

SureCross MultiHop Data Radio



SureCross™ MultiHop Data Radio

Configurable FlexPower MultiHop Data Radio for extending the range of a Modbus or serial communication network

Features



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

- Selectable transmit power levels of 250 mW or 1 Watt and license-free operation up to 4 watt EIRP, with a high-gain antenna, in the U.S. and Canada for 900 MHz
- FlexPower™ power options allows for +10 to 30V 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 extended 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
- FHSS radios operate and synchronize automatically; selectable network IDs reduce interference from collocated networks
- Certified for use in Class I, Division 2, Group A, B, C, D Hazardous Locations when properly installed in accordance with the National Electrical Code, the Canadian Electrical Code, or applicable local codes/regulations (see Specifications)

For additional information, the most recent version of all documentation, and a complete list of accessories, refer to Banner Engineering's website

Models

Model	Power	Frequency	Transmit Power
DX80DR9M-H	+10 to 30V dc or 3.6 to 5.5V dc low power option	900 MHz ISM Band	250 mW or 1 Watt (DIP switch selectable)
DX80DR2M-H		2.4 GHz ISM Band	63 mW (100 mW EIRP)



WARNING: Not To Be Used for Personnel Protection

Never use this product as a sensing device for personnel protection. Doing so could lead to serious injury or death. This product 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.

MultiHop Radio Overview

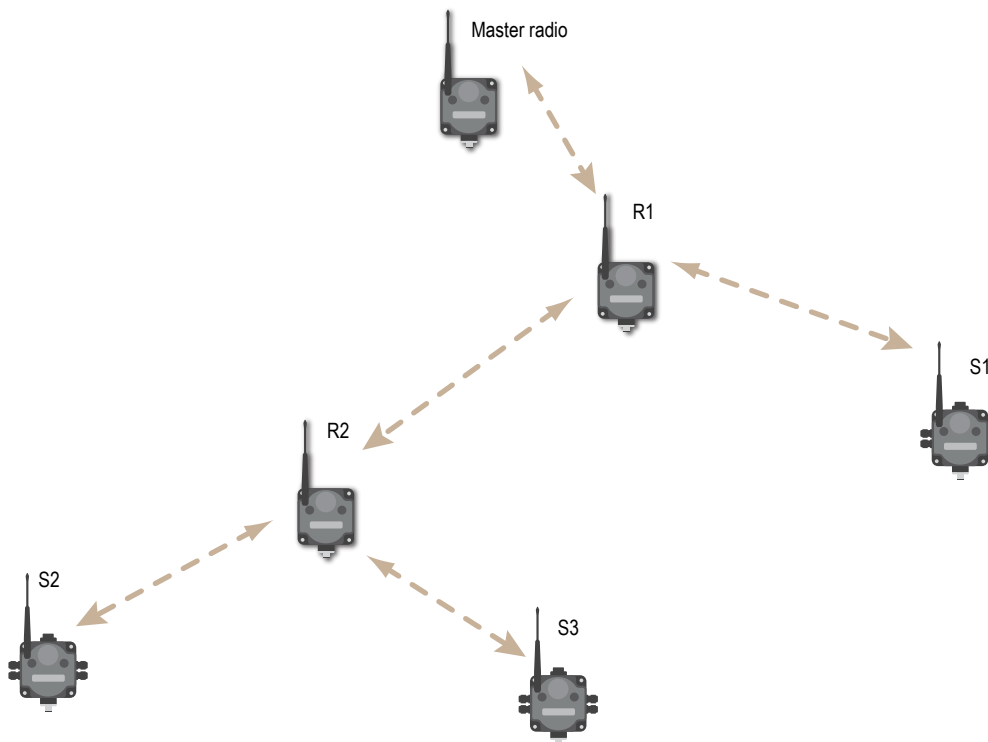
MultiHop networks are made up of one master radio and many repeater and slave radios. The MultiHop networks are self-forming and self-healing networks constructed around a parent-child communication relationship. The MultiHop Radio architecture creates a hierarchical network of devices to solve the most challenging wireless applications. A MultiHop Radio is either a master radio, a repeater radio, or a slave radio.

- The single master device controls the overall wireless network.
- The repeater mode allows for range extension of the wireless network.
- The slave radios are the end point of the wireless network.

At the root of the wireless network is the master radio. All repeater or slave radios within range of the master radio connect as children of the master radio, which serves as their parent. After repeater radios synchronize to the master radio, additional radios within range of the repeater can join the network. The radios that synchronize to the repeater radio form the same parent/child relationship the repeater has with the master radio: the repeater is the parent and the new radios are children of the repeater.

The network formation continues to build the hierarchical structure until all MultiHop radios connect to a parent radio. A MultiHop radio can only have one designated parent radio. If a radio loses synchronization to the wireless network it may reconnect to the network through a different parent radio.

For the simple example network shown below, the following relationships exist:



- The master radio is parent to repeater R1.
- Repeater R1 is child to the master radio, but is parent to R2 and S1.
- Repeater R2 is child to repeater radio R1, but is parent to slave S2 and S3.

On the LCD of each device, the parent device address (PADR) and local device address (DADR) are shown.

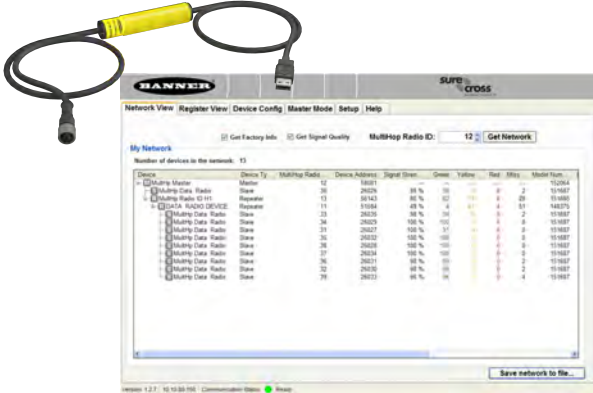
MultiHop Master Radio. Within a network of MultiHop data radios, there is only one master radio. The master radio controls the overall timing of the network and is always the parent device for other MultiHop radios. The host system connects to this master radio.

MultiHop Repeater Radio. When a MultiHop radio is set to repeater mode, it acts as both a parent and a child. The repeater receives data packets from its parent, then re-transmits the data packet to the children within the repeater's network. The incoming packet of information is re-transmitted on both the radio link and the local serial link.

MultiHop Slave Radio. The slave radio is the end device of the MultiHop radio network. A radio in slave mode does not re-transmit the data packet on the radio link, only on the local serial (wired) bus.

MultiHop Configuration Tool

Banner's MultiHop Configuration Tool offers an easy way to configure and view your MultiHop radio network. 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. These adapter cables pass information between your computer and a MultiHop Radio operating at 250 mW.



Cable Model No.: BWA-HW-006

Adapter cable, USB to RS-485. This cable cannot power a MultiHop radio operating at 1 Watt.



Cable Model No.: BWA-HW-026

Splitter cable, wall plug for external power split to 5-pin Euro-style male and 5-pin Euro female (to power a M-H at 1 Watt while configuring it through the MHCT)

Use this power supply cable together with the USB to RS-485 adapter cable to configure a MultiHop radio in 1 Watt mode.

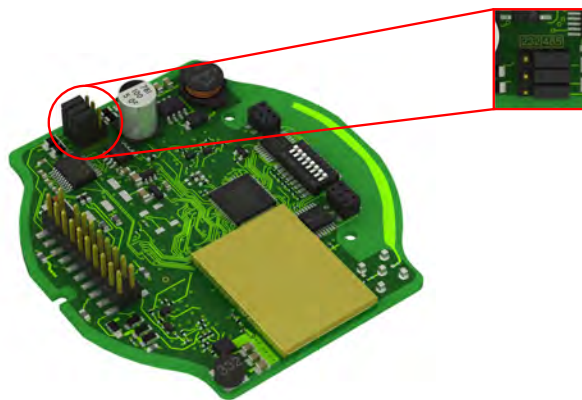
When the MultiHop Configuration Tool launches, it automatically checks to see if a newer version of the software is available. If a newer version is available, a dialog box displays on the screen to ask you if you want to download the new version or ignore the new version. If you select download, the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

Wiring

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).



Wiring for MultiHop Radios

Connecting dc power to the communication pins will cause permanent damage. For FlexPower devices, do not apply more than 5.5V 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 to 30V dc used to power the radio.

	Wire No.	Wire Color	10 to 30V dc (RS-485)	FlexPower (RS-485)	FlexPower (RS-232)
	1	Brown	10 to 30V dc	10 to 30V dc	10 to 30V 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 to 5.5V dc	3.6 to 5.5V dc

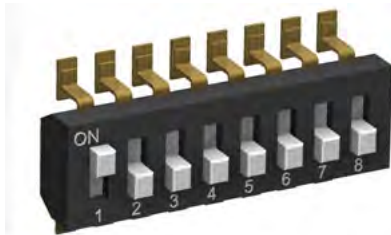
Additional Information

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 Performance and SureCross DX80 (Star Network) Quick Start Guide: Banner part number
- SureCross Performance and SureCross DX80 (Star Network) Wireless I/O Network Manual:
- DX70 (Point to Point) Wireless Pairs Manual and Data Sheet:
- MultiHop Radio Quick Start Guide:
- MultiHop Radio Product Manual:

Device Configuration

DIP Switch Changes



Before making any changes to the DIP switch positions, disconnect the power. For devices with batteries integrated into the housing, remove the battery for at least one minute.

DIP switch changes will not be recognized if power isn't cycled to the device.

Accessing the DIP Switches

To access the 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 Class I, Division 2 certified devices, skip this step (the ribbon cable is glued).
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 / User defined receiver slots	OFF*	OFF*						
Serial line baud rate 38400 / 32 receiver slots	OFF	ON						
Serial line baud rate 9600 / 128 receiver slots	ON	OFF						
Serial line baud rate Custom / 4 receiver slots	ON	ON						
Parity: None			OFF*	OFF*				
Parity: Even			OFF	ON				
Parity: Odd			ON	OFF				
Disable serial (Low Power Mode)/Alternative select (switches 1-2)			ON	ON				
900 MHz: 1.00 Watt (30 dBm) transmit power ** 2.4 GHz models: 40 ms frame					OFF*			
900 MHz: 0.25 Watts (24 dBm) transmit power ** 2.4 GHz models: 20 ms frame					ON			
Application mode: Modbus						OFF*		
Application mode: Transparent						ON		
Radio setting: Repeater							OFF*	OFF*
Radio setting: Master							OFF	ON
Radio setting: Slave							ON	OFF
Radio setting: Reserved							ON	ON

* Default configuration

** For 2.4 GHz radios, the transmit power is fixed at 0.063 Watts (18 dBm). DIP switch 5 is used instead to set the frame size.

Application Mode

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

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.

Baud Rate and Parity

Use the DIP switches to select the baud rate and the parity. The options for baud rate are: 19200, 38400, or 9600. The default is 19200. Select None, Even, or Odd parity. The default parity is None.

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). The default setting is 1 watt.

For 2.4 GHz radios, the transmit power is fixed at 0.063 watt (18 dBm) and DIP switch 5 is used to set the frame size. The default position (OFF) sets the frame to 40 milliseconds. To increase throughput, set the frame size to 20 milliseconds. Note that increasing the throughput will decrease the battery life.

Manufacturer Parameter Registers

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

44100s Manufacturing Information

Address	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

44200s Device Name

Address	Name	Format
4201–4209	Name characters 1-18	ASCII

44300s Software Information

Address	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
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

46400s Message Parameters

Address	Name	Format
6401	Device address	Hex
6402	Parent address	Hex, read only

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.

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

Radio

Range

- 900 MHz: Up to 9.6 kilometers (6 miles)*
- 2.4 GHz: Up to 3.2 kilometers (2 miles)*

Transmit Power

- 900 MHz: 30 dBm conducted (up to 36 dBm EIRP)
- 2.4 GHz: 18 dBm conducted, less than or equal to 20 dBm EIRP

900 MHz Compliance (1 Watt Radios)

- FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247
- IC: 7044A-RM1809

2.4 GHz Compliance

- 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

Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

Antenna

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

* With the standard 2 dB antenna. 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.



Notice: This equipment must be professionally installed. The output power must be limited, through the use of firmware or a hardware attenuator, when using high-gain antennas such that the +36 dBm EIRP limit is not exceeded.

General

Power*

Interface

Requirements: +10 to 30V dc (For European applications: +10 to 24V dc, $\pm 10\%$) on the brown wire, or 3.6 to 5.5V on the gray wire

900 MHz Consumption: Gray wire (3.8V) at 650 mW;
Brown wire (12V) at 900 mW

2.4 GHz Consumption: Gray wire (3.8V) at 120 mW;
Brown wire (12V) at 250 mW

Housing

Polycarbonate

Weight: 0.26 kg (0.57 lbs)

Mounting: #10 or M5 (M5 hardware included)

Max. Tightening Torque: 0.56 N·m (5 in·lbf)

Indicators: Two bi-color LEDs

Buttons: Two

Display: Six character LCD

Wiring Access

One 5-pin Euro-style male connector

* For European applications, power the DX80 from a Limited Power Source as defined in EN 60950-1.

Communication

Hardware (RS-485)

Interface: 2-wire half-duplex RS-485

Baud Rates: 9.6k, 19.2k (default), or 38.4k

Data Format: 8 data bits, no parity, 1 stop bit

Note, the MultiHop models also support 2400 baud communication via Modbus register parameters.

Packet Size (MultiHop)

900 MHz: 175 bytes

2.4 GHz: 125 bytes

Intercharacter Timing (MultiHop)

3.5 milliseconds

Environmental

Rating

IEC IP67; NEMA 6

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)

Shock and Vibration

IEC 68-2-6 and IEC 68-2-7

Shock: 30g, 11 millisecond half sine wave, 18 shocks


Vibration: 0.5 mm p-p, 10 to 60 Hz

Refer to the SureCross™ MultiHop product manual, Banner 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.

Classified Areas Certifications

FlexPower Gateway/Low-Profile Data Radio

CSA: Class I, Division 2, Groups A, B, C, D (Ex/A Ex nA II T4); Certificate: 1921239 C  US

LCIE/ATEX: Zone 2 (II 3G / Ex nA IIC); Certificate: LCIE 10 ATEX 1012 X 

Included with Device (Low-Profile Housings)

The following items ship with the low-profile housing DX80 radios.

Included with Device	Model	Qty	Item
Mounting Hardware Kit	BWA-HW-001	4	Screw, M5-0.8 x 25mm, SS
		4	Screw, M5-0.8 x 16mm, SS
		4	Hex nut, M5-0.8mm, SS
		4	Bolt, #8-32 x 3/4", SS

Antenna*	BWA-902-C, or BWA-202-C	1	Antenna, 902-928 MHz, 2 dBd Omni, Rubber Swivel RP-SMA Male, or Antenna, 2.4 GHz, 2 dBd Omni, Rubber Swivel RP-SMA Male
SureCross Literature CD	79685	1	SureCross Literature CD
SureCross Quick Start Guide**	128185	1	SureCross Quick Start Guide
Data sheet			
Cable	MQDC1-506	1	Cable, 5-Euro (single ended), Straight, 2m

* Internal antenna devices do not ship with this antenna.

** Ships with Gateways

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. Contact the Factory for more information.

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Antenna Installation

Always 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.

Always 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 *Agency 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 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 of the Banner product.

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