Sure Cross® U-GAGE K50U Ultrasonic Sensor

Datasheet

The Sure Cross® K50U sensor works in a variety of environments to provide a measurement of the distance between the target and the sensor. It is designed for plug-and-play use with the Wireless Q45U Node (or any other Banner 1-wire serial node), creating a cost-effective and easy-to-use solution for monitoring remote or mobile tanks and totes.

Benefits

- Monitor wirelessly to avoid long cable runs
- Threaded housing for easy installation
- Easily monitor remote and mobile tanks and totes
- Completely wireless solution with 2+ year battery life at default sample rates



- Provides a distance measurement from the target to the sensor
- Built-in temperature compensation
- Rugged design for demanding sensing environments; rated IEC IP67, NEMA 6P
- Connects using a 1-wire serial interface
- Designed to work with FlexPower 1-Wire Serial Interface Node models DX80N9X1S-P6 and DX80N2X1S-P6, the 10 to 30 V dc powered 1-Wire Serial Interface Node models DX80N9X6S-P6 and DX80N2X6S-P6, MultiHop M-H6 and M-H6L radios, and Wireless Q45 Sensor Nodes DX80N2Q45U and DX80N9Q45U

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	Range and Frequency	Supply Voltage	I/O
K50UX1ARA	Range: 100 mm to 1 m (3.94 in to 39.4 in) Freq: 224 kHz	3.6 to 5.5 V dc or 10 to 30 V dc	Distance to target using a 1-wire serial interface
K50UX1CRA	Range: 300 mm to 3 m (11.8 in to 118 in) Freq: 114 kHz		

Overview

The K50U is an easy-to-use ultrasonic sensor with extended range and built-in temperature compensation. This sensor is designed to interface with a Node with 1-Wire Serial Interface. To install the sensor to either the serial Node or a cable, follow these instructions:

1. Align the notch in the Node's or cable's female connector with the key in the sensor's male connector.
2. Gently slide the sensor end into the Node's or cable's connector.
3. Rotate the Node's or cable's threaded nut to tighten the sensor down. DO NOT attempt to rotate the sensor after it is connected to the Node's serial port or the cable end, this will damage the sensor.

Indicator LEDs communicate the status of the sensor. The flashing green Power LED indicates the sensor is in Run Mode (the sensor's normal operating condition).

Configure this sensor using the Sure Cross® *Sensor Configuration Tool* (instruction manual *170002*) and adapter cable BWA-USB1WIRE-001 (datasheet *170020*).

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**

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ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

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 K50U 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.

LED Indicators

	Signal LED (red)	Power LED (green)
Power is Off		Off
Sensor is operating normally (power is on, sensor is in Run mode)		Flashing
Serial Communications Transmit/Receive	Intermittent Flashing	
Error	Continuous Flashing	
Reserved	Off	

Self-Diagnostic Error Mode—In the unlikely event of a microprocessor memory error, the Signal LED continuously flashes. If this occurs, the setup parameters have been lost and the sensor may be corrupt. Contact your Banner representative for further information.

Sensor Configuration Tool

The Sensor Configuration Tool offers an easy way to manage sensor parameters, retrieve data, and visually show sensor data from a number of different sensors. The Sensor Configuration Tool software runs on any Windows machine and uses an adapter cable to connect the sensor to your computer.

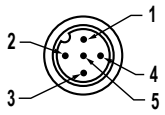
Download the most recent version of the Sensor Configuration Tool from Banner Engineering's website: *www.bannerengineering.com/wireless*. The Sensor Configuration Tool currently supports the following sensors:

Sensor Type	Model	USB Adapter Cable
Temperature and Humidity	M12FTH3Q and M12FT3Q	Model BWA-HW-006: USB-to-RS-485 adapter cable OR Model BWA-UCT-900: USB to RS-485 adapter cable
	M12FTH4Q and M12FT4Q	Model BWA-USB1WIRE-001: USB-to-RS-232 1-Wire adapter cable
Vibration and Temperature	QM42VT1	Model BWA-USB1WIRE-001: USB-to-RS-232 1-Wire adapter cable
	QM42VT2	Model BWA-HW-006: USB-to-RS-485 adapter cable OR Model BWA-UCT-900: USB to RS-485 adapter cable OR When updating the firmware, you must use one of the two USB to RS-485 adapter cables plus a splitter pigtail cable p/n 83265

Sensor Type	Model	USB Adapter Cable
GPS	GPS50M	Model BWA-HW-006: USB-to-RS-485 adapter cable AND a field-wireable M12/Euro-style connector or connecter with pigtail OR Model BWA-UCT-900: USB to RS-485 adapter cable AND a field-wireable M12/Euro-style connector or connecter with pigtail
U-GAGE K50U Ultrasonic	K50UX1CRA	Model BWA-USB1WIRE-001: USB-to-RS-232 1-Wire adapter cable
	K50UX2CRA	Model BWA-HW-006: USB-to-RS-485 adapter cable OR Model BWA-UCT-900: USB to RS-485 adapter cable
	K50UX1ARA	Model BWA-USB1WIRE-001: USB-to-RS-232 1-Wire adapter cable
	K50UX2ARA	Model BWA-HW-006: USB-to-RS-485 adapter cable OR Model BWA-UCT-900: USB to RS-485 adapter cable

Wiring

This sensor is designed to be plugged directly into compatible Nodes. The Node powers the sensor and periodically requests data using the 1-wire serial interface. Refer to the Class I Division 2 control drawings (p/n *143086*) for wiring specifications or limitations.

5-pin M12/Euro-style Connector (Male)	Pin	Wire Color	Sensor Connection
	1	Brown	Power IN (+), 3.6 to 5.5 V dc
	2	White	1-Wire serial device select (sinking input to sensing device)
	3	Blue	Ground (-)
	4	Black	Not used/reserved
	5	Gray	1-Wire serial communications

Holding Registers

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

Sensor Register	Output Type	I/O Range		Holding Register Representation	
		Min	Max	Min (Dec)	Max (Dec)
1	Distance (mm)	0	65535	0	65535
2	Temp °C	–1638.4	1638.3	–32768	32767
3	Temp °F	–1638.4	1638.3	–32768	32767
4	Distance (in)	0	655.35	0	65535

Distance readings below 250 mm (9.84 in) for model K50UX1CRA and below 75 mm (2.95 in) for model K50UX1ARA 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.

Specifications

Supply Voltage
3.6 to 5.5 V dc or 10 to 30 V dc

Current
Default sensing: 180 µA
Disabled sensing: 40 µA
Active comms: 3.3 mA

Construction
Housing: PBT polyester
Transducer: epoxy/ceramic composite

Indicators
Two LEDs

Connection
Integral 5-pin M12/Euro-style male quick disconnect

K50UX1CRA 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)

K50UX1ARA Performance

Sensing range: 100 mm to 1 m (3.94 in to 39.4 in)
Ultrasonic frequency: 224 kHz
Temperature effect: 0.02% of distance/°C
Resolution: 0.1% of distance (1.5 mm minimum)

Communication Hardware

1-wire serial interface
Baud Rates: 9.6k, 19.2k (default), or 38.4k
Data Format: 8 data bits, No parity (default), even parity, or odd parity
1 stop bit

Communication Protocol

Sure Cross DX80 Sensor Node 1-Wire Serial Interface

Communications Line

Level Receive ON: Greater than 2 V
Level Receive OFF: Less than 0.7 V
Level Transmit ON: 2.7 to 3 V
Level Transmit OFF: 0 V (pulldown resistor of 10 kOhm)

Environmental Rating[1]

Leakproof design, rated IEC IP67 (NEMA 6)

Operating Conditions

–40 °C to +70 °C (–40 °F to +158 °F)
95% at +50 °C maximum relative humidity (non-condensing)

Discrete Inputs

One Sinking
Rating: 3 mA max current at 30 V dc
ON Condition: Less than 0.7 V
OFF Condition: Greater than 2 V or open

Discrete Outputs

Discrete Outputs. One NMOS Sinking (Not used)
Discrete Output Rating: Less than 10 mA maximum current at 30 V; ON-State Saturation: Less than 0.7 V at 20 mA
Discrete Output ON Condition. Less than 0.7 V
Discrete Output OFF Condition. Open

Compatible Nodes

900 MHz Models	2.4 GHz Models
DX80N9X1S-P6	DX80N2X1S-P6
DX80N9X6S-P6	DX80N2X6S-P6
DX80DR9M-H6 and -H6L	DX80DR2M-H6 and -H6L
DX80N9Q45U	DX80N2Q45U

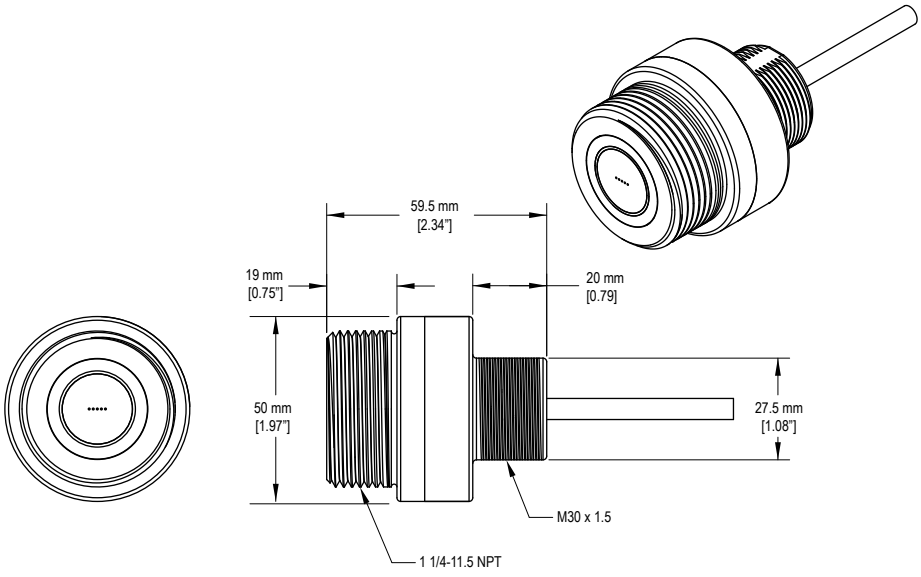
Vibration and Mechanical Shock

All models meet MIL-STD-202F, Method 201A (Vibration: 10 Hz to 60 Hz maximum, 0.06 inch (1.52 mm) double amplitude, 10G maximum acceleration) requirements. Also meets IEC 60947-5-2 (Shock: 30G 11 ms duration, half sine wave) requirements.

Certifications

CE

Dimensions



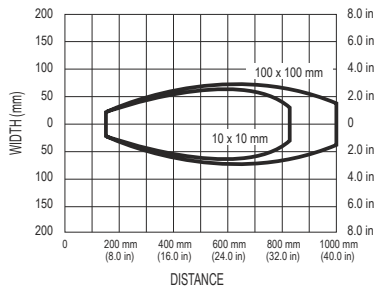
All measurements are listed in millimeters [inches], unless noted otherwise.

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

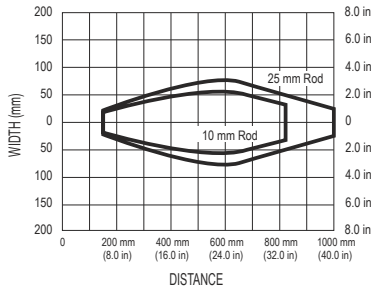
Performance Curves

1 Meter Models

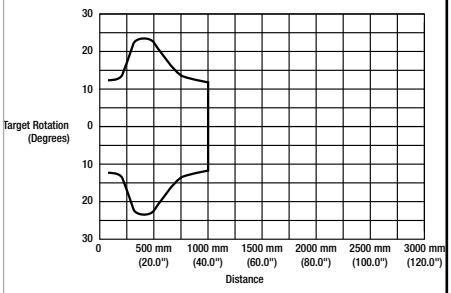
With Plate Target (Typical)



With Rod Target (Typical)

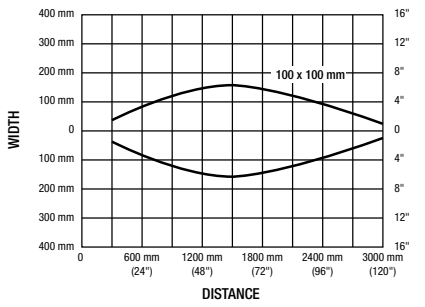


Maximum Target Rotation Angle

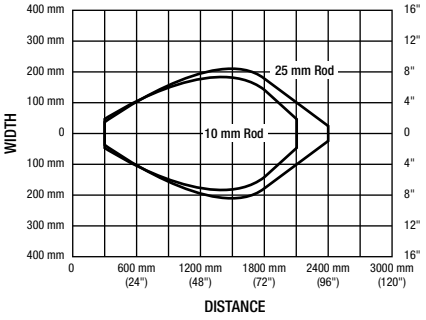


3 Meter Models

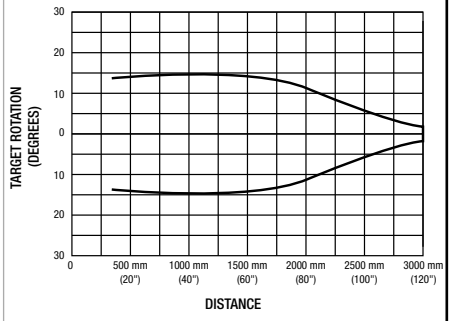
With Plate Target (Typical)



With Rod Target (Typical)



Maximum Target Rotation Angle

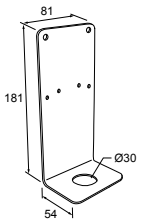


Accessories

Brackets

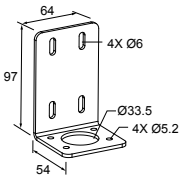
BWA-BK-004

- Mounts both the K50U Ultrasonic sensor and a Wireless Q45U Node or DX80 Node



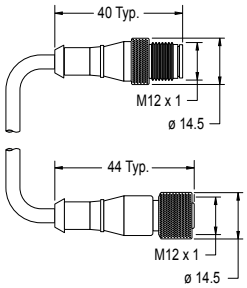
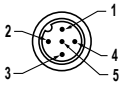
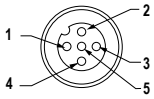
BWA-BK-006

- Mounts both the K50U Ultrasonic sensor and a Wireless Q45U Node



Euro-Style Cordsets - Double Ended

When using the FlexPower Node with integrated battery, use a double ended cordset. When using a FlexPower Node with external power supply, use a single ended cordset. **If using the communication lines, the cable length cannot exceed 3 meters (10 ft).**

5-Pin Threaded M12/Euro-Style Cordsets—Double Ended and Less Than 3 m Long				
Model	**Length**	**Style**	**Dimensions**	**Pinout**
DEE2R-51D	0.31 m (1 ft)	Female Straight/ Male Straight		Male  Female  1 = Brown 2 = White 3 = Blue 4 = Black 5 = Green/Yellow
DEE2R-53D	0.91 m (3 ft)			
DEE2R-58D	2.44 m (8 ft)			

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