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
- FlexPower power input options allow for +10 to 30V dc, solar, or battery power sources
- Serial communication style (RS232 or RS485) is user selectable
- 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
- Fully symmetric, bidirectional transceivers enable two-way communications and receive acknowledgements
- FHSS radios operate and synchronize automatically; no user setup is required; Selectable network IDs reduce interference from collocated networks
- Transparent operation adds little latency to serial data; connects seamlessly to Modbus serial networks as a wire replacement
- Basic configurable parameters (baud rate, power level) are switch selectable; an AT command set allows control of all user-selectable functions through the serial interface
- 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.

2.4 GHz

900 MHz

Models

Model	Power	Frequency	Transmit Power
DX80DR9M	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		2.4 GHz ISM Band	100 mW EIRP

132031

Data Radio Front Panel Interface

1.	Rotary Switch 1 (left)	Sets the network ID (NID) to a hexidecimal value from 0 to F, for a total of 16 network IDs. A master device and its corresponding slaves must be assigned the same network ID.
	Rotary Switch 2 (right)	Sets the device role (master or slave). Set the master device to 0 and set the slave devices all to 1. Only one device within each network is the master.
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.
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 and modify other data radio configuration parameters without the use of a PC or other external software interfaces.
6.	5-Pin M12 Euro-style quick-disconnect port	The Euro-style power is used for serial connections and power.

Data Radio Set-up Menu

When power is applied, the data radio immediately 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.

Network ID and Device Mode

The network ID (NID) can be set from the left rotary switch while in RUN mode. Once changed, allow five seconds for the devices to synchronize on the new NID.

The device mode can be set from the right rotary switch while in RUN mode. The LCD indicates the user's choices of 0 (master) or 1 (slave).

Setting the device mode to 2 through 15 displays NO DEV on the LCD and the unit fails to synchronize with the master device.
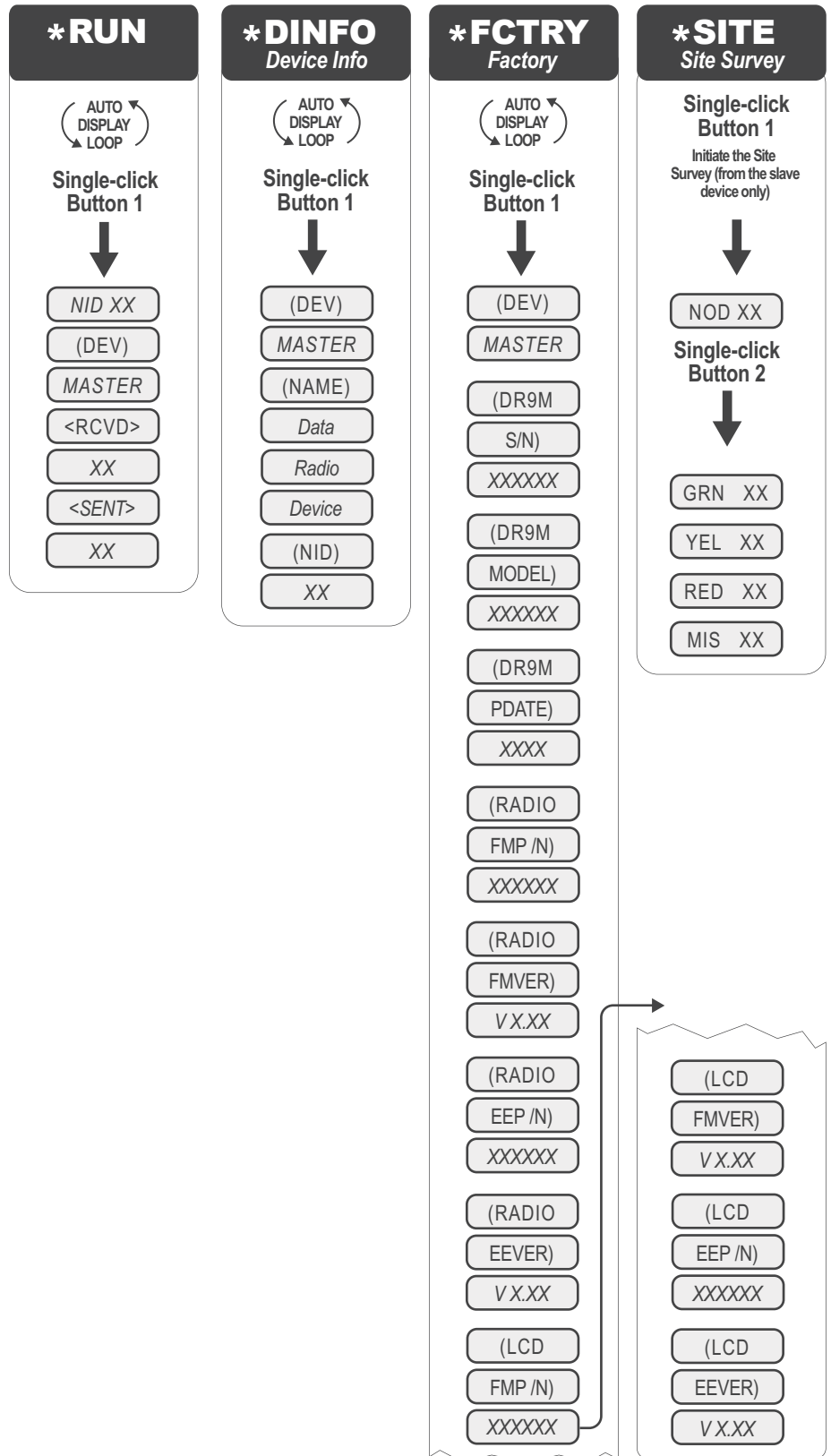
Menu Navigation

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. While paused, use button 1 to advance through the items in that menu.

Site Survey

Triple-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.
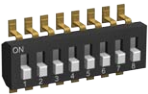
*RUN

AUTO DISPLAY LOOP

Single-click Button 1

- NID XX
- (DEV)
- MASTER
- <RCVD>
- XX
- <SENT>
- XX

*DINFO
Device Info

AUTO DISPLAY LOOP

Single-click Button 1

- (DEV)
- MASTER
- (NAME)
- Data
- Radio
- Device
- (NID)
- XX

*FCTRY
Factory

AUTO DISPLAY LOOP

Single-click Button 1

- (DEV)
- MASTER
- (DR9M
- S/N)
- XXXXXX
- (DR9M
- MODEL)
- XXXXXX
- (DR9M
- PDATE)
- XXXX
- (RADIO
- FMP /N)
- XXXXXX
- (RADIO
- FMVER)
- V X.XX
- (RADIO
- EEP /N)
- XXXXXX
- (RADIO
- EEVER)
- V X.XX
- (LCD
- FMP /N)
- XXXXXX

- (LCD
- FMVER)
- V X.XX
- (LCD
- EEP /N)
- XXXXXX
- (LCD
- EEVER)
- V X.XX

*SITE
Site Survey

Single-click Button 1

Initiate the Site Survey (from the slave device only)

- NOD XX

Single-click Button 2

- GRN XX
- YEL XX
- RED XX
- MIS XX

Quick Start Step 1: Set Network ID and Address Mode

Extended Address Mode and Device Binding

Data Radios use a network ID to form groups of radios that can communicate with each other. Follow the procedure outlined below for binding radios to a particular master device (also known as extended addressing mode). Although it is possible to manually set the network ID using the left rotary switch, many of the advanced features of the data radio (including multi-hop networks) are not possible unless the extended addressing mode is used.

Extended address mode preserves the concept of a network ID, but uses the factory-programmed serial number of the master to generate each network ID. The process of teaching a slave unit its network ID is automated, but requires that the user place both master and slave into binding mode. Binding mode is similar to what would be done after purchasing a new garage door opener pendant: the pendant must be "introduced" to the door (network) it will open.

To place a unit in extended address mode, move DIP switch 8 to ON. Once in extended address mode, the binding operation must be performed at least once. Running binding mode more than once is unnecessary and produces the same result, but will not harm the units. To return bound units to rotary switch address mode, change DIP switch 8 to the OFF position. To bind two data radios together:

	User Action	Display/Status
	Binding the Devices	
1	Open the units and remove the covers. Move DIP switch 8 to the ON position, then cycle power to the device to activate the DIP switch change.	
2	Place the units at least two meters apart.	
3	Set one unit to be a master (right rotary = 0) and one to be a slave (right rotary = 1). Ignore the LCD messages prior to entering binding mode. Until the devices complete the binding procedure, the LCD displays the previous status (master vs slave) of the device instead of the status represented by the new rotary dial position. Additional slaves can be bound to the same network as long as the same master device is used to bind each new device. Banner recommends binding only one slave device at a time.	
4	Triple-click the right button on the master device. Both LEDs should flash red and the LCD screen displays "BINDNG" and "MASTER." The master transmits its NID information to any slave that is also in binding mode.	*BINDNG *MASTER*
5	Triple-click the right button on the slave. As on the master, both LEDs flash red and the LCD screen displays "BINDNG" and "SLAVE." When the slave picks up the binding code transmitted by the master, the slave screen displays "BOUND" and the slave automatically exits binding mode. (The slave enters and remains in an out-of-sync condition until the master exits binding mode.)	*BINDNG *SLAVE* *BOUND*
6	As many additional slaves as necessary may be bound to the same master. To set up multiple slaves to the same master device, repeat steps 1 through 4 for each slave device.	
7	When there are no additional slaves to be added to the network, exit binding mode on the master by double-clicking the right button.	
8	Reset power to the master device. The devices begin communicating when the slave synchronizes to the master device.	
	Setting the Network ID	
9	After the devices are successfully bound, the left and right rotary switches now work together to establish the communication timing within that network. Set the left and right rotary switches of the master device to a unique combination, from 00 to 99, with the left rotary switch acting as the digits "tens" place and the right rotary switch acting as the "ones" place. For example, set the left rotary switch to 1 and the right switch to 0 to set the master device to a network ID of 10.	
10	All slave devices bound to this master will "follow" the master device to this network ID and begin communicating. The master device and all slaves bound to that master will display the selected NID.	

Quick Start Step 2: Apply power and serial communication

User Action	Display/Status	Notes
Apply power...	POWER	This reading occurs only when power is applied to the data radio.
The LCD display shows the status of the device.	*RUN	The data radio starts in *RUN mode.
	NID 1	Displays current Network ID (NID)
	(DEV)	Device is ...
	MASTER	... Master (Device Address = 0)
	<RCVD> 0	Indicates the number of data packets received and sent.
	<SENT> 0	

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.

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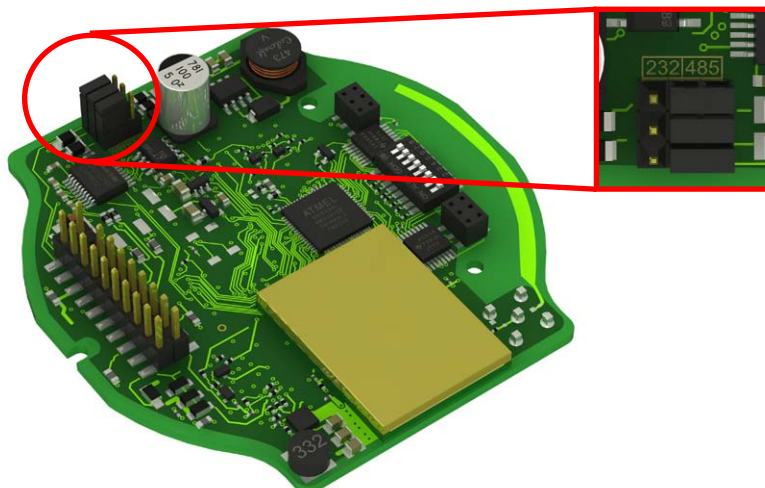
## Using 10 to 30V dc to Power the Data Radio and Gateway

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.

DX80DR9 Data Radio

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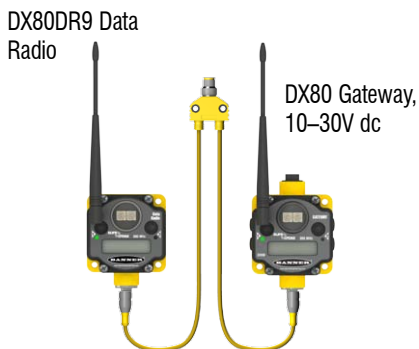
Cable Model No: CSB-M1240M1241
Splitter cable, 4-pin Euro-style QD, No trunk male, two female branches, yellow. Use to connect the Data Radio to the 10–30V dc DX80 Gateway.

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.

DX80DR9 Data Radio

DX80 FlexPower Gateway
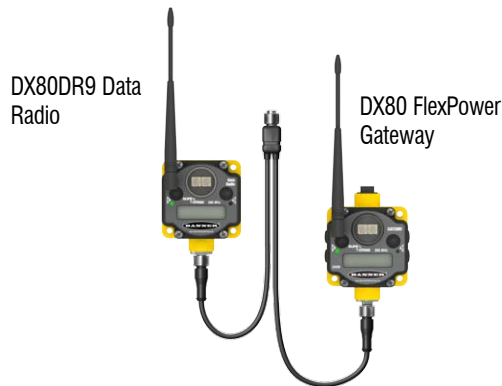
Cable Model No: CSRB-M1250M125.47M125.73
Splitter cable, 5-pin Euro-style QD, No trunk male, two female branches, black. Most commonly used with solar and other FlexPower devices.

Quick Start Step 3: Verify Communications

Master Device

Verify LED 1 is on and flashing green.

Status	LED 1	LED 2
Power ON	Green Flash	—
Serial Communication Active	—	Yellow Flash
Serial Communication Error	—	Red Flash
System Error	Red Flash	Red Flash

Slave Device

Verify LED 1 is flashing green and LED 2 is off. Until communication is established with the master device, LED 2 flashes red. When communication is established, the slave's LED 1 flashes green.

Status	LED 1	LED 2
RF Link Ok	Green Flash	—
RF Link Error	—	Red Flash (1 per 3 sec)
Serial Communication Active	—	Yellow Flash
Serial Communication Error	—	Red Flash
System Error	Red Flash	Red Flash (1 per sec)

When testing the devices before installation, verify the data radio master and slave are at least two meters apart or the communications may fail.

Serial communication errors usually indicate a mismatch in the baud rate or parity between the data radio and the communication equipment the data radio is wired to. However, not all baud rate mismatches are detected as communications errors, especially for short messages. If data is consistently received in error, even when the data radios are not far apart, verify the serial rates between the wired components are not mismatched.

Quick Start Step 4: Site Survey

A site survey analyzes the radio signal between a data radio slave and its master 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 RF communication potential, compare link quality in different locations in a factory, or assist with final antenna placement and aiming. Only the slave devices can initiate a site survey and only one radio link can be analyzed at a time.

	User Action	Display/Status	Notes
Site Survey Menu	On the slave device, press button 1 until the display reads *SITE.	*SITE	Only the slave devices within a data radio network can initiate a site survey.
	Single-click button 2 on the slave data radio device.		The site survey begins. LED 2 on both the master and slave devices flashes for every received RF packet. To indicate the master is in site survey mode, LED 1 is a solid green.
Survey Readings	Single-click push button 2 on the slave radio device	GRN 60	The radio devices analyze the quality of the signal between the master and slave devices by counting the number of data packets received and measuring the signal strength. 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.
	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.	YLW 25	
		RED 10	
		MIS 05	
	Double-click push button 2 on either 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 master and one slave) repeatedly exchange data packets. For every round-trip exchange of data, the slave unit 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, known as 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 slave units can initiate a site survey. Other slaves 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 slaves, the site survey analyzes the signal strength between the selected slave and the master device only. Disable site survey on one slave before initiating it from another.

Master 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 slave. Because the statistics represent the lesser of the round-trip results, one person can ascertain the link quality from either device.

Triple-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 5: 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.

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.

Avoid Direct Sunlight
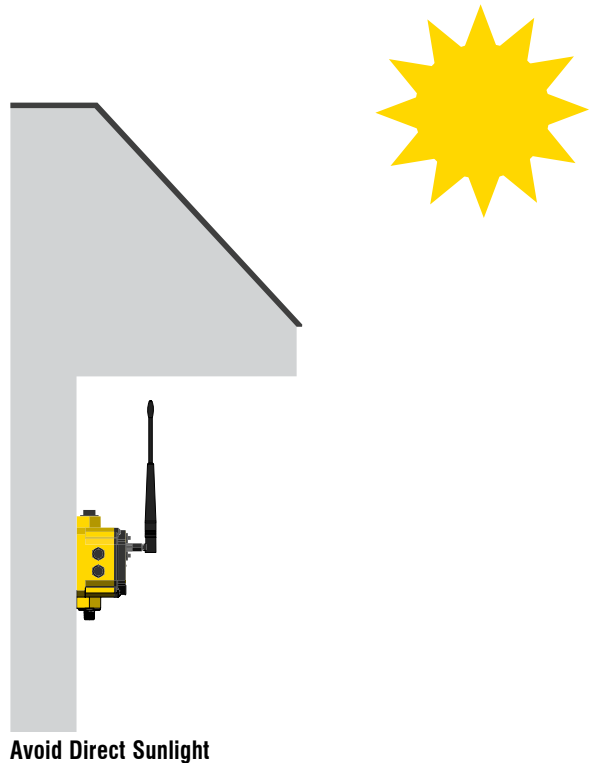
For additional information, including installation and setup, weatherproofing, device menu maps, troubleshooting, and a list of accessories, refer to the SureCross™ DX80 Wireless I/O Network product manual, Banner p/n 132607.

Configuration
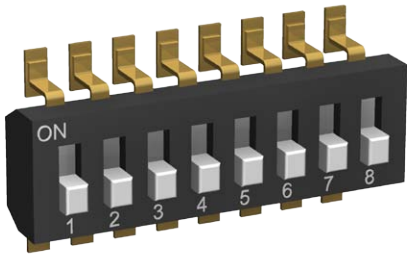
Turn the Power Off

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

Device Settings	Switches							
	1	2	3	4	5	6	7	8
Serial Line Baud Rate 19200	OFF*	OFF*						
Serial Line Baud Rate 9600	ON	OFF						
Serial Line Baud Rate 38400	OFF	ON						
Serial Line Baud Rate 19200	ON	ON						
Parity: None			OFF*	OFF*				
Parity: Odd			ON	OFF				
Parity: Even			OFF	ON				
Parity: None			ON	ON				
Transmit Power Level**: 1.00 W / 30 dBm					OFF*	OFF*		
Transmit Power Level: 0.75 W / 29 dBm					ON	OFF		
Transmit Power Level: 0.50 W / 27 dBm					OFF	ON		
Transmit Power Level: 0.25 W / 24 dBm					ON	ON		
RF Bit Rate**: 76.8 kbps							OFF*	
RF Bit Rate: 19.2 kbps							ON	
Rotary Switch Address Mode								OFF*
Extended Address Mode								ON

*   Default position shown

**   Disabled for 2.4 GHz. The transmit power for 2.4 GHz is fixed at 0.063 W/18 dBm and the RF bit rate is 250 kbps.

Accessing the DIP Switches

To access the DIP switches, follow these steps:

1. Unscrew the four screws that mount the cover to the bottom housing.
2. Remove the cover from the housing without damaging the ribbon cable or the pins the cable plugs into.
3. Gently unplug the ribbon cable from the board mounted into the bottom housing.
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.

Address Mode

The SureCross wireless devices may use one of two types of addressing modes: rotary switch addressing or extended addressing. In rotary switch address mode, the left rotary dial establishes the network ID and the right rotary dial sets the device ID. The wireless network is restricted to a maximum of 16 devices.

Extended address mode binds Nodes to a specific Gateway, allowing network expansion to more than 16 devices in a wireless network. For more information on extended address mode, refer to the SureCross™ Wireless I/O Network product manual.

The device ships in rotary switch address mode by default, with the DIP switch in the OFF position. To use extended address mode, change the DIP switch to the ON position.

Overview

After powering up, the data radio begins standard operating mode, known as RUN mode. When in RUN mode, the radio receives data from the serial port RS485 interface and transmits that data as a radio frequency (RF) packet. Received RF packets are demodulated to baseband and transmitted through the serial port.

Timing

As data enters the serial port, it is queued up in a 255-byte buffer until there is a break in the bitstream that indicates the end of a packet. Once a suitable break is measured, the data packet moves into a second 255-byte buffer. The radio transmitter sends the packet over the air.

At the receiver, the demodulated data is stored in a buffer that is the same size as the original data packet. Once the complete data packet has been received, it is sent uninterrupted through the serial port. The net effect of the cascaded buffering, transmitting, and receiving is that serial packets emerge from the data radio delayed but unchanged.

To prevent data loss during serial transmission, packet sizes should be limited to 255 bytes. The inactivity between packets must be at least 3.6 milliseconds.

For non-Modbus applications, once the minimum inactivity time to delimit a packet is met, users must still consider the time required to transmit the packet over the air to avoid overrunning the buffers. For the best results, run at the higher (76.8 kb/s) data rate over the air and consult the factory for application-specific guidance.

Packet Counting

Part of the RUN mode display is dedicated to displaying a cumulative total of serial packets sent and received. A *sent* packet is transmitted out the wired serial lines. A *received* packet is received on the wired serial port. The packet counter increments when a valid break in the data is measured, as discussed in the timing section above. The counter values reset when power cycles to the device or may be manually reset by quadruple-clicking button 2, then using button 1 to choose which values to reset and button 2 to initiate clearing the value. To exit this feature without clearing a value, double-click button 2.

The packet counts are kept in a 32-bit register capable of holding over 4 billion counts before rolling over. Because the display is limited to six digits, values over 999,999 display across two successive LCD screens, the first of which is denoted by a leading '+' sign. For example, a count value of 12,345,678 displays as '+   12' and then '345678' on the next screen.

Power Supplies

The data radio can accept two types of dc power sources. Use the brown wire to supply +10 to 30V dc to the device. Use the gray wire to power the data radio from a low-voltage source. This voltage must not exceed 5.5V dc or the data radio will be damaged.

When both a +10–30V dc and a 3.6–5.5V dc voltage are present, the circuitry automatically selects the source. The gray wire supply is the power source when its voltage is greater than 3.4V dc. Even when the gray wire supplies the power, there will be a quiescent draw on the brown wire of about 5 mA. The 3.4V dc threshold is not a controlled parameter and some current sharing may occur when the gray wire is near this threshold.
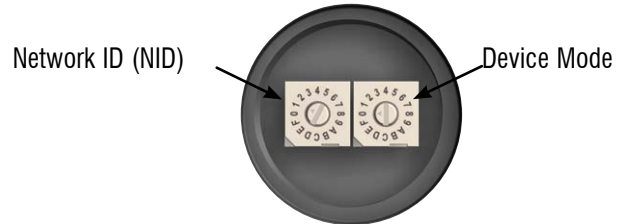
Rotary Switch Address Mode (DIP Switch 8 is OFF)

For most installations Banner recommends using binding mode and extended addressing to establish the wireless networks. Using rotary switch addressing mode with 1 Watt data radios may allow collocated radios to interfere with each other.

In rotary dial address mode (DIP switch 8 is OFF), the wireless RF network is defined by the network ID (NID) assigned to the master and its slaves. Because the data stream appearing on the serial input of one radio within the network is reproduced on the serial outputs of all other radios in the same network, the only configuration necessary is to set the network ID and device mode.

Within a given network, one device is set to device mode 0 to establish the master; all other slave devices are set to a device mode of 1. All other device modes (2–15) are reserved for future use and will not be recognized.

Use the rotary switches (shown right) to define both the NID and device mode for each device. Follow the steps below to set up your data radio network.

Network ID (NID)   Device Mode

Rotary Switches on the Data Radio

	User Action	Display/Status	Notes
	Verify DIP switch 8 is in the OFF position.		If you move DIP switch 8 to the OFF position, cycle power to the device before continuing this procedure.
Set Network ID	Remove the rotary switch access covers.		Turn counterclockwise to remove and clockwise to tighten
	On the master device, set the left rotary switch to 1.		The factory default NID setting on all devices is 1. Each network operating in the same area must be set to a unique network ID. Assign the same NID to all devices within a single network (hexidecimal 0–F).
	On all slave devices within the same network, set the left rotary switch to 1.		
Set Device ID	On the master data radio, set the right rotary switch to 0.		A device mode of 0 causes the device to transmit a time synchronization beacon that is required from only one device within each network. This is the master device.
	On the slave data radios, set the right rotary switch to 1.		A device mode of 1 causes the slave devices to synchronize to the master device set to the same network ID. Device modes 2 through 15 are reserved for future use and will not be recognized as slave devices within the data radio network.
	Install rotary switch access covers. Refer to the installation section for IP67 instructions.		A successful RF link is identified by a blinking green LED 1 on each slave device.

Note: The data radio master device need not be connected to the Modbus master device. The two network functions are independent.

Network Implementation Details

Serial radios connect a Modbus control system to one or more DX80 Gateway devices acting as Modbus slaves. The data radios do not use addressing, error checking, or acknowledgement in the radio packets. Instead, the data stream appearing on the serial input of one radio within the network is reproduced on the serial outputs of all other radios in the same network. Addressing and error correction occur at the application layer. The system operates as it would in a hardwired Modbus multi-drop serial network, except with an increased latency, as described in the Timing section.

All deterministic properties of the DX80 I/O networks are preserved. If a data radio link drops multiple packets, the target DX80 Gateway reacts as if the serial line was cut, driving all outputs in the local TDMA system to the predefined state. The data radio links are collision free because the master control system uses polling to initiate all data exchanges so all data radio packets originate from the same place.

Each DX80 I/O network is inherently collision free. The only potential collisions on the two radio links occur when hardwired DX80 Gateway devices and data radios are collocated. Fortunately, the application layer (Modbus) retries the packet until it succeeds. Using 2.4 GHz radios for the DX80 I/O network links and 900 MHz in the data radio links (or vice versa) also minimizes data collisions.
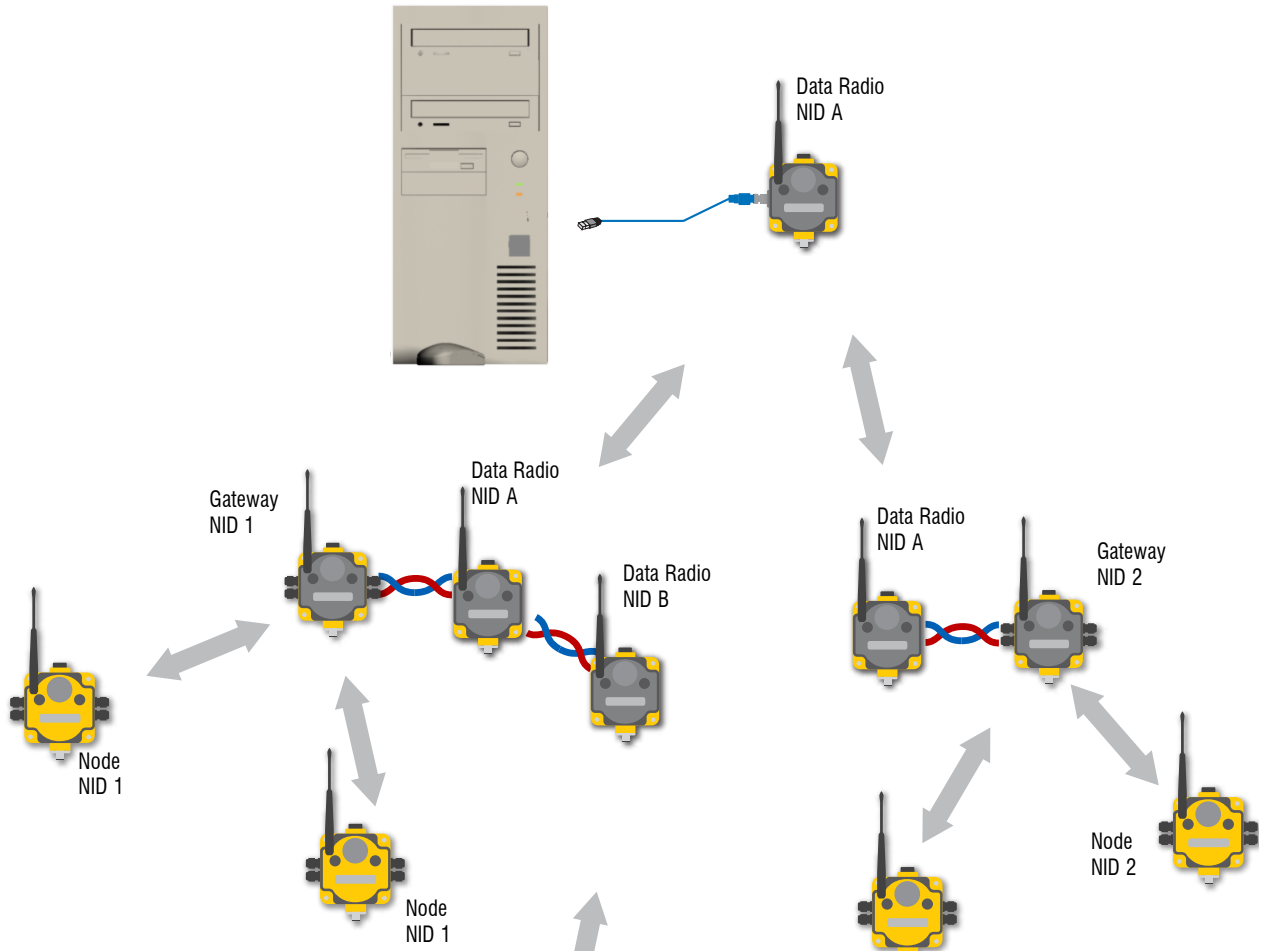
Within any data radio network, there are two types of device: masters and slaves. Every network needs one master and the remainder of the devices are slaves. Use the data radio's right rotary switch to determine which device is the master and which devices are the slaves. Set the right rotary switch to 0 to select the master function and select 1 for the slaves. The master/slave settings establish which device is the timekeeper for the network.

Note that the master/slave function of the data radio network is at the physical layer; it has no bearing on the Modbus functionality at higher network layers, e.g. the Modbus master need not be wired to the data radio master.
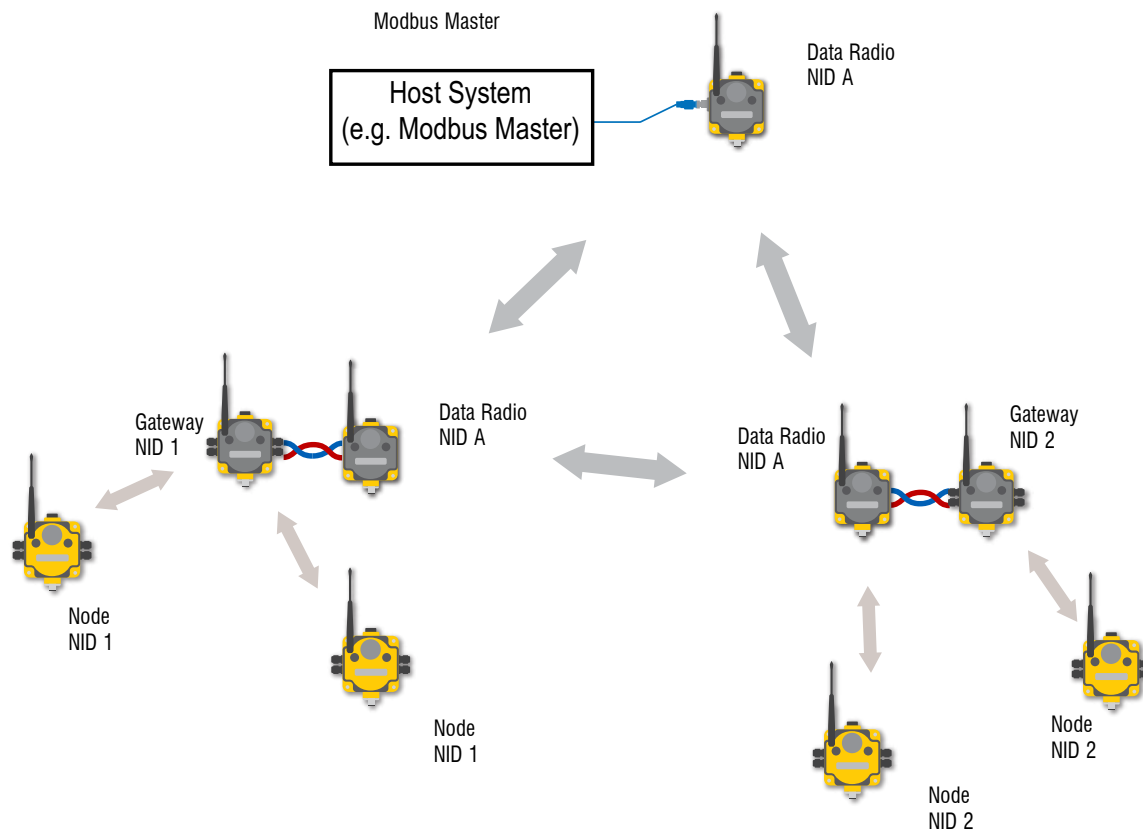
The Modbus master inside the PC connects serially to the data radio on Network ID (NID) A. Two data radio slaves programmed to NID A communicate with the data radio master. Each data radio slave is hard-wired serially to a DX80 Gateway, communicating using the Modbus protocol. Each DX80 Gateway, in turn, is using a wireless I/O link to communicate with two DX80 Nodes. All three wireless networks shown can coexist because they are on unique network IDs.

This concept can be expanded by chaining independent data radio connections through the serial interface. Very large networks can be created without complex network addressing. Modbus networks can be extended while still maintaining the determinism and latency of the underlying DX80 I/O networks.

Data Radio
NID A

Data Radio
NID A

Gateway
NID 1

Data Radio
NID B

Data Radio
NID A

Gateway
NID 2

Node
NID 1

Node
NID 1

Node
NID 2

Node
NID 2

This figure is similar to the previous example, but extends the concept. Notice how the serial line exits the lower left data radio (operating on NID A) and connects to another data radio, this one operating on Network ID B. The data radio on NID B transmits data down to another cluster of DX80s that are using NID 3 to communicate their I/O.

In this configuration, the devices using NID 3 could be twice as far from the Modbus host in the PC as the range of a single pair of data radios, illustrating it is possible to implement a multi-hop network as easily as changing the Network ID on the second pair of data radios. Use this configuration when the distance between the source and ultimate destination exceeds the distance the range of a single hop for the data radios.

Data Radio
NID B

Gateway
NID 3

Node
NID 3

Node
NID 3
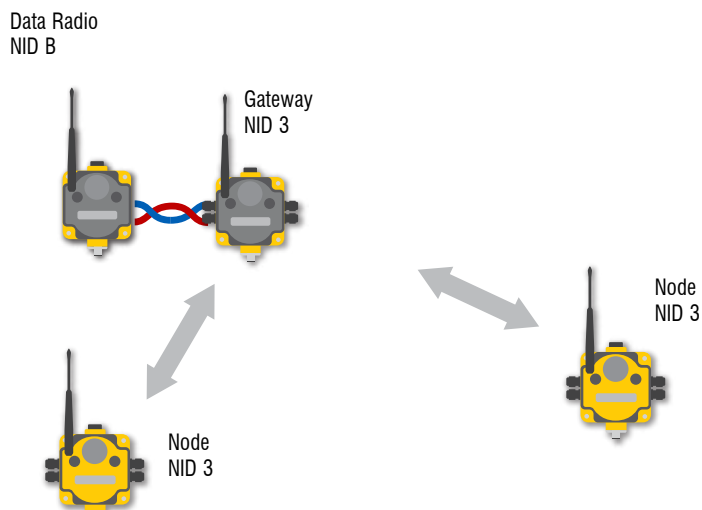
FCC Certification, 900 MHz, 1 Watt Radio

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.

Part Number	Antenna Type	Maximum Gain	Maximum Power Setting
—	Integral antenna	Unity gain	+30 dBm
BWA-901-x	Omni, 1/4 wave dipole	≤2 dBi	+30 dBm
BWA-902-C	Omni, 1/2 wave dipole, Swivel	≤2 dBi	+30 dBm
BWA-906-A	Omni Wideband, Fiberglass Radome	≤8.2 dBi	+27.8 dBm
BWA-905-B	Omni Base Whip	≤7.2 dBi	+28.8 dBm
BWA-9Y10-A	Yagi	≤10 dBi	+26 dBm

Table 1. Type certified Antenna

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.

Part Number	Antenna Type	Maximum Gain
—	Integral antenna	Unity gain
BWA-202-C	Omni, 1/2 wave dipole, Swivel	≤2 dBi
BWA-205-C	Omni, Collinear, Swivel	≤5 dBi
BWA-207-C	Omni, Coaxial Sleeve, Swivel	≤7 dBi

Table 1. Type certified Antenna

Certified Countries List

Country	900 MHz (150 mW)	900 MHz (1 Watt)	2.4 GHz (65 mW)
Australia			x
Austria			x
Bahamas, The	x		x
Bahrain (Kingdom of)			x
Belgium			x
Brazil			x
Bulgaria			x
Canada	x	x	x
Chile			x
China (People's Republic of)			x
Colombia	x		x
Cyprus			x
Czech Republic			x
Denmark			x
Estonia			x
Egypt			x
Finland			x
France			x
Germany			x
Greece			x
Hungary			x
Iceland			x
India			x
Ireland			x
Israel			x *
Italy			x
Latvia			x
Liechtenstein			x
Lithuania			x
Luxembourg			x
Malta			x
Mexico	x	x	x
Netherlands			x
New Zealand			x
Norway			x
Panama	x		x
Poland			x
Portugal			x

Romania			x
Saudi Arabia (Kingdom of)			x
Singapore			x
Slovakia			x
Slovenia			x
South Africa			x
Spain			x
Sweden			x
Switzerland			x
Taiwan			x **
Thailand			x
United Arab Emirates			x
United Kingdom			x
United States of America	x	x	x
* External antenna models			
** Only specific models. Refer to certificate for the model list.			

Additional Messages

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

Transmit Power
900 MHz: 30 dBm Conducted (up to 36 dBm EIRP)
2.4 GHz: 18 dBm Conduced, ≤20 dBm EIRP

900 MHz Compliance (1 Watt Radios)
FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247
IC: 7044A-RM1809

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

Spread Spectrum Technology. FHSS (Frequency Hopping Spread Spectrum)

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

*   With the standard 2 dB antenna. High-gain antennas are available, but the range depends on the environment and line of sight. To determine the range of your wireless network, perform a Site Survey.

General

Power Requirements. +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

Power Consumption (900 MHz)
Gray wire (3.8V): 120 mW (low traffic) or 650 mW (high traffic)
Brown wire (12V): 230 mW (low traffic) or 900 mW (high traffic)
For low traffic applications, a slave device consumes 25% less power than a master device.

Power Consumption (2.4 GHz)
Gray wire (3.8V): 80 mW (low traffic) or 120 mW (high traffic)
Brown wire (12V): 200 mW (low traffic) or 250 mW (high traffic)
For low traffic applications, a slave device consumes 25% less power than a master device.

Housing
Polycarbonate
Weight: 0.26 kg (0.57 lb.)
Mounting: #10 or M5 (M5 hardware included)
M5 Fasteners Max. Tightening Torque: 0.56 N·m (5 in·lbf)

Interface
Indicators: Two bi-color LEDs
Buttons: Two
Display: Six Character LCD

Wiring Access
One 5-pin Euro-style male connector
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

Hardware (RS-485)
Interface: 2-wire RS-485
Baud Rates: 9.6k, 19.2k (default), or 38.4k
Data Format: 8 data bits, no parity, 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

*   Refer to the SureCross™ DX80 Wireless I/O Network product manual, Banner p/n 132607, for installation and waterproofing instructions.
**   Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.

Classified Areas Certifications

CSA
  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-902-C, or BWA-202-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

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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.

Lightning Arrestors/Surge Protection. 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.

All specifications published in this document are subject to change. Banner reserves the right to modify the specifications of products, prior to their order, without notice. Banner Engineering reserves the right to update or change documentation at any time. For the most recent version of any documentation, please refer to our website: www.bannerengineering.com. © 2009-2011 Banner Engineering Corp. All rights reserved.