

## 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. Wireless MultiHop data radio networks are formed around a MultiHop master and one or more slaves and extend the range of a Modbus or other serial communication network.



- *FlexPower*® power options allow for 10 to 30 V dc, solar, and battery power sources for low power applications.
- Serial communication style (RS-232 or RS-485) is user selectable
- Multiple hops allow for an extended range
- Message routing improves link performance
- Self-healing, auto-routing RF network with multiple hops extends the network's range
- DIP switches select operational modes: master, repeater, or slave
- Built-in site survey mode enables rapid assessment of a location's RF transmission properties
- Frequency Hopping Spread Spectrum (FHSS) technology ensures reliable data delivery within the unlicensed Industrial, Scientific, and Medical (ISM) band

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



### 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.

## Models

Models	Frequency	Transmit Power
DX80DR2M-H-KR	2.4 GHz ISM Band	65 mW (100 mW EIRP)

## Configuration Instructions

### 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. Configure any I/O points to use the sensors connected to the Sure Cross devices.
8. Conduct a site survey between the MultiHop radios. If the site survey instructions are not included in this datasheet, refer to the product manual.
9. Install your wireless sensor network components. If the installation instructions are not included in this datasheet, refer to the product manual.



For additional information, refer to one of the following documents:

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

### Configure the DIP Switches

Before changing DIP switch positions, disconnect the power. DIP switch changes are not recognized until after power is cycled to the device.

### Accessing the Internal DIP Switches

To access the internal DIP switches, follow these steps:

1. Unscrew the four screws that mount the cover to the bottom housing.
2. Remove the cover from the housing without damaging the ribbon cable or the pins the cable plugs into.
3. Gently unplug the ribbon cable from the board mounted into the bottom housing.
4. Remove the black cover plate from the bottom of the device's cover.  
The DIP switches are located behind the rotary dials.



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

### DIP Switch Settings (MultiHop)

	Switches							
Device Settings	1	2	3	4	5	6	7	8
Serial line baud rate 19200 OR User defined receiver slots	OFF <sup>1</sup>	OFF <sup>1</sup>						
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 <sup>2</sup>	ON <sup>2</sup>						
Parity: None			OFF <sup>1</sup>	OFF <sup>1</sup>				
Parity: Even			OFF	ON				
Parity: Odd			ON	OFF				
Disable serial (low power mode) and enable the receiver slots select for switches 1-2			ON <sup>2</sup>	ON <sup>2</sup>				
Transmit power 900 MHz radios: 1.00 Watt (30 dBm) 2.4 GHz radios: 0.065 Watts (18 dBm) and 60 ms frame					OFF <sup>1</sup>			
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 <sup>1</sup>		
Application mode: Transparent						ON		
MultiHop radio setting: Repeater							OFF <sup>1</sup>	OFF <sup>1</sup>
MultiHop radio setting: Master							OFF	ON
MultiHop radio setting: Slave							ON <sup>2</sup>	OFF <sup>2</sup>
MultiHop radio setting: Reserved							ON	ON

<sup>1</sup> Default configuration

<sup>2</sup> Default configuration for the E housing models only

### 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.

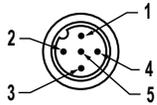
*Prior to date code 15341 and radio firmware version 3.6, the frame timing was 40 ms (OFF) or 20 ms (ON).*

## Wire Your Sure Cross® Device

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

### Apply Power to the MultiHop Radio

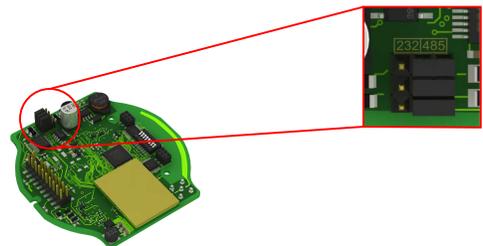
Connecting power to the communication pins will cause permanent damage. For *FlexPower* devices, do not apply more than 5.5 V to the gray wire. The FlexPower Multihop radios will operate equally well when powered from the brown or gray wire. It is not necessary to supply both. The power for the sensors can be supplied by the radio's SPx terminals or from the 10 V dc to 30 V dc used to power the radio.

	Pin	Wire Color	Models powered by 10 to 30 V dc with RS-485	FlexPower models with RS-485	FlexPower models with RS-232
	1	brown	10 V dc to 30 V dc	10 V dc to 30 V dc	10 V dc to 30 V dc
	2	white	RS-485 / D1 / B / +	RS-485 / D1 / B / +	RS-232 Tx
	3	blue	dc common (GND)	dc common (GND)	dc common (GND)
	4	black	RS-485 / D0 / A / -	RS-485 / D0 / A / -	RS-232 Rx
	5	gray	-	3.6 V dc to 5.5 V dc	3.6 V dc to 5.5 V dc

## Serial Communication

### RS-232 and RS-485 Communication

Three jumpers control the communication mode. To change the communication mode, change all three jumper positions. The jumpers are shown configured for RS-485 communication (factory default position).



## Set the MultiHop Radio (Slave) ID

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

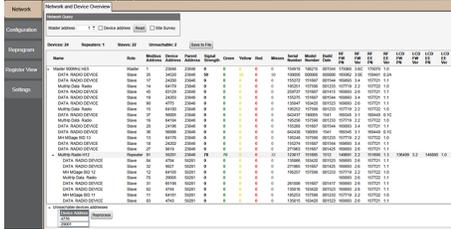
Modbus Slave IDs 01 through 10 are reserved for slaves directly connected to the host (local I/O). Polling messages addressed to these devices are not relayed over the wireless link. Use Modbus Slave IDs 11 through 60 for MultiHop master, repeater, and slave radios. Up to 50 devices (local slaves and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

## MultiHop Configuration Software

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



The software 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 configure it. The adapter cable is not required when connecting to a DXM Controller.

Download the most recent software revision from the Wireless Reference Library on Banner Engineering's website: [www.bannerengineering.com](http://www.bannerengineering.com).

## Installing Your Sure Cross® Radios

Please refer to one of the following instruction manuals for details about successfully installing your wireless network components.

- MultiHop Data Radio Instruction Manual: [151317](#)

## Manufacturer Parameter Registers

The following are the device-specific and manufacturer parameters for the MultiHop radio devices. These registers are all within the 4xxxx range.

### 04100s Manufacturing Information

Address (4xxxx)	Name	Format
4101-4104	Serial number, digits 1-8	ASCII, read only
4111-4113	Model number, digits 1-6	ASCII, read only
4121-4123	Production date, digits 1-6	ASCII, read only

### 04200s Device Name

Address (4xxxx)	Name	Format
4201-4209	Name characters 1-18	ASCII

### 04300s Software Information

Address (4xxxx)	Name	Format
4301-4303	RF firmware p/n	ASCII, read only
4304-4305	RF firmware version	ASCII, read only
4306-4308	RF EEPROM part number, digits 1-6	ASCII, read only

Address (4xxxx)	Name	Format
4309–4310	RF EEPROM version number, characters 1–3	ASCII, read only
4311–4313	LCD firmware p/n	ASCII, read only
4314–4315	LCD firmware version	ASCII, read only
4316–4318	LCD EEPROM part number, digits 1–6	ASCII, read only
4319–4320	LCD EEPROM version number, characters 1–3	ASCII, read only

## 06400s Message Parameters

Strings stored in ASCII format are read as two characters per Modbus register. The lower numbered Modbus register contains the right-most characters in the string. Within a given Modbus register, the upper byte contains the ASCII character that goes to the right of the character in the lower byte.

Address (4xxxx)	Name	Format
6401	Device address	Hex
6402	Parent address	Hex, read only

## Storing a Model Number

For example, the model number 148691 is stored as shown below.

Address (4xxxx)	Name	Modbus Register Value (in hex)	Character Representation
4111	Model number digits 6-5	0x3139	1 9
4112	Model number digits 4-3	0x3638	6 8
4113	Model number digits 2-1	0x3431	4 1

## Parameters Stored as Numbers

Parameters stored as number values (not ASCII) read out directly as 16-bit values. Examples of parameters of this type include the Parent Address or Device Address.

Address (4xxxx)	Name	Value (in hex)	Value (decimal)
6401	Device address	0x002A	42
6402	Parent address	0x0023	35

## Specifications

### MultiHop 2.4 GHz Korean Radio Specifications

#### Radio Range<sup>¶</sup>

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)

#### Radio Packet Size (MultiHop)

2.4 GHz: 75 bytes (37 Modbus registers)

### RS-485 Communication Specifications

#### 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

<sup>¶</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.

## MultiHop H-KR Specifications

### Supply Voltage

10 V dc to 30 V dc (Outside the USA: 12 V dc to 24 V dc, ±10%) on the brown wire, or 3.6 V dc to 5.5 V dc low power option on the gray wire <sup>2</sup>

### Wiring Access

One 5-pin threaded M12/Euro-style male quick disconnect

### 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)

### Consumption

Master radio consumption (900 MHz): Maximum current draw is < 100 mA and typical current draw is < 30 mA at 24 V dc. (2.4 GHz consumption is less.)

Repeater/slave radio consumption (900 MHz): Maximum current draw is < 40 mA and typical current draw is < 20 mA at 24 V dc. (2.4 GHz consumption is less.)

### Interface

Two bi-color LED indicators; Two buttons; Six character LCD

### Certifications



## 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® MultiHop Product Instruction Manual (p/n [151317](#)) 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 Device (Low-Profile Housings)

The following items ship with the low-profile housings.

- 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-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)

## 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](http://www.bannerengineering.com/patents).

<sup>2</sup> For European applications, power this device from a Limited Power Source as defined in EN 60950-1.