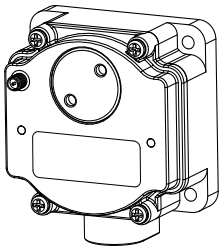
Sure Cross® Serial Data Radio

Datasheet



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

- Serial communication style (RS-232 or RS-485) is user selectable
- Star or tree network topology configuration
- DIP switches select operational modes
- FHSS radios operate and synchronize automatically

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

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.

Models

Models	Supply Voltage	Frequency	ETSI EN Compliance	Transmit Power
DX80SR9M-H	10 to 30 V dc	900 MHz ISM Band	N/A	1 Watt
DX80SR2M-H		2.4 GHz ISM Band	ETSI EN 300 328 V1.7.1 (2006-05)	65 mW (100 mW EIRP)
DX80SR2ME-H			ETSI EN 300 328: V1.8.1 (2012-04)	

Configuration Instructions

Setting Up Your Serial Data Radio Network

To set up and install your wireless Serial Data Radio network, follow these steps:

1. Before installing your serial data radios, first verify that your serial devices work. Connect your serial devices using an RS-232 or RS-485 cable. Note the baud rate and parity of your serial devices so that you can use the DIP switches to configure the serial data radios to use these parameters. Set your serial devices to 8 data bits and 1 stop bit.
2. Configure the DIP switches of all devices.
3. Apply power to all devices.
4. Form the wireless network by binding the repeater and slave radios to the master radio.
5. Observe the LED behavior to verify the devices are communicating with each other.
6. Install your wireless sensor network components. For more details about installing your radios, refer to the *SureCross Installation Guide* (p/n 151514) downloadable from the Technical Publications > Product Manuals page of *www.bannerengineering.com/surecross*.

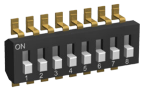
Configure the DIP Switches

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.

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 (Serial Data Radio)

	Switches							
Device Settings	1	2	3	4	5	6	7	8
Software default (19200)	OFF *	OFF *	OFF *					
Serial baud 1200	OFF	OFF	ON					
Serial baud 2400	OFF	ON	OFF					
Serial baud 9600	OFF	ON	ON					
Serial baud 19200	ON	OFF	OFF					
Serial baud 38400	ON	OFF	ON					
Serial baud 57600	ON	ON	OFF					
Serial baud 115200	ON	ON	ON					
Parity: none				OFF *	OFF *			
Parity: odd				OFF	ON			
Parity: even				ON	OFF			
Parity: none				ON	ON			
Broadcast mode						OFF *		
Routed mode (Master to slave; Repeater/slave to master)						ON		
Repeater							OFF *	OFF *
Star configuration master							OFF	ON
Slave							ON	OFF
MultiHop configuration master							ON	ON

* Default configuration

Baud Rate and Parity

Use the Baud Rate and Parity setting DIP switches to configure the radio's serial port. These settings must match the device wired to the radio's serial port. A faster baud rate setting may improve system response time. Changing the baud rate does NOT change the radio transmission rate.

The Software default (OFF, OFF, OFF) also provides the ability to set custom baud rate and timing parameter settings via AT commands. For more information, contact the factory.

Routed vs Broadcast Messages

Use routed messaging when using a point-to-point or point-to-point-with-repeater topology. Routing is more robust and faster than broadcast messaging.

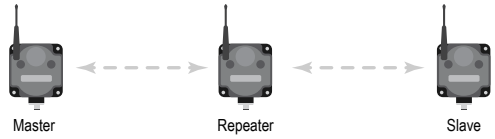
Broadcast messaging allows for more flexible radio layouts and is used in the star and MultiHop tree topologies. These topologies are much more flexible but they are slower. When using broadcast mode, a small percentage of data packets will not be reach their destination. Broadcast mode requires the application layer to automatically retry packets that time out. In networks with multiple slaves, the master radio must use broadcast mode, but the slaves can be set to use routing mode to route their data packets back to the master radio.

Network Topologies

Cable Replacement Configuration - Point to Point Networks

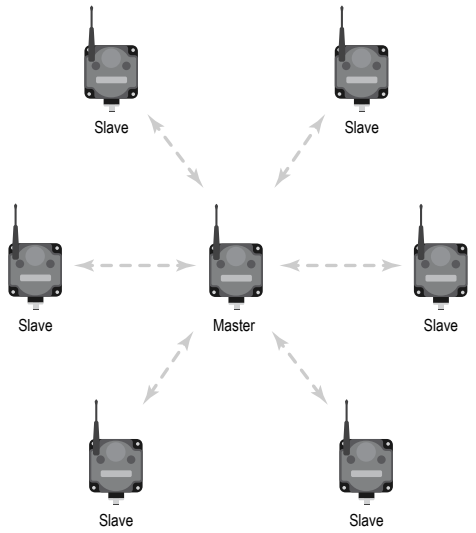
Point to Point Network	Master Configuration	Slave Configuration
	Route to slave: DIP switches 6 ON, 7 OFF, 8 ON.	Route to master: DIP switches 6 ON, 7 ON, 8 OFF.

In this simple cable replacement application, the radio system knows all data originating at one end must be transmitted to the other end. This allows the radio system to automatically correct for transmission problems and it also provides the greatest throughput. This is the fastest configuration.

Point to Point Network	Master Configuration	Repeater Configuration	Slave Configuration
	Route to slave: DIP switches 6 ON, 7 ON, 8 ON.	DIP switches 6 OFF, 7 OFF, 8 OFF.	Route to master: DIP switches 6 ON, 7 ON, 8 OFF.

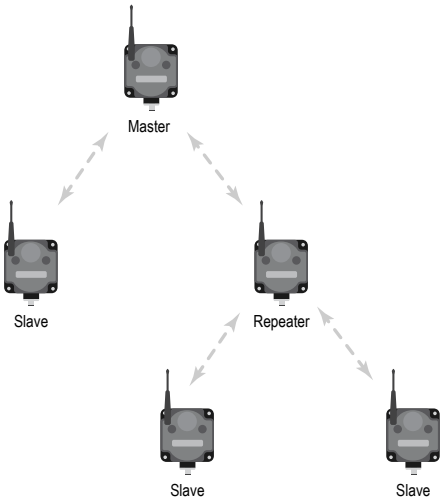
In this simple cable replacement application, the radio system still knows all data originating at one end must be transmitted to the other end. The system still corrects for transmission problems, but it takes time to repeat the message. The network delay is double that of a system with no repeater.

Broadcast Mode Configuration

Star Network	Master Configuration	Slave Configuration
	DIP switches 6 OFF, 7 OFF, 8 ON.	Route to master: DIP switches 6 ON, 7 ON, 8 OFF.

In this more complex topology, the master radio at the center of the network can communicate to many slave radios.

A common example would be a PLC at the center communicating with many remote I/O systems. The star topology is slower than a point-to-point network, but faster than a tree network.

Tree Network	Master Configuration	Repeater Configuration	Slave Configuration
	DIP switches 6 OFF, 7 ON, 8 ON.	DIP switches 6 OFF, 7 OFF, 8 OFF.	Broadcast: DIP switches 6 OFF, 7 ON, 8 OFF.

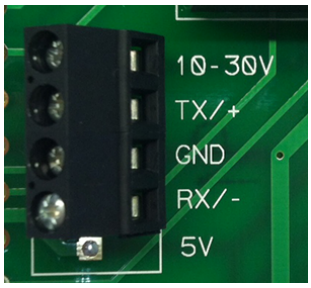
A tree network using MultiHop radios is the most powerful wireless system possible; many repeaters and slaves can be combined to cover vast areas and get around hills or buildings. In the other networks, the wireless "hops" are minimized. In this system you can "hop" as much as you need to, but the trade-off is speed. This is the slowest of the network layouts.

Important:

Star and tree topologies use a Broadcast radio technique. Broadcasting allows for many radios and large complex systems but also introduces a small chance that a data packet can be lost. These networks topologies require the control system to automatically resend missing data packets. Most control protocols (like Modbus) will work fine. Other serial stream based protocols may not be as tolerant and should only be used with point to point topologies.

Wiring for Serial Data Radios

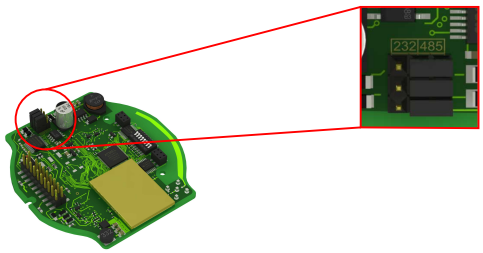
Refer to the Class I Division 2/Zone 2 control drawings (p/n *143086*) for wiring specifications or limitations.



Terminals	RS-485	RS-232
10-30V	Power source, 10 to 30 V dc (Outside the USA: 12 to 24 V dc, ± 10%)	Power source, 10 to 30 V dc (Outside the USA: 12 to 24 V dc, ± 10%)
Tx / +	+	Tx
GND	dc common (GND)	dc common (GND)
Rx / -	-	Rx

RS-232 and RS-485 Communication

Three jumpers are used to change the radio's serial port from an RS-485 physical layer (default) to an RS-232 physical layer. Normally all devices within the entire network will have the same physical layer. Using different physical layers is possible but will increase complexity and be more difficult to troubleshoot.

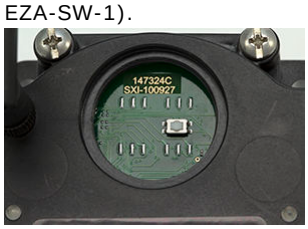


Bind the Serial Data Radios to Form Networks

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

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

1. Apply power to all radios and place the radios configured as slaves or repeaters at least two meters away from the master radio.
2. Remove the round access cover from the top of the radio to expose the button using a spanner wrench (Banner model EZA-SW-1).



3. Triple click the button to put the master radio into binding mode.
   Both LEDs flash red.
4. Triple click the button to put the repeater or slave radio into binding mode.
   The child 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 child radio finds the master radio and is bound, both red LEDs are solid for four seconds, then both red LEDs flash simultaneously four times.
5. On the repeater or slave radio, install the round access cover to protect the button. Gently tighten using the spanner wrench to ensure a water-resistant seal.
6. Repeat steps 3 through 5 for as many slave or repeater radios as are needed for your network.
7. When all radios are bound, double click the button to exit binding mode on the master.
   The network begins to form after the master data radio exits binding mode.
8. On the master radio, install the round access cover to protect the button. Gently tighten using the spanner wrench to ensure a water-resistant seal.

Child Radios Synchronize to the Parent Radios

The synchronization process enables a SureCross radio to join a wireless network formed by a master radio. A simple point-to-point network with one master radio and one slave radio synchronizes quickly after power up; larger MultiHop networks may take a few minutes to synchronize. First, all radios within range of the master data radio wirelessly synchronize to the master radio. These radios may be slave radios or repeater radios.

After repeater radios are synchronized to the master radio, any radios that are not in sync with the master but can "hear" the repeater radio will synchronize to the repeater radios. Each repeater “family” that forms a wireless network path creates another layer of synchronization process. The table below details the process of synchronization with a parent. When testing the devices before installation, verify the radio devices are at least two meters apart or the communications may fail.

Master LED Behavior

All bound serial radios set to operate as masters follow this LED behavior after powering up.

Process Steps	Response	LED 1	LED 2
1	Apply power to the master radio	-	Solid amber
2	The master radio enters RUN mode.	Flashes green	-
	Serial data packets begin transmitting between the master and its children radios.	-	Flashes amber
	In binding mode	Flashes red	Flashes red

Slave and Repeater LED Behavior

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

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

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*

Specifications

Radio Range[1]
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 (SR2Mx-H Models)
FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247
SR2M-H Model: ETSI EN 300 328 V1.7.1 (2006-05)
SR2ME-H Model: ETSI EN 300 328: V1.8.1 (2012-04)
IC: 7044A-DX8024

Spread Spectrum Technology
FHSS (Frequency Hopping Spread Spectrum)

Wiring Access
4 position terminal

Communication Hardware (Serial Data Radio SRxM-H)
Interface: 2-wire half-duplex RS-485 (default) or RS-232
Baud rates: 1200, 2400, 9600, 19.2k (default), 38.4k, 57.6k, 115.2k
Data format: 8 data bits, 1 stop bit, no parity (default), even parity, odd parity

Supply Voltage
10 to 30 V dc (Outside the USA: 12 to 24 V dc, ±10%). [2]

Average Current for 900 MHz Radios (1500 byte packets at 50 ms intervals)
Master Mode: 0.12 A at 12 V; 0.06 A at 24 V
Slave Mode: 0.03 A at 12 V; 0.017 A at 24 V

Average Current for 2.4 GHz Radios (1500 byte packets at 50 ms intervals
Master Mode: 0.035 A at 12 V; 0.02 A at 24 V
Slave Mode: 0.022 A at 12 V; 0.014 A at 24 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: One (under the small round cover)

Packet Size (Serial Data Radio)
SR9M-H and SR2M-H Models: 1500 bytes maximum
SR2ME-H Models: 900 bytes maximum

Wireless Data Transfer Rate
900 MHz: 300 kbps
2.4 GHz: 250 kbps

[1] Radio range is with the 2 dB antenna that ships with the product. Range depends on the environment and decreases significantly without line of sight.
[2] For European applications, power this device from a Limited Power Source as defined in EN 60950-1.

Environmental Rating
IEC IP67; NEMA 6 [3]

Operating Conditions[4]
–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

Certifications

CSA: Class I Division 2 Groups ABCD, Class I Zone 2 AEx/Ex nA II T4 — Certificate: 1921239

ATEX: II 3 G Ex nA IIC T4 Gc (Group IIC Zone 2) — Certificate LCIE 10 ATEX 1012 X

Refer to the Class I Division 2/Zone 2 control drawings (p/n *143086*) for wiring specifications or limitations. All battery-powered devices must only use the lithium battery manufactured by Xeno, model XL-205F.

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.

Any misuse, abuse, or improper application or installation of this product or use of the product for personal protection applications when the product is identified as not intended for such purposes will void the product warranty. Any modifications to this product without prior express approval by Banner Engineering Corp will void the product warranties. 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.

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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.

[3] Refer to the *Sure Cross® Installation Guide* (p/n 151514) for installation and waterproofing instructions.
[4] Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.