SureCross MultiHop Radio

Configurable FlexPower MultiHop Radio with discrete, analog, counter, and SDI-12 I/O

SureCross® MultiHop data radios are wireless industrial communication devices used to extend the range of a Modbus or other serial communication network.

- Wireless industrial I/O device with two sinking discrete inputs, two NMOS discrete outputs, two 0 to 20 mA analog inputs, one thermistor input, one counter or SDI-12 input, and two switch power outputs
- Selectable transmit power levels of 250 mW or 1 Watt and license-free operation up to 4 watt EIRP, with a high-gain antenna, in the U.S. and Canada for 900 MHz
- *Flex*Power® power options allows for +10 to 30V dc, solar, and battery power sources for low power applications.
- Configurable for latching relay driver mode; provides boosted power for an H-Bridge solenoid
- 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
- FHSS radios operate and synchronize automatically; selectable network IDs reduce interference from collocated networks

For additional information, the most recent version of all documentation, and a complete list of accessories, refer to Banner Engineering's website, *www.bannerengineering.com/surecross*.

			I/O	
Models	**Freq.**	**Transmit Power**	**SDI-12 Configuration**	**H-Bridge Configuration**
DX80DR9M-H12	900 MHz ISM Band	250 mW or 1 Watt (DIP switch selectable)	**Inputs**: Two sinking discrete, two 0 to 20 analog , one thermistor, and two SDI-12 **Outputs**: Two NMOS discrete **Switch Power**: Two (for SDI-12) **Serial interface**: RS-485	**Inputs**: Two sinking discrete, two 0 to 20 analog , one thermistor, and one sinking counter **Outputs for H-Bridge**: Two NMOS discrete and two switch power **Serial interface**: RS-485
DX80DR2M-H12	2.4 GHz ISM Band	65 mW (100 mW EIRP)		

DX80...C (IP20; NEMA 1) models are also available. To order this model with an IP20 housing, add a C to the end of the model number: DX80DR9M-H12C.

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.

Important: Never Operate 1 Watt Radios Without Antennas.
To avoid damaging the radio circuitry, never power up SureCross Performance or SureCross MultiHop (1 Watt) radios without an antenna.

MultiHop Radio Overview

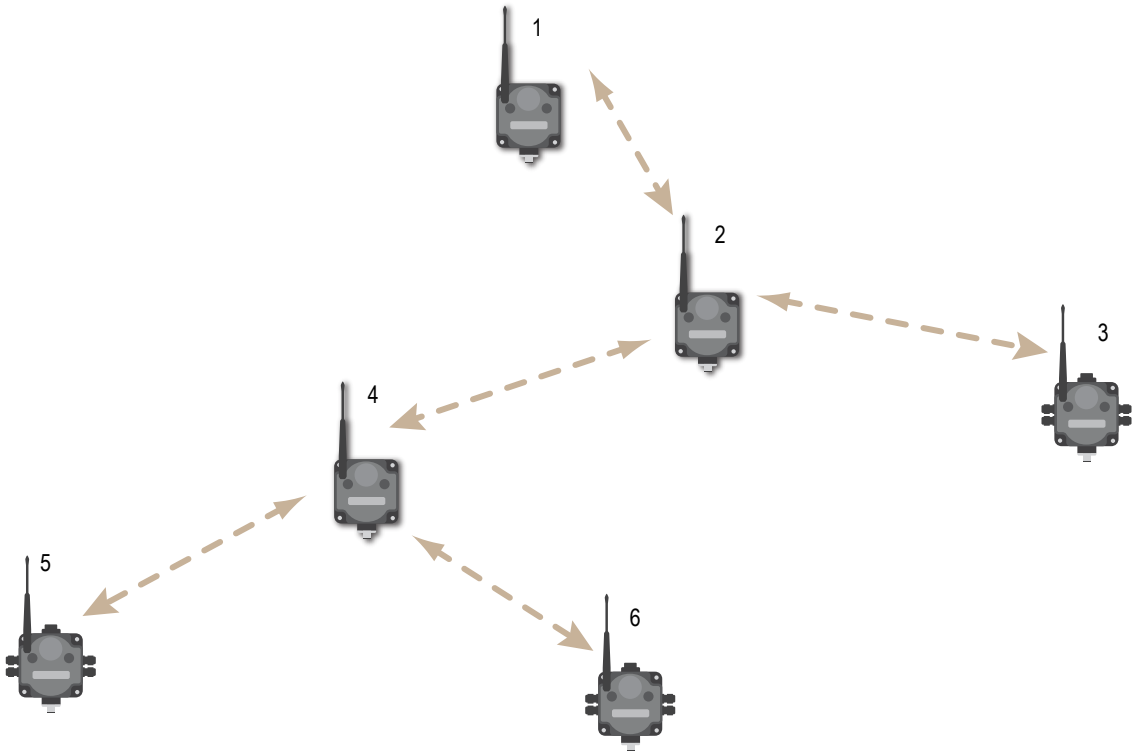
MultiHop networks are made up of one master radio and many repeater and slave radios.
The MultiHop networks are self-forming and self-healing networks constructed around a parent-child communication relationship. The MultiHop Radio architecture creates a hierarchical network of devices to solve the most challenging wireless applications. A MultiHop Radio is either a master radio, a repeater radio, or a slave radio.

- The single master device controls the overall wireless network.
- The repeater mode allows for range extension of the wireless network.
- The slave radios are the end point of the wireless network.

At the root of the wireless network is the master radio. All repeater or slave radios within range of the master radio connect as children of the master radio, which serves as their parent. After repeater radios synchronize to the master radio, additional radios within range of the repeater can join the network. The radios that synchronize to the repeater radio form the same parent/child relationship the repeater has with the master radio: the repeater is the parent and the new radios are children of the repeater.

The network formation continues to build the hierarchical structure until all MultiHop radios connect to a parent radio. A MultiHop radio can only have one designated parent radio. If a radio loses synchronization to the wireless network it may reconnect to the network through a different parent radio.

For the simple example network shown below, the following relationships exist:



- Radio 1 is the master radio and is parent to radio 2 (repeater).
- Radio 2 (repeater) is child to radio 1 (master), but is parent to radios 3 (slave) and 4 (repeater).
- Radio 4 (repeater) is child to radio 2 (repeater), but is parent to radios 5 and 6 (both slaves).

On the LCD of each device, the parent device address (PADR) and local device address (DADR) are shown.

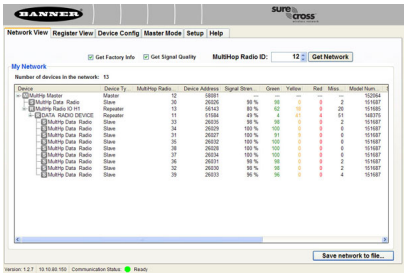
MultiHop Master Radio. Within a network of MultiHop data radios, there is only one master radio. The master radio controls the overall timing of the network and is always the parent device for other MultiHop radios. The host system connects to this master radio.

MultiHop Repeater Radio. When a MultiHop radio is set to repeater mode, it acts as both a parent and a child. The repeater receives data packets from its parent, then re-transmits the data packet to the children within the repeater's network. The incoming packet of information is re-transmitted on both the radio link and the local serial link.

MultiHop Slave Radio. The slave radio is the end device of the MultiHop radio network. A radio in slave mode does not re-transmit the data packet on the radio link, only on the local serial (wired) bus.

MultiHop Configuration Tool

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



The MultiHop Configuration Tool requires that you connect your master radio to your computer using either a USB to RS-485 (for RS-485 radios) or a USB to RS-232 (for RS-232 radios) converter cable. For RS-485 models, Banner recommends using cable model BWA-UCT-900, an RS-485 to USB adapter cable with a wall plug that can power your 1 Watt MultiHop radio while you are configuring it.

If you use an adapter cable that does not also supply 10-30V dc to your radio, use the DIP switches to set the MultiHop Radio to transmit at 250 mW.

When the MultiHop Configuration Tool launches, it automatically checks to see if a newer version of the software is available. If a newer version is available, a dialog box displays on the screen to ask you if you want to download the new version or ignore the new version. If you select download, the newer version automatically downloads, installs, and relaunches the program for you.

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. For binding instructions, refer to the product manual.
6. Observe the LED behavior to verify the devices are communicating with each other.
7. Conduct a site survey between the MultiHop Radios. For site survey instructions, refer to the product manual.
8. Install your wireless sensor network components. For installation instructions, refer to the product manual.

For additional information, including installation and setup, weatherproofing, device menu maps, troubleshooting, and a list of accessories, refer to one of the following product manuals.

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

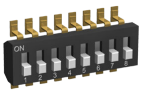
Configuring the DIP Switches

Before making any changes to the DIP switch positions, disconnect the power. For devices with batteries integrated into the housing, remove the battery for at least one minute. DIP switch changes will not be recognized if power isn't 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*	OFF*						
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	ON						
Parity: None			OFF*	OFF*				
Parity: Even			OFF	ON				
Parity: Odd			ON	OFF				
Disable serial (low power mode) and enable the receiver slots select for switches 1-2			ON	ON				
900 MHz: 1.00 Watt (30 dBm) transmit power ** 2.4 GHz models: 40 ms frame					OFF*			
900 MHz: 0.25 Watts (24 dBm) transmit power ** 2.4 GHz models: 20 ms frame					ON			
Application mode: Modbus						OFF*		
Application mode: Transparent						ON		
MultiHop radio setting: Repeater							OFF*	OFF*
MultiHop radio setting: Master							OFF	ON
MultiHop radio setting: Slave							ON	OFF
MultiHop radio setting: Reserved							ON	ON

* Default configuration

** For 2.4 GHz radios, the transmit power is fixed at 0.065 Watts (18 dBm). DIP switch 5 is used instead to set the frame timing.

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

Use the DIP switches to select the baud rate and the parity. The options for baud rate are: 19200, 38400, or 9600. For parity, select None, Even, or Odd.

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.

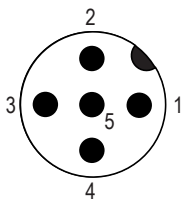
For 2.4 GHz radios, the transmit power is fixed at 0.065 watt (18 dBm) and DIP switch 5 is used to set the frame timing. The default position (OFF) sets the frame timing to 40 milliseconds. To increase throughput, set the frame timing to 20 milliseconds. Note that increasing the throughput decreases the battery life.

Wiring Your SureCross® Device

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

Wiring for RS-485 MultiHop Radios

Connecting dc power to the communication pins will cause permanent damage. For FlexPower devices, do not apply more than 5.5V to the gray wire. The FlexPower Multihop radios operate equally well when powered from the brown or gray wire; it is not necessary to supply both. The power for the sensors can be supplied by the radio's SPx terminals or from the 10 to 30V dc used to power the radio.



Wire No.	Wire Color	10 to 30V dc (RS-485)	FlexPower (RS-485)
1	Brown	10 to 30V dc	10 to 30V dc
2	White	RS-485 / D1 / B / +	RS-485 / D1 / B / +
3	Blue	dc common (GND)	dc common (GND)
4	Black	RS-485 / D0 / A / -	RS-485 / D0 / A / -
5	Gray	-	3.6 to 5.5V dc

Wiring for DX80...M-HxC RS-485 MultiHop Models

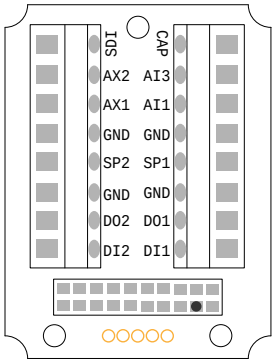
Connecting dc power to the communication pins will cause permanent damage. For FlexPower devices, do not apply more than 5.5V to the gray wire. The FlexPower Multihop radios operate equally well when powered from the brown or gray wire; it is not necessary to supply both. The power for the sensors can be supplied by the radio's SPx terminals or from the 10 to 30V dc used to power the radio.

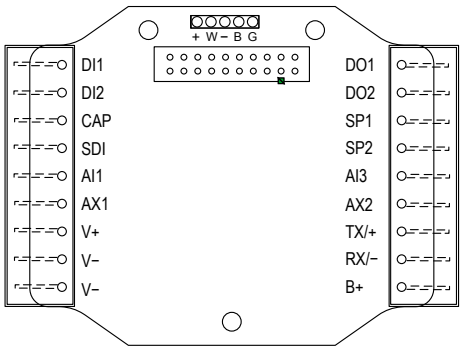
Wire No.	10 to 30V dc (RS-485)	FlexPower (RS-485)
V+	10 to 30V dc	10 to 30V dc
Tx/+	RS-485 / D1 / B / +	RS-485 / D1 / B / +
V-	dc common (GND)	dc common (GND)
Rx/-	RS-485 / D0 / A / -	RS-485 / D0 / A / -
B+	-	3.6 to 5.5V dc

Terminal Blocks and Wiring

Connecting dc power to the communication pins will cause permanent damage. For the DX80...C models, PWR in the wiring diagram refers to V+ on the wiring board.

Terminal Block (IP67 Base) **Terminal Block (IP20 Base)**





3

AI*x* or A*x*. Analog IN *x*.

AX1. Counter IN.

AX2. Thermistor IN.

B+. 3.6 to 5.5V dc (for battery powered models only).

CAP. Capacitor input for powering the H-bridge.

DI*x*. Discrete IN *x*.

DO*x*. Discrete OUT *x*.

GND. Ground/dc common connection.

RX/-. Serial comms line

SDI. SDI-12 IN.

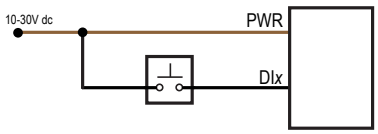
SP*x*. Switch Power. Provides variable power sources for external devices.

TX/+. Serial comms line

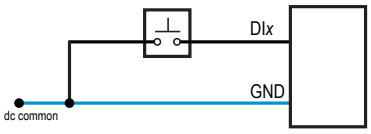
V+. Power, 10 to 30V dc power connection.

V-. Ground/dc common connection.

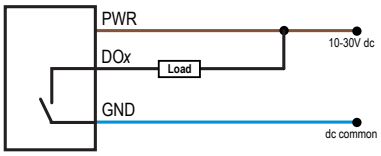
Discrete Input Wiring for PNP Sensors



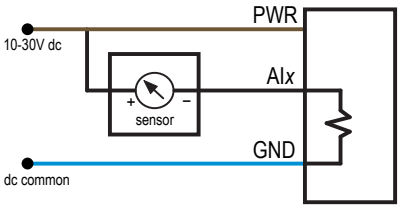
Discrete Input Wiring for NPN Sensors



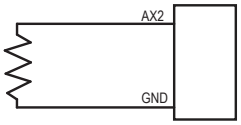
Discrete Output Wiring (NPN or NMOS)



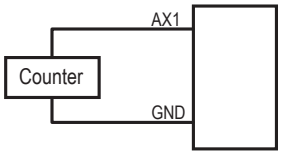
Analog Input Wiring (10 to 30V dc Power)



Thermistor Input



Counter Input

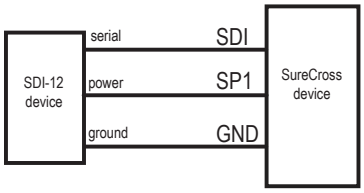


Do not exceed analog input ratings for analog inputs. Only connect sensor outputs to analog inputs.

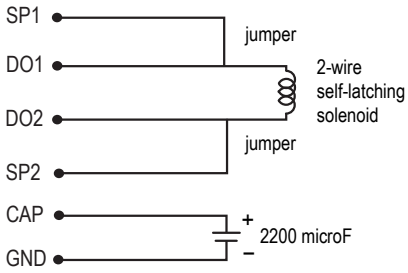
When using the counter inputs, disable the SDI-12 inputs (but can be configured to use the H-bridge outputs).

Input Wiring for SDI-12 Sensors

H-Bridge Output



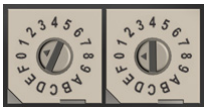
When using the SDI-12 inputs, disable the counter and H-bridge outputs.



When using the H-bridge outputs, disable the SDI-12 inputs (but can be configured for the counter input).

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 61 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 61.

Modbus Register Tables

Inputs

Register (4xxxx)	Input #	I/O 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							
4	4							
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 (high)		0	65535	0	65535	AX1
10	10	Counter IN (low)		0	65535	0	65535	
11	11							
12	12							
13	13							
14	14							

Register (4xxxx)	Input #	I/O Type	Units	I/O Range		Holding Register Representation		Terminal Block Labels
				Min. Value	Max. Value	Min. (Dec.)	Max. (Dec.)	
15	15	SDI-12 Device						SDI
16	16	SDI-12 Device						SDI

Outputs

Register (4xxxx)	Output #	I/O 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	Switch Power 1 or H-bridge						SP1
504	4	Switch Power 2						SP2

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. (Because Modbus numbering begins at 1, users need to subtract 1 from the register address given to form the numeric value entered into the “address” field of the Modbus RTU protocol command string.) Parameter description headings refer to addresses in the range of 40000 as is customary with Modbus convention.

H-Bridge Configuration

The DX80DR9M-H12 MultiHop radio can be configured to operate external SDI-12 devices or a dc-latching solenoid (H-bridge). When configured for SDI-12 devices, disable the H-bridge and counter inputs. When configured for an H-bridge output, disable the SDI-12 inputs. Counter inputs can be used when the device is configured as an H-bridge device.

The MultiHop radio devices can operate up to two SDI-12 devices defined as inputs 15 and 16. The factory default setting is one SDI-12 device connected using input 16.

Configuration

The MultiHop DX80DR*M-H12 device can be configured as an H-bridge output to drive dc-latching solenoids. The H-bridge parameters are associated with the switch power settings and are disabled from the factory. Once enabled, the factory default parameters will work for most applications and should not be changed without understanding the H-bridge structure. Configure the H-bridge output using the MultiHop Configuration Tool or use the following procedures.

Modbus register configuration

1. Disable SDI-12 inputs (write a 0 to registers 1701, 1751).
2. Enable switch power 1 and 2 (write a 1 to registers 2101, 2151). No inputs can be configured to use a switched power when using the H-bridge configuration.
3. On the switch power 1 parameter section, define the voltage setting for the H-bridge device (write 55 to register 3601 to set up for 12 V).
4. The factory default setting of the Default Output State and Hold Last State Enable are “0”. Adjust if needed.
5. Enable the H-bridge configuration (write 1 to register 3604).
6. Other H-bridge parameters are available to define variations from the factory default. Contact a Banner application engineer for specific requirements.

H-bridge Parameter	Register (4xxxx)	Factory Default Value
External Cap Charge Time	3605	2 (80 ms)
H-bridge Active Time	3606	1 (40 ms)
H-bridge Turn-ON Mask	3607	33
H-bridge Turn-OFF Mask	3608	18
Booster Enabled When Active	3609	0

Physical Wiring Setup

The DX80DR*M-H12 requires external wire jumpers and an external capacitor to function properly. The H-bridge hardware connections are:

Wiring	Terminals	Wiring Steps
Wire jumper	SP1 to DO1	Connect a wire from SP1 terminal to DO1 terminal on the wiring board.
Wire jumper	SP2 to DO2	Connect a wire from SP2 terminal to DO2 terminal on the wiring board.
Connect dc Latching relay wires	Relay + to SP1 Relay – to SP2	Connect the dc-latching solenoid to terminals SP1 and SP2 of the wiring board.
External capacitor	Capacitor + to CAP Capacitor – to GND	The H-bridge function requires an external capacitor of 2200 µF, 16V.

H-bridge Operation

To operate the H-bridge output, write the output register for SP1 (register 0503) to ‘1’ to activate the H-bridge output. Write the output register for SP1 to 0 to de-activate the H-bridge output.

The H-bridge operation is not functional when there is a loss of RF communications, and the solenoid to remain in its last state. The user is responsible for correcting the RF communications problem and regaining control of the external device.

SDI-12 Configuration

The DX80DR*M-H12 MultiHop radios can support up to two sensors using the SDI-12 (Serial Data Interface at 1200 baud) protocol. The MultiHop SDI-12 interface supports up to nine storage registers for each SDI-12 device. Each of the nine storage registers use configuration registers to define the data properties. Use the MultiHop Configuration Tool for easy configuration.

The SDI-12 interface uses resources on the MultiHop radio that disable the H-bridge control and counter inputs. When manually configuring the MultiHop radio device, verify these features are disabled using Modbus registers.

Example Modbus Register Configuration

This example configuration is for the first SDI-12 device.

	Command	Register (4xxxx)	Register Value
1	Disable the counter input	1401	0
	Disable the H-bridge, switch power mode	3604	0
	Disable continuous switch power out	2101 2151	0 0
2	Enable I/O 15, SDI-12 interface	1701	1
3	Set the sample rate (in 0.040 second increments)		
	Set the switch power to be associated to input 15 by:		

	Command	Register (4xxxx)	Register Value
	Enabling the switch power	1704	1
	Setting the switch power voltage (for example, to 15 volts)	1705	32
	Setting the switch power warmup time (in # of 0.040 second intervals)	1706	50 (2 seconds)
4	Set the first SDI-12 device's address	11001	1
5	Enable a register for each data value read back from the SDI-12 device:		
	Enable SDI-12 device 1, register 1	11011	1
	Enable SDI-12 device 1, register 2	11012	1

Configure each SDI-12 register for the data properties, referring to the SDI-12 parameter section for more information. In most cases, the standard settings will work. To configure a second SDI-12 device, repeat steps 2 through 5, but use register 11201 (register value 2) for step 4 and registers 11211 and 11212 for step 5.

SDI-12 Operation

The SDI-12 interface reads the SDI-12 device every interval defined by the sample rate. Results are placed in registers 11101 through 11118 with two results registers allocated for each SDI-12 register regardless of the defined word size.

Modbus Register Configuration

The factory default settings for the inputs, outputs, and device operations can be changed by the user through the device Modbus registers.

To change parameters, the data radio network must be set to Modbus mode and the data radio must be assigned 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 data sheet.

For more information about registers, refer to the MultiHop Product Manual, Banner part number 151317.

SDI-12 Configuration Registers

Device Address of SDI-12 Device A: 11001

Device Address of SDI-12 Device B: 11201

The following table lists all registers for the first SDI-12 device. To determine the register for the second SDI-12 device, add 200.

	Configuration Registers for SDI-12 device A				
	Register Enable	Decimal Point Move	Move Right/Left	Signed/Unsigned	16 or 32 Bit
SDI-12 Parameter 1	11011	11012	11013	11014	11015
SDI-12 Parameter 2	11021	11022	11023	11024	11025
SDI-12 Parameter 3	11031	11032	11033	11034	11035
SDI-12 Parameter 4	11041	11042	11043	11044	11045
SDI-12 Parameter 5	11051	11052	11053	11054	11055
SDI-12 Parameter 6	11061	11062	11063	11064	11065
SDI-12 Parameter 7	11071	11072	11073	11074	11075
SDI-12 Parameter 8	11081	11082	11083	11084	11085
SDI-12 Parameter 9	11091	11092	11093	11094	11095

SDI-12 Device Result Registers

The SDI-12 interface supports the M! and C! commands and uses the D0! command to read SDI-12 sensor data into the result registers. The first value read using the D0! command will go into the first result register; second value read will go into the second register. A maximum of nine registers is supported by the SDI-12 M! command. Select the concurrent command (C!) by setting the MultiHop Modbus register 51002 (serial input 1) or 51202 (serial input 2) value to one (1).

The following table lists all registers for the first SDI-12 device. To determine the register for the second SDI-12 device, add 200.

	Result Registers for Device A	
	High Word	Low Word
SDI-12 Result Register 1	11101	11102
SDI-12 Result Register 2	11103	11104
SDI-12 Result Register 3	11105	11106
SDI-12 Result Register 4	11107	11108
SDI-12 Result Register 5	11109	11110
SDI-12 Result Register 6	11111	11112
SDI-12 Result Register 7	11113	11114
SDI-12 Result Register 8	11115	11116
SDI-12 Result Register 9	11117	11118

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 C	× 10

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

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

SDI-12 Devices

SDI-12 Device Parameter		Parameter Enable	Decimal Point Move (0–7)	Move Right (0) or Left (1)	Signed (0) or Unsigned (1)	16 bit (0) or 32 bit (1)
1		Off	0	Left	Unsigned	32-bit
2		Off	0	Left	Unsigned	32-bit
3		Off	0	Left	Unsigned	32-bit
4		Off	0	Left	Unsigned	32-bit
5		Off	0	Left	Unsigned	32-bit
6		Off	0	Left	Unsigned	32-bit
7		Off	0	Left	Unsigned	32-bit
8		Off	0	Left	Unsigned	32-bit
9		Off	0	Left	Unsigned	32-bit

Specifications

Radio

Radio Range

900 MHz: Up to 9.6 kilometers (6 miles) *

2.4 GHz: Up to 3.2 kilometers (2 miles) *

Radio Transmit Power

900 MHz: 30 dBm conducted (up to 36 dBm EIRP)

2.4 GHz: 18 dBm conducted, less than or equal to 20 dBm EIRP

900 MHz Compliance (1 Watt Radios)

FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247

IC: 7044A-RM1809

2.4 GHz Compliance

FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247

ETSI/EN: In accordance with EN 300 328: V1.7.1 (2006-05)

IC: 7044A-DX8024

Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

General

Power*

Requirements: +10 to 30V dc (For European applications: +10 to 24V dc, ± 10%) on the brown wire, or 3.6 to 5.5V on the gray wire

Master radio consumption (900 MHz): Maximum current draw is <100 mA and typical current draw is <30 mA at 24V 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 24V dc. (2.4 GHz consumption is less.)

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: #10 or M5 (SS M5 hardware included)

Max. Tightening Torque: 0.56 N·m (5 lbf·in)

Antenna Connection

Ext. Reverse Polarity SMA, 50 Ohms

Max Tightening Torque: 0.45 N·m (4 lbf·in)

Radio	General
* 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. To determine the range of your wireless network, perform a Site Survey.	**Interface** Indicators: Two bi-color LEDs Buttons: Two Display: Six character LCD **Wiring Access** M-Hx models: Four PG-7, One 1/2-inch NPT, One 5-pin Euro-style male connector M-HxC models: External terminals * For European applications, power the DX80 from a Limited Power Source as defined in EN 60950-1.

Notice: This equipment must be professionally installed. The output power must be limited, through the use of firmware or a hardware attenuator, when using high-gain antennas such that the +36 dBm EIRP limit is not exceeded.

Inputs	Outputs
Discrete Inputs Rating: 3 mA max current at 30V dc Sample Rate: 40 milliseconds ON Condition (NPN): Less than 0.7V OFF Condition (NPN): Greater than 2V or open **Analog Inputs** Rating: 24 mA Impedance: 22 Ohms Sample Rate: 1 second Accuracy: 0.1% of full scale +0.01% per °C Resolution: 12-bit **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: 1.7V **Thermistor (MultiHop)** Model: Omega's 44006 or 44031 families of 10 kOhm Sample: 1 second Accuracy: 0.4° C (10 to 50° C); Up to 0.8° C (−40 to +85° C)	**Discrete Output Rating (MultiHop NMOS)** Less than 1 A max current at 30V dc ON-State Saturation: Less than 0.7V at 20 mA **Discrete Output ON Condition** Less than 0.7V **Discrete Output OFF Condition** Open 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.

Communication	Environmental
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 **Packet Size (MultiHop)** 900 MHz: 175 bytes (85 Modbus registers) 2.4 GHz: 125 bytes (60 Modbus registers) **Intercharacter Timing (MultiHop)** 3.5 milliseconds	**Ratings** M-H12 models: IEC IP67; NEMA 6; (See UL section below for any applicable UL specifications) M-H12C models: IEC IP20; NEMA 1 **Conditions** Operating Temperature: −40 to +85° C (Electronics); −20 to +80° C (LCD) Operating Humidity: 95% max. relative (non-condensing) Radiated Immunity: 10 V/m, 80-2700 MHz (EN61000-6-2)

Communication	Environmental
	Shock and Vibration IEC 68-2-6 and IEC 68-2-7 Shock: 30g, 11 millisecond half sine wave, 18 shocks Vibration: 0.5 mm p-p, 10 to 60 Hz

Refer to the SureCross® MultiHop product manual, Banner 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.

Certifications

CE

Included with Model

The following items ship with the DX80 radios.

- BWA-HW-002: DX80 Access Hardware Kit, containing four PG-7 plastic threaded plugs, four PG-7 nylon gland fittings, four PG-7 hex nuts, one 1/2-inch NPT plug, and one 1/2-inch nylon gland fitting. (Not included with IP20 DX80...C models)
- BWA-HW-001: Mounting Hardware Kit, containing four M5-0.8 x 25mm SS screws, four M5-0.8 x 16mm SS screws, four M5-0.8mm SS hex nuts, and four #8-32 x 3/4" SS bolts
- 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)
- Quick Start Guide (128185 for DX80 Gateways or 152653 for MultiHop models)
- MQDC1-506: 5-Euro (single ended) straight cable, 2m (Not included with FlexPower devices)
- BWA-HW-011: IP20 Screw Terminal Headers (2 pack) (Included only with the IP20 DX80...C models)

Warnings

The manufacturer does not take responsibility for the violation of any warning listed in this document.

Make no modifications to this product. Any modifications to this product not expressly approved by Banner Engineering could void the user's authority to operate the product. Contact the Factory for more information.

All specifications published in this document are subject to change. Banner reserves the right to modify the specifications of products without notice. Banner Engineering reserves the right to update or change documentation at any time. For the most recent version of any documentation, refer to our website: *www.bannerengineering.com*.

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.**

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp.