



SureCross Wireless I/O Products Manual



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Part 1

Introduction

Topics:

- *Introducing SureCross*
- *Features*
- *Dimensions*

Chapter 1

Introducing SureCross

The SureCross Wireless Network

The SureCross™ DX80 wireless I/O network provides reliable monitoring without the burden of wiring or conduit installation and can operate independently or in conjunction with a PLC and/or PC software.

The SureCross DX80 network is a deterministic system—the network identifies when the radio signal is lost and drives relevant outputs to user-defined conditions. Once the radio signal is reacquired, the network returns to normal operation.

Each wireless network system consists of one Gateway and one or more Nodes that ship with factory defined inputs and outputs. Devices may be all discrete I/O, all analog I/O, mixed discrete and analog I/O, and FlexPower™.

SureCross Gateways and Nodes

A SureCross Gateway device acts as the master device within each radio network, initiates communication and reporting with the Nodes, and controls the timing for the entire network.

The Gateway also holds the configuration for the network. Every wireless network must have one Gateway that schedules communication traffic and controls the I/O configuration for the network. A radio network contains only one Gateway, but can contain many Nodes. Similar to how a gateway device on a wired network acts as a “portal” between networks, the SureCross Gateway acts as the portal between the wireless network and the central control process.

Generally, a node is any point within a network. A SureCross Node is a wireless network slave device used to provide sensing capability in a remote area or factory. The Node collects sensor data from sensors and communicates the data back to the SureCross Gateway.

SureCross Nodes are available in a wide variety of power or input/output options. Each Node device can be connected to sensors or output devices and reports I/O status to the Gateway. Devices may be all discrete I/O, mixed discrete and analog I/O, or FlexPower™.

GatewayPro and Ethernet Bridge

The DX80 GatewayPro combines, in one DX80 unit, the function of a standard Gateway with the ability to interface to Ethernet using Modbus/TCP or EtherNet/IP™ protocols. The GatewayPro has a serial port as well as an industrial Ethernet port.

To achieve the same functionality with a standard Gateway, add a DX83 Ethernet Bridge to any standard DX80 Gateway device. The DX83 Ethernet Bridge adds the Web page configuration ability to your system as well as the ability to interface to Ethernet using Modbus/TCP or EtherNet/IP protocols. A DX83 Ethernet Bridge connected to a DX80 Gateway functions as a DX80 GatewayPro while allowing the Gateway to have I/O points.

Host Systems

Host-connected systems collect I/O data for logging, controlling other devices, or performing calculations.

Host-connected systems can contain up to 15 Nodes (Rotary Switch addressing) or 56 Nodes (extended addressing mode) within a single network and may be all discrete, all analog, or a mix of discrete and analog I/O. Inputs from Nodes within the network are transmitted to the Gateway, which communicates the information to a host device for processing. While the Gateway is the master device within the radio network, the Gateway may be a slave to the Modbus network.

What is FlexPower?

Banner's FlexPower technology allows for a true wireless solution by allowing the device to operate using either 10-30V dc, 3.6V lithium D cell batteries, or solar power.

This unique power management system can operate a FlexPower Node and an optimized sensing device for up to five years on a single lithium D cell.

- The FlexPower Node may be powered from 10 to 30V dc and use an external battery supply module to provide a battery back-up solution.
- When a FlexPower Node receives 10 to 30V dc, it operates like a standard 10 to 30V dc Node.
- Good applications for FlexPower devices operating from batteries include sensors that require no or very little power, including dry contacts, RTDs, and thermocouples.

The following FlexPower options are available:

- DX81, a single battery supply module;
- DX81P6, a 6-pack of lithium batteries;
- DX81H, a single battery supply module designed specifically to power the DX99 Intrinsically Safe devices with polycarbonate housings; and
- BWA-SOLAR-001, a solar power assembly that includes the solar panel, rechargeable batteries, and solar power controller.



DX81: Single battery supply module



DX81P6: Six-pack battery supply module



BWA-SOLAR-001: Solar supply; includes solar panel, rechargeable batteries, and controller.

DX81H: Single battery supply module designed specifically to power the DX99 Intrinsically Safe devices with polycarbonate housings

Chapter 2

Features

DX80 Gateway and Node Components

The DX80 Gateway and Node use the same housing and include the same physical features.



1. Port, NPT gland, or plug. If unused, install the provided plug into the 1/2 NPT threaded port. Refer to the Installation section if an IP67 seal is required.

2. Rotary switch 1 (left). Sets the Network ID (NID) to a hexadecimal value from 0 to F, for a total of 16 Network IDs. A Gateway and its corresponding Nodes must be assigned the same Network ID.

Rotary switch 2 (right). On the Gateway, sets the Gateway's LCD viewing device address. The Gateway is predefined as Device Address 0. On the Node, sets the Node's Device Address (hexadecimal 1 to F). Each Node within a network must have a unique Node Device Address.

3. Push button 1. Single-click to advance across all top-level DX80 menus. Single-click to move down interactive menus, once a top-level menu is chosen.

4. 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.

5. LED 1 and 2. Provide real-time feedback to the user regarding RF link status, serial communications activity, and the error state.

6. LCD Display. Six-character display provides run mode user information and shows enabled I/O point status. This display allows the user to conduct a Site Survey (RSSI) and modify other DX80 configuration parameters without the use of a PC or other external software interfaces. On the Node, after 15 minutes of inactivity, the LCD goes blank. Press any button to refresh the display.

7. 5-Pin M12 Euro-style quick-disconnect serial port

DX80 GatewayPro

The GatewayPro has many of the same features as the Gateway and Node, including the LEDs, the buttons, LCD, and Euro-style connector.



1. Industrial ethernet port, female.

2. Rotary switch 1 (left). Sets the Network ID (NID) to a hexadecimal value from 0 to F, for a total of 16 Network IDs. A Gateway and its corresponding Nodes must be assigned the same Network ID.

Rotary switch 2 (right). On the Gateway, sets the Gateway's LCD viewing device address. The Gateway is predefined as Device Address 0. On the Node, sets the Node's Device Address (hexidecimal 1 to F). Each Node within a network must have a unique Node Device Address.

3. Push button 1. Single-click to advance across all top-level DX80 menus. Single-click to move down interactive menus, once a top-level menu is chosen.

4. 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.

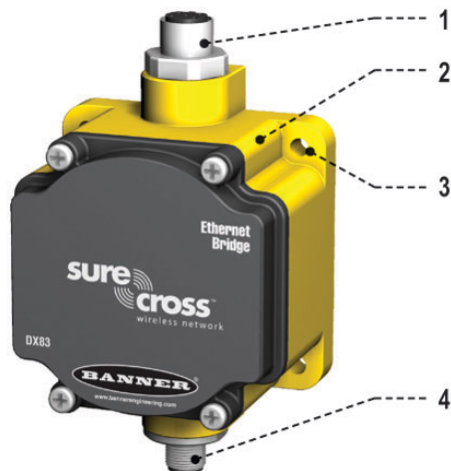
5. LED 1 and 2. Provide real-time feedback to the user regarding RF link status, serial communications activity, and the error state.

6. LCD Display. Six-character display provides run mode user information and shows enabled I/O point status. This display allows the user to conduct a Site Survey (RSSI) and modify other DX80 configuration parameters without the use of a PC or other external software interfaces. On the Node, after 15 minutes of inactivity, the LCD goes blank. Press any button to refresh the display.

7. 5-pin M12 Euro-style quick disconnect serial port.

DX83 Ethernet Bridge

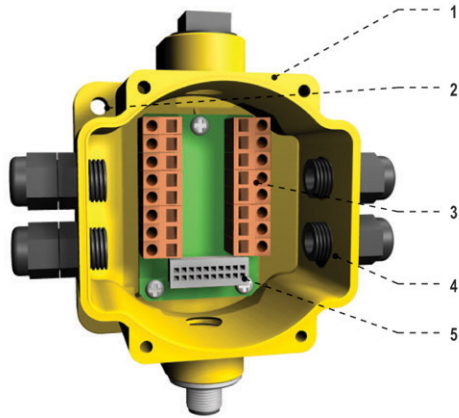
The DX83 Ethernet Bridge uses the same housing and same mounting holes as the Gateway and Node.



1. Industrial ethernet port, female.
2. Housing. The rugged, industrial DX80 housing meets IEC IP67 standards.
3. Mounting hold, #10/M5 clearance. Mounting Holes accept metric M5 or UNC/UNF #10 hardware -- DIN rail mount adapter bracket available.
4. 5-Pin M12 Euro-style quick-disconnect serial port

DX80 Gateway and Node Wiring Chamber

The DX80 Gateway and Node use the same housing and terminal block for wiring.



1. Housing. The rugged, industrial DX80 housing meets IEC IP67 standards.
2. Mounting hold, #10/M5 clearance. Mounting Holes accept metric M5 or UNC/UNF #10 hardware -- DIN rail mount adapter bracket available.
3. Wiring terminal strip. The 16 spring-clip type wiring terminals accept wire sizes: AWG 12-28 or 2.5 sq mm.
4. Port, PG-7 gland or blank. The PG-7 threaded ports can accept provided cable glands or blanks.
5. Ribbon connector. Ribbon cable connects wiring base to LCD/radio.

The GatewayPro has no serviceable parts inside the housing and no wiring chamber. During setup or standard operation, there should not be a need to open the GatewayPro.

Pinouts

5-pin Euro-Style Hookup

Wiring the 5-pin Euro-style connector depends on the model and power requirements of the device.



Wire No.	Wire Color	Gateway, GatewayPro, DX85	FlexPower Gateway, Data Radio	10–30V dc Power	Battery Power
1	Brown	10 to 30V dc	10 to 30V dc	10 to 30V dc	
2	White	RS485 / D1 / B / +	RS485 / D1 / B / +		

Wire No.	Wire Color	Gateway, GatewayPro, DX85	FlexPower Gateway, Data Radio	10–30V dc Power	Battery Power
3	Blue	dc common (GND)	dc common (GND)	dc common (GND)	dc common (GND)
4	Black	RS485 / D0 / A / -	RS485 / D0 / A / -		
5	Gray	Comms Gnd	3.6 to 5.5V dc		3.6 to 5.5V dc

Connecting dc power to the communication pins will cause permanent damage. For FlexPower devices, do not apply more than 5.5V to the gray wire (BAT terminal in models with the mini-board).

DX80...C Hookup

Wiring power to the DX80...C models varies depending the power requirements of the model.

Terminal Block Label	Gateway, DX85*	10–30V dc Power	Battery Power**
V+	10 to 30V dc	10 to 30V dc	
Tx	RS485 / D1 / B / +		
V-	dc common (GND)	dc common (GND)	dc common (GND)
Rx	RS485 / D0 / A / -		
B+			3.6 to 5.5V dc

* Connecting dc power to the communication pins will cause permanent damage.

** For FlexPower devices, do not apply more than 5.5V to the gray wire.

Industrial Ethernet Hookup

The industrial Ethernet connection is on the DX83 and GatewayPro models and connects the SureCross system to an Ethernet-based host system.



Wire No.	Wire Color	Description
1	White/Orange	+Tx
2	White/Blue	+Rx
3	Orange	-Tx
4	Blue	-Rx

DX80 Menu Structure

The Gateways, Nodes, and Data Radios each have their own menu structure and options.

DX80 Gateway Set-up Menu

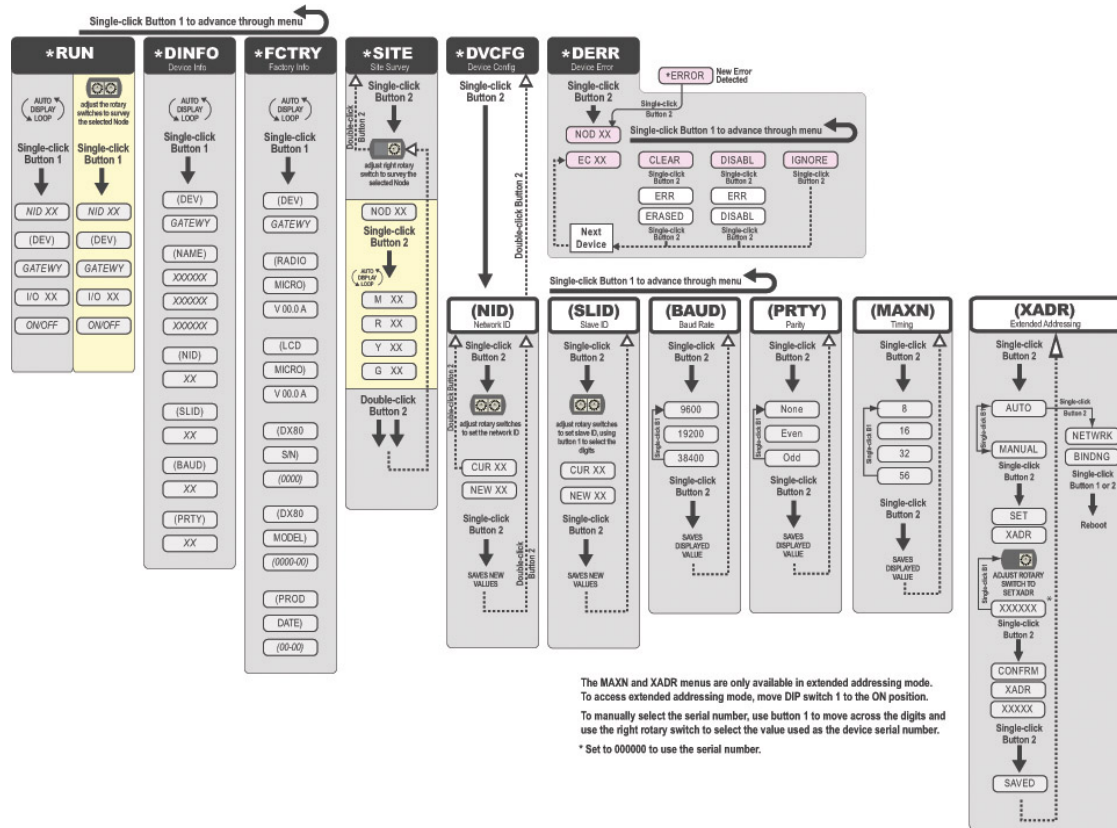
When power is applied, the DX80 begins running. The display screen auto loops through the RUN menu and communication begins between the Gateway and Node(s). Auto looping through the RUN menu is the normal operating mode for all devices on the wireless network.

From the RUN Menu (or any menu), single-click button 1 to advance through the top-level menus. The device auto display loops through the menu options if either of the RUN, DINFO, or FCTRY menus are selected. If the device is paused on the SITE, DVCFG, or DERR menu options, the display does not auto loop.

To enter manual scrolling mode, double-click button 2 at the top level menu. Use the instructions shown in the chart below to navigate the menu system. To return to the top level menus and auto display loop mode, double-click button 2 twice.

The * before the menu name indicates a top-level menu option. The () indicate a submenu items.

The Network ID (NID) can be set at any time using the left rotary switch. Once changed, allow five seconds for the devices to update to the new Network ID.



DX80 Node Set-up Menu

When power is applied, the DX80 begins running. The display screen auto loops through the RUN menu and communication begins between the Gateway and Node(s). Auto looping through the RUN menu is the normal operating mode for all devices on the wireless network.

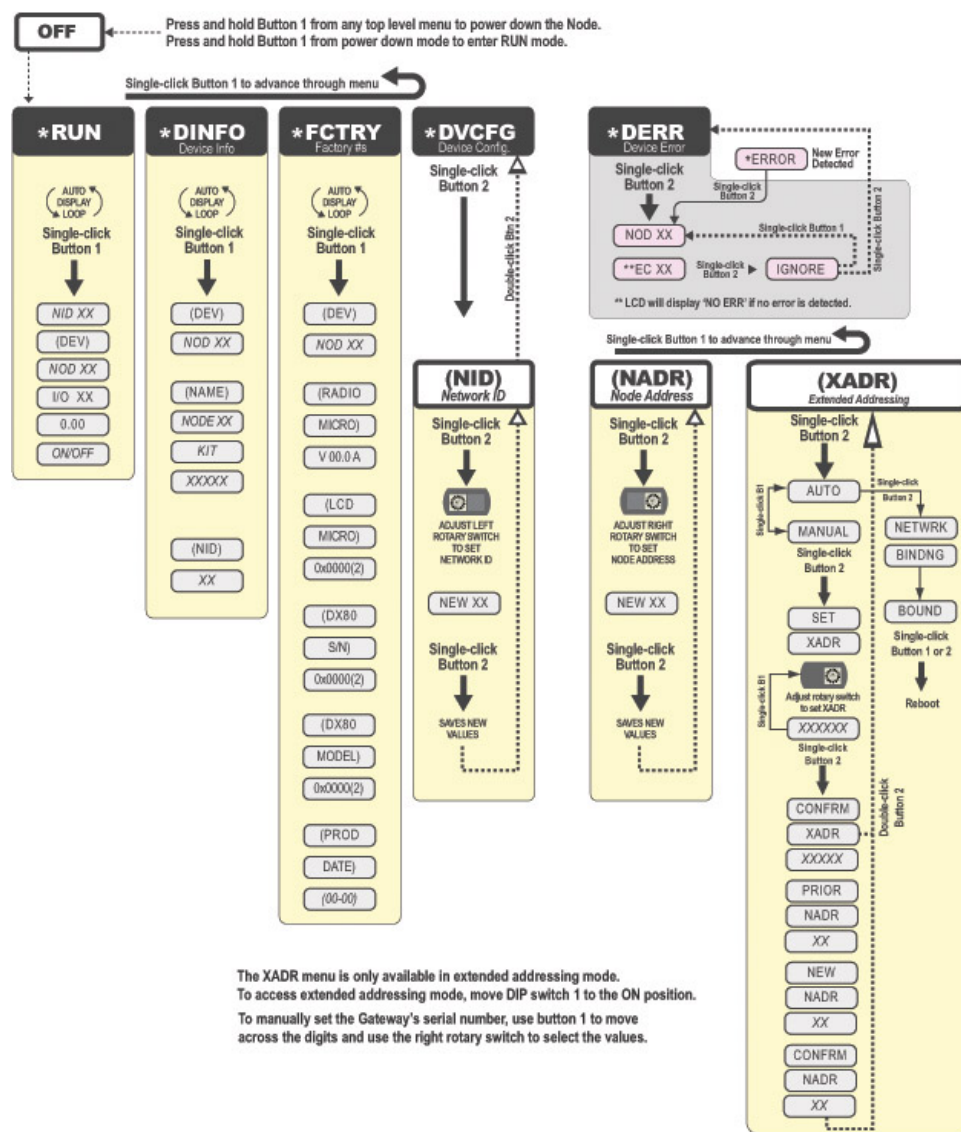
From the RUN Menu (or any menu), single-click button 1 to advance through the top-level menus. The device auto display loops through the menu options if either of the RUN, DINFO, or FCTRY menus are selected. If the device is paused on the DVCFG or DERR menu options, the display does not auto display loop.

To enter manual scrolling mode, double-click button 2 at the top level menu. Use the instructions shown in the chart below to navigate the menu system. To return to the top level menus and auto display loop mode, double-click button 2 twice.

Node LCD Timeout: After 15 minutes of inactivity, the LCD screen stops displaying information. Press any button to refresh the display if the Node has entered this energy-saving mode.

The * before the menu name indicates a top-level menu option. The () indicate a submenu items.

The Network ID (NID) and Device ID (NADR) can be set at any time using the rotary switches. The left rotary switch sets the Network ID and the right rotary switch sets the Node Address. Once changed, allow five seconds for the devices to update to the new Network ID.



RUN Menu

The RUN menu displays the network ID, device name, and the I/O values of the device. On a Gateway, the I/O displayed may be the I/O of the Gateway or of a selected Node, which is determined by the position of the rotary switches.

DINFO (Device Information) Menu

The Device Info menu displays the device-specific information, such as the device name, the network ID, slave ID, baud rate, and parity. When in extended address mode, the DINFO menu also displays the maximum Node setting and the extended addressing binding code used to form the network.

FCTRY (Factory) Menu

The FCTRY menu displays the version numbers of various components within the device, including the radio micro number, the LCD number, the device's serial number, the device's model number, and the production date.

SITE (Site Survey) Menu

Access the SITE menu to see the results of a Site Survey conducted with this Gateway. The SITE menu displays the device number of the Node the Site Survey was conducted with as well as the missed, green, yellow, and red received

packet count. For more information on determining what these values represent, refer to the Site Survey chapter of this manual.

The SITE menu is only available on the Gateways.

DVCFG (Device Configuration) Menu

On Gateways, the DVCFG menu allows users to set various device-specific parameters, including the network ID, slave ID, baud rate, and parity. When in extended address mode, use this menu to set the maximum number of Nodes within the network and the extended address binding code.

On Nodes, use the DVCFG to set the network ID, Node address (also referred to as a device address), and extended address binding code.

DERR (Device Error) Menu

On the Gateway

Use the DERR menu to clear, disable, or ignore error messages generated by devices within the network. The Node number that generated the error and the error code (EC) display onscreen. Single-click button 1 to advance through the menu of CLEAR (clear this particular instance of the error from the system), DISABL (disable this particular error from appearing from this specific Node), and IGNORE (ignore this error but do not remove it from the system).

After the error messages for a Node are cleared, disabled, or ignored, errors for any additional Nodes display on the Gateway's LCD.

On the Node

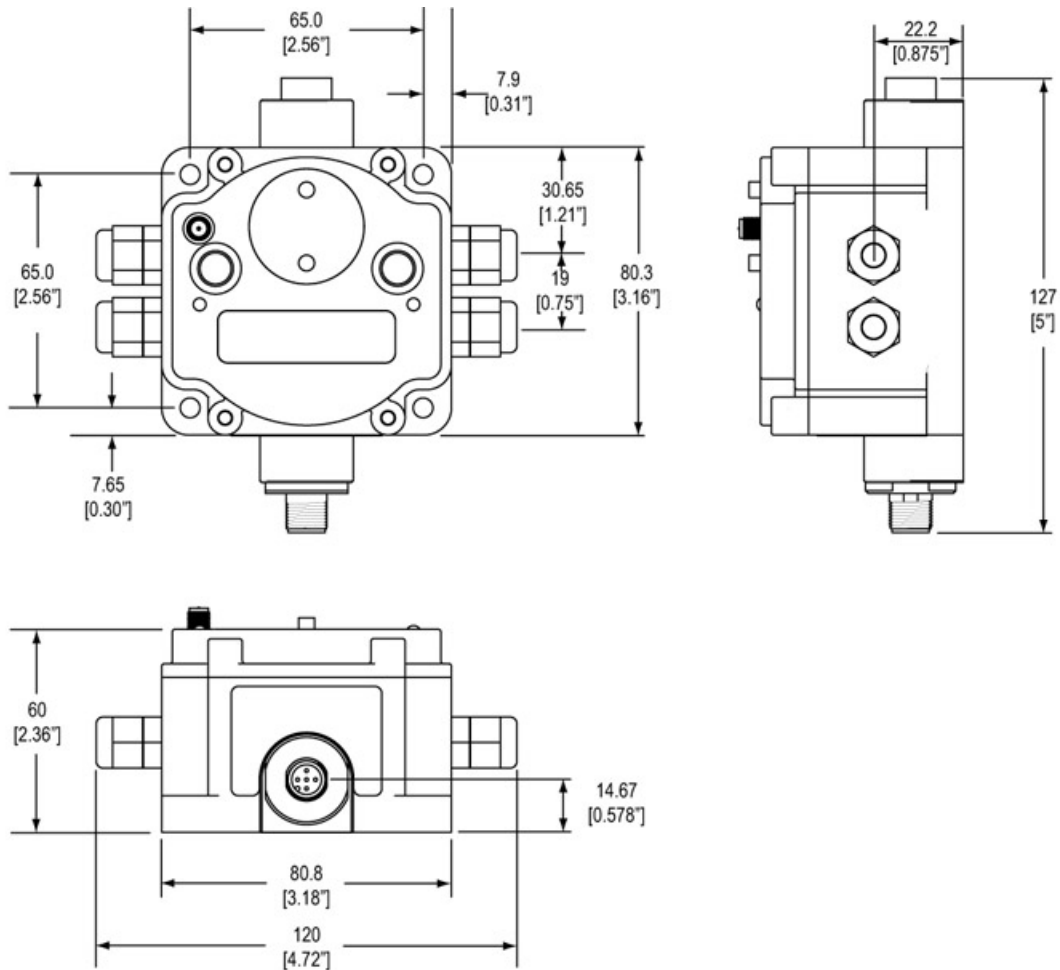
Use the DERR menu to view and ignore error messages for that Node.

Chapter 3

Dimensions

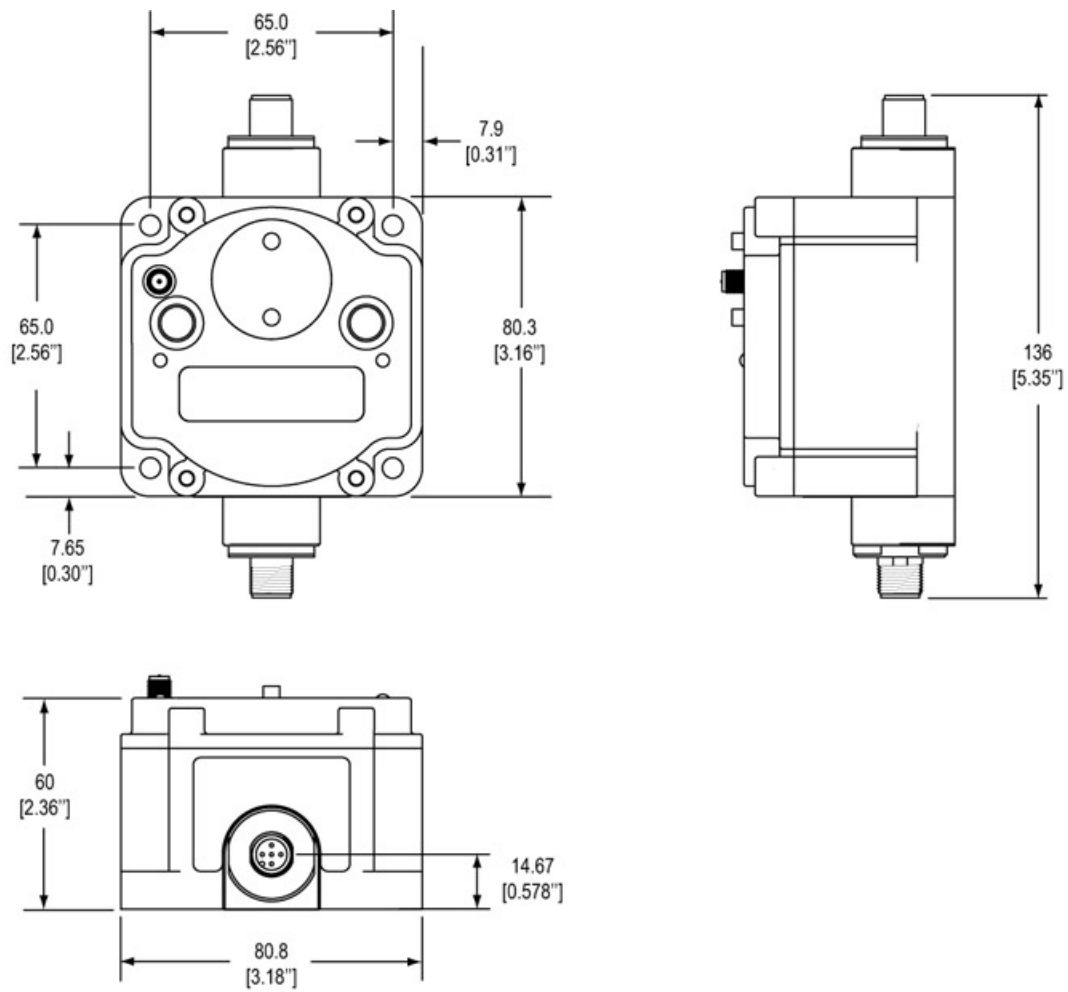
DX80 Gateway and Node

The DX80 Gateways and Nodes have the same external and mounting dimensions.



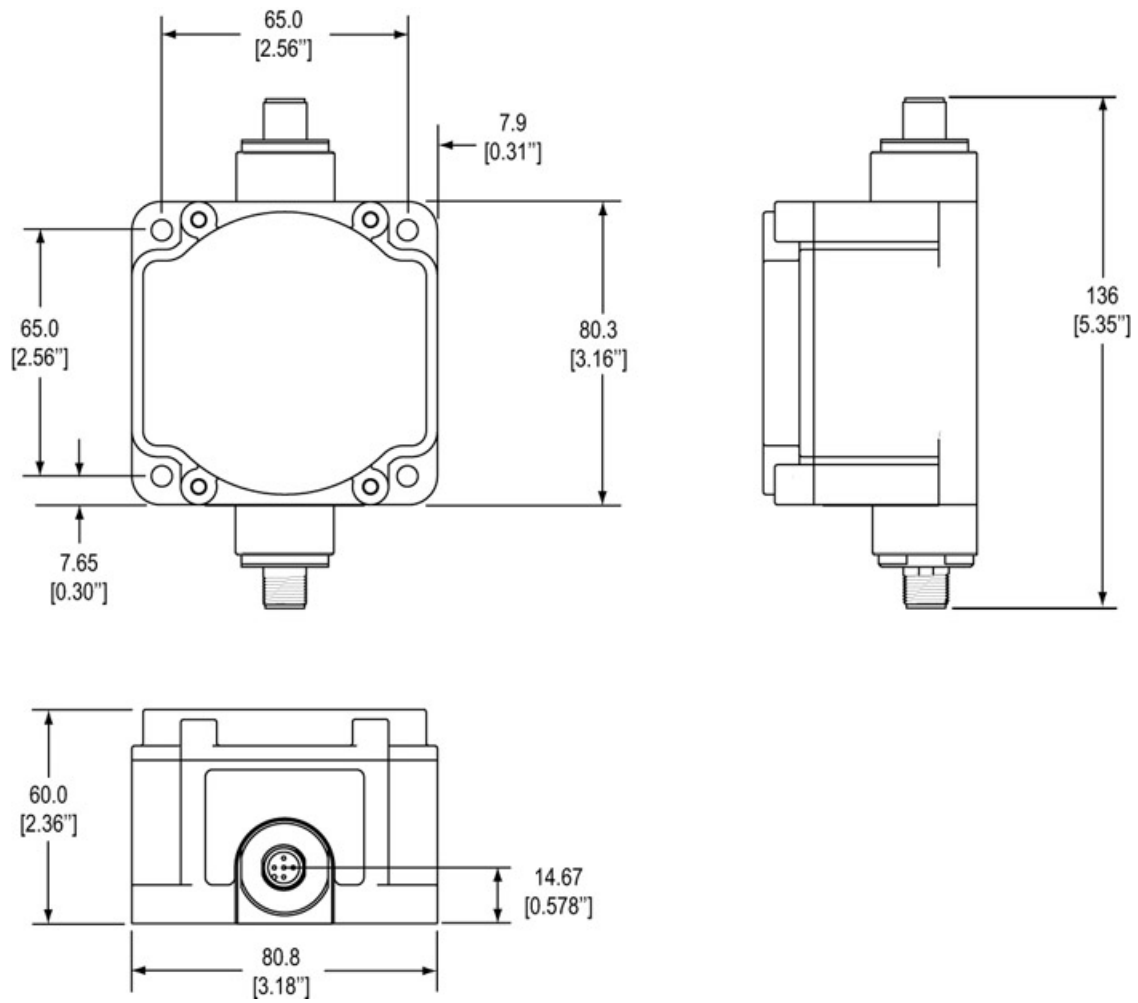
DX80 GatewayPro

The DX80 GatewayPro has the same external and mounting dimensions as the Gateway and Node, but does not have any side access holes or glands.



DX83 Ethernet Bridge

Like the GatewayPro, the DX83 Ethernet Bridge has the same external and mounting dimensions, but no side access holes or glands.



Part 2

Using the SureCross Wireless Network

Topics:

- [*Setting Up Your Wireless Network*](#)
- [*Installing Your SureCross™ Radios*](#)
- [*Advanced Setup*](#)

Chapter 4

Setting Up Your Wireless Network

Applying Power to the Gateway or Node

Connect power to the Gateway or Node using the wiring table shown.



	Wire Color	Gateway	Node (10-30V dc)	Node (FlexPower)
1	brown	+10 to 30V dc input	10 to 30V dc	
2	white	RS485 / D1 / B / +		
3	blue	dc common (GND)	dc common (GND)	dc common (GND)
4	black	RS485 / D0 / A / -		
5	gray	Comms gnd		3.6 to 5.5V dc ¹

¹ Do not apply more than 5.5V dc to the gray wire.

1. Apply power to the Gateway by connecting the 10 to 30V dc cable as shown in the wiring diagram. The Gateway begins in *RUN mode, displays the current network ID (NID), then identifies itself as a Gateway.
2. Apply power to the Node by connecting the 10 to 30V dc cable or the DX81 Battery Supply Module as shown. The Node starts in *RUN mode, displays the current network ID, then identifies itself as a Node and lists the device ID. Once running, the Node begins displays its I/O points.

Forming Networks and Assigning Node Addresses Using Extended Address Mode

To select extended address mode, turn the device off. Set DIP switch 1 to the 'ON' position, then turn the device on. Do not set the DIP switch while the power is on to the device.

On the Gateway

To automatically bind the Gateway and its Node(s), follow these steps:

1. Remove the Gateway's top cover.
2. Move DIP switch 1 to the ON position to activate Extended Addressing Mode.
3. Apply power to the Gateway.
The LCD shows POWER, then *RUN.
4. Triple click button 2 to enter binding mode.

The red LEDs flash alternately when the Gateway is in binding mode. Any Node entering binding mode will bind to this Gateway. The LCD shows NETWRK BINDNG.

On the Node

1. Remove the Node's top cover.
2. Mode DIP switch 1 to the ON position to activate Extended Addressing Mode.
3. Apply power to the NODE.
The LCD shows POWER, then *RUN.
4. Use both of the Node's rotary dials to assign a decimal Node address (device ID) between 01 and 56.
The left rotary dial represents the tens digit (0-5) and the right dial represents the ones digit (0-9) of the Node address (device ID).
5. Triple click button 2 to enter binding mode.
The Node enters binding mode and locates the Gateway that is also in binding mode. While the Node is in binding, the LCD shows NETWRK BINDNG. When the Node is bound, the LEDs are both solid red for a few seconds. The Node cycles its power, then entering RUN mode. The LCD shows BOUND, then *RUN.
6. Repeat steps 1 through 5 for each additional Node that needs to communicate to that Gateway.

On the Gateway

1. Single click either button 2 or button 2 on the Gateway.
The Gateway enters binding mode and reboots. The LCD reads POWER, then *RUN.
2. Verify the Gateway and Node are communicating.





IMPORTANT: For special kits, indicated by device model numbers beginning in DX80K, do not change the position of the right rotary dial. Set the left rotary dial to zero.


Verify Communications on the Gateway

After powering up and binding the Gateway and its Nodes, verify all devices are communicating properly.

Verify LED 1 is on and green.



Status	LED 1	LED 2
Power ON	 Green ON	-
System Error	 Red flashing	 Red flashing
Modbus Communication Active	-	 Yellow flashing

Status	LED 1	LED 2
Modbus Communication Error	-	 Red flashing

For Gateway and Ethernet Bridge systems, active Modbus communication refers to the communication between the Gateway and the Ethernet Bridge.

For GatewayPro systems, the Modbus communication LEDs refer to the communication internal to the Gateway Pro.

For Gateway only systems, the Modbus communication LEDs refer to the communication between the Gateway and its host system (if applicable).





Verify Communications on the Node

After powering up and binding the Gateway and its Nodes, verify all devices are communicating properly.

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

A Node will not sample its inputs until it is communicating with the Gateway to which it is bound.



Status	LED 1	LED 2
System Error	 Red flashing	 Red flashing (1 per second)
RF Link Ok	 Green flashing (1 per second)	-
RF Link Error	-	 Red flashing (1 per 3 seconds)

When testing the Gateway and Node, verify all radios and antennas are at least two meters apart or the communications may fail.

Conducting a Site Survey

Site Survey (Gateway and Nodes)

Conducting a Site Survey, also known as an RSSI (Radio Signal Strength Indication), analyzes the radio communications link between the Gateway and any Node within the network by analyzing the radio signal strength of received data packets and reporting the number of missed packets that required a retry.

Perform a Site Survey before permanently installing the radio network to ensure reliable communication. Activate Site Survey mode from either the Gateway buttons or the Gateway Modbus holding register 15. Only the Gateway can initiate a Site Survey, and the Site Survey analyzes the radio communications link with one Node at a time.

Conducting a Site Survey Using the Menu System

A Site Survey can be started from the Menu System.

Follow these steps to initiate a Site Survey using the Gateway's buttons and menu system.

1. Remove the rotary switch access cover.
2. To check the status of Node 1, change the Gateway's right rotary switch setting to 1.
The Gateway is now enabled to read the status of Node 1; the display scrolls through the Node's I/O status.
3. Single-click button 1 to scroll across the menu levels until reaching the Site Survey (*SITE) menu.
4. Single-click button 2 to enter the Site Survey menu.
5. Single-click button 2 to begin conducting a Site Survey with the Node selected in step 2.
The Gateway analyzes the quality of the signal from the selected Node by counting the number of data packets it receives from the Node.
6. Examine reception readings (M, R, Y, G) of the Gateway at various locations. Note that the numbers displayed are a percentage. M displays the percent of missed packets while R, Y, and G display the percentage of received packets at a given signal strength.

M = Percentage of missed packets; R = RED marginal signal; Y = YELLOW good signal; G = GREEN excellent signal

Record the results if you need troubleshooting assistance from the factory.
7. Change the Gateway's right rotary switch setting to conduct a Site Survey with another Node and repeat steps 2 through 7.
8. To end the Site Survey, double-click button 2.
9. Change the right rotary switch back to 0 (Gateway).
The LCD displays the device readings for the Gateway.
10. Double-click button 2 to move back to the top level menu.
11. Single-click button 1 to return to RUN mode.
12. Install the rotary switch access cover, referring to the Installation section of the manual to create an IP67 seal.

Conducting a Site Survey Using Modbus Commands

A Site Survey can be started using Modbus commands sent from the host system.

All DX80 models reserve the Modbus register I/O 15 (write only) for control messages. The control message code for the Site Survey command is listed below.

To start a Site Survey using a Modbus write holding register command, send a control code of 32 (0x20) and the Node number 1–15 (0x01 to 0x0F) to the Gateway Modbus holding register for I/O 15.

Modbus Register		
	[15:8]	[7:0]
I/O 15	Control Code	Data Field

I/O 15 Control Messages			
Control Code	Data Field	Restrictions	Description
32	Node # 1-15	Gateway only	<p>Enable Site Survey between Gateway and Node defined by the data field. All error messages from the Gateway are ignored when running Site Survey.</p> <p>Only one Node can participate in Site Survey at any given time. To disable the Site Survey, use control code 0x20 with Node 0. A Node must be enabled to run the Site Survey, then disabled before selecting the next Node.</p>

Example Command

	Modbus Register	
I/O 15	32	02

When Site Survey runs, the accumulated results are stored in the Gateway's I/O 7 and I/O 8 holding registers. The LEDs on the both the Gateway and the Node's front panel display the signal strength for the wireless RF link. The quality of the communications link is indicated by:

- LED 1 – Green = excellent signal strength
- LED 2 – Yellow = good signal strength
- LED 1 – Red = poor signal strength

The signal strength is the transmitted signal strength relative to the ambient RF signal present in a specific location, or noise floor.

The Gateway device also displays the Site Survey results on the LCD. For one transmit and receive interval, the Gateway saves the lowest signal strength. The LCD and Modbus registers contain the results of the last 100 samples. The totals are a running tally of the last 100 samples and are continuously updated. Four categories are displayed:

- G = Green – excellent signal strength.
- Y = Yellow – good signal strength
- R = Red – poor signal strength
- M = Missed packet

To disable Site Survey, send a control code of 32 (0x20) and a Node number of 0 (0x0).

Site Survey Data Holding

With Site Survey active, registers I/O 7 and 8 are Site Survey data holding registers that store the accumulated Site Survey results. Error collections in holding register 8 are saved when Site Survey runs and restored after Site Survey is disabled.

	Register	
	[15:8]	[7:0]
I/O 7	Missed Total	Red Total
I/O 8	Yellow Total	Green Total



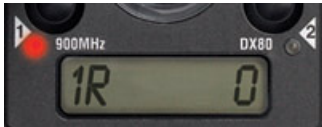

Example Results

	[15:8]	[7:0]
I/O 7	0	10
I/O 8	10	80

Note: This is the register arrangement when using Modbus/TCP. When conducting a Site Survey using Modbus RTU (using the User Configuration Tool), the yellow totals are in bits [0:7] and green totals are in bits [8:15].

Interpreting the Site Survey Results

Site Survey results are listed as a percentage of data packets received and indicate the signal strength of the received signal.

	Result	Description
	Green	Packets received at a strong signal strength. A strong signal strength is greater than -90 dBm at the receiver.
	Yellow	Packets received at a good signal strength. A good signal is between -90 and -100 dBm at the receiver.
	Red	Packets received at a weak signal strength. A weak signal is less than -100 dBm at the receiver.
	Missed	Packets not received on the first transmission and requiring a retry.

Judging if the reliability of a network's signal meets the needs of the application is not simply a matter of green, yellow, and red packets received. In normal operating mode, when data packets are not received, the transmitter re-sends the packet until all data is received.

For slow monitoring applications such as a tank farm, where data is required in terms of seconds or minutes, receiving most of the data in the 'red' range, indicating a weak but reliable signal, transmits enough data for accurate monitoring. Nodes positioned near the outside range of the radio signal may have 90% of the data packets received in the red zone, again indicating a weak, but reliable signal.

A good rule of thumb is to keep the missed packets average to less than 40%. When the network misses more than 40% of the data packets, the signal is usually too unreliable or obstacles may be interfering with the signal. When Site Survey reports the missed packets are 40% or higher, improve the radio system performance by:

- Mounting the network's antennas higher,
- Using higher gain antennas, or
- Adding data radios to the network.

Mounting the devices' antennas higher allows the radio signal to clear obstacles in the area and improves the line of sight between SureCross™ devices. Higher gain antennas will focus the energy of the radio signal in a specific direction and extend the signal's range. Using data radios is another option to consider when trying to extend the range of a radio network. For more information on data radios, please refer to Banner's white paper on range extension.

Site Survey Troubleshooting

Some tips and tricks about improving radio signal reception may improve the site survey results.

Marginal Site Survey (RSSI) Results

If the distance between devices is greater than about 5,000 meters (3 miles) line-of-sight *OR* objects, such as trees or man-made obstructions, interfere with the path, and the MISSED packet count exceeds 40 per 100 packets, consider the following steps:

- Raise the DX80 units to a higher elevation, either by physically moving the devices or installing the antenna(s) remotely at a higher position.
- Use high-gain antenna(s) such as Yagi and/or Omni (see Accessories).
- Decrease the distance between devices.
- Use data radios to extend the position of the Gateway relative to the host system.

Chapter 5

Installing Your SureCross™ Radios

Ideal Mounting Conditions

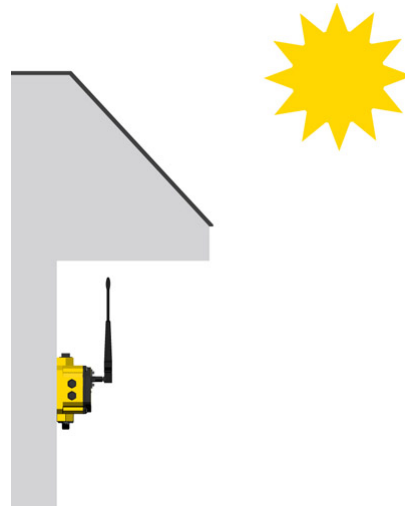
Ideal mounting conditions include avoiding direct sunlight, mounting so as not to collect rain or snow, reducing chemical exposure, and minimizing mechanical stress.

Avoid Direct Sunlight

To minimize the damaging effects of ultra-violet radiation, avoid mounting any SureCross™ device facing intense direct sunlight.

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

For harsh outdoor applications, consider installing your SureCross™ radio inside a secondary enclosure. For a list of available enclosures, refer to the *Accessories* chapter.



Avoid Collecting Rain

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

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

Reduce Chemical Exposure

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

Minimize Mechanical Stress

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

- Avoid mounting the devices 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 devices to external loads. Do not step on them or use them as handgrips.
- Do not allow long lengths of cable to hang from the glands on the Gateway or Node. Cabling heavier than 100 grams should be supported instead of allowed to hang from the housing.

It is the user's responsibility to install these devices so they will not be subject to overvoltage transients. Always ground the devices in accordance with local, state, or national regulations.

Watertight Side Holes

To make the glands watertight, use PTFE tape and follow these steps.



To make the glands watertight:

1. Wrap four to eight passes of polytetrafluoroethylene (PTFE) tape around the threads as close as possible to the hexagonal body of the gland.
2. Manually thread the gland into the housing hole. Never apply more than 5 in-lbf of torque to the gland or its cable clamp nut.*

Seal any unused PG-7 access holes with one of the supplied black plastic plugs. To install a watertight PG-7 plug:

1. Wrap four to eight passes of PTFE tape around the plug's threads, as close as possible to the flanged surface.
2. Carefully thread the plastic plug into the vacant hole in the housing and tighten using a slotting screwdriver. Never apply more than 10 in-lbf torque to the plastic plug.

* This is not a lot of torque and is equivalent to the torque generated without using tools. If a wrench is used, apply only very light pressure. Torquing these fittings excessively damages the device.

Rotary Switch Access Cover

Check the rotary switch access cover o-ring every time the access cover is removed. Replace the o-ring when it is damaged, discolored, or showing signs of wear.



The o-ring should be:

- Seated firmly against the threads without stretching to fit or without bulging loosely, and
- Pushed against the flanged cover.

When removing or closing the rotary switch access cover, manually twist the cover into position. Do not allow cross-threading between the cover and the device's face.

Once the cover is in place and manually tightened, use a small screwdriver (no longer than five inches total length) as a lever to apply enough torque to bring the rotary switch access cover even with the cover surface.

Watertight NPT Ports

To make the glands and plugs watertight, use PTFE tape and follow these steps.

Watertight 1/2" NPT Glands

To make the glands watertight:

1. Wrap four to eight passes of polytetrafluoroethylene (PTFE) tape around the threads as close as possible to the hexagonal body of the gland.
2. Manually thread the gland into the housing hole. Never apply more than 5 in-lbf of torque to the gland or its cable clamp nut.*



Watertight 1/2" NPT Plug

Seal the 1/2" NPT port if it is not used. To install a watertight NPT plug:

1. Wrap 12 to 16 passes of PTFE tape evenly across the length of the threads.
2. Manually thread the plug into the housing port until reaching some resistance.
3. Using a 9/16" crescent wrench, turn the plug until all the plug's threads are engaged by the housing port or until the resistance doubles. Do not overtighten as this will damage the SureCross unit. These threads are tapered and will create a waterproof seal without overtightening.

* This is not a lot of torque and is equivalent to the torque generated without using tools. If a wrench is used, apply only very light pressure. Torquing these fittings excessively damages the device.

Installation Quick Tips

The following are some quick tips for improving the installation of wireless network components.

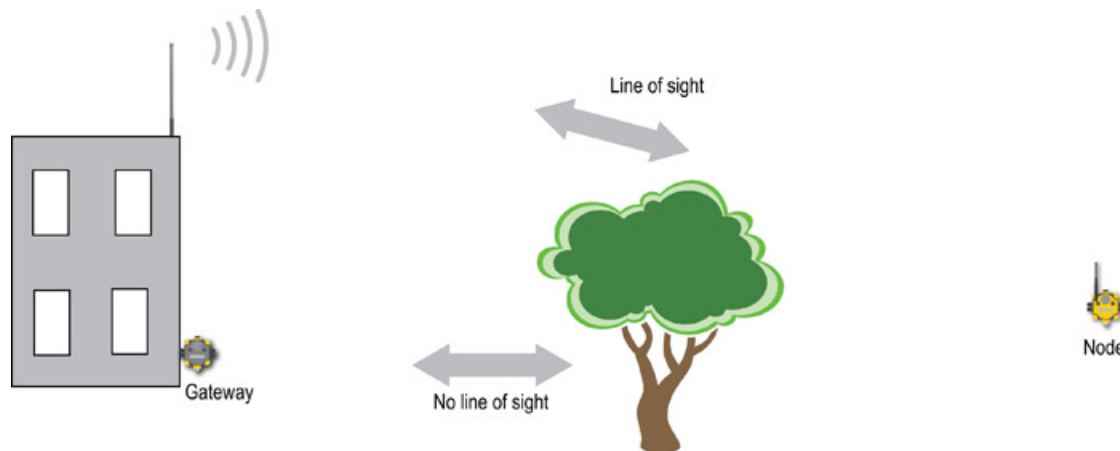
Create a Clear Communication Path

Wireless communication is hindered by radio interference and obstructions in the path between the transmitter and receiver. To achieve the best radio performance, carefully consider the installation locations for the Gateways and Nodes and select locations without obstructions in the path.

For more information about antennas, please refer to the *Antenna Basics* reference guide, Banner document p/n 132113.

Increase the Height of the Antennas

Position the external antenna vertically for optimal RF communication. If necessary, consider changing the height of the SureCross radio, or its antenna, to improve reception. For outdoor applications, mounting the antenna on top of a building or pole may help achieve a line-of-sight radio link with the other radios in the network.

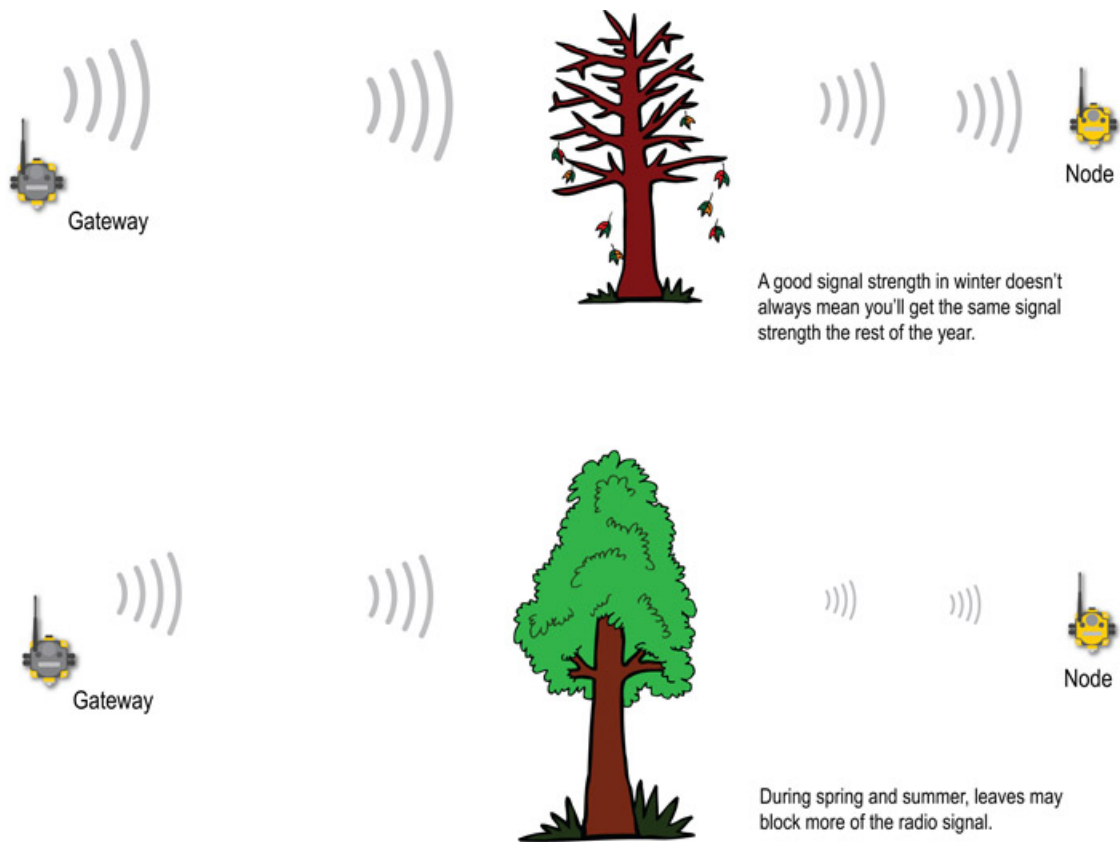


Avoid Collocating Radios

When the radio network's master device is located too close to another radio device, communications between all devices is interrupted. For this reason, do not install a Gateway device within two meters of another Gateway or Node.

Be Aware of Seasonal Changes

When conducting the initial Site Survey, the fewest possible missed packets for a given link is better. However, seasonal changes may affect the signal strength and the total signal quality. Radios installed outside with 50% missed packets in the winter months may have 80% or more missed packets in the summer when leaves and trees interfere with radio reception.



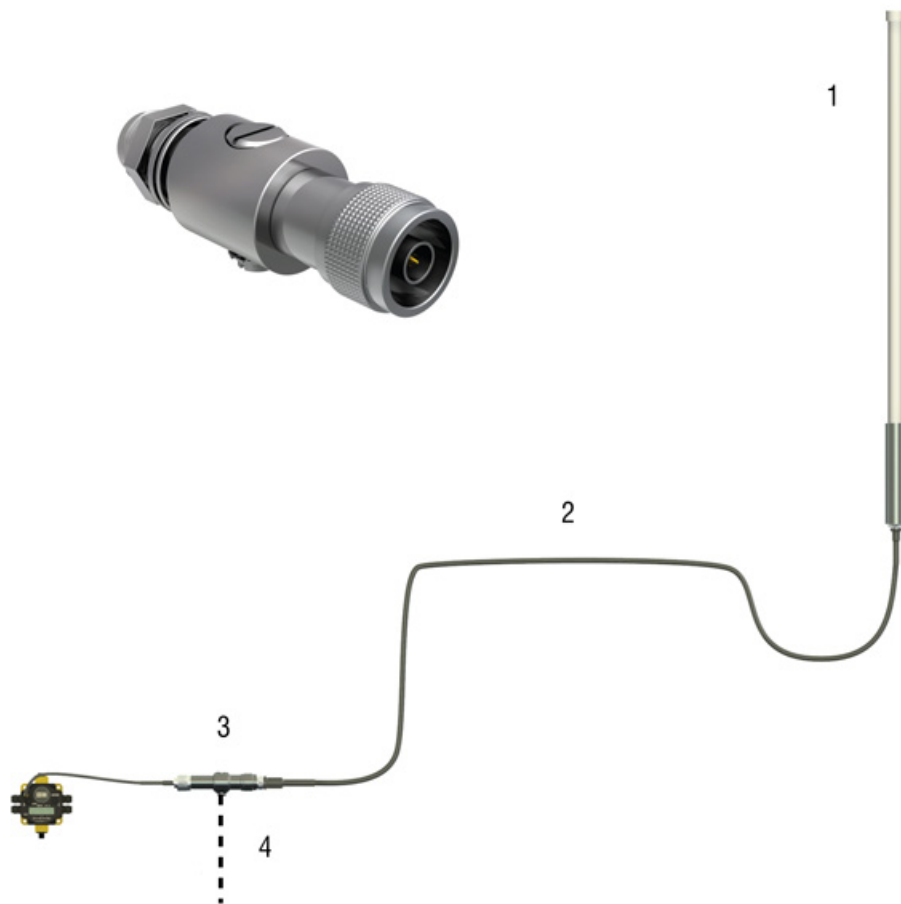
Basic Remote Antenna Installation

When installing a remote antenna system, always include a lightning arrestor or coaxial surge suppressor in the system.

Remote antenna systems installed without surge protection invalidate the warranty of the radio devices. A remote antenna system is any antenna system where the antenna is not connected directly to the radio and typically use coaxial cable to connect the antenna to the radio.

Surge suppressors should be properly grounded and mounted at ground level near where the cabling enters a building. Install the surge suppressor indoors or inside a weatherproof enclosure to minimize corrosion or component deterioration. For best results, mount the surge suppressor as close to the ground as possible to minimize the length of the ground connection and use a single-point ground system to avoid creating ground loops.

For more detailed information about how antennas work and how to install them, refer to the *Antenna Basics* chapter.



1. Antenna mounted remotely from the radio device.
2. Coaxial cable
3. Surge suppressor
4. Ground wire to a single-point ground system

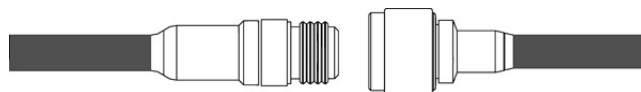
I/O Isolation

When connecting analog and discrete I/O to external equipment such as VFDs (Variable Frequency Drives), it may be appropriate to install interposing relays and/or loop isolation devices to protect the DX80 unit from transients, noise, and ground plane interference originating from devices or the environment. Contact Banner Engineering Corp. for more information.

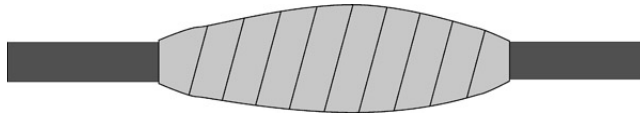
Weatherproofing Remote Antenna Installations

Prevent water damage to the cable and connections by sealing the connections with rubber splicing tape and electrical tape.

To protect the connections, follow these steps.



Step 1: Verify both connections are clean and dry before connecting the antenna cable to the antenna or other cable and hand-tightening.



Step 2: Tightly wrap the entire connection with rubber splicing tape.

Begin wrapping the rubber splicing tape one inch away from the connection and continue wrapping until you are one inch past the other end of the connection. Each new round of tape should overlap about half the previous round.



Step 3: Protect the rubber splicing tape from UV damage by tightly wrapping electrical tape on top of the rubber splicing tape. The electrical tape should completely cover the rubber splicing tape and overlap the rubber tape by one inch on each side of the connection.

Antenna Installation Warning

Always install and properly ground a qualified surge suppressor when installing a remote antenna system. Remote antenna configurations installed without surge suppressors invalidate the manufacturer's warranty.

Always keep the ground wire as short as possible and make all ground connections to a single-point ground system to ensure no ground loops are created. No surge suppressor can absorb all lightning strikes. Do not touch the SureCross™ device or any equipment connected to the SureCross device during a thunderstorm.

Chapter 6

Advanced Setup

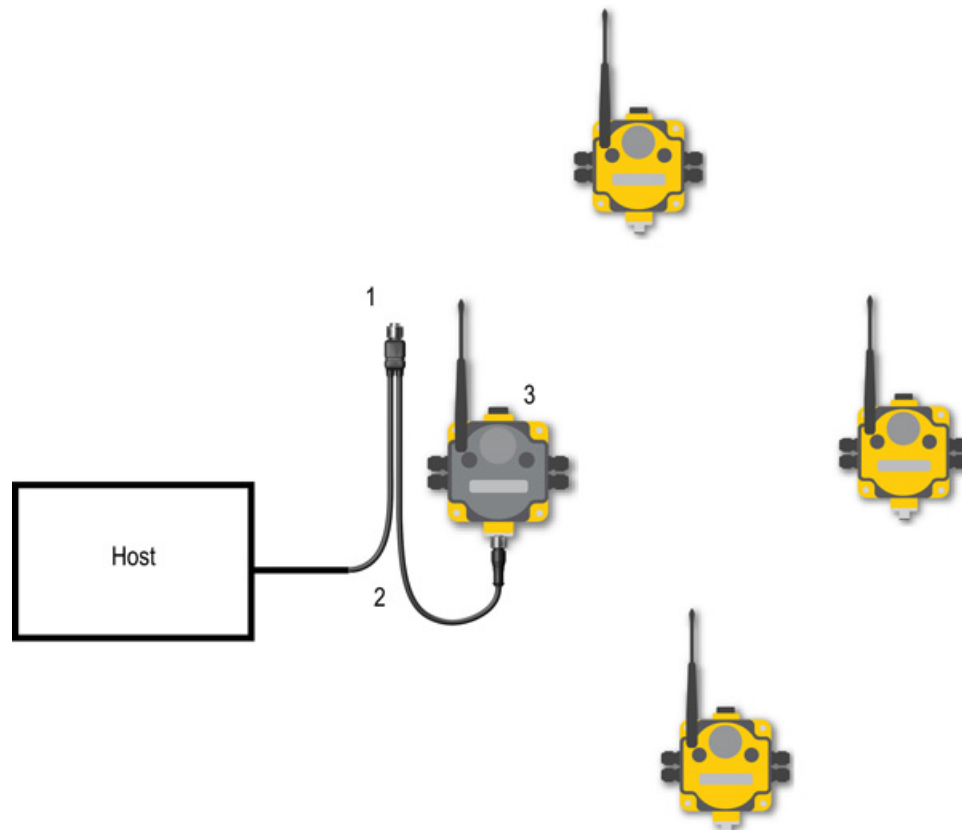
Web-based Configuration

The DX80 wireless systems are configured using an Ethernet network connection and a common Web page browser. An Ethernet connection can be established from a DX80 GatewayPro or from a DX83 Ethernet Bridge serially connected to the DX80 Gateway.

The Ethernet Bridge and GatewayPro each ship with an Ethernet crossover cable. One end of the cable is a RJ45 connector and the other end is an industrial Ethernet connector. This cable is designed to be connected directly to a computer. For a list of the accessories, please refer to [Accessories](#) on page 127. For more examples of system layouts, please refer to [System Layouts on page 67](#).

Example Layout #1

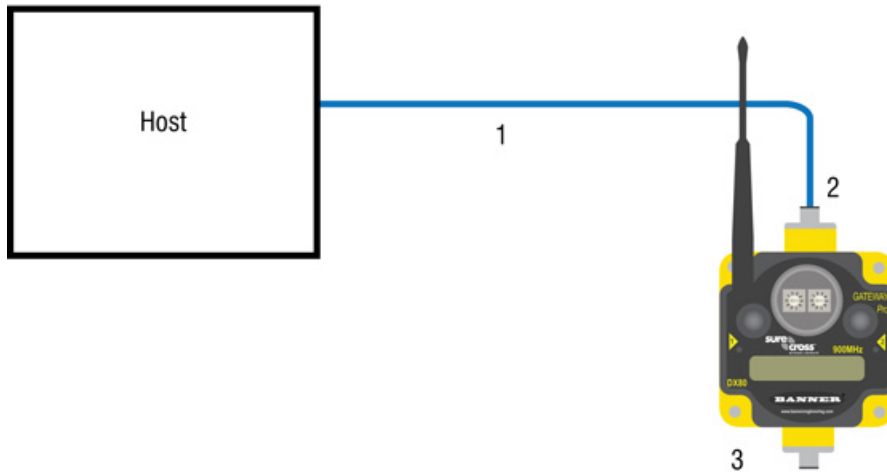
When connecting a DX80 Gateway to a host system, the wireless network must be configured using the User Configuration Tool (UCT). When you are not using a GatewayPro or Ethernet Bridge, you cannot configure the wireless network using the Web Configurator.



1. Power connection
2. Splitter cable and Modbus RTU communication
3. DX80 Gateway

Example Layout #2

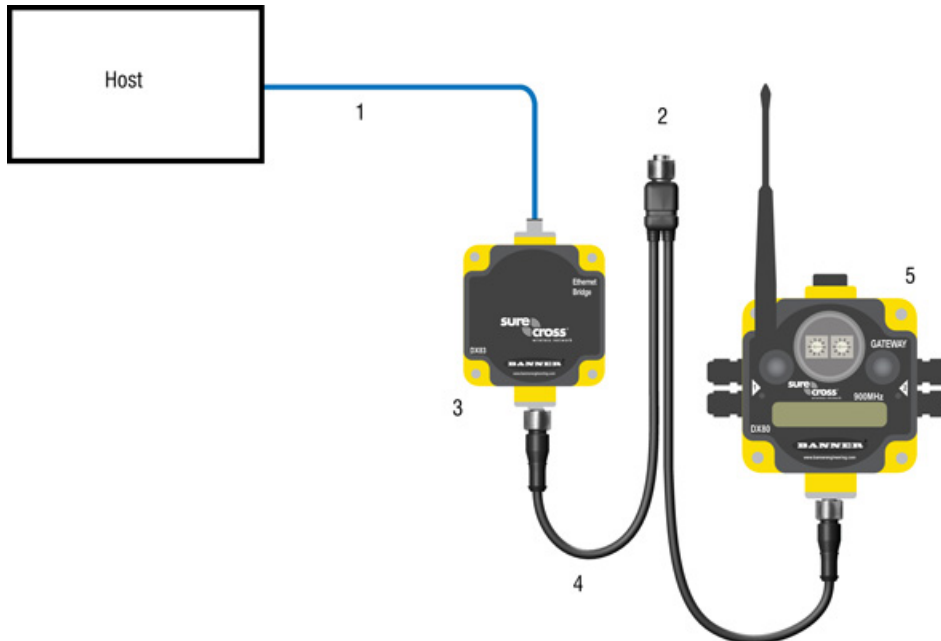
This system uses a GatewayPro connected directly to a host system using an Ethernet crossover cable. This system can be configured using the web pages.



1. Ethernet crossover cable using the Modbus/TCP or EtherNet/IP communication protocol
2. Industrial Ethernet connection
3. DX80 GatewayPro

Example Layout #3

This example system layout may also be configured using the web pages. Instead of using a GatewayPro to connect to the host system, a Gateway and Ethernet Bridge is used to achieve the same function. In this configuration, the Gateway is Modbus Slave 1.



1. Ethernet crossover cable using the Modbus/TCP or EtherNet/IP communication protocol
2. Power connection

3. DX83 Ethernet Bridge
4. Splitter cable CSRB-M1250M125.47M125.73 using Modbus RTU
5. DX80 Gateway

Typically, the Modbus RTU connection at a GatewayPro is not used because the GatewayPro contains a master and slave device. The Modbus RTU factory default settings for a standard Gateway are: 19200 baud; 8 data bits; No stop bits; 1 parity bit; Modbus Slave ID 1.

Accessing the Web-based Configuration Pages

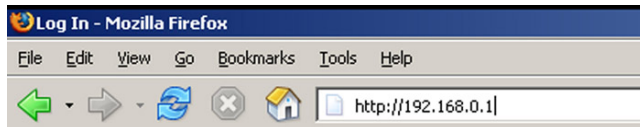
The configuration Web pages are served from the DX83 Ethernet Bridge or DX80 GatewayPro device and many be accessed using any Internet browser.

Set up the browser for a direct connection to the Internet. If you are experiencing problems connecting, verify the browser is not set to use a proxy server (see Appendix A for proxy settings.) Note also that a crossover Ethernet cable is required when connecting directly from a host computer to the DX83 Ethernet Bridge or DX80 GatewayPro.

The factory default IP address for the DX83 Ethernet Bridge or DX80 GatewayPro devices is: 192.168.0.1

To change the default IP address, set up the host PC with an IP address different from the Ethernet Bridge or Gateway Pro IP addresses. (Refer to Banner document 133116 for detailed instructions on setting up the host computer's network IP address.) For example, change the PC host IP address to: 192.168.0.2

Open a Web browser and log into the Ethernet Bridge or GatewayPro by typing the IP address in the browser location window: <http://192.168.0.1>



The Web home page for the Ethernet Bridge or GatewayPro displays. To log in, click on any tab at the top of the page.



Enter the following user name and password:

User name: system

Password: admin

To log out of the configuration system, close the browser.

Changing the IP Address

Use the page tabs at the top of the page to select the hierarchical path: *System > Setup > Network*. To change the IP address, type in the new IP address and click the **Change IP** button. The IP address change activates when the Ethernet Bridge or GatewayPro reboots (cycles power).

IMPORTANT: Verify the new IP address is correct before cycling power to the device. Once the IP address is changed, you must enter in the new IP address to access the Web page-based configuration screens. Write down the new IP address (and any other changed parameters on this screen) or print this page and file for your record.

What is Extended Address Mode?

Extended address mode assigns a unique code, the extended address code, to all devices in a particular network, thereby controlling which radios can exchange information.

The wireless I/O network is defined by the Network ID (NID) assigned to the Gateway and all its Nodes, ensuring communication. Each device within this common network also has a unique Device Address assigned.

Extended address mode adds the ability to isolate networks from one another by assigning a unique code, the extended address code, to all devices in a particular network. Only devices sharing the extended address code can exchange data. In addition to isolating networks, the extended addressing mode allows up to 56 Nodes to connect to a single Gateway. Without extended addressing, only 15 Nodes can connect to a single Gateway.

The extended address in the Gateway defaults to a code derived from its serial number although the code can be customized using the manual binding procedure. Binding DX80 devices locks Nodes to a specific Gateway by teaching the Nodes the Gateway's extended address code. After the devices are bound, the Nodes only accept data from the Gateway to which they are bound.

To select extended address mode, turn the device off. Set DIP switch 1 to the 'ON' position, then turn the device on. Do not set the DIP switch while the device is powered.

Manually Choosing an Extended Address Code

Manually choosing the extended address code is particularly useful when replacing components of an existing wireless network.

To determine the existing extended address code, access the DINFO (Device Information) menu of either the existing Gateway or another Node in the network. Follow the submenu structure to the XADR display for that device.

To manually bind a Gateway

1. Remove the Gateway's top cover.
2. Move DIP switch 1 to the ON position to activate Extended Addressing Mode.
3. Apply power to the Gateway.
The Gateway's LCD shows POWER, then RUN.
4. On the Gateway, single click button 1 to advance across the menus, stopping at the DVCFG menu.
The Gateway's LCD shows (DVCFG).

5. Single click button 2 to select DVCFG. Single click button 1 to select from the available menu options, stopping at XADR.
6. Single click button 2 to enter the XADR menu.
AUTO is automatic binding mode and uses the Gateway's serial number as the extended address code.
7. Single click button 1 to select manual mode.
8. Single click button 2 to enter manual mode.
MANUAL allows the user to manually enter an extended address code.
9. Single click button 2 to advance to the extended address code entry step.
Once in manual mode, use the right rotary dial to select the digits of the extended address code. The LCD shows SET XADR 000000.
10. Use the right rotary switch to begin setting the extended address code. Digit selection begins with the left most digit. After selecting the first digit, single click button 1 to advance right to the next digit. All six digits must be filled, even if it is with leading zeros. For example, to use 2245 as the code, enter 002245 into the device.
To use the Gateway's serial number, enter 000000 as the extended addressing code.
11. Continue entering the code using a single click of button 1 to advance from left to right.
Upon reaching the sixth digit, the cursor returns to the first digit.
12. Single click button 2 when code entry is complete.
The Gateway LCD displays the entered value for confirmation by showing CONFRM XADR, then repeating back your value.
13. Single click button 2 to save the code and exit the XADR menu.

When entering the extended address code, the digits auto fill with whatever position the rotary switch is currently in. For example, after entering the 00 part of the extended address code 002245, the third digit auto fills with a 0 until the rotary dial is rotated to 2.

After manually changing the extended address code on a Gateway in an existing network, change the extended address code for all Nodes in that network by either manually setting the code on all Node(s) or by beginning the automatic binding sequence on the Gateway and auto-binding all the Node(s).

To manually bind a Node

1. Remove the Node's top cover.
2. Move DIP switch 1 to the ON position to activate extended address mode.
3. Apply power to the Node.*
The LCD displays POWER, then RUN.
4. On the Node, single click button 1 to advance across the menus, stopping at the DVCFG menu.
5. Single click button 2 to select DVCFG. Single click button one to select from the available menu options, stopping at XADR.
6. Single click button 2 to enter the XADR menu.
AUTO is automatic binding mode and uses the Gateway's serial number as the extended address code.
7. Single click button 1, stopping at manual mode.
MANUAL allows the user to manually enter an extended address code.
8. Single click button 2 to enter manual mode.
9. Single click button 2 to enter the extended address code entry step.
The LCD shows SET XADR 000000.
10. Use the right rotary switch to begin setting the extended address code. Digit selection begins with the left most digit. After selecting the first digit, single click button 1 to advance right to the next digit. All six digits must be filled, even if it is with leading zeros. For example, to use 2245 as the code, enter 002245 into the device.
11. Continue entering the code using a single click of button 1 to advance from left to right.
Upon reaching the sixth digit, the cursor returns to the first digit.
12. Single click button 2 when code entry is complete. The Node LCD displays the entered value for confirmation.
The LCD shows CONFRM XADR XXXXXX.

13. If the rotary dial hasn't been returned to the previous Node address (device address or ID), the LCD displays the prior setting as a reminder. Return the rotary dial to its previous Node address.
14. The new Node address setting displays (NEW NADR XX).
15. The Node confirms the new Node address by displaying CONFRM NADR XX.
16. Double click button 2 to exit the XADR menu and to return to RUN mode.

When entering the extended address code, the digits auto fill with whatever position the rotary switch is currently in. For example, after entering the 00 part of the extended address code 002245, the third digit auto fills with a 0 until the rotary dial is rotated to 2.

* For devices with batteries integrated into the housing, remove the battery for one minute to cycle power to the device.

Setting the Network ID in Extended Addressing Mode

When using extended address mode, use the menu system to set the Network ID.

To set the Network ID, follow these steps on the Gateway:

1. From the top level menus, single click button 1 to advance through the menus, stopping at DVCFG (Device Configuration).
The Gateway's LCD displays *DVCFG
2. Single click button 2 to enter the DVCFG menu options and stop at (NID).
The Gateway's LCD displays (NID)
3. Single click button 2.
Enters the (NID) menu option.
4. Using both rotary dials on the front of the Gateway, select a Network ID. The left rotary dial acts as the left digit and the right rotary dial acts as the right digit of the Network ID. In extended addressing mode, the Network ID can only be set from the rotary dials while in the (NID) menu.
Any Nodes bound to this Gateway 'follow' the Gateway to the new Network ID automatically. The current Network ID and the new Network ID display on the LCD panel.
5. Single click button 2.
Saves the new values.
6. Double click button 2.
Exits this submenu and the LCD displays (NID).
7. Double click button 2.
Exits to the main menu system and returns to RUN mode. The LCD displays *DVCFG.

Automatic Binding Using the Menu Navigation

The easiest way to bind the Gateway to its Nodes is by triple clicking button 2 to enter automatic binding mode. If you would prefer to begin automatic binding mode using the menu structure instead of the buttons, follow these steps.

1. **On the Gateway:** remove the top cover.
2. Move DIP switch 1 to the ON position.
Extended Addressing Mode is activated using DIP switch 1.
3. Apply power to the Gateway.
The Gateway's LCD displays POWER, then *RUN.
4. On the Gateway, single click button 1 to advance across the menus, stopping at the DVCFG menu.
The Gateway's LCD displays (DVCFG).
5. Single click button 2 to select DVCFG. Single click button 1 to select from the available menu options, stopping at XADR.
The Gateway's LCD displays (XADR).
6. Single click button 2 to enter XADR mode. When the display reads (AUTO), single click button 2 again to begin the automatic binding mode.

The LEDs flash alternately when the Gateway is in binding mode. Any Node entering binding mode will bind to this Gateway. The Gateway's LCD displays NETWRK BINDNG.

7. **On the Node:** remove the top cover.
8. Move DIP switch 1 to the ON position.
Extended address mode is activated using DIP switch 1.
9. Apply power to the Node.¹
The Node's LCD displays POWER, then *RUN.
10. On the Node, single click button 1 to advance across the menus, stopping at the DVCFG menu.
The Node's LCD displays (DVCFG).
11. Single click button 2 to enter the DVCFG menu.
12. Single click button 1 to select from the available submenu options, stopping at XADR.
The Node's LCD displays (XADR).
13. Single click button 2 to enter the XADR submenu.
14. When the display reads (AUTO), single click button 2 to begin the automatic binding mode.
The Node enters binding mode. The Node's LCD displays NETWRK BINDNG. When the Node is bound, the LEDs are both solid red for a few seconds. The Node cycles its power, then enters RUN mode.
15. Use both of the Node's rotary dials to assign a decimal Device Address between 01 and 56.
The left rotary dial represents the tens digit (0–5) and the right dial represents the ones digit (0–9) of the Device Address.
16. Repeat steps 7 through 15 for each additional Node that needs to communicate to that Gateway.
17. **On the Gateway:** single click button 1 or button 2.
When button 1 or 2 is pressed, the Gateway exits binding mode and reboots. The Gateway's LCD displays POWER, then *RUN.

¹ For devices with batteries integrated into the housing, remove the battery for one minute to cycle power to the device. After making any changes to DIP switch settings, you must cycle power to the device or the DIP switch changes will not be recognized.

Setting the Maximum System Nodes

Selecting the maximum number of system Nodes changes the timing for the wireless network.

Use the MAXN submenu, located under the *DVCFG (Device Configuration) menu, to set the maximum number of Nodes for this system. For example, if you are running four Nodes in your wireless network, set the system's maximum Node count to 8. This allows up to 8 Nodes in the wireless network and offers the highest throughput, 62.5 milliseconds, for each Node. The choices are 8, 16, 32, and 56 Nodes.

Modbus Communication Parameters

To access the Modbus device, you may first need to configure system-level communication parameters on the DX80 Gateway, in addition to the serial hookups shown below. The following procedure is necessary to change the Gateway Slave ID, Baud Rate, and Parity.

Setting up the Network and Device IDs, powering up the devices, and conducting the Site Survey for a host-connected network is the same as for the non-host DX80 wireless system. All device I/O for the network is accessed using the host/master device.

Parameter	Default Value	Description
Slave ID	1	Defines the slave number (01-99) for the serial Modbus RTU protocol. When operating more than one network with a Modbus Master device, change the Slave IDs.
Baud Rate	19200	Defines communication data rate (19.2, 38.4 or 9.6 kbps) between the Gateway and the Host through the serial interface.
Parity	None	Defines serial parity (none, even, or odd) between Gateway and Host.

Setting the Slave ID on a DX80 Gateway

By default, all Gateways are set to Modbus Slave ID 1.

To change the Slave ID on the Gateway, follow these steps.

1. Single click button 1 to advance between menus. Stop when you reach the DVCFG menu.
2. Press button 2 once at the *DVCFG menu to enter the Device Configuration menu.
3. Press button 1 to advance through the items in the *DVCFG menu. Stop advancing when you've reached the setting for the slave ID (SLID).
The screen is displaying (SLID).
4. Press button 2 once to enter the slave ID (SLID) submenu.
The screen displays the current slave ID number.
5. Press button 1 to advance across the three digit slave ID while using the right rotary dial to select the number. To make a change, rotate the right rotary dial to zero, then to the desired number.
As you press button 1 to select the digit, the digit changes to reflect the position of the right rotary dial. To set the slave ID to 3, the display should read 003.
6. Press button 2 once to save your current setting.
The display reads SAVED.
7. Double click button 2 to exit the *DVCFG menu.
8. If using a Network ID (NID), adjust both rotary switches back to the NID value.
To avoid losing the network connection between the Gateway and Nodes, reset the rotary switches back to their appropriate values before leaving the *DVCFG sub-menus. If the Gateway and Nodes lose their connection, the network may take up to 20 seconds to re-synchronize.
9. Double-click Gateway push button 2 to return to the Device Configuration (*DVCFG) menu.
10. Click Gateway push button 1 until reaching the *RUN menu option.

Setting the Baud Rate

Setting the baud rate establishes the communication rate between the Gateway and the host system to which it is wired.

Continuing from the previous menu position, follow these steps to set the baud rate.

1. Single-click Gateway push button 1 to move to the next menu option, the BAUD rate.
2. Single-click Gateway push button 2 to display the current setting. Single-click Gateway push button 1 to cycle through the available options. Stop on the desired setting.
The options are 9600, 19200, 38400. The factory default is 19200.
3. Single-click Gateway push button 2 to save the new setting.
4. If using a network ID (NID), adjust both rotary switches back to the NID value.
To avoid losing the network connection between the Gateway and Nodes, reset the rotary switches back to their appropriate values before leaving the *DVCFG sub-menus. If the Gateway and Nodes lose their connection, the network may take up to 20 seconds to re-synchronize.
5. Double-click Gateway push button 2 to return to the Device Configuration (*DVCFG) menu.
6. Click Gateway push button 1 until reaching the *RUN menu option.

Setting Parity

Continuing from the previous menu position, follow these steps to set the parity.

1. Single-click Gateway push button 1 to move to the next field, the PARITY field.
2. Single-click Gateway push button 2 to display the current setting. Single-click Gateway push button 1 to cycle through the available options. Stop on the desired setting.
The options are NONE, EVEN, ODD. The factory default is NONE.
3. Single-click Gateway push button 2 to save the new setting.

4. If using a network ID (NID), adjust both rotary switches back to the NID value.
To avoid losing the network connection between the Gateway and Nodes, reset the rotary switches back to their appropriate values before leaving the *DVCFG sub-menus. If the Gateway and Nodes lose their connection, the network may take up to 20 seconds to re-synchronize.
5. Double-click Gateway push button 2 to return to the Device Configuration (*DVCFG) menu.
6. Click Gateway push button 1 until reaching the *RUN menu option.

Default Output Conditions

Default Output Conditions

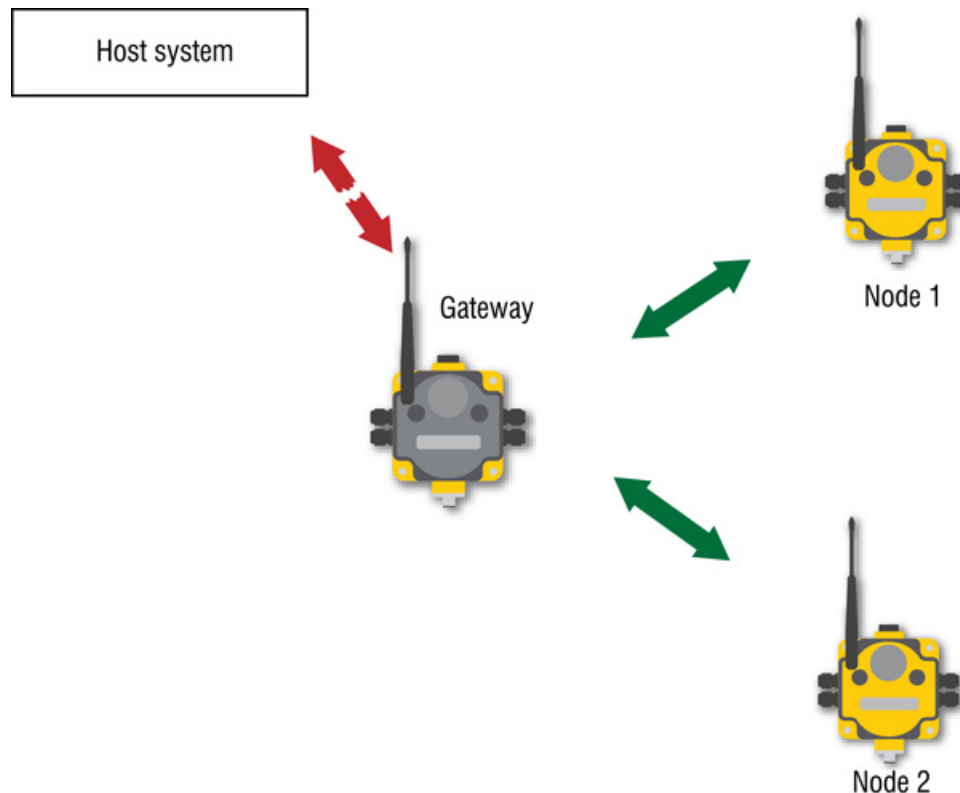
The timeout structure of the DX80 system sets relevant outputs to user-defined conditions when radio or host communications fail.

If the timeout features are enabled, the outputs are set to default states or the last known state before the error. The timeout error conditions are cleared by either a reset command sent from the host, by using the front panel display, or by using the auto-recover feature on the DX80. Communications timeouts occur in three areas within the DX80 system:

- Host Link Failure to the DX80 Gateway device (Modbus Timeout)
- Gateway Link Failure with any Node device
- Node Link Failure with the Gateway

Host Link Failure

A host link failure is detected when the defined timeout period has elapsed with no communications between the host system (or Modbus master device) and the DX80 Gateway, typically set to four seconds.

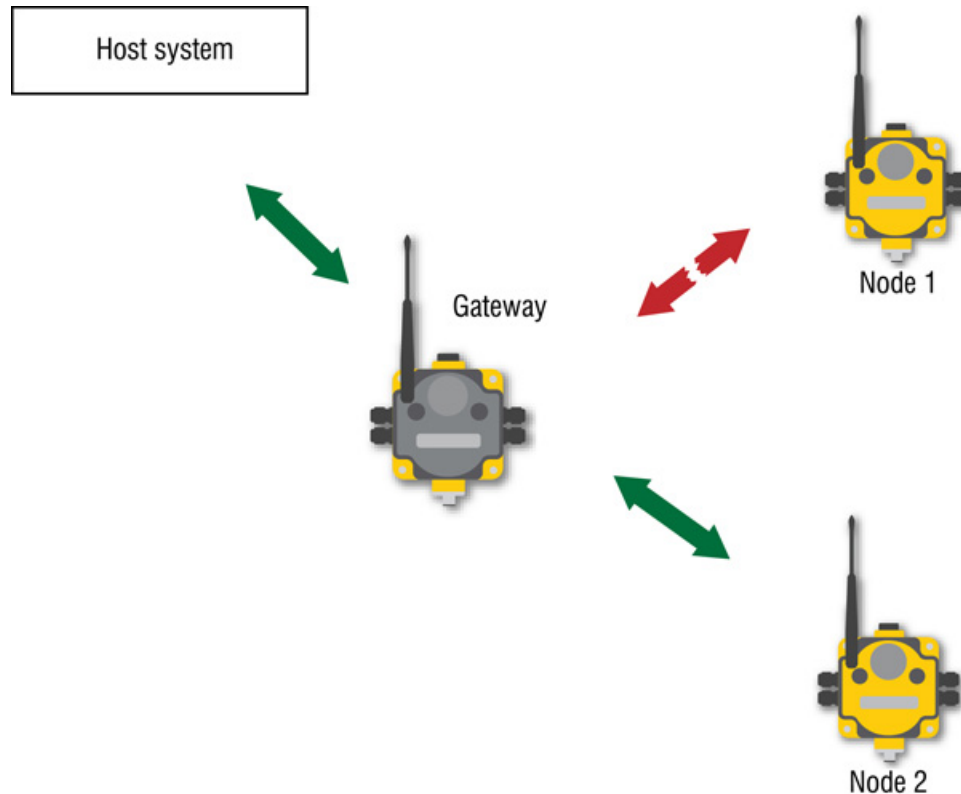


The Gateway places an error code in the Gateway I/O 8 register and sends a message to all relevant Nodes within the system to set outputs to the user-defined default states. Each Node has an enable flag for a host link failure condition. If the Node's 'host link failure' flag is not set, the outputs on this Node are not affected.

In the example shown, a host link failure between the host system and the Gateway would result in the outputs of Node 1 and Node 2 sent to the defined conditions if both Nodes have the host link failure checkbox selected.

Gateway Link Failure

Gateway link failure and Node link failure conditions are determined by three global parameters, 'Polling Interval', 'Maximum Missed Message Count' and 'Re-link Count.'



The Polling Interval defines how often the Gateway communicates with each Node to verify the RF link is operating. The Gateway increments a Node's missed message count if a Node does not immediately report back from a polling request. If a Node's missed message count exceeds the 'Maximum Missed Message Count,' the Gateway generates a timeout error in the Modbus I/O 8 register of the appropriate Node.

The auto-recover feature uses the 'Re-link Count' parameter. If enabled, the error condition heals itself if the Gateway to Node communications have successfully exchanged N-number of good polling messages. The N-number is the 'Re-link Count,' or the number of messages required to re-establish a RF link.

When the Node's 'Gateway Link Failure' flag is set and the Gateway determines a timeout condition exists for a Node, any outputs linked from the failing Node are set to the user-defined default state. Each Node has a 'Gateway Link Failure' flag that can be set or cleared depending on the particular application.

In the sample system shown, the communication link between the Gateway and Node 1 has failed. Node 2 must have its 'Gateway Link Failure' flag set to allow its outputs that are linked to Node 1 are set to the defined default state when the communication link between Node 1 and the Gateway fails.

Node Link Failure

A Node Link Failure may be determined by the polling interval or the out-of-sync timing.

When a Node detects a communications failure with the Gateway and the 'Node Link Failure' flag is set, the output points are set to the user-defined states and the inputs are frozen. When output points are set to their default states because of an error condition, only the Gateway can clear the error condition and resume normal operation. The front panel buttons or the Gateway's register I/O 15 clear error conditions.

Clearing a lost RF link error does not restore communications. Banner recommends determining and resolving the cause of the RF link error, then allowing the system to auto-recover the lost communications.

In the sample system shown, the communication link between the Gateway and Node 1 has failed. Node 1 must have its 'Node Link Failure' flag set to allow its outputs to be set to the defined default state when it cannot communicate with the Gateway.

Polling Interval. The global 'polling interval' defines the time interval during which the Node should expect a polling request from the Gateway.

Out of Sync. An 'out of sync' condition is met when a Node fails to receive the Gateway's beacon within a factory-set time period, about 10 seconds. Both the 'out of sync' and 'polling interval' conditions are used to detect a failure because the Node can remain in sync with the Gateway but be unable to transmit data. If the Gateway drops out of the network, the Nodes will detect the 'out of sync' condition long before the polling interval expires.

Part 3

Host Configuration

The SureCross™ DX80 Gateway uses Modbus RTU, Modbus/TCP, or EtherNet/IP™ protocols to communicate with host systems or external devices.

- The **Modbus Serial Line RTU** protocol is a master-slave protocol typically used for industrial applications. Only one master at any given time is connected to the bus while up to 247 slaves nodes can be connected to the serial bus.
- The **Modbus TCP/IP** protocol is an open standard implementation of Modbus on Internet protocols. Modbus TCP/IP is similar to Modbus RTU but transmits information within TCP/IP data packets.
- **EtherNet/IP** is also an application layer protocol for industrial automation. EtherNet/IP is built on the TCP/IP protocols and uses standard Ethernet hardware.

Modbus is the native protocol for the DX80 wireless system. All wireless devices are organized with a two-byte register for each I/O point. Sixteen registers are allocated for each device, typically eight registers for inputs and eight registers for outputs. In the world of Modbus, these registers are addressed consecutively beginning with the Gateway, then Node 1 through Node N.

EtherNet/IP separates the input registers and output registers into blocks. The two blocks of registers, or instances, are consecutively ordered from the Gateway, then Node 1 through Node 15. The EtherNet/IP interface implementation also allows for 100 extra input and output registers that can be customized for specific applications.

This configuration guide outlines the procedures involved in configuring I/O parameters by writing to registers. Parameter configuration using registers can be done with a host system connected to a Gateway, GatewayPro, or Gateway and Ethernet Bridge combination and any supported protocol.

For more information on Modbus, including basic reference guides, please refer to www.modbus.org. For more information on specific SureCross components, refer to the data sheets for the SureCross devices.

EtherNet/IP™ is a trademark of ControlNet International, Ltd and Open DeviceNet Vendor Association, Inc.

Topics:

- [SureCross DX80 Modbus Register Definitions](#)
- [Web-based Configuration](#)
- [Message Registers \(I/O 7 and 8\)](#)
- [Control Registers \(I/O 15\)](#)
- [Extended Control Registers \(I/O 15 and 16\)](#)
- [Host Configuration Examples](#)

SureCross DX80 Modbus Register Definitions

Modbus distinguishes between inputs and outputs and between bit-addressable and word addressable data items.

For more information, please refer to www.modbus.org. A less documented but commonly used method to separate the data types is using a mapped address structure.

Reference	Description
0xxxx	Read/Write Discrete Output. Drives output data to a discrete output point.
1xxxx	Read Discrete Inputs. Controlled by the corresponding discrete input point.
3xxxx	Read Input Registers. Contains a 16-bit number received from an external source, like an analog signal.
4xxxx	Read/Write Output or Holding Registers. Stores 16-bits of numerical data (binary or decimal), or sends the data to an output point.

The xxxx shown in the preceding table represents the four-digit address location in user data memory. Because function codes generally denote the leading character, the leading character is omitted from the address specifier for a given function. The leading character also identifies the I/O data type. The SureCross™ DX80 Modbus registers are all holding registers 4xxxx using the mapped address structure.

Modbus Holding Registers

There are sixteen Modbus holding registers for each SureCross™ device. Calculate the holding register number for each device using the equation: Register number = I/O# + (Node# × 16).

Since the Gateway is always first, at Node 0, the Gateway's holding registers are registers 1 through 16. Registers for Node 1 are 17 through 32, as shown in the Modbus Holding Register table below. Though only ten Nodes are shown, the table can continue for as many Nodes as are used in a given network.

Using the equation or the Modbus Holding Registers table, the register number for I/O point 15 for Node 7 is 127.

Modbus Holding Registers									
I/O Pt.	Gateway	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8
1	1	17	33	49	65	81	97	113	129
2	2	18	34	50	66	82	98	114	130
3	3	19	35	51	67	83	99	115	131
4	4	20	36	52	68	84	100	116	132
5	5	21	37	53	69	85	101	117	133
6	6	22	38	54	70	86	102	118	134
7	7	23	39	55	71	87	103	119	135
8	8	24	40	56	72	88	104	120	136
9	9	25	41	57	73	89	105	121	137
10	10	26	42	58	74	90	106	122	138
11	11	27	43	59	75	91	107	123	139
12	12	28	44	60	76	92	108	124	140
13	13	29	45	61	77	93	109	125	141
14	14	30	46	62	78	94	110	126	142

Modbus Holding Registers									
I/O Pt.	Gateway	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8
15	15	31	47	63	79	95	111	127	143
16	16	32	48	64	80	96	112	128	144

Special Modbus Registers

Special Modbus registers include the device status registers and the system discrete registers.

Device Status Registers 0xC00–0xC003 (49152–49156)*

The Device Status registers contain a bit-packed representation defining the devices that are operational in the wireless system. A Modbus holding register Read (function 0x03) of the four holding registers returns eight bytes of data, one bit representing each possible device in the system. If a bit contains a '1' value, the device is operating in the system (I/O 8 register equals 128), otherwise the bit is a '0' value. Bit 0 of the 64-bit word represents the Gateway device, bit 1 represents Node 1, bit 2 is Node 2, etc.

Modbus Read Holding Registers Function Code

Request		
Function code	Byte 1	0x03
Starting address	Bytes 2, 3	0xC0 00
Quantity of registers	Bytes 4, 5	0x00 04

Response		
Function code	Byte 1	0x03
Byte count	Byte 2	0x08
Register 0xC000 (49152) – Devices 15:0	Bytes 3, 4	Bit pack for devices 15:1, Gateway
Register 0xC001 (49153) – Devices 31:16	Bytes 5, 6	Bit pack for devices 31:16
Register 0xC002 (49154) – Devices 47:32	Bytes 7, 8	Bit pack for devices 47:32
Register 0xC003 (49156) – Devices 63:48	Bytes 9, 10	Bit pack for devices 63:48

* Decimal values are in ()

System Discrete Registers 0xCn00–0xCn03 (49408–51203)

The System Discrete Modbus registers show the discrete value for single I/O point for every device in the system. The returned eight bytes of data include 1 bit for every device in the system. The input point selected is based on the Modbus register address range.

Modbus Holding Register Address (Hex)	Modbus Holding Register Address (Decimal)	System Wide Input Bit Pack
0xC100-0xC103	49408-49411	Input point #1

Modbus Holding Register Address (Hex)	Modbus Holding Register Address (Decimal)	System Wide Input Bit Pack
0xC200-0xC203	49664-49667	Input point #2
0xC300-0xC303	49920-49667	Input point #3
0xC400-0xC403	50176-50179	Input point #4
0xC500-0xC503	50432-50435	Input point #5
0xC600-0xC603	50688-50691	Input point #6
0xC700-0xC703	50944-50947	Input point #7
0xC800-0xC803	51200-51203	Input point #8

Supported Modbus Function Codes

The supported Modbus function codes are 0x03 (read), 0x06 (write single), and 0x10 (write multiple).

All DX80 Modbus registers are defined as ‘holding registers’ in the 4xxxx address space. The first 16 registers are allocated to the Gateway (1 through 16), the following 16 registers are allocated to Node #1 (17 through 32), the next 16 registers to Node #2 (33 through 48) and so on. The supported Modbus function codes are defined below.

Function	Code	Description
3	0x03	Read Holding Registers, 1 – 125, contiguous block of holding regs.
6	0x06	Write Single Register
16	0x10	Write Multiple Registers, 1 – 0x78, contiguous block of registers

03 (0x03) Read Holding Registers

This function code reads the contents of a contiguous block of holding registers in a remote device. The request specifies the starting register address and the number of registers.

06 (0x06) Write Single Holding Register

This function code writes a single holding register in a remote device. The request specifies the address of the register to be written and the single register of data.

16 (0x10) Write Multiple Holding registers

This function code writes a block of contiguous registers (1 to about 120 registers) in a remote device. The requested written values are specified in the request data field.

For more information about Modbus, see www.modbus.org.

Modbus RTU and Modbus/TCP Register Map

Modbus/TCP and Modbus RTU provide device control and monitoring using holding registers in the 40000 register block.

Each wireless device in the system is allocated 16 holding registers. The Gateway uses the first 16 registers followed by each Node in the network, based on the Node address. For Node 5, the starting Modbus registers are $1 + (\text{Node\#} \times 16) = 1 + (5 \times 16) = 81$, the ending register is 97.

I/O Point	Gateway Modbus Holding Register	Node Modbus Register
1	1	$1 + (\text{Node\#} \times 16)$
2	2	$2 + (\text{Node\#} \times 16)$
3	3	$3 + (\text{Node\#} \times 16)$

I/O Point	Gateway Modbus Holding Register	Node Modbus Register
4	4	4 + (Node# × 16)
5	5	5 + (Node# × 16)
6	6	6 + (Node# × 16)
7	7	7 + (Node# × 16)
8	8	8 + (Node# × 16)
9	9	9 + (Node# × 16)
10	10	10 + (Node# × 16)
11	11	11 + (Node# × 16)
12	12	12 + (Node# × 16)
13	13	13 + (Node# × 16)
14	14	14 + (Node# × 16)
15	15	15 + (Node# × 16)
16	16	16 + (Node# × 16)

For example:

Registers	Device and Input Connections	Register	Device and Input Connections	Register	Device and Input Connections
1	Gateway I/O 1	17	Node #1 I/O 1	33	Node #2 I/O 1
2	Gateway I/O 2	18	Node #1 I/O 2	34	Node #2 I/O 2
3	Gateway I/O 3	19	Node #1 I/O 3	35	Node #2 I/O 3
4	Gateway I/O 4	20	Node #1 I/O 4	...	...
5	Gateway I/O 5	21	Node #1 I/O 5	...	...
6	Gateway I/O 6	22	Node #1 I/O 6	...	...
7	Gateway I/O 7	23	Node #1 I/O 7	...	...
8	Gateway I/O 8	24	Node #1 I/O 8	...	...
9	Gateway I/O 9	25	Node #1 I/O 9	905	Node #56 I/O 9
10	Gateway I/O 10	26	Node #1 I/O 10	906	Node #56 I/O 10
11	Gateway I/O 11	27	Node #1 I/O 11	907	Node #56 I/O 11
12	Gateway I/O 12	28	Node #1 I/O 12	908	Node #56 I/O 12
13	Gateway I/O 13	29	Node #1 I/O 13	909	Node #56 I/O 13
14	Gateway I/O 14	30	Node #1 I/O 14	910	Node #56 I/O 14
15	Gateway I/O 15	31	Node #1 I/O 15	911	Node #56 I/O 15
16	Gateway I/O 16	32	Node #1 I/O 16	912	Node #56 I/O 16

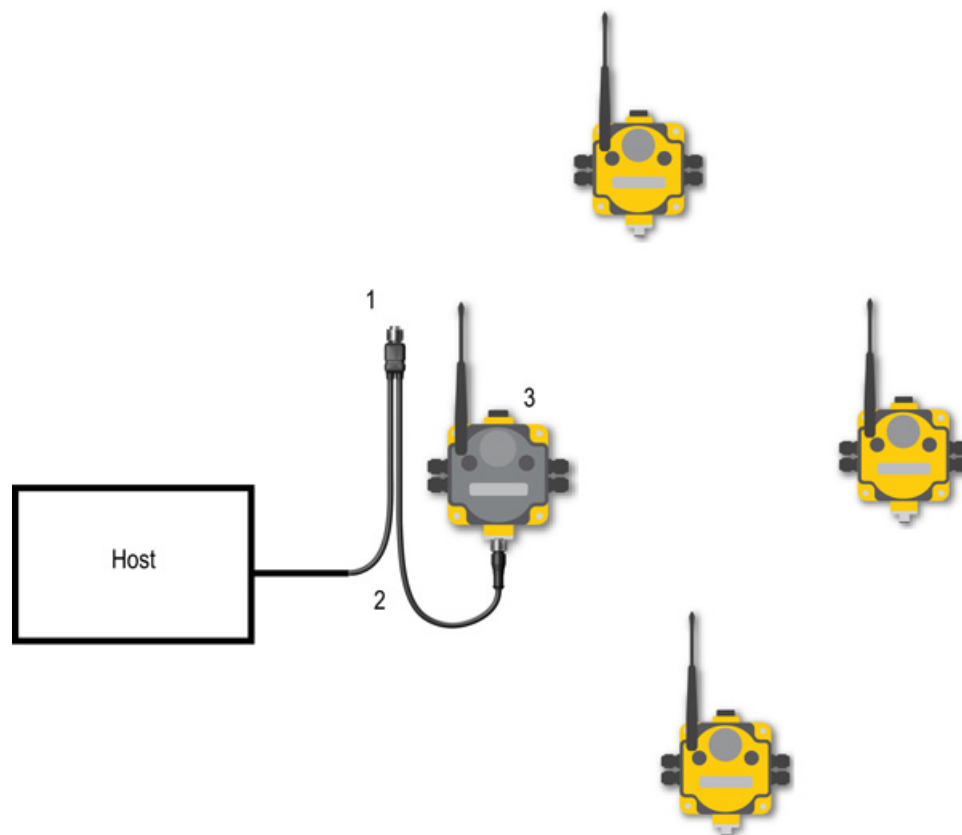
Web-based Configuration

The DX80 wireless systems are configured using an Ethernet network connection and a common Web page browser. An Ethernet connection can be established from a DX80 GatewayPro or from a DX83 Ethernet Bridge serially connected to the DX80 Gateway.

The Ethernet Bridge and GatewayPro each ship with an Ethernet crossover cable. One end of the cable is a RJ45 connector and the other end is an industrial Ethernet connector. This cable is designed to be connected directly to a computer. For a list of the accessories, please refer to [Accessories](#) on page 127. For more examples of system layouts, please refer to [System Layouts](#) on page 67 .

Example Layout #1

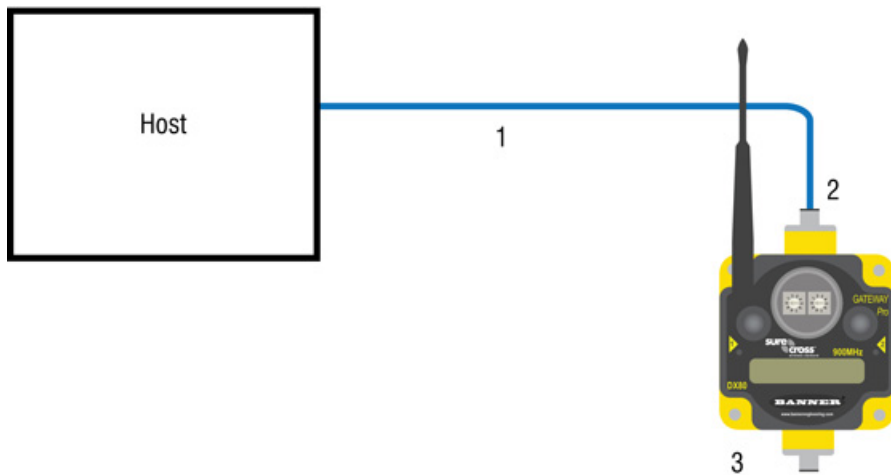
When connecting a DX80 Gateway to a host system, the wireless network must be configured using the User Configuration Tool (UCT). When you are not using a GatewayPro or Ethernet Bridge, you cannot configure the wireless network using the Web Configurator.



1. Power connection
2. Splitter cable and Modbus RTU communication
3. DX80 Gateway

Example Layout #2

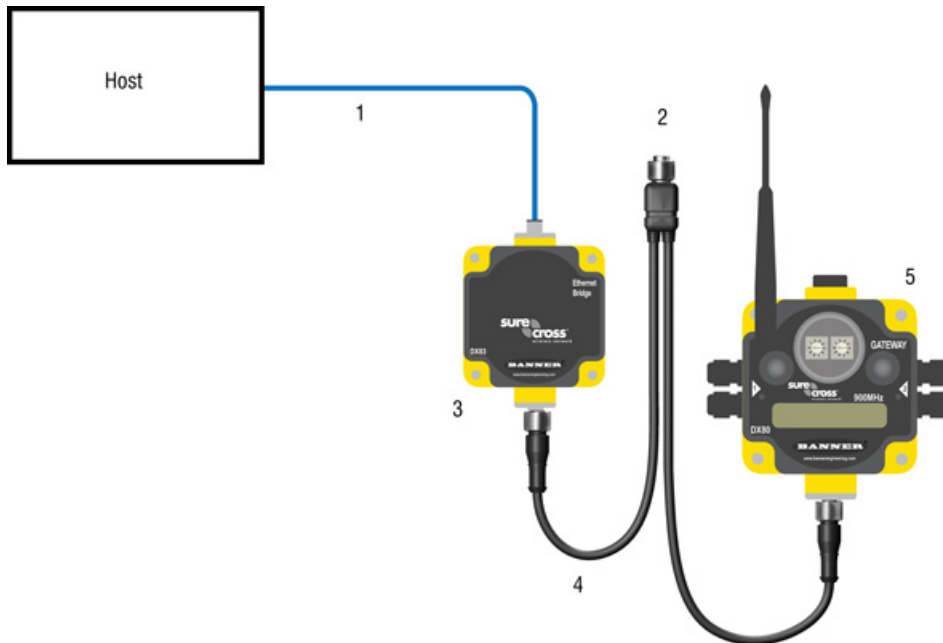
This system uses a GatewayPro connected directly to a host system using an Ethernet crossover cable. This system can be configured using the web pages.



1. Ethernet crossover cable using the Modbus/TCP or EtherNet/IP communication protocol
2. Industrial Ethernet connection
3. DX80 GatewayPro

Example Layout #3

This example system layout may also be configured using the web pages. Instead of using a GatewayPro to connect to the host system, a Gateway and Ethernet Bridge is used to achieve the same function. In this configuration, the Gateway is Modbus Slave 1.



1. Ethernet crossover cable using the Modbus/TCP or EtherNet/IP communication protocol
2. Power connection
3. DX83 Ethernet Bridge
4. Splitter cable CSRB-M1250M125.47M125.73 using Modbus RTU
5. DX80 Gateway

Typically, the Modbus RTU connection at a GatewayPro is not used because the GatewayPro contains a master and slave device. The Modbus RTU factory default settings for a standard Gateway are: 19200 baud; 8 data bits; No stop bits; 1 parity bit; Modbus Slave ID 1.

Accessing the Web-based Configuration Pages

The configuration Web pages are served from the DX83 Ethernet Bridge or DX80 GatewayPro device and many be accessed using any Internet browser.

Set up the browser for a direct connection to the Internet. If you are experiencing problems connecting, verify the browser is not set to use a proxy server (see Appendix A for proxy settings.) Note also that a crossover Ethernet cable is required when connecting directly from a host computer to the DX83 Ethernet Bridge or DX80 GatewayPro.

The factory default IP address for the DX83 Ethernet Bridge or DX80 GatewayPro devices is: 192.168.0.1

To change the default IP address, set up the host PC with an IP address different from the Ethernet Bridge or Gateway Pro IP addresses. (Refer to Banner document 133116 for detailed instructions on setting up the host computer's network IP address.) For example, change the PC host IP address to: 192.168.0.2

Open a Web browser and log into the Ethernet Bridge or GatewayPro by typing the IP address in the browser location window: `http://192.168.0.1`



The Web home page for the Ethernet Bridge or GatewayPro displays. To log in, click on any tab at the top of the page.



Enter the following user name and password:

User name: system

Password: admin

To log out of the configuration system, close the browser.

Saving the System Configuration

Save the system configuration by going to the *System > Setup > Config File* page.

- To write the changes to the factory default XML file (BootConfig.xml), click the **Save** button.
- To save the configuration changes under a different file name, enter the new XML file name, including the .XML extension, in the New File Name box and click the **Save As** button.

To define which XML configuration file loads when the device cycles power or restarts, enter the file name in the Startup Configuration box.

Cycle power to the Ethernet Bridge or GatewayPro to complete this update. After the device powers up, the changes should be registered.

Enabling EtherNet/IP Communication Protocol

By default the Ethernet Bridge and GatewayPro systems communicate using Modbus/TCP, but the system can also use EtherNet/IP™.

To change the system to EtherNet/IP, log in using the following user name and password.

User name: root

Password: sxi

At the bottom of the *System > Setup > Network* page is a checkbox to enable EtherNet/IP. Only select this box if the GatewayPro system is running on an EtherNet/IP network. This change cannot be enabled from a login other than the “root” login.

After selecting the EtherNet/IP Enabled checkbox, click the **Set Ports** button to save any changes made to the HTTP Port, Modbus Server Port, Telnet Port, and EtherNet/IP Enabled box. Cycle power to the Ethernet Bridge or GatewayPro to complete this update. After the device powers up, the changes should be registered.

For some SureCross devices, the Ethernet/IP checkbox may be enabled as the factory default.

To use EtherNet/IP, the GatewayPro or DX83 Ethernet Bridge interface requires the user to enable the EtherNet/IP interface, define the EtherNet/IP registers, and save the system configuration using the *System > Setup > Config File* page.

Defining EtherNet/IP Registers to Send to the Buffer

Define the registers sent to the EtherNet/IP interface buffers.

On the *System > Data > Local Registers* tabs, select the EtherNet/IP checkbox for every register to be visible by Ethernet/IP. After selecting the registers, click the **Update** button to save the changes on this configuration page.

For some SureCross devices, the EtherNet/IP checkbox may be enabled at the factory.

In the example screen shown, Node #1 Tank Alarm is mapped to EtherNet/IP buffer input 1, Node #1 Tank Level is mapped to buffer input 2, and Node #1 Status is mapped to buffer input 3. Only local registers defined by the EIP checkbox will be mapped to the EtherNet/IP buffer inputs.

After all selected inputs for device 1 are mapped to the EtherNet/IP buffer inputs, EIP selected inputs for the remaining devices are mapped in the order of the device (e.g. device 1, device 2, device 3).

Local Register #	Register Name	Hex	Update	Register Data	Unsigned	EIP	Register Type	Default Data	Server Timeout(s)
00017	Node #1 Tank Alarm	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Integer	0.000000	0.0
00018		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00019		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00020		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00021	Node #1 Tank Level	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Integer	0.000000	0.0
00022		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00023		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00024	Node #1 Status	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Integer	0.000000	0.0
00025		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00026		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00027		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00028		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00029		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00030		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00031		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0
00032		<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	Integer	0.000000	0.0

The following tables show how the selecting inputs and outputs using the EIP checkbox maps device registers to the EIP buffer inputs and outputs.

Wireless System Local Registers

Reg	Gateway	EIP
1	Gateway input 1	✓
2	Gateway input 2	
3	Gateway input 3	
4	Gateway input 4	
5	Gateway input 5	
6	Gateway input 6	✓
7	Gateway input 7	
8	Gateway input 8	
9	Gateway output 1	
10	Gateway output 2	✓
11	Gateway output 3	
12	Gateway output 4	✓
13	Gateway output 5	
14	Gateway output 6	
15	Gateway output 7	
16	Gateway output 8	
	Node 1	
17	Node 1 input 1	
18	Node 1 input 2	
19	Node 1 input 3	✓
20	Node 1 input 4	✓
21	Node 1 input 5	
22	Node 1 input 6	
23	Node 1 input 7	
24	Node 1 input 8	
25	Node 1 output 1	✓
26	Node 1 output 2	
27	Node 1 output 3	✓
28	Node 1 output 4	
29	Node 1 output 5	
30	Node 1 output 6	
31	Node 1 output 7	
32	Node 1 output 8	



Word#	EIP Inputs	Word#	EIP Outputs
0	Gateway input 1	0	Gateway output 2
1	Gateway input 6	1	Gateway output 4
2	Node 1 input 3	2	Node 1 output 1
3	Node 1 input 4	3	Node 1 output 3
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
225		225	
226		226	
227		227	

EtherNet/IP Registers

EtherNet/IP on ControlLogix PLC Register Map

The DX80 wireless system is controlled by a ControlLogix PLC using EtherNet/IP through assembly objects and the Common Industrial Protocol (CIP). Add the SureCross Gateway to the ControlLogix PLC as a “Generic Ethernet Module.”

There is one input assembly object for all DX80 input points and one output assembly object for all DX80 output points. Each object is 228 elements long, with each element a 16-bit integer.

Input Assembly Object, DX80 Input, Instance 100 (0x64)

Words are not allocated for any specific unit but are used, in device order, for each of the device input registers selected using the EIP checkbox.

Output Assembly Object, DX80 Outputs, Instance 112 (0x70)

Words are not allocated for any specific unit but are used, in device order, for each of the device output registers selected using the EIP checkbox.

For proper EtherNet/IP communication, the minimum requested packet interval should be 50 milliseconds or higher.

Instance 100		Instance 112	
Word #	Inputs	Word #	Outputs
0	Input 1	0	Output 1
1	Input 2	1	Output 2
2	Input 3	2	Output 3
3	Input 4	3	Output 4
4	Input 5	4	Output 5
5	Input 6	5	Output 6
6	Input 7	6	Output 7
7	Input 8	7	Output 8
8	Input 9	8	Output 9
9	Input 10	9	Output 10
10	Input 11	10	Output 11
11	Input 12	11	Output 12
12	Input 13	12	Output 13
13	Input 14	13	Output 14
14	Input 15	14	Output 15
15	Input 16	15	Output 16
...
...
...
225	Input 226	225	Output 226
226	Input 227	226	Output 227
227	Input 228	227	Output 228

EtherNet/IP to PLC5 and SLC5 Register Map

Allen-Bradley's PLC5 and SLC5 family of devices use PCCC communications over EtherNet/IP. The DX80 wireless system supports these PLCs using input and output register arrays.

There is one input assembly object for all DX80 input points and one output assembly object for all DX80 output points. Each object is 228 elements long, with each element a 16-bit integer. The DX80 wireless data table addresses are N7 for read and N14 for write. The MSG instruction only handles up to 103 words; use multiple MSG instructions if all data is required.

N7 - Read Registers		N14 - Write Registers	
0	Input 1	0	Output 1
1	Input 2	1	Output 2
2	Input 3	2	Output 3
3	Input 4	3	Output 4
4	Input 5	4	Output 5
5	Input 6	5	Output 6

N7 - Read Registers		N14 - Write Registers	
6	Input 7	6	Output 7
7	Input 8	7	Output 8
8	Input 9	8	Output 9
9	Input 10	9	Output 10
10	Input 11	10	Output 11
11	Input 12	11	Output 12
12	Input 13	12	Output 13
13	Input 14	13	Output 14
14	Input 15	14	Output 15
15	Input 16	15	Output 16
...
...
...
225	Input 226	225	Output 226
226	Input 227	226	Output 227
227	Input 228	227	Output 228

Message Registers (I/O 7 and 8)

Informational messages are warning or error conditions that include a message code and data field.

The type of warning or error condition is encoded in the message code while the data field contains additional information for some message codes.

Each DX80 model reserves four registers (defined I/O points) to provide information or control an operation. The reserved registers (I/O points) are 7, 8, 15, and 16. Informational messages are transmitted using Modbus I/O 8 register; control messages are transmitted using register I/O 15. Registers 7 and 16 have special functions depending on the action requested.

Error Handling Message Codes

All device errors are captured and sent to the Gateway for storage in the devices' register for I/O point 8.

All messages are sent to the Gateway regardless of the priority, and redundant messages are not sent more than once. For example, if a communications timeout is detected 10 times in a row, the device sends the timeout message only once.

The Gateway stores only the highest priority message in the register. A 0x00 message will not be saved unless there is a 0x0 in the I/O point register. All non-zero messages must be cleared by the user. A value of 254 in the register for I/O point 8 disables all error reporting.

To clear any I/O point 8 device message, use the Gateway's front panel menu system. A host connection can also choose to clear or disable Modbus I/O 8 registers. A Node device ignores error messages; errors must be cleared from either the Gateway or the host. The auto-recover feature allows for automatic erasing of errors for a Node if the error condition 'heals' itself. For example, an RF communications link disrupted by a temporary obstacle 'heals' itself when the obstruction is removed. Auto recovery is enabled by factory default and is the recommended setting.

Any new error/warning messages interrupt the active front panel. Once the user has confirmed receipt of the message, the user can clear, disable, or ignore the error/warning message. If the user ignores the message, additional messages from that Node will be collected if they are of a higher priority and will interrupt the display only for new messages.

If the user chooses to disable error messages, which is not recommended, the Gateway discards all messages from the Node.

Informational Message Codes

Informational messages include the Site Survey data and device specific messages.

Register I/O 8 is reserved for device messages or Site Survey data (when in Site Survey mode). The Node checks for temperature and battery problems before every transmission back to the Gateway. Other conditions are detected as they occur and are immediately reported back to the Gateway. Once the error message is sent back to the Gateway, the Node does not resend the message until the error condition changes or there is a higher priority message. The higher the message code, the higher the priority

Register		
	[15:8]	[7:0]
Device Register 8	Message Code	Data Field

I/O 8 Device Messages			
Message Code	Data Field	Message Code and Data Field (Decimal)	Description
0x00	0x00	00	No device is present. The Node has not joined the network since the last power cycle.
0x00	0x80	128	Normal Operation - A 128 in the data field indicates a device is synchronized with the Gateway.
Warning Conditions			
0x01	<i>Message</i>	256	Unknown message - Message was received correctly (correct checksum), but is not a known command.
Error Conditions			
0x35	0x01	13569	RF Device timeout - A Node is not responding. The defined polling interval with allowable missed count was reached.
0x36	0x00	13824	Modbus timeout - A Gateway Modbus timeout (time of inactivity on the serial channel) was detected.
0xFE	0x00	65024	Register 8 device messages are disabled. Register 8 clears or disables messages using the Gateway's register 15.

* Modbus errors or warnings are indicated on the Gateway's LCD.

Control Registers (I/O 15)

Use control messages to start device-level actions.

Each DX80 device allocates 16 registers. Registers one through six are inputs and nine through fourteen are outputs. Registers 7, 8, 15, and 16 are reserved for warnings, error messages, and control operations. The control messages use the device's register 15. Some control messages are device specific, depending on the action required.

The table below defines the different control messages, codes, and restrictions. Typically, the control messages are used to start a device level action, like 'reset device' (0x100). The 0x1000 command code sent to an M-GAGE™ device register 15 performs a baseline function on that M-GAGE.

For control messages, only register 15 is used.

Control Codes

Node Reg 15	Control Code [15:8]	Data Field [7:0]
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The register word is made up of two parts, the control code in the upper byte and the data field in the lower byte. Some control codes do not have a data field. For these control codes, use 0x00 as the data field.

I/O 15 Control Messages				
Control Code in Hex (Dec)	Data Field in Hex (Dec)	Control Code and Data Field in Decimal	Restrictions	Description
0x00 (00)	0x00	0000		No operation.
0x01 (01)	0x00	256		Reset Micro. Force a restart condition, like power-up. A reset function to the Gateway forces all devices out of sync. A reset function to a Node device only affects that Node. A reset function may cause the Gateway to detect a timeout condition.
0x02 (02)	0x00	512		Restore system and device defaults from the EEPROM. This command restores all factory default conditions for the system settings.
0x03 (03)	0x00	768	Applies only to the 64 processor	Restore I/O defaults from EEPROM. This command restores all factory default conditions for all the device's I/O points.
0x04 (04)	Node # 0x00-38 (1-56)	1024+Node#	Gateway Only	Reset the error of the specified Node defined by the data field. The control code is available only on the Gateway I/O 15 register and results in a 0x00 placed in the Modbus register I/O 8 of the appropriate Node.
0x05 (05)	Node # 0x00-38 (1-56)	1280+Node#	Gateway Only	Ignore the error of the specified Node defined by the data field. The control code is available only on the Gateway I/O 15 register.
0x06 (06)	Node # 0x00-38 (1-56)	1536+Node#	Gateway Only	Disable the error of the Node defined by the data field. Control code available only on the Gateway I/O 15 register (This results in a 0xFE placed in the Modbus register I/O 8 of the appropriate Node). Reset using the Reset Error function (0x04)
0x07 (07)	00	1792	Gateway Only	Clear I/O linking in EEPROM. The I/O link table will be written with zeros.
0x08 (08)	00	2048	Gateway Only	Abort Channel Search. If this command is received when channel search is in progress, the change search mode is aborted.
0x10 (16)	00	4096	M-GAGE Nodes Only	Baseline M-GAGE™.

I/O 15 Control Messages				
Control Code in Hex (Dec)	Data Field in Hex (Dec)	Control Code and Data Field in Decimal	Restrictions	Description
0x11 (17)	Bit Mask, see description	4352	0 = all bits off 63 = all bits on	Gateway Link failure. Set the outputs to default states based on Bit Mask. Bit0 in the data field = I/O 9, bit1 = I/O 10, etc. The Gateway Link Failure flag must be set to enable this feature.
0x12 (18)	00	4608		Host Communication Timeout. Set all outputs on this device to default states. The Host Link Failure flag must be set to enable this feature.
0x13 (19)	Bit Mask	4864		Force device sample and report of selected enabled inputs. The bit mask defines which I/O point will be sampled. Bit 0 = I/O 1, Bit 1 = I/O 2, etc. A value of 0x3F (63) selects all inputs.
0x20 (32)	Node # 0x00–38 (1–56)	8192+Node#	Gateway Only	Enable Site Survey between Gateway and Node defined by the data field. All error messages from the Gateway are ignored when running Site Survey. Only one Node can participate in Site Survey at any given time. To disable the Site Survey, use control code 0x20 with Node 0. A Node must be enabled to run the Site Survey, then disabled before selecting the next Node.
0x30 (48)	0x00-18	12288-12312	FlexPower™ Devices only	Enable all switched power outputs. The data field selects the voltages. 0x00 = turn off 0x05 = 5V 0x07 = 7V 0x0F = 15V 0x14 = 20V 0x18 = 24V
0x31 (49)	0x00-18	12544-12586	FlexPower™ Devices only	Enable switched power #1, data field selects the voltage (See above)
0x32 (50)	0x00-18	12800-12824	FlexPower™ Devices only	Enable switched power #2, data field selects the voltage (See above)
0x33 (51)	0x00-18	13056-13080	FlexPower™ Devices only	Enable switched power #3, data field selects the voltage (See above)
0x34 (52)	0x00-18	13312-13336	FlexPower™ Devices only	Enable switched power #4, data field selects the voltage (See above)

Example: M-GAGE Baseline

To perform a baseline function on M-GAGE Node 1, write to register 31 (the Node's register 15).

Reg 31	0x10 (16)	0x00
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A baseline function on Node 1 will be initiated. (The command, both bytes together, in decimal would be 4096.)

Example: Forcing a Sample and Report

To force a sample and report of all Node 1's inputs, write the command and data to register 31.

Reg 31	0x13 (19)	0x3F
--------	-----------	------

The full command, both bytes together into a word, in decimal would be $4864 + 63 = 4927$

Extended Control Registers (I/O 15 and 16)

Use extended control messages to configure I/O parameters.

Extended control messages allow custom configuration of I/O parameters, such as sample rate, threshold, and hysteresis, in a DX80 device. The I/O parameters are set using a host interface. The extended control message has three parts contained in registers of the Node to be updated.

- Register 15 contains the extended control code and parameter number. The extended control code defines the I/O point and/or function to be executed; the parameter number defines the I/O point parameter.
- Register 16 contains the parameter data. Write to register 16 first, then write to register 15.

Node Reg 16	Write/Read Parameter Data [15:0]	
Node Reg 15	Extended Control Code [15:8]	Parameter Number [7:0]

- Register 7 contains the extended control message acknowledgement from the receiving device. The acknowledgement data is copied from the parameter control code and the parameter number written to register 15 and indicates the transaction has successfully completed.

Node Reg 7	Ack Extended Control Code [15:8]	Ack Parameter Number [7:0]
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Extended Control Codes

Use the extended control codes to write to the specific I/O points of the given Node.

The write control codes are 129 through 144 while the read control codes are 161 through 168. Note that some control codes are reserved and not used at this time.

Hex Extended Control Code (Dec)	Description	Hex Extended Control Code (Dec)	
0x81 (129)	Write I/O 1	0xA1 (161)	Read I/O 1
0x82 (130)	Write I/O 2	0xA2 (162)	Read I/O 2
0x83 (131)	Write I/O 3	0xA3 (163)	Read I/O 3
0x84 (132)	Write I/O 4	0xA4 (164)	Read I/O 4
0x85 (133)	Write I/O 5	0xA5 (165)	Read I/O 5
0x86 (134)	Write I/O 6	0xA6 (166)	Read I/O 6
0x87 (135)	Serial #1 Write	0xA7 (167)	Serial #1 Read
0x88 (136)	Serial #2 Write	0xA8 (168)	Serial #2 Read
0x89 (137)	Write I/O 9	0xA9 (169)	Read I/O 9
0x8A (138)	Write I/O 10	0xAA (170)	Read I/O 10

Hex Extended Control Code (Dec)	Description	Hex Extended Control Code (Dec)	
0x8B (139)	Write I/O 11	0xAB (171)	Read I/O 11
0x8C (140)	Write I/O 12	0xAC (172)	Read I/O 12
0x8D (141)	Write I/O 13	0xAD (173)	Read I/O 13
0x8E (142)	Write I/O 14	0xAE (174)	Read I/O 14
0x8F (143)	Counter Low	0xAF (175)	Reserved
0x90 (144)	Counter High	0xB0 (176)	Reserved

Parameter Numbers

Parameter numbers indicate which specific parameters are being changed.

The parameter number definition table lists all parameters that can be changed using register commands.

The information is in the following format: Parameter number in hex. Definition.

0x01. Enable Flag (bit 0). Enables (1) or disables (0, default) the I/O point.

0x02. I/O Type (bits 7:0). Defines the operations required to operate this I/O point. Every enabled I/O point must have a defined I/O type. <See I/O type table>

0x03. Sample Rate (bits 15:0). The rate at which the I/O point is sampled. The value represents the number of 62.5 ms increments. The sample rate/interval can be from 1 (0.0625 seconds, default) to 65535 (4095 seconds.)

0x04. For Inputs: Report Rate (bits 15:0). For Outputs: Duty Cycle (bits 15:0). For inputs, 0x04 is a report rate, or how often the device reports the status of the I/O point. The value represents the number of 62.5 ms increments. Report rates can be from 0 to 4095 seconds. A non-zero report rate guarantees a report on a periodic basis and at change of state. When set to zero, there will only be a report at change of state. Value range: 0 through 65535.

For outputs, 0x04 sets the Duty Cycle. Using the 16-bit field, each “on” bit represents 1/16 seconds. For example, 0000 0000 0000 1111 (0x000F) sets the duty cycle to 1/4 seconds; 0000 0000 0000 0011 (0x0003) sets the duty cycle to 1/8 seconds.

0x05. Warm-up Time (bits 7:0). Values 00 through 127 set the number of 62.5 millisecond increments and values 129 through 255 sets the number of 250 microsecond increments. When the device supplies power to external sensors, this parameter defines how long power is applied before the input point is examined for changes. Value range: 00 (off, default) through 255.

0x06. Samples High (bits 7:0). The number of samples an I/O point must be detected high (1) before it is a change of state. This parameter can be applied to a discrete input or an analog input using the threshold parameter. Value range: 0 (disable, default) through 255.

0x07. Samples Low (bits 7:0). The number of samples an I/O point must be detected low (0) before it is a change of state. This parameter can be applied to a discrete input or an analog input using the threshold parameter. Value range: 0 (disable, default) through 255.

0x08. Threshold (bits 15:0). The trigger point or threshold for an analog input. When an analog input is greater than or equal to the active threshold value, a ON or 1 event is reported (if not inverted). If the analog input does not reach the active threshold value, no event change is reported. If the Active Threshold parameter is 0, there is no threshold and analog input will report when any change occurs. Value range: 0 (disable, default) through 65535 (two-byte value).

0x09. Hysteresis (bits 15:0). Works with the active threshold parameter to define when to disable event reporting of an analog input. The hysteresis parameter defines how much below the active threshold the analog input is required to be before the analog input is considered to be off. Value range: 0 (disable, default) through 65535 (two-byte value).

0x0A. Pulse Width (bits 7:0). The number of 62.5 ms intervals a digital output is active (1) before returning to zero. Zero disables the pulse width feature and any value on an output point remains indefinitely. Maximum pulse width is about 16 seconds. Value range: 0 (disable, default) through 255.

0x0B. Switch Power Voltage (bits 7:0).

0x0C. Units (bits 7:0).

0x0D. Power Supply # (bits 7:0). Turns on a local power supply to supply power to an external device. A parameter value of 0 indicates no power supply. A parameter value of 1, 2, 3, or 4 enables that particular internal supply connection.

Value range: 0 (external power supply, default), 1 (selects SP1), 2 (selects SP2), 3 (selects SP3), and 4 (selects SP4).

Three parameters define a power supply connection: power supply selection, voltage, and warm-up time. The voltage parameter defines the supply voltage. The warm-up parameter defines the time the power supply is on before evaluating the input point.

0x0E. Report Type (bits 0). Defines the internal data structure and reporting definition for an I/O point. If a discrete point changes state, all I/O points are reported to the Gateway in discrete values. An analog input can be treated as a digital value using the Threshold and Hysteresis parameters.

Analog report type (two bytes long): 1 (default)

Discrete/bit report type: 0

0x0F. Delta (bits 15:0). Defines the change required between two successive sample points to trigger a report condition. Parameters entered as a percentage are calculated from a range of 1 to 65535. The actual parameter entered in EEPROM is a two-byte value between 1 and 65535. To disable (default), set to 0.

0x10. Invert Flag (bit 0). Complements the polarity of the sensed I/O point. A value of 1 becomes 0. An analog value is not changed, but an analog value with a threshold and hysteresis is complemented. Value range: 0 (inactive) to 1 (active).

0x11. Default Value (bits 15:0). Defines the safe state for each output on all devices. This parameter only applies to outputs. A value of 65535, or 0xFFFF, sets the default value to the last known state. There are five conditions that cause the output points to be set:

1. Power-up. At power-up the default states can define the state of the output points. If not enabled, the power-up states for the outputs is 0.
2. Node Out-of-Sync. If enabled, the output points are set to the 'Default State' when a Node determines it is out of sync with the Gateway (7 to 10 sec). If not enabled, no action takes place for the output points when an out-of-sync condition is detected.
3. Host Link Failure. A Modbus user-defined timeout period expired. This error condition forces all device outputs to the user-defined default state. Each device can be enabled/disabled for this feature.
4. Gateway Link Failure. The Gateway has detected a problem with a Node in the system. Any Node outputs linked to the failing device are set to the default states. Each device can be enabled or disabled to use this feature.
5. Node Link Failure. The Node detected a problem communicating with the Gateway. The Node sets all outputs to the user-defined default states. Each device can be enabled or disabled to use this feature.

Input Type # (Hex)

Type #	Description	Type #	Description
0x30	Analog IN 1	0x08	PNP IN 4
0x31	Analog IN 2	0x1C	PNP IN 5
0x32	Analog IN 3	0x1E	PNP IN 6
0x33	Analog IN 4	0x20	PNP IN 7
0x0E	Async Counter Freq Read 2	0x22	PNP IN 8

Type #	Description	Type #	Description
0x4B	Bridge IN 1	0x3B	SDI 12 COMMs
0x4C	Bridge IN 2	0xB1	Serial Read
0x09	Counter IN 1	0xB2	Serial Write
0x0A	Counter IN 2	0x37	Battery voltage
0x0B	Counter IN 3	0xB0	Clear async count
0x0C	Counter IN 4	0xAF	Clear sync count
0xA0	M-GAGE	0xF0	Constant
0x19	Multiple Discrete NPN	0xB3	Force sample/report
0x1A	Multiple Discrete PNP	0xA1	M-GAGE baseline
0x01	NPN IN 1	0xA7	M-GAGE configure
0x03	NPN IN 2	0xB4	Set threshold with offset
0x05	NPN IN 3	0xA3	Frequency read
0x07	NPN IN 4		
0x1B	NPN IN 5		
0x1D	NPN IN 6		
0x1F	NPN IN 7		
0x21	NPN IN 8		
0x02	PNP IN 1		
0x04	PNP IN 2		
0x06	PNP IN 3		

Input Temperature Types

Type #	Description	Type #	Description
0x47	10 Ohm RTD (3-wire) IN 1	0x38	Thermocouple K1
0x48	10 Ohm RTD (3-wire) IN 2	0x39	Thermocouple K2
0x49	10 Ohm RTD (3-wire) IN 3	0x3A	Thermocouple K3
0x4A	10 Ohm RTD (3-wire) IN 4	0x4E	Thermocouple K4
0x40	100 Ohm RTD (3-wire) IN 1	0xCB	Thermocouple L1
0x41	100 Ohm RTD (3-wire) IN 2	0xCC	Thermocouple L2
0x42	100 Ohm RTD (3-wire) IN 3	0xCD	Thermocouple L3
0x43	100 Ohm RTD (3-wire) IN 4	0x55	Thermocouple L4
0x3C	Thermistor IN 1	0xCE	Thermocouple M1
0x3D	Thermistor IN 2	0xCF	Thermocouple M3
0x3E	Thermistor IN 3	0xD0	Thermocouple M3
0x3F	Thermistor IN 4	0x56	Thermocouple M4
0x5C	Thermistor IN 5	0xD1	Thermocouple N1
0xBC	Thermocouple B1	0xD2	Thermocouple N2

Type #	Description	Type #	Description
0xBD	Thermocouple B2	0xD3	Thermocouple N3
0xBE	Thermocouple B3	0x57	Thermocouple N4
0x50	Thermocouple B4	0xD4	Thermocouple P1
0xBF	Thermocouple C1	0xD5	Thermocouple P2
0xC0	Thermocouple C2	0xD6	Thermocouple P3
0xC1	Thermocouple C3	0x58	Thermocouple P4
0x51	Thermocouple C4	0x44	Thermocouple R1
0xC2	Thermocouple D1	0x45	Thermocouple R2
0xC3	Thermocouple D2	0x46	Thermocouple R3
0xC4	Thermocouple D3	0x47	Thermocouple R4
0x52	Thermocouple D4	0xD7	Thermocouple S1
0xC5	Thermocouple E1	0xD8	Thermocouple S2
0xC6	Thermocouple E2	0xD9	Thermocouple S3
0xC7	Thermocouple E3	0x59	Thermocouple S4
0x53	Thermocouple E4	0xDA	Thermocouple T1
0xC8	Thermocouple G1	0xDB	Thermocouple T2
0xC9	Thermocouple G2	0xDC	Thermocouple T3
0xCA	Thermocouple G3	0x5A	Thermocouple T4
0x54	Thermocouple G4	0xDD	Thermocouple U1
0x34	Thermocouple J1	0xDE	Thermocouple U2
0x35	Thermocouple J2	0xDF	Thermocouple U3
0x36	Thermocouple J3	0x5B	Thermocouple U4
0x4D	Thermocouple J4		

Output Types

Type #	Description	Type #	Description
0x80	Analog OUT 1	0x64	Discrete OUT NMOS 1
0x81	Analog OUT 2	0x65	Discrete OUT NMOS 2
0x82	Analog OUT 3	0x6C	Discrete OUT NMOS 3
0x83	Analog OUT 4	0x6D	Discrete OUT NMOS 4
0x60	Discrete OUT 1	0x66	Multiple Discrete OUT
0x61	Discrete OUT 2		
0x62	Discrete OUT 3	0x6B	Switch Power Output
0x63	Discrete OUT 4		
0x67	Discrete OUT 5		
0x68	Discrete OUT 6		

Type #	Description	Type #	Description
0x69	Discrete OUT 7		
0x6A	Discrete OUT 8		

Host Configuration Examples

The following are some specific examples of using registers to clear an error condition, change device I/O parameters, and initiate a Site Survey.

Clearing Error Conditions Using Register Commands

The Gateway stores only the highest priority message in the register. A 0x00 message will not be saved unless there is a 0x0 in the I/O point register.

All non-zero messages must be cleared by the user. To disable all error reporting, send a value of 254 in the register for I/O point 8. To clear any I/O point 8 device message, use the Gateway's front panel menu system. A host connection can also choose to clear or disable I/O 8 registers. Node devices ignore error messages. Errors must be cleared from either the Gateway or the host.

Control Code	Data Field	Restrictions	Description
04	Node # 1-56	Gateway only	Reset error of Node # (defined by the data field). Control code available only on the Gateway I/O 15 register. (This results in a 00 placed in the register I/O 8 of the appropriate Node)
05	Node # 1-56	Gateway only	Ignore error of Node # (defined by the data field). Control code available only on the Gateway I/O 15 register.
06	Node # 1-56	Gateway only	Disable Error of Node # (defined by the data field). Control code available only on the Gateway I/O 15 register (This results in a 254 placed in the register I/O 8 of the appropriate Node). Reset using the Reset Error function (04)

Setting the Sample Rate

The sample rate establishes how often the SureCross device samples the sensors connected to it.

To set the sample rate to 900 seconds (15 minutes) on I/O point 1, Node #2, two register writes are required: register 47 and register 48 (Node 2's register 15 and 16). Verify the transaction is completed by reading register 39 and verifying the parameter control code and parameter number match the intended action.

1. Write the parameter control code (write I/O #1 = 129 = 0x81) and the parameter number (sample interval = 0x03) into register 47. Concatenated, the register value is 0x8103.
2. Write the parameter data (900 seconds = 14400 62.5 millisecond intervals = 0x3840) into register 48.

Reg 48	0x38	0x40
Reg 47	0x81	0x03

3. Read register 39 to verify the message is completed.

Reg 39	0x81	0x03
--------	------	------

Setting the Counter Preset using Register Commands

Set the value of Node 5's Event Counter 2 to 0x1234567. This counter preset requires four register writes and two register reads to verify that the transaction was completed. Remember, the counter mask bit field designates which counter is written.

1. Write the upper counter bits [31:16].

Reg 96	0x0123	
Reg 95	0x90	0x02

2. Read register 87 to verify the message was completed.

Reg 87	0x90	0x02
--------	------	------

3. Write the lower counter bits [15:0].

Reg 96	0x4567	
Reg 95	0x8F	0x01

4. Read register 87 to verify the message was completed.

Reg 87	0x8F	0x01
--------	------	------

Conducting a Site Survey Using Modbus Commands

A Site Survey can be started using Modbus commands sent from the host system.

All DX80 models reserve the Modbus register I/O 15 (write only) for control messages. The control message code for the Site Survey command is listed below.

To start a Site Survey using a Modbus write holding register command, send a control code of 32 (0x20) and the Node number 1–15 (0x01 to 0x0F) to the Gateway Modbus holding register for I/O 15.

Modbus Register		
	[15:8]	[7:0]
I/O 15	Control Code	Data Field

I/O 15 Control Messages			
Control Code	Data Field	Restrictions	Description
32	Node # 1-15	Gateway only	<p>Enable Site Survey between Gateway and Node defined by the data field. All error messages from the Gateway are ignored when running Site Survey.</p> <p>Only one Node can participate in Site Survey at any given time. To disable the Site Survey, use control code 0x20 with Node 0. A Node must be enabled to run the Site Survey, then disabled before selecting the next Node.</p>

Example Command

	Modbus Register	
I/O 15	32	02

When Site Survey runs, the accumulated results are stored in the Gateway's I/O 7 and I/O 8 holding registers. The LEDs on the both the Gateway and the Node's front panel display the signal strength for the wireless RF link. The quality of the communications link is indicated by:

- LED 1 – Green = excellent signal strength
- LED 2 – Yellow = good signal strength
- LED 1 – Red = poor signal strength

The signal strength is the transmitted signal strength relative to the ambient RF signal present in a specific location, or noise floor.

The Gateway device also displays the Site Survey results on the LCD. For one transmit and receive interval, the Gateway saves the lowest signal strength. The LCD and Modbus registers contain the results of the last 100 samples. The totals are a running tally of the last 100 samples and are continuously updated. Four categories are displayed:

- G = Green – excellent signal strength.
- Y = Yellow – good signal strength
- R = Red – poor signal strength
- M = Missed packet

To disable Site Survey, send a control code of 32 (0x20) and a Node number of 0 (0x0).

Site Survey Data Holding

With Site Survey active, registers I/O 7 and 8 are Site Survey data holding registers that store the accumulated Site Survey results. Error collections in holding register 8 are saved when Site Survey runs and restored after Site Survey is disabled.

	Register	
	[15:8]	[7:0]
I/O 7	Missed Total	Red Total
I/O 8	Yellow Total	Green Total

Example Results

	[15:8]	[7:0]
I/O 7	0	10
I/O 8	10	80

Note: This is the register arrangement when using Modbus/TCP. When conducting a Site Survey using Modbus RTU (using the User Configuration Tool), the yellow totals are in bits [0:7] and green totals are in bits [8:15].

Part 4

System Layouts

Because of the flexibility of the DX80 wireless devices, many different configurations using Gateways, Nodes, Gateway Pros, Ethernet Bridges, Modbus slave devices, data radios, data radio repeaters, and/or solar powered systems are possible, both as stand-alone systems and host-connected systems.



DX83 Ethernet Bridge



DX80 Gateway, 900 MHz



DX80DR9M Data Radio

Topics:

- [Stand-Alone Systems](#)
- [Modbus RTU](#)
- [Modbus/TCP and EtherNet/IP](#)
- [Data Radios](#)

Stand-Alone Systems

Mapped Pairs (DX70)

In this system, a DX70 pair is used to map I/O in a simple one-to-one configuration. Inputs on one DX70 is mapped to the outputs of the other device. DX70 kits are configured at the factory and require no additional set up by the user.

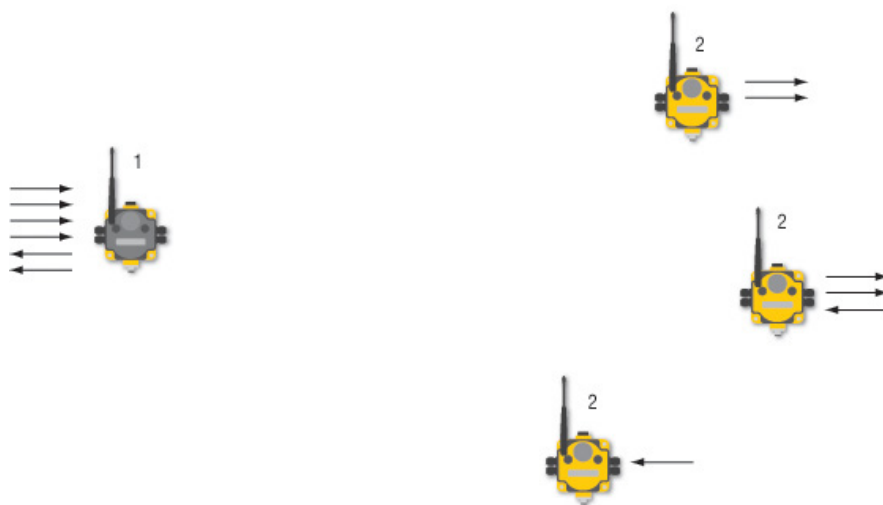


Item	Model No.	Description
1	DX70G...	DX70 Gateway
2	DX70N...	DX70 Node

Gateway with Multiple Nodes (DX80)

In this configuration, the Gateway is the master of the wireless network.

This network may be configured using the User Configuration Tool (UCT) and RS-485 to USB adapter cable. The UCT is used to map inputs and outputs between Nodes and Gateways.



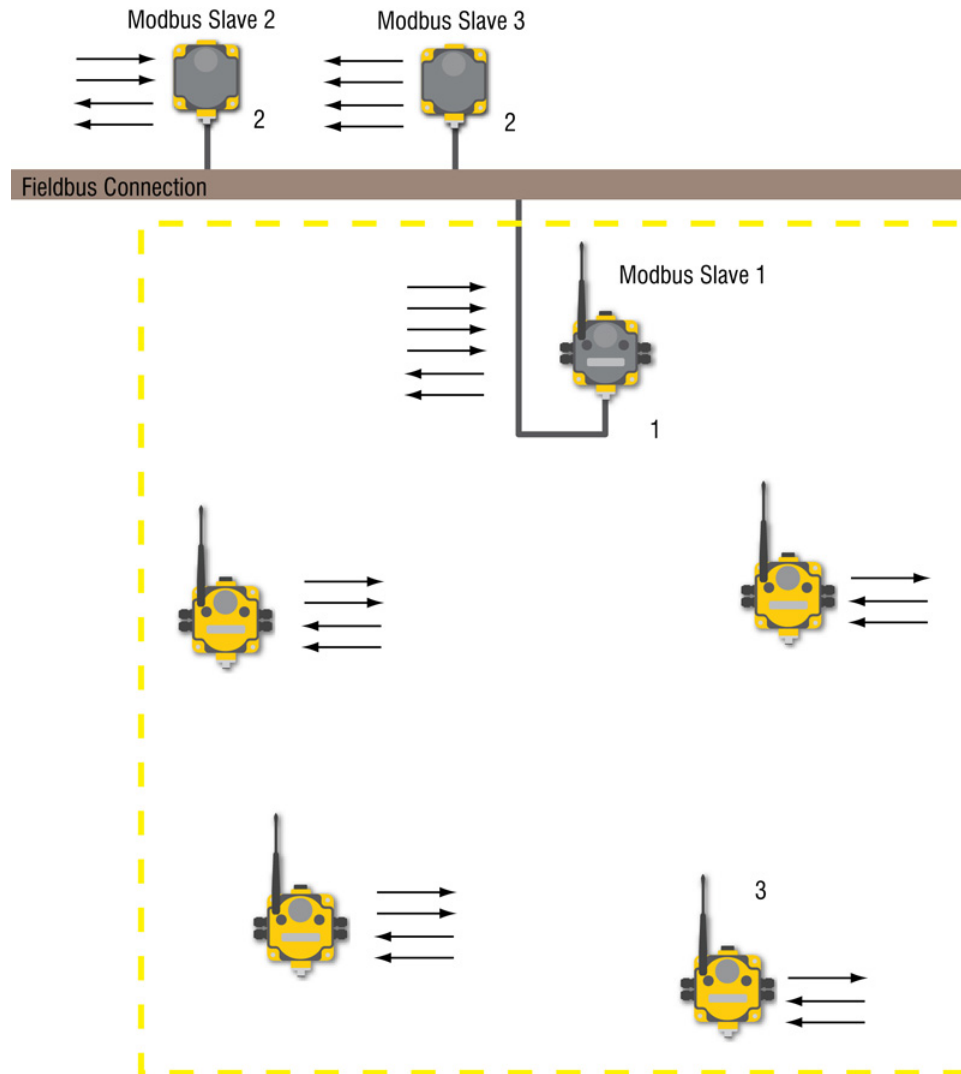
Item	Model No.	Description
1	DX80G...	DX80 Gateway
2	DX80N...	DX80 Node
	81398	User Configuration Tool (software included on SureCross documentation CD, not shown)
	BWA-HW-006	RS-485 to USB adapter cable (not shown)

Gateway Configured as a Modbus Master

This example network uses the DX80 Gateway device as both master of the wireless network as well as the master of the Modbus network. This configuration is used when the I/O capacity of the Gateway is exceeded.

The Gateway is configured with a table of mapping entries that allow the DX85 Expanded I/O devices (as Modbus slaves) to be linked to the wireless Nodes. The DX85 devices add additional I/O points to the network through hard-wired fieldbus connections on the Gateway side.

Note: The four inputs/eight output models must be mapped to the eight input/four output models.



Item	Model No.	Description
1	DX80G...	DX80 Gateway
2	DX85M...	DX85 Modbus RTU Remote I/O
3	DX80N...	DX80 Nodes or FlexPower Nodes
	81398	User Configuration Tool (software included on SureCross documentation CD, not shown)
	BWA-HW-006	RS-485 to USB adapter cable (not shown)

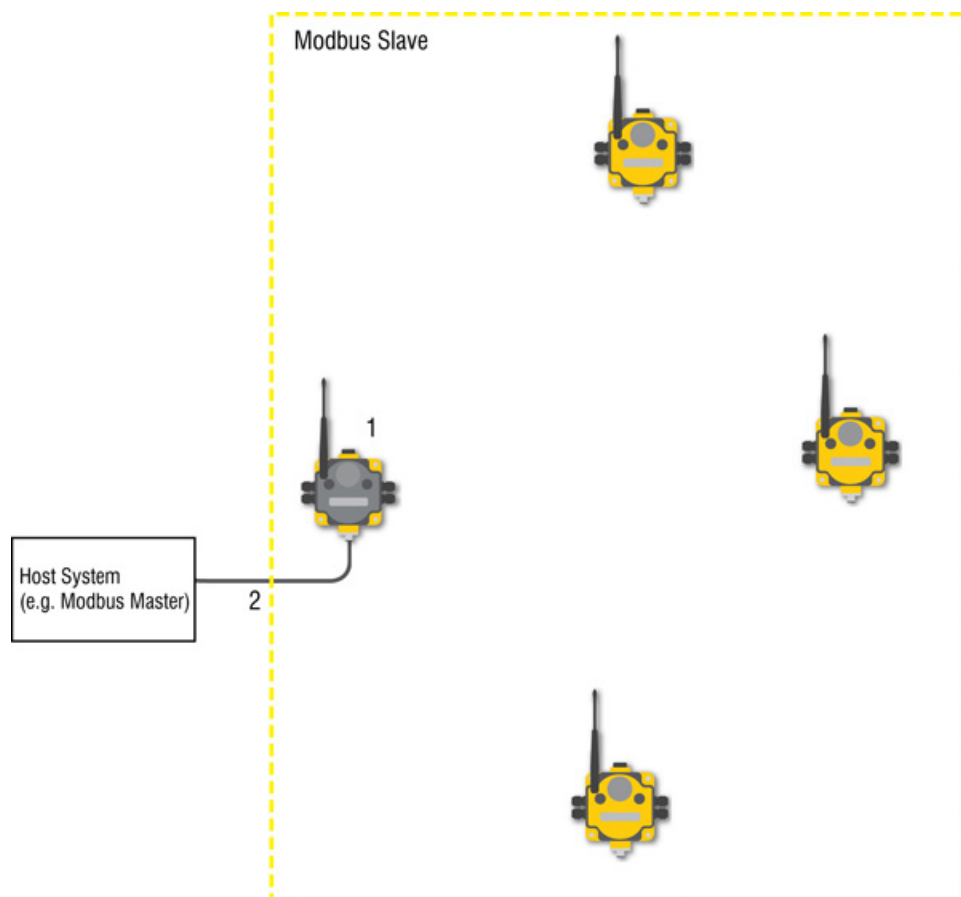
Modbus RTU

Modbus RTU Host Controlled Operation

A simple host-connected system uses an RS485 serial cable to connect the DX80 Gateway device to a host system.

The host system may be a PC or a PLC unit. Because the serial cable is used to connect to a host system, the communications protocol used is Modbus RTU. The wireless network is a Modbus slave.

In this configuration, the wireless network collects I/O data and sends it back to a Modbus host system.



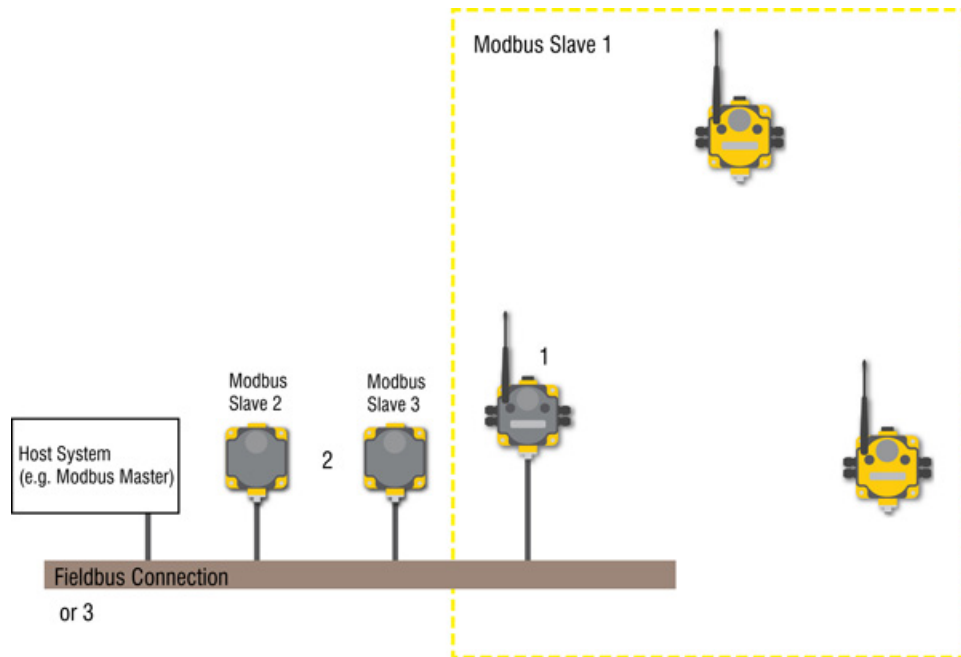
Item	Model No.	Description
1	DX80G...	DX80 Gateway
2	CSRB-M1250M125.47M125.73	Cable, RS-485, quick disconnect 5-pin Euro, male trunk, female branches, black
	MQDC1-5***	Cable, RS-485, quick disconnect 5-pin Euro, female single end, lengths vary (not shown)

Modbus RTU with Multiple Slave Devices

In the example host controlled configuration, the Gateway is a Modbus slave to the host system, but remains the master of the wireless network.

The Gateway is connected directly to the host system using an RS485 serial cable. This system may also connect DX85 Expanded I/O devices to the serial cable to expand the available I/O. The DX80 Gateway and each DX85 connected as shown below are Modbus slave devices to the host system.

Purpose: This wireless network also collects I/O data and sends it back to a Modbus host system, but adds local wired I/O points.



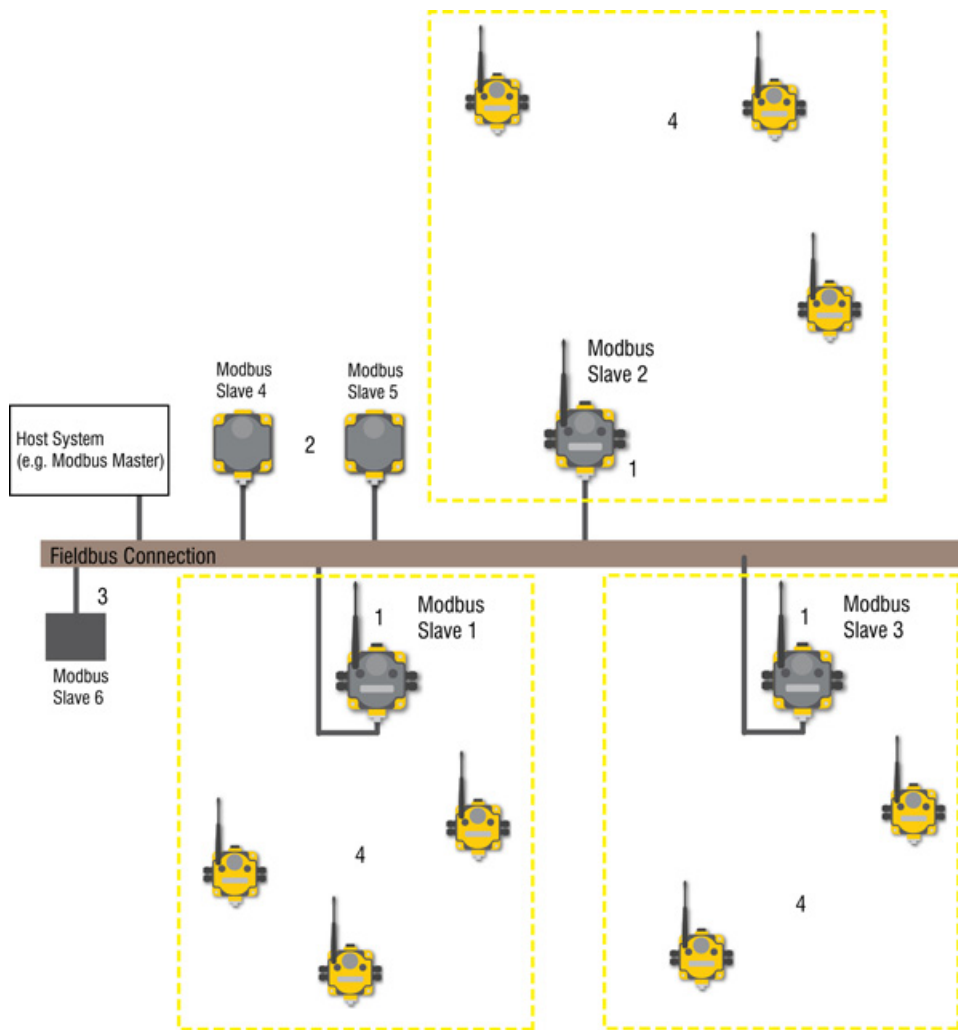
Item	Model No.	Description
1	DX80G...	DX80 Gateway
2	DX85M...	DX85 Modbus RTU Remote I/O
3	MQDC1-5***	Cable, RS-485, quick disconnect 5-pin Euro, female single end, lengths vary (not shown)

Modbus RTU with Multiple Slave Devices - Layout 2

In this example host controlled configuration, the Gateway is a Modbus slave to the host system, but remains the master of the wireless network.

The Gateway is connected directly to the host system using a field bus connection. This system also connects DX85 Expanded I/O devices and a third-party Modbus slave device to the serial bus to expand the available I/O. The DX80 Gateway and each DX85 connected as shown below are Modbus slave devices to the host system.

Purpose: This wireless network collects I/O data and sends it back to a Modbus host system, but adds local wired I/O points and expands the network using field bus.



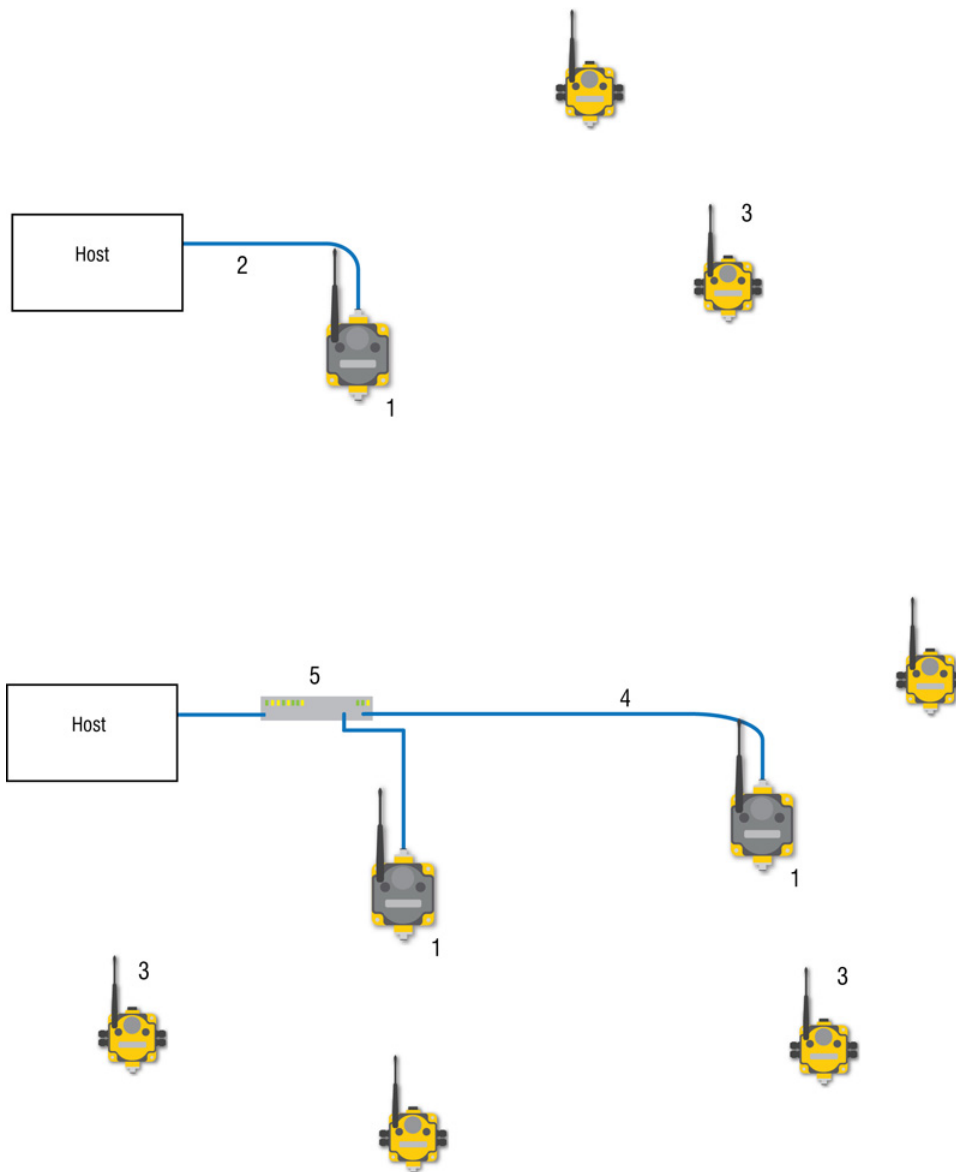
Item	Model No.	Description
1	DX80G...	DX80 Gateway
2	DX85M...	DX85 Modbus RTU Remote I/O
3		Third party Modbus slave device
4	DX80N...	Nodes or FlexPower Nodes

Modbus/TCP and EtherNet/IP

Host Connected - DX80 GatewayPro

Connect a DX80 GatewayPro to a host system using the industrial Ethernet connection on the DX80 GatewayPro.

To connect the DX80 GatewayPro directly to the host system, use a crossover cable. By default, the DX80 GatewayPro is a Modbus/TCP or EtherNet/IP™ server. To configure the GatewayPro as a Modbus client device, change the configuration using the configuration Web pages.



Item	Model No.	Description
1	DX80P**6S	DX80 GatewayPro, Protocol converter or Advanced Config*
2	BWA-EX2M	Ethernet Cable, M12 Industrial/RJ45, Crossover, 2 m (using Modbus/TCP or EtherNet/IP)
3	DX80N...	Nodes or FlexPower Nodes
4	BWA-E2M	Ethernet Cable, M12 Industrial/RJ45, Straight, 2 m
5		Ethernet hub or switch box

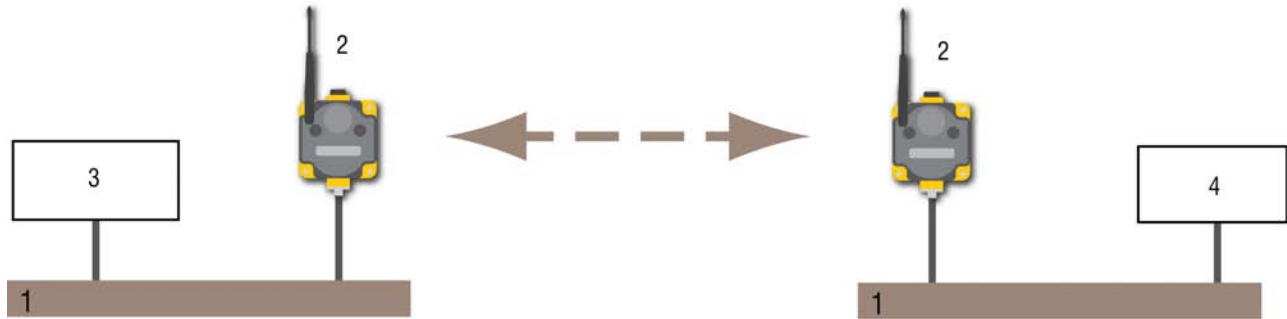
* If I/O is needed on the GatewayPro, use DX85 Modbus RTU Remote I/O devices similar to a previous configuration.

Data Radios

Data Radios

Data radios extend the range of the Modbus network while keeping the network addressing system simple.

In this basic example, the data radios act as a wire replacement to extend the Modbus network.

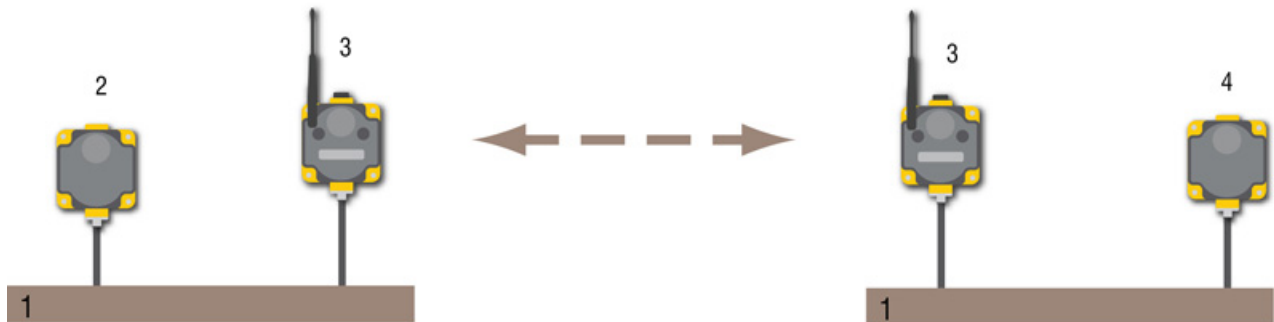


1. Fieldbus connection
2. Data radio
3. Modbus master device
4. Modbus slave device

Data Radios with DX85 Modbus RTU Remote I/O Devices

In this example network, DX85 Extended Remote I/O devices are wired to the data radios and act as Modbus master or slave devices.

The data radios extend the range of the Modbus network.

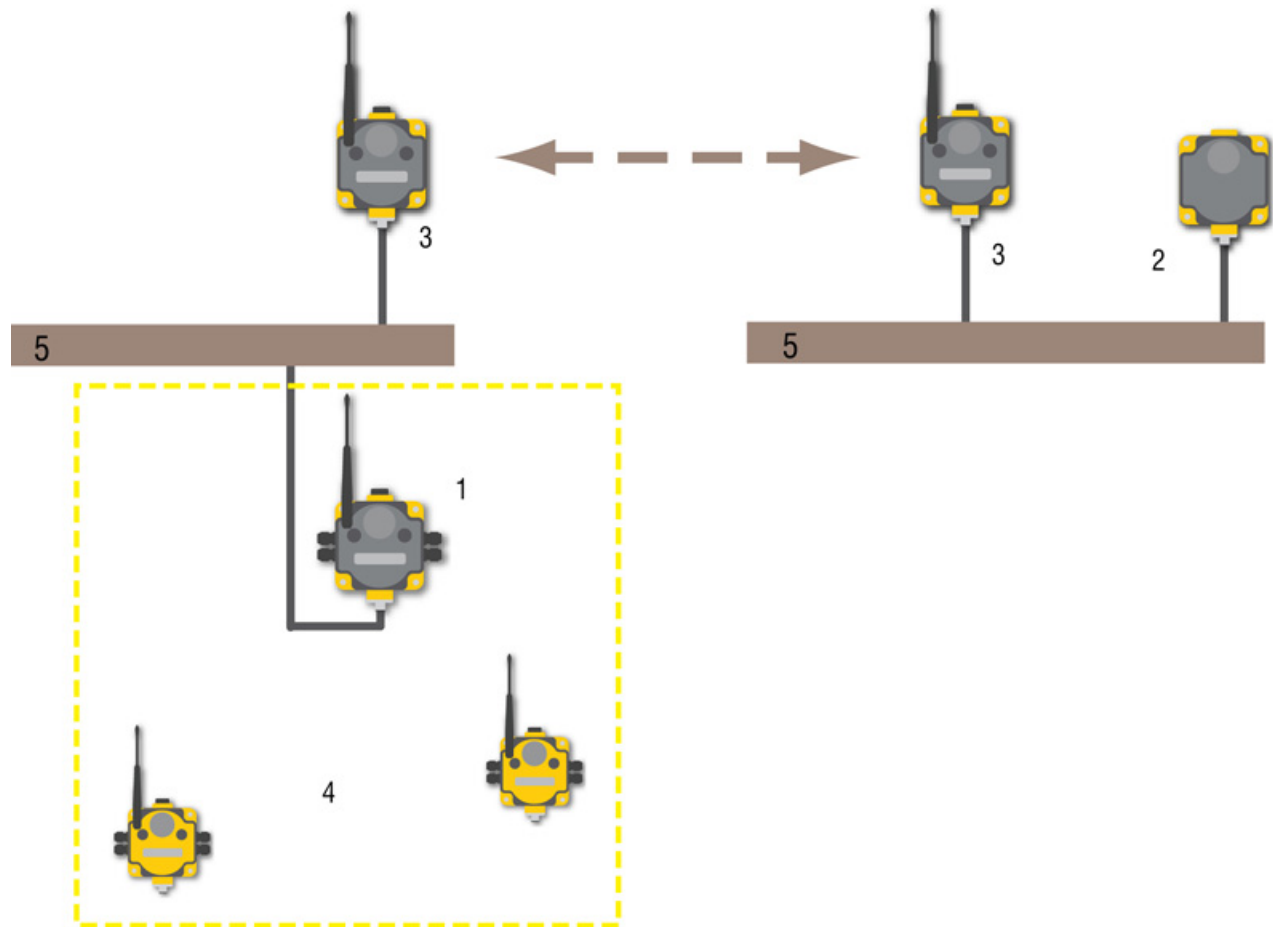


1. Fieldbus connection
2. DX85 as Modbus master
3. Data radio
4. DX85 as Modbus slave

Data Radios with a Gateway as the Modbus Master

In this example network, a Gateway is both the master for the radio network consisting of Nodes and the master for the Modbus network.

The DX85 shown is a Modbus slave; the data radios extend the range of the Modbus network.



Item	Model No.	Description
1	DX80G...	DX80 Gateway (configured as a Modbus master for this example)
2	DX85M...	DX85 Modbus RTU Remote I/O (configured as a Modbus slave for this example)
3	DX80DR*M	DX80 Data Radio
4	DX80N...	Nodes or FlexPower Nodes
5		Fieldbus connection

Part 5

Sensor Connections

This reference guide lists typical connections. If you have additional questions about a specific sensor or its connection instructions, please contact Banner Engineering or the manufacturer of the sensor you are using.

Discrete Sensors. Neither the inputs nor the outputs on the DX80 devices are isolated. Under certain operating conditions, externally powered sensors may need to have ground in common with the DX80 device to which they are connected. The power sources do not have to be the same.

Analog Sensors. For analog sensors, the ground/dc common of the sensor should be connected to the ground of the DX80 device. For best results, Banner recommends that the power source for the sensor and DX80 device is the same.

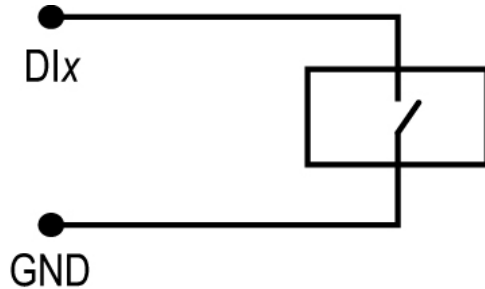
Topics:

- [Discrete Inputs](#)
- [Discrete Outputs](#)
- [Analog Inputs](#)
- [Analog Outputs](#)

Discrete Inputs

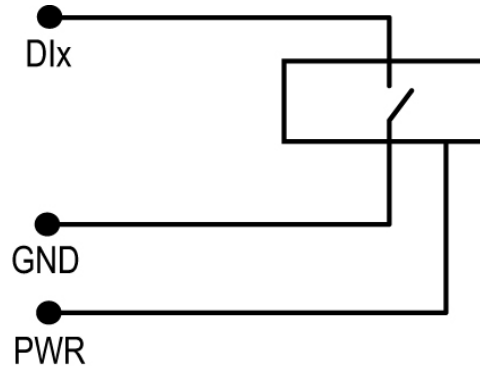
Discrete Inputs, Sinking, Powered using DX80 Terminals

Two-Wire Sensors



Wiring diagram for a sinking (NPN) two-wire sensor powered using the DX80 device terminal block.

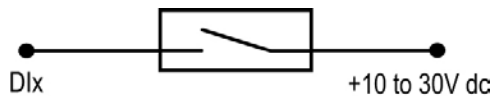
Three-Wire Sensors



Wiring diagram for a sinking (NPN) three-wire sensor powered using the DX80 device terminal block.

Discrete Inputs, Sourcing, Powered Externally

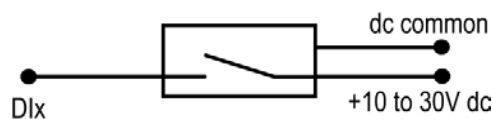
Two-Wire Sensors



Wiring diagram for a sourcing (PNP) two-wire sensor powered externally. Under certain conditions, the dc commons between the sensor and the DX80 might need to be connected.

The sensor's power source might need to be the same as the SureCross device power source.

Three-Wire Sensors

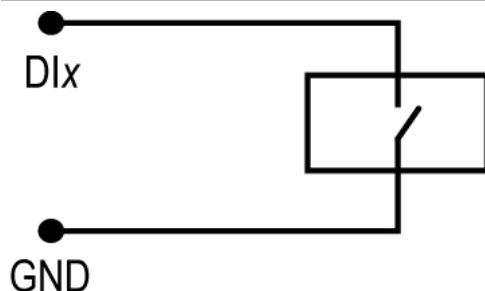


Wiring diagram for a sourcing (PNP) three-wire sensor powered externally. Under certain conditions, the dc commons between the sensor and the DX80 might need to be connected.

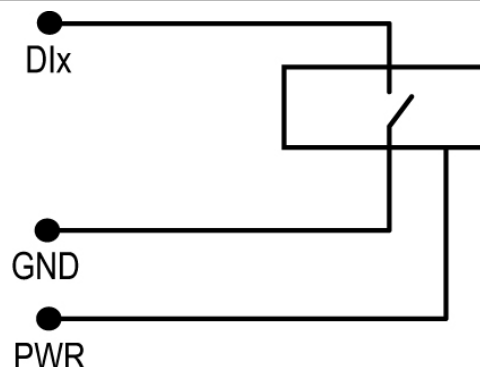
The sensor's power source might need to be the same as the SureCross device power source.

Discrete Inputs, Sinking, Powered using DX80 Terminals

Two-Wire Sensors



Three-Wire Sensors

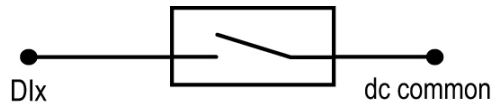


Two-Wire Sensors

Wiring diagram for a sinking (NPN) two-wire sensor powered using the DX80 device terminal block.

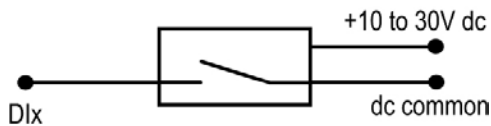
Three-Wire Sensors

Wiring diagram for a sinking (NPN) three-wire sensor powered using the DX80 device terminal block.

Discrete Inputs, Sinking, Powered Externally**Two-Wire Sensors**

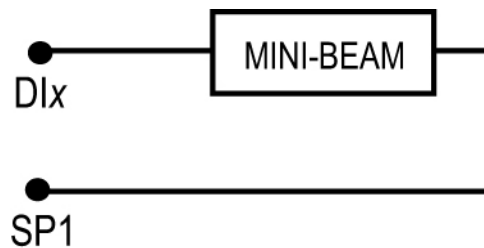
Wiring diagram for a sinking (NPN) two-wire sensor grounded outside the DX80 device. Under certain conditions, the dc commons between the sensor and the DX80 might need to be connected.

The sensor's power source might need to be the same as the SureCross device power source.

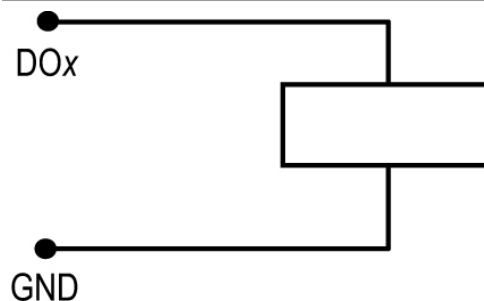
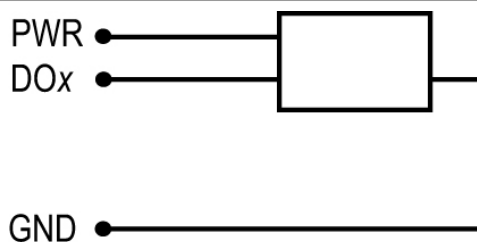
Three-Wire Sensors

Wiring diagram for a sinking (NPN) three-wire sensor grounded outside the DX80 device. Under certain conditions, the dc commons between the sensor and the DX80 might need to be connected.

The sensor's power source might need to be the same as the SureCross device power source.

Discrete Inputs, MINI-BEAM**MINI-BEAM**

Two-wire MINI-BEAM sensor using a FlexPower™ Node and powered using the DX80's switch power.

Discrete Outputs**Discrete Outputs, Sourcing, Powered using DX80 Terminals****Two-Wire Sensors****Three-Wire Sensors**

Two-Wire Sensors

Wiring diagram for a sourcing (PNP) two-wire output load powered using the DX80 device terminal block.

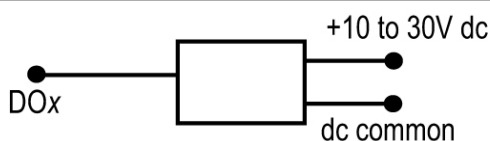
Three-Wire Sensors

Wiring diagram for a sourcing (PNP) three-wire output load powered using the DX80 device terminal block.

Discrete Outputs, Sourcing, Powered Externally**Two-Wire Sensors**

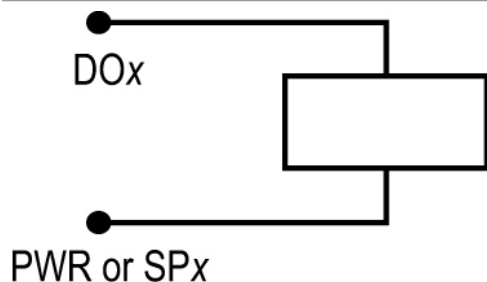
Wiring diagram for a sourcing (PNP) two-wire output load powered from outside the DX80 device. Under certain conditions, the dc commons between the sensor and the DX80 might need to be connected.

The sensor's power source might need to be the same as the SureCross device power source.

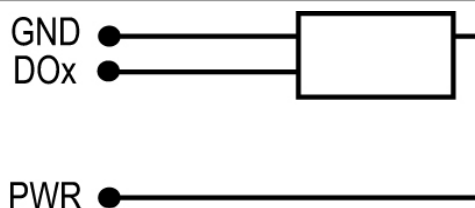
Three-Wire Sensors

Wiring diagram for a sourcing (PNP) three-wire output load powered from outside the DX80 device. Under certain conditions, the dc commons between the sensor and the DX80 might need to be connected.

The sensor's power source might need to be the same as the SureCross device power source.

Discrete Outputs, Sinking, Powered using DX80 Terminals**Two-Wire Sensors**

Wiring diagram for a sinking (NPN) two-wire output.

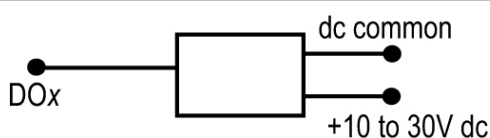
Three-Wire Sensors

Wiring diagram for a sinking (NPN) three-wire output.

Discrete Outputs, Sinking, Powered Externally**Two-Wire Sensors**

Wiring diagram for a sinking (NPN) two-wire output. Under certain conditions, the dc commons between the sensor and the DX80 might need to be connected.

The sensor's power source might need to be the same as the SureCross device power source.

Three-Wire Sensors

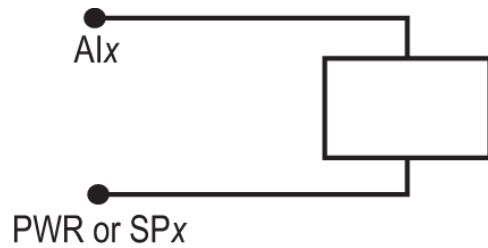
Wiring diagram for a sinking (NPN) three-wire output. Under certain conditions, the dc commons between the sensor and the DX80 might need to be connected.

The sensor's power source might need to be the same as the SureCross device power source.

Analog Inputs

Analog Inputs, Powered using DX80 Terminals

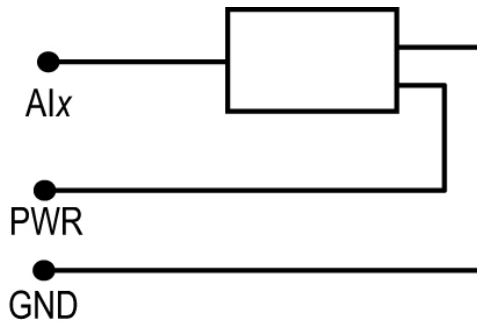
Two-Wire Sensors



Two-wire analog sensor powered from a 10 to 30V dc power DX80 device using the PWR terminal.

Do not exceed analog input ratings for analog inputs. Only connect sensor outputs to analog inputs.

Three-Wire Sensors

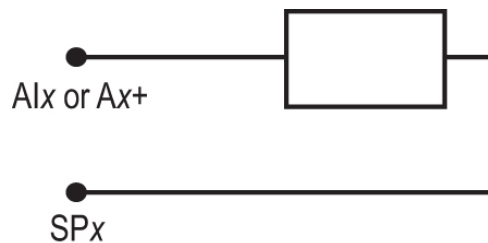


Three-wire analog sensor powered from 10 to 30V dc power DX80 device using the PWR terminal.

Do not exceed analog input ratings for analog inputs. Only connect sensor outputs to analog inputs.

Analog Inputs, Powered from Switch Power

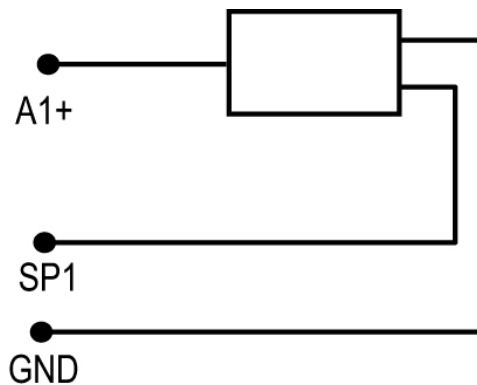
Two-Wire Sensors



Two-wire analog sensor using a FlexPower™ Node and powered using the Node's switch power.

Do not exceed analog input ratings for analog inputs. Only connect sensor outputs to analog inputs.

Three-Wire Sensors



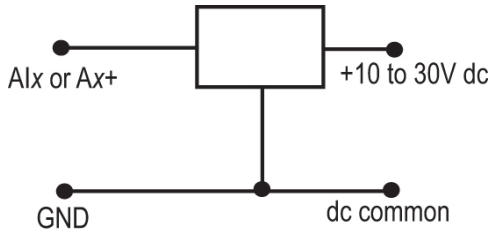
Three-wire analog sensor using a FlexPower™ Node and powered using the Node's switch power.

Do not exceed analog input ratings for analog inputs. Only connect sensor outputs to analog inputs.

Analog Inputs, Powered Externally

Two-Wire Sensors

Three-Wire Sensors

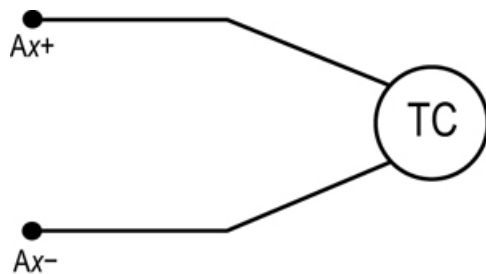


Three-wire analog sensor using a FlexPower Node but the sensor is powered externally (not from the DX80 device).

Do not exceed analog input ratings for analog inputs. Only connect sensor outputs to analog inputs.

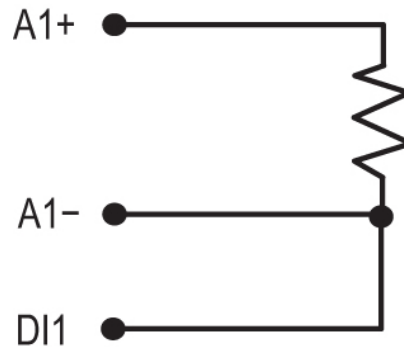
Analog Inputs, Temperature Sensors

Thermocouple



TC Type	- Wire	+ Wire
J	red	white
K	red	yellow
R	red	black

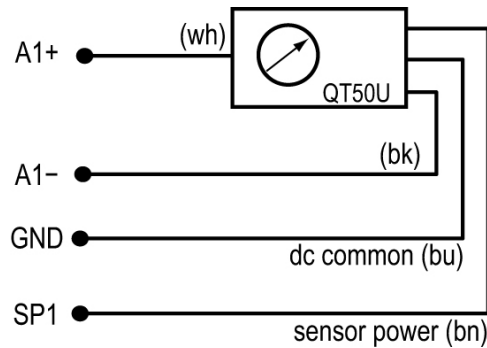
RTD



This wiring diagram applies to a standard three-wire RTD sensor. When using thermocouple and RTD sensors, the quality of the power supply influences the accuracy of the signal.

Analog Inputs, QT50U Long-Range Ultrasonic Sensor

QT50U Ultrasonic Sensor

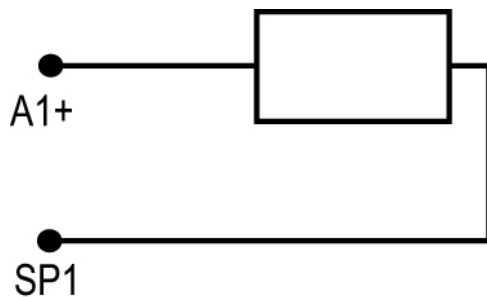


Four-wire QT50U sensor, using a FlexPower™ Node, and powered using the Node's switch power terminal. The QT50U output is set to 4–20 mA.

Do not apply power to the Ax+ connection.

Analog Inputs, Proximity Sensors

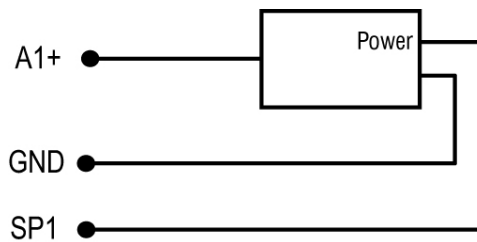
Proximity Sensor, NAMUR



Two-wire NAMUR proximity sensor using a FlexPower™ Node and powered using the Node's switch power.

Do not apply power to the Ax+ connection.

Proximity Sensor, Non-NAMUR

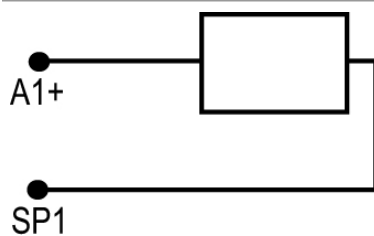


Three-wire non-NAMUR proximity sensor using a FlexPower™ Node and powered using the Node's switch power.

Do not apply power to the Ax+ connection.

Analog Inputs, Pressure Sensors

Pressure Sensor



Pressure Sensor

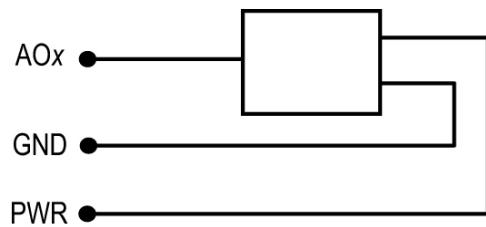
Two-wire pressure sensor using a FlexPower™ Node and powered using the Node's switch power.

Do not apply power to the Ax+ connection.

Analog Outputs

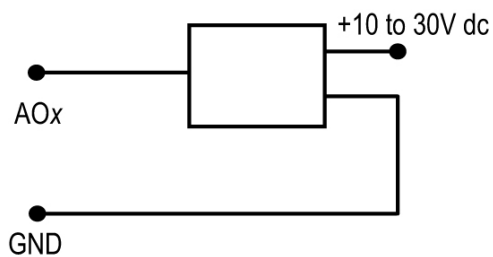
Analog Outputs, Three-Wire Sensors

Powered from the DX80 Terminals



Three-wire analog output device powered off the DX80 device.

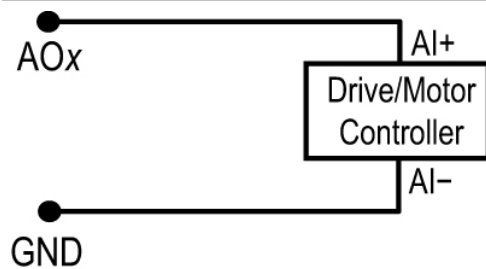
Powered Externally



Three-wire analog output device powered externally (not from the DX80 device).

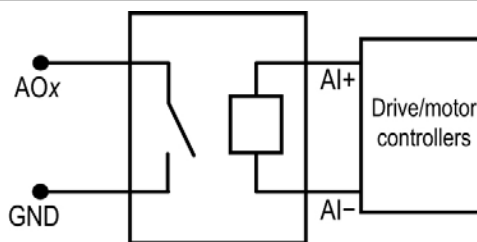
Analog Outputs, Drive Motor Controllers

AI- Referenced to Ground



When the AI- can be referenced to ground, use this wiring diagram for drive/motor controllers.

AI- Not Referenced to Ground



When the AI- cannot be referenced to ground, use this wiring diagram for drive/motor controllers.

Part 6

Antenna Basics

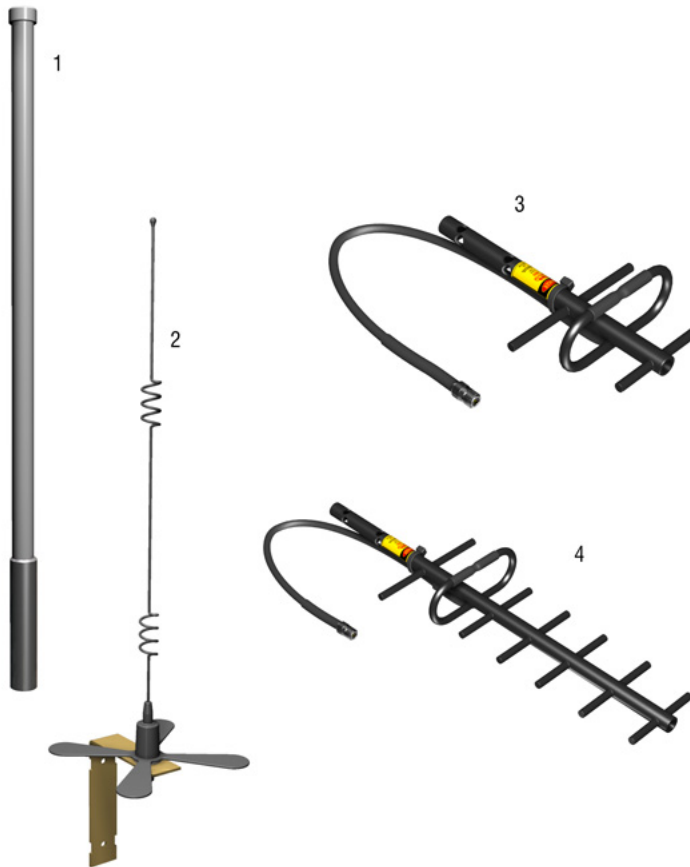
Topics:

- *What Do Antennas Do?*
- *Omni-Directional Antennas*
- *Directional (Yagi) Antennas*
- *Path Loss, or Link Loss, Calculations*
- *Antenna Installation Warning*

What Do Antennas Do?

Antennas transmit radio signals by converting radio frequency electrical currents into electromagnetic waves. Antennas receive the signals by converting the electromagnetic waves back into radio frequency electrical currents.

Because electromagnetic waves do not require a medium in which to travel, antennas can function in air, space, under water or other liquid, and even through solid matter for limited distances. Every antenna has specific characteristics that determine the signal's range and radiation pattern or shape.



1. Omni antenna with radome
2. Omni antenna with ground plane
3. Low-gain Yagi antenna
4. High-gain Yagi antenna

Anatomy of an Antenna

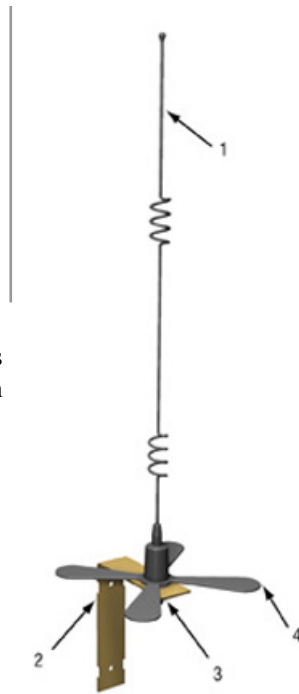
There are many components to an antenna system, including the parts of the antenna and the cabling used to connect the antenna to the radio.



Antenna extension cable with an SMA connector at one end and an N-type male connector at the other end. This cable typically connects between the SureCross™ device and the antenna or another extension cable.



Antenna extension cable with an N-type male connector at one end and an N-type female connector at the other end. This extension cable connects between another cable and a surge protector or antenna.



1. Antenna element
2. Mounting bracket
3. N-type connector
4. Ground plane



Surge suppressors mount between the antenna and the radio system to protect the electrical equipment from damage during a lightning strike or other electrical surge. No surge suppressor can absorb all lightning strikes. Do not touch any radio device or any equipment connected to the radio device during a thunderstorm.

Always install and properly ground a qualified surge suppressor when installing a remote antenna system. Remote antenna configurations installed without surge suppressors invalidate the Banner Engineering Corp. warranty. Always keep the ground wire as short as possible and make all ground connections to a single-point ground system to ensure no ground loops are created.

Antenna Gain

The antenna's gain, measured in decibels, relates directly to the radio signal's radiation pattern and range.

Adding gain to a radio system does not amplify the signal. Antennas with greater gain only focus the signal. A low-gain antenna transmits (and receives) the radio signal equally in all directions. A high-gain antenna transmits its signal farther in one direction than the low-gain system.

Decibels

Mathematical equations indicate that for every 3 dB increase in the gain, the effective transmission power doubles. Experimentation indicates that for every 6 dB increase in the gain, the radio signal range doubles. Therefore, if a 0 dB antenna (unity gain) transmits three miles, a 6 dB antenna on the same radio transmits the signal six miles.

To simplify conversions between dBi, dBm, dBd, use the following approximation: $\text{dBm} = \text{dBi} = \text{dBd} + 2.15$, where dBm refers to a ratio of the measured power referenced to 1 milliWatt, dBi is a measurement of an antenna's gain compared to a mathematically ideal isotropic antenna, and dBd is a ratio of the antenna's forward gain to a half-wave dipole antenna.

Why Do You Need Gain?

According to rules set by the FCC, radio systems like the SureCross™ radio device may not exceed 30 dBm Effective Isotropic Radiated Power (EIRP), or approximately 1 Watt. Because the 900 MHz SureCross™ radio system has a conducted power of 21 dBm (150 mW), the maximum system gain that may be used with the Banner system is 9 dBm. Using these higher gain antennas allows users to focus the signal both for transmission and for reception.

For systems requiring cables and connectors, the losses from the cables and connectors add up to reduce the effective transmission power of a radio network. What starts out as a 9 dB antenna may only have an effective gain of 5 dB once losses are totaled. Because the 9 dB limit applies to the radio system, including connectors and cables, using a higher gain antenna may be necessary to transmit the required distance and would still comply with FCC regulations.

In addition to increasing the range, adding gain changes the radiation pattern. How the radiation pattern changes depends on the type of antenna: omni-directional or directional.

Line of Sight

Accurate radio transmission depends on a clear path between radio antennas known as the line of sight.

If any obstructions, including buildings, trees, or terrain, interrupt the visual path between antennas, the obstructions will also interfere with the radio signal transmission, resulting in multi-path fade or increased signal attenuation.

Multi-path fade is the result of radio signals reaching the receiver via two or more paths. In industrial settings, a received signal may include the line of sight signal in addition to signals reflected off buildings, equipment, trees, or outdoor terrain. Signal attenuation is the decrease in signal strength as a result of travel through the medium, in this case the air.



1. Line of sight
2. Obstruction in the "lobe" (Fresnel zone) of the radio signal.

Despite a clear line of sight, obstructions in the Fresnel zone, a three-dimensional ellipsoid formed with the two antennas as the foci, will still interfere with the radio signal and cause multi-path fade. Raise the antennas high enough to clear any obstructions. Ideally there should be no obstructions anywhere in the Fresnel zone, even if line of sight is preserved.

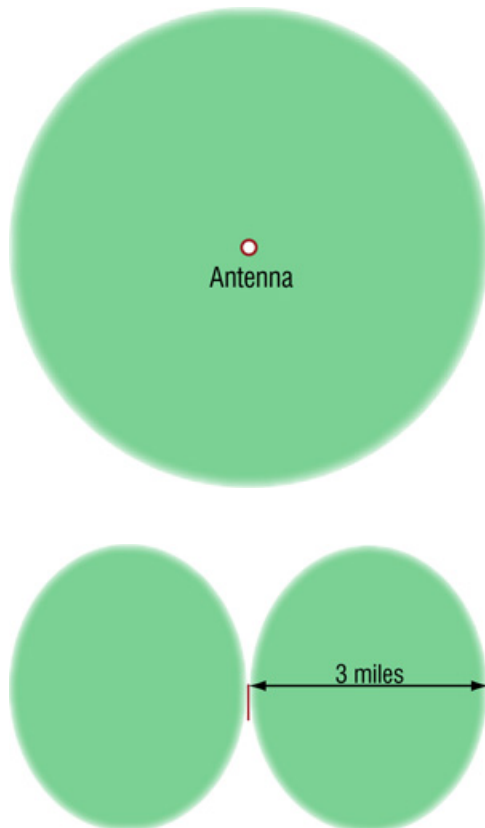
If a radio network site is spread over a large area with multiple obstructions or a variety of terrain, conduct a site survey to determine optimum antenna locations, antenna mounting heights, and recommended gains for reliable performance.

Omni-Directional Antennas

Omni-directional antennas mount vertically and transmit and receive equally in all directions within the horizontal plane.

Omni-directional antennas are used with the SureCross™ Gateway, because the Gateway is usually at the center of the star topology radio network.

An omni-directional, or omni, antenna transmits and receives radio signals in the 'doughnut' pattern shown. Note the lack of a signal very close to the antenna. Most dipole omni antennas have a minimum distance for optimum signal reception. From the top view, the signal radiates equally in all directions from the antenna. For this reason, omni-directional antennas are best used for the device in the center of a star topology network.

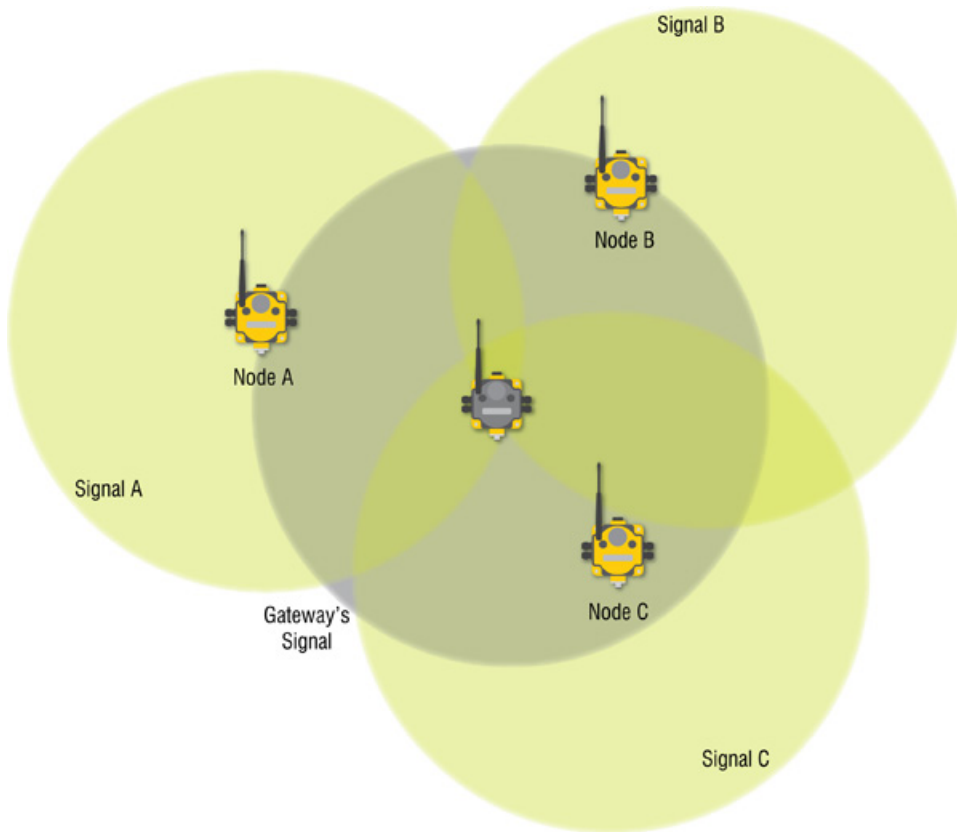


The top view of an omni-directional antenna's radiation pattern appears to extend evenly in all directions.

Viewed from the side, however, the radiation pattern of an omni-directional antenna is doughnut shaped.

With the star topology network, using the omni-directional antenna on the Gateway ensures that all Nodes fall within the antenna radiation pattern.

Low-gain omni-directional antennas work well in multipath industrial environments, such as inside metal buildings. High-gain antennas work well in line-of-sight conditions.

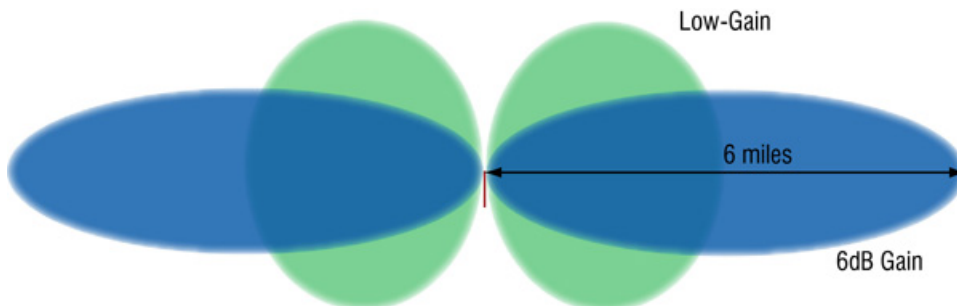


Using an omni-directional antenna in the center of a star topology ensures all radio devices receive a signal.

High Gain

An omni antenna with increased gain also has a circular radiation pattern when viewed from the top. From the side view, however, the decreased energy sent vertically increases the energy transmitted horizontally. The radiation pattern stretches to extend the range, focusing the signal along a horizontal plane.

This makes higher gain omni antennas more sensitive to changes in elevation between the Gateway and its Nodes.



Increasing the gain of omni-directional antennas results in less energy sent vertically and more energy sent horizontally, extending the range.

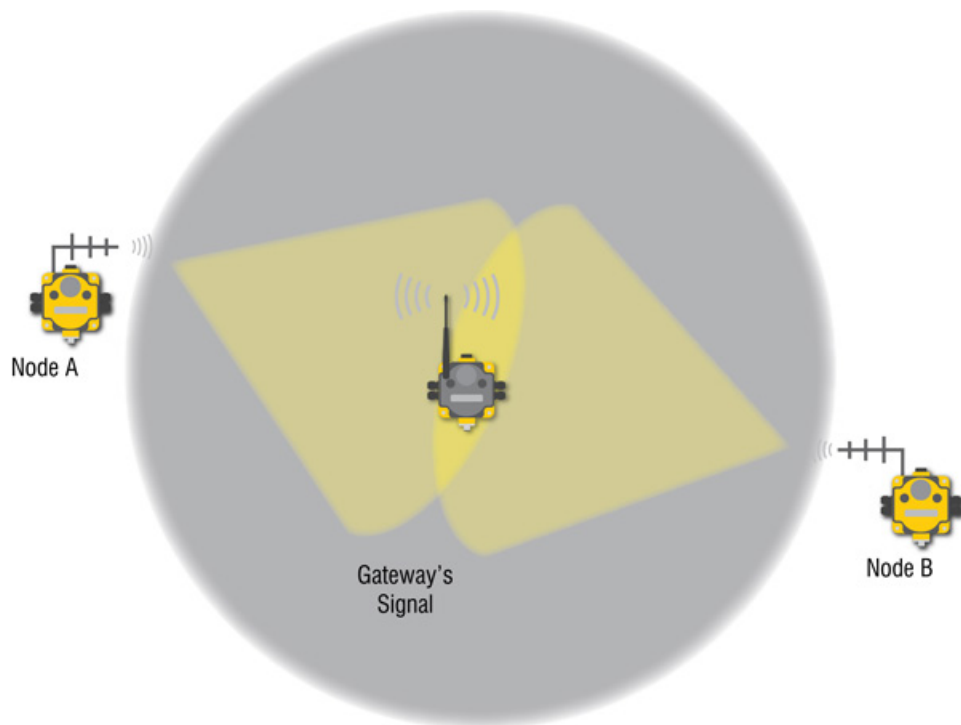
Directional (Yagi) Antennas

A directional, or Yagi, antenna focuses the radio signal in one specific direction.

If you compare antenna radiation patterns to light, an omni antenna radiates a radio signal like a light bulb — evenly in a spherical pattern. A directional antenna radiates similar to a flashlight — focusing the signal only in one direction. The higher the gain, the more focused the beam becomes.

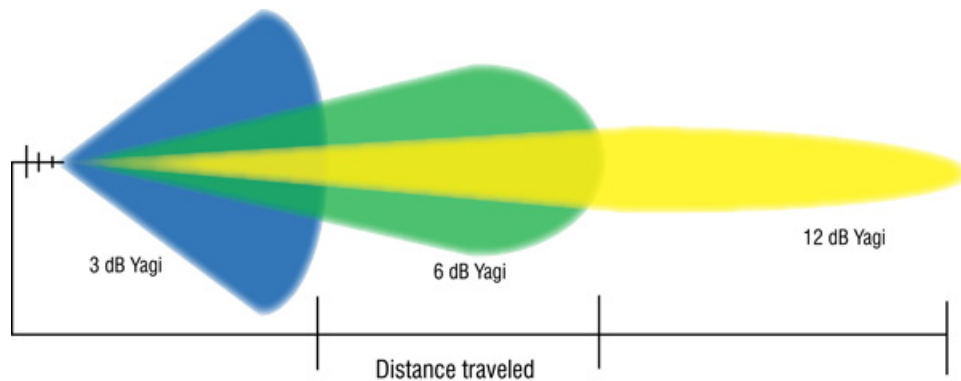
Yagi antennas are best used in line-of-sight radio systems because Yagis focus the radio signal in a specific direction.

In the following example, the Gateway uses an omni antenna to receive radio signals from multiple directions but the Nodes use Yagi antennas aimed directly at the Gateway to send and receive the radio signal.



High-Gain Yagis

Because Yagi antennas yield narrower radiation patterns, accurately aiming a high-gain Yagi is important when setting up a radio network. The higher the gain of the antenna, the more the signal is focused along a specific plane. High-gain antennas should only be used for line-of-sight applications.



Because of the narrow radio signal path, Yagis are sensitive to mechanical mounting problems like wind, causing the antennas to become misaligned.



Path Loss, or Link Loss, Calculations

Path loss, or link loss, calculations determine the exact capabilities of a radio system by calculating the total gain (or loss) of a radio system.

System Total Gain = Transmitter gain + Free space loss + Receiver gain

The transmitter and receiver gains are typically positive numbers while the free space loss is a larger negative number. The total gain for any radio system should be negative. Compare this total gain value to the receiver sensitivity of the Banner SureCross™ radios listed below.

Radio Receivers	Rated Sensitivity
900 MHz	-104 dBm
2.4 GHz	-100 dBm

Path loss calculations must include all components of a radio system because any item connected to a radio system has a specific loss associated with it.

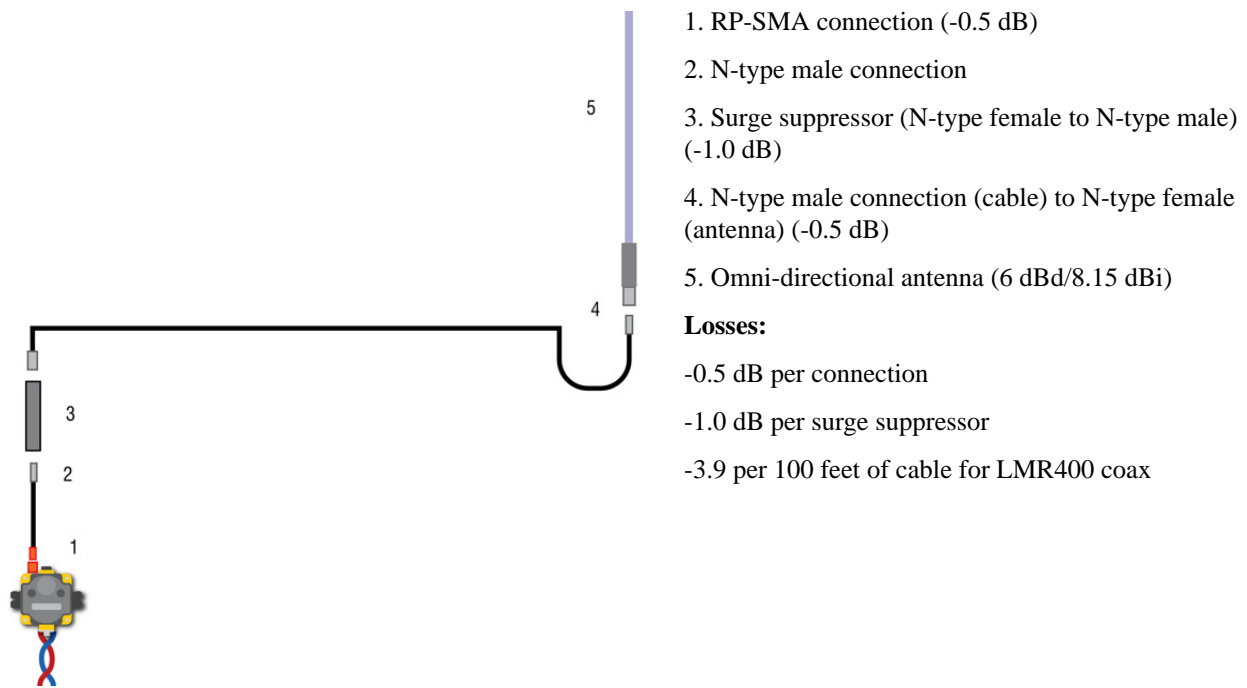
Common items used within a radio network are cables, connectors, and surge suppressors. Cabling loss is usually measured per foot while losses for connectors and other items are specific to the component. When calculating the total gain of a radio system, include losses from all components of the system in your link budget calculations.

Item	Estimated Loss (dB)
Surge suppressor	1 dB
N-type connectors (per pair)	0.5 dB
SMA connector	0.5 dB
LMR400 coax cable	3.9 dB per 100 ft (0.039 dB per ft) 0.128 dB per meter (1.28 dB per 10 meters)

Example Calculation - Transmitter System

To calculate the loss of the transmitter system shown below, include the losses from each connector pair, the surge suppressor, and the cable.

Radio's Power Output	DX70 or DX80 radio	21 dBm
Gains (+) or Losses (-)	Connector pairs	-1.0 dB
	Surge suppressor	-1.0 dB
	Cable (50 ft length)	-1.95 dB
	Omni antenna*	+8.15 dBi
Effective output of radio system		25.2 dBm



* Varies based on the antenna. Please refer to the technical specifications for the specific antenna used in the radio system.

Example Calculations - Free Space Loss

In addition to losses from cabling, connectors, and surge suppressors, radio signals also experience loss when traveling through the air. The equations for free space loss are:

$$\text{FSL}_{900\text{MHz}} = 31.5 + 20 \text{ Log } d \text{ (where } d \text{ is in meters)}$$

$$\text{FSL}_{2.4\text{GHz}} = 40 + 20 \text{ Log } d \text{ (where } d \text{ is in meters)}$$

For a 900 MHz radio system transmitting three miles, the free space loss is:

$$\text{FSL}_{900\text{MHz}} = 31.5 + 20 \text{ Log } (3 \times 5280/3.28)$$

$$\text{FSL}_{900\text{MHz}} = 31.5 + 20 \text{ Log } (4829.27)$$

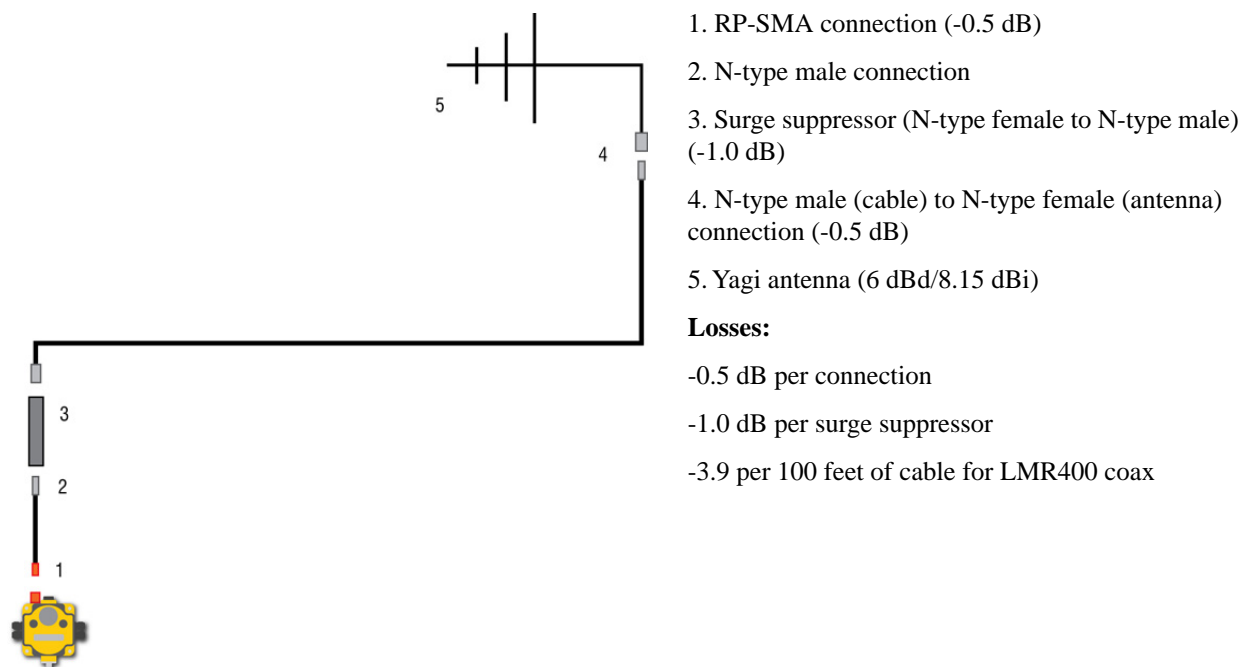
$$\text{FSL}_{900\text{MHz}} = 31.5 + 73.68 = 105.18 \text{ dB}$$

Because this is a loss calculation, free space loss is a negative number.

Example Calculations - Receiver System

To calculate the link loss of the receiver system shown below, include the losses from each connector pair, the surge suppressor, and the cable.

Radio's Power Output	DX70 or DX80 radio	N/A
Gains (+) or Losses (-)	Connector pairs	-1.0 dB
	Surge suppressor	-1.0 dB
	Cable (50 ft length)	-1.95 dB
	Yagi antenna*	+8.15 dBi
Effective gain of receiving antenna system		4.2 dBm



1. RP-SMA connection (-0.5 dB)
2. N-type male connection
3. Surge suppressor (N-type female to N-type male) (-1.0 dB)
4. N-type male (cable) to N-type female (antenna) connection (-0.5 dB)
5. Yagi antenna (6 dBd/8.15 dBi)

Losses:

- 0.5 dB per connection
- 1.0 dB per surge suppressor
- 3.9 per 100 feet of cable for LMR400 coax

* Varies based on the antenna. Please refer to the technical specifications for the specific antenna used in the radio system.

Example Calculation - Complete System

The total losses for the entire system are:

Effective output of radio system	25.20 dBm
Free space loss	-105.18 dB
Effective gain of receiving antenna system	4.20 dBi
Total received power	-75.78 dBm

Compare the total received power to the sensitivity of the radio receiver to determine if the signal will be reliably received by subtracting the receive sensitivity of the radio from the total received power: $-75.78 \text{ dBm} - (-104 \text{ dBm}) = 28.22$

If the result is greater than 10 dB, the receiver should reliably receive the radio signal.

Antenna Installation Warning

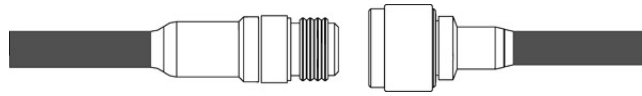
Always install and properly ground a qualified surge suppressor when installing a remote antenna system. Remote antenna configurations installed without surge suppressors invalidate the manufacturer's warranty.

Always keep the ground wire as short as possible and make all ground connections to a single-point ground system to ensure no ground loops are created. No surge suppressor can absorb all lightning strikes. Do not touch the SureCross™ device or any equipment connected to the SureCross device during a thunderstorm.

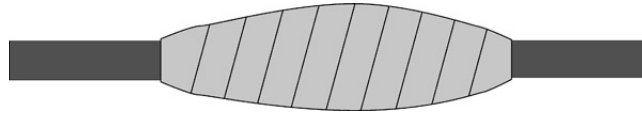
Weatherproofing Remote Antenna Installations

Prevent water damage to the cable and connections by sealing the connections with rubber splicing tape and electrical tape.

To protect the connections, follow these steps.



Step 1: Verify both connections are clean and dry before connecting the antenna cable to the antenna or other cable and hand-tightening.



Step 2: Tightly wrap the entire connection with rubber splicing tape.

Begin wrapping the rubber splicing tape one inch away from the connection and continue wrapping until you are one inch past the other end of the connection. Each new round of tape should overlap about half the previous round.

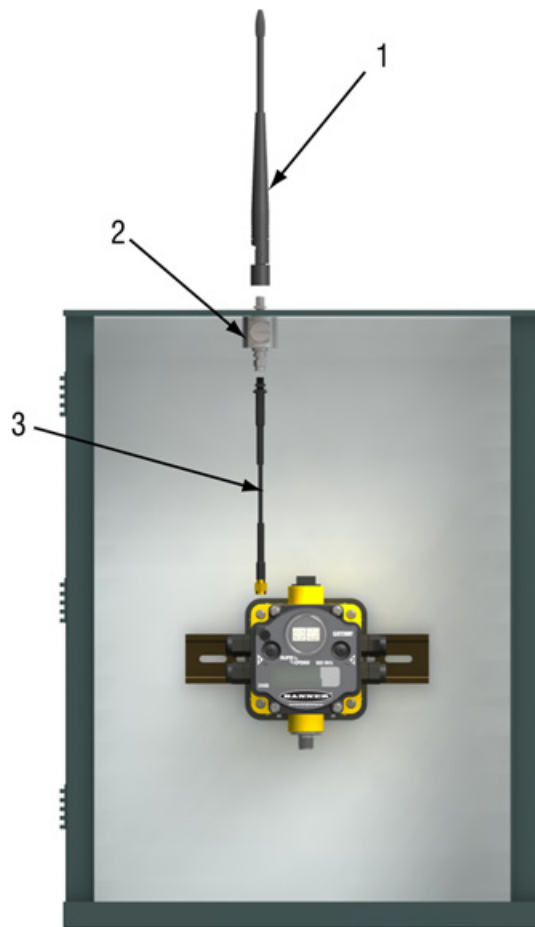


Step 3: Protect the rubber splicing tape from UV damage by tightly wrapping electrical tape on top of the rubber splicing tape. The electrical tape should completely cover the rubber splicing tape and overlap the rubber tape by one inch on each side of the connection.

Mounting an RP-SMA Antenna Directly to the Cabinet

This antenna mounts directly to the outside of the box, with the SureCross device mounted inside the box.

This situation may be used either inside or outside the building.

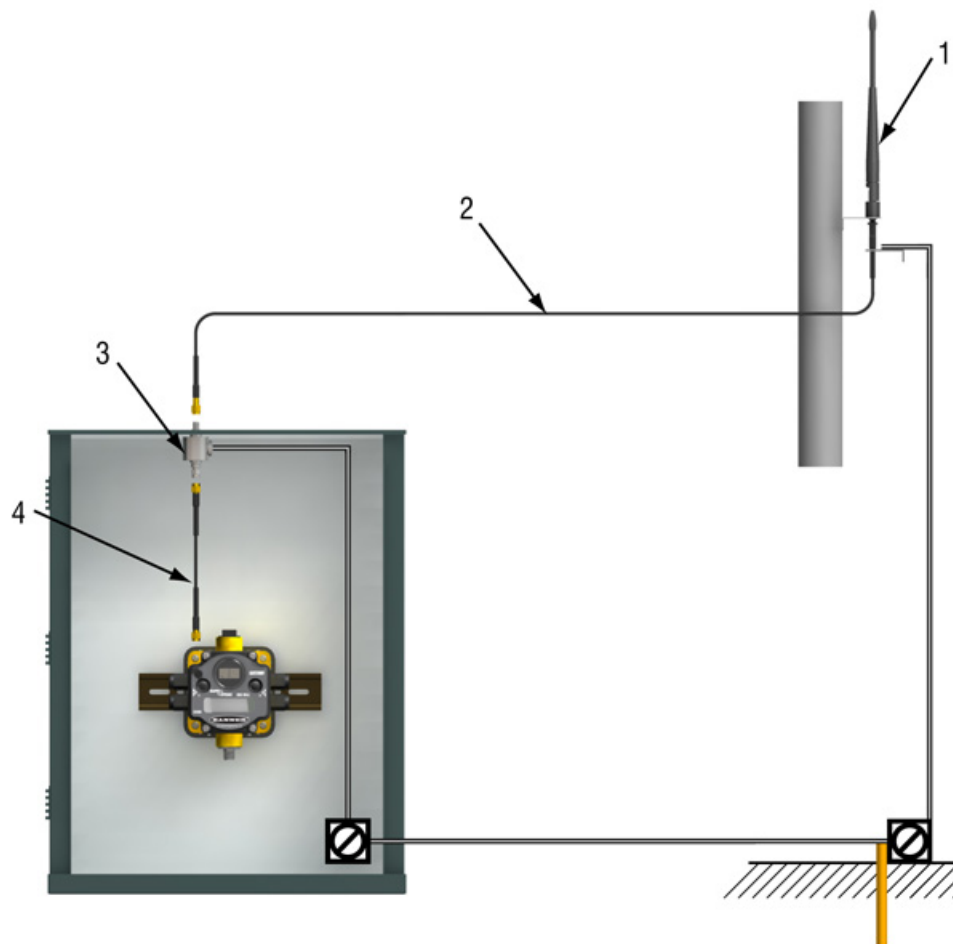


	Model Number	Description
1	BWA-902-C	Antenna, Omni, 902-928 MHz, 2 dBd, Rubber Swivel, RP-SMA MALE
	BWA-202-C	Antenna, Omni, 2.4 GHz, 2 dBd, Rubber Swivel, RP-SMA MALE
	BWA-205-C	Antenna, Omni, 2.4 GHz, 5 dBd, Rubber Swivel, RP-SMA MALE
	BWA-207-C	Antenna, Omni, 2.4 GHz, 7 dBd, Rubber Swivel, RP-SMA MALE
2	BWC-LMRSFRPB	Surge Suppressor, Bulkhead, RP-SMA Type, 900 MHz/2.4 GHz
3	BWC-1MRSFRSB02	RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 0.2 m
	BWC-1MRSFRSB1	RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 1 m
	BWC-1MRSFRSB2	RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 2 m
	BWC-1MRSFRSB4	RG58 Cable, RP-SMA TO RP-SMA Female, Bulkhead, 4 m

Mounting an RP-SMA Antenna Remotely

This antenna mounts remotely from the box, with the SureCross device mounted inside the box.

This situation may be used either inside or outside the building, though a Yagi antenna is usually used in outdoors applications while an omni-directional antenna may be used either inside a building or outside.

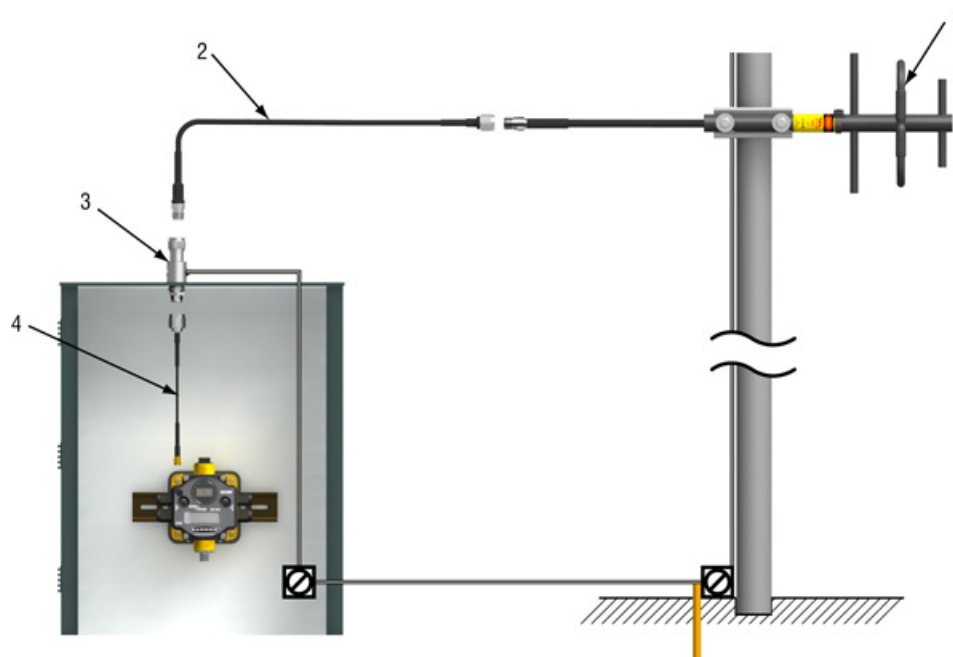


Model Number	Description
1	BWA-902-C Antenna, Omni, 902-928 MHz, 2 dBd, Rubber Swivel, RP-SMA MALE
	BWA-202-C Antenna, Omni, 2.4 GHz, 2 dBd, Rubber Swivel, RP-SMA MALE
	BWA-205-C Antenna, Omni, 2.4 GHz, 5 dBd, Rubber Swivel, RP-SMA MALE
	BWA-207-C Antenna, Omni, 2.4 GHz, 7 dBd, Rubber Swivel, RP-SMA MALE
2	BWC-1MRSFRSB02 RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 0.2 m
	BWC-1MRSFRSB1 RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 1 m
	BWC-1MRSFRSB2 RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 2 m
	BWC-1MRSFRSB4 RG58 Cable, RP-SMA TO RP-SMA Female, Bulkhead, 4 m
3	BWC-LMRSFRPB Surge Suppressor, Bulkhead, RP-SMA Type, 900 MHz/2.4 GHz
4	BWC-1MRSFRSB02 RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 0.2 m
	BWC-1MRSFRSB1 RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 1 m
	BWC-1MRSFRSB2 RG58 Cable, RP-SMA TO RP-SMA Female Bulkhead, 2 m
	BWC-1MRSFRSB4 RG58 Cable, RP-SMA TO RP-SMA Female, Bulkhead, 4 m

Mounting N-Type Antennas Remotely

This antenna mounts remotely from the box, with the SureCross device mounted inside the box.

This situation may be used either inside or outside the building, though a Yagi antenna is usually used in outdoors applications while an omni-directional antenna may be used either inside a building or outside.



	Model Number	Description
1	BWA-9Y6-A	Antenna, Yagi, 900 MHz, 6.5 dBd, N Female
	BWA-9Y10-A	Antenna, Yagi, 900 MHz, 10 dBd, N Female
	BWA-9O6-A	Antenna, Omni, 900 MHz, 6 dBd, Fiberglass, N Female
	BWA-9O5-B	Antenna, Omni, 900 MHz, 5 dBd/7.2 dBi, With ground plane, N Female
	BWA-2O8-A	Antenna, Omni, 2.4 GHz, 8.5 dBi, N Female, Fiberglass 24"
	BWA-2O6-A	Antenna, Omni, 2.4 GHz, 6 dBi, N Female, Fiberglass 16"
2	BWC-4MNFN3	LMR400 Cable, N-Male to N-Female, 3 Meters
	BWC-4MNFN6	LMR400 Cable, N-Male to N-Female, 6 Meters
	BWC-4MNFN15	LMR400 Cable, N-Male to N-Female, 15 Meters
	BWC-4MNFN30	LMR400 Cable, N-Male to N-Female, 30 Meters
3	BWC-LFNBMN	Surge Suppressor, Bulkhead, N-Type, 900 MHz/2.4 GHz
4	BWC-1MRSMN05	LMR200 Cable, RP-SMA to N-Male, 0.5 Meters
	BWC-1MRSMN2	LMR200 Cable, RP-SMA to N-Male, 2 Meters

Part 7

SureCross Power Solutions

Topics:

- [*10 to 30V dc Power*](#)
- [*What is FlexPower?*](#)
- [*Battery Life Calculations*](#)
- [*Example Solar Powered Systems*](#)

10 to 30V dc Power

For locations with power, the 10–30V dc devices offer an easy-to-install solution for sensing devices.

- 10–30V dc can power more sensors and more types of sensors to obtain the necessary data.
- The number of sensors powered by the SureCross device is only limited by the number of I/O points available.
- The Node may be set to high-speed I/O sample and reporting rates for quicker data collection.

What is FlexPower?

Banner's FlexPower technology allows for a true wireless solution by allowing the device to operate using either 10-30V dc, 3.6V lithium D cell batteries, or solar power.

This unique power management system can operate a FlexPower Node and an optimized sensing device for up to five years on a single lithium D cell.

- The FlexPower Node may be powered from 10 to 30V dc and use an external battery supply module to provide a battery back-up solution.
- When a FlexPower Node receives 10 to 30V dc, it operates like a standard 10 to 30V dc Node.
- Good applications for FlexPower devices operating from batteries include sensors that require no or very little power, including dry contacts, RTDs, and thermocouples.

The following FlexPower options are available:

- DX81, a single battery supply module;
- DX81P6, a 6-pack of lithium batteries;
- DX81H, a single battery supply module designed specifically to power the DX99 Intrinsically Safe devices with polycarbonate housings; and
- BWA-SOLAR-001, a solar power assembly that includes the solar panel, rechargeable batteries, and solar power controller.



DX81: Single battery supply module



DX81P6: Six-pack battery supply module



BWA-SOLAR-001: Solar supply; includes solar panel, rechargeable batteries, and controller.

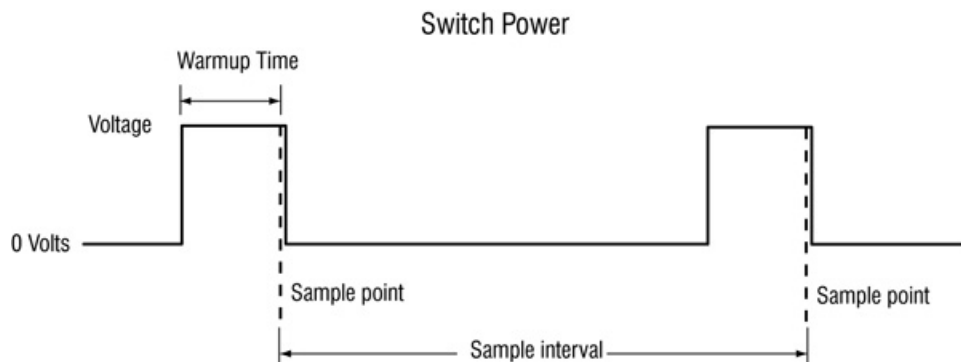
DX81H: Single battery supply module designed specifically to power the DX99 Intrinsically Safe devices with polycarbonate housings

Switch Power (with FlexPower)

Efficient power management technology enables some FlexPower devices to include an internal power supply, called switch power (SP), that briefly steps up to power sensors requiring 5, 10, or 15V power (ideally, 4–20 mA loop-powered sensors).

When the switch power output cycles on, the voltage is boosted to the voltage needed to power the sensor for a specific warmup time. This warmup time denotes how long the sensor must be powered before a reliable reading can be taken. After the warmup time has passed, the input reads the sensor, then the switch power shuts off to prolong battery life. The switch power voltage, warm-up time, and sample interval are configurable parameters.

- To reduce power consumption and extend battery life, slower sample and reporting rates are used. Faster sample and report rates can be configured, but this will decrease the battery's life. For details, refer to the included table of DIP switch configurable parameters.
- The FlexPower switched power management system can operate a FlexPower Node and a sensing device for up to five years on a single lithium D cell.



FlexPower with Integrated Battery

A few FlexPower devices operate using a 3.6V lithium D cell battery integrated into the housing.

These integrated battery devices:

- Operate only from the battery and cannot use an external power supply,
- Are limited in the available I/O because of the limited connectivity, and
- Can only be powered from the integrated battery.

FlexPower Solar Supply

Banner's FlexPower Solar Supply Assembly can be used to power up to two radio devices, including a FlexPower Node, a FlexPower Gateway, or a data radio.

When used with a FlexPower Node and sensors, the Solar Assembly supplies enough power to run most sensors at higher sample and report rates than a single battery can reasonably support. Rechargeable batteries power the devices while the solar panel recharges the batteries.



Battery Life Calculations

Analog Configuration

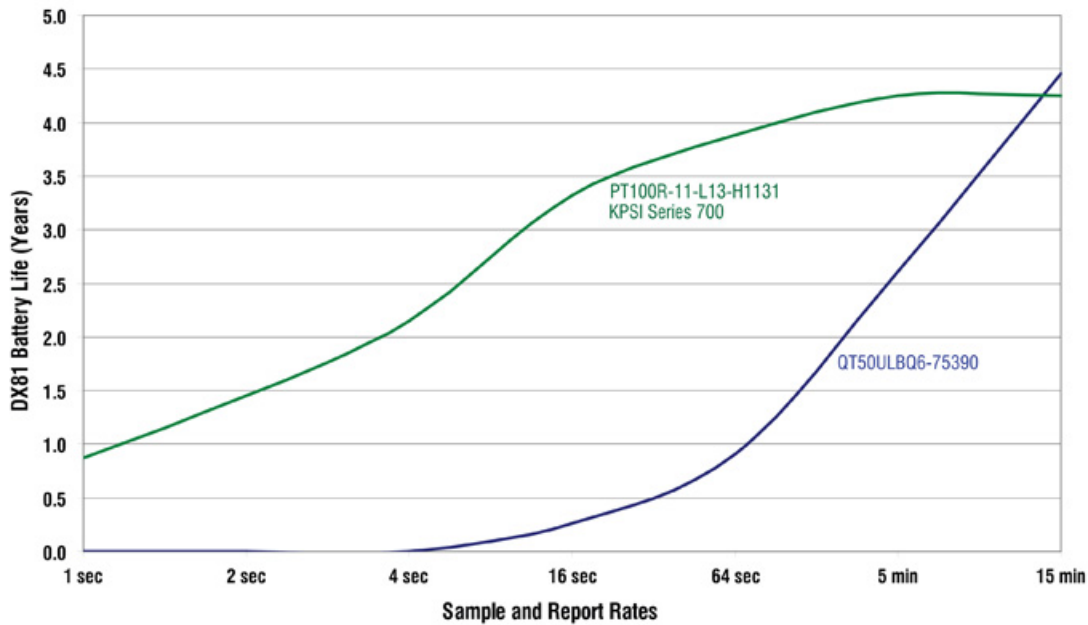
The battery life calculations, in years, for some analog sensors are shown in the table below.

	Manufacturer	Device	Model	Boost Voltage	Warmup Time
1	Banner	U-Sonic/Distance	QT50ULBQ6-75390	15V	500 ms
2	Esterlink/KPSI	Submersible Level	KPSI Series 700	10V	10 ms
3	Turck	Pressure	PT100R-11-L13-H1131	10V	10 ms

Battery Life in Years

Sample and Report Rates							
	1 second	2 seconds	4 seconds	16 seconds	64 seconds	5 minutes	15 minutes
1	0.00	0.00	0.00	0.26	0.91	2.61	4.45
2	0.87	1.45	2.15	3.32	3.89	4.25	4.25
3	0.87	1.45	2.15	3.32	3.89	4.25	4.25

Note, battery life calculations are based on the sensor operating 24 hours a day, 365 days a year.



For each sensor characterized, a boost voltage and warmup time was specified. The sample and reports rates were varied to calculate the estimated battery life. For example, a Banner QT50ULBQ6-75390 sensor set to a boost voltage of 15 volts, a warm-up time of 500 milliseconds, and a sample and report rate of 15 minutes, should have a battery life of 4.45 years.

All battery life calculations are approximations based on a strong radio signal. Weaker radio connections and missed packets will decrease the battery life.

Discrete Configuration

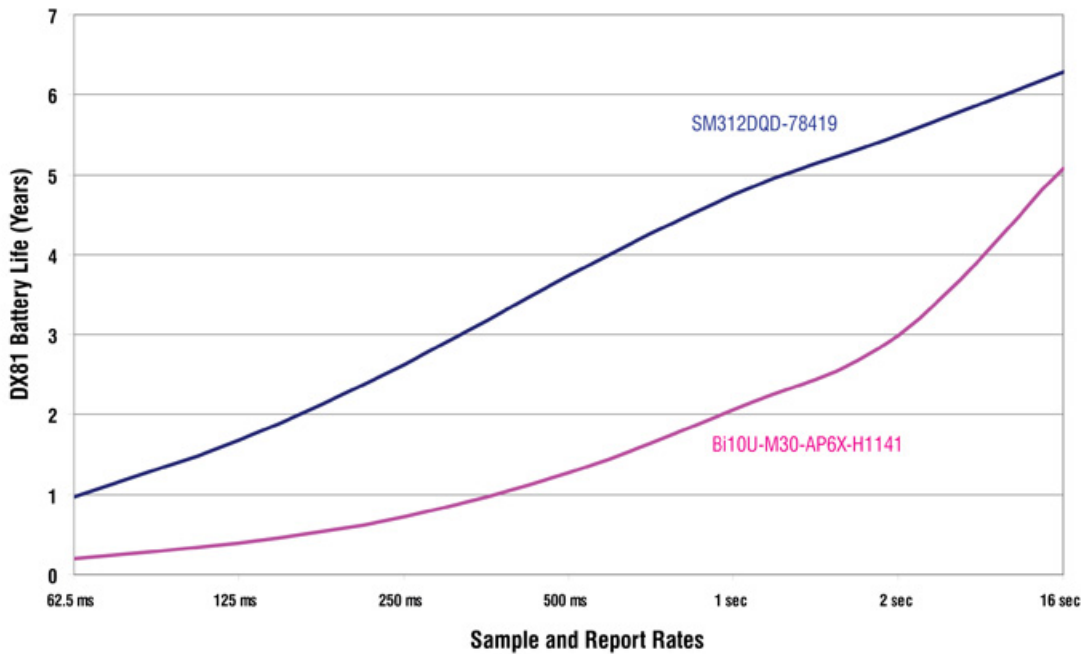
The battery life calculations, in years, for some discrete sensors are shown in the table below.

	Manufacturer	Device	Model	Boost Voltage	Warmup Time
1	Banner	Optical	SM312DQD-78419	5V	4 ms
2	Turck	Inductive Proximity	Bi10U-M30-AP6X-H1141	10V	10 ms

Battery Life in Years

	Sample and Report Rates						
	62.5 ms	125 ms	250 ms	500 ms	1 second	2 seconds	16 seconds
1	0.97	1.67	2.62	3.74	4.75	5.49	6.28
2	0.20	0.40	0.72	1.27	2.05	2.99	5.07

Note, battery life calculations are based on the sensor operating 24 hours a day, 365 days a year.



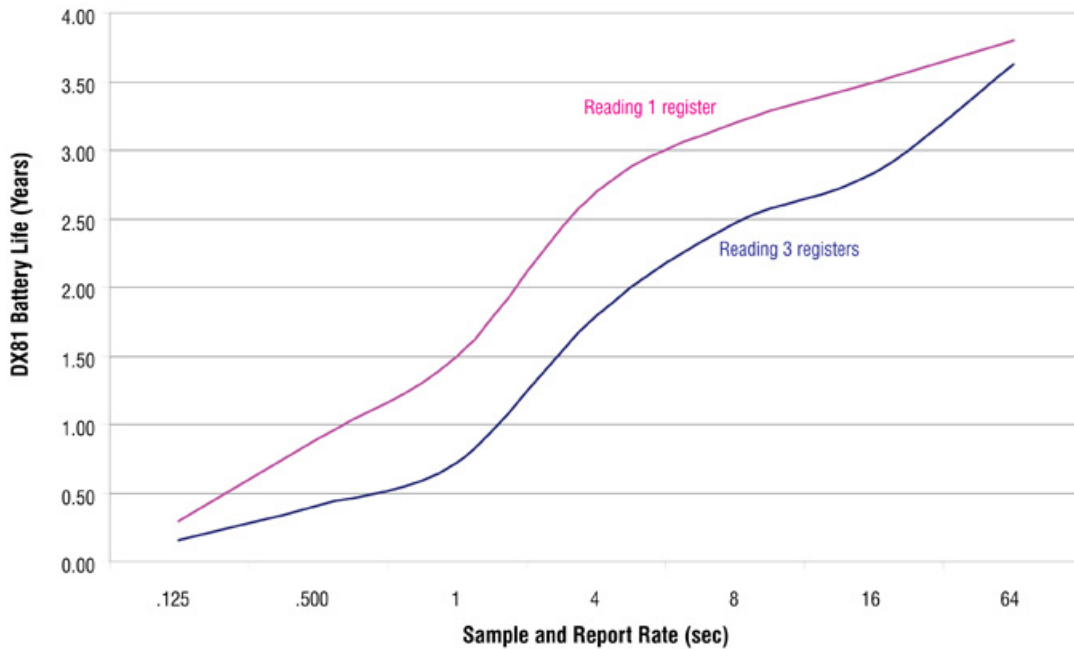
For each sensor characterized, a boost voltage and warmup time was specified. The sample and reports rates were varied to calculate the estimated battery life. For example, a Banner Optical sensor, model SM312DQD-78419, set to a boost voltage of 5 volts, a warm-up time of 4 milliseconds, and a sample and report rate of 16 seconds, should have a battery life of just over 6 years.

The curves for discrete devices represent a “worst case” as far as battery use because we are assuming for each sample of the sensor’s output a change in state has occurred (e.g., target present to target absent or vice versa), sending a radio message from Node to Gateway. No messaging occurs unless there is a change to report. Actual battery life depends on how many state changes actually occur.

All battery life calculations are approximations based on a strong radio signal. Weaker radio connections and missed packets will decrease the battery life.

Temperature and Humidity Sensor

The following battery life calculations are based on reading/reporting one register or reading/reporting the contents of all three registers.



These values are estimated based on the current hardware and software configuration and are subject to change without notice. Environmental conditions will also contribute to the battery's lifespan. Current estimates are based on a battery operating at room temperature.

All battery life calculations are approximations based on a strong radio signal. Weaker radio connections and missed packets will decrease the battery life.

Calculating Battery Life

To estimate the battery life for a sensor not included in our list, use the configuration and cable shown to measure the current draw of your system.

To measure the current draw of a system similar to the one shown below, use Banner cable BWA-HW-010.

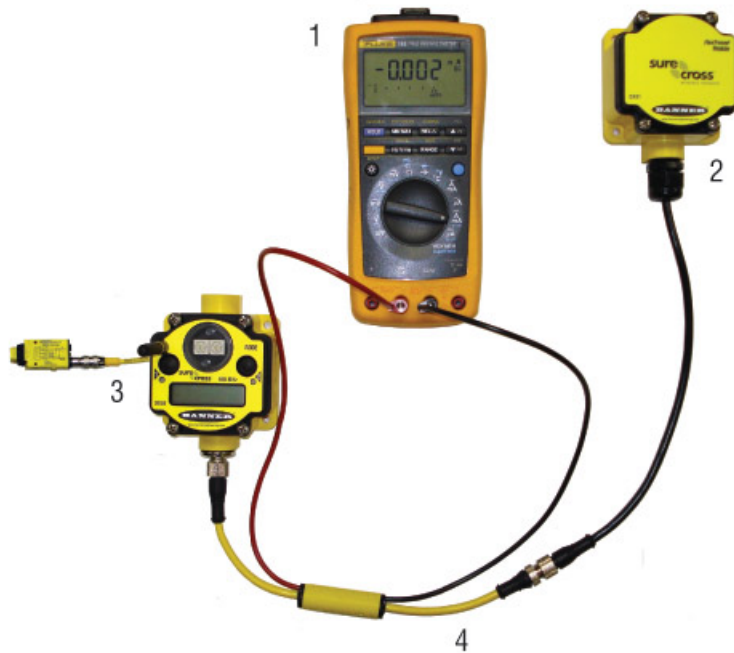
1. Connect the cable to the FlexPower Node and the battery supply module as shown below. The cable's male end plugs into the FlexPower Node and the female end plugs into the battery module.
2. Connect an averaging Fluke meter to the leads. Set the meter to read in amps, not milliamps.
3. Turn off the Node's LCD panel by clicking button 2 five times.
4. Allow the meter to measure the operation for at least 10 times the length of the sample rate.

To estimate the battery life in hours, use the following equation:

$$\text{Battery Life (in hours)} = (16,000 \text{ mA Hr}) \div (\text{average current in mA})$$

To estimate the battery life in years, use the following equation:

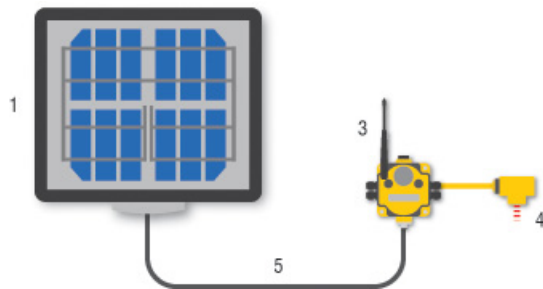
$$\text{Battery Life (in years)} = (16,000 \text{ mA Hr}) \div [(\text{average current in mA})(8736 \text{ Hr per year})]$$



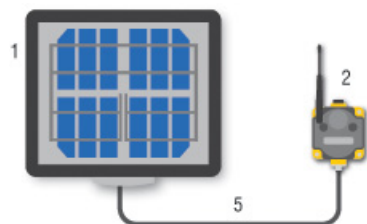
Item	Model No.	Description
1		Averaging Fluke Meter
2	DX81	DX81 Battery Supply Module
3		DX80 FlexPower Node with MINI-BEAM
4	BWA-HW-010	Cable, FlexPower Current Monitoring

Example Solar Powered Systems

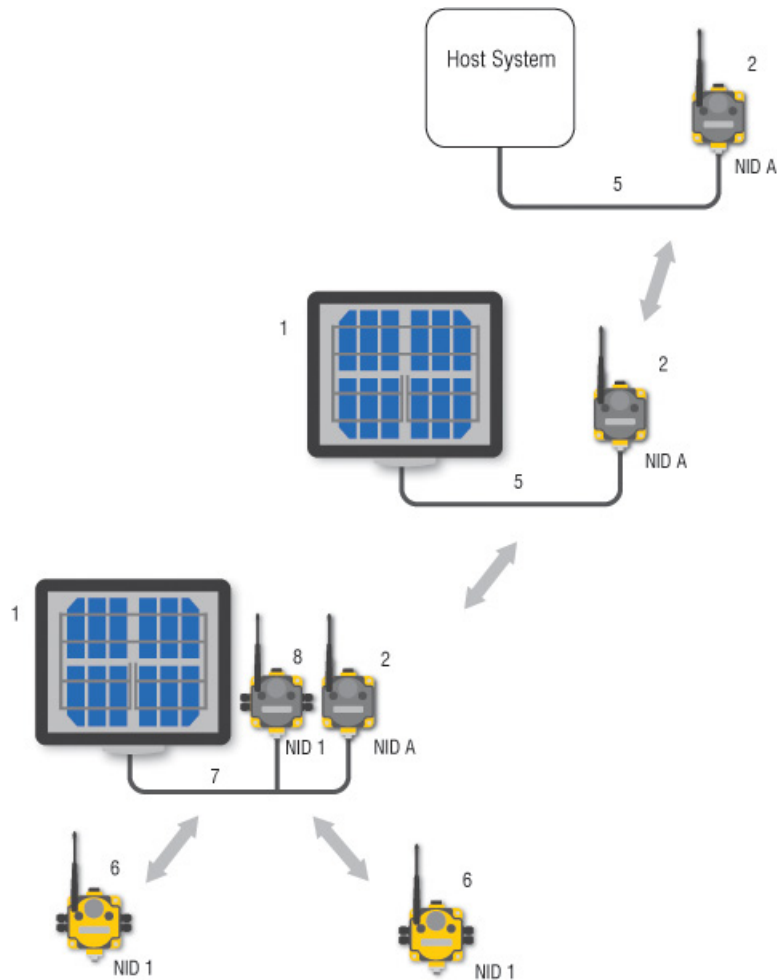
For installations without wired power, a solar powered system with an integrated solar controller and rechargeable batteries may be used to power data radios, FlexPower Gateways, or FlexPower Nodes connected to sensors that require more power than a single battery unit can supply.



Powering a data radio or data radio repeater with a solar panel allows for the expansion of the wireless network to installations with no reliable power source.



The example system shows a solar power system powering data radios and Gateways, expanding the wireless network far beyond the limits of wired power sources.



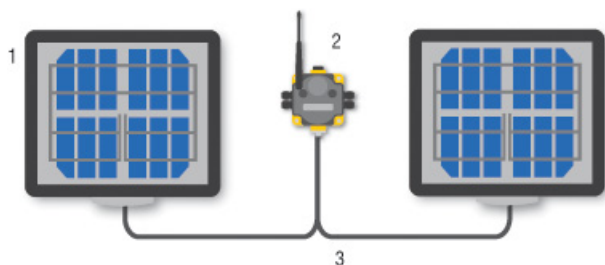
Item	Model No.	Description
1	BWA-SOLAR-001	FlexPower Solar Supply, includes panel, solar controller, rechargeable batteries, and mounting materials
2	DX80DR*M	Data radio, 900MHz or 2.4GHz
3	DX80N9X2S2N2M2	FlexPower Node, 900MHz, Boost Power, 2 discrete IN, 2 NMOS discrete OUT, 2 analog IN (2.4GHz also available)
4	QT50U-75390	U-GAGE Long range ultra-sonic sensor, low power consumption
5	MQDC1-501.5	Cable, RS-485 quick disconnect, 5-pin Euro, straight, 0.5 m*
6	DX80N...	FlexPower Node or 10 to 30V dc Node
7	CSRB-M1250M125.47M125.73	Cable, RS-485, quick disconnect, 5-pin Euro, male trunk, female branches, black*
8	DX80G*M2S	FlexPower Gateway, Serial RS485 Interface, No I/O

* For RS-232 communications, an RS-232 crossover cable must be used between the RS-485 and the data radio or Gateway.

Cables may be either yellow or black. Black is shown here for clarity.

Parallel Solar Systems

Two or more solar systems can be directly ORed together using a splitter cable. Using the Solar Supply in parallel provides a modular approach to incrementally increase the capacity in some challenging applications or locations.



Item	Model No.	Description
1	BWA-SOLAR-001	FlexPower Solar Supply, includes panel, solar controller, rechargeable batteries, and mounting materials
2	DX80N...	FlexPower Node or 10 to 30V dc Node
3		Power Splitter Cable, quick disconnect, 5-pin Euro, female trunk, male branches

Battery Backup Feature

The DX81P6 6-Pack Battery Supply Module can operate as a power backup for the FlexPower Solar Supply when the units are connected using the splitter cable..

The FlexPower Solar Supply can be ORed with the DX81P6 Battery Supply Module using the CSRB-M1250M125.47M125.73 splitter cable. When the solar panel temporarily disconnects the load because of a lack of sunlight, the DX81P6 Battery Supply Module supports the system and powers the load. This battery backup can support a sensor system consisting of a 2-wire transmitter powered continuously with 15V at 20 mA and a DX80 Node transmitting once per second for up to 30 days.

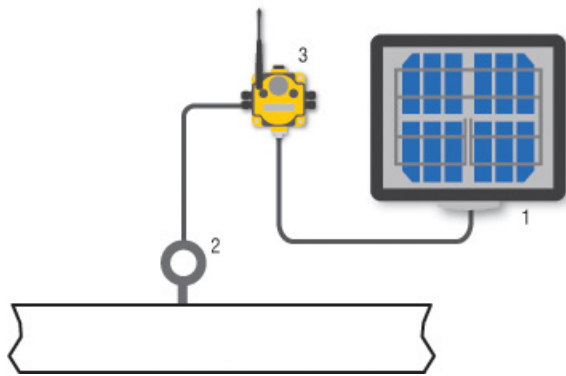
Optional mapping allows a battery backup function to be mapped to a wireless error output to determine if the devices are powered by the solar panel assembly or the battery supply module.

Autonomous Process Monitoring with Continuous Sensor Operation

A single FlexPower Solar Supply can supply any continuously powered 4–20 mA, two-wire transmitter at 13V and power the DX80 FlexPower Node for continuous sensor operation.

This application requires at least 1.7 hours of sun per day and the battery provides about 10 days of autonomy with a full transmitter signal of 20 mA. Marginal solar situations can be supplemented with a DX81P6 Battery Supply Module acting as a battery backup unit to add an additional month of autonomous operation.

The FlexPower Node's boost converter provides an adjustable continuous 21V courtesy power output.

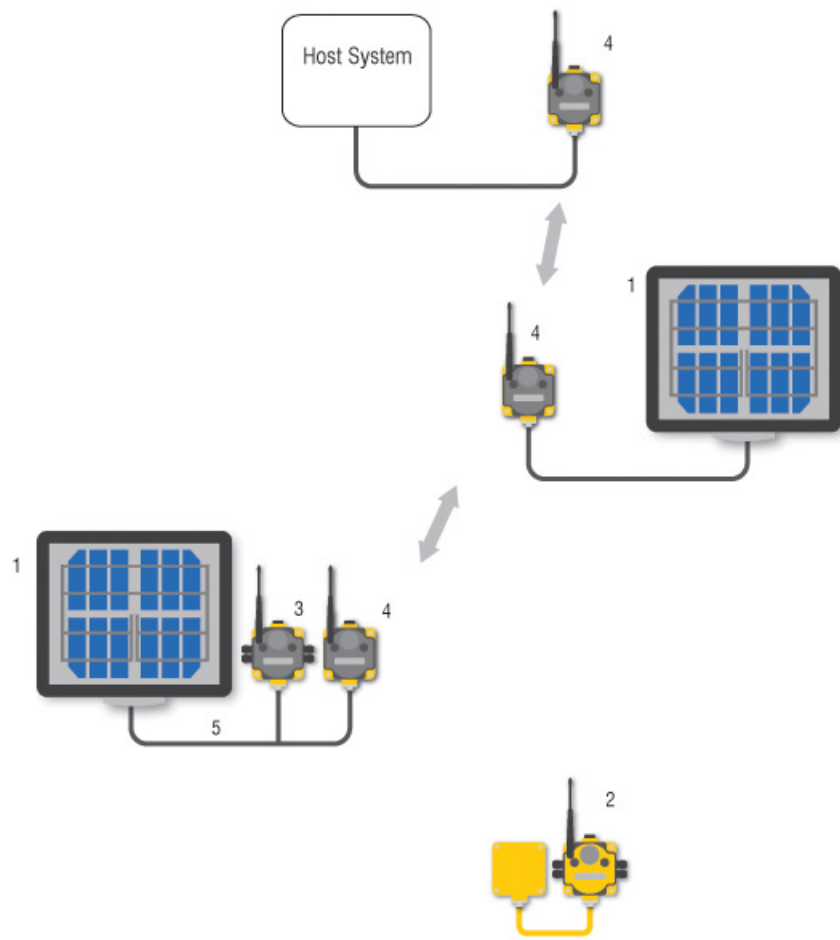


Item	Model No.	Description
1	BWA-SOLAR-001	FlexPower Solar Supply, includes panel, solar controller, rechargeable batteries, and mounting materials
2		Pressure Transmitter, 4-20 mA, two-wire
3	DX80N9X2S-CS1	FlexPower Node for continuous sensor operation

Wireless Network Range Extension

For extending the range of the wireless network, the solar panel and rechargeable battery pack powers data radios and special FlexPower Gateways.

In the system shown, the solar panel system powers a remotely located data radio and Gateway. FlexPower Nodes make up the remainder of the wireless network. To extend this wireless network even farther from the host system, a solar panel powered data radio repeater can be used.



Item	Model No.	Description
1	BWA-SOLAR-001	FlexPower Solar Supply, includes panel, solar controller, rechargeable batteries, and mounting materials
2	DX80N...	FlexPower Node or 10 to 30V dc Node
3	DX80G*M2S	FlexPower Gateway, No I/O
4	DX80DR*M	Data radio, 900MHz or 2.4GHz
5	CSRB-M1250M125.47M125.73	Cable, RS-485, quick disconnect, 5-pin Euro, male trunk, female branches, black*

Part 8

Maintenance and Troubleshooting

Topics:

- [Maintenance](#)
- [Troubleshooting](#)
- [Accessories](#)

Chapter 7

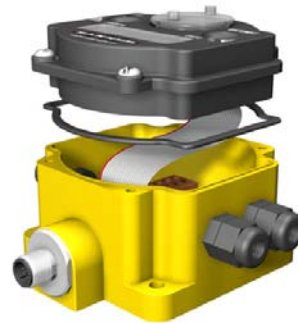
Maintenance

Replacing the Main Body Gasket

Check the main body gasket every time a SureCross™ device is opened.

Replace the gasket when it is damaged, discolored, or showing signs of wear. The gasket must be:

- Fully seated within its channel along the full length of the perimeter, and
- Positioned straight within the channel with no twisting, stress, or stretching.



Replacing the Rotary Switch Access Cover O-Ring

Check the rotary switch access cover o-ring every time the access cover is removed from the Gateway, GatewayPro, or Node.

Replace the o-ring when it is damaged, discolored, or showing signs of wear. The o-ring should be:

- Seated firmly against the threads without stretching to fit or without bulging loosely, and
- Pushed against the flanged cover.

When removing or closing the rotary switch access cover, manually twist the cover into position. Do not allow cross-threading between the cover and the DX80 face.

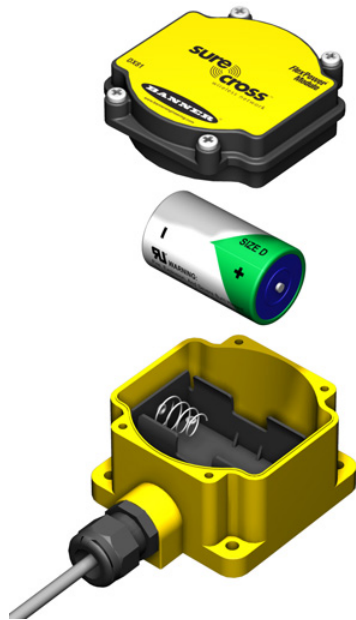
Once the cover is in place and manually tightened, use a small screwdriver (no longer than five inches total length) as a lever to apply enough torque to bring the rotary switch access cover even with the DX80 cover surface.



Battery Replacement

DX81 and DX81H FlexPower Module Battery Replacement

To replace the lithium "D" cell battery in the DX81 FlexPower™ battery kit, follow these steps.



1. Unplug the battery device from the SureCross device it powers.
2. Remove the four screws mounting the battery pack face plate to the body and remove the face plate.
3. Remove the discharged battery and replace with a new battery. Only use a 3.6V lithium battery from Xeno, model number XL-205F.
4. Verify the battery's positive and negative terminals align to the positive and negative terminals of the battery holder mounted within the case. Caution: There is a risk of explosion if the battery is replaced incorrectly.
5. After replacing the battery, allow up to 60 seconds for the device to power up.

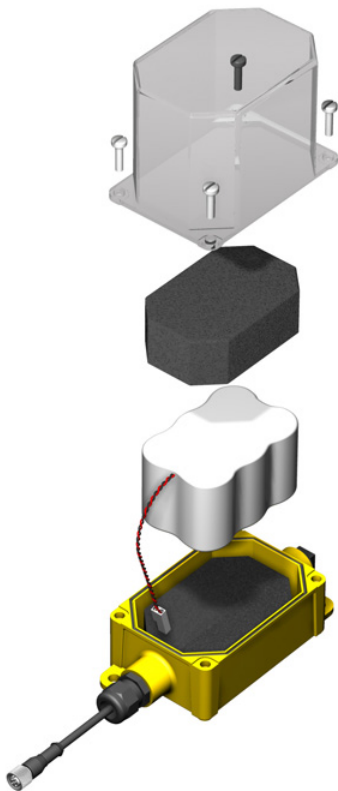
When removing the battery, press the battery towards the negative terminal to compress the spring. Pry up on the battery's positive end to remove from the battery holder. Properly dispose of your used battery according to local regulations by taking it to a hazardous waste collection site, an e-waste disposal center, or any other facility qualified to accept lithium batteries.

As with all batteries, these are a fire, explosion, and severe burn hazard. Do not burn or expose them to high temperatures. Do not recharge, crush, disassemble, or expose the contents to water.

Replacement battery model number: BWA-BATT-001. For pricing and availability, contact Banner Engineering.

DX81P6 FlexPower™ Module Battery Replacement

To replace the lithium "D" cell battery pack in the DX81P6 FlexPower™ battery kit, follow these steps.



1. Unplug the battery device from the SureCross device it powers.
2. Remove the four screws mounting the clear plastic battery pack cover to the housing.
3. Remove the cover and foam spacer.
4. Disconnect the discharged battery pack.
5. Remove the discharged battery pack and replace with a new battery pack. Caution: There is an explosion risk if the battery pack is replaced incorrectly.
6. After replacing the battery pack, allow up to 60 seconds for the device to power up.

Properly dispose of the used battery packs according to local regulations by taking it to a hazardous waste collection site, an e-waste disposal center, or any other facility qualified to accept lithium batteries.

As with all batteries, these are a fire, explosion, and severe burn hazard. Do not burn or expose them to high temperatures. Do not recharge, crush, disassemble, or expose the contents to water.

Replacement battery pack model number: BWA-BATT-002. For pricing and availability, contact Banner Engineering.

DX80 Integrated Battery Replacement

To replace the lithium "D" cell battery in any integrated housing model, follow these steps.



1. Remove the four screws mounting the face plate to the housing and remove the face plate.
2. Remove the discharged battery and replace with a new battery. Only use a 3.6V lithium battery from Xeno, model number XL-205F.
3. Verify the battery's positive and negative terminals align to the positive and negative terminals of the battery holder mounted within the case. The negative end is toward the spring. Caution: There is a risk of explosion if the battery is replaced incorrectly.
4. After replacing the battery, allow up to 60 seconds for the device to power up.

When removing the battery, press the battery towards the negative terminal to compress the spring. Pry up on the battery's positive end to remove from the battery holder. Properly dispose of your used battery according to local regulations by taking it to a hazardous waste collection site, an e-waste disposal center, or other facility qualified to accept lithium batteries.

As with all batteries, these are a fire, explosion, and severe burn hazard. Do not burn or expose them to high temperatures. Do not recharge, crush, disassemble, or expose the contents to water.

Replacement battery model number: BWA-BATT-001. For pricing and availability, contact Banner Engineering.

DX99 Integrated Battery Replacement (DX99...B Housings)

To replace the lithium "D" cell battery in the metal housings with integrated batteries, follow these steps.



1. Unscrew the lid on the back side of the metal enclosure.
2. Remove the discharged battery and replace with a new battery. Only use a 3.6V lithium battery from Xeno, model number XL-205F.
3. Verify the battery's positive and negative terminals align to the positive and negative terminals of the battery holder mounted within the case. The negative end is toward the spring. Caution: There is a risk of explosion if the battery is replaced incorrectly.
4. Screw on the lid and tighten.
5. After replacing the battery, allow up to 60 seconds for the device to power up.

When removing the battery, press the battery towards the negative terminal to compress the spring. Pry up on the battery's positive end to remove from the battery holder. Properly dispose of your used battery according to local regulations by taking it to a hazardous waste collection site, an e-waste disposal center, or other facility qualified to accept lithium batteries.

As with all batteries, these are a fire, explosion, and severe burn hazard. Do not burn or expose them to high temperatures. Do not recharge, crush, disassemble, or expose the contents to water.

Replacement battery model number: BWA-BATT-001. For pricing and availability, contact Banner Engineering.

DX99 Integrated Battery Replacement (DX99...D Housings)

To replace the lithium "D" cell battery in the metal housings with integrated batteries, follow these steps.



1. Unscrew the lid of the metal enclosure.
2. Remove the discharged battery and replace with a new battery. Only use a 3.6V lithium battery from Xeno, model number XL-205F.
3. Verify the battery's positive and negative terminals align to the positive and negative terminals of the battery holder mounted within the case. Caution: There is a risk of explosion if the battery is replaced incorrectly.
4. Screw on the lid and tighten.
5. After replacing the battery, allow up to 60 seconds for the device to power up.

When removing the battery, press the battery towards the negative terminal to compress the spring. Pry up on the battery's positive end to remove from the battery holder. Properly dispose of your used battery according to local regulations by taking it to a hazardous waste collection site, an e-waste disposal center, or other facility qualified to accept lithium batteries.

As with all batteries, these are a fire, explosion, and severe burn hazard. Do not burn or expose them to high temperatures. Do not recharge, crush, disassemble, or expose the contents to water.

Replacement battery model number: BWA-BATT-001. For pricing and availability, contact Banner Engineering.

Chapter 8

Troubleshooting

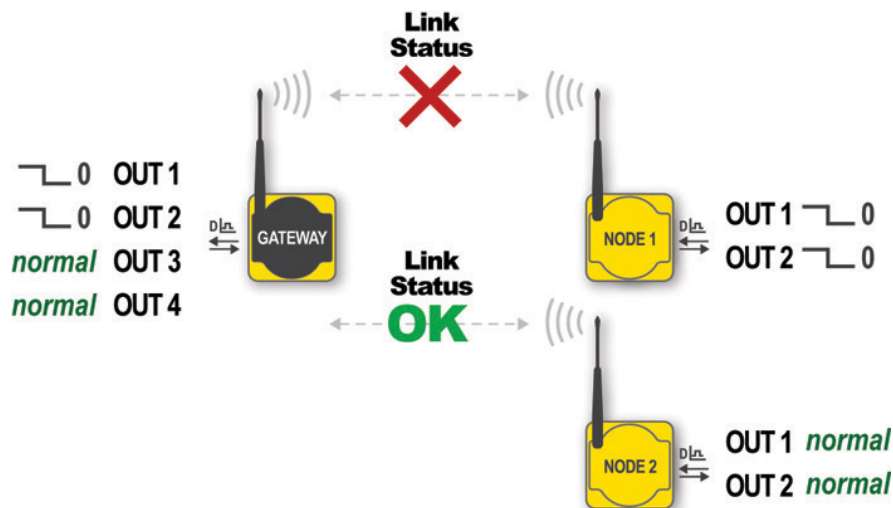
Radio Link Time-Out and Recovery (Non-Host Connected Systems)

The SureCross™ DX80 wireless devices employ a deterministic link time-out method to address RF link interruption or failure. As soon as a specific Node/Gateway RF link fails, all pertinent wired outputs are de-energized until the link is recovered (see component data sheet for more information.) Through this process, users of Banner wireless networks can be assured that disruptions in the communications link result in predictable system behavior.

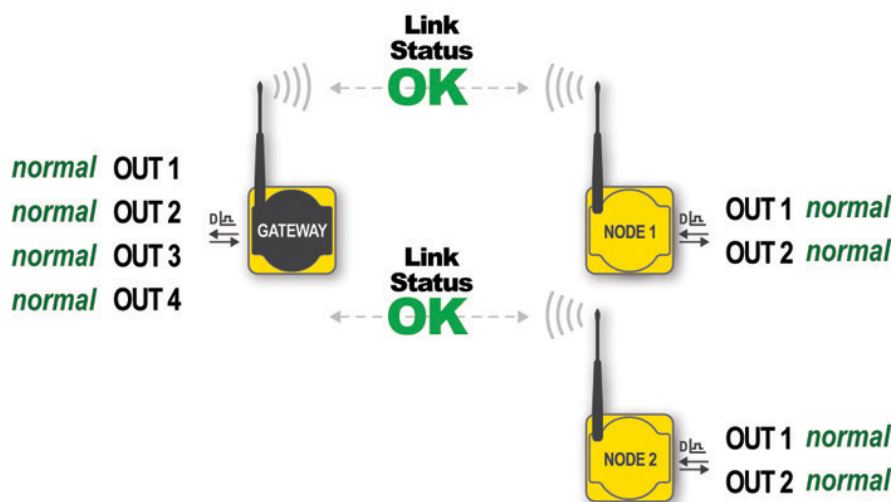
The link time-out feature uses a fully-acknowledged polling method to determine the RF link status of each Node on the network. If after a specified number of sequential polling cycles the Node does not acknowledge a message, the Gateway considers the link with that Node timed out. LCD displays on both the Node and Gateway show *ERROR. Following a time-out, the Node de-energizes outputs and the Gateway sets all outputs linked to the Node in question to a de-energized state. Inputs from the Node mapped to outputs on the Gateway are suspended during a link time-out.

Once a link has failed, the Gateway must receive a specified number of good RF communications packets from the Node in question before the link is reinstated. Outputs are restored to current values when the link is recovered.

Link between Gateway and Node 1 timed out.



Link between Gateway and Node 1 recovered.



Modbus Error Codes

The following are some of the Modbus error codes or messages that may appear on the SureCross devices' LCD.

Message Code 00, Data Field 128

Normal operation.

Message Code 01, Data Field Message

Unknown message. The message was received correctly (correct checksum), but it is not a recognized command.

Message Code 53: Radio Device Time-Out

One of the Nodes is not responding to the Gateway's requests; the defined polling interval with allowable missed count was reached.

To determine the affected Node, press the Gateway's push button 2; the Node number is displayed on the LCD. Likely problems with the Node include:

- The Node may no longer be powered. Verify there is power to the Node and verify the Node's LEDs indicate normal operation.
- The Node may not be connected to its antenna.
- Something may be obstructing the radio signal between the Gateway and Node. Verify a new obstruction isn't present.
- If not in a hazardous location, access the Node's LCD by pressing either push button. Note any information displayed on the screen that may indicate a potential problem.
- After re-establishing communication between the Gateway and Node, conduct a Site Survey and document the signal performance.

Message Code 54

Modbus time-out . A Gateway timeout (time of inactivity on the serial channel) was detected.

Message Code 254

Modbus register 8 device messages are disabled. The Modbus register 8 clears or disables message using the Gateway's Modbus register 15.

LCD Message Codes

BAD EE

System Error. A system error typically represents a failure of the EE PROM. Contact the factory for replacement.

EC XX

The XX lists the Modbus register 8 message code listed in the Modbus Error Codes section.

DX80 Display shows *ERROR: The Gateway uses fully-acknowledged polling to ensure each Node RF link is robust. If a prescribed number of sequential polling cycles are not acknowledged by a Node, the Gateway considers the radio link with that Node to be timed out . All outputs on the Node in question are set to "OFF" (discrete) or "0" (analog, regardless of type). If the Node's RF link recovers and the Gateway or Gateway Pro determines enough acknowledged polling messages have accumulated, the link is reinstated and outputs are restored to the current values.

No LCD

All DX80 devices display "POWER" on the LCD for the first five to ten seconds after applying power. A DX80 Gateway always has a green LED 1 on when power is connected. DX80 Node devices flash a red LED 2 every three seconds or a green LED 1 every second depending on the RF Link status.

Battery-powered devices turn off the LCD after fifteen minutes (factory default). Push any button to reactivate the LCD. Battery-powered devices may be in power-down mode. To put battery powered devices into power-down mode, hold button 1 for three to five seconds. To return from power-down mode, hold button 1 for three to five seconds.

Recheck the power connections and power requirements. Line-powered devices require 10 to 30V dc. Battery-powered devices require 3.6 to 5.5V dc.

After replacing the battery, allow up to sixty seconds for the device to power up.

LED Message Codes

LEDs Both Flash Red and LCD Indicates BAD EE

System Error . A system error typically represents a failure of the EE PROM. Contact the factory for replacement.

Gateway or GatewayPro LED 2 Flashes Red

: For a Gateway system, a Modbus communications error indicates a bad transmission or checksum error between the host and the Gateway device. For a GatewayPro system, a Modbus communications error indicates a communications problem internal to the GatewayPro. For a Gateway and Ethernet Bridge system, a Modbus communication error indicates a communication problem between the Gateway and the Ethernet Bridge.

The default communications settings for the RS485 port are: 1 start bit, 8 data bits, no parity, 1 stop bit, and 19.2k baud. The DX80 Gateway uses Modbus RTU protocol for all communications. Supported Modbus function codes are 3, 6, and 16.

Verify the DX80 model supports RS485 serial communications.

RS485 termination or biasing is not supplied on the Gateway and should be provided externally to the DX80. (Termination is not required by the Gateway, proper biasing of the serial lines is required.)

Bad connection or bad cable.

Node LED 2 Flashes Red (No Sync/Link Loss)

: There are two settings on every Node device used to synchronize to the Gateway device:

1. The Network ID on the Node must match the Gateway Network ID. (1-99)
2. Each Node ID within that network must be set to a unique number (1-99).

If the Gateway and Node are less than two meters apart, device communication may fail (radios may saturate). If the Gateway is less than two meters from another Gateway, send and receive transmissions between all devices the Gateways communicate with fails.

The Gateway and Node may be too far apart to achieve synchronization – consult the factory for options.

Use a qualified antenna on both the Gateway and Node devices.

After any system parameter change, cycle the power to re-synchronize all devices.

When a Node loses synchronization, it is programmed to attempt re-synchronization for five seconds, then sleep for fifteen seconds. Synchronizing may require up to twenty seconds.

Re-cycle power on the Gateway and Node devices.

GatewayPro LED 2 is Not Blinking Yellow

The GatewayPro's LED 2 should always be blinking yellow to indicate Modbus communication. If the LED 2 does not blink yellow, verify the baud rates, slave IDs, parity, and stop bits are set correctly.

Check the cables connecting the GatewayPro to the host device.

No LEDs

All DX80 devices display "POWER" on the LCD for the first five to ten seconds after applying power. A DX80 Gateway always has a green LED 1 on when power is connected. DX80 Node devices flash a red LED 2 every three seconds or a green LED 1 every second depending on the RF Link status.

Put battery powered devices into power-down mode using button 1 on the front panel. To put a battery device into power-down mode, hold button 1 for three to five seconds. To return from power-down mode, hold button 1 for three to five seconds.

Recheck the power connections and power requirements. Line powered devices require 10 to 30V dc. Battery-powered devices require 3.6 to 5.5V dc.

After replacing the battery, allow up to sixty seconds for the device to power up.

The GatewayPro cannot be attached to another Modbus master device or a Modbus slave ID 1 via RS485. Special configuration using the Web page configuration tool allows the GatewayPro to become a slave unit when necessary.

Power Problems

Sensor Not Powered

Many SureCross devices have several switch power outputs for powering sensors. Enable the power supplies using the I/O point parameters for sensor supply #, supply output voltage, and warm-up time.

Site Survey Troubleshooting

Some tips and tricks about improving radio signal reception may improve the site survey results.

Marginal Site Survey (RSSI) Results

If the distance between devices is greater than about 5,000 meters (3 miles) line-of-sight **OR** objects, such as trees or man-made obstructions, interfere with the path, and the MISSED packet count exceeds 40 per 100 packets, consider the following steps:

- Raise the DX80 units to a higher elevation, either by physically moving the devices or installing the antenna(s) remotely at a higher position.
- Use high-gain antenna(s) such as Yagi and/or Omni (see Accessories).
- Decrease the distance between devices.
- Use data radios to extend the position of the Gateway relative to the host system.

Host Systems

No Communication with the Gateway Using RS-485

The default communications settings for the RS485 port are: 1 start bit, 8 data bits, no parity, 1 stop bit, and 19.2k baud. The DX80 Gateway uses Modbus RTU protocol for all communications. Supported Modbus function codes are 3, 6, and 16.

Verify the DX80 model supports RS485 serial communications.

Verify the Slave ID address is set for the bus environment. Factory default Slave ID = 1.

The factory default for the Modbus timeout is set to zero (disabled). Verify the time is set correctly.

RS485 termination or biasing is not supplied on the Gateway and should be provided externally to the Gateway. (Termination is not required by the Gateway, proper biasing of the serial lines is required.)

No Communication with the Gateway When Using the DX83 Ethernet Bridge

Load a properly configured XML file into the DX83 Ethernet Bridge.

The DX83 Ethernet Bridge can be jumpered for RS485 or RS232 communications; verify the jumpers are set properly. All DX80 devices are RS485 based. Please refer to the Jumper Configuration section.

Inputs and Outputs

Some Inputs or Outputs are Not Working

1. From the Node, access the menu system and use manual scrolling mode within **RUN** to freeze the I/O status on the LCD display for the device in question. Verify that when the input device changes state or changes value, the LCD mirrors the behavior.

If the Node is in a hazardous location, access the Node's I/O from the Gateway by changing the Gateway's right rotary dial to the Node number in question. For example, to view the I/O status of Node 3, move the Gateway's right rotary dial to 3. The Gateway's LCD now scrolls through Node 3's I/O. To freeze the display on a particular I/O point,

double-click button 2. The autoscrolling on the Gateway stops at the *RUN screen. Single-click button 1 to advance through the Node's I/O points.

2. Verify that the LCD on the output side mirrors the linked input's behavior. If the input device state LCD on the origination DX80 and the LCD on the destination DX80 behave the same, there may be a wiring issue or an interfacing problem. Consult the factory.

3. Nodes will not sample inputs unless they are in sync with a Gateway. Verify your Node is in sync with its Gateway.

Web Page Configuration

No Web Page Access

The IP address is wrong. The device defaults to 192.168.0.1 and the host system should be set to 192.168.0.x. If the IP addresses were changed from the default settings, verify the first three sections of the address are the same for both the devices and the host.

Check the proxy settings on the browser. (See Appendix A).

When the devices are attached directly to a computer without using a hub or switch, use a crossover cable. When using a hub or switch, use a straight cable.

After changing the IP address to the Gateway Pro or Ethernet Bridge, cycle the power to the device to activate the change.

Unknown IP Address

The device's default IP address is 192.168.0.1. The host should be set to 192.168.0.2. If another address is used, write it down or print out the set-up page and store in a safe place. If the IP address of the device was changed and is unknown, follow the Restoring Factory Default Settings instructions.

Restoring Factory Default Settings

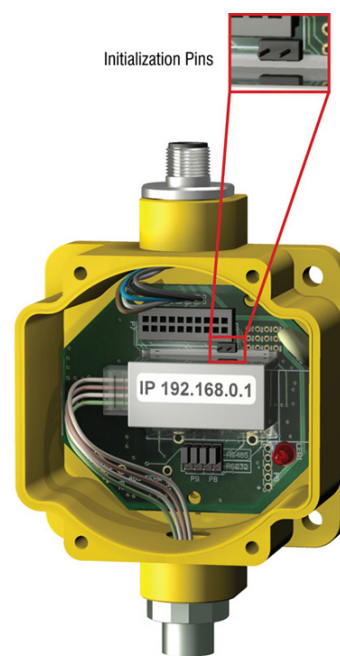
Restoring the factory default settings resets the settings for the IP address, the root login and root password, the HTTP port setting, and a few other communication settings.

Restoring the factory default settings resets the settings for:

Parameter	Default Setting
IP Address	192.168.0.1
Root Login	root
Root Password	sxi
HTTP Port	80
Modbus Server Port	502
Telnet Port	23
EtherNet/IP Protocol	Disabled

To restore these settings, leave the device powered up and running and follow these steps:

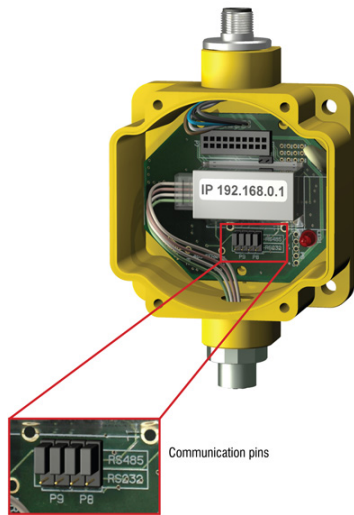
1. Open the DX80 GatewayPro or DX83 Ethernet Bridge housing to access the board
2. Install the initialization (init) jumper on the pins shown
3. Wait 30 seconds
4. Remove the jumper
5. Cycle power to the device



Using the configuration Web page, verify the parameters have returned to the factory defaults listed in the table.

Serial Communication Configuration

The Gateway Pro and Ethernet Bridge devices use jumpers to select between RS-485 and RS-232 communications.



Because all DX80 devices are RS-485 based (at this time), verify the jumpers are set correctly.

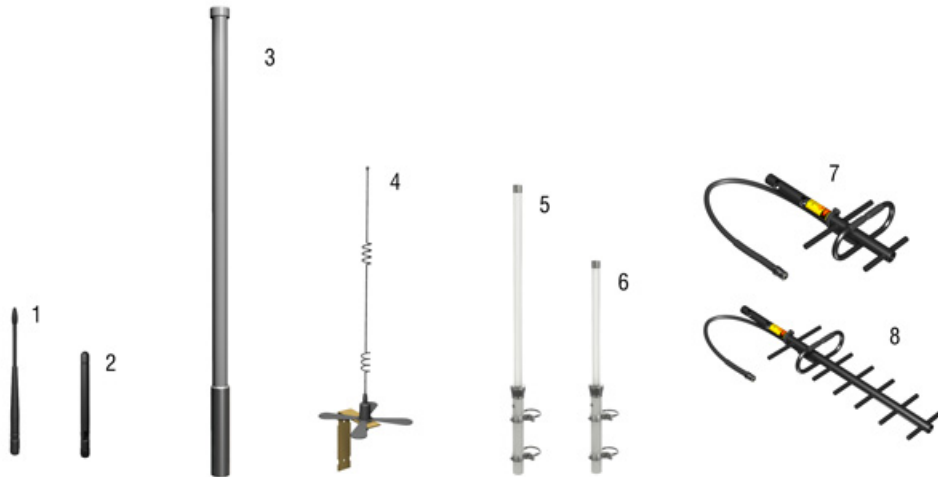
Install the four jumpers across the two top rows of pins for RS-485 and across the bottom two rows of pins for RS-232.

Chapter 9

Accessories

The accessories list includes FCC approved antennas, antenna cabling, surge suppressors, power supplies, replacement batteries, enclosures, cables, and other hardware.

Antennas



Not to scale

Part No.	Model No.	Description	
Omni-Directional Antennas			
1	76908	BWA-9O2-C	902-928 MHz, 2 dBi, RP-SMA Male (ships with 900 MHz DX80 devices)
2	77816	BWA-2O2-C	2.4 GHz, 2 dBi, RP-SMA Male, Rubber swivel, 3 1/4" (ships with 2.4 GHz DX80 devices)
	77817	BWA-2O5-C	2.4 GHz, 5 dBi, RP-SMA Male, Rubber swivel, 6 1/2"
	77818	BWA-2O7-C	2.4 GHz, 7 dBi, RP-SMA Male, Rubber swivel, 9 1/4"
3	77481	BWA-9O6-A	902-928 MHz, 6 dBd, N Female, Fiberglass, 71.5" Outdoor
4	77819	BWA-9O5-B	902-928 MHz, 5 dBd/7.2 dBi, N Female, with Ground Plane, 32" Indoor/Outdoor
5	81080	BWA-2O8-A	2.4 GHz, 8.5 dBi, N Female, 24" Indoor/Outdoor
6	81081	BWA-2O6-A	2.4 GHz, 6 dBi, N Female, 16" Indoor/Outdoor
Directional (Yagi) Antennas			
7	77479	BWA-9Y6-A	890-960 MHz, 6.5 dBd, N Female, 6.8" x 13" Outdoor
8	77480	BWA-9Y10-A	890-960 MHz, 10 dBd, N Female, 6.8" x 24" Outdoor

DX85 Modbus RTU Remote I/O Devices

These remote I/O devices have a Modbus interface and are used to expand the I/O of the Gateway or the Modbus host.



DX85 Modbus RTU Remote I/O



DX85...C Modbus RTU Remote I/O

DX85 Part No.	DX85...C Part No.	Model No.	Description
77675	10202	DX85M6P6	DX85 Expanded Remote I/O, 6 Discrete IN, 6 Discrete OUT
77676	10201	DX85M4P4M2M2	DX85 Expanded Remote I/O, 4 Discrete IN, 4 Discrete OUT, 2 Analog IN, 2 Analog OUT (0-20 mA)
79306	10204	DX85M4P8	DX85 Expanded Remote I/O, 4 Discrete IN, 8 Discrete OUT
79307	10203	DX85M8P4	DX85 Expanded Remote I/O, 8 Discrete IN, 4 Discrete OUT
79966	10205	DX85M0P0M4M4	DX85 Expanded Remote I/O, 4 Analog IN, 4 Analog OUT (0-20 mA)

Note: Add a “C” to the end of any DX85 model to order that I/O mix with an IP20 housing. The IP20 models are Class I, Division 2 certified. All list prices and data sheets remain the same for either the IP67 or the IP20 housing.

FlexPower Supplies and Replacement Batteries



Part No.	Model No.	Description
76972	DX81	Battery Supply Module with mounting hardware
82864	DX81H	Battery Supply Module with mounting hardware, for DX99 polycarbonate housing devices

	Part No.	Model No.	Description
	77674	DX81P6	Battery Supply Module, 6 "D" cells, with mounting hardware
	81057	BWA-SOLAR-001	FlexPower Solar Supply, includes panel (13 11/16" x 15 3/16"), controller, rechargeable battery pack, mounting hardware
	78261	BWA-BATT-001	Lithium "D" cell, single, for DX81 and DX81H Battery Supply Module
	81394	BWA-BATT-002	Lithium "D" cells, 6-pack for DX81P6 Battery Supply Module
	78473	BWA-BATT-003	Rechargeable battery pack, controller, and wiring for BWA-SOLAR-001





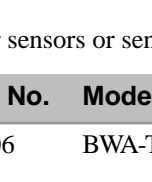
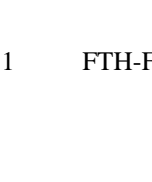
Other Power Supplies

Part No.	Model No.	Description
10250	BWA-SOLAR-CHARGER	Wall charger for BWA-BATT-003 battery pack.
83245	BWA-SPANEL-001	Solar Panel
65837	SPS101Q	DC Power Supply, 120 mA, 12–30V dc, 5-pin Euro-style QD
65848	SPS101QP	DC Power Supply, 120 mA, 12–30V dc, 5-pin Euro-style QD and pigtail

Part No.	Model No.	Description
77422	PS24W	DC Power Supply, 500 mA, 24V dc, Demo kit power supply
74321	EZAC-E-QE5	DC Power Supply, 700 mA, 24V dc, 5-pin Euro-style QD, Hardwired AC power connection
73466	EZAC-E-QE5-QS5	DC Power Supply, 700 mA, 24V dc, 5-pin Euro-style QD, 5-pin Mini QD AC power connection
76809	PSDINA-24-4	DC Power Supply, 4 Amps, 24V dc, Terminal block connection, Converts 85-264V ac 50/60 Hz
11280	PS24DX	DC Power Supply, 200 mA, 24V dc, in the DX80 low-profile housing

FlexPower Sensors




The following sensors are optimized for use with the FlexPower Nodes.

Part No.	Model No.	Description	
	78447	SM312LPQD-78447	MINI-BEAM, Low Power, 5V, Polarized Retroreflective, 3 m
	78419	SM312DQD-78419	MINI-BEAM, Low Power, 5V, Diffuse, 38 cm
	80922	T30UFDNCQ	Ultra-Sonic, T30U, 3.6 to 5V Low Power, 300 mm to 3 m Range, 1-wire serial interface
	79610	M12FTH1Q	Temperature and Humidity Sensor, $\pm 2\%$ Accuracy, 1-wire serial interface
	81050	M12FTH2Q	Temperature and Humidity Sensor, $\pm 3.5\%$ Accuracy, 1-wire serial interface
	75390	QT50ULBQ6-75390	Ultra-Sonic, QT50U, 200 mm to 8 m Range

Other sensors or sensor components include:

Part No.	Model No.	Description
10406	BWA-THERMISTOR-001	NTC Thermistor, 2 KOHms, $\pm 0.2\% C$
81930	FTH-FIL-001	Temperature and Humidity Sensor Filter, Aluminum Grill Filter Cap (default filter cap)
81931	FTH-FIL-002	Temperature and Humidity Sensor Filter, Stainless Steel Sintered Filter, 10 micrometer porosity

Surge Suppressors

	Part No.	Model No.	Description
	79296	BWC-LMRSFRPB	Surge Suppressor, bulkhead, RP-SMA Type
	78548	BWC-LFNBMN	Surge Suppressor, bulkhead, N-Type
	12477	BWC-LFNBMN-DC	Surge Suppressor, bulkhead, N-Type, dc Blocking

Cables

Antenna Cables



	Part No.	Model No.	Description
1	77486	BWC-1MRSMN05	LMR200 RP-SMA to N Male, 0.5M
	77820	BWC-1MRSMN2	LMR200 RP-SMA to N Male, 2M
2	78544	BWC-1MRSFRSB0.2	RG58, RP-SMA to RP-SMAF Bulkhead, 0.2M
	78337	BWC-1MRSFRSB1	RG58, RP-SMA to RP-SMAF Bulkhead, 1M
	78338	BWC-1MRSFRSB2	RG58, RP-SMA to RP-SMAF Bulkhead, 2M
	77488	BWC-1MRSFRSB4	RG58, RP-SMA to RP-SMAF Bulkhead, 4M
3	77489	BWC-4MNFN3	LMR400 N Male to N Female, 3M
	77490	BWC-4MNFN6	LMR400 N Male to N Female, 6M
	77821	BWC-4MNFN15	LMR400 N Male to N Female, 15M
	77822	BWC-4MNFN30	LMR400 N Male to N Female, 30M

Ethernet Cables

Part No.	Model No.	Description
77669	BWA-E2M	Ethernet cable, RSCD RJ45 440, 2M
78469	BWA-E8M	Ethernet cable, RSCD RJ45 440, 8M

Part No.	Model No.	Description
78467	BWA-EX2M	Ethernet cable, crossover, RSCD RJ45CR 440, 2M

Adapter Cables



Part No.	Model No.	Description
81325	BWA-HW-006	Adapter cable, USB to RS485, for use with the User Configuration Tool software (UCT)

Splitter Cables



Part No.	Model No.	Description
83265	CSRB-M1250M125.47M125.73	Splitter cable, 5-pin Euro-style QD, No trunk male, two female branches, black (shown). Use to split power between two FlexPower or solar powered devices. DO NOT use this cable to connect a FlexPower devices to a 10–30V dc powered device.
75286	CSB-M1240M1241	Splitter cable, 4-pin Euro-style QD, No trunk male, two female branches, yellow (not shown). Used to split power between two 10–30V dc powered devices, such as a data radio and Gateway, or between a DX85 and Gateway.
13805	CSRB-M1253.28M1253.28M1253.28	Cable, Splitter, for dual power sources, 5-pin Euro female to 2 5-pin Euro males Used to connect one FlexPower device (data radio, FlexPowered Gateway, etc) to two power sources, such as the FlexPower Solar Supply and DX81P6 Battery Pack.

Part No.	Model No.	Description
14642	BWA-HW-026	Cable, Splitter, wall wart for external power split to 5-pin Euro-style male and 5-pin Euro female (to power a M-H at 1 Watt while configuring it through the MHCT)
13250	BWA-DRSPLITTER	Cable, Splitter, DB9 Female (RS232) trunk to 5-pin Euro-style male and female

Euro-Style Cables

Part No.	Model No.	Description
78382	BWA-QD5.5	Prewired 5-pin Euro connector, 1/2-14 NBSM
78383	BWA-QD8.5	Prewired, 8-pin Euro connector, 1/2-14 NBSM
78384	BWA-QD12.5	Prewired 12-pin Euro connector, 1/2-14 NBSM
58912	FIC-M12F4	Euro-Style Field-Wireable Connector 4-pin Female Straight
62837	DEUR-506.6C	Cable, 5-pin Euro-style, double ended, male/female, 2m
72333	DEE2R-51D	Cable, 5-pin Euro-style, double ended, male/female, 0.3m
72334	DEE2R-53D	Cable, 5-pin Euro-style, double ended, male/female, 1m
72636	DEE2R-58D	Cable, 5-pin Euro-style, double ended, male/female, 2.4m
71038	MQDC1-501.5	Cable, 5-pin Euro-style, single ended, female, 0.5m
12597	MQDC1-501.6	Cable, 4-pin Euro-style, single ended, male, straight, 0.5m, longer pigtail ends for DX80...C models
51127	MQDC1-506	Cable, 5-pin Euro-style, single ended, female, 2m
47812	MQDC1-515	Cable, 5-pin Euro-style, single ended, female, 5m
47814	MQDC1-530	Cable, 5-pin Euro-style, single ended, female, 9m
51128	MQDC1-506RA	Cable, 5-pin Euro-style, single ended, female, right-angle, 2m
47813	MQDC1-515RA	Cable, 5-pin Euro-style, single ended, female, right-angle, 5m
47815	MQDC1-530RA	Cable, 5-pin Euro-style, single ended, female, right-angle, 9m

Right-angle cordsets are not compatible with the DX70 devices.

When facing the Node or Gateway toward you and the quick disconnect connection is facing down, the right-angle cables exit to the right.

Other Cables

Part No.	Model No.	Description
79985	BWA-RIBBON-001	Ribbon cable, 20-pin DBL socket
10200	BWA-HW-010	Cable, FlexPower Current Monitoring

Enclosures and Relay Boxes



Part No.	Model No.	Description
11320	BWA-EF14128	Enclosure Fiberglass Hinged 14"x12"x8"
11321	BWA-EF1086	Enclosure Fiberglass Hinged 10"x8"x6"
11322	BWA-EF866	Enclosure Fiberglass Hinged 8"x6"x6"
11326	BWA-PA1412	Panel, 14 x 12
11327	BWA-PA108	Panel, 10 x 8
11327	BWA-PA86	Panel, 8 x 6
11329	BWA-PM12	Pole Mount, 12 inch
11340	BWA-PM8	Pole Mount, 8 inch
11341	BWA-PM6	Pole Mount, 6 inch
11346	IB6RP	Interface Relay Box, 18-26V dc inputs, isolated relay outputs (not shown)

Replacement Parts

Part No.	Model No.	Description	Items
76907	BWA-HW-001	Mounting Hardware Kit	Screw, M5-0.8 x 25 mm, SS (4) Screw, M5-0.8 x 16mm, SS (4) Hex nut, M5-0.8mm, SS (4) Bolt, #8-32 x 3/4", SS (4)
76906	BWA-HW-002	DX80 Access Hardware Kit	Plastic threaded plugs, PG-7 (4)

Part No.	Model No.	Description	Items
			Nylon gland fittings, PG-7 (4)
			Hex nuts, PG-7 (4)
			Plug, 1/2" NPT
			Nylon gland fitting, 1/2" NPT
76910	BWA-HW-003	PTFE Tape	
16328	BWA-HW-004	Replacement Seals	O-ring, rotary access cover, PG21 (2)
			O-ring, body gasket (2)
			Access cover, rotary, clear plastic (2)
83244	BWA-HW-009	Solar Assembly Hardware Pack	Includes brackets, bolts, set screws
79438	BWA-CG.5-10	Cable Glands, 1/2-inch NPT	10 pieces, cordgrips for cable diameters 0.17" to 0.45"
79984	BWA-HP.5-10	Dummy Hole Plugs, 1/2-inch NPT	10 pieces
81233	BWA-HW-007	Housing Kit, DX80	DX80 top and bottom (10)
80850	BWA-HW-008	Housing Kit, DX81	DX81 top and bottom (10)
77161	SMBDX80DIN	Bracket assembly, DIN rail, flat mount	
81930	FTH-FIL-001	Temperature and Humidity Sensor Filters	Aluminum Grill Filter Cap (default filter cap)
81931	FTH-FIL-002		Stainless Steel Sintered Filter, 10 micrometer porosity
10283	BWA-HW-011	Terminal Block Headers, IP20, 2 pack	
10878	BWA-HW-012	DX99 Antenna Extension Pack	Screw, M4-0.7 x 20, pan head, black steel
			Flexible Antenna Cable, 12", SMA male to SMA female

Part 9

Certifications and Additional Information

Topics:

- [Agency Certifications](#)
- [Additional Information](#)

Chapter 10

Agency Certifications

FCC Certification, 900MHz

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

FCC ID: TGUDX80 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: TGUDX80.

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.

Model Number	Antenna Type	Maximum Gain
	Integral antenna	Unity gain

Model Number	Antenna Type	Maximum Gain
BWA-901-x	Omni, 1/4 wave dipole	2 dBi
BWA-902-C	Omni, 1/2 wave dipole, Swivel	2 dBi
BWA-906-A	Omni Wideband, Fiberglass Radome	8.2 dBi
BWA-905-B	Omni Base Whip	7.2 dBi
BWA-9Y10-A	Yagi	10 dBi

Table 1. Type certified antennas

FCC Certification, 900 MHz, 1 Watt Radios

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.

Model 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, 2.4GHz

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.

Model 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

Certified For Use in the Following Countries

The SureCross radio devices are approved for use in the following countries.

Country	Frequency	Model Families				
		DX80	DX70	DX91	DX99	DXDR
Australia	2.4 GHz	x	x			x
Austria	2.4 GHz	x	x	x	x	x
Bahamas, The	900 MHz	x	x	x	x	x
Bahamas, The	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
Colombia	900 MHz	x	x	x	x	x
Colombia	2.4 GHz	x	x	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

Country	Frequency	Model Families				
		DX80	DX70	DX91	DX99	DXDR
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
Panama	900 MHz	x	x	x	x	x
Panama	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
Saudia Arabia (Kingdom of)	2.4 GHz	x	x	x	x	x
Slovakia	2.4 GHz	x	x	x	x	x
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
Taiwan	2.4 GHz	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

Bulgaria - Authorization required for outdoor and public service use.

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 présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la Classe A prescrites dans le Règlement sur le brouillage radioélectrique édités par le ministre des Communications du Canada.

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

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

* Israel - DX80 and DX99 models are certified for the external antenna models only.

Luxembourg - General authorization is required for public service.

** Taiwan - Taiwan is certified to operate specific DX80 and DX99 models. For a list of specific models, refer to the certificate.

Additional Statements - 900 MHz

This device has been designed to operate with the antennas listed on Banner Engineering's website and having a maximum gain of 9 dBm. Antennas not included in this list or having a gain greater than 9 dBm are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen such that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

Transmit Power Levels

The SureCross wireless products were certified for use in these countries using the standard antenna that ships with the product. When using other antennas, verify you are not exceeding the transmit power levels allowed by local governing agencies.

Exporting SureCross Devices

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. A list of approved countries appears in the SureCross Wireless I/O Network product manual, in the *Agency Certifications* section. The SureCross wireless products were certified for use in these countries using the standard antenna that ships with the product. When using other antennas, verify you are not exceeding the transmit power levels allowed by local governing agencies. Consult with Banner Engineering if the destination country is not on this list.

Chapter 11

Additional Information

Units Defined

The units parameter defines the range and/or type of data value associated with an input or output.

Selecting Units from within any configuration tool changes the units definition of several parameters, including threshold, hysteresis, and delta. For example, if the units are 0-20 mA, the threshold, hysteresis, and delta values are entered as milliampere values. Selecting Temp C changes the threshold, hysteresis, and delta units to degrees Celsius.

Signed values range from -32768 to +32767 and allow for the measurement of negative values. Signed values are typically used for measuring temperatures. Signed values are stored as two's complement values.

Unsigned values range from 0 to 65535 and are used to measure values that do not go below zero, such as 4 to 20 mA, distance, or a counter.

Input Units

0. Raw. Displays the raw A/D conversion data with data ranges from 0 to 65535. This units type is typically used only for factory calibration.

1. 4 to 20 mA. Analog unit. Modbus register contents are scaled such that 0 represents 4 mA and 65535 represents 20 mA.

2. 0 to 20 mA. Default analog input unit. Modbus register contents are scaled such that 0 represents 0 mA and 65535 represents 20 mA.

3. Discrete (On/Off). Default discrete input unit.

4. 0 to 10V (Volts). Analog input using 0 to 10V instead of current. Modbus register contents are scaled such that 0 represents 0V and 65535 represents 10V.

6. Temp C. Celsius, high resolution. Analog input for temperature devices such as thermocouples, RTD, and thermistors. In high resolution mode, temperature = (Modbus register value) ÷ 20.

7. Temp F. Fahrenheit, high resolution. Analog input for temperature devices such as thermocouples, RTD, and thermistors. In high resolution mode, temperature = (Modbus register value) ÷ 20.

8. Temp C LowRes. Celsius, low resolution. To measure a greater temperature range, use the low resolution unit. In low resolution mode, temperature = (Modbus register value) ÷ 2.

9. Temp F Low Res. Fahrenheit, low resolution. To measure a greater temperature range, use the low resolution unit. In low resolution mode, temperature = (Modbus register value) ÷ 2.

10. Asynchronous Counter, 32-bit. The 32-bit counter value records counts up to 4.29 billion.

11. Asynchronous Counter, 16-bit. The 16-bit counter value records counts up to 65535.

Output Units

0. Raw. Displays the raw A/D conversion data with data ranges from 0 to 65535. This units type is typically used only for factory calibration.

1. 4 to 20 mA. Analog unit. Modbus register contents are scaled such that 0 represents 4 mA and 65535 represents 20 mA.

2. 0 to 20 mA. Default analog input unit. Modbus register contents are scaled such that 0 represents 0 mA and 65535 represents 20 mA.

3. Discrete (On/Off). Default discrete input unit.

4. 0 to 10V (Volts). Analog unit using 0 to 10V instead of current. Modbus register contents are scaled such that 0 represents 0V and 65535 represents 10V.

5. Signed Analog, 0 to 10V. For a signed value, such as temperature, that is to be converted to a voltage out value. Use null to set the start point and span to define the range. The null value is the starting temperature to be associated with 0V. The span is the entire temperature range that is to be associated with 0 to 10V.

6. Signed Analog, 0 to 20 mA. For a signed value, such as temperature, that is to be converted to a mA out value. Use null to set the start point and span to define the range. The null value is the starting temperature to be associated with 0 mA. The span is the entire temperature range that is to be associated with 0 to 20 mA.

7. Unsigned Analog, 0 to 20 mA. For unsigned values, such as a counter, that is to be converted to a mA out value. Use the null to set the start point and span to define the range. The null value is the distance to be associated with 0 mA. The span is the entire distance range that is to be associated with 0 to 20 mA.

8. Signed Analog, 4 to 20 mA (A). In older models, this units type is for degree Celsius conversions only. Use null to set the start point and span to define the range. The null value is the starting temperature to be associated with 4 mA. The span is the entire temperature range that is to be associated with 4 to 20 mA. For newer firmware models, type codes 8 and 9 are treated the same.

9. Signed Analog, 4 to 20 mA (B). In older models, this units type is for degree Fahrenheit conversions only. Use null to set the start point and span to define the range. The null value is the starting temperature to be associated with 4 mA. The span is the entire temperature range that is to be associated with 4 to 20 mA. For newer firmware models, type codes 8 and 9 are treated the same.

10. Unsigned Analog, 0 to 10V. For an unsigned value, such as 0 to 20 mA, that is to be converted to a voltage out value. Use the null to set the start point and span to define the range. The null value is the distance to be associated with 0V. The span is the entire distance range that is to be associated with 0 to 10V.

11. Counter, 16-bit. The 16-bit counter value records counts up to 65535.

12. Unsigned Analog, 4 to 20 mA. For an unsigned value, such as 0 to 10V, that is to be converted to a mA out value. Use the null to set the start point and span to define the range. The null value is the distance to be associated with 4 mA. The span is the entire distance range that is to be associated with 4 to 20 mA.

Units Conversion in the Banner Wireless System

The units conversion table defines the range of values for each type of I/O.

The wireless devices have many different units of measure for inputs including: 0–20 mA, 4–20 mA, 0–10V dc, temperature (°C or °F), humidity (RH), 32-bit value, or 16-bit value. Outputs can be either current (4–20 mA, 0–20 mA) or voltage (0–10V dc).

The following table defines the range of values and descriptions for input units. For temperature signed values, the register resolution is based on the device configuration mode: in high resolution mode the register contains 0.1° and in low resolution mode the register contains 1°.

Input Type	I/O Range		Holding Register Representation		Data Conversion	Description
	Min. Value	Max. Value	Min. Value	Max. Value		
Discrete	0	1	0	1	-	-
0–20 mA	0.0 mA	20.0 mA	0	65535	$(20\text{mA} \div 65535) \times \text{Reg Value} = \text{mA}$	Linear mapping of unsigned register value to current

Input Type	I/O Range		Holding Register Representation		Data Conversion	Description
	Min. Value	Max. Value	Min. Value	Max. Value		
4–20 mA	4.0 mA	20.0 mA	0	65535	$((16\text{mA} \div 65535) \times \text{Reg Value}) + 4 = \text{mA}$	Linear mapping of unsigned register value to current
0–10V dc	0.0V dc	10.0V dc	0	65535	$(10\text{V} \div 65535) \times \text{Reg Value} = \text{V}$	Linear mapping of unsigned register value to voltage
Temp C/F (high resolution)	-1638.3	+1638.4	-32768	32767	$(\text{Reg Value}) \div 20 = \text{Temp}$	Signed Values
Temp C/F (low resolution)	-1638.3	+1638.4	-32768	32767	$(\text{Reg Value}) \div 2 = \text{Temp}$	Signed Values
Counter	0	65535	0	65535	-	-
16-bit T30UF	0 mm	65535 mm	0	65535	None; stored as millimeter value	Unsigned
Humidity	0% RH	100% RH	0	10000	$(\text{Reg Value}) \div 100 = \text{Relative Humidity (RH)}$	Unsigned

* 0.01 ma A/D resolution, 0.02 mA accuracy + 0.01% per degrees C (about 0.08 mA over ± 40 degrees)

Temperature Measurements: In high resolution mode, the temperature = (Modbus register value) $\div 20$. For high resolution temperature input, 0 in the register is interpreted as 0° and 65535 in the register (0xFFFF) is interpreted as $-1 \div 20 = -0.05^\circ$.

In low resolution mode, the temperature is (Modbus register value) $\div 2$. For low resolution temperature input, 0 in the register is interpreted as 0° and 65535 in the register (0xFFFF) is interpreted as $-1 \div 2 = -0.5^\circ$.

Signed/Unsigned Unit Types

Using the signed or unsigned unit type allows the user to generically map any input to any output. The signed and unsigned unit types read the null and span parameters to create the linear translation between one scale and another. The output type is set to mA or V.

Output = (Fullscale/Span)(InputValue – Null) + Offset

Output Scale	Fullscale (range)	Offset
0–20 mA	20 mA	0 mA
4–20 mA	16 mA	4 mA
0–10V	10V	0V

Fullscale. Defined in the table; the output range

Span. The total range of values mapped to the output

Null. The starting point for the output scale

Input Value. The value mapped to the output

Offset. Defined in the table; the starting output value.

Example: Temperature Map

Map a temperature input from a Node to a 4–20 mA output. The starting temperature is –20°F and the last temperature will be 50°F (4 mA = –20°F, 20 mA = 50°F). This defines the null as –20°F and the span as 70.

With an input temperature value of –5°F, the output value will be:

$$\text{Output} = (\text{Fullscale} \div \text{Span})(\text{InValue} - \text{Null}) + \text{Offset}$$

$$(\text{Fullscale} \div \text{Span}) = 16 \div 70 = 0.22857$$

$$(\text{Value} - \text{Null}) = -5 - (-20) = 15$$

$$\text{Offset} = 4$$

$$\text{Output} = 0.22857 \times 15 + 4 = 7.42 \text{ mA}$$

Example: Distance Map

Map a distance input from a Node to a 0–10V output. The starting distance is 200mm and the last distance will be 2000mm (4 mA = 200mm, 20 mA = 2000mm). This defines the null as 200 and the span as 1800.

With an input distance reading of 1560mm, the output value will be:

$$\text{Output} = (\text{Fullscale} \div \text{Span})(\text{InValue} - \text{Null}) + \text{Offset}$$

$$(\text{Fullscale} \div \text{Span}) = 10 \div 1800 = 0.00555$$

$$(\text{Value} - \text{Null}) = 1560 - 200 = 1360$$

$$\text{Offset} = 0$$

$$\text{Output} = 0.00555 \times 1360 + 0 = 7.54 \text{ V}$$

Alarm Conditions

The standard alarm conditions are as follows:

$$\text{Unsigned Alarm} = 0\text{x}\text{FFFF}$$

$$\text{Signed Alarm} = 0\text{x}\text{7FFF}$$

If special alarm conditions are needed, consult the factory for details.

What is Extended Address Mode?

Extended address mode assigns a unique code, the extended address code, to all devices in a particular network, thereby controlling which radios can exchange information.

The wireless I/O network is defined by the Network ID (NID) assigned to the Gateway and all its Nodes, ensuring communication. Each device within this common network also has a unique Device Address assigned.

Extended address mode adds the ability to isolate networks from one another by assigning a unique code, the extended address code, to all devices in a particular network. Only devices sharing the extended address code can exchange data. In addition to isolating networks, the extended addressing mode allows up to 56 Nodes to connect to a single Gateway. Without extended addressing, only 15 Nodes can connect to a single Gateway.

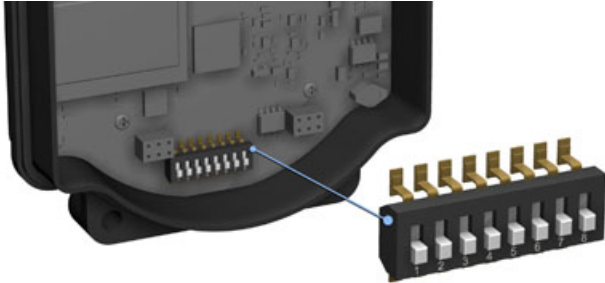
The extended address in the Gateway defaults to a code derived from its serial number although the code can be customized using the manual binding procedure. Binding DX80 devices locks Nodes to a specific Gateway by teaching the Nodes the Gateway's extended address code. After the devices are bound, the Nodes only accept data from the Gateway to which they are bound.

To select extended address mode, turn the device off. Set DIP switch 1 to the 'ON' position, then turn the device on. Do not set the DIP switch while the device is powered.

More Details About Extended Address Mode

During automatic binding, the Gateway broadcasts the extended address code to all Nodes currently in binding mode. To manually bind, enter the extended address code manually into each network device. Manually binding is particularly useful when replacing or upgrading network devices.

Important: The extended addressing code is independent from the system network ID (NID). Consequently, multiple networks can share a NID and will not exchange data; the networks are completely isolated from one another. Users of the DX80 product do not need to be aware of other nearby networks to ensure their network does not unintentionally exchange data with other networks. However, assigning different NIDs to different networks improves collocation performance in dense installations; this is true whether the network is in standard addressing mode or extended addressing mode.



	Rotary Switch Mode	Extended Address Mode
Menus		There are more menu options in extended address mode.
Rotary Dials	The left rotary dial sets the Network ID and the right dial sets the Device ID/Address.	On the Gateway, both rotary dials, while in the (NID) menu, set the Network ID. On the Node both rotary dials are used to set the Device ID.
Nodes in Network	A maximum of 15 Nodes can be used in the wireless network	A maximum of 56 Nodes can be used in the wireless network.

Setting up the Wireless Network Using the Rotary Dials

Follow these steps to set up your wireless network using the rotary dials instead of using extended addressing mode. Banner recommends using Extended Addressing Mode, but some older products may only recognize Rotary Dial Address Mode.

Setting up the Wireless Network

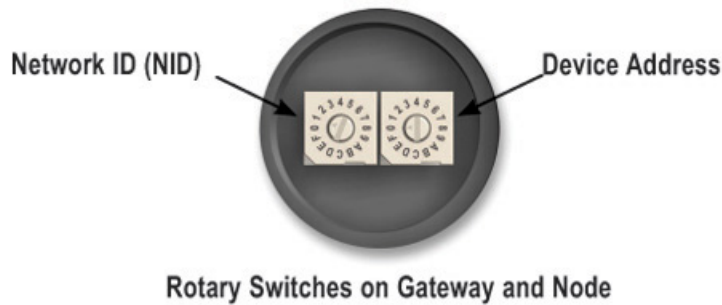
Rotary Dial Address Mode

Rotary dial address mode uses the left dial to set the Network ID and the right dial to set the Device Address (device ID).

The wireless RF network is defined by the Network ID (NID) assigned to the Gateway and its Nodes. Each device within this common network must have a unique Device Address assigned.

For factory configured kits, the Network ID and Device Addresses have been assigned. Otherwise, use the Rotary Switches (shown below) to define both the NID and Device Address for each device. Follow the steps to set up your DX80 network.

To operate more than 15 Nodes in your wireless network, refer to the instructions on extended address mode and device binding.



Setting the Network ID Using the Rotary Dials

The wireless network is defined by the Network ID (NID) assigned to the Gateway and its Nodes. Each device within this common network must have a unique Device Address assigned.

When using rotary switch addressing mode, set the Network ID on the Gateway and all its Nodes using the left rotary switch. Set the Device ID using the right rotary switch.

1. Remove rotary switch access covers. Turn counterclockwise to remove and clockwise to tighten.
2. On the Gateway, set the left rotary switch to 1. The factory default NID setting on all devices is 1. Set to another Network ID when operating more than one network in the same area.
3. On all Nodes within the same network, set the left rotary switch to 1. Assign the same NID to all devices within a single network (hexidecimal 0-F).

When more than one network is operating in the same space, assign a unique Network ID to each network.

Setting the Device Address Using the Rotary Dials

The Device ID establishes a unique identifier for each device within a wireless network.

1. On the Gateway, set the right rotary switch to 0.
A device address of 0 on the Gateway displays settings for the Gateway itself. To view settings for another device on the network, adjust the right rotary switch on the Gateway to the desired device address.
2. On the first Node (device address = 1), set the right rotary switch to 1. Do not change the Device ID for preconfigured kits as this would affect the factory mapping of the I/O.
3. On the second Node (device address = 2), set the right rotary switch to 2.
4. Continue setting the device address for each additional Node using a unique number (...3,4,5).

After setting both the Network ID and Device Addresses, install the rotary switch access covers, referring to the Installation section for IP67 instructions.

A successful RF link is identified by a blinking green LED 1 on each node.

Setting Up Channel Search Mode

A Gateway runs Channel Search Mode on power up or when the Gateway's Network ID is changed. Once Channel Search Mode begins, the Gateway determines if its assigned Network ID is available for use or is already in use by another radio network. For example, if a Gateway powers up set to Network ID 2, Channel Search Mode begins running as shown below.

Apply power to the Gateway (see Applying Power instructions)

1. Apply power to the Gateway and set the rotary dial to a Network ID number (shown here as Network ID 2).

Channel Search Mode begins running. LED 1 is solid red and LED 2 is flashing yellow. The LCD displays START CHANNL SEARCH MODE. The selected Network ID (NID) is tested to determine availability. The test takes one minute to complete and counts down from 60 seconds. The LCD shows SEARCH NID 2 1M 0S. If the Network ID is not already in use, the LCD displays NID OK and enters RUN mode.

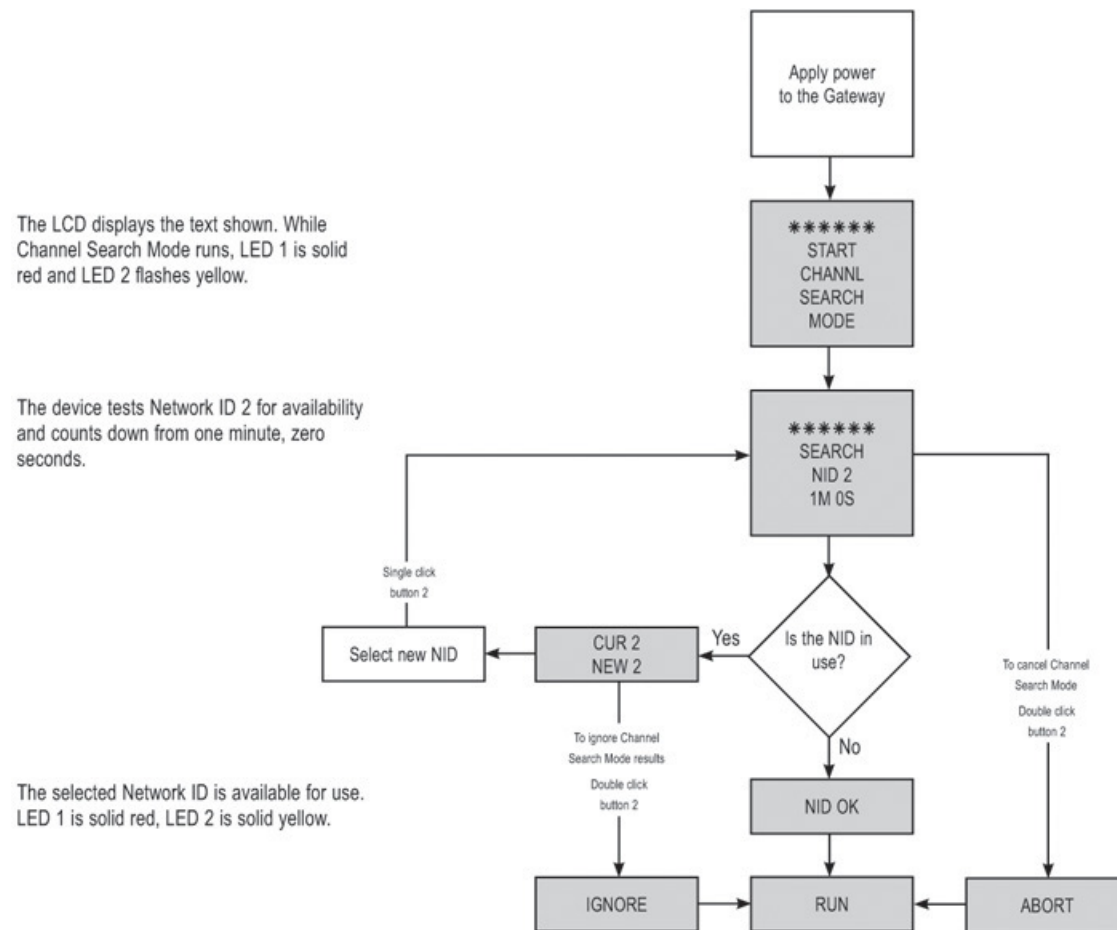
2. If the Network ID is already in use by another DX80 Gateway device, an IN USE message displays. Use the left rotary dial to select another ID.
3. After selecting a new Network ID, click button two once to restart Channel Search Mode.
The screen cycles between displaying the current Network ID setting and a new NID setting until either the left rotary dial is changed to another Network ID or the test is aborted. (LED 1 is solid red and LED 2 flashes red.)
Once a new Network ID is selected, Channel Search Mode begins again.
4. Once in RUN mode, the LCD display shows the current I/O status of the Gateway.
The Gateway and Gateway Pro start in *RUN mode. The LCD shows the current Network ID (NID), identifies the device, then beings cycling through the I/O points (GatewayPro has no I/O points).

To cancel Channel Search Mode, double-click button two. The word ABORT displays on the LCD and both LEDs are solid red. The Gateway enters RUN mode, operating on the Network ID chosen.

To ignore the Channel Search Mode results and use a Network ID that Channel Search Mode determined was in use, double-click button two. The word IGNORE displays on the LCD and both LEDs are solid red. The Gateway enters RUN mode, operating on the Network ID chosen despite being in use by another device.

Channel Search Mode Flowchart

The example shown below is testing Network ID 2.



Applying Power to the Gateway or Node

Connect power to the Gateway or Node using the wiring table shown.



	Wire Color	Gateway	Node (10-30V dc)	Node (FlexPower)
1	brown	+10 to 30V dc input	10 to 30V dc	
2	white	RS485 / D1 / B / +		
3	blue	dc common (GND)	dc common (GND)	dc common (GND)
4	black	RS485 / D0 / A / -		
5	gray	Comms gnd		3.6 to 5.5V dc ¹

¹ Do not apply more than 5.5V dc to the gray wire.

1. Apply power to the Gateway by connecting the 10 to 30V dc cable as shown in the wiring diagram. The Gateway begins in *RUN mode, displays the current network ID (NID), then identifies itself as a Gateway.
2. Apply power to the Node by connecting the 10 to 30V dc cable or the DX81 Battery Supply Module as shown. The Node starts in *RUN mode, displays the current network ID, then identifies itself as a Node and lists the device ID. Once running, the Node begins displays its I/O points.

Verify Communications on the Gateway

After powering up and binding the Gateway and its Nodes, verify all devices are communicating properly.

Verify LED 1 is on and green.



Status	LED 1	LED 2
Power ON	Green ON	-
System Error	Red flashing	Red flashing
Modbus Communication Active	-	Yellow flashing
Modbus Communication Error	-	Red flashing

For Gateway and Ethernet Bridge systems, active Modbus communication refers to the communication between the Gateway and the Ethernet Bridge.

For GatewayPro systems, the Modbus communication LEDs refer to the communication internal to the Gateway Pro.

For Gateway only systems, the Modbus communication LEDs refer to the communication between the Gateway and its host system (if applicable).





Verify Communications on the Node

After powering up and binding the Gateway and its Nodes, verify all devices are communicating properly.

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

A Node will not sample its inputs until it is communicating with the Gateway to which it is bound.



Status	LED 1	LED 2
System Error	 Red flashing	 Red flashing (1 per second)
RF Link Ok	 Green flashing (1 per second)	-
RF Link Error	-	 Red flashing (1 per 3 seconds)

When testing the Gateway and Node, verify all radios and antennas are at least two meters apart or the communications may fail.

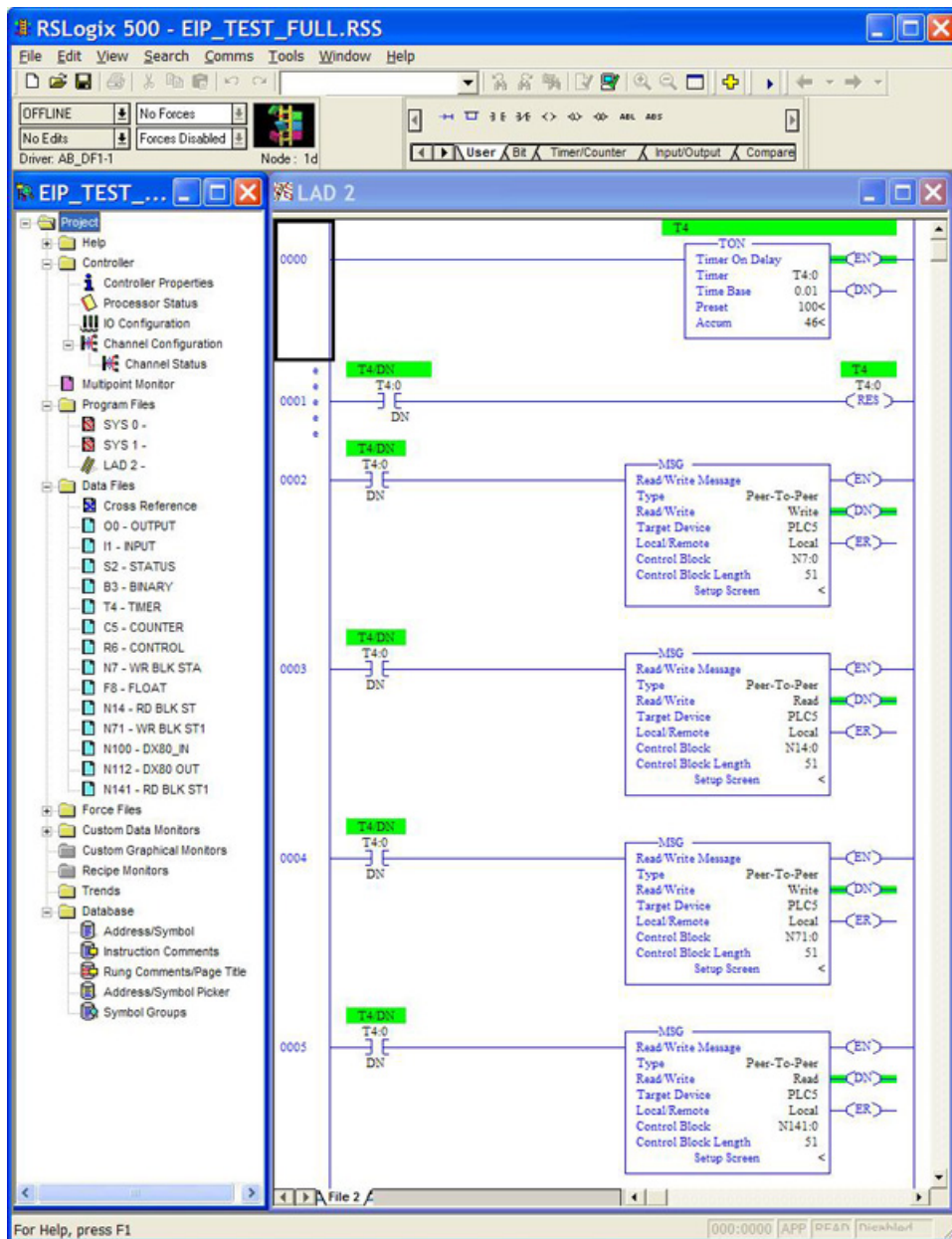
Host System Software Configuration

The following screenshots are configuration examples for specific software that may be used on a host system.

SLC 5 and ControlLogix Configuration

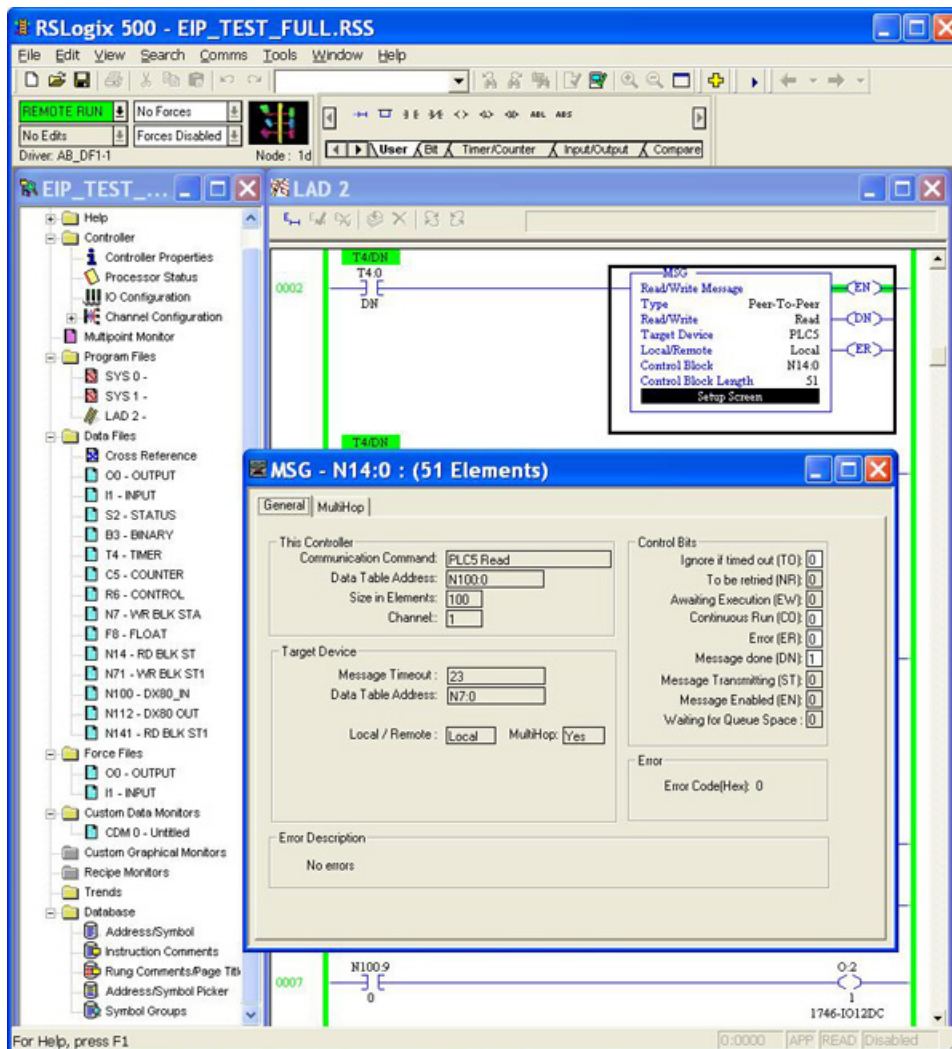
SLC 5 Set-up MSG

In the example screen shown, a counter is set up to activate the MSG Read or MSG Write blocks every one second. Also two write and two read MSG blocks are shown. Each MSG block can only handle up to 103 words.



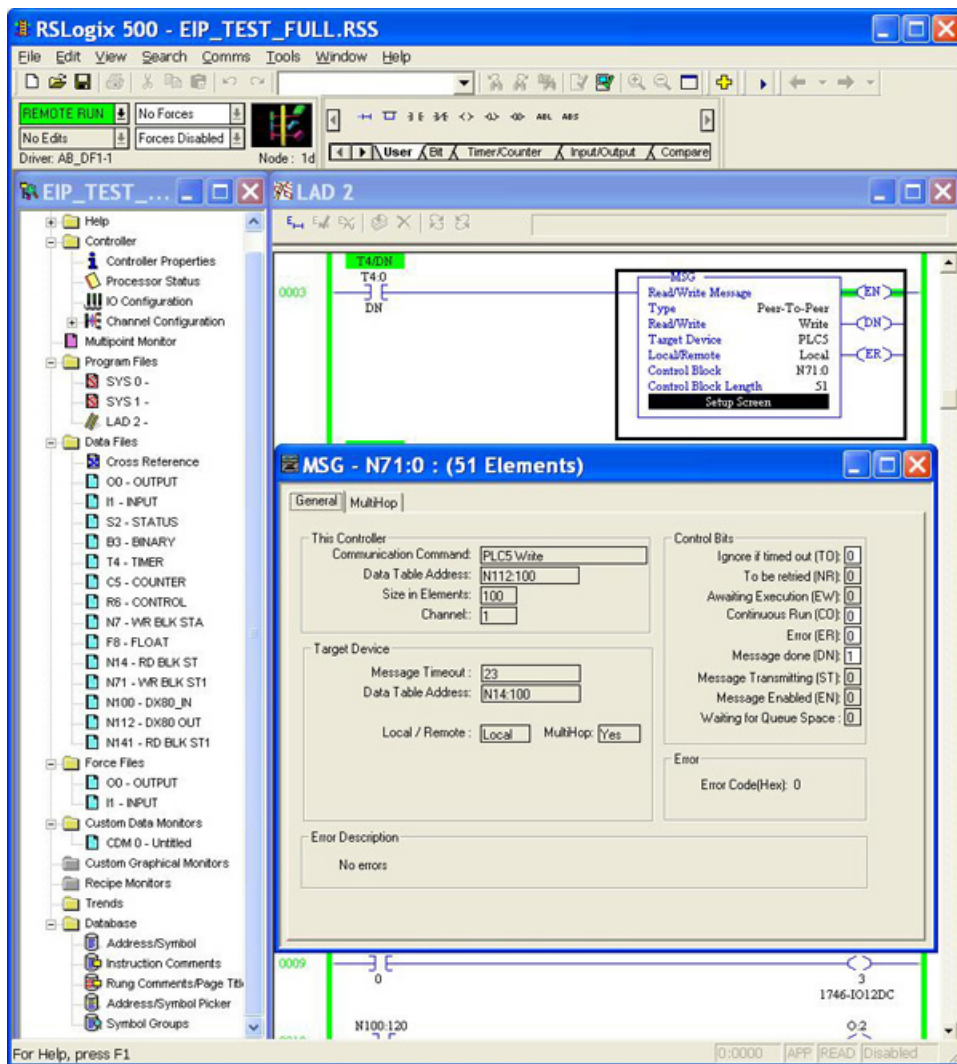
SLC 5 – MSG Read Instruction

The SLC 5 MSG read instruction with multi-hop enabled is shown. Click on the ‘MultiHop’ tab and enter in the IP address of the DX80 Device (factory default 192.168.0.1)



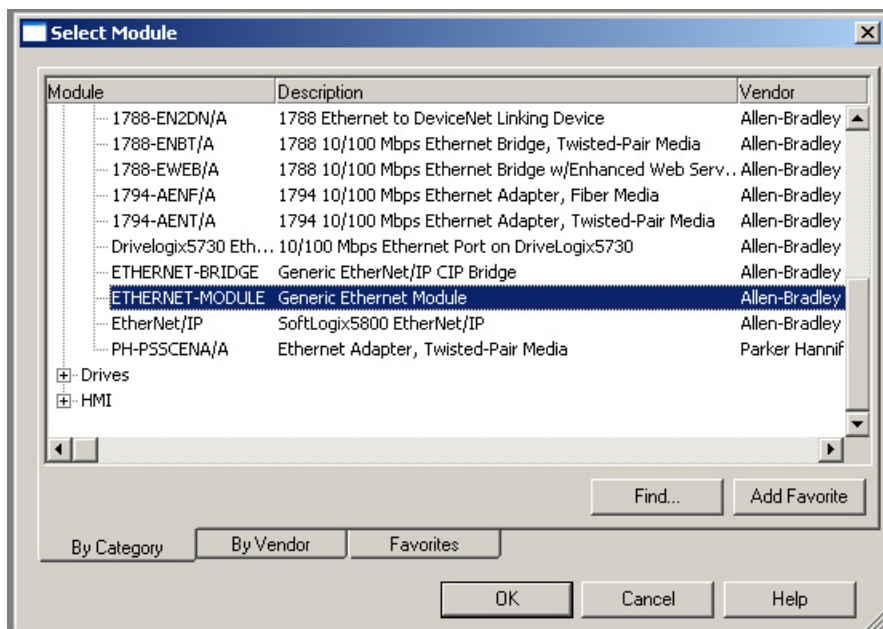
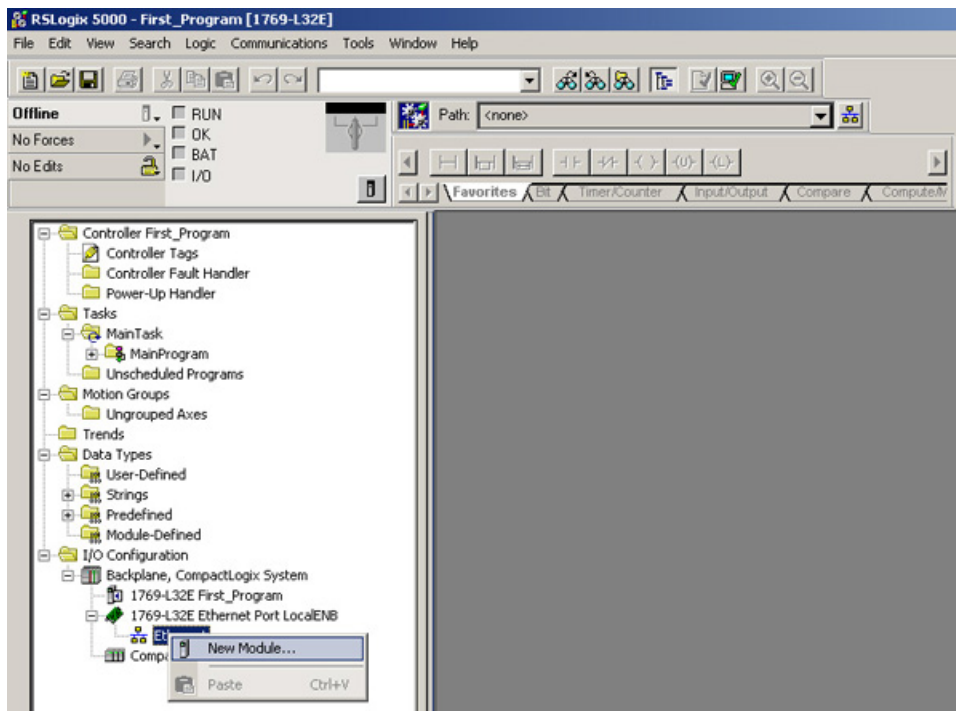
SLC 5 – MSG Write Setup

The SLC 5 MSG write setup instruction with multi-hop enabled is shown. Click on the 'MultiHop' tab and enter in the IP address of the DX80 Device (factory default 192.168.0.1)

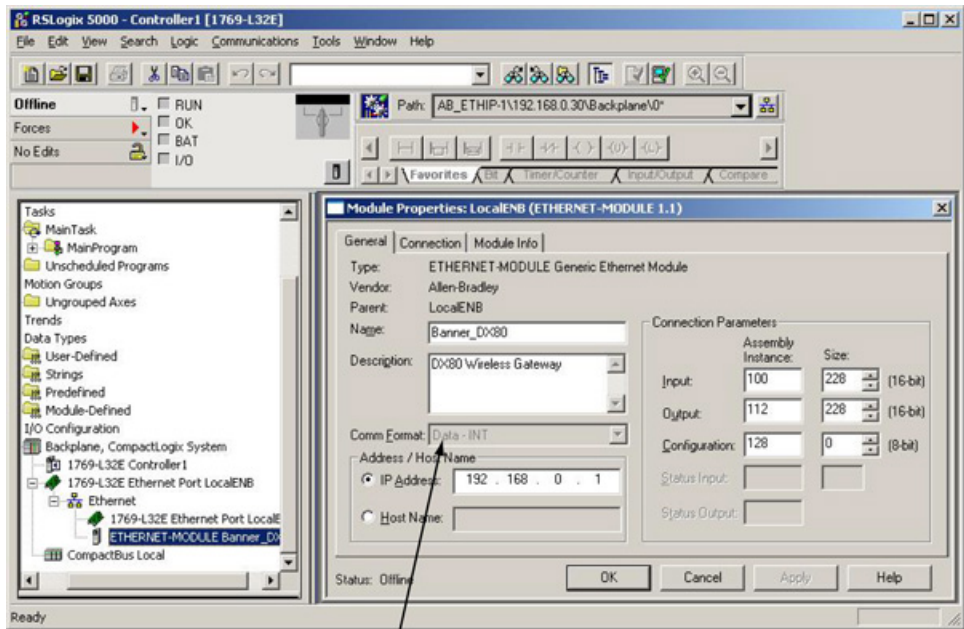


RSLogix 5000 Configuration

To create an implicit Class 1 configuration to the DX80 using Ethernet/IP when using a ControlLogix family PLC, configure the DX80 as a “Generic Ethernet Module” under the ENET_MODULE.

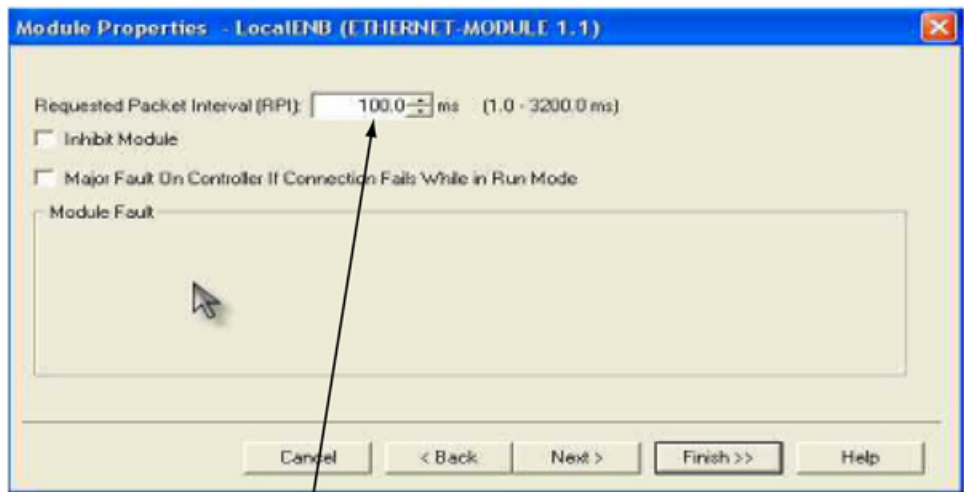


Configure Banner Module Properties



Allen-Bradley PLCs default to 32-bit integers.
Manually change that setting using this screen.

Requested Packet Interval



Verify the Requested Packet Interval is 50 milliseconds or higher.

Banner DX80 inputs from wireless devices

RSLogix 5000 - Controller1 [1769-L32E]*

Path: AB_ETHIP:1\192.168.0.30\BackplaneV0*

Controller Tags - Controller1(controller)

Name	Value	Force	Style	Data	Description
Banner_Dx80.C	(...)	(...)		AB...	
Banner_Dx80.I	(...)	(...)		AB...	
Banner_Dx80.I.Data	(...)	(...)	Decimal	INT...	
Banner_Dx80.I.Data[0]	0		Decimal	INT	Dx80 Gateway Input 1
Banner_Dx80.I.Data[1]	0		Decimal	INT	Dx80 Gateway Input 2
Banner_Dx80.I.Data[2]	0		Decimal	INT	Dx80 Gateway Input 3
Banner_Dx80.I.Data[3]	0		Decimal	INT	Dx80 Gateway Input 4
Banner_Dx80.I.Data[4]	0		Decimal	INT	Dx80 Gateway Input 5
Banner_Dx80.I.Data[5]	0		Decimal	INT	Dx80 Gateway Input 6
Banner_Dx80.I.Data[6]	0		Decimal	INT	Dx80 Gateway Resvd
Banner_Dx80.I.Data[7]	0		Decimal	INT	Gateway Status
Banner_Dx80.I.Data[8]	0		Decimal	INT	Node 1 Input 1
Banner_Dx80.I.Data[9]	0		Decimal	INT	Node 1 Input 2
Banner_Dx80.I.Data[10]	0		Decimal	INT	Node 1 Input 3
Banner_Dx80.I.Data[11]	0		Decimal	INT	Node 1 Input 4
Banner_Dx80.I.Data[12]	0		Decimal	INT	Node 1 Input 5
Banner_Dx80.I.Data[13]	0		Decimal	INT	Node 1 Input 6
Banner_Dx80.I.Data[14]	0		Decimal	INT	Node 1 Reserved
Banner_Dx80.I.Data[15]	128		Decimal	INT	Node 1 Status
Banner_Dx80.I.Data[16]	0		Decimal	INT	Node 2 Input 1
Banner_Dx80.I.Data[17]	0		Decimal	INT	Node 2 Input 2

Banner DX80 outputs from wireless devices

RSLogix 5000 - Controller1 [1769-L32E]*

Path: AB_ETHIP:1\192.168.0.30\BackplaneV0*

Controller Tags - Controller1(controller)

Name	Value	Force	Style	Data	Description
Banner_Dx80.C	(...)	(...)		AB...	
Banner_Dx80.I	(...)	(...)		AB...	
Banner_Dx80.O	(...)	F...		AB...	
Banner_Dx80.O.Data	(...)	(...)	Decimal	INT...	
Banner_Dx80.O.Data[0]	0 2...		Decimal	INT	Dx80 Gateway Out 1
Banner_Dx80.O.Data[1]	0		Decimal	INT	Dx80 Gateway Out 2
Banner_Dx80.O.Data[2]	0		Decimal	INT	Dx80 Gateway Out 3
Banner_Dx80.O.Data[3]	0		Decimal	INT	Dx80 Gateway Out 4
Banner_Dx80.O.Data[4]	0		Decimal	INT	Dx80 Gateway Out 5
Banner_Dx80.O.Data[5]	0		Decimal	INT	Dx80 Gateway Out 6
Banner_Dx80.O.Data[6]	0		Decimal	INT	Dx80 Gateway Resv
Banner_Dx80.O.Data[7]	0		Decimal	INT	Dx80 Gateway Control
Banner_Dx80.O.Data[8]	0		Decimal	INT	Dx80 Node 1 Out 1
Banner_Dx80.O.Data[9]	0		Decimal	INT	Dx80 Node 1 Out 2
Banner_Dx80.O.Data[10]	0		Decimal	INT	Dx80 Node 1 Out 3
Banner_Dx80.O.Data[11]	0		Decimal	INT	Dx80 Node 1 Out 4
Banner_Dx80.O.Data[12]	0		Decimal	INT	Dx80 Node 1 Out 5
Banner_Dx80.O.Data[13]	0		Decimal	INT	Dx80 Node 1 Out 6
Banner_Dx80.O.Data[14]	0		Decimal	INT	Dx80 Node 1 Resv
Banner_Dx80.O.Data[15]	0		Decimal	INT	Dx80 Node 1 Control
Banner_Dx80.O.Data[16]	0		Decimal	INT	Dx80 Node 2 Out 1
Banner_Dx80.O.Data[17]	0		Decimal	INT	Dx80 Node 2 Out 2

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