



Power

Novus FXM 650, 1100, 2000

> *Total Power Solutions by Alpha Technologies*



Uninterruptible Power Supplies
Operator's Manual
Rev 0408

Overview

Introduction

The Novus FXM is available in 3 models – FXM 650, FXM 1100 and FXM 2000. The FXM 650 and the FXM 1100/2000 look different, but all of the front panel connectors and circuit breakers operate in the same way. However the circuit breakers for each unit have different ratings. See “Specifications” on page 89 for details. All units operate in the same way unless stated otherwise in this manual.

The FXM 650 is available in the following two version:

- FXM 650-24VDC – with a 24 VDC battery string voltage
- FXM 650-48VDC – with a 48 VDC battery string voltage

The FXM 1100 is available in the following version:

- FXM 1100-48VDC – with a 48 VDC battery string voltage

The FXM 2000 is available in the following version:

- FXM 2000-48VDC – with a 48 VDC battery string voltage.

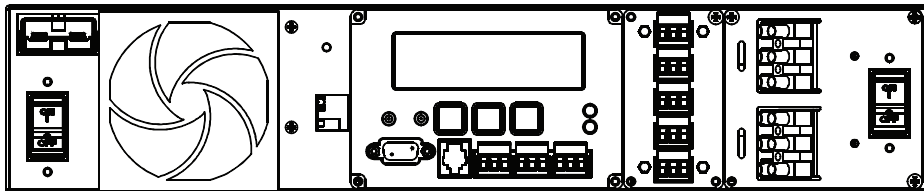


Figure 3.1- FXM 650 Front Panel

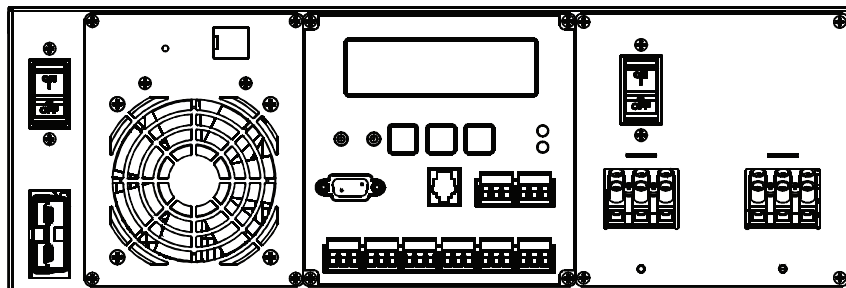


Figure 3.2- FXM 1100/2000 Front Panel

Front Panel Description

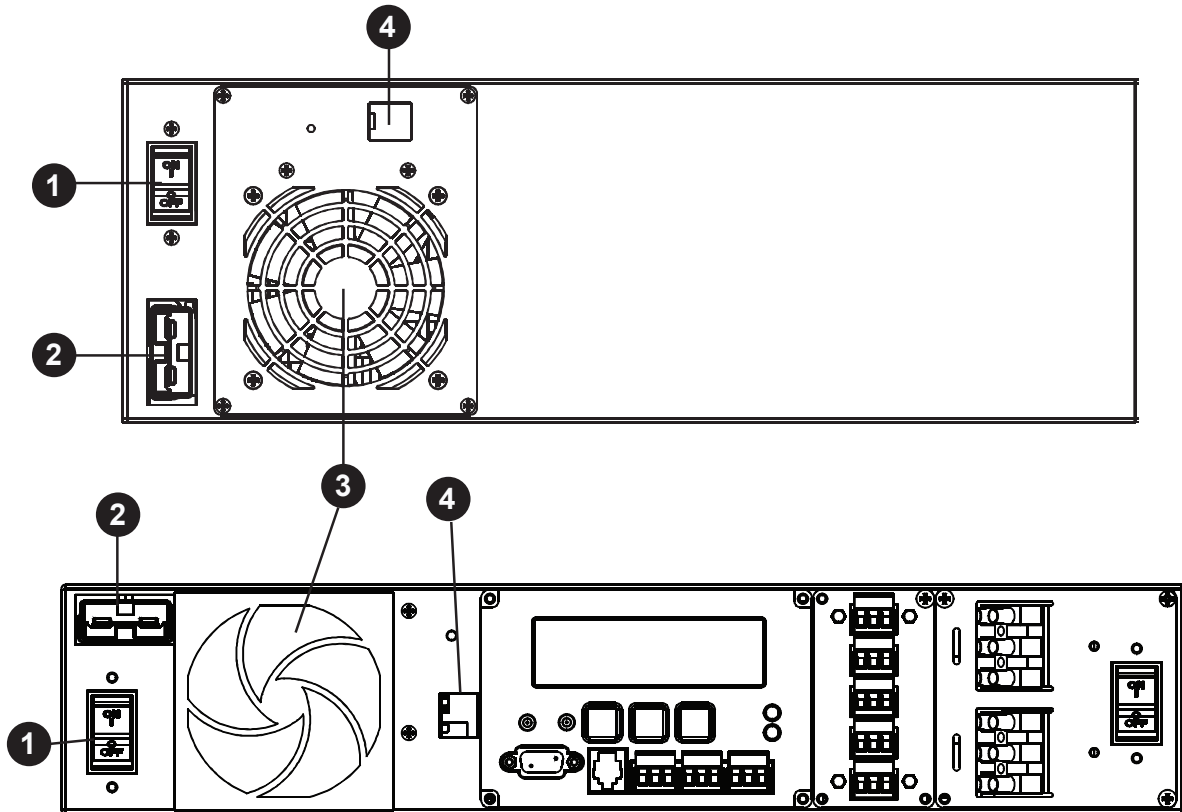


Figure 3.3 - Front Panel Description

- 1** *Battery Breaker*

This circuit breaker provides overcurrent protection and is an on/off switch for battery power. It must be on for proper FXM operation.
- 2** *Battery Connector*

This connects the external batteries to the FXM.
- 3** *Internal Fan*

This microprocessor-controlled fan regulates the FXM's internal temperature for optimum performance. It must not be blocked. If the fan fails, an Alarm is generated (See "Troubleshooting" on page 87).
- 4** *LAN*

This optional RJ-45 connector is the FXM's Ethernet connector.

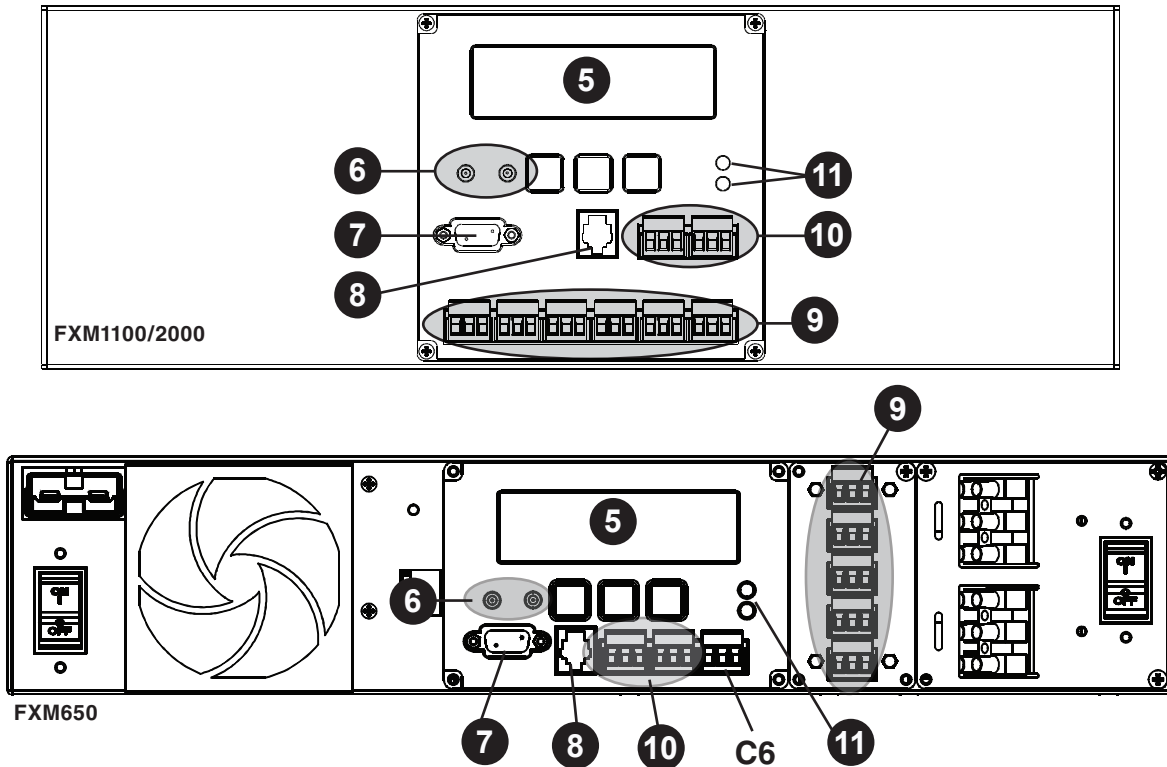


Figure 3.4 - Front Panel Description (cont'd)

5 *LCD Control Panel*

This panel and the cancel, scroll and select buttons below it let you monitor and control the FXM. More information is given in “Operation” on page 33.

6 *Battery Voltage Test Points*

These let you measure the battery voltage. They accept 2 mm diameter test probe tips. The battery circuit breaker must be on to measure the voltage.



Note: The battery voltage test points are not and should not be used as a power outlet.

7 *RS-232*

This DE-9 connector allows you to use a straight-through DE-9 to DE-9 connector cable to connect the FXM to a computer for remote control and monitoring. See “Communicating with the RS-232 Interface” on page 44.

8 *Battery Temp*

This connector attaches the battery temperature sensor

to the FXM for it to monitor the battery temperature. The charging voltage is temperature dependant and the FXM's microprocessor adjusts it for optimum charging.

- The sensor **MUST** be attached to the FXM for normal operation. Firmly attach the sensor end to the centre battery's case with high-strength flameproof tape (such as duct tape) as shown in "Wiring the External Batteries" on page 28. If it isn't, a "Temperature Probe Unplugged" alarm will appear on the LCD. See "Troubleshooting", Temp Probe Unplugged on page 87.

9 Contacts C1 to C6

Contacts C1 to C5 allow you to connect the FXM to an external monitoring panel or to traffic control equipment.

The factory default settings are as given below, but you can program them to meet your requirements (See "Programming the Dry Contacts and the Clock" on page 51). See also "Novus User Software, Operations, Relay and Load Shed" on page 63.

For Contact C6, the default factory configuration for the FXM 650-48, FXM 1100 and FXM 2000 is +48VDC output (FXM 650-24 is +24VDC), but it can be factory configured as a dry contact.

Figure 3.5 shows the contact's layout while Figure 3.6 shows the +48VDC or +24VDC terminal block layout.

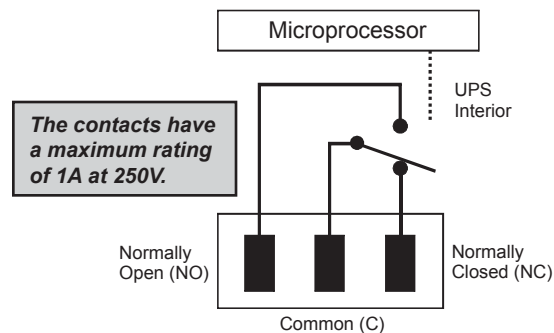


Figure 3.5 - Contact Layout
(Standard for C1 to C5, Factory Option for C6)

- **C1:** This contact is energized when line power is unqualified and the FXM provides backup battery power to the load(s). It can be called the "On Battery" contact.
- **C2, C3:** These contacts are energized when the battery drops below a pre-set voltage level. They can be called the "Low Battery" contacts.

You can change the pre-programmed level to match the batteries used and the actual operating conditions. **See**

“Operating the Novus FXM “#35 Low Battery Warning Voltage.” on page 40.

- **C4:** This contact is energized after the FXM has been in Inverter mode for 2 hours. It can be called the “Timer” contact.

You can change the pre-programmed 2 hours to match your operating conditions. **See** “Programming the Dry Contacts and the Clock, Setting the Timer Contact.” on page 52.

- **C5:** This contact is energized when the FXM is operating close to the specified limits. It can be called the “Alarm” contact.
- **C6:** The factory default layout for this contact is a relay that is energized when the FXM is in Line or Inverter modes and is de-energized when it is in Standby mode. It provides 48VDC (500 mA) or 24VDC (500 mA) from the external batteries to an external fan or other equipment. C6 can be factory-configured as a dry contact.

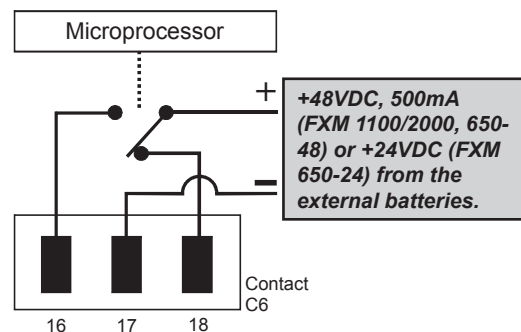


Figure 3.6- 48VDC/24VDC Contact Layout
(De-energized Shown, Factory Default for C6)

10 Contacts C7 and C8

These optically isolated inputs let you attach an external switch panel for remote control of the FXM or have the FXM control Alpha Technologies’s optional Automatic Transfer Switch (ATS).

- **User Input (C7):** This relay has 3 contacts to control the FXM (Figure 3.7). They are:
 - 19 (S1):** Shorting this contact starts the FXM’s self test. Also see “Operating the FXM, Self Test.” on page 40.
 - 20 (S2):** Shorting this contact activates an alarm. Also see “Troubleshooting”, User Input Alarm on page 87.
 - 21 (S3):** Shorting this contact disables the AC output. There is no AC output power, the LCD display shows “SHUTDOWN” (Model 1000 only), but the FXM is still energized. A manual restart is required to put the FXM back to normal operation.

22 (C): Isolated return for contacts S1, S2 and S3. It is located on contact C8 (#22).

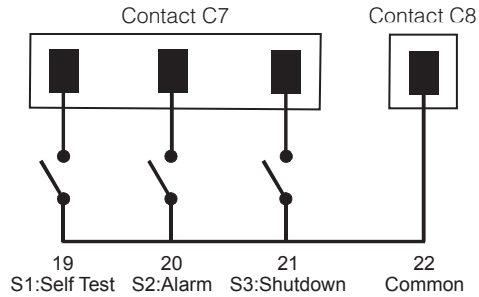


Figure 3.7- User Input Layout

- **ATS (C8):** When the FXM is in Inverter mode, this normally open relay closes (Figure 3.8), sending 48 VDC (FXM 650-48, 1100, 2000) or 24 VDC (FXM 650-24) from the external batteries to this dry contact. If the optional Alpha Technologies's Automatic Transfer Switch (ATS) is connected, it will cause the ATS to switch the load from line power to the FXM's battery backup power.

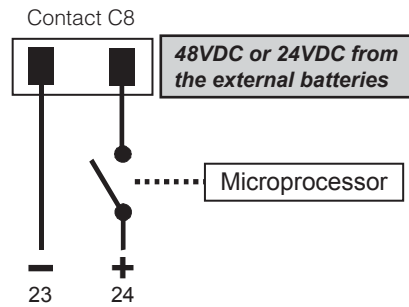


Figure 3.8 ATS Layout

11 Status and Alarm LEDs

- **Status:** When this green LED is on, the FXM is in Line mode and line power is provided to the load. When it is flashing, it is in Inverter mode and backup battery power is provided to the load.
- **Alarm:** When this red LED is on, the FXM has a fault. When it is flashing, it has an alarm (**See** "Troubleshooting" on page 87).

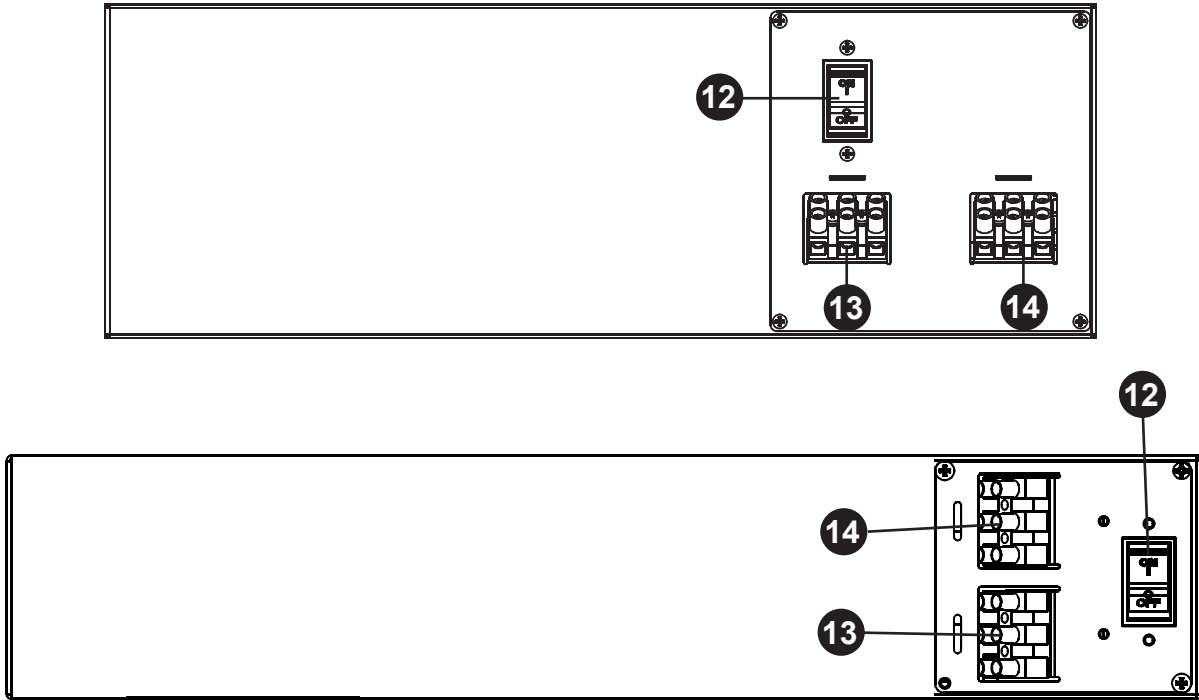


Figure 3.9 - Front Panel Description (cont'd)

12 *Input Circuit Breaker*

This circuit breaker is an on/off switch for line power into the FXM and provides input protection. It must be on for proper FXM operation.

13 *Input Terminal Block*

This terminal block is the FXM's AC line power input.

14 *Output Terminal Block*

This terminal block is the FXM's AC power output.

Wiring the External Batteries



WARNING

The batteries must be installed by qualified personnel trained in the safe use of high-energy power supplies and their batteries.. Refer to Product Safety Information on page 5.

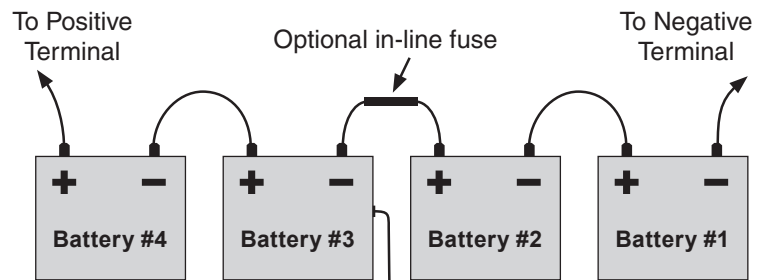


Notes:

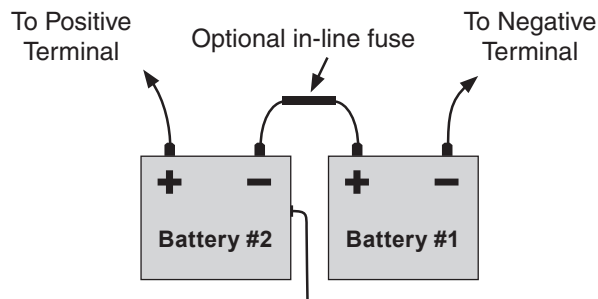
1. Use new batteries when installing a new unit. Verify they are all the same battery type with identical date codes.
2. For the FXM 650-24, the battery string is 24VDC. For the FXM 650-48/1100/2000, the battery string is 48VDC.
3. If you are making your own battery wiring harness, use at least 10 AWG (for FXM 650/1100) or 8 AWG (FXM 2000).
4. The battery return connection is to be treated as an Isolated DC return (DC-I) as defined in GR-1089-CORE.

Procedure

1. For FXM 650-48/1100/2000 (48 V battery string), number the batteries from 1 to 4 with labels or tape. For FXM 650-24 (24 V battery string), number the batteries from 1 to 2. See Figure 3.11.



Tape the battery temperature sensor to the side of either battery #2 or #3.



Tape the battery temperature sensor to the side of either battery #2 or #1.

Figure 3.11- External Battery Wiring (for 48VDC string (top) and 24VDC string)

2. Coat the battery terminals with battery corrosion inhibitor.



Caution: Torque the battery terminals according to the manufacturer's specifications as given on the name plate or data sheet.

3. Wire the batteries as shown in Figure 3.11. If used, install the in-line fuse as shown.
4. Verify battery connector polarity and DC voltage with a DC voltmeter. If correct, attach it to the FXM's external battery connector. Otherwise, perform troubleshooting before connecting it to the FXM.
5. Route the sensor end of the battery temperature cable to the batteries. Tape it to the side of battery as shown in Figure 3.11.
6. If multiple battery strings are used, repeat steps 1 to 4 as required.

Wiring the Novus FXM



WARNING

Make sure the line power is off. Turn off all input and output circuit breakers on the FXM before making any electrical connections.



WARNING

If stranded wires are used to connect the input and output terminal blocks, ferules or equivalent crimping terminals must be used.

Procedure

1. Connect the temperature sensor to the FXM (Batt Temp connector **8** in Figure 3.4 on page 15). Attach the end of the battery temperature sensor to the side of the centre battery (See Figure 3.11).
2. If used, connect the following ports:
 - Ethernet port **4** in Figure 3.3,
 - RS-232 port **7** in Figure 3.4
 - Dry Contacts **9** in Figure 3.4
 - User Inputs **10** in Figure 3.4
3. Connect the load to the FXM's Output terminal block **14** in Figure 3.9. Torque to 12.0 lb-in (1.4 N-m).
4. Connect the line power to the FXM's AC Input terminal block **13** in Figure 3.9. Torque to 12.0 lb-in (1.4 N-m).



WARNING

Before proceeding, verify that the line wire is attached to the line terminal block, the ground wire is attached to the ground terminal block and the neutral wire is attached to the neutral terminal block to prevent accidental shocks or electrocutions.

5. Connect the external batteries to the Battery connector **2** in Figure 3.3. Refer to "Wiring the external batteries" on page 28.
6. If needed, attached the terminal block covers and battery harness restraining bracket (See "Mounting the Novus FXM" on page 26).

ATS/GTS Option

The ATS (automatic transfer switch) and the GTS (generator transfer switch) are two separate optional add-on switching units for the FXM family (FXM 650, 1100 and 2000). The ATS provides power and/or bypass capacity (automatic or manual) so the operator may disconnect the FXM family of products from line power for easy removal and servicing. In bypass mode, the loads are directly connected to the line power without any conditioning. The ATS and GTS can be used alone or together to allow the use of 3 different back-up sources (line, batteries and or generator). Refer to the ATS/GTS Installation Manual (Alpha P/N 020-161-B0) for details.



WARNING

Make sure you have read and understood the instructions given in the ATS/GTS Installation Manual before making any connection to the supply.

Installation and wiring instructions are provided on a separate installation manual (020-161-B0).

7. Operation

The following sections describe the operation of the Novus FXM.

- Operating the control panel on page 34.
- Turning the FXM On and Off on page 37.
- Replacing the batteries on page 83.
- Operating the Novus FXM on page 40.
- Making measurements on page 42.
- Viewing the 25-event log on page 43.
- Communicating with the RS-232 interface on page 44.

Operating the Control Panel

The LCD control panel provides “at a glance” monitoring. This panel, when used along with the **CANCEL**, **SCROLL** and **SELECT** buttons below it, lets you program, make measurements and troubleshoot the FXM. The layout is shown in Figure 7.1 below.

The FXM is monitored and controlled with a series of menus and submenus. The Menu Tree is shown in Figure 7.3. For a tutorial on how to use this panel, see “Replacing the Batteries” on page 83.

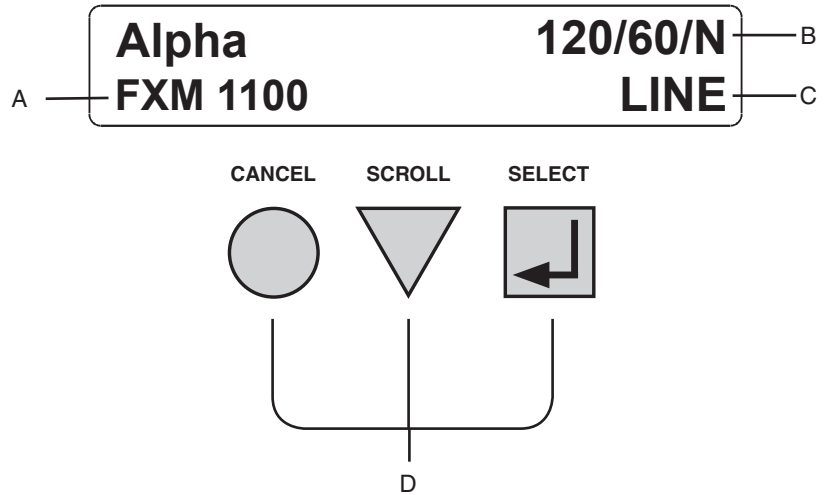


Figure 7.1 – LCD Control Panel (Logo Screen shown)

A **FXM model name**

B **FXM voltage configuration - 120 VAC or 230 VAC**

FXM Frequency - 50 Hz or 60 Hz

Sense Type setting - Normal (N) or Generator (G); see "Operating the Novus FXM", Sense Type on page 40..

C **Present operating mode - (LINE mode shown) See Figure 7.2.**

D Control buttons:

SELECT - Pressing SELECT moves you down 1 level in the menu tree (Figure 7.3) or accepts a change when programming (See page 40).

SCROLL - Pressing SCROLL moves you through the submenus (Figure 7.3) or toggles between choices when programming (See page 40).

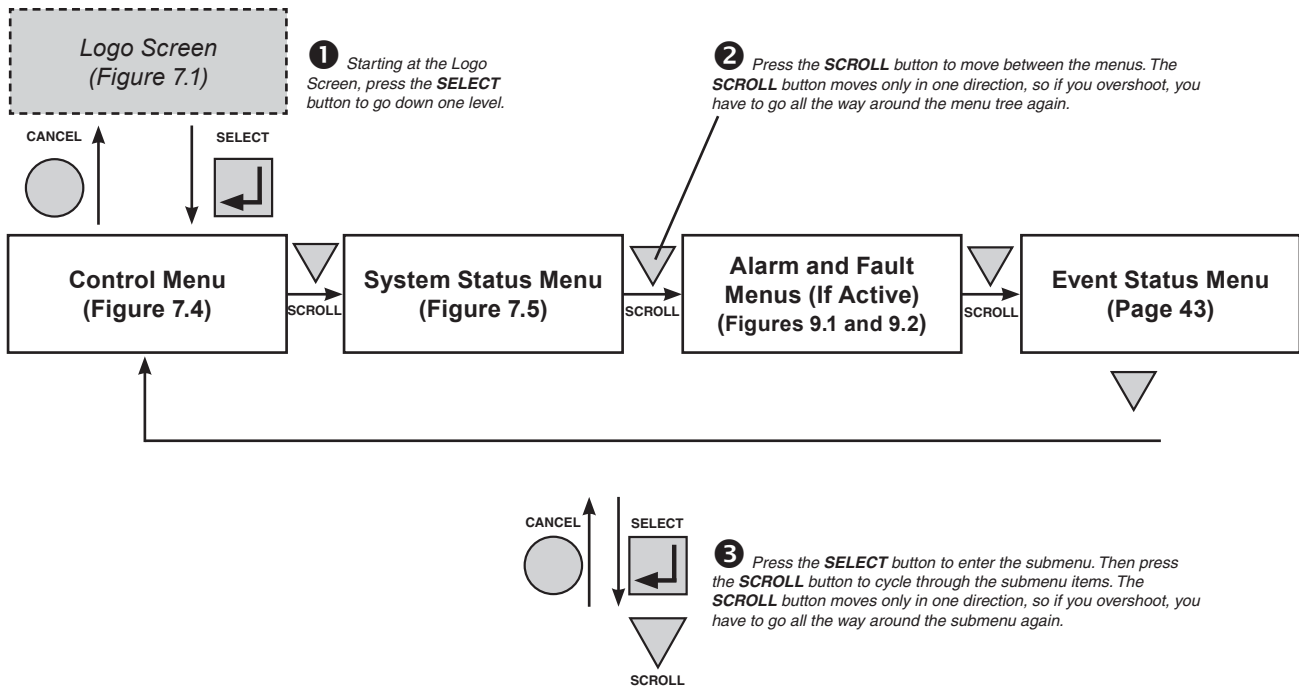
CANCEL - Pressing CANCEL moves you up one level in the menu tree (Figure 7.3).

The FXM's operating mode automatically changes as a result of changes in the line or the FXM's operating mode (Figure 7.2. Also see "Specifications, Boost/Buck/Line Transfer Thresholds" on page 89). The LCD panel automatically updates to reflect this.

UPS Operating Modes	
LCD Shows	Description
SHUTDOWN	The FXM's inverter is turned off. Line power is disconnected from the load.
LINE	The FXM is turned on. Line power is provided to the load.
BOOST1 OR BOOST2	The FXM's transformer is raising line voltage without using the batteries. AVR is enabled (See page 40).
BUCK1 OR BUCK2	The FXM's transformer is lowering line voltage without using the batteries. AVR is enabled (See page 40).
INVERTER	The FXM is providing backup battery power to the load. Also See Figure 7.4, "Control Menu, INVERTER".
RETRAN	The FXM is transferring from INVERTER mode to Line mode.
TRAN	The FXM is transferring from the state it is now in into Inverter mode.
STANDBY	The FXM is on and waiting for the line power to qualify or the user clear some faults. CAUTION: Do not touch the AC output terminals, which may be still energized.
BYPASS	This mode is manually set with the Control Menu (See Figure 7.4, "Control Menu, INV BYPASS") This locks the unit into line mode and turns off the battery charger so the unit can work with a manual break-before-make bypass switch.

Figure 7.2 – UPS Operating Modes

Pressing the CANCEL, SCROLL and SELECT buttons let you to navigate through the menus and submenus to control, monitor and troubleshoot the FXM as shown in Figure 7.3 below. For a tutorial on how to use these menus, see "Control Panel Tutorial" on page 83.



The **CONTROL MENU** (Figure 7.4) lets you control, program and adjust the FXM for connection to traffic intersection equipment or other applications. You can control the:

- INVERTER
- INV BYPASS
- BATT TEST
- AUTO TEST
- SHUTDOWN
- SENSE TYPE
- FUNC MODE
- VOLTAGE
- FREQUENCY
- QUAL TIME
- BATT COMP
- DATE SEL
- INV RECORD
- CHARGE CUR

The **SYSTEM STATUS** menu (Figure 7.5) lets you measure various inputs, outputs and other values. The available measurements are:

- VIN
- VOUT
- IOUT AC
- BATT TEMP
- FREQ IN
- OUTPUT PWR
- BATT VOLT
- CHGR CUR
- DATE
- TIME
- INV COUNT
- INV TIMER
- SHED TIMER 1, 2 OR 3
- VERSION

The **ALARM and FAULT** menus (Figures 9.1 and 9.2) are invisible and disabled until the FXM has a malfunction.

When the front panel's alarm LED is on or flashing, press **SELECT**.

One of the malfunctions listed in Figures 9.1 and 9.2 will appear on the LCD. Press the **SCROLL** button to see if more than one malfunction is present.

Fix the malfunction. Press the **SELECT** button to clear the malfunction from the screen.

If the malfunction is fixed, the malfunction is cleared from the LCD. If it isn't fixed, it will reappear on the screen.

The **EVENT STATUS** menu (See page 43) displays the last 25 FXM events on the LCD. For the 100-event log, see page 54.

Press the **SELECT** button to access the menu. Press the **SELECT** then the **SCROLL** button to scroll through the events. To see what a specific event was, press the **SELECT** button. Press the **SCROLL** button to see what malfunction triggered the event.

Figure 7.3 - LCD Menu Tree

Turning the Novus FXM On and Off

Under normal operation, the FXM is always powered ON to supply uninterruptible power to the load. By turning off the FXM, the power supply to the load will also be disconnected. If for any reason you need to turn off the FXM while maintaining power to your critical load, make sure that you have a plan in place to provide an alternate source of power.

Turn Off Procedure

1. Turn off the AC input circuit breaker.
2. Turn off the battery circuit breaker. The status LED turns off and the LCD panel goes blank.

The FXM is now turned off and no backup power is supplied to the load.

Turn On Procedure (LINE mode)

Before you put the FXM back into commission, make sure that the line is qualified and the batteries are fully charged.

1. Turn on the battery circuit breaker. The LCD displays **STANDBY** and the fan turns on for about a minute.



Notes

- i. If the temperature is below -15°C , the LCD display may not function. See "Troubleshooting" on page 88.
- ii. Turn on the AC input circuit breaker. The FXM qualifies the line power. The LCD displays **RETRAN**, then shows **LINE**, **BUCK** or **BOOST**. The status LED turns on.
- iii. If there is no line power, the FXM will remain in STANDBY mode until the line power is qualified. If you need to provide backup battery power to the load, perform a manual start by using the inverter command (See "Operating the Novus FXM Inverter" on page 40).
- iv. The FXM has auto-frequency detection. When it is first turned on, it senses the line frequency and adjusts its output frequency to match that of the input (Also see "Specifications" on page 89). The load should be receiving power, If not, perform troubleshooting on page 87.

Switching the FXM from Line mode to Inverter mode

You can also force the FXM to operate in the inverter mode by manually turning off the input circuit breaker. Doing so will effectively disconnect any line power to the FXM, simulating a power outage which triggers the FXM to switch to the inverter mode of operation.

Procedure

1. Turn off the input circuit breaker. The LCD shows **INVERTER**, the status LED starts flashing to show the FXM is running on backup battery power. Confirm that the load is receiving power.

Switching the FXM from Inverter mode to Line mode

The FXM remains in inverter mode for as long as the input circuit breaker is turned off. Backup power is provided to the load until the batteries are drained to a preset level which triggers the FXM to shutdown automatically. If it is not necessary to operate the FXM in inverter mode, you should switch the FXM back to Line mode as soon as possible.

Procedure

1. Turn on the input circuit breaker. The FXM qualifies the line power. The LCD displays **RETRAN**, then shows **LINE**, **BUCK** or **BOOST**. The status LED turns on.



Note

If the FXM constantly switches between Inverter and Line modes due to a noisy line, the FXM's input parameters should be broadened from normal to generator (See "Operating the Novus FXM, Sense Type." on page 40. Also See Specifications, "Boost/Buck/Line Transfer Thresholds" on page 89).

In generator mode, the range of acceptable input frequency and voltage is expanded to accept the fluctuations created by a generator.

Operating the Novus FXM

The control menu (Figure 7.4) lets you operate the FXM or program it to suit your operating conditions. You can also use the Novus User Software to make these adjustments (See “Novus User Software” on page 56).

Procedure

1. From the logo screen (See Figure 7.1) go to the Control Menu (See Figure 7.3).
2. Press the **SELECT** button to enter the submenu (See Figure 7.4).
3. Press the **SCROLL** button to move between items in the submenu.
4. When you have reached the item you want to change, press the **SELECT** button. The item chosen is blinking.
5. To toggle between the choices, press the **SCROLL** button. Stop when you reach the choice you want.
6. To make the change, press the **SELECT** button. The blinking stops.

Control Menu		
LCD Shows	Meaning	Description
INVERTER	Inverter	When turned on, this forces the FXM to provide backup battery power to the load. This can only be activated when the FXM is turned on and there is no line power available. <i>Also See</i> “Adjusting and Controlling the Novus FXM, #31 Inverter On/Off.” on page 50.
INV BYPASS	Inverter Bypass	This function can only be turned on when the FXM is in line mode. When turned on, this locks the FXM into line mode, turns off the battery charger and makes the output voltage equal to the input voltage. This is done to: Replace the batteries (<i>See</i> page 83). OR Allow the use of a break-before-make manual bypass switch so the FXM can be shut off for maintenance or replacement without interrupting power to the load.
SELF TEST	Self Test	This is the FXM’s self test. When it is turned on, the FXM is forced to verify its proper operation by providing backup battery power to the load and then switches back to Line mode. The default setting for the run time is 2 minutes, but this can be changed in the RS-232 menus (<i>See</i> “Adjusting and Controlling the Novus FXM #30: Self Test Options” on page 50.).
AUTO TEST	Automatic Test	If the GUI’s periodic self test is enabled (<i>See</i> page 56), this starts the test no matter when it is scheduled to take place.
SHUTDOWN	Shutdown	When this function is turned on, the FXM’s inverter is shut off. The line is disconnected from the load, so no line power is provided to it.
SENSE TYPE	Sense Type	This function can only be used when the FXM is in Standby or Shutdown mode (See Figure 7.2). This function toggles between: NORMAL: The FXM can operate successfully with most line conditions. or GENERATOR: The FXM’s input voltage and frequency parameters are expanded so the FXM can work with the fluctuations caused by a generator or noisy line.

Control Menu		
LCD Shows	Meaning	Description
FUNC MODE	Functional Mode	The functional mode can only be changed when the FXM is in Standby or Shutdown mode (See Figure 7.2. Also See Specifications, "Boost/Buck/Line Transfer Thresholds" on page 89). This function toggles between: AUTOMATIC VOLTAGE REGULATION (AVR): The buck and boost modes are active. OR QUALITY: The buck and boost modes are turned off, the input voltage is the FXM's output voltage. If you are connecting an Alpha Technologies Automatic Transfer Switch (ATS) to traffic intersection equipment, then you MUST switch the FXM to quality since most traffic equipment cannot handle the high voltage output of the FXM when it is in AVR mode.
VOLTAGE	Voltage	This lets you set the FXM's output voltage setting to 120VAC, 230VAC or 220VAC. This should ONLY be done by a qualified technician acting under the instructions of Alpha Technologies customer service department. Failure to contact Alpha technologies before doing this procedure could result in voiding of the warranty.
FREQUENCY	Frequency	The frequency can only be changed when the FXM is in Standby mode. This lets you set the FXM's frequency setting to 50Hz or 60Hz. This should ONLY be done by a qualified technician acting under the instructions of Alpha Technologies customer service department. Failure to contact Alpha technologies before doing this procedure could result in voiding of the warranty.
QUAL TIME	Line Qualify Time	This lets you set how long it takes for the FXM to return to Line mode after the line has become requalified to make sure the line is stable. It can be set to 3, 10, 20, 30, 40 or 50 seconds. The factory default setting is 3 seconds. Also See "Adjusting and Controlling the Novus FXM, #34: Line Qualify Time." on page 50.
BATT COMP	Battery Temperature Compensation	This lets you set the battery temperature compensation to match the batteries you are using. It can be set to -2.5, -4, -5 or -6 mV/°C/Cell. The factory default setting is -5 mV/°C/Cell.
DATE SEL	Date Format Selection	This lets you toggle the FXM's date format between YY-MM-DD or MM-YY-DD, DD-MM-YY, YYYY-MM-DD, MM-DD-YYYY OR DD-MM-YYYY. The factory default setting is MM-DD-YY.
INV RECORD	Inverter Record Clear	This clears the inverter counter and timer from the LCD's system status menu (See page 43). This does not clear the 100-event log in the RS-232 menus (See page 54).
CHARGE CUR	Charger Current	This allows you to set the battery charger current to either 0A, 3A, 6A or 10A. NOTE: If you set the battery charger to 0A, you will turn the charger off.

Figure 7.4 – Control Menu