

# **200FLOW Instrument Instruction Manual**

**METTLER TOLEDO**

A graphic element consisting of a series of parallel, slightly curved lines that form a diamond or arrow-like shape pointing downwards and to the right. The lines are more densely packed in the center and become more sparse towards the edges.



## IMPORTANT SAFETY INFORMATION

Please read and observe the following:

**INSTALLATION:** This instrument must be installed by trained instrumentation personnel in accordance with relevant local codes and instructions in this manual. Observe all instrument specifications and ratings.

**SHOCK HAZARD:** Make sure power to all wires is turned off before proceeding with installation or service of this instrument. High voltage may be present on the input power and relay wires.

**RELAY CONTROL ACTION:** Relays will always de-energize on loss of power, equivalent to normal state, regardless of relay state setting for powered operation. Configure any control system using these relays with fail-safe logic accordingly.

**PROCESS UPSETS:** Because process safety conditions may depend on consistent operation of this instrument, take appropriate action to maintain conditions during sensor cleaning, replacement or sensor or instrument calibration.

This manual includes safety information with the following designations and formats:

**WARNING: POTENTIAL FOR PERSONAL INJURY.**

**CAUTION: possible instrument damage or malfunction.**

**NOTE:** important operating information.



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# CHAPTER 1: GETTING STARTED

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## INTRODUCTION

The 200FLOW is process instrument for measuring flow rate. It can process signals from each of four pulse-type flow sensors, manufactured by Signet, Data Industrial, Hoffer, Asahi/America and others.

A 16-character Liquid Crystal Display conveys measuring data and setup information. It is backlit for viewing in all lighting conditions. The menu structure allows the operator to modify all operational parameters by using keys on the front panel. A menu-lockout feature, with password protection, is available to prevent the unauthorized use of the meter. The 200FLOW can be configured with up to four relays for process control.

The 200FLOW instrument is equipped with a communication interface that can be configured as either an RS422 or an RS232. This interface provides real-time data output and complete instrument configuration capabilities for central monitoring via Personal Computer (PC) or Programmable Logic Controller (PLC).

## FEATURES

**Display:** 1 line x 16 character backlit LCD.

**Measurements:** gallons/minute, total gallons, cubic meters/hour, total cubic meters, liters/minute, total liters, hertz, feet/second, and % recovery.

**Measurement Channels:** 4 (2 measurements per channel).

**Measurement Cycle Time:** 2 seconds (8 measurements processed per cycle).

**Programmable:** all setup information is stored in a non-volatile memory.

**Setpoints (alarms):** 8 independent alarms programmable as high or low limits.

**Relays:** up to 4 with programmable delay time and hysteresis.

**Outputs:** 2 analog output circuits (4-20mA). Can be multiplexed (time-shared) for a total of 4 analog outputs.

**Communications:** RS232/RS422 interface, bi-directional.

**Security:** keypad lockout with password.

**Calibration:** complete instrument, output, and sensor calibration. Calibration can be NIST traceable.

**Watchdog Timer:** with a power supply monitor, to prevent instrument lockup.

**Built-In Diagnostics:** several self tests performed automatically and can be initiated at any time.

## OVERVIEW OF OPERATION

When power is applied to the 200FLOW, the initialization process begins. The instrument will perform a number of self tests. Any problems detected during these tests will be reported by a displayed message.

Next, all setup parameters (setpoints, states, relay conditions, etc.) are restored from non-volatile memory.

The meter will then begin the measurement process. A complete measurement cycle is performed once every two seconds and consists of the following:

1. Measure four signals and compute eight measurements.
2. Check setpoints against the measurements.
3. Control the relays.
4. Update analog output signals.
5. Transmit measurement data over the communication port.
6. Display data (if not displaying a menu).

At any time during this process the menus can be accessed by pressing one of the menu keys. The display of a menu will not affect the measurement process.

## INSTALLATION & SETUP PROCEDURE

The following guide shows the steps necessary to install a 200FLOW meter and begin operation.

1. Follow the meter installation procedure for physically mounting the meter, as outlined in Chapter 2: Installing the 200FLOW. The meter may be mounted in a panel, on a pipe, or on a wall. The optional sealed rear cover is required for wall and pipe mounting.
2. Make all necessary electrical connections to the meter. The wiring procedure is outlined in Chapter 2: Installing the 200FLOW. Note that wall and pipe mounting will require wiring before the back plate is installed and the instrument can be mounted.
3. Required wiring: input power and sensor cables.
4. Optional wiring: relays, analog outputs, and serial port.
5. Enter constants for each sensor as outlined in Chapter 10: Sensor Calibration.
6. Select the desired units for each sensor as shown in Chapter 4: Making Measurements.
7. Optional: program the analog outputs as shown in Chapter 8: Using Analog Outputs.
8. Optional: program the setpoints as shown in Chapter 5: Using Setpoints.
9. Optional: program the relays as shown in Chapter 6: Using Relays.
10. Optional: program other features such as averaging method, security, etc.

# CHAPTER 2: INSTALLING THE 200FLOW

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## UNPACKING

Each 200FLOW is packed in an individual biodegradable carton. Retain the packaging in the event that the instrument must be returned to Thornton Inc. for service or calibration. Open the carton carefully to insure that the product is not damaged or dropped.

This carton should contain:

- 1-200FLOW Instrument
- 1-200FLOW Instruction Manual
- 1-Certificate of Calibration

## INSTALLATION

The 200FLOW can be mounted in a panel, on a pipe or attached to a wall.

### Panel Mounting Cutout and Installation

The panel cutout should measure 7.56 inches wide by 3.780 inches high (192 mm X 96 mm). Drill four holes for the #10 mounting screws. See Figure 15.2 for panel cutout size and mounting screw hole spacing. When mounting multiple instruments on the same panel, note the front flange dimensions in Figure 15.1 in order to allow enough space between instruments. Panel cutouts should be clean and free of burrs and sharp edges. The proper dimensions allow an instrument to slide freely into the cutout.

Install the panel gasket (supplied with instrument) on the instrument as shown in Figure 15.4. Slide the instrument into the cutout and secure it with the mounting screws.

**CAUTION: Do not over tighten the screws as this may crack the case.**

If the rear cover is used in a panel mounted installation, the 200FLOW unit must be installed in the panel opening before the rear cover is installed.

### Wall Mounting

The 200FLOW can be easily mounted to a wall when the rear cover is installed. The flanges on the ends of the cover contain holes for screws to fasten the assembly to the wall. See Figures 15.1 and 15.7.

### Pipe Mounting

The 200FLOW can be mounted to a pipe with the pipe mounting accessory kit (shown in Figure 15.6). The assembly procedure is shown in Figure 15.5.

## ELECTRICAL CONNECTIONS

All electrical connections are made at terminal blocks at the rear of the 200FLOW case, which can accept 12 to 28 AWG wire (0.08 to 3.31 mm<sup>2</sup>).

**WARNING: MAKE SURE POWER TO ALL WIRES IS TURNED OFF BEFORE PROCEEDING WITH THE INSTALLATION. HIGH VOLTAGE MAY BE PRESENT ON THE INPUT POWER WIRES AND RELAY WIRES.**

**CAUTION: To prevent electrostatic discharge (ESD) from damaging the instrument during electrical wiring installation, the installer must be electrically grounded, i.e., wear a conductive wrist strap connect to earth ground.**

**CAUTION: Run signal and power wiring in separate conduit or wire bundles to prevent electrical noise pickup.**

### Input Power and Relay Connections

Terminal block TB1 and TB4 contain connections for the input line power and relay contacts. Depending upon the model number, the 200FLOW will have either 2 or 4 relays. Table 2.1 shows the wiring sequence.

All relays have “dry contacts”; they are potential-free and require external power to be wired in series with the load and instrument terminals. Relays 3 and 4, if specified, are solid state AC-only relays (triacs) and require

a minimum current of 10 mA to switch reliably. With very small loads such as a neon bulb, test meter, or PLC, a load resistor is required in parallel with the intended load, e.g. 10K ohm, 2 watt resistor, for operation with 115 VAC.

TB4 Label	Input Power
L	115V/230 VAC Line Power
N	115V/230VAC Neutral
O	Earth Ground
TB1 Label	Relay Function
NC1	Relay1: Normally Closed
C1	Relay1: Common
NO1	Relay1: Normally Open
NC2	Relay 2: Normally Closed
C2	Relay 2: Common
NO2	Relay 2: Normally Open
C3	Relay 3: Common
NO3	Relay 3: Normally Open
C4	Relay 4: Common
NO4	Relay 4: Normally Open

Table 2.1: Input Power and Relay Connections

**WARNING: MISWIRING THE AC POWER MAY DAMAGE THE INSTRUMENT AND WILL VOID ALL WARRANTIES.**

### Setting Input Voltage for 115 VAC or 230 VAC

The input voltage for a 200FLOW can be set for either 115 VAC or 230 VAC operation to minimize power line AC noise pickup. The input voltage is preset at the factory and is indicated on the serial number labeled on the side of the unit. Jumpers on the printed circuit board can be changed to change the input voltage. See Figure 15.8. Jumper pins are located between the power transformer and the fuse. For 115 VAC operation jumpers across pins 1-2 and 3-4 must be used. For 230 VAC operation only a jumper across pins 2-3 must be installed. The jumpers can be accessed by removing two screws from the back panel and carefully lifting the panel off.

**WARNING: IF THE INPUT VOLTAGE JUMPERS ARE CHANGED YOU MUST LABEL THE UNIT WITH NEW VOLTAGE**

**REQUIREMENT. IN ADDITION, THE FUSE MUST BE CHANGED TO THE PROPER TYPE TO AVOID RISK OF FIRE HAZARD.**

Fuse requirements:

For 115 VAC: 1/8 Amp. SB, 250 VAC

For 230 VAC: 1/16 Amp, SB, 250 VAC

### Setting Input Voltage for 24 VDC

The 200FLOW can be operated from a +24 VDC power supply instead of the typical 115 VAC or 230 VAC source. DC operation can draw up to 300 mA steady state or 600 mA in-rush. This is also 4-wire instrument operation with separate wiring for power and for analog output signals.

Remove any AC power connections from terminal block TB4.

1. Move circuit board jumper W6 to the 24 V position (left two pins) as shown in Figure 15.8.
2. Connect + 24V DC power to the connection labeled PS+ on terminal block TB3. Connect the power supply ground to the connection labeled PS- on TB3.

**WARNING: AC POWER CONNECTIONS MUST BE REMOVED WHEN USING THE +24V POWER INPUT.**

**NOTE: The +24 VDC input is not fused within the meter.**

### Output Connections

Connections for all outputs are made to terminal block TB2. The serial port can be configured as an RS232 port (shown in Table 2.2.) or an RS422 port (shown in Table 2.3).

TB2 Label	RS232 Function
GND	Ground
TXD+	Not Used
TXD-	Transmit Data
RXD+	Not Used
RXD-	Receive Data

Table 2.2: RS232 Connections

TB2 Label	RS 422 Function
GND	Ground
TXD+	Transmit Data Positive
TXD-	Transmit Data Negative
RXD+	Receive Data Positive
RXD-	Receive Data Negative

Table 2.3: RS422 Connections

Each analog output has + and - connections labeled AO1 or AO2. Analog outputs are self-powered with maximum load resistance of 500 ohms.

**CAUTION: Do not connect analog outputs to circuits supplying power.**

**CAUTION: Do not connect analog output cable shield(s) to the adjacent GND terminal. Connect shields only to the earth ground terminal next to AC line power.**

TB2 Label	Analog Output Function
AO2-	Output 2 (-)
AO2+	Output 2 (+)
AO1-	Output 1 (-)
AO1+	Output 1 (+)

Table 2.4: Analog Output Connections

### Sensor Connections

Flow sensors are connected directly to terminal block TB3. No patch cords are used. Wiring may be extended using appropriate cable identified with each sensor type. The wiring configuration depends upon the type of sensor. The following connections are available:

Note: Sensors that require a pull-up resistor must have a jumper wire installed between the xIN and xJ terminals of the designated channel.

Sensor leads must be wired according to the specific model and type as shown below.

**CAUTION: Miswiring may damage sensors.**

In the tables below, terminal designation "x" represents channel A, B, C or D.

Generic Connection Description	
TB3 Terminal (x= Channel A,B,C or D)	Function
xIN	*Signal Input (0 to $\pm 5$ volts nominal; $\pm 36V$ max).
xJ	+12 volt pull-up supply (through 1 K ohms)
GND	Ground for sensor and shield
+5V	+5V supply (not current limited)

\*The pulse signal must go below 0.9 V and above 1.4 V for reliable detection.

Asahi/America Vortex Sensors (Thornton 33308-33335)	
Sensor Terminal	TB3 Connection
+10 to 30 VDC	PS+
Pulse	xIN
Common	GND
Shield	Earth ground (TB4)

Extension cable: 3-conductor with shield, 20 AWG (Belden 9364 or equivalent), 1000 ft (305 m) max.

Blue-White F900 Series Sensors		
Wire Color	Function	TB3 Connection
Bare Wire	Signal output	xIN
Red	+ power	xJ
Black	Ground	GND

Install a 100K ohm resistor (four part 55-100K supplied with 200FLOW) between xIN and xJ terminals.

Extension cable: 2-conductor twisted pair with shield, 22 AWG (Belden 8451 or equivalent).

<b>Burkert 8020, 8030 &amp; 8035 Series Hall Sensors (12-36VDC) and Thornton models 30901-33935 (5VDC)</b>		
<b>Sensor Terminal</b>	<b>Function</b>	<b>TB3 Connection</b>
1	L+	+5V
2	Pulse Output	xIN
3	L-, shield	GND

Install a 100K ohm resistor (four part 55-100K supplied with 200FLOW) between xIN and xJ terminals.

Extension cable: 2-conductor twisted pair with shield, 22 AWG (Belden 8451 or equivalent).

<b>Data Industrial 200 Series &amp; GLI Sensors (Thornton 33142-33145, 33159-33162, 33273)</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Red	Signal output	xJ
Black	Ground	GND
Bare	Shield	GND

Install a 0.33 uF, 50V ceramic capacitor (four part 62025 supplied with 200FLOW) between xIN and xJ terminals.

Extension cable: 2-conductor twisted pair with shield 20AWG (Belden 9320 or equivalent), 2000 ft (610 m) max.

<b>Data Industrial 4000 Series (Thornton 33171-33172, 33174-33177, 33349-33350)</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Translucent	Signal output	xIN
Black	Signal return	GND
Red	power (+12V)	xJ
Bare	Shield	GND

Extension cable: 3-conductor with shield, 20 AWG (Belden 9364 or equivalent), 2000 ft (610 m) max.

<b>Flow Technology (EG&amp;G) SA Series with CA03 Signal Conditioner</b>		
<b>CA03 Terminal</b>	<b>Function</b>	<b>TB3 Connection</b>
4	Pulse Output	xIN
3	Common	GND
2	Power	PS+
1	Shield	GND

Extension cable: 3-conductor with shield, 20 AWG (Belden 9364 or equivalent) 1000 ft (305 m) max.

<b>Fluidyne Insertion Vortex Sensors with Pulse Output (Thornton 33358-33375)</b>		
<b>Sensor Terminal</b>	<b>Function</b>	<b>TB3 Connection</b>
+	Signal output	xIN
-	Signal return	GND
Earth ground	Ground	¥

Install a 2.8K ohm, 1/4 or 1/2 W resistor (user supplied) between terminals PS+ and xIN.

User supplied cable: 2-conductor twisted pair with shield 20AWG (Belden 9320 or equivalent), 2000 ft (610 m) max.

<b>GEMS Model 2500-Series with RFD Output</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
White	Signal	xIN
Red	+ Power	+5V
Black	Common	GND

Install a jumper between xIN and xJ terminals.

Extension cable: 2-conductor twisted pair with shield, 22 AWG (Belden 9320 or equivalent).

<b>Hoffer HO Series Turbine Sensors with RPM51E Pulse Output (Thornton 33336-33348, 33376, 33377)</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Red	VDC+	PS+
Black	Common	GND
White	Signal output	xIN
Bare	Shield	GND

Extension cable: 3-conductor with shield 20AWG (Belden 9364 or equivalent), 3000 ft (915 m) max.

<b>Proteus Sensors (Thornton 33286)</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Green	Signal output	xIN
Red	+ Power	xJ
Black	Ground	GND

Extension cable: 2-conductor twisted pair with shield, 22 AWG (Belden 8451 or equivalent).

<b>Signet 515 Magnetic Paddlewheel Sensors (Thornton 33189, 33190, 33193, 33195, 33196, 33199, 33229)</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Red	Signal output	xIN
Black	Signal return	GND
Silver	Shield	GND

Install a 100K ohm resistor (four part 55-100K supplied with 200FLOW) between xIN and xJ terminals.  
Extension cable: 2-conductor twisted pair with shield, 22 AWG (Belden 8451 or equivalent), 200ft (61 m) max.

<b>Signet 152 Series Vortex Sensors</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Red	Signal output	xIN
Black	+ power	+5V
White	Ground	GND
Bare	Shield	GND

Install a jumper between xIN and xJ terminals. Extension cable: 3-conductor with shield 20AWG (Belden 9364 or equivalent).

<b>Signet 2507, 2536, 2540 Hall-Effect Paddlewheel Sensors (Thornton 33282, 33285, 33287, 33298, 33305)</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Red	Signal output	xIN
Black	+ power	+5V
Silver	Shield	GND

For 2536, install a jumper between xIN and xJ terminals.  
For others, install a 100K ohm resistor (four part 55-100K supplied with 200FLOW) between xIN and xJ terminals.  
Extension cable: 2-conductor twisted pair with shield, 22AWG (Belden 8451 or equivalent), 1000 ft (305 m) max.

<b>Sponsler Series Turbine Sensors with 0097 powered pick-up coil (Thornton 33441-33450)</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Red	VDC+	PS+
Black	Common	GND
Orange	Signal output	xIN
Bare	Shield	GND

Extension cable: 3-conductor with shield 20AWG (Belden 9364 or equivalent), 3000 ft (915 m) max.

<b>Thornton PFA Ultrasonic Vortex Sensors*</b> <b>(317-100, -101, -102, -103)</b>		
<b>Wire Color</b>	<b>Function</b>	<b>TB3 Connection</b>
Red	12-24 VDC	PS+
White	Common	GND
Purple	Pulse output	xIN
Bare	Shield	GND
Green	4-20 mA	no connection

Install a jumper between xIN and xJ terminals. Extension cable: 3-conductor with shield, 20 AWG (Belden 9364) or equivalent.

\*NOTE: A maximum of two Thornton PFA vortex sensors may be powered from a single 200FLOW instrument.

### **Discrete Input Connections**

The 200FLOW meter is equipped with a digital Input/Output line, which is used for multiplexing analog outputs (See Chapter 8: Using Analog Outputs) or resetting totalized flow (See Chapter 5: Using Setpoints). This control line is located on terminal block TB3 and is labeled "I/O (14)". This line can accept dry contacts or TTL/CMOS logic levels. It is pulled-up to +5 volts through a 10 Kohm resistor. This line should not be connected to any other power supply and should only be switched to circuit ground, terminal "GND (13)" at the 200FLOW. A diagnostic menu is available to test and display the state of this line.



## CHAPTER 3: USING THE 200FLOW

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### APPLYING POWER TO THE 200FLOW

After applying power to the meter, the display will show an introduction message for three seconds and then begin making measurements. This message shows the model number and the software version number as follows:

67XX FLOW VX.X

While the message is being displayed the instrument is performing self diagnostics. Various circuits are tested during this process and any failure will be noted with a message. The diagnostics can be repeated at any time via the menus.

The default measurement display is the flow reading from the cells on channel A and B as shown below:

A0.00GM B0.00GM

All 200FLOW meters are calibrated from the factory. The meter can be recalibrated or the calibration verified from the menus. See Chapter 9: Meter Calibration for more information on meter calibration.

### THE DISPLAY

The 200FLOW uses a 1 line by 16 character alphanumeric display to convey all measurement and setup information. This instrument will display one or two measurements, each with channel indication and unit of measure. A typical display of measurement data is:

A35.6GM B21.9GM

This display indicates that channel A is measuring 35.6 GPM and channel B is measuring 21.9 GPM. The display of the other measurements can be achieved by pressing the UP or DOWN keys.

In the menus, an underline cursor and flashing characters will indicate a field that can be changed. A typical menu appears as follows:

SP1=17.00 \_High

This menu indicates that setpoint #1 is programmed at a value of 17.00 and is set as a high limit. The cursor is under the digit “7” indicating that the UP and DOWN keys can be used to change it. The LEFT and RIGHT keys will move the cursor to the next or previous field.

### Display Contrast Adjustment

The contrast quality of the display can change with ambient temperature and lighting conditions. The display contrast is adjusted from the factory for operation at standard room temperature (25°C). If the meter is operated at an ambient temperature that is much different then it may be necessary to make an adjustment. A potentiometer is accessible from the back side of the instrument to change the contrast. Use a small slotted screwdriver to gently turn the potentiometer. A counter-clockwise turn will increase the contrast and a clock-wise turn will decrease the contrast. The rear panel is shown in Figure 3.1.

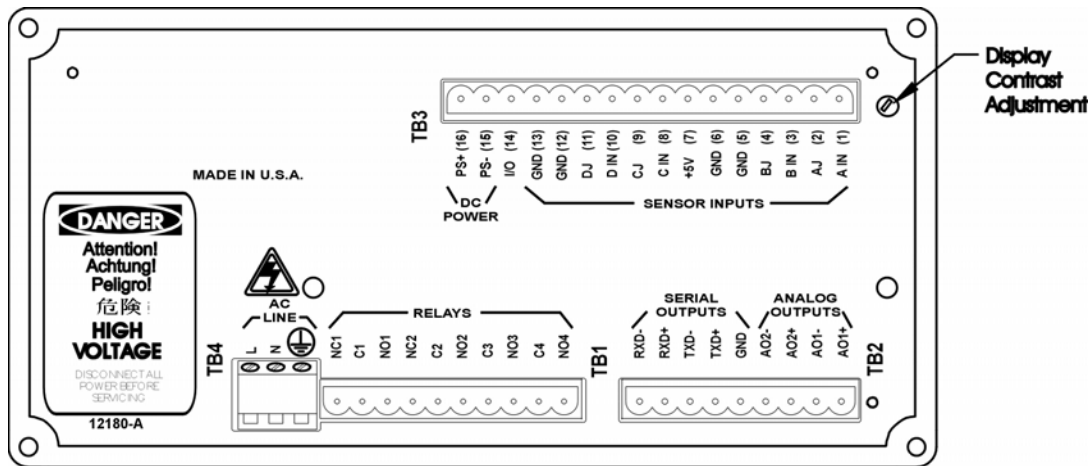


Figure 3.1: 200FLOW Rear Panel

## THE KEYPAD

The 200FLOW is equipped with an 11-key keypad as shown in Figure 3.2.

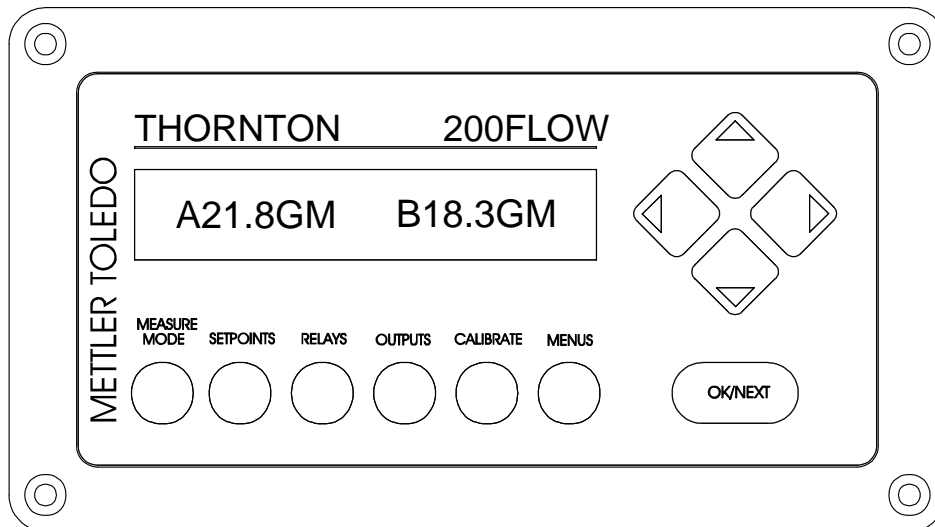


Figure 3.2: 200FLOW Front Panel

The keypad has 6 keys that provide direct access to specific menus as follows:

1. **MEASURE** - menus to change measurement modes of each channel.
2. **SETPOINTS** - menus for programming setpoints.
3. **RELAYS** - menus for programming relays.
4. **OUTPUTS** - menus for programming outputs.
5. **CALIBRATE** - menus to perform calibration.
6. **MENUS** - all other menus (Sensor constants, security, averaging, etc.).

The other keys are referred to as control keys and are used to make changes within a menu.

1. **OK/NEXT** Key - used to accept a selection and proceed to the next menu level.
2. **UP** Key - up arrow is used to scroll up through a list of options.
3. **DOWN** Key - down arrow is used to scroll down through a list of options.
4. **LEFT** Key - left arrow is used to move the cursor to the left within a menu.
5. **RIGHT** Key - right arrow is used to move the cursor to the right within a menu.

## USING THE MENUS

There are six menu keys across the bottom of the 200FLOW front panel. The first five of these keys (MEASURE, SETPOINTS, RELAYS, OUTPUTS, and CALIBRATION) are used to enter specific menus. These menus allow the modification of parameters most frequently used by the operator. The sixth key labeled MENUS allows access to all other menus for various functions such as setting security levels, offline diagnostics, etc.

The UP and DOWN arrow keys scroll vertically through the menus. Part or all of the display changes to the next option whenever an UP or DOWN arrow key is pressed. A field is defined as a section of the display that can be changed. The characters of the field will also blink. The LEFT and RIGHT arrow keys move the underline cursor across the display from one field to the next. Pressing the

OK/NEXT arrow key causes the instrument to accept the options that are displayed and move to the next menu.

Numbers are set one digit at a time using the arrow keys. The LEFT and RIGHT arrow keys are used to position the underline cursor below the digit to be changed. The UP and DOWN arrow keys are then used to change the value of the digit. Each digit can be scrolled through the values: .(decimal point), 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 The first digit of any number can also be set to a negative sign (-).

To exit the menu either scroll completely through a set of menus with the OK/NEXT key or press any of the six menu keys at any time. The meter will display a prompt asking if the recent changes should be saved.

Save Changes Yes

To save the changes press the OK/NEXT key with “Yes” on the display. To discard the changes use the UP or DOWN arrow keys to change “Yes” to “No”, then press the OK/NEXT arrow key.

If the instrument is displaying a menu and a key is not pressed for two minutes, the instrument will automatically exit the menus without saving any changes. When performing a calibration the operator may need to wait for a measurement to stabilize so the menu time out feature will automatically be disabled.

### Menu Example

Press the MEASURE key and the display will show:

A=GPM ( )

This menu indicates that the Channel A primary measurement is set for flow rate (GPM). The section “**GPM**” is the field to be changed and will be flashed as long as the cursor is under it. Pressing the UP arrow key will change the “**GPM**” to “**Gal (Auto)**”. The RIGHT arrow key will move the cursor to the “**(AUTO)**” field. AUTO indicates auto-ranging

to K Gal or M Gal, as required for displaying large totalized flow values.

The OK/NEXT key is used to accept the entry and move to the next menu. When the last menu level is reached the following message is displayed:

Save Changes Yes

Pressing the OK/NEXT key will save the changes and exit the menus. The UP and DOWN arrow keys can be used to change the “Yes” to “No”. Pressing the OK/NEXT key with “No” will discard the changes and exit the menus.

## INSTALLING A SENSOR

Each flow sensor has a calibration constant (s) that must be programmed into the meter for proper operation. These constants are listed in the sensor manual or calibration certificate for the particular flow sensor and pipe size. See Chapter 10: Sensor Calibration for entry of the constant(s).

## MEASUREMENT DESIGNATIONS

The 200FLOW instrument will measure four flow rates. The 200FLOW can process and display eight calculated measurements. Each channel has a primary measurement and a secondary measurement. A variety of computations can be assigned to these measurements. These measurements are designated by a single letter as follows:

A = channel A primary measurement  
a = channel A secondary measurement

B = channel B primary measurement  
b = channel B secondary measurement

C = channel C primary measurement  
c = channel C secondary measurement

D = channel D primary measurement  
d = channel D secondary measurement

Note the upper case letters are used to indicate the primary measurements and lower case letters are used to indicate the secondary measurements.

Each of the eight calculated measurements can be one of the following:

1. Gallons/minute
2. Total Gallons
3. Cubic-meters/hour
4. Total cubic meters
5. Liters/minute
6. Total liters
7. Feet/second
8. Hertz
9. %Recovery

It should be noted that even if totalized flow is not selected as a displayed measurement, it may be viewed momentarily via the MENUS key.

## DISPLAYING MEASUREMENTS

### Changing the Display of Measurements

The 200FLOW's display can show either one or two measurements at a time. The display of measurements can be changed by using the UP or DOWN arrow keys. Pressing one of these keys will cause the meter to change the display mode (show an alternative set of data).

The display modes for two measurements per line are:

- |          |                           |
|----------|---------------------------|
| Mode #1: | A primary and B primary   |
| Mode #2: | C primary and D primary   |
| Mode #3: | A primary and A secondary |
| Mode #4: | B primary and B secondary |
| Mode #5: | C primary and C secondary |
| Mode #6: | D primary and D secondary |

Note that when two measurements from the same channel are displayed, the secondary measurement indicator ( a or b ) is not displayed. This allows for greater precision in the display of the primary measurement.

The default display setting (after a system reset) is mode #1 (A Primary & B Primary).

The display modes for one measurement per line are:

- |          |             |
|----------|-------------|
| Mode #1: | A Primary   |
| Mode #2: | B Primary   |
| Mode #3: | C Primary   |
| Mode #4: | D Primary   |
| Mode #5: | A Secondary |
| Mode #6: | B Secondary |

Mode #7: C Secondary  
Mode #8: D Secondary

Note: When displaying 2-measurements per line, only 3 or 4 significant digits of resolution will be displayed. Changing the display to 1-measurement per line will allow up to 7 significant digits to be displayed.

### Setting the Number of Measurements per Display Line

The 200FLOW can be set to display either one or two measurements per line.

To change this feature:

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until "Display Menu" is displayed.

Display Menu

Press the OK/NEXT key to access this menu. Use the Up or DOWN keys to toggle the field until "Disp Format" appears. Press OK/NEXT to access this menu.

Set: Disp Format

Use the UP and DOWN keys to toggle the field between "1" and "2".

Measure per Line = 1

Press OK/NEXT when done. The meter will ask if changes should be saved.

Save Changes Yes

Press OK/NEXT key to save the changes and return to the display of measurement data.

### Measurement Display Scrolling

The 200FLOW has an automatic display scrolling feature for measurement data. With

this feature enabled, the display will show a mode for 5 seconds, then cycle to the next mode automatically. This cycling is repeated indefinitely.

To enable or disable this feature:

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until "Display Menu" is displayed.

Press the OK/NEXT key to access this menu.

Display Menu

Use the Up or Down arrow keys to toggle the field until "Auto Scroll" appears. Press OK/NEXT to access this menu.

Set: Auto Scroll

Use the UP or DOWN arrow keys to toggle the field from "Off" to "On". Press the OK/NEXT key when done. The meter will ask if changes should be saved.

Auto Scroll = off

Press the OK/NEXT key to save the changes and return to the display of measurement data.

Save Changes Yes

### ALARM INDICATIONS

A setpoint can be programmed as either a high limit or low limit. When a measurement is higher than a high point (or lower than a low point) then the setpoint is considered to be in an alarm state. This condition is indicated by flashing the corresponding measurement value on the display.

# CHAPTER 4: MAKING MEASUREMENTS

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## MEASUREMENT PROCESS

The 200FLOW will process eight measurements from each of the four channels. The measurements of each channel are referred to as the primary and the secondary measurement. The instrument will process a total of eight different measurements per cycle.

Measurements are designated as follows:

- A = channel A primary measurement
- a = channel A secondary measurement
- B = channel B primary measurement
- b = channel B secondary measurement
- C = channel C primary measurement
- c = channel C secondary measurement
- D = channel D primary measurement
- d = channel D secondary measurement

Note that upper case letters are used to indicate the primary measurements and lower case letters are used to indicate the secondary measurements.

## MEASUREMENT TYPES

Each of the four measurements (channel A primary, etc.) can be programmed as one of the following

1. Gallons/minute
2. Total Gallons
3. Cubic-meters/hour
4. Total cubic meters
5. Liters/minute
6. Total liters
7. Feet/second
8. Hertz
9. %Recovery

### Flow Rates

The flow rate units are gallons/minute (GPM), cubic meters/hour (m3hr), and liters/minute (L/m).

Flow rate is computed by:

$$\text{GPM} = (\text{Frequency} \times 60 / \text{Multiplier}) + \text{Adder}$$

### Total Flow

The totalized flow units are gallons (Gal), cubic meters (m3), and liters (Litr). The meter will measure up to 100 M Gallons. The totalized flow measurement for each channel is always measured and updated, regardless of the measurement modes selected for the channel.

Total flow readings can be cleared via the menus, (see end of this chapter), the RS232/RS422 interface, or by an external control signal (See Chapter 2: Installing the 200FLOW and Chapter 5: Using Setpoints).

The totalized flow measurement can be viewed with more precision via the menus. Press the MENUS key and the following menu will appear:

Menus use arrows

Press the Up arrow key until the "View Total Flow" menu appears.

View Total Flow

Press the OK/NEXT key to access the next menu.

View Total on A

Select the desired channel by using the UP/DOWN arrow keys. Press the OK/NEXT key to access the next menu.

A: 1.108593 Kgal

The total flow measurement will be displayed with 7 digits and a decimal point. Pressing the RIGHT/LEFT arrow keys will update the reading on the display. Pressing the UP/DOWN arrow keys will change the channel.

Reset of totalized flow via the MENUS key is accomplished as follows. Press MENUS and press the UP arrow key until "Reset Total Flow" is displayed. Press OK/NEXT and se-

lect the channel to be reset. Press OK/NEXT to display “Reset Ch X: No? Use the UP arrow key to select “Yes” and press OK/NEXT twice to execute the reset.

## Flow Velocity

Flow velocity can be measured in feet/second (ft/s). To allow the 200FLOW meter to perform this measurement, the exact inside pipe diameter must be entered via the menus (the measurement must also be set for ft/s).

To set the pipe inside diameter, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the “Set Pipe ID” menu appears.

Set Pipe ID

Press the OK/NEXT key to access the next menu.

A: Pipe ID = 0.000"

Use the arrow keys to adjust the number as desired. This number is entered with units of inches. Press the OK/NEXT key to save this value and move on to channel B. Repeat the process until done.

## % Recovery for Reverse Osmosis

Percent Recovery is the ratio of pure water output to feedwater input through a Reverse osmosis membrane. This is done to help balance the flow of liquid through the membrane. Flow sensors are installed in the product and reject stream from the membrane. The 200FLOW will perform the calculations required to indicate percent recovery. Two flow sensors must be connected to a 200FLOW to achieve a percent recovery measurement.

The formula for obtaining Percent Rejection is:

$$[\text{Product} / (\text{Product} + \text{Reject})] \times 100 = \% \text{Rej}$$

The Product sensor must be installed on the Channel measuring % recovery.

See the schematic diagram below of an RO installation with sensors installed for Percent Recovery:

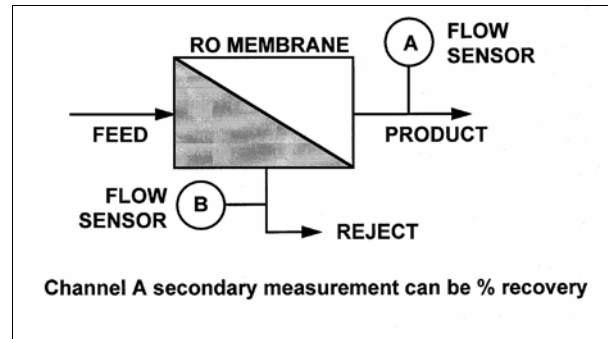


Figure 4.1: Percent Recovery

**IMPORTANT:** If the product flow sensor is installed in channel A, then percent recovery must be measured in channel A and reject flow must be measured in channel B. Likewise, if the product sensor is installed in channel C then the percent recovery measurement must also be programmed in channel C and reject flow must be measured in channel D.

## Flow Difference

The difference in flowrate between two channels may be selected as a measurement. These are selected as A-B, B-A, C-D, and D-C, depending on the channel.

## Flow Sum

The addition of two flow channels may be selected as a measurement. Within the Measurement Mode, these are selected as A+B, B+A or C+D, D+C, depending on the channel. Please note that the units for each measurement must be set to the same units (i.e. Channel A= GPM, Channel B= GPM)

## SELECTING A MEASUREMENT TYPE

To set or change a measurement type for each of the eight measurements:

Press the MEASURE key and the display will show the measurement type assigned to channel A primary. The display may appear as:

A = GPM ( )

This menu indicates that channel A primary measurement is set for gallons/minute (GPM). The section “**GPM**” is the first field to be changed and will be flashed as long as the cursor is under it. Pressing the UP arrow key will change the “**GPM**” to “**Gal**”.

A = Gal (Auto)

Use the UP and DOWN arrow keys to select the desired measurement type.

The field on the right half side of the display is the range field. Some measurements can be set for a fixed range, others can be set only for auto ranging. For example, frequency (Hz) can be set for units, kilo, or auto ranging. To change the field, use the RIGHT arrow key to move the cursor under “(Auto)”. Use the UP and DOWN arrow keys to select the desired range.

The OK/NEXT key is used to accept the entry for channel A primary and move to the next menu for setting channel “a” secondary. Press the OK/NEXT key again to set the measurement types for channels B, C, and D respectively.

When the last menu level is reached (after setting channel “d” secondary), the following message is displayed:

Save Changes Yes

Pressing the OK/NEXT key will save the changes and exit the menus. The UP and DOWN arrow keys can be used to change the “Yes” to “No”. Pressing the OK/NEXT key with “No” will discard the changes and exit the menus.



# CHAPTER 5: USING SETPOINTS

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## OVERVIEW

A setpoint is a limit or alarming condition applied to a measurement. A setpoint can be programmed as either a high limit or a low limit. When the measurement value is higher than a high setpoint, or lower than a low setpoint, a setpoint alarm condition exists. The meter will indicate this condition by blinking the measurement on the display. The 200FLOW can also be programmed to control a relay upon this alarm condition. Refer to **Chapter 6: Using Relays** for more information on relays.

Eight setpoints are available and can be assigned to any of the eight measurements (A, a, B, b, C, c, D, d). More than one setpoint can be assigned to the same measurement and more than one setpoint can activate a relay.

The following parameters can be programmed for setpoint operation:

1. The assigned signal: which signal (A, a, B, etc.) is monitored by the setpoint.
2. The setpoint value: the measurement value that triggers the setpoint alarm condition.
3. The setpoint type: High, Low or Off
4. The assigned relay: which relay will be controlled when a setpoint alarm occurs (this is optional).

## SETPOINT SIGNAL

The setpoint signal is the measurement that will be monitored by the setpoint. The signal can be either:

1. A - Channel A primary
2. a - Channel a secondary
3. B - Channel B primary
4. b - Channel b secondary
5. C - Channel C primary
6. c - Channel c secondary
7. D - Channel D primary
8. d - Channel d secondary

## SETPOINT VALUE

The setpoint value is the limit that will trigger a setpoint alarm condition. This number is entered as a four digit number with a multiplier. The multipliers are:

“-” (blank) = multiply value by 1

“K” (kilo) = multiply value by 1,000 ( $10^3$ ).

“M” (Mega) = multiply value by 1,000,000 ( $10^6$ ).

For example, a setpoint value of 1.000M is equivalent to 1,000,000.

## SETPOINT TYPE

The setpoint type can be “High”, “Low”, or “Off”. A setpoint alarm condition is true when the measurement is above the high limit or below the low limit.

## ASSIGNED RELAY

The assigned relay will change state according to the setpoint condition. When a setpoint alarm condition exists, the assigned relay will change state. If the relay is normally closed, then it will be opened.

**Default settings after a system reset:** Setpoints are disabled, no signals assigned, no relays assigned and values are zero.

## PROGRAMMING A SETPOINT

Press the SETPOINT key to access the first setpoint menu. This menu is used to assign a measurement to each of the eight setpoints.

SP1 on signal: A

The cursor is under the setpoint number field. Use the UP and DOWN arrow keys to select the desired setpoint number (1 to 8). Use the RIGHT arrow key to move the cursor to the signal field. Then use the UP and DOWN arrow keys to select the desired signal. The signal can be set to “-” which indicates that

the setpoint is not assigned to a signal (disabled).

To change the assigned signal of another setpoint, move the cursor back to the setpoint number. Change the setpoint number, then move the cursor back to the assigned signal field.

SP1 = .0000 \_off

Press the OK/NEXT key when done to proceed to the next menu.

Set the desired value and multiplier.

Examples of numerical entries:

Desired Value	Menu Entry
10.34	10.34_
1,456	1.456K
18,180,000	18.18M
567,456	567.5K

Move the cursor right to the setpoint state field. To turn the setpoint on, select either High or Low. Press the OK/NEXT key when done to proceed to the next menu.

The next menu is used to assign a relay to the setpoint. This is optional. The menu will appear as:

SP1 use Relay #\_

After selecting the desired setpoint number, move the cursor to the relay field. The choices are: 1-4 (if equipped with the 4 relay option) and “\_”. The “\_” indicates that there are not any relays assigned to the setpoint.

Press the OK/NEXT key when done. The meter will ask if changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display of measurement data.

Example: Setup a Setpoint

Program setpoint #2 with the following conditions:

1. Assigned to channel A secondary signal (“a”).
  2. A value of 100
  3. Set as a high limit
  4. Use relay #2
- Press the SETPOINT key

Use the arrow keys to select setpoint #2 and signal “a”. The display will appear as follows:

SP2 on signal: a

Press the OK/NEXT key:

Use the arrow keys to set the value at 100 and the state to high. The display will appear as follows:

SP2 = 100.0 \_ High

Press the OK/NEXT key:

Use the arrow keys to set the relay number to 2. The display will appear as follows:

SP2 Use Relay #2

Press the OK/NEXT key.

Save Changes Yes

Press the OK/NEXT key again to save the changes and return to the display of measurement data.

## USING A SETPOINT TO ENABLE REMOTE RESET OF TOTALIZED FLOW

A setpoint can be used to enable reset of totalized flow above a specified value. The I/O line is used as a signal to perform the reset. When the total flow value exceeds the setpoint and the I/O line is switched to a low value (0 volts to GND or shorted) then the totalized flow on that channel (and any other channel exceeding its respective setpoint) will be reset to zero. To use this feature, the External Flow “reset” must be enabled from the menus. The I/O line must be held low for

at least 0.5 seconds to perform the reset. To enable the external total flow reset feature, press the MENUS key and the following menu will appear:

Menus Use arrows

Press the UP arrow key until the “Other Options” menu appears.

Other Options

Press the OK/NEXT key to access the next menu.

Set: Mux Analog

Use the UP/DOWN arrow keys to select “Total Reset”.

Total Reset: **Dis**

Use the UP/DOWN arrow key to either enable (En) or disable (Dis) the external flow reset feature. Press the OK/NEXT key when done to exit the menus.

# CHAPTER 6: USING RELAYS

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## DESCRIPTION

The 200FLOW is equipped with up to four relays. Each relay can be programmed to activate when a setpoint is exceeded (defined as a setpoint error condition). The programmable parameters for a relay are:

1. Delay Time: up to 999 seconds
2. Hysteresis Value: up to 99%
3. State: relay operation can be normal or inverted

## ELECTRICAL CONNECTIONS

For relays 1 and 2, each has a common connection, a normally open connection and a normally closed connection. The 3rd and 4th relays, if included have only a common connection and a normally open connection as shown in Table 2.1.

## DELAY TIME

Delay time is the length of time that the setpoint must be exceeded continuously (in a setpoint alarm condition) before activating the relay. When the setpoint alarm condition occurs, the delay timer is started. If during the delay time the setpoint error condition no longer exists, the delay timer is reset and the relay will not be activated. The maximum delay time is 999 seconds (16 minutes and 39 seconds).

## HYSTERESIS

The hysteresis value is entered as a percentage of the setpoint value. For a high setpoint, the measurement must fall more than this percentage below the setpoint value before the relay is deactivated. With a low setpoint, the measurement must rise at least this percentage above the setpoint value before the relay is deactivated.

For example: a high setpoint is set at 100 and the measurement is currently above this value so the setpoint alarm condition exists. If the hysteresis value is 10% then the meas-

urement must fall below 90 before the relay is deactivated.

## RELAY STATE

The relay can be programmed for normal or inverted operation. When the relay is in the inverted state, the relay operation is reversed. When there is no setpoint error condition the relay is activated. The normally open contacts are closed.

Default settings after the system reset:

1. Relay is disabled.
2. Delay is 0 seconds.
3. Hysteresis is 0%
4. Relay state is normal

## PROGRAMMING A RELAY

To enable or modify a relay:

Press the RELAYS key. The first relay menu is used to set the delay time.

R<sub>1</sub> Delay = 000 sec

In this menu, the cursor is initially under the relay number. Use the UP and DOWN arrow keys to select the desired relay number (1 to 4). Use the RIGHT arrow key to move the cursor to the delay time field. Then use the UP and DOWN arrow keys to set the delay time (000 to 999 seconds).

To change the delay time of another relay, move the cursor back to the relay number. Change the relay number, then move the cursor back to the relay time field.

Press the OK/NEXT key when done to proceed to the next menu.

R<sub>1</sub> Hyster = 00%

Select the desired relay number then move the cursor to the hysteresis value field. Enter the hysteresis value (00 to 99%).

Press the OK/NEXT key when done to proceed to the next menu.

R1 State = Normal

Select the desired relay number, then move the cursor to the relay state field. Use the DOWN arrow key to select either Normal or Invert. Press the OK/NEXT key when done. The meter will ask if changes should be saved.

Press the OK/NEXT key to save the changes and return to the display of measurement data.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display of measurement data.

### Example: Setup a Relay

Program relay #2 with the following conditions:

1. Delay of 60 seconds.
2. A hysteresis of 10%.
3. Inverted state.

Press the RELAYS key.

Use the arrow keys to select relay #2 and set a delay time of "060". The display will appear as follows:

R2 Delay =060 sec

Press the OK/NEXT key.

Use the arrow keys to set the hysteresis value to "10%". The display will appear as follows:

R2 Hyster = 10%

Press the OK/NEXT key.

Use the arrow keys to set the state to inverted. The display will appear as follows:

R2 State = Invert

Press the OK/NEXT key. The meter will now ask if changes should be saved.

Save Changes Yes

## **CHAPTER 7: COMMUNICATIONS (RS232/RS422)**

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The content of this chapter is now available in 200FLOW Communications Manual #84421.

# CHAPTER 8: USING ANALOG OUTPUTS

## DESCRIPTION

An analog output is a current signal that is proportional to a measurement. The

200FLOW's analog outputs have a minimum value of 4mA and a maximum value of 20mA. Each output can be scaled to a range of a measurement signal. If specified, there are two analog circuits, each of which can be multiplexed between two measurements to give a total of four measurement outputs. The output circuit(s) can be recalibrated for 0-20 mA if desired. See **Analog Output Calibration** later in this chapter.

To use analog outputs, the following parameters must be programmed:

1. Assigned Signal - The analog output will be proportional to the value of the assigned signal. Any of the four measurements (A, a B, b) can be assigned to the output.
2. Minimum Value - This is the measurement reading that will correspond to an output of 4mA.
3. Maximum Value - This is the measurement reading that will correspond to an output of 20mA.

The analog outputs can be scaled for their minimum and maximum values. This programming process is independent from any measurement. See **Electrical Connections** for details.

## MULTIPLEXED ANALOG OUTPUTS

The multiplexed analog output feature of the 200FLOW meter allows a total of four analog output signals to be shared on the two output circuits. Analog output #3 is shared with output #1 and analog output #4 is shared with output #2. Control of the output signals is done via the I/O line located at the rear panel on terminal block TB3. With the multiplexed analog output feature enabled from the menus, setting the I/O line high (+5 volts, open circuit) will direct analog outputs 1 and 2 to be transmitted from terminal block TB2.

Setting the I/O line low (0 volts, I/O shorted to ground) will direct outputs 3 and 4 to be transmitted from terminal block TB2. See Table 8.1

	Output Circuits	
I/O-GND Terminals	Terminals A01	Terminals A02
Open, +5V	Output 1	Output 2
Closed, 0V	Output 3	Output 4

**Table 8.1: I/O Control of Analog Output Multiplexing**

Note: When switching the analog output signals a few seconds may be required for the current level to stabilize.

To enable the multiplexed analog output feature, press the MENUS key and the following menu will appear:

Menus Use arrows

Press the UP arrow key until the "Other Options" menu appears:

Other Options

Press the OK/NEXT key to access the next menu.

Set: Mux Analog

Press OK/NEXT.

Muxed analog Off

Use the UP/Down arrow keys to either enable ("ON") or disable ("OFF") the multiplexed analog output feature.

Press OK/NEXT. Leave the totalization reset function disabled when using multiplexed outputs.

## ELECTRICAL CONNECTIONS

Connections to the analog output signals are made at terminal block TB2. Each analog output circuit has a signal line (labeled AO1+ or AO2+) and a (-) return line (labeled A01- or A02-). Table 2.4 shows the electrical connections.

The analog outputs are isolated from line power, sensors and earth ground. Each analog output channel can drive a resistive load up to 500 ohms.

When using multiplexed analog outputs, the I/O line can be controlled with a TTL logic level or a mechanical switch connected to ground, terminals "I/O (14)" and "GND (13)".

## PROGRAMMING THE ANALOG OUTPUTS

To setup an analog output channel, press the OUTPUTS key:

Output: Analog

Press the OK/NEXT key to access this menu. The next menu is used to assign a measurement signal to the output. The choices are: A, a, B, b, C, c, D, d, and \_. The selection of "\_" is used to disable the output by not assigning a signal to the output. The output will remain at 4mA when it is disabled. The menu may appear as:

Aout1 signal = A

In this menu the cursor is initially under the output number. Use the UP or DOWN keys to select the desired output number ( 1 or 2). Press the RIGHT arrow key to move the cursor under the assignment field.

Aout1 signal = A

Use the UP or DOWN arrow keys to change the assigned measurement. Press the OK/NEXT key to accept it and proceed to the next menu.

Aout1 Min = 0.000\_

This menu is used to set the measurement value that will correspond to a 4mA output. Press the RIGHT arrow key to move the cursor under the number field and set the desired value. The last position in this menu is the multiplier which can be one of the following:

"\_" (blank) = multiply value by 1.

"**K**" (kilo) = multiply value by 1,000 ( $10^3$ )

"**M**" (Mega = multiply value by 1,000,000 ( $10^6$ ))

After setting the desired value, press the OK/NEXT key to accept minimum value and proceed to the next menu.

Aout1 Max=0.000

This menu is used to set the measurement value that will correspond to an output of 20mA. Repeat the process as described above. Press the OK/NEXT key to accept the maximum value and proceed to the next menu.

1: If err set Max

Using an arrow key, select max or min as the fail safe mode for the output signal on over-range or failure conditions. The output will go to 20mA if set for max; to 4mA (or 0mA if recalibrated) if set for min. The meter will ask if changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display of measurement data.

### Example: Setup an Analog Output

Set analog output #2 with the following parameters:

1. Assigned to channel B primary measurement
2. Minimum value of 1.000 GPM
3. Maximum value of 20.00 GPM

Press the OUTPUTS key. The display will show:



Output: Analog

Press the OK/NEXT key.

Use the arrow keys to select analog output #2 and assign measurement B to this output. The display will appear as follows:

Aout2 signal = B

Press the OK/NEXT key.

Use the arrow keys to set the minimum value to 1.000 GPM. The display will appear as follows:

Aout2 Min=1.000\_

Press the OK/NEXT key.

Use the arrow keys to set the maximum value to 20.00 GPM. The display will appear as follows:

Aout2 Max=20.00\_

Press the OK/NEXT key.

Save Changes Yes

Press the OK/NEXT key to save changes and return the display of measurement data

To multiplex the two analog output circuits to represent four outputs, See **Multiplexed Analog Outputs** earlier in this chapter.

## ANALOG OUTPUT CALIBRATION

The analog output signals can be calibrated to achieve the highest level of accuracy. This is a two step process where 4mA and 20mA levels are adjusted. A current meter is connected in series with the output. The arrow keys are then used to adjust the current output for the appropriate level (4mA, then 20mA). To obtain 0-16 or 0-20 mA signals, follow the procedure but adjust for the desired current range.

For NIST traceability, the outputs can be calibrated with NIST calibrated current meter.

Procedure: Connect the current meter in series with the output signal.

Press the CAL key and the display will show:

Calibrate Sensor

Use the UP and DOWN keys to change the display until the "Analog" option is displayed:

Calibrate Analog

Press the OK/NEXT key to proceed to the next menu.

Cal Analog Ch1

Use the UP and DOWN keys to select the desired output channel number (1 or 2). Press the OK/NEXT key to proceed to the next menu. Use the left arrow key to move the cursor to the middle digit.

1:Adj 4mA=XXXXX

Use the UP and DOWN keys to adjust the output current for a 4mA level (as measured by the current meter). The number displayed is an arbitrary value proportional to the analog output signal, near 10,000 for 4 mA and near 55,000 for 20 mA. Adjusting a more significant digit of this number will change the output signal level faster. Adjust a less significant digit for closer resolution.

Press the OK/NEXT key when done adjusting the 4mA. The next menu is for adjusting the 20mA output.

1:Adj 20mA=XXXXX

Adjust the 20mA level in a similar manner. Press the OK/NEXT key when done adjusting the 20mA. The meter will ask if changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display measurement data.

# CHAPTER 9: METER CALIBRATION

---

## OVERVIEW

The 200FLOW meter is factory calibrated within specifications. It is not normally necessary to perform meter re-calibration unless an out of spec operation is shown by Calibration Verification (see **Calibration Procedure** below). Periodic verification/re-calibration may also be necessary to meet Q.A. requirements. The 200FLOW meter is re-calibrated by installing a known frequency signal in place of the sensor and using the calibration menus to complete the process. A meter calibration will adjust the measurements for any tolerances in the crystal and therefore it is necessary to perform the calibration on only one channel. Verification of calibration can be performed on each channel to confirm proper operation.

## CALIBRATION EQUIPMENT

To perform a meter calibration, a frequency generator is needed with the following specifications.

1. Output: square wave 0 to 5 volts.
2. Rise/Fall time <50nsec.
3. Duty cycle 50%
4. Frequency Value: 1000 Hz.
5. Accuracy: <30 ppm (0.0030%).

The recommended calibration value is 1000 Hz (1KHz).

## CALIBRATION PROCEDURE

### Step 1: Select the Meter Calibration

Press the CALIBRATE key and the display will show:

**Calibrate Sensor**

Use the UP and DOWN keys to change the display until it reads:

**Calibrate Meter**

Press the OK/NEXT key to proceed to the next menu.

### Step 2: Select the channel

**Cal Meter Ch A**

Use the UP and DOWN keys to select channel B if desired. Press the OK/NEXT key to proceed to the next menu.

**A Freq = 100.00\_**

### Step 3: Enter the calibration value

This menu is used to enter the value of the calibration signal. Use the UP and DOWN keys to change the digit. Use the RIGHT and LEFT arrow keys to move the cursor to the next digit. The last character on the display is the multiplier, which should be \_.

**A Freq = 1000.00\_**

When the value of the calibration is entered, press the OK/NEXT key when ready to proceed to the next menu.

Step 4: Connect the calibration signal on the selected channel. For example, A IN and GND terminals:

**A = XXXX.XX Hz Ok?**

The instrument will display the value of the calibration signal as measured by the meter. The reading may fluctuate slightly but the changes should be no more than + 1 digit (least significant). For example, may fluctuate from 1000.00 to 1000.01 Hz. It is recommended that you wait at least 1 minute to be certain that the measurement has settled.

To discontinue the calibration, press any of the menu keys. To proceed with the calibration process (after the readings have stabilized), press the OK/NEXT key.

### Step 5: Perform the calibration

The calibration procedure may take a few seconds to complete. When the instrument is done, the following message will be displayed.

Done, press Ok\_

The meter will ask to perform a 2nd point calibration. For a meter calibration, the 2nd point is not necessary. Select “N” and press the OK/Next key.

Press the OK/NEXT key. The meter will ask if the changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display of measurement data.

## **CALIBRATION VERIFICATION**

The calibration verification menu can be used to quickly confirm the meter’s performance. A calibration or verification device is installed on a channel and this menu is used to display the actual frequency value of the signal input. The verification menu can be found in two locations, either in the calibrate menu or under the menus option. When using the calibrate menu, press the CALIBRATE key, then select “verify calibration”. This option is included on two separate menu trees to allow the calibration menu to be locked yet still allow operators to verify calibrations.

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the DOWN arrow key until the “Verify Calibrate” menu is displayed.

Verify Calibrate

Press the OK/NEXT key to access this menu.

Verify Cal: Ch A

Use the UP arrow key to select the desired channel. Press the OK/NEXT key when set. The meter will now display the actual values of the calibrator. A typical display may appear as:

A: XXXX.XX Hz

# CHAPTER 10: SENSOR CALIBRATION

---

## OVERVIEW

Best performance is normally obtained by entering the factory-documented cell constants per **Enter/Editing Cell Constants** later in this chapter. However, if the sensor's performance is not acceptable then it can be calibrated. It is important to ensure that the meter is properly calibrated and a very accurate standard is available before performing a sensor calibration.

Sensors can be calibrated with either a one-point or two-point calibration process. With a two-point process, the sensor must be run at two flow rates. Under most circumstances only a 1 point calibration process is needed.

The flow rate must be known with high accuracy before the sensor can be calibrated. The process is done by entering the known value into the meter and instructing the meter to perform a calibration.

When a one-point calibration process is performed, the meter will compute a new sensor multiplier factor. With a two-point process, the meter will compute a new multiplier and additive factor.

## CALIBRATION PROCEDURE

Press the CALIBRATE key and the display will show:

Calibrate Sensor

Press the OK/NEXT key to proceed to the next menu.

Cal Sensor Ch A

Use the UP arrow key to select the desired channel. Press the OK/NEXT key when set.

Cal Ch A #1:GPM

Use the UP arrow key to select the units of measurement to be calibrated. The choices

are GPM (gallons/minute), mh (cubic meters/hour), or Lm (liters/minute).

The next menu will allow the known value of the flow rate to be entered.

A GPM = 100.00\_

Enter the known value. Press the OK/NEXT key when done.

The meter will now display the reading of the signal to be calibrated. For example, a typical display for calibrating flow may appear as:

A = XX.XX GM Ok?

When the reading has stabilized, press the OK/NEXT key to perform the calibration. The calibration process may take a few seconds to complete. The meter may display the following message:

Please Wait...

When the instrument is done, the following message will be displayed:

Done, press Ok\_

Press the OK/NEXT key. The meter will display the menu for performing the second calibration point.

Do point #2 No

If doing a two-point calibration, then use the UP key to change the "No" to "Yes". Press the OK/NEXT key to perform the 2nd calibration point or to exit the menus.

Save Changes Yes

Press OK/NEXT key to save changes and resume measurement.

## ENTERING/EDITING CELL CONSTANTS

Upon the installation of a sensor, the cell constants must be entered into the meter. The same menu is also used to edit the constants.

If a certificate of calibration with multiple point linearization data is provided (typical of vortex and turbine sensors), see **Multipoint Linearization Data Entry** later in this chapter; otherwise continue below. Some flow sensors use only the multiplier factor (also called “K” factor). In these cases, the adder factor is left at zero. The 200FLOW accepts flow sensor constants only in units of pulses/gallon (even if readout will be in liters/min or other units). Adder factors, if used, must be in units of GPM.

Asahi, Burkert, Hoffer, Signet, EG&G, and Blue-White flow sensors typically use a K factor in the correct units, which can be entered directly into the 200FLOW as the Multiplier. Leave the Adder set to zero for these sensors.

Data Industrial, GLI and Proteus sensors provide a K value in units of GPM/Hz and Offset in units of Hz. To convert these for entry into the 200FLOW instrument, compute as follows:

Divide 60 by the K value. Enter the result as the Multiplier. For example, if the K value is 2, the Multiplier would be  $60/2 = 30$ .

Multiply the Offset by the original K value and enter the result as the Adder. For example, if the Data Industrial Offset is 0.3, the Adder would be  $0.3 \times 2 = 0.6$ .

The procedure to enter and edit the constants is as follows:

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until “Edit Sensor Cal ” menu is displayed.

Edit Sensor Cal

Press the OK/NEXT key.

Edit Cal Table: N

Press the OK/NEXT key to access this menu

A Cell M=1.0000\_

The cursor is initially under the channel field. Use the UP arrow key to select the desired channel (either “A Cell”, “B Cell”, “C Cell”, or “D Cell”).

The next field selects either the multiplier, M, or the adder, A factor.

Use the RIGHT arrow key to move the cursor to the number field. Use the arrow keys to modify the number as desired. The last position in the menu is the value multiplier which should be left at “\_” (blank); although: “ $\mu$ ” (micro), “m” (milli), “K” (kilo) and “M” (Mega) are also available.

After setting the desired value, the RIGHT arrow key can be used to move the cursor back to the channel field (1st field) so that the other constants can be entered and edited. All of the changes are recorded when you proceed to a different constant.

Pressing the OK/NEXT key will accept all set values. The meter will ask if changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return the display of measurement data.

**NOTE: If multipoint linearization data has been stored as described below and it is later decided to use a flow sensor with a Multiplier (and Adder) on that channel instead, set the data in the linearization table to zeros and then enter the Multiplier (and Adder) as above.**

## MULTIPOINT LINEARIZATION DATA ENTRY

**NOTE: In the Edit Cal linearization table the instrument will always save all entries made to the table. Because of memory**

limitations, that menu cannot be exited without saving changes.

As an alternative to a single Multiplier (and Adder), the 200FLOW can accept a six point calibration table for improved accuracy with documented sensors, e.g. vortex and turbine sensors. The user must enter six calibration values and six corresponding frequency values from the specific certificate of calibration packed with each sensor. If more than six are provided, choose the six representing the most used portion of the range, to optimize accuracy. Calibration values are entered as menu items "K1" to "K6" in units of pulses per gallon. The corresponding frequency values are entered as menu items "F1" to "F6" in units of Hertz.

Enter the data as follows:

Press MENUS key, then use Up Arrow key to make display read:

Edit Sensor Cal

Press OK/NEXT key

Edit Cal Table: N

Press Up Arrow key to obtain

Edit Cal Table: Y

Press OK/NEXT key

A: K1=1.0000 P/G

Change the channel indicator or the data point number as needed using the Arrow keys. With the cursor under the "K1" factor, pressing the Up Arrow key will change the factor to "K2", etc. After reaching the "K6" factor, the menu will proceed to display the frequency factors ("F1" to "F6"). Enter all values in the correct locations and save changes. Repeat for additional channels.

An example of typical calibration data is the following:

Calibration Factor (pulses/gallon)	Frequency (Hz)
---------------------------------------	-------------------

K1 = 1172.30*	F1 = 384.9*
K2 = 1151.86	F2 = 189.9
K3 = 1161.36	F3 = 96.3
K4 = 1158.33	F4 = 66.8
K5 = 1189.64	F5 = 39.3
K6 = 1323.07	F6 = 17.0

\* IMPORTANT: the "K" factor corresponding to the highest frequency must be entered first, as "K1". K factors must be entered in order, corresponding to highest to lowest frequency: "F1" must hold the highest frequency. Also, calibration and frequency numbers must correspond, as K1/F1, K2/F2, etc. Do not mix "K1" with "F2" etc.

# CHAPTER 11: SECURITY/LOCKOUT

## SECURITY FEATURES

All menus, or only specific ones, can be protected from unauthorized use by using the lockout feature. When enabled, the menu(s) will be inaccessible unless the proper five digit password is entered. Each menu key on the front panel can be locked out individually. The functions that can be locked are:

1. MEASURE MODE: locks the measure mode key.
2. SETPOINTS: locks the setpoint key.
3. RELAYS: locks the relays key.
4. OUTPUTS: locks the output key.
5. CALIBRATE: locks the calibrate key.
6. MENUS: locks the menu key.
7. DISPLAY: locks the arrow keys such that the display mode for measurements cannot be changed.

The password can be changed at any time, although the current password must be entered before the change is allowed. The password and lockout state is retained through a power-down sequence and a system reset.

All units shipped from the factory are set with the password of "00000". It is suggested that this password be changed to another five digit sequence before using the lockout feature.

## CHANGING THE PASSWORD

To change the password, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the "Change Password" menu is displayed.

Change Password

Press the OK/NEXT key to access this menu. The next menu will request the current password.

Old Pass = 00000

After setting the current password, press the OK/NEXT key. If the current password is not properly set, then the following message will be displayed before exiting the menus:

**NOTE: If the lockout feature is used, it is recommended that the MENUS key also be locked to prevent any indirect changes to the meter's setup.**

Invalid Password

If the password was properly entered, then the meter will request the new password:

New Pass = 00000

After setting the new password, press the OK/NEXT key. The meter will ask if changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display of measurement data.

## ENABLING THE LOCKOUT

To enable the lockout, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP key until the "Set/Clr Lockout" menu is displayed.

Set/Clr Lockout

Press the OK/NEXT key to access this menu. The next menu will request the current password.

Password = 00000

After setting the password, press the OK/NEXT key. If the correct password has been entered, then the following menu will allow the enabling or disabling of the lockout feature.

**Enable Lockout N**

If “N” is selected then the lockout is disabled and the meter will exit the menus. If “Y” is selected the next menu will allow each menu to be individually locked out.

**Lock M Measure Y**

The first field lists the functions to be locked. Use the UP and DOWN arrow keys to access the list. The choices are: MEASURE, SET-POINT, RELAYS, OUTPUTS, CALIBRATE, MENUS, DISPLAY. When the desired function is selected, move the cursor to the next field to change the state. A “Y” indicates that this function is locked and an “N” indicates that the function is not locked. use the LEFT arrow key to move the cursor back to the function field to select another key for lock-out. When done setting all the functions, press the OK/NEXT key. The meter will ask if changes should be saved.

**Save Changes Yes**

Press the OK/NEXT key to save the changes and return to the display of measurement data.

## **ACCESSING A LOCKED MENU**

If the lockout feature is enabled and a key is pressed that is also locked, the following message will be displayed:

**Password = 00000**

If the proper password is entered, then access to that menu will be allowed. This menu key will operate as normal. When the menu is exited, the lockout will be re-enabled.



# CHAPTER 12: OTHER FUNCTIONS

## AVERAGING

The 200FLOW has various levels of measurement averaging or damping, each for specific applications. The options are: low, medium, high and special. Each channel can be assigned an averaging level. The assigned averaging will apply to both the primary and secondary measurements of that channel.

Low averaging is useful in applications that require a fast response to changes in the system. Medium and high averaging help to reduce display fluctuations.

Special (Spec) averaging is self-adjusting. If a large change in the measurement is detected, then the meter will respond immediately to the change (does not use any averaging). Small changes to the measurement (i.e., flow turbulence less than 5%) will be highly averaged. If flow turbulence can exceed 5%, then special averaging should not be used.

To set the averaging, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the "Set Averaging" menu is displayed.

Set Averaging

Press the OK/NEXT key to access this menu.

A: Average = High

The cursor is initially under the channel field. Use the UP and DOWN keys to change the channel if desired. Use the RIGHT arrow key to move the cursor to the level field. The display will appear as:

A: Average = High

Use the UP and DOWN arrow keys to change the averaging level. Press the

OK/NEXT key when done. The next menu will show the averaging level for channel B. Press the OK/NEXT key after setting channel B. The meter will ask if changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display of measurement data.

**CAUTION: A system reset will set all operational parameters to their default conditions and may require extensive reprogramming.**

## SYSTEM RESET

1. All Primary Measurement Modes: GPM
2. All Secondary Measurement Modes: Gal
3. Display Mode: Mode #1 (A primary and B primary)
4. Setpoints (all): Off, value = 0, no relay assigned, active on over-range
5. Relays (all): Delay = 0, hysteresis = 0, state = normal
6. Serial Port: Data output off.
7. Analog Outputs: no signal assigned, min = 0, max = 0
8. Cell Constants: multiplier = 1, adder = 0.
9. Auto Display Scroll: Off
10. Multiplexed analog outputs: Off
11. Totalization Reset: Disabled
12. Pipe ID (all): 0"

A system reset will not change the password, lockout state, meter calibration, analog output calibration, or line power frequency.

To reset the meter, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until "System Reset" is displayed.

System Reset

Press the OK/NEXT key to access this menu.

Reset Unit? Yes

Press the OK/NEXT key to perform the reset. The meter will display a confirmation message for three seconds then exit the menus.

Unit is Reset

Press the OK/NEXT key to save the changes and return to the display of measurement data.

Save Changes Yes

## SENDING DATA TO A PRINTER OR COMPUTER

The 200FLOW can be set to output measurement data automatically to a printer or computer at a fixed time interval. The time interval can be set from 1 second up to 255 seconds. The data is transmitted as a string of ASCII characters, terminated with a carriage return character. All four measurements are contained in the string. To use this feature, the baud rate, parity, and output timer must be set as follows:

### Setting the Baud Rate and Parity

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the “Set Serial Port” menu is displayed.

Set Serial Port

Press the OK/NEXT key to access this menu. A typical menu may appear as:

Baud = 9600 P = Even

The cursor is initially under the baud rate setting. Press the UP or DOWN arrow keys to change the baud rate. Use the RIGHT arrow key to move the cursor to the parity field. The parity setting can be switched between even parity and no parity.

Press the OK/NEXT key when done. The meter will ask if changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display of measurement data.

### Setting the Data Output Timer

Press the OUTPUTS key.

Output: Analog

Press the UP arrow key until “Serial” is displayed. Press the OK/NEXT key to access this menu.

Output off > 002s

Press the UP arrow key to toggle the serial output from “Off” to “On”. Setting the serial out feature to “On” enables the automatic data output. Use the RIGHT arrow key to move the cursor to the time field.

Output on > 002s

Use the arrow keys to set the desired time interval in seconds.

Press OK/NEXT when done. The meter will ask if changes should be saved.

Save Changes Yes

Press the OK/NEXT key to save the changes and return to the display of measurement data.

NOTE: Entering a value greater than 255 seconds will automatically set the timer interval to 255 seconds.

# CHAPTER 13: TROUBLESHOOTING

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## OFF-LINE SELF-DIAGNOSTICS

A number of diagnostic and self test functions are available via the menus. The following functions can be tested:

1. **ROM:** the program memory is tested for any changes in it's contents. If one or more bits have changed, then the test has failed.
2. **RAM:** the data memory is tested for reading and writing.
3. **AOUT1:** analog output circuit #1 is tested by controlling output current from 0mA to 20mA in 1mA steps by the arrow keys.
4. **AOUT2:** analog output circuit #2 is tested by controlling output current from 0mA to 20mA in 1mA steps by the arrow keys.
5. **COMM:** the communication port is tested for its ability to receive and transmit data. A jumper wire is connected from the transmit line to the receive line before conducting the test.
6. **NVRAM:** the non-volatile memory is tested for functionality. This memory is used to hold setup information in case of a power down condition (or low line voltage).
7. **DISPLAY:** the display is tested by writing various patterns. This is a visual test conducted by the operator.
8. **KEYPAD:** display the name of a key when pressed. pressing the OK/NEXT key twice will exit this test.
9. **I/O LINE:** this test menu will display the state of the I/O line as either "HIGH" or "LOW". The state on the display is updated every second.
10. **FLOW IN:** each flow channel input can be selected and tested for functionality. For this test a jumper wire must be connected on TB3 between the I/O terminal and the input terminal (A IN, B IN, C IN or D IN) of the channel to be tested. if the test fails, recheck the jumper and its location. If it fails again, the circuit card is defective.

To perform any of these tests, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the "Diagnostic" menu is displayed.

Diagnostic Menu

Press the OK/NEXT key to access this menu.

Test? Rom

The cursor is under the first field, which indicates the test to be conducted. The choices are: ROM, RAM, AOUT1, AOUT2, COMM, NVRAM, DISPLAY, KEYPAD, I/O Line or exit. Use the RIGHT arrow key to select the desired test. Press the OK/NEXT key to perform the test. Select "Exit" to exit this menu.

The test results are displayed with the following messages (for example, the ROM test):

ROM: Passed ok

or

Rom: Failed ok

## ON-LINE DIAGNOSTICS

### Error & Over-range Indications

A measurement that cannot be properly measured or computed is considered to be in an error state. The display will show the asterisk character ("\*") in place of the allocated digits.

If a measurement is valid but is out of the set range, or it will not fit on the display, it is considered to be in the over-range condition. The display will show the "-" character in place of the allocated digits.

## “Check Setup” Message

The 200FLOW constantly checks the condition of the setup data (setpoints, sensor constants, etc.). If the meter detects an unauthorized change in this data (i.e., corrupted data) then a message will be displayed every few seconds as follows:

### Check Setup

This message can be cleared by exiting any menu.

## TROUBLESHOOTING

Problem	Possible Cause
1. Display is blank	<ul style="list-style-type: none"><li>• no power to unit</li><li>• blown fuse</li><li>• loose display cable</li><li>• display contrast potentiometer needs adjustment</li><li>• display cable improperly connected</li><li>• circuit board failure</li></ul>
2. Wrong readings	<ul style="list-style-type: none"><li>• sensor improperly installed</li><li>• incorrect cell constant entered</li><li>• meter improperly calibrated</li><li>• defective sensor</li><li>• measurement circuit board failure</li></ul>
3. Keypad not functioning	<ul style="list-style-type: none"><li>• keypad cable connector loose or broken</li><li>• defective keypad</li></ul>
4. Negative readings in %recovery	<ul style="list-style-type: none"><li>• the % recovery measurement is calculated on the opposite channel</li></ul>
5. Readings fluctuate too much	<ul style="list-style-type: none"><li>• cells and/or cables installed too close to equipment that generated high levels of electrical noise</li></ul>
6. Data not sent out to serial port	<ul style="list-style-type: none"><li>• serial port wiring is wrong</li><li>• wrong baud rate and/or parity</li><li>• automatic data output not enabled</li><li>• data output timer set too high</li></ul>

## RECOVERY PROCEDURE

If the meter is unable to make valid measurements, then the following procedure may help to resolve the problem.

1. Check sensor wiring. Look for loose wires at the terminal block or wrong wiring.
2. Perform a system reset as outlined in **Chapter 12: Other Functions**.
3. Re-enter the cell constants as shown in **Chapter 10: Sensor Calibration**. Set the

desired measurement mode and multiplier as shown in **Chapter 4: Making Measurements**.

# CHAPTER 14: SERVICE

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## FUSE REPLACEMENT

The 200FLOW is protected from accidental voltage overloading, short circuits, and related damage by a 1/8 amp time-delayed fuse (for 115 VAC units only). The 230 VAC unit uses a 1/16 amp time-delayed fuse. The fuse is located on the printed circuit board (PCB) inside of the case.

**WARNING: FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ONLY WITH FUSE OF THE SPECIFIED TYPE AND CURRENT RATING.**

To replace the fuse:

1. Disconnect all power to the 200FLOW unit before proceeding.
2. Remove the two screws from the center of the rear panel.

3. Slowly pull the rear panel assembly out of the unit, no more than 1".
4. Disconnect the two cables connecting the case to the PCB.
5. The fuse is located near the transformer. Remove the old fuse and replace it with one with the same rating as indicated above.
6. Position the PCB near the case and connect the two cables to the PCB. Make sure each cable is properly seated and oriented.
7. Gently push the rear panel assembly back into the case. Make sure the four mounted posts align with the holes in the assembly.
8. When the assembly is properly seated, re-install the two mounting screws.
9. Reconnect power to the meter.

## SPARE PARTS LIST

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Description	Rec'd QTY	Part #
1. Fuse:		
For 115VAC (Type 2AG, 1/8 Amp SB, Littlefuse® #228.125)	1	35088
For 230VAC (Type 2AG, 1/16 Amp SB, Littlefuse® #218.063)	1	35091
2. Display Assembly	1	06235
3. Power Selection Jumper(s):		
For 115VAC	2	25242
For 230VAC	1	25242
4. 200FLOW Programmed IC	-	43700
5. Panel Mounting Kit (gasket, screws, nuts, included with instrument)	-	02181
6. Input Kit (resistors & capacitors used with some flow sensors)	-	02184
7. Plug-in connector for TB1 (10-pin)	1	22626
8. Plug-in connector for TB2 (9-pin)	1	22617
9. Plug-in connector for TB3 (16-pin)	1	22624

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## ACCESSORIES

Back cover for IP65 rating, required for wall mounting	1000-62
Pipe mounting kit (requires back cover above)	1000-63

## CALIBRATION CONSTANTS FOR COMMON FLOW SENSORS

For other models consult flow sensor installation manual, available from manufacturers' websites and Chapter 10: Sensor Calibration.

### Data Industrial Sensor Flow Constants

Thornton Part No.	Data Ind. Part No.	Pipe Size	Fitting	Pipe Material	Multiplier Constant	Adder Constant
33349	410200	1/2"	Flow-thru/Pipe	PVC	422.24	0.1204
33350	411200	3/4"	Flow-thru/Pipe	PVC	182.54	0.0710
33176	400200	1/2"	Flow-thru/Pipe	PVC	145.27	0.1444
33177	401200	3/4"	Flow-thru/Pipe	PVC	104.62	0.1513
33175	402200	1"	Flow-thru/Pipe	PVC	97.815	0.1120
33142	228PV1.5	1 1/2"	Socket Tee	PVC	35.315	-0.3160
33143	228PV2	2"	Socket Tee	PVC	22.018	1.0682
33144	228PV3	3"	Socket Tee	PVC	7.2211	1.8861
33145	228PV4	4"	Socket Tee	PVC	3.9088	3.8068
33172	400500	1/2"	Socket Union	PVDF	100.21	0.0005
33174	401500	3/4"	Socket Union	PVDF	97.879	0.1633
33171	402500	1"	Socket Union	PVDF	95.755	0.0197
33162	228PF1.5	1 1/2"	Weld Tee	PVDF	28.807	0.6738
33159	228PF2	2"	Weld Tee	PVDF	15.244	0.7203
33160	228PF3	3"	Weld Tee	PVDF	10.836	3.2868
33161	228PF4	4"	Weld Tee	PVDF	5.8224	7.4608
33173	228PF6	6"	Weld Tee	PVDF	3.2538	4.5861

## Signet Sensor Flow Constants

Values below are the Multiplier. The Adder is left at zero for all Signet sensors.

<b>Pipe Size</b>	<b>Magnetic P515-Series</b>	<b>Hall-Effect 2536-Series</b>
Sch 80 Tees PVC & CPVC		
1/2"	480.19	991.71
3/4"	257.72	545.14
1"	174.67	352.43
1 1/4"	83.39	177.18
1 1/2"	58.58	117.85
2"	32.48	66.739
2 1/2"	21.833	42.994
3"	13.541	26.652
4"	7.626	15.006
Sch 80 PVC Saddles for Sch 80 PVC Pipe		
2"	32.480	66.739
2 1/2"	21.833	42.994
3"	13.541	26.652
4"	7.626	15.006
6"	4.162	8.325
8"	2.370	5.016
Sch 80 PVC Saddles for Sch 40 PVC Pipe		
2"	27.350	54.700
2 1/2"	18.874	37.159
3"	12.638	23.697
4"	6.728	13.456
6"	3.730	7.459
8"	2.153	4.529

# **CHAPTER 15: TECHNICAL ILLUSTRATIONS**

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**15.1 OVERALL DIMENSIONS**

**15.2 PANEL CUTOUT**

**15.3 EXPLODED ASSEMBLY**

**15.4 PANEL MOUNTING**

**15.5 PIPE MOUNTING**

**15.6 PIPE MOUNTING BRACKET**

**15.7 REAR COVER ASSEMBLY**

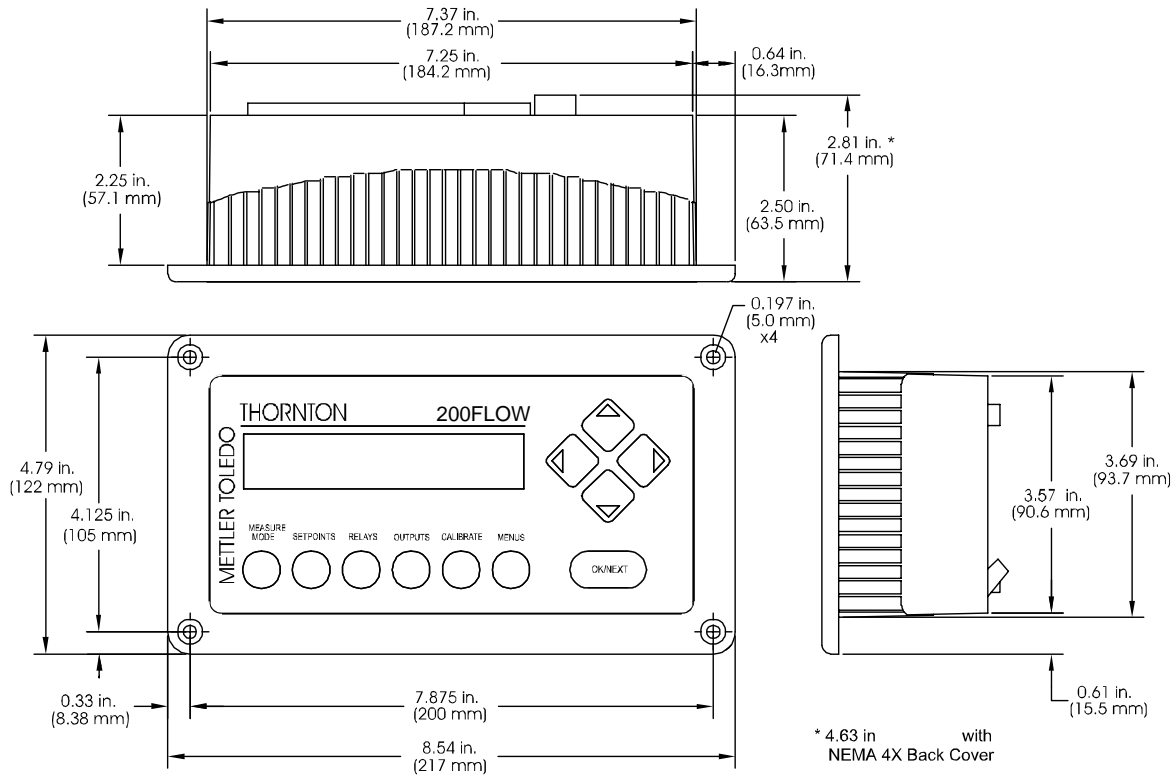
**15.8 PRINTED CIRCUIT BOARD LAYOUT**

**15.9 REAR PANEL WIRING**

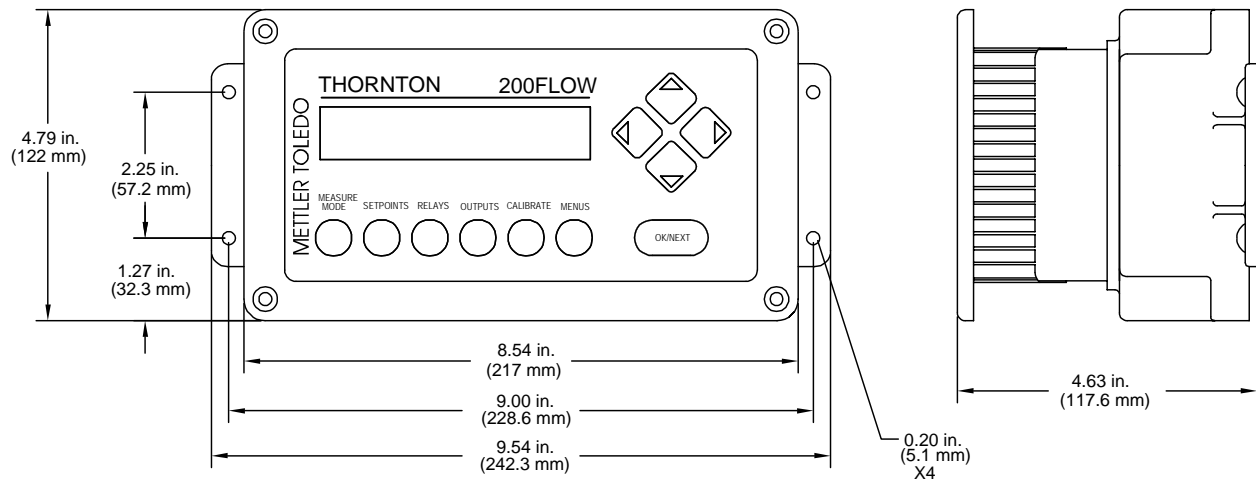


# OVERALL DIMENSIONS

## Panel Mounting

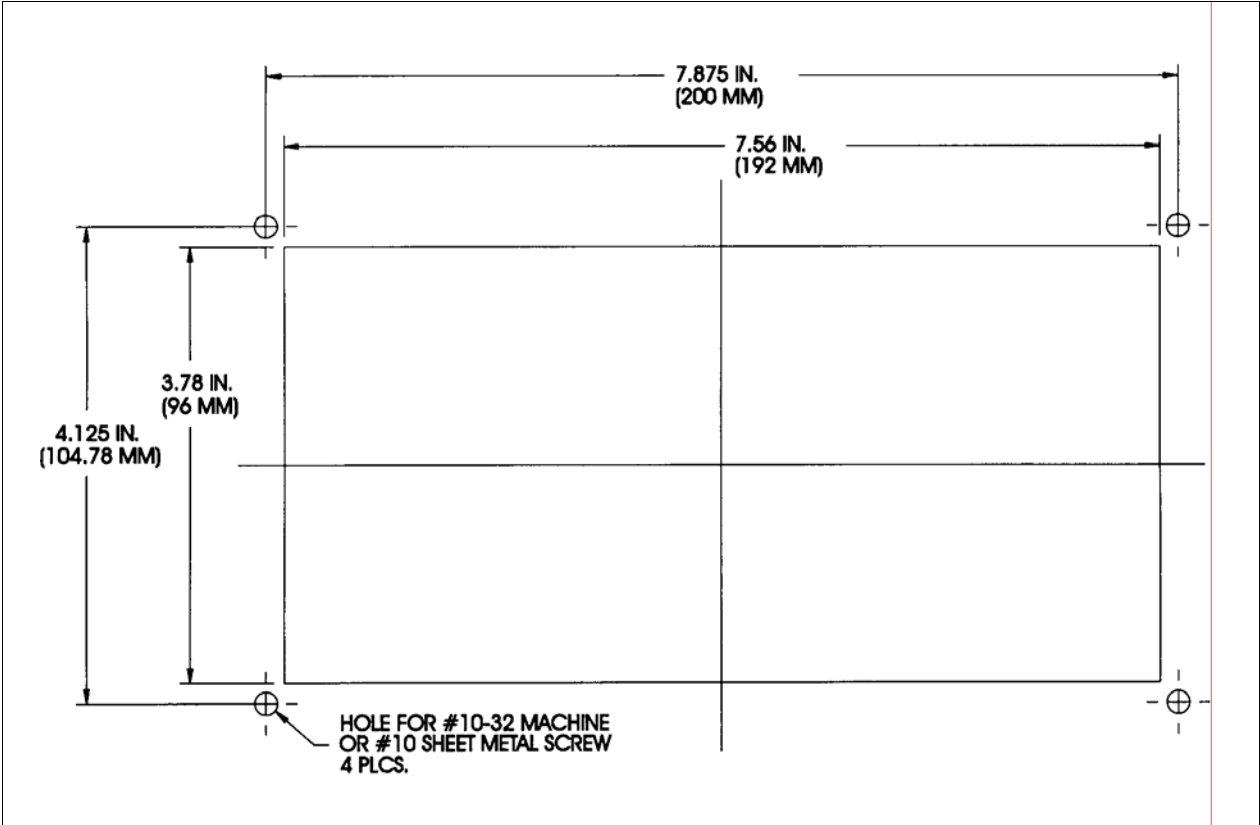


## Wall Mounting



### 15.1: Overall Dimensions

# PANEL CUTOUT



15.2: Panel Cutout

# EXPLODED ASSEMBLY

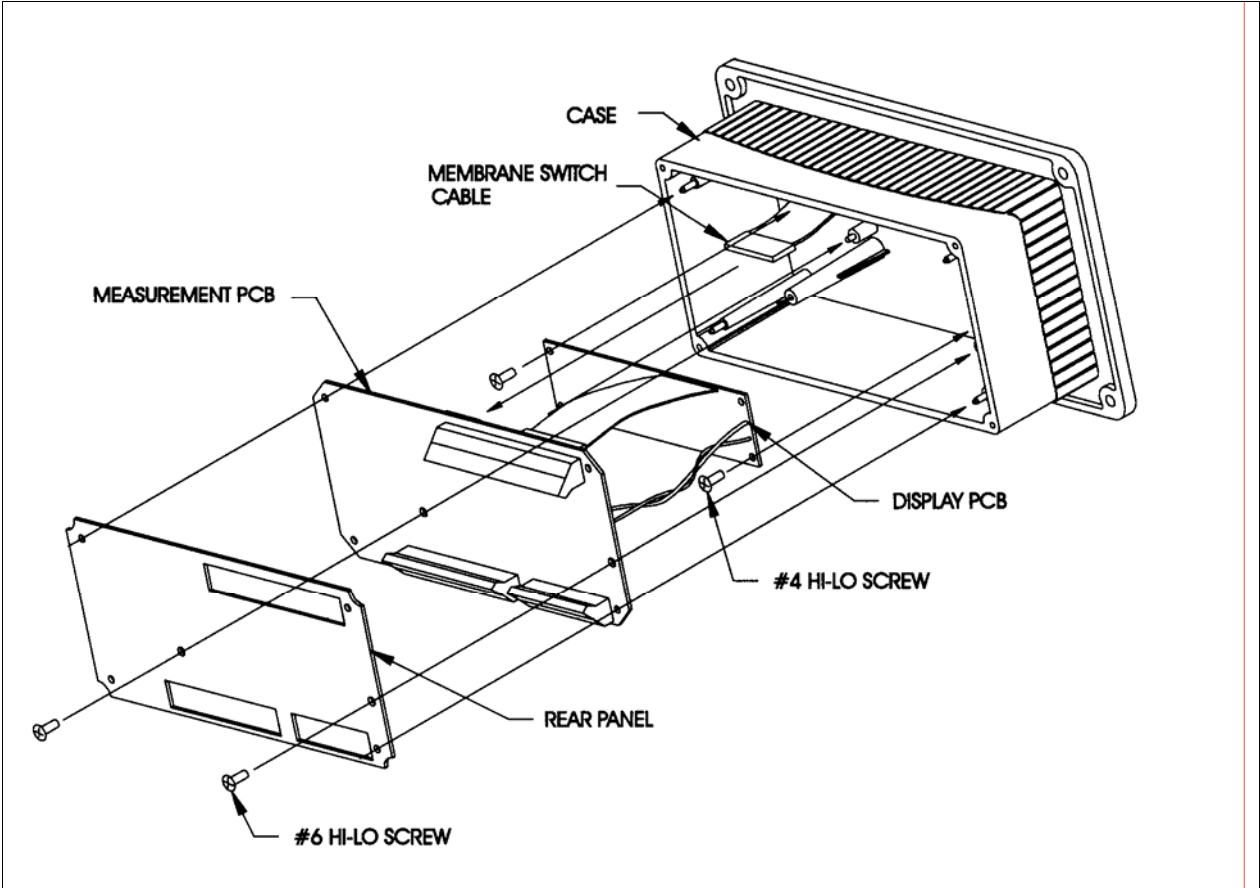


Figure 15.3: Exploded Assembly

# PANEL MOUNTING

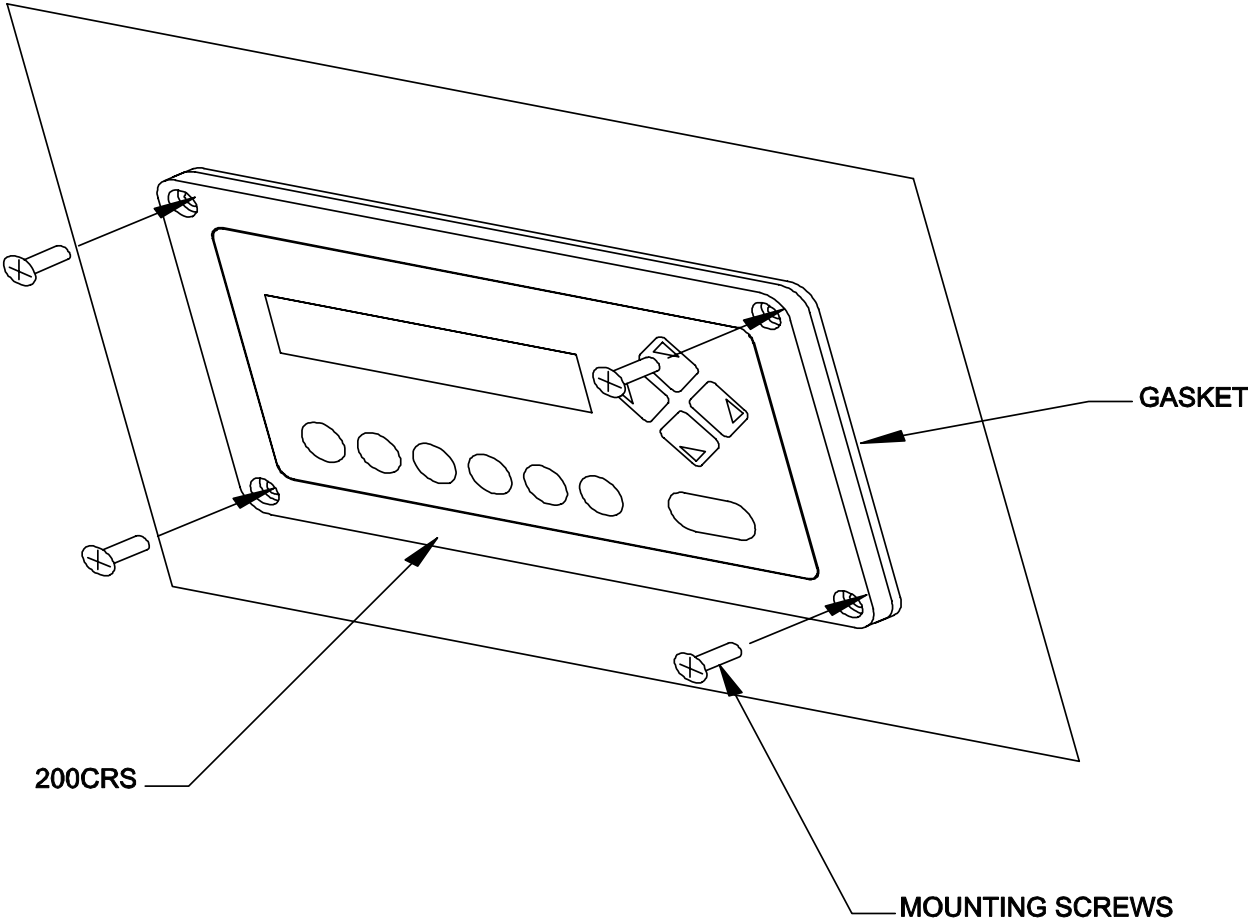


Figure15.4: Panel Mounting

# PIPE MOUNTING

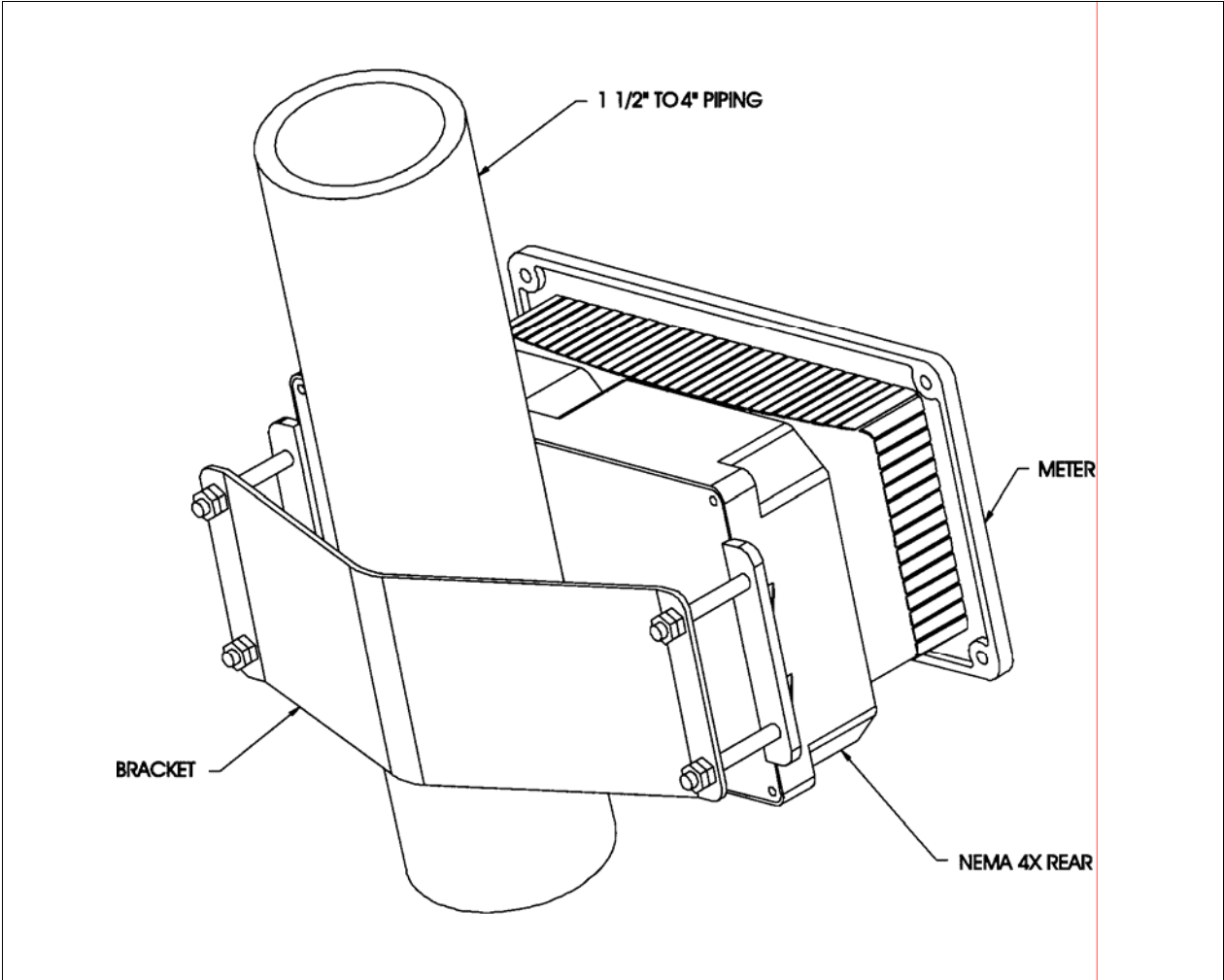


Figure 15.5: Pipe Mounting

# PIPE MOUNTING BRACKET

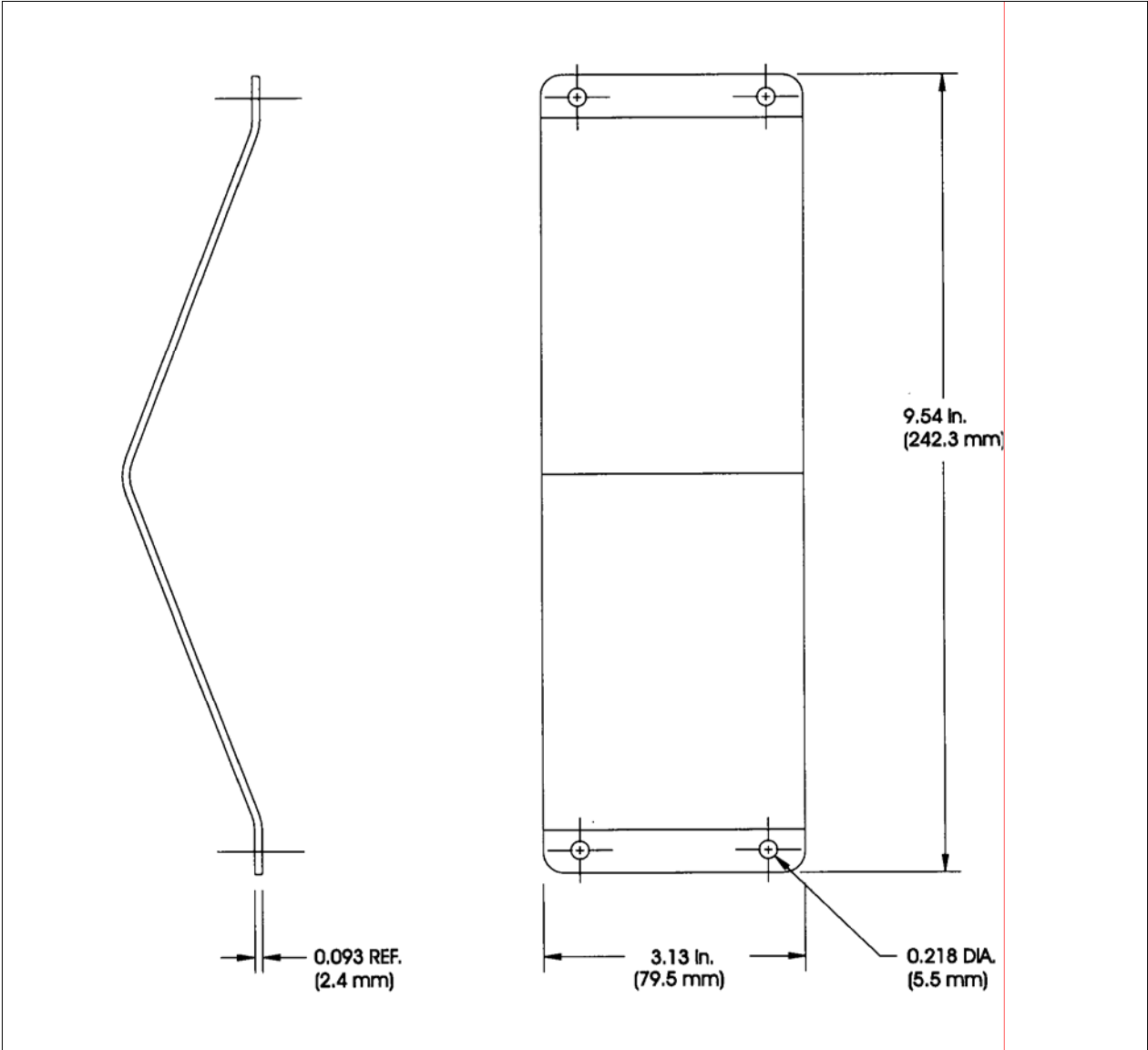
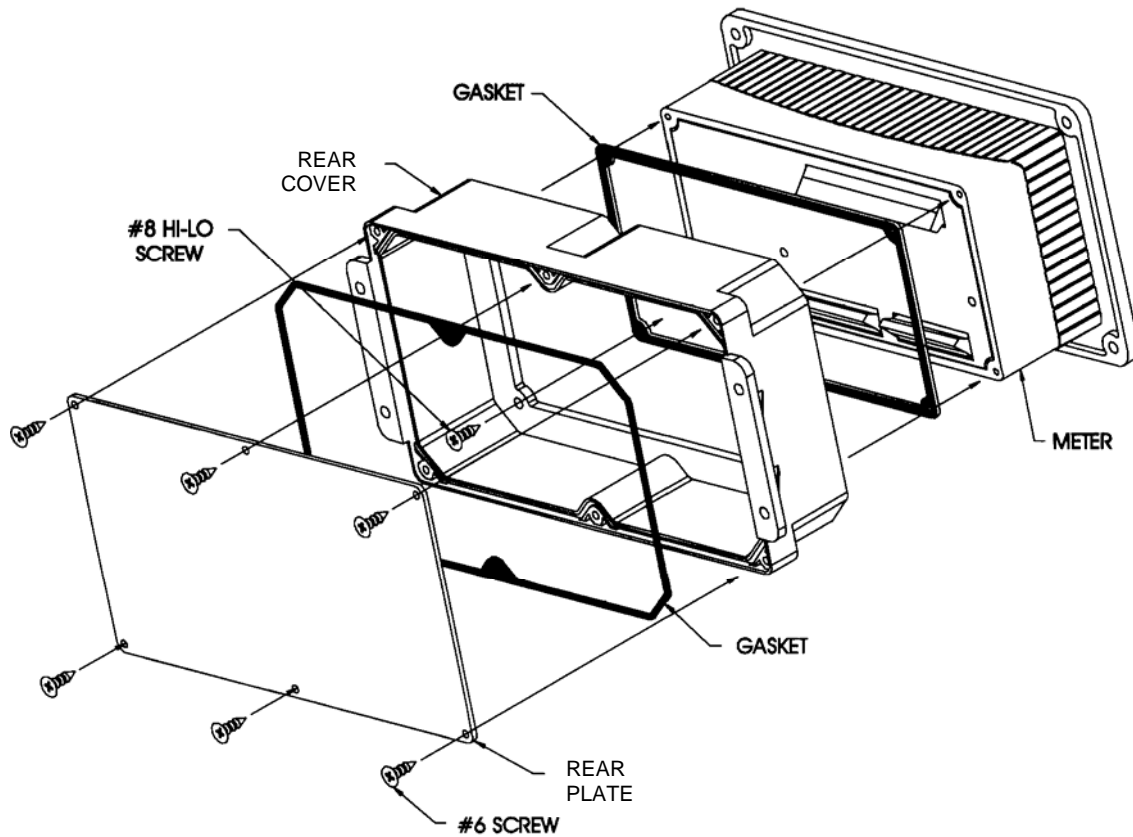


Figure 15.6: Pipe Mounting Bracket

## REAR COVER ASSEMBLY 1000-62 (Ordered Separately)



**Figure 15.7: Rear Cover Assembly**

### Installation Instructions

1. Remove terminal block cover. Remove all wiring from the rear terminal strips on the 200FLOW instrument, if installed.
2. Drill holes in side walls of the rear cover for waterproof or conduit connectors as required.
3. Install waterproof or conduit connectors into the holes. Use rubber gaskets for all installations requiring waterproof connections.
4. Attach the rear cover to the instrument using the four #8 Hi-Lo screws provided.
5. Feed wiring through the connectors and install wiring on the terminal strips. Do not reinstall the terminal block cover.
6. Place the rear plate onto the rear of the cover. Install the six #6 screws and tighten. The rear cover installation is now complete.

# PRINTED CIRCUIT BOARD LAYOUT

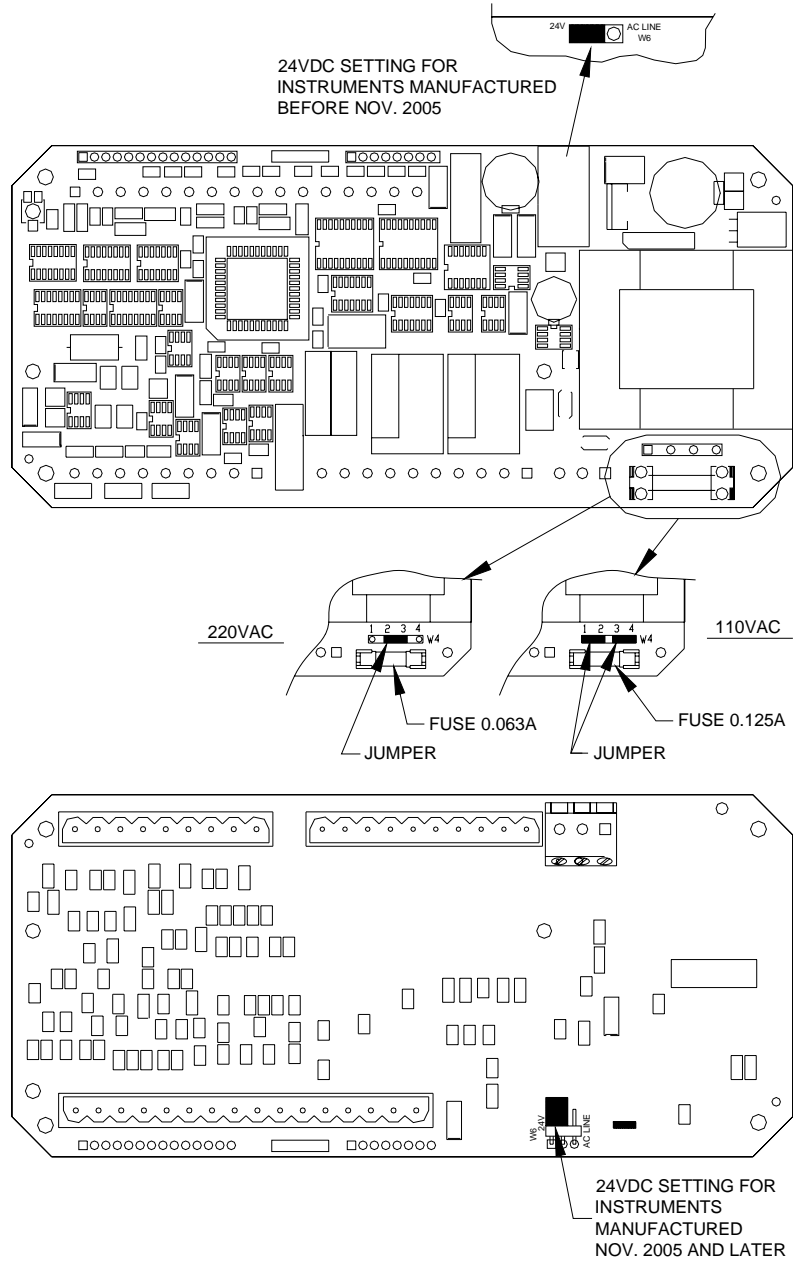


Figure 15.8: Printed Circuit Board Layout



# REAR PANEL WIRING

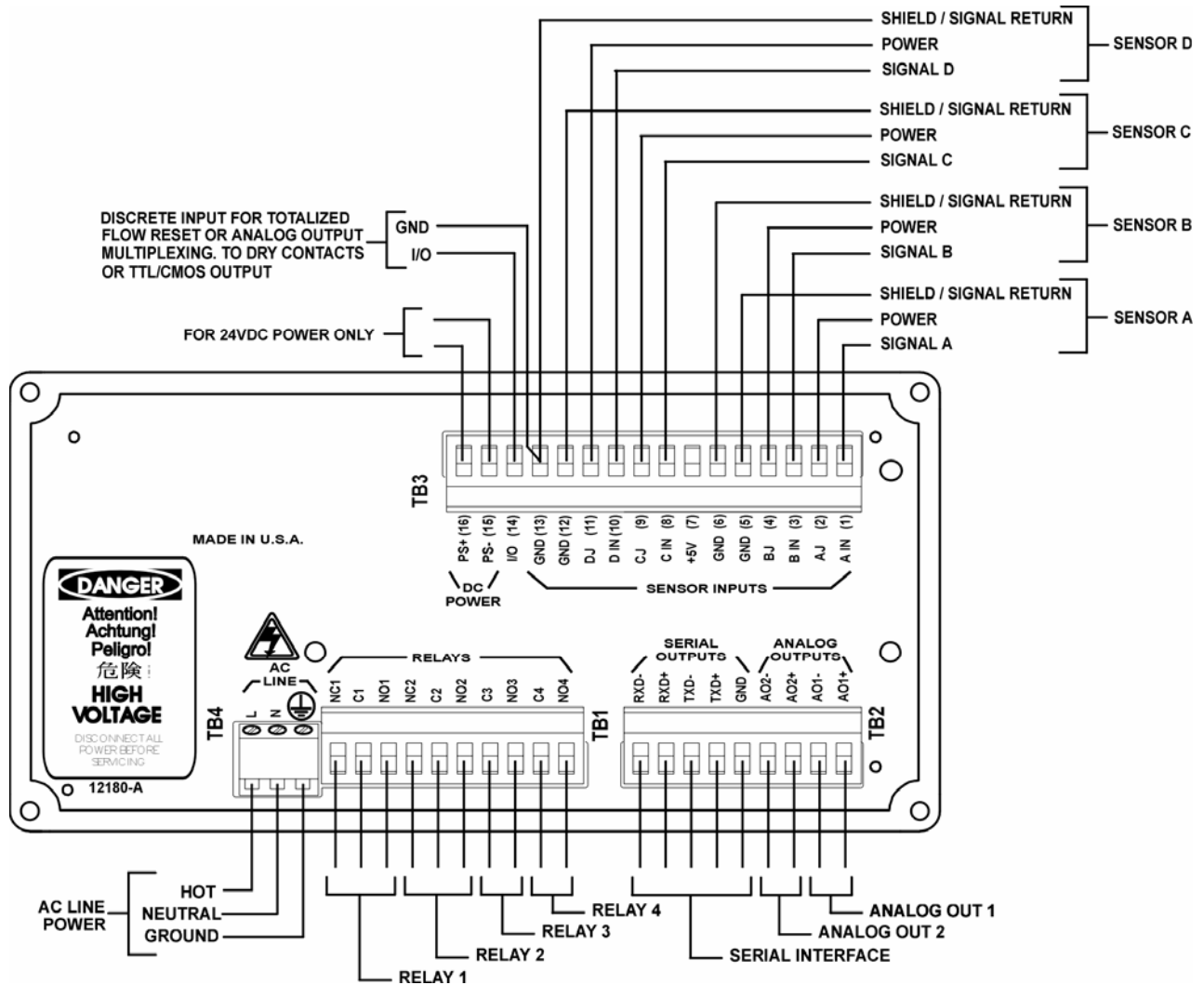


Figure 15.9: Rear Panel Wiring

# 200FLOW SPECIFICATIONS

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## Functional

### Ranges

Flow Rate:	0 to 9999 GPM, L/min, m <sup>3</sup> /hr
Totalized Flow:	0 to 9,999,999 Gallons; 37,850,000 Liters; 37,850 m <sup>3</sup>
Flow Velocity:	equivalent ft/s
Frequency:	0.5 to 4,000 Hz
% Recovery:	0 to 100%

Resolution:	.001 Hz
Input pulses:	Low < 1.0 Volt High > 1.4 Volts (36 Volts maximum)

### Discrete Input for one of the following--

Totalized flow reset:	By external dry contact or TTL control signal when totalized flow setpoint is exceeded. (Manual reset is always available.)
Analog output multiplexing:	By external dry contact or TTL control signal to switch between Outputs 1 & 2 and Outputs 3 & 4 for the two analog output circuits. Requires approximately 3 seconds to stabilize after switching. (Not used if only Outputs 1 & 2 are needed.)

## Outputs

Setpoints/Alarms:	Eight independent setpoints can be set as high or low limits. Any relay can be activated by more than one setpoint.
Relays:	2 SPDT, 5 amp at 250 VAC or 30 VDC, resistive load, standard; Optional: additional 2 SPST solid state 5 amp at 250 VAC only resistive load, 10 mA minimum. All relays have individually adjustable delay and hysteresis (deadband)
Analog outputs:	Optional: Two powered 0/4-20 mA circuits, 500 ohm load maximum, fully scalable to any flow, totalized flow, % recovery, etc. range, isolated from input and from ground. Each circuit may be multiplexed (time-shared) between the pair of analog outputs for a total of four measurement outputs.
Serial output:	RS232, maximum distance of 50 feet (15 m); RS422, maximum distance of 4000 feet (1220 m); field selectable up to 19.2 Kbaud. All outputs updated as often as once every 2 seconds.

## Performance

Accuracy:	±0.05 Hz
Repeatability:	±0.02 Hz
Update Rate:	All measurements and outputs, once per two seconds
Ratings/approvals:	CSA/NRTL, UL listed, CE compliant
Analog output accuracy:	± 0.05 mA

## Environmental

General:	If the equipment is used in a manner not specified by Thornton Inc., the protection provided by the equipment may be impaired. For indoor use, Pollution Degree 1
Storage temperature:	-40 to 70°C (-40 to 158°F)
Operating temperature:	-10 to 55°C (14 to 131°F)
Humidity:	0 to 95% RH, non-condensing

UL Electrical Environment:	Installation (overvoltage) Category II
<b>Enclosure</b>	
Display:	16 character backlit LCD (4.8 x 9.6 mm)
Keypad:	11 flush, tactile feedback keys
Material:	ABS-PC polymer alloy
Panel cutout:	3.78 x 7.56" (96 x 192 mm) DIN
Wall mount:	Available with accessory back cover
Pipe mount:	For 1-1/2 to 4" pipe, available with accessory kit and back cover
Weight:	1.9 lb. (0.9 kg)
Rating:	NEMA 4X, IP65 panel mount and accessory back cover
Sensor cable length, max:	200 feet (61 m) to 2000 feet (610 m), depending on sensor specifications
<b>Power</b>	
Line:	90-130 VAC or 180-250 VAC, 50-60 Hz, 12W maximum; or 9-30 VDC, 300 mA steady state, 600 mA inrush.
Memory retention:	On power loss all stored values are retained in non-volatile memory without batteries

## 200FLOW Models

Part No.	Relays	Analog Outputs	Power (VAC)*
6720-1	2SPDT	0	110
6720-2	2SPDT	0	220
6722-1	2SPDT	2	110
6722-2	2 SPDT	2	220
6742-1	2 SPDT & 2 solid state AC	2	110
6742-2	2 SPDT & 2 solid state AC	2	220

\* All models can also operate from 24VDC as 4-wire transmitters.

## CE Declaration of Conformity

Mettler-Toledo Thornton, Inc., 36 Middlesex Turnpike, Bedford, MA 01730, USA declares that the 200FLOW Instruments, Models 6720-1, 6720-2, 6722-1, 6722-2, 6742-1, 6742-2, 6720K1, 6722K1 and 6742K1 meet the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Directive 73/23/EEC for Low Voltage.

Compliance was demonstrated to the following specifications:

EN 55011	Emissions: Radiated and Conducted, Class A
EN 50082-1	Immunity
IEC 61010-1	Safety

## CSA and NRTL/C Certification

Mettler-Toledo Thornton Inc., 36 Middlesex Turnpike, Bedford, MA 01730, USA has obtained Certification of Compliance from the Canadian Standards Association for the 200FLOW Instruments, Models 6720-1, 6720-2, 6722-1, 6722-2, 6742-1, 6742-2, 6720K1, 6722K1 and 6742K1. These models bear the NRTL/C and CSA marks, signifying that the products have been evaluated to the applicable ANSI/UL and CSA Standards for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories, which have been recognized to perform certifications to U.S. Standards.

Class

Class 2252 01 - Process Control Equipment, Ordinary Locations

Class 2252 81 - Process Control Equipment

Applicable Requirements

CSA Std C22.2	No.	0-M1982	General Requirements - Canadian Electrical Code, Part II
		0.4-M1982	Bonding and Grounding of Electrical Equipment (Protective Grounding)
		142-M1987	Process Control Equipment
UL Std	No.	916	Energy Management Equipment

## UL Listing

Mettler-Toledo Thornton Inc., 36 Middlesex Turnpike, Bedford, MA 01730, USA has obtained Underwriters Laboratories' Listing for 200FLOW Instruments. They bear the UL Listed mark signifying that the products have been evaluated to the applicable UL standards for electrical process control equipment, UL3121-1.

# WARRANTY

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This Warranty is given expressly and in lieu of all other warranties, express or implied. The Buyer agrees that there is no warranty of merchantability and that there are no other warranties, express or implied, which extend beyond the description on the face of this agreement.

Mettler-Toledo Thornton, Inc. (hereinafter referred to as The Company) warrants to the original Buyer each electrode, component, or instrument manufactured and/or sold by The Company to be free from defects in material and workmanship in normal use and service for a period of one (1) year from shipment, unless expressly stated otherwise by the product packaging or expressly agreed to in advance by the Company. The obligation of The Company under this warranty is limited to repair or replacement of the defective product at The Company's discretion. All warranty claims shall be returned to The Company pursuant to The Company's Returned Goods Authorization program. Shipping costs (including return shipping) are the responsibility of The Buyer. The Company assumes no responsibility for any direct or indirect costs associated with removal of defective products, or re-installation of replacement products. The Company shall not be responsible for damage to any electrode, component, or instrument resulting from misuse, negligence, accident or resulting from repairs, alterations, or installations made by any person or firm not duly authorized by The Company. No agent is authorized to assume for The Company any liability except as above set forth. The Company warrants that services will be performed in a workmanlike manner in conformity with standard industry practice. Should any nonconformity be detected within 30 days after the work is completed and prompt notification is made by Buyer in writing to the Company, Company will supply the necessary service, direction, or consultation to correct the nonconformity.

**Returned Goods Policy:** A Returned Material Authorization (RMA) number must accompany all returned goods. This authorization is obtained by calling our Technical Service (800) 510-7873 or (781) 301-8600. All transportation costs on authorized returns must be prepaid. Authorized replacement parts sent prior to receipt and evaluation of merchandise being returned will be invoiced in full. Credit will be issued only after the returned part is received and evaluated by factory personnel. The Company is not responsible for products returned without proper authorization.

**Factory Restocking Charge:** Items returned to The Company more than 30 days after shipment will be subject to a 25 % restocking charge, plus any additional charges for refurbishment to salable condition. The Company will not accept returns more than 90 days after shipment, unless returned under warranty or for non-warranty repair.

**Special Products:** Cancellation or return of special products will not be accepted.

**Disclaimer of Damages:**

In no event shall The Company be liable for any type of special consequential, incidental or penal damages, whether such damages arise out of or are a result of breach of contract, warranty, tort (including negligence), strict liability or otherwise. Such damages shall include, but not be limited to loss of profits or revenues, loss of use of the equipment or associated equipment, cost of substitute equipment, facilities, down time costs, increased construction costs or claims of The Buyer's customers or contractors for such damages. The Buyer agrees that in the event of a transfer, assignment, or lease of the equipment sold hereunder The Buyer shall secure for The Company the protection afforded to it in this paragraph.





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