PD301 - PD306 Head Mount
SMART TEMPERATURE TRANSMITTERS

HART®

Non-HART

EXSense series

- Smart Temperature Transmitters with HART® Protocol
- Universal Input: RTD, TC, Ohm & mV
- Program with PC or HART Communicator
- Low-Cost Model PD301, PC Programmable
- Order Configured at the Factory Ready to Install
- Explosion-Proof or General Purpose Connection Head
- Transmitter Mounts Into Form B Connection Head
- Operating Temperature: -40 to 85°C

PRECISION DIGITAL CORPORATION
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PRECISION DIGITAL

www.predig.com

Disclaimer

The information contained in this document is subject to change without notice. Precision Digital makes no representations or warranties with respect to the contents hereof; and specifically disclaims any implied warranties of merchantability or fitness for a particular purpose.

⚠ **CAUTION**: Read complete instructions prior to installation and operation of the temperature transmitter.	⚡ **WARNING**: Risk of electric shock or personal injury.

⚡

Warning

This product is not recommended for life support applications or applications where malfunctioning could result in personal injury or property loss. Anyone using this product for such applications does so at his/her own risk. Precision Digital Corporation shall not be held liable for damages resulting from such improper use.

Limited Warranty

Precision Digital Corporation warrants this product against defects in material or workmanship for the specified period under "Specifications" from the date of shipment from the factory. Precision Digital's liability under this limited warranty shall not exceed the purchase value, repair, or replacement of the defective unit.

Registered Trademarks

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www.predig.com

INTRODUCTION

The ExSense T Series is a line of smart temperature transmitters available with HART® communication capabilities. All head mount models can be configured using a USB adapter and the free PC software available for download at **www.predig.com**.

The PD301 model is the most basic temperature transmitter.

The HART capable models (*i.e.* PD302, 304, 306) can also be configured using a HART modem and a PC running the free PC software provided or using a handheld HART communicator.

The PD303 & PD304 models include the head mount transmitter (hockey-puck) and the connection head.

The PD305 & PD306 models are complete temperature transmitter assemblies that include the connection head and temperature sensor.

The line of accessories include: connection heads, screw terminal blocks, temperature probes, thermowells, and thermowell extensions and unions for high temperature applications.

The connection heads can be ordered for safe area (general purpose) applications or for hazardous area (explosion-proof) applications with FM, CSA, and ATEX Certifications. They are available in aluminum and stainless steel.

ORDERING INFORMATION

The following are a few examples of models that can be ordered. Use the online ExSense Builder to create a model to satisfy a particular application; choose other sensor types, lengths, and thermowells.

Base Model	Description
PD301-C0	Head Mount Temperature Transmitter
PD302-C0	HART Head Mount Temperature Transmitter
PD303-G2-C0	Temperature Transmitter with General Purpose Connection Head
PD303-A2-C0	Exp-Proof Temperature Transmitter w/FM, CSA, ATEX Connection Head
PD304-A2-C0	Exp-Proof HART Temperature Transmitter w/FM, CSA, ATEX Connection Head
PD305-A2-C0-P11R06	Exp-Proof Temp Transmitter with FM, CSA, ATEX Connection Head & 6" Pt100 Probe
PD306- A2-C0-P11R06	Exp-Proof HART Temp Transmitter w/FM, CSA, ATEX Connection Head & 6" Pt100 Probe
PDA8301	USB Adapter for Head Mount Transmitter
PDA8302	HART to USB Modem

Note: HART models can be configured using the HTTemp PC software and PDA8302 USB to HART modem. The input Type and Units cannot be changed with HART Communicators.

C0 = Factory default
C1 = Custom configuration
C2 = Custom configuration with Certificate of Calibration

A 2= Exp-proof aluminum enclosure, ½" NPT x 2 conduit & ½" NPT process connection
G2 = General purpose aluminum, ½" NPT x 2 conduit & ½" NPT process connection

P11 = 100 Pt RTD with 6" leads
R06 = 6" Rigid probe
S06 = Spring-loaded 6" probe to use with thermowell
T106 = Type 1 thermowell to match spring-loaded 6" probe

Go to **www.predig.com/ExSenseBuilder** to build a complete model number and to specify the transmitter's configuration setup.

Note: Standard RTD is 1/4" in diameter. For other sizes, contact factory.

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SPECIFICATIONS

Except where noted all specifications apply to operation at +25°C.

General

INPUT	Universal RTD, TC, Resistance, or Voltage
OUTPUT	Two-wire 4-20 mA scalable
ACCURACY & INPUT RANGES	±0.08% of span typical, see table on page 10 for details
TEMPERATURE DRIFT	RTD: ±0.004°C/°C TC: ±0.03°C/°C
PROGRAMMING METHOD	PD301: PDA8301 USB modem & PC software PD302: PDA8301 USB or PDA8302 HART modem & PC software or field handheld HART communicator
UNDERRANGE	3.8 mA
OVERRANGE	20.5 mA
SENSOR BREAK	Selectable ≤ 3.6 mA Low Alarm or ≥ 22 mA High Alarm
RESPONSE TIME	1 second
LONG TERM STABILITY	Better than 0.05% per year
START UP TIME	Less than 5 seconds
NOISE FILTER	Programmable 0 to 85 µA
DAMPING TIME	Programmable 0 to 30 sec
OUTPUT RESOLUTION	0.3 µA
NON-VOLATILE MEMORY	All programmed settings are stored in non-volatile memory for a minimum of ten years

POWER SUPPLY	7.5 to 45 VDC, reverse polarity protected
LOAD IMPEDANCE	790 Ω @ 24 VDC max or ((V supply - 7.5 V)/0.0208 A) Ω
NORMAL MODE REJECTION	64 dB at 50/60 Hz
ISOLATION	2 kV input-to-output
SHOCK & VIBRATION RESISTANCE	4g/2 to 150 Hz as per IEC 60 068-26
EMC	Immunity & emission interference according to GB/T17626.2-1998), compliance with IEC 61000-4-3: 1995
ENVIRONMENTAL	Operating temperature range: -40 to 85°C Storage temperature range: -40 to 100°C Relative humidity: 0 to 90% non-condensing
CONNECTIONS	Screw terminals accept 12 to 22 AWG
ENCLOSURE	**Head mount transmitter:** Polycarbonate housing with epoxy potting, NEMA 1, IP00 (NEMA 4X, IP66 with PDA1080WM). **Connection head:** Cast aluminum, 0.3% max copper content, corrosion resistant powder coating, color: blue. NEMA 4X, 7, & 9, IP68. One ½" NPT conduit opening, one ½" NPT process connection.
MOUNTING	Installation Angle: No limit Installation Area: Connection head according to DIN 43 729 Form B. See Mounting Dimensions on page 31.

TIGHTENING TORQUE	Screw terminal connectors: 4.5 lb-in (0.5 Nm)
WEIGHT	1.18 oz (33.5 g); head mount transmitter only
OVERALL DIMENSIONS	Dia. 1.73" x 0.89" (44 mm x 22.5 mm) head mount transmitter only. Connection head, probe, and thermowell dimensions are not included.
WARRANTY	1 year parts & labor

Accuracy & Ranges

Input	Type	Input Range	Accuracy (% of span)	Min Span (4-20 mA)
RTD	Pt100	-200 to 850°C (-328 to 1562°F)	±0.2°C or 0.08%	10°C (18°F)
	Pt500	-200 to 250°C (-328 to 482°F)	±0.5°C or 0.20%	10°C (18°F)
	Pt1000	-200 to 250°C (-328 to 482°F)	±0.3°C or 0.12%	10°C (18°F)
	Cu50	-50 to 150°C (-58 to 302°F)	±0.2°C or 0.08%	10°C (18°F)
	Cu100	-50 to 150°C (-58 to 302°F)	±0.3°C or 0.12%	10°C (18°F)
	Ni100	-60 to 180°C (-76 to 356°F)	±0.2°C or 0.08%	10°C (18°F)
	Ni500	-60 to 180°C (-76 to 356°F)	±0.5°C or 0.20%	10°C (18°F)
	Ni1000	-60 to 150°C (-76 to 302°F)	±0.3°C or 0.12%	10°C (18°F)
Poten-tiometer	Ohms	0 to 400 Ω	±0.1 Ω or 0.08%	10 Ω
		0 to 2,000 Ω	±1.5 Ω or 0.12%	100 Ω

Accuracy & Ranges (Continued)

Input	Type	Input Range	Accuracy (% of span)	Min Span (4-20 mA)
TC	B	0 to 1820°C (32 to 3308°F)	±2.0°C or 0.08%	500°C (900°F)
	E	-270 to 1000°C (-454 to 1832°F)	±0.5°C or 0.08%	50°C (90°F)
	J	-210 to 1200°C (-346 to 2192°F)	±0.5°C or 0.08%	50°C (90°F)
	K	-270 to 1372°C (-454 to 2501°F)	±0.5°C or 0.08%	50°C (90°F)
	N	-270 to 1300°C (-454 to 2372°F)	±1.0°C or 0.08%	50°C (90°F)
	R	-50 to 1768°C (-58 to 3214.4°F)	±2.0°C or 0.08%	500°C (900°F)
	S	-50 to 1768°C -58 to 3214.4°F)	±2.0°C or 0.08%	500°C (900°F)
	T	-270 to 400°C (-454 to 752°F)	±0.5°C or 0.08%	50°C (90°F)
	C	0 to 2320 °C (32 to 4208 °F)	±0.5°C or 0.08%	50°C (90°F)
	D	0 to 2320 °C (32 to 4208 °F)	±0.5°C or 0.08%	50°C (90°F)
Voltage	mV	-10 to 75 mV	±20µV or 0.08%	5 mV
		-100 to 100 mV	±20µV or 0.08%	5 mV
		-100 to 500 mV	±30µV or 0.08%	6 mV
		-100 to 2000 mV	±50µV or 0.08%	20 mV

Connection Head Ratings & Approvals

FM & CSA	FM Approved & CSA Certified:
	Head Mount for use in Class I, Division 1, Groups B, C, and D; Dust-Ignition-proof for Class II, Division 1, Groups E, F, and G, Class III; hazardous (classified) locations, indoor and outdoor (Type 4X and IP66)
	Ta = -50°C to +125°C
	FM CERT 3009725
	CSA CERT 1097880
ATEX & IECEx	ATEX Certified: Flameproof and Dust
	⟨Ex⟩ II 2 G D
	Ex d IIC Gb
	Ex tb IIIC Db IP68
	Ta = -40°C to +85°C
	ATEX CERT Sira09ATEX1023U
	IECEx Certified: Flameproof and Dust
	Ex d IIC Gb
	Ex tb IIIC Db IP68
	Ta = -40°C to +85°C
	IECEx CERT SIR 09.0006U

Year of Construction

This information is printed on the enclosure nameplate.

SAFETY INFORMATION

> ⚠ **!**
>
> **CAUTION**: Read complete instructions prior to installation and operation of the temperature transmitter.

Installation and service should be performed only by trained service personnel.

INSTALLATION

For hazardous area applications, the installer is responsible for following all the appropriate hazardous area installation requirements.

For Installation in USA: The Smart Temperature Transmitter must be installed in accordance with the National Electrical Code (NEC) NFPA 70.

For Installation in Canada: The Smart Temperature Transmitter must be installed in accordance with the Canadian Electrical Code CSA 22.1.

For European Community: The Smart Temperature Transmitter must be installed in accordance with the ATEX directive 94/9/EC; the enclosure certificates ATEX CERT: Sira09ATEX1023U and IECEx CERT: SIR 09.0006U.

⚠️

CAUTION: Disconnect from supply before opening enclosure. Keep cover tight while circuits are alive. Conduit seals must be installed within 18" of the enclosure.

All wiring connectors are accessed by opening the connection head cover. It is not necessary to remove temperature transmitter from the connection head during installation.

Models PD303 and PD305 should be configured in a safe area prior to installation, using the USB adapter and PC software. Models PD304 and PD306 configuration and programming can be performed through the HART communication interface by accessing the loop and following all the hazardous area safety procedures.

Unpacking

Remove the temperature transmitter from box. Inspect the packaging and contents for damage. Report damages, if any, to the carrier.

If any part is missing or the temperature transmitter malfunctions, please contact your supplier or the factory for assistance.

Mounting

The Head Mount Smart Temperature Transmitter is designed to mount on a DIN 43 729 Form B connection head using M4 screws.

The PD303-PD306 with explosion-proof or safe area NEMA 4 housings can be mounted using two different methods, those are: conduit mounting, or direct mounting.

In those cases where the preferred installation of the ExSense transmitter is directly mounted to a probe or thermowell, care should be exercised to assure that the maximum temperature specification of the transmitter is not exceeded due to heat transfer from the process. High temperature applications require the use of a pipe/thermowell extension and union of the appropriate length.

Please refer to the graph below. The graph will provide an approximation of the temperature rise of the ExSense enclosure above ambient with different pipe/thermowell extension lengths and process temperatures. One should allow for some safety margin, as there are a number of variables that effect this information that cannot be easily accounted for. The maximum operating temperature of the PD303-PD306 ExSense transmitter is 85°C.
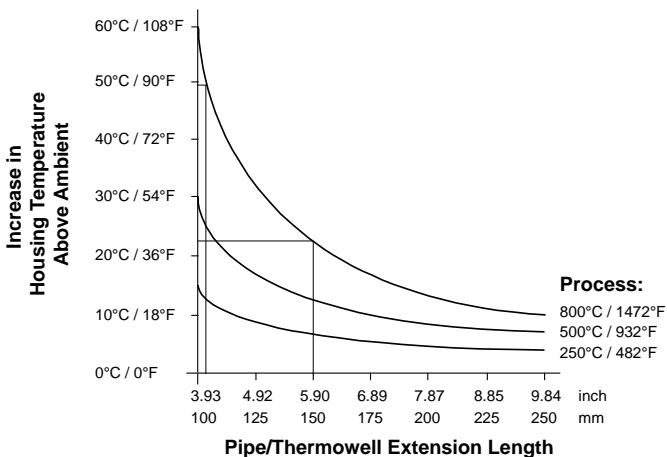
Connections

Make sure to turn off the power to the loop before accessing the screw terminals on the transmitter.

To access the connectors on models PD303-306, remove the connection head cover.

The connection diagram on the transmitter head clearly indicates where to connect the loop power and the various types of sensors.

1: + Loop output (4-20 mA)
2: - Loop output (4-20 mA)
3: RTD 3-wire connection (odd color lead)
4: TC+, mV+, or RTD 4-wire connection
5: RTD 3-wire connection (same color lead)
6: TC-, mV-, or RTD 3-wire connection (same color lead)

Note: mV signals are connected to terminals 4(+) and 6(-).

Refer to Figure 1 for terminal positions and connections.

⚠	Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the temperature transmitter and ensure personnel safety.

Note: The 4-20 mA signal may be grounded at one point only, usually at the negative of the power supply or it may be left ungrounded.

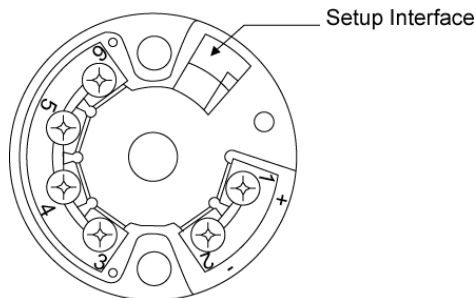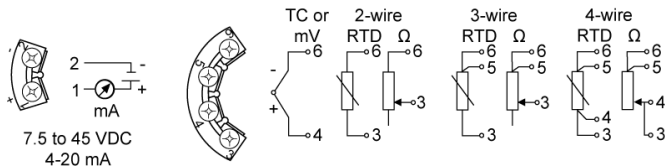**Figure 1. Sensor & Loop Connectors**

Sensor & 4-20 mA Output Connections

Figure 2. Sensor & 4-20 mA Connections

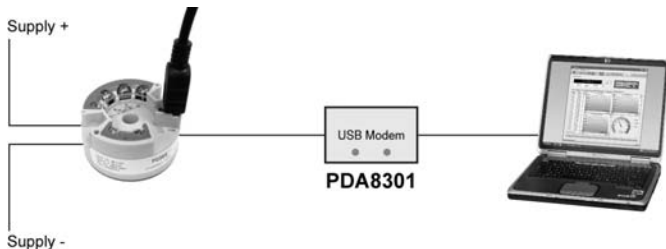## Connections to PC & Communicator

Figure 3. Connections to PC with USB Modem

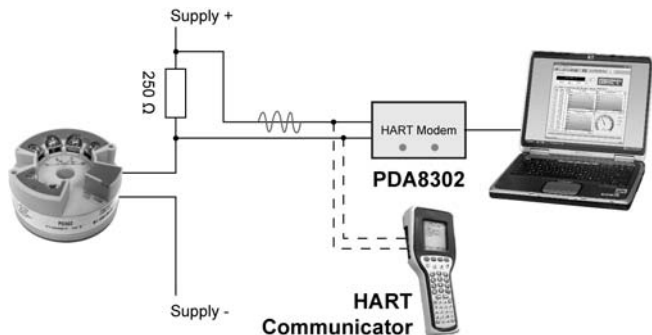## HART Connections to PC & Communicator

Figure 4. Connections to PC & HART Communicator

SETUP AND PROGRAMMING

> HART communication requires a minimum of 250 Ω in
> the 4-20 mA loop. See Load Impedance specification to
> calculate the maximum load based on the power supply
> voltage (e.g. 650 Ω @ 24 VDC).
>
> The HART signal can be accessed using a HART
> communicator or a HART modem anywhere in the loop.

Overview

There are no jumpers, switches, or potentiometers involved in the
setup process of the smart temperature transmitter.

All setup and programming can be performed by one of these
methods:

1. USB modem and PC running the free software provided
2. Using a HART modem and a PC running the free software
   provided
3. Using a HART Communicator (not all parameters are available)

*Note: Input Type and Units cannot be changed with a HART
   Communicator.*

It is recommended to commission the smart temperature transmitter
prior to installation in a hazardous area.

After all connections have been completed and verified, apply power
to the temperature transmitter.

Temperature Transmitter Software

The HART Temperature Transmitter Software (HTTemp) can be downloaded free from **www.predig.com**. This is a simple user-friendly application to be used with the ExSense T Series only.

The software allows the user to setup all the transmitter parameters available, using the USB modem or through the HART communication interface for models equipped with the HART protocol.

Follow these steps to download and run the software:

1. Download the software from **www.predig.com** and save.
2. Unzip the file to a selected folder location.
3. Create a shortcut for the HTTemp_.exe program file on the desktop.
4. If using the USB modem PDA8301, connect the USB connectors to the transmitter and to the PC. See the instructions below to install the USB drivers.
5. If using HART communication, connect the HART modem PDA8302 across the 250 Ω resistor and to the USB port on the PC. See the instructions below to install the USB drivers.
6. Once the USB driver has been successfully installed double-click on the HTTemp program shortcut to run the software.
7. Click on "Environment – Serial Port" and select the COM port at the bottom of the list (e.g. COM3). This is a Virtual COM port created by the USB driver. If there are no other COM ports in use, then only one port will be shown.
8. Click on the "Get" button of the "Current Value" window. The process value registered by the input sensor should be displayed in this window.
9. If the communication was not successful, a "Communication Failure!" message will be displayed.
10. Close the program and repeat steps 5-7 above. If the problem still persists, follow the instructions for the HART modem driver installation provided.

PDA8301 & PDA8302 USB Driver Installation

1. Connect the modem to the USB port and follow the on-screen instructions.

2. When prompted for the driver location, browse to the folder where the downloaded software was unzipped. If connected to the Internet, allow the program to search for the driver.

3. The driver installation program requires the process to be repeated twice. Please DO NOT press Cancel; go ahead and repeat the process again. After the second time the driver installation is completed and a message is displayed indicating that the new hardware is ready to be used.
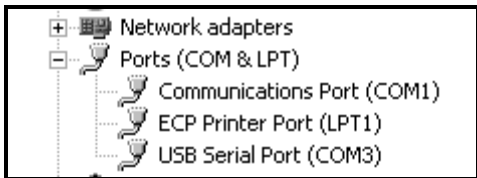
Determining the COM Port Number

To determine the COM port number associated with the new USB device installed:

1. Click on "Start" – "Control Panel" – "System"

2. Click on "Hardware" – "Device Manager" – "Ports"

3. Here is the USB Serial Port associated with the new USB device (e.g. COM3).
4. If there are more USB Serial ports enabled, disconnect the modem from the USB port and notice which COM port disappears from the above screen. Connect the modem to the USB port again and notice which port is enabled. This is the COM port to be selected in the HTTemp program.

4-20 mA Loop Current Setup

The Current Setup window is used to trim the analog output to match the device reading the 4-20 mA current.

1. Click on Read next to the 4.000 mA box and type the actual mA reading corresponding to the 4 mA output (e.g. 3.998).
2. Click on Read next to the 20.000 mA box and type the actual mA reading corresponding to the 20 mA output (e.g. 20.002).
3. Click on Update to upload the new values to the transmitter.

Test the loop by selecting a Fix Loop value and clicking Send. When the Fix Loop is used, the loop is put in manual mode.

Click on Exit to finish testing the loop and return the loop to automatic control mode.
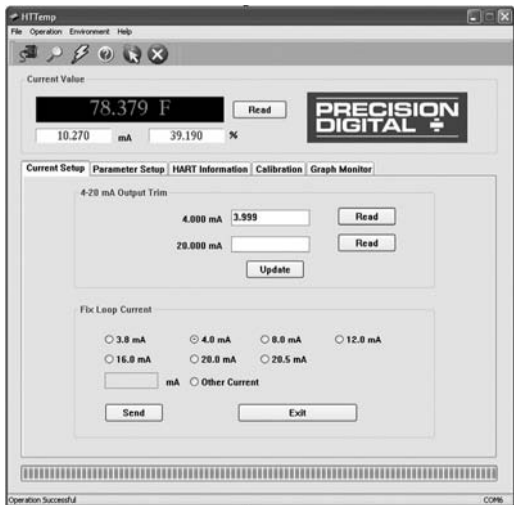
Parameter Setup

The Parameter Setup window is used to set up the input type, range for the 4-20 mA, temperature units, and other settings related to the sensor and analog output. The Display Mode allows the selection of PV, mA, or % for the display.

The 4.000 mA and 20.000 mA settings correspond to the display values at which the 4-20 mA output is generated.

Use the Offset parameter to make minor adjustments to the 4 mA value.

The ExSense T transmitters support 2, 3, and 4-wire RTDs. The selection must match the actual RTD wiring.

Minimum Input Span

The minimum input span is the minimum difference between the Zero value and the Full value signals required to generate the 4-20 mA output signal on the temperature transmitter (e.g. 18°F for RTDs). Refer to table on page 10 for the minimum span specifications.

Decimal Point

This parameter is not applicable transmitters without display.

Alarm Current

An open thermocouple or RTD generates an alarm current condition, which can be either ≤ 3.6 mA or ≥ 22 mA. If the input signal exceeds the transmitter range significantly, the output will go to the alarm current value.

Underrange and Overrange

An underrange condition generates a 3.8 mA output and an overrange condition generates a 20.5 mA output.

HART Information

The HART Information window allows the user to program or read the transmitter information and to modify the HART address for multi-drop applications.

The Short address is 0 for standalone applications and 1-15 for multi-drop applications. In multi-drop applications the analog output current is forced to 4 mA.

The Long Address is 6-digit long and should be set to any unique number, but it should be different than the Short Address number.

Calibration

For most applications it should not be necessary to calibrate the 4-20 mA output. Instead of Calibration use the Parameter Setup to set the 4-20 mA output values.

If a precise calibration is needed for a specific input type and range, follow the steps below:

1. Connect a calibrated signal source to the input.
2. Apply the low value signal at which 4 mA will be generated.
3. Click on Calibration to 4 mA.
4. Apply the high value signal at which 20 mA will be generated.
5. Click on Calibration to 20 mA.

Graph Monitor

The Graph Monitor window is used to monitor the PV, mA, and %. Monitor the three variables at once or just one of the variables.

A log data file can be saved for later viewing; it contains the time, data value, and units. The screen update rate is selectable between 2 sec and 30 min.
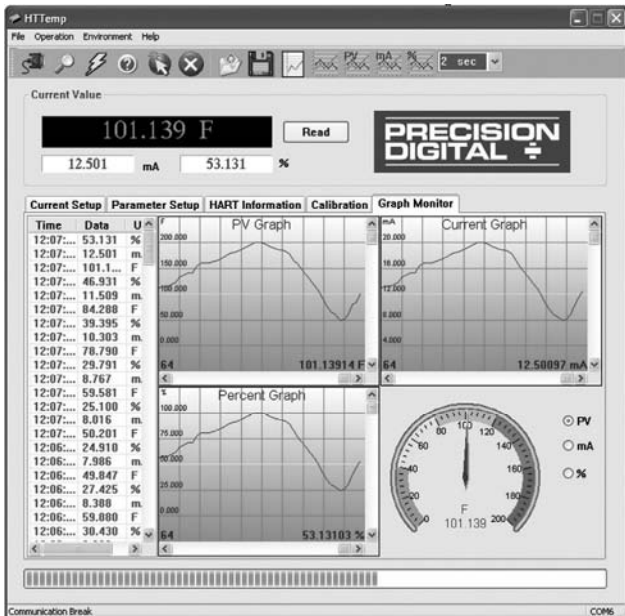

Note: There is no provision to export the log file to other applications. The saved file may be viewed only with the HTTemp software.

APPLICATION

PD306 HART Transmitter & Remote Display

In this application the Smart HART Head Mount Temperature Transmitter is being powered by the PD6000 dual-scale meter; the meter displays the temperature on the top display and the mA current on the bottom display. A PLC, DCS, or other devices could be connected in the loop as shown. The 250 ohm resistor is the minimum loop resistance needed for HART communication with a HART modem or a HART communicator.
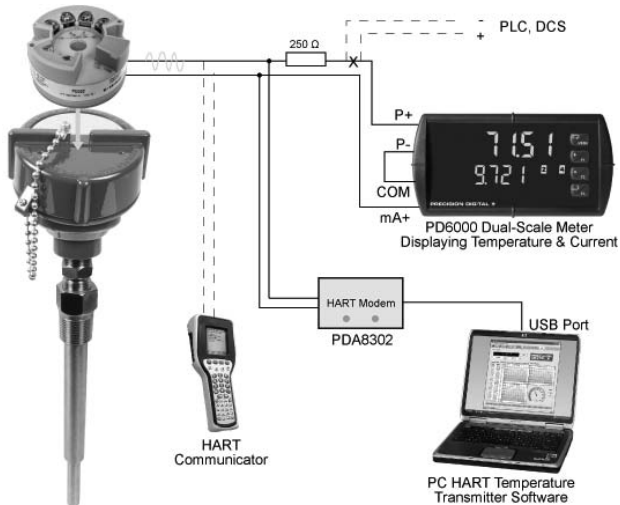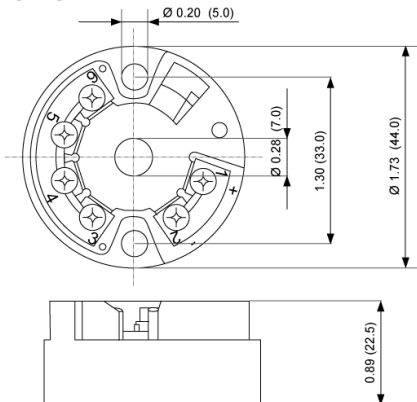
MOUNTING DIMENSIONS

All units: inches [mm]

Figure 5. Head Mount Transmitter Dimensions
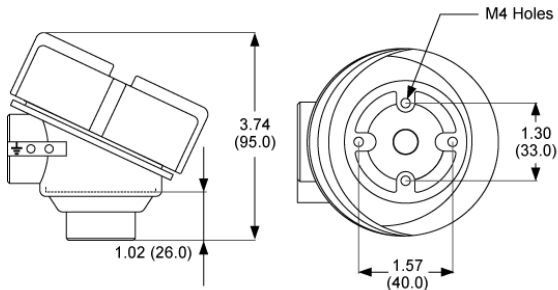

Figure 6. Connection Head Dimensions

TEMPERATURE PROBES

RTD and TC probes may be specified and order separately using the following Model Configuration chart.

ERP Field Location	1	2	3	4	5	6	7	8	9	10
Model Number	P	D	A	P	1	2	-	R	0	6

Sensor Type

P1 = Pt100 RTD
TJ = Type J TC
TK = Type K TC
TT = Type T TC

Sensor Lead Length

1 = 6"   Note: Lead length must be
2 = 12"   appropriate for the extension
3 = 18"   length, if used.
4 = 24"
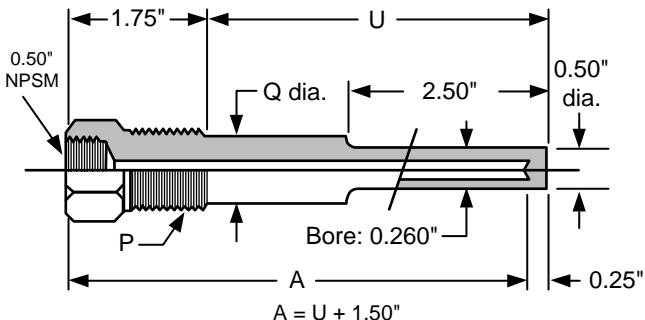X = 5-9 for other lengths

Probe Type

R = Rigid probe
S = Spring-loaded probe

Probe Length

06 = 6" Probe
09 = 9" Probe
12 = 12" Probe
XX = Length in inches

THERMOWELLS

Thermowells may be ordered separately using the following sample drawing and the Model Configuration chart.

$$A = U + 1.50"$$

Thermowell Model Configuration

Model	Description				
PDAT1	Thermowell, Stepped Stem, Threaded				
	CODE	**"P" Process Thread**		Shank Dia. Q	"H" HEX(A/F)
	P1	1/2" NPT		5/8"	1 1/8"
	P2	3/4" NPT		3/4"	1 1/8"
	P3	1" NPT		7/8"	1 3/8"
		CODE	**Material Of Construction**		
		S1	SS304		
		S2	SS316		
			CODE	**"U" Immersion Length**	
			000	Specify in Inches	
				Example 025 = 2.5"	
PDAT106 =	**P2**	**S2**	**045**	**A = 06 (045 + 015)**	
PDAT109 =	**P2**	**S2**	**075**	**A = 09 (075 + 015)**	
PDAT112 =	**P2**	**S2**	**105**	**A = 12 (105 + 015)**	

Thermowell Type

T1 = Thermowell, stepped stem, threaded with ½" NPSM sensor connection, ¾" NPT process connection, SS316.
TX: Where X = 2-9 to be determined.

Note: Other thermowell types and sizes are available upon request.

TROUBLESHOOTING

If the Smart Temperature Transmitter is not working as expected, refer to the recommendations below.

Symptom	Check/Action
No communication	• Voltage too low • Check loop impedance
Fault or alarm current (≤3.6 mA or ≥ 22.0 mA)	• Defective or open sensor • Incorrect programmed range
4-20 mA output is not correct	• Check voltage across transmitter • Reduce loop impedance
Output is fixed at 4 mA	• Transmitter configured for multi-drop mode • Change HART address to zero
Temperature reading is not correct	• Wrong or defective sensor • Check scaling • Check offset value
Other symptoms not described above	• Call Technical Support for assistance.

How to Contact Precision Digital

- For Technical Support:

  Call: (800) 610-5239 or (508) 655-7300

  Fax: (508) 655-8990

  Email: support@predig.com

- For Sales Support:

  Call: (800) 343-1001 or (508) 655-7300

  Fax: (508) 655-8990

  Email: sales@predig.com

- For the latest version of this manual please visit:

  www.predig.com

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