

ESERV-M12T
Modbus Gateway
User Manual

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INTRODUCTION

Thank you for purchasing an **ESERV-M12T Modbus Gateway** product! This product has been manufactured to the highest standards of quality and performance to ensure your complete satisfaction.



Figure 1. *An ESERV-M12T Modbus Gateway*

ABOUT ESERV-M12T MODBUS GATEWAYS

ESERV-M12T Modbus Gateways connect Modbus networks (RS-232, RS-422 or RS-485) to Ethernet networks, allowing the Modbus network to become a node on the network. The serial ports can be accessed over a LAN/WAN using Direct IP Mode connections. ESERV-M12T Modbus Gateways feature 10BaseT or 100BaseTX copper network media and fiber optic media options, depending on the model. **ESERV-M12T Modbus Gateways** are built for use in industrial environments, featuring an IP30 approved slim line DIN rail mountable case. They operate from a range of DC power supply voltages and feature pluggable terminal block power connectors. An external power supply, sold separately, is required.

Model Number	Features
ESERV-M12T	2 PORT, TB, DIN, CU ETHERNET
ESERV-M12T-ST	2 PORT, TB, DIN, FIBER, MULTIMODE, ST

ESERV-M12T PRODUCT FEATURES

- Two serial ports with pluggable terminal blocks, single Ethernet port)
- Multi-interface serial ports
- All ports are software selectable as RS-232, RS-422 or RS-485 2- and 4-wire
- Configuration can be done via network or direct serial connection
- Slim line DIN rail mountable case
- Accepts DC power over a wide voltage range
- 10/100 Mbps Ethernet with Auto Selection, Auto MDI/MDIX
- LAN and WAN Communications
- TCP Client or Server operation - configurable
- Firmware Upload for future revisions/upgrades
- Software Support - Windows 2000/2003 Server/XP/Vista x32
- Configuration of Ethernet and serial port settings using Modbus Gateway Manager software

MODBUS GATEWAY MANAGER CONFIGURATION SOFTWARE

The Ethernet Modbus Gateway Manager configuration software enables you to find connected Modbus gateways, configure them, upgrade Modbus gateway firmware, and save/load configuration files. It features a graphical user interface (GUI) that is convenient and easy to use.

ESERV-M12-T MODBUS GATEWAY HARDWARE

ESERV-M12T Modbus Gateways are enclosed in DIN rail mountable enclosures and feature LED indicators, power, Ethernet and serial connectors and a recessed Mode switch.

PACKAGE CHECKLIST

ESERV-M12T Modbus GatewayS are shipped with the following items included:

- ESERV-M12T Modbus Gateway Module
- Quick Start Guide
- CD with User Manual, Quick Start Guide and firmware

ESERV-M12T MODBUS GATEWAYS ENCLOSURES AND MOUNTING

Modules are DIN rail mountable.



Figure 2.

Front View of an ESERV-M12T Modbus Gateway

LED INDICATORS

ESERV-M12T Modbus Gateways have three types of LED indicators: **Ethernet Link LEDs**, a **Ready LED** and **Serial Port LEDs**.



Figure 3. Ready Ethernet Port LED

ETHERNET LINK LED

The **Ethernet Link** LED illuminates (green) if the Ethernet is connected. When the LED is blinking it indicates that there is data traffic on the Ethernet link.

E1 is used to connect to the network.

READY LED

The **Ready** LED (green) blinks if the system is operating correctly, once per second in normal operating conditions, or three times per second in reset, configuration mode, or when loading factory defaults. If the LED is off or steady, it indicates the system is not operating correctly.

SERIAL PORT LEDs

ESERV-M12T Modbus Gateways feature two serial ports. Each serial port has an associated LED. Serial Port LEDs blink (green) when data is being transmitted or received on the serial port. When the LED is On, it indicates the serial port is open.



Figure 4. Serial Port LEDs

MODE SWITCH

A recessed momentary reset switch is located on the top of the enclosure. To activate the switch, insert a small plastic tool through the hole in the enclosure and press lightly.

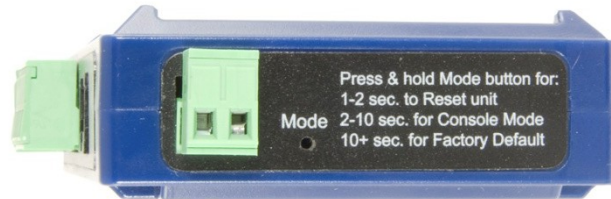


Figure 5. *Mode Switch*

The Mode switch can be used to:

- Initiate a Hardware Reset
- Enter Console Mode
- Reload factory defaults

Note: Refer to Section 3. Modbus Gateway Setup and Connections for more information on using the Mode switch.

ETHERNET CONNECTOR

Modbus gateway models using 10BaseT/100BaseTX network connections use an RJ45 receptacle. The Modbus ESERV-M12T gateway is connected to a standard Ethernet network drop using a straight-through RJ45 (male) Ethernet cable.

Fiber Optic Connectors

The ESERV-M12T-ST uses a multimode fiber optic network connection with ST style connectors.



Figure 6. *ST Connector*

SERIAL PORT CONNECTORS

The ESERV-M12T Modbus Gateway features two serial ports, both using five-position removable terminal blocks for RS-232, RS-422 and RS-485 connections.



Figure 7. *Five-Position Pluggable Terminal Block*

Note: Refer to Appendix D for connection pin-outs.

POWER CONNECTOR

The power connector is a 2-position pluggable terminal block.



Figure 8. *Power Connection*

MOUNTING HARDWARE

ESERV-M12T modules can be DIN rail mounted. The DIN mounting clip and spring is included on each module.



Figure 9. *ESERV-M12T DIN Clips*

MODBUS GATEWAY SETUP AND CONNECTIONS

This section describes how to setup and connect ESERV-M12T Modbus Gateways.

Note: In this section devices to be connected to the Modbus gateway's serial connection are simply referred to as the "Modbus network".

CONNECTING THE POWER SUPPLY

Connect a DC power supply to the power terminals on the top of the Modbus gateway. Polarity of the wires is indicated on the label on the side of the Modbus gateway. Acceptable voltages are between 10 VDC and 58 VDC. The power supply must be capable of supplying 4 Watts for ESERV-M12T units.

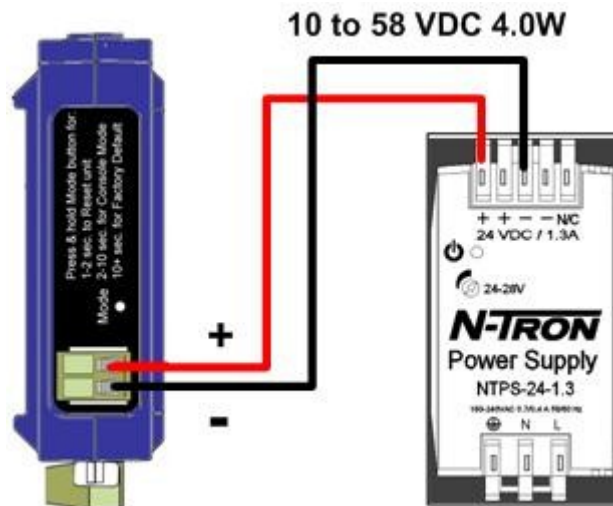


Figure 10. ESERV-M12T Power Connection

CONNECTING ESERV-M12T MODBUS GATEWAYS TO MODBUS NETWORKS

ESERV-M12T Modbus Gateway can be configured to connect to Modbus networks using RS-232, RS-422, RS-485 2-wire and RS-485 4-wire.

RS-232 connections support eight signal lines plus Signal Ground. Signals are single ended and referenced to Ground. Default communications parameters are 9600, 8, N, 1 and no flow control implemented.

RS-422 connections support two signal pairs: RXA(-), RXB(+) and TXA(-), TXA(+), plus GND. The data lines are differential pairs (A & B) in which the B line is positive relative to the A line in the idle (mark) state. Ground provides a common mode reference.

RS-485 connections support 2-wire or 4-wire operation.

When configured for **4-wire operation** the connection supports two signal pairs: RXA(-), RXB(+) and TXA(-), TXA(+), plus GND. This makes full-duplex operation possible. The data lines are differential pairs (A & B) in which the B line is positive relative to the A line in the idle (mark) state. Ground provides a common mode reference.

When configured for **2-wire operation** the connection supports one signal pair: DataB(+) and DataA(-) signal channels using half-duplex operation. The data lines are differential with the Data B line positive relative to Data A in the idle (mark) state. Ground provides a common mode reference.

CONNECTING THE ESERV-M12T

The **ESERV-M12T** has two serial connections that support RS-232, RS-422 and RS-485 (2- and 4-wire). The unit has two connectors, both of which are 5-position terminal blocks. Make the appropriate connections to the terminal blocks to match the serial connection mode you select when configuring the Modbus gateway.

Note: Refer to Appendix D for connector pin out information.

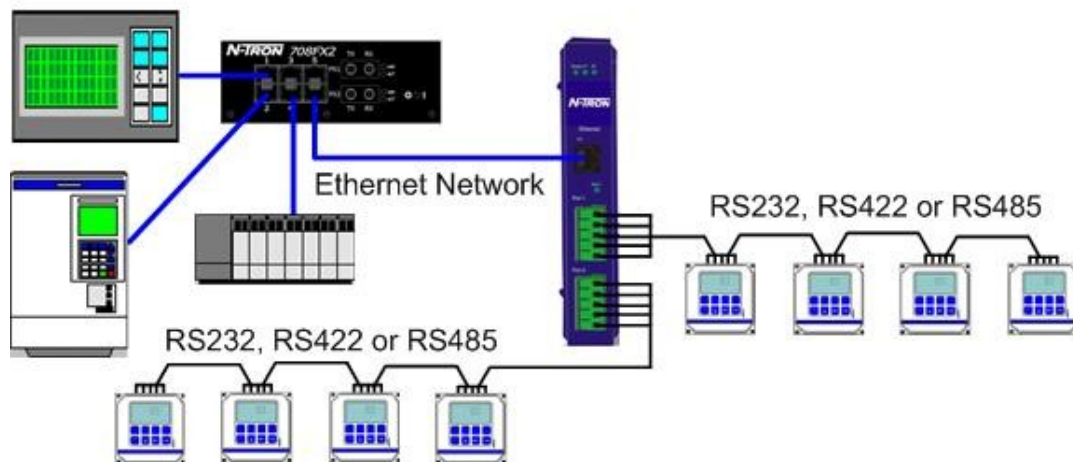


Figure 11.

ESERV-M12T Connections

CONNECTING ESERV-M12T MODBUS GATEWAYS TO A NETWORK

NETWORK CONNECTION (10BASET/100BASETX)

When connecting a Modbus gateway equipped with a 10BaseT/100BaseTX network

connection (RJ45 connector) a standard network cable is connected from the Modbus gateway to a network drop. PCs configuring and/or communicating with the Modbus gateway are also connected to the network.

ESERV-M12T CONFIGURATION CONNECTIONS

ESERV-M12T Modbus Gateways can be configured over the network or via a serial port.

CONFIGURING THE ESERV-M12T MODBUS GATEWAY VIA THE NETWORK CONNECTION

When configuring via the network, either Modbus Gateway Manager software or the web interface can be used.

CONFIGURING WITH MODBUS GATEWAY MANAGER

ESERV-M12T Modbus Gateways can be configured over the network Modbus Gateway Manager software running on a PC.

To open the **Modbus Gateway Manager**:

1. From the Desktop, click Start → Programs → N-TRON → Modbus Gateway Manager → Configuration Manager.

The Modbus Gateway Manager Device Discovery window appears.



Figure 12.

Modbus Gateway Manager Discovery Window

2. Configure your Modbus gateway as required.

Note: For more information on configuration options refer to Section 4: Description of Modbus gateway Properties.

Configuring with the Web Interface

ESERV-M12T Modbus Gateways can be configured over the network using a standard internet browser such as Internet Explorer or Firefox.

To open the web configuration interface:

1. On a PC connected to the network, open a browser.
2. In the browser's address bar, type the IP address of the Modbus gateway.

Note: Your Modbus gateway comes from the factory pre-configured to receive an IP address assignment from a DHCP server. If a DHCP Server is not available on your network, it will default to 169.254.102.39.

The web interface Login page appears.

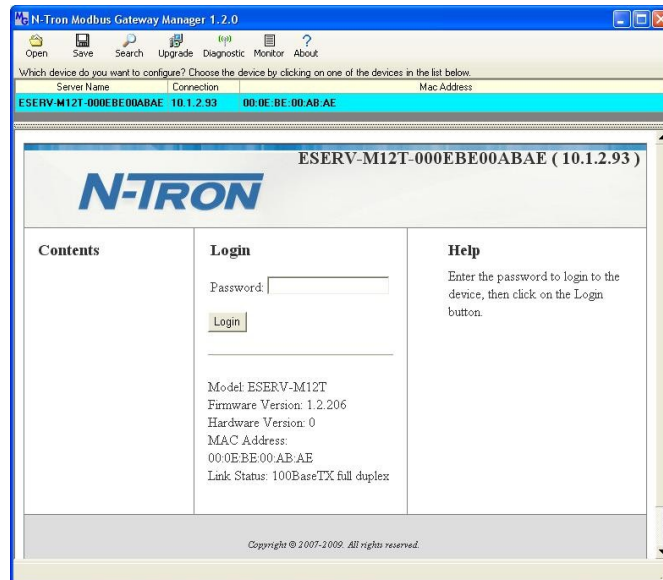


Figure 13.

Modbus Gateway Manager Login Screen

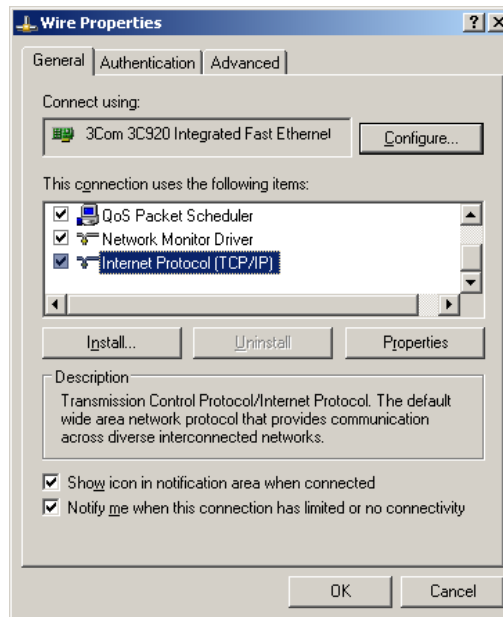
3. Configure your Modbus gateway as required.

Note: For more information on configuration options refer to Section 4: Description of Modbus Gateway Properties.

CONFIGURING THE ESERV-M12T MODBUS GATEWAY ON NETWORKS WITHOUT A DHCP SERVER

Your Modbus Gateway comes from the factory set up to receive an IP assignment from a DHCP Server. If there is not a DHCP server on your network, the Modbus Gateway will default to IP address **169.254.102.39**. If this address does not work with your PC, there are two methods to manually configure the network information.

1. Method 1: Change your PC Network to Match the Modbus Gateway
 - a. Open your network connection

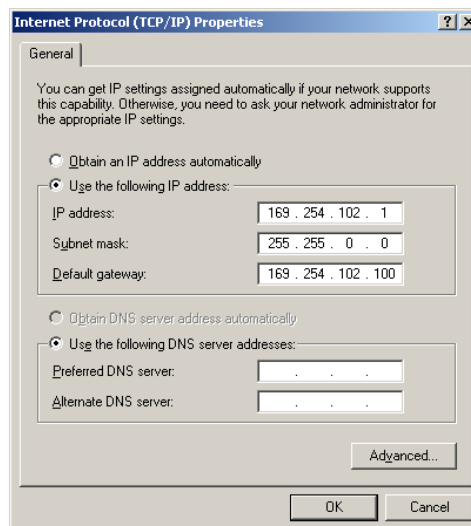


- b. Click on Internet Protocol (TCP/IP) and click <properties>. Change the parameters to the following:

IP Address = 169.254.102.1

Subnet Mask = 255.255.0.0

Default Gateway = 169.254.102.100



- c. Use the Modbus Gateway Manager Software to search for, discover, and configure the Modbus Gateway.

2. Method 2: Change the Modbus Gateway's network settings to match your PC using Console Mode
 - a. Connect a null modem serial cable (crossover cable) from port 1 on the Modbus Gateway to an available COM port on your PC.
 - b. Open Hyper Terminal or similar serial emulation software and connect to the COM port used in step one. Ensure the port is configured to 115,200 baud, 8 data bits, no parity, and 1 stop bit.
 - c. Enter Console Mode. Press and hold the Modbus Gateway's for 2 to 10 seconds. The LED indicators will respond as follows:

Model	Port 1 LED	Port 2 LED	Ready LED
ESERV-M12T	OFF	ON	OFF

- d. Release the reset button. The READY LED will blink once per second for five seconds. This indicates that the Modbus Gateway is re-booting in Console Mode.
- e. When the Modbus Gateway has successfully restarted in Console Mode, the READY LED will be OFF and the PORT 1 LED will be ON.
- f. Open the Ethernet Modbus Manager Software and select "Serial Port" as the method to connect to the Modbus Gateway.
- g. After logging in, click on <Network>.
- h. Un-check the box next to "I Want DHCP to setup the Network."
- i. Re-configure the Modbus Gateway's network settings to something within the range of your PC's network settings. For example:

PC Network Settings

IP Address = 192.168.0.1

Subnet Mask = 255.255.0.0

Default Gateway = 192.168.0.100

Change the Modbus Gateway's network settings to:

IP Address = 192.168.0.50

Subnet Mask = 255.255.0.0

Default Gateway = 192.168.0.100

- j. Save the settings and remove power from the Modbus Gateway.
- k. Re-apply power. Open the Ethernet Modbus Gateway Manager Software and select “Network” as the method to connect to the device.

CONFIGURING THE ESERV-M12T MODBUS GATEWAY VIA THE SERIAL PORT (CONSOLE MODE)

Your Modbus gateway can be configured via a serial port using the Ethernet Modbus Gateway Manager. To use this feature the Modbus gateway's serial port must be connected to the serial port of a PC (using a null modem cable).

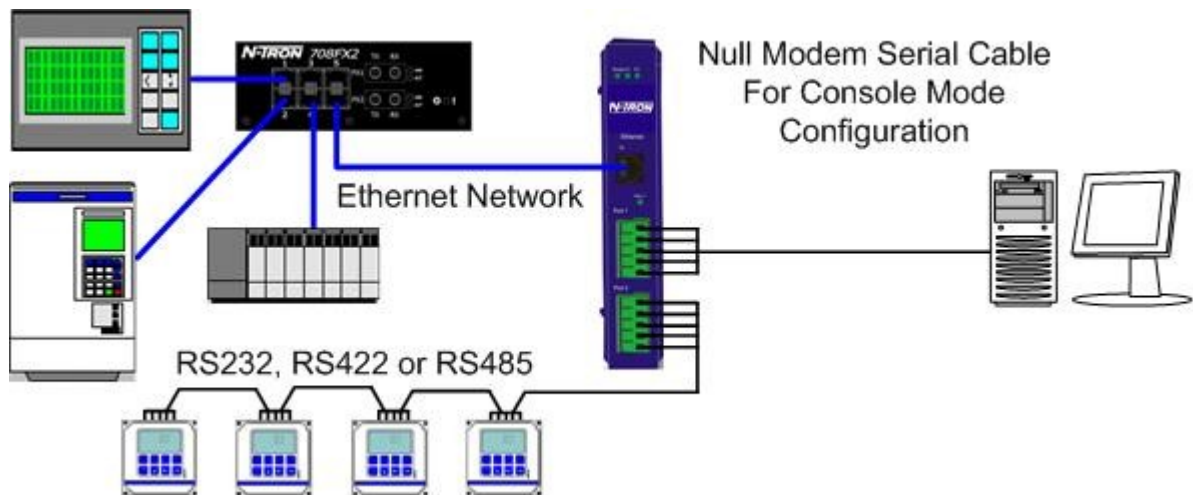


Figure 14.

Console Mode Setup

To configure the Modbus gateway it must be put into Console Mode, using the Mode switch.

To enter Console Mode, press and hold the Mode switch for between two and ten seconds. The LED indicators respond as follows:

1. The Ready LED blinks three times per second while the button is being pressed.
2. The Modbus gateway is in Console Mode when:
 - Port 1 LED on the ESERV-M12T is On and the Port 2 LED is Off.

To configure the Modbus gateway, open the Modbus Gateway Manager software and set up the Modbus gateway's parameters as required.

Note: For more information on configuration options refer to Section 4: Description of Modbus Gateway Properties.

To exit **Console Mode**, press and hold the Reset switch for two seconds, or turn off the power from the ESERV-M12T, wait a few seconds, and turn the power on again.

The LEDs go back to their normal states when the device resumes normal operation.

ESERV-M12T MODBUS GATEWAY OPERATIONAL CONNECTIONS

ESERV-M12T Modbus Gateways can operate in Direct IP Mode.

USING ESERV-M12T MODBUS GATEWAYS IN DIRECT IP MODE

A Direct IP connection allows applications using TCP/IP socket programs to communicate with the COM ports on the Modbus gateway. In this type of application the Modbus gateway is configured as a TCP server. The socket program running on the PC establishes a communication connection with the Modbus gateway. The data is sent directly to and from the serial port on the server.

To set up a Direct IP Mode connection:

1. Connect the Modbus gateway to the network and a Modbus network as described in previous sections.
2. Configure the Modbus gateway with the appropriate network settings (using Modbus Gateway Manager or the web interface).
3. Configure your software application with the appropriate IP address and port number to communicate with the Modbus network(s).

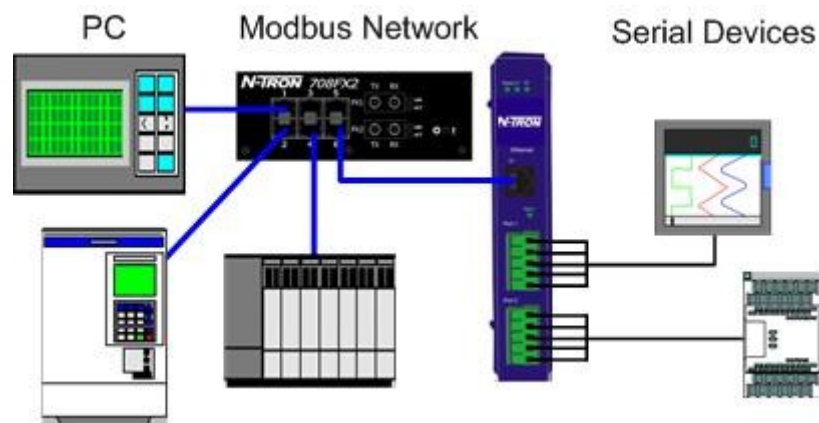


Figure 15.

Direct IP Connection

INITIATING A HARDWARE RESET ON THE MODBUS GATEWAY

To initiate a Hardware Reset on the Modbus gateway, press and hold the Mode switch for 0 to 2 seconds, and then release it. The LED indicators respond as follows:

1. The Ready LED blinks three times per second while the button is being pressed.
2. The Modbus gateway is in Reset Mode when:
 - Port 1 LED on the ESERV-M12T is On and the Port 2 LED is Off.
3. The LEDs go back to their normal states when the device resumes normal operation.

RELOADING FACTORY DEFAULTS

To reload Factory Defaults, press and hold the Mode switch for more than 10 seconds. The LED indicators respond as follows:

1. The Ready LED blinks three times per second while the button is being pressed.
2. The Modbus gateway is in Factory Default Mode when:
 - Port 1 LED on the ESERV-M12T and the Port 2 LED are both On.The Modbus gateway reloads all factory default configuration parameters.
3. The LEDs go back to their normal states when the device resumes normal operation.

Note: Factor default parameters are listed in Appendix A

DESCRIPTION, MODBUS GATEWAY PROPERTIES

The following ESERV-M12T Modbus Gateway properties are ordered alphabetically to assist you in finding the information you need.

ATTACHED

The Attached is selectable between Master and Slaves. If Master is selected, it will run in TCP server mode, if Slaves is selected, it will run in TCP client mode.

BAUD RATE

Baud Rate is the communication speed of the link between the Modbus gateway and the device attached to its serial port. Both these devices must be configured to operate at the same baud rate. Baud rate values range from 75 to 230,400 Baud. (Refer to Appendix B for specific baud rates that are supported.)

CHARACTER TIMEOUT

Character Timeout controls the maximum duration between received characters before sending the characters to the network. Larger values may decrease the number of network packets, but increase the amount of time to receive characters. Smaller values may increase the number of network packets, but decrease the amount of time to receive characters. The range is 1 through 65535.

CONFIGURATION FILES

Configuration files contain all configuration settings for the Modbus gateway. When the Modbus gateway settings have been configured you can save the settings using The Ethernet Modbus Gateway Manager. Existing configuration files can be Opened (from the Ethernet Modbus Gateway Manager), which loads them into the Modbus gateway. This allows the same configuration to be applied to multiple Modbus gateways, or to reload a previously used configuration.

DATA/PARITY/STOP

The number of **Data** bits, type of **Parity** and number of **Stop** bits selected define the serial port parameters at which the Modbus gateway will operate. These parameters must be configured to match the parameters set on the Modbus network connected to the Modbus gateway's serial port.

Data Bits controls the number of bits of data in each character. Options include 5, 6, 7 or 8 data bits.

Parity controls the error checking mode. Options are No Parity, Odd, Even, Mark or Space.

Stop Bits controls the number of bits to indicate the end of a character. Options include 1, 1.5 and 2. (1.5 bits is only valid when 5 data bits is selected, which is rare. The 2 stop bits setting is only valid when 6, 7 or 8 data bits is selected.)

DEFAULT GATEWAY

The **Default Gateway** address sets the default route to remote networks, enabling users to access the Modbus gateway from outside the local network.

DHCP

DHCP (Dynamic Host Configuration Protocol) is a protocol used on special servers that supply IP addresses to network nodes on request.

When DHCP is enabled on the Modbus gateway (factory default), on power up it sends a DHCP request to the DHCP server, which assigns a dynamic IP address, subnet mask, and default server to the Modbus gateway.

When DHCP is disabled (static IP addressing), the IP Address, Subnet and Default Gateway fields must be set manually by entering the appropriate addresses in these fields. If you do not know what addresses to use in these fields, ask your network administrator.

Notes:

A dynamic address assigned by the DHCP server may change if the server loses the Ethernet connection or power is removed. If a device on the network that normally communicates with the Modbus gateway is configured to communicate with a specific IP address of the Modbus gateway, and the IP address has been changed, the device will not be able to communicate with the Modbus gateway. Therefore, disabling DHCP and using a static IP address is recommended. If a DHCP server is not found on the network, the Modbus gateway automatically configures to IP address 169.254.102.39

FIRMWARE VERSION

The **Firmware Version** number (Vx.x.x) indicates the Modbus gateway's currently loaded firmware release. From time to time new firmware is made available and can be uploaded into the Modbus gateway using the Ethernet Modbus Gateway Manager.

HARDWARE VERSION

The **Hardware Version** number of the Modbus gateway hardware is displayed on the Login page of the Ethernet Modbus Gateway Manager.

ID ROUTING

ID routing allows the gateway to manage slave device IDs between various Modbus interfaces. By filling in the user defined slave ID table, a Modbus Gateway routes requests to the correct serial port. One connection can command serial slaves on multiple serial ports.

By filling in the drop down menu of ports with slave devices attached, adding IP addresses of slaves, up to 10 address ranges can be routed.

By default all boxes are unchecked, the drop down menu is set to serial port one, and all fill in boxes are blank.

IP ADDRESS

Software or hardware attempting to access the Modbus gateway via the network must know the **IP Address** of the server. If DHCP is selected, the Modbus gateway requests and receives a dynamic IP address from a DHCP server when it first connects to the network. If DHCP is not selected you must type in a static IP address when configuring Network settings (on the Modbus Gateway Manager Network page). The static IP address remains the same each time the server is powered up or starts/restarts.

ESERV-M12T Modbus gateways come from the factory preset to receive an IP assignment from a DHCP Server. If a DHCP Server is not available on your network, it will default to 169.254.102.39. If you need to change the static IP address and do not know what address to use, consult your network administrator.

LINK STATUS

Link Status of the currently selected Modbus gateway is shown on the Login page of the Ethernet Modbus Gateway Manager. Link status indicates the type of Ethernet connection between the computer and Modbus gateway. It will either display 10BaseT or 100BaseTX in full duplex or half duplex. Link status is dependent on the LAN, switches, hubs used in the LAN topology.

MAC ADDRESS

The **MAC Address** is a hardware level address of the Modbus gateway that cannot be changed. It is assigned in the factory. Every Ethernet device manufactured has its own unique MAC address. The MAC address of each Modbus gateway is printed on the device's label. The MAC address of the currently selected Modbus gateway is also displayed on the Login page of the Ethernet Modbus Gateway Manager.

MODBUS PRIORITY

This allows the gateway to move high priority messages to the front of the serial message buffer. The priority can be based on the originating IP address, the Modbus ID, the Modbus function code, or any combination of the three. Up to five different priorities can be set.

The default will have all the check boxes unchecked and all the fill in boxes blank.

MODBUS SERIAL RETRIES

This is the maximum number of times that the Modbus gateway will retry to send a Modbus message to a Modbus client, before reporting a 0Bh exception if it is selected. This should be limited to between 0 and 5.

MODBUS ASCII

The Modbus ASCII message protocol is a human readable version of the Modbus message, and is one of the three Modbus formats supported by the ESERV-M12T Modbus Gateway.

A major advantage of Modbus ASCII is it allows up to a 1 second gap between bytes. It uses a Longitudinal Redundancy Check (LRC) checksum to verify message accuracy.

MODBUS MESSAGE BUFFERING

The ESERV-M12T has two Modbus serial buffers, one for each serial port. Each will buffer up to 32 Modbus messages. These buffers help ensure messages don't get lost in a data traffic jam, and are part of what makes Modbus such an outstandingly reliable serial protocol.

MODBUS MESSAGE TIMEOUT

Message timeout is supported by the ESERV-M12T. This is the maximum amount of time before a response to a message is expected.

MODBUS RTU MESSAGE

The Modbus RTU message is broken into 4 different parts. The address field, the function code, this is copied directly over from the Modbus TCP message, the data and the error check, a 16 bit cyclic redundancy check or CRC.

MODBUS SERIAL CONTROL

MESSAGE TIMEOUT

The message timeout is the maximum time the gateway allows for a response from the slave device. The default is 1000ms.

CHARACTER TIMEOUT

The character timeout is the maximum time the gateway allows between characters from the slave device, used only in RTU mode. The default is 10ms.

CRC/LRC ERROR CHECK

The CRC/LRC check calculates the CRC/LRC for the message received, and compares this to the CRC/LRC with the message. If not the same the message is rejected.

MESSAGE RETRIES

Message retries is the number of times the gateway resends the message if it gets a character timeout or CRC/LRC error. The default is two.

MODBUS TCP MESSAGE

The Modbus TCP message may be broken up into multiple different TCP frames. The Modbus TCP message contains three main blocks to the Modbus TCP message. The first is the MBAP header. It describes the Modbus message, including the Transaction Identifier, Protocol Identifier, Length and Unit ID. The second part is the Function Code. The third is the Data. The Function Code and Data are the standard Modbus PDU.

MODEL

The **Model** number of the currently selected Modbus gateway is displayed on the Login page of the Ethernet Modbus Gateway Manager.

NETWORK MODE

The network mode is the method used to configure the network parameters. It is either “DHCP” or “Static IP”.

NETWORK PROTOCOLS

Network Protocols available for use on ESERV-M12T Modbus gateways include TCP.

PASSWORD

When you first receive the ESERV-M12T Modbus gateway from the factory the **Password** is blank so that you can initially access the Modbus gateway without entering a value into this field. To ensure security you should create and save a password the first time you configure the Modbus gateway. After a password has been set up it must be entered each time you login to the Ethernet Modbus Gateway manager. The password is used to access the configuration pages from the Ethernet Modbus Gateway Manager Login page and can be changed from the General page.

PORT# ID REMAP

This allows the gateway to remap the Modbus ID to another ID on the serial port. This would be used when there are two identical Modbus serial networks talking to Modbus TCP controllers.

The first box is the starting ID of a range you want to remap; the second box is the last ID of that range. If you are just remapping one ID the second box is not filled in. The third box is the start of the remap range on the serial port. The fourth box will auto fill in based on the range filled in the first 2 boxes. The range must check to make sure it is a valid range, and does not overlap with any of the other ranges set. Up to 5 address ranges can be remapped per port.

The default will have all the check boxes unchecked, and all fill in boxes blank.

SERIAL INTERFACE MODES

Four serial interface modes of operation are:

- RS-232 - Point-to-point serial communications connection used by PC COM ports and many other systems. Capable of baud rates up to 115.2 kbaud over short distances (typically 50 feet).
- RS-422 - Point-to-point communications using a transmit pair and a receive pair. RS-422 can operate at higher speeds and longer distances than RS-232.
- RS-485 2-wire - Similar speed and distance specifications as RS-422 but allows multidrop connections.

- RS-485 4-wire - Similar speed and distance specifications as RS-422 but allows multi-drop and full duplex connections.

Select the appropriate serial interface mode for the type of connection between the Modbus gateway's serial port and the device connected to it.

Note: Refer to the Appendix D for connector and pin-out details.

MODBUS GATEWAY NAME

Modbus Gateway Name is a unique name assigned to the Modbus gateway. It must be a valid hostname as defined by RFC-952 and RFC-1123. The rules are:

- It must consist only of the characters "A" to "Z", "a" to "z", "0" to "9" or "-"
- It can start or end with a letter or a number, but it must not start or end with a "-".
- It must not consist of all numeric values.

GATEWAY SERIAL PORT NUMBER

The **Gateway Serial Port Number** of the currently selected port is shown in this field.

- The ESERV-M12T Modbus Gateways features two serial ports.

SUBNET MASK

The **Subnet Mask** specifies the network mask the Modbus gateway uses when on a subnetted network.

- For a Class A network (IP addresses 0.0.0.0 through 127.255.255.255) the default subnet mask is 255.0.0.0.
- For a Class B network (IP addresses 128.0.0.0 through 191.255.255.255) the default subnet mask is 255.255.0.0
- For a Class C network (IP addresses 192.0.0.0 through 233.255.255.255) the default subnet mask is 255.255.255.0

- For a Class D network (IP addresses 224.0.0.0 through 239.255.255.255) and Class E Networks (IP addresses 240.0.0.0 through 255.255.255.255) the subnet mask is ignored.
- ESERV-M12T Modbus Gateways come from the factory with a default subnet mask value of: 255.255.255.0

TCP (TRANSMISSION CONTROL PROTOCOL)

TCP (Transmission Control Protocol) provides reliable connection-oriented network communication with error checking. In TCP mode the Modbus gateway can be configured as a client or a server.

When the Modbus gateway is configured as a **TCP client** it initiates connections with a server on the network. You must set up the IP address and port number of the server that you want the client (Modbus gateway) to communicate with. You also select whether the Modbus gateway is to connect at power up or only when it receives data from the device connected to its serial port.

When the Modbus gateway is configured as a **TCP server** it waits for connections to be initiated by another network device. You must set up the TCP port number that it will listen to for connections and set the maximum (up to eight) number of simultaneous connections it will accept. You can filter the connections it will accept based on specific IP addresses or ranges of IP addresses that you specify.

UPGRADING THE MODBUS GATEWAY FIRMWARE

Occasionally, updated firmware may become available for your Modbus gateway. The firmware can be upgraded using the Ethernet Modbus Gateway Manager software. The following procedure describes the firmware updating process:

1. Click the **Upgrade** button to open the **Firmware Upgrade** dialog box.

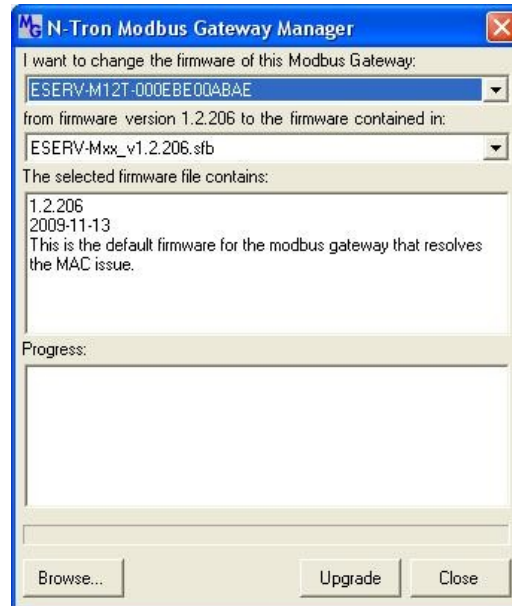


Figure 16. *Firmware Upgrade Dialog Box*

The name of the currently selected Modbus gateway appears in the top drop down list. Other Modbus gateways (that have already been discovered) can be selected from the drop down list, if desired.

The current firmware version of the selected Modbus gateway is shown in the text below the Modbus gateway name.

Information about the selected firmware file is shown in the third text box.

DOWNLOADING FIRMWARE FILES

The **Firmware File** list (second box) displays all firmware files in the firmware installation folder. Only firmware that is compatible with the selected Modbus gateway is available in this list.

To download the latest firmware files from a file:

1. Click the **Browse** button to open an **Open File** dialog box.
2. Browse to the drive and folder containing the firmware file.

3. Select and download the file to the local firmware folder.

UPLOADING THE FIRMWARE TO THE MODBUS GATEWAY

To upgrade the firmware:

1. In the **Modbus Gateway Selection** drop down list, select the Modbus gateway to be upgraded.
2. In the **Firmware Description** drop down list, select the firmware to upload to the Modbus gateway.
3. Click the **Upgrade** button.
Progress Bar and **Progress Box** provides information on the progress of the transfer.
4. In the **Firmware File** drop down list, select the firmware file to upload to the Modbus gateway.
5. Click **Upgrade**.
The Progress box and Progress bar display information on the upgrading process.
6. When the upgrade process is complete, click **Close**.

DIAGNOSTICS

Clicking the **Diagnostics** icon opens the **Diagnostics** dialog box and enables you to check the operation of connected Modbus gateways on the local computer.

The **Computer Information** box displays information about the type of network connections, the IP addresses, Subnet Masks and Default Gateways in use.

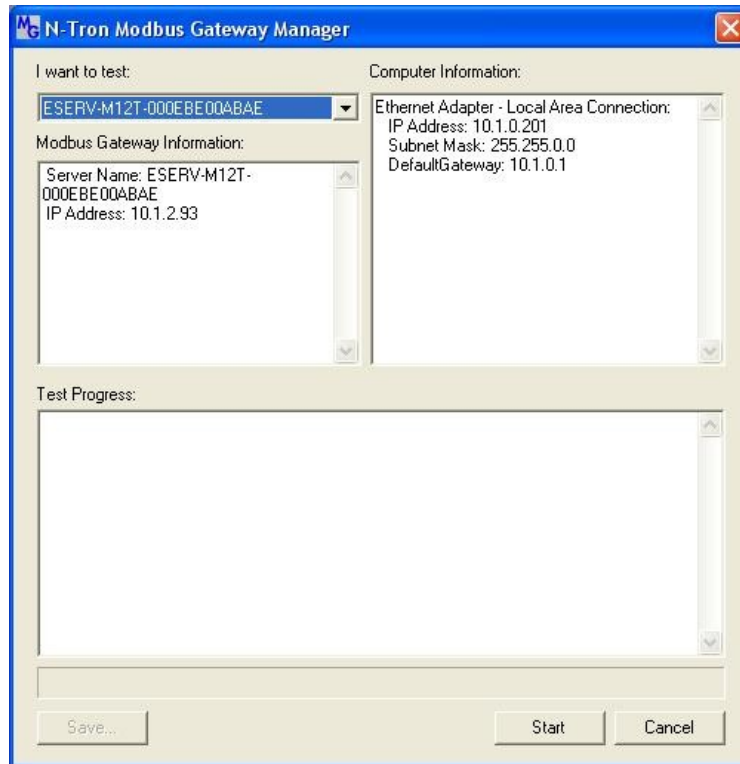


Figure 17.

Diagnostics Dialog Box

TESTING A MODBUS GATEWAY CONNECTION

To run diagnostics on a Modbus gateway:

1. Click the **Diagnostics** icon.
The **Diagnostics** dialog box appears.
2. In the drop down box select the specific Modbus gateway you want to check.
3. Click the **Start** button

Information about the progress of the pinging process is displayed in the **Test Progress** box.

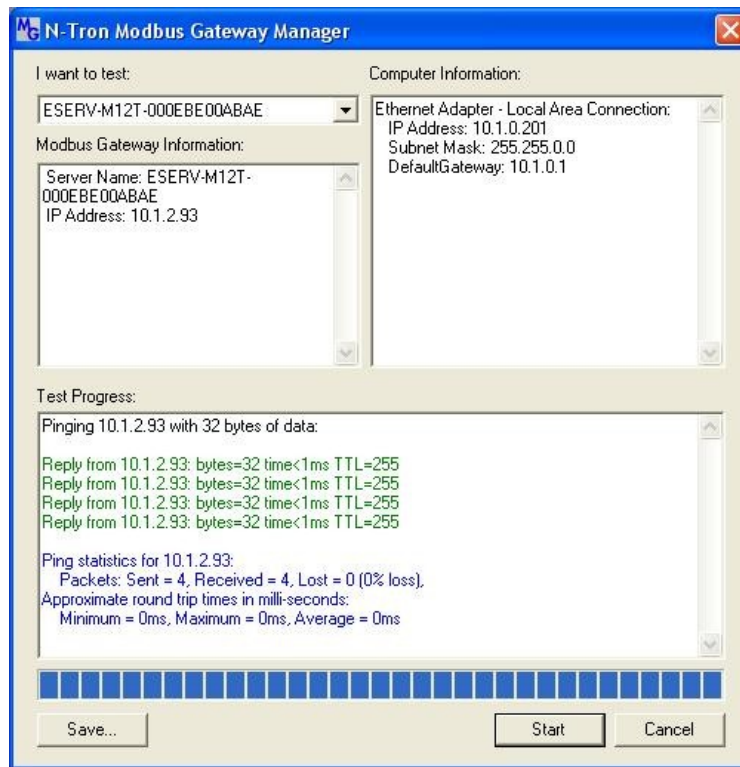


Figure 18.

Testing a Modbus Gateway Connection

APPLICATION EXAMPLES

Modbus gateways can be used to integrate Modbus networks in a wide variety of settings. But as each setting has its own requirements, users may not understand how a gateway helps, or if it's appropriate for their specific needs.

The following scenarios are examples only, and many others are possible. Contact N-TRON technical support for information on other applications.

ETHERNET MASTER AND SERIAL SLAVES

Your Modbus gateway can be used to integrate serial slave devices on a Modbus TCP network. This allows TCP Masters to control serial slave devices. The example below is using a gateway with two serial ports.

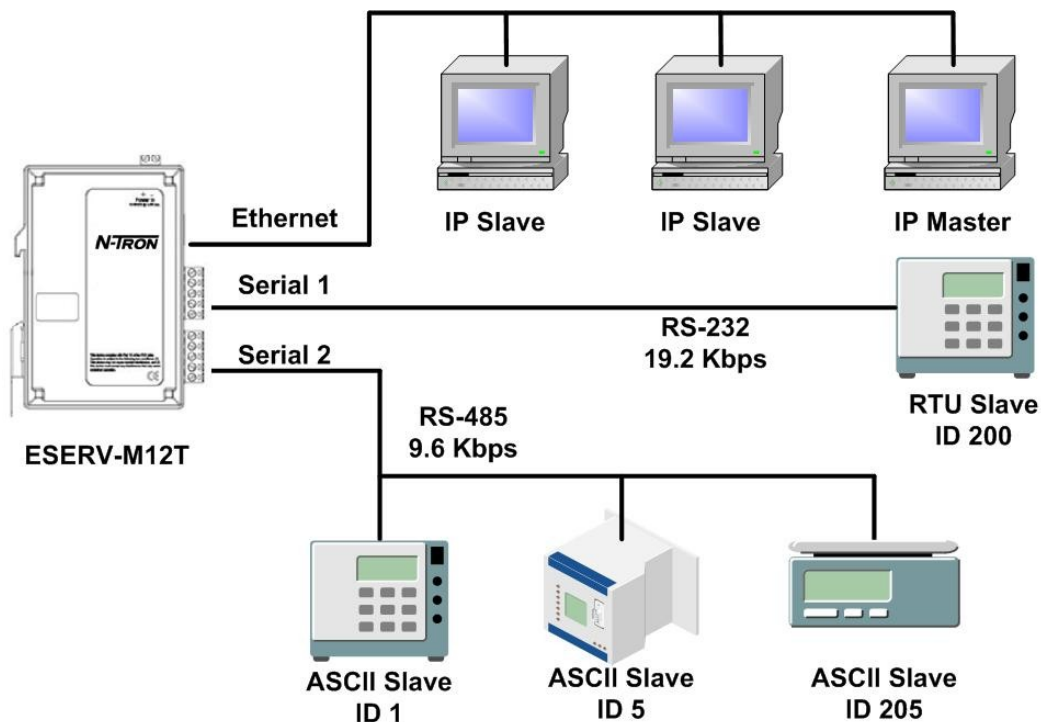


Figure 19.

Ethernet Master With Serial Slaves

1. Log into your gateway.
2. Access the serial port one setup screen by clicking the link on the left side of the screen.

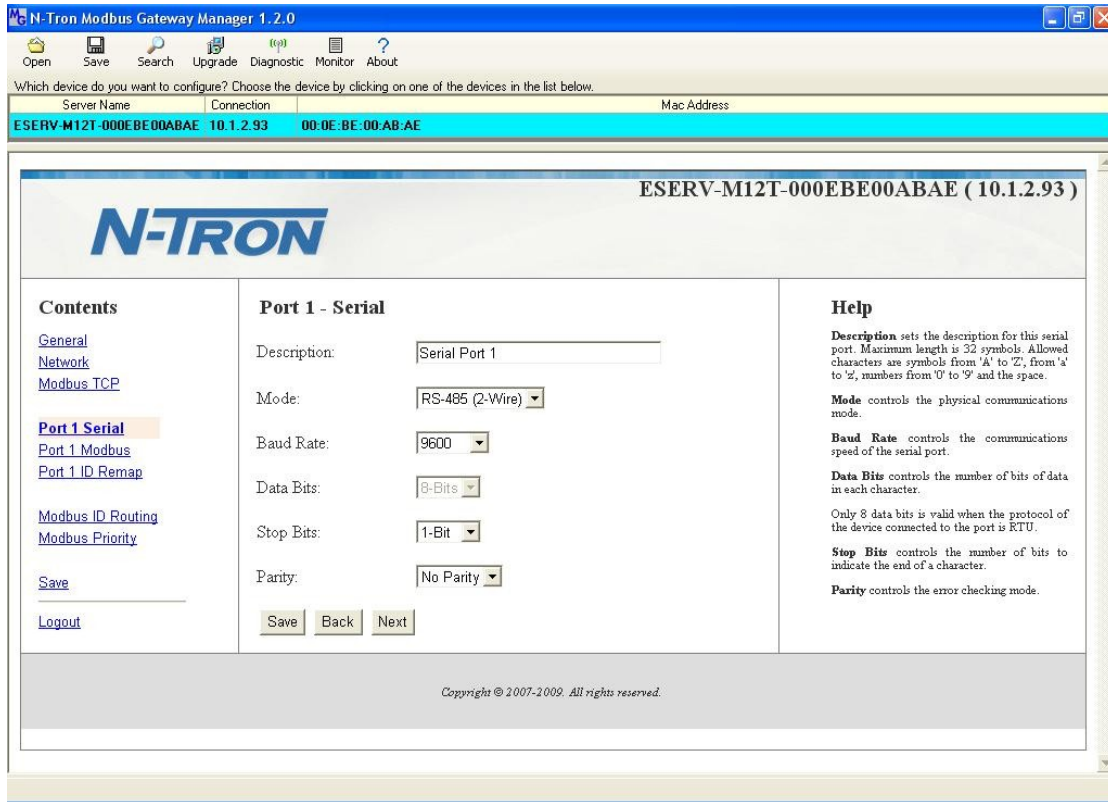


Figure 20.

Serial Port 1 Setup

3. Configure Serial Port 1. In this case it is RS-232, 19.2 kbps, 8 data bits, 1 stop bit, and even parity. Save the settings
4. Access Port 1 Modbus by clicking the link on the left side of the screen.

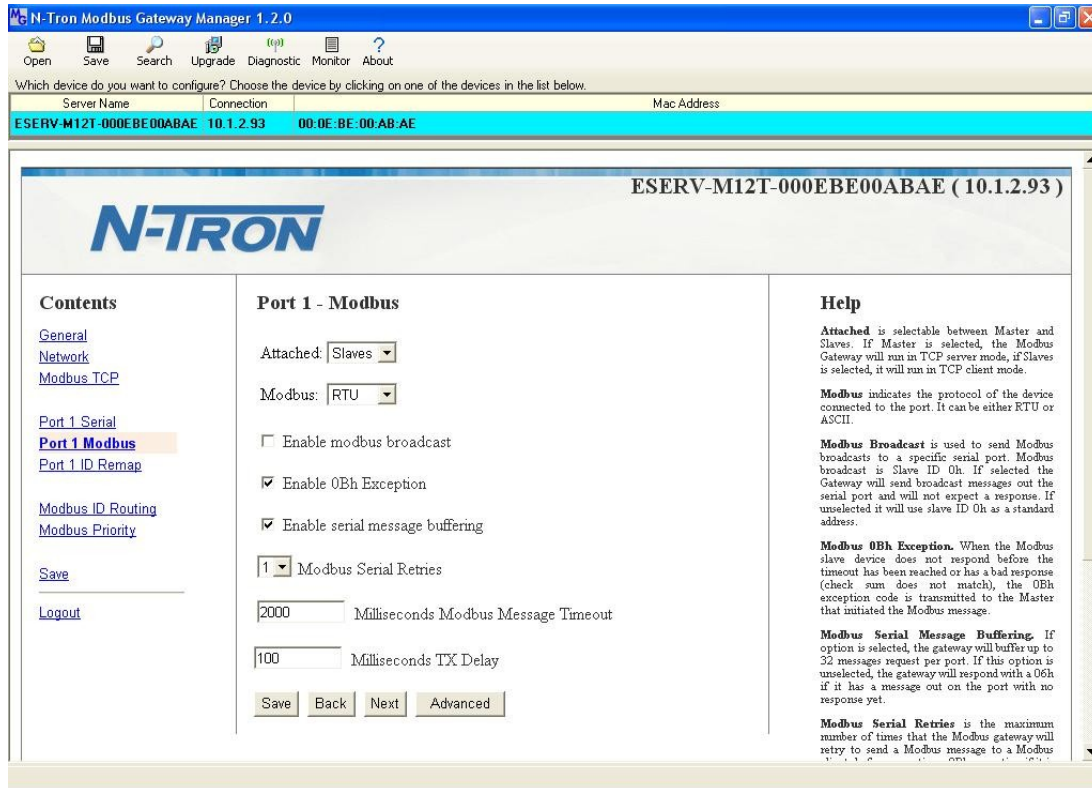


Figure 21.

Port 1 Modbus

5. Configure the Port 1 Modbus Settings. In this case Attached should be slaves, Modbus should be RTU. The other settings depend on your application.
6. Configure Port 2 Serial and Modbus is the same fashion.
7. Access Modbus ID Remapping for each port and configure as necessary.

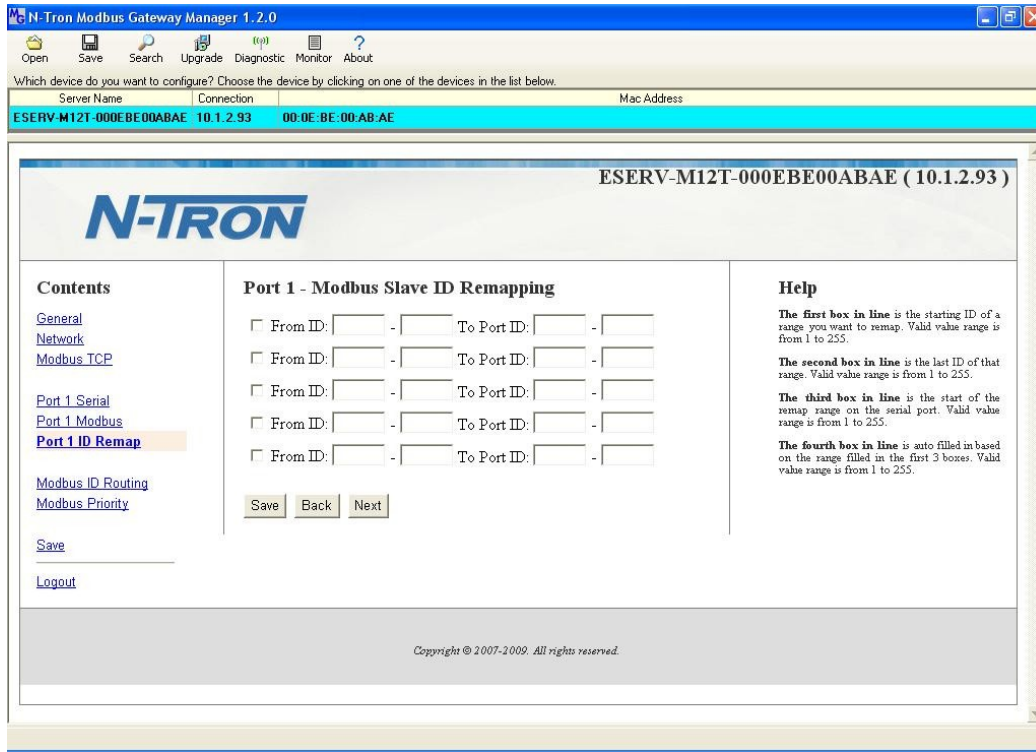


Figure 22.

Port x Modbus Slave ID Remapping

8. Access Modbus ID Routing. Configure as necessary. In this example, Slave ID 200 is mapped to serial port 1, Slave ID 1 through 5 and 205 are mapped to serial port 2.

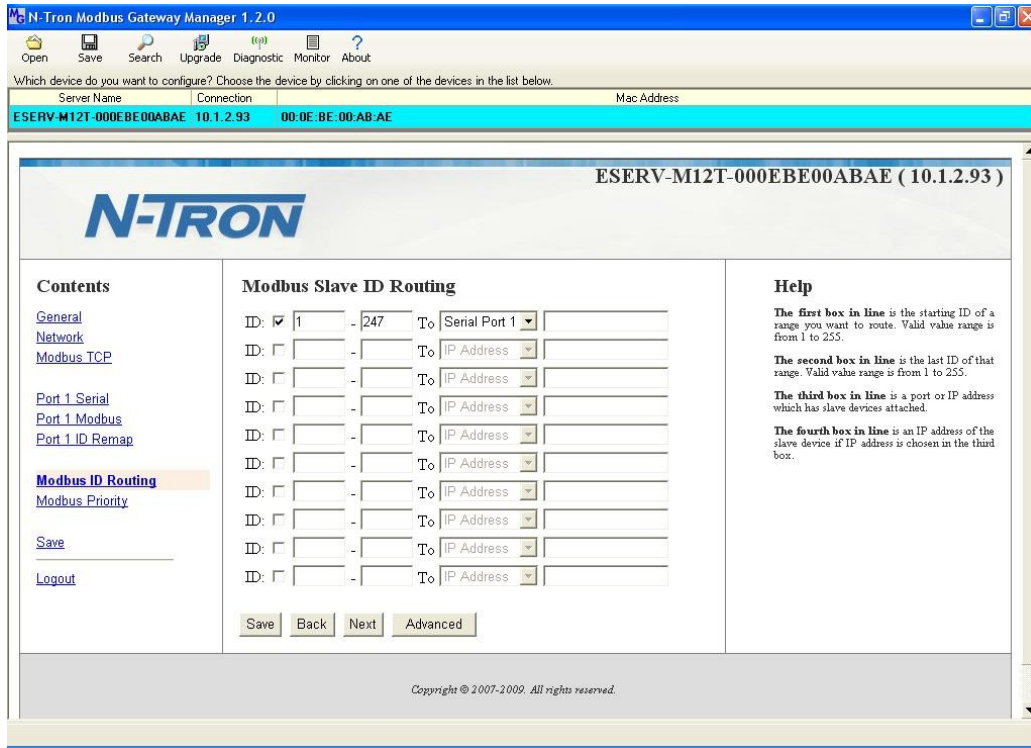


Figure 23.

Modbus ID Routing

9. Access Modbus Priority and configure as necessary.

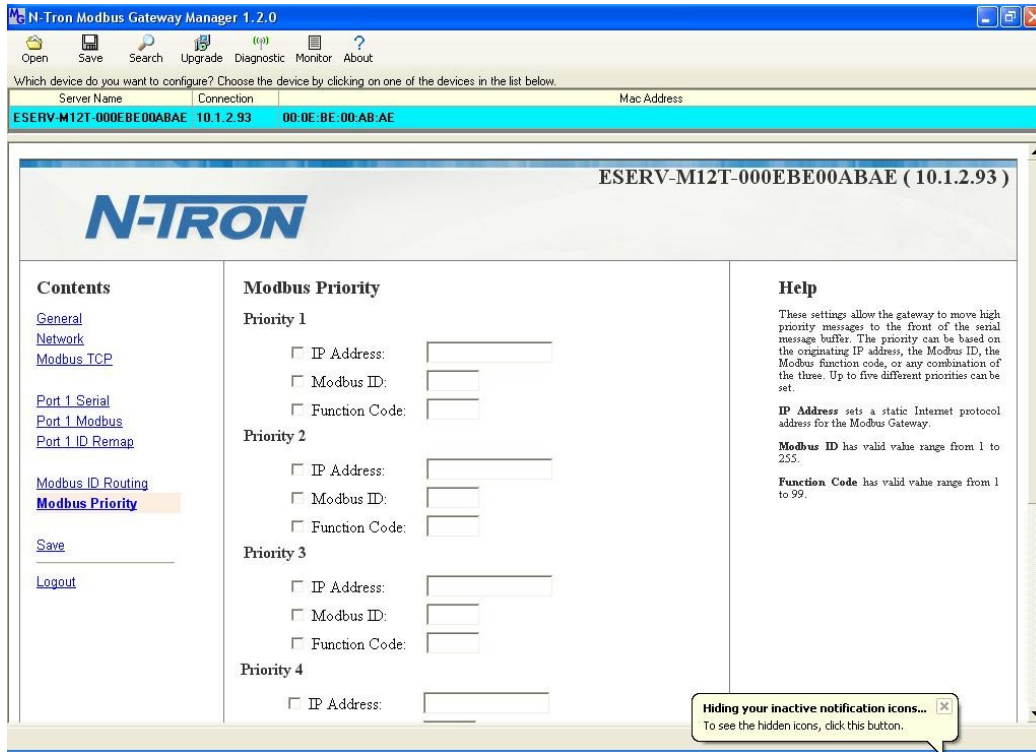


Figure 24.

Modbus Priority

Serial & Ethernet Masters, Serial & Ethernet Slaves

Your Modbus Gateway can also integrate multiple master devices onto serial and Ethernet Networks.

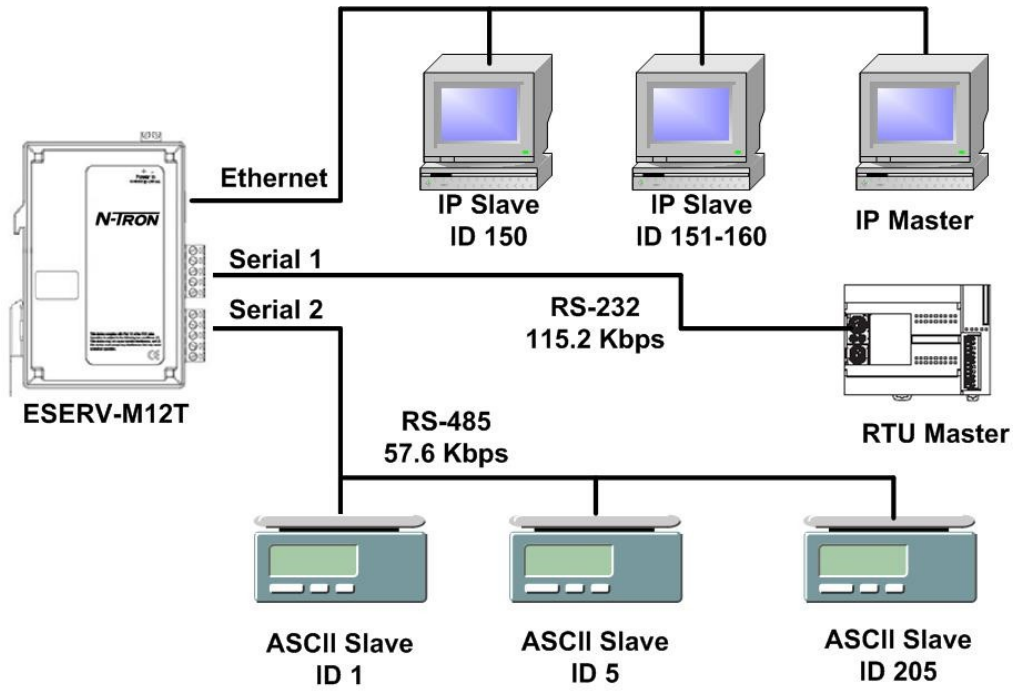


Figure 25.

Serial & Ethernet Masters, Serial & Ethernet Slaves

1. In this example, Serial Port 1 has an RTU Master attached. Configure the serial port settings as appropriate for the device. Access the Port 1 Modbus screen and configure it the port for Modbus Master and RTU.

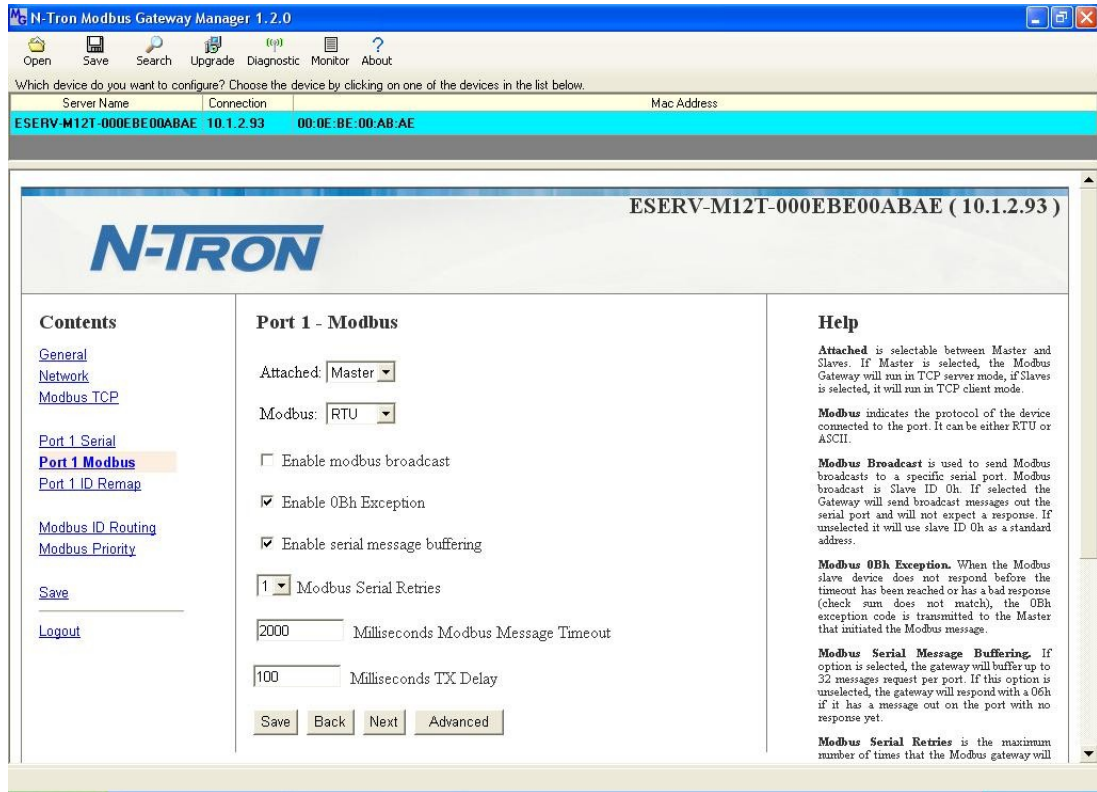


Figure 26.

Port 1 Modbus

2. Configure the Modbus Slave ID routing. In this case Modbus Slaves 1 through 5 and 205 are on Serial Port 2. Modbus Slaves 150 and 151 through 160 have IP assignments.

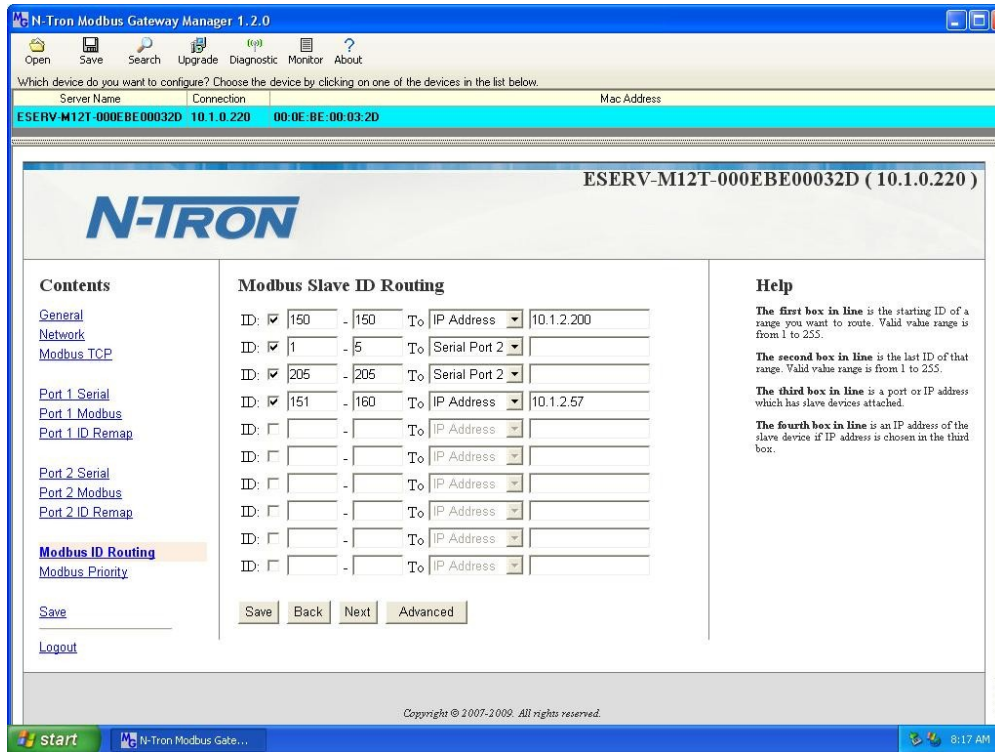


Figure 27. Modbus Slave ID Routing

SERIAL MASTERS, IP SLAVES

Serial Masters can be used to control IP Slaves.

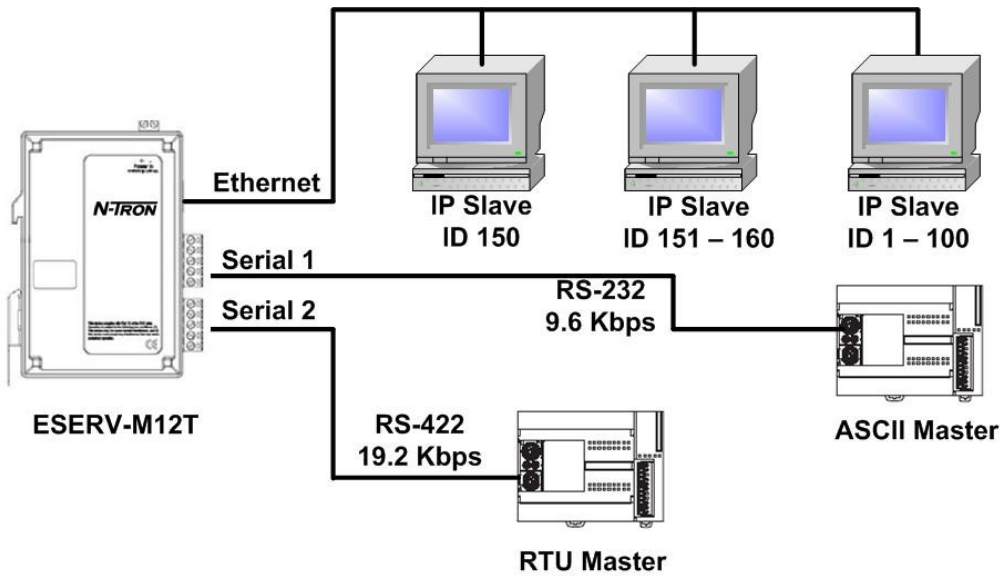


Figure 28. Serial Masters, IP Slaves

1. In this example, an ASCII Master is connected to Serial Port 1 and an RTU Master is connected to Serial Port 2. Configure the serial ports as appropriate for these devices.

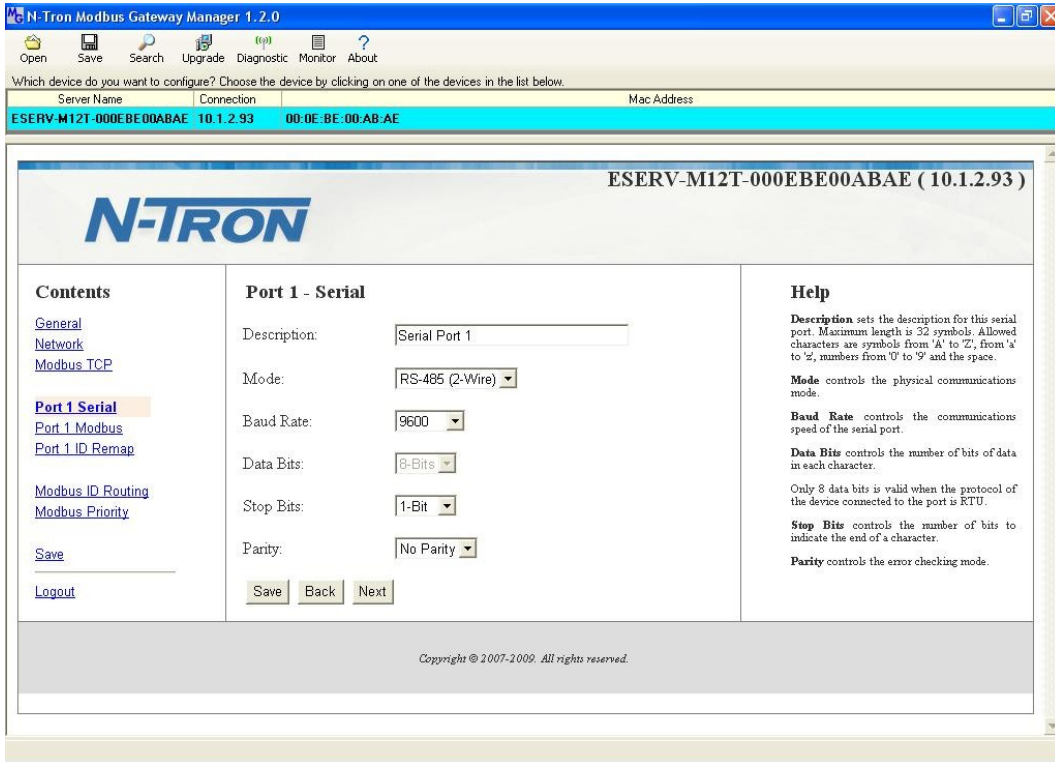


Figure 29.

Port 1 Serial

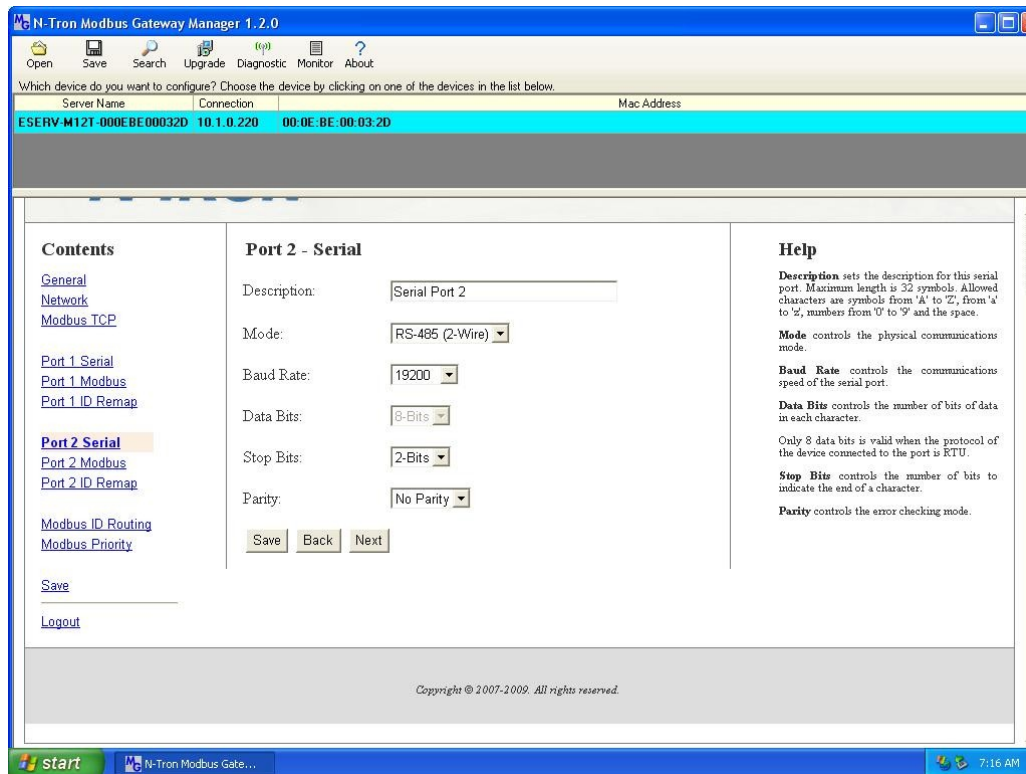


Figure 30.

Port 2 Serial

2. Access the Modbus screen for each port and configure as appropriate. In this case, Port 1 has an ASCII Master and Port 2 has an RTU Master attached.

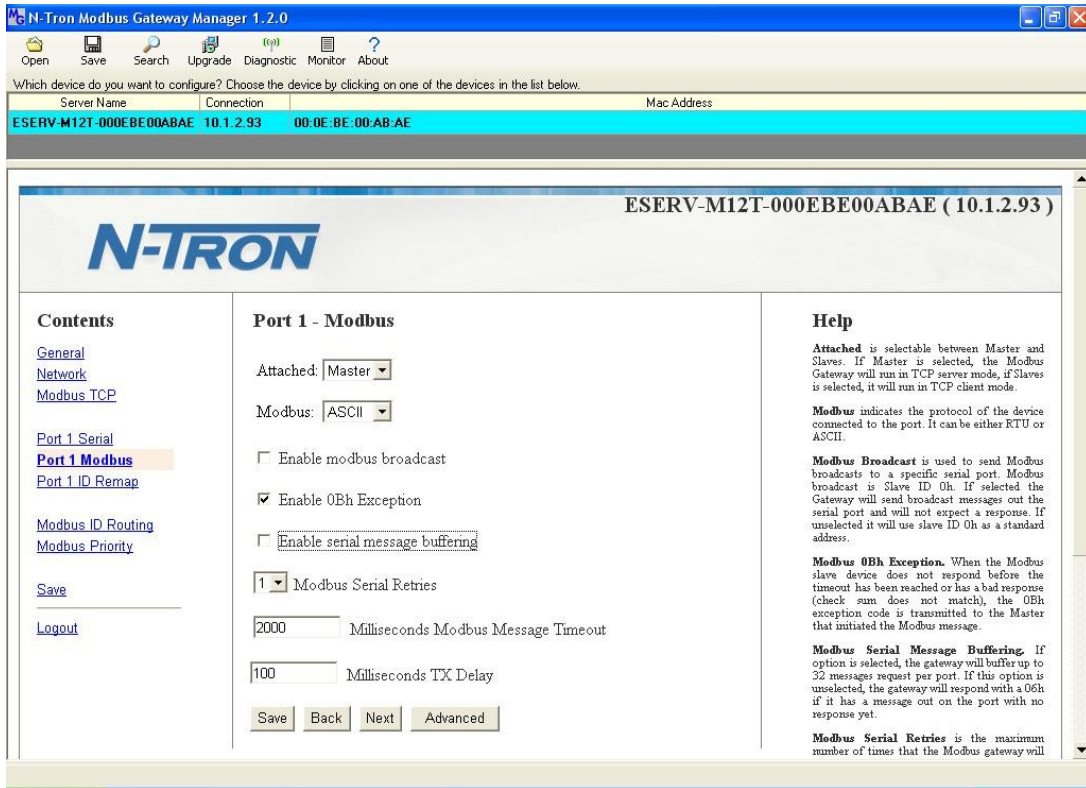


Figure 31.

Port 1 Modbus

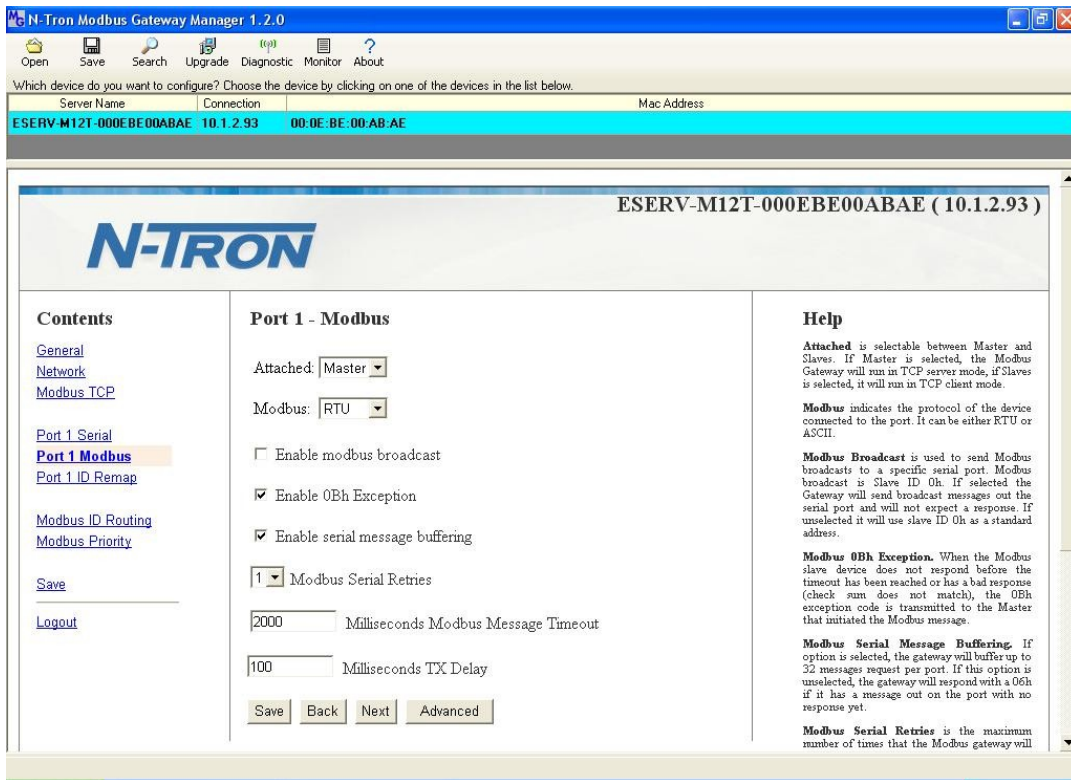


Figure 32. Port 2 Modbus

3. Setup the Slave ID Routing to associate IP addresses with the appropriate Slave ID.

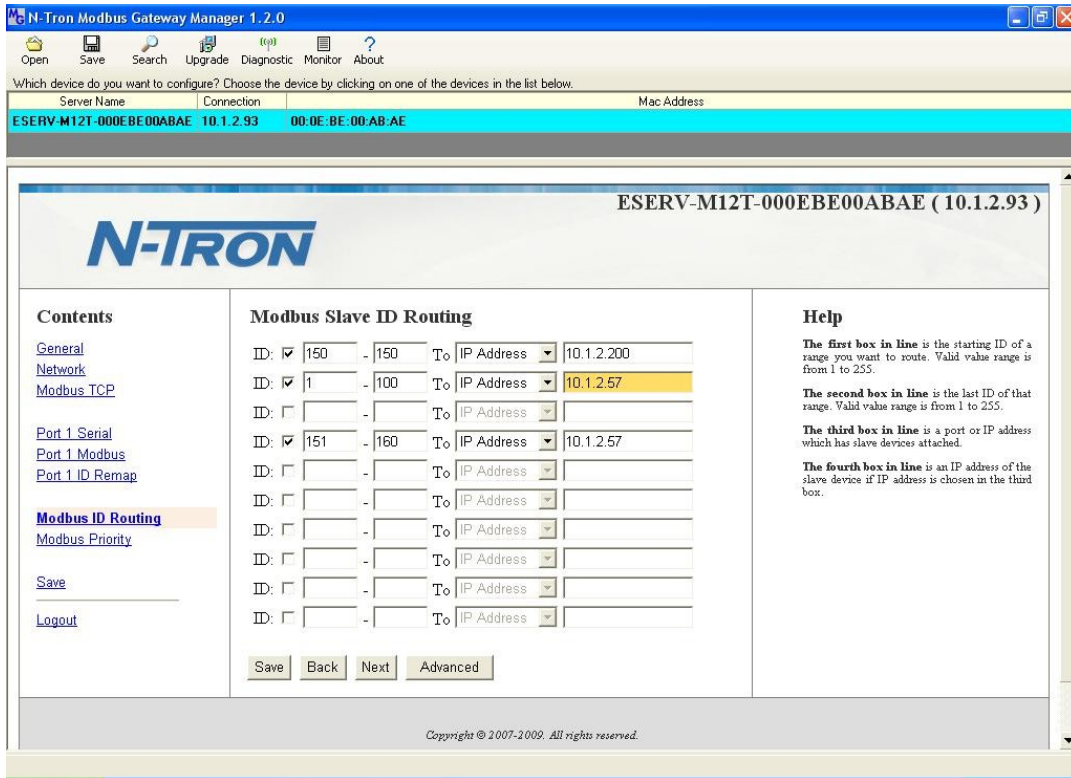


Figure 33.

Modbus Slave ID Routing

IDENTICAL HARD CODED SLAVES

In this example, two slave devices that are hard coded with the same ID are required. This is accomplished by putting them on different serial ports.

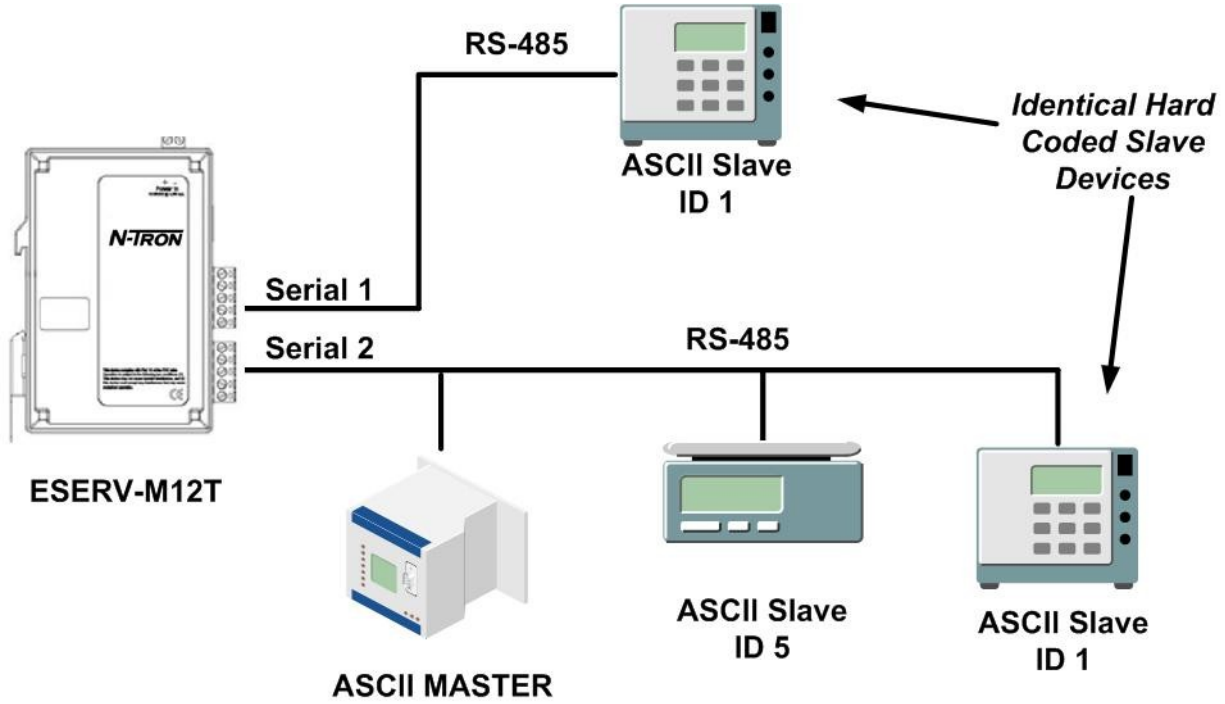


Figure 34.

Identical Hard Coded Slaves

IDENTICAL PRODUCTION LINES

In this example, identical or backup production lines can be controlled by the same IP Master. This allows the duplicate networks to be configured identically, saving documentation and maintenance time.

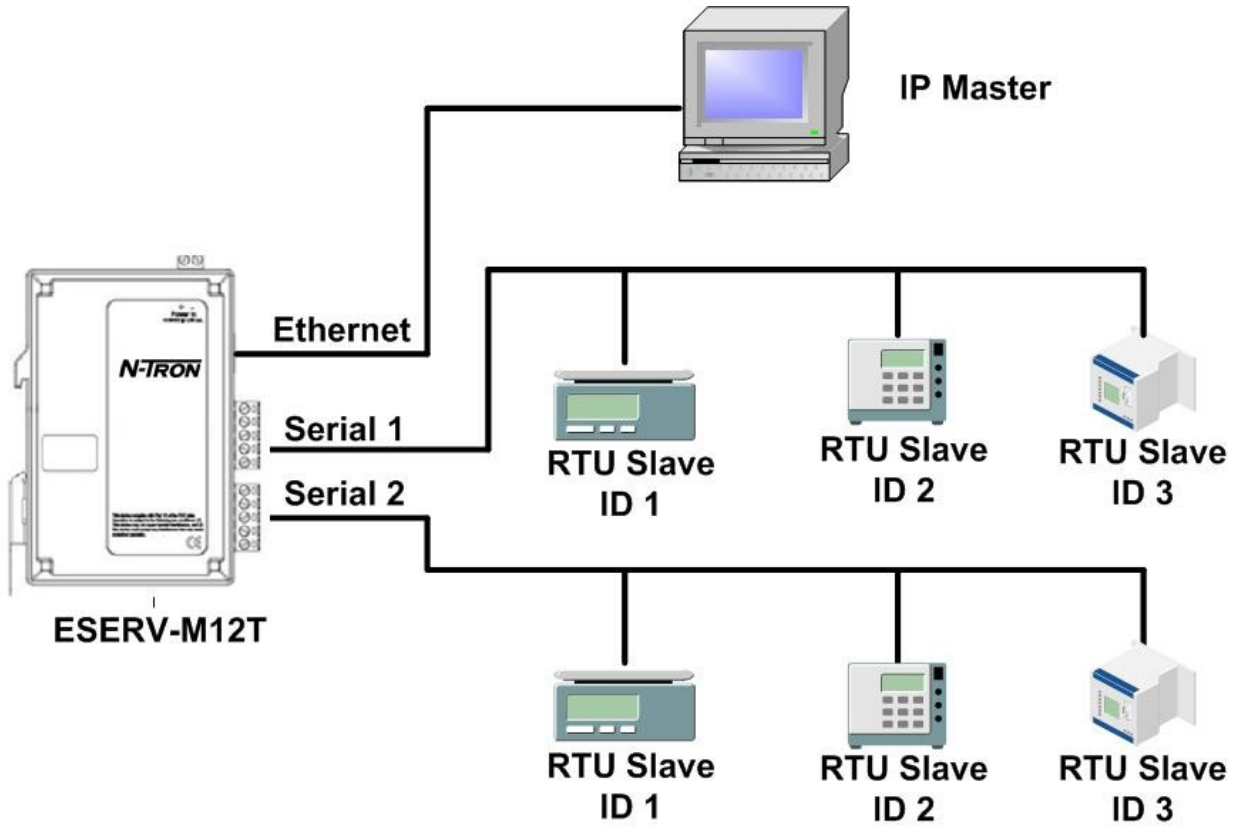


Figure 35.

Identical Production Lines

MODBUS ASCII/RTU BASICS

The Modbus protocol emerged in the mid-1970s as an early protocol for linking terminals with Modicon PLCs using a master/slave (sometimes called a master/client) relationship. A simple, open, message-based protocol, it caught on quickly and became a de facto standard in the industry. It supports asynchronous point-to-point and multidrop communications and can be used with a variety of serial interfaces (RS-232, RS-422, RS-485, modems, etc).

The original Modbus specification included two possible transmission modes: ASCII and RTU. Modbus RTU mode is the most common implementation, using binary coding and CRC error-checking. Modbus ASCII messages, though somewhat more readable because they use ASCII characters, is less efficient and uses less effective LRC error checking. ASCII mode uses ASCII characters to begin and end messages whereas RTU uses time gaps (3.5 character times) of silence for framing. The two modes are incompatible so a device configured for ASCII mode cannot communicate with one using RTU.

All Modbus communications are initiated by Modbus masters using a polling query/response format. The master can send broadcast messages (using a slave address of 0), which all slaves accept, but do not reply to. More commonly the master polls individual slaves sequentially. In each poll it sends a message containing a **device address**, followed by a **function code**, any **data** that maybe required, and an **error check** field. The addressed slave responds with a similar message structure. Typically it repeats back its address and the function code, and then sends a field indicating the number of bytes of data it is sending, followed by the data and the error check field.

Slave addresses can range from 1 to 247. Function codes include several common ones typically used in all applications, and additional ones that may be implemented in specific cases. Common function codes include: Read Coil Status (01), Read Input Status (02), Read Holding Registers (03) and Read Input Registers (04).

When a master sends a message to a slave it expects to receive a valid response within certain length of time. If the slave does not receive the message, or if the slave receives the message but an error is detected, it does not respond. If the slave cannot respond appropriately for some other reason (e.g. it does not recognize the function code), it will return a message containing an exception response.

HINTS AND TIPS

A few simple suggestions that may assist you if your system is experiencing problems include:

- Slowing down the polling rate may be helpful if power cycling doesn't cure the problem.
- A common misperception is that every serial network must terminate with a resistor. While this was true of early serial network configurations, it's typically the wrong answer – call our technical support and verify if you're an exception, at 251-342-2164.

A sometimes difficult problem is difference in grounding voltage between various network locations. Stray voltage from lightning or other sources may also find its way onto the network. These conditions make isolation necessary in many settings.

APPENDICES

This section includes the following Appendices:

- Appendix A: Default Gateway Settings
- Appendix B: Product Specifications
- Appendix C: Dimensional Diagrams
- Appendix D: Connector Pin outs

APPENDIX A: DEFAULT GATEWAY SETTINGS

Setting	Default Value
Gateway Name	TBD
Password	password field is blank from factory
DHCP	Enabled
IP Address	DHCP will configure. If a DHCP Server is not available, the unit will default to 169.254.102.39
Net Mask	255.255.0.0
Gateway	169.254.102.100
MAC Address	Fixed - see bottom label
Firmware Version	(Vx.x.x)
Hardware Version	(Vx.x.x)
Port	1, 2
Serial port mode	RS-232
Baud Rate	9600
Data bits	8
Parity	None, Even, Odd, Mark, Space
Stop bits	1 & 2

Flow Control	None
---------------------	------

Protocol	TCP
-----------------	-----

Serial timeout	0 seconds
-----------------------	-----------

Inter-character timer	0 ms
------------------------------	------

TCP port	Port 1 = 4000 Port 2 = 4001
-----------------	--------------------------------

Max connection	1
-----------------------	---

APPENDIX B: PRODUCT SPECIFICATIONS

This section includes the following specifications:

- General Specifications
- Controls, Indicators and Connector Specifications
- Serial Interface Specifications
- Network Specifications

GENERAL SPECIFICATIONS

Hardware and included accessories	Device	ESErv-M12T Modbus gateway module
	CD	CD with Ethernet Gateway Modbus Manager software for Windows 2000, 2003 Server/XP/Vista x32
Optional Accessories	NTPS-24-1.3 Power Supply	DIN-RAIL Power Supply, 1.3 Amp @24 VDC
Configuration Options	Via serial port	Using Ethernet Modbus Gateway Manager via a serial connection, (press Reset button to enter Console Mode)
	Via network	Using Ethernet Modbus Gateway Manager via a Ethernet connection
		Using a standard web browser such as Internet Explorer 6.0/7.0 or Firefox 1.5/2.0
Software	Modbus Gateway Manager for Modbus gateway configuration	Windows 2000, 2003 Server, XP, & Vista x32
Environment	Operating Temperature	-34 to 80 °C (-29 to 176 °F)
	Storage Temperature	-40 to 85 °C (-40 to 185 °F)
	Operating Humidity	10 to 90% non-condensing
Certifications	FCC	Part 15 Class A
	CE	CISPR (EN55022) Class A
		EN61000-6-1 Generic Standards for Residential, Commercial & Light Industrial

		EN61000-4-2 to 11 ESD, RFI, EFT, Surge, and CI
	UL	508
Enclosure	Rating	IP30
	Mounting	DIN rail mount (35 mm)
	Dimensions, Small Case	1.2 in x 3.3 x 4.7 in (3.1 x 8.4 x 11.9 cm)
Power Supply (External Supply Required)	Voltage Requirements	10 to 58 VDC
	Power Consumption	ESErv-M12T – 4.0W (Max)

CONTROLS, INDICATORS AND CONNECTOR SPECIFICATIONS

Switches	Reset button	<p>Hold in for 0 to 2 seconds for hardware reset</p> <p>Hold in for 2 to 10 seconds for Console Mode (Do a hardware reset or recycle power to exit Console Mode)</p> <p>Hold in for more than 10 seconds to reset to factory defaults</p>
Indicators	Serial LED (one per port)	<p>Color = Green</p> <p>On = Port open</p> <p>Blink = Data traffic</p>
	Link LED	<p>Color = Green</p> <p>On = 100BaseTX</p> <p>Off = 10BaseT</p> <p>Blink = Data traffic</p>
	Ready LED	<p>Color = Green</p> <p>Blink (once per second) = System OK</p> <p>Off = System NOT OK</p>
Connectors	10BaseT/100BaseTX Ethernet	Single RJ-45F (8 pin)
	ST fiber	ST connector
	Serial	Two pluggable lockable 5.08 mm terminal blocks
	DC Power	5.08mm 2-position pluggable, lockable terminal block

SERIAL INTERFACE SPECIFICATIONS

Mode Selection	RS-232/422/485 software selectable
RS-232 lines	TXD, RXD, RTS, CTS, DTR, DSR, DCD, GND
RS-422 lines	TXDA(-), TXDB(+), RXDA(-), RXDB(+), GND
RS-485 lines (2 wire)	Data A(-), Data B(+), GND
RS-485 lines (4 wire)	TXDA(-), TXDB(+), RXDA(-), RXDB(+), GND
Baud Rates	75, 150, 300, 600, 1200, 2400, 4800, 7200, 9600, 14400, 19200, 28800, 38400, 57600, 115200, 230400
Data Bits	5, 6, 7, 8
Parity	None, even, odd, mark, space
Stop bits	1, 1.5, 2
Flow control	None, RTS/CTS, XON/XOFF
RS-422/485 biasing	Auto 4.7K ohm pullups and pulldowns
RS-422/485 termination	Auto termination with thru hole resistor (user supplied)
RS-485 data control	Auto control via MCU

FIBER INTERFACE SPECIFICATIONS

Fiber Interface	Fiber Mode	Multimode
	Range	2km
	Cable	62.5/125µm
	Connector	ST
	TX Power Min	-19 dBm
	RX Sensitivity Max	-32 dBm
	Wavelength	1310 nm

NETWORK SPECIFICATIONS		
Memory	Serial Memory	10 K bytes per port
	Network Memory	10 K bytes
I/P Port Addresses	5300	Configuration setting in TCP Mode
	8888	ESERV-M12T update
Network Communications	LAN	10/100 Mbps Auto-detecting 10BaseT or 100BaseTX
Network Physical Layer Standards	Ethernet	IEEE 802.3 auto-detecting & auto MDI/MDX 10BaseT and 100BaseTX
Protocols Supported		TCP, IPv4, ARP, Telnet, HTTP 1.0, ICMP/PING, DHCP/BOOTP
	IP Mode	Static, DHCP or Auto IP
Connection Modes	TCP	User definable
		Server, Client,
Search		Serial direct COM and Ethernet auto search or specific IP
Firmware Upgrade		Via serial, Ethernet or auto web search
Character count		0 to 65535
Timeouts	Character	0 to 65535 ms, default set at 10 ms
	Modbus Message	0 to 65535 ms, default set at 1,000 ms
	Serial	0 to 65535 sec

APPENDIX C: DIMENSIONAL DIAGRAMS

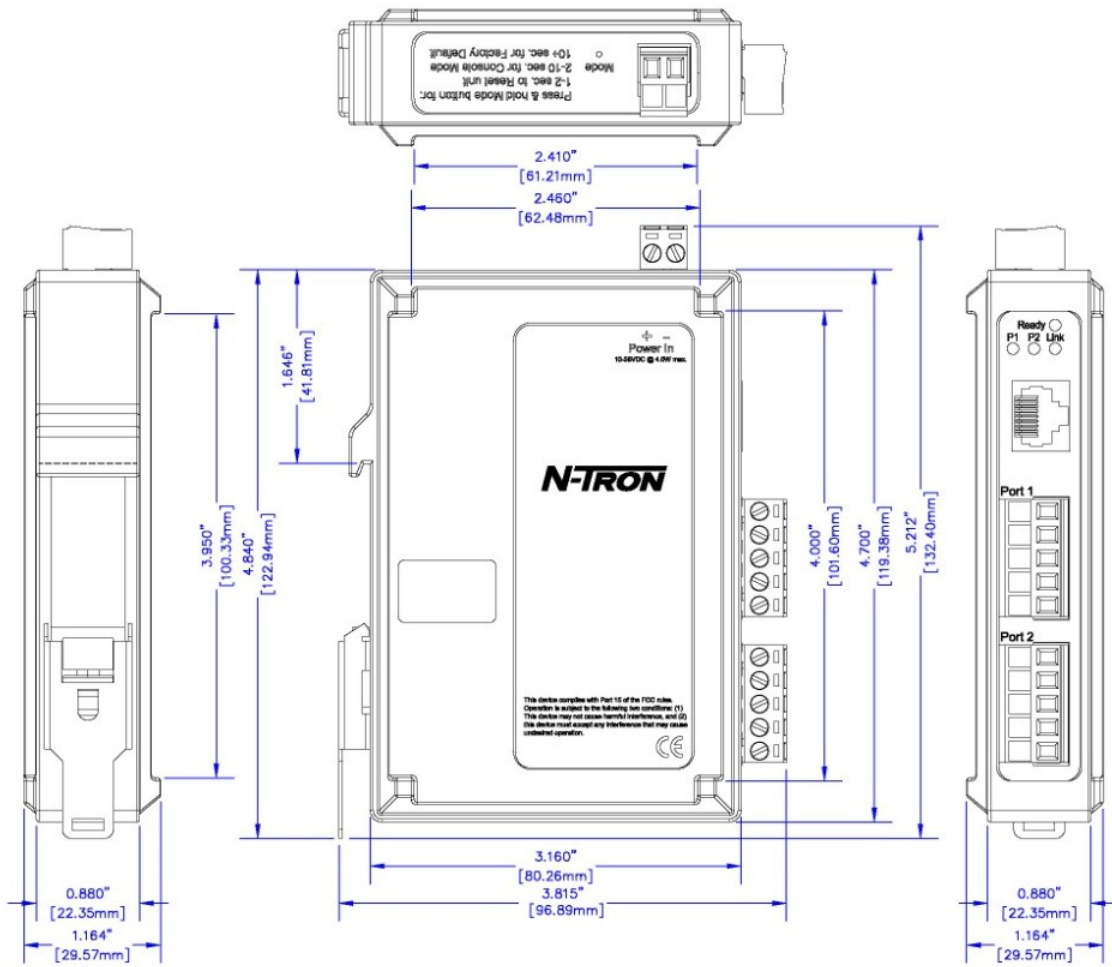
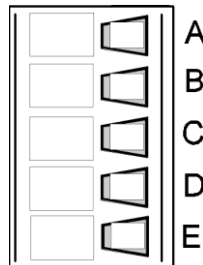


Figure 36.

Dimensional Diagram of an ESERV-M12T Modbus

APPENDIX D: CONNECTOR PINOUT

ESEPV-M12T SERIAL PORT PINOUTS

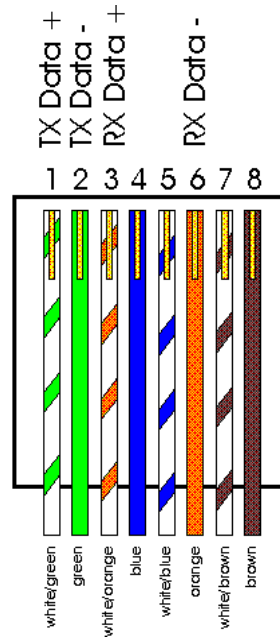


Terminal	RS-232	RS-422/RS-485 4-Wire	RS-485 2-Wire
A	RTS (Output)	TXA(-)	DATA A(-)
B	TD (Output)	TXB(+)	DATA B(+)
C	CTS (Input)	RXA(-)	---
D	RD (Input)	RXB(+)	---
E	GND	GND	GND

In the RS-422 mode, TX lines are outputs and RX lines are inputs. Connect the Modbus gateway TXB(+) line to the RXB(+) line of the Modbus network, and the Modbus gateway TXA(-) to the RXA(-) of the Modbus network.

Ground is signal ground and provides a common mode reference for the RS-422 Receiver and Transmitters.

STANDARD ETHERNET CABLE RJ-45 PIN-OUT



RJ-45 Pin	Signal	Wire Color
1	TX+	White-Green
2	TX+	Green
3	RX+	White-Orange
4	Not used	Blue
5	Not used	White-Blue
6	RX-	Orange
7	Not used	White-Brown
8	Not used	Brown

GLOSSARY

Term	Definition
ADU	Application Data Unit
ASCII	American Standard Code for Information Interchange
Baud Rate	Number of bits per second
CRC	Cyclical Redundancy Checking
Data Bits	Number of bits per byte, normally 7 with Modbus ASCII, and 8 with Modbus RTU
DHCP	Dynamic Host Configuration Protocol
Flow Control	The process of managing the rate of data transmission between two nodes.
Function Code	A code field that tells the Gateway what kind of action to perform
Modbus Gateway	A bridge to get from Modbus TCP to Modbus Serial
GUI	Graphical User Interface
IP	Internet Protocol
IPv4	Internet Protocol version 4
LED	Light emitting diode. Used as a visual indicator
MBAP	MODBUS Application Protocol
MEI	Multi Electrical Interface via RS-232/422/485
Modbus	A request/reply protocol and offers services specified by function codes.
Parity Bit	A binary digit that is added to ensure that the number of bits with value of one in a given set of bits is always even or odd. It may also be a Mark (1), or a Space (0).
PDU	Protocol Data Unit
RS-232	Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
RS-422	Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Point to Point Systems
RS-485	Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems
RTU	Remote Terminal Unit

Term	Definition
Stop Bit	Number of bit times after a character is transmitted before the next character can start transmission.
TCP	Transmission Control Protocol
Unit ID	Unit Identifier. This is the same as the slaves address.

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Mobile, AL 36609 USA

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Warning

Do not perform any services on the unit unless qualified to do so.

Do not substitute unauthorized parts or make unauthorized modifications to the unit.

Do not operate the unit with the top cover removed, as this could create a shock or fire hazard.

Do not operate the equipment in a manner not specified by this manual.

GENERAL SAFETY WARNINGS

WARNING: If the equipment is used in a manner not specified by N-Tron Corp., the protection provided by the equipment may be impaired.

Contact Information

N-Tron Corp.
820 South University Blvd.
Suite 4E
Mobile, AL 36609
TEL: (251) 342-2164
FAX: (251) 342-6353
WEBSITE: www.n-tron.com
E-MAIL: N-TRON_Support@n-tron.com

ENVIRONMENTAL SAFETY

WARNING: Disconnect the power and allow to cool 5 minutes before touching.

ELECTRICAL SAFETY

WARNING: Disconnect the power cable before removing the top cover.

WARNING: Do not operate the unit with any cover removed.

WARNING: Do not work on equipment or cables during periods of lightning activity.

WARNING: Do not perform any services on the unit unless qualified to do so.

WARNING: Do not block the air vents.

WARNING: Observe proper DC Voltage polarity when installing power input cables. Reversing voltage polarity can cause permanent damage to the unit and void the warranty.

WARNING

Never install or work on electrical equipment or cabling during periods of lightning activity.
Never connect or disconnect power when hazardous gasses are present.

UNPACKING

Remove all the equipment from the packaging, and store the packaging in a safe place. File any damage claims with the carrier.

N-TRON LIMITED WARRANTY

N-TRON, Corp. warrants to the end user that this hardware product will be free from defects in workmanship and materials, under normal use and service, for the applicable warranty period from the date of purchase from N-TRON or its authorized reseller. If a product does not operate as warranted during the applicable warranty period, N-TRON shall, at its option and expense, repair the defective product or part, deliver to customer an equivalent product or part to replace the defective item, or refund to customer the purchase price paid for the defective product. All products that are replaced will become the property of N-TRON. Replacement products may be new or reconditioned. Any replaced or repaired product or part has a ninety (90) day warranty or the remainder of the initial warranty period, whichever is longer. N-TRON shall not be responsible for any custom software or firmware, configuration information, or memory data of customer contained in, stored on, or integrated with any products returned to N-TRON pursuant to any warranty.

OBTAINING WARRANTY SERVICE: Customer must contact N-TRON within the applicable warranty period to obtain warranty service authorization. Dated proof of purchase from N-TRON or its authorized reseller may be required. Products returned to N-TRON must be pre-authorized by N-TRON with a Return Material Authorization (RMA) number marked on the outside of the package, and sent prepaid and packaged appropriately for safe shipment. Responsibility for loss or damage does not transfer to N-TRON until the returned item is received by N-TRON. The repaired or replaced item will be shipped to the customer, at N-TRON's expense, not later than thirty (30) days after N-TRON receives the product. N-TRON shall not be responsible for any software, firmware, information, or memory data of customer contained in, stored on, or integrated with any products returned to N-TRON for repair, whether under warranty or not.

ADVANCE REPLACEMENT OPTION: Upon registration, this product qualifies for advance replacement. A replacement product will be shipped within three (3) days after verification by N-TRON that the product is considered defective. The shipment of advance replacement products is subject to local legal requirements and may not be available in all locations. When an advance replacement is provided and customer fails to return the original product to N-TRON within fifteen (15) days after shipment of the replacement, N-TRON will charge customer for the replacement product, at list price.

WARRANTIES EXCLUSIVE: IF AN N-TRON PRODUCT DOES NOT OPERATE AS WARRANTED ABOVE, CUSTOMER'S SOLE REMEDY FOR BREACH OF THAT WARRANTY SHALL BE REPAIR, REPLACEMENT, OR REFUND OF THE PURCHASE PRICE PAID, AT N-TRON'S OPTION. TO THE FULL EXTENT ALLOWED BY LAW, THE FOREGOING WARRANTIES AND REMEDIES ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER WARRANTIES, TERMS, OR CONDITIONS, EXPRESS OR IMPLIED, EITHER IN FACT OR BY OPERATION OF LAW, STATUTORY OR OTHERWISE, INCLUDING WARRANTIES, TERMS, OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, SATISFACTORY QUALITY, CORRESPONDENCE WITH DESCRIPTION, AND NON-INFRINGEMENT, ALL OF WHICH ARE EXPRESSLY DISCLAIMED. N-TRON NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE, INSTALLATION, MAINTENANCE OR USE OF ITS PRODUCTS. N-TRON SHALL NOT BE LIABLE UNDER THIS WARRANTY IF ITS TESTING AND EXAMINATION DISCLOSE THAT THE ALLEGED DEFECT OR MALFUNCTION IN THE PRODUCT DOES NOT EXIST OR WAS CAUSED BY CUSTOMER'S OR ANY THIRD PERSON'S MISUSE, NEGLIGENCE, IMPROPER INSTALLATION OR TESTING, UNAUTHORIZED ATTEMPTS TO OPEN, REPAIR OR MODIFY THE PRODUCT, OR ANY OTHER CAUSE BEYOND THE RANGE OF THE INTENDED USE, OR BY ACCIDENT, FIRE, LIGHTNING, POWER CUTS OR OUTAGES, OTHER HAZARDS, OR ACTS OF GOD.

LIMITATION OF LIABILITY: TO THE FULL EXTENT ALLOWED BY LAW, N-TRON ALSO EXCLUDES FOR ITSELF AND ITS SUPPLIERS ANY LIABILITY, WHETHER BASED IN CONTRACT OR TORT (INCLUDING NEGLIGENCE), FOR INCIDENTAL, CONSEQUENTIAL, INDIRECT, SPECIAL, OR PUNITIVE DAMAGES OF ANY

KIND, OR FOR LOSS OF REVENUE OR PROFITS, LOSS OF BUSINESS, LOSS OF INFORMATION OR DATA, OR OTHER FINANCIAL LOSS ARISING OUT OF OR IN CONNECTION WITH THE SALE, INSTALLATION, MAINTENANCE, USE, PERFORMANCE, FAILURE, OR INTERRUPTION OF ITS PRODUCTS, EVEN IF N-TRON OR ITS AUTHORIZED RESELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, AND LIMITS ITS LIABILITY TO REPAIR, REPLACEMENT, OR REFUND OF THE PURCHASE PRICE PAID, AT N-TRON'S OPTION. THIS DISCLAIMER OF LIABILITY FOR DAMAGES WILL NOT BE AFFECTED IF ANY REMEDY PROVIDED HEREIN SHALL FAIL OF ITS ESSENTIAL PURPOSE.

DISCLAIMER: Some countries, states, or provinces do not allow the exclusion or limitation of implied warranties or the limitation of incidental or consequential damages for certain products supplied to consumers, or the limitation of liability for personal injury, so the above limitations and exclusions may be limited in their application to you. When the implied warranties are not allowed to be excluded in their entirety, they will be limited to the duration of the applicable written warranty. This warranty gives you specific legal rights which may vary depending on local law.

GOVERNING LAW: This Limited Warranty shall be governed by the laws of the State of Alabama, U.S.A