Sure Cross® Performance Gateway with I/O Mapping

Datasheet

The Sure Cross® wireless system is a radio frequency network with integrated I/O that can operate in most environments and eliminate the need for wiring runs. Wireless networks are formed around a Gateway, which acts as the wireless network master device, and one or more Nodes.

WARNING: Not To Be Used for Personnel Protection

Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

CAUTION: Never Operate 1 Watt Radios Without Antennas

To avoid damaging the radio circuitry, never power up Sure Cross® Performance or Sure Cross MultiHop (1 Watt) radios without an antenna.

CAUTION: Electrostatic Discharge (ESD)

ESD Sensitive Device. This product uses semiconductors that can be damaged by electrostatic discharge (ESD). When performing maintenance, care must be taken so the device is not damaged. Disconnect power from the device when accessing the internal DIP switches. Proper handling procedures include wearing anti-static wrist straps. Damage from inappropriate handling is not covered by warranty.

For additional information, updated documentation, and accessories, refer to Banner Engineering's website, *www.bannerengineering.com/surecross*.

Models	Frequency	Environmental Rating	I/O
DX80G9M6S-PM8	900 MHz ISM Band	IP67, NEMA 6	Inputs: Six sourcing discrete Outputs: Six sourcing discrete I/O is automatically mapped to the PM8 Node using the Gateway's menu system
DX80G2M6S-PM8	2.4 GHz ISM Band		

DX80...C (IP20; NEMA 1) models are also available. To order this model with an IP20 housing, add a C to the end of the model number: For example, DX80G9M6S-PM8C.

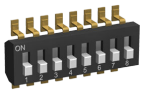
Configure the DIP Switches

Before making any changes to the DIP switch positions, disconnect the power. DIP switch changes will not be recognized if power isn't cycled to the device.

Accessing the Internal DIP Switches

To access the internal DIP switches, follow these steps:

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.
4. Remove the black cover plate from the bottom of the device's cover.
   The DIP switches are located behind the rotary dials.



After making the necessary changes to the DIP switches, place the black cover plate back into position and gently push into place. Plug the ribbon cable in after verifying that the blocked hole lines up with the missing pin. Mount the cover back onto the housing.

DIP Switch Settings

	Switches	
Device Settings	1	2
Transmit Power Level: 1 Watt (30 dBm)	OFF (default)	
Transmit Power Level: 250 mW (24 dBm), DX80 Compatibility Mode	ON	

Transmit Power Levels

The 900 MHz radios can be operated at 1 watt (30 dBm) or 250 mW (24 dBm). While the Performance radios operate in 1 Watt mode, they cannot communicate with the older 150 mW radios. To communicate with the older 150 mW radios, operate this radio in 250 mW mode. For 2.4 GHz models, this DIP switch is disabled. The transmit power for 2.4 GHz is fixed at about 65 mW EIRP (18 dBm), making the 2.4 GHz Performance models automatically compatible with older 2.4 GHz models.

Wiring Your Sure Cross® Device

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

Terminal Blocks and Wiring (PM8 and PM8C Models)

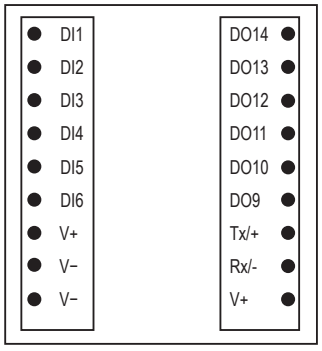


Figure 1. -PM8 Board

DIx. Discrete IN 1 through 6.
DOx. Discrete OUT 9 through 14.
GND. Ground/dc common connection
PWR. 10 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 to 30 V dc power connection
V–. Ground/dc common connection

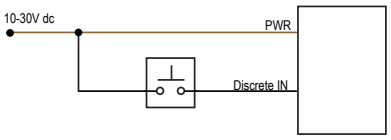


Figure 2. Discrete Input Wiring for PNP Sensors

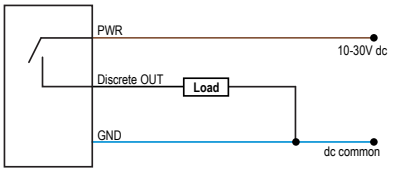


Figure 3. Discrete Output Wiring (PNP)

Bind Radios to Form Networks

Binding Nodes to a Gateway ensures the Nodes only exchange data with the Gateway they are bound to.

Apply power to the Gateway and the Node you are binding.

1. To enter binding mode on the Gateway, triple-click button 2.
   The red LEDs flash alternately when the Gateway is in binding mode. Any Node entering binding mode will bind to this Gateway.
2. To enter binding mode on the Node, triple-click button 2.

   The Node enters binding mode and locates the Gateway in binding mode. The red LEDs flash alternately. The Node automatically exits binding mode. After the Node is bound, the LEDs are both solid red for a few seconds. The Node cycles its power, then enters Run mode.
3. Use both of the Node's rotary dials to assign a the Node Address defined in the Gateway's datasheet. The left rotary dial represents the tens digit (0 through 4) and the right dial represents the ones digit (0 through 9) of the Node Address.
4. Repeat steps 2 and 3 for all Nodes that need to communicate to this Gateway.
5. Exit binding mode on the Gateway by single-clicking either button 1 or button 2.

LED Behavior for the Gateways

Verify all devices are communicating properly. The radios and antennas must be a minimum distance apart to function properly. Recommended minimum distances are:

900 MHz 150 mW radios: 6 feet
900 MHz 1 Watt radios: 15 feet
2.4 GHz 65 mW radios: 1 foot

LED 1	LED 2	Gateway Status
Solid green		Power ON
Flashing red	Flashing red	Device Error
	Flashing amber	Modbus Communication Active
	Flashing red	Modbus Communication Error

For Gateway and Ethernet Bridge systems, active Modbus communication refers to the communication between the Gateway and the Ethernet Bridge. For GatewayPro systems, the Modbus communication LEDs refer to the communication internal to the GatewayPro. For Gateway-only systems, the Modbus communication LEDs refer to the communication between the Gateway and its host system (if applicable).

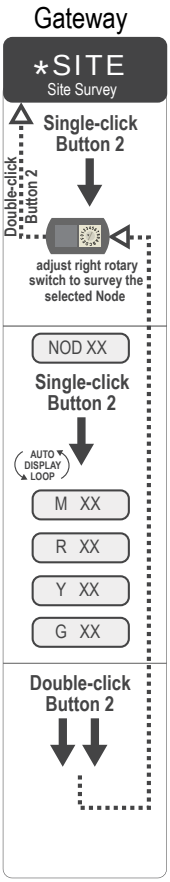
Conducting a Site Survey (Gateway and Nodes)

A Site Survey, also known as a Radio Signal Strength Indication (RSSI), analyzes the radio communications link between the Gateway and any Node within the network by analyzing the radio signal strength of received data packets and reporting the number of missed packets that required a retry.

Perform a Site Survey before permanently installing the radio network to ensure reliable communication. Activate Site Survey mode from either the Gateway buttons or the Gateway Modbus holding register 15. Only the Gateway can initiate a Site Survey, and the Site Survey analyzes the radio communications link with one Node at a time.

SITE (Site Survey) Menu

The SITE menu displays the results of a Site Survey conducted with this Gateway.



The SITE menu displays the device number of the Node the Site Survey was conducted with as well as the missed, green, yellow, and red received packet count.

The SITE menu is only available on the Gateways.

To access the SITE menu, single-click button 1 to scroll across the menu levels until reaching the Site Survey (SITE) menu.

See *Conducting a Site Survey Using the Menu System* on page 4.

See *Interpreting the Site Survey Results* on page 5.

Conducting a Site Survey Using the Menu System

Initiate a Site Survey using the Gateway's buttons and menu system.

1. Remove the rotary dial access cover.
2. To check the status of Node 1, change the Gateway's right rotary dial to 1.
   The Gateway is now enabled to read the status of Node 1; the display scrolls through the Node's I/O status.
3. Single-click button 1 to scroll across the menu levels until reaching the Site Survey (SITE) menu.
4. Single-click button 2 to enter the Site Survey menu.
5. Single-click button 2 to begin conducting a Site Survey with the Node selected in step 2.
   The Gateway analyzes the quality of the signal from the selected Node by counting the number of data packets it receives from the Node.
6. Examine reception readings (M, R, Y, G) of the Gateway at various locations.

   Site survey results display as a percentage. M represents the percent of missed packets while R, Y, and G represent the percent of received packets at a given signal strength.

   M = Percent of missed packets; R = RED marginal signal; Y = YELLOW good signal; G = GREEN excellent signal.
   Record the results if you need troubleshooting assistance from the factory.
7. Change the Gateway's right rotary dial to conduct a Site Survey with another Node and repeat steps 2 through 6.
8. To end the Site Survey, double-click button 2.
9. Change the Gateway's right rotary dial back to 0.
   The LCD displays the device readings for the Gateway.
10. Double-click button 2 to move back to the top level menu.
11. Single-click button 1 to return to RUN mode.
12. Install the rotary dial access cover, referring to the Installation section of the manual to create an IP67 seal.

Interpreting the Site Survey Results

Site Survey results are listed as a percentage of data packets received and indicate the signal strength of the received signal.

	Result	Description
	Green	Packets received at a strong signal strength. A strong signal strength is greater than −90 dBm at the receiver.
	Yellow	Packets received at a good signal strength. A good signal is between −90 and −100 dBm at the receiver.
	Red	Packets received at a weak signal strength. A weak signal is less than −100 dBm at the receiver.
	Missed	Packets not received on the first transmission and requiring a retry.

Judging if the reliability of a network's signal meets the needs of the application is not just a matter of green, yellow, and red packets received. In normal operating mode, when data packets are not received, the transmitter re-sends the packet until all data is received.

For slow monitoring applications such as a tank farm, where data is required in terms of seconds or minutes, receiving most of the data in the 'red' range, indicating a weak but reliable signal, transmits enough data for accurate monitoring. Nodes positioned near the outside range of the radio signal may have 90% of the data packets received in the red zone, again indicating a weak, but reliable signal.

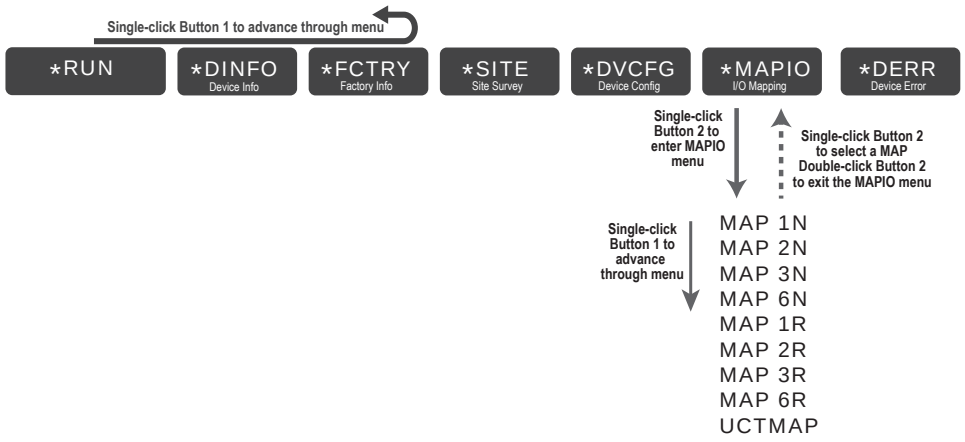
We recommend keeping the missed packets average to less than 40%. When the network misses more than 40% of the data packets, the signal is usually too unreliable or obstacles may be interfering with the signal. When Site Survey reports the missed packets are 40% or higher, improve the radio system performance by:

- Mounting the network's antennas higher,
- Using higher gain antennas, or
- Adding data radios to the network.

Mounting the devices' antennas higher allows the radio signal to clear obstacles in the area and improves the line of sight between SureCross® devices. Higher gain antennas focus the energy of the radio signal in a specific direction and extend the signal's range. Using data radios is another option to consider when trying to extend the range of a radio network. For more information on data radios, please refer to Banner's white paper on range extension on *www.bannerengineering.com/surecross*.

MAPIO Menu for the PM8 Gateway

The PM8 Gateway and Node use the LCD menu system to automatically map I/O. The first map in the list is the factory default setting. In addition to the MAPIO menu, an entry was added to the bottom of the DVCFG menu to display the currently selected I/O map.



MAP 1N

MAP 1N maps the I/O between the PM8 Gateway and one PM8 Node.

Gateway	Maps to	Node 1
Discrete IN 1	-->	Discrete OUT 9
Discrete IN 2	-->	Discrete OUT 10
Discrete IN 3	-->	Discrete OUT 11
Discrete IN 4	-->	Discrete OUT 12
Discrete IN 5	-->	Discrete OUT 13
Discrete IN 6	-->	Discrete OUT 14
Discrete OUT 9	<--	Discrete IN 1
Discrete OUT 10	<--	Discrete IN 2
Discrete OUT 11	<--	Discrete IN 3
Discrete OUT 12	<--	Discrete IN 4
Discrete OUT 13	<--	Discrete IN 5
Discrete OUT 14	<--	Discrete IN 6

MAP 2N

MAP 2N maps the I/O between the PM8 Gateway and two PM8 Nodes.

Gateway	Maps to	Node 1	Node 2
Discrete IN 1	-->	Discrete OUT 9	
Discrete IN 2	-->	Discrete OUT 10	
Discrete IN 3	-->	Discrete OUT 11	
Discrete IN 4	-->		Discrete OUT 9
Discrete IN 5	-->		Discrete OUT 10
Discrete IN 6	-->		Discrete OUT 11
Discrete OUT 9	<--	Discrete IN 1	
Discrete OUT 10	<--	Discrete IN 2	
Discrete OUT 11	<--	Discrete IN 3	

Gateway	Maps to	Node 1	Node 2
Discrete OUT 12	<--		Discrete IN 1
Discrete OUT 13	<--		Discrete IN 2
Discrete OUT 14	<--		Discrete IN 3

MAP 3N

MAP 3N maps the I/O between the PM8 Gateway and three PM8 Nodes.

Gateway	Maps to	Node 1	Node 2	Node 3
Discrete IN 1	-->	Discrete OUT 9		
Discrete IN 2	-->	Discrete OUT 10		
Discrete IN 3	-->		Discrete OUT 9	
Discrete IN 4	-->		Discrete OUT 10	
Discrete IN 5	-->			Discrete OUT 9
Discrete IN 6	-->			Discrete OUT 10
Discrete OUT 9	<--	Discrete IN 1		
Discrete OUT 10	<--	Discrete IN 2		
Discrete OUT 11	<--		Discrete IN 1	
Discrete OUT 12	<--		Discrete IN 2	
Discrete OUT 13	<--			Discrete IN 1
Discrete OUT 14	<--			Discrete IN 2

MAP 6N

MAP 6N maps the I/O between the PM8 Gateway and six PM8 Nodes.

Gateway	Maps to	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6
Disc IN 1	-->	Disc OUT 9					
Disc IN 2	-->		Disc OUT 9				
Disc IN 3	-->			Disc OUT 9			
Disc IN 4	-->				Disc OUT 9		
Disc IN 5	-->					Disc OUT 9	
Disc IN 6	-->						Disc OUT 9
Disc OUT 9	<--	Disc IN 1					
Disc OUT 10	<--		Disc IN 1				
Disc OUT 11	<--			Disc IN 1			
Disc OUT 12	<--				Disc IN 1		
Disc OUT 13	<--					Disc IN 1	
Disc OUT 14	<--						Disc IN 1

MAP 1R

MAP 1R maps the I/O from Node 1 to Node 7, using the Gateway as a repeater.

Node 1	Maps to	Node 7
Discrete IN 1	-->	Discrete OUT 9
Discrete IN 2	-->	Discrete OUT 10
Discrete IN 3	-->	Discrete OUT 11
Discrete IN 4	-->	Discrete OUT 12
Discrete IN 5	-->	Discrete OUT 13
Discrete IN 6	-->	Discrete OUT 14
Discrete OUT 9	<--	Discrete IN 1
Discrete OUT 10	<--	Discrete IN 2
Discrete OUT 11	<--	Discrete IN 3
Discrete OUT 12	<--	Discrete IN 4
Discrete OUT 13	<--	Discrete IN 5
Discrete OUT 14	<--	Discrete IN 6

MAP 2R

Map 2R maps the I/O from Node 1 and Node 2 to Node 7, using the Gateway as a repeater.

Node 7	Maps to	Node 1	Node 2
Discrete IN 1	-->	Discrete OUT 9	
Discrete IN 2	-->	Discrete OUT 10	
Discrete IN 3	-->	Discrete OUT 11	
Discrete IN 4	-->		Discrete OUT 9
Discrete IN 5	-->		Discrete OUT 10
Discrete IN 6	-->		Discrete OUT 11
Discrete OUT 9	<--	Discrete IN 1	
Discrete OUT 10	<--	Discrete IN 2	
Discrete OUT 11	<--	Discrete IN 3	
Discrete OUT 12	<--		Discrete IN 1
Discrete OUT 13	<--		Discrete IN 2
Discrete OUT 14	<--		Discrete IN 3

MAP 3R

MAP 3R maps the I/O from Nodes 1 through 3 to Node 7, using the Gateway as a repeater.

Node 7	Maps to	Node 1	Node 2	Node 3
Discrete IN 1	-->	Discrete OUT 9		
Discrete IN 2	-->	Discrete OUT 10		
Discrete IN 3	-->		Discrete OUT 9	
Discrete IN 4	-->		Discrete OUT 10	
Discrete IN 5	-->			Discrete OUT 9
Discrete IN 6	-->			Discrete OUT 10
Discrete OUT 9	<--	Discrete IN 1		

Node 7	Maps to	Node 1	Node 2	Node 3
Discrete OUT 10	<--	Discrete IN 2		
Discrete OUT 11	<--		Discrete IN 1	
Discrete OUT 12	<--		Discrete IN 2	
Discrete OUT 13	<--			Discrete IN 1
Discrete OUT 14	<--			Discrete IN 2

MAP 6R

MAP 6R maps the I/O from Nodes 1 through 6 to Node 7, using the Gateway as a repeater.

Node 7	Maps to	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6
Disc IN 1	-->	Disc OUT 9					
Disc IN 2	-->		Disc OUT 9				
Disc IN 3	-->			Disc OUT 9			
Disc IN 4	-->				Disc OUT 9		
Disc IN 5	-->					Disc OUT 9	
Disc IN 6	-->						Disc OUT 9
Disc OUT 9	<--	Disc IN 1					
Disc OUT 10	<--		Disc IN 1				
Disc OUT 11	<--			Disc IN 1			
Disc OUT 12	<--				Disc IN 1		
Disc OUT 13	<--					Disc IN 1	
Disc OUT 14	<--						Disc IN 1

UCTMAP

Select UCTMAP to use the User Configuration Tool (UCT) software to map I/O between the Gateway and its Nodes.

Modbus Register Table

I/O	Modbus Holding Register		I/O Type	I/O Range		Holding Register Representation	
	Gateway	Any Node		Min.	Max.	Min. (Dec.)	Max. (Dec.)
1	1	1 + (Node# × 16)	Discrete IN 1	0	1	0	1
2	2	2 + (Node# × 16)	Discrete IN 2	0	1	0	1
3	3	3 + (Node# × 16)	Discrete IN 3	0	1	0	1
4	4	4 + (Node# × 16)	Discrete IN 4	0	1	0	1
5	5	5 + (Node# × 16)	Discrete IN 5	0	1	0	1
6	6	6 + (Node# × 16)	Discrete IN 6	0	1	0	1
7	7	7 + (Node# × 16)	Reserved				
8	8	8 + (Node# × 16)	Device Message				
9	9	9 + (Node# × 16)	Discrete OUT 9	0	1	0	1
10	10	10 + (Node# × 16)	Discrete OUT 10	0	1	0	1
11	11	11 + (Node# × 16)	Discrete OUT 11	0	1	0	1
12	12	12 + (Node# × 16)	Discrete OUT 12	0	1	0	1

I/O	Modbus Holding Register		I/O Type	I/O Range		Holding Register Representation	
	Gateway	Any Node		Min.	Max.	Min. (Dec.)	Max. (Dec.)
13	13	13 + (Node# × 16)	Discrete OUT 13	0	1	0	1
14	14	14 + (Node# × 16)	Discrete OUT 14	0	1	0	1
15	15	15 + (Node# × 16)	Control Message				
16	16	16 + (Node# × 16)	Reserved				

Specifications

Radio Range[1]
900 MHz, 1 Watt: Up to 9.6 km (6 miles)
2.4 GHz, 65 mW: Up to 3.2 km (2 miles)

Minimum Separation Distance
900 MHz, 1 Watt: 4.57 m (15 ft)
2.4 GHz, 65 mW: 0.3 m (1 ft)

Radio Transmit Power
900 MHz, 1 Watt: 30 dBm (1 W) conducted (up to 36 dBm EIRP)
2.4 GHz, 65 mW: 18 dBm (65 mW) conducted, less than or equal to 20 dBm (100 mW) EIRP

900 MHz Compliance (1 Watt)
FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247
IC: 7044A-RM1809

2.4 GHz Compliance
FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247
ETSI EN 300 328 V1.8.1 (2012-06)
IC: 7044A-DX8024

Spread Spectrum Technology
FHSS (Frequency Hopping Spread Spectrum)

Link Timeout
Gateway: Configurable via User Configuration Tool (UCT) software
Node: Defined by Gateway

Operating Conditions[3]
–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
IEC 68-2-6 and IEC 68-2-27
Shock: 30g, 11 millisecond half sine wave, 18 shocks
Vibration: 0.5 mm p-p, 10 to 60 Hz

Supply Voltage
10 to 30 V dc (Outside the USA: 12 to 24 V dc, ±10%). [2]
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.)

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)

Antenna Connection
Ext. Reverse Polarity SMA, 50 Ohms
Max Tightening Torque: 0.45 N·m (4 lbf·in)

Interface
Indicators: Two bi-color LEDs
Buttons: Two
Display: Six character LCD

Wiring Access
Two 1/2-inch NPT ports

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

Communication Protocol
Modbus RTU

Environmental Ratings[4]
PM8 Model: IEC IP67; NEMA 6
"C" Housing Models/External wiring terminals: IEC IP20; NEMA 1

Certifications
CE

Discrete Inputs
Six sourcing/PNP
Rating: 3 mA max current at 30 V dc
Sample Rate: 62.5 milliseconds
Report Rate: On change of state
Discrete Input ON Condition: Greater than 4.5 V
Discrete Input OFF Condition: Less than 4 V

Discrete Outputs
Six sourcing/PNP
Update Rate: 125 milliseconds
ON Condition: Supply minus 2 V
OFF Condition: Less than 2 V
Output State Following Timeout: OFF

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

Included with Model

The following items ship with the PM2 and PM8 radios.

- One 1/2-inch NPT plug (not included with IP20 "C" models)
- Two 1/2-inch nylon gland fittings (not included with IP20 "C" models)

1 Radio range is with the 2 dB antenna that ships with the product. High-gain antennas are available, but the range depends on the environment and line of sight. To determine the range of your wireless network, perform a Site Survey.
2 For European applications, power the DX80 from a Limited Power Source as defined in EN 60950-1.
3 Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.
4 Refer to the *Sure Cross® Wireless I/O Networks Instruction Manual* (p/n 132607) for installation and waterproofing instructions.

- BWA-9O2-C (900 MHz) or BWA-2O2-C (2.4 GHz): Antenna, 2 dBd Omni, Rubber Swivel RP-SMA Male. (Not included with Internal antenna models)
- BWA-HW-011: IP20 Screw Terminal Headers (2 pack) (included only with the IP20 "C" models)

Warnings

Antenna Installations. 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. A list of approved countries appears in the *Radio Certifications* section of the product manual. 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. Consult with Banner Engineering Corp. if the destination country is not on this list.

Violating Warnings. The manufacturer does not take responsibility for the violation of any warning listed in this document. Make no modifications to this product; any modifications to this product not expressly approved by Banner Engineering could void the user's authority to operate the product. All specifications published in this document are subject to change; Banner reserves the right to modify product specifications or update documentation at any time. For the most recent version of any documentation, refer to: *www.bannerengineering.com*.

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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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