interface inputs will not override the pattern sequence.

3.8.10   Operation

Three selections are provided for coordination operation. The first selection is to not have coordination, FREE. If a pattern is experiencing a problem that is determined to be the coord pattern of the intersection, the selection of FREE will revert CU operation to a stand-alone, isolated intersection controller.

A coordination pattern may be tested on a CU-by-CU basis by selecting MANUAL operation. Whatever pattern set for manual control will become operational after selection even if the CU is interconnected through 7-wire, internal TBC, a MARC system master, or a central system. The pattern operation may be monitored under the display ACTIVE STATUS - COORD TIMERS.

The selection of AUTO is the normal setting for coordinated applications. This setting permits the internal coordinator to run under the control of 7-wire, internal TBC, a MARC system master, or a central system.

3.8.11   Control Strategies

The coordinator provides 7 control strategies (modes of coordinated phase termination to service calls on the non-coordinated phases). The control strategies (modes) are:

Permissive mode

Yield mode

Permissive yield mode

Permissive omit mode

Sequential omit mode

Full actuated mode

Mutual Coordination

3.8.11.1 Permissive Mode

Permissive mode provides for a controlled release (permissive period) to each of the non-coordinated phases in sequence. When a call is not present for the phase to be serviced next in sequence, the coordinator reallocates the time for that phase to the end of the coordinated phase.

Prior to the completion of the coordinated phase time and the beginning of the first permissive period, the coordinated phase pedestrian will display the pedestrian clear indication and dwell don't walk. This eliminates the need to provide ample time in each subsequent phase time for the coordinated phase pedestrian clear. The coordinated phase pedestrian display will dwell in don't walk until the coordinated phase terminates and returns to green or the last permissive period in the cycle is complete without the coordinated phase terminating.

Permissive mode provides two types of permissive periods. The permissive period controls the time during which the coordinator releases the coordinated phase(s), allowing the CU to begin servicing calls on the non-coordinated or dual coordinated phases.

The first type of permissive operation consists of standard vehicle permissive. The length of the period is determined by the phase time and the minimum time (Minimum Time = Minimum Green or Maximum Initial + vehicle Yellow + Red Clear).

Minimum time is based on the longer of minimum green or maximum initial when the seconds/actuation setting is greater than zero. Otherwise, minimum time is based on minimum green. The minimum time is internally set to five seconds in cases where the timings are programmed for less.

The second type of permissive operation consists of a separate pedestrian permissive concurrent with the vehicle permissive. The length of this period is determined by the phase time and Walk + Pedestrian Clear + Phase Vehicle Yellow + Red Clear. In no case will the pedestrian permissive period be longer than the vehicle permissive period. When a phase is selected as next during the pedestrian permissive period, the pedestrian movement may start with the beginning of the associated vehicle movement (phase green) regardless of when the pedestrian call is received.

When the coordinated phase(s) terminate during any permissive period, the coordinator allows the CU to service all the subsequent phase(s) in normal order before returning to the coordinated phase(s) that will not terminate on subsequent permissive periods in the same cycle.

3.8.11.1.1 Permissive Mode Application

Permissive mode is the most typical of current day coordination strategies. The key element of this mode is the scheduling of releases from the coordinated phase(s) on a sliding window basis. The sliding window release causes the coordinator to open a permissive window for phases 3 and 7 only (assuming a standard 8-phase dual ring) at the point where termination of the coordinated phase(s) should occur. If there is no demand on phase 3 or 7, the coordinator will extend the coordinated phase(s) and wait for demand on phase 3 or 7 to occur. The coordinator will retain the phases 3 and 7 permissive until the CU can no longer service a minimum call on phase 3 or 7. At this point the coordinator will prevent Phase 3 and 7 from being serviced and then open a permissive window for phases 4 and 8 only.

During the phase 3 and 7 permissive period, the CU will maintain the coordinated phase green and don't walk. This allows a late platoon or stragglers to pass through the intersection.

When the coordinator opens a permissive window for Phases 4 and 8 only demand on Phases 4 and 8 are considered in the decision to terminate the coordinated phase(s). Because Phases 4 and 8 are traditionally through phases discussion will include coverage of pedestrian demand. If demand, vehicle, or pedestrian, are not present at this point, the coordinated phases are extended waiting for demand. At the point in time when Phase 4 and 8 pedestrian movements can no longer be serviced, the coordinator will prevent pedestrian service on Phase 4 and 8 while maintaining a permissive condition for vehicle service. If the no demand continues until the CU can no longer service a minimum vehicle call on Phase 4 or 8, the coordinator will prevent Phase 4 and 8 from being serviced and then open a permissive window for Phases 1 and 5 only. Phases 1 and 5 will be evaluated until they can no longer be serviced. The coordinator will then restart the coordinated phases WALK and be ready for the next cycle.

The above example described a condition where no demand existed at the intersection. During early morning and late evening patterns this is a relatively common occurrence at some sites although not frequent. The normal condition is a light sporadic flow that causes the coordinator to release to a phase, the sliding window calculations are terminated, and the CU is allowed to service any demand in the forward rotation returning to the coordinated phase(s). The coordinator maintains a limit on time to service phases so as to insure a proper return to the start of the coordinated phase(s) on or before the scheduled start of the next cycle. Time allocated to non-coordinated phases may be limited to the time scheduled in the pattern or allowed to utilize all excess time up to the point in cycle where the phase must be terminated in order to provide programmed time for phases next in the sequence.

Permissive mode provides a safeguard for the excessive early release of the yield mode under light traffic by extending the coordinated phase(s) pending future demand. A point to remember is that if one car is in Phase 3 and no other demand exists, the coordinator will release to Phase 3, service that vehicle, and then return to the coordinated phases. Under field conditions with moderately dispersed flow, this mode will both extend the coordinated phase and provide early return. This is a significant advantage where the design can widen a natural band width.

This mode works well under moderate to heavy traffic flows where extension of the coordinated phase(s) is not the primary desire or the absence of demand on the next phases in sequence after the coordinated phases (causing a coordinated phase extension) will not

grid lock an adjacent intersection. This mode will operate satisfactorily in 80% or more of all locations operating in coordination.

3.8.11.2 Yield Mode

Yield mode emulates the traditional operation of the electro-mechanical dial controllers or external coordination units before implementation of intelligent CUs. Yield mode maximizes early return to the coordinated phase(s).

Yield mode provides for a single release (yield period) during which the coordinated phase(s) may terminate, and service calls on any of the non-coordinated phases.

Yield mode provides an operator programmable extension of the yield, termed yield period. A zero value in the yield period causes the coordinator to sense demand for a period of 3% of the cycle length (three seconds minimum) – the ultimate in early return. The coordinator calculates the minimum service of all non-coordinated phases and places an internal limit as to the maximum yield period so a large value will not result in a release to non-coordinated phases when times will not permit return to the coordinated phase(s) at the start of the local cycle. Therefore, the user may select a yield period long with respect to the cycle length to allow the controller to wait for demand.

Yield period is a variable time equal to the lesser of a calculated maximum yield period and the entered yield period.

In the absence of any non-coordinated phase calls, the coordinated phase(s) will remain walk during the yield period.

When the coordinated phase(s) terminate during the yield period, the coordinator allows the CU to service all the subsequent phase(s) in normal order before returning to the coordinated phase(s).

A limitation has been set on yield mode so that it will apply only to units running with no more than two rings in a cluster. A cluster is any number of rings with barriers established based on non-concurrent phase definition.

The yield period will terminate after a time equal to the lesser of a calculated maximum yield period and the entered yield period.

The calculated maximum yield period will be the difference between the non-coordinated phase time sum and the non-coordinated phase minimum service time sum.

The definition of the yield period remains simple as long as the application is simple. When it is applied to dual ring clusters with unequal times in the coordinated phases or lead/lag operation, the definition becomes a bit more complex. The yield period begins based on the beginning of the first coordinated phase yield period and will continue until the end of the last coordinated phase yield period, except that a phase will not be serviced if adequate time does not exist to service it at its normal position in the cycle.

An example of the reason for the exception above is a lagging turn whose yield period began with the completion of the first coordinated phase time and for which adequate time may not continue to be available through the yield period following the last coordinated phase. Therefore, it will be omitted when adequate time does not exist to service it at its normal position in the cycle.

A key element is that all permissive modes provide a release from the coordinated phase(s) to phase(s) in sequence of rotation and extend the coordinated phase(s) when a lack of demand exists in the next phase(s) to be serviced. The yield mode does not evaluate demand by phase sequence. This mode releases to any phase after the coordinated phase(s) that has demand and thus, unused times can be allocated to subsequent phases when the force is applied as a point in the cycle. This mode is best suited for moderate to heavy traffic to preclude excessive amounts of time being allocated to an early return to the coordinated phase(s).

3.8.11.3   Permissive Yield Mode

Permissive yield mode provides for a controlled release to each of the non-coordinated phases in sequence as defined in permissive mode with the following addition:

Immediately prior to the first permissive, when not shortway offset correcting (going short), the coordinator will provide a variable period for the coordinated phase extension called the permissive yield period (PYP).

During the PYP, the coordinated phase detectors will be monitored as though it were an actuated phase, and the coordinated phase will not terminate unless the coordinated phase gaps out (passage timer times out or the traffic gap exceeds the gap reduction effective gap time).

The PYP will terminate when the coordinated phase gaps out or after a time equal to the lesser of a calculated maximum permissive and the entered yield period (coordinated phase extension).

The coordinated phase pedestrian is actuated. If called, the PYP will not terminate until the pedestrian timing is complete. If walk plus pedestrian clear is greater than the PYP accommodates, a late return will occur.

The calculated maximum permissive will be the difference between the non-coordinated phase time sum and the non-coordinated phase minimum service time sum.

At the end of the PYP, the amount of coordinated phase extension will be calculated, and the following non-coordinated phase times will be shortened proportionally to equal the coordinated phase extension.

The amount of time a non-coordinated phase is shortened is based on available time (Timing Plan Phase Time minus Minimum Service Time) as a percentage of the total available time for all the non-coordinated phases.

The non-coordinated phases shortened based on extension of the coordinated phase(s) are those that appear following the last coordinated phase and cycle zero or any dual coordinated phase that may be set.

When the entered cycle length is greater than the calculated cycle length, the positive difference is used as a pattern PYP time. This time is proportionally distributed to all the non-coordinated phases where it may be taken back based on the coordinated phase extending in the PYP.

A limitation has been set on permissive yield mode in that it will apply only to units running with no more than two rings in a cluster. When programmed to operate outside this

limitation, a NO COORD - BAD P FREE will be logged and the unit will run free (not coordinated).

3.8.11.3.1 Permissive Yield Mode Application

Permissive yield mode incorporates the sliding window scheme of the permissive mode then adds special operation functions to resolve unique intersection control problems. The term permissive applies to the use of the permissive mode sliding window operation. The term yield applies to the fact that this mode uses the yield period timing NOT that this mode resembles the yield mode.

The first special function is the fact that ALL pedestrian movements are actuated by pedestrian push buttons. If pedestrian movements are to occur every cycle they must be recalled. In all coordination modes, if the time is not allocated for phases to service the pedestrian demand, the coordinator upon return to the coordinated phase(s) may be required to make an offset correction to accommodate the delay caused by the pedestrian service. This may be severely detrimental to traffic flow. For that reason, not programming time for pedestrian service in the pattern is best limited to OFF PEAK and PM short cycle patterns where cycle lengths are used to reduce delays.

The second special function is the operation of vehicle demand extension of the coordinated phase(s). The time programmed in the pattern phase timings represents the minimum time the coordinated phase(s) will be green and the start of the coordinated phase(s) green for offset control. At the point the coordinator would normally open a permissive window for Phase 3 and 7, the CU looks at the coordinated phase(s) detectors to determine if gap out has occurred. Volume density is active as though the phase(s) were not coordinated. If gap out has not occurred, the controller will extend the coordinated phase(s) for a period of time up to the value programmed in the yield period. The extension of the coordinated phase(s) will deduct time from non-coordinated phases as described later.

A point of reference to the use of permissive yield (full actuated coordination) mode is the location of the intersection in the time space plot diagram. Permissive yield mode is most effective at intersections where the platoon movements are nearly coincidental, not sequential. If the platoon flows are sequential in time, the time programmed should be sufficient for the late platoon to be in place before going actuated. Secondly, the extension of coordinated phase(s) should not allow excessive back-up at adjacent intersections. Coordination by design should increase platoon speeds. If adjacent intersections terminate early, the platoon could be forced to excessive stopping hazards thus defeating the coordination patterns and increasing stops and delays. This is especially important during rain, ice, and snow periods where speeds are reduced, and platoon arrivals are customarily late.

The third special function is a combination of features that develop the coordinator to obtain virtual split. The primary function is the fact that the sum of the intervals (pattern phase times) does NOT have to equal the cycle length. This feature allows the user to program phase times that would normally equal 90 seconds and then program a cycle length of 130 seconds. The CU internal coordinator will assign all the unprogrammed time, 40 seconds in this example to all non-coordinated phases proportional to the percentage of variable time (Timing Plan Value minus Phase Minimum Service) allocated to phases in the pattern.

Table 3-11. Coordinated Phase Extension at 40 Seconds					
Phase	**Pattern**	**Min**	**Vari**	**%**	**Virtual**
2 and 6	30	Coord Phase Not Included			30
3 and 7	15	10	5	5/20	25
4 and 8	30	20	10	10/20	50
1 and 5	15	10	5	5/20	25
Total	90	20			130

If coordinated phase demand at the end of the coordinated phase time caused extension of the coordinated phase, the limit on that extension would be 40 seconds. If said extension were 40 seconds, the non-coordinated phase time would be reduced by the same value increased above. If the coordinated phase extension were 20 seconds, the following occurs.

Table 3-12. Coordinated Phase Extension at 20 Seconds				
Phase	**Pattern**	**%**	**% 20 Sec**	**Virtual**
2 and 6	30			50
3 and 7	15	5/20	5	20
4 and 8	30	10/20	10	40
1 and 5	15	5/20	5	20
Total	90			130

The key point of the operation is that each cycle allocates time in the sequence based on actual demand and the coordinator guarantees start of the coordinated phase(s) at the local cycle zero and evaluation of actuated coordinated phase(s) demand at the same point in each cycle.

This mode is especially useful for OFF PEAK patterns where the lowest cycle length is desired to reduce delays yet retain coordination. Note that if non-coordinated phase demand is light and pattern is set to handle heavy non-coordinated phase demand, the excess early release of coordinated phase green may cause problems.

3.8.11.4   Permissive Omit Mode

Permissive omit mode provides for operation as defined in permissive yield mode with the following addition:

In single ring configurations, the coordinated phase, once terminated to service a call, will not occur again until the last permissive is over.

In dual ring configurations, the coordinated phase, once terminated to service a call, will not occur again until servicing a phase in the coordinated phase sub-cluster, or after the last permissive. Further, any actuated phases in the coordinated phase sub-cluster that precede a coordinated phase will not be serviced prior to their normal time in the background cycle.

The above is accomplished by omitting the coordinated phase beginning with the first permissive period. This omit will be lifted when the stated conditions are right for coordinated phase re-service.

3.8.11.4.1   Permissive Omit Mode Application

The purpose of this mode is to prevent the return to the coordinated phase sub-cluster prior to its time in the background cycle. It also allows non-coordinated phases to dwell or cycle based on time constraints of the timing plan.

Applications where side street demand is sporadic, or complaints are received concerning excessive delays are a good use for this mode. During AM start up coordination, patterns are normally started 15 to 30 minutes prior to the start of flow generation to allow sync of the whole system. At these times traffic is also sporadic at side streets and some cycles non-existent. The use of recalls places excessive delay on the coordinated phase(s) without warrant. But release to side street on demand holds the phase after the vehicle like a sloppy passage time selection or a hung detector without recall. This allows side street traffic to get a call at the last possible point in cycle or maintain the green after a minimum service call. The coordinated phase(s) do not experience excess delay because the demand is from an adjacent intersection or early release platoon that will be in step after one stop.

Critical intersections are intersections where the capacity is not sufficient to clear the demand each cycle on the coordinated phase(s) based on reasonable cycle lengths. If demand is not cleared, the progression is either capsized or in the process of being capsized. The time requirements to start a platoon must include start-up from stop for the demand. The start-up time is generally 3 to 4 times greater than moving the same volume where the flow is already at speed. Therefore, flow is maximized at critical intersections when the arriving platoon is not required to stop then restart; but arrive after flow is established and all but the unavoidable demand is precluded from arriving early.

Most systems have intersections where side street demand is not at critical levels. These intersections can afford longer coordinated phase(s) green times necessary to start up a platoon. Designs should therefore attempt to stop all early and stragglers of the platoon and only release at a time when the adjacent critical intersections can have flow established. Other designs require the use of dual coordinated phases to accomplish this function. The use of dual coordinated phases generated complaints in the pre-rush peak by causing the intersection to terminate flow when there was no demand and the critical intersection lacked critical demand loading. The permissive omit mode resolves this problem by requiring at least one vehicle to call the phase necessary to terminate the coordinated phase(s) flow. This

design precluded an early release thus controlling the time that the platoon arrived at the critical intersection.

3.8.11.5   Sequential Omit Mode

Sequential omit mode provides for operation as defined in permissive yield mode with the following exceptions:

Sequential omit mode provides a phase-by-phase sliding window of service (lifted omit). One and only one phase in a ring will have the omit lifted at any time.

Following the permissive yield period, the coordinated phase, will be omitted until the last permissive is over.

Following the permissive yield period, the opening of a permissive window will occur concurrent with the closing of the prior permissive. The closing of each permissive window will occur at its normal position in the cycle.

The virtual split along with sequential omit mode and cycle force put all unused time into the phase following the coord phase.

A limitation has been set on sequential omit coordinated mode in that it will apply only to units running with no more than two rings in a cluster. When programmed to operate outside this limitation a NO COORD - BAD P FREE will be logged and the unit will run free (not coordinated).

3.8.11.6   Full Actuated Mode

Full actuated coordination mode provides for operation as defined in permissive yield mode with the following exceptions:

Following the permissive yield period, any phase may be served in the standard sequence provided the permissive period for that phase has not expired.

Following the permissive yield period, any phase may be re-serviced in the standard sequence provided the permissive period for that phase has not expired.

Following the permissive yield period and prior to the end of the permissive for the phase before the first coordinated phase, the coordinated phase will operate as an actuated phase.

A limitation has been set on full actuated coordination mode in that it will apply only to units running with no more than two rings in a cluster. When programmed to operate outside this limitation a NO COORD - BAD P FREE will be logged and the unit will run free (not coordinated).

3.8.11.7   Mutual Coordination Mode

Mutual Coordination, also referred to as Non-Background Cycle Coordination, or Yellow Yield Coordination is not a conventional form of time-based coordination like those above. Rather, it is a communication-based coordination of two or more closely spaced signalized intersections. A master intersection runs in free operation while the adjacent slave intersection's mainline movements are held waiting for the master intersection to reach the end of mainline green. As the master intersection reaches the beginning of the clearance phase, the hold is released for the slave intersections, allowing these intersections to service

their ancillary movements in normal phase rotation. After each slave intersection has serviced its ancillary movements, a hold is reinstated as it returns to its mainline movements. It then waits again for a release from the master intersection. Consult the Yunex Traffic ITS help desk for details on using this mode.

3.8.12   Maximum Mode

Maximum timers are programmed on a per phase basis under phase data. This selection defines the current maximum timer, if any, to be operated concurrently with coordination. If a maximum timer is selected, the times allocated within the timing plan must be cross verified to the selected maximum timers on a per phase basis to ensure the timing plan times do not exceed the maximum timer values. The CU will cause phase termination based on the shorter of either the maximum timer or the programmed timing plan time for the phase.

The selection of maximum inhibit causes the coordinator to use only the timing plan times. This is assumed to be the selection for most applications.

3.8.13   Force Mode

The force point for each phase is automatically calculated by the CU internal coordinator.

The plan force mode provides a coordination force off based upon the plan timing. Each phase will be forced a fixed time after it has become active. This mode provides all unused time in the cycle to the coordinated phase(s).

The cycle force mode provides a coordination force off based upon the cycle timing. Each actuated phase will be forced at a fixed position in the cycle. This mode provides unused time in the cycle to the next phase that can take it.

3.8.14   Sync Monitor

The coordinator monitors the offset command requests for validity of the imposed sync reference.

The coordinator will discontinue offset correction when the length of time between sync pulses exceeds the cycle in effect by five seconds and until the next sync pulse is received.

The coordinator will revert to sync monitor free mode when:

There is no sync pulse for three consecutive cycles.

- No offset line is active for 15 seconds or the amount of time entered in Revert To Backup. When the Revert to Backup time is zero then 15 seconds is used. Otherwise, the amount of time used is the entry in Revert To Backup time.

- More than one offset is active for 15 seconds.

During sync monitor free mode, the offset command requests will continue to be monitored and should the command request return to valid operation, the coordinator will implement the pattern commanded.

The sync monitor free mode may be replaced by a TBC event. See the "On Line" definition in the Time Base section.

3.8.15   Manual Control

The coordinator is capable of being set to manually operate in any pattern (Timing Plan plus Offset) through program entry. A manual selection of pattern overrides all other pattern interface commands.

The coordinator is capable of being set to manually operate in any pattern by an entry through the front panel. A manual selection of pattern overrides the pattern interface commands.

A manual sync of the pattern is controlled by an entry through the front panel.

3.8.16   Free

The coordinator is capable of free mode of operation. During this mode all coordinator control of the CU operation is removed.

The coordinator is capable of being set to the free mode defined under sync monitor and through program entry.

The coordinator will recognize input requests that conflict with the internal coordination operation and either ignore them or automatically revert to free mode when the inputs are active. The inputs that conflict with internal coordination are:

Walk rest modifier	Ignore
Manual control enable	Free
Stop time (either ring)	Free
Automatic flash	Free
Preemption (any)	Free

When stop time is not assigned or automatic flash has no entry phases programmed, activation of those inputs will result in free (non-coordinated) operation.

3.8.17   Command Priority

The coordination patterns are capable of being selected based on program entry, interconnect inputs, TBC events, and a system interface. The pattern select priority is as follows:

Program entry

- System interface
- TBC event
- Interconnect inputs

When the TBC online input is active, the TBC events have no priority and program selection is based on manual inputs or interconnect inputs.

3.8.18   External Coordination Interface

The coordinator external interface for Type 1 CUs is through Port 1. The external interface for Type 2 CUs is through Connectors A, B, and C or D.

The availability of coordinator input/output functions are dependent on the CU hardware configuration, terminal and facilities wiring and configuration, and user programming.

The coordinator operates with an external interface as follows:

Coordination inputs – The coordinator selects the pattern to be used, according to the current status of the timing plan and offset requests. In the applicable mode, eight inputs for a hardwire type interconnect interface are available.

Coordination outputs – Eight outputs for master type interconnect interface drivers are available. The coordination outputs echo the active pattern. All outputs are constantly on when active except offset, which is OFF for a minimum of three seconds or three percent of the cycle once each cycle beginning at the 0 point of the cycle.

An output mode is available that provides an interrupted sync pulses on the active offset output. The interrupted sync pulses are provided at intervals equal to 20% and 25% of the cycle on alternate cycles.

Levels – All logic signals are low state (nominal 0 VDC) for the operate condition of all coordination inputs and outputs.

Connector pins – Input/output pin terminations are provided in accordance with the following table:

Table 3-13. Coordination Inputs and Outputs	
Coordination Inputs	**Coordination Outputs**
Timing Plan A (Cycle/Dial A)	Timing Plan A (Cycle/Dial A)
Timing Plan B (Cycle/Dial B)	Timing Plan B (Cycle/Dial B)
Timing Plan C (Split A)	Timing Plan C (Split A)
Timing Plan D (Split B)	Timing Plan D (Split B)
Offset 1	Offset 1
Offset 2	Offset 2
Offset 3	Offset 3
Free (no coordination)	Free (no coordination)

Input/output command association – Coordination inputs and outputs are interpreted as command requests in accordance with the information in Table **3-14**.

Table 3-14. Timing Plan					
Command	**TP A**	**TP B**	**TP C**	**TP D**	**Reference**
TP 00	OFF	OFF	OFF	OFF	Dial 1 Split 1
TP 01	OFF	OFF	ON	OFF	Dial 1 Split 2
TP 02	OFF	OFF	OFF	ON	Dial 1 Split 3
TP 03	OFF	OFF	ON	ON	Dial 1 Split 4
TP 04	ON	OFF	OFF	OFF	Dial 2 Split 1
TP 05	ON	OFF	ON	OFF	Dial 2 Split 2
TP 06	ON	OFF	OFF	ON	Dial 2 Split 3
TP 07	ON	OFF	ON	ON	Dial 2 Split 4
TP 08	OFF	ON	OFF	OFF	Dial 3 Split 1
TP 09	OFF	ON	ON	OFF	Dial 3 Split 2
TP 10	OFF	ON	OFF	ON	Dial 3 Split 3
TP 11	OFF	ON	ON	ON	Dial 3 Split 4
TP 12	ON	ON	OFF	OFF	Dial 4 Split 1
TP 13	ON	ON	ON	OFF	Dial 4 Split 2
TP 14	ON	ON	OFF	ON	Dial 4 Split 3
TP 15	ON	ON	ON	ON	Dial 4 Split 4

For the purpose of utilization in an existing traditional interconnect system, a reference with dial and split numbers is provided.

Table 3-15. Offset			
Command	**Off 1**	**Off2**	**Off3**
Offset 1	ON	OFF	OFF
Offset 2	OFF	ON	OFF
Offset 3	OFF	OFF	ON
Sync	OFF	OFF	OFF
Others	See Sync Monitoring		
Voltage Levels: OFF = +24 V; ON = 0 V			

3.8.19　Coordination Indications

Indications are provided on the display and appropriately identified to facilitate the determination of coordination operation.

Coordinator settings and activity are capable of being monitored on the display (for example hold, omit, and force off indication will denote when these functions are used).

The indications provide the following current status:

- Running pattern, control source
- Running pattern, timing plan plus offset

- Correction in progress
- System zero
- Cycle counter

3.9 Time Base Control

The CU includes provisions for internal TBC.

3.9.1   Operation

The internal TBC is a special routine operating within the CU. It is based on the NTCIP 1211 concept of Schedules, Day Plans and Actions. In SEPAC, up to 255 Schedules are supported. Each Schedule calls one of 255 Day Plans. Each Day Plan, in turn, activates one of 15 different Actions, depending upon the time of day.

Within a TBC Action, it is possible to:

- Call any of 253 coordination patterns, Free operation(254), or Automatic Flash (255)
- Control phase functions
- Control special function outputs
- Control auxiliary outputs
- Select detector diagnostic value set that is operational
- Control system detector reporting
- Control dimming functions

The TBC coordination pattern sync (cycle zero) will be user programmable to be referenced to any hour/minute or the event time.

TBC settings and activity may be monitored on the CU display.

3.9.2   Clock Calendar

The TBC is provided with a line frequency driven clock (default) and backed up by a super-capacitor supported crystal-controlled clock. During normal operation, the line frequency driven clock controls all timings and synchronizes the crystal-controlled clock to the line frequency clock one time per minute. When power is removed and reapplied, the crystal-controlled clock provides the current time to the line frequency clock.

The TBC provides for automatically determining the current day of week, day of month, month of year, and year based on the data set as a starting point. The calendar provides automatic compensation for leap years.

When the set clock input is active, the internal clock is reset to 04:00:00.

3.9.3   Memory and Clock Backup

A backup voltage source is provided with the TBC circuitry. When service power is not available to the controller, the RTC and Short-Term Non-Volatile Memory shall be maintained for a minimum of 30 days at 25°C on NEMA-based controllers.

The time base clock shall be maintained to within ±0.005 % at 20ºC (68ºF) and to within ±0.02% over the specified operating temperature range as compared to coordinated universal time (WWV) standard for a period of thirty days during periods when AC power is not applied.

3.9.4   Daylight Saving Time

The TBC provides for Daylight Saving Time in accordance with NTCIP 1201 v03 or via the Linux operating system. SEPAC supports up to 2 levels of DST operation, that is two advances and two retreats per year.

3.9.5   Schedule

A TBC schedule provides the means to define the day plan to be operational on any given date. TBC provides for 255 schedules to be defined.

A TBC schedule consists of:

- Day-Of-Week (DOW) – Sunday through Saturday
- Month-Of-Year (MOY) – January through December
- Day-Of-Month (DOM) – 1 through 31
- Day Plan – 1 through 255

The active schedule is determined by comparing the current DOW, MOY, and DOM to the parameters entered. The parameters are connected with a logical AND. TBC will select the schedule that has the most specific (least number of fields set) date. The most specific date is based on the following:

- If MOY is the same as the current date, select the most specific DOM
- If the DOM is the same as the current month, select the most specific DOW
- If the DOW is the same as the current week, the first occurrence within the time base event table will be selected.

A schedule is not valid when the DOW, MOY, DOM, or day plan parameters is zero.

3.9.6   Day Plans

A TBC Day Plan provides the means to define the action to be operational at specific times when the Day Plan is selected. TBC provides for 255 Day Plans to be defined.

A TBC Day Plan consists of up to 15 events. A Day Plan event consists of:

- Hour – 0 through 23
- Minute – 0 through 59

- Action – 0 through 255

A day plan event is not valid when the action is zero.

3.9.7   Actions

A TBC action provides the means to define the various functions to be operational when the action is selected. TBC provides for 255 actions to be defined.

A TBC action consists of:

- Pattern control
- Phase function control
- Auxiliary control
- Special function control
- Dimming control
- Detector control

The current action is determined by the following process:

1) Look at the day plan for today for an event to run
   a) If there are no events in the day plan for today, run no event.
   b) If an appropriate event is found, run it.
   c) Otherwise proceed to Step 2.
2) Look at the day plan for yesterday for something to run.
   a) If any event is found, run the last event.
   b) Otherwise, run no event.

3.9.7.1   Pattern Control

A TBC action provides the means to define a pattern control as follows:

Table 3-16. Pattern Control	
Number	**Function**
0	Use interconnect
1–253	Run this pattern
254	Free
255	Flash

When the TBC On Line input is active, the TBC pattern control does not have priority and pattern selection is based on interconnect inputs. When the On Line input is active, the coord pattern control will revert to TBC pattern control based on sync monitor failure.

The TBC pattern control provides the capability of partial interconnect control as well (when dial or split is based on interconnect inputs, offset is automatically based on interconnect inputs).

3.9.7.2 Phase Function Control

A TBC action provides the means to define 16 phase function controls. See Chapter 2, Section 2.7.10 for details on the mapping of control to function.

3.9.7.3 Auxiliary Control

A TBC action provides the means to define 3 auxiliary function controls. Each output is non-cyclic, each totally independent of any other output. These outputs are not affected by any other input including the On Line input.

3.9.7.4 Special Function Control

A TBC action provides the means to define 8 special phase function controls. See Chapter 2, Section 2.7.11 for details on the mapping of control to function.

3.9.7.5 Dimming Control

A TBC action provides the means to define one dimming control. The CU may be programmed to provide output dimming based on a TBC action and dimming enable input (both must be active to enable).

3.9.7.6 Detector Control

A TBC action provides the means to define 3 detector controls.

3.9.8 Data Entry, Display, and Removal

TBC data may be entered through the CU front panel, downloaded through the system interface, or imported from a Datakey or a USB flash drive.

TBC data may be displayed or scanned (forward or backward) from any point in time. Traffic events, auxiliary events, or special days may be displayed or scanned.

TBC data may be removed as individual events, all traffic events and auxiliary events, all special days, or all time base data.

3.9.9 External TBC Interface

The TBC external interface for Type 1 CUs is through Port 1. The external interface for Type 2 CUs is through Connectors A, B, and C or D.

The availability of TBC input/output functions are dependent on the CU hardware configuration, terminal and facilities wiring and configuration, and user programming.

The TBC operates with an external interface as follows:

- Time base inputs – In the applicable modes, the TBC On Line input is available to disable the time base pattern outputs to the internal coordination program.

  In the applicable modes, the dimming enable input is available to enable dimming when the auxiliary event calls for dimming operation.

In the applicable modes, the set clock input is available to set the CU clock to 04:00 hours.

- Time base outputs – In the applicable modes, outputs for time base auxiliary and special functions are available. The outputs are on when their respective auxiliary/special function is part of the current time base event.

  In the applicable modes, Auxiliary #2 output performs a dual purpose. When there is no TBC event programming for Auxiliary #2, this output will function as an any preempt status output.

  In the applicable modes, Auxiliary #3 output performs a dual purpose. When there is no TBC event programming for Auxiliary #3, this output will function as a detector diagnostic reset output.

  System Special Function #1 to #8 outputs may be programmed individually as local TBC outputs. Once so programmed, a system special function output will not respond to system commands as to its state.

- Output levels– All logic signals are low state (nominal 0 VDC) for the operate condition.

- Connector pins– Input/output pin terminations are provided in accordance with the following:

Table 3-17. Time Base Inputs and Outputs	
Time Base Inputs	**Time Base Outputs**
On Line	Auxiliary # 1 Outputs
Dimming Enable	Auxiliary # 2 Outputs
Set Clock	Auxiliary # 3 Outputs
	Special Function # 1
	Special Function # 2
	Special Function # 3
	Special Function # 4
	Special Function # 5
	Special Function # 6
	Special Function # 7
	Special Function # 8

3.9.10   TBC Indications

Indications are provided on the display and appropriately identified to facilitate the determination of time base operation.

The indications provide the following:

- Date, time, DOW

- Schedule Day Plan and Action

- Current auxiliary functions

3.10   Preemption

The CU includes provisions for an internal preemptor with the capability of 12 unique preempt sequences.

3.10.1   Operation

Internal preemption is a special program operating within the CU. The preemption program accepts commands from 12 programmable preempt inputs and provides the timing and signal display programmed to occur in response to each.

Preemption controls are internally applied. Internally applied preempt controls will have priority.

Each preempt input provides 2 modes of priority control based on the form of the input signal. The standard input form, for preempt (railroad or emergency vehicle), is a continuous ground true logic input. The alternate input form, for transit priority (bus or transit vehicles), is a pulsating (1 to 30 HZ) ground true logic input. Transit priority is discussed in more detail in Section 3.11.

When the preempt link value equals the preempt programmed (Preempt 1 linked to Preempt 1), a constant input actuation will place a call for the transit priority routine of the same number.

The preempt input must be held steady, on or off, for the programmed de-bounce time, before that state is recognized by the preemption program.

The preemption program recognizes the current signal display at the time of preempt and provides transition timing and signal display to a programmed preempt condition. 2 preempt conditions with an intermediate set of clearances are capable of being programmed (for example, track clear and dwell). When the preempt has been satisfied, the preemption program provides an exit transition timing and signal display to a programmed (one for each of the 12 preempts) return-to-normal condition.

Calling a transit priority via the preempt input will insert a delay of 500 milliseconds into the recognition of a standard preempt routine. This delay is required to allow the unit to determine whether the current actuation is a transit priority or preempt call. Similarly, a transit priority call will terminate 500 milliseconds before the CU can determine that the pulsating signal is actually finished and not just in an off cycle.

When a transit priority routine is configured and the preempt call for the same input is a pulse signal, the duration of the pulse signal must be a minimum of one second or the CU may interpret the signal as a priority call or no call.

Preempt parameters may be entered through the CU keypad, downloaded through the system interface, or imported from a Datakey or a USB flash drive. Preempt settings and activity are capable of being monitored on the CU display. Preempt controls are internally applied and will override the standard unit input modifiers (for example, hold, omit, etc.).

3.10.2   Preempt Routines

The preemption program provides for 12 preempt routines.

3.10.2.1   Input Priority

The preemption program provides for setting priorities of the preemption inputs with respect one to the other and to other inputs. The priorities are as follows:

- Preempt routines 1-2, by default, have priority over and override transit priority routines. If a preempt call becomes active while a transit priority is active, the controller will terminate the transit priority and enter the preempt routine at Preempt Interval 1 (selective pedestrian clear). The transit priority will continue once the preempt is completed. This behavior is configurable by the OV PRI field on the Preempt Overrides display. If OV PRI is set to 0, that Preempt will not override an active transit priority, but will be served after the priority routine has completed.

- Preempt 1 normally has priority over Preempt 2. If Preempt 1 becomes active while the preemption program is in the Preempt 2 routine, the CU immediately terminates the Preempt 2 routine and enters the Preempt 1 routine at Preempt Interval 1 (selective pedestrian clear). When Preempt 2 has been terminated by Preempt 1, control will not return to Preempt 2 at the end of Preempt 1 except when Preempt 2 demand is still present at the end of Preempt 1 or Preempt 2 duration time has not expired at the end of Preempt 1.

  The priority of Preempt 1 over Preempt 2 is capable of being canceled through program entry. If the priority has been canceled and the Preempt 1 becomes active while the preemption program is in the Preempt 2 routine, the Preempt 2 routine will complete normally through Interval 8 (dwell). After Preempt 2 Interval 8 is complete, the CU will enter the Preempt 1 routine at Interval 1 (selective pedestrian clear) only if the Preempt 1 demand is still present or Preempt 1 duration time has not expired.

  When Preempt 2 becomes active while the preemption program is in the Preempt 1 routine, the Preempt 1 routine will complete normally through Interval 8 (dwell) regardless of the priority of Preempt 1 versus Preempt 2. After Preempt 1 Interval 8 is complete, the CU will enter the Preempt 2 routine at Interval 1 (selective pedestrian clear) only if the Preempt 2 demand is still present or Preempt 2 duration time has not expired. Whenever both inputs become active at the same time, Preempt 1 will occur first.

  Whenever more than one preempt routine reaches the point of transition (delay and minimum green/walk timed out) simultaneously, the lower numbered routine will have control.

  Preempt 2 will normally have priority over Preempt 3. The priority of Preempt 2 over Preempt 3 is capable of being canceled through program entry.

  Preempts 3-12 will normally have equal status (priority canceled). A priority of Preempt 3 over Preempt 4, Preempt 4 over Preempt 5, etc. is capable of being established through program entry.

Operation capability as described above for Preempt 1 and 2 is provided for Preempt 2 and 3, 3 and 4, 4 and 5, etc.

- All preempt routines normally have priority over automatic flash. If any preempt becomes active while the CU is in automatic flash, automatic flash will terminate normally, and the CU will enter the preempt routine at Preempt Interval 2 (selective yellow clear). This behavior is configurable by the OV FLSH field on the Preempt Overrides display.

  The method by which flashing operation is accomplished determines the transition between automatic flash and preempt as follows:

  - Voltage monitor output inactive – The signal display for a transition from automatic flash to Interval 2 is red for all vehicle phases, don't walk for all pedestrian phases, and red for all vehicle overlaps that are programmed in normal operation. The signal display for a transition from automatic flash in Preempt Interval 3 (selective red clear) is red for all vehicle phases, don't walk for all pedestrian phases, and red for all vehicle overlaps that are programmed in normal operation.

  - Load switch driver output flashing – The CU will provide a timed exit transition period when any flashing yellow display will be followed by a red, flashing red, or dark display. The load switch driver outputs during this period will be yellow for those that were flashing yellow and red for those that were flashing red or dark.

    The exit flash transition timing is 1) Yellow – longest phase yellow change of phases receiving a steady yellow and 2) Red – longest phase red clearance of phases receiving a steady red.

  The priority of preempt over automatic flash is capable of being canceled through program entry. If the priority of preempt over automatic flash has been canceled and a preempt input becomes active while the CU is in automatic flash, the CU will remain in automatic flash until the demand (both automatic flash and preempt) is terminated. Preempt demand is determined by the state of the call and duration timing.

- Start-up flash always has priority over all preempt routines. If a preempt input becomes active or is active during start-up flash, the CU will maintain the start-up flash condition for the duration of both the preempt demand and start-up flash time.

- External start always has priority over all preempt routines. If external start becomes active during a preempt routine, the CU will revert to start-up flash rather than the initialization condition. The CU will maintain the start-up flash condition for the duration of the external start, preempt demand, and start-up flash time.

3.10.2.2   Output Modification

The preempt routines provide for setting ring and phase outputs to the following conditions after delay has timed out and preempt transition has begun:

- Phase on, next, and check – ON/NEXT output per programmed intervals, CHK has no output unless in cycle.

- Ring status bits – Code 7 (NEMA)

A preempt output, when Auxiliary 2 is not programmed for output as a TBC auxiliary function, it will have a Preempt function. The Preempt output will become active whenever any preempt routine is in control.

Whenever an Auxiliary 2 event has been programmed and it is desired to again implement the Preempt/priority output, the clear memory function within TBC must be used to eliminate all TBC or all auxiliary events (Code 0 or Code 2).

3.10.2.3   Timing

The preempt routine provides a number of intervals for each preempt routine. The timing intervals and ranges are as follows:

Table 3-18. Timing Intervals and Ranges		
Interval Number	**Interval Name**	**Range**
I	Minimum green	0-255 sec
II	Minimum walk	0-255 sec
A	Delay	0-999 sec
B	Gate Extend	0-99 sec
C	Extend	0-999 sec
D	Duration	0-999 sec
E	Maximum call	0-999 sec
F	Lock out	0-999 sec
1	Selective pedestrian clear	0-255 sec
2	Selective yellow change	0-255 tsec
3	Selective red clear	0-255 tsec
4	Track green	0-255 sec
5	Track pedestrian clear	0-255 sec
6	Track yellow change	0-255 tsec
7	Track red clear	0-255 tsec
8	Dwell (hold)	0-255 sec
9	Return pedestrian clear	0-999 sec
10	Return yellow change	0-255 tsec
11	Return red clear	0-255 tsec

** Exit phase (return-to-normal display)

- Minimum green – A preempt initiated transition will not cause the termination of an existing green prior to its display for lesser of the minimum green time for the phase or this period.

- Minimum walk time – A preempt initiated transition will not cause the termination of an existing walk prior to its display for the lesser of the walk time for the phase or this period.

- Interval 1 (selective pedestrian clear) will terminate when all pedestrian signals that are to be don't walk in Interval 4 (track green) are don't walk, or when its time has expired, or when any pedestrian clear interval active at the beginning

of Interval 1 has been active the lesser of the normal pedestrian clear or the preempt selective pedestrian clear.

- Interval 2 (selective yellow change) will terminate when all vehicle signals that are to be red in Interval 4 (track green) are red, or when its time has expired, or when any yellow change interval active at the beginning of Interval 2 has been active the preempt selective yellow timing.

- Interval 3 (selective red clear) will terminate when its time has expired, or when any red clear interval active at the beginning of Interval 3 has been active the Preempt Selective Red timing.

- Interval 8 (dwell) terminates when its time has expired, the duration timing has completed, and the preempt demand is no longer active.

- The preempt yellow timing (selective yellow, track yellow, or return yellow) will be equal to the preempt yellow entry except when the preempt yellow entry is less than three seconds and then the preempt yellow timing will be equal to the traffic yellow (phase and overlap) timing.

- The preempt red timing (selective red, track red, or return red) will be equal to the preempt red entry except when the preempt red entry equals zero and then the preempt red timing will be equal to the traffic red (phase and overlap) timing.

3.10.2.4 Delay, Gate Extend, Extend, and Duration

The preempt routine provides a timed interval (delay) after the preempt call is received before the CU operation is interrupted and a preempt transition begins.

When a preempt call is received, the delay will begin timing. The completion of the delay will start the preempt routine at Interval 1 (selective pedestrian clear) if the minimum green/walk timing is complete.

When the preempt input memory has been programmed for non-locking and the preempt call terminates during the delay, the delay and duration timing will reset and a preempt transition and display will not occur.

Once a preempt transition has begun, the routine will complete regardless of the call status or memory programming.

The gate extend timer will be reset whenever a preempt actuation is received and will begin timing when the preempt actuation terminates. Re-actuation of the preempt input during this period causes preempt routine to restart from the beginning.

The extend timer will be reset whenever a preempt actuation is received and will begin timing when the preempt actuation terminates. A call for the preempt routine will be placed for the period between the extend timer reset and time out (extends the call).

The duration timer will begin timing when the preempt call is received. Duration timing will be internally set to a value equal to delay plus duration parameters and will time concurrently with delay. The duration timing will be reset with each preempt actuation (extends dwell for the passage of subsequent emergency vehicles).

3.10.2.5   Greens and Return

The preempt routine provides for the selection of vehicle and pedestrian signal status in Interval 4 (track green) and Interval 8 (dwell) and the phase(s) to receive service first following the completion of preempt.

Each vehicle load switch driver group (G-Y-R) and each pedestrian load switch driver group (W-PC-D) is selectable as to the output condition (R, G, FY, FR, or DARK) and (D, W, FW, or dark) in Intervals 4 (track green) and Interval 8 (dwell) separately.

The CU is capable of setting a limit on the time a preempt call may remain active (MXCALL) and be considered valid. When the preempt call has been active for this time period, the CU will return to normal operation (release from dwell). This preempt call will be considered invalid until such time as a change in state occurs (no longer active).

The preempt routine provides the capability to link itself to a higher priority preempt to enable multiple clearance movements prior to a dwell state. More than one preempt routine may be linked to the same preempt routine.

Special sequence (for example, -GRN/-YEL and EXT PED CLR) control and red revert timing will be functional while in a preempt routine.

Because all phase and overlap load switch driver sets are not always used for normal signal control, SEPAC 5.3.0 has provided control of these drivers during track green and dwell even though they may not be programmed as active during normal operation. This control may satisfy requirements for special signals and control during preempt routines.

The phase(s) to receive service first on exit from a preempt are capable of being selected via the keypad.

All calls present at the beginning of the preempt routine will be present (subject to phase memory programming and detector status) and will be serviced with the user entered exit calls.

On exit from a preempt routine, a return to coordinated operation or a transit priority routine is prevented for a specified time period (lockout) or until one complete cycle of service to phases with serviceable calls, unless the R2C option is enabled.

3.10.2.6   Transition

The preemption program provides the signal display for an orderly and safe transition from the point of entry to the first preempt green state (track green), from the first to second green state (track green to dwell), and from the second green to the return-to-normal green state (dwell to normal).

The normal interval timing in effect at the moment preempt is recognized (after delay and minimum green/walk are satisfied) will continue operating through Preempt Intervals 1, 2, and 3 so as not to provide abnormally long pedestrian clear, yellow, or red timings.

During a preempt-to-preempt transition, the minimum green/walk operation will be satisfied prior to the track green or dwell interval termination to service the higher priority preempt. The shorter of minimum green/walk or the appropriate interval time (track or dwell) must have occurred prior to the transition.

The display during intervals (1, 2, and 3), (5, 6, and 7), and (9, 10, and 11) are the result of a comparison between the prior display and the next display according to the following chart:

	Table 3-19. Vehicle Signal Transitions			
Prior Display	**Preempt Interval**			**Next Display**
	1	**2**	**3**	
	5	**6**	**7**	
	9	**10**	**11**	
R	R	R	R	R
R	R	R	R	G
R	R	R	R	Dark
R	R	R	R	FR
R	R	R	R	FY
R	R	R	R	FG
Y*	Y/R	Y/R	R	R
Y*	Y/R	Y/R	R	G
Y*	Y/R	Y/R	R	FR
Y*	Y/R	Y/R	R	FY
Y*	Y/R	Y/R	R	FG
Y*	Y/R	Y/R	R	Dark
G	G	Y	R	R
G	G	G	G	G
G	G	Y	R	FR
G	G	Y	R	FY
G	G	G	G	FG
G	G	Y	R	Dark
FR	FR	R	R	R
FR	FR	FR	FR	G
FR	FR	FR	FR	FR
FR	FR	FR	FR	FY
FR	FR	FR	FR	FG
FR	FR	R	R	Dark
FY	FY	Y	R	R

Table 3-19. Vehicle Signal Transitions				
Prior Display	**Preempt Interval**			**Next Display**
	1	**2**	**3**	
	5	**6**	**7**	
	9	**10**	**11**	
FY	FY	FY	FY	G
FY	FY	Y	R	FR
FY	FY	FY	FY	FY
FY	FY	FY	FY	FG
FY	FY	Y	R	Dark
Dark	Dark	Dark	Dark	R
Dark	Dark	Dark	Dark	G
Dark	Dark	Dark	Dark	FR
Dark	Dark	Dark	Dark	FY
Dark	Dark	Dark	Dark	FG
Dark	Dark	Dark	Dark	Dark
* Would apply to Interval 1-2-3 only.				

Table 3-20. Pedestrian Signal Transitions				
Prior Display	**Preempt Interval**			**Next Display**
	1	**2**	**3**	
	5	**6**	**7**	
	9	**10**	**11**	
D	D	D	D	D
D	D	D	D	W
D	D	D	D	FW
D	D	D	D	Dark
F*	F/D	D	D	D
F*	F/D	D	D	W
F*	F/D	D	D	FW
F*	F/D	D	D	Dark
W	F	D	D	D

Table 3-20. Pedestrian Signal Transitions				
Prior Display	**Preempt Interval**			**Next Display**
	1	**2**	**3**	
	5	**6**	**7**	
	9	**10**	**11**	
W	W	W	W	W
W	W	W	W	FW
W	F	D	D	Dark
FW	F	D	D	D
FW	FW	FW	FW	W
FW	FW	FW	FW	FW
FW	F	D	D	Dark
Dark	Dark	D	D	D
Dark	Dark	D	D	W
Dark	Dark	D	D	FW
Dark	Dark	Dark	Dark	Dark
* Would apply to Interval 1-2-3 only.				

When extended pedestrian clear is programmed, Intervals 1, 5, and 9 will time concurrently with Intervals 2+3, 6+7, and 10+11 respectively.

Preempt will restart at any point in the preempt sequence starting with track green and through return red clear when an OFF to ON transition of the preempt input occurs. This is to cover the cases where a train has come and gone before the timing has completed then another train appears.

Table 3-21. LRT Signal Transitions				
Prior Display	**Preempt Interval**			**Next Display**
	1	**2**	**3**	
	9	**10**	**11**	
FL HBAR	FL VBAR	FL VBAR/HBAR	HBAR	HBAR
VBAR	VBAR	FL VBAR	HBAR	HBAR
FL VBAR	FL VBAR/HBAR	FL VBAR/HBAR	FL VBAR/HBAR	HBAR
HBAR	HBAR	HBAR	HBAR	HBAR

SRMOD (detailed in Section 2.8.6.1) will affect the transitions in Table 3-19, Table 3-20, and Table 3-21. If SRMOD is selected for the Selective Interval (1, 2, & 3) or Return Interval (9, 10, & 11) the Display shall be forced to use the transition row where the Next Display's are Red, Don't Walk, or AMB regardless of the programmed Next Display. Then the programmed Next Display will be displayed after Interval 3 or 11. The only exception would be when all of the Prior Display's are identical to the Next Displays. If that is the case the All-Red period will not be enforced.

3.10.2.7　　　　　　　Cycle

The preempt routine allows cycling during the dwell interval prior to the completion of duration and termination of the preempt call. The dwell interval time establishes the minimum cycling time.

When the dwell state includes phase greens that are permitted to cycle, cycling will begin in the dwell state. Phase or overlap outputs that are not permitted to cycle will maintain the output state as defined in the dwell interval.

When the dwell state does not include phase greens that are permitted to cycle, cycling will begin with the cycling allowed phases which would normally follow the dwell phase greens.

Pedestrian outputs will not cycle unless their applicable phase is also permitted to cycle.

When under coordinator control prior to the preempt beginning and if the coordinated phases are permitted to cycle, the coordinator will run while cycling. Also in this scenario, if no exit phases are configured, the CU will exit preemption without needing to perform a transition and the coordinator will stay in step. Otherwise, with exit phases defined, it will perform the normal return interval of the preempt.

Exit cycling operation to normal will operate like entrance to preempt.

3.10.2.8　　　　　　　Return to Coord

The preempt routine allows for the ability to jump into coordination after the return interval, to avoid lengthy transitions back to normal traffic, via the R2C parameter. When set, upon

exiting preempt, traffic will resume with the coordination plan programmed, skipping the lockout period.

> **Note: Return to Coord is not compatible with exit phases**

3.10.3   Active Displays

From the Main menu (Figure 2-1) press 1 and then 3.

```
PREEMPT/PRIORITY DISPLAYS
 1-PREEMPT TIMERS
 2-PRIORITY TIMERS
 3-PRIORITY DETECTORS
 4-PRIORITY STATUS
 5-PRIORITY PHASE UTILIZATION
 6-PRIORITY VEH QUEUE-LRT/TSP
```

Figure 3-2. Preempt/Priority Display

3.10.3.1   Preempt Timers Display

```
PREEMPT TIMERS

PREEMPT.....1....2....3....4....5....6..
 STATUS...
 TIMING...
PREEMPT.....7....8....9...10...11...12..
 STATUS...
 TIMING...
```

Figure 3-3. Preempt Timers Display

Line 2 displays the active preempt:

       Format: Name   # Interval Timing

       Example: PREEMPT 6 SEL PCL 14

Lines 3 & 6 displays preempt column names.

Lines 4 & 7 displays preempt status text:

       DEL call delay timing

       DUR maximum dwell period

       CAL input active

       EXT input extension timing

       MAX input active for maximum time allowed

       LOC lockout (GLB) is active

Lines 5 & 8 displays preempt status timing.

3.10.4   Memory

The preemption program provides input memory that is capable of being set to locking or non-locking through program entry.

When input memory is set for non-locking, termination of the input prior to implementation of the routine will not initiate preempt operation.

3.10.5   External Preempt Interface

The preemptor external interface for Type 1 CUs is through Port 1. The external interface for Type 2 CUs is through Connectors A, B, and C.

The preemptor operates with an external interface as follows:

- Preempt inputs – The preemptor selects the preempt routine to be active, according to the current status of the inputs and the preempt priority entries. In the applicable mode, 6 inputs for preempt actuation are available. By default, these correspond to preempt routines 1-6.

  Each Preempt/Priority input provides 2 modes of control based on the form of the input signal. The standard input form, for Preempt (railroad or emergency vehicle), is a continuous ground true logic input. The alternate input form, for transit priority (bus or transit vehicles), is a pulsating (1 to 30 HZ) ground true logic input.

- Preempt outputs – 6 outputs, one for each preempt routine is available. The outputs are ON when their respective preempt is in control.

  The Priority Active output provides ground true logic output when a priority routine is in control.

  Each Preempt # output provides ground true logic output when either the corresponding priority or Preempt # routine is in control.

  An output mode is available that provides a 1 pulsating (1 HZ) ground true output on the inactive Preempt # outputs plus a steady ground true output on the active Preempt # output.

- Input levels – All logic signals are low state (nominal 0 VDC) for the operate condition of all preempt inputs.

- Connector Pins – Input/output pin terminations are provided in accordance with the following:

Table 3-22. Preemption Inputs and Outputs	
Preemption Inputs	**Preemption Outputs**
Preempt 1 input	Preempt 1 output
Preempt 2 input	Preempt 1 output
Preempt 3 input	Preempt 1 output
Preempt 4 input	Preempt 1 output
Preempt 5 input	Preempt 1 output
Preempt 6 input	Preempt 1 output
	Preempt/priority
	Priority active

3.10.6   Preempt Indications

Indications are provided on the display and appropriately identified to facilitate the determination of preempt operation.

The indications provide the following:

Current status

- Preempt call
- Preempt in control
- Preempt interval
- Preempt interval counter

3.11   Priority

This section details the implementation of modifications to the existing traffic signal controller software as required to manage enhanced priority service control features associated with both Light Rail Transit (LRT) and Transit Signal Priority (TSP).

> **NOTE: SEPAC's LRT/TSP Priority Operation system is supported only for Permissive or Permissive-Yield modes of coordination, and for Plan force-off. Use of other coordination modes or of Cycle force-off is not supported and may give unexpected or undesirable results.**
>
> **In addition, only FULL FUNCTION SEPAC mode is supported, DIAMOND CONTROL is not supported at this time.**

The operation includes the development of full and partial priority features and train control features discussed further in this section. The definitions of partial and full priority are as follows:

- Minimal priority – This mode of operation provides the ability for the controller to make minimal interrupts to normal traffic operations for the service of the transit vehicle. No changes to the phase timing or phase sequence will take place to service the transit vehicle. However, Minimal will extend phase timings to the co-phase once service for the transit vehicle has started.

- Partial priority – The controller may shorten conflicting phases to a transit vehicle or lengthen the concurrent phases to start the transit vehicle signal green when the transit vehicle arrives. The lengthen action is not restricted to gaining access but may also function to provide additional time to complete service to an LRV currently receiving service.

  During operations when coordination is controlling traffic, partial priority allows coordination to manage the traffic phases according to the split phase timing.

  If an offset attained condition existed prior to priority, the partial priority operation will attempt to maintain that condition after completion of service. Because partial priority may shift the coordinated split phase timing relationship to the master sync cycle during shortening of phases or lengthening of the co-phases, partial priority techniques are used to recover these times and re-establish alignment.

- Full priority – The controller may be programmed to allow skipping of vehicle and pedestrian phases as needed to get to the motor vehicle and pedestrian phases that run concurrent with the LRV movements (co-phases).

  During operations when coordination is controlling traffic, full priority allows coordination to suspend traffic phase management. The split phase timing remains locked to the master sync cycle while the traffic phases can shift to acquire or maintain the time in the co-phases. Full priority recovery techniques are used to re-align the traffic phases to the coord phase cycle. There are several available methods as discussed later to use during full priority recovery.

  If an offset attained condition existed prior to priority, the full priority operation will attempt to maintain that condition after completion of service.

  When full priority level is selected, timing evaluations occur to determine if the partial priority operation may be substituted for full priority.

- Disable priority – This mode of operation provides the ability for the controller to not interrupt normal traffic operations for service of the transit vehicle. Only Transit Signal recall is available.

NOTE: For priority and preemption to function together, the priority must have both a minimum green and maximum green or use a check out detector to terminate the priority call.

3.11.1   Detection

```
PRIORITY 1 DETECTION
 PE DET                     N-LOCK:   1
   DELAY:  10 SEC         EXTEND/10:   0
 PR DET (DET=## FOR INPUT SOURCE)
          .1A...2A...3A...4A...5A...6A
  ADV DET: 65   66   67   68   69   70
     BDET: 71  CDET: 72  XDET: 73
```

Figure 3-4. Priority Detection Display

The PE input has the ability to select lock or non-lock for that input according to the value in N-LOCK in the individual priority detection display (Figure 3-4).

The remaining 9 detector selections for each individual priority are always locking. These nine detector selections have no choice to provide N-LOCK.

- N-LOCK – PE detector non-locking

  Defines whether the PE detector will be non-locking when used as a priority detector

  ♦ 0-No – Locking memory
  ♦ 1-Yes – Non-locking memory

  When non-locking equals 1 and the activating request ends prior to the service engaging it, that request will not be retained.

NOTE: The service engaging occurs immediately after the delay times out. Delay set to 0 defeats non-locking.

- DELAY – Delay for PE detector in seconds

  The time in seconds that the priority actuation through the PE detector must be active before triggering service.

  Delay must be greater than zero for non-locking to be effective.

- EXTEND – Extend for PE detector in tenths of seconds

  The time that each priority actuation will be extended from the point the actuation terminated

- 1A-6A – LRT Advance Detector 1 through 6 assignments.

  Assignment of a SEPAC detector to function as priority Advance Detector 1 through 6.

NOTE: Phase recalls (Min/Max/Soft/etc.) do not have any effect on LRT/TSP operations. LRT/TSP priority service can only be requested through detector inputs from devices in the field. A Transit Signal recall is available, but this is a display only service with no priority operation.

- BDET – LRT backup detector assignment

  Assignment of a SEPAC detector to function as the backup detector.

- CDET – LRT checkout detector assignment

  Assignment of a SEPAC detector to function as checkout detector.

- XDET – Cancel detector assignment.

Assignment of a SEPAC detector to function as the cancel input.

> **NOTE: Priority delay and extension capabilities for the 10 detection input sources for priority as LRT or TSP entered in the SEPAC priority detection display (Figure 3-4).**
>
> **NOTE: Each of the 10 sources, PE, 1A, 2A, 3A, 4A, 5A, 6A, BACKUP, CHECKOUT, and CANCEL, has an independently programmable delay and extension that operates in LRT or TSP use for each individual priority.**

The physical input PE also known as preempt or (pulsing) priority has delay and extension.

If the PE input is determined to control preempt, the delay and extension is programmed in the individual Preempt menu selection 1-MISCELLANEOUS.

If the PE input is determined to control priority, the delay and extension is programmed in the individual Priority menu selection 1-DETECTION where the physical input source is specified for the remaining 9 detection inputs.

When a source detector number is assigned to any of the 9 input sources that are NOT the PE, the delay and extension are programmed in the TIMING section of the data entry for the specific detector source number entered.

For example, the delay and extension for Detector 23 is entered in the screen accessed by the key sequence Main+3+7+{Detector Group}+{Detector}. For Detector 23 enter the delay and extension value.

3.11.2   Service

This section describes the Priority 1 Service display (Figure 3-5)

```
PRIORITY 1 SERVICE
  PHASE....1234.5678.9012.3456
CO-PHASE:  0100 0100 0000 0000 <EXCL: 0
QJ-PHASE:  0000 0000 0000 0000
MIN WLK:   0  N-LOUT:  1   FREE PAT: 253
MIN GRN:   6  LOUT A:  1 SEC
MAX GRN:  60  LOUT B:  1 SEC
```

Figure 3-5. Priority 1 Service Display

The Priority 1 Service display provides the following information:

- CO_PHASE – Priority Co-phases compatible with transit vehicle

    - 0   Not compatible with transit vehicle

    - 1   Compatible with transit vehicle

- EXCL – Exclusive Co-Phase Service

    - 0   Service the co-phase and any compatible phases

    - 1   Service only the co-phase

> **NOTE: Exclusive Co-Phase may be use in conjunction with NO co-phases for All Red priority service. This is only legal for Full Priority service of an LRT vehicle.**

- QJ-PHASE

    - ♦ 0 Not a queue jump phase

    - ♦ 1 Assigned as a queue jump phase

> **NOTE: When selecting a queue jump phase, the following rules apply:**
>
> **Queue Jump phases must always be preceding the co-phases in the ring structure.**
>
> **Queue Jump phases will always be omitted until the priority needs to jump to them.**
>
> **Queue Jumps will not be satisfied if you are already in the co-phases when the priority call comes in.**

- MIN WLK – Minimum walk time in seconds (0 – 255).

    This parameter applies to conflicting phases on entry and all phases on exit.

- MIN GRN – Priority minimum green in seconds

    Establishes the minimum time that the transit signal vertical bar will display or the TSP DWL GRN interval will occur to service the transit vehicle.

- MAX GRN – Priority right-of-way limit in seconds

    - ♦ LRT – Vertical Bar

    - ♦ TSP – DWL GRN (traffic phase green)

    Establishes the maximum time that the DWL GRN interval will occur to service the transit vehicle (other criteria may end service early).

- N-LOUT – No Lockout - Global (GLB)

    - ♦ 0 – No. Allows GLB lockout.

    - ♦ 1 – Yes. Disallows GLB lockout.

    Establishes whether this priority should disallow lockout of Ext Strt, Auto flash, Stop time, Preemption, and Start flash.

> **NOTE: If N-LOUT = 0, then even a full priority will be downgraded to Minimal until the lockout has expired.**

- LOUT A – Lockout A in seconds

    - ♦ 0 – Lockout for one cycle

    - ♦ 1-3 – No Lockout

    - ♦ 4+ – Lockout for seconds entered

    Lockout is applied by a priority to itself after it finishes its exit.

    Vehicle service during lockout is as if Minimal priority were set.

- LOUT B – Lockout B in seconds

    - ♦ 0 – Lockout for one cycle

    - ♦ 1-3 – No lockout

    - ♦ 4+ – Lockout for seconds entered

Lockout service to other priorities after exit from this priority. Vehicle service during lockout is as if Minimal priority is set.

- FREE PAT – Free Pattern

Defines the timing plan that is the source for phase reduction/extension when running in (standard) free operation.

> **NOTE: MAXGRN times for the co-phases must be greater than zero while the intersection is operating free.**

If the controller is operating as coord free mode by making the offset greater than the cycle length, the source for phase reduction/extension is dial/split of the timing plan producing the coord free request.

3.11.3   Transit Signal

This section describes the Priority 1 Transit Signal display (Figure 3-6).

```
PRIORITY 1 TRANSIT SIGNAL
 OVERLAP.....: ABCD EFGH IJKL MNOP
 SIGNAL TYPE.: 2000 0000 0000 0000
 BLANKOUT SIG: 2000 0000 0000 0000

 PREGRN/10:  60  (0-255)
 RECALL...:   0  (0-NO 1-MIN 2-MAX 3-COP)
```

Figure 3-6. Priority 1 Transit Signal Display

The Priority 1 Transit Signal display provides the following information:

- SIGNAL TYPE – Signal type on Overlap A–P for TSP signal

This entry establishes the overlap and selects the signal head type for a Transit Signal priority.

When the value under each overlap letter for Signal Type is set to 0 the set of 16 entries defines this priority as a non-Transit Signal priority.

Signal Type for A–P positions:

- ♦ 0 – This overlap is not used for TSP signal by this priority.
- ♦ 1 – Invalid.
- ♦ 2 – This overlap is used as a 2-section signal by this priority.
- ♦ 3 – This overlap is used as a 3-section signal by this priority

The OVERLAP line identifies the association of the data entry on the next lines SIGNAL TYPE assigned.

Position the cursor under the desired letter on SIGNAL TYPE row and enter 2 to set that overlap for use by this priority as a 2-Section signal or enter 3 to set that overlap for use by this priority as a 3-Section signal. Any entry of 2 or 3 will be set at the cursor position and any other existing SIGNAL TYPE overlap entry with a 2 or 3 in the Overlap A–P group on this display will be automatically removed. An entry of 2 will set the BLANKOUT SIGN for the same overlap to 2 automatically.

NOTE: Different priorities cannot have a same overlap set to different signal head types.

2-Section signal head type uses Red and Green output of the overlap while 3-Section signal head type uses all three (i.e., Red, Yellow and Green) outputs of the overlap.

To remove an overlap association with this priority set A–P to 0. The direct method is to set the overlap having a 2/3 to 0 (which makes all other A–P be 0).

NOTE: If SIGNAL TYPE overlap is omitted for this priority, the Transit Signal vehicle will not be serviced.

If SIGNAL TYPE overlap is omitted (by TOD or Preemption Cycling) the vehicle will enter the queue but will not be acted upon until the omit is removed. TSD, TED, and TTL timers will continue to countdown (with the exception of during Preemption) and the vehicle could be removed from the queue without service.

NOTE: To permit Transit Signal service during preempt dwell, the SIGNALTYPE overlap must be enabled in the cycle map.

CAUTION: Running Transit Signal All-Red priority during preempt dwell could make it possible for the Transit Signal vehicle to run in conflict with the preempt vehicle in rare intersection configurations. In this case, the Transit Signal SIGNAL TYPE overlap MUST BE OMITTED from the preempt cycle map.

- BLANKOUT SIG – Blankout Signal on Overlap A–P for TSP signal

  This entry establishes the overlap source and sets the color for the Blankout Signal.

  When the value under each overlap letter for Blankout Signal is set to 0 the set of 16 entries defines this priority as a non-Blankout Signal Transit Signal priority.

  Blankout Signal for A–P positions:

  - 0 – This overlap is not used for Blankout Signal.
  - 1 – This overlap uses Red output to show Blankout Signal.
  - 2 – This overlap uses Yellow output to show Blankout Signal.
  - 3 – This overlap uses Green output to show Blankout Signal.

  The OVERLAP line identifies the association of the data entry on the next lines BLANKOUT SIG. assigned.

  Position the cursor under the desired letter on BLANKOUT SIG row and enter 1-3 to set the color of the Blankout Signal as mentioned above. Any entry of 1-3 will be set at the cursor position and any other existing BLANKOUT SIG overlap entry with a 1-3 in the Overlap A–P group on this display will be automatically removed.

  An overlap set to use 2-Section signal head as a SIGNAL TYPE is by default set to 2 as Blankout Signal output. Any other value on BLANKOUT SIG than 2 for the same overlap will cause an "Transit Overlap Conflict". Users are free to move the Blankout Signal output to any other overlap.

> **NOTE: Different priorities can have different overlaps set to different Blankout Signals outputs.**

To remove an overlap association of BLANKOUT SIG with this priority set A–P to 0. The direct method is to set the overlap having a 1-3 to 0 (which makes all other A–P be 0).

> **NOTE: If BLANKOUT SIG overlap is omitted for this priority, the LRT vehicle will be serviced without Blankout Signal.**

- PREGRN/10 – Pre-green in tenths of seconds (0–255)

  This entry establishes the length of the Transit Signal pre-green signal interval.

  Transit signal display – Flashing Horizontal Bar

- RECALL – Priority recall

  - 0 – None: No Recall
  - 1 – Min: Recall will service the priority for MINGRN
  - 2 – Max: Recall will service the priority for MAXGRN
  - 3 – Cop: Recall will service the priority when the co-phases are green

> **NOTE: When using a recall with the priority, the green, yellow, and red for the transit vehicle must be less than the time to service the co-phases. Otherwise, the co-phase will rest in red and wait for the transit vehicle overlap to complete timing.**

3.11.4   Level/Misc+

```
This section describes the Priority 1
Level/Misc display (PRIORITY 1 LEVEL /
MISC
 LEVEL...: 2 (0-MIN 1-PART 2-FULL 3-DIS)
 PR.DET...PE..1A..2A..3A..4A..5A..6A..BU
 TSD..:    0   50   45   40   35   30   20    0
 TED..:    0   65   60   55   50   45   35   10
 TTL..:    0  100  100  100  100  100   40   60
SORTxTSD: 1A   2A   3A   4A   5A   6A   BU   ..
                                          [1]
```

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```
PRIORITY 1 LEVEL / MISC
 LEVEL...: 2 (0-MIN 1-PART 2-FULL 3-DIS)
 PR.DET...PE..1A..2A..3A..4A..5A..6A..BU
 TSD..:    0   50   45   40   35   30   20    0
 TED..:    0   65   60   55   50   45   35   10
 TTL..:    0  100  100  100  100  100   40   60
SORTxTSD: 1A   2A   3A   4A   5A   6A   BU   ..
                                          [1]
```

Figure 3-7. Priority 1 Level/Misc Display

The Priority 1 Level/Misc display provides the following information:

- LEVEL – Level of priority

  Selects modifications used to reach co-phase(s) include the following:

- 0 – Min. No changes to the phase timing or phase sequence will take place to service the transit vehicle. However, Minimal will extend phase timings to the co-phase once service for the transit vehicle has started.

- 1 – Partial (Phase Reduction). Provides the ability for the controller to shorten conflicting phases, shorten conflicting walk timing, lengthen compatible phases, or modify phase sequences to service the transit vehicle as close to arrival time as possible.

  During coordination, all timing shifts are made according to the programmed phase PRED time of the active plan up to the limit calculated by coord for shortway phase reduction. Different actions occur for phases already timing a split and those that have not yet started. Phases that have not started their split timing will reduce the split time. Phases that are timing their split when priority begins cannot change the timing in progress. However, coord phases will have the hold removal MOVED to be sooner. Non-coord phases will have the force off moved to be sooner.

  The coord free is a coordinated function not a standard free function. The coord free values come from the running dial/split that specified the coord free by the offset greater than the cycle length. This dial split provides the PRED and PEXT values.

  During standard free the free dial split provides the PRED and the priority maximum (PriMax) green time provides the split time.

> **NOTE: PriMax is NOT the MAX GRN (MXG) for Right of Way entered in the Priority Menu Selection 2 for Service.**

  During coord all extension timing shifts are made according to the programmed phase EXT time of the active plan that may be reduced if the total PRED time for the ring is less than the extension time.

- 2 – Full (Vehicle and Pedestrian Omit). Provides all the features of partial priority plus the ability for the controller to skip conflicting vehicle phases and/or pedestrian phases to service the transit vehicle as close to arrival time as possible.

  During operations when coordination is controlling traffic, full priority allows coordination to suspend traffic phase management. The split phase timing remains locked to the master sync cycle while the traffic phases can shift to acquire or maintain the time in the co-phases. Full priority recovery techniques are used to re-align the traffic phases to the coordination phase cycle. There are several available methods as discussed later to use during full priority recovery.

  If an offset-attained condition existed prior to priority, the full priority operation will attempt to maintain that condition after completion of service.

  When full priority level is selected, timing evaluations occur to determine if the partial priority operation may be substituted for full priority.

- 3 – Disable. Detectors disabled. Only recall service allowed.

3.11.4.1   Advance Detector Timing Values

TSD – Time-of-Service-Desired in seconds from priority detection. This is the time from detection to transit green.

TED – Time-of-estimated-departure in seconds for priority detection. This is not the time required to transit the intersection but the full time from detection to clearing the intersection.

TTL – Time-to-live in seconds for priority detection

0 – Disables TTL processing for this detector, which will not timeout (Tmo, Tss, or Tpo) and will not be a factor for ending the priority service. Displays as TTL WTG.

- The SORTxTSD line displays the logical invoking detector source names (left to right as farthest to closest), which internal processing has determined will be the logical order of farthest to closest sources in the running priority bank. SORTxTSD values show ** (Not This Bank) for non-running priority banks.

- Text "ab" indicates that a physical source has been assigned as a logical invoking source, but vehicle queue use has been blocked.

> **NOTE: Priority without co-phase assignment will cause the block.**

- Text "rb" is similar to "ab". The properly available source has been blocked due to Transit Signal recall and the recall display service is executing. The source is not able to access the vehicle queue to request service.

- Text indicates that fewer than the total available logical invoking sources have been assigned to physical sources.

> **NOTE: See the Help for the Vehicle Queue display at Main+1+3+6 for an explanation of PE evaluation as to whether the PE is associated with or blocked for access as an invoking detector when more than one invoking source is assigned for the priority.**

- There are eight logical invoking sources: PE, 1A, 2A, 3A, 4A, 5A, 6A, and BU. The internal evaluation to determine the logical order is performed in the order as shown from PE through BU. This order is seen when TSD values are the same for multiple sources. The logical order is arranged according to decreasing TSD value (farthest to closest) with identical values appearing in the processing order.

- Transit vehicle advance invoking detector sources typically may be assigned in an expected order from farthest to closest for this particular intersection. The user may decide that 1A is farthest, moving through 6A to be closest. The TSD values are then set in decreasing amounts from farthest to closest source. The user must be aware that the names 1A through 6A have no implied or dedicated directional order. The internal invoking detector processing rearranges the detector order based on the programmed TSD value for each detector. The result is a logical order for the sources. Vehicle queue processing uses the logical order not the physical programming order.

  The user should check the SORTxTSD order to verify that the intended farthest to closest physical assignments have resulted in the same logical order for

farthest to closest Invoking sources. SORTxTSD values show ** (Not This Bank) for non-running priority banks.

3.11.5   Partial Data+

This section describes the Priority 1 Partial Data+ display (Figure 3-8).

```
PRIORITY 1 PARTIAL DATA
  SEQUENCE:   0 (SEQ # : 1-16, 17-19)


    PHASE....1234.5678.9012.3456
  EXIT CALL: 0000 0000 0000 0000 (1-YES)
```

Figure 3-8. Priority 1 Partial Data Display

The Priority 1 Partial Data display provides the following information:

SEQUENCE – The sequence for priority entry.

> Establishes the sequence the partial priority may use to facilitate priority entry. Only phase leading the co-phase will become lagging.

- ♦ Non-Diamond: 1-16
- ♦ Diamond: 17-19 = 4Ph, 3Ph, Separate

NOTE: Partial will not use sequences while the intersection is operating free.

EXIT CALL – Exit Call phases

- ♦ 0 – No exit call
- ♦ 1 – Exit call placed

> Establishes which phases will receive a pedestrian call to insure service on exit from priority service.

3.11.6   Full Data+

This section describes the Priority 1 Full Data + display (Figure 3-9).

```
PRIORITY 1 FULL DATA
  FP WAIT :   0   FPW LVL: 1   FPW OVR: 0
  PED SKIP:   0   FRC FUL: 0
    PHASE....1234.5678.9012.3456
  PHS OMIT:  0000 0000 0000 0000 <SKIP
  PED OMIT:  0000 0000 0000 0000

                                    [1]
```

Figure 3-9. Priority 1 Full Data Display

The Priority 1 Full Data display provides the following information:

FP WAIT – Full Priority Wait in seconds (0–999, 0=Disable). Full priority wait sets the number of seconds that full priority service will be treated as either Minimal or Partial as defined by FPW LVL.

FPW LVL – Full Priority Wait Level (0-Minimal/1-Partial). If a FP WAIT block has been set, full priority wait level determines if Minimal or Partial should be used to service full priority calls during the full priority wait block. The default is Partial Priority.

FPW OVR – Full Priority Wait Override (0-No/1-Yes). If a FP WAIT block has been set, full priority wait override determines if the FP WAIT block can be overridden. For the FPW OVR to operate the full priority must be servicing without a checkout detector and the next full priority call must be for the same priority.

PED SKIP – Maximum Pedestrian Skip in seconds (0–999, 0=Disable). With a pedestrian omit but no vehicle omit, this entry establishes the maximum time a pedestrian movement may be forced to wait for service. After the skip time is reached the pedestrian omit is ignored to allow the pedestrian service. When pedestrian is provided in this manner, there may be a delay reaching the co-phase on time due to the unplanned nature of the pedestrian service.

> **NOTE: Values 1–999 do not block the recover pedestrian wait time operations. Both operations are allowed within the same priority. Pedestrian skip is an entry function while pedestrian wait is an exit function. The two may actually apply for different pedestrian movements.**

FRC FUL – Force Full (0-No/1-Yes). If set, force full will determine whether the transit vehicle full priority call must always use the full priority routines. If not set, Partial Priority may be substituted for Full Priority if service can be provided on time.

> **NOTE: If configuring a priority with co-phases that normally do not start in the ring sequence together (under standard 8 phase-quad: 1 & 6, 2 & 5, 3 & 8, 4 & 8) force full should be set to ensure both phases are green at TSD=0.**

PHS OMIT – Phase Omit (0-No/1-Yes). Phase omit determines whether a conflicting vehicle phase must be omitted in order to cycle to the co-phase and service the transit vehicle during full priority.

♦ 0 –No. Phase may be served

♦ 1 – Yes. Phase always omitted

PED OMIT – Pedestrian Omit (0-No/1-Yes). Pedestrian omit determines whether a conflicting pedestrian movement must be omitted in order to cycle to the co-phase and service the transit vehicle during full priority.

♦ 0 – No. Pedestrian movement may be serviced

♦ 1 – Yes. Pedestrian movement will be omitted unless overridden by Ped Skip

> **NOTE: Setting the PHS OMIT or PED OMIT to 0 does not guarantee the vehicle or pedestrian movement receives service. The full priority routine may determine that a movement set to zero still needs to be omitted in order to service the transit vehicle as close to arrival time as possible.**

3.11.7   Recovery+

This section describes the Priority 1 Recovery (Full) display (Figure 3-10).

```
PRIORITY 1 RECOVERY (FULL)
  METHOD..: 0 (0-NORM 1-WAIT 2-RECOVERY)
  RETURN..: 1 (0-CYCL 1-JUMP)
  PED WAIT:   0 SEC  PED OVR: 0 (1-YES)
    PHASE....1234.5678.9012.3456
  RECOVERY:  0001 0001 0000 0000

                                    [1]
```

Figure 3-10. Priority 1 Recovery (Full) Display

3.11.7.1   Recovery from Full Priority Operation

This section describes the various recovery options available for full priority operation.

Method – Each of the three values for method follows the setting of the return programming and sets what criteria apply to get there.

- ♦ 0-Normal: goes to the next phases in sequence.

- ♦ 1-Wait: goes to the longest waiting phases: Traffic Queue, Pedestrian or Vehicle, in that order.

- ♦ 2-Recovery: goes to the phases programmed by the Recovery setting.

Return

- ♦ 0-Cycle: may retain coordination if the recovery can return to coordination and remain in sync. Otherwise, cycle drops coordination at the location provided by Method. If the location is in the coordinated phases, the phases will be required to end. The unit must cycle through phases in free until reaching the coordinated phases.

- ♦ 1-Jump: waits in coordination at the location provided by Method. When the next coordinated permissive opens (or the drop is within an open permissive) the recovery process is complete for re-aligning the split phase timing with the traffic phase timing.

NOTE: Using 0-Normal and 1-Jump allows coordination to operate and recover full priority without offset correction. However, the phases that follow the co-phase may not be those expected. The next phases to be serviced depend upon when the priority ends and what is the next coordinated permissive. An example is priority ending just a few seconds into coordinated phases 2 and 6. The coordinated pedestrian and hold operations do not occur there because the recovery is not complete until the permissive opens to phases 3 and 7.

PED WAIT – Pedestrian Waiting time. This entry establishes the minimum time a pedestrian demand waits before it defines the recovery phase.

- ♦ 0 – No limit to pedestrian wait time

- ♦ 1-999 sec – Minimum pedestrian wait time

♦ The PED WAIT value also applies to the longest traffic vehicle waiting time as the threshold that must be achieved for a phase vehicle waiting to be considered as a recovery phase candidate.

Because the pedestrian has precedence over vehicle, the identical time waiting for each will result in selecting pedestrian (assuming that queue has not precluded both pedestrian and vehicle).

> **NOTE: Full priority PED SKIP VALUES 1-999 do not block these pedestrian-recovery wait time operations. Both operations are allowed within the same Priority. Pedestrian skip is an entry function while pedestrian wait is an exit function. The two may actually apply for different pedestrian movements.**

PED OVR – Pedestrian override

♦ 0 – Pedestrian wait does not override queue. Standard order of precedence is observed: traffic queue, pedestrian, and vehicle.

♦ 1 – Pedestrian wait overrides queue. Override order of precedence is pedestrian, traffic queue, and vehicle

RECOVERY – (Define) recovery phases

♦ 0 – Phase is not a recovery phase

♦ 1 – Phase is a recovery phase

3.11.8   Que Monitor+

This section describes the Priority Queue Monitor (Full) display (Figure 3-11).

```
PRIORITY 1 QUEUE MONITOR (FULL)

QUEUE....1....2....3....4....5....6
PHS #:    0    0    0    0    0    0
DET #:    2    0   14   22    0    0
TIME.:   20   30   40   50    0    0

                                 [1]
```

Figure 3-11. Priority 1 Queue Monitor (Full) Display

The Priority Queue Monitor (Full) display provides the following information:

PHS # – Phase associated with above queue (0–16: 0 disables queue)

DET # – Detector associated with above queue (0–80: 0 disables queue)

TIME – Time in seconds (0–255: 0 disables queue)

This entry establishes the minimum occupancy time before queue overrides.

3.11.9   Priority Data Bank Copy

This section describes the Priority+Bank Copy display (Figure 3-12).

```
PRIORITY+BANK COPY
  COPYING BANK.......FROM:  1 TO:    1
  COPYING PRIOR......FROM:  1 TO:    1
 ENTER THE FROM & TO BANK/PRIORITY ##
 THEN ENTRY HERE INITIATES THE COPY>>>>0
  [A 0 IN ANY TO FIELD OR IN FROM PRIOR
   COPIES TO ALL MATCHING GIVEN VALUES]
```

Figure 3-12. Priority+Bank Copy Display

The Priority+Bank Copy display provides the following information:

FROM BANK – Copy From - Bank Number

The source bank number of the copy. Allows the user to equate the data for one or more priority banks by copying from one bank to one or more banks.

Range of values from 1–4. 0 bank is not allowed as a From bank.

TO BANK – Copy To - Bank Number

The destination bank number of the copy.

Range of values from 0–4. Bank 0 copies from a source bank to all other banks.

FROM PRIORITY – Copy From – Priority Number

The source priority number of the copy

Range of values from 0-12. Priority 0 copies all priorities of a bank.

TO PRIORITY – Copy To - Priority Number

The destination priority number of the copy

Range of values from 0-12. Priority 0 copies to all priorities of a destination bank.

EXECUTE COPY – Copy Bank/Priority Data

Causes the copy to take place.

No data. The action of enter executes the copy according to the FROM and TO values entered above for bank and priority.

3.11.9.1 Copy Examples

Seven copy actions are described in this section.

The # is a Bank or Priority number as described above for the specific field.

The abbreviations used are:

- ♦ FB – From bank
- ♦ TB – To bank
- ♦ FP – From priority
- ♦ TP – To priority

Be sure to review the destination priority data after a copy as all data in the copy may not be appropriate.

This operation is like phase bank copy.

Copy Action 1

FB - # / TB - # / FP - # / TP - #

Copies data from the designated From priority in the designated From bank to the priority in the To bank.

Copy Action 2

FB - # / TB - # / FP - # / TP - 0

Copies data from the designated From priority in the designated From bank to ALL priorities in the To bank.

NOTE: TP is 0.

Copy Action 3

FB - # / TB - # / FP - 0 / TP - 0

Copies data from all priorities in the designated From bank to the like numbered priority in the To bank.

NOTE: FP and TP are both 0.

Copy Action 4

FB - # / TB - 0 / FP - # / TP - #

Copies data from the designated From priority in the designated From bank to the designated To priority in every bank.

NOTE: TB is 0.

Copy Action 5

FB - # / TB - 0 / FP - # / TP - 0

Copies data from the designated From priority in the designated From bank to all priorities in every bank.

NOTE: TB and TP are both 0.

Copy Action 6

FB - # / TB - 0 / FP - 0 / TP - 0

Copies data from all priorities in the designated From bank to the like numbered priorities in every bank.

NOTE: TB, FP, and TP all 0.

Copy Action 7

... / ... / FP - 0 / TP - #

INVALID BANK COPY Operation Error. Copy from all priorities to a single priority is not allowed.

3.11.10 Select Editing Priority Bank

This section describes select editing the Priority Bank.

```
PRIORITY 1 DATA BANK

   CURRENTLY EDITING PRIORITY BANK: 1
      (AVAILABLE BANKS = 1-2-3-4)

      [RUNNING PRIORITY BANK IS 1]
SEE Help (+) FOR MORE INFORMATION
```

Figure 3-13. Priority 1 Data Bank Display

The Priority 1 Data Bank display provides the following information:

Select editing priority bank – Selection of priority bank for the front panel.

♦ All priority data viewed or modified will be contained in the priority bank selected. Changes to data in the running priority bank will take immediate effect.

♦ The [1] [2] [3] [4] in the lower right corner of the data entry displays indicate the current editing bank.

♦ Use the - (minus) key to sequence through the [1] [2] [3] [4] editing banks. The Minus key equals placing the next number into the current editing bank.

3.11.11 Active Displays

From the Main menu (Figure 2-1) press 1 and then 3.

```
PREEMPT/PRIORITY DISPLAYS
 1-PREEMPT TIMERS
 2-PRIORITY TIMERS
 3-PRIORITY DETECTORS
 4-PRIORITY STATUS
 5-PRIORITY PHASE UTILIZATION
 6-PRIORITY VEH QUEUE-LRT/TSP
```

Figure 3-14. Preempt/Priority Display

3.11.11.1   Priority Timers Display

From the preempt/priority display, press **2-Priority Timers**.

```
PRIORITY TIMERS

PRIORITY...1....2....3....4....5....6...
   STATUS..
   TIMING..
PRIORITY...7....8....9...10...11...12...
   STATUS..
   TIMING..
```

Figure 3-15. Priority Timers Display

Line 2 displays three operations:

- One driving priority at the left end.

TYPE	#	Interval	Timing
FULL PRI	1	FL AMBR	3

OR

Driving	#	Intrvl	Text (Driving Waits)
FULL PRI	1	VBAR	WTG SS=2 VBAR 2

- One secondary service (SS=) priority at the right end. Only one secondary service is shown on Line 2 even though others may show as simultaneously active on Line 6.

Driving	#	Intrvl	Tmg	Sec#	Intrvl	Tmg
FULL PRI	1	VBAR	1	SS=2	FL HBAR	2

- One TSP driving priority

Driving	#	Intrvl	Tmg
PART PRI	3	DWL GRN	2

OR

Driving	#	Intrvl	Text (Call holding)
PART PRI	3	DWL GRN	CAL

Lines 3 and 6 displays priority # columns (1-6, 7-12)

The number changes when a priority is operating. Various types of information include the following:

- #=P – Primary service by the driving priority.

- #=S – Secondary service is being hosted by the #=P. There may be more than one secondary service active. Secondary service always operates in the same mode as the primary host.

- #LP – Locked primary service.

  During lockout the number operates as Minimal priority is set.

- #LS – Locked secondary service.

  During lockout the number operates as Minimal priority is set.

- #=R – Recall priority display service.

  N priority is running to provide this display. Lockout does not apply.

- #BR – Recall priority display service due to backup timer-initiated request.

  When the #=R display remains continuously in its assigned co-phase(s) for the time set in the backup timer, the display initiation begins as if the co-phase(s) have just returned from some other phase. The backup timer load occurs at the end of the clearance timed horizontal bar period. The value during coord is the active plan cycle length. During free, the value is the sum of the Traffic MAX

settings for all active Ring 1 Phases. The Traffic MAX may be from Max 1, Max 2, or coord free d/s split times.

Lines 4 and 7 display priority status text.

Lines 5 and 8 display priority status timing or text related to the status on Lines 4 and 7.

3.11.11.1.1　　Individual Text Used

Line 1 preempt operation

OPERATIONS FOR LRT/TSP PRIORITY ---

Line 2 mode text

(Blank)　...

No Driving Priority is engaged.

♦ PRIORITY

Priority as if Minimal is set.

(No part or full actions)

♦ PART PRI

Partial control priority.

♦ PART SWP

Partial Priority+Sequence Swap.

♦ FULL PRI

Full control priority

♦ RECALL

NOT USED: Running recall service.

Transit Signal recall operates as a display service without any active priority intervention.

♦ AUTO F2P

Automatic switch from full to partial priority based on timing requirements.

♦ FPF P4F

The FPF timer is timing. User has set PP4 FUL to 1.

♦ FPF N4F

The FPF timer is timing. User has set PP4 FUL to 0.

♦ RCVRY2FP

Either a partial or full priority operation was in recovery when a serviceable full priority request was pending. Criteria to prevent this override were not present. The recovery operation was truncated, the exiting priority was closed, and the new full priority was started. The recovery from RCVRY2FP is a combination of partial, if required, and the full priority termination programmed.

As part of the attempts to limit the disruption due to false activating detector calls, the RCVRY2FP is blocked from performing successive executions. A second request for RCVRY2FP will produce full PRI instead. Another RCVRY2FP will then be allowed (alternating).

♦ F2PEXT2F

The AUTO F2P is being provided. The available extension has been consumed and NO check out has been received. The partial priority operation has been switched back to full priority.

This back to full involvement of full priority does not trigger the full priority frequency timer operation.

When the appropriate termination condition occurs, the priority will end.

The recovery operation executes as partial priority.

This operation applies to both LRT and TSP operations.

The TSP end is determined by a continuous activation of the closest detector input to maintain the DWL GRN right-of-way until the extension is consumed.

This change is a planned override condition during normal operations.

♦ FP ABORT

The full priority LRT is providing service, but the pre-green has not been able to begin due to TSD timing that is greater than the pre-green time. (Interval is waiting). An active cancel is delaying service. The delay has been in effect for the amount of time programmed in the priority data for MAX GRN. The priority is being aborted without any LRT display. The vehicle has been removed from the queue.

♦ P2F OVRD

Partial priority is being converted to full priority due to detected override triggers in order to provide the required service. This change is an unplanned override condition during abnormal operations.

Line 2 interval text

♦ CYCLING

The driving priority is entering but the TSD timing or access to the co-phase(s) still precludes providing service (LRT signal display or TSP DWL GRN).

♦ WAITING

The running priority is now providing service with the co-phases green and the current vehicle TSD time is counting.

For LRT – TSD is greater than the pre-green value.

For TSP – The TSD has not yet counted down to 0 to start the DWL GRN interval and MNG timing.

♦ DWL GRN

This is the TSP Right-Of-Way interval. The TSP priority has reached the co-phase(s) and the TSD has counted down to 0. There may be timing, WTG or

CAL displayed. The text is used by both driving and secondary service TSP priorities.

♦ FL HBAR

The interval is the pre-green display to the approaching LRT vehicle. This is a flashing horizontal bar signal.

♦ VBAR

The interval is the LRT Vehicle Right-of-Way through the intersection. This is a steady vertical bar signal.

♦ FL VBAR

The interval is the LRT vehicle clearance indication that the right-of-way is ending. This is the vertical bar signal flashing.

♦ HBAR

Indicates that the LRT vehicle does not have the right of way. The display is a steady horizontal bar signal. When the screen shows a timing value this is the timed horizontal bar clearance interval set by the user. When the horizontal bar is followed by WTG the timed interval has ended and the transit signal remains steady horizontal bar. The driving priority vehicle service continues because some other event is preventing the end of service. This event may be secondary service, which has the ability to continue beyond the point where the driving priority would have desired to end. (The driving priority hosts all secondary service operations.)

♦ RECOVRY

The driving priority is exiting.

During coord operations (not free)

For partial priority this action reclaims the time used by extension.

For full priority with return to recovery phases, this text shows during the time needed to reach the recovery phases plus waiting for an accessible permissive to open to other phases.

For full priority with JUMP this is from the end of the running priority while waiting for an accessible permissive to open to other phases.

> **NOTE: There may be intervening phases between the co-phases and opening the permissive point. Setting wait will usually provide these opportunities.**

During free operations (not coord)

For partial priority the PRED and PEXT values are part of modifications made to the Priority Max. Explicit recovery operations do not occur.

For full priority and operation as NONE, no PRED or PEXT values are used to modify the Priority Max. Explicit recovery operations do not occur.

♦ SS=

Secondary service displays on Line 2 at the right end when the driving priority is hosting an executing secondary service priority. The number following the SS= is the priority associated with the secondary service.

> **NOTE: See the information at the end of the Help for this screen regarding the attributes of the secondary service priority that are inherited from the driving priority that is hosting it.**

Line 2 field with timing or text

- Primary or secondary service in LRT and TSP have common meanings:
    - Numerical – counts the interval shown.
    - Text

        (Blank)

        The interval does not have timing or any special text display.
- WTG

    The priority has counted the interval or timer, where shown, to 0, and the process is waiting for some other criteria to be met to continue the priority processing.
- CAL

    The TSP MNG has completed, and the closest activating detector is maintaining an input, which is requesting the TSP priority to maintain the co-phase green. The terminating criteria include MXG, TTL, partial priority extension has been consumed and no closest detector input.

> **NOTE: Check out is operational if assigned to an available detector input. The check-out truncates the retention requested by closest detector CAL being active.**

Line 3 and 6 extended priority # (1–12)

OVERVIEW – Full explanations are above.

#.. – Neither driving nor secondary action

#=P – Driving priority controls this one

#=S – Secondary service priority controls

#LP – Locked primary service.

#LS – Locked secondary service.

#=R – Recall priority display service.

#BR – Recall priority display service due to backup timer-initiated request.

Line 4 and 7 status text

- TSD

    TSD timing shows on Line 5 or 8
- TED

    TED timing shows on Line 5 or 8
- TTL

    TTL provides the Line 5 or 8 display of timing or TEXT as timed out or WTG.

    See the Line 5 explanation for texts.

- CAL

  This text shows when there is a vehicle in the queue for this priority.

  The CAL text only appears on this line when no other text is required there. (See CAL on Line 5)

- LOC

  Priority currently is locked out.

  Lockout means that a vehicle can begin an active priority service, but that service will be provided as if set for Minimal priority. This locked service provides the L shown on Line 3 or 6 between the equal sign (=) and the type of service (for example, 1=LP or 2=LS).

  See Line 5 GLB for description of global lockout actions

  For Lockout A the value applies to Me. The ending priority sets lockout of itself according to the meaning of the programmed value:

  - Value=0 – Sets CYC, which means that the unit must service all phases with demand before lockout will end.

  - Value=1, 2, or 3 – Disables Lockout A

  - Value=4 or higher – Shows on Line 8 in a count down timer to end that lockout.

  For Lockout B the value applies to all others. The ending priority sets lockout of all other priorities according to the meaning of the programmed value:

  - Value=0 – Sets CYC, which means that the unit must service all phases with demand before lockout will end.

  - Value=1, 2 or 3 – Disables Lockout B

  - Value=4 or higher – Sets a count down timer on Line 8 for all other priorities to end their lockout.

  If priorities have a lockout timing when Lockout B starts, any value higher than Lockout B remains intact. Any value lower than Lockout B is raised to Lockout B value.

- EXT

  Partial priority extension timing (Counts UP) shows on Line 5/8. The display remains for 0.3 seconds after count stops increasing. When removed, Line 5/8 will show Tmo (timed out) for the remainder of the priority time.

  For TSP – The partial priority extension time is being used to extend the TSP green time because the closest activating detector is currently active. This action will no longer extend after the maximum allowed extension has been consumed. There are also other timing factors that may preclude reaching the maximum extension value (TTL Tmo or MXG Tmo or activation ends).

NOTE: TSP may not display Tmo if the driving priority ends at the same time.

- E4C

For LRT ONLY – The partial priority extension time is being diverted to time the oversized LRT clearance period.

- ◆ G4C

  For LRT ONLY – Green time is being diverted to time the oversized LRT clearance period.

  A partial priority may have no extension time available so green time must be diverted.

  A priority providing service as Minimal priority (either by programmed level or when required by FPF or LOC) cannot have extension time capability so green time must be diverted.

- ◆ GEC

  For LRT ONLY – ALL of the extension time plus some green time is being diverted to time the oversized amount of the LRT clearance period.

  When the partial priority extension time does not provide sufficient time as required for the oversized LRT clearance period, the remaining time must be diverted from the green time. GEC means green time plus all of the extension time is required to cover the oversized amount of the LRT clearance.

3.11.11.1.2   Common Area

The diverted time is used for the oversize time amount by which the LRT clearance (flashing vertical bar plus steady timed horizontal bar) exceeds the total time provided by the Traffic Phase Yellow plus Timed All Red Clearance. The diverted time starts when the vertical bar right-of-way must end to start the oversized LRT clearance displays.

> E4C – The time value shown is the total extension used, not the amount of diverted time.

> G4C – The time value shown is the total green time diverted.

> GEC – The time value shown is the total green time diverted plus all of the extension time.

> EXT, E4C, GEC

  Partial priority extension starts timing when all of the available traffic co-phase green time is consumed.

> CHK

  This priority service has seen the checkout input active.

NOTE: Maintaining the checkout input active from one priority into a following priority will result in termination of the new priority service following the minimum LRT vertical bar or TSP minimum dwell green time.

> MNG

  The LRT minimum green (vertical bar) or TSP minimum dwell period is timing and shown.

> MXG

LRT maximum green (vertical bar) status or TSP maximum dwell period (See associated ops below).

TSP

TSP has ended because there was no sustaining actuation of the closest detector

Line 8 will display NCC for no closest call.

3.11.11.1.3   LRT Recall Signal Display

AMB

Steady horizontal bar waiting for next demand.

FLA

Flashing horizontal bar pre-green

W_B

vertical bar right-of-way

FLW

Flashing vertical bar LRT clearance

T_A

Timed horizontal bar display

A2B

Timing steady horizontal bar to backup call

See the description above in the summary for Line 3 #BR backup timer.

Line 5 timing from Line 4 or text

[Line 4 TTL => Tmo, Tcv, Tss and Tpo]

Tmo

For TTL – Driving priority TTL has expired.

The Tmo can often be seen when the vertical bar continues until the vehicle TTL expires. In this case, Tmo is present while timing the flashing vertical bar and horizontal bar clearance.

Tcv

Typically shows when the vehicle is currently being processed to begin service and is the closest vehicle detector and the vehicle TTL has expired prior to providing service. This vehicle must be removed from the queue by the priority processing when determined to have fulfilled its purpose.

Tss

Secondary service vehicle TTL has expired.

The Tss may be present while timing the flashing vertical bar and horizontal bar clearance.

Tpo

Preempt is currently active and the LRT/TSP vehicle in the queue has its TTL expire prior to the end of preempt. This vehicle must be removed from the queue by the priority processing when determined to have fulfilled its purpose.

GLB

Lockout source is global. Typically, by start flash, stop timing, preempt, or remote flash.

Lockout means that a vehicle can begin an active priority service, but that service will be provided as if set for Minimal priority.

When the priority has NO LOUT set to 1, that priority does not show LOC GLB and is allowed to operate in its defined mode instead of using forced none.

CYC

Lockout Source A or B executed with Value=0, which sets CYC. The unit must service all phases with demand before lockout will end.

Lockout means that a vehicle can begin an active priority service, but that service will be provided as if set for Minimal priority.

WTG

The priority has counted the interval or timer, where shown, to 0, and the process is waiting for some other criteria to be met to continue the priority processing.

If the vehicle TTL timing value is to be shown and the programmed value is 0, WTG will not display Tmo or Tss. When the TTL WTG shows, TTL is not a limiting factor for the priority.

SPS

Lockout by a central in a second-per-second control operation such as SCOOT. (This code is not currently displayed.)

CAL

Displays on Line 5 during an active preempt when a vehicle in queue requests priority service. The CAL replaces the normally displayed GLB from preempt. The CAL does not override the LOC issued by preempt. The priority must wait until preempt completes.

After preempt completes, the ability to override the LOC is available when the priority setting for NO LOUT has value 1. The priority would be able to execute its defined mode.

If the priority generating CAL while preempt executes has NO LOUT set to 0, the end of preempt will mean that a vehicle can begin an active priority service, but that service will be provided as if set for Minimal priority (locked service).

Line 4 MXG => Ln 5 Counting, Tmo or INH

LRT maximum green (vertical bar) status or TSP maximum dwell period:

Counting for MXG: toward timeout.

Tmo

For MXG – The associated priority maximum green has expired.

INH

For MXG – Priority maximum green value is set to 0 so that maximum timeout is inhibited (shows for two seconds then allows other displays).

NCC

Line 4 TSP => Line 5 NCC

TSP has ended because there was no sustaining actuation of the closest detector.

Line 5 will display NCC for no closest call. (The driving priority must remain active to see this text.)

Line 4 AMB => Ln 5 BLANK

Line 4 FLA, W_B, FLW, T_A, A2B =>   Ln 5 Counting

Line 4 FLA => Ln 5 WTG – This situation happened in a test of the interlock against conflicting displays.

Hierarchy for Line 4 and 5 timing

TSD, CHK, MNG, TED, MXG, TTL. EXT timing may replace some displays. E4C or GEC will replace EXT timing. G4C timing will replace MXG and TTL. The sequence TED, MNG, TED can occur.

Unique timing of TSD, TED and MNG values may result in the sequence of TSD, TED, TTL as the TSD, and TED time out before the co-phase green starts. The MNG would appear next and is typically followed by MXG.

The first type of terminating event seen will be displayed and maintained. Events are CHK, MXG Tmo, EXT Tmo, E4C Tmo, GEC Tmo, G4C Tmo, TTL Tmo, or TTL Tss. TSP NCC may be seen if the driving priority remains active.

Special attributes of Line 2 SS=

The secondary service priority always assumes the attributes of the driving (primary) priority. This means that the partial priority primary will force the secondary priority to function as a partial priority even if set for full. Likewise, a primary full priority will force a secondary priority to operate as a full when set for partial. (Noticeable changes occur related to extension.) The secondary service cannot begin until its vehicle TSD counts down to the normal starting point – LRT pre-green time value or TSP start of DWL GRN when TSD becomes 0. The partial priority LRT total minimum service (pre-green, minimum VBAR, flashing VBAR, and timed HBAR] must fit within the Green Time plus Unused Primary Service Extension time and the Traffic Yellow plus All Red time for the remaining co-phases. The TED + E4C must also fit within this amount of time.

Full priority primary hosting does not have these restraints. The full priority essentially is limited by check out, maximum green or TTL.

NOTE: There is only one value of extension time available, and it is generated by the primary service host. The secondary service shares in the amount that has not expired.

3.11.11.2   Priority Detectors Display

```
PRIORITY  1 DETECTORS     : TSD FAR->NEAR
LOGICAL: .1A..2A..3A..4A..5A..6A..BU..PE
INP SRC:  65  66  67  68  69  70  71 248
STATUS : ... ... ... ... ... ... ... ..B
TIMING :   0   0   0   0   0   0   0   0
     LOG INP STS TIM  LOG INP STS TIM
      C  72  ...   0   X  73  ...   0
UP/DOWN - PREV/NEXT PRIORITY
```

Figure 3-16. Priority 1 Detectors Display

In the active screen display use the Key A <UP> or Key B <DN> to change the priority source of the information.

The priority number is retained for reentry.

Status 3 (duplicated and explained later)

> N – No detector assigned to this logical use
>
> B – Blocked for use in priority vehicle queue
>
> **.** – Active detector with both RAW and VER OFF
>
> C – Sustained VER INPUT call now
>
> D – Timing delay - Value in timing
>
> E – Timing extension - Value in timing
>
> F – Failed detector diagnostics

Logical source identification text:

> Eight invoking sources
>
> > ♦ PE – Pulsing priority input pin
> >
> > 1A, 2A, 3A, 4A, 5A, 6A = Six Advance Det
> >
> > ♦ BU – Backup detector
>
> Two control sources
>
> > ♦ C – Check out detector
> >
> > ♦ X – Cancel detector

The eight invoking source columns are in the TSD order from farthest (largest) on the left to closest (smallest) on the right. When a source is not assigned (N) or is blocked for use (B) the column order for those sources is taken from the screen where the TSD value is entered: PE, 1A, 2A, 3A, 4A, 5A, 6A, and BU

The active running priority bank data determines the order for all priorities.

> **NOTE: This screen does not currently show the blocked because of Transit Signal recall. See the SortxTSD display information in the data entry screen where TTL is entered.**

INP SRC is the detector number whose actuation provides the input to the logical priority function named in the text.

Value shown as 0 means no assignment. PE detectors are uniquely defined as 248 through 253 for Priority 1 through 6. Detectors 1 through 80 come from the SEPAC detector pool. If a detector is allocated to a priority, that detector will automatically be removed from traffic use.

> **NOTE: Such an allocation may result in a constant call on a phase if the association has removed all sources of input required for that phase vehicle (or pedestrian) function.**

Status has three independent display areas (columns):

> Column 1 is raw detector input state from the field connection: . = OFF, R = ON.

> Column 2 is verified detector input state (VER INPUT) after processing for delay, continued actuation and extension. PE also processes the NON-LOCK setting during the delay timing portion (= OFF, V = ON).

> Column 3 is a status applied to the overall detector state and the results shown in Column 1 and Column 2:

> N – No detector assigned to this logical use

> B – Blocked for use in priority vehicle queue

> . – Active detector with both RAW and VER OFF

> C – Sustained VER INPUT call now

> D – Timing delay - Value in timing

> E – Timing extension - Value in timing

> F – Failed detector diagnostics

Delay and extension timing is shown in whole seconds.

Information for two control detector input assignments resides below the eight columns of activating detectors. Space constraints required abbreviations in two places for each:

> LOG – Logical for C=Check Out, X=Cancel

> INP – INP SRC with detector source ##

> STS – STATUS as above

> TIM – TIMING as above

3.11.11.3 Priority Phase Utilization

```
PRIORITY00 PAT254 SEQ01 PH.1PR.1UN.1SY.1
PHASE......1...2...3...4...5...6...7...8
CPHZ*10   150 400 150 300 150 400 150 300
USED*10     0   0 148   0   0   0 148   0
IMPC*10     0   0   0   0   0   0   0   0
PRED*10     0   0   0   0   0   0   0   0
PEXT*10     0   0   0   0   0   0   0   0
PPHZ*10     0   0   0   0   0   0   0   0
```

Figure 3-17. Priority Phase Utilization Display

This display provides an overview of phase activity in priority and the accumulating phase ON time prior to the onset of driving priority. This display does not provide information related to any currently operating secondary service priority.

Line 1 – PRIORITY00 PAT245 SEQ01 PH.1PR.1UN.1SY.1

Priority – the default when no driving is active, and changes based on the enhanced service Type

The following number is the driving priority number – 0=None or 1-12.

Pattern (PAT) – The active pattern: 254 when coord is not running and there is no driving priority active. Otherwise, pattern would be the coord or priority free pattern.

SEQ is the current running sequence.

PH is the traffic phase bank running.

PR is the priority bank running.

UN is the unit bank running.

SY is the system bank running.

Line 2 has Phase Numbers 1–8 (initial displays do not include Phases 9–16.

Values are calculated for Phases 9–16 if these phases are active in the phase sequence.)

Lines 3-8 are shown as seconds x 10 with the displays limited at 9999 and –999. The actual internal data values are limited at +32766 and -32766 tenths of seconds.

Line 3 CPHZ – Phase times from the pattern shown on Line 1. (pattern 254 forces all CPHZ times to be 0)

If priority selects 254 as the free plan and programmed values have not been entered, the 254 will show CPHZ as 0.

When coord is running, these CPHZ times are the base values to calculate the impact of used to expected time.

When coord is not running and the free pattern (254) has phase times, these will show on the CPHZ line but will not be used as the base for the impact values.

When coord is not running and there is a driving priority operational, the values for the impact base are shown on the PPHZ line. These are the priority maximum G+Y+AR without any modifications by PRED or PEXT.

See the info at Line 8 PPHZ for full priority during coord display.

In coord all forms of priority (none, partial, and full) use this CPHZ base time.

Line 4 USED – Accumulated phase ON time.

The current phase ON shows changing values. Without a driving priority, the used is cleared as each phase ends. When there is a driving priority the used is retained until processed into the report for determining the impact number. The values are positive numbers 0 – end.

Special handling is provided to normalize used values that exceed the expected base due to sustained presence in a phase. This method also allows the

asynchronous beginning of co-phases to retain a history of used time prior to priority providing service yet not show inflated size due to resting in a phase.

Line 5 IMPC – IMPACT of priority action upon this phase (formerly Utilization in report)

IMPACT time to be placed into report.

Stored report values have had DN/UP rounding applied before being divided by 10. This process deflates partial seconds, which are less than 0.5 and inflates partial seconds, which are 0.5 or greater. (Deflate makes both positive and negative numbers move closer to 0. Inflate makes both move farther from 0.)

The range limitations of +127 and −128 have been enforced.

- Values are positive numbers when more time was available to the phase than was planned (Used > Expected).

- Values are negative numbers when less time was used by the phase than was planned (Used < Expected).

The criterion for expected has a wide variety of requirements.

Impact results from possible time, which is created from expected time:

- Phases that occur before priority action have Impact=0. (The Utilization version showed Minus Split/Traffic Max ON time.)

- During priority action, partial shows Impact=0 for phases not accessed during the priority. Full shows skipped phases (with demand and omit applied) as full minus base time). All other phases that do not occur show 0.

- For co-phases the base is modified when required by the termination of the priority before the end of the phase ON such that Expected becomes possible.

- Typically, a partial priority co-phase without accrued extension shows Impact=0. A full priority co-phase will have Impact greater than 0 when the co-phase time exceeds the base time.

- Partial priority early green time shows as a minus value.

- The used time for a full priority co-phase that provides service to clear out phases is the sum of three time segments

  - The co-phase used time prior to the clear out phases.

  - The co-phase used time after the clear out phases.

  - The sum of all clear out phase time accumulated by phases in the ring the co-phase belongs to.

Reason – The clear out phases occurred within a band of time that would have been directly accumulated by the co-phase if the traffic phases of the clear out did not have the opportunity to be serviced.

Stated differently, the end of the co-phase green time did not shift because clear out phases received service. Therefore, the measured traffic green co-phase used time that was lessened by the clear out phases does not represent the true impact unless the clear out phase times are included.

When a clear out phase receives service from within the running priority co-phase, the prior used time is replaced by the time of the clear out for the report. Therefore, an omitted phase for full entry may show positive impact when that phase receives clear out service.

> **NOTE: If a potential clear out phase does not appear during the clear-out process, the previously determined impact value (0 or minus) remains intact. Minus could result because the phase has vehicle omit by priority while there is demand. The value obtained while that phase was a potential clear out phase remains intact when that clear out phase does not receive service.**

Line 6 PRED – Programmed Reduction for partial priority operations during coord or free. The PRED values have two functions:

- When entering priority these amounts produce the early green operation where the co-phases are moved closer to the approaching priority vehicle. The early green is recovered at the next coord cycle TO. In free there is no recovery of early green time.

- When exiting priority these amounts are used to recover the extension Used by the co-phase during coord operation. The extension moved the end of the co-phase farther from the preceding T0. The recovery occurs as the PRED reduces the PHZ time for phases following the co-phase, thus bringing the NEXT T0 closer and into the correct relationship. In free there is no recovery of extension time. The amount of actual extension available depends upon a number of additional conditions.

Programmed phase reduction values:

In COORD the values come from the currently running coord plan. The PRED values reduce the starting value for the coord ring phase split timing (PHZ) for the non co-phases. The co-phase is not reduced by PRED and does not contribute to early green modification. The maximum PRED amount per phase is limited according to the value produced by coord (including 0.2 seconds taken away per phase) if the coord split does not allow removing at least the PRED value +0.2 seconds.

In COORD FREE the values come from the currently running coord plan that requests this COORD FREE. The PRED values reduce the priority maximum green for the non co-phases. There is no maximum limit applied.

In free the values come from the free D/S plan specified by the driving priority. The PRED values reduce the priority maximum green for the non co-phases. There is no maximum limit applied.

No COORD FREE or FREE reduced priority maximum can be less than 0. Also, a resulting value less than the phase minimum time is equivalent to force off.

Line 7 PEXT – Programmed Extensions for partial priority operations during coord or free

Programmed co-phase phase extension values:

- During COORD operation, the maximum amount of extension is limited to the total time of PRED available in Ring 1. Additionally, when concurrent co-phases

are specified, the limit uses the shortest of the concurrent co-phase extensions.

> **NOTE: The executed PEXT cannot exceed the available PRED total from Ring 1. It is possible to program PEXT as 20 with all Ring 1 PRED values = 0 making PEXT==>0.**

- ♦ The Ring 2 PRED values are needed for reducing the Ring 2 Phases during partial priority early green and recovery of the used extension time following the partial priority.
- ♦ The co-phase PRED is available to use for extension. A special extension recovery allows the co-phase to be reduced in the next cycle to complete the recovery of extension time.
- ♦ In phase sequences with multiple rings, it is important to balance the amount and placement of PRED time between barriers. An imbalance may result is an offset Correction if time is not recovered properly.

In COORD the values come from the currently running coord plan. The limited amount of PEXT does not affect the co-phase timing until the co-phase is going to end its green. At that point the extension is used to maintain the green by one-tenth second in each pass until all of the extension is consumed or some other criteria terminates the extension processing. The PEXT does not increase the starting value for the coord ring phase split timing (PHZ) for the co-phases. Therefore, extension is only consumed as needed. The maximum amount is limited as described above.

In COORD FREE the values come from the currently running coord plan that requests this COORD FREE.

In FREE the values come from the free D/S plan specified by the driving priority.

For both COORD FREE and FREE, the PEXT values increase the priority maximum green for the co-phases. At the point when the running priority service is to be started, the remaining co-phase green is added to the extension and this value is placed into the priority maximum for the co-phase(s). The maximum amount is limited as described above.

Line 8 PPHZ – Shows the base time for FREE operation impact calculations of used to expected time. The values are the priority maximum G+Y+AR without any modifications by PRED or PEXT.

> The sources for these values are TRAFFIC Max 1 or Max 2 or the split time from the currently active coord plan that requests COORD FREE. Whichever one is active provides the source during free.

> When free, all forms of priority (none, partial, and full) use this PPHZ base time.

> When a driving priority is operational in FREE, the impact base values are shown on the PPHZ line.

> Additionally, the PPHZ line shows the base values when COORD operates during a full priority. The values are not maximum green but are the PriMax G+Y+AR base. These are shown to provide an indication of the amount of entry

conflicting phase green maximum time that would be available (after subtracting the Y+AR time).

The full priority entry PriMax does not modify the base values by subtracting PRED. (Code was changed to remove this PRED action.)

Each priority has two priority maximum timers (Pri Max 1 and 2) that operate in parallel with the Traffic Phase Max 1 and 2 timers. When the traffic phase green starts, the Pri Max is loaded.

Special conditions apply for when PRED and PEXT timing will be used to modify the value to be loaded. Only during FREE operation and only for a partial priority operation will the modifications be applied.

See Line 6 PRED Help for sources.

See Line 7 PEXT Help for sources.

While free, when evaluating the ability of the current phase to start the co-phase, the remaining traffic maximum time not the Pri Max time is used to determine when service can be started in partial priority. The available extension time is added to this value for the test. (These PPHZ values are of the same concept as the Line 3 CPHZ times.)

3.11.11.4 Priority Vehicle Queue-LRT/TSP

This section describes the Priority Vehicle Queue-LRT/TSP display (Figure 3-18).

```
VEH#..P.ST.TSD.TED.TTL.EXP-INVK.ACT-INVK
  NO VEH IN QUE




  PRIORITY VEH QUEUE-LRT/TSP
```
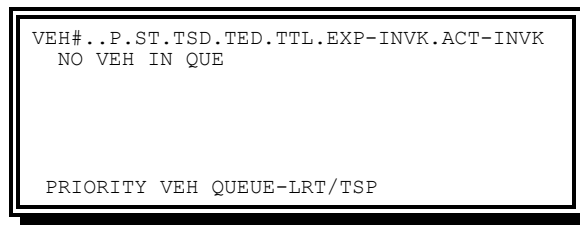
Figure 3-18. Priority Vehicle Queue-LRT/TSP Display

The vehicles in queue are arranged in order of decreasing TSD current timing value. Entries for 19 vehicles are available in the queue. This screen limits the display to six lines of vehicles having the shortest TSD timing values. The line displayed closest to the header line on the screen has the shortest TSD timing value.

An empty vehicle queue displays the text NO VEH IN QUE.

The first line on the screen provides field designation text as follows:

VEH# – Each vehicle is assigned the next number in sequence when first placed into the queue. The numbers (1–9999) track the vehicles within this unit.

The current number is retained intact across normal program restarts. The priority report has an overflow indicator when 9999 advances to 1. The 0 is not a valid physical vehicle number. The central office program has the choice to clear the overflow and keep the vehicle number or clear both.

P – Priority # 1–12 that owns the vehicle

ST – State number that indicates the mode

- ◆ 0 Veh – Not actively being processed to provide priority service. Timer decrement is done and cancel is allowed.
- ◆ 1 Veh – Actively being processed to provide priority service next when the timing is right. Cancel is allowed.

  This is the current vehicle that is serviceable in the mode that the user entered data describes when this priority is not locked out.

  Lockout means that a vehicle can begin an active priority service, but that service will be provided as if set for Minimal priority.

NOTE: See Help for M131 for lockout info.

- ◆ 6 Veh – Being serviced by priority now as primary service.
- ◆ 7 Cancel – In effect. The timers for TSD and TED are stopped for this vehicle.

  As part of the attempts to limit the disruption due to false activating detector calls, a change has been made to the TTL timer. Formerly, the TTL timer was stopped by cancel. The new operation allows the TTL timer to continue to count down. This vehicle may or may not be removed from the queue. That action depends upon the current vehicle being evaluated for service. The purpose for TTL timeout is to clean up mismatches of physical trains or true TSP calls to vehicles in the queue.

- ◆ 9 Veh – Received closest invoking detector actuation. Closest means that the imminent arrival here is expected. Cancel does not apply to this vehicle. The closest invoking detector has the lowest TSD value. The true backup detector input has special status because its TSD is set to 0. As such, the backup detector is also a closest detector because the true backup status indicates the vehicle is at the intersection.

  When the detector assigned to the backup input source does not have a TSD set to 0 that input does NOT have the special true backup status but is merely one among many invoking detectors that are arranged by deceasing TSD values.

- ◆ 10 – This vehicle service is controlled as a secondary service being hosted by the primary service priority that is currently providing service to its own vehicle.

TSD – Current timing value of TSD (time of service desired). The display counts down in whole seconds from 999-10. The display counts down in tenth seconds from 9.9-0.

TED – Current timing value of TED (time of estimated departure). The display counts down in whole seconds from 999-10. The display counts down in tenth seconds from 9.9-0.

TTL – Current timing value of TTL (time to live). The display counts down in whole seconds from 999-10. The display counts down in tenth seconds from 9.9-0.

When the TTL reaches 0, the vehicle is removed from the queue unless one of the following conditions exists:

When the state is 6 and the TTL has timed to 0, the display shows Tmo to indicate timed out until the priority servicing the vehicle completes and removes the vehicle from the queue.

When TTL has timed to 0 and the vehicle is the current vehicle, serviceable and has seen the closest detector actuation but priority servicing vehicle (State 6) has not started yet, the display shows Tcv to indicate current vehicle timed out.

When priority servicing of the vehicle starts the State 9 changes to 6 and the full TTL of the last invoking detector seen is loaded into the TTL timer.

When the State is 10 and the TTL has timed to 0, the display shows Tss to indicate timed out until the supplemental service priority completes and removes the vehicle from the queue.

When the preempt is in control and the TTL has timed to 0, the display shows Tpo to indicate this vehicle is blocked by preempt and is waiting for priority to resume processing after the preempt ends. Priority must remove this vehicle from the queue.

EXP-INVOKE – This area contains multiple fields that identify the expected invoking detectors for this priority vehicle. The active designations are 1-8 as follows:

- ♦ 1=PE

- ♦ 6 ADV DET – 2=1A, 3=2A, 4=3A, 5=4A, 6=5A, 7=6A

- ♦ 8=BDET (Backup).

The numerical designation 1-8 refers to the physical input. The order of these numbers is determined by the TSD values programmed for the assigned detectors. The invoking order (from left to right) is from longest to shortest TSD value. The order is called the logical sequence.

A typical designation of logical sequence would be LRV1, LRV2, LRV3, LRV4, LRV5, LRV6, and LRV7 where LRV1 is defined as first seen and the farthest away. The backup detector, potentially LRV8, has unique properties related to its TSD value. When the TSD is 0, the true backup has the customary definition as the request for immediate priority service. (This action occurs due to the TSD=0.) If the backup TSD is not 0, that detector is an invoking detector subject to the TSD ordered sequence, perhaps as LRV8 or the TSD may be such that backup will not follow LRV7.

NOTE: There are fewer LRV_ numbers for the description above when fewer invoking detectors are assigned. (See the blocked PE description in the next section.)

Any physically available detector input from 1 to 80 may be used for priority operations. However, any detector input used for priority is automatically removed from use by traffic. The six possible PE sources have arbitrary numbers assigned to provide consistent displays:

PE1 to Priority 1 as Det 248

PE2 to Priority 2 as Det 249

PE3 to Priority 3 as Det 250

PE4 to Priority 4 as Det 251

PE5 to Priority 5 as Det 252

PE6 to Priority 6 as Det 253

A special condition applies to the PE input for a priority that also has other programmed invoking detectors. If the PE detector for that priority has a non-0 value set in TSD, TED, or TTL that PE detector is managed by the priority and the pulsing input is not redirected to activate the same numbered preempt. The pulsing PE input only activates the priority (assuming that a co-phase entry exists). When the PE detector has 0 in TSD, TED, and TTL that PE is designated as blocked for priority and is available to activate preempt.

When PE is blocked, the PE does not appear among the logical detectors associated with this priority.

> **NOTE: When the PE detector is blocked for priority, that input cannot invoke priority even when the preempt is linked to itself as a means to provide priority from a steady PE input. Preempt will be provided by the blocked PE input.**
>
> **NOTE: The zero value PE timing block only applies when there are other defined invoking detectors in addition to the PE input. Without other invoking detectors programmed, the PE detector is always available to its associated priority, even when TSD, TED, and TTL are 0 (assuming that a co-phase entry exists).**

ACT-INVOKE – This area contains multiple fields that identify the actual invoking detectors that have been seen for this priority vehicle.

The active designations are 1-8 as follows:

> 1=PE
>
> Six ADV DET – 2=1A, 3=2A, 4=3A, 5=4A, 6=5A, 7=6A
>
> 8=BDET (Backup).

The detectors are displayed in the logical order.

3.11.12 Special Action Taken for True Backup

If this invoking detector is TRUE backup, only one backup vehicle is allowed to be generated in the queue for the same priority when there are multiple backup actuations. Backup is a user-activated pushbutton in a stopped LRT train waiting at the intersection LRT signal. The concern is that failure to get an immediate response will produce multiple actuations. Other advance invoking detectors are sensor activations and multiple inputs should properly indicate multiple train vehicles.

> **NOTE: If the BU detector TSD is NOT 0, this BU is one among many and duplicate calls will make multiple vehicle entries in the queue for the same priority.**

3.11.13 Rules for Invoking Detector Responses

Starting with NO VEH IN QUE, the first invoking detector seen creates a new vehicle entry for the priority to which it has been assigned. When processing the next invoking detector action, if no existing vehicle can be found for its priority to accept the new detection, a new vehicle is created for its priority.

Invoking detectors are analyzed from the closest to the farthest. The actual detector is used even if there is a gap in the expected logical sequence. If there is a gap, the logical sequence list is backfilled from the actual detector through the farthest detector.

If LRV3 is the first invoking detector seen, the vehicle generated shows invoking detectors for LRV1, LRV2, and LRV3 (assuming that these are valid).

The following are detector response examples:

An invoking detector is seen for this priority. Searching the vehicle queue begins from closest to farthest vehicle looking for a vehicle of this priority that does not have the current invoking detector assigned. If such a vehicle is located, the current detector is assigned to that existing vehicle and the TSD, TED, and TTL of that current detector are applied to the existing vehicle.

A vehicle has previously been created by LRV1. The current detector is LRV2. The existing vehicle does not have an LRV2 association. Therefore, the current LRV2 is applied to the existing vehicle and the timers are updated.

Another invoking detector is seen and is LRV3.

The current LRV3 is applied to the existing vehicle and the timers are updated.

Another invoking detector is seen for this priority. Searching the vehicle queue begins from closest to farthest vehicle looking for a vehicle of this priority, which does not have the current invoking detector assigned. If no such vehicle is located, the current detector creates a new vehicle with the TSD, TED, and TTL of that current detector.

If LRV3 is the current invoking detector seen, the new vehicle is created and shows invoking detectors for LRV1, LRV2, and LRV3.

> **NOTE: This situation is multiple vehicles of the same priority.**

Two vehicles exist from the examples above for this priority.

The current detector is LRV1 for this priority. Another vehicle is added to the queue and becomes the third vehicle associated with this priority.

3.12 System Interface

Although defined as systems interface, all of these capabilities are available and may be of value in the stand-alone controller (for example, alarms, MOE, speed, etc.).

3.12.1 System Control

The local controller receives command data from a central system such as TACTICS or from the on-street master. This data includes:

- Plan selection
- Coordinated, free, standby, or flash mode selection
- A system-wide clock synchronization command
- Request for local data response

- Timing parameter downloading and verification
- Special functions

3.12.2   Backup (Communications)

Local TBC and coordination capabilities exist for backup operation on the loss of communications with the master.

In the absence of being polled by a master, within a user defined period (see Chapter 2, Section 2.10.1.2), the local will revert to backup TBC and coordination mode. When again polled by the master, the local will return to the system mode and transition to the master called program.

When in Boston Mode (SPECIAL SEQ set to '3'), the user defined period has a lower limit of five minutes.

3.12.3   Local Alarms Report

The following functions are monitored and the status of each is logged in the local alarms report for later uploading to the central office master.

The first 11 items listed below are transmitted to the on-street master once each minute:

Cycle fault – See Section 4.1.2.6 Cycling Diagnostics

Cycle failure – See Section 4.1.2.6 Cycling Diagnostics

Coordination fault – See Section 4.1.2.6 Cycling Diagnostics

Coordination failure – See Section 4.1.2.6 Cycling Diagnostics

Priority fault – See Section 4.1.2.6 Cycling Diagnostics

Priority failure – See Section 4.1.2.6 Cycling Diagnostics

Voltage monitor – If the local controller voltage monitor function is not normal, the status will be logged as OFF-LINE VOLTAGE MONITOR. If subsequent to a voltage monitor logging the voltage monitor function is corrected, the status will be logged as ON-LINE if no other failure or off line condition is present.

Conflict flash – If the CU MMU/CONFLICT FLASH input remain active for a period of time exceeding the start-up flash time, the status is logged as OFF-LINE CONFLICT FLASH. If subsequent to a conflict flash logging the MMU/CONFLICT FLASH input is removed, the status will be logged as on line if no other failure or off line condition is present.

Local flash – If the CU LOCAL FLASH input become active, MMU/CONFLICT FLASH input is not active, and flash is not commanded by the master, the status will be logged as OFF-LINE LOCAL FLASH. If subsequent to a local flash logging the LOCAL FLASH input is removed, the status will be logged as on line if no other failure or off line condition is present.

Automatic flash – If automatic flash be commanded, MMU/CONFLICT FLASH input is not active, and LOCAL FLASH input is not active, the status will be logged as OFF-LINE REMOTE FLASH. If subsequent to an automatic flash logging the command is

removed, the status will be logged as on line if no other failure or off line condition is present.

Preempt – If any of the CU preempt inputs become active the status will be logged as OFF LINE PREEMPT #. If subsequent to a preempt logging the preempt input is removed, the status will be logged as on line if no other failure or off line condition is present.
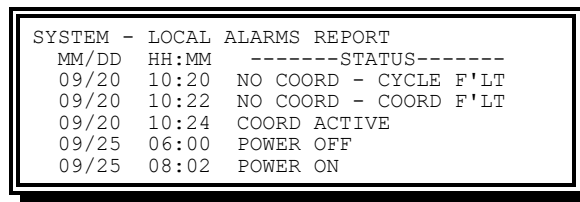
Local free – If any of the CU inputs and/or programming cause it to not respond to coordination control, the status will be logged as NO COORD - LOCAL FREE. If subsequent to a local free logging the CU becomes able to respond to coordination control, the status will be logged as COORD ACTIVE if no other failure or NO COORD condition is present.

Special status – If any of the six special status inputs become active, the status will be logged as SPECIAL STATUS # ON. If subsequent to a special status on logging the input is removed, the status will be logged as SPECIAL STATUS # OFF.

Power on/off – If a power interruption exceeding 50 milliseconds occur, the status will be logged as POWER OFF. When power returns following an interruption of longer than 550 milliseconds, the status will be logged as POWER ON.

The Local Alarms report has the capacity to store up to 120 alarms. When the alarms are logged, they will remain until the report capacity is exceeded at which time the oldest alarm will be deleted and the new one will be added.

The Local Alarms Report display is shown in Figure 3-19.

```
SYSTEM - LOCAL ALARMS REPORT
  MM/DD  HH:MM   -------STATUS-------
  09/20  10:20  NO COORD - CYCLE F'LT
  09/20  10:22  NO COORD - COORD F'LT
  09/20  10:24  COORD ACTIVE
  09/25  06:00  POWER OFF
  09/25  08:02  POWER ON
```

Figure 3-19. Local Alarms Report Display

The Local Alarms Report display includes the following information:

ALARM ### - RESERVED – This alarm number has been reserved for future use.

ALARM LOG FAULT – Local alarm logging routine contains invalid record reference data.

BBDATA CHG FAULT – Background task diagnostics indicate that a data change in progress for disk files bbdata1 and bbdata2 has not changed state for at least 30 seconds, which indicates an abnormality. Corrective action to provide closure has been taken.

CFGDATA CHG FAULT – Background task diagnostics indicate that a data change in progress for disk files /r0/cfgdata and /f0/siemens/cfgdata has not changed state for at least 30 seconds, which indicates an abnormality. Corrective action to provide closure has been taken.

CFGDATA/SWOP INCOMPAT – The current startup sepac.ini settings differ from the cfgdata sepac.ini settings for either the machine type (for example, Safetran versus Siemens) or the operation modifier items.

A valid sepac.ini has not been processed and the starting program determines by Heuristic means that the host boot code is not a Yunex Traffic product.

When cfgdata analysis related to software option, database type existing (FIO-170, FIO-NEMA, TS2, NYS, ITS, CBD) and the FIO/SIU hardware currently detected finds incompatibilities.

CFGDATA INITIALZE – The CFGDATA (permanent) file content requires default initialization. The conditions include:

- Inability to load a valid cfgdata file from either the SRAM or flash storage locations. This may result from missing files or damage to the files resulting in a bad CRC.

- The data structure size within the cfgdata file does not match the structure size required by the current program version.

- The data structure ID within the cfgdata file does not match the structure ID required by the current program version.

- The cfgdata file states that the current software option value is 0 (not defined).

- The cfgdata validation finds incompatibility requiring default data initialization.

- The attempt to create a replacement cfgdata module in running memory has encountered an error.

- The software special option identifier of the current program does not match the identifier in the cfgdata. For example, cfgdata is 332g and the program is 332SEg.

CFGDATA INIT - DATAKEY – Configuration data resident in a DATAKEY has replaced the currently operating CFGDATA.

CFGDATA INIT - KEYPAD – Default parameters were loaded into the CFGDATA (permanent) file based on the LOAD DEFAULT keypad command. This may be either Load Default in the current Software Option or when switching the Software Option setting.

COMM LOG FAULT – Communications fault logging routine contains invalid record reference data.

COORD ACTIVE – The CU entered coordinated operation based on local conditions and programming.

COORD OFFSET FAULT – The local controller is making an offset correction. An offset correction during the first ten cycles of a pattern or during the ten cycles following the logging of a COORD OFFSET FAULT.

CRIT'L ALARMS CLEAR – All defined critical alarms are no longer active/present (see Section 3.12.13).

CYCLE MOE LOG FAULT (ECOM only) – Cycle MOE logging routine contains invalid record reference data.

CYCLE ZERO PED DELAY – Service to an oversized pedestrian occurred. An oversized pedestrian is a pedestrian whose timing is not satisfied by the coordination pattern split time.

CYCLE ZERO PHASE FALT – The coordination cycle reached zero prior to the coordination phase timers reaching a corresponding position. This fact is not logged in the following instances:

- The first cycle of a pattern

- When offset correcting by going short

- The first cycle following a COORD OFFSET FAULT

- When logging a CYCLE ZERO PED DELAY

This may occur the first cycle without correction after going long during some pattern changes when an actuated phase is timing at T Zero (for example, leading turns with unequal times).

DATA CHANGE – KEYPAD – New data has been entered through the keypad.

DATA CHANGE – REMOTE – New data has been downloaded.

DATA LOCK – REMOTE (ECOM only) – Illinois District 1 (special firmware) received a data lock command through communications.

DATA LOCK – TIMEOUT (ECOM only) – Illinois District 1 (special firmware) performed an automatic data lock approximately ten minutes after one of the following occurrences:

- UNLOCK was gained

- The last keystroke

DATA UNLOCK - REMOTE (ECOM only) – Illinois District 1 (special firmware) received a data unlock command through communications.

DET LOG FAULT – Detector fault logging routine contains invalid record reference data.

DIAG: ADDRESS FAULT – The processor attempts to access a word or an instruction at an odd address.

DIAG: BUS FAULT – The processor attempts to access memory that does not exist.

DIAG: CFGDATA CRC ERR – cfgdata is invalid and recovery attempts failed.

DIAG: DIVIDE BY ZERO – The processor encounters an instruction to divide by zero.

DIAG: EEPROM CRC ERR – The results of the running EEPROM diagnostic denotes a fault.

DIAG: EPROM CRC ERR – The results of the running EPROM diagnostic denote a fault.

DIAG: FALSE INTERRUPT – The processor receives a bus fault during interrupt processing.

DIAG: FIELDIO FAIL – During software options FIO, TS2, or NYS. If MAXTRIES (currently defined as 10.) successive attempts fail, FIELDIO FAIL is declared in the following circumstances:

- When the FIO Initialize function encounters a problem with IO Module ID, request module status either to obtain status or reset error bits. Set FIO watchdog timeout, set millisecond counter or configure inputs.

- The write outputs routine checks the FIO status one time per second. If an error condition exists, an attempt to reset the error is made.

♦ During all software options if the field I/O process does a graceful exit. Typically, when the first attempt to open the SDLC communication port returns an error. This instance is usually unrecoverable and not subject to retry actions. For example, when there is some hardware failure or a mismatch to boot code, such as selecting ITS or CBD software options and boot code is for TEES 96 FIO message handling.

DIAG: FIO EVENT OVRN – (OS-9 Only) The FIO/SIU processing has experienced a delay and has not remained synchronized to the tenth second processing. The alarm is entered upon incident detection and no further log entries occur until at least one pass of normal operation occurs. Additionally, the alarm is suppressed if the program detects a situation, such as an SDLC message timeout, that will precipitate the delay.

DIAG: FIO MAX RETRIES – During software option FIO, TS2, or NYS, if the set outputs response has Error Bit 0 set in the status, the Set Outputs command has not been implemented. Typically, this error occurs following an FIO comm loss incident that has not been reset prior to issuing the next Set Outputs command.

DIAG: FIO RESET – When two successive FIO message timeouts occur and fewer than three reset attempts have executed, the FIO is issued a reset command.

DIAG: INV. TS2-A1 CNF – If either the T&F BIU 1 or T&F BIU 2 is programmed as present AND any of the following is true:

♦ Port 1 is not enabled (no TS2 Card plugged in OR TS2 Card reports that the Port 1 connector disable (8–10) is active).

♦ The MMU is not programmed as present.

♦ T&F BIU 2 is programmed as present and T&F BUI1 is not programmed as present.

DIAG: INVALID OPCODE – The processor encounters an invalid instruction.

DIAG: INVALID TRAP – The processor encounters an invalid software interrupt instruction.

DIAG: NO IP STACK – When attempting to set IP address data, the response was an error reported by the operating system.

DIAG: PROGRAM CRC ERR – The DRAM operating module for the program has failed the CRC check.

DIAG: PWRFAIL LOADFLT – The attempt to start operation of the pwrfail module caused an error or the background validation task finds the pwrfail module CRC invalid.

The pwrfail module informs SEPAC of transitions in the AC power when the OS does not provide the system ACFAIL event.

DIAG: RAM TEST – The power up RAM read/write test failed.

DIAG: RESP FRAME FAIL – A third time occurrence of MMU response frame fault or an individual T&F BIU has a third time response frame fault. We went to locking flash.

DIAG: RNG DNLOAD FAIL – A communications download of unit data tried to change the ring structure and an error was found in the downloaded ring structure data. The new data was not implemented. We went to flash.

DIAG: SYSTEM FAULT – Miscellaneous processor faults.

DIAG: TRAF TASK WDOG – Tenth second processing has consumed more then 250 ms without reaching a conclusion.

DIAG: TRAF TASK XS DLY – Synchronization between the tenth second processing and the real time has slipped more than two seconds (2083 ms) without the occurrence of a traffic task watchdog.

DIAG: UNSPECIFIED – Processor faults not defined elsewhere.

DIAG: VRTX FAULT – A VRTX operating system error.

DIALUP FAILED – A SOLO critical alarm dial up failed to connect and report the alarms.

EEPROM CRC INITIALIZE – Default parameters were loaded into EEPROM following an EEPROM CRC diagnostic error.

EEPROM INIT - KEYPAD – Default parameters were loaded into EEPROM based on the LOAD DEFAULT keypad command.

EEPROM WRITE ERROR – Attempts to write a value to the EEPROM failed to produce data match within the required time frame, or an attempt to refresh the RAM data in the EEPROM image has failed to produce a match.

FRAME ### FAULT – More than five out of the most recent ten response frame number transfers are not received properly.

FRAME ### ON LINE – Response frame number transfers are being received properly.

HARDWARE/SWOP PROBLEM – A hardware/software option problem exists when the IO Type (FIO/SIU) in the cfgdata file matches the type expected by the software option selected but the physically present device identifier is not this type. This condition may occur when selecting a new software option and the hardware in the unit does not support the selection.

Examples include the following:

♦ Software Option TS2 with FIO – 2A (does not comply with TS2 Type 1 or Type 2).

♦ Software Option NYS with FIO NEMA type (does not comply with NYS IO definitions).

♦ Software Options ITS and CBD evaluate hardware required by programming versus hardware found by interrogation of connected devices (does not provide full operation as requested).

INCOMPAT MEM RESTART – Default parameters were loaded based on keypad command from the INCOMPATIBLE PROM & EEPROM display.

INVALID ABC I/O MODE (ECOM only) – Boston (special firmware) is operating with an invalid ABC I/O mode programmed.

INVALID PROM RESTART – Default parameters were loaded based on keypad command from the INVALID PROM display.

MMU LOG FAULT (ECOM only) – MMU logging routine contains invalid record reference data.

MMU UNDETECTED CNFLCT – Conflicting channels were not red and the MMU did not report a conflict for ten response frame transfers. We went to flash.

MMU UTILZATION CNFLCT – The MMU program card channel compatibility and the CU channel utilization did not agree (MMU = not compatible/CU = compatible).

MOES LOG FAULT – Measure of effectiveness logging routine contains invalid record reference data.

NO COORD - BAD P FREE – The CU entered free operation based on the pattern requested not passing the valid plan checks.

NO COORD - COMND FREE – The CU entered free operation based on a master or local command.

NO COORD - COORD FAIL – The CU had a cycle fault running coordinated on an attempt to pickup after a coordination fault.

NO COORD - COORD FALT – The CU had a cycle fault running coordinated but was cleared when running free.

NO COORD - COORD FREE – The CU entered free operation based on the pattern offset being set equal to or larger than the cycle length.

NO COORD - CYCLE FALT – The CU did not service a call while running coordinated.

NO COORD - FAIL FREE – The CU entered free operation based on the cycling diagnostics.

NO COORD - INPUT FREE – The CU entered free operation based on some input having a higher priority than coordination.

NO COORD - TRANS FREE – The CU entered free operation in order to transition to the requested pattern.

NO SYSTEM - BACKUP – The unit reverted to backup mode from system control.

NO SYSTEM - STANDBY – The unit reverted to standby mode based on a master command.

OFF LINE - CONFL FL – The CU conflict monitor became active.

OFF LINE - CYCLE FAIL – The CU did not service a call while running free.

OFF LINE - LOCAL FL – The CU manual flash became active.

OFF LINE - PREEMPT # – The CU entered the # preemption sequence.

OFF LINE - PRIORITY # – The CU entered the # transit priority sequence.

OFF LINE - REMOTE FL – The CU entered programmed flash.

OFF LINE - VOLT MONIT – The CU voltage monitor output was OFF because of an internal voltage failure.

ON LINE – The CU has no off line alarm conditions.

POWER OFF – The CU experienced a loss of AC power for longer than 50 milliseconds.

POWER ON – The CU AC power was reapplied following a loss of AC power for longer than 550 milliseconds.

PREEMPT INPUT MAX FLT (ECOM only) – The preempt input has been active longer than the MXCALL time.

PROGRAM DAY 0 – The software clock has been cleared to 01/01/80 00:00:00 PDAY 0 because both the software clock and RTC chip time are invalid.

RAW ERR LOG FAULT – An attempt to place an entry into the temporary raw error log found that the log pointers were out of the prescribed range and a full initialization of that log has been done.

RTC CHIP ADJUST – RTC chip time has been adjusted to match the software clock because the RTC chip time invalid or did not match the valid software clock time .

RTC CHIP FAILURE – RTC chip read/write time-out occurred, or a read provided out of range values.

RTC CHIP FAULT – RTC chip time has drifted outside the +1/2 second tolerance.

SDLC .1 SEC DLY FAIL – A third time occurrence in a day of the alarm SDLC .1 SEC DLY FAULT. The system went to locking flash.

SDLC .1 SEC DLY FAULT – The TS2 SDLC card failed to respond in five out of the last ten tenth second interactions. The system went to flash.

SIGNATURE INVALID – The signature data held in the semi-permanent (SRAM) data files is not valid due to missing or corrupt files.

SIGNATURE-CHK BATTERY – The RAM signature was lost by the battery failing to hold data or a new firmware set was installed in which the signature was in a different RAM location.

If the battery were truly the cause, you would also expect to find the RTCIC clock cleared and requires clock programming messages PROGRAM DAY 0.

SOFTWARE CLOCK ADJUST – Software clock time has been adjusted to match the RTC chip because the software clock time was invalid.

SPECIAL STATUS # OFF – The CU special status input number became inactive.

SPECIAL STATUS # ON – The CU special status input number became active.

SPEED LOG FAULT – Speed trap logging routine contains invalid record reference data.

SYSTEM ACTIVE – The unit is picked up by the MARC360 master.

T&F SIGNATURE FAULT (ECOM only) – Illinois District 1 (special firmware) is operating with an invalid terminal and facilities signature.

TIME CHANGE - KEYPAD – The TBC date/time has been changed through the keypad.

TIME CHANGE - REMOTE – The TBC date/time has been changed by the master or a personal computer through the master or direct.

TRAF RESP LOG FAULT – Traffic responsive logging routine contains invalid record reference data.

TRAFFIC TASK DELAYED – The task did not start within 0.1 seconds from the last time it started.

VOL COUNT LOG FAULT – Volume count logging routine contains invalid record reference data.

WATCHDOG TIMEOUT – The CU watchdog function was not serviced in the allocated time and the unit went through an initialization startup.

WD RESTART - 10THTSK – The watchdog mechanism encountered a problem with the tenth second processing and took corrective action.

WD RESTART - FIELDIO – The watchdog mechanism encountered a problem with the FIO/SIU processing and took corrective action.

WDOG START - BACKGND – The watchdog mechanism encountered a problem with the background process and took corrective action.

WDOG START - DISPLAY – The watchdog mechanism encountered a problem with the display data production process and took corrective action.

WDOG START - F PANEL – The watchdog mechanism encountered a problem with the display output process and took corrective action.

WDOG START - KEYBOARD – The watchdog mechanism encountered a problem with the keypad input processing and took corrective action.

WDOG START - LED – The watchdog mechanism encountered a problem with the front panel activity LED and ancillary timing functions and took corrective action.

WDOG START - LV1 DIAG – The watchdog mechanism encountered a problem with the Level 1 diagnostics and semi-permanent data validation (SRAM) and took corrective action.

WDOG START - PLAYER – The watchdog mechanism encountered a problem with the Tributary 1 presentation layer (Port 3) and took corrective action.

WDOG START - PRINTER – The watchdog mechanism encountered a problem with the Tributary 2 presentation layer (Port 2) and print functions and took corrective action.

WDOG START - TBC – The watchdog mechanism encountered a problem with the time base process and took corrective action.

WDOG START - TBE – The watchdog mechanism encountered a problem with the validation of OS-9 system time to RTCIC time and took corrective action.

WDOG START - TRIB 1 – The watchdog mechanism encountered a problem with the Tributary 1 protocol layer -ECOM (Port 3) and took corrective action.

WDOG START - TRIB 2 – The watchdog mechanism encountered a problem with the Tributary 2 protocol layer -ECOM (Port 2) and took corrective action.

WDOG START - WDBCKUP – The watchdog mechanism encountered a problem with the process watching most processes and took corrective action.

WDOG START - WDPRIME – The watchdog mechanism encountered a problem with the process watching tenth second and WDBCKUP and took corrective action.

3.12.4 Local MOE Report

Measures of Effectiveness (MOEs) are accumulated and reported to enable the evaluation of coordination pattern parameters based on actual data collected during the periods the pattern is in control. MOE calculations are made one time each sequence cycle for volume, stops, delays, and use for each phase in the CU and then averaged over the duration of the pattern.

Volume – The average number of actuations during the sequence cycle for the duration of the pattern. Accumulates the vehicle actuations sum for each phase-per-sequence cycle and averages for the duration of the pattern.

Stops – The average number of vehicles that must stop at an intersection during the cycle for the duration of the pattern. Accumulates the vehicle actuations sum for each phase-per-sequence cycle during non-green time and averages for the duration of the pattern.

Delays – The average time in seconds that vehicles are stopped during the sequence cycle for the duration of the pattern. Accumulates the waiting time (number of cars waiting multiplied by time) for each phase-per-sequence cycle and averages for the duration of the pattern.

Utilization – The average seconds of green time used by each phase during the sequence cycle for the duration of the pattern. Accumulates the green time used for each phase per sequence cycle and averages for the duration of the pattern.

Only normal vehicle detectors (detector Mode 0) accumulate MOE data. Failed detectors will still accumulate MOE data.

The MOE report has the capacity to store up to 24 patterns of MOE data. When it is logged, the pattern MOE will remain until the report capacity is exceeded at which time the oldest pattern MOE will be deleted and the new one will be added.

The Local MOE Report display is shown in Figure 3-20.

```
SYSTEM - LOCAL MOE'S
BEGIN: 09/21  07:15          PAT:005
PHASE......1...2...3...4...5...6...7...8
VOLUME.:  50 100  50 100  50 100  50 100
STOPS..:  40  20  40  70  40  20  40  70
DLAY*10:  85  65  90  70  85  65  90  70
UTILIZ.:  15  35  10  30  15  35  10  30
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 3-20. Local MOE Report Display

MOE data is a pattern cycle zero to cycle zero calculation. At the pattern cycle zero the values are processed then reset to zero. Under light traffic conditions (for example, a phase has infrequent calls or service), the values will be low.

3.12.5 Cycle MOE Report

Coordination green use on a cycle-by-cycle basis is collected and available in the CUs Cycle MOE report. The Cycle MOE Report display is shown in Figure 3-21.

```
SYSTEM - CYCLE MOE
BEGIN:   :  :                   PAT:
PHASE......1...2...3...4...5...6...7...8
UTILIZ.:
PHASE......9..10..11..12..13..14..15..16
UTILIZ.:
FORCE..:
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 3-21. Cycle MOE Report Display

The Cycle MOE report includes a DATA event that lists the pattern number along with the coordination pattern times for each phase.

The Cycle MOE report includes a COORD event for each cycle providing history on the under (-) or over (+) use of the pattern time programmed for the cycle. Also included is data on which phases were forced in that cycle.

The Cycle MOE report entries will denote when offset correction was in progress during the cycle. A CORR+ event denotes that offset correction added time to the cycle to enable correction. A CORR- event denotes that offset correction subtracted time from the cycle to enable correction.

The Cycle MOE report has the capacity to store up to 60 events. When an event is logged it will remain until the report capacity is exceeded at which time the oldest event will disappear and the new will be added.

3.12.6   Communications

Each local intersection controller may be provided with a system interface that allows the reception of Central-Office Master or On-Street Master commands and the transmission of local intersection data to the respective site.

3.12.6.1   Modem (Internal)

The modem provides 2-wire half duplex communications.

The modem complies with the following requirements:

> Data rate – 300 to 1200 baud.
>
> Modulation – Phase coherent frequency shift keying (FSK).
>
> Data format – Asynchronous, serial by bit.
>
> Line and signal requirement – Type 3002 voice-grade, unconditioned.
>
> Tone carrier frequencies (transmit and receive) – 1200 Hz (Mark) and 2200 Hz (Space) with ±0.03% tolerance. The operating band is (1/2 power, -3db) between 1000 Hz and 2400 Hz.
>
> Transmitting output signal level – 0 to 3 dB continuous.
>
> Receiver input sensitivity – 3 to -40 db.
>
> Receiver lowpass filter – Provides 10 db./octave, minimum active attenuation for all frequencies above the operating band.
>
> Clear-to-send (CTS) delay – 27 ms (±2 ms).
>
> Receive line signal detect time – 8 ms (±2 ms) mark frequency.
>
> Modem recovery time – Capable of receiving data within 15 milliseconds after completion of transmission.
>
> Error rate – Will not exceed 1 bit in 100,000 bits, with a signal-to-noise ratio of 16 dB measured with flat-weight over a 300 to 3000 Hz band.
>
> Transmit noise – Less than 50 dB across a 600-ohm resistive load within the frequency spectrum of 300 to 3000 Hz at maximum output.

Indication is provided to indicate carrier detect, transmit data, and receive data.

The modem operates within the local CU.

> **NOTE: This is recommended for ECOM usage only, as NTCIP requires a higher data rate for effective communications.**

3.12.7   Communications Report

The communications report has the capacity to store up to 60 faults. When a fault is logged will remain until the report capacity is exceeded at which time the oldest fault will disappear and the new will be added.

The Communications Fault Report display is shown in Figure 3-22.

```
SYSTEM - COMM FAULT REPORT
  MM/DD  HH:MM  --------STATUS-------
  09/20  10:20  MARC HAS RECEIVE PROB
  09/21  22:10  MID XMIT STOPPED
  09/22  06:00  MODEM TIMEOUT
  09/23  11:11  MODEM TIMEOUT
  09/24  18:01  MODEM TIMEOUT
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 3-22. Communications Fault Report Display

The Communications Fault Report display provides the following information:

CNTL RESP DIE IN XMIT – Logged when the sending station ceases to send characters during the control mode for two seconds.

COMM DATA ERROR – Logged when handshake response returns a NAK after the local select.

COMM CRASH – Logged on the following:

After a select, the request to get a new memory block to be passed for processing produces a non-zero error that was not the error indicating that a block was not available.

After a poll request has gotten a new memory block, passed it for processing, and there is a non-zero error that was not the error indicating a time-out waiting to finish processing the block.

When the transmit queue identification is neither Port 2 ACIA or Port 3 ACIA.

The queue posting returns a non-zero error that is not queue full.

COMM MEMORY ALOCATION – Logged when a poll request tries to get a new memory block and there is an error indicating that a block was not available.

COMM REQUEST – Logged when a reverse interrupt handshake response is received after transmitting data.

DATA RESP DIE IN XMIT – Logged when receiving data; a time-out occurred waiting for another character (first DLE to last CRC character)

SEPAC COMM ERROR – Logged when an unexpected handshake response (not NAK, 0, NULL) after the local select or unexpected character following a DLE (not SOH, STX, ETX, ETB, DLE, ENQ) when receiving data.

EARLY DATA EOT – Logged when looking for control characters in non-transparent mode and the EOT character comes when no previously defined control state (SOH, STX, ETX, ETB) has been found.

MSTR DOES NOT RESPOND – Logged on the following:

- Initial message is neither a select or a poll (assumed to be a broadcast).
- Handshake response time-out after the local select.
- Waiting for a data block and the first character was ENQ
- Not selected and there is a time-out waiting for the repeated poll request.

MSTR HAS RECEIVE PROB – Logged on the following:

- An EOT comes in a SOH, STX, or ETB control state and there is no existing ERROR condition.
- Exceed max retries (3) transmitting data because of time-out, garbled, NAK, or WACK handshake response.
- Exceed max retries (3) transmitting data during the handshake under the following conditions:
  - The handshake response was 0 or 1 and that response was the correct handshake.
  - The block just sent was not the last block in a multiple block ETB process.
  - There was an error (time out) while waiting to be provided the next block. Time out sends ENQ until the number of retries has been exceeded.

MID XMIT STOPPED – Denotes that the receiving station has sent the character sequence (EOT), which stops the sending station wherever it is in its transmission.

MODEM TIMEOUT – Denotes that the SEPAC has control of the communications line but has not transmitted a character for 0.1 seconds. Additionally, the Port 3 ACIA has its RTS turned off and the transmitter interrupts are disabled.

RECEIVE CRC ERROR – Denotes that the CRC for the message just received was incorrect.

UNDEFINED COMM ERROR – Denotes the CU can not find a valid error number to report in the communications log.

3.12.7.1 Auxiliary Devices

Means are provided to communicate to auxiliary devices that are connected to a CU RS-232 interface.

A generic download to a communications port exists that enables the CU to receive data from a remote location and direct same to a specific port.

A generic upload from a communications port exists that enables the CU to trap data from a specific port and direct same to a remote location.

Devices that have successfully used this capability at the time of this publication are EDI SSM monitors and 3M # 562 priority control units. Also, these devices were concurrently connected to the same RS-232 interface.

3.12.8   System Detectors

The user may assign any vehicle, special, or pedestrian detector input as system detector inputs. The CU processes the assigned system detectors data (volume + occupancy by scanning each input at a rate of sixty times a second) for a period of one minute and then transmits the results of this processing to the on-street master.

Figure 3-23 provides conversions to percent and sensor averaging. Use the information presented when reading this section.
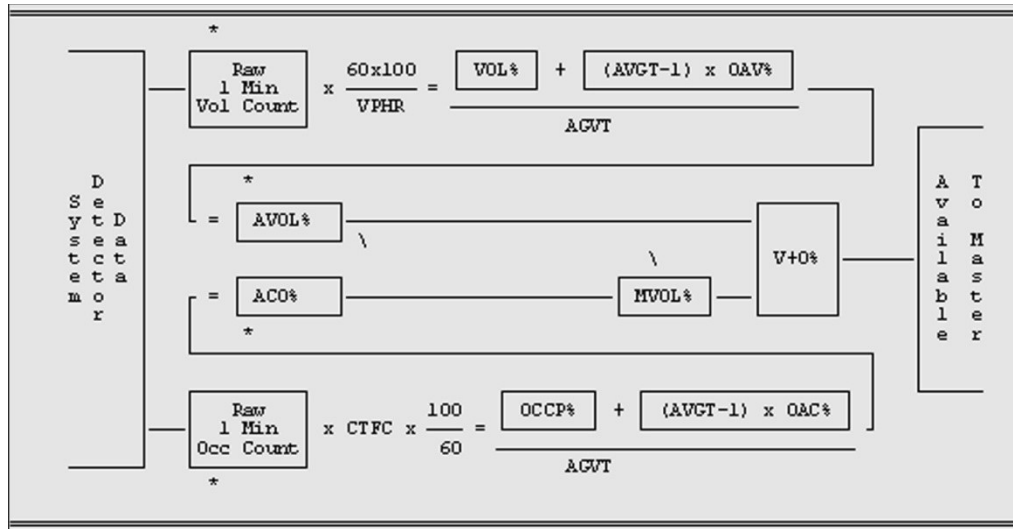
Figure 3-23. System Detector Volume/Occupancy Diagram

NOTE: The AVOL% and ACO% are stored in memory for one minute and become OAV% and OAC% values.

(*) These values are stored and transmitted to the central office to be logged for report purposes.

MVOL% equals the minimum AVOL% needed before ACO% can be added. Volume only can be achieved by setting MVOL to a high percentage.

The detector processing is as follows:

> Average volume percent (AVOL%) – The detector volume percentage (VOL%) is computed by taking the raw one-minute volume counts, multiplying by sixty to obtain the projected counts in an hour, multiplying by one hundred to convert the final result to a percentage, and then dividing by the vehicle per hour reference (VPHR). The vehicle per hour reference (VPHR) is a user assigned value depicting an estimate of the lane capacity in terms of the number of vehicles per hour.
>
> VOL% =((1 Min Volume Count)x60x100) / VPHR
>
> The average volume percent (AVOL%) is computed by summing a portion of the old average percent (OAV%) and the new volume percent. To simplify the ratio calculation, the portion of the old average volume percent and the new volume

percent are based on the detectors averaging time (AVGT) in minutes and may be varied between one (1) and ninety-nine (99) minutes (user selectable).

AVOL% =(((AVGT-1) x OAV%) + VOL%) / AVGT

Average corrected occupancy percent (ACO%) – The percent occupancy (OCCP%) is computed by taking the raw one-minute occupancy count, multiplying by the correction factor (CTFC; initially set to one), multiplying by one hundred to convert the final result to a percentage, and dividing by the maximum number of counts that can be received in one minute (MXOCC).

OCCP% = ((1 Min Occp Cnt)xCTFCx100)/MXOCC

NOTE: The maximum occupancy counts for a one-minute period (100% occupancy) is 3600 counts where each count equals 1/60th of a second.

The average percent occupancy (AOCCP%) is computed by summing a portion of the old average percent occupancy and the new percent occupancy. As with the average volume percent, the portion of the old average percent occupancy (OAC%) and the new percent occupancy are based on the detectors averaging time (AVGT) in minutes.

AOCCP% = ((AVGT-1) x OAC%) + OCCP%) / AVGT

The ratio of the old average percent volume or occupancy to the new percent volume or occupancy determines the system's speed of response to the current traffic conditions. Please note that setting the AVGT to one (1) minute results in the immediate minute to minute response based on new volume or occupancy data. The average percent occupancy may require adjustments due to detector operation. These adjustments are made by changing the correction factor (CTFC) resulting in an average corrected percent occupancy (ACO%).

Volume + Occupancy Percent (V+O%) – Each detector V+O value is computed every minute by summing the average volume percent and the average corrected percent occupancy. The volume value must exceed an operator set threshold, for each detector, before the occupancy is added in. This protects the system from vehicles that are parked over a detector for long periods of time.

The System Detector report has the capacity to store up to 96 sample periods. When a sample period data set has been logged it will remain until the report capacity is exceeded at which time the oldest sample period data set will disappear and the new will be added.

The System Detector Report display is shown in Figure 3-24.

```
SYSTEM - SYS DET REPORT
BEGIN:  09/21  07:15  INT: 15  MULT: 10
DETECTOR...1...2...3...4...5...6...7...8
RAW VOL:   9  13   9   9  13  18   9  13
RAW OCC:  12  23  12  11  23   4  11  23
AVOL%..:  54  31  54  21  79  42  54  31
AC0%...:  20  38  20  19  38   7  19  39
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 3-24. System Detector Report Display

3.12.8.1   Queue Selection

The local controller can select patterns based on computed V+O of two queue selection routines (Queue 1 and Queue 2).

Routine priority has the following order:

- Queue 2 Level 2
- Queue 2 Level 1
- Queue 1 Level 2
- Queue 1 Level 1

Each routine has programmable threshold settings. If the threshold (Level 1 or 2) is reached on a routine, the local controller will call for a pre-programmed pattern, overriding the pattern called for by the normal control source (system, TBC, interconnect, etc.).

It is possible to select different patterns with each of the routines.

It is possible to define all or part of the pattern these queue routines will override. When only part of a pattern is overridden, the remaining will selected in the normal manner.

When a queue routine defines a partial pattern, the source of the normal pattern provides sync, otherwise TBC provides sync reference. If no TBC event exists prior to occurrence of queue override, then sync to 24:00 hours when event sync is programmed else sync to last event time.

The outputs of each queue routine may be mapped to Special Function 1 to 8 controls. This allows the queue routines to be used to select features or functions other than patterns or partial patterns.

For example, Queue 1 Level 1 output and TX Diamond Four Phase input could be mapped to Special Function 1 When Queue Routine 1 system detectors exceed Level 1entry parameters, the TX Diamond Four Phase would run. When Queue Routine 1 system detectors activity dropped below Level 1, the default TX Diamond Three Phase Sequence would run.

3.12.9   Volume Count Report

Means are provided to use any vehicle, special, or pedestrian detector input as count detector inputs for the CUs volume count report. The volume count report includes a provision for logging volume history for up to 24 count detector inputs.

The Detector Volume Count Report parameters and output will not be capable of being entered or viewed through the front panel. It must be downloaded and viewed through a PC.

The Detector Volume Count Report has the capacity to store up to 72 count periods. When a count period data event has been logged, it will remain until the report capacity is exceeded at which time the oldest count period data event will disappear and the new will be added.

3.12.10 Speed Traps

The speed trap function provides speed monitoring capability. Two speed trap detector spacings can be used, 11 feet or 22 feet, depending on the application. Provision is made in the local controller to monitor the speed, in MPH or KPH. Also, a nominal speed range may

be set for each pattern (combination of cycle/split/offset. The percent of vehicles higher, within, or lower than the nominal speed range may be logged.

The Speed Report has the capacity to store up to 24 patterns of speed data. When the pattern speed data has been logged, it will remain until the report capacity is exceeded at which time the oldest pattern speed data will be deleted and the new one will be added.

The Speed Report display is shown in Figure 3-25.

```
SYSTEM - SPEED REPORT
  --- BEGIN --   PATRN   PERCENT OF TOTAL
  MM/DD  HH:MM  D/S/O  LOWR   W/IN   HIGH
  09/21  07:00  2/2/2   10     80     10
  09/21  08:00  3/1/1   15     85      5
  09/21  10:00  3/1/2    5     85     10
  09/21  12:00  2/2/2   20     70     10
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 3-25. System Speed Report Display

3.12.11 External System Interface

The availability of system input/output functions are dependent on the CU hardware configuration, terminal and facilities wiring and configuration, and user programming (See Chapters 13 and 14).

The system functions operate with an external interface as follows:

> System inputs
>
> > Special status inputs may be used for logging specific events in the controller assembly. For example, if one of these inputs were wired to a cabinet door switch, it would log each occurrence of when the cabinet door was opened.
> >
> > MMU/conflict flash status input may be used for logging an occurrence of monitor-initiated flash operation.
> >
> > Local flash input may be used for logging an occurrence of local (manual) initiated flash operation
> >
> > Special detector inputs may be used as system, phase vehicle, or phase pedestrian detector inputs.
>
> System outputs
>
> > Special function outputs may be programmed individually as local TBC outputs. When programmed as local TBC outputs, a special function output will not respond to system commands as to its state until the clear memory function within TBC is used to eliminate all TBC or all auxiliary events (Code 0 or Code 2).
> >
> > Special function outputs may be through a PC command. This control supplements the master (MARC360, etc.) and local TBC control of these functions. That is to say, either may set an inactive function to ON but all must call for an inactive output before the output is OFF. When it is set active through a PC, the output will remain ON until set inactive by the PC or power is cycled at the local.
>
> Input levels – All logic signals are low state (nominal 0 VDC) for the operate condition of all preempt inputs.

Connector pins – Input/output pin terminations are provided in accordance with the following table:

Table 3-23. System inputs and outputs	
System Inputs	**System Outputs**
Special Status #1	Special Function #1
Special Status #2	Special Function #2
Special Status #3	Special Function #3
Special Status #4	Special Function #4
Special Status #5	Special Function #5
Special Status #6	Special Function #6
MMU/Conflict Status	Special Function #7
Local Flash Status	Special Function #8
Special Detector #1	
Special Detector #2	
Special Detector #3	
Special Detector #4	
Special Detector #5	
Special Detector #6	
Special Detector #7	
Special Detector #8	

3.12.12 System Indications

Indications are provided on the display and appropriately identified to facilitate the determination of system operation.

The indications provide the following current status:

- Communications port settings
- Communications port status
- Carrier activity
- Transmitting data
- Receiving data

3.12.13 SOLO Modem (External)

For SOLO intersection (address=00) applications, an auto dial/auto answer modem may be provided to automatically answer calls from the Central-Office Master and to transmit stored data to the Central-Office Master through standard voice-grade, telephone lines.

The modem will conform to the following requirements:

US Robotics Courier V.Everything 56Kbps Fax Modem

Table 3-24. Configuration Switch Settings		
Switch 1	ON/DOWN	DTR Always ON
Switch 2	ON/DOWN	Numeric Result Codes
Switch 3	ON/DOWN	Display Result Codes
Switch 4	ON/DOWN	No Echo, Offline Commands
Switch 5	OFF/UP	Auto Answer On Ring
Switch 6	ON/DOWN	Carrier Detect Override
Switch 7	OFF/UP	Display All Result Codes
Switch 8	ON/DOWN	Enable AT Command Set
Switch 9	ON/DOWN	Disconnect With +++
Switch 10	OFF/UP	Load NVRAM Defaults

Within the terminal program (baud rate set equal to that to be used by CU):

* Type AT &F0 <Enter>
* Type AT M1 X0 S0=1 S7=30 <Enter>
* Type AT &A0 <Enter>
* Type AT &K0 <Enter>
* Type AT &N2 <Enter>
  - Lock Speed – &N2=1200 bps
* Type AT &W <Enter>

Most modems support the above features but may use different commands in their setup.

The telephone number routine allows the unit to instruct a modem to dial an internally stored number. When the first field of the telephone number is zero, the unit will substitute S= into the dialing string. S= instructs the modem to dial an internally stored number 0 to 3.

A SOLO intersection (address=00) equipped with an external modem has the capability of user definition of critical alarms and alarm telephone numbers for automatic reporting on occurrence.

The critical alarm definition data will not be capable of being entered through the CU front panel. It must be downloaded from a PC.

The following events are capable of being defined as critical alarms:

Automatic flash

Conflict flash

Coordination fail

Coordination fault

Cycle fail

Cycle fault

Local flash

Local free

Preemption

Special Status 1–6

Voltage monitor

Any special status (1 to 6) defined as critical will become an alarm function and will lose its non-system functionality (for example, ASA, ASB, ASC, ASD, clock set, and dimming).

When system data is downloaded to a SEPAC, special identification is established as part of the download based on the master menu letter choice of the downloading PC (for example, If the master menu letter is A in the PC that downloaded the SEPAC system database, the local will report as Group A).

On occurrence of an alarm defined as critical in a SOLO SEPAC, its critical alarm dial up routine will begin.

The critical alarm dial-up routine will dial Telephone #1 five times (one time equals 30 seconds of ringing then a minute wait). If #1 does not answer during the five tries, #2 is dialed five times. If #2 does not answer during its five tries, the routines returns to #1 and repeats the above cycle two more times (#1 then #2) before a DIALUP FAILED is logged. When there is no #2 telephone number, the routine inserts a five-minute wait in place of each #2 dialing noted above. In total the routine attempts to connect (dials) for 30 plus minutes prior to giving up and logging a DIALUP FAILED message.

If telephone #1 and #2 do not exist, no dial up attempt is made and no dial up failure logged. When a dial up routine is entered, if it is determined a modem is not attached or is not responding correctly (for example, no power), no dial up attempt is made and no dial up failure logged.

If the initial rounds of dialing fail to connect and report a critical alarm, the EPAC310 will make another attempt each hour thereafter to report same by repeating the above routine. On these hourly attempts, a DIALUP FAILED message will not be logged on failure to connect in order to not fill up the log with that message.

For NTCIP, operational indication is available on the front panel of the local intersection CU to denote when a carrier signal is being received, valid data is being received, and the unit is transmitting.

3.12.13.1   Messages

The local system interface receives a command message composed of a serial bit stream. The receipt of a valid command message initiates a reply message of a serial bit stream. When a command is not received correctly within a user set period, the local system interface causes a transfer of intersection operation to local TBC.

Each local system controller is given a unique address from 001 to 032 through an entry through the front panel. Devices that may be resident at the local intersection (the CU, local detectors, eight system detectors, and two speed traps) are capable of being remotely monitored or controlled. A sequence of command or monitor messages are transmitted from the central office master or on street master to local intersection controllers. The local intersection to which the message is directed responds to the master. A command address of zero is received by all locals. The zero command is used to communicate traffic patterns and other system messages to all locals simultaneously.

The message length is variable, depending on the nature of the message. The message content includes one or more of the following types of information:

Set

- Date (month, day, year)
- Time (day, hour, minute, second)
- Traffic pattern (dial, split, offset)
- Sync (pattern to master cycle)
- Intersection mode
- CU mode

Monitor

- Date/time
- Traffic pattern
- Sync
- CU mode
- System detectors
- Intersection alarms
- Intersection status
- CU display status
- CU I/O status
- Intersection mode

Download parameters

- Basic traffic – Phase
- Basic traffic – Unit
- Coordination – All
- TBC – All

- ♦ Preemption – All

- ♦ System – All

Upload Parameters

- ♦ Basic traffic – Phase

- ♦ Basic traffic – Unit

- ♦ Coordination – All

- ♦ TBC – All

- ♦ Preemption – All

- ♦ System – All

Upload reports

- ♦ Local alarms report

- ♦ Communication fault report

- ♦ System detector report

- ♦ Detector fault report

- ♦ Local MOE

- ♦ Speed report

- ♦ EDI monitor report and data

Message security provides a cyclic redundancy check (CRC). Invalid messages are rejected to prevent false commands at the local.

Operational indication is available on the front panel of the local intersection CU to denote when a carrier signal is being received, valid data is being received, and the unit is transmitting.

The Communications Fault Report has the capacity to store up to 60 faults. When a fault has been logged, it will remain until the report capacity is exceeded at which time the oldest fault will disappear and the new will be added.

The Communications Fault Report display is shown in Figure 3-26.

```
SYSTEM - COMM FAULT REPORT
  MM/DD  HH:MM  --------STATUS-------
  09/20  10:20  MARC HAS RECEIVE PROB
  09/21  22:10  MID XMIT STOPPED
  09/22  06:00  MODEM TIMEOUT
  09/23  11:11  MODEM TIMEOUT
  09/24  18:01  MODEM TIMEOUT
UP/DOWN - PREV/NEXT WINDOW      C-CLEAR
```

Figure 3-26. System Comm Fault Report Display

CNTL RESP DIE IN XMIT – Logged when the sending station ceases to send characters during the control mode for 2 seconds.

COMM DATA ERROR – Logged when handshake response returns a NAK after the local select.

COMM CRASH – Logged on the following:

After a select, the request to get a new memory block to be passed for processing produces a non-zero error that was not the error indicating that a block was not available.

After a poll request has gotten a new memory block, passed it for processing, and there is a non-zero error that was not the error indicating a time-out waiting to finish processing the block.

When the transmit queue identification is neither Port 2 ACIA or Port 3 ACIA.

The queue posting returns a non-zero error that is not queue full.

COMM MEMORY ALOCATION – Logged when a poll request tries to get a new memory block and there is an error indicating that a block was not available.

COMM REQUEST – Logged when a reverse interrupt handshake response is received after transmitting data.

DATA RESP DIE IN XMIT – Logged when receiving data; a time-out occurred waiting for another character (first DLE to last CRC character)

SEPAC COMM ERROR – Logged when an unexpected handshake response (not NAK, 0, NULL) after the local select or unexpected character following a DLE (not SOH, STX, ETX, ETB, DLE, ENQ) when receiving data.

EARLY DATA EOT – Logged when looking for control characters in non-transparent mode and the EOT character comes when NO previously defined control state (SOH, STX, ETX, ETB) has been found.

MSTR DOES NOT RESPOND – Logged on the following:

Initial message is neither a select nor a poll (assumed to be a broadcast).

Handshake response time-out after the local select.

Waiting for a data block and the first character was ENQ.

Not selected and there is a time-out waiting for the repeated poll request.

MSTR HAS RECEIVE PROB – Logged on the following:

An EOT comes in a SOH, STX, or ETB control state and there is no existing ERROR condition.

Exceeded maximum retries (3) transmitting data because of time-out, garbled, NAK, or WACK handshake response.

Exceeded maximum retries (3) transmitting data during the handshake under the following conditions:

♦ The handshake response was 0 or 1 and that response was the correct handshake.

♦ The block just sent was not the last block in a multiple block ETB process.

♦ There was an error (time-out) while waiting to be provided the next block. Time-out sends ENQ until the number of retries has been exceeded.

MID XMIT STOPPED – Denotes that the receiving station has sent the character sequence (EOT) that stops the sending station wherever it is in its transmission.

MODEM TIMEOUT – Denotes that the SEPAC has control of the communications line but has not transmitted a character for 0.1 seconds. Additionally, the Port 3 ACIA has its RTS turned off and the transmitter interrupts disabled.

RECEIVE CRC ERROR – Denotes that the CRC for the message just received was incorrect.

UNDEFINED COMM ERROR – Denotes the CU cannot find a valid error number to report in the communications log.

4 Diagnostics

A CU with SEPAC software provides resident diagnostic capabilities, some automatic and some user-initiated describing its own internal state. It does not require internal access or changes to the CU to initiate the diagnostic routines.

4.1 Automatic Diagnostics

The CU performs diagnostics automatically (for example, without operator request) to verify essential elements are operating properly and take the action defined in this chapter based on those diagnostics.

The CU automatically and continually performs self-checking diagnostics of memory and processor operation.

The automatic diagnostics perform an orderly search and testing of internal logic. The diagnostics evaluation is displayed in messages on the CU front panel display as an operator interface.

The automatic diagnostics capabilities provided are described in the sections that follow.

4.1.1   On Power Up

The CU contains provisions to verify whether essential elements are operational on power up. When a fault is detected, an appropriate message is displayed, and the CU maintains the start-up flash state.

4.1.1.1   Memory

The CU contains provisions to verify all memory elements on power up. For a unit to exit the power up diagnostics and begin running traffic, all tests must be passed.

The following memory diagnostics are performed:

> EEPROM diagnostic – This diagnostic performs a check on EEPROM and makes a comparison with the stored value.
>
> The following EEPROM power up diagnostic messages will be displayed to indicate the results of the test.
>
> ♦ EEPROM ......: Passed
>
> This message indicates that no faults were found.
>
> ♦ EEPROM ......: Checksum is invalid -> WAIT
>
> This message indicates a fault. The CU will initialize the EEPROM then cause the following display to appear:

```
EEPROM Initialization Complete!!!
PRESS A KEY OR CYCLE POWER TO CONTINUE.
```

Figure 4-1. EEPROM Initialization Complete

A local alarm log entry EEPROM CRC INITIALIZE showing date and time will occur when default parameters are loaded into EEPROM following an EEPROM CRC diagnostic error.

A local alarm log entry EEPROM INIT - KEYPAD showing date and time will occur when default parameters were loaded into EEPROM based on the LOAD DEFAULT keypad command.

> PROM diagnostic – This diagnostic verifies that the OS PROM contains the proper program. The routine performs a check on PROM and makes a comparison with the stored value.
>
> The following EPROM power up diagnostic messages will be displayed to indicate the results of the test.
>
> ♦ EPROM ....: TESTING
>
> This message indicates the EPROM test is in progress.
>
> ♦ EPROM ....: Passed
>
> This message indicates that no faults were found.

When the power up PROM diagnostics detects the PROM CRC is not the one that was running but is the same revision number, the message shown in Figure 2-1 is displayed.

```
WARNING...PROM CRC IS INVALID!

  UNIT OPERATION WITH THIS PROM SET IS
NOT RECOMMENDED. CONTINUE OPERATION IN
A TEST ENVIRONMENT ONLY.

- PRESS "E" TO LOAD DEFAULT & CONTINUE
```

Figure 4-2. Operation Not Recommended Message

After the user presses the E key, the message "Initializing EEPROM. PLEASE WAIT" appears. When the initializing task is complete, the message "EEPROM Initialization Complete! Press a key or cycle power to continue" will display.

When the power-up PROM diagnostics detects the PROM CRC is not the one that was running but is an older revision number that may or may not be compatible or when the PROM CRC is not the one that was running but is an new revision number that is not compatible, the message shown in Figure 4-3 appears.

```
CAUTION...INCOMPATIBLE PROM & EEPROM!
     PROM:  2.10    EEPROM:  1.80

  UNIT OPERATION REQUIRES THAT EEPROM
INITIALIZATION OCCUR. THIS WILL DELETE
ALL CURRENT OPERATING DATA.

- PRESS "E" TO LOAD DEFAULT & CONTINUE
```

Figure 4-3. Initialization Required Message

A Local Alarm log entry INVALID PROM RESTART showing date and time will occur when default parameters are loaded based on keypad commands from the INVALID PROM display.

A Local Alarm log entry INCOMPAT MEM RESTART showing date and time will occur when default parameters are loaded based on keypad commands from the INCOMPATIBLE PROM & EEPROM display.

4.1.1.2   Invalid Configuration Data

Yunex Traffic SEPAC software evaluates the configuration data to the software option running. When a mismatch occurs, the warning shown in Figure 4-4 appears.

```
          ....WARNING....
CONFIGURATION DATA IN MODULE CFGDATA
 IS NOT COMPATIBLE WITH THE CURRENT
 SOFTWARE VERSION THAT IS STARTING UP.
THE USER MUST MAKE A SOFTWARE OPTION
 CHOICE. DEFAULT DATA WILL BE PROVIDED.

    - PRESS "E" TO CONTINUE
```

Figure 4-4. Configuration Incompatibility Message

When the user presses the E key the Load Default Parameters display (Figure 4-5) appears.

```
LOAD DEFAULT PARAMETERS


   CURRENT SOFTWARE OPTION: NOT SET


PREV/NEXT TO CYCLE          E-LOAD DEFAULT
```

Figure 4-5. Load Default Parameters Display

When a selection has been made from the Load Default Parameters display (Figure 4-5), the Initializing Cfgdata display (Figure 4-6) appears.

```
Initializing Cfgdata
         ** PLEASE WAIT **
Cfgdata Initialization Complete !!!
Press a key or cycle power to continue
```

Figure 4-6. Initializing Cfgdata Message

Pressing a key when Figure 4-6 is displayed will result in a restart followed by the Main Menu (Figure 2-1).

4.1.2   During Normal Operation

These diagnostic routines verify whether essential elements are operational while the CU is running. When a fault is found, it is logged in the Local Alarm log and the CU will initiate and maintain flashing operation.

4.1.2.1   Memory

The CU continues to verify ROM and EEPROM during normal operation at a minimum rate of 1024 bytes per second. When a fault is detected, the CU initiates and maintains the start-up flash state.

EEPROM diagnostic

- ♦ A diagnostic to verify that the EEPROM contains data, and that data has not changed since the last write. The routine performs a check on EEPROM and makes a comparison with a preprogrammed value.

  When the diagnostic fails, a Local Alarm log entry "DIAG: EEPROM CRC ERROR" showing date and time will occur and the CU initiates flashing operation (fault monitor and voltage monitor output inactive and load switch driver red output flashing).

- ♦ A diagnostic to determine when EEPROM writes have been unsuccessful.

  When the diagnostic fails, a Local Alarm log entry "EEPROM WRITE FAILURE" showing date and time will occur and the CU will initiate flashing operation (fault monitor and voltage monitor output inactive and load switch driver red output flashing). The EEPROM must be replaced.

PROM diagnostic – This test verifies that the OS PROM contains the proper program. The routine performs a check on PROM and makes a comparison with the stored value.

When the diagnostic fails, a Local Alarm log entry DIAG: EPROM CRC ERROR showing date and time will occur and the CU initiates flashing operation (see Chapter 3, Section 3.7.1.1).

RAM (EEPROM Image) update – This routine compares the EEPROM image RAM with EEPROM and copies the EEPROM data into this RAM when the comparison is not equal.

4.1.2.2   Main Processor

System faults that are trapped by the running diagnostics are logged in the Local Alarm report showing date and time following a system fault. An automatic restart to the startup flash timing/state will occur until more than two system faults have occurred in a single calendar day at which time a PRESS ANY KEY message will appear on the front panel. System faults are listed below (all begin with **** ERROR:).

*** ERROR: BUS FAULT – The processor attempted to access memory that does not exist.

*** ERROR: ADDRESS FAULT – The processor attempted to access a word or an inappropriate instruction at an odd address.

*** ERROR: INVALID OPCODE – The processor encountered an invalid instruction.

*** ERROR: DIVIDE BY ZERO – The processor encountered an instruction to divide by zero.

*** ERROR: SYSTEM FAULT – Miscellaneous processor faults.

*** ERROR: FALSE INTERRUPT – The processor receives a bus fault during interrupt processing.

*** ERROR: INVALID TRAP – The processor encounters an invalid software interrupt instruction.

*** ERROR: UNSPECIFIED – Processor faults not defined elsewhere.

*** ERROR: RAM TEST FAILED – The power up RAM read/write test failed.

*** ERROR: VRTX FAULT – A VRTX operating system error.

4.1.2.3   SDLC Processor

The CU contains provisions to verify that the SDLC processor is present and working on power up.

During normal operation, an SDLC .1 SEC DLY FAULT is logged in the Local Alarm log and the controller is put in TS-2 DIAG FLASH when more than five of the most recent 10 TS-2 SDLC responses are not received correctly. An SDLC .1 SEC DLY FAIL is logged to the Local Alarm log when an SDLC .1 SEC DLY FAULT recurs three times in a row. The controller is then put in TS2 DIAG FLSH – NO XIT.

4.1.2.4   Processor Monitor

The CU contains provisions to monitor the operation of the microprocessor. The monitor receives signals, at least one time every 100 milliseconds from the microprocessor. When the signal is not received for 600 milliseconds, the processor monitor initiates flashing operation (fault monitor and voltage monitor output inactive).

When a processor monitor (watchdog) time out occurs, after a restart the front panel display will be the Main Menu (Figure 2-1) with the bottom line showing ** WATCHDOG TIMEOUT **. This display will remain until a key is pressed.

A Local Alarm log entry WATCHDOG TIMEOUT showing date and time will occur concurrent with the above display.

The watchdog restart is a special feature of the CU that recognizes failures in the unit and puts the controller in startup sequence automatically, eliminating the need to manually reset the controller. Start-up flash allows the user to set a transitional flash time that occurs before the initialization condition following a power interruption and watchdog restart.

CAUTION: If the start-up time is set to 00 seconds and the watchdog puts the unit in the start-up sequence due to a failure in the unit, the intersection will go directly to the initialization condition with no transitional flash time prior to the change.

See Chapter 3, Section 3.7.1.1 for details on what happens when more than two watchdog restarts have occurred in a single calendar day.

4.1.2.5   Port 1

When AC power is present and the Port 1 disable input is not true, the CU will transmit command frames and expect response frames in accordance with NEMA TS 2.

The CU will log response frame faults in the Local Alarm report (see Chapter 3, Section 3.12.3 for details on this report). Each logged event shows the date, time, and response frame number.

4.1.2.5.1   MMU Compatibility Programming

When Port 1 Address 16 MMU is programmed as present, the CU will transmit Command Frame 3 and expect Response Frame 131 as a reply.

A FRAME 131 fault is logged in the Local Alarm log when more than five out of the most recent ten Response Frame 131 transfers are not received properly.

The CU provides an MMU utilization diagnostic that verifies the MMU program card channel compatibility to the CU load switch utilization (phase sequence). An MMU UTILIZATION CNFLCT is logged in the Local Alarm log when this verification is not satisfactory.

In the MMU utilization diagnostic (MMU program card to CU channel compatibility evaluation) relies on MMU compatibility being based on physical traffic movement limitations while the CU compatibility is based on logical traffic movement limitations.

In the MMU utilization diagnostic, the CU sequence may be more restrictive than MMU programming would imply. The reason for this is that the CU may prohibit physically compatible phases from receiving simultaneous service (based on desired operation) with no impact on safe operation. The MMU can permit phase interactions that the CU cannot provide but the CU is not allowed to provide phase interactions that the MMU will not permit.

The MMU utilization diagnostic (comparison of the MMU program card channel compatibility and the CU calculated channel compatibility) is processed in the following manner:

> There is no error when the CU and MMU agree on compatibility or incompatibility of two channels.
>
> There is no error when the CU and MMU disagree on compatibility or incompatibility of two channels where the MMU indicates compatibility.
>
> There is no error when the CU and MMU disagree on compatibility or incompatibility of two channels, but the channel is unused.

Channel is unused is true when:

> No control is assigned to the channel.
>
> Phase initialization equals 0 for the phase control (vehicle or pedestrian) assigned to the channel.
>
> Walk and pedestrian clear equal 0 for the phase pedestrian assigned to the channel.
>
> All the overlap phases equal 0 for the overlap assigned to the channel.
>
> Phase initialization equals 0 for all overlap phases of the overlap assigned to the channel.

♦ There is an error when the CU and MMU disagree on compatibility or incompatibility of two channels where the MMU indicates incompatibility.

The CU will not exit start-up flash if the MMU utilization diagnostic indicates an error, or a response frame fault occurs.

Otherwise, when the MMU utilization diagnostic indicates an error status or a response frame fault occurs, the CU initiates flashing operation (fault monitor and voltage monitor output inactive and load switch driver red output flashing).

4.1.2.5.2   MMU Field Status

When Port 1 Address 16 MMU is programmed as present, the CU will transmit Command Frame 1 and expect Response Frame 129 as a reply.

A FRAME 129 FAULT is logged in the Local Alarm log when more than five out of the most recent ten Response Frame 129 transfers are not received properly.

The CU evaluates the response frame with the MMU channel to determine if incompatible channels are active.

When the above conditions have been true for ten consecutive Response Frame 129 transfers and the response frame indicates the MMU has not transferred to the failed state or a Response Frame 129 Fault occurs, the CU initiates flashing operation (fault monitor and voltage monitor output inactive and load switch driver red output flashing) and an MMU UNDETECTED CNFLCT is logged in the Local Alarm log when this verification is not satisfactory.

4.1.2.5.3   Signal Control Output Status

When Port 1 Address 16 MMU is programmed as present, The CU will transmit Command Frame 0 and expect Response Frame 128 as a reply.

A FRAME 128 FAULT is logged in the Local Alarm log when more than five out of the most recent ten Response Frame 128 transfers are not received properly.

When this frame fault occurs, the CU initiates flashing operation (fault monitor and voltage monitor output inactive and load switch driver red output flashing).

4.1.2.5.4   Terminal and Facilities (Type 1 Controller Unit)

When Port 1 Address 0 T&F BIU #1 is programmed as present, The CU will transmit Command Frame 10 and expect Response Frame 138 as a reply.

T&F BIU # 1 being programmed as present is the flag to inform the CU that it is being used in a Type 1 terminal and facilities. The use of any other T&F BIU without T&F BIU # 1 is considered a fault and DIAG: INV. TS2-A1 CNF is logged and flashing as defined below is initiated.

When Port 1 Address 1 T&F BIU #2 is programmed as present, the CU will transmit Command Frame 11 and expect Response Frame 139 as a reply.

When Port 1 Address 2 T&F BIU #3 is programmed as present, the CU will transmit Command Frame 12 and expect Response Frame 140 as a reply.

When Port 1 Address 3 T&F BIU #4 is programmed as present, the CU will transmit Command Frame 13 and expect Response Frame 141 as a reply.

A FRAME 138 FAULT, FRAME 139 FAULT, FRAME 140 FAULT, or FRAME 141 FAULT is logged in the Local Alarm log when more than five out of the most recent ten Response Frame 138–141 transfers are not received properly. This is performed separately for each frame type.

When one of these frame faults occur, the CU initiates flashing operation (fault monitor and voltage monitor output inactive and load switch driver red output flashing).

4.1.2.5.5 Detector Racks Inputs

When Port 1 Address 8 Detector BIU #1 is programmed as present, the CU will transmit Command Frame 20 and expect Response Frame 148 as a reply.

When Port 1 Address 9 Detector BIU #2 is programmed as present, the CU will transmit Command Frame 21 and expect Response Frame 149 as a reply.

When Port 1 Address 10 Detector BIU #3 is programmed as present, the CU will transmit Command Frame 22 and expect Response Frame 150 as a reply.

When Port 1 Address 11 Detector BIU #4 (ECOM) or BIU #1 (NTCIP) is programmed as present, the CU will transmit Command Frame 23 and expect Response Frame 151 as a reply.

A FRAME 148 FAULT, FRAME 149 FAULT, FRAME 150 FAULT, or FRAME 151 FAULT is logged in the Local Alarm log when more than five out of the most recent ten Response Frame 148–151 transfers are not received properly. This is performed separately for each frame type.

When one of these frame faults occur, the CU operates as though a continuous call is present on all enabled respective detectors.

4.1.2.5.6 Detector Racks Resets

When Port 1 Address 8 Detector BIU #1 is programmed as present, the CU will transmit Command Frame 24 and expect Response Frame 152 as a reply.

When Port 1 Address 9 Detector BIU #2 (ECOM) or BIU #1 (NTCIP) is programmed as present, the CU will transmit Command Frame 25 and expect Response Frame 153 as a reply.

When Port 1 Address 10 Detector BIU #3 is programmed as present, the CU will transmit Command Frame 26 and expect Response Frame 154 as a reply.

When Port 1 Address 11 Detector BIU #4 (ECOM) or BIU #1 (NTCIP) is programmed as present, the CU will transmit Command Frame 27 and expect Response Frame 155 as a reply.

A FRAME 152 FAULT, FRAME 153 FAULT, FRAME 154 FAULT, or FRAME 155 FAULT is logged in the Local Alarm log when more than five out of the most recent ten Response Frame 152–155 transfers are not received properly. This is performed separately for each frame type.

4.1.2.5.7   Auxiliary Input/Output (Type 1 CU)

When the Port 1 Address 17 diagnostic is programmed as present, the CU will transmit Command Frame 30 and expect Response Frame 158 as a reply.

A FRAME 158 FAULT is logged in the Local Alarm log when more than five out of the most recent ten response frame transfers are not received.

4.1.2.5.8   Transfer Outputs Frame (Type A1 (and P1 in ECOM) CU)

When Port 1 Address 0 T&F BIU #1 is programmed as present, the CU will transmit Command Frame 18.

A FRAME 18 FAULT is logged in the Local Alarm log when the transfer outputs frame has not been transmitted for 500 milliseconds.

When this frame fault occurs, the CU initiates flashing operation (fault monitor output inactive and load switch driver red output flashing).

4.1.2.6   Cycling Diagnostics

The CU provides a cycling diagnostic to verify that phases with serviceable calls are receiving service in a timely manner.

The cycling diagnostic is a phase-by-phase test. For this test, the following definitions are included:

Not serviced – A phase does not go green.

Serviceable call – A phase has a call and can be serviced normally.

Serviced normally – The following conditions are true:

- ♦ The phase is active
- ♦ The phase omit is not active
- ♦ No phase hold is active
- ♦ External start is not active
- ♦ No stop time is active
- ♦ Manual control enable is not active
- ♦ Programmed flash is not active

Two cycles – When running coordinated, two times the pattern cycle length. When running non-coordinated, twice the Ring 1 phases maximum service (maximum green, yellow, and red time sum).

When the CU is operating in the coordinated mode and cycling diagnostics indicate that a serviceable call exists that has not been serviced for two cycles, the status is logged as a NO COORD - CYCLE FAULT. The CU will automatically revert to free.

When a cycle fault is in effect and the serviceable call has been serviced within two cycles after the cycle fault, the CU status is logged as a NO COORD - COORD FAULT. A coordination retry is attempted. If a cycle fault does not occur again

within two cycles, the status is logged as COORD ACTIVE, if no other failure or COORD FAULT condition exists.

When a COORD FAULT is in effect and a cycle fault occurs again within two cycles of the coordination retry, the status is logged as a NO COORD - COORD FAILURE and the CU will not attempt another coordination retry prior to entry or download of phase, unit, or coordination data or the AC power being recycled to the CU.

Cycle failure – When a CU is operating in non-coordinated mode, whether the result of a cycle fault or free being the current mode, and cycling diagnostics indicate that a serviceable call exists that has not been serviced for two cycles, the status is logged as OFF-LINE - CYCLE FAILURE. The CU automatically and immediately reverts to flash (fault monitor and voltage monitor inactive). The CU will not exit this state prior to the entry or download of phase or unit data or AC power being removed and reapplied.

4.1.2.7   Detector Diagnostics

Each active detector (vehicle, pedestrian, and special enabled by assignment) is capable of being tested by diagnostics for conformance to specified parameters. The detector diagnostics monitor activity on each active detector for constant calls, absence of calls, or erratic output.

Each actuated phase is tested to verify that a vehicle detector is assigned. If the Maximum 1 green is greater than zero and no vehicle detector is assigned to the phase, a continuous vehicle call is placed.

Vehicle and special detector inputs will be tested for conformance to the specified parameters only when operating in an appropriate input mode (inputs are detector inputs).

Any detector input not assigned to a vehicle, pedestrian, or system detector function will not be tested for conformance to the specified parameters.

Any detector input assigned a vehicle or pedestrian detector function on a phase that does not exist (ring assigned = 0 or initialization code = 0) will not be tested for conformance to the specified parameters. Should the same detector input also be assigned a system detector function, it would be tested.

Any detector input assigned to a phase programmed as non-actuated (pedestrian recall code = 3) will not be tested for conformance to the specified parameters. As in the case above, if also assigned a system detector function, it would be tested.

Any detector input assigned a pedestrian detector function on a phase with zero walk time or on a phase pedestrian that has no means of controlling load switches will not be tested for conformance to the specified parameters. As in the case above, if also assigned a system detector function, it would be tested.

An active detector is classified as on line when the results of the diagnostic procedures indicate that data from the detector is within the allowable range of values.

An active detector is classified as failed when the results of the diagnostic procedures indicate that data from the detector is not within the allowable range of values.

System detector status (on line or failed) is transmitted to the master when polled.

Each detector is monitored for constant calls, absence of calls, or erratic counts.

No activity – If an active detector does not exhibit an actuation during a program entered period (00–255 minutes in one-minute increments), it is considered a fault by the diagnostics and the detector is classified as failed. The diagnostics provide two user-programmable no activity periods (see Chapter 2, Section 2.10.3.1 for details).

Maximum presence – If an active detector exhibits continuous detection for a program entered period (00–255 minutes in one-minute increments), it is considered a fault by the diagnostics and the detector is classified as failed. The diagnostics provide two user-programmable maximum presence periods.

Erratic output – If an active detector exhibits excessive actuations (program entered maximum counts per minute 00–255 in increments of one), it is considered a fault by the diagnostics and the detector is classified as failed. The diagnostics provides two user-programmable excessive counts.

Not supported – Any assigned detector will be classified as failed if:

- BIU is enabled and Port 1 hardware is not installed
- BIU is enabled, Port 1 hardware is installed, and Port 1 is disabled
- BIU is not enabled and a hardware input is not available

Fault status – When a fault status defined in the respective Response Frame 152 to 155 is true for an active detector, it is considered a fault by the diagnostics and the detector is classified as one of the following:

- Failed – Watchdog
- Failed – Open loop
- Failed – Shorted loop
- Failed – Excess change

Indications are provided to facilitate the determination of the current diagnostic status of each detector (see Chapter 2 sections 2.2.5.5 and 2.10.3.2 for details).

The selection of the active parameter set (Value 0 or Value 1) is controlled by a TBC auxiliary event.

The CU includes a program entry for no activity, maximum presence, and erratic output for each detector. The respective diagnostic is disabled when the program entry is 00.

When a detector is classified as failed by these diagnostics, the CU operates as though a continuous call is present until such time as the detector is classified as on line.

The CU logs detector diagnostic status (for example, on line or failed) in non-volatile memory. Each logged event shows the date and time of occurrence. See Chapter 2, Section 2.11.3.

4.1.2.7.1 Diagnostic Output

The detector reset output will become active for one half of one second whenever the no activity, maximum presence, or erratic output detector diagnostics detect a new fault.

For models with a D Connector, when Auxiliary 3 is not programmed for output as a TBC auxiliary function, it will become a detector reset function.

For models using ABC I/O modes providing a detector reset output, this output will be operational.

For models using Port 1 and Detector BIUs, Frames 24 to 27 will have the respective reset bits set to active.

Whenever an Auxiliary 3 event has been programmed and it is desired to again implement the detector reset output, the clear memory function within TBC must be used to eliminate all TBC or all auxiliary events (Code 0 or Code 2).

4.1.2.7.2   Detector Fault Report

The Detector Fault report has the capacity to store a minimum of 60 events. When the events have been logged, they remain until the report capacity is exceeded, at which time the oldest event is deleted and the new one is added.

The Detector Fault Report display is shown in Figure 4-7.

```
SYSTEM - DETECTOR FAULT REPORT
  MM/DD  HH:MM   -------STATUS-------
  09/20  10:20   VEH 1 - FAIL ERR CNTS
  09/20  10:45   VEH 1 - ON LINE
  09/20  12:10   SPC 2 - FAIL MAX PRES
  09/20  12:55   SPC 2 - ON LINE
  09/21  03:15   SPC 3 - FAIL NO ACTY
```

Figure 4-7. Detector Fault Report Display

Status messages that can be displayed on this report include the following:

  VEH # - ON LINE – The detector is operating within the parameters established for diagnostic faults.

  VEH # - FAIL MAX PRES – The detector failed the Maximum Presence diagnostic.

  VEH # - FAIL NO ACTY – The detector failed the No Activity diagnostic.

  VEH # - FAIL ERR CNTS – The detector failed the Erratic Counts diagnostic.

  VEH # - FAIL SUPPORT – There is no hardware or external detection online to support the detector. Common causes are:

  1) The detector is outside the range of the FIO

  2) The FIO has been set to the wrong I/O mode, inadvertently causing #1

  3) The BIU for the detector is not installed or has failed

  4) External detection (camera or Sensys) not correctly setup to control the detector

  VEH # - FAIL BIU FAULT – A response frame fault occurred for the detector BIU.

  VEH # - FAIL DET WDOG – The detector BIU channel status input for the detector is OFF. This may indicate the following:

  ♦ The detector is not a TS 2 detector

  ♦ The detector failure occurred

  ♦ A detector watchdog time out occurred

♦ An external detection source has stopped reporting that is assigned to the detector

VEH # - FAIL OPEN LOOP – The detector reported an open loop fault to the detector BIU.

VEH # - FAIL SHRT LOOP – The detector reported a shorted loop fault to the detector BIU.

VEH # - FAIL XS CHANGE – The detector reported an excessive inductance change fault to the detector BIU.

The number in the report entry will be the detector number as applicable. The VEH in the report entry will be SPC when the entry applies to a special detector input or PED when the entry applies to a pedestrian detector input.

4.2 Operator-Initiated Diagnostics

The CU performs diagnostics enabling operator verification of properly operating inputs, outputs, keypad, and display.

The operator-initiated diagnostics are performed only after an operator request through the CU keypad. The CU automatically and immediately reverts to flash (fault monitor and voltage monitor inactive) during this diagnostic. The diagnostics evaluation is displayed on the CU front panel display or on a controller test set as an operator interface.

This diagnostic is not intended for use while the CU is in control of intersection operation.

The operator-initiated diagnostics capabilities provided are detailed in the following sections.

See Chapter 2, section 2.3.5 for more information on diagnostics.

4.2.1   Memory

These test routines verify that essential elements are functioning normally. If a fault is found an appropriate error message is displayed.

ROM diagnostic – This test verifies that the ROMs contain the proper program. The routine performs a CRC on each ROM and makes a comparison with a pre-programmed value.

RAM diagnostic – This test verifies that all RAM elements are operating correctly. A value is automatically written to a RAM location and this location is read to verify that it contains the value.

Diagnostic error messages:

1a. ROM TEST - TESTING

1b. ROM TEST - PASSED

1c. ROM TEST - FAILED

2a. EEPROM TEST - TESTING

2b. EEPROM TEST - PASSED

2c. EEPROM TEST - FAILED

3a. RAM TEST - TESTING

3b. RAM TEST - PASSED

3c. RAM TEST - FAILED

4.2.2 Inputs

The CU provides test routines to enable operator verification that input functions are proper. This test determines whether the input buffers are operating correctly. The user must activate each input. The routine identifies each input by an indication on the front panel. The user must observe the front panel display and determine correct operation.

4.2.3 Outputs

The CU provides test routines to enable operator verification that output functions are proper. This test determines whether the output drivers are operating correctly. Each output is actuated in a fixed sequence. The user must observe the output sequence and determine correct operation.

4.2.4 Integral Display

The CU provides test routines to enable operator verification that display functions are proper. This test determines whether front panel drivers and decoders are operating properly. All the characters in the available character set are displayed. The user must observe the front panel display and determine correct operation.

4.2.5 Integral Keypad

The CU provides test routines to enable operator verification that keypad functions are proper. This test determines whether the keypad is operating correctly. The operator must press each of the keypad keys. The display indicates the key pressed. The user must observe the front panel display and determine correct operation.

4.2.6 User-Initiated Diagnostics Procedure

The user-initiated diagnostics procedure is as follows:

1. Connect the CU to a NEMA test set.

2. Turn ON power to the CU.

3. Make sure all logic inputs are inactive.

4. Gain access.

5. Verify output sequence.

6. Activate any logic input.

7. Verify inputs as you activate each.

8. Verify keypad as you press the key.

4.3 Other Diagnostics

The CU performs additional diagnostics to verify and display events and status. The other diagnostics capabilities provided are discussed in the following sections.

4.3.1   Power Failure

When the AC power is lost for 100 ms, the processor goes into a wait mode. If AC power is restored within approximately 500 ms, the user program commences running as though there were no interruption. If AC power does not return, however, both processors are reset by the hardware time-out.

When the AC power is lost for 50 ms, an alarm entry, POWER OFF, showing date and time will occur.

When the AC power returns, after a power down of longer than 550 ms, an alarm entry POWER ON showing date and time will occur.

4.4 Data Entry Error Messages

Error messages from the data entry evaluation diagnostic routines will be presented on the front panel. The message will remain until specific user action has been completed.

Diagnostic error messages include the following:

```
OUT OF RANGE       - PRESS "E" TO RETURN

PHASE CONCURRENT   - PRESS "E" TO RETURN

PHASE INACTIVE     - PRESS "E" TO RETURN

TOO MANY CONCURRENT PHASES

RING DOES NOT TERMINATE PROPERLY

PHASE ORDER JUMPS RINGS

PHASE 9 NOT IN RING ONE - "E" TO RETURN

PHASE 9 NOT IN RING ONE

RING ONE MISSING

RING TWO MISSING

RING THREE MISSING

CONFLICT TABLE INCONSISTENT

A PHASE NOT COMPATIBLE WITH RING ONE

NO PHASE COMPATIBLE WITH RING ONE

RINGS INCONSISTENT

PHASES IN THE SAME RING CONCURRENT

NINE CONFLICTS    - PRESS "E" TO RETURN

OUTPUTS ALREADY ASSIGNED

INVALID PHASE PAIR- PRESS "E" TO RETURN

PHASE NONEXISTANT - PRESS "E" TO RETURN

NOT IN SAME RING  - PRESS "E" TO RETURN
```

```
ALTS INCOMPATIBLE - PRESS "E" TO RETURN
PHASE NOT IN RING - PRESS "E" TO RETURN
PHASE INCOMPATIBLE PRESS "E" TO RETURN
INVALID EXIT PHASE- PRESS "E" TO RETURN
INVALID DATA FIELD- PRESS "E" TO RETURN
ACCESS REQUIRED   - PRESS "E" TO RETURN
PRINTER UNAVAILABLE PRESS "E" TO RETURN
CABLE DISCONNECTED- PRESS "E" TO RETURN
CABLE LOSS- DEFAULT LOADED "E" TO RETURN
SEPAC NOT AVAILABLE- PRESS "E" TO RETURN
SEPAC ERROR DEFAULT LOADED "E" TO RETURN
DATA LOSS- DEFAULT LOADED "E" TO RETURN
UNIT TRANSFER ERROR PRESS "E" TO RETURN
BEG MON MUST BE < END MON "E" TO RETURN
Beg MON MUST BE < END MON "E" TO RETURN
NO "FROM" PROGRAM DAY     "E" TO RETURN
CAN'T EQUATE "FROM" DAY   "E" TO RETURN
CAN'T TRANSFER "FROM" DAY "E" TO RETURN
NO EQUATE-TRANSFER CODE   "E" TO RETURN
MAXIMUM EQUATES EXIST     "E" TO RETURN
NO CONCURRENT 1ST RING PHASE - PRESS "E"
I/O MODE OVERRIDES- PRESS "E" TO RETURN
PORT 1 DISABLED - PRESS "E" TO RETURN
```

5 Flashing Yellow Arrow

The FYA display consists of four arrow lenses in a signal head that is used exclusively for turning traffic and is separate from any heads containing ball indications for through traffic. A typical vertical left turn signal would look like what is shown in Figure 2-1.
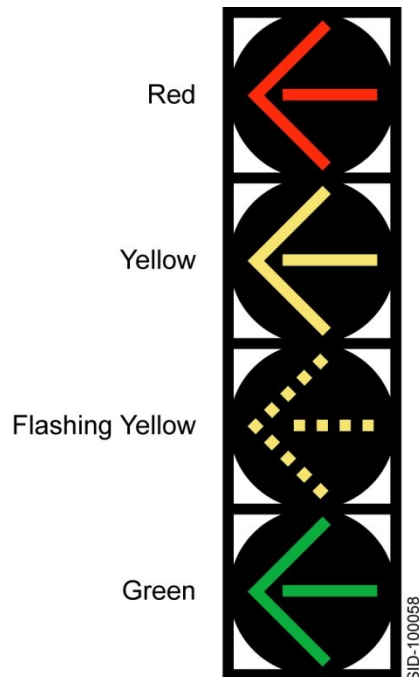
Figure 5-1. Typical Vertical Left Turn Signal

5.1 FYA Overview

Flashing yellow arrow operation uses four signal lenses:

RED steady arrow – Associated overlap red provides RED for FYA operation.

YELLOW steady arrow – Associated overlap yellow provides yellow clearance prior to red for FYA operation.

YELLOW flashing arrow – Associated overlap green that is flashing. Provides permissive right of way indication for FYA operation. Internal logic in the traffic software suppresses the associated overlap flashing green output when the protected portion (green arrow) of the display sequence is serviced.

GREEN steady arrow – Protected phase green provides protected right of way indication for FYA operation.

A consistent set of preempt programming entries must be provided for the protected movements and permissive movements and the associated overlap. The overlap yellow and red are an integral part of the FYA protected and permissive display and its transitions.

By default, SEPAC supports NEMA FYA configurations B and G.

5.2 FYA Sequence

In Yunex Traffic SEPAC software, the overlap operation provides the in-cycle flashing green output to drive the FYA section.

Table **5**-**1** represents the sequence when Phase 1 is the protected phase and Phase 2 is the permissive phase.

LDSW Output Used	Phs 1 RoW	Clear To				Phs 2 RoW	Clear To			
		Phs 2		Not Phs 2			Not Phs 2		Phs 1	
		Yel	Red	Yel	Red		Yel	Red	Yel	Red
OLA Red	-	-	R	-	R	-	-	R	-	-
OLA Yel	-	Y	-	Y	-	-	Y	-	-	-
OLA Grn	-	-	-	-	-	FG	-	-	FG	FG
Phs 1 Grn	G	-	-	-	-	-	-	-	-	-

Table 5-1. Sequence Chart

NOTE: The phase numbers in the above table are for example only. The protected and permissive phases for each overlap are user programmable.

Phase 1 Yellow and Phase 1 Red LDSW outputs are available but NOT used for this sequence.

5.3 Configuring FYA

To enable a flashing yellow arrow overlap, press **E** while on an FYA overlap from the Overlap Data menu (Figure 2-146).

```
FYA OVERLAP – A          DELAY/10:  50
        PHASES..12345678 90123456
  PERM PHASES: 01000000 00000000
  PROT PHASES: 10000000 00000000
 -PED PHASES: 00000000 00000000
     OVERLAPS..ABCDEFGH IJKLMNOP
PERM OVERLAPS: x0000000 00000000
PROT OVERLAPS: x0000000 00000000
```

Figure 5-2. FYA Overlap Display

NOTE: In this example, Overlap A is used to generate the protected/permissive sequence.

This display allows the user to configure permissive phases and overlaps, protected phases and overlaps, and a delay to begin the permissive flashing yellow indication.

When more than one permissive movement (phase or overlap) is programmed, the permissive interval (defined in Table **5**-**1** as Phs 2 RoW) will NOT begin until *all* permissive movements are green. A likely alternate for the example shown in Figure 5-2 would be to program both Phase 2 and Phase 6 as the permissive phases. Permissive phases should be enabled to operate concurrently.

When more than one protected movement (phase or overlap) is programmed, the protected interval (defined in Table **5**-**1** as Phs 1 RoW) will begin at the beginning of *each* protected movement.

When only one permissive movement is programmed, the protected and permissive movements must be in the same ring to be considered valid. The same rule would apply in the case of PERM/PROT overlaps, it would apply to the overlap's parents.

5.3.1   Supported Configurations

In Full Function Mode, NEMA FYA configuration B is normally recommended. The protected phase red and yellow outputs are not used and are typically dummied off.

For a compact operation, configuration G is typical. In this case, the FYA overlap Red and Yellow are mapped to the protected phase load switch, leaving only the protected Green in place. The overlap Flashing Arrow is mapped to the appropriate Ped Clear (Yellow)

Other configurations are also supported but require more extensive output mapping, including both interior and exterior turns for Texas Diamond Mode.

5.4 Preemption

Because FYA operation has defined a new green state for load switches (Permissive = Flashing Green output to drive the FYA), preempt dwell intervals require the ability to use this state. Figure 5-3 and Figure 5-4 show the Yunex Traffic SEPAC actuated signal control software screens for this capability.

From the Preempt 1 menu (Figure 2-211) select **3-VEHICLE STATUS**.

Figure 5-3 shows Phase 2 using the green output for the DWELL setting.

```
PREEMPT 1 VEHICLE STATUS
PHASE....1.2.3.4.5.6.7.8.9.0.1.2.3.4.5.6
 TRK GRN 0 0 0 0 0 0 0 0 4 4 4 4 4 4 4 4
 DWELL   0 1 0 0 0 0 0 0 4 4 4 4 4 4 4 4
 (0-RED.1-GRN.2-FLR.3-FLY.4-DARK.5-FLG)
 CYCLE   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
    (0-NO..1-ACT..2-MN REC..3-MX REC)
```

Figure 5-3. Preempt 1 Vehicle Status Display

From the Preempt 1 menu (Figure 2-211) select **5-OVERLAP STATUS**.

Figure 5-4 shows Overlap A using the flashing green output for the DWELL setting.

```
PREEMPT 1 OVERLAP STATUS
OVERLAP..A.B.C.D.E.F.G.H.I.J.K.L.M.N.O.P
 TRK GRN 0 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
 DWELL   5 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
 CYCLE   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
(0-R.1-G.2-FR.3-FY.4-DK.5-FG|0-NO.1-ACT)
 TRAIL   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

Figure 5-4. Preempt 1 Overlap Status Display

The default flashing rate is 60 flashes/minute (1 flash per second with a 50 percent duty cycle).

The preempt transitions for the permissive green state are the same as the normal green state.

Flashing green in preempt has no direct connection with the FYA protected/permissive operation. For example, they are independently implemented but, for those that require the protected/permissive operation, mutually supportive.

> **NOTE: An alternate flash rate (150 fpm) for the flashing green is controlled by the data entry under the special function mapping controls titled OLI-P FL G PHS/FAST FLASH. If no data entry is made on that line, the default flash rate is provided (60 fpm). If data is entered on that line, the alternate flash rate is provided (150 fpm). This flashing green rate is universally applied to all flashing greens in the controller, both for phases and for overlaps.**

5.4.1   Track Intervals

If the protected phase green is provided, the associated overlap must be set to FLASHING GREEN (5) to have proper clearances.

If the permissive phase is provided and the associated overlap is to display the flashing yellow arrow at that time, set the associated overlap to FLASHING GREEN (5). If the associated overlap is to display red arrow at that time, set the associated overlap to RED (0).

5.4.2   Hold/Dwell Intervals without Cycling Operation

See rules for Track Intervals in 5.4.1.

5.4.3   Hold/Dwell Intervals with Cycling Operation

Set the Associated Overlap to RED (0).

If the protected green phase is available during cycling, the associated overlap must be set to 1-ACT to have proper clearances. If the permissive phase is also available during cycling, the flashing yellow arrow display will appear and cannot be blocked out.

If the permissive phase is available during cycling and the protected phase is not available during cycling, to provide the flashing yellow arrow display at that time, set the associated

overlap to 1-ACT. If the FYA signal is to display red arrow at that time, set the associated overlap to 0-NO.

6 In Cycle Flashing Signals

6.1 Flashing Red

Overlap red control to cause same to flash at a rate of 60 fpm during the green, yellow, and red timing of user-entered phase(s). One phase may be set as the flashing control. No more than eight flashing overlaps are allowed.

The first step to implementing flashing red operation is to enable the time base function mapping option.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
SPEC FUNCTION 1        10000000 00000000
SPEC FUNCTION 2        01000000 00000000
SPEC FUNCTION 3        00100000 00000000

 UP/DOWN TO SCROLL
```

Figure 6-1. Time Base Function Mapping Display

Scroll up the display until you get to the OLI-P R PHS Special Function.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
AS8-15=OLI-P FL G 150f 00000000 00000000
AS8-15=OLI-P FL R PHS  00000000 00000000
RESERVED               00000000 00000000

 UP/DOWN TO SCROLL
```

Figure 6-2. Time Base Function Mapping Display – Special Function

The entry of 1 in any SPC FUNCTION column denotes that overlap minus green/yellow control will be used to generate flashing red operation on Overlap I through P.

The next step is to program an Overlap Included phases and the flashing red phase desired.

In this example, Overlap I will be programmed.

```
OVERLAP - I       12345678 90123456
        PARENTS: 10000000 00000000
   +GRN PHASES: 00000000 00000000
   -G/Y PHASES: 01000000 00000000
   -PED PHASES: 00000000 00000000
```

Figure 6-3. Overlap - I Display

```
The above entries denote that Overlap I
will flash red during the timing of Phase
2 green, yellow, and red clear. The
operation will provide flashing red only
on overlaps that are currently red. For
this reason Overlap I should NTRAIL GREEN
STANDARD:   0  YEL/10:  40
 TRAIL GREEN  PREEMPT:   0  RED/10:  20
```

OT have Phase 2 as included phases.

In this example, there is a protected turn during Phase 1 and a permissive turn during Phase 2 (flashing red).

6.2 Fast Flashing Green

Overlap green control will cause green to flash at a rate of 100 or 150 fpm during user-entered phase green. One Phase may be set as the flashing control. There can be no more than eight flashing overlaps.

The first step to implementing fast flashing green operation is to enable the time base function mapping option.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
SPEC FUNCTION 1        00000000 00000000
SPEC FUNCTION 2        01000000 00000000
SPEC FUNCTION 3        00100000 00000000

 UP/DOWN TO SCROLL
```

Figure 6-4. Time Base Function Mapping Display

Scroll up the display until you get to the OLI-P FL G 100f or OLI-P FL G 150f Special Function.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
AS8-15=OLI-P FL G 150f 10000000 00000000
AS8-15=OLI-P FL R PHS  00000000 00000000
RESERVED               00000000 00000000

 UP/DOWN TO SCROLL
```

Figure 6-5. Time Base Function Mapping Display – Special Function

The entry of 1 in any SPC FUNCTION column denotes that overlap minus green/yellow control will be used to generate fast flashing green operation on Overlap I through P.

The next step is to program Overlap Included phases and the flashing green phase desired.

In this example, program Overlap I will be programmed.

```
OVERLAP - I
        PHASES: 12345678 90123456
       OVL PHS: 11000000 00000000
      +GRN PHS: 00000000 00000000
      -G/Y PHS: 10000000 00000000
      -PED PHS: 00000000 00000000
 TRAIL GREEN STANDARD:   0  YEL/10:  40
 TRAIL GREEN  PREEMPT:   0  RED/10:  20
```

Figure 6-6. Overlap - I Display (1 of 2)

The entries shown in Figure 6-6 denote that Overlap I will fast flash green during Phase 1 green. The operation provides fast flashing green only on overlaps that are currently green. For this reason, Overlap I should have Phase 1 and 2 as included phases.

In this example, we have a protected turn (fast flashing green) during Phase 1 and a permissive turn during Phase 2.

7 Adaptive Maximum

7.1 Operation

The CU provides an optional feature that provides a phase-by-phase adaptive maximum operation based on vehicle demand.

The CU provides a user entry of dynamic maximum (0–255 seconds) and dynamic step (0–25.5 seconds).

When the adaptive maximum operation is enabled (dynamic maximum greater than 0), the CU sets the phase adaptive maximum value equal to the normal maximum (Max 1, Max 2) for each phase.

After a phase exceeds its maximum two times in a row and on each successive maximum out thereafter, one step value will be added to the adaptive maximum until such addition would mean the adaptive maximum was greater than the larger of the normal maximum or the dynamic maximum.

After a phase gaps out two times in a row and on each successive gap out thereafter, one maximum step value will be subtracted from the adaptive maximum until such subtraction would mean the adaptive maximum was less than the smaller of the normal maximum or the dynamic maximum.

If the phase gaps out in one cycle and maxes out the next cycle or vice versa, the adaptive maximum will not change.

When a phase has not received service for a period equal to two times the Ring 1 sum of the larger of the normal maximum or dynamic maximum for each phase, the CU operates as though the phase has gapped out twice in a row. Subsequently and until such time as the phase receives service, the CU operates as though a gap out occurred every 60 seconds.

Maximum recall will disable adaptive maximum green operation on a phase.

A failed detector will disable adaptive maximum green operation on a phase.

For the cycle fail diagnostic, when running non-coordinated, two cycles equals two times the sum of the larger of the normal max (Max 1, Max 2) or the dynamic maximum for Ring 1 phases.

When force off terminates a phase, the CU will not consider it a max out or gap out in the adaptive maximum operation.

When interval advance terminates a phase, the CU will not consider it a maximum out or gap out in the adaptive maximum operation.

When a phase is conditional serviced, the CU will not consider it a maximum out or gap out in the adaptive maximum operation.

The dynamic maximum values are functional with pattern maximum parameters.

The dynamic maximum values are enabled by time base or system interface events via Phase Banks.

7.2 Implementation

To implement adaptive maximum operation, first enter the step and dynamic maximum values for the desired phases. Remember, phases with a dynamic maximum of 0 do not have adaptive maximum enabled and will run normal maximum operation.

From the Vehicle Data Menu (Figure 2-106) press **2-DYNAMIC MAX+**.

```
PHASE......1...2...3...4...5...6...7...8
DMAX       0  80   0  80   0  80   0  80
DSTP/10    0  50   0  50   0  50   0  50



                                    [1]
```

Figure 7-1. Dynamic Max Display

The above entries denote that Phases 2, 4, 6, and 8 will have adaptive maximum enabled with step values of five seconds and dynamic maximum values of 80 seconds.

Phases 1,3,5, and 7 will not have adaptive maximum enabled.

8 Adaptive Protected/Permissive

8.1 Operation

The CU provides an optional adaptive protected/permissive operation. This control measures the volume of turn vehicle traffic and available gap windows in the opposing through vehicle traffic to determine whether the turn should operate protected or permissive.

The user set variables are:

> Minimum Turn Volume – The minimum volume on the turn detector necessary to consider running protected operation (0–999 VPH).

> Minimum Vehicle Gap – The minimum gap between opposing through detector calls during the opposing through green needed to accommodate a permissive turn vehicle. When this variable is 0, the routine will use a value of ten seconds to prevent operation without parameters (0–999 seconds).

> Gap Percentage – The percentage of through gap windows that will be used by turning vehicles (0–999 percent).

> Maximum Constant Call – The maximum time a constant call on the turn detector can exist before this routine will discontinue calling for permissive operation (0–999 minutes).

The fixed variables are:

> Smooth Averaging Time – The period over which measured variables are smoothed (five minutes).

The measured variables are:

> Smoothed Turn Volume – The calculated volume of turn detector calls based on a rolling average for the smooth averaging time.

> Smoothed Gap Windows – The calculated number of through detector gap windows during the through green sufficient to allow permissive turn vehicles on a rolling average for the smooth averaging time.

If the smoothed turn volume is less than the minimum turn volume, this routine will call for permissive operation (omit the turn phase).

If the smoothed gap windows multiplied by the gap percentage exceeds the smoothed turn volume, this routine will call for permissive operation (omit the turn phase).

If there has been a constant turn detector call longer than maximum constant call, this routine will call for protected operation (NOT omit the turn phase).

Detectors are assigned in pairs to this routine. One detector is for the turn phase and one detector is for the through phase of the opposing turn. If either of these detectors failed any diagnostic, this routine will call for protected operation (NOT omit the turn phase).

When more than one detector has a Mode 5 or Mode 6 code for the same adaptive protected/permissive routine (for example, switch phases are equal), the lowest numbered detector will be used, and any others will be ignored.

When this routine is calling for permissive operation, the turn detector will be switched to the through phase.

8.2 Programming

From the Detector Config Data menu (Figure 2-128), select **1-VEHICLE DETECTOR 1**.

```
VEH DET 1     PHASE 12345678 90123456
 ASSIGNED PHASES....10000000 00000000
 SWITCH PHASES......10000000 00000000
   MODE   5    CALL  1    EXT/10   3
   VOLUME 0    PASS  1    DLY/10 120
   OCCUPY 0    ADDED 1    FAIL   255
   LOCK   0    QUEUE 0    QLIMIT   0
                                    [1]
```

Figure 8-1. Vehicle Detector Data Display (Det 1)

From the Detector Config Data menu (Figure 2-128), select **2-VEHICLE DETECTOR 2**.

```
VEH DET 2     PHASE 12345678 90123456
 ASSIGNED PHASES....01000000 00000000
 SWITCH PHASES......10000000 00000000
   MODE   6    CALL  1    EXT/10  50
   VOLUME 0    PASS  1    DLY/10   5
   OCCUPY 0    ADDED 1    FAIL   255
   LOCK   0    QUEUE 0    QLIMIT   0
                                    [1]
```

Figure 8-2. Vehicle Detector Data Display (Det 2)

Information on this screen includes the following:

Assigned phase – The phase number to receive calls from the detector.

Operation mode – Mode 5 (PPL) for the turn detector and Mode 6 (PPT) for the opposing through detector. The through detector must sense all lanes for through vehicles. The Mode 5 assigned phase will receive the phase omit.

Switched phase – The phase number of the turn phase. Both Mode 5 and Mode 6 detectors must point to the same phase. This is how the detector pairs are grouped.

EXT/10 – For Mode 5 detectors, this value becomes the maximum constant call for the detector pair. For Mode 6 detectors, this value becomes the gap percentage for the detector pair.

DEL/10 – For Mode 5 detectors, this value becomes the minimum turn volume for the detector pair. For Mode 6 detectors, this value becomes the minimum vehicle gap for the detector pair.

From the Time Base menu (Figure 2-180), select **0-SPC FUNC MAPPING**.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
SPEC FUNCTION 1        10000000 00000000
SPEC FUNCTION 2        01000000 00000000
SPEC FUNCTION 3        00100000 00000000

 UP/DOWN TO SCROLL
```

Figure 8-3. Time Base Special Function Mapping Display

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
DISABLE PROT/PERM OMIT 10000000 00000000
PHASE 2 SIGN CONTROL   00000000 00000000
PHASE 4 SIGN CONTROL   00000000 00000000

 UP/DOWN TO SCROLL
```

Figure 8-4. Time Base Special Function Adaptive Prot/Perm Display

The above entry shows that the adaptive protected/permissive routines will be disabled any time Special Function 1 is enabled by time base or system interface events.

9 Lane Usage Sign Control
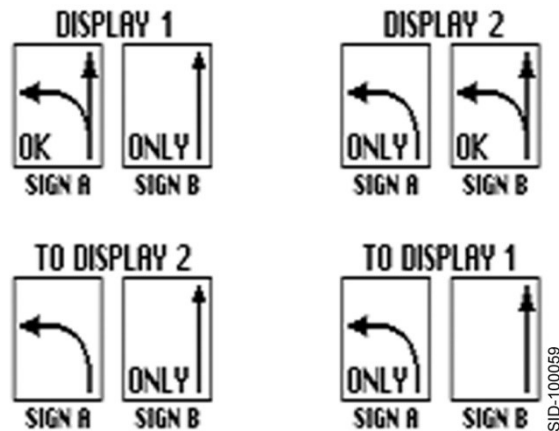
Figure 9-1. Lane Sign Usage Control

The CU time base special function mapping provides for mapping Special Functions 1–8 as lane usage sign control. An ABC I/O mode is also available to use phase on, phase check, and phase next outputs as sign control outputs. When these two areas are programmed, the CU will control four pairs of lane usage signs. The sign pairs are associated with Phases 2, 4, 6, and 8.

Each lane usage sign pair has four active states as follows:

> State 1 (Display 1) – The default mode during all periods in which the CU is operating in a non-flashing state (stop-and-go).

> State 2 (To Display 2) – Provided as a transition mode when a command for Display 2 is received while Display 1 is active.

> State 3 (Display 2) – The alternate mode as requested by a time base auxiliary event or system command.

> State 4 (To display 1) – Provided as a transition mode when the command for Display 2 is terminated while Display 2 is active.

A change of state will occur only one second after the beginning of the respective phase red.

Each state will be maintained for a minimum of two cycles. Two cycles is defined as follows:

> When running coordinated, two times the pattern cycle length.

> When running non-coordinated, two times the longest path between barriers (maximum green, yellow, and red times sum).

If the command for Display 2 is terminated during State 2 (To Display 2), State 1 (Display 1) will follow.

If the command for Display 2 becomes active during State 4 (To Display 1), State 3 (Display 2) will follow.

After a power interruption that causes a CU startup, the lane usage sign control will initialize in State 1.

The outputs for control elements of the lane usage sign pairs and their status in each state is shown in Table 9-1.

Table 9-1. Control Elements Outputs							
SIGN 1A (Phase 2) SIGN 2A (Phase 4) SIGN 3A (Phase 6) SIGN 4A (Phase 8)				SIGN 1B (Phase 2) SIGN 2B (Phase 4) SIGN 3B (Phase 6) SIGN 4B (Phase 8)			
	THRU & OK	LEFT	ONLY		THRU	LEFT & OK	ONLY
SIGN 1	PHS 1 ON	PHS 1 NXT	PHS 1 CHK	STATE	PHS 2 ON	PHS 2 NXT	PHS 2 CHK
SIGN 2	PHS 3 ON	PHS 3 NXT	PHS 3 CHK	STATE	PHS 4 ON	PHS 4 NXT	PHS 4 CHK
SIGN 3	PHS 5 ON	PHS 5 NXT	PHS 5 CHK	STATE	PHS 6 ON	PHS 6 NXT	PHS 6 CHK
SIGN 4	PHS 7 ON	PHS 7 NXT	PHS 7 CHK	STATE	PHS 8 ON	PHS 8 NXT	PHS 8 CHK
State 1	ON	ON	OFF	1	ON	OFF	ON
State 2	OFF	ON	OFF	2	ON	OFF	ON
State 3	OFF	ON	ON	3	ON	ON	OFF
State 4	OFF	ON	ON	4	ON	OFF	OFF

9.1 Implementation

The first step to implementing lane usage sign operation is to establish a means to output the lane usage sign operation. ABC CONN OUTPUT Mode 18 modifies the phase ON, NEXT, and CHECK hardware output drivers to operate as lane usage sign control outputs.

From the Unit Data menu (Figure 2-140), select **8- I/O MISC**.

```
I/O MISC
RING I/O   RING..1..2..3..4  2070 AUX
 INPUT RESPONSE  1  2  0  0   SWITCH: 0
 OUTPUT SELECT   1  2  0  0
I/O MODES....INPUT..OUTPUT..BIT
 "ABC" CONN :   0      18      0
 "D" CONN   :   0       0      -
```

Figure 9-2. I/O Misc Display

The next step to implementing lane usage sign operation is to establish the means to call for Display 2.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
SPEC FUNCTION 1        10000000 00000000
SPEC FUNCTION 2        01000000 00000000
SPEC FUNCTION 3        00100000 00000000


 UP/DOWN TO SCROLL
```

Figure 9-3. Time Base Function Mapping Display

```
DISABLE PROT/PERM OMITS 00000000 00000000
PHASE 2 SIGN CONTROL    10000000 00000000
PHASE 4 SIGN CONTROL    01000000 00000000
PHASE 6 SIGN CONTROL    00100000 00000000
PHASE 8 SIGN CONTROL    00010000 00000000
```

Figure 9-4. Time Base Function Mapping Display Parameters

The above entries show that Display 2 for the Phase 2 sign will be called when Special Function 1 is set active by time base or system interface events. Display 2 for the Phase 4 sign will be called when Special Function 2 is active. Display 2 for the Phase 6 sign will be called when Special Function 3 is active. Display 2 for the Phase 8 sign will be called when Special Function 4 is active.

A possible cabinet configuration might use load switches to drive AC-powered signs and could be wired as shown in Figure 9-5.
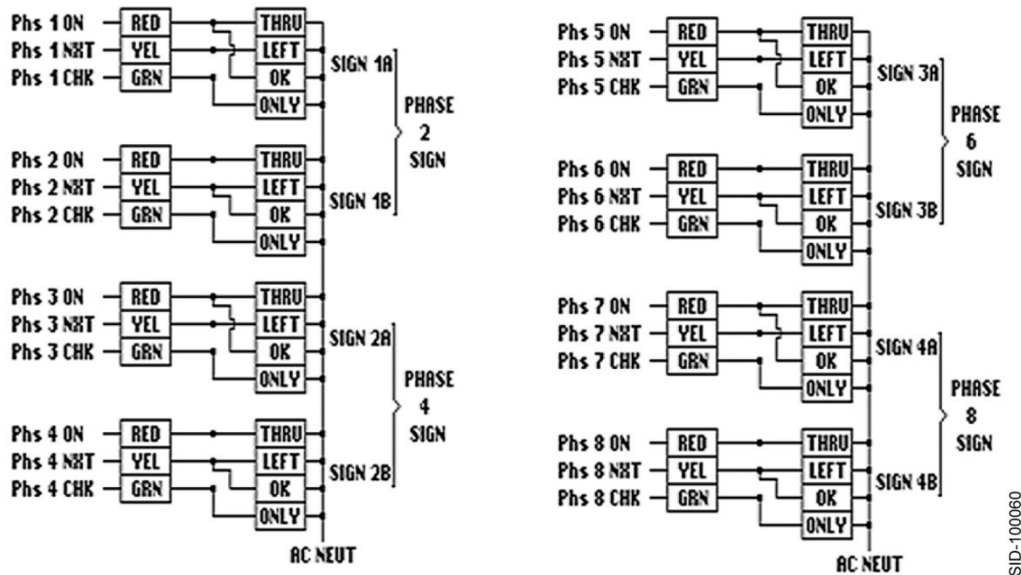
Figure 9-5. Sample Load Switches Wiring Diagram

10 Texas Diamond Intersection Control
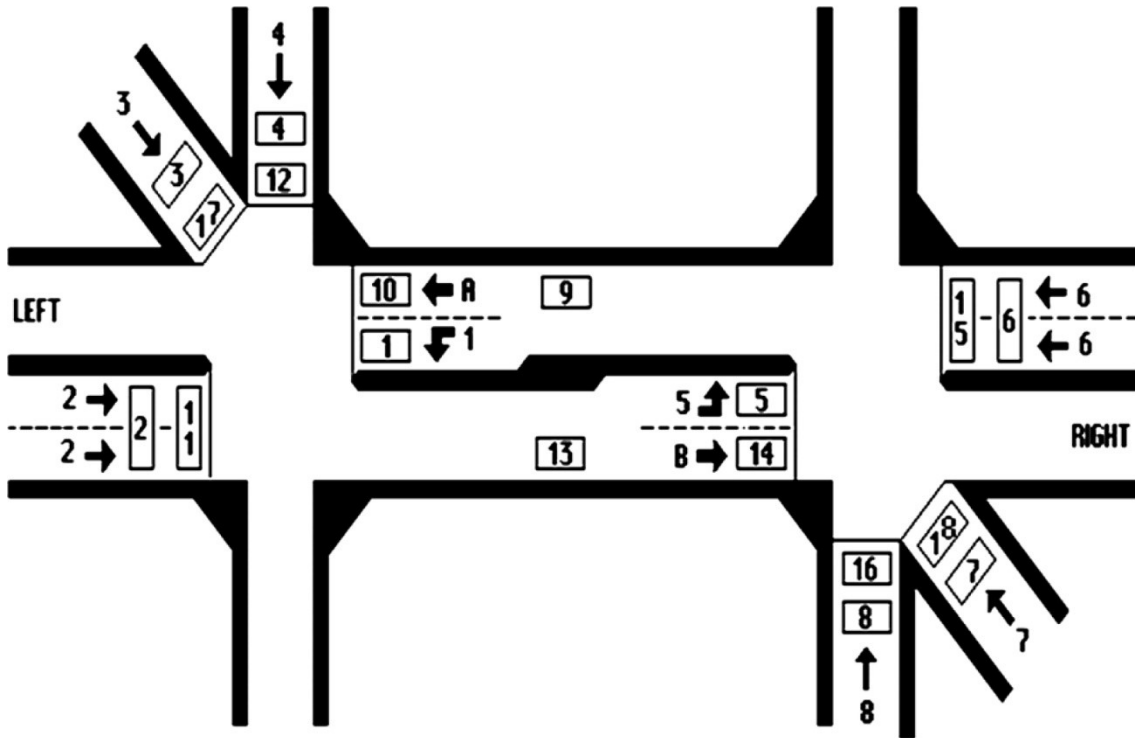
Figure 10-1. Texas Diamond Intersection

When TX Diamond Load Default is requested (Utilities, Load Default, TX Diamond), configuration data compatible with the following modes is loaded and Diamond Mode shall be active.

10.1   Four-Phase Diamond Mode

When SEQUENCE 17 is programmed (unit data, startup, and misc.), the CU operates in the Four-Phase Diamond mode.

When operating in the Four-Phase Diamond Mode, the CU performs the sequence shown in Figure 10-2.
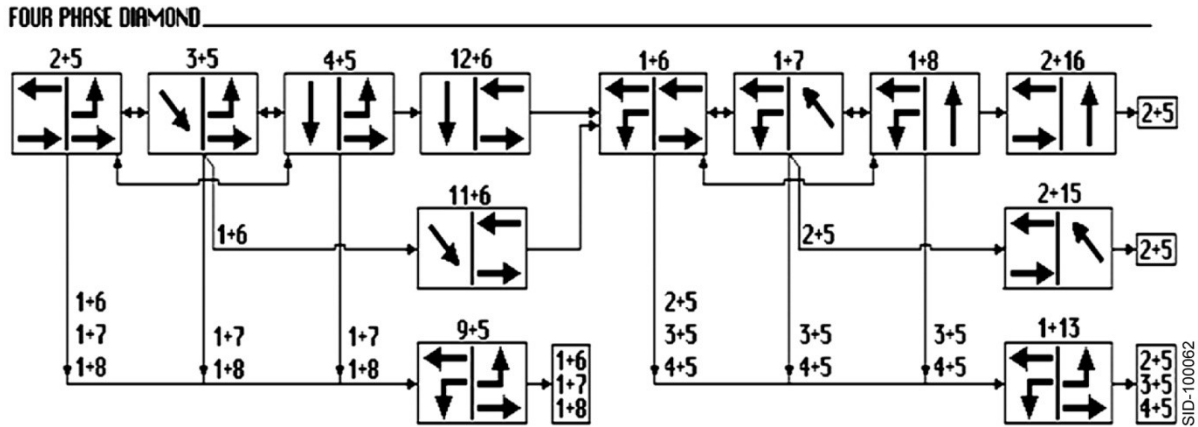
Figure 10-2. Four Phase Diamond Operating Sequence

10.1.1 Sequence Change

Operation may be switched from the Four-Phase Diamond Mode to any of the following:

> Separate Intersections Mode any phase
>
> Three-Phase Diamond Mode Phase 1+5
>
> NEMA Mode Phase 1+5

10.1.2 Detector Logic

Detectors with an (*) must only be assigned to some phases to provide the operation defined for this mode. Any specific data entry is generally ignored, in this mode, except the extend time for Detectors 12, 16, 17, and 18, which provide the defined user-set gap.

Detectors without an (*) must be programmed in accordance with the default program data at the end of this section to provide the operation noted.

* Detector 1 does the following:

> Call Phase 6 when Overlap A (1+2) is not green and a Phase 7 or Phase 8 call does not exist.
>
> Extend Phase 9 when Phase 9 is green.

Detector 2 calls and extends Phase 2.

Detector 3 does the following:

> Call Phase 3 when Phase 3 and Phase 11 are not green.
>
> Extend Phase 3 when Phase 3 is green.
>
> Extend Phase 11 when Phase 11 is green.

Detector 4 does the following:

> Call Phase 4 when Phase 4 and Phase 12 are not green.
>
> Extend Phase 4 when Phase 4 is green.
>
> Extend Phase 12 when Phase 12 is green.

* Detector 5 does the following:

> Call Phase 2 when Overlap B (5+6) is not green and a Phase 3 or Phase 4 call does not exist.
>
> Extend Phase 13 when Phase 13 is green.

Detector 6 calls and extends Phase 6.

Detector 7 does the following:

> Call Phase 7 when Phase 7 and Phase 15 are not green.
>
> Extend Phase 7 when Phase 7 is green.
>
> Extend Phase 15 when Phase 15 is green.

Detector 8 does the following:

> Call Phase 8 when Phase 8 and Phase 16 are not green.
>
> Extend Phase 8 when Phase 8 is green.
>
> Extend Phase 16 when Phase 16 is green.

* Detectors 9 and 10 do the following:

> Call Phase 6 when Overlap A (1+2) is not green and a Phase 7 and Phase 8 call does not exist.
>
> Extend Phase 2 when Phase 2 is green and a Phase 3 or Phase 4 call exists.
>
> Extend Phase 9 when Phase 9 is green.

Detector 11 does the following:

> Call Phase 2 when Phase 2 is not green.
>
> Extend Phase 2 when Phase 2 is green until a user-set gap (0–9.9 seconds) in Detector 11 activity occurs. At this time Detector 11 becomes inactive. This state (Detector 11 inactive) is maintained until Phase 2 yellow.

* Detector 12 does the following:

> Call Phase 4 when Phase 4 is not green.
>
> Extend Phase 4 when Phase 4 is green until a Phase 6 call exists and a user-set gap (0–9.9 seconds) in Detector 12 activity occurs. At this time Detector 12 becomes inactive. This state (Detector 12 inactive) is maintained until Phase 4 yellow or the Phase 6 call disappears prior to Phase 4 yellow.
>
> Extend Phase 12 when Phase 12 is green.

* Detectors 13 and 14 do the following:

> Call Phase 2 when Overlap B (5+6) is not green and a Phase 3 and Phase 4 call does not exist.
>
> Extend Phase 6 when Phase 6 is green and a Phase 7 or Phase 8 call exists.
>
> Extend Phase 13 when Phase 13 is green.

Detector 15 does the following:

> Call Phase 6 when Phase 6 is not green.

Extend Phase 6 when Phase 6 is green until a user-set gap (0–9.9 seconds) in Detector 15 activity occurs. At this time Detector 15 becomes inactive. This state (Detector 15 inactive) is maintained until Phase 6 yellow.

* Detector 16 does the following:

Call Phase 8 when Phase 8 is not green.

Extend Phase 8 when Phase 8 is green until a Phase 2 call exists and a user-set gap (0–9.9 seconds) in Detector 16 activity occurs. At this time Detector 16 becomes inactive. This state (Detector 16 inactive) is maintained until Phase 8 yellow or the Phase 2 call disappears prior to Phase 8 yellow.

Extend Phase 16 when Phase 16 is green.

* Detectors 17 do the following:

Call Phase 3 when Phase 3 is not green.

Extend Phase 3 when Phase 3 is green until a Phase 6 call exists and a user-set gap (0–9.9 seconds) in Detector 17 activity occurs. At this time Detector 17 becomes inactive. This state (Detector 17 inactive) is maintained until Phase 3 yellow or the Phase 6 call disappears prior to Phase 3 yellow.

Extend Phase 11 when Phase 11 is green.

* Detector 18 does the following:

Call Phase 7 when Phase 7 is not green.

Extend Phase 7 when Phase 7 is green until a Phase 2 call exists and a user-set gap (0–9.9 seconds) in Detector 18 activity occurs. At this time Detector 18 becomes inactive. This state (Detector 18 inactive) is maintained until Phase 7 yellow or the Phase 2 call disappears prior to Phase 7 yellow.

Extend Phase 15 when Phase 15 is green.

10.1.3   Ring Structure

Texas Std I.D.	1725	1825	25	35	45	L-R	NA	3516	4516	16	17	18	R-L	NA
Ring 1	2			3	4	9	10	11	12					
Traffic Std I.D.														
Ring 2	15	16	5					6		7	8	13		14

Figure 10-3. Four-Phase Diamond Mode Ring Structure

Table 10-1. Four-Phase Diamond Mode Ring Structure							
Phase	**Ring**	**Next**	**Concurrent**	**Phase**	**Ring**	**Next**	**Concurrent**
1	1	2	6-7-8-13-14	9	1	10	5
2	1	3	5-15-16	10	1	11	5
3	1	4	5	11	1	12	6
4	1	9	5	12	1	1	6
5	2	6	2-3-4-9-10	13	2	14	1
6	2	7	1-11-12	14	2	15	1
7	2	8	1	15	2	16	2
8	2	13	1	16	2	5	2

10.1.4　Sequence Control Logic

The following sequence control logic applied to Four-Phase Diamond mode:

DUAL ENTRY PHS 2 and 6

OMIT PHS 10 and 14

IF PHS 5 NOT GREEN THEN OMIT PHS 9

IF (PHS 3 ON OR PHS 4 ON) AND (PHS 6 ACTUATION OR PHS 6 CHECK) THEN OMIT PHS 9

IF PHS 3 NOT GREEN THEN OMIT PHS 11

IF PHS 4 NOT GREEN THEN OMIT PHS 12

IF PHS 1 NOT GREEN THEN OMIT PHS 13

IF (PHS 7 ON OR PHS 8 ON) AND (PHS 2 ACTUATION OR PHS 2 CHECK) THEN OMIT PHS 13

IF PHS 7 NOT GREEN THEN OMIT PHS 15

IF PHS 8 NOT GREEN THEN OMIT PHS 16

IF (NOT PHS 1 ON) AND

- ♦ (PHS 9 ON) OR
- ♦ (PHS 11 ON) OR
- ♦ (PHS 12 ON) OR
- ♦ (PHS 6 ACTUATION OR PHS 6 CHECK) OR
- ♦ (PHS 7 ACTUATION OR PHS 7 CHECK) OR
- ♦ (PHS 8 ACTUATION OR PHS 8 CHECK) THEN PLACE PHS 1 ACTUATION

IF ((PHS 13 ON) AND

- ♦ (NOT PHS 2 CHECK) AND
- ♦ (NOT PHS 3 CHECK) AND

> ♦ (NOT PHS 4 CHECK) THEN PLACE PHS 2 ACTUATION

IF (NOT PHS 5 ON) AND

> ♦ (PHS 13 ON) OR
>
> ♦ (PHS 15 ON) OR
>
> ♦ (PHS 16 ON) OR
>
> ♦ (PHS 2 ACTUATION OR PHS 2 CHECK) OR
>
> ♦ (PHS 3 ACTUATION OR PHS 3 CHECK) OR
>
> ♦ (PHS 4 ACTUATION OR PHS 4 CHECK) THEN PLACE PHS 5 ACTUATION

IF ((PHS 9 ON) AND

> ♦ (NOT PHS 6 CHECK) AND
>
> ♦ (NOT PHS 7 CHECK) AND
>
> ♦ (NOT PHS 8 CHECK) THEN PLACE PHS 6 ACTUATION

IF (PHS 5 ON AND NOT PHSASE 9 ON) AND

> ♦ (PHS 6 ACTUATION OR PHS 6 CHECK) OR
>
> ♦ (PHS 7 ACTUATION OR PHS 7 CHECK) OR
>
> ♦ (PHS 8 ACTUATION OR PHS 8 CHECK) THEN PLACE PHS 9 ACTUATION

IF (NOT PHS 6 ON) AND (PHS 6 ACTUATION OR PHS 6) CHECK THEN PLACE PHS 11 and PHS 12 ACTUATION

IF (PHS 1 ON AND NOT PHS 13 ON) AND (PHS 2 ACTUATION OR PHS 2 CHECK) OR

> ♦ (PHS 3 ACTUATION OR PHS 3 CHECK) OR
>
> ♦ (PHS 4 ACTUATION OR PHS 4 CHECK) THEN PLACE PHS 13 ACTUATION

IF (NOT PHS 2 ON) AND (PHS 2 ACTUATION OR PHS 2 CHECK) THEN PLACE PHS 15 and PHS 16 ACTUATION

10.2   Three-Phase Diamond Mode

When SEQUENCE 18 is programmed (Unit Data, Startup, and Misc.), the CU operates in Three-Phase Diamond Mode.

When operating in Three-Phase Diamond Mode, the CU performs the sequence shown in Figure 10-4.

BASIC THREE PHASE DIAMOND
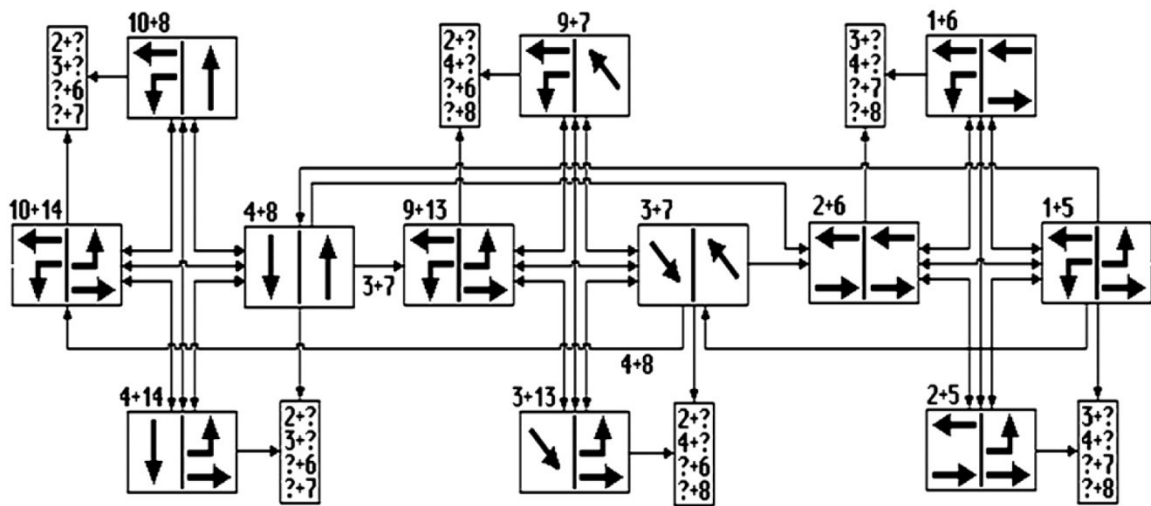
Figure 10-4. Basic Three-Phase Diamond Operating Sequence

10.2.1   Sequence Change

Operation may be switched from Three-Phase Diamond Mode to any of the following:

Separate Intersections mode any phase

Four-Phase Diamond Mode Phase 2+5

NEMA Mode Phase 1+5

10.2.2   Detector Logic

Detectors with a (*) must only be assigned to some phases to provide the operation defined for this mode. Any specific data entry is generally ignored, in this mode.

Detectors without an (*) must be programmed in accordance with the Default Program Data at the end of this section to provide the operation noted.

* Detector 1 does the following:

- Call Phase 1 when Phase 2 is green.
- Call Phase 9 when Phase 3 is green.
- Call Phase 10 when Phase 4 is green.
- Extend Phase 1 when Phase 1 is green and a Phase 2, Phase 3, or Phase 4 call exists.
- Extend Phase 9 when Phase 9 is green and a Phase 2, Phase 3, or Phase 4 call exists.
- Extend Phase 10 when Phase 10 is green and a Phase 2, Phase 3, or Phase 4 call exists.

Detector 2 calls and extends Phase 2.

Detector 3 calls and extends Phase 3.

Detector 4 calls and extends Phase 4.

* Detector 5 does the following:

- ♦ Call Phase 5 when Phase 6 is green.

- ♦ Call Phase 13 when Phase 7 is green.

- ♦ Call Phase 14 when Phase 8 is green.

- ♦ Extend Phase 5 when Phase 5 is green and a Phase 6, Phase 7, or Phase 8 call exists.

- ♦ Extend Phase 13 when Phase 13 is green and a Phase 6, Phase 7, or Phase 8 call exists.

- ♦ Extend Phase 14 when Phase 14 is green and a Phase 6, Phase 7, or Phase 8 call exists.

Detector 6 calls and extends Phase 6.

Detector 7 calls and extends Phase 7.

Detector 8 calls and extends Phase 8.

* Detectors 9 and 10 do the following:

- ♦ Call Phase 9 when Phase 3 is green.

- ♦ Call Phase 10 when Phase 4 is green.

- ♦ Extend Phase 9 when Phase 9 is green and a Phase 3 or Phase 4 call exists.

- ♦ Extend Phase 10 when Phase 10 is green and a Phase 3 or Phase 4 call exists.

Detector 11 does the following:

- ♦ Call Phase 2 when Phase 2 is not green.

- ♦ Extend Phase 2 when Phase 2 is green until a user-set gap (0–9.9 seconds) in Detector 11 activity occurs at which time Detector 11 will become inactive. This state (Detector 11 inactive) will be maintained until Phase 2 yellow.

Detector 12 does the following:

- ♦ Call Phase 4 when Phase 4 is not green.

- ♦ Extend Phase 4 when Phase 4 is green until a user-set gap (0–9.9 seconds) in Detector 12 activity occurs at which time Detector 12 will become inactive. This state (Detector 12 inactive) will be maintained until Phase 4 yellow.

* Detectors 13 and 14 do the following:

- ♦ Call Phase 13 when Phase 7 is green.

- ♦ Call Phase 14 when Phase 8 is green.

- ♦ Extend Phase 13 when Phase 13 is green and a Phase 7 or Phase 8 call exists.

- ♦ Extend Phase 14 when Phase 14 is green and a Phase 7 or Phase 8 call exists.

Detector 15 does the following:

- ♦ Call Phase 6 when Phase 6 is not green.

- ♦ Extend Phase 6 when Phase 6 is green until a user-set gap (0–9.9 seconds) in Detector 15 activity occurs at which time Detector 15 will become inactive. This state (Detector 15 inactive) will be maintained until Phase 6 yellow.

Detector 16 does the following:

- ♦ Call Phase 8 when Phase 8 is not green.

- ♦ Extend Phase 8 when Phase 8 is green until a user-set gap (0–9.9 seconds) in Detector 16 activity occurs at which time Detector 16 will become inactive. This state (Detector 16 inactive) will be maintained until Phase 8 yellow.

Detector 17 do the following:

- ♦ Call Phase 3 when Phase 3 is not green.

- ♦ Extend Phase 3 when Phase 3 is green until a user-set gap (0–9.9 seconds) in Detector 17 activity occurs at which time Detector 17 will become inactive. This state (Detector 17 inactive) will be maintained until Phase 3 yellow.

Detector 18 do the following:

- ♦ Call Phase 7 when Phase 7 is not green.

- ♦ Extend Phase 7 when Phase 7 is green until a user-set gap (0–9.9 seconds) in Detector 18 activity occurs at which time Detector 18 will become inactive. This state (Detector 18 inactive) will be maintained until Phase 7 yellow.

10.2.3   Ring Structure

Texas Std I.D.	NA	NA	15	48	15	37	26	15
Ring 1	12	11	10	4	9	3	2	1
Traffic Std I.D.								
Ring 2	16	15	14	8	13	7	6	5

Figure 10-5. Three-Phase Diamond Mode Ring Structure

Phase	Ring	Next	Concurrent	Phase	Ring	Next	Concurrent
Table 10-2. Three-Phase Diamond Mode Ring Structure
1	1	12	5-6	9	1	3	7-13
2	1	1	5-6	10	1	4	8-14
3	1	2	7-13	11	1	10	15-16
4	1	9	8-14	12	1	11	15-16
5	2		1-2	13	2		3-9
6	2		1-2	14	2		4-10
7	2		3-9	15	2		11-12
8	2		4-10	16	2		11-12

10.2.4   Sequence Control Logic

The following sequence control logic applied to Three-Phase Diamond mode:

DUAL ENTRY PHS 1, 5, 9, 10, 13 & 14

OMIT PHS 11, 12, 15, & 16

IF PHS 3 IS DARK (NOT PRESENT) THEN OMIT PHS 13

IF PHS 4 IS DARK (NOT PRESENT) THEN OMIT PHS 14

IF PHS 7 IS DARK (NOT PRESENT) THEN OMIT PHS 9

IF PHS 8 IS DARK (NOT PRESENT) THEN OMIT PHS 10

IF (PHS 1 GRN) AND (PHS 7 ACTUATION OR PHS 7 CHECK) THEN OMIT PHS 13

IF (PHS 1 GRN) AND (PHS 8 ACTUATION OR PHS 8 CHECK) THEN OMIT PHS 14

IF (PHS 5 GRN) AND (PHS 3 ACTUATION OR PHS 3 CHECK) THEN OMIT PHS 9

IF (PHS 5 GRN) AND (PHS 4 ACTUATION OR PHS 4 CHECK) THEN OMIT PHS 10

IF (PHS 2 ON) AND

   (PHS 7 ACTUATION OR PHS 7 CHECK) OR

   (PHS 8 ACTUATION OR PHS 8 CHECK) THEN

   PLACE PHS 1 ACTUATION

IF (PHS 3 ON) AND

(PHS 8 ACTUATION OR PHS 8 CHECK) THEN

PLACE PHS 10 ACTUATION

IF (PHS 4 ON) AND (PHS 7 ACTUATION OR PHS 7 CHECK) THEN PLACE PHS 9
ACTUATION

IF (PHS 6 ON) AND

(PHS 3 ACTUATION OR PHS 3 CHECK) OR

(PHS 4 ACTUATION OR PHS 4 CHECK) THEN

PLACE PHS 5 ACTUATION

IF (PHS 7 ON) AND (PHS 4 ACTUATION OR PHS 4 CHECK) THEN PLACE PHS 14
ACTUATION

IF (PHS 8 ON) AND (PHS 3 ACTUATION OR PHS 3 CHECK) THEN PLACE PHS 13
ACTUATION

10.3   Separate Intersections Mode

When SEQUENCE 19 is programmed (unit data, startup, and misc.), the CU operates
in Separate Intersections Mode.

When operating in Separate Intersections Mode, the CU performs the sequence
shown in Figure 10-6.

Figure 10-6. Separate Intersection Operating Sequence

10.3.1   Sequence Change

Operation may be switched from Separate Intersections Mode to any of the following:

Four-Phase Diamond Mode Phase 2+5

Three-Phase Diamond Mode Phase 1+5

NEMA Mode Phase 1+5

10.3.2   Detector Logic

Detectors must be programmed in accordance with the default program data at the end of this section to provide the operation noted.

Detector 1 calls and extends Phase 1.

Detector 2 calls and extends Phase 2.

Detector 3 calls and extends Phase 3.

Detector 4 calls and extends Phase 4.

Detector 5 calls and extends Phase 5.

Detector 6 calls and extends Phase 6.

Detector 7 calls and extends Phase 7.

Detector 8 calls and extends Phase 8.

Detectors 9 and 10 do the following:

- Call Phase 1 when Phase 1 and Phase 2 are not green.
- Extend Phase 1 when Phase 1 is green.
- Extend Phase 2 when Phase 2 is green.

Detector 11 does the following:

- Call Phase 2 when Phase 2 is not green.
- Extend Phase 2 when Phase 2 is green until a user-set gap (0–9.9 seconds) in Detector 11 activity occurs. At this time Detector 11 becomes inactive. This state (Detector 11 inactive) is maintained until Phase 2 yellow.

Detector 12 does the following:

- Call Phase 4 when Phase 4 is not green.
- Extend Phase 4 when Phase 4 is green until a user-set gap (0–9.9 seconds) in Detector 12 activity occurs. At this time Detector 12 becomes inactive. This state (Detector 12 inactive) is maintained until Phase 4 yellow.

Detectors 13 and 14 do the following:

- Call Phase 5 when Phase 5 and Phase 6 are not green.
- Extend Phase 5 when Phase 5 is green.
- Extend Phase 6 when Phase 6 is green.

Detector 15 does the following:

- Call Phase 6 when Phase 6 is not green.
- Extend Phase 6 when Phase 6 is green until a user-set gap (0–9.9 seconds) in Detector 15 activity occurs. At this time Detector 15 becomes inactive. This state (Detector 15 inactive) is maintained until Phase 6 yellow.

Detector 16 does the following:

- Call Phase 8 when Phase 8 is not green.

♦ Extend Phase 8 when Phase 8 is green until a user-set gap (0–9.9 seconds) in Detector 16 activity occurs at which time Detector 16 will become inactive. This state (Detector 16 inactive) will be maintained until Phase 8 yellow.

Detector 17 does the following:

♦ Call Phase 3 when Phase 3 is not green.

♦ Extend Phase 3 when Phase 3 is green until a user-set gap (0–9.9 seconds) in Detector 17 activity occurs. At this time Detector 17 becomes inactive. This state (Detector 17 inactive) is maintained until Phase 3 yellow.

Detector 18 does the following:

♦ Call Phase 7 when Phase 7 is not green.

♦ Extend Phase 7 when Phase 7 is green until a user-set gap (0–9.9 seconds) in Detector 18 activity occurs. At this time Detector 18 becomes inactive. This state (Detector 18 inactive) is maintained until Phase 7 yellow.

10.3.3   Ring Structure

Ring 1	1	2	3	4	9	10	11	12

NO BARRIERS

Ring 2	5	6	7	8	13	14	15	16
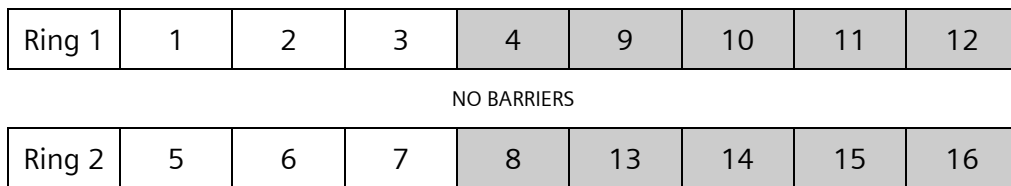
Figure 10-7. Separate Intersection Mode Ring Structure

Table 10-3. Standard Intersections Mode Ring Structure							
Phase	Ring	Next	Concurrent	Phase	Ring	Next	Concurrent
1	1	2	5-6-7-8-13-14-15-16	9	1	10	5-6-7-8-13-14-15-16
2	1	3	5-6-7-8-13-14-15-16	10	1	11	5-6-7-8-13-14-15-16
3	1	4	5-6-7-8-13-14-15-16	11	1	12	5-6-7-8-13-14-15-16
4	1	9	5-6-7-8-13-14-15-16	12	1	1	5-6-7-8-13-14-15-16
5	2	6	1-2-3-4-9-10-11-12	13	2	14	1-2-3-4-9-10-11-12
6	2	7	1-2-3-4-9-10-11-12	14	2	15	1-2-3-4-9-10-11-12
7	2	8	1-2-3-4-9-10-11-12	15	2	16	1-2-3-4-9-10-11-12
8	2	13	1-2-3-4-9-10-11-12	16	2	5	1-2-3-4-9-10-11-12

10.3.4   Sequence Control Logic

The sequence control logic for Separate Intersections mode is:

> OMIT PHS 9, 10, 11, 12, 13, 14, 15, and 16

10.4   NEMA Diamond Mode

When SEQUENCE 01–16 is programmed (unit data, startup, and misc.), the CU operates in NEMA Diamond Mode.

When operating in NEMA Diamond Mode, the CU performs the sequence shown in Figure 10-8.

NEMA MODE
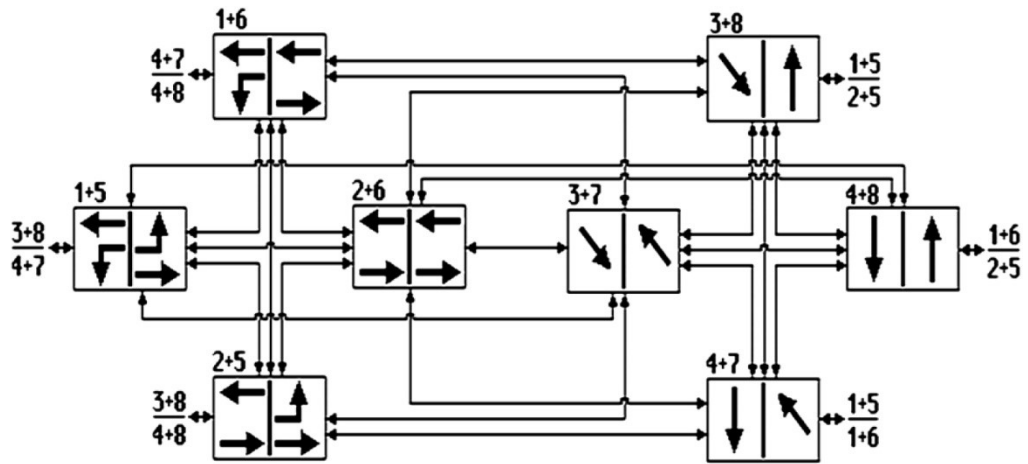
Figure 10-8. Separate Intersection Operating Sequence

10.4.1   Sequence Change

Operation may be switched from NEMA Mode to any of the following:

       Four-Phase Diamond Mode Phase 1+5

       Three-Phase Diamond Mode Phase 1+5

       Separate Intersections Mode any Phase

10.4.2   Detector Logic

       See Separate Intersections Mode

10.4.3   Ring Structure

Ring 1	1	2	3	4	9	10	11	12
Ring 2	5	6	7	8	13	14	15	16

Figure 10-9. Separate Intersection Mode Ring Structure

Table 10-4. NEMA Mode Ring Structure							
Phase	Ring	Next	Concurrent	Phase	Ring	Next	Concurrent
1	1	2	5-6	9	1	10	13-14
2	1	3	5-6	10	1	11	13-14
3	1	4	7-8	11	1	12	15-16
4	1	9	7-8	12	1	1	15-16
5	2	6	1-2	13	2	14	9-10
6	2	7	1-2	14	2	15	9-10
7	2	8	3-4	15	2	16	11-12
8	2	13	3-4	16	2	5	11-12

10.4.4   Sequence Control Logic

The sequence control logic for NEMA mode is:

> OMIT PHS 9, 10, 11, 12, 13, 14, 15, and 16

10.5   Special Output Operation

The controller interlock output is active (true - low state) as long as the voltages in the CU do not drop below predetermined levels required to provide normal operation.

The Confirm Select A and Confirm Select B outputs will not be operational.

10.6   Special Input Operation

The master select input, when active, has no effect on the CU operation.

Computer select 1 input, when active, functions as Vehicle Detector 17 input.

Computer select 2 input, when active, functions as Vehicle Detector 18 input.

Computer select 3 input, when active, has no effect on the CU operation.

The free (no coordination) input, when active, disables the coordination timing control of the CU.

The TBC On Line input, when active, disables the time base pattern outputs to the internal coordination program.

Internal coordination control is determined by the state of the above inputs as defined in Table **10**-**5**.

Table 10-5. Internal Coordination Control Inputs		
Computer On Line	**Interconnect Free**	**TX Input Name**
Free (No Coordination)	TBC On Line	Operation
TRUE	DONT CARE	Free (No Coordination)
FALSE	FALSE	Local TBC Operation
FALSE	TRUE	Interconnect Operation

When internal coordination is in control, the mode (Separate Intersections, Four-Phase Diamond, Three-Phase Diamond, and NEMA Diamond) is controlled by internal coordination. Each coordination pattern provides an entry to automatically select the desired mode. During the periods when internal coordination is in control, the mode inputs below will have no effect.

When internal coordination is in control and a change in mode (Separate Intersections, Four-Phase Diamond, Three-Phase Diamond, and NEMA) is requested, the CU momentarily drops free to transition to the new mode.

When Diamond mode is True and separate intersections input is active, the CU operates in separate intersections mode as detailed above. When Diamond mode is False, this input will have no effect on CU operation.

When the diamond mode is True and the Force 4 Phase input is active, the CU operates in the Four-Phase Diamond mode detailed above. When Diamond mode is False, this input will have no effect on CU operation.

When Diamond mode is True and the Force 3 Phase input is active, the CU operates in the Three-Phase Diamond mode detailed above. When Diamond mode is False, this input will have no effect on CU operation.

When Diamond mode is True, the operation of the CU as Separate Intersections mode, Four-Phase Diamond mode, Three-Phase Diamond mode, or NEMA mode will be determined by the state of the above inputs as defined in Table **10**-**6**.

Table 10-6. CU Mode Inputs				
Separate Intersection	**Force 4 Phase**	**Force 3 Phase**	**Diamond Sequence**	**Mode**
TRUE	X	X	Separate Intersections	
FALSE	FALSE	FALSE	Normal (Keypad /TBC)	
FALSE	FALSE	TRUE	3 Phase Diamond	
FALSE	TRUE	FALSE	4 Phase Diamond	
FALSE	TRUE	TRUE	Normal (Keypad / TBC)	
X = DONT CARE				

The operation of the CU as Separate Intersections mode, Four-Phase Diamond mode, Three-Phase Diamond mode, or NEMA mode will be selected through the keypad, internal coordination, time base control, and the inputs defined above. The hierarchy will be in the order (highest to lowest) internal coordination, inputs, time base, and keypad.

10.7 Programming

10.7.1 Diamond Operation Rules

10.7.1.1 Basic Traffic

Under Diamond mode, the existence of phases is not user-controlled nor is the sequence through the front panel unit data/ring configuration data entry section (F-4-5). The only control available to the user under Diamond mode is to remove the phase(s) from the sequence through an initialization data entry of DARK under the phase data/initialization and non-actuated data entry section of the front panel (F-3-4).

If a particular diamond mode sequence requires a non-standard operation from a particular detector, the only data entry that will affect that detector under that configuration is the entry of assigned phase, extend, and delay times. Extend and delay have an effect if such times are required under the non-standard operation as stated elsewhere in this manual.

Data entries for detectors that operate in a manner standard to CUs or will operate in a standard manner when in a diamond mode sequence that permits such operation will be affected by any relevant data entered. Detectors not assigned by the diamond mode are free from any arbitrary constraints on usage and may be assigned and used subject only to the logical constraints imposed by input availability and phase assignment.

Overlap programming is integral to the traffic signal display for Diamond mode and is subject to operator modification. Care should be taken when such modifications are contemplated.

10.7.1.2 Coordination

Diamond mode is ONLY compatible with coordination modes Permissive and Yield. All other coordination modes will cause a Bad Plan Free error.

It is assumed that each coordination timing plan is tailored for a particular Diamond mode sequence (Separate Intersections mode, Four-Phase Diamond mode, Three-Phase Diamond mode, or NEMA mode). The diamond mode sequence is either entered in the offset sequence or the default sequence when the offset sequence is less than 17. This means that the order in which front panel entries are made is significant as the offset sequence must be entered first if the plan is expected to run on anything other than the default sequence.

Under coordination, only the primary phases are controlled. Primary phases are phases needing timing control by coordination. DARK phases and unused phases in a particular Diamond mode sequence are never primary. The primary phases for each Diamond mode sequence are as follows:

> Four-Phase Diamond mode – 1, 2, 3, 4, 5, 6, 7, 8, 12, and 16
>
> Three-Phase Diamond mode – 1, 2, 3, 4, 5, 6, 7, 8, 9, and 13

If either 4 or 3 is DARK, 13 is not primary. Likewise, if either 8 or 7 is DARK, 9 is not primary.

> Separate Intersections mode and NEMA mode – 1, 2, 3, 4, 5, 6, 7, and 8.

Front panel entry of Diamond mode sequence coordination phase times is designed to verify the entered time against the sequence selected for that timing plan.

Coordination phase times for non-primary phases serve as the maximum time for that phase when that timing plan is active.

Coordination phase times for DARK phases can be any value (but these times will have no effect on the cycle).

In Three-Phase Diamond mode, coordination permissive operation might preclude service of 1 and 5 when transitioning from 2+6 to 4 or 8 if the calls arrive after the vehicle permissive has closed on 1 and 5.

The CU does not calculate the cycle length for any diamond mode sequence. The user must enter the proper cycle length to run for each diamond mode sequence under coordination. The CU will verify the cycle against the calculated bad plan cycle (phase times for Ring 1 phases less than 9, for example phases 1, 2, 3, and 4). Care must be taken that a cycle length is entered, or a bad plan is noted.

10.7.1.2.1 Four-Phase Diamond Mode

The coordination primary phases (split times must be entered for these phases, if active) and timing association for the Four-Phase Diamond mode are as shown in Table 10-7.

Table 10-7. Four-Phase Diamond Mode Coordination Primary Phases							
Texas Std ID	1825	25	35	45	4516	16	17	18
Ring 1	2		3	4	12	1		
Coord Std ID	2+16	2+5	3+5	4+5	6+12	1+6	1+7	1+8
Ring 2	16	5			6		7	8

The cycle length should equal the sum of the pattern times for Phases 2, 3, 4, 6, 7, and 8.

<u>Primary Phases</u>

The pattern time for Phase 1 should be based on whether it is one of the pattern-coordinated phases.

> Coordinated Phases = 1 and 7: Phase 1 time = Phase 6 + 7 time - Phase 12 time + Phase 8 Min Green

> Coordinated Phases = 1 and 8: Phase 6 + 7 + 8 time - Phase 12 time

> All Others: Phase 1 time = Phase 6 time - Phase 12 time + Phase 8 Min Green

The pattern time for Phase 5 should be based on whether it is one of the pattern-coordinated phases.

> Coordinated Phases = 3 and 5: Phase 5 time = Phase 2 + 3 time - Phase 16 time + Phase 4 Min Green

> Coordinated Phases = 4 and 5: Phase 2 + 3 + 4 time - Phase 16 time

> All Others: Phase 5 time = Phase 2 time - Phase 16 time + Phase 4 Min Green

The pattern time for Phase 12 is assumed to be less than the pattern time for Phase 6.

The pattern time for Phase 16 is assumed to be less than the pattern time for Phase 2.

<u>Non-Primary Phases</u>

The pattern time for Phase 9 (left to right clearances) is assumed to be less than the pattern time for Phase 3, 4, or 12.

The pattern time for Phase 11 (3+5 to 1+6 clearance) is assumed to be less than the pattern time for Phase 6.

The pattern time for Phase 13 (right to left clearances) is assumed to be less than the pattern time for 7, 8, or 16.

The pattern time for Phase 15 (1+7 to 2+5 clearance) is assumed to be less than the pattern time for Phase 2.

10.7.1.2.2 Three-Phase Diamond Mode

The coordination primary phases (split times MUST be entered for these phases, if active) and timing association for the Three-Phase Diamond mode are as shown in Table 10-8.

Table 10-8. Three-Phase Diamond Mode Coordination Primary Phases (ECOM)					
Texas Std ID	48	15	37	26	15
Ring 1	4	9	3	2	1
Coord Std ID	4+8	9+13	3+7	2+6	1+5
Ring 2	8	13	7	6	5

The cycle length should equal the sum of the pattern times for Phases 4, 9, 3, 2, and 1 or 8, 13, 7, 6, and 5.

Primary Phases

The pattern time for Phases 9 and 13 should be set to limit the Phase 4 + 8 to Phase 3+7 clearance.

Non-Primary Phases

The pattern time for Phase10 is assumed to be less than or equal to the pattern time for Phase 1.

The pattern time for Phase14 is assumed to be less than or equal to the pattern time for Phase 5.

10.8   Time Base

The first step to implementing time base or system control of diamond mode sequences is to map special function control to the Diamond mode sequences. To get to the time base function mapping display, do the following:

- From the Main menu (Figure 2-1), select **6-TIME BASE DATA**.

- From the Time Base Data menu (Figure 2-180), select **0-SPC FUNC MAPPING**.

```
TIME BASE SPC FUNC MAPPING
SPC FUNC SELECTOR SRC: .GLOBAL. .LOCAL..
S-FUNCTION NAME .......12345678 90123456
TX DIAMOND - FOUR  PH  10000000 00000000
TX DIAMOND - THREE PH  01000000 00000000
TX DIAMOND - SEPARATE  00100000 00000000

 UP/DOWN TO SCROLL
```

Figure 10-10. Time Base Function Mapping Display

The above display shows that:

TX DIAMOND FOUR PHASE (SEQ 17) will be called any time Special Function 1 is called.

TX DIAMOND THREE PHASE (SEQ 18) will be called any time Special Function 2 is called.

TX DIAMOND SEPARATE INTERSECTIONS (SEQ 19) will be called any time Special Function 3 is called.

Nothing else is required for system selection of the Diamond mode sequences. To program local time base to call for these sequences, enter auxiliary events calling for Special Function 1, 2, or 3 as shown in Figure 10-11.

```
TIME BASE ACTION # 001
                    123456789 0123456
  PATN:001       PHS: 000000000 0000000
   0=I'CONN      AUX: 100------
   1-253=PATN    SPC: 10000000-    0=NO
   254=FREE      DIM: 0--------    1=YES
   255=FLASH     DET: 000------
 UP/DOWN TO SCROLL                 E- EDIT
```

Figure 10-11. Time Base Function Mapping Display

The above shows that:

Special Function 1 (TX DIAMOND FOUR PHASE -SEQ 17) will be called when ACTION 001 is called in a Day Plan.

10.9   Default Program Data

When Diamond mode is active, all phases are active and INITIAL Code 0 NONE has no effect. Set the phase to 5 DARK when it is desired to be NOT present.

When Diamond mode is active, ring structure data for RING, NEXT, and CONCUR have no impact on CU operation and may not display the expected information.

11 UTCS Interfaces

A CU with SEPAC software provides the UTCS interfaces described in this chapter.

The UTCS configuration parameters are detailed in Section 2.3.6.6.

11.1   General

SEPAC will listen on UDP port 8117 for UTCS messages when configured for Ethernet Mode. Under SCOOT control (STD/ACA msg type) Detector Switching is disabled. However, Detector Switching is **not** disabled under BTCS control (BTCS msg type).

11.2   SCOOT STD/ACA Message Types

The SEPAC uses the following:

> Resident SCOOT configuration data (Stage A-H Phase Masks) to determine the phase(s) that are associated with a specific stage.

> Resident SCOOT configuration data (SCOOT detector mask) to determine the local detectors that are to be used as SCOOT detectors.

> Resident SCOOT configuration data (SCOOT phase mode mask) to determine the phase operational mode, phase dwell state, and green signals for reply status bits.

Dual ring configurations should operate in dual entry mode (a phase ON in each ring at all times) when not under SCOOT control. Otherwise SCOOT central will not attempt to bring the SEPAC on line.

11.2.1   Definitions

Stage – Phase or combination of phases as defined in the Stage A-H Phase Masks.

Permitted stage – Any stage that has its stage force bit set in Control Byte 1. Control Byte 1 may include multiple stage force bits at the same time.

Permitted Phase – Any phase defined by the stage phase mask of a permitted stage.

Excluded Phase – Any phase that is not a permitted phase.

11.2.2   Protocol

The system communications operate in a mode where the secondary station initiates transmission only as the result of receiving a command from the primary station addressed to the secondary station.

All commands and responses start with the Opening Flag 7E. All stations continuously hunt for this opening flag. Thus, the opening flag is used for message synchronization.

The transmitter examines the message content following the opening flag (including the checksum) and on the occurrence of the opening flag or Control Escape Byte 7D and:

Complement the sixth bit of the byte (7E becomes 5E and 7D becomes 5D), and

Insert a Control Escape Byte 7D immediately prior the byte

The SEPAC provides two message types for the SCOOT Interface. The first (STD-standard) limits the local address to seven with minimal response data while the second (ACA-extended) provides for 15 local addresses with extended response data.

11.3   SCOOT STD (Standard) Message Types

The SCOOT standard command and response messages are described in the following sections.

11.3.1   SCOOT STD Command Message

The SCOOT STD Command message will include the following bytes:

Opening flag (7E)

Address/control byte

- Bit 7 – 1 (Prevents this byte from being a 7E or 7D)

- Bit 6-4 – Local address (0–7 same as SEPAC system address)

- Bit 3-0 – Bytes to follow (includes control escape bytes and checksum but excludes any control escape byte for checksum)

Control Byte 1

- Bit 7-0 – Stage Force H-A (Bit 7=Stage H/Bit 0=Stage A)

Control Byte 2

- Bit 7-1 – Stage Demand H-B (Bit 7=Stage H/Bit 1=Stage B)

- Bit 0 – Common demand (all stages)

Control Byte 3

- Bit 7-4 – Special function (Bit 7=SF4/Bit 4=SF1)

- Bit 3-1 – Spare bits (set to zero)

- Bit 0 – Stage gap out

Checksum byte (complement of 8-bit 1)

11.3.1.1   STD Control Byte 1

Receipt of non-zero Control Byte 1 (stage force) in SCOOT commands for three seconds will cause SEPAC to implement SCOOT coord control. During periods of SCOOT coord control, SEPAC will:

Remove internal coord control but will run coord in the background (as is done in priority routines) thereby enabling a transfer from SCOOT to internal coord (ACTRA [ECOM only], or MONARC [NTCIP only], or time base called) in sync with the running pattern. Pattern sequence will continue to operate.

Not operate cycling diagnostics while under SCOOT coord control.

Operate phase(s) defined in the Stage A phase mask in accordance with the SCOOT phase mode defined in the SCOOT configuration data as follows:

- ♦ Mode 0 – Non-actuated (vehicle and pedestrian) regardless of their individual phase programming

- ♦ Mode 1 – Pedestrians are actuated unless individual phase programming is non-actuated

  All other phases will operate in accordance with their individual phase programming (actuated or non-actuated).

Prevent excluded phases from receiving service (phase omit active).

Service is not a permitted stage unless it has demand. Without stage demand, the phase(s) defined in the permitted stage(s) are prevented from receiving service (phase omit active).

Terminate excluded phase(s) if stage demand exists on permitted stage(s) through the Force Off command. The Force Off command cannot terminate a phase while timing minimum green, walk, or pedestrian clearance.

When a Force Off command is issued, insure the next permitted stage with stage demand appears even though the actuation(s) disappear prior to the start of stage green (for example, right turn on red).

Allow any permitted phase to time normally but will not be allowed to terminate (go to yellow). Pedestrians will only occur at the beginning of the phase green (pedestrian omit is active when the phase is green).

On initial recognition of a Stage-A Force command bit (with no other force command bits active), the SEPAC will exert a pedestrian recycle control on each ring in which a Stage-A phase green is active.

SCOOT central will initiate such a Stage-A Force command one time each cycle while exercising control.

Use phase hold, for the duration of the Stage Force command, to operate phase(s) in accordance with the SCOOT phase mode (SCOOT configuration data) as follows:

- ♦ SCOOT phase mode – 0

  Stage A dwell –Walk hold (green/walk)

  Stage B-H NA phase dwell – Walk hold (green/walk)

  Stage B-H Actuated phase dwell – Green hold (green/don't walk)

- ♦ SCOOT Phase Mode 1

  Stage A dwell – Green hold (green/don't walk)

  Stage B-H NA phase dwell – Walk hold (green/walk)

  Stage B-H Actuated phase dwell – Green hold (green/don't walk)

Report in ECOM message 04, 0E, 25, and 56 an extended Local Mode 4 for SCOOT control.

Will recognize inputs/operations that conflict with the SCOOT coord control and revert to free mode when the inputs/operations are active. The inputs that conflict are:

- Stop time (any ring)
- Manual control enable
- Automatic flash
- Preemption (any)
- Priority (any)
- Startup flash
- Diagnostic flash
- Low voltage
- Idle restart (data change caused restart)

When stop time is not assigned or automatic flash has no entry phases programmed, activation of those inputs will result in free mode.

Receipt of zero Control Byte 1 in SCOOT commands for three seconds causes SEPAC to discontinue SCOOT coord control and revert to the next level of coord control (system, time base, interconnect, etc.).

The absence of SCOOT commands for three seconds causes SEPAC to discontinue SCOOT coord control and revert to the next level of coord control (system, time base, interconnect, etc.).

11.3.1.2   STD Control Byte 2

Receipt of SCOOT commands for three seconds causes SEPAC to implement the control called for by Control Byte 2 as follows:

When the Control Byte 2 common demand bit is set, SEPAC operates as though vehicle minimum recall was enabled on all vehicle phases.

When the Control Byte 2 Stage B-H Demand bit is set, SEPAC operates as though vehicle minimum recall was enabled on the vehicle phases for the stage.

Stage A will operate as though vehicle minimum recall was enabled when any Stage B-H Demand bit is set.

The absence of SCOOT commands for three seconds causes SEPAC to discontinue the control called for by Control Byte 2.

11.3.1.3   STD Control Byte 3

Receipt of SCOOT commands for three seconds causes SEPAC to implement the control called for by Control Byte 3 as follows:

When the Control Byte 3 Special Function # bit is set, SEPAC will set its Special Function # to active. This special function control is logically OR'd with SEPAC TBC, ACTRA (ECOM only), MONARC (NTCIP only) broadcast, special ECOM set command, or SEPAC front panel control.

When the Control Byte 3 Gap Out bit is set, SEPAC allows the current stage to gap out and service another permitted stage (no hold active on actuated phases). The gap out bit will have no effect on non-actuated phases.

> **NOTE: Use of this feature in dual ring configurations requires that all stages using the active phases and all stages using the phases that may time concurrently with the active phases must be permitted. In those cases where this recommendation is not followed, the central may fail SEPAC.**

The absence of SCOOT commands for three seconds causes SEPAC to discontinue the control called for by Control Byte 3.

11.3.2　SCOOT STD Reply Message

The SCOOT STD reply message will include the following:

Opening flag (7E)

Address/control byte

- ♦ Bit 7 – 1 (prevents this byte from being a 7E or 7D)
- ♦ Bit 6-4 – Local address (0–7 same as SEPAC system address)
- ♦ Bit 3-0 – Bytes to follow minus five (include control escape bytes and checksum but exclude any control escape byte for checksum)

Status Byte 1

- ♦ Bit 7-0 – Stage green status (Bit 7=Stage H/Bit 0=Stage A)

Status Byte 2

- ♦ Bit 7-1 – Stage demand status (Bit 7=Stage H/Bit 1=Stage B)
- ♦ Bit 0 – Detector fault

Status Byte 3

- ♦ Bit 7-4 – Bus demand 4-1 (Bit 7=BD4/Bit 4=BD1)
- ♦ Bit 3 – Controller fault
- ♦ Bit 2 – Manual control
- ♦ Bit 1 – Hurry call
- ♦ Bit 0 – Emergency vehicle

Status Byte 4

- ♦ Bit 7-4 – Special function confirm (Bit 7=SF4/Bit 4=SF1)
- ♦ Bit 3-2 – Spare (set to zero)
- ♦ Bit 1-0 – Remote request status input (Bit 1=RQ2/Bit 0=RQ1)

SCOOT Detector 01 and 02 Bit Masks (Bit 7-4=Det 2/Bit 3-0=Det 1)

SCOOT Detector 03 and 04 Bit Masks (Bit 7-4=Det 4/Bit 3-0=Det 3)

SCOOT Detector 05 and 06 Bit Masks (Bit 7-4=Det 6/Bit 3-0=Det 5)

SCOOT Detector 07 and 08 Bit Masks (Bit 7-4=Det 8/Bit 3-0=Det 7)

SCOOT Detector 09 and 10 Bit Masks (Bit 7-4=Det 10/Bit 3-0=Det 9)

SCOOT Detector 11 and 12 Bit Masks (Bit 7-4=Det 12/Bit 3-0=Det 11)

Checksum Byte (complement for 8-bit 1)

11.3.2.1   STD Status Byte 1 Stage Green Bits

Status Byte 1 Stage Green bits are set when the SEPAC stages are green as defined in this section.

SEPAC reports stage green as follows:

> Where only one phase is defined in a stage, green is reported when the phase is outputting the required signal.

> Where more than one phase is defined in a stage, green is reported when all the phases defined in the stage are outputting the required signal.

The required signal will be in accordance with the information in Table 11-1.

Table 11-1. Stage Green Required Signals	
SCOOT phase mode = 0	
Stage-A phase	Walk
NA phase	Walk
Actuated phase	Green
SCOOT phase mode = 1	
Stage-A phase	Green
NA phase	Green
Actuated phase	Walk

During periods of SCOOT coord control, the stage green reply bits are a logical ANDing of:

> Stage Force command bits

> The true image of SEPAC stage green status defined above

At all other times the stage green reply bits will be the true image of the SEPAC stage green status defined above.

11.3.2.2   STD Status Byte 2

Status Byte 2 Stage Demand bits are set when the SEPAC stages have demand as defined in this section.

SEPAC will consider a phase has demand if:

The phase is green, or

The phase has a call (vehicle or pedestrian, or both – Phase check active) when it is not green.

The SEPAC reports stage demand as follows:

Where only one phase is defined in a stage, demand is reported when the phase has a demand as defined above.

Where more than one phase is defined in a stage, demand is reported when all the phases defined in the stage have a demand as defined above.

Where a phase is defined in more than one stage and a stage demand can not be reported because no concurrent phase demand exists on any of the other phases to enable a stage, a stage demand will be reported on the last stage including the phase with demand.

Dual ring configurations must provide individual stages for each combination of active phases that may time concurrently.

The stage demand reply bits will be a logical ANDing of:

The valid image of SEPAC stage demand status defined above

A logical NOT'ing of stage green reply bits (prevents reporting stage demand for the green stage)

Status Byte 2 detector fault bit is set when the SEPAC detector diagnostic indicates any detector has failed the diagnostic.

11.3.2.3　　　　　STD Status Byte 3

Status Byte 3 Bus Demand 4 bit is set when the SEPAC Special Status 6 Input is active. The same is true for Bus Demand 3/Special Status 5, Bus Demand 2/Special Status 4, and Bus Demand 1/Special Status 3.

Status Byte 3 Controller Fault bit is set when the SEPAC stop time input is active.

Status Byte 3 Manual Control bit is set when the SEPAC manual control enable input is active.

Status Byte 3 hurry call is set when the SEPAC Priority 1–12 is active.

Status Byte 3 Emergency Vehicle bit is active when the SEPAC Preempt 1–6 is active.

11.3.2.4　　　　　STD Status Byte 4

Status Byte 4 SF4 Confirm bit is set when the SEPAC Special Function 4 control is active from any source. The same is true for SF3 Confirm/Special Function 3, SF2 Confirm/Special Function 2, and SF1 Confirm/Special Function 1.

Status Byte 4 Remote Request 2 bit is set when the SEPAC Special Status 2 Input is active. The same is true for Remote Request 1/Special Status 1.

11.3.2.5　　　　　STD SCOOT Detector 01–02

SCOOT Detector 01–02 actuation activity during the last second. A bit is set (1) when an actuation was present in the time slice.

Bit 7 – SCOOT Detector 2 (1 – detection in fourth 250 ms approximately)

Bit 6 – SCOOT Detector 2 (1 – detection in third 250 ms approximately)

Bit 5 – SCOOT Detector 2 (1 – detection in second 250 ms approximately)

Bit 4 – SCOOT Detector 2 (1 – detection in first (oldest) 250 ms approximately)

Bit 3 – SCOOT Detector 1 (1 – detection in fourth 250 ms approximately)

Bit 2 – SCOOT Detector 1 (1 – detection in third 250 ms approximately)

Bit 1 – SCOOT Detector 1 (1 – detection in second 250 ms approximately)

Bit 0 – SCOOT Detector 1 (1 – detection in first (oldest) 250 ms approximately)

11.3.2.6 STD SCOOT Detector 03-n

Only as many detector bytes will be returned as are necessary to include the detectors in use. Physical detectors at a SEPAC will be mapped into the reply message in numerical order (lowest numbered configured SEPAC detector becomes SCOOT Detector #1, etc.).

11.4 SCOOT ACA (Extended) Message Type

The SCOOT ACA (extended) command and response messages are as follows and described in the following sections.

11.4.1 SCOOT ACA Command Message

The SCOOT ACA command message will include the following bytes:

Opening flag (7E)

Message/address control byte

- ♦ Bit 7 – 1 (prevents this byte from being a 7E or 7D)
- ♦ Bit 6-4 – Message type
  - ▪ 0 – Standard SCOOT
  - ▪ 1 – Anaheim SCOOT
- ♦ Bit 3-0 = Local address (1–15 = SEPAC system address)

Remaining bytes control byte

- ♦ Bit 7 – 1 (prevents this byte from being a 7E or 7D)
- ♦ Bit 6-0 – Bytes to follow (includes all control escape bytes)

Control Byte 1

- ♦ Bit 7-0 – Stage Force H-A (Bit 7=Stage H/Bit 0=Stage A)

Control Byte 2

- ♦ Bit 7-1 – Stage Demand H-B (Bit 7=Stage H/Bit 1=Stage B)
- ♦ Bit 0 – Common demand (all stages)

Control Byte 3

- ♦ Bit 7-4 – Special function (Bit 7=SF4/Bit 4=SF1)

- ♦ Bit 3-2 – Spare bits (set to zero)

- ♦ Bit 1 – Flash

- ♦ Bit 0 – Stage gap out

Checksum byte (complement for 8-bit 1)

11.4.1.1   ACA Control Byte 1

This byte is the same as STD Control Byte 1 (See Section 11.3.1.1).

11.4.1.2   ACA Control Byte 2

This byte is the same as

STD Control Byte 2 (See Section 11.3.1.2).

11.4.1.3   ACA Control Byte 3

This byte is the same as STD Control Byte 3 (See 11.3.1.3) except as described in this section.

When the Control Byte 3 Flash bit is set, SEPAC immediately enters a SCOOT flash mode. In SCOOT flash mode, all vehicle load switches flash red. Alternate flashing will be as defined in the SEPAC Flash display (Figure 2-143).

SEPAC exits SCOOT flash mode with the startup sequence defined.

11.4.2   SCOOT ACA Reply Message

The SCOOT ACA reply message includes the following:

Opening flag (7E)

Message/address control byte

- ♦ Bit 7 – 1 (prevents this byte from being a 7E or 7D)

- ♦ Bit 6-4 – Message type

  - ▪ 0 – Standard SCOOT

  - ▪ 1 – Anaheim SCOOT

- ♦ Bit 3-0 – Local address (1–15 = SEPAC system address)

Remaining bytes control byte

- ♦ Bit 7 – 1 (prevents this byte from being a 7E or 7D)

- ♦ Bit 6-0 – Bytes to follow (includes all control escape bytes)

Status Byte 1

- ♦ Bit 7-0 – Stage green status (Bit 7=Stage H/Bit 0=Stage A)

Status Byte 2

- ♦ Bit 7-1 – Stage demand status (Bit 7=Stage H/Bit 1=Stage B)

- ♦ Bit 0 – Detector fault

Status Byte 3

- ♦ Bit 7-4 – Special function confirm (Bit 7=SF4/Bit 4=SF1)
- ♦ Bit 3 – Controller fault
- ♦ Bit 2 – Manual control
- ♦ Bit 1 – Hurry call
- ♦ Bit 0 – Emergency vehicle

Status Byte 4

- ♦ Bit 7 – Remote request status input
- ♦ Bit 6 – Police flash
- ♦ Bit 5 – Railroad preempt
- ♦ Bit 4 – Spare (set to zero)
- ♦ Bit 3-0 – Bus demand 4-1 (Bit 3=BD4/Bit 0=BD1)

Status Byte 5

- ♦ Bit 7-0 – Phase green status (Bit 7=Phase 08/Bit 0=Phase 01)

Status Byte 6

- ♦ Bit 7-0 – Phase yellow status (Bit 7=Phase 08/Bit 0=Phase 01)

Status Byte 7

- ♦ Bit 7-0 – Phase detector call status (Bit 7=Phase 08/Bit 0=Phase 01)

Status Byte 8

- ♦ Bit 7-0 – Phase walk status (Bit 7=Phase 08/Bit 0=Phase 01)

Status Byte 9

- ♦ Bit 7-0 – Phase pedestrian clear status (Bit 7=Phase 08/Bit 0=Phase 01)

Status Byte 10

- ♦ Bit 7-0 – Pedestrian call status (Bit 7=Phase 08/Bit 0=Phase 01)

Status Byte 11

- ♦ Bit 7-0 – Overlap green status (Bit 7=Ovlp H/Bit 0=Ovlp A)

Status Byte 12

- ♦ Bit 7-0 – Overlap yellow status (Bit 7=Ovlp H/Bit 0=Ovlp A)

SCOOT Detector 01 and 02 Bit Masks (Bit 7-4=Det 2/Bit 3-0=Det 1)

SCOOT Detector 03 and 04 Bit Masks (Bit 7-4=Det 4/Bit 3-0=Det 3)

SCOOT Detector 05 and 06 Bit Masks (Bit 7-4=Det 6/Bit 3-0=Det 5)

SCOOT Detector 07 and 08 Bit Masks (Bit 7-4=Det 8/Bit 3-0=Det 7)

SCOOT Detector 09 and 10 Bit Masks (Bit 7-4=Det 10/Bit 3-0=Det 9)

SCOOT Detector 11 and 12 Bit Masks (Bit 7-4=Det 12/Bit 3-0=Det 11)

Checksum Byte (complement for 8-bit 1)

11.4.2.1 ACA Status Byte 1

This byte is the same as STD Status Byte 1 (See Section 11.3.2.1).

11.4.2.2 ACA Status Byte 2

This byte is the same as STD Status Byte 2 (See Section 11.3.2.2).

11.4.2.3 ACA Status Byte 3

The Status Byte 3 SF4 Confirm bit is set when the SEPAC Special Function 4 control is active from any source. The same is true for SF3 Confirm/Special Function 3, SF2 Confirm/Special Function 2, and SF1 Confirm/Special Function 1.

Status Byte 3 Controller Fault bit is set when SEPAC stop time input is active.

Status Byte 3 Manual Control bit is set when SEPAC manual control enable input is active.

Status Byte 3 Hurry Call is set when the Priority 1–12 is active.

Status Byte 3 Emergency Vehicle bit is active when SEPAC Preempt 3–6 is active.

11.4.2.4 ACA Status Byte 4

Status Byte 4 Remote Request 1 bit is set when SEPAC Special Status 1 Input is active.

Status Byte 4 Police Flash bit is set when SEPAC Local Flash Status Input is active.

Status Byte 4 Railroad Preempt bit is set when SEPAC Preempt 1–2 is active.

Status Byte 4 Bus Demand 4 bit is set when the SEPAC Special Status 6 Input is active. The same is true for Bus Demand 3/Special Status 5, Bus Demand 2/Special Status 4, and Bus Demand 1/Special Status 3.

11.4.2.5 ACA Status Byte 5

Status Byte 5 Phase Green Status bit is set when SEPAC phase output is green.

- ♦ (Bit 7=Phase 08/Bit 0=Phase 01).

11.4.2.6 ACA Status Byte 6

Status Byte 6 Phase Yellow Status bit is set when SEPAC phase output is yellow.

- ♦ (Bit 7=Phase 08/Bit 0=Phase 01)

11.4.2.7 ACA Status Byte 7

Status Byte 7 Phase Detector Call Status bit is set when a call exists for the respective phase vehicle service (Bit 7=Phase 08/Bit 0=Phase 01).

11.4.2.8 ACA Status Byte 8

Status Byte 8 Phase Walk Status bit is set when the SEPAC phase output is walk.

- (Bit 7=Phase 08/Bit 0=Phase 01)

11.4.2.9 ACA Status Byte 9

Status Byte 9 Phase Pedestrian Clear Status bit is set when SEPAC phase output is pedestrian clear.

- (Bit 7=Phase 08/Bit 0=Phase 01)

11.4.2.10 ACA Status Byte 10

Status Byte 10 Pedestrian Call Status bit is set when an actuation occurs on any respective phase pedestrian detector input (Bit 7=Phase 08/Bit 0=Phase 01). SEPAC resets the bit following the transmission of a SCOOT reply message.

11.4.2.11 ACA Status Byte 11

Status Byte 11 Overlap Green Status bit is set when SEPAC overlap output is green (Bit 7=Overlap H/Bit 0=Overlap A).

11.4.2.12 ACA Status Byte 12

Status Byte 12 Overlap Yellow Status bit is set when SEPAC overlap output is yellow (Bit 7=Overlap H/Bit 0=Overlap A).

11.4.2.13 ACA SCOOT Detector 01-02

This byte is the same as STD SCOOT Detector 01–02 (See 11.3.2.5).

11.4.2.14 ACA SCOOT Detector 03-n

This byte is the same as STD SCOOT Detector 03-n (See 11.3.2.6).

11.5 SCOOT Status Screen

From the Main menu (Figure 2-1), select **1-ACTIVE STATUS**.

Figure 11-1 shows the Active Status menu when SCOOT is active and is using a MSG TYPE of STD or ACA.

```
ACTIVE STATUS

  1-RING TIMERS        6-DETECTORS
  2-COORD TIMERS       7-INTERSECTION
  3-PREEMPT TIMERS     8-PORT 1 FRAMES
  4-TIME BASE          9-INPUT / OUTPUT
  5-COMMUNICATIONS     0-MMU MONITORING
  A-SCOOT STATUS
```
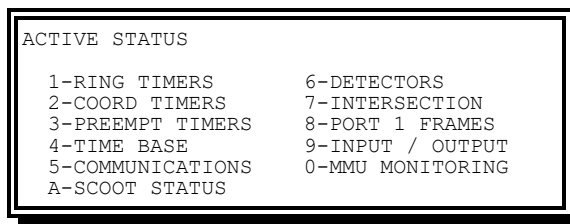
Figure 11-1. Active Status Menu – SCOOT Present

From the Active Status menu (Figure 2-1), select A-SCOOT STATUS.

```
SCOOT STATUS MENU

        1-SCOOT MESSAGE
        2-SCOOT DATA
        3-SCOOT COMM STATUS
```

Figure 11-2. SCOOT Status Menu

From the SCOOT Status menu (Figure 11-2), select 1-SCOOT MESSAGE.

Figure 11-3 shows the standard message type.

```
SCOOT STATUS: SCOOT NOT ACTIVE
MSG IN .: 7E xx xx xx xx xx     CKS :xx
MSG OUT : 7E xx xx xx xx xx
DET : xx xx xx xx xx xx

HOLD: xxxx   OMIT: xxxx   CALL: xxxx
SEC:x    IN:x     OUT:x    TTL:x
```

Figure 11-3. SCOOT Status Display – Standard

Figure 11-4 shows the ACA (extended) message type.

```
SCOOT STATUS: SCOOT NOT ACTIVE
MSG IN .: 7E xx xx xx xx xx xx CKS :xx
MSG OUT : 7E xx xx xx xx xx xx xx xx
DET : xx xx xx xx xx xx xx xx xx xx xx
      xx xx xx xx xx
HOLD: xxxx   OMIT: xxxx   CALL: xxxx
SEC:x    IN:x     OUT:x    TTL:x
```

Figure 11-4. SCOOT Status Display – ACA (Extended)

SEPAC SCOOT Status (Line 1) provides the following information:

- ♦ SCOOT NOT ACTIVE – There are no SCOOT commands for this address.

- ♦ SCOOT WITH NO COORD – SCOOT commands for this address with zero stage force byte.

- ♦ SCOOT STARTING UP – SCOOT commands for this address with non-zero stage force byte for less than three seconds.

- ♦ COORD VIA SCOOT – SCOOT commands for this address with non-zero stage force byte for more than three seconds.

MSG IN (Line 2) – The SCOOT command message for this address with all control escape bytes replaced with the actual data byte.

CKS (Line 2) – The checksum data byte of the SCOOT reply message with all control escape bytes replaced with the actual data byte.

MSG OUT (Line 3 or Lines 3 and 4) – The SCOOT reply message (less detector data and checksum) with all control escape bytes replaced with the actual data byte.

DET (Line 4 or Line 5) – The SCOOT detector data bytes (0–6) of SCOOT reply message with all control escape bytes replaced with the actual data byte.

HOLD (Line 6) – The hold phase mask (Hex) generated from the SCOOT command message.

OMIT (Line 6) – The omit phase mask (Hex) generated from the SCOOT command message.

CALL (Line 6) – The demand (calls) phase mask (Hex) generated from the SCOOT command message.

SEC (Line 7) – Number of seconds elapsed while this display was active.

IN (Line 7) – Number of messages received for this address while this display was active (in SEC time).

OUT (Line 7) – Number of messages this address transmitted while this display was active.

TTL (Line 7) – Number of messages seen on the interface (all addresses) while this display was active.

From the SCOOT Status menu (Figure 11-2) select **2-SCOOT DATA**.

```
SCOOT DATA                COMM: ETHERNET
          STAGE / PHASE HEX MASKS
...A ...B ...C ...D ...E ...F ...G ...H
0022 0044 0084 0048 0088 0011 0021 0012

  SYSTEM DETECTOR HEX MASKS: 0000 0000
  PHASE MODE HEX MASKS ....: 0000
```

Figure 11-5. SCOOT Data Display

LINE 4 DATA – Phase masks (Hex) for each SCOOT stage (left = high order bits and right = low order bits).

LINE 6 DATA – The detector mask (Hex) for SCOOT detectors (Vehicle Detector 01–32) assigned (left = high order bits / right = low order bits).

LINE 7 DATA – The phase mode mask (Hex) for the 16 phases (left = high order bits / right = low order bits).

The default configuration data (prior to any download from central) shall be:

Stage A – Phase 2 and 6

Stage B – Phase 3 and 7

Stage C – Phase 3 and 8

Stage D – Phase 4 and 7

Stage E – Phase 4 and 8

Stage F – Phase 1 and 5

Stage G – Phase 1 and 6

Stage H – Phase 2 and 5

SCOOT Phase Mode Mask – 0x00

11.6   BTCS Message Type

BTCS is short for Boston UTCS.

If configured for a serial port as the MODE, the port shall be configured with 8 data bits, 1 start bit, 1 stop bit, EVEN parity and the programmed baud rate configured in that ports configuration screen.

SEPAC shall send a BTCS Reply Message only as the result of receiving a valid BTCS Command Message.

A BTCS Command Message shall be considered valid if all of the following conditions are met:

1. The decoded address matches the local address

2. The computed CRC value matches the Checksum Byte.

The BTCS Reply Message shall begin between 10 and 20 milliseconds following the end of the BTCS Command Message (Checksum Byte).

Receipt of three valid BTCS Command messages, with at most three seconds between each message, shall cause SEPAC to implement BTCS Control, if Coord Phases are configured on the BTSC Config screen (Figure 2-91). While under BTCS Control, SEPAC shall exercise control in accordance with the BTCS Command Message as defined in Section 11.6.1.

SEPAC shall continue to exercise control in accordance with the BTCS Command Messages until power is interrupted or three seconds has elapsed from receipt of the last valid message.

11.6.1   BTCS Command Message

Table 11-2. BTCS Command Message Bit Order on The Wire																					
FIRST								BIT ORDER ON THE WIRE													LAST
BYTE 1												BYTE 4									
0	1	2	3	4	5	6	7	0	1	.	.	.	6	7	0	1	2	3	4	5	6	7

The BTCS Command message will include the following bytes:

1. Control Byte 1

Bit 0-2 = Local Address (0-7 same as SEPAC System Address modulo 8)
Bit 3 = Not Used
Bit 4 = Hold-On-Line
Bit 5 = Dial Release
Bit 6 = Hold
Bit 7 = Force Off 1

2. Control Byte 2

Bit 0 = Force Off 2
Bit 1 = Flash
Bit 2 = Pedestrian Call
Bit 3 = Call All
Bit 4 = Special Function 1
Bit 5 = Special Function 2
Bit 6 = Special Function 3
Bit 7 = Spare 1

3. Control Byte 3

Bit 0 = Phase Omit
Bit 1 = Free
Bit 2 = Spare 2
Bit 3 = Spare 3
Bit 4 = Spare 4
Bit 5 = Spare 5
Bit 6 = Spare 6
Bit 7 = Spare 7

4. Control Byte 4

Checksum (Exclusive OR of Bytes 1 to 3)

11.6.1.1 Control Byte 1

Local Address Bits

SEPAC shall compare the value of the '**Local Address**' bits to its System Address parameter. System Address is taken modulo 8 to permit a Local Address 0. When a match occurs, SEPAC shall accept the Command message subject to the validation of the Checksum Byte.

Not Used Bit

SEPAC shall ignore the status of the '**Not Used**' bit.

Hold-On-Line Bit

When under BTCS Control and the '**Hold-On-Line**' bit set (1), SEPAC shall implement BTCS Coord Control. During periods of BTCS Coord Control, SEPAC shall:

- o Remove Internal Coord control (Phase Omits, Phase Holds, Pedestrian Omits, etc.) but shall continue to run Coordination in the background (as we do in Priority routines) thereby enabling a transfer from BTCS Control to Internal Coord (MARC System, Time Base, or Interconnect called) in sync with the running pattern.
- o Disable MARC System, Time Base, or Interconnect called Automatic Flash.
- o Utilize the Coord Phase(s) defined in Section 2.3.6.6.4 as the BTCS Coord Phase(s). SEPAC shall cause the BTCS Coord Phase(s) to operate as Non-Actuated

(Vehicle & Pedestrian) regardless of their individual phase programming. All other phases shall operate in accordance with their individual phase programming (actuated or non-actuated).

- o Operate as though the BTCS Coord Phase(s) had a Phase Hold active during periods when the '**Hold**' bit is set (1). This will cause the BTCS Coord Phase(s) to dwell in a Walk Hold state until released by the '**Hold**' bit.
- o Operate as though the Walk Rest Modifier was active. This will cause the BTCS Coord Phase(s) to dwell in a Walk state when the '**Hold**' bit is reset (0) and no serviceable calls exist.
- o Utilize Ped Recycle to cause the BTCS Coord Phase(s) to pickup in a Walk state.
- o Operate as though the Inhibit Maximum Termination input were active on all rings.
- o Recognize inputs / operations that conflict with the BTCS Coord Control and revert to Free mode when the inputs / operations are active. The inputs that conflict are:
    - Stop Time (Any Ring)
    - Manual Control Enable
    - Preemption (Any)
    - Priority (Any)
    - Startup Flash
    - Diagnostic Flash
    - Low Voltage
    - Idle Restart (Data Change caused Restart)

    When Stop Time is NOT assigned and/or Automatic Flash has no Entry Phases programmed, activation of those inputs will result in Free mode.
- o NOT operate Cycling Diagnostics while under BTCS Coord Control.
- o Report in ECOM message 0E & 56 an extended Local Mode 4 for BTCS Control.

Receipt of valid BTCS Command message with the '**Hold-On-Line**' bit reset (0) shall cause SEPAC to discontinue BTCS Coord Control and revert to the next level of Coord control (MARC, Time Base, Interconnect, etc.).

Dial Release Bit

SEPAC shall ignore the status of the '**Dial Release**' bit.

Hold/Yield Bit

When BTCS Coord Control is in effect and the '**Hold/Yield**' bit is set (1), SEPAC shall apply the BTCS Phase Hold on the BTCS Coord Phase(s).

Force Off 1 Bit

When BTCS Coord Control is in effect and the '**Force Off 1**' bit is set (1), SEPAC shall operate as though the Force Off (1) input was active. The logical ring this signal is applied to is dependent on SEPAC's Ring Input Response parameters.

11.6.1.2   Control Byte 2

Force Off 2 Bit

When BTCS Coord Control is in effect and the '**Force Off 2**' bit is set (1), SEPAC shall operate as though the Force Off (2) input was active. The logical ring this signal is applied to is dependent on SEPAC's Ring Input Response parameters.

Flash Bit

When under BTCS Control, BTCS Coord Control is NOT in effect and the '**Flash**' bit is set (1), SEPAC shall activate Remote Flash in accordance with its internal programming.

Ped Call Bit

When under BTCS Control and the '**Ped Call**' bit is set (1), SEPAC shall operate as though it's Time Base Phase Function 11 control was active. With appropriate programming, pedestrian recalls will be applied to the programmed phase(s).

Call All Bit

When under BTCS Control and the '**Call All**' bit is set (1), SEPAC shall operate as though it's Time Base Phase Function 12 control was active. With appropriate programming, vehicle recalls will be applied to the programmed phase(s).

Special Function 1 Bit

When under BTCS Control and the '**Special Function 1**' bit is set (1), SEPAC shall operate as though it's Time Base Special Function 1 control was active. With default programming, Special Function 1 output appears on Conn C - Pin A.

Special Function 2 Bit

When under BTCS Control and the '**Special Function 2**' bit is set (1), SEPAC shall operate as though it's Time Base Special Function 2 control was active. With default programming, Special Function 2 output appears on Conn C - Pin B.

Special Function 3 Bit

When under BTCS Control and the '**Special Function 3**' bit is set (1), SEPAC shall operate as though it's Time Base Special Function 3 control was active. With default programming, Special Function 3 output appears on Conn C - Pin c.

Spare 1 Bit

When under BTCS Control and the '**Spare 1**' bit is set (1), SEPAC shall operate as though it's Time Base Special Function 4 control was active. With default programming, Special Function 4 output appears on Conn A - Pin CC.

11.6.1.3   Control Byte 3

Phase Omit Bit

When BTCS Coord Control is in effect and the '**Phase Omit**' bit is set (1), SEPAC shall operate as though it's Time Base Phase Function 13 control was active. With appropriate programming, phase omits will be applied to the programmed phase(s).

Free Bit

When under BTCS Control, BTCS Coord Control is NOT in effect and the '**Free**' bit is set (1), SEPAC shall:

- o Remove Internal Coord control (Phase Omits, Phase Holds, Pedestrian Omits, etc.) but shall continue to run Coordination in the background (as we do in Priority routines) thereby enabling a transfer from BTCS Control to Internal Coord (MARC System, Time Base, or Interconnect called) in sync with the running pattern.
- o Disable MARC System, Time Base, or Interconnect called Automatic Flash.

Spare 2 Bit

When under BTCS Control and the '**Spare 2**' bit is set (1), SEPAC shall operate as though its Time Base Special Function 5 control was active. With default programming, Special Function 5 output appears on Conn A - Pin r.

Spare 3 Bit

When under BTCS Control and the '**Spare 3**' bit is set (1), SEPAC shall operate as though its Time Base Special Function 6 control was active. With default programming, Special Function 6 output appears on Conn A - Pin y.

Spare 4 Bit

When under BTCS Control and the '**Spare 4**' bit is set (1), SEPAC shall operate as though it's Time Base Phase Function 14 control was active. With appropriate programming, phase omits will be applied to the programmed phases.

Spare 5 Bit

When under BTCS Control and the '**Spare 5**' bit is set (1), SEPAC shall operate as though it's Time Base Phase Function 15 control was active. With appropriate programming, pedestrian omits will be applied to the programmed phases.

Spare 6 Bit

When under BTCS Control and the '**Spare 6**' bit is set (1), SEPAC shall operate as though it's Time Base Phase Function 16 control was active. With appropriate programming, vehicle and pedestrian recalls will be applied to the programmed phases.

Spare 7 Bit

SEPAC shall ignore the status of the '**Spare 7**' bit.

11.6.1.4 Control Byte 4

Checksum Bits

SEPAC shall utilize the '**Checksum**' bits to validate the content of the Command message by doing the Exclusive OR of Bytes 1 to 3

11.6.2 BTCS Reply Message

Table 11-3. BTCS Reply Message Bit Order on The Wire																						
FIRST								BIT ORDER ON THE WIRE														LAST
BYTE 1															BYTE 8							
0	1	2	3	4	5	6	7	0	1	.	.	.	6	7	0	1	2	3	4	5	6	7

The BTCS Reply message will include:

- Reply Byte 1

  Bit 0-7 = Phase Green Status (Bit 0=Phase 8 / Bit 7=Phase 1)

- Reply Byte 2

  Bit 0 = Door
  Bit 1 = Conflict Monitor
  Bit 2 = Flash
  Bit 3 = System Flash
  Bit 4 = Preempt
  Bit 5 = Controller Repaired
  Bit 6 = SP1
  Bit 7 = SP2

- Reply Byte 3

Bit 0-7 = Phase Check Status (Bit 0=Phase 8 / Bit 7=Phase 1)

- Reply Byte 4

   Bit 0-7 = Phase Detector Status (Bit 0=Phase 8 / Bit 7=Phase 1)

- Reply Byte 5

   Bit 0-7 = Pedestrian Detector Status (Bit 7=Phase 8 / Bit 0=Phase 1)

- Reply Byte 6

   Bit 0 = System Detector 4 Volume
   Bit 1 = System Detector 4 Occupancy
   Bit 2 = System Detector 3 Volume
   Bit 3 = System Detector 3 Occupancy
   Bit 4 = System Detector 2 Volume
   Bit 5 = System Detector 2 Occupancy
   Bit 6 = System Detector 1 Volume
   Bit 7 = System Detector 1 Occupancy

- Reply Byte 7

   Bit 0 = System Detector 8 Volume
   Bit 1 = System Detector 8 Occupancy
   Bit 2 = System Detector 7 Volume
   Bit 3 = System Detector 7 Occupancy
   Bit 4 = System Detector 6 Volume
   Bit 5 = System Detector 6 Occupancy
   Bit 6 = System Detector 5 Volume
   Bit 7 = System Detector 5 Occupancy

- Reply Byte 8

   Checksum (Exclusive OR of Bytes 1 to 7)

11.6.2.1   Reply Byte 1

Phase Green Status Bits
   When under BTCS Control, SEPAC shall set '**Phase Green Status**' bit based on the
   following:
         Bit 0 = Load switch 24 Green Status (Assumed to be Phase 8 Green)
         Bit 1 = Load switch 23 Green Status (Assumed to be Phase 7 Green)
         Bit 2 = Load switch 22 Green Status (Assumed to be Phase 6 Green)
         Bit 3 = Load switch 21 Green Status (Assumed to be Phase 5 Green)
         Bit 4 = Load switch 20 Green Status (Assumed to be Phase 4 Green)
         Bit 5 = Load switch 19 Green Status (Assumed to be Phase 3 Green)
         Bit 6 = Load switch 18 Green Status (Assumed to be Phase 2 Green)
         Bit 7 = Load switch 17 Green Status (Assumed to be Phase 1 Green)
   Since any TS 2 logical signal control (Phase # Vehicle, Phase # Pedestrian, or Overlap #
   Vehicle) may be mapped to multiple load switches, Boston needs to map vehicle or
   pedestrian signals to these status returns, and Load Switches 17 to 24 cannot be used -
   this approach was chosen.

11.6.2.2   Reply Byte 2

Door Bit

When under BTCS Control, SEPAC shall set the '**Door**' bit when the 'Indicator Lamp Control' input (Con A - Pin T) is active.

Conflict Monitor Bit

When under BTCS Control, SEPAC shall set the '**Conflict Monitor**' bit when the 'MMU Flash Status' input (Con B - Pin n) is active and SEPAC is NOT in Start Flash, Remote Flash or Fault Flash.

Flash Bit

When under BTCS Control, SEPAC shall set the '**Flash**' bit when any of the following occur:

- o A Type 129 Response Frame from the MMU has Bit 62 reset (0=Red Enable NOT active)
- o When the CVM is False (Startup Flash, Diag Flash, Low Voltage, etc.)
- o During Automatic Flash when the CVM is True

According to TS 2, "the Red Enable input to the MMU shall be connected to the AC Line side of the signal bus relay coil."

The signal bus relay coil is wired in parallel to the flash relay coil except when disconnected by a 'signal off' switch. Therefore, this bit will be set any time the cabinet is in a Flash or Signal Off state.

System Flash Bit

When under BTCS Control, SEPAC shall set the '**System Flash**' bit when it has activated Remote Flash based on MARC System, Time Base or Interconnect called Automatic Flash.

Preempt Bit

When under BTCS Control, SEPAC shall set the '**Preempt**' bit based on any of the following states being active:

- o Manual Control Enable
- o Preemption (Any)
- o Priority (Any)

Controller Repaired Bit

When under BTCS Control, SEPAC shall set the '**Controller Repaired**' bit when any of the following occur:

- o Power is restored
- o A 'Set CU Repair Bit' from the System Data Menu screen

SEPAC shall reset the bit following the transmission of three BTCS Reply Messages with the bit set.

SP1 Bit

When under BTCS Control, SEPAC shall set the '**SP1**' bit when the 'Special Status 1' input (Con A - Pin EE) is active.

SP2 Bit

When under BTCS Control, SEPAC shall set the '**SP2**' bit when the 'Special Status 2' input (Con A - Pin FF) is active.

11.6.2.3   Reply Byte 3

Phase Check Status Bits

When under BTCS Control, SEPAC shall set a '**Phase Check Status**' bit based on the respective Phase Check output being ON. SEPAC shall reset the bit based on the respective Phase Check output being OFF.

Bit 0 = Special Detector 8 assigned Phase Check
Bit 1 = Special Detector 7 assigned Phase Check
Bit 2 = Special Detector 6 assigned Phase Check
Bit 3 = Special Detector 5 assigned Phase Check
Bit 4 = Special Detector 4 assigned Phase Check
Bit 5 = Special Detector 3 assigned Phase Check
Bit 6 = Special Detector 2 assigned Phase Check
Bit 7 = Special Detector 1 assigned Phase Check

11.6.2.4 Reply Byte 4

Phase Detector Status Bits

When under BTCS Control, SEPAC shall set a '**Phase Detector Status**' bit based on an actuation of any respective Phase Vehicle Detector input. SEPAC shall reset the bit following the transmission of a BTCS Reply Message.

Bit 0 = Special Detector 8 assigned Phase Vehicle Detector
Bit 1 = Special Detector 7 assigned Phase Vehicle Detector
Bit 2 = Special Detector 6 assigned Phase Vehicle Detector
Bit 3 = Special Detector 5 assigned Phase Vehicle Detector
Bit 4 = Special Detector 4 assigned Phase Vehicle Detector
Bit 5 = Special Detector 3 assigned Phase Vehicle Detector
Bit 6 = Special Detector 2 assigned Phase Vehicle Detector
Bit 7 = Special Detector 1 assigned Phase Vehicle Detector

11.6.2.5 Reply Byte 5

Pedestrian Detector Status Bits

When under BTCS Control, SEPAC shall set a '**Pedestrian Detector Status**' bit based on an actuation of any respective Phase Pedestrian Detector input. SEPAC shall reset the bit following the transmission of a BTCS Reply Message.

Bit 0 = Special Detector 8 assigned Phase Pedestrian Detector
Bit 1 = Special Detector 7 assigned Phase Pedestrian Detector
Bit 2 = Special Detector 6 assigned Phase Pedestrian Detector
Bit 3 = Special Detector 5 assigned Phase Pedestrian Detector
Bit 4 = Special Detector 4 assigned Phase Pedestrian Detector
Bit 5 = Special Detector 3 assigned Phase Pedestrian Detector
Bit 6 = Special Detector 2 assigned Phase Pedestrian Detector
Bit 7 = Special Detector 1 assigned Phase Pedestrian Detector

11.6.2.6 Reply Byte 6

System Detector 1-4 Volume Bits

When under BTCS Control, SEPAC shall accumulate Volume for each System Detector. SEPAC shall set the respective '**System Detector Volume**' bit whenever the accumulated volume is greater than zero. SEPAC shall reduce the accumulated volume by one for each transmission of a BTCS Reply Message where the bit is set.

Bit 0 = System Detector 4 End of Vehicle

     Bit 2 = System Detector 3 End of Vehicle
     Bit 4 = System Detector 2 End of Vehicle
     Bit 6 = System Detector 1 End of Vehicle

System Detector 1-4 Occupancy Bits

When under BTCS Control, SEPAC shall accumulate Occupancy for each System Detector. SEPAC shall set the respective '**System Detector Occupancy**' bit whenever the accumulated occupancy exceeds one second. SEPAC shall reduce the accumulated occupancy by one second for each transmission of a BTCS Reply Message where the bit is set.

     Bit 1 = System Detector 4 Occupancy
     Bit 3 = System Detector 3 Occupancy
     Bit 5 = System Detector 2 Occupancy
     Bit 7 = System Detector 1 Occupancy

11.6.2.7   Reply Byte 7

System Detector 5-8 Volume Bits

When under BTCS Control, SEPAC shall accumulate Volume for each System Detector. SEPAC shall set the respective '**System Detector Volume**' bit whenever the accumulated volume is greater than zero. SEPAC shall reduce the accumulated volume by one for each transmission of a BTCS Reply Message where the bit is set.

     Bit 0 = System Detector 8 End of Vehicle
     Bit 2 = System Detector 7 End of Vehicle
     Bit 4 = System Detector 6 End of Vehicle
     Bit 6 = System Detector 5 End of Vehicle

System Detector 5-8 Occupancy Bits

When under BTCS Control, SEPAC shall accumulate Occupancy for each System Detector. SEPAC shall set the respective '**System Detector Occupancy**' bit whenever the accumulated occupancy exceeds one second. SEPAC shall reduce the accumulated occupancy by one second for each transmission of a BTCS Reply Message where the bit is set.

     Bit 1 = System Detector 8 Occupancy
     Bit 3 = System Detector 7 Occupancy
     Bit 5 = System Detector 6 Occupancy
     Bit 7 = System Detector 5 Occupancy

11.6.2.8   Reply Byte 8

Checksum Bits

Exclusive OR of prior seven bytes

11.6.3   BTCS Status Screen

Figure 11-6 shows the Active Status menu when UTCS is active with MSG TYPE of BTCS.

```
ACTIVE STATUS

  1-RING TIMERS        6-DETECTORS
  2-COORD TIMERS       7-INTERSECTION
  3-PREEMPT/PRIORITY   8-PORT1/ITS FRAMES
  4-TIME BASE          9-INPUT / OUTPUT
  5-COMMUNICATIONS     0-MMU/CMU MONITOR
  A-BTCS STATUS
```
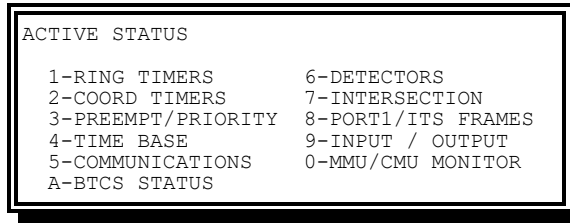
Figure 11-6 Active Status Menu with BTCS Status

From the Active Status menu (Figure 11-6), select **A-BTCS STATUS**.

```
BTCS STATUS MENU

        1-BTCS STATUS
        2-BTCS COMM STATUS
```
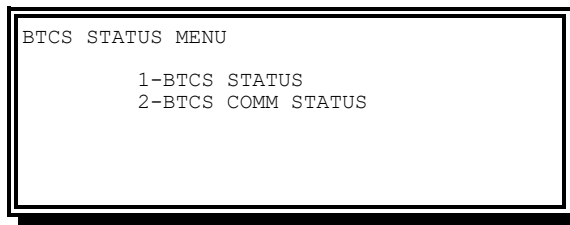
Figure 11-7 BTCS Status Menu screen with BTCS Status

From the BTCS Status menu (Figure 11-7), select **1-BTCS STATUS**.

```
BTCS STATUS
  HOL..: NO     CALL ALL: NO     SP1: NO
  HOLD.: NO     PED CALL: NO     SP2: NO
  FO1..: NO     DIAL REL: NO     SP3: NO
  FO2..: NO                      SP4: NO
  FLASH: NO     SF1.....: NO     SP5: NO
  POMIT: NO     SF2.....: NO     SP6: NO
  FREE.: NO     SF3.....: NO     SP7: NO
```
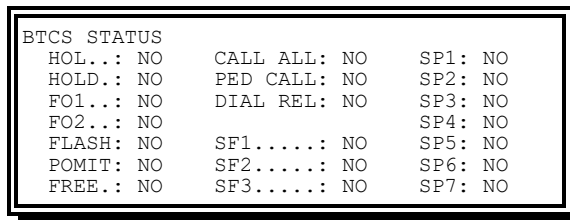
Figure 11-8 BTCS Status Screen

This screen shows a YES or NO for status of the corresponding bit of the BTCS message frame.

To properly configure for BTCS Operation, at a minimum UTCS must be active and configured to a MSG TYPE of BTCS and COORD PHASES must be configured in the BTCS Config screen (Figure 2-91).

When under BTCS Control, SEPAC shall populate the screen with the current status. When not under BTCS Control, the YES/NO status area will show up blank. This can be used as an indicator of functioning communication.

11.6.4   BTCS Config Screen

From the Active Status menu (Figure 11-6), select **A-BTCS STATUS**.

```
BTCS STATUS MENU

        1-BTCS STATUS
        2-BTCS COMM STATUS
```
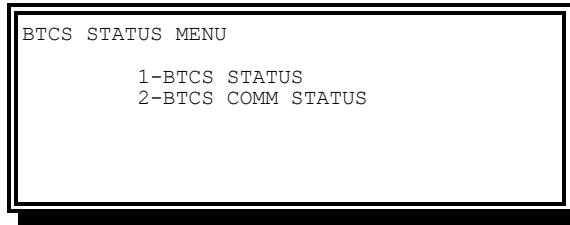
Figure 11-9 BTCS Status Menu screen with BTCS Status

From the BTCS Status Menu (Figure 11-9) select **2-BTCS COMM STATUS**.

```
BTCS COMM STATUS        COMM:   ETHERNET
  LOCAL ADDRESS.: 0
  MASTER IP ADDR: 0.0.0.0
  MASTER PORT...: 0
  RECEIVED OK...: 0
  RECEIVED BAD..: 0
  TRANSMITTED...: 0
                              C-CLEAR
```
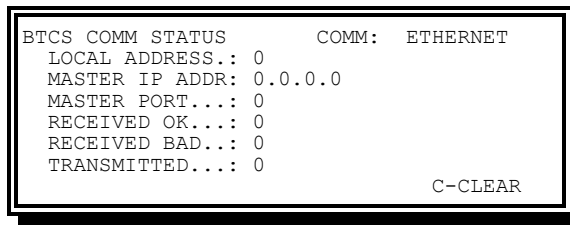
Figure 11-10 BTCS Comm Status Screen (Default Data)

This screen shows various communication status diagnostics.

- Local Address: The BTCS Address that the controller is responding to

- Master IP Address: The IP address of the SCOOT Comm Server. If this toggles between multiple addresses, it indicates that multiple SCOOT Comm Servers are attempting to control this intersection.

- Master Port: The IP port in use on the SCOOT Comm Server

- Received Ok: The number of valid BTCS poll messages received since power up or clear

- Received Bad: The number of invalid BTCS poll messages received since power up or clear (serial only)

- Transmitted: The number of BTCS replies sent to the SCOOT Comm server since power up or clear. This should be the same value as Received OK.

12 External Detection

12.1 Sensys Wireless Magnetometer Setup Example

The example below shows a Sensys AP and two other devices being used in conjunction. It also highlights three errors to be corrected. Note the problem with Device 1, an AP. The Error indicator is showing because one of the sensors was damaged during recent construction. Device 2, Camera 10.227.180.192, was also damaged during the construction, but its replacement was misconfigured to be Device 4 instead of 2. Thus, calls are being forced for the two detectors on the device where it was originally, and a spoof warning is issued for the device where it is trying to be.

Cameras utility, version 1.4 (OS-9).
Viewing external detection data from Cameras, Magnetometers, etc.

```
Dev#   IP Address      12345678 90123456 78901234 56789012  Status  Timestamp
  1  10.227.8.24       -------C|------..|........|........  m- -E-  1173863505ms
  2  10.227.180.192    ........|........|........|FF......  c- --W  1173863922ms
  3  0.0.0.0           ........|........|........|........  -- ---         0ms
  4  10.227.180.191    ........|........|--------|........  cf S--  1173863263ms
  5  0.0.0.0           ........|........|........|........  -- ---         0ms
  6  0.0.0.0           ........|........|........|........  -- ---         0ms
  7  0.0.0.0           ........|........|........|........  -- ---         0ms
  8  0.0.0.0           ........|........|........|........  -- ---         0ms

Dev#   IP Address      34567890 12345678 90123456 78901234  Status  Timestamp
  9  0.0.0.0           ........|........|........|........  -- ---         0ms
 10  0.0.0.0           ........|........|........|........  -- ---         0ms
 11  0.0.0.0           ........|........|........|........  -- ---         0ms
 12  0.0.0.0           ........|........|........|........  -- ---         0ms
 13  0.0.0.0           ........|........|........|........  -- ---         0ms
 14  0.0.0.0           ........|........|........|........  -- ---         0ms
 15  0.0.0.0           ........|........|........|........  -- ---         0ms
 16  0.0.0.0           ........|........|........|........  -- ---         0ms
    Detector: .-none, --no call, C-call, F-forced call, =-forced no-call
    Status: S-ID Spoof, E-Err/LoVis, W-Watchdog, c-Cam, m-Mag, f-Fail to off
    Device list saved across reboots.
Grp: Det=0x00000000 03000080 Used=0x00000000 03FF3FFF OffLn=0x00000000 03000000
Hit <cr>-new snapshot, r-reset data, d-del list, s-save list, <other>-quit:
```

Figure 12-1. Sensys Wireless Magnetometer Setup Example

12.2 Sensys Wireless Magnetometer Setup for SEPAC

This section contains notes and suggestions for setting up wireless magnetometers from Sensys Networks, Inc. to work directly with SEPAC without requiring Sensys' Contact Closure cards. They apply to video_detect 1.4 running on SEPAC 3.36 or higher, and SEPAC 4.05 or

higher. Also included are notes for correctly coordinating with other devices, which share a common interface into SEPAC.

Having Sensys wireless magnetometer APs talk directly to SEPAC over TCP/IP has several features and limitations. The main feature is that Sensys Contact Closure (CC) cards are not needed. This reduces or eliminates detector racks, reduces power consumption, and reduces the overall cost. Also, if networking is provided between intersections, a single AP can talk to controllers at adjacent intersections, providing easy upstream detection. The first limitation is that not all the CC card features are available (delay, extend, pulse, and logical OR). However, delay and extend features can be done by SEPAC, along with logical OR'ing when phase assignments are made. The second limitation is latency. The CC card and AP together can run in a special fixed latency mode for use in speed detection, whereas direct reporting latency for an AP in default latency mode varies randomly between 0.001 and 0.126 seconds (nominal) for network detection.

There are no special SEPAC screens related to setting up the magnetometers. It is all done in the AP using TrafficDOT 1.9.0-2 or later. Results are viewed with the cameras utility on the controller.

There are three goals to meet when configuring network reporting detectors:

> Two or more devices must not attempt to control the same detector.
>
> An AP should not attempt to control a detector that is controlled by other hardware.
>
> An AP should be configured in a consistent, sensible way for easy testing and troubleshooting.

This section provides information to help meet these goals and to assist agencies in creating consistent standards. It presumes that the AP is running v1.8.0.1 or higher firmware, that the AP and sensors have already been fully configured as specified in the Sensys manual, and that the system is operational except for sending detection information to the SEPAC controller.

12.2.1   Enable Access Points

The AP has a special mode, STS, which must be turned on to talk to Yunex Traffic traffic controllers. The AP must be running v1.8.0.1 or higher firmware to have this mode available. The mode selector is found on the Others tab of the System Configuration dialog (System > Configuration). The STS Enable option box should be checked, as shown in Figure 12-2, then saved to the AP (Operations > Save).
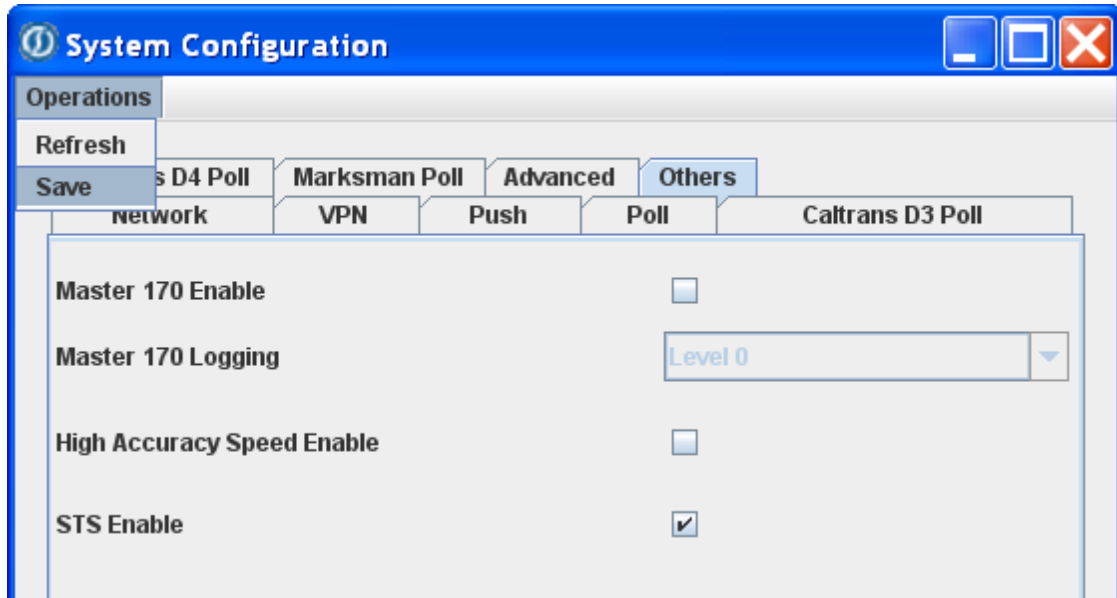
Figure 12-2. System Configuration Screen

12.2.2   DOT Table Configuration

The mapping of sensors to controller detectors is done in the Dot Table (Configure > Dot Table...) by adding a special form of comment in the Description column for each sensor. The comment must be of the form:

<IP Address>-<Output Group>-<Output Number>

For example: 192.168.1.3-1-30

Figure 12-3. DOTS Configuration Screen

12.2.2.1   IP Address

The IP address is that of the SEPAC controller that needs the detection information. Only numeric IP addresses are accepted. Because each sensor has its own IP address entry, a single AP can talk to many controllers.

12.2.2.2   Output Group

The Output Group is the same as the Device ID number in SEPAC. The value range is 0–255, but only 1–16 is recognized by SEPAC. A sensor may need to be placed in a particular output group for various reasons:

> Because the Device ID must be unique among all the APs and Other devices reporting to a particular controller

> Because SEPAC is limited to 32 outputs, but an AP can have up to 54 sensors

> To place a particular sensor into the desired detector range, as described below.

In SEPAC, the device ID is only used to select which detector group the sensor will work with. Devices 1–8 work only with Detectors 1–32, and Devices 9–16 work only with Detectors 33–64. All other device IDs are ignored.

> Recommended Practice – For local intersection sensors, use Output Group 1 for Detectors 1–32 and 9 for Detectors 33–64.

> Recommended Practice – For sensors sent to a downstream controller, use an Output Group that matches the downstream controller's phase number for the approaching traffic. If other devices are in use on the downstream intersection,

subtract one from the phase number. To access Detectors 33–64, add eight to the number it would otherwise have. For example, if Phase 2 is northbound traffic in the corridor, the northbound exit sensors would be sent to the next controller north in Group 2 (or 10), and southbound exit sensors to the next controller south in Group 6 (or 14).

12.2.2.3 Output Number

The output number maps the sensor into the set of 32 detectors in a detector group. The legal value range is 1–32. The combination of output group and output number allow any of the 64 vehicle detectors to be accessed. For Groups 1–8, the output Number is the same as the final detector number. For Groups 9–16, the output number + 32 is the final detector number. The following are two examples:

> Sensor 9A37 is mapped to Group 1, Output 12 (w.x.y.z-1-22), so it will show up as Detector 22 (0+22).

> Sensor 9A3C is mapped to Group 9, Output 6 (w.x.y.z-9-6), so it will show up as Detector 38 (32+6).

> **NOTE: It is not possible to logically OR two sensors by assigning them to the same detector.**

12.2.3 Recommendations Based on Cabinet Type

There is no single way to set up APs that work in all cabinets and situations. The following are general recommendations designed to keep the network detectors outside the normal detector hardware range for each cabinet type. This is to prevent a situation where a network detector and a loop detector are attempting to manage the same detector input. Individual traffic agencies may choose to establish more specific recommendations or standards.

As stated in the goals at the beginning of this document, care should be taken not to have an AP attempt to control the same detection inputs as any loop detectors, etc., that might be present. Any other configuration is acceptable, except as noted, but it is best if the Sensys sensors do not coincide with detection inputs being managed by field I/O hardware or SIUs. Such configurations can limit the controller's ability to generate reportable faults if there are problems with the AP. It also allows the possibility of someone accidentally installing a conflicting loop detector card. Thus, the information in the following sections is especially important when there are loops being used in conjunction with Access Points or cameras.

> **NOTE: Texas Diamond mode is not recommended with network detection, because specific detectors are used for predefined purposes. CC cards are recommended instead, as they will supply proper detector error reporting and the logical OR needed to simulate longer detector loops.**

12.2.3.1 NEMA TS-1

In TS-1, there are eight vehicle detector inputs on the A, B, and C connectors. However, extensions in SEPAC allow for 8, 16, 20, or 32 vehicle detectors to be supported by the field I/O. All detectors are available for the AP use, but mapping a sensor to a detector supported

by the field I/O may result in the Detector Fault Report not correctly showing On Line, Fail Det Wdog, and Fail Support messages for the cameras.

> Recommended practice – Use ABC input mode 0, 10, 11, or 19 that supports only Detectors 1–8 on the field I/O, and then map the sensors beginning with Detector 9 for up to 56 sensors.

> Alternate practice – Map the sensors starting at Detector 33 regardless of the ABC input mode. This would be appropriate for situations where the local intersection is using loop controllers but is receiving upstream detections from one or more APs.

12.2.3.2   NEMA TS-2

The number and location of the detector inputs varies with the number and addresses of the detector BIUs installed. Sensors must not be mapped into the range of an active detector BIU, even if no detector cards are present for that detector.

> Recommended practice – Map sensors beginning with the lowest one that is not accessible to an installed detector BIU, such as 1, 17, 33, or 49.

> Alternate practice – Always map sensors beginning at Detector 33, provided that no more than two detector BIUs are in use.

12.2.3.3   Caltrans 2070

The standard 2070 with -2a field I/O supports Detectors 1–38 with skips for a total of 28. Thus, the sensors could start as low as Detector 39 without overlapping. Though all detectors are actually available for use, mapping to a detector supported by the field I/O may result in the Detector Fault Report not correctly showing On Line, Fail Det Wdog, and Fail Support messages for the sensors. If sensors must be mapped to an FIO supported detector, put labeled block outs on the vulnerable slots to prevent the insertion of a detector card.

> Recommended practice – Map sensors beginning with Detector 39 for up to 26 sensors.

> Alternate practice – For the largest intersections, sensors may also be mapped to the ten skipped detectors: 2, 8, 10, 16, 20, 26, 27, 28, 30, and 36, and then use 39–64 for a total of 36 sensors.

12.2.3.4   Nassau County 2070

The Nassau County variant of the 2070 brings in Detectors 1–28 from the field I/O. Thus, sensors could start at 29 without overlapping the FIO. Though all detectors are available for use, mapping to a detector supported by the field I/O may result in the Detector Fault Report not correctly showing On Line, Fail Det Wdog, and Fail Support messages for the sensors.

Recommended practice – Map sensors beginning with Detector 29 for up to 36 sensors.

12.2.3.5   ATC and ITS

The number of the detector inputs available for sensors depends on which input assemblies are active. Mapping sensors into the range of an active input assembly may result in the Detector Fault Report not correctly showing On Line, Fail Det Wdog, and Fail Support

messages for the sensors. With only Input Assembly 1 active, sensors may be mapped beginning with Detector 23. With Input Assembly 1 and 2 active, detectors may begin with Detector 43. If sensors must be mapped to an active input assembly, place labeled block outs on the vulnerable slots to prevent the insertion of a detector card.

> Recommended practice, Input Assembly 1 alone – Map sensors beginning with Detector 23 for up to 42 sensors.

> Recommended practice, Input Assembly 1 and 2 – Map sensors beginning with Detector 43 for up to 22 sensors. This might be the case where inductive loops are used for the local intersection, but Sensys sensors are bringing detections from upstream.

> Alternate practice – Use Input Assembly 4 only, making all system and pedestrian detectors available along with two preempts, and leaving all 64 vehicle detectors available for sensors.

12.2.3.6 ITS/CBD (v1)

The CBD variant reads only Detectors 1–12 from the input file. Thus, the sensor mapping could start as early as Detector 13.

> Recommended practice – Map sensors beginning with Detector 13 for up to 52 sensors.

12.2.3.7 ITS/CBD v2

The CBD v2 variant reads only Detectors 1–24 from the input file. Thus, the sensor mapping could start as early as Detector 25.

Recommended practice – Map sensors beginning with Detector 25 for up to 40 sensors.

12.2.4 The Cameras Utility

The cameras utility is available to help the user see how network detection devices (cameras, priority devices and access points) are configured and how they are interacting with the controller. It also determines whether or not devices are remembered when the controller reboots. This utility may only be run from a terminal connected to the controller's console port or from a telnet session to the controller. The utility shows:

- the version of cameras utility,

- the IP address associated with each device,

- which detectors are controlled by a device,

- the state of the detectors when the snapshot was taken,

- the type of the device: camera/priority or magnetometer,

- the failure mode: fail-to-on or fail-to-off,

- any warning or error status information about the camera,

- a timestamp to confirm that new messages are arriving,

- and whether or not a boot up configuration file has been saved.

This aids the user in making sure that:

- no two devices have the same device ID (spoof warning),

- each device is controlling the intended detectors,

- no detector is controlled by more than one device,

- all devices are alive and reporting,

- and that any devices which fail to come back on line after a power failure or controller reboot will cause forced calls or be ignored.

The utility also allows the entire data area to be reset without resetting the controller. A reset is useful when a device is taken off line permanently, when it is given a new ID number, or whenever the configuring of devices has confused the controller in some way.

12.2.4.1   Telneting In

Since Access Points may be configured remotely, it is important that the cameras utility also be available remotely. This is done by establishing a telnet session to the controller, just as would be done to view the screen utility. There are at least two ways to do this on Windows machines: from the command prompt (DOS prompt), or from Hyperterminal, although the command prompt is easier. From a Windows command prompt or Linux shell, enter `telnet <IP_Address>`.

Examples: `telnet 192.168.1.21, telnet main-at-5th`

This should give a `User name?:` prompt on OS-9 controllers or a `login:` prompt on Linux controllers. Enter the user name and password as defined by your agency to complete the login. For Linux controllers, it is also necessary to su to root. Now enter the command cameras at the $ prompt.

OS-9 example:

```
OS-9/68K V3.2   Siemens CPU2070E - 68300   09/12/02 14:22:46


User name?: super

Password:

Process #38 logged on    09/12/02 14:22:50

Welcome!


$ cameras
```

Linux example:

```
Welcome to ATCnx

atc-nx login: admin

Password:

$ su root

Password:
```

```
$ cameras
```

12.2.4.2 Setting Up

When cameras, access points, or priority inputs are being set up, start the cameras utility, and delete any saved device list by hitting **d<enter>**. At this point, resetting the controller or hitting **r<enter>** will permanently reset the data in the table. The devices may be configured and reconfigured as needed. Once all the devices are set up and working correctly, hit **s<enter>** to save the device list. Now the controller will expect to see all the devices whenever it boots. If a device does not show up, calls will be forced for the detectors controlled by that device until it comes back on line.

Don't forget to use the cameras utility to save a new device list whenever permanent changes are made to the reporting configuration of a sensor or the number of sensors reported by an AP, or if the address of the AP is changed. If this is not done, the controller may end up with ghost devices or detectors the next time it reboots.

12.2.4.3 Status Info

The status columns indicate several things about each device. The first column displays the device type: **c** for EagleVision camera or IntelliCorr device, and **m** for Sensys magnetometer. The second column indicates the failure mode: dash for fail-to-on, f for fail-to-off mode. The next group of three columns display only warning or errors and should normally be blank, i.e., ---. The warning and errors are:

- S – Spoof warning: another device is attempting to spoof or use the same device number as the device listed. This could be at the local intersection or anywhere else on the network. This problem needs to be corrected because if the local device ever goes off line for more than 45-60 seconds, the spoofing device will become the "real" device, putting calls on unexpected detectors at strange times.

- E – Detector Error warning: the Access Point is no longer communicating with one or more of its sensors and is forcing calls accordingly. Use TrafficDOT to discover and replace any failed sensor as soon as possible. (Note: for cameras this indicates low visibility.)

- W – Watchdog error: the Access Point has failed the watchdog check: at least three messages in five seconds. Forced calls are being placed for all detectors controlled by the device, indicated by F instead of C in the call table. Check for power to the AP and proper network connectivity.

The example in Figure 12-1 shows a Sensys Access Point and two EagleVision cameras being used in conjunction. One camera is being used as a fail-to-off device. It also highlights three errors to be corrected. Note the problem with device 1, an AP. The Error indicator is showing because one of the sensors was damaged during recent construction. Device 2, camera 10.227.180.192, was also damaged during the construction, but its replacement was misconfigured to be device 4 instead of 2. Thus, calls are being forced for the two detectors on the device where it was originally, and a spoof warning is issued for the device where it is trying to be.

12.2.5   Testing the System

When the devices have been configured, the entire system may be tested to ensure that a particular device output is activating the expected detector in the controller. Set the SEPAC controller to Screen 1-9-5 to view the final detector outputs. Bring up TrafficDOT's main window. Pass a metal object over each sensor in turn and confirm that TrafficDOT and SEPAC agree on the detection.

13 NEMA Hardware

This chapter refers to m60 series controllers as well as legacy m50 controllers. The part number for the older m50 manual is:

PIM-177D for EPACM50 hardware

13.1   Specifications

13.1.1   Power Input

- Voltage – 89 to 135 VAC

- Frequency – 57 to 63 Hz

- Power – 25 watts at 120 VAC

13.1.1.1   Power Interruption

A power interruption is defined as 0 volts AC.

Two or more power interruptions that are separated by power restorations of 1500 or more milliseconds are considered to be separate interruptions.

Three interruptions of 300 milliseconds or less that are separated by power restorations of 300 milliseconds or more will not cause the CU to revert to its start-up state.

The CU will react to a power interruption, upon restoring power, as follows:

- Interruption of 500 milliseconds or less: Continue to operate as though the power interruption had not occurred.

- Interruption of more than 500 milliseconds and less than 1000 milliseconds: Continue to operate or revert to its start-up state.

- Interruption of 1000 milliseconds or more: Revert to its start-up state.

13.1.2   Environment

- Temperature – -30°F (-34°C) to +165°F (+74°C). Rate of change is not to exceed 30°F (17°C) per hour at the maximum relative humidity of 95%.

- Humidity – Not to exceed 95% relative over the temperature range of +40°F (4°C) to 110°F (43°C) declining to 18% at 165°F (74°C).

13.1.3   Physical

The CU conforms to the physical requirements detailed in the following sections.

13.1.3.1 Dimensions

Dimensions – 15.5 in. wide x 8.25 in. high x 10.25 in. deep; does not include mating connectors.

13.1.3.2 Dimensions

M60-NEMA – Approximately 8.4 lbs.

M60-ATC – Approximately 10 lbs.

13.1.3.3 Design

The CU is of modular design. Circuit boards are readily accessible for maintenance. All fuses, connectors, and controls are accessible from the front of the CU.

13.1.3.4 Rigid Printed Circuit Assemblies

13.1.3.4.1 Materials

All printed circuit boards are made from NEMA FR-4 glass epoxy or equivalent (see NEMA LI 1-1989, Industrial Laminated Thermosetting Products).

13.1.3.4.2 Mating Surfaces

All electrical mating surfaces are made of non-corrosive material.

13.1.3.4.3 Component Identification

The printed circuit assemblies are designed so that each component is identified with a circuit reference symbol. The identification is etched or silk screened on circuit boards.

13.1.4 Timing

Accuracy – Timing is accomplished by digital methods. Any timed interval will not deviate more than ±100 milliseconds based on its set value at a power line frequency of 60 Hz.

13.1.5 Programming

35-position keypad

13.1.6 Memory

FLASH memory. No battery is required to maintain operating parameters while power is off.

13.1.7 Display

Liquid crystal 16 line by 40 characters per line alpha-numeric display for parameter entry and viewing.

13.2   Interface Standards

Type 1 CU uses an input/output interface conforming to the requirements of NEMA TS 2. See TS 2-2016 Chapter 3, Section 3.3 for all input/output functions with the terminals and facilities, MMU, detector rack(s), and auxiliary devices.

Type 2 CU uses an input/output interface conforming to the requirements of NEMA TS 2. See TS 2-2016 Chapter 3, Section 3.3 for all input/output functions with the terminals and facilities, MMU, detector rack(s), and auxiliary devices.

The CU provides an input/output interface meeting the requirements detailed in the following sections.

13.2.1   Port 1 Physical and Protocol

Port 1 is used to facilitate communications between the CU, the terminal and facilities, the MMU, and the detector rack(s), as defined in NEMA TS 2-2016. Port 1 may also be used for manufacturer's use.

The Port 1 uses a 15-pin metal shell D sub-miniature type connector. When it is desirable to disable all Port 1 communications activity, all Port 1 addresses must be defined as not present through program entry or Pin 10 may be connected to Pin 8 on the Port 1 connector.

It is necessary to disable all Port 1 communications activity when a CU meeting the requirements of this standard is installed in a controller assembly that has no accommodation for Port 1, such as a controller assembly meeting the requirements of NEMA Standard TS 1-1989.

Input/output connector pin terminations of the Port 1 SDLC interface are in accordance with the data in Table **13**-**1**.

Pin	Function	I/O
Table 13-1. 15-Pin (Receptacle) AMP #205205-1 or Equivalent		
1	Tx Data +	O
2	Logic Ground	–
3	Tx Clock +	O
4	Logic Ground	–
5	Rx Data +	I
6	Logic Ground	–
7	Rx Clock +	I
8	Logic Ground	–
9	Tx Data -	O
10	Port 1 Disable	I
11	Tx Clock -	O
12	Earth Ground	–
13	Rx Data -	I
14	Reserved	
15	Rx Clock -	I

13.2.1.1.1 Port 1 Protocol

The transfer of data takes place by means of the Synchronous Data Link Control (SDLC) protocol. The data transfer rate is 153,600 bits per second, plus or minus one percent.

See Chapter 15 for more detail on the Port 1 Protocol.

13.2.2   Port 2 RS-232 Interface

A Port 2 RS-232 data terminal equipment (DTE) interface and connector is provided for a local personal computer or a remote personal computer through an external modem.

The Port 2 connector is mounted on the front of the CU and uses a 25-pin D sub-miniature type female connector. The connector is equipped with latching blocks.

Input/output connector pin terminations of the Port 2 RS-232 interface are in accordance with the data in Table **13**-**2**. Note that the Port 4 system console interface is also included on this connector.

Table 13-2. 25-Pin (Receptacle) AMP #205207-1 or Equivalent		
Pin	**Function**	**I/O**
1	Earth Ground (FG)	–
2	Transmit Data (TD)	To DCE
3	Receive Data (RD)	From DCE
4	Request to Send (RTS)	To DCE
5	Clear To Send (CTS)	From DCE
7	Logic Ground (SG)	–
8	Data Carrier Detect (DCD)	From DCE
14*	Secondary Transmit Data (STD)	From DTE
16*	Secondary Receive Data (SRD)	To DTE
20	Data Terminal Ready (DTR)	To DCE
22	Ring Indicator (RI)	From DCE
6, 9-13, 15, 17-19, 21, and 23-25 Not Used RS-232 Pin 1 reference is Frame Ground RS-232 Pin 7 reference is Signal Ground *Port 4 / system console		

13.2.3   Port 3 System Interface

A Port 3 interface and connector are provided for interconnecting the CU to the system interconnect lines.

13.2.3.1   FSK System Interface

The FSK system interface provides two-wire half duplex or four-wire full duplex communications over an unconditioned Type 3002 voice-grade private line channel or equivalent customer-owned cable.

Note: NTCIP was not designed or developed to be used over a 1200 baud FSK communication channel. Due to the packet size of NTCIP communications, either serial or IP communications must be used.

13.2.3.1.1 Connector

The Port 3 FSK connector is mounted on the front of the CU and is a 9-pin metal shell D sub-miniature type connector. The connector is equipped with latching blocks.

Input/output connector pin terminations of the optional Port 3 FSK interface are in accordance with the data in Table **13**-**3**.

Table 13-3. 9-Pin (Plug) AMP #205204-1 or Equivalent		
Pin	Function	I/O
1	Audio Transmit 1	O or I/O*
2	Audio Transmit 2	O or I/O*
3	Reserved	
4	Audio Receive 1	I
5	Audio Receive 2	I
6	Earth Ground	–
7	Reserved	
8	Reserved	
9	Earth Ground	–

*When a half duplex modem is used, the two-wire interconnect uses only Pin 1 and Pin 2.

13.2.3.1.2 Transmission Method

Communications over the system interface uses time division multiplex techniques. Transmissions use phase coherent frequency shift keying (FSK) modulation at a data rate of 1200 bps. The data format is asynchronous, bit serial.

13.2.3.1.3 Transmitter Characteristics

The transmitter portion of the system interface is a digital to FSK modulator. Output level is 0 dBm $\pm$15% into a 600-ohm load. Frequency stability of the transmitted signal is $\pm$5% over the CU operating temperature range. Transmit frequencies are 1200 Hz for MARK (logic 1) and 2200 Hz for Space (logic 0).

13.2.3.1.4 Receiver Characteristics

The receiver portion of the system interface is a FSK to digital demodulator. Receiver sensitivity is a minimum of –34dBm. In band signal-to-noise ratio is 10dB or greater.

13.2.3.2   Port 3 Expansion (M60-NEMA Only)

13.2.3.2.1 Port 3 RS-232

Input/output connector pin terminations of the Port 3 RS-232 DTE interface are in accordance with the data in Table 13-4 and Table 13-5.

Models with a 25-pin connector

Table 13-4. 25-Pin (Receptacle) AMP #205207-1 or Equivalent		
Pin	**Function**	**I/O**
1	Earth Ground (FG)	–
2	Transmit Data (TD)	To DCE
3	Receive Data (RD)	From DCE
4	Request to Send (RTS)	To DCE
5	Clear To Send (CTS)	From DCE
7	Logic Ground (SG)	–
8	Data Carrier Detect (DCD)	From DCE
20	Data Terminal Ready (DTR)	To DCE
22	Ring Indicator (RI)	From DCE
6, 9-19, 21, and 23-25 Not Used • RS-232 Pin 1 reference is Frame Ground • RS-232 Pin 7 reference is Signal Ground		

Models with a 9-pin connector

Table 13-5. 9-Pin (Receptacle) AMP #205203-1 or Equivalent		
Pin	**Function**	**I/O**
1	Data Carrier Detect (DCD)	From DCE
2	Receive Data (RD)	From DCE
3	Transmit Data (TD)	To DCE
4	Data Terminal Ready (DTR)	To DCE
5	Logic Ground (SG)	–
7	Request to Send (RTS)	To DCE
8	Clear To Send (CTS)	From DCE
9	Not Used	
• RS-232 Pin 5 reference is Signal Ground • RS-232 connector shell is Frame Ground		

13.2.3.2.2 Port 3 Fiber Optic

The optional fiber optic interface provides a Port 3 dual fiber optic converter.

The fiber optic interface card is provided with a four-position switch that must set to configure the card.

Table 13-6. Configuration Switch		
Position	Function	Default
1	TTL – ON enables TTL port. Must be ON for the CU to communicate through the fiber link.	ON
2	Port B – ON enables fiber optic Port B. Disable if this CU is at the end of the fiber link.	ON
3	Port A – ON enables fiber optic Port A.	ON
4	Test – ON enables test mode. Test mode allows visual testing of LED activity.	OFF

13.2.4   M60-ATC I/O Expansion (M60-ATC only)

The optional M60 ATC I/O expansion module brings out Port8, Datakey, USB, and Ethernet 0 and 1. This module is standard on M60-ATC and optional for M60-ATC Lite.

13.2.4.1   Port 8 System Interface

The expansion module provides a Port 8 interface and connectors for interconnecting the CU to GPS and other auxiliary devices. For flexibility it is available on a 9-pin connector as an EIA-574 (aka RS-232) interface and on a 25-pin connector as a TEES C13S (RS-485) interface. A switch on the module PCB determines which interface receiver is active. Both connectors are equipped with screw locks.

13.2.4.1.1 Port 8 EIA-574

Input/output connector pin terminations of the Port 8 EIA-574 DTE interface are in accordance with the data in Table 13-7. Pin 1 is a dual-purpose input, providing either Data Carrier Detect or a Pulse-Per-Second timing input. The PPS input may be used to regulate the system clock to a high degree of accuracy when the time-of-day source has been set for EXT1 (see ATC 6.25 for the tod utility). The PPS input typically comes from a GPS device or a WWV receiver.

	Table 13-7. 9-Pin (Receptacle) AMP #205203-1 or Equivalent		
Pin	**Function**	**I/O**
1	Data Carrier Detect (DCD)	From DCE or PPS
2	Receive Data (RD)	From DCE
3	Transmit Data (TD)	To DCE
4	Data Terminal Ready (DTR)	To DCE
5	Logic Ground (SG)	–
7	Request to Send (RTS)	To DCE
8	Clear To Send (CTS)	From DCE
9	Not Used	

- EIA-574 Pin 5 reference is Signal Ground
- EIA-574 connector shell is Frame Ground
- PPS is a Pulse-Per-Second time regulation input

13.2.4.1.2 Port 8 C13S

Input/output connector pin terminations of the Port 8 C13S RS-485 interface are in accordance with TEES 2009 section A9-7 and reproduced the data in Table 13-8.

Table 13-8. 25-Pin (Receptacle) AMP #205207-1 or Equivalent		
Pin	**Function**	**I/O**
1	Tx Data +	O
2	RX Data +	I
3	TX Clock +	O
4	RX Clock +	I
5	Request to Send (RTS) +	O
6	Clear to Send (CTS) +	I
7	Data Carrier Detect (DCD) +	I
8	Not Used	
9	Linesync +	O
10	nReset +	O
11	Powerdown +	O
12	Bias +5 VDC (Iso)	–
13	Signal Ground (Iso)	–
14	Tx Data –	O
15	RX Data –	I
16	TX Clock –	O
17	RX Clock –	I
18	Request to Send (RTS) –	O
19	Clear to Send (CTS) –	I
20	Data Carrier Detect (DCD) –	I
21	Not Used	
22	Linesync –	O
23	nReset –	O
24	Powerdown –	O
25	Equipment Ground	–
• C13S Pin 12 reference is Isolated Signal Ground for use with Bias +5 VDC • C13S Pin 25 reference is Equipment/Frame Ground		

13.2.4.2 Datakey® Interface

The expansion module provides an interface to read and write Datakey® SFK-series serial memory devices. Both 5V and 3.3V keys are supported. These devices may be used to store intersection configurations.

13.2.4.3 USB Interfaces

The expansion module provides four USB 2.0 interfaces are provided for use with USB memory and other devices.

Caution: some USB devices incorrectly connect signal ground with the metal shell of the device. Inserting devices of this type could cause the CU to reset.

13.2.4.4 Ethernet RJ45 Interfaces

The expansion module provides four additional Ethernet IEEE 802.3u 10/100BASE-TX (RJ45) interfaces. These connect to one of two internal network switches. Table 13-9 shows all the Ethernet connections in the M60-ATC.

ATC #	Label	Location	Network	Speed	Usage
1	n/a	Internal	ENET1	10	Engine board eth0
2	ENET	FIO Front Panel	ENET1	10/100	Centrals
3	ETH0:3	Expansion Module	ENET1	10/100	Net Diagnostics
4	n/a	Internal	ENET1	10	Interface Slot A1
5	n/a	Internal	ENET2	10	Engine board eth1
6	EHT1:6	Expansion Module	ENET2	10/100	Controller Diag.
7	ETH1:7	Expansion Module	ENET2	10/100	Controller Expan.
8	ETH0:8	Expansion Module	ENET1	10	Interface Slot A2

Table 13-9. Ethernet Connections

13.2.5 Type 1 – Interface Standards

A Type 1 CU provides an input/output interface to meet the following requirements.

The connector has a metallic shell, is connected to the earth ground internally, is mounted on the front of the unit, and intermates with a MS3106( )-18-1S.

Input/output connector pin terminations of Connector A interface is in accordance with the data in Table 13-10.

NEMA TS 2 Type 1 Models

Table 13-10. 10-Pin (Receptacle) Type # -18-1S		
Pin	**Function**	**I/O**
A	AC Neutral	I
B	Not Used	-
C	AC Line	I
D	Not Used	-
E	Not Used	-
F	Fault Monitor	O
G	Logic Ground	O
H	Earth Ground	I
I	Not Used	-
J	Not Used	-

13.2.6   Type 2 – Interface Standards

A Type 2 CU provides an input/output interface to meet the requirements detailed in the following sections.

13.2.6.1   Electrical Limits of Input/Output Terminations

13.2.6.1.1 Logic Levels

All logic signals (except as explicitly defined elsewhere) are low state (nominal 0 volts) for the True (operate) state of all input and output terminations. Input/output terminations, when not activated, are internally biased to the False (high) non-operate state (+24 VDC).

13.2.6.1.2 Transient Immunity

The operation of the CU is not affected during operation by the application to any input or output terminal of pulses of 10 microseconds duration, 300-volt positive or negative amplitude, and with a maximum repetition rate of one pulse per second. For the purposes of this requirement, a pulse source having an output impedance of not less than 1 k ohms, nor greater than 10 k ohms should be used.

13.2.6.1.3 Inputs

Inputs have the following characteristics:

A voltage between 0 and 8 volts is considered the low state.

A voltage greater than 16 volts is considered the high state.

The transition from the low state to high state (and vice versa) occurs between 8 and 16 volts.

External transition from the low state to high state (and vice versa) is accomplished within 0.1 milliseconds.

Over the voltage range 0 to 26 VDC, the maximum current in or out of any input control terminal should be less than 10 milliamperes. Input impedance does not exceed 11 K ohms to 24 VDC, nor will the surge impedance be less than 100 ohms resistive.

Any input signal dwelling in a defined logic state for less than eight milliseconds will not be recognized. Any input signal dwelling in a defined logic state for more than 17 milliseconds will be recognized. Successive similar logic state transitions will not be recognized when occurring less than eight milliseconds apart and will be recognized when occurring more than 34 milliseconds apart.

13.2.6.1.4 Outputs

Electrical outputs have the following characteristics:

Output circuits

- The Low (operate) voltage is between 0 and 4 volts.

- Current sinking capability in the Low state (True) is at least 200 milliamperes from an inductive load.

- With an external impedance of 100 k ohms or greater, the transition from 4 to 16 volts (and vice versa) is accomplished within 0.1 milliseconds.

- The High state impedance does not exceed 11 k ohms to 24 VDC.

- Any external steady-state voltage applied to an output terminal should not exceed +30 VDC, nor should it cause flow of more than three milliamperes into the terminal, when the output is in the high state.

- Any valid True output signal, except load switch driver outputs when dimming is enabled, will dwell in this state for at least 50 milliseconds.

Regulated 24 VDC for external use

- Positive 24 ±2 VDC is regulated over an AC line voltage variation from 89 to 135 volts and from no load to full load.

- Current capability is 500 milliamperes continuous with less than 0.5 volt peak-to-peak ripple.

13.2.6.2 NEMA ABC Connectors

The connectors on the CU have a metallic shell. The connector is connected to the chassis internally. The connectors are mounted on the front of the unit in accordance with the following:

Connector A inter-mates with a MS3116( )-22-55S

Connector B inter-mates with a MS3116( )-22-55P

Connector C inter-mates with a MS3116( )-24-61P

13.2.6.2.1 Connector Pin Functions

ABC Input Mode 0 and Output Mode 0 provide input and output pin functions that are NEMA TS 1 compatible.

Table 13-11. ABC INPUT MODE 0/OUTPUT MODE 0 PIN/FUNCTIONS								
Connector A **55 Pin (plug) Type # -22-55P**			**Connector B** **55 Pin (socket) Type # -22-55S**			**Connector C** **61 Pin (socket) Type # -24-61S**		
Pin	Function	I/O	Pin	Function	I/O	Pin	Function	I/O
A	Fault Monitor	O	**A**	**Phase 1 Phase Next**	**O**	A	Status Bit A (2)	O
B	+24 VDC (External)	O	B	Preempt 2 Detector	I	B	Status Bit B (2)	O
C	Voltage Monitor	O	**C**	**Phase 2 Phase Next**	**O**	C	Phase 8 Don't Walk	O
D	Phase 1 Red [LS 01R]	O	D	Phase 3 Green [LS 03G]	O	D	Phase 8 Red [LS 08R]	O
E	Phase 1 Don't Walk [LS 17R]	O	E	Phase 3 Yellow [LS 03Y]	O	E	Phase 7 Yellow [LS 07Y]	O
F	Phase 2 Red [LS 02R]	O	F	Phase 3 Red [LS 03R]	O	F	Phase 7 Red [LS 07R]	O
G	Phase 2 Don't Walk [LS 09R]	O	G	Phase 4 Red [LS 04R]	O	G	Phase 6 Red [LS 06R]	O
H	Phase 2 Ped Clear [LS 09Y]	O	H	Phase 4 Ped Clear [LS 10Y]	O	H	Phase 5 Red [LS 05R]	O
J	Phase 2 Walk [LS 09G]	O	J	Phase 4 Don't Walk [LS 10R]	O	J	Phase 5 Yellow [LS 05Y]	O
K	Vehicle Detector 2	I	**K**	**Phase 4 Check**	**O**	K	Phase 5 Ped Clear [LS 19Y]	O
L	Pedestrian Detector 2	I	L	Vehicle Detector 4	I	L	Phase 5 Don't Walk [LS 05R]	O
M	**Phase 2 Hold**	**I**	M	Pedestrian Detector 4	I	**M**	**Phase 5 Phase Next**	**O**
N	Stop Time (1)	I	N	Vehicle Detector 3	I	**N**	**Phase 5 Phase On**	**O**
P	Inhibit Max Term (1)	I	P	Pedestrian Detector 3	I	P	Vehicle Detector 5	I
R	External Start	I	**R**	**Phase 3 Phase Omit**	**I**	R	Pedestrian Detector 5	I
S	Interval Advance	I	**S**	**Phase 2 Phase Omit**	**I**	S	Vehicle Detector 6	I
T	Indicator Lamp Control	I	**T**	**Phase 5 Pedestrian Omit**	**I**	T	Pedestrian Detector 6	I
U	AC Neutral	I	**U**	**Phase 1 Phase Omit**	**I**	U	Pedestrian Detector 7	I
V	Earth Ground	I	V	Pedestrian Recycle (2)	I	V	Vehicle Detector 7	I
W	Logic Ground	O	W	Preempt 4 Detector	I	W	Pedestrian Detector 8	I
X	Flashing Logic Out	O	X	Preempt 5 Detector	I	**X**	**Phase 8 Hold**	**I**
Y	Status Bit C (1)	O	Y	Phase 3 Walk [LS 18G]	O	Y	Force Off (2)	I
Z	Phase 1 Yellow [LS 01Y]	O	Z	Phase3 Ped Clear [LS 18Y]	O	Z	Stop Time (2)	I
a	Phase 1 Ped Clear [LS 17Y]	O	a	Phase 3 Don't Walk [LS 18R]	O	a	Inhibit Max Term (2)	I
b	Phase 2 Yellow [LS 02Y]	O	b	Phase 4 Green [LS 04G]	O	b	Test C	I
c	Phase 2 Green [LS 02G]	O	c	Phase 4 Yellow [LS 04Y]	O	c	Status Bit C (2)	O
d	**Phase 2 Check**	**O**	d	Phase 4 Walk [LS 10G]	O	d	Phase 8 Walk [LS 12G]	O
e	**Phase 2 Phase On**	**O**	**e**	**Phase 4 Phase On**	**O**	e	Phase 8 Yellow [LS 08Y]	O
f	Vehicle Detector 1	I	**f**	**Phase 4 Phase Next**	**O**	f	Phase 7 Green [LS 07G]	O
g	Pedestrian Detector 1	I	**g**	**Phase 4 Phase Omit**	**I**	g	Phase 6 Green [LS 06G]	O
h	**Phase 1 Hold**	**I**	**h**	**Phase 4 Hold**	**I**	h	Phase 6 Yellow [LS 06Y]	O
i	Force Off (1)	I	**I**	**Phase 3 Hold**	**I**	I	Phase 5 Green [LS 06G]	O
j	External Min Recall	I	**j**	**Phase 3 Pedestrian Omit**	**I**	j	Phase 5 Walk [LS 19G]	O
k	Manual Control Enable	I	**k**	**Phase 6 Pedestrian Omit**	**I**	**k**	**Phase 5 Check**	**O**
m	Call To NA I	I	**m**	**Phase 7 Pedestrian Omit**	**I**	**m**	**Phase 5 Hold**	**I**
n	Test A (Remote Fl) **	I	**n**	**Phase 8 Pedestrian Omit**	**I**	**n**	**Phase 5 Phase Omit**	**I**
p	AC Line	I	p	OL A Yellow [LS 13Y]	O	**p**	**Phase 6 Hold**	**I**
q	I/O Mode Bit A	I	q	OL A Red [LS 13R]	O	**q**	**Phase 6 Phase Omit**	**I**
r	Status Bit B (1)	O	**r**	**Phase 3 Check**	**O**	**r**	**Phase 7 Phase Omit**	**I**
s	Phase 1 Green [LS 01G]	O	**s**	**Phase 3 Phase On**	**O**	**s**	**Phase 8 Phase Omit**	**I**
t	Phase 1 Walk [LS 17G]	O	**t**	**Phase 3 Phase Next**	**O**	t	Vehicle Detector 8	I
u	**Phase 1 Check**	**O**	u	OL D Red [LS 16R]	O	u	Red Rest Mode (2)	I
v	**Phase 2 Pedestrian Omit**	**I**	v	Preempt 6 Detector	I	v	Omit Red Clear (2)	I
w	Omit Red Clear (1)	I	w	OL D Green [LS 16G]	O	w	Phase 8 Ped Clear [LS 12Y]	O
x	Red Rest (1)	I	**x**	**Phase 4 Pedestrian Omit**	**I**	x	Phase 8 Green [LS 08G]	O
y	I/O Mode Bit B	I	y	Free (No Coordination)	I	y	Phase 7 Don't Walk [LS 20R]	O
z	Call To NA II	I	z	Max II Selection (2)	I	z	Phase 6 Don't Walk [LS 11R]	O
AA	Test B	I	AA	OL A Green [LS 13G]	O	AA	Phase 6 Ped Clear [LS 11Y]	O

BB	Walk Rest Modifier	I	BB	OL B Yellow	[LS 14Y]	O	**BB**	**Phase 6 Check**		**O**
CC	Status Bit A (1)	O	CC	OL B Red	[LS 14R]	O	**CC**	**Phase 6 Phase On**		**O**
DD	**Phase 1 Phase On**	**O**	DD	OL C Red	[LS 15R]	O	**DD**	**Phase 6 Phase Next**		**O**
EE	**Phase 1 Pedestrian Omit**	**I**	EE	OL D Yellow	[LS 16Y]	O	**EE**	**Phase 7 Hold**		**I**
FF	Pedestrian Recycle (1)	I	FF	OL C Green	[LS 15G]	O	**FF**	**Phase 8 Check**		**O**
GG	Max II Selection (1)	I	GG	OL B Green	[LS 14G]	O	**GG**	**Phase 8 Phase On**		**O**
HH	I/O Mode Bit C	I	HH	OL C Yellow	[LS 15Y]	O	**HH**	**Phase 8 Phase Next**		**O**
							JJ	Phase 7 Walk	[LS 20G]	O
							KK	Phase 7 Ped Clear	[LS 20Y]	O
							LL	Phase 6 Walk	[LS 11G]	O
							MM	**Phase 7 Check**		**O**
							NN	**Phase 7 Phase On**		**O**
							PP	**Phase 7 Phase Next**		**O**
Shaded areas above denote pin terminations whose function varies based on the ABC Input/Output Mode. Alterable pin terminations indicated in **bold** are NEMA TS 2 alterable pins; the balance are Yunex Traffic specific.										

(#) – Ring number.

[LS ##*c*] – Loadswitch number (##) and color channel (*c*) associated with the output.

** – A facility wired to use automatic flash by activating Test Input A (Pin # n) of Connector A may not be compatible with the CUs of other manufacturers. Disconnect this input from the facility before placing any other manufacturer's CU in the facility.

> **NOTE: Pins marked as reserved or spare in NEMA TS 1 are neither reserved nor spare in NEMA TS 2. The pins that are now functional in accordance with NEMA TS 2 are: Connector A pins - A, q, y, HH, Connector B pins - B, W, X, v, y, and Connector C pin - b.**

13.2.6.3 ABC I/O Modes

The status of the connector ABC I/O mode bits (inputs) or ABC input and output mode data entry establishes the function of the mode defined inputs and outputs.

The ABC input or output mode data entry overrides the TS2 I/O mode bits and implements the input and output mode based on the program entry. If these data fields are 0, the CU will respond to the I/O mode inputs according to the I/O mode to make active.

Having I/O mode hardware inputs allows the terminal and facilities to control the function of inputs and outputs. On the surface, this sounds like the best approach but should an I/O mode input fail, the CU would most likely operate in the wrong mode so the use of an I/O mode program entry is recommended.

The use of separate input and output mode data entry provides more flexibility as to exactly what functions are available.

Input modes other than 0 will not be compatible with a NEMA TS1-1989CU.

Input modes other than 0 through 5 may not be compatible with the CUs of other manufacturers.

Output modes other than 0 will not be compatible with a NEMA TS1-1989 CU.

Output modes other than 0 through 5 may not be compatible with the CUs of other manufacturers.

13.2.6.3.1 ABC Input Mode 0–7 Functions

Table 13-12. ABC Input Mode 0–7 Functions					
Pin	**Mode 0**	**Mode 1**	**Mode 2**	**Mode 6***	**Mode 7**
A-h	Phase 1 Hold	Preempt 1 Detector	Preempt 1 Detector	-	Vehicle Detector 23
A-M	Phase 2 Hold	Preempt 3 Detector	Preempt 3 Detector	-	Vehicle Detector 24
B-i	Phase 3 Hold	Vehicle Detector 9	Vehicle Detector 9	-	Vehicle Detector 9
B-h	Phase 4 Hold	Vehicle Detector 10	Vehicle Detector 10	-	Vehicle Detector 10
C-m	Phase 5 Hold	Vehicle Detector 13	Vehicle Detector 13	-	Vehicle Detector 13
C-p	Phase 6 Hold	Vehicle Detector 14	Vehicle Detector 14	-	Vehicle Detector 14
C-EE	Phase 7 Hold	Vehicle Detector 15	Vehicle Detector 15	-	Vehicle Detector 15
C-X	Phase 8 Hold	Vehicle Detector 16	Vehicle Detector 16	-	Vehicle Detector 16
B-U	Phase 1 Phase Omit	Vehicle Detector 11	Vehicle Detector 11	-	Vehicle Detector 11
B-S	Phase 2 Phase Omit	Vehicle Detector 12	Vehicle Detector 12	-	Vehicle Detector 12
B-R	Phase 3 Phase Omit	Timing Plan C	Vehicle Detector 17	-	Vehicle Detector 17
B-g	Phase 4 Phase Omit	Timing Plan D	Vehicle Detector 18	-	Vehicle Detector 18
C-n	Phase 5 Phase Omit	Alternate Sequence A	Vehicle Detector 19	-	Vehicle Detector 19
C-q	Phase 6 Phase Omit	Alternate Sequence B	Vehicle Detector 20	-	Vehicle Detector 20
C-r	Phase 7 Phase Omit	Alternate Sequence C	Special Status 1 (Alarm 1)	-	Vehicle Detector 21
C-s	Phase 8 Phase Omit	Alternate Sequence D	Special Status 2 (Alarm 2)	-	Vehicle Detector 22
A-EE	Phase 1 Ped Omit	Dimming Enable	Dimming Enable	Special Status 1	Vehicle Detector 25
A-v	Phase 2 Ped Omit	Automatic Flash	Local Flash Status	Automatic Flash	Vehicle Detector 26
B-j	Phase 3 Ped Omit	Timing Plan A	Address Bit 0	Timing Plan A	Vehicle Detector 27
B-x	Phase 4 Ped Omit	Timing Plan B	Address Bit 1	Timing Plan B	Vehicle Detector 28
B-T	Phase 5 Ped Omit	Offset 1	Address Bit 2	Offset 1	Vehicle Detector 29
B-k	Phase 6 Ped Omit	Offset 2	Address Bit 3	Offset 2	Vehicle Detector 30
B-m	Phase 7 Ped Omit	Offset 3	Address Bit 4	Offset 3	Vehicle Detector 31
B-n	Phase 8 Ped Omit	TBC On Line	MMU Flash Status	MMU Flash Status	Vehicle Detector 32
A-n	Test A (Auto Flash)	-	-	Vehicle Detector 9	-
A-AA	Test B	-	-	Vehicle Detector 10	-
C-b	Test C	-	-	Vehicle Detector 11	-
A-FF	Ped Recycle (1)	-	-	Special Status 2	-
B-V	Ped Recycle (2)	-	-	TBC On Line	--
B-W	Preempt 4 Detector	-	-	Preempt 1 Detector	-
B-X	Preempt 5 Detector	-	-	Timing Plan C	-
B-v	Preempt 6 Detector	-	-	Timing Plan D	-
A-x	Red Rest Mode (1)	-	-	Reserved	-
C-u	Red Rest Mode (2)	-	-	Reserved	-
A-w	Omit Red Clear (1)	-	-	Reserved	-
C-v	Omit Red Clear (2)	-	-	Zero Reset	-

(-) denotes same operation as Mode 0.

***NOTE**: Mode 6 changes functions on pins beyond NEMA TS-2 specification of alterable pins.

13.2.6.3.2 ABC Input Mode 10-19 Functions

Pin	Mode 10	Mode 11		Mode 18	Mode 19
	Table 13-13. ABC Input Mode 10–19 Functions				
A-h	Preempt 1 Detector	Preempt 1 Detector		Preempt 1 Detector	Preempt 1 Detector
A-M	Preempt 3 Detector	Preempt 3 Detector		Preempt 3 Detector	Preempt 3 Detector
B-I	Preempt 2 Detector	Preempt 2 Detector		Vehicle Detector 9	Preempt 2 Detector
B-h	Preempt 4 Detector	Preempt 4 Detector		Vehicle Detector 10	Preempt 4 Detector
C-m	Free (No Coordination)	Free (No Coordination)		Vehicle Detector 13	Free (No Coordination)
C-p	Set Clock	Special Status 5		Vehicle Detector 14	Special Status 5
C-EE	Conflict Flash Status	Conflict Flash Status		Vehicle Detector 15	Conflict Flash Status
C-X	Manual Flash Status	Manual Flash Status		Vehicle Detector 16	Manual Flash Status
B-U	Preempt 5 Detector	Preempt 5 Detector		Vehicle Detector 11	Preempt 5 Detector
B-S	Preempt 6 Detector	Preempt 6 Detector		Vehicle Detector 12	Preempt 6 Detector
B-R	Timing Plan C	Special Detector 5		Vehicle Detector 17	Timing Plan C
B-g	Timing Plan D	Special Detector 6		Vehicle Detector 18	Timing Plan D
C-n	Alternate Sequence A	Special Status 1		Vehicle Detector 19	Special Status 1
C-q	Alternate Sequence B	Special Status 2		Vehicle Detector 20	Special Status 2
C-r	Alternate Sequence C	Special Status 3		Special Status 1 (Alarm 1)	Special Status 3
C-s	Alternate Sequence D	Special Status 4		Special Status 2 (Alarm 2)	Special Status 4
A-EE	Dimming Enable	Special Status 6		Dimming Enable	Special Status 6
A-v	Automatic Flash	Automatic Flash		Local Flash Status	Automatic Flash
B-j	Timing Plan A	Special Detector 7		Spare Input	Timing Plan A
B-x	Timing Plan B	Special Detector 8		Separate Intersections	Timing Plan B
B-T	Offset 1	Special Detector 2		Force 3 Phase	Offset 1
B-k	Offset 2	Special Detector 3		Force Four Phase	Offset 2
B-m	Offset 3	Special Detector 4		Spare Input	Offset 3
B-n	TBC On Line	Special Detector 1		MMU Flash Status	Computer Control

13.2.6.3.3 ABC Output Mode 0-7 Functions

Table 13-14. ABC Output Mode 0–7 Functions					
Pin	Mode 0	Mode 1	Mode 2	Mode 6*	Mode 7
A-DD	Phase 1 Phase On	Preempt 1 Status	Preempt 1 Status	Free (No Coord) Status	LDSW 21 Red
A-e	Phase 2 Phase On	Preempt 3 Status	Preempt 3 Status	Auto Flash Status	LDSW 22 Red
B-s	Phase 3 Phase On	TBC Auxiliary 1	TBC Auxiliary 1	TBC Auxiliary 1	LDSW 23 Red
B-e	Phase 4 Phase On	TBC Auxiliary 2	TBC Auxiliary 2	TBC Auxiliary 2	LDSW 24 Red
C-N	Phase 5 Phase On	Timing Plan A	Timing Plan A	Timing Plan A	LDSW 25 Red
C-CC	Phase 6 Phase On	Timing Plan B	Timing Plan B	Timing Plan B	LDSW 26 Red
C-NN	Phase 7 Phase On	Offset 1	Offset 1	Offset 1	LDSW 27 Red
C-GG	Phase 8 Phase On	Offset 2	Offset 2	Offset 2	LDSW 28 Red
B-A	Phase 1 Phase Next	Preempt 2 Status	Preempt 2 Status	Preempt 2 Status	LDSW 21 Yellow
B-C	Phase 2 Phase Next	Preempt 4 Status	Preempt 4 Status	Preempt 1 Status	LDSW 22 Yellow
B-t	Phase 3 Phase Next	Preempt 5 Status	Preempt 5 Status	Reserved	LDSW 23 Yellow
B-f	Phase 4 Phase Next	Preempt 6 Status	Preempt 6 Status	Reserved	LDSW 24 Yellow
C-M	Phase 5 Phase Next	Offset 3	Offset 3	Offset 3	LDSW 25 Yellow
C-DD	Phase 6 Phase Next	Timing Plan C	Timing Plan C	Timing Plan C	LDSW 26 Yellow
C-PP	Phase 7 Phase Next	Timing Plan D	Timing Plan D	Timing Plan D	LDSW 27 Yellow
C-HH	Phase 8 Phase Next	Reserved	Reserved	TBC Auxiliary 3	LDSW 28 Yellow
A-u	Phase 1 Check	Free Status	Free Status	-	LDSW 21 Green
A-d	Phase 2 Check	Automatic Flash Status	Automatic Flash Status	-	LDSW 22 Green
B-r	Phase 3 Check	TBC Auxiliary 3	TBC Auxiliary 3	-	LDSW 23 Green
B-K	Phase 4 Check	Reserved	Reserved	-	LDSW 24 Green
C-k	Phase 5 Check	Reserved	Special Function 1	-	LDSW 25 Green
C-BB	Phase 6 Check	Reserved	Special Function 2	-	LDSW 26 Green
C-MM	Phase 7 Check	Reserved	Special Function 3	-	LDSW 27 Green
C-FF	Phase 8 Check	Reserved	Special Function 4	-	LDSW 28 Green
A-Y	Status Bit C (1)	-	-	Spare 3	-
A-r	Status Bit B (1)	-	-	Spare 2	-
A-CC	Status Bit A (1)	-	-	Spare 1	-
C-A	Status Bit A (2)	-	-	Special Function 1	-
C-B	Status Bit B (2)	-	-	Special Function 2	-
C-c	Status Bit C (2)	-	-	Special Function 3	-

(-) denotes same operation as Mode 0.

*NOTE: Mode 6 changes functions on pins beyond NEMA TS-2 specification of alterable pins.

13.2.6.3.4 ABC Output Mode 10-14 Functions

Table 13-15. ABC Output Mode 10–14 Functions					
Pin	**Mode 10**	**Mode 11**	**Mode 12**	**Mode 13**	**Mode 14**
A-DD	Preempt 1 Status	Preempt 1 Status	Preempt 1 Status	Preempt 1 Status	Preempt 1 Status
A-e	Preempt 3 Status	Preempt 3 Status	Preempt 3 Status	Preempt 3 Status	Preempt 3 Status
B-s	TBC Auxiliary 1	TBC Auxiliary 1	TBC Auxiliary 1	TBC Auxiliary 1	TBC Auxiliary 1
B-e	TBC Auxiliary 2	TBC Auxiliary 2	TBC Auxiliary 2	TBC Auxiliary 2	TBC Auxiliary 2
C-N	Timing Plan A	Special Function 7	Timing Plan A	Timing Plan A	Special Function 7
C-CC	Timing Plan B	Special Function 8	Timing Plan B	Timing Plan B	Special Function 8
C-NN	Offset 1	Reserved	Offset 1	Offset 1	Reserved
C-GG	Offset 2	Reserved	Offset 2	Offset 2	Reserved
B-A	Preempt 2 Status	Preempt 2 Status	Preempt 2 Status	Preempt 2 Status	Preempt 2 Status
B-C	Preempt 4 Status	Preempt 4 Status	Preempt 4 Status	Preempt 4 Status	Preempt 4 Status
B-t	Preempt 5 Status	Preempt 5 Status	Preempt 5 Status	Preempt 5 Status	Preempt 5 Status
B-f	Preempt 6 Status	Preempt 6 Status	Preempt 6 Status	Preempt 6 Status	Preempt 6 Status
C-M	Offset 3	Reserved	Offset 3	Offset 3	Reserved
C-DD	Timing Plan C	Special Function 5	Timing Plan C	Timing Plan C	Special Function 5
C-PP	Timing Plan D	Special Function 6	Timing Plan D	Timing Plan D	Special Function 6
C-HH	Any Priority	Any Priority	Any Priority	Any Priority	Any Priority
A-u	Free Status	Free Status	Free Status	Free Status	Free Status
A-d	Automatic Flash Status	Automatic Flash Status	Automatic Flash Status	Automatic Flash Status	Automatic Flash Status
B-r	TBC Auxiliary 3	TBC Auxiliary 3	TBC Auxiliary 3	TBC Auxiliary 3	TBC Auxiliary 3
B-K	Detector Reset	Detector Reset	Detector Reset	Detector Reset	Detector Reset
C-k	Special Function 1	Special Function 1	Special Function 1	Special Function 1	Special Function 1
C-BB	Special Function 2	Special Function 2	Special Function 2	Special Function 2	Special Function 2
C-MM	Special Function 3	Special Function 3	Special Function 3	Special Function 3	Special Function 3
C-FF	Special Function 4	Special Function 4	Special Function 4	Special Function 4	Special Function 4

Output Mode 12 provides Interrupted Sync Pulses on the active Offset output. Interrupted Sync Pulses are provided at intervals equal to 20% and 25% of the cycle on alternate cycles.

Output Modes 13 and 14 provide a flashing output on the inactive preempt status outputs.

13.2.6.3.5 ABC Output Mode 15-19 Functions

Pin	Mode 15	Mode 16	Mode 17	Mode 18	Mode 19
				Table 13-16. ABC Output Mode 15–19 Functions	
A-DD				Sign 1A - THRU & OK	Preempt 1 Status
A-e				Sign 1B - THRU	Preempt 3 Status
B-s				Sign 2A - THRU & OK	TBC Auxiliary 1
B-e				Sign 2B - THRU	TBC Auxiliary 2
C-N				Sign 3A - THRU & OK	Ring 3 Dwell
C-CC				Sign 3B - THRU	Ring 4 Dwell
C-NN				Sign 4A - THRU & OK	Reserved
C-GG				Sign 4B - THRU	Reserved
B-A				Sign 1A - LEFT	Preempt 2 Status
B-C				Sign 1B - LEFT & OK	Preempt 4 Status
B-t				Sign 2A - LEFT	Preempt 5 Status
B-f				Sign 2B - LEFT & OK	Preempt 6 Status
C-M				Sign 3A - LEFT	Cycle 0
C-DD				Sign 3B - LEFT & OK	Ring 1 Dwell
C-PP				Sign 4A - LEFT	Ring 2 Dwell
C-HH				Sign 4B - LEFT & OK	Any Priority
A-u				Sign 1A - ONLY	Free Status
A-d				Sign 1B - ONLY	Automatic Flash Status
B-r				Sign 2A - ONLY	TBC Auxiliary 3
B-K				Sign 2B - ONLY	Detector Reset
C-k				Sign 3A - ONLY	Special Function 1
C-BB				Sign 3B - ONLY	Special Function 2
C-MM				Sign 4A - ONLY	Special Function 3
C-FF				Sign 4B - ONLY	Special Function 4

13.2.6.4   D Connector Pin/Functions

Input/output connector pin terminations of the optional Connector D interface are in accordance with the data in Table **13**-**7**.

table					
Table 13-17. 37-Pin (socket) AMP # 747315-2					
Pin	Function	I/O	Pin	Function	I/O
1	Mode * Input 1	I	20	Mode * Input 13	I
2	Mode * Input 2	I	21	Mode * Input 14	I
3	Mode * Input 3	I	22	Mode * Output 1	O
4	Mode * Input 4	I	23	Mode * Output 2	O
5	Mode * Input 5	I	24	Mode * Output 3	O
6	Mode * Input 6	I	25	Mode * Output 4	O
7	Mode * Input 7	I	26	Mode * Output 5	O
8	Mode * Input 8	I	27	Mode * Output 6	O
9	Automatic Flash	I	28	Mode * Output 7	O
10	Preempt 1 Detector	I	29	Mode * Output 8	O
11	Preempt 2 Detector	I	30	Auxiliary 1	O
12	Preempt 3 Detector	I	31	Auxiliary 2 or Any Preempt	O
13	Preempt 4 Detector	I	32	Auxiliary 3 or Detector Reset	O
14	MMU/Conflict Flash Status	I	33	Logic Common	O
15	Local Flash Status	I	34	Port 3 Audio Transmit 1 [†]	O
16	Mode * Input 9	I	35	Port 3 Audio Transmit 2 [†]	O
17	Mode * Input 10	I	36	Port 3 Audio Receive 1	I
18	Mode * Input 11	I	37	Port 3 Audio Receive 2	I
19	Mode * Input 12	I			

(*) Denotes multipurpose inputs or outputs. The function of the input or output is dependent on CU D connector mode programming and whether the unit has a system address other than 000.

([†]) When a half duplex modem is used, the two-wire interconnect uses only Pins 34 and 35.

13.2.6.4.1 D Input Mode Functions

A mode input # function is dependent on CU D connector mode programming and whether the unit has a system address other than 000.

Pin	Mode 0	Mode 1	Mode 2	Mode 3	4-7	Mode 8	Mode 9
	Table 13-18. D Input Mode Functions – Address = 000						
1	TBC On Line	Special Detector 1	On Line	Special Detector 1		On Line	Computer Control
2	T Plan A (Dial A)	Special Detector 7	T Plan A (Dial A)	Special Detector 7		T Plan A (Dial A)	T Plan A (Dial A)
3	T Plan B (Dial B)	Special Detector 8	T Plan B (Dial B)	Special Detector 8		T Plan B (Dial B)	T Plan B (Dial B)
4	T Plan C (Split A)	Special Detector 5	T Plan C (Split A)	Special Detector 5		T Plan C (Split A)	T Plan C (Split A)
5	T Plan D (Split B)	Special Detector 6	T Plan D (Split B)	Special Detector 6		T Plan D (Split B)	T Plan D (Split B)
6	Offset 1	Special Detector 2	Offset 1	Special Detector 2		Offset 1	Offset 1
7	Offset 2	Special Detector 3	Offset 2	Special Detector 3		Offset 2	Offset 2
8	Offset 3	Special Detector 4	Offset 3	Special Detector 4		Offset 3	Offset 3
16	Alt Sequence A	Special Status 1	Alt Sequence A	Special Status 1		Special Status 1	Special Status 1
17	Alt Sequence B	Special Status 2	Alt Sequence B	Special Status 2		Special Status 2	Special Status 2
18	Alt Sequence C	Special Status 3	Alt Sequence C	Special Status 3		Special Status 3	Special Status 3
19	Alt Sequence D	Special Status 4	Alt Sequence D	Special Status 4		Special Status 4	Special Status 4
20	Set Clock	Special Status 5	Preempt 5 Detector	Preempt 5 Detector		Preempt 5 Detector	Preempt 5 Detector
21	Dimming Enable	Special Status 6	Preempt 6 Detector	Preempt 6 Detector		Free	Preempt 6 Detector

Note that Alt Sequence A-D inputs provide Sequences 1-16.

Note that Timing Plans A-D along with Offsets 1-3 provide 48 Dial/Split/Offset combinations from 1/1/1 through 4/4/3. These map to Plans 1-48, as shown: 1/1/1 = 1, 1/1/2 = 2, 1/1/3 = 3, 1/2/1 = 4, ... 2/1/1 = 13, ... 4/4/3 = 48.

Pin	Mode 0	Mode 1	Mode 2	Mode 3	4-7	Mode 8	Mode 9
Table 13-19. D Input Mode Functions – Address <> 000							
1	Special Detector 1	TBC On Line	Special Detector 1	On Line		Special Detector 1	Computer Control
2	Special Detector 7	T Plan A (Dial A)	Special Detector 7	T Plan A (Dial A)		Special Detector 7	T Plan A (Dial A)
3	Special Detector 8	T Plan B (Dial B)	Special Detector 8	T Plan B (Dial B)		Special Detector 8	T Plan B (Dial B)
4	Special Detector 5	T Plan C (Split A)	Special Detector 5	T Plan C (Split A)		Special Detector 5	T Plan C (Split A)
5	Special Detector 6	T Plan D (Split B)	Special Detector 6	T Plan D (Split B)		Special Detector 6	T Plan D (Split B)
6	Special Detector 2	Offset 1	Special Detector 2	Offset 1		Special Detector 2	Offset 1
7	Special Detector 3	Offset 2	Special Detector 3	Offset 2		Special Detector 3	Offset 2
8	Special Detector 4	Offset 3	Special Detector 4	Offset 3		Special Detector 4	Offset 3
16	Special Status 1	Alt Sequence A	Special Status 1	Alt Sequence A		Special Status 1	Special Status 1
17	Special Status 2	Alt Sequence B	Special Status 2	Alt Sequence B		Special Status 2	Special Status 2
18	Special Status 3	Alt Sequence C	Special Status 3	Alt Sequence C		Special Status 3	Special Status 3
19	Special Status 4	Alt Sequence D	Special Status 4	Alt Sequence D		Special Status 4	Special Status 4
20	Special Status 5	Set Clock	Preempt 5 Detector	Preempt 5 Detector		Preempt 5 Detector	Preempt 5 Detector
21	Special Status 6	Dimming Enable	Preempt 6 Detector	Preempt 6 Detector		Free	Preempt 6 Detector

Input Mode 0 – Provides coordination and alternate sequence inputs when no system address is programmed, and special detectors and special status inputs when a system address is programmed.

Input Mode 1 – Provides input functions just opposite of Input Mode 0. Also provides coordination and alt sequence inputs when a system address is programmed and special detectors and special status inputs when no system address is programmed.

Input Mode 2 – Provides input functions like Mode 0 except Preempt 5 and Preempt 6 inputs replace functions on Pin 20 and Pin 21.

Input Mode 3 – Provides input functions like Mode 1 except Preempt 5 and Preempt 6 inputs replace functions on Pin 20 and Pin 21.

Input Mode 4 – Not used at this time.

Input Mode 5 – Not used at this time.

Input Mode 6 – Not used at this time.

Input Mode 7 – Not used at this time.

Input Mode 8 – Provides input functions like Mode 2 except Pins 16, 17, 18, 19, and 21 do not change function based on system address. This input mode also automatically modifies the output functions as shown in Table **13**-**20**.

Table 13-20. Input Mode 8 Functions		
	Address = 000	**Address <> 000**
Pin	Function	Function
32	Free (No Coordination)	Free (No Coordination)

The modifications to Pin 21 and 32 functions as defined above eliminate the Preempt 6 and TBC Auxiliary 3 capability.

Input Mode 9 – Provides input functions that may be used with a central computer system.

13.2.6.4.2 D Output Mode Functions

A Mode Output # function is dependent on CU D connector mode programming and whether the unit has a system address other than 000.

Table 13-21. D Output Mode Functions – Address = 000							
Pin	**Mode 0**	**Mode 1**	**2-3**	**Mode 4**	**Mode 5**	**6-8**	**Mode 9**
22	T Plan A (Dial A)	Special Function 7		Preempt 6 Status	T Plan A (Dial A)		R3 Dwell
23	T Plan B (Dial B)	Special Function 8		Any Priority	T Plan B (Dial B)		R4 Dwell
24	T Plan C (Split A)	Special Function 5		Preempt 4 Status	T Plan C (Split A)		R1 Dwell
25	T Plan D (Split B)	Special Function 6		Preempt 5 Status	T Plan D (Split B)		R2 Dwell
26	Offset 1	Special Function 2		Preempt 1 Status	Offset 1		Special Function 2
27	Offset 2	Special Function 3		Preempt 2 Status	Offset 2		Special Function 3
28	Offset 3	Special Function 4		Preempt 3 Status	Offset 3		Cycle 0
29	Automatic Flash	Special Function 1		Special Function 1	Automatic Flash		Special Function 1

Note that Sequences 1-16 map to Alternate Sequences 0-15, respectively. These provide Alt Sequence A-D outputs.

Note that Plans 1-48 map to Dial/Split/Offset combinations from 1/1/1 through 4/4/3, respectively. These provide Timing Plans A-D and Offsets 1-3 outputs.

Pin	Mode 0	Mode 1	2-3	Mode 4	Mode 5	6-8	Mode 9
				Table 13-22. D Output Mode Functions – Address <> 000			
22	Special Function 7	T Plan A (Dial A)		Preempt 6 Status	T Plan A (Dial A)		R3 Dwell
23	Special Function 8	T Plan B (Dial B)		Any Priority	T Plan B (Dial B)		R4 Dwell
24	Special Function 5	T Plan C (Split A)		Preempt 4 Status	T Plan C (Split A)		R1 Dwell
25	Special Function 6	T Plan D (Split B)		Preempt 5 Status	T Plan D (Split B)		R2 Dwell
26	Special Function 2	Offset 1		Preempt 1 Status	Offset 1		Special Function 2
27	Special Function 3	Offset 2		Preempt 2 Status	Offset 2		Special Function 3
28	Special Function 4	Offset 3		Preempt 3 Status	Offset 3		Cycle 0
29	Special Function 1	Automatic Flash		Special Function 1	Automatic Flash		Special Function 1

Output Mode 0 – Provides coordination outputs when no system address is programmed and System Special Function outputs when a system address is programmed.

Output Mode 1 – Provides output functions just opposite of Output Mode 0. Also provides coordination outputs when a system address is programmed and System Special Function outputs when no system address is programmed.

Output Mode 2 – Provides output functions like Mode 0 except when any Preempt routine has control. Then it is like Output Mode 4 below.

When Auxiliary #2 is not programmed for output as a TBC auxiliary function, it will become an Any Preempt active function.

Output Mode 3 – Provides output functions like Mode 1 except when any Preempt routine has control. Then it is like Mode 4 below.

Output Mode 4 – Provides preempt status outputs that are active whenever a Preempt routine is in control.

Output Mode 5 – Provides output functions like Mode 0 (Address = 000) except provides interrupted Sync Pulses on the active offset output. Interrupted Sync Pulses are provided at intervals equal to 20% and 25% of the cycle on alternate cycles.

Output Mode 6 – Provides output functions like Mode 4 except when a Preempt is active provides a flashing output on the inactive Preempt status outputs.

Output Mode 7 – Not used at this time.

Output Mode 8 – Not used at this time.

Output Mode 9 – Provides output functions that are provided as status feedback for the central computer system control established with Input Mode 9. It is established automatically when Input Mode 9 is programmed.

14 2070 ATC Hardware

The part number for Yunex Traffic 2070LX hardware manual is PIM-200.

If installed on hardware from another vendor listed on the CALTRANS Qualified Products List, refer to that manual for that vendor.

The Yunex Traffic SEPAC software recognizes it is operating with 2070-2A, 2070-2E+, 2070-2N or 2070-8 field I/O.   It recognizes only the newer (TEES 97 and later) series of field I/O messages.

The Yunex Traffic SEPAC software recognizes it is operating with a front panel of eight lines or 16 lines of display.

14.1   2070LX ATC Serial Ports

CALTRANS 2002 and later Transportation Electrical Equipment Specification (TEES) physically locates Serial Ports 1 and 2 in the second slot, labeled A2 as shown in Figure 14-1.

SP3	SP1	SP5			2070LX ATC
					TEES 2002 and Later
(SP4)	SP2	(SP3)		SP8	
A1	A2	A3	A4	A5	Rear View

Figure 14-1. 2070LX ATC Serial Port Locations

14.2   2070LX ATC Front Panel

14.2.1   Sixteen Line Display

At this writing, Yunex Traffic does not manufacture a 2070-3D sixteen-line display. However, the Yunex Traffic SEPAC software recognizes when a third party or future Yunex Traffic sixteen-line display is present and behaves as it would on an M60 display.

14.2.2   Extended Keypad

The Yunex Traffic SEPAC software uses the triple-key sequences listed in Table 14-1 to emulate those keys which are present on the M60 display but absent on the 2070. All sequences begin with two asterisks; there must be less than one second between each keypress.

Table 14-1. Key Sequence Emulations	
Key Name	**Sequence**
F1	**1
F2	**2
F3	**3
F4	**4
F4	**5
HELP	**+

14.3   2070-8 Field I/O

The Yunex Traffic SEPAC software recognizes it is operating with a 2070-8 field I/O and initializes the default parameters in accordance with the relative sections of this manual.

14.3.1   ABC Connector Pin/Functions

The Yunex Traffic SEPAC software and 2070-8 field I/O provides input/output functions on the ABC connectors in accordance with Chapter 13, Section 13.2.6.2.1.

14.3.1.1   ABC Input Mode Functions

The Yunex Traffic SEPAC software and 2070-8 field I/O provides input modes on the ABC connectors in accordance with Chapter 13, Section 13.2.6.3.

14.3.1.2   ABC Output Mode Functions

The Yunex Traffic SEPAC software and 2070-8 field I/O provides output modes on the ABC connectors in accordance with Chapter 13, Section 13.2.6.3.

14.3.2   D Connector Pin/Functions

The SEPAC software and 2070-8 field I/O provides input/output functions on the D connector as shown in the tables below.

Table 14-2. 2070-8 D connector 61-Pin (Plug) Type # -24-61P							
Pin	**Function**	**I/O**	**Port**	**Pin**	**Function**	**I/O**	**Port**
A	Vehicle Detector 09	I	10–1	j	Mode * Input 01	I	14–1
B	Vehicle Detector 10	I	10–2	k	Mode * Input 02	I	14–2
C	Vehicle Detector 11	I	10–3	m	Mode * Input 03	I	14–3
D	Vehicle Detector 12	I	10–4	n	Mode * Input 04	I	14–4
E	Vehicle Detector 13	I	10–5	p	Mode * Input 05	I	14–5
F	Vehicle Detector 14	I	10–6	q	Mode * Input 06	I	14–6
G	Vehicle Detector 15	I	10–7	r	Mode * Input 07	I	14–7
H	Vehicle Detector 16	I	10–8	s	Mode * Input 08	I	14–8
J	Vehicle Detector 17	I	11–1	t	Preempt 1 Detector	I	15–1
K	Vehicle Detector 18	I	11–2	u	Preempt 2 Detector	I	15–2
L	Vehicle Detector 19	I	11–3	v	Preempt 3 Detector	I	15–3
M	Vehicle Detector 20	I	11–4	w	Preempt 4 Detector	I	15–4
N	Vehicle Detector 21	I	11–5	x	Preempt 5 Detector	I	15–5
P	Vehicle Detector 22	I	11–6	y	Preempt 6 Detector	I	15–6
R	Vehicle Detector 23	I	11–7	z	Auxiliary 1	O	12–7
S	Vehicle Detector 24	I	11–8	AA	Aux 2 or Any Preempt	O	12–8
T	Spare 01	I	12–1	BB	Mode * Output 8	O	13–1
U	Spare 02	I	12–2	CC	Mode * Output 5	O	13–2
V	Spare 03	I	12–3	DD	Mode * Output 6	O	13–3
W	Spare 04	I	12–4	EE	Mode * Output 7	O	13–4
X	Spare 05	I	12–5	FF	Mode * Output 3	O	13–5
Y	Free (No Coord)	I	12–6	GG	Mode * Output 4	O	13–6
Z	Spare 06	I	12–7	HH	Mode * Output 1	O	13–7
a	Local Flash Status	I	12–8	JJ	Mode * Output 2	O	13–8
b	Mode * Input 09	I	13–1	KK	Not Assigned	-	---
c	Mode * Input 10	I	13–2	LL	Aux 3 or Det Reset	O	11–8
d	Mode * Input 11	I	13–3	MM	Not Assigned	-	---
e	Mode * Input 12	I	13–4	NN	+24 VDC	-	---
f	Mode * Input 13	I	13–5	PP	2070N DC Ground	-	---
g	Automatic Flash	I	13–6				
h	Conflict Flash Status	I	13–7				
i	Mode * Input 14	I	13–8				

(*) Indicates multipurpose inputs or outputs. The function of the input or output is dependent on CU D connector mode programming and whether the unit has a system address other than 000.

14.3.2.1   D Input Mode Functions

IA Mode Input # function is dependent on CU D connector mode programming and whether the unit has an address other than 000.

Table 14-3. D Input Mode Functions – Address = 000							
Pin	**Mode 0**	**Mode 1**	**Mode 2**	**Mode 3**	**4-7**	**Mode 8**	**Mode 9**
b	Alt Sequence A	Special Status 1	Alt Sequence A	Special Status 1		Special Status 1	Special Status 1
c	Alt Sequence B	Special Status 2	Alt Sequence B	Special Status 2		Special Status 2	Special Status 2
d	Alt Sequence C	Special Status 3	Alt Sequence C	Special Status 3		Special Status 3	Special Status 3
e	Alt Sequence D	Special Status 4	Alt Sequence D	Special Status 4		Special Status 4	Special Status 4
f	Set Clock	Special Status 5	Preempt 5 Detector	Preempt 5 Detector		Preempt 5 Detector	Preempt 5 Detector
i	Dimming Enable	Special Status 6	Preempt 6 Detector	Preempt 6 Detector		Free (No Coord)	Preempt 6 Detector
j	On Line	Special Detector 1	On Line	Special Detector 1		On Line	Computer Control
k	T Plan A (Dial A)	Special Detector 7	T Plan A (Dial A)	Special Detector 7		T Plan A (Dial A)	T Plan A (Dial A)
m	T Plan B (Dial B)	Special Detector 8	T Plan B (Dial B)	Special Detector 8		T Plan B (Dial B)	T Plan B (Dial B)
n	T Plan C (Split A)	Special Detector 5	T Plan C (Split A)	Special Detector 5		T Plan C (Split A)	T Plan C (Split A)
p	T Plan D (Split B)	Special Detector 6	T Plan D (Split B)	Special Detector 6		T Plan D (Split B)	T Plan D (Split B)
q	Offset 1	Special Detector 2	Offset 1	Special Detector 2		Offset 1	Offset 1
r	Offset 2	Special Detector 3	Offset 2	Special Detector 3		Offset 2	Offset 2
s	Offset 3	Special Detector 4	Offset 3	Special Detector 4		Offset 3	Offset 3

Note that Alt Sequence A-D inputs provide Sequences 1-16.

Note that Timing Plans A-D along with Offsets 1-3 provide 48 Dial/Split/Offset combinations from 1/1/1 through 4/4/3. These map to Plans 1-48, as shown: 1/1/1 = 1, 1/1/2 = 2, 1/1/3 = 3, 1/2/1 = 4, ... 2/1/1 = 13, ... 4/4/3 = 48.

Table 14-4. D Input Mode Functions – Address <> "000"							
Pin	Mode 0	Mode 1	Mode 2	Mode 3	4-7	Mode 8	Mode 9
b	Special Status 1	Alt Sequence A	Special Status 1	Alt Sequence A		Special Status 1	Special Status 1
c	Special Status 2	Alt Sequence B	Special Status 2	Alt Sequence B		Special Status 2	Special Status 2
d	Special Status 3	Alt Sequence C	Special Status 3	Alt Sequence C		Special Status 3	Special Status 3
e	Special Status 4	Alt Sequence D	Special Status 4	Alt Sequence D		Special Status 4	Special Status 4
f	Special Status 5	Set Clock	Preempt 5 Detector	Preempt 5 Detector		Preempt 5 Detector	Preempt 5 Detector
i	Special Status 6	Dimming Enable	Preempt 6 Detector	Preempt 6 Detector		Free (No Coord)	Preempt 6 Detector
j	Special Detector 1	On Line	Special Detector 1	On Line		Special Detector 1	Computer Control
k	Special Detector 7	T Plan A (Dial A)	Special Detector 7	T Plan A (Dial A)		Special Detector 7	T Plan A (Dial A)
m	Special Detector 8	T Plan B (Dial B)	Special Detector 8	T Plan B (Dial B)		Special Detector 8	T Plan B (Dial B)
n	Special Detector 5	T Plan C (Split A)	Special Detector 5	T Plan C (Split A)		Special Detector 5	T Plan C (Split A)
p	Special Detector 6	T Plan D (Split B)	Special Detector 6	T Plan D (Split B)		Special Detector 6	T Plan D (Split B)
q	Special Detector 2	Offset 1	Special Detector 2	Offset 1		Special Detector 2	Offset 1
r	Special Detector 3	Offset 2	Special Detector 3	Offset 2		Special Detector 3	Offset 2
s	Special Detector 4	Offset 3	Special Detector 4	Offset 3		Special Detector 4	Offset 3

The following provides descriptions for the input modes:

Input Mode 0 – Provides coordination and alt sequence inputs when no system address is programmed and special detectors and special status inputs when a system address is programmed.

Input Mode 1 – Provides input functions just opposite of Input Mode 0. Also provides coordination and alt sequence inputs when a system address is programmed and special detectors and special status inputs when no system address is programmed.

Input Mode 2 – Provides input functions like Mode 0 except Preempt 5 and Preempt 6 inputs replace functions on Pin f and Pin i.

Input Mode 3 – Provides input functions like Mode 1 except Preempt 5 and Preempt 6 inputs replace functions on Pin f and Pin i.

Input Mode 4 – Not used at this time.

Input Mode 5 – Not used at this time.

Input Mode 6 – Not used at this time.

Input Mode 7 – Not used at this time.

Input Mode 8 – Provides input functions like Mode 2 except Pin b, c, d, e, and i do not change function based on the address. This input mode automatically modifies the output functions as shown in Table **14**-**5**.

Table 14-5. Input Mode 8 Output Functions Modifications		
	Address = 000	**Address <> 000**
Pin	Function	Function
LL	Free (No Coordination)	Free (No Coordination)

The modifications to Pin i and LL functions as defined above eliminate the Preempt 6 and TBC Auxiliary 3 capability.

Input Mode 9 – Provides input functions that may be used with a central computer system.

14.3.2.2　　　　　D Output Mode Functions

A Mode Output # function is dependent on CU D Connector Mode programming and whether the unit has a system address other than 000.

Table 14-6. D Output Mode Functions – Address = 000							
Pin	**Mode 0**	**Mode 1**	**2-3**	**Mode 4**	**Mode 5**	**6-8**	**Mode 9**
BB	Automatic Flash	Spc Function 1		Spc Function 1	Automatic Flash		Spc Function 1
CC	Offset 1	Spc Function 2		Preempt 1 Status	Offset 1		Spc Function 2
DD	Offset 2	Spc Function 3		Preempt 2 Status	Offset 2		Spc Function 3
EE	Offset 3	Spc Function 4		Preempt 3 Status	Offset 3		Cycle 0
FF	T Plan C (Split A)	Spc Function 5		Preempt 4 Status	T Plan C (Split A)		Ring 1 Dwell
GG	T Plan D (Split B)	Spc Function 6		Preempt 5 Status	T Plan D (Split B)		Ring 2 Dwell
HH	T Plan A (Dial A)	Spc Function 7		Preempt 6 Status	T Plan A (Dial A)		Ring 3 Dwell
JJ	T Plan B (Dial B)	Spc Function 8		Any Priority	T Plan B (Dial B)		Ring 4 Dwell

Note that Sequences 1-16 map to Alternate Sequences 0-15, respectively. These provide Alt Sequence A-D outputs.

Note that Plans 1-48 map to Dial/Split/Offset combinations from 1/1/1 through 4/4/3, respectively. These provide Timing Plans A-D and Offsets 1-3 outputs.

Pin	**Mode 0**	**Mode 1**	**2-3**	**Mode 4**	**Mode 5**	**6-8**	**Mode 9**
BB	Spc Function 1	Automatic Flash		Spc Function 1	Automatic Flash		Spc Function 1
CC	Spc Function 2	Offset 1		Preempt 1 Status	Offset 1		Spc Function 2
DD	Spc Function 3	Offset 2		Preempt 2 Status	Offset 2		Spc Function 3
EE	Spc Function 4	Offset 3		Preempt 3 Status	Offset 3		Cycle 0
FF	Spc Function 5	T Plan C (Split A)		Preempt 4 Status	T Plan C (Split A)		Ring 1 Dwell
GG	Spc Function 6	T Plan D (Split B)		Preempt 5 Status	T Plan D (Split B)		Ring 2 Dwell
HH	Spc Function 7	T Plan A (Dial A)		Preempt 6 Status	T Plan A (Dial A)		Ring 3 Dwell
JJ	Spc Function 8	T Plan B (Dial B)		Any Priority	T Plan B (Dial B)		Ring 4 Dwell

Table 14-7. D Output Mode Functions – Address <> 000

The following provides descriptions for the output modes:

Output Mode 0 – Provides coordination outputs when no system address is programmed and System Special Function outputs when a system address is programmed.

Output Mode 1 – Provides output functions just opposite of Output Mode 0. Also provides coordination outputs when a system address is programmed and System Special Function outputs when no system address is programmed.

Output Mode 2 – Provides output functions like Mode 0 except when any Preempt routine has control, then it is like Mode 4 below.

When Auxiliary #2 is not programmed for output as a TBC auxiliary function, it becomes an any preempt active function. The any Preempt output becomes active when Any Preempt routine is in control.

Output Mode 3 – Provides output functions like Mode 1 except when Any Preempt routine has control, then it is like Mode 4 below.

Output Mode 4 – Provides preempt status outputs that are active whenever a Preempt routine is in control.

Output Mode 5 – Provides output functions like Mode 0 (Address = 000) except it provides interrupted sync pulses on the active offset output. Interrupted sync pulses are provided at intervals equal to 20% and 25% of the cycle on alternate cycles.

Output Mode 6 – Provides output functions like Mode 4 except when a Preempt is active. At that time, it provides a flashing output on the inactive Preempt status outputs.

Output Mode 7 – Not used at this time.

Output Mode 8 – Not used at this time.

Output Mode 9 – Provides output functions that are provided as status feedback for the central computer system control established with Input Mode 9. It is established automatically when Input Mode 9 is programmed.

14.3.3   Loop Back Diagnostic

The ABW12232 loop back cable is required to run the Loop Back I/O Test (Option 5 from the Diagnostics menu [Figure 2-73]).

14.4   2070-2E+ Field I/O

The SEPAC software recognizes it is operating with a 2070-2E+, 2070-2E or older 2070-2A field I/O and initializes the default parameters so they are compatible with the typical 332 cabinet operation as shown in Table **14**-**8**.

Table 14-8.2070-2 Field I/O					
SEPAC Veh Det	104 Pin #	Default Function	SEPAC Veh Det	104 Pin #	Default Function
1	56	Phase 01 Vehicle Detector	20	--	Not Available
2	--	Mimic of Detector 31	21	40	Phase 06 Vehicle Detector
3	39	Phase 02 Vehicle Detector	22	44	Phase 06 Vehicle Detector
4	43	Phase 02 Vehicle Detector	23	64	Phase 06 Vehicle Detector
5	63	Phase 02 Vehicle Detector	24	77	Phase 06 Vehicle Detector
6	76	Phase 02 Vehicle Detector	25	48	Phase 06 Vehicle Detector
7	47	Phase 02 Vehicle Detector	26	--	Not Available
8	--	Mimic of Detector 32	27	--	Not Available
9	58	Phase 03 Vehicle Detector	28	--	Not Available
10	--	Mimic of Detector 33	29	57	Phase 07 Vehicle Detector
11	41	Phase 04 Vehicle Detector	30	--	Not Available
12	45	Phase 04 Vehicle Detector	31	42	Phase 08 Vehicle Detector
13	65	Phase 04 Vehicle Detector	32	46	Phase 08 Vehicle Detector
14	78	Phase 04 Vehicle Detector	33	66	Phase 08 Vehicle Detector
15	49	Phase 04 Vehicle Detector	34	79	Phase 08 Vehicle Detector
16	--	Mimic of Detector 34	35	50	Phase 08 Vehicle Detector
17	60	Phase 01 Vehicle Detector	36	--	Not Available
18	62	Phase 03 Vehicle Detector	37	59	Phase 05 Vehicle Detector
19	55	Phase 05 Vehicle Detector	38	61	Phase 07 Vehicle Detector

When operating with a 2070-2x field I/O, the SEPAC software modifies operation as follows:

When all FLSH entries (F-4-2-1) are 0, remote flash will not occur.

When the local flash status input (Pin 81) is ON (true/active), all load switch outputs will be dark. When this input transitions from ON to OFF, the software will operate as though an external start had occurred.

14.4.1   A Connector Pin/Functions

The SEPAC software and 2070-2 field I/O provides input/output functions on the C1S (A) connector in accordance with this section of this manual.

Pin	Function	I/O	Name	Port	Pin	Function	I/O	Name	Port
Table 14-9. 2070-2 Field I/O C1S ("A") Connector
1	Logic Ground	-	---	---	55	Vehicle Detector 19	I	I16	I3-1
2	Phase 4 Don't Walk (LDSW 6 Red)	O	O0	O1–1	56	Vehicle Detector 01	I	I17	I3–2
3	Phase 4 Walk (LDSW 6 Green)	O	O1	O1–2	57	Vehicle Detector 29	I	I18	I3–3
4	Phase 4 Red (LDSW 5 Red)	O	O2	O1–3	58	Vehicle Detector 09	I	I19	I3–4
5	Phase 4 Yellow (LDSW 5 Yellow)	O	O3	O1–4	59	Vehicle Detector 37	I	I20	I3–5
6	Phase 4 Green (LDSW 5 Green)	O	O4	O1–5	60	Vehicle Detector 17	I	I21	I3–6
7	Phase 3 Red (LDSW 4 Red)	O	O5	O1–6	61	Vehicle Detector 38	I	I22	I3–7
8	Phase 3 Yellow (LDSW 4 Yellow)	O	O6	O1–7	62	Vehicle Detector 18	I	I23	I3–8
9	Phase 3 Green (LDSW 4 Green)	O	O7	O1–8	63	Vehicle Detector 05	I	I28	I4–5
10	Phase 2 Don't Walk (LDSW 3 Red)	O	O8	O2–1	64	Vehicle Detector 23	I	I29	I4–6
11	Phase 2 Walk (LDSW 3 Green)	O	O9	O2–2	65	Vehicle Detector 13	I	I30	I4–7
12	Phase 2 Red (LDSW 2 Red)	O	O10	O2–3	66	Vehicle Detector 33	I	I31	I4–8
13	Phase 2 Yellow (LDSW 2 Yellow)	O	O11	O2–4	67	Ped Detector 2	I	I32	I5–1
14	Logic Ground	-	---	---	68	Ped Detector 6	I	I33	I5–2
15	Phase 2 Green (LDSW 2 Green)	O	O12	O2–5	69	Ped Detector 4	I	I34	I5–3
16	Phase 1 Red (LDSW 1 Red)	O	O13	O2–6	70	Ped Detector 8	I	I35	I5–4
17	Phase 1 Yellow (LDSW 1 Yellow)	O	O14	O2–7	71	Preempt 3 Detector	I	I36	I5–5
18	Phase 1 Green (LDSW 1 Green)	O	O15	O2–8	72	Preempt 4 Detector	I	I37	I5–6
19	Phase 8 Don't Walk (LDSW 12 Red)	O	O16	O3–1	73	Preempt 5 Detector	I	I38	I5–7
20	Phase 8 Walk (LDSW 12 Green)	O	O17	O3–2	74	Preempt 6 Detector	I	I39	I5–8
21	Phase 8 Red (LDSW 11 Red)	O	O18	O3–3	75	Spare 2	I	I40	I6–1
22	Phase 8 Yellow (LDSW 11 Yellow)	O	O19	O3–4	76	Vehicle Detector 06	I	I41	I6–2
23	Phase 8 Green (LDSW 11 Green)	O	O20	O3–5	77	Vehicle Detector 24	I	I42	I6–3
24	Phase 7 Red (LDSW 10 Red)	O	O21	O3–6	78	Vehicle Detector 14	I	I43	I6–4
25	Phase 7 Yellow (LDSW 10 Yellow)	O	O22	O3–7	79	Vehicle Detector 34	I	I44	I6–5

Table 14-9. 2070-2 Field I/O C1S ("A") Connector									
Pin	Function	I/O	Name	Port	Pin	Function	I/O	Name	Port
26	Phase 7 Green (LDSW 10 Green)	O	O23	O3–8	80	Interval Advance	I	I45	I6–6
27	Phase 6 Don't Walk (LDSW 9 Red)	O	O24	O4–1	81	Local Flash Status	I	I46	I6–7
28	Phase 6 Walk (LDSW 9 Green)	O	O25	O4–2	82	Stop Time (1) & (2)	I	I47	I6–8
29	Phase 6 Red (LDSW 8 Red)	O	O26	O4–3	83	Phase 3 Don't Walk (LDSW 18 Red)	O	O40	O6–1
30	Phase 6 Yellow (LDSW 8 Yellow)	O	O27	O4–4	84	Phase 3 Walk (LDSW 18 Green)	O	O41	O6–2
31	Phase 6 Green (LDSW 8 Green)	O	O28	O4–5	85	Overlap D Red (LDSW 17 Red)	O	O42	O6–3
32	Phase 5 Red (LDSW 7 Red)	O	O29	O4–6	86	Overlap D Yellow (LDSW 17 Yellow)	O	O43	O6–4
33	Phase 5 Yellow (LDSW 7 Yellow)	O	O30	O4–7	87	Overlap D Green (LDSW 17 Green)	O	O44	O6–5
34	Phase 5 Green (LDSW 7 Green)	O	O31	O4–8	88	Overlap C Red (LDSW 16 Red)	O	O45	O6–6
35	Phase 2 Ped Clear (LDSW 3 Yellow)	O	O32	O5–1	89	Overlap C Yellow (LDSW 16 Yellow)	O	O46	O6–7
36	Phase 6 Ped Clear (LDSW 9 Yellow)	O	O33	O5–2	90	Overlap C Green (LDSW 16 Green)	O	O47	O6–8
37	Phase 4 Ped Clear (LDSW 6 Yellow)	O	O34	O5–3	91	Phase 1 Don't Walk (LDSW 15 Red)	O	O48	O7–1
38	Phase 8 Ped Clear (LDSW 12 Yellow)	O	O35	O5–4	92	Logic Ground	-	---	---
39	Vehicle Detector 03	I	I0	I1–1	93	Phase 1 Walk (LDSW 15 Green)	O	O49	O7–2
30	Vehicle Detector 21	I	I1	I1–2	94	Overlap B Red (LDSW 14 Red)	O	O50	O7–3
41	Vehicle Detector 11	I	I2	I1–3	95	Overlap B Yellow (LDSW 14 Yellow)	O	O51	O7–4
42	Vehicle Detector 31	I	I3	I1–4	96	Overlap B Green (LDSW 14 Green)	O	O52	O7–5
43	Vehicle Detector 04	I	I4	I1–5	97	Overlap A Red (LDSW 13 Red)	O	O53	O7–6
44	Vehicle Detector 22	I	I5	I1–6	98	Overlap A Yellow (LDSW 13 Yellow)	O	O54	O7–7
45	Vehicle Detector 12	I	I6	I1–7	99	Overlap A Green (LDSW 13 Green)	O	O55	O7–8
46	Vehicle Detector 32	I	I7	I1–8	100	Phase 3 Ped Clear (LDSW 18 Yellow)	O	O36	O5–5
47	Vehicle Detector 07	I	I8	I2–1	101	Phase 1 Ped Clear (LDSW 15 Yellow)	O	O37	O5–6
48	Vehicle Detector 25	I	I9	I2–2	102	Aux 3 or Det Reset	O	O38	O5–7
49	Vehicle Detector 15	I	I10	I2–3	103	Watchdog	O	O39	O5–8
50	Vehicle Detector 35	I	I11	I2–4	104	Logic Ground	-	---	---
51	Preempt 1 Detector	I	I12	I2–5					
52	Preempt 2 Detector	I	I13	I2–6					
53	Manual Control Enable	I	I14	I2–7					
54	Spare 1	I	I15	I2–8					

14.4.1.1 ABC Input Mode Functions

Input modes is not used at this time.

14.4.1.2 ABC Output Mode Functions

<table>
<tr><td colspan="5">Table 14-10. ABC Output Mode Functions</td></tr>
<tr><td>**Pin**</td><td>**Mode 0**</td><td>**Mode 1**</td><td>**Mode 2-3-5-7-8-9**</td><td>**Modes 4 & 6**</td></tr>
<tr><td>35</td><td>Phase 2 Ped Clear</td><td>Not Used (OFF)</td><td></td><td>Preempt 1 Status</td></tr>
<tr><td>36</td><td>Phase 6 Ped Clear</td><td>Not Used (OFF)</td><td></td><td>Preempt 2 Status</td></tr>
<tr><td>37</td><td>Phase 4 Ped Clear</td><td>Not Used (OFF)</td><td></td><td>Preempt 3 Status</td></tr>
<tr><td>38</td><td>Phase 8 Ped Clear</td><td>Not Used (OFF)</td><td>Reserved</td><td>Preempt 4 Status</td></tr>
<tr><td>83</td><td>Phase 3 Don't Walk</td><td>Auxiliary 1</td><td></td><td>Auxiliary 1</td></tr>
<tr><td>84</td><td>Phase 3 Walk</td><td>Aux 2 or Any Preempt</td><td></td><td>Aux 2 or Any Preempt</td></tr>
<tr><td>91</td><td>Phase 1 Don't Walk</td><td>Not Used (OFF)</td><td></td><td>Any Priority</td></tr>
<tr><td>93</td><td>Phase 1 Walk</td><td>Not Used (OFF)</td><td></td><td>Special Function 1</td></tr>
<tr><td>100</td><td>Phase 3 Ped Clear</td><td>Not Used (OFF)</td><td></td><td>Preempt 6 Status</td></tr>
<tr><td>101</td><td>Phase 1 Ped Clear</td><td>Not Used (OFF)</td><td></td><td>Preempt 5 Status</td></tr>
</table>

The following provides descriptions for the output modes:

Output Mode 0 – Provides pedestrian load switch outputs.

Output Mode 1 – Reserved at this time. Provides only Aux 1 and Aux 2/Any Preempt.

Output Mode 2 – Reserved at this time. See Output Mode 1.

Output Mode 3 – Reserved at this time. See Output Mode 1.

Output Mode 4 – Provides preempt status outputs that are active whenever a preempt routine is in control.

Output Mode 5 – Reserved at this time. See Output Mode 1.

Output Mode 6 – Provides output functions like Mode 4 except when a preempt is active. Then it provides a flashing output on the inactive preempt status outputs.

Output Mode 7 – Reserved at this time. See Output Mode 1.

Output Mode 8 – Reserved at this time. See Output Mode 1.

Output Mode 9 – Reserved at this time. See Output Mode 1.

14.4.2 D Connector Pin/Functions

The SEPAC software and 2070-2x field I/O provides input/output functions on the C11S (D) connector in accordance with this section of the manual.

Table 14-11. 2070-2 Field I/O C11S ("D") Connector

Pin	Function	I/O	Name	Port	Pin	Function	I/O	Name	Port
1	Mode * Output 1	O	O56	O8–1	21	Mode * Input 07	I	I54	I7–7
2	Mode * Output 2	O	O57	O8–2	22	Mode * Input 08	I	I55	I7–8
3	Mode * Output 3	O	O58	O8–3	23	Mode * Input 09	I	I56	I8–1
4	Mode * Output 4	O	O59	O8–4	24	Mode * Input 10	I	I57	I8–2
5	Mode * Output 5	O	O60	O8–5	25	Mode * Input 11	I	I58	I8–3
6	Mode * Output 6	O	O61	O8–6	26	Mode * Input 12	I	I59	I8–4
7	Mode * Output 7	O	O62	O8–7	27	Mode * Input 13	I	I60	I8–5
8	Mode * Output 8	O	O63	O8–8	28	Mode * Input 14	I	I61	I8–6
9	Logic Ground	-	---	---	29	Automatic Flash	I	I62	I8–7
10	CM Flash Status	I	I24	I4–1	30	Free (No Coord)	I	I63	I8–8
11	Spare 1	I	I25	I4–2	31	Logic Ground	-	---	---
12	Spare 2	I	I26	I4–3	32	Not Used	-	---	---
13	Spare 3	I	I27	I4–4	33	Not Used	-	---	---
14	Logic Ground	-	---	---	34	Not Used	-	---	---
15	Mode * Input 01	I	I48	I7–1	35	Not Used	-	---	---
16	Mode * Input 02	I	I49	I7–2	36	Not Used	-	---	---
17	Mode * Input 03	I	I50	I7–3	37	Logic Ground	-	---	---
18	Mode * Input 04	I	I51	I7–4					
19	Mode * Input 05	I	I52	I7–5					
20	Mode * Input 06	I	I53	I7–6					

14.4.2.1   D Input Mode Functions

A Mode Output # function is dependent on CU D connector mode programming and whether the unit has a system address other than 000.

Table 14-12. D Input Mode Functions – Address = 000

Pin	Mode 0	Mode 1	Mode 2	Mode 3	4-7	Mode 8	Mode 9
15	On Line	Special Detector 1	On Line	Special Detector 1		On Line	Computer Control
16	T Plan A (Dial A)	Special Detector 7	T Plan A (Dial A)	Special Detector 7		T Plan A (Dial A)	T Plan A (Dial A)
17	T Plan B (Dial B)	Special Detector 8	T Plan B (Dial B)	Special Detector 8		T Plan B (Dial B)	T Plan B (Dial B)
18	T Plan C (Split A)	Special Detector 5	T Plan C (Split A)	Special Detector 5		T Plan C (Split A)	T Plan C (Split A)
19	T Plan D (Split B)	Special Detector 6	T Plan D (Split B)	Special Detector 6		T Plan D (Split B)	T Plan D (Split B)
20	Offset 1	Special Detector 2	Offset 1	Special Detector 2		Offset 1	Offset 1
21	Offset 2	Special Detector 3	Offset 2	Special Detector 3		Offset 2	Offset 2
22	Offset 3	Special Detector 4	Offset 3	Special Detector 4		Offset 3	Offset 3
23	Alt Sequence A	Special Status 1	Alt Sequence A	Special Status 1		Special Status 1	Special Status 1
24	Alt Sequence B	Special Status 2	Alt Sequence B	Special Status 2		Special Status 2	Special Status 2
25	Alt Sequence C	Special Status 3	Alt Sequence C	Special Status 3		Special Status 3	Special Status 3
26	Alt Sequence D	Special Status 4	Alt Sequence D	Special Status 4		Special Status 4	Special Status 4
27	Set Clock	Special Status 5	Preempt 5 Detector	Preempt 5 Detector		Preempt 5 Detector	Preempt 5 Detector
28	Dimming Enable	Special Status 6	Preempt 6 Detector	Preempt 6 Detector		Free (No Coord)	Preempt 6 Detector

Pin	Mode 0	Mode 1	Mode 2	Mode 3	4-7	Mode 8	Mode 9
\-	Table 14-13. D Input Mode Functions – Address <> 000						
15	Special Detector 1	On Line	Special Detector 1	On Line		Special Detector 1	Computer Control
16	Special Detector 7	T Plan A (Dial A)	Special Detector 7	T Plan A (Dial A)		Special Detector 7	T Plan A (Dial A)
17	Special Detector 8	T Plan B (Dial B)	Special Detector 8	T Plan B (Dial B)		Special Detector 8	T Plan B (Dial B)
18	Special Detector 5	T Plan C (Split A)	Special Detector 5	T Plan C (Split A)		Special Detector 5	T Plan C (Split A)
19	Special Detector 6	T Plan D (Split B)	Special Detector 6	T Plan D (Split B)		Special Detector 6	T Plan D (Split B)
20	Special Detector 2	Offset 1	Special Detector 2	Offset 1		Special Detector 2	Offset 1
21	Special Detector 3	Offset 2	Special Detector 3	Offset 2		Special Detector 3	Offset 2
22	Special Detector 4	Offset 3	Special Detector 4	Offset 3		Special Detector 4	Offset 3
23	Special Status 1	Alt Sequence A	Special Status 1	Alt Sequence A		Special Status 1	Special Status 1
24	Special Status 2	Alt Sequence B	Special Status 2	Alt Sequence B		Special Status 2	Special Status 2
25	Special Status 3	Alt Sequence C	Special Status 3	Alt Sequence C		Special Status 3	Special Status 3
26	Special Status 4	Alt Sequence D	Special Status 4	Alt Sequence D		Special Status 4	Special Status 4
27	Special Status 5	Set Clock	Preempt 5 Detector	Preempt 5 Detector		Preempt 5 Detector	Preempt 5 Detector
28	Special Status 6	Dimming Enable	Preempt 6 Detector	Preempt 6 Detector		Free (No Coord)	Preempt 6 Detector

Note that Alt Sequence A-D inputs provide Sequences 1-16.

Note that Timing Plans A-D along with Offsets 1-3 provide 48 Dial/Split/Offset combinations from 1/1/1 through 4/4/3. These map to Plans 1-48, as shown: 1/1/1 = 1, 1/1/2 = 2, 1/1/3 = 3, 1/2/1 = 4, ... 2/1/1 = 13, ... 4/4/3 = 48.

The following provides descriptions for the input modes:

Input Mode 0 – Provides coordination and alt sequence inputs when no system address is programmed and Special Detectors and Special Status Inputs when a system address is programmed.

Input Mode 1 – Provides input functions just opposite of Input Mode 0. Also provides coordination and alt sequence inputs when a system address is programmed and Special Detectors and Special Status Inputs when no system address is programmed.

Input Mode 2 – Provides input functions like Mode 0 except Preempt 5 and Preempt 6 inputs replace functions on Pin 27 and Pin 28.

Input Mode 3 – Provides input functions like Mode 1 except Preempt 5 and Preempt 6 inputs replace functions on Pin 27 and Pin 28.

Input Mode 4 – Not used at this time.

Input Mode 5 – Not used at this time.

Input Mode 6 – Not used at this time.

Input Mode 7 – Not used at this time.

Input Mode 8 – Provides input functions like Mode 2 except Pins 23, 24, 25, 26, and 28 do not change their function based on the address. The modifications to Pin-28 function, as defined above, eliminate the Preempt 6 capability.

Input Mode 9 – Provides input functions that may be used with a central computer system.

14.4.2.2   D Output Mode Functions

A mode output # function is dependent on CU D connector mode programming and whether the unit has a system address other than 000.

Pin	Mode 0	Mode 1	2-3	Mode 4	Mode 5	6-8	Mode 9
				Table 14-14. D Output Mode Functions – Address = 000			
1	T Plan A (Dial A)	Special Function 7		Preempt 6 Status	T Plan A (Dial A)		R3 Dwell
2	T Plan B (Dial B)	Special Function 8		Any Priority	T Plan B (Dial B)		R4 Dwell
3	T Plan C (Split A)	Special Function 5		Preempt 4 Status	T Plan C (Split A)		R1 Dwell
4	T Plan D (Split B)	Special Function 6		Preempt 5 Status	T Plan D (Split B)		R2 Dwell
5	Offset 1	Special Function 2		Preempt 1 Status	Offset 1		Special Function 2
6	Offset 2	Special Function 3		Preempt 2 Status	Offset 2		Special Function 3
7	Offset 3	Special Function 4		Preempt 3 Status	Offset 3		Cycle 0
8	Automatic Flash	Special Function 1		Special Function 1	Automatic Flash		Special Function 1

Pin	Mode 0	Mode 1	2-3	Mode 4	Mode 5	6-8	Mode 9
				Table 14-15. D Output Mode Functions – Address <> 000			
1	Special Function 7	T Plan A (Dial A)		Preempt 6 Status	T Plan A (Dial A)		R3 Dwell
2	Special Function 8	T Plan B (Dial B)		Any Priority	T Plan B (Dial B)		R4 Dwell
3	Special Function 5	T Plan C (Split A)		Preempt 4 Status	T Plan C (Split A)		R1 Dwell
4	Special Function 6	T Plan D (Split B)		Preempt 5 Status	T Plan D (Split B)		R2 Dwell
5	Special Function 2	Offset 1		Preempt 1 Status	Offset 1		Special Function 2
6	Special Function 3	Offset 2		Preempt 2 Status	Offset 2		Special Function 3
7	Special Function 4	Offset 3		Preempt 3 Status	Offset 3		Cycle 0
8	Special Function 1	Automatic Flash		Special Function 1	Automatic Flash		Special Function 1

Note that Plans 1-48 map to Dial/Split/Offset combinations from 1/1/1 through 4/4/3, respectively. These provide Timing Plans A-D and Offsets 1-3 outputs.

The following provides descriptions for the output modes:

Output Mode 0 – Provides coordination outputs when no system address is programmed and System Special Function outputs when a system address is programmed.

Output Mode 1 – Provides output functions just opposite of Output Mode 0. Also provides coordination outputs when a system address is programmed and System Special Function outputs when no system address is programmed.

Output Mode 2 – Provides output functions like Mode 0 except when any Preempt routine has control then it is like Mode 4 below. When Auxiliary #2 is not programmed for output as a TBC auxiliary function, it becomes an Any Preempt active function. The any preempt output becomes active when any Preempt routine is in control.

Output Mode 3 – Provides output functions like Mode 1 except when any Preempt routine has control. Then it is like Mode 4 below.

Output Mode 4 – Provides preempt status outputs that are active whenever a Preempt routine is in control.

Output Mode 5 – Provides output functions like Mode 0 (Address = 000) except provides Interrupted sync pulses on the active offset output. Interrupted sync pulses are provided at intervals equal to 20% and 25% of the cycle on alternate cycles.

Output Mode 6 – Provides output functions like Mode 4 except when a Preempt is active provides a flashing output on the inactive Preempt status outputs.

Output Mode 7 – Not used at this time.

Output Mode 8 – Not used at this time.

Output Mode 9 – Provides output functions that are provided as status feedback for the central computer system control established with Input Mode 9. It is established automatically when Input Mode 9 is programmed.

14.4.3　Loop Back Diagnostic

The ABW12150 loop back cable is required to run the Loop Back I/O Test (Option 5 from the Diagnostics menu [Figure 2-73]).

14.4.4　SEPAC Displays

The SEPAC software with a 2070-2x field I/O provides front panel I/O status displays that vary from a NEMA field I/O, due to physical differences in hardware.

14.4.4.1　Active Status Displays

When running SEPAC with a 2070-2x field I/O, SEPAC presents Active Status displays referenced in Section2.2.9.2, regardless of the FIO option running. These displays show the status of the input and output pins regardless of the function caused by alternate I/O modes.

14.4.4.2   Diagnostic Screens

The Diagnostics Menu (Figure 14-2) allows the user to select which diagnostic test to run.

14.4.4.2.1 Input Diagnostics

```
DIAGNOSTICS

        1-KEYPAD TEST
        2-STANDARD INPUT
        3-SPECIAL INPUT
        4-OUTPUT TEST
        5-LOOP BACK I/O TEST
        F-EXIT DIAGNOSTICS TO RESTART
```

Figure 14-2. SEPAC Diagnostics Menu

From the SEPAC Diagnostics menu (Figure 14-2), select **2-STANDARD INPUT**.

```
INPUT DIAGNOSTIC STANDARD      CF - ..
   VEH DET (01-10) .X.....X.X   ST - .
   VEH DET (11-20) .....X...X   IA - .
   VEH DET (21-30) .....XXX.X   LF - .
   VEH DET (31-40) .....X..XX   MCE- .
   PED DET (01-08) X.X.X.X.     RR - .
   PREEMPT (01-06) ......       WRM- .
      ANY SPECIAL -.
```

Figure 14-3. Input Diagnostic Standard Display

The standard input diagnostic begins with the display shown in Figure 14-3, assuming no inputs to the controller unit are active.

From the Diagnostics menu (Figure 14-2), select **3-SPECIAL INPUT**.

```
INPUT DIAGNOSTIC SPECIAL
  CF -.   DB/SD8-.  O1/SD2-.   SC/SS5-.
  SP1-.   DA/SD7-.  OL/SD1-.   DM/SS6-.
  SP2-.   SB/SD6-.  AA/SS1-.     AF -..
  SP3-.   SA/SD5-.  AB/SS2-.     FR -.
          O3/SD4-.  AC/SS3-.
          O2/SD3-.  AD/SS4-.
   ANY STANDARD-.
```

Figure 14-4. Input Diagnostic Special Display

The special input diagnostic begins with the display shown in Figure 14-4, assuming no inputs to the controller unit are active.

15 NEMA TS 2 Port 1 Protocol

Each device attached to Port 1 is responsible for transmitting frames. Frames transmitted by the CU are referred to as command frames and frames transmitted by secondary stations or other auxiliary equipment are referred to as response frames.

15.1   Command Frames

The transmission of Port 1 command frames is controlled by the CU. The CU transmits all frame types within a one-second window, with the window repeating itself in a cyclical manner every second that the CU is operating.

Table 15-1. Command Frames			
Type	**Dest.**	**Address.**	**Function**
0	MMU	16/19	Load switch drivers (3)
1	MMU	16	MMU status
3	MMU	16	MMU programming
9	ALL	255	Date and time broadcast
10	T#1	0	TF BIU #1 outputs
11	T#2	1	TF BIU #2 outputs
12	T#3	2	TF BIU #3 outputs
13	T#4	3	TF BIU #4 outputs
18	ALL	255	TF BIUs output transfer
20	D#1	8	DET BIU #1 inputs
21	D#2	9	DET BIU #2 inputs
22	D#3	10	DET BIU #3 inputs
23	D#4	11	DET BIU #4 inputs
24	D#1	8	DET BIU #1 detector resets
25	D#2	9	DET BIU #2 detector resets
26	D#3	10	DET BIU #3 detector resets
27	D#4	11	DET BIU #4 detector resets
30	(1)	17	Diagnostic information input
40	ALL	0-254	Poll for service (2)
41			Reserved
42	ALL	0-254	Sec destination message (2)
43	ALL	0-254	Sec exchange status (2)

NOTES:

1. Frame Type 30 is for diagnostic purposes.

2. Secondary-to-secondary messaging

3. Type 0 command may be sent to address 19 with no response expected if 19 is enabled and 16 is not. Only one of 16 and 19 may be enabled at the same time.

15.1.1 Command Frame Timing

Each frame type has a defined frequency of transmission. If the command frames are required to be transmitted, as determined by CU programming, the frequency of transmission is as shown below.

Table 15-2. Command Frames and Frequency of Transmission		
Type	**Frequency**	**Description**
0	10x Sec	Load switch drivers
1	10x Sec	MMU status
3	1x Sec	MMU programming
9	1x Sec	Date and time broadcast
10	10x Sec	TF BIU #1 outputs
11	10x Sec	TF BIU #2 outputs
12	10x Sec	TF BIU #3 outputs
13	10x Sec	TF BIU #4 outputs
18	10x Sec	TF BIUs output transfer
20	10x Sec	DET BIU #1 inputs
21	10x Sec	DET BIU #2 inputs
22	10x Sec	DET BIU #3 inputs
23	10x Sec	DET BIU #4 inputs
24	1x Sec	DET BIU #1 detector resets
25	1x Sec	DET BIU #2 detector resets
26	1x Sec	DET BIU #3 detector resets
27	1x Sec	DET BIU #4 detector resets
30	1x Sec	Diagnostic information input
40*	10x Sec	Poll for device (2)
* The Type 40 frame may be replaced by a Type 42 or 43, as required, during secondary-to-secondary messaging.		

15.1.2 Command Frame Scheduling

The one-second window, during which time all frame types are transmitted, is divided into ten 100-millisecond windows.

The scheduling of the transmission of frames is such that they are transmitted in the order shown in the following table in each of the one second windows.

Table 15-3. Command Frame Scheduling			
Win	**Type**	**Dest**	**Function**
1	9	ALL	Date and time broadcast
	0	MMU	Load switch drivers
	1	MMU	MMU status input
	10	T#1	TF BIU #1 outputs
	11	T#2	TF BIU #2 outputs
	12	T#3	TF BIU #3 outputs
	13	T#4	TF BIU #4 outputs
	18	ALL	TF BIUs output transfer
	20	D#1	DET BIU #1 inputs
	21	D#2	DET BIU #2 inputs
	22	D#3	DET BIU #3 inputs
	23	D#4	DET BIU #4 inputs
	40*	?	Poll for service
2			Repeat Type 0 to 23 from Window 1
	3	MMU	MMU programming
	40*	?	Poll for service
3			Repeat Type 0 to 23 from Window 1
	24	D#1	DET BIU #1 detector resets
	40*	?	Poll for service
4			Repeat Type 0 to 23 from Window 1
	25	D#2	DET BIU #2 detector resets
	40*	?	Poll for service
5			Repeat Type 0 to 23 from Window 1
	26	D#3	DET BIU #3 detector resets
	40*	?	Poll for service
6			Repeat Type 0 to 23 from Window 1
	27	D#4	DET BIU #4 detector resets
	40*	?	Poll for service
7			Repeat Type 0 to 23 from Window 1
	30		Diagnostic information input
	40*	?	Poll for service
8			Repeat Type 0 to 23 from Window 1
	40*	?	Poll for service
9			Repeat Type 0 to 23 from Window 1
	40*	?	Poll for service
10			Repeat Type 0 to 23 from Window 1
	40*	?	Poll for service
* The Type 40 Frame may be replaced by a Type 42 or 43, as required, during secondary-to-secondary messaging.			

15.2　Response Frames

Response frames are only transmitted as a result of receiving a command frame.

Table 15-4. Response Frames			
Type	**Source**	**Address.**	**Function**
128	MMU	16	ACK 0
129	MMU	16	ACK 1 + data
131	MMU	16	ACK 3 + data
138	T#1	0	ACK 10 + TF BIU 1 input
139	T#2	1	ACK 11 + TF BIU 2 input
140	T#3	2	ACK 12 + TF BIU 3 input
141	T#4	3	ACK 13 + TF BIU 4 input
148	D#1	8	ACK 20 + DET BIU 1 input
149	D#2	9	ACK 21 + DET BIU 2 input
150	D#3	10	ACK 22 + DET BIU 3 input
151	D#4	11	ACK 23 + DET BIU 4 input
152	D#1	8	ACK 24 + DET BIU 1 DIAG
153	D#2	9	ACK 25 + DET BIU 2 DIAG
154	D#3	10	ACK 26 + DET BIU 3 DIAG
155	D#4	11	ACK 27 + DET BIU 4 DIAG
158		17	ACK 30 + data
168	ALL	0–254	No service required
169	ALL	0–254	Sec source message
170	ALL	0–254	Secondary NAK
171	ALL	0–254	Secondary ACK

15.3　Frame Formats

The detailed formats for the information fields of the frame types summarized above are provided in this section.

15.3.1　Type 0 – Load Switch Drivers

Type 0 is the channel driver and load switch flash status being sent to the MMU.

Table 15-5. Type 0 Command Frame		
Bit	**Function**	
1	0	
2	0	

Table 15-5. Type 0 Command Frame		
Bit	**Function**	
3	0	
4	0	Type 0 command frame
5	0	
6	0	
7	0	
8	0	
9	Channel 1 green driver+(walk)	
10	Channel 1 green drive -(walk)	
11	Channel 2 green driver+(walk)	
12	Channel 2 green driver-(walk)	
13	Channel 3 green driver+(walk)	
14	Channel 3 green driver-(walk)	
15	Channel 4 green driver+(walk)	
16	Channel 4 green driver-(walk)	
17	Channel 5 green driver+(walk)	
18	Channel 5 green driver-(walk)	
19	Channel 6 green driver+(walk)	
20	Channel 6 green driver-(walk)	
21	Channel 7 green driver+(walk)	
22	Channel 7 green driver-(walk)	
23	Channel 8 green driver+(walk)	
24	Channel 8 green driver-(walk)	
25	Channel 9 green driver+(walk)	
26	Channel 9 green driver-(walk)	
27	Channel 10 green driver+(walk)	
28	Channel 10 green driver-(walk)	

Table 15-5. Type 0 Command Frame	
Bit	**Function**
29	Channel 11 green driver+(walk)
30	Channel 11 green driver-(walk)
31	Channel 12 green driver+(walk)
32	Channel 12 green driver-(walk)
33	Channel 13 green driver+(walk)
34	Channel 13 green driver-(walk)
35	Channel 14 green driver+(walk)
36	Channel 14 green driver-(walk)
37	Channel 15 green driver+(walk)
38	Channel 15 green driver-(walk)
39	Channel 16 green driver+(walk)
40	Channel 16 green driver-(walk)
41	Channel 1 yellow driver+(pedestrian clear)
42	Channel 1 yellow driver -(pedestrian clear)
43	Channel 2 yellow driver+(pedestrian clear)
44	Channel 2 yellow driver-(pedestrian clear)
45	Channel 3 yellow driver+(pedestrian clear)
46	Channel 3 yellow driver-(pedestrian clear)
47	Channel 4 yellow driver+(pedestrian clear)
48	Channel 4 yellow driver-(pedestrian clear)
49	Channel 5 yellow driver+(pedestrian clear)
50	Channel 5 yellow driver-(pedestrian clear)
51	Channel 6 yellow driver+(pedestrian clear)
52	Channel 6 yellow driver-(pedestrian clear)
53	Channel 7 yellow driver+(pedestrian clear)
54	Channel 7 yellow driver-(pedestrian clear)
55	Channel 8 yellow driver+(pedestrian clear)

Table 15-5. Type 0 Command Frame	
Bit	**Function**
56	Channel 8 yellow driver-(pedestrian clear)
57	Channel 9 yellow driver+(pedestrian clear)
58	Channel 9 yellow driver-(pedestrian clear)
59	Channel 10 yellow driver+(pedestrian clear)
60	Channel 10 yellow driver-(pedestrian clear)
61	Channel 11 yellow driver+(pedestrian clear)
62	Channel 11 yellow driver-(pedestrian clear)
63	Channel 12 yellow driver+(pedestrian clear)
64	Channel 12 yellow driver-(pedestrian clear)
65	Channel 13 yellow driver+(pedestrian clear)
66	Channel 13 yellow driver-(pedestrian clear)
67	Channel 14 yellow driver+(pedestrian clear)
68	Channel 14 yellow driver-(pedestrian clear)
69	Channel 15 yellow driver+(pedestrian clear)
70	Channel 15 yellow driver-(pedestrian clear)
71	Channel 16 yellow driver+(pedestrian clear)
72	Channel 16 yellow driver-(pedestrian clear)
73	Channel 1 Red Driver+(don't walk)
74	Channel 1 Red Driver-(don't walk)
75	Channel 2 Red Driver+(don't walk)
76	Channel 2 Red Driver-(don't walk)
77	Channel 3 Red Driver+(don't walk)
78	Channel 3 Red Driver-(don't walk)
79	Channel 4 Red Driver+(don't walk)
80	Channel 4 Red Driver-(don't walk)
81	Channel 5 Red Driver+(don't walk)

Table 15-5. Type 0 Command Frame	
Bit	**Function**
82	Channel 5 Red Driver-(don't walk)
83	Channel 6 Red Driver+(don't walk)
84	Channel 6 Red Driver-(don't walk)
85	Channel 7 Red Driver+(don't walk)
86	Channel 7 Red Driver-(don't walk)
87	Channel 8 Red Driver+(don't walk)
88	Channel 8 Red Driver-(don't walk)
89	Channel 9 Red Driver+(don't walk)
90	Channel 9 Red Driver-(don't walk)
91	Channel 10 Red Driver+(don't walk)
92	Channel 10 Red Driver-(don't walk)
93	Channel 11 Red Driver+(don't walk)
94	Channel 11 Red Driver-(don't walk)
95	Channel 12 Red Driver+(don't walk)
96	Channel 12 Red Driver-(don't walk)
97	Channel 13 Red Driver+(don't walk)
98	Channel 13 Red Driver-(don't walk)
99	Channel 14 Red Driver+(don't walk)
100	Channel 14 Red Driver-(don't walk)
101	Channel 15 Red Driver+(don't walk)
102	Channel 15 Red Driver-(don't walk)
103	Channel 16 Red Driver+(don't walk)
104	Channel 16 Red Driver-(don't walk)
105	Reserved
106	Reserved
107	Reserved
108	Reserved

Table 15-5. Type 0 Command Frame

Bit	Function
109	Reserved
110	Reserved
111	Reserved
112	Load switch flash

15.3.2   Type 1 – MMU Status Input

Type 1 is a request for load switch output and MMU fault status to be returned by the MMU.

Table 15-6. Type 1 Command Frame

Bit	Function	
1	1	
2	0	
3	0	
4	0	Type 1 command frame
5	0	
6	0	
7	0	
8	0	

15.3.3   Type 3 – MMU Programming Input

Type 3 is a request for MMU programming to be returned by the MMU.

Bit	Function	
	Table 15-7. Type 3 Command Frame	
Bit	**Function**	
1	1	
2	1	
3	0	
4	0	Type 3 command frame
5	0	
6	0	
7	0	
8	0	

15.3.4   Type 9 – Date and Time Broadcast

Type 9 is a broadcast of the current date/time plus the defined terminal and facilities BIUs and detector BIUs within its programming.

Bit	Function	
	Table 15-8. Type 9 Command Frame	
Bit	**Function**	
1	1	
2	0	
3	0	
4	1	Type 9 command frame
5	0	
6	0	
7	0	
8	0	
9	Month	
10	Month	

Table 15-8. Type 9 Command Frame	
Bit	**Function**
11	Month
12	Month
13	Reserved
14	Reserved
15	Reserved
16	Reserved
17	Day
18	Day
19	Day
20	Day
21	Day
22	Reserved
23	Reserved
24	Reserved
25	Year
26	Year
27	Year
28	Year
29	Year
30	Year
31	Year
32	Reserved
33	Hour
34	Hour
35	Hour
36	Hour
37	Hour

Table 15-8. Type 9 Command Frame	
Bit	**Function**
38	Reserved
39	Reserved
40	Reserved
41	Minutes
42	Minutes
43	Minutes
44	Minutes
45	Minutes
46	Minutes
47	Reserved
48	Reserved
49	Seconds
50	Seconds
51	Seconds
52	Seconds
53	Seconds
54	Seconds
55	Reserved
56	Reserved
57	Tenths of seconds
58	Tenths of seconds
59	Tenths of seconds
60	Tenths of seconds
61	Reserved
62	Reserved
63	Reserved
64	Reserved

Table 15-8. Type 9 Command Frame	
Bit	**Function**
65	TF BIU #1 present
66	TF BIU #2 present
67	TF BIU #3 present
68	TF BIU #4 present
69	TF BIU #5 present
70	TF BIU #6 present
71	TF BIU #7 present
72	TF BIU #8 present
73	DET BIU #1 present
74	DET BIU #2 present
75	DET BIU #3 present
76	DET BIU #4 present
77	DET BIU #5 present
78	DET BIU #6 present
79	DET BIU #7 present
80	DET BIU #8 present

15.3.5   Type 10 – TF BIU #1 Outputs

Type 10 controls the state of the outputs in Terminal and Facilities BIU #1.

Table 15-9. Type 10 Command Frame		
Bit	**Function**	
1	0	
2	1	
3	0	
4	1	Type10 command frame
5	0	

Table 15-9. Type 10 Command Frame		
Bit	**Function**	
6	0	
7	0	
8	0	
9	Output 1	Load Switch 01 red +
10	Output 1	Load Switch 01 red -
11	Output 2	Load Switch 01 yellow +
12	Output 2	Load Switch 01 yellow -
13	Output 3	Load Switch 01 green +
14	Output 3	Load Switch 01 green -
15	Output 4	Load Switch 02 red +
16	Output 4	Load Switch 02 red -
17	Output 5	Load Switch 02 yellow +
18	Output 5	Load Switch 02 yellow -
19	Output 6	Load Switch 02 green +
20	Output 6	Load Switch 02 green -
21	Output 7	Load Switch 03 red +
22	Output 7	Load Switch 03 red -
23	Output 8	Load Switch 03 yellow +
24	Output 8	Load Switch 03 yellow -
25	Output 9	Load Switch 03 green +
26	Output 9	Load Switch 03 green -
27	Output 10	Load Switch 04 red +
28	Output 10	Load Switch 04 red -
29	Output 11	Load Switch 04 yellow +
30	Output 11	Load Switch 04 yellow -
31	Output 12	Load Switch 04 green +
32	Output 12	Load Switch 04 green -

Table 15-9. Type 10 Command Frame		
Bit	**Function**	
33	Output 13	Load Switch 05 red +
34	Output 13	Load Switch 05 red -
35	Output 14	Load Switch 05 yellow +
36	Output 14	Load Switch 05 yellow -
37	Output 15	Load Switch 05 green +
38	Output 15	Load Switch 05 green -
39	Input/Output 1	Load Switch 06 red +
40	Input/Output 1	Load Switch 06 red -
41	Input/Output 2	Load Switch 06 yellow +
42	Input/Output 2	Load Switch 06 yellow -
43	Input/Output 3	Load Switch 06 green +
44	Input/Output 3	Load Switch 06 green -
45	Input/Output 4	Load Switch 07 red +
46	Input/Output 4	Load Switch 07 red -
47	Input/Output 5	Load Switch 07 yellow +
48	Input/Output 5	Load Switch 07 yellow -
49	Input/Output 6	Load Switch 07 green +
50	Input/Output 6	Load Switch 07 green -
51	Input/Output 7	Load Switch 08 red +
52	Input/Output 7	Load Switch 08 red -
53	Input/Output 8	Load Switch 08 yellow +
54	Input/Output 8	Load Switch 08 yellow -
55	Input/Output 9	Load Switch 08 green +
56	Input/Output 9	Load Switch 08 green -
57	Input/Output 10	TBC Auxiliary 1
58	Input/Output 11	TBC Auxiliary 2

Table 15-9. Type 10 Command Frame		
Bit	**Function**	
59	Input/Output 12	Preempt 1 Status (*)
60	Input/Output 13	Preempt 2 Status (*)
61	Input/Output 14	Used as input
62	Input/Output 15	Used as input
63	Input/Output 16	Used as input
64	Input/Output 17	Used as input
65	Input/Output 18	Used as input
66	Input/Output 19	Used as input
67	Input/Output 20	Used as input
68	Input/Output 21	Used as input
69	Input/Output 22	Used as input
70	Input/Output 23	Used as input
71	Input/Output 24	Used as input
72	Reserved	Reserved
(*) Preempt status outputs may be modified by Connector Output mode. ABC Output Mode 13 or 14 will provide a flashing output on the inactive preempt status output. The same is true for D Connector Output Mode 6.		

15.3.6   Type 11 – TF BIU #2 Outputs

Type 11 controls the state of the outputs in terminal and facilities BIU #2.

Table 15-10. Type 11 Command Frame		
Bit	**Function**	
1	1	
2	1	
3	0	
4	1	Type 11 command frame
5	0	
6	0	

Bit	Function	
	Table 15-10. Type 11 Command Frame	
Bit	**Function**	
7	0	
8	0	
9	Output 1	Load Switch 09 red +
10	Output 1	Load Switch 09 red -
11	Output 2	Load Switch 09 yellow +
12	Output 2	Load Switch 09 yellow -
13	Output 3	Load Switch 09 green +
14	Output 3	Load Switch 09 green -
15	Output 4	Load Switch 10 red +
16	Output 4	Load Switch 10 red -
17	Output 5	Load Switch 10 yellow +
18	Output 5	Load Switch 10 yellow -
19	Output 6	Load Switch 10 green +
20	Output 6	Load Switch 10 green -
21	Output 7	Load Switch 11 red +
22	Output 7	Load Switch 11 red -
23	Output 8	Load Switch 11 yellow +
24	Output 8	Load Switch 11 yellow -
25	Output 9	Load Switch 11 green +
26	Output 9	Load Switch 11 green -
27	Output 10	Load Switch 12 red +
28	Output 10	Load Switch 12 red -
29	Output 11	Load Switch 12 yellow +
30	Output 11	Load Switch 12 yellow -
31	Output 12	Load Switch 12 green +
32	Output 12	Load Switch 12 green -

Bit	Function	
	Table 15-10. Type 11 Command Frame	
33	Output 13	Load Switch 13 red +
34	Output 13	Load Switch 13 red -
35	Output 14	Load Switch 13 yellow +
36	Output 14	Load Switch 13 yellow -
37	Output 15	Load Switch 13 green +
38	Output 15	Load Switch 13 green -
39	Input/Output 1	Load Switch 14 red +
40	Input/Output 1	Load Switch 14 red -
41	Input/Output 2	Load Switch 14 yellow +
42	Input/Output 2	Load Switch 14 yellow -
43	Input/Output 3	Load Switch 14 green +
44	Input/Output 3	Load Switch 14 green -
45	Input/Output 4	Load Switch 15 red +
46	Input/Output 4	Load Switch 15 red -
47	Input/Output 5	Load Switch 15 yellow +
48	Input/Output 5	Load Switch 15 yellow -
49	Input/Output 6	Load Switch 15 green +
50	Input/Output 6	Load Switch 15 green -
51	Input/Output 7	Load Switch 16 red +
52	Input/Output 7	Load Switch 16 red -
53	Input/Output 8	Load Switch 16 yellow +
54	Input/Output 8	Load Switch 16 yellow -
55	Input/Output 9	Load Switch 16 green +
56	Input/Output 9	Load Switch 16 green -
57	Input/Output 10	TBC Auxiliary 3
58	Input/Output 11	Free status
59	Input/Output 12	Preempt 3 status (*)

Table 15-10. Type 11 Command Frame		
Bit	**Function**	
60	Input/Output 13	Preempt 4 status (*)
61	Input/Output 14	Preempt 5 status (*)
62	Input/Output 15	Preempt 6 status (*)
63	Input/Output 16	Used as input
64	Input/Output 17	Used as input
65	Input/Output 18	Used as input
66	Input/Output 19	Used as input
67	Input/Output 20	Used as input
68	Input/Output 21	Spare 1
69	Input/Output 22	Spare 2
70	Input/Output 23	Spare 3
71	Input/Output 24	Spare 4
72	Reserved	Spare
(*) Preempt status outputs may be modified by Connector Output mode. ABC Output Mode 13 or 14 will provide a flashing output on the inactive preempt status output. The same is true for D Connector Output Mode 6.		

15.3.7   Type 12 – TF BIU #3 Outputs

Type 12 controls the state of the outputs in terminal and facilities BIU #3.

Table 15-11. Type 12 Command Frame		
Bit	**Function**	
1	0	
2	0	
3	1	
4	1	Type 12 command frame
5	0	
6	0	
7	0	

Table 15-11. Type 12 Command Frame		
Bit	**Function**	
8	0	
9	Output 1	Timing Plan A
10	Output 2	Timing Plan B
11	Output 3	Timing Plan C
12	Output 4	Timing Plan D
13	Output 5	Offset 1 (*)
14	Output 6	Offset 2 (*)
15	Output 7	Offset 3 (*)
16	Output 8	Automatic flash status
17	Output 9	System Spec Function 1
18	Output 10	System Spec Function 2
19	Output 11	System Spec Function 3
20	Output 12	System Spec Function 4
21	Output 13	Reserved
22	Output 14	Reserved
23	Output 15	Reserved
24	Reserved	Reserved
25	Input/Output 1	Ring 1 Status Bit A
26	Input/Output 2	Ring 1 Status Bit B
27	Input/Output 3	Ring 1 Status Bit C
28	Input/Output 4	Ring 2 Status Bit A
29	Input/Output 5	Ring 2 Status Bit B
30	Input/Output 6	Ring 2 Status Bit C
31	Input/Output 7	Used as input
32	Input/Output 8	Used as input
33	Input/Output 9	Used as input

Table 15-11. Type 12 Command Frame		
Bit	**Function**	
34	Input/Output 10	Used as input
35	Input/Output 11	Used as input
36	Input/Output 12	Used as input
37	Input/Output 13	Used as input
38	Input/Output 14	Used as input
39	Input/Output 15	Used as input
40	Input/Output 16	Used as input
41	Input/Output 17	Used as input
42	Input/Output 18	Used as input
43	Input/Output 19	Used as input
44	Input/Output 20	Used as input
45	Input/Output 21	Used as input
46	Input/Output 22	Used as input
47	Input/Output 23	Used as input
48	Input/Output 24	Used as input
(*) Offset outputs may be modified by Connector Output mode. ABC Output Mode 12 provides interrupted sync pulses on the active offset output. Interrupted sync pulses are provided at intervals equal to 20% and 25% of the cycle on alternate cycles. The same is true for D Connector Output Mode 5.		

15.3.8   Type 13 – TF BIU #4 Outputs

Type 13 controls the state of the outputs in terminal and facilities BIU #4.

Table 15-12. Type 13 Command Frame		
Bit	**Function**	
1	1	
2	0	
3	1	
4	1	Type 13 command frame

Bit	Function	
Table 15-12. Type 13 Command Frame
5	0	
6	0	
7	0	
8	0	
9	Output 1	Phase 1 Phase On (*)
10	Output 2	Phase 2 Phase On (*)
11	Output 3	Phase 3 Phase On (*)
12	Output 4	Phase 4 Phase On (*)
13	Output 5	Phase 5 Phase On (*)
14	Output 6	Phase 6 Phase On (*)
15	Output 7	Phase 7 Phase On (*)
16	Output 8	Phase 8 Phase On (*)
17	Output 9	Phase 1 Phase Next (*)
18	Output 10	Phase 2 Phase Next (*)
19	Output 11	Phase 3 Phase Next (*)
20	Output 12	Phase 4 Phase Next (*)
21	Output 13	Phase 5 Phase Next (*)
22	Output 14	Phase 6 Phase Next (*)
23	Output 15	Phase 7 Phase Next (*)
24	Reserved	Reserved
25	Input/Output 1	Phase 8 Check (*)
26	Input/Output 2	Phase 1 Check (*)
27	Input/Output 3	Phase 2 Check (*)
28	Input/Output 4	Phase 3 Check (*)
29	Input/Output 5	Phase 4 Check (*)
30	Input/Output 6	Phase 5 Check (*)
31	Input/Output 7	Phase 6 Check (*)

Table 15-12. Type 13 Command Frame		
Bit	**Function**	
32	Input/Output 8	Phase 7 Check (*)
33	Input/Output 9	Phase 8 Check (*)
34	Input/Output 10	Used as input
35	Input/Output 11	Used as input
36	Input/Output 12	Used as input
37	Input/Output 13	Used as input
38	Input/Output 14	Used as input
39	Input/Output 15	Spare 5
40	Input/Output 16	Spare 6
41	Input/Output 17	Spare 7
42	Input/Output 18	Spare 8
43	Input/Output 19	Spare 9
44	Input/Output 20	Reserved
45	Input/Output 21	Reserved
46	Input/Output 22	Reserved
47	Input/Output 23	Reserved
48	Input/Output 24	Reserved
Outputs may NOT be modified by Connector Output mode.		

15.3.9 Type 18 – Terminal and Facilities BIUs Output Transfer

Type 18 is broadcast to indicate to the terminal and facilities BIUs it is time to update their outputs.

Table 15-13. Type 18 Command Frame		
Bit	**Function**	
1	0	
2	1	
3	0	
4	0	Type 18 command frame
5	1	
6	0	
7	0	
8	0	

15.3.10 Type 20 – DET BIU #1 Inputs

Type 20 is a request for Vehicle Detector 01-16 activity from Detector BIU # 1.

Table 15-14. Type 20 Command Frame		
Bit	**Function**	
1	0	
2	0	
3	1	
4	0	Type 20 command frame
5	1	
6	0	
7	0	
8	0	

15.3.11 Type 21 – DET BIU #2 Inputs

Type 21 is a request for Vehicle Detector 17-32 activity from Detector BIU #21.

Table 15-15. Type 21 Command Frame		
Bit	**Function**	
1	1	
2	0	
3	1	
4	0	Type 21 command frame
5	1	
6	0	
7	0	
8	0	

15.3.12 Type 22 – DET BIU #3 Inputs

Type 22 is a request for Vehicle Detector 33-48 activity from Detector BIU # 3.

Table 15-16. Type 22 Command Frame		
Bit	**Function**	
1	0	
2	1	
3	1	
4	0	Type 22 command frame
5	1	
6	0	
7	0	
8	0	

15.3.13 Type 23 – DET BIU #4 Inputs

Type 23 is a request for Vehicle Detector 49-64 activity from Detector BIU #41.

Table 15-17. Type 23 Command Frame		
Bit	**Function**	
1	1	
2	1	
3	1	
4	0	Type 23 command frame
5	1	
6	0	
7	0	
8	0	

15.3.14 Type 24 – DET BIU #1 Detector Resets

Type 24 is Detector 01-16 Resets and a request for Diagnostic Information on Detector 01-16 from Detector BIU #1.

Table 15-18. Type 24 Command Frame		
Bit	**Function**	
1	0	
2	0	
3	0	
4	1	Type 24 command frame
5	1	
6	0	
7	0	
8	0	
9	Detector Card Slots 1	
10	Detector Card Slots 3	
11	Detector Card Slots 5	
12	Detector Card Slots 7	
13	Reserved	
14	Reserved	
15	Reserved	
16	Reserved	

15.3.15 Type 25 – DET BIU #2 Detector Resets

Type 25 is Detector 17-32 Resets and a request for Diagnostic Information on Detector 17-32 from Detector BIU #2.

Table 15-19. Type 25 Command Frame		
Bit	**Function**	
1	1	
2	0	
3	0	
4	1	Type 25 command frame
5	1	
6	0	
7	0	
8	0	
9	Detector Card Slots 1	
10	Detector Card Slots 3	
11	Detector Card Slots 5	
12	Detector Card Slots 7	
13	Reserved	
14	Reserved	
15	Reserved	
16	Reserved	

15.3.16 Type 26 – DET BIU #3 Detector Resets

Type 26 is Detector 33-48. It resets a request for diagnostic information on Detector 33-48 from Detector BIU #3.

Bit	Function	
Table 15-20. Type 26 Command Frame		
1	0	
2	1	
3	0	
4	1	Type 26 command frame
5	1	
6	0	
7	0	
8	0	
9	Detector Card Slots 1	
10	Detector Card Slots 3	
11	Detector Card Slots 5	
12	Detector Card Slots 7	
13	Reserved	
14	Reserved	
15	Reserved	
16	Reserved	

15.3.17 Type 27 – DET BIU #4 Detector Resets

Type 27 is Detector 49-64 Resets and a request for diagnostic information on Detector 49-64 from Detector BIU #4.

		Table 15-21. Type 27 Command Frame	
Bit	**Function**		
1	1		
2	1		
3	0		
4	1	Type 27 command frame	
5	1		
6	0		
7	0		
8	0		
9	Detector Card Slots 1		
10	Detector Card Slots 3		
11	Detector Card Slots 5		
12	Detector Card Slots 7		
13	Reserved		
14	Reserved		
15	Reserved		
16	Reserved		

15.3.18 Type 30 – Diagnostic Information Input

Type 30 is a request for diagnostic information.

Table 15-22. Type 30 Command Frame		
Bit	**Function**	
1	0	
2	1	
3	1	
4	1	Type 30 command frame
5	1	
6	0	
7	0	
8	0	

15.3.19 Type 40 – Poll for Service

Type 40 is used to poll the secondary stations for a secondary-to-secondary message exchange.

Table 15-23. Type 40 Command Frame		
Bit	**Function**	
1	0	
2	0	
3	0	
4	1	Type 40 command frame
5	0	
6	1	
7	0	
8	0	

15.3.20 Type 42 - Secondary Destination Message

Type 42 carries the secondary source message from the primary station to the destination address.

Table 15-24. Type 42 Command Frame		
Bit	**Function**	
1	0	
2	1	
3	0	
4	1	Type 42 command frame
5	0	
6	1	
7	0	
8	0	
9	Manufacturer ID – Bit 0	
10	Manufacturer ID – Bit 1	
11	Manufacturer ID – Bit 2	
12	Manufacturer ID – Bit 3	
13	Manufacturer ID – Bit 4	
14	Manufacturer ID – Bit 5	
15	Manufacturer ID – Bit 6	
16	Manufacturer ID – Bit 7	
17	Manufacturer ID – Bit 8	
18	Manufacturer ID – Bit 9	
19	Manufacturer ID – Bit 10	
20	Manufacturer ID – Bit 11	
21	Manufacturer ID – Bit 12	
22	Manufacturer ID – Bit 13	
23	Manufacturer ID – Bit 14	
24	Manufacturer ID – Bit 15	

Bit	Function
25	Source address – Bit 0
26	Source address – Bit 1
27	Source address – Bit 2
28	Source address – Bit 3
29	Source address – Bit 4
30	Source address – Bit 5
31	Source address – Bit 6
32	Source address – Bit 7
33	Message data – Bit 1
~	~
~	~
~	~
288	Message data – Bit 255

Table 15-24. Type 42 Command Frame

15.3.21 Type 43 – Secondary Exchange Status

Type 43 reports the resulting status of the message exchange to the original source station.

Bit	Function	
Table 15-25. Type 43 Command Frame		
Bit	**Function**	
1	1	
2	1	
3	0	
4	1	Type 43 command frame
5	0	
6	1	
7	0	
8	0	
9	Status complete	
10	Destination address error	
11	Manufacturer Id error	
12	Destination timeout	
13	Reserved	
14	Reserved	
15	Reserved	
16	Reserved	

15.3.22 Type 128 - ACK 0

Type 128 is the MMU positive acknowledge for Type 0 frame.

Bit	Function	
Table 15-26. Type 128 Response Frame	
Bit	**Function**	
1	0	
2	0	
3	0	
4	0	Type 128 response frame
5	0	
6	0	
7	0	
8	1	

15.3.23 Type 129 - ACK 1 + Data

Type 129 is the MMU positive acknowledge, with response data, for Type 1 frame.

Bit	Function	
Table 15-27. Type 129 Response Frame	
Bit	**Function**	
1	1	
2	0	
3	0	
4	0	Type 129 response frame
5	0	
6	0	
7	0	
8	1	
9	Channel 1 Green	
10	Channel 2 Green	
11	Channel 3 Green	

Bit	Function
Table 15-27. Type 129 Response Frame	
12	Channel 4 Green
13	Channel 5 Green
14	Channel 6 Green
15	Channel 7 Green
16	Channel 8 Green
17	Channel 9 Green
18	Channel 10 Green
19	Channel 11 Green
20	Channel 12 Green
21	Channel 13 Green
22	Channel 14 Green
23	Channel 15 Green
24	Channel 16 Green
25	Channel 1 Yellow
26	Channel 2 Yellow
27	Channel 3 Yellow
28	Channel 4 Yellow
29	Channel 5 Yellow
30	Channel 6 Yellow
31	Channel 7 Yellow
32	Channel 8 Yellow
33	Channel 9 Yellow
34	Channel 10 Yellow
35	Channel 11 Yellow
36	Channel 12 Yellow
37	Channel 13 Yellow
38	Channel 14 Yellow

Bit	Function
Table 15-27. Type 129 Response Frame
39	Channel 15 Yellow
40	Channel 16 Yellow
41	Channel 1 Red
42	Channel 2 Red
43	Channel 3 Red
44	Channel 4 Red
45	Channel 5 Red
46	Channel 6 Red
47	Channel 7 Red
48	Channel 8 Red
49	Channel 9 Red
50	Channel 10 Red
51	Channel 11 Red
52	Channel 12 Red
53	Channel 13 Red
54	Channel 14 Red
55	Channel 15 Red
56	Channel 16 Red
57	Controller Voltage Monitor (1=Fail)
58	+24 Volt Monitor I (1=Fail)
59	+24 Volt Monitor II (1=Fail)
60	+24 Volt Monitor Inhibit (1=Inhibit)
61	Reset (1=Reset)
62	Red Enable (1=Enable)
63	Reserved
64	Reserved

Table 15-27. Type 129 Response Frame	
Bit	**Function**
65	Conflict
66	Red failure
67	Spare Bit 1 (Field Check)*
68	Spare Bit 2 (Dual Indication)*
69	Spare Bit 3 (Blinking Noise)*
70	Spare Bit 4 (Watchdog)*
71	Spare Bit 5
72	Spare Bit 6
73	MMU Diagnostic Failure
74	Minimum Clearance Failure
75	Port 1 Timeout Failure
76	Fail (1=failed, Output Relay Transferred)
77	Fail (1=failed, Immediate Response To Failure)
78	Reserved
79	Local Flash Status
80	Start-up Flash Call
81	FYA Flash Rate Failure (MMU-2 only)
82	Reserved
83	Reserved
84	Reserved
85	Reserved
86	Reserved
87	Reserved
88	Reserved
*Available on some models of MMU	

15.3.24 Type 131 – ACK 3 + Data

Type 131 is the MMU positive acknowledge, with response data, for Type 3 frame.

Table 15-28. Type 131 Response Frame		
Bit	**Function**	
1	1	
2	1	
3	0	
4	0	Type 131 response frame
5	0	
6	0	
7	0	
8	1	
9	Channels 1-2 Compatibility Status	
10	Channels 1-3 Compatibility Status	
11	Channels 1-4 Compatibility Status	
12	Channels 1-5 Compatibility Status	
13	Channels 1-6 Compatibility Status	
14	Channels 1-7 Compatibility Status	
15	Channels 1-8 Compatibility Status	
16	Channels 1-9 Compatibility Status	
17	Channels 1-10 Compatibility Status	
18	Channels 1-11 Compatibility Status	
19	Channels 1-12 Compatibility Status	
20	Channels 1-13 Compatibility Status	
21	Channels 1-14 Compatibility Status	
22	Channels 1-15 Compatibility Status	
23	Channels 1-16 Compatibility Status	
24	Channels 2-3 Compatibility Status	

Table 15-28. Type 131 Response Frame	
Bit	**Function**
25	Channels 2-4 Compatibility Status
26	Channels 2-5 Compatibility Status
27	Channels 2-6 Compatibility Status
28	Channels 2-7 Compatibility Status
29	Channels 2-8 Compatibility Status
30	Channels 2-9 Compatibility Status
31	Channels 2-10 Compatibility Status
32	Channels 2-11 Compatibility Status
33	Channels 2-12 Compatibility Status
34	Channels 2-13 Compatibility Status
35	Channels 2-14 Compatibility Status
36	Channels 2-15 Compatibility Status
37	Channels 2-16 Compatibility Status
38	Channels 3-4 Compatibility Status
39	Channels 3-5 Compatibility Status
40	Channels 3-6 Compatibility Status
41	Channels 3-7 Compatibility Status
42	Channels 3-8 Compatibility Status
43	Channels 3-9 Compatibility Status
44	Channels 3-10 Compatibility Status
45	Channels 3-11 Compatibility Status
46	Channels 3-12 Compatibility Status
47	Channels 3-13 Compatibility Status
48	Channels 3-14 Compatibility Status
49	Channels 3-15 Compatibility Status
50	Channels 3-16 Compatibility Status
51	Channels 4-5 Compatibility Status

Table 15-28. Type 131 Response Frame	
Bit	**Function**
52	Channels 4-6 Compatibility Status
53	Channels 4-7 Compatibility Status
54	Channels 4-8 Compatibility Status
55	Channels 4-9 Compatibility Status
56	Channels 4-10 Compatibility Status
57	Channels 4-11 Compatibility Status
58	Channels 4-12 Compatibility Status
59	Channels 4-13 Compatibility Status
60	Channels 4-14 Compatibility Status
61	Channels 4-15 Compatibility Status
62	Channels 4-16 Compatibility Status
63	Channels 5-6 Compatibility Status
64	Channels 5-7 Compatibility Status
65	Channels 5-8 Compatibility Status
66	Channels 5-9 Compatibility Status
67	Channels 5-10 Compatibility Status
68	Channels 5-11 Compatibility Status
69	Channels 5-12 Compatibility Status
70	Channels 5-13 Compatibility Status
71	Channels 5-14 Compatibility Status
72	Channels 5-15 Compatibility Status
73	Channels 5-16 Compatibility Status
74	Channels 6-7 Compatibility Status
75	Channels 6-8 Compatibility Status
76	Channels 6-9 Compatibility Status
77	Channels 6-10 Compatibility Status
78	Channels 6-11 Compatibility Status

| Table 15-28. Type 131 Response Frame ||
Bit	Function
79	Channels 6-12 Compatibility Status
80	Channels 6-13 Compatibility Status
81	Channels 6-14 Compatibility Status
82	Channels 6-15 Compatibility Status
83	Channels 6-16 Compatibility Status
84	Channels 7-8 Compatibility Status
85	Channels 7-9 Compatibility Status
86	Channels 7-10 Compatibility Status
87	Channels 7-11 Compatibility Status
88	Channels 7-12 Compatibility Status
89	Channels 7-13 Compatibility Status
90	Channels 7-14 Compatibility Status
91	Channels 7-15 Compatibility Status
92	Channels 7-16 Compatibility Status
93	Channels 8-9 Compatibility Status
94	Channels 8-10 Compatibility Status
95	Channels 8-11 Compatibility Status
96	Channels 8-12 Compatibility Status
97	Channels 8-13 Compatibility Status
98	Channels 8-14 Compatibility Status
99	Channels 8-15 Compatibility Status
100	Channels 8-16 Compatibility Status
101	Channels 9-10 Compatibility Status
102	Channels 9-11 Compatibility Status
103	Channels 9-12 Compatibility Status
104	Channels 9-13 Compatibility Status

Table 15-28. Type 131 Response Frame	
Bit	**Function**
105	Channels 9-14 Compatibility Status
106	Channels 9-15 Compatibility Status
107	Channels 9-16 Compatibility Status
108	Channels 10-11 Compatibility Status
109	Channels 10-12 Compatibility Status
110	Channels 10-13 Compatibility Status
111	Channels 10-14 Compatibility Status
112	Channels 10-15 Compatibility Status
113	Channels 10-16 Compatibility Status
114	Channels 11-12 Compatibility Status
115	Channels 11-13 Compatibility Status
116	Channels 11-14 Compatibility Status
117	Channels 11-15 Compatibility Status
118	Channels 11-16 Compatibility Status
119	Channels 12-13 Compatibility Status
120	Channels 12-14 Compatibility Status
121	Channels 12-15 Compatibility Status
122	Channels 12-16 Compatibility Status
123	Channels 13-14 Compatibility Status
124	Channels 13-15 Compatibility Status
125	Channels 13-16 Compatibility Status
126	Channels 14-15 Compatibility Status
127	Channels 14-16 Compatibility Status
128	Channels 15-16 Compatibility Status
129	Channel 1 Min Yellow Change Disable
130	Channel 2 Min Yellow Change Disable
131	Channel 3 Min Yellow Change Disable

Table 15-28. Type 131 Response Frame	
Bit	**Function**
132	Channel 4 Min Yellow Change Disable
133	Channel 5 Min Yellow Change Disable
134	Channel 6 Min Yellow Change Disable
135	Channel 7 Min Yellow Change Disable
136	Channel 8 Min Yellow Change Disable
137	Channel 9 Min Yellow Change Disable
138	Channel 10 Min Yellow Change Disable
139	Channel 11 Min Yellow Change Disable
140	Channel 12 Min Yellow Change Disable
141	Channel 13 Min Yellow Change Disable
142	Channel 14 Min Yellow Change Disable
143	Channel 15 Min Yellow Change Disable
144	Channel 16 Min Yellow Change Disable
145	Minimum Flash Time – Bit 0
146	Minimum Flash Time – Bit 1
147	Minimum Flash Time – Bit 2
148	Minimum Flash Time – Bit 3
149	24 Volt Latch
150	CVM/Fault Monitor Latch
151	Reserved
152	Reserved
153	Reserved
154	Reserved
155	Reserved
156	Reserved
157	Reserved
158	Reserved

Table 15-28. Type 131 Response Frame	
Bit	**Function**
159	Reserved
160	Reserved
161	Reserved
162	Reserved
163	Reserved
164	Reserved
165	Reserved
166	Reserved
167	Reserved
168	Reserved

15.3.25 Type 138 – ACK 10 + TF BIU 1 Input

Type 138 is the input activity response from terminal and facilities BIU #1.

Table 15-29. Type 138 Response Frame		
Bit	**Function**	
1	0	
2	1	
3	0	
4	1	Type 138 Response Frame
5	0	
6	0	
7	0	
8	1	
9	Input/Output 1	Used As Output
10	Input/Output 2	Used As Output
11	Input/Output 3	Used As Output
12	Input/Output 4	Used As Output

Bit	Function	
Table 15-29. Type 138 Response Frame		
13	Input/Output 5	Used As Output
14	Input/Output 6	Used As Output
15	Input/Output 7	Used As Output
16	Input/Output 8	Used As Output
17	Input/Output 9	Used As Output
18	Input/Output 10	Used As Output
19	Input/Output 11	Used As Output
20	Input/Output 12	Used As Output
21	Input/Output 13	Used As Output
22	Input/Output 14	Preempt 1 Detector
23	Input/Output 15	Preempt 2 Detector
24	Input/Output 16	Test A
25	Input/Output 17	Test B
26	Input/Output 18	Automatic Flash
27	Input/Output 19	Dimming Enable
28	Input/Output 20	Manual Control Enable
29	Input/Output 21	Interval Advance
30	Input/Output 22	External Minimum Recall
31	Input/Output 23	External Start
32	Input/Output 24	TBC On Line
33	Input 1	Ring 1 Stop Time
34	Input 2	Ring 2 Stop Time
35	Input 3	Ring 1 Max 2 Selection
36	Input 4	Ring 2 Max 2 Selection
37	Input 5	Ring 1 Force Off
38	Input 6	Ring 2 Force Off
39	Input 7	Call To NA I

Table 15-29. Type 138 Response Frame		
Bit	**Function**	
40	Input 8	Walk Rest Modifier
41	Opto-Input 1	Pedestrian Detector 1
42	Opto-Input 2	Pedestrian Detector 2
43	Opto-Input 3	Pedestrian Detector 3
44	Opto-Input 4	Pedestrian Detector 4
45	Reserved	
46	Reserved	
47	Reserved	
48	Reserved	

15.3.26 Type 139 – ACK 11 + TF BIU 2 Input

Type 139 is the input activity response from terminal and facilities BIU #2.

Table 15-30. Type 139 Response Frame		
Bit	**Function**	
1	1	
2	1	
3	0	
4	1	Type 139 Response Frame
5	0	
6	0	
7	0	
8	1	
9	Input/Output 1	Used As Output
10	Input/Output 2	Used As Output
11	Input/Output 3	Used As Output
12	Input/Output 4	Used As Output
13	Input/Output 5	Used As Output

Bit	Function	
Table 15-30. Type 139 Response Frame		
14	Input/Output 6	Used As Output
15	Input/Output 7	Used As Output
16	Input/Output 8	Used As Output
17	Input/Output 9	Used As Output
18	Input/Output 10	Used As Output
19	Input/Output 11	Used As Output
20	Input/Output 12	Used As Output
21	Input/Output 13	Used As Output
22	Input/Output 14	Used As Output
23	Input/Output 15	Used As Output
24	Input/Output 16	Preempt 3 Detector
25	Input/Output 17	Preempt 4 Detector
26	Input/Output 18	Preempt 5 Detector
27	Input/Output 19	Preempt 6 Detector
28	Input/Output 20	Call To NA II
29	Input/Output 21	Spare 1 (R1 Red Rest)
30	Input/Output 22	Spare 2 (R2 Red Rest)
31	Input/Output 23	Spare 3
32	Input/Output 24	Spare 4
33	Input 1 Ring 1 Inhibit Maximum Term	
34	Input 2 Ring 2 Inhibit Maximum Term	
35	Input 3 Local Flash Status	
36	Input 4 MMU Flash Status	
37	Input 5 Alarm 1 (Spec Status 1)	
38	Input 6 Alarm 2 (Spec Status 2)	
39	Input 7 Free/No Coordination	
40	Input 8 Test C	

Table 15-30. Type 139 Response Frame	
Bit	**Function**
41	Opto-Input 1 Pedestrian Detector 5
42	Opto-Input 2 Pedestrian Detector 6
43	Opto-Input 3 Pedestrian Detector 7
44	Opto-Input 4 Pedestrian Detector 8
45	Reserved
46	Reserved
47	Reserved
48	Reserved

15.3.27 Type 140 – ACK 12 + Terminal and Facilities BIU 3 Input

Type 140 is the input activity response from terminal and facilities BIU #3.

Table 15-31. Type 140 Response Frame		
Bit	**Function**	
1	0	
2	0	
3	1	
4	1	Type 140 response frame
5	0	
6	0	
7	0	
8	1	
9	Input/Output 1	Used as output
10	Input/Output 2	Used as output
11	Input/Output 3	Used as output
12	Input/Output 4	Used as output
13	Input/Output 5	Used as output

Bit	Function	
Table 15-31. Type 140 Response Frame		
14	Input/Output 6	Used as output
15	Input/Output 7	Ring 1 red rest
16	Input/Output 8	Ring 2 red rest
17	Input/Output 9	Ring 1 omit red clear
18	Input/Output 10	Ring 2 omit red clear
19	Input/Output 11	Ring 1 pedestrian recycle
20	Input/Output 12	Ring 2 pedestrian recycle
21	Input/Output 13	Alternate Sequence A
22	Input/Output 14	Alternate Sequence B
23	Input/Output 15	Alternate Sequence C
24	Input/Output 16	Alternate Sequence D
25	Input/Output 17	Phase 1 phase omit (*)
26	Input/Output 18	Phase 2 phase omit (*)
27	Input/Output 19	Phase 3 phase omit (*)
28	Input/Output 20	Phase 4 phase omit (*)
29	Input/Output 21	Phase 5 phase omit (*)
30	Input/Output 22	Phase 6 phase omit (*)
31	Input/Output 23	Phase 7 phase omit (*)
32	Input/Output 24	Phase 8 phase omit (*)
33	Input 1 Phase 1 hold (*)	
34	Input 2 Phase 2 hold (*)	
35	Input 3 Phase 3 hold (*)	
36	Input 4 Phase 4 hold (*)	
37	Input 5 Phase 5 hold (*)	
38	Input 6 Phase 6 hold (*)	
39	Input 7 Phase 7 hold (*)	
40	Input 8 Phase 8 hold (*)	

Table 15-31. Type 140 Response Frame	
Bit	**Function**
41	Opto-input 1 Timing Plan A
42	Opto-input 2 Timing Plan B
43	Opto-input 3 Timing Plan C
44	Opto-input 4 Timing Plan D
45	Reserved
46	Reserved
47	Reserved
48	Reserved
Inputs may NOT be modified by Connector Input mode.	

15.3.28 Type 141 – ACK 13 + Terminal and Facilities BIU 4 Input

Type 141 is the input activity response from terminal and facilities BIU #4.

Table 15-32. Type 141 Response Frame		
Bit	**Function**	
1	1	
2	0	
3	1	
4	1	Type 141 Response Frame
5	0	
6	0	
7	0	
8	1	
9	Input/Output 1	Used As Output
10	Input/Output 2	Used As Output
11	Input/Output 3	Used As Output
12	Input/Output 4	Used As Output

Table 15-32. Type 141 Response Frame	
Bit	**Function**
13	Input/Output 5 Used As Output
14	Input/Output 6 Used As Output
15	Input/Output 7 Used As Output
16	Input/Output 8 Used As Output
17	Input/Output 9 Used As Output
18	Input/Output 10 Address Bit 0
19	Input/Output 11 Address Bit 1
20	Input/Output 12 Address Bit 2
21	Input/Output 13 Address Bit 3
22	Input/Output 14 Address Bit 4
23	Input/Output 15 Spare 5
24	Input/Output 16 Spare 6
25	Input/Output 17 Spare 7
26	Input/Output 18 Spare 8
27	Input/Output 19 Spare 9
28	Input/Output 20 Reserved
29	Input/Output 21 Reserved
30	Input/Output 22 Reserved
31	Input/Output 23 Reserved
32	Input/Output 24 Reserved
33	Input 1 Phase 1 Pedestrian Omit (*)
34	Input 2 Phase 2 Pedestrian Omit (*)
35	Input 3 Phase 3 Pedestrian Omit (*)
36	Input 4 Phase 4 Pedestrian Omit (*)
37	Input 5 Phase 5 Pedestrian Omit (*)
38	Input 6 Phase 6 Pedestrian Omit (*)
39	Input 7 Phase 7 Pedestrian Omit (*)

Table 15-32. Type 141 Response Frame	
Bit	**Function**
40	Input 8 Phase 8 Pedestrian Omit (*)
41	Opto-Input 1 Offset 1
42	Opto-Input 2 Offset 2
43	Opto-Input 3 Offset 3
44	Opto-Input 4 Spare
45	Reserved
46	Reserved
47	Reserved
48	Reserved
Inputs May Not Be Modified By Connector Input Mode.	

15.3.29 Type 148 – ACK 20 + DET BIU 1 Input

Type 148 is the detector activity response from Detector BIU #1 for detectors 01-16.

Table 15-33. Type 148 Response Frame		
Bit	**Function**	
1	0	
2	0	
3	1	
4	0	Type 148 response frame
5	1	
6	0	
7	0	
8	1	
9	Detector 1 Time Stamp Bit 0	
10	Detector 1 Time Stamp Bit 1	

Table 15-33. Type 148 Response Frame	
Bit	**Function**
11	Detector 1 Time Stamp Bit 2
12	Detector 1 Time Stamp Bit 3
13	Detector 1 Time Stamp Bit 4
14	Detector 1 Time Stamp Bit 5
15	Detector 1 Time Stamp Bit 6
16	Detector 1 Time Stamp Bit 7
17	Detector 1 Time Stamp Bit 8
18	Detector 1 Time Stamp Bit 9
19	Detector 1 Time Stamp Bit 10
20	Detector 1 Time Stamp Bit 11
21	Detector 1 Time Stamp Bit 12
22	Detector 1 Time Stamp Bit 13
23	Detector 1 Time Stamp Bit 14
24	Detector 1 Time Stamp Bit 15
25	Detector 2 Time Stamp Bit 0
26	Detector 2 Time Stamp Bit 1
27	Detector 2 Time Stamp Bit 2
28	Detector 2 Time Stamp Bit 3
29	Detector 2 Time Stamp Bit 4
30	Detector 2 Time Stamp Bit 5
31	Detector 2 Time Stamp Bit 6
32	Detector 2 Time Stamp Bit 7
33	Detector 2 Time Stamp Bit 8
34	Detector 2 Time Stamp Bit 9
35	Detector 2 Time Stamp Bit 10
36	Detector 2 Time Stamp Bit 11
37	Detector 2 Time Stamp Bit 12

Table 15-33. Type 148 Response Frame	
Bit	**Function**
38	Detector 2 Time Stamp Bit 13
39	Detector 2 Time Stamp Bit 14
40	Detector 2 Time Stamp Bit 15
41	Detector 3 Time Stamp Bit 0
42	Detector 3 Time Stamp Bit 1
43	Detector 3 Time Stamp Bit 2
44	Detector 3 Time Stamp Bit 3
45	Detector 3 Time Stamp Bit 4
46	Detector 3 Time Stamp Bit 5
47	Detector 3 Time Stamp Bit 6
48	Detector 3 Time Stamp Bit 7
49	Detector 3 Time Stamp Bit 8
50	Detector 3 Time Stamp Bit 9
51	Detector 3 Time Stamp Bit 10
52	Detector 3 Time Stamp Bit 11
53	Detector 3 Time Stamp Bit 12
54	Detector 3 Time Stamp Bit 13
55	Detector 3 Time Stamp Bit 14
56	Detector 3 Time Stamp Bit 15
57	Detector 4 Time Stamp Bit 0
58	Detector 4 Time Stamp Bit 1
59	Detector 4 Time Stamp Bit 2
60	Detector 4 Time Stamp Bit 3
61	Detector 4 Time Stamp Bit 4
62	Detector 4 Time Stamp Bit 5
63	Detector 4 Time Stamp Bit 6
64	Detector 4 Time Stamp Bit 7

Table 15-33. Type 148 Response Frame	
Bit	**Function**
65	Detector 4 Time Stamp Bit 8
66	Detector 4 Time Stamp Bit 9
67	Detector 4 Time Stamp Bit 10
68	Detector 4 Time Stamp Bit 11
69	Detector 4 Time Stamp Bit 12
70	Detector 4 Time Stamp Bit 13
71	Detector 4 Time Stamp Bit 14
72	Detector 4 Time Stamp Bit 15
73	Detector 5 Time Stamp Bit 0
74	Detector 5 Time Stamp Bit 1
75	Detector 5 Time Stamp Bit 2
76	Detector 5 Time Stamp Bit 3
77	Detector 5 Time Stamp Bit 4
78	Detector 5 Time Stamp Bit 5
79	Detector 5 Time Stamp Bit 6
80	Detector 5 Time Stamp Bit 7
81	Detector 5 Time Stamp Bit 8
82	Detector 5 Time Stamp Bit 9
83	Detector 5 Time Stamp Bit 10
84	Detector 5 Time Stamp Bit 11
85	Detector 5 Time Stamp Bit 12
86	Detector 5 Time Stamp Bit 13
87	Detector 5 Time Stamp Bit 14
88	Detector 5 Time Stamp Bit 15
89	Detector 6 Time Stamp Bit 0
90	Detector 6 Time Stamp Bit 1

Table 15-33. Type 148 Response Frame	
Bit	**Function**
91	Detector 6 Time Stamp Bit 2
92	Detector 6 Time Stamp Bit 3
93	Detector 6 Time Stamp Bit 4
94	Detector 6 Time Stamp Bit 5
95	Detector 6 Time Stamp Bit 6
96	Detector 6 Time Stamp Bit 7
97	Detector 6 Time Stamp Bit 8
98	Detector 6 Time Stamp Bit 9
99	Detector 6 Time Stamp Bit 10
100	Detector 6 Time Stamp Bit 11
101	Detector 6 Time Stamp Bit 12
102	Detector 6 Time Stamp Bit 13
103	Detector 6 Time Stamp Bit 14
104	Detector 6 Time Stamp Bit 15
105	Detector 7 Time Stamp Bit 0
106	Detector 7 Time Stamp Bit 1
107	Detector 7 Time Stamp Bit 2
108	Detector 7 Time Stamp Bit 3
109	Detector 7 Time Stamp Bit 4
110	Detector 7 Time Stamp Bit 5
111	Detector 7 Time Stamp Bit 6
112	Detector 7 Time Stamp Bit 7
113	Detector 7 Time Stamp Bit 8
114	Detector 7 Time Stamp Bit 9
115	Detector 7 Time Stamp Bit 10
116	Detector 7 Time Stamp Bit 11
117	Detector 7 Time Stamp Bit 12

Bit	Function
	Table 15-33. Type 148 Response Frame
Bit	**Function**
118	Detector 7 Time Stamp Bit 13
119	Detector 7 Time Stamp Bit 14
120	Detector 7 Time Stamp Bit 15
121	Detector 8 Time Stamp Bit 0
122	Detector 8 Time Stamp Bit 1
123	Detector 8 Time Stamp Bit 2
124	Detector 8 Time Stamp Bit 3
125	Detector 8 Time Stamp Bit 4
126	Detector 8 Time Stamp Bit 5
127	Detector 8 Time Stamp Bit 6
128	Detector 8 Time Stamp Bit 7
129	Detector 8 Time Stamp Bit 8
130	Detector 8 Time Stamp Bit 9
131	Detector 8 Time Stamp Bit 10
132	Detector 8 Time Stamp Bit 11
133	Detector 8 Time Stamp Bit 12
134	Detector 8 Time Stamp Bit 13
135	Detector 8 Time Stamp Bit 14
136	Detector 8 Time Stamp Bit 15
137	Detector 9 Time Stamp Bit 0
138	Detector 9 Time Stamp Bit 1
139	Detector 9 Time Stamp Bit 2
140	Detector 9 Time Stamp Bit 3
141	Detector 9 Time Stamp Bit 4
142	Detector 9 Time Stamp Bit 5
143	Detector 9 Time Stamp Bit 6
144	Detector 9 Time Stamp Bit 7

Table 15-33. Type 148 Response Frame	
Bit	**Function**
145	Detector 9 Time Stamp Bit 8
146	Detector 9 Time Stamp Bit 9
147	Detector 9 Time Stamp Bit 10
148	Detector 9 Time Stamp Bit 11
149	Detector 9 Time Stamp Bit 12
150	Detector 9 Time Stamp Bit 13
151	Detector 9 Time Stamp Bit 14
152	Detector 9 Time Stamp Bit 15
153	Detector 10 Time Stamp Bit 0
154	Detector 10 Time Stamp Bit 1
155	Detector 10 Time Stamp Bit 2
156	Detector 10 Time Stamp Bit 3
157	Detector 10 Time Stamp Bit 4
158	Detector 10 Time Stamp Bit 5
159	Detector 10 Time Stamp Bit 6
160	Detector 10 Time Stamp Bit 7
161	Detector 10 Time Stamp Bit 8
162	Detector 10 Time Stamp Bit 9
163	Detector 10 Time Stamp Bit 10
164	Detector 10 Time Stamp Bit 11
165	Detector 10 Time Stamp Bit 12
166	Detector 10 Time Stamp Bit 13
167	Detector 10 Time Stamp Bit 14
168	Detector 10 Time Stamp Bit 15
169	Detector 11 Time Stamp Bit 0
170	Detector 11 Time Stamp Bit 1

Table 15-33. Type 148 Response Frame	
Bit	**Function**
171	Detector 11 Time Stamp Bit 2
172	Detector 11 Time Stamp Bit 3
173	Detector 11 Time Stamp Bit 4
174	Detector 11 Time Stamp Bit 5
175	Detector 11 Time Stamp Bit 6
176	Detector 11 Time Stamp Bit 7
177	Detector 11 Time Stamp Bit 8
178	Detector 11 Time Stamp Bit 9
179	Detector 11 Time Stamp Bit 10
180	Detector 11 Time Stamp Bit 11
181	Detector 11 Time Stamp Bit 12
182	Detector 11 Time Stamp Bit 13
183	Detector 11 Time Stamp Bit 14
184	Detector 11 Time Stamp Bit 15
185	Detector 12 Time Stamp Bit 0
186	Detector 12 Time Stamp Bit 1
187	Detector 12 Time Stamp Bit 2
188	Detector 12 Time Stamp Bit 3
189	Detector 12 Time Stamp Bit 4
190	Detector 12 Time Stamp Bit 5
191	Detector 12 Time Stamp Bit 6
192	Detector 12 Time Stamp Bit 7
193	Detector 12 Time Stamp Bit 8
194	Detector 12 Time Stamp Bit 9
195	Detector 12 Time Stamp Bit 10
196	Detector 12 Time Stamp Bit 11
197	Detector 12 Time Stamp Bit 12

Table 15-33. Type 148 Response Frame	
Bit	**Function**
198	Detector 12 Time Stamp Bit 13
199	Detector 12 Time Stamp Bit 14
200	Detector 12 Time Stamp Bit 15
201	Detector 13 Time Stamp Bit 0
202	Detector 13 Time Stamp Bit 1
203	Detector 13 Time Stamp Bit 2
204	Detector 13 Time Stamp Bit 3
205	Detector 13 Time Stamp Bit 4
206	Detector 13 Time Stamp Bit 5
207	Detector 13 Time Stamp Bit 6
208	Detector 13 Time Stamp Bit 7
209	Detector 13 Time Stamp Bit 8
210	Detector 13 Time Stamp Bit 9
211	Detector 13 Time Stamp Bit 10
212	Detector 13 Time Stamp Bit 11
213	Detector 13 Time Stamp Bit 12
214	Detector 13 Time Stamp Bit 13
215	Detector 13 Time Stamp Bit 14
216	Detector 13 Time Stamp Bit 15
217	Detector 14 Time Stamp Bit 0
218	Detector 14 Time Stamp Bit 1
219	Detector 14 Time Stamp Bit 2
220	Detector 14 Time Stamp Bit 3
221	Detector 14 Time Stamp Bit 4
222	Detector 14 Time Stamp Bit 5
223	Detector 14 Time Stamp Bit 6
224	Detector 14 Time Stamp Bit 7

Table 15-33. Type 148 Response Frame	
Bit	**Function**
225	Detector 14 Time Stamp Bit 8
226	Detector 14 Time Stamp Bit 9
227	Detector 14 Time Stamp Bit 10
228	Detector 14 Time Stamp Bit 11
229	Detector 14 Time Stamp Bit 12
230	Detector 14 Time Stamp Bit 13
231	Detector 14 Time Stamp Bit 14
232	Detector 14 Time Stamp Bit 15
233	Detector 15 Time Stamp Bit 0
234	Detector 15 Time Stamp Bit 1
235	Detector 15 Time Stamp Bit 2
236	Detector 15 Time Stamp Bit 3
237	Detector 15 Time Stamp Bit 4
238	Detector 15 Time Stamp Bit 5
239	Detector 15 Time Stamp Bit 6
240	Detector 15 Time Stamp Bit 7
241	Detector 15 Time Stamp Bit 8
242	Detector 15 Time Stamp Bit 9
243	Detector 15 Time Stamp Bit 10
244	Detector 15 Time Stamp Bit 11
245	Detector 15 Time Stamp Bit 12
246	Detector 15 Time Stamp Bit 13
247	Detector 15 Time Stamp Bit 14
248	Detector 15 Time Stamp Bit 15
249	Detector 16 Time Stamp Bit 0
250	Detector 16 Time Stamp Bit 1

Table 15-33. Type 148 Response Frame	
Bit	**Function**
251	Detector 16 Time Stamp Bit 2
252	Detector 16 Time Stamp Bit 3
253	Detector 16 Time Stamp Bit 4
254	Detector 16 Time Stamp Bit 5
255	Detector 16 Time Stamp Bit 6
256	Detector 16 Time Stamp Bit 7
257	Detector 16 Time Stamp Bit 8
258	Detector 16 Time Stamp Bit 9
259	Detector 16 Time Stamp Bit 10
260	Detector 16 Time Stamp Bit 11
261	Detector 16 Time Stamp Bit 12
262	Detector 16 Time Stamp Bit 13
263	Detector 16 Time Stamp Bit 14
264	Detector 16 Time Stamp Bit 15
265	Detector 1 Call Status Bit 0
266	Detector 2 Call Status Bit 0
267	Detector 3 Call Status Bit 0
268	Detector 4 Call Status Bit 0
269	Detector 5 Call Status Bit 0
270	Detector 6 Call Status Bit 0
271	Detector 7 Call Status Bit 0
272	Detector 8 Call Status Bit 0
273	Detector 9 Call Status Bit 0
274	Detector 10 Call Status Bit 0
275	Detector 11 Call Status Bit 0
276	Detector 12 Call Status Bit 0
277	Detector 13 Call Status Bit 0

Table 15-33. Type 148 Response Frame	
Bit	**Function**
278	Detector 14 Call Status Bit 0
279	Detector 15 Call Status Bit 0
280	Detector 16 Call Status Bit 0
281	Detector 1 Call Status Bit 1
282	Detector 2 Call Status Bit 1
283	Detector 3 Call Status Bit 1
284	Detector 4 Call Status Bit 1
285	Detector 5 Call Status Bit 1
286	Detector 6 Call Status Bit 1
287	Detector 7 Call Status Bit 1
288	Detector 8 Call Status Bit 1
289	Detector 9 Call Status Bit 1
290	Detector 10 Call Status Bit 1
291	Detector 11 Call Status Bit 1
292	Detector 12 Call Status Bit 1
293	Detector 13 Call Status Bit 1
294	Detector 14 Call Status Bit 1
295	Detector 15 Call Status Bit 1
296	Detector 16 Call Status Bit 1

15.3.30 Type 149 – ACK 21 + DET BIU 2 Input

Type 149 is the detector activity response from Detector BIU #2 for Detectors 17-32. This frame type is identical to Type 148 except for the frame type number and address.

15.3.31 Type 150 – ACK 22 + DET BIU 3 Input

Type 150 is the detector activity response from Detector BIU #3 for Detectors 33-48. This frame type is identical to Type 148 except for the frame type number and address.

15.3.32 Type 151 – ACK 23 + DET BIU 4 Input

Type 151 is the detector activity response from Detector BIU #4 for Detectors 49-64. This frame type is identical to Type 148 except for the frame type number and address.

15.3.33 Type 152 – ACK 24 + DET BIU 1 Diagnostic

Type 152 is the diagnostic response from Detector BIU #1 for Detectors 01-16.

Table 15-34. Type 152 Response Frame		
Bit	**Function**	
1	0	
2	0	
3	0	
4	1	Type 152 response frame
5	1	
6	0	
7	0	
8	1	
9	Detector 1 – Watchdog failure	
10	Detector 1 – Open loop	
11	Detector 1 – Shorted loop	
12	Detector 1 – Excessive change in inductance	
13	Detector 1 – Bit 4 (reserved)	
14	Detector 1 – Bit 5 (reserved)	
15	Detector 1 – Bit 6 (reserved)	
16	Detector 1 – Bit 7 (reserved)	
17	Detector 2 – Watchdog failure	
18	Detector 2 – Open loop	
19	Detector 2 – Shorted loop	
20	Detector 2 – Excessive change in inductance	
21	Detector 2 – Bit 4 (reserved)	

| Table 15-34. Type 152 Response Frame ||
Bit	Function
22	Detector 2 – Bit 5 (reserved)
23	Detector 2 – Bit 6 (reserved)
24	Detector 2 – Bit 7 (reserved)
25	Detector 3 – Watchdog failure
26	Detector 3 – Open loop
27	Detector 3 – Shorted loop
28	Detector 3 – Excessive change in inductance
29	Detector 3 – Bit 4 (reserved)
30	Detector 3 – Bit 5 (reserved)
31	Detector 3 – Bit 6 (reserved)
32	Detector 3 – Bit 7 (reserved)
33	Detector 4 – Watchdog failure
34	Detector 4 – Open loop
35	Detector 4 – Shorted loop
36	Detector 4 – Excessive change in inductance
37	Detector 4 – Bit 4 (reserved)
38	Detector 4 – Bit 5 (reserved)
39	Detector 4 – Bit 6 (reserved)
40	Detector 4 – Bit 7 (reserved)
41	Detector 5 – Watchdog failure
42	Detector 5 – Open loop
43	Detector 5 – Shorted loop
44	Detector 5 – Excessive change in inductance
45	Detector 5 – Bit 4 (reserved)
46	Detector 5 – Bit 5 (reserved)
47	Detector 5 – Bit 6 (reserved)
48	Detector 5 – Bit 7 (reserved)

| Table 15-34. Type 152 Response Frame ||
Bit	Function
49	Detector 6 – Watchdog failure
50	Detector 6 – Open loop
51	Detector 6 – Shorted loop
52	Detector 6 – Excessive change in inductance
53	Detector 6 – Bit 4 (reserved)
54	Detector 6 – Bit 5 (reserved)
55	Detector 6 – Bit 6 (reserved)
56	Detector 6 – Bit 7 (reserved)
57	Detector 7 – Watchdog failure
58	Detector 7 – Open loop
59	Detector 7 – Shorted loop
60	Detector 7 – Excessive change in inductance
61	Detector 7 – Bit 4 (reserved)
62	Detector 7 – Bit 5 (reserved)
63	Detector 7 – Bit 6 (reserved)
64	Detector 7 – Bit 7 (reserved)
65	Detector 8 – Watchdog failure
66	Detector 8 – Open loop
67	Detector 8 – Shorted loop
68	Detector 8 – Excessive change in inductance
69	Detector 8 – Bit 4 (reserved)
70	Detector 8 – Bit 5 (reserved)
71	Detector 8 – Bit 6 (reserved)
72	Detector 8 – Bit 7 (reserved)
73	Detector 9 – Watchdog failure
74	Detector 9 – Open loop

Table 15-34. Type 152 Response Frame	
Bit	**Function**
75	Detector 9 – Shorted loop
76	Detector 9 – Excessive change in inductance
77	Detector 9 – Bit 4 (reserved)
78	Detector 9 – Bit 5 (reserved)
79	Detector 9 – Bit 6 (reserved)
80	Detector 9 – Bit 7 (reserved)
81	Detector 10 – Watchdog failure
82	Detector 10 – Open loop
83	Detector 10 – Shorted loop
84	Detector 10 – Excessive change in inductance
85	Detector 10 – Bit 4 (reserved)
86	Detector 10 – Bit 5 (reserved)
87	Detector 10 – Bit 6 (reserved)
88	Detector 10 – Bit 7 (reserved)
89	Detector 11 – Watchdog failure
90	Detector 11 – Open loop
91	Detector 11 – Shorted loop
92	Detector 11 – Excessive change in inductance
93	Detector 11 – Bit 4 (reserved)
94	Detector 11 – Bit 5 (reserved)
95	Detector 11 – Bit 6 (reserved)
96	Detector 11 – Bit 7 (reserved)
97	Detector 12 – Watchdog failure
98	Detector 12 – Open loop
99	Detector 12 – Shorted loop
100	Detector 12 – Excessive change in inductance
101	Detector 12 – Bit 4 (reserved) 2

| Table 15-34. Type 152 Response Frame ||
Bit	Function
102	Detector 12 – Bit 5 (reserved) 2
103	Detector 12 – Bit 6 (reserved) 2
104	Detector 12 – Bit 7 (reserved) 2
105	Detector 13 – Watchdog failure
106	Detector 13 – Open loop
107	Detector 13 – Shorted loop
108	Detector 13 – Excessive change in inductance
109	Detector 13 – Bit 4 (reserved)
110	Detector 13 – Bit 5 (reserved)
111	Detector 13 – Bit 6 (reserved)
112	Detector 13 – Bit 7 (reserved)
113	Detector 14 – Watchdog failure
114	Detector 14 – Open loop
115	Detector 14 – Shorted loop
116	Detector 14 – Excessive change in inductance
117	Detector 14 – Bit 4 (reserved)
118	Detector 14 – Bit 5 (reserved)
119	Detector 14 – Bit 6 (reserved)
120	Detector 14 – Bit 7 (reserved)
121	Detector 15 – Watchdog failure
122	Detector 15 – Open loop
123	Detector 15 – Shorted loop
124	Detector 15 – Excessive change in inductance
125	Detector 15 – Bit 4 (reserved)
126	Detector 15 – Bit 5 (reserved)
127	Detector 15 – Bit 6 (reserved)
128	Detector 15 – Bit 7 (reserved)

| Table 15-34. Type 152 Response Frame ||
Bit	Function
129	Detector 16 – Watchdog failure
130	Detector 16 – Open loop
131	Detector 16 – Shorted loop
132	Detector 16 – Excessive change in inductance
133	Detector 16 – Bit 4 (reserved)
134	Detector 16 – Bit 5 (reserved)
135	Detector 16 – Bit 6 (reserved)
136	Detector 16 – Bit 7 (reserved)

15.3.34 Type 153 – ACK 25 + DET BIU 2 Diagnostic

Type 153 is the diagnostic response from Detector BIU #2 for Detectors 17-32. This frame type is identical to Type 152 except for the frame type number and address.

15.3.35 Type 154 – ACK 26 + DET BIU 3 Diagnostic

Type 154 is the diagnostic response from Detector BIU #3 for Detectors 33-48. This frame type is identical to Type 152 except for the frame type number and address.

15.3.36 Type 155 – ACK 27 + DET BIU 4 Diagnostic

Type 154 is the diagnostic response from Detector BIU #4 for Detectors 49-64. This frame type is identical to Type 152 except for the frame type number and address.

15.3.37 Type 158 – ACK 30 + Data

Bits 09-48 of this frame function identically to Bits 09-48 of Type 138 Frame from terminal and facilities BIU #1 and the CU acts on them in an identical manner.

Bits 49-88 of this frame function identically to Bits 09-48 of Type 139 Frame from terminal and facilities BIU #2 and the CU acts on them in an identical manner.

Bits 89-128 of this frame function identically to Bits 09-48 of Type 140 Frame from terminal and facilities BIU #3 and the CU acts on them in an identical manner.

Bits 129-168 of this frame function identically to Bits 09-48 of Type 141 Frame from terminal and facilities BIU #4 and the CU acts on them in an identical manner.

The CU logically OR's all bits received in this frame with those received in other frames prior to acting on them.

Type 158 is the diagnostic response to Frame 30.

Table 15-35. Type 158 Response Frame		
Bit	**Function**	
1	0	
2	1	
3	1	
4	1	Type 158 response frame
5	1	
6	0	
7	0	
8	1	
9–168	See text above	
169	Detector Call #1	
170	Detector Call #2	
171	Detector Call #3	
172	Detector Call #4	
173	Detector Call #5	
174	Detector Call #6	
175	Detector Call #7	
176	Detector Call #8	
177	Detector Call #9	
178	Detector Call #10	
179	Detector Call #11	
180	Detector Call #12	
181	Detector Call #13	
182	Detector Call #14	
183	Detector Call #15	
184	Detector Call #16	

Table 15-35. Type 158 Response Frame	
Bit	**Function**
185	Detector Call #17
186	Detector Call #18
187	Detector Call #19
188	Detector Call #20
189	Detector Call #21
190	Detector Call #22
191	Detector Call #23
192	Detector Call #24
193	Detector Call #25
194	Detector Call #26
195	Detector Call #27
196	Detector Call #28
197	Detector Call #29
198	Detector Call #30
199	Detector Call #31
200	Detector Call #32

15.3.38 Type 168 – No Service Required

Type 168 is the response to a Type 40 frame when the secondary station does not have a message to exchange.

Table 15-36. Type 168 Response Frame

Bit	Function	
1	0	
2	0	
3	0	
4	1	Type 168 response frame
5	0	
6	1	
7	0	
8	1	

15.3.39 Type 169 – Sec Source Message

Type 169 is the response to a Type 40 frame when the secondary station has a message to exchange.

Table 15-37. Type 169 Response Frame

Bit	Function	
1	1	
2	0	
3	0	
4	1	Type 169 Response Frame
5	0	
6	1	
7	0	
8	1	
9	Manufacturer Id – Bit 0	
10	Manufacturer Id – Bit 1	
11	Manufacturer Id – Bit 2	
12	Manufacturer Id – Bit 3	
13	Manufacturer Id – Bit 4	

Table 15-37. Type 169 Response Frame
Bit	**Function**
14	Manufacturer Id – Bit 5
15	Manufacturer Id – Bit 6
16	Manufacturer Id – Bit 7
17	Manufacturer Id – Bit 8
18	Manufacturer Id – Bit 9
19	Manufacturer Id – Bit 10
20	Manufacturer Id – Bit 11
21	Manufacturer Id – Bit 12
22	Manufacturer Id – Bit 13
23	Manufacturer Id – Bit 14
24	Manufacturer Id – Bit 15
25	Destination Address – Bit 0
26	Destination Address – Bit 1
27	Destination Address – Bit 2
28	Destination Address – Bit 3
29	Destination Address – Bit 4
30	Destination Address – Bit 5
31	Destination Address – Bit 6
32	Destination Address – Bit 7
33	Message Data – Bit 1
	~ ~ ~
	~ ~ ~
	~ ~ ~
288	Message Data – Bit 255

15.3.40 Type 170 – Secondary NAK

Type 170 is the negative acknowledge (NAK) for a Type 42 frame if the frame has been correctly received and the destination station determines the manufacturer-specific ID number is not valid.

Table 15-38. Type 170 Response Frame		
Bit	**Function**	
1	0	
2	1	
3	0	
4	1	Type 170 response frame
5	0	
6	1	
7	0	
8	1	

15.3.41 Type 171 – Secondary ACK

Type 171 is the positive acknowledge (ACK) for a Type 42 or 43 frame if the frame has been correctly received from the primary station.

Table 15-39. Type 171 Response Frame		
Bit	**Function**	
1	1	
2	1	
3	0	
4	1	Type 171 response frame
5	0	
6	1	
7	0	
8	1	

16 ATC Cabinet

An ATC (ITS v2) cabinet is a serially interconnected cabinet for use with the 2070LX ATC or with specially equipped m60 ATC controllers.

16.1   ATC Cabinet Components

ATC provides for both rackmount and shelf-mount configurations. In general, the rack-mount version will be discussed here with differences noted as applicable. The ATC Cabinet Serial Bus # 1 provides the cabinet control and communication path between the CU, CMU monitor unit and SIU units in the input and output assemblies.

16.1.1   Monitoring System

The ATC cabinet monitor unit uses a serial memory device to store all the configuration parameters for the monitor system and is completely removable and interchangeable.

The EDI monitor key CMU data key programming tool provides the hardware programming interface between a PC and the serial memory device. This tool connects to a serial port of the PC and uses software to read, write, and verify the contents of the serial memory device. Software wizards provide simplified initial setup of the parameter database as well as check for data consistency errors.

16.1.2   Output Assemblies

An ATC cabinet output assembly (OA) handles the switching of power to the signal heads. The OA comes in 2 versions, one accommodates 8 High Density Switch Packs (HDPA) for 16 channels and the other accommodates an additional 8 HDPAs for a total of 32 channels. The primary OA has an SIU and hosts the CMU. The secondary OA has an SIU only. The OA includes provisions for managing cabinet flash with flash transfer relays and flash configuration jumpers. The ATC cabinet may include one or both assemblies to support 16 or 32 channels, respectively.

16.1.2.1   ATC Output Format Configuration Data

Output assemblies may be enabled by selecting the corresponding output format as shown in Figure 16-1. These output formats enable the correct SDLC addresses on Serial Bus 1. From the unit data menu Figure 2-140, press **7-PORT 1/ITS DATA**.

```
ITS CONFIGURATION DATA      (0-NO/1-YES)
 ENTR DESCRIPTION.............. ACTIVE
115  OUT FORMAT 15: ATC 16 Ch  1
116  OUT FORMAT 16: ATC 32 Ch  0
117  RESERVED                  0
118  RESERVED                  0
119  INPUT ASSY 1: ADDR 9      1
UP/DOWN TO SCROLL
```

Figure 16-1 Default ATC Output Format

The default ATC output configuration is for 16 channels, i.e., the primary output assembly at Addr 01. Selecting output format 116 configures for 32 channels, i.e., both primary and secondary output assemblies at Addr 01 and Addr 03. Formats 115 and 116 are mutually exclusive.

16.1.2.1   ATC Output Default Assignments

The default assignments for the ATC cabinet are like those in NEMA TS 2 with the exception of the Phase Status outputs. The default ATC output assignments are noted in Table 16-1.

Table 16-1. Default Output Assignments		
Chn #	**LS #**	**FUNCTION**
1	1	Phase 1 vehicle
2	2	Phase 2 vehicle
3	3	Phase 3 vehicle
4	4	Phase 4 vehicle
5	5	Phase 5 vehicle
6	6	Phase 6 vehicle
7	7	Phase 7 vehicle
8	8	Phase 8 vehicle
9	9	Phase 2 pedestrian
10	10	Phase 4 pedestrian
11	11	Phase 6 pedestrian
12	12	Phase 8 pedestrian
13	13	Overlap A
14	14	Overlap B
15	15	Overlap C
16	16	Overlap D

Table 16-1. Default Output Assignments		
Chn #	**LS #**	**FUNCTION**
17	17	Phase 1 pedestrian
18	18	Phase 3 pedestrian
19	19	Phase 5 pedestrian
20	20	Phase 7 pedestrian
21-32	21-32	Unassigned by default

The Yunex Traffic SEPAC software obtains the input functions in Table **16**-**2** from the primary output assembly in an ATC cabinet.

Table 16-2. Input Functions	
OPTO	**FUNCTION**
1	Manual Control Enable
2	Interval Advance
3	Stop Timing
4	Local Flash Status

16.1.3   Input Assemblies

An ATC cabinet input assembly generally provides 12 slots for input cards (detectors or isolators). Each input card provides two inputs. The ATC cabinet may include one to five of these assemblies, however SEPAC can only make use of the first four. Input Assemblies may be enabled as shown in Figure 16-2

```
ITS CONFIGURATION DATA      (0-NO/1-YES)
 ENTR DESCRIPTION.............. ACTIVE
119 INPUT  ASSY 1: ADDR 9      1
120 INPUT  ASSY 2: ADDR A      0
121 INPUT  ASSY 3: ADDR B      0
122 INPUT  ASSY 4: ADDR C      0
123 INPUT  ASSY 5: ADDR D      0
UP/DOWN TO SCROLL
```

Figure 16-2 Default ATC Input Format

The Yunex Traffic SEPAC software provides functionality for each input assembly as shown in the following sections.

16.1.3.1 Input Assembly 1

This input assembly uses address 9.
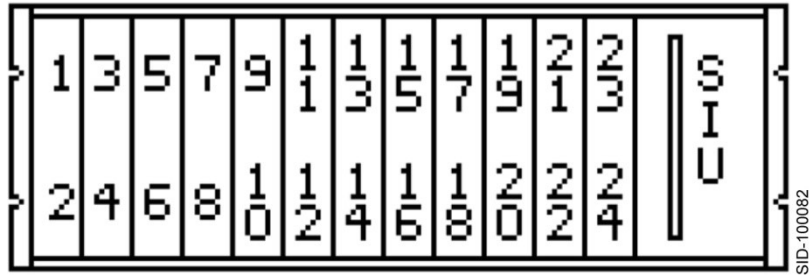
Figure 16-3. Input Assembly 1

The Yunex Traffic SEPAC software provides functionality for this input assembly as shown in Table **16**-**3**.

Table 16-3. Input Assembly 1 Functions				
Input	Slot	Description	Default 8 Phase	Default TX Diamond
1	1F	Vehicle Detector 1	Phs 1v	Phs 1v
2	1W	Vehicle Detector 2	Phs 2v	Phs 2v
3	2F	Vehicle Detector 3	Phs 3v	Phs 3v
4	2W	Vehicle Detector 4	Phs 4v	Phs 4v
5	3F	Vehicle Detector 5	Phs 5v	Phs 5v
6	3W	Vehicle Detector 6	Phs 6v	Phs 6v
7	4F	Vehicle Detector 7	Phs 7v	Phs 7v
8	4W	Vehicle Detector 8	Phs 8v	Phs 8v
9	5F	Vehicle Detector 9	NA	Phs 1v
10	5W	Vehicle Detector 10	NA	Phs 1v
11	6F	Vehicle Detector 11	NA	Phs 2v
12	6W	Vehicle Detector 12	NA	Phs 4v
13	7F	Vehicle Detector 13	NA	Phs 5v
14	7W	Vehicle Detector 14	NA	Phs 5v
15	8F	Vehicle Detector 15	NA	Phs 6v
16	8W	Vehicle Detector 16	NA	Phs 8v
17	9F	Vehicle Detector 17	NA	Phs 3v
18	9W	Vehicle Detector 18	NA	Phs 7v
19	10F	Vehicle Detector 19	NA	NA
20	10W	Vehicle Detector 20	NA	NA
21	11F	Vehicle Detector 21	Phs 2p	Phs 2p
22	11W	Vehicle Detector 22	Phs 4p	Phs 4p
23	12F	Vehicle Detector 23	Phs 6p	Phs 6p
24	12W	Vehicle Detector 24	Phs 8p	Phs 8p

The Yunex Traffic SEPAC software includes the capability to assign detector inputs as vehicle or pedestrian, and to any of the 16 phases. This allows the flexibility for all input assemblies to provide detection as needed. The default ATC data for assignment is noted above in the default column. NA in the default column indicates that the detector input is NOT ASSIGNED by the default data.

Table 16-4. Input Assembly 1 Opto Functions		
Opto	Description	Assignment
1	Preempt Input 1	Fixed Assignment
2	Preempt Input 2	Fixed Assignment
3	Special Status Input 1	Fixed Assignment
4	Special Status Input 2	Fixed Assignment

The optically isolated inputs of Input Assembly 1 are also used. Their assignment is fixed and shown in Table 16-5.

16.1.3.2 Input Assembly 2

This input assembly uses Address A. The Yunex Traffic SEPAC software provides detector functionality for this input assembly as shown in Table 16-5. It also provides optically isolated inputs as shown in Table **16**-**6**.

Table 16-5. Input Assembly 2 Functions			
Input	**Slot**	**Description**	**Default**
1	1F	Vehicle Detector 25	NA
2	1W	Vehicle Detector 26	NA
3	2F	Vehicle Detector 27	NA
4	2W	Vehicle Detector 28	NA
5	3F	Vehicle Detector 29	NA
6	3W	Vehicle Detector 30	NA
7	4F	Vehicle Detector 31	NA
8	4W	Vehicle Detector 32	NA
9	5F	Vehicle Detector 33	NA
10	5W	Vehicle Detector 34	NA
11	6F	Vehicle Detector 35	NA
12	6W	Vehicle Detector 36	NA
13	7F	Vehicle Detector 37	NA
14	7W	Vehicle Detector 38	NA
15	8F	Vehicle Detector 39	NA
16	8W	Vehicle Detector 40	NA
17	9F	Vehicle Detector 41	NA
18	9W	Vehicle Detector 42	NA
19	10F	Vehicle Detector 43	NA
20	10W	Vehicle Detector 44	NA
21	11F	Vehicle Detector 45	NA
22	11W	Vehicle Detector 46	NA
23	12F	Vehicle Detector 47	NA
24	12W	Vehicle Detector 48	NA

Table 16-6. Input Assembly 2 Opto Functions		
Opto	**Description**	**Assignment**
1	Preempt Input 3	Fixed Assignment
2	Preempt Input 4	Fixed Assignment
3	Special Status Input 3	Fixed Assignment
4	Special Status Input 4	Fixed Assignment

16.1.3.3   Input Assembly 3

This input assembly uses Address A. The Yunex Traffic SEPAC software provides detector functionality for this input assembly as shown in Table 16-7. It also provides optically isolated inputs as shown in Table 16-8.

Table 16-7. Input Assembly 3 Functions			
Input	**Slot**	**Description**	**Default**
1	1F	Vehicle Detector 49	NA
2	1W	Vehicle Detector 50	NA
3	2F	Vehicle Detector 51	NA
4	2W	Vehicle Detector 52	NA
5	3F	Vehicle Detector 53	NA
6	3W	Vehicle Detector 54	NA
7	4F	Vehicle Detector 55	NA
8	4W	Vehicle Detector 56	NA
9	5F	Vehicle Detector 57	NA
10	5W	Vehicle Detector 58	NA
11	6F	Vehicle Detector 59	NA
12	6W	Vehicle Detector 60	NA
13	7F	Vehicle Detector 61	NA
14	7W	Vehicle Detector 62	NA
15	8F	Vehicle Detector 63	NA
16	8W	Vehicle Detector 64	NA
17	9F	Special Detector 1*	NA/On line
18	9W	Special Detector 2*	NA/Dial A
19	10F	Special Detector 3*	NA/Dial B
20	10W	Special Detector 4*	NA/Split A
21	11F	Special Detector 5*	NA/Split B
22	11W	Special Detector 6*	NA/Offset 1
23	12F	Special Detector 7*	NA/Offset 2
24	12W	Special Detector 8*	NA/Offset 3

*Special Detector Inputs may be used as general inputs or DSO inputs depending on the D input mode selection

<table>
<tr><td colspan="3" align="center">Table 16-8. Input Assembly 3 Opto Functions</td></tr>
<tr><td align="center">Opto</td><td align="center">Description</td><td align="center">Assignment</td></tr>
<tr><td align="center">1</td><td align="center">Preempt Input 5</td><td align="center">Fixed Assignment</td></tr>
<tr><td align="center">2</td><td align="center">Preempt Input 6</td><td align="center">Fixed Assignment</td></tr>
<tr><td align="center">3</td><td align="center">Special Status Input 5</td><td align="center">Fixed Assignment</td></tr>
<tr><td align="center">4</td><td align="center">Special Status Input 6</td><td align="center">Fixed Assignment</td></tr>
</table>

16.1.3.4   Input Assembly 4

This input assembly uses Address C. The Yunex Traffic SEPAC software provides detector functionality for this input assembly as shown in Table 16-9. It also provides optically isolated inputs as shown in **Table 16-8**Table 16-10

Input	Slot	Description	Default
		Table 16-9. Input Assembly 4 Functions	
1	1F	Pedestrian Detector 1	Phs 1p
2	1W	Pedestrian Detector 2	Phs 1p
3	2F	Pedestrian Detector 3	Phs 1p
4	2W	Pedestrian Detector 4	Phs 1p
5	3F	Pedestrian Detector 5	Phs 1p
6	3W	Pedestrian Detector 6	Phs 1p
7	4F	Pedestrian Detector 7	Phs 1p
8	4W	Pedestrian Detector 8	Phs 1p
9	5F	N/A	—
10	5W	N/A	—
11	6F	N/A	—
12	6W	N/A	—
13	7F	N/A	—
14	7W	N/A	—
15	8F	N/A	—
16	8W	N/A	—
17	9F	N/A	—
18	9W	N/A	—
19	10F	N/A	—
20	10W	N/A	—
21	11F	N/A	—
22	11W	N/A	—
23	12F	N/A	—
24	12W	N/A	—

N/A – These inputs are currently not accessible to SEPAC

Table 16-10. Input Assembly 4 Opto Functions		
Opto	**Description**	**Assignment**
1	Preempt Input 5	Fixed Assignment
2	Preempt Input 6	Fixed Assignment
3	Special Status Input 5	Fixed Assignment
4	Special Status Input 6	Fixed Assignment

16.1.3.5 Input Assembly 5

This input assembly uses Address D. Yunex Traffic SEPAC software provides no input functionality for this input assembly. See Table 16-11.

Table 16-11. Input Assembly 5 Functions			
Input	**Slot**	**Description**	**Default**
1	1F	N/A	—
2	1W	N/A	—
3	2F	N/A	—
4	2W	N/A	—
5	3F	N/A	—
6	3W	N/A	—
7	4F	N/A	—
8	4W	N/A	—
9	5F	N/A	—
10	5W	N/A	—
11	6F	N/A	—
12	6W	N/A	—
13	7F	N/A	—
14	7W	N/A	—
15	8F	N/A	—
16	8W	N/A	—
17	9F	N/A	—
18	9W	N/A	—
19	10F	N/A	—
20	10W	N/A	—
21	11F	N/A	—
22	11W	N/A	—
23	12F	N/A	—
24	12W	N/A	—

N/A – These inputs are currently not accessible to SEPAC

Table 16-12. Input Assembly 4 Opto Functions		
Opto	**Description**	**Assignment**
1	N/A	—
2	N/A	—
3	N/A	—
4	N/A	—

N/A – These inputs are currently not accessible to SEPAC

16.2   ATC (ITS v2) Cabinet Protocol

In an ATC cabinet, the CU uses Serial Bus 1 (SB1) to communicate to devices within the cabinet. These devices include SIU, CMU, etc.

The following address frame numbers are assigned to the assemblies and monitor as shown in Table 16-13.

Table 16-13. Address Frame Numbers			
System Assy / Unit	**Address**		
	-	↓A7	A0↓
Reserved	00	0000	0000
Primary Output Assy	01	0000	0001
Reserved	02	0000	0010
Secondary Output Assy	03	0000	0011
Reserved	04	0000	0100
Reserved	05	0000	0101
Reserved	06	0000	0110
Reserved	07	0000	0111
Reserved	08	0000	1000
Input Assy #1	09	0000	1001
Input Assy #2	10	0000	1010
Input Assy #3	11	0000	1011
Input Assy #4	12	0000	1100
Input Assy #5	13	0000	1101
Reserved	14	0000	1110
Cabinet Monitor Unit	15	0000	1111
Reserved	16	0001	0000
Reserved	17	0001	0001
Reserved	18	0001	0010
2070-1 CPU	19	0001	0011
2070-2 FI/O	20	0001	0100
Addresses 21–254 are reserved			
Broadcast to all	255	1111	1111

Each device attached to SB1 is responsible for transmitting frames. Frames transmitted by the CU are referred to as command frames and frames transmitted by devices within the cabinet are referred to as response frames.

16.2.1   Command Frames

The transmission of SB1 command frames is controlled by the CU. The CU transmits some frame types occasionally as needed, while others are transmitted cyclically within a one-second window.

Table 16-14. SB1 Command Frames				
Type	**Dest.**	**Address**	**Frequency**	**Function**
49	SIU	Mult.	Occ.	Module status
50	SIU	Mult.	Occ.	MC management
51	SIU	Mult.	Occ.	Configure inputs
52	SIU	Mult.	—	Raw input data
53	SIU	Mult.	10x Sec	Filtered input data
54	SIU	Mult.	10x Sec	Input transition buffer
55	SIU	Mult.	10x Sec	Set outputs
56	SIU	Mult.	—	Configure input tracking
57	SIU	Mult.	—	Configure complex output
58	2070-2E	20	Occ.	Configure watchdog (-2x only)
59	—	—	—	Reserved
60	SIU, CMU	Mult.	Occ.	Module ID
61	—	—	—	Switch pack drivers*
62	CMU	15	Occ.	Set Failed State Action (FSA)
63	—	—	—	Reserved
64	—	—	—	Reserved
65	—	—	—	Get CMU configuration*
66	All	255	1x Sec	Time and date
67	CMU	15	10x Sec	Switch pack drivers (short)
80	SIU, CMU	Mult.	—	Module description
81	CMU	15	—	Switch pack drivers (long)
82	CMU	15	Occ.	CMU configuration
83	CMU	15	—	Switch pack drivers (High Res.)

*Deprecated for ATC

16.2.1.1　　　　　Command Frame Scheduling

The one-second window, during which time all frame types is transmitted, is divided into ten 100-millisecond windows.

The scheduling of the transmission of frames is such that they are transmitted in the order shown in Table 16-15 for each of the one-second windows.

Table 16-15. Command Frame Scheduling			
Win	**Type**	**Dest**	**Function**
1	66	ALL	Date and time broadcast
	55	1	Set outputs
	53	1	Filtered input data
	54	1	Input transition buffer
	55	3	Set outputs
	53	9	Filtered input data
	54	9	Input transition buffer
	55	9	Set outputs
	53-55	—	Repeated for each active Input Assembly
	67	15	Switch pack drivers (short)
2	55	1	Set outputs
	53	1	Filtered input data
	54	1	Input transition buffer
	55	3	Set outputs
	53	9	Filtered input data
	54	9	Input transition buffer
	55	9	Set outputs
	53-55	—	Repeated for each active Input Assembly
	67	15	Switch pack drivers (short)
3	Repeat Window 2		
4	Repeat Window 2		
5	Repeat Window 2		
6	Repeat Window 2		
7	Repeat Window 2		
8	Repeat Window 2		
9	Repeat Window 2		
10	Repeat Window 2		

16.2.2 Response Frames

Response frames are only transmitted as a result of receiving a command frame.

Table 16-16. SB1 Response Frames		
Type	**Source**	**Function**
177	Mult.	Ack 49 – Module status
178	Mult.	Ack 50 – MC management
179	Mult.	Ack 51 – Configure inputs
180	Mult.	Ack 52 – Raw input data
181	Mult.	Ack 53 – Filtered input data
182	Mult.	Ack 54 – Input transition buffer
183	Mult.	Ack 55 – Set outputs
184	Mult.	Ack 56 – Config input tracking
185	Mult.	Ack 57 – Config complex outputs
186	20	Ack 58 – Reserved
187	—	Ack 59 – Reserved
188	Mult.	Ack 60 – Module ID
189	—	Ack 61 – CMU status
190	15	Ack 62 – Set FSA
191	—	Ack 63 – Reserved
192	—	Ack 64 – Reserved
193	—	Ack 65 – CMU configuration
194	255	Not used
195	15	Ack 67 – CMU short status
208	Mult.	Ack 80 – Module description
209	15	Ack 81 – Switch pack drivers (long)
210	15	Ack 82 – CMU configuration
211	15	Ack 83 – Switch pack drivers (short)

16.2.3   Serial Bus #1 Frames

The detailed formats for the information fields of the frame types summarized above are included in the following sections.

16.2.3.1   Type 49 – Module Status

This command frame is sent when module status is needed.

Byte	Contents	Description
	Table 16-17. Type 49 Module Status	
1	49	Frame type
2	Reset status	Reset system status bits: Bit 7 – SIU hardware reset Bit 6 –Communications loss > two sec Bit 5 – Not used Bit 4 –SCC RX error count roll over Bit 3 –SCC TX error count roll over Bit 2 –MC interrupt error Bit 1 –Linesync error Bit 0 –SIU watchdog reset

A 1 in a reset system status bit will reset the respective status, and the response frame will report the current status. The SCC error count bytes do not reset. When a count rolls over (255–0), the corresponding roll-over bit is set.

16.2.3.2   Type 177 – Module Status

This frame is the ACK for a Type 49 command frame.

<table>
<tr><td colspan="3">Table 16-18. Type 177 Module Status</td></tr>
<tr><th>Byte</th><th>Contents</th><th>Description</th></tr>
<tr><td>1</td><td>177</td><td>Frame type</td></tr>
<tr><td>2</td><td>System status</td><td>System status bits:

Bit 7 – SIU hardware reset
Bit 6 – Communications loss > 2 sec
Bit 5 – Not used
Bit 4 – SCC RX error count roll over
Bit 3 – SCC TX error count roll over
Bit 2 – MC interrupt error
Bit 1 – Linesync error
Bit 0 – SIU watchdog reset</td></tr>
<tr><td>3</td><td>Receive errors</td><td>SCC receive error count</td></tr>
<tr><td>4</td><td>Transmit errors</td><td>SCC transmit error count</td></tr>
<tr><td>5</td><td>Timestamp MSB</td><td>MC timestamp MSB</td></tr>
<tr><td>6</td><td>Timestamp NMSB</td><td>MC timestamp NMSB</td></tr>
<tr><td>7</td><td>Timestamp NLSB</td><td>MC timestamp NLSB</td></tr>
<tr><td>8</td><td>Timestamp LSB</td><td>MC timestamp LSB</td></tr>
</table>

Each of the system status bits are individually reset by a 1 in the corresponding bit of any subsequent request module status frame, and the response frame will report the current status bits. The SCC error count bytes will not be reset. When a count rolls over (255–0), its corresponding roll-over flag is set.

16.2.3.3   Type 50 – Millisecond Counter Management

This frame is used to set the value of the millisecond counter.

<table>
<tr><td colspan="3">Table 16-19. Type 50 MC Management</td></tr>
<tr><th>Byte</th><th>Contents</th><th>Description</th></tr>
<tr><td>1</td><td>50</td><td>Frame type</td></tr>
<tr><td>2</td><td>New MSB</td><td>New MC timestamp MSB</td></tr>
<tr><td>3</td><td>New NMSB</td><td>New MC timestamp NMSB</td></tr>
<tr><td>4</td><td>New NLSB</td><td>New MC timestamp NLSB</td></tr>
<tr><td>5</td><td>New LSB</td><td>New MC timestamp LSB</td></tr>
</table>

16.2.3.4   Type 178 – MC Management

This frame is the ACK for a Type 50 command frame.

Table 16-20. Type 178 MC Management		
Byte	**Contents**	**Description**
1	178	Frame type

2	Status	Status bits
		    Bit 7-1 = Not used
		    Bit 0 = Status

The Status bit returns a 0 on completion or 1 on error. The 32-bit value is loaded into the millisecond counter at the next 0–1 transition of the LINESYNC signal.

16.2.3.5   Type 51 – Configure Inputs

This frame is used to change input configurations.

Table 16-21. Type 51 Configure Inputs		
Byte	**Contents**	**Description**
1	51	Frame type
2	Number of items	Number of items following

3	Input #	Input number
		    Bit 7 – Ignore input flag.
		        1 – Do not report
		        0 – Report transitions for input
		    Bit 6-0 – Input # (I0-I59)

4	Leading filter	Leading edge filter Specifies the number of consecutive input samples that must be 0 before the input is considered to have entered to 0 state from 1 state (range 1 to 255, 0 = disabled)
5	Trailing filter	Trailing edge filter Specifies the number of consecutive input samples that must be 1 before the input is considered to have entered to 1 state from 0 state (range 1 to 255, 0 = disabled)
Repeat Bytes 3–4–5 for each Item		

16.2.3.6   Type 179 – Configure Inputs

This frame is the ACK for a Type 51 command frame.

Table 16-22. Type 179 Configure Inputs		
Byte	**Contents**	**Description**
1	179	Frame type

2	Status	Status bits
		      Bit 7-1 – Not used
		      Bit 0 – Status

The Status bit returns a 0 on completion or 1 on error.

16.2.3.7   Type 52 –Raw Input Data

This frame is used to poll SIUs for the current unfiltered status of all inputs.

Table 16-23. Type 52 Raw Input Data		
Byte	**Contents**	**Description**
1	52	Frame type

16.2.3.8   Type 180 –Raw Input Data

This frame is the ACK for a Type 52 command frame.

Table 16-24. Type 180 Raw Input Data		
Byte	**Contents**	**Description**
1	180	Frame type
2	Inputs I7–I0	Inputs I7(msb)-I0(lsb)
3	Inputs I15–I8	Inputs I15(msb)-I8(lsb)
4	Inputs I23–I16	Inputs I23(msb)-I16(lsb)
5	Inputs I31–I24	Inputs I31(msb)-I24(lsb)
6	Inputs I39–I32	Inputs I39(msb)-I32(lsb)
7	Inputs I47–I40	Inputs I47(msb)-I40(lsb)
8	Inputs I55–I48	Inputs I55(msb)-I48(lsb)
9	Inputs A3–I56	Inputs A3(msb)-A0, I59-I56(lsb)
10	MC Time MSB	MC timestamp MSB
11	MC Time NMSB	MC timestamp NMSB
12	MC Time NLSB	MC timestamp NLSB
13	MC Time LSB	MC timestamp LSB

The Input bit returns a 0 for not active or 1 for active.

16.2.3.9   Type 53 –Filtered Input Data

This frame is used to poll SIUs for the current filtered status of all inputs.

Table 16-25. Type 53 Filtered Input Data		
Byte	**Contents**	**Description**
1	53	Frame type

16.2.3.10   Type 181 –Filtered Input Data

This frame is the ACK for a Type 53 command frame.

<table>
<tr><td colspan="3" align="center">Table 16-26. Type 181 Filtered Input Data</td></tr>
<tr><th>Byte</th><th>Contents</th><th>Description</th></tr>
<tr><td>1</td><td>181</td><td>Frame type</td></tr>
<tr><td>2</td><td>Inputs I7–I0</td><td>Inputs I7(msb)-I0(lsb)</td></tr>
<tr><td>3</td><td>Inputs I15–I8</td><td>Inputs I15(msb)-I8(lsb)</td></tr>
<tr><td>4</td><td>Inputs I23–I16</td><td>Inputs I23(msb)-I16(lsb)</td></tr>
<tr><td>5</td><td>Inputs I31–I24</td><td>Inputs I31(msb)-I24(lsb)</td></tr>
<tr><td>6</td><td>Inputs I39–I32</td><td>Inputs I39(msb)-I32(lsb)</td></tr>
<tr><td>7</td><td>Inputs I47–I40</td><td>Inputs I47(msb)-I40(lsb)</td></tr>
<tr><td>8</td><td>Inputs I55–I48</td><td>Inputs I55(msb)-I48(lsb)</td></tr>
<tr><td>9</td><td>Inputs A3–I56</td><td>Inputs A3(msb)-A0, I59-I56(lsb)</td></tr>
<tr><td>10</td><td>MC Time MSB</td><td>MC timestamp MSB</td></tr>
<tr><td>11</td><td>MC Time NMSB</td><td>MC timestamp NMSB</td></tr>
<tr><td>12</td><td>MC Time NLSB</td><td>MC timestamp NLSB</td></tr>
<tr><td>13</td><td>MC Time LSB</td><td>MC timestamp LSB</td></tr>
</table>

The Input bit returns a 0 for not active or 1 for active. Raw input data is provided for inputs that are not configured for filtering.

16.2.3.11   Type 54 –Input Transition Buffer

This frame is used to poll SIUs for the contents of the input transition buffer.

<table>
<tr><td colspan="3" align="center">Table 16-27. Type 54 Input Transition Buffer</td></tr>
<tr><th>Byte</th><th>Contents</th><th>Description</th></tr>
<tr><td>1</td><td>54</td><td>Frame type</td></tr>
<tr><td>2</td><td>Block number</td><td>Block number</td></tr>
</table>

The block number is a monotonically increasing number incremented after each command issued by the controller unit.

16.2.3.12 Type 182 –Input Transition Buffer

This frame is the ACK for a Type 54 command frame.

Table 16-28. Type 182 Input Transition Buffer		
Byte	**Contents**	**Description**
1	182	Frame type
2	Block number	Block number
3	Number of items	Number of items to follow

4	Item #	Item # plus state:
		    Bit 7 – State of the Input after the transition:
		        1 – Active
		        0 – Not active
		    Bit 6-0 – Input # (I0–I59)

5	MC Time NLSB	MC time NLSB
6	MC Time LSB	MC time LSB

7	Status	Status
		    Bit 7-4 – Not used (=0)
		    Bit 3 – 255 entry buffer limit exceeded
		    Bit 2 – 1024 buffer limit exceeded
		    Bit 1 – Same block # requested
		    Bit 0 – Block # is out of sequence

8	MC Time MSB	MC timestamp MSB
9	MC Time NMSB	MC timestamp NMSB
10	MC Time NLSB	MC timestamp NLSB
11	MC Time LSB	MC timestamp LSB
Repeat Bytes 4–11 for each Item		

Each detected state transition for each active input is placed in the queue as it occurs.

16.2.3.13 Type 55 – Set Outputs

This frame is used to command SIUs to set the outputs according to the data in the frame.

	Table 16-29. Type 55 Set Outputs	
Byte	**Contents**	**Description**
1	55	Frame type
2	Output O7–O0	Output O7(msb)–O0(lsb) Data
3	Output O15–O8	Output O15(msb)–O8(lsb) Data
4	Output O23–O16	Output O23(msb)–O16(lsb) Data
5	Output O31–O24	Output O31(msb)–O24(lsb) Data
6	Output O39–O32	Output O39(msb)–O32(lsb) Data
7	Output O47–O40	Output O47(msb)–O40(lsb) Data
8	Output O55–O48	Output O55(msb)–O48(lsb) Data
9	Output O59–O56	Output O59(msb)–O56(lsb) Data
10	Output O7–O0	Output O7(msb)–O0(lsb) Control
11	Output O15–O8	Output O15(msb)–O8(lsb) Control
12	Output O23–O16	Output O23(msb)–O16(lsb) Control
13	Output O31–O24	Output O31(msb)–O24(lsb) Control
14	Output O39–O32	Output O39(msb)–O32(lsb) Control
15	Output O47–O40	Output O47(msb)–O40(lsb) Control
16	Output O55–O48	Output O55(msb)–O48(lsb) Control
17	Output O59–O56	Output O59(msb)–O56(lsb) Control

16.2.3.14   Type 183 – Set Outputs

This frame is the ACK for a Type 55 command frame.

	Table 16-30. Type 183 Set Outputs	
Byte	**Contents**	**Description**
1	183	Frame type

2	Status	Status bits
		    Bit 7-2 – Not used
		    Bit 1 – Linesync lost
		    Bit 0 – Error in setting output

Each status bit returns a 0 for no error or 1 for error.

16.2.3.15   Type 56 – Configure Input Tracking

This frame is used to configure the definition for an output that responds to transitions on a particular input. The maximum number of active definitions is eight.

	Table 16-31. Type 56 Configure Input Tracking	
Byte	**Contents**	**Description**
1	56	Frame type
2	Number of items	Number of items: 0–16 Tracking definitions in this message.
3	Output #	Output # 　　Bit 7 – Enable input tracking: 　　　　1 – Enable 　　　　0 – Remove 　　Bit 6-0 – Output # (O0-O54)
4	Input #	Input # 　　Bit 7 – Tracking: 　　　　1 – Output OFF = Input ON 　　　　0 – Output ON = Input ON 　　Bit 6-0 – Input # (I0-I59)
Repeat bytes 3 and 4 for each item		

16.2.3.16　　　　　　　Type 184 – Configure Input Tracking

This frame is the ACK for a Type 56 command frame.

	Table 16-32. Type 184 Configure Input Tracking	
Byte	**Contents**	**Description**
1	184	Frame type
2	Status	Status bits 　　Bit 7-1 – Not used (=0) 　　Bit 0 – Status
3	MC Time MSB	MC timestamp MSB
4	MC Time NMSB	MC timestamp NMSB
5	MC Time NLSB	MC timestamp NLSB
6	MC Time LSB	MC timestamp LSB

The Status bit returns a 0 for NO error or 1 when the maximum number of configurable outputs will be exceeded.

16.2.3.17　　　　　　　Type 57 – Configure Complex Output

This frame is used to configure the definition for an output that provides a complex operation. The maximum number of active definitions is eight.

	Table 16-33. Type 57 Configure Complex Output	
Byte	**Contents**	**Description**
1	57	Frame type

Table 16-33. Type 57 Configure Complex Output		
Byte	**Contents**	**Description**
2	Number of items	Number of items: 0–16 Complex output definitions in message

3	Output #	Output #
		    Bit 7 = Not used (=0)
		    Bit 6-0 = Output # (O0-O54)

4	Pri Duration MSB	Primary duration MSB
5	Pri Duration LSB	Primary duration LSB
6	Sec Duration MSB	Secondary duration MSB
7	Sec Duration LSB	Secondary duration LSB

8	Input #	Input #
		    Bit 7 = Not used (=0)
		    Bit 6-0 = Input # (I0–I59)

Table 16-33. Type 57 Configure Complex Output		
Byte	**Contents**	**Description**

9	Field Definition	Field Definition:
		Bit 7
		    1 – Output configured for single-pulse operation.
		    0 – Output configured for continuous oscillation
		Bit 6
		    1 – Triggered by the specific input.
		    0 –Begins within 2 mSec of command.
		Bit 5
		    1 – Gated active by the specific input.
		    0 – Gating is inactive.
		Bit 4
		    1 – Enable complex output function for this output.
		    0 – Remove complex output function for this output
		Bit 3
		    1 – During Primary = logic 1 during Secondary = 0.
		    0 – During Primary = logic 0 during Secondary = 1.
		Bit 2
		    1 – Trigger or gate derived from filtered input.
		    0 – Trigger or gate derived from raw input.
		Bit 1
		    1 – Triggered outputs are triggered by an On-to-Off transition of the specified input and shall be triggered immediately upon command receipt if the input is Off. Gated outputs are active while the input is Off.
		    0 – Triggered outputs are triggered by an Off-to-On transition of the specified input and shall be triggered immediately upon command receipt if the input is On. Gated outputs are active while the input is On.
		Bit 0
		    1 – Linesync based clock used for time ticks.
		    0 – MC used for time ticks.

Repeat bytes 3-9 for each item.		

16.2.3.18   Type 185 - Configure Complex Output

This frame is the ACK for a Type 57 command frame.

	Table 16-34. Type 185 Configure Complex Output	
Byte	**Contents**	**Description**
1	185	Frame type

2	Status	Status bits
		    Bit 7-1 = Not used (=0)
		    Bit 0 = Status

3	MC Time MSB	MC timestamp MSB
4	MC Time NMSB	MC timestamp NMSB
5	MC Time NLSB	MC timestamp NLSB
6	MC Time LSB	MC timestamp LSB

The Status bit returns a 0 for NO error or 1 when the maximum number of configurable outputs will be exceeded.

16.2.3.19   Type 60 – Module ID

The Field I/O Identification Command requests the FI/O type of 2070-2x or 2070-8 Field I/O modules. While these modules are outside of the strict ATC 5301 standard, SEPAC will make use of them if present. The destination of this frame is the CMU.

	Table 16-35. Type 60 Module ID	
Byte	**Contents**	**Description**
1	60	Frame type

16.2.3.20   Type 188 – Module ID

This frame is the ACK for a Type 60 command frame.

	Table 16-36. Type 188 Module ID	
Byte	**Contents**	**Description**
1	188	Frame type

2	FI/O ID	Field I/O ID
		    1 = 2070-2A, 2070-2E
		    2 = 2070-8
		    3 = 2070-2N

16.2.3.21   Type 62 – Set FSA (Failed State Action)

Send to local flash command. The destination of this frame is the CMU.

Table 16-37. Type 62 Set FSA
Byte	**Contents**	**Description**
1	62	Frame message
2	FSA mode	Set failed state action b0 – Set LFSA (Latching) b1 – Set NFSA (Non-latching) b2:7 – reserved

LFSA – CMU latched failed state action

NFSA – CMU non-latched fail state action

16.2.3.22   Type 190 – Set FSA

This frame is the ACK for a Type 62 command frame.

Table 16-38. Type 190 Set FSA
Byte	**Contents**	**Description**
1	190	Frame message

16.2.3.23   Type 66 – Time and Date

This frame will be transmitted from the 2070LX ATC one time every second. The destination address will be the all-station address of 255 (0xFF). No response from secondary devices is allowed to the all-station address. The transmission of this frame shall begin within + 100 milliseconds of the CU real time contained within the frame.

This will ensure that time clocks in all devices in the cabinet have the same time and date. It could also provide basic time keeping capability to devices without the need for hardware RTC and super-cap if appropriate.

Table 16-39. Type 66 Time and Date		
Byte	**Contents**	**Description**
1	66	Frame type
2	Binary month	Month – 1-12
3	Binary day	Day – 1-31
4	Binary year	Year – 0-99
5	Binary hour	Hour – 0-23
6	Binary minute	Minute – 0-59
7	Binary second	Second – 0-59
8	Binary tenth sec	Tenth Second – 0-9

16.2.3.24 Type 67 – Switch Pack Drivers

The format of this command frame is identical to Message 81 and 83 but requests a short status response from the CMU. This frame may be used as an alternate to Message 81 or 83. The destination of this frame is the CMU. The channel numbers in the Contents column in Table **16**-**40** refer to the channel numbers of the CMU. The ATC includes a definition, through program entry, of the CMU channel to ATC load switch utilization.

The Dark Channel Map Select bits will select a preprogrammed mask in the CMU serial memory key that disables Lack of Signal Input monitoring for the selected channels.

Table 16-40. Type 67 Switch Pack Drivers		
Byte	**Contents**	**Description**
1	67	Frame Type
2	Chn 8:1 red	Switch Pack Status A bit set to 1 indicates the HDSP output is set On.
3	Chn 16:9 red	
4	Chn 24:17 red	
5	Chn 32:25 red	
6	Chn 8:1 yellow	
7	Chn 16:9 yellow	
8	Chn 24:17 yellow	
9	Chn 32:25 yellow	
10	Chn 8:1 green	
11	Chn 16:9 green	
12	Chn 24:17 green	
13	Chn 32:25 green	
14	Map select	Dark Channel Map Select Bit 1 and bit 0 will select one of four dark channel maps programmed in the serial memory key that disables Lack of Signal Input monitoring for a selected channel. Bits 2 through 7 are reserved. 00 – Mask #1 01 – Mask #2 10 – Mask #3 11 – Mask #4

16.2.3.25 Type 195 – CMU Short Status

If the CMU is in FSA (Byte #2, fault type not equal to 0), the Channel Color Status bytes will contain an exact image of the signals that were applied to the CMU at the point in time of the detection of the failure. Control Status 1, Control Status 2, and Output Assembly Flasher Status will always reflect current status.

Table 16-41. Type 195 CMU Short Status
Byte	**Contents**	**Description**
1	195	Frame type
2	Fault type	Enumerated Fault Code 00 – No Fault 01 – CMU/HDSP +24 VDC 02 – CMU +12 VDC 03 – Conflict 04 – Serial Bus #1 05 – Serial Bus #3 06 – ATC LFSA Flash (Type 62) 07 – ATC NFSA Flash (Type 62) 08 – Diagnostic 09 – Multiple 10 – Lack of Signal Input 11 – Short Yellow Clearance 12 – Skipped Yellow Clearance 13 – Yellow + Red Clearance 14 – Field Output Check 15 – Serial Memory Key Absent 16 – Serial Memory Key FCS Error 17 – Serial Memory Key Data Error 18 – Local Flash 19 – Circuit Breaker Trip 20 – CMU/HDSP AC+ RAW Fail 21 – NRESET Active 22 – HDSP Diagnostic 23 – FYA Flash Rate Fault 24 – CMU +48 VDC 25:127 – Reserved 128:255 – Spare
3	Chn Fault 8:1	Channel fault status
4	Chn Fault 16:9	Channel Fault Status bits will be set to
5	Chn Fault 24:17	1 for channels that were detected in
6	Chn Fault 32:25	fault for fault types 03, 09, 10, 11, 12, 13, and 14. For fault type 01, 05, 20 and 22 a bit will be set in Channel Fault Status 32:1 for each enabled HDSP channel that failed. For Type 01, if the CMU 24 VDC input failed then Channel Fault Status will be set to 0. For Type 20, if the CMU AC+ input failed then Channel Fault Status will be set to 0. For all other fault types, the Channel Fault Status bits will be set to 0.

Table 16-41. Type 195 CMU Short Status		
Byte	**Contents**	**Description**
7	Chn Red 8:1	Channel color status
8	Chn Red 16:9	Channel Color Status bits will be set to
9	Chn Red 24:17	1 for channels that are sensed active.
10	Chn Red 32:25	For channel inputs that have been
11	Chn Yellow 8:1	remapped to a virtual channel (29–32),
12	Chn Yellow 16:9	the Channel Color Status bits will be set
13	Chn Yellow 24:17	to 0. For virtual channel (29–32) inputs
14	Chn Yellow 32:25	that have not been assigned to a
15	Chn Green 8:1	physical output, the Channel Color
16	Chn Green 16:9	Status bits will be set to 0.
17	Chn Green 24:17	
18	Chn Green 32:25	

19	Control Status #1	Control Status #1
		    b7 – Start-up call (1=Exit from flash)
		    b6 – Flasher output fail (1 = Fail)
		    b5 – Rear door open (1=Open)
		    b4 – Front door open (1=Open)
		    b3 – MC coil (1=Active)
		    b2 – MC Secondary (1=Active)
		    b1 – FTR coil drive (1= Active)
		    b0 – Output relay transfer (1=Fault)

20	Control Status #2	Control Status #2
		    b7 – Reserved
		    b6 – Reserved
		    b5 – Reserved
		    b4 – Reserved
		    b3 – Reserved
		    b2 – HDFU #2 Comm Error
		    b1 – HDFU #1 Comm Error
		    b0 – Configuration change
		        This bit set to 1 indicates the
		        configuration programming has
		        changed since the last poll of
		        Message 82. It will be set to 1
		        when the CMU is exiting flash
		        (Start-Up Call bit changes from 0
		        to 1) and at CMU power-up.

Table 16-41. Type 195 CMU Short Status		
Byte	**Contents**	**Description**
21	Flasher Status	Flasher Status (1=Fail)
		b0 – HDFU #1 FL1–1
		b1 – HDFU #1 FL1–2
		b2 – HDFU #1 FL2–1
		b3 – HDFU #1 FL2–2
		b4 – HDFU #2 FL1–1
		b5 – HDFU #2 FL1–2
		b6 – HDFU #2 FL2–1
		b7 – HDFU #2 FL2–2
22	0x00	Reserved
23	0x00	Reserved
24	0x00	Reserved

16.2.3.1 Type 80 – Module Description

The Field I/O Identification Command requests the FI/O type of 2070-2x or 2070-8 Field I/O modules. While these modules are outside of the strict ATC 5301 standard, SEPAC will make use of them if present. The destination of this frame is the CMU.

Table 16-42. Type 80 Module ID		
Byte	**Contents**	**Description**
1	80	Frame type

16.2.3.2 Type 208 – Module ID

This frame is the ACK for a Type 80 command frame.

Table 16-43. Type 208 Module ID		
Byte	**Contents**	**Description**
1	208	Frame type
2	Device	Enumerated Device Type
		1 = CMU-212
		2 = CMU-2212-LV
		3 = CMU-2212-HV
		4 = CMU-2212-VHV
		5 = SIU-218
		6 = SIU-2228
		7-255 = Reserved

3:42	ASCII Text	A packed 40-character field describing the device properties. Allowable ASCII characters are 0x20-0x7E. If less than 40 characters are used, the unused locations will be set to 0x00. Default programming will be 0x00.

16.2.3.3   Type 81 – Switch Pack Drivers (long)

The destination of this frame is the CMU. The channel numbers in the contents column below refer to the channel numbers of the CMU. SEPAC includes program entries of load switch numbers, which correspond to these channel numbers. The dark channel map select bits select a preprogrammed mask in the CMU DATAKEY that disables lack of Signal Input monitoring for the selected channels.

Table 16-44. Type 81 Switch Pack Drivers		
Byte	**Contents**	**Description**
1	81	Frame type
2	Chn 8:1 red	HDSP status.
3	Chn 16:9 red	A bit set to 1 indicates the load
4	Chn 24:17 red	switch output is set On.
5	Chn 32:25 red	
6	Chn 8:1 yel	
7	Chn 16:9 yel	
8	Chn 24:17 yel	
9	Chn 32:25 yel	
10	Chn 8:1 grn	
11	Chn 16:9 grn	
12	Chn 24:17 grn	
13	Chn 32:25 grn	

14	Map select	Dark channel map select
		Bits 7-2 – Reserved
		Bits1-0 – Select dark channel map
		    00 – Mask #1
		    01 – Mask #2
		    10 – Mask #3
		    11 – Mask #4

Dark channel maps are programmed in the serial memory key that disables lack of signal input monitoring for a selected channel.

16.2.3.4   Type 209 – CMU Status

If the CMU is in failed state action (Byte #2, fault type not equal to 0), all bytes of the information field of this frame except Control Status 1, Control Status 2, and Output

Assembly Flasher Status will contain an exact image of the signals that were applied to the CMU at the point in time of the detection of the failure. Control Status 1, Control Status 2, and Output Assembly Flasher Status will always reflect current status.

Table 16-45. Type 209 CMU Status		
Byte	**Contents**	**Description**
1	209	Frame type
2	Fault type	Enumerated fault code
		00 – No Fault
		01 – CMU/HDSP +24VDC
		02 – CMU +12VDC
		03 – Conflict
		04 – Serial Bus #1
		05 – Serial Bus #3
		06 – ATC LFSA Flash (Type 62)
		07 – ATC NFSA Flash (Type 62)
		08 – Diagnostic
		09 – Multiple Indications
		10 – Lack of Signal Input
		11 – Short Yellow Clearance
		12 – Skipped Yellow Clearance
		13 – Yellow + Red Clearance
		14 – Field Output Check
		15 – Serial Mem Key Absent
		16 – Serial Mem Key FCS Error
		17 – Serial Mem Key Data Error
		18 – Local Flash
		19 – CB Trip
		20 – CMU/AMU AC+ Raw Fail
		21 – NRESET Active
		22 – HDSP Diagnostic
		23 – FYA Flash Rate Fault
		24 – CMU +48 VDC
		25:127 – Reserved
		128:255 – Spare
3	Chn Fault 8:1	Channel fault status
4	Chn Fault 16:9	Channel Fault Status bits will be set to 1 for channels that were detected in fault for fault types 03, 09, 10, 11, 12, 13, and 14.
5	Chn Fault 24:17	
6	Chn Fault 32:25	
		For fault type 01, 05, 20 and 22 a bit will be set in Channel Fault Status 32:1 for each enabled HDSP channel that failed. For Type 01, if the CMU 24 VDC input failed, then Channel Fault

Byte	Contents	Description
		Status will be set to 0. For Type 20, if the CMU AC+ failed, then Channel Fault Status will be set to 0. For all other fault types, the Channel Fault Status bits will be set to 0.
7	Chn Red 8:1	Channel color status
8	Chn Red 16:9	Channel Color Status bits will be set to 1 for channels that are sensed active. For channel inputs that have been remapped to a virtual channel (29–32), the Channel Color Status bits will be set to 0. For virtual channel (29–32) inputs that have not been assigned to a physical output, the Channel Color Status bits will be set to 0.
9	Chn Red 24:17	
10	Chn Red 32:25	
11	Chn Yellow 8:1	
12	Chn Yellow 16:9	
13	Chn Yellow 24:17	
14	Chn Yellow 32:25	
15	Chn Green 8:1	
16	Chn Green 16:9	
17	Chn Green 24:17	
18	Chn Green 32:25	
19	Chn Red 8:1	Field Check Status
20	Chn Red 16:9	Field Check Status bits will be set to 1 for channels that are sensed with field check status. For channel inputs that have been remapped to a virtual channel (29–32), the Field Check Status bits will be set to 0. For virtual channel (29–32) inputs that have not been assigned to a physical output, the Field Check Status bits will be set to 0.
21	Chn Red 24:17	
22	Chn Red 32:25	
23	Chn Yellow 8:1	
24	Chn Yellow 16:9	
25	Chn Yellow 24:17	
26	Chn Yellow 32:25	
27	Chn Green 8:1	
28	Chn Green 16:9	
29	Chn Green 24:17	
30	Chn Green 32:25	
31	Control Status #1	Control Status #1 b7 – Start-up call (1=Exit from flash) b6 – Flasher output fail (1 = Fail) b5 – Rear door (1=Open) b4 – Front door (1=Open) b3 – Main contactor coil (1=Active) b2 – Main contactor secondary (1=Active) b1 – FTR coil drive (1= Active) b0 – Output relay transfer (1=Fault)
32	Control Status #2	Control Status #2

Table title (top of table): Table 16-45. Type 209 CMU Status

Table 16-45. Type 209 CMU Status		
Byte	**Contents**	**Description**
		b7 – Reserved b6 – Reserved b5 – Reserved b4 – Reserved b3 – Reserved b2 – HDFU #2 Comm Error b1 – HDFU #1 Comm Error b0 – Configuration change 　　This bit set to 1 indicates the configuration programming has changed since the last poll of Message 82. It will also be set to 1 when the CMU is exiting flash (start-up call bit changes from 0 to 1) and at CMU power-up.
33	AC+ Raw voltage	CMU AC+ RAW voltage
34	Assy #1 AC+ Raw	HDSP Signal Voltage (AC+ RAW) 　　Signal Voltage for any HDSP in Assembly #1 (Channels: 1-16) 　　Signal Voltage for any HDSP in Assembly #2 (Channels: 17-32)
35	Assy #2 AC+ Raw	
36	Chn 1 red voltage	Channel input voltages 　　The channel input voltages will be the most recent values reported from the HDSPs. For channel inputs that have been remapped to a virtual channel (29–32), the channel voltage value will be set to 0.
37	Chn 2 red voltage	
38	Chn 3 red voltage	
39	Chn 4 red voltage	
40	Chn 5 red voltage	
41	Chn 6 red voltage	
42	Chn 7 red voltage	
43	Chn 8 red voltage	
44	Chn 9 red voltage	
45	Chn 10 red voltage	
46	Chn 11 red voltage	
47	Chn 12 red voltage	
48	Chn 13 red voltage	
49	Chn 14 red voltage	
50	Chn 15 red voltage	
51	Chn 16 red voltage	
52	Chn 17 red voltage	
53	Chn 18 red voltage	
54	Chn 19 red voltage	

Table 16-45. Type 209 CMU Status		
Byte	**Contents**	**Description**
55	Chn 20 red voltage	
56	Chn 21 red voltage	
57	Chn 22 red voltage	
58	Chn 23 red voltage	
59	Chn 24 red voltage	
60	Chn 25 red voltage	
61	Chn 26 red voltage	
62	Chn 27 red voltage	
63	Chn 28 red voltage	
64	Chn 29 red voltage	
65	Chn 30 red voltage	
66	Chn 31 red voltage	
67	Chn 32 red voltage	
68	Chn 1 yel voltage	Channel input voltages (continued)
69	Chn 2 yel voltage	
70	Chn 3 yel voltage	
71	Chn 4 yel voltage	
72	Chn 5 yel voltage	
73	Chn 6 yel voltage	
74	Chn 7 yel voltage	
75	Chn 8 yel voltage	
76	Chn 9 yel voltage	
77	Chn 10 yel voltage	
78	Chn 11 yel voltage	
79	Chn 12 yel voltage	
80	Chn 13 yel voltage	
81	Chn 14 yel voltage	
82	Chn 15 yel voltage	
83	Chn 16 yel voltage	
84	Chn 17 yel voltage	
85	Chn 18 yel voltage	
86	Chn 19 yel voltage	
87	Chn 20 yel voltage	
88	Chn 21 yel voltage	
89	Chn 22 yel voltage	
90	Chn 23 yel voltage	
91	Chn 24 yel voltage	

Table 16-45. Type 209 CMU Status		
Byte	**Contents**	**Description**
92	Chn 25 yel voltage	
93	Chn 26 yel voltage	
94	Chn 27 yel voltage	
95	Chn 28 yel voltage	
96	Chn 29 yel voltage	
97	Chn 30 yel voltage	
98	Chn 31 yel voltage	
99	Chn 32 yel voltage	
100	Chn 1 grn voltage	Channel input voltages (continued)
101	Chn 2 grn voltage	
102	Chn 3 grn voltage	
103	Chn 4 grn voltage	
104	Chn 5 grn voltage	
105	Chn 6 grn voltage	
106	Chn 7 grn voltage	
107	Chn 8 grn voltage	
108	Chn 9 grn voltage	
109	Chn 10 grn voltage	
110	Chn 11 grn voltage	
111	Chn 12 grn voltage	
112	Chn 13 grn voltage	
113	Chn 14 grn voltage	
114	Chn 15 grn voltage	
115	Chn 16 grn voltage	
116	Chn 17 grn voltage	
117	Chn 18 grn voltage	
118	Chn 19 grn voltage	
119	Chn 20 grn voltage	
120	Chn 21 grn voltage	
121	Chn 22 grn voltage	
122	Chn 23 grn voltage	
123	Chn 24 grn voltage	
124	Chn 25 grn voltage	
125	Chn 26 grn voltage	
126	Chn 27 grn voltage	
127	Chn 28 grn voltage	
128	Chn 29 grn voltage	

Table 16-45. Type 209 CMU Status		
Byte	**Contents**	**Description**
129	Chn 30 grn voltage	
130	Chn 31 grn voltage	
131	Chn 32 grn voltage	
132	Chn 1 red current	Scaled load current
133	Chn 2 red current	The Output Load Current values for the current sense will be programmed in scaled milliamps.
134	Chn 3 red current	If Param > 250
135	Chn 4 red current	Then Current = "> 2200" mA
136	Chn 5 red current	Else If Param > 120
137	Chn 6 red current	Then Current = (Param * 16) − 1800
138	Chn 7 red current	Else Current = Param
139	Chn 8 red current	
140	Chn 9 red current	
141	Chn 10 red current	
142	Chn 11 red current	
143	Chn 12 red current	
144	Chn 13 red current	
145	Chn 14 red current	
146	Chn 15 red current	
147	Chn 16 red current	
148	Chn 17 red current	
149	Chn 18 red current	
150	Chn 19 red current	
151	Chn 20 red current	
152	Chn 21 red current	
153	Chn 22 red current	
154	Chn 23 red current	
155	Chn 24 red current	
156	Chn 25 red current	
157	Chn 26 red current	
158	Chn 27 red current	
159	Chn 28 red current	
160	Chn 29 red current	
161	Chn 30 red current	
162	Chn 31 red current	
163	Chn 32 red current	
164	Chn 1 yellow current	Scaled load current
165	Chn 2 yellow current	

Table 16-45. Type 209 CMU Status		
Byte	**Contents**	**Description**
166	Chn 3 yellow current	The Output Load Current values for the current sense will be programmed in scaled milliamps. If Param > 250 Then Current = "> 2200" mA Else If Param > 120 Then Current = (Param * 16) − 1800 Else Current = Param
167	Chn 4 yellow current	
168	Chn 5 yellow current	
169	Chn 6 yellow current	
170	Chn 7 yellow current	
171	Chn 8 yellow current	
172	Chn 9 yellow current	
173	Chn 10 yellow current	
174	Chn 11 yellow current	
175	Chn 12 yellow current	
176	Chn 13 yellow current	
177	Chn 14 yellow current	
178	Chn 15 yellow current	
179	Chn 16 yellow current	
180	Chn 17 yellow current	
181	Chn 18 yellow current	
182	Chn 19 yellow current	
183	Chn 20 yellow current	
184	Chn 21 yellow current	
185	Chn 22 yellow current	
186	Chn 23 yellow current	
187	Chn 24 yellow current	
188	Chn 25 yellow current	
189	Chn 26 yellow current	
190	Chn 27 yellow current	
191	Chn 28 yellow current	
192	Chn 29 yellow current	
193	Chn 30 yellow current	
194	Chn 31 yellow current	
195	Chn 32 yellow current	
196	Chn 1 green current	Scaled load current The Output Load Current values for the current sense will be programmed in scaled milliamps. If Param > 250 Then Current = "> 2200" mA Else If Param > 120 Then Current = (Param * 16) − 1800
197	Chn 2 green current	
198	Chn 3 green current	
199	Chn 4 green current	
200	Chn 5 green current	
201	Chn 6 green current	
202	Chn 7 green current	

Table 16-45. Type 209 CMU Status		
Byte	**Contents**	**Description**
203	Chn 8 green current	Else Current = Param
204	Chn 9 green current	
205	Chn 10 green current	
206	Chn 11 green current	
207	Chn 12 green current	
208	Chn 13 green current	
209	Chn 14 green current	
210	Chn 15 green current	
211	Chn 16 green current	
212	Chn 17 green current	
213	Chn 18 green current	
214	Chn 19 green current	
215	Chn 20 green current	
216	Chn 21 green current	
217	Chn 22 green current	
218	Chn 23 green current	
219	Chn 24 green current	
220	Chn 25 green current	
221	Chn 26 green current	
222	Chn 27 green current	
223	Chn 28 green current	
224	Chn 29 green current	
225	Chn 30 green current	
226	Chn 31 green current	
227	Chn 32 green current	
228	Binary seconds	CMU time and date
229	Binary minutes	
230	Binary hours (0:23)	
231	Binary date	
232	Binary month	
233	Binary year	
234	Voltage * 4	CMU 24 VDC supply voltage
235	Voltage * 4	CMU 48 VDC supply voltage
236	Degrees F + 40	CMU temperature (Fahrenheit)
237	Red Channel 8:1	Channel Current Sense Status
238	Red Channel 16:9	Status bits will be set to 1 for channels that are
239	Red Channel 24:17	sensed active. Status bits will be set to 0 for

Table 16-45. Type 209 CMU Status		
Byte	**Contents**	**Description**
240	Red Channel 32:25	channels that have the current sense monitor function disabled.
241	Yellow Channel 8:1	
242	Yellow Channel 16:9	
243	Yellow Channel 24:17	
244	Yellow Channel 32:25	
245	Green Channel 8:1	
246	Green Channel 16:9	
247	Green Channel 24:17	
248	Green Channel 32:25	
249	Flasher Status	Output assembly flasher status (1=Fail) b0 – HDFU #1 FL1-1 b1 – HDFU #1 FL1-2 b2 – HDFU #1 FL2-1 b3 – HDFU #1 FL2-2 b4 – HDFU #2 FL1-1 b5 – HDFU #2 FL1-2 b6 – HDFU #2 FL2-1 b7 – HDFU #2 FL2-2

16.2.3.1 Type 82 - Get CMU Configuration

The controller will request the serial memory key programming using this message and validate that the CMU permissive program settings are equal or less permissive than the SEPAC programming, and that the HDSP configuration programming is consistent with output functionality model 2218 assignment. If the programming of the CMU is not proper, the CU will issue a Type 62 frame with the L bit set causing a LFSA in the CMU. This check will be performed at CU initialization and when the Type 209 or Type 195 Control Status 2, Configuration Change bit is set to 1.

Table 16-46. Type 82 Get CMU Configuration		
Byte	**Contents**	**Description**
1	82	Frame message

16.2.3.2   Type 210 - CMU Configuration

This frame is the ACK for a Type 82 command frame.

Table 16-47. Type 210 CMU Configuration		
Byte	**Contents**	**Description**
1	210	Frame message
2:513	Bytes 1 thru 512	Serial memory key contents

16.2.3.3   Type 83 – Switch Pack Drivers (High Resolution)

The destination of this frame is the CMU. The channel numbers in the contents column below refer to the channel numbers of the CMU. SEPAC includes program entries of load switch numbers, which correspond to these channel numbers. The Dark Channel Map Select bits select a preprogrammed mask in the CMU DATAKEY that disables lack of Signal Input monitoring for the selected channels.

Table 16-48. Type 83 Switch Pack Drivers (High Resolution)		
Byte	**Contents**	**Description**
1	83	Frame type
2	Chn 8:1 red	HDSP status.
3	Chn 16:9 red	A bit set to 1 indicates the load switch output is set On.
4	Chn 24:17 red	
5	Chn 32:25 red	
6	Chn 8:1 yel	
7	Chn 16:9 yel	
8	Chn 24:17 yel	
9	Chn 32:25 yel	
10	Chn 8:1 grn	
11	Chn 16:9 grn	
12	Chn 24:17 grn	
13	Chn 32:25 grn	

14	Map select	Dark channel map select
		Bits 7-2 – Reserved
		Bits1-0 – Select dark channel map
		    00 – Mask #1
		    01 – Mask #2
		    10 – Mask #3
		    11 – Mask #4

Dark channel maps are programmed in the serial memory key that disables lack of signal input monitoring for a selected channel.

16.2.3.4   Type 211 – CMU Status (High Resolution)

If the CMU is in failed state action (Byte #2, fault type not equal to 0), all bytes of the information field of this frame except Control Status 1, Control Status 2, and Output Assembly Flasher Status will contain an exact image of the signals that were applied to the CMU at the point in time of the detection of the failure. Control Status 1, Control Status 2, and Output Assembly Flasher Status will always reflect current status.

Byte	Contents	Description
Table 16-49. Type 211 CMU Status (High Resolution)	
1	211	Frame type
2	Fault type	Enumerated fault code 00 – No Fault 01 – CMU/HDSP +24VDC 02 – CMU +12VDC 03 – Conflict 04 – Serial Bus #1 05 – Serial Bus #3 06 – ATC LFSA Flash (Type 62) 07 – ATC NFSA Flash (Type 62) 08 – Diagnostic 09 – Multiple Indications 10 – Lack of Signal Input 11 – Short Yellow Clearance 12 – Skipped Yellow Clearance 13 – Yellow + Red Clearance 14 – Field Output Check 15 – Serial Mem Key Absent 16 – Serial Mem Key FCS Error 17 – Serial Mem Key Data Error 18 – Local Flash 19 – CB Trip 20 – CMU/AMU AC+ Raw Fail 21 – NRESET Active 22 – HDSP Diagnostic 23 – FYA Flash Rate Fault 24 – CMU +48 VDC 25:127 – Reserved 128:255 – Spare
3	Chn Fault 8:1	Channel fault status
4	Chn Fault 16:9	Channel Fault Status bits will be set to 1 for channels that were detected in fault for fault types 03, 09, 10, 11, 12, 13, and 14. For fault type 01, 05, 20 and 22 a bit will be set in Channel Fault Status 32:1 for each enabled HDSP channel that failed. For Type 01, if the CMU 24 VDC input failed, then
5	Chn Fault 24:17	
6	Chn Fault 32:25	

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
		Channel Fault Status will be set to 0. For Type 20, if the CMU AC+ failed, then Channel Fault Status will be set to 0. For all other fault types, the Channel Fault Status bits will be set to 0.
7	Chn Red 8:1	Channel color status
8	Chn Red 16:9	Channel Color Status bits will be set to 1 for channels that are sensed active. For channel inputs that have been remapped to a virtual channel (29–32), the Channel Color Status bits will be set to 0. For virtual channel (29–32) inputs that have not been assigned to a physical output, the Channel Color Status bits will be set to 0.
9	Chn Red 24:17	
10	Chn Red 32:25	
11	Chn Yellow 8:1	
12	Chn Yellow 16:9	
13	Chn Yellow 24:17	
14	Chn Yellow 32:25	
15	Chn Green 8:1	
16	Chn Green 16:9	
17	Chn Green 24:17	
18	Chn Green 32:25	
19	Chn Red 8:1	Field Check Status
20	Chn Red 16:9	Field Check Status bits will be set to 1 for channels that are sensed with field check status. For channel inputs that have been remapped to a virtual channel (29–32), the Field Check Status bits will be set to 0. For virtual channel (29–32) inputs that have not been assigned to a physical output, the Field Check Status bits will be set to 0.
21	Chn Red 24:17	
22	Chn Red 32:25	
23	Chn Yellow 8:1	
24	Chn Yellow 16:9	
25	Chn Yellow 24:17	
26	Chn Yellow 32:25	
27	Chn Green 8:1	
28	Chn Green 16:9	
29	Chn Green 24:17	
30	Chn Green 32:25	
31	Control Status #1	Control Status #1 　　b7 – Start-up call (1=Exit from flash) 　　b6 – Flasher output fail (1 = Fail) 　　b5 – Rear door (1=Open) 　　b4 – Front door (1=Open) 　　b3 – Main contactor coil (1=Active) 　　b2 – Main contactor secondary (1=Active) 　　b1 – FTR coil drive (1= Active) 　　b0 – Output relay transfer (1=Fault)
32	Control Status #2	Control Status #2 　　b7 – Reserved 　　b6 – Reserved 　　b5 – Reserved 　　b4 – Reserved 　　b3 – Reserved

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
		b2 – HDFU #2 Comm Error
		b1 – HDFU #1 Comm Error
		b0 – Configuration change
		This bit set to 1 indicates the configuration programming has changed since the last poll of Message 82. It will also be set to 1 when the CMU is exiting flash (start-up call bit changes from 0 to 1) and at CMU power-up.
33	AC+ Raw voltage	CMU AC+ RAW voltage
34	Assy #1 AC+ Raw	HDSP Signal Voltage (AC+ RAW)
35	Assy #2 AC+ Raw	Signal Voltage for any HDSP in Assembly #1 (Channels: 1-16) Signal Voltage for any HDSP in Assembly #2 (Channels: 17-32)
36	Chn 1 red voltage	Channel input voltages
37	Chn 2 red voltage	The channel input voltages will be the most recent values reported from the HDSPs. For channel inputs that have been remapped to a virtual channel (29–32), the channel voltage value will be set to 0.
38	Chn 3 red voltage	
39	Chn 4 red voltage	
40	Chn 5 red voltage	
41	Chn 6 red voltage	
42	Chn 7 red voltage	
43	Chn 8 red voltage	
44	Chn 9 red voltage	
45	Chn 10 red voltage	
46	Chn 11 red voltage	
47	Chn 12 red voltage	
48	Chn 13 red voltage	
49	Chn 14 red voltage	
50	Chn 15 red voltage	
51	Chn 16 red voltage	
52	Chn 17 red voltage	
53	Chn 18 red voltage	
54	Chn 19 red voltage	
55	Chn 20 red voltage	
56	Chn 21 red voltage	
57	Chn 22 red voltage	
58	Chn 23 red voltage	
59	Chn 24 red voltage	
60	Chn 25 red voltage	
61	Chn 26 red voltage	
62	Chn 27 red voltage	

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
63	Chn 28 red voltage	
64	Chn 29 red voltage	
65	Chn 30 red voltage	
66	Chn 31 red voltage	
67	Chn 32 red voltage	
68	Chn 1 yel voltage	Channel input voltages (continued)
69	Chn 2 yel voltage	
70	Chn 3 yel voltage	
71	Chn 4 yel voltage	
72	Chn 5 yel voltage	
73	Chn 6 yel voltage	
74	Chn 7 yel voltage	
75	Chn 8 yel voltage	
76	Chn 9 yel voltage	
77	Chn 10 yel voltage	
78	Chn 11 yel voltage	
79	Chn 12 yel voltage	
80	Chn 13 yel voltage	
81	Chn 14 yel voltage	
82	Chn 15 yel voltage	
83	Chn 16 yel voltage	
84	Chn 17 yel voltage	
85	Chn 18 yel voltage	
86	Chn 19 yel voltage	
87	Chn 20 yel voltage	
88	Chn 21 yel voltage	
89	Chn 22 yel voltage	
90	Chn 23 yel voltage	
91	Chn 24 yel voltage	
92	Chn 25 yel voltage	
93	Chn 26 yel voltage	
94	Chn 27 yel voltage	
95	Chn 28 yel voltage	
96	Chn 29 yel voltage	
97	Chn 30 yel voltage	
98	Chn 31 yel voltage	
99	Chn 32 yel voltage	
100	Chn 1 grn voltage	Channel input voltages (continued)
101	Chn 2 grn voltage	
102	Chn 3 grn voltage	
103	Chn 4 grn voltage	
104	Chn 5 grn voltage	
105	Chn 6 grn voltage	
106	Chn 7 grn voltage	

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
107	Chn 8 grn voltage	
108	Chn 9 grn voltage	
109	Chn 10 grn voltage	
110	Chn 11 grn voltage	
111	Chn 12 grn voltage	
112	Chn 13 grn voltage	
113	Chn 14 grn voltage	
114	Chn 15 grn voltage	
115	Chn 16 grn voltage	
116	Chn 17 grn voltage	
117	Chn 18 grn voltage	
118	Chn 19 grn voltage	
119	Chn 20 grn voltage	
120	Chn 21 grn voltage	
121	Chn 22 grn voltage	
122	Chn 23 grn voltage	
123	Chn 24 grn voltage	
124	Chn 25 grn voltage	
125	Chn 26 grn voltage	
126	Chn 27 grn voltage	
127	Chn 28 grn voltage	
128	Chn 29 grn voltage	
129	Chn 30 grn voltage	
130	Chn 31 grn voltage	
131	Chn 32 grn voltage	
132	Chn 1 red current (LS)	HDSP Load Current – scaled to 1mA per bit
133	Chn 1 red current (MS)	
134	Chn 2 red current (LS)	
135	Chn 2 red current (MS)	
136	Chn 3 red current (LS)	
137	Chn 3 red current (MS)	
138	Chn 4 red current (LS)	
139	Chn 4 red current (MS)	
140	Chn 5 red current (LS)	
141	Chn 5 red current (MS)	
142	Chn 6 red current (LS)	
143	Chn 6 red current (MS)	
144	Chn 7 red current (LS)	
145	Chn 7 red current (MS)	
146	Chn 8 red current (LS)	
147	Chn 8 red current (MS)	
148	Chn 9 red current (LS)	
149	Chn 9 red current (MS)	
150	Chn 10 red current (LS)	

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
151	Chn 10 red current (MS)	
152	Chn 11 red current (LS)	
153	Chn 11 red current (MS)	
154	Chn 12 red current (LS)	
155	Chn 12 red current (MS)	
156	Chn 13 red current (LS)	
157	Chn 13 red current (MS)	
158	Chn 14 red current (LS)	
159	Chn 14 red current (MS)	
160	Chn 15 red current (LS)	
161	Chn 15 red current (MS)	
162	Chn 16 red current (LS)	
163	Chn 16 red current (MS)	
164	Chn 17 red current (LS)	
165	Chn 17 red current (MS)	
166	Chn 18 red current (LS)	
167	Chn 18 red current (MS)	
168	Chn 19 red current (LS)	
169	Chn 19 red current (MS)	
170	Chn 20 red current (LS)	
171	Chn 20 red current (MS)	
172	Chn 21 red current (LS)	
173	Chn 21 red current (MS)	
174	Chn 22 red current (LS)	
175	Chn 22 red current (MS)	
176	Chn 23 red current (LS)	
177	Chn 23 red current (MS)	
178	Chn 24 red current (LS)	
179	Chn 24 red current (MS)	
180	Chn 25 red current (LS)	
181	Chn 25 red current (MS)	
182	Chn 26 red current (LS)	
183	Chn 26 red current (MS)	
184	Chn 27 red current (LS)	
185	Chn 27 red current (MS)	
186	Chn 28 red current (LS)	
187	Chn 28 red current (MS)	
188	Chn 29 red current (LS)	
189	Chn 29 red current (MS)	
190	Chn 30 red current (LS)	
191	Chn 30 red current (MS)	
192	Chn 31 red current (LS)	
193	Chn 31 red current (MS)	
194	Chn 32 red current (LS)	

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
195	Chn 32 red current (MS)	
196	Chn 1 yellow current (LS)	HDSP Load Current – scaled to 1mA per bit
197	Chn 1 yellow current (MS)	
198	Chn 2 yellow current (LS)	
199	Chn 2 yellow current (MS)	
200	Chn 3 yellow current (LS)	
201	Chn 3 yellow current (MS)	
202	Chn 4 yellow current (LS)	
203	Chn 4 yellow current (MS)	
204	Chn 5 yellow current (LS)	
205	Chn 5 yellow current (MS)	
206	Chn 6 yellow current (LS)	
207	Chn 6 yellow current (MS)	
208	Chn 7 yellow current (LS)	
209	Chn 7 yellow current (MS)	
210	Chn 8 yellow current (LS)	
211	Chn 8 yellow current (MS)	
212	Chn 9 yellow current (LS)	
213	Chn 9 yellow current (MS)	
214	Chn 10 yellow current (LS)	
215	Chn 10 yellow current (MS)	
216	Chn 11 yellow current (LS)	
217	Chn 11 yellow current (MS)	
218	Chn 12 yellow current (LS)	
219	Chn 12 yellow current (MS)	
220	Chn 13 yellow current (LS)	
221	Chn 13 yellow current (MS)	
222	Chn 14 yellow current (LS)	
223	Chn 14 yellow current (MS)	
224	Chn 15 yellow current (LS)	
225	Chn 15 yellow current (MS)	
226	Chn 16 yellow current (LS)	
227	Chn 16 yellow current (MS)	
228	Chn 17 yellow current (LS)	
229	Chn 17 yellow current (MS)	
230	Chn 18 yellow current (LS)	
231	Chn 18 yellow current (MS)	
232	Chn 19 yellow current (LS)	
233	Chn 19 yellow current (MS)	
234	Chn 20 yellow current (LS)	
235	Chn 20 yellow current (MS)	
236	Chn 21 yellow current (LS)	
237	Chn 21 yellow current (MS)	
238	Chn 22 yellow current (LS)	

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
239	Chn 22 yellow current (MS)	
240	Chn 23 yellow current (LS)	
241	Chn 23 yellow current (MS)	
242	Chn 24 yellow current (LS)	
243	Chn 24 yellow current (MS)	
244	Chn 25 yellow current (LS)	
245	Chn 25 yellow current (MS)	
246	Chn 26 yellow current (LS)	
247	Chn 26 yellow current (MS)	
248	Chn 27 yellow current (LS)	
249	Chn 27 yellow current (MS)	
250	Chn 28 yellow current (LS)	
251	Chn 28 yellow current (MS)	
252	Chn 29 yellow current (LS)	
253	Chn 29 yellow current (MS)	
254	Chn 30 yellow current (LS)	
255	Chn 30 yellow current (MS)	
256	Chn 31 yellow current (LS)	
257	Chn 31 yellow current (MS)	
258	Chn 32 yellow current (LS)	
259	Chn 32 yellow current (MS)	
260	Chn 1 green current (LS)	HDSP Load Current – scaled to 1mA per bit
261	Chn 1 green current (MS)	
262	Chn 2 green current (LS)	
263	Chn 2 green current (MS)	
264	Chn 3 green current (LS)	
265	Chn 3 green current (MS)	
266	Chn 4 green current (LS)	
267	Chn 4 green current (MS)	
268	Chn 5 green current (LS)	
269	Chn 5 green current (MS)	
270	Chn 6 green current (LS)	
271	Chn 6 green current (MS)	
272	Chn 7 green current (LS)	
273	Chn 7 green current (MS)	
274	Chn 8 green current (LS)	
275	Chn 8 green current (MS)	
276	Chn 9 green current (LS)	
277	Chn 9 green current (MS)	
278	Chn 10 green current (LS)	
279	Chn 10 green current (MS)	
280	Chn 11 green current (LS)	
281	Chn 11 green current (MS)	
282	Chn 12 green current (LS)	

Byte	Contents	Description
	Table 16-49. Type 211 CMU Status (High Resolution)	
283	Chn 12 green current (MS)	
284	Chn 13 green current (LS)	
285	Chn 13 green current (MS)	
286	Chn 14 green current (LS)	
287	Chn 14 green current (MS)	
288	Chn 15 green current (LS)	
289	Chn 15 green current (MS)	
290	Chn 16 green current (LS)	
291	Chn 16 green current (MS)	
292	Chn 17 green current (LS)	
293	Chn 17 green current (MS)	
294	Chn 18 green current (LS)	
295	Chn 18 green current (MS)	
296	Chn 19 green current (LS)	
297	Chn 19 green current (MS)	
298	Chn 20 green current (LS)	
299	Chn 20 green current (MS)	
300	Chn 21 green current (LS)	
301	Chn 21 green current (MS)	
302	Chn 22 green current (LS)	
303	Chn 22 green current (MS)	
304	Chn 23 green current (LS)	
305	Chn 23 green current (MS)	
306	Chn 24 green current (LS)	
307	Chn 24 green current (MS)	
308	Chn 25 green current (LS)	
309	Chn 25 green current (MS)	
310	Chn 26 green current (LS)	
311	Chn 26 green current (MS)	
312	Chn 27 green current (LS)	
313	Chn 27 green current (MS)	
314	Chn 28 green current (LS)	
315	Chn 28 green current (MS)	
316	Chn 29 green current (LS)	
317	Chn 29 green current (MS)	
318	Chn 30 green current (LS)	
319	Chn 30 green current (MS)	
320	Chn 31 green current (LS)	
321	Chn 31 green current (MS)	
322	Chn 32 green current (LS)	
323	Chn 32 green current (MS)	
324	HDFU #1, 1-1 current (LS)	HDFU Load current – scaled to 1mA per bit
325	HDFU #1, 1-1 current (MS)	
326	HDFU #1, 1-2 current (LS)	

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
327	HDFU #1, 1-2 current (MS)	
328	HDFU #1, 2-1 current (LS)	
329	HDFU #1, 2-1 current (MS)	
330	HDFU #1, 2-2 current (LS)	
331	HDFU #1, 2-2 current (MS)	
332	HDFU #1, Aux 1 current (LS)	
333	HDFU #1, Aux 1 current (MS)	
334	HDFU #1, Aux 2 current (LS)	
335	HDFU #1, Aux 2 current (MS)	
336	HDFU #2, 1-1 current (LS)	
337	HDFU #2, 1-1 current (MS)	
338	HDFU #2, 1-2 current (LS)	
339	HDFU #2, 1-2 current (MS)	
340	HDFU #2, 2-1 current (LS)	
341	HDFU #2, 2-1 current (MS)	
342	HDFU #2, 2-2 current (LS)	
343	HDFU #2, 2-2 current (MS)	
344	HDFU #2, Aux 1 current (LS)	
345	HDFU #2, Aux 1 current (MS)	
346	HDFU #2, Aux 2 current (LS)	
347	HDFU #2, Aux 2 current (MS)	
348	Binary seconds	CMU time and date
349	Binary minutes	
350	Binary hours (0:23)	
351	Binary date	
352	Binary month	
353	Binary year	
354	Voltage * 4	CMU 24 VDC supply voltage
355	Voltage * 4	CMU 48 VDC supply voltage
356	Degrees F + 40	CMU temperature (Fahrenheit)
357	Red Channel 8:1	Channel Current Sense Status
358	Red Channel 16:9	Status bits will be set to 1 for channels that are sensed active. Status bits will be set to 0 for channels that have the current sense monitor function disabled.
359	Red Channel 24:17	
360	Red Channel 32:25	
361	Yellow Channel 8:1	
362	Yellow Channel 16:9	
363	Yellow Channel 24:17	
364	Yellow Channel 32:25	
365	Green Channel 8:1	
366	Green Channel 16:9	
367	Green Channel 24:17	
368	Green Channel 32:25	

Table 16-49. Type 211 CMU Status (High Resolution)		
Byte	**Contents**	**Description**
369	Flasher Status	Output assembly flasher status (1=Fail) b0 – HDFU #1 FL1-1 b1 – HDFU #1 FL1-2 b2 – HDFU #1 FL2-1 b3 – HDFU #1 FL2-2 b4 – HDFU #2 FL1-1 b5 – HDFU #2 FL1-2 b6 – HDFU #2 FL2-1 b7 – HDFU #2 FL2-2

17 ITS v1 Cabinet

An ITS v1 cabinet is a serially interconnected cabinet for use with the 2070LX ATC.

17.1 ITS v1 Cabinet Components

The ITS Cabinet Serial Bus # 1 provides the cabinet control and communication path between the 2070LX ATC, CMU monitor unit and SIU units in the input and output assemblies.

17.1.1 Monitoring System

The ITS cabinet monitor unit uses a serial memory device to store all the configuration parameters for the monitor system and is completely removable and interchangeable.

The EDI monitor key CMU data key programming tool provides the hardware programming interface between a PC and the serial memory device. This tool connects to a serial port of the PC and uses software to read, write, and verify the contents of the serial memory device. Software wizards provide simplified initial setup of the parameter database as well as check for data consistency errors.

17.1.2 Output Assemblies

An ITS cabinet output assembly (OA) handles the switching of 120 VAC power to the signal heads. The OA comes in two versions, one accommodates six switch packs, and one accommodates 14 switch packs. The OA also has an SIU and auxiliary monitor unit (AMU). The OA includes provisions for managing cabinet flash with flash transfer relays and flash configuration jumpers. The ITS cabinet may include one or the other or a combination of one or more of each configuration.

The default ITSv1 data for assignment is noted above in the default column. NA in the default column denotes that the detector input is NOT ASSIGNED by the default data.

Table 17-1. Output Assemblies		
Chn #	**LS #**	**FUNCTION**
1	1	Phase 1 vehicle
2	2	Phase 2 vehicle
3	3	Phase 2 pedestrian
4	4	Phase 3 vehicle
5	5	Phase 4 vehicle
6	6	Phase 4 pedestrian
7	7	Phase 5 vehicle
8	8	Phase 6 vehicle
9	9	Phase 6 pedestrian
10	10	Phase 7 vehicle
11	11	Phase 8 vehicle
12	12	Phase 8 pedestrian
13-28	13-28	Not assigned in default data

The Yunex Traffic SEPAC software obtains the input functions in Table 17-2 from the first (smallest position number) OA in an ITS cabinet.

Table 17-2. Input Functions	
OPTO	**FUNCTION**
1	Manual Control Enable
2	Interval Advance
3	Stop Timing
4	Local Flash Status

When the ITS cabinet does NOT include an OA, these functions are provided by the first input assembly.

The Yunex Traffic SEPAC software provides for combinations of output assemblies ONLY as described in the following sections.

17.1.2.1   Output Form 1 (14-0-0-0)

This output form consists of:

   (1) 14-pack output assembly (Pos #1 – Addr 01).
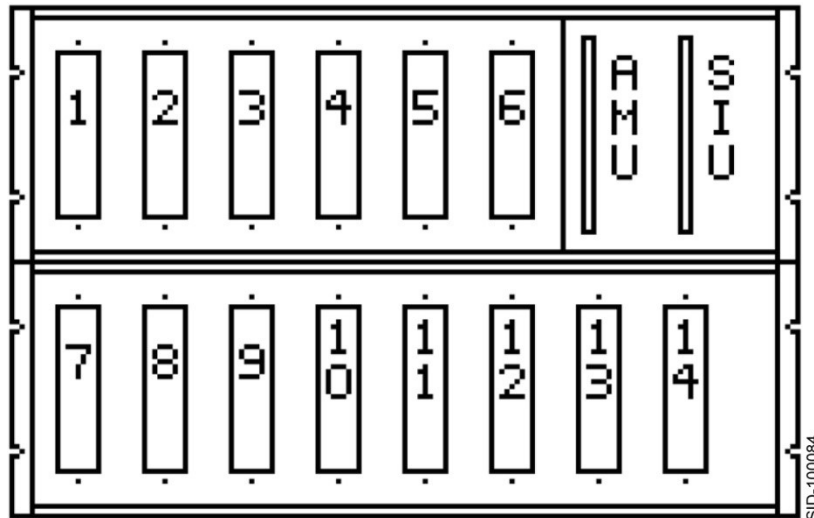
Figure 17-1. Output Form 1 (14-0-0-0)

NOTE: The 14-pack output assembly does not provide a flash relay for Load Switch Positions 13 and 14. Also, position number is logical rather than physical.

17.1.2.2   Output Form 2 (14-0-14-0)

This output form consists of:

      (1) 14-pack output assembly (Pos #1 – Addr 01)

      (1) 14-pack output assembly (Pos #3 – Addr 03)
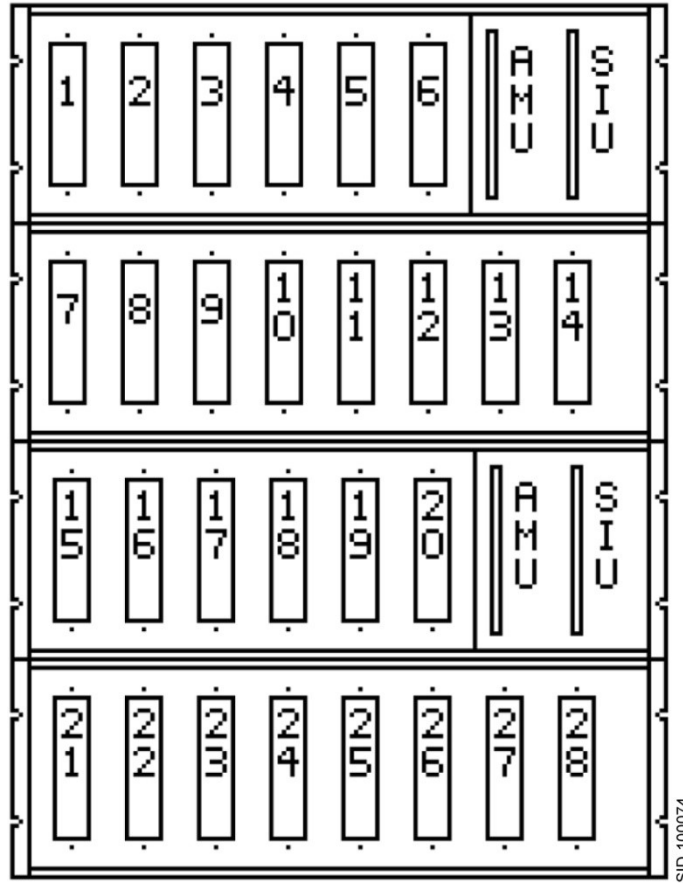
Figure 17-2. Output Form 2 (14-0-14-0)

> **NOTE: The 14-pack output assemblies do not provide a flash relay for Load Switch Positions 13, 14, 27, and 28.**

17.1.2.3   Output Form 3 (14-0-6-0)

This output form consists of:

(1) 14-pack output assembly (Pos #1 – Addr 01)

(1) 6-pack output assembly (Pos #3 – Addr 07)
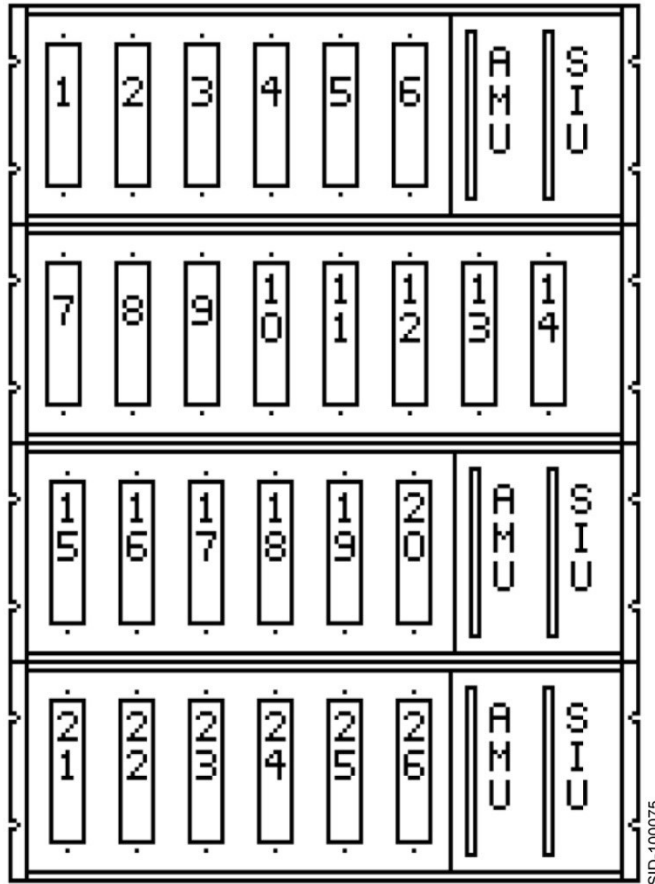
Figure 17-3. Output Form 3 (14-0-6-0)

> **NOTE: The 14-pack output assembly does not provide a flash relay for Load Switch Positions 13 and 14.**

17.1.2.4   Output Form 4 (14-0-6-6)

This output form consists of:

> (1) 14-pack output assembly (Pos #1 – Addr 01)

> (1) 6-pack output assembly (Pos #3 – Addr 07)

> (1) 6-pack output assembly (Pos #4 – Addr 04)
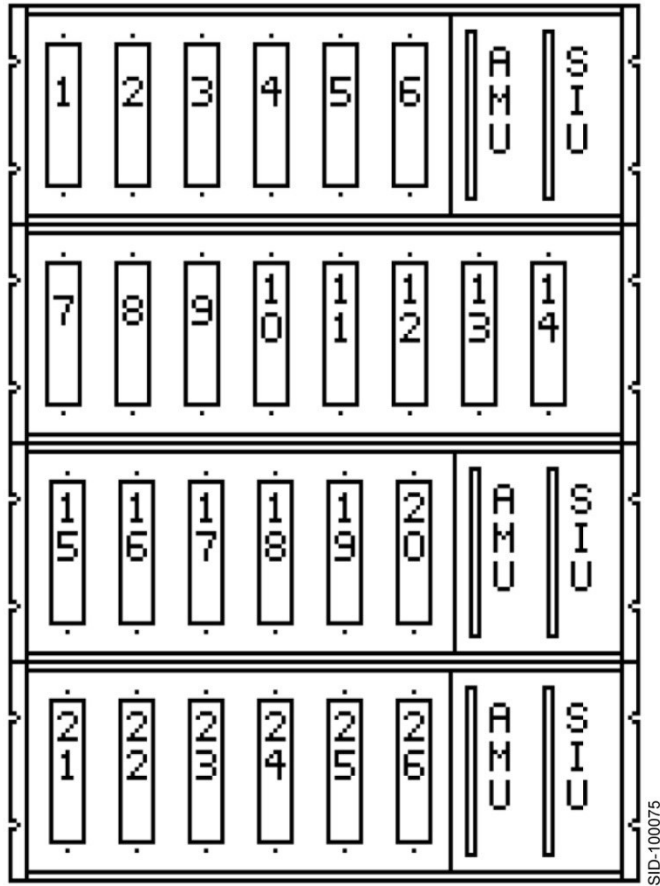
Figure 17-4. Output Form 4 (14-0-6-6)

> **NOTE: The 14-pack output assembly does not provide a flash relay for Load Switch Positions 13 and 14.**

17.1.2.5 Output Form 5 (6-0-0-0)

This output form consists of:

(1) 6-pack output assembly (Pos #1 – Addr 05)
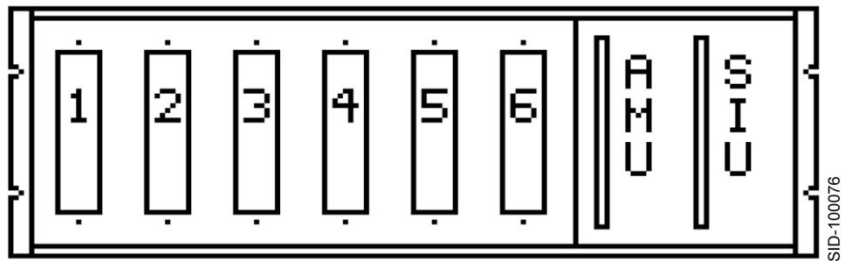
Figure 17-5. Output Form 5 (6-0-0-0)

17.1.2.6 Output Form 6 (6-6-0-0)

This output form consists of:

(1) 6-pack output assembly (Pos #1 – Addr 05)

(1) 6-pack output assembly (Pos #2 – Addr 06)
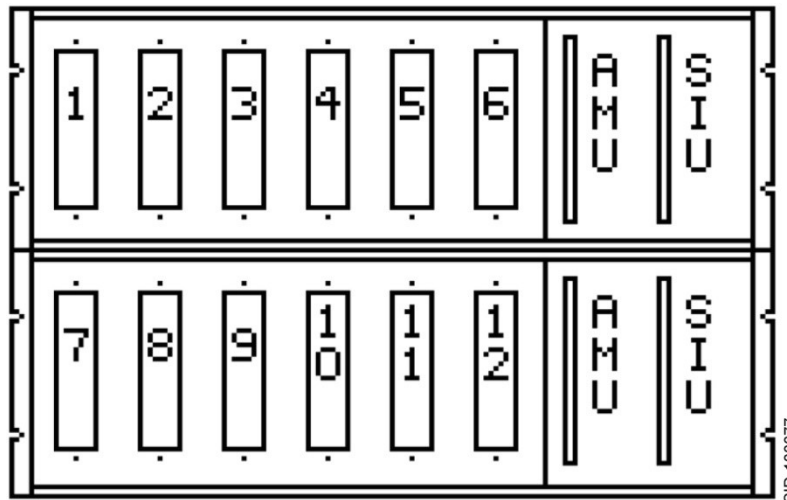
Figure 17-6. Output Form 6 (6-6-0-0)

17.1.2.7 Output Form 7 (6-6-6-0)

This output form consists of:

(1) 6-pack output assembly (Pos #1 – Addr 05)

(1) 6-pack output assembly (Pos #2 – Addr 06)

(1) 6-pack output assembly (Pos #3 – Addr 07)
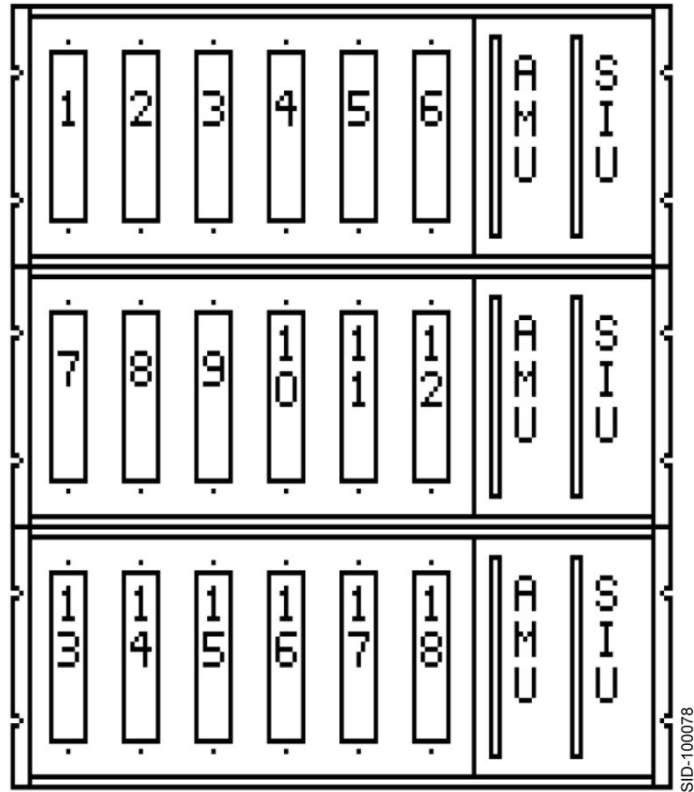
Figure 17-7. Output Form 7 (6-6-6-0)

17.1.2.8   Output Form 8 (6-6-6-6)

This output form consists of:

(1) 6-pack output assembly (Pos #1 – Addr 05)

(1) 6-pack output assembly (Pos #2 – Addr 06)

(1) 6-pack output assembly (Pos #3 – Addr 07)

(1) 6-pack output assembly (Pos #4 – Addr 04)
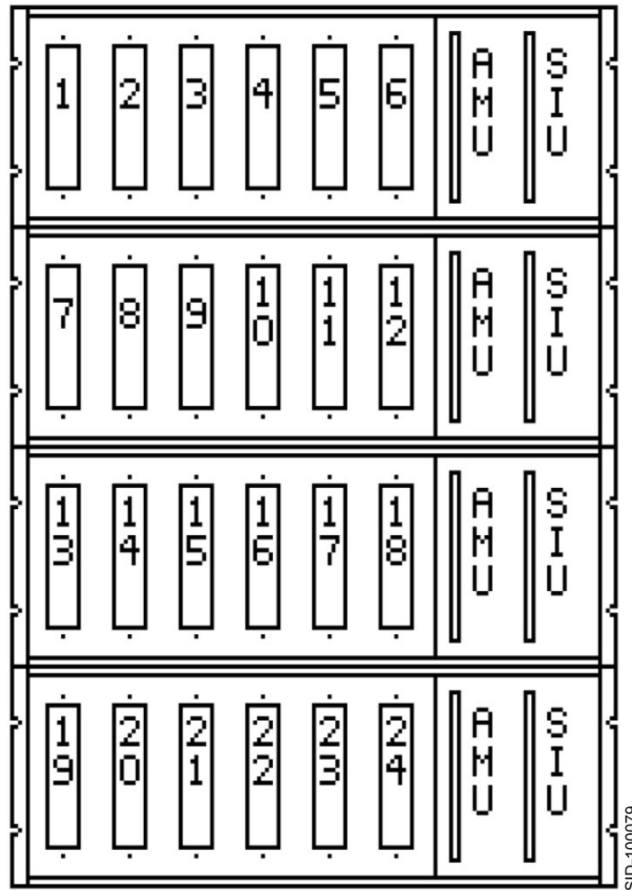
Figure 17-8. Output Form 8 (6-6-6-6)

17.1.2.9   Output Form 9 (6-0-14-0)

This output form consists of:

      (1) 6-pack output assembly (Pos #1 – Addr 05)

      (1) 14-pack output assembly (Pos #3 – Addr 03)
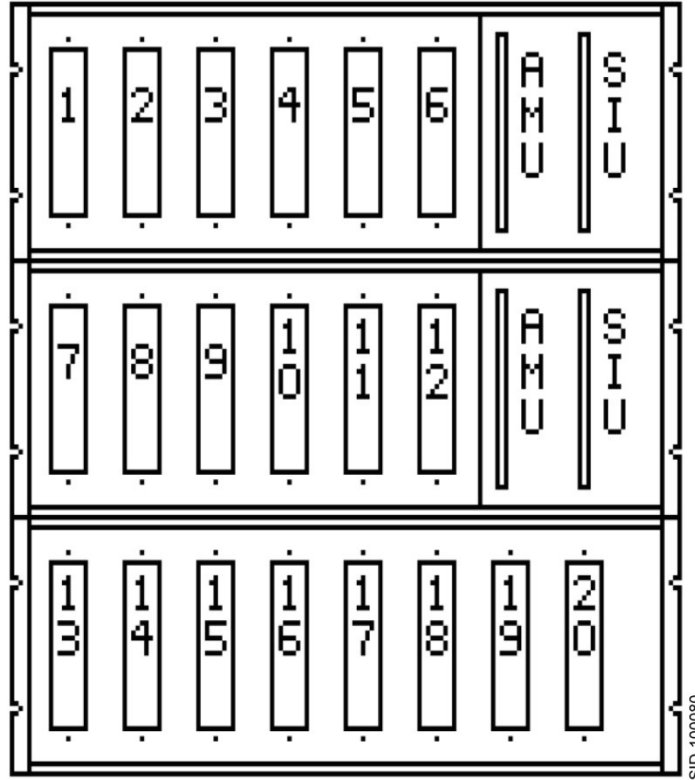
Figure 17-9. Output Form 9 (6-0-14-0)

NOTE: The 14-pack output assembly does not provide a flash relay for Load Switch Positions 19 and 20.

17.1.2.10 Output Form 10 (6-6-14-0)

This output form consists of:

(1) 6-pack output assembly (Pos #1 – Addr 05)

(1) 6-pack output assembly (Pos #2 – Addr 06)

(1) 14-pack output assembly (Pos #3 – Addr 03)
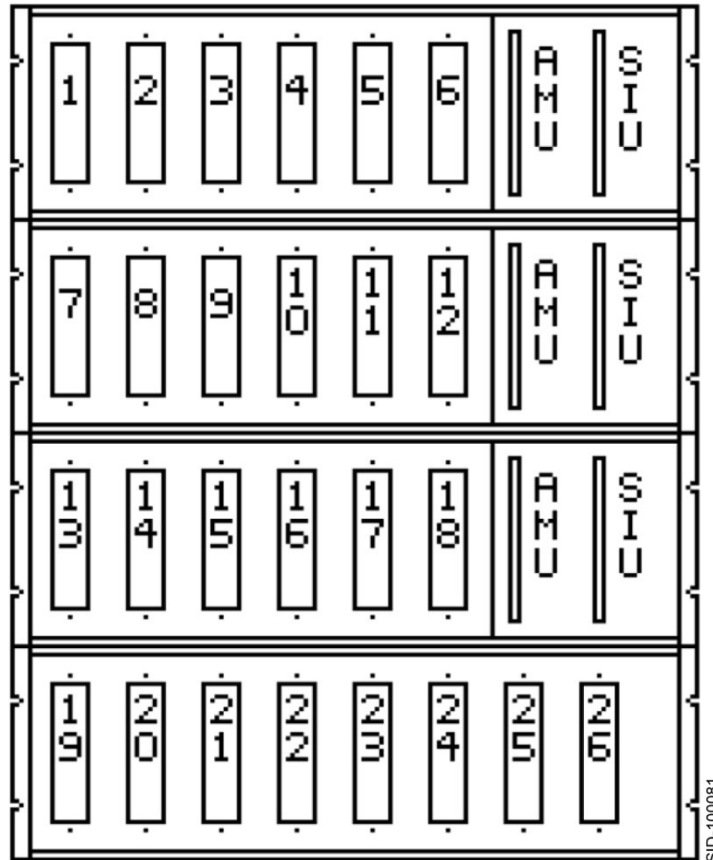
Figure 17-10. Output Form 10 (6-6-14-0)

NOTE: The 14-pack output assembly does not provide a flash relay for Load Switch Positions 25 and 26.

17.1.3   Input Assemblies

An ITS cabinet input assembly provides 12 slots for input cards (detectors or isolators). Each input card provides two inputs. The ITS cabinet may include one to five of these assemblies.

The Yunex Traffic SEPAC software provides functionality for each input assembly as shown in the following sections.

17.1.3.1   Input Assembly 1

This input assembly uses address 9.

Figure 17-11. Input Assembly 1

The Yunex Traffic SEPAC software provides functionality for this input assembly as shown in Table 17-3

Input	Slot	Description	Default
		Table 17-3. Input Assembly 1 Functions	
Input	**Slot**	**Description**	**Default**
1	1F	Vehicle Detector 1	Phs 1v
2	1W	Vehicle Detector 2	Phs 1v
3	2F	Vehicle Detector 3	Phs 2v
4	2W	Vehicle Detector 4	Phs 2v
5	3F	Vehicle Detector 5	Phs 2v
6	3W	Vehicle Detector 6	Phs 2v
7	4F	Vehicle Detector 7	Phs 2v
8	4W	Vehicle Detector 8	Phs 3v
9	5F	Vehicle Detector 9	Phs 3v
10	5W	Vehicle Detector 10	Phs 4v
11	6F	Vehicle Detector 11	Phs 4v
12	6W	Vehicle Detector 12	Phs 4v
13	7F	Vehicle Detector 13	Phs 4v
14	7W	Vehicle Detector 14	Phs 4v
15	8F	Vehicle Detector 15	NA
16	8W	Vehicle Detector 16	NA
17	9F	Vehicle Detector 17	NA
18	9W	Vehicle Detector 18	NA
19	10F	Vehicle Detector 19	NA
20	10W	Vehicle Detector 20	NA
21	11F	Vehicle Detector 21	NA
22	11W	Vehicle Detector 22	NA
23	12F	Pedestrian Detector 2	Phs 2p
24	12W	Pedestrian Detector 4	Phs 4p

The Yunex Traffic SEPAC software includes the capability to assign detector inputs as vehicle or pedestrian, and to any of the 16 phases, allows the flexibility for all input assemblies to

provide detection as needed. The default ITS v1 data for assignment is noted above in the default column. NA in the default column indicates that the detector input is NOT ASSIGNED by the default data.

When the ITS cabinet does NOT include an output assembly and this is the first (lowest address) input assembly used, the Yunex Traffic SEPAC software obtains the input functions through the Opto inputs of the SIU as shown in Table 17-2.

When the ITS cabinet does include an output assembly, the status of these Optos is not currently used by the Yunex Traffic SEPAC software.

17.1.3.2 Input Assembly 2

This input assembly uses Address A.
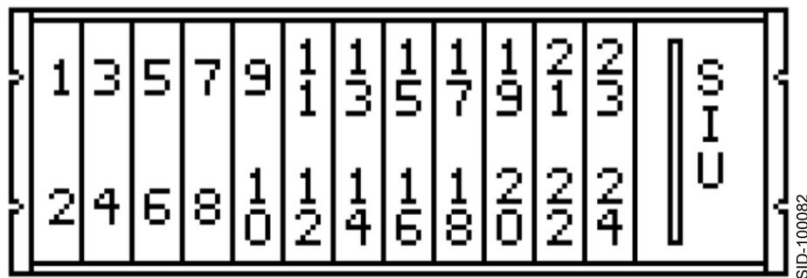
Figure 17-12. Input Assembly 2

The Yunex Traffic SEPAC software provides functionality for this input assembly as shown in Table 17-4.

Table 17-4. Input Assembly 2 Functions			
Input	Slot	Description	Default
1	1F	Vehicle Detector 23	Phs 5v
2	1W	Vehicle Detector 24	Phs 5v
3	2F	Vehicle Detector 25	Phs 6v
4	2W	Vehicle Detector 26	Phs 6v
5	3F	Vehicle Detector 27	Phs 6v
6	3W	Vehicle Detector 28	Phs 6v
7	4F	Vehicle Detector 29	Phs 6v
8	4W	Vehicle Detector 30	Phs 7v
9	5F	Vehicle Detector 31	Phs 7v
10	5W	Vehicle Detector 32	Phs 8v
11	6F	Vehicle Detector 33	Phs 8v
12	6W	Vehicle Detector 34	Phs 8v
13	7F	Vehicle Detector 35	Phs 8v
14	7W	Vehicle Detector 36	Phs 8v
15	8F	Vehicle Detector 37	NA
16	8W	Vehicle Detector 38	NA
17	9F	Vehicle Detector 39	NA
18	9W	Vehicle Detector 40	NA
19	10F	Vehicle Detector 41	NA
20	10W	Vehicle Detector 42	NA
21	11F	Preempt 1	---
22	11W	Alarm 1	---
23	12F	Pedestrian Detector 6	Phs 6p
24	12W	Pedestrian Detector 8	Phs 8p

When the ITS cabinet does NOT include an output assembly and this is the first (lowest address) input assembly used, the Yunex Traffoc SEPAC software obtains the input functions through the Opto inputs of the SIU as shown in Table 17-2.

When the ITS cabinet does include an output assembly, the status of these Optos is not currently used by the Yunex Traffic SEPAC software.

17.1.3.3 Input Assembly 3

This input assembly uses Address B.
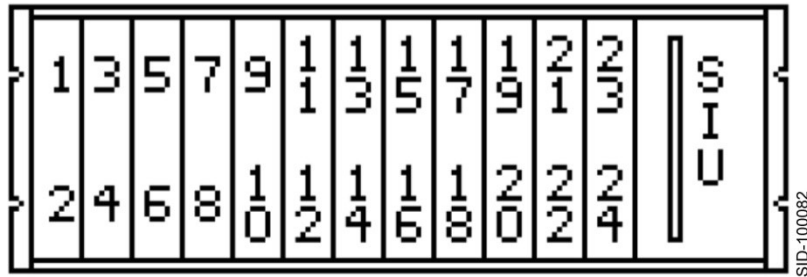
Figure 17-13. Input Assembly 3

The Yunex Traffic SEPAC software provides functionality for this input assembly shown in Table 17-5.

Table 17-5. Input Assembly 3 Functions			
Input	**Slot**	**Description**	**Default**
1	1F	Vehicle Detector 43	NA
2	1W	Vehicle Detector 44	NA
3	2F	Vehicle Detector 45	NA
4	2W	Vehicle Detector 46	NA
5	3F	Vehicle Detector 47	NA
6	3W	Vehicle Detector 48	NA
7	4F	Vehicle Detector 49	NA
8	4W	Vehicle Detector 50	NA
9	5F	Vehicle Detector 51	NA
10	5W	Vehicle Detector 52	NA
11	6F	Vehicle Detector 53	NA
12	6W	Vehicle Detector 54	NA
13	7F	Vehicle Detector 55	NA
14	7W	Vehicle Detector 56	NA
15	8F	Vehicle Detector 57	NA
16	8W	Vehicle Detector 58	NA
17	9F	Vehicle Detector 59	NA
18	9W	Vehicle Detector 60	NA
19	10F	Vehicle Detector 61	NA
20	10W	Vehicle Detector 62	NA
21	11F	Vehicle Detector 63	NA
22	11W	Vehicle Detector 64	NA
23	12F	Preempt 2	---
24	12W	Alarm 2	---

When the ITS cabinet does NOT include an output assembly and this is the first (lowest address) input assembly used, the Yunex Traffic SEPAC software obtains the input functions through the Opto inputs of the SIU as shown in Table 17-2.

When the ITS cabinet does include an output assembly, the status of these Optos is not currently used by the Yunex Traffic SEPAC software.

17.1.3.4   Input Assembly 4

This input assembly uses Address C.
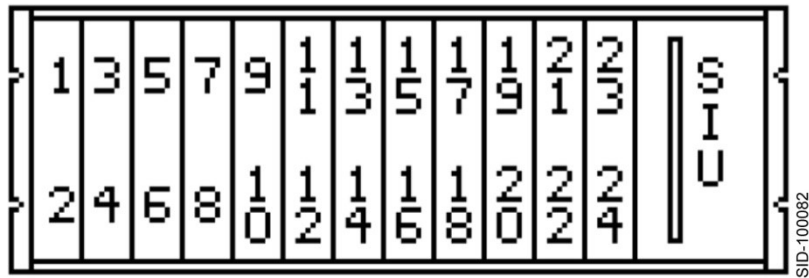
Figure 17-14. Input Assembly 4

The Yunex Traffic SEPAC software provides functionality for this input assembly as shown in Table 17-6.

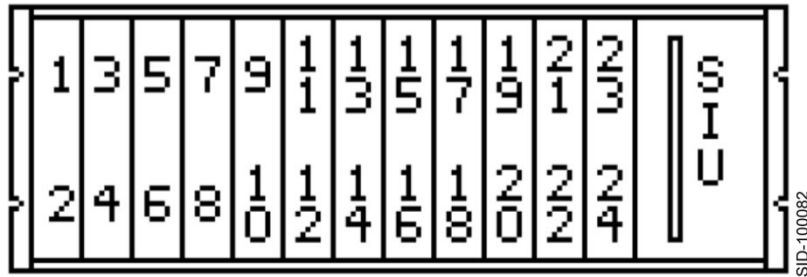| Table 17-6. Input Assembly 4 Functions			
Input	Slot	Description	Default
1	1F	Special Detector 1	NA
2	1W	Special Detector 2	NA
3	2F	Special Detector 3	NA
4	2W	Special Detector 4	NA
5	3F	Special Detector 5	NA
6	3W	Special Detector 6	NA
7	4F	Special Detector 7	NA
8	4W	Special Detector 8	NA
9	5F	Pedestrian Detector 1	NA
10	5W	Pedestrian Detector 2	Phs 2p
11	6F	Pedestrian Detector 3	NA
12	6W	Pedestrian Detector 4	Phs 4p
13	7F	Pedestrian Detector 5	NA
14	7W	Pedestrian Detector 6	Phs 6p
15	8F	Pedestrian Detector 7	NA
16	8W	Pedestrian Detector 8	Phs 8p
17	9F	Not used	---
18	9W	Not used	---
19	10F	Not used	---
20	10W	Not used	---
21	11F	Preempt 3	---
22	11W	Preempt 4	---
23	12F	Alarm 3	---
24	12W	Alarm 4	---

When the ITS cabinet does not include an output assembly and this is the first (lowest address) input assembly used, the Yunex Traffic SEPAC software obtains the input functions through the Opto inputs of the SIU as shown in Table 17-2.

When the ITS cabinet does include an output assembly, the status of these Optos is not currently used by the Yunex Traffic SEPAC software.

17.1.3.5   Input Assembly 5

This input assembly uses Address D.
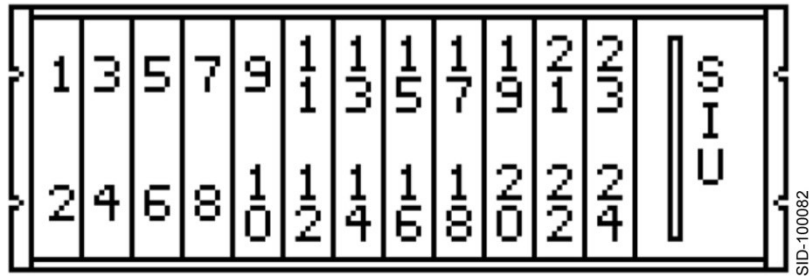
Figure 17-15. Input Assembly 5

Yunex Traffic SEPAC software provides no input functionality for this input assembly. See Table 17-7.

Table 17-7. Input Assembly 5 Functions

Input	Slot	Description	Default
1	1F	Not used	N/A
2	1W	Not used	N/A
3	2F	Not used	N/A
4	2W	Not used	N/A
5	3F	Not used	N/A
6	3W	Not used	N/A
7	4F	Not used	N/A
8	4W	Not used	N/A
9	5F	Not used	N/A
10	5W	Not used	N/A
11	6F	Not used	N/A
12	6W	Not used	N/A
13	7F	Not used	N/A
14	7W	Not used	N/A
15	8F	Not used	N/A
16	8W	Not used	N/A
17	9F	Not used	N/A
18	9W	Not used	N/A
19	10F	Not used	N/A
20	10W	Not used	N/A
21	11F	Not used	N/A
22	11W	Not used	N/A
23	12F	Not used	N/A
24	12W	Not used	N/A

17.2   ITS v1 Cabinet Protocol

In an ITS v1 cabinet, the CU uses Serial Bus 1 (SB1) to communicate to devices within the cabinet. These devices include SIU, CMU, etc.

The following address frame numbers are assigned to the assemblies and monitor as shown in Table 17-8.

Table 17-8. Address Frame Numbers			
System Assy / Unit	**Address**		
	-	↓A7	A0↓
Reserved	00	0000	0000
14-Pack Output Assy Pos #1	01	0000	0001
Reserved	02	0000	0010
14-Pack Output Assy Pos #3	03	0000	0011
06-Pack Output Assy Pos #4	04	0000	0100
06-Pack Output Assy Pos #1	05	0000	0101
06-Pack Output Assy Pos #2	06	0000	0110
06-Pack Output Assy Pos #3	07	0000	0111
Reserved	08	0000	1000
Input Assy #1	09	0000	1001
Input Assy #2	10	0000	1010
Input Assy #3	11	0000	1011
Input Assy #4	12	0000	1100
Input Assy #5	13	0000	1101
Reserved	14	0000	1110
Cabinet monitor unit	15	0000	1111
Reserved	16	0001	0000
Reserved	17	0001	0001
Reserved	18	0001	0010
2070-1 CPU	19	0001	0011
2070-2 FI/O	20	0001	0100
Addresses 21–254 are reserved			
Broadcast to all	255	1111	1111

Each device attached to SB1 is responsible for transmitting frames. Frames transmitted by the CU are referred to as command frames and frames transmitted by devices within the cabinet are referred to as response frames.

17.2.1   Command Frames

The transmission of SB1 command frames is controlled by the CU. The CU transmits all frame types within a one-second window, with the window repeating itself in a cyclical manner every second that the CU is operating.

Table 17-9. Command Frames			
Type	**Dest.**	**Address.**	**Function**
49			Module status
50			MC management
51			Configure inputs
52			Raw input data
53			Filtered input data
54			Input transition buffer
55			Set outputs
56			Configure input tracking
57			Configure complex output
58			Reserved
59			Reserved
60			Module ID
61			Switch pack drivers
62			Set FSA
63			Reserved
64			Reserved
65			Get CMU configuration
66	All	255	Time and date
67			Switch pack drivers

17.2.1.1   Command Frame Timing

Each frame type has a defined frequency of transmission. If the command frames are required to be transmitted, as determined by CU programming, the frequency of transmission is as shown in Table 17-10.

Table 17-10. SB1 Command Frames				
Type	**Dest.**	**Address**	**Frequency**	**Function**
49	SIU	Mult.	Occ.	Module status
50	SIU	Mult.	Occ.	MC management
51	SIU	Mult.	Occ.	Configure inputs
52	SIU	Mult.	—	Raw input data
53	SIU	Mult.	10x Sec	Filtered input data
54	SIU	Mult.	10x Sec	Input transition buffer
55	SIU	Mult.	10x Sec	Set outputs
56	SIU	Mult.	—	Configure input tracking
57	SIU	Mult.	—	Configure complex output
58	2070-2E	20	Occ.	Configure watchdog (-2x only)
59	—	—	—	Reserved
60	SIU, CMU	Mult.	Occ.	Module ID
61	CMU	15	—	Switch pack drivers (long)
62	CMU	15	Occ.	Set Failed State Action (FSA)
63	—	—	—	Reserved
64	—	—	—	Reserved
65	CMU	15	Occ.	CMU configuration
66	All	255	1x Sec	Time and date
67	CMU	15	10x Sec	Switch pack drivers (short)

17.2.1.2   Command Frame Scheduling

The one-second window, during which time all frame types is transmitted, is divided into ten 100-millisecond windows.

The scheduling of the transmission of frames is such that they are transmitted in the order shown in Table 17-11 for each of the one-second windows.

Table 17-11. Command Frame Scheduling			
Win	**Type**	**Dest**	**Function**
1	66	ALL	Date and time broadcast
	55	1	Set outputs
	53	1	Filtered input data
	54	1	Input transition buffer
	55	3	Set outputs
	53	9	Filtered input data
	54	9	Input transition buffer
	55	9	Set outputs
	53-55	—	Repeated for each active Input Assembly
	67	15	Switch pack drivers (short)
2	55	1	Set outputs
	53	1	Filtered input data
	54	1	Input transition buffer
	55	3	Set outputs
	53	9	Filtered input data
	54	9	Input transition buffer
	55	9	Set outputs
	53-55	—	Repeated for each active Input Assembly
	67	15	Switch pack drivers (short)
3			Repeat Window 2
4			Repeat Window 2
5			Repeat Window 2
6			Repeat Window 2
7			Repeat Window 2
8			Repeat Window 2
9			Repeat Window 2
10			Repeat Window 2

17.2.2   Response Frames

Response frames are only transmitted as a result of receiving a command frame.

Table 17-12. Response Frames			
Type	**Source**	**Address.**	**Function**
177			Ack 49 – Module status
178			Ack 50 – MC management
179			Ack 51 – Configure inputs
180			Ack 52 – Raw input data
181			Ack 53 – Filtered input data
182			Ack 54 – Input transition buffer
183			Ack 55 – Set outputs
184			Ack 56 – Config input tracking
185			Ack 57 – Config complex outputs
186			Ack 58 – Reserved
187			Ack 59 – Reserved
188			Ack 60 – Module ID
189			Ack 61 – CMU status
190			Ack 62 – Set FSA
191			Ack 63 – Reserved
192			Ack 64 – Reserved
193			Ack 65 – CMU configuration
194	---	---	Not used
195			Ack 67 – CMU short status

17.2.3   Serial Bus #1 Frames

The detailed formats for the information fields of the frame types summarized above are included in the following sections.

17.2.3.1   Type 49 – Module Status

This command frame is sent when module status is needed.

Table 17-13. Type 49 Module Status		
Byte	**Contents**	**Description**
1	49	Frame type
2	Reset status	Reset system status bits: Bit 7 – SIU hardware reset Bit 6 –Communications loss > two sec Bit 5 – Not used Bit 4 –SCC RX error count roll over Bit 3 –SCC TX error count roll over Bit 2 –MC interrupt error Bit 1 –Linesync error Bit 0 –SIU watchdog reset

A 1 in a reset system status bit will reset the respective status, and the response frame will report the current status. The SCC error count bytes do not reset. When a count rolls over (255–0), the corresponding roll-over bit is set.

17.2.3.2 Type 177 – Module Status

This frame is the ACK for a Type 49 command frame.

<table>
<tr><td colspan="3">Table 17-14. Type 177 Module Status</td></tr>
<tr><td>Byte</td><td>Contents</td><td>Description</td></tr>
<tr><td>1</td><td>177</td><td>Frame type</td></tr>
<tr><td>2</td><td>System status</td><td>System status bits:
    Bit 7 – SIU hardware reset
    Bit 6 – Communications loss > 2 sec
    Bit 5 – Not used
    Bit 4 – SCC RX error count roll over
    Bit 3 – SCC TX error count roll over
    Bit 2 – MC interrupt error
    Bit 1 – Linesync error
    Bit 0 – SIU watchdog reset</td></tr>
<tr><td>3</td><td>Receive errors</td><td>SCC receive error count</td></tr>
<tr><td>4</td><td>Transmit errors</td><td>SCC transmit error count</td></tr>
<tr><td>5</td><td>Timestamp MSB</td><td>MC timestamp MSB</td></tr>
<tr><td>6</td><td>Timestamp NMSB</td><td>MC timestamp NMSB</td></tr>
<tr><td>7</td><td>Timestamp NLSB</td><td>MC timestamp NLSB</td></tr>
<tr><td>8</td><td>Timestamp LSB</td><td>MC timestamp LSB</td></tr>
</table>

Each of the system status bits are individually reset by a 1 in the corresponding bit of any subsequent request module status frame, and the response frame will report the current status bits. The SCC error count bytes will not be reset. When a count rolls over (255–0), its corresponding roll-over flag is set.

17.2.3.3   Type 50 – MC Management

This frame is used to set the value of the millisecond counter.

Table 17-15. Type 50 MC Management		
Byte	**Contents**	**Description**
1	50	Frame type
2	New MSB	New MC timestamp MSB
3	New NMSB	New MC timestamp NMSB
4	New NLSB	New MC timestamp NLSB
5	New LSB	New MC timestamp LSB

17.2.3.4   Type 178 – MC Management

This frame is the ACK for a Type 50 command frame.

Table 17-16. Type 178 MC Management		
Byte	**Contents**	**Description**
1	178	Frame type

2	Status	Status bits
		    Bit 7-1 = Not used
		    Bit 0 = Status

The Status bit returns a 0 on completion or 1 on error. The 32-bit value is loaded into the millisecond counter at the next 0–1 transition of the LINESYNC signal.

17.2.3.5 Type 51 – Configure Inputs

This frame is used to change input configurations.

Byte	Contents	Description
Table 17-17. Type 51 Configure Inputs		
1	51	Frame type
2	Number of items	Number of items following
3	Input #	Input number Bit 7 – Ignore input flag. 1 – Do not report 0 – Report transitions for input Bit 6-0 – Input # (I0-I59)
4	Leading filter	Leading edge filter Specifies the number of consecutive input samples that must be 0 before the input is considered to have entered to 0 state from 1 state (range 1 to 255, 0 = disabled)
5	Trailing filter	Trailing edge filter Specifies the number of consecutive input samples that must be 1 before the input is considered to have entered to 1 state from 0 state (range 1 to 255, 0 = disabled)
Repeat Bytes 3–4–5 for each Item		

17.2.3.6 Type 179 – Configure Inputs

This frame is the ACK for a Type 51 command frame.

Byte	Contents	Description
Table 17-18. Type 179 Configure Inputs		
1	179	Frame type
2	Status	Status bits Bit 7-1 – Not used Bit 0 – Status

The Status bit returns a 0 on completion or 1 on error.

17.2.3.7   Type 52 –Raw Input Data

This frame is used to poll SIUs for the current unfiltered status of all inputs.

Table 17-19. Type 52 Raw Input Data		
Byte	**Contents**	**Description**
1	52	Frame type

17.2.3.8   Type 180 –Raw Input Data

This frame is the ACK for a Type 52 command frame.

Table 17-20. Type 180 Raw Input Data		
Byte	**Contents**	**Description**
1	180	Frame type
2	Inputs I7–I0	Inputs I7(msb)-I0(lsb)
3	Inputs I15–I8	Inputs I15(msb)-I8(lsb)
4	Inputs I23–I16	Inputs I23(msb)-I16(lsb)
5	Inputs I31–I24	Inputs I31(msb)-I24(lsb)
6	Inputs I39–I32	Inputs I39(msb)-I32(lsb)
7	Inputs I47–I40	Inputs I47(msb)-I40(lsb)
8	Inputs I55–I48	Inputs I55(msb)-I48(lsb)
9	Inputs I59–I56	Inputs I59(msb)-I56(lsb)
10	MC Time MSB	MC timestamp MSB
11	MC Time NMSB	MC timestamp NMSB
12	MC Time NLSB	MC timestamp NLSB
13	MC Time LSB	MC timestamp LSB

The Input bit returns a 0 for not active or 1 for active.

17.2.3.9   Type 53 –Filtered Input Data

This frame is used to poll SIUs for the current filtered status of all inputs.

Table 17-21. Type 53 Filtered Input Data		
Byte	**Contents**	**Description**
1	53	Frame type

17.2.3.10   Type 181 –Filtered Input Data

This frame is the ACK for a Type 53 command frame.

Table 17-22. Type 181 Filtered Input Data		
Byte	**Contents**	**Description**
1	181	Frame type
2	Inputs I7–I0	Inputs I7(msb)-I0(lsb)
3	Inputs I15–I8	Inputs I15(msb)-I8(lsb)
4	Inputs I23–I16	Inputs I23(msb)-I16(lsb)
5	Inputs I31–I24	Inputs I31(msb)-I24(lsb)
6	Inputs I39–I32	Inputs I39(msb)-I32(lsb)
7	Inputs I47–I40	Inputs I47(msb)-I40(lsb)
8	Inputs I55–I48	Inputs I55(msb)-I48(lsb)
9	Inputs I59–I56	Inputs I59(msb)-I56(lsb)
10	MC Time MSB	MC timestamp MSB
11	MC Time NMSB	MC timestamp NMSB
12	MC Time NLSB	MC timestamp NLSB
13	MC Time LSB	MC timestamp LSB

The Input bit returns a 0 for not active or 1 for active. Raw input data is provided for inputs that are not configured for filtering.

17.2.3.11   Type 54 –Input Transition Buffer

This frame is used to poll SIUs for the contents of the input transition buffer.

Table 17-23. Type 54 Input Transition Buffer		
Byte	**Contents**	**Description**
1	54	Frame type
2	Block number	Block number

The block number is a monotonically increasing number incremented after each command issued by the controller unit.

17.2.3.12 Type 182 –Input Transition Buffer

This frame is the ACK for a Type 54 command frame.

Byte	Contents	Description
Table 17-24. Type 182 Input Transition Buffer		
1	182	Frame type
2	Block number	Block number
3	Number of items	Number of items to follow
4	Item #	Item # plus state: Bit 7 – State of the Input after the transition: 1 – Active 0 – Not active Bit 6-0 – Input # (I0–I59)
5	MC Time NLSB	MC time NLSB
6	MC Time LSB	MC time LSB
7	Status	Status Bit 7-4 – Not used (=0) Bit 3 – 255 entry buffer limit exceeded Bit 2 – 1024 buffer limit exceeded Bit 1 – Same block # requested Bit 0 – Block # is out of sequence
8	MC Time MSB	MC timestamp MSB
9	MC Time NMSB	MC timestamp NMSB
10	MC Time NLSB	MC timestamp NLSB
11	MC Time LSB	MC timestamp LSB
Repeat Bytes 4–11 for each Item		

Each detected state transition for each active input is placed in the queue as it occurs.

17.2.3.13 Type 55 – Set Outputs

This frame is used to command SIUs to set the outputs according to the data in the frame.

Table 17-25. Type 55 Set Outputs		
Byte	**Contents**	**Description**
1	55	Frame type
2	Output O7–O0	Output O7(msb)–O0(lsb) Data
3	Output O15–O8	Output O15(msb)–O8(lsb) Data
4	Output O23–O16	Output O23(msb)–O16(lsb) Data
5	Output O31–O24	Output O31(msb)–O24(lsb) Data
6	Output O39–O32	Output O39(msb)–O32(lsb) Data
7	Output O47–O40	Output O47(msb)–O40(lsb) Data
8	Output O55–O48	Output O55(msb)–O48(lsb) Data
9	Output O59–O56	Output O59(msb)–O56(lsb) Data
10	Output O7–O0	Output O7(msb)–O0(lsb) Control
11	Output O15–O8	Output O15(msb)–O8(lsb) Control
12	Output O23–O16	Output O23(msb)–O16(lsb) Control
13	Output O31–O24	Output O31(msb)–O24(lsb) Control
14	Output O39–O32	Output O39(msb)–O32(lsb) Control
15	Output O47–O40	Output O47(msb)–O40(lsb) Control
16	Output O55–O48	Output O55(msb)–O48(lsb) Control
17	Output O59–O56	Output O59(msb)–O56(lsb) Control

17.2.3.14   Type 183 – Set Outputs

This frame is the ACK for a Type 55 command frame.

Table 17-26. Type 183 Set Outputs		
Byte	**Contents**	**Description**
1	183	Frame type

2	Status	Status bits
		    Bit 7-2 – Not used
		    Bit 1 – Linesync lost
		    Bit 0 – Error in setting output

Each status bit returns a 0 for no error or 1 for error.

17.2.3.15　　　　　　　Type 56 – Configure Input Tracking

This frame is used to configure the definition for an output that responds to transitions on a particular input. The maximum number of active definitions is eight.

Byte	Contents	Description
	Table 17-27. Type 56 Configure Input Tracking	
1	56	Frame type
2	Number of items	Number of items: 0–16 Tracking definitions in this message.
3	Output #	Output # 　Bit 7 – Enable input tracking: 　　1 – Enable 　　0 – Remove 　Bit 6-0 – Output # (O0-O54)
4	Input #	Input # 　Bit 7 – Tracking: 　　1 – Output OFF = Input ON 　　0 – Output ON = Input ON 　Bit 6-0 – Input # (I0-I59)
Repeat bytes 3 and 4 for each item		

17.2.3.16　　　　　　　Type 184 – Configure Input Tracking

This frame is the ACK for a Type 56 command frame.

Byte	Contents	Description
	Table 17-28. Type 184 Configure Input Tracking	
1	184	Frame type
2	Status	Status bits 　Bit 7-1 – Not used (=0) 　Bit 0 – Status
3	MC Time MSB	MC timestamp MSB
4	MC Time NMSB	MC timestamp NMSB
5	MC Time NLSB	MC timestamp NLSB
6	MC Time LSB	MC timestamp LSB

The Status bit returns a 0 for NO error or 1 when the maximum number of configurable outputs will be exceeded.

17.2.3.17   Type 57 – Configure Complex Output

This frame is used to configure the definition for an output that provides a complex operation. The maximum number of active definitions is eight.

Byte	Contents	Description
	Table 17-29. Type 57 Configure Complex Output	
Byte	**Contents**	**Description**
1	56	Frame type
2	Number of items	Number of items: 0–16 Complex output definitions in message
3	Output #	Output # Bit 7 = Not used (=0) Bit 6-0 = Output # (O0-O54)
4	Pri Duration MSB	Primary duration MSB
5	Pri Duration LSB	Primary duration LSB
6	Sec Duration MSB	Secondary duration MSB
7	Sec Duration LSB	Secondary duration LSB
8	Input #	Input # Bit 7 = Not used (=0) Bit 6-0 = Input # (I0–I59)

Table 17-29. Type 57 Configure Complex Output		
Byte	**Contents**	**Description**

9	Field Definition	Field Definition:
		Bit 7
		    1 – Output configured for single-pulse operation.
		    0 – Output configured for continuous oscillation
		Bit 6
		    1 – Triggered by the specific input.
		    0 –Begins within 2 mSec of command.
		Bit 5
		    1 – Gated active by the specific input.
		    0 – Gating is inactive.
		Bit 4
		    1 – Enable complex output function for this output.
		    0 – Remove complex output function for this output
		Bit 3
		    1 – During Primary = logic 1 during Secondary = 0.
		    0 – During Primary = logic 0 during Secondary = 1.
		Bit 2
		    1 – Trigger or gate derived from filtered input.
		    0 – Trigger or gate derived from raw input.
		Bit 1
		    1 – Triggered outputs are triggered by an On-to-Off transition of the specified input and shall be triggered immediately upon command receipt if the input is Off. Gated outputs are active while the input is Off.
		    0 – Triggered outputs are triggered by an Off-to-On transition of the specified input and shall be triggered immediately upon command receipt if the input is On. Gated outputs are active while the input is On.
		Bit 0

Table 17-29. Type 57 Configure Complex Output		
Byte	**Contents**	**Description**
		1 – Linesync based clock used for time ticks. 0 – MC used for time ticks.
Repeat bytes 3-9 for each item.		

17.2.3.18   Type 185 - Configure Complex Output

This frame is the ACK for a Type 57 command frame.

Table 17-30. Type 185 Configure Complex Output		
Byte	**Contents**	**Description**
1	185	Frame type

2	Status	Status bits
		    Bit 7-1 = Not used (=0)
		    Bit 0 = Status

3	MC Time MSB	MC timestamp MSB
4	MC Time NMSB	MC timestamp NMSB
5	MC Time NLSB	MC timestamp NLSB
6	MC Time LSB	MC timestamp LSB

The Status bit returns a 0 for NO error or 1 when the maximum number of configurable outputs will be exceeded.

17.2.3.19   Type 60 – Module ID

The destination of this frame is the CMU.

Table 17-31. Type 60 Module ID		
Byte	**Contents**	**Description**
1	60	Frame type

17.2.3.20   Type 188 – Module ID

This frame is the ACK for a Type 60 command frame.

Table 17-32. Type 188 Module ID		
Byte	**Contents**	**Description**
1	188	Frame type
2	SB1 address	Serial Bus #1 address

17.2.3.21   Type 61 – Switch Pack Drivers

The destination of this frame is the CMU. The channel numbers in the contents column below refer to the channel numbers of the CMU. The Yunex Traffic SEPAC includes program entries of load switch numbers, which correspond to these channel numbers. The dark channel map select bits select a preprogrammed mask in the CMU DATAKEY that disables lack of signal input monitoring for the selected channels.

Table 17-33. Type 61 Switch Pack Drivers		
Byte	**Contents**	**Description**
1	61	Frame type
2	Chn 8:1 red	Load switch status.
3	Chn 16:9 red	A bit set to 1 indicates the load switch output is set On.
4	Chn 24:17 red	
5	Chn 28:25 red	
6	Chn 8:1 yel	
7	Chn 16:9 yel	
8	Chn 24:17 yel	
9	Chn 28:25 yel	
10	Chn 8:1 grn	
11	Chn 16:9 grn	
12	Chn 24:17 grn	
13	Chn 28:25 grn	

14	Map select	Dark channel map select
		Bits 7-2 – Reserved
		Bits1-0 – Select dark channel map
		    00 – Mask #1
		    01 – Mask #2
		    10 – Mask #3
		    11 – Mask #4

Dark channel maps are programmed in the serial memory key that disables lack of signal input monitoring for a selected channel.

17.2.3.22   Type 189 – CMU Status

If the CMU is in failed state action (Byte #2, fault type not equal to 0), all bytes of the information field of this frame except Control Status 1, Control Status 2, and Output Assembly Flasher Status will contain an exact image of the signals that were applied to the CMU at the point in time of the detection of the failure. Control Status 1, Control Status 2, and Output Assembly Flasher Status will always reflect current status. If a channel block is not used (AMU not present) the Channel Fault Status bits, Channel Input Status bits, and Channel Input Voltage Values bits for that block will be set to 0.

Table 17-34. Type 189 CMU Status		
Byte	**Contents**	**Description**
1	189	Frame type
2	Fault type	Enumerated fault code 00 – No Fault 01 – CMU/AMU +24VDC 02 – CMU +12VDC 03 – Conflict 04 – Serial Bus #1 05 – Serial Bus #3 06 – ATC LFSA Flash (Type 62) 07 – ATC NFSA Flash (Type 62) 08 – Diagnostic 09 – Multiple Indications 10 – Lack of Signal Input 11 – Short Yellow Clearance 12 – Skipped Yellow Clearance 13 – Yellow + Red Clearance 14 – Field Output Check 15 – Serial Mem Key Absent 16 – Serial Mem Key FCS Error 17 – Serial Mem Key Data Error 18 – Local Flash 19 – CB Trip 20 – CMU/AMU AC+ Raw Fail 21 – NRESET Active 22:127 – Reserved 128:255 – Spare
3	Chn Fault 8:1	Channel fault status
4	Chn Fault 16:9	Channel Fault Status bits will be set to 1 for channels that were detected in fault for fault types 03, 09, 10, 11, 12, 13, and 14.
5	Chn Fault 24:17	
6	Chn Fault 32:25	For fault type 01, 05, and 20 a bit will be set in Channel Fault Status 8:1 for each enabled AMU that failed. Bit 0 will be set if the CMU detected a failure: b0 – CMU b1 – AMU #1 b2 – AMU #2

Table 17-34. Type 189 CMU Status		
Byte	**Contents**	**Description**
		b3 – AMU #3 b4 – AMU #4 For all other fault types, the Channel Fault Status bits will be set to 0.
7	Chn Red 8:1	Channel color status
8	Chn Red 16:9	Channel Color Status bits will be set to 1 for channels that are sensed active. For channel inputs that have been remapped to a virtual channel (29–32), the Channel Fault Status bits will be set to 0. For virtual channel (29–32) inputs that have not been assigned to a physical output, the Channel Fault Status bits will be set to 0.
9	Chn Red 24:17	
10	Chn Red 32:25	
11	Chn Yellow 8:1	
12	Chn Yellow 16:9	
13	Chn Yellow 24:17	
14	Chn Yellow 32:25	
15	Chn Green 8:1	
16	Chn Green 16:9	
17	Chn Green 24:17	
18	Chn Green 32:25	
19	Chn Red 8:1	Channel field check status
20	Chn Red 16:9	Field Check Status bits will be set to 1 for channels that are sensed with field check status. For channel inputs that have been remapped to a virtual channel (29–32), the Field Check Status bits will be set to 0. For virtual channel (29–32) inputs that have not been assigned to a physical output, the Field Check Status bits will be set to 0.
21	Chn Red 24:17	
22	Chn Red 32:25	
23	Chn Yellow 8:1	
24	Chn Yellow 16:9	
25	Chn Yellow 24:17	
26	Chn Yellow 32:25	
27	Chn Green 8:1	
28	Chn Green 16:9	
29	Chn Green 24:17	
30	Chn Green 32:25	
31	Control Status #1	Control Status #1 b7 – Start-up call (1=Exit from flash) b6 – Flasher output fail (1 = Fail)

Table 17-34. Type 189 CMU Status		
Byte	**Contents**	**Description**
		b5 – Rear door (1=Open) b4 – Front door (1=Open) b3 – Main contactor coil (1=Active) b2 – Main contactor secondary (1=Active) b1 – FTR coil drive (1= Active) b0 – Output relay transfer (1=Fault)
32	Control Status #2	Control Status #2 b7 – Reserved b6 – Reserved b5 – Reserved b4 – Reserved b3 – Reserved b2 – Reserved b1 – Reserved b0 – Configuration change This bit set to 1 indicates the configuration programming has changed since the last poll of Message 65. It will also be set to 1 when the CMU is exiting flash (start-up call bit changes from 0 to 1) and at CMU power-up.
33	AC+ Raw voltage	CMU AC+ RAW voltage
34	Assy #1 AC+ Raw	Assembly AC+ RAW voltage
35	Assy #2 AC+ Raw	
36	Assy #3 AC+ Raw	
37	Assy #4 AC+ Raw	
38	Chn 1 red voltage	Channel input voltages The channel input voltages will be the most recent values reported from the AMUs. For channel inputs that have been remapped to a virtual channel (29–32), the channel voltage value will be set to 0. For virtual channel (29–32) inputs that have not been assigned to a physical output, the channel voltage value will be set to 0.
39	Chn 2 red voltage	
40	Chn 3 red voltage	
41	Chn 4 red voltage	
42	Chn 5 red voltage	
43	Chn 6 red voltage	
44	Chn 7 red voltage	
45	Chn 8 red voltage	

Table 17-34. Type 189 CMU Status		
Byte	**Contents**	**Description**
46	Chn 9 red voltage	
47	Chn 10 red voltage	
48	Chn 11 red voltage	
49	Chn 12 red voltage	
50	Chn 13 red voltage	
51	Chn 14 red voltage	
52	Chn 15 red voltage	
53	Chn 16 red voltage	
54	Chn 17 red voltage	
55	Chn 18 red voltage	
56	Chn 19 red voltage	
57	Chn 20 red voltage	
58	Chn 21 red voltage	
59	Chn 22 red voltage	
60	Chn 23 red voltage	
61	Chn 24 red voltage	
62	Chn 25 red voltage	
63	Chn 26 red voltage	
64	Chn 27 red voltage	
65	Chn 28 red voltage	
66	Chn 29 red voltage	
67	Chn 30 red voltage	
68	Chn 31 red voltage	
69	Chn 32 red voltage	
70	Chn 1 yel voltage	Channel input voltages (continued)
71	Chn 2 yel voltage	
72	Chn 3 yel voltage	
73	Chn 4 yel voltage	
74	Chn 5 yel voltage	
75	Chn 6 yel voltage	

Table 17-34. Type 189 CMU Status		
Byte	**Contents**	**Description**
76	Chn 7 yel voltage	
77	Chn 8 yel voltage	
78	Chn 9 yel voltage	
79	Chn 10 yel voltage	
80	Chn 11 yel voltage	
81	Chn 12 yel voltage	
82	Chn 13 yel voltage	
83	Chn 14 yel voltage	
84	Chn 15 yel voltage	
85	Chn 16 yel voltage	
86	Chn 17 yel voltage	
87	Chn 18 yel voltage	
88	Chn 19 yel voltage	
89	Chn 20 yel voltage	
90	Chn 21 yel voltage	
91	Chn 22 yel voltage	
92	Chn 23 yel voltage	
93	Chn 24 yel voltage	
94	Chn 25 yel voltage	
95	Chn 26 yel voltage	
96	Chn 27 yel voltage	
97	Chn 28 yel voltage	
98	Chn 29 yel voltage	
99	Chn 30 yel voltage	
100	Chn 31 yel voltage	
101	Chn 32 yel voltage	
102	Chn 1 grn voltage	Channel input voltages (continued)
103	Chn 2 grn voltage	
104	Chn 3 grn voltage	
105	Chn 4 grn voltage	

Table 17-34. Type 189 CMU Status		
Byte	**Contents**	**Description**
106	Chn 5 grn voltage	
107	Chn 6 grn voltage	
108	Chn 7 grn voltage	
109	Chn 8 grn voltage	
110	Chn 9 grn voltage	
111	Chn 10 grn voltage	
112	Chn 11 grn voltage	
113	Chn 12 grn voltage	
114	Chn 13 grn voltage	
115	Chn 14 grn voltage	
116	Chn 15 grn voltage	
117	Chn 16 grn voltage	
118	Chn 17 grn voltage	
119	Chn 18 grn voltage	
120	Chn 19 grn voltage	
121	Chn 20 grn voltage	
122	Chn 21 grn voltage	
123	Chn 22 grn voltage	
124	Chn 23 grn voltage	
125	Chn 24 grn voltage	
126	Chn 25 grn voltage	
127	Chn 26 grn voltage	
128	Chn 27 grn voltage	
129	Chn 28 grn voltage	
130	Chn 29 grn voltage	
131	Chn 30 grn voltage	
132	Chn 31 grn voltage	
133	Chn 32 grn voltage	
134	Channel 1	Scaled channel load current
135	Channel 2	

Table 17-34. Type 189 CMU Status		
Byte	**Contents**	**Description**
136	Channel 3	The value reported will be the measured current in Amps times 256 divided by the full scale (FS) parameter.
137	Channel 4	For 1 primary turn, FS–10 (range is 0 to 10 A$_{RMS}$)
138	Channel 5	For 2 primary turns, FS–5 (range is 0 to 5 A$_{RMS}$)
139	Channel 6	For 3 primary turns, FS–3.3 (range is 0 to 3.3 A$_{RMS}$)
140	Channel 7	For 4 primary turns, FS–2.5 (range is 0 to 2.5 A$_{RMS}$)
141	Channel 8	
142	Channel 9	
143	Channel 10	
144	Channel 11	
145	Channel 12	
146	Channel 13	
147	Channel 14	
148	Channel 15	
149	Channel 16	
150	Channel 17	
151	Channel 18	
152	Channel 19	
153	Channel 20	
154	Channel 21	
155	Channel 22	
156	Channel 23	
157	Channel 24	
158	Channel 25	
159	Channel 26	
160	Channel 27	
161	Channel 28	
162	Binary seconds	CMU time and date
163	Binary minutes	
164	Binary hours (0:23)	

Table 17-34. Type 189 CMU Status		
Byte	**Contents**	**Description**
165	Binary date	
166	Binary month	
167	Binary year	
168	Voltage * 4	24 VDC supply voltage
169	Voltage * 8	12 VDC supply voltage
170	Degrees F + 40	CMU temperature (Fahrenheit)
171	Channel 8:1	Channel current sense status
172	Channel 16:9	Status bits will be set to 1 for channels that are sensed active. Status bits will be set to 0 for channels that have the current sense monitor function disabled.
173	Channel 24:17	
174	Channel 28:25	
175	Assembly 2:1	Output assembly flasher status (1=Fail)
176	Assembly 4:3	b0 – Assembly #1 (#3) FL1-1 b1 – Assembly #1 (#3) FL1-2 b2 – Assembly #1 (#3) FL2-1 b3 – Assembly #1 (#3) FL2-2 b4 – Assembly #2 (#4) FL1-1 b5 – Assembly #2 (#4) FL1-2 b6 – Assembly #2 (#4) FL2-1 b7 – Assembly #2 (#4) FL2-2
177		Reserved
178		Reserved

17.2.4   Type 62 – Set FSA

The destination of this frame is the CMU.

Table 17-35. Type 62 Set FSA		
Byte	**Contents**	**Description**
1	62	Frame message

2	FSA mode	Set failed state action
		    b0 – Set LFSA (Latching)
		    b1 – Set NFSA (Non-latching)

Table 17-35. Type 62 Set FSA		
Byte	Contents	Description
		b2:7 – reserved

LFSA – CMU latched failed state action

NFSA – CMU non-latched fail state action

17.2.4.1 Type 190 – Set FSA

This frame is the ACK for a Type 62 command frame.

Table 17-36. Type 190 Set FSA		
Byte	Contents	Description
1	190	Frame message

17.2.4.2 Type 65 - Get CMU Configuration

The 2070LX ATC will request the serial memory key programming using this message and validate that the CMU permissive program settings are equal or less permissive than the 2070LX ATC programming, and that the AMU configuration programming is consistent with output assembly SIU assignment. If the programming of the CMU is not proper, the 2070LX ATC will issue a Type 62 frame with the L bit set causing a LFSA in the CMU. This check will be performed at 2070LX ATC initialization and when the Type 189 or Type 195 Control Status 2, Configuration Change bit is set to 1.

Table 17-37. Type 65 Get CMU Configuration		
Byte	Contents	Description
1	65	Frame message

17.2.4.3 Type 193 - CMU Configuration

This frame is the ACK for a Type 65 command frame.

Table 17-38. Type 193 CMU Configuration		
Byte	**Contents**	**Description**
1	193	Frame message
2:513	Bytes 1 thru 512	Serial memory key contents

Serial Memory Key Content

Table 17-39. Serial Memory Key Content		
Byte	**Contents**	**Description**
1	0x01	Serial memory key version
2	Ch 1–9 1–2	Permissive program for Ch 1–32
3	Ch 1–17 1–10	A bit set to 1 programs a channel pair to the permissive state. In the event the CMU has fewer than 32 channels, the bit positions corresponding to the nonexistent channels will be 0.
4	Ch 1–25 1–18	
5	Ch 2–3 1–26	
6	Ch 2–11 2–4	Default programming will be 0.
7	Ch 2–19 2–12	The contents parameter contains on channel pair per bit position. For example, the contents of byte #5, Ch 2–3, ..., 1–26, is as follows:
8	Ch 2–27 2–20	
9	Ch 3–6 2–28	b0 – Channel pair 1–26
10	Ch 3–14 3–7	b1 – Channel pair 1–27
11	Ch 3–22 3–15	b2 – Channel pair 1–28
12	Ch 3–30 3–23	b3 – Channel pair 1–29
13	Ch 4–10 3–31	b4 – Channel pair 1–30
14	Ch 4–18 4–11	b5 – Channel pair 1–31
15	Ch 4–26 4–19	b6 – Channel pair 1–32
16	Ch 5–7 4–27	b7 – Channel pair 2–3
17	Ch 5–15 5–8	If b1 is set, Channel 1 is permissive with channel 27.
18	Ch 5–23 5–16	
19	Ch 5–31 5–24	
20	Ch 6–13 5–32	
21	Ch 6–21 6–14	

Byte	Contents	Description
	Table 17-39. Serial Memory Key Content	
22	Ch 6–29 6–22	
23	Ch 7–12 6–30	
24	Ch 7–20 7–13	
25	Ch 7–28 7–21	
26	Ch 8–12 7–29	
27	Ch 8–20 8–13	
28	Ch 8–28 8–21	
29	Ch 9–13 8–29	
30	Ch 9–21 9–14	
31	Ch 9–29 9–22	
32	Ch 10–15 9–30	
33	Ch 10–23 10–16	
34	Ch 10–31 10–24	
35	Ch 11–18 10–32	
36	Ch 11–26 11–19	
37	Ch 12–14 11–27	
38	Ch 12–22 12–15	
39	Ch 12–30 12–23	
40	Ch 13–19 12–31	
41	Ch 13–27 13–20	
42	Ch 14–17 13–28	
43	Ch 14–25 14–18	
44	Ch 15–16 14–26	
45	Ch 15–24 15–17	
46	Ch 15–32 15–25	
47	Ch 16–24 16–17	
48	Ch 16–32 16–25	
49	Ch 17–25 17–18	
50	Ch 18–19 17–26	
51	Ch 18–27 18–20	

| Table 17-39. Serial Memory Key Content |||
Byte	Contents	Description
52	Ch 19–22 18–28	
53	Ch 19–30 19–23	
54	Ch 20–26 19–31	
55	Ch 21–23 20–27	
56	Ch 21–31 21–24	
57	Ch 22–29 21–32	
58	Ch 23–28 22–30	
59	Ch 24–28 23–29	
60	Ch 25–29 24–29	
61	Ch 26–31 25–30	
62	Ch 28–30 26–32	
63	Ch 31–32 28–31	
64	Ch 8:1	Lack of signal input enable:
65	Ch 16:9	A bit set to 1 enables the lack of signal input monitoring function for that channel. This bit will be set to 0 for any channel that has an input mapped to a virtual channel. In the event the CMU has fewer than 32 channels, the bit positions corresponding to the nonexistent channels will be 0. Default programming will be 1.
66	Ch 24:17	
67	Ch 32:25	
68	Ch 8:1	Dark Channel Map #1
69	Ch 16:9	Bit – 1; disables the lack of signal input (LOSI) monitoring function for the channel.
70	Ch 24:17	Bit – 0; LOSI enable programming determines LOSI operation.
71	Ch 32:25	Default programming will be 0.
72	Ch 8:1	Dark Channel Map #2
73	Ch 16:9	See Dark Channel Map #1.
74	Ch 24:17	
75	Ch 32:25	
76	Ch 8:1	Dark Channel Map #3
77	Ch 16:9	See Dark Channel Map #1.
78	Ch 24:17	

Table 17-39. Serial Memory Key Content		
Byte	**Contents**	**Description**
79	Ch 32:25	
80	Ch 8:1	Dark Channel Map #4 See Dark Channel Map #1.
81	Ch 16:9	
82	Ch 24:17	
83	Ch 32:25	
84	Ch 8:1	GY multiple channel enable: A bit set to 1 enables the green/yellow multiple channel monitoring function for that channel. This bit shall be set to 0 for any channel that has had a green or yellow input remapped to a virtual channel. In the event the CMU has fewer than 32 channels, the bit positions corresponding to the nonexistent channels will be 0. Default programming will be 1.
85	Ch 16:9	
86	Ch 24:17	
87	Ch 32:25	
88	Ch 8:1	YR multiple channel enable: A bit set to 1 enables the yellow/red multiple channel monitoring function for that channel. This bit will be set to 0 for any channel that has had a yellow or red input remapped to a virtual channel. In the event the CMU has fewer than 32 channels, the bit positions corresponding to the nonexistent channels will be 0. Default programming is 1.
89	Ch 16:9	
90	Ch 24:17	
91	Ch 32:25	
92	Ch 8:1	GR multiple channel enable: A bit set to 1 enables the green/red multiple channel monitoring function for that channel. This bit shall be set to 0 for any channel that has had a green or red input remapped to a virtual channel. In the event the CMU has fewer than 32 channels, the bit positions corresponding to the nonexistent channels will be 0. Default programming will be 1.
93	Ch 16:9	
94	Ch 24:17	
95	Ch 32:25	
96	Ch 8:1	Minimum yellow change enable: A bit set to 1 enables the minimum yellow change monitoring function for that channel. In the event the CMU has fewer than 32 channels, the bit positions corresponding to the nonexistent channels shall be 0. Default programming will be 1.
97	Ch 16:9	
98	Ch 24:17	
99	Ch 32:25	
100	Ch 8:1	Minimum yellow change + red clear enable:
101	Ch 16:9	

Table 17-39. Serial Memory Key Content		
Byte	**Contents**	**Description**
102	Ch 24:17	A bit set to 1 enables the minimum yellow change plus red monitoring function for that channel. In the event the CMU has fewer than 32 channels, the bit positions corresponding to the nonexistent channels will be 0. Default programming will be 1.
103	Ch 32:25	
104	Ch 8:1	Yellow input disable:
105	Ch 16:9	A bit set to 1 forces the yellow input to the Off state for that channel. In the event the CMU has fewer than 28 physical channels, the bit positions corresponding to the nonexistent channels will be 0. Default programming will be 0.
106	Ch 24:17	
107	Ch 32:25	
108	Ch 8:1	Current sense enable:
109	Ch 16:9	A bit set to 1 enables the lack of indication current monitoring function for that channel. This bit will be set to 0 for any channel that has an input mapped to a virtual channel. In the event the CMU has fewer than 28 physical channels, the bit positions corresponding to the nonexistent channels shall be 0. Default programming will be 1.
110	Ch 24:17	
111	Ch 28:25	
112	Ch 4:1	Current sense full scale parameter
113	Ch 8:5	These bits define the FS parameter for the current sense circuit for each channel. Default programming will be 00.
114	Ch12:9	
115	Ch16:13	b1,b0 – Channel n
116	Ch20:17	b3,b2 – Channel n+1
117	Ch24:21	b5,b4 – Channel n+2
118	Ch28:25	b7,b6 – Channel n+3
		00 – .25 Amps
		01 – .33 Amps
		10 – .50 Amps
		11 – 1.0 Amps
119	Channel 1	Channel current sense threshold
120	Channel 2	The threshold value for channel current sense shall be programmed in percent (0 to 95) of full scale (FS). Default programming will be 25 (25% of 1.0 Amp full scale = 250 milliamperes).
121	Channel 3	
122	Channel 4	
123	Channel 5	
124	Channel 6	

Table 17-39. Serial Memory Key Content		
Byte	**Contents**	**Description**
125	Channel 7	
126	Channel 8	
127	Channel 9	
128	Channel 10	
129	Channel 11	
130	Channel 12	
131	Channel 13	
132	Channel 14	
133	Channel 15	
134	Channel 16	
135	Channel 17	
136	Channel 18	
137	Channel 19	
138	Channel 20	
139	Channel 21	
140	Channel 22	
141	Channel 23	
142	Channel 24	
143	Channel 25	
144	Channel 26	
145	Channel 27	
146	Channel 28	
147	Red Ch 8:1	Field output check enable:
148	Red Ch 16:9	A bit set to 1 enables the field output check monitoring function for that input. This bit will be set to 0 for any input that has been remapped to a virtual channel. In the event the CMU has fewer than 32 channels, the bit positions corresponding to the nonexistent inputs will be 0. Default programming will be 1.
149	Red Ch 24:17	
150	Red Ch 32:25	
151	Yel Ch 8:1	
152	Yel Ch 16:9	
153	Yel Ch 24:17	
154	Yel Ch 32:25	

Table 17-39. Serial Memory Key Content

Byte	Contents	Description
155	Grn 8:1	
156	Grn Ch 16:9	
157	Grn Ch 24:17	
158	Grn Ch 32:25	
159	6–15 seconds	Minimum flash time Values of 0 through 5 will result in six seconds of minimum flash. Default programming will be 6.
160	+12 VDC Enable	+12 VDC power supply monitor enable Bit 0 set to 1 will enable the +12 VDC power supply monitor. Default programming will be 0x01.
161	Ch 29 Red	Virtual channel assignment
162	Ch 29 Yellow	Channels that have not been assigned will be set to 0. Default programming will be 0.
163	Ch 29 Green	
164	Ch 30 Red	Bits 4:0 specify the physical channel number (1 to 28)
165	Ch 30 Yellow	
166	Ch 30 Green	Bits 6:5 specify the physical input
167	Ch 31 Red	01 – Red
168	Ch 31 Yellow	10 – Yellow
169	Ch 31 Green	11 – Green
170	Ch 32 Red	Bit 7 – Reserved
171	Ch 32 Yellow	
172	Ch 32 Green	
173	AMU Position 1	AMU configuration
174	AMU Position 2	The number of load switch positions in each output assembly position will be programmed in each byte. CMU channel numbers will be assigned sequentially starting with AMU position #1. Default programming will be 14,0,0,0.
175	AMU Position 3	
176	AMU Position 4	0 – Position not used 6 – Six pack output assembly 14 – Fourteen pack output assembly

Table 17-39. Serial Memory Key Content		
Byte	**Contents**	**Description**
		The 14 pack is valid only for position #1 (#1=14, #2=0) and #3 (#3=14, #4=0). All other values are reserved.
177 | 216	ASCII String	Monitor ID
		A packed 40-character ID will be stored in ASCII format. Allowable characters are 020h through 07Eh. If less than 40 characters are used, the unused locations will be set to 00h. Default programming will be 00h.
217 | 256	ASCII String	User ID
		A packed 40-character ID will be stored in ASCII format. Allowable characters are 020h through 07Eh. If less than 40 characters are used, the unused locations will be set to 00h. Default programming will be 00h.
257 | 510	0x00	Reserved for future use.
511	FCS lsb	16-bit check value
512	FCS msb	FCS polynomial calculation of bytes #1 through #510.

17.2.4.4   Type 66 – Time and Date

This frame will be transmitted from the 2070LX ATC one time every second. The destination address will be the all-station address of 255 (0xFF). No response from secondary devices is allowed to the all-station address. The transmission of this frame shall begin within + 100 milliseconds of the CU real time contained within the frame.

This will ensure that time clocks in all devices in the cabinet have the same time and date. It could also provide basic time keeping capability to devices without the need for hardware RTC and super-cap if appropriate.

Table 17-40. Type 66 Time and Date		
Byte	**Contents**	**Description**
	66	Frame type
	Binary month	Month – 1-12
	Binary day	Day – 1-31
	Binary year	Year – 0-99
	Binary hour	Hour – 0-23
	Binary minute	Minute – 0-59
	Binary second	Second – 0-59
	Binary tenth sec	Tenth Second – 0-9

17.2.4.5 Type 67 – Switch Pack Drivers

The format of this command frame is identical to Message 61 but requests a short status response from the CMU. This frame may be used as an alternate to Message 61. The destination of this frame is the CMU. The channel numbers in the Contents column in Table **16**-**40** refer to the channel numbers of the CMU. The ATC includes a definition, through program entry, of the CMU channel to ATC load switch utilization.

The Dark Channel Map Select bits will select a preprogrammed mask in the CMU serial memory key that disables lack of signal input monitoring for the selected channels.

Table 17-41. Type 67 Switch Pack Drivers		
Byte	**Contents**	**Description**
1	67	Frame Type
2	Chn 8:1 red	Load Switch Status
3	Chn 16:9 red	A bit set to 1 indicates the load switch output is set On.
4	Chn 24:17 red	
5	Chn 28:25 red	
6	Chn 8:1 yellow	
7	Chn 16:9 yellow	
8	Chn 24:17 yellow	
9	Chn 28:25 yellow	
10	Chn 8:1 green	
11	Chn 16:9 green	
12	Chn 24:17 green	
13	Chn 28:25 green	
14	Map select	Dark Channel Map Select
		Bit 1 and bit 0 will select one of four dark channel maps programmed in the serial memory key that disables lack of signal input monitoring for a selected channel. Bits 2 through 7 are reserved.
		00 – Mask #1
		01 – Mask #2
		10 – Mask #3
		11 – Mask #4

17.2.4.6 Type 195 – CMU Short Status

If the CMU is in FSA (Byte #2, fault type not equal to 0), the Channel Color Status bytes will contain an exact image of the signals that were applied to the CMU at the point in time of the detection of the failure. Control Status 1, Control Status 2, and Output Assembly Flasher Status will always reflect current status.

If a channel block is not used (AMU not present) the Channel Fault Status bits and Channel Color Status bits for that block will be set to 0.

Table 17-42. Type 195 CMU Short Status		
Byte	**Contents**	**Description**
1	195	Frame type
2	Fault type	Enumerated Fault Code
		00 – No Fault
		01 – CMU/AMU +24 VDC
		02 – CMU +12 VDC
		03 – Conflict
		04 – Serial Bus #1
		05 – Serial Bus #3
		06 – ATC LFSA Flash (Type 62)
		07 – ATC NFSA Flash (Type 62)
		08 – Diagnostic
		09 – Multiple
		10 – Lack of Signal Input
		11 – Short Yellow Clearance
		12 – Skipped Yellow Clearance
		13 – Yellow + Red Clearance
		14 – Field Output Check
		15 – Serial Memory Key Absent
		16 – Serial Memory Key FCS Error
		17 – Serial Memory Key Data Error
		18 – Local Flash
		19 – CB Trip
		20 – CMU/AMU AC+ RAW Fail
		21 – NRESET Active
		22:127 – Reserved
		128:255 – Spare
3	Chn Fault 8:1	Channel fault status
4	Chn Fault 16:9	Channel Fault Status bits will be set to 1 for channels that were detected in fault for fault types 03, 09, 10, 11, 12, 13, and 14.
5	Chn Fault 24:17	
6	Chn Fault 32:25	For fault type 01, 05, and 20 a bit will be set in Channel Fault Status 8:1 for each enabled AMU that failed. Bit 0 will be set if the CMU detected a failure:

Table 17-42. Type 195 CMU Short Status		
Byte	**Contents**	**Description**
		b0 – CMU b1 – AMU #1 b2 – AMU #2 b3 – AMU #3 b4 – AMU #4 For all other fault types, the Channel Fault Status bits will be set to 0.
7	Chn Red 8:1	Channel color status Channel Color Status bits will be set to 1 for channels that are sensed active. For channel inputs that have been remapped to a virtual channel (29–32), the Channel Fault Status bits will be set to 0. For virtual channel (29–32) inputs that have not been assigned to a physical output, the Channel Fault Status bits will be set to 0.
8	Chn Red 16:9	
9	Chn Red 24:17	
10	Chn Red 32:25	
11	Chn Yellow 8:1	
12	Chn Yellow 16:9	
13	Chn Yellow 24:17	
14	Chn Yellow 32:25	
15	Chn Green 8:1	
16	Chn Green 16:9	
17	Chn Green 24:17	
18	Chn Green 32:25	
19	Control Status #1	Control Status #1 b7 – Start-up call (1=Exit from flash) b6 – Flasher output fail (1 = Fail) b5 – Rear door (1=Open) b4 – Front door (1=Open) b3 – MC coil (1=Active) b2 – MC Secondary (1=Active) b1 – FTR coil drive (1= Active) b0 – Output relay transfer (1=Fault)
20	Control Status #2	Control Status #2 b7 – Reserved b6 – Reserved b5 – Reserved b4 – Reserved

Table 17-42. Type 195 CMU Short Status		
Byte	**Contents**	**Description**
		b3 – Reserved
		b2 – Reserved
		b1 – Reserved
		b0 – Configuration change
		This bit set to 1 indicates the configuration programming has changed since the last poll of Message 65. It will be set to 1 when the CMU is exiting flash (Start-Up Call bit changes from 0 to 1) and at CMU power-up.
21	Assembly 2:1	Output assembly flasher status (1=Fail)
22	Assembly 4:3	b0 – Assembly #1 (#3) FL1–1
		b1 – Assembly #1 (#3) FL1–2
		b2 – Assembly #1 (#3) FL2–1
		b3 – Assembly #1 (#3) FL2–2
		b4 – Assembly #2 (#4) FL1–1
		b5 – Assembly #2 (#4) FL1–2
		b6 – Assembly #2 (#4) FL2–1
		b7 – Assembly #2 (#4) FL2–2
23		Reserved
24		Reserved

18 Flashing Yellow Arrow

18.1   Cabinet Configuration

The most commonly used FYA Configurations for SEPAC standard 8-phase intersections are Mode B and Mode G (NEMA TS 2-2016 Section 4.6). Examples of each are given below.

18.1.1   FYA Mode B Setup

The signal heads for the FYAs should be connected to the outputs in the cabinet as shown in Table 18-1 for NEMA configuration B.

Table 18-1. Signal Head Connections – MMU2 Mode B				
Signal	**Phase 1**	**Phase 3**	**Phase 5**	**Phase 7**
Solid Red Arrow	LDSW 13 Red	LDSW 14 Red	LDSW 15 Red	LDSW 16 Red
Solid Yellow Arrow	LDSW 13 Yellow	LDSW 14 Yellow	LDSW 15 Yellow	LDSW 16 Yellow
Flashing Yellow Arrow	LDSW 13 Green	LDSW 14 Green	LDSW 15 Green	LDSW 16 Green
Solid Green Arrow	LDSW 1 Green	LDSW 3 Green	LDSW 5 Green	LDSW 7 Green

The yellow and red outputs on LDSW 1, 3, 5, and 7 are not connected to any field wiring and should be terminated with load resistors in the cabinet. This corresponds to MMU2 FYA mode B.

18.1.2   FYA Mode G Compact Setup

The signal heads for the FYAs may be driven by the pedestrian yellow output for a compact configuration. This is useful in NEMA 12-channel cabinets or when there are no available overlaps. The signal heads should be connected to the outputs in the cabinet as shown in Table 18-1Table 18-2 for NEMA configuration G.

Table 18-2. Signal Head Connections – MMU2 Mode G				
Signal	**Phase 1**	**Phase 3**	**Phase 5**	**Phase 7**
Solid Red Arrow	LDSW 1 Red	LDSW 3 Red	LDSW 5 Red	LDSW 7 Red
Solid Yellow Arrow	LDSW 1 Yellow	LDSW 3 Yellow	LDSW 5 Yellow	LDSW 7 Yellow
Flashing Yellow Arrow	LDSW 9 Yellow	LDSW 10 Yellow	LDSW 11 Yellow	LDSW 12 Yellow
Solid Green Arrow	LDSW 1 Green	LDSW 3 Green	LDSW 5 Green	LDSW 7 Green

18.2   Controller Configuration

18.2.1   FYA Setup

For more information on configuration for FYA, see Chapter 5.

Verify that Overlaps A-D are mapped to LDSW 13-16, respectively, in F-4-9. Configure the overlap as FYA on F-4-3. On the FYA overlap display, select the protected phase(s) in the PROT PHASES row and the permissive phase(s) in the PERM PHASES row. The example in Figure 18-1 shows the settings for Overlap A.

```
FYA OVERLAP - A          DELAY/10:  50
        PHASES..12345678 90123456
  PERM PHASES: 01000000 00000000
  PROT PHASES: 10000000 00000000
  -PED PHASES: 00000000 00000000
      OVERLAPS..ABCDEFGH IJKLMNOP
PERM OVERLAPS: x0000000 00000000
PROT OVERLAPS: x0000000 00000000
```

Figure 18-1. FYA Overlap Settings Display

For non-compact FYA modes, in F-4-2-1 Flash Settings, verify that the FYA Overlap Load Switches are included in the FLSH row. If they are not, the left-turn heads will be dark during program flash, causing the MMU to latch a red fail and go to cabinet flash. The output may be programmed to flash red or yellow as desired.

```
FLASH SETTINGS        TEST-A AS FLASH: 0

LDSW:123456789 0123456789 0123456789 012
FLSH:111111110 0001000000 0000000000 000
 ALT:000000000 0000000000 0000000000 000

0-DARK  1-RED  2-YELLOW  3-STEADY YELLOW
```

Figure 18-2. FYA Flash Settings

18.2.2   Preemption with FYA

Any time an FYA changes from flashing-yellow to solid yellow, the opposing through movement must simultaneously change from green to yellow or a yellow-trap exists.

For every preempt that includes a protected phase, set the associated overlap for that phase to 5-FG (Flashing Green) in the DWELL row of the Preempt Overlap Status display (F-7-x-5, where x varies based on which preempt is being programmed). Note that the overlap will not actually flash (its output will be steady), but this setting is required or there will be no yellow clearance following the preemption.

For every preempt that includes a permissive phase, set the associated overlap for that phase to 5 if flashing yellow arrow operation is desired or set it to 0 if the left turn should remain red. Note that if 0 is selected, yellow trap must be defeated by forcing the controller to all-red prior to preemption. To avoid confusion and wasted time associated with a force to all-

red, it is recommended to allow FYA operation during emergency vehicle preemption by using the 5 setting.

For a typical setup on Preemptor 3, with Dwell Phases 1 and 6, F-7-4-5 would look like Figure 18-3.

```
PREEMPT 3 OVERLAP STATUS
OVERLAP..A.B.C.D.E.F.G.H.I.J.K.L.M.N.O.P
 TRK GRN 0 4 0 4 4 4 4 4 4 4 4 4 4 4 4 4
 DWELL   5 4 5 4 4 4 4 4 4 4 4 4 4 4 4 4
 CYCLE   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
(0-R.1-G.2-FR.3-FY.4-DK.5-FG|0-NO.1-ACT)
 TRAIL   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

Figure 18-3. Overlap Status Display

Note that both Overlaps A and C are set to 5 in the DWELL row. Overlap A is included because Phase 1 is a Dwell phase and Overlap C is included because Phase 6 is a Dwell phase and FYA operation is active.

When this preempt is active, the intersection will show the indications shown in Figure 18-4.
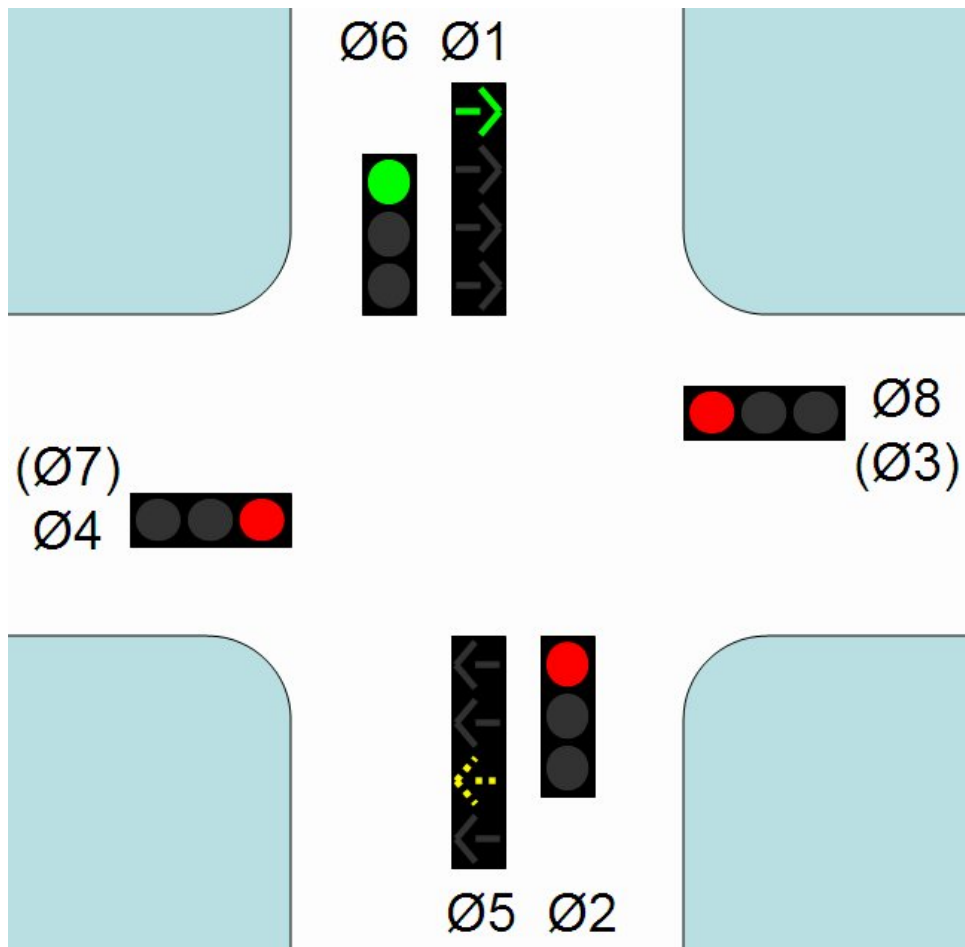
Figure 18-4. Preemption with FYA Example

18.2.3 Time of Day Changes to FYA Operation

Operation mode can be changed by time-of-day, to permissive-only, protected-only, or permitted/protected operation. The following items should be considered:

♦ Make sure detector locations and phase assignments will work for whatever mode is to be used. SEPAC allows time-of-day control of detector phase-switching using phase function mapping.

 More information on this topic can be found in Chapter 2, Section 2.7.10.

♦ Consider any potential issues with preemption/yellow trap.

♦ Do not switch directly from protected-only to permissive-only mode unless there is a recall on any phase across the barrier. See Section 18.3 for more information.

♦ Make sure you do not accidentally omit both the protected and permissive displays. If you do, vehicles will be trapped.

18.2.3.1 Permissive-Only Operation
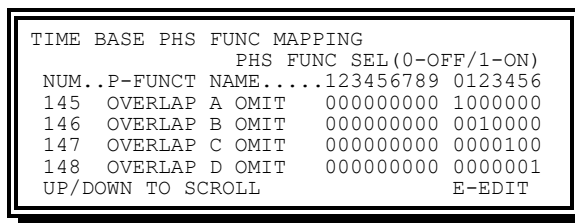
To provide permissive-only operation on an approach by time-of-day, omit the protected phase in a coordinator pattern.

Alternatively, the protected phase can be omitted in an action plan using a phase function. Phase Functions 17, 19, 21, and 23 omit Phases 1, 3, 5, and 7, respectively. Phase omits in an action plan do not have any affect if a coordinator plan is also running unless the coordinator plan also omits the same phases. For this reason, the only need for omitting a phase in an action plan is to provide permissive-only operation while the controller is running free. For more information, see Chapter 2, Section 2.7.10.

18.2.3.2 Protected-Only Operation

To provide protected-only operation on an approach by time-of-day, omit the associated overlap in an action plan.

To do this, the overlap omit must be mapped to a phase function in F-6–9. Scroll through screens to get to numbers 145–148 and make sure they are mapped to the phase functions. The example shown in Figure 18-5 has omits for Overlaps A, B, C, and D mapped to Phase Functions 10, 12, 14, and 16, respectively.

```
TIME BASE PHS FUNC MAPPING
                PHS FUNC SEL(0-OFF/1-ON)
 NUM..P-FUNCT NAME.....123456789 0123456
 145  OVERLAP A OMIT   000000000 1000000
 146  OVERLAP B OMIT   000000000 0010000
 147  OVERLAP C OMIT   000000000 0000100
 148  OVERLAP D OMIT   000000000 0000001
 UP/DOWN TO SCROLL              E-EDIT
```

Figure 18-5. Time Base Phase Function Mapping Display

When the phase functions have been mapped, enable the appropriate phase function in an action plan, F-6-5, as shown in Table 18-3.

Table 18-3. Phase Function Action Plan	
To provide protected-only operation for this phase group	**Enable this phase function in an action plan**
Phase 1/2	10
Phase 3/4	12
Phase 5/6	14
Phase 7/8	16

By default, all phase functions are disabled (setting 0) in all action plans. To enable a phase function in a particular action plan, change its setting to 1. Figure 18-6 is an example of an action plan that disables FYA operation on phase groups 1/2 and 5/6, making these approaches protected-only.

```
TIME BASE ACTION # 001
                  123456789 0123456
  PATN:001     PHS: 000000000 0000000
   0=I'CONN    AUX: 000------
   1-253=PATN  SPC: 00000000-   0=NO
   254=FREE    DIM: 0--------   1=YES
   255=FLASH   DET: 000------
 UP/DOWN TO SCROLL              E-EDIT
```

Figure 18-6. Time Base Action Display

To run this action plan, enter it into the desired day plan and time under F-6-4.

18.2.4   Status Monitoring of FYA

From the Controller Front Panel

F-1-7 (Figure 18-7) shows the current state of the FYA overlaps.

```
INTERSECTION    SEQ:01 B:1
 PHASE.....1234.5678.9012.3456
  V SIG..: RGRR RGRR .... ....
  P SIG..: DDDD DDDD .... ....
  V CALL.: .... .... .... ....
  P CALL.: .... .... .... ....
 OVERLAP...ABCD.EFGH.IJKL.MNOP
  V SIG..: gRgR .... .... ....
```

Figure 18-7. Intersection AS Display

In the Overlap Vehicle Signal row (the last row), a lower-case g means that the overlap is flashing green (for example, the FYA is flashing). An upper-case Y means solid yellow, an upper-case R means solid red, and a period (.) means that the overlap is dark. The overlap should be dark when the protected phase is green.

18.2.5   NEMA MMU2 FYA Modes

The NEMA standard provides for 8 output modes regarding FYA output configuration in a cabinet. Modes A-F, as well as I-J, allow the FYA to be driven by two dedicated load switches, those being the overlap's loadswitch and the protected-turn phase loadswitch.

Modes G-H are sometimes referred to 'compact modes' because they only use one loadswitch and also make use of a pedestrian load switch's yellow output.

Both modes G and H can be easily configured via the F-4-9 Output Mapping display. Figure 18-8 shows part of the output configuration for FYA overlap A in mode G.

```
OUTPUT MAPPING             EDIT MODE: LDSW
                            E-TOGGLE MODE
LDSW ..1.. ..2.. ..3.. ..4.. ..5.. ..6..
RED   OLA R PH2    PD2 D PH3    PH4    PD4
YEL   OLA Y  -     OLA G  -      -      -
GRN   PH1 G  -     PD2 W  -      -      -
FIO    1     2      3     4      5      6
```

Figure 18-8. Output Mapping display

18.3   Special Circumstance Where Vehicles Could Be Trapped

When changing time-of-day operation from protected-only to either permissive or permitted/protected operation, the change will not occur while the through phase for an approach is green. This prevents late display of the flashing yellow arrow after the onset of the associated through phase. A special circumstance can happen where left-turning vehicles could become trapped, without any possibility of service.

For example:

♦ Controller is timing green on Phase 2.

♦ The Phase 1 approach is currently operating in protected-only mode, by time-of-day, so Overlap A is omitted.

♦ There are vehicles waiting for Phase 1, facing a red arrow.

♦ There is no demand across the barrier (Phases 3, 4, 7, or 8).

♦ The controller now reaches a time-of-day where the Phase 1 approach will be changed from protected-only to permissive-only.

♦ The overlap-omit is not removed from Overlap A until Phase 2 is not green, but the phase omit on Phase 1 is applied immediately.

♦ Because Phase 1 is omitted, the vehicles waiting will never receive a green arrow, but they will also not receive a flashing-yellow arrow until a call comes in across the barrier, allowing Phase 2 to turn yellow and red. These vehicles are trapped until someone arrives on the side street.

To avoid this scenario, an approach should not change time-of-day operation directly from protected-only mode to permissive-only mode. The only exception is if there is a recall placed on any phase across the barrier.

19 Installation

This chapter contains information for unpacking, inspecting, installing, re-packing, and testing a CU. The complete controller assembly is packed for shipment in heavy-duty containers.

19.1 Unpacking Instructions

The controller assembly should be unpacked in accordance with the following instructions:

> Carefully inspect the container for damage before opening. If the container appears damaged, it should be opened in the presence of the carrier.

> Observe the markings on the containers and put each container on a flat surface with the top up, preparatory to unpacking.

> Cut strapping and remove the container.

> Remove the contents of each box and check against the packing list attached to the shipment.

> Inspect all items for shipping damage when it is unpacked. Check for dents, scratches, and bent parts. If the items are damaged, notify the carrier immediately.

> After unpacking, retain the shipping container and packing material for possible use if reshipment of the items becomes necessary. The containers and packing material have been specifically designed for protection of the items during normal shipment.

19.2 Handling

Normal precautions for lifting and transporting electronic signaling equipment should be observed when handling the system units.

ELECTRO-STATIC DISCHARGE

MOS devices are NOT THE ONLY electronic components that can be damaged by static electricity.

Technology trends toward greater complexity, increased density, and thinner dielectrics result in parts becoming more sensitive to Electro-Static Discharge damage. Some components can be destroyed or damaged by as little as 20 volts of static electricity. (It requires more than 3500 volts before you can feel it.) Electro-static discharge damage can happen anywhere, while trading modules in the field or working on equipment in the shop.

Be aware: You can inflict electro-static discharge damage by simply touching runners and edge connectors that lead to static sensitive components.)

To ensure that your Yunex Traffic ITS equipment remains as static free as the day you received it, follow these simple procedures:

Minimize handling of all modules and semiconductors. When they are handled, make sure it is only at a static-free workstation, and personnel are properly grounded.

Keep parts and modules in their original containers until you are ready to use them.

Wear a wrist grounding device and make sure it is in contact with the skin; it is useless if not in contact with the skin and ground. Wear a wrist strap at your workstation as well as when in a cabinet.

Keep all common plastics out of your static-free work areas, for example, Styrofoam cups, potato chip bags, clear, white, or non-anti-static cushioning and wraps, etc. These items can cause damage to static- sensitive devices.

If you are returning faulty modules for repair, make sure they are inside anti-static bags. This will prevent any additional damage.

19.3   Physical Inspection

Directly following unpacking and before installation, inspect each controller assembly item to detect any damage that might have occurred during transit. A check of the following items is suggested:

Tighten any loose screws or locknuts on mechanical assemblies that have worked loose.

Examine all controls, indicators, and enclosure panels for evidence of jamming or mechanical damage.

Remove cover and inspect the circuit board assemblies for damage.

In the event of equipment damage, contact the agent of the company performing shipment. Inform Yunex Traffic ITS Technical Service of the situation and obtain instructions before proceeding further with system installation.

19.4   Installation

The CU has been standardized with the requirements of the traffic control industry. The controls permit considerable latitude for timing and feature application. During the setup of an intersection, it is imperative that adequate precautions be taken to prevent settings and procedures that can affect the safety of the intersection.

The CU should be installed in a location that allows easy access to the front of the CU. The CU should have sufficient room so that it can be easily removed if required. Care should be taken to prevent blocking the cooling vents on the back of the CU.

Putting the CU in control of the intersection is dependent upon the actual terminal facilities configuration and local law. The following procedure generally applies.

- ♦ Obtain the services of the police for aid in intersection safety. Check that MAIN POWER circuit breaker is Off, the FLASH/NORMAL switch is in the Flash position.

- ♦ Put the main power circuit breaker in the ON position when traffic is clear of the intersection. Observe that the CU initialization program is correct. Check that the flash program is correct.

♦ Observe vehicle detector unit indicator lamps for indications that vehicle calls are received as vehicles cross the sensors. Observe that vehicle and pedestrian calls are placed in all phases.

♦ Permit the CU to operate for several minutes while checking that all controller times and function controls are properly set up and that the CU is responding to calls for service and timing correctly.

♦ When satisfied that the CU is functioning properly, check traffic for a safe point to place the intersection under automatic control and place the FLASH/NORMAL switch in the Normal position.

19.5   Reshipment

The controller assembly items should be prepared for reshipment by performing the following instructions:

Pack the item in the original Yunex Traffic shipping container.

Use a qualified carrier to ship the item to its destination.

20 Warranty

20.1   Warranties

EQUIPMENT: YUNEX TRAFFIC warrants that this equipment manufactured by YUNEX TRAFFIC be free of defects in material or workmanship for a period of one (1) year from date of receipt by buyer. Should any failure to conform to this warranty appear within the warranty period YUNEX TRAFFIC, upon prompt written notification thereof, will, at its option, repair or replace any part(s) which, upon examination, by YUNEX TRAFFIC is found to be defective, warranty inspections and repairs will be performed at the YUNEX TRAFFIC manufacturing facilities after receipt of the item from Buyer. No equipment shall be returned during the warranty period without our prior written consent, which consent will not be unreasonably withheld.

SERVICES: YUNEX TRAFFIC warrants that the recommendations, guidance, and performance of its personnel will reflect competent, professional knowledge and judgment. In the event any portion of the services furnished fails to comply with this warranty obligation and YUNEX TRAFFIC is so notified in writing prior to warranty expiration, YUNEX TRAFFIC will promptly re-perform such portion of the service without additional compensation from Buyer.

WARRANTY CONDITIONS: These warranties are conditioned upon the proper receipt, handling, storage, maintenance, and installation of Equipment furnished or serviced hereunder in a safe and prudent manner and in accordance with any YUNEX TRAFFIC recommendation, and upon such Equipment or material having been operated and maintained in a normal and proper manner under competent supervision and not having been subjected to accident, alteration, abuse, or misuse. All transportation charges associated with repairing or replacing Equipment at YUNEX TRAFFIC designated repair facility shall be Buyer's responsibility.

20.2   Limitations of Warranties and Remedies

WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER STATUTORY, EXPRESS, OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ALL WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OR TRADE. Remedies provided above are Buyer's sole remedies for any failure by YUNEX TRAFFIC to comply with its warranty obligations. Correction of non-conformities in the manner and for the period of time provided herein shall constitute complete fulfillment of all the liabilities of YUNEX TRAFFIC for defective equipment, materials, or services, whether the claims by Buyer are based in contract, in tort (including negligence or strict liability), or otherwise.

20.2.1   Limitation of Liability

Neither YUNEX TRAFFIC not its sub-contractors or suppliers of any tier will be liable to Buyer for any special, indirect, liquidated, incidental or consequential damage or loss or for damage or loss of property or equipment not furnished under a purchase order resulting therefrom

on which the liability is based, or claims of Buyer's customers. The remedies set forth herein are exclusive and for each item of equipment, material, or services, the total cumulative liability of YUNEX TRAFFIC under any purchase order accepted by YUNEX TRAFFIC or anything done in connection therewith, will be limited to the price of the item of equipment, material or services. In all cases where Buyer's claim, whether based in contract, in tort (including negligence and strict liability), under any warranty, or otherwise, arises out of or in connection with the sale, delivery, or use of defective equipment, material, or services supplied hereunder or damage resulting therefrom, Buyer's exclusive remedies and YUNEX TRAFFIC sole liability shall be limited to those specifically outlined in the warranty provision.

The provisions of this section, Limitation of Liability, shall also protect YUNEX TRAFFIC suppliers and sub-contractors and shall apply, to the full extent permitted by law and regardless of fault and shall survive either termination, cancellation or expiration of the order.

The provisions of this section, Limitation of Liability, shall apply notwithstanding any other provision of the purchase order.

The equipment and material are intended for use only for the purpose for which they were expressly provided. With respect to any other use, YUNEX TRAFFIC makes no representation or warranty and assumes no liability of any kind, whether in contract or tort (including negligence and strict liability).

20.3 Warranty Questions and Answers

- QUESTION – What is not covered in the YUNEX TRAFFIC warranty?

  ANSWER – Equipment failures due to acts of God including damage by flood, vehicles, lightning strikes, etc., or errors or damage in installation, or improperly maintained equipment. Damage during transportation is not a failure within warranty; the purchaser recourse is against the carrier.

- QUESTION – Must equipment always be returned to Marion, KY?

  ANSWER – At YUNEX TRAFFIC option, such repairs may be made by YUNEX TRAFFIC personnel in the field.

- QUESTION – What do I do in an emergency?

  ANSWER – Call YUNEX TRAFFIC Technical Service Department before making any expenditure of funds. At YUNEX TRAFFIC option and with OUR prior approval, a third party may be authorized to make such repairs. At the time of your call, the details of the work to be done, charges and billing will be determined.

- QUESTION – May I rent or supply equipment for use while YUNEX TRAFFIC equipment is under repair and bill YUNEX TRAFFIC?

  ANSWER – No. Backup equipment is the purchaser's responsibility.

- QUESTION – May I make some repairs without prior authorization and bill later?

  ANSWER – No, good business practice, just as you apply in your own business, dictates that NO UNAUTHORIZED REPAIRS WILL BE PAID by YUNEX TRAFFIC.

♦ QUESTION – What if it is found that the cause of a failure for which YUNEX TRAFFIC has made a Field Service trip was due to equipment not supplied by YUNEX TRAFFIC?

ANSWER – Those service calls will be billed to you.

♦ QUESTION – When I have equipment under warranty repaired, or replaced, what is my remaining warranty?

ANSWER – Equipment will retain its warranted status, until the end of the original warranty period given when the equipment was purchased. (See Question 2.)

♦ QUESTION – If I return equipment and it is found not to be defective, what will happen?

ANSWER – The cost of testing will be billed to you in such cases.

♦ QUESTION – How is the repair of equipment out of warranty handled?

ANSWER – After the equipment is received from you, prepaid, it will be restored to the original design specifications and returned. You will be billed for this service and granted a ninety-day warranty from the date of shipment of the repaired equipment.

♦ QUESTION – Will my returned equipment be the most up-to-date modification?

ANSWER – Advances in the state of the art from time to time in worthwhile improvements in performance and reliability. When such is possible, you will be contacted by YUNEX TRAFFIC Technical Service Department and given the option to approve such a modification. Charges for the modification and the effect on the balance of your equipment will be discussed in full.

♦ QUESTION – Whom do I contact for more information?

ANSWER – Call or write YUNEX TRAFFIC -- Supervisor, Technical Service Department.

21 Software License Agreement

SOFTWARE LICENSE AGREEMENT

THIS SOFTWARE LICENSE AGREEMENT (this "Agreement") is entered into by Yunex Traffic, a Siemens Business ("Licensor"), and Licensee. Capitalized terms are defined in Section 12 of this Agreement.

1. LICENSE OF SOFTWARE

1.1. Grant of License. Licensor grants to Licensee, and Licensee accepts from Licensor, a nonexclusive, nontransferable license to use the SEPAC Software and Documentation solely: during the term of this Agreement;

i. on the Designated Operating System(s);

ii. at the Site(s) of the Business Unit(s);

iii. for use by the maximum number of users specified on any associated Purchase Order or Contract; and

iv. for Licensee's own internal business purposes in the United States and not for processing the data of any third party (whether on an outsourcing, service bureau, or other basis) except data supplied by Licensee's customers or suppliers which is necessary for Licensee's internal business purposes.

1.2. Ownership of Software and Documentation. Except as otherwise expressly set forth in this Agreement, Licensor and Third Party retain all right, title and interest in and to their respective Software and Documentation in all forms and all copies and modifications of the Software and Documentation, including all worldwide rights to patents, copyrights, trademarks and trade secrets in or relating to the Software or Documentation. Licensee is not acquiring any right, title or interest of any nature whatsoever in any Software or Documentation except the license to use the Software and Documentation granted under **Section 1.1**.

1.3. Term. Licensee's license to use the Software and Documentation will be effective until terminated in accordance with the provisions of this Agreement.

1.4. Restrictions on Use. The license to use the Software and Documentation under this agreement is subject to the following restrictions and limitations:

1. Licensee will not use the Software or Documentation, or authorize or permit any other Person to use the Software or Documentation, for any purpose other than those expressly authorized under **Section 1.1.**

2. Licensee will not sublicense, transfer or otherwise assign its rights in the Software or Documentation to any other Person nor allow any other Person to access or use the Software or Documentation, except as expressly provided in this **Section 1.4.** If Licensee sells all or substantially all of the assets relating to Licensee's business operations (the "Assets"), Licensee may assign its rights under this Agreement to continue using the Software and Documentation to the acquirer of those Assets, so long as the acquirer of the Assets agrees in writing to be bound by each of the terms and conditions of this Agreement.

3. Licensee will not translate, reverse engineer, de-compile or disassemble the Software for any reason.

4. Licensee will not copy the Software, in whole or in part, without the prior written consent of Licensor, except that Licensee may make a reasonable number of copies of the Licensor Software (in object code form) for backup and archival purposes, and, if use on more than one computer system is required, Licensee may make the number of Object Code copies reasonably required in order for Licensee to operate the Licensor Software in accordance with this Agreement. The original and any copies of the Licensor Software will at all times remain the sole property of Licensor.

5. Licensee may make additional copies of the Software Documentation, excluding education materials, without Licensor's prior written consent, but all of those copies will be subject to all of the confidentiality and other restrictions set forth in this Agreement, and all of those copies must be used solely for Licensee's internal training and support purposes (and not for resale or redistribution). The original and any copies of the Software Documentation will at all times remain the sole property of Licensor

6. Licensee may not modify the Software, whether through the services of its own employees or of independent contractors (other than Licensor), without the prior consent of Licensor.

7. In no event will Licensee export any Software or Documentation or use any Software or Documentation outside the United States without the prior

written consent of Licensor which will not be unreasonable withheld, provided Licensee has provided evidence of its compliance with this Section 1.4.8. Licensee agrees to comply with all export laws, restrictions, national security controls and regulations of the United States or other applicable foreign agency or authority, at Licensee's sole expense, and not to export or re-export, or allow the export or re-export, of the Software or any Confidential Information or any copy or direct product thereof in violation of any such restrictions, laws or regulations, or in violation of the embargo provisions of the U.S. Export Administration Regulations (or any successor regulations or supplement), except in accordance with all licenses and approvals required under, applicable export laws and regulations, including without limitation, those of the U.S. Department of Commerce. Licensee will not allow any Person who is not an employee of Licensee, including without limitation any of its customers, suppliers or contractors, to access or use the Software or Documentation without the prior written consent of Licensor.

1.5 This Agreement applies to updates or supplements to the original Software and Documentation provided by Licensor, unless Licensor provides other terms along with the update or supplement.

1.6 The Software and Documentation may contain certain Third Party Components or Software and Third Party Documentation that may each be subject to a separate license agreement (a "Third Party Component Agreement"). The Third Party Components or Software, Documentation, and Third Party Component Agreement(s) are provided in Appendix A. The terms of any Third Party Component Agreement(s) are herein incorporated by reference in this Agreement. In the event of any inconsistencies between this Agreement and any Third Party Component Agreement, the terms of this Agreement shall control.

1.7 The Software and Documentation may contain certain Open Source Software or Components ("OSS") and Documentation that may each be subject to a separate license agreement (an "Open Source Software Agreement"). The OSS, Documentation, and OSS Component Agreement(s) are provided in Appendix A. The terms of any Open Source Software Agreement(s) are herein incorporated by reference in this Agreement. In the event of any inconsistencies between this Agreement and any Open Source Software Agreement, the terms of the Open Source Software Agreement shall control.

1.8 Licensee Responsibility. Licensee assumes sole responsibility for the following:

1. Licensee is responsible for obtaining any software required for use of the Software, including any operating system software, database software, or third party applications software.

2. Licensee is responsible for conversion of any of Licensee's existing data files for use with the Software. Licensor is not providing any data conversion services to Licensee.

3. Licensee is responsible for taking reasonable backup precautions. Licensor will not be responsible for loss of data or documentation, whether or not attributable to the Software.

1.9 Proprietary Legends. Licensee must retain all legends relating to copyright, trademarks, patents or confidentiality on all permitted copies of the Software and Documentation, and Licensee must reproduce such notices on any permitted copies of the Software and the Documentation or any portion of the Software or Documentation.

2. LICENSE FEES AND PAYMENTS

2.1 License Fees. In consideration of the license of the Software and Documentation, Licensee will pay the License Fees specified on any associated Purchase Order or Contract, in accordance with the payment terms specified in any associated Purchase Order or Contract.

2.2 Taxes. Licensee must pay any and all federal, state or local taxes (other than taxes based on Licensor's income), including sales taxes imposed in connection with the purchase of the license of the Software under this Agreement or the purchase of Professional Services or Maintenance and Support Services in connection with this Agreement.

3. SOFTWARE MAINTENANCE AND SUPPORT SERVICES

If applicable, Licensor will provide Maintenance and Support Services to Licensee in accordance with any separate contract for services subject to the terms and conditions specified therein.

4. PROFESSIONAL SERVICES

If applicable, Licensor will provide Maintenance and Support Services to Licensee in accordance with any separate contract for services subject to the terms and conditions specified therein.

5. LIMITED WARRANTIES AND REMEDIES

5.1. Limited Warranties. Licensor warrants, for a period of ninety (90) days following initial delivery to Licensee of the Licensor Software, and provided Licensee is not in breach of any of Licensee's obligations under this Agreement, that:

    1. The Licensor Software, as delivered under this Agreement, will conform in all material respects to the Software Documentation for the current version of the Licensor Software, provided that (1) all software which is not Licensor Software, all firmware and all hardware products are operating in accordance with their respective specifications, and (2) Licensee is using the Licensor Software on the Designated Operating System(s) in a proper manner and in compliance with all operating instructions included in the Software Documentation.

    2. Licensor has good title to the Licensor Software and/or the rights to grant all licenses granted to Licensee under this Agreement, and the grant of those licenses will not result in the material breach of any material agreement to which Licensor is a party.

5.2. Disclaimer of Additional Warranties. THE WARRANTIES SPECIFIED IN SECTION 5.1 ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES. LICENSOR EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. LICENSEE ASSUMES ALL RISKS ASSOCIATED WITH OPERATING THE SOFTWARE (EXCEPT AS SPECIFICALLY PROVIDED IN ARTICLE 7 WITH RESPECT TO INFRINGEMENT OF THIRD PARTY RIGHTS), AND LICENSOR DOES NOT WARRANT THAT THE SOFTWARE WILL BE ERROR FREE OR WILL MEET LICENSEE'S SPECIFIC NEEDS.

5.3. Exclusive Remedies. If any of the warranties specified in Section 5.1 are breached, then the following terms will apply:

    1. Licensee will promptly notify Licensor of the breach and any associated details reasonably requested by Licensor in its attempt to remedy the problem. Licensee will cooperate with Licensor in re-creating the conditions that existed at the time the Licensor Software failed, if reasonably requested by Licensor.

    2. Licensor will diligently and in good faith attempt to correct the reported defect by repairing or modifying the Licensor Software within a commercially reasonable period of time.

      1. If any defective portion of the Licensor Software causes the entire Licensor Software to fail in its essential purpose, and if Licensor is unable to cure that defect by repairing or modifying the Licensor Software as provided in Section 5.3.2, then Licensee may elect to terminate its right to use the Software and Documentation and return all Software and Documentation to Licensor and receive a fu11 refund of the purchase price as Licensee's sole and exclusive remedy.

THE FOREGOING REMEDIES ARE EXCLUSIVE AND WILL BE LICENSEE'S SOLE REMEDIES WITH RESPECT TO ANY CLAIM ARISING OUT OF OR RELATING TO ANY BREACH OF WARRANTY OR OTHER FAILURE OF THE SOFTWARE TO OPERATE AS INTENDED, WHETHER BASED IN CONTRACT, BREACH OF WARRANTY, TORT OR OTHERWISE.

6. LIMITATION OF LIABILITY

IN NO EVENT WILL LICENSOR, LICENSEE OR THIRD PARTY BE LIABLE TO THE OTHER PARTY(S) OR ANY OTHER PERSON FOR ANY INDIRECT, INCIDENTAL, SPECIAL, PUNITIVE OR CONSEQUENTIAL DAMAGES, INCLUDING LOSS OF PROFITS, REVENUE, DATA, OR USE, INCURRED BY EITHER PARTY(S) OR ANY OTHER PERSON, WHETHER IN AN ACTION IN CONTRACT, BREACH OF WARRANTY OR TORT, EVEN IF THE OTHER PARTY(S) OR ANY OTHER PERSON HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT WILL LICENSOR'S LIABILITY TO LICENSEE OR ANY OTHER PERSON EVER EXCEED ALL AMOUNTS PAYABLE BY LICENSEE UNDER THIS AGREEMENT, REGARDLESS OF THE FORM OF ACTION, WHETHER IN CONTRACT, NEGLIGENCE, TORT OR OTHERWISE, EXCEPT WITH RESPECT TO LICENSOR'S OBLIGATIONS UNDER ARTICLE 7 TO INDEMNIFY ANY OTHER PERSONS INFRINGEMENT CLAIMS OR LICENSEE'S OBLIGATIONS UNDER ARTICLE 2 TO PAY FEES.

7. INFRINGEMENT INDEMNITY

7.1. Indemnification. Licensor will indemnify, defend and hold Licensee harmless from any loss, damage or cost (including reasonable attorneys fees and court costs) arising out of any third party claim that the Licensor Software infringes any copyright, trade secret or United States patent right of any other party. Licensor's obligation to indemnify Licensee under this Article 7 does not extend to any Third Party or other Persons software. Licensor's obligation to indemnify Licensee is

contingent upon Licensee promptly notifying Licensor of any such claim, granting Licensor the sole control over the defense and settlement (except as set forth below) of such claim and cooperating with Licensor in the defense of the claim (at the expense of Licensor).

7.2. Defense of Infringement Claims. Licensor will have the sole right to defend or settle any claim subject to indemnification under this Article 7. Licensee will have right to participate with Licensor in the defense or appeal of any such claim or judgment, at Licensee's option and at Licensee's own expense (such expense not being indemnified by Licensor), but Licensor will have sole control and authority with respect to any such defense, compromise, settlement, appeal or similar action.

7.3. Satisfaction of Obligations. At Licensor's option, Licensor may satisfy its entire obligation under this Article 7 by either: (a) modifying or replacing the Licensor Software so that it performs comparable functions without infringement; (b) obtaining a royalty-free license for Licensee to use the infringing Licensor Software; or (c) refunding to Licensee an amount equal to the License Fees paid with respect to the infringing Licensor Software, less the portion of the License Fees attributable to the period over which Licensee actually used the Licensor Software.

7.4. Exceptions. Licensor will have no obligation to Licensee under this Article 7 to the extent that the alleged infringement or violation is based upon (1) Licensee's use of the Licensor Software other than as set forth in this Agreement and in the Software Documentation; or (2) any modification to or alteration of the Licensor Software performed by anyone other than Licensor; or (3) Licensor's compliance with Licensee's designs, specifications or instructions.

7.5. THIS ARTICLE 7 STATES LICENSOR'S ENTIRE OBLIGATION TO LICENSEE REGARDING ANY INFRINGEMENT OF ANY PATENT, COPYRIGHT, TRADEMARK, TRADE SECRET, OR OTHER INTELLECTUAL PROPERTY RIGHT OF ANY OTHER PERSON.

8. CONFIDENTIALITY

8.1. Limitations on Disclosure and Use of Confidential Information. Each recipient of Confidential Information (the "Recipient") agrees that it will not disclose, provide or otherwise make available any Confidential Information of the other Party (the "Disclosing Party") without the other party's prior written consent. In addition, each Recipient agrees that it will not:

    1. use the Disclosing Party's Confidential Information for any purpose beyond the scope of this Agreement;

    2. copy any part of the Confidential Information or disclose any part of the Confidential Information to any Person other than Recipient's employees or consultants who need the information to perform their duties;

    3. authorize or permit any such employee or consultant to use or disclose any part of the Confidential Information in violation of this Agreement;

    4. reverse engineer, de-compile or disassemble any of the Confidential Information nor use any of the Confidential Information for the purpose of reverse engineering, decompiling or disassembling; or

    5. produce any product nor offer any service of any nature whatsoever based in whole or in part on the Confidential Information nor cause or assist any other Person in doing so.

8.2. Exclusions. The Recipient's obligations under this Agreement will not apply to any portion of the Confidential Information that:

    1. at the time of disclosure to Recipient, was in the public domain or subsequently becomes a part of the public domain through no breach of this Agreement;

    2. Recipient had in its possession at the time of disclosure by the Disclosing Party, as established by written documentation in existence at that time, and that was not acquired directly or indirectly from the Disclosing Party or with knowledge of confidentiality restrictions;

    3. Recipient subsequently acquires by lawful means from a third-party who is under no obligation of confidentiality or non-use owed to Disclosing Party; or

    4. Recipient subsequently develops without any use of or reference to the Confidential Information.

8.3. Disclosure Pursuant to Legal Process. If Recipient is legally compelled to disclose any portion of the Confidential Information in connection with a lawsuit or similar proceeding or to any governmental agency, Recipient will give Disclosing Party prompt notice of that fact, including in its notice the legal basis for the required disclosure and the nature of the Confidential Information that must be disclosed. Recipient will cooperate fully with Disclosing Party in obtaining a protective order or other appropriate protection relating to the disclosure and subsequent use of the Confidential Information. Recipient will disclose only that portion of the Confidential Information that is legally required to be disclosed.

8.4. Enforcement. Recipient acknowledges that Disclosing Party would have no adequate remedy at law should Recipient breach its obligations under this Article 8 and agrees that Disclosing Party will be entitled to enforce its rights under this Article 8 by obtaining appropriate equitable relief including a temporary restraining order and an injunction. No delay or failure by Disclosing Party in exercising any right under this Agreement will be construed to be a waiver of that

right or of the right to assert a claim with respect to any future breach of this Agreement.

8.5. Return of Confidential Information. Upon request by the Disclosing Party, the Recipient will return any portion of the Confidential Information that Recipient no longer has the right to use, including all copies of that Confidential Information, and all abstracts, summaries or documents produced using that Confidential Information, or, if so directed by the Disclosing Party in writing, the Recipient will destroy all copies of that Confidential Information (including abstracts, summaries or documents produced using that Confidential Information) and will certify to the Disclosing Party in writing that all copies, abstracts, summaries and documents have been destroyed.

8.6. Source Code. If Licensee is authorized by Licensor to obtain a copy of the Source Code, Licensee agrees that such Source Code will be included in the definition of Software set forth in Section 11 of this Agreement and will be subject to all provisions and limitations of this Agreement, including the provisions of Sections 1 and 8.

9. DISPUTE RESOLUTION

9.1. Any controversy or claim arising out of or relating to this Agreement or the existence, validity, breach or termination thereof, whether during or after its term, will be finally settled by compulsory arbitration in accordance with the Commercial Arbitration Rules of the American Arbitration Association ("AAA") and this Article 9, except as specified below. The arbitration proceeding will take place in Atlanta, Georgia. The arbitration panel will consist of 3 arbitrators, one arbitrator appointed by each Party within 30 days after the respondent receives notice of the filing of the arbitration and a third neutral arbitrator appointed by the two arbitrators designated by the Parties. The Parties expressly agree that the arbitrators will be empowered to, at either Party's request, grant injunctive relief. An award granted by the arbitrators will be the exclusive remedy of the Parties for all claims, counterclaims, issues or accountings presented or pleaded to the arbitrators. The award will (1) be granted exclusive of any tax, deduction or offset and (2) include interest from the date that the award is rendered until it is fully paid, computed at the rate of 12% per annum. Judgment upon the arbitral award may be entered in any court that has jurisdiction thereof. Any additional costs, fees or expenses incurred in enforcing the arbitral award will be charged against the Party that resists its enforcement.

9.2. Nothing in this Article 9 will prevent either Party from (1) seeking interim or permanent injunctive relief or taking any other action in any court to enforce or protect its intellectual property rights or its rights under Article 8, or (2) filing an action against the other Party in the courts having jurisdiction over it in order to enforce an arbitral award granted pursuant to a proceeding under this Article 9.

10. BREACH; TERMINATION

10.1. Termination of License. Licensee's license to use the Software and Documentation will be effective until terminated in accordance with the express provisions of this Article 10.

10.2. Termination for Breach. Either Party (the "Non-Breaching Party") may terminate the license upon written notice to the other Party (the "Breaching Party") should the Breaching Party breach Article 8, or should the Breaching Party breach in any material respect any other term of this Agreement and fail to cure that breach within ten (10) days after receipt of written notice of the breach from the Non-Breaching Party. Each party agrees not to exercise its right to terminate this Agreement if (i) the Breaching Party promptly ceases the breaching behavior, (ii) damages are a sufficient remedy for such breach, and (iii) such damages are paid in a timely manner. Notwithstanding the foregoing, Licensor may pursue its right to terminate the license if Licensee materially violates Licensor's proprietary rights in the Software.

10.3. Effect of Termination. Upon termination, Licensee will discontinue the use of and will return to Licensor all copies of the Software and related Documentation and will destroy, and document in writing such destruction of, any embodiments of these materials stored in or on a reusable electronic or similar medium, including memory, disk packs, tapes, and other peripheral devices. Termination will not relieve Licensee from its obligation to pay any and all License Fees and any other fees that are owed by Licensee under this Agreement.

10.4. Survival. The provisions of Section 1.2 and Articles 5, 6, 7, 8, 9, 10 and 11 of this Agreement will survive and continue in full force and effect notwithstanding the termination or expiration of this Agreement.

11. MISCELLANEOUS PROVISIONS

11.1. Governing Law. This Agreement is governed by the laws of the State of Georgia without reference to that state's choice of law provisions. Each Party hereby consents to the jurisdiction of any federal or state court within the State of Georgia.

11.2. Notices. All notices, communications and deliveries under this Agreement must be made in writing signed by the Party making the same, must specify the Section under this Agreement pursuant to which it is given or being made (if applicable), and will be given or made to the respective representatives specified in the Notices paragraph on Exhibit A.

11.3. Severability; No Waiver. If any provision of this Agreement is held to be invalid or unenforceable, the remaining provisions of this Agreement will remain in full force and effect. The waiver by either Party of any default or breach of this Agreement will not constitute a waiver of any other or subsequent default or breach.

11.4. No Assignment. Licensee may not assign or sublicense its rights or obligations under this Agreement without the prior express written consent of Licensor.

11.5. Force Majeure. Neither Party will be held responsible for any delay or failure in performance (other than payment obligations) to the extent that such delay or failure is caused by fire, flood, explosion, war, strike, embargo, government regulation, civil or military authority, act of God, acts or omissions of carriers or other similar causes beyond its control.

11.6. Effect of This Agreement. This Agreement constitutes the complete understanding between the parties with respect to the terms and conditions set forth in this Agreement and supersedes all previous written or oral agreements and representations. The terms and conditions of this Agreement will control over any terms and conditions in any solicitation, request for proposal, proposal, purchase order, acknowledgment or other written form. This Agreement may be modified only in a writing which expressly references this Agreement and is executed by both of the parties to this Agreement. This Agreement may be executed in several counterparts, all of which taken together will constitute one single Agreement between the parties.

11.7. Interpretation of Agreement. The following rules of interpretation must be applied in interpreting this Agreement: (1) the section and subsection headings used in this Agreement are for reference and convenience only, and will not enter into the interpretation of this Agreement, (2) all references to Articles, Sections and Exhibits are to Articles and Sections in this Agreement and Exhibits to this Agreement, as the case may be, (3) the provisions of the Exhibits are incorporated in this Agreement, and (4) as used in this Agreement, the term "including" will always be deemed to mean "including without limitation".

11.8. Compliance with Laws. The Parties will comply with all federal, state and local laws, statutes, rules and regulations applicable to the performance of their rights and obligations under this Agreement.

11.9. Relationship of the Parties. For all purposes, Licensor and Licensee will be deemed to be independent contractors and nothing contained herein will be deemed to constitute a joint venture, partnership, employer-employee relationship or other agency relationship. No Party is, nor will either Party hold itself out to be, vested with any power or right to contractually bind or act on behalf of the other Party.

11.10. Non-solicitation of Employees. During the term of this Agreement and for a period of one (1) year thereafter, neither Party will solicit the employment of any employee of the other Party involved in the performance of this Agreement or the delivery of services without the express written consent of such other Party; provided that neither Party shall be prohibited hereby from hiring any person who is an employee of the other Party who responds to general "help wanted" advertisements published in newspapers or other broadly circulated media.

11.11. Intentionally left blank

11.12. Publicity. Neither Party shall make any public announcements or issue any press releases regarding the terms of this Agreement or use the name of the other Party without the prior written consent of the other Party, which will not be unreasonably withheld. The parties may issue a joint press release as mutually agreed upon by the parties.

11.13. Interpretation of Agreement. The following rules of interpretation must be applied in interpreting this Agreement: (1) the section and subsection headings used in this Agreement are for reference and convenience only, and will not enter into the interpretation of this Agreement, (2) all references to Articles, Sections and Exhibits are to Articles and Sections in this Agreement and Exhibits to this Agreement, as the case may be, (3) the provisions of the Exhibits are incorporated in this Agreement, and (4) as used in this Agreement, the term "including" will always be deemed to mean "including without limitation".

12. DEFINITIONS

12.1. "Confidential Information" means all business or technical information of the disclosing Party that is not generally known to the public and that derives value from not being generally known, whether such information is disclosed orally or in writing. Confidential Information may include any software, documentation, algorithm, device, compilation of information, method, technique or process. This Agreement, the Software (in both Source Code and Object Code versions) and Documentation constitute Confidential Information.

12.2. "Business Unit(s)" means the company, division or other business operation of the Licensee, as designated on any associated Purchase Order or Contract.

12.3 "Designated Operating System(s)" means the computer operating system and database software, if applicable, designated on any associated Purchase Order or Contract or any operating system to which an exchange is allowed under any associated Purchase Order or Contract, if applicable.

12.4. "Documentation" means the Software Documentation and the Third Party Documentation.

12.5. "Effective Date" means the date on which this Agreement has been executed by both Licensor and Licensee, as indicated on the signature page to this Agreement.

12.6. "License Fees" means the license fees payable by Licensee in accordance with Section 2.1, as specified in any associated Purchase Order or Contract.

12.7. "<u>Licensor Software</u>" means the computer programs and data in machine-readable form specifically listed as Licensor Software on any associated Purchase Order or Contract, together with any error corrections, updates, modifications or enhancements thereto furnished by Licensor in connection with the Maintenance and Support Services, Professional Services or otherwise.

12.8. "<u>Maintenance and Support Services</u>" means the software maintenance and support services furnished by Licensor with respect to the Software, as contemplated under <u>Article 3</u>.

12.9. "<u>Maintenance Fees</u>" means the fees payable by Licensee for Maintenance and Support Services, as specified in any associated Purchase Order or Contract.

12.10. "<u>Party</u>" means Licensor or Licensee, individually, and "Parties" means Licensor and Licensee, collectively.

12.11. "<u>Person</u>" means any individual, corporation, limited liability company, partnership, trust or other legal entity.

12.12. "<u>Professional Services</u>" means any programming, project management, consulting, installation, and/or training or education services provided by Licensor to Licensee, as contemplated in Article 4.

12.13. "<u>Site(s)</u>" means the physical location(s), as designated on any associated Purchase Order or Contract, for which information may be processed by the Software. A Site may contain more than one business operation (plant and warehouse). All Sites must be a part of the Business Unit's operations.

12.14. "<u>Software</u>" means the Licensor Software and any Third Party Software and/or Open Source Software specifically described on <u>Appendix A</u>, together with any error corrections, updates, modifications or enhancements thereto furnished by Licensor in connection with the Maintenance and Support Services, Professional Services or otherwise.

12.15. "<u>Source Code</u>" means the human readable form of the Software, including written comments and programmer documentation, flow charts, logic diagrams, pseudo code, notations or other supporting writings, regardless of the media on which it is stored, and intended for translation into an executable or intermediate form, or is intended for direct execution through interpretation.

12.16. "<u>Software Documentation</u>" means all operator and user manuals, education materials, guides, listings, specifications and other materials, including on-line information and materials, relating to the use of the Licensor Software delivered to Licensee as described in Exhibit A.

12.17. "<u>Third Party</u>" means the third party(s) owner(s) of all right, title and interest in and to the Third Party Components or Software and Third Party Documentation.

12.18. "<u>Third Party Documentation</u>" means all operator and user manuals, education materials, guides, listings, specifications and other materials, including on-line information and materials, relating to the use of the Third Party Components or Software delivered to Licensee in connection with this Agreement.

12.19. "<u>Third Party Components or Software</u>" means the computer programs and data in machine-readable form specifically designated as Third Party Software on Exhibit A or Appendix A, together with any error corrections, updates, modifications or enhancements thereto furnished by Licensor in connection with the Maintenance and Support Services, Professional Services or otherwise.

Appendix A

Third Party/Open-Source Software License Summary

SEPAC Releases

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