DXM100-Bx and 1000-Bx Wireless Controller Product Manual

Original Instructions
p/n: 190037 Rev. N
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Chapter Contents

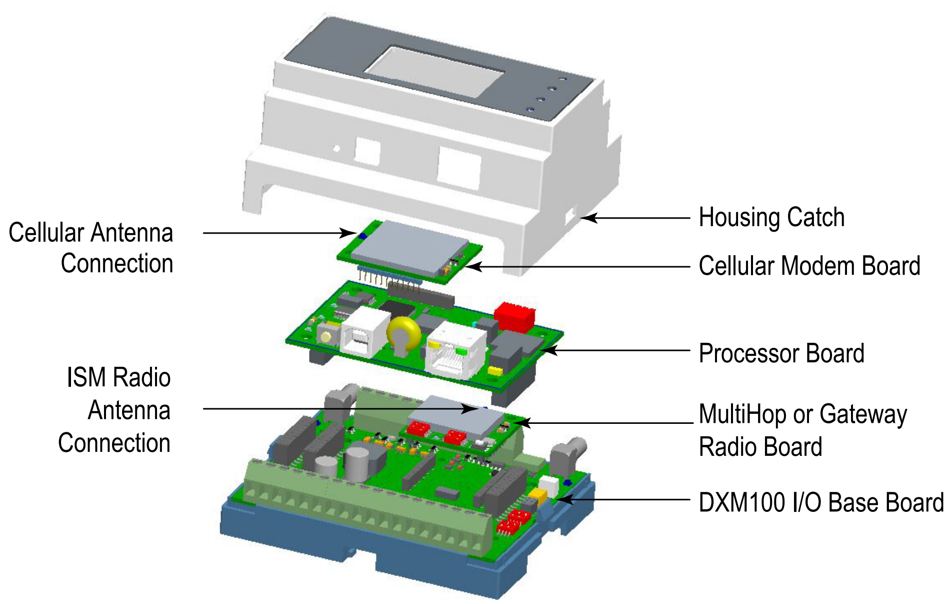
Chapter 1 Overview

Hardware Overview

The DXM can have several different configurations. The DXM has a model number label on the housing. Use the model number and model table to identify which boards are included in the your controller.

Not all combinations of base boards and radios are supported.

> **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.



The DXM100 I/O Base Board is shown. The DXM1000 I/O Base Board is similar.

I/O Base Board—The DXM I/O base board provides connections for all inputs, outputs and power. The I/O base board 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.

ISM Radio—The ISM radio, either a MultiHop or DX80 Gateway, 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 radio (North America) or a 2.4 GHz radio (world-wide).

Processor—The processor board plugs into the base board using the two 20 pin socket connectors. The board sits above the ISM radio socket and held by the base board standoffs. Position the processor board so the USB and RJ45 Ethernet connection is to the front, away from the SMA antenna connections.

Cellular Modem (Optional)—The optional cellular modem (purchased separately) board plugs into the processor board with the U.FL antenna connection to the left. Attach the antenna cable from the cellular modem to the left U.FL connection on the base board.

In some DXM models, the cellular modem may be replaced with an ISM radio. In this configuration, position the top ISM radio antenna connection to the left of the SMA antenna connector.

LCD (Display) Board—The top housing contains the LCD board. The display board is connected to the base board using a ribbon cable with a 20 pin connector.

DXM100-B1 System Overview

Banner's DXM Logic Controller integrates Banner's wireless radio, cellular connectivity, and local I/O to provide a platform for the Industrial Internet of Things (IIoT).

Inputs and Outputs	Connectivity	Logic Controller	User Interface
Universal inputs	Cellular	Action rules	LCD screen
Discrete outputs	Sure Cross radios	Programming language	LED indicators
Courtesy power and switch power	Ethernet	Scheduler	
	USB	Push to the cloud	
	RS-485 client and RS-485 server	Data logging	
	RS-232		
	CAN		

Inputs and Outputs

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

- Universal inputs
- Discrete outputs, courtesy and switch power outputs
- Battery backup, solar controller

Connectivity--The DXM's wired and wireless connectivity options make it easy to share data between local and remote equipment. The cellular modem option eliminates the need for IT infrastructures to connect remote equipment for sensing and control. The integrated Sure Cross® wireless radio enables Modbus connectivity to remote sensors, indicators, and control equipment.

Wired Connectivity

- Ethernet: Modbus TCP or Ethernet/IP
- Field Bus: Modbus RS-485 Client/Server, RS-232, or Controller Area Network (CAN)

Wireless Connectivity

- Sure Cross® Wireless Radio: DX80 900 MHz, DX80 2.4 GHz, MultiHop 900 MHz, or MultiHop 2.4 GHz
- Cellular modem: LTE-M (United States) or LTE-M/NB-IoT (outside the United States)

Logic Controller—Program the DXM's logic controller using action rules and/or ScriptBasic language, which can execute concurrently. The control functions allow freedom when creating custom sensing and control sequences. The logic controller supports the Modbus protocol standards for data management, ensuring seamless integration with existing automation systems. File and LCD password protection is an option.

Register Mapping

- Cyclical Read rules from wireless devices or local wired Modbus devices that include optional scaling, error conditions, and the ability to activate a read rule
- Cyclical or Change of State write rules to wireless devices or local wired Modbus devices with scaling
- Modbus/TCP Client read or write rules for external devices on the network

Action Rules

- Thresholds (IF/THEN/ELSE) with timers, minimum on/off time, and logging options
- Math/Logic Rules (arithmetic and bitwise operators)
- Control Logic (logical operators and SR/T/D/JK flip flops)
- Trending (multiple averaging filters)
- Tracking (counts, on/off times)
- Push data on conditions

Scheduler

- Time/calendar-based events
- Holiday skips and one-time events
- Dynamic scheduler updating
- Astronomical clock

Optional Text Programming Language
ScriptBasic to create variables, arrays, functions, loops, IF/THEN/ELSE, logical and arithmetic operators, API commands, register access, string functions and operators, time commands

Data Logging
Cyclic Data/event logging

User Interface—A simple user interface consists of an LCD screen and four LED indicators. Use the LCD to access system status and setup, view user-selectable events or data, and to bind and perform site surveys for Sure Cross radios. Configure the user-programmable LEDs to indicate the status of the DXM, processes, or equipment.

User programmable LCD
Binding Sure Cross radios
Conducting a Site Survey
Viewing sensor information
Viewing the system's status

User-Defined LED indicators
Four multicolored LEDs: green, amber, red
Programmable behavior

DXM100-B1 Models

Model	Base	Radio Configuration
DXM100-	**B1**	**R1**
	B1 = Modbus controller for data aggregation of sensors and wireless networks Power: 12−30 VDC/Solar/Battery Comms: RS-485, CAN, RS-232 w/flow or secondary RS-485 Inputs: Four universal IN Outputs: Four NMOS OUT, two analog OUT (0-10V or 4-20mA) Power OUT: Two selected 5V or 16V switched power, one 5V courtesy power	Blank = None R1 = 900 MHz, 500 mW PE5 Performance Radio (North America) R2 = 900 MHz, 500 mW HE5 MultiHop Data Radio (North America) R3 = 2.4 GHz, 65 mW PE5 Performance Radio (Worldwide) R4 = 2.4 GHz, 65 mW HE5 MultiHop Data Radio (Worldwide) R5 = 900 MHz, 65 mW HE5L MultiHop Data Radio (Used for MGAGE networks) R8 = 900 MHz, Performance Radios approved for Australia/New Zealand R9 = 900 MHz, MultiHop Radio approved for Australia/New Zealand

Some example models include, but are not limited to, the following:

Models	Description
DXM100-B1R1	DXM100-B1 Wireless Controller with DX80 ISM 900 MHz radio
DXM100-B1R2	DXM100-B1 Wireless Controller with DX80 ISM 900 MHz MultiHop radio
DXM100-B1R3	DXM100-B1 Wireless Controller with DX80 ISM 2.4 GHz radio
DXM100-B1R4	DXM100-B1 Wireless Controller with DX80 ISM 2.4 GHz MultiHop radio

Cellular Communication—Controllers accept Banner LTE-M (CATM1) modems only. Cellular modems are ordered separately as accessories under the following part numbers:
- LTE CAT-M1 AT&T (North America only): **SXI-CATM1ATT-001**
- LTE CAT-M1 Verizon (United States only):**SXI-CATM1VZW-001**
- LTE CAT-M1/NB-IoT Multi-Carrier (Europe only): **SXI-CATM1WW-001**

DXM100-B2 System Overview

Banner's DXM Logic Controller integrates Banner's wireless radio, cellular connectivity, and local I/O to provide a platform for the Industrial Internet of Things (IIoT).

Inputs and Outputs	Connectivity	Logic Controller	User Interface
Universal inputs	Cellular	Action rules	LCD screen
Discrete outputs	Sure Cross Radios	Programming language	LED indicators

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Inputs and Outputs	Connectivity	Logic Controller	User Interface
Courtesy power and switch power	Ethernet	Scheduler	
DC latching outputs	USB	Push to the cloud	
Analog outputs	RS-485 client and RS-485 server	Data logging	
SDI-12 serial interface			

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, DC latching outputs
- Battery backup, solar controller, SDI-12 serial interface

Connectivity—The DXM's wired and wireless connectivity options make it easy to share data between local and remote equipment. The cellular modem option eliminates the need for IT infrastructures to connect remote equipment for sensing and control. The integrated Sure Cross® wireless radio enables Modbus connectivity to remote sensors, indicators, and control equipment.

Wired Connectivity
- Ethernet: Modbus/TCP or Ethernet/IP
- Field Bus: Modbus RS-485 Client/Server

Wireless Connectivity
- Sure Cross® Wireless Radio: DX80 900 MHz, DX80 2.4 GHz, MultiHop 900 MHz, or MultiHop 2.4 GHz
- Cellular modem: LTE-M (United States) or LTE-M/NBIoT (outside the United States)

Logic Controller—Program the DXM's logic controller using action rules and/or ScriptBasic language, which can execute concurrently. The control functions allow freedom when creating custom sensing and control sequences. The logic controller supports the Modbus protocol standards for data management, ensuring seamless integration with existing automation systems. File and LCD password protection is an option.

Register Mapping
- Cyclical Read rules from wireless devices or local wired Modbus devices that include optional scaling, error conditions, and the ability to activate a read rule
- Cyclical or Change of State write rules to wireless devices or local wired Modbus devices with scaling
- Modbus/TCP Client read or write rules for external devices on the network

Action Rules
- Thresholds (IF/THEN/ELSE) with timers, minimum on/off time, and logging options
- Math/Logic Rules (arithmetic and bitwise operators) Control Logic (logical operators and SR/T/D/JK flip flops)
- Trending (multiple averaging filters)
- Tracking (counts, on/off times) Push data on conditions

Scheduler
- Time/calendar-based events
- Holiday skips and one-time events
- Dynamic scheduler updating
- Astronomical clock

Optional Text Programming Language
- ScriptBasic to create variables, arrays, functions, loops, IF/THEN/ELSE, logical and arithmetic operators, API commands, register access, string functions and operators, time commands

Data Logging
- Cyclic Data/event logging

User Interface—A simple user interface consists of an LCD screen and four LED indicators. Use the LCD to access system status and setup, view user-selectable events or data, and to bind and perform site surveys for Sure Cross radios. Configure the user-programmable LEDs to indicate the status of the DXM, processes, or equipment.

User-Programmable LCD
- Binding Sure Cross radios
- Conducting a Site Survey
- Viewing sensor Information
- Viewing the system's status

User-Defined LED indicators
- Four multicolored LEDs: green, amber, and red
- Programmable behavior

DXM100-B2 Models

Model Family	Base	Radio
DXM100-	**B2**	**R1**
	B2=Smart valve control, SDI-12 data collection Power: 12−30 V DC/solar/battery Comms: RS-485, (1) SDI-12 serial interface Inputs: Four universal IN Outputs: Four NMOS OUT, two 0-10V analog, two DC latching Power OUT: Two adjustable 5V to 24V switched power, one SDI switched power, and one 5V courtesy power	Blank = None R1 = 900 MHz, 500 mW PE5 Performance Radio (North America) R2 = 900 MHz, 500 mW HE5 MultiHop Data Radio (North America) R3 = 2.4 GHz, 65 mW PE5 Performance Radio (Worldwide) R4 = 2.4 GHz, 65 mW HE5 MultiHop Data Radio (Worldwide) R5 = 900 MHz, 65 mW HE5L MultiHop Data Radio (Used for MGAGE networks) R8 = 900 MHz, Performance Radios approved for Australia/New Zealand R9 = 900 MHz, MultiHop Radio approved for Australia/New Zealand

Some example models include, but are not limited to, the following:

Models	Description
DXM100-B2R1	DXM100-B2 Wireless Controller with DX80 ISM 900 MHz radio
DXM100-B2R2	DXM100-B2 Wireless Controller with DX80 ISM 900 MHz MultiHop radio
DXM100-B2R3	DXM100-B2 Wireless Controller with DX80 ISM 2.4 GHz radio
DXM100-B2R4	DXM100-B2 Wireless Controller with DX80 ISM 2.4 GHz MultiHop radio

Cellular Communication—Controllers accept Banner LTE-M (CATM1) modems only. Cellular modems are ordered separately as accessories under the following part numbers:

- LTE CAT-M1 AT&T (North America only): **SXI-CATM1ATT-001**
- LTE CAT-M1 Verizon (United States only):**SXI-CATM1VZW-001**
- LTE CAT-M1/NB-IoT Multi-Carrier (Europe only): **SXI-CATM1WW-001**

DXM1000-B1 System Overview

Banner's DXM Logic Controller integrates Banner's wireless radio, cellular connectivity, and local I/O to provide a platform for the Industrial Internet of Things (IIoT).

Inputs and Outputs	Connectivity	Logic Controller	User Interface
Universal inputs	Cellular	Action rules	LCD screen
Discrete outputs	Sure Cross® Radio	Programming language	LED indicators
Courtesy power and switch power	Ethernet	Scheduler	
	USB	Push to the cloud	
	RS-485 client and RS-485 server	Data logging	
	RS-232		

Modbus registers for internal local registers (Modbus ID 199)

Local Registers	Type	Description
1–845	32-bit integer	Local data registers
846–849	32-bit integer	Reset, Constant, Timer

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Local Registers	Type	Description
851–900	32-bit non-volatile integer	Data flash, non-volatile
901–1000		Reserved for internal use
1001–5000	Floating point	Floating point registers, local data registers
5001–7000	32-bit integer	Local data registers
7001–8000	32-bit non-volatile integer	Data flash, non-volatile
> 10000		Read-only virtual registers, system-level data

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

- Universal Inputs
- Discrete outputs
- Courtesy power
- Switch power
- Battery backup
- Solar controller

Connectivity—The DXM's wired and wireless connectivity options make it easy to share data between local and remote equipment. The cellular modem option eliminates the need for IT infrastructures to connect remote equipment for sensing and control. The integrated Sure Cross® wireless radio enables Modbus connectivity to remote sensors, indicators, and control equipment.

Wired Connectivity

Ethernet: Modbus TCP or Ethernet/IP

Field Bus: Modbus RS-485 Controller/Peripheral (client/server)

Wireless Connectivity

Sure Cross Wireless Radio: DX80 900 MHz, DX80 2.4 GHz, MultiHop 900 MHz, or MultiHop 2.4 GHz

Cellular modem: LTE-M (United States) or LTE-M/NB-IoT (outside the United States)

Logic Controller—Program the DXM's logic controller using action rules and/or ScriptBasic language, which can execute concurrently. The control functions allow freedom when creating custom sensing and control sequences. The logic controller supports the Modbus protocol standards for data management, ensuring seamless integration with existing automation systems. File and LCD password protection is an option.

Register Mapping

Cyclical Read rules from wireless devices or local wired Modbus devices that include optional scaling, error conditions, and the ability to activate a read rule

Cyclical or Change of State write rules to wireless devices or local wired Modbus devices with scaling

Modbus/TCP Client read or write rules for external devices on the network

Action Rules

Thresholds (IF/THEN/ELSE) with timers, minimum on/off time, and logging options

Math/Logic Rules (arithmetic and bitwise operators)

Control Logic (logical operators and SR/T/D/JK flip flops)

Trending (multiple averaging filters)

Tracking (counts, on/off times)

Push data on conditions

Scheduler

Time/calendar-based events

Holiday skips

One-time events

Dynamic scheduler updating

Astronomical clock

Optional Text Programming Language

ScriptBasic to create variables, arrays, functions, loops, IF/THEN/ELSE, logical and arithmetic operators, API commands, register access, string functions and operators, time commands

Data Logging

Cyclic data/event logging

User Interface—A simple user interface consists of an LCD screen and four LED indicators. Use the LCD to access system status and setup, view user-selectable events or data, and to bind and perform site surveys for Sure Cross radios. Configure the user-programmable LEDs to indicate the status of the DXM, processes, or equipment.

User programmable LCD

Binding Sure Cross radios

Conducting a Site Survey

Viewing sensor information

Viewing the system's status

User Defined LED indicators

Four defined LED indicators: green, amber, and red

Programmable behavior

DXM1000-B1 Models

Model	Base	Radio Configuration
DXM1000-	**B1**	**R1**
DXM1000-	B1 = Modbus controller for data aggregation of sensors and wireless networks Power: 12−30 V DC / Solar / Battery Comms: RS-485, RS-232 w/flow or secondary RS-485 Inputs: Four universal IN Outputs: Four NMOS OUT, two analog OUT (0-10 V or 4-20 mA) Power Out: Two selected 5 V or 16 V switched power one 5 V courtesy power	Blank = None R1 = 900 MHz, 1 W PE5 Performance Radio (North America) R2 = 900 MHz, 1 W HE5 MultiHop Data Radio (North America) R3 = 2.4 GHz, 65 mW PE5 Performance Radio (Worldwide) R4 = 2.4 GHz, 65 mW HE5 MultiHop Data Radio (Worldwide) R5 = 900 MHz, 65 mW HE5L MultiHop Data Radio (Used for M-GAGE networks) R8 = 900 MHz, Performance Radios approved for Australia/New Zealand R9 = 900 MHz, MultiHop Radio approved for Australia/New Zealand

Some example models include, but are not limited to, the following:

Models	Description
DXM1000-B1R1	DXM1000-B1 Wireless Controller with DX80 ISM 900 MHz radio
DXM1000-B1R2	DXM1000-B1 Wireless Controller with DX80 ISM 900 MHz MultiHop radio
DXM1000-B1R3	DXM1000-B1 Wireless Controller with DX80 ISM 2.4 GHz radio
DXM1000-B1R4	DXM1000-B1 Wireless Controller with DX80 ISM 2.4 GHz MultiHop radio

Cellular Communication—Controllers accept Banner LTE-M (CATM1) modems only. Cellular modems are ordered separately as accessories under the following part numbers:
- LTE CAT-M1 AT&T (North America only): **SXI-CATM1ATT-001**
- LTE CAT-M1 Verizon (United States only): **SXI-CATM1VZW-001**
- LTE CAT-M1/NB-IoT Multi-Carrier (Europe only): **SXI-CATM1WW-001**

DXM1000-B2 System Overview

Banner's DXM Logic Controller integrates Banner's wireless radio, cellular connectivity, and local I/O to provide a platform for the Industrial Internet of Things (IIoT).

Inputs and Outputs	Connectivity	Logic Controller	User Interface
Universal inputs	Cellular	Action rules	LCD screen
Discrete outputs	Sure Cross radios	Programming language	LED indicators
Courtesy and switch power outputs	Ethernet	Scheduler	
DC latching outputs	USB	Push to the cloud	
Analog outputs	RS-485 client and server	Data logging	
SDI-12 serial interface			

Modbus registers for internal local registers (Modbus ID 199)

Local Registers	Type	Description
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851–900	32-bit non-volatile integer	Data flash, non-volatile
901–1000		Reserved for internal use

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Continued from page 11

Local Registers	Type	Description
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5001–7000	32-bit integer	Local data registers
7001–8000	32-bit non-volatile integer	Data flash, non-volatile
> 10000		Read-only virtual registers, system-level data

Inputs/Outputs

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

Universal inputs, discrete outputs, courtesy power, switch power

Battery backup, solar controller, DC latching outputs, SDI-12 serial interface

Connectivity—The DXM's wired and wireless connectivity options make it easy to share data between local and remote equipment. The cellular modem option eliminates the need for IT infrastructures to connect remote equipment for sensing and control. The integrated Sure Cross® wireless radio enables Modbus connectivity to remote sensors, indicators, and control equipment.

Wired Connectivity

Ethernet: Modbus/TCP or Ethernet/IP

Field Bus: Modbus RS-485 Client/Server

Wireless Connectivity

Sure Cross Wireless Radio: DX80 900 MHz, DX80 2.4 GHz, MultiHop 900 MHz, or MultiHop 2.4 GHz

Cellular modem: LTE-M (United States) or LTE-M/NBIoT (outside the United States)

Logic Controller—Program the DXM's logic controller using action rules and/or ScriptBasic language, which can execute concurrently. The control functions allow freedom when creating custom sensing and control sequences. The logic controller supports the Modbus protocol standards for data management, ensuring seamless integration with existing automation systems. File and LCD password protection is an option.

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Math/Logic Rules (arithmetic and bitwise operators)

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One-time events

Dynamic scheduler updating

Astronomical clock

Optional Text Programming Language

ScriptBasic to create variables, arrays, functions, loops, IF/THEN/ELSE, logical and arithmetic operators, API commands, register access, string functions and operators, time commands

Data Logging

Cyclic data/event logging

User Interface—A simple user interface consists of an LCD screen and four LED indicators. Use the LCD to access system status and setup, view user-selectable events or data, and to bind and perform site surveys for Sure Cross radios. Configure the user-programmable LEDs to indicate the status of the DXM, processes, or equipment.

User-Programmable LCD

Binding Sure Cross radios

Conducting a Site Survey

Viewing sensor Information

Viewing the system's status

User-Defined LED Indicators

Four multicolored LEDs: green, amber, and red

Programmable behavior

DXM1000-B2 Models

Model	Base	Radio Configuration
DXM1000-	B2	R1
	B2 = Smart valve control, SDI-12 data collection Power: 12−30 V DC/solar/battery Comms: RS-485, one SDI-12 serial interface Inputs: Four universal IN Outputs: Four NMOS OUT, two 0-10V analog, two DC latching Power OUT: Two adjustable 5V to 24V switched power, one SDI switched power, and one 5V courtesy power	Blank = None R1 = 900 MHz, 1 W PE5 Performance Radio (North America) R2 = 900 MHz, 1 W HE5 MultiHop Data Radio (North America) R3 = 2.4 GHz, 65 mW PE5 Performance Radio (Worldwide) R4 = 2.4 GHz, 65 mW HE5 MultiHop Data Radio (Worldwide) R5 = 900 MHz, 65 mW HE5L MultiHop Data Radio (Used for MGAGE networks) R8 = 900 MHz, Performance Radios approved for Australia/New Zealand R9 = 900 MHz, MultiHop Radio approved for Australia/New Zealand

Some example models include, but are not limited to, the following:

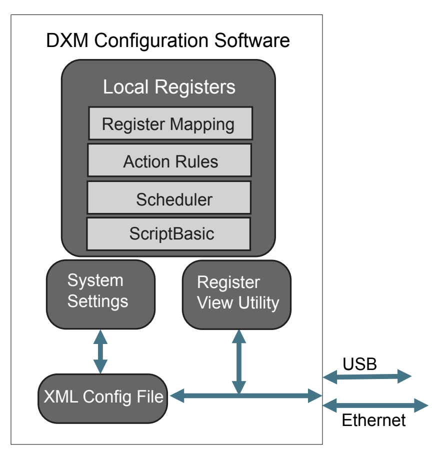
Models	Description
DXM1000-B2R1	DXM1000-B2 Wireless Controller with DX80 ISM 900 MHz radio
DXM1000-B2R2	DXM1000-B2 Wireless Controller with DX80 ISM 900 MHz MultiHop radio
DXM1000-B2R3	DXM1000-B2 Wireless Controller with DX80 ISM 2.4 GHz radio
DXM1000-B2R4	DXM1000-B2 Wireless Controller with DX80 ISM 2.4 GHz MultiHop radio

Cellular Communication—Controllers accept Banner LTE-M (CATM1) modems only. Cellular modems are ordered separately as accessories under the following part numbers:
- LTE CAT-M1 AT&T (North America only): **SXI-CATM1ATT-001**
- LTE CAT-M1 Verizon (United States only): **SXI-CATM1VZW-001**
- LTE CAT-M1/NB-IoT Multi-Carrier (Europe only): **SXI-CATM1WW-001**

DXM Configuration Software

Download the latest version of all configuration software from http://www.bannerengineering.com. For more information on using the DXM Configuration Software, refer to the instruction manual (p/n 209933).

Overview of the configuration software features



The configuration software configures the DXM client by creating an XML file that is transferred to the DXM client using a USB or Ethernet connection. The DXM client can also receive the XML configuration file from a Web server using a cellular or Ethernet connection.

This configuration file governs all aspects of the DXM client and server operation.

The wireless network devices are a separate configurable system. Use the DX80 Performance Configuration Software to configure the internal DX80 client radio and the wireless server nodes bound to it. Use the MultiHop Configuration Software if the internal radio is a MultiHop device.

All configuration software can be connected to the DXM client using a USB cable or an Ethernet connection.

DXM Automation Protocols

The DXM supports the following automation protocols.

Modbus RTU

The DXM manages two separate physical ports running the Modbus RTU protocol. The DXM is the Modbus client when operating the Modbus client RTU port. The DXM uses the client Modbus RTU bus to communicate with locally connected Modbus devices or uses the Banner wireless radio to communicate with remote Modbus devices.

The other Modbus RTU port is used by a host system to access the DXM as a server device. The server Modbus RTU port allows access all the internal registers concurrently with the client RTU port. Set the Modbus ID using the LCD menu: **SYSTEM CONFIG › DXM Modbus ID**.

By default, the Modbus RTU ports are active. Configure the port parameters using the configuration software.

Modbus TCP/IP

A host system acting as a Modbus client can access the DXM using the Modbus TCP/IP protocol over Ethernet. Standard Modbus port 502 is used by the DXM for all Modbus TCP/IP requests.

All internal registers are available to the host system concurrently with Modbus RTU.

By default, Modbus TCP/IP is active. Configure the DXM using Modbus TCP rules in the configuration software.

EtherNet/IP™

The Ethernet port is actively running EtherNet/IP. From the factory, the DXM is configured to read and write registers on DX80 wireless devices 1 through 16. Custom configurations can be set using the configuration software.

By default, EtherNet/IP is active.

DXM Modbus Overview

The DXM uses internal 32-bit registers to store information. The processor's internal Local Registers serve as the main global pool of registers and are used as the common data exchange mechanism. External Modbus device registers can be read into the Local Registers or written from the local data registers.

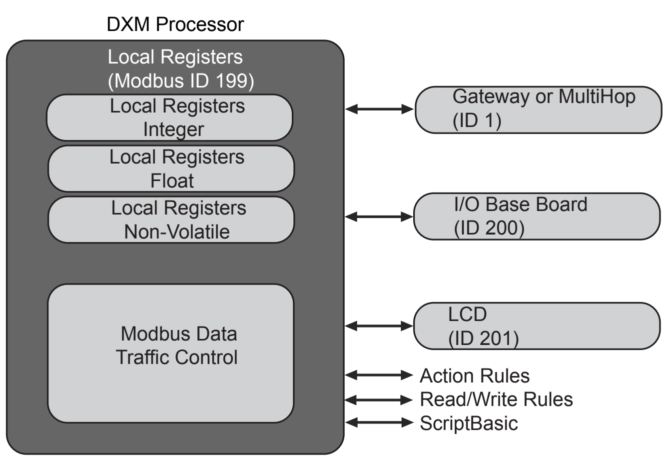
The DXM, as a Modbus client or server, exchanges data using the Local Registers. Modbus over Ethernet (Modbus/TCP) uses the Local Registers as the accessible register data.

Action, Read/Write, and Threshold Rules allow you to manipulate the processor's Local Registers. The ScriptBasic programming capabilities extend the use of Local Registers with variables to create a flexible programming solution for more complex applications.

The processor's Local Registers are divided into three types: integer, floating point, and non-volatile. When using Local Registers internally, the user can store 32-bit numbers. Using Local Registers with external Modbus devices follows the Modbus standard of a 16-bit holding register. Local Registers are accessible as Modbus ID 199.

Accessing the I/O base board and the LCD follows the same communication as an external Modbus device. Each device has a unique Modbus ID. The I/O base board is Modbus ID 200 and the LCD is Modbus ID 201.

Overview of the DXM Modbus processor



Chapter Contents

Chapter 2 Quick Start Guide

Device Setup

Apply Power from a PSW-24-1 to the Controller

Follow these instructions to apply 12–30 V DC power to the controller using a wall plug.

Equipment used:
- **DXM Wireless Controller**
- **MQDMC-401** 0.3 m (1 ft) cordset with a 4-pin M12 quick disconnect fitting
- **PSW-24-1** Wall plug power supply; 24 V DC, 1 A

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.

1. Connect the brown wire from the **MQDMC-401** cordset to the DXM's PW (+ power) terminal.
2. Connect the blue wire from the **MQDMC-401** cordset to the DXM's GD (- ground) terminal.
3. Connect the **PSW-24-1** power supply to the **MQDMC-401** cordset.
4. Plug in the **PSW-24-1** wall plug power supply.

Binding and Conducting a Site Survey with the ISM Radio

Before the ISM radio can communicate, the ISM radio within the DXM must be bound to the other radios in the wireless network.

Use the DXM LCD menu to bind external radios to the internal ISM radio.

If you are having difficulty running binding or site surveys, it may be because of the speed of the XML configuration file or script running on the DXM. To resolve this issue, try one of the following options:
- Disable the XML and script by setting DIP switch 4 on the processor board to ON and cycling the power to the DXM. After binding the devices, turn DIP switch 4 back OFF and cycle power again to return to normal operation of the XML and script.
- Adjust the XML or script to slow down the RTU read or write rules.
- Upload a blank XML, bind all devices, then upload the configured XML file.

Bind a DX80 Node to a DXM and Assign the Node Address

Binding Nodes to a Gateway ensures the Nodes only exchange data with the Gateway they are bound to. After a Gateway enters binding mode, the Gateway automatically generates and transmits a unique extended addressing (XADR), or binding, code to all Nodes within range that are also in binding mode. The extended addressing (binding) code defines the network, and all radios within a network must use the same code.

1. Apply power to all the devices.

   Separate radios by two meters when running the binding procedure. Put only one DXM Gateway into binding mode at a time to prevent binding to the wrong Gateway.
2. Enter binding mode on the DXM radio:
   a. Use the arrow keys to select the **ISM Radio** menu on the LCD and press **ENTER**.
   b. Highlight the **Binding** menu and press **ENTER**.

3. Assign the Node address to the Node.
    - For Nodes without rotary dials: Use the DXM arrow keys to select the Node address to assign to the DX80 Node about to enter binding mode. The DXM assigns this Node address to the next Node that enters binding mode. Only bind one Node at a time.
    - For Nodes with rotary dials: Use the Node's rotary dials to assign a valid decimal Node Address (between 01 and 47). The left rotary dial represents the tens digit (0 through 4) and the right dial represents the ones digit (0 through 9) of the Node Address. You can leave the DXM "Bind to" address set to 1 because the Node's rotary dials will override that setting.
4. Start binding mode on the DXM radio by pressing **ENTER** on the DXM radio.
5. Enter binding mode on the DX80 Node.
    - For housed radios, triple-click button 2.
    - For board-level radios, triple-click the button.
    - For Nodes without buttons, refer to the Node's datasheet for instructions on entering binding mode.

    The left and right LEDs flash alternately and the Node searches for a Gateway in binding mode. After the Node binds, the LEDs stay solid momentarily, then they flash together four times. The Node automatically exits binding mode and reboots.
6. Label the Node with the assigned address number for future reference.
7. Press **BACK** on the DXM to exit binding mode for that specific Node address.

    The Node LEDs continue to flash red until the DXM exits binding mode with that Node address.
8. Repeat these steps for as many DX80 Nodes as are needed for your network.
9. When you are finished binding, press **BACK** on the DXM until you return to the main menu.

Bind a MultiHop Radio to a DXM and Assign the Device ID

Before beginning the binding procedure, apply power to all the devices. Separate radios by two (2) meters when running the binding procedure. Put only one DXM MultiHop client radio into binding mode at a time to prevent binding the server or repeater radios to the wrong client radio.

Binding MultiHop radios ensures all MultiHop radios within a network communicate only with other radios within the same network. The MultiHop client radio automatically generates a unique binding code when it enters binding mode. This code is transmitted to all radios within range that are also in binding mode. After a repeater/server radio is bound, the repeater/server radio accepts data only from the client radio to which it is bound. The binding code defines the network, and all radios within a network must use the same binding code.

1. Enter binding mode on the DXM radio:
    a. Use the arrow keys select the **ISM Radio** menu on the LCD and press **ENTER**.
    b. Highlight the **Binding** menu and press **ENTER**.
2. Assign the device address to the repeater or server radios. Valid device IDs are 11 through 60.
    - For MultiHop radios without rotary dials: Use the DXM arrow keys to select the device ID to assign to the MultiHop radio about to enter binding mode. The DXM assigns this device ID to the next radio that enters binding mode. Only bind one server radio at a time.
    - For MultiHop radios with rotary dials: Use the MultiHop radio's rotary dials to assign a device ID . The left rotary dial represents the tens digit (1 through 6) and the right dial represents the ones digit (0 through 9) of the device ID. You can leave the DXM "Bind to" address set to 1 because the MultiHop's rotary dials will override that setting.
3. Start binding mode on the DXM radio by pressing **ENTER** on the DXM radio.
4. After entering binding mode on the DXM, put the MultiHop repeater or server radio into binding mode.
    - For housed radios, triple-click button 2.
    - For board-level radios, triple-click the button.
    - For radios without buttons, refer to the radio's datasheet for instructions on entering binding mode.

    After binding is completed, the MultiHop radio automatically exits binding mode and begins operation.
5. Press **BACK** on the DXM to exit binding mode for that specific device address.

    The MultiHop radio's LEDs continue to flash red until the DXM exits binding mode with that MultiHop radio.
6. Label the MultiHop radio with the assigned address number for future reference.
7. Repeat these steps, changing the device address, for as many MultiHop radios as are needed for your network.

8. When you are finished binding, press **BACK** on the DXM until you return to the main menu.

   All radio devices begin to form the network after the client data radio exits binding mode.

Conduct a Site Survey from the DXM

Conduct a Site Survey to verify the wireless communication between the radios within your wireless network.

Conduct the site survey when the Nodes and DXM Controller are at the proposed installation sites to determine each radio's signal strength with the DXM.

For a DX80 network, the Gateway controls the site survey and the results display on the LCD. Running a site survey on a DX80 network does not affect the throughput of the DX80 network. The DX80 Gateway-Node system can run a site survey analysis while the network is operational. For a MulitHop network, the client device passes the site survey request to the intended Modbus server device. The Site Survey runs and the results display on the LCD. Running a site survey on a MultiHop network stops all network traffic to that device.

1. On the DXM: Use the arrow buttons to select the **ISM Radio** menu and press **ENTER**.
2. Select the **Site Survey** menu and press **ENTER**.
3. Use the Up or Down arrows to select the device ID number and press **ENTER** to run the site survey with that radio.

   The site survey results display as green, yellow, red, and missed packets. Green indicates the highest signal strength, then yellow, and red. Missed packets were not received.
4. When you are finished running the Site Survey, press **Back** twice to return to the main menu and exit site survey mode.

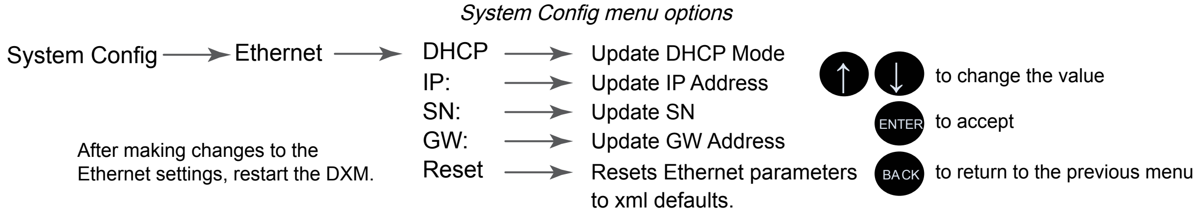
If the Site Survey fails (100 missed packets), verify the radios are at least 10 feet from the DXM and/or rerun the binding procedure. If you find poor signal quality, common solutions include moving the DXM to a more central location relative to the Nodes or using higher-gain antennas on the DXM. Contact your local Banner Engineering representative for assistance.

Set a Static IP Address

Change the IP address of the DXM to connect to a local area network, Modbus TCP/IP host controller, or EtherNet/IP host controller.

There are two ways to set the IP address: using the DXM's LCD menu or using the configuration software to change the XML file. IP addresses entered into the LCD menu system override the IP addresses in the XML configuration files. To use the IP addresses set in the XML configuration file, clear the IP addresses from the menu system.

System Config menu options



1. On the DXM, use the arrows and move to the **System Config** menu. Press **ENTER**.
2. Use the arrow keys to select the **Ethernet** menu. Press **ENTER**.
3. Highlight the **DHCP** selection and press **ENTER**. Set DHCP to OFF.
4. The system will request a restart, press **ENTER** to confirm.
5. Follow steps 1 and 2 to reenter the Ethernet menu. Use the arrow keys to select **IP**. Press **ENTER**.

   The IP address displays (for example, 192.168.0.1).
6. Use the up and down arrows to change the IP address. Press **ENTER** to move to the next octet.
7. Press **ENTER** on the final octet to accept the changes.
8. Cycle power to the DXM.

   The changes are saved on the DXM and the new IP address will be used.

Use this same procedure to set the subnet mask (SN) and default gateway (GW) to match your network requirements. Your IT department can provide these settings if needed.

Configuration Instructions

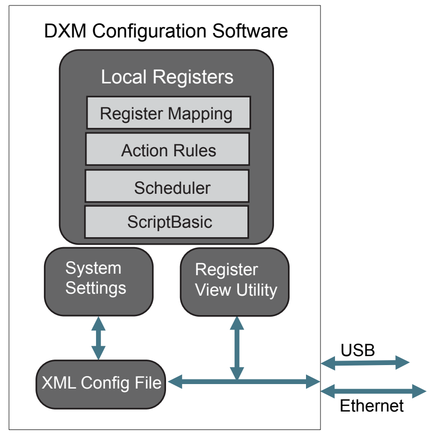
Configuring the Controller

Configure the DXM using the configuration software. The DXM Configuration Software allows the user to define parameters for the DXM, then saves the configuration in an XML file on the PC. To configure the DXM, connect the DXM's USB or Ethernet port to a computer.

After the configuration file is saved, upload the XML configuration file to the DXM for operation.

This quick start guide outlines the basic operations to set up a DXM using the configuration software. For a more comprehensive explanation of features, refer to the DXM Configuration Software Instruction Manual (p/n 209933).

DXM Configuration Software



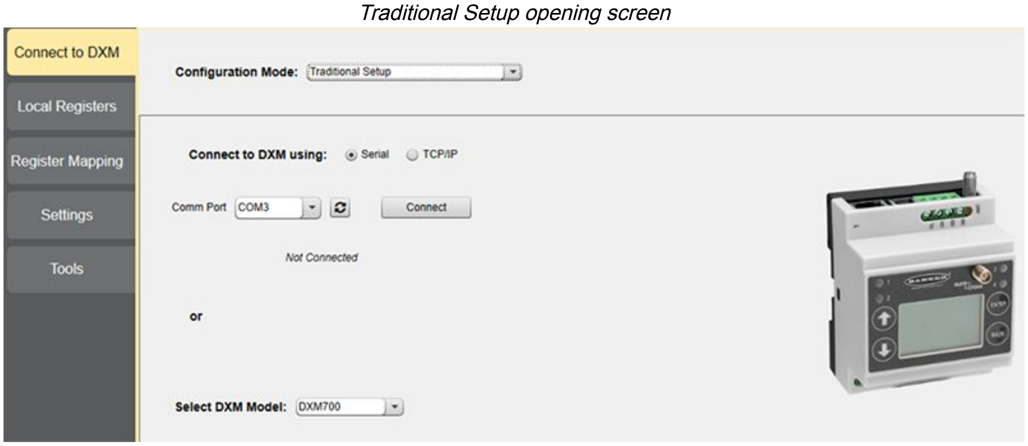
Introduction to Traditional Setup Mode

This section will walk you through the traditional method of setting up the DXM Configuration Software and communicating with a connected DXM device. Version 4 of the configuration software supports multiple DXM device models, each of which incorporates different features.

As soon as a DXM model is connected to your computer, the software automatically detects the correct model and loads the appropriate screens. You may also manually select which model of DXM you are configuring if you intend to create a configuration file without connecting a device. This ensures that the interface and the configuration file use the correct features.

Not all screens are available for all models. To change to another model of DXM, go to the **Connect to DXM** screen and use the drop-down list to select another model. If the active configuration is incompatible with the selected model, you will be prompted to either proceed and wipe out the active configuration or cancel the model change and preserve the configuration.

Traditional Setup opening screen



Connect via USB or Ethernet. If connecting via Ethernet, set network parameters through the DXM LCD menu in the **System Cfg › Ethernet** menu. Network parameters can also be set within the configuration software. Setting parameters on the LCD menu overrides the parameters stored in the configuration file. To use the network parameters in the configuration file, reset the network parameters on the DXM LCD menu.

Since the DXM-R90x connects only via TCP, its **Connect to DXM** screen differs from the other DXM models. When the **Select DXM Model** drop-down is set to DXM-R90x, a new network discovery table is displayed. Click **Scan Network for DXMs** to detect DXM devices on the host computer's network. Discovered DXMs are listed in the network discovery table. Double-click any row entry to connect to that DXM. If the DXM's IP address is already known, the standard TCP connection option is available below the network discovery table.

Banner recommends disconnecting the COMM port through the **Device** menu before turning off power or disconnecting the USB cable. Use **Device › Reboot** to restart the DXM if needed; the tool automatically disconnects the COMM port, then reconnect it again.

> **TIP:** If connection attempts are failing (Application Status Icon in the footer of the tool is Red), close the configuration software and disconnect the USB cable from the computer. Reconnect the cable, launch the software, and attempt connecting again.

If you cannot connect to your DXM Controller, refer to for more information.

> **IMPORTANT:** Any model of DXM may connect to the configuration software regardless of which device model is selected in the tool. Compatibility is checked before configuration files are uploaded to the device.

Configuration Example: Reading Registers on a Modbus Server Device

The local registers are the main global pool of registers that are defined by the user to store data within the DXM. The local registers are listed on the **Local Registers › Local Registers in Use** screen.

The bottom status bar displays the communications status, application status, and the DXM Configuration Software version.

In this short example, we will configure the DXM to read six registers on an external Modbus server device and save the data into the local registers.

The software only loads a file to the DXM. Internal parameter settings that are changed in the tool but not saved to the file will not be sent to the device.

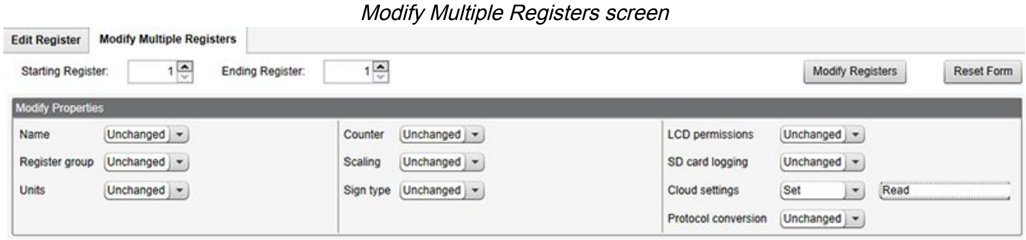
Modify Multiple Registers

Modify a range of registers from the **Local Registers › Local Registers in Use › Modify Multiple Registers** screen.

Select which parameter fields to modify. Most parameters have three selections.

- Unchanged—no changes
- Default—change to default settings
- Set—modify the parameter. Other selections will appear based on the parameter.

Modify Multiple Registers screen



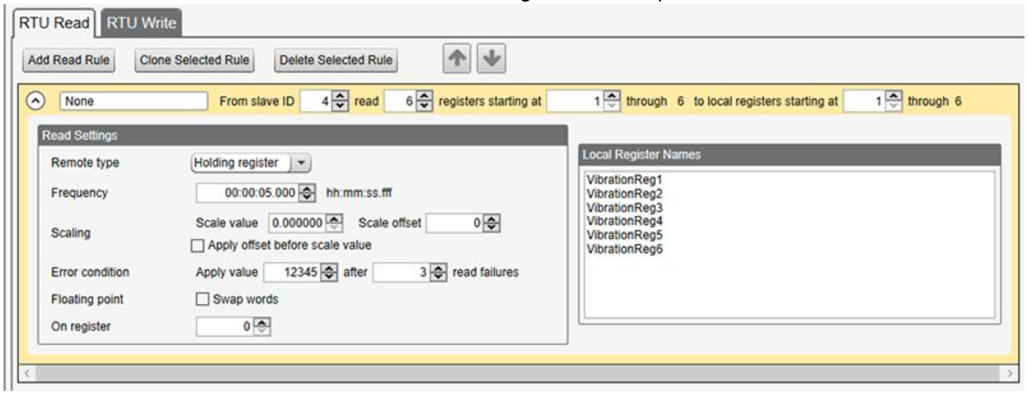
1. Enter the **Starting register** and **Ending register**.
2. Select the value to change using the drop-down list next to each value.
3. Enter the new value in the field provided.
4. To push register values to the web server, set **Cloud Settings** to **Read**.
   If the **Cloud Settings** are set to **Read**, the web server only views data from the device and cannot write data to the device. If the permissions are set to Write, the web server only writes to the device and cannot read the data. If the permissions are set to Read/Write, the web server can read the data from the device and write to the device from the web.
5. Click **Modify Registers** to save and apply the changes.

Create an RTU Read Rule

Follow these steps to create a new read rule.

This example screen shows a read rule created to read six registers (address 1 through 6), from Modbus ID 4. The results are stored in the Local Registers 1 through 6.

Read Rules - Configuration Example

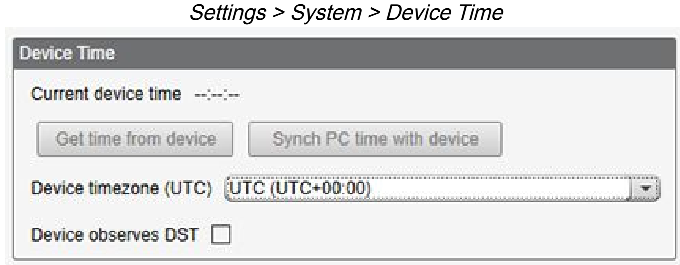


1. From the **Register Mapping › RTU › RTU Read** screen, click **Add Read Rule**.
2. Click the arrow next to the name to display the parameters.
3. Name your rule.
4. Select the device ID.
5. Select how many registers to read, and the beginning register.
6. Define the register type, how often to read the register, and any other appropriate parameters.
7. If necessary, select the error condition. For this example, if the read function fails after three attempts, the read rule writes 12345 to the DXM local registers. Notice the list of local register names this read rule is using.

Set the Time

Use the **Settings › System** screen to define the time zone and daylight saving option. The time zone and DST options are saved into the configuration file.

Settings > System > Device Time



1. Go to the **Settings › System** screen.
2. If you connect the DXM to a computer, click **Sync PC Time with Device** to set the time on the DXM to match the time of the computer.
3. Set your time zone and select whether or not your device observes daylight saving time (DST).

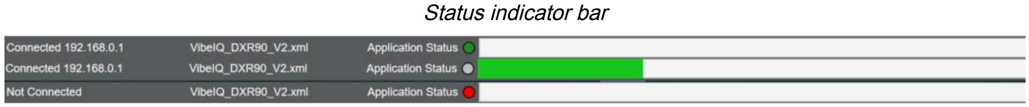
Save and Upload the Configuration File

After making any changes to the configuration, you must save the configuration files to your computer, then upload it to the device.

Changes to the XML file are not automatically saved. Save your configuration file before exiting the tool and before sending the XML file to the device to avoid losing data. If you select **DXM › Send XML Configuration to DXM** before saving the configuration file, the software will prompt you to choose between saving the file or continuing without saving the file.

1. Save the XML configuration file to your hard drive by going to the **File › Save As** menu.
2. Go to the **DXM › Send XML Configuration to DXM** menu.

Status indicator bar



- If the Application Status indicator is red, close and restart the DXM Configuration Tool, unplug and re-plug in the cable and reconnect the DXM to the software.
- If the Application Status indicator is green, the file upload is complete.
- If the Application Status indicator is gray and the green status bar is in motion, the file transfer is in progress.

After the file transfer is complete, the device reboots and begins running the new configuration.

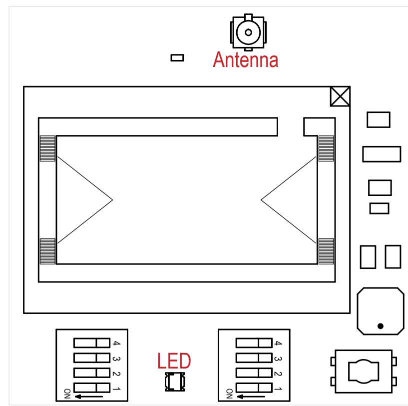
Chapter Contents

Chapter 3 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 Switches for the MultiHop Radio

MultiHop ISM radio models include R2, R4, or R5 in the model number.

- DXMxxx-xxR2 - MultiHop 900 MHz
- DXMxxx-xxR4 - MultiHop 2.4 GHz
- DXMxxx-xxR5 - MultiHop 900 MHz, 100 mW
- DXMxxx-xxR9 - MultiHop 900 MHz, (Australia)

Making changes to the baud or parity settings requires that you make the same settings to the Modbus Client Communications section within the DXM Configuration Software (**Settings › General**.

Disabling the serial port disables the ISM radio in the DXM. Selecting Transparent mode causes radio communications to be slower and denies access to device I/O register data.

DIP switch settings

	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*			

Continued on page 23

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	D1 Switches				D2 Switches			
Device Settings	1	2	3	4	1	2	3	4
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		
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. The default settings for D2 DIP switches 3 and 4 are ON. This allows for forcing the device into client mode and DXM menu control for the radio power settings.

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.

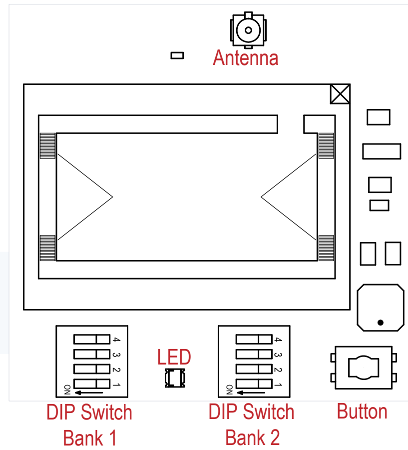
DIP Switch Settings for the Performance Gateway Radio Module

The 900 MHz radios have a high output option that will transmit at 500 mW (27 dBm). The low output option transmits at 250 mW (24 dBm). The 250 mW mode reduces the radio's range but improves the battery life in short-range applications. For 2.4 GHz models, this DIP switch is disabled. The transmit power for 2.4 GHz is fixed at about 65 mW EIRP (18 dBm).

DX80 Performance Gateway ISM radio devices include R1, R3, or R8 in the model number.

- DXMxxx-xxR1 - DX80 Performance 900MHz
- DXMxxx-xxR3 - DX80 Performance 2.4GHz
- DXMxxx-xxR8 - DX80 Performance 900MHz (Australia)

DIP switch bank 1 and bank 2



IMPORTANT: To adjust the transmit power on the Gateway radio, Banner recommends using the LCD menu (**System Conf › ISM Radio › RF CNTRL**).

DIP switch settings for bank 1

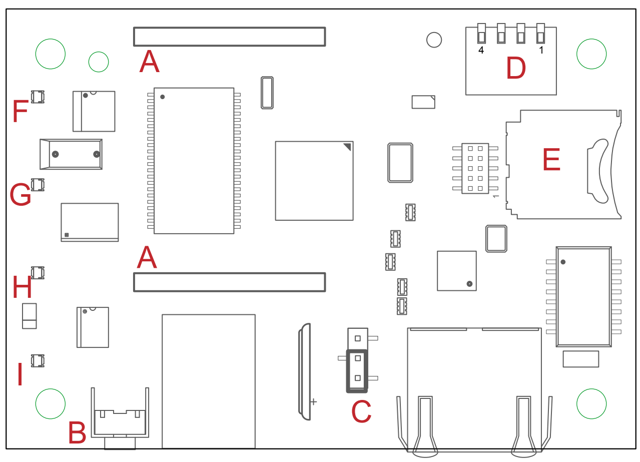
DIP Switch 1	
OFF	500 mW (27 dBM) (default configuration; 900 MHz only)
ON	250 mW (24 dBm, 900 MHz models only), DX80 compatibility mode

Chapter Contents

Chapter 4 Processor Board

Processor Board for the DXM1x0 Models

Processor board for the DXM

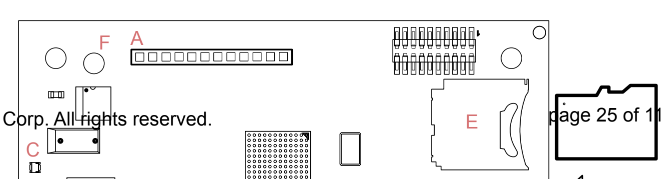


Processor board features

Callout	Description	Function
A	Cellular modem connection	Install the cellular modem onto the processor board with the cellular modem's U.FL connector on the left. The antenna cable will go between the cellular U.FL connector and the left I/O base board U.FL connector. Always disconnect the power to the device before installing or removing a cellular modem.
B	Button	Use the processor board button to force a cloud push. To force a push to the cloud, press and hold this button for five (5) seconds to send an immediate push message from the device (if properly configured).
C	Boot load jumpers	
D	DIP switches	
E	Micro SD card	
F	LED 1	Heartbeat, indicates the processor is running
G	LED 2	Indicates the cellular modem power cutoff is active; if the incoming power is less than 11.2 V, the cellular modem is powered down
H	LED 3	XML configuration file was rejected; or file load in process; or the second phase of boot loading is in process (flashing)
I	LED 4	ScriptBasic program failed to load; or the beginning phase of boot loading is in process (flashing = in process, on = complete)

Processor Board for the DXM1x00 Models

A - Cellular modem connection
B - Bootload



C - LED
D - DIP switches
E - Micro SD card

Cellular Modem Connection—Install the cellular modem onto the processor board with the cellular modem's U.FL connector on the left. The antenna cable will go between the cellular U.FL connector and the left I/O base board U.FL connector. Always disconnect the power to the device before installing or removing a cellular modem.

Button Operation—Pressing and holding the button down during power-up puts the processor into manual programming mode. Programming requires a microchip SAM-BA programming application. To force a push to the cloud, press and hold this button for five (5) seconds to send an immediate push message from the device (if properly configured)

LED Operation—The single LED indicates the processor is running.
- Flashing green—The processor is running
- Single red flash at power-up time—The Bootloader is present
- Toggling Red/Orange—The Bootloader is examining the new file
- Toggling Red/Green—The Bootloader is loading the new image

DIP Switch Settings for the Processor Board

After making changes to the DIP switch settings, cycle power to the device.

DIP switches for the DXM processor board

Settings	DIP Switches			
	1	2	3	4
Disable Ethernet Port	OFF *			
	ON			
Disable LCD Display		OFF *		
		ON		
Not used			OFF *	
Bypass XML				OFF *
				ON

Bypass XML

Turn on to have the XML file ignored at boot time. This is useful for ignoring a corrupt or questionable XML configuration file. After the device is running, a new XML file can be loaded using the DXM configuration tool.

Turn on to stop the processor from executing the defined configuration. This is useful if the loaded configuration is using all the processing time and not allowing DXM Configuration Tool operations.

The factory default position is OFF.

Disable Ethernet Port

Set to on to power down the Ethernet interface. Disabling the unused Ethernet port reduces power consumption.

The factory default position is OFF.

Disable LCD Display

Set to on to disable the LCD. This DIP switch should be on when the LCD display board is not connected.

The factory default position is OFF.

Ethernet

Before applying power to the DXM, verify the Ethernet cable is connected.

The number of times the processor attempts to connect to the Ethernet network is configured in the DXM Configuration Software (**Settings › Network Ethernet Connection Acquisition**). The default setting is two retries one minute after the device boots up and another retry two minutes later.

The Ethernet connection supports the DXM Configuration Software, Modbus/TCP, and EtherNet/IP. ScriptBasic also has access to Ethernet for custom programming. Use the software or LCD menu system to configure the characteristics of the Ethernet connection, including the IP address. Any parameters not changeable from the menu system are configurable from the configuration software.

Ethernet parameter changes entered through the LCD menu override the XML configuration parameters. To return to using the network settings in the XML configuration file, remove the Ethernet parameters defined by the LCD menu using the **System Config › Ethernet › Reset** menu.

USB

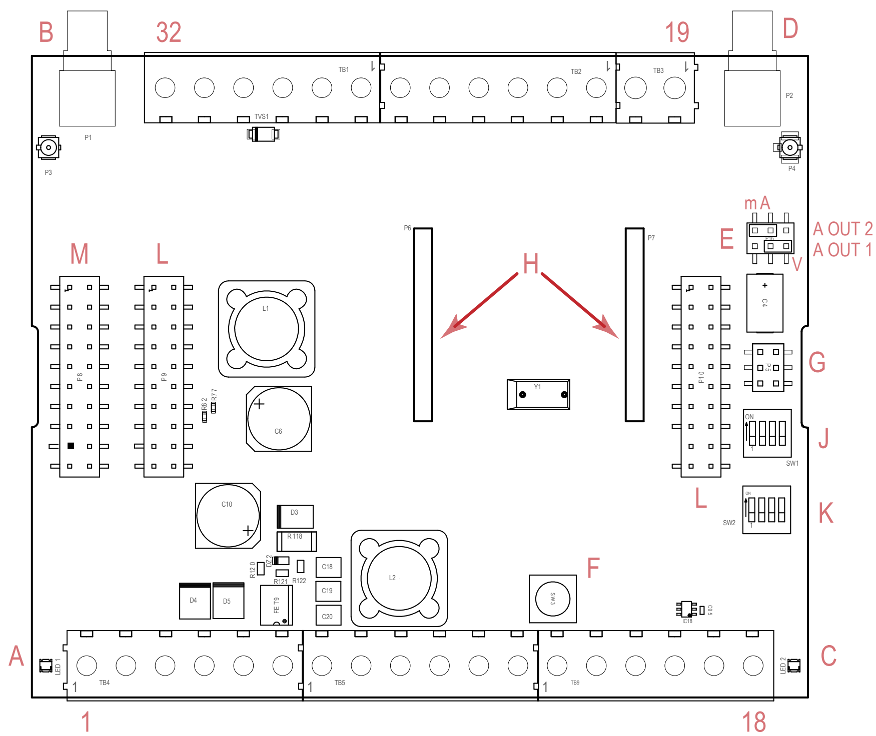
The USB port is used with the DXM Configuration Software to program the DXM100-Bx or 1000-Bx Wireless Controller. The USB port is also used as the console output for the processor and ScriptBasic.

Turn on debug messages to the serial console by selecting **Print push debug messages to serial console** in the DXM Configuration Software **Settings › Cloud Services** screen.

Chapter Contents

Chapter 5 IO Base Boards

I/O Base Board Connections for the B1 Models



1	No connection	12	CT. RS-232 CTS	23	N3. NMOS OUT 3
2	PW. 12 to 30 V dc or solar power in (+)	13	S-. Secondary RS-485 –	24	N2. NMOS OUT 2
3	GD. Ground	14	S+. Secondary RS-485 +	25	N1. NMOS OUT 1
4	B+. Battery in (< 15 V DC)	15	CL. CANL (DXM100-B1 only)	26	GD. Ground
5	GD. Ground	16	CH. CANH (DXM100-B1 only)	27	U4. Universal Input 4
6	M-. Primary RS-485 –	17	GD. GND	28	U3. Universal Input 3
7	M+. Primary RS-485 +	18	P3. Courtesy Power 5 V	29	GD. Ground
8	GD. Ground	19	A2. Analog OUT 2	30	P1. Adjustable Courtesy Power (5 V or 16 V)
9	TX. RS-232 Tx	20	A1. Analog OUT 1	31	U2. Universal Input 2
10	RX. RS-232 Rx	21	P2. Adjustable Courtesy Power (5 V or 16 V)	32	U1. Universal Input 1

Continued on page 29

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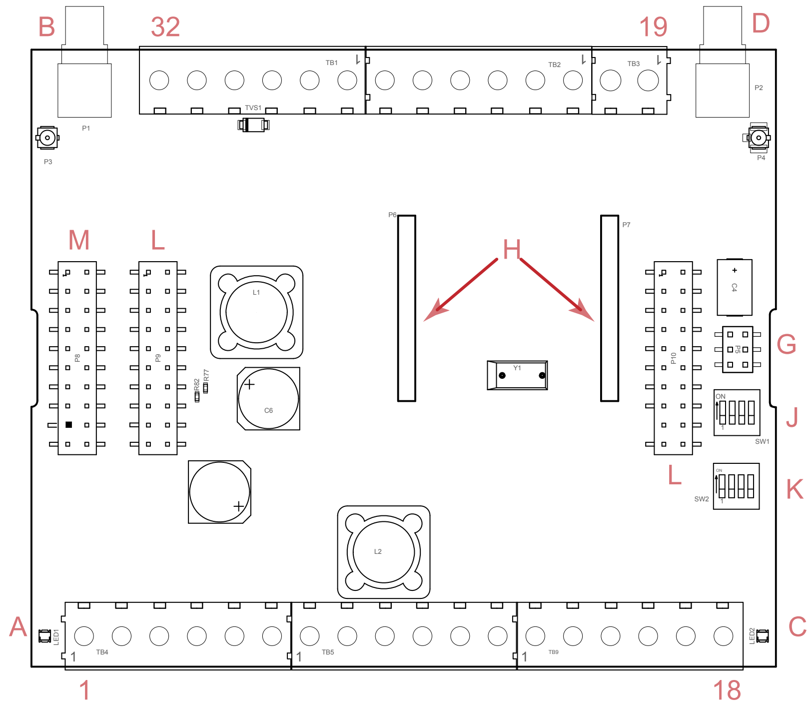
11	RT. RS-232 RTS	22	N4. NMOS OUT 4		

A	Base board LED	E	Jumpers - Configures Analog Out 1 and 2 for mA or V	J	Modbus Server ID DIP Switches
B	A1. Cellular or secondary antenna	F	Radio Binding Button	K	Modbus Server ID DIP Switches
C	Radio LED	G	Programming header	L	Processor Board Connection
D	A2. ISM Antenna	H	ISM Radio Board Connection	M	Display Connection

I/O Base Board for the B2 and S2 Models



1	No connection	12	2B. DLatch 2B	23	N3. NMOS OUT 3
2	PW. 12–30 V DC or solar power in (+)	13	S-. Secondary RS-485 – (not used for the S2)	24	N2. NMOS OUT 2
3	GD. Ground	14	S+. Secondary RS-485 + (not used for the S2)	25	N1. NMOS OUT 1
4	B+. Battery in (< 15 V DC)	15	SP. SDI-12 Courtesy Power	26	GD. Ground
5	GD. Ground	16	SD. SDI-12 Data	27	U4. Universal Input 4
6	M-. Primary RS-485 –	17	GD. GND	28	U3. Universal Input 3
7	M+. Primary RS-485 +	18	P3. Courtesy Power 5 V	29	GD. Ground
8	GD. Ground	19	A2. Analog OUT 2 (0–10 V)	30	P1. Adjustable Courtesy Power (5–24 V)
9	1A. DLatch 1A	20	A1. Analog OUT 1 (0–10 V)	31	U2. Universal Input 2
10	1B. DLatch 1B	21	P2. Adjustable Courtesy Power (5–24 V)	32	U1. Universal Input 1
11	2A. DLatch 2A	22	N4. NMOS OUT 4		

A	Base board LED			J	Modbus Server ID DIP Switches

Continued on page 30

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B	A1. Cellular or secondary antenna			K	Modbus Server ID DIP Switches
C	Radio LED	G	Programming header	L	Processor Board Connection
D	A2. ISM Antenna	H	ISM Radio Board Connection	M	Display Connection

DIP Switches for the IO Board

The DXM100-Bx or 1000-Bx Wireless Controller I/O board DIP switches are set from the factory to Modbus ID 200.

Set the Modbus ID on the IO Base Board (for Models without LCDs)

For DXM Server models without an LCD menu system, use DIP switches J and K to set the Modbus ID.

This device can use 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 DXM100-S1, DXM100-S2, DXM100-S1R2, and DXM100-S2R2 models.

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 (DX100-S1 and -S1R2 models only) [1]				ON
Standard Communication Mode				OFF

The DIP switches at location K define the lower digit of the Modbus ID.

DIP Switches J		DIP Switch K, Switches 1, 2, 3, 4 (0 is OFF, 1 is ON)									
1	2	0,0,0,0	1,0,0,0	0,1,0,0	1,1,0,0	0,0,1,0	1,0,1,0	0,1,1,0	1,1,1,0	0,0,0,1	1,0,0,1
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

DXM100-Bx or 1000-Bx Wireless Controller Example—To set the DXM100-Bx or 1000-Bx Wireless Controller to a Modbus ID of 34, set the following:

Location J DIP switches set to 1=OFF, 2=ON
Location K DIP switches set to 1=OFF, 2=OFF, 3=ON, 4=OFF

The location J DIP switches set the upper Modbus ID digit to 3 while the location K DIP switches set the lower digit to 4.

Setting 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).

- For the DXM100-Bx or 1000-Bx Wireless Controller model, all switches on DIP switch K should be in the OFF position to use the Modbus register server ID.

(1) Must be in the ON position for the -S1 and -S1R2 model)
(2) Uses value in Modbus register 6804.

I/O Board Jumpers for the B1 and S1 Models

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.

Jumper	Function	Positions
E	Analog output characteristics for AO2 (pin 19) and AO1 (pin 20)	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.

Apply Power to the DXM100-Bx Controller

Apply power to the DXM100-Bx or 1000-Bx Wireless Controller using either 12 to 30 V DC or a 12 V DC solar panel and 12 V sealed lead acid battery operating together.

The DXM100 has three power input and three power output options:

- Input Power:
  - 12 to 30 V DC
  - 12 to 30 V DC solar panel
  - 12 V DC sealed lead acid battery with automatic charging

- Courtesy Output Power Supplies:
  - One 5 V DC fixed
  - Two 5 V DC or 16 V DC (DXM100-B1 models) or Two 5 V to 24 V DC (DXM100-B2 models)

The DXM continuously monitors the health of the power inputs. If a power input fault is detected, the DXM automatically switches over to battery with continuous uninterrupted operation.

If the incoming voltage drops below 11.2 V DC, the cellular modem does not turn on and will not turn on until the voltage is above 11.8 V DC. A text file (CmVMon.txt) on the internal micro SD card saves the periodic sampling of the incoming voltage. If cellular operation stops because of voltage, it is logged in this file.

Pin	Description
Pin 1	No connection
Pin 2	12 to 30 V DC input (+) or solar panel connection (+)
Pins 3, 5, 8, 17, 26, 29	Main logic ground for the DXM100-Bx or 1000-Bx Wireless Controller
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.

Connecting a Battery

When attaching a battery to the DXM 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.

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.

Supplying Power from a Solar Panel

To power the DXM100-Bx or 1000-Bx Wireless Controller 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 DXM 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 200):

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

Connecting the Communication Pins

The base board communications connections to the DXM100-B1 Wireless Controller are RS-485 (primary), RS-485 (secondary) or RS-232. The base board communications connections to the DXM100-B2 Wireless Controller are RS-485 (primary) and RS-485 (secondary).

RS-485. The primary RS-485 bus is a common bus shared with the ISM radio board (Modbus ID 1) or optional cellular board. The DXM100-Bx or 1000-Bx Wireless Controller is defined as the Modbus Client on this bus. Other internal Modbus servers include the local processor registers (Modbus ID 199), the base I/O controller (Modbus ID 200), and the display board (Modbus ID 201). When assigning Modbus IDs to externally connected devices, only use IDs 2 through 198.

RS-232. The RS-232 bus is not currently defined for the DXM100-B1 models. There is no RS-232 for the DXM100-B2 models.

Pin	Parameter	Description
Pin 6	Primary RS-485 –	Running Modbus protocol at 19.2k baud, use this bus to connect to other Modbus Server devices. The DXM100-Bx or 1000-Bx Wireless Controller is a Modbus Client device on this RS-485 port.
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. (DXM100-B1 models only; not available on the DXM100-B2 models)
Pin 10	RS-232 Rx	
Pin 13	Secondary RS-485 –	The DXM100-Bx or 1000-Bx Wireless Controller is a Modbus server on this bus (see "I/O Base Board Connections for the B1 Models" on page 28).
Pin 14	Secondary RS-485 +	
Pin 15	CANL –	DXM100-B1 models only. Not available on the DXM100-B2 or DXM1000 models.
Pin 16	CANH +	

Modbus RTU Client and Server Ports

The DXM can be a Modbus RTU client device to other server devices and can be a Modbus server device to another Modbus RTU client. The DXM uses the primary RS-485 port (M+/M-) as a Modbus RTU client to control external server devices. All wired devices connected to the client RS-485 port must be server devices.

- As a Modbus RTU client device, the DXM controls the external server connected to the primary RS-485 port, the local ISM radio, the local I/O base board, and the local display board.
- As a Modbus RTU server device, the DXM local registers can be read from or written to by another Modbus RTU client device.

The secondary port (S+/S-) is the Modbus RTU server connection. The secondary (server) Modbus RS-485 port (S+/S-) is controlled by another Modbus client device, not the DXM. The server port is used by an external Modbus client device that will access the DXM as a Modbus server device.

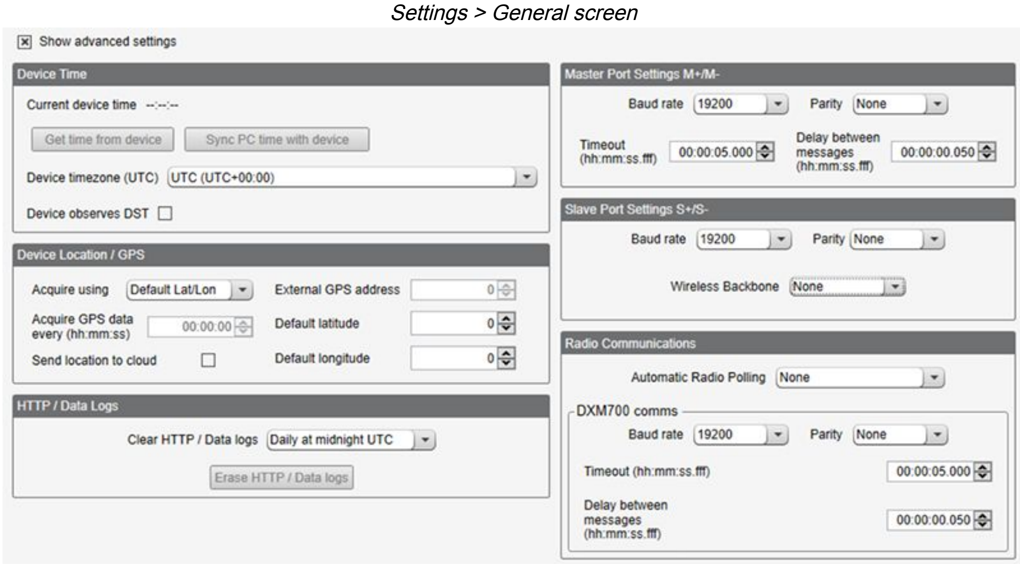
Use the configuration software to define operational settings for both the Modbus RTU client port and the Modbus RTU server port.

Use the DXM's LCD menu to set the Modbus ID for the secondary RS-485 port.

Set the Client and Server Port Parameters

The basic communications parameters for the RS-485 ports are set in the DXM Configuration Software and are saved in the XML configuration file.

Settings > General screen



1. In the DXM Configuration Software, go to the **Settings › General** screen.
2. To set the parameters for the Modbus Client, change the settings in the **Client Port Settings M+/M-** section.
3. To set the parameters for the Modbus Servers, change the settings in the **Server Port Settings S+/S-** section.

Baud Rate
: Defined for both the Modbus client and server
: Settings include: 19200 (default), 1200, 2400, 9600, 38400, 57600, and 115200.

Delay between messages
: Applies to the Modbus client port
: Sets the minimum wait time from the end of a Modbus transaction to the beginning of the next Modbus transaction.

Parity
: Defined for both the Modbus client and server
: Settings include: None (default), odd, even, space, and mark

Timeout
: Applies to the Modbus client port
: Covers the expected time for messages to be sent throughout the wireless network. For the DXM, the **Timeout** parameter is the maximum amount of time the DXM should wait after a request is sent until the response message is received from the Modbus server device.

Wireless Modbus Backbone
: Applies to the Modbus server port
: Define when there is an ISM radio plugged into the processor board. When this is done, the Modbus server port uses the MultiHop radio as the server port instead of the terminal block connection on the I/O base board. Settings include: None (default), Modbus, or Ethernet

Set the DXM Modbus Server Port ID

Set the DXM Modbus server port ID using the LCD menu system.

1. On the LCD, use the down arrow to highlight **System Config** and click the **Enter** button.
2. Highlight **DXM Modbus ID** and click **Enter**.
3. Use the up and down arrow buttons to change the DXM Modbus Server Port ID.
4. Press **Enter** to accept the ID change.
5. Use the configuration software to cycle power to the device.

After cycling power to the device, the updated DXM Modbus ID is listed under the **System Config** menu.

Inputs and Outputs

The I/O base board is a Modbus server device (ID 200) that communicates to the processor board using Modbus commands. Use the DXM Configuration Software to create a configuration using read/write maps that will access inputs or outputs on the I/O board.

Communication with the I/O board runs at a maximum rate of 10 ms per transaction. The parameter setting for the bus with the I/O board and the processor board are fixed. External Modbus communication runs at a maximum rate of 50 ms per transaction. The parameter settings for the external RS-485 buses are controlled by the DXM Configuration Software.

Refer to for more descriptions of each Modbus register on the DXM100-Bx or 1000-Bx Wireless Controller.

Universal Inputs

The universal inputs on the DXM100-Bx or 1000-Bx Wireless Controller can be programmed to accept several different types of inputs:

- Discrete NPN/PNP
- 0 to 20 mA analog
- 0 to 10 V analog
- 10k temperature thermistor
- Potentiometer sense
- Bridge
- NPN raw fast

Any input can be used as a synchronous counter by configuring the input as a discrete NPN/PNP input.

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. Refer to the DXM100 Controller Instruction Manual (p/n 190037) 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 IO Registers for the B1 IO Base Board" on page 76 for universal input register definitions.

Pin	Universal Input	Modbus Register	Description
27	4	4	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 defined in "Modbus IO Registers for the B1 IO Base Board" on page 76. 0 = NPN 1 = PNP 2 = 0 to 20 mA 3 = 0 to 10 V dc 4 = 10k Thermistor 5 = Not used 6 = Not used 7 = Bridge 8 = NPN Raw Fast (default)
28	3	3	
31	2	2	
32	1	1	

Thermistor Input

A thermistor input must use a 10k temperature 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 Modbus registers defined in "Modbus IO Registers for the B1 IO Base Board" on page 76.

Potentiometer Input

A potentiometer input is created from three inputs: a voltage source (pin 30) that supplies 5 V to the potentiometer and two inputs set to voltage inputs to read the voltage across the potentiometer. See Using Universal Inputs to Read a Potentiometer (p/n b_4462775) for more information.

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.

Synchronous Counters

When an input is configured as a counter (inputs set to NPN/PNP), the input counts the input signal transitions. The count value is stored into 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 34.

Synchronous counter sample the inputs every 10 ms. The input logic does not detect rising or falling edges, but instead 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.

Example: Configure Input 1 as a Synchronous Counter

1. Connect the DXM to the PC.
2. Launch the DXM Configuration Software software.
3. Connect to the DXM 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.

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

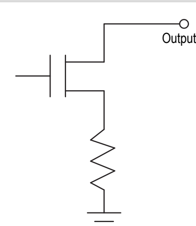
1. Connect the DXM to the PC.
2. Launch the DXM Configuration Software software.
3. Connect to the DXM by selecting the **Device › Connection Settings** menu option. You may connect using either USB or Ethernet.
4. Select a COMM port from the drop-down list and click **Connect**.
5. Click on the **Register 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 200 (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 DXM to the PC.
2. Launch the DXM Configuration Software software.
3. Connect to the DXM 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 200 (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.

NMOS Outputs for the DXM100

NMOS output pins for the DXM100 models

Pin	NMOS Discrete Outputs	Modbus Register	Description	Wiring
22	4	504	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	
23	3	503		
24	2	502		
35	1	501		

Analog (DAC) Outputs for the B1 and S1 Models

The B1 and S1 analog outputs may be configured as either 0 to 20 mA outputs (default) or 0 to 10 V outputs.

To change the analog (DAC) output type:

1. Remove power to the device.

2. Remove the DXM cover.
3. Change the hardware jumper position (see the table for the pin number and "I/O Base Board Connections for the B1 Models" on page 28 for the pin locations).
4. Replace the DXM cover.
5. Restore power to the DXM.
6. Set the Output Type Select Modbus register (on the I/O board, ID 200) to a value of 2 (default) to select 0 to 20 mA or a value of 3 to select 0 to 10 V. For analog output 1 write to Modbus register 4008, for analog output 2 write to Modbus register 4028 (see the table for the values).

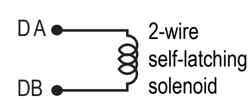
DXM100/1000-B1 and S1 Models			
Pin	Analog Output	Modbus Register	Description
20	1	507	0 to 20 mA or 0 to 10 V DC output (I/O board jumper selectable) Accuracy: 0.1% of full scale +0.01% per °C Resolution: 12-bit
19	2	508	

Analog (DAC) Outputs for the B2 and S2 Models

The B2 and S2 analog outputs are 0 to 10 V dc outputs and cannot be changed.

DXM100/1000-B2 and S2 Models			
Pin	Analog Output	Modbus Register	Description
20	1	509	0 to 10 V DC output Accuracy: 0.1% of full scale +0.01% per °C Resolution: 12-bit
19	2	510	

DC Latching Outputs for the B2 and S2 Models

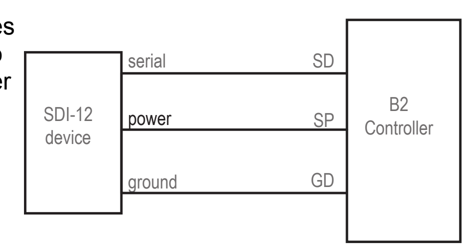
Pin	DC Latching Outputs	Modbus Register	Description	Wiring
9	D1A	507	Write a 1 to the output register to activate the DC Latching output from A to B. Write a 0 to the output register to deactivate the DC Latching output from B to A.	
10	D1B			
11	D2A	508		
12	D2B			

The DXM Configuration Software allows the user to adjust parameters that govern the operation of the DC latch outputs. Most applications will not require any changes for correct operation. Software parameters include:

- **Enable H-Bridge**—Enable or disable the H-bridge output. Default Enabled.
- **Voltage**—The voltage applied to the output when the output is activated. Default 13 V DC.
- **Cap Warmup Time**—The amount of time given to charge the output capacitor. The more time given to charge the output capacitor the more energy will be available to turn on the output. Default 80 ms
- **Switch Time**—The amount of time the output is turned on to be able to change the solenoid output. Default 40 ms

SDI-12 Interface for the B2 and S2 Models

The SDI-12 interface on the B2 Wireless Controllers can support up to five devices with twelve 32-bit register values each. The SDI-12 interface can be configured to increase the number of registers per device address for devices with large register sets. The factory default enables one SDI-12 device using device address 1 with up to nine registers with a SDI-12 command of "M!".



Use the configuration software or the LCD menu system to adjust the SDI-12 parameters.

Basic SDI-12 Interface Parameters

Up to five devices/commands can be accessed using the SDI-12 interface. There are three parameters for each device/ command: Enable, Device Address, Device Command. For more information, refer to the SDI-12 Technical Notes.

Enable. Instructs the DXM device to activate or deactivate the SDI-12 device. Write a 1 to enable, and write a 0 to disable. The factory default for device 1 is enabled; devices 2 through 5 are disabled.

Device Address. Each SDI-12 device must have a unique device address. This parameter is the ASCII code for the device address. Valid device addresses are `0–9` and `a–z` that map to ASCII codes `48–57` and `97–122`, respectively. The factory default addresses are:

- SDI-12 Device 0 uses ASCII code 48
- SDI-12 Device 1 uses ASCII code 49
- SDI-12 Device 2 uses ASCII code 50
- SDI-12 Device 3 uses ASCII code 51
- SDI-12 Device 4 uses ASCII code 52

Device Command The SDI-12 interface supports "M!" or "C!" commands. Use the Device Command parameter to define which command to use for this device. The factory default is "M!" commands for all devices (value of 10 in the Modbus register).

Supported M! commands

SDI-12 Command	Register Value	SDI-12 Command	Register Value
xM!	0 or 10	xM5!	15
xM1!	11	xM6!	16
xM2!	12	xM7!	17
xM3!	13	xM8!	18
xM4!	14	xM9!	19

Supported C! commands

SDI-12 Command	Register Value	SDI-12 Command	Register Value
xC!	1 or 20	xC5!	25
xC1!	21	xC6!	26
xC2!	22	xC7!	27
xC3!	23	xC8!	28
xC4!	24	xC9!	29

The Modbus configuration registers are listed. All registers are defined as Modbus holding registers. The factory default values are shown in parentheses. All values are in decimal unless noted otherwise.

Device/CMD Configuration	Registers (Default Value)		
	Enable	Device Address	Device Command
SDI-12 Device/CMD 1	1751 (1)	11001 (48) [1]	11002 (10)
SDI-12 Device/CMD 2	1701 (0)	11201 (49)	11202 (10)
SDI-12 Device/CMD 3	1651 (0)	11401 (50)	11402 (10)
SDI-12 Device/CMD 4	1601 (0)	11601 (51)	11602 (10)
SDI-12 Device/CMD 5	1551 (0)	11801 (52)	11802 (10)

[1] The default device addresses 48 through 52 are in ASCII.

SDI-12 Device Result Registers

The result registers store all information received from the SDI-12 devices.

The registers are 16-bit registers and require two registers to store a 32-bit value. The factory default configuration defines the result registers as 32-bit registers, floating point format, and the first nine result registers are enabled for use. A host system reads the SDI-12 device data from these registers.

Result Registers	Register 1	Register 2	Register 3	Register 4	Register 5	Register 6
SDI-12 Device/CMD 1 Result Upper	11101	11103	11105	11107	11109	11111
SDI-12 Device/CMD 1 Result Lower	11102	11104	11106	11108	11110	11112
SDI-12 Device/CMD 2 Result Upper	11301	11303	11305	11307	11309	11311
SDI-12 Device/CMD 2 Result Lower	11302	11304	11306	11308	11310	11312
SDI-12 Device/CMD 3 Result Upper	11501	11503	11505	11507	11509	11511
SDI-12 Device/CMD 3 Result Lower	11502	11504	11506	11508	11510	11512
SDI-12 Device/CMD 4 Result Upper	11701	11703	11705	11707	11709	11711
SDI-12 Device/CMD 4 Result Lower	11702	11704	11706	11708	11710	11712
SDI-12 Device/CMD 5 Result Upper	11901	11903	11905	11907	11909	11911
SDI-12 Device/CMD 5 Result Lower	11902	11904	11906	11908	11910	11912

Result Registers	Register 7	Register 8	Register 9	Register 10	Register 11	Register 12
SDI-12 Device/CMD 1 Result Upper	11113	11115	11117	11119	11121	11123
SDI-12 Device/CMD 1 Result Lower	11114	11116	11118	11120	11122	11124
SDI-12 Device/CMD 2 Result Upper	11313	11315	11317	11319	11321	11323
SDI-12 Device/CMD 2 Result Lower	11314	11316	11318	11320	11322	11324
SDI-12 Device/CMD 3 Result Upper	11513	11515	11517	11519	11521	11523
SDI-12 Device/CMD 3 Result Lower	11514	11516	11518	11520	11522	11524
SDI-12 Device/CMD 4 Result Upper	11713	11715	11717	11719	11721	11723
SDI-12 Device/CMD 4 Result Lower	11714	11716	11718	11720	11722	11724
SDI-12 Device/CMD 5 Result Upper	11913	11915	11917	11919	11921	11923
SDI-12 Device/CMD 5 Result Lower	11914	11916	11918	11920	11922	11924

SDI-12 Device Settings

The following are generic sampling, power, and warmup parameters that should work for all SDI-12 devices. See the tested device table below. In most cases, parameters will not need to be adjusted but if needed there are three common SDI-12 device parameters that control the communications and power of the SDI-12 device. Contact Banner Engineering Corp support for more guidance.

- **Sample Rate**. Formed using two 16-bit parameters, a HI word and a LOW word. The sample rate is how often the SDI-12 device is powered up, then interrogated for data. The value in the registers is the number of 0.010 second counts. For example, the default values are HI word (1) and LOW word (24,464), which after combining the words in hexadecimal will calculate to 90,000 × 0.010 seconds. Adjusting this value affects the battery life.
- **Warmup time**. Amount of time to wait, in 0.010 second increments, from powering on the device to the time to send communications to the device. The default value is 200, or 200 × 0.010 seconds. Adjusting this value affects the battery life.
- **Voltage**. The default voltage setting is approximately 6.7 volts or a register value of 148. Adjusting this value affects the battery life.

	Registers (Default Value)							
Device / Cmd Configuration	Enable	Device Address	Switch Power Enable	Device Command	Sample Hi	Sample Low	Warmup Time	Voltage
SDI-12 Device/CMD 1	1751 (1)	11001 (48) [1]	1754 (4)	11002 (10)	1752 (1)	1753 (24464)	1755 (200)	1756 (148)
SDI-12 Device/CMD 2	1701 (0)	11201 (49)	1704 (4)	11202 (10)	1702 (1)	1703 (24464)	1705 (200)	1706 (148)
SDI-12 Device/CMD 3	1651 (0)	11401 (50)	1654 (4)	11402 (10)	1652 (1)	1653 (24464)	1655 (200)	1656 (148)
SDI-12 Device/CMD 4	1601 (0)	11601 (51)	1604 (4)	11602 (10)	1602 (1)	1603 (24464)	1605 (200)	1606 (148)
SDI-12 Device/CMD 5	1551 (0)	11801 (52)	1554 (4)	11802 (10)	1552 (1)	1553 (24464)	1555 (200)	1556 (148)

These SDI-12 probes have been tested and are functional with the factory default settings.

MFG	Models	Technical Note
Acclima	SEN-SDI (TDT SDI-12 Soil Moisture Sensor)	SDI-12 and the Acclima TDT SDI-12 Soil Moisture Probe (p/n b_4182040)
Adcon Telemetry	HydraProbeII	
AquaCheck	Sub-surface Probe	SDI-12 and the AquaCheck Sub-Surface Soil Moisture Probe (p/n b_4182041)
Decagon	MPS-2, MPS-6, 5TE, TS1, T8	SDI-12 and the Decagon 5TE Soil Moisture Probe (p/n b_4182042) SDI-12 and the Decagon GS3 Soil Moisture Probe (p/n b_4182043) SDI-12 and the Decagon MPS-2 Soil Moisture Probe (p/n b_4182044)
HSTI	HydraScout	SDI-12 and the HydraScout HSTI Probe (p/n b_4182045)
Sentek	EnviroSCAN	SDI-12 and the Sentek EnviroScan Soil Moisture Probe (p/n b_4182046)

[1] The default device addresses 48 through 52 are in ASCII.

Chapter Contents

Chapter 6 Cellular Modem Boards

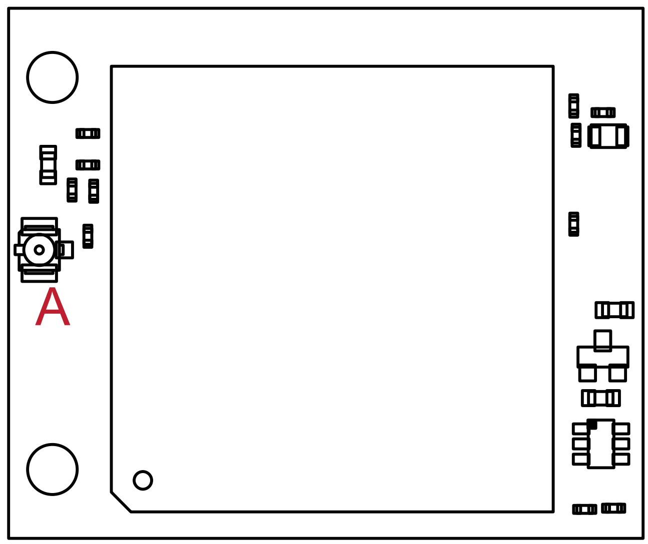
Cellular Modem Board

The LTE-M (United States) or LTE-M/NB-IoT (outside the United States) cellular modem is an optional accessory that is installed on the processor board on the two 12-pin sockets.

A - U.FL antenna connection

The U.FL connector should be to the left, with the antenna cable going to the left antenna U.FL connector. The SIM card slides into the socket on the back of this board.

Cellular modem board



Cellular Power Requirements

If the incoming voltage drops below 11.2 V DC, the cellular modem does not turn on and will not turn on until the voltage is above 11.8 V DC. A text file (CmVMon.txt) on the internal micro SD card saves the periodic sampling of the incoming voltage. If cellular operation stops because of voltage, it is logged in this file.

Using the DXM Cellular Modem

The DXM cellular modem provides a remote network connectivity solution for the DXM.

To use the cellular modem:

1. Verify the cellular modem is installed and the correct antenna is connected to the cellular antenna port.
2. Activate the cellular service.
3. Configure the DXM to use the cellular network as the network interface.

Activating a Cellular Modem

Follow these basic steps, as detailed in this document, to activate the cellular capabilities of your DXM Controller.

1. Purchase a cellular modem kit from Banner Engineering Corp.
2. Install the cellular modem, connect the antenna cable, and connect the cellular antenna.
3. Activate a cellular plan to the SIM card, then insert the SIM card into the cellular modem.
4. Configure the DXM to use the cellular modem.

Purchase one of these cellular modem kit models

Cellular Kit Model	Kit Description	Important Notes
SXI-CATM1VZW-001	**Verizon CAT M1** cellular modem using Telit ME910 modem kit (Verizon part number SXIM1V). Includes a cellular modem, SIM card, internal adhesive antenna, external SMA antenna, and antenna cable. The SIM card is specific to the LTE-M technology and cannot be used in other cellular modems. Requires a LTE Verizon cellular wireless plan attached to the ICCID (SIM card) number and IMEI (International Mobile Equipment Identity) number. Cellular plans can be purchased through celldata.bannercds.com.	This cellular modem kit is for use in applications that require monthly data usage approaching 50 MB or 250 MB with push intervals no more frequent than every 10 minutes. This modem is only for use in the **contiguous United States** region. Please visit our support site for more details on coverage areas and cellular plan pricing.
SXI-CATM1ATT-001	**AT&T CAT M1** cellular modem using Telit ME910 modem kit (AT&T part number SXIM1A). Includes a cellular modem, SIM card, internal adhesive antenna, external SMA antenna, and antenna cable. The SIM card is specific to the LTE-M technology and cannot be used in other cellular modems. Requires a LTE AT&T cellular wireless plan attached to the ICCID (SIM card) number and IMEI (International Mobile Equipment Identity) number. Cellular plans can be purchased through celldata.bannercds.com.	This cellular modem kit is for use in applications that require monthly data usage approaching 50 MB or 250 MB with push intervals no more frequent than every 10 minutes. This modem is only for use in the **North American** region. Please visit our support site for more details on coverage areas and cellular plan pricing.
SXI-CATM1WW-001	**Worldwide CAT M1** cellular modem using Telit ME910 model kit. Includes a cellular modem, SIM card, internal adhesive antenna, external SMA antenna, and antenna cable. The SIM card is specific to the LTE-M/NB-IoT technology and cannot be used in other cellular modems. Requires an LTE cellular plan attached to the ICCID (SIM card) number and IMEI (International Mobile Equipment Identity) number. Cellular plans can be purchased through celldata.bannercds.com or a local roaming SIM provider.	This cellular modem kit is for use in applications that require monthly data usage approaching 50 MB or 250 MB with push intervals no more frequent than every 10 minutes. This modem is only for use in the **European** region within those countries that are members of the EU/EEA and adopt RED/CE compliant products. Please visit our support site for more details on coverage areas and cellular plan pricing.
SXI-LTE-001	**Verizon LTE** cellular modem using Telit LE910 modem kit (Verizon part number SENSX002). Includes a cellular modem, SIM card, antenna, and antenna cable. The SIM card is specific to the LTE technology and cannot be used in other cellular modems. Requires a LTE Verizon cellular wireless plan attached to the ICCID (SIM card) number and IMEI (International Mobile Equipment Identity) number. Cellular plans can be purchased through celldata.bannercds.com or a local roaming SIM provider.	This cellular modem is only used with the Wireless Network Bridge Hub (NET-HUB). Please visit our support site for more details on coverage areas and cellular plan pricing.

For additional information, refer to the Banner Cloud Data Services support center (support.bannercds.com). The support center includes video tutorials, product documentation, technical notes, and links to download configuration software.

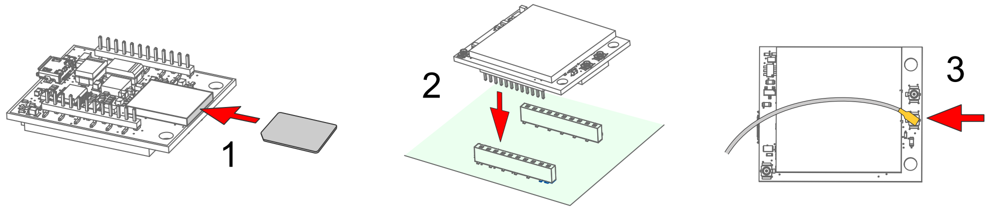
IMPORTANT: Only the DXM100 and DXM150 models in conjunction with an SXI-LTE-001 (obsolete) cellular modem can offer SMS/text messaging capabilities directly from the device. Contact a support specialist at Banner Engineering for configuration instructions, or SMS/text messaging can be delivered using the Banner CDS web service from any DXM model.

Install the Cellular Modem (DXM100, 150, 700, and 1000 Models)

Follow these steps to install the cellular modem and antenna cable.

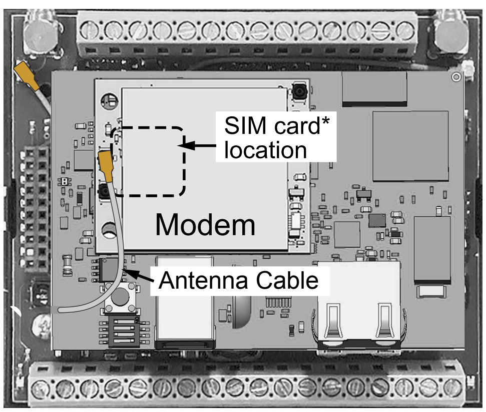
IMPORTANT:
- **Electrostatic discharge (ESD) sensitive device**
- ESD can damage the device. Damage from inappropriate handling is not covered by warranty.
- Use proper handling procedures to prevent ESD damage. Proper handling procedures include leaving devices in their anti-static packaging until ready for use; wearing anti-static wrist straps; and assembling units on a grounded, static-dissipative surface.

Installing the cellular modem



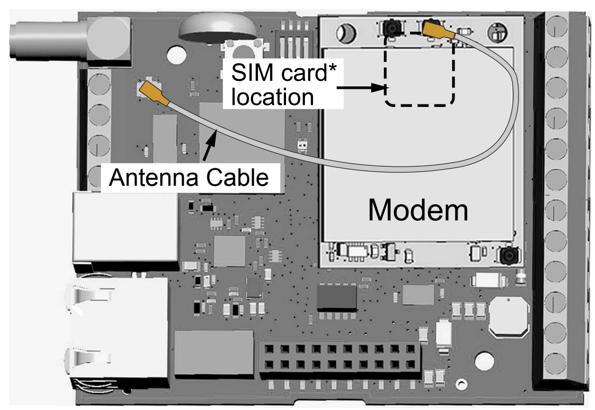
1. SIM cards come in a credit card sized carrier. Carefully snap it out of the carrier.
2. Make note of the IMEI number of the cellular modem and the ICCID number of the SIM card.
   The numbers can be found on the cellular modem and the SIM card or SIM card carrier. You will need the SIM number to associate a wireless plan to this SIM card.
3. Insert the SIM card into the socket on the underside of the cellular modem while ensuring the conductive pads on the SIM card are interfacing with the terminals of the modem.
   There is a matching notch in the socket and SIM card that will only allow the SIM to be inserted with one orientation. Do not force the SIM card into the socket.
4. Orient the cellular modem according to the pin layout.

DXM100, 150, and 1000



*SIM card is located on the underside of installed modem

DXM700



*SIM card is located on the underside of installed modem

   - For the DXM100, DXM150, and DXM1000 models—Install the cellular modem board onto the processor board as shown. Use the diagram to verify the orientation is correct.
   - For the DXM700 models—Install the cellular modem board onto the base board as shown. Use the diagram to verify the orientation is correct.

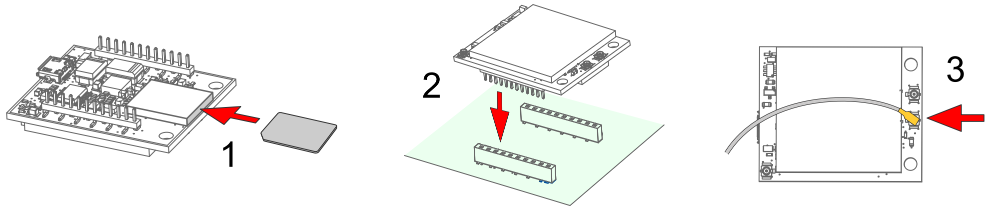
   a. Verify the pins are properly aligned.
   b. Verify the hole in the cell modem aligns with the hole on the DXM board.
   c. Firmly press the modem into the 24-pin socket.
5. Attach the antenna cable between the cellular modem board to the base board as shown.
6. Install the external cellular antenna on the DXM's SMA connector located next to the antenna cable.

Install the Cellular Modem (DXM1200 Models)

Follow these steps to install the cellular modem and antenna cable.

> **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.

Installing the cellular modem



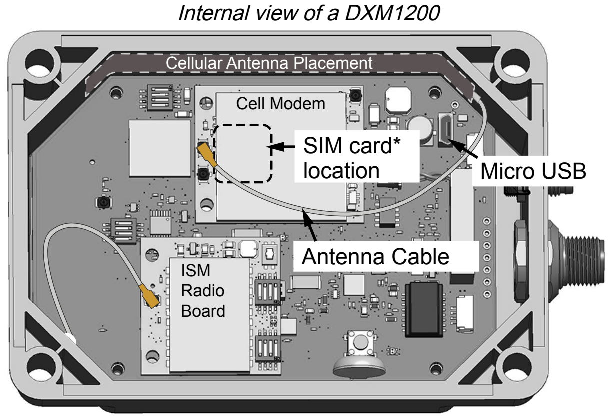
1. SIM cards come in a credit card sized carrier. Carefully snap it out of the carrier.
2. Make note of the IMEI number of the cellular modem and the ICCID number of the SIM card.

   The numbers can be found on the cellular modem and the SIM card or SIM card carrier. You will need the SIM number to associate a wireless plan to this SIM card.
3. Insert the SIM card into the socket on the underside of the cellular modem while ensuring that the conductive pads on the SIM card are interfacing with the terminals of the modem.

   There is a matching notch in the socket and SIM card that will only allow the SIM to be inserted with one orientation. Do not force the SIM card into the socket.
4. Apply the internal antenna as shown paying attention to the antenna cable position.
   a. Pull back the adhesive protective paper from the middle of the antenna, only exposing the middle portion. Antenna application is easier if just a small middle portion of the adhesive is uncovered.
   b. Center the antenna on the side wall. Use the exposed adhesive in the middle of the antenna to hold the antenna in place while aligning the antenna to the full length of the housing.
   c. Slowly peel off the paper backing exposing the adhesive and stick to the plastic housing. The antenna should run below the rim of the housing.
   d. Press firmly.
5. Orient the cellular modem according to the diagram below.

   The cellular modem is inserted into the main board with the antenna cable from the applied internal antenna attached to the cellular modem PCB.

   Internal view of a DXM1200

   *SIM card is located on the underside of installed modem

   a. Verify the pins are properly aligned.
   b. Verify the hole in the cell modem aligns with the hole on the DXM board.
   c. Firmly press the modem into the 24-pin socket.
6. Attach the antenna cable between the cellular modem board to the base board. The antenna cable uses the top antenna connection.

Activate a 4G LTE CAT M1 Cellular Plan

Activate a cellular plan for your DXM using the Banner Cloud Data Services website.

1. Go to celldata.bannercds.com to purchase cellular data plans.
2. If you have previously created an account, click **Login** and enter your username and password to continue.
3. If you are creating a login for the first time:
   a. Select the region in which the device will operate.

   b. Select the cellular subscription plan. Please use the calculator and regional coverage information to determine the plan needed for your device (https://www.bannerengineering.com/us/en/products/wireless-sensor-networks/iot-cloud-cellular-data-services/cellular-data-plans/Service-Plan-Calculator.html).
   c. Create a username and password (use an email address for the username).
   d. Enter your payment information, mailing address, agree to the terms and conditions.
4. Go to the **My Services and Equipment** section.
5. Enter the SIM Number (ICCID) and the Module Number (IMEI).

   The **ICCID** is the 20-digit number of the SIM, the bottom barcode number on the SIM card carrier. If the carrier card is not available, the ICCID is also printed on the SIM card, but must be removed from its socket to be read. The **IMEI** is the 15-digit number on top of the 4G LTE device.
6. Click **Activate**.

Enter the ICCID and IMEI numbers then click Activate

Although new activations are typically functional in 20 minutes or less, it may take up to 24 hours for the cellular plan to become active on the wireless network.

Activate a Worldwide 4G LTE MNB-IOT Cellular Plan (RED-CE)

The Worldwide 4G LTE-M/NB-IOT cellular modem is operational in those European countries that are members of the EU/EEA and adopt RED/CE-compliant products.

An international roaming SIM is provided with the Worldwide module and may be activated following the steps listed in "Activate a 4G LTE CAT M1 Cellular Plan" on page 43. However, there may be regions that are not covered by the provided SIM card. In this case, a local SIM card must be activated and operated with this device to acquire connectivity services.

1. Work with the local Banner technical support person to identify and purchase machine-to-machine (M2M) (data plan only) SIM cards in 3FF 'micro' form factor.

   Typical monthly data use will be 20-50 MB per month. When choosing a plan, pay close attention to data rates.
2. When activating the SIM, note the Access Point Name (APN) that the SIM provider states to use with their SIM.

   The IMEI is the 15-digit number on top of the cell module PCB, below the words **Telit ME910G1-WW** and above the barcode. The ICCID is the 20-digit number printed on the SIM card itself.

Configure the DXM Controller for a Cellular Modem

Use the DXM Configuration Software to create a configuration using a cellular connection.

> **IMPORTANT:** Only the DXM100 and DXM150 models in conjunction with an SXI-LTE-001 (obsolete) cellular modem can offer SMS/text messaging capabilities directly from the device. Contact a support specialist at Banner Engineering for configuration instructions, or SMS/text messaging can be delivered using the Banner CDS web service from any DXM model.

1. Go to the **Settings › Cloud Services** screen.
2. Set the **Push Interface** to **Cell**

   All push data will be sent using the cellular modem.
3. Go to the **Settings › Cellular** screen. Under the **Cell Configuration** section, select the **Cell module** from the drop-down list.
   - **For the United States (contiguous)**—For Verizon LTE/CATM modems, select **SXI-LTE-001** or **SXI-CATM1VZW-001** and set the **APN** to **vzwinternet**.
   - **For North America**—For ATT LTE/CATM modems, select **SXI-CATM1ATT-001** and set the **APN** to **iot0119.com.attz**. Requires a SIM module to be purchased from a wireless carrier based on the IMEI number

of the cellular modem. The wireless carrier will provide the APN parameters. Not all parameters may be required.

- **For regions outside of North America**—Select **SXI-CATM1WW-001** and set the **APN** to **m2m.tele2.com** when using the SIM card provided with the kit from Banner Engineering. When using a local roaming SIM, please use the APN as suggested by your cellular connectivity (SIM) provider.

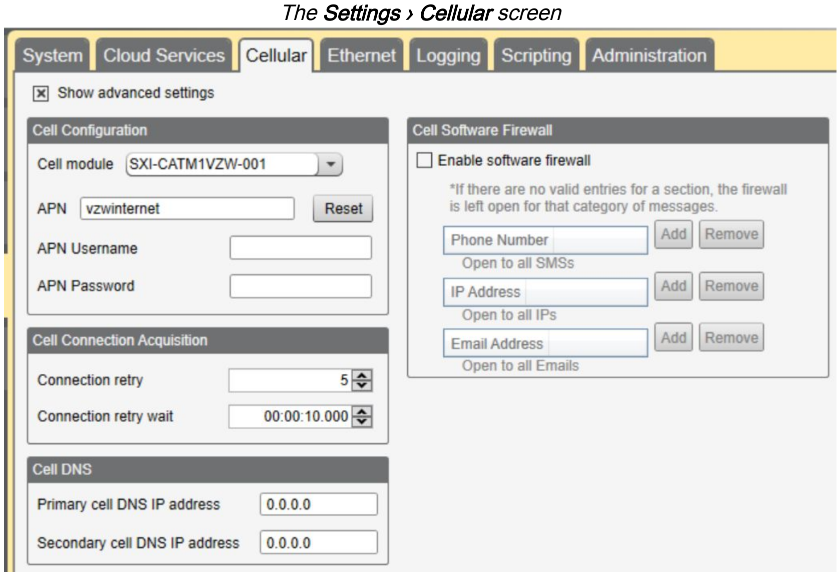
4. To send data to the webserver, complete the parameters on the **Settings › Cloud Services** screen. Set the **Cloud push interval** and the **Web Server** settings. (For more information, refer to the DXM Configuration Software Instruction Manual (p/n 201127).

*The **Settings › Cloud Services** screen*

IMPORTANT: Banner Engineering offers several prepackaged solutions that report to the Banner Cloud Data Services web-based software platform via cellular connectivity. Many of these solutions execute the data push using a ScriptBasic file instead of the XML configuration file. If you are using a Banner prepackaged solution (ex. SOLUTIONSKIT9-VIBE), then you do not need to set the **Cloud Push Interval** on the **Settings › Cloud Services** screen. You still need to set the **Push Interface** to **Cell** and select the appropriate **Cell Module** and **APN**.

When the DXM is configured to use the cellular modem, the information on the cellular modem is found on the LCD menu under **System Info › Cell**. The menu does not display values until a transaction with the wireless cell tower is complete.

*The **Settings › Cellular** screen*



If there are no webserver parameters defined, the user must force a push to retrieve the data from the cellular network. On the LCD menu, select **Push › Trigger Data Push**.

Obtaining LTE service outside of the Banner Cellular Data Plans—Customers have the option of securing a data plan for the Verizon network themselves without using the Banner cellular data portal (celldata.bannercds.com). Suitable plans would include those available from Verizon directly or from a Mobile Virtual Network Operator (MVNO) licensed to resell Verizon network data plans. (The **SXI-LTE-001** or **SXI-CATM1VZW-001** will not function on AT&T, T-Mobile, or Sprint networks.) When purchasing a data plan, it is important to refer to the modem by its official Verizon network name (for example, SENSX002) and give the IMEI number (found on the cellular modem) to the plan provider. To use the SIM card that comes with the cellular modem kit, give the SIM card number to the provider. The required SIM card form factor is 3FF - Micro.

Chapter Contents

Chapter 7 LCD and Menu System

The LCD has four user-defined LED indicators, four control buttons, and an LCD. The four buttons control the menu system on the LCD menu.

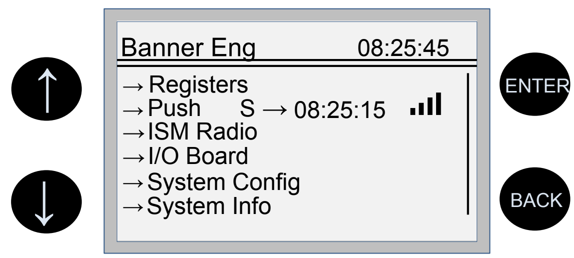
The top-level menu always displays the time in a 24-hour format.

- The up and down arrows scroll through display items.
- The **ENTER** button selects the highlighted items on the display.
- The **BACK** button returns to a previous menu option.

The left display column shows an arrow at the beginning of the line if the menu has submenus. The right column shows a vertical line with an arrow at the bottom if the user can scroll down to see more menu items.

The DXM can be configured to require a passcode be entered before the LCD and Menu system will operate. The passcode configuration is defined in the DXM Configuration Software.

Top-level menu



Registers

The **Registers** submenu displays the processor's local registers that can be configured using the DXM Configuration Software.

Registers menu

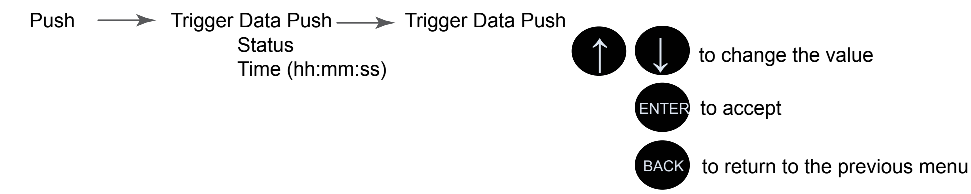
To configure these local registers, launch the DXM Configuration Software. Go to **Local Registers** and expand the view for a local register by clicking on the down arrow next to the register number. In the LCD Permissions field, select None, Read, Write, or Read/Write.

Read allows the register to be displayed and Write or Read/Write allows the register value to be changed using the LCD. The Units and Scaling parameters are optional and affect the LCD.

Push

The **Push** menu displays information about the last data sent to the Webserver.

Push menu



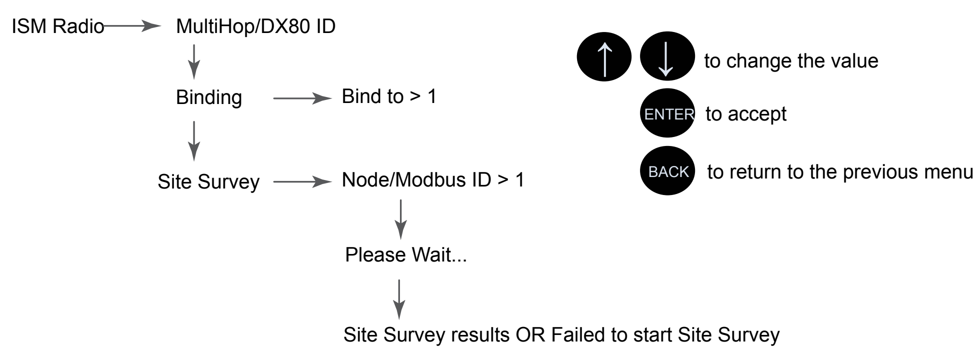
The user can force an immediate push to the webserver using Trigger Push. If a current push is in process it may take several minutes to complete over cellular.

- The **Trigger Push** submenu forces an immediate push to the web server.
- The status and time fields indicate the success or failure of the last attempted push and the time of the last attempted push.

ISM Radio

The **ISM Radio** menu allows the user to view the Modbus ID of the internal ISM radio, enter binding mode, or run a site survey. This top-level **ISM Radio** menu is different from the **System Config › ISM Radio** submenu.

ISM Radio menu



The first option under the **ISM Radio** menu only displays the type of radio in the DXM (MultiHop or DX80 Star) and the Modbus ID of the radio. To change the ISM Radio Modbus ID refer to the **System** menu.

Select **Binding** to enter binding mode or select **Site Survey** to run a site survey.

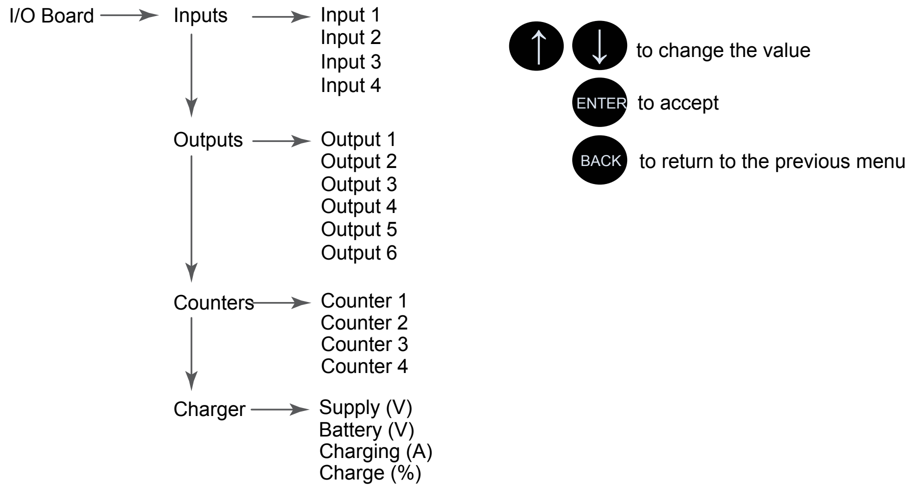
Binding— All ISM radio devices must be bound to the internal Gateway/client device before the DXM can access wireless devices. The first submenu under binding allows the user to set the wireless address of the device to bind with. This is required to bind with wireless devices that do not have rotary dials (for example M-GAGEs, ultrasonic sensors, and Q45 devices). See "Binding and Conducting a Site Survey with the ISM Radio" on page 15. For more information on binding a particular device, refer to the individual datasheet.

Site Survey—After creating a wireless network using the binding process, run a site survey on each device to see the link quality. See "Conduct a Site Survey from the DXM" on page 17.

IO Board

Use the **I/O Board** menu to view input values, output values, input counters values, and the charger status on the DXM I/O board. To change the configuration parameters, use the **System Config** menu.

I/O Board menu



The **I/O Board** menu includes the following submenus.

Inputs
Lists the inputs. Depending upon the input type, the value and unit's information will also be displayed.

Outputs
The DXM base configuration can include discrete, current, or voltage outputs. The output values will be displayed based on their configuration settings.

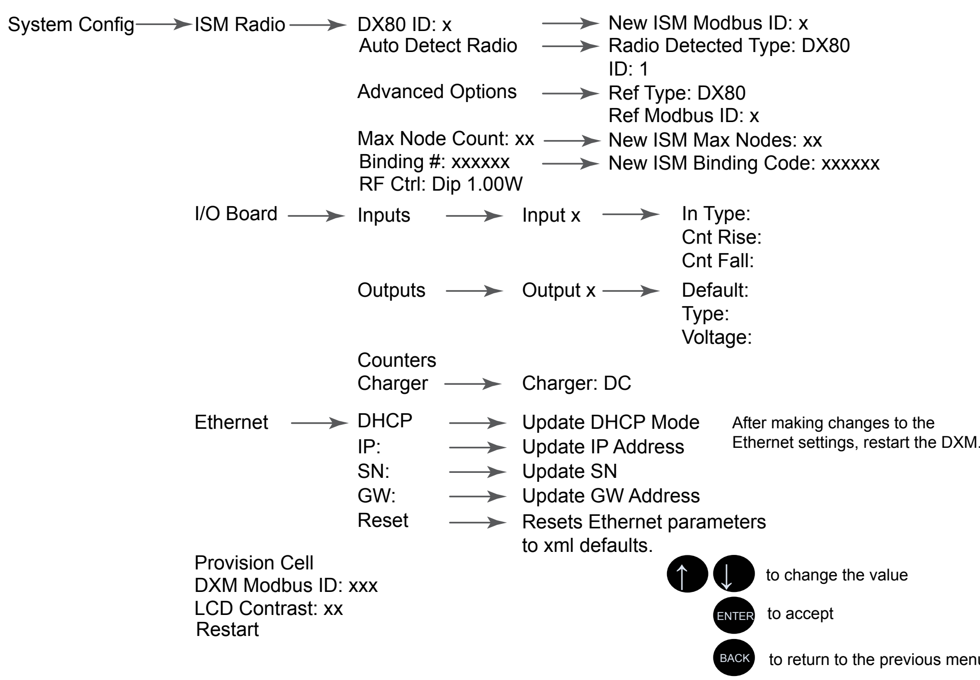
Counters
Counters on the DXM base board are associated to inputs but the count value is stored in a different register. Adjust or view the count registers using the LCD menu.

Charger
The on-board solar/battery charger of the DXM stores information about the charging circuit in Modbus registers. Use the LCD menu to view information about the incoming voltage, charging current, battery voltage, and battery charge percentage.

System Config

Use the **System Config** menu to set DXM system parameters.

System Config menu



ISM Radio

DX80/MultiHop ID—The ISM radio is set at the factory to be Modbus device address 1 (Modbus ID 1). For some applications, you may need to change the Modbus ID. Adjust the Modbus device address using the LCD menu system. Any other method may cause issues with the DXM not knowing which Modbus device address is assigned to the radio, which causes issues with running Binding or Site Survey from the LCD menu.

Set the radio Modbus ID to a valid number (1 through 247) that is not being used by the DXM system. Processor Local Registers allocate ID 199, the I/O board is set to ID 200, and the display board is set to ID 201. With a DX80 Gateway (star network), it's easy to choose a new ID. With a MultiHop network, remember that the client MultiHop radio allocates a range of Modbus IDs for wireless devices, typically 11 through 110.

When setting the new ISM Modbus ID, the system changes the Modbus ID on the internal radio and changes the reference to it on the DXM. The reference Modbus ID is what the DXM uses to access the internal radio when running Binding or Site Survey.

Auto Detect Radio—If the internal Modbus ID of the radio was changed or the internal radio was changed, but not recorded, use Auto Detect Radio to determine the radio ID and radio type. The auto-detect routine broadcasts discovery messages and waits for a response. If other devices are connected to the external RS-485 ports, they may need to be disconnected for this process to work properly.

Advanced Options—The Advanced Options menu is typically not used unless the Modbus ID is changed without the DXM being involved, such as when you write directly to the radio Modbus registers.

- **Reference Type** selects the radio type between DX80 star architecture radios and a MultiHop radio. The DXM uses this reference to determine how to communicate to the internal radio. If set incorrectly, the DXM may not be able to run Site Survey from the LCD menu. Unless you are changing or adding the internal radio device, there should no reason to change the radio type.
- **Reference Modbus ID** defines the Modbus ID the DXM uses when communicating with the internal radio. If this is set incorrectly, the DXM will not be able to run Binding or Site Survey through the LCD menu.

Max Node Count—Defines the maximum number of devices for the DX80 wireless network.

Binding #—This parameter allows the user to define the Binding code within the ISM radio. Typically, you will not have to adjust this number unless you are replacing an existing Gateway or client radio.

RF Ctrl—Displays the status of the ISM radio DIP switch 1 (off or on). The menu doesn't allow the user to change the DIP switch setting through the display.

IO Board

Use the **System Config › I/O Board** submenu to change the configuration parameters for the inputs, outputs, counters, and charger.

Use the **Inputs** menu to change the input type. The universal inputs on the DXM are defined from the factory as sinking inputs. To change the input type:

1. Go to the **System Config › I/O Board › Inputs** menu.
2. Select which input to change.
3. Select the input type. The available parameters include the Input Type and the Counter Edge Detect.

Input parameters

Input Type	Description
Sinking	Discrete input, low active, 0 = ON, 1 = OFF
Sourcing	Discrete input, high active, 1 = ON, 0 = OFF
Current	Analog input, 0–20 mA
Voltage	Analog input, 0–10 V DC
Thermistor 2*	Thermistor input, 10k - J (r-t curve), beta(K) 3890
Thermistor 1*	Thermistor input, 10k - G (r-t curve), beta(K) 3575

Counter	Description
In Type	Sinking or sourcing

Continued on page 51

Continued from page 50

Counter	Description
Cnt Rise	Increment the count when the input transitions from 0 -> 1
Cnt Fall	Increment the count when the input transitions from 1 -> 0

Use the **Output** menu to change the default condition, output type, and switched power voltage.

Output parameters

Output Type	Description
Default	Force output registers to a default condition if the I/O board has not been communicated with for a user-defined time. The communications timeout parameter must be set to use the Default condition.
Type	Select the output type: NMOS Sinking, Switch Power (Swch Pwr), Analog.
Voltage	Outputs defined as switched power can adjust the voltage: 5 V or 16 V

Use the **Charger** menu to change the charging algorithm for the battery. This parameter can also be set by writing Modbus register 6071 of the I/O board. See "Supplying Power from a Solar Panel" on page 31.

Charger parameters

Charger Parameters	Description
DC	Used when 12–24 V DC power supplies connected to the DXM power pins and the attached batteries are used as backup batteries. This limits the current during the battery charging process. (factory default setting)
Solar	Select Solar when a solar panel is connected to the power pins of the DXM. Solar panels are current limited by their design and therefore can charge the battery without managing the input power.

Ethernet

Use the **Ethernet** submenu to sets the IP Address, Gateway Address, and Subnet mask of the DXM's Ethernet interface. You may change these settings either from the LCD menu (**System Config › Ethernet**) or from the XML configuration file created by the DXM Configuration Software.

The network address settings from the LCD menu have the highest priority and override settings in the XML configuration file. To use the parameter settings from the XML configuration file or use DHCP, execute the **Reset** under **System Config › Ethernet** or use the LCD to set the IP Address, Gateway Address, and Subnet Mask to 255.255.255.255. Reboot the DXM after changing the Ethernet parameters.

The Ethernet cable should be attached before powering up the DXM.

Provision Cell

If the DXM has a cellular modem installed, the modem must be provisioned on the network. This menu provisions the cellular modem on the network. For step-by-step directions, see "Using the DXM Cellular Modem" on page 40.

DXM Modbus ID

Use the secondary Modbus RS-485 port when the DXM is connected to a Modbus RTU network as a Modbus server device. Set the Modbus ID for the secondary RS-485 port using the LCD menu **System Config › DXM Modbus ID**.

LCD Contrast

Use the **LCD Contrast** option to adjust the LCD contrast. Adjust the starting number lower to decrease the display contrast. The factory default is 28. Do not set a number less than 15 or the display may not be bright enough to see to change back.

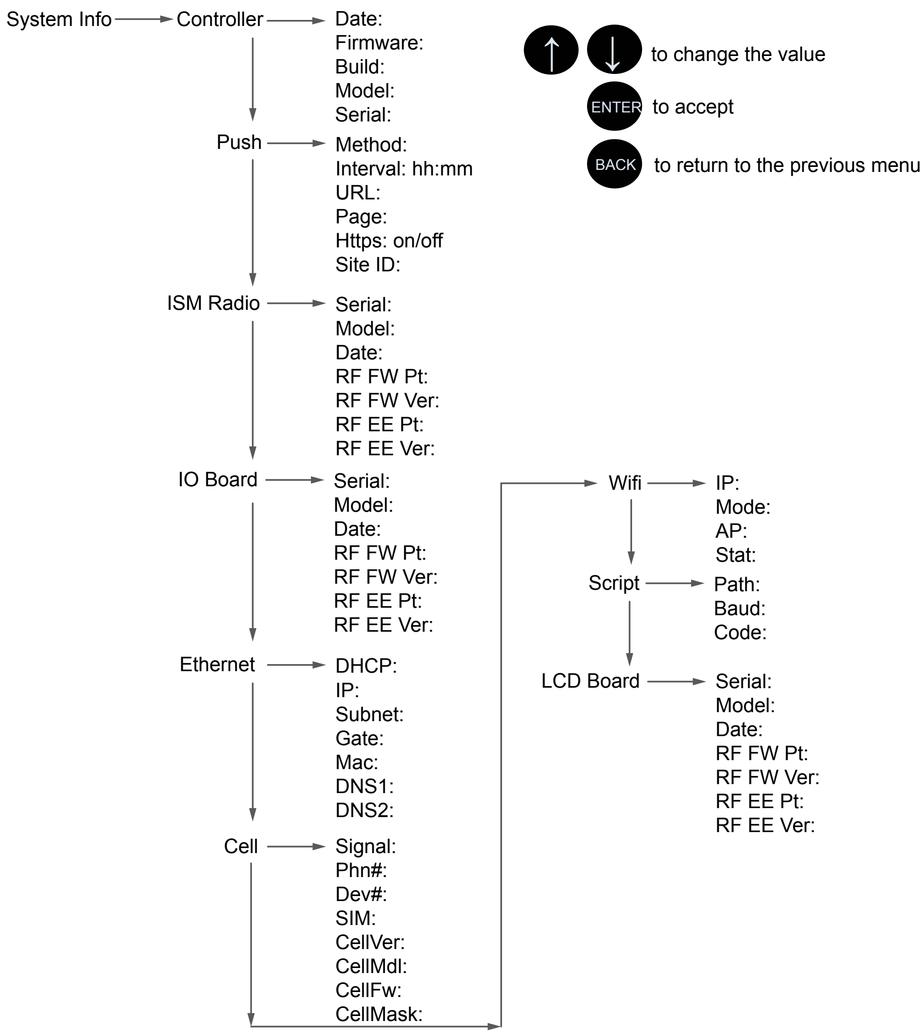
Reset

Use the **Restart** menu to force the main processor to restart. This does not affect the other boards in the system.

System Info

Various DXM system settings are shown in this menu. The Push, Ethernet, and Cell parameters are helpful for debugging network connections. This is a read-only menu.

System Info menu



Cell
Shows the cellular MEID number (Mobil Equipment Identifier), MDN (Mobil Device Number), version, signal, firewall setting, and firewall mask. Some of these parameters are not visible until the cellular network is accessed.

Controller
Displays the date, build, model, and serial number.

Ethernet
Displays the IP address, MAC address, DHCP, Gateway address, and DNS settings.

I/O Board
Displays the serial number, model, date, firmware part numbers, and version numbers.

ISM Radio
Displays the serial number, model, date, firmware part numbers, and version numbers.

LCD Board
Displays the serial number, model, date, firmware part numbers, and version numbers.

Push
Shows the current parameters loaded from the XML configuration that applies to pushing data to a web server, including method (Ethernet or cellular), interval, URL, page, HTTPS, and site ID.

Sript
Displays the name of the ScriptBasic file running.

Wi-Fi
Displays the Wi-Fi IP address and other settings.

Display Lock

Display Lock protects the DXM LCD menu system from being used until the proper passcode is entered.

Display Lock menu

Display Lock → Enter password
>> x

↑ ↓ to change the value

ENTER to accept

BACK to return to the previous menu

The display lock feature uses the configuration software to set a passcode within the DXM. A valid passcode is 1 to 9 digits long and uses numbers 0 through 9. For example, `1234` or `209384754`.

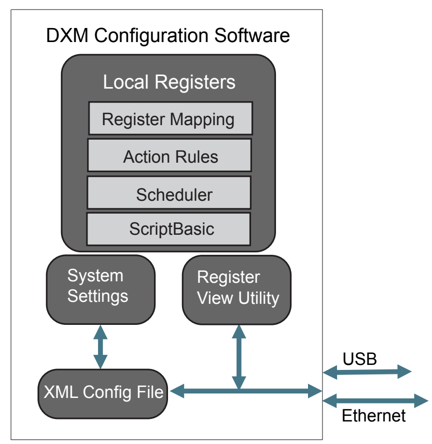
Chapter Contents

Chapter 8 Configuration Instructions

DXM Configuration Software

Download the latest version of all configuration software from http://www.bannerengineering.com. For more information on using the DXM Configuration Software, refer to the instruction manual (p/n 209933).

Overview of the configuration software features



The configuration software configures the DXM client by creating an XML file that is transferred to the DXM client using a USB or Ethernet connection. The DXM client can also receive the XML configuration file from a Web server using a cellular or Ethernet connection.

This configuration file governs all aspects of the DXM client and server operation.

The wireless network devices are a separate configurable system. Use the DX80 Performance Configuration Software to configure the internal DX80 client radio and the wireless server nodes bound to it. Use the MultiHop Configuration Software if the internal radio is a MultiHop device.

All configuration software can be connected to the DXM client using a USB cable or an Ethernet connection.

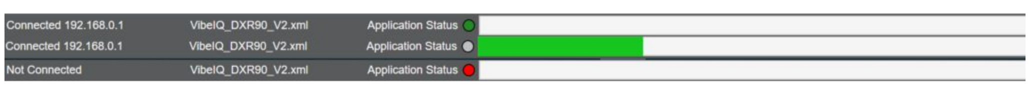
Save and Upload the Configuration File

After making any changes to the configuration, you must save the configuration files to your computer, then upload it to the device.

Changes to the XML file are not automatically saved. Save your configuration file before exiting the tool and before sending the XML file to the device to avoid losing data. If you select **DXM › Send XML Configuration to DXM** before saving the configuration file, the software will prompt you to choose between saving the file or continuing without saving the file.

1. Save the XML configuration file to your hard drive by going to the **File › Save As** menu.
2. Go to the **DXM › Send XML Configuration to DXM** menu.

Status indicator bar



- If the Application Status indicator is red, close and restart the DXM Configuration Tool, unplug and re-plug in the cable and reconnect the DXM to the software.
- If the Application Status indicator is green, the file upload is complete.
- If the Application Status indicator is gray and the green status bar is in motion, the file transfer is in progress.

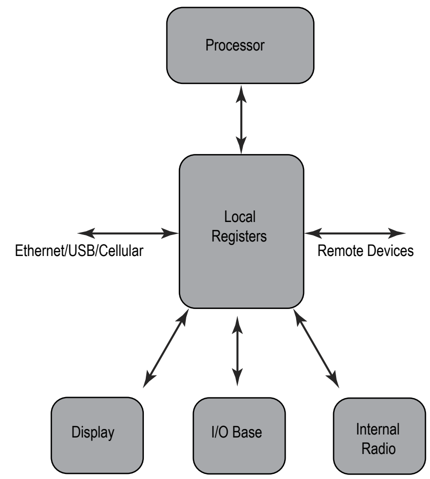
After the file transfer is complete, the device reboots and begins running the new configuration.

Register Flow and Configuration

The DXM register data flow goes through the Local Registers, which are data storage elements that reside within the processor.

Using the DXM Configuration Software, the controller can be programmed to move register data from the Local Register pool to remote devices, the internal radio, the I/O base (if applicable), or the display.

Register flow



Basic Approach to Configuration

When programming an application in the DXM, first plan the overall data structure of the Local Registers. The Local Registers are the main storage elements in the DXM. Everything goes into or out of the Local Registers.

1. In the DXM Configuration Software, name the Local Registers to provide the beginning structure of the application.
2. Configure the read/write rules to move the data. The Read/Write rules are simple rules that move data between devices (Nodes, Modbus servers, sensors, etc) and the Local Registers.
3. Most applications require the ability to manipulate the Local Register data, not just move data around. Use the **Action rules** to make decisions or transform the data after the data is in the Local Registers. Action rules can apply many different functions to the Local Register data, including conditional statements, math operations, copy operations, or trending.
4. To perform scheduled events in Local Registers, go to the **Scheduler** screen in the DXM Configuration Software. These rules provide the ability to create register events by day of the week. The scheduler can also create events based on sunrise or sunset.

Troubleshooting a Configuration

View Local Registers using the **Local Registers › Local Registers in Use** screen of the DXM Configuration Software.

When a configuration is running on the DXM, viewing the Local Registers can help you to understand the application's operation. This utility can also access data from remote devices.

To configure the Local Register data to display on the LCD menu, go to the **Local Registers** screen, set the **LCD permissions** to read or read/write.

Saving and Loading Configuration Files

The DXM Configuration Software saves its configuration information in an XML file. Use the **File** menu to Save or Load configuration files.

Save the configuration file before attempting to upload the configuration to the DXM. The DXM Configuration Software uploads the configuration file saved on the PC to the DXM; it will not send the configuration loaded in the tool.

Uploading or Downloading Configuration Files

The DXM requires an XML configuration file to become operational. To upload or download configuration files, connect a computer to the DXM using the USB port or Ethernet port. Then use the **Upload Configuration to Device** or **Download Configuration from Device** under the **Device** menu.

Scheduler

Use the **Scheduler** screens to create a calendar schedule for local register changes, including defining the days of the week, start time, stop time, and register values.

Schedules are stored in the XML configuration file, which is loaded to the DXM. Reboot the DXM to activate a new schedule.

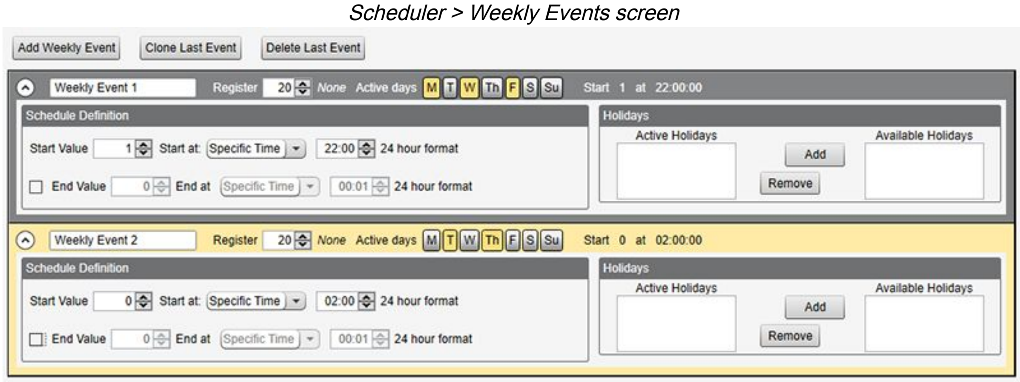
If power is cycled to the DXM in the middle of a schedule, the DXM looks at all events scheduled that day and processes the last event before the current time.

For screens that contain tables with rows, click on any row to select it. Then click **Clone** or **Delete** to copy/paste or remove that row.

Create a Weekly Event

Use the **Tools › Scheduler › Weekly Events** screen to define weekly events.

Scheduler > Weekly Events screen



1. Click **Add Weekly Event**.

   A new schedule rule is created.
2. Click on the arrow to the left of the new rule to expand the parameters into view.

   The user-defined parameters are displayed.
3. Name your new rule.
4. Enter the local register.
5. Select the days of the week this rule applies to.
6. Enter the starting value for the local register.
7. Use the drop-down list to select the type of Start at time: a specific time or a relative time.
8. Enter the starting time.
9. Enter the end time and end value for the local register.

Register updates can be changed up to two times per day for each rule. Each rule can be set for any number of days in the week by clicking the buttons M, T, W, Th, F, S, or Su.

If two register changes are defined for a day, define the start time to be before the end time. Select **End Value** to enable the second event in a 24-hour period. To span across two days (crossing the midnight boundary), set the start value in the first day, without selecting **End Value**. Use the next day to create the final register state.

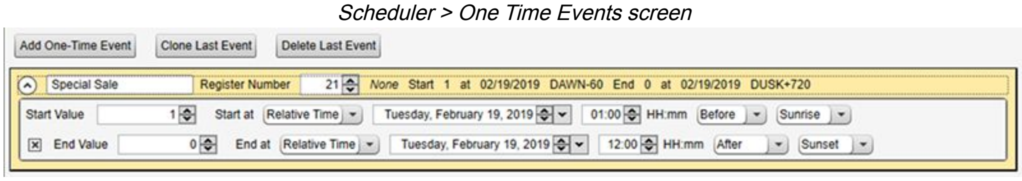
Start and end times can be specified relative to sunrise and sunset, or set to a specific time within a 24-hour period. When using sunrise or sunset times, set the GPS coordinates on the device so it can calculate sunrise and sunset.

Create a One-Time Event

Define one-time events to update registers at any time within a calendar year.

Similar to Weekly events, the times can be specific or relative to sunrise or sunset. Define one-time events using the **Tools › Scheduler › One Time Events** screen.

Scheduler > One Time Events screen



1. Click on **Add One Time Event**.

   A new one-time event is created.
2. Click on the arrow to expand the parameters into view.

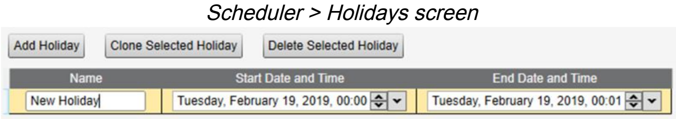
   The user-defined parameters are displayed.
3. Name your one-time event by clicking on the name link and entering a name.

4. Enter the local register.
5. Enter the starting time, date, and starting value for the local register.
6. Enter the ending time, date, and ending value for the local register.

Create a Holiday Event

Use the **Tools › Scheduler › Holidays** screen to create date and/or time ranges that interrupt weekly events.

Scheduler > Holidays screen



1. Click on **Add Holiday**.
   A new rule is created.
2. Enter a name your new holiday rule.
3. Select the start date and time for the new holiday.
4. Select the stop date and time for the new holiday.

Authentication Setup

The DXM has three areas that can be configured to require login and password authentication.

- Webserver/ Cloud Services Authentication
- Mail Server Authentication
- DXM Configuration Authentication

The webserver and mail server authentication depends upon the service provider.

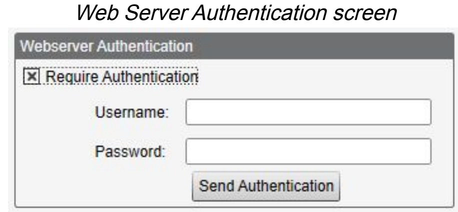
Set the Controller to use Authentication

The DXM can be configured to send login and password credentials for every HTTP packet sent to the webserver. This provides another layer of security for the webserver data.

Configuration requires both the webserver and the DXM to be given the same credentials for the login and password. The webserver authentication username and password are not stored in the XML configuration file and must be stored in the DXM.

1. From within the DXM Configuration Software, go to the **Settings › Cloud Services** screen.
2. In the upper right, select **Show advanced settings**.
3. Define the username and password in the **Web Server Authentication** section of the screen.
   The first time you select **Require Authentication**, a pop-up box appears with additional instructions. Since the data is not stored in the XML configuration file, it is hidden from view of the DXM Configuration Software.
4. Click on **Send Authentication**.
   The controller must be connected to the PC for this operation to succeed.
   The data transmits directly to the DXM's non-volatile memory. If successful, a pop-up window appears, asking to reboot the device.
5. Select **Yes** to reboot the device.

Web Server Authentication screen

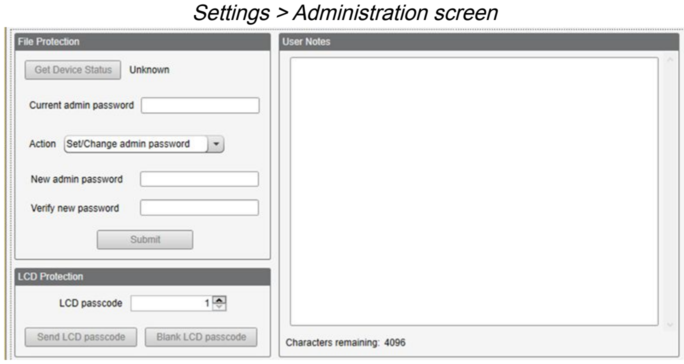


Controller Configuration Authentication

The DXM can be programmed to allow changes to the configuration files only with proper authentication by setting up a password on the **Settings › Administration** screen in the DXM Configuration Software.

With the DXM connected to the PC, click **Get Device Status**. The DXM status displays next to the button.

Settings > Administration screen



Use the DXM Configuration Software to:

- Set the Admin Password
- Change the Admin Password
- Remove the Admin Password

To change or remove an admin password, the current password must be supplied. The DXM must be connected to the PC to change the administration password.

The DXM can be unlocked without knowing the administration password, but doing this erases the configuration program, logging files, and any ScriptBasic program on the device. For instructions on how to do this, see the "Additional Information" on page 63 section.

EtherNetIP Configuration

The DXM is defined from the factory to send/receive register data from the Gateway and the first 16 Nodes with an EtherNet/IP™[1] host.

To expand the number of devices going to Ethernet/IP, change the **Devices in system** parameter in the DX80 Gateway (default setting is 8) to 32. To change this value:

1. Launch the the DX80 Configuration Software.
2. In the menu bar, go to **Device › Connection Settings** and select **Serial** or **Ethernet DXM**.
3. In the **Configuration › Device Configuration** screen, click on the arrow next to the Gateway to expand and display the Gateway's parameters.
4. In the **System** section, use the **Devices in system** drop-down list to make your selection.

This allows the user to maximize the use of the EtherNet/IP buffer to 28 devices.

EDS (Electronic Data Sheet) files allow users of the EtherNet/IP protocol to easily add a Banner DXM device to the PLC. Download the EDS files from the Banner website.

- DXM EDS Configuration File (for PLCs) (p/n b_4205242)
- DXM EIP Config File for DXM Controller with Internal Gateway (Models: DXM1xx-BxR1, DXM1xx-BxR3, and DXM1xx-BxCxR1) (p/n 194730)

Download an Existing Configuration from the DXM

If you have an existing configuration file, save the XML file locally as a backup on your computer.

1. Apply power to the DXM.
2. Connect an ethernet or USB cable between your computer and the DXM.
3. Launch the DXM Configuration Software v4 and select your DXM model.
4. On the **Device › Connection Settings** menu, select one of the following:
   - Select **TCP/IP** as the connection type and enter the **IP Address** of the DXM Controller; or
   - Select **Serial** as the connection type and select the appropriate **Comm port**
5. On the menu bar, select **Device › Get XML configuration from DXM** to download the XML configuration file.
6. Save the XML file locally on your computer.

[1] EtherNet/IP is a trademark of Rockwell Automation.

Configuring the Controller

Use the configuration software to define the **Protocol conversion** for each local register to be **EIP Originator › DXM** or **EIP DXM › Originator** from the **Edit Register** or **Modify Multiple Register** screens.

Define a DXM local register as **EIP Originator › DXM** when the host PLC (Originator) will send data to the DXM local register (DXM).

Define a DXM local register as **EIP DXM › Originator** when that register data will be sent from the DXM (DXM) to the host PLC (Originator).

Data from an EIP controller in assembly instance 112 is data destined for the DXM local registers. The PLC is normally configured for INT or UINT data transfer. This allows for a seamless transfer of data.

EIP Assembly Instance 112 (16-bit)			DXM Local Registers	
Adrs	Data		Adrs	Data
0	1122		1	1122
1	3344		2	3344
2	5566		3	5566
3	7788		4	7788
4	9900		5	9900

Data from the DXM local registers is sent to the EIP controller using assembly instance 100. Each local register in the DXM defined as **EIP DXM › Originator** is collected in numerical order and placed into the data buffer destined for assembly instance 100. DXM local registers are capable of 32-bits, but only the lower 2-bytes (16-bits) for each local register are transferred.

EIP Assembly Instance 100 (16-bit)			DXM Local Registers	
Adrs	Data		Adrs	Data
0	1122		11	1122
1	3344		12	3344
2	5566		13	5566
3	7788		14	7788
4	9900		15	9900

Configure Local Registers to Export Data to a PLC

1. On the DXM Configuration Software: Go to the **Local Registers** screen.
2. Select the register(s) that will be exported to a Host PLC.
   A maximum of 228 registers can be read or written with Ethernet/IP.
3. In the **Storage/Connectivity** section, select **EIP DXM -> Originator** from the **Protocol conversion** drop-down list.
   To change a block of continuous local registers, use the **Modify Multiple Registers** screen.

Configure Local Registers to Import Data from a PLC

1. On the DXM Configuration Software: Go to the **Local Registers** screen.
2. Select the register(s) that will be imported from a Host PLC.
   A maximum of 228 registers can be read or written with Ethernet/IP.
3. In the **Storage/Connectivity** section, select **EIP Originator -> DXM** from the **Protocol conversion** drop-down list.
   To change a block of continuous local registers, use the **Modify Multiple Registers** screen.

To view the EIP Input and Output registers, go to the **Tools › Protocol Conversion** screen. You may also export the register map to a CSV file.

Save and Upload the Configuration File

After making any changes to the configuration, you must save the configuration files to your computer, then upload it to the device.

Changes to the XML file are not automatically saved. Save your configuration file before exiting the tool and before sending the XML file to the device to avoid losing data. If you select **DXM › Send XML Configuration to DXM** before saving the configuration file, the software will prompt you to choose between saving the file or continuing without saving the file.

1. Save the XML configuration file to your hard drive by going to the **File › Save As** menu.
2. Go to the **DXM › Send XML Configuration to DXM** menu.

Status indicator bar

- If the Application Status indicator is red, close and restart the DXM Configuration Tool, unplug and re-plug in the cable and reconnect the DXM to the software.
- If the Application Status indicator is green, the file upload is complete.
- If the Application Status indicator is gray and the green status bar is in motion, the file transfer is in progress.

After the file transfer is complete, the device reboots and begins running the new configuration.

Configuring the Host PLC

On the host PLC, install the DXM using an EDS file or by using the following parameters:

- Assembly1: Originator to DXM = Instance 112, 456 bytes (228 words)
- Assembly2: DXM to Originator = Instance 100, 456 bytes (228 words)

The Originator is the host PLC system, and the DXM is the DXM. The host system sees the DXM as a generic device with the product name of Banner DXM (ProdType: 43 - Generic Device, ProdName: Banner DXM, Integer Type - INT).

IMPORTANT: Do not set the Requested Packet Interval (RPI) any faster than 150 ms.

Define the Network Interface Settings

On the **Cloud Services** screen (shown with **Show advanced settings** selected), define the network connection settings by selecting Ethernet or Cell from the **Network Interface** drop-down list. This determines how the DXM sends data.

If you don't require pushing data to a web server, set the **Cloud Push** interval to zero.

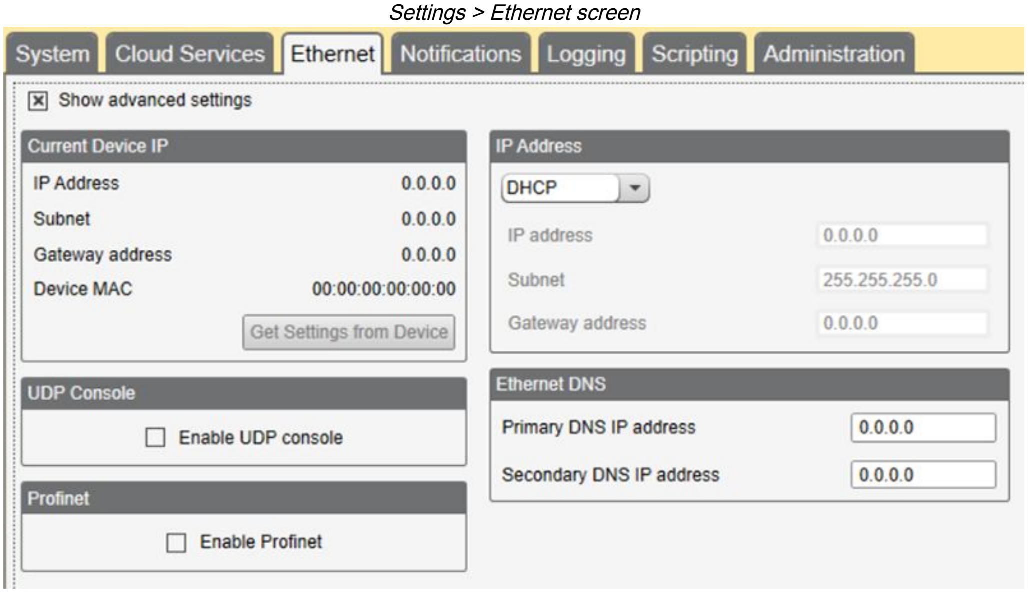
Cloud Services screen

Configure your Ethernet Connection

When selecting Ethernet, go to the **Settings › Ethernet** screen.

1. To define the Ethernet IP address, give the DXM a static IP address. In most cases, you may select the device to use DHCP and have the IP address automatically assigned.
2. DNS settings are not typically required. The DXM uses a public service to resolve Domain names, but if the network connection does not have Internet access, the DNS settings may be required.

Settings > Ethernet screen



Configure your Cellular Connection

To use a cellular connection, select Cell as the network connection on the **Settings › Cloud Services** screen (see "Configure the DXM Controller for a Cellular Modem" on page 44). The **Cellular** screen does not display unless the **Network interface** is set to Cell.

Using a 4G LTE cell module requires a cellular plan; follow the instructions on p/n 205026 to activate a cell modem.

1. On the **Settings › Cellular** screen, select your cellular modem from the drop-down list.
2. Set the APN.
   - If you are using a Banner 4G LTE-M Verizon Module (ME910C1), set the **APN** to `vzwinternet`.
   - If you are using a Banner 4G LTE AT&T Module (ME910C1), set the **APN** to `iot0119.com.attz`.
   - If you are using a Banner 4G LTE-M/NB-IoT Worldwide Module (ME910G1), set the **APN** to `m2m.tele2.com`.
   - If you are using a third-party SIM card, the APN, APN Username, and Password must be provided by the cellular service provider.

Ethernet and Cellular Push Retries

The DXM can be configured to send register data packets to a webserver. When the Ethernet or cell communications path is not operating, the DXM retries the send procedure. The communications retry process is outlined below for each configuration.

Regardless of the communications type (Ethernet or cellular), a failed attempt results in the register data packet being saved on the local storage device[1]. The number of retries will depend upon the network connection type.

When there is bad cellular signal strength or there is no Ethernet connection, the transmission attempts are not counted as failed attempts to send data. Only when there is a good network connection and there are 10 failed attempts will the controller archive the data on the local storage device. Data archived on the local storage device must be manually retrieved.

[1] Enable HTTP logging to save data on the local storage device; this is the factory default. See **Settings › Logging** in the DXM Configuration Software.

Ethernet Push Retries

With an Ethernet-based network connection, the DXM retries a message five times. The five retry attempts immediately follow each other. After all attempts are exhausted, the register data packet is saved on the local storage device.

At the next scheduled time, the DXM attempts to send the saved packet as well as the newly created register data packet. If it cannot send the new register data packet, the new register data packet is appended to the saved file on the local storage device to be sent later. After 10 rounds of retries, the data set is archived on the local storage device under folder **_sxi**. No additional attempts to resend the data are made; the data file must be manually retrieved.

Using SSL on Ethernet will have no retries but will save each failed attempt to the local storage device until 10 failed rounds. At this time, the register data packet is archived.

Cellular Push Retries

In a cellular-connected system there are no retries. Failed transmissions are saved on the local storage device.

After 10 successive failed attempts, the data is archived in the **_sxi** folder.

Send attempts with a low signal quality are not counted against the 10-count limit. For example, if the cellular antenna is disconnected for period that the DXM controller would have sent 20 messages under normal circumstances, all 20 messages would be saved and will be retried when the antenna is reconnected.

If the signal quality was good, but the cellular network was not responding, the DXM archives the register data packets after 10 failed attempts.

Event-Action Rule or Log File Push Retries

Event-based pushes caused by Action rules follow the same process when failures occur, based on the network connection. The failed Event-based messages are resent with the next cyclical schedule or the next event message that triggers a push message.

Chapter Contents

Chapter 9 Additional Information

Working with Modbus Devices

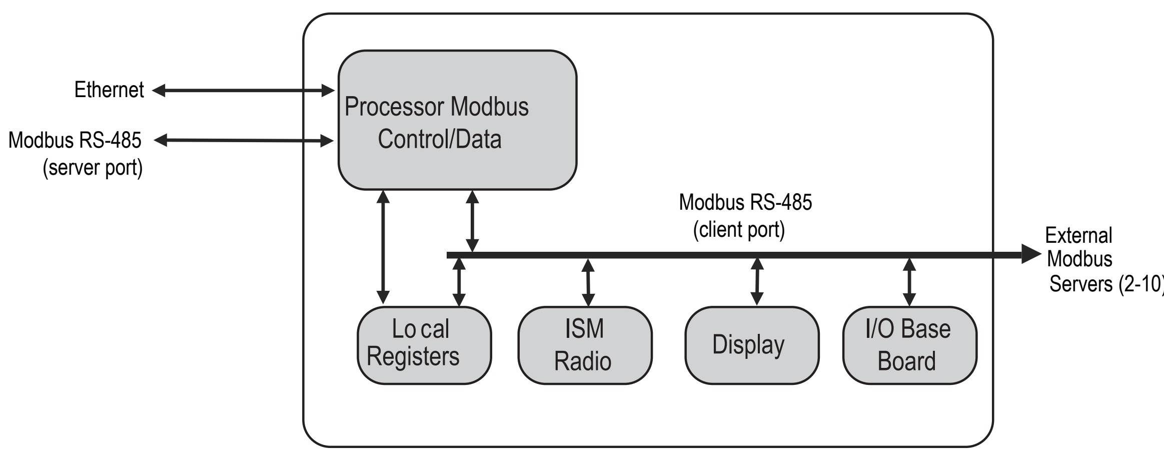
The DXM has two physical RS-485 connections using Modbus RTU protocol.

The DXM can be a Modbus RTU client device to other server devices and can be a Modbus server device to another Modbus RTU client. The DXM uses the primary RS-485 port (M+/M-) as a Modbus RTU client to control external server devices. All wired devices connected to the client RS-485 port must be server devices.

- As a Modbus RTU client device, the DXM controls the external server connected to the primary RS-485 port, the local ISM radio, the local I/O base board, and the local display board.
- As a Modbus RTU server device, the DXM local registers can be read from or written to by another Modbus RTU client device.

The secondary port (S+/S-) is the Modbus RTU server connection. The secondary (server) Modbus RS-485 port (S+/S-) is controlled by another Modbus client device, not the DXM. The server port is used by an external Modbus client device that will access the DXM as a Modbus server device.

Processor Modbus system overview



The DXM has dual Modbus roles: a Modbus server device and a Modbus client device. These run as separate processes.

The Modbus server port can only access the DXM local registers. To operate as a Modbus server device, the DXM needs to be assigned a unique Modbus ID as it pertains to the host Modbus network. This ID is separate from the internal Modbus IDs the DXM uses for its own Modbus network. The DXM Modbus ID is defined through the LCD menu. Other Modbus server port parameters are defined by using the configuration software.

The DXM operates the Modbus client port. Each device on the client port must be assigned a unique Modbus ID. There are Modbus IDs that are reserved for internal devices in the DXM.

DXM Internal Modbus IDs (factory default)

Modbus ID	Device
1	DX80 Performance Gateway or MultiHop ISM Radio—MultiHop wireless devices connected to the internal MultiHop radio should be assigned Modbus IDs starting at 11.
199	Local Registers—Internal storage registers of the DXM
200	I/O Base Board—All data and parameters for each input or output of the DXM.
201	LCD Display—The user has access to the LED indicators on the DXM.

Assigning Modbus IDs

Assign the DXM Modbus ID only if a Modbus client device is reading or writing the DXM Local Register data through the Modbus RS-485 server port (S+, S-).

Set the DXM ID from the LCD menu under **System › DXM Server ID**. The DXM can have any unique ID between 1 and 246, depending upon the host Modbus network. Other RS-485 server port parameters are set in the configuration software under the **Settings › General** tab.

DXM Client Configuration—When the DXM operates as a Modbus client device, use the configuration software to configure read or write operations of the DXM Modbus network. The DXM communicates with all internal and external peripheral devices using the external Modbus bus RS-485 (M+, M-)

configured from the factory with Modbus IDs. Assign IDs 2 through 10 to Modbus server devices that are physically wired to the DXM. Assign IDs 11 through 60 to wireless server devices within the MultiHop network.

Do not assign an ID of greater than 10 to Modbus server devices that are physically wired using the RS-485 port if there is an internal MultiHop ISM radio in the DXM. The MultiHop ISM radio attempts to send any Modbus data intended for IDs 11 through 60 across the radio network, which conflicts with wired server devices if the IDs overlap. The MultiHop client radio can be changed from the factory default of 11 through 60 Modbus IDs if more hardwired servers are required.

Wireless and Wired Devices

Wireless DX80 Gateway—The DX80 Gateway architecture is a star architecture in which all Nodes in the system send their data back to the Gateway. The host can access the entire network data from the Gateway, which is Modbus ID 1. Because the DXM will not be sending any Modbus messages across the wireless link, the timeout parameter can be set low (less than 1 second) and the device is treated like a directly connected device.

MultiHop Client—The MultiHop client radio forms a wireless tree network using repeaters and servers. Each device in a MultiHop network must be assigned a unique Modbus ID and accessed as a separate device. For the DXM to talk with a MultiHop device in the wireless network, the client MultiHop device interrogates every message on the RS-485 bus. If they are within the wireless device range (IDs 11 through 60), the message is sent across the wireless network. To change this range, the user must adjust the offset and range setting in the MultiHop client radio (Modbus ID 1). Modbus register 6502 holds the Modbus offset (default 11). Modbus register 6503 holds the number of Modbus servers allowed (maximum of 100).

Modbus IDs for wireless and wired devices

Modbus ID	Description
1	Allocated for the internal ISM radio device, either a DX80 Gateway or MultiHop client radio
2–10	Server addresses available for directly connected Modbus server devices to the client RS485 port (M+ , M-)
11–60	Allocated for wireless MultiHop radio network devices. If there is not an internal MultiHop in the DXM, these server addresses are available to use for directly connected devices.
61–198	Available to users for directly connected Modbus server devices or the expansion of the wireless network server IDs to go past 50 wireless devices.
199	Allocated for internal Local Register
200	Allocated for the I/O base board; will be different for special DXM server-only models.
201	Allocated for the LCD board, the user can read/write LEDs.

Modbus Communication Timeouts

A Modbus timeout is the amount of time a Modbus server is given to return an acknowledgment of a message sent by the Modbus client. If the Modbus client waits for the timeout period and no response is seen, the Modbus client considers it a lost message and continues on to the next operation.

The timeout parameter is simple to set for Modbus devices directly connected to the DXM, if there are no MultiHop wireless devices. Special considerations need to be made to set the timeout parameter when a MultiHop network uses the DXM as the client radio.

Configure controllers operating wireless networks to allow for enough time for hardware transmission retries. Set the **Communications Timeout** parameter to cover the expected time for messages to be sent throughout the wireless network. For the DXM, the **Communications Timeout** parameter is the maximum amount of time the DXM should wait after a request is sent until the response message is received from the Modbus server device. Use the DXM Configuration Software to set the timeout parameter on the **Settings › System** screen (select **Show advanced settings**).

The default setting for the timeout parameter is 5 seconds.

MultiHop Networks vs DX80 Star Networks

The DX80 star Gateway collects all the data from the Nodes, which allows the host system to directly read the data from the Gateway without sending messages across the wireless network. This allows for DX80 Gateway to be treated like any other wired Modbus device.

In a MultiHop network, the data resides at each device, forcing the controller to send messages across the wireless network to access the data. For this reason, carefully consider the value of the wireless timeout parameter.

Calculating the Communications Timeout for Battery-Powered MultiHop Radios

Battery-powered MultiHop radios are configured to run efficiently to maximize battery life. By optimizing battery life, the allowed communications window to receive messages is slow (once per 1.3 seconds) and sending message rates are standard (once per 0.04 seconds).

A MultiHop device is set from the factory with the retry parameter of 8. This means that under worst-case conditions, a message is sent from the DXM to an end device a total of nine times (one initial message and eight retry messages). The end device sends the acknowledgment message back to the DXM a maximum of nine times (one initial message and eight retries). A single Modbus transaction may send up to two messages + 16 retry messages before the transaction is complete. In addition, the radios randomly wait up to one time period before retransmitting a retry message. So to allow for the random wait time, add one extra time period for each in-between time of retries.

To calculate the communication timeout parameter for a client to a server radio (no repeaters):

Client to Server Send time = (9 × 1.3 sec) + (8 retry wait × 1.3 sec) = 22 seconds
Server to Client Send time = (9 × 0.04 sec) + (8 retry wait × 0.04 sec) = 1 second
Total Send/Receive time = 23 seconds
Minimum Timeout period = 23 seconds

If the link quality of the network is poor, the maximum transfer times may happen. Set the timeout parameter to accommodate the maximum number of retries that may happen in your application.

When MultiHop repeaters are added to the wireless network, each additional level of hierarchical network increases the required timeout period. Since MultiHop repeaters are running at the highest communications rate, the overall effect is not as great.

Client to Repeater Send time = (9 × 0.04 sec) + (8 retry wait × 0.04 sec) = 1 second
Repeater to Client Send time = (9 × 0.04 sec) + (8 retry wait × 0.04 sec) = 1 second
Additional Timeout period for a repeater = 2 seconds

Using the timeout calculation above of 23 seconds, if a repeater is added to the network the timeout should be set to 25 seconds. For each additional MultiHop repeater device creating another level of network hierarchy, add an additional two seconds to the timeout period.

Calculating the Communication Timeout for 10–30 VDC MultiHop Radios

Line-powered (10–30 V DC) MultiHop devices operate at the maximum communication rate, resulting in a much lower timeout parameter setting. For each repeater added to the network, increase the timeout parameter 2 seconds.

For a client radio to a 10–30 V DC powered server radio (no repeaters):

Client to Server Send time = (9 × 0.04 sec) + (8 retry wait × 0.04 sec) = 1 second
Server to Client Send time = (9 ×* 0.04 sec) + (8 retry wait × 0.04 sec) = 1 second
Total send/receive time = 2 seconds
Minimum timeout period = 2 seconds

Adjusting the Receive Slots and Retry Count Parameters

The number of receive slots governs how often a MultiHop device can communicate on the wireless network.

Battery-powered devices typically have DIP switches that allow the user to set the number of receive slots, which directly affects the battery life of the radio. Adjusting the receive slots changes how often a message can be received. By default, the receive slots are set to 4 (every 1.3 seconds). When the receive slots are set to 32, the radio listens for an incoming message every 0.16 seconds.

Users may also leave the retry mechanism to the application that is accessing the wireless network, in this case the DXM. Adjust the number of retries in the MultiHop devices by writing the number of retries desired to Modbus register 6012. The factory default setting is 8.

Calculating the Communication Timeout for a DX80 Star Network

In the DX80 network, all Node data is automatically collected at the Gateway to be read. The DXM does not use the wireless network to access the data, which allows for much faster messaging and much lower timeout values.

For a DXM with an internal DX80 Gateway, set the timeout value 0.5 seconds. If other Modbus devices are connected to the RS-485 lines, the timeout parameter governs all communication transactions and must be set to accommodate all devices on the bus.

Modbus TCP Client

The DXM can operate as a Modbus TCP client on Ethernet. Users may define up to five socket connections for Modbus TCP server devices to read Modbus register data over Ethernet. Use the DXM Configuration Software to define and configure Modbus TCP client communications with other Modbus TCP servers.

Modbus Register Summary

DXM Modbus Registers

The DXM may have up to four internal Modbus server devices.

All Modbus registers are defined as 16-bit Modbus Holding Registers. When connecting external Modbus server devices, only use Modbus IDs 2 through 198. The local registers, the I/O base, and the LCD IDs are fixed, but the internal radio ID can be changed if needed.

DXM Internal Modbus IDs (factory default)

Modbus ID	Device
1	DX80 Performance Gateway or MultiHop ISM Radio—MultiHop wireless devices connected to the internal MultiHop radio should be assigned Modbus IDs starting at 11.
199	Local Registers—Internal storage registers of the DXM
200	I/O Base Board—All data and parameters for each input or output of the DXM.
201	LCD Display—The user has access to the LED indicators on the DXM.

Modbus Registers for the MultiHop Radio Board Module

The DX80 MultiHop client radio is a tree-based architecture device that allows for repeater radios to extend the wireless network. Each device in a MultiHop network is a Modbus device with a unique Modbus ID.

Modbus registers in a MultiHop network are contained within each individual radio device. To obtain Modbus register data from a MultiHop device, configure the DXM to access each device across the wireless network as an individual Modbus server device.

Example MultiHop Modbus registers with generic devices.

MulitHop Device	Modbus ID	Modbus Registers
DXM client radio	1	none
Server radio	11	Modbus register 1–16 are inputs, 501–516 are outputs
Repeater radio	12	Modbus register 1–16 are inputs, 501–516 are outputs

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MulitHop Device	Modbus ID	Modbus Registers
Server radio	15	Modbus register 1–16 are inputs, 501–516 are outputs

Modbus Registers for the Performance Gateway Radio Module

The DX80 Performance Gateway is a star-based architecture device that contains all the Modbus registers for the wireless network within the Gateway. To access any input or output values within the entire wireless network, read the appropriate Modbus register from Gateway.

There are 16 Modbus registers allocated for each device in the wireless network. The first 16 registers (1–16) are allocated for the Gateway, the next 16 (17–32) are allocated for Node 1, the next 16 (33–48) are allocated for Node 2 and so forth. There are no inputs or outputs on the DXM embedded Gateway but the Modbus registers are still allocated for them.

Although only seven Nodes are listed in the table, the Modbus register numbering continues for as many Nodes as are in the network. For example, the register number for Node 10, I/O point 15 , is 175. Calculate the Modbus register number for each device using the equation:

```
Register Number = I/O# + (Node# × 16)
```

Modbus holding registers

I/O Point	Gateway	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
1	1	17	33	49	65	81	97	113
2	2	18	34	50	66	82	98	114
3	3	19	35	51	67	83	99	115
4	4	20	36	52	68	84	100	116
5	5	21	37	53	69	85	101	117
6	6	22	38	54	70	86	102	118
7	7	23	39	55	71	87	103	119
8	8	24	40	56	72	88	104	120
9	9	25	41	57	73	89	105	121
10	10	26	42	58	74	90	106	122
11	11	27	43	59	75	91	107	123
12	12	28	44	60	76	92	108	124
13	13	29	45	61	77	93	109	125
14	14	30	46	62	78	94	110	126
15	15	31	47	63	79	95	111	127
16	16	32	48	64	80	96	112	128

Access all wireless network registers by reading Modbus ID 1

DX80 Device	Modbus ID	Modbus Registers
DXM Gateway radio	1	Modbus registers 1–8 are inputs, 9–16 are outputs
Node 1	-	Modbus registers 17–24 are inputs, 25–32 are outputs
Node 2	-	Modbus registers 33–40 are inputs, 41–48 are outputs
Node 3	-	Modbus registers 49–56 are inputs, 57–64 are outputs

Alternative Modbus Register Organization

The Sure Cross DX80 Alternative Modbus Register Organization registers are used for reordering data registers to allow host systems to efficiently access all inputs or outputs using a single Modbus command. The register groups include the input/output registers, bit-packed registers, and analog registers. This feature is only available with the Performance models using version 3 or newer of the LCD firmware code.

Alternative Modbus register organization

Name	Modbus Register Address (Decimal)
Inputs and Outputs, in order by device	2201 through 4784
Discrete Bit Packed (Status, Discrete Inputs, Discrete Outputs)	6601 through 6753
Analog Inputs (1–8) and Analog Outputs (1–8)	6801 through 9098

Input Registers and Outputs Registers

Modbus registers 2201 through 2584 are used to organize all inputs together.

In this format, users can sequentially read all input registers using one Modbus message. Modbus registers 4401 through 4784 organize all outputs together to allow users to sequentially write to all output registers using one Modbus message.

Input and output registers

Inputs (2201–2584)		Outputs (4401–4784)	
Modbus Register Address (Decimal)	16-bit Register Value	Modbus Register Address (Decimal)	16-bit Register Value
2201–2208	Gateway Inputs 1 through 8	4401–4408	Gateway Outputs 1 through 8
2209–2216	Node 1 Inputs 1 through 8	4409–4416	Node 1 Outputs 1 through 8
2217–2224	Node 2 Inputs 1 through 8	4417–4424	Node 2 Outputs 1 through 8
...	...	...	...
2577–2584	Node 47 Inputs 1 through 8	4777–4784	Node 47 Outputs 1 through 8

Refer to your device's datasheet for a list of the active inputs and outputs. Not all inputs or outputs listed in this table may be active for your system.

Discrete Bit-Packed Registers

Discrete bit-packed registers include the discrete status registers, discrete inputs, and discrete outputs.

Bit packing involves using a single register, or range of contiguous registers, to represent I/O values.

When networks use similar Nodes to gather data using the same I/O registers for each Node, discrete data from multiple Nodes can be bit packed into a single register on the Gateway. The bit-packed data is arranged by I/O point starting at Modbus register 6601. For example, Discrete IN 1 for all the Nodes in the network is stored in three contiguous 16-bit registers.

The most efficient way to read (or write) discrete data from a Sure Cross® DX80 Gateway is by using these bit-packed registers because users can read or write registers for all devices using one Modbus message. The following registers contain discrete bit-packed I/O values for the Gateway and all Nodes. Values are stored first for the Gateway, then for each Node in order of Node address.

Discrete bit-packed register addresses and bit positions

Bit-Packed Device Status Registers

	Bit Position															
Register Address	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
6601	Node 15	Node 14	Node 13	Node 12	Node 11	Node 10	Node 9	Node 8	Node 7	Node 6	Node 5	Node 4	Node 3	Node 2	Node 1	Gateway
6602	Node 31	Node 30	Node 29	Node 28	Node 27	Node 26	Node 25	Node 24	Node 23	Node 22	Node 21	Node 20	Node 19	Node 18	Node 17	Node 16
6603	Node 47	Node 46	Node 45	Node 44	Node 43	Node 42	Node 41	Node 40	Node 39	Node 38	Node 37	Node 36	Node 35	Node 34	Node 33	Node 32

Bit-Packed Discrete Input 1

	Bit Position															
Register Address	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
6611	Node 15	Node 14	Node 13	Node 12	Node 11	Node 10	Node 9	Node 8	Node 7	Node 6	Node 5	Node 4	Node 3	Node 2	Node 1	Gateway
6612	Node 31	Node 30	Node 29	Node 28	Node 27	Node 26	Node 25	Node 24	Node 23	Node 22	Node 21	Node 20	Node 19	Node 18	Node 17	Node 16
6613	Node 47	Node 46	Node 45	Node 44	Node 43	Node 42	Node 41	Node 40	Node 39	Node 38	Node 37	Node 36	Node 35	Node 34	Node 33	Node 32

Bit-Packed Discrete Output 1

	Bit Position															
Register Address	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
6691	Node 15	Node 14	Node 13	Node 12	Node 11	Node 10	Node 9	Node 8	Node 7	Node 6	Node 5	Node 4	Node 3	Node 2	Node 1	Gateway
6692	Node 31	Node 30	Node 29	Node 28	Node 27	Node 26	Node 25	Node 24	Node 23	Node 22	Node 21	Node 20	Node 19	Node 18	Node 17	Node 16
6693	Node 47	Node 46	Node 45	Node 44	Node 43	Node 42	Node 41	Node 40	Node 39	Node 38	Node 37	Node 36	Node 35	Node 34	Node 33	Node 32

Discrete bit-packed registers for inputs and outputs

Inputs		Outputs	
Modbus Register Address (Decimal)	**Description (Inputs)**	**Modbus Register Address (Decimal)**	**Description (Outputs)**
6601–6603	Status for all devices		
6611–6613	Input 1 from all devices	6691–6693	Output 1 from all devices
6621–6623	Input 2 from all devices	6701–6703	Output 2 from all devices
6631–6633	Input 3 from all devices	6711–6713	Output 3 from all devices
6641–6643	Input 4 from all devices	6721–6723	Output 4 from all devices
6651–6653	Input 5 from all devices	6731–6733	Output 5 from all devices
6661–6663	Input 6 from all devices	6741–6743	Output 6 from all devices
6671–6673	Input 7 from all devices	6751–6753	Output 7 from all devices
6681–6683	Input 8 from all devices		

Status registers (6601–6603) contain a bit-packed representation defining the devices that are operational in the wireless system. Each bit indicates Node in Sync (1) or Node Not in Sync (0).

A one (1) written to the Discrete Status Register area indicates the device is active within the wireless system. A zero (0) indicates the device is not active within the wireless network.

Input registers from all devices use Modbus registers 6611 through 6683 to organize the least significant bit into a sequential array of registers. The first register contains the least significant bit from the input values for the Gateway through Node 15. The second register contains the input values for Node 16 through Node 31, and the third register contains the input values for Nodes 32 through 47.

For discrete inputs, only the least significant bit is used. For analog inputs, the least significant bit indicates if the analog value is above or below the selected threshold value (when using the threshold parameter configured in the User Configuration Software). For example, a least significant bit of one (1) indicates the analog value is above the selected threshold value. A least significant bit of zero (0) indicates the analog value is below the threshold value.

Output registers from all devices use Modbus registers 6691 through 6753 to organize the least significant bit into a sequential array of registers. Output 8 (I/O point 16) cannot be written using the discrete format.

Analog 16-Bit Registers (Registers 6801 through 9098)

The most efficient way to read (or write) analog data from a Gateway is by using these 16-bit analog registers. Most networks consist of similar Nodes reporting data using the same I/O registers for each Node. For this reason, the analog data is arranged by I/O point using Modbus registers 6801 through 9098.

For example, Input 1 for Gateway and all Nodes is stored in the first 48 contiguous blocks of 16-bit analog registers, beginning with register 6801.

In this format, users can read a 16-bit holding register for all devices or write to a register for all devices using one Modbus message. Using these registers is the most efficient way to read all status registers, read all analog inputs, or write all analog outputs.

The following registers contain analog I/O values for the Gateway and all Nodes. Values are stored first for the Gateway, then for each Node in order of Node address.

Analog input and output registers

Inputs		Outputs	
Modbus Register Address (Decimal)	Description (Inputs)	Modbus Register Address (Decimal)	Description (Outputs)
6801	Input 1 for Gateway	8001	Output 1 for Gateway
6802	Input 1 for Node 1	8002	Output 1 for Node 1
6803	Input 1 for Node 2	8003	Output 1 for Node 2
...	...	...	...
6951	Input 2 for Gateway	8151	Output 2 for Gateway
6952	Input 2 for Node 1	8152	Output 2 for Node 1
6953	Input 2 for Node 2	8153	Output 2 for Node 2
...	...	...	...
7101	Input 3 for Gateway	8301	Output 3 for Gateway
7102	Input 3 for Node 1	8302	Output 3 for Node 1
7103	Input 3 for Node 2	8303	Output 3 for Node 2
...	...	...	...
7851	Input 8 (Status Register) for Gateway	9051	Output 8 for Gateway
7852	Input 8 (Status Register) for Node 1	9052	Output 8 for Node 1
7853	Input 8 (Status Register) for Node 2	9053	Output 8 for Node 2
...	...	...	...

For example, 6801 contains the input 1 value for the Gateway, 6802 contains the input 1 value for Node 1, and 6848 contains the input 1 value for Node 47.

Internal Local Registers (ID 199) for the DXM100 and DXM150

The main storage elements for the DXM are its Local Registers, which can store 4-byte values that result from register mapping, action rules, or ScriptBasic commands.

- Local Registers 1 through 850 are standard 32-bit unsigned registers.
- Local Registers 851 through 900 are non-volatile registers that are limited to 100,000 write cycles.
- Local Registers 1001 through 1900 are floating point format numbers. Each register address stores half of a floating point number. For example, registers 1001 and 1002 store the first full 32-bit floating point number.
- Local Registers 10001 through 19000 are system, read-only, registers that track DXM data and statistics.

Modbus Registers for Internal Local Registers (Modbus ID 199)

Local Registers	Type	Description
1–845	32-bit unsigned	Internal processor memory

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Local Registers	Type	Description
846–849	32-bit unsigned	Reset, Constant, Timer
851–900	32-bit unsigned	Data flash, non-volatile
1001–1900	32-bit IEEE Floating Point	Floating point registers, internal processor memory
> 10000		Read-only virtual registers

Local Registers 1–850 (Internal Processor Memory, 32-bit, Unsigned)—The Local Registers are the main global pool of registers. Local Registers are used as basic storage registers and as the common data exchange mechanism. External Modbus device registers can be read into the Local Registers or written from the Local Registers. The DXM, as a Modbus client device or a Modbus server device, exchanges data using the Local Registers. Modbus over Ethernet (Modbus/TCP) uses the Local Registers as the accessible register data.

Local Registers 851–900 (Data Flash, Non-volatile, 32-bit, Unsigned)— The top 50 Local Registers are special non-volatile registers. The registers can store constants or calibration type data that must be maintained when power is turned off. This register data is stored in a data flash component that has a limited write capability of 100,000 cycles, so these registers should not be used as common memory registers that change frequently.

Local Registers 1001–1900 (32-bit IEEE Floating Point)— These Local Registers are paired together to store a 32-bit IEEE floating point format number in big endian format. Registers 1001 [31:16], 1002 [15:0] store the first floating point value; registers 1003, 1004 store the second floating point number. There are a total of 500 floating point values; they are addressed as two 16-bit pieces to accommodate the Modbus protocol. Use these registers when reading/writing external devices that require Modbus registers in floating point format. Since Modbus transactions are 16-bits, the protocol requires two registers to form a 32-bit floating point number.

Virtual Registers— The DXM has a small pool of virtual registers that show internal variables of the main processor. Some register values will be dependent upon the configuration settings of the DXM. Do not use **Read Rules** to move Virtual Local Registers data into Local Registers. Use the **Action Rule › Register Copy** function to move Virtual Local Registers into Local Registers space (1-850).

Virtual registers

Virtual Registers	Definition	
10001	GPS latitude direction (N, S, E, W)	GPS Coordinate Data if the DXM is configured to read an external GPS unit.
10002	GPS latitude	
10003	GPS longitude direction (N, S, E, W)	
10004	GPS longitude	
10011–10012	Resync timer	Engineering use
10013–10014	Resync timer rollover	Engineering use
10015–10016	Reboot cause (Restart Codes above)	Reboot Type
10017–10018	Watchdog reset count	Counter to track how many resets have been caused by the Watchdog
10021	IO Board Battery Voltage (mV)	mV
10022	IO Board - Incoming Supply Voltage (mV)	mV
10023	Cut-off Feature	0—No successful readings 1—Normal range 2—Cut-off engaged
10024	IO Board - Battery Charging Current (mA)	mA
10025–10026	HTTP Push SSL Acquires	Statistical counts of connections, disconnections and forced disconnects when the DXM creates a connection using SSL/TLS (Encrypted connections)
10027–10028	HTTP Push SSL Releases	
10029–10030	HTTP Push SSL Forced Releases	
10031–10032	HTTP Push Attempts	Statistical counts of connections, disconnections and forced disconnects when the DXM controller creates a connection using HTTP non-encrypted
10033–10034	HTTP Push Successes	
10035–10036	HTTP Push Failures	

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Virtual Registers	Definition	
10037–10038	HTTP Push Last Status	Last DXM push status 0 = Initial state, no push attempt as finished yet 1 = Attempt complete 2 = Attempt aborted
10039–10040	Cellular Strength, BER	Cellular signal strength. Value range: 0–31 0 = –113 dBm or less 1 = –111 dBm 2–30 = –109 dBm through –53 dBm in 2 dBm steps 31 = –51 dBm or greater 99 = not known or not detectable; BER not used
10055–10056	Alarms, SMTP, attempts	Email attempts (only available with some model configurations)
10057–10058	Alarms, SMTP, fails	Email failures (only available with some model configurations)
10059–10060	Alarms, SMS, attempts	SMS text message attempts (only available with some model configurations)
10061–10062	Alarms, SMS, fails	SMS text message failures (only available with some model configurations)
10100	Number of read maps in default	Read Map statistics
10101	Number of read map successes	
10102	Number of read map timeouts	
10103	Number of read map errors	
10104	Read map success streak	
10105	Number of write map successes	Write Map statistics
10106	Number of write map timeouts	
10107	Number of write map errors	
10108	Write map success streak	
10109	Number of passthrough successes	API message passing statistics
10110	Number of passthrough timeouts	
10111	Number of passthrough errors	
10112	Passthrough success streak	
10113	Number of 43 buffer successes	DX80 Gateway automatic messaging buffer statistics
10114	Number of 43 buffer timeouts	
10115	Number of 43 buffer errors	
10116	43 buffer success streak	
11000	Read map success count	Read/Write maps statistics
12000	Write map success count	
13000	Read map timeout count	
14000	Write map timeout count	
15000	Read map error count	
16000	Write map error count	
17000	Read map success streak	
18000	Write map success streak	
19000	Read map is in default	

The reset codes are in virtual register 11015 and define the condition of the last restart operation.

Reset Code	Definition
0	Undefined
1	Unknown

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Reset Code	Definition
2	General
3	Brownout
4	Watchdog
5	User
6	Software
7	Return from backup mode

Internal Local Registers (ID 199) for the DXM700, DXM1000, and DXM1200

The main storage elements for the DXM are its local registers, which can store 4-byte values that result from register mapping, action rules, or ScriptBasic commands.

Local registers updated from Modbus transactions are restricted to a 16-bit data value to follow standard Modbus holding register definition.

The local registers defined in action rules must all be within the same register group. For example, an action rule cannot have inputs from an integer group with the result register defined as a floating point register. To move between integers and floats, use the Register Copy Rule.

- Local registers 1–850 and 5001–7000 are 32-bit integer registers
- Local registers 851–900 and 7001–8000 are non-volatile 32-bit integer registers
- Local registers 901-1000 are reserved for internal use
- Local registers 1001–5000 are floating point format numbers, each address stores half of a floating point number; for example, registers 1001 and 1002 store the first full 32-bit floating point number
- Local registers 10000 and higher are read-only virtual registers; virtual registers collect various system-level data

Modbus registers for internal local registers (Modbus ID 199)

Local Registers	Type	Description
1–845	32-bit integer	Local data registers
846–849	32-bit integer	Reset, Constant, Timer
851–900	32-bit non-volatile integer	Data flash, non-volatile
901–1000		Reserved for internal use
1001–5000	Floating point	Floating point registers, local data registers
5001–7000	32-bit integer	Local data registers
7001–8000	32-bit non-volatile integer	Data flash, non-volatile
> 10000		Read-only virtual registers, system-level data

Local registers 1–850 and 5001–7000 (Internal Processor Memory, 32-bit, Unsigned)—The local registers are the main global pool of registers. Local registers are used as basic storage registers and as the common data exchange mechanism. External Modbus device registers can be read into the local registers or written from the local registers. The DXM, as a Modbus client device or a Modbus server device, exchanges data using the local registers. Modbus over Ethernet (Modbus/TCP) uses the local registers as the accessible register data.

Local registers 851–900 and 7001–8000 (Data Flash, Non-volatile, 32-bit, Unsigned)—The top 50 local registers are special non-volatile registers. The registers can store constants or calibration-type data that must be maintained when power is turned off. This register data is stored in a data flash component that has a limited write capability of 100,000 cycles, so these registers should not be used as common memory registers that change frequently.

Local registers 1001–5000— These local registers are paired together to store a 32-bit IEEE floating point format number in big-endian format. Registers 1001 [31:16], 1002 [15:0] store the first floating point value; registers 1003, 1004 store the second floating point number. There are a total of 2000 floating point values; they are addressed as two 16-bit pieces to accommodate the Modbus protocol. Use these registers when reading/writing external devices that require Modbus registers in floating-point format. Since Modbus transactions are 16 bits, the protocol requires two registers to form a 32-bit floating point number.

Virtual registers—The DXM has a small pool of virtual registers that show the internal variables of the main processor. Some register values will be dependent upon the configuration settings of the DXM. Do not use **Read Rules** to move virtual local registers data into local registers. Use the **Action Rule › Register Copy** function to move virtual local registers into local registers space (1–850).

Modbus registers for virtual registers

Registers	Definition	
10001	GPS latitude direction (N, S, E, W)	GPS Coordinate Data if the DXM is configured to read an external GPS unit.
10002	GPS latitude	
10003	GPS longitude direction (N, S, E, W)	
10004	GPS longitude	
10011–10012	Resync timer	Engineering use
10013–10014	Resync timer rollover	Engineering use
10015–10016	Reboot cause (Restart Codes above)	Reboot Type
10017–10018	Watchdog reset count	Counter to track how many resets have been caused by the Watchdog
10021	IO Board Battery Voltage (mV)	mV (Not applicable for DXM700 or DXM1200 models)
10022	IO Board - Incoming Supply Voltage (mV)	mV (Not applicable for DXM700 or DXM1200 models)
10023	IO Board Voltage Cut-off Feature	0—No successful readings (Not applicable for DXM700 or DXM1200 models) 1—Normal range 2—Cut-off engaged
10024	IO Board - Battery Charging Current (mA)	mA (Not applicable for DXM700 or DXM1200 models)
10025–10026	Http Push SSL Acquires	Statistical counts of connections, disconnections and forced disconnects when the DXM creates a connection using SSL/TLS (Encrypted connections)
10027–10028	Http Push SSL Releases	
10029–10030	Http Push SSL Forced Releases	
10031–10032	Http Push Attempts	Statistical counts of connections, disconnections and forced disconnects when the DXM controller creates a connection using HTTP non-encrypted
10033–10034	Http Push Successes	
10035–10036	Http Push Failures	
10037–10038	Http Push Last Status	Last DXM push status 0 = Initial state, no push attempt as finished yet 1 = Attempt complete 2 = Attempt aborted
10039–10040	Cellular Strength, BER	Cellular signal strength. Value range: 0–31 0 = –113 dBm or less 1 = –111 dBm 2–30 = –109 dBm through –53 dBm in 2 dBm steps 31 = –51 dBm or greater 99 = not known or not detectable; BER not used
10055–10056	Alarms, smtp, attempts	Email attempts (only available with some model configurations)
10057–10058	Alarms, smtp, fails	Email failures (only available with some model configurations)
10100	Number of read maps in default	Read Map statistics
10101	Number of read map successes	
10102	Number of read map timeouts	
10103	Number of read map errors	
10104	Read map success streak	
10105	Number of write map successes	Write Map statistics
10106	Number of write map timeouts	
10107	Number of write map errors	
10108	Write map success streak	
10109	Number of passthrough successes	API message passing statistics

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Registers	Definition	
10110	Number of passthrough timeouts	
10111	Number of passthrough errors	
10112	Passthrough success streak	
10113	Number of 43 buffer successes	DX80 Gateway automatic messaging buffer statistics
10114	Number of 43 buffer timeouts	
10115	Number of 43 buffer errors	
10116	43 buffer success streak	
11000	Read map success count	Read/Write maps statistics
12000	Write map success count	
13000	Read map timeout count	
14000	Write map timeout count	
15000	Read map error count	
16000	Write map error count	
17000	Read map success streak	
18000	Write map success streak	
19000	Read map is in default	

TCP Client Statistics--The "x" represents the socket 0 through 4. The flex socket is not used. This range repeats for the next socket.

Register	Definition
2x001	Socket x connection attempts (20001 is the first socket, 21001 is the second socket...)
2x003	Socket x connections
2x005	Socket x disconnections
2x007	Socket x transmits
2x009	Socket x receives
2x011	Socket x resolver attempts (reserved)
2x013	Socket x resolvers (reserved)
2x015–2x020	Reserved
2x021	Socket x Rule 0 transmits
2x023	Socket x Rule 0 receives
2x025	Socket x Rule 0 timeouts
2x027	Socket x Rule 0 broadcasts
2x029	Reserved
2x031	Socket x Rule 1 transmits
2x033	Socket x Rule 1 receives
2x035	Socket x Rule 1 timeouts
2x037	Socket x Rule 1 broadcasts
2x039	Reserved

Reset Codes—The reset codes are in virtual register 11015 and define the condition of the last restart operation.

Reset Code	Definition
0	Undefined
1	Unknown

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Reset Code	Definition
2	General
3	Brownout
4	Watchdog
5	User
6	Software
7	Return from backup mode

Modbus IO Registers for the B1 IO Base Board

The I/O base board stores the input and output values in Modbus holding registers. Since the I/O base board is defined as a separate device, configure the DXM to read or write the values on the I/O base board.

Base Board Input Connection		
Modbus Register	Range	Description
1	0–65535	Universal input 1
2	0–65535	Universal input 2
3	0–65535	Universal input 3
4	0–65535	Universal input 4

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.

B1 Controller Base Board Output Connection		
Modbus Register	Range	Description
501	0–1	NMOS Output 1
502	0–1	NMOS Output 2
503	0–1	NMOS Output 3
504	0–1	NMOS Output 4
505	0–1	Switched Power 1 (5 V or 16 V)
506	0–1	Switched Power 2 (5 V or 16 V)
507	0–20000	Analog Output 1 default (0-20.000 mA)
	0–10000	Analog Output 1 (0-10.000 V)
508	0–20000	Analog Output 2 default (0-20.000 mA)
	0–10000	Analog Output 2 (0-10.000 V)

Modbus IO Registers for the B2 IO Base Board

The I/O base board stores the input and output values in Modbus holding registers. Since the I/O base board is defined as a separate device, configure the DXM to read or write the values on the I/O base board.

Base Board Input Connection		
Modbus Register	**Range**	**Description**
1	0–65535	Universal input 1
2	0–65535	Universal input 2
3	0–65535	Universal input 3
4	0–65535	Universal input 4

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.

B2 Controller Base Board Output Connection		
Modbus Register	**Range**	**Description**
501	0–1	NMOS Output 1
502	0–1	NMOS Output 2
503	0–1	NMOS Output 3
504	0–1	NMOS Output 4
505	0–1	Switched Power 1 (5 V to 24 V)
506	0–1	Switched Power 2 (5 V to 24 V)
507	0–1	DC Latching Output 1
508	0–1	DC Latching Output 2
509	0–10000	Analog Output 1 (0 to 10.000 V)
510	0–10000	Analog Output 2 (0 to 10.000 V)

Modbus Configuration Registers for the Universal Inputs

Each input or output on the I/O base board has associated Modbus registers that configure its operation.

Universal Input Parameters Registers				
Universal Inputs	**1**	**2**	**3**	**4**
Enable Full-Scale Registers	3303	3323	3343	3363
Temperature °C/°F Registers	3304	3324	3344	3364
Input Type Registers	3306	3326	3346	3366
Threshold Registers	3308	3328	3348	3368
Hysteresis Registers	3309	3329	3349	3369
Enable Rising Registers	4908	4928	4948	4968
Enable Falling Registers	4909	4929	4949	4969
High Register for Counter Registers	4910	4930	4950	4970
Low Register for Counter Registers	4911	4931	4951	4971

Modbus Configuration Registers for the Analog Output

The I/O base board has two analog outputs that are selectable as 0 to 20 mA (factory default) or 0 to 10 V. To change the analog output characteristic, physical jumpers on the I/O board and a Modbus register parameter must both be changed.

For step-by-step instructions on changing the output characteristics see "Analog (DAC) Outputs for the B1 and S1 Models" on page 35.

Parameters for Analog Output 1 start at 4001 through 4008. Parameters for Analog Output 2 start at 4021 through 4028.

Registers for analog output (4xxxx) parameters

Analog output 1	Analog output 2	Description	Values
4001	4021	Maximum Analog Value	
4002	4022	Minimum Analog Value	
4003	4023	Enable Register Full-Scale	0 = Store readings in unit-specific data 1 = Linear rate from 0 to 65535
4004	4024	Hold Last State Enable	0 = Disables Hold Last State and uses the Default Output State setting during an error condition 1 = Sets the output to its last known value
4005	4025	Default Output State	
4008	4028	Analog Output Type	0 to 20 mA or 0 to 10 V DC output (I/O board jumper selectable) Accuracy: 0.1% of full scale +0.01% per °C Resolution: 12-bit After changing the jumper position, write the appropriate value to the Modbus registers to define your analog output to match the setting selected by the jumper. 2 = 0 to 20 mA output (default) 3 = 0 to 10 V output
2952		Enable Default Communication Timeout	0 = Disable 1 = Enable
2953		Communication Default I/O Timeout (100 ms/Count)	Number of 100 ms periods
2954		Enable Default on Power Up	0 = Disable 1 = Sends device outputs to their default condition

Analog Output Type—The analog outputs may be configured as either 0 to 20 mA outputs (default) or 0 to 10 V outputs. To change the analog output type change the hardware jumper position and write to the Modbus register that defines the analog output type. For analog output 1, write to Modbus register 4008, for analog output 2 write to Modbus register 4028. Write a value of 2 (default) to select 0 to 20 mA; write a value of 3 to select 0 to 10 V.

Default Output Conditions—Default output triggers are the conditions that drive outputs to defined states. Example default output conditions include when radios are out of sync, when a device cycles power, or during a host communication timeout.

- **2952 Enable Default Communication Timeout**— A "communication timeout" refers to the communication between any Modbus client host and the DXM baseboard. Set this register to 1 to enable the default condition when the host has not communicated with the DXM baseboard for the period of time defined by the Communication Default IO Timeout.
- **2953 Communication Default I/O Timeout (100 ms/Count)**—This parameter defines the host timeout period in 100-millisecond increments. If a host does not communicate within this timeout period, the device outputs are set to the default values.
- **2954 Enable Default on Power Up**—Setting this parameter to 1 sends the device outputs to their default condition when the DXM baseboard is powered up. Set to 0 to disable this feature.

Default Output State—The Default Output State parameter represents the default condition of the analog output. When an error condition exists, the outputs are set to this 16-bit user-defined output state. To define the error conditions for device outputs, refer to the MultiHop default output parameters 2950–2954.

Enable Register Full-Scale—Set to 1 to enable a linear range from 0 to 65535 for the specified input range. For a 4 to 20 mA output, a value of 0 represents 4 mA and 65535 represents 20 mA. Set this parameter to 0 to store 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 outputs), values are stored as µA (micro Amps), and voltage values are stored as mV (millivolts).

Hold Last State Enable—Set the Hold Last State to 1 to set the output to its last known value before the error occurred. Set this parameter to 0 to disable the Hold Last State and use the Default Output State setting during an error condition.

Maximum Analog Value—The Maximum Analog Value register stores the maximum allowed analog value. The specific units of measure apply to the register value. For example, the register may contain 20000, for 20 mA, or for a voltage output the register may contain 8000, for 8 volts.

Minimum Analog Value—The Minimum Analog Value register stores the minimum allowed analog value. The specific units of measure apply to register value. For example, the register may contain 4000, for 4 mA, or for a voltage output the register may contain 2000, for 2 volts.

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 4 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.

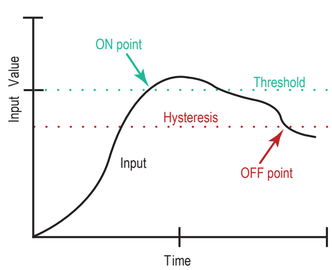
High/Low Register for Counter

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 DXM, 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.

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Modbus Register	Description
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.

Modbus Registers for the LCD Board (Modbus ID 201)

Control the four user-defined LEDs using the display board's Modbus registers. Using write maps or ScriptBasic, write the Modbus registers shown below with 0 (off) or 1 (on). The LCD is Modbus ID 201.

Modbus Register	I/O Connection	Modbus Register	I/O Connection
1102 : bit 0	LED 1	1104 : bit 0	LED 3
1103 : bit 0	LED 2	1105 : bit 0	LED 4

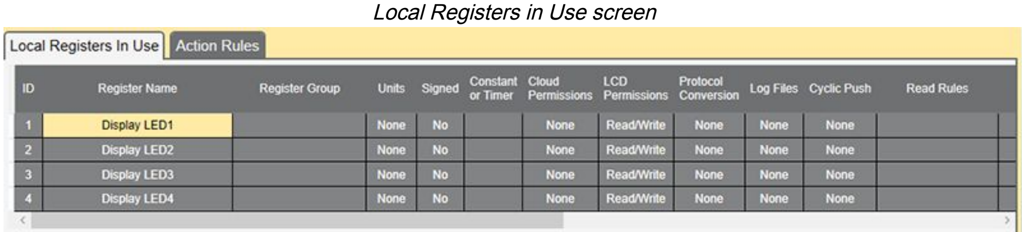
Using the Display LEDs

Turn on the DXM LEDs by writing to the LEDs' Modbus registers.

This example shows how to configure the DXM using the configuration software to read four universal inputs and write the state values to the display LEDs.

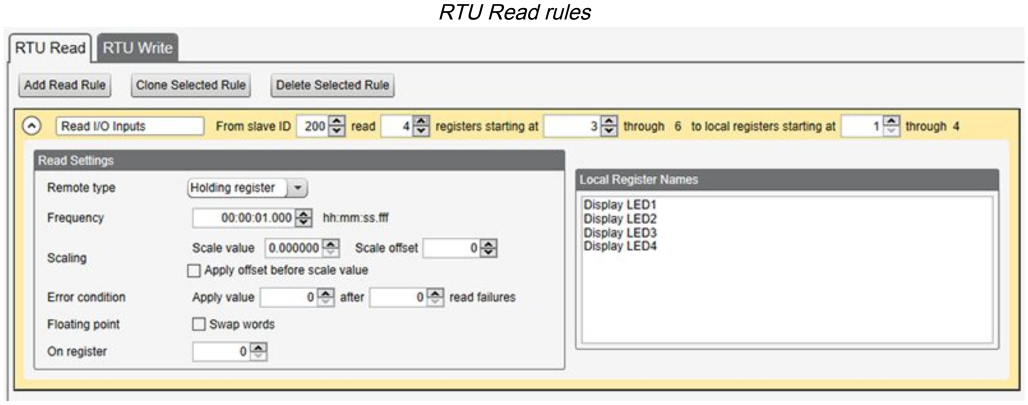
1. Using the configuration software, go to the **Local Registers › Local Registers in Use** screen.
2. Define the local registers by assigning names to the first four registers and setting the LCD permissions parameter to read/write. The LCD permissions show the register contents on the LCD menu under the **REGISTER** menu. You can also set the value from the LCD menu.

Local Registers in Use screen



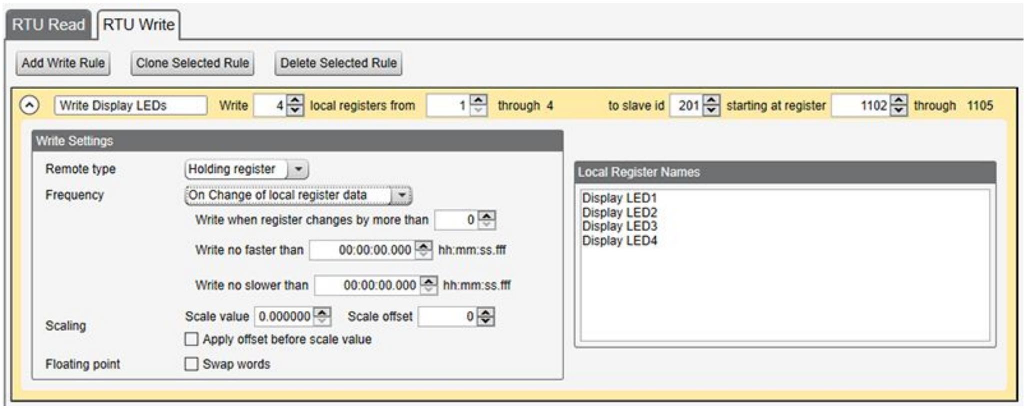
3. Create a **Read Rule** to read the four universal inputs from the I/O board (Modbus ID 200) and write the values in local registers 1 through 4.

RTU Read rules



4. Create a **Write Rule** to write the four local register values to the DXM display registers 1102 through 1105 (Modbus ID 201). Define the **Write Rule** to only write the display registers when the inputs change.

RTU Write rules



5. Save the XML configuration from the **File › Save As** menu.
6. Connect to the DXM using a USB cable and select **Device › Connection Settings** from the menu bar.
7. Upload the XML configuration file to the DXM by selecting **Device › Upload Configuration to Device** from the menu bar.

After a configuration file is uploaded, the DXM reboots. The new configuration is now running.

Turning on any one of the universal inputs 1 through 4 on the I/O base board of the DXM now turns on an LED on the display.

Using Courtesy Power or Switch Power

Pin 18 of the DXM100-Bx or 1000-Bx Wireless Controller is a constant power source that supplies 5 V up to 500 mA.

Pins 21 (switch power 2) and 30 (switch power 1) are switched power outputs. Configure the switched power outputs using Modbus registers or by using the DXM Configuration Software's **Settings › I/O Board** screen. The output voltage can be selected and is controlled using a Modbus register on the I/O board (Modbus ID 200). The voltage options are:

- 5 V or 16 V for DXM100-B1 models; or
- 5 to 24 V DC for DXM100-B2 models.

Turn the switched power on or off using the output register 505 for switch power 1 or 506 for switch power 2. For continuous power, set the Default Output register to 1, then cycle the power.

Switch Power	Enable Register	Enable Register Value	Voltage Register	Voltage Register Value	Default Output Register	Output Register
1 (pin 30)	2201	Write a 0 to turn OFF Write a 1 to turn ON (default)	3601	Write a 0 to select 5 V (default) Write a 1 to select 16 V Write a 2 to select 24 V (DXM100-B2 model only)	3602	505
2 (pin 21)	2251		3621		3622	506

Enable Register
: Configuration registers that turn on the ability to use the switched power output.
: Default setting = ON

Voltage Register
: Configuration registers that define the output voltage to the switched power output.
: Default setting = 5 V

Default Output Register
: Configuration registers that turn on the switched power outputs for continuous power out.
: Set register to 1 for continuous power. Cycle power if this register is changed.
: Default setting = 0

Modbus Output Register
: Turn on or turn off the voltage output. If both outputs 505 and 506 are turned on at the same time but are set to different voltages, the output voltage is 5 V for DXM100-B1 models and set to the lower voltage setting for DXM100-B2 models.

Associating a Switched Power Output to an Input

Use the DXM Configuration Software to associate a switched power output to a universal input.

Switched power 1 and 2 (pins 30 and 21) can be associated to any Universal input to apply power to a sensor, take a reading, and then remove power from the sensor. This conserves power in battery-operated systems. The switched power supply can be used in one of two different ways: supplying courtesy power to an output pin or associated to an input. (Only one method can be active at a time.)

To manually configure the switched power output using I/O board Modbus registers, write the specified value to the listed register.

Courtesy Power Output Configuration Parameters [1]	Modbus Registers to Write To	
	Switched Power 1	Switched Power 2
Switched Power Enable	2201	2251
Voltage	3601	3621
Default Output	3602	3622
Output Register	505	506

Default Output
Set the register value to 1 for continuous power. The default setting is 0.

Cycle power if this register value is changed.

Output Register
Write to the Output register to turn on or turn off the voltage output.

If both Output Registers 505 and 506 are turned on at the same time, but are set to different voltages, the output voltage is 5 V for DXM100-B1 models and set to the lower voltage setting for DXM100-B2 models.

Switched Power Enable
Enables the switched power supply. Set to 1 to enable; set to 0 to disable.

This does not enable the supply output to the actual output pin. To enable the supply output to the output pin, set Modbus register 505 or 506 to 1. Set to 0 when associating the switched power supply to an input.

Voltage
For the B1 and S1 models, set the Modbus register value to 0 for a switched power supply at 5 volts. Set the Modbus register value to 1 for a switched power supply at 16 volts.

For the B2 and S2 models, set one of the following register values to select your switched power output voltage.

For 5 V, set the Modbus register to 204
For 7 V, set the Modbus register to 125
For 10 V, set the Modbus register to 69
For 15 V, set the Modbus register to 32
For 20 V, set the Modbus register to 12
For 24 V, set the Modbus register to 3

When associating a switched power supply to an input, set the **Switch Power Output Enable** register to off (0). Set Modbus register 2201 for switched power 1 and Modbus register 2251 for switched power 2. This allows the input sampling mechanism to control the output.

Use the following configuration parameters to define the switch power associated with an input.

Input Parameter	Universal Input Configuration Parameter Modbus Registers to Write To			
	Universal Input 1	Universal Input 2	Universal Input 3	Universal Input 4
Input Enable	1001	1051	1101	1151
Sample Interval (high)	1002	1052	1102	1152
Sample Interval (low)	1003	1053	1103	1153
Switched Power Enable Mask	1004	1054	1104	1154
Switched Power Warmup	1005	1055	1105	1155
Switched Power Voltage	1006	1056	1106	1156
Extended Input Read	1007	1057	1107	1157
Input Out-of-Sync Enable	1008	1058	1108	1158

Extended Input Read
The Extended Input Read is a bit field parameter that allows multiple inputs to be sampled with the same switch power parameters.

If the bit field is set to 0x000F, the first four inputs are sampled after the switch power parameters are satisfied.

If the Extended Input Read parameter is set in the Universal input 1 configuration registers, set Universal inputs 2 through 4 **Extended Input Read** and **Sample Interval** parameters to zero.

Input Enable
Set to 1 to enable the input. Set to 0 to disable the input.

[1] Only used when supplying courtesy power to the output pin, not when associating switched power to an input.

Out-of-Sync Enable
To enable the input to continue operating when the device is out of sync with the client radio, set to 1.

To disable the input when the device is not synchronized to the client radio, set to 0.

Sample Interval (high), Sample Interval (low)
The sample interval (rate) is a 32-bit value (requires two Modbus registers) that represents how often the I/O board samples the input.

The register value is the number of time units. One time unit is equal to 0.01 seconds.

For example, a Modbus register value of 1000 represents a sample interval of 10 seconds (1000 × 0.010 seconds = 10 seconds).

Switch Power Enable Mask
The Switch Power Enable Mask works with the warm-up and voltage parameters to define the switch power output. The bit mask can select any number of switch powers.

0x0 - No switch power enabled
0x1 - Enable Switch Power 1
0x2 - Enable Switch Power 2
0x3 - Enable Switch Power 1 and Switch Power 2

Switch Power Voltage
The Switch Power Voltage parameter defines the output voltage of the switch power output.

This parameter applies only to inputs using switched power. If switch power is not used with an input, use the Courtesty Power Voltage parameter to control the voltage.

See *Voltage* entry for Modbus register values used to select the output voltage.

Switch Power Warm-up
When an input controls power to external sensors, the Switch Power Warm-up parameter defines how long power is applied to the external sensor before the input point is examined for changes.

The register value is the number of time units, and a time unit is 0.01 seconds. For a warm-up time of 1 second, this parameter value is 100 (0.01 seconds × 100 = 1 second).

To associate universal input 1 with switched power 1, follow these instructions. Set Input 1 to sample every 60 seconds, with a warmup time of 10 seconds.

1. Verify Switched Power 1 Output Enable is off (0). Set Modbus Register 2201 = 0
2. Set the **Sample Interval** to 1 minute. Modbus Registers 1002 = 0, 1003= 6000 (0.01 seconds × 6000 = 60 seconds).
3. Set the **Switched Power Enable Mask** to use Switch Power 1. Modbus Register 1004 = 1
4. Set the **Switched Power Warm-up** time to 10 seconds. Modbus Register 1005 = 1000 (0.01 seconds × 1000 = 10 seconds).
5. Set the **Switched Power Voltage** to 16 volts. Modbus Register 1006 = 1.

Working with Solar Power

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

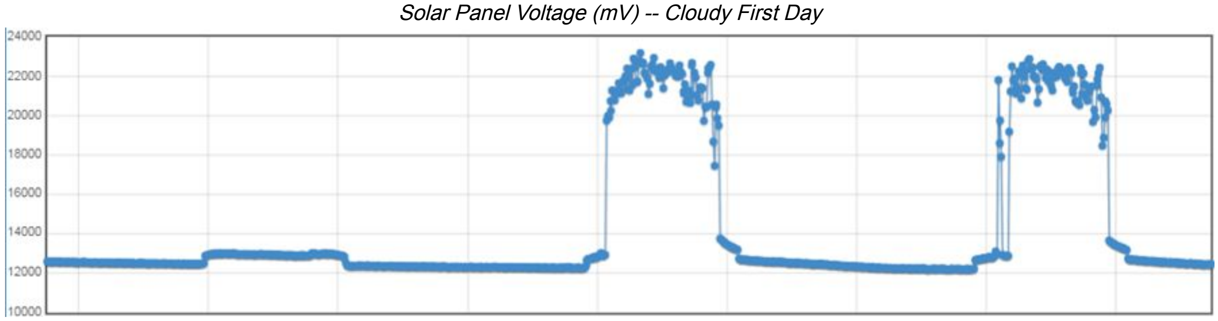
Battery capacity (Ahr) is a standard amp rating taken over 20 hours. Battery capacity should be monitored for reliable system power and may need to be increased for cold weather locations.

Monitoring Solar Operation

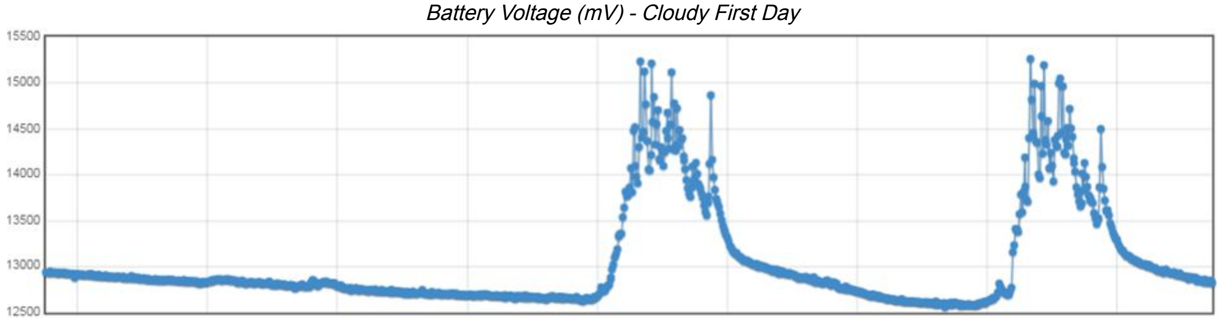
The DXM solar controller uses Modbus registers to allow the user to monitor the state of the solar panel input voltage, the battery voltage, the charging current, and the temperature in °C. The DXM can be configured to monitor the health of the charging system as well as send an alert message when the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

Solar Panel Voltage (mV) -- Cloudy First Day



Battery Voltage (mV) - Cloudy First Day



Clear the Password on DXM100 and DXM150 Models Only

By default, the DXM Controllers do not require a password to load a configuration file. If a password is defined, the password must be entered before uploading a configuration file. To change the password, you must already know the current password. If you do not know the current password, follow these steps to clear the password.

> **IMPORTANT:** Clearing the password erases the current configuration and any program files, log files, or history files.

IMPORTANT: DO NOT follow these instructions if you have a DXM700, DXM1000, or DXM1500 model. If you attempt to clear the password of a DXM700, DXM1000, or DXM1500 with these instructions, the firmware of your device will be erased and your controller will no longer function.

1. Turn the power OFF to the DXM Controller.
2. Set DIP switch 4 to the ON position.
3. Press and hold the processor button.
4. Turn the power ON to the DXM Controller.
   The processor board's LED flashes to indicate the process is complete (about 10-20 seconds).
5. Set DIP switch 4 to the OFF position.
6. Cycle power to the DXM Controller.
7. Reload the configuration file before resuming normal operation.

Clear the Password on DXM700-Bx, DXM1000-Bx, or DXM1200-Bx Models

By default, the DXM Controllers do not require a password to load a configuration file. If a password is defined, the password must be entered before uploading a configuration file.

To change the password, you must already know the current password. If you do not know the current password, follow these steps to clear the password.

IMPORTANT: Clearing the password erases the current configuration and any program files, log files, or history files.

1. Turn on the power to the DXM Controller.
2. Set DIP switch 4 to the ON position.
3. Press and hold the processor button until the processor board LED flashes.
4. Set DIP switch 4 to the OFF position.
5. Cycle power to the DXM Controller.
6. Reload the configuration file before resuming normal operation.

Chapter Contents

Chapter 10 PROFINET®

PROFINET is a data communications protocol for industrial automation and processes. PROFINET IO defines how controllers (IO controllers) and peripheral devices (IO devices) exchange data in real-time. PROFINET® is a registered trademark of PROFIBUS Nutzerorganisation e.V. and the standard is maintained by PROFIBUS & PROFINET International (PI), an organization headquartered in Karlsruhe, Germany.

Only the DXMR90-4K, DXMR90-X1, DXMR110-8K, DXM700, DXM1000, and DXM1200 Controller models support PROFINET IO.

General Station Description Markup Language File

A PROFINET General Station Description (GSD) file is a description of an IO device provided by the device manufacturer in an XML format (GSDML.xml).

The GSD file is a standardized way of describing the device information to engineering tools and the IO controller and can work across a variety of tools as a standard set of device information.

DXM PROFINET IO Data Model

The PROFINET IO data model is based on the typical, expandable field device that has a backplane with slots. Modules have different functionalities.

Modules are plugged into slots. In the PROFINET IO data model, Slot 0, Subslot 1 is reserved for the Device Access Point (DAP) or network interface.

Configure the DXM Controller for a PROFINET IO Connection

To use PROFINET, follow these instructions.

1. Using the DXM Configuration Software, go to the **Settings › Ethernet** screen.
2. Select **Enable PROFINET**.
3. Save the configuration file and upload it to the DXM Controller (see "Save and Upload the Configuration File" on page 20).

   After PROFINET is enabled, the IP address for the DXM Controller is controlled by the PROFINET host.

The PROFINET data type and data size to/from the DXM Controller is configurable. The PROFINET data is processed from the Local Register of the DXM Controller.

Configure the IO-Link ports in the XML according to the modules selected for each port.

Save and Upload the Configuration File

After making any changes to the configuration, you must save the configuration files to your computer, then upload it to the device.

Changes to the XML file are not automatically saved. Save your configuration file before exiting the tool and before sending the XML file to the device to avoid losing data. If you select **DXM › Send XML Configuration to DXM** before saving the configuration file, the software will prompt you to choose between saving the file or continuing without saving the file.

1. Save the XML configuration file to your hard drive by going to the **File › Save As** menu.
2. Go to the **DXM › Send XML Configuration to DXM** menu.

Status indicator bar

- If the Application Status indicator is red, close and restart the DXM Configuration Tool, unplug and re-plug in the cable and reconnect the DXM to the software.
- If the Application Status indicator is green, the file upload is complete.
- If the Application Status indicator is gray and the green status bar is in motion, the file transfer is in progress.

After the file transfer is complete, the device reboots and begins running the new configuration.

Slots and Modules for DXMR90-4K and DXMR110-8K PROFINET

There are ten slots to accommodate the DXM Controller data.

Slots for input and output values

Values	Maximum Data Size
Input values	1440 bytes
Output values	1440 bytes

Slot 1 - Input (DXM --> PLC)

Module ID	Submodule ID	Module	Size (bytes)	Register Start	Register End	Direction
0x44	0x01	Banner IO-Link Client Info	9	1	3	Input
				6	6	
				123	123	

It is important to note that the module placed in slot 2 corresponds to Port 1; the module placed in slot 3 corresponds to Port 2; the module placed in slot 4 corresponds to port 3. etc.

For the DXMR90-4K IO-Link Client device, slots 6 through 9 are unused.

If the IO-Link In/Out process data modules (all except digital input and output) are used, the attached IO-Link device **must have PDI and PDO size less than or equal to the number of data bytes allowed in the module. Data transfers will not be applied otherwise.** For example, plugging in the 16/16 byte module to a slot corresponding to a device that has 22 bytes of PDO results in an error. Process data sent from the PLC to DXM will not be applied.

Slots 2-9 (1 per IO-link port)

Module ID	Submodule ID	Module	Size (bytes)	Register Start	Register End	Direction
0x45	0x01	IO-Link In/Out 32/32 Byte + Status	36	x001	x017	Bidirectional
				x506	x507	
			46	x051	x067	
				x851	x859	
0x46	0x01	IO-Link In/Out 16/16 Byte + Status	20	x001	x009	Bidirectional
				x506	x507	
			30	x051	x059	
				x851	x859	
0x47	0x01	IO-Link In/Out 8/8 Byte + Status	12	x001	x005	Bidirectional
				x506	x507	
			22	x051	x055	

Continued on page 89

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Module ID	Submodule ID	Module	Size (bytes)	Register Start	Register End	Direction
				x851	x859	
0x48	0x01	IO-Link In/Out 4/4 Byte + Status	8	x001	x003	Bidirectional
				x506	x507	
			18	x051	x053	
				x851	x859	
0x49	0x01	IO-Link In/Out 2/2 Byte + Status	6	x001	x002	Bidirectional
				x506	x507	
			16	x051	x052	
				x851	x859	
0x4A	0x01	IO-Link In/Out 1/1 Byte + Status	5	x001	x002	Bidirectional
				x506	x507	
			15	x051	x052	
				x851	x859	
0x4B	0x01	Digital Output	5	x051	x051	Output Module
				x851	x851	
				x853	x853	
				x858	x858	
0x4C	0x01	Digital Input	2	x001	x001	Bidirectional
			4	x051	x051	
				x851	x851	
				x853	x853	
				x858	x859	

Slot 10 (ISDU)

Module ID	Submodule ID	Module	Size (bytes)	Register Start	Register End	Direction
0x4D	0x01	ISDU 190 Byte + Status	196	351	442	Bidirectional
			196	200	291	
0x4E	0x01	ISDU 80 Byte + Status	86	351	396	
			86	200	245	

Example Configuration		
Slot	**Module**	**Description**
Slot 1	Banner IO-Link Client Info	Vendor ID, Device ID, Number of Supported Channels, and Firmware Version information
Slot 2	IO-Link In/Out 32/32 Byte + Status	Get/send IO-Link PDI/PDO for IO-Link device on Port 1 with PD Size between 17 and 32 bytes
Slot 3	IO-Link In/Out 16/16 Byte + Status	Get/send IO-Link PDI/PDO for IO-Link device on Port 2 with PD Size between 9 and 16 bytes
Slot 4	IO-Link In/Out 2/2 Byte + Status	Get/send IO-Link PDI/PDO for IO-Link device on Port 3 with PD Size between 1 and 2 bytes
Slot 5	Digital Output	Use SIO Output mode on Port 4
Slot 10	ISDU 190 Byte + Status	ISDU read/write access for all ports in IO-Link mode

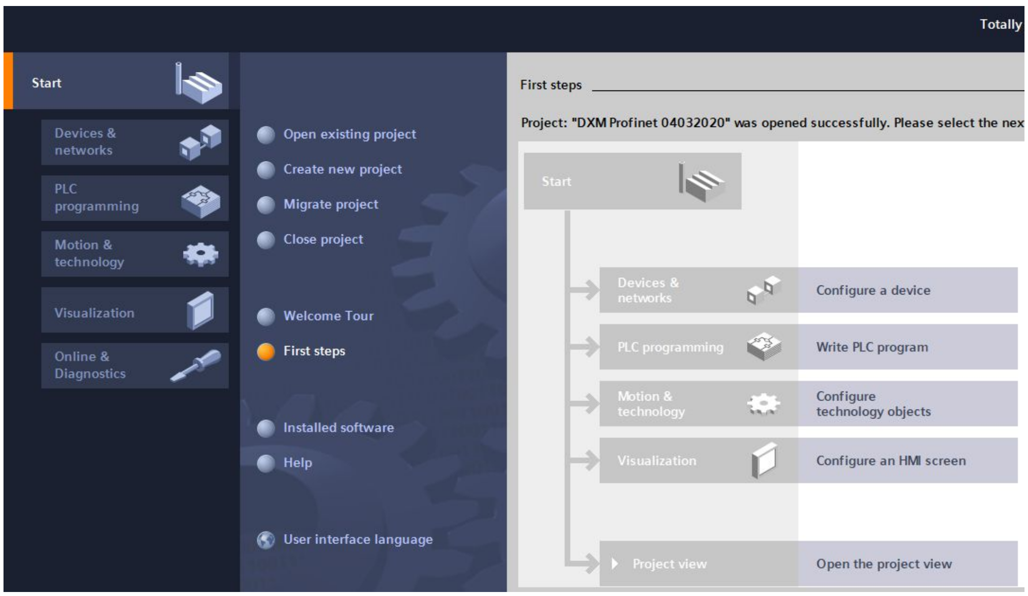
Configuration Instructions

Install the GSD File

Although these instructions are specific for the Siemens TIA Portal (v14) software, you may use these instructions as a basis for installing the GSD file into another controller.

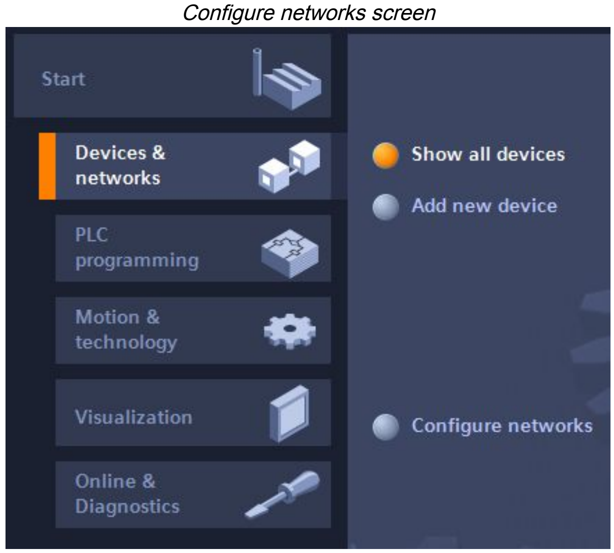
1. Download the GSD file from www.bannerengineering.com.
2. Launch the Siemens TIA Portal (v14) software.
3. Click **Open existing project**.
4. Select a project and open it.
5. After the project is uploaded, click **Devices & networks**.

Devices and networks screen



6. Click **Configure networks**.

Configure networks screen

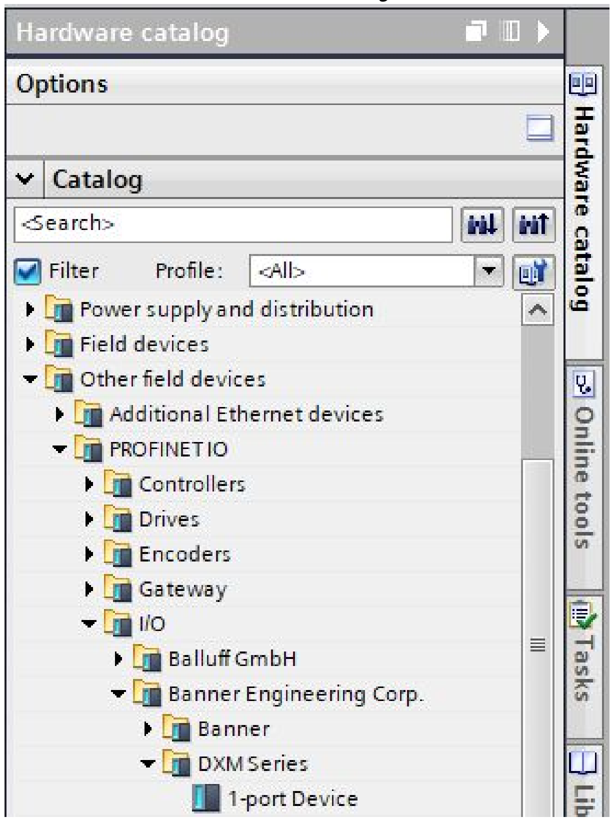


7. Click **Options** and select **Manage general station description file (GSD)**.

   The **Install general station decription file** window opens.

8. Click the **More options (...)** icon to the right of the **Source path** field and browse to the location the DXM GSD file was downloaded to.
9. Select the DXM GSD file.
10. Click **Install**.

Hardware catalog



The system installs the DXM GSD file and places it in the **Hardware catalog**. In the example, the DXM GSD file is located under **Other field devices › PROFINET IO › Banner Engineering Corp. › Banner**.

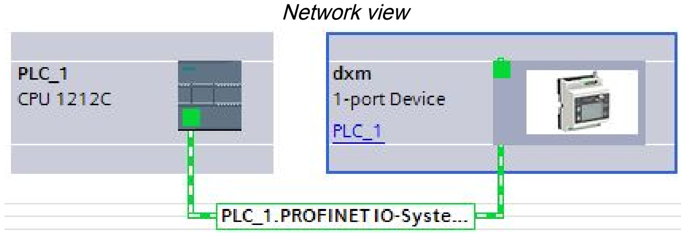
If the DXM GSD file does not install properly, save the log and contact Banner Engineering Corp.

Change the Device IP Address

Follow these instructions to change the IP address of the DXM device using the Siemens TIA Portal (v14) software. Use these instructions as a basis if you are using another controller (PLC).

1. Launch the Siemens TIA Portal (v14) software.
2. Click **Open existing project**.
3. Select a project and open it.
4. Click **Devices & networks**.

Network view



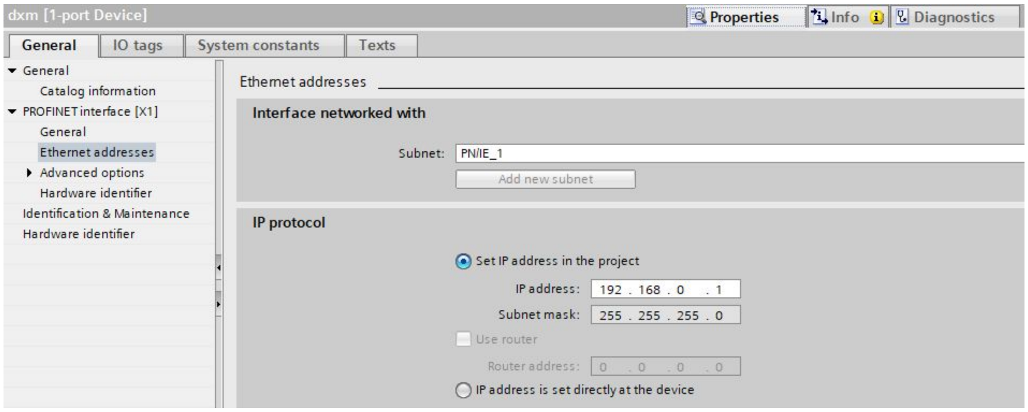
The **Network view** displays.

5. Double-click on the DXM icon to open the **Device view** screen.
6. Click on the DXM icon in the graphic area of the **Device view** screen.

The **Module properties** window displays and the module can now be configured.

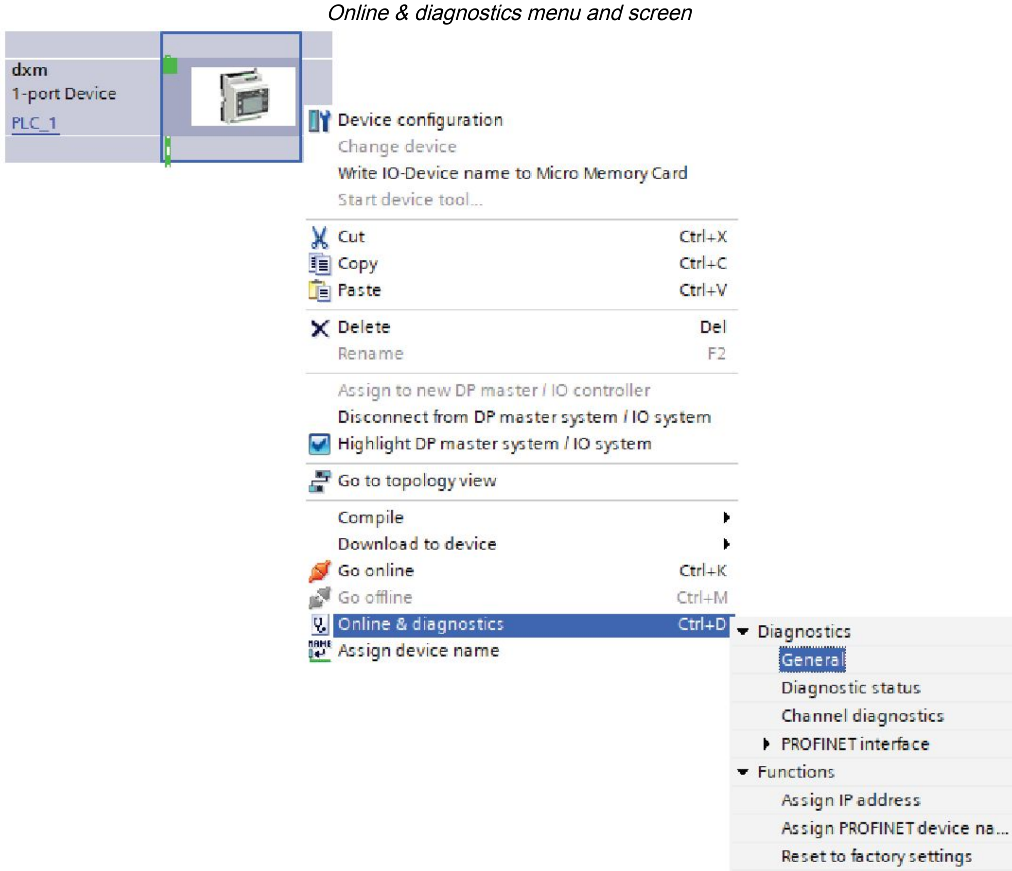
7. Click **Properties**.
8. Click **General**.
9. Select **PROFINET Interface › Ethernet addresses**.

Ethernet addresses



10. Select **Set IP address in the project**.
11. Enter the IP address.
12. Right-click on the device icon and select **Online & diagnostics**.

Online & diagnostics menu and screen



The **Online & diagnostics** windows displays.

13. Select **Assign IP address** under **Functions**.
14. Click **Accessible devices**.

    The Select device window searches the network for available devices.

15. Determine the device to be adjusted via the MAC address and select it.
16. Click **Apply**.

    The IP address for the device is updated.
17. Click **Assign IP address** to complete the step.

    This step is completed for every device.

By default, each DXM shipped from the factory is assigned the IP address 192.168.0.1.

Immediately after the PROFINET protocol is enabled, the DXM has an IP address of 0.0.0.0. We recommend using the TIA Portal to give the DXM an IP address so that the address is saved in the unit. When the PLC powers up, this IP address is accessible. The PLC can change the IP address if it is configured to do so.

If the PLC assigns the DXM IP address (for example, using the Set IP address in the project option in Siemens TIA Portal), the DXM receives the specified address, but only after the program has been loaded into the PLC and is running. If the DXM is restarted after it was discovered and configured by the PLC, the DXM retains the IP address that was assigned to it using the LCD or software until after the PLC discovers the DXM and assigns it the specified address again. However, if this address is different than what is specified in the PLC, the DXM reverts to the address specified in the PLC after the PLC becomes active again.

These configuration options conform to the PROFINET standard.

Change the Device Name

Follow these instructions to change the name of the DXM using the Siemens TIA Portal (v14) software. Use these instructions as a basis if you are using another controller (PLC).

1. Open a project and click on **Devices & networks**.

   The Network view displays.
2. Right-click on the DXM icon and select **Assign device name**.

   The **Assign PROFINET device name** window displays. The software searches for devices of the same type.
3. Enter the desired name in the **PROFINET device name** field. Note that each name can be used only once.
4. Click **Assign name**.

   The device now has a PROFINET name.

Chapter Contents

Chapter 11 Product Support and Maintenance

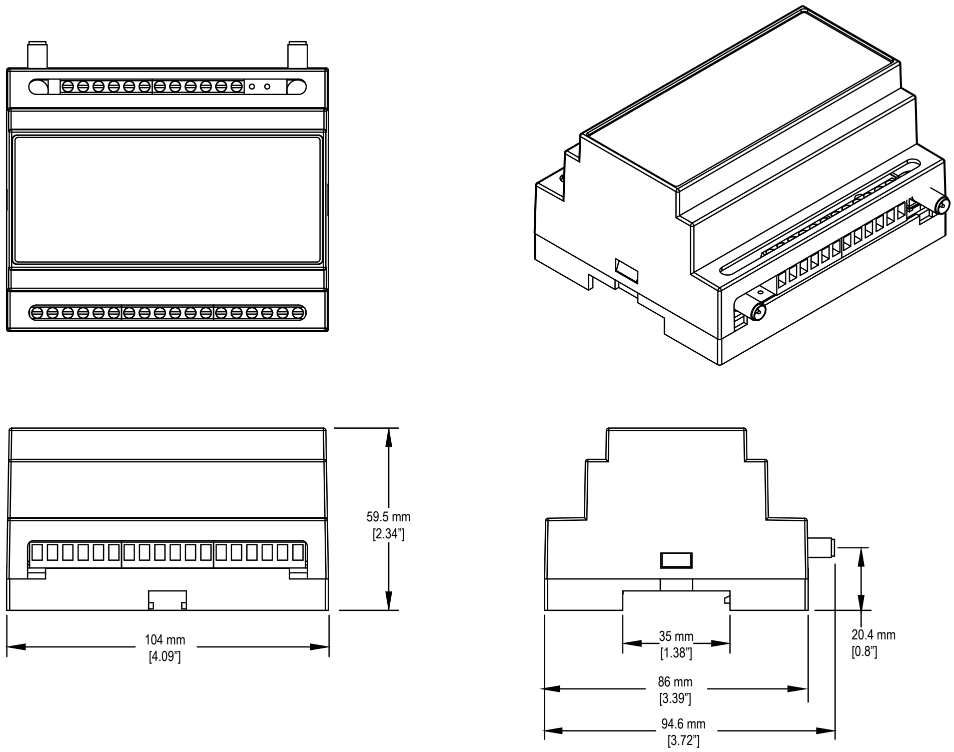
DXM Accessories

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 MQDC1-506—5-pin M12, straight, single-ended, 6 ft MQDC1-530—5-pin M12, straight, single-ended, 30 ft MQDC1-506RA—5-pin M12, right-angle, single-ended, 6 ft MQDC1-530RA—5-pin M12, right-angle, single-ended, 30 ft	**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
Static and Surge Suppressor BWC-PRC827-DC—Surge Suppressor, bulkhead, DC Blocking, N-Type Female, N-Type Male	**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
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	**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 **Cellular Antenna** BWA-CELLA-002—Cellular multiband, 2 dBi, RP-SMA male connection, 6.3 inch blade style. Datasheet: b_4475176
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	**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)

DXM100 and DXM1000 Dimensions

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



File System and Archive Process

The DXM file system consists of two physical components: the serial EEPROM that stores non-volatile configuration information and a local storage device that stores file backup data and user-created files.

EEPROM Files—The serial EEPROM stores basic data that is required to be non-volatile, including network configuration data, IP address, MAC address, network masks, firewall settings, and authentication information. The controller XML configuration file created by the DXM Configuration Software is stored in EEPROM. The small section of non-volatile local registers is also stored in EEPROM.

Local Storage Device Files—The local storage device (micro SD card or embedded flash memory chip) contains most files at the root level. The archive directory contains files kept by the system for history backup. Archive files are stored in the directory **_sxi** and are only accessible by removing the local storage device.

- Data Log Files
- HTTP Push Files
- User-created ScriptBasic file
- ScriptBasic program file
- CmVMon file
- _sxi Archive directory

Data Log files

Users may create up to four data log files using the DXM Configuration Software. The log files are stored in the root directory on the local storage device. When the file size limit is reached, the filename is changed to include the date and time and the file is moved into the archive directory **_sxi**. Archived log files are deleted based on the Clear Logs parameter.

HTTP Push File

If the DXM is configured to send data to a webserver or host system, the device creates an HTTP.LOG file on the local storage device. The HTTP log is created only if the Logging Interval is non-zero and the HTTP enable log is set. An entry is placed in the HTTP log file at the Logging Interval specified by the user. At the Push Interval time, the HTTP log file is sent to the webserver or host system. If the transmission is successful, the HTTP log file is time-stamped and placed into the archive directory (**_sxi**). If the transmission fails, the file remains in the root directory and subsequent Logging Intervals are appended to the file and are sent at the next Push Interval. See "Ethernet and Cellular Push Retries" on page 61.

User Created ScriptBasic Files

Users may use ScriptBasic to create files on the local storage device by using the FILEOUT function. The filenames are fixed and up to five files can be created in the root directory.

ScriptBasic Program File

The main ScriptBasic program that runs at boot time is stored on the local storage device in the root directory.

CmVMon File

The CmVMon.txt file (Cellular milli-Volt Monitor) is created by the system and is used to track power events. Every power-up cycle is date/time stamped with the voltage read from the I/O board. The value 24487 is equal to 24.487 volts. If the voltage drops below 11.2 V, another entry is put in the log file indicating the cellular modem will shut down.

CM	2015-09-22 18:52:43	VMon	Power entered normal range 24487
CM	2015-10-13 20:49:47	VMon	Power entered normal range 24004
CM	2015-10-16 15:00:20	VMon	Power entered normal range 24014
CM	2015-10-19 19:12:26	VMon	Power entered normal range 12845

_sxi Archive Directory

Only two types of files are moved into the archive directory: data log files and HTTP log files. Data log files are date/time stamped and placed into the archive directory when the size limit is reached. HTTP log files are date/time stamped then placed into the archive directory when they are successfully sent to the webserver or host system. If the HTTP log files were not successfully sent after the retries have been exhausted, the files are placed into a root directory called **sav**.

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 200.

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

Updating the DXM Processor Firmware

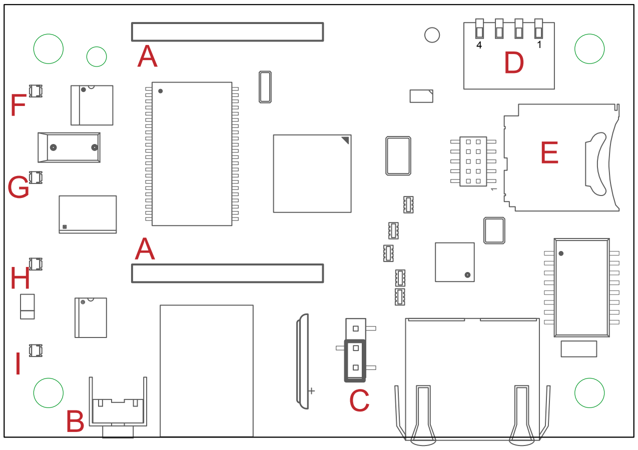
There are two different update procedures, depending on the DXM firmware version of your device.

Update Your DXM Processor Firmware (Prior to Version 2.0)

To update DXM Processor firmware prior to version 2.0, use the SAM-BA program from MicroChip/Atmel. Following these instructions to update the DXM100 or DXM150 processor firmware.

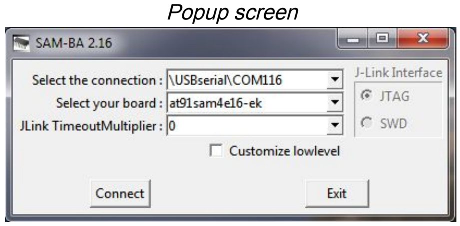
1. Download the SAM-BA software from http://www.microchip.com/developmenttools/productdetails.aspx?partno=atmel+sam-ba+in-system+programmer.
2. Install the SAM-BA program.
3. Set the processor board jumper (jumper C, shown below in the "boot load off" position).

Processor board



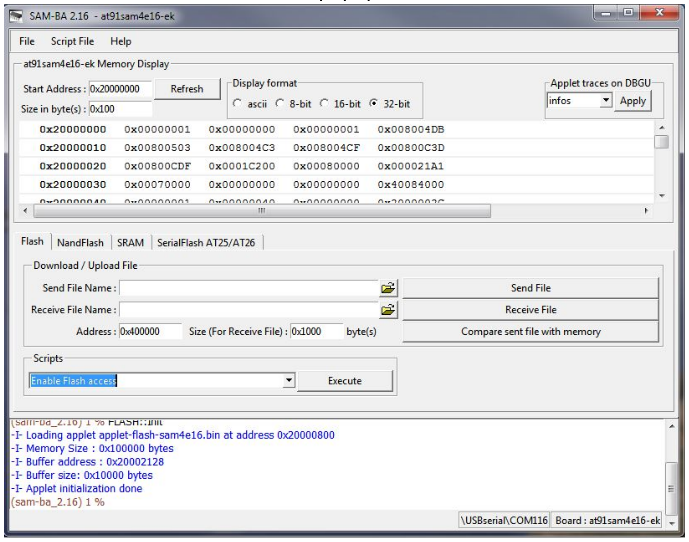
   a. Disconnect the DXM Controller from its power supply.
   b. Open the hardware cover.
   c. Using your fingers or tweezers, move the jumper to the "boot load on" position (jumper on the top two pins).
   d. Connect the DXM back to its power supply.
   e. The lower left LED on the I/O base board is solid when power is turned on. After the LED begins flashing, remove power.
   f. Move the jumper back to its original position.
   g. Replace the hardware cover.
   h. Connect the DXM back to its power supply.
4. Launch the SAM-BA program. Select the COM port and correct board. Click **CONNECT**.

Popup screen



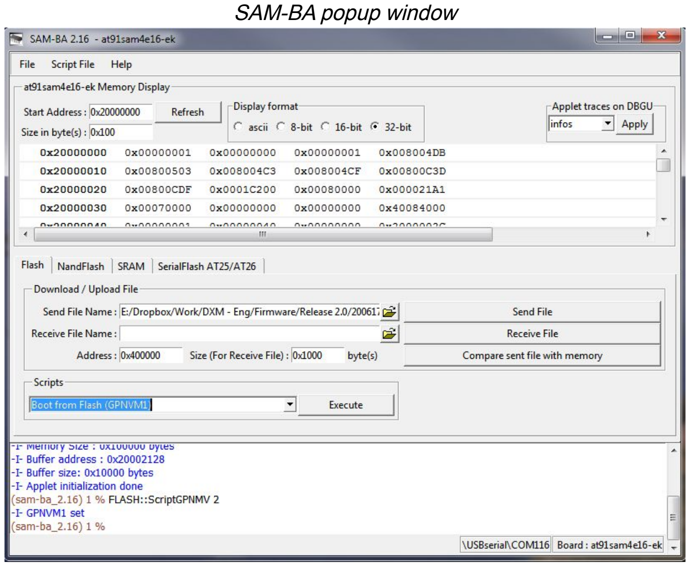
   The SAM-BA program attempts to automatically detect the COM port and the correct device.
5. On the **SCRIPTS** pull-down m] enu select **ENABLE FLASH ACCESS**. Click **EXECUTE**.

SAM-BA popup window



6. In the **SCRIPTS** pull-down menu, select **BOOT FROM FLASH (GPNVM1)**. Click **EXECUTE**. Click **EXECUTE** again if the message indicates it failed.
7. In the **Flash** tab, click on the folder icon for the **Send File Name** field. Select the boot load file (must be a *.bin file) and click **SEND FILE**. The file is: DXM PROCESSOR FIRMWARE V2.02 or go to the software section of the Wireless Reference Library on www.bannerengineering.com.

SAM-BA popup window



The load process takes a few seconds.

8. After the load is complete, the program asks if you want to lock the flash region. Click **NO**.
9. Close the SAM-BA bootloader program.
10. Cycle the power to the DXM.

The new code should now be running and the LEDs should be on.

Updating Your DXM Processor Firmware (Version 2 or Later)

DXMs with processor firmware version 2.0 or later have a built-in boot loader program to update the firmware. Use the configuration software version 3 or later, the BannerCDS webserver, or manually write the files on the SD card to update the firmware.

The new firmware file loads into the **BOOT** directory of the SD card on the DXM. The configuration software or BannerCDS website handles the reprogramming process automatically. During the programming process, the internal LEDs on the processor board indicate the status of the programming.

Update process overview

Reprogramming Step	Approximate time required	Description
Loading new firmware file (*.HEX)	Configuration software: 2 minutes over Ethernet or 15 minutes over USB BannerCDS: 2 minutes over Ethernet or 5 minutes over Cellular	Send the new firmware image to the DXM. After the new image is on the device, the controller resets. LED3 is red during the loading process.
Verify the contents of the new firmware file	1 minute	When the DXM finds a file that should be installed, LED4 (amber) flashes at about a 1 second rate while the contents of the file are validated.
New firmware file is valid		After validation successfully completes, LED4 is on (amber).
New firmware file is being loaded	2 minutes; do not remove power to the DXM during the programming process.	LED3 (red) blinks approximately once per second. LED3 continues to blink during the application programming process.
Finished		After programming has completed, the DXM resets and begins running the new firmware

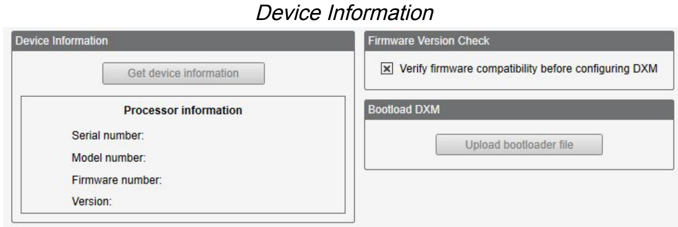
The firmware file names follow an 8.3 filename convention. The first 5 characters are the firmware part number in hexadecimal; the last 3 characters of the part number are the major/minor version number. For example, if `30FA9052.hex` is the firmware programming file, 200617 decimal (30FA9 hex) is the firmware part number and 0.5.2 (0502) is the decoded version number.

Update the DXM Processor Firmware Using the DXM Configuration Software

To update your processor firmware using the DXM Configuration Software, follow these instructions.

1. Using the DXM Configuration Software version 3 or later, connect to the DXM via USB[1] or Ethernet.
   File loads to the DXM will take about 15 minutes using USB or approximately 2 minutes using Ethernet.
2. On the configuration software, go to **Settings › General › Device Information** to verify the current firmware version.
   You must load a different version with the same firmware number for the boot loader to operate. Download firmware files from the Banner website.

Device Information



3. Under **Settings › Reprogram**, click **Select upgrade file** to select the firmware file to program.

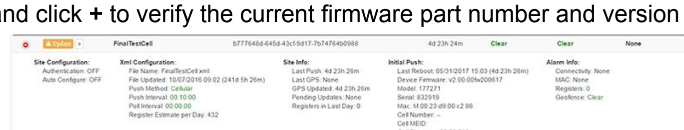
After the file load is completed, the DXM restarts and loads the new firmware file. It takes about 2 minutes to complete the programming process. The device reboots when finished. Verify the firmware has been updated, under **Settings › General › Device Information**.

Update Your Processor Firmware Using the BannerCDS Website

To update your processor firmware (version 2.0 or later) using the DXM website, follow these instructions.

To use the website to update the firmware file, first configure the DXM to push data to the website.

1. Go to **Dashboard › Sites** and click **+** to verify the current firmware part number and version on the DXM.

   Data collected from the DXM is displayed.
2. From the main **Dashboard › Sites** screen, click on **Update**.
   A popup box appears.

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[1] While the file download is in process over a USB connection, do not use other applications on the PC. After the DXM reboots for a firmware update, the USB port may be unresponsive. Clear the connection by disconnecting the USB cable and restarting the DXM Configuration Software.

3. Set the **Communications Type** to **Push Reply**, and set the **Update Type** to **Firmware file**.
4. Choose the appropriate **Upload File** (*.HEX) and click **Queue**. Click **Close**.

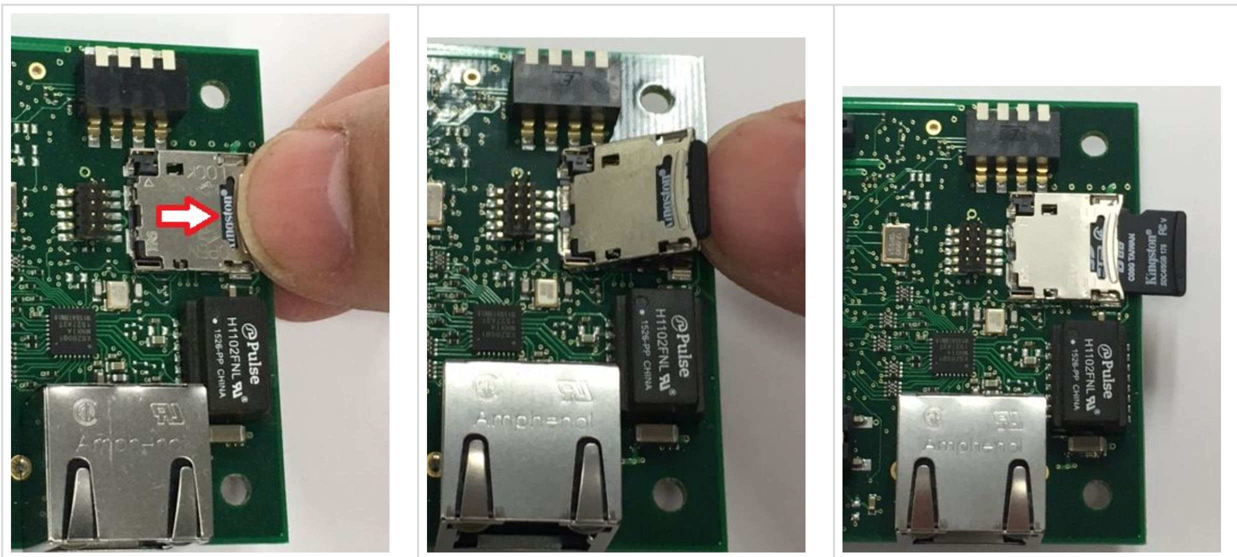
   At the next scheduled push interval, the DXM retrieves the new firmware file. The new firmware file must be the same part number of firmware that is currently in the DXM.

Update Your Processor Firmware Manually

To manually update your processor firmware (version 2.0 or later) using SD card, follow these instructions.

The firmware file can manually be put on the SD card in the BOOT directory (must have version 2.0 or later on the DXM).

1. Disconnect the DXM from its power supply.
2. Remove the micro SD card from the DXM.



   a. Open the cover housing to the DXM.
   b. Use your fingernail to slide the top metal portion of SD card holder.
   c. The metal cover hinges upward, allowing access to remove the SD card.
   d. Press down on the SD cover and slide back into position to close the SD card holder.
3. Insert the micro SD card into an SD card reader to access the data from a PC.
4. Load the new firmware file (*.hex) into the BOOT directory of the micro SD card.
5. Re-insert the micro SD card into the DXM by sliding the card into the holder.
6. Reconnect the DXM to its power supply.

   The automatic boot process should begin. If the boot process does not begin, verify the firmware file is correct and it is a different version than what is currently installed on the device.

Troubleshooting Issues

Problem	Solution
Communication contention between the LCD and the process	The LCD and the processor applications share the external Modbus connection. If the processor is configured to constantly interact with Modbus, it may cause issues with the LCD attempting to use the functions of the ISM radio. To alleviate the contention do one of these things: • Load a DXM configuration file that slows down the read/write rules. • Disable the DXM configuration file from loading into the processor by setting DIP switch 4 to ON (on the processor board). Reboot the device. When the processor reboots, it will not load the configuration file and remains idle.
Cellular modem did not turn on	If the incoming voltage drops below 11.2 V DC, the cellular modem does not turn on and will not turn on until the voltage is above 11.8 V DC. A text file (CmVMon.txt) on the internal micro SD card saves the periodic sampling of the incoming voltage. If cellular operation stops because of voltage, it is logged in this file.

Modbus Operation

All Modbus transactions are managed by a central Modbus engine. If there are Modbus messages intended for a Modbus server that doesn't exist, the Modbus engine waits for a response until the timeout period is expired. This slows down the Modbus polling loop for read and write operations.

For this reason, verify all Modbus read and write operations are intended for Modbus server devices that are in the network. If a Modbus server is not in the network, either a wired or wireless device, the operation of the LCD menu system can be compromised. Operations like Binding, Site Survey, or accessing the ISM menu may be slower. This is because all internal devices (such as the ISM radio, LCD, etc) of the DXM are also Modbus servers.

DXM100 Documentation

- DXM Wireless Controller Sell Sheet, p/n 194063
- DXM100-B1 Wireless Controller Datasheet, p/n 186724
- DXM100-B2 Wireless Controller Datasheet, p/n 195232
- DXM100-Bx Wireless Controller Instruction Manual, p/n 190037
- DXM100-S1 Modbus Server Datasheet, p/n 195454
- DXM100-S2 Modbus Server Datasheet, p/n 195231
- DXM100-Sx Modbus Server Instruction Manual, p/n 188231
- 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
- Banner CDS Web Service Quick Start Guide, p/n 201126
- Banner CDS Web Service Instruction Manual, p/n 178337
- Activating a Cellular Modem, p/n b_4419353
- Additional technical notes and videos

For more information about the DXM100 family of products, including technical notes, configuration examples, and ScriptBasic programs, please visit www.bannerengineering.com.

DXM1000 Documentation

- DXM Wireless Controller Sell Sheet, p/n 194063
- DXM1000-B1 Wireless Controller Datasheet, p/n 210852
- DXM100 and 1000-Bx Wireless Controller Instruction Manual, p/n 190037
- DXM ScriptBasic Instruction Manual, p/n 191745
- DXM Controller Configuration Quick Start, p/n 191247
- DXM Configuration Software (p/n b_4447978)
- DXM Configuration Software Instruction Manual, p/n 158447
- DXM EDS Configuration file for Allen-Bradley PLCs
- EIP Configuration File for DXM 1xx-BxR1 and R3 models (p/n 194730)
- Activating a Cellular Modem (p/n b_4419353)
- Video tutorials: search "DXM Tutorial" at youtube.com/bannerengineering.
- Additional technical notes

For more information about the DXM1000 family of products, including technical notes, configuration examples, and ScriptBasic program examples, please refer to the Banner website: www.bannerengineering.com.

DXM Support Policy

The DXM Wireless Controllers are industrial wireless controllers that facilitate Industrial Internet of Things (IIoT) applications. As a communications gateway, it interfaces local serial ports, local I/O ports, and local ISM radio devices to the Internet using either a cellular connection or a wired Ethernet network connection. In a continuing effort to provide the best operation for the DXM, stay connected with Banner Engineering Corp to hear about the latest updates through the Banner website. Create a login today to stay informed of all Banner product releases.

Firmware Updates

The DXM has been designed to be a robust and secure IOT device. To provide the most reliable and secure device possible, periodic firmware updates are released to enhance and expand the capabilities of the DXM. Firmware updates and description details are found on the Banner website. Customers with critical update requirements will get access to pre-released firmware from the factory.

Website Information

The Banner website is the main method of disseminating DXM information to customers. The data found on the website include:

- DXM instruction manuals
- Configuration manuals
- Firmware downloads
- Firmware release notes
- Errata data, any known issues with a release of firmware
- Possible work-around solutions for known issues
- DXM Solutions Guides

Feature Requests

Our customer is our most valuable resource to improve our DXM. If you have suggestions for improvements to the DXM or configuration software, please contact Banner Engineering Corp.

Potential DXM Issues

Potential issues with the DXM are collected from Banner's support engineers to provide solutions. Users can get help from the website documentation or by calling Banner Engineering for support help. Solutions are as simple as configuration adjustments, work-around configuration solutions, or potential new firmware updates.

DXM Security

The DXM was designed to collect local wireless sensor data, local sensor data, provide simple control, and send the data to the cloud.

The DXM does not run a Linux or Windows-based operating system but an embedded real-time operating system (RTOS) environment. As a proprietary operating system, the security aspects are easier to manage and minimize.

Security updates are released through the Banner Engineering Corp website (www.bannerengineering.com) and New Product Release Announcements (NPRA).

Specifications

Radio Specifications for Performance and MultiHop (500 mW)

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)

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)

Link Timeout (Performance)
Gateway: Configurable via User Configuration Software
Node: Defined by Gateway

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

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

RS-232 Communication Specifications

Communication Hardware (MultiHop RS-232)

Interface: 2-wire RS-232

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

DXM100-B1 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

Courtesy Power Out

One output at 5 Volts, 500 mA maximum

No short circuit protection

Power Consumption

35 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

Switched Power Out

Two selectable 5 V or 16 V outputs

5 V: 400 mA maximum

16 V: 125 mA maximum

Construction

Polycarbonate; DIN rail mount option

Communication Protocols

Modbus RTU Client/Server, Modbus TCP, and Ethernet/IP

Security Protocols

VPN, SSL, and HTTPS

Logging

8 GB maximum; removable Micro SD card format

Counters, Synchronous

32-bits unsigned

10 ms clock rate minimum

Universal Inputs

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

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 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

Certifications

CE/UKCA approval only applies to 2.4 GHz models NOM approval only applies to 900 MHz 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

03737-22-04042

For additional product support, go to www.bannerengineering.com.

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.

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	1.0	30	0.5

DXM100-B2 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

Courtesy Power Out
: One output at 5 Volts, 500 mA maximum
: No short circuit protection

Switched Power Outputs
: Two adjustable 5 V to 24 V outputs
: One SDI-12 adjustable 5 V to 24 V output
: 5 V: 400 mA maximum
: 16 V: 125 mA maximum
: 24 V: 85 mA maximum

Power Consumption
: 35 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

Communication Protocols
: Modbus RTU Client/Server, Modbus TCP, and Ethernet/IP

Security Protocols
: VPN, SSL, and HTTPS

Logging
: 8 GB maximum; removable Micro SD card format

Construction
: Polycarbonate; DIN rail mount option

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

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

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

Certifications
: CE/UKCA approval only applies to 2.4 GHz models

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1831 Diegem, BELGIUM

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03737-22-04042

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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	1.0	30	0.5

DXM1000-B1 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

Courtesy Power Out
: One output at 5 Volts, 500 mA maximum
: No short circuit protection

Power Consumption
: 35 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

Switched Power Out
: Two selectable 5 V or 16 V outputs
: 5 V: 400 mA maximum
: 16 V: 125 mA maximum

Communication Protocols
: Modbus RTU Client/Server, Modbus TCP, and Ethernet/IP

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

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

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 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

Security Protocols
VPN, SSL, and HTTPS

Construction
Polycarbonate; DIN rail mount option

Logging
8 GB maximum; removable Micro SD card format

DXM1000-B2 Power and I/O 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

Courtesy Power Out
One output at 5 Volts, 500 mA maximum
No short circuit protection

Switched Power Outputs
Two adjustable 5 V to 24 V outputs
One SDI-12 adjustable 5 V to 24 V output
5 V: 400 mA maximum
16 V: 125 mA maximum
24 V: 85 mA maximum

Power Consumption
35 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

Communication Protocols
Modbus RTU Client/Server, Modbus TCP, and Ethernet/IP

Security Protocols
SSL, TLS, and HTTPS

Logging
8 GB maximum; removable Micro SD card format

Construction
Polycarbonate; DIN rail mount option

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

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

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

Environmental Specifications (DXM)

Operating Conditions
–20 °C to +60 °C (–4 °F to +140 °F)
95% maximum relative humidity (non-condensing)
Radiated Immunity: 10 V/m (EN 61000-4-3)
Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.

Environmental Rating
IP20

Shock and Vibration
All models meet IEC 60068-2-6 and IEC 60068-2-27 testing criteria
Shock: 15G 11 ms duration, half sine wave per IEC 60068-2-27
Vibration: 10 Hz to 55 Hz, 0.5 mm peak-to-peak amplitude per IEC 60068-2-6

Contact Us

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

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

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

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:

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 106. 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

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Model Number	Antenna Type	900 MHz Radio Module	Maximum Gain	Impedance	Minimum Required Cable/Connector Loss
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.

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 108. 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

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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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Agência Nacional de Telecomunicações

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 DXM100-Bx or 1000-Bx Wireless Controller 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 DXM100-Bx or 1000-Bx Wireless Controller, 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 DXM100-Bx or 1000-Bx Wireless Controller 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.

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. Any misuse, abuse, or improper application or installation of this product or use of the product for personal protection applications when the product is identified as not intended for such purposes will void the product warranty. Any modifications to this product without prior express approval by Banner Engineering Corp will void the product warranties. All specifications published in this document are subject to change; Banner reserves the right to modify product specifications or update documentation at any time. Specifications and product information in English supersede that which is provided in any other language. For the most recent version of any documentation, refer to: www.bannerengineering.com.

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