Sure Cross® Performance Mapping PM8-KR Gateway

Datasheet

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.

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:
- **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.

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

Models

Models	Frequency	Environmental Rating	I/O
DX80G2M6S-PM8-KR	2.4 GHz ISM Band	IP67, NEMA 6	**Inputs**: Six sourcing discrete
DX80G2M6S-PM8C-KR		IP20, NEMA 1	**Outputs**: Six sourcing discrete I/O is automatically mapped to the PM8 Node using the Gateway's menu system

Configuration Instructions

Wire 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)

Refer to the Class I Division 2/Zone 2 control drawings (p/n *143086*) for wiring specifications and limitations.
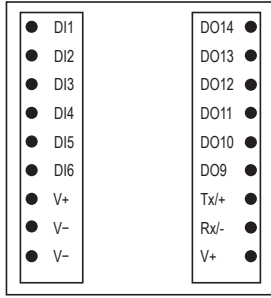
Figure 1. -PM8 Board

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
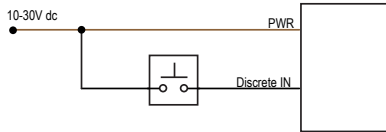V−. Ground/dc common connection

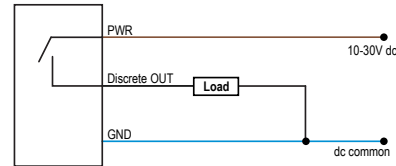*Figure 2. **Discrete Input Wiring for PNP Sensors***

*Figure 3. **Discrete Output Wiring (PNP)***

Bind the DX80 Nodes to the DX80 Gateway and Assign the Node Address

Before beginning the binding procedure, apply power to all the devices. Separate radios by 2 meters when running binding procedure. Put only one Gateway into binding at a time to prevent binding to the wrong Gateway.

1. Enter binding mode on the Gateway.
   - For housed DX80 Gateways, triple-click the right-hand button. LEDs alternatively flash red.
   - For board level DX80 Gateways, triple-click the binding button. LED flashes green and red.
2. Use both of the Node's rotary dials to assign 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.
3. 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. For the pre-mapped kits, the Node's rotary dials must be set based on the mapping defined by the Gateway. For more information, refer to the mapping tables in the MAPIO Menu section of the Gateway's datasheet.
4. Label the Node with the assigned address for future references.
5. Repeat steps 2 through 4 for all Nodes that need to communicate to this Gateway.
6. Exit binding mode on the Gateway by single-clicking either button 1 or button 2.

For Gateways with single line LCDs, after binding your Nodes to the Gateway, make note of the binding code displayed under the Gateway's *DVCFG menu, XADR submenu on the LCD. Knowing the binding code prevents having to re-bind all Nodes if your Gateway is ever replaced.

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 and 250 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

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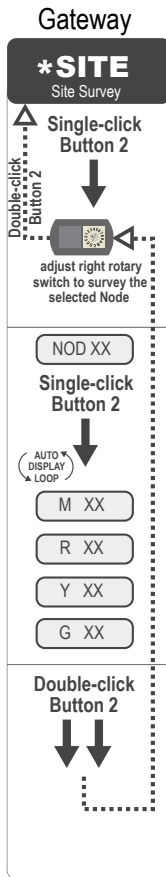
The SITE menu displays the device number of the Node the Site Survey was conducted with as well as the missed, green, yellow, and red received packet count.

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 *Conduct a Site Survey Using the Menu System* on page 3.

See *Interpreting the Site Survey Results* on page 4.

Conduct 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 25%. When the network misses more than 25% 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 25% or higher, improve the radio system performance by:
- **Mounting the network's antennas higher** to clear obstacles in the area and improve the line of sight between Sure Cross® devices
- **Using higher gain antennas** to focus the energy of the radio signal in a specific direction and extend the signal's range
- **Adding data radios to the network** 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/wireless*.

Installing Your Sure Cross® Radios

Please refer to one of the following instruction manuals for details about successfully installing your wireless network components.
- DX80 and Performance Wireless I/O Network Instruction Manual: *132607*

MAPIO Menu for the PM8 Gateway

The PM8 Gateway and Node use the LCD menu system to automatically map I/O. The Node's rotary dials need to be set properly for the I/O mapping to work.

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.

Single-click Button 1 to advance through menu

*RUN | ***DINFO** Device Info | ***FCTRY** Factory Info | ***SITE** Site Survey | ***DVCFG** Device Config | ***MAPIO** I/O Mapping | ***DERR** Device Error

Single-click Button 2 to enter MAPIO menu

Single-click Button 2 to select a MAP
Double-click Button 2 to exit the MAPIO menu

Single-click Button 1 to advance through menu

MAP 1N
MAP 2N
MAP 3N
MAP 6N
MAP 1R
MAP 2R
MAP 3R
MAP 6R
UCTMAP

MAP 1N

MAP 1N maps the I/O between the PM8 Gateway and one PM8 Node. Verify Node 1's rotary dials are set to 01.

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. Verify Node 1's rotary dials are set to 01 and Node 2's rotary dials are set to 02.

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	
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. Verify Node 1's rotary dials are set to 01, Node 2's rotary dials are set to 02, and Node 3's rotary dials are set to 03.

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. Verify Node 1's rotary dials are set to 01, Node 2's rotary dials are set to 02, through Node 6's rotary dials set to 06.

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. Verify Node 1's rotary dials are set to 01 and Node 7's rotary dials set to 07.

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

Node 1	Maps to	Node 7
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. Verify Node 1's rotary dials are set to 01, Node 2's rotary dials are set to 02, and Node 7's rotary dials set to 07.

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. Verify Node 1's rotary dials are set to 01, Node 2's rotary dials are set to 02, Node 3's rotary dials are set to 03, and Node 7's rotary dials set to 07.

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		
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. Verify Node 1's rotary dials are set to 01, Node 2's rotary dials are set to 02, through Node 7's rotary dials set to 07.

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					

Node 7	Maps to	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6
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
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

Performance 2.4 GHz Korean Radio Specifications

Radio Range[1]
2.4 GHz, 65 mW: Up to 3.2 km (2 miles)

Antenna Minimum Separation Distance
2.4 GHz, 65 mW: 0.3 m (1 ft)

Radio Transmit Power
2.4 GHz, 65 mW: 18 dBm (65 mW) conducted, less than or equal to 20 dBm (100 mW) EIRP

Spread Spectrum Technology
FHSS (Frequency Hopping Spread Spectrum)

2.4 GHz Compliance for Korean Radio 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
Gateway: Configurable via User Configuration Tool (UCT) 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

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[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. Always verify your wireless network's range by performing a Site Survey.

PM8-KR Specifications

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

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)

Discrete Inputs
Six 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

Certifications

CE

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.)

Wiring Access
Two 1/2-inch NPT ports

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

Discrete Outputs
Six 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

Environmental Specifications

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
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

Environmental Ratings
IEC IP67; NEMA 6
Refer to the Sure Cross® Wireless I/O Networks Instruction Manual (p/n 132607) for installation and waterproofing instructions.

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

Environmental Specifications for the C Housings

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
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

Environmental Ratings
"C" Housing Models/External wiring terminals: IEC IP20; NEMA 1
Refer to the Sure Cross® Wireless I/O Networks Instruction Manual (p/n 132607) for installation and waterproofing instructions.

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

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)
- **BWA-9O2-C** (900 MHz) or **BWA-2O2-C** (2.4 GHz) Antenna, 2 dBd Omni, Rubber Swivel RP-SMA Male
- **BWA-HW-011** IP20 Screw Terminal Headers (2 pack) (IP20 "C" models only)

Warnings

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.

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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For patent information, see *www.bannerengineering.com/patents*.