

**Intuicom<sup>®</sup>**

**DIO Transceiver**

**User Guide**

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## 1 Overview

The Intuicom DIO wireless transceiver is a single product capable of being configured to perform any role in a remote contact closure/discrete IO application. The DIO has eight inputs, eight outputs, and can be configured as a base, remote, or remote/repeater. The DIO is capable of operating bi-directionally (sending and receiving contact-closure signals) in both Point-to-Point and Point-to-Multipoint architectures. The DIO features the ability to perform message confirmation and notification of link integrity.

Combining bi-directional IO capabilities with individually addressable units, the DIO support an almost limitless combination of configurations. Units can be sending and receiving IO signals while repeating signals for other units – no dedicated repeater units required.

The DIO is available in spread-spectrum 900MHz and 2.4GHz license-free models. The DIO can be configured using Intuicom CommPro™ software or through any terminal emulation program – any available PC in the field can be used for configuration.

DIO applications include:

- Traffic Controller signaling: loop detectors, metering, counters, remote power and signage.
- General SCADA: remote power control, event monitoring
- Security: remote event detection, remote alarm triggering
- Timing signal distribution

## 2 Network Architectures

### 2.1 Point-to-Point

The following diagram depicts a basic point-to-point architecture where the inputs of each DIO are mapped (by configuration) to the outputs of the other. Point-to-point configurations are the simplest to configure, and also result in the lowest end-to-end latency.

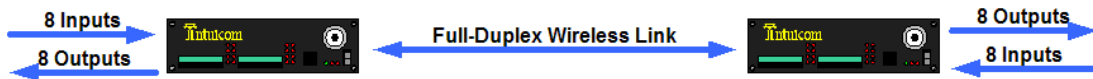


Figure 2-1: Point to Point Network Architecture

### 2.2 Point-to-Multipoint

The following diagram depicts a point-to-multipoint network architecture, where one master DIO transceiver is linking with an unlimited number of remote or slave DIO transceivers. While the master DIO transceiver is configured to listen to up to eight inputs (could be eight from one remote, or one each from eight remotes, etc), the remote DIO transceivers can be configured to listen to one or more of the master DIO's inputs.



Figure 2-2: Point to Multipoint Network Architecture

### 2.3 Utilizing a Repeater

The following diagram depicts a point-to-multipoint network architecture with one DIO transceiver utilizing the slave/repeater function allowing it to act as both a remote and a repeater for other remotes simultaneously.

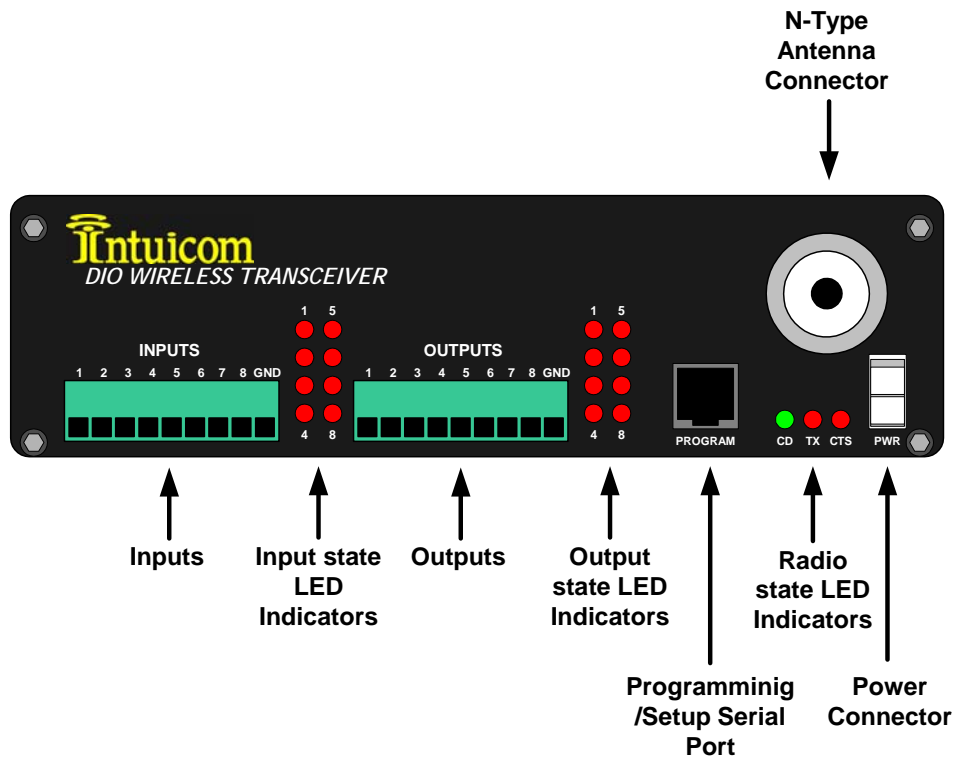


**Figure 2-3: Point to Multipoint with Repeater**



### 3 DIO Front Panel

All connectors and LED indicators for operation of the DIO Transceiver are available on the front panel.



**Figure 3-1: DIO Transceiver Front Panel**

## 4 Power Connection

The DIO accepts an input voltage between 6 and 30 VDC. The mating power connector has a locking ramp (Molex P/N: 39-01-2020). The DIO is supplied with a AC to DC adapter (Intuicom P/N: FIP4-PSDIO-12). A DC cable is available as an optional accessory (Intuicom P/N: FIP4-PGDIO-xx).

Care must be taken to ensure the correct supply voltage polarity. The DIO can be damaged if the polarity is reversed –such damage is not covered under warranty.

The power connector's polarity is depicted in the following diagrams:

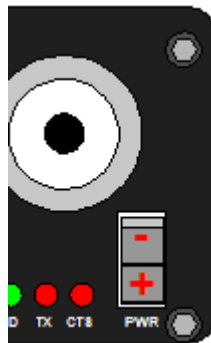


Figure 4-1: DIO Front Panel Power Jack

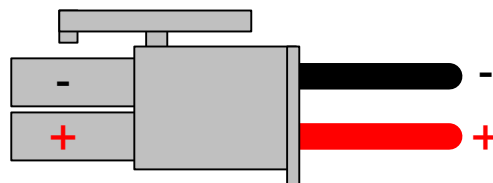


Figure 4-2: DIO Power Plug

## 5 Programming Cable Connection

A programming cable is required for configuration. A programming cable is included with each pair of radios. The programming cable has one DB9 female end and one RJ12 end. The programming cable pinout is as follows:

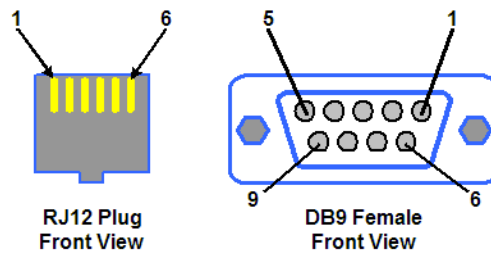


Figure 5-1: Programming Cable Connectors

RJ12 Plug Pins	DB9 Female Pins
1	5
2	4
3	8
4	2
5	3
6	7

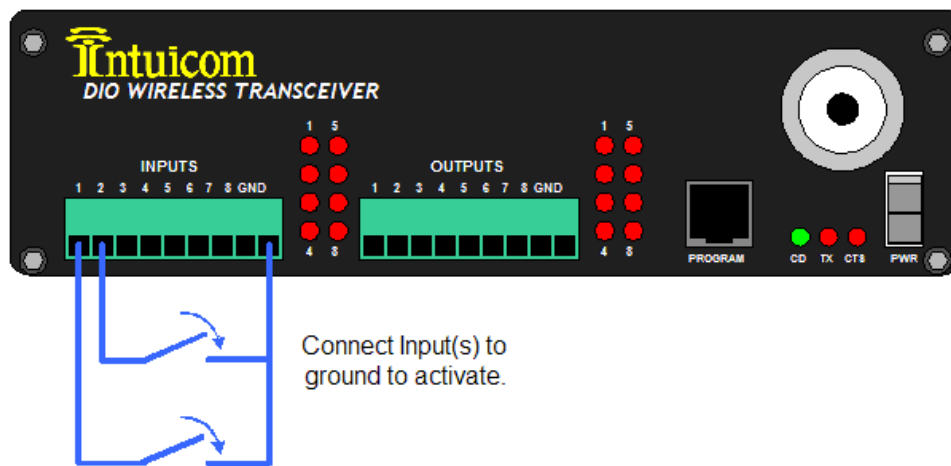
Table 5-1: Programming Cable Pinout

Replacement programming cables can be ordered from Intuicom (Intuicom P/N: FIP4-PRGDIO-R).

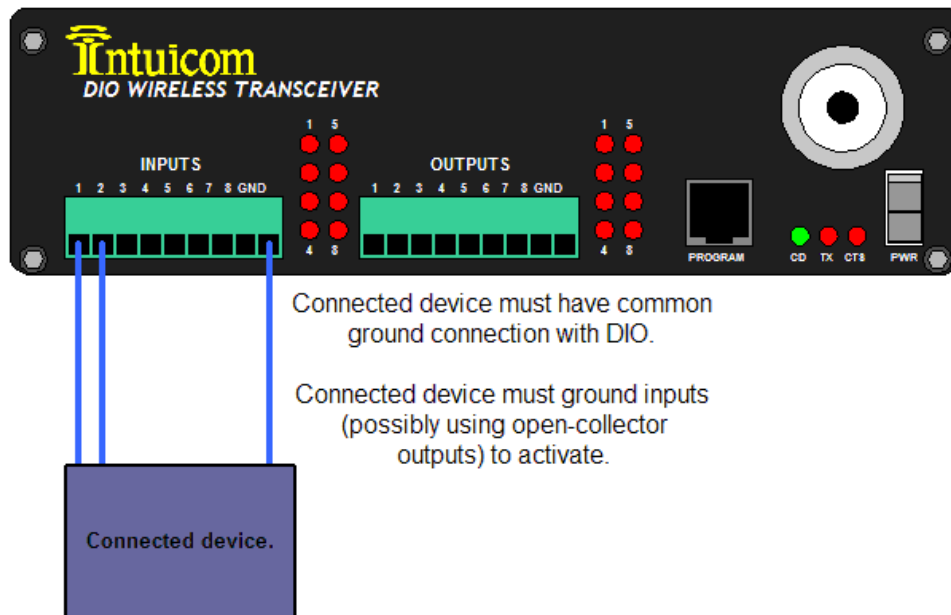
For setup, the programming cable must be attached to the RJ12 jack on the front panel of the DIO as well as connected to a DB9 male serial connection on a PC.

## 6 Inputs

The eight inputs on the DIO are ground activated and accept an input voltage range from 0 to 30 VDC. The detachable terminal block connector has nine positions: one position for each input, and one position for a common ground to the connected device(s). Inputs are activated by bringing the input to ground. This can be accomplished through a simple switch between the input and the common ground terminal. Inputs can also be activated by connecting them to another device's open-collector (or compatible) output – and connecting a common ground between the two devices. See the example wiring diagrams.



**Figure 6-1: Input Connection - Simple Contact Closure**



**Figure 6-2: Input Connection – Device**

## 7 Outputs

The DIO has eight mosfet open-drain outputs. mostfet open-drain outputs work like open-collector outputs, and can be thought of as low-current DC switches. Each output can sink up to 550ma, with the total across all outputs not to exceed 2A. The detachable nine position Phoenix terminal block connector has one position for each output and one position for a common ground connection to the connected device(s).

The DIOs outputs can be utilized in a number of ways. The following two examples depict different ways to interface the DIO outputs.

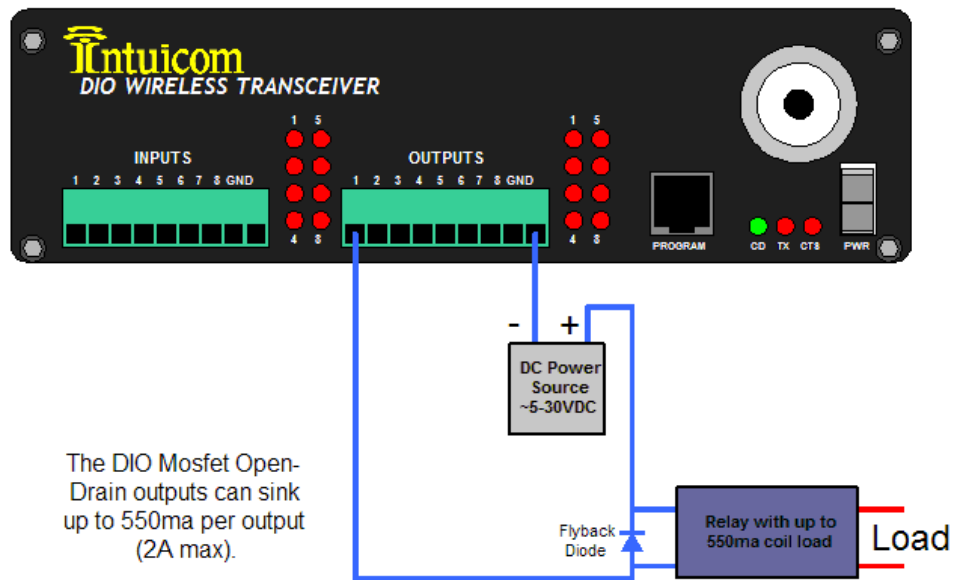


Figure 7-1: Output Connection - Relay

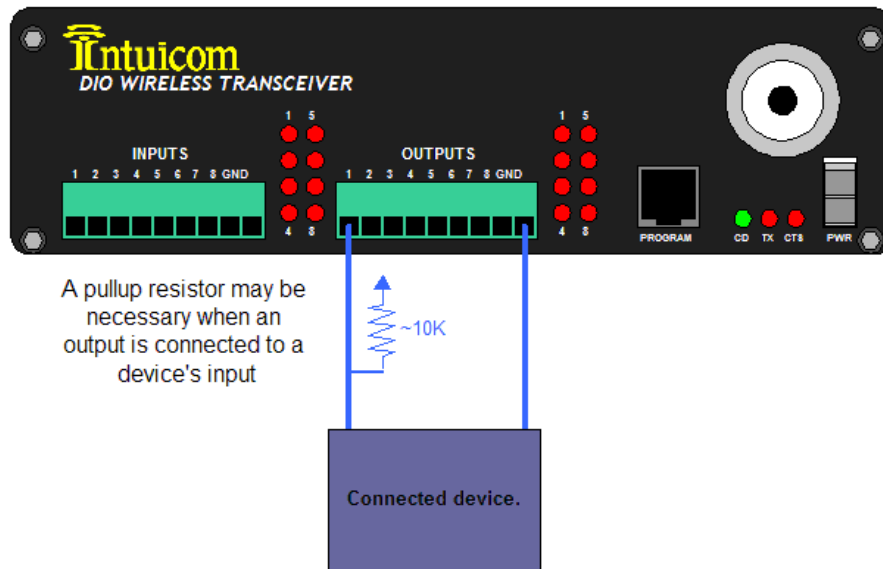


Figure 7-2: Output Connection - Device with Pullup Resistor

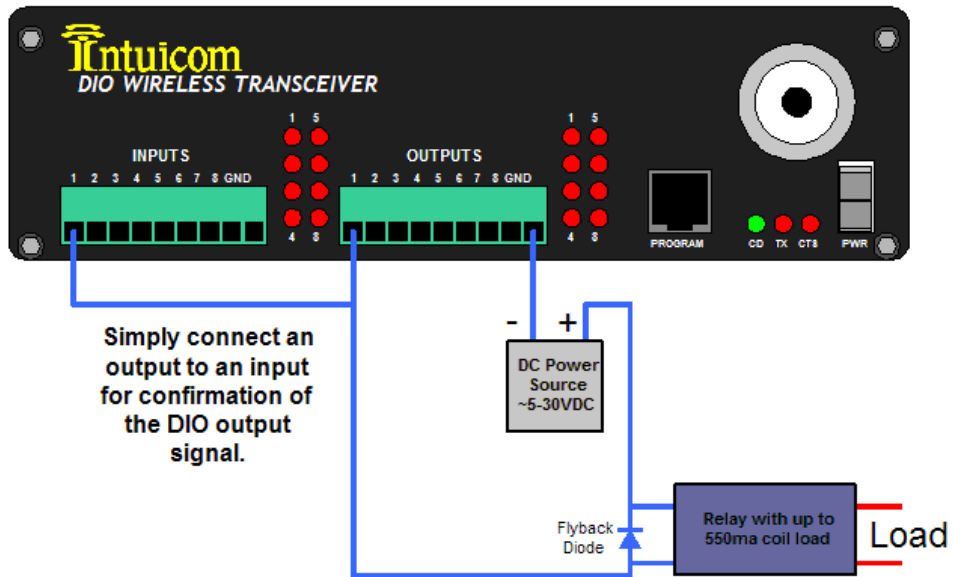
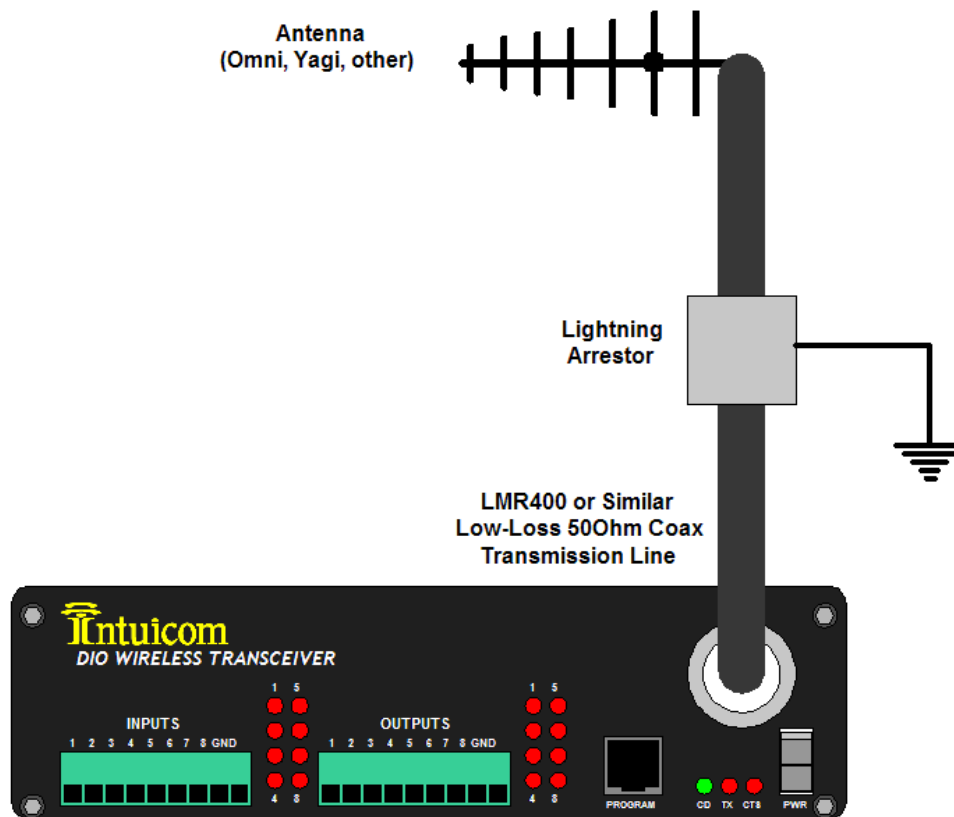


Figure 7-3: Output Connection - Relay with Confirmation

## 8 Antenna Connection

The DIO has an industry-standard N-Type female antenna connector on the front panel. Connect an antenna appropriate for the unit's frequency band (either 900MHz or 2.4GHz) and for the application (omni, yagi, etc) prior to operation.

- Be sure to use high-quality low-loss 50Ω coax cable (LMR400 or similar) for the transmission line between the antenna connector and the antenna.
- Ensure connector ends are correctly installed on the coax transmission line. Poorly made connections can appear good but severely degrade performance.
- Depending upon the installation location, an in-line lightning arrestor may be necessary to enhance safety and protect equipment.
- Be sure to adequately waterproof transmission line connections. Moisture present in connections may degrade performance and damage equipment.



**Figure 8-1: Antenna Connection**



## 9 Configuration

The DIO Transceiver is configured using Intuicom CommPro software. CommPro will allow the user to read, modify, and save a unit's configuration, as well as export a PDF copy for archival reference and documentation.

To be able to use CommPro to configure a DIO unit, be sure:

- CommPro is installed
- A serial port (COM port) is available
- A programming cable is connected between the COM port and the DIO unit's programming port
- Power is applied to the unit.

### 9.1 Configuration Process and Concepts

#### 9.1.1 Step 1: Create a radio configuration

Start CommPro and select the Configuration application. Create a new configuration by selecting **New...Config...DIO Transceiver (all Models)** from the menu.

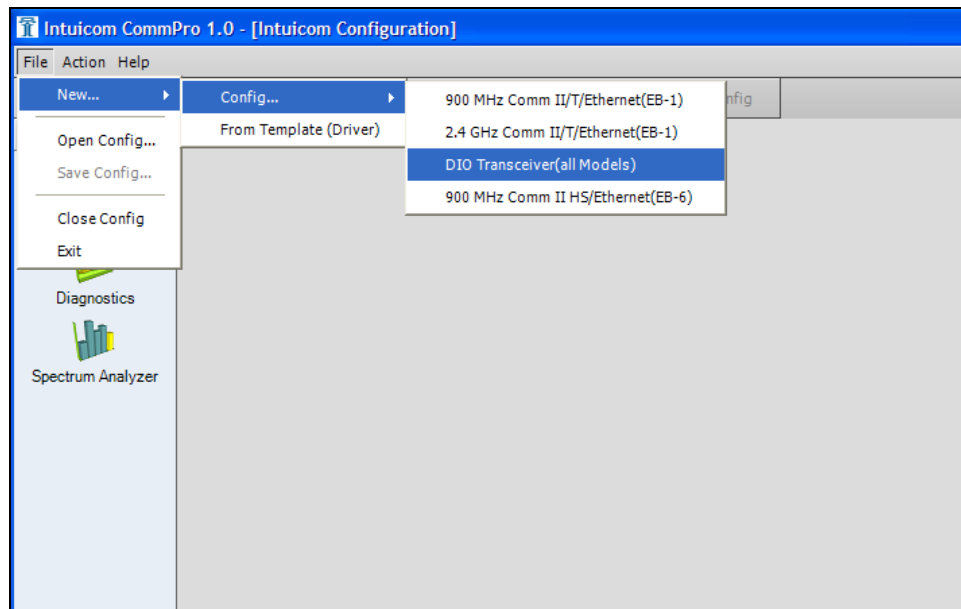


Figure 9-1: CommPro - Create new DIO Configuration

A default DIO configuration will appear in the configuration area of the screen. At this point you may choose to read the DIO's current configuration, by clicking on the “**READ CONFIG**” button on the toolbar, or simply modify the on screen defaults to suit.

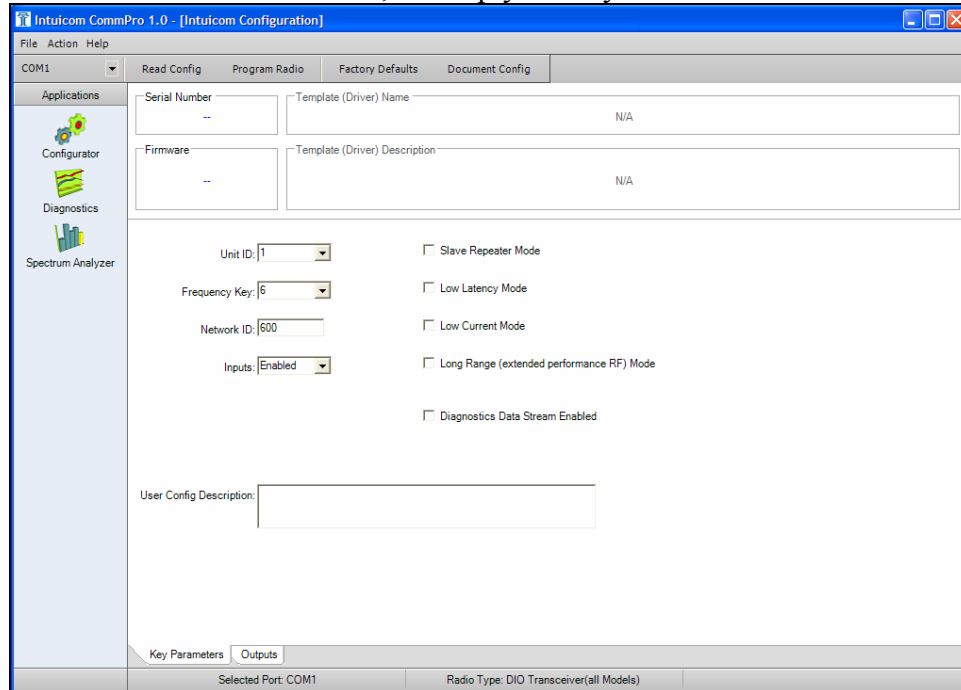


Figure 9-2: CommPro - Configuration Key Parameters

### 9.1.2 Step 2: Customizing the Configuration

The DIO configuration area has two tabs: *Key Parameters*, and *Outputs*. Start by modifying the parameters on the *Key Parameters* tab:

#### *Unit ID*

Each DIO unit in a given network should have a unique Unit ID. One (and only one) units is designated the Master DIO in the network, this unit must be assigned ID “0”. Unit IDs are used later to configure the DIO's outputs.

#### *Frequency Key*

All DIO units in a given network must have the same Frequency Key. DIO networks nearby each other should have different Frequency Keys to minimize interference. The actual value for the Frequency Key is not important, only that every unit in a network has the same value. It is recommended to change from the default value of “6”.

#### *Network ID*

Like the Frequency Key, all units in a given network must have the same Network ID to be able to communicate. A network ID can be any value from 1 to 4095 except 255.

Pick a value for Network ID and assign it to every unit that will participate in the same network.

### ***Inputs***

The Inputs parameter controls whether this unit's inputs are enabled or disabled.

### ***Slave Repeater Mode***

A given unit (except for the Master) can be a repeater while operating as a remote or slave unit. Note that this mode is not compatible with Low Latency Mode or Low Current Mode.

### ***Low Latency Mode***

This mode is designed to minimize state transition time latency from one input to a given output. This mode is intended to be used when units are operated in a point-to-point configuration. This mode is not compatible with Slave/Repeater Mode or Long Range Mode.

### ***Low Current Mode***

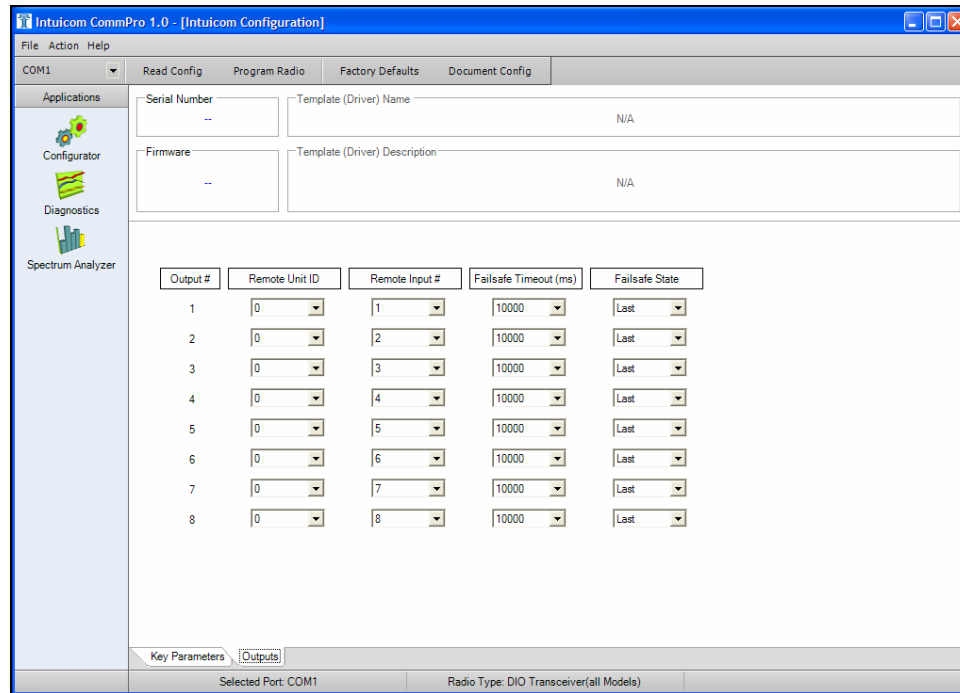
Low Current Mode can conserve power by disabling the Input and Output status LEDs.

### ***Long Range (Extended Performance RF) Mode***

Long Range Mode can improve RF performance in noisy RF environments at the cost of latency. All radios in a given network must be configured the same, either enabling or disabling this mode.

### ***Diagnostics Data Stream Enabled***

The option allows CommPro's Diagnostics module to connect and display real-time diagnostics for a network. This mode should only be enabled while operating diagnostics and should be disabled again after diagnostics analysis is complete. This mode is only valid when enabled (and should only be enabled) on the MASTER radio of a network.



**Figure 9-3: CommPro - Configure Outputs**

The **Outputs** tab of the configuration area has a table of parameters for configuring the DIO's Outputs. There is one row of parameters for each Output:

***Remote Unit ID***

This specifies which remote DIO unit this output number will follow, or “listen to.” This can be any valid ID in the network, but is cannot be THIS unit's ID.

***Remote Unit Input #***

This parameter configures which specific Input Number (1-8) on the Remote Unit's (configured with Remote Unit ID) Inputs to follow or “listen to.”

***Failsafe Timeout (ms)***

Failsafe Timeout specifies an amount of time in milliseconds to wait without hearing from the Remote Unit for this Output before driving the Output state specified by the next parameter, Failsafe State. The default timeout is 10s or 10000ms.

***Failsafe State***

There are four options for Failsafe State, the state that the output is driven to when the Failsafe Timeout time is exceeded: LAST, ON, OFF, or FLASH. LAST keeps the current state the same after the Failsafe Timeout time is exceeded. ON, drives the output into the ON or conductive state, OFF drives the output to the OFF or non-conductive state, and FLASH, alternates between ON and OFF at ~ 1Hz.

### 9.1.3 Step 3: Write Configuration to Radio

When all on-screen parameters have been set in CommPro, the configuration must be written to the attached unit to take effect. Writing to the radio is accomplished by clicking the “**WRITE CONFIG**” button on the toolbar.

The configuration can also be saved to a CommPro radio configuration file for later use. Select **FILE->Save Config** from the **FILE** menu to save the configuration.

A PDF of the configuration can be created by selecting the “**DOCUMENT CONFIG**” button from the toolbar.

### 9.1.4 Step 4: Test Configuration/Network

After configuring all DIO units for a given network, testing is recommended to confirm correct operation before deploying the units to the field.

## 9.2 Example Configuration

The following example configuration consists of two DIO units in a point-to-point configuration with one DIO's inputs mapped to the other DIO's outputs and vice-versa. Notice that one unit has a Unit ID of 0, making it the Master for the network.

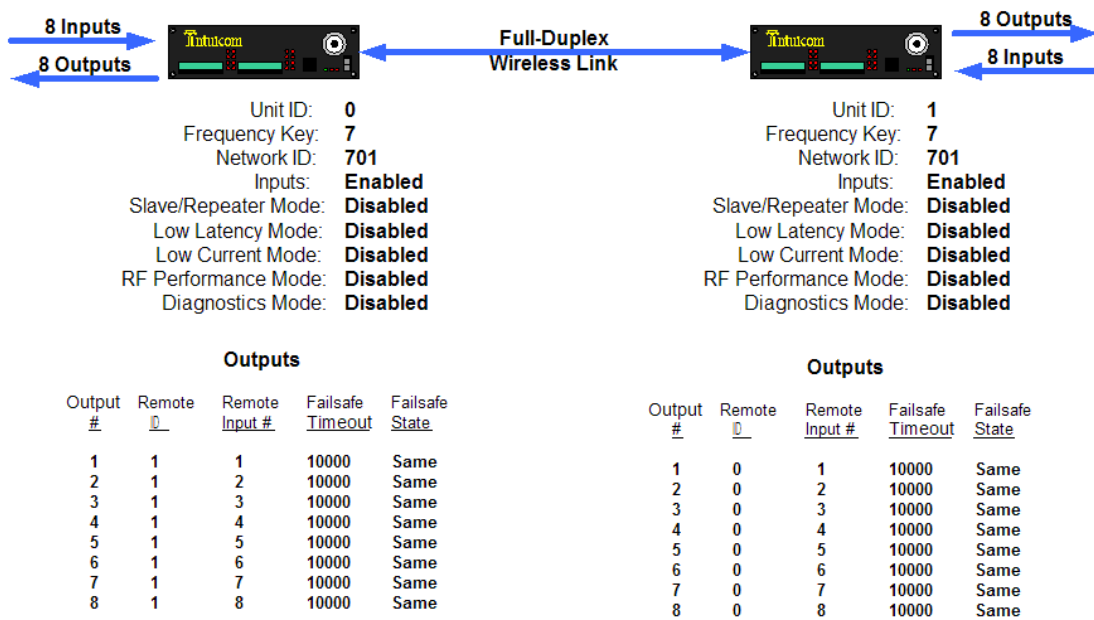


Figure 9-4: CommPro - Example DIO Network Configuration

# 10 Technical Specifications

## GENERAL SPECIFICATIONS

Enclosure	Ruggedized extruded aluminum		
Size	H: 46 mm (1.81") x W: 157 mm (6.18") x L: 111 mm (4.37")		
Weight	603.8 g (21.3 lbs.)		
Temperature Operating Range	-40° C to +75° C		
Connectors/Signals			
External Antenna	N Type Female, Professional installation only		
Setup/Diagnostic	RJ12, (TXD, RXD, CTS, RTS, GND), DCE		
Power	Locking Receptacle (MOLEX® Mini-Fit Jr.)		
Input Voltage	900 MHz: 6-30 VDC    2.4 GHz: 9.5-30 VDC		
Power Consumption (typical)			
Operating Mode	900 MHz at 24 VDC (mA)	2.4 GHz at 24 VDC (mA)	
Base	75	80	
Remote	55	70	
Remote/Repeater	83	98	
Operating Modes			
System Configurations	Point-to-Point (bi-directional), Point-to-Multipoint (bi-directional), Multipoint-to-Point (bi-directional),		
Unit Operational Modes	Base, Repeater, Remote, Remote/Repeater		

## WIRELESS TRANSCEIVER

SPECIFICATIONS	900 MHZ	2.4 GHZ	
Frequency Range	902-928 MHz	2.4-2.4835 GHz	
Transmitter			
Output Power	1000 mW	500 mW	
Range, Line of Sight	60 Miles	20 Miles	
Modulations	Spread Spectrum, GFSK	Spread Spectrum, GFSK	
Occupied Bandwidth	230 KHz	230 KHz	
Spreading Method	Frequency Hopping	Frequency Hopping	
Receiver			
Sensitivity	-108 dBm at 10 <sup>-5</sup> BER; -110 dBm at 10 <sup>-4</sup> BER	-108 dBm at 10 <sup>-5</sup> BER; -110 dBm at 10 <sup>-4</sup> BER	
Selectivity	20 dB at fc ± 115 KHz; 60 dB at fc ± 145 KHz	40 dB at fc ± 115 KHz; 60 dB at fc ± 145 KHz	
System Gain	140 dB	137 dB	
Data Transmission			
Error Detection	32 Bit CRC, retransmit on error	32 Bit CRC, retransmit on error	
Data Encryption	Substitution, dynamic key	Substitution, dynamic key	
I/O Interface Specifications			
Inputs	8 digital, 3-40 VDC, ground activated		
Outputs	8 digital, 550 mA Max Load current per output (mosfet open drain), 2 Amps total		
I/O Connector Type	Quick release terminal block		
Indicators			
Power	Yes		
Input	Yes		
Output	Yes		
Link	Yes		
I/O Timing Specifications (bi-directional)	<b>Low Latency Mode</b>	<b>Normal Mode</b>	<b>Long Distance Mode</b>
End-to-End Change Latency (typical)	bi-directional < 12 ms	bi-directional < 14 ms	bi-directional < 15 ms
Max. Change Frequency (Min. I/O Change Time)	25 Hz (20 ms)	20 Hz (25 ms)	10 Hz (50 ms)
Failsafe Time	100 ms - 10 s, user select	100 ms - 10 s, user select	100 ms - 10 s, user select

Note: Specifications subject to change without notice.

## 11 FCC Notification

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation. This device must be operated as supplied by Intuicom, Inc. Any changes or modifications made to the device without the express written approval of Intuicom may void the user's authority to operate the device.

**CAUTION:** The 900MHz Communicator II models have a maximum transmitted output power of 955mW. It is recommended that the transmit antenna be kept at least 23 cm away from nearby persons to satisfy FCC RF exposure requirements.

The 2.4GHz Communicator II models have maximum transmitted output power of 500mW. It is recommended that the transmit antenna be kept at least 23 cm away from nearby persons to satisfy FCC RF exposure requirements.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**Note:** Whenever any Intuicom module is placed inside an enclosure a label *must* be placed on the outside of that enclosure which includes the module's FCC ID.



## 12 Warranty

### **LIMITED WARRANTY TO END-USERS**

Intuicom, Inc.  
1880 South Flatiron Ct., Suite R  
BOULDER, CO 80301

- A. Standard Limited Warranty for Software Products. For Products that include a software license, INTUICOM makes a limited warranty to the End User that the software will perform substantially in accordance with the accompanying written materials and that the transfer media on which the Product is provided will be free from defects in materials or workmanship under normal use and service for a period of ninety (90) days from the date of delivery (the "Limited Warranty") pursuant to the software license included with the Product. The software license specifically disclaims all other warranties relating to the Products, including any and all other warranties with respect to the performance of the Products.
- B. Hardware and Other Equipment Manufactured By Intuicom. Hardware products manufactured by INTUICOM include a limited warranty for defects in materials or workmanship under normal use and service for a period of one (1) year from the date of delivery. Intuicom, at its sole discretion, will repair or replace hardware covered under this limited warranty. Cables, antennas or other accessories manufactured by INTUICOM include a limited warranty for defects in materials or workmanship under normal use and service for a period of ninety (90) days from the date of delivery. Repairs not covered under this limited warranty will be billed as set forth in INTUICOM's current Hardware Service Policy and Instructions.
- C. Hardware Manufactured By Others. INTUICOM makes no warranties whatsoever with respect to Hardware manufactured by third parties. Customers shall look only to the original manufacturer of the Hardware, pursuant to the terms of any manufacturer warranty for any alleged defects and indemnifies and holds INTUICOM harmless from and against any claims by any party related directly or indirectly to any defects in the Hardware, and functional failure, improper operation, failure to operate according to specifications or any other matter related to the Hardware. INTUICOM shall not be liable or responsible for the failure of the Manufacturer to perform under or honor any warranty with respect to the Hardware. Customer acknowledges and agrees that Customer shall have the risk of any loss, damage or functional failure related to the HARDWARE and shall have the responsibility for maintaining the proper operation of the HARDWARE and complying with all maintenance guidelines and specifications from the Manufacturer and all other conditions to receiving warranty coverage from the Manufacturer.
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