

Datasheet



(Shown without its antenna)

Sure Cross® MultiHop Ethernet data radios are wireless industrial communication devices used to create point to multipoint configurations of wireless Ethernet networks.

- Selectable transmit power levels of 250 mW or 1 Watt for 900 MHz models and 65 mW for 2.4 GHz models
- *FlexPower*® power options allow for 10 to 30 V dc, solar, and battery power sources for low power applications.
- Simple, non-configurable ethernet switch operation
- No IP address configuration is required
- Self-healing, auto-routing RF network with multiple hops extends the network's range
- Network topology is selectable between star or MultiHop topology
- AES (Advanced Encryption Standard) using a 256-bit cryptographic key
- 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	Power	Frequency
DX80ER9M-H	10 to 30 V dc or	900 MHz ISM Band
DX80ER2M-H	3.6 to 5.5 V dc low power option	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.

MultiHop Ethernet Data Radio Overview

The MultiHop Ethernet Data Radio system provides extremely reliable communication in large plants, over long distances, or through difficult terrain. A network can easily cover many square miles and has a raw bit rate of 300Kbps.

Master, Repeater, and Slave Radios

All radios can be configured as a master, repeater, or slave radio.

Master Radio: Every network has only one master radio and all data is routed to or from the master. Because of this, the network will have better throughput if the master radio is connected to the PLC or HMI that generates the most data traffic.

Repeater Radio: Repeater radios are slaves that also repeat. Although it is possible to use many repeaters in a network, it is usually better to carefully define only a few devices as repeaters to help the network form faster and result in fewer repeated messages. Repeating a message many times unnecessarily slows down the network. Repeater radios should be stationary and always on; a moving or powered off repeater causes a slight delay in communications while the network reforms through other repeaters.



Slave Radios: Slave radios cannot repeat and are used at the endpoints of the network. Mobile radios and radios that may not always be on while the network is in use should be configured as slave radios to prevent other devices from attempting to connect through them to the master.

Topology

The MultiHop Ethernet data radio may operate in either star topology mode or in MultiHop topology mode.

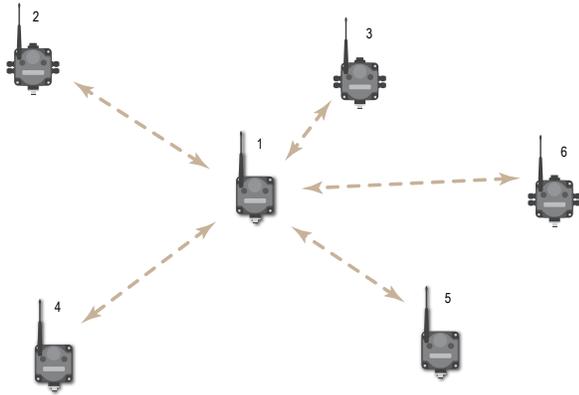


Figure 1. Star topology

At the center of the wireless star topology is the master radio. All wireless traffic is managed by the master and messages can only be sent to or from the master. If a data packet needs to get from one slave to another slave it is routed through the master. In a star topology network, the master radio is the parent and all slave radios are the children.

For the simple example star topology network shown, the following relationships exist:

- Radio 1 is the Ethernet master radio.
- Radios 2 through 6 are the Ethernet slave radios.

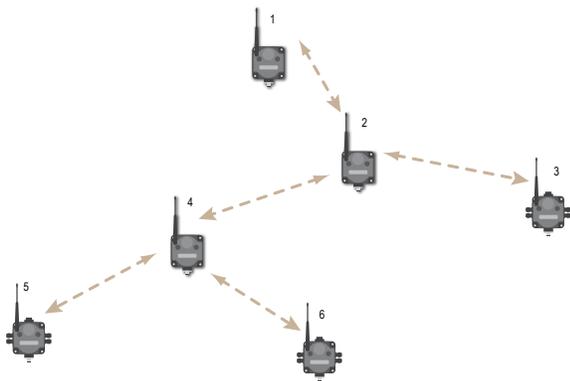


Figure 2. MultiHop topology

MultiHop networks are similar to star networks but use repeaters to relay or repeat wireless messages. MultiHop networks are self forming. The master establishes a wireless connection to every device within range, then repeaters establish wireless connections to repeaters and slaves further away from the master. The network self-heals: if a repeater is lost, slaves automatically attempt to reconnect to the master through other repeaters.

The advantage of using repeaters is that you can reach very long distances and "hop" over obstacles like buildings or hills. The disadvantage is that repeating takes time. Adding a repeater doubles the wireless range but also doubles the time it takes to communicate.

In MultiHop networks, the master radio is the parent to all devices connected to it. Repeater radios are also parents to radios below them. A parent may have many children, but a child has only one parent.

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

- Radio 1 is the master radio within the MultiHop Ethernet data radio network.
- Radios 2 and 4 are repeater radios.
- Radio 2 acts as a parent radio to radios 3 and 4, but is the child of radio 1.
- Radio 3 is an slave radio. Its parent is radio 2 and, as a slave radio, cannot have any children radios.
- Radio 4's parent radio is radio 2 and its children are radios 5 and 6.

Which Topology is Better?

Star topology is faster and simpler. Use a star topology when all devices are easily within range. MultiHop networks are more capable and flexible. Use a MultiHop network for more challenging terrain, longer ranges, or where future additions to the network may require a repeater.

Network Size and Throughput

Both the star and MultiHop radio network can support up to a total of 100 radios. However, desired throughput limits your network's size. All radios in a network share the network's bandwidth, or total throughput. Doubling the number of radios reduces by half each radio's available data throughput. For wireless systems, it is important to limit data traffic on the ethernet wire to the minimum amount needed. One approach to increase the network size without lowering throughput is to collocate another network. It is possible to install multiple networks in the same physical area.

Setting Up Your MultiHop Ethernet Data Radio Network

Banner Engineering recommends configuring and binding your wireless network before deploying the network in the field.

Step 1: Set the rotary dials

Set the left and right rotary dials each to 0.

Step 2: Set the Hardware DIP Switches

Refer to the DIP switch configuration section for complete definitions of all DIP switches. By default, all DIP switches are in the ON position.

Configuring for a star topology	OR Configuring for a MultiHop topology
<ol style="list-style-type: none"> 1. Define the master radio using DIP switch 4 in the OFF position. Only one radio in the network can be the master (server) radio. 2. Define the network topology on the master radio using DIP switch 5. By default (ON), the star topology is selected. 3. All remaining radios are slave radios, with DIP switches 4 and 5 in the ON position. 	<ol style="list-style-type: none"> 1. Define one radio as the master radio, using DIP switch 4 in the OFF position. Only one radio in the wireless network can be the master (server) radio. 2. Define the network topology on the master radio using DIP switch 5. To select MultiHop operation, DIP switch 5 should be in the OFF position on the master radio. 3. For all slave and repeater radios, DIP switch 4 should be in the ON position. 4. For repeater radios, move DIP switch 5 to OFF.

Step 3: Install the Wiring Terminal Header

Your MultiHop Ethernet Data Radio shipped with a small terminal header, part number 26732 (model BWA-HW-044). Plug this terminal header into the terminals on the right side of the data radio.

Step 4: Connect 10 to 30 V dc Power

Wire your 10 to 30 V dc power to the Ethernet Data Radio using wiring connection 9. For low power operation, see *Low Power Operation* in the Additional Information section.

Step 5: Bind Your Radios

To form the wireless network, bind all the slave radios to the designated master radio. Binding slave radios to their master radio ensures the slaves only exchange data with that master. After a slave radio is bound, the slave accepts data only from the master to which it is bound.

To bind the slave radios to the master radio, position the radios at least six feet away from each other to ensure good communications, then follow these steps.

1. On the master radio: triple-click button 2 to enter binding mode. The red LEDs flash alternately when the master is in binding mode. Any slave entering binding mode will bind to this master.
2. On the slave radio: triple-click button 2 to enter binding mode. The slave radio enters binding mode and locates the master that is also in binding mode. The red LEDs flash alternately. After the slave is bound, the LEDs are both solid red for a few seconds. The slave automatically exits binding mode, cycles power, and enters RUN mode.
3. Repeat the previous step for all slave radios that are to be bound to this master radio.
4. On the master radio: double-click button 2 to exit binding mode and cycle power.

After all devices exit binding mode, allow a few seconds for all devices to be in sync with the Master device. The master device green LED always blinks and the slave/repeater device LED blinks green when it is synchronized to the master device.

Step 6: Perform a Site Survey

After placing your radios in the network locations, but before permanently installing them, perform a Site Survey to analyze the radio signal strength of your chosen location. For details about Site Survey and how to run one, refer to *Conducting a Site Survey*, located in the *Additional Information* section of this datasheet.

Step 7: Connect the Ethernet Data Radios

Connect an ethernet cable to the ethernet port on each radio. Many radio systems require you to set the IP address of the radios themselves. This is not necessary for Banner's MultiHop Ethernet Data Radios; they will transmit data regardless of their IP address. The amber LED 2 flashes when data is transmitting.

Note: If you have trouble getting the system to work here are a few tips:

1. Before installing the radios, verify the ethernet system works using an ethernet cable. Many problems with ethernet are a result of improperly configured IP addresses.
2. Limit the data traffic. These long range radios do not have unlimited bandwidth. Verify the radios are properly configured and bound by testing on a lightly used ethernet network.
3. View the internal web page of the master radio. Although it is not necessary to set an IP address on the Banner radios, you may want to when troubleshooting problems. The master radio has an internal web page with diagnostic information. By default, the internal web page is at 192.168.17.17. To access this page you must connect the master radio to your PC and use a web browser. Login: root. Password: sxi.

DIP Switch Settings (MultiHop Ethernet Data Radio)

These DIP switches are accessible from the outside of the housing. Internal DIP switches are located inside the housing on the top board. See *Additional Information* for more information about the internal DIP switches.



The Ethernet Communication DIP switches are accessible from the outside of the housing.

DIP switch changes are not recognized until after power is cycled to the device.

	Active Switches					
Device Settings	1	2	3	4	5	6
Ethernet (wireless Ethernet-to-Ethernet connection)	ON *	ON *				
Serial (wireless serial-to-serial connection, RS485 or RS232)	ON	OFF				
Reserved	OFF	ON				
Reserved	OFF	OFF				
Radio speed: 300 kbit			ON*			
Radio speed: 200 kbit			OFF			
Master - MultiHop				OFF	OFF	
Master - Star				OFF	ON	
Repeater (MultiHop only)				ON	OFF	
Slave (MultiHop or Star)				ON*	ON*	
RS-485 Serial						ON*
RS-232 Serial						OFF

* Default configuration

Ethernet or Serial Mode. These radios operate in either ethernet or serial mode. In ethernet mode the radios route ethernet data packets from their source to their final destination. Packets are routed by their IP address, making ethernet systems efficient in Multihop mode and with many radios.

Because serial protocols are different, it is not practical to route packets with some configurations of radio devices. As a result, set all device rotary dials to 00 when in serial mode to create a broadcast between the radios. For two-device radio systems configured in serial mode, it is possible to force routing between them by setting the rotary dials on both radios to 01 to create routed messaging between two radios.

Radio Speed 300/200 kbps. A speed of 300 kbps (default) is recommended for most applications. Operating at 200 kbps provides more gain and can be an option in very long range applications.

Master Multihop or Star. Use a star topology when all devices are easily within range. Use the MultiHop topology when the wireless network may require a repeater radio.

Repeater or Slave. Most radios in a network are slave radios. Careful selection of repeaters helps the network form up with as few as possible wireless hops. Minimizing hops increases overall throughput.

RS-232 or RS-485. This setting selects the serial physical layer. Note that the physical layer does not need to be the same on all radios in a network. In this way, the wireless network can be used to convert from RS-485 to RS-232.

Specifications

Radio Range¹

900 MHz, 1 Watt: Up to 9.6 km (6 miles)
2.4 GHz, 65 mW: Up to 3.2 km (2 miles)

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

Receive Sensitivity

900 MHz: -104 dBm at 300 kbps; -107 dBm at 200 kbps; -108 dBm at 100 kbps
2.4 GHz: -104 dBm at 250 kbps

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 Ethernet)

FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247
ETSI/EN 300 328: V1.7.1 (2006-05)
IC: 7044A-DX8024

Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

Communication

Ethernet: 10/100 baseT Ethernet RJ45 connection
Radio: 200kbps to 300kbps
Encryption: AES (Advanced Encryption Standard) using a 256-bit cryptographic key

Environmental Rating

IEC IP20; NEMA 1³

Supply Voltage

10 to 30 V dc (Outside the USA: 12 to 24 V dc, ±10%) on the brown wire, or 3.6 to 5.5 V dc low power option on the gray wire²

Current Consumption

Idle: 50 mA at 24 V; 100 mA at 12 V; 170 mA at 5 V
Transmit 250 mW: 60 mA at 24V ; 120 mA at 12 V; 200 mA at 5 V
Transmit 1 Watt: 70 mA at 24 V; 130 mA at 12 V; 240 mA at 5 V

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)

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
Display: Six character LCD

Operating Conditions⁴

-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

Additional Configuration Information

LED Behavior for Master Radios

All bound radios operating as masters follow this LED behavior after powering up.

Process Steps	Response	Two Button/LED Models	
		LED 1	LED 2
1	Apply power to the master radio	-	Solid amber
2	The master radio first begins operating.		Solid red

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 this device from a Limited Power Source as defined in EN 60950-1.

³ Refer to the *Sure Cross® MultiHop Product Instruction Manual* (p/n 151317) for installation and waterproofing instructions.

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

		Two Button/LED Models	
Process Steps	Response	LED 1	LED 2
3	The master radio enters RUN mode.	Flashes green	-
	Data packets begin transmitting between the master and its children radios.	-	Flashes amber

LED Behavior for Slave and Repeater Radios

All bound slave or repeater radios follow this LED behavior after powering up.

		Two Button/LED Models	
Process Steps	Response	LED 1	LED 2
1	Apply power to the radio	-	Solid amber (briefly)
2	The slave/repeater first begins operating		Solid red
3	The slave/repeater searches for a parent device.	Flashes red	-
4	A parent device is detected. The slave/repeater searches for other parent radios within range.	Solid red	-
5	The slave/repeater selects a suitable parent.	-	Solid amber
6	The slave/repeater attempts to synchronize to the selected parent.	-	Solid red
7	The slave/repeater is synchronized to the parent.	Flashes green	-
8	The slave/repeater enters RUN mode.	Solid green, then flashes green	
	Data packets begin transmitting between the slave/repeater and its parent radio.	-	Flashes amber

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.

MultiHop Radio DIP Switches (Internal Switches)

The default settings are marked by *.

Baud Rate

These switches set the baud rate of the RS-232 or RS-485 serial connection. The wireless data transmission data rate is not changed by these switches. On most systems, the baud rate on all devices in the network should be the same.

Baud Rate (bits per second)	DIP Switches		
	1	2	3
19,200 bps	OFF *	OFF *	OFF *
9,600 bps	OFF	OFF	ON

	DIP Switches		
Baud Rate (bits per second)	1	2	3
19,200 bps	OFF	ON	OFF
38,400 bps	OFF	ON	ON
115,200 bps	ON	OFF	OFF
230,400 bps	ON	OFF	ON
1,200 bps	ON	ON	OFF
Reserved for future use	ON	ON	ON

Parity

	DIP Switches	
Parity	4	5
None	OFF *	OFF *
Odd	OFF	ON
Even	ON	OFF

Broadcast Retries

In serial mode, all data is broadcast. With a typical (95%) link, broadcast messages make one hop most of the time. Increase the broadcast to six retries for stream-based serial packets that cannot tolerate data loss. Set the broadcast retries to no retries for deterministic protocols, like Modbus RTU, that resend data periodically. Increasing retries slows down throughput.

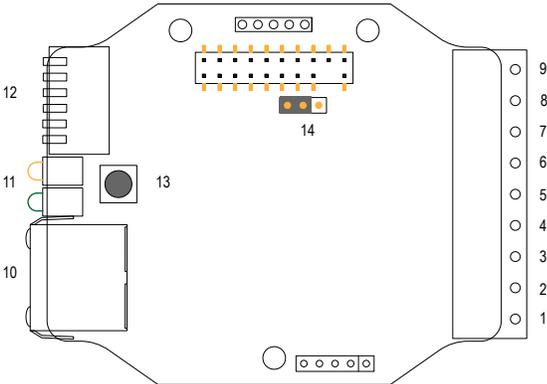
	DIP Switches	
Broadcast Retries	6	7
One retry	OFF *	OFF *
Three retries	OFF	ON
Six retries	ON	OFF
No retries	ON	ON

Radio Transmit Power

The 900 MHz data radios can be operated at 1 watt (30 dBm) or 0.250 watt (24 dBm). For 2.4 GHz radios, the transmit power is fixed at 0.065 watt (18 dBm).

	DIP Switches
Radio Transmit Power (900 MHz only)	8
1 Watt (30 dBm)	OFF *
250 mW (24 dBm)	ON

Wiring Connections



This wiring board image does not include the supplied terminal header that shipped with your device. Install the wiring terminal header, part number 26732 (model number BWA-HW-044), before wiring your data radio.

- 1. RS-485 +
- 2. RS-485 -
- 3. Ground
- 4. RTS
- 5. CTS
- 6. Tx
- 7. Rx
- 8. Ground
- 9. Power: 10–30V dc or 5V dc IN, depending on internal hardware jumper 14.
- 10. RJ45 Ethernet connection.
- 11. Yellow and green LEDs. Indicates internal communication between the radio board and the ethernet board. The yellow LED indicates the receive message. The green LED indicates the transmit message.
- 12. DIP switches
- 13. Reset button (cycles power). Press and hold for 10 seconds to return the IP address to the factory default.
- 14. Jumper. Left two pins: 10-30V dc power IN (default: 10-30V dc). Right two pins: 5V for battery/solar power IN

Low Power Operation

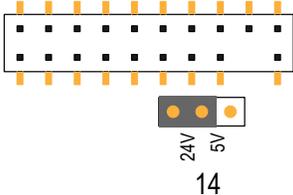
To operate this radio from a power source other than 10 to 30V dc, follow these instructions.

The factory default position for jumper 14 is 24V dc power (shown).

To wire a battery or solar power source (5V dc) as the power supply, move the jumper (shown in the image to the right) to jumper between the two pins on the right.

Wire the power source to the device using wiring terminal 9 (see *Wiring Board* section).

Warning: Connecting 24V dc to wiring terminal 9 while the jumper is set to accept 5V will damage the radio.

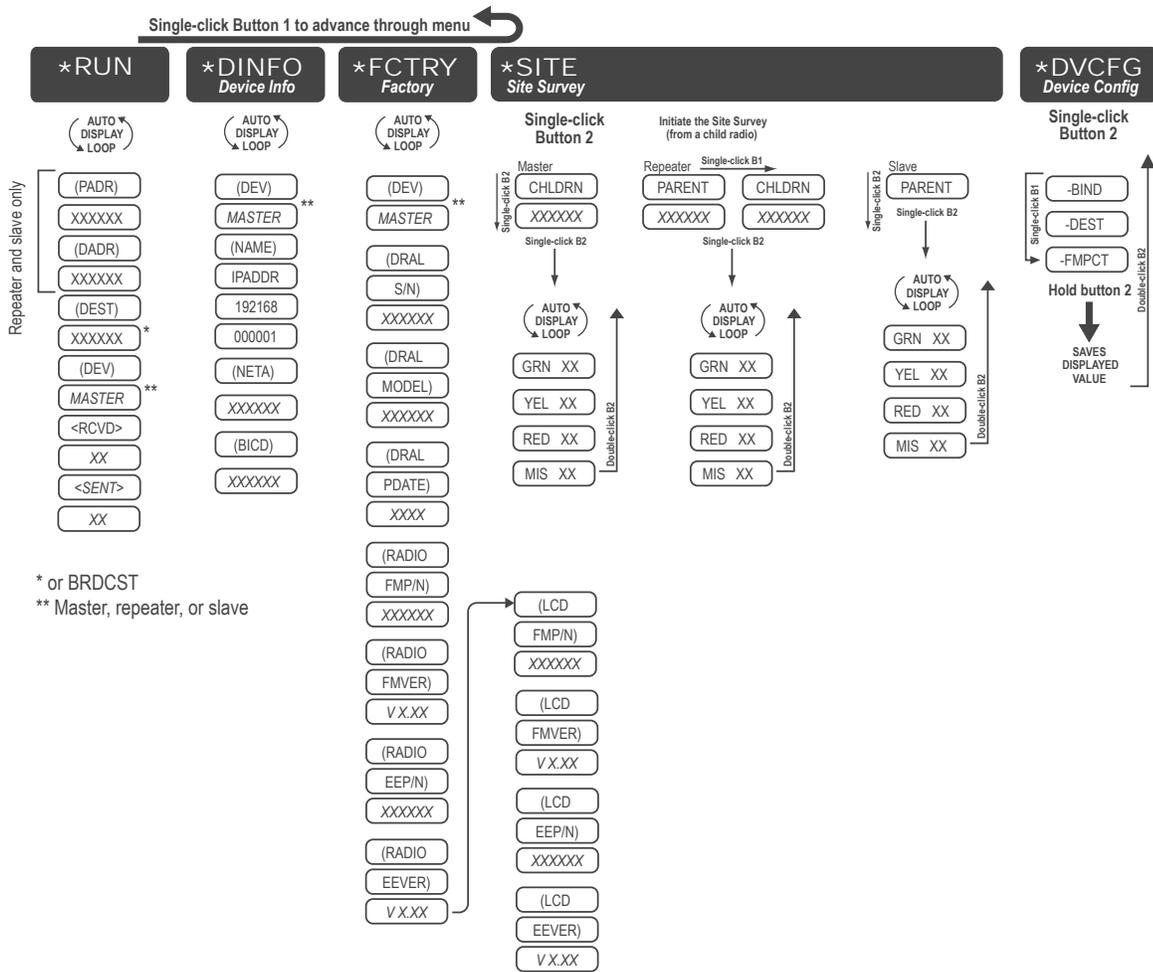


MultiHop Ethernet Data Radio Menu System



When power is applied, the MultiHop radio begins running. The display screen autoscrolls through the *RUN menu and communication between the devices is enabled. Autoscrolling through the *RUN menu is the normal operating mode for all devices on the wireless network.

Access the menu system using the push buttons and the LCD.



From the *RUN Menu (or any menu), single-click button 1 to advance through the top-level menus. Top-level menus are displayed on the LCD with an asterisk (*) in front of the menu name.

Double-click button 2 to pause or resume the auto display loop. Use button 1 to advance through the items in that menu. (Enter "auto scrolled" menus by double clicking button 2. Enter the other menus by single clicking button 2.)

RUN Menu

The RUN menu displays the network ID, parent address, device address, current destination address, operational mode (master, repeater, slave), and the number of received and sent data packets.

PADR. Parent's device address, a unique number based on the parent device's serial number and assigned by the factory. The PADR is the 6-digit serial number minus 65535.

DADR. Device address, a unique number based on the serial number and assigned by the factory. The DADR is the 6-digit serial number minus 65535.

DEST. The current destination address to route messages. When this displays BRDCST, the device is either in transparent mode and is broadcasting the messages to all devices, or the device is in the early stages of Modbus mode and is broadcasting messages to determine the paths to specific device addresses.

DEV. Reports the device type: master, repeater, or slave.

RCVD. The number of serial messages received.

SENT. The number of serial messages sent.

DINFO (Device Info) Menu

The DINFO menu displays the device information.

DEV. Reports the device type: master, repeater, or slave.

NAME. The IP Address of the Ethernet Data Radio is displayed in the following format: 192168 017017. This represents an IP address of: 192.168.17.17

NETA. Network Address (display only).

BICD. Binding Code (display only).

FCTRY (Factory) Menu

The FCTRY menu displays the factory information about the device, including the model, dates of manufacture, and the part numbers and version numbers of the radio, and LCD.

S/N. The device's serial number.

Model #. The DX80ER*M family model number.

PDate. Production date.

FMP/N. Firmware part number.

FMVER. Firmware version number.

EEP/N. EE part number

EEVER. EE version number.

SITE (Site Survey) Menu

Single-click button 2 to pause/resume the auto display loop. While paused, use button 1 to advance through the GRN, YEL, RED, and MIS displays.

DVCFG (Device Configuration) Menu

Single-click button 2 to enter this menu. Use button 1 to move through the options in this menu.

-BIND. Binding Code. Single click button 2 to manually set the binding code. Once in the binding code command, use button 2 to select the digits; use button 1 to increment the selected digit. Press and hold button 2 to save the new binding code. The device asks if you want to save the new setting (button 2) or discard the new setting and reselect (button 1).

-DEST. Destination Address. To force message routing when operating in transparent mode, set a specific destination address.

-FMPCT. Formation percentage, default value of 50%. This device will not form a parent/child relationship with a parent radio that misses more than 50% of the timing beacons (approximately a 25% site survey link value). If the only option for a child is a parent with a less than a 25% site survey link value, change this value.

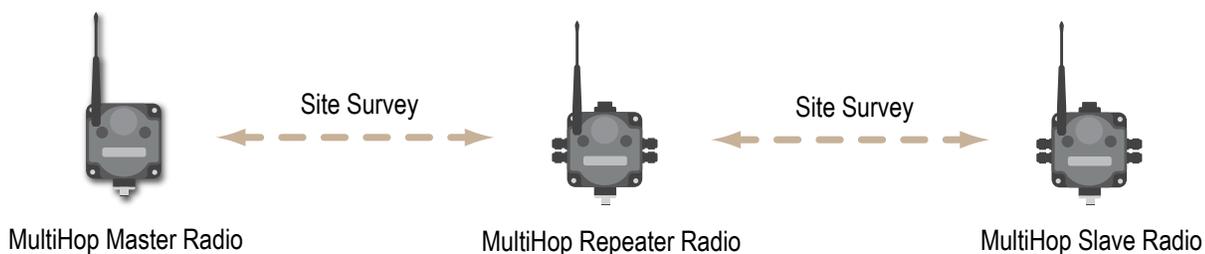
Conduct a Site Survey

A site survey analyzes the radio signal between a MultiHop child radio and its parent and reports the number of data packets missed or received at relative signal strengths.

Conduct a MultiHop Site Survey (from the LCD Menu System)

Perform the site survey before permanently installing your network to pre-screen a site for its radio communication potential, compare link quality in different locations in a factory, or assist with final antenna placement and aiming.

Site surveys can be conducted from either the master, repeater, or slave radios. A master radio is always a parent and the slave radios are always children radios within the radio communication relationship. A repeater radio, however, may be both a child radio to the master or another repeater and a parent radio to other repeater or slave radios. For a more detailed description of the parent-child relationships, refer to the device data sheets.



Other radios bound within the same network remain synchronized to the network, but are blocked from sending data while the site survey is running. The site survey analyzes the signal strength between the selected child and its parent radio only. Disable site survey on one radio before initiating it from another.

Radios in site survey mode have a solid green LED for the duration of the site survey and the LCD display scrolls the results. Because the statistics represent the lesser of the round-trip results, one person can ascertain the link quality from either device.

Single-click button 2 to pause or resume autoscrolling the site survey results. While paused, button 1 single-step advances through the four signal strength categories: green, yellow, red, and missed. Double-click button 2 to exit the results display. (Refer to the data sheet for the menu structure.)

1. On a MultiHop radio, press button 1 until the display reads *SITE.
When the site survey runs, serial and I/O data radio communication between that parent and its children stops.
2. Single-click button 2 to enter the Site Survey menu.
Master radio: The display reads CHLDRN. Repeater radio: The display reads PARENT. Slave radio: The display reads PARENT.
3. Select the MultiHop radio to analyze.

MultiHop Model	Select the radio to analyze:
From the master radio	Single-click button 2 to display the child radio's device address. (A radio's device address is displayed under its *RUN menu). Single click button 1 to scroll between all the master radio's children. When you reach the child radio you want to run the site survey with, single-click button 2.
From the repeater radio	Single-click button 1 to cycle between PARENT and CHLDRN. Single-click button 2 to select PARENT or CHLDRN. If conducting the site survey with one of the repeater's children, single-click button 1 to scroll among a repeater's children radios. (Each data radio's device address is displayed under its *RUN menu.) Single-click button 2 at the device address screen to select the child or parent and begin the site survey.
From the slave radio	Single-click button 2 to display PARENT. Single-click button 2 to begin the site survey.

The site survey begins. LED 2 on both the parent and child radios flash for every received RF packet. To indicate the parent is in site survey mode, LED 1 is a solid green. The data radio analyzes the quality of the signal between the parent and child by counting the number of data packets received and measuring the signal strength (green, yellow, and red).

4. Examine reception readings (G, Y, R, M) of the devices at various locations. M displays the percent of missed packets while G, Y, and R display the percent of received packets at those signal strengths. These values are continuously updated as long as the site survey is running.
GRN = GREEN excellent signal strength; YEL = YELLOW good signal strength; RED = RED marginal signal strength; MIS = Percentage of missed packets. When possible, install all devices to optimize the percentage of YELLOW and GREEN data packets received.
5. While the site survey is in process, single-click button 2 to pause or resume autoscrolling the site survey results. While paused, button 1 single-step advances through the four signal strength categories: green, yellow, red, and missed. Double-click button 2 to exit the results display.
6. Double-click button 2 on either the child or the parent device.
Site survey ends and the devices automatically resume operation.

Configuring the Ethernet Radio Using the Web Tool

The Ethernet Data Radio is typically configured using the hardware DIP switches on the side of the device. It is not necessary to access the software configuration to create a Ethernet wireless network.

To configure your MultiHop Ethernet Radio:

1. Connect the radio to your computer's Ethernet port.
2. Launch an Internet browser.
3. Go to the Ethernet IP address: 192.168.17.17. This is the default IP address of the Ethernet Data Radio. Your Ethernet Data Radio's IP address also displays on the LCD under the *DINFO menu (see menu system diagram). Your computer's Ethernet connection parameters must be set to communicate with this IP address. For more information about how to configure your computer's IP address, refer to document [133116](#).
4. Login in as "root" with a password of "sxi".

The configuration page loads to your Web browser.

Ethernet Radio

Reset the device

Enter programming mode*

* Entering programming mode will cause the device to become unresponsive until the firmware is updated or the device is power cycled

Click Reset the Device to reboot the Ethernet Data Radio. To restore factory default settings, use the button on the wiring board (see *Wiring Connections*).

Select Enter Programming Mode to update the firmware of the radio. To override the DIP switch settings, select something other than Hardware. After selecting this option, the device becomes unresponsive: the LEDs stop flashing and the device drops out of the wireless network until programming is complete or the power is cycled for the device.

Options under the Ethernet Radio heading allow you to select between operating your wireless network as either a star network or a MultiHop network. After making any changes in this section, click the Save button to save your changes to the radio.

Ethernet Radio

Master	<input checked="" type="radio"/> Hardware <input type="radio"/> Master <input type="radio"/> Slave
Master Broadcast Only	<input type="checkbox"/>
Suppress Master Re-broadcast	<input type="checkbox"/>
Master Re-broadcast Multicast	<input type="checkbox"/>

When the device is a master:

Star	<input checked="" type="radio"/> Hardware <input type="radio"/> Multihop <input type="radio"/> Star
------	---

When the device is a slave:

Slave	<input checked="" type="radio"/> Hardware <input type="radio"/> Repeater <input type="radio"/> Slave
-------	--

Hardware/Master/Slave: Select Hardware to use the DIP switch settings. Select Master to override the DIP switches and make this device a master (either the master of a star network or the master of a MultiHop network.) Select Slave to make this devices either a star slave, MultiHop repeater, or MultiHop slave.

Master Broadcast Only: Factory default setting is OFF (not selected). When Master Broadcast Only mode is selected, the internal wireless routing table on the master device is ignored. All master radio messages are transmitted to all wireless devices in the network; messages originating in slave/repeater devices are routed back to the master device. Using Master Broadcast Only results in lower throughput and messages are not acknowledged, making them less reliable.

Suppress Master Re-broadcast: Factory default setting is OFF (not selected). When not selected, the master device automatically re-broadcasts radio messages coming in from radio devices back out the radio network when the destination address is not known. This affects slave/repeater messages coming to the master that are unknown point to point messages and all broadcast type messages. This allows for slave/repeater devices to send messages to other slave/repeater devices within the wireless network. If all messages originate from Ethernet devices connected to the master wireless device or when a wireless network only has a master and slave device (one-to-one networks), this feature can be selected, suppressing re-broadcast messaging. In most cases this switch will have little to no affect on performance.

Master Re-broadcast Multicast: Factory default setting is OFF (not selected). With this feature off, the master wireless device does not re-broadcast Multicast messages received from radio devices out to the radio network. Multicast messages are found in certain protocols such as EtherNet/IP. To create a network with multiple end devices that want to use multicast messaging to communicate, enable this feature. The performance is decreased when using this feature.

Optimize the wireless network operation by connecting Ethernet devices that create (produce) multicast messages to slave/repeater devices.

When the device is a master: By default, the Ethernet Data Radio is set, from the master radio, to operate as a star network. Only the master radio selects when the network is in star configuration and when it is in MultiHop configuration.

When the device is a slave: When the device is a slave radio, select slave operation or repeater operation. If the network operates as a star network, only the slave configuration is recognized. Only MultiHop networks use repeater radios.

Use the Network section to change the IP address if needed. If you change the IP address, carefully make note of the new address, then cycle power to the radio to activate the new IP address. To reset the IP address to its factory default settings, press and hold down the reset button on the ethernet board (see *Wiring Connections* section) for ten seconds.

Network	
IP Address	192.168.17.17
Network Mask	255.255.0.0
<input type="button" value="Save"/>	

Network Status	
MAC Address	00:23:D9:00:18:7E
Ethernet	100 Mbps Full Duplex

The Device section displays the Ethernet Radio model number, serial number, version number, and uptime setting. When calling the factory for technical assistance, have this information available.

Device	
Model #	157704
Serial #	194733
Version	2.0.2
Uptime	1349 seconds

The Ethernet Statistics section displays the number received and transmitted Ethernet packets and indicates if any receive or transmit errors have occurred.

Ethernet Statistics

Received Packets	1109
Transmitted Packets	1261
Receive Errors	0
Transmit Errors	0

Ethernet Statistics - Input Buffer

Incoming Packets Tracked	756
Total Time (ms)	7580
Minimum Time	10
Maximum Time	20
Average Time	10
Total Size (bytes)	63229
Minimum Size	66
Maximum Size	269
Average Size	83

The Radio Statistics section displays the number of received and transmitted wireless packets.

Radio Statistics

Receive Count	777
Transmit Count	767

Technical Note: Using the MultiHop Ethernet Data Radio with an EtherNet/IP® or Modbus RTU System

The MultiHop Ethernet Data Radio is designed specifically to send small amounts of data very long distances. This long range comes at the expense of throughput, requiring you to slow down data throughput significantly compared to other wireless short range systems. When using the Ethernet data radio to replace an ethernet cable, some timing parameters need to be relaxed on the EtherNet/IP or Modbus/TCP host system and unnecessary ethernet traffic limited.

- EtherNet/IP systems have a requested packet interval (RPI); the maximum allowable RPI is 3200 milliseconds.
- Modbus/TCP systems have a timeout.

Star Topology Mode

The time to transmit data in star mode is 150 milliseconds per 60 registers (120 bytes) over an EtherNet/IP or Modbus TCP/IP connection.

The absolute minimum requested packet interval (RPI) for a simple, one hop system is 100 milliseconds for 60 registers (120 bytes) over an EtherNet/IP or Modbus TCP/IP connection. Do not set the RPI faster than 100 milliseconds.

Example 1 - Using an EtherNet/IP host system and four remote devices

Each remote device has an input and output assembly connection of 60 registers or less, for a total of $4 \times 2 = 8$ connections. Set the EtherNet/IP's host system RPI to a minimum of 8×150 milliseconds, or 1,200 milliseconds.

Example 2 - Using one remote device to provide 1,000 registers of input data

A connection consisting of 1000 registers of input data will take 17 radio transmissions to send all the registers ($1000 \div 60 = 17$), requiring 17×150 milliseconds = 2,550 milliseconds. Because this device also has an output connection of six registers that requires an additional 150 milliseconds, set the RPI to 2400 or higher.

MultiHop Topology Mode

When using the Ethernet Data Radio in MultiHop mode with a repeater, the time required to transmit is doubled and the RPI for each connection becomes 300 milliseconds per 60 registers. The RPI increases another 150 milliseconds for each additional repeater in the data path.

Important Timing Considerations

- Good radio links transmit faster than poor radio links. Missed packets are retried, which consumes bandwidth.
- All data is routed through the radio master; the network will be faster when the master radio is connected to the PLC.
- Each wireless hop slows down the network.
- Use unicast messaging; multicast messaging causes unnecessary additional traffic on the network.
- The previous examples are for the standard data rate of 300 Kbps. Proportionally increase the RPI at 200Kbps

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.

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