Tracer®$_{VMA}$ *with AutoReg*™

Flowmeter with Automatic Flow Regulation
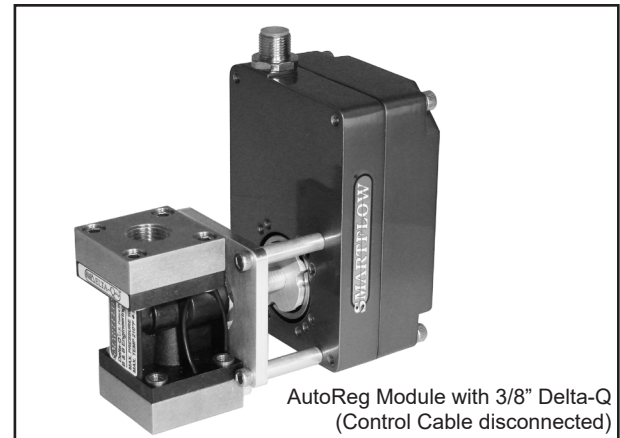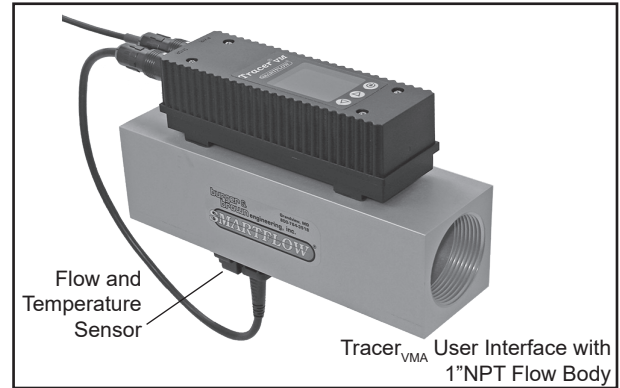Operating Instructions

General

The Tracer$_{VMA}$ Flowmeter with AutoReg provides:

- Analog Flow Output (Selectable 0 to 3.5V, 0 to 5V or 0 to 10V)
- Analog Temperature Output (Selectable 0 to 4.1V, 0 to 5V or 0 to 10V) (Lowest Voltage Output settings match Tracer$_{VM}$ Base Units for ease of direct replacement if needed.)
- Programmable Alarm Switch for High or Low Temperature and/or Flow. Switch can be set for Turbulent Flow instead of programmed settings. 1A, 30VAC/30VDC
- Flow Rate Display (GPM or LPM)
- Fluid Temperature Display (°F or °C)
- Reynolds Number Display
- BTU's per Minute Display
- FCI Display (Turbulent Flow or "TF" on display)
- Volume Totalizer Display
- Automatic Shutoff Timer
- Glycol Scale Options, 0%, 10%, 20% or 30% (for FCI Calculation)

Automatic Regulation Control Features

- Regulation via Flow Rate or Reynolds Number
- Actuator Alarm notifies user via switch when the AutoReg is unable to achieve the desired set point (15 seconds - 999 seconds).

Tracer$_{VMA}$ User Interface with
1"NPT Flow Body

AutoReg Module with 3/8" Delta-Q
(Control Cable disconnected)

Available Flow Ranges and Accuracy					
Body Size	Range (LPM)	Range (GPM)	Flow Accuracy (Full Scale)	Reynolds Number Deadband	Flow Rate Deadband
3/8" & 1/2"	1 to 18	.3 to 4.8	±1.5%	300	0.1
3/8" & 1/2"	2 to 40	.5 to 10.6	±1.5%	300	0.1
3/4" & 1"	5 to 100	1.3 to 26.4	±1.5%	1000	1.0
1"	10 to 200	2.6 to 52.8	±1.5%	1000	2.0

Temperature

Operating Range ....0 to 120°C (32 to 248°F)
Accuracy ....±0.5°C

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" & 1" Body Sizes....................Anodized Aluminum or Stainless Steel (optional)
Electronics Cover...Nylon
Cable ....9-Conductor, 24AWG, 4.8M long

Operating

Internal Relay................................ 1A, 30VAC/30VDC
Min. Power Required............................... 1.5A, 24VDC
Power Usage ....3.0A Max.
200 to 300mA Typical
Maximum Pressure .... 10.3bar (150 psi)
Output Signals...Ratiometric

Tracer$_{VMA}$ Interface and Sensor are calibrated as a matched pair. Separating the pair voids the calibration.

Burger & Brown
ENGINEERING

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BTU Basics
To obtain the most accurate BTU/m calculation, use the Tracer$_{VMA}$ 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$_{VMA}$ 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$_{VMA}$) 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 5. 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.

Pipe Configuration
For best performance, install a straight run of pipe equal to 10 pipe diameters on the inlet side of the Tracer$_{VMA}$ 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
Attach the power and switching connections to the bare wires of the cable according to the chart at right. Individual wires are 24AWG stranded copper. Attach 24VDC 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.

> Power supply other than 24VDC 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.

Zeroing Process
When the unit obtains power, the AutoReg Module will go through a zeroing process that will completely close the regulator before it starts controlling the flow rate. This zeroing process may take up to 30 seconds.

Power is still available to the AutoReg Module when the User Interface display is off. However if there is an interruption to the power supply, the AutoReg Module will re-zero when power is restored.

EMI/RFI Interference
Care should be taken to route power and signal cables 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$_{VMA}$ User Interface 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.

Install AutoReg module downstream from the User Interface at least 5 pipe diameters from the sensor outlet. Flow regulator response time will increase in relation to distance between AutoReg module and Tracer$_{VMA}$ User Interface.

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.

9-Conductor Cable Color Chart	
Wire Color	**Function**
Black	DC Ground (Earth) (Ground for Analog Output)
Yellow	+DC Input (24VDC)
Red	not used
Blue	not used
Orange	Flow Analog Voltage Output (+)
Violet	Temp. Analog Voltage Output (+)
Green	Relay Common
Brown	Relay Normally Open
Gray	Relay Normally Closed

Operating Instructions

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

User Mode displays all available process information:
- Flow rate
- Temperature
- Reynolds Number
- Turbulent Flow Indication "TF"
- 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 or turbulent flow)
- Flow Rate Setpoint
- Actuator Alarm
- Reynolds Number Setpoint
- Regulation Method (Flow, Reynolds Number, off)

Calibration Mode configures the flowmeter for:
- Flow sensor selection
- Temperature and Flow Calibration
- Available Battery Voltage (disregard for Tracer$_{VMA}$ User Interface)
- Firmware information and updates
- Factory default settings

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

Zeroing Process

When the unit obtains power, the AutoReg Module will go through a zeroing process that will completely close the regulator before it starts controlling the flow rate. This zeroing process may take up to 30 seconds.

Power is still available to the AutoReg Module when the User Interface display is off. However if there is an interruption to the power supply, the AutoReg Module will re-zero when power is restored.

User Mode

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

Press △ or ▽ buttons to scroll through displays of Flow Rate, Temperature and Reynolds Number. Totalizer and BTU/m display are available when enabled.

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.

Battery Life Indicator in upper right corner of the display may flash on this model but will turn off automatically. It has no function on this model.

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.

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 5).

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".

| Setup Mode |
| VOLUME TOTALIZER |
| FLOW UNITS |
| ALARM TEMP HIGH |
| ALARM FLOW HIGH |
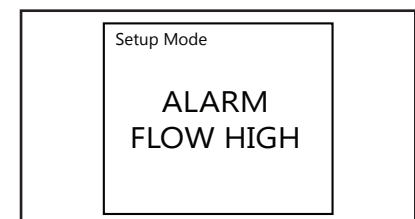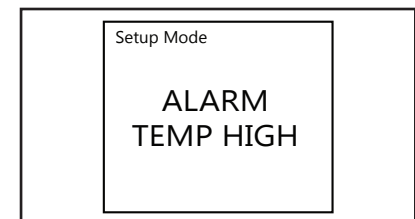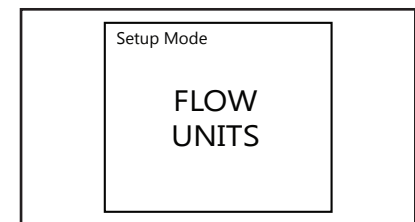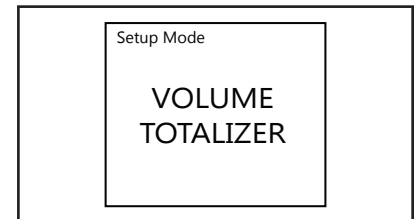
Setup Mode (continued)

Set BTU/m Input Temperature

Press ⏻ to view or change. Press △ or ▽ buttons to select input temperature point between 40°F - 181°F. 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.)
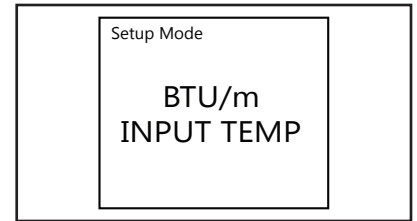
Automatic Display Shut-off

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.
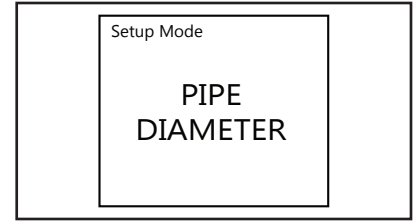
Pipe Diameter is used to calculate Turbulent Flow.

Press ⏻ to view or change. Press △ or ▽ buttons to select correct pipe size. This is pre-set at the factory during calibration to match meter input size. It is not usually necessary to change this. Press ⏻ to select.

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.
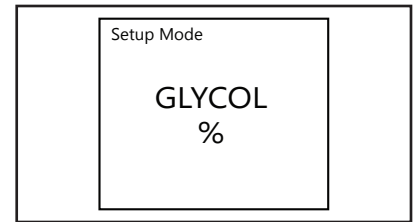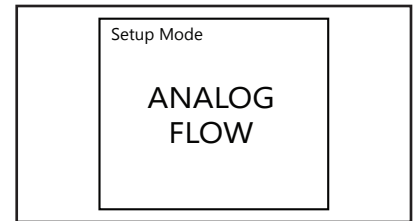
Analog Temperature Output

Press ⏻ to view or change. Press △ or ▽ buttons to select:
- 0.5V - 4.1V (matches Tracer_{VM} Base Output)
- 5V FS (5Volts Full Scale)
- 10V FS (10Volts Full Scale)
- DISABLED

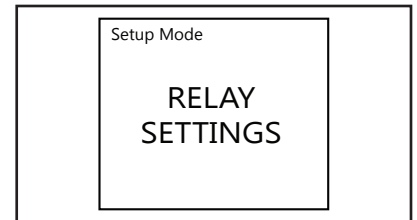Press ⏻ to select.

Analog Flow Output

Press ⏻ to view or change. Press △ or ▽ buttons to select:
- 0.5V - 3.5V (matches Tracer_{VM} Base Output)
- 5V FS (5Volts Full Scale)
- 10V FS (10Volts Full 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.

Flow Setpoint

Press ⏻ to view or change. Press △ or ▽ buttons to select desired setpoint within the flow range. Press ⏻ to select.

Setup Mode

**BTU/m
INPUT TEMP**

Setup Mode

**PIPE
DIAMETER**

Setup Mode

**GLYCOL
%**

Setup Mode

**ANALOG
FLOW**

Setup Mode

**RELAY
SETTINGS**

Actuator Alarm

Press ⏻ to view or change. Press △ or ▽ buttons to select alarm between 15 and 999 seconds. The actuator Alarm changes relay state when the regulator is unable to meet the programmed flow rate or reynolds number. This alarm does not have a "DISABLED" option. Press ⏻ to select.

Reynolds Setpoint

Press ⏻ to view or change. Press △ or ▽ buttons to select target Reynolds Number. Reynolds Number between 4000 and 8000 is generally assumed to be turbulent. See Value Curve Chart at right. Press ⏻ to select.

Note: in the 200LPM range, Reynolds Number should be set >10,000. Refer to the on-line Scientific Cooling Calculator for help selecting the appropriate Reynolds Number or Flow Rate: www.smartflow-usa.com/scientific-cooling-calculator/.

Regulation Method

Press ⏻ to view or change. Regulation Method selects control of the flow regulator between Flow Rate and Reynolds Number values as entered in the menu items above (Flow Setpoint and Reynolds Setpoint). Press △ or ▽ buttons to select:
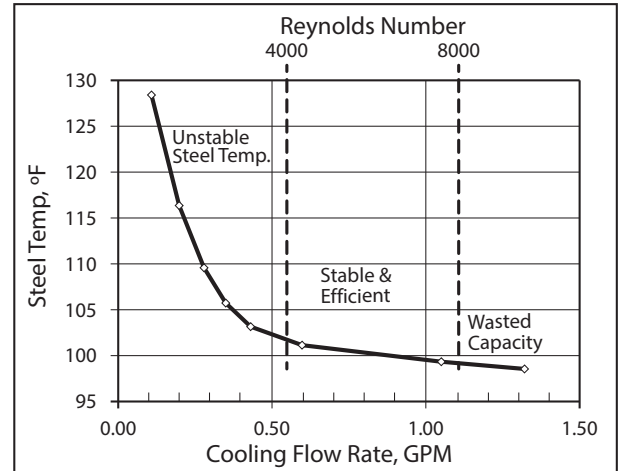- FLOW
- REYNOLDS
- DISABLED

Press ⏻ to select.

EXIT/OFF

Press ⏻ to power down.

Value Curve

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
> Disregard for this model.

Firmware Info
> Press ⏻ to display program version.
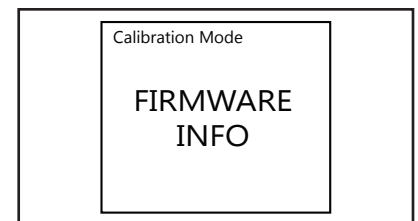
Factory Default
> Factory use only.

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

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	User Interface is 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$_{VMA}$ flow path.
	Check flow sensor value (Calibration Mode) matches the rate code in the model number.
	Check power supply, 1.5A, 24VDC with Earth Ground.
No display	Check connection to 24VDC power supply.

Replacement Parts	
Part Number	**Description**
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

Limited Warranty

Seller warrants that this product supplied will conform to the description herein stated and that the product will be of standard quality. This is the sole warranty made by Seller with respect to this product. Seller expressly disclaims any other express or implied warranties, including, but not limited to, the implied warranty of merchantability and the implied warranty of fitness for a particular purpose. Seller shall not be liable for any cost or damages, whether direct, incidental or consequential, including, but not limited to, any injury, loss or damage resulting from the use of this product, regardless of whether any claim for such cost or damages is based on warranty, contract, negligence, tort or strict liability. The sole liability of Seller is limited to repairing or replacing this product. This warranty shall not apply to any products that have been repaired or altered by anyone other than Seller. The warranty shall not apply to any products subject to misuse due to common negligence or accident, nor to any products manufactured by Seller which are not installed or operated in accordance with the printed instructions of Seller or which have been operated beyond the rated capacity of the goods. Seller states that the product's useful safe life is 5 years. Actual life may vary widely depending on operating environment such as temperature, pressure, and chemical exposure. Users are cautioned to refer to instructions for operating limits and a partial list of incompatible chemicals.