SureCross Gateway Module for Wireless Q45 Sensors

Configurable Gateway radio module with discrete inputs, discrete outputs, and DIP switches that map inputs from up to four Nodes or two Wireless Q45 Sensors to the Gateway's outputs

SureCross® embeddable board radio modules were specifically designed for the needs of industrial users to provide connectivity where traditional wired connections are not possible or cost prohibitive. Wireless networks are formed around a Gateway, which acts as the wireless network master device, and one or more Nodes. SureCross embeddable board radio modules communicate with all SureCross radios.

- Wireless industrial I/O device with two sourcing discrete inputs and two sourcing discrete outputs
- 10 to 30V dc power input
- DIP switches allow the user to select one of eight defined I/O mapping configurations to automatically map the Nodes' inputs to this Gateway's outputs
- Site Survey analyzes the network's signal strength and reliability and conveys the results using the two-color LED
- Frequency Hopping Spread Spectrum (FHSS) technology and Time Division Multiple Access (TDMA) control architecture ensure reliable data delivery within the unlicensed Industrial, Scientific, and Medical (ISM) band
- Transceivers provide bidirectional communication between the Gateway and Node, including fully acknowledged data transmission
- Lost RF links are detected and relevant outputs set to user-defined conditions

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

Models	Frequency	Inputs and Outputs
DX80G2M6-B2Q-KR	2.4 GHz ISM Band	**Inputs**: Two sourcing discrete **Outputs**: Two sourcing discrete

> ⚠️ **WARNING: Not To Be Used for Personnel Protection**
> **Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death.** This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

> ⚠️ **CAUTION: Electrostatic Discharge (ESD)**
> **ESD Sensitive Device.** Use proper handing procedures to prevent ESD damage to these devices. The module does not contain any specific ESD protection beyond the structures contained in its integrated circuits. Proper handling procedures should include leaving devices in their anti-static packaging until ready for use; wearing anit-static wrist straps; and assembling units on a grounded, static-dissipative surface.

The SureCross® Wireless Q45 Sensor Network

The SureCross® DX80 wireless I/O network provides reliable monitoring without the burden of wiring or conduit installation. The SureCross wireless network can operate independently or in conjunction with a Modbus host system, 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 out-

puts 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 Wireless Q45 Sensors.

A Gateway 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 may contain many Wireless Q45 Sensors. 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 host controller.

If the Gateway has a Modbus RTU RS-485 connection, you may use up to 47 Nodes in a single wireless network when the Gateway is used as a Modbus slave to a Modbus RTU host controller. When used as a Modbus slave device, the Gateway holds the Modbus registers of all wireless devices within the network. Note that the -B2Q Gateway Board Module does not have a Modbus RTU RS-485 connection, but the -Q Gateway does have the Modbus RTU RS-485 connection.

The Wireless Q45 Sensors are wireless network end-point devices used to provide sensing capability in a remote area or factory. The Wireless Q45 Sensors collect data and communicate the data back to the Gateway.

Setting Up and Installing a Wireless Q45 Sensor Network

To set up and install your Gateway and Wireless Q45 Sensor network, follow these steps.

1. Configure the Gateway and Wireless Q45 Sensor I/O Mapping
2. Wire the Gateway's I/O
3. Apply power to the Gateway
4. Bind the Wireless Q45 Sensors to the Gateway
5. Observe the LED behavior to verify the devices are communicating to each other
6. Conduct a Site Survey between the Gateway and the Wireless Q45 Sensors
7. Install your Wireless Q45 Sensor Network

Configuring the DIP Switches

Before making any changes to the DIP switch positions, disconnect the power. DIP switch changes will not be recognized if power isn't cycled to the device.

For parameters not set via DIP switches, use the User Configuration Tool (UCT) to make configuration changes. For parameters set using the DIP switches, the DIP switch positions override any changes made using the User Configuration Tool.

DIP Switch Settings

Transmit Power

The 900 MHz radios can be operated at 1 watt (30 dBm) or 250 mW (24 dBm). While the radios operate in 1 Watt mode, they cannot communicate with 150 mW DX80 radio devices. To communicate with the 150 mW radio models, operate this radio in 250 mW mode. For 2.4 GHz radios, this DIP switch is disabled. The transmit power for 2.4 GHz is fixed at about 100 mW EIRP (18 dBm), making the 2.4 GHz Performance models automatically compatible with the DX80 2.4 GHz models.

DIP Switch	
1	Transmit Power Level
OFF *	1 Watt (30 dBm, 900 MHz models only)
ON	250 mW (24 dBm, 900 MHz models only), DX80 compatibility mode

Modbus/UCT Configured or DIP Switch Configured

In Modbus/UCT Configured mode, the device parameters are changed using the User Configuration Tool (UCT) or a Modbus command. All DIP switch positions are ignored. In DIP Switch Configured mode, use the DIP switches to configure the parameters listed in the table. By default, this Gateway uses the DIP switches to configure the device.

DIP Switch	
2	Modbus/UCT Configured or DIP Switch Configured
OFF *	DIP switch configured
ON	Modbus or UCT configured (DIP switches 3-8 are ignored)

Output State During a Radio Link Loss

The SureCross DX80 wireless devices use a deterministic radio link time-out method to address RF link interruption or failure. When a radio link fails, all pertinent wired outputs are sent to defined states until the link is recovered, ensuring that disruptions in the communications link result in predictable system behavior.

Select the state the outputs are changed to during a link loss.

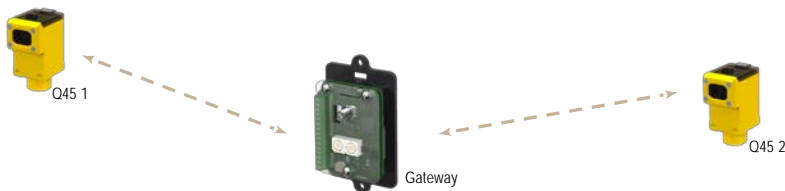| DIP Switches		
3	4	Output State During a Radio Link Loss
OFF *	OFF *	Off (discrete) or 0 mA (analog)
ON	OFF	On (discrete) or 20 mA (analog)
OFF	ON	Hold last stable state
ON	ON	Reserved

* Default configuration

Heartbeat

In heartbeat mode, the Nodes send "heartbeat" messages to the Gateway at specific intervals to indicate the radio link is active. The heartbeat is always initiated by the Node and is used only to verify radio communications.

DIP Switch	
5	Heartbeat Settings
OFF *	30 seconds (30 to 60 second link loss timeout)
ON	5 seconds (5 to 10 second link loss timeout)

* Default configuration

I/O and Link Loss Alarm Mapping for Wireless Q45 Sensors

The link loss alarm is set to zero (0) when the radio link is working and set to one (1) when the radio link is lost.
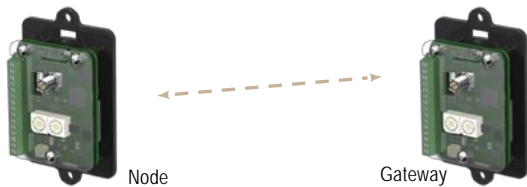

DIP Switches			
6	7	8	I/O Mapping
OFF *	OFF *	OFF *	Q45 01, input 1 → Gateway Discrete OUT 1 Q45 02, input 1 → Gateway Discrete OUT 2
OFF	ON	OFF	Q45 01, input 1 → Gateway Discrete OUT 1

DIP Switches			
6	7	8	I/O Mapping
			Q45 01 link loss alarm → Gateway Discrete OUT 2
ON	OFF	OFF	Q45 01, input 1 → Gateway Discrete OUT 1 Q45 01, input 2 → Gateway Discrete OUT 2 Gateway Discrete IN 1 → Q45 01, output 1 Gateway Discrete IN 2 → Q45 01, output 2

* Default configuration. To use up to 47 Nodes or Wireless Q45 Sensors with this Gateway, you must use a Modbus host controller system. For more information about using a host controller system, refer to the *Host Configuration* manual, Banner document part number 132114.

I/O Mapping for one DX80N2X6S-PB2 Node and a DX80G2M6S-B2Q Gateway

Node   Gateway

DIP Switches			
6	7	8	I/O Mapping Between a DX80N2X6S-PB2 and a DX80G2M6S-B2Q Gateway
ON	OFF	ON	Node 01 Discrete IN 1 → Gateway Discrete OUT 1 Node 01 Discrete IN 2 → Gateway Discrete OUT 2 Gateway Discrete IN 1 → Node 01 Discrete OUT 1 Gateway Discrete IN 2 → Node 01 Discrete OUT 2

### I/O Mapping for two DX80N2X6S-PB2 Nodes and a DX80G2M6S-B2Q Gateway

Node 1   Gateway   Node 2

DIP Switches			
6	7	8	I/O Mapping Between a DX80N2X6S-PB2 and a DX80G2M6S-B2Q Gateway
ON	ON	OFF	Node 01 Discrete IN 1 → Gateway Discrete OUT 1 Node 02 Discrete IN 1 → Gateway Discrete OUT 2 Gateway Discrete IN 1 → Node 01 Discrete OUT 1 Gateway Discrete IN 2 → Node 02 Discrete OUT 1

Wire the Gateway's I/O and Apply Power

	Pin	Description	Label
	1		
	2		
	3	Discrete IN 1 (PNP)	DI1
	4	Discrete IN 2 (PNP)	DI2
	5	Ground	GND
	6	Discrete OUT 1 (PNP)	DO1
	7	Discrete OUT 2 (PNP)	DO2
	8		
	9		
	10		
	11		
	12	Ground	GND
	13	10 to 30V dc	PWR
	14	Ground	GND

The three ground connections are tied together internally.

Input and Output Wiring
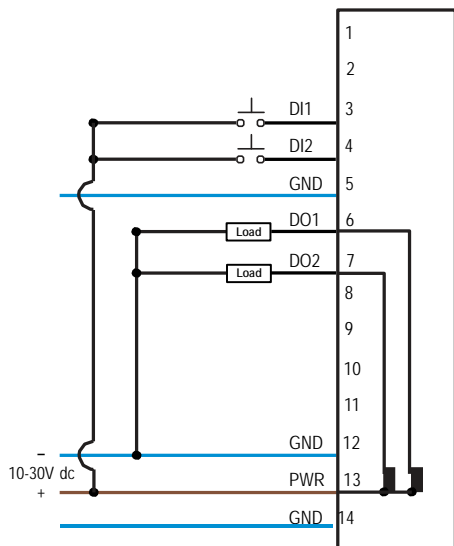
Modbus Register Table

I/O #	Modbus Holding Register		I/O Type	I/O Range		Holding Register Representation	
	Gateway	Any Node		Min.	Max.	Min. (Dec.)	Max. (Dec.)
1	1	1 + (Node# × 16)	Discrete IN 1	0	1	0	1
2	2	2 + (Node# × 16)	Discrete IN 2	0	1	0	1

I/O #	Modbus Holding Register		I/O Type	I/O Range		Holding Register Representation	
	Gateway	Any Node		Min.	Max.	Min. (Dec.)	Max. (Dec.)
		...					
7	7	7 + (Node# × 16)	Reserved				
8	8	8 + (Node# × 16)	Device Message				
9	9	9 + (Node# × 16)	Discrete OUT 1	0	1	0	1
10	10	10 + (Node# × 16)	Discrete OUT 2	0	1	0	1
		...					
15	15	15 + (Node# × 16)	Control Message				
16	16	16 + (Node# × 16)	Reserved				

Bind the Q45s to the Gateway and Assign the Node Address

Before beginning the binding procedure, apply power to all the devices.

Binding Wireless Q45 Sensors to their Gateway ensures the Q45s only exchange data with the Gateway they are bound to. After the Gateway enters binding mode, the Gateway generates and transmits a unique extended addressing, or binding, code to all Wireless Q45 Sensors within range that are also in binding mode. The extended addressing (binding) code defines the network, and all radios within a network must use the same code.

For Gateways with LCDs, after binding your Wireless Q45 Sensors to the Gateway, make note of the binding code displayed under the Gateway's *DVCFG menu, XADR submenu on the LCD. Knowing the binding code prevents having to re-bind all Q45s if your Gateway is ever replaced. To create your network, bind the Wireless Q45 Sensors to the Gateway and assign them a Node address using the Gateway's rotary dials. Valid Node addresses are 01 through 47. The following instructions are specific to binding Wireless Q45 Sensors to a Gateway.

1. Enter binding mode on the Gateway.

Model	To Enter Binding Mode:
-B2Q Board Modules	Triple-click the button.
-Q and -QC Gateway Radios	Triple-click button 2.

   On the board modules, the green and red LED flashes. On the -Q and -QC Gateway models, both LEDs flash red.

2. Assign the Q45 a Node address using the Gateway's rotary dials. Use the left rotary dial for the left digit and the right rotary dial for the right digit. For example, to assign your Q45 to Node 01, set the left dial to 0 and the right dial to 1.

3. Loosen the clamp plate on the top of the Wireless Q45 Sensor and lift the cover.

4. Enter binding mode on the Wireless Q45 Sensor by triple-clicking the button.
   The red and green LEDs flash alternately and the sensor searches for a Gateway in binding mode. After the Q45 is bound, the LEDs stay solid momentarily, then they flash together four times. The Q45 exits binding mode.

5. Label the sensor with the Q45's Node address number and place the sticker on the Wireless Q45 Sensor.

6. Repeat steps 2 through 5 for as many Wireless Q45 Sensors as are needed for your network.

7. After binding all Wireless Q45 Sensors, exit binding mode on the Gateway.

Model	To Exit Binding Mode:
-B2Q Board Modules	Double-click the button.
-Q and -QC Gateway Radios	Double-click button 2.

LED Behavior for the Gateways

After powering up and binding the Gateway and its Nodes, verify all devices are communicating properly. When testing communication between the Gateway and Node, verify all radios and antennas are at least two meters apart or the communications may fail.

LED (Bi-color)	Gateway Status
(solid green)	Power ON
(green and red flashing alternately)	Binding mode
(flashing red)	Device Error
(green and red flashing together, looks amber)	Modbus Communication Active
(flashing red)	Modbus Communication Error
(solid red)	The Gateway is trying to conduct a Site Survey with a Node that doesn't exist.
(green and red solid together, looks amber)	No radio communication detected

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

Conduct a Site Survey from a Gateway Board Model

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. Only the Gateway can initiate a Site Survey, and the Site Survey analyzes the radio communications link with one Node at a time. Follow these steps to conduct a Site Survey from the board module Gateway.

1. To start the Site Survey, set the Gateway's rotary dials to the Node address you'd like to conduct a Site Survey with. For example, to analyze the signal strength between this Gateway and Node 02, rotate the left rotary dial to 0 and the right rotary dial to 2.
   The Site Survey automatically begins running. If there is a device at address 02, the LED flashes amber. If there is no device at address 02, the LED is solid red. The amber LED flashes at varying rates to indicate the signal strength.
2. To exit the Site Survey, set the Gateway's rotary dials to 00. Otherwise, after 15 minutes the Gateway automatically exits Site Survey mode.
   The LED flashes green to indicate the Gateway is in standard operating mode.

The amber LED flashes at specific rates to indicate the Site Survey results. Each signal strength represents the majority of the data packets being received at that signal strength. For example, a strong signal strength indicates the majority of the data packets were received at a strong signal, but a few many have been received at a good or weak signal strength.

- Eight flashes per second: Very strong signal strength
- Four flashes per second: Strong signal strength
- Two flashes per second: Good signal strength
- One flash per second: Weak signal strength
- Solid amber LED: No radio communication detected

Specifications

Radio and General

Radio Range

2.4 GHz: Up to 3.2 kilometers (2 miles)

Radio Transmit Power

2.4 GHz: 18 dBm (65 mW) conducted, less than or equal to 20 dBm (100 mW) EIRP

2.4 GHz Compliance

FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247

ETSI/EN: In accordance with EN 300 328: V1.7.1 (2006-05)

IC: 7044A-DX8024

Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

Radio range is with the 2 dB antenna that ships with the product. High-gain antennas are available, but the range depends on the environment and line of sight. To determine the range of your wireless network, perform a Site Survey.

Power

Requirements: +10 to 30V dc (Outside the USA: +12 to 24V dc, ±10%). (See UL section below for any applicable UL specifications)

Antenna Connection

Ext. Reverse Polarity SMA, 50 Ohms

Max Tightening Torque: 0.45 N·m (4 lbf·in)

Interface

Indicators: One bi-color LED

Buttons: One

Wiring Access

Terminal block

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

Inputs and Outputs

Discrete Input

Two, sourcing

Rating: 3 mA max current at 30V dc

Sample Rate: 62.5 milliseconds

Report Rate: On change of state

ON Condition (PNP): Greater than 8V

OFF Condition (PNP): Less than 5V

Discrete Output

Two, sourcing

Update Rate: 1 second

ON Condition (PNP): Supply minus 2V

OFF Condition (PNP): Less than 2V

Output State Following Timeout: De-energized (OFF)

Discrete Output Rating (PNP)

100 mA max current at 30V dc

ON-State Saturation: Less than 3V at 100 mA

OFF-state Leakage: Less than 10 µA

Environmental

Environmental

Operating Temperature: −40 to +85 °C

Operating Humidity: 95% max. relative (non-condensing)

Radiated Immunity

10 V/m, 80-2700 MHz (EN61000-6-2)

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

Accessories for the Board Models

These accessories are used with the M-HBx MultiHop and -PBx Performance board modules.

	Model No.	Description
	BWA-HW-034	DIN rail clip, black plastic

MultiHop M-HBx and Performance PBx Models Mounted on the Base

Most MultiHop M-HBx and Performance PBx models ship from the factory mounted on a plastic base.
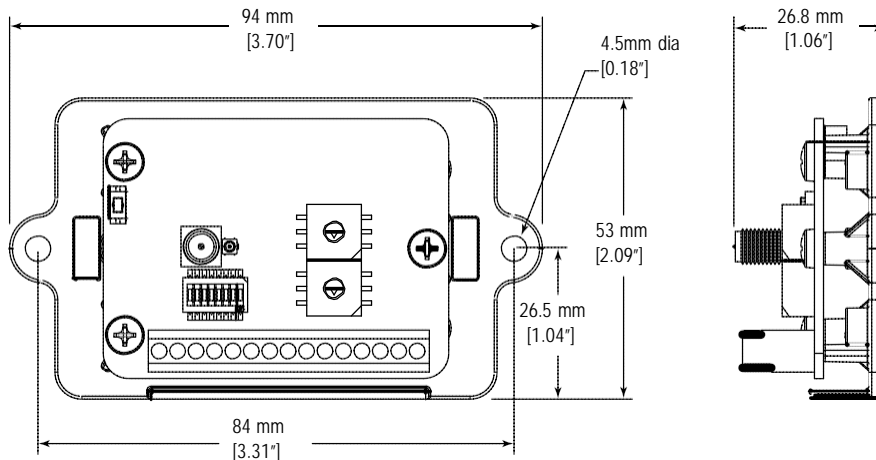
Warnings

Antenna Installations. Install and properly ground a qualified surge suppressor when installing a remote antenna system. Remote antenna configurations installed without surge suppressors invalidate the manufacturer's warranty. Keep the ground wire as short as possible and make all ground connections to a single-point ground system to ensure no ground loops are created. No surge suppressor can absorb all lightning strikes; do not touch the SureCross® device or any equipment connected to the SureCross device during a thunderstorm.

Exporting SureCross Radios. It is our intent to fully comply with all national and regional regulations regarding radio frequency emissions. **Customers who want to re-export this product to a country other than that to which it was sold must ensure the device is approved in the destination country.** A list of approved countries appears in the *Radio Certifications* section of the product manual. The SureCross wireless products were certified for use in these countries using the antenna that ships with the product. When using other antennas, verify you are not exceeding the transmit power levels allowed by local governing agencies. Consult with Banner Engineering Corp. if the destination country is not on this list.

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