SureCross™ MultiHop Data Radio

Configurable Flex*Power*™ *Data Radio with Modbus application mode for extending the range of a Modbus or serial communication network*

900 MHz

Features

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

- Selectable power levels up to 1 watt transmit power; licensed for 4 watt EIRP in the U.S. and Canada for 900 MHz
- *Flex*Power power input options allow for +10 to 30V dc, solar, or battery power sources
- Serial communication style (RS232 or RS485) is user selectable
- Multiple hops allow for an extended range
- Message routing improves link performance
- SureCross architecture creates self-forming and self-healing wireless networks
- DIP switches select operational modes: master, repeater, or slave
- Built-in site survey mode enables rapid assessment of a location's RF transmission properties by one person; hands-free operation and rapid display updates enable efficient antenna placement optimization
- FHSS radios operate and synchronize automatically; no user setup is required; 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 and a complete list of accessories, including FCC approved antennas, refer to Banner Engineering's website, www.bannerengineering.com/surecross.

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	DIP switch selectable up to 1 watt
DX80DR2M-H		2.4 GHz ISM Band	100 mW EIRP

⚠ WARNING . . . Not To Be Used for Personnel Protection

Never use these products for personnel protection. Doing so could lead to serious injury or death.

These products do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A failure or malfunction can cause either an energized or de-energized output condition. Consult your current Banner Safety Products catalog for safety products that meet OSHA, ANSI, and IEC standards for personnel protection.

Printed in USA 12/09 P/N 148345

Data Radio Front Panel Interface

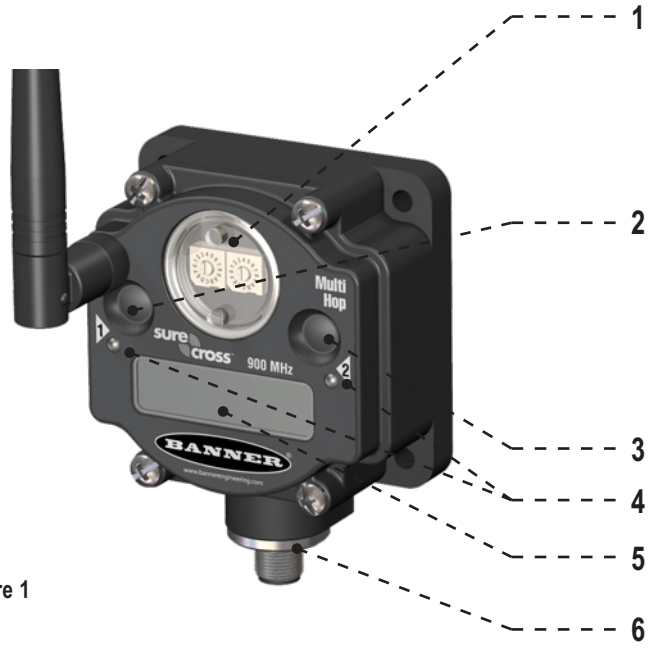


Figure 1

1.	**Rotary Switches**	Sets the Modbus Slave ID when operating in Modbus mode.
2.	**Push Button 1**	Single-click to advance across all top-level data radio menus. Single-click to move down interactive menus, once a top-level menu is chosen.
3.	**Push Button 2**	Double-click to select a menu and to enter manual scrolling mode. Double-click to move up one level at a time. Triple click to enter binding mode.
4.	**LED 1 and 2**	Provide real-time feedback to the user regarding RF link status, serial communications activity, and the error state.
5.	**LCD Display**	Six-character display provides run mode user information such as the number of packets sent and received. This display allows the user to conduct a site survey.
6.	**5-Pin M12 Euro-style quick-disconnect port**	The Euro-style power is used for serial connections and power.

Figure 2

5-pin M12 Euro Hookup (RS-485)

	Wire Color	Function
1	Brown	+10 to 30V dc Input
2	White	RS485 / D1 / B / +
3	Blue	dc common (GND)
4	Black	RS485 / D0 / A / −
5	Gray	3.6 to 5.5V dc

Do not connect dc power to the communications pins because permanent damage may result.

Do not apply more than 5.5V dc to the gray wire.

5-pin M12 Euro Hookup (RS-232 Serial)

	Wire Color	Function
1	Brown	+10 to 30V dc Input
2	White	RS232 Tx
3	Blue	dc common (GND)
4	Black	RS232 Rx
5	Gray	3.6 to 5.5V dc

Do not apply more than 5.5V dc to the gray wire.

Note, the data radio will operate equally well when powered from the brown or gray wire. It is not necessary to supply both.

Example Cable Connections

Using 10 to 30V dc to Power the Data Radio and Gateway

When using 10 to 30V dc to power both the data radio and the Gateway, use the 4-pin Euro-style splitter cable to avoid damaging the Gateway or Data Radio.

Figure 3

Cable Model No: CSB-M1240M1241
Splitter cable, 4-pin Euro-style QD, No trunk male, two female branches, yellow. Use to connect the Data Radio to the 10–30V dc DX80 Gateway.

Using the Solar Supply to Power the Data Radio and FlexPower Gateway

When using the FlexPower Solar Supply to power both the data radio and the FlexPower Gateway, use the 5-pin Euro-style splitter cable.

Figure 4

Cable Model No: CSRB-M1250M125.47M125.73
Splitter cable, 5-pin Euro-style QD, No trunk male, two female branches, black. Most commonly used with solar and other FlexPower devices.

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).

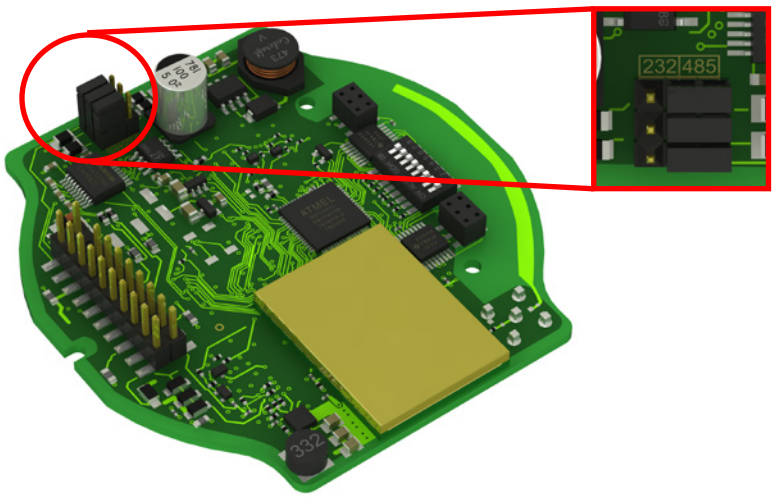


Figure 5

Architecture Overview

The MultiHop Data Radio architecture creates a hierarchical network of devices to solve the most challenging wireless applications. A MultiHop Data 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 of the data radio allows for range extension of the wireless network.
- A data radio in slave mode is the end point of the wireless network.

At the root of the wireless network is the master data radio. All repeater or slave radios within range of the master data radio connect as children of the master data radio, which serves as their parent. After repeater radios synchronize to the master data radio, additional radios within range of the repeater can join the network. The data radios that synchronize to the repeater radio form the same parent/child relationship the repeater has with the master data 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 data radios connect to a parent radio. A data radio can only have one designated parent radio. If a data radio loses synchronization to the wireless network it may reconnect to the network through a different parent radio.

For the simple example network shown in figure 6, the following relationships exist:

- The master data radio is parent to repeater R1.
- Repeater R1 is child to the master data 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.

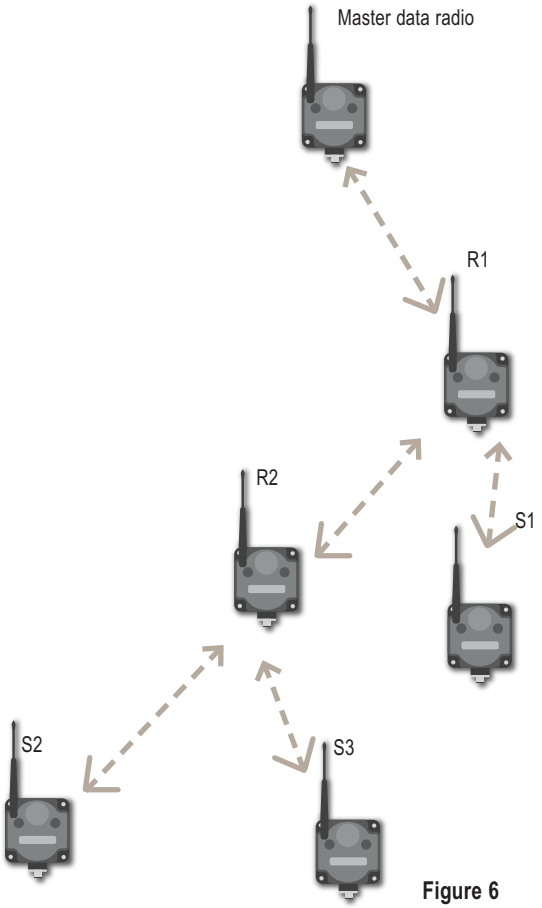


Figure 6

Data Radio Master Mode

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

Data Radio Repeater Mode

When a data 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. (The local serial bus is disabled when DIP switches 3 and 4 are set to "Disable Serial.")

Data Radio Slave Mode

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

The MultiHop Data Radio operates in either Modbus mode or transparent mode. Use the internal DIP switches to select the mode of operation. All MultiHop Data Radios within a wireless network must be in the same mode.

Transparent Mode

In **transparent** mode, the data radio immediately packetizes data received from the hardwired serial connection and transmits the packets to all radios within range. Rules for packet size, inter-character timing, and packet timing must be followed for reliable packet transmission.

Modbus Mode

Modbus application mode provides additional functionality to optimize RF packet routing performance and allows register-based access and configuration of various parameters on the data radio. Modbus application mode requires that the system host device be running a Modbus master program and that the master data radio is connected directly to the host. The additional functionality (relative to transparent mode) is described below.

Packet Routing

In Modbus application mode, the master radio first discovers all connected Modbus slaves in the network, then uses the Modbus slave ID contained in the incoming Modbus message to wirelessly route the packet only to the radio attached to the target Modbus slave. The packet is then passed via the radio's serial interface to the Modbus device where it is processed. This is entirely transparent to the user. Direct packet by packet routing offers an advantage over broadcast addressing with multihop paths because each hop in the path can be retried independently in the event of a packet error. This results in significantly more reliable packet delivery over multihop paths.

Modbus slave IDs 01 to 10 are reserved for slaves directly connected to the host (local I/O). As such, polling messages addressed to these devices are not relayed over the wireless link. Modbus slaves 11 to 58 can be used for remote Modbus slaves — devices serially connected to a data radio — allowing a maximum of 48 attached devices.

Figure 7 illustrations a basic wireless network operating in Modbus application mode.

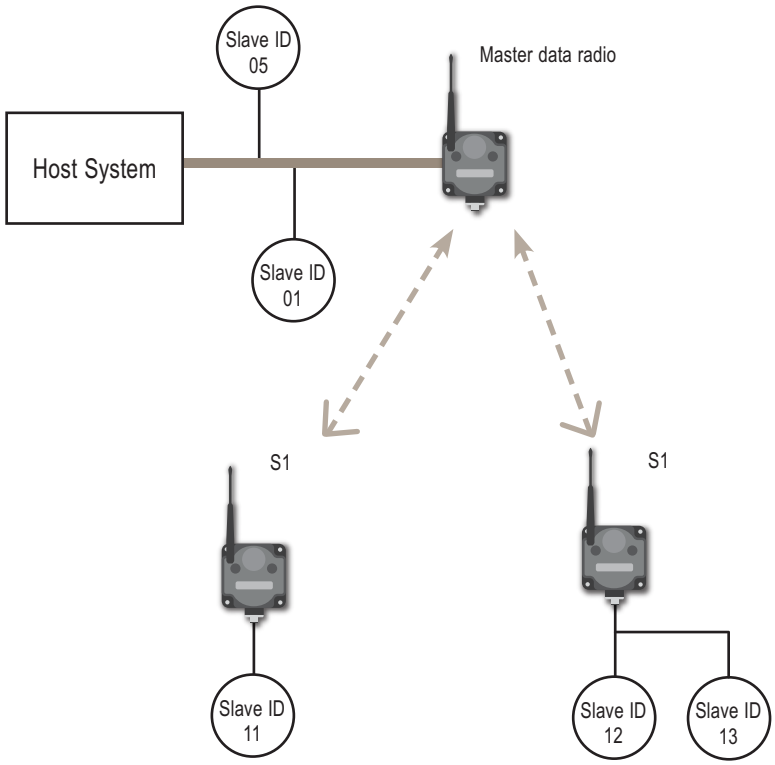


Figure 7 Slave devices may be any Modbus slave, including Banner's DX85 Remote I/O devices or DX80 Gateways.

Internal Data Radio Registers

The Modbus application mode also enables the host to access a radio's internal Modbus registers to access radio configuration and status information. To enable access of a radio's internal Modbus registers, the radio itself must be assigned a Modbus slave ID using the rotary switches on the front of the device. The left rotary switch acts as the tens unit while the right rotary switch acts as the ones unit. To set the slave ID to 12, set the left switch to 1 and the right switch to 2.

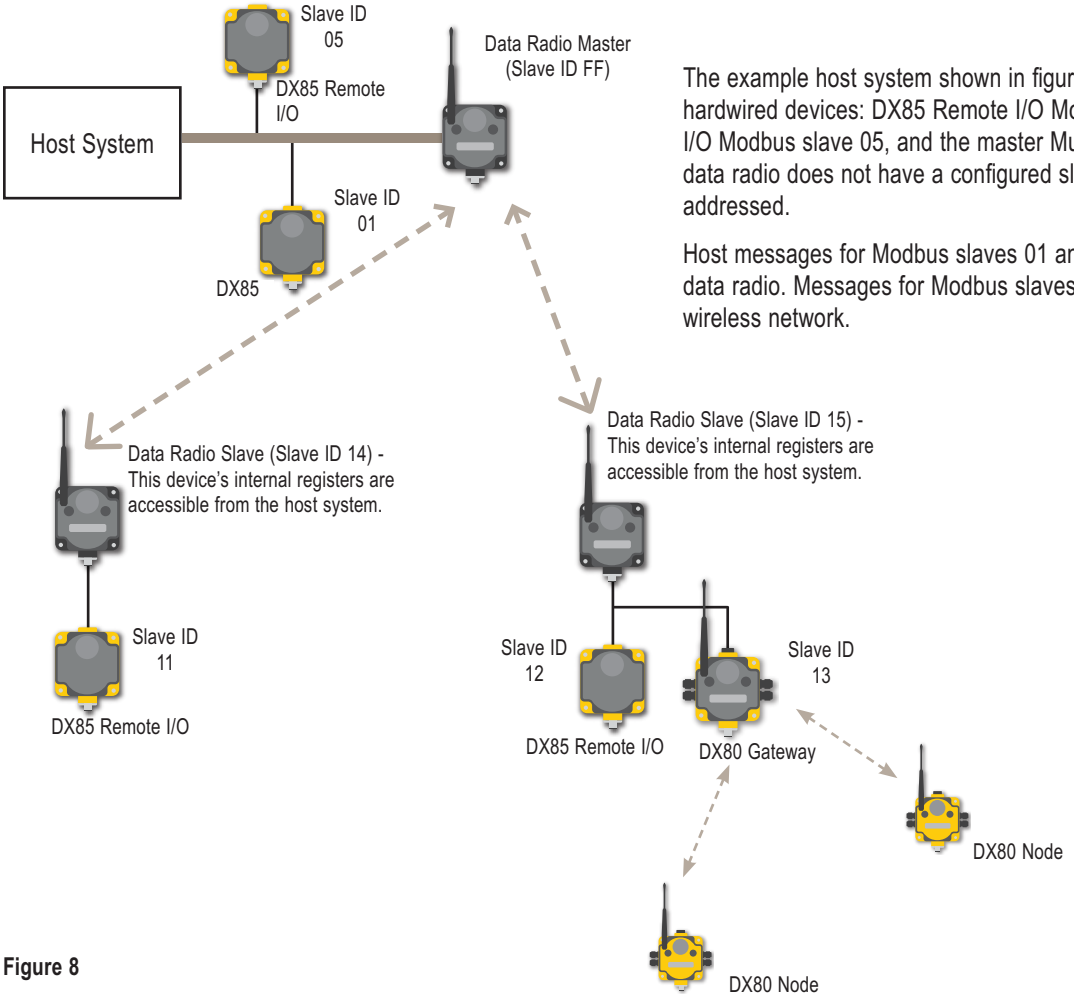
When a Modbus message is received by the radio, the packet's slave ID is compared to its own rotary switch address. If it matches, the radio accesses its internal Modbus registers. If it does not match, the radio delivers the packet to the serial interface thereby interrogating a connected Modbus slave. The range of acceptable Modbus slave IDs is from 11 to 58; a slave ID setting of 0xFF disables access to the data radio's internal registers but still delivers addressed messages to Modbus slaves that are serially connected to the radio. Detailed information about the contents and functions of the data radio's Modbus registers is provided in table 2.

All MultiHop Data Radio internal registers are defined as 16-bit holding registers (4xxxx). To access the internal registers, set the data radio to operate in Modbus mode (using the DIP switches) and set a valid wireless slave ID (11 through 58).

*Note: The radio's rotary switch address must not be a duplicate of an attached Modbus slave ID.

Table 1 - Rotary Switch Positions

Rotary Dial Positions	Function
11 through 58	Valid wireless Modbus slave IDs
FF	Devices set to FF are not directly addressed by the Modbus host system but can deliver the message to the serially connected Modbus slaves



The example host system shown in figure 8 is connected to three hardwired devices: DX85 Remote I/O Modbus slave 01, DX85 Remote I/O Modbus slave 05, and the master MultiHop Data Radio. The master data radio does not have a configured slave ID so it cannot be directly addressed.

Host messages for Modbus slaves 01 and 05 are ignored by the master data radio. Messages for Modbus slaves 11 through 15 are sent out the wireless network.

Figure 8

Table 2 - Data Radio Registers

Address (4xxxx)	Name	Format
Manufacturing Information		
4101-4104	Serial Number Digit 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
Device Name		
4201-4209	Name Characters 1-18	ASCII
Software Information		
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
Parameters		
6401	Device Address	Hex
6402	Parent Address	Hex, read only

Strings stored in ASCII format are read out 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.

For example, the model number 148691 is stored as shown in table 3.

Table 3. Organization of ASCII Strings within Registers

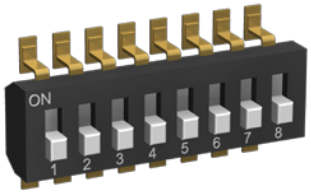
Address (4xxxx)	Name	ASCII Character Value (in hex)	Character Representation
4111	Model Number Digits 6-5	0x3139	1 9
4112	Model Number Digits 4-3	0x3638	6 8
4113	Model Number Digits 2-1	0x3431	4 1

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

Table 4. Parameters stored as numbers

Address (4xxxx)	Name	Value (hex)	Value (decimal)
6401	Device Address	0x0100	256
6402	Parent Address	0x0101	257

DIP Switches



Turn the Power Off

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

Table 5 - DIP Switch Positions

	Switches							
Device Settings	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Serial Line Baud Rate 19200	OFF*	OFF*						
Serial Line Baud Rate 38400	OFF	ON						
Serial Line Baud Rate 9600	ON	OFF						
Serial Line Baud Rate Reserved	ON	ON						
Parity: None			OFF*	OFF*				
Parity: Even			OFF	ON				
Parity: Odd			ON	OFF				
Disable Serial (Low Power Mode)			ON	ON				
Transmit Power**: 1.00 W / 30 dBm					OFF*			
Transmit Power**: 0.25 W / 24 dBm					ON			
Application Mode - Modbus						OFF*		
Application Mode - Transparent						ON		
Data Radio Setting - Repeater							OFF*	OFF*
Data Radio Setting - Master							OFF	ON
Data Radio Setting - Slave							ON	OFF
Data Radio Setting - Reserved							ON	ON

* Default setting

** Disabled for 2.4 GHz. The transmit power for 2.4 GHz is fixed at 0.063 W/18 dBm

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.

Application Mode

See previous section for the explanation of transparent and Modbus application modes.

Transmit Power Levels

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, this DIP switch is disabled. The transmit power for 2.4 GHz is fixed at 0.063 watt (18 dBm).

Quick Start Step 1: Binding Devices and Forming Networks

Data Radios use the master device identification number to form groups of radios that can communicate with each other. Follow the procedure outlined below for binding radios to a particular master data radio.

Accessing the DIP Switches

1. Disconnect the power to all data radio devices.
2. Unscrew the four screws that mount the cover to the bottom housing.
3. Remove the cover from the housing without damaging the ribbon cable or the pins the cable plugs into.

Setting the DIP Switches

4. Using DIP switches 7 and 8, set one unit to be the master data radio (Sw 7 = OFF, Sw 8 = ON).
5. Using DIP switches 7 and 8, set the other data radios to be repeaters or slaves.
6. Set any addition DIP switches now. (See *DIP Switches* section for the positions and descriptions.)
7. Power the devices to activate the DIP switch changes.

Binding the Data Radios

8. Place the data radios configured as slaves or repeaters at least two meters away from the master data radio.
9. Triple click button 2 on the master data radio.

   Both LEDs flash red and the LCD shows *BINDNG and *MASTER. The master radio transmits its binding code to any data radio that is also in binding mode.
10. Triple click button 2 on the slave/repeater data radio.

    When the slave/repeater receives the binding code transmitted by the master, the LCD displays BOUND, then automatically exits binding mode.
11. Repeat step 10 for as many slave/repeater data radios as are needed for your network.
12. When all data radios are bound, exit binding mode on the master by double-clicking button 2.

    All radio devices begin to form the network after the master data radio exits binding mode.

Synchronization with Parent Radios

The synchronization process enables a SureCross data radio to join a wireless network formed by a master data radio. After power-up, synchronization may take a few minutes to complete.

First, all data radios within range of the master data radio wirelessly synchronize to the master data radio. These data radios may be slave radios or repeater radios.

After repeater data radios are synchronized to the master data radio, the repeater's child radios synchronize to the repeaters. 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 data radio devices are at least two meters apart or the communications may fail.

Radio Communication from the Slaves/Repeaters LED Indicators

All data radios set to slave or repeater modes follow this sequence after powering up and after binding to their parent radios.

Process Steps	Response	LED 1	LED 2
1	Apply power to the data radio	-	Solid yellow
2	The slave/repeater searches for a parent device.	Flashes red (1 per 3 sec)	
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 yellow
5	The slave/repeater attempts to synchronize to the selected parent.		Solid red

Process Steps	Response	LED 1	LED 2
6	The slave/repeater is synchronized to the parent.	Flashes green	
7	The slave/repeater enters RUN mode. Serial data packets begin transmitting between the slave/repeater and its parent radio.	Flashes green	Flashes yellow

Radio Communication from the Master LED Indicators

All data radios set to operate as masters follow this synchronization sequence after powering up and after binding to their child radios.

Process Steps	Response	LED 1	LED 2
1	Apply power to the data radio		Solid yellow
2	The master data radio enters RUN mode.	Flashes green (1 per 3 sec)	
3	The master data radio enters RUN mode. Serial data packets begin transmitting between the master and its children radios.	Flashes green	Flashes yellow

Quick Start Step 2: Site Survey

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

Step	User Action	Display/Status	Notes
1	On the child data radio device, press button 1 until the display reads *SITE.	*SITE	Only the child data radios can initiate a site survey. When the site survey runs, all normal radio communication between that parent and all its children stops.
2	Single-click button 2 on the child data radio.		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.
3	Single-click push button 2 on the child radio		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.
4	Examine reception readings (G, Y, R, M) of the devices at various locations. Note that the numbers displayed are a percentage. 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.	GRN 60 YLW 25 RED 10 MIS 05	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	Double-click push button 2 on either the child or the parent device	*SITE	End site survey. The devices automatically return to their normal *RUN mode.

Site Survey

Site survey mode works by having two radios (one child and one parent) repeatedly exchange data packets. For every round-trip exchange of data, the child data radio keeps track of the weaker of the two paths. Both units report the statistics as a percentage on their LCD display.

The reports consists of sorting the data into one of four categories: Green, Yellow, Red, or Missed Packets. Green indicates strong signal, yellow is less strong but still robust, red means the packet was received but has a margin of less than 15 dB, and a missed packet means the data did not arrive or contained a checksum error. For most applications, the system can tolerate up to 40% missed packets without serious degradation, but situations with more missed packets should be reviewed for proper antenna selection and placement, cabling, and transmit power levels.

Only the child data radios can initiate a site survey. Other child radios on the same network ID remain synchronized to the network, but are blocked from sending data while the site survey is running. In installations with multiple child radios, the site survey analyzes the signal strength between the selected child and its parent radio only. Disable site survey on one child before initiating it from another.

Parent devices in site survey mode have a solid green LED for the duration of the site survey and the LCD display scrolls the results of the site survey as compiled by the child data radio. 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.

Quick Start Step 3: Installation

Avoid Direct Sunlight

To minimize the damaging effects of ultra-violet radiation, avoid mounting the data radios facing intense direct sunlight.

- Mount the data radio within a protective enclosure,
- Mount the data radio under an overhang or other source of shade,
- Install the data radio indoors, or
- Face the unit north when installing outside.

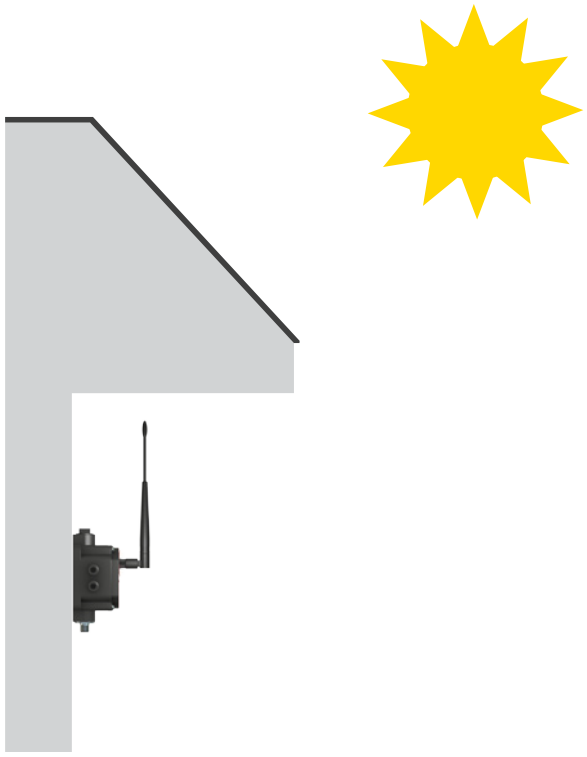


Figure 9. Avoid Direct Sunlight

Avoid Collecting Rain

When possible, mount the SureCross devices where rain or snow will drain away from the unit.

- Mount the units vertically so that precipitation, dust, and dirt do not accumulate on permeable surfaces.
- Avoid mounting the units on flat or concave surfaces, especially if the display will be pointing up.

Reduce Chemical Exposure

Before installing the SureCross devices in a chemically harsh environment, contact Banner for more information regarding the life-expectancy. Solvents, oxidizing agents, and other chemicals will damage the devices.

Minimize Mechanical Stress

While the SureCross devices are very durable, they are sophisticated electronic devices that are sensitive to shock and excessive loading.

- Avoid mounting the units to an object that may be shifting or vibrating excessively. High levels of static force or acceleration may damage the housing or electronic components.
- Do not subject the units to external loads.

Data Radio Set-up Menu

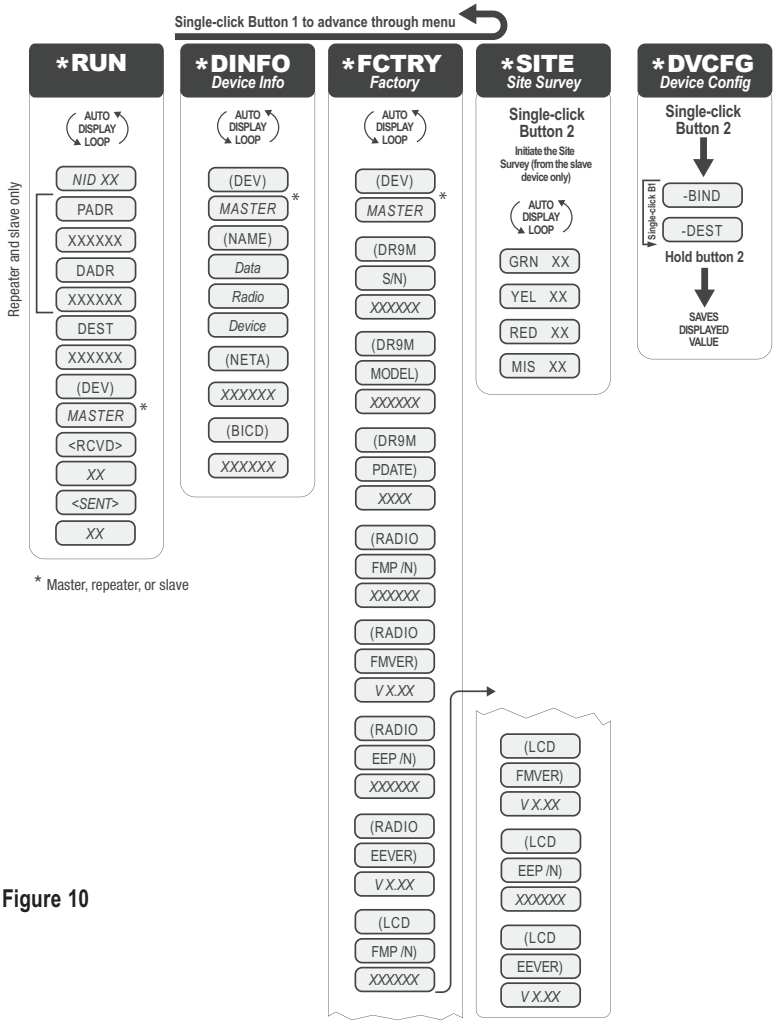


Figure 10

When power is applied, the data 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.

Menu Navigation

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

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. The PADR is the 6-digit serial number minus 65535.

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

DEST. The current destination address, used in transparent mode to route messages. A value of 65535 indicates a general broadcast instead of a specific destination.

RCVD. The number of serial messages received.

SENT. The number of serial messages sent.

DINFO (Device Info)

The DINFO menu displays the device information.

(NAME). An 18-character name users may assign to the device.

(NETA). Network Address (display only).

(BICD). Binding Code (display only).

FCTRY (Factory)

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

S/N. The device’s serial number.

Model #. The DX80DR9M family model number.

PDate. Production date.

Radio FMP/N. Firmware part number.

SITE (Site Survey)

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.

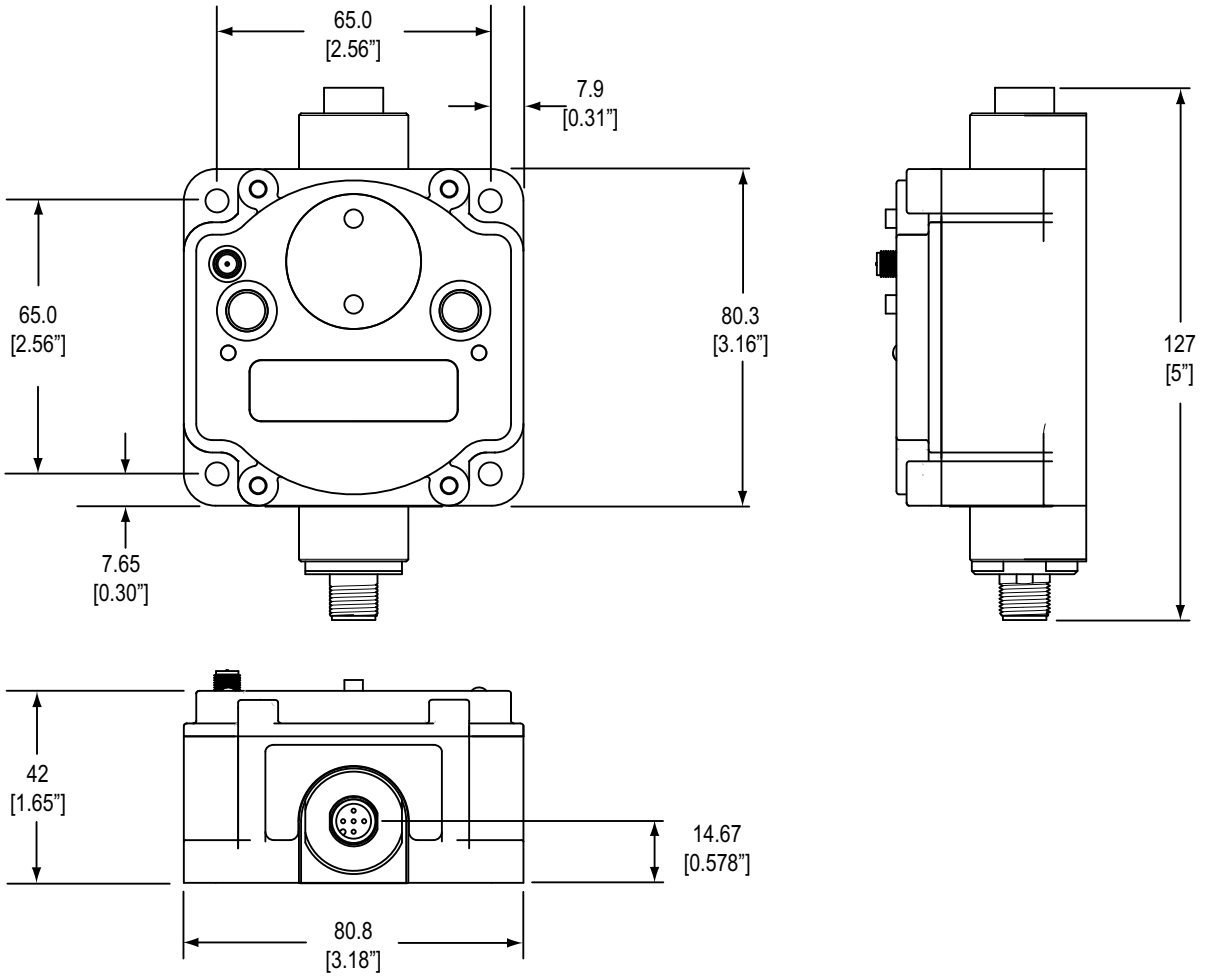
DVCFG (Device Configuration)

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. In transparent mode, you can set the specific destination to force message routing.

Dimensions


65.0
[2.56"]
7.9
[0.31"]
65.0
[2.56"]
80.3
[3.16"]
7.65
[0.30"]
127
[5"]
42
[1.65"]
14.67
[0.578"]
80.8
[3.18"]

FCC Certification, 900 MHz, 1 Watt Radio

The DX80 Module complies with Part 15 of the FCC rules and regulations.

FCC ID: UE3RM1809 This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Notices

IMPORTANT: The radio modules have been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

IMPORTANT: The radio modules have been certified for fixed base station and mobile applications. If modules will be used for portable applications, the device must undergo SAR testing.

IMPORTANT: If integrated into another product, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door, or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text: **Contains FCC ID: UE3RM1809**.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna,
- Increase the separation between the equipment and receiving module,
- Connect the equipment into an outlet on a circuit different from that to which the receiving module is connected, and/or
- Consult the dealer or an experienced radio/TV technician for help.

Antenna WARNING: This device has been tested with Reverse Polarity SMA connectors with the antennas listed in Table 1 Appendix A. When integrated into OEM products, fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Antennas not listed in the tables must be tested to comply with FCC Section 15.203 (unique antenna connectors) and Section 15.247 (emissions).

FCC-Approved Antennas

WARNING: This equipment is approved only for mobile and base station transmitting devices. Antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

DX80 Module may be used only with Approved Antennas that have been tested with this module.

Table 6. Type certified Antenna

Part Number	Antenna Type	Maximum Gain	Minimum Required Cable/ Connector Loss
—	Integral antenna	Unity gain	0
BWA-9O1-x	Omni, 1/4 wave dipole	≤2 dBi	0
BWA-9O2-C	Omni, 1/2 wave dipole, Swivel	≤2 dBi	0
BWA-9O6-A	Omni Wideband, Fiberglass Radome	≤8.2 dBi	2.2 dB
BWA-9O5-B	Omni Base Whip	≤7.2 dBi	1.2 dB
BWA-9Y10-A	Yagi	≤10 dBi	4 dB

FCC Certification, 2.4 GHz

The DX80 Module complies with Part 15 of the FCC rules and regulations.

FCC ID: UE300DX80-2400 This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Notices

IMPORTANT: The DX80 Modules have been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

IMPORTANT: The DX80 Modules have been certified for fixed base station and mobile applications. If modules will be used for portable applications, the device must undergo SAR testing.

IMPORTANT: If integrated into another product, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door, or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text: Contains FCC ID: UE300DX80-2400.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna,
- Increase the separation between the equipment and receiving module,
- Connect the equipment into an outlet on a circuit different from that to which the receiving module is connected, and/or
- Consult the dealer or an experienced radio/TV technician for help.

Antenna Warning WARNING: This device has been tested with Reverse Polarity SMA connectors with the antennas listed in Table 1 Appendix A. When integrated into OEM products, fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Antennas not listed in the tables must be tested to comply with FCC Section 15.203 (unique antenna connectors) and Section 15.247 (emissions).

FCC-Approved Antennas

WARNING: This equipment is approved only for mobile and base station transmitting devices. Antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

DX80 Module may be used only with Approved Antennas that have been tested with this module.

Table 7. Type certified Antenna

Part Number	Antenna Type	Maximum Gain
—	Integral antenna	Unity gain
BWA-2O2-C	Omni, 1/2 wave dipole, Swivel	≤2 dBi
BWA-2O5-C	Omni, Collinear, Swivel	≤5 dBi
BWA-2O7-C	Omni, Coaxial Sleeve, Swivel	≤7 dBi
BWA-2O6-A	Omni, Fiberglass Indoor/Outdoor, 16"	≤6 dBi
BWA-2O8-A	Omni, Fiberglass Indoor/Outdoor, 24"	≤8.5 dBi

Certified Countries List

		Models				
Country	Frequency	DX80	DX70	DX91	DX99	DX80DR
Australia	2.4 GHz	x	x			x
Austria	2.4 GHz	x	x	x	x	x
Bahrain (Kingdom of)	2.4 GHz	x	x	x	x	x
Belgium	2.4 GHz	x	x	x	x	x
Brazil	2.4 GHz	x	x		x	x
Bulgaria	2.4 GHz	x	x	x	x	x
Canada	900 MHz	x	x	x	x	x
Canada	2.4 GHz	x	x	x	x	x
China (People's Republic of)	2.4 GHz	x	x			x
Cyprus	2.4 GHz	x	x	x	x	x
Czech Republic	2.4 GHz	x	x	x	x	x
Denmark	2.4 GHz	x	x	x	x	x
Estonia	2.4 GHz	x	x	x	x	x
Finland	2.4 GHz	x	x	x	x	x
France	2.4 GHz	x	x	x	x	x
Germany	2.4 GHz	x	x	x	x	x
Greece	2.4 GHz	x	x	x	x	x
Hungary	2.4 GHz	x	x	x	x	x
Iceland	2.4 GHz	x	x	x	x	x
India	2.4 GHz	x				x
Ireland	2.4 GHz	x	x	x	x	x
Israel	2.4 GHz	x*	x		x*	x
Italy	2.4 GHz	x	x	x	x	x
Latvia	2.4 GHz	x	x	x	x	x
Liechtenstein	2.4 GHz	x	x	x	x	x
Lithuania	2.4 GHz	x	x	x	x	x
Luxembourg	2.4 GHz	x	x	x	x	x
Malta	2.4 GHz	x	x	x	x	x
Mexico	900 MHz	x	x		x	x
Mexico	2.4 GHz		x		x	
Netherlands	2.4 GHz	x	x	x	x	x
New Zealand	2.4 GHz	x	x			x
Norway	2.4 GHz	x	x	x	x	x
Poland	2.4 GHz	x	x	x	x	x
Portugal	2.4 GHz	x	x	x	x	x
Romania	2.4 GHz	x	x	x	x	x
Saudi Arabia (Kingdom of)	2.4 GHz	x	x	x	x	x
Slovakia	2.4 GHz	x	x	x	x	x

		Models				
Country	**Frequency**	**DX80**	**DX70**	**DX91**	**DX99**	**DX80DR**
Slovenia	2.4 GHz	x	x	x	x	x
South Africa	2.4 GHz	x	x			x
Spain	2.4 GHz	x	x	x	x	x
Sweden	2.4 GHz	x	x	x	x	x
Switzerland	2.4 GHz	x	x	x	x	x
United Kingdom	2.4 GHz	x	x	x	x	x
United States of America	900 MHz	x	x	x	x	x
United States of America	2.4 GHz	x	x	x	x	x
* External antenna models						

Bulgaria

Authorization required for outdoor and public service use.

France

In Guyane (French Guiana) and La Reunion (Reunion Island), outdoor use not allowed.

Italy

If used outside of own premises, general authorization is required.

Luxembourg

General authorization is required for public service.

Canada

This Class A digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouiller du Canada. Le present appareil numérique n'emet pas de bruits radioélectriques dépassant les limites applicables aux appareils numeriques de le Classe A préscrites dans le Reglement sur le brouillage radioélectrique édits par le ministere des Communications du Canada.

It is Banner Engineering's 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 that the device is approved in the destination country. Consult with Banner Engineering if the destination country is not on this list.

Specifications

Many of the parameters are configurable. The values in the tables represent factory defaults unless otherwise noted.

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 **2.4 GHz:** 18 dBm Conducted (≤ 20 dBm EIRP with standard 2 dB antenna)
Spread Spectrum Technology	FHSS (Frequency Hopping Spread Spectrum)
Antenna Connector	Ext. Reverse Polarity SMA, 50 Ohms
Antenna Max. Tightening Torque	0.45 N•m (4 in•lbf)

* With standard 2 dB antenna. The range depends on the environment and line of sight. High-gain antennas are available to increase the range.

General	
Power*	+10 to 30V dc (For European applications: +10 to 24V dc, ± 10%) on the brown wire 3.6 to 5.5V dc on the gray wire
Typical Power Consumption, 900 MHz	**Gray wire (3.8V)**: 650 mW **Brown wire (12V)**: 900 mW
Typical Power Consumption, 2.4 GHz	**Gray wire (3.8V)**: 120 mW **Brown wire (12V)**: 250 mW
Mounting	#10 or M5 (M5 hardware included)
M5 Fasteners Max. Tightening Torque	0.56 N•m (5 in•lbf)
Case Material	Polycarbonate
Weight	0.26 kg (0.57 lb.)
Indicators	Two LED, bi-color
Switches	Two Push Buttons
Display	Six Character LCD
Cable Glands Max. Tightening Torque	0.56 N•m (5 in•lbf)

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

Communications	
Interface	2-wire RS-485 or RS-232 (user selectable)
Baud Rates	9.6k, 19.2k (default), or 38.4k
Data Format	8 data bits, selectable parity (even, odd, or none), 1 stop bit

Environmental	
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

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

Compliance	
900 MHz Models	FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247 IC: 7044A-RM1809
2.4 GHz Models	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
Certification	Class I, Division 2, Groups A, B, C, D. Certificate: 1921239 Ex/A Ex nA II T4
	LCIE/ATEX Zone 2. Certificate: LCIE 09 ATEX 1035 U II 3G Ex nA IIC

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.

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-9O2-C, or BWA-2O2-C**	1	Antenna, 902-928 MHz, 2 dBd Omni, Rubber Swivel RSMA Male, or Antenna, 2.4 GHz, 2 dBd Omni, Rubber Swivel RSMA Male
SureCross Literature CD	**79685**	1	SureCross Literature CD

For more information:
Contact your local Banner representative
or
Banner Corporate Offices around the world.

Corporate Headquarters

Banner Engineering Corp.
9714 Tenth Ave. North
Mpls., MN 55441
Tel: 763-544-3164
www.bannerengineering.com
sensors@bannerengineering.com

Europe

Banner Engineering Europe
Park Lane
Culliganlaan 2F
Diegem B-1831 BELGIUM
Tel: 32-2 456 07 80
Fax: 32-2 456 07 89
www.bannereurope.com
mail@bannereurope.com

Latin America

Contact Banner Engineering Corp. (US) or e-mail
Mexico:
mexico@bannerengineering.com
Brazil:
brasil@bannerengineering.com

Asia — China

Banner Engineering China
Shanghai Rep Office
Rm. G/H/I, 28th Flr.
Cross Region Plaza
No. 899, Lingling Road
Shanghai 200030 CHINA
Tel: 86-21-54894500
Fax: 86-21-54894511
www.bannerengineering.com.cn
sensors@bannerengineering.com.cn

Asia — Japan

Banner Engineering Japan
Cent-Urban Building 305
3-23-15 Nishi-Nakajima
Yodogawa-Ku, Osaka 532-0011
JAPAN
Tel: 81-6-6309-0411
Fax: 81-6-6309-0416
www.bannerengineering.co.jp
mail@bannerengineering.co.jp

Asia

Banner Engineering Asia — Taiwan
Neihu Technology Park
5F-1, No. 51, Lane 35, Jihu Rd.
Taipei 114 TAIWAN
Tel: 886-2-8751-9966
Fax: 886-2-8751-2966
www.bannerengineering.com.tw
info@bannerengineering.com.tw

India

Banner Engineering India
Pune Head Quarters
Office No. 1001
Sai Capital, Opp. ICC
Senapati Bapat Road
Pune 411016 INDIA
Tel: 91-20-66405624
Fax: 91-20-66405623
www.bannerengineering.co.in
india@bannerengineering.com

The manufacturer does not take responsibility for the violation of any warning listed in this document.

CAUTION . . .

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.

Always use lightning arrestors/surge protection with all remote antenna systems to avoid invalidating the Banner Engineering Corp. warranty. No surge protector can absorb all lightning strikes. Do not touch the SureCross device or any equipment connected to the SureCross device during a thunderstorm.

WARRANTY: Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.

P/N 148345