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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 warranty 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 receive 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.
Chapter 1: Specifications and Options

• Dimensions

![Dimensions Diagram]
### Specifications

#### Communications
- **Digital Output**: Ethernet TCP/IP Modbus, Ethernet TCP/IP to internal web page, Ethernet TCP/IP to APG-provided website
- **Inputs**: 0-2 Isolated Solid State Relays
  - 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
- **Isolated 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 Sensors
- **Ultrasonic**: MNU
- **Magnetostrictive**: MPX-E1, MPX-R1
- **Pressure**: PT-400-L5, PT-400-L31, PT-500-L5, PT-500-L31
- **Controllers**: DCR-1006A, MND
• **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**

[Diagram showing wiring connections]

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

POWER
LAN + DC
To Network Connection

POE Power Injector

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

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

Modbus Sensor Daisy-chain Wiring

Equivalent 270 Ω terminating resistor internal to RST-5003

Use shielded cable

Trunk Line

Sensor Line Drops

270 Ω terminating resistor at last sensor

Note: Terminating resistor size recommended based on input resistance of RST-5003. Length of cable and overall impedance of network may necessitate a different size resistor.
System Overview - RST-5003 with Modbus and 4-20 mA sensors and Internet Connection

Server Hosting Website and Logged Data

Network / Internet Connection

Computer on Local Network

Computer on Internet

Connection to Internet

Modbus Input

4-20 mA Input

(2) Solid State Relays

4-20 mA Type Level Sensor

RST-5003

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](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.

  🔴 **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 independent 12-28 VDC supply if not using POE.
  • Connect and set up one Modbus sensor at a time.

  🔴 **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.
- **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.

> **NOTE:** If your web browser performs a web search for “rst_xxx” instead 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.

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.)
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).

**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.

**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.

![Embedded WEB Server](image)

Figure 2.8

![User Name and Password](image)

Figure 2.9

![NOTE](image)

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

**Assigning Modbus Sensor 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 description of each parameter in this menu (Page 36).

![RS-485 Network Settings](image)

Figure 2.10
Change *Numb of Sensors On Line* to reflect 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 separately, 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 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.levelandflow.com).

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

<table>
<thead>
<tr>
<th>Decimal Address</th>
<th>Hex minus 1</th>
<th>Decimal Address</th>
<th>Hex minus 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>299</td>
<td>12A</td>
<td>306</td>
<td>131</td>
</tr>
<tr>
<td>300</td>
<td>12B</td>
<td>307</td>
<td>132</td>
</tr>
<tr>
<td>301</td>
<td>12C</td>
<td>308</td>
<td>133</td>
</tr>
<tr>
<td>302</td>
<td>12D</td>
<td>309</td>
<td>134</td>
</tr>
<tr>
<td>303</td>
<td>12E</td>
<td>310</td>
<td>135</td>
</tr>
<tr>
<td>304</td>
<td>12F</td>
<td>311</td>
<td>136</td>
</tr>
<tr>
<td>305</td>
<td>130</td>
<td>312</td>
<td>137</td>
</tr>
</tbody>
</table>
• Total number of registers requested, up to 14, given in hex:

<table>
<thead>
<tr>
<th># of Registers</th>
<th>Hex equivalent</th>
<th># of Registers</th>
<th>Hex equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>01</td>
<td>08</td>
<td>08</td>
</tr>
<tr>
<td>02</td>
<td>02</td>
<td>09</td>
<td>09</td>
</tr>
<tr>
<td>03</td>
<td>03</td>
<td>10</td>
<td>0A</td>
</tr>
<tr>
<td>04</td>
<td>04</td>
<td>11</td>
<td>0B</td>
</tr>
<tr>
<td>05</td>
<td>05</td>
<td>12</td>
<td>0C</td>
</tr>
<tr>
<td>06</td>
<td>06</td>
<td>13</td>
<td>0D</td>
</tr>
<tr>
<td>07</td>
<td>07</td>
<td>14</td>
<td>0E</td>
</tr>
</tbody>
</table>

• RST-5003 Generic Modbus Register List

Input Registers (0x04)

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

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](http://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.
<table>
<thead>
<tr>
<th>Sensor #</th>
<th>Description</th>
<th>Reading</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Input</td>
<td>270.03</td>
<td>Inches</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>69.764</td>
<td>Inches</td>
<td></td>
</tr>
</tbody>
</table>

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**

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

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>1 - feet</td>
</tr>
<tr>
<td></td>
<td>2 - inches</td>
</tr>
<tr>
<td></td>
<td>3 - meters</td>
</tr>
</tbody>
</table>

*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.
### Application Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Information</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>1=feet, 2=inch, 3=meters</td>
<td></td>
</tr>
<tr>
<td>Decimal Place</td>
<td>0-3</td>
<td></td>
</tr>
<tr>
<td>Full Distance</td>
<td>0.0-100.000.0 Inches</td>
<td>0.0</td>
</tr>
<tr>
<td>Empty Distance</td>
<td>0.0-100.000.0 Inches</td>
<td>100.0</td>
</tr>
<tr>
<td>Application Type</td>
<td>StandCylTank CBottom</td>
<td></td>
</tr>
<tr>
<td>Volume Units</td>
<td>Feet3</td>
<td></td>
</tr>
<tr>
<td>Tank Parameter 1</td>
<td>Tank Diameter Inches</td>
<td>0.0</td>
</tr>
<tr>
<td>Tank Parameter 2</td>
<td>Cone Diameter (at bottom of cone) Inches</td>
<td>0.0</td>
</tr>
<tr>
<td>Tank Parameter 3</td>
<td>Cone Length Inches</td>
<td>0.0</td>
</tr>
<tr>
<td>Tank Parameter 4</td>
<td>Not Used</td>
<td>0.0</td>
</tr>
<tr>
<td>Tank Parameter 5</td>
<td>Not Used</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**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 explanation of each Application Type and its associated parameters.

PARAMETER | RANGE
---|---
Volume Units
1 = Feet
2 = Million Feet
3 = Gallons
4 = Meters
5 = Liters
6 = Inches
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

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Tank Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - Value (Distance)</td>
<td>Parameter 1</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 2</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

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.
### 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 Tank with Hemispherical Bottom | Parameter 1 | Tank Diameter
 | Parameter 2 | Bottom Radius
 | Parameter 3 | Not Used
 | Parameter 4 | Not Used
 | Parameter 5 | Not Used

### Application Type | Tank Parameter | Function
--- | --- | ---
3 - Standing Cylindrical Tank with Conical Bottom | Parameter 1 | Tank Diameter
 | Parameter 2 | Bottom Radius
 | Parameter 3 | Cone Length (Height)
 | Parameter 4 | Not Used
 | Parameter 5 | Not Used

![Diagram 1](image1)

![Diagram 2](image2)
<table>
<thead>
<tr>
<th>Application Type</th>
<th>Tank Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 - Standing Rectangular Tank with Chute</td>
<td>Parameter 1</td>
<td>Tank X Dimension</td>
</tr>
<tr>
<td></td>
<td>Parameter 2</td>
<td>Tank Y Dimension</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>Chute X Dimension</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>Chute Y Dimension</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Chute Length (Height)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Tank Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 - Horizontal Cylindrical Tank with Spherical Ends</td>
<td>Parameter 1</td>
<td>Tank Length</td>
</tr>
<tr>
<td></td>
<td>Parameter 2</td>
<td>Tank Diameter</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>Radius of Ends</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Tank Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 - Spherical Tank</td>
<td>Parameter 1</td>
<td>Tank Diameter</td>
</tr>
<tr>
<td></td>
<td>Parameter 2</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Not Used</td>
</tr>
<tr>
<td>Application Type</td>
<td>Tank Parameter</td>
<td>Function</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>7 - Pounds</td>
<td>Parameter 1</td>
<td>Multiplier</td>
</tr>
<tr>
<td>(Linear Scaling)</td>
<td>Parameter 2</td>
<td>Unit Definition (label)</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

*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 multiplier could convert the distance or level measurement of a tank with simple geometry into a measurement of weight.

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Tank Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 - User Defined Units</td>
<td>Parameter 1</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 2</td>
<td>Unit Definition (label)</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

*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.

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Tank Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 - Vertical Oval Tank</td>
<td>Parameter 1</td>
<td>Tank Length</td>
</tr>
<tr>
<td></td>
<td>Parameter 2</td>
<td>Tank Depth</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>Tank Width</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Tank Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 - Horizontal Oval Tank</td>
<td>Parameter 1</td>
<td>Tank Length</td>
</tr>
<tr>
<td></td>
<td>Parameter 2</td>
<td>Tank Depth</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>Tank Width</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>Not Used</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Tank Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 - Curve Fit Polynomial (Strapping Chart)</td>
<td>Parameter 1</td>
<td>X^3 Coefficient</td>
</tr>
<tr>
<td></td>
<td>Parameter 2</td>
<td>X^2 Coefficient</td>
</tr>
<tr>
<td></td>
<td>Parameter 3</td>
<td>X^1 Coefficient</td>
</tr>
<tr>
<td></td>
<td>Parameter 4</td>
<td>X^0 Coefficient</td>
</tr>
<tr>
<td></td>
<td>Parameter 5</td>
<td>Not Used</td>
</tr>
</tbody>
</table>
### Analog Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Information</th>
<th>Values</th>
<th>Parameter</th>
<th>Information</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference Position</strong></td>
<td>0 = Bottom, 1 = Top</td>
<td>0</td>
<td><strong>Trip1 Value</strong></td>
<td>0 to 10,000.00</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>4mA Value</strong></td>
<td>0.0 - 100.000.0 Inches</td>
<td>0.0</td>
<td><strong>Trip1 Window</strong></td>
<td>0 to 10,000.00</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>20mA Value</strong></td>
<td>0.0 - 100.000.0 Inches</td>
<td>100.0</td>
<td><strong>Trip1 Type Output</strong></td>
<td>(0-17.19-27.29)</td>
<td>Near 0</td>
</tr>
<tr>
<td><strong>4mA Calibration</strong></td>
<td>0 to 4095</td>
<td>125</td>
<td><strong>Trip2 Value</strong></td>
<td>0 to 10,000.00</td>
<td>0.40</td>
</tr>
<tr>
<td><strong>20mA Calibration</strong></td>
<td>0 to 4095</td>
<td>4096</td>
<td><strong>Trip2 Window</strong></td>
<td>0 to 10,000.00</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>1 to 32</td>
<td>20</td>
<td><strong>Trip2 Type Output</strong></td>
<td>(0-17.19-27.29)</td>
<td>Near 0</td>
</tr>
<tr>
<td><strong>Window</strong></td>
<td>0.0 - 100.000.0 Inches</td>
<td>20.0</td>
<td><strong>Retry Time</strong></td>
<td>30 to 3600 Seconds</td>
<td>30</td>
</tr>
<tr>
<td><strong>Out of Range Samples</strong></td>
<td>0 to 250</td>
<td>20.0</td>
<td><strong>Remote Call in Time</strong></td>
<td>1 to 86,400 Seconds</td>
<td>60 (45)</td>
</tr>
<tr>
<td><strong>Sample Rate</strong></td>
<td>1 to 15 Hertz</td>
<td>10.0</td>
<td><strong>Remote Bytes</strong></td>
<td>8 or 240</td>
<td>8</td>
</tr>
<tr>
<td><strong>Calculated Units</strong></td>
<td>0.0 - 100.000.0 Inches</td>
<td>23.1</td>
<td><strong>Current Reading</strong></td>
<td>4.00 to 20.00 milliamps</td>
<td>7.68</td>
</tr>
<tr>
<td><strong>Trip1 Status</strong></td>
<td>Green = ON, Red = OFF</td>
<td>Trip1 ON</td>
<td><strong>Trip2 Status</strong></td>
<td>Green = ON, Red = OFF</td>
<td>Trip2 ON</td>
</tr>
</tbody>
</table>

**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.
**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.

---

![Diagram showing 4ma and 20ma values](image)

**Figure 4.6**

---

**PARAMETER** | **RANGE**
---|---
4ma Calibration | 0 - 4095

Default: 825

4ma Calibration fine tunes the amount of received 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 received 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.
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.)

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.

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

Analog Calculated Displays

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.

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).
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.
**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.

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.

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.

2. **Hysteresis Near**

_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.

3. **Far**

_Far_ activates the Trip whenever the _Calc. Dist, Level, Volume_ is greater than the _Trip Value_ setting.

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.
**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*

*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)”.

**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)

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-pow-ered contacts.
External Website Communication Status

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retry Time</td>
<td>30 - 180 Seconds</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>BUTTON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call In</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Call in Time</td>
<td>1 - 86400 Seconds</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Bytes</td>
<td>8 or 240 Bytes</td>
</tr>
</tbody>
</table>

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 occurred in the transmission.

Analog Sensor Current Reading

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Reading</td>
<td>4.00 to 20.00 milliamps</td>
</tr>
</tbody>
</table>

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

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:**

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

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

<table>
<thead>
<tr>
<th>Definition</th>
<th>Range</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>9600 Baud</td>
<td>Checked</td>
<td>9600 Baud</td>
</tr>
<tr>
<td>Numb of Sensors On Line</td>
<td>0 to 10</td>
<td>0</td>
</tr>
<tr>
<td>Sensor Number to View</td>
<td>1 to 10</td>
<td>1</td>
</tr>
<tr>
<td>New Sensor Number</td>
<td>0=No Change or 1 to 10</td>
<td>0</td>
</tr>
<tr>
<td>RS485 Sample Rate</td>
<td>1 to 20 Seconds</td>
<td>1</td>
</tr>
</tbody>
</table>
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 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 of 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*.

**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.
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.