

Features

The Sure Cross® wireless system is a radio frequency network with integrated I/O that operates in most environments to eliminate the need for wiring runs.

- Wireless industrial I/O device with up to 12 sourcing discrete inputs or outputs. Default configuration is set to 6 inputs and 6 outputs (without bit-packing).
- 10 V DC to 30 V DC power input
- DIP switches for user configuration
- Modbus serial interface
- Site Survey analyzes the network's signal strength and reliability and displays the results on the Gateway's LCD
- Frequency Hopping Spread Spectrum (FHSS) technology ensures reliable data delivery
- Transceivers provide bidirectional communication between the Gateway and Node, including fully acknowledged data transmission
- Lost RF links are detected and relevant outputs set to user-defined conditions



For additional information, updated documentation, and a list of accessories, refer to Banner Engineering's website, www.bannerengineering.com.

Models

Models	Frequency	I/O
DX80G2M6S-P8-KR	2.4 GHz ISM Band	Discrete I/O: Up to 12 sourcing inputs or up to 12 sourcing outputs (for a total of 12 I/O) (Default configuration is 6 IN and 6 OUT, without bit-packing)

Configuration Instructions

Setting Up Your Wireless Network

To set up and install your wireless network, follow these steps.

For complete instructions, including binding, configuration, installation, weatherproofing, device menu maps, troubleshooting, and a list of accessories, refer to Sure Cross® Wireless I/O Network Instruction Manual (p/n [132607](#))

1. Disconnect the power from your Sure Cross® devices.
2. Configure the DIP switches of all devices. DIP switch configurations are always listed in the product's datasheet.
3. If your device has I/O, connect the sensors to the Sure Cross devices. Available I/O is always listed in the product's datasheet. If your device does not have I/O, skip this step.
4. Refer to the wiring diagrams to apply power to all devices.
 - For housed models, the Gateway's LED 1 is solid green and the Node's LED 2 flashes red to indicate there is no radio link to the Gateway.
 - For board-level models, the Gateway's LED is solid green and the Node's LED flashes red to indicate there is no radio link to the Gateway.
5. Form the wireless network by binding the Nodes to the Gateway.
6. Observe the LED behavior to verify the devices are communicating with each other.
 - For housed models, the Gateway's LED 1 is solid green and the Node's LED 1 flashes green to indicate it is communicating with the Gateway.
 - For board-level models, the Gateway's LED is solid green and the Node's LED flashes green to indicate it is communicating with the Gateway.
7. Configure any I/O points to use the sensors connected to the Sure Cross devices.
8. Conduct a site survey between the Gateway and Nodes.
9. Install your wireless sensor network components.

Configure the DIP Switches

Before changing DIP switch positions, disconnect the power.⁽¹⁾

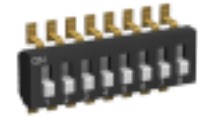
Any changes made to the DIP switches are not recognized until after power is cycled to the device. For parameters not set using the DIP switches, use the configuration software to make configuration changes. For parameters set using the DIP switches, the DIP switch positions override any changes made using the configuration software.

⁽¹⁾ For devices powered by batteries integrated into the housing, triple-click button 2, then double-click button 2 to reset the device without removing the battery.

Access the Internal DIP Switches

Follow these steps to access the internal DIP switches.

1. Unscrew the four screws that mount the cover to the bottom housing.
2. Remove the cover from the housing without damaging the ribbon cable or the pins the cable plugs into.
3. Gently unplug the ribbon cable from the board mounted into the bottom housing. Skip this step if there is no ribbon cable (integrated battery models) or the ribbon cable is glued down (for C housing models).
4. Remove the black cover plate from the bottom of the device's cover. The DIP switches are located behind the rotary dials.
5. Make the necessary changes to the DIP switches.
6. Place the black cover plate back into position and gently push into place.
7. If necessary, plug the ribbon cable in after verifying that the blocked hole lines up with the missing pin.
8. Mount the cover back onto the housing.



DIP Switch Settings

* Default configuration

When DIP switch 2 is in its default position (OFF), the I/O is set to 6 discrete inputs and 6 discrete outputs, non-bit-packed. DIP switches 5 through 8 are ignored. For this 6 IN/6 OUT non bit-packed configuration, the discrete INs use I/O points 1 through 6 and the discrete OUTs use I/O points 9 through 14.

DIP switch 1 and 2 settings

Device Settings	DIP Switches	
	1	2
Transmit power level: 500 mW (27 dBm)	OFF*	
Transmit power level: 250 mW (24 dBm), DX80 compatibility mode	ON	
Modbus or software configured (overrides switches 5-8)		OFF*
DIP switch configured (Uses 5-8 for I/O configuration)		ON

For DIP switches 5 through 8 to be recognized, DIP switch 2 must be in the ON position. For the 8 bit-packed IN/4 non bit-packed OUT configuration, all discrete INs use I/O point 1 and the discrete OUTs use I/O points 9 through 12. For the 4 non bit-packed IN/8 bit-packed output configuration, the discrete INs use I/O points 1 through 4 and all bit-packed outputs use I/O point 9.

DIP switch 5-8 settings

Device Settings	DIP Switches			
	5	6	7	8
12 inputs, 0 outputs	OFF*	OFF*	OFF*	OFF*
11 inputs, 1 output	OFF	OFF	OFF	ON
10 inputs, 2 outputs	OFF	OFF	ON	OFF
9 inputs, 3 outputs	OFF	OFF	ON	ON
8 inputs, 4 outputs	OFF	ON	OFF	OFF
7 inputs, 5 outputs	OFF	ON	OFF	ON
6 inputs, 6 outputs	OFF	ON	ON	OFF
5 inputs, 7 outputs	OFF	ON	ON	ON
4 inputs, 8 outputs	ON	OFF	OFF	OFF
3 inputs, 9 outputs	ON	OFF	OFF	ON
2 inputs, 10 outputs	ON	OFF	ON	OFF
1 input, 11 outputs	ON	OFF	ON	ON
0 inputs, 12 outputs	ON	ON	OFF	OFF
6 inputs, 6 outputs (non bit-packed)	ON	ON	OFF	ON
8 bit-packed inputs, 4 non bit-packed outputs	ON	ON	ON	OFF
4 non bit-packed inputs, 8 bit-packed outputs	ON	ON	ON	ON

Modbus/Software Configured or DIP Switch Configured for I/O Configuration

In the OFF position, this device is configured for six discrete inputs and six discrete outputs (non-bit packed) for products built after May 2011. For products built before May 2011, this default position configures the device for 12 inputs and zero outputs (bit packed). In the OFF

position, users can send commands directly from the host system to the devices to select custom I/O configuration. Users may also use the DX80 Performance Configuration Software to write custom configurations.

In the ON position, use DIP switches 5 through 8 to select one of the pre-programmed discrete I/O configurations shown in the DIP Switch Settings table.

Configuring the Discrete I/O of the 12 I/O Device

The 12 I/O device can be configured into any combination of 12 discrete inputs or outputs. Inputs are stored in a bit packed form in I/O point 1, device register 1. Outputs are stored in a bit packed form in I/O point 9, device register 9.

To define which of the 12 I/O points are inputs, adjust the bit field stored as I/O 1's threshold parameter [15:0]. Set bit 0 of the 16-bit parameter data word to define I/O 1 as an input, set bit 1 to define I/O 2 as an input, et cetera. Each bit position of the parameter is associated to a I/O point. In the example below, the first five I/O points are defined as inputs.

Input Parameter	Bit 15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Input Point #					12	11	10	9	8	7	6	5	4	3	2	1
Parameter Data					0	0	0	0	0	0	0	1	1	1	1	1

Define outputs the same way by adjusting the bit field stored in I/O 9's threshold parameter [15:0]. Verify the bit pattern for outputs does not overlap the input pattern. In the example below, I/O points 6-12 are set as outputs.

Input Parameter	Bit 15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Input Point #					12	11	10	9	8	7	6	5	4	3	2	1
Parameter Data					1	1	1	1	1	1	1	0	0	0	0	0

For inputs, the first I/O point selected as an input is placed in bit position 0 in register 1. The second input point is in bit position 1, et cetera. Likewise, for outputs, the first I/O point selected as an output is placed in bit position 0 in register 9, the second input point is in bit position 2. The bit-packed values are stored in right-justified format.

Input Parameter	Bit 15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Input Point #					0	0	0	0	0	0	0	IN 5	IN 4	IN 3	IN 2	IN 1
Parameter Data					0	0	0	0	0	0	OUT 7	OUT 6	OUT 5	OUT 4	OUT 3	OUT 2

Configure the Discrete I/O on the 12 I/O Devices

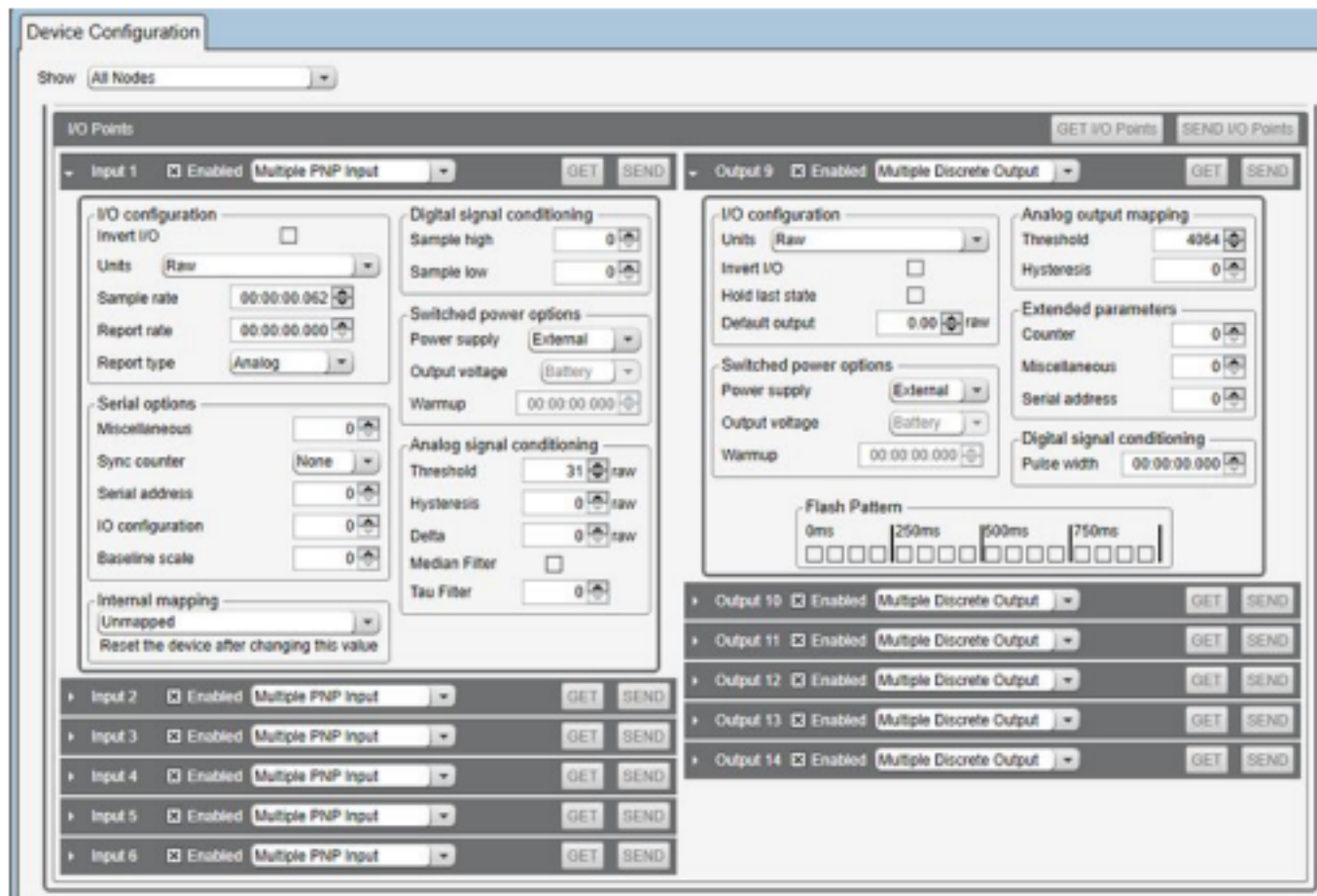
When using the DX80 Performance Configuration Software to configure either a Gateway or Node, select the Gateway or specific Node from the software's drop-down list. To configure a DX85 Remote I/O model, set the DX85's ID to 01 and select the Gateway from the drop-down list.

To define which of the 12 I/O points are inputs for the selected device, adjust the threshold parameter for I/O point 1:

1. Go to the Configuration > Device Configuration screen.
2. On the I/O Points heading, click GET I/O Points. This downloads all existing I/O parameter settings from your device and loads the settings into the User Configuration Software.
3. Click the arrow to display Input 1's parameters.
4. Enter a value into the Threshold parameter field. Use the bit mask as defined in ["Configuring the Discrete I/O of the 12 I/O Device" on page 3](#).

For example, set bit 0 of the 16-bit parameter data word to define I/O 1 as an input, set bit 1 to define I/O 2 as an input, et cetera. Each bit position of the parameter is associated to an I/O point. In the example, the first five I/O points are defined as inputs (0000 0001 1111 = 0x001F = 0031).

To define which of the 12 I/O points are outputs for the selected device, adjust the threshold parameter for I/O point 9. In the example, bits 11 through 5 are used to set seven outputs (1111 1110 0000 = 0x0FE0 = 4064).



5. Click Send or Send I/O Points to upload the settings to the wireless network.

Wire Your Sure Cross Device

Use the following wiring diagrams to first wire the sensors and then apply power to the Sure Cross® devices.

5-pin A-Code M12 Male Wiring

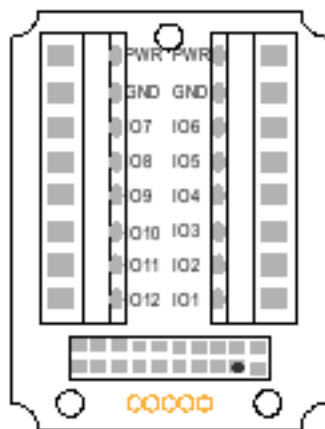
Wiring the 5-pin M12 connector depends on the model and power requirements of the device. Connecting power to the communication pins will cause permanent damage.

5-pin M12 male connector wiring

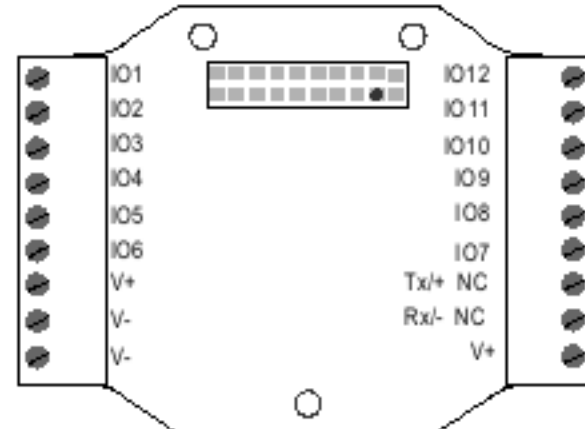
5-pin M12 Male Connector	Pin	Wire Color	Description
	1	Brown (bn)	10 to 30 V DC
	2	White (wh)	RS485 / D1 / B / +
	3	Blue (bu)	DC common (GND)
	4	Black (bk)	RS485 / D0 / A / -
	5	Gray (gy)	Comms Ground

P8 Terminal Blocks and Wiring

IP67 wiring board (P8 models)



IP20 wiring board (P8C models)



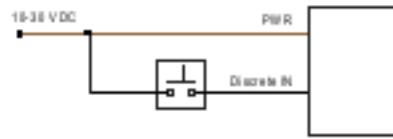
IOx. Input or output (depending on configuration)
GND. Ground/DC common connection

- PWR. 10 V DC to 30 V DC power connection
- RX/-. Serial communication line for the Gateway. No connection for Nodes
- TX/+. Serial communication line for the Gateway; no connection for Nodes
- V+. 10 V DC to 30 V DC power connection
- V-. Ground/DC common connection

When using the DIP switches to configure the input and output selection, wire the inputs beginning with IO1. After all inputs are wired, begin using the remaining IOx as outputs. For example, if you are using 10 inputs and 2 outputs, use terminals IO1 through IO10 for the inputs and terminals IO11 and IO12 for the outputs.

For the default configuration of 6 IN and 6 OUT, use IO1 through IO6 to wire the inputs and IO7 through IO12 to wire the outputs.

Discrete input wiring for PNP sensors



Discrete output wiring (PNP)



The DIx and DOx of these wiring diagrams correspond to the IOx on the terminal block.

LED Behavior for the Gateways and Nodes

Verify all devices are communicating properly. Nodes do not sample inputs until they are communicating with the Gateway. The radios and antennas must be a minimum distance apart to function properly. Recommended minimum distances are:

- 900 MHz radios transmitting at ≤ 250 mW: 6 feet
- 900 MHz radios transmitting at ≥ 500 mW: 15 feet
- 2.4 GHz radios (transmitting at 65 mW): 1 foot

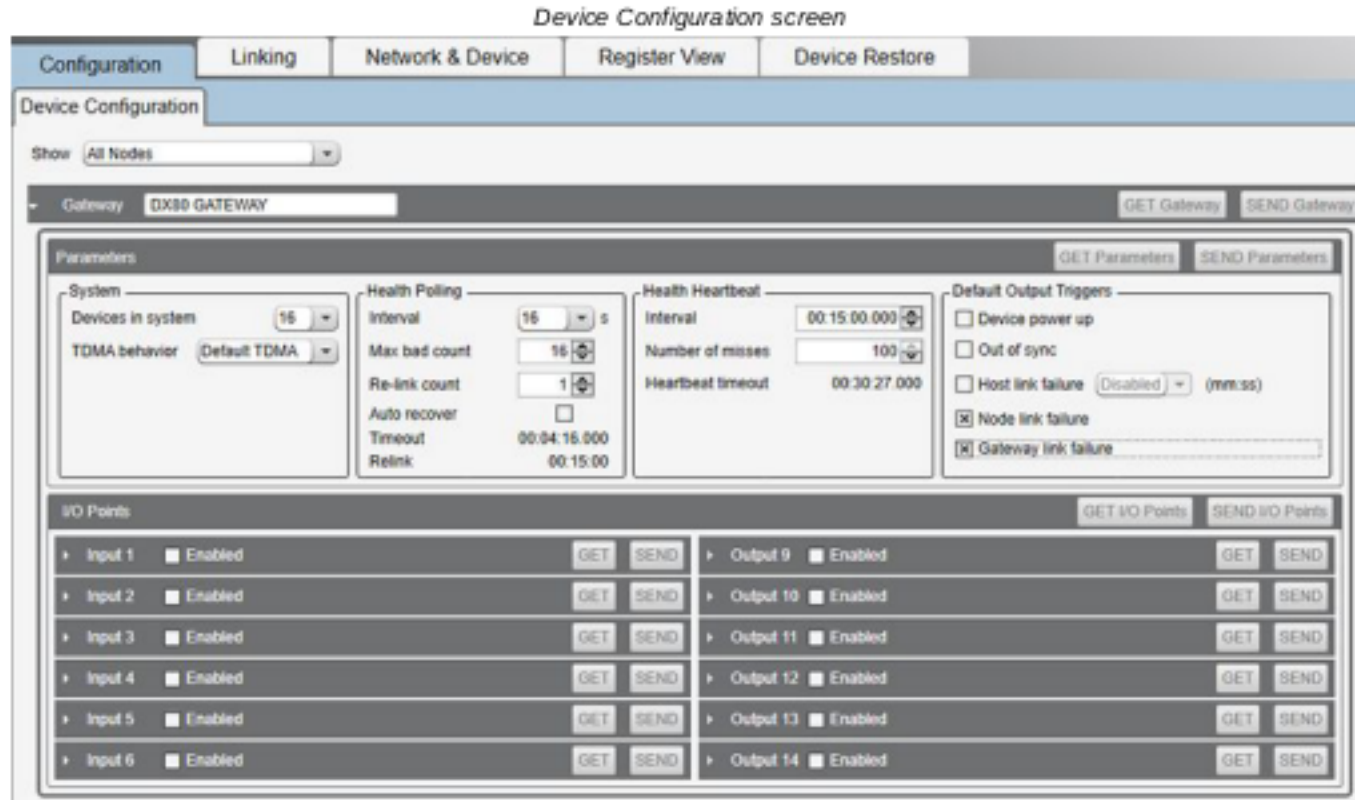
LED behavior

Devices with Two LEDs		Devices with One LED	Gateway Status	Node Status
LED 1	LED 2			
Green		Green	Power is on	N/A
Flashing green			N/A	Radio link is okay
Flashing red	Flashing red	Flashing red	Device error	Device error
	Flashing amber	Green and red flash (amber) together	Modbus communication active	N/A
	Flashing red	Flashing red	Modbus communication error	No radio link (flashes once every 3 s)
Flashing red (alternately)	Flashing red (alternately)	Green and red flash alternately	Device is in binding mode	Device is in binding mode
		Red	Gateway is trying to conduct a Site Survey with a Node that doesn't exist	
		Green and red solid (amber) together	No radio communication detected	
Red (for 4 seconds)	Red (for 4 seconds)	Green/red solid (amber) for 4 seconds, then flash 4 times		Binding mode is complete

For Gateway systems, the Modbus communication LEDs refer to the communication between the Gateway and its host system (if applicable).

DX80 Performance Configuration Software

The configuration software offers an easy way to link I/O points in your wireless network, view I/O register values, and set system communication parameters when a host system is not part of the wireless network. The software runs on any computer with the Windows Vista, Windows 7, Windows 8, or Windows 10 operating system.



Use a USB to RS-485 adapter cable to connect a standalone DX80 Gateway to the computer. For DXM Controllers with an internal DX80 radio, connect a computer to the DXM Controller using the supplied USB or Ethernet connection. Download the most recent revisions of the configuration software from Banner Engineering's website: <https://www.bannerengineering.com/us/en/products/wireless-sensor-networks/reference-library/software.html>.

The USB to RS-485 adapter cable is not required for the DXM Controller. For standalone DX80 Gateway devices use:

- USB to RS-485 adapter cable model BWA-UCT-900 for 1 Watt radios
- USB to RS-485 adapter cable model BWA-HW-006 for all other radios

Holding Registers

Modbus Registers		EIP Registers		I/O Type		Holding Register Representation (Dec.)	
Gateway / DX85	Node	Node		Bit-Packed	Non Bit-Packed (default configuration)	Min.	Max.
1	1 + (Node# × 16)	0 + (Node# × 8)	Instance 100 / N7	Bit-Packed Discrete IN (IO1–IO12)	Discrete IN 1 (IO1)	0	4095
2	2 + (Node# × 16)	1 + (Node# × 8)			Discrete IN 2 (IO2)	0	1
3	3 + (Node# × 16)	2 + (Node# × 8)			Discrete IN 3 (IO3)	0	1
4	4 + (Node# × 16)	3 + (Node# × 8)			Discrete IN 4 (IO4)	0	1
5	5 + (Node# × 16)	4 + (Node# × 8)			Discrete IN 5 (IO5)	0	1
6	6 + (Node# × 16)	5 + (Node# × 8)			Discrete IN 6 (IO6)	0	1
7	7 + (Node# × 16)	6 + (Node# × 8)		Reserved			
8	8 + (Node# × 16)	7 + (Node# × 8)		Device Message			
9	9 + (Node# × 16)	0 + (Node# × 8)	Instance 112 / N14	Bit-Packed Discrete OUT (IO1–IO12)	Discrete OUT 1 (IO7)	0	4095
10	10 + (Node# × 16)	1 + (Node# × 8)			Discrete OUT 2 (IO8)	0	1
11	11 + (Node# × 16)	2 + (Node# × 8)			Discrete OUT 3 (IO9)	0	1
12	12 + (Node# × 16)	3 + (Node# × 8)			Discrete OUT 4 (IO10)	0	1
13	13 + (Node# × 16)	4 + (Node# × 8)			Discrete OUT 5 (IO11)	0	1
14	14 + (Node# × 16)	5 + (Node# × 8)			Discrete OUT 6 (IO12)	0	1
15	15 + (Node# × 16)	6 + (Node# × 8)		Control Message			
16	16 + (Node# × 16)	7 + (Node# × 8)		Reserved			

For other non bit-packed configurations, the inputs begin at I/O point 1 and the outputs begin after the last input.

For DIP switches 5 through 8 to be recognized, DIP switch 2 must be in the ON position. For the 8 bit-packed IN/4 non bit-packed OUT configuration, all discrete INs use I/O point 1 and the discrete OUTs use I/O points 9 through 12. For the 4 non bit-packed IN/8 bit-packed output configuration, the discrete INs use I/O points 1 through 4 and all bit-packed outputs use I/O point 9.

Installing Your Sure Cross® Radios

Please refer to one of these instruction manuals to install your wireless network components.

- DX80 Performance Wireless I/O Network Instruction Manual: [132607](#)
- MultiHop Data Radio Instruction Manual: [151317](#)

Specifications

Radio Specifications for 2.4 GHz Performance (Korea)

Radio Range

2.4 GHz (65 mW): Up to 3.2 km (2 miles) with the supplied antenna

High-gain antennas are available, but the transmit power and range depend on the antenna gain, environment, and line of sight. Always verify your wireless network's range by performing a Site Survey.

Radio Transmit Power (2.4 GHz radios)

Conducted: < 18 dBm (65 mW)

EIRP with the supplied antenna: < 20 dBm (100 mW)

Antenna Minimum Separation Distance

2.4 GHz radios transmitting at 65 mW: 0.3 m (1 ft) with the supplied antenna

Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

2.4 GHz Compliance (Korean Models)

KCC-CRM-BE2-DX

Antenna Connection

Ext. Reverse Polarity SMA, 50 Ohms

Max Tightening Torque: 0.45 N·m (4 lbf-in)

Link Timeout (Performance)

Gateway: Configurable via User Configuration Software

Node: Defined by Gateway

RS-485 Communication Specifications

Communication Hardware (RS-485)

Interface: 2-wire half-duplex RS-485

Baud rates: 9.6k, 19.2k (default), or 38.4k

Data format: 8 data bits, no parity, 1 stop bit

P8-KR Specifications

Supply Voltage

10 V DC to 30 V DC (Outside the USA: 12 V DC to 24 V DC, ± 10%)

Power Consumption

900 MHz Consumption: Maximum current draw is < 100 mA and typical current draw is < 50 mA at 24 V DC. (2.4 GHz consumption is less.)

Interface

Two bi-color LED indicators, Two buttons, Six character LCD

Housing

Polycarbonate housing and rotary dial cover; polyester labels; EDPM rubber cover gasket; nitrile rubber, non-sulphur cured button covers

Weight: 0.26 kg (0.57 lbs)

Mounting: #10 or M5 (SS M5 hardware included)

Max. Tightening Torque: 0.56 N·m (5 lbf-in)

Wiring Access

Four PG-7, one 1/2-inch NPT, one 5-pin M12 male quick-disconnect connector

Discrete Inputs

Rating: 3 mA max current at 30 V DC

Sample Rate: Up to 62.5 milliseconds

Report Rate: On change of state

ON Condition (PNP): Greater than 4.5 V

OFF Condition (PNP): Less than 4 V

Discrete Outputs

Update Rate: Up to 62.5 milliseconds

Output State Following Timeout: OFF

ON Condition (PNP): Supply minus 2 V

OFF Condition (PNP): Less than 2 V

Discrete Output Rating (PNP)

100 mA max current at 30 V DC

ON-State Saturation: Less than 3 V at 100 mA

OFF-state Leakage: Less than 10 µA

Certifications



Banner Engineering BV
Park Lane, Culliganlaan 2F bus 3
1831 Diegem, BELGIUM

Included with the DX80 and DX80...C Models

- BWA-HW-002: DX80 Access Hardware Kit, containing four PG-7 plastic threaded plugs, four PG-7 nylon gland fittings, four PG-7 hex nuts, one 1/2-inch NPT plug, and one 1/2-inch nylon gland fitting. (Not included with IP20 DX80...C models)
- BWA-HW-001: Mounting Hardware Kit, containing four M5-0.8 × 25mm SS screws, four M5-0.8 × 16 mm SS screws, four M5-0.8 mm SS hex nuts, and four #8-32 × 3/4" SS bolts
- BWA-HW-003: PTFE tape
- BWA-902-C (900 MHz) or BWA-202-C (2.4 GHz): Antenna, 2 dBd Omni, Rubber Swivel RP-SMA Male (not included with internal antenna models)

- BC-M12F5-22-2 (p/n [235936](#)): 5-pin A-Code 2 m cordset with an M12 female (straight) connector on one end and flying leads on the other end (not included with FlexPower devices)
- BWA-HW-011: IP20 Screw Terminal Headers (2 pack) (included only with the IP20 DX80...C models)
- Product datasheet and product family Quick Start Guide ([128185](#) for Performance models or [152653](#) for MultiHop models)

Environmental Specifications (IP67 Housing Models)

Operating Conditions

- 40 °C to +85 °C (–40 °F to +185 °F) (Electronics); –20 °C to +80 °C (–4 °F to +176 °F) (LCD)
- 95% maximum relative humidity (non-condensing)
- Radiated Immunity: 10 V/m (EN 61000-4-3)

Shock and Vibration

- All models meet IEC 60068-2-6 and IEC 60068-2-27 testing criteria
- Shock: 30G 11 ms duration, half sine wave per IEC 60068-2-27
- Vibration: 10 Hz to 55 Hz, 0.5 mm peak-to-peak amplitude per IEC 60068-2-6

Environmental Ratings

- IEC IP67; NEMA 6
- For installation and waterproofing instructions, go to www.bannerengineering.com and search for the complete instruction manual (p/n 132607)

Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.

Warnings



WARNING:

- Do not use this device for personnel protection
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

IMPORTANT:Please download the complete Performance P8-KR Gateway technical documentation, available in multiple languages, from www.bannerengineering.com for details on the proper use, applications, Warnings, and installation instructions of this device.

IMPORTANT:Por favor descargue desde www.bannerengineering.com toda la documentación técnica de los Performance P8-KR Gateway, disponibles en múltiples idiomas, para detalles del uso adecuado, aplicaciones, advertencias, y las instrucciones de instalación de estos dispositivos.

IMPORTANT: Veuillez télécharger la documentation technique complète des Performance P8-KR Gateway sur notre site www.bannerengineering.com pour les détails sur leur utilisation correcte, les applications, les notes de sécurité et les instructions de montage.

Install and properly ground a qualified surge suppressor when installing a remote antenna system. Remote antenna configurations installed without surge suppressors invalidate the manufacturer's warranty. Keep the ground wire as short as possible and make all ground connections to a single-point ground system to ensure no ground loops are created. No surge suppressor can absorb all lightning strikes; do not touch the Sure Cross® device or any equipment connected to the Sure Cross® device during a thunderstorm.

Exporting Sure Cross® Radios. It is our intent to fully comply with all national and regional regulations regarding radio frequency emissions. Customers who want to re-export this product to a country other than that to which it was sold must ensure the device is approved in the destination country. The Sure Cross wireless products were certified for use in these countries using the antenna that ships with the product. When using other antennas, verify you are not exceeding the transmit power levels allowed by local governing agencies. This device has been designed to operate with the antennas listed on Banner Engineering's website and having a maximum gain of 9 dBi. Antennas not included in this list or having a gain greater than 9 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen such that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication. Consult with Banner Engineering Corp. if the destination country is not on this list.

IMPORTANT:

- Never operate a radio without connecting an antenna
- Operating radios without an antenna connected will damage the radio circuitry.
- To avoid damaging the radio circuitry, never apply power to a Sure Cross® Performance or Sure Cross® MultiHop radio without an antenna connected.

IMPORTANT:

- Electrostatic discharge (ESD) sensitive device
- ESD can damage the device. Damage from inappropriate handling is not covered by warranty.
- Use proper handling procedures to prevent ESD damage. Proper handling procedures include leaving devices in their anti-static packaging until ready for use; wearing anti-static wrist straps; and assembling units on a grounded, static-dissipative surface.

Banner Engineering Corp Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

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