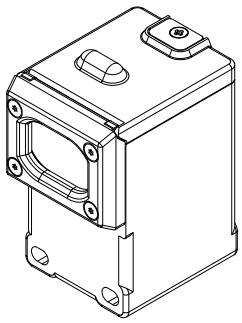
Sure Cross® Wireless Q45VA Vibration and Temperature Sensor

Datasheet

The Wireless Q45VA All-in-One Sensor Node combines Banner's VT1 Vibration and Temperature Sensor with the Sure Cross® Q45VT Wireless Sensor Node. The Q45VA is a compact, industrial, battery-powered device that wirelessly communicates with any Sure Cross Performance Gateway on a variety of machines to analyze vibration and temperature data to identify and predict failures in rotating machinery.

Benefits

- Delivers pre-processed high accuracy vibration values for monitoring rotating equipment such as:
  - Motors
  - Pumps
  - Rotary Compressors
  - Exhaust or HVAC fan motors
  - Spindles
- Easy-to-use rugged device that can be easily mounted to equipment
- Use with the DXM Wireless Controller to track and trend vibration and temperature characteristics in real time to predict need for maintenance, predict potential component failure and avoid process downtime.
- Battery powered for “peel and stick” functionality with 2+ years of battery life
- Detects vibration characteristics on 2 axis (radial and axial) such as RMS Velocity, High Frequency Acceleration, Peak Acceleration, Peak Velocity Component Frequency, etc
- Achieves vibration accuracy of ±10% RMS velocity (in/sec)
- **Eliminate control wires**—The Sure Cross wireless system is a radio frequency network with integrated I/O that removes the need for power and control wires
- **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



- Transmit power levels of 250 mW or 1 Watt for 900 MHz models and 65 mW for 2.4 GHz models are user-selectable
- DIP switches for user configuration of sample time and vibration characteristics
- 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:

- **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

Model	Radio Frequency	Inputs and Outputs
DX80N2Q45VA	2.4 GHz ISM Band	Vibration and temperature[1] detection
DX80N9Q45VA	900 MHz ISM Band	

[1] Only models produced after date code 1925x include the temperature sensor.

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.

Storage Mode

While in **storage mode**, the Q45VA's radio does not operate. The Q45VA 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 Q45VA into storage mode, press and hold the binding button for five seconds. The Q45VA is in storage mode when the LEDs stop blinking.

General Operation

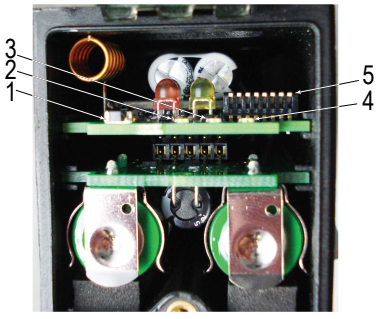
For the first 15 minutes after power up, the Node samples the sensor every two seconds (fast sample mode). After 15 minutes, the Node defaults to 5 minute sample intervals. Activate fast sample mode by single clicking the button (the amber LED is solid).

ISO 10816 provides guidance for evaluating vibration velocity severity motors, pumps, fans, compressors, gear boxes, blowers, dryers, presses, and other machines that operate in the 10 to 1000 Hz frequency range.

Machine			Class I Small Machines	Class II Medium Machines	Class III Large Rigid Foundation	Class IV Large Soft Foundation
Vibration Velocity Vrms	in/s	mm/s				
	0.01	0.28				
	0.02	0.45				
	0.03	0.71		good		
	0.04	1.12				
	0.07	1.80				
	0.11	2.80		satisfactory		
	0.18	4.50				
	0.28	7.10		unsatisfactory		
	0.44	11.2				
	0.70	18.0				
	1.10	28.0		unacceptable		
	1.77	45.9				

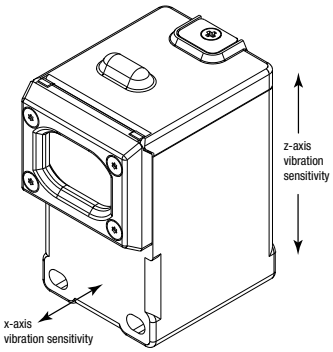
Figure 1. Vibration Severity per ISO 10816

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

Installing the Q45



The vibration sensors have an X and Z axis indication on the face of the sensor.

- Install the X axis in line with the shaft of the motor or axially.
- Install the Z axis to go into or through the motor or radial.

For the best results, install the sensor as close to the motor bearing as possible. If this is not possible, install the sensor on a surface that is in rigid connection with vibration characteristics of the motor. Using a cover shroud or other flexible mounting location may result in reduced accuracy or reduced ability to detect certain vibration characteristics.

The Q45VA body can be affixed to the motor using Loctite 330 and 7387 Activator or similar adhesive. For information about optional brackets, see *Brackets* (p. 9).

Configuration Instructions

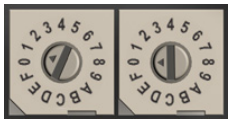
Bind to the Gateway and Assign the Node Address

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.



Figure 2. Buttons on a housed Gateway

1. 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.
2. Assign the Q45VA 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 Q45VA 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 Q45VA and lift the cover.
4. Enter binding mode on the Q45VA by triple-clicking the Q45VA's binding button.
   The red and green LEDs flash alternately and the sensor searches for a Gateway in binding mode. After the Q45VA is bound, the LEDs stay solid momentarily, then they flash together four times. The Q45VA exits binding mode.
5. Label the sensor with the Q45VA's Node address number for future reference.
6. Repeat steps 2 through 5 for as many Q45VA as are needed for your network.
7. After binding all Q45VA, 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 Q45VA 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 Q45VAs if your Gateway is ever replaced.

Bind to a DXM Gateway and Assign the Node Address

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

1. On the DXM radio using the arrow keys 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 Q45VA to.
4. Loosen the clamp plate on the top of the Q45VA and lift the cover.
5. Enter binding mode on the Q45VA 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 Q45VA binds, the LEDs stay solid momentarily, then they flash together four times. The Q45VA exits binding mode.
6. Label the sensor with the Q45VA'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 Q45VAs as are needed for your network.
9. Click **BACK** on DXM until back to the main menu when finished binding.

DIP Switches

After making any changes to any DIP switch position, reboot the Q45VA 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	5	6	7	8
Transmit power: 1 Watt	OFF*							
Transmitt power: 250 mW (compatible with 150 mW radios)	ON							
Default I/O Configuration[2]		OFF*	OFF*	OFF*				
I/O Configuration 1		OFF	OFF	ON				
I/O Configuration 2		OFF	ON	OFF				
I/O Configuration 3		OFF	ON	ON				
I/O Configuration 4		ON	OFF	OFF				
I/O Configuration 5		ON	OFF	ON				
Reserved		ON	ON	OFF				
Reserved		ON	ON	ON				
Sample/Report Rate: User configured (5 minutes by default)					OFF*	OFF*		
Sample/Report Rate: 150 seconds					OFF	ON		
Sample/Report Rate: 60 seconds					ON	OFF		
Reserved					ON	ON		
English Units (in/s and °F)							OFF*	
Metric Units (mm/s and °C)							ON	
Reserved								OFF*

* Default position

I/O Configurations (Set by DIP Switches 2, 3, and 4)							
Input Register		Default I/O	I/O Configuration 1	I/O Configuration 2	I/O Configuration 3	I/O Configuration 4	I/O Configuration 5
1	Z-Axis	RMS Velocity (in/sec)	RMS Velocity (in/sec)	High-Frequency RMS Acceleration (G)	RMS Velocity (in/sec)	Full Bandwidth RMS Acceleration (G)	RMS Velocity (in/sec)
2		High-Frequency RMS Acceleration (G)	Peak Acceleration (G)	Peak Acceleration (G)	Peak Velocity Component Frequency (Hz)	Full Bandwidth Peak Acceleration (G)	Full Bandwidth RMS Acceleration (G)
3	-	Temperature (°F)	Temperature (°F)	Temperature (°F)	Temperature (°F)	Temperature (°F)	Temperature (°F)
4	-	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
5	X-Axis	RMS Velocity (in/sec)	RMS Velocity (in/sec)	High-Frequency RMS Acceleration (G)	RMS Velocity (in/sec)	Full Bandwidth RMS Acceleration (G)	RMS Velocity (in/sec)

[2] User configurable if switch 7 is OFF; for input serial addresses, see *Modbus Registers and I/O Serial Addresses* (p. 5)

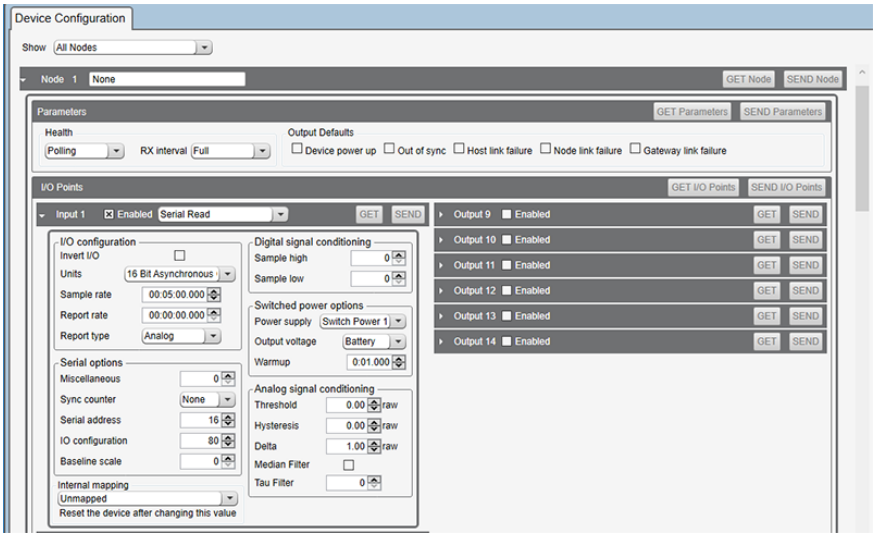
I/O Configurations (Set by DIP Switches 2, 3, and 4)							
Input Register		**Default I/O**	**I/O Configuration 1**	**I/O Configuration 2**	**I/O Configuration 3**	**I/O Configuration 4**	**I/O Configuration 5**
6		High-Frequency RMS Acceleration (G)	Peak Acceleration (G)	Peak Acceleration (G)	Peak Velocity Component Frequency (Hz)	Full Bandwidth Peak Acceleration (G)	Full Bandwidth RMS Acceleration (G)

If DIP switch 7 is on, all in/s units change to mm/s. DIP switch 7 will only switch units with DIP switch I/O configurations, not with any user configuration.

Configure the Q45 Using the User Configuration Software

The User Configuration Software offers an easy way to change sensor settings, show sensor data from different sensors, and retrieve data from the Gateway radio. The software runs on any Windows computer and uses an adapter cable to connect the Gateway to your computer.

Download the most recent version of the software from Banner Engineering's website: *www.bannerengineering.com/wireless*.



1. Go to the **Configuration** > **Device Configuration** screen.
2. On the top of the screen, select **Nodes Currently in the System** from the drop-down list and click **Get devices in system**.
   All Nodes bound to the Gateway connected to the computer display.
3. Click the arrow next to the Nodes to display the parameters specific to that Node.
   In this example, the parameters for Node 1 are shown.
4. Under the Node 1 I/O points section, click **GET I/O Points**.
   All I/O types for this Node are loaded onto the screen.
5. To view the parameters for an I/O point, click the arrow next to that I/O point.
   In this example, the parameters for I/O point 1 are shown.
6. To set the **Serial address**, go to the **Serial options** section of the I/O point's parameters and enter the value.
   In this example, the **Serial address** is set to 16 for output Z-Axis RMS Velocity (in/sec).
7. After making changes to the I/O point parameters, click **SEND** to send the changes to the network.
8. Repeat steps 5 and 8 for each input to manually change the configuration of the vibration parameters by changing the serial address.

For more information on using the User Configuration Software, refer to the instruction manual (p/n *140628*).

Modbus Registers and I/O Serial Addresses

I/O Serial Addresses					
Serial Address	**Output Type**	**I/O Range**		**Holding Register Representation**	
		Min	**Max**	**Min (Dec)**	**Max (Dec)**
16	Z-Axis RMS Velocity (in/sec) [1, 5]	0	6.5535	0	65535

I/O Serial Addresses					
Serial Address	Output Type	I/O Range		Holding Register Representation	
		Min	Max	Min (Dec)	Max (Dec)
25	Z-Axis High-Frequency RMS Acceleration [2, 5]	0	65.535	0	65535
-	Reserved	-	-	-	-
64	X-Axis RMS Velocity (in/sec) [1, 5]	0	6.5535	0	65535
73	X-Axis High-Frequency RMS Acceleration (G) [2, 5]	0	65.535	0	65535
20	Z-Axis Peak Acceleration (G) [2, 6]	0	65.535	0	65535
68	X-Axis Peak Acceleration (G) [2, 6]	0	65.535	0	65535
18	Z-Axis Peak Velocity Component Frequency (Hz) [4, 5]	0	6553.5	0	65535
66	X-Axis Peak Velocity Component Frequency (Hz) [4, 5]	0	6553.5	0	65535
19	Z-Axis RMS Acceleration (G) [2, 5]	0	65.535	0	65535
67	X-Axis RMS Acceleration (G) [2, 5]	0	65.535	0	65535
24	Z-Axis Kurtosis [2, 6]	0	65.535	0	65535
72	X-Axis Kurtosis [2, 6]	0	65.535	0	65535
37	Z-Axis Crest Factor [2, 6]	0	65.535	0	65535
69	X-Axis Crest Factor [2, 6]	0	65.535	0	65535
17	Z-Axis Peak Velocity (in/sec) [1, 5]	0	6.5535	0	65535
23	Z-Axis Peak Velocity (mm/sec) [1, 5]	0	65.535	0	65535
65	X-Axis Peak Velocity (in/sec) [1, 5]	0	6.5535	0	65535
71	X-Axis Peak Velocity (mm/sec) [1, 5]	0	65.535	0	65535
22	Z-Axis RMS Velocity (mm/sec) [2, 5]	0	65.535	0	65535
70	X-Axis RMS Velocity (mm/sec) [2, 5]	0	65.535	0	65535
27	Full Bandwidth RMS Acceleration Z-Axis (G) [2, 6]	0	65.535	0	65535
75	Full Bandwidth RMS Acceleration X-Axis (G) [2, 6]	0	65.535	0	65535
28	Full Bandwidth Peak Acceleration Z-Axis (G) [2, 7]	0	65.535	0	65535
76	Full Bandwidth Peak Acceleration X-Axis (G) [2, 7]	0	65.535	0	65535
192	Temperature (°C)[3]	–1638.4	1638.4	–32768	32767
193	Temperature (°F)[3]	–1638.4	1638.4	–32768	32767

[1] Value = Register value ÷ 10000
[2] Value = Register value ÷ 1000
[3] Value = Register value ÷ 20
[4] Value = Register value ÷ 10
[5] Measurement bandwidth = 10 Hz to 1 kHz
[6] Measurement bandwidth = 1 kHz to 4 kHz
[7] Measurement Bandwidth = 10 Hz to 4 kHz

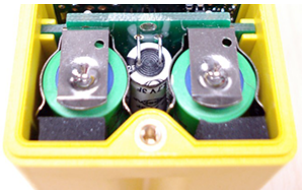
I/O #	Modbus Holding Register		I/O Type	I/O Range		Holding Register Representation	
	Gateway	Any Node		Min.	Max.	Min.	Max.
1	1	1 + (Node# × 16)	Sensor Input Register 1				
2	2	2 + (Node# × 16)	Sensor Input Register 2				
3	3	3 + (Node# × 16)	Sensor Input Register 3				
4	4	4 + (Node# × 16)	Sensor Input Register 4				
5	5	5 + (Node# × 16)	Sensor Input Register 5				
6	6	6 + (Node# × 16)	Sensor Input Register 6				
7	7	7 + (Node# × 16)	Reserved				
8	8	8 + (Node# × 16)	Device Message				
		...					
15	15	15 + (Node# × 16)	Control Message				
16	16	16 + (Node# × 16)	Reserved				

By default, data is supplied to the Node every five minutes, unless the Node requests the data sooner. The default configuration is shown and all optional outputs types are listed. Use the User Configuration Software to adjust the Sensor Register output type. For more information, see *Configure the Q45 Using the User Configuration Software* (p. 5).

Temperature values outside the operating range of the device are forced to the maximum or minimum values.

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 Q45VA 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 Q45VA housing.

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

Specifications

Performance Radio with Internal Antenna Specifications

Radio Range[3]
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: FCC Part 15, Subpart C, 15.247
IC: 7044A-RM1809

2.4 GHz Compliance
FCC ID UE300DX80-2400: FCC Part 15, Subpart C, 15.247
RED Directive 2014/53/EU
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)

Q45VA Sensor Specifications

Default Sensing Interval
5 minutes

Indicators
Red and green LEDs (radio function)

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

Shock
400G

Environmental Rating
NEMA 6P, IEC IP67

Typical Battery Life
See chart.

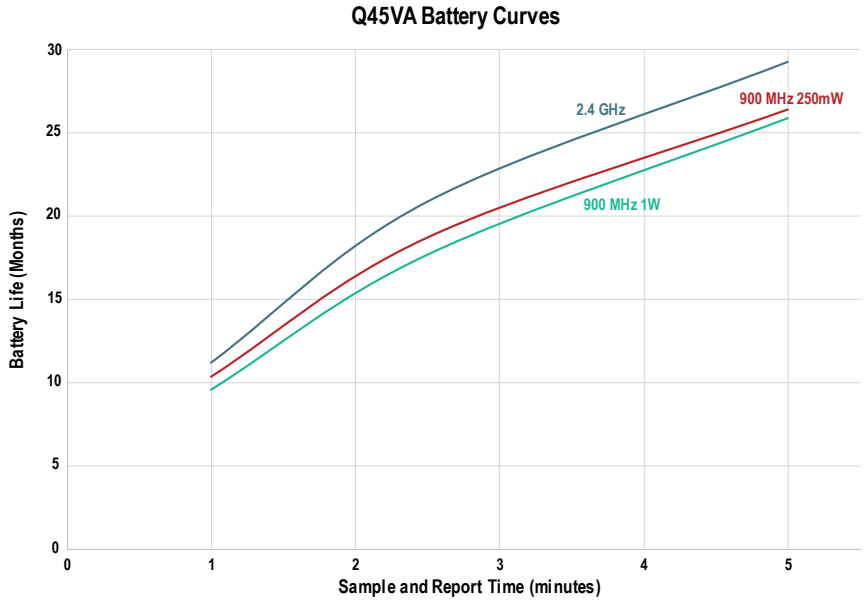
Vibration Sensor
Measuring Range: 0 to 46 mm/sec or 0 to 1.8 in/sec RMS
Frequency Range: 10 Hz to 4 kHz
Accuracy: ±10% at 25 °C
Sampling Frequency: 20 kHz (default)
Record Length: 8192 points (default)
Sample Duration: 0.4 s (default)

Temperature Sensor
Measuring Range: –40 °C to +105 °C (–40 °F to +221 °F)

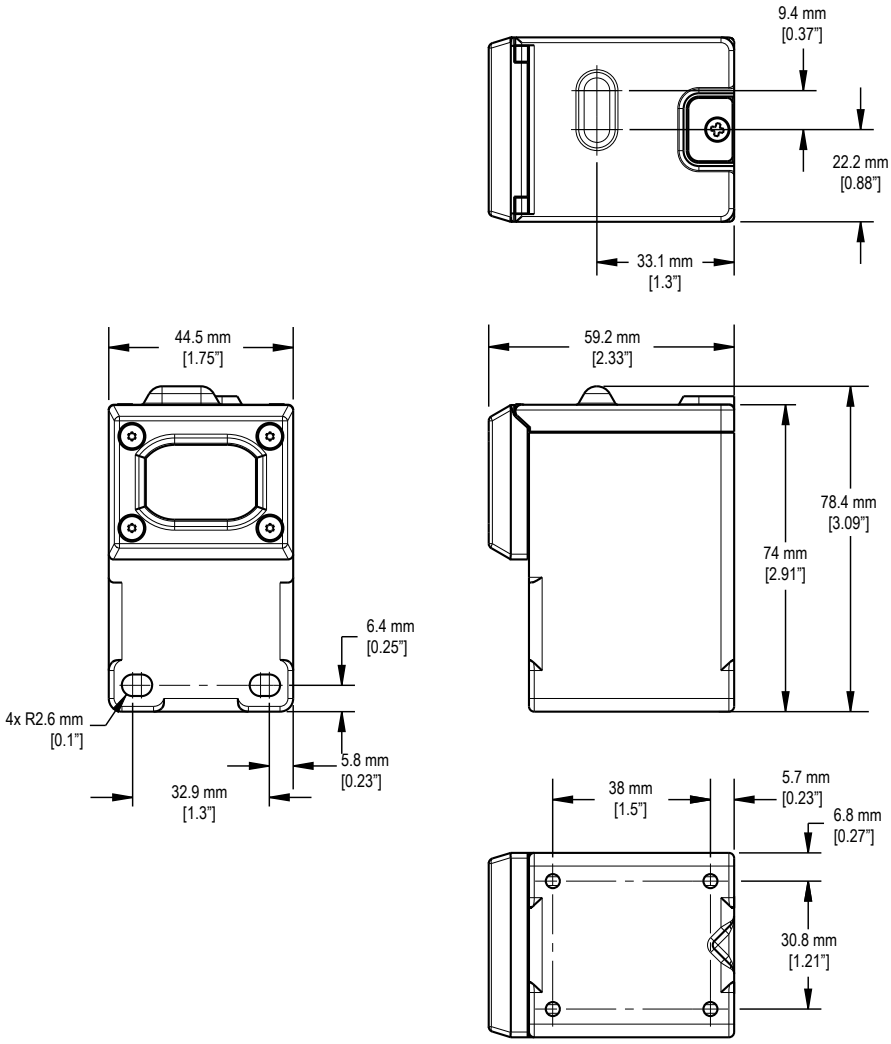
Operating Conditions
Ambient temperature: –40 °C to +70 °C (–40 °F to +158 °F)
Contact temperature: –40 °C to +105 °C (–40 °F to +221 °F)
90% at +50 °C maximum relative humidity (non-condensing)

[3] 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 for a Q45VA



Dimensions

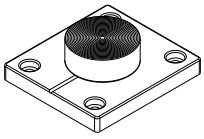


Accessories

Brackets

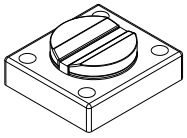
BWA-BK-009

- Mounts the device to a surface using adhesive
- Alignment mark indicates the front of device
- Includes a base plate, two screw retainers, four mounting screws, a set screw, and a mounting disc
- 44.5 mm × 49.5 mm
- For installation instructions, see Q45VA Bracket Assembly Quick Start Guide (p/n *208986*)



BWA-BK-010

- Includes a magnetic mounting bracket and four mounting screws
- 44.5 mm × 49.5 mm
- SmCo magnet with a 40 lb pull strength
- For use on flat or curved surfaces



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