SGW Series

Modbus Gateway
USER MANUAL

Manual Number: SGW-USER-M

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Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations, or nonhazardous locations only.

Cet appareillage est utilisable dans les emplacements de Classe I, Division 2, Groupes A, B, C et D, ou dans les emplacements non dangereux seulement.

WARNING: EXPLOSION HAZARD

- **Do not disconnect equipment while the circuit is live or unless the area is known to be free of ignitable concentrations.**
- **Substitution of any component may impair suitability for Class I, Division 2.**

AVERTISSEMENT: RISQUE D'EXPLOSION

- **Avant de deconnecter l'equipement, couper le courant ou s'assurer que l'emplacement est designe non dangereux.**
- **La substitution de composants peut rendre ce materiel inacceptable pour les emplacements de Classe I, Division 2.**

STRIDE® MB GATEWAY
USER MANUAL REVISION HISTORY

Please include this Manual Number and the Manual Issue, both shown below, when communicating with AutomationDirect Technical Support regarding this publication.

Manual Number: ***SGW-USER-M***
Manual Issue: ***1st Edition, Revision G***
Issue Date: ***October 21, 2021***

Publication History		
Issue	***Date***	***Description of Changes***
First Edition	03/28/2018	Initial Release
1st Edition, Revision A	06/29/2018	Clarified input voltage range, clarified supported web browsers.
1st Edition, Revision B	10/26/2018	Updated IP addresses in Application Examples.
1st Edition, Revision C	09/09/2019	Updated screenshots, minor clarifications.
1st Edition, Revision D	02/12/2020	Added Appendix D: Security Considerations for Control Systems Networks.
1st Edition, Revision E	08/17/2020	Clarified imported configuration filenames.
1st Edition, Revision F	04/01/2021	Corrected terminating resistor on RS-485 wiring diagrams.
1st Edition, Revision G	10/21/2021	Corrected RS-232 Flow Control options.

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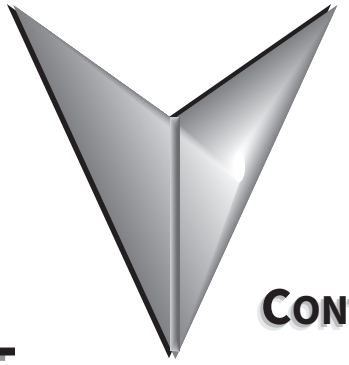

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Getting Started

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User Manual Overview

The Purpose of this User's Manual

Thank you for purchasing our *STRIDE*® Modbus Gateway. This User Manual describes the gateway and its specifications, and guides you in the installation, configuration, and methods of operation of the *STRIDE*®Modbus gateway.

Who Should Read This Manual

This manual contains important information for those who will install, maintain, and/or operate a *STRIDE*® Modbus Gateway.

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Special Symbols

NOTE: When you see the "notepad" icon in the left-hand margin, the paragraph to its immediate right will be a special note.

SECURITY NOTE: When you see the "padlock" icon in the left-hand margin, the paragraph to its immediate right will be a security-related suggestion or note.

WARNING: When you see the "exclamation mark" icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death (in extreme cases).

Introduction

Modbus is one of the most popular communication protocols in the automation industry because it supports both traditional RS-232/422/485 devices and industrial Ethernet devices. Many industrial devices, such as PLCs, HMIs, instruments and meters use Modbus as their standard communication protocol. However, the Modbus protocols running over serial and Ethernet are so different that a communication gateway is needed as a bridge for integrating devices from these two networks. The *STRIDE*® Modbus Gateway provides that bridge between Modbus RTU (Serial) products and Modbus TCP (Ethernet) products.

The gateway converts bidirectionally between Modbus RTU or Modbus ASCII protocols and Modbus TCP. In addition to its compact size, the gateway features up to two 10/100 Mbps Ethernet ports and up to four RS232/422/485 serial ports.

SECURITY NOTE: When implementing any method of remote access to your equipment, you need to consider the security exposure in order to minimize the risks to your processes and your equipment. Security should always be carefully evaluated for each installation. Refer to "Appendix D: Security Considerations for Control Systems Networks" for more information.

Product Overview

Key features include:

- ✓ *Industrial 1, 2, or 4 serial port, and 1 or 2 Ethernet port Modbus Gateways (Modbus RTU/ASCII <-> ModbusTCP)*
- ✓ *Automatic read function "Agent Mode"*
- ✓ *Ethernet ports each support up to 16 TCP devices, client or server*
- ✓ *Serial ports each support up to 128 slave devices or 1 master device*
- ✓ *DIP switch selectable termination resistor for RS-485 2-wire mode*
- ✓ *High Serial Isolation Voltage (2kV)*
- ✓ *UL61010 with Class 1 Division 2 hazardous location rating*
- ✓ *Metal housing with wide temperature rating (–40 to +75°C)*

Hardware

STRIDE Modbus Gateway Models		
Part Number	***Ethernet Ports RJ45, 10/100Mbps***	***Serial Ports D-sub 9 pin***
SGW-MB1511-T	1	1
SGW-MB1512-T	1	2
SGW-MB1524-T	2	4

Ethernet Interface	
Port	Shielded RJ45
Speed	10/100 Mbps
Protection	Built-in 1.5 kV magnetic isolation
Protocol Supported	Modbus TCP/IP client and server
Modbus TCP devices supported	16 simultaneous Modbus TCP connections per Ethernet port
Cable Type	Autodetects Ethernet cable types (MDI/MDIX)
Default IP address	192.168.0.249 192.168.1.249 (Ethernet Port 2, SGW-MB1524-T)

Serial Interface	
Port	D-sub 9-pin male port
Interface mode	**RS-232**, RS-485 and RS-422, software selectable
Supported Baud Rates	300, 600, 1200, 4800, 9600, 14.4k, 19.2k, 38.4k, 57.6k, **115.2k**, 230.4k, 460.8k
Parity	Odd, Even or **None**
Data Bits	7 or **8** bits
Stop Bits	**1** or 2
Flow control	RTS or **None**
Termination	DIP switch to enable/disable 120Ω matching resistor for RS-485 2-wire
ESD Protection	15kV for all signals
Isolation Protection	2kV
Serial Devices Supported	128 slaves or 1 master per port
Protocols Supported	Modbus RTU, Modbus ASCII

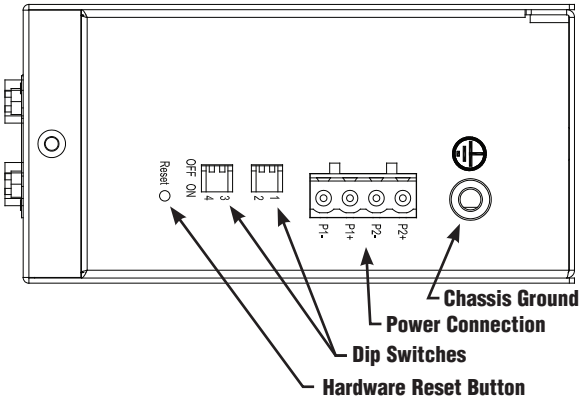
*Note: Default values are shown in **bold** text.*

Power Details		
Power Consumption	SGW-MB1511-T	1.8 W
	SGW-MB1512-T	1.8 W
	SGW-MB1524-T	3.2 W
Power Input	Redundant input terminals	
Input Voltage	12 / 24 / 48 VDC	
Max. Input Voltage Range	9.6 – 60 VDC	
Appliance Class	Class III, SELV power source	
Reverse Power Protection	Yes	
Overload Protection	Yes	

Environmental	
Operating Temperature Range	-40 to +75 °C [-40 to +167 °F]
Storage Temperature Range	-40 to +85 °C [-40 to +185 °F]
Humidity	5 to 95% RH (non-condensing)
Maximum Altitude	2000m
Environmental Air	For use in Pollution Degree 2 Environment
Protection level	Metal case, IP40
Agency Approvals	UL61010-1, UL61010-2-201, Class I Div 2 12.12.01-2015; CSA C22.2 No. 213-16; CAN/CSA No. 61010-1-12; CAN/CSAC22.2 No. 61010-2-201:14, CE, FCC
EMI	EN 55032 Class A
	FCC Part 15 Subpart B Class A
EMS	IEC 61000-4-2 (ESD): ±6kV (contact), ±8kV (air)
	IEC 61000-4-3 (RS): 10V/m (80MHz–2GHz)
	IEC 61000-4-4 (EFT): Power Port: ±2kV; Data Port: ±1kV
	IEC 61000-4-5 (Surge): PowerPort: ±1kV/DM, ±2kV/CM; Data Port: ±1kV
	IEC 61000-4-6 (CS): 10V (150KHz–80MHz)
Mechanical Standards	IEC 60068-2-6 (Vibration)
	IEC 60068-2-27 (Shock)
	IEC 60068-2-32 (Free Fall)

Hardware Reset Button

The Hardware Reset Button is a small recessed button located on the top of the device. Pressing the button will reset all settings to their default values.

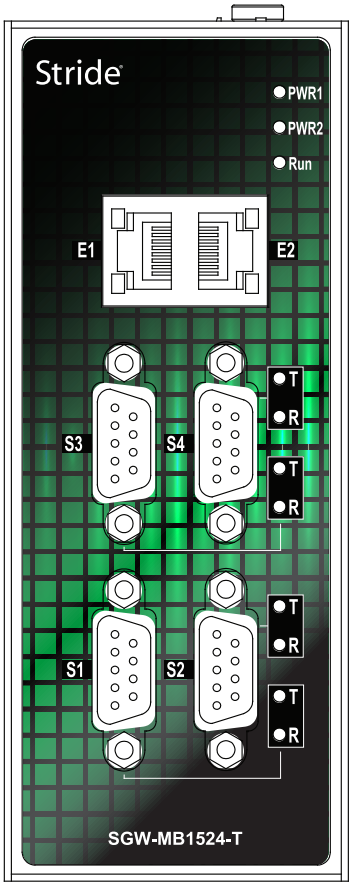


DIP Switches

A 120Ω termination resistor for each serial port configured for RS485 2-wire is enabled (ON) or disabled (OFF) by the corresponding DIP switch.

LEDs

The front panel provides status via the following LEDs:



PWR1 (Green)

LED ON indicates voltage is applied to Power 1 terminals.

PWR2 (Green)

LED ON indicates voltage is applied to Power 2 terminals.

RUN (Green)

Blinking Indicates the device is functioning normally. Steady on indicates power is on and device is booting up.

SPEED (RJ45 Yellow)

There is one yellow SPEED LED for each Ethernet port. LED ON indicates Ethernet speed is 100 Mbps. LED OFF indicates Ethernet speed is 10 Mbps.

Link/Activity (RJ45 Green)

There is one green Link/Activity LED for each Ethernet port. The Link/Activity LED is ON when a valid link is established, and flashes to indicate that the gateway sees data traveling on the Ethernet network. If any network device is sending or receiving data, the Link/Activity LED will be flashing. During heavy communication loads, this indicator will be steady ON. If the LED is OFF, then a problem with the Ethernet connection has been detected.

T (Serial port Transmit, Green)

The T or Transmit Data LED flashes to indicate that the gateway is sending data through the serial port.

R (Serial port Receive, Green)

The R or Receive Data LED flashes to indicate that the gateway is receiving data through the serial port.

Installation, DIN Rail Mounting

NOTE: The gateway can also be panel mounted with purchase of accessory mounting bracket (part #SE2-PM1 for SGW-MB1511-T and SGW-MB1512-T, part #SE2-PM3 for SGW-MB1524-T).

These devices are open-type and are meant to be installed in an enclosure which is only accessible with the use of a tool and suitable for the environment when installed in Class 1, Division 2 Hazardous Locations. The gateway can be snapped onto a standard 35mm x 7.5 mm height DIN rail (Standard: CENELEC EN50022) and can be mounted either vertically or horizontally. Allow 20mm [0.79”] of clearance between the gateway and other equipment on the DIN rail, side-to-side and top-to-bottom.

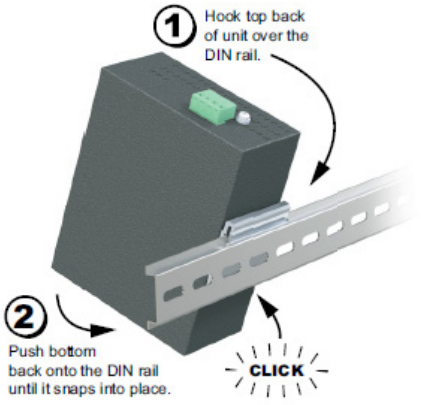
DIN rail mounting steps:

1) Hook top back of unit over the DIN rail.
2) Push bottom back onto the DIN rail until it snaps into place.

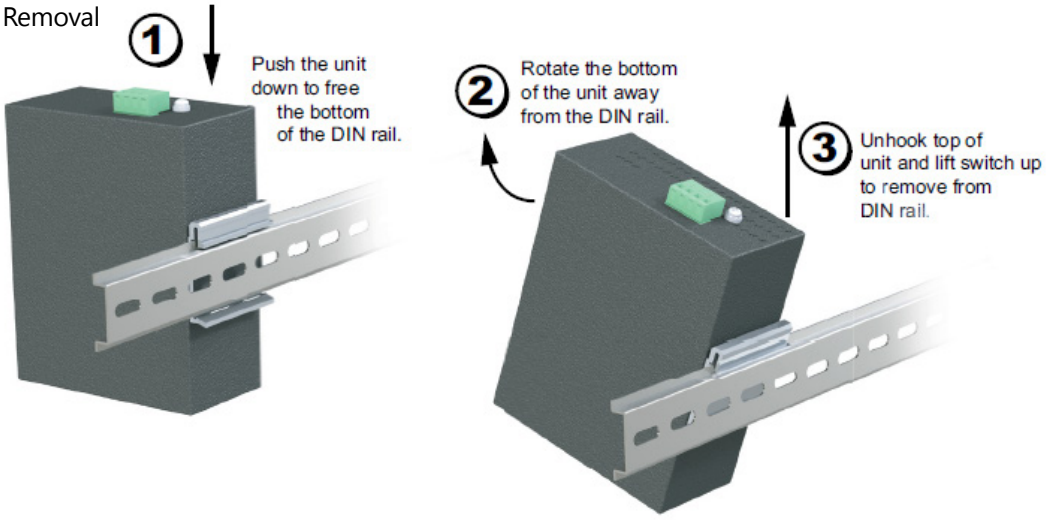
DIN rail removal steps:

1) Push the unit down to free the bottom of the DIN rail.
2) Rotate the bottom of the unit away from the DIN rail.
3) Unhook top of unit from DIN rail.

Mounting

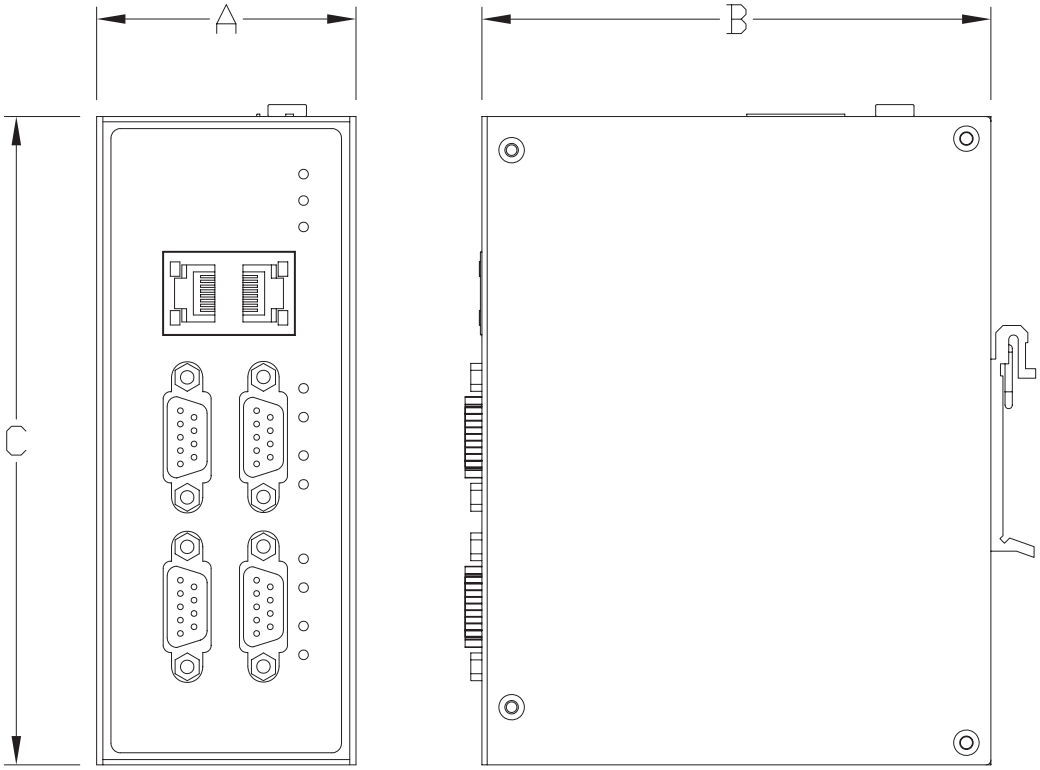


Removal



Dimensional Drawings

NOTE: Allow 20mm [0.79”] clearance around each gateway for proper cooling.



Dimensions				
Part No.	Weight	Width (A)	Depth (B)	Height (C)
		mm [inches]		
SGW-MB1511-T	0.17 kg [0.36 lb]	30.0 [1.18]	68.0 [2.68]	115.0 [4.53]
SGW-MB1512-T	0.17 kg [0.36 lb]			
SGW-MB1524-T	0.32 kg [0.71 lb]	54.0 [2.13]	106 [4.17]	135.0 [5.32]

Wiring

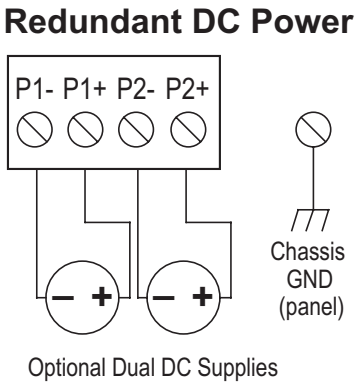
Power

The switch can be powered from the same DC source that is used to power your other devices. To maintain the UL listing, this must be an SELV (Safety Extra Low Voltage) power supply. A DC voltage in the range of 12 to 48VDC needs to be applied between the P1+ terminal and the P1- terminal as shown below. The chassis screw terminal should be tied to panel or chassis ground. To reduce down time resulting from power loss, the switch can be powered redundantly with a second power supply as shown below. A recommended DC power supply is AutomationDirect.com part number PSL-24-010.

Terminal block connector is Degson 2EDGK-5.08-04P-14-1000AH or equivalent.

Maximum terminal screw torque is 4.43 lb-in (0.5 N·m).

Ferrule required for stranded wire.
Wire Size Range: 24 – 12 AWG
Wire Strip Length: 7mm



Before performing any wiring to these switches make sure...

- *The area is currently nonhazardous (especially when working in Class 1, Div 2 or Zone 2 hazardous locations).*
- *Power is off to the switch*
- *The screw terminal block is unplugged. This is especially important due to the aluminum housing. Connecting or disconnecting wires to the screw block when it's in place and power is turned on can allow the screwdriver to short the power to the case.*

Ethernet Wiring

Use data-quality (not voice-quality) twisted pair cable rated category 5e (or better) with standard RJ45 connectors. Straight-through or crossover Ethernet cable can be used for all devices the switch is connected to because all the ports are capable of auto-MDI/MDIX-crossover detection.

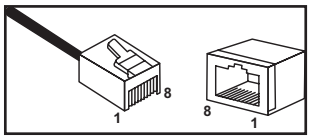
The RJ45 Ethernet port connector bodies on these products are metallic and connected to the Chassis GND terminal. Therefore, shielded cables may be used to provide further protection. To prevent ground loops, the cable shield should be tied to the metal connector body at one end of the cable only. Electrical isolation is also provided on the Ethernet ports for increased reliability.

Ethernet Cable Wiring

Ethernet Port		
Pin	***MDI-X Signal***	***MDI Signal***
1	Receive Data + (RD+)	Transmit Data + (TD+)
2	Receive Data – (RD–)	Transmit Data – (TD–)
3	Transmit Data + (TD+)	Receive Data + (RD+)
6	Transmit Data – (TD–)	Receive Data – (RD–)
4, 5, 7, 8	Unused	Unused
Note: + and – indicate level polarities.		

Straight-thru Cable Wiring	
Pin 1	Pin 1
Pin 2	Pin 2
Pin 3	Pin 3
Pin 4	Pin 4
Pin 5	Pin 5
Pin 6	Pin 6
Pin 7	Pin 7
Pin 8	Pin 8

Cross-over Cable Wiring	
Pin 1	Pin 3
Pin 2	Pin 6
Pin 3	Pin 1
Pin 4	Pin 4
Pin 5	Pin 5
Pin 6	Pin 2
Pin 7	Pin 7
Pin 8	Pin 8

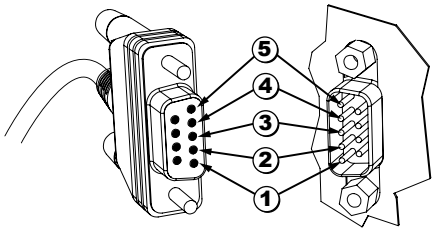


Ethernet Plug & Connector Pin Positions

NOTE: For reference only. Either cable wiring will work.

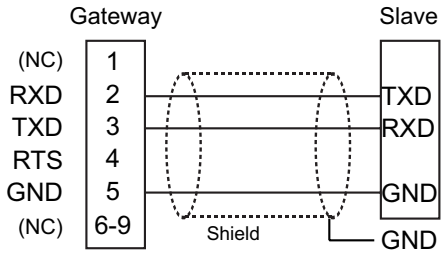
Serial Port Wiring

Serial Port Pinout



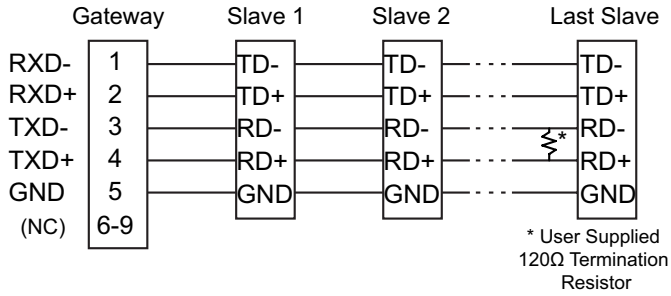
Serial Port			
Pin	**RS-232**	**RS-422/485 4-wire**	**RS-485 2-wire**
1	–	RXD –	–
2	RXD	RXD +	–
3	TXD	TXD –	Data –
4	RTS	TXD +	Data +
5	GND	GND	GND
6	–	–	–
7	–	–	–
8	–	–	–
9	–	–	–

RS232 Wiring



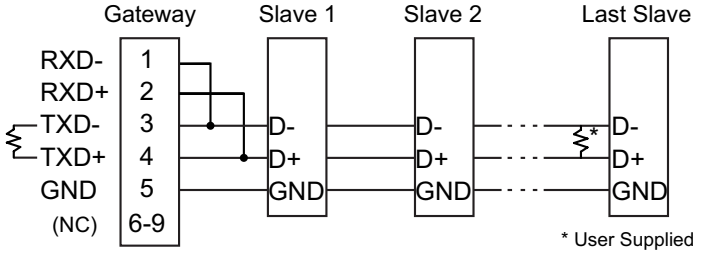
Recommended Cable - AutomationDirect L-19772 shielded cable or equivalent

RS422/RS485 4-wire Wiring



Recommended Cable - AutomationDirect L-19773 shielded cable or equivalent

RS485 2-wire Wiring



The Gateway contains a DIP switch selectable120Ω Termination Resistor between TXD+ and TXD- for each serial port on RS-485 2-wire, when the Gateway is wired at one end of the serial network.

Recommended Cable - AutomationDirect L-19954 shielded cable or equivalent

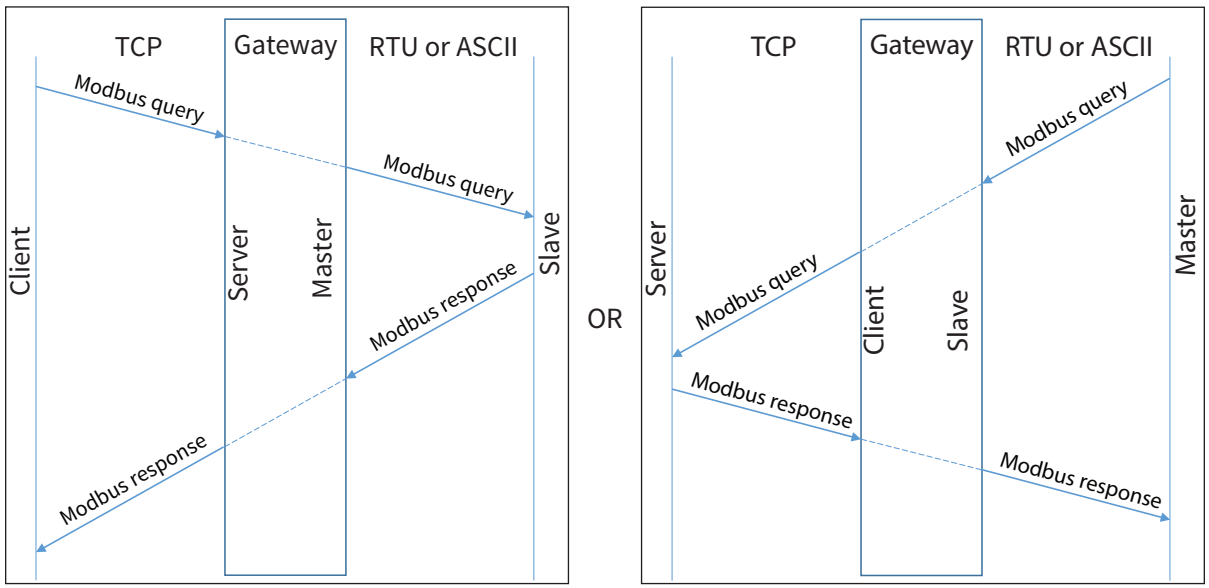
Operation

The *STRIDE*® Modbus Gateway may be configured to function in Transparent Mode or Agent Mode.

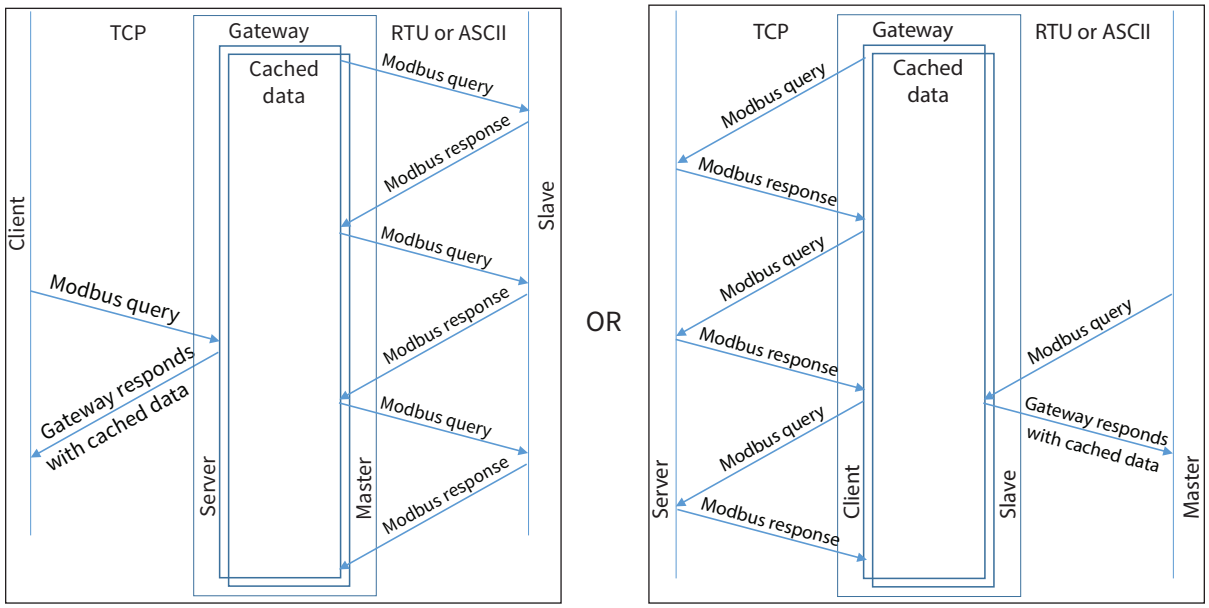
Transparent Mode is a simple protocol bridge. Modbus TCP packets that arrive at the gateway Ethernet port will be translated to Modbus RTU or Modbus ASCII and transmitted out the appropriate serial port. Likewise, communications arriving at the serial port will be translated to Modbus TCP and transmitted out the Ethernet port. Data simply passes across the gateway.

Agent Mode is a valuable feature of the *STRIDE*® Modbus Gateway. The Agent can be configured to poll specific Modbus data addresses at the serial or Ethernet nodes and store that data into gateway shared memory. If a Modbus query comes in for one of those data points, the gateway will immediately respond with the data it has stored and thereby respond much faster than it would if it had to forward that request and wait for the response.

Transparent Mode



Agent Mode



Summary of Modbus Modes

In This Chapter...

Introduction 2–2

Mode 1: Transparent, RTU Master mode:
Modbus TCP Client/Master Device to Gateway to Modbus RTU Slave Devices 2–3

Mode 2: Agent, RTU Master mode:
Modbus TCP Client/Master Device to Gateway Memory. Gateway Talks Directly to Modbus RTU Slave Devices. 2–4

Mode 3: Transparent, RTU Slave mode:
Modbus RTU Master Device to Gateway to Modbus TCP Server/Slave Devices 2–6

Mode 4: Agent, RTU Slave mode:
Modbus RTU Master Device to Gateway Memory. Gateway Talks Directly to Modbus TCP Server/Slave Devices. 2–7

Introduction

As mentioned in the previous chapter, the STRIDE® Modbus Gateway may be configured to operate in four distinct modes:

- Mode 1: Transparent mode, with serial port functioning as a master device
- Mode 2: Agent mode, with serial port functioning as a master device
- Mode 3: Transparent mode, with serial port functioning as a slave device
- Mode 4: Agent mode, with serial port functioning as a slave device

Operation under each of the four modes is discussed in this chapter. For simplicity, the discussion uses RTU protocol for the serial port. The operations would be essentially identical if the serial port used ASCII protocol.

Mode 1: Transparent, RTU Master mode: Modbus TCP Client/Master Device to Gateway to Modbus RTU Slave Devices

In this mode, the Current Working Mode is set to "Transparent" and the Serial Port Mode is set to "RTU Master". These settings are displayed on the Device Information page and Operating Settings page of the web interface, respectively, as shown below.

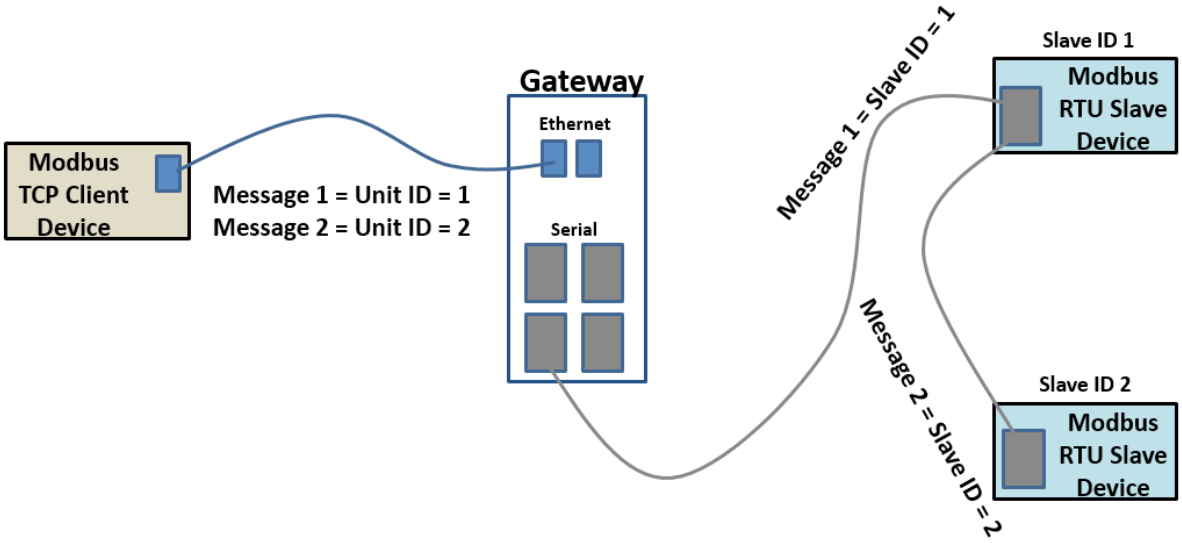
Device Information			
Device Name	SGW-MB1524-T	SN	K10A0004A180100036
Model Type	MB-Gateway	Firmware Version	V3.5.019
IP(E1)	192.168.0.249	MAC(E1)	00:1E:CD:1B:FA:15
IP(E2)	192.168.1.249	MAC(E2)	00:1E:CD:1B:FA:16

(•) **Transparent Mode**

( ) **Agent Mode**

Operating Settings				
S1	S2	S3	S4	
Serial Port Mode	RTU Master ▾			
Filter Enable	☐			
Filter ID Start	1			
Filter ID End	247			
Protocol	TCP ▾			
Gateway Modbus TCP Port	502			

A typical network using the gateway to connect a Modbus TCP client device to multiple Modbus RTU slave devices is illustrated below. The Modbus messages are simply translated in the gateway from Modbus TCP framing to Modbus RTU framing and then sent on to the serial network. Addressing a specific slave device is handled by the Unit Identifier (Slave ID) contained in the Modbus message.



Mode 2: Agent, RTU Master mode: Modbus TCP Client/Master Device to Gateway Memory. Gateway Talks Directly to Modbus RTU Slave Devices

In this mode, the Current Working Mode is set to "Agent" and the Serial Port Mode is set to "RTU Master". These settings are displayed on the Device Information page and Operating Settings page of the web interface, respectively, as shown below.

Device Information			
Device Name	SGW-MB1524-T	SN	K10A0004A180100036
Model Type	MB-Gateway	Firmware Version	V3.5.019
IP(E1)	192.168.0.249	MAC(E1)	00:1E:CD:1B:FA:15
IP(E2)	192.168.1.249	MAC(E2)	00:1E:CD:1B:FA:16

○ **Transparent Mode**

◉ **Agent Mode**

Operating Settings			
S1	S2	S3	S4

Serial Port Mode	RTU Master ▾
Filter Enable	☐
Filter ID Start	1
Filter ID End	247
Protocol	TCP ▾ (Note: In Agent mode, you can modify the Modbus port on the 'Gateway Settings' page.)
Gateway Modbus TCP Port	502 (Note: In Agent mode, you can modify the Modbus port on the 'Gateway Settings' page.)

In Agent mode, the gateway must be assigned a Modbus ID, as shown below, since the Modbus TCP Client will query the gateway memory using that Unit ID rather than querying the slave devices directly.

Gateway Settings	
Gateway Modbus ID	220
Protocol	TCP ▾
Gateway Modbus Port	502
Default Timeout(ms)	1000
Inter-packet TX Delay(ms)	100

A list of messages must be created defining the data to be collected from various RTU slave devices connected to the serial port, and the addresses within the gateway at which to store the collected data.

Add Message | Delete Message | Modify Message

Display 50 per page | Refresh | Search:

Item	Serial Port	Slave ID	Alias	Function	Data Address	Data Length	Mapping Address Head	Status
1	1	1	Device_Alias	3	0	1	0	
2	1	2	Device_Alias	3	100	1	1	

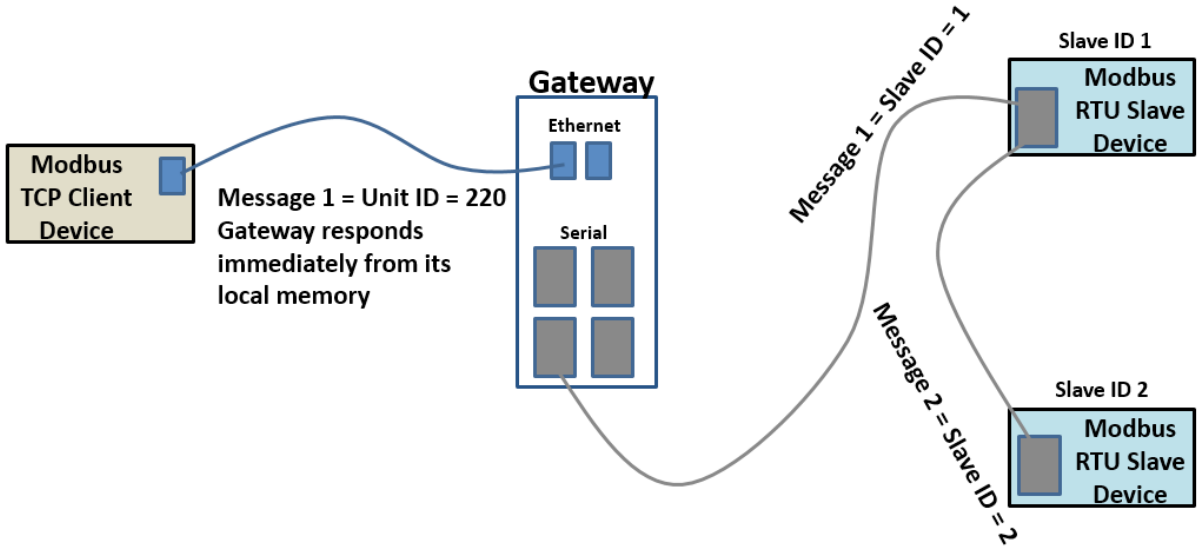
firstpage prev 1 next lastpage

Refresh to get latest status.

In Agent mode, the Gateway sends messages created by the Slave list to the Modbus RTU slave devices. The response data from these messages are stored in local memory of the Gateway for access by the Modbus TCP Client device. The data is stored in 4 different memory blocks depending upon the Function Code used.

Coils (0x)	Inputs (1x)	Holding Registers (4x)	Input Registers (3x)
Data stored from Function Code 1	Data stored from Function Code 2	Data stored from Function Code 3	Data stored from Function Code 4

The Gateway generates the serial messages from the slave list items. It stores the data from the responses in its local memory that is available to Modbus TCP devices. Modbus TCP client devices query the gateway using its Unit ID, and the gateway responds immediately with its cached data.



NOTE: Modbus writes sent from the Modbus TCP client go across directly to the Modbus RTU slave devices as if the gateway were in Transparent mode. When the gateway is in Agent mode, addresses that devices will use to WRITE data into must be configured in the Message List even though conceptually this is a list of data that is READ from connected devices.

Mode 3: Transparent, RTU Slave mode: Modbus RTU Master Device to Gateway to Modbus TCP Server/Slave Devices

In this mode, the Current Working Mode is set to "Transparent" and the Serial Port Mode is set to "RTU Slave". These settings are displayed on the Device Information page and Operating Settings page of the web interface, respectively, as shown below.

Device Information			
Device Name	SGW-MB1524-T	SN	K10A0004A180100036
Model Type	MB-Gateway	Firmware Version	V3.5.019
IP(E1)	192.168.0.249	MAC(E1)	00:1E:CD:1B:FA:15
IP(E2)	192.168.1.249	MAC(E2)	00:1E:CD:1B:FA:16

◉ **Transparent Mode**

○ **Agent Mode**

Operating Settings

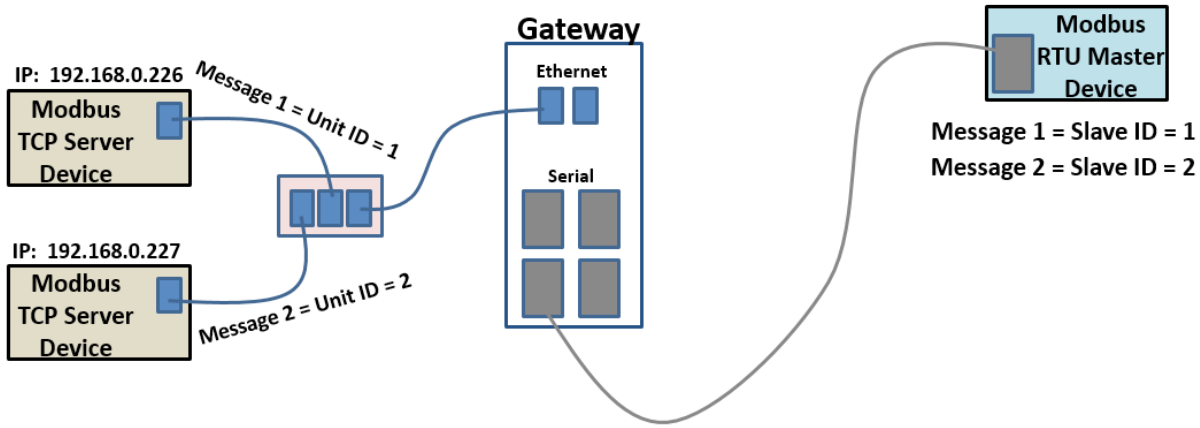
S1 | S2 | S3 | S4

Serial Port Mode: RTU Slave

Slave ID	Remote IP	Remote Port	Protocol	Local Port	Ethernet Port Bind	
1	192.168.0.226	502	TCP	NA	E1	+ -
2	192.168.0.227	502	TCP	NA	E1	+ -

In RTU Slave mode, each TCP server device must be configured in the gateway with an IP address, remote port, and Unit ID (Slave ID). A unique local port is set only when the protocol is UDP.

A typical network using the gateway to connect a Modbus RTU master device to multiple Modbus TCP server devices is illustrated below. The gateway reads the Slave ID from the message of the Modbus RTU master device and does a lookup in the table to find the target IP address. It also places the Slave ID value into the Unit ID field of the Modbus TCP frame.



NOTE: Remember that only one master may be connected to each serial port.

Mode 4: Agent, RTU Slave mode: Modbus RTU Master Device to Gateway Memory. Gateway Talks Directly to Modbus TCP Server/Slave Devices

In this mode, the Current Working Mode is set to "Agent" and the Serial Port Mode is set to "RTU Slave". These settings are displayed on the Device Information page and Operating Settings page of the web interface, respectively, as shown below.

Device Information			
Device Name	SGW-MB1524-T	SN	K10A0
Model Type	MB-Gateway	Firmware Version	V3.5.0
IP(E1)	192.168.0.249	MAC(E1)	00:1E:
IP(E2)	192.168.1.249	MAC(E2)	00:1E:

○ Transparent Mode

◉ Agent Mode

Operating Settings

S1 | S2 | S3 | S4

Serial Port Mode: RTU Slave

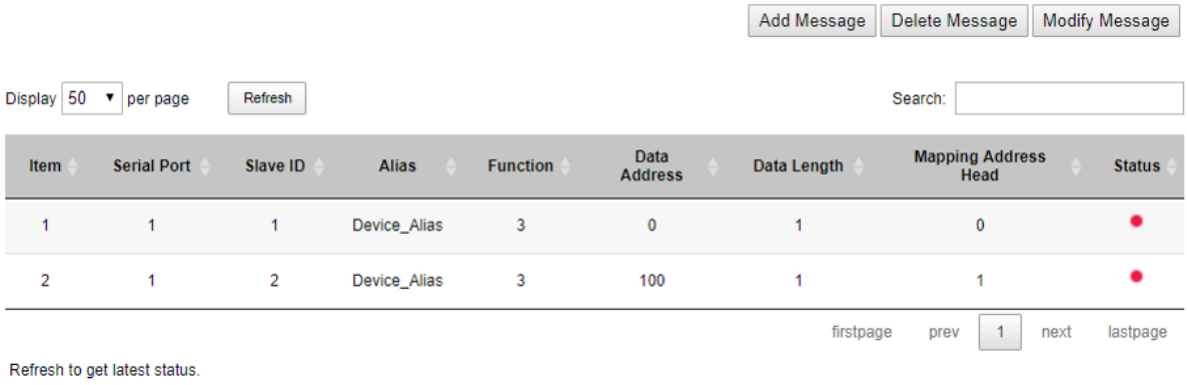
Slave ID	Remote IP	Remote Port	Protocol	Local Port	Ethernet Port Bind	
1	192.168.0.226	502	TCP	NA	E1	+ -
2	192.168.0.227	502	TCP	NA	E1	+ -

In Agent mode, the gateway must be assigned a Modbus ID, as shown below, since the Modbus RTU Master will query the gateway memory using that Unit ID rather than querying the slave devices directly.

Gateway Settings

Gateway Modbus ID	220
Protocol	TCP
Gateway Modbus Port	502
Default Timeout(ms)	1000
Inter-packet TX Delay(ms)	100

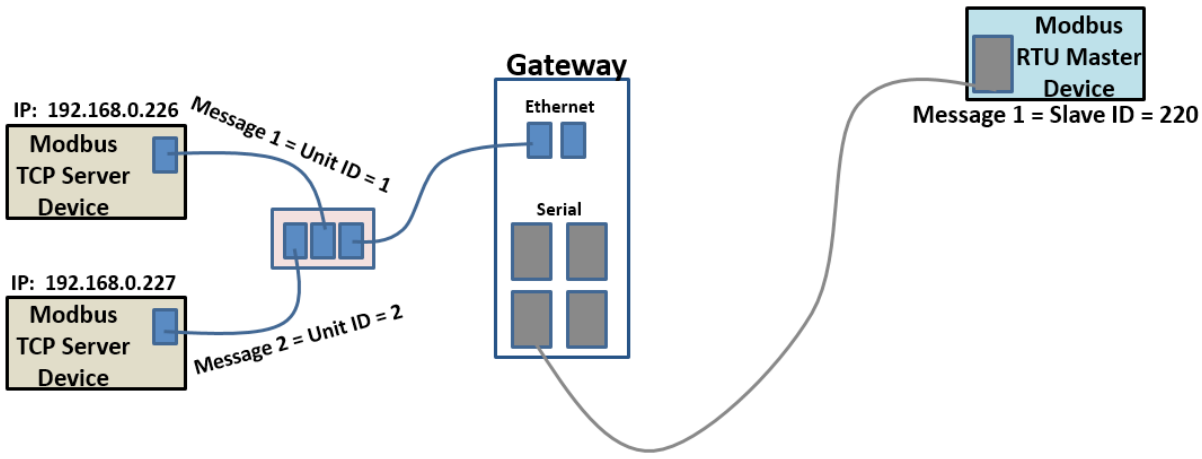
A list of messages must be created defining the data to be collected from various TCP server devices connected to the Ethernet port specified in the Operating Settings, and the addresses within the gateway at which to store the collected data.



In Agent mode, the Gateway sends messages created by the Slave list to the Modbus TCP server devices. The response data from these messages are stored in local memory of the Gateway for access by the RTU master device. The data is stored in 4 different memory blocks depending upon the Function Code used.

Coils (0x)	Inputs (1x)	Holding Registers (4x)	Input Registers (3x)
Data stored from Function Code 1	Data stored from Function Code 2	Data stored from Function Code 3	Data stored from Function Code 4

The Gateway generates the Modbus TCP messages from the Slave list items. It must first reference the table in the Operating settings to do a lookup from the Slave ID of the Slave list message to find the corresponding IP address. It stores the data from the responses in its local memory that is available to Modbus RTU devices. The Modbus RTU master device queries the gateway using its Unit ID, and the gateway responds immediately with its cached data.



NOTE: Modbus writes sent from the Modbus RTU master go across directly to the Modbus TCP server devices as if the gateway were in Transparent mode. When the gateway is in Agent mode, addresses that devices will use to WRITE data into must be configured in the Message List even though conceptually this is a list of data that is READ from connected devices.

Web Console Configuration

In This Chapter...

Initial Connection 3-2
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Operating Settings 3-5
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Import 3-12
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Change Password 3-14
Load Factory Default 3-15
Reboot 3-16

Initial Connection

The gateway is configured through a web console, which is accessed using any web browser.

The default management interface access is:

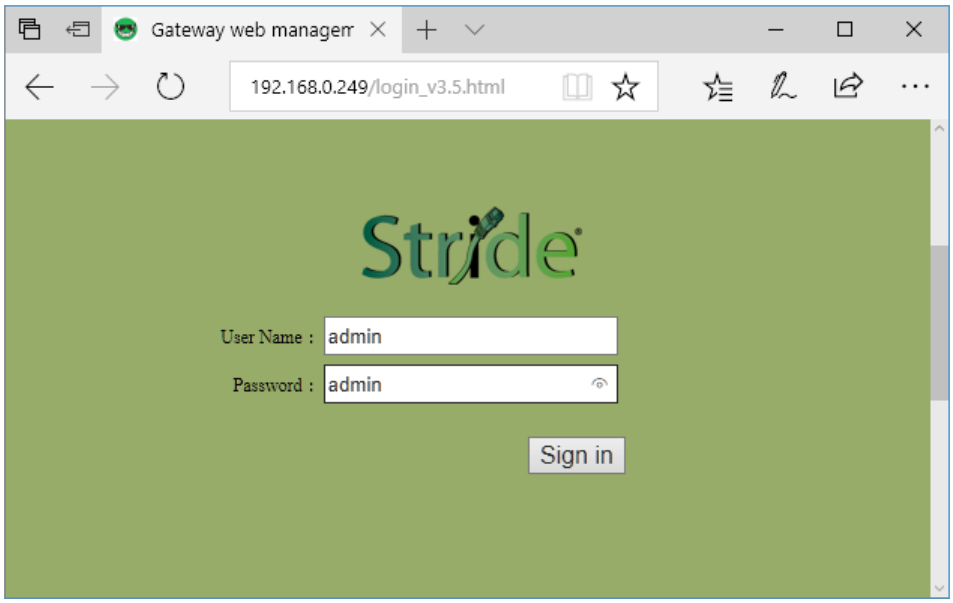
- IP address: 192.168.0.249 (if connecting at port E1)
  or 192.168.1.249 (if connecting at port E2)
- Port: 80
- Username: admin
- Password: admin

NOTE: SGW-MB1511-T and SGW-MB1512-T have one Ethernet port (E1); SGW-MB1524-T has two Ethernet ports (E1 & E2).

For initial setup, the PC used to connect to the *STRIDE®* Modbus Gateway must have an IP address that allows it to connect to the device's default IP address. The Modbus gateway's IP address can be changed later within the web console.

NOTE: The Modbus gateway's web console supports the latest version of all modern browsers.

In your browser, type the gateway's IP address (192.168.0.249 or 192.168.1.249) in the address field and press Enter. When prompted by a dialog box, enter the default Username and Password.



After logging in, you will be presented with the device's overview page.

SECURITY NOTE: We recommend that you change the login password and enable HTTPS ecryption for additional security. These settings are found on the Change Password page as described later in this chapter.

Device Info Page

The Device Information page displays a summary of information to identify the gateway.

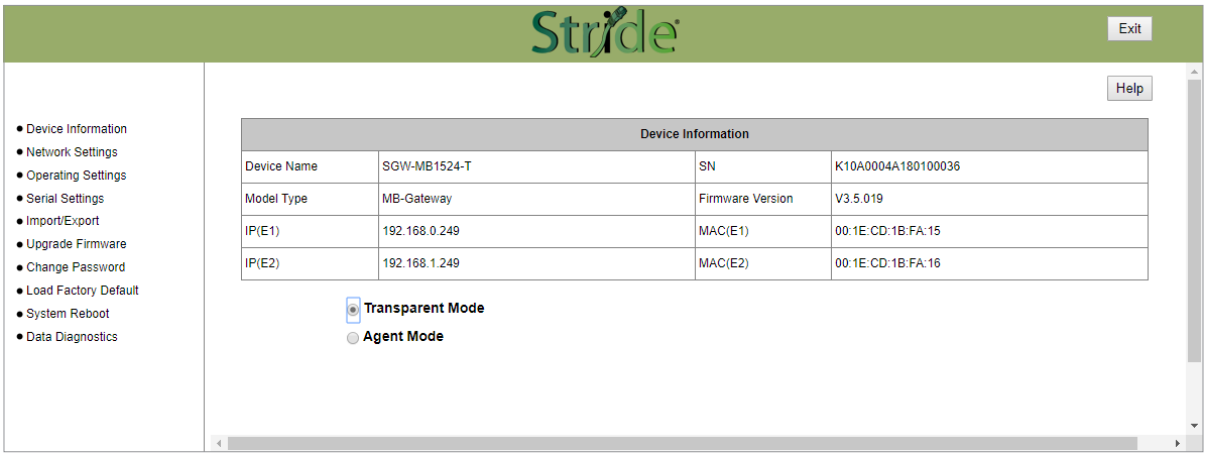
The device name is configured on the Network Settings page. The device name helps users distinguish between multiple gateways.

The serial number ("SN"), model type and MAC address(es) are not configurable. These are characteristics of the individual gateway and may help distinguish between multiple gateways. The values that display on this page may be compared to the values printed on the device label.

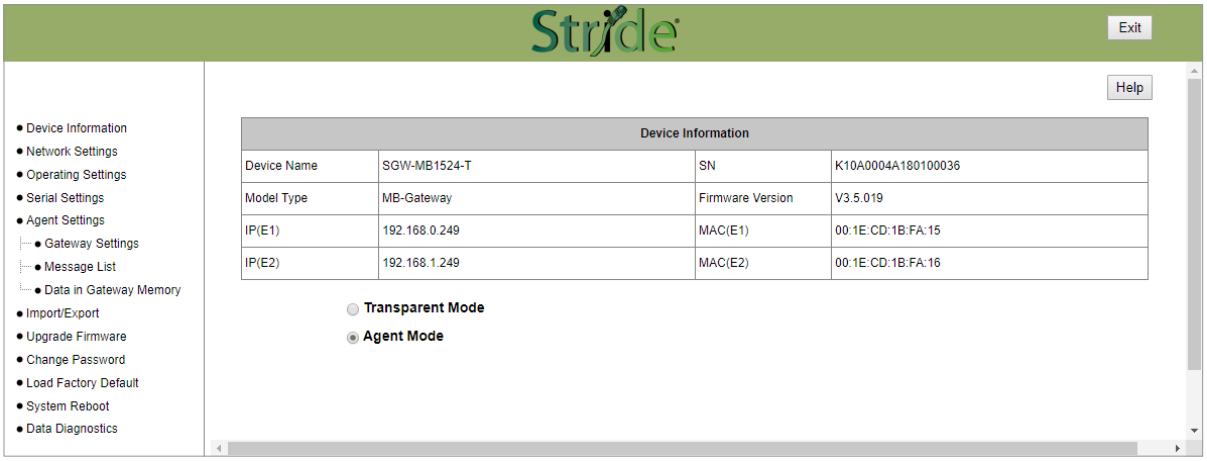
The IP address(es) are configured on the Network Settings page. IP addresses must be unique on the network.

You can switch the device between Agent mode and Transparent mode by clicking the "Agent Mode" (or "Transparent Mode") button. The button toggles the gateway immediately between the two operating modes without requiring further confirmation. The menu in the left column will update to reflect options relevant to the current mode of operation.

Device Info screen with gateway in Transparent mode:



Device Info screen with gateway in Agent mode:

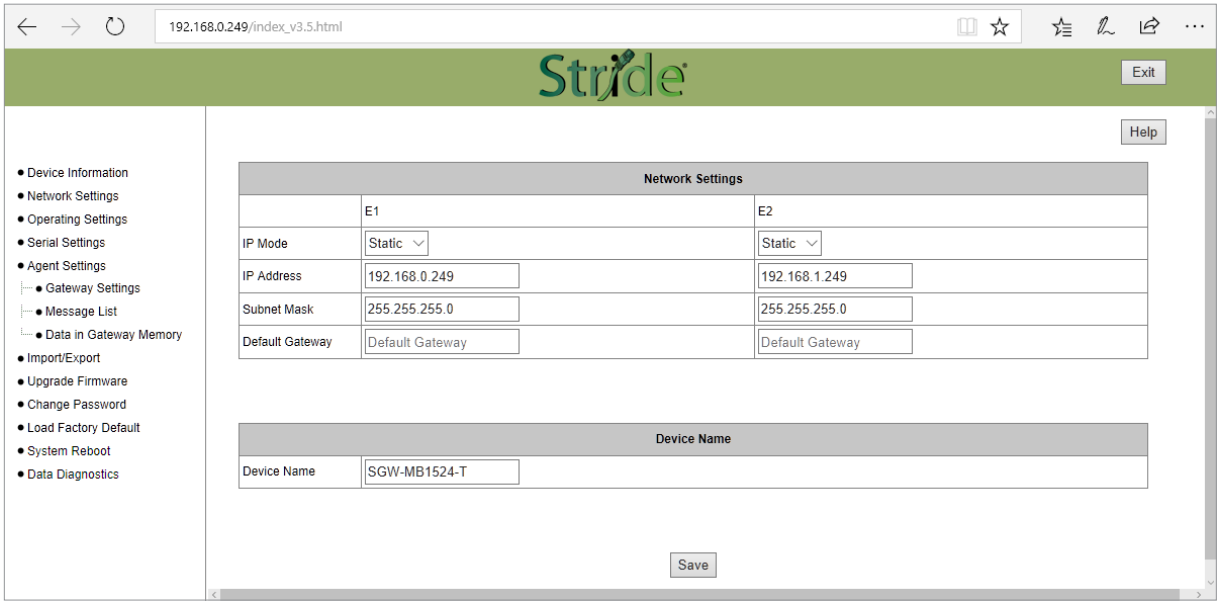


Network Settings

The Network Settings page allows selection between DHCP and static network settings for the Ethernet port(s), with the following requirements:

- *IP addresses must be unique on the network.*
- *On models with two Ethernet ports, the two ports may be configured on the same subnet or different subnets.*
- *A Default Gateway must be configured if any devices will be configured as Modbus TCP servers on a subnet different than that of the STRIDE gateway Ethernet port.*

Click Save to save the current changes to the unit before leaving this screen.



Default Network Settings:

- *IP configuration: Static*
- *IP address: E1 – 192.168.0.249; E2 – 192.168.1.249*
- *Subnet Mask: 255.255.255.0*
- *Default Gateway: no value*

NOTE: SGW-MB1511-T and SGW-MB1512-T have one Ethernet port; SGW-MB1524-T has two Ethernet ports.

NOTE: You may lose communications with the STRIDE Gateway module if you configure an IP address and/or Subnet Mask that is not compatible with the subnet of your PC's Network Interface Card. You may be required to change the subnet settings of your PC.

Device Name:

- *The default gateway name is the model number. You can set the name, limited to 16 alphanumeric characters or special characters dash (-) or underline (_). The gateway name is used for reference and identification when managing several different gateway modules on a network.*

NOTE: Remember to click the SAVE button before you leave this page. Leaving the page before saving changes will cancel changes.

Operating Settings

The Operating Settings page is where each serial interface's operation mode is configured.

The Serial Port Mode field describes the function of each serial port on the Gateway.

Each serial port can independently function as a master (communicating with up to 128 serial slave devices) or as a slave (communicating with a serial master device), using either RTU or ASCII protocols.

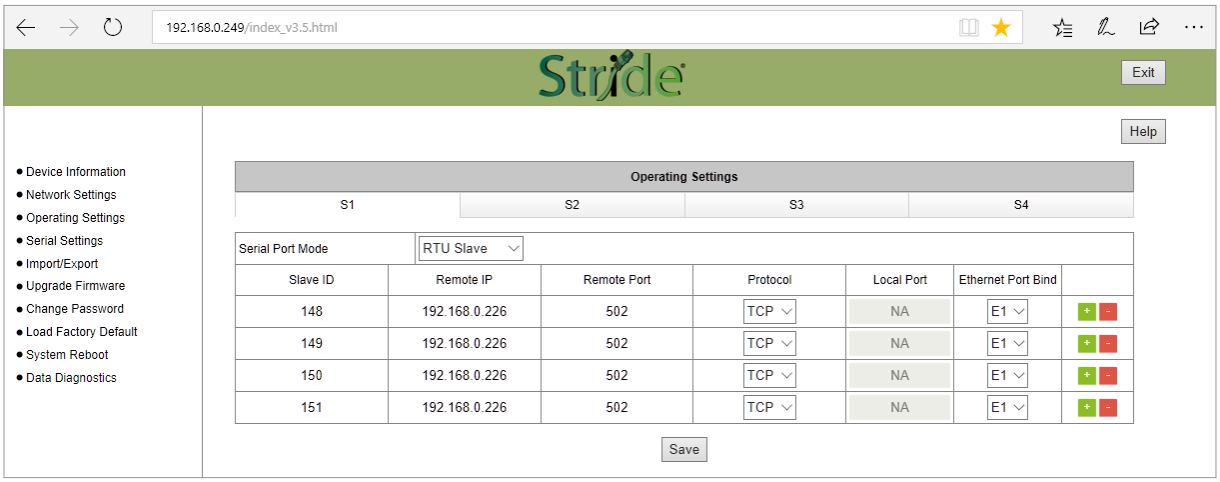
The Operating Settings page exposes different settings depending on whether each port is operating as a master (with Modbus TCP master device (client) and Modbus RTU/ASCII slave devices) or as a slave (with a Modbus RTU/ASCII master device and Modbus TCP slave devices (servers)).

For Modbus RTU/ASCII Master to Modbus TCP Servers (Slaves)

To connect a Modbus RTU or ASCII master device to one or more Modbus TCP server (slave) devices, the gateway serial port will function as an ASCII or RTU slave.

Up to 16 Modbus TCP server devices can be configured. Devices can be added or removed from the list using the green + or red - buttons, respectively. The Slave ID, IP address and remote port of each Modbus TCP server device on the Ethernet ports must be configured. Additionally, the Ethernet protocol, TCP or UDP, of each Modbus TCP server device must be configured. A Default Gateway must be configured on the Network Settings page if any devices will be configured as Modbus TCP servers on a subnet different than that of the STRIDE Gateway Ethernet port.

For SGW-MB1524-T, which has two Ethernet ports, when the gateway's serial port is operating as an RTU or ASCII slave the Ethernet port through which each TCP server can be reached must be selected in the Ethernet Port Bind field.



Gateway Operating Settings:

- *Serial Port Mode: RTU Slave or ASCII Slave*
- *Slave ID: set the ID to match each Modbus TCP server (slave)*
- *Remote IP: enter the IP address of each Modbus TCP server (slave). A Default Gateway must be configured on the Network Settings page if any devices will be configured as Modbus TCP servers on a subnet different than that of the STRIDE gateway Ethernet port.*
- *Remote Port: enter the port number for each Modbus TCP server (slave). Each server must have a unique port number. This is a TCP or UDP port that will identify the server in the Modbus TCP packet.*
- *Protocol: select TCP or UDP*
- *Local Port: For UDP, this is the source port that will identify communication traffic for each slave ID. For TCP traffic the source port is automatically determined.*

- *Ethernet Port Bind: select Ethernet port E1 or E2 (model SGW-MB1524-T only). The Ethernet Port Bind is used by the Gateway when the Modbus TCP device IP address is not on the same subnet as the Gateway IP address.*

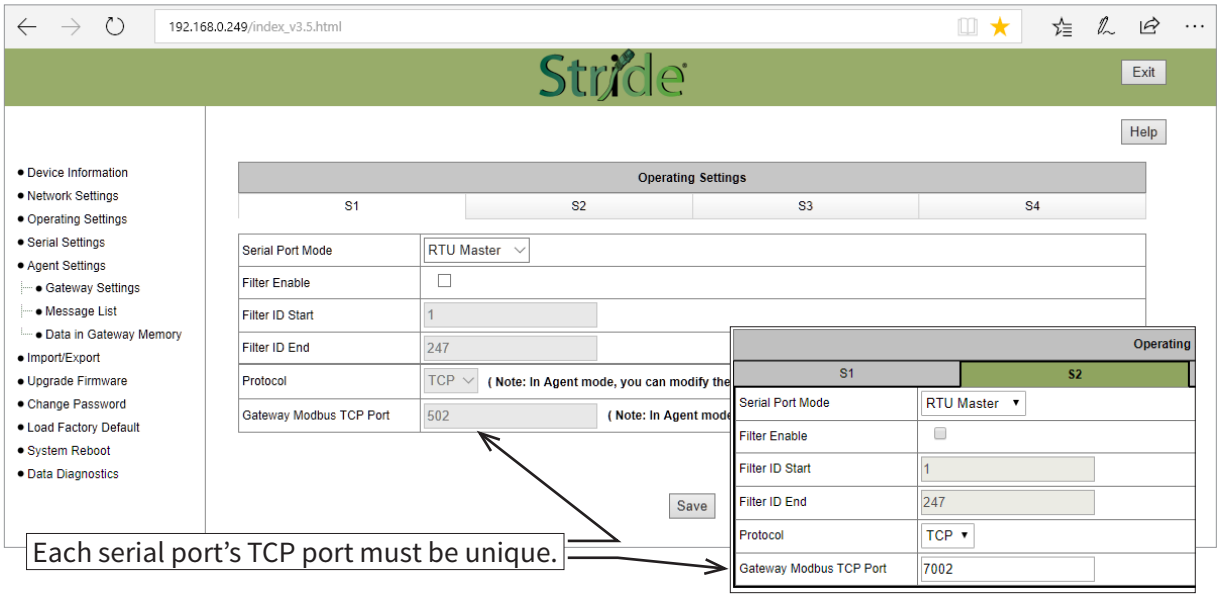
NOTE: Remember to click the SAVE button before you leave this page or switch to another serial port tab. Leaving the page or selecting another serial port before saving changes will cancel changes.

For Modbus TCP Master (Client) Device to Modbus RTU/ASCII Slave Devices

To connect a Modbus TCP client (master) device to one or more Modbus RTU or ASCII slave devices, the gateway serial port will function as an ASCII or RTU master.

In that case, the Ethernet Protocol (TCP or UDP) and Gateway Modbus TCP Port to associate with the serial port must be configured. When multiple serial ports are set as RTU Masters, a unique Gateway Modbus TCP port must be assigned to each serial port in order to differentiate the serial networks. For SGW-MB1524-T, a Modbus TCP client attached to either Ethernet port can communicate to RTU/ASCII slaves on the serial port using the configured Modbus TCP Port.

The Filter option will eliminate Slave ID numbers from the processed traffic when enabled. To enable the filter feature, check the Filter Enable box and enter the starting number and ending number of the nodes that should never appear in messages that will be processed.



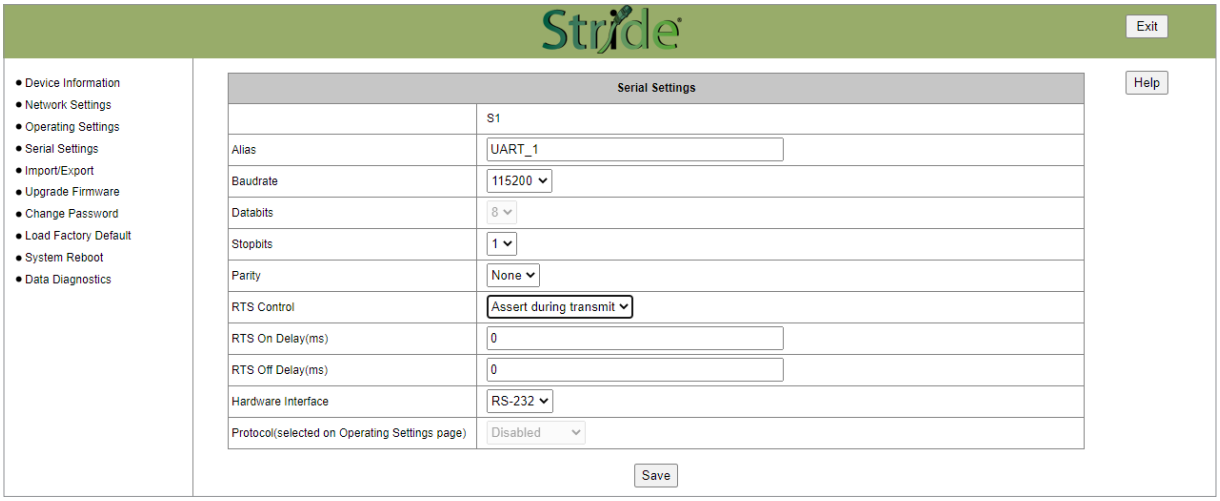
Gateway Operating Settings:

- *Serial Port Mode: RTU Master or ASCII Master*
- *Filter Enable: eliminate a range of Slave IDs from communication*
- *Filter ID Start: set lowest Modbus Slave ID to ignore (0-247, must be ≤ Filter ID End)*
- *Filter ID End: set highest Modbus Slave ID to ignore (0-247, must be ≥ Filter ID Start)*
- *Protocol: select TCP or UDP (When the Modbus Gateway is in Agent Mode, the protocol is set on the Gateway Settings page.)*
- *Gateway Modbus TCP Port: set the TCP port number to communicate with RTU/ASCII slaves on this serial port. (When the Modbus Gateway is in Agent Mode, the Gateway Modbus TCP Port is set on the Gateway Settings page.)*

NOTE: Remember to click the SAVE button before you leave this page or switch to another serial port tab. Leaving the page or selecting another serial port before saving changes will cancel changes.

Serial Settings

The Serial Setting page is where each serial port's communication parameters are configured.

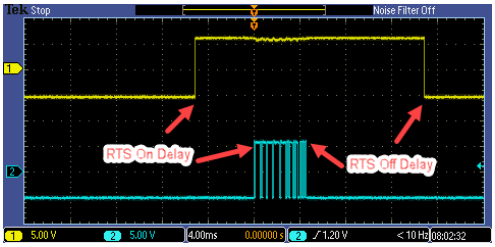


Serial Parameters:

- *Alias: serial port alias name. This is a convenience for your reference.*

The following settings must match the settings in all connected devices:

- *Baudrate: 300–460800bps, the default value is 115200bps*
- *Databits: 7 or 8 bits. The value is locked to 8 bits for RTU or 7 bits for ASCII serial modes.*
- *Stopbits: 1 or 2, the default value is 1*
- *Parity: Odd, Even or None, the default value is None*
- *RTS Control: On, Assert during Transmit, or Off; the default value is On.*
  In version 3.5.019 and newer, RTS control behaves as follows:
  - *RTS Off (default) - After the Gateway is powered up, the RTS signal goes false and stays false.*
  - *RTS On - After the Gateway is powered up, the RTS signal goes true and stays true all the time.*
  - *Assert during transmit - Although flow control is rarely required by Modbus RTU or Modbus ASCII networks, RTS control is occasionally needed for devices such as media converters and radio modems. In version 3.5.019 and newer, RTS control behaves as follows:*



In this mode, the RTS signal goes to false when the Gateway is powered up. When the Gateway is ready to transmit, the RTS signal will go true. The Gateway will then wait the specified amount of time from the "RTS On Delay(ms)" field before transmitting. After transmitting all the data in that packet, the Gateway will wait the specified amount of time from the "RTS Off Delay(ms)" field before setting the RTS signal to false. This cycle is repeated every time the Gateway transmits: no matter whether the Gateway is transmitting a request (in RTU/ASCII Master mode) or transmitting a response (in RTU/ASCII Slave mode).

- *Hardware Interface: RS-232, RS-485 or RS-422; the default value is RS-232*
- *Protocol (selected on Operating Settings Page): RTU Slave, ASCII Slave, RTU Master, ASCII Master*

NOTE: In some situations, such as a high amount of electrical noise, poor cabling, etc., it may be necessary to reduce the baud rate on the gateway module AND serial devices on the network.

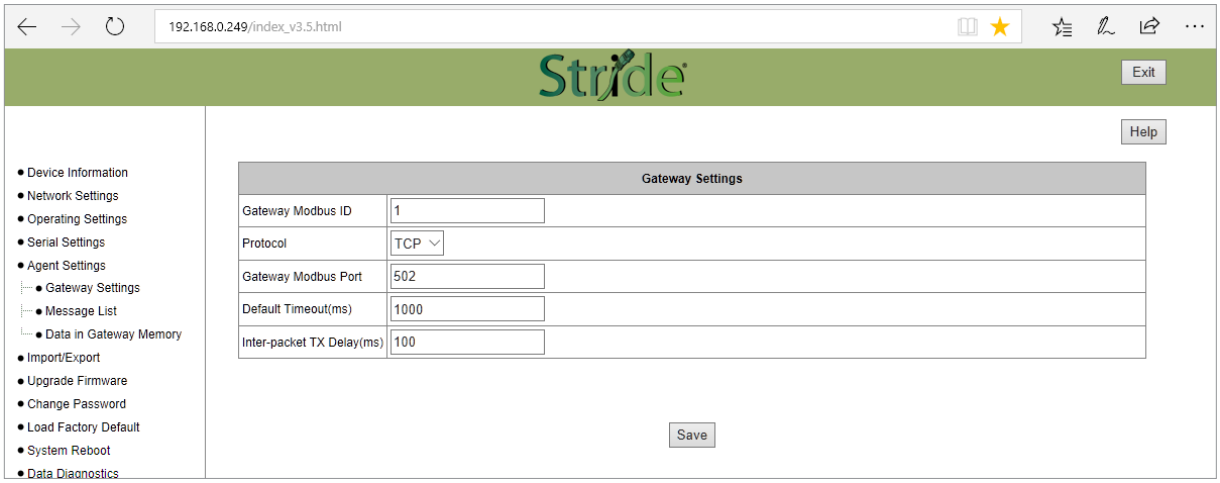
NOTE: Remember to click the SAVE button before you leave this page. Leaving the page before saving changes will cancel changes.

Agent Settings

The pages grouped in the navigation tree under Agent Settings configure the gateway to work in Agent mode, and are visible only when that mode is selected.

Gateway Settings

Configure the gateway Modbus ID, timeout, and inter-packet transmit delay.



Gateway Settings:

- *Gateway Modbus ID: Unique Modbus ID assigned to the gateway to allow clients to request data from the gateway's local cache, 1–247.*
- *Protocol: TCP or UDP.*
- *Gateway Modbus Port: set the TCP port number to communicate with RTU/ASCII slaves on this serial port.*
- *Default timeout (ms): default timeout before retrying a data request; default is 1000ms.*
- *Interpacket TX delay (ms): Poll Time setting for the delay between requests polling slave devices to populate local cache; default is 100ms.*

NOTE: Remember to click the SAVE button before you leave this page. Leaving the page before saving changes will cancel changes.

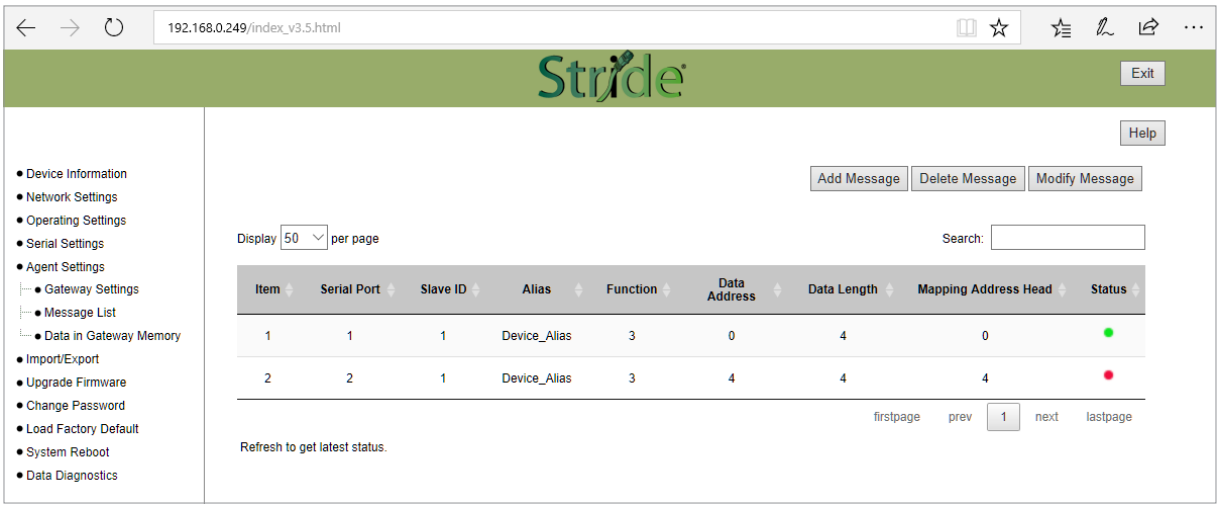
Message List

The Message List page displays a table that summarizes the data stored locally in the gateway's memory. Modbus client devices may request this data from the gateway's local cache.

NOTE: When the gateway is in Agent mode, addresses that devices will use to WRITE data into must be configured in the Message List even though conceptually this is a list of data that is READ from connected devices.

Configure and manage the message request list. A summary of configured messages is displayed, which can be filtered to display a subset of the list using the "Search" field.

From this page, messages can be added, deleted or modified.

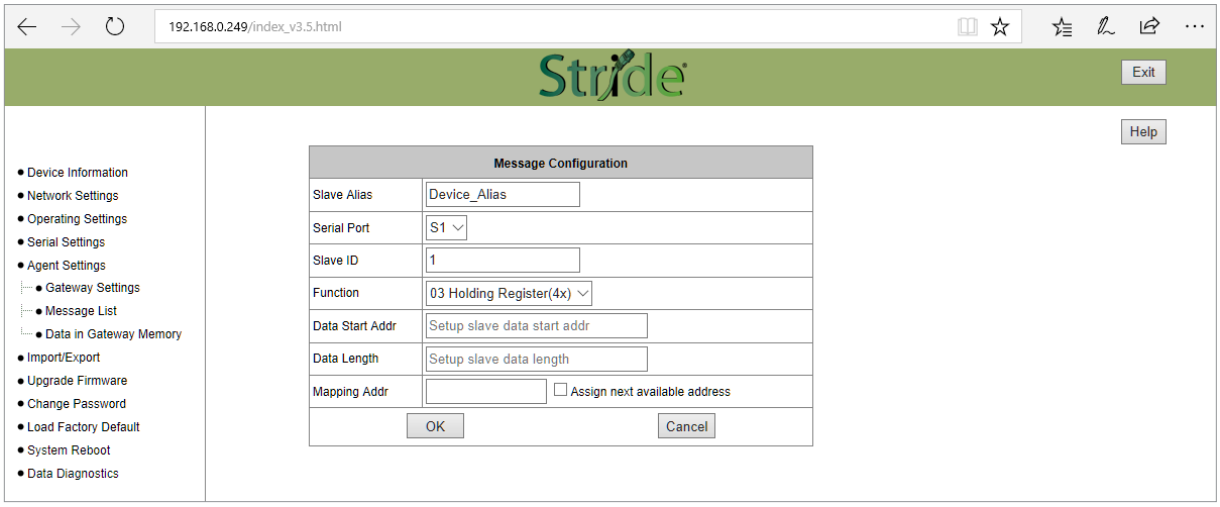


Each parameter of the Message List is explained in the Add Message section to follow.

A green dot in the Status column indicates that the message is successfully connected to its target device. A red dot indicates that it is not successfully connected. The web page must be manually refreshed to update the status indicator.

ADD MESSAGE

Clicking the "Add Message" button brings up a Message Configuration dialog box to configure a new message.



Add New Message Settings:

- *Slave alias: name for each device to help users recognize it more easily*
- *Serial port: the gateway serial port number to which the device is attached*
- *Slave ID: the device's Modbus node ID on the communication network*
- *Function: the Modbus protocol function code. Function codes are listed in the table below.*
- *Data Start Address: the address in the target device from which the gateway will read the data*
- *Data Length: the data block size the gateway will read*
- *Mapping Address: the location in the gateway's shared memory (cached data) from which the data will be retrieved when a Modbus TCP query is received. Ensure that this memory block does not overwrite a block configured for another message.*
- *Assign next available address: conveniently assigns the next available address to this request, to ensure data blocks do not overlap (overwrite).*

Modbus Functions				
Modbus Function Code	***Type***	***Address Range***	***Equivalent Modicon Style Addressing***	***Number of Elements***
1	Read Coil	0-65535	0001-065536	1-2000
2	Read Discrete Input	0-65535	100001-165536	1-2000
3	Read Holding Registers	0-65535	400001-465536	1-125
4	Read Input Registers	0-65535	300001-365536	1-125

There are several different ways of addressing when communicating to Modbus devices. **The *STRIDE*® gateways use the method of specifying a Function Code and start address as addresses.** Another way that is very common and is seen often in AutomationDirect products is the use of the Modicon style addressing. This method employs a PLC style address that contains a Modbus memory type in the highest digit of the address followed by the offset from 1. The table above shows comparable addresses for both of these addressing styles.

Delete Message

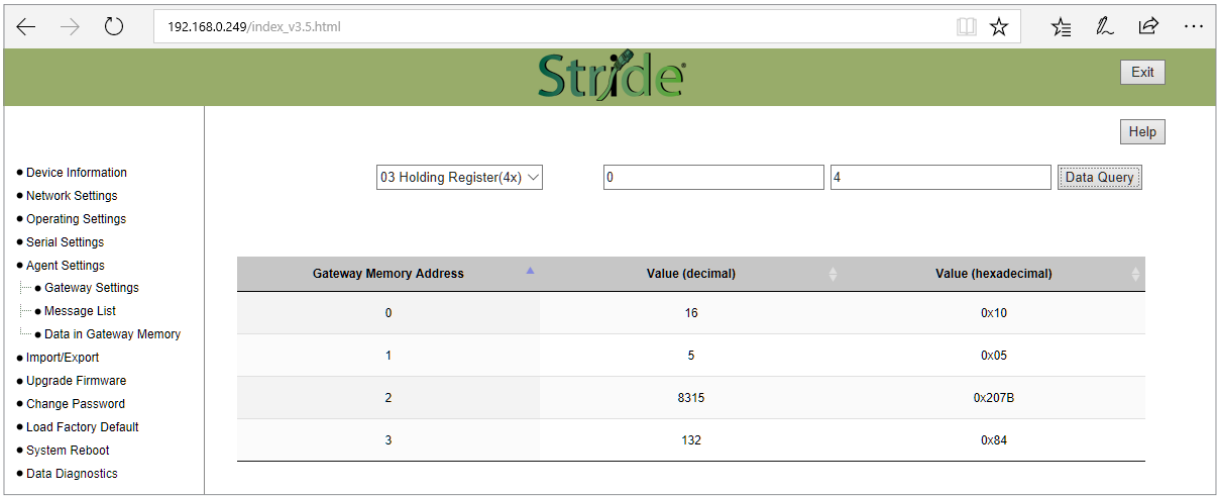
To delete a message from the list, click anywhere within the row of the message in the list, then click the “Delete Message” button. The message will be deleted immediately.

Modify Message

To modify an existing message from the list, click anywhere within the row of the message in the list, then click the “Modify Message” button. The Message Configuration dialog box will open, with the same options as presented when adding a new message.

Data in Gateway Memory

The Data in Gateway Memory page is available under Agent Settings when the gateway is in Agent mode. On the Data in Gateway Memory page, you may query the real-time data stored in the gateway’s local cache as configured on the Message List page.



To query the Modbus data stored in gateway memory:

1) Enter the Modbus function code (shown in the previous table).

2) Enter the starting address to query within the selected region. The Starting Address refers to the gateway internal address (0–65535) as shown in the previous table.

3) Enter the number of records to retrieve (data block size). Ensure that all addresses in that block are configured in the table on the Message List page. Querying data outside of those ranges will result in invalid values displaying on this page.

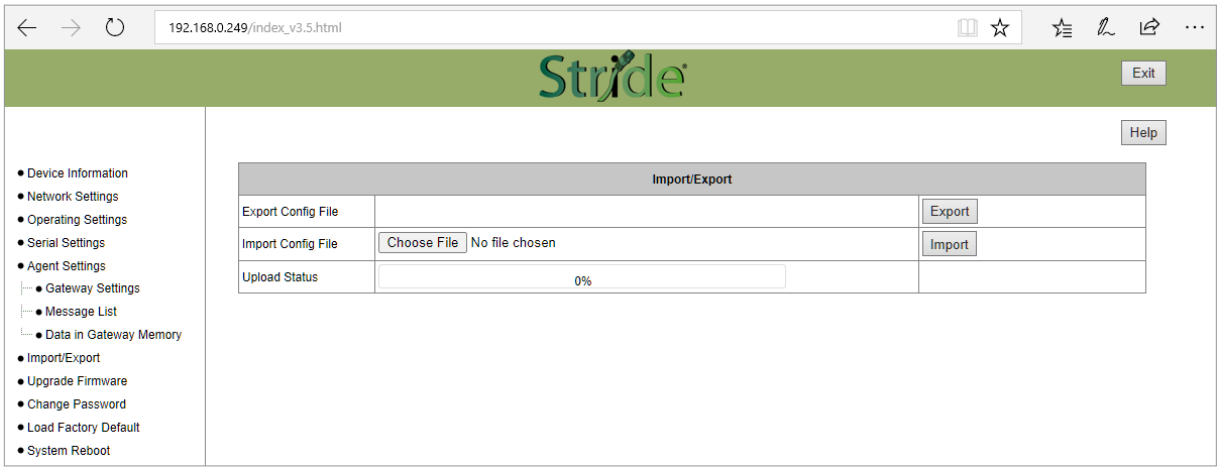
4) Click the “Data Query” button.

The results of the data query are displayed on the Data in Gateway Memory page, and are automatically updated in realtime. This page may be useful for troubleshooting the communications network.

IMPORT/EXPORT

The gateway configuration settings may all be stored to or loaded from a text file as a convenience when replacing the gateway or configuring multiple gateways with identical or similar settings.

Import/Export Screen



EXPORT

Export the configuration file to a connected PC for backup or for configuring additional gateways. The exported file can be edited by any text editor, such as Notepad++.

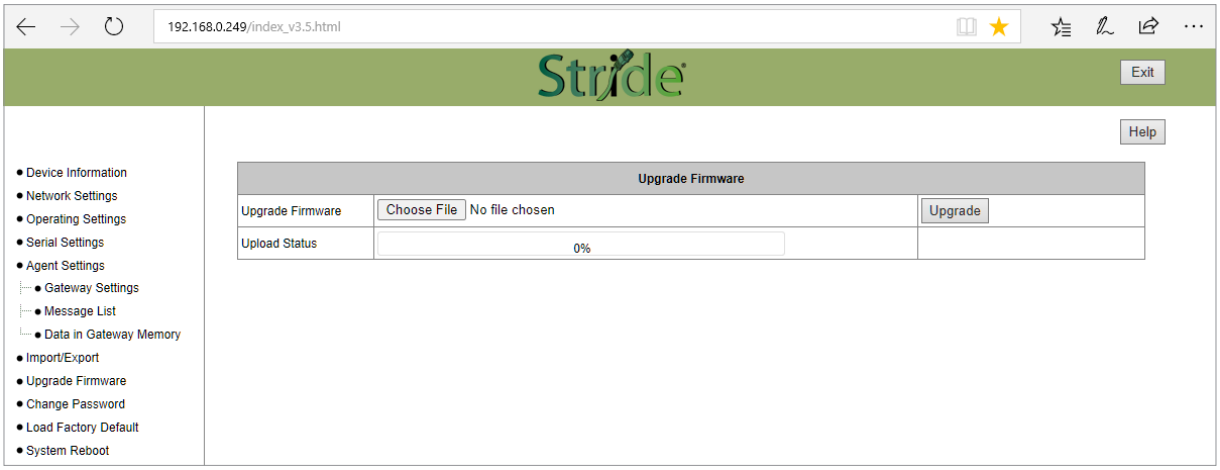
IMPORT

An exported configuration file can be used to format a replacement gateway, to format additional gateways, or the exported file can be modified and re-imported to the same gateway to revise device settings. The filename must be [the part number].txt which is the same as an exported configuration filename: SGW-MB1511-T.txt or SGW-MB1512-T.txt or SGW-MB1524-T.txt

Upgrade Firmware

Occasionally firmware revisions are released to make new features available or to fix bugs.

Upgrade Firmware Screen

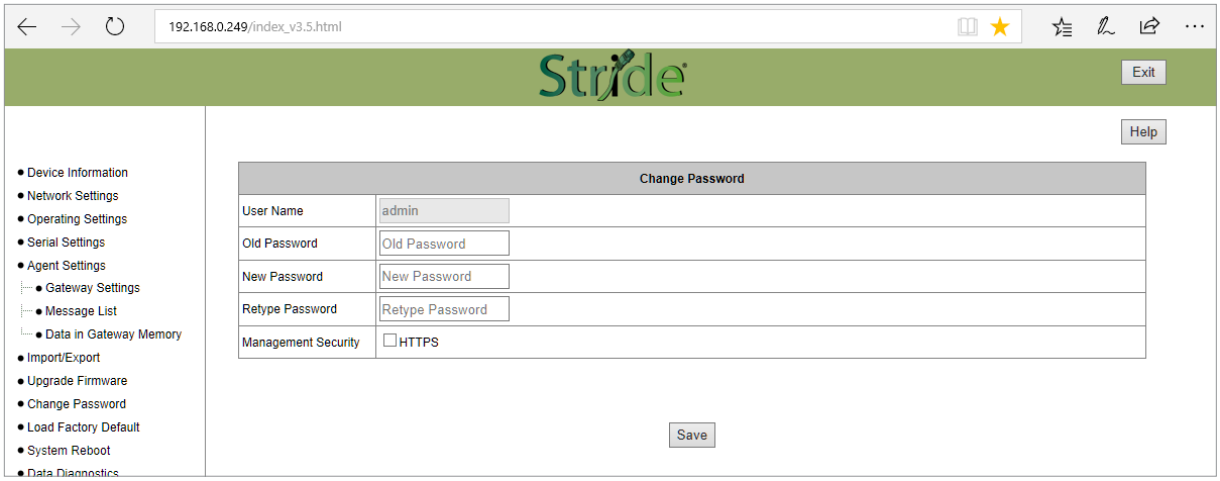


To update the firmware, click Browse to locate and select the new firmware file on your PC, then click Upgrade.

The gateway must be rebooted after firmware is upgraded in order for the new firmware to take effect.

Change Password

The *STRIDE®* gateways allow browser management access for the username "admin". The default password is admin. To provide an additional level of security, the password may be changed.



*SECURITY NOTE: HTTPS may be selected to encrypt the traffic between the browser and the gateway. When HTTPS is selected, the IP address in the browser address bar must be preceded by "**https://**".*

For example, "https://192.168.0.249".

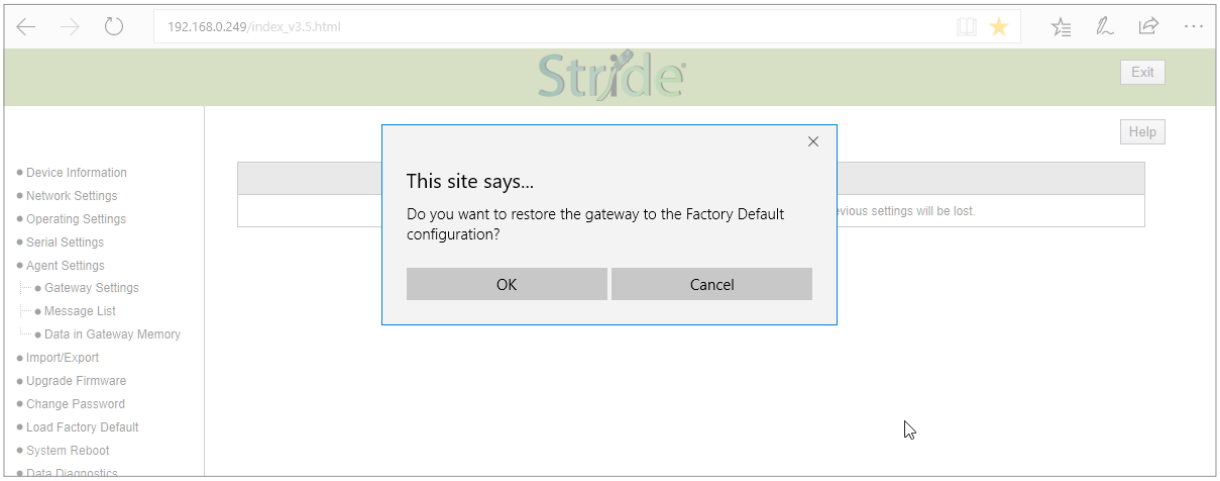
When a new password is entered here or HTTPS is selected, the browser will log you out of the current session and return you to the login page to login using the new password.

NOTE: Make sure to record the new password. If the password is lost, the gateway must be reset to factory defaults using the hardware reset button.

NOTE: Remember to click the SAVE button before you leave this page. Leaving the page before saving changes will cancel changes.

Load Factory Default

In addition to the hardware Reset Defaults button on the top of the gateway, default settings may be loaded from the browser interface. Upon clicking the “Load Factory Default” button, the gateway will ask for confirmation of the changes then reboot in order for the change to defaults to take effect.



NOTE: This will reset the IP address(es), the password and the HTTPS access. If the device IP address had been previously changed, its default IP address after loading factory defaults may not be accessible by your current PC settings.

REBOOT

The Reboot option will reboot the gateway. Rebooting here, or cycling power at the gateway itself, is required after a firmware upgrade to make the new firmware take effect. All other configuration changes are implemented without requiring a reboot.

Application Examples

In This Chapter...

Example 1:
Using Modbus Poll to STRIDE Modbus Gateway with BRX Slave A–2
Example 2:
Using Modbus Poll to STRIDE MB Gateway with CLICK Slave A–9
Example 3:
Using P3000 as Master (Client) to STRIDE Modbus Gateway with CLICK Slave. A–17

Example 1:
Using Modbus Poll to *STRIDE* Modbus Gateway with BRX Slave

This example will illustrate how to use Modbus Poll, which is a PC-based Modbus master simulator tool, to connect through the *STRIDE*® Modbus Gateway to a BRX PLC via 2-wire RS-485. For simplicity in this example, the gateway will be configured in Transparent Mode.

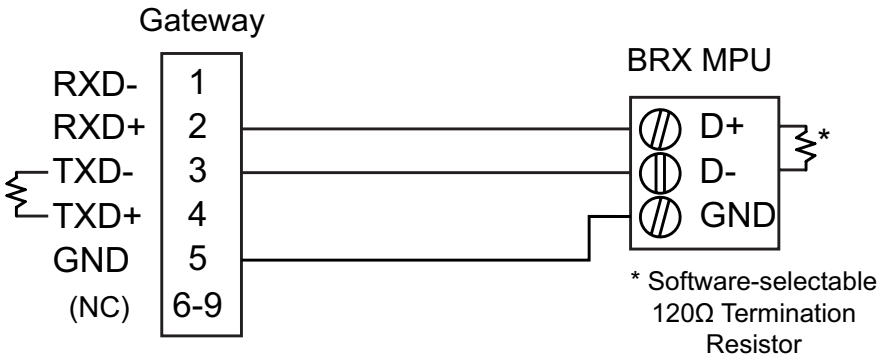
Items needed for this example:

- *STRIDE Modbus Gateway*
- *BRX PLC (any model)*
- *PC with Modbus Poll installed (free demo is available at www.modbustools.com)*
- *AutomationDirect ZL-DB9F-CBL-2P D-sub 9-pin pigtail cable, or small length of AutomationDirect L-19954 RS-485 cable or equivalent and D-sub 9-pin socket (female) connector*
- *Ethernet switch and cables to connect from the PC to STRIDE Modbus Gateway*

Step 1: Connect the STRIDE Modbus Gateway serial port to the BRX MPU serial port.

Using the ZL-DB9F-CBL-2P cable, or D-sub 9-pin connector and a short length of RS-485 cable, connect Serial Port 1 of the *STRIDE* Modbus Gateway to the BRX serial port as shown:

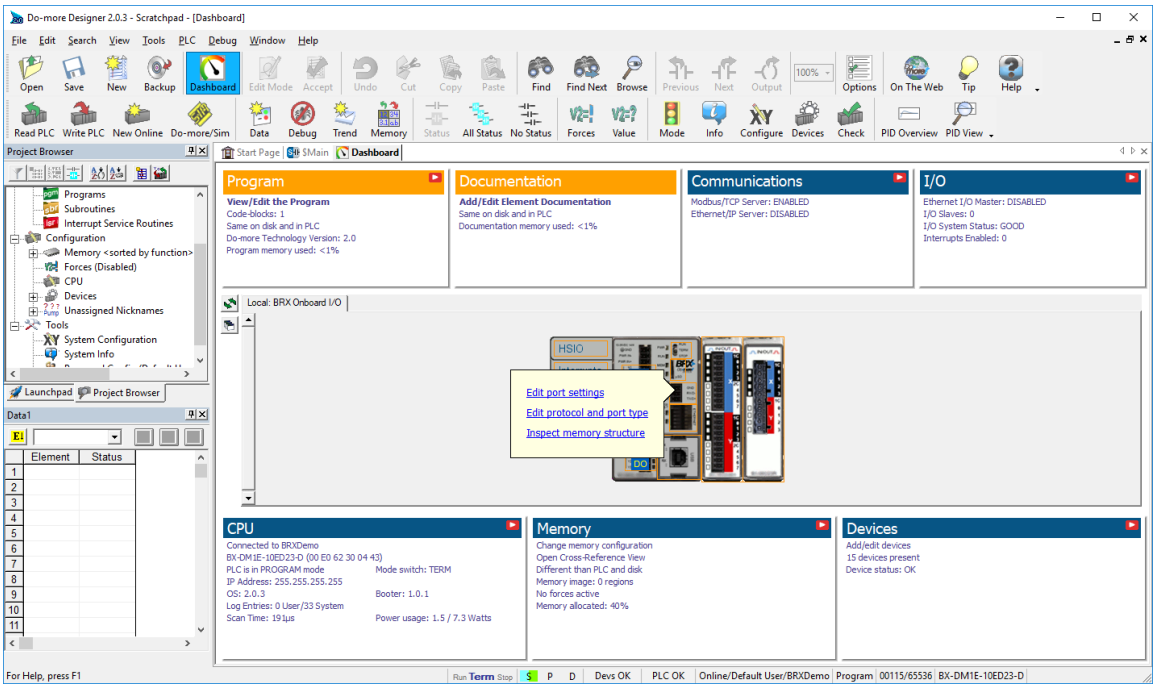
RS-485 2-wire Wiring Diagram



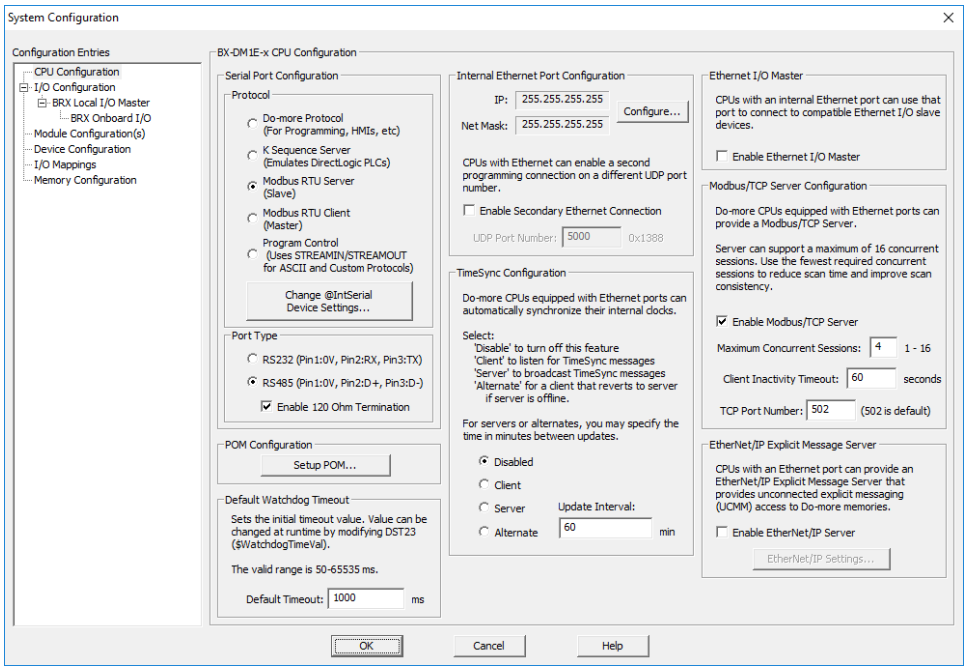
The Gateway contains a DIP switch selectable 120Ω Termination Resistor between TX+ and TX- for each serial port on RS485 2-wire, when the Gateway is wired at one end of the serial network

Step 2: Configure the BRX MPU serial port.

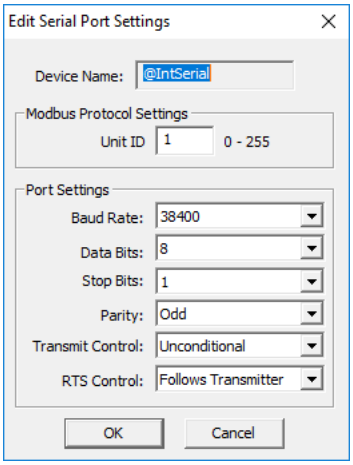
Connect to the BRX MPU with BRX Do-more! Designer software using either the BRX serial or USB Pluggable Option Module.



Click on the built-in serial port on the image of the BRX MPU within the Do-more! Designer software. From the dialog box that pops up, select "Edit Protocol and Port Type"



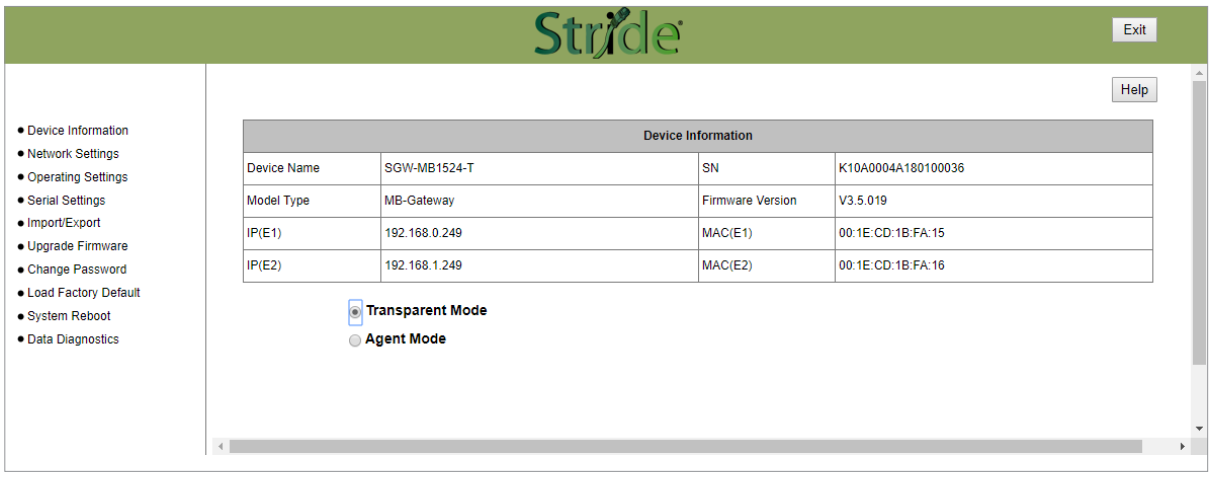
In the Serial Port Configuration column, select "RS-485" under "Port Type" and select "Modbus RTU server (slave)" under "Protocol". Then click "Change @IntSerial Device Settings..."



Setup the port as shown for 38400 baud rate, Odd parity, 1 Stop bit and Unit ID 1. Match everything else as shown. Note the Unit ID configured in the PLC. Once this has been done, click "OK" to close this dialog then "OK" again to close the preceding dialog.

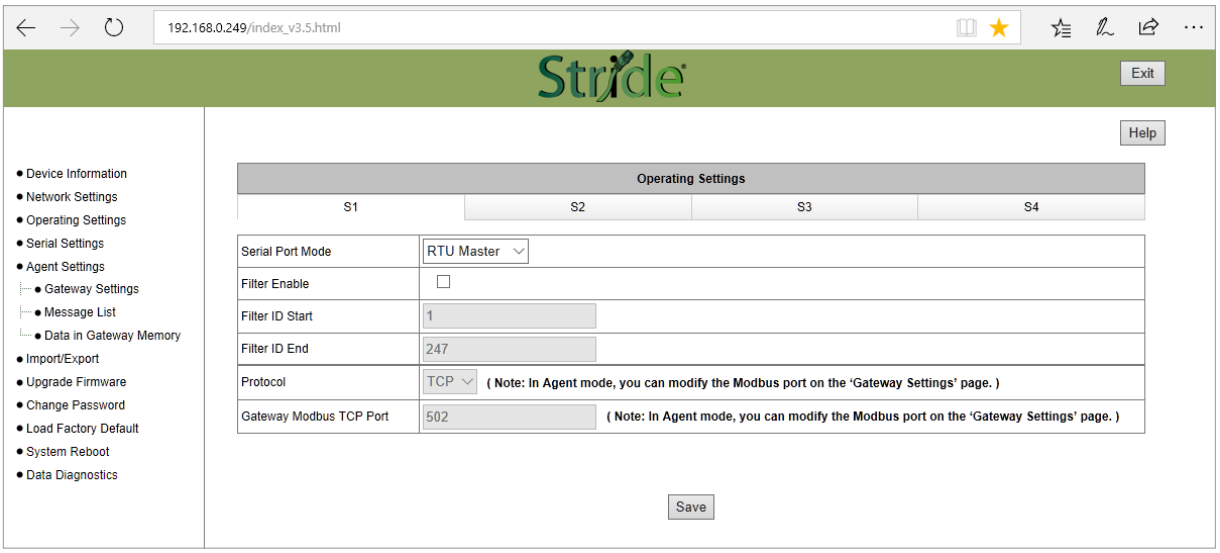
STEP 3: CONFIGURE THE STRIDE MODBUS GATEWAY

Open up a web browser, such as Internet Explorer, enter in the IP address of the *STRIDE* Modbus Gateway, and log into the *STRIDE* Modbus Gateway web console as described in the Initial Connection section of Chapter 3 to access the Device Information as shown:

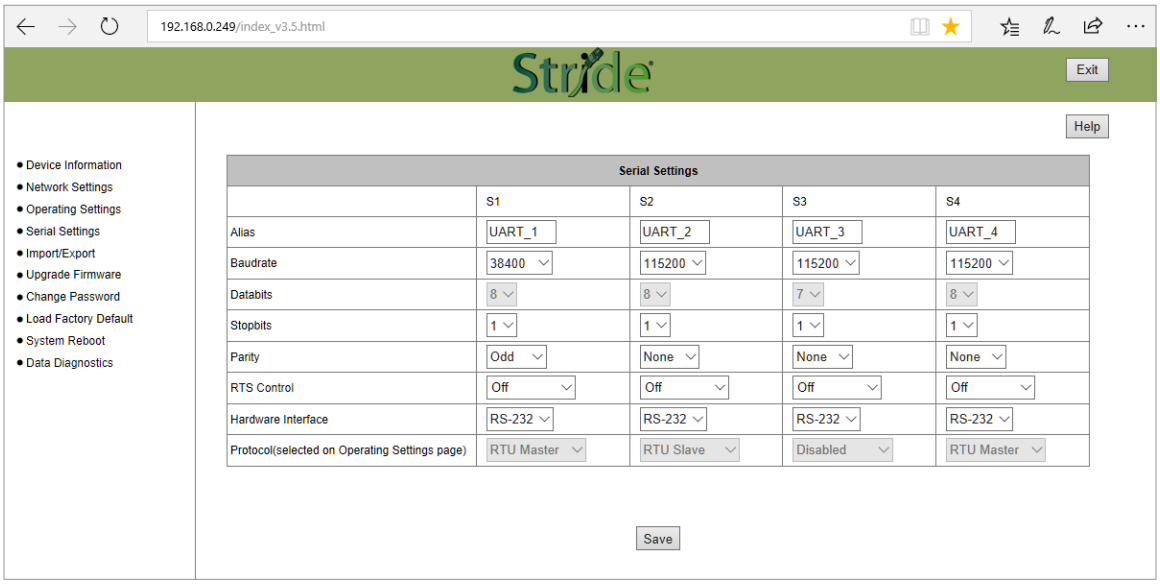


Set the gateway to Transparent Mode.

On the Operating Settings page, set Serial Port 1 to RTU Master mode as shown below and click Save.



Click "Serial Settings" from the navigation menu



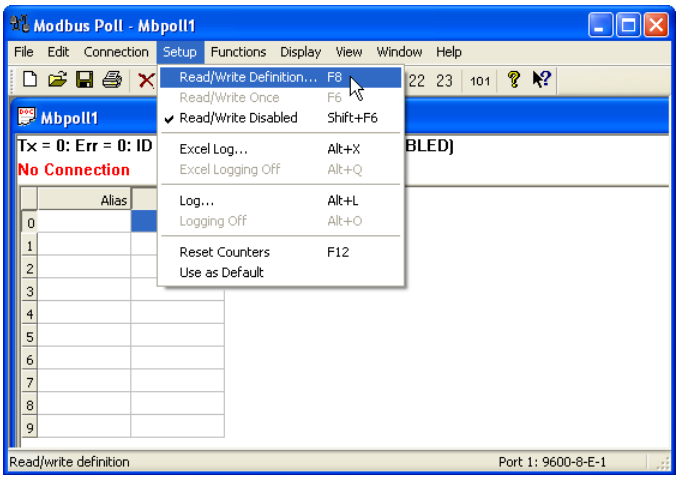
Set the serial port parameters to match the configuration of the BRX MPU, and set the hardware interface to RS-485 2-wire.

Click "Save" to store and apply the settings.

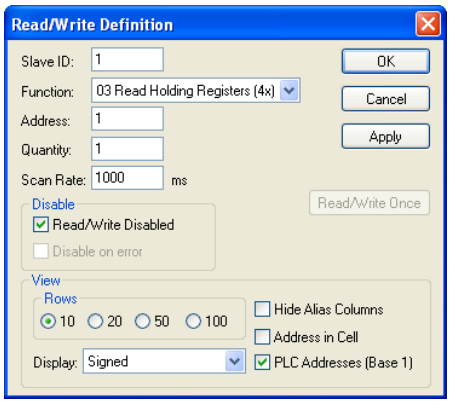
Step 4: Connect to the STRIDE Modbus Gateway using the Modbus Poll simulator software.

Once the software has been obtained from www.modbustools.com and installed according to the directions provided from their website, open up the Modbus Poll software.

Click on the Setup pulldown menu and select Read/Write Definition as shown:



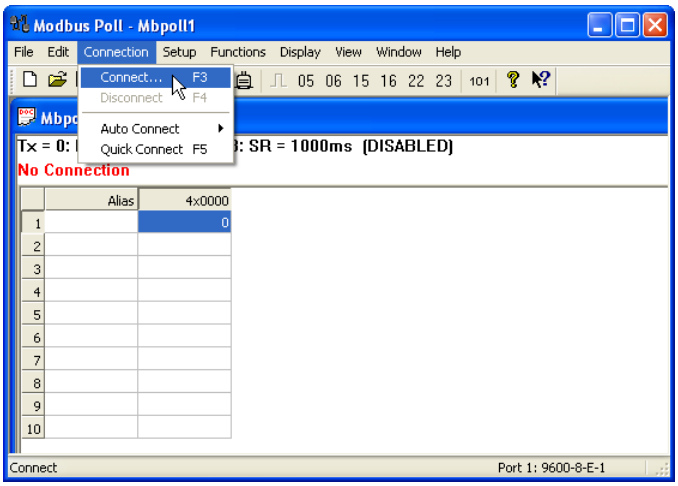
Configure the Read/Write definition for a simple read of the register 400001, which equates to MHR1 (16 bit word, decimal data type) in the BRX MPUs.



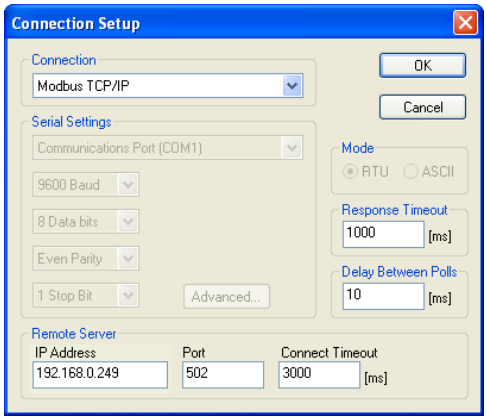
*Enter 1 for the Slave ID. This matches the Unit ID in the protocol that will determine which Modbus Serial slave will be targeted on the serial side of the **STRIDE** Modbus Gateway. Entering 1 here will match up to the Station Number configured above in Do-more! Designer for the BRX MPU.*

Choosing Function 3 sets up the read for 4xxxxx registers. Checking the "PLC Addresses (Base 1)" in the lower right corner matches the addressing to the cross reference chart mentioned above. Once this windows has been configured as shown above, click on OK.

Now click on the Connection pulldown menu and select Connect:

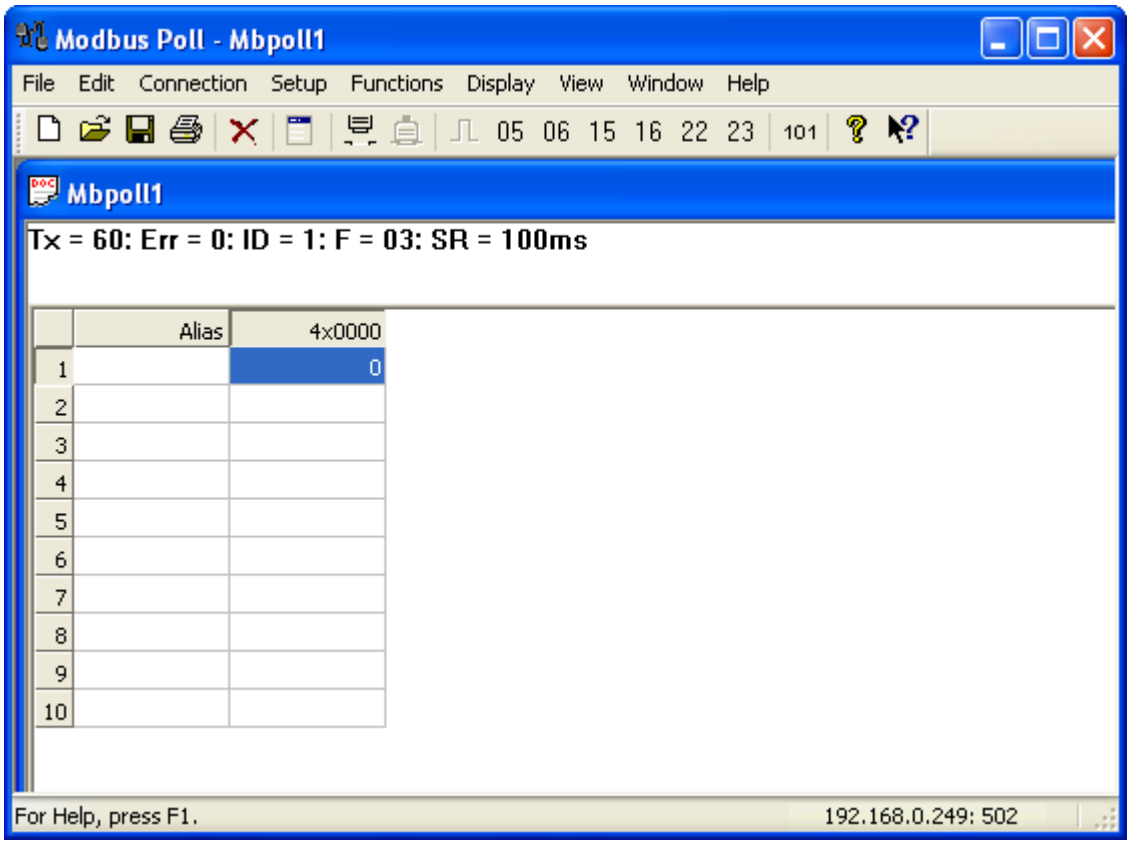


In the Connection Setup window, choose the Modbus TCP/IP connection type. Enter the IP address of your *STRIDE* Modbus Gateway module in the lower left hand corner. Match everything else as shown:



Click on OK to connect to the *STRIDE* Modbus Gateway.

If everything has been configured correctly, the counter next to “TX =” will increment rapidly and the counter next to “Err =” will not increment. If the Error counter is incrementing, go back and verify that all the steps prior to this one have been followed. If you get an error that says, “Modbus TCP connection failed”, verify that the IP address of the PC and the IP address of the *STRIDE* Modbus Gateway are in compatible subnets and can communicate.



Once Modbus Poll is communicating to the PLC, go into Do-more! Designer, open a Data View window and enter MHR1. Change the display type to “Decimal” to match the Modbus Poll

Change the value in data view for MHR1 to various values and watch the value change in Modbus Poll to match.

Example 2:
Using Modbus Poll to *STRIDE* MB Gateway with CLICK Slave

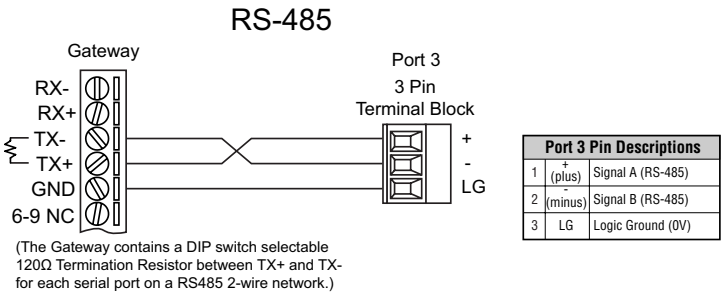
This example will illustrate how to use Modbus Poll, which is a PC based Modbus master simulator tool, to connect through the *STRIDE* Modbus Gateway to a CLICK PLC via 2 wire RS-485.

Items needed for this example:

- *STRIDE Modbus Gateway*
- *CLICK PLC (any C0-01xx-x or C0-02xx-x PLC with 3 pin terminal RS-485 port)*
- *PC with Modbus Poll installed (free demo is available at www.modbustools.com)*
- *Small length of AutomationDirect L-19954 RS-485 cable or equivalent*
- *Ethernet switch and cables to connect from the PC to STRIDE Modbus Gateway*

Step 1: Connect the STRIDE Modbus Gateway serial port to Port 3 of the CLICK PLC.

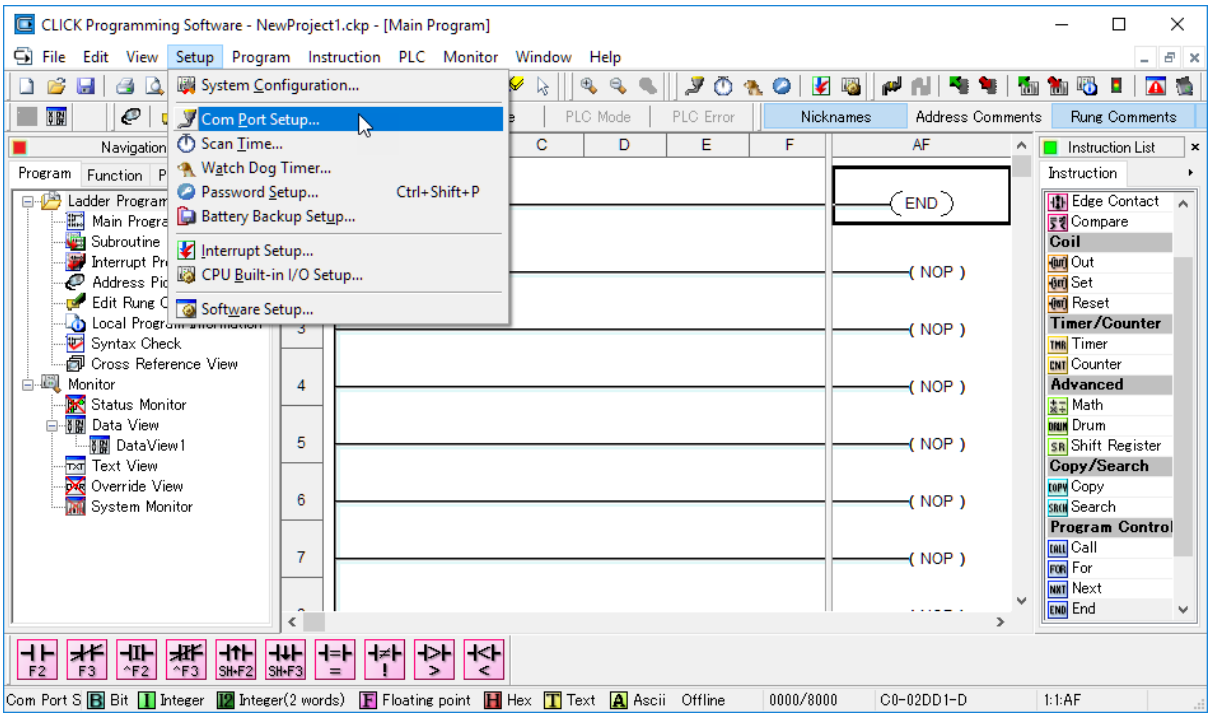
Using the short length of RS-485 cable, connect the *STRIDE* Modbus Gateway to CLICK's Port 3 as shown:



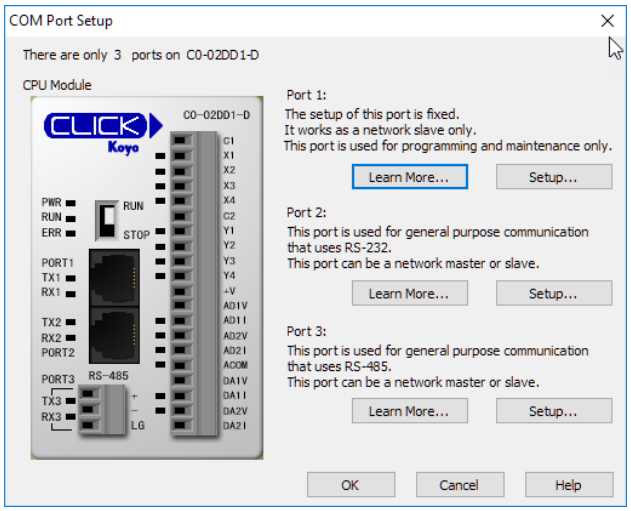
Port 3 Pin Descriptions		
1	+ (plus)	Signal A (RS-485)
2	- (minus)	Signal B (RS-485)
3	LG	Logic Ground (0V)

Step 2: Configure the CLICK serial port.

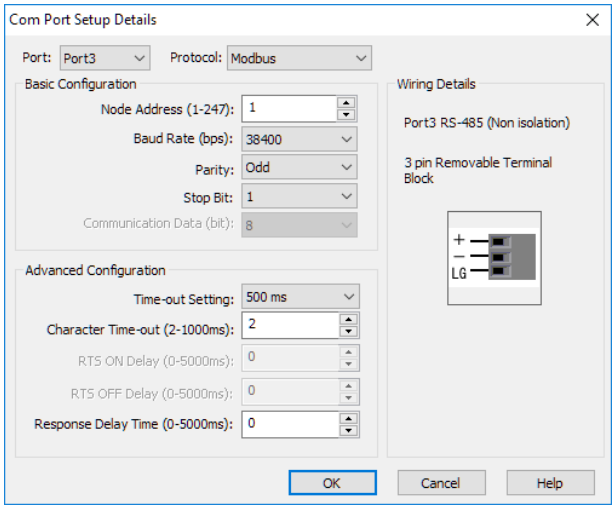
Connect to the CLICK PLC with CLICK programming software. Go to the Setup pulldown and select Com Port Setup... as shown:



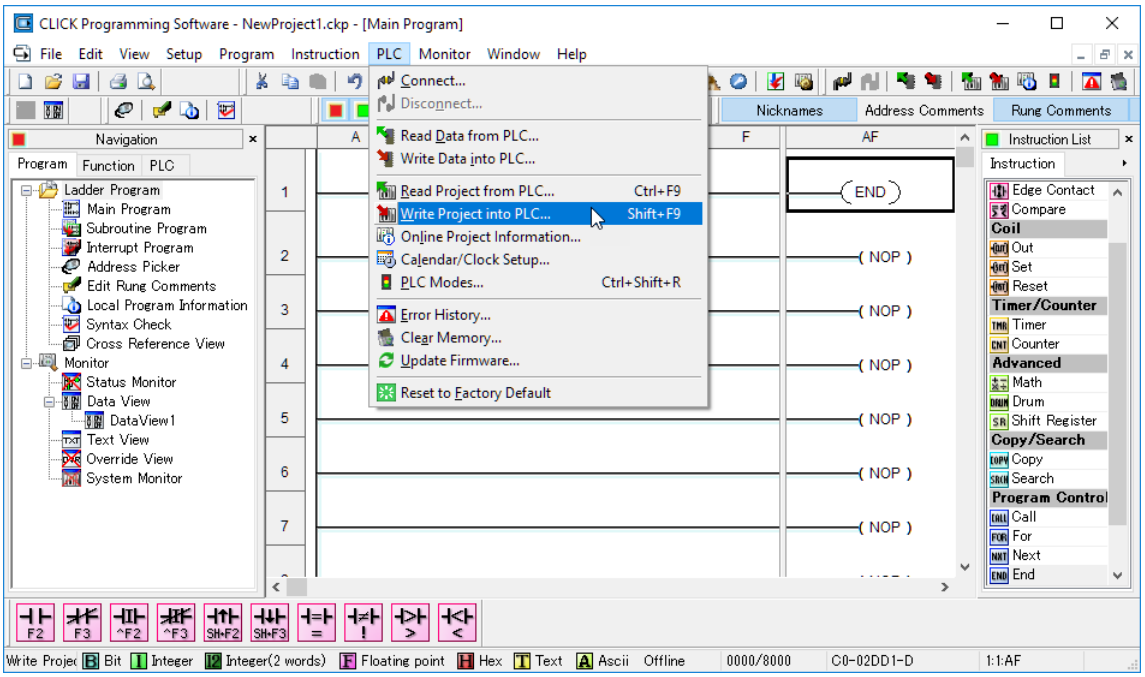
Click the Port 3: Setup... button to configure Port 3 of the PLC.



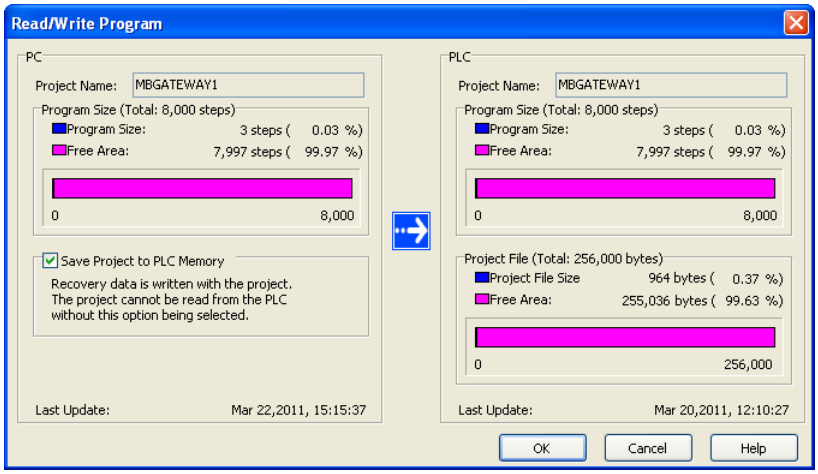
Configure the port for 38400 baud rate, Odd parity, 1 Stop Bit and Node Address 1. Leave the other settings as shown below. Note the Node Address number configured here. Once the settings are configured, Click on the Ok button.



Next, transfer the project to the PLC for the Port 3 settings to take effect. Select the PLC pulldown menu and choose Write Project into PLC...

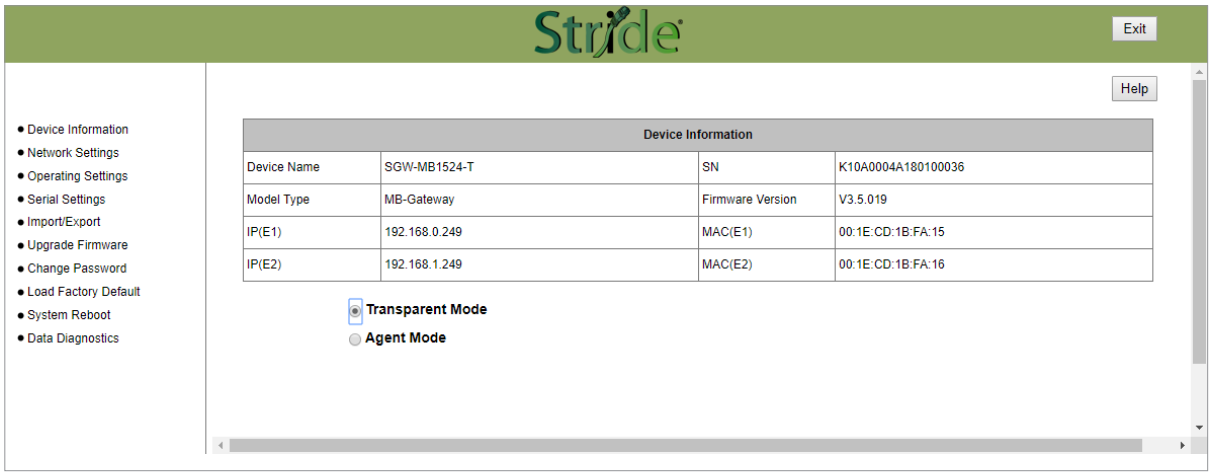


Choose Ok and follow the steps when prompted to transfer the project to the PLC.



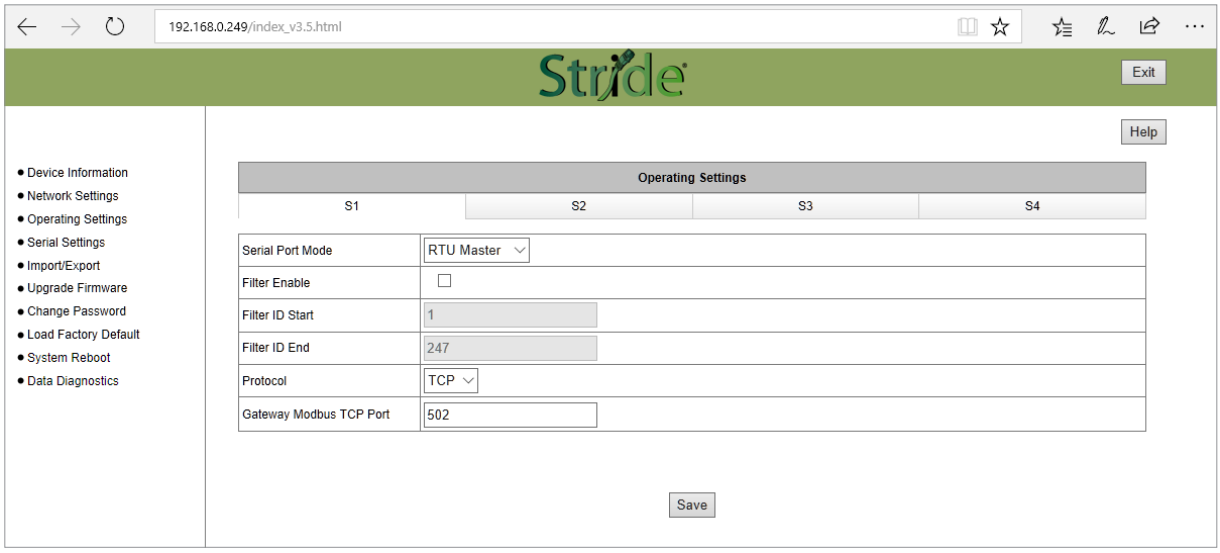
STEP 3: CONFIGURE THE STRIDE MODBUS GATEWAY

Open up a web browser, such as Internet Explorer, enter in the IP address of the *STRIDE* Modbus Gateway, and log into the *STRIDE* Modbus Gateway web console as described in the Initial Connection section of Chapter 2 to access the Device Information as shown:

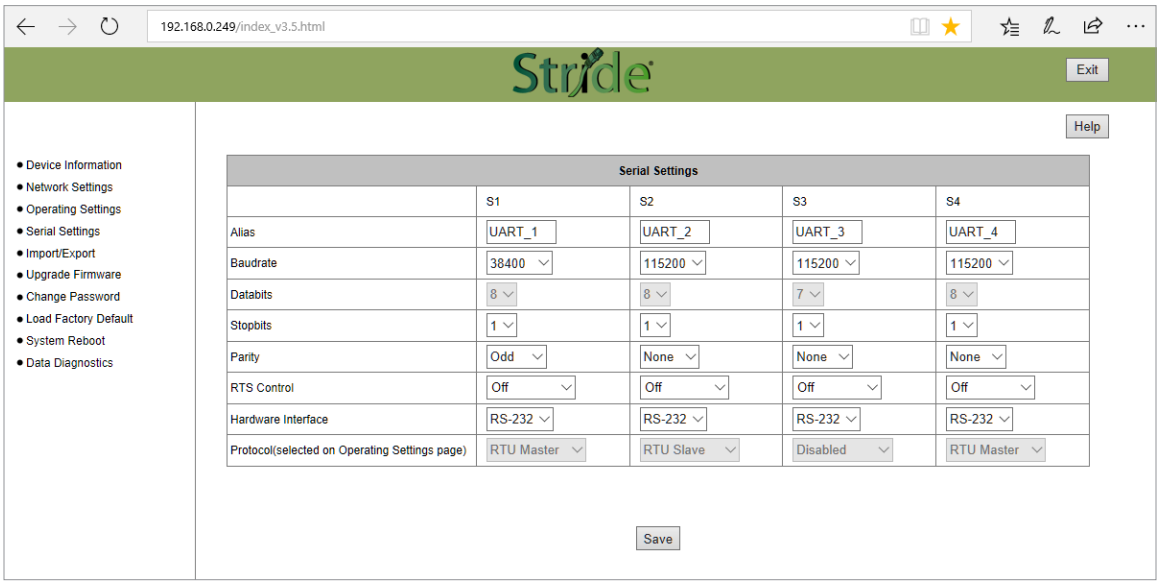


Set the gateway to Transparent Mode.

On the Operating Settings page, set Serial Port 1 to RTU Master mode as shown below and click Save.



Click "Serial Settings" from the navigation menu



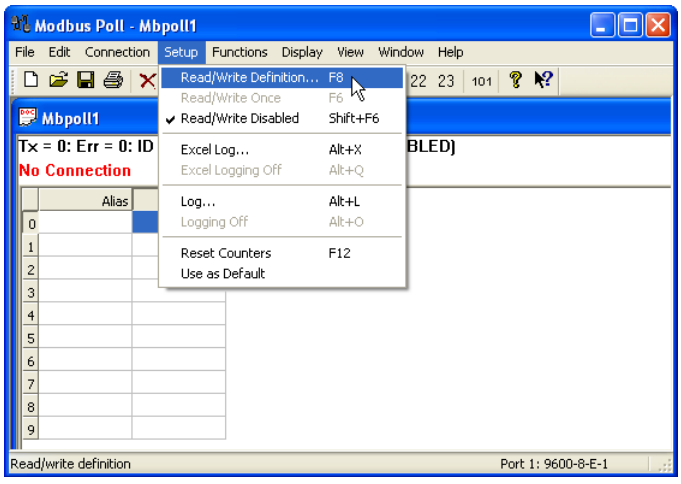
Set the serial port parameters to match the configuration of the CLICK PLC, and set the hardware interface to RS-485 2-wire.

Click "Save" to store and apply the settings.

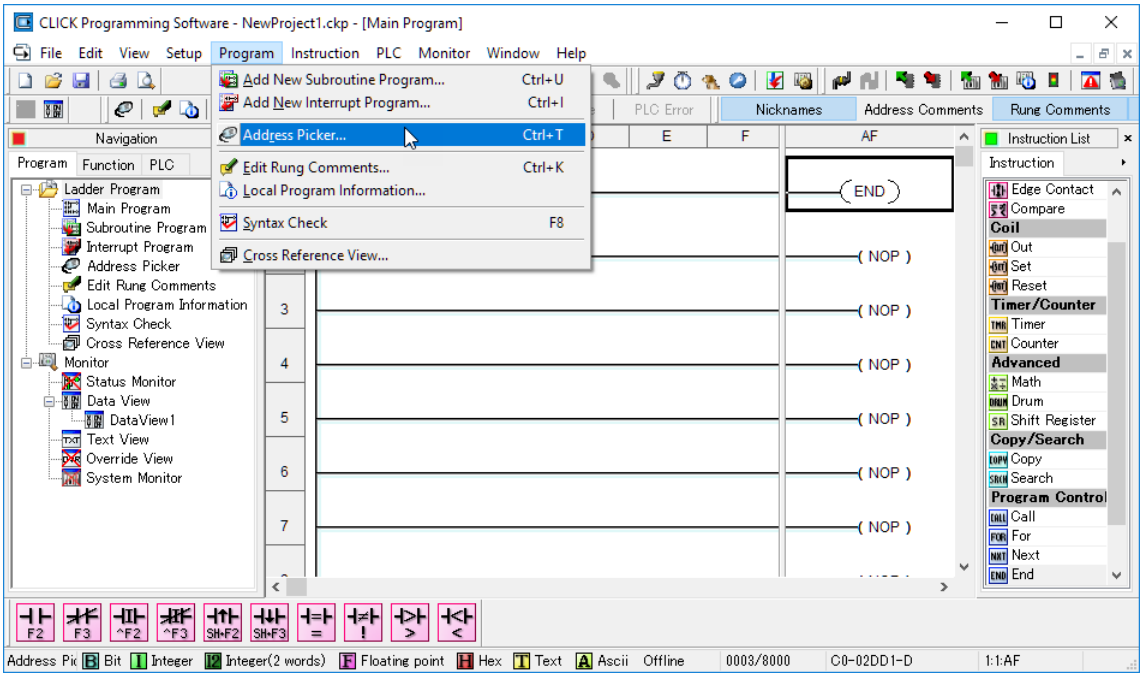
STEP 4: CONNECT TO THE STRIDE MODBUS GATEWAY USING THE MODBUS POLL SIMULATOR SOFTWARE.

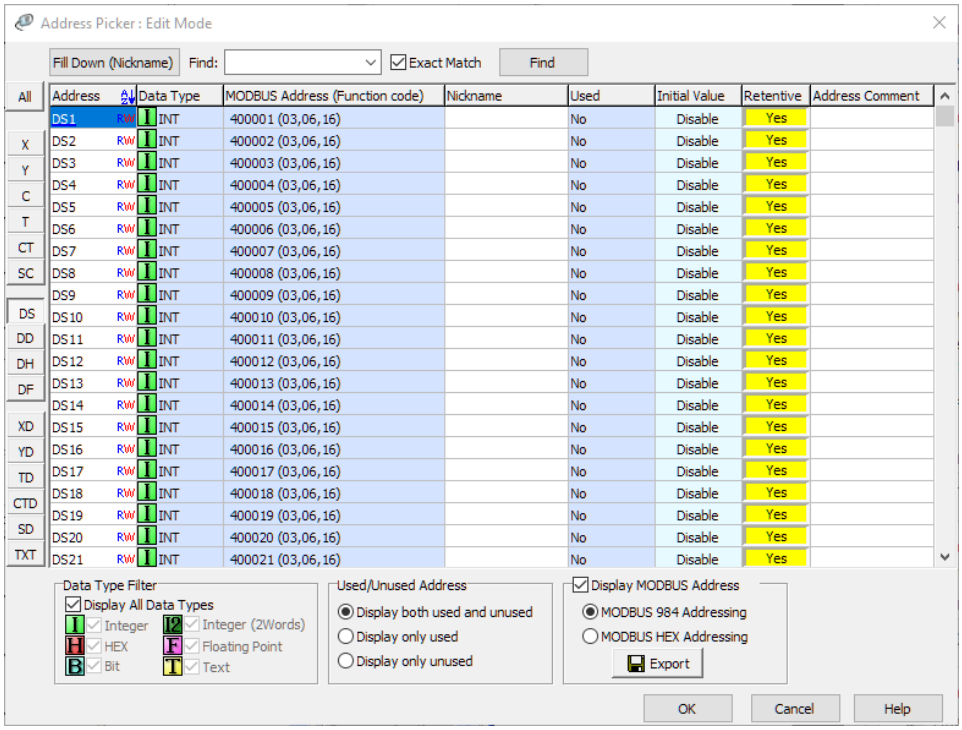
Once the software has been obtained from *www.modbustools.com* and installed according to the directions provided from their website, open up the Modbus Poll software.

Click on the Setup pulldown menu and select Read/Write Definition as shown:



Configure the Read/Write definition for a simple read of the register 400001, which equates to DS1 in the CLICK PLC as shown.

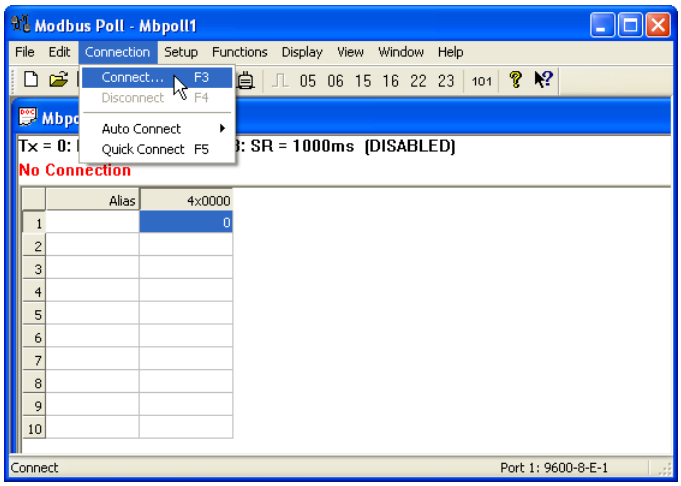




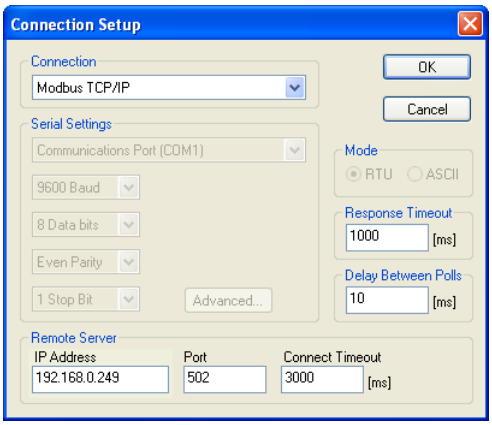
*Enter 1 for the Slave ID. This matches the Unit ID in the protocol that will determine which Modbus Serial slave will be targeted on the serial side of the **Stride** Modbus Gateway. Entering 1 here will match up to the Station Number configured above in the CLICK software.*

Choosing Function 3 sets up the read for 4xxxxx registers. Checking the "PLC Addresses (Base 1)" in the lower right corner matches the addressing to the cross reference chart mentioned above. Once this window has been configured as shown above, click on OK.

Now click on the Connection pulldown menu and select Connect:

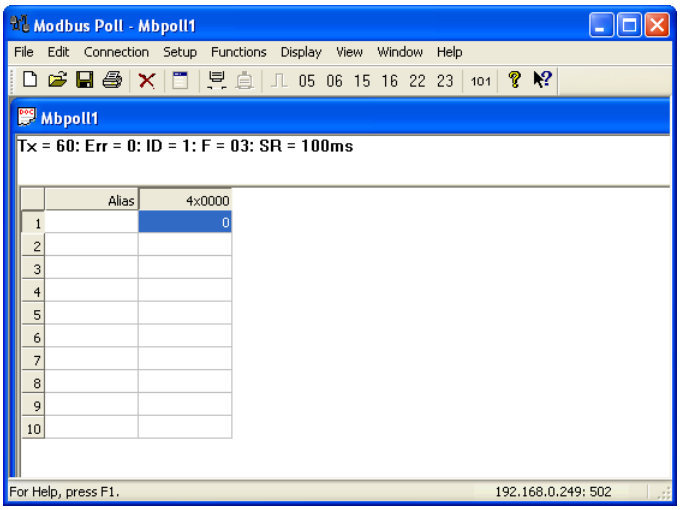


In the Connection Setup window, choose the Modbus TCP/IP connection type. Enter the IP address of your *STRIDE* Modbus Gateway module in the lower left hand corner. Match everything else as shown:

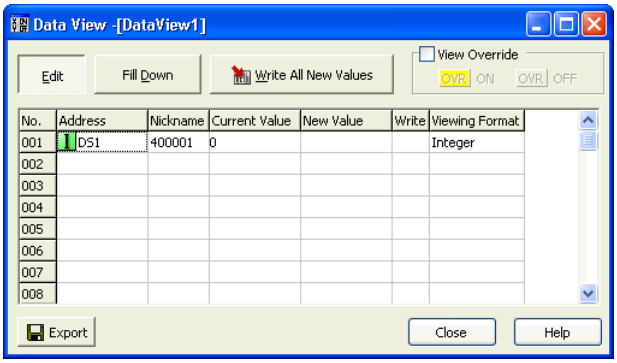


Click on OK to connect to the *STRIDE* MB Gateway.

If everything has been configured correctly, the counter next to "TX =" will increment rapidly and the counter next to "Err =" will not increment. If the Error counter is incrementing, go back and verify that all the steps prior to this one have been followed. If you get an error that says, "Modbus TCP connection failed", verify that the IP address of the PC and the IP address of the *STRIDE* Modbus Gateway are in compatible subnets and can communicate.



Once Modbus Poll is communicating to the PLC, go into the CLICK programming software, open up a Data View window and enter in DS1 as shown.



Change the value in data view for DS1 to various values and watch the value change in Modbus Poll to match.

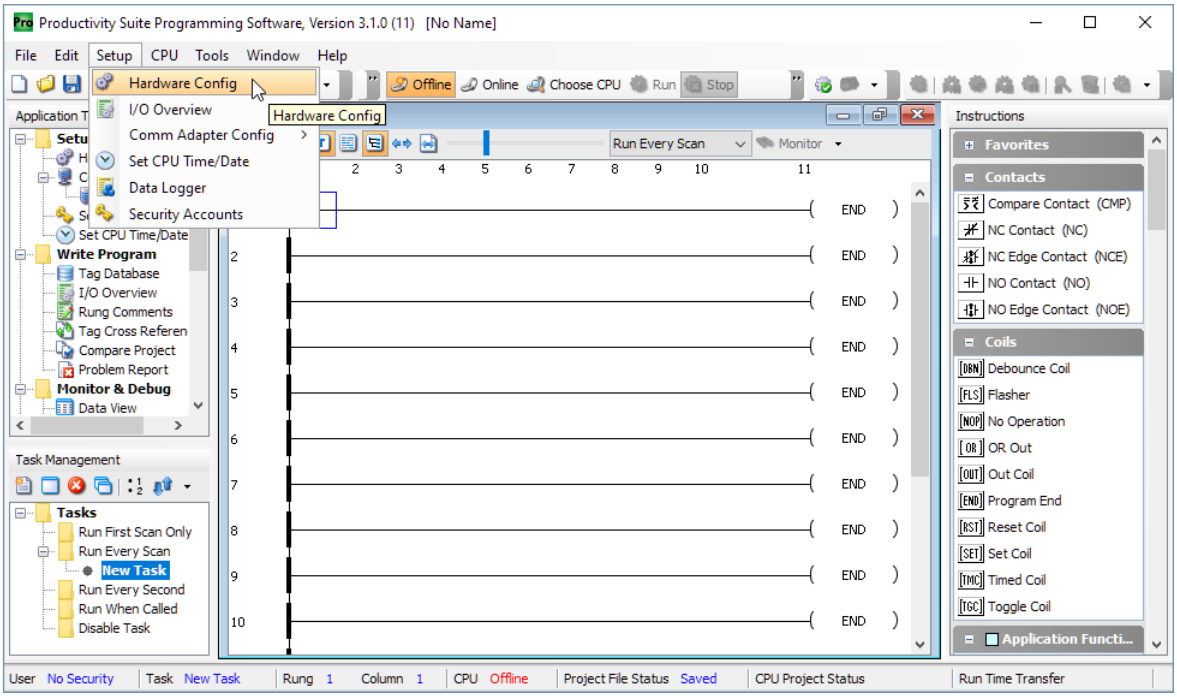
EXAMPLE 3:
USING P3000 AS MASTER (CLIENT) TO *STRIDE* MODBUS GATEWAY WITH CLICK SLAVE.

STEP 1: CONNECT CLICK TO THE STRIDE MODBUS GATEWAY AS SHOWN IN EXAMPLE 2.

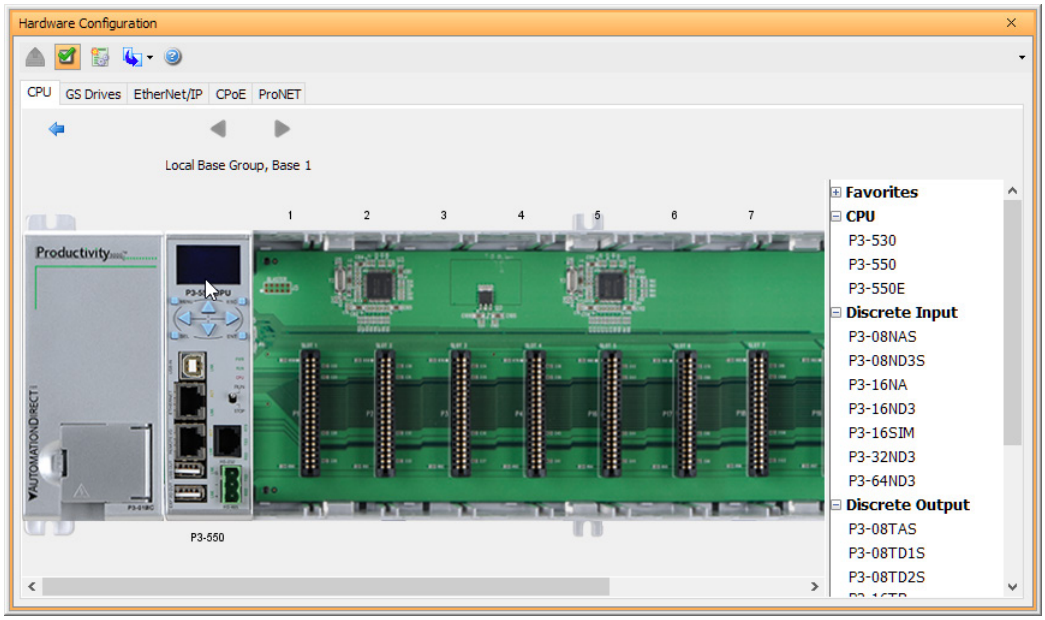
STEP 2: CONNECT P3000 CPU (P3-550) TO STRIDE MODBUS GATEWAY VIA ETHERNET SWITCH AND TWO ETHERNET CABLES.

Configure the IP address of the P3000 or P3-550 CPU and the *STRIDE* Modbus Gateway to be compatible subnets. Steps to configure the IP address of the P3-550 CPU areas follows:

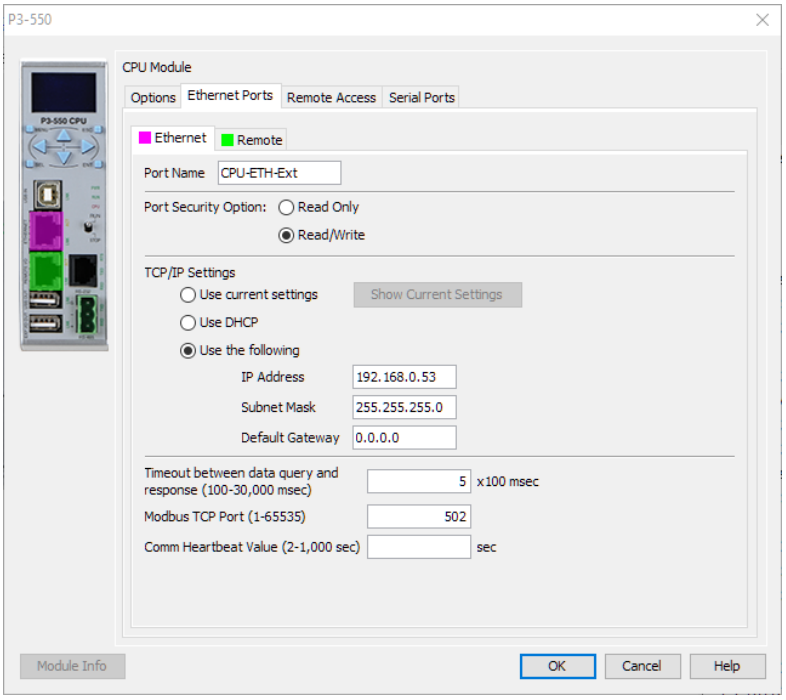
Click on Setup on the top menu bar and choose “Hardware Configuration”.



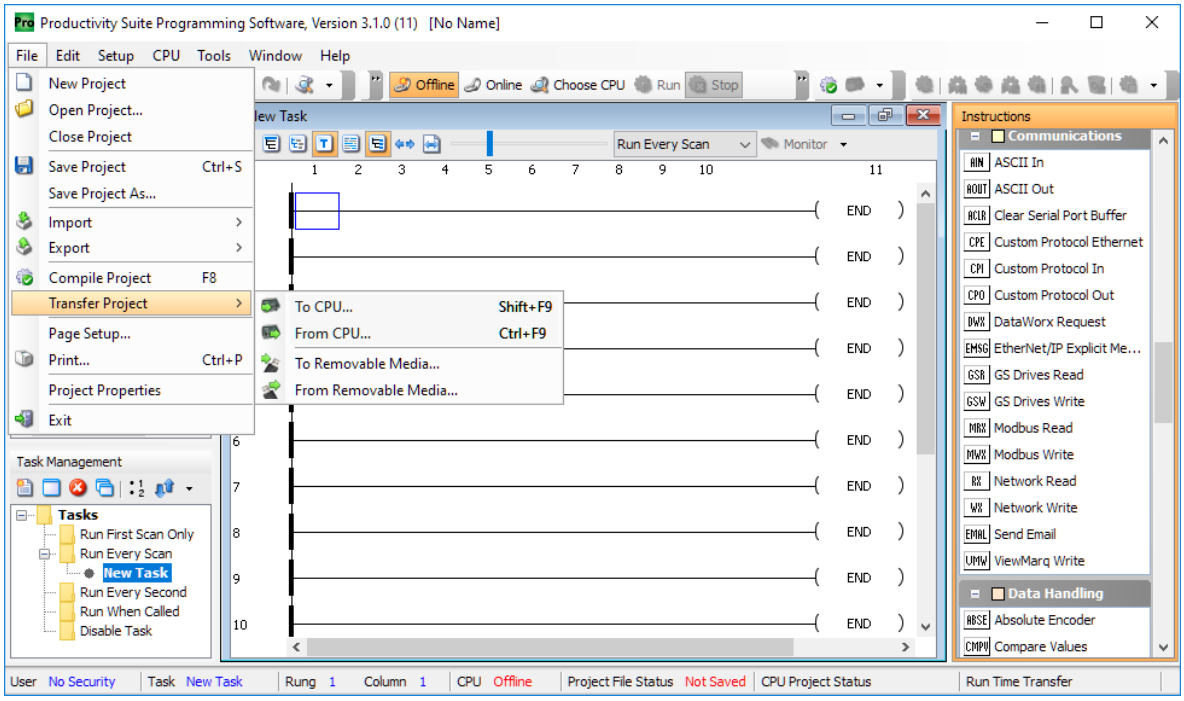
Double click on the image of the P3-550 in the center of the hardware configuration.



Click on the “Ethernet Ports” tab and configure the IP address in the “Use the Following:” IP address field. Once the correct IP address and Subnet Mask is entered, click on the OK button and close the hardware configuration window.

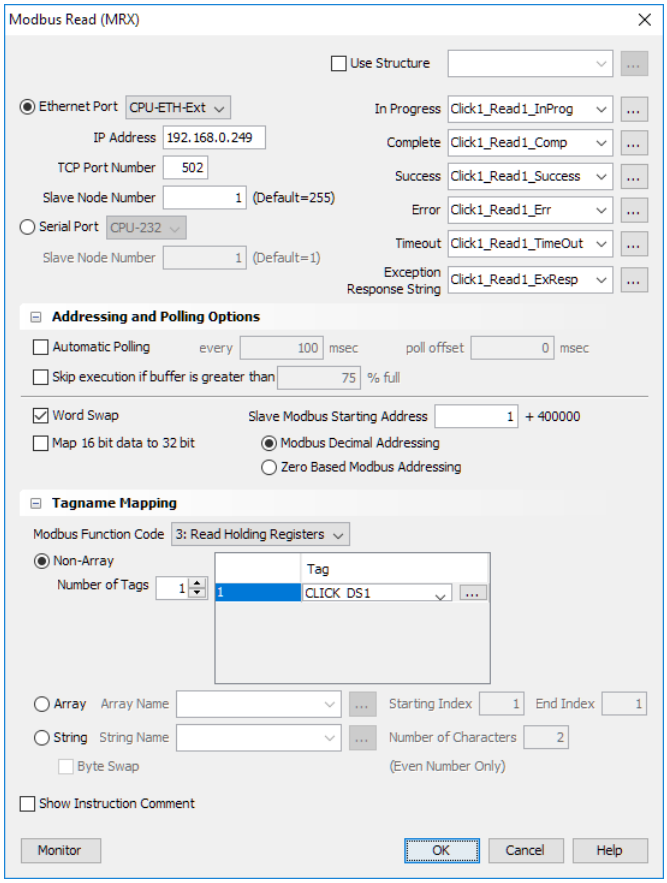


Transfer the project to the PLC in order to have the new settings take effect. To do this, select File from the pulldown menu and then Transfer Project >To PLC…



STEP 3: CONFIGURE THE MRX INSTRUCTION TO READ DATA FROM THE STRIDE MODBUS GATEWAY.

Double click on the instruction MRX Read to configure the MRX instruction as shown.



IP Address: address of the *STRIDE* Modbus Gateway.

TCP Port Number: Leave at default 502.

Slave Node Number: This should match the Node address of Port 3 of the CLICK PLC. Leave at 1 in this case.

Slave Modbus Starting Address: Set to 1 to read address DS1 in the CLICK PLC.

Tag Name Mapping: Create a Tag called CLICK_DS1 as an Signed Int 16 Tag to read in DS1 from the CLICK PLC.

Use the status bits and Exception Response String to verify whether communications were successful or not. If the Error bit comes on, look at the Exception Response String to see which error occurred. If the Timeout Bit comes on, check the IP address settings of the P3-550 and the *STRIDE* Modbus Gateway and make sure that they are in compatible subnets.

If the Successful Status bit comes on, add the CLICK_DS1 tag to the Data View at the bottom of the Productivity Suite Programming Software and check the values. Change the values in the CLICK data view for DS1 and verify that the CLICK_DS1 tag matches.

STRIDE MODBUS GATEWAY OPERATING MODE EXAMPLES

IN THIS CHAPTER...

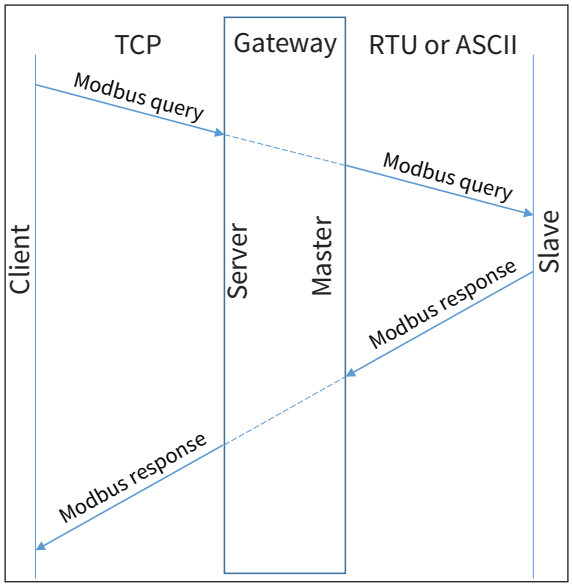
Example 1:
TRANSPARENT Mode, with Modbus TCP Master (Client) Devices to Modbus RTU/ASCII Slave Devices B–2

Example 2:
TRANSPARENT Mode, with Modbus RTU/ASCII Master Devices to Modbus TCP Slave (Server) Devices B–6

Example 3:
AGENT Mode, with Modbus TCP Master (Client) Devices to Modbus RTU/ASCII Slave Devices B–11

Example 4:
AGENT Mode, with Modbus RTU/ASCII Master Devices to Modbus TCP Slave (Server) Devices B–16

EXAMPLE 1:
TRANSPARENT MODE, WITH MODBUS TCP MASTER (CLIENT) DEVICES TO MODBUS RTU/ASCII SLAVE DEVICES



Provide power to the *STRIDE* Modbus Gateway, connect to an Ethernet port and log on to the gateway configuration interface.

Our example assumes default values in the gateway. Click Load Factory Default.

Set the operation mode to Transparent Mode.

Browse to “Operating Settings” to select S1 and set its parameters, as shown in Figure 1.

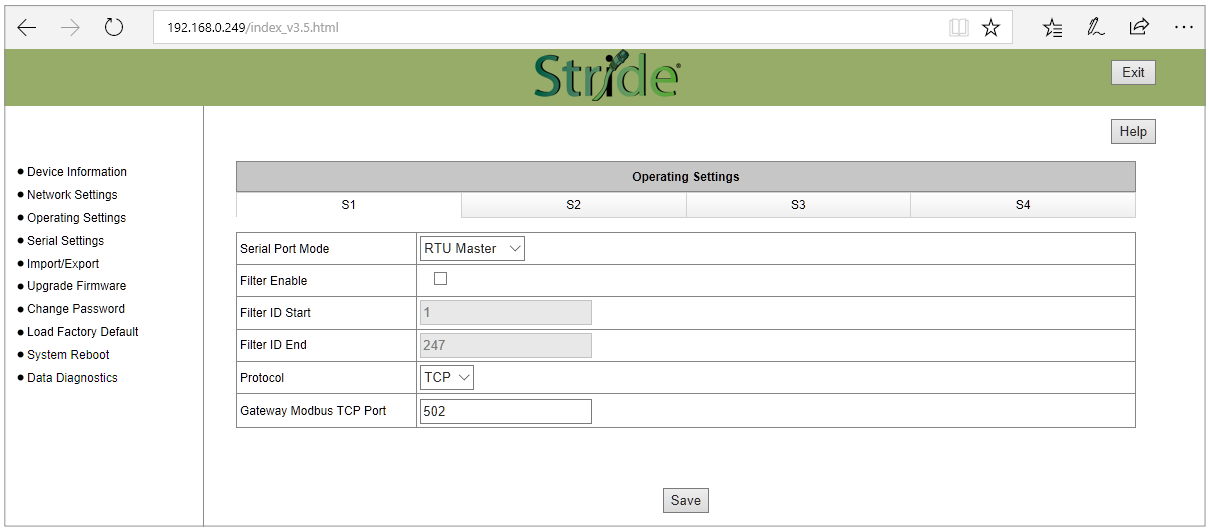


Figure 1. *STRIDE* Modbus Operating Settings.

Click Save.

Then browse to "Serial Settings" to configure serial port S1 as shown in Figure 2.

Click the Save button to save and apply the changes.

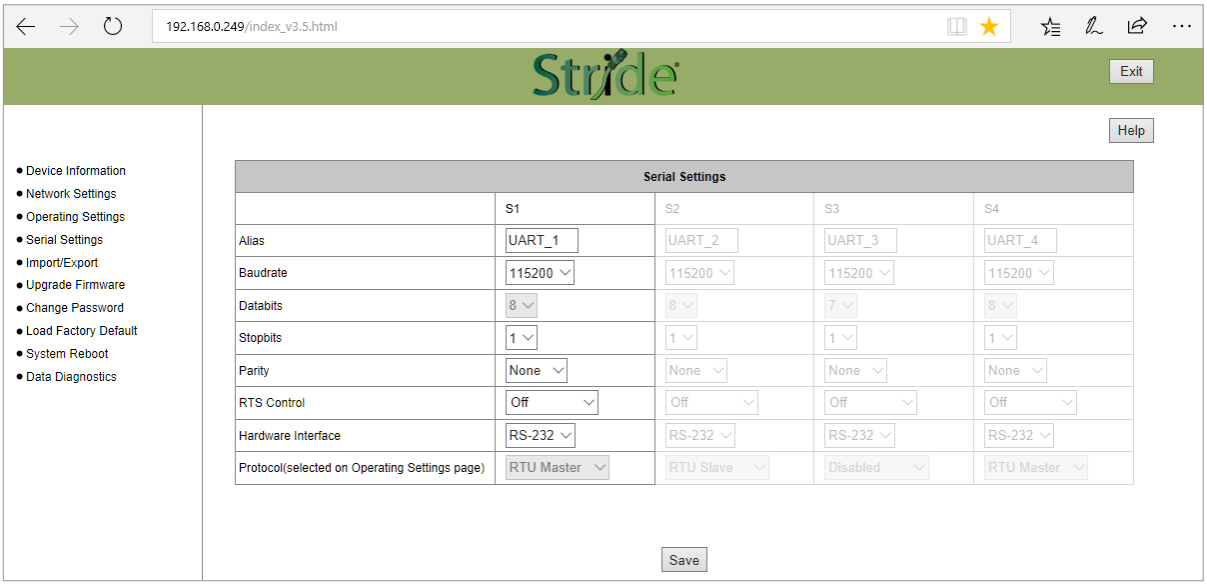


Figure 2. *STRIDE* Modbus Serial Settings.

Connect the *STRIDE* Modbus Gateway serial port S1 to your PC's serial port (possibly requiring a USB to serial converter), and run Modbus Slave software on the PC. The Modbus Slave parameters must be configured as shown in Figure 3.

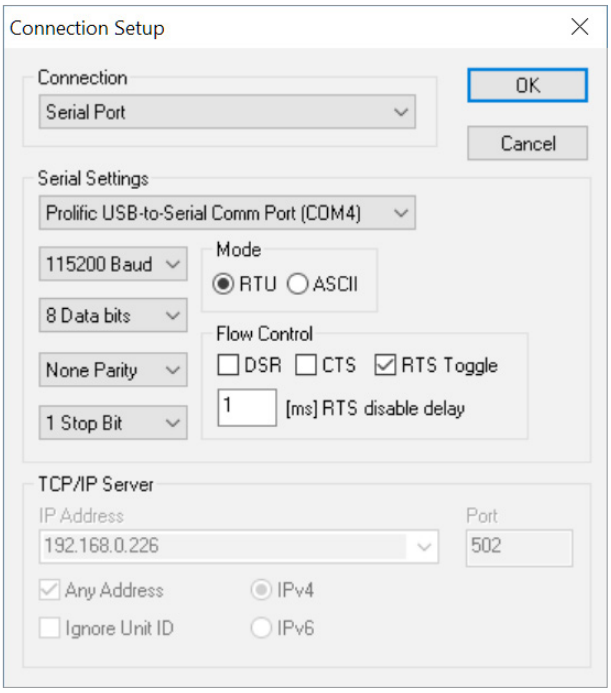


Figure 3. Modbus Slave Configuration.

Click OK button (shown in Figure 3) to return to the data window shown in Figure 4.

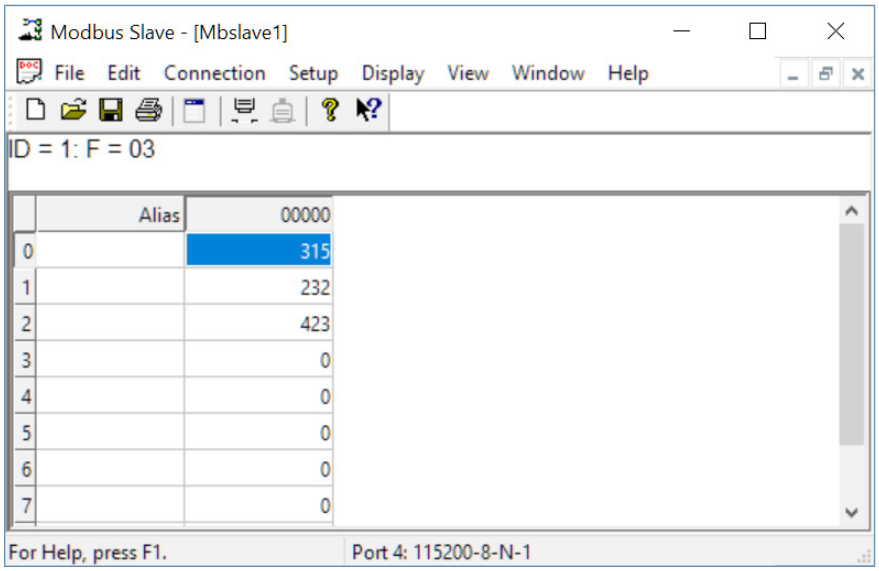


Figure 4. Modbus Slave.

Open Modbus Poll on your PC and set the parameters as shown in Figure 5.

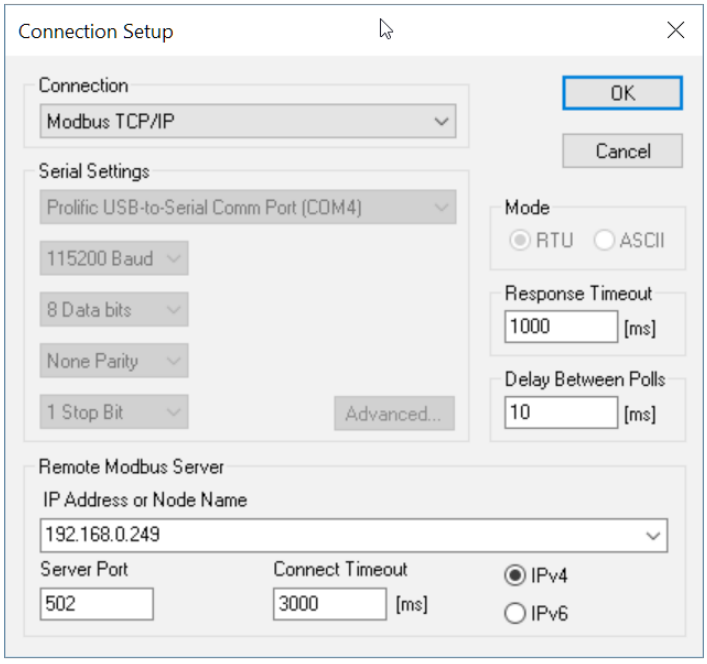


Figure 5. Modbus Poll Configuration.

Click OK button (shown in Figure 5) to return to the data window shown in Figure 6.

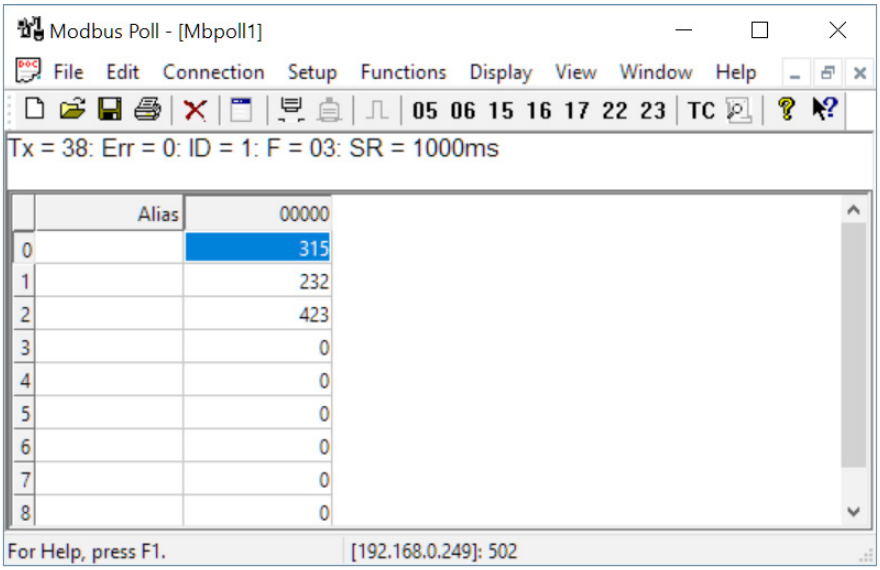


Figure 6. Modbus Poll.

Now let's experiment with our master reading data from our slave. Enter data in address 1 and address 2 in Modbus Slave and watch as Modbus Poll reads that data, as shown in Figure 7.

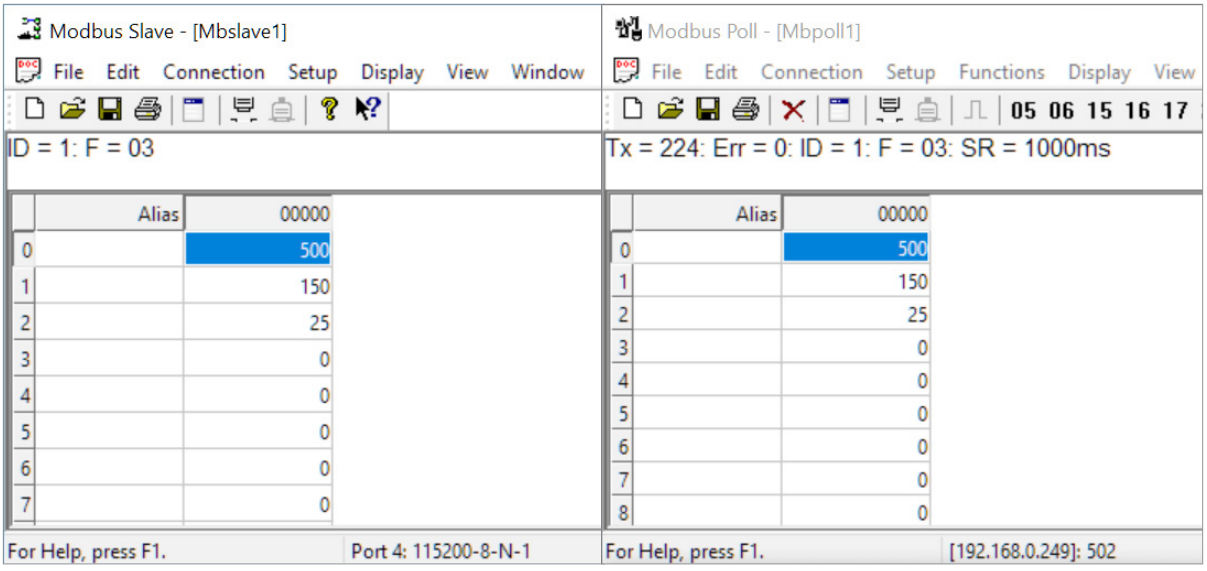
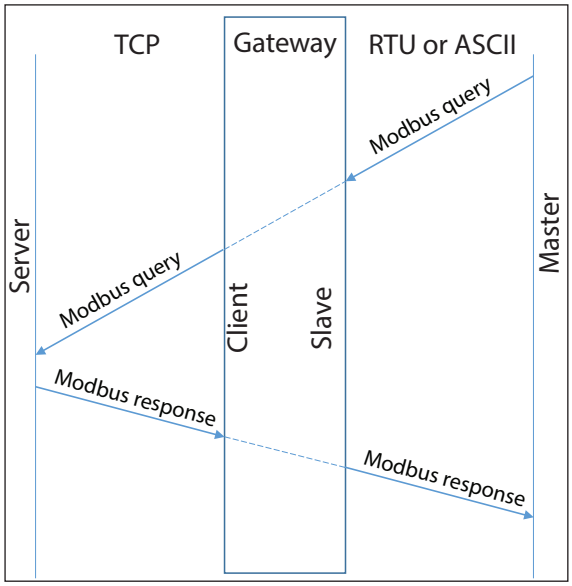


Figure 7. Data Test Result.

EXAMPLE 2:
TRANSPARENT MODE, WITH MODBUS RTU/ASCII MASTER DEVICES TO MODBUS TCP SLAVE (SERVER) DEVICES



Provide power to the *STRIDE* Modbus Gateway, connect to an Ethernet port and log on to the gateway configuration interface.

Our example assumes default values in the gateway. Click Load Factory Default.

Set the operation mode to Transparent Mode. Browse to "Operating Settings" to configure serial port S1 as shown in Figure 9. Note that the Remote IP Address is your PC's IP address, since the PC (Modbus Slave) is the slave device for this example.

Click Save.

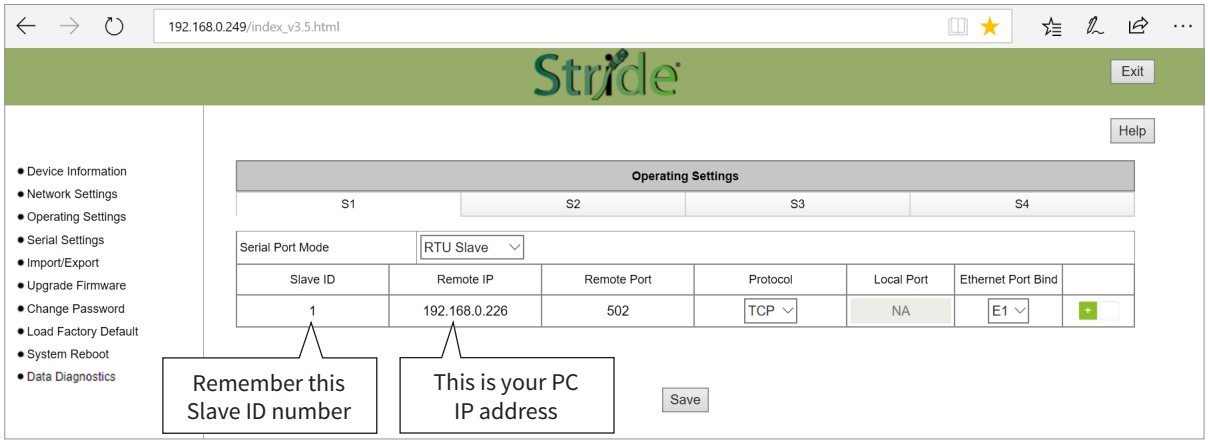


Figure 9. *STRIDE* Modbus Gateway Serial Settings.

Browse to *STRIDE* Modbus "Serial Settings" to select S1 and set its parameters, as shown in Figure 10. Click Save to save and apply the changes.

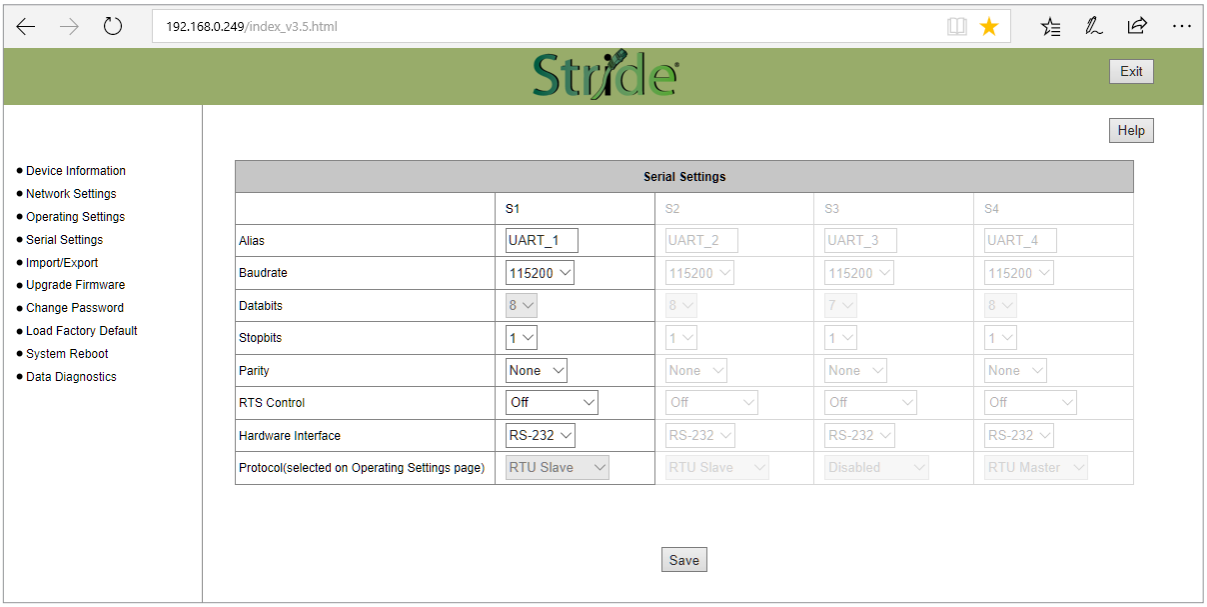


Figure 10. *STRIDE* Modbus Gateway Serial Settings.

Connect the *STRIDE* Modbus Gateway serial port S1 to your PC's serial port (possibly requiring a USB to serial converter), and run Modbus Poll software on the PC. The Modbus Poll parameters must be configured as shown in Figure 11.

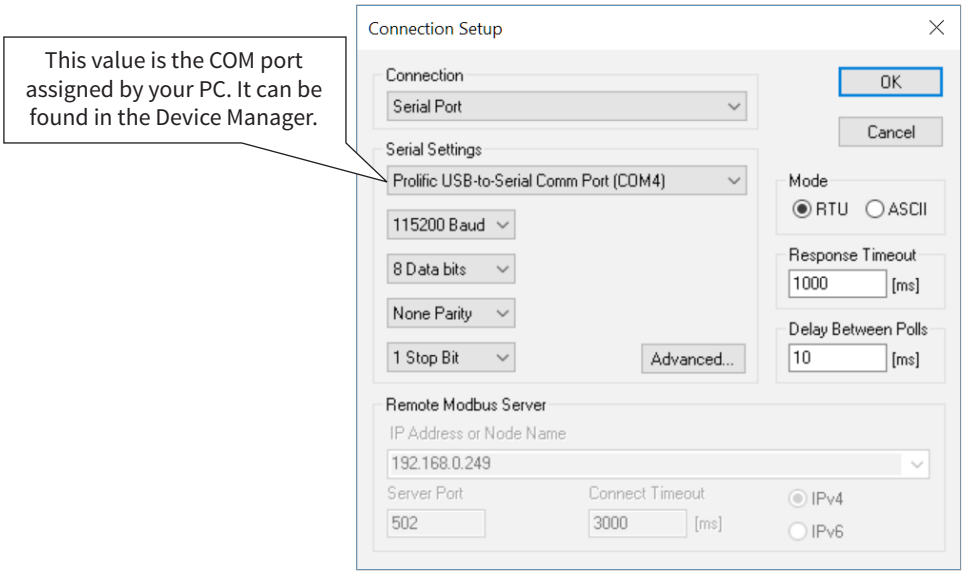


Figure 11. Modbus Poll Configuration.

Click OK in Figure 11 to return to the Modbus Poll main window.

Select Setup - Read/Write Definition.

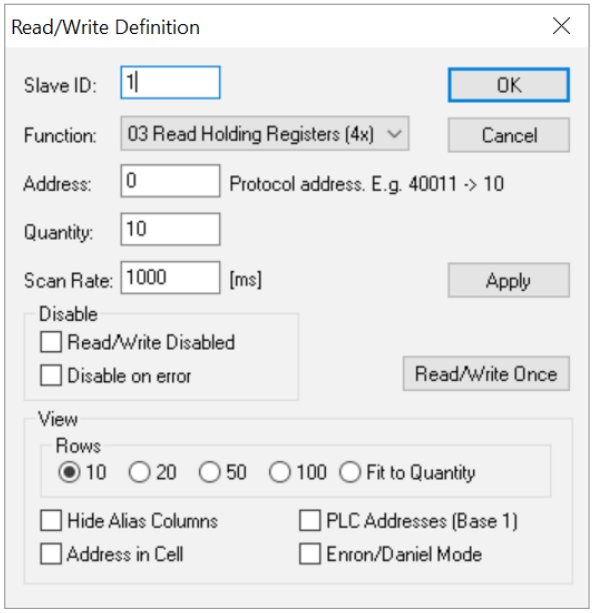


Figure 12. Modbus Poll Read/Write Definition.

Enter the Slave ID of the Gateway as shown in Figure 12. This is the Slave ID you assigned to the Gateway in its "Operating Settings" configuration.

Click OK shown in Figure 12 to return to the application interface shown in Figure 13.

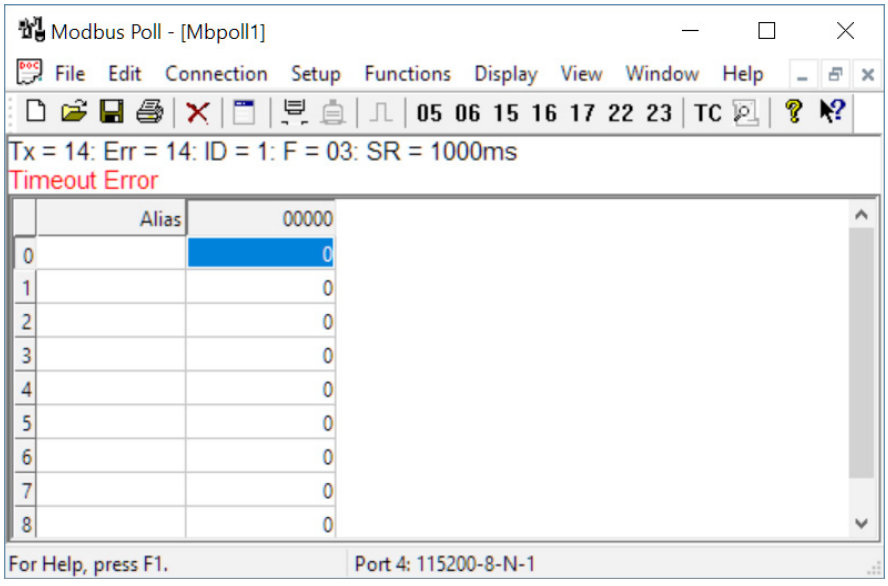


Figure 13. Modbus Poll Initial Connection.

The Modbus Poll software will indicate a Timeout Error until the Modbus Slave software is connected in the next step.

Run the Modbus Slave software on your PC and set the parameters shown in Figure 14.

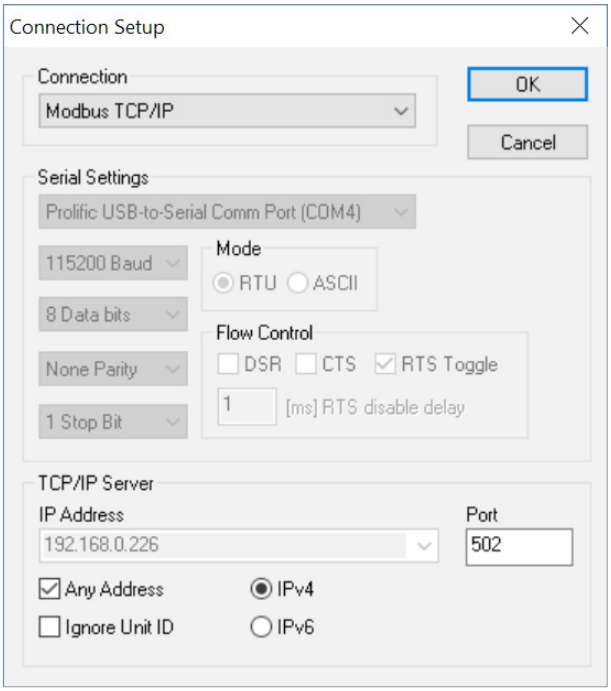


Figure 14. Modbus Slave Configuration.

Click OK shown in Figure 14 to return to the Modbus Slave main window.

Select Setup - Slave Definition.

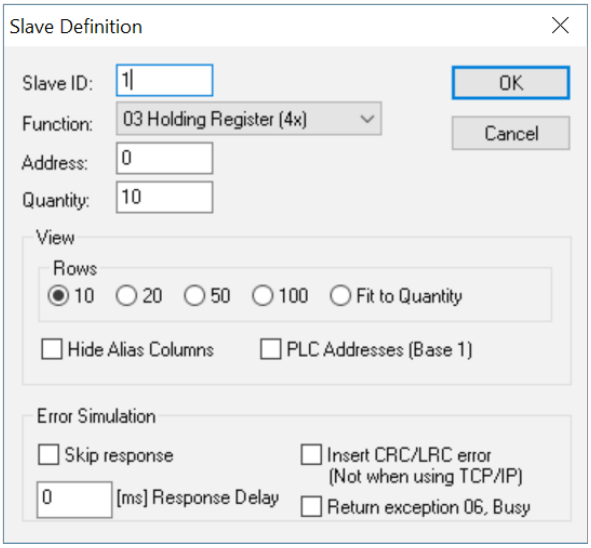


Figure 15. Modbus Poll Read/Write Definition.

Enter the Slave ID as shown in Figure 15. This is the Slave ID you assigned to the Modbus TCP Client in the “Operating Settings” configuration.

Click OK shown in Figure 15 to return to the application interface shown in Figure 16.

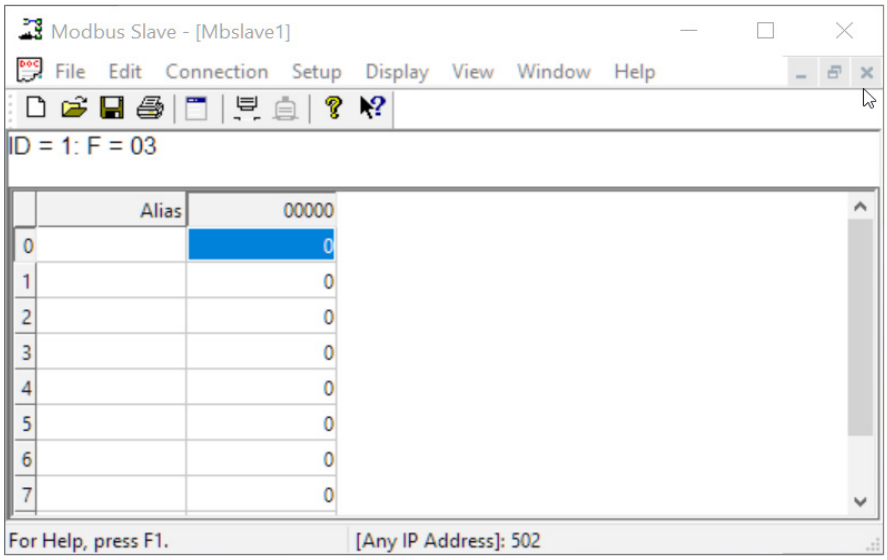


Figure 16. Modbus Slave.

Now let's experiment with our master reading data from our slave. Enter data in address 2 and address 3 in Modbus Slave and watch as Modbus Poll reads that data, as shown in Figure 17.

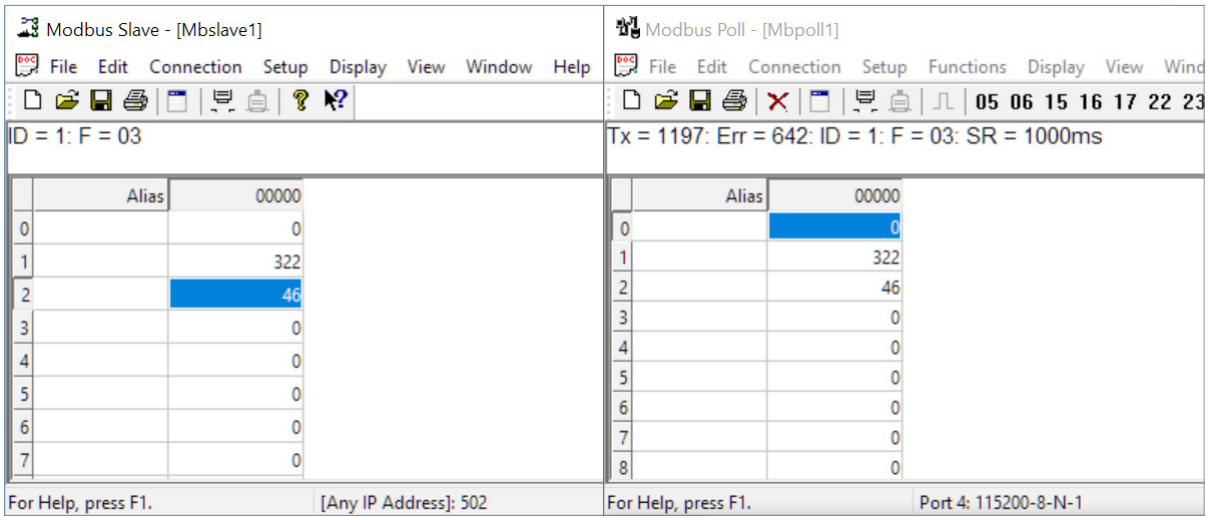
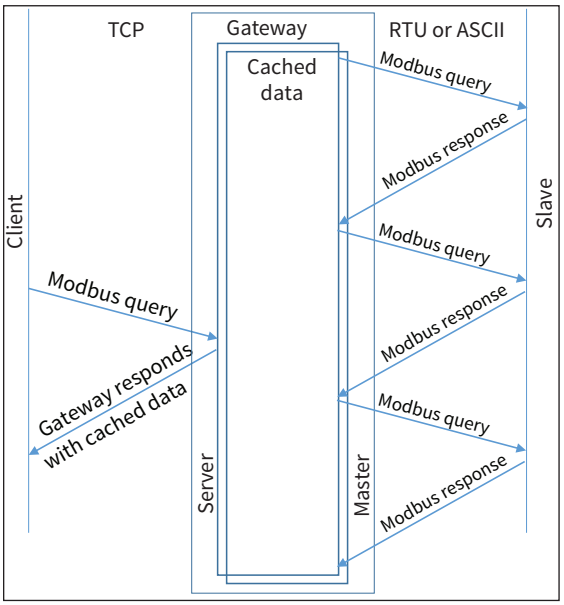


Figure 17. Data Test Result.

EXAMPLE 3:
AGENT MODE, WITH MODBUS TCP MASTER (CLIENT) DEVICES TO MODBUS RTU/ASCII SLAVE DEVICES



Provide power to the *STRIDE* Modbus Gateway, connect to an Ethernet port and log on to the gateway configuration interface.

Our example assumes default values in the gateway. Click Load Factory Default.

Set the operation mode to Agent Mode. Browse to "Operating Settings" to configure serial port S1 as shown in Figure 18. Click Save.

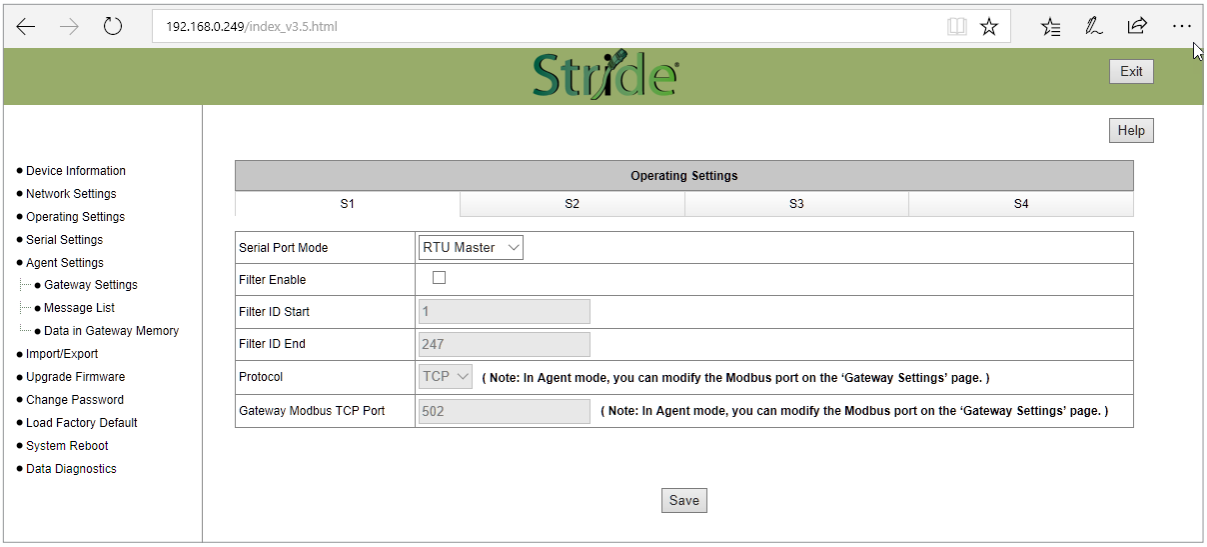


Figure 18. *STRIDE* Modbus Operating Settings.

Browse to "Serial Settings" to select S1 and set its parameters, as shown in Figure 19.

Click Save to save the changes.

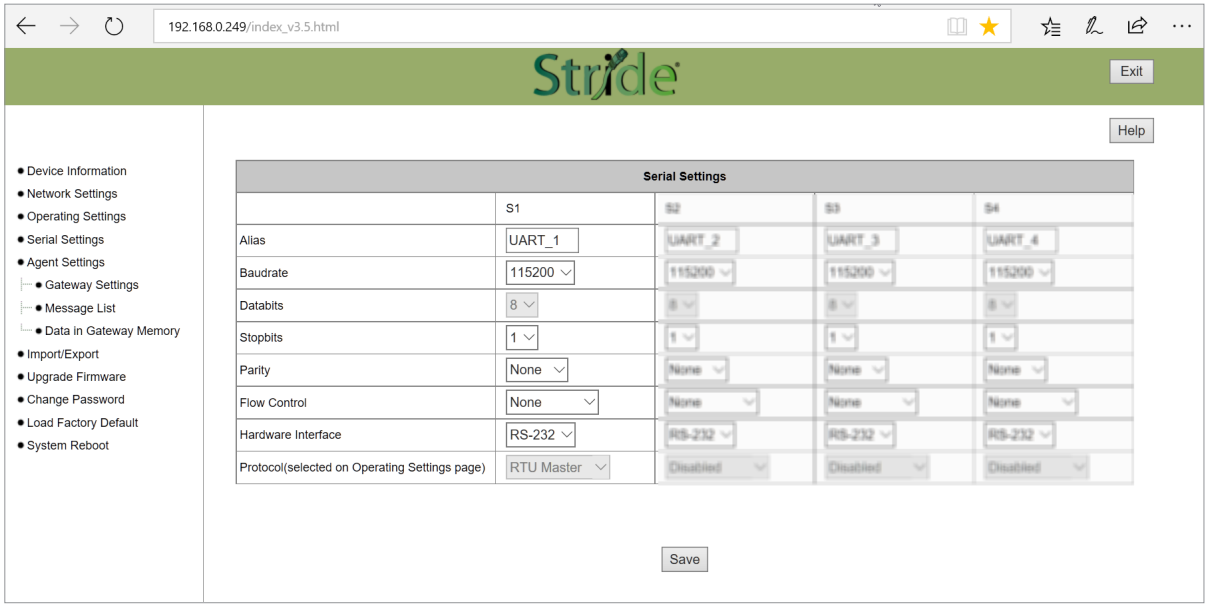


Figure 19. Serial Settings Configuration.

Browse to "Gateway Settings" and configure the parameters as shown in Figure 20.

Click Save to save and apply the changes.

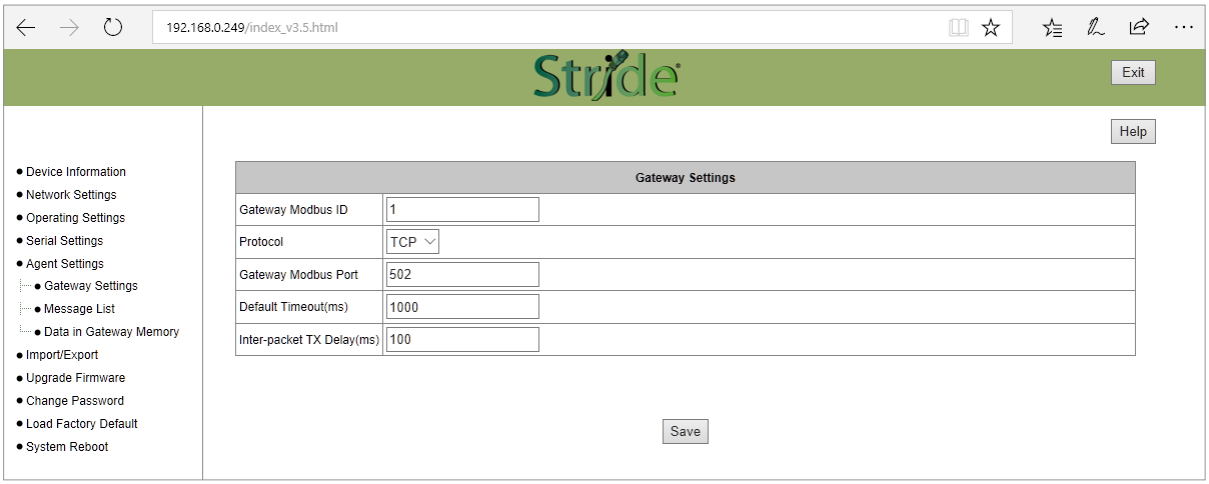


Figure 20. *STRIDE* Modbus Gateway Operating Settings.

Browse to Message List-Add Message to add a message, shown in Figure 21.

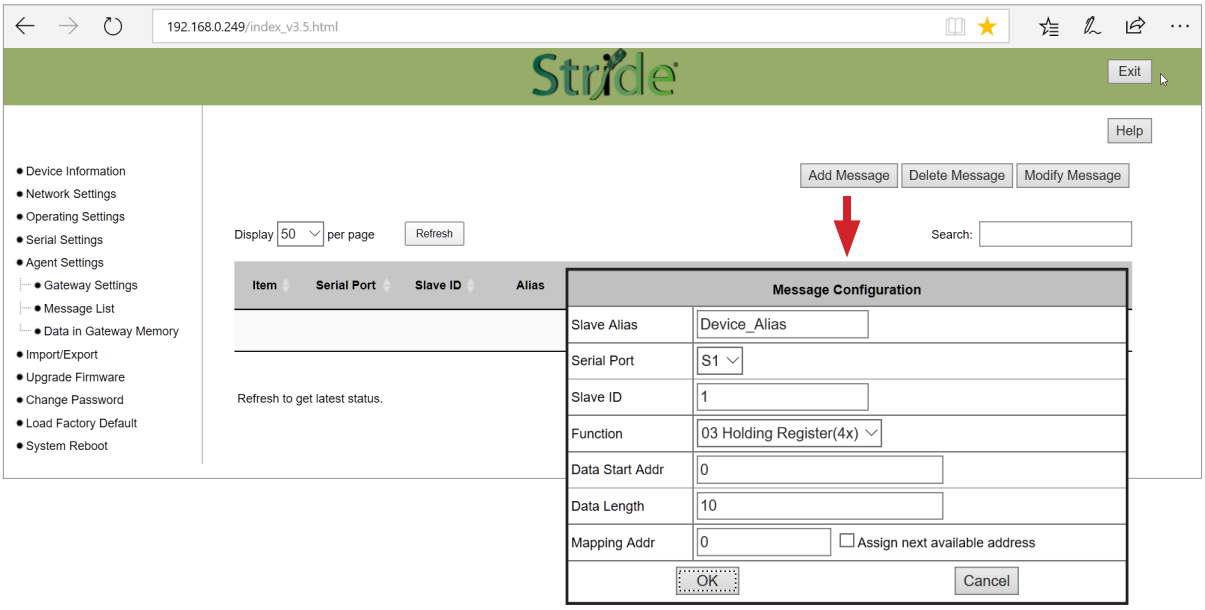


Figure 21. Add Message.

Connect the *STRIDE* Modbus Gateway's serial port S1 to PC's serial port (possibly requiring a USB to serial converter), and run the Modbus Slave software on PC. The Modbus Slave parameters must be configured as shown in Figure 22.

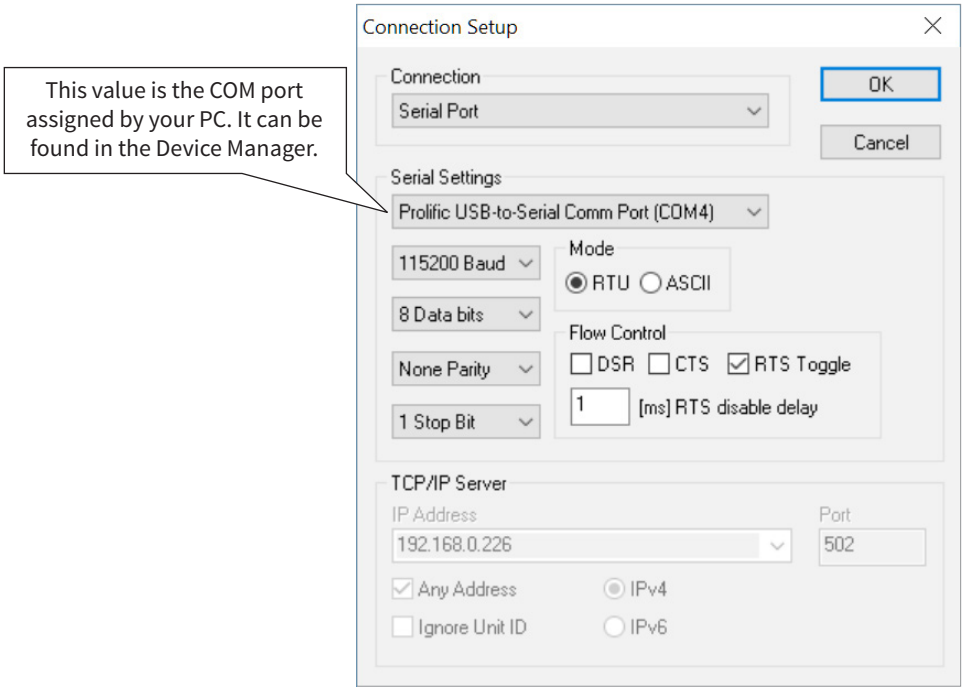


Figure 22. Modbus Slave Configuration.

Click OK as shown in Figure 22 to return to the application interface shown in Figure 23.

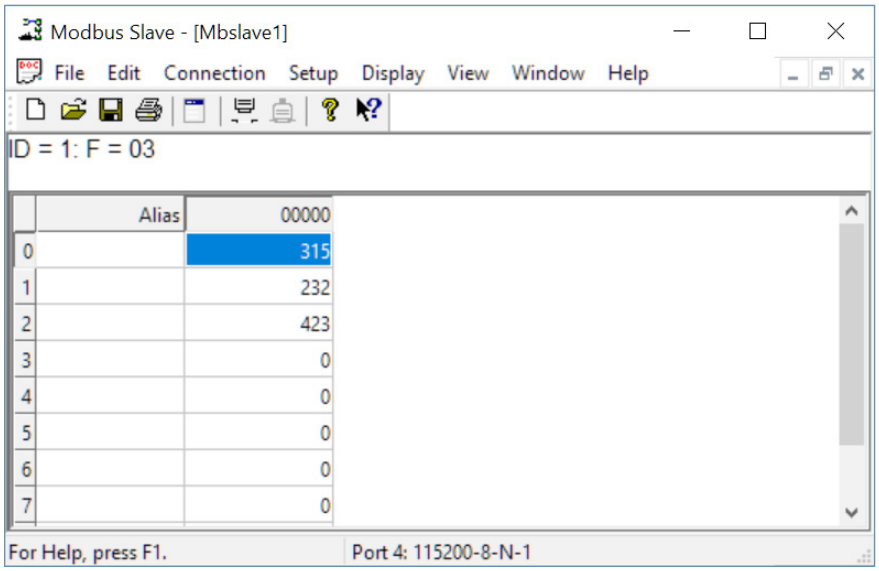


Figure 23. Modbus Slave.

Open Modbus Poll on your PC and set the parameters as shown in Figure 24.

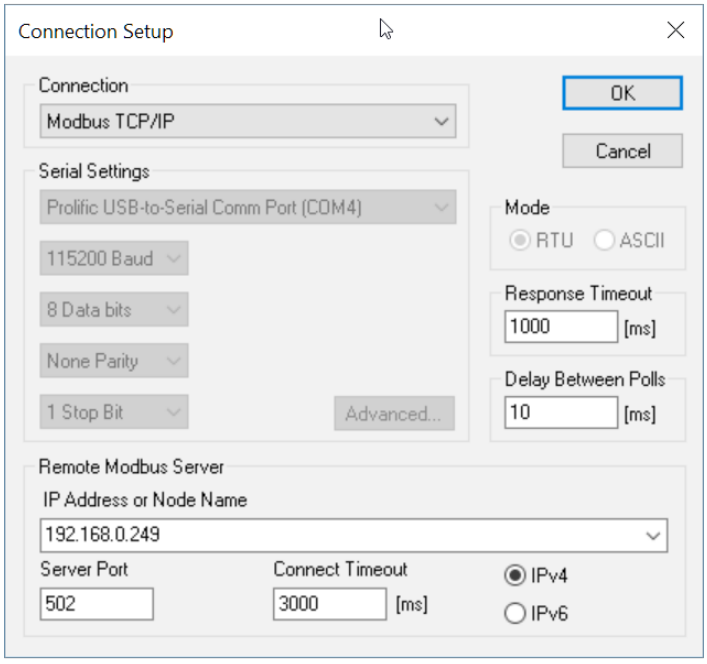


Figure 24. Modbus Poll Configuration.

Click the OK button shown in Figure 24.

Now let's experiment with watching data as it is read from Modbus Slave by the gateway then read from the Gateway by Modbus Poll. Enter data in address 1 and address 2 in Modbus Slave and watch the values change in Modbus Poll, as shown in Figure 25.

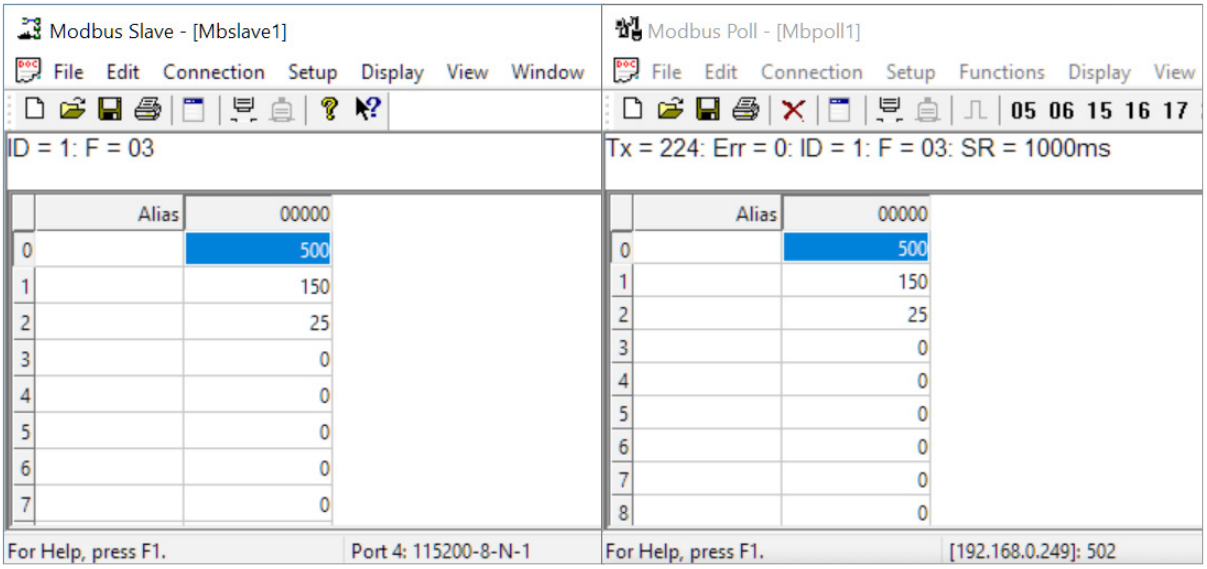


Figure 25. Data Test Result.

Now let's take a look at the data as it's stored in the gateway.

In the gateway User Interface, browse to the Data in Gateway Memory page.

Enter the Mapping Address (found on the "Message List" page) and the quantity of values you'd like to view. For our example, these values are 0 and 4, respectively.

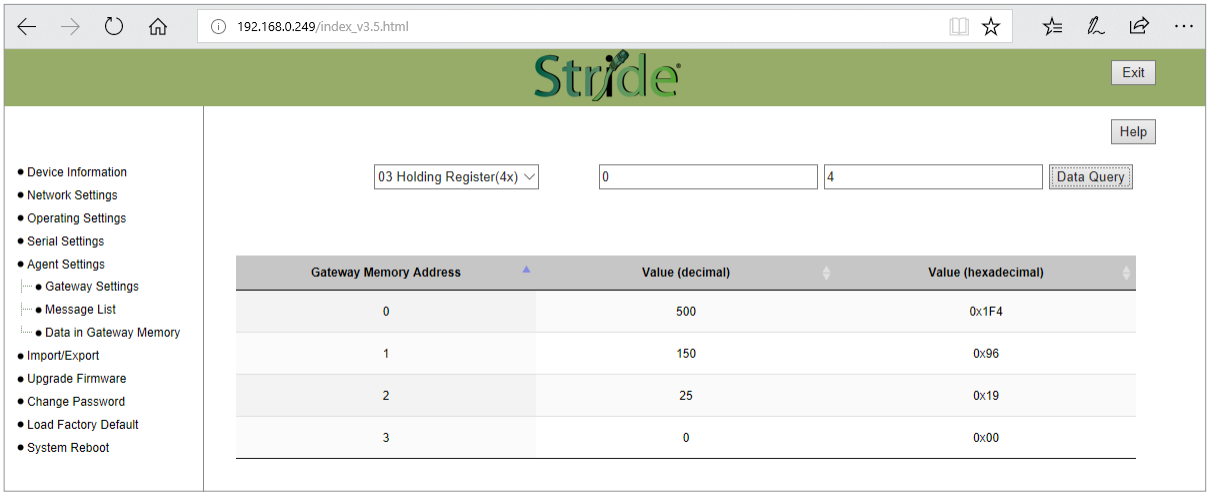
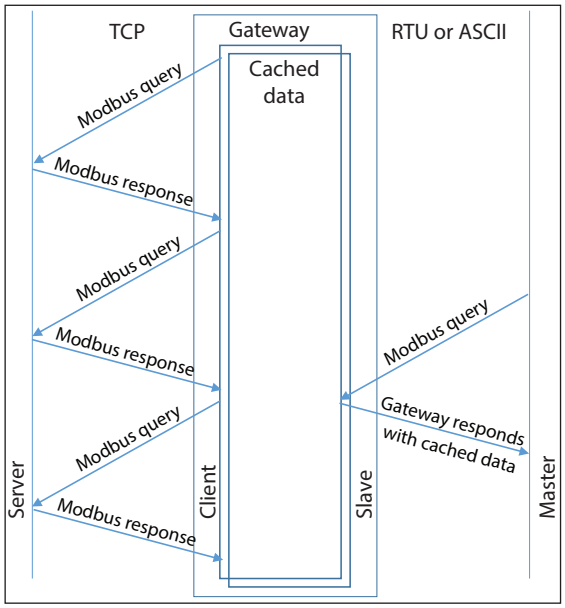


Figure 26. *STRIDE* Modbus Data in Gateway Memory.

Make changes in the Modbus slave user interface and watch the values change in the gateway's memory.

EXAMPLE 4:
AGENT MODE, WITH MODBUS RTU/ASCII MASTER DEVICES TO MODBUS TCP SLAVE (SERVER) DEVICES



Provide power to the *STRIDE* Modbus Gateway, connect to an Ethernet port and log on to the gateway configuration interface.

Our example assumes default values in the gateway. Click Load Factory Default.

Set the operation mode to Agent Mode. Browse to "Operating Settings" and select S1. Setup parameters for one Modbus TCP server as shown in Figure 27. Note that the Remote IP Address is your PC's IP address, since the PC (Modbus Slave) is the slave device for this example. Remember the Slave ID you assign here.

Click Save.

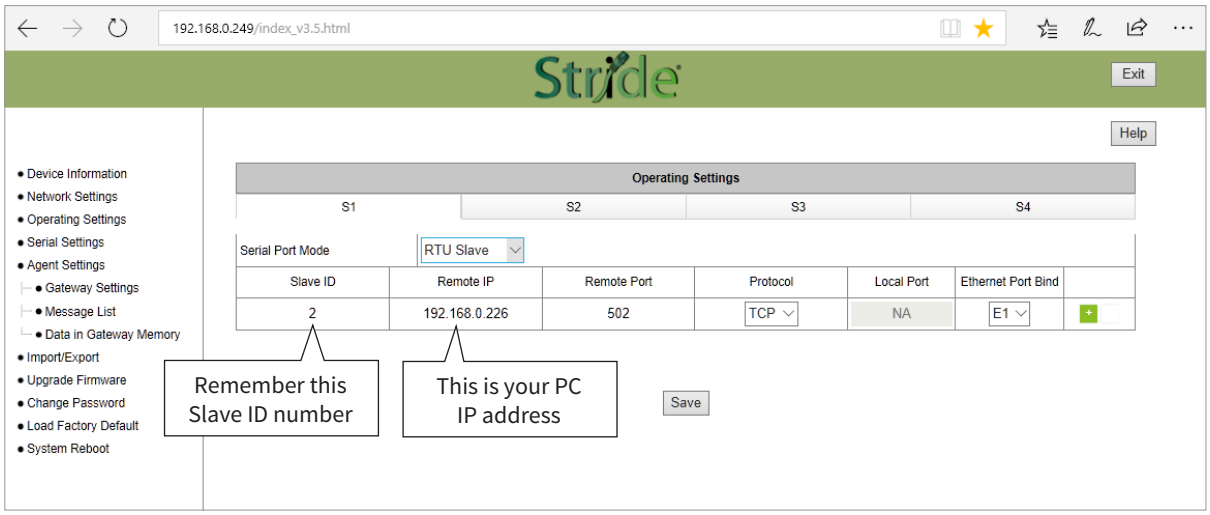


Figure 27. *STRIDE* Modbus Operating Settings.

Browse to “Serial Settings” to configure the gateway shown in Figure 28.

Click Save to save the changes.

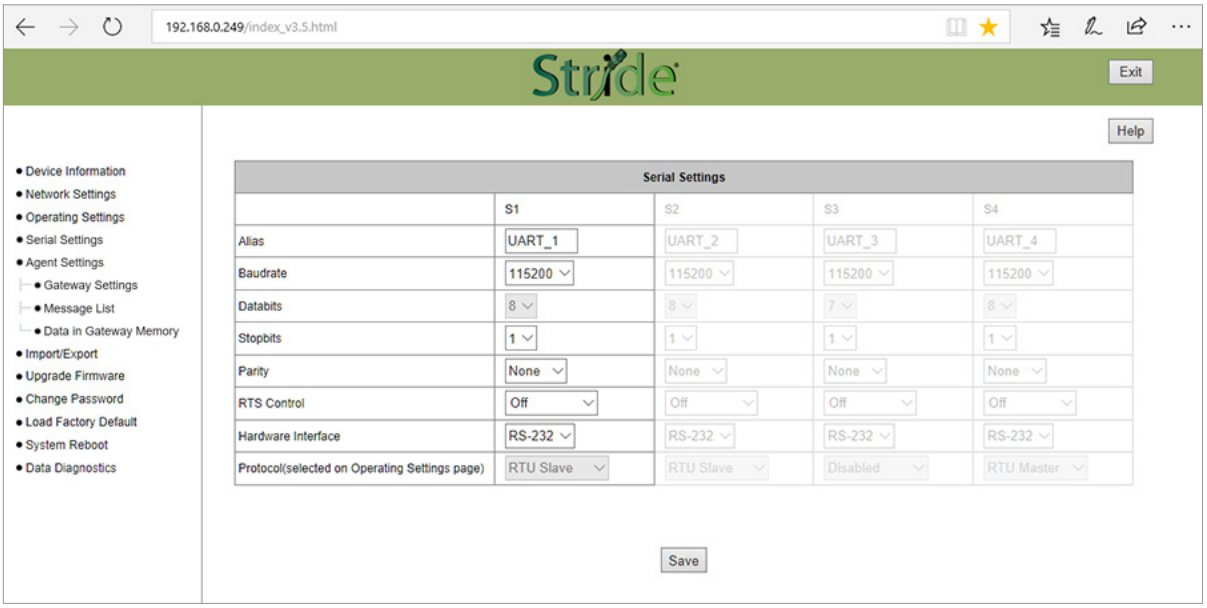


Figure 28. Serial Settings Configuration.

Browse to the “Gateway Settings” page to configure the gateway as shown in Figure 29. Click Save to save and apply the changes.

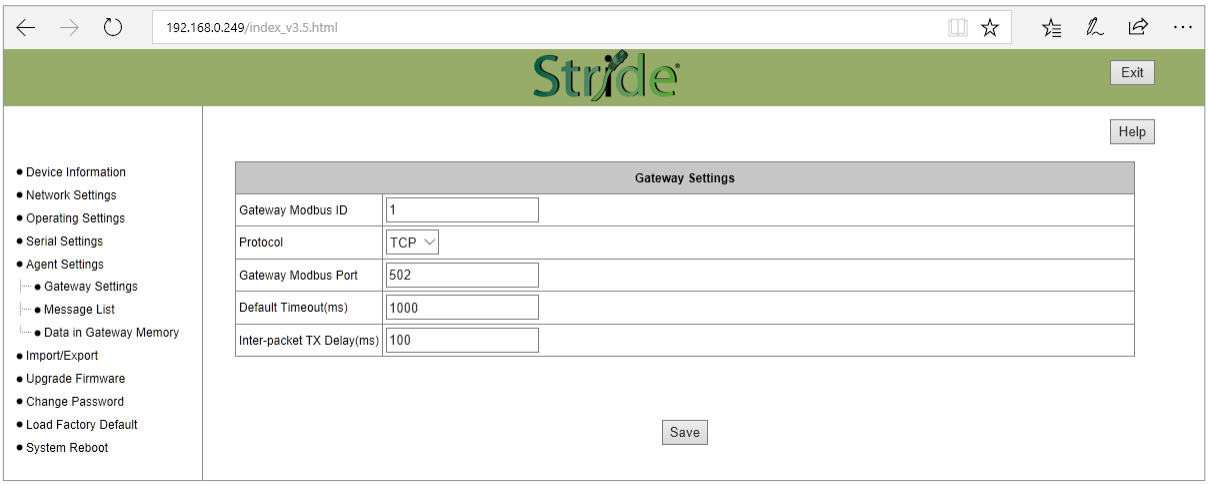


Figure 29. Gateway Settings Configuration.

Browse to Message List-Add Message to add a message, shown in Figure 30. The Slave ID is the ID you assigned to the slave device in the Operating Settings configuration in Figure 27.

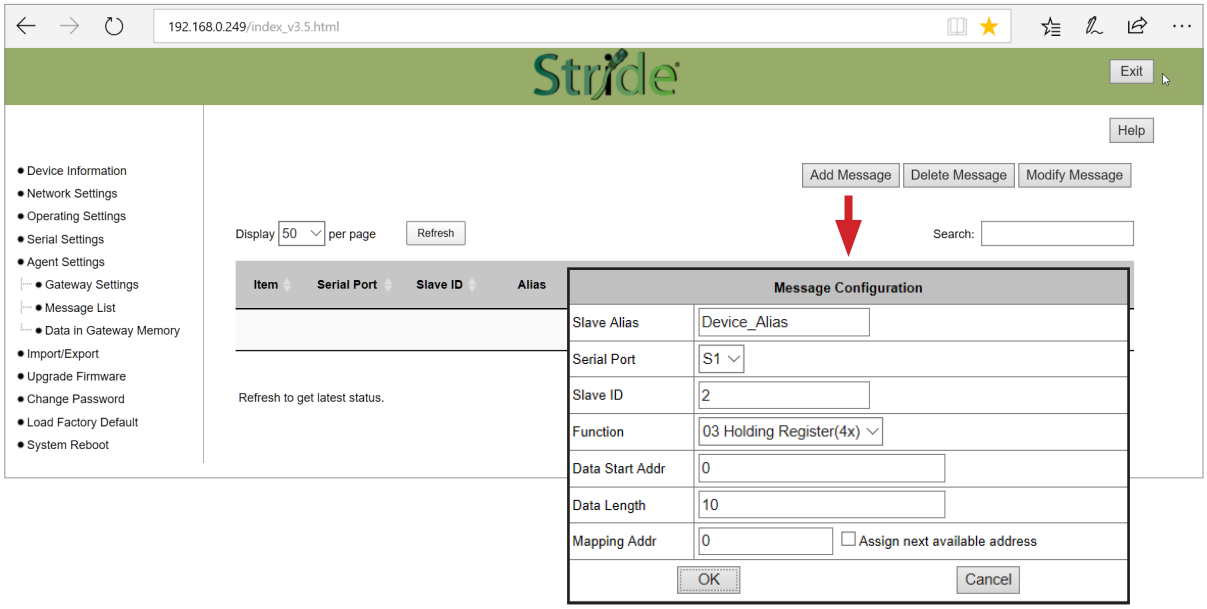


Figure 30. Add Message.

Connect the *STRIDE* Modbus Gateway serial port S1 to your PC's serial port (possibly requiring a USB to serial converter), and run Modbus Poll software on the PC. The Modbus Poll parameters must be configured as shown in Figure 31.

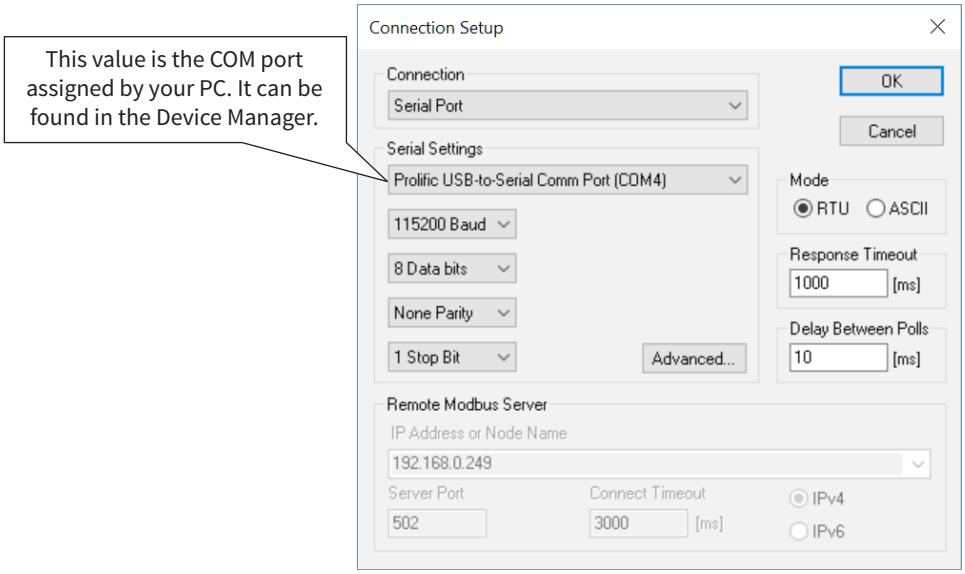


Figure 31. Modbus Poll Configuration.

Click OK in Figure 29 to return to the application interface shown in Figure 32.

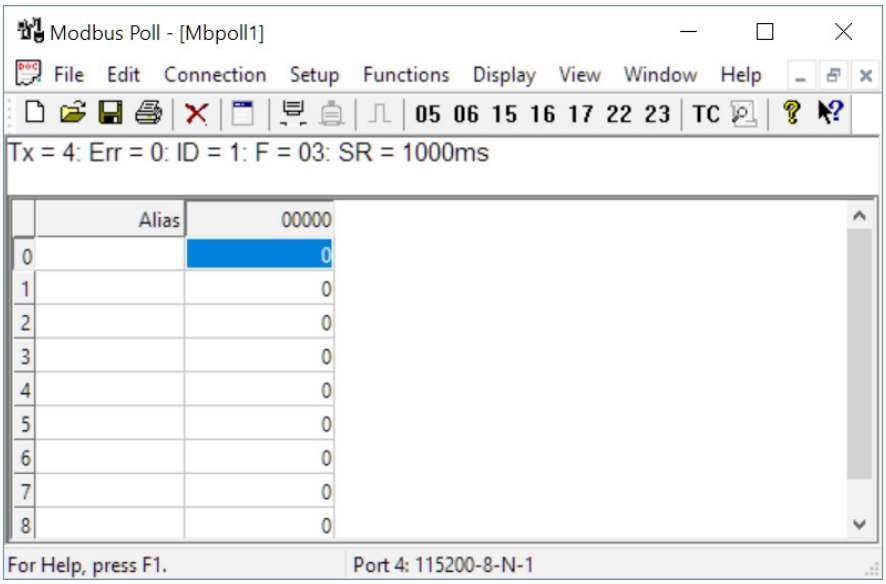


Figure 32. Modbus Poll Initial Connection.

The Modbus Poll software will return zero values for all data from the Modbus Gateway Agent until the Modbus Slave software is connected to the gateway in the next step.

Run the Modbus Slave software on your PC and set the parameters shown in Figure 33.

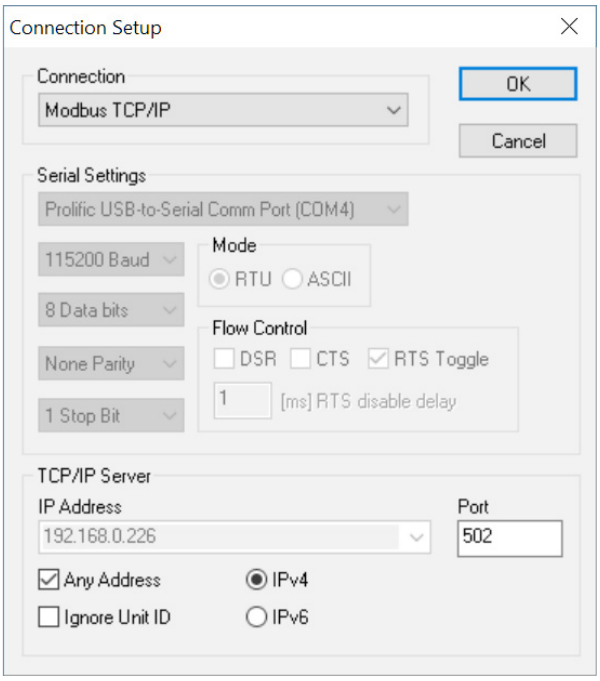


Figure 33. Modbus Slave Port Configuration.

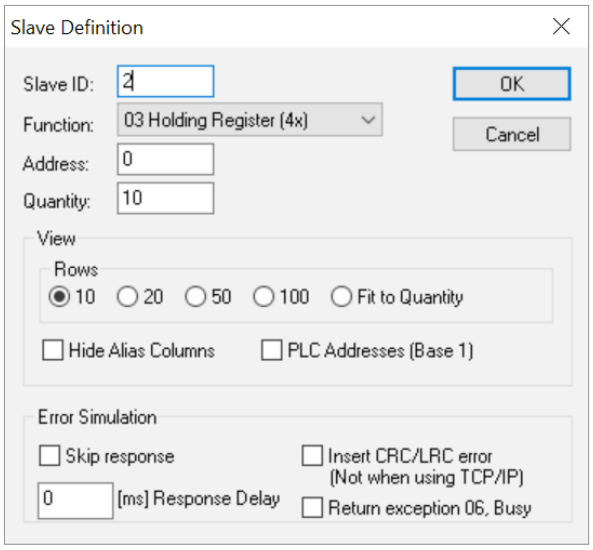


Figure 34. Modbus Slave Definition.

Click OK shown in Figure 33 to return to the Modbus Slave main window.

Select Setup - Slave Definition.

Enter the Slave ID of the Gateway as shown in Figure 34. This is the Slave ID you assigned to the Gateway in its “Operating Settings” configuration.

Click OK shown in Figure 34 to return to the application interface shown in Figure 35.

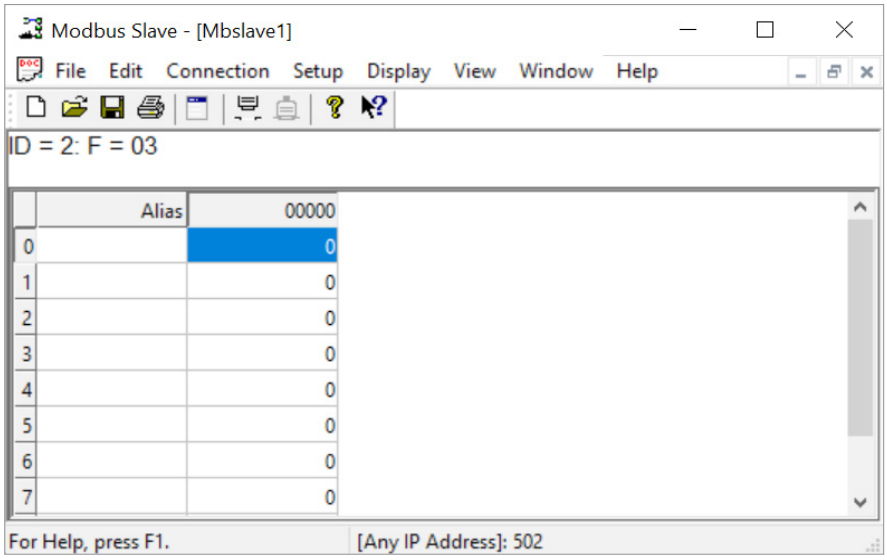


Figure 35. Modbus Slave.

Now let’s experiment with watching data across our network. Enter data in address 2 and address 3 in Modbus Slave and watch as that data is stored in the Agent then read by Modbus Poll, shown in Figure 36.

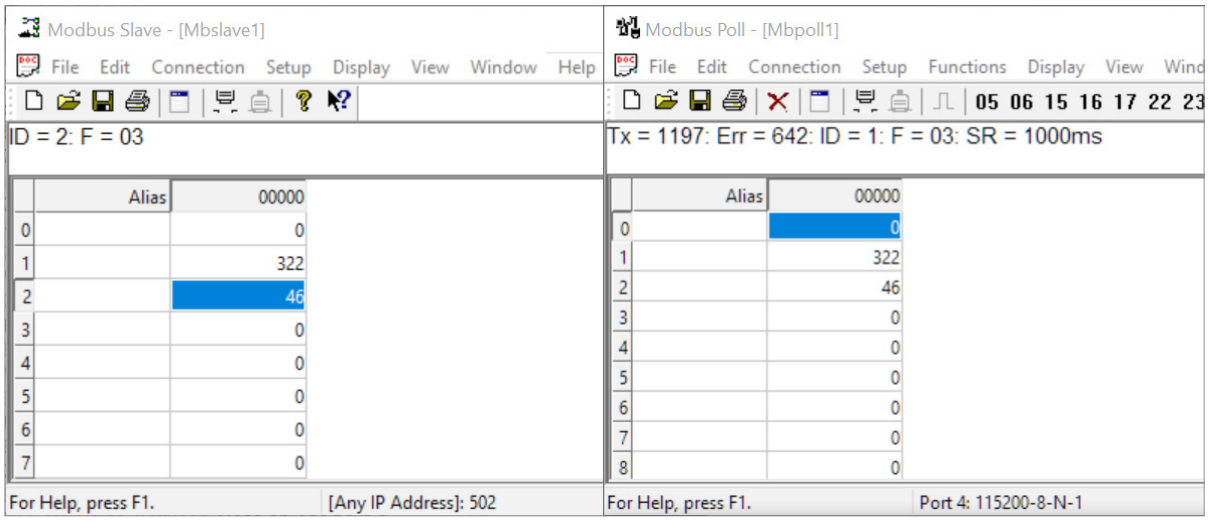


Figure 36. Agent Test Result.

Now let’s take a look at the data as it’s stored in the gateway.

In the gateway User Interface, browse to the Data in Gateway Memory page.

Enter the Mapping Address (found on the Gateway Settings page) and the quantity of values you'd like to view. For our example, these values are 0 and 4, respectively.

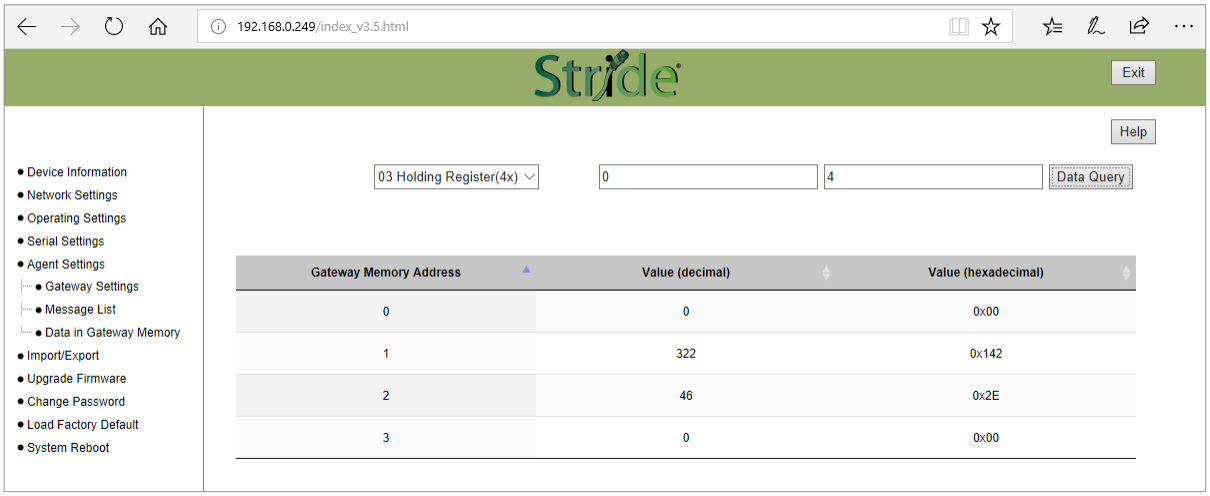


Figure 37. Data Stored in Gateway Modbus Registers.

Make changes in the Modbus slave user interface and watch the values change in the gateway's memory.

Modbus Error Codes

In This Chapter...

Modbus Error Codes C–2

Modbus Error Codes

MB-GATEWAY Modbus Error Codes		
Error Code	**Name**	**Explanation**
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the slave. If a Poll Program Complete command was issued, this code indicates that no program function preceded it.
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the slave.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for the slave.
04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while the slave was attempting to perform the requested action.
05	ACKNOWLEDGE	The slave has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master. The master can next issue a Poll Program Complete message to determine if processing is completed.
06	SLAVE DEVICE BUSY	The slave is engaged in processing a long–duration program command. The master should retransmit the message later when the slave is free.
07	NEGATIVE ACKNOWLEDGE	The slave cannot perform the program function received in the query. This code is returned for an unsuccessful programming request using function code 13 or 14 decimal. The master should request diagnostic or error information from the slave.
08	MEMORY PARITY ERROR	The slave attempted to read extended memory, but detected a parity error in the memory. The master can retry the request, but service may be required on the slave device.

Security Considerations for Control Systems Networks

In This Chapter...

Security Considerations for Control Systems Networks D-2

Security Considerations for Control Systems Networks

Manufacturers are realizing that to stay competitive, their Automation and Control Systems need to be more integrated within their plant. The systems often need to be integrated with upstream Enterprise Data Systems, and even further integrated to allow information to be accessible across multiple plants, or even through the Internet. This convergence of the IT world with the Automation World creates challenges in maintaining secure systems and protecting your investments in processes, personnel, data and intellectual property.

While Automation Networks and Systems have built-in password protection schemes, this is only one very small step in securing your systems. Automation Control System Networks need to incorporate data protection and security measures that are at least as robust as a typical business computer system. We recommend that users of PLCs, HMI products and SCADA systems perform your own network security analysis to determine the proper level of security required for you application. However, the Department of Homeland Security's National Cybersecurity and Communications Integration Center (NCCIC) and Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) has provided direction related to network security and safety under an approach described as "Defense in Depth", which is published at https://www.us-cert.gov/sites/default/files/recommended_practices/NCCIC_ICS-CERT_Defense_in_Depth_2016_S508C.pdf.

This comprehensive security strategy involves physical protection methods, as well as process and policy methods. This approach creates multiple layers and levels of security for industrial automation systems. Such safeguards include the location of control system networks behind firewalls, their isolation from business networks, the use of intrusion detection systems, and the use of secure methods for remote access such as Virtual Private Networks (VPNs). Further, users should minimize network exposure for all control system devices and such control systems and these systems should not directly face the internet. Following these procedures should significantly reduce your risks both from external sources as well as internal sources, and provide a more secure system.

It is the user's responsibility to protect such systems, just as you would protect your computer and business systems. AutomationDirect recommends using one or more of these resources in putting together a secure system:

- *ICS-CERT's Control Systems recommended practices at the following web address: https://ics-cert.us-cert.gov/Recommended-Practices*
- *Special Publication 800-82 of the National Institute of Standards and Technology – Guide to Industrial Control Systems (ICS) Security https://csrc.nist.gov/publications/detail/sp/800-82/rev-2/final*
- *ISA99, Industrial Automation and Control Systems Security http://www.isa.org/MSTemplate.cfm?MicrositeID=988&CommitteeID=6821 (please note this is a summary and these standards have to be purchased from ISA)*

The above set of resources provides a comprehensive approach to securing a control system network and reducing risk and exposure from security breaches. Given the nature of any system that accesses the internet, it is incumbent upon each user to assess the needs and requirements of Security Considerations for Control Systems Networks their application, and take steps to mitigate the particular security risks inherent in their control system.