Sure Cross® Wireless Q45D Sensor Node (Diffuse)

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 Q45D is a compact, industrial, battery-powered diffuse-mode photoelectric sensor that can be used to wirelessly transmit presence/absence inputs and a totalized count to a wireless Gateway/Controller. An object is detected when it reflects the sensor’s transmitted light energy back to the sensor. No reflector or receiver is needed to detect objects.

Benefits
- Powerful device that delivers factory automation and IIoT solutions for many applications including but not limited to:
  - Presence/absence
  - Pallet completion
  - Part count totalizing up to 960 parts/minute
  - Part rate monitoring and Overall Equipment Effectiveness (OEE)
  - Machine status monitoring (jams, diverts, etc.) and cycle count
  - Rotational speed
- Easy installation—Battery powered for peel-and-stick functionality with a two-year battery life capability; no need for power or control wires
- Reduce complexity—Machine or process reconfiguration made easier; great for retrofit applications and remote locations where implementing a wired solution would be difficult, impractical, or cost prohibitive
- Detects objects up to 300 mm (12 in) away
- Includes the diffuse-mode photoelectric sensor, a wireless Node, and an internal battery to make it easy to install
- Counts up to 960 parts per minute
- Transceivers provide bidirectional communication between the Gateway and Node, including fully acknowledged data transmission
- DIP switches for user configuration
- Diagnostics allow user-defined output settings in the unlikely event of lost RF signal
- Frequency Hopping Spread Spectrum (FHSS) technology ensures reliable data delivery within the unlicensed Industrial, Scientific, and Medical (ISM) band

Important: Please download the complete Wireless Q45 Sensor 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 Q45 Sensor 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 Q45 Sensor 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.

Models

<table>
<thead>
<tr>
<th>Models</th>
<th>Frequency</th>
<th>Sensing Range</th>
<th>Inputs and Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX80N2Q45D</td>
<td>2.4 GHz ISM Band</td>
<td>300 mm (12 in)</td>
<td>Photoelectric sensor with event counter</td>
</tr>
<tr>
<td>DX80N9Q45D</td>
<td>900 MHz ISM Band</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Storage Mode

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 binding button (inside the housing on the radio board) for five seconds. To put any Q45 into storage mode, press and hold the binding button for five seconds. The Q45 is in storage mode when the LEDs stop blinking.

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 for Alignment or Test Mode. Indicates sensor function (optical sensor models) or when input 1 is active (dry contact models). The amber LED is not used during normal operation.
5. Excess gain potentiometer. Turn clockwise to increase the gain.
6. DIP switches

DIP Switches

<table>
<thead>
<tr>
<th>Settings</th>
<th>DIP Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>900 MHz Transmit Power Level: 1 Watt (30 dBm) (default)</td>
<td>OFF *</td>
</tr>
<tr>
<td>900 MHz Transmit Power Level: 250 mW (24 dBm) (DX80 Compatibility Mode)</td>
<td>ON</td>
</tr>
<tr>
<td>No Counter, 62.5 ms Sample Rate/Change of State Reporting (default)</td>
<td>OFF *</td>
</tr>
<tr>
<td>Counter Enabled, 62.5 ms Sample Rate/60 s Report Rate</td>
<td>OFF</td>
</tr>
<tr>
<td>Counter Enabled, 62.5 ms Sample Rate/User-Defined Report Rate</td>
<td>OFF</td>
</tr>
<tr>
<td>Counter Enabled, 31.25 ms Sample Rate/60 s Report Rate</td>
<td>OFF</td>
</tr>
<tr>
<td>Counter Enabled, 31.25 ms Sample Rate/User-Defined Report Rate</td>
<td>OFF</td>
</tr>
<tr>
<td>Counter Enabled, 62.5 ms Sample Rate/60 s Report Rate and Change of State Reporting on Sensor IN 1</td>
<td>ON</td>
</tr>
<tr>
<td>Counter Enabled, 62.5 ms Sample Rate/User-defined Report Rate and Change of State Reporting on Sensor IN 1</td>
<td>ON</td>
</tr>
</tbody>
</table>
| Software Configured (User-Defined)                                      | ON         

For user-defined (configured using the User Configuration Software) DIP switch selections, the counter’s report rate is defined by the report rate of Sensor IN 1.

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.
Modbus Registers

<table>
<thead>
<tr>
<th>I/O #</th>
<th>Modbus Holding Register</th>
<th>I/O Type</th>
<th>I/O Range</th>
<th>Holding Register Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gateway</td>
<td>Any Node</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1 + (Node# × 16)</td>
<td>Sensor IN 1 State</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2 + (Node# × 16)</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3 + (Node# × 16)</td>
<td>Counter High Word</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4 + (Node# × 16)</td>
<td>Counter Low Word</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>7 + (Node# × 16)</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>8 + (Node# × 16)</td>
<td>Device Message</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>14</td>
<td>14 + (Node# × 16)</td>
<td>Clear Counter</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>15 + (Node# × 16)</td>
<td>Control Message</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>16 + (Node# × 16)</td>
<td>Reserved</td>
<td></td>
</tr>
</tbody>
</table>

Using the Event Counter

The counter "counts" when the input is on for a minimum of the sample rate. The counter input is off when the input is off for a minimum of the sample rate. For example, if your sample rate is set to 62.5 ms, the counter input is on, and therefore counts, when the input is on for at least 62.5 ms. If the input is not on for 62.5 ms, the counter does not increment.

To clear the counter when you are using a host-controlled system, send a control message to Node register 15. Control messages on Node register 15 are acknowledged with the same value echoed to Node register 7.

1. Write 5388 (0x150C) to Node register 15.
2. Read Node register 7 until it echoes the Node register 15 value.

To clear the counter when you are not using a host-controlled system, write a 1 to the Node’s output register 14. Clearing the counter requires that this register goes from a 0 to a 1. If there is already a 1 in the register, first write a 0, then write the 1. You can use the Gateway I/O mapping to map an input, such as a button, to clear the counter value.

Installation Instructions

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

1. Enter binding mode on the Gateway.
   - For housed DX80 Gateways, triple-click button 2 on the Gateway. Both LEDs flash red.
   - For Gateway board modules, triple-click the binding 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. 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 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.
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. After binding all Q45s, 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.
Optical Alignment Mode (Diffuse)

In diffuse-mode sensing, light emitted from the sensor strikes the surface of the object to be detected and is diffused back, sending some light back to the receiver, which is usually housed with the emitter. With a diffuse-mode sensor, the object is detected when it "makes" the beam, that is, the object reflects the sensor’s transmitted light energy back to the sensor.

The Wireless Q45 Sensor enters and remains in optical alignment mode for 15 minutes after the button is pushed, after the Wireless Q45 Sensor exits binding mode, or after the Q45 is powered up (battery replaced).

During optical alignment mode, the sensor’s yellow LED lights up whenever the sensor detects the reflected beam.

After 15 minutes, the Wireless Q45 Sensor automatically exits optical alignment mode and begins normal operation. After the sensor begins normal operation, the amber/yellow sensor state LED is inactive. To exit alignment mode earlier, click the button five times.

Replace or Install 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.

The replacement battery model number is BWA-BATT-006. For pricing and availability, contact Banner Engineering.

Specifications

Performance Radio with Internal Antenna Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radio Range</strong></td>
<td>900 MHz, 1 Watt (Internal antenna): Up to 3.2 km (2 miles) with line of sight</td>
</tr>
<tr>
<td></td>
<td>2.4 GHz, 65 mW (Internal antenna): Up to 1000 m (3280 ft) with line of sight</td>
</tr>
<tr>
<td><strong>Antenna Minimum Separation Distance</strong></td>
<td>900 MHz, 150 mW and 250 mW: 2 m (6 ft)</td>
</tr>
<tr>
<td></td>
<td>900 MHz, 1 Watt: 4.57 m (15 ft)</td>
</tr>
<tr>
<td></td>
<td>2.4 GHz, 65 mW: 0.3 m (1 ft)</td>
</tr>
<tr>
<td><strong>Radio Transmit Power</strong></td>
<td>900 MHz, 1 Watt: 30 dBm (1 W) conducted (up to 36 dBm EIRP)</td>
</tr>
<tr>
<td></td>
<td>2.4 GHz, 65 mW: 18 dBm (65 mW) conducted, less than or equal to 20 dBm (100 mW) EIRP</td>
</tr>
<tr>
<td><strong>Spread Spectrum Technology</strong></td>
<td>FHSS (Frequency Hopping Spread Spectrum)</td>
</tr>
<tr>
<td><strong>Link Timeout</strong></td>
<td>Gateway: Configurable via User Configuration Software</td>
</tr>
<tr>
<td></td>
<td>Node: Defined by Gateway</td>
</tr>
</tbody>
</table>

Q45D Diffuse Sensor Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Report Rate</strong></td>
<td>On Change of State</td>
</tr>
<tr>
<td><strong>Default Sample Rate</strong></td>
<td>62.5 milliseconds</td>
</tr>
<tr>
<td><strong>Indicators</strong></td>
<td>Red and green LEDs (radio function); amber LED (only for alignment mode)</td>
</tr>
<tr>
<td><strong>Adjustments</strong></td>
<td>Multi-turn sensitivity control (allows precise sensitivity setting - turn clockwise to increase gain)</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>Molded reinforced thermoplastic polyester housing, oring-sealed transparent Lexan® cover, molded acrylic lenses, and stainless steel hardware. Designed to withstand 1200 psi washdown.</td>
</tr>
</tbody>
</table>

Certifications

- NOM
- NYCE

(NOM approval only applies to 900 MHz models)

Range depends on the environment and decreases significantly without line of sight. Always verify your wireless network’s range by performing a Site Survey.)
### Battery Life (Typical for 900 MHz, 1 Watt)

- With no counter and change-of-state reporting of greater than 5 minutes: 2.1 years
- With no counter and change-of-state reporting of about 30 s: 1.6 years
- With a counter set to 62.5 ms sample rate and 60 s report rate: 1.5 years
- With a counter set to 31.25 ms sample rate and 60 s report rate: 1 year

### Battery Life (Typical for 2.4 GHz)

- With no counter and change-of-state reporting of greater than 5 minutes: 2.6 years
- With no counter and change-of-state reporting of about 30 s: 2.5 years
- With a counter set to 62.5 ms sample rate and 60 s report rate: 2.3 years
- With a counter set to 31.25 ms sample rate and 60 s report rate: 1.2 years

### 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

**Performance curves are based on a 90% reflectance white test card.**

<table>
<thead>
<tr>
<th>Excess Gain</th>
<th>Beam Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="" alt="Excess Gain Graph" /></td>
<td><img src="" alt="Beam Pattern Graph" /></td>
</tr>
</tbody>
</table>

**Battery Life**

- **Battery Life for 900 MHz Radios**
  - 62.5 ms Sample Rate
  - 31.25 ms Sample Rate

- **Battery Life for 2.4 GHz Radios**
  - 62.5 ms Sample Rate
  - 31.25 ms Sample Rate
Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product. THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE. This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.

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

Exporting Sure Cross® Radios

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

Notas Adicionales

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 dBi y Yagi para una ganancia máxima de antena 10 dBi que en seguida se enlistan. También se incluyen aquellas con aprobación ATEX tipo Omnidireccional siempre que no excedan una ganancia máxima de antena 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." 

<table>
<thead>
<tr>
<th>Antenas SMA</th>
<th>Modelo</th>
<th>Antenas Tipo-N</th>
<th>Modelo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antena, Omni 902-928 MHz, 2 dBi, junta de caucho, RP-SMA Macho</td>
<td>BWA-902-C</td>
<td>Antena, Omni 902-928 MHz, 6 dBi, fibra de vidrio, 1800mm, N Hembra</td>
<td>BWA-906-A</td>
</tr>
<tr>
<td>Antena, Omni 902-928 MHz, 5 dBi, junta de caucho, RP-SMA Macho</td>
<td>BWA-905-C</td>
<td>Antena, Yagi, 900 MHz, 10 dBi, N Hembra</td>
<td>BWA-9Y10-A</td>
</tr>
</tbody>
</table>

Mexican Importer

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