

Datasheet



The SureCross® 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.

- 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).
- Selectable transmit power levels of 250 mW or 1 Watt for 900 MHz models and 65 mW for 2.4 GHz models
- 10 to 30 V dc power input
- DIP switches for user configuration
- Frequency Hopping Spread Spectrum (FHSS) technology and Time Division Multiple Access (TDMA) control architecture ensure reliable data delivery within the unlicensed Industrial, Scientific, and Medical (ISM) band
- 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 accessories, refer to Banner Engineering's website, www.bannerengineering.com/surecross.

Models	Frequency	I/O
DX80N9X6S-P8	900 MHz ISM Band	Discrete I/O: Up to 12 PNP inputs or up to 12 PNP outputs (for a total of 12 I/O) (Default configuration is 6 IN and 6 OUT, without bit-packing)
DX80N2X6S-P8	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: DX80N9X6S-P8C.



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.



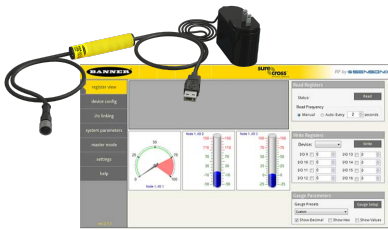
CAUTION: Never Operate 1 Watt Radios Without Antennas

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



SureCross User Configuration Tool

The User Configuration Tool (UCT) software runs on any Windows machine and uses a converter cable to connect your Gateway to the computer.



The User Configuration Tool (UCT) offers an easy way to link I/O points in your wireless network, view I/O register values graphically, and set system communication parameters when a host system is not part of the wireless network. Download the most recent revisions of the UCT software from Banner Engineering's website: <http://www.bannerengineering.com/wireless>.

The UCT requires a special USB to RS-485 (model number BWA-UCT-900 for 1 Watt radios, BWA-HW-006 can be used for all other radios) converter cable to pass information between your computer and the Gateway.

Setting Up Your Wireless Network

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

Disconnect the power from your SureCross devices.

1. Configure the DIP switches of all devices.
2. Connect the sensors to the SureCross devices.
3. Apply power to all devices.
On the Gateway, LED 1 is solid green. On the Node, LED 2 flashes red to indicate there is no radio link to the Gateway.
4. Form the wireless network by binding the Nodes to the Gateway. If the binding instructions are not included in the datasheet, refer to the product manual for binding instructions.
5. Observe the LED behavior to verify the devices are communicating with each other.
On the Gateway, LED 1 is solid green. On the Node, LED 1 flashes green to indicate it is communicating with the Gateway.
6. Conduct a site survey between the Gateway and Nodes. If the site survey instructions are not included in this datasheet, refer to the product manual for detailed site survey instructions.
7. Install your wireless sensor network components. If installation instructions are not included in this datasheet, refer to the product manual for detailed installation instructions.

For additional information, including installation and setup, weatherproofing, device menu maps, troubleshooting, and a list of accessories, refer to one of the following product manuals.

- SureCross Quick Start Guide: [128185](#)
- SureCross Wireless I/O Network Instruction Manual: [132607](#)
- Web Configurator Instruction Manual (used with "Pro" and DX83 models): [134421](#)
- Host Controller Systems Instruction Manual: [132114](#)

Configure the DIP Switches

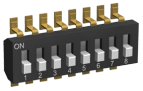
Before making any changes to the DIP switch positions, disconnect the power. DIP switch changes will not be recognized if power isn't cycled to the device.

For parameters not set via DIP switches, use the User Configuration Tool (UCT) to make configuration changes. For parameters set using the DIP switches, the DIP switch positions override any changes made using the User Configuration Tool.

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

Device Settings	Switches							
	1	2	3	4	5	6	7	8
Transmit power level: 1 Watt (30 dBm)	OFF*							
Transmit power level: 250 mW (24 dBm), DX80 compatibility mode	ON							
Modbus or UCT configured (overrides switches 5-8)		OFF*						
DIP switch configured (Uses 5-8 for I/O configuration)		ON						
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

* 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 the 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.

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.

Modbus/UCT 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 User Configuration Tool (UCT) to write custom configuration

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.

Transmit Power Levels

The 900 MHz radios can be operated at 1 watt (30 dBm) or 250 mW (24 dBm). While the radios operate in 1 Watt mode, they cannot communicate with 150 mW DX80 radio devices. To communicate with the 150 mW radio models, operate this radio in 250 mW mode. For 2.4 GHz radios, this DIP switch is disabled. The transmit power for 2.4 GHz is fixed at about 100 mW EIRP (18 dBm), making the 2.4 GHz Performance models automatically compatible with the DX80 2.4 GHz models.

User Defined Configuration of Discrete I/O on the 12 I/O Devices

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.

Defining Inputs and Outputs

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

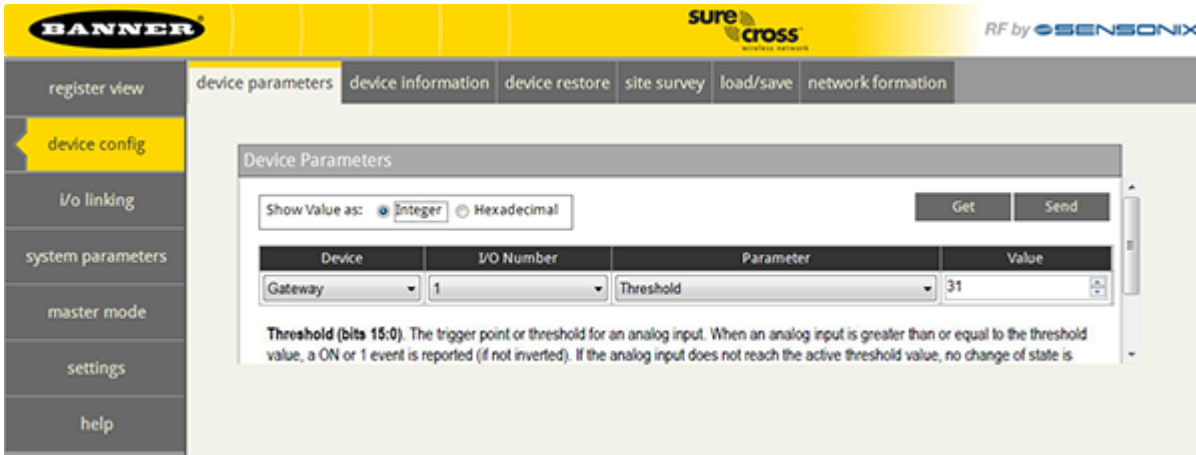
For inputs, the first I/O point selected as an input is placed in bit position 0 in register 1. The second input point is in bit position 1, et cetera. Likewise, for outputs, the first I/O point selected as an output is placed in bit position 0 in register 9, the second input point is in bit position 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	OUT 7	OUT 6	OUT 5	OUT 4	OUT 3	OUT 2	OUT 1

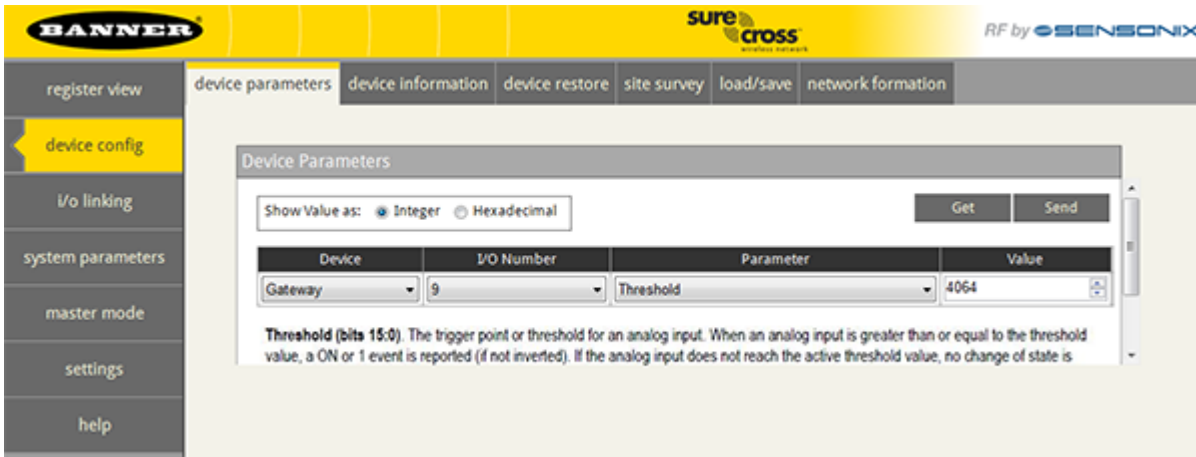
Defining Inputs and Outputs Using the UCT

To configure either a Gateway or Node, select the Gateway or specific Node from the dropdown list. To configure a DX85 Remote I/O model, set the DX85's Slave ID to 01 and select the Gateway from the dropdown 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. 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 (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 below, bits 11 through 5 are used to set seven outputs (1111 1110 0000 = 0x0FE0 = 4064)



Mixing Performance and Non-Performance Radios in the Same Network

To comply with federal regulations, the 150 mW radios and 1 Watt radios communicate differently. To mix Performance radios with non-Performance radios:

- Performance radios must operate in 250 mW mode, not 1 Watt mode (DIP switch 1 ON)
- Non-Performance radios must be set to use Extended Address Mode (DIP switch 1 ON)

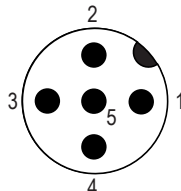
For more detailed instructions about setting up your wireless network, refer to the Quick Start Guide, Banner document number 128185. For more information about using Performance and non-Performance radios within the same network, refer the technical note titled *Mixing Performance Radios and 150 mW Radios in the Same Network* listed on the FAQ/ Knowledgebase section of Banner's Wireless Sensor Networks website.

Wiring Your SureCross® Device

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

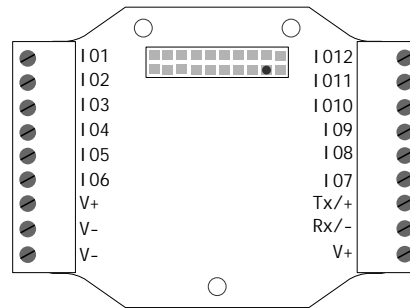
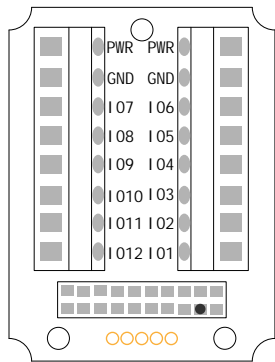
5-pin Euro-Style Wiring for Nodes

Wiring the 5-pin Euro-style connector depends on the model and power requirements of the device. Not all models can be powered by 10 to 30 V dc and not all models can be powered by 3.6 to 5.5 V dc. Refer to the Specifications to verify the power requirements of your device. For FlexPower devices, do not apply more than 5.5 V to the gray wire.

	Wire No.	Wire Color	10 to 30 V dc Powered	Battery Powered
	1	Brown	10 to 30 V dc	
	2	White		
	3	Blue	dc common (GND)	dc common (GND)
	4	Black		
	5	Gray		3.6 to 5.5 V dc

Terminal Blocks and Wiring (12 Sourcing I/O Models)

IP67 Wiring Board (-P8 Models)	IP20 Wiring Board (-P8C Models)
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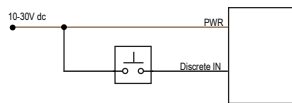
I0x. Input or output (depending on configuration)
 GND. Ground/dc common connection.
 PWR. Power, 10 to 30 V dc power connection.

Rx/-. Serial comms line for Gateways and DX85s only. No connection for Nodes.
 Tx/+. Serial comms line for Gateways and DX85s only. No connection for Nodes
 V+. Power, 10 to 30 V dc power connection.
 V-. Ground/dc common connection.

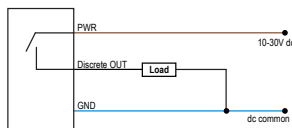
When using the DIP switches to configure the input and output selection, wire the inputs beginning with IO1. After all inputs are wired, begin using the remaining IOx as outputs. For example, if you are using 10 inputs and 2 outputs, use terminals IO1 through 10 for the inputs and terminals IO 11 and 12 for the outputs.

For the default configuration of 6 IN and 6 OUT, use IO 1 through 6 to wire the inputs and IO 7 through 12 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.

DX80...C Wiring





Wiring power to the DX80...C models varies depending the power requirements of the model. Connecting dc power to the communication pins (Tx/Rx) causes permanent damage. For FlexPower devices, do not apply more than 5.5 V to the B+ terminal.

Terminal Label	Gateway, DX85	10 to 30 V dc Powered Nodes	Battery Powered Nodes
V+	10 to 30 V dc	10 to 30 V dc	
Tx/+	RS485 / D1 / B / +		
V-	dc common (GND)	dc common (GND)	dc common (GND)
Rx/-	RS485 / D0 / A / -		
B+			3.6 to 5.5 V dc

LED Behavior for the Nodes

After binding the Gateway and Nodes, verify all devices are communicating properly. A Node will not sample its inputs until it is communicating with its Gateway. The radios and antennas must be a minimum distance apart to function properly. Recommended minimum distances are:

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

LED 1	LED 2	Node Status
 (flashing green)		Radio Link Ok
 (flashing red)	 (flashing red)	Device Error
	 (flashing red, 1 per 3 sec)	No Radio Link

Modbus Register Table

I/O Point	Modbus Holding Register		I/O Type	I/O Range		Holding Register Representation		Terminal Block Labels
	Gateway or DX85	Any Node		Min. Value	Max. Value	Min. (Dec.)	Max. (Dec.)	
1	1	1 + (Node# × 16)	Bit-Packed Discrete IN	0	1	0	1	IO1 to IO12
2	2	2 + (Node# × 16)	Non Bit-Packed Discrete IN (depending on DIP switch configuration)					
3	3	3 + (Node# × 16)						
4	4	4 + (Node# × 16)						
5	5	5 + (Node# × 16)						
6	6	6 + (Node# × 16)						
7	7	7 + (Node# × 16)	Reserved					
8	8	8 + (Node# × 16)	Device Message					
9	9	9 + (Node# × 16)	Bit-Packed Discrete OUT	0	1	0	1	IO1 to IO12
10	10	10 + (Node# × 16)	Non Bit-Packed Discrete OUT (depending on DIP switch configuration)					
11	11	11 + (Node# × 16)						
12	12	12 + (Node# × 16)						
13	13	13 + (Node# × 16)						
14	14	14 + (Node# × 16)						
15	15	15 + (Node# × 16)	Control Message					
16	16	16 + (Node# × 16)	Reserved					

Specifications

Radio ¹	General
<p>Range</p> <p>900 MHz (1 Watt): Up to 9.6 km (6 miles) 2.4 GHz: Up to 3.2 km (2 miles)</p> <p>Minimum Separation Distance</p> <p>900 MHz (1 Watt): 4.57 m (15 ft) 2.4 GHz (65 mW): 0.3 m (1 ft)</p> <p>Transmit Power</p> <p>900 MHz (1 Watt): 30 dBm (1 W) conducted (up to 36 dBm EIRP) 2.4 GHz: 18 dBm (65 mW) conducted, less than or equal to 20 dBm (100 mW) EIRP</p> <p>900 MHz Compliance (1 Watt)</p> <p>FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247 IC: 7044A-RM1809</p> <p>2.4 GHz Compliance</p> <p>FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247 ETSI/EN: In accordance with EN 300 328: V1.7.1 (2006-05) IC: 7044A-DX8024</p> <p>Spread Spectrum Technology</p> <p>FHSS (Frequency Hopping Spread Spectrum)</p> <p>Link Timeout</p> <p>Gateway: Configurable via User Configuration Tool (UCT) software Node: Defined by Gateway</p>	<p>Power</p> <p>10 to 30 V dc (Outside the USA: 12 to 24 V dc, $\pm 10\%$). (See UL section below for any applicable UL specifications) ²</p> <p>900 MHz Consumption: Maximum current draw is < 40 mA and typical current draw is < 30 mA at 24 V dc. (2.4 GHz consumption is less.)</p> <p>Housing</p> <p>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)</p> <p>Antenna Connection</p> <p>Ext. Reverse Polarity SMA, 50 Ohms Max Tightening Torque: 0.45 N·m (4 lbf·in)</p> <p>Interface</p> <p>Indicators: Two bi-color LEDs Buttons: Two Display: Six character LCD</p> <p>Wiring Access</p> <p>DX80 models: Four PG-7, One 1/2-inch NPT, One 5-pin Euro-style male connector DX80...C models: External terminals</p>

Inputs	Outputs
<p>Discrete Inputs</p> <p>Rating: 3 mA max current at 30 V dc Sample Rate: 62.5 milliseconds Report Rate: On change of state ON Condition (PNP): Greater than 4.5 V OFF Condition (PNP): Less than 4 V</p>	<p>Discrete Outputs</p> <p>Update Rate: Up to 62.5 milliseconds ON Condition (PNP): Supply minus 2 V OFF Condition (PNP): Less than 2 V Output State Following Timeout: OFF</p> <p>Discrete Output Rating (PNP)</p> <p>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</p>

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.

Environmental ³

Rating DX80 models: IEC IP67; NEMA 6 DX80...C models: IEC IP20; NEMA 1	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
Conditions Operating Temperature: -40 to 85 °C (Electronics); -20 to 80 °C (LCD) Operating Humidity: 95% max. relative (non-condensing) Radiated Immunity: 10 V/m, 80-2700 MHz (EN61000-6-2)	

Included with Model

The following items ship with the DX80 radios.

- 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 x 25mm SS screws, four M5-0.8 x 16mm SS screws, four M5-0.8mm SS hex nuts, and four #8-32 x 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)
- Quick Start Guide (128185 for DX80 Gateways or 152653 for MultiHop models)
- MQDC1-506: 5-Euro (single ended) straight cable, 2m (Not included with FlexPower devices)
- BWA-HW-011: IP20 Screw Terminal Headers (2 pack) (Included only with the IP20 DX80...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 SureCross® device or any equipment connected to the SureCross device during a thunderstorm.

Exporting SureCross 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 SureCross 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.

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³ Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.

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