Sure Cross® MultiHop H1E-NB-KR Data Radio

Datasheet

The Sure Cross® wireless system is a radio frequency network with integrated I/O that operates in most environments to eliminate the need for wiring runs. Wireless MultiHop data radio networks are formed around a MultiHop master and one or more slaves and extend the range of a Modbus or other serial communication network.

- Wireless industrial I/O device with four sinking discrete inputs, two NMOS discrete outputs, two analog (0–20 mA) inputs, one thermistor input, one counter input, and two switch power outputs
- *Flex*Power® power options allow for 10 to 30 V dc, solar, and battery power sources for low power applications.
- Self-healing, auto-routing RF network with multiple hops extends the network's range
- Serial and I/O communication on a Modbus platform
- Message routing improves link performance
- DIP switches select operational modes: master, repeater, or slave
- Built-in site survey mode enables rapid assessment of a location's RF transmission properties
- Frequency Hopping Spread Spectrum (FHSS) technology ensures reliable data delivery within the unlicensed Industrial, Scientific, and Medical (ISM) band

For additional information, updated documentation, and a list of accessories, refer to Banner Engineering's website, *www.bannerengineering.com/wireless*.

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.

Models

Model	Frequency	Power	Housing	I/O
DX80DR2M-H1E-NB-KR	2.4 GHz ISM Band	10 to 30 V dc or integrated battery (ships without the battery)	IEC IP65, NEMA 4X	**Inputs**: Four sinking discrete, two 0 to 20 mA analog, one thermistor, one sinking counter **Outputs**: Two NMOS discrete, two switch power **Serial interface**: RS-485

Configuration Instructions

Setting Up Your MultiHop Network

To set up and install your wireless MultiHop network, follow these steps:

1. If your radios have DIP switches, configure the DIP switches of all devices.
2. Connect the sensors to the MultiHop radios if applicable.
3. Apply power to all devices.
4. If your MultiHop radio has rotary dials, set the MultiHop Radio (Slave) ID. If your MultiHop radio has no rotary dials, continue to the next step.
5. Form the wireless network by binding the slave and repeater radios to the master radio. If the binding instructions are not included in this datasheet, refer to the quick start guide or product manual.
6. Observe the LED behavior to verify the devices are communicating with each other.
7. Configure any I/O points to use the sensors connected to the Sure Cross devices.
8. Conduct a site survey between the MultiHop radios. If the site survey instructions are not included in this datasheet, refer to the product manual.

9. Install your wireless sensor network components. If the installation instructions are not included in this datasheet, refer to the product manual.

For additional information, refer to one of the following documents:

- MultiHop Data Radio Quick Start Guide: *152653*
- MultiHop Data Radio Instruction Manual: *151317*
- MultiHop Register Guide (End User Edition): *155289*

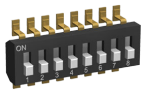
Configure the DIP Switches

Before changing DIP switch positions, disconnect the power. For devices with batteries integrated into the housing, remove the battery(ies) for at least one minute. DIP switch changes are not recognized until after power is cycled to the device.

Accessing the Internal DIP Switches

To access the internal DIP switches, follow these steps:

1. Unscrew the four screws that mount the cover to the bottom housing.
2. Remove the cover from the housing without damaging the ribbon cable or the pins the cable plugs into.
3. Gently unplug the ribbon cable from the board mounted into the bottom housing. For integrated battery models (no ribbon cable) and Class I, Division 2 certified devices (ribbon cable is glued down), skip this step.
4. Remove the black cover plate from the bottom of the device's cover.
   The DIP switches are located behind the rotary dials.



After making the necessary changes to the DIP switches, place the black cover plate back into position and gently push into place. Plug the ribbon cable in after verifying that the blocked hole lines up with the missing pin. Mount the cover back onto the housing.

DIP Switch Settings (MultiHop)

	Switches							
Device Settings	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Serial line baud rate 19200 OR User defined receiver slots	OFF [1]	OFF [1]						
Serial line baud rate 38400 OR 32 receiver slots	OFF	ON						
Serial line baud rate 9600 OR 128 receiver slots	ON	OFF						
Serial line baud rate Custom OR 4 receiver slots	ON [2]	ON [2]						
Parity: None			OFF [1]	OFF [1]				
Parity: Even			OFF	ON				
Parity: Odd			ON	OFF				
Disable serial (low power mode) and enable the receiver slots select for switches 1-2			ON [2]	ON [2]				
Transmit power 900 MHz radios: 1.00 Watt (30 dBm) 2.4 GHz radios: 0.065 Watts (18 dBm) and 60 ms frame					OFF [1]			
Transmit power 900 MHz radios: 0.25 Watts (24 dBm) 2.4 GHz radios: 0.065 Watts (18 dBm) and 40 ms frame					ON			
Application mode: Modbus						OFF [1]		
Application mode: Transparent						ON		
MultiHop radio setting: Repeater							OFF [1]	OFF [1]
MultiHop radio setting: Master							OFF	ON
MultiHop radio setting: Slave							ON [2]	OFF [2]
MultiHop radio setting: Reserved							ON	ON

[1] Default configuration

[2] Default configuration for the E housing models only

Application Mode

The MultiHop radio operates in either Modbus mode or transparent mode. Use the internal DIP switches to select the mode of operation. All MultiHop radios within a wireless network must be in the same mode.

Modbus mode uses the Modbus protocol for routing packets. In Modbus mode, a routing table is stored in each parent device to optimize the radio traffic. This allows for point to point communication in a multiple data radio network and acknowledgement/retry of radio packets. To access a radio's I/O, the radios must be running in Modbus mode.

In **transparent** application mode, all incoming packets are stored, then broadcast to all connected data radios. The data communication is packet based and not specific to any protocol. The application layer is responsible for data integrity. For one to one data radios it is possible to enable broadcast acknowledgement of the data packets to provide better throughput. In transparent mode, there is no access to the radio's I/O.

Baud Rate and Parity

The baud rate (bits per second) is the data transmission rate between the device and whatever it is physically wired to. Set the parity to match the parity of the device you are wired to.

Disable Serial

If the local serial connection is not needed, disable it to reduce the power consumption of a data radio powered from the solar assembly or from batteries. All radio communications remain operational.

Receiver Slots

The number of receiver slots indicates the number of times out of 128 slots/frames the radio can transmit to its parent radio. Setting a slave's receiver slots to 4 reduces the total power consumption by establishing that the slave can only transmit to its parent four times per 128 slots.

Transmit Power Levels/Frame Size

The 900 MHz data radios can be operated at 1 watt (30 dBm) or 0.250 watt (24 dBm). For most models, the default transmit power is 1 watt.

For 2.4 GHz radios, the transmit power is fixed at 0.065 watt (18 dBm) and DIP switch 5 is used to set the frame timing. The default position (OFF) sets the frame timing to 60 milliseconds. To increase throughput, set the frame timing to 40 milliseconds. Note that increasing the throughput decreases the battery life.

Prior to date code 15341 and radio firmware version 3.6, the frame timing was 40 ms (OFF) or 20 ms (ON).

Wire Your Sure Cross® Device

Use the following wiring diagrams to first wire the sensors and then apply power to the Sure Cross devices.

Wiring for DX80...E Radios

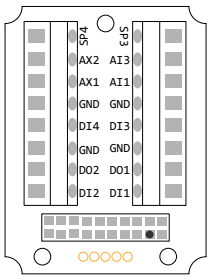
Connecting power to the communication pins will cause permanent damage. The integrated battery DX80...E radios may also be powered by 10 V dc to 30 V dc. The power for the sensors can be supplied by the radio's SPx terminals or from the 10 V dc to 30 V dc used to power the radio. The BAT connection is a low voltage connection to the internal battery. Remove the internal battery if a low voltage source is connected to the BAT terminal. When powering the device from the integrated battery, the BAT connection must remain open.

		Integrated battery (RS-485) for P1E, M-H1E, M-H12E, and P16E Models	Integrated battery (RS-232) for P3E, P4E, M-H3E, and M-H4E Models
	1	10 V dc to 30 V dc (optional)	10 V dc to 30 V dc (optional)
	2	RS-485 / D1 / B / +	RS-232 Tx
	3	dc common (GND)	dc common (GND)
	4	RS-485 / D0 / A / -	RS-232 Rx

Terminal Blocks and Wiring for M-H1 Models

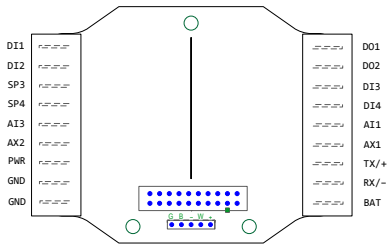
Connecting power to the communication pins will cause permanent damage. For the DX8*x*...C models, PWR in the wiring diagram refers to V+ on the wiring board and GND in the wiring diagram refers to V- on the wiring board. Do not exceed analog input ratings for analog inputs. Only connect sensor outputs to analog inputs. Refer to the Class I Division 2/Zone 2 control drawings (p/n *143086*) for wiring specifications and limitations.

M-H1



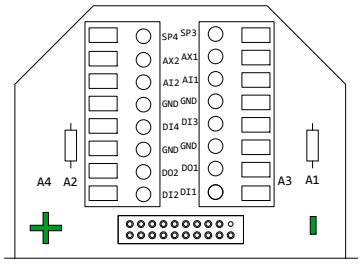
AI*x* or A*x*. Analog IN *x*
AX1. Counter IN.
AX2. Thermistor IN.
DI*x*. Discrete IN *x*
DO*x*. Discrete OUT *x*

M-H1C



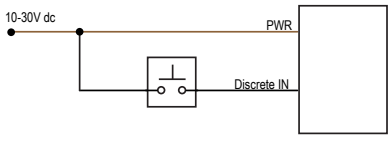
B+. 3.6 to 5.5 V dc (use for battery powered models only)
RX/-. Serial communication line for the Gateway. No connection for Nodes
TX/+. Serial communication line for the Gateway; no connection for Nodes

M-H1E

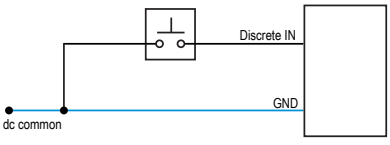


GND. Ground/dc common connection
PWR. 10 to 30 V dc power connection
SP*x*. Switch Power; provides variable power sources for external devices

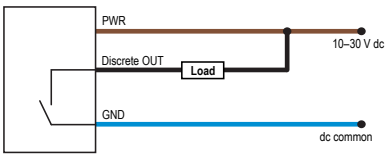
Discrete Input Wiring for PNP Sensors



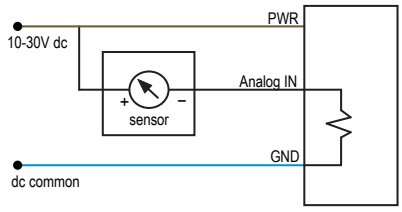
Discrete Input Wiring for NPN Sensors



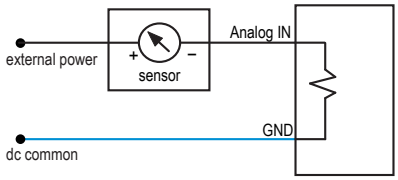
Discrete Output Wiring (NPN or NMOS)



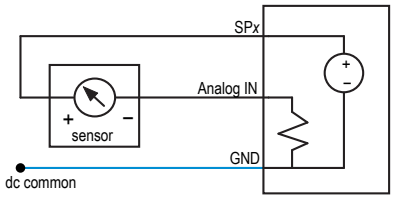
Analog Input Wiring (10–30 V dc Power)



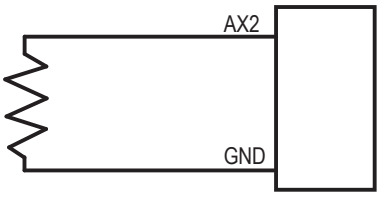
Analog Input Wiring (4–20 mA, 2-Wire, Externally-Powered Sensors)



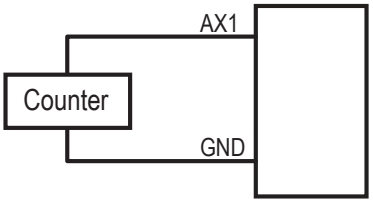
Analog Input Wiring (4–20 mA, 2-Wire, Switch-Powered Sensors) [1]



Thermistor Inputs



Counter Inputs

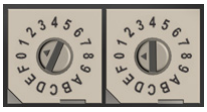


Set the MultiHop Radio (Slave) ID

On a MultiHop radio, use the rotary dials to set the device's MultiHop Radio ID.

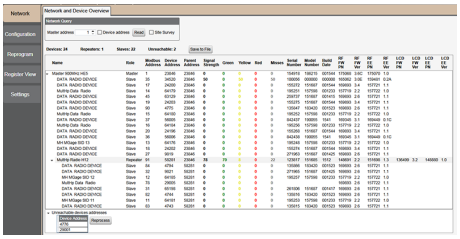
Modbus Slave IDs 01 through 10 are reserved for slaves directly connected to the host (local I/O). Polling messages addressed to these devices are not relayed over the wireless link. Use Modbus Slave IDs 11 through 60 for MultiHop master, repeater, and slave radios. Up to 50 devices (local slaves and remote slaves) may be used in this system.

With the left dial acting as the left digit and the right dial acting as the right digit, the MultiHop Radio ID can be set from 01 through 60.



MultiHop Configuration Software

Use Banner's MultiHop Configuration Software to view your MultiHop radio network and configure the radio and its I/O.



The software connects to a MultiHop master radio using one of four methods.

- Serial; using a USB to RS-485 (for RS-485 radios) or a USB to RS-232 (for RS-232 radios) converter cable.
- Modbus TCP; using an Ethernet connection to an Ethernet radio master.
- Serial DXM; using a USB cable to a DXM Controller to access a MultiHop master radio.
- TCP DXM: using an Ethernet connection to a DXM Controller to access a MultiHop master radio.

For MultiHop DX80DR* models, Banner recommends using BWA-UCT-900, an RS-485 to USB adapter cable with a wall plug that can power your 1 Watt MultiHop radio while you configure it. The adapter cable is not required when connecting to a DXM Controller.

Download the most recent software revision from the Wireless Reference Library on Banner Engineering's website: *www.bannerengineering.com*.

Installing Your Sure Cross® Radios

Please refer to one of the following instruction manuals for details about successfully installing your wireless network components.

- MultiHop Data Radio Instruction Manual: *151317*

Modbus Registers

Register (4xxxx)	Input #	Input Type	Units	I/O Range		Holding Register Representation		Terminal Block Labels
				Min. Value	Max. Value	Min. (Dec.)	Max. (Dec.)	
1	1	Discrete IN 1	-	0	1	0	1	DI1
2	2	Discrete IN 2	-	0	1	0	1	DI2
3	3	Discrete IN 3	-	0	1	0	1	DI3
4	4	Discrete IN 4	-	0	1	0	1	DI4

[1] Only possible in models with switch power (SPx) outputs.

Register (4xxxx)	Input #	Input Type	Units	I/O Range		Holding Register Representation		Terminal Block Labels
				Min. Value	Max. Value	Min. (Dec.)	Max. (Dec.)	
5	5	Analog IN 1	mA	0.0	20.0	0	65535	AI1
6	6							
7	7	Analog IN 3	mA	0.0	20.0	0	65535	AI3
8	8	Thermistor	°F	-1638.3	+1638.4	-32768	32767	AX2
9	9	Counter IN 1	MSW [2]	0	65535	0	65535	AX1
10			LSW [3]	0	65535	0	65535	

Register (4xxxx)	Output #	Output Type	Units	I/O Range		Holding Register Representation		Terminal Block Labels
				Min. Value	Max. Value	Min. (Dec.)	Max. (Dec.)	
501	1	Discrete OUT 1	-	0	1	0	1	DO1
502	2	Discrete OUT 2	-	0	1	0	1	DO2
503	3							
504	4							
505	5	Switch Power 3						SP3
506	6	Switch Power 4						SP4

Modbus Addressing Convention

All Modbus addresses refer to Modbus holding registers. When writing your own Modbus scripts, use the appropriate commands for interfacing to holding registers. Parameter description headings refer to addresses in the range of 40000 as is customary with Modbus convention.

Modbus Register Configuration

Change the factory default settings for the inputs, outputs, and device operations using the device Modbus registers. To change parameters, set the data radio network to Modbus mode and assign the data radio a valid Modbus slave ID.

Generic input or output parameters are grouped together based on the device input or output number: input 1, input 2, output 1 etc. Operation type specific parameters (discrete, counter, analog 4 to 20 mA) are grouped together based on the I/O type number: analog 1, analog 2, counter 1, etc. Not all inputs or outputs may be available for all models. To determine which specific I/O is available on your model, refer to the Modbus Input/Output Register Maps listed in the device's datasheet. For more information about registers, refer to the MultiHop Product Manual (p/n *151317*).

Factory Default Configuration

Discrete Inputs (NPN)

Enable	Sample	Boost Enable	Boost Warmup	Boost Voltage	Extended Input Read	NPN/PNP	Sample High	Sample Low
ON	40 ms	OFF	OFF	OFF	OFF	NPN	OFF	OFF

Analog Inputs

Enable	Sample	Boost Enable	Boost Warmup	Boost Voltage	Extended Input Read	Analog Max	Analog Min	Enable Fullscale
ON	1 sec	OFF	OFF	OFF	OFF	20000	0	ON

Thermistor Inputs

Enable	Sample	Boost Enable	Boost Warmup	Boost Voltage	Extended Input Read	Analog Max	Analog Min	Enable Fullscale	Enable Deg F	Temp Scaling
ON	1 sec	OFF	OFF	OFF	OFF	32767	-32768	OFF	Deg F	× 20

Counter Inputs

Enable	Sample	Boost Enable	Boost Warmup	Boost Voltage	Extended Input Read	Freq or Event Counter
ON	1 sec	OFF	OFF	OFF	OFF	Event

[2] Most Significant Word
[3] Least Significant Word

Discrete Outputs

Enable	Flash Enable
ON	OFF

Switch Power

I/O Group	Continuous Voltage	Default Output Voltage	Hold Last Voltage Enable
Switch Power (all)	0	0	OFF

Storage and Sleep Modes

Storage Mode (applies to battery-powered models only)—While in **storage mode**, the radio does not operate. All Sure Cross® radios powered from an integrated battery ship from the factory in storage mode to conserve the battery. To wake the device, press and hold button 1 for 5 seconds. To put any *Flex*Power® or integrated battery Sure Cross radio into storage mode, press and hold button 1 for 5 seconds. The radio is in storage mode when the LEDs stop blinking, but in some models, the LCD remains on for an additional minute after the radio enters storage mode. After a device has entered storage mode, you must wait 1 minute before waking it.

Sleep Mode (applies to both battery and 10–30 V dc powered models)—During normal operation, the Sure Cross radio devices enter **sleep mode** after 15 minutes of operation. The radio continues to function, but the LCD goes blank. To wake the device, press any button.

Installing or Replacing the Battery (DX80...E Models)

To replace the lithium "D" cell battery in any integrated housing model, follow these steps.

1. Remove the four screws mounting the face plate to the housing and remove the face plate. Do not remove the radio cover from the face plate.
2. Remove the discharged battery and replace with a new battery.
   Only use a 3.6 V lithium battery (see list below).
3. 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.
4. After replacing the battery, allow up to 60 seconds for the device to power up.

For outside or high humidity environments, dielectric grease may be applied to the battery terminals to prevent moisture and corrosion buildup.

Properly dispose of your used battery 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. 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.

For hazardous or non-hazardous locations, the replacement battery model number is BWA-BATT-001 (Xeno model number XL-205F). For non-hazardous locations only, the replacement battery model number is BWA-BATT-011. For pricing and availability, contact Banner Engineering.

Specifications

MultiHop 2.4 GHz Korean Radio Specifications

Radio Range[4]
2.4 GHz, 65 mW: Up to 3.2 km (2 miles)

Antenna Minimum Separation Distance
2.4 GHz, 65 mW: 0.3 m (1 ft)

Radio Transmit Power
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)

2.4 GHz Compliance for Korean Radio Models
KCC-CRM-BE2-DX

Antenna Connection
Ext. Reverse Polarity SMA, 50 Ohms
Max Tightening Torque: 0.45 N·m (4 lbf·in)

Radio Packet Size (MultiHop)
2.4 GHz: 75 bytes (37 Modbus registers)

RS-485 Communication Specifications

Communication Hardware (MultiHop RS-485)
Interface: 2-wire half-duplex RS-485
Baud rates: 9.6k, 19.2k (default), or 38.4k via DIP switches; 1200 and 2400 via the MultiHop Configuration Tool
Data format: 8 data bits, no parity, 1 stop bit

[4] Radio range is with the 2 dB antenna that ships with the product. High-gain antennas are available, but the range depends on the environment and line of sight. Always verify your wireless network's range by performing a Site Survey.

MultiHop H1E-NB-KR Specifications

Supply Voltage
3.6 V dc low power option from an internal battery or 10 to 30 V dc

Power Consumption
Master radio consumption (900 MHz): Maximum current draw is < 100 mA and typical current draw is < 30 mA at 24 V dc. (2.4 GHz consumption is less.)
Repeater/slave radio consumption (900 MHz): Maximum current draw is < 40 mA and typical current draw is < 20 mA at 24 V dc. (2.4 GHz consumption is less.)

Discrete Inputs
Rating: 3 mA max current at 30 V dc
Sample Rate: 40 milliseconds
ON Condition (NPN): Less than 0.7 V
OFF Condition (NPN): Greater than 2 V or open

Counter Inputs
Event counter: Input rating 1 Hz to 10 kHz (For battery powered devices, the recommended input rating is less than 1 kHz)
Rate (frequency) counter: 1 Hz to 25 kHz
Threshold: 1.7 V

Analog Inputs
Rating: 24 mA
Impedance: Approximately 22 Ohms[5]
Sample Rate: 1 second
Accuracy: 0.1% of full scale +0.01% per °C
Resolution: 12-bit

Housing
Polycarbonate housing and rotary dial cover; polyester labels; EDPM rubber cover gasket; nitrile rubber, non-sulphur cured button covers
Weight: 0.26 kg (0.57 lbs)
Mounting: 1/4-inch or M7 (SS M7 hardware included)
Max. Tightening Torque: 0.56 N·m (5 lbf·in)

Interface
Two bi-color LED indicators, Two buttons, Six character LCD

Wiring Access
Two 1/2-inch NPT ports

Thermistor Input (MultiHop)
Model: Omega's 44006 or 44031 family of 10 kOhm thermistors
Sample Rate: 1 second
Accuracy: 0.4 °C (10 °C to 50 °C); Up to 0.8 °C (–40 °C to 85 °C)

Discrete Output Rating (MultiHop NMOS)
Less than 1 A max current at 30 V dc
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

Certifications

CE

Environmental Specifications for the E Housing

Operating Conditions
–40 °C to +85 °C (–40 °F to +185 °F) (Electronics); –20 °C to +80 °C (–4 °F to +176 °F) (LCD)
95% maximum relative humidity (non-condensing)
Radiated Immunity: 10 V/m (EN 61000-4-3)

Shock and Vibration
IEC 68-2-6 and IEC 68-2-27
Shock: 30g, 11 millisecond half sine wave, 18 shocks
Vibration: 0.5 mm p-p, 10 to 60 Hz

Environmental Ratings
IEC IP65
Refer to the Sure Cross® MultiHop Product Instruction Manual (p/n *151317*) for installation and waterproofing instructions.

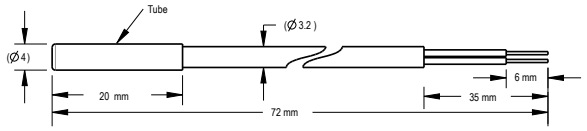
Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.

Accessories

Thermistor Probes

BWA-THERMISTOR-PROBE-001

- Temperature sensor with thermistor PS103G2
- Beta Value(K) 0 ~50°C: 3575
- Base thermistor accuracy of 0.2%
- Operating Temperature Range: –20 °C to +105 °C
- Maximum Power Rating: 30 mW at 25 °C; derated to 1 mW at 125 °C
- Dissipation Constant: 1 mW/°C
- Plated nickel finish; PVC insulation



Included with the DX80..E Models

- Mounting hardware kit
- BWA-HW-003: PTFE tape
- BWA-9O2-C (900 MHz) or BWA-2O2-C (2.4 GHz): Antenna, 2 dBd Omni, Rubber Swivel RP-SMA Male. (Not included with Internal antenna models)
- BWA-BATT-001: Replacement battery, 3.6 Volt, "D" Lithium Cell
- BWA-HW-032: Access Hardware for "E" Housing (One each of 1/2-inch plug, 1/2-inch gland)
- Product datasheet and product family Quick Start Guide (*128185* for DX80 Gateways or *152653* for MultiHop models)

[5] To verify the analog input's impedance, use an Ohm meter to measure the resistance between the analog input terminal (AI*x*) and the ground (GND) terminal.