prosense®

AUTOMATIONDIRECT.com

Installation and Maintenance Instructions for DPTW Series

Differential Pressure Transmitter

CE

In this Chapter...

Caution

⚠ Warning! Read Before Installation ⚠

General

A failure resulting in injury or damage may be caused by excessive overpressure, excessive vibration or pressure pulsation, excessive instrument temperature, corrosion of the pressure containing parts, or other misuse. Contact AutomationDirect.com technical support before installing if there are any questions or concerns.

Overpressure

Pressure spikes in excess of the rated overpressure capability of the transmitter may cause **irreversible electrical and/or mechanical damage** to the pressure measuring and containing elements.

Water/Fluid hammer and surges can destroy any pressure transmitter and must always be avoided. **A pressure snubber should be installed to eliminate the damaging hammer effects.** Fluid hammer occurs when a liquid flow is suddenly stopped, as with quick closing solenoid valves. Surges occur when flow is suddenly begun, as when a pump is turned on at full power or a valve is quickly opened.

Liquid surges are particularly damaging to pressure transmitters if the pipe is originally empty. To avoid damaging surges, fluid lines should remain full (if possible), pumps should be brought up to power slowly, and valves opened slowly. To avoid damage from both fluid hammer and surges, a surge chamber should be installed.

Symptoms of fluid hammer and surge's damaging effects:

- Pressure transmitter exhibits an output at zero pressure (large zero offset).
- Pressure transmitter output remains constant regardless of pressure
- In severe cases, there will be no output.

Freezing: Prohibit freezing of media in pressure port. Unit should be drained to prevent possible overpressure damage from frozen media.

Static Electrical Charges

Any electrical device may be susceptible to damage when exposed to static electrical charges. To avoid damage to the transmitter observe the following:

- Ground the body of the transmitter BEFORE making any electrical connections.
- When disconnecting, remove the ground LAST!

1. Preface

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task
- Are authorized by the plant owner/operator
- Are familiar with federal/national regulations
- Before beginning work, the specialist staff must have read and understood these instructions

2. Overview

The ProSense DPTW differential pressure transmitter series is precision engineered for accurate differential or gauge pressure measurement. The wet-wet design uses a silicon based variable capacitance sensor with stainless steel media isolation diaphragms and silicone pressure transmission fluid making it compatible with a wide variety of liquids, gases, and steam applied to both pressure sensing ports. The DPTW series is ideal for industrial, commercial, and OEM process measurement applications including differential, positive, or negative pressures; hydrostatic liquid level in pressurized or open tanks; and flow measurement using primary differential pressure flow elements such as an annular pitot tube, orifice plate or venturi tube. The DPTW series is available in pressure measurement ranges from 4 inches water column up to 400 inches water column with static (line) proof pressure of 300 psig and can easily be rescaled to a different linear pressure range and units of measure using display pushbuttons. An integral square root function also allows for the display and output of flow in instantaneous flow rate units of measure such as gallons/minute or display of integrated flow volume in units such as gallons. The integral pressure port manifold has 1/4-inch NPT female process pressure connections and includes a built-in equalizing valve used to open both ports to the line pressure during installation to prevent sensor damage or calibration shift due to overpressure. The DPTW series is powered with nominal 24VDC power and provides a two-wire, 4-20mA output signal proportional to the measured pressure. The very compact design of the DPTW series is up to 8-times smaller than conventional style DP transmitters and features a rugged NEMA 4X (IP65) rated aluminum die cast housing and rotatable 6-digit LCD display with bright LED backlight.

3. Features

- **Media Compatibility:** Wetted materials consist of 316 stainless steel, alumina ceramic and viton to handle a wide range of media with the ability to offer ranges as low as 4″ W.C. F.S. (URL).
- **Linear Scaling Function:** The linear (scaling) function allows the user to adjust zero and span values providing a corresponding 4-20mA output signal.
- **Flow Measurement/Square Root Extraction Function:** Momentary flow rate and integrated volume can be displayed and analog signal can be output.

- **Digital Filter Function:** User adjustable damping of the output signal by means of internally calculated moving average to provide a stable output signal in applications where the user wants to reduce the pulsating of the display and / or output signal.
- **LED Back Light:** To supplement the LCD display when conditions require (dark area, night etc.).
- **Loop Check Function:** Allows the user to output an analog signal corresponding to differential pressure without applying pressure, simplifying system maintenance and troubleshooting.
- **Zero and Span Adjustment:** The adjustment of the Zero (4mA) and Span (20mA) reading via internal push buttons.
- **Key Lock Function:** Prevents inadvertent overwriting of setting values. Can not be reset by restoring power when activated.
- **IP65 / NEMA 4X Environmental Rating:** Enclosure environmental rating suitable for indoor and outdoor installation, depending upon operating temperature range.*
- **CE Compliant**

*Display not to be mounted in direct sunlight.

4. Specifications

DPTW Series Specifications	
Performance Specifications	
Reference Temperature	73°F (23°C)
Accuracy	± 0.50% of span (URL*) Includes the effects of linearity, hysteresis, and repeatability
Display Accuracy	± 0.5% of span (URL) + 1 digit
Stability	± 0.25% of span (URL)/year
Output Resolution	0.1% of span (URL)
Temperature Effects	Temperature Effects: (–10°C to 60°C) ± 0.03% FS/C°
Memory	Permanently stored in EEPROM nonvolatile memory
Environmental Specifications	
Temperature Limits	Storage: 5°F to 150°F (–15°C to 65°C) Operating: 14°F to 140°F (–10°C to 60°C) Medium: 14°F to 140°F (–10°C to 60°C)** Compensated: 14°F to 140°F (–10°C to 60°C)
Functional Specifications	
Rangeablility/Adjustment	Zero –10% to 110% Span Span –10% to 110% Span (Accuracy and output resolution based upon full scale (URL) value)
Unit of Measure	inH_2O (IWC) or User defined
Static (Line) Pressure	Pressure Range: 4 inH_2O to 400 inH_2O Proof: 300 psi Burst: 800 psi

**** Upper Range Limit (URL)***

***** For steam or other higher temperature processes, ensure that the temperature at the DPTW process connections do not exceed the Medium Temperature Limits. For steam use longer sensing lines and/or a siphon (pigtail) and fill with water to lower the medium temperature to acceptable limits.***

Specifications Cont.

DPTW Series Specifications	
Performance Specifications Continued	
Single Side (Differential)	Pressure Range: ≤ 8 inH_2O Proof: 30 psid Burst: 130 psid Pressure Range: ≥ 20 inH_2O Proof: 100 psid Burst: 130 psid
Static (Line) Pressure Effects	Pressure Range: Effect: ≥ 20 inH_2O ± 0.3% Range/100 psi (URL) 8 inH_2O ± 0.7%Range/100 psi (URL) 4 inH_2O ± 1.5% Range/100 psi (URL)
Response Time	100ms (when Filter Function set to 0)
Filter Function	0, 2, 4, 8, or 16 seconds
Vibration	5g's 150Hz
Shock Effect	10g's 16ms
Electrical Specifications	
Output Signal	4-20 mA (2 Wire)
Load Impedance	545Ω @ 24VDC (refer to Load Limitations graph)
Supply Voltage	12-32 Vdc
Insulation Resistance	50Vdc (>100 MΩ)
EMC Compliance	EMC Directive 2014/30/EU EN 61326-1:2013 EN 61326-2-3:2013 (EMI Class A/EMS Table 2)
Physical Specifications	
Environmental Rating	IP65 / NEMA 4X
Mounting	Mounting bracket included
Process Connections	Manifold with 1/4 NPT Female ports and equalizing valve
Display	6-digit LCD with LED backlight, 10mm character height
Display Update	500ms
Electrical Connection	PG 13.5 Female Preinstalled Cable Gland (Cable diameters 0.35" to 0.47") Terminal block: 14-22 AWG stranded or solid wire
Wetted Material	
Diaphram	316 SS, Viton® & Alumina Ceramic
Process Connection	316 SS
Media Compatibility	Fluids and gases compatible with 316 SS, Viton® and Alumina Ceramic
Non-Wetted Material	
Enclosure	Aluminum, epoxy coated

5. Mounting

5.1 General

The DPTW was designed to be mounted using the bracket supplied. Pressure connections are made via the (2) 1⁄4" NPT female pressure ports. Although the display can be rotated in 90 degree increments by removing the display cover it is preferable to orientate the electrical termination downward, particularly in applications where protection from the environment is required.

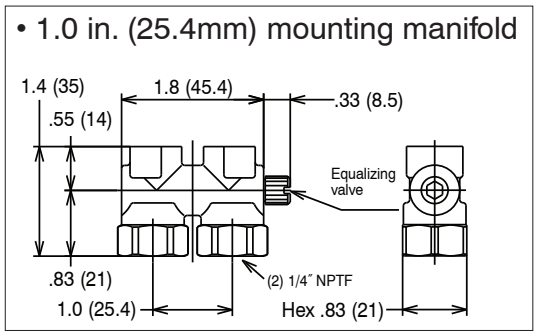
5.2 Mounting Orientation

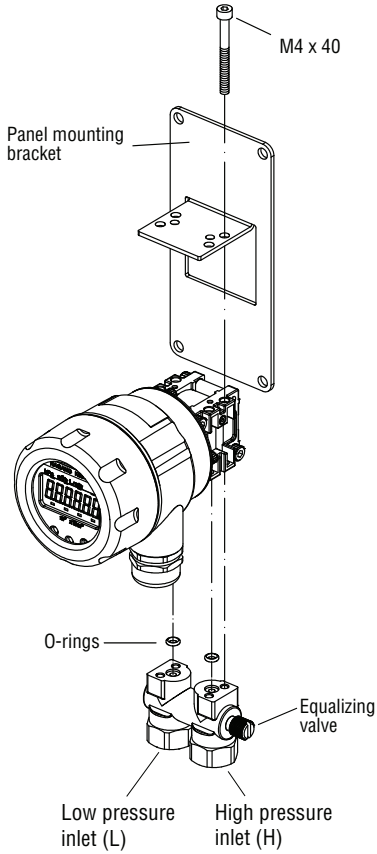
It is preferable to orientate the unit with the pressure ports either downward or upward. If mounting with pressure ports to the side an "orientation effect" will be seen at zero pressure as the pressure generated by the silicone oil fill will appear as a zero offset. If mounting in this manner this effect may be taken out by resetting zero (refer to Section 12) in final mounting orientation.

5.3 Installing Pressure Port Manifold

(1) **Mounting 25.4mm Manifold (1⁄4″ NPT female ports)**
Manifold is secured using the (4) socket head bolts (M4x40) and appropriate allen wrench which is supplied. Check for dust and dirt on the O-ring and seal area, clean if necessary, before installing to ensure proper connection. The direction of the manifold is not important, determine best position by ability to operate the equalizing valve.The equalizing valve is used to open both ports to the line pressure at time of installation. Once installed and the system has been pressurized the valve needs to be closed to isolate the low and high pressure sides of the device.
Tighten the equalizing valve with a torque of 0.75 ft-lbs ±5%. When loosening the valve do not back off by more than three turns from the closed position.
Bleed port set screws should not be fully removed as sealing components can be dislodged from housing.

(2) **Panel Mounting**
Similar to (1) above except that the DPTW is put between the manifold and the panel mounting bracket then the (4) socket head bolts (M4x40) are installed.





6. Piping

Note: High (H) and Low (L) pressure sides of the device are marked on the yellow label affixed to the housing of the unit.

Install the high pressure side of the applied differential pressure in the pressure inlet of the high pressure side (H) and the low pressure side in the pressure inlet of the low pressure side (L).

(Refer to the Dimension Drawings Section 15.)

After the piping is completed check for leaks.

Piping of 1.0 in (25.4mm) Manifold (1⁄4″ NPT female ports)

Use caution when installing to keep metal chips and other debris from entering pressure transmitter. In addition, when sealing tape is used, do not apply to last two threads at the end of the fitting

Note:

- When transporting and / or mounting do not apply excessive shock or use device as a step.
- The piping should be of proper length so as not to apply load to the connection point on the transmitter.
- **CAUTION! At the time of mounting or when bleeding air from the device be sure to open the equalizing valve with a flathead screwdriver so that excessive pressure (more than the allowable maximum differential pressure) is not applied to the differential pressure sensor. Maximum torque to apply to equalizer valve is 0.75 ft-lbs ±5%. Bleed port set screws should not be fully removed as sealing components can be dislodged from housing.**

7. Wiring

7.1 Cable/Wire Specifications

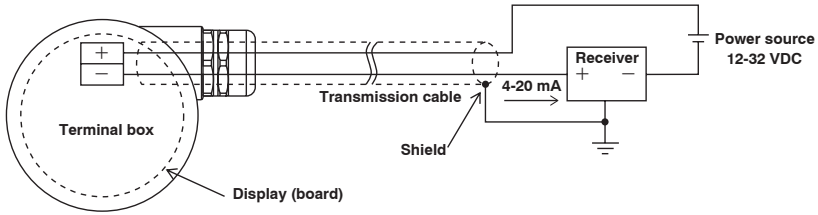
Use appropriate cable described below which is suitable for power supply requirements and ground to housing.

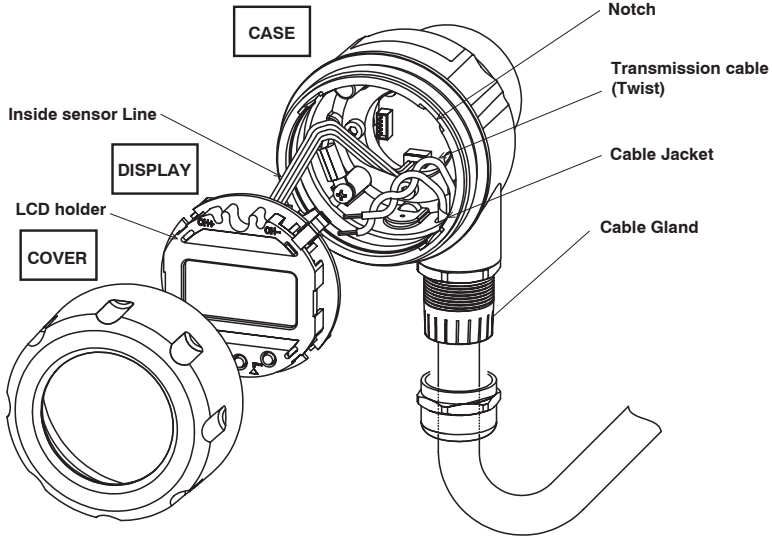
Wiring Terminals

Terminal Strip	SMKDSP1.5/2-5.08 Phoenix Contact
Cable Requirements	• Two core shielded cable • Cable outer diameter: 0.35″ to 0.47″ 9-12mm (Required for correct installation with Cable Gland) • Wire Gauge: 14-22 AWG (multi-strand or solid)

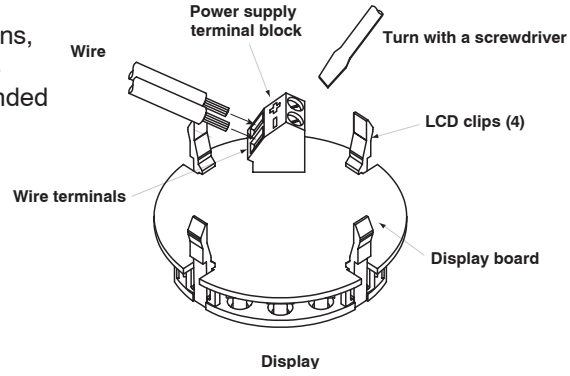
7.2 Wiring Instructions

- To reduce potential for noise do not run pressure transmitter cable /wires alongside (same conduit as) high voltage (line power) lines. For optimum results use dedicated conduit for DPTW cable / wires.
- Must use cable within previously noted diameters to maintain environmental ratings when using the cable gland.
- When connecting shield / drain wire, only connect one end which should be at the receiver ground.
- Wiring stripping instructions, remove cable jacket 2-3″ and strip wires 0.25″. Shield / drain wire should not be exposed at the pressure transmitter termination.
- Remove cover and carefully remove the display to access the terminal strip, take care not to mishandle the display and associated electronics.



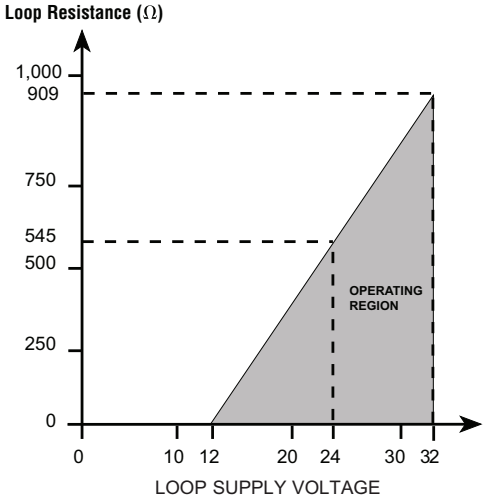


- Turn display over to expose terminal strip, make positive and negative connections, insert wire depth is equal to recommended strip length (0.25″).

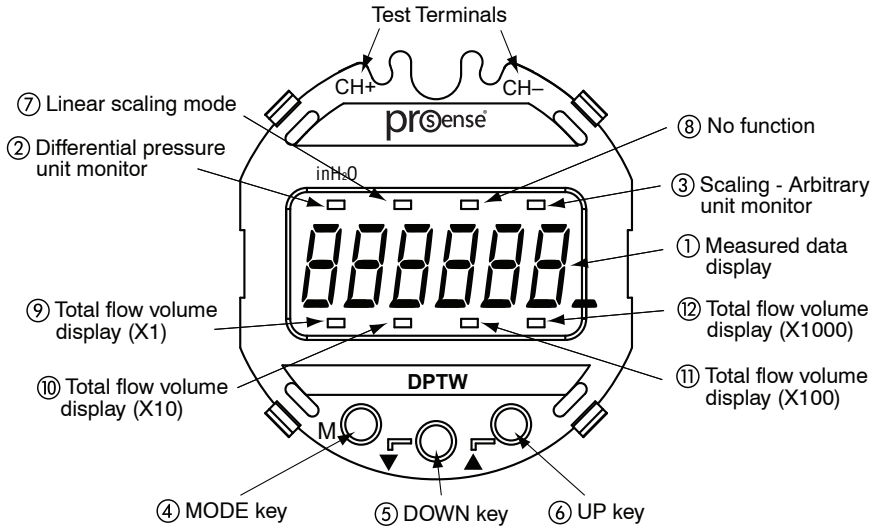


- After completing connections locate retaining clips in the appropriate notches and carefully place into the housing. Be sure that internal sensor transmission wire does not cross the power supply lines just installed.
- If using the Cable Gland be sure to properly tighten sealing grommet before applying any tension on the cable, the cable gland provides strain relief and environmental sealing.
- Tighten DPTW cover to maintain environmental rating.
- Connect to power source and receiver and power on to confirm correct wiring (see Section 10 for more detail).
- Power Supply Requirements: Although the 4-20mA signal can travel over long distances one of the most common problems is inadequate power at the pressure transmitter due to the voltage drop across the loop. Be sure to review table below to determine that 12-32V is getting to the pressure transmitter.

Load Limitations 4–20mA Output



V_{min} = 12V+ [0.022A*(RL)]
(Includes a 10% safety factor)
$R_L = R_S + R_W$
R_L = Loop Resistance (ohms)
R_S = Sense Resistance (ohms)
R_W = Wire Resistance (ohms)

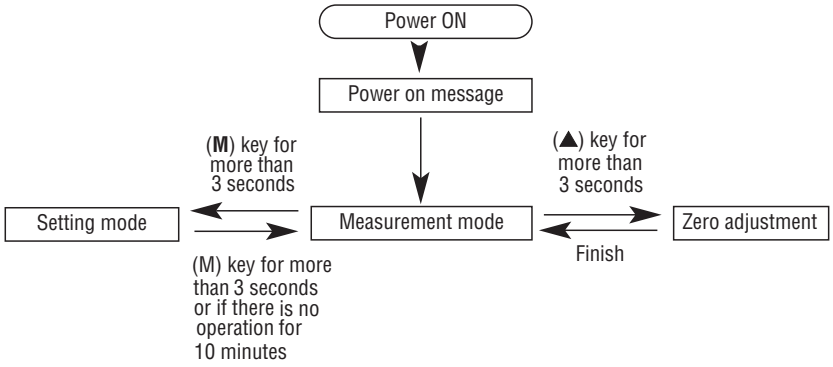


DESIGNATION	FUNCTION
① **Measured data display**	Differential pressure, linear scaling value are displayed.
② **Differential pressure unit monitor**	When this unit monitor is ON, the differential pressure (inH_2O) is indicated on the measured data display.
③ **Scaling; arbitrary unit monitor**	When this unit monitor is ON, the scaling value of an arbitrary unit (linear scaling), is indicated on the measured data display.
④ **MODE key (M)**	This key is used to switch the setting mode and the measurement mode and to change the setting item.
⑤ **DOWN key** ▼	This key is used to change (decrease)and select the set value .
⑥ **UP key** ▲	This key is used to change (increase) and select the set value and to shift from the measurement mode to the zero adjustment mode.

DESIGNATION	FUNCTION
⑦ **Linear scaling mode**	Used to adjust zero/ span values to 4-20mA output signal.
⑧ **No function**	None
⑨ **to** ⑫ **Total flow volume display**	Display multiplier, X1, X10, X100, X1000

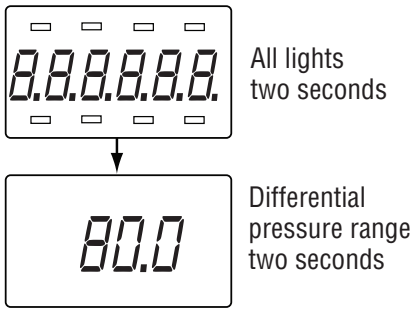
9. Mode Changes

- Measurement Mode (Section 11 for further detail) will be entered upon power-on. Setting Mode (Section 14 for further detail) is entered by pressing and holding the MODE button for more than 3 seconds. If there is no button operation for 10 minutes in the setting mode, it will shift back to the Measurement Mode automatically.
- To go from the Measurement Mode to the Zero Adjustment Mode (Section 12 for further detail) press and hold the UP ⏏ button for more than 3 seconds.



10. Power-On Message

After the power is turned on, the power-on message is displayed for 6 seconds as shown below and then the display is shifted to the measurement mode (Section 11). In addition, the analog output during power-on message is at the zero point (4mA).



11. Measurement Mode

The measurement mode includes differential pressure display mode, linear display mode, and square root display mode (flow measurement). For the Setting items **1** to **27**, please refer to the Setting Mode (Section14).

11.1 Filter (Damping)

Set the filter before setting pressure display mode or linear (scaling) display mode.

The filter is based on the moving average of the pressure data to decrease display "bounce" and to smooth the analog output due to system pressure fluctuations at the user's discretion.

Five selections: (0, 2, 4, 8, and 16 seconds).

If "0" is selected the filter is not applied.
See Section 14.4 for full menu.

Filter Setting ==> item ①

11.2 Differential Pressure Display Mode (Re-scaling in "inH20" units)

This mode is used for display and analog output of the actual differential pressure.

(1) **Analog output**
The analog output can be adjusted as follows; the zero point (4mA) and the span point (20mA) can each be adjusted from –10 to 110%F.S. (URL)*.

(2) **Pressure display**
The pressure display has a display span between the zero point and the span point as determined by the adjustment of zero and span (see previous paragraph) and can display the range of –5 to 105%F.S.(URL). In addition, the decimal point position of the pressure display is fixed for each pressure range.
Pressure Unit: inH2O
See Section 14.4 for full menu.

Output zero point and span point setting ==> Setting item ③, ④

* This means that although the zero point is typically set at 0%F.S. and the span point is set as 100%F.S., the zero point can be adjusted to the point where zero (4mA) is 110%F.S. and the span point (20mA) can be adjusted to -10%F.S thus reversing the output. In addition, through this adjustment zero and span can be adjusted accordingly for elevated tank levels.

Setting example 1 : Differential pressure display mode

The setting to use the differential pressure range 0 to 20 inH_2O ("W.C.) and to display the zero point and span point of the analog output as –2 inH_2O and 18 inH_2O respectively is as follows:

In the example the filter (moving average time) is set at 2 seconds, the differential pressure display and the analog output are based on the moving average equivalent to the differential pressure data per 100ms for the past 2 seconds (20 times).

See Section 14.4 for full menu.

Select the filter of "2 seconds"	==> Setting item ①
Select the "Differential pressure display mode - [non]"	==> Setting item ②
Set output zero point as "–10.0%F.S."	==> Setting item ③
Set output span point as "90.0%F.S."	==> Setting item ④

■ **Display and analog output**

Ex. Differential pressure of 8 inH_2O

- Differential pressure display: 8.00
- Analog output: 12(mA)

	Differential Pressure Display (inH_2O)		Analog Output (mA)
Output span point	18.00	==>	20
	∫		∫
	8.00	==>	**12**
Output zero points	–2.00	==>	4

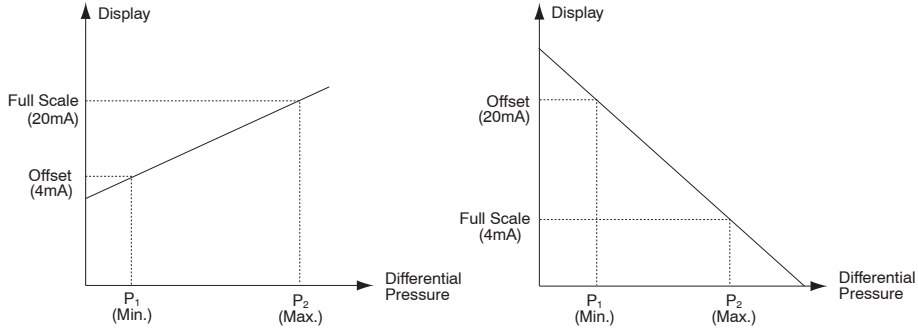
11.3 Linear Display Mode (Re-scaling in arbitrary user defined units)

This mode is used for display / analog output of the scaling value where the differential pressure is linearly converted to an arbitrary user defined physical quantity.

(1) Linear display

By setting the OFFSET to the minimum differential pressure P1 and the FULL SCALE to the maximum differential pressure P2, the linear display indicates the value on the line between the two points (the maximum display span). The actual linear display span depends on the setting of the zero point and span point of the analog output as shown in (2) Analog output. It can display the range of –5 to 105%F.S. of the linear display span.

- The setting range for the minimum differential pressure P1 and the maximum differential pressure P2 is 0 to 100%F.S. of the differential pressure range, and the maximum differential pressure P2 is set from the value which is more than 25%F.S. of the differential pressure range above the minimum differential pressure P1.
- The setting range for the OFFSET and FULL SCALE values is –1999 to 1999, and the decimal point can be set arbitrarily. At this time, the arbitrary unit monitor LED turns on.



See Section 14.4 for full menu.

Min. differential pressure P_1 and max. differential pressure P_2 setting	==> Setting item ⑥, ⑦
OFFSET & FULL SCALE setting	==> Setting item ⑧, ⑨, ⑩

(2) Analog output

The zero point (4mA) and span point (20mA) of analog output can be set in the range of –10 to 110%F.S. of the maximum display span (between OFFSET and FULL SCALE). The span between the zero point and the span point in this analog output is the linear display span.

Analog output zero point and span point setting	Setting item ⑪ , ⑫

As shown in the previous diagram, usually, the OFFSET is set as Output zero point (4mA) and the FULL SCALE is set as Output span point (20mA), but the OFFSET can be reversed to Output span point (20mA) and the FULL SCALE can be reversed to Output zero point (4mA).

Setting example 2 : Linear display mode

A DPTW with a differential pressure range of 0 to 200 inH_2O used as a level transmitter, the linear display setting to display the OFFSET for minimum 20 inH_2O as 0.0, the FULL SCALE for maximum differential pressure 120 inH_2O as 50.0, the unit as arbitrary unit (cm), the zero point (4mA) analog output as 0.0, and the span point (20mA) as 50.0 is as follows:

See Section 14.4 for full menu.

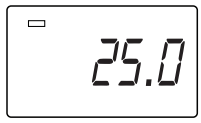
Select the filter of “0 seconds”	==> Setting item ①
For display mode, select “Linear display mode - [Lin]”	==> Setting item ②
Set min. differential pressure P1 as “20 inH_2O”	==> Setting item ⑥
Set max. differential pressure P2 as “120 inH_2O”	==> Setting item ⑦
Set decimal point position of linear display as “one digit”	==> Setting item ⑧
Set OFFSET of linear display as “0.0cm”	==> Setting item ⑨
Set FULL SCALE of linear display as “50.0cm”	==> Setting item ⑩
Set output zero point as “0.0%F.S.” (0.0m) of max. display span*	==> Setting item ⑪
Set output span point as “100.0%F.S.” (50.0m) of max. display span*	==> Setting item ⑫

*Maximum display span: OFFSET to FULL SCALE

Linear display and analog output

Ex. Differential pressure 70 inH_2O

- Linear display: 25.0(cm)
- Analog output: 12(mA)



Differential Pressure (inH_2O)		Linear Display (cm)		Analog Output (mA)
120	==>	50.0	==>	20 Span Point
∫		∫		∫
70	==>	**25.0**	==>	**12**
20	==>	0.0	==>	4 Zero Point

11.4 Square Root Display Mode

Flow Measurement

Combining sensing elements such as an orifice plate or pitot tube with the DPTW, the square root display mode is used for the display of the momentary flow rate, integrated volume and for analog output corresponding to the momentary flow rate.

(1) Momentary flow rate

Maximum display span from zero to the maximum momentary flow rate. The momentary flow rate display span depends on the setting of the zero point and span point of the analog output as shown in (2) Analog Output. It can display 0 to 105% F.S. of the momentary flow rate display span. The scaling method can be performed only by setting the maximum momentary flow rate and then generate differential pressure using the following square root formula.

Momentary flow rate Dx is expressed by the square root formula (a), and can be calculated only by measuring the generated differential pressure Px (percent value over the differential pressure range).

$$(a) \qquad D_x = k\sqrt{\frac{P_x(\%)}{100(\%)}}$$

In addition, the coefficient k is determined by substituting the maximum momentary flow rate Dm, which is measured from the formula (a), and the corresponding differential pressure Pm into the formula (b).

$$(b) \qquad k = \frac{D_m}{\sqrt{\frac{P_m}{100}}}$$

- The **differential pressure Pm generated** during the maximum momentary flow rate can be set in the range of 25 to 100%F.S. of the differential pressure range.
- The setting range for values of the **maximum momentary flow rate** is 0 to 1999. Note: The decimal point can be set arbitrarily.

Setting of max. momentary flow rate and then generated differential pressure	==> Setting item ⑭, ⑮, ⑯

- When the display resolution lowers and the wobbling of momentary flow rate increases in the low flow domain of the differential pressure flow meter, the domain (below the set value) will be forcedly indicated as zero by means of the low-cut for momentary flow rate.

Moreover, the analog output has a fixed value of 4mA at the zero point. For setting of low-cut, input the percent value over the maximum display span. Its range is 0 to 30%F.S. and the decimal point position can be set up to one digit after decimal point as fixed point.

Setting of low-cut	==> Setting item ⑰

(2) Analog output

The zero point (4mA) and span point (20mA) of analog output can be set in the range of 0 to 110%F.S. of the maximum display span (0 to maximum momentary flow rate). The span between the zero point and the span point in this analog output is the momentary flow rate display span.

(3) Integrated volume

- The units of integrated volume include two standards: Time factor and flow rate volume factor.

Setting of integrated volume unit	==> Setting item ⑳, ㉑

- The number of digits of integrated volume display is a maximum of 6 figures (999999); the display will return to 0 once the maximum reading has been met.

- The zero reset of an integrated volume is executed by pressing S key for more than 3 seconds and displaying “cLr” (clear) for 2 seconds.

- As **backup in case of POWER OFF,** the integrated volume value is stored in the nonvolatile memory for every hour. After power returns, integration starts from the integrated volume value stored in the memory.
- Integration is halted during the “FFF” display at the time of differential pressure range OVER (Refer to paragraph 11.5 (1))
- The indicated value which is blinking is integrated during the “blink” display at the time of momentary flow rate display span OVER (Refer to paragraph 11.5 (2)).

(4) Display switching method of momentary flow rate and integrated volume

Display switching methods of momentary flow rate and integrated volume include the **automatic switching display method** to display them by turns at intervals of fixed time (1 to 10 seconds) and the manual switching display method to change the display by pressing (**M**) key.

Selection of display switching method (automatic or manual)	==> Setting item ㉒
Setting of display switching time for automatic	==> Setting item ㉓

Setting example 3: Square root display mode (Flow measurement using arbitrary units)

A differential pressure flow meter application uses a DPTW with differential pressure measuring range of 40 inH2O. At a maximum momentary flow rate of 120 in the arbitrary units of Gallons per Minute (GPM), the differential pressure is 32 inH2O (80% F.S.). For integrated volume display a time factor of minute will be used and a flow factor weight of 1 will be used to display one per count. The low-cut is set for 10%F.S. and the display switching method is set for manual.

1. Setting of momentary flow rate

The differential pressure at the maximum momentary flow rate must be set (32 inH2O) and the maximum momentary flow rate must be set (120.0 GPM).

2. Setting of integrated volume

The following two settings must be made for integrated flow volume which will be displayed in Gallons times the selected weight flow factor of 1:

- Setting of time factor (minute)
- Setting of flow factor weight (1)

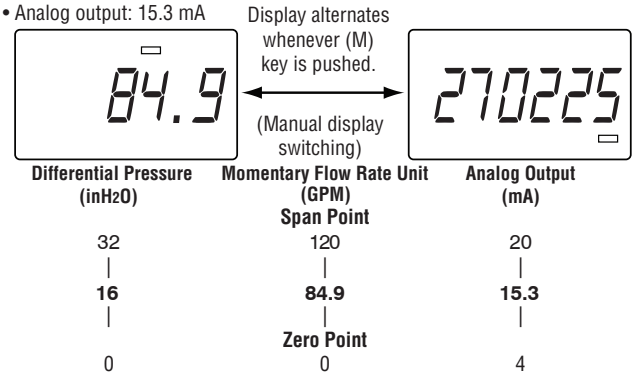
Select the filter of "0 seconds"	==> Setting item ①
Select the "Square root display mode - [rot]"	==> Setting item ②
Set the differential pressure at max. momentary flow rate as 32 inH2O (80%F.S.)	==> Setting item ⑭
Select "1-digit" as decimal point position of momentary flow rate	==> Setting item ⑮
Set the max. momentary flow rate as "120.0"	==> Setting item ⑯
Set the low-cut as "10.0%F.S." of max. display span*	==> Setting item ⑰
Set the output zero point as "0.0%F.S." 0 of max. display span*	==> Setting item ⑱
Set the output span point as "100.0%F.S." 120.0 of max. display span*	==> Setting item ⑲
Select "nin" (minute) as time factor of integrated volume	==> Setting item ⑳
Select "1" as weight of flow factor of integrated volume	==> Setting item ㉑
Select "bt" (manual) as display switching method	==> Setting item ㉒

*Maximum display span: 0 to Maximum momentary flow rate

Setting example 3 continued:

Square root display and analog output

Momentary flow rate display (GPM)
Measured differential pressure: 16 inH2O Integrated volume display (Gallons)
• Displayed momentary flow: 84.9 GPM Integrated volume 270225



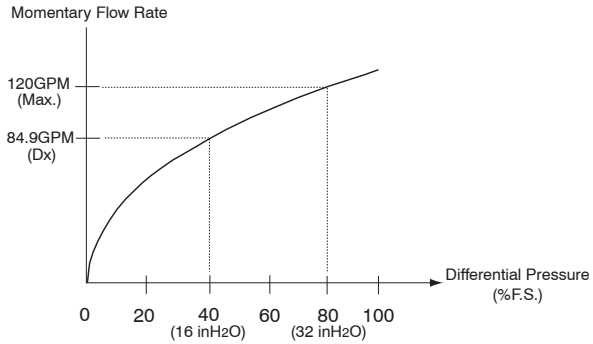
The momentary flow rate Dx at the measured differential pressure of 16 inH2O (40% F.S.) is calculated by the following formula:

The coefficient k is determined by substituting the maximum momentary flow rate Dm=120 and the then differential pressure Pm=80%F.S.(32 inH2O) into the formula (b) of the preceding paragraph 11.4 (1).

$$k = \frac{D_m}{\sqrt{\frac{P_m\,\%}{100\,\%}}} = \frac{120}{\sqrt{\frac{80\,\%}{100\,\%}}} = 134.2$$

Therefore, the momentary flow rate Dx is determined by the formula (a) of the preceding paragraph 11.4(1).

$$D_x = k\sqrt{\frac{P_x\%}{100\,\%}} = 134.2\sqrt{\frac{40\%}{100\,\%}} = 84.9$$



Refer to Section 17 for an additional Flow Measurement programming example.

11.5 Out of Range Display

(1) Range Over display

In the Measurement Mode, if the pressure is below –15% F.S. (URL) "–FFF" will be displayed, and if it is more than 115%F.S., "FFF" will be displayed.

(2) Span Over display

When the user has adjusted the span of the device this case will apply. The display range in each display mode is –5 to 105%F.S. of the display span. When this range is exceeded, the value of –5%F.S. or 105%F.S. will be held (depending upon whether unit is below or above the span values) in a blinking state.

(3) Analog output

The analog output is linked with the display and is at 3.2mA when the display span is at or less than –5%F.S. and at 20.8mA when the display span is at or greater than 105%F.S.

Out of Range Display Example

Differential pressure mode (Differential pressure range 0 to 20 inH_2O) Pressure display span 20 inH_2O)
Span point: 20.0
Zero point: 0.0

• Overage display

≤ -15%F.S. (–3.0 inH_2O)

≥115%F.S. (23.0 inH_2O)

• Span over display

≤ -5%F.S. (–1.0 inH_2O)

≥105%F.S. (21.0 inH_2O)

12. Zero Adjustment Mode

In the measurement mode, the pressure connection (H, L) is open to the atmosphere and ⏏ key is pressed for more than 3 seconds in order to shift to zero adjustment mode for zero point adjustment of the differential pressure sensor.

- If the zero point adjustment is correctly performed, the message "AdJ" will be displayed for 2 seconds, and the display will return to the measurement mode.
- If zero point correction is performed when the applied pressure is over ±10%F.S., the error message "E-0" will be displayed for 2 seconds, and the display will return to the measurement mode without completing the zero point adjustment.

– Normal Message –

– Error Message –

CAUTION: Only perform the zero point correction when both the H and L ports are open to the atmosphere. If done incorrectly the accuracy of the device may be effected.

13. Key Lock

Function	Key Manual	Indicator
Setting of key lock	MODE+▲ one second	LoC
Release of key lock	MODE+▲ one second	UnL

Operation during key lock

Function	Key Manual	Indicator
Zero adjust.	▲key greater than 3 sec.	LoC (Return to measurement mode)
Hold value reset	▼key greater than 3 sec.	LoC (Return to measurement mode)
Setting Mode	(M)key greater than 3 sec.	LoC (Return to measurement mode)

14. Setting Mode

The setting modes include differential pressure display mode setting, linear display mode setting, and flow measurement/square root mode setting. In addition, loop check (refer to Section 14.5) can be performed in each mode setting.

For the setting procedure of each display mode, refer to paragraphs 14.3 and 14.4.

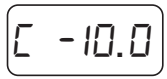
14.1 Setting Items for Differential Pressure Display Mode

(Re-scaling in "inH_2O" units). Set the filter before setting the differential pressure setting mode. See Section 14.4 for full menu.

No.	Setting Item	LCD Display	Setting Description	Setting Range	Default*
①	**Filter**		Selection of moving average time of differential pressure: 2 (sec)	0,2,4,8,16 sec	4

*The factory default.

The setting of the following table is the Setting example 1: pressure display mode of Section 11-2. This applies when re-scaling in "inH20" units. See Section 14.4 for full menu.

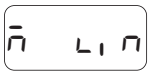
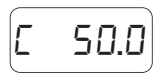
No.	Setting Item	LCD Display	Setting Description	Setting Range	Default
②	**Display mode**		Selection of differential pressure display mode: non	non: Differential pressure display mode Lin: Linear display mode	non
③	**Output zero point(1)**		Differential pressure of analog output zero point 4mA: –10.0(%F.S.)	Differential pressure range: –10 to 110%F.S.	0.0
④	**Output span point(1)**		Differential pressure of analog output span point (20mA): 90.0(%F.S.)	Differential pressure range: –10 to 110%F.S.	100.0
⑤	**Loop check(2)**		Arbitrary change of differential pressure display and analog output: –10.00 (psi).)	Display: Differential pressure display span; Analog output: 4 to 20mA	0.0 (4.00 mA)

(1) For setting of zero point and span point in the analog output, input the percent value over the differential pressure range.

(2) Regardless of generated differential pressure, the loop check can be changed by arbitrarily linking the pressure display with the analog output using ▲, ▼ key. (Refer to Section 14.5). This example of LCD display shows the zero point display at the time of loop check start.

14.2 Setting Items for Linear Display Mode

(Re-scaling in arbitrary user Set the filter before setting the linear display mode (Refer to the preceding Section 11.1). The setting of the following table is the Setting example 2: Linear display mode of Section 11.3. (Arbitrary unit: cm). This applies when re-scaling in arbitrary user defined units. See Section 14.4 for full menu.

No	Setting Item	LCD Display	Setting Description	Setting Range	Default
②	**Display mode**		Selection of linear display mode: Lin	non: Differential pressure display mode; Lin: Linear display mode	non
⑥	**Min. differential pressure(1)**		Min. differential pressure corresponding to OFFSET ⑨:20.0(inH_2O)	Differential pressure range: 0 to 75%F.S.	0.0
⑦	**Max. differential pressure(1)**		Max. differential pressure corresponding to FULL SCALE ⑩:120inH_2O)	Differential pressure range: 25 to 100%F.S.	100.0
⑧	**Decimal point position**		Display after decimal point Number of digits:1(digit)	0,1,2,3 digit	0
⑨	**OFFSET**		OFFSET corresponding min. differential pressure ⑥: 0.0 (cm)	–1999 to 1999	0
⑩	**FULL SCALE**		FULL SCALE corresponding to max. differential pressure ⑦:50.0 (cm)	–1999 to 1999	1000
⑪	**Output zero point(2)**		Analog output zero point : (4mA): 0.0 (%F.S.)	Max. display span: –10 to 110%F.S.	0.0
⑫	**Output span point(2)**		Analog output span point : (20mA): 100.0 (%F.S.)	Max. display span: –10 to 110%F.S.	100.0
⑬	**Loop check(3)**		Arbitrary change of linear display and analog output: 50.0 (cm), 20mA	Display: Linear display span; Analog output: 4 to 20mA	0 (4.0mA)

(1) The decimal point position is fixed for each differential pressure range.
The max. differential pressure can be set from the value which is 25%F.S above the minimum differential pressure. The values under 25%F.S. cannot be increased or decreased by ▲, ▼ key.

(2) For setting zero point and span point of the analog output, input the percent value over the maximum display span (between OFFSET and FULL SCALE). Its decimal point position can be set up to one digit after the decimal point (xx.x).

(3) Regardless of whether pressure is applied or not, the loop check can be activated which links the display and the output allowing the operator to arbitrarily adjust the output to check the system, troubleshoot etc (using the ▲, ▼ keys), (Refer to Section 14.5) This example shows the display set to the span point.

14.3 Setting Items for Square Root Display (Flow Measurement)

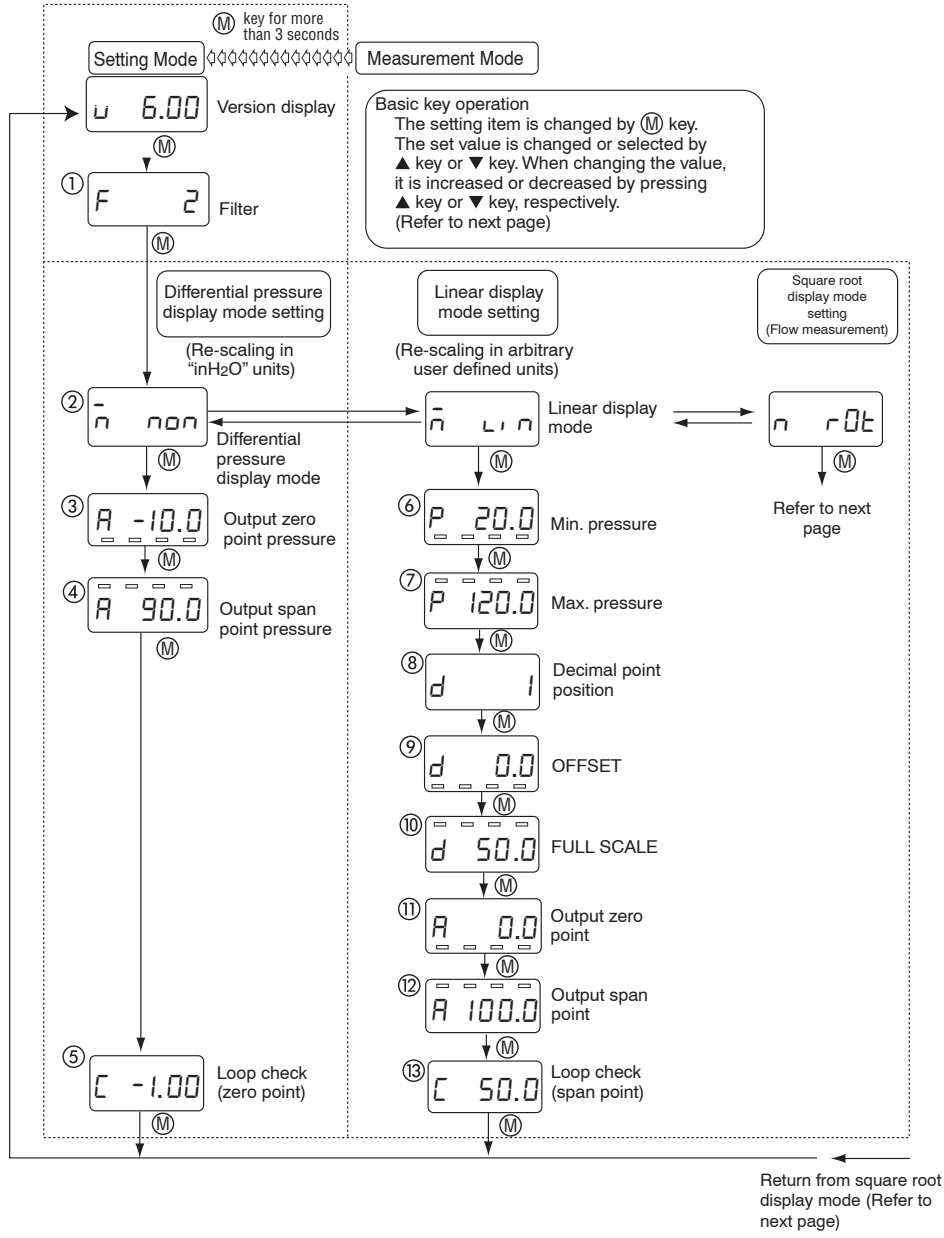
No.	Setting Item	LCD Display	Setting Description	Setting Range	Default
②	Display mode	n rot	Selection for flow measurement/ square root extraction mode	**non:** Differential pressure display mode **Lin:** Linear display mode **Rot:** Square root display mode	non
⑭	Maximum differential selection[1]	P.400	Maximum differential pressure relating to the flow rate	25 to 100% F.S. of sensor range	100.0% of sensor range
⑮	Flow rate decimal pt. position	d 0	Displays of value after decimal point, # of digits	0,1,2,3 digit	0
⑯	Max. momentary flow	d 1000	Max. momentary of flow using arbitrary units	0 to 1999	1000
⑰	Low cut	L 0.0	Forces display and output to zero	0.0 to 30.0% F.S. of max. display span	0.0
⑱	Output zero point[2]	A 0.0	Momentary flow rate of analog output zero point (4mA): 100.0% F.S.	–10 to 100% F.S. of max. display span	0.0
⑲	Output span point[2]	A100.0	Momentary flow rate of analog output zero point (20mA): 100.0% F.S.	–10 to 100% F.S. of max. display span	100.0
⑳	Time factor	U SEC	Measurement of max. momentary flow rate over time selected	Seconds, minutes or hours	Sec
㉑	Flow rate volume factor	U 1	Flow rate x time selected	1,10,100,1000	1
㉒	Display switch setting	S bt	Selection of display switching method of momentary flow rate and integrated volume	ti = automatic bt = manual	bt
㉓	Switch time interval	t 5	Selection for ti: automatic Displays switching time interval in seconds	1 to 10 seconds (10 stage)	5
㉔	Loop check[3]	c 0.0	Output check using arbitrary value – displays pressure correlating to the 4 to 20mA signal	Display: momentary flow rate display span Analog output: 4 to 20mA 0.0 to 100.0%	0 (4.0mA)

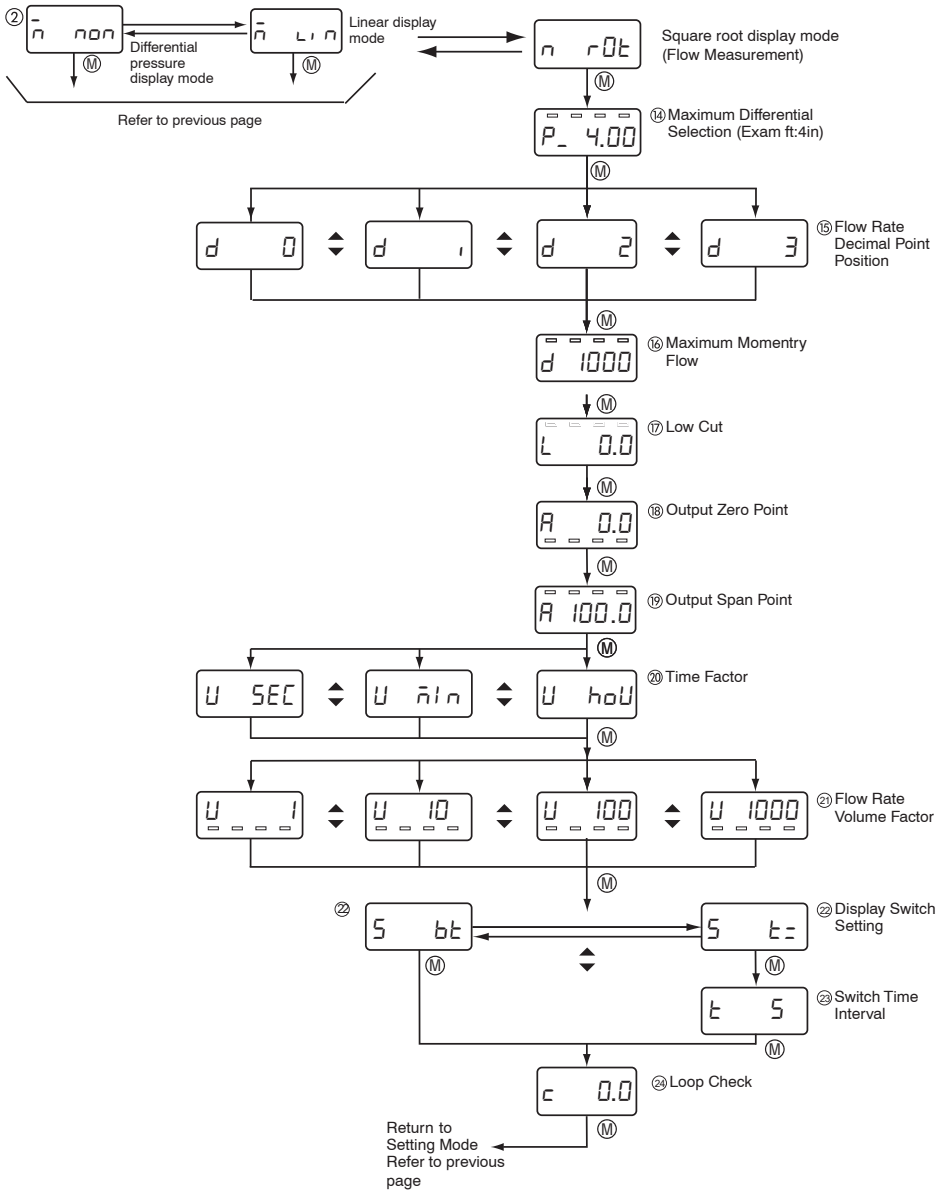
(1) In the setting of a differential pressure the decimal point position is fixed for each differential pressure range. The max. differential pressure can be set from the value which is 25%F.S of the differential pressure range above the minimum differential pressure.The values under 25%F.S. cannot be increased or decreased by ▲, ▼ key.

(2) For setting zero point and span point of the analog output, input the percent value over the maximum display span (between OFFSET and FULL SCALE). Its decimal point position can be set up to one digit after the decimal point (xx.x).

(3) Regardless of generated differential pressure or low-cut, the loop check can be changed arbitrarily linking the momentary flow rate display with the analog output using the ▲, ▼ keys. (Refer to Section 14.5.)
This example of LCD display shows the display set to zero point.

14.4 Setting Procedure (Setting Examples from 14.1, 14.2)




②
Differential pressure display mode
Linear display mode
Refer to previous page
Square root display mode (Flow Measurement)
⑭ Maximum Differential Selection (Exam ft:4in)
⑮ Flow Rate Decimal Point Position
⑯ Maximum Momentry Flow
⑰ Low Cut
⑱ Output Zero Point
⑲ Output Span Point
⑳ Time Factor
㉑ Flow Rate Volume Factor
㉒
㉒ Display Switch Setting
㉓ Switch Time Interval
㉔ Loop Check
Return to Setting Mode Refer to previous page

14.5 Loop Check

In each display mode, regardless of applied pressure, the loop check can be changed by arbitrarily linking the display with the analog output using the key operation. The display will show representative pressure readings correlating to the 4-20mA signal.

Loop check method

(1) Remove the front cover from the DPTW.

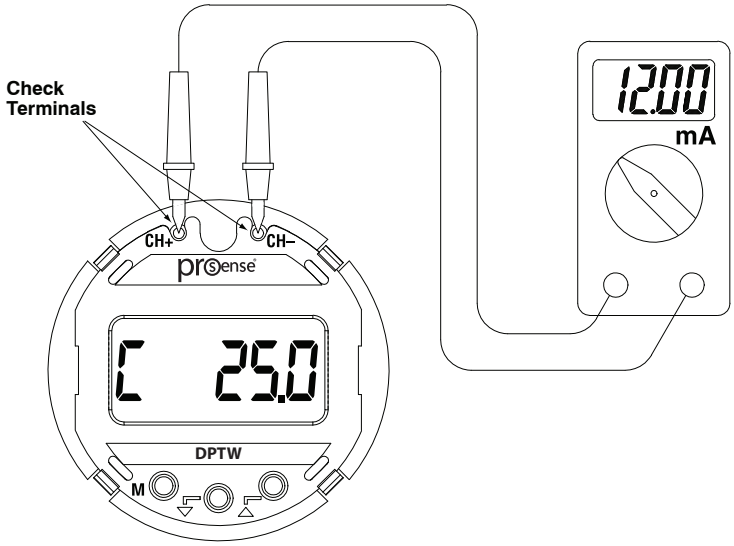
(2) Shift to either the differential pressure, linear display or square root (flow measurement) modes. (See Section 14). Use (M) button to scroll to Loop Check function as indicated within Section 14.1, 14.2 or 14.3 respectively. The display and output (4mA) are at the zero point when loop check starts.

(3) If the ▲ is pressed, the display will increase along with the output. By pressing ▼ key, decrease will occur. Release the key at the desired indication. For example, if the key is released at 25.0m, the display will stop and be held at analog output 12mA corresponding to the indication, ref. example from section 14.2

Analog Output Check Terminals

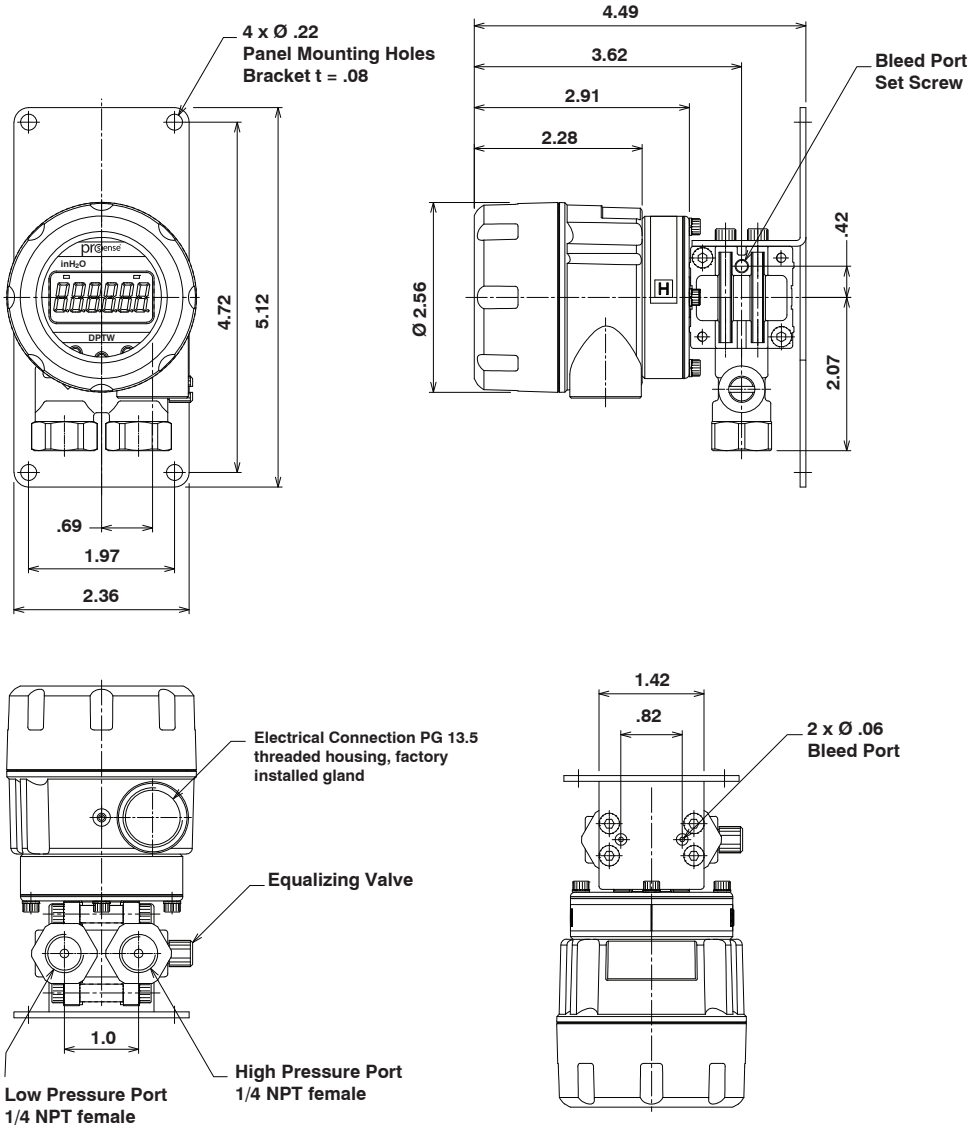
When the front cover is removed, the analog output check terminals (pad: CH+, CH–) are visible at the upper part of the display substrate. The analog output can be checked during measurement mode or loop check by applying a probe, such as a tester for current measurement, onto the check terminal of the substrate, as shown in the following figure. In addition, receivers are not affected by the tester's probes.

Loop check / linear display



15. Dimension Drawings

Dimensions in inches



16. Maintenance and Warranty

Periodic inspection

Depending upon the type of use periodic inspection is recommeded at least once a year. Please refer to the following items for periodic inspection.

(1) Appearance

(2) Display/output check via appropriate pressure standard

(3) Display/output check via Loop Check (refer to Section 14.5)

CAUTION

- Avoid electrostatic charging. When cleaning this product, please use a soft, damp, cloth.
- Do not use thinner, etc. which may cause deterioration and failure

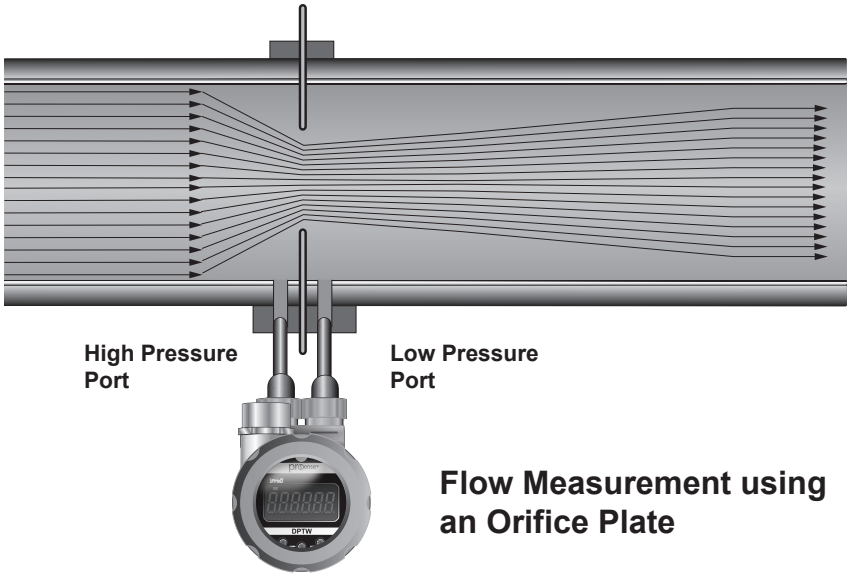
Product warranty

Except as otherwise provided, the product warranty of this product is as follows:

Period: 12 months

17. Advanced Water Flow Rate and Volume Application Example

This example demonstrates the use of DPTW differential pressure transmitter to measure and control flow rate in GPM. Also, to switch from flow rate reading to volume, automatic or manual. Although, the DPTW differential pressure transmitter can be purchased with several ranges, for this application a transmitter with 0 to 40 inH_2O pressure range has been selected. As well, an orifice plate with 2.40" bore, an eight-inch line diameter pipe and a variable frequency water pump. The transmitter shall provide the analog output to the variable frequency water pump. The variable frequency water pump uses the 4-20mA input to control the amount of energy sent to the pump to slow down or speed up the pump to maintain a constant flow.



Flow Measurement using an Orifice Plate

Flow rate is calculated by measuring the differential pressure across an orifice plate. The DPTW will be using the orifice plate manufacturer's data of maximum flow rate with corresponding differential pressure drop.

Manufacturer orifice plate specifications:

Line Size **= 8"** *diameter*

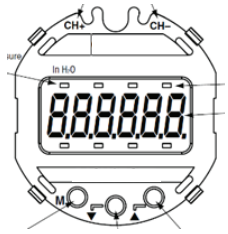
Bore **= 2.4"** *bore*

Maximum Flow **= 88** *GPM* **@20** ***inH2O***

DPTW Differential Pressure Transmitter Flow and integrated Volume Program Guidelines:

Below is an Illustration to program the transmitter in GPM and integrated volume in gallons as the arbitrary units. Proceed to scale down the transmitter range from 40 inH2O to 20 inH2O. That, is the maximum differential pressure equivalent to 88 GPM of water (20 mA). Follow the steps below to rescale and program the transmitter from 0 to 20 inH2O of water equivalent to the arbitrary units of 0 to 88 GPM.

- Remove Access Cover to Expose MODE, UP and DOWN Buttons
- Press and hold M button for more than three seconds to get into program mode.
- Press UP or Down arrow to make changes.
- Press and release M button to select changes and to walk through the menu.
- Continue to step-1 after power-on message.
- Press and hold M button anytime for more than three seconds to return to measuring mode.



Step 1	• **F 0** To enter filter selection (selections of 0,2,4,8, and 16 times). • The filter function is used when pressure fluctuates to improve analog output and difficult to read display. • Select the filter F0. Since pressure fluctuation is not expected. • Press and release M button to select and move to the next step.	
Step 2	• **n rot** To enter configuration mode. There are three pressure modes, linear, non-linear, and square root function. • Select square root function to convert pressure into flow rate and to use arbitrary units. • Press UP or Down arrow to display “n rot”. • Press and release M button to select and move to the next step.	
Step 3	• **P 20.0** To enter the maximum differential pressure corresponding to the maximum flow rate (88 GPM). • This is the orifice plate specification value. • Press Up or Down arrow until 20.0 is displayed. That, is the maximum differential pressure corresponding to 88 GPM of water. • Press and release M button to select and move to the next step.	
Step 4	• **d 1** To select the decimal point position. There are four decimal point selections (0,1, 2, and 3 digits). • Press Up or Down arrow until 1 is display. For this application one digit after decimal point shall be used. • Press and release M button to select and move to the next step.	
Step 5	• **d 88.0** To enter the maximum arbitrary units 88 GPM of water corresponding to differential pressure of 20 inH_2O. • Press Up or Down arrow until 88.0 is selected. That, is the 88 GPM of water corresponding to 20 inH_2O. • Press and release M button to select and move to the next step.	

Step 6	• **L 0.0** To enter low-cut to flow rate. It forces display to zero and analog output to 4 mA. • Low-cut shall not be used on this application, constant flow rate shall be maintained. • Press Up or Down arrow until 0.0 is selected. Press and release M button to select and move to the next step.	
Step 7	• **A 0.0** To enter analog output zero reference corresponding to 4 mA. • The operational range is from 0 to 88 GPM of water. Therefore, select 0% FS or 4mA analog output. • Press Up or Down arrow until 0.0 is displayed. That, is the analog output at 0% FS (4mA at 0 GPM of water). • Press and release M button to select and move to the next step	
Step 8	• **A 100.0** To enter span analog output reference corresponding to 20 mA. • The operational range is from 0 to 88 GPM of water. Therefore, 100% full span is selected as the span or 20 mA analog output. • Press UP or Down arrow until 100.0 is displayed. That, is the analog output at 100% FS (20mA at 88 GPM). • Press and release M button to select and move to the next step.	
Step 9	• **U nin** To enter time factor. When flow rate is GPM, minutes shall be selected as the same time factor. • Press UP or Down arrow until “n in” is displayed. That, is the time factor corresponding to minutes. • Press and release M button to select and move to the next step.	
Step 10	• **U 1** To enter Flow rate volume factor. When flow rate is GPM, 1 shall be selected to match flow factor units of gallons X1. • Selectable options 1,10, 100 and 1000. • 1 shall be selected since the arbitrary units are in gallons. • Press UP or Down arrow until “1” is displayed. That, is the unit factor corresponding to gallons. • Press and release M button to select and move to the next step.	

Step 11	• **S bt** To enter switch mode of momentary flow rate and integrated volume. There is manual mode (bt) or automatic mode (ti). • For this application manual switch mode shall be selected. It only displays integrated volume when cover is removed and M button is pressed. Otherwise it only displays flow rate. • Automatic setting time is selectable from 1 to 10 seconds cycle. Press UP or Down arrow until "bt" is displayed. Press and release M button to select and move to the next step.	
Step 12	• **C 0.0** Loop check mode allows program and analog output verification with the transmitter pressurized or non-pressurized. It simulates the process and allows for troubleshooting. • Press Up or Down arrow to change within transmitter range (0 to 88 GPM of water). • Press and release M button to return to the begin of program • After verification press and hold M button for more three seconds to return to measuring mode.	

Function Verification:

The DPTW loop-check allows to verify program and analog output with the transmitter pressurized or non-pressurized.

• Once Step-11 is reached, the unit is in Loop-check mode. • The system can be verified by increasing or decreasing the flow rate value (0 to 88 GPM of water). • Use the Up or down arrow and observe the display segments get brighter as the flow rate value increases. That, is an indication that the analog output and wiring are reacting properly.