



OPERATING INSTRUCTIONS

CALFLO™ CFTM THERMAL MASS FLOW & TEMPERATURE METER



Principle of Operation

Please read carefully! No liability can be accepted for damage caused by improper use or installation of the flow meter.

The CalFlo™ CFTM Thermal Mass Flow and Temperature Meter represents the logical evolution matching modern microprocessor intelligence with over 30 years of thermal flow expertise. With its patent pending auto-self-calibration, the CalFlo™ CFTM is the first truly “set-it and forget-it” flow and temperature solution. No need for expensive on-going calibration as CFTM is designed to maintain accuracy for many years. With standard features such as highly accurate temperature sensing with auto-self-calibration, it becomes the most exciting flow sensor in decades. The Modbus version presents the user with analog flow and temperature, has a totalizing counter, and provides independent high and low adjustable flow and temperature switches. The analog version provides two independent linear 4-20mA outputs for both flow and temperature. A single potentiometer sets the flow range for analog versions.

Safety Precautions

If you are unsure of the suitability of a CalFlo™ Flow Meter for your installation, please consult your FLO-CORP representative for further information.

NOTE: REMOVE ALL PACKING INSERTS BEFORE OPERATING LEVEL TRANSMITTER.

Authorized Personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorized by the plant operator. During work on and with the device the required personal protection equipment must always be worn.

Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel over fill or damage to system components through incorrect mounting or adjustment.

General Safety Instructions

The user must take note of the safety instructions in this operating instructions manual, the country specific installation standards as well as all prevailing safety regulations and accident prevention rules. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for trouble-free operation of the instrument. During the entire duration of use, the user is obliged to determine the compliance of the required occupational safety measures with the current valid rules and regulations and also take note of new regulations.

Disclaimer

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

FEATURES & BENEFITS

- Standard patent pending auto-calibration (no temperature drift)
- Separate adjustments for temperature and flow (Modbus version)
- Counter totalizer (Modbus version)
- Choice between Modbus RTU Output or 4-20mA
- Encapsulated for vibration resistance
- Withstands up to 1400 psi static pressure
- No moving parts

SPECIFICATIONS

Service	Oil or water-based solutions
Measuring Velocity Range	0.25 -10ft/sec (7.62-350 cm/s), auto-ranging
Set-point Range	5% to 90% of maximum flow
Process Temperature	-4°F to 175°F (-20°C to 90°C)
Pressure	Up to 1,400 PSI (100 bar)
Response Time	Max 5 seconds normal flow
Linearity Deviation	< 5%
Repeatability	< 2%
Protection Class	IP65
Housing Material	PBTP, glassfibre reinforced (Ultradur®)
Sensor Probe	Standard: Stainless Steel (WN1.4305 V2A, 303 Ti) Optional: stainless steel (WN 1.4571 V4A , 316 Ti), Titanium, Hastelloy C4 and Hastelloy C22
Thread	1/2" NPT
Connection	M12-plug, 5-Pin
Operating Voltage	19 to 30VDC, incl. residual ripple
Ambient Temperature	-4°F to 158°F (-20°C to 70°C)
Initial Operation	Approx. 10s after connection of power

CONNECTION DIAGRAM

PIN	COLOR	SIGNAL
1	White	4-20 mA flow signal
2	Brown	4-20 mA Temperature
3	Green	24 VDC+
4	Yellow	RS-485 A
5	Grey	RS-485 B
6	Pink	Future Use
7	Blue	Future Use
8	Red	0VDC (zero reference or common)

The unit shares GRD and RS-485B, the RS-485 link should not be used for a multi-drop environment and is limited to 38400 baud.

PIPING POSITION

Because the sensing resides at the very tip of the instrument, accuracy can be lost if the tip is not immersed in liquid at all times. The preferred location is a vertical discharge line as opposed to a vertical return line which may have air pockets as illustrated below



The unit is best installed on a horizontal line the best location to ensure constant liquid contact is the side of the pipe as opposed to the top where cavitation bubbles are more likely to exist.

The unit should be installed in straight pipe with minimum turbulence, at least 5 pipe diameters upstream and 3 pipe diameters downstream of any fittings such as elbows, tees or reducers and at least 15 pipe diameters from any pumps.

INSTALLATION

- The tip of the unit should protrude into the liquid a minimum of 1/5th of an inch (5mm).
- It is highly recommended that the unit should be installed in either a welded or saddle tee rather than a threaded tee which could create turbulence and affect the accuracy.
- The pipe threads of the unit should be sealed with either Teflon tape or other commercial grade non-thermal conductive pipe sealant.
- Tighten the unit with a wrench using the metal hex nut at the base of the housing.

ELECTRICAL

- Insert the M12 connector gently into the housing, and do not force it as it only fits one way.
- With the 24 VDC power source off, connect the green wire from the unit to positive (+) and the red wire to negative (-).
- For Modbus applications connect the yellow wire and the gray wire to the Modbus master.
- For Analog applications, the white wire provides a 4-20mA output for flow and the brown wire provides a 4-20mA output for temperature.
- Turn on the power source.
- After the power has been applied for ten seconds or so the green "Act" LED should begin to blink.

- The unit is factory calibrated, but the analog version allows field scaling by using the Set button as described below:
 - For the analog version:
 - To set the Maximum Flow (20mA):
 - When the flow is at maximum, hold the “Set” button down until the Act light blinks twice
 - The output will become 20mA
 - To set the Minimum Flow (4mA - mainly for non-water solutions)
 - When the flow is at minimum, hold the Set button down until the Act light blinks 4 times
 - The output will become 4 mA
- The Modbus version provides a means to set the minimum flow through register “1136”. Flows below this setting are presented as 0.
- Temperature is fixed at 4mA = 32°F and 20mA = 212°F
- Modbus Registers:

Legend		
Register	All Registers are holding registers	
RW	R	Read-Only
	RW	Read Write
NV	Value is stored in flash	
Format	C	Character value (1 Modbus register)
	I	Integer value (1 Modbus register)
	L	32 bit Integer, MSB first (2 Modbus registers)
	F	32-bit floating point; Upper 16-bits (MSR) in lowest- numbered / first listed register (257/258 = MSR/LSR). Encoding is per IEEE standard 754 single precision.
	S	String (8 chars)
	LS	Long String (20 chars)

PORT SETTINGS

Modbus RTU (preferably “relaxed” with a 1 second timeout), default is 38400 baud (but can be changed via register), 8-N-1 serial settings, DeviceID=42 (also can be changed via register).

It is recommended when reading registers to read #100. If this does not produce a reading, attempt to read #101. All memory registers start with 0 or 1 (example: #3100 or #3101 ; #100 or #101).

Register	RW	NV	Format	Range	Description
Measurements					
0	R		F		Volumetric Flow
2	RW		F		Totalized Flow
4	R		F		Temperature
6	R		F		Flow Velocity
100	R		I		Cycle Count
Modbus					
512	RW	NV	C	1-254	Modbus Slave Address
513	RW	NV	I	300-115200	Baud Rate
Units					
1000	RW	NV	I		Units of measure. See table below; this sets all the registers in this group except 1256, 1136, and 1140
70	RW	NV	S		velocity description automatically set by register 1000 eg "m/s"
50	RW	NV	S		As above for volume flow units; eg "lpm"
60	RW	NV	S		As above for temperature unit; eg "C"
80	RW	NV	S		As above for totalizer units; eg "liters"
90	RW	NV	S		As above for pipe size units; eg, "mm"
1256	RW	NV	F		Inner diameter of the pipe
1136	RW	NV	F		Minimum readable velocity (velocities below this threshold will read as 0)
Identity					
900	R	NV	L		Article Number
902	R	NV	C		Factory Country of Origin
903	R	NV	I		Serial Number
905	R	NV	I		Hardware Revision
910	RW	NV	LS		Sensor Location Identifier (eg chilled water 2)
920	R	NV	S		Temp Exceeded Flag
921	R	NV	F		Min Temp Encountered
922	R	NV	F		Max Temp Encountered
950	R	NV	S		Device Identity String (i-captor 4.102)

Master Unit Modes	Refers to register 1000
0	Mixed/Custom
1	C, m/s, LPM, Liters
2	F, ft/s, GPM, Gallons
3	F, ft/s, GPH, Gallons