

# Sure Cross® DXM100 Wireless Controller

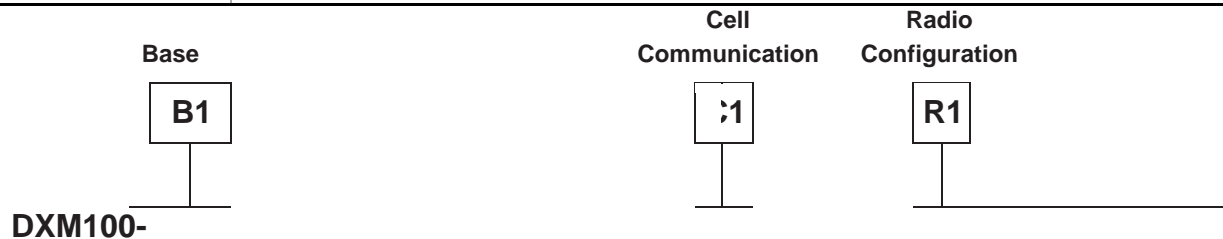
## Datasheet

The DXM100 Controller is an industrial wireless controller that facilitates 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.



- Sure Cross® DX80 Wireless Gateway or MultiHop radio with 900 MHz or 2.4 GHz ISM bands available
- Logic controller with action rules and ScriptBasic programming
- Cellular radio Internet connectivity
- Automation protocols include Modbus TCP, Modbus RTU, and EtherNet/IP™
- Secure email and text Internet messaging for alarms, alerts, and data log files
- Data logging with removable SD card
- Interactive programmable user interface with LCD and LED indicators
- Factory configured as a Modbus RTU to EtherNet/IP protocol converter
- Universal, on-board I/O with analog and discrete I/O
- Industry standard RS-485, Ethernet, and USB communication ports • Multiple managed power options with battery backup

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



B1 = Power: 12-30 V dc/Solar/Battery

Comms: RS-485 and RS-232 with flow control or secondary RS-485  
4 universal IN  
4 NMOS OUT, and  
2 analog OUT

Blank = None

C1 = CDMA Cellular (Verizon)

Blank = None

R1 = DX80 900 MHz, 1 Watt, PE5  
R2 = DX80 900 MHz, 1 Watt, HE5 Data Radio  
R3 = DX80 2.4 GHz, PE5  
R4 = DX80 2.4 GHz, HE5 Data Radio



### WARNING: Not To Be Used for Personnel Protection

**Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death.** This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.



### CAUTION: Electrostatic Discharge (ESD)

**ESD Sensitive Device.** Use proper handling procedures to prevent ESD damage to these devices. The module does not contain any specific ESD protection beyond the structures contained in its integrated circuits. Proper handling procedures should include leaving devices in their anti-static packaging until ready for use; wearing anti-static wrist straps; and assembling units on a grounded, static-dissipative surface.

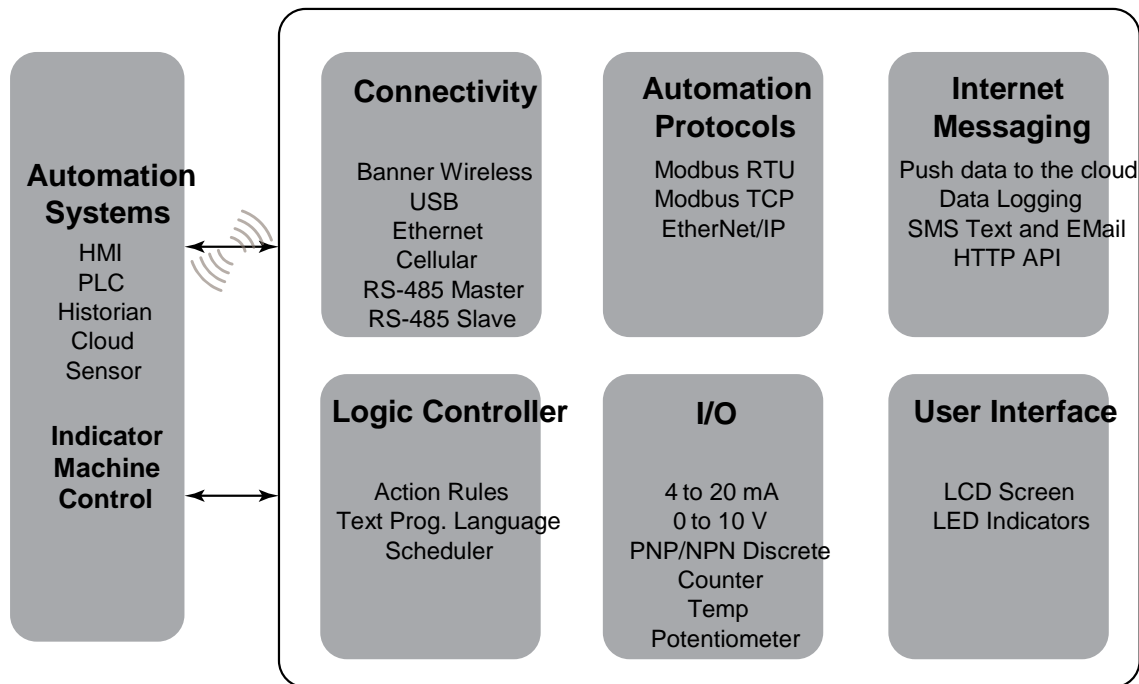
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## DXM System Overview

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).



The DXM Controller'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.

The DXM Controller incorporates several **automation protocols** into its system, including:

- Modbus RTU—Integrates into existing RS-485 serial-based Modbus-enabled automation systems.
- Modbus TCP—Uses Ethernet to attach to existing Modbus-enabled automation systems.
- EtherNet/IP—Automation systems that use the EtherNet/IP protocol can directly attach to the DXM Controller using Ethernet.

**Internet messaging** tools share information generated by sensors, indicators, and control equipment with automation systems and personnel. When Internet messaging is used in combination with the logic controller, the DXM Controller can generate and send historical data logs, alerts, and alarms using Ethernet or cellular connectivity options. Banner's API interface allows the user to create connections with web-based automation or business systems.

Program the DXM Controller's **logic controller** using action rules and text 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.

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

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 Controller, processes, or equipment.

## Connectivity

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The DXM Controller is equipped with five types of communications ports: Ethernet, Cellular, ISM Radio, Modbus Serial (RS-485 Master/Slave and RS-232), and USB.

**Ethernet** communications support protocol conversion of Modbus RTU to Ethernet, Modbus TCP, and EtherNet/IP comms. Use this port to connect to the Internet, an intranet, or other Modbus enabled equipment. The DXM Controller can be configured to push any register data to any user's application directly with Modbus or through Banner's Application Program Interface (API). The DXM Controller can also be configured to send text and email alerts/alarms as well as upload data logs via Ethernet to industrial automation systems. The Ethernet protocol also provides the method to upload either XML or ScriptBasic configuration files to the DXM Controller either locally or remotely with the DXM Configuration Tool. Use the DXM Configuration Tool to configure the Ethernet connection.

Use the **cellular** communication to connect to the Internet. The DXM Controller can push any register data to any user's application directly with the cellular radio by using Banner's API. The DXM Controller can be configured to send text and email alerts/alarms as well as upload email data logs. The cellular radio can be used to download values directly into the DXM Controller's registers. Cellular also provides the method to upload either XML or ScriptBasic configuration files to the DXM Controller either locally or remotely with the DXM Configuration Tool.

**ISM** communications uses Banner's proprietary Sure Cross® Wireless Network. The DXM Controller supports ISM communications to all of Banner's wireless products. ISM networks can be configured as point-to-point, star, tree, or point-to-multipoint networks. ISM radios are either 900 MHz for long range or 2.4 GHz for short range applications and countries outside of North America. Banner's proprietary ISM radio incorporates frequency hopping and time division multiplexing for safe and reliable communications.

Use the **Modbus serial** communication ports to connect to local Modbus devices. The DXM Controller supports three types of serial ports: RS-485 Master, RS-485 Slave, or RS-232. The secondary RS-485 port is a Modbus slave port for the DXM Controller. This allows other Modbus master devices to read/write data to the DXM Controller, which acts as a Modbus slave.

The DXM Controller can be a Modbus RTU master device to other slave devices and can be a Modbus slave device to another Modbus RTU master. The DXM Controller uses the primary RS-485 port (pins 6 and 7) as a Modbus RTU master to control external slave devices. The secondary port (pins 11 and 12) is the Modbus RTU slave connection.

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

## Application Program Interface (API)

The DXM Controller contains an API function that facilitates connectivity to applications such as Industrial Automation Systems. The API defines the proprietary register-value type data structure of the DXM Controller, allowing applications to consume DXM Controller-generated data with standard internet services. The DXM Controller pushes the register-value data file to the Internet based on control configuration. Typically, the application's database consumes the register-value data file.

## DXM Automation Protocols

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The DXM Controller supports the following automation protocols.

**Modbus RTU.** The DXM Controller manages two separate physical ports running the Modbus RTU protocol. The DXM

Controller is the Modbus Master when operating the Modbus master RTU port. The DXM Controller uses the master 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 Controller as a slave

device. The slave Modbus RTU port allows access all the internal registers concurrently with the master RTU port. By default, the Modbus RTU ports are active. Configure the port parameters using the DXM Configuration Tool.

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

**EtherNet/IP™.** The Ethernet port is actively running EtherNet/IP. From the factory the DXM Controller is configured to read and write registers on DX80 wireless devices 1 through 16. Custom configurations can be set using the DXM Configuration Tool. By default, EtherNet/IP is active.

## Internet Messaging Tools

### Data Logging

The DXM Controller can log all local register data collected from sensors, indicators, or control equipment as well as events generated by action rules. The DXM Controller can simultaneously manage three data logs and one event log, with each log assigned a unique name.

All logs are stored in a removable SD card and can be send to any email recipient. Data is entered into a log based on user-defined time intervals from a minimum of one second up to a maximum of 24 hours. Data can also be entered into a log if a register's value is greater than zero with time intervals from a minimum of one second up to a maximum of 24 hours. Data logs are automatically pushed to a server based on a user-defined file size, defined by byte length.

Data logs can be set to clear automatically either at midnight, or on three, seven, or 10 day intervals, or logs can persist indefinitely. If indefinite persistence is selected, the user must also select how the log is managed. "Write-over" or "stop logging" are supported options.

### Text and Email

The DXM Controller supports both SMTP email and SMS text messaging formats for sending alarms and alert notifications to recipients on the Internet. A total of six recipients can be defined: three for email and three for text messages.

### Alarm and Alert Notifications

Any local register within the DXM Controller can be used to generate an alert or an alarm when a pre-defined condition has been detected by action rules or ScriptBasic in the logic controller. The DXM Controller does not distinguish between alarm and alert status, it simply sends a message when the condition is met. The user must indicate in the subject or body of the message whether the message is an alarm or alert event.

### SMS (Text message) Commanding

The DXM Controller with a cellular modem can be remotely accessed using SMS messages. Simple text messages can:

- Force a push to the cloud
- Reboot the controller
- Read/write local registers

The incoming firewall provides security; only defined phone numbers are permitted to access the controller. When SMS command messages are sent from approved phone numbers to the DXM Controller, the DXM responds for fully acknowledged messaging control. Use the DXM Configuration Tool to configure the SMS Commanding feature.

## Logic Controller

The DXM Controller's control functionality provides the mechanism to change the behavior of industrial equipment whether local with on-board I/O and Modbus serial or remote with an ISM radio.

Control functions within the DXM Controller include:

- Reading, writing, and resource allocation for local registers
- Action Rules with threshold
- Math and logic functions used to make decisions based on local register values
- Notifications for alerts and alarms
- Trending for minimum, maximum, and averaging
- Scheduler to select specific times for actions and decisions

- ScriptBasic, a text-based programming language

Use either Action Rules or ScriptBasic to customize the DXM Controller's operating sequence. The DXM Controller allows concurrent operation of sequences for both action rules and ScriptBasic programs.

## Inputs and Outputs

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### Universal Inputs

The universal inputs on the DXM100 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

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

Use the DXM Configuration Tool 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.

### Analog (DAC) Outputs

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

### On-Board Thermistor

The DXM Controller has an integrated thermistor temperature transducer. The temperature value is measured in tenths of a degree Celsius and is not calibrated.

## DXM Internal Radio

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### Gateway Performance 1 Watt Radio

The DX80 Gateway (PE5) 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.

### MultiHop 1 Watt Radio

The DX80 MultiHop master radio (HE5) 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 get Modbus register data from a MultiHop device, configure the DXM Controller to access each device across the wireless network as an individual Modbus slave device.

## DXM Cellular Modem

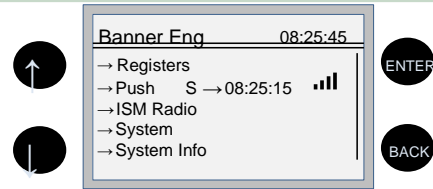
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The DXM internal cellular modem provides a remote network connectivity solution for the DXM Controller. The internal CDMA cellular modem is certified on the Verizon network and provides all the connectivity a hard-wired Ethernet connection provides. After a cellular plan is activated, the built-in provisioning process enables the cellular modem on the network in minutes.

## User Interface

The user interface (UI) has four user-defined LED indicators, four control buttons, and an LCD. The four buttons control the menu system on the LCD menu. Several menu levels display general configuration information and allow the user to set selected configuration parameters.

- The **Registers** menu displays the user-defined registers and associated values. The user-defined registers are set up using the DXM Configuration Tool.
- The **Push** menu displays information about the last data sent to the Webserver.
- The **ISM Radio** menu allows the user to set the Modbus Slave ID of the internal ISM radio, invoke binding, or run a site survey.
- The **System** menu changes the Modbus Slave ID of the DXM Controller, provision the internal cellular modem, select the incoming power algorithm for battery charging, or force a restart of the DXM Controller.
- The **System Info** menu displays the various settings of the DXM Controller, firmware versions, and network settings.



## DXM Modbus Overview

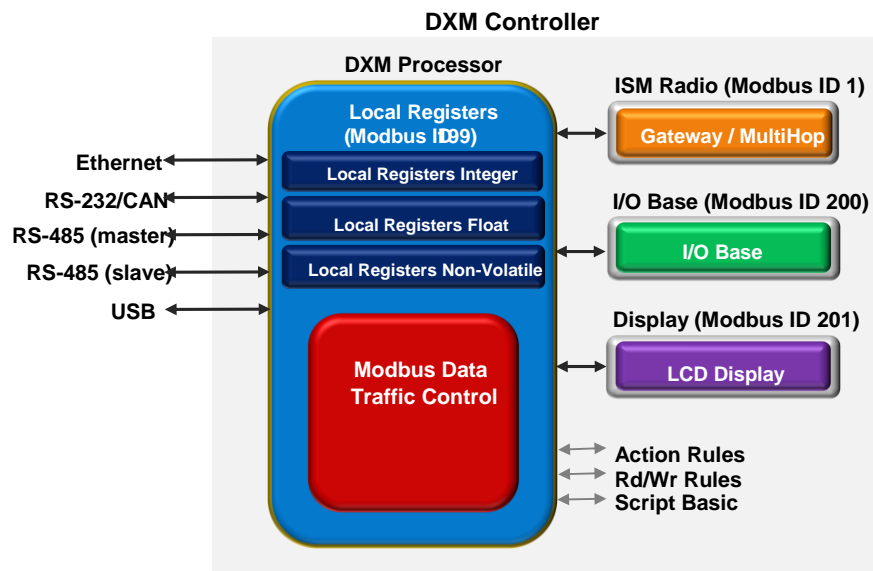
The DXM Controller uses internal 32-bit registers to store information. The processor's internal local registers serve as the main global pool of registers and are used as the common data exchange mechanism. External Modbus device registers can be read into the local registers or written from the local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

The DXM Controller, as a Modbus master device or slave device, exchanges data using the local registers. Modbus over Ethernet (Modbus/TCP) uses the local registers as the accessible register data.

Using Action, Read/Write, and Threshold Rules allows you to manipulate the processor's local registers. The ScriptBasic programming capabilities extends 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 different 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 and the LCD follows the same communication as an external Modbus device. Each device has an ID number to uniquely identify itself. The I/O base is Modbus ID 200 and the LCD is Modbus ID 201.



## DXM Configuration Tool Overview

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

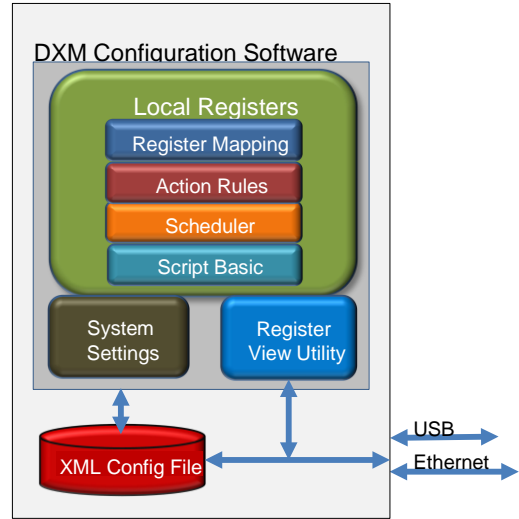
The **Register Mapping** function has two main components: a read rule and a write rule. These rules allow the user to program the ability to read or write information from Modbus slaves to/from the local registers.

The **Action Rules** allow for logic functions and manipulation of local register data. Action rules are processed autonomously from other local register functions. There are three types of action rules: thresholds, register copy, and math/logic.

Use the **Scheduler** to program when values are sent to a local register during a specific time, day, or week. Events can be programmed by days of the week with the ability to create holidays for exception conditions.

Use the **Register View Utility** to read or write local registers within the DXM Controller or Modbus Slave devices connected to the DXM Controller. This allows the user to debug connections to external devices by viewing live local register data within the controller.

The **System Settings** define parameters for the DXM Controller, including email notifications, Cloud settings, time of day settings, local logging settings, SMS messaging, ScriptBasic programming control, and Ethernet network settings.

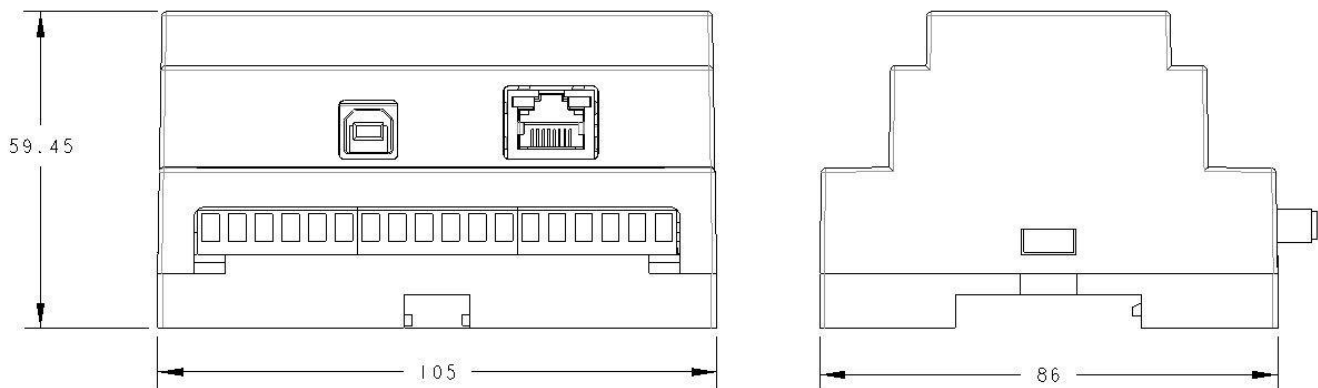


The DXM Configuration Tool configures the DXM Controller by creating an XML file that is transferred to the DXM Controller using a USB or Ethernet connection. The DXM Controller can also receive the XML configuration file from a Web server using a cellular or Ethernet connection.

This configuration file governs all aspects of the DXM Controller operation. The wireless network devices are a separate configurable system. Use the DX80 User Configuration Tool (UCT) to configure the internal DX80 wireless Gateway and the attached wireless Nodes. Use the MultiHop Configuration Tool (MCT) if the internal radio is a MultiHop device.

All tools can be connected to the DXM Controller using a USB cable or an Ethernet connection. Each tool can be run individually or launched through the DXM Configuration Tool.

## DXM100 Dimensions



All measurements are listed in millimeters, unless noted otherwise.





2.4 GHz, 65 mW: 0.3 m (1 ft)

## Specifications

### Supply Voltage

12 to 30 V dc 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 outputs at 5 or 16 Volts  
5 V: 400 mA maximum  
16 V: 125 mA maximum

### Power Consumption

35 mA average at 12 Volts

### Radio (ISM Band) Transmit Power

900 MHz at 1 Watt  
2.4 GHz at 65 mW

### Radio Range<sup>1</sup>

900 MHz, 1 Watt: Up to 9.6 km (6 miles)  
2.4 GHz, 65 mW: Up to 3.2 km (2 miles)

### Minimum Radio Separation Distance

900 MHz, 1 Watt: 4.57 m (15 ft)

### Communication Hardware (RS-232)

Baud rate: 9.6k or 19.2k (default)  
Data format: 8 bits; odd, even, or no parity; 1 stop bit

### Communication Hardware (RS-485)

Interface: 2-wire half-duplex RS-485  
Baud rates: 9.6k, 19.2k (default), or 38.4k  
Data format: 8 data bits, no parity, 1 stop bit

### 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

### Operating Conditions<sup>2</sup>

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

### Shock and Vibration IEC 68-2-6 and IEC 68-2-27

Shock: 30g, 11 millisecond half sine wave, 18 shocks  
Vibration: 0.5 mm p-p, 10 to 60 Hz

## Accessories

### 4-Pin Threaded M12/Euro-Style Cordsets

Model	Length	Style	Dimensions	Pinout (Male)
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### Solar Power Battery Charging

1 Amp maximum with 20 Watt solar panel

### Security Protocols

VPN, SSL, and HTTPS

### Radio Transmit Power

900 MHz, 1 Watt: 30 dBm (1 W) conducted (up to 36 dBm EIRP)  
2.4 GHz, 65 mW: 18 dBm (65 mW) conducted, less than or equal to 20 dBm (100 mW) EIRP

### 900 MHz Compliance (1 Watt)

FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247  
IC: 7044A-RM1809

### 2.4 GHz Compliance

FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247  
ETSI EN 300 328 V1.8.1 (2012-06)  
IC: 7044A-DX8024

### Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

### Antenna Connection

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

### Logging

8 GB maximum; removable Micro SD card format

### Communication Protocols

Modbus RTU Master/Slave, Modbus/TCP, and Ethernet/IP

### Construction

Polycarbonate; DIN rail mount option

### 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

### NMOS Outputs

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 Rating

IEC IP20

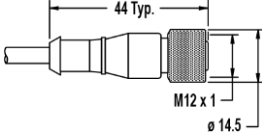
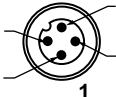
### Certifications



<sup>1</sup> Radio range is with the 2 dB antenna that ships with the product. High-gain antennas are available, but the range depends on the environment and line of

sight. To determine the range of your wireless network, perform a Site Survey.

<sup>2</sup> Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.

<b>MQDMC-401</b>	0.3 m (1 ft)	Straight		 <p>1 2 3 4</p> <p>1 = Brown 2 = White 3 = Blue 4 = Black</p>
<b>Power Supplies</b>				
<b>Models</b>	<b>Description</b>		<b>Datasheet</b>	
PSD-24-4	DC Power Supply, Desktop style, 3.9 A, 24 V dc, Class 2, 4-pin M12/Euro-style quick disconnect (QD)		<a href="#">173620</a>	
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		<a href="#">180340</a>	

## Warnings

**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.** A list of approved countries appears in the *Radio Certifications* section of the product manual. 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. Consult with Banner Engineering Corp. if the destination country is not on this list.

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