RST-5003 Control Module
User Manual

Web Enabled Series

APG®

Table of Contents

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Introduction

Thank you for purchasing an RST-5003 Web Enabled Control Module from APG. We appreciate your business! Please take a few minutes to familiarize yourself with your RST-5003 and this manual.

The RST-5003 Web Enabled Control Module offers a wide degree of integrated, flexible, remote and local control and monitoring for your system. The RST-5003 can control up to 10 APG Modbus sensors--any combination of level, pressure, magnetostrictive and ultrasonic--along with one 4-20 mA sensor, and two input or output relay terminals. All readings are available for control and monitoring via TCP/IP for local or remote network access. The RST-5003 also had flexible power options: it can use either POE or an independent 12-28 VDC power source.

Reading your label

Every APG controller comes with a label that includes the controller's model number, part number, and serial number. The RST-5003 label also indicates the default IP address, subnet mask, and mac address. Please ensure that the model number on your label matches your order.

Warranty and Warranty Restrictions

This product is covered by APG's waranty to be free from defects in material and workmanship under normal use and service of the product for 24 months. For a full explanation of our Warranty, please visit https://www.apgsensors.com/about-us/terms-conditions. Contact Technical Support to recieve a Return Material Authorization before shipping your product back.

Scan the QR code below to read the full explanation of our Warranty on your tablet or smartphone.

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Chapter 1: Specifications and Options

- **Dimensions**

7/8"

4"

4 1/2"

B A G N D 2 4 V
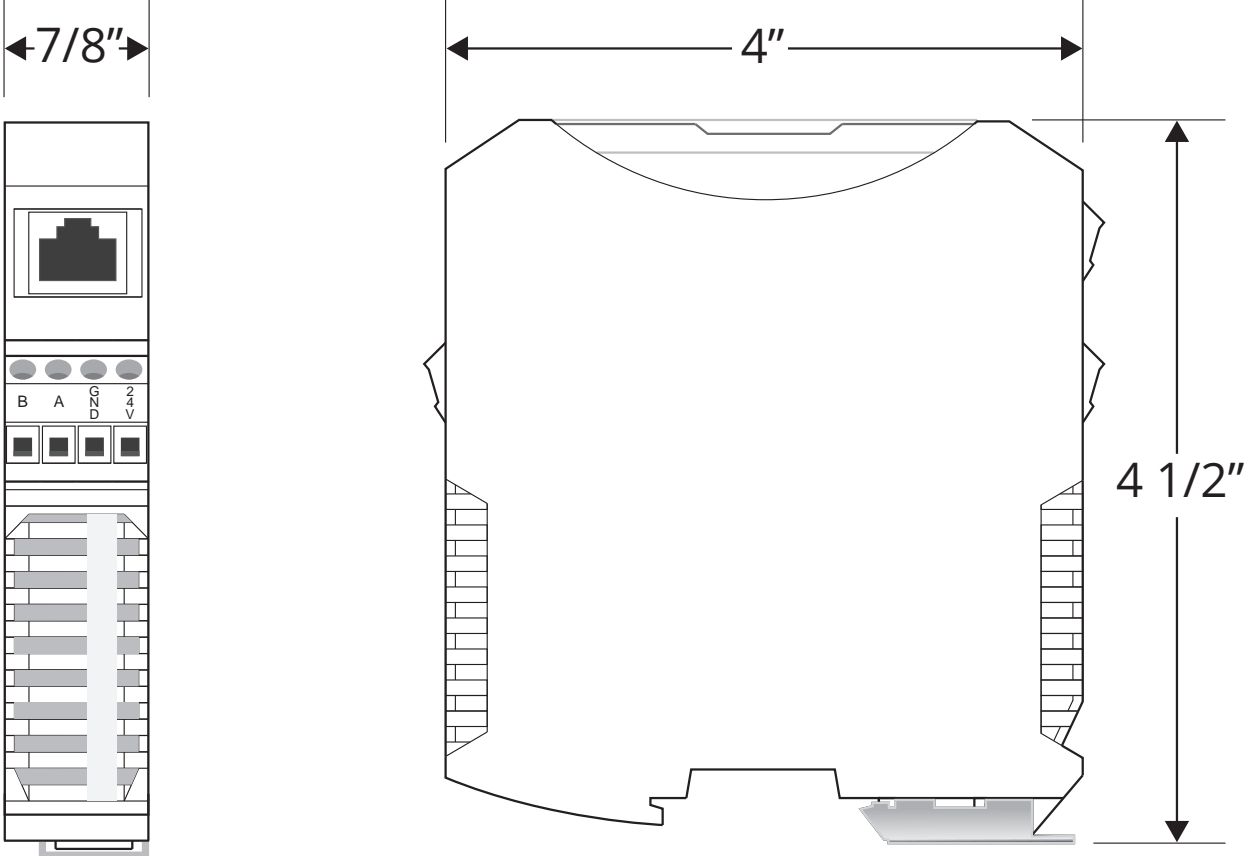
- ## Specifications

Communications
Digital Output	Ethernet TCP/IP Modbus
	Ethernet TCP/IP to internal web page
	Ethernet TCP/IP to APG-provided website
	0-2 Isolated Solid State Relays
Inputs	RS-485 Modbus
	4-20 mA
	0-2 Discrete Switches

Electrical
Operational Supply Voltage (at sensor)	48 VDC via POE (requires injector or switch)
	12-28 VDC
Current Draw	40 mA @ 48 VDC
Power Rating	2.0 W Max
Issolated SSRs	120V, 120 mA Max

Accuracy
Resolution	12 bit

Environmental
Operating Temperature	-40 to 60°C (-40 to 140°F)

Materials of Construction
Housing	Polyamide

Mounting
33 mm Din-Rail

Compatible APG Modbus Senors
Ultrasonic	MNU
Magnetostrictive	MPX-E1, MPX-R1
Pressure	PT-400-L5, PT-400-L31, PT-500-L5, PT-500-L31
Controllers	DCR-1006A, MND

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• **Model Number Configurator**

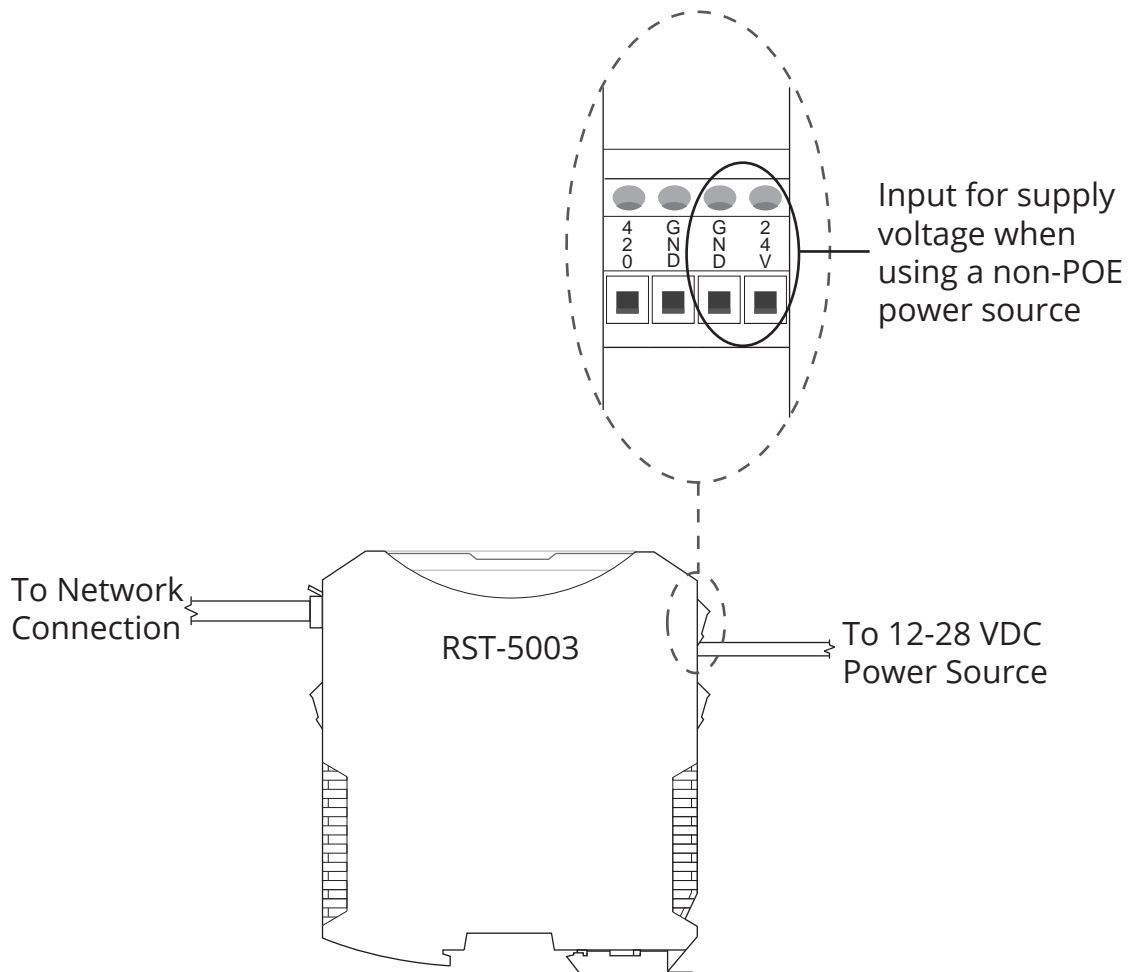Model Number: RST - ____
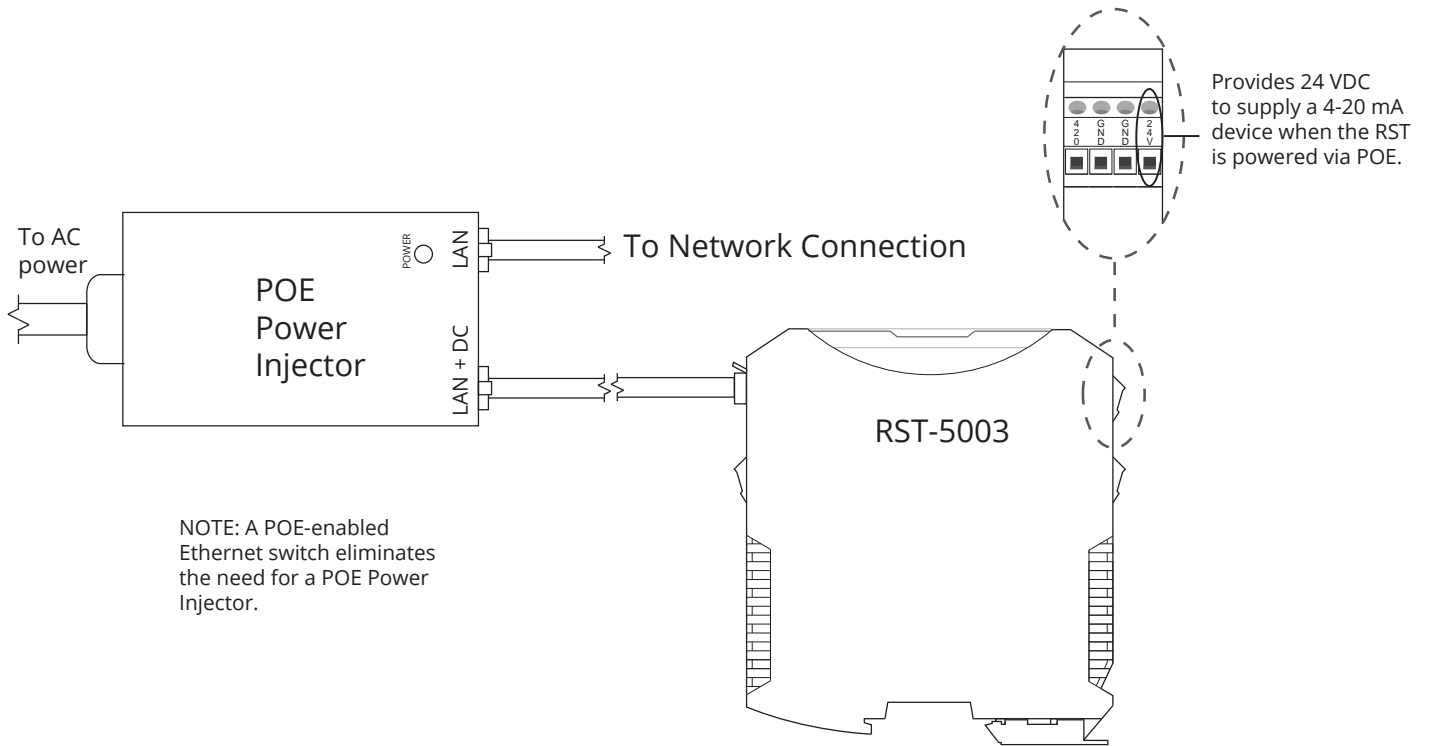   A

A. Model

☐ **5003**   2 relay outputs
☐ **5013**   1 relay output, 1 switch input
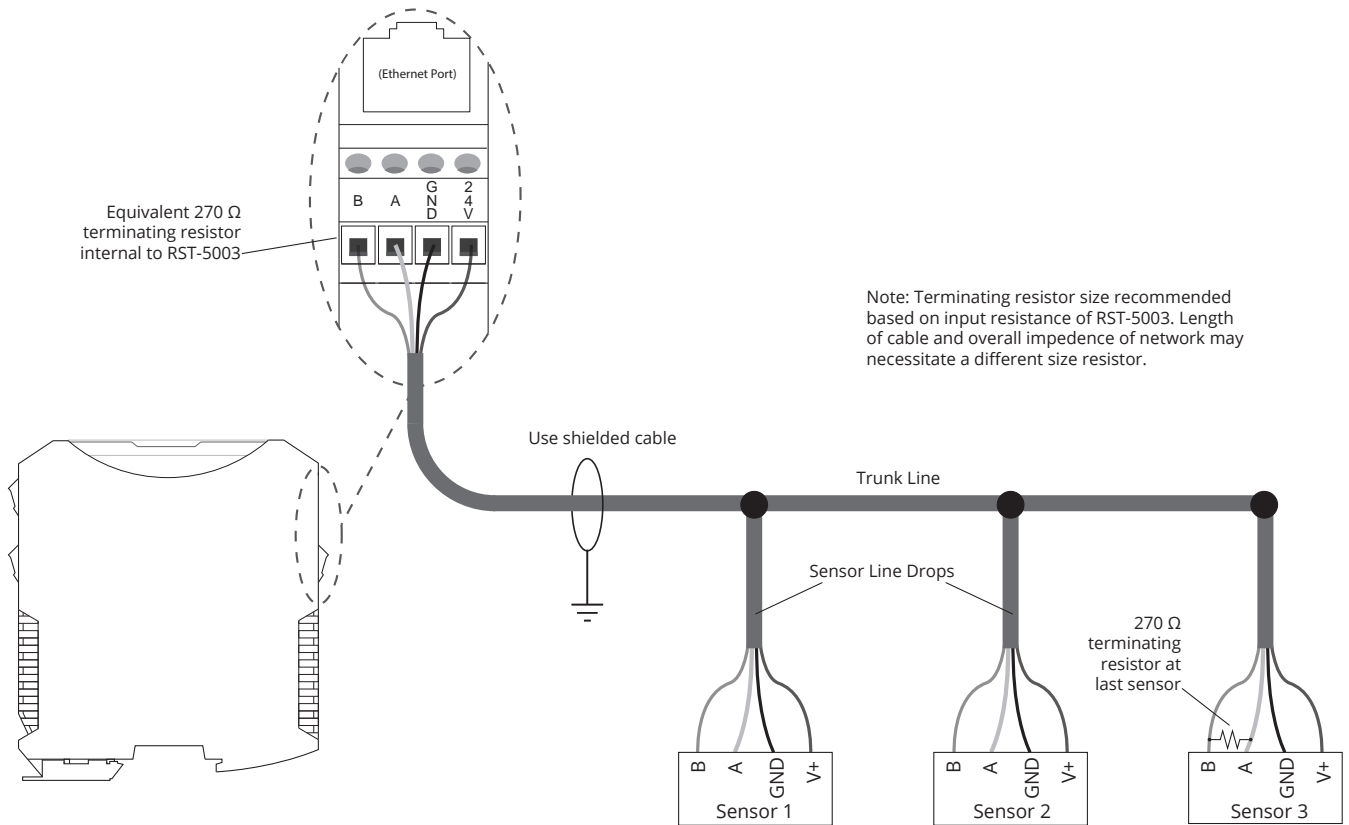☐ **5113**   2 switch inputs

• **System Wiring Diagrams**

External 12-28 VDC Source Wiring

Input for supply voltage when using a non-POE power source

To Network Connection

RST-5003

To 12-28 VDC Power Source

POE (Power over Ethernet) Wiring

Provides 24 VDC to supply a 4-20 mA device when the RST is powered via POE.

To AC power

POWER

LAN

POE Power Injector

LAN + DC

To Network Connection

RST-5003

NOTE: A POE-enabled Ethernet switch eliminates the need for a POE Power Injector.

Modbus Sensor Daisy-chain Wiring

(Ethernet Port)

B   A   GND   24V

Equivalent 270 Ω terminating resistor internal to RST-5003

Note: Terminating resistor size recommended based on input resistance of RST-5003. Length of cable and overall impedence of network may necessitate a different size resistor.

Use shielded cable

Trunk Line

Sensor Line Drops

270 Ω terminating resistor at last sensor

B   A   GND   V+
Sensor 1

B   A   GND   V+
Sensor 2

B   A   GND   V+
Sensor 3

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System Overview - RST-5003 with Modbus and 4-20 mA sensors and Internet Connection

Server Hosting Website and Logged Data

Computer on Internet

Network / Internet Connection

Computer on Local Network

Connection to Internet

RST-5003

4-20 mA Input

(2) Solid State Relays

Modbus Input

4-20 mA Type Level Sensor

MNU Ultrasonic Sensors

MP Magnetostrictive Float Level Sensors
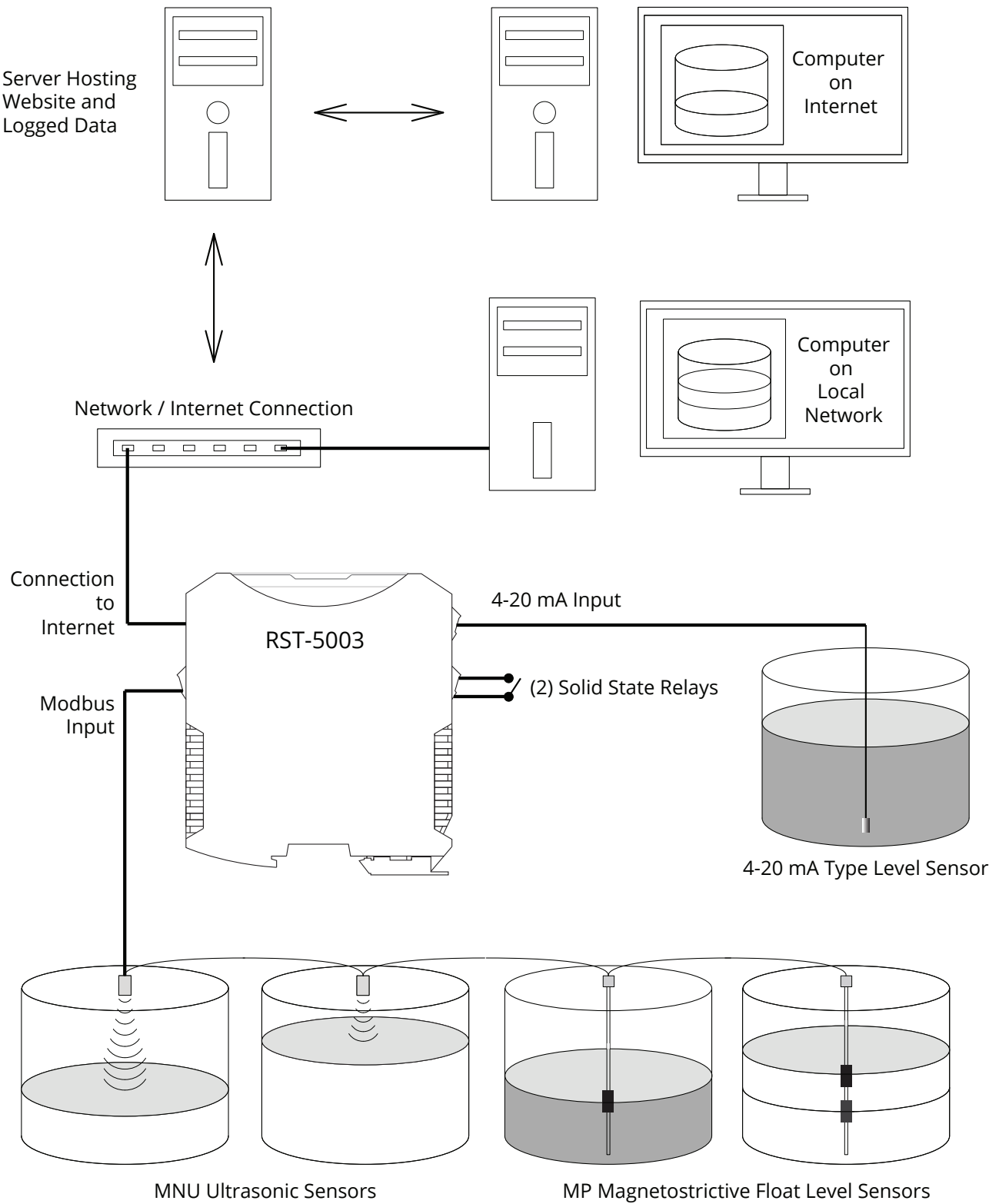
Chapter 2: Installation and Removal Procedures and Notes

- **Tools Needed**

    - You do not need any tools to install your RST-5003. Please consult each sensor's user manual for any sensor installation notes and instructions.

    > ✏ NOTE: For any APG sensor user manual, please visit http://apgsensors.com/support.

- **Connection Notes**

    - Up to 10 Modbus sensors can be connected to the RST-5003 in any combination.
    - Only one 4-20 mA sensor can be connected to the RST-5003.

    > ℹ IMPORTANT: Each Modbus sensor must be connected to the network individually and assigned a unique Sensor Number before the next sensor can be added.

- **Electrical Installation**

    - Connect any 4-20 mA sensor, relays, or switched inputs first.
    - Connect RST to Ethernet/network.
    - Connect independant 12-28 VDC supply if not using POE.
    - Connect and set up one Modbus sensor at a time.

    > ℹ IMPORTANT: Multiple Modbus sensors added to the network simultaneously are all assigned the same Modbus address/sensor number: 1. Sensors MUST be added to the network individually.

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- ## Software Setup

Initial setup of the RST-5003 and individual Modbus sensors is done via an embedded web server. The page can be accessed by using either the serial number or local IP address of the RST-5003 and a web browser (Internet Explorer, Chrome, Firefox, etc).

> ✏️ NOTE: Port 6700 must be open on your local network for the RST-5003 to connect.

Accessing RST-5003 Embedded Web Server

The easier way to access the embedded web server is to type rst_xxx into a web browser on a computer connected to the same local network as the RST-5003. xxx represents the numeric portion of the RST-5003's serial number. See Figures 2.1 and 2.2.
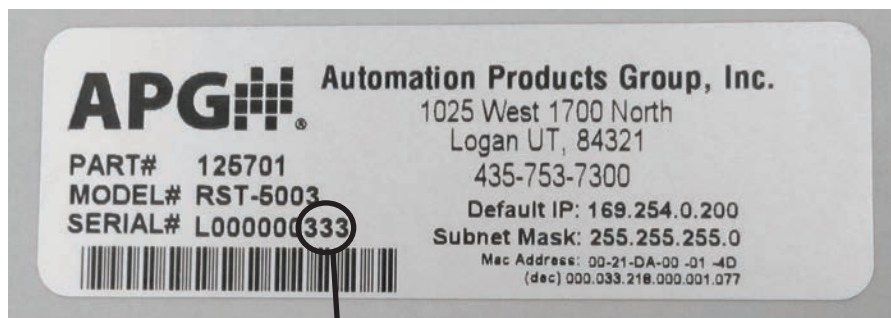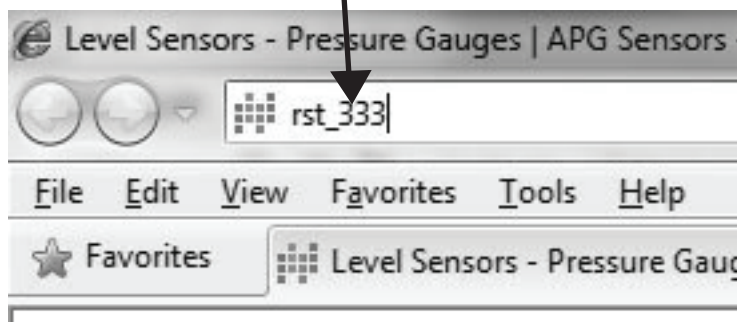

Figure 2.1

Figure 2.2

> ✏️ NOTE: If your web browser performs a web search for "rst_xxx" istead of loading the page, type "http://rst_xxx".

Some networks will block this direct access to the RST-5003. If this is the case, you will need to use the IP address of your RST-5003 to access the embedded web server. The IP address can be obtained two ways: ask your local network administrator, or logon to your APG-provided website, www.levelandflow.com.

After logging on to your APG-provided website, a list of sites will be displayed on your screen (see Figure 2.3). Select the site where the new RST-5003 is installed.

Figure 2.3

From the list of sensors at this site, select the sensor with the serial number that corresponds to the new RST-5003. (See Figure 2.4.)

Figure 2.4

On the Sensor Information screen you will see the IP Address of the newly installed RST-5003. (See Figure 2.5.)

Type the RST's IP address into your browser's address bar (See Figure 2.6).
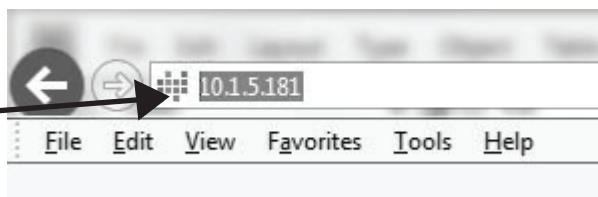
Figure 2.5

Figure 2.6

📝 NOTE: For further information on using your APG-provided remote website, please visit www.apgsensors.com/support for a user manual, or contact us at 1-888-525-7300.

Logging on to the RST-5003 Embedded Web Server

The RST's embedded webpage should now be open, showing the Main Display page (See Figure 2.7). This page lists the sensors attached to the RST-5003 and displays each sensor's current reading. A 4-20 mA sensor will have "Analog Input" as its Sensor Number. The configured sensor number for each Modbus sensor will show as its Sensor Number. Every new Modbus sensor defaults to sensor number 1.

Sensor #	Description	Reading	Units
Analog Input		270.03	Inches
1		69.764	Inches
Refresh		Home	

Figure 2.7

ℹ️ IMPORTANT: Multiple Modbus sensors added to the network simultaneously are all assigned the same sensor number: 1. Sensors must be added to the network individually.

Click on Home to bring up the Menu page (See Figure 2.8). The first menu link clicked during each session will prompt a User Name and Password login for the RST-5003 (See Figure 2.9). The default User Name is **admin**, and the default Password is **password**.
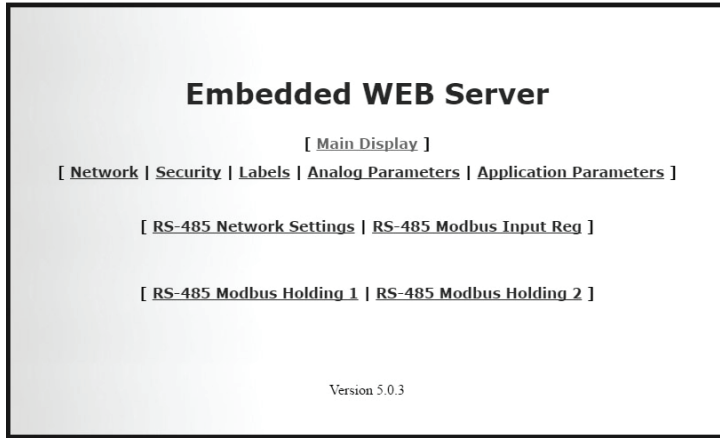
Figure 2.8

Figure 2.9

✏ NOTE: See the Security Setting Menu (Page 35) to change this user name and password.

Assigning Modbus Senor Numbers

Click on RS-485 Network Settings to bring up the RS485 Settings page. (See Figure 2.10.) See section RS-485 Network Settings for a full descrition of each parameter in this menu (Page 36).

Figure 2.10

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Change *Numb of Sensors On Line* to relfect the total number of Modbus sensors you will be connecting. Click Change to send the new value to the RST-5003.

With *Sensor Number to View* set to 1 (for the latest sensor added to the Modbus network), set *New Sensor Number* to the highest available number. Click Change to send the new value to the RST-5003.

Repeat this process for each Modbus sensor as it is added to the network.

> ✏ NOTE: If you control the power to each Modbus sensor seperately, powering up a new sensor after assigning a Modbus address to the previous sensor will allow you to assign an address to the new sensor without leaving the RS845 Settings Menu.

> ❗ IMPORTANT: None of parameters in the RS485 Settings menu automatically update. Each one must be manually configured.

- ## Removal Instructions

  - Disconnect power to the RST-5003 first.
  - Disconnect network connection.
  - Disconnect any sensors, relays, and switched inputs.
  - Remove the RST-5003 and store it in a dry place, at a temperature between -40° F and 180° F.

Chapter 3: Programming with Modbus TCP/IP

- ## Modbus Polling via Ethernet with Modbus TCP/IP

Using the RST-5003's IP address, and port number 502, readings can be polled from the RST-5003 for any attached sensors via RS-485 Modbus commands. Up to 14 32-bit Input Registers, beginning with register 298, can be polled with a single command. Below is a sample Modbus command illustrating the necessary syntax.

Example:
  00 01 : Transaction Identifier
  00 00 : Protocol Identifier
  00 06 : Message Length (6 bytes to follow)
  0B   : The Reporting Unit Identifier [i.e., Sensor Number] (0B hex = 11)
    04 : The Function Code (04 = read Input Registers)
  01 2E : The Data Address of the first register requested. (12E hex + 1 = 303)
  00 02 : The total number of registers requested. (read 2 registers, i.e. 303 to 304)

  Byte order (hex values)
  00 01 00 00 00 06 0B 04 01 2E 00 02

Notes:
- Reporting Unit indicates the sensor reading being polled from the RST-5003, in hex. 01 - 0A are for Modbus sensors 1 - 10 attached to the RST-5003. 0B reads the interpreted values from the 4-20 mA sensor attached to the RST-5003. Unused registers (i.e., those not associated to an attached sensor) will return zeros when polled.

- Function Code 04 reads the Input Registers. No other functionality (e.g., polling from or writing to Holding Registers) is supported via Modbus TCP/IP with the RST-5003. Complete control functionality is available through the embedded web server and through your APG-provided website (www.leveland-flow.com).

- Data Address of registers, decimal to "hex minus 1" conversion:

Decimal Address	Hex minus 1	Decimal Address	Hex minus 1
299	12A	306	131
300	12B	307	132
301	12C	308	133
302	12D	309	134
303	12E	310	135
304	12F	311	136
305	130	312	137

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- Total number of registers requested, up to 14, given in hex:

# of Registers	Hex equivalent	# of Registers	Hex equivalent
01	01	08	08
02	02	09	09
03	03	10	0A
04	04	11	0B
05	05	12	0C
06	06	13	0D
07	07	14	0E

• RST-5003 Generic Modbus Register List

Input Registers (0x04)

Register	Returned Data
30299	Sensor Type
30300	Distance/Level 1, Top (in mm, unsigned)
30301	Distance/Level 2, Bottom (in mm, unsigned)
30302	Sensor Temperature Reading (in ^{0}C, signed)
30303-30304	Calculated 1 (raw)
30305-30306	Calculated 2 (raw)
30307 (upper bits)	Version
30307 (lower bits)	Signal Strength
30308	Battery Voltage
30309 (upper bits)	Sensor Trip 1 Alarm
30309 (lower bits)	Sensor Trip 1 Status
30310 (upper bits)	Sensor Trip 2 Alarm
30310 (lower bits)	Sensor Trip 2 Status
30311 (upper bits)	Sensor Trip 3 Alarm
30311 (lower bits)	Sensor Trip 3 Status
30312 (upper bits)	Sensor Trip 4 Alarm
30312 (lower bits)	Sensor Trip 4 Status

This is the list of generic Input Registers for polling the RST-5003 and any connected sensors. Actual registers used vary by sensor. Please see the user manual for each sensor for a full and accurate list of registers.

> ✏️ NOTE: For more information about Modbus RTU, please visit www.modbus.org.

- **Modbus Programming of Individual Sensors**

  The RST-5003 does NOT support full Modbus programming of attached sensors. Full control and configuration of individual sensors is supported through the RST-5003's embedded web server and through the APG-provided webpage, www.levelandflow.com.

  > ✎ NOTE: For any APG sensor user manual, please visit http://apgsensors.com/support.

Chapter 4: RST-5003 Embedded Web Server

- **Accessing the RST-5003 Embedded Web Server**

  See the Software Setup section of chapter 2 (pages 7 - 9) for instructions for accessing and signing into the RST-5003 embedded web server.

- **Navigating the RST-5003 Embedded Web Server**

  The RST-5003 embedded web server has two primary screens--the Main Display Page (Figure 4.1) and Menu Page (Figure 4.2)--and a screen for each of 9 submenus. The submenus can be understood in three groups:

  - 4-20 mA Sensor Input Configuration Submenus
    - Application Parameters
    - Analog Parameters
  - Modbus Sensor Configuration Registers
    - RS-485 Modbus Input Reg
    - RS-485 Modbus Holding 1
    - RS-485 Modbus Holding 2
  - RST-5003 Utility Menus
    - Network
    - Security
    - Labels
    - RS-485 Network Settings

  The Menu Page also has a link back to the Main Display Page.

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Sensor #	Description	Reading	Units
Analog Input		270.03	Inches
1		69.764	Inches

Refresh   Home

Figure 4.1

Embedded WEB Server

[Main Display]

[Network | Security | Labels | Analog Parameters | Application Parameters]

[RS-485 Network Settings | RS-485 Modbus Input Reg]

[RS-485 Modbus Holding 1 | RS-485 Modbus Holding 2]

Version 5.0.3

Figure 4.2

- **4-20 mA Sensor Input Configuration Submenus**

Analog Application Settings

Application Parameters

Parameters	Information	Values
▶ Units	1=feet,2=inches,3=meters	2
▶ Decimal Place	0-3	2
▶ Full Distance	Not Used	0.0
▶ Empty Distance	Not Used	100.0
▶ Application Type	Value	0
▶ Volume Units	Not Used	1
▶ Tank Parameter 1	Not Used	0.0
▶ Tank Parameter 2	Not Used	0.0
▶ Tank Parameter 3	Not Used	0.0
▶ Tank Parameter 4	Not Used	0.0
▶ Tank Parameter 5	Not Used	0.0

| Change | Refresh | Home |

Figure 4.3

The Application Parameters menu configures the application-specific parameters applied to the calculated reading from the 4-20 mA sensor.

PARAMETER   **RANGE**
Units   1 - feet
                       2 - inches
                       3 - meters

Units is used to select the units of measurement for distance or level applications. The units will also determine the resolution of *Calculated Units*, *4ma Value*, *20ma Value*, *Window*, *Current Reading* (See Figure 4.5), and all of the Application Parameters (See Figure 4.3). The resolution is: feet 0.01, inches 0.1, and meters 0.001.

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Figure 4.4

PARAMETER	RANGE
Decimal Place	0 - 0
	1 - 0.1
	2 - 0.01
	3 - 0.001

Decimal Place sets the resolution of *Calc. Dist,Level,Volume* (See Figure 4.5). This resolution is also used *Trip Values* and *Trip Windows* (See Figure 4.5), and the reading on Main Display Page (See Figure 4.1).

PARAMETER	RANGE
Full Distance	0 - Sensor Maximum

Full Distance sets the distance from the sensor *Reference Position* (See Figure 4.5) to the full level of the vessel being monitored. Not used when Application Type is set to 0 Value.

PARAMETER	RANGE
Empty Distance	0 - Sensor Maximum

Empty Distance sets the distance from the sensor *Reference Position* (See Figure 4.5) to the empty level of the vessel being monitored. Not used when Application Type is set to 0 Value.

PARAMETER	RANGE
Application Type	0 = Value (Distance)
	1 = Level
	2 = Volume of Standing Cylindrical Tank with or without Hemispherical Bottom
	3 = Volume of Standing Cylindrical Tank with or without Conical Bottom
	4 = Volume of Standing Rectangular Tank with or without Chute Bottom
	5 = Volume of Horizontal Cylindrical Tank with or without Spherical Ends
	6 = Volume of Spherical Tank
	7 = Pounds (Linear Scaling)
	8 = User Defined Units
	9 = Volume of Vertical Oval Tank
	10 = Volume of Horizontal Oval Tank
	11 = Polynomial (strapping chart)

Application Type is used to choose the parameter configuration to convert the distance/value of *Calculated Units* into *Calc. Dist,Level,Volume*. After selecting an Application Type and pressing "Change," the Application Parameters menu updates to reflect the parameters of the chosen application (Compare Figure 4.3 and Figure 4.4).

See *Tank Parameters* for an explaination of each *Application Type* and its associated parameters.

PARAMETER	RANGE
Volume Units	1 = Feet^3
	2 = Million Feet^3
	3 = Gallons
	4 = Meters^3
	5 = Liters
	6 = Inches^3
	7 = Barrels

Volume Units selects the units of measure for *Calc. Dist,Level,Volume* when a volumetric application is selected. The settings is not used when the Application Type is set to 0, 1, 7, or 8.

Tank Parameters

Application Type	Tank Parameter	Function
0 - Value (Distance)	Parameter 1	Not Used
	Parameter 2	Not Used
	Parameter 3	Not Used
	Parameter 4	Not Used
	Parameter 5	Not Used

Value (Distance) calculates *Calc. Dist,Level,Volume* using only the *4ma Value* and *20ma Value* settings. The result is a linear value or distance measurement.

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Application Type	Tank Parameter	Function
1 - Level	Parameter 1	Not Used
	Parameter 2	Not Used
	Parameter 3	Not Used
	Parameter 4	Not Used
	Parameter 5	Not Used

Level calculates *Calc. Dist,Level,Volume* using only the *4ma Value* and *20ma Value* settings, just as *Value (Distance)* does. The difference is that *Level* allows for the definition of *Full Distance* and *Empty Distance*, which then creates a display for percentage of level on the remote website.

Application Type	Tank Parameter	Function
2 - Standing Cylindrical	Parameter 1	Tank Diameter
Tank with	Parameter 2	Bottom Radius
Hemispherical	Parameter 3	Not Used
Bottom	Parameter 4	Not Used
	Parameter 5	Not Used
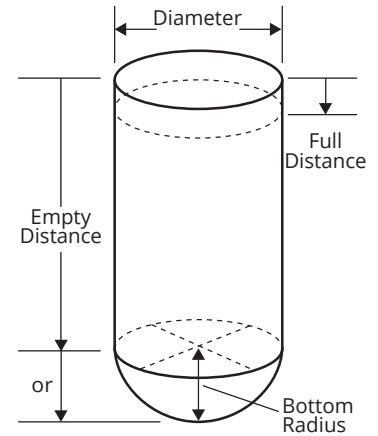
Application Type	Tank Parameter	Function
3 - Standing Cylindrical	Parameter 1	Tank Diameter
Tank with	Parameter 2	Bottom Radius
Conical	Parameter 3	Cone Length (Height)
Bottom	Parameter 4	Not Used
	Parameter 5	Not Used
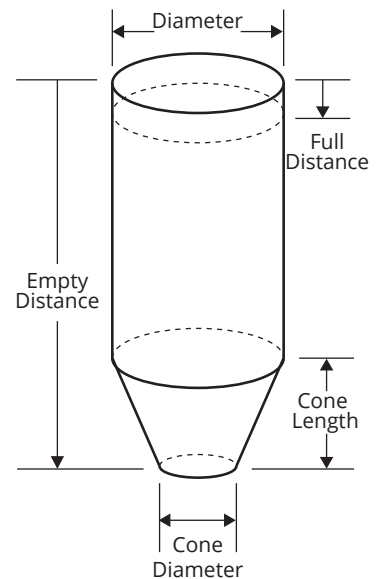
Application Type	Tank Parameter	Function
4 - Standing Rectangular Tank with Chute	Parameter 1	Tank X Dimension
	Parameter 2	Tank Y Dimension
	Parameter 3	Chute X Dimension
	Parameter 4	Chute Y Dimension
	Parameter 5	Chute Length (Height)
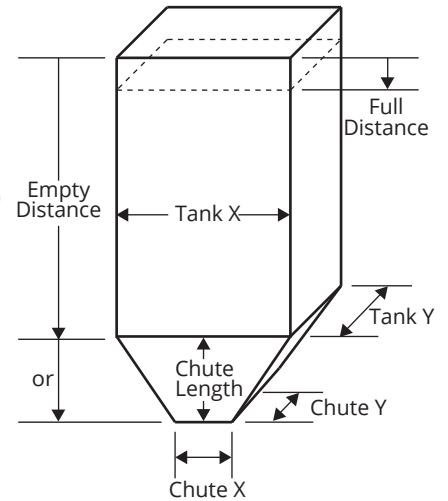
Application Type	Tank Parameter	Function
5 - Horizontal Cylindrical Tank with Spherical Ends	Parameter 1	Tank Length
	Parameter 2	Tank Diameter
	Parameter 3	Radius of Ends
	Parameter 4	Not Used
	Parameter 5	Not Used
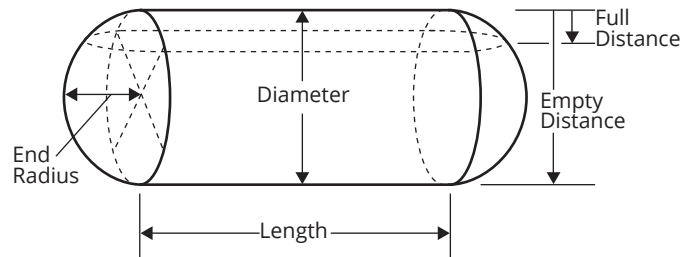
Application Type	Tank Parameter	Function
6 - Spherical Tank	Parameter 1	Tank Diameter
	Parameter 2	Not Used
	Parameter 3	Not Used
	Parameter 4	Not Used
	Parameter 5	Not Used

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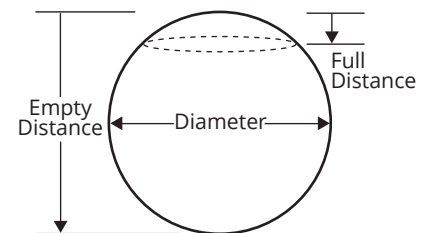
Application Type	Tank Parameter	Function
7 - Pounds	Parameter 1	Multiplier
(Linear Scaling)	Parameter 2	Unit Definition (label)
	Parameter 3	Not Used
	Parameter 4	Not Used
	Parameter 5	Not Used

Pounds allows for a multiplier (*Parameter 1*) to be applied to the *Calculated Units*, creating a linear scalar as the output to *Calc. Dist,Level,Volume*. Such a multplier could convert the distance or level measurement of a tank with simple geometry into a measurement of weight.

Application Type	Tank Parameter	Function
8 - User Defined Units	Parameter 1	Not Used
	Parameter 2	Unit Definition (label)
	Parameter 3	Not Used
	Parameter 4	Not Used
	Parameter 5	Not Used

User Defined Units allows the user to set custom units for the output to *Calc. Dist,Level,Volume*. The label for the custom units is stored in *Parameter 2*, and is applied to the the *4ma Value* and *20ma Value* settings, which are used to calculate the output.

Application Type	Tank Parameter	Function
9 - Vertical Oval	Parameter 1	Tank Length
Tank	Parameter 2	Tank Depth
	Parameter 3	Tank Width
	Parameter 4	Not Used
	Parameter 5	Not Used

Application Type	Tank Parameter	Function
10 - Horizontal Oval	Parameter 1	Tank Length
Tank	Parameter 2	Tank Depth
	Parameter 3	Tank Width
	Parameter 4	Not Used
	Parameter 5	Not Used

Application Type	Tank Parameter	Function
11 - Curve Fit Polynomial	Parameter 1	X^3 Coefficient
(Strapping Chart)	Parameter 2	X^2 Coefficient
	Parameter 3	X^1 Coefficient
	Parameter 4	X^0 Coefficient
	Parameter 5	Not Used

Analog Parameters

Parameters	Information	Values		Parameters	Information	Values
▶ Reference Position	0=Bottom 1=Top	0		▶ Trip1 Value	0-10,000.00	0.20
▶ 4ma Value	0.0-100,000.0 Inches	0.0		▶ Trip1 Window	0-10,000.00	0.10
▶ 20ma Value	0.0-100,000.0 Inches	100.0	Change	▶ Trip1 Type Output	(0-17,19-27,29) 0=Near	0
▶ 4ma Calibration	0 to 4095	825		▶ Trip2 Value	0-10,000.00	0.40
▶ 20ma Calibration	0 to 4095	4095		▶ Trip2 Window	0-10,000.00	0.10
▶ Average	1 to 32	20		▶ Trip2 Type Output	(0-17,19-27,29) 0=Near	0
▶ Window	0.0-100,000.0 Inches	20.0				
▶ Out of Range Samples	0 to 250	20		▶ Retry Time	30 to 3600 Seconds	30
▶ Sample Rate	1 to 15 Hertz	10				
			Call In	▶ Remote Call in Time	1 to 86400 Seconds	60 (45)
				▶ Remote Bytes	8 or 240	8
▶ Calculated Units	0.0-100,000.0 Inches	23.1				
▶ Calc Dist,Level,Volume	Feet^3	0.00	Refresh	▶ Current Reading	4.00 to 20.00 milliamps	7.68
▶ Trip1 Status	Green=ON Red=OFF	Trip1 ON	Home	▶ Trip2 Status	Green=ON Red=OFF	Trip2 ON

Figure 4.5

PARAMETER	RANGE
Reference Position	1 = Top
	0 = Bottom
	0 = Not Used

Reference Position defines the zero-reference point of the sensor in relation to the vessel being monitored. Ultrasonic sensors measure from the top down and submersible pressure transducers measure from the bottom up. MPX magnetostrictive sensors and non-submersible pressure sensors do not use a top or bottom reference point. *Reference Position* is not used when *Application Type* is set to 0 Value (See Figure 4.3).

ⓘ IMPORTANT: Parameter values stored on the RST-5003 will not update until the "Change" button is clicked.

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PARAMETER	RANGE
4ma Value	0 - Sensor Max Distance

4ma Value assigns the RST-5003 distance output corresponding to the output of 4 mA from the sensor.

PARAMETER	RANGE
20ma Value	0 - Sensor Max Distance

20ma Value assigns RST-5003 distance output corresponding to the output of 20 mA from the sensor.

> ✎ NOTE: For ultrasonic sensors only:
> For Distance configuration (i.e., to interpret a greater mA output as a target surface further from sensor), set the *4ma Value* to be less than the *20ma Value*.
> For Fill configuration (i.e., to interpret a greater mA output as a target surface closer to sensor), set the *4ma Value* to be greater than the *20ma Value*. See Figure 4.6.
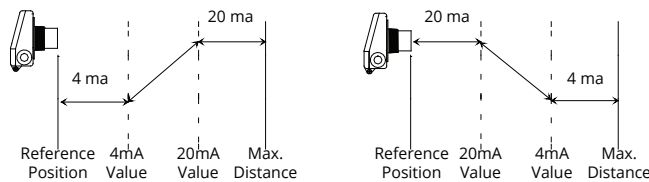
Figure 4.6

PARAMETER	RANGE
4ma Calibration	0 - 4095 Default: 825

4ma Calibration fine tunes the amount of recieved signal interpreted by the RST-5003 as the 4 mA signal.

PARAMETER	RANGE
20ma Calibration	0 - 4095 Default: 4095

20ma Calibration fine tunes the amount of recieved signal interpreted by the RST-5003 as the 20 mA signal.

PARAMETER	RANGE
Average	1-32

Average sets the number of qualified samples to average for the displayed reading. Qualified samples are placed in a first-in, first-out buffer, the contents of which are averaged for *Calculated Units*. The larger the number of qualified samples being averaged, the smoother the output reading will be, and the slower the reading will be to react to quick changes.

PARAMETER	RANGE
Window	0 - Sensor Maximum

Window determines the corresponding physical range for qualified samples, based on the current *Calculated Units*. Samples beyond the +/- *Window* range of the current *Calculated Units* will not qualify unless the average moves. Samples outside the extents of the *Window* are written to the *Out of Range Samples* buffer. (See Figure 4.7.)

PARAMETER	RANGE
Out of Range Samples	0-250

Out of Range Samples sets the number of consecutive samples outside the *Window* necessary to automatically adjust the current *Calculated Units* and move the *Window*.

PARAMETER	RANGE
Sample Rate	1 - 15 Hz

Sample Rate is the number of samples of the sensor output taken by the RST-5003 every second.

Example:
Window = 6 Inches
Out of Range Samples = 10

	All readings are accepted within this area	
Readings are rejected within this area unless they persist for 10 consecutive samples	6" 6"	**Readings are rejected within this area unless they persist for 10 consecutive samples**

Min. Reading   Current value of Calculated Units   Max. Reading
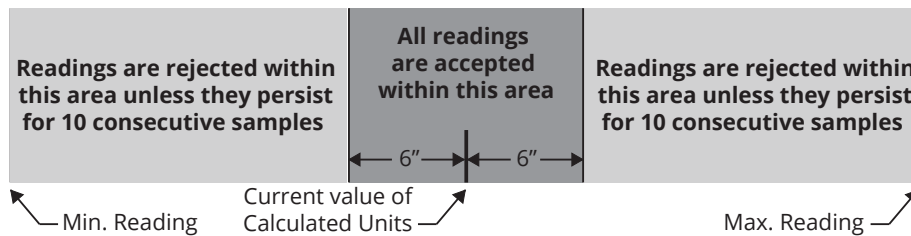
Figure 4.7

Analog Calculated Displays

▶ Calculated Units	0.0-100,000.0 Inches	270.0
▶ Calc Dist,Level,Volume	Inches	270.03

Figure 4.8

DISPLAY	RANGE
Calculated Units	Determined by *Units*

Calculated Units displays the "raw" reading--converted from the *Current Reading* (See Figure 4.15) from the sensor, based on the *4ma Value* and *20ma Value* settings--using the decimal places determined by the *Units* (See Figure 4.3). *Calculated Units* functions as the midpoint for *Window*.

DISPLAY	RANGE
Calc. Dist,Level,Volume	

Calc. Dist,Level,Volume displays the output calculated from *Calculated Units* using the Application Parameters (See Figures 4.3 and 4.4). *Calc. Dist,Level,Volume* is the evaluation basis for Trip settings (see Figures 4.9 and 4.11) and shows as the Reading on the Main Display Page (See Figure 4.1).

Analog-to-SS-Relay Trip Outputs and Settings

▶ Trip1 Value	0.00-50.00 Feet	2.50
▶ Trip1 Window	0.00-50.00 Feet	1.00
▶ Trip1 Type Output	(0 to 29) 0=Near	0
▶ Trip2 Value	0.00-50.00 Feet	3.00
▶ Trip2 Window	0.00-50.00 Feet	1.00
▶ Trip2 Type Output	(0 to 29) 0=Near	0

Figure 4.9

▶ Trip1 Status	Green=ON Red=OFF	Trip1 ON	Home	▶ Trip2 Status	Green=ON Red=OFF	Trip2 ON

Figure 4.10

The RST-5003 and RST-5013 have output relays that can be configured to turn on or off based on the *Calc. Dist,Level,Volume* of the sensor.

Trip Type Outputs are configured with two independent digits: the first for Alarm Type (Blank, 1, or 2), and the second for Trip Condition (0-5, 7, or 9).

PARAMETER	RANGE
Trip Value	0 - Sensor Max Distance

Trip Value sets the value of the primary trip position, which is closest to the *Reference Position* of the sensor.

PARAMETER	RANGE
Trip Window	0 - Sensor Max Distance

Trip Window sets the value from the primary trip position to the secondary trip position, which is farther from the sensor's *Reference Position*.

Alarm Type

Blank_ - No Alarm

Designates that no alarm is to be activated or deactivated on the remote APG-provided website (i.e., www.levelandflow.com) for the indicated Trip Condition. To initiate only the visual Trip Status indicator (See Figure 4.10) for Trip Condition 3, *Trip Type* would be set to **3**.
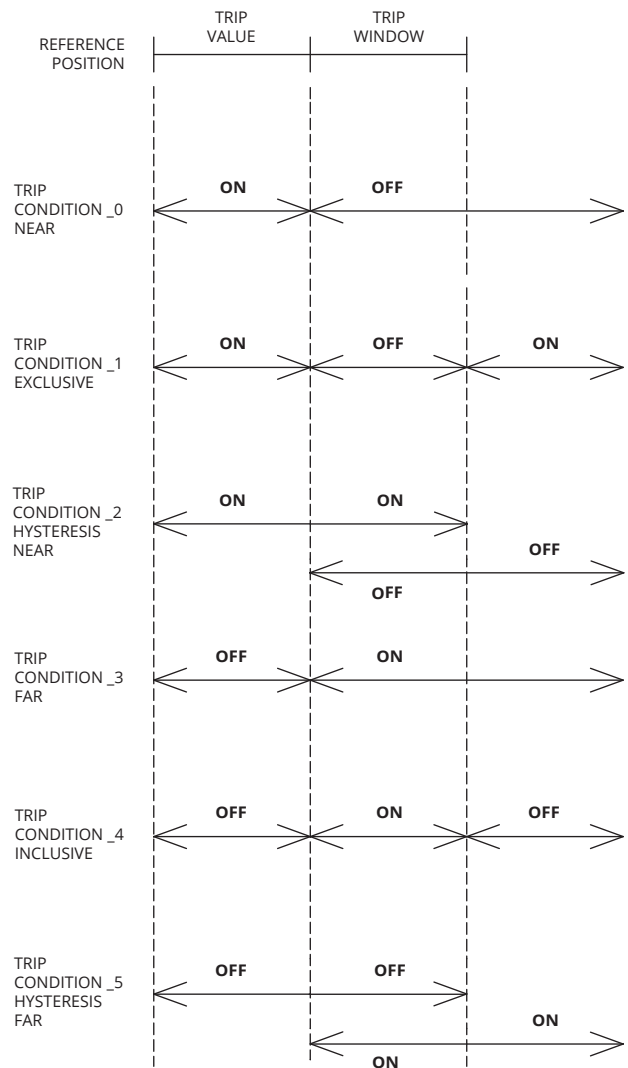
Figure 4.11

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Alarm Type

1_ - Active Alarm

Designates the active trip point as a web alarm condition. To initiate web alarm whenever the Trip Condition 3 is ON, *Trip Type* would be set to **13**.

Alarm Type

2_ - Inactive Alarm

Designates an inactive trip point as a web alarm condition. To initiate a web alarm whenever the Trip Condition 3 is OFF, *Trip Type* would be set to **23**.

Trip Condition

0 - Near

Near activates the Trip whenever the *Calc. Dist,Level,Volume* is less than the *Trip Value* setting.

Trip Condition

1 - Exclusive

Exclusive activates the Trip whenever the *Calc. Dist,Level,Volume* is less than the *Trip Value* setting OR greater than the *Trip Value + Trip Window* settings.

Trip Condition

2 - Hysteresis Near

Figure 4.11

Hysteresis Near activates the Trip whenever the *Calc. Dist,Level,Volume* becomes less than than the *Trip Value* setting. The Trip remains activated until the *Calc. Dist,Level,Volume* becomes greater than the *Trip Value + Trip Window* settings. The Trip remains off until the *Calc. Dist,Level,Volume* becomes less than the *Trip Value* setting again.

Trip Condition

3 - Far

Far activates the Trip whenever the *Calc. Dist,Level,Volume* is greater than the *Trip Value* setting.

Trip Condition

4 - Inclusive

Inclusive activates the Trip whenever the *Calc. Dist,Level,Volume* is greater than the *Trip Value* setting AND less than the *Trip Value + Trip Window* settings.
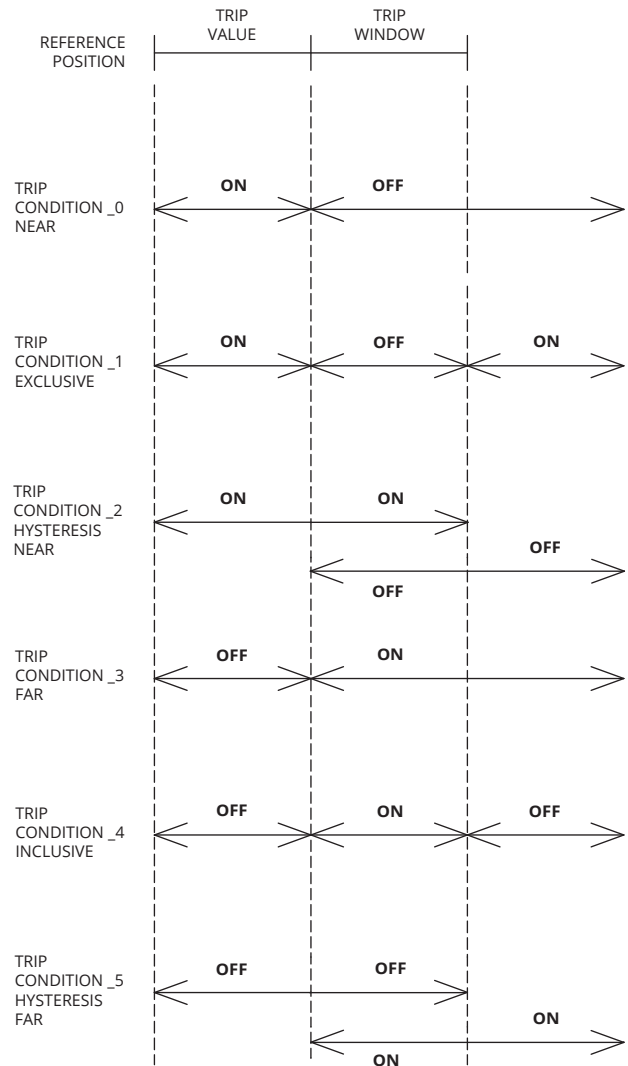
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Trip Condition

5 - Hysteresis Far

Hysteresis Far activates the Trip whenever the *Calc. Dist,Level,Volume* becomes greater than the *Trip Value + Trip Window* settings. The Trip remains activated until the *Calc. Dist,Level,Volume* becomes less than the *Trip Value* setting. The Trip remains off until the *Calc. Dist,Level,Volume* becomes greater than the *Trip Value + Trip Window* settings again.

Trip Condition

6 - Disable Trip
16 - Disable Relay
26 - N/A

Disable de-activates the Trip or SS Relay output.

Trip Condition

7 - Loss of Echo

Loss of Echo activates the output when the maximum calculated reading (i.e., the greater of *4ma Value* and *20ma Value*, see Figure 4.6) is reached.

Trip Condition

8 - Timed Interval

Timed Interval activates the output for a set amount of seconds every set amount of minutes (See Figure 4.12). When Trip Type is set to 8, Trip Value and Trip Window are changed to "Interval Time (minutes)" and "On Time (seconds)".

INTERVAL TIME (in minutes)

"ON" TIME (in seconds)
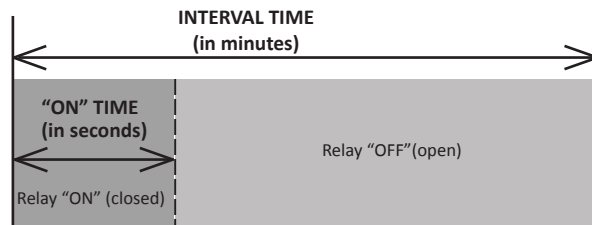
Relay "OFF"(open)

Relay "ON" (closed)

Figure 4.12

Trip Condition

9 - Abrupt Change

Abrupt Change activates the output whenever a user-defined maximum rate of level change (change in distance or level divided by elapsed time) is exceeded. *Trip Value* defines the distance and *Trip Window* defines the time.

Switched Input Alarms (RST-5013 and RST-5113 only)

▶ Trip1 Value	0-10,000.00	10.00
▶ Trip1 Window	0-10,000.00	10.00
▶ Trip1 Type Input	(18,28,30) 28=Alarm on OFF Trip Input	28
▶ Trip2 Value	0-10,000.00	10.00
▶ Trip2 Window	0-10,000.00	10.00
▶ Trip2 Type Input	(18,28,30) 28=Alarm on OFF Trip Input	28

Figure 4.13

The RST-5013 and RST-5113 have switched inputs (one and two, respectively) designed to continuously monitor the status of a simple switch or contact closure. The RST can be configured to alarm on either an open or closed input, and will immediately report to the remote APG-provided website, regardless of the call-in interval, whenever an alarm condition is detected. The following are the three configuration options for the switched input:

Input Alarm/Trip Type
18 - Closed Input Alarm

Closed Input Alarm activates the alarm when the input switch or contact closes.

Input Alarm/Trip Type
28 - Open Input Alarm

Open Input Alarm activates the alarm when the input switch or contact opens.

Input Alarm/Trip Type
30 - On Time Check Limit Alarm

On Time Check Limit Alarm will immediately report to the remote website whenever the input remains continuously closed beyond the user specified time limit (in seconds, as set in the *Trip Value* parameter). The RST will report to the website a second time once the alarm condition clears.

> ⓘ IMPORTANT: Inputs are NOT designed to monitor switches controlling a voltage or electrical signal. The inputs are designed to detect continuity at the closure of un-powered contacts.

External Website Communication Status

Figure 4.14

The RST-5003 embedded web server includes one parameter, one button, and two status reports for communication with the remote APG-provided website (i.e., www.levelandflow.com).

PARAMETER   **RANGE**
Retry Time   30 - 180 Seconds

Retry Time sets the time delay (in seconds) between attempts by the RST-5003 to contact the external website.

BUTTON
Call In

Call In forces the LOE to call in to the external website.

DISPLAY   **RANGE**
Remote Call in Time   1 - 86400 Seconds

Remote Call in Time displays the duration of the last communication between the RST-5003 and the external website.

DISPLAY   **RANGE**
Remote Bytes   8 or 240 Bytes

Remote Bytes displays the number of bytes of data sent in the last communication between the RST-5003 and the external website. 8 bytes indicates a normal, successful transmission. 240 bytes indicates an error occured in the transmission.

Analog Sensor Current Reading

Figure 4.15

DISPLAY   **RANGE**
Current Reading   *4.00 - 20.00 milliamps*

Current Reading displays the current 4-20 mA reading from the analog sensor. The RST converts this reading to a distance/value measurement based on the *4ma Value* and *20ma Value* settings (See Figures 4.3 and 4.5). This converted "raw" reading (*Calculated Units*) is the basis for the *Window* function, rather than the 4-20 mA reading from the sensor (See Figure 4.7).

- ## Modbus Sensor Configuration Registers

RS-485 Modbus Input Registers

Modbus Input Registers Sensor #1 Comm Good

Address	Value	Definition
30299	6	Sensor Type
30300	1767	Distance/level 1 (Top)
30301	0	Distance/level 2 (Bottom)
30302	21	Temperature C
30303-30304	69.566	Volume 1 Data
30305-30306	0.000	Volume 2 Data
30307	3	Version Number
30307	0	Signal Strength
30308	NA	Sensor Voltage
30309	Relay Off Alarm Off	Trip 1 Status
30310	Relay Off Alarm Off	Trip 2 Status

Refresh		Home

Figure 4.16

This display-only menu shows the contents of the Input Registers for the selected Modbus sensor (See Figure 4.1). Registers used vary by sensor. Please see the user manual for each sensor for a full list of registers.

- Sensor Type Number and Sensor Model Number List:

Type Number	Model Number	Type Number	Model Number
0	LOE-2126	9	PT-400/PT-500-L31 (Level)
1	LOE-6126	10	PT-400/PT-500-L5 (Pressure)
2	LOE-3136	11	DCR-1006A
3	LOE-7126	12	LPD
4	RST-5001	13	MND
5	MPX-E1/R1 (2 floats)	14	RST-5003/4
6	MPX-E1/R1 (1 float)	15	AUS-7123
7	PG-7	16	MTM-1000
8	PG-10		

Note: This list represents sensors that interface with various APG Modbus software packages. Not all interface with the RST-5003.

RS-485 Modbus Holding 1

MODBUS Holding Registers 1 Sensor #1 Comm Good

Address	Value	Definition	Value Restrictions
40401	2	Units	1=Feet 2=Inches 3=Meters
40402	0	Application Type = Distance	0=Distance 1=Level 2-7,9-11=Volume
40403	3	Volume Units = Gallons	1-7
40404	3	Decimal Place	0-3
40405	7620	Max Distance	0 to Max Distance mm
40406	304	Full Distance	0 to Max Distance mm
40407	2500	Empty Distance	0 to Max Distance mm
40408	100	Sensitivity	0-100
40409	20	Pulses	0-20
40410	300	Blanking	0 to Max Distance mm
40411	0	Gain Control	0-4
40412	2	Averaging / Response Time	0-20
40413	150	Filter Window	0 to Max Distance mm
40414	2	Out Of Range	0-255
40415	200	Sample Rate	10-1000
40416	1.011	Multiplier (Calibration)	0-1.999
40417	-10	Offset	-32000 to 32000 mm
40418	0	Fail Safe	0-2
40419	15	Fail Safe Delay	15-9999
40420	1	Temperature Compensation	0-1

Change   Refresh   Home

Figure 4.17

This menu shows the contents of the first set of Holding Registers for the selected Modbus sensor (See Figure 4.1). The register names and value restrictions are automatically configured for the type of sensor detected (See Figure 4.16). Because register name and use varies by sensor, including a full breakdown of the registers in this manual would be counterproductive. Please see the user manual for each sensor for a full list of registers.

MODBUS Holding Registers 2 Sensor #1 Comm Good

Address	Value	Definition	Value Restrictions
40421	0	RTD Offset	-100 C to 100 C
40422	0	Float Window	1-255
40423	0	1st Float Offset	-32000 to 32000 mm
40424	0	2nd Float Offset	-32000 to 32000 mm
40425	0	Gain Offset	0-255
40426	0	0 Volt / 4ma Set Point	0 to Max Distance mm
40427	0	5 Volt / 20ma Set Point	0 to Max Distance mm
40428	0	0 Volt / 4ma Calibration	0-4095
40429	0	5 Volt / 20ma Calibration	0-4095
40430	1000	Trip 1 Value	0 to Max Distance mm
40431	100	Trip 1 Window	0 to Max Distance mm
40432	6	Trip 1 Type	0-7
40433	2000	Trip 2 Value	0 to Max Distance mm
40434	200	Trip 2 Window	0 to Max Distance mm
40435	6	Trip 2 Type	0-7
40436-40437	0	Parameter 1 Data = Not Used	0-2147483647 mm
40438-40439	0	Parameter 2 Data = Not Used	0-2147483647 mm
40440-40441	0	Parameter 3 Data = Not Used	0-2147483647 mm
40442-40443	0	Parameter 4 Data = Not Used	0-2147483647 mm
40444-40445	0	Parameter 5 Data = Not Used	0-2147483647 mm

Change		Refresh	Home

Figure 4.18

This menu shows the contents of the second set of Holding Registers for the selected Modbus sensor (See Figure 4.1). The register names and value restrictions are automatically configured for the type of sensor detected (See Figure 4.16). Because register name and use varies by sensor, including a full breakdown of the registers in this manual would be counterproductive. Please see the user manual for each sensor for a full list of registers.

- **RST-5003 Utilty Menus**

Network Settings

Network Settings	
▶ LAN IP Address	10.1.5.120
▶ Remote IP Address	174.127.118.68
▶ Subnet Mask	255.255.0.0
▶ Default Gateway	10.1.1.1
▶ Primary DNS Server	10.1.3.22
▶ Secondary DNS Server	10.1.3.2
▶ MAC Address	0.33.218.0.1.32
▶ Port Number	6700
▶ External Website Access On	☑ Checked = On
▶ DHCP Success	☑ Checked = On
▶ Alarm Filter On	☑ Checked = On
▶ Domain Name	www.levelandflow.com
▶ Domain Name IP Address	"174.127.118.68"
▶ Serial Number	288

| Change | | Refresh | Home |

Figure 4.19

The Network Settings are provided for advanced users only and should not normally require changes. Each RST ships with the DHCP enabled, which means it will automatically connect to the the APG-provided remote website (usually www.levelandflow.com) and configure its own Network Settings when plugged into a port providing direct internet access.

🖉 NOTE: Port 6700 must be open on your local network for the RST-5003 to connect.

🖉 NOTE: Please contact APG for access to your remote access website.

Security Settings

Figure 4.20

The Security Settings allow users to set their own user name and password for logging into the embedded webpage.

Labels

Figure 4.21

The Labels menu allow users to create custom labels for the Main Menu and the sensors attached to the RST-5003.

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Labels

▶ Main Table Title	Mini Measure System
▶ Analog Input Description	4-20 Tank 1 Level
▶ Modbus Sensor 1 Description	Ultrasonic Tank 2 Level

Change		Refresh	Home

Mini Measure System

Sensor #	Description	Reading	Units
Analog Input	4-20 Tank 1 Level	270.03	Inches
1	Ultrasonic Tank 2 Level	69.528	Inches

Refresh	Home

Figure 4.22

When labels are created in the Labels menu, they will be reflected on the Main Menu page (See Figure 4.22).

RS-485 Network Settings

RS-485 Network Settings

Definition	Range	Value
9600 Baud	Checked	☑ 9600 Baud
Numb of Sensors On Line	0 to 10	0
Sensor Number to View	1 to 10	1
New Sensor Number	0=No Change or 1 to 10	0
RS485 Sample Rate	1 to 20 Seconds	1

Change		Refresh	Home

Figure 4.23

The RS-485 (Modbus) Settings menu controls the settings for the Modbus sensors (up to 10) attached to the RST-5003.

PARAMETER	RANGE
Baud Rate Checkbox	9600 Baud

Baud Rate Checkbox is used to indicate the baud rate of the of the sensors connected to the RST-5003. All APG Modbus sensors communicate at 9600 Baud.

PARAMETER	RANGE
Numb of Sensors On Line	0 - 10

Numb of Sensors On Line sets the number Modbus sensors connected to the RST-5003. This setting is not automatically populated or updated. The user must change the setting manually. *Numb of Sensors On Line* must always be equal or greater than the number of actual sensors attached to the RST-5003.

> 🖉 NOTE: For best results, set Numb of Sensors On Line to the highest number of number of sensor TO BE connected. No further adjustments will be needed as those sensors are connected to the RST-5003.

PARAMETER	RANGE
Sensor Number to View	1 - 10

Sensor Number to View selects number of the sensor for the RST-5003 to poll for populating the Main Menu and for editing parameters in the Modbus Holding Register menus.

PARAMETER	RANGE
New Sensor Number	0 = No Change
	1 - 10

New Sensor Number changes the sensor number assigned to the sensor selected by *Sensor Number to View*.

> ℹ IMPORTANT: When "Change" is pressed to assign a new sensor number, *Sensor Number to View* DOES NOT update.

PARAMETER	RANGE
RS485 Sample Rate	1 - 20 Seconds

RS485 Sample Rate determines how often the RST-5003 polls the selected Modbus sensor.

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Chapter 5: Maintenance

- ## General Care

  Your RST-5003 series controller is very low maintenance and will need little care as long as it was installed correctly. However, you should avoid applications for which the controller was not designed, such as extreme temperatures, contact with incompatible corrosive chemicals and fumes, or other damaging environments.

- ## Repair and Returns

  Should your RST-5003 series control module require service, please contact the factory via phone, email, or online chat. We will issue you a Return Material Authorization (RMA) number with instructions.

  - Phone: 888-525-7300
  - Email: sales@apgsensors.com
  - Online chat at www.apgsensors.com

  Please have your RST-5003's part number and serial number available. See Warranty and Warranty Restrictions for more information.

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