Tracer®VM with User Interface

Flowmeter with FCI (Fluid Characteristic Indication)
Operating Instructions

Electronics Housing and Display

Process Flow Body

Flow and Temperature Sensor

General

The Tracer VM Flowmeter provides:
- 0.5 to 3.5V, 0 to 5V or 0 to 10V Selectable Analog Flow Output
- 0.5 to 4.1V, 0 to 5V or 0 to 10V Selectable Analog Temperature Output
- 1A, 30VAC/30VDC Programmable Alarm Switch for High or Low Temperature and/or Flow. Switch can be set for Turbulent Flow instead of programmed settings.
- Fluid Flow Rate Display in gallons per minute (GPM) or liters per minute (LPM), selectable
- Fluid Temperature Display (°F or °C), selectable
- BTU's per Minute Display
- FCI Display (Turbulent Flow or "TF" on display)
- Volume Totalizer Display
- Reynolds Number Display
- Rechargeable Battery for temporary portable operation (up to 8 hrs)
- Glycol Scale Options, 0%, 10%, 20% or 30% (for FCI Calculation)

Pushbutton Protector

Remove and discard Pushbutton Protector before first use.

Pushbutton Protector
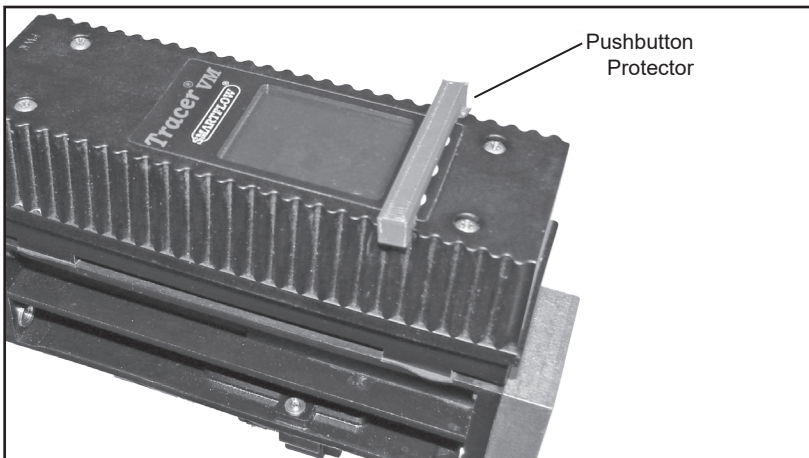
Tracer VM Interface and Sensor are calibrated as a matched pair. Separating the pair voids the calibration.
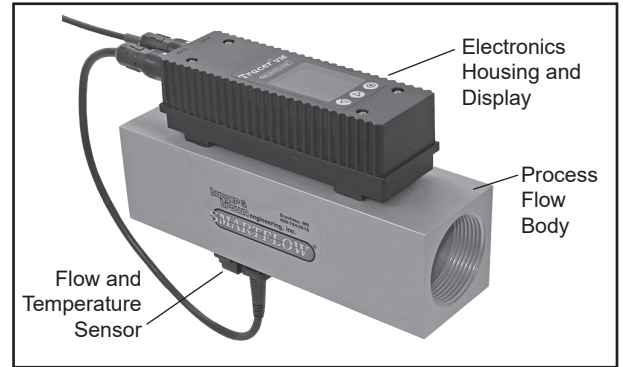
Temperature

Operating Range .... 32 to 248°F (0 to 120°C)
Accuracy .... ±2% of Display Value
Repeatability .... ±1% of Display Value

Component Materials

Sensing Element............... Silicon-Based MEMS Sensor
Seal (sensor to housing) .... EPDM Rubber
Flow Path Insert .... PPA 40 GF
3/8" & 1/2" Body Sizes .... Glass-Filled Nylon Flow Body with Brass or Nylon End Caps
3/4" thru 1-1/2" Body Sizes .... Anodized Aluminum or Stainless Steel (optional)
Electronics Cover.. Nylon
Cable .... 9-Conductor, 24AWG, 4.8M long

Operating

Internal Relay...................................... 30VAC/30VDC
Power Required.. 8 to 28VDC
Maximum Pressure .... 10.3bar (150 psi)
Output Signals... Ratiometric

Available Flow Ranges and Accuracy

Body Size	Range (LPM)	Range (GPM)	Flow Accuracy (Full Scale)
3/8" & 1/2"	1 to 18	.3 to 4.8	±1.5%/3%*
3/8" & 1/2"	2 to 40	.5 to 10.6	±1.5%/3%*
3/4" & 1"	5 to 100	1.3 to 26.4	±1.5%
1" & 1-1/2"	10 to 200	2.6 to 52.8	±1.5%

* In the center of the flow range, accuracy is ±1.5%. At the low and high ends of the flow range, accuracy is ±3%.

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SMARTFLOW®

BTU Basics

To obtain the most accurate BTU/m calculation, use the Tracer_{VM} to measure the supply side water temperature (in °F) before installing in a cooling water return line.

BTU's per minute calculation is based on the increase in water temperature multiplied by the flow rate. The Tracer_{VM} calculates this information based on supply side temperature entered manually. Due to inherent differences in most thermometers, the most accurate BTU calculation will result from using the same thermometer (inside the Tracer_{VM}) to measure supply and return line temperatures. Record the supply side temperature and enter it using the "Set BTU/m Input Temperature" instructions on page 5.

Turbulent Flow

"TF" notification appears on the display when Turbulent Flow is likely inside the cooling circuit of the selected size.

Turbulent flow is the mixing and swirling of water inside a cooling line that provides optimum heat transfer. Water flow rate greater than the point of Turbulent Flow provides diminishing benefits with increased pumping. Turbulent flow tracking allows technicians to apply mathematical cooling principles to all machines in a water system. Visit the Technical Documents section of www.smartflow-usa.com for a detailed discussion of Turbulent Flow.

Input the percentage of glycol (0, 10, 20 or 30% only) in cooling water for accurate Turbulent Flow Indication (default value is 0). See Setup Mode option on page 6. Antifreeze compounds of ethylene glycol are sometimes added to cooling water. Glycol compounds have much higher viscosity than water. As a result, higher flow rates are required to reach Turbulent Flow when glycol is used.

Turbulent Flow Indicator is based on Reynolds Number of 4000.

Reynolds Number

Reynolds Number displayed by the Tracer_{VM} flowmeter is calculated using the inside diameter of the flow passage. Factory preset "Pipe Diameter" matches the Nominal Thread Size of the meter. "Pipe Diameter" setting may be changed in the Setup Mode if needed (see page 5).

Flow Passage Inside Diameter Program Reference		
Nominal Thread Size	Drill Diameter	Drill Diameter
0.25″	.438″	11.1mm
0.38″	.578″	14.7mm
0.50″	.703″	17.9mm
0.75″	.922″	23.4mm
1.0″	1.156″	29.4mm
1.5″	1.734″	44.0mm

Pipe Configuration

For best performance, install a straight run of pipe equal to 10 pipe diameters on the inlet side of the Tracer_{VM} flowmeter and a straight run of pipe equal to 5 pipe diameters on the outlet side of the flowmeter.
Use appropriate pipe sealant to prevent leakage on inlet and outlet sides of the flowmeter.

Power

When using Cable Assembly (EFM-CBL-OPC-A, connector one end only), attach the power and switching connections to the bare wires of the cable according to the chart below. Individual wires are 24AWG stranded copper. Attach 8 to 28VDC power to the unit for correct operation.

In normal operation, the internal relay is energized. If power to the unit is lost, or if unit is turned off, relay state changes to signal an alarm.

Cable with 120VAC adapter (CBL-VMI-WWA) does not have Analog or Relay Output connections.

Battery Charging:
Unit must be turned ON to charge the battery.

Power supply other than 8 to 28VDC may damage the electronics! Ensure that power supply provides Earth Ground (0V) and not a reference. Earth Ground is required for reliable flow and temperature outputs.

Cable with 120VAC Wall adapter (CBL-VMI-WWA) is intended for off-line battery charging purposes only. Do not use this cable for permanent processing installations. User Interface must be ON for the battery to accept a charge.

9-Conductor Cable Color Chart	
Wire Color	**Function**
Black	DC Ground (Earth)
Yellow	+DC Input (8 to 28VDC)
Red	not used
Blue	Analog Output Ground (-)
Orange	Flow Analog Voltage Output (+)
Violet	Temp. Analog Voltage Output (+)
Green	Relay Common
Brown	Relay Normally Open
Gray/White	Relay Normally Closed

EMI/RFI Interference

Care should be taken to route power and signal cable away from motors and pumps. Signal integrity may be adversely affected by close proximity of the wiring to machinery producing high frequency emissions.

Cable

Maximum effective signal cable length is 4.8M (16ft) as supplied. Splicing extra length to the cable is not recommended.

Flow and Mounting Direction

Orient the Tracer$_{VM}$ so the flow direction of the process fluid matches the directional arrow on the body of the meter. Flow in the opposite direction of the arrow will yield inaccurate voltage output. The presence of air bubbles in the process fluid will also create an inaccurate voltage output.

Maintenance Instructions

Copper Plumbing Alert

DO NOT connect an aluminum body flowmeter directly to copper plumbing. Galvanic corrosion is very likely to occur. Stainless steel body material is strongly recommended for this application.

Operating Instructions

Modes of Operation
There are three modes of operation for the Tracer$_{VM}$ Flowmeter:
User Mode, Setup Mode and Calibration Mode.

User Mode displays all available process information:
- Flow rate
- Temperature
- Turbulent Flow Indication "TF"
- Reynolds Number
- Alarm Indication (when configured in Setup Mode)
- BTU's per minute (when input temperature is provided in Setup Mode)
- Total volume (when configured in Setup Mode)

Setup Mode configures the flowmeter for:
- Volume totalizer on/off
- Unit selection (English or Metric)
- Switching set points (alarm)
- BTU/m temperature input
- Automatic shut off time
- Pipe diameter (factory set to match body size)
- Glycol scale options (0%, 10%, 20% or 30%)
- Analog Output: Temperature (4.1V, 5V, 10V, off)
- Analog Output: Flow (3.5V, 5V, 10V, off)
- Relay settings (alarm, turbulent flow, off)

Calibration Mode configures the flowmeter for:
- Flow sensor selection
- Temperature sensor selection
- Temperature and Flow Calibration
- Available Battery Voltage (display only)
- Firmware information and updates
- Factory default settings

Users should not make changes within Calibration Mode. Accidental loss of factory calibration may occur. ⚠️

User Mode

Press ⏻ to enter User Mode. User Mode is display only.

Press △ or ▽ buttons to scroll through displays of flow rate, temperature, Reynolds Number and BTU/m.

BTU/m is automatically disabled until input temperature is entered within User Mode.

Totalizer function is off when shipped. See Setup Mode instruction to enable and zero Total Volume display. When totalizer is enabled, total flow volume will be visible on all User Mode screens. When the display is off, totalizer does not add to the total volume.

To exit User Mode, press ⏻ to power down the meter.

Setup Mode

The display must be off to enter Setup Mode. Press and hold ▽ button, then hold down ⏻ . "Setup Mode" appears in the upper left corner of the display. Press △ or ▽ buttons to scroll through the list of selectable options.

Volume Totalizer calculates total flow volume from "on" point. For best results, disable "Automatic Display Shut-off" (page 5) when using the Volume Totalizer. Total volume updates only when the display is on. (Maximum value is approximately 42,949,000 liters or 11,338,000 gallons. Display will reset to zero and restart.)

Press ⏻ to select. Press △ or ▽ to enable or disable then press ⏻ to select. If enabled, Press ⏻ then △ or ▽ buttons to select On, Off or Reset. At ON/OFF/RST screen, press △ or ▽ to move through next menu options.

Flow Units select LPM (liters per minute) or GPM (gallons per minute).
Press ⏻ to change units. Press △ or ▽ buttons to select LPM or GPM unit. Press ⏻ to select.

Temperature Units select °F or °C.
Press ⏻ to change units. Press △ or ▽ buttons to select °F or °C unit. Press ⏻ to select.

Battery Life Indicator

Setup Mode

VOLUME TOTALIZER

Setup Mode

FLOW UNITS
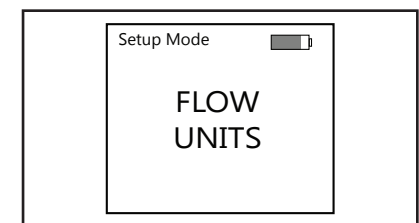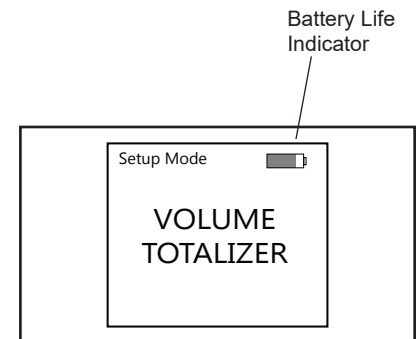
Relay Set Point Programming (Alarm)

Note: If no relay switching is desired, set all alarms to "OFF" and set "**Relay Settings**" function to "ALARM" (see page 6).

Alarm Temperature High causes relay to change state when the set point temperature is exceeded.

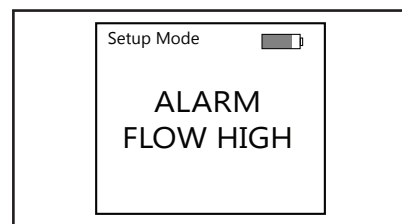Press ⏻ to view or change. Press △ or ▽ buttons to select desired high temperature point between 32°F - 248°F (0°C - 120°C). Press ⏻ to select. To disable, set temperature setting to "OFF".
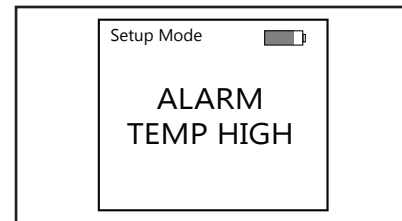
Alarm Temperature Low causes relay to change state when the process temperature falls below the set point.

Press ⏻ to view or change. Press △ or ▽ buttons to select desired low temperature point between 32°F - 248°F (0°C - 120°C). Press ⏻ to select. To disable, set temperature setting to "OFF".

Alarm Flow High causes relay to change state when the set point flow rate is exceeded.

Press ⏻ to view or change. Press △ or ▽ buttons to select desired high flow point from 1 - 66 GPM (2 - 250 LPM). Press ⏻ to select. To disable, set flow rate setting to "OFF".

Alarm Flow Low causes relay to change state when the process flow rate falls below the set point.

Press ⏻ to view or change. Press △ or ▽ buttons to select desired low flow rate from 1 - 66 GPM (2 - 250 LPM). Press ⏻ to select. To disable, set flow rate setting to "OFF".
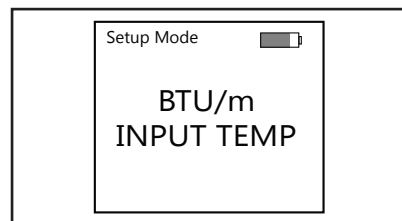
Set BTU/m Input Temperature

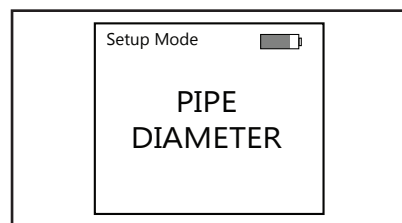Press ⏻ to view or change. Press △ or ▽ buttons to select input temperature point between 40°F - 220°F (4.4°C - 104.4°C). Press ⏻ to select. To disable, select "OFF". (For the most accurate calculation, measure the input temperature using Tracer_{VM} flowmeter. Then move the flowmeter to the output side of the circuit using the measured temperature input.)

Automatic Display Shut-off

Press ⏻ to view or change. Press △ or ▽ buttons to select shut-off time between 15 and 240 seconds, or select "DISABLE" for continuous display. Press ⏻ to select.

**Pipe Diameter** is used to calculate Turbulent Flow.

Press ⏻ to view or change. Press △ or ▽ buttons to select nominal thread size. (See "Reynolds Number" explanation on page 2 for details.) This is pre-set at the factory during calibration to match meter body. It is not usually necessary to change this. Press ⏻ to select.

Setup Mode

ALARM TEMP HIGH

Setup Mode

ALARM FLOW HIGH

Setup Mode

BTU/m INPUT TEMP

Setup Mode

PIPE DIAMETER

Setup Mode (continued)

Percentage of Glycol is used to calculate Turbulent Flow.

Press ⏻ to view or change. Press △ or ▽ buttons to select appropriate percentage of glycol present in the process water. Options are: 0%, 10%, 20% and 30%. This is pre-set at the factory to 0%. Higher flow rate is required to achieve Turbulent Flow when glycol is present. Press ⏻ to select.
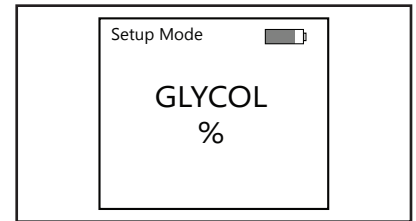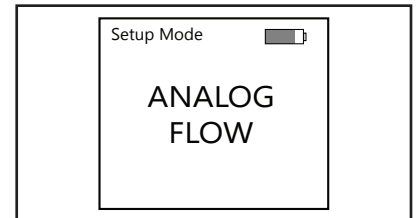
Analog Temperature Output

Press ⏻ to view or change. Press △ or ▽ buttons to select:
- 0.5V - 4.1V (0.5 to 4.1Volts Scale)
- 5VS (0 to 5Volts Scale)
- 10VS (0 to 10Volts Scale)
- DISABLED

Press ⏻ to select.

Analog Flow Output

Press ⏻ to view or change. Press △ or ▽ buttons to select:
- 0.5V - 3.5V (0.5 to 3.5Volts Scale)
- 5VS (0 to 5Volts Scale)
- 10VS (0 to 10Volts Scale)
- DISABLED
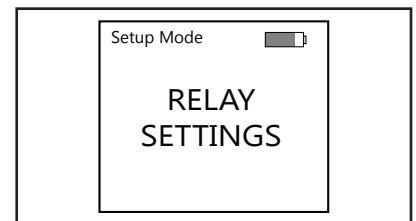
Press ⏻ to select.

Relay Settings

Note: If no relay switching is desired, set all Relay Set Point alarms to "OFF" (see page 3) and set "**Relay Settings**" function to "ALARM" .

Press ⏻ to view or change. Press △ or ▽ buttons to select:
- TFLOW (change state when Turbulent Flow is not present)
- ALARM (change state using programmed temp. and flow settings)

Press ⏻ to select.

EXIT/OFF

Press ⏻ to power down.

```
Setup Mode        [▮▮▯]

    GLYCOL
      %
```

```
Setup Mode        [▮▮▯]

    ANALOG
    FLOW
```

```
Setup Mode        [▮▮▯]

    RELAY
    SETTINGS
```

For valuable Mold Cooling Articles and Turbulent Flow Calculation Tools, visit the Technical Documents page of the SMARTFLOW-USA web site: http://www.smartflow-usa.com/ documents.htm

Calibration Mode
Users should not make changes in Calibration Mode unless directed by Burger & Brown Engineering. Loss of Factory Calibration May Result.

The display must be off to enter Calibration Mode. Press and hold △ button, then press ⏻ to enter Calibration Mode. "Calibration Mode" appears in the upper left corner of the display. Press △ or ▽ buttons to scroll through the list of selectable options.

Flow Sensor
> Press △ or ▽ buttons to change the value. Press ⏻ to select. This value is set at the factory to match flow range of the sensor.

Temperature Calibration
> Calibration Value appears in this screen. Do not change it unless you have calibrated the Tracer_{VM} according to the temperature calibration procedure. Press △ or ▽ buttons to change the value. Press ⏻ to select.

Flow Calibration
> Calibration Value appears in this screen. Do not change it unless directed by the factory. Press △ or ▽ buttons to change the value. Press ⏻ to select.

Analog Temperature Calibration
> Calibration Value appears in this screen. Do not change it unless directed by the factory. Press △ or ▽ buttons to change the value. Press ⏻ to select.

Analog Flow Calibration
> Calibration Value appears in this screen. Do not change it unless directed by the factory. Press △ or ▽ buttons to change the value. Press ⏻ to select.

Battery
> Press ⏻ to display available battery voltage.

Firmware Info
> Press ⏻ to display program version.

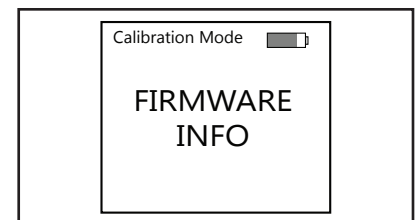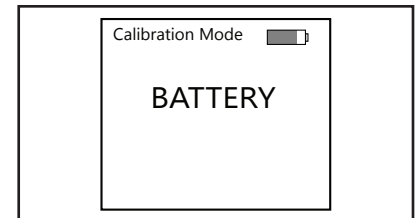**Factory Only**
> Factory use only.

Factory Default
> ⚠ *WARNING! This function returns the meter to factory settings before calibration. A password is needed to change this setting, it is not user-serviceable.*

EXIT/OFF
> Press ⏻ to power down.

```
Calibration Mode    [▮▮ ]
        BATTERY
```

```
Calibration Mode    [▮▮ ]
       FIRMWARE
         INFO
```

Troubleshooting

Display	Resolution
ERR	Memory Error, Contact the Factory, not user serviceable.
Flow and Temperature readings are 0.00	Check cable between sensor and electronics housing is plugged in both places. Re-seat connections.
Flow and Temperature readings are erratic	Electronics are calibrated for each specific sensor. Check that electronics circuitry has not been mixed with a different sensor.
	Size of supply and return pipe should be the same as the Tracer$_{VM}$ flow path.
	Check flow sensor value (Calibration Mode) matches the rate code in the model number.
	Check power supply for voltage between 8 & 28VDC with Earth Ground.
No display	Check for connection to power supply
	Check that battery is charged and plugged into the circuit board. Unit must be "ON" to charge the battery.

Replacement Parts	
Part Number	**Description**
CU-J934-A	Replacement rechargeable battery with cable and connector
CBL-VMI-OCL	Cable Assembly - 14" long cable for flow sensor to electronics housing
EFM-CBL-OPC-A	Cable Assembly - 16ft long cable for electronics housing, 9 internal conductors, one connector end, bare wires opposite end - See page 2 for color chart
CBL-VMI-WWA	Cable Assembly - 10ft long cable for electronics housing with 120VAC adapter installed, one connector end, 120V adapter connected to opposite end Note! This cable is use for charging the battery only and not for use in a permanent installation. There are no flow or temperature output leads on this cable.
EFM-CBL-OPC-O-A	Cable Assembly - 16ft long cable for electronics housing for eDart, one connector end with cylindrical connectors on opposite end

Limited Warranty