DXM150-Sx Wireless Modbus Server Product Manual

Original Instructions
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Chapter 1 System Overview

DXM150-Sx Hardware Configuration Overview

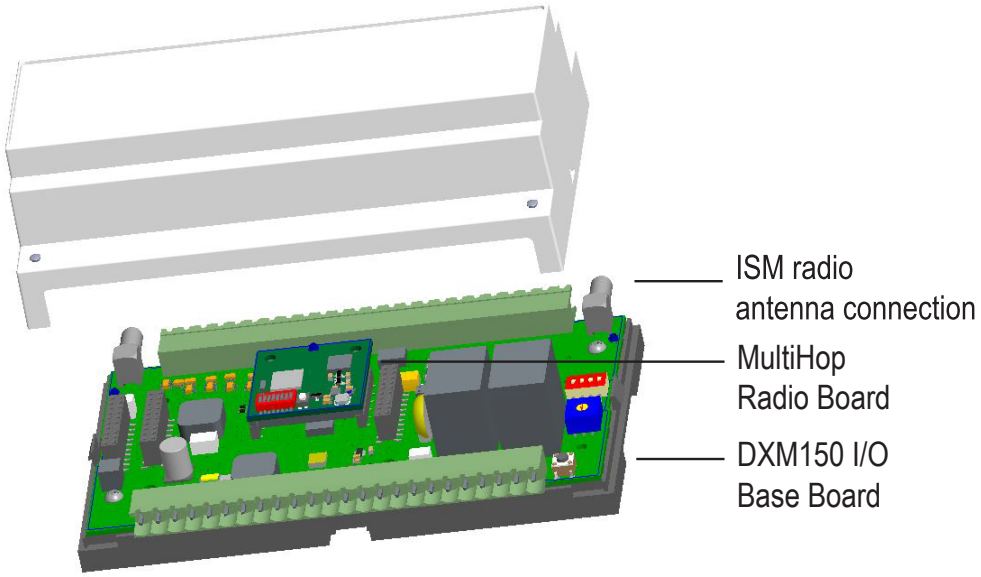
The DXM150 can have multiple configurations. The DXM150 will have a model number label on the housing. Use the model number and model table in the datasheet to identify which boards are included in the controller.

When opening the DXM150, follow proper ESD grounding procedures.

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.

DXM150-Sx hardware



The DXM150 I/O base board provides connections for all inputs, outputs and power. The base board also contains a 12 V solar controller that accepts connections to a solar panel and sealed lead acid (SLA) battery. The battery connection can also be used with line power to provide a battery backup in case of line power outages.

The ISM radio fits on the I/O base board in the parallel sockets. Install the ISM radio so the U.FL antenna connection is to the side with the SMA antenna connectors. Connect the U.FL cable from the ISM radio U.FL to the right side U.FL connector. The ISM radio boards are available with either a 900 MHz (North America) or a 2.4 GHz (International) radio.

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DXM150-S1 Overview

Banner's DXM Logic Controller integrates Banner's wireless radio and local I/O for a remote I/O device.

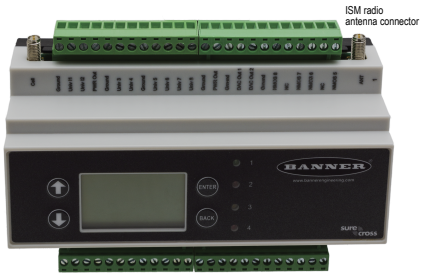
Inputs and Outputs	Connectivity
Universal inputs	Sure Cross® radios
Discrete outputs	RS-485 client
Courtesy power	
Switch power	
Isolated inputs	
Relay outputs	

Inputs and Outputs

On-board universal and programmable I/O ports connect to local sensors, indicators, and control equipment.

Universal inputs, discrete outputs, courtesy power and switched power outputs, isolated inputs, relay outputs

Battery backup, solar controller



Connectivity

The integrated Sure Cross® wireless radio enables Modbus connectivity to remote sensors, indicators, and control equipment.

Wired Connectivity -- Field Bus: Modbus RS-485 Client

Wireless Connectivity -- Sure Cross MultiHop 900 MHz, or MultiHop 2.4 GHz

DXM150-S1 Models

Base

DXM150- S1

S1 =Modbus server with high I/O count for MultiHop wireless networks or wired networks
Power: 12–30 V DC / Solar / Battery
Comms: RS-485
Inputs: Two isolated discrete, eight universal
Outputs: Two relay, four NMOS, two analog
Power Out: Two jumper selectable between 2.7 V or battery, 4.2 V or incoming power

Radio Configuration

R2

Blank = None
R2 = 900 MHz HE5 MultiHop Data Radio (North America)
R4 = 2.4 GHz HE5 MultiHop Data Radio (Worldwide)

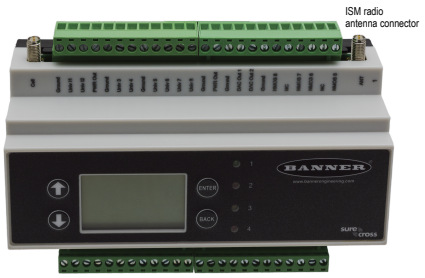
DXM150-S2 Overview

Banner's DXM Logic Controller integrates Banner's wireless radio and local I/O for a remote I/O device.

Inputs and Outputs	Connectivity
Universal inputs	Sure Cross® radios
PNP/NPN outputs	RS-485 client
Analog outputs	RS-485 server
Isolated inputs	
Courtesy power out	

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Inputs and Outputs



On-board universal and programmable I/O ports connect to local sensors, indicators, and control equipment.

Universal inputs, discrete outputs, courtesy power and switched power outputs, isolated inputs

Battery backup, solar controller

Connectivity

The integrated Sure Cross® wireless radio enables Modbus connectivity to remote sensors, indicators, and control equipment.

Wired Connectivity -- Field Bus: Modbus RS-485 Client

Wireless Connectivity -- Sure Cross MultiHop 900 MHz, or MultiHop 2.4 GHz

DXM150-S2 Models

Base

DXM150- S2

S2 = Modbus server with high I/O count for MultiHop wireless networks or wired networks
Power: 12–30 V DC / Solar / Battery
Comms: RS-485
Inputs: Two isolated discrete, eight universal
Outputs: Eight PNP/NPN selectable, two analog
Power Out: Two courtesy power out; two jumper selectable between 2.7 V or battery, 4.2 V or incoming power

Radio Configuration

R2

Blank = None
R2 = 900 MHz HE5 MultiHop Data Radio (North America)
R4 = 2.4 GHz HE5 MultiHop Data Radio (Worldwide

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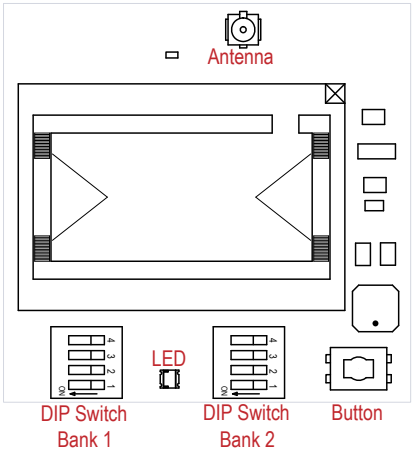
Chapter 2 ISM Radio

ISM Radio Board (ID 1)

Plug the ISM radio into the I/O base board with the U.FL antenna connector closest to the SMA connectors. Typically, users will not need to adjust the DIP switch settings on the physical radio modules.

For the DXM models with a display, set the radio options using the LCD menu.

ISM radio board



Button Operation

For DXM models without an LCD, use the button to bind the ISM radio. For models with an LCD, use the ISM menu to bind the radio.

LED Operation

The LED located on the ISM radio module indicates power and communications traffic. ISM board LED operations also display on the LED on the right side of the I/O base board.

- Solid green DX80 ISM radio LED indicates power.
- Flashing green MultiHop ISM radio LED indicates operation.
- Red and green combined: Communications traffic and binding.

DIP Switch Settings for the MultiHop HE5 Board Module

	D1 Switches				D2 Switches			
Device Settings	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
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				
Transmit power 900 MHz radios: 500 mW (27 dBm) 2.4 GHz radios: 65 mW (18 dBm) and 60 ms frame					OFF*			
Transmit power 900 MHz radios: 250 mW (24 dBm) 2.4 GHz radios: 65 mW (18 dBm) and 40 ms frame					ON			
Application mode: Modbus						OFF*		
Application mode: Transparent						ON		

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	D1 Switches				D2 Switches			
Device Settings	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
MultiHop radio setting: Repeater							OFF	OFF
MultiHop radio setting: Client							OFF	ON
MultiHop radio setting: Server							ON	OFF
MultiHop radio setting: DXM LCD Menu Control							ON*	ON*

* Default configuration

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 acknowledgment/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 acknowledgment 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

Disable an unused local serial connection to reduce the power consumption of a data radio powered from the solar assembly or from batteries. All radio communications remain operational.

Transmit Power Levels/Frame Size

The 900 MHz data radios can be operated at 500 mW (27 dBm) or 250 mW (24 dBm). For most models, the default transmit power is 500 mW.

For 2.4 GHz radios, the transmit power is fixed at 65 mW (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. For battery-powered devices, increasing the throughput decreases battery life.

Binding the ISM Radio of a Modbus Server

A DXM150 (for example, model **DXM1x0-S*R2**) contains two boards: a MultiHop ISM radio and an I/O base board. Each board is a separate Modbus device and requires a unique Modbus ID.

- The ISM radio is not required to have a Modbus ID because there are no registers to manage, but it generally does have a Modbus ID assigned to it.
- The I/O board must have a Modbus ID to access the I/O register data and configuration data.

To bind the DXM150 (as either a repeater or server radio) to its client radio, follow the MultiHop binding instructions. If the binding instructions are not included in the client radio datasheet, refer to the MultiHop Quick Start Guide (p/n 152653) or Instruction Manual (p/n 151317).

The ISM radio board's Modbus ID is assigned from the client radio during binding using the client radio's rotary dials or the DXM Controller's LCD Binding menu. For example, if the client's binding number is 25, the DXM Server ISM radio's Modbus ID is set to 25.

By default, the I/O board's Modbus ID is set to 11.

- For DXM Server models without an LCD, use the I/O board DIP switches to change the Modbus ID.

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- For DXM Server models with an LCD, the DIP switches are set by the factory to allow the user to change the Modbus ID of the I/O board and ISM radio using the menu system. For more information, see LCD and Menu System (DXM100-Sx).

Use the MultiHop Configuration Software to display and configure a MultiHop radio network. With the DXM150, only the ISM radio displays on the Network View screen. The Modbus ID of the I/O board is a separate device that is not a part of the radio network. Although the I/O board does not show up in the Network View, it is accessible when using the Register View functions.

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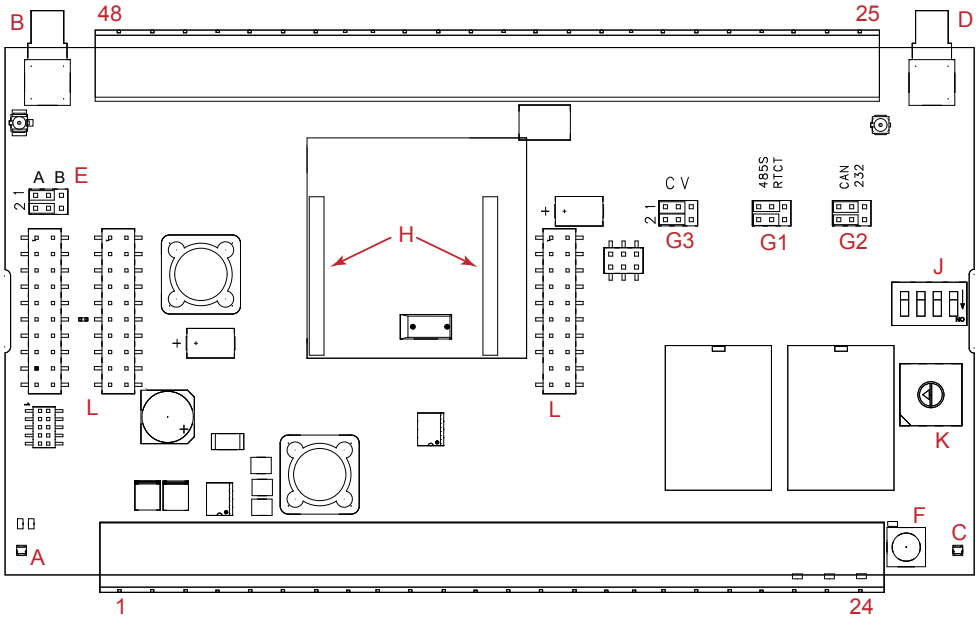
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Chapter 3 IO Base Boards

Board Connections for the S1 Models

Board Connections



1	NC	17	Input 2B	33	Analog Output 1 (0 to 10 V)
2	12 to 30 V DC or solar power in (+)	18	Ground	34	Ground
3	Ground	19	Output 1 Normally Open	35	PWR Out - Jumper
4	Battery in (< 15 V dc) (must be a sealed lead acid battery)	20	Output 1 Common	36	Ground
5	Ground	21	Output 1 Normally Closed	37	Universal Input 8
6	Primary RS-485 –	22	Output 3 Normally Open	38	Universal Input 7
7	Primary RS-485 +	23	Output 3 Common	39	Universal Input 6
8	Ground	24	Output 3 Normally Closed	40	Universal Input 5
9	Not used	25	NMOS Output 5	41	Ground
10	Not used	26	No connection	42	Universal Input 4
11	Not used	27	NMOS Output 6	43	Universal Input 3

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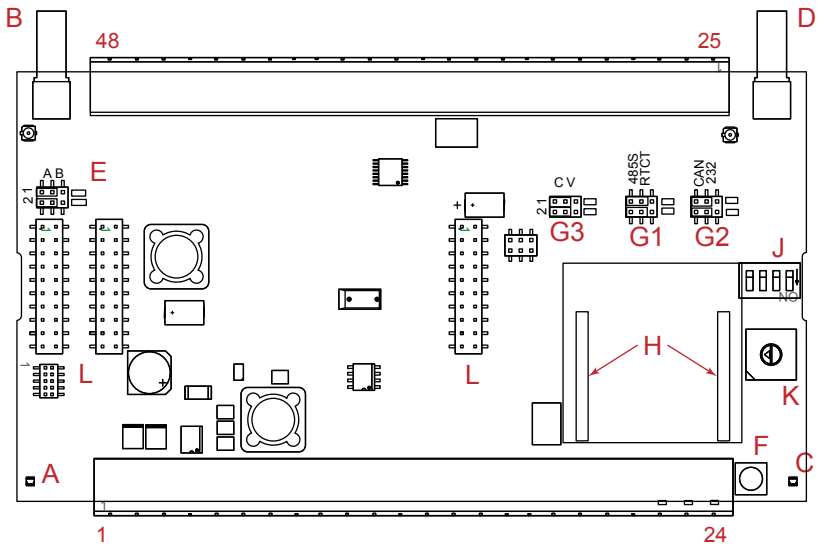
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12	Not used	28	NMOS Output 7	44	Ground
13	Ground	29	No connection	45	PWR Out - Jumper
14	Input 1A	30	NMOS Output 8	46	Universal Input 2
15	Input 1B	31	Ground	47	Universal Input 1
16	Input 2A	32	Analog Output 2 (0 to 10 V)	48	Ground

A	Base Board LED	E	PWR Out Jumpers	G3	Analog Output Characteristics Jumpers (Jumper 1 sets analog out 1, jumper 2 sets analog out 2)
B	Not Used	F	Radio Binding Button	H	ISM Radio Connection
C	Radio LED	G1	Not Used	J	Modbus ID DIP Switches
D	Radio Module Antenna	G2	Not Used	K	Rotary Dials
				L	SAM4 Processor Board Connection

Board Connections for the S2 Models

Board Connections



1	NC	17	Input 2B	33	Analog Output 1 (0–20 mA or 0–10 V)
2	12 to 30 V DC or solar power in (+)	18	Ground	34	Ground
3	Ground	19	Output 1 PNP/NPN	35	PWR Out - Jumper
4	Battery in (< 15 V dc) (must be a sealed lead acid battery)	20	Output 2 PNP/NPN	36	Ground
5	Ground	21	Output 3 PNP/NPN	37	Universal Input 8
6	Primary RS-485 –	22	Output 4 PNP/NPN	38	Universal Input 7
7	Primary RS-485 +	23	PWR Out OR	39	Universal Input 6
8	Ground	24	Ground	40	Universal Input 5
9	RS-232 Tx / CAN	25	Ground	41	Ground

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10	RS-232 Rx / CAN	26	PWR OUT OR	42	Universal Input 4
11	Secondary RS-485 – or RS-232 RXRDY	27	Output 8 PNP/NPN	43	Universal Input 3
12	Secondary RS-485 + or RS-232 TXRDY	28	Output 7 PNP/NPN	44	Ground
13	Ground	29	Output 6 PNP/NPN	45	PWR Out - Jumper
14	Input 1A	30	Output 5 PNP/NPN	46	Universal Input 2
15	Input 1B	31	Ground	47	Universal Input 1
16	Input 2A	32	Analog Output 2 (0–20 mA or 0–10 V)	48	Ground

A	Base Board LED	E	PWR Out Jumpers	G3	Analog Output Characteristics Jumpers (Jumper 1 sets analog out 1, jumper 2 sets analog out 2)
B	Cellular Antenna	F	Radio Binding Button	H	ISM Radio Connection
C	Radio LED	G1	RS-485 Jumpers	J	Modbus ID DIP Switches
D	Radio Module Antenna	G2	RS-232 Jumpers	K	Rotary Dials
				L	SAM4 Processor Board Connection

DIP Switches for the IO Board

The DXM150-Sx Wireless Modbus Server I/O board DIP switches are set from the factory to Modbus ID 11.

IO Board Jumpers

Hardware jumpers on the DXM I/O board allow the user to select alternative pin operations. Turn the power off to the device before changing jumper positions.

I/O board jumpers

Jumper	Function	Positions
E	Courtesy power output	Courtesy power outputs provide continuous power and cannot be turned on or off. Jumper 2 is the power jumper for pin 45. Jumper 1 is the power jumper for pin 35. • The pin 45 jumper selects 2.7 V when in the "a" position and 12 V battery in the "b" position. • The pin 35 jumper selects 4.2 V when in the "a" position and device power on pin 2 in the "b" position.
G1	RS-485 Modbus Serve or RS-232 Flow Control	Defines the operation of pins 11 and 12. Set the jumpers to use pins 11 and 12 as a secondary Modbus RS-485 server port or flow control pins for the RS-232 port. Both jumpers must be set to the same operation, RS-485 Modbus Server or Flow control. The default setting is RS-485.
G2	Generic RS-232 Serial Port or CAN Serial Port	Defines the operation of pins 9 and 10. Set the jumpers to use pins 9 and 10 as a CAN serial port or a generic RS-232 serial port. Both jumpers must be set to the same operation, CAN or RS232. The default setting is CAN serial port. Controller Area Network (CAN) is only available with DXM150 models.
G3	Analog output characteristics for AO2 (pin 32) and AO1 (pin 33)	Defines current (0–20 mA) or voltage (0–10 V) for analog output 1 and 2. By default, current (0–20 mA) is selected using jumpers 1 and 2 and registers 4008 and 4028 contain a value of 2. To select voltage (0–10 V) for output Aout1, set jumper 1 in the voltage position (V) and set Modbus register 4008 on the I/O board (SID 200) to 3. To select voltage (0–10 V) for output Aout2, set jumper 2 in the voltage position (V) and set Modbus register 4028 on the I/O board (SID 200) to 3.

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Applying Power to the S1 Model

Apply power using either 12 to 30 V DC or a 12 V DC solar panel and 12 V sealed lead acid battery.

Pin	Description
Pin 1	No connection
Pin 2	12 to 30 V DC input (+) or solar panel connection (+)
Pins 3, 5, 8, 13, 18, 31, 34, 36, 41, 44, 48	Main logic ground for the DXM150-S1
Pin 4	Solar or backup battery positive input. Battery voltage must be less than 15 V dc. Use only a sealed lead acid (SLA) battery.
Pin 35, Pin 45	These outputs are controlled by hardware jumpers. Jumper 2 is the power jumper for pin 45. Jumper 1 is the power jumper for pin 35. Refer to the wiring board for more information. • The pin 45 jumper selects 2.7 V when in the "a" position and 12 V battery in the "b" position. • The pin 35 jumper selects 4.2 V when in the "a" position and device power on pin 2 in the "b" position.

Apply Power to the DXM150x-B2 or S2 Controllers

Apply power using either 12 to 30 V DC or a 12 V DC solar panel and 12 V sealed lead acid battery.

Power pins for the B2 and S2 models

Pin	Description
Pin 1	No connection
Pin 2	12 to 30 V DC input (+) or solar panel connection (+)
Pins 3, 5, 8, 13, 18, 31, 34, 36, 41, 44, and 48	Main logic ground for the DXM150
Pin 4	Solar or backup battery positive input. Battery voltage must be less than 15 V DC. Use only a sealed lead acid (SLA) battery.
Pin 23, 26, 35, and 45	Courtesy power output, configuration based on jumper block E (see "IO Board Jumpers" on page 12)

Supplying Power from a Solar Panel

To power the DXM150-Sx Wireless Modbus Server from a 12 V DC solar panel, connect the solar panel to power pins 2(+) and 3(-). Connect a 12 V DC SLA or LFP rechargeable battery to pins 4(+) and 5(-).

The factory default setting for the battery charging configuration assumes you are using 12 to 30 V DC power to recharge the battery. If the incoming power is from a solar panel, you must change the charging configuration.

The battery charging configuration defaults to a battery backup configuration. To change the charging configuration from the menu system:

1. From the DXM150 LCD menu, navigate to **System Config › I/O Board › Charger**.
2. Select **Solar** for solar panel configurations or **DC** for battery backup configurations.

To change the charging configuration by writing to Modbus register 6071 on the I/O base board (ID 11):

1. Write a 0 to select the solar power charging configuration.

Connecting a Battery

When attaching a battery to the DXM150 as a backup battery or as a solar battery, verify the charging algorithm is set properly. The factory default setting for the battery charging algorithm assumes you are using 12 to 30 V DC to recharge the battery.

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The charging algorithm is designed to work only with a sealed lead acid (SLA) or lithium ferrophosphate (LFP) battery..

- When using 12 to 30 V DC, connect the 12 to 30 V DC + to pin 2 and connect the ground to pin 3.
- When using main DC power with a backup battery (default configuration), connect the incoming main power pin 2 (+) and to pin 3 (-). Connect the 12 V battery to pin 4 (+) and pin 5 (-). The incoming main power must be 15 to 30 V DC to charge the battery.

Connecting the Communication Pins

The base board communications connection for an external Modbus device uses the primary RS-485.

RS-485. The primary RS-485 bus is a common bus shared with the ISM radio board (Modbus ID 1).

RS-232. The RS-232 bus is not currently defined.

Pin	Parameter	Description
Pin 6	Primary RS-485 –	Use this bus to connect other Modbus server devices into the wireless network. Modbus Register 6101 = Baud Rate 0 = 19.2k 1 = 9600 2 = 38400 Modbus Register 6103 = Parity 0 = no parity 1 = odd 2 = even
Pin 7	Primary RS-485 +	
Pin 9	RS-232 Tx	Serial RS-232 connection. This bus must use a ground connection between devices to operate correctly.
Pin 10	RS-232 Rx	
Pin 13	Secondary RS-485 –	Not used
Pin 14	Secondary RS-485 +	
Pin 15	CANL –	
Pin 16	CANH +	

Inputs and Outputs

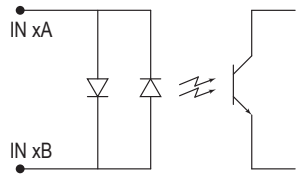
The I/O base board is a Modbus server device that communicates using Modbus commands. Refer to the Modbus Registers section for more descriptions of each Modbus register on the DXM150-Sx Wireless Modbus Server.

Isolated Discrete Inputs

The DXM has two (2) optically isolated inputs. The input signals are electrically isolated forming a barrier to protect the DXM from different ground potentials of the input signals.

Input 1 uses terminals 1A and 1B and the second input uses 2A and 2B. An input voltage should be applied between the terminals between 0 and 30 V DC, the on/off transition threshold is approximately 2.6 V.

Isolated discrete input pins

Pin	Modbus Register	Input	Description	
Pin 14	501	Input 1A	Optically isolated AC input type, 0 to 12 to 30 V DC Input to output isolation of 2.5 kV	
Pin 15		Input 1B		
Pin 16	503	Input 2A		
Pin 17		Input 2B		

Synchronous Counters—An isolated input can be programmed to count the input signal transitions. When an input is enabled as a counter, the counter value is stored in two 16-bit Modbus registers for a total count of 32 bits (unsigned). To program an input to capture the edge transition counts, follow "Example: Configure Input 1 as a Synchronous Counter" on page 15.

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The counters are synchronous because the inputs are sampled at a 10 ms clock rate. The input logic does not detect rising or falling edges, it samples the input every 10 ms to find level changes. The input signals must be high or low for more than 10 ms or the input will not detect transitions. Because most signals are not perfect, a realistic limit for the synchronous counter would be 30 to 40 Hz.

Universal inputs can also be configured as a synchronous counter. See "Modbus Register Summary" on page 20 for all the register definitions. The procedure for creating a synchronous counter is the same as an isolated input with the addition of changing the input type to PNP or NPN.

Universal Inputs

The universal inputs can be programmed to accept different types of inputs: discrete NPN/PNP, 0 to 20 mA analog, 0 to 10 V analog, 10k thermistor, potentiometer sense, bridge, and NPN raw fast. Use the DXM Configuration Software tool to write to the appropriate Modbus registers in the I/O board to configure the input type.

The universal inputs are treated as analog inputs. When the universal inputs are defined as mA, V, or temperature, use Modbus registers to configure the operational characteristics of the inputs. These parameters are temperature conversion type, enable full scale, threshold and hysteresis. See "Modbus Register Summary" on page 20 for the parameter definitions.

When a universal input is configured as an NPN or PNP input type, it can be enabled to be a synchronous counter. Enable the counter function by setting Modbus register 'Enable Rising' or 'Enable Falling' to 1. See "Modbus Register Summary" on page 20 for the universal input register definitions.

Universal input pins

Pin	Univ. Input	Description
Pin 47	Universal Input 1	Program the universal inputs to accept input types NPN, PNP, 10k thermistor, 0 to 10 V, 0 to 20 mA, or potentiometer. The default setting is 8: NPN raw fast. To set the input type, write the following values to the Input Type Modbus registers. 0 = NPN 1 = PNP 2 = 0 to 20 mA 3 = 0 to 10 V DC 4 = 10k Thermistor 5 = Potentiometer Sense (DXM150 only) 6 = Not used 7 = Bridge 8 = NPN Raw Fast (default)
Pin 46	Universal Input 2	
Pin 43	Universal Input 3	
Pin 42	Universal Input 4	
Pin 40	Universal Input 5	
Pin 39	Universal Input 6	
Pin 38	Universal Input 7	
Pin 37	Universal Input 8	

Bridge Input

The bridge input is not implemented yet.

NPN vs NPN Raw Fast

The difference between NPN and NPN Raw Fast is the amount of settling time given to the input. Switch the input type to NPN if the input is not detecting a transition.

Potentiometer Sense (DXM150 only)

A potentiometer input is created from two inputs: a voltage source (pin 45) that supplies a voltage to the potentiometer and an input sense (Potentiometer Sense) to read the resistance. See Using Universal Inputs to Read a Potentiometer (p/n b_4462775) for more information.

Thermistor Input

A thermistor input must use a 10k thermistor between ground and the universal input. The thermistor must be a 10k NTC (Banner model number **BWA-THERMISTOR-002**) or equivalent. Select the temperature conversion of degrees C (default) or degrees F by writing to the Modbus registers defined in Key definition for "IO_Base_Boards" not found in the DITA map..

Example: Configure Input 1 as a Synchronous Counter

1. Connect the DXM150 to the PC.
2. Launch the DXM Configuration Software software.
3. Connect to the DXM150 by selecting the **Device › Connection Settings** menu option. You may connect using either USB or Ethernet.
4. Select a COMM port from the drop-down list and click **Connect**.
5. Click on the **Register View** tab on the left part of the page.
6. Change the **Source Register** selection to **I/O Board Registers**.
7. In the **Write Registers** area, write Modbus register 4908 to 1 to enable counting on the rising edge of the input signal.
8. Read Modbus registers 4910 and 4911 to get the 32-bit value of the count.

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Example: Change Universal Input 2 to a 0 to 10 V DC Input

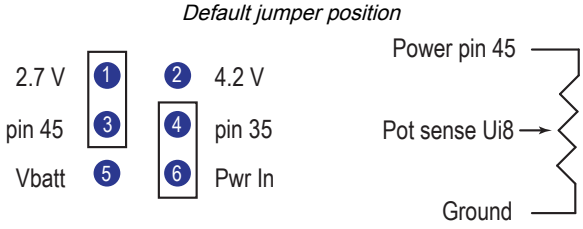
1. Connect the DXM150 to the PC.
2. Launch the DXM Configuration Software software.
3. Connect to the DXM150 by selecting the **Device › Connection Settings** menu option. You may connect using either USB or Ethernet.
4. Select a COMM port from the drop-down list and click **Connect**.
5. Click on the **Register View** tab on the left part of the page.
6. Change the **Source Register** selection to **I/O Board Registers**.
7. Write a 3 to Modbus register 3326 on Modbus ID 11 (I/O board).
8. Cycle power to the device.
9. Using the **Register View** tab, read register 3326 to verify it is set to 3.

Example: Change Analog Output 1 to a 0 to 10 V DC Output

1. Connect the DXM150 to the PC.
2. Launch the DXM Configuration Software software.
3. Connect to the DXM150 by selecting the **Device › Connection Settings** menu option. You may connect using either USB or Ethernet.
4. Select a COMM port from the drop-down list and click **Connect**.
5. Click on the **Register View** tab on the left part of the page.
6. Change the **Source Register** selection to **I/O Board Registers**.
7. Set jumper 1 on the I/O base board to the 0 to 10 V position. Refer to the base board image for the analog output jumper position.
8. Write a 3 to Modbus register 4008 on Modbus ID 11 (I/O board).
9. Cycle power to the device.
10. Using the **Register View** tab, read register 4008 to verify it is set to 3.

Example: Change Universal Input 8 to Read a Potentiometer Input

1. Launch the DXM Configuration Software tool.
2. Click on the **Register View** tab on the left part of the page.
3. In the upper right part of the window select **Modbus Registers using Modbus ID** radio button and enter Modbus ID 11.
4. To set universal input 8 as the sense, write Modbus register 3446 with 5 (Potentiometer Sense).
5. Verify the jumpers are still set to their default position. One jumper should be on pins 1 and 3 to get a 2.7 V source voltage out pin 45. The default position of the other jumper is on pins 4 and 6.

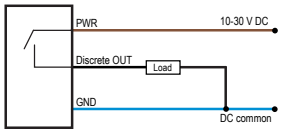
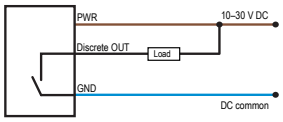


6. Connect one potentiometer side to power output (pin 45), connect the tap point of the pot to universal input 8 (pin 37), and connect the other end of the pot to ground (pin 36).

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PNP and NPN Outputs for the B2 and S2 Models

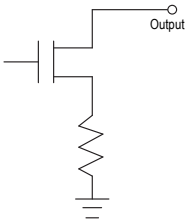
Pins for the PNP/NPN outputs for the DXM150-B2, DXM1500-B2, and DXM150-S2 models

Pin	Output	Modbus Register	Description	PNP OUT Wiring	NPN OUT Wiring
19	1	501	PNP/NPN Output 1		
20	2	502	PNP/NPN Output 2		
21	3	503	PNP/NPN Output 3		
22	4	504	PNP/NPN Output 4		
30	5	505	PNP/NPN Output 5		
29	6	506	PNP/NPN Output 6		
28	7	507	PNP/NPN Output 7		
27	8	508	PNP/NPN Output 8		

The DXM150-B1, DXM1500-B1, and DXM150-S1 models do not have PNP/NPN outputs.

NMOS Outputs

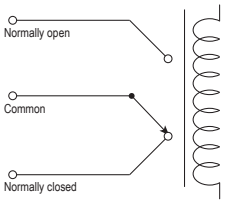
Pins for the NMOS outputs for the DXM150-B1, DXM1500-B1, and DXM150-S1 models

Pin	Modbus Registers	Output	Description	Wiring
Pin 25	505	NMOS Discrete Outputs	Less than 1 A maximum current at 30 V DC ON-State Saturation: Less than 0.7 V at 20 mA ON Condition: Less than 0.7 V OFF Condition: Open	
Pin 27	506			
Pin 28	507			
Pin 30	508			

The DXM150-B2, DXM1500-B2, and DXM150-S2 models do not have NMOS outputs.

Relay Outputs for the DXM150-B1, 1500-B1, and 150-S1

Relay output pins

Pin	Output	Description	Wiring
Pin 19	Output 1: Normally Open	SPDT (Form C) relay, 250 V AC, 16 A	
Pin 20	Output 1: Common		
Pin 21	Output 1: Normally Closed		
Pin 22	Output 3: Normally Open		
Pin 23	Output 3: Common		
Pin 24	Output 3: Normally Closed		

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Analog Outputs (DAC)

The following characteristics are configurable for each of the analog outputs.

Pins for the analog (DAC) outputs

Pin	Output	Description
Pin 33	Analog Output 1	0 to 20 mA or 0 to 10 V DC output (selectable using the Analog Output Characteristics Jumpers) Accuracy: 0.1% of full scale +0.01% per °C Resolution: 12-bit
Pin 32	Analog Output 2	

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Chapter 4 Additional Information

Setting the Modbus ID on the I/O Base Board

Only DXM150-Sx and SxR2 Modbus Server models require that the Modbus ID be adjusted on the I/O base board. The DXMs use DIP switch J and rotary dial K to set the Modbus ID. The device can use a Modbus register 6804 in the I/O board to access the full range of Modbus IDs.

DIP Switch location J defines the course group of Modbus IDs. DIP Switch 4 must be set to ON for DXM1*xx*-Sx and DXM1*xx*-SxR2 models. Use rotary dial K to select the lower digit of the Modbus ID.

Location J DIP Switches

Settings	Location J DIP Switches			
	1	2	3	4
Modbus ID set to 11 through 19	OFF	OFF		
Modbus ID set to 20 through 29	ON	OFF		
Modbus ID set to 30 through 39	OFF	ON		
Modbus ID set to 40 through 49	ON	ON		
Not Used			-	
Modbus Server Configuration (S1 model only) (1)				ON
I2C Processor Communication				OFF

Use rotary dial location K and DIP switch location J to set the Modbus IDs.

Location K Rotary Dials — Position 0 through 9

DIP Switches J		Location K Rotary Dials — Position 0 through 9									
1	2	0	1	2	3	4	5	6	7	8	9
OFF	OFF	x (2)	11	12	13	14	15	16	17	18	19
ON	OFF	20	21	22	23	24	25	26	27	28	29
OFF	ON	30	31	32	33	34	35	36	37	38	39
ON	ON	40	41	42	43	44	45	46	47	48	49

Example to Set the DXM Modbus ID using DIP Switches

To set the DXM to a Modbus ID of 25, set the following:

Location J DIP switches set to: 1= ON, 2=OFF
Rotary dial set to 5

The DIP switch sets the upper digit of the server ID to 2 while the rotary dial sets the lower digit to 5.

(1) Must be in the ON position for the -S1 model)
(2) Uses value in Modbus register 6804.

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Example to Set the DXM I/O Board Modbus ID using Modbus Registers

Write to the I/O board's Modbus register 6804 to set the Modbus ID to any valid Modbus ID (1 through 245).

Rotary dial K should be in the zero position to use the Modbus register server ID

Modbus Register Summary

Modbus Registers

The DXM150-S1 and S2 devices can have two Modbus IDs: one for the MultiHop ISM radio (by default, set to 1) and one for the I/O base (by default, set to 11).

All Modbus registers are defined as 16-bit Modbus Holding Registers. When connecting additional Modbus server devices, only use Modbus IDs 11 through 60. The client device can be expanded to use Modbus IDs 2 through 198 with modifications to the client radio settings.

Modbus Registers for the -B1 and -S1 Model I/O Board

By default, the I/O board Modbus ID is 11.

Base board input connection

Modbus Register	Description
1	Isolated discrete input 1 (1A and 1B)
2	Isolated discrete input 2 (2A and 2B)
3	Universal input 1
4	Universal input 2
5	Universal input 3
6	Universal input 4
7	Universal input 5
8	Universal input 6
9	Universal input 7
10	Universal input 8

Base board output connection

Modbus Register	Description
501	Relay 1
502	Not used
503	Relay 2
504	Not used
505	NMOS Output 5
506	NMOS Output 6
507	NMOS Output 7
508	NMOS Output 8
509	DAC Output 1
510	DAC Output 2

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Modbus Registers for the -B2 and -S2 IO Board

By default, the I/O board Modbus ID is 11.

Base board input connection

Modbus Register	Description
1	Optically isolated input 1
2	Optically isolated input 2
3	Universal input 1
4	Universal input 2
5	Universal input 3
6	Universal input 4
7	Universal input 5
8	Universal input 6
9	Universal input 7
10	Universal input 8

Base board output connection

Modbus Register	Description
501	PNP/NPN Output 1
502	PNP/NPN Output 2
503	PNP/NPN Output 3
504	PNP/NPN Output 4
505	PNP/NPN Output 5
506	PNP/NPN Output 6
507	PNP/NPN Output 7
508	PNP/NPN Output 8
509	DAC Output 1
510	DAC Output 2

Board output settings

Register	Description	Values	Register	Description
3704	Enable Discrete Output 1	0 = NPN; 1 = PNP	3705	Invert Output
3724	Enable Discrete Output 2	0 = NPN; 1 = PNP	3725	Invert Output
3744	Enable Discrete Output 3	0 = NPN; 1 = PNP	3745	Invert Output
3764	Enable Discrete Output 4	0 = NPN; 1 = PNP	3765	Invert Output
3784	Enable Discrete Output 5	0 = NPN; 1 = PNP	3785	Invert Output
3804	Enable Discrete Output 6	0 = NPN; 1 = PNP	3805	Invert Output
3824	Enable Discrete Output 7	0 = NPN; 1 = PNP	3825	Invert Output
3844	Enable Discrete Output 8	0 = NPN; 1 = PNP	3845	Invert Output

For example, to change between PNP/NPN outputs, set parameter register 3704 to 0 for NPN and 1 for PNP.

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Modbus Configuration Registers for the Discrete and Universal Inputs

Modbus configuration registers are identified below. The configuration software creates a graphical view of the I/O board parameters. This allows for easy and quick configuration of the I/O board parameters.

For the DXM150-Bx models, use the DXM Configuration Software to configure the registers using the **Local Registers › Local Registers in Use › Edit Registers** screen.

For the DXM150-Sx models, a DXM client radio is required to access the remote Modbus server device and configure the discrete and universal inputs. Manually write to these Modbus registers to set parameters or configure the input parameters using the **Configuration › Configure Device › Inputs** screen of the MultiHop Configuration Software.

Registers for isolated discrete input 1

Register	Isolated Discrete Input 1
3013	Enable rising edge counter
3014	Enable falling edge counter
3015	High register for counter
3016	Low register for counter

Registers for isolated discrete input 2

Register	Isolated Discrete Input 2
3033	Enable rising edge counter
3034	Enable falling edge counter
3035	High register for counter
3036	Low register for counter

Universal input parameter Modbus registers

Universal Inputs	1	2	3	4	5	6	7	8
Enable Full Scale	3303	3323	3343	3363	3383	3403	3423	3443
Temperature °C/°F	3304	3324	3344	3364	3384	3404	3424	3444
Input Type	3306	3326	3346	3366	3386	3406	3426	3446
Threshold	3308	3328	3348	3368	3388	3408	3428	3448
Hysteresis	3309	3329	3349	3369	3389	3409	3429	3449
Enable Rising	4908	4928	4948	4968	4988	5008	5028	5048
Enable Falling	4909	4929	4949	4969	4989	5009	5029	5049
High Register for Counter	4910	4930	4950	4970	4990	5010	5030	5050
Low Register for Counter	4911	4931	4951	4971	4991	5011	5031	5051

Universal input register ranges

Register Types	Unit	Minimum Value	Maximum Value
Discrete input/output		0	1
Universal input 0 to 10 V	mV	0	10000 *
Universal input 0 to 20 mA	µA	0	20000 *
Universal input temperature (–40 °C to +85 °C)	C or F, signed, in tenths of a degree	–400	850
Universal potentiometer	unsigned	0	65535

* Setting Enable Full Scale to 1 sets the ranges to a linear scale of 0 to 65535.

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Modbus Configuration Registers for the IO (Definitions)

Enable Full Scale

Set to 1 to enable a linear range from 0 to 65535 for specified input range. For a 4 to 20 mA input, a value of 0 represents 0 mA and 65535 represents 20 mA. Set this parameter to 0 to store input readings in unit-specific data. For example, the register data representing a 15.53 mA reading is 15530. For units of current (0 to 20 mA inputs), values are stored as µA (micro Amps) and voltage values are stored as mV (millivolts).

Enable Rising/Falling

Use these registers to enable the universal input logic to count on a rising transition or a falling transition. Write a one (1) to enable; write a zero (0) to disable.

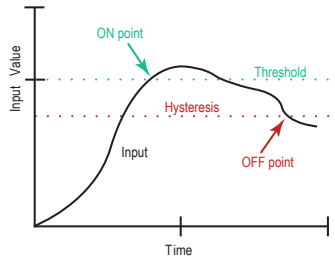
High/Low Register for Counter

The low and high registers for the counter hold the 32-bit counter value. To erase the counter, write zeroes to both registers. To preset a counter value, write that value to the appropriate register.

Hysteresis and Threshold

Threshold and hysteresis work together to establish the ON and OFF points of an analog input. The threshold defines a trigger point or reporting threshold (ON point) for a sensor input. When the input value is higher than the threshold, the input is ON. Hysteresis defines how far below the threshold the analog input is required to be before the input is considered OFF. A typical hysteresis value is 10% to 20% of the unit's range.

In the example shown, the input is considered on at 15 mA. To consider the input off at 13 mA, set the hysteresis to 2 mA. The input will be considered off when the value is 2 mA less than the threshold.



Input Type

Program the universal inputs to accept input types NPN, PNP, 10k thermistor, 0 to 10 V, 0 to 20 mA, or potentiometer. The default setting is 8: NPN raw fast. To set the input type, write the following values to the Input Type Modbus registers.

0 = NPN
1 = PNP
2 = 0 to 20 mA
3 = 0 to 10 V DC
4 = 10k Thermistor
5 = Potentiometer Sense (DXM150 only)
6 = Not used
7 = Bridge
8 = NPN Raw Fast (default)

Temperature °C/°F

Set to 1 to represent temperature units in degrees Fahrenheit, and set to 0 (default) to represent temperature units in degrees Celsius.

Modbus Configuration Registers for Power

To monitor the input power characteristics of the DXM150, read the following power Modbus registers. The on-board thermistor is not calibrated but can be used as a non-precision temperature input.

Configuration registers for power

Modbus Register	Description
6071	Battery backup charging algorithm. 0 = Battery is recharged from a solar panel 1 = Battery is recharged from 12 to 30 V DC (default)
6081	Battery voltage (mV). If no battery is present, the value in this register is less than 5 V. If the value in this register is greater than the incoming voltage register, the battery is powering the system.
6082	Battery charging current (mA). The charging configuration charges the battery when the incoming voltage register value is greater than the battery voltage register value. This register shows the charging current in milliamps.
6083	Incoming supply voltage (mV) (solar or power supply). The incoming power can be from a solar panel or from a power supply. The battery is charging when the incoming voltage register value is greater than the battery voltage register value. The battery is powering the system when the incoming voltage register value is less than the battery voltage register value.
6084	On-board thermistor temperature (ºC). A thermistor measures the temperature of the solar controller board and its surrounding area and uses the temperature as part of the battery charge calculations. This register stores the thermistor reading in tenths of degrees C. This is not a calibrated input: divide by 10 to calculate the temperature in degrees C. For calibrated temperature inputs, define one of the universal inputs as a temperature input.

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Working with Solar Power

A reliable solar system requires careful planning and monitoring to size the components correctly. The recommendations provided are for the DXM150 system as an autonomous system.

Adding extra components increases the power requirements and likely requires increasing the solar system components. Depending upon the geographical location, the size of the solar panel and battery may vary.

Setting the DXM for Solar Power

By default, the DXM is set from the factory to charge a backup battery from a line power source.

For DXM models with an LCD, use the buttons and menu system to change the charging algorithm to solar power. Go to **System Config › I/O Board › Charger**. Use the up/down arrows to select **Solar**.

For DXM models without an LCD, use the configuration software to adjust the I/O board Modbus register 6071. Set the register to 0 to select battery charging from a solar panel, and set to 1 to select battery charging from incoming 12 to 30 V DC supply.

To minimize the power consumption (may not apply to all models):

- If Ethernet is not being used, disable Ethernet to save up to 25% of the consumed power. Set DIP switch 1 to the ON position on the processor board then reboot.
- Instead of powering external devices all the time, take advantage of the switched power mechanisms to turn off devices when possible.
- Minimize the number of cellular transactions and the amount of data pushed through the cellular modem.

Solar Components

The components of a solar system include the battery and the solar panel.

Battery

The DXM solar controller is designed to use a 12 V sealed lead acid (SLA) battery. The characteristics of a solar system require the battery to be of a certain type. There are two types of lead acid batteries:

- SLI batteries (Starting Lights Ignition) are designed for quick bursts of energy, like starting engines
- Deep Cycle batteries - greater long-term energy delivery. This is the best choice for a solar battery.

Since a solar system charges and discharges daily, a deep-cycle battery is the best choice. There are different versions of a lead acid battery: wet cell (flooded), gel cell, and an absorbed glass mat (AGM).

Wet cell batteries are the original type of rechargeable battery and come in two styles, serviceable and maintenance-free. Wet cell batteries typically require special attention to ventilation as well as periodic maintenance but are the lowest cost. The gel cell and AGM battery are sealed batteries that cost more but store very well and do not tend to sulfate or degrade as easily as a wet cell. Gel or AGM batteries are the safest lead acid batteries you can use.

Battery capacity is a function of the ambient temperature and the rate of discharge. Depending upon the specific battery, a battery operating at –30 °C can have as much as 40 percent less capacity than a battery operating at 20 °C. Choose enough battery capacity based on your geographical location.

Average voltage readings relative to battery charge

State of Battery Charge (%)	Open Circuit Voltage
100	13.0 or higher
75	12.6
50	12.1
25	11.66
0	11.4 or less

A larger capacity battery typically lasts longer for a given solar application because lead-acid batteries do not like deep cycling (discharging a large percentage of its capacity). Depending upon the battery, a battery discharging only 30 percent of its capacity before recharging will have approximately 1100 charge/discharge cycles. The same battery discharging 50

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percent of its capacity will have approximately 500 charge/discharge cycles. Discharging 100 percent leaves the battery with only 200 charge/discharge cycles.

Use this information as a guide to the approximate state of charge and in determining when to apply conservation measures. Batteries degrade over time based on discharge/charge cycles and environmental conditions. Always monitor the battery system to obtain the best performance of the solar-powered system.

Solar Panel

Banner solar panels come in two common sizes for the DXM: 5-watt and 20-watt. Both panels are designed to work with the DXM but provide different charging characteristics. Use the 5-watt panel for light-duty operation and use the 20-watt panel when you require greater charging capabilities.

Solar Panel	Voltage	Current	Typical DXM Configurations
5 Watt	17 V	0.29 A	DXM Controller configured as a server, ISM radio, I/O base board
20 Watt	21 V	1 A	DXM Controller with ISM radio and Cellular modem

Photovoltaic panels are very sensitive to shading. Unlike solar thermal panels, PV solar panels cannot tolerate shading from a branch of a leafless tree or small amounts of snow in the corners of the panel. Because all cells are connected in a series string, the weakest cell will bring down the other cells' power level.

Good quality solar panels will not degrade much from year to year, typically less than 1 percent.

To capture the maximum amount of solar radiation throughout the year, mount a fixed solar panel to optimize the sun's energy. For the northern hemisphere, face the panel true south. For the southern hemisphere, face the panel true north. If you are using a compass to orientate the panels, compensate for the difference between true north and magnetic north. Magnetic declination varies across the globe.

A solar panel's average tilt from horizontal is at an angle equal to the latitude of the site location. For optimum performance, adjust the tilt by plus 15 degrees in the winter or minus 15 degrees in the summer. For a fixed panel with a consistent power requirement throughout the year, adjust the tilt angle to optimize for the winter months: latitude plus 15 degrees. Although in the summer months, this angle may not be the most efficient, there are more hours of solar energy available.

For sites with snow in the winter months, the increased angle helps to shed snow. A solar panel covered in snow produces little or no power.

Recommended Solar Configurations

These solar panel and battery combinations assume direct sunlight for at least two to three hours a day. Solar insolation maps provide approximate sun energy for various locations. The depth of battery discharge is assumed to be 50 percent.

Solar panel and battery combinations for a DXM system

Solar Panel Output (W)	Battery Capacity (Ahr)	Days of Autonomy	DXM Current (mA)	DXM Model
5	10	10	25	DXM-Sx models with an ISM radio and I/O base board
20	14	10	30	DXM-Bx models with an ISM radio and no cellular modem
20	20	10	35	DXM-Bx models with an ISM radio and cellular modem

Battery capacity (Ahr) is a standard amp rating taken over 20 hours. Battery capacity should be monitored for reliable system power and may need to be increased for cold weather locations.

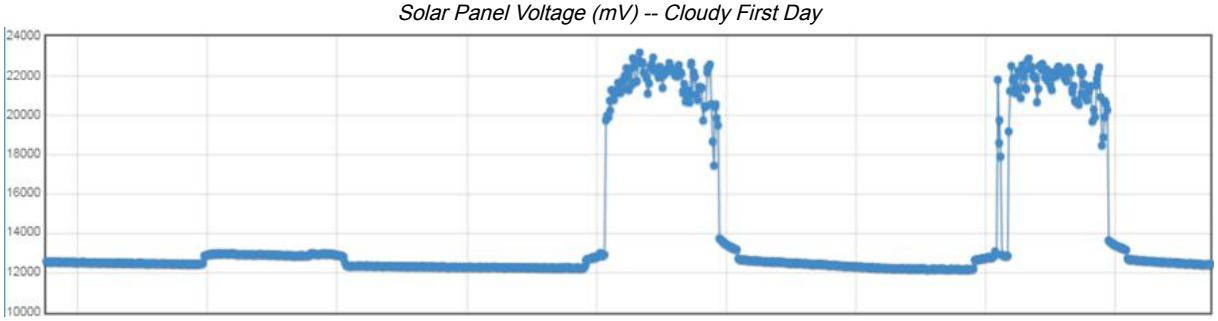
Monitoring Solar Operation

The DXM solar controller uses Modbus registers to allow the user to monitor the state of the solar panel input voltage, the battery voltage, the charging current, and the temperature in °C. The DXM150 can be configured to monitor the health of the charging system as well as send an alert message when the battery is too low.

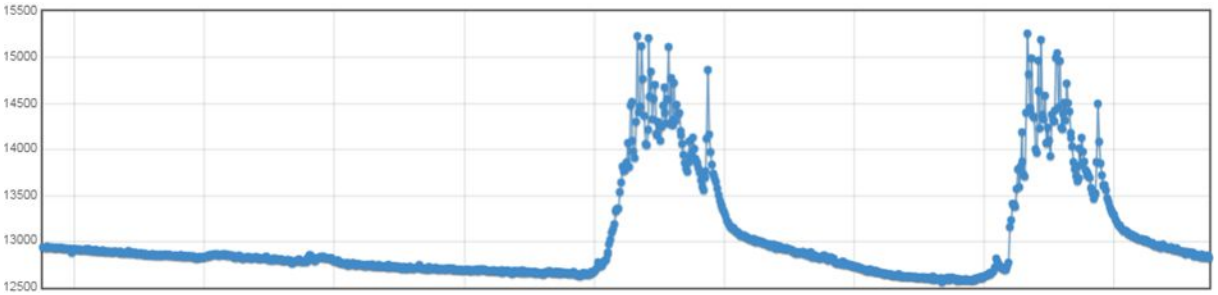
The charts show a typical charging cycle, with each vertical grid representing about eight hours. The chart shows three days of charging.

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Solar Panel Voltage (mV) -- Cloudy First Day



Battery Voltage (mV) - Cloudy First Day



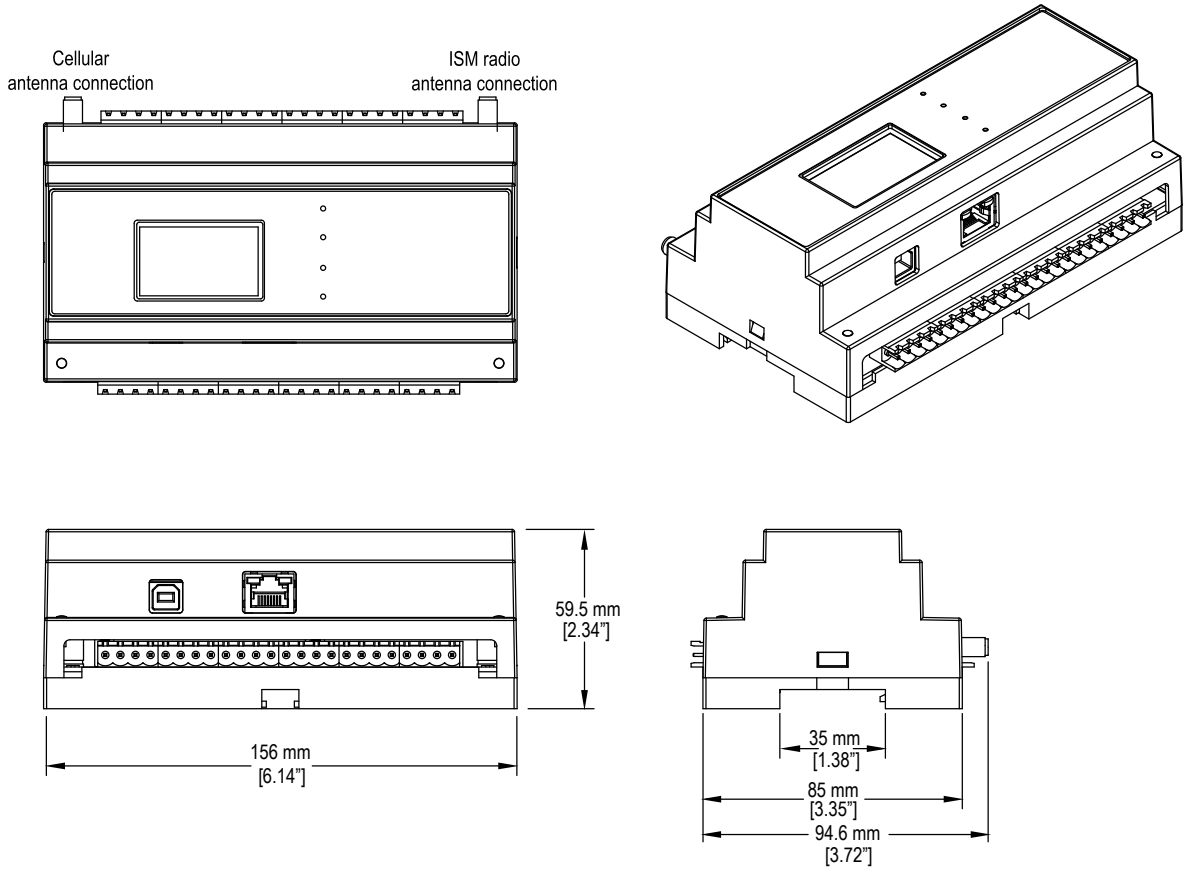
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Chapter 5 DXM150 and DXM1500 Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise. The measurements provided are subject to change.

Dimensions for the DXM150 and DXM1500 models



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Chapter 6 Troubleshooting

Restoring Factory Default Settings for the IO Base Board

To reset the I/O base board to factory defaults, write to two Modbus registers in the base board. The default ID for the base board is 11.

To reset the DXM I/O base board parameters back to factory defaults:

1. Write a 1 to Modbus register 4152
2. Write a 10 to Modbus register 4151

To reboot (cycle power) the DXM I/O base board:

1. Write a 0 to Modbus register 4152
2. Write a 10 to Modbus register 4151

Restoring Factory Defaults for the I/O Base Board

Register	Values	Description
4151	0–255	Reset/restore trigger. This timer is based in 100 millisecond units. Once written, the timer starts to count down to zero. After the timer expires, the restore factory defaults are applied if register 4152 = 1. If register 4152 is zero, the I/O board is reset. Default value: 0 1 = 100 milliseconds, 10 = 1 second.
4152	0–1	0 = Reboots (cycles power) to the I/O base board 1 = Restores factory defaults for I/O parameters

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Chapter 7 Accessories

For a complete list of all the accessories for the Sure Cross wireless product line, please download the Accessories List (p/n b_3147091).

Cordsets

BC-M12F5-22-2—5-pin M12, straight, single-ended, 2 m
BC-M12F5-22-10—5-pin M12, straight, single-ended, 10 m
BC-M12F5A-22-2—5-pin M12, right-angle, single-ended, 2 m
BC-M12F5A-22-10—5-pin M12, right-angle, single-ended, 10 m

Static and Surge Suppressor

BWC-PRC827-DC—Surge Suppressor, bulkhead, DC Blocking, N-Type Female, N-Type Male

Short-Range Omni Antennas

BWA-2O2-D—Antenna, Dome, 2.4 GHz, 2 dBi, RP-SMA Box Mount
BWA-9O2-D—Antenna, Dome, 900 MHz, 2 dBi, RP-SMA Box Mount
BWA-9O2-RA—Antenna, Rubber Fixed Right Angle, 900 MHz, 2 dBi, RP-SMA Male Connector

Medium-Range Omni Antennas

BWA-9O5-C—Antenna, Rubber Swivel, 900 MHz 5 dBi, RP-SMA Male Connector
BWA-2O5-C—Antenna, Rubber Swivel, 2.4 GHz 5 dBi, RP-SMA Male Connector

Enclosures and DIN Rail Kits

BWA-AH864—Enclosure, Polycarbonate, with Opaque Cover, 8 × 6 × 4
BWA-AH1084—Enclosure, Polycarbonate, with Opaque Cover, 10 × 8 × 4
BWA-AH12106—Enclosure, Polycarbonate, with Opaque Cover, 12 × 10 × 6
BWA-AH8DR—DIN Rail Kit, 8", 2 trilobular/self-threading screws
BWA-AH10DR—DIN Rail Kit, 10", 2 trilobular/self-threading screws
BWA-AH12DR—DIN Rail Kit, 12", 2 trilobular/self-threading screws

Misc Accessories

BWA-CG.5-3X5.6-10—Cable Gland Pack: 1/2-inch NPT, Cordgrip for 3 holes of 2.8 to 5.6 mm diam, 10 pack
BWA-HW-052— Cable Gland and Vent Plug Pack: includes 1/2-inch NPT gland, 1/2-inch NPT multi-cable gland, and 1/2-inch NPT vent plug, one each

Antenna Cables

BWC-1MRSMN05—LMR200 RP-SMA to N-Type Male, 0.5 m
BWC-2MRSFRS6—LMR200, RP-SMA Male to RP-SMA Female Bulkhead, 6 m
BWC-4MNFN6—LMR400 N-Type Male to N-Type Female, 6 m

Long-Range Omni Antennas

BWA-9O8-AS—Antenna, Fiberglass, 3/4 Wave, 900 MHz, 8 dBi, N-Type Female Connector
BWA-2O8-A—Antenna, Fiberglass, 2.4 GHz, 8 dBi, N-Type Female Connector

Long-Range Yagi Antennas

BWA-9Y10-A—Antenna, 900 MHz, 10 dBd, N-Type Female Connector

Power Supplies

PSD-24-4—DC Power Supply, Desktop style, 3.9 A, 24 V DC, Class 2, 4-pin M12 quick disconnect (QD)
PSDINP-24-13 —DC power supply, 1.3 Amps, 24 V DC, with DIN Rail Mount, Class I Division 2 (Groups A, B, C, D) Rated
PSDINP-24-25 — DC power supply, 2.5 Amps, 24 V DC, with DIN Rail Mount, Class I Division 2 (Groups A, B, C, D) Rated
BWA-SOLAR PANEL 20W—Solar Panel, 12 V, 20 W, Multicrystalline, 573 × 357 × 30, "L" style mounting bracket included (does not include controller)

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Chapter 8 Product Support and Maintenance

DXM150 Documentation

- DXM Wireless Controller Sell Sheet, p/n 194063
- DXM150-B1 Wireless Controller Datasheet, p/n 178136
- DXM150-B2 Wireless Controller Datasheet, p/n 195952
- DXM150-Bx Wireless Controller Instruction Manual, p/n 190038
- DXM150-S1 Modbus Server Datasheet, p/n 160171
- DXM150-S2 Modbus Server Datasheet, p/n 200634
- DXM150-Sx Modbus Server Instruction Manual, p/n 195455
- DXM ScriptBasic Instruction Manual, p/n 191745
- DXM Controller API Protocol, p/n 186221
- DXM Controller Configuration Quick Start, p/n 191247
- DXM Configuration Software v4, p/n b_4496867
- DXM Configuration Software v4 Instruction Manual, p/n 209933
- DXM EDS Configuration file for Allen-Bradley PLCs, p/n b_4205242
- EIP Configuration File for DXM 1xx-BxR1 and R3 models, p/n 194730
- Activating a Cellular Modem, p/n b_4419353
- Additional technical notes and videos

For more information about the DXM150 family of products, including technical notes, configuration examples, and ScriptBasic programs, please visit www.bannerengineering.com/wireless.

Contact Us

Banner Engineering Corp. | 9714 Tenth Avenue North | Plymouth, MN 55441, USA | Phone: + 1 888 373 6767

For worldwide locations and local representatives, visit www.bannerengineering.com.

Specifications

Radio Specifications for MultiHop

Radio Transmit Power (900 MHz, 500 mW radios)

Conducted: 27 dBm (500 mW)

EIRP with the supplied antenna: < 36 dBm

Radio Transmit Power (2.4 GHz radios)

Conducted: < 18 dBm (65 mW)

EIRP with the supplied antenna: < 20 dBm (100 mW)

Radio Range

A 2 dB antenna ships with this device.

Transmit power and range are subject to many factors, including antenna gain, installation methods, characteristics of the application, and environmental conditions.

Please refer to the following documents for installation instructions and high-gain antenna options.

Installing Your Sure Cross® Radios (151514)
Conducting a Site Survey (133602)
Sure Cross® Antenna Basics (132113)

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Antenna Minimum Separation Distance

900 MHz radios transmitting at ≥ 500 mW: 4.57 m (15 ft) with the supplied antenna

2.4 GHz radios transmitting at 65 mW: 0.3 m (1 ft) with the supplied antenna

Antenna Connection

Ext. Reverse Polarity SMA, 50 Ohms

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

Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

Radio Packet Size (MultiHop)

900 MHz: 175 bytes (85 Modbus registers)

2.4 GHz: 75 bytes (37 Modbus registers)

900 MHz Compliance (SX7023EXT Radio Module)

Radio module is indicated by the product label marking

Contains FCC ID: UE3SX7023EXT

Contains IC: 7044A-SX7023EXT

2.4 GHz Compliance (SX243 Radio Module)

Radio module is indicated by the product label marking

Contains FCC ID: UE3SX243

Radio Equipment Directive (RED) 2014/53/EU

Contains IC: 7044A-SX243

DXM150-S1 Power and IO Specifications

Supply Voltage

12 to 30 V DC (use only with a suitable Class 2 power supply (UL) or a SELV (CE) power supply) or

12 V DC solar panel and 12 V sealed lead acid battery

Power Consumption

20 mA average at 12 Volts (exclusive of load)

Solar Power

12 V sealed lead acid battery

2 A maximum charge current

12 V, 20 W maximum solar panel

Solar Power Battery Charging

1 A maximum with 20 Watt solar panel

Selectable (Jumper) Power Out

Output on pin 45, jumper selects 2.7 V or battery

Output on pin 35, jumper selects 4.2 V or incoming power

100 mA maximum

Indicators

Four LEDs, four control buttons, one LCD

Construction

Polycarbonate; DIN rail mount option

Communication Protocol

Modbus RTU Server

Discrete Inputs

Optically isolated AC input type

Input to output isolation: 2.5 kV

Universal Inputs

Sinking/Sourcing discrete, 4–20 mA analog, 0–10 V analog, counter, and temperature 10 kOhm thermistor

Counters, Synchronous

32-bits unsigned

10 ms clock rate minimum

Analog Outputs (DAC)

0 to 10 V DC output

Accuracy: 0.1% of full scale +0.01% per °C

Resolution: 12-bit

Discrete Output Rating (NMOS)

Less than 1 A max current at 30 V DC

ON-State Saturation: Less than 0.7 V at 20 mA

ON Condition: Less than 0.7 V

OFF Condition: Open

Relay Outputs

SPDT (Form C) relay

250 V AC, 16 A

Certifications

CE/UKCA approval only applies to 2.4 GHz models

Banner Engineering BV
Park Lane, Culliganlaan 2F bus 3
1831 Diegem, BELGIUM

Turck Banner LTD Blenheim House
Blenheim Court
Wickford, Essex SS11 8YT
GREAT BRITAIN

ANATEL
Agência Nacional de Telecomunicações
03737-22-04042

DXM150-S2 Power and IO Specifications

Supply Voltage

12 to 30 V DC (use only with a suitable Class 2 power supply (UL) or a SELV (CE) power supply) or

12 V DC solar panel and 12 V sealed lead acid battery

Power Consumption

20 mA average at 12 Volts (exclusive of load)

Solar Power

12 V sealed lead acid battery

2 A maximum charge current

12 V, 20 W maximum solar panel

Solar Power Battery Charging

1 A maximum with 20 Watt solar panel

Courtesy Power Out

Two incoming power or battery power

100 mA maximum

Selectable (Jumper) Power Out

Output on pin 45, jumper selects 2.7 V or battery

Output on pin 35, jumper selects 4.2 V or incoming power

100 mA maximum

Communication Protocol

Modbus RTU Server

Construction

Polycarbonate; DIN rail mount option

Indicators

Four LEDs, four control buttons, one LCD

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Universal Inputs
Sinking/Sourcing discrete, 4–20 mA analog, 0–10 V analog, counter, and temperature 10 kOhm thermistor

Counters, Synchronous
32-bits unsigned
10 ms clock rate minimum

Discrete Inputs
Optically isolated AC input type
Input to output isolation: 2.5 kV

Analog Outputs (DAC)
0 to 20 mA or 0 to 10 V DC output
Accuracy: 0.1% of full scale +0.01% per °C
Resolution: 12-bit

Discrete Outputs
Eight sourcing/PNP, sinking/NPN
ON Condition: Supply minus 2 V
OFF Condition: Less than 2 V

Discrete Output Rating (PNP)
100 mA max current at 30 V DC
ON-State Saturation: Less than 3 V at 100 mA
OFF-state Leakage: Less than 10 µA

Discrete Output Rating (NPN)
100 mA max current at 30 V DC
ON-State Saturation: Less than 1.6 V at 100 mA
OFF-state Leakage: Less than 200 µA for loads greater than 3 kΩ. For load current of 100 mA, leakage is less than 1% of load current.

Certifications
CE/UKCA approval only applies to 2.4 GHz models

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Turck Banner LTD Blenheim House
Blenheim Court
Wickford, Essex SS11 8YT
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Required Overcurrent Protection

WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.
Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
Supply wiring leads < 24 AWG shall not be spliced.
For additional product support, go to www.bannerengineering.com.

Supply Wiring (AWG)	Required Overcurrent Protection (A)	Supply Wiring (AWG)	Required Overcurrent Protection (A)
20	5.0	26	1.0
22	3.0	28	0.8
24	2.0	30	0.5

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 Software
Data format: 8 data bits, no parity, 1 stop bit

FCC and ISED Certification for 900 MHz

This equipment contains transmitter module RM1809 or SX7023EXT.

Radio Module RM1809	Radio Module SX7023EXT
FCC ID: UE3RM1809	FCC ID: UE3SX7023EXT
IC: 7044A-RM1809	IC: 7044A-SX7023EXT
HVIN: RM1809	HVIN: 223150

FCC Notices

IMPORTANT: The transmitter modules RM1809 and SX7023EXT have been certified by the FCC / ISED for use with other products without any further certification (as per FCC section 2.1091). Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

IMPORTANT: The transmitter modules RM1809 and SX7023EXT have been certified for fixed base station and mobile applications. If modules will be used for portable applications, the device must undergo SAR testing.

IMPORTANT: If integrated into another product, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door, or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text:

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Transmitter Module [RM1809 or SX7023EXT]
Contains FCC ID: [UE3RM1809 or UE3SX7023EXT]
Contains IC: [7044A-RM1809 or 7044A-SX7023EXT]
HVIN: [RM1809 or 223150]

This device complies with Part 15 of the FCC Rules. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation is subject to the following two conditions: 1) This device may not cause harmful interference; and 2) This device must accept any interference received, including interference that may cause undesired operation.

Antenna WARNING: This device has been tested with Reverse Polarity SMA connectors with the antennas listed in "Certified Antennas for 900 MHz" on page 33. When integrated into OEM products, fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Antennas not listed in the tables must be tested to comply with FCC Section 15.203 (unique antenna connectors), FCC Section 15.247 (emissions), and ISED RSS-Gen Section 6.8.

FCC and ISED Approved Antennas

WARNING: Antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons.

AVERTISSEMENT : Les antennes utilisées pour cet émetteur doivent être installées de manière à assurer une distance de séparation d'au moins 20 cm de toutes les personnes.

NOTICE: This equipment is approved only for mobile and base station transmitting devices. The antenna(s) used for this transmitter must not transmit simultaneously with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.

The radio transmitter modules RM1809 and SX7023EXT have been approved by FCC and ISED Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Certified Antennas for 900 MHz

Model Number	Antenna Type	900 MHz Radio Module	Maximum Gain	Impedance	Minimum Required Cable/Connector Loss
-	Integral Antenna	RM1809	Unity gain		0
BWA-9O1-x	Omni, 1/4 wave dipole	RM1809	≤2 dBi	50 Ω	0
BWA-9O2-C	Omni, 1/2 wave dipole, Swivel	RM1809 or SX7023EXT	≤2 dBi	50 Ω	0
BWA-9O6-A	Omni Wideband, Fiberglass Radome	RM1809	≤8.2 dBi	50 Ω	2.2 dB
BWA-9O5-B	Omni Base Whip	RM1809	≤7.2 dBi	50 Ω	1.2 dB
BWA-9Y10-A	Yagi	RM1809	≤10 dBi	50 Ω	4 dB
BWA-9O5-C	Coaxial sleeve	SX7023EXT	≤5 dBi	50 Ω	0
BWA-9O6-AS	Omni	SX7023EXT	≤6 dBi	50 Ω	0

FCC and ISED Certification for 2.4 GHz

This equipment contains transmitter module DX80-2400 or SX243.

Radio Module DX80-2400	Radio Module SX243
FCC ID: UE300DX80-2400	FCC ID: UE3SX243
IC: 7044A-DX8024	IC: 7044A-SX243
HVIN: DX80G2 / DX80N2	HVIN: SX243

FCC Notices

IMPORTANT: The transmitter modules DX80-2400 and SX243 have been certified by the FCC / ISED for use with other products without any further certification (as per FCC section 2.1091). Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

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IMPORTANT: The transmitter modules DX80-2400 and SX243 have been certified for fixed base station and mobile applications. If modules will be used for portable applications, the device must undergo SAR testing.

IMPORTANT: If integrated into another product, the FCC ID/IC label must be visible through a window on the final device or it must be visible when an access panel, door, or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text:

Transmitter Module [DX80-2400 or SX243]
Contains FCC ID: [UE300DX80-2400 or UE3SX243]
Contains IC: [7044A-DX8024 or 7044A-SX243]
HVIN: [DX80G2, DX80N2 or SX243]

This device complies with Part 15 of the FCC Rules. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation is subject to the following two conditions: 1) This device may not cause harmful interference; and 2) This device must accept any interference received, including interference that may cause undesired operation.

Antenna Warning: This device has been tested with Reverse Polarity SMA connectors with the antennas listed in "Certified Antennas for 2.4 GHz" on page 34. When integrated into OEM products, fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Antennas not listed in the tables must be tested to comply with FCC Section 15.203 (unique antenna connectors), FCC Section 15.247 (emissions), and ISED RSS-Gen Section 6.8.

FCC and ISED Approved Antennas

AVERTISSEMENT : Les antennes utilisées pour cet émetteur doivent être installées de manière à assurer une distance de séparation d'au moins 20 cm de toutes les personnes.

NOTICE: This equipment is approved only for mobile and base station transmitting devices. The antenna(s) used for this transmitter must not transmit simultaneously with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.

The radio transmitter modules DX80-2400 and SX243 have been approved by FCC and ISED Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Certified Antennas for 2.4 GHz

Model	Antenna Type	2.4 GHz Radio Module	Maximum Gain	Impedance
	Integral antenna	DX80-2400 or SX243	Unity gain	
BWA-2O2-C	Omni, 1/2 wave dipole, Swivel	DX80-2400 or SX243	≤ 2 dBi	50 Ω
BWA-2O2-D	Omni, Dome, Box Mount	DX80-2400 or SX243	≤ 2 dBi	50 Ω
BWA-2O2-E	Omni, 1/4 wave dipole, Swivel	DX80-2400 or SX243	≤ 2 dBi	50 Ω
BWA-2O5-C	Omni, Collinear, Swivel	DX80-2400	≤ 5 dBi	50 Ω
BWA-2O5-MA	Omni, full-wave dipole, NMO	DX80-2400	≤ 4.5 dBi	50 Ω
BWA-2O6-A	Omni, Dome, Box Mount	DX80-2400	≤ 6 dBi	50 Ω
BWA-2O7-C	Omni, Coaxial Sleeve, Swivel	DX80-2400	≤ 7 dBi	50 Ω

ANATEL

Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados. Para maiores informações, consulte o site da ANATEL www.gov.br/anatel/pt-br/

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Notas Adicionales (con Antena)

Información México: La operación de este equipo está sujeta a las siguientes dos condiciones: 1) es posible que este equipo o dispositivo no cause interferencia perjudicial y 2) este equipo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

Banner es una marca registrada de Banner Engineering Corp. y podrán ser utilizadas de manera indistinta para referirse al fabricante. "Este equipo ha sido diseñado para operar con las antenas tipo Omnidireccional para una ganancia máxima de antena de 6 dBd y Yagi para una ganancia máxima de antena 10 dBd que en seguida se enlistan. También se incluyen aquellas con aprobación ATEX tipo Omnidireccional siempre que no excedan una ganancia máxima de antena

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de 6dBd. El uso con este equipo de antenas no incluidas en esta lista o que tengan una ganancia mayor que 6 dBd en tipo omnidireccional y 10 dBd en tipo Yagi, quedan prohibidas. La impedancia requerida de la antena es de 50 ohms."

Approved Antennas

BWA-9O2-C--Antena, Omni 902-928 MHz, 2 dBd, junta de caucho, RP-SMA Macho
BWA-9O5-C--Antena, Omni 902-928 MHz, 5 dBd, junta de caucho, RP-SMA Macho
BWA-9O6-A--Antena, Omni 902-928 MHz, 6 dBd, fibra de vidrio, 1800mm, N Hembra
BWA-9Y10-A--Antena, Yagi, 900 MHz, 10 dBd, N Hembra

Mexican Importer

Banner Engineering de Mèxico, S. de R.L. de C.V. | David Alfaro Siqueiros 103 Piso 2 Valle oriente | San Pedro Garza Garcia Nuevo Leòn, C. P. 66269

81 8363.2714

Warnings

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: Please download the complete DXM150-Sx Wireless Modbus Server technical documentation, available in multiple languages, from www.bannerengineering.com for details on the proper use, applications, Warnings, and installation instructions of this device.

IMPORTANT: Por favor descargue desde www.bannerengineering.com toda la documentación técnica de los DXM150-Sx Wireless Modbus Server, disponibles en múltiples idiomas, para detalles del uso adecuado, aplicaciones, advertencias, y las instrucciones de instalación de estos dispositivos.

IMPORTANT: Veuillez télécharger la documentation technique complète des DXM150-Sx Wireless Modbus Server sur notre site www.bannerengineering.com pour les détails sur leur utilisation correcte, les applications, les notes de sécurité et les instructions de montage.

Install and properly ground a qualified surge suppressor when installing a remote antenna system. Remote antenna configurations installed without surge suppressors invalidate the manufacturer's warranty. Keep the ground wire as short as possible and make all ground connections to a single-point ground system to ensure no ground loops are created. No surge suppressor can absorb all lightning strikes; do not touch the Sure Cross® device or any equipment connected to the Sure Cross® device during a thunderstorm.

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 than 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.

IMPORTANT:

- **Never operate a radio without connecting an antenna**
- Operating radios without an antenna connected will damage the radio circuitry.
- To avoid damaging the radio circuitry, never apply power to a Sure Cross® Performance or Sure Cross® MultiHop radio without an antenna connected.

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.

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Banner Engineering Corp Limited Warranty

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