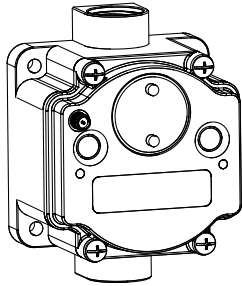


## Datasheet

Sure Cross® MultiHop data radios are wireless industrial communication devices used to extend the range of a Modbus or other serial communication network.



- Wireless industrial I/O device with one configurable discrete input, one configurable analog input, one thermistor input, one SDI-12 input, one asynchronous counter input, and one switch power output
- Selectable transmit power levels of 250 mW or 1 Watt for 900 MHz models and 65 mW for 2.4 GHz models
- Self-healing, auto-routing RF network with multiple hops extends the network's range
- Serial and I/O communication on a Modbus platform
- Message routing improves link performance
- DIP switches select operational modes: master, repeater, or slave
- Built-in site survey mode enables rapid assessment of a location's RF transmission properties
- FHSS radios operate and synchronize automatically
- Field-wireable terminals for wiring I/O

For additional information, updated documentation, and accessories, refer to Banner Engineering's website, [www.bannerengineering.com/surecross](http://www.bannerengineering.com/surecross).

Models	Frequency	I/O
DX80DR9M-H14	900 MHz ISM Band	Inputs: One configurable discrete, one configurable analog, one thermistor, one SDI-12, and one asynchronous counter Switch Power: One
DX80DR2M-H14	2.4 GHz ISM Band	

Integrated battery models are also available without batteries. If you purchase a model without the battery, Banner Engineering recommends using the XENO XL-205F battery or equivalent. For Class I Division 1/Zone 0 and Class I Division 2/Zone 2 environments, only a XENO XL-205F battery is certified.



### 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.



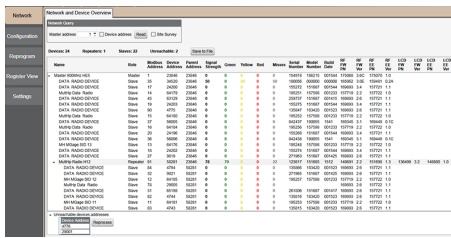
### CAUTION: Electrostatic Discharge (ESD)

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.



## MultiHop Configuration Tool

Use Banner's MultiHop Configuration Tool software to view your MultiHop radio network and configure the radio and its I/O.



The MultiHop Configuration Tool connects to a MultiHop master radio using one of four methods.

- Serial; using a USB to RS-485 (for RS-485 radios) or a USB to RS-232 (for RS-232 radios) converter cable.
- Modbus TCP; using an Ethernet connection to an Ethernet radio master.
- Serial DXM; using a USB cable to a DXM controller to access a MultiHop master radio.
- TCP DXM: using an Ethernet connection to a DXM controller to access a MultiHop master radio.

For MultiHop DX80DR\* models, Banner recommends using BWA-UCT-900, an RS-485 to USB adapter cable with a wall plug that can power your 1 Watt MultiHop radio while you are configuring it. The adapter cable is not required when connecting to a DXM controller.

Download the most recent revisions of the UCT software from Banner Engineering's website: <http://www.bannerengineering.com/wireless>.

## Setting Up Your MultiHop Network

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

1. If your radios have DIP switches, configure the DIP switches of all devices.
2. Connect the sensors to the MultiHop radios if applicable.
3. Apply power to all devices.
4. If your MultiHop radio has rotary dials, set the MultiHop Radio (Slave) ID. If your MultiHop radio has no rotary dials, continue to the next step.
5. Form the wireless network by binding the slave and repeater radios to the master radio. If the binding instructions are not included in this datasheet, refer to the quick start guide or product manual.
6. Observe the LED behavior to verify the devices are communicating with each other.
7. Conduct a site survey between the MultiHop radios. If the site survey instructions are not included in this datasheet, refer to the product manual.
8. Install your wireless sensor network components. If the installation instructions are not included in this datasheet, refer to the product manual.

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:

- MultiHop Radio Quick Start Guide: [152653](#)
- MultiHop Radio Product Manual: [151317](#)
- MultiHop Register Guide (End User Edition): [155289](#)

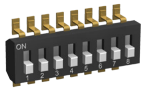
## Configure the DIP Switches

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 devices with batteries integrated into the housing, remove the battery for at least one minute.

### 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. For integrated battery models (no ribbon cable) and Class I, Division 2 certified devices (ribbon cable is glued down), skip this step.
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
Serial line baud rate 19200 OR User defined receiver slots	OFF	OFF						
Serial line baud rate 38400 OR 32 receiver slots	OFF	ON						
Serial line baud rate 9600 OR 128 receiver slots	ON	OFF						
Serial line baud rate Custom OR 4 receiver slots	ON *	ON *						
Parity: None			OFF	OFF				
Parity: Even			OFF	ON				
Parity: Odd			ON	OFF				
Disable serial (low power mode) and enable the receiver slots select for switches 1-2			ON *	ON *				
Transmit power 900 MHz radios: 1.00 Watt (30 dBm) 2.4 GHz radios: 0.065 Watts (18 dBm) and 60 ms frame					OFF *			
Transmit power 900 MHz radios: 0.25 Watts (24 dBm) 2.4 GHz radios: 0.065 Watts (18 dBm) and 40 ms frame					ON			
Application mode: Modbus						OFF *		
Application mode: Transparent						ON		
MultiHop radio setting: Repeater							OFF	OFF
MultiHop radio setting: Master							OFF	ON
MultiHop radio setting: Slave							ON *	OFF *
MultiHop radio setting: Reserved							ON	ON

\* Default configuration

### Application Mode

The MultiHop radio operates in either Modbus mode or transparent mode. Use the internal DIP switches to select the mode of operation. All MultiHop radios within a wireless network must be in the same mode.

Modbus mode uses the Modbus protocol for routing packets. In Modbus mode, a routing table is stored in each parent device to optimize the radio traffic. This allows for point to point communication in a multiple data radio network and acknowledgement/retry of radio packets. To access a radio's I/O, the radios must be running in Modbus mode.

In transparent application mode, all incoming packets are stored, then broadcast to all connected data radios. The data communication is packet based and not specific to any protocol. The application layer is responsible for data integrity. For one to one data radios it is possible to enable broadcast acknowledgement of the data packets to provide better throughput. In transparent mode, there is no access to the radio's I/O.

### Baud Rate and Parity

The baud rate (bits per second) is the data transmission rate between the device and whatever it is physically wired to. Set the parity to match the parity of the device you are wired to.

### Disable Serial

If the local serial connection is not needed, disable it to reduce the power consumption of a data radio powered from the solar assembly or from batteries. All radio communications remain operational.

## Receiver Slots

The number of receiver slots indicates the number of times out of 128 slots/frames the radio can transmit to its parent radio. Setting a slave's receiver slots to 4 reduces the total power consumption by establishing that the slave can only transmit to its parent four times per 128 slots.

## Transmit Power Levels/Frame Size

The 900 MHz data radios can be operated at 1 watt (30 dBm) or 0.250 watt (24 dBm). For most models, the default transmit power is 1 watt.

For 2.4 GHz radios, the transmit power is fixed at 0.065 watt (18 dBm) and DIP switch 5 is used to set the frame timing. The default position (OFF) sets the frame timing to 60 milliseconds. To increase throughput, set the frame timing to 40 milliseconds. Note that increasing the throughput decreases the battery life.

*Prior to date code 15341 and radio firmware version 3.6, the frame timing was 40 ms (OFF) or 20 ms (ON).*

## Wiring Your Sure Cross® Device

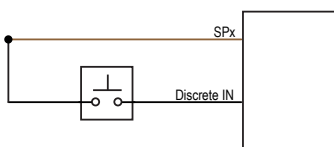
Use the following wiring diagrams to first wire the sensors and then apply power to the Sure Cross devices.

### Wiring Diagrams

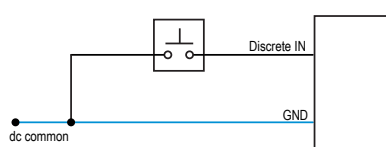
Do not exceed analog input ratings for analog inputs. Only connect sensor outputs to analog inputs.

	Pin	Jumper Position	Description
	1	J1 set to 5	Discrete Input (NPN or PNP)
	1	J1 set to 8	SDI-12 Data
	2		Ground
	3		Switch Power 1 (3.6 to 24 V)
	4	J2 set to C	Analog Current Input (0-20 mA)
	4	J2 set to V	Analog Voltage Input (0-10 V)
	5		Ground
	6	J3 set to 3	Counter Input
	6	J3 set to 4	Thermistor Input

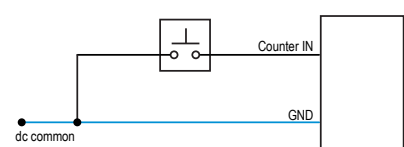
Discrete Input Wiring for PNP Sensors



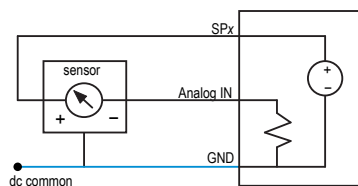
Discrete Input Wiring for NPN Sensors



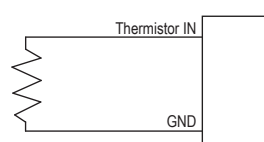
Counter Input Wiring



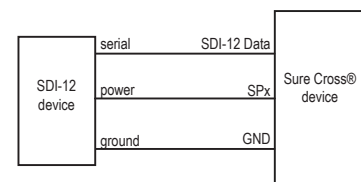
Analog Input Wiring



Thermistor Input Wiring



I Input Wiring for SDI -12 Sensors

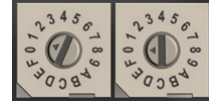


Switch power 1 (SP1) is active for this device.

## Set the MultiHop Radio (Slave) ID

On a MultiHop radio, use the rotary dials to set the device's MultiHop Radio ID.

Modbus Slave IDs 01 through 10 are reserved for slaves directly connected to the host (local I/O). Polling messages addressed to these devices are not relayed over the wireless link. Use Modbus Slave IDs 11 through 60 for MultiHop master, repeater, and slave radios. Up to 50 devices (local slaves and remote slaves) may be used in this system.



With the left dial acting as the left digit and the right dial acting as the right digit, the MultiHop Radio ID can be set from 01 through 60.

## Modbus Register Tables

Register (4xxxx)	Input #	Inputs	I/O Range		Holding Register Representation	
			Min. Value	Max. Value	Min. (Dec.)	Max. (Dec.)
1	1	Discrete IN 1	0	1	0	1
2	2					
	...					
5	5	Analog IN 1 (mA)	0.0	20.0	0	65535
6	6					
7	7					
8	8	Thermistor (°F)	-1638.3	1638.4	-32768	32767
9	9	Counter High Word *	0	65535	0	65535
10	10	Counter Low Word *	0	65535	0	65535
11	11					
12	12	SDI-12 Device/CMD 5 *				
13	13	SDI-12 Device/CMD 4 *				
14	14	SDI-12 Device/CMD 3 *				
15	15	SDI-12 Device/CMD 2 *				
16	16	SDI-12 Device/CMD 1				

\* The factory default setting for SDI-12 devices 2 through 5 and the counter input is disabled. The counter and SDI-12 inputs cannot be enabled at the same time.

## Modbus Addressing Convention

All Modbus addresses refer to Modbus holding registers. When writing your own Modbus scripts, use the appropriate commands for interfacing to holding registers. Parameter description headings refer to addresses in the range of 40000 as is customary with Modbus convention.

## SDI -12 Configuration

The SDI-12 interface on the MultiHop DX80DR9M-H12 radio can support up to five devices with (12) 32-bit register values each. The H12 SDI-12 interface can be configured to increase the number of registers per device address for devices with large register sets. The factory default enables one SDI-12 device using device address 1 with up to nine registers with a SDI-12 command of "M!".

The MultiHop H12 device is configured by writing non-volatile Modbus registers with configuration parameters. Read or write the device configuration parameters using standard Modbus commands. For more information about manually configuring the SDI-12 interface, refer to the MultiHop Register Parameter document, p/n 155289.

## Basic SDI -12 Interface Parameters

Up to five devices/commands can be accessed using the SDI-12 interface. There are three parameters for each device/command: Enable, Device Address, Device Command.

**Enable.** Instructs the MultiHop device to activate or deactivate the device. Write a 1 to enable, and write a 0 to disable. The factory default for device 1 is enabled; devices 2 through 5 are disabled.

Device Address. Each SDI-12 device must have a unique device address. This parameter is the ASCII code for the device address. Valid device addresses are 0–9 and a–z that map to ASCII codes 48–57 and 97–122, respectively. The factory default addresses are:

- SDI-12 Device 0 uses ASCII code 48
- SDI-12 Device 1 uses ASCII code 49
- SDI-12 Device 2 uses ASCII code 50
- SDI-12 Device 3 uses ASCII code 51
- SDI-12 Device 4 uses ASCII code 52

Device Command The SDI-12 interface supports "M!" or "C!" commands. Use the Device Command parameter to define which command to use for this device. The factory default is "M!" commands for all devices (value of 10 in the Modbus register).

Supported M! Commands		Supported C! Commands	
SDI -12 Command	Register Value	SDI -12 Command	Register Value
xM!	0 or 10	xC!	1 or 20
xM1!	11	xC1!	21
xM2!	12	xC2!	22
xM3!	13	xC3!	23
xM4!	14	xC4!	24
xM5!	15	xC5!	25
xM6!	16	xC6!	26
xM7!	17	xC7!	27
xM8!	18	xC8!	28
xM9!	19	xC9!	29

The Modbus configuration registers are listed. All registers are defined as Modbus holding registers. The factory default values are shown in parentheses. All values are in decimal, unless noted otherwise.

Device/CMD Configuration	Registers (Default Value)		
	Enable	Device Address	Device Command
SDI-12 Device/CMD 1	1751 (1)	11001 (48) <sup>1</sup>	11002 (10)
SDI-12 Device/CMD 2	1701 (0)	11201 (49)	11202 (10)
SDI-12 Device/CMD 3	1651 (0)	11401 (50)	11402 (10)
SDI-12 Device/CMD 4	1601 (0)	11601 (51)	11602 (10)
SDI-12 Device/CMD 5	1551 (0)	11801 (52)	11802 (10)

## SDI-12 Device Result Registers

The result registers store all information received from the SDI-12 devices.

The registers are 16-bit registers and require two registers to store a 32-bit value. The factory default configuration defines the result registers as 32-bit registers, floating point format, and the first nine result registers are enabled for use. A host system reads the SDI-12 device data from these registers.

Result Registers	Register 1	Register 2	Register 3	Register 4	Register 5	Register 6
SDI-12 Device/CMD 1 Result Upper	11101	11103	11105	11107	11109	11111
SDI-12 Device/CMD 1 Result Lower	11102	11104	11106	11108	11110	11112
SDI-12 Device/CMD 2 Result Upper	11301	11303	11305	11307	11309	11311
SDI-12 Device/CMD 2 Result Lower	11302	11304	11306	11308	11310	11312
SDI-12 Device/CMD 3 Result Upper	11501	11503	11505	11507	11509	11511
SDI-12 Device/CMD 3 Result Lower	11502	11504	11506	11508	11510	11512

<sup>1</sup> The default device addresses 48 through 52 are in ASCII.

Result Registers	Register 1	Register 2	Register 3	Register 4	Register 5	Register 6
SDI-12 Device/CMD 4 Result Upper	11701	11703	11705	11707	11709	11711
SDI-12 Device/CMD 4 Result Lower	11702	11704	11706	11708	11710	11712
SDI-12 Device/CMD 5 Result Upper	11901	11903	11905	11907	11909	11911
SDI-12 Device/CMD 5 Result Lower	11902	11904	11906	11908	11910	11912

Result Registers	Register 7	Register 8	Register 9	Register 10	Register 11	Register 12
SDI-12 Device/CMD 1 Result Upper	11113	11115	11117	11119	11121	11123
SDI-12 Device/CMD 1 Result Lower	11114	11116	11118	11120	11122	11124
SDI-12 Device/CMD 2 Result Upper	11313	11315	11317	11319	11321	11323
SDI-12 Device/CMD 2 Result Lower	11314	11316	11318	11320	11322	11324
SDI-12 Device/CMD 3 Result Upper	11513	11515	11517	11519	11521	11523
SDI-12 Device/CMD 3 Result Lower	11514	11516	11518	11520	11522	11524
SDI-12 Device/CMD 4 Result Upper	11713	11715	11717	11719	11721	11723
SDI-12 Device/CMD 4 Result Lower	11714	11716	11718	11720	11722	11724
SDI-12 Device/CMD 5 Result Upper	11913	11915	11917	11919	11921	11923
SDI-12 Device/CMD 5 Result Lower	11914	11916	11918	11920	11922	11924

## SDI-12 Device Settings

Device / Cmd Configuration	Registers (Default Value)							
	Enable	Device Address	Switch Power Enable	Device Command	Sample Hi	Sample Low	Warmup Time	Voltage
SDI-12 Device/CMD 1	1751 (1)	11001 (48) <sup>2</sup>	1754 (1)	11002 (10)	1752 (0)	1753 (22500)	1755 (50)	1756 (148)
SDI-12 Device/CMD 2	1701 (0)	11201 (49)	1704 (0)	11202 (10)	1702 (0)	1703 (22500)	1705 (50)	1706 (148)
SDI-12 Device/CMD 3	1651 (0)	11401 (50)	1654 (0)	11402 (10)	1652 (0)	1653 (22500)	1655 (50)	1656 (148)
SDI-12 Device/CMD 4	1601 (0)	11601 (51)	1604 (0)	11602 (10)	1602 (0)	1603 (22500)	1605 (50)	1606 (148)
SDI-12 Device/CMD 5	1551 (0)	11801 (52)	1554 (0)	11802 (10)	1552 (0)	1553 (22500)	1555 (50)	1556 (148)

These SDI-12 probes have been tested and are functional with the factory default settings.

MFG	Models	Technical Note
Acclima	SEN-SDI (TDT SDI-12 Soil Moisture Sensor)	<a href="#">SDI-12 and the Acclima TDT SDI-12 Soil Moisture Probe</a>
Adcon Telemetry	HydraProbeII	
AquaCheck	Sub-surface Probe	<a href="#">SDI-12 and the AquaCheck Sub-Surface Soil Moisture Probe</a>
Decagon	MPS-2, MPS-6, 5TE, TS1, T8	<a href="#">SDI-12 and the Decagon 5TE Soil Moisture Probe</a> <a href="#">SDI-12 and the Decagon GS3 Soil Moisture Probe</a> <a href="#">SDI-12 and the Decagon MPS-2 Soil Moisture Probe</a>
HSTI	HydraScout	<a href="#">SDI-12 and the HydraScout HSTI Probe</a>
Sentek	EnviroSCAN	<a href="#">SDI-12 and the Sentek EnviroScan Soil Moisture Probe</a>

## Storage and Sleep Modes

Storage Mode (applies to battery-powered models only)—While in storage mode, the radio does not operate. All Sure Cross® radios powered from an integrated battery ship from the factory in storage mode to conserve the battery. To wake the device, press and hold button 1 for 5 seconds. To put any *FlexPower*® or integrated battery Sure Cross radio into

<sup>2</sup> The default device addresses 48 through 52 are in ASCII.

storage mode, press and hold button 1 for 5 seconds. The radio is in storage mode when the LEDs stop blinking, but in some models, the LCD remains on for an additional minute after the radio enters storage mode. After a device has entered storage mode, you must wait 1 minute before waking it.

Sleep Mode (applies to both battery and 10–30 V dc powered models)—During normal operation, the Sure Cross radio devices enter sleep mode after 15 minutes of operation. The radio continues to function, but the LCD goes blank. To wake the device, press any button.

## Replacing the Integrated Battery (DX80 Models)

To replace the lithium "D" cell battery in any integrated housing model, follow these steps.

1. Remove the four screws mounting the face plate to the housing and remove the face plate.
2. Remove the discharged battery by pressing the battery toward the negative terminal to compress the spring. Pry up on the battery's positive end to remove from the battery holder.
3. Replace with a new battery. Only use a 3.6 V lithium battery from Xenon, model number XL-205F.
4. Verify the battery's positive and negative terminals align to the positive and negative terminals of the battery holder mounted within the case. The negative end is toward the spring.

Caution: There is a risk of explosion if the battery is replaced incorrectly.

5. After replacing the battery, allow up to 60 seconds for the device to power up.
6. Properly dispose of your used battery according to local regulations by taking it to a hazardous waste collection site, an e-waste disposal center, or other facility qualified to accept lithium batteries.



As with all batteries, these are a fire, explosion, and severe burn hazard. Do not burn or expose them to high temperatures. Do not recharge, crush, disassemble, or expose the contents to water.

Replacement battery model number: BWA-BATT-001. For pricing and availability, contact Banner Engineering.

## Specifications

### Radio Range<sup>3</sup>

- 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 (MultiHop)

- FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247
- ETSI EN 300 328: V1.8.1 (2012-04)
- IC: 7044A-DX8024

### Spread Spectrum Technology

- FHSS (Frequency Hopping Spread Spectrum)

### Supply Voltage

- 3.6 V dc low power option from an internal battery

### Current Draw at 3.6 V dc

- 900 MHz, 1 Watt: Approximately 1 mA
- 900 MHz, 250 mW: Approximately 0.5 mA
- 2.4 GHz, 65 mW: Approximately 0.3 mA

### Communication Hardware (MultiHop RS-485)

- Interface: 2-wire half-duplex RS-485
- Baud rates: 9.6k, 19.2k (default), or 38.4k via DIP switches; 1200 and 2400 via the MultiHop Configuration Tool
- Data format: 8 data bits, no parity, 1 stop bit

### Packet Size (MultiHop)

- 900 MHz: 175 bytes (85 Modbus registers)
- 2.4 GHz: 75 bytes (37 Modbus registers)

### Intercharacter Timing (MultiHop)

- 3.5 milliseconds

<sup>3</sup> 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.



Antenna Connection

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

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)

Interface

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

Wiring Access

Two 1/2-inch NPT

Operating Conditions<sup>4</sup>

-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<sup>5</sup>

IEC IP67; NEMA 6

Certifications



Discrete Input

Rating: 3 mA max current at 30 V dc  
Sample Rate: 40 milliseconds  
ON Condition (NPN): Less than 0.7 V  
OFF Condition (NPN): Greater than 2 V or open

Analog Input

Rating: 24 mA  
Impedance: Approximately 220 Ohms<sup>6</sup>  
Sample Rate: 1 second  
Accuracy: 0.1% of full scale +0.01% per °C  
Resolution: 12-bit

Thermistor Input

Model: 44006, 44016, or 44031 family of 10 kOhm thermistors  
Sample Rate: 1 second  
Accuracy: 0.4 °C (10 °C to 50 °C); Up to 0.8 °C (-40 °C to 85 °C)

Counter Input

Event Counter: Input rating 1 Hz to 10 kHz (For battery powered devices, the recommended input rating is less than 1 kHz)  
Rate (Frequency) Counter: 1 Hz to 25 kHz  
Threshold: 1.7 V

## Included with Model

The following items ship with the M-H14 and P14 radios.

- BWA-HW-059: DX80 Access Hardware Kit, containing one 1/2-inch NPT strain relief fitting with o-ring, and one 1/2-inch NPT plastic vent plug.
- 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.
- Quick Start Guide (128185 for DX80 Gateways or 152653 for MultiHop models)
- BWA-BATT-001: Replacement battery, 3.6 V lithium "D" cell

## 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.

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<sup>4</sup> Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.

<sup>5</sup> Refer to the *Sure Cross® MultiHop Product Instruction Manual* (p/n 151317) for installation and waterproofing instructions.

<sup>6</sup> To verify the analog input's impedance, use an Ohm meter to measure the resistance between the analog input terminal (AIx) and the ground (GND) terminal.

## 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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