

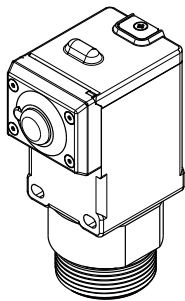
Datasheet

Sure Cross® Wireless Q45 Sensors combine the best of Banner’s flexible Q45 sensor family with its reliable, field-proven, Sure Cross wireless architecture to solve new classes of applications limited only by the user’s imagination. Containing a variety of sensor models, a radio, and internal battery supply, this product line is truly plug and play.

The Q45UA combines the functionality of a K50U ultrasonic sensor with the reliability of the Q45 Wireless Node into one compact package, eliminating the need for ordering multiple components and reducing the physical size of the device. This solution allows monitoring of fluid or dry assets in remote locations without human intervention. The industrial grade, battery-powered device can be used to wirelessly transmit level or position to a wireless controller/gateway for remote monitoring or control with local LED indication. All configuration is done through internal DIP switches or the DX80 User Configuration Tool. In addition, caustic chemical resistant versions are available.

Benefits

- Provides for ability to deliver factory automation and IIoT solutions for many applications including but not limited to:
 - Supply tank level
 - Remote fuel tank level
 - Epoxy/chemical totes or containers
 - 55 gallon drum level
 - Dry goods bin fill level
 - Presence and absence
 - Holding tank levels
- Prevent tank overfills and pump cavitation by providing level status and alarming capabilities
- Battery powered for "peel and stick" functionality with a two-year battery life capability
- Easy-to-use/rugged device that can be mounted permanently to equipment or temporarily threaded into bung holes of supply tanks.
- **Mobility**—Since not tethered by wires, sensor can move with the container. When container is replaced, simply swap out the sensor to the new one
- **Reduce complexity**—Machine or process reconfiguration made easier; great for retrofit applications
- **Deploy easily**—Simplify installation on existing equipment enables deployment in remote and hard-to-access locations where implementing a wired solution would be difficult, impractical, or not cost-effective



- DIP switches for user configuration for sample and report times and transmit power levels of 250 mW or 1 Watt for 900 MHz models
- Frequency Hopping Spread Spectrum (FHSS) technology ensures 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
- Diagnostics allow user-defined output settings in the unlikely event of lost RF signal



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.

Models

Model	Radio Frequency	Inputs and Outputs	Ultrasonic Input Range and Frequency
DX80N2Q45UAC	2.4 GHz ISM Band	Inputs: One Ultrasonic Input, One Thermistor Input	Range: 300 mm to 3 m (11.8 in to 118 in)
DX80N9Q45UAC	900 MHz ISM Band	Outputs: One Four-Color LED Indicator Light	Frequency: 114 kHz



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

General Operation

For the first 15 minutes after power up, the Node samples the sensor every 0.25 seconds (fast sample mode). After 15 minutes, the Node defaults to 5 minute sample intervals. Activate fast sample mode by single clicking the button (the amber LED is solid).

Storage Mode for the Q45

While in **storage mode**, the Q45's radio does not operate. The Q45 ships from the factory in storage mode to conserve the battery. To wake the device, press and hold the button for five seconds. To put any Q45 into storage mode, press and hold the button for five seconds. The Q45 is in storage mode when the LEDs stop blinking.

Principles of Operation

Ultrasonic sensors emit one or multiple pulses of ultrasonic energy, which travel through the air at the speed of sound. A portion of this energy reflects off the target and travels back to the sensor. The sensor measures the total time required for the energy to reach the target and return to the sensor. The distance to the object is then calculated using the following formula: $D = ct \div 2$

D = distance from the sensor to the target

c = speed of sound in air

t = transit time for the ultrasonic pulse

To improve accuracy, an ultrasonic sensor may average the results of several pulses before outputting a new value.

Temperature Effects

The speed of sound is dependent upon the composition, pressure and temperature of the gas in which it is traveling. For most ultrasonic applications, the composition and pressure of the gas are relatively fixed, while the temperature may fluctuate.

In air, the speed of sound varies with temperature according to the following approximation:

$$\text{In metric units: } C_{m/s} = 20 \sqrt{273 + T_C}$$

$$\text{In English units: } C_{ft/s} = 49 \sqrt{460 + T_F}$$

$C_{m/s}$ = speed of sound in meters per second

$C_{ft/s}$ = speed of sound in feet per second

T_C = temperature in °C

T_F = temperature in °F

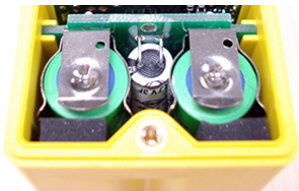
Temperature Compensation

Changes in air temperature affect the speed of sound, which in turn affects the total time for the echo measured by the sensor. An increase in air temperature shifts both sensing window limits closer to the sensor. Conversely, a decrease in air temperature shifts both limits farther away from the sensor. This shift is approximately 3.5% of the limit distance for a 20° C change in temperature.

The Q45 series ultrasonic sensors are temperature compensated, to reduce sensor errors from temperature by about 90%. Exposure to direct sunlight can affect the sensor's ability to accurately compensate for changes in temperature.

Replacing the Batteries

To replace the lithium "AA" cell battery, follow these steps. 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. Properly dispose of used batteries 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.

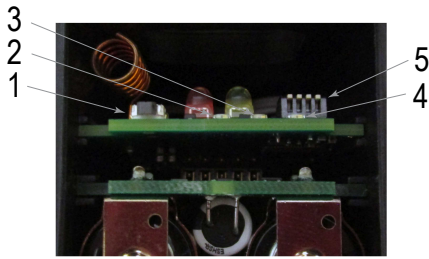


1. Lift the plastic cover.
2. Slide the board containing the batteries out of the Q45 housing.
3. Remove the discharged batteries and replace with new batteries. Use two 3.6 V AA lithium batteries, such as Xeno's XL-60F or equivalent.
4. Verify the battery's positive and negative terminals align to the 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. Slide the board containing the new batteries back into the Q45 housing.

Replacement battery model number: BWA-BATT-006. For pricing and availability, contact Banner Engineering.

Configuration Instructions

Button and LEDs



- 1 Button
- 2 Red LED (flashing) indicates a radio link error with the Gateway.
- 3 Green LED (flashing) indicates a good radio link with the Gateway.
- 4 Amber LED is not used.
- 5 DIP Switches

DIP Switches

After making any changes to any DIP switch position, reboot the Wireless Q45 Sensor by triple-clicking the button, waiting a second, then double-clicking the button.

The DIP switches are in the OFF position. To turn a DIP switch on, push the switch toward the battery pack. DIP switches one through four are numbered from left to right.

Description	DIP Switches			
	1	2	3	4
Transmit power: 1 Watt	OFF *			
Transmit power: 250 mW (compatible with 150 mW radios)	ON			
Sample/Report Rate: User configured (5 minutes by default)		OFF *	OFF *	
Sample/Report Rate: 16 seconds		OFF	ON	
Sample/Report Rate: 64 seconds		ON	OFF	
Sample/Report Rate: Sample on Demand		ON	ON	
Light mode: flash (recommended to conserve the battery) ¹				OFF *
Light mode: solid				ON

* Default position

Transmit Power Levels

The 900 MHz radios transmit at 1 Watt (30 dBm) or 250 mW (24 dBm). While the Performance radios operate in 1 Watt mode, they cannot communicate with the older 150 mW radios. To communicate with 150 mW radios, operate this radio in 250 mW mode. For 2.4 GHz models, this DIP switch is disabled. The transmit power for 2.4 GHz is fixed at about 65 mW EIRP (18 dBm), making the 2.4 GHz Performance models automatically compatible with older 2.4 GHz models.

Sample and Report Rates

The sample interval, or rate, defines how often the Sure Cross device samples the input. For battery-powered applications, setting a slower rate extends the battery life.

The report rate defines how often the Node communicates the I/O status to the Gateway. For *FlexPower*® applications, setting the report rate to a slower rate extends the battery life.

What is Sampling on Demand?

Sample on Demand allows a host system to send a Modbus command to any register and require the Node's inputs to immediately sample the sensor and report readings back to the host system. Sampling on demand can be used between the normal periodic reporting.

To use the Sample on Demand feature requires using a host-controlled system capable of sending Modbus commands to the Gateway.

¹ The light consumes most of the sensor's power. If the light remains off most of the time, the batteries will last much longer. In flashing mode, the light can be on for up to one year on a pair of batteries.

Sample an Input Using a Host System

To sample the input, have the Host System write to the Node's register 15. To calculate which register this is for your Node, use this equation: $15 + (\text{Node} \# \times 16)$.

- From the host system, write 0x13xx to the Node's register 15, where xx defines the input you want to sample.

For Input	Write Value (in hex)	Write Value (in decimal)
1	0x1301	4865
2	0x1302	4866
3	0x1304	4868
4	0x1308	4872
5	0x1310	4880
6	0x1320	4896
All Inputs	0x133F	4927

- To send the Sample on Demand command to more than one input, add together the binary representation values. For example, to demand a sampling of inputs 1, 2, and 3, the Hex command is 0x1307.

Bind the Q45 to the Gateway and Assign the Node Address

Before beginning the binding procedure, apply power to all the devices. Separate the devices by two meters when running binding procedure. Put only one Gateway into binding at a time to prevent binding to the wrong Gateway.

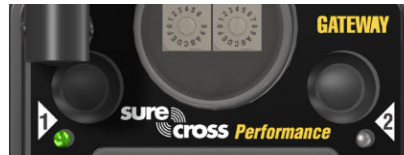


Figure 1. Buttons on a housed Gateway

- Enter binding mode on the Gateway.
 - For housed DX80 Gateways, triple-click button 2 on the Gateway. Both LEDs flash red.
 - For board-level DX80 Gateways, triple-click the binding button on the Gateway. The green and red LED flashes.
- 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 10, set the Gateway's left dial to 1 and the right dial to 0. Valid Node addresses are 01 through 47.



- Loosen the clamp plate on the top of the Q45 and lift the cover.
- Enter binding mode on the Q45 by triple-clicking the Q45's binding 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.
- Label the sensor with the Q45's Node address number for future reference.
- Repeat steps 2 through 5 for as many Q45 as are needed for your network.
- After binding all Q45, exit binding mode on the Gateway.
 - For housed DX80 Gateways, double-click button 2 on the Gateway.
 - For board-level DX80 Gateways, double-click the binding button on the Gateway.

For Gateways with single-line LCDs, after binding your Q45 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.

Bind a Q45 Node to a DXM Gateway and Assign the Node Address

Before beginning the binding procedure, apply power to all the devices. Separate radios by 2 meters when running binding procedure. Put only one DXM Gateway into binding at a time to prevent binding to the wrong Gateway.

- On the DXM radio using the arrow keys select the **ISM Radio** menu on the LCD and click **ENTER**.
- Highlight the **Binding** menu and click **ENTER**.
- Use the arrow keys to select the Node address to bind the Q45 to.
- Loosen the clamp plate on the top of the Q45 and lift the cover.

5. Enter binding mode on the Q45 by triple-clicking the power/binding button.
The red and green LEDs flash alternately and the sensor searches for a Gateway in binding mode. After the Q45 binds, the LEDs stay solid momentarily, then they flash together four times. The Q45 exits binding mode.
6. Label the sensor with the Q45's Node address number for future reference.
7. Click **BACK** on DXM to exit binding for that specific Node address.
8. Repeat steps 3 through 7 changing the Node address for as many Q45s as are needed for your network.
9. Click **BACK** on DXM until back to the main menu when finished binding.

Modbus Registers

I/O #	Modbus Holding Register		I/O Type *	I/O Range		Holding Register Representation	
	Gateway	Any Node		Min.	Max.	Min.	Max.
1	1	1 + (Node# × 16)	Distance (mm)	0	65535	0	65535
2	2	2 + (Node# × 16)	Temp °C	-1638.4	1638.3	-32768	32767
3	3	3 + (Node# × 16)	Temp °F	-1636.4	1638.3	-32768	32767
4	4	4 + (Node# × 16)	Distance (in)	0	655.35	0	65535
5	5	5 + (Node# × 16)					
6	6	6 + (Node# × 16)					
7	7	7 + (Node# × 16)	Reserved				
8	8	8 + (Node# × 16)	Device Message				
9	9	9 + (Node# × 16)	Discrete OUT 1: Red Light	0	1	0	1
10	10	10 + (Node# × 16)	Discrete OUT 2: Yellow Light	0	1	0	1
11	11	11 + (Node# × 16)	Discrete OUT 3: Green Light	0	1	0	1
12	12	12 + (Node# × 16)	Discrete OUT 4: Blue Light	0	1	0	1
		...					
15	15	15 + (Node# × 16)	Control Message				
16	16	16 + (Node# × 16)	Reserved				

Distance readings below 250 mm (9.84 in) result in a register value of 0. If no reflection is received because the target is too far away, the register value is an error value of 65535.

The temperature = (Modbus register value) ÷ 20. The distance (in) = (Modbus register value) ÷ 100.

Specifications

Performance Radio with Internal Antenna Specifications

Radio Range²

900 MHz, 1 Watt (Internal antenna): Up to 3.2 km (2 miles) with line of sight
2.4 GHz, 65 mW (Internal antenna): Up to 1000 m (3280 ft) with line of sight

Antenna Minimum Separation Distance

900 MHz, 150 mW and 250 mW: 2 m (6 ft)
900 MHz, 1 Watt: 4.57 m (15 ft)
2.4 GHz, 65 mW: 0.3 m (1 ft)

Radio Transmit Power

900 MHz, 1 Watt: 30 dBm (1 W) conducted (up to 36 dBm EIRP)
2.4 GHz, 65 mW: 18 dBm (65 mW) conducted, less than or equal to 20 dBm (100 mW) EIRP

Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

900 MHz Compliance (1 Watt)

FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247
IC: 7044A-RM1809

2.4 GHz Compliance

FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247
ETSI EN 300 328: V1.8.1 (2012-06)
IC: 7044A-DX8024

Link Timeout

Gateway: Configurable via User Configuration Tool (UCT) software
Node: Defined by Gateway

Radiated Immunity HF

10 V/m (EN 61000-4-3)

² Range depends on the environment and decreases significantly without line of sight. Always verify your wireless network's range by performing a Site Survey.

Specifications for the Q45UA Node

Ultrasonic Performance

Sensing range: 300 mm to 3 m (11.8 in to 118 in)
 Ultrasonic frequency: 114 kHz
 Temperature effect: 0.02% of distance/°C
 Resolution: 0.1% of distance (1.5 mm minimum)

Construction

Molded reinforced thermoplastic polyester housing, oring-sealed transparent Lexan® cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown.

Default Sensing Interval

5 minutes

Typical Battery Life

See chart.

Indicators

Red and green LEDs (radio function)

Environmental Specifications

Operating Conditions

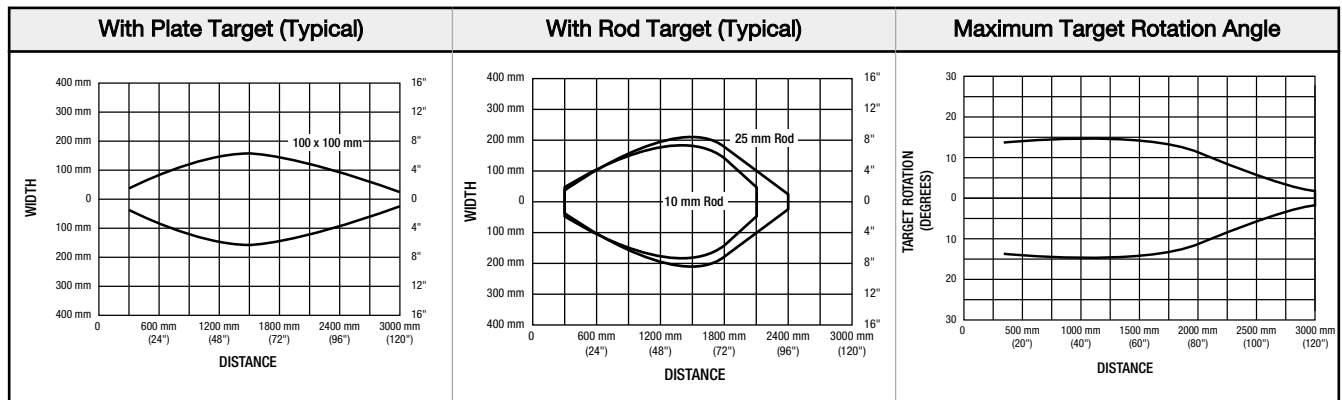
-40 °C to +70 °C (-40 °F to +158 °F); 90% at +50 °C maximum relative humidity (non-condensing)
 Radiated Immunity: 10 V/m (EN 61000-4-3)

Environmental Rating

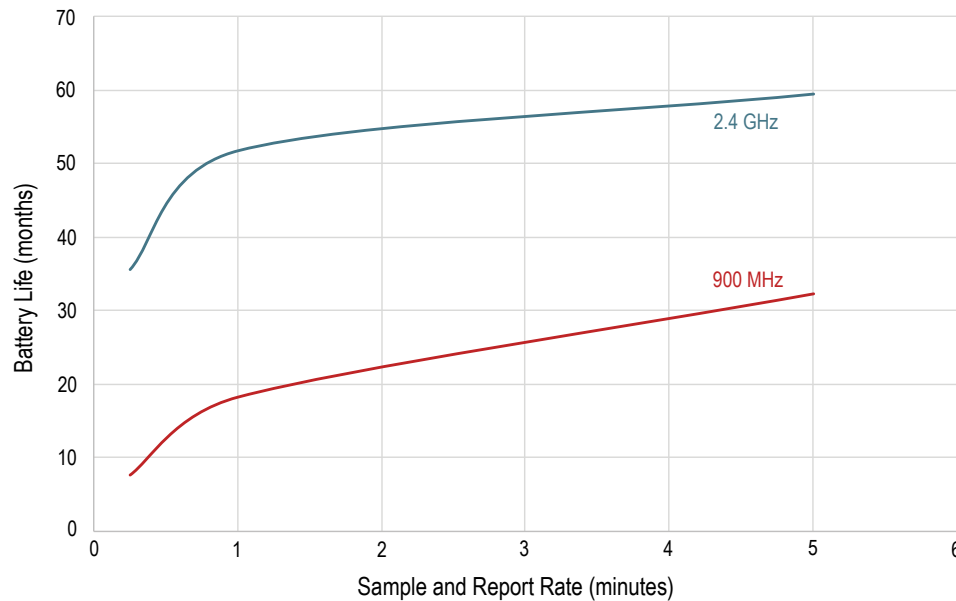
NEMA 6P, IEC IP67

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

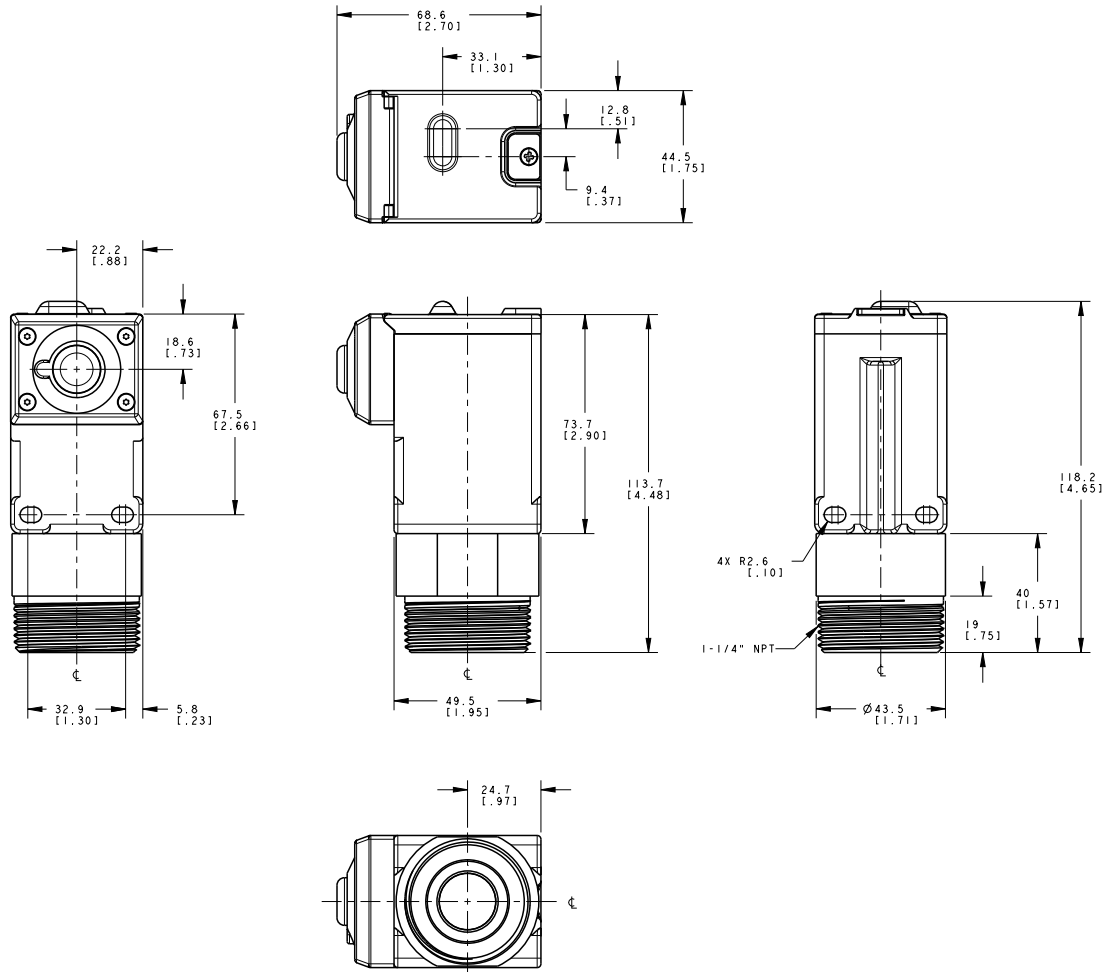
Performance Curves



Battery Life



Dimensions



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