Sure Cross® MultiHop Data Radio

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 two sinking discrete inputs and one DC latching output
- Selectable transmit power levels of 250 mW or 1 Watt for 900 MHz models and 65 mW for 2.4 GHz models
- *Flex*Power® technology driven by one lithium primary battery integrated into the housing or 10 to 30 V dc
- Self-healing, auto-routing RF network with multiple hops extends the network's range
- Message routing improves link performance
- Operates as a slave device when powered by the internal battery; may be configured as a repeater when powered by 10 to 30 V dc; not designed to operate as a master radio
- Built-in site survey mode enables rapid assessment of a location's RF transmission properties
- FHSS radios operate and synchronize automatically

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

Models	Frequency	DC Latch Configuration I/O
DX80DR9M-DCLATCHE	900 MHz ISM Band	Inputs: Two sinking discrete Outputs for DC Latch: DC Latch
DX80DR2M-DCLATCHE	2.4 GHz ISM Band	

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

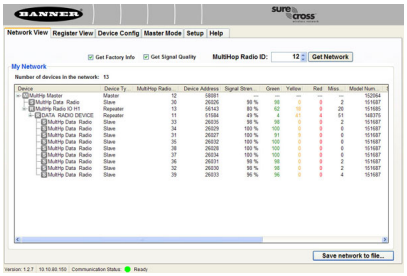
To avoid damaging the radio circuitry, never power up Sure Cross® Performance or Sure Cross MultiHop (1 Watt) radios without an antenna.

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 requires that you connect your master radio to your computer using either a USB to RS-485 (for RS-485 radios) or a USB to RS-232 (for RS-232 radios) converter cable. For RS-485 models, Banner recommends using cable model 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.

If you use an adapter cable that does not also supply 10-30V dc to your radio, use the DIP switches to set the MultiHop Radio to transmit at 250 mW.

When the MultiHop Configuration Tool launches, it automatically checks to see if a newer version of the software is available. If a newer version is available, a dialog box displays on the screen to ask you if you want to download the new version or ignore the new version. If you select download, the newer version automatically downloads, installs, and relaunches the program for you.

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*

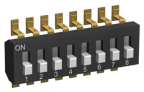
Configure the DIP Switches

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

The DC Latching MultiHop radio may operate as a slave radio when powered by the internal battery. To operate this model as a repeater radio, the radio must be powered by 10 to 30 V dc. This model is not designed to operate as a master radio.

	Switches							
Device Settings	1	2	3	4	5	6	7	8
	ON *	ON *	ON *	ON *		OFF *		
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			
MultiHop radio setting: Repeater							OFF	OFF
MultiHop radio setting: Slave							ON *	OFF *

* Default configuration

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.

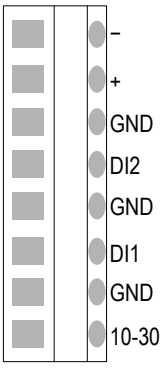
Prior to date code 15341 and radio firmware version 3.6, the frame timing was 40 ms (OFF) or 20 ms (ON).

Wiring Your Sure Cross® Device

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

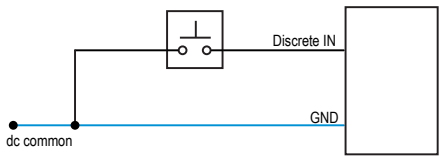
Terminal Blocks and Wiring

Power this model by 10 to 30 V dc when it operates as a repeater radio. The power for the sensors can be supplied by the 10 to 30 V dc used to power the radio.

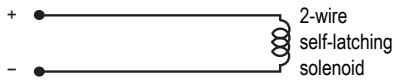


\+ and -. DC Latching relay outputs
DI1 and DI2. Discrete inputs, sinking
GND. Ground/dc common connection
10-30. 10 to 30 V dc

Discrete Input Wiring for NPN Sensors



DC Latching



Replacing the Integrated Battery (DX80...E 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. Do not remove the radio cover from the face plate.
2. Remove the discharged battery and replace with a new battery.
   Only use a 3.6V lithium battery from Xeno, model number XL-205F.
3. Verify the battery's positive and negative terminals align to the positive and negative terminals of the battery holder mounted within the case.

   Caution: There is a risk of explosion if the battery is replaced incorrectly.
4. After replacing the battery, allow up to 60 seconds for the device to power up.

For outside or high humidity environments, conductive grease may be applied to the battery terminals to prevent moisture and corrosion buildup.

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.

Bind the MultiHop Radios to Form Networks

To create your MultiHop network, bind the MultiHop slave radios to the designated master radio.

Binding MultiHop radios ensures all MultiHop radios within a network only communicate with other radios within the same network. The MultiHop master radio automatically generates a unique binding code when the master radio enters binding mode. This code is then transmitted to all MultiHop radios within range that are also in binding mode. After a MultiHop slave is bound, the slave radio accepts data only from the master to which it is bound. The binding code defines the network, and all radios within a single network must use the same binding code.

Before using the slave radios, you must bind them to the MultiHop master radio and assign a device ID using the master's rotary dials. To bind and assign an address to MultiHop slave radios without rotary dials, follow these steps.

1. Apply power to the master radio.
2. Put the MultiHop master radio into binding mode.
   - For master radios with two buttons: triple-click button 2
   - For master radios with one button: trick-click the button

   For the two LED/button models, both LEDs flash red and the LCD shows *BINDNG and *MASTER. For single LED/button models, the LED flashes alternatively red and green.
3. Using the master radio's rotary dials, select the Device ID to assign to the MultiHop slave radio. Use the left rotary dial for the left digit and the right rotary dial for the right digit. For example, to assign your slave radio to Device ID 10, set the left dial to 1 and the right dial to 0.
4. Put the MultiHop slave radio into binding mode.
   - For two button radios, triple-click button 2.
   - For one button radios, triple-click the button.

   The slave radio enters binding mode and searches for any Master radio in binding mode. While searching for the Master radio, the two red LEDs flash alternately. When the slave radio finds the Master radio and is bound, both red LEDs are solid for four seconds, then both red LEDs flash simultaneously four times. After the slave receives the binding code transmitted by the master, the slave radio automatically exits binding mode.
5. Repeat this sequence (steps 3 and 4) for as many MultiHop slave radios as you need to bind.
   If two MultiHop slave radios are accidentally assigned the same Device ID, rerun the binding procedure on one of the radios to reassign the ID. The binding sequence may be run as many times as necessary.
6. To exit binding mode on the MultiHop master radio, double-click button 2 on the MultiHop master radio. The master radio restarts and enters RUN mode.

Modbus Register Tables

Register (4xxxx)	Input #	Inputs	I/O Range		Holding Register Representation		Terminal Block Labels
			Min. Value	Max. Value	Min. (Dec.)	Max. (Dec.)	
1	1	Discrete IN 1	0	1	0	1	DI1
2	2	Discrete IN 2	0	1	0	1	DI2

Register (4xxxx)	Output #	Outputs	I/O Range		Holding Register Representation		Terminal Block Labels
			Min. Value	Max. Value	Min. (Dec.)	Max. (Dec.)	
503	3	DC Latch OUT	0	1	0	1	+ and –

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.

DC Latching Operation

To operate the outputs, write the output register 0503 to 1 to activate the DC Latching output. Write the output register 0503 to 0 to deactivate the outputs. The 0503 operation is not functional when radio communications are lost; the solenoid remains in its last state. The user is responsible for correcting the radio communications problem and regaining control of the external device.

Specifications

Radio Range
- 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

Discrete Inputs
- 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

Supply Voltage
- 3.6 V dc low power option from an internal battery or 10 to 30 V dc

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: 1/4-inch or M7 (SS M7 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

Wiring Access
- Two 1/2-inch NPT

Spread Spectrum Technology
- FHSS (Frequency Hopping Spread Spectrum)

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

Intercharacter Timing (MultiHop)
- 3.5 milliseconds

[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.

Environmental Ratings
"E" Housing Models: IEC IP65; NEMA 4X [2]

Operating Conditions[3]
–40 °C to +65 °C (–40 °F to +149 °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

Certifications

CE

Included with Device

The following items ship with this model:

- BWA-9O2-C (900 MHz) or BWA-2O2-C (2.4 GHz): Antenna, 2 dBd Omni, Rubber Swivel RP-SMA Male.
- BWA-BATT-001: Replacement battery, 3.6 Volt, D Lithium Cell
- BWA-HW-032: Access Hardware for "E" Housing (One each of 1/2-inch plug, 1/2-inch gland)

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*.

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.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp.

[2] Refer to the *Sure Cross® MultiHop Product Instruction Manual* (p/n 151317) for installation and waterproofing instructions.
[3] Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.