MultiHop Configuration Tool

Instruction Manual

Original Instructions
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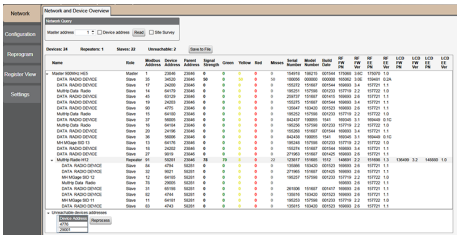
150473

Contents

1 **MultiHop Configuration** Tool

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



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

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

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

Download the most recent software revision from Banner Engineering's website: *www.bannerengineering.com/wireless*.

1.1 **Installation**

Use the MultiHop Configuration Tool to configure the radios within your MultiHop radio network. The MultiHop Configuration Tool uses a USB to RS-485 converter cable to connect a MultiHop radio to a USB connection on a computer.

Installing the **Software**—Before connecting the USB to RS-485 adapter cable, install the MultiHop Configuration software downloaded from the Banner Engineering website. To ensure a complete installation, verify you have an active Internet connection or .NET 4.5 (or higher) before installing the software.

Figure 1. BWA-UCT-900 Adapter Cable

Figure 2. BWA-HW-026 Power Cable

Connecting the **MultiHop** Radio using the USB/Converter:

1. Complete the software installation.
2. Connect the USB end of the Banner USB converter to a USB port on the computer. The computer should recognize the Banner USB converter device.
3. Connect a Banner MultiHop radio to the Euro-style connector end of the USB converter. The MultiHop radio powers up. When using a third-party USB converter, manually wire the communication and power connections. Refer to Banner's MultiHop radio datasheet for the wiring pin-out configurations.
4. Launch the MultiHop Configuration Tool software.
5. Select the USB from the pull down list.
6. Use the Device > **Connection Settings** menu to select a port. The factory default baud rate is 19.2k, 1 stop bit, no parity.

Connecting to a **MultiHop** Radio using a DXM Controller:

1. Connect a USB cable from a USB port on the computer to the USB port on the DXM Controller.
2. For Ethernet, connect an Ethernet cable from the DXM Controller to an ethernet switch.
3. Cycle power on the DXM Controller after the Ethernet cable is attached to the DXM Controller.

For most of the MultiHop Configuration Tool screens, a grayed box represents a parameter read from the device, the control is inactive, or the software is reading a field. A white box represents parameters entered by the user.

1.2 Menu Bar

The File and Device menus select the basic file operations and communication configuration for the DX80 Gateway.

Access the File and Device menus from the menu bar.

1.2.1 File Menu

Exit—Closes the COMM port and exits the program. Any data that is not saved is lost.

Load—Loads a specific XML configuration file into the tool for editing. This XML configuration file is unique to the MultiHop Configuration Tool and is not compatible with other configuration tool XML files.

New—Loads blank configuration settings into the tool.

Save—Saves the current settings in the configuration tool under the current XML file name. The program switches to Save As if there is no XML file name assigned.

Save As—Saves the current settings in the configuration tool to a new file name specified by the user.

1.2.2 Device Menu

Traffic Watcher—Views all serial data traffic between the host and the master radio. The Traffic Watcher logs file loads, error messages, and data transfers.

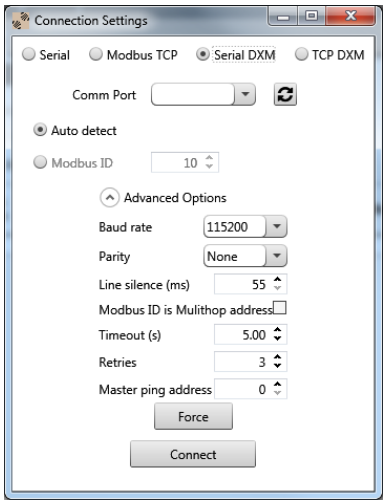
Connection Settings—Sets the COMM port to communicate with the master radio. There are four possible connection with the MultiHop Configuration Tool.

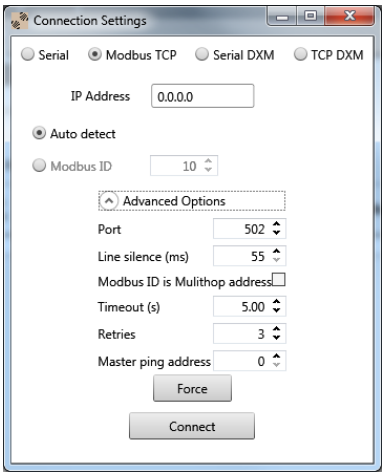
Serial—Direct connection to the master radio using a RS485 to USB converter cable.
Serial DXM—Connecting to a DXM internal ISM radio using USB
TCP DXM—Connecting to a DXM internal ISM radio using Ethernet; select the VPN checkbox only when your DXM is connected to the Internet via a cell modem

1.3 **Connection Settings**

The DX80 User Configuration Tool or the MultiHop Configuration Tool connects directly to a standalone Gateway or Master device by using the USB to RS-485 adapter cable. When using a DXM Controller, you may connect to the internal radio or any MultiHop radio attached to the DXM Controller, through the DXM Controller.

After the software launches, go to Device > **Connection Settings** to choose one of the four communication modes: Serial, Modbus over TCP, Serial DXM, or TCP DXM.





1.3.1 Basic **Connection Settings**

Comm Port / IP Address—Select the COMM port of the PC or, when using Ethernet, the IP address of the device. Click the refresh button to refresh the COMM ports on the PC.

Connect/Click to Cancel—Click to verify a radio is present by reading back the RF firmware. After a connection is in progress, this button changes to Click to Cancel.

Modbus ID—Modbus address ID of the radio.

Modbus TCP—Use when connecting to a standard DX80 Gateway or MultiHop master radio using an Ethernet connection. The IP address must be known to communicate with the device.

Serial—Use when directly connecting to a standard DX80 Gateway or MultiHop radio using the USB to RS-485 adapter cable.

Serial DXM—Use when configuring an internal radio of the DXM Controller using the USB connection on the DXM Controller.

TCP DXM—Use when configuring the internal radio of the DXM Controller using the Ethernet port. The standard DXM TCP port is 8844.

1.3.2 Advanced **Connection Settings**

Baud Rate (Serial only)—Defines the baud rate for the serial connection of the USB to RS-485 converter or DXM USB connection. Default of 19200 for the USB to RS-485 converter or 115k for the DXM USB connection.

Force—Click to have the software use the selected parameters and force a connection to a device without validating the device is present.

Line Silence—Specifies the wait time between two consecutive Modbus messages created by the DXM Controller. Too short of a wait time may cause external Modbus devices to miss or create errors on Modbus traffic. A typical setting should be 50 to 100 ms.

Master Ping—For most applications, leave the Master Ping set to 0. To communicate directly with a DXM baseboard, set the value to 2. Using Master Ping allows you to have multiple master radios on a single network. For more information about this advanced setting, contact Banner Engineering Corp and ask to speak to a Wireless applications engineer.

Parity (Serial only)—The default parity setting is None. Optional settings are Even or Odd.

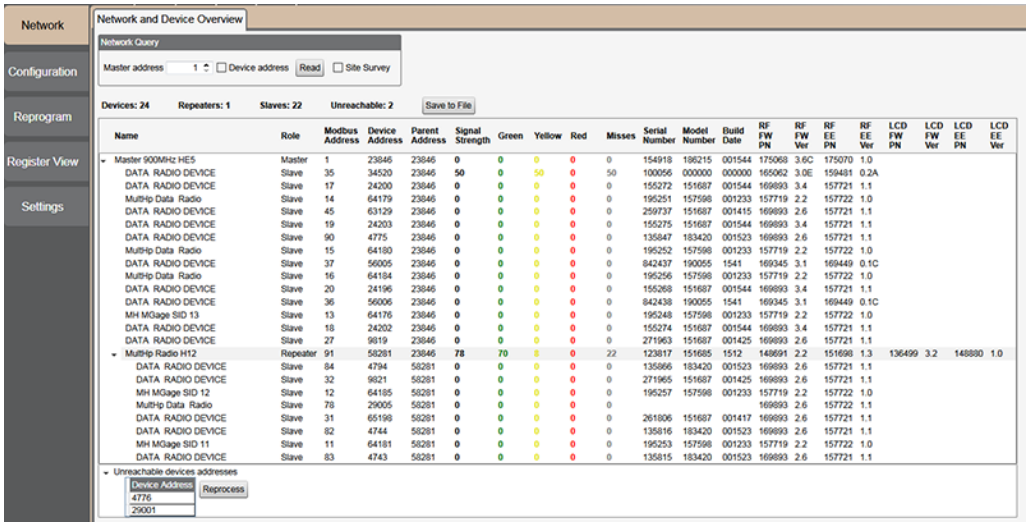
Port (Ethernet only)—Defines the Ethernet port used when communicating via Modbus/TCP or to the DXM Controller. The default is 502.

Retries—The number of times the software resends Modbus messages before it errors out. The minimum number of retries is three.

Timeout—The time allowed for a Modbus message to complete. The default time out is 0.5 seconds for a serial connection and 5 second for a TCP connection. This may need to be extended for battery-powered devices or networks with communications paths that include multiple repeater devices.

2 Network and Device Overview

The Network and Device Overview screen displays an organized view of the MultiHop radio network, noting which devices are the master, repeaters, and slaves.



The network structure is indicated by the format of the list. MultiHop radios are indented to indicate which parent they are communicating with. In addition to displaying the structure of the data radio network, signal quality information is displayed in a color-coded format for easy viewing.

To view the structure of your network and all factory information, such as model and serial numbers, without conducting a Site Survey, select the master radio's ID and click Read.

To conduct a signal strength analysis, or Site Survey, select Site Survey, then click Read. Depending on the size of your network, analyzing the signal strength and displaying the network structure may take a few minutes (about 15 seconds per radio.)

To run Site Survey on a individual radio, highlight the line of the device then right click.

To read the manufacturing or site survey information for a specific device, click on the device name and select from the context-sensitive menu.

To save the network configuration to a file, click Save to File. The information displayed on the screen (device name, type, address, etc) is saved to a text file.

Device Address—The device address (DADR) is a unique number based on the device's serial number and is set by the factory. This address displays as part of the RUN menu's auto-loop display on the device's LCD screen while the radio is operating.

Device Role—The devices are listed as Master (only one per network), Repeater, or Slave. Set the device type using each radio's DIP switches.

Master—The master radio controls the overall timing of the network and is always a parent device for other MultiHop radios. The host system connects to this master radio.

Repeater—When a MultiHop radio is set to repeater mode, it acts as both a parent and a child. The repeater receives data packets from its parent, then re-transmits the data packet to the children within the repeater's network.

Slave—The slave radio is the end device of the data radio network. A MultiHop radio in slave mode does not re-transmit the data packet on the radio link.

Modbus Address—Set the MultiHop radio ID using the radio's rotary dials. Note that the MultiHop radio ID is also the Modbus Slave ID. The Modbus Address (Modbus ID) must be a unique number to access I/O point data on the radio device. For radio devices that do not have I/O and to not want to be individually accessed, a Modbus ID is not required.

Model Number—The model number is a 6-digit number used by the manufacturer to identify the device model of the radio.

Name—Use the name string to identify the radio device. The name is saved in the MultiHop device. Change the name using the **Configuration** screen.

Parent Address—The master radio and repeater radios act as a parent device to slave radios. The parent radio provides network timing and data routing to slave radios.

Radio (RF) and LCD Firmware (FW) and EEPROM (EE)—These parameters are set at the factory. You may be asked for this information if you call Banner Engineering for technical support. To update these programs, obtain the newest versions from the factory, then use the Reprogram screen to copy these files to your radio.

RF FW—Part number and version number for installed firmware of the radio microprocessor.

RF EE—Part number and version number for installed EEPROM of the radio microprocessor.

LCD FW—Part number and version number for installed firmware of the LCD microprocessor.

LCD EE—Part number and version number for installed EEPROM of the LCD microprocessor.

Serial Number—The serial number is a 6-digit, unique number that identifies that specific radio. No other radio will be assigned this number. Each Sure Cross radio uses its serial number to generate the device address that displays on the Network and Device Overview screen and the radio's LCD.

Signal Strength—The master radio conducts a site survey with all radios within the MultiHop radio network and displays the number of packets successfully transmitted at the various signal strengths represented by the "green," "yellow," and "red" delineations.

Green—a strong radio signal
Yellow—a good radio signal
Red—a marginal radio signal
Misses—represents the number of packets not received on their first transmission

Unreachable—The unreachable devices are radios the master radios has detected but was unable to locate them during the last scan. From the Unreachable drop-down list, select a device or range of devices and click Reprocess. The master radio will attempt to connect to and read this device.

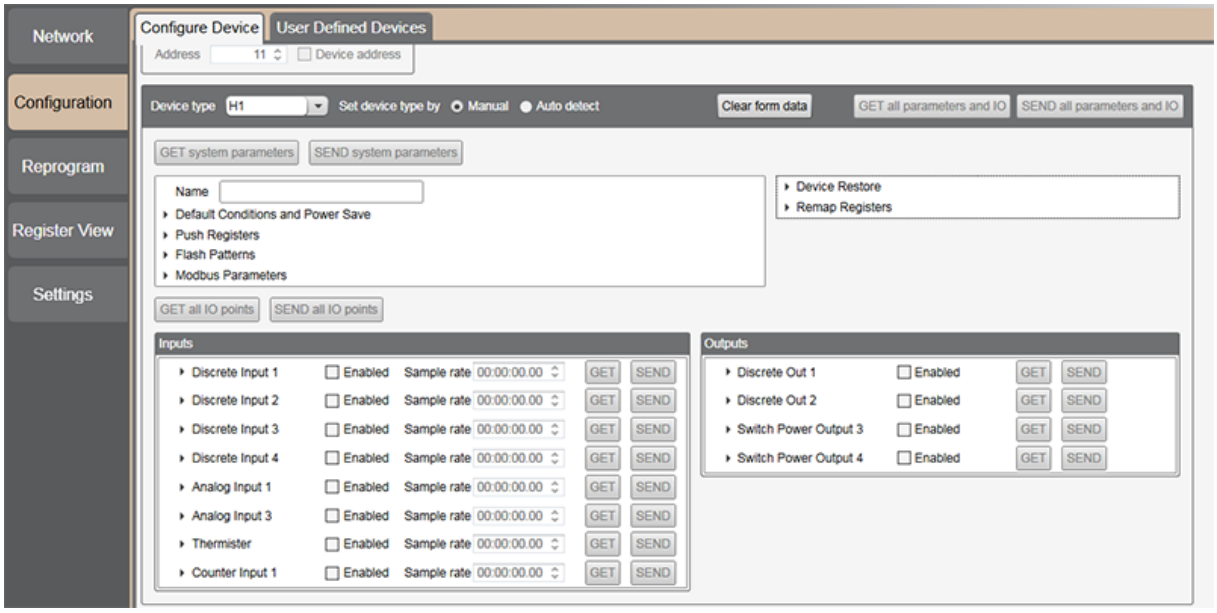
3 Configuration

The **Configuration** main tab allows you to configure your device by defining device-level parameters and I/O parameters. Use the User **Defined** Devices screen to create a user-defined device for use in your radio network.

3.1 **Configure** Device

Use the **Configure** Device screen to define the default conditions, push registers, flash patterns, Modbus parameters, device restore conditions, and to remap registers.

Enter the Modbus ID of the MultiHop radio you want to configure. To select a MultiHop radio by its unique device address (Not Modbus ID), select the Device Address checkbox and then enter the Device address.



Manual Mode—Select the Manual Mode checkbox and select the Device Type from the drop-down list. Selectable device types are:

H—M-H (no I/O) models
H1—M-H1 models (including SPRFs)
H2—M-H2 models (including SPRFs)
H3—M-H3 models (including SPRFs)
H4—M-H4 models (including SPRFs)
H5—M-H5 models (including SPRFs)
H6—M-H6 models (including SPRFs)
H12—M-H12 models (including SPRFs)
H14—M-H14 models (including SPRFs)
H1B—M-H1B Board Modules (including SPRFs)
DXM100x1—All DXM100x1 models
H2B—M-H2B Board Modules (including SPRFs)
DXM100x2—All DXM100x2 models
DC-LATCH—MultiHop DC-LATCH models
DXM150x1—All DXM150x1 models
HM—MultiHop M-GAGE models
DXM150x2—All DXM150x2 models
U—MultiHop Ultrasonic and Ultrasonic/Light models

To read the existing parameters, click GET All Parameters. To write changes to the selected device, click SEND All Parameters.

3.1.1 Reading **Configuration** Data from the **MultiHop** Radios

To read, or "get" configuration data from a MultiHop radio anywhere in the network, enter the MultiHop Modbus ID and click the appropriate GET button.

Note: The MultiHop Modbus ID is assigned to each device using the rotary dials on the front of all MultiHop radios.

3.1.2 Name

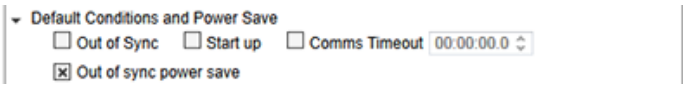
Assign a name to each radio to make the device easier to track in the MultiHop Configuration Tool.

The Name, which appears on the **Configuration** > **Configure** Device screen, must be less than 18 characters and contain the standard alpha-numeric characters and the following standard ASCII characters: *, +, -, /, <, >, and a space.

After making any changes, click SEND to write the changes to the radio. The status bar at the bottom of the screen indicates when the process is complete by listing the Communication Status as Ready, with a green light. Errors display as a red light and a brief explanation of the error status. A yellow status light and a description of Getting Data indicate the network is retrieving the requested data from the selected MultiHop radio device.

3.1.3 Default **Conditions**

Default conditions are the conditions under which outputs are sent to their defined default state. These conditions apply to all outputs on the selected radio.



When a radio is Out of Sync, it is not communicating with its parent radio. Selecting the Out of Sync condition sets all outputs (on this device) to their specific default values when this radio has lost its communication link with its parent radio. The default output values are selected under each of the output parameter sections of this screen.

Selecting Start Up sets this radio's outputs to their default values when this radio is powered up.

A **Communication** Timeout refers to the communication between the host system and the selected radio (which may be any radio within the MultiHop network). Selecting Communication Timeout sets this radio's outputs to their selected default values when the host system has not communicated with this radio within the time specified. Set the communication timeout in seconds.

Selecting Out of sync power save sets the radio to low power mode if the radio is out of sync for more than 5 minutes. The radio wakes up every 5 minutes to search for a parent radio. This setting is recommended for battery-powered devices.

After making any changes, click SEND to write the changes to the radio. The status bar at the bottom of the screen indicates when the process is complete by listing the Communication Status as Ready, with a green light. Errors display as a red light and a brief explanation of the error status. A yellow status light and a description of Getting Data indicate the network is retrieving the requested data from the selected MultiHop radio device.

3.1.4 Push Registers

Push registers automatically transmit register data from a MultiHop device back to the master MultiHop radio.

In the MultiHop system, every device is treated as a separate unit. In the Modbus protocol, every device is a Modbus slave device. To get I/O register information, a host system must interrogate each Modbus slave one at a time. This is the standard mode of operation of MultiHop devices and works well for most applications.

Push registers are a feature of the MultiHop system. The user can define up to four registers per MultiHop I/O device that transmit data to be stored at the master MultiHop data radio. This allows a host system to interrogate only the master device for I/O information without dealing with the latency of the wireless link.

Using the push registers is beneficial in applications where:

- End devices are battery powered with infrequent changes, but notification of changes wants to be immediate. Instead of a host continually polling a device for I/O changes, which consumes battery power, push registers transmit data back to the master device when it changes and/or on a periodic cycle.
- A host polling loop becomes impractical because of the time required to communicate with each remote device individually (large networks). The data changes are usually infrequent and the devices are typically battery powered. With large networks, push registers allow each end device to transmit data to the master when it changes and does not rely on the host request to initiate a transaction.

Using push registers is not beneficial in typical monitoring applications with periodic data requirements of a minute or longer.

A side benefit of using the push registers is the ability to use a device status register for each MultiHop device. With a push register interval defined, a Master Sweep Interval can be defined to verify the communication of each device pushing data back to the master device. During the master sweep interval, every device must communicate with the master device or the status register will be zero (missed communications).

For more information, refer to the Technical Note on MultiHop push registers.

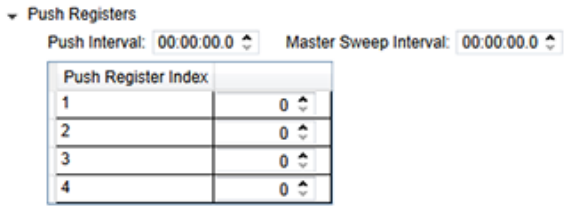
Reading Push Registers

To read the push register data from the master device, send a Modbus read command to the remote slave ID for registers 47909-47912 (push registers 1-4). The master device intercepts the Modbus command to the remote slave (because of the register addresses) and substitutes the local cached register values.

Read the status register for a MultiHop device the same as reading the push registers: the host sends a Modbus read command to the remote slave ID and register 47904. To use the status register for each MultiHop device, the master sweep interval must be defined using the MultiHop Configuration tool.

A status register value of zero indicates no device; a value of one (1) indicates the device has reported.

Configuring Push Registers



Up to four push registers may be defined for each MultiHop radio. For most applications, input registers are mapped to the push registers, but other registers may be configured as push registers, such as the battery read voltage.

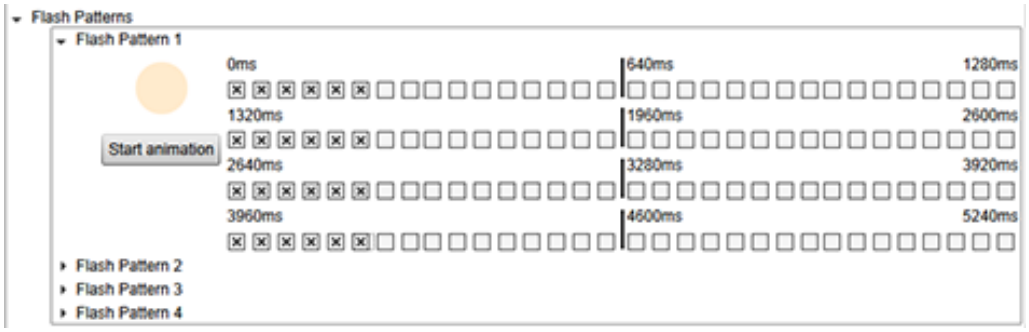
To configure a register as a push register:

1. Select the desired MultiHop Radio ID number at the top of the screen.
2. Use the drop-down list to select an input or enter the register number.

Enter a Push Interval value, in seconds, that defines how often the push register values are transmitted back to local registers on the master radio.

3.1.5 Flash **Patterns**

Setting the flash pattern establishes an on and off pattern that can be used for a discrete output or switch power.



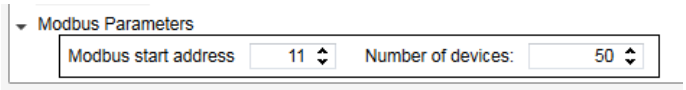
Define Flash **Patterns** by selecting specific timeslots to turn the output on or off. While originally the flash pattern was designed to turn on and off an indicator light, the flash pattern can be set for any discrete output or switch power. Each slot represents one frame size, which may vary from radio to radio. The default frame is 40 milliseconds. Users may configure up to four different flash patterns per radio device.

In the example shown, Flash Pattern 1 is configured to turn on the EZ-LIGHT for 240 milliseconds, then turn off the light for 1040 milliseconds. To preview the flash pattern, click on the Start **Animation** button. The EZ-LIGHT graphic flashes on and off in the programmed flash pattern.

After making any changes, click SEND to write the changes to the radio. The status bar at the bottom of the screen indicates when the process is complete by listing the Communication Status as Ready, with a green light. Errors display as a red light and a brief explanation of the error status. A yellow status light and a description of Getting Data indicate the network is retrieving the requested data from the selected MultiHop radio device.

3.1.6 Modbus Parameters

Enter the first Modbus address and the total number of MultiHop devices in the network. These parameters only apply to the master MultiHop radio.



3.1.7 Device Restore

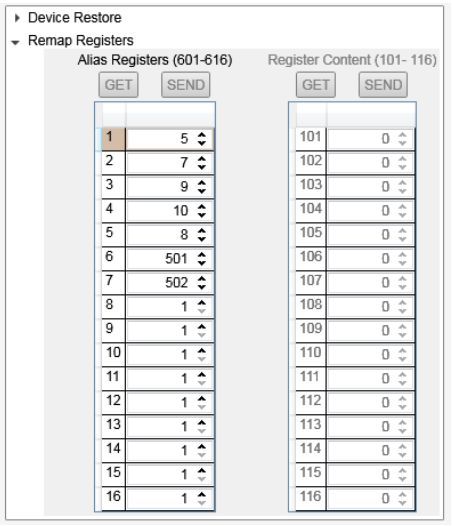
Use these commands to restore default settings to the selected device.

To restore default device parameters:

1. At the top of the screen, select a MultiHop device.
2. Click on GET All Parameters to get that device's I/O configuration.
3. In the Device Restore section, select the appropriate checkboxes.
    - Restore Default I/O **Configuration**. Restores default I/O configuration parameters to the values indicated in the device's datasheet, such as sample and report rates.
    - Restore Default System Parameters. Restore default system parameters, such as the radio configuration and binding code.
    - **Re-Initialize** Variables from Serial Number. Restores the default values of all variables calculated from the serial number. This is not typically recommended.
4. Click on Restore Device to restore the selected default values to your device.

3.1.8 Remap Registers or Register Aliasing

Use the Remap Registers section of the **Configure** Device screen to map registers to contiguous register locations to optimize Modbus read/write functions.

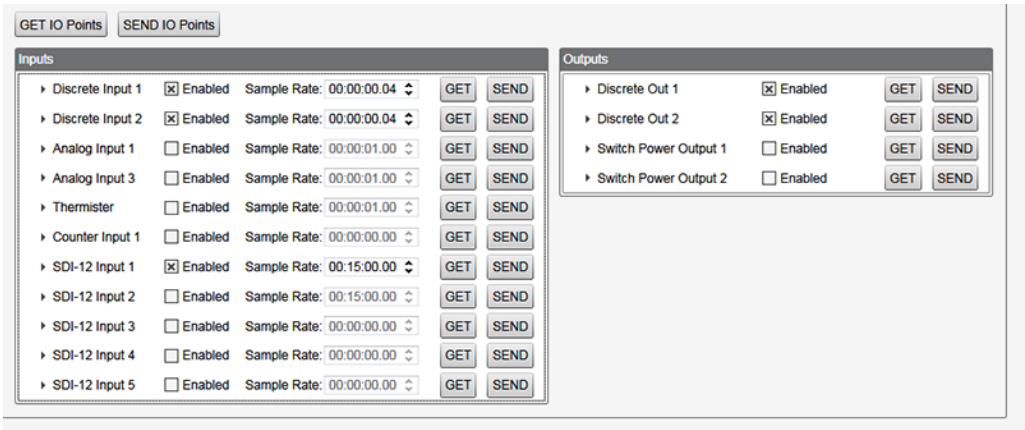


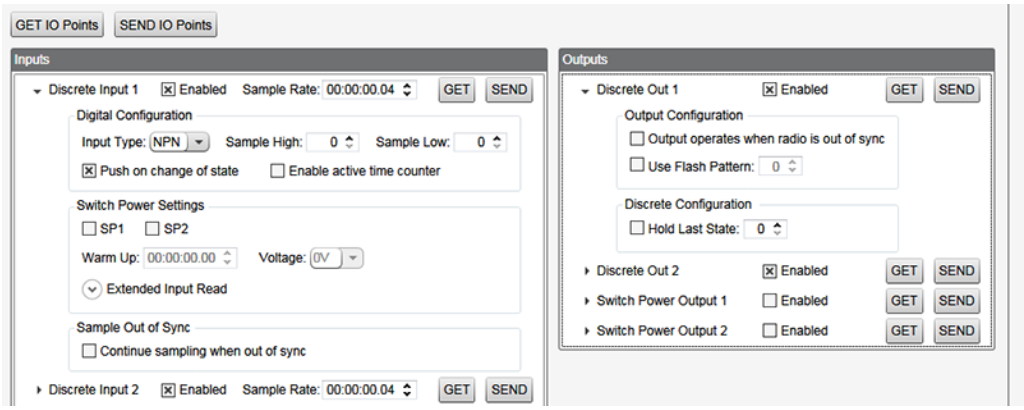
1. Verify the desired MultiHop Radio Address is selected in **Configuration** Address.
2. Click the arrow next to Remap Registers.
3. Fill in the source registers you would like to alias. The Alias Registers rows 1 through 16 are the user-defined entries of addresses of the registers to alias (rearrange). This alias table is stored in the MultiHop radio register addresses 601 through 616. In the example, source registers addresses 5, 7, 9, 10, 8, 501, and 502 are entered into the table.

The aliased Register Contents are in registers 101 through 116. For this example, when a host system reads Modbus registers 101 through 107 of the MultiHop radio, the register contents come from register 5, 7, 9, 10, 8, 501 and 502.

3.1.9 Get I/O Points

To configure the inputs and outputs for each MultiHop radio, enter the radio ID at the top of the screen and click GET all parameters and IO. All inputs and outputs available for the select device display on the screen.





Select the device you want to configure by using the drop-down list to select the device address. Click GET all parameters and IO to retrieve any existing configuration data from the device.

General **Instructions**

The following commands are general to the entire screen.

Address—Select the address of the device you want to configure. Click GET to retrieve that device's information before making changes to it.

Enabled—Turns on any specific I/O point. When unselected, the specific I/O point is disabled for the MultiHop radio device selected at the top of the screen

GET—Click GET to read parameters from the radio.

Name—Enter a name for the device. This name displays on the other configuration screens.

SEND—After making any changes, click SEND to write the changes to the radio. The status bar at the bottom of the screen indicates when the process is complete by listing the Communication Status as Ready, with a green light. Errors display as a red light and a brief explanation of the error status. A yellow status light and a description of Getting Data indicate the network is retrieving the requested data from the selected MultiHop radio device.

Inputs

The following parameters are used to configure the inputs.

Continue sampling when out of sync (Discrete)—Select to have the MultiHop device continue sampling the I/O even when the radio is out of sync with its parent radio. This is particularly valuable on counter inputs.

Counter—Select the counter type: event or frequency. The frequency counter calculates the frequency of the input signal, in Hz. The event counter counts the total number of times an input signal changes to the high/ON/1 state. The frequency counter is typically used to measure flow rates, such as measuring the flow rate of items on a conveyor or the speed at which a windmill spins. The event counter can be used to measure the total operational cycles of a spinning shaft or the total number of items traveling down a conveyor.

Delta—The delta parameter defines the change required between sample points of an analog input before the analog input reports a new value. To turn off this option, set the Delta value to 0. To use the delta function, the push registers must be defined.

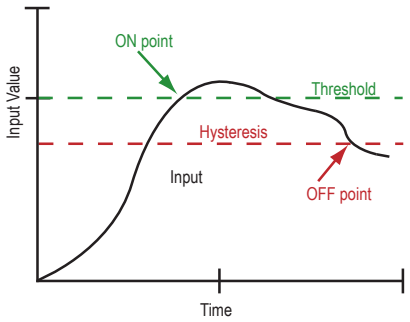
Enable **active time** counter (Discrete)—Select the checkbox to have the device count the length of time the discrete input is held high.

Enable full scale (Analog)—Turning Fullscale ON sets the entire register range of 0 through 65535 to represent the selected minimum through maximum input values. With Fullscale turned on, a register value of 0 represents the selected minimum value in microamps (for current inputs). A register value of 65535 represents the selected maximum value in microamps. For example, a register value of 0 is 0 and the register value of 65535 represents 20 mA (or 20,000 microamps). With Fullscale turned OFF, the register value represents unit-specific input readings. For units of current (mA), register values are stored as microAmps. Voltage values are stored as millivolts. A sensor reading of 15.53 mA is stored as 15530.

Enable full scale (Temperature)—Turning Fullscale OFF sets the register range of 0x8000 (–32767) through 0x7FFF (+32768) to represent the range of input values. With Fullscale turned OFF, a register value of 1450 represents 72.5 degrees (register values = temperature × 20). With Fullscale turned ON, users can specify the register minimum and maximum range of values. These min/max values are represented in the register as 0 (min) and 65535 (max).

Enable push on change of state—Enables push registers for this input. When the discrete input changes state, the register value is pushed to the master radio if this register is configured to be a push register. For analog inputs, use the threshold and hysteresis parameters to define "on" and "off" points.

Hysteresis and Threshold (Analog)—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. Setting a threshold establishes an ON point. 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 graphically, 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 (Discrete)—Select either NPN or PNP discrete input types.

Preset Value (Counter)—Enter a number in the selection box and press the Set Value button to write a preset counter value to the register.

Sample High and Sample Low—For analog inputs, the sample high parameter defines the number of consecutive samples the input signal must be above the threshold before a signal is considered active. Sample low defines the number of consecutive samples the input signal must be below the threshold minus hysteresis before a signal is considered deactivated. The sample high and sample low parameters are used to avoid unwanted input transitions.

Sample Out of Sync—When a device is not in sync with the wireless network, it will not sample its I/O points. If **Continue** Sampling When Out of Sync is selected, the device continues to sample the I/O when the device is out of sync. This may be useful for counter applications when the network is powered down often.

Sample Rate—The sample interval, or rate, defines how often the Sure Cross device samples the input. For battery-powered applications, setting a slower rate extends the battery life. Set the sample rate/interval using 0.04 second intervals.

SDI-12 Input—Manually edit the result register parameters.

Address—Enter the device ID for the SDI-12 device.

Command—Select the command type that applies to your SDI-12 sensor.

Registers—Enable each used registers and set the Register Options that apply to your SDI-12 sensor.

Switch Power **Settings** (Inputs)—

Enabled—Associates I/O switch power functions to a specific input. Do not use these parameters to configure continuous, or device-level, switch power. Select one of the available switch power (SP) checkboxes to link that switch power to the input you're currently configuring.

Voltage and Warm-Up—Select the desired voltage and warm-up time. The voltage setting establishes the voltage of the switch power. The warmup time is the length of time the switch power must be on before the device can sample the input.

Extended Input Read **Settings**—To associate these switch power settings to more than one input, click on the Ext. Input Read **Settings** link. Select the appropriate checkboxes to associate multiple inputs to this switch power. In the example shown below, the selected switch power settings are associated with both input 1 and input 2.

Temperature **resolution** (Temperature)—Select high to store temperatures values in the registers as the measured temperature × 20. Set to low to store temperature values in tenths of a degree (measured temp × 10). For example, if the measured temperature is 20.5 degrees, turning temperature scaling to high stores the temperature value as 410 while use low resolution stores the temperature as 205.

Units (Temperature)—Select either Celsius or Fahrenheit for your temperature readings.

Outputs

The following parameters are used to configure the outputs, including the switch power outputs.

Default Output Value (Outputs)—Select the default output value. When the selected default condition occurs and Hold Last State parameter is set to OFF, this output is set to the selected default output value (e.g. out of sync, communication timeout, start up).

Enable default state (Switch Power Output)—When enabled, this switch power output remains on during the selected default condition (e.g. out of sync, communication timeout, start up). When disabled, the switch power cycles off during the selected default condition.

Flash **Pattern**—The flash pattern defines the ON/OFF timing of an output or switched power output. Flash patterns are typically used to control ON/OFF rates of a light to conserve battery power or draw attention to a light indicator. Set up a light's flash pattern by configuring the flash pattern of the discrete output or, if the light is powered using switch power, using the switch power's flash pattern.

Use Flash **Pattern**—To use a programmed flash pattern, set the Enable Flash Pattern to ON, then select the appropriate flash pattern from the drop-down list. The flash patterns are defined in the Device Parameters section of this screen. Select from one of the four user-defined flash patterns. Set the flash patterns in the Device Parameters section of this screen.

Hold Last State (Outputs)—When "hold last state" is on, this output retains its last value during the selected default condition (e.g. out of sync, communication timeout, start up). Set the default output conditions in the Device Parameters section of this Device Config screen.

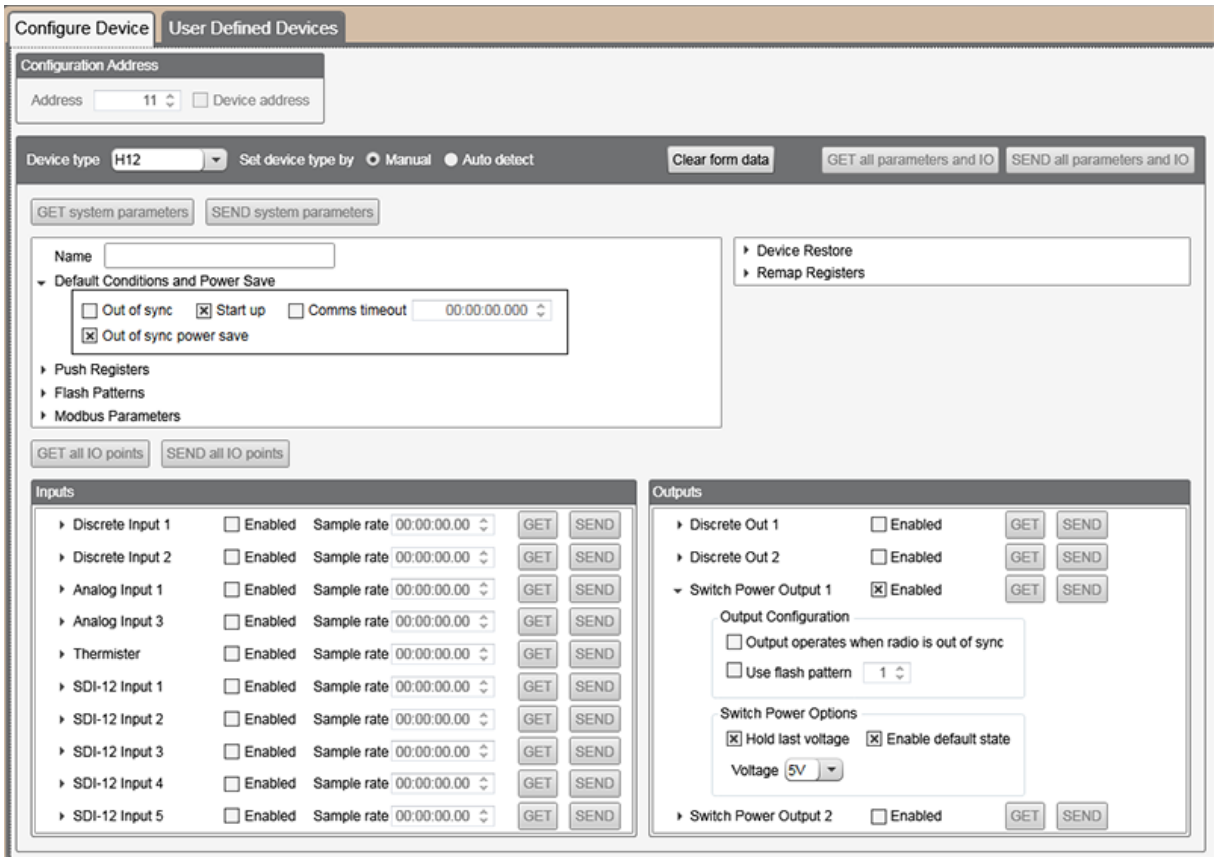
Hold Last Voltage (Switch Power **Options)**—When the "hold last voltage" option is set, the switch power output retains its last value during the selected default condition (e.g. out of sync, communication timeout, start up).

Switch Power **Options** (Switch Power Output)—When linking a switch power output to a specific input, select the Enable checkbox and set the Enable default state to OFF. Use the settings for the specific input to link the switch power output and set the voltage and warm-up time. For continuous power, set the voltage on this screen and set the default state to ON. Verify the default "start-up" conditions are set in the device parameters screens.

Voltage—To set a voltage for the switch power output, select a value. When configured for continuous voltage output, this switch power output no longer cycles on, warms up the sensors, then cycles back down. Because the output voltage remains constant, continuous voltage is typically used with solar power installations.

Configuring the Switch Power Output for **Continuous** Voltage

To configure the Switch Power output to supply continuous voltage to a sensor, follow these steps.

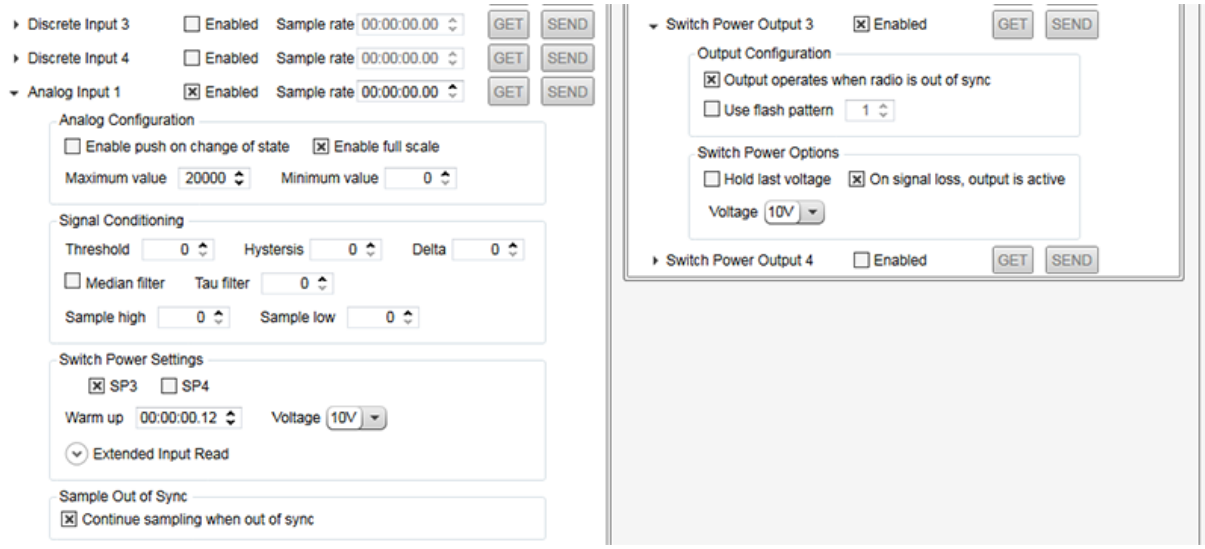


1. Select the device that will be supplying the continuous voltage.

2. Click GET all parameters and IO.
3. Under the Default **Conditions** and Power Save settings, select Start Up.
   This configures the enabled and configured Switch Power terminal to output continuous voltage as soon as the radio powers up.
4. Select the Switch Power Output and enable it.
5. Under Switch Power **Options**, select On signal loss, output is **active** (may also be called Enable Default State).
6. From the drop-down list, select the continuous voltage value.
7. Click SEND all parameters and IO to send the new settings to the wireless network device.

Configuring the Switch Power Output

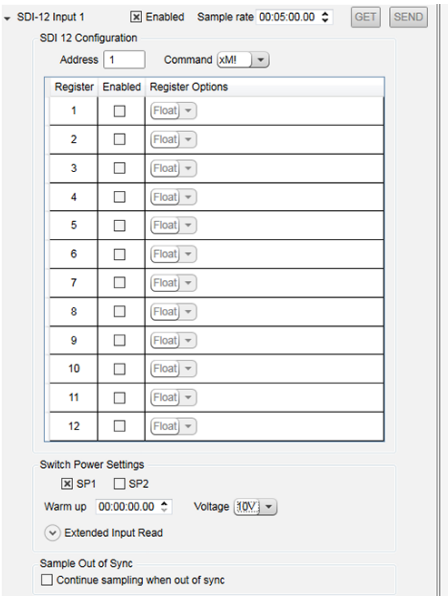
To operate the switch power (SP) terminals as switch power that cycles on for a specific length of time then cycles off to conserve power, enable the desired SP terminal and set the voltage and warm-up time for the specific input associated with the switch power. Follow these steps to associate SP3 to Analog IN 1.



1. Go to the Analog IN 1 section of the **Configuration** > **Configure** Device screen and select the Enabled checkbox.
2. Select the SP3 checkbox to enable switch power 3 to power analog IN 1.
3. Set the voltage and warm-up time according to the sensor's needs.
4. Use the Switch Power Output 3 section to enable the switch power.
5. Set the appropriate Output Configuration and Switch Power Option.

Configuring the SDI-12 Inputs

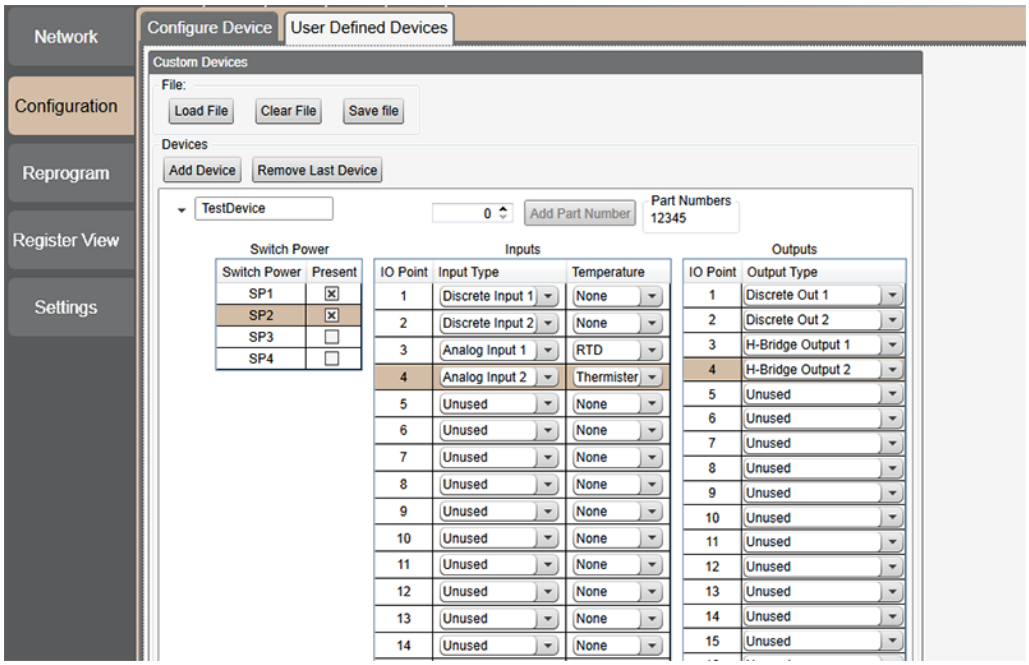
To configure the SDI-12 inputs for use with an Acclima or Decagon 5TE SDI-12 sensor, follow these steps.



1. Select the Enable checkbox to enable the SDI-12 input.
2. Select an Sample Interval (sample rate), in hours:minutes:seconds.
3. Select the Address (device ID) for the SDI-12 device. The sample screenshot shows the configuration for SDI-12 device 1.
4. Under the Switch Power **Settings**, select either 1 or 2 to have SP1 or SP2 power your SDI-12 device.
5. Enter the appropriate Voltage needed to power your sensor.
6. Select a Warm-Up time, in hours:minutes:seconds. This is the amount of time your sensor requires power before an accurate reading can take place. Refer to your SDI-12 documentation for this value.
7. If you want your SDI-12 device to continue sampling when the MultiHop radio has lost its radio connection to its parent radio, select the Enable Input Out-of-Sync checkbox.
8. Enable each register that you need and select the appropriate register option from the drop-down list.
9. Click on the Send button to send this configuration to the selected MultiHop device.

3.2 User **Defined** Devices

If your device is undefined, use the User **Defined** Devices screen to define the device or to upload a configuration file specific to your device. This is particularly useful for special, non-standard MultiHop devices.

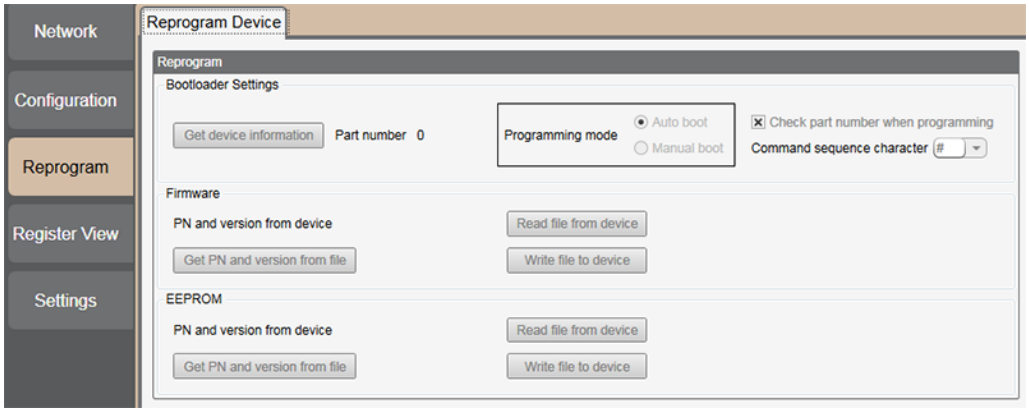


1. Name your new device template. In the example shown, we have named our template TestDevice.
2. Enter the part number of your device and click Add Part Number.
3. If your device includes switch power outputs, select the switch power outputs that are active.
4. Define each input and output type.
5. Click Save File to save the file to your hard drive.
6. Click Load File to load the file to your device.

4 Reprogram Device

Use the Reprogram Device screen to update the firmware and EEPROM files.

Before updating the program files, verify you are using RS-485 to communicate with the MultiHop radio. The Reprogram Device screen only works when the M-Hx models are in RS-485 communication mode. The communication model is selectable using jumpers for the M-H model, but is hardwired to RS-485 for the M-Hx models.



Select Auto Boot to let the configuration tool manage the boot loading process. This is the recommended setting.

Select Manual Boot to require the user to manually perform the beginning of the boot load process. With the device turned off, start the boot load process by clicking Write **file** to device with all the appropriate parameters defined. Turn on the power to the MultiHop device within 15 seconds, and the device should go into boot mode. Manual mode was created to deal with varying startup timing with USB ports.

Select Check part number when programming to have the Configuration Tool automatically verify the firmware or EEPROM file features match the features of your radio. For example, selecting this option allows the Configuration Tool to verify you aren't trying to write the firmware or EEPROM for an I/O radio to a data radio that does not have I/O.

The Command sequence character is the AT command delimiter. Most MultiHop radios require the # character. The % character is used for the DXM Controller I/O board.

To write a new version of the firmware or EEPROM files to the device using Auto Boot mode:

1. Click Write File to Device.
2. Select the new file from your hard drive.
3. A dialogue box pops up to verify you want to overwrite the configuration file already on the data radio. Click on OK to continue or Cancel to cancel the write process.
4. The Communication Status display at the bottom of the screen indicates when the configuration tool has finished writing the file out to the radio. When the status is "Ready," the process is complete. If there are errors during the programming process, use manual mode to update the files.

To write a new version of the firmware or EEPROM files to the selected device using Manual Boot mode:

1. Cycle power to the radio by disconnecting then reconnecting the power to the radio. The firmware version will be read when the radio reboots.
2. After the radio reboots, browse to the firmware file location on your hard drive. Select the appropriate files.
3. Click Write File to Device for the firmware, then click OK on the pop-up box to start the process.
4. Immediately cycle power to the MultiHop radio.
5. Complete the same steps for the EEPROM if necessary.

To save your firmware or EEPROM files to your hard drive using Auto Boot mode:

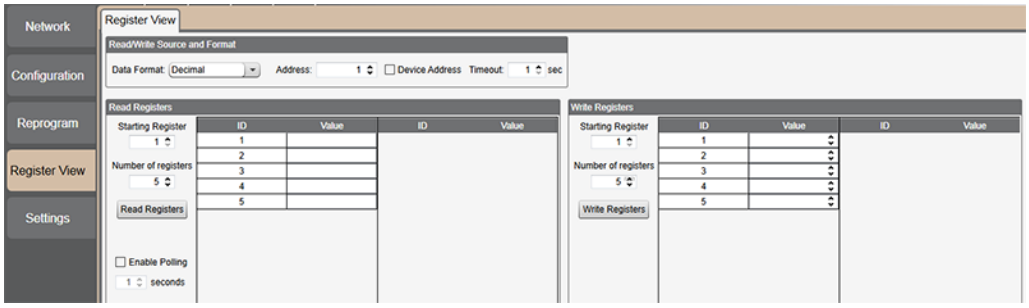
1. Select a location and file name on your computer.

To save your firmware or EEPROM files to your hard drive using Manual Boot mode:

1. Cycle power to the radio by disconnecting then reconnecting the power to the radio. The firmware version will be read when the radio reboots.
2. After the radio reboots, browse to the firmware file location on your hard drive. Select the appropriate files.
3. Click Write File to Device for the firmware, then click OK on the pop-up box to start the process.
4. Immediately cycle power to the MultiHop radio.
5. Complete the same steps for the EEPROM if necessary.

5 Register View

Use the Register View screen to read and write register contents when operating in Modbus mode.



To read registers:

1. Select the MultiHop Radio ID of the desired radio.
2. Under Data Format, select how to display the registers values, either decimal or hexadecimal.
3. Under Read Registers, select the starting register and the number of registers from that starting point to read. In the sample screen shown, register 1 and the 5 following registers will be read and displayed on the screen.
4. Select Enable Polling and enter a polling frequency in seconds.
5. Click Read Registers. The status bar at the bottom of the screen indicates when the process is complete by displaying a communication status of "Ready" and an green "light."

The values stored in the selected registers displays on the screen.

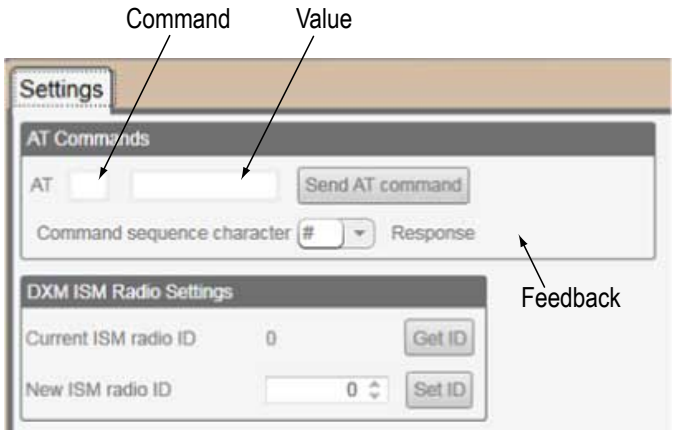
To write registers:

1. Select the MultiHop Radio ID of the desired radio.
2. Under Write Registers, select the starting register and the number of registers from that starting point to read.
3. Enter in the values, in hex, to be written to each register.
4. Click Write Registers to send these changes to the radio. The status bar at the bottom of the screen indicates when the process is complete by displaying a communication status of "Ready" and a green "light."

6 Settings

Use the **Settings** screen to send AT commands to the MultiHop radio when using the RS-485 to USB adapter cable (not over a TCP connection) or to set the ISM radio id of a MultiHop radio within a DXM Controller.

AT Commands are control commands that access system parameters. This feature is only for advanced users. Do not use these commands unless you understand the intended operation.



To send an AT command to the MultiHop radio:

1. Enter the command in the first field, just to the right of the "AT."
2. Enter the value in the second field, near the Send AT command button.
3. Click Send AT command. The status bar at the bottom of the screen indicates "Ready" when the process is complete.

When the AT command was successfully sent to the radio, the feedback field displays OK.

To assign a New ISM radio ID to a MultiHop radio within a DXM Controller, enter the new radio id and click Set ID.

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