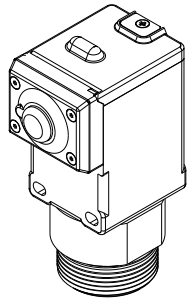
# Q45UAA and Q45UAC All-in-One Ultrasonic Node

# Features

Sure Cross® Wireless Q45 Sensors combine the best of Banner's flexible 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 an 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 Performance Configuration Software. In addition, caustic chemical-resistant versions are available.



**Benefits**

- Provides for the 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
- **Mobility**—Since it is not tethered by wires, the sensor can move with the container. When the container is replaced, simply swap out the sensor to the new one.
- Easy-to-use/rugged device that can be mounted permanently to equipment or temporarily threaded into bung holes of supply tanks.
- **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
- 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 a lost radio signal

# Models

| Model | Ultrasonic Input Range and Frequency | Radio Frequency | Inputs and Outputs |
|---|---|---|---|
| **DX80N9Q45UAA** | Range: 100 mm to 1 m (3.94 in to 39.4 in)<br>Frequency: 240 kHz | 900 MHz ISM Band | Inputs: One Ultrasonic Input, One Thermistor Input<br>Outputs: One Four-Color LED Indicator Light |
| **DX80N9Q45UAA NB** (ships without the battery) | | | |
| **DX80N9Q45UAC** | Range: 300 mm to 3 m (11.8 in to 118 in)<br>Frequency: 114 kHz | | |
| **DX80N9Q45UAC NB** (ships without the batter) | | | |

The following models are no longer available for order, but are still covered by the information in this document.

| Model | Ultrasonic Input Range and Frequency | Radio Frequency | Inputs and Outputs |
|---|---|---|---|
| **DX80N2Q45UAA** | Range: 100 mm to 1 m (3.94 in to 39.4 in)<br>Frequency: 240 kHz | 2.4 GHz ISM Band | Inputs: One Ultrasonic Input, One Thermistor Input<br>Outputs: One Four-Color LED Indicator Light |
| **DX80N2Q45UAA NB** | | | |
| **DX80N2Q45UAC** | Range: 300 mm to 3 m (11.8 in to 118 in)<br>Frequency: 114 kHz | | |
| **DX80N2Q45UAC NB** | | | |

# 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).

Original Instructions
04-Feb-25

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207212
p/n: 207212 Rev. H

ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

## Storage Mode

While in **storage mode**, the device's radio does not operate to conserve the battery. To put any device into storage mode, press and hold the binding button for five seconds. The device is in storage mode when the LEDs stop blinking. To wake the device, press and hold the binding button (inside the housing on the radio board) for five seconds.

## Slow Scan Mode

In slow scan mode, the device enters a deeper sleep mode to conserve battery power after the device loses its communication link with its primary radio. The device wakes up periodically to search for the primary radio. If the parent or primary radio is not found, the device goes back to sleep for another sleep cycle. If the parent or primary radio is detected, the device exits slow scan mode. To manually exit slow scan mode, press the binding button.

## 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 ÷ 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:

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

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

$T_C$ = temperature in °C

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

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

$T_F$ = temperature in °F

## Temperature Compensation

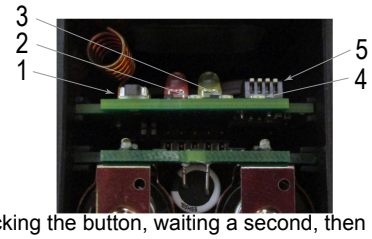
Changes in air temperature affect the speed of sound, which in turn affects the total time for the echo measured by the sensor. An increase in air temperature shifts both sensing window limits closer to the sensor. Conversely, a decrease in air temperature shifts both limits farther away from the sensor. 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.

# Configuration Instructions

## Button and LEDs

1. Binding 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 (default setting) | OFF | | | |

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Continued from page 2

| Description | DIP Switches | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Transmit power: 250 mW (compatible with 150 mW radios) | ON | | | |
| Sample/Report Rate: User configured (5 minutes by default) (default setting) | | 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] (default setting) | | | | OFF |
| Light mode: solid | | | | ON |

**Transmit Power.** The 900 MHz radios have a high output option that will transmit at 1 W (30 dBm). The low output option transmits at 250 mW (24 dBm). The 250 mW mode reduces the radio's range but improves the battery life in short-range applications. 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).

**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 battery-powered applications, setting the report rate to a slower rate extends the battery life.

**Sample on Demand.** Sample on demand allows a host system to send a Modbus command to a register and require the inputs to immediately sample the sensor and report readings back to the host system and/or Gateway. Sampling on demand can be used between the normal periodic reporting. The sample-on-demand feature requires using a host-controlled system capable of sending Modbus commands to the client radio.

## 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 + (Node # × 16).

1. 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 |

2. 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.

# Apply Power to the Q45 AA-Cell Models

Follow these instructions to install or replace the lithium "AA" cell batteries.

**CAUTION:**

- **As with all batteries, these are fire, explosion, and severe burn hazards. There is a risk of explosion if the battery is replaced incorrectly.**
- Do not burn or expose them to high temperatures. Do not recharge, crush, disassemble, or expose the contents to water.
- Verify the battery's positive and negative terminals align to the positive and negative terminals of the battery holder mounted within the case.
- Properly dispose of used batteries according to local regulations by taking them to a hazardous waste collection site, an e-waste disposal center, or another facility qualified to accept lithium batteries.

[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.


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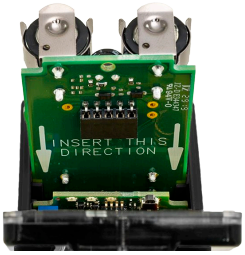
1. Loosen the clamp plate with a small Phillips screwdriver and lift the cover.
2. Slide the battery board out of the Q45 housing.
3. If applicable, remove the discharged batteries.
4. Install the new batteries.
   Use Banner's **BWA-BATT-006** replacement batteries or equivalent 3.6 V AA lithium batteries, such as Xeno's XL-60F.
5. Verify the battery's positive and negative terminals align to the positive and negative terminals of the battery holder mounted within the case.
6. Slide the board containing the new batteries back into the Q45 housing.
7. Close the cover and gently tighten the clamp plate with the small Phillips screwdriver.

*Q45 battery board*




## Bind 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 the binding procedure. Put only one Gateway into binding at a time to prevent binding to the wrong Gateway.

1. On the Gateway: Enter binding mode.
   - For housed DX80 Gateways, triple-click button 2 on the Gateway. Both LEDs flash red.
   - For Gateway board modules, triple-click the button. The green and red LED flashes.
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 10, set the Gateway's left dial to 1 and the right dial to 0. Valid Node addresses are 01 through 47.
3. On the Q45: Loosen the clamp plate on the top of the Q45 and lift the cover.
4. Enter binding mode on the Q45 by triple-clicking the Q45's 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 for future reference.
6. Repeat steps 2 through 5 for as many Q45s as are needed for your network.
7. On the Gateway: After binding all Q45s, exit binding mode.
   - For housed DX80 Gateways, double-click button 2.
   - For board-level DX80 Gateways, double-click the button.

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 to a DXM and Assign the Node Address

Before beginning the binding procedure, apply power to all the devices. Separate the radios by two meters when running the binding procedure. Put only one DXM into binding mode at a time to prevent the Q45 from binding to the wrong Gateway.

1. On the DXM: Use the arrow keys to select the **ISM Radio** menu on the LCD and click **ENTER**.
2. Highlight the **Binding** menu and click **ENTER**.
3. Use the arrow keys to select the Node address to bind the Q45 to.
4. On the Q45: Loosen the top clamp plate and lift the cover.
5. Enter binding mode by triple-clicking the binding button.
   The red and green LEDs flash alternately and the sensor searches for a Gateway in binding mode. After the Node binds, the LEDs stay solid momentarily, then they flash together four times. The Node exits binding mode.
6. Label the sensor with the Node address number for future reference.
7. On the DXM: Click **BACK** to exit binding for that specific Node address.
8. Repeat steps 3 through 7 and change the Node address for as many Q45s as are needed for your network.
9. On the DXM: After you have finished forming your network, click **BACK** until you reach the main menu.

## 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) | | | | | |

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| I/O # | Modbus Holding Register | | I/O Type * | I/O Range | | Holding Register Representation | |
|---|---|---|---|---|---|---|---|
| | Gateway | Any Node | | Min. | Max. | Min. | Max. |
| 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 the listed minimums 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.

- 250 mm (9.84 in) for the **UAC** models
- 75 mm (2.95 in) for the **UAA** models

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

# Specifications

## Q45UAA and UAC Specifications

**Supplied Antenna**

This device includes an internal 2 dB antenna. Range depends on the environment and decreases significantly without line-of-sight. Always verify your wireless network's range by performing a Site Survey.

**Radio Transmit Power (900 MHz, 1 W radios)**

Conducted: 30 dBm (1 W)

EIRP with the supplied antenna: < 36 dBm

**Radio Transmit Power (2.4 GHz radios)**

Conducted: < 18 dBm (65 mW)

EIRP with the supplied antenna: < 20 dBm (100 mW)

**Antenna Minimum Separation Distance**

900 MHz radios transmitting at ≥ 500 mW: 4.57 m (15 ft) with the supplied antenna

2.4 GHz radios transmitting at 65 mW: 0.3 m (1 ft) with the supplied antenna

**Radio Range**

900 MHz (1 W): Up to 3.2 km (2 miles) with line of sight (internal antenna)

2.4 GHz (65 mW): Up to 1000 m (3280 ft) with line of sight (internal antenna)

**Link Timeout (Performance)**

Gateway: Configurable via User Configuration Software

Node: Defined by Gateway

**Spread Spectrum Technology**

FHSS (Frequency Hopping Spread Spectrum)

**Model UAC 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: 1 mm

**900 MHz Compliance (RM1809 Radio Module)**

Radio module is indicated by the product label marking

Contains FCC ID: UE3RM1809

Contains IC: 7044A-RM1809

IFT: RCPBARM13-2283

**2.4 GHz Compliance (DX80-2400 Radio Module)**

Radio module is indicated by the product label marking

Contains FCC ID: UE300DX80-2400

Radio Equipment Directive (RED) 2014/53/EU

Contains IC: 7044A-DX8024

ANATEL: 15966-21-04042 Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados. Para maiores informações, consulte o site da ANATEL www.gov.br/anatel/pt-br/

**2.4 GHz Compliance (SX243 Radio Module)**

Radio module is indicated by the product label marking

Contains FCC ID: UE3SX243

Radio Equipment Directive (RED) 2014/53/EU

Contains IC: 7044A-SX243

**Model UAA Performance**

Sensing range: 100 mm to 1 m (3.94 to 39.4 in)

Ultrasonic Frequency: 240 kHz

Temperature effect: 0.02% of distance/°C

Resolution: 1 mm

**Indicators**

Red and green LEDs (radio function)


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**Construction**

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

**Default Sensing Interval**

5 minutes

**Typical Battery Life**

See "Q45UA Battery Life" on page 7

**Certifications**

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Park Lane, Culliganlaan 2F bus 3
1831 Diegem, BELGIUM

Turck Banner LTD Blenheim House
Blenheim Court
Wickford, Essex SS11 8YT
GREAT BRITAIN

CE/UKCA approval only applies to 2.4 GHz models

# FCC Part 15 Class A for Intentional Radiators

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

(Part 15.21) Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

# Industry Canada Statement for Intentional Radiators

This device contains licence-exempt transmitters(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil contient des émetteurs/récepteurs exemptés de licence conformes à la norme Innovation, Sciences, et Développement économique Canada. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage.
2. L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

# Environmental Specifications for the Q45

**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**

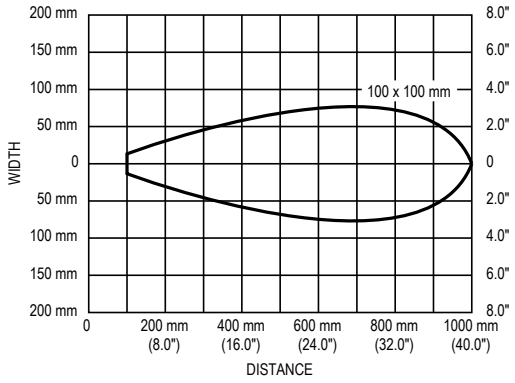
NEMA 6P
IP67

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

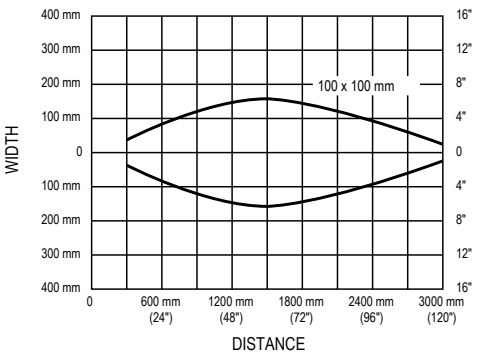
# Performance Curves

| Q45UUA Models (1 meter) | Q45UAC Models (3 meters) |
|---|---|

*With Plate Target (Typical)*




*With Plate Target (Typical)*

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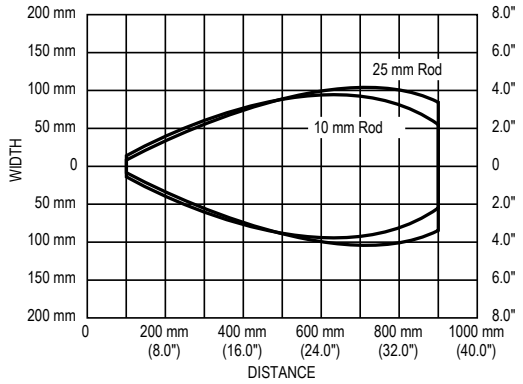
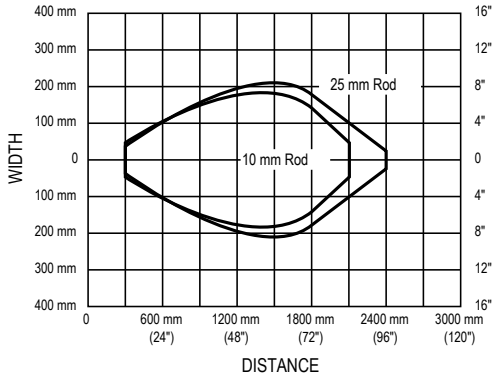
| Q45UUA Models (1 meter) | Q45UAC Models (3 meters) |
|---|---|

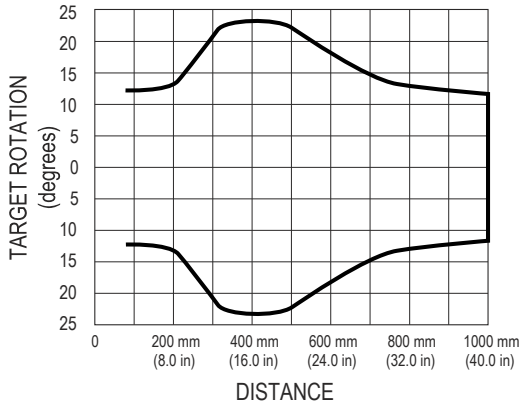
*With Rod Target (Typical)*



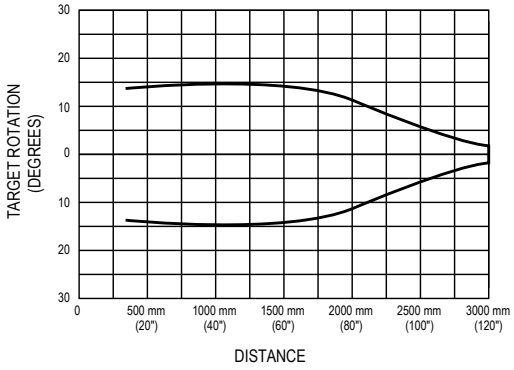

*With Rod Target (Typical)*




*Maximum Target Rotation Angle*

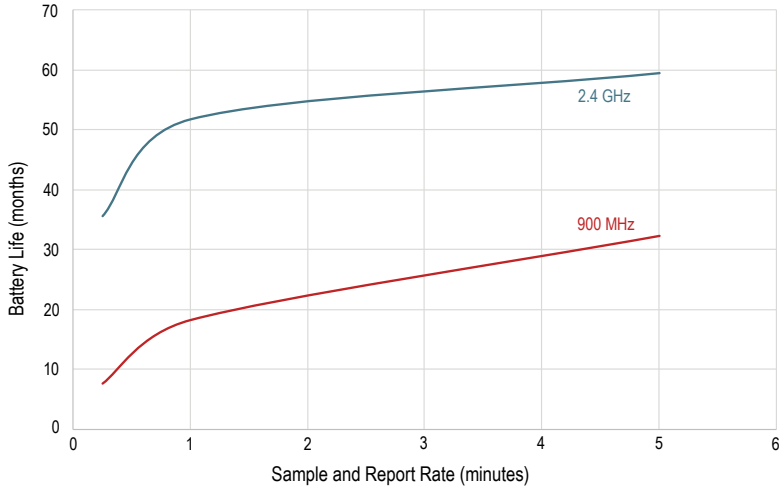



*Maximum Target Rotation Angle*




## Battery Life

*Battery life for the Q45UA*





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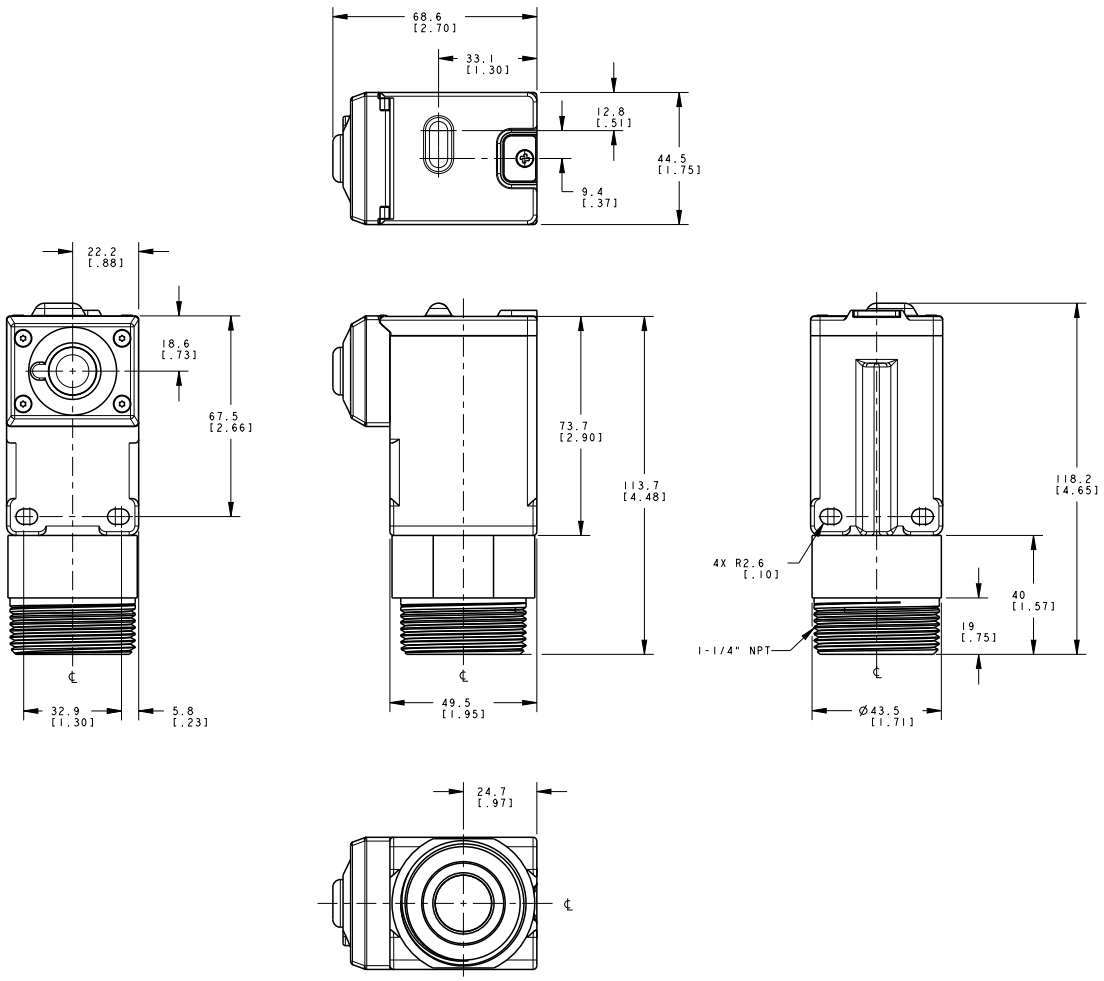
## Dimensions




# Warnings (Internal Antenna Models)

**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.** Consult with Banner Engineering Corp. if the destination country is not on this list.

**IMPORTANT:** Please download the complete Wireless Q45UA Ultrasonic Node technical documentation, available in multiple languages, from www.bannerengineering.com for details on the proper use, applications, Warnings, and installation instructions of this device.

**IMPORTANT:** Por favor descargue desde www.bannerengineering.com toda la documentación técnica de los Wireless Q45UA Ultrasonic Node, disponibles en múltiples idiomas, para detalles del uso adecuado, aplicaciones, advertencias, y las instrucciones de instalación de estos dispositivos.

**IMPORTANT:** Veuillez télécharger la documentation technique complète des Wireless Q45UA Ultrasonic Node sur notre site www.bannerengineering.com pour les détails sur leur utilisation correcte, les applications, les notes de sécurité et les instructions de montage.

**WARNING:**

- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

**IMPORTANT:**

- **Electrostatic discharge (ESD) sensitive device**
- ESD can damage the device. Damage from inappropriate handling is not covered by warranty.
- Use proper handling procedures to prevent ESD damage. Proper handling procedures include leaving devices in their anti-static packaging until ready for use; wearing anti-static wrist straps; and assembling units on a grounded, static-dissipative surface.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# Banner Engineering Corp Limited Warranty

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For patent information, see www.bannerengineering.com/patents.

# Notas Adicionales (con Antena)

Información México: La operación de este equipo está sujeta a las siguientes dos condiciones: 1) es posible que este equipo o dispositivo no cause interferencia perjudicial y 2) este equipo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

Banner es una marca registrada de Banner Engineering Corp. y podrán ser utilizadas de manera indistinta para referirse al fabricante. "Este equipo ha sido diseñado para operar con las antenas tipo Omnidireccional para una ganancia máxima de antena de 6 dBd y Yagi para una ganancia máxima de antena 10 dBd que en seguida se enlistan. También se incluyen aquellas con aprobación ATEX tipo Omnidireccional siempre que no excedan una ganancia máxima de antena de 6dBd. El uso con este equipo de antenas no incluidas en esta lista o que tengan una ganancia mayor que 6 dBd en tipo omnidireccional y 10 dBd en tipo Yagi, quedan prohibidas. La impedancia requerida de la antena es de 50 ohms."

**Approved Antennas**

**BWA-9O2-C**--Antena, Omni 902-928 MHz, 2 dBd, junta de caucho, RP-SMA Macho
**BWA-9O5-C**--Antena, Omni 902-928 MHz, 5 dBd, junta de caucho, RP-SMA Macho
**BWA-9O6-A**--Antena, Omni 902-928 MHz, 6 dBd, fibra de vidrio, 1800mm, N Hembra
**BWA-9Y10-A**--Antena, Yagi, 900 MHz, 10 dBd, N Hembra

# Mexican Importer

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