PT-500E Series

Submersible Level Transmitters For Potable Water

User Manual

APG

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CONTENTS

INTRODUCTION

Thank you for purchasing a PT–500E series submersible pressure transmitter from APG. We appreciate your business! Please take a few minutes to familiarize yourself with your PT–500E and this manual.

The PT-500E is a rugged submersible pressure transmitter specially designed for potable water applications requiring NSF/ANSI/CAN 61 and NSF/ANSI/CAN 372 certifications and can be used in other tank liquid level measurement, water and wastewater applications, and well depth measurement.

Reading your label
Every APG instrument comes with a label that includes the instrument's model number, part number, serial number, and a wiring pinout table. Please ensure that the part number and pinout table on your label match 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 www.apgsensors.com/warranty-returns/. Contact Technical Support to receive a Return Material Authorization before shipping your product back.

Repair and Returns

Should your PT–500E series pressure transmitter 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 apgsensors.com

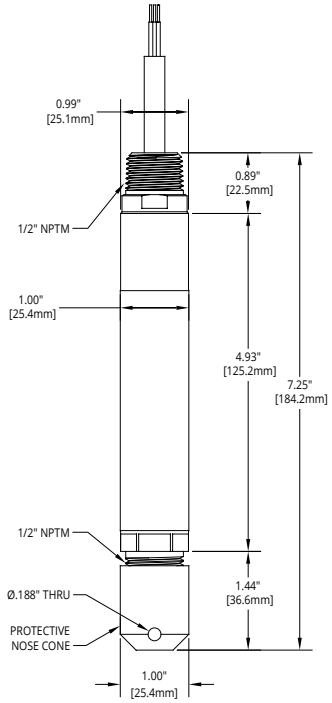
Please have your PT–500E's part number and serial number available. See Warranty and Warranty Restrictions for more information.

NOTE: APG recommends sending your unit in for NIST calibration services at least once a year, though frequency may vary by sensor, regulation, or application. Contact our Technical Support to schedule a service.

NOTE: APG recommends replacing your liquid ingress prevention accessory at least once a year. To learn more, contact our Technical Support.

CHAPTER 1: DIMENSIONS AND WIRING

Dimensions



PT–500E with Removable Nose Cone

Electrical Pinout Table, Supply Power Table, and System Wiring Diagrams

PT–500E Series Pinout Table

		Modbus	4-20mA	Voltage
Pigtail	**Red**	+ Power	+ Power/Signal	+ Power
	Black	– Power	– Power/Signal	– Power
	Green	B (TX–)	—	+ Out
	White	A (TX+)	—	– Out
	Shield Drain	Case Gnd	Case Gnd	Case Gnd

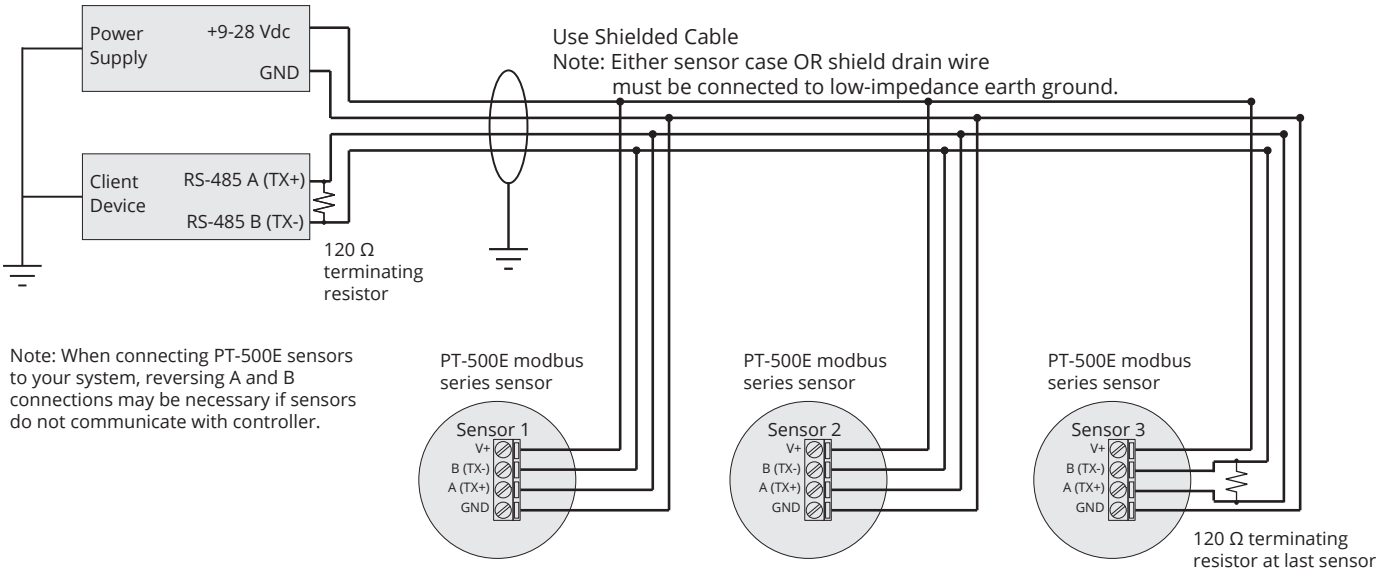
Note: Either transducer case OR shield drain wire must be physically connected to low–impedance earth ground.

PT–500E Series Supply Power Table

	Modbus	4-20mA	0-5 VDC	0-10 VDC	mV/V
Power Supply	9–28 VDC	9-28 VDC	9-28 VDC	14-28 VDC	10 VDC*

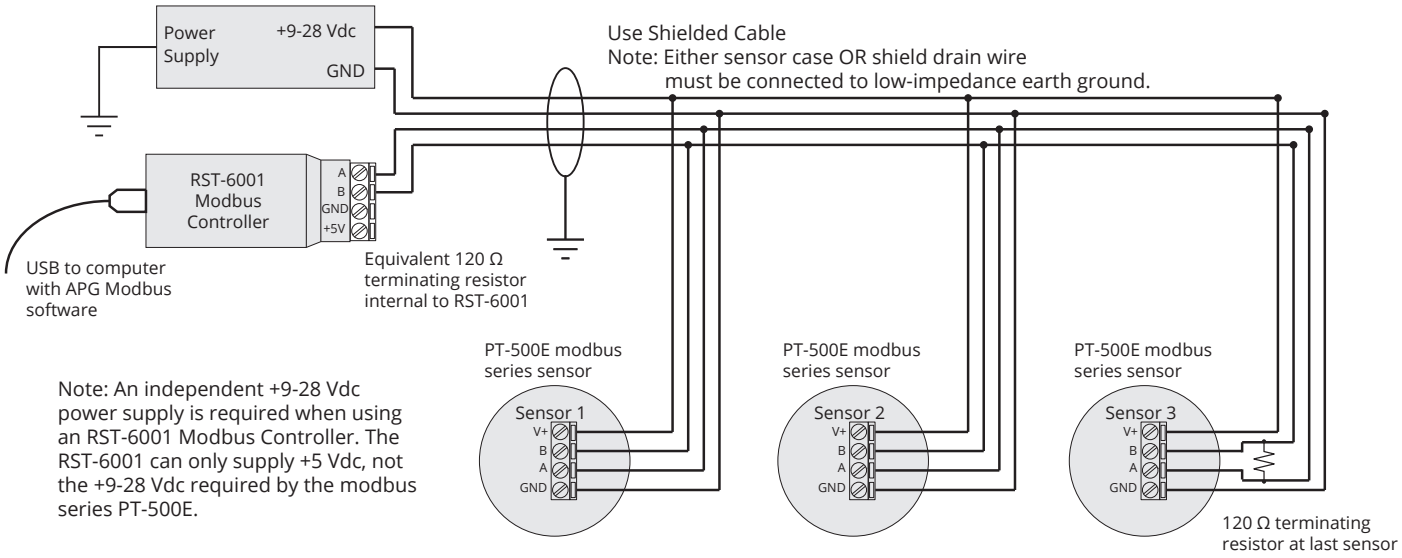
* mV/V output calibrated to 10 VDC input

Modbus System Wiring



Note: When connecting PT-500E sensors to your system, reversing A and B connections may be necessary if sensors do not communicate with controller.

Modbus System Wiring with RST–6001



Note: An independent +9-28 Vdc power supply is required when using an RST-6001 Modbus Controller. The RST-6001 can only supply +5 Vdc, not the +9-28 Vdc required by the modbus series PT-500E.

CHAPTER 2: INSTALLATION AND REMOVAL PROCEDURES AND NOTES

Tools Needed

- Wrench sized appropriately for your PT–500E's process or conduit connection.

Mounting Instructions

Your PT–500E can be mounted via NPT process connection or free–hanging. Mounting your pressure transducer is easy if you follow a few simple steps:

- Never over–tighten the sensor. In all cases, tighten the sensor as little as possible to create an adequate seal.
- Always start screwing in your sensor by hand to avoid cross–threading. Thread failure can be a problem if you damage threads by over–tightening them or by crossing threads.

> ***NOTE***:
> If your PT–500E has a vent tube, do not seal, cover, or close the vent tube with anything other than an APG–provided venting cap or desiccant drying cartridge (See Figure 4.1 and 4.2). Unapproved seals or covers will prevent proper sensor operation.

Electrical Installation

- Attach the wires of your PT–500E to your control system according to the pinout table above.

> ***IMPORTANT***:
> Some manufacturer's Modbus equipment uses reversed TX+/TX– pins. When making connections between APG equipment, reversing connections may be necessary if sensor does not communicate with controller.

> ***IMPORTANT***:
> For lightning transient/surge protection to be effective, either PT–500E case OR shield drain wire must be physically connected to low–impedance earth ground.

Removal Instructions

Removing your PT–500E from service must be done with care. It's easy to create an unsafe situation, or damage your sensor, if you are not careful to follow these guidelines:

- For sensors installed via NPT process connection, make sure the pressure is completely removed from the line or vessel. Follow any and all procedures for safely isolating any media contained inside the line or vessel.
- Remove the sensor with an appropriately sized wrench (per your process connection).
- For suspended sensors, retrieve the sensor from the vessel. Follow any and all procedures for safely isolating any media contained inside the line or vessel.
- Carefully clean the sensor's fitting and diaphragm of any debris (see General Care) and inspect for damage.
- Store your sensor in a dry place, at a temperature between -40° F and 180° F.

DANGER:
Removing your process connected PT–500E Pressure Transmitter while there is still pressure in the line could result in injury or death.

IMPORTANT:
Any contact with the diaphragm can permanently damage the sensor. Use extreme caution.

CHAPTER 3: PROGRAMMING (MODBUS RTU OUTPUT ONLY)

Modbus Programming

PT–500E L5/L31 modbus series sensors use standard Modbus RTU protocol (RS–485). The sensors can only operate as server devices. Sensor default transmission settings are **9600 Baud**, **8 Bits**, **1 Stop Bit**, **No Parity**, and require a minimum delay of 300 ms between transactions to return the contents of all registers. Commands returning fewer registers will require shorter delays. See PT–500E Modbus Register Lists on pages 5 – 7.

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

Modbus Programming with RST–6001 and APG Modbus Software

APG RST–6001 Modbus Controller can be used in tandem with APG Modbus to program and control up to 20 PT–500E L5 or PT–500E L31 sensors. Through APG Modbus, you can monitor the raw readings from the sensor, including level or pressure, temperature and battery voltage, or configure the sensor. See PT–500E Modbus Register Lists on pages 5 – 7.

NOTE:
For APG Modbus programming instructions, or to download APG Modbus software, please visit https://www.apgsensors.com/resources/product-resources/software-downloads/

PT–500E Modbus Register Lists

The registers listed below are reference addresses. To convert a reference address to an offset address, remove the first digit then subtract one.
Example 1: Reference address = 30300 → Offset register = 299
Example 2: Reference address = 40400 → Offset register = 399

Input Registers (0x04)

Register	Returned Data
30299	Model Type
30300	Pressure (L5 – PSI; L31 – mmH_2O)
30301	N/A
30302	Temperature Reading (in ˚C, signed)
30303-30304	Calculated (raw)
30305-30306	N/A
30307	N/A
30308	Battery Voltage
30309	Trip 1 Status
30310	Trip 2 Status

NOTE:
The Calculated Readings will be returned without a decimal place. In order to obtain the true result, the Decimal Place setting must be taken into account.

Holding Registers (0x03) – PT–500E L5 pressure series

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	0-16
40402	Application Type	0 or 8
40403	N/A	
40404	Decimal (Calculated)	0 – 3
40405	Max Pressure	*0 – 32,000 PSI
40406	Full Pressure	0 – 32,000 PSI
40407	Zero Offset	-15,000 – 30,000 PSI
40408	Pressure Decimal	0 – 3
40409	A/D Gain	*1, 2, 4, 8, 16, 32, 64, 128
40410	N/A	
40411	Parameter Default	0 = No; 1 = Restore Defaults
40412	Averaging	0 – 10
40413	Calibration Value	*-32,767 – 32,767
40414	Calibration Flag	*0 – 300
40415	Sample Rate	10 to 1000 milliseconds
40416	Scale	*0 – 65,535
40417	Offset	-20,000 – 20,000
40418	Voltage Offset	-20 – 20
40419	Baud Rate	0 – 3 (2400, 9600, 19200)
40420	Parity	0 – 2 (none, even, odd)
40421	Stop Bit	0 – 1 (0 = 1 stop bit; 1 = 2 stop bits)
40422-40423	Pressure X^3	*N/A
40424-40425	Pressure X^2	*N/A
40426-40427	Pressure X^1	*N/A
40428-40429	Pressure X^0	*N/A
40430	Trip 1 Pressure	-15,000 – 30,000 PSI
40431	Trip 1 Window	0 – 30,00 PSI
40432	Trip 1 Type	0 – 29
40433	Trip 2 Pressure	-15,000 – 30,000 PSI
40434	Trip 2 Window	0 – 30,00 PSI
40435	Trip 2 Type	0 – 29
40436-40437	Multiplier	0.0010 – 99.9999 (float)
40438-40439	Description	A – Z, 0 – 9, /.-,+* (16 char)
40446	Temperature Offset	-20 – 20
40447-40448	Temperature X^3	*N/A
40449-40450	Temperature X^2	*N/A
40451-40452	Temperature X^1	*N/A
40453-40454	Temperature X^0	*N/A

*Setting is factory calibrated. Do not adjust.

Holding Registers (0x03) – PT–500E L31 level series

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	1 = Feet, 2 = Inches, 3 = Meters
40402	Application Type	0 – 11
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	*0 – 65,535 mm
40406	Full Level	0 – 65,535 mm
40407	Zero Offset	0 – 610 mm
40408	N/A	
40409	A/D Gain	*1, 2, 4, 8, 16, 32, 64, 128
40410	Specific Gravity	1 – 2,000
40411	Parameter Default	0 = No; 1 = Restore Defaults
40412	Averaging	0 – 10
40413	Calibration Value	*0 – 65,535
40414	Calibration Flag	*0 – 300
40415	Sample Rate	10 to 1000 milliseconds
40416	Scale	*0 – 65,535
40417	Offset	-20,000 – 20,000
40418	Voltage Offset	-20 – 20
40419	Baud Rate	0 – 3 (2400, 9600, 19200)
40420	Parity	0 – 2 (none, even, odd)
40421	Stop Bit	0 – 1 (0 = 1 stop bit; 1 = 2 stop bits)
40422-40423	Pressure X^3	*N/A
40424-40425	Pressure X^2	*N/A
40426-40427	Pressure X^1	*N/A
40428-40429	Pressure X^0	*N/A
40430	Trip 1 Level	0 – 65,535 (mm)
40431	Trip 1 Window	0 – 65,535 (mm)
40432	Trip 1 Type	0 – 29
40433	Trip 2 Level	0 – 65,535 (mm)
40434	Trip 2 Window	0 – 65,535 (mm)
40435	Trip 2 Type	0 – 29
40436-40437	Parameter 1	0 – 1,000,000 (mm)
40438-40439	Parameter 2	0 – 1,000,000 (mm)
40440-40441	Parameter 3	0 – 1,000,000 (mm)
40442-40443	Parameter 4	0 – 1,000,000 (mm)
40444-40445	Parameter 5	0 – 1,000,000 (mm)
40446	Temperature Offset	-20 – 20
40447-40448	Temperature X^3	*N/A
40449-40450	Temperature X^2	*N/A
40451-40452	Temperature X^1	*N/A
40453-40454	Temperature X^0	*N/A

*Setting is factory calibrated. Do not adjust.

PT–500E Modbus Sensor Parameters – L5 pressure series

40401 – Units

Determines the units of measure for the calculated reading.

0 = PSI	5 = mmH2O†	10 = mmHG‡	14 = inSW
1 = BAR	6 = cmH2O†	11 = cmHG‡	15 = ftSW
2 = mBAR	7 = mH2O†	12 = inHG‡	16 = mSW
3 = kPa	8 = inH2O†	13 = kg/cm^2	
4 = MPa	9 = ftH2O†		

† All H2O pressure measurements @ 20° C.
‡ All HG pressure measurements @ 0° C.

40402 – Application Type

Determines the units of measure for the calculated reading.
0 = Standard (units selected in 40401 are displayed)
8 = Custom (units selected in 40401 and multiplier in 40436-40437 are used to compute desired units; description in 40438-40439 is label for measurement)

PT–500E Modbus Sensor Parameters – L31 level series

40401 – Units

Determines the units of measure for the calculated reading when Application Type is set to 0, 1, or 7.
1 = Feet 2 = Inches 3 = Meters

40402 – Application Type

Determines the type of calculated reading performed by the sensor.
0 = Distance
1 = Level
2 = Standing Cylindrical Tank with or without Hemispherical Bottom
3 = Standing Cylindrical Tank with or without Conical Bottom
4 = Standing Rectangular Tank with or without Chute Bottom
5 = Horizontal Cylindrical Tank with or without Spherical Ends
6 = Spherical Tank
7 = Pounds (Linear Scaling)
8 = N/A
9 = Vertical Oval Tank
10 = Horizontal Oval Tank
11 = Strapping Chart

40403 – Volume Units

Determines the units of measure for the calculated reading when Application Type is set to 2-6 or 9-11.

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

PT–500E Modbus Application Parameters – L31 level series

Application 0 – Distance

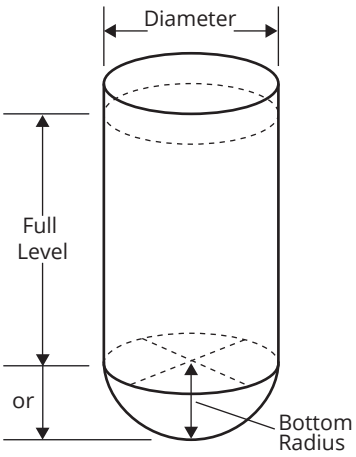
Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	1 = Feet, 2 = Inches, 3 = Meters
40402	Application Type	0
40403	Volume Units	—
40404	Decimal (Calculated)	0 – 3

Application 1 – Level

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	1 = Feet, 2 = Inches, 3 = Meters
40402	Application Type	1
40403	Volume Units	—
40404	Decimal (Calculated)	0 – 3

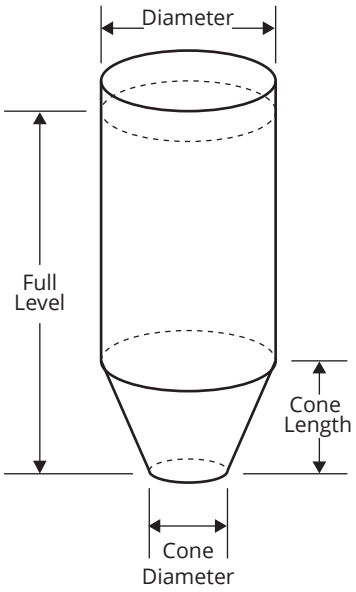
Application 2 – Volume of Standing Cylindrical Tank ± Hemispherical Bottom

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	—
40402	Application Type	2
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	Tank Diameter	0 – 1,000,000 (mm)
40438-40439	Radius of Bottom Hemisphere	0 – 1,000,000 (mm)



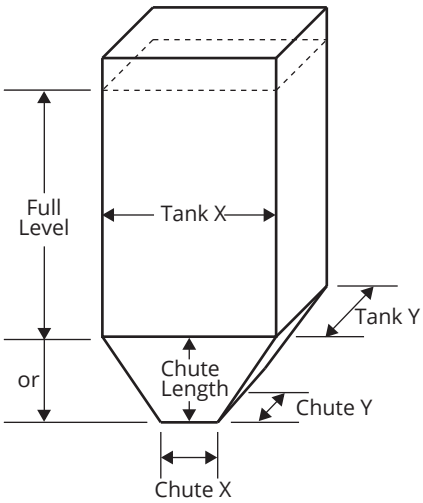
Application 3 – Volume of Standing Cylindrical Tank ± Conical Bottom

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	—
40402	Application Type	3
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	Tank Diameter	0 – 1,000,000 (mm)
40438-40439	Cone Diameter(at bottom of cone)	0 – 1,000,000 (mm)
40440-40441	Length (height) of Cone	0 – 1,000,000 (mm)



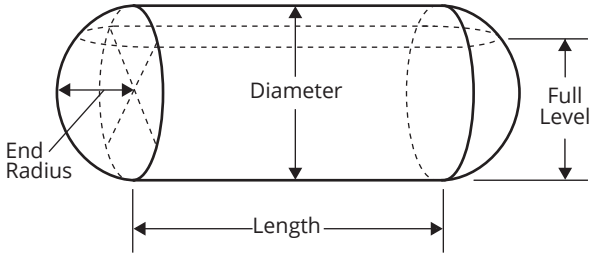
Application 4 – Volume of Standing Rectangular Tank ± Chute Bottom

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	—
40402	Application Type	4
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	Tank X Dimension	0 – 1,000,000 (mm)
40438-40439	Tank Y Dimension	0 – 1,000,000 (mm)
40440-40441	Chute X Dimension	0 – 1,000,000 (mm)
40442-40443	Chute Y Dimension	0 – 1,000,000 (mm)
40444-40445	Length (height) of Chute	0 – 1,000,000 (mm)



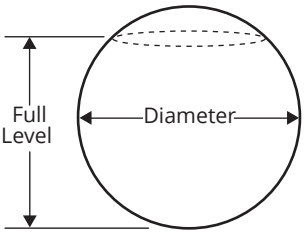
Application 5 – Volume of Horizontal Cylindrical Tank ± Hemispherical Ends

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	—
40402	Application Type	5
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	Tank Length	0 – 1,000,000 (mm)
40438-40439	Tank Diameter	0 – 1,000,000 (mm)
40440-40441	Radius of End Hemispheres	0 – 1,000,000 (mm)



Application 6 – Volume of Spherical Tank

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	—
40402	Application Type	6
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	Tank Diameter	0 – 1,000,000 (mm)

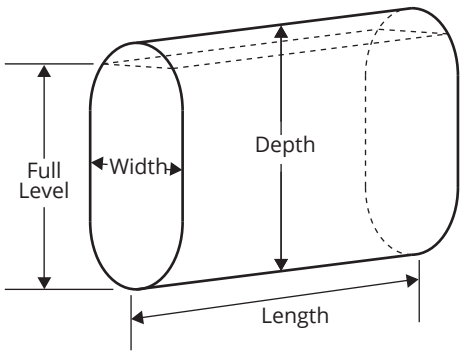


Application 7 – Pounds (Linear Scaling)

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	1 = Feet, 2 = Inches, 3 = Meters
40402	Application Type	7
40403	Volume Units	—
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	Multiplier (linear scalar)	0 – 1,000,000 (1000 = 1.000)

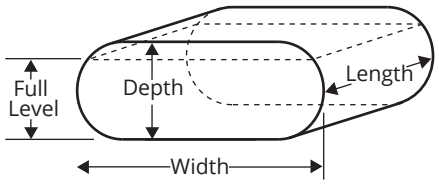
Application 9 – Volume of Vertical Oval Tank

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	—
40402	Application Type	9
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	Tank Length	0 – 1,000,000 (mm)
40438-40439	Tank Depth	0 – 1,000,000 (mm)
40440-40441	Tank Width	0 – 1,000,000 (mm)



Application 10 – Volume of Horizontal Oval Tank

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	—
40402	Application Type	10
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	Tank Length	0 – 1,000,000 (mm)
40438-40439	Tank Depth	0 – 1,000,000 (mm)
40440-40441	Tank Width	0 – 1,000,000 (mm)



Application 11 – Strapping Chart (Polynomial Values)

Register	Function	Value Range
40400	Device Address	1 to 247
40401	Units	1 = Feet, 2 = Inches, 3 = Meters
40402	Application Type	11
40403	Volume Units	1 – 7
40404	Decimal (Calculated)	0 – 3
40405	Max Level	(factory set)
40406	Full Level	0 – 65,535 mm
40436-40437	X^3 Coefficient	0 – 1,000,000
40438-40439	X^2 Coefficient	0 – 1,000,000
40440-40441	X^1 Coefficient	0 – 1,000,000
40442-40443	X^0 Coefficient	0 – 1,000,000

CHAPTER 4: MAINTENANCE

General Care

Your PT–500E series pressure transmitter is very low maintenance and will need little care as long as it is installed correctly. However, in general, you should:

- For process connected sensors, keep the transmitter and the area around it generally clean.
- Avoid applications for which the transmitter was not designed, such as extreme temperatures, contact with incompatible corrosive chemicals, or other damaging environments.
- Inspect the threads whenever you remove the transmitter from duty or change its location.
- Avoid touching the diaphragm. Contact with the diaphragm, especially with a tool, could permanently shift the output and ruin accuracy.
- Clean the diaphragm or the diaphragm bore with extreme care. If using a tool is required, make sure it does not touch the diaphragm.

> ***IMPORTANT***:
> Any contact with the diaphragm can permanently damage the sensor. Use extreme caution.

Zero Adjust (4–20 mA, 0–5 VDC, and 0–10 VDC only)

The zero output (4mA, or 0 VDC) can be adjusted by holding a magnet perpendicular to the can, approximately 1-1/2" from the top or bottom of the can.

Holding the magnet close to the top of the can increases the output (See Figure 3.1). Holding the magnet close to the bottom of the can decreases the output (See Figure 3.2).

If the zero output values do not change right away, hold the magnet in place near the top of the can until the values change, for up to two minutes. If there is no change, repeat the procedure near the bottom of the can. If there is still no change, consult the factory.

Unvented PT–500E transmitters do not automatically adjust to changes in barometric pressure. We recommend that PT–500E transmitters be zeroed upon receipt, and after major weather events.

Figure 3.1

Figure 3.2

NOTE: Span calibration must be done at the factory for all analog models.

Vent Tube Drying

Condensation in the vent tube can damage the electronics in your sensor, resulting in unreliable readings. APG offers two methods of preventing vent tube condensation: a venting cap, and a desiccant drying cartridge.

The venting cap is a PVC tube with a hydrophobic patch that allows moisture to pass out of the tube without allowing water in (See Figure 4.1). The cap is sealed by an o–ring, and is easily installed in the field.

The desiccant drying cartridge with vent tube adapter absorbs any moisture in the vent tube to keep vapor from condensing (See Figure 4.2). The installation of the desiccant drying cartridge is quick and easy. Common installation methods are cable tie, Velcro, and cable clamps.

> ***IMPORTANT***:
> Do NOT use desiccant cartridge in the presence of vapors or liquids containing phosphate esters, synthetic lubricants, hydrocarbon solvents, methanol, acetone, lacquer solvents, or other organics.

Figure 4.1

Figure 4.2

> ***NOTE***:
> Desiccant crystals change from blue to pink as they become saturated. Cartridge must be replaced when all crystals have saturated.

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