MICRO-FLO

MICRO-FLO
Digital Paddlewheel Flow meter
Operating Manual

Blue-White®
Industries, Ltd.

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1.0 Introduction

The Micro-Flo flowmeter is designed to display flow rate and flow total on a six digit LCD display. The meter can measure bi-directional flows in either vertical or horizontal mounting orientation. Six flow ranges and four optional pipe and tubing connections are available. Pre-programmed calibration K-factors can be selected for the corresponding flow range or a custom field calibration can be performed for higher accuracy at a specific flow rate. **The meter is factory programmed for the correct K-factor of the body size included with the meter.**

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2.0 Features

- Four connection options available:
  1/8" F/NPT, 1/4" F/NPT, 1/4" OD x .170 ID Tubing & 3/8" OD x 1/4" ID Tubing sizes.
- Six body size/flow range options available:
  30 to 300 ml/min, 100 to 1000 ml/min, 200 to 2000 ml/min,
  300 to 3000 ml/min, 500 to 5000 ml/min, 700 to 7000 ml/min.
- 3 model display variations:
  FS = Sensor mounted display
  FP = Panel mounted display (includes 6' cable)
  FV = No display. Sensor only. 5vdc current sinking output
- 6 digit LCD, up to 4 decimal positions.
- Displays both rate of flow and total accumulated flow.
- Open collector alarm setpoint.
- User selectable or custom programmable K-factor.
  Flow units: Gallons, Liters, Ounces, milliliters
  Time units: Minutes, Hours, Days
- Volumetric field calibration programming system.
- Non-volatile programming and accumulated flow memory.
- Total reset function can be disabled.
- Clear PVC viewing lens or PVDF chemical resistant lens.
- Weather resistant Valox PBT enclosure. NEMA 4X

3.0 Model number matrix

METER FUNCTION
FS = Flow rate and Totalizing. On-sensor mounting
FP = Flow rate and Totalizing. Remote panel mounting
FV = Flow sensor only (no display)

POWER SUPPLY
1 = Transformer U.S. 115VAC/15VDC
2 = Transformer E.U. 220VAC/15VDC
3 = Transformer U.S. 230VAC/15VDC
None = No selection (customer supplied)

FLOW RANGE SELECTION
10 =   30-300 ml/min
20 = 100-1000 ml/min
30 = 200-2000 ml/min
40 = 300-3000 ml/min
50 = 500-5000 ml/min
60 = 700-7000 ml/min
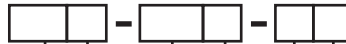
O-RING SEAL
V = Viton
E = EPDM

CONNECTOR
4 = .250" OD tubing PVDF
5 = .125" Female NPT PVC
6 = .375" OD tubing PVDF
7 = .250" Female NPT PVC

LENS MATERIAL
0 = Clear PVC
1 = Opaque PVDF

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4.0 Specifications

Max. Working Pressure:
  PVC lens,   130 psig (9 bar) @ 70° F (21° C)
  PVDF lens,   150 psig (10 bar) @ 70° F (21° C)
Max. Fluid Temperature:
  PVC lens, F/NPT connectors   130° F (54° C) @ 0 PSI
  PVDF lens, tubing connectors   200° F (93° C) @ 0 PSI
Full scale accuracy   +/- 6%
Input Power requirement: 9 - 28 VDC (31mA @ 15Vdc)
Sensor only output cable: 3-wire shielded cable, 6ft
Pulse output signal: Digital square wave (2-wire) 25ft max.
                                     Voltage high = 5Vdc,
                                     Voltage low < .25Vdc
                                     50% duty cycle
Output frequency range: 4 to 500Hz
Alarm output signal: **NPN** Open collector. Active low above
                                     programmable rate set point.
                                     30Vdc maximum, 50mA max load.
                                     Active low < .25Vdc
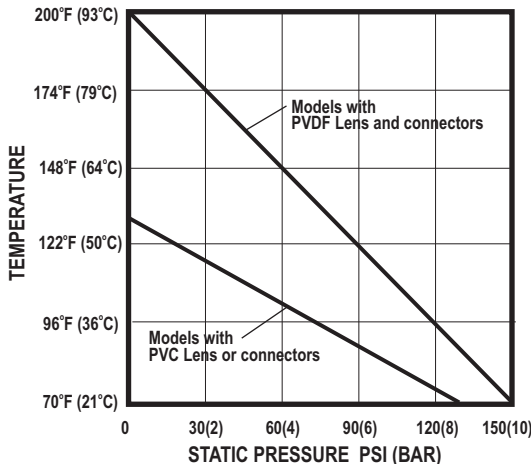   2K ohm pull up resistor required.
Enclosure: NEMA type 4X, (IP56)
Approximate shipping wt: 1 lb. (.45 kg)

4.1 Temperature and Pressure limits

Maximum Temperature vs. Pressure
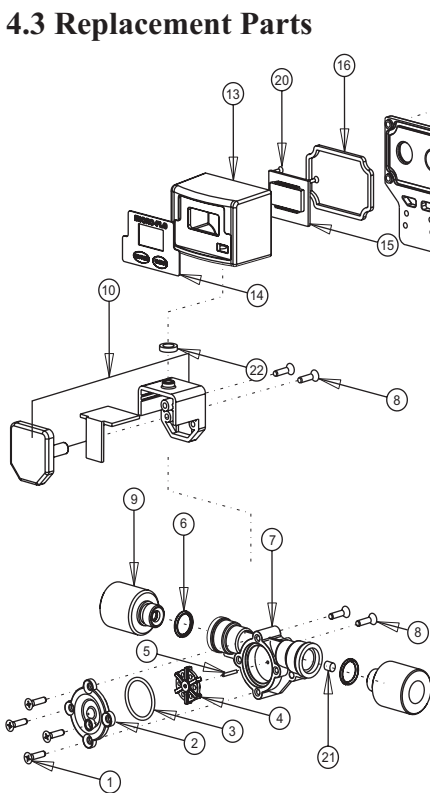
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4.2 Dimensions

5.00 in
[127 mm]

2.22 in
[56.26 mm]

1.48 in
[37.71 mm]

3.51 in
[89.03 mm]
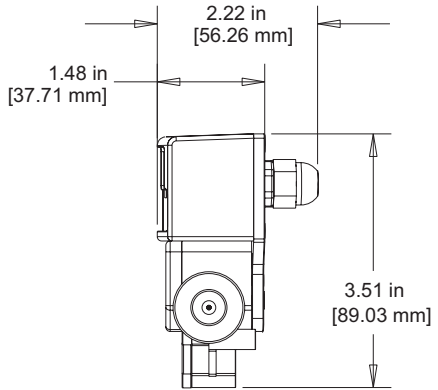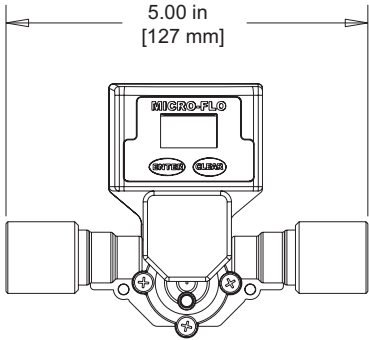
4.3 Replacement Parts

PARTS LIST

Key	Part No.	Description	Qty.
1	90011-081	Screw 6-32x.50 Phil Flt SS	4
2	90002-227	Lens Cap Clear PVC	1
	90002-228	Lens Cap Opaque PVDF	3
	90003-143	O-Ring Viton	1
	90003-146	O-Ring EP	
4	90002-230	Paddle PVDF	1
5	90007-592	Axle PVDF	1
6	90003-012	O-Ring Viton	2
	90003-011	O-Ring EP	
7	76001-300	Body S1 PVDF (30-300ml/min)	1
	76001-301	Body S2 PVDF(100-1000ml/min)	
	76001-302	Body S3 PVDF (200-2000ml/min)	
	76001-303	Body S4 PVDF (300-3000ml/min)	
	76001-304	Body S5 PVDF (500-5000ml/min)	
	76001-305	Body S6 PVDF (700-7000ml/min)	
8	90011-113	Screw #4x.50 Phil Blk	4
9	76000-137	Adapter .250 F/NPT PVC	2
	76000-456	Adapter .125 F/NPT PVC	
	90002-038	Adapter .37OD x .25ID Tube PVDF	
	90002-042	Adapter .25OD x .17ID Tube PVDF	
10	90012-252	Sensor	1
13	90002-242	Enclosure, Valox	1
14	90012-254	LCD display	1
15	90010-260	Circuit board	1
16	90006-604	Gasket, rear enclosure	1
17	90002-243	Cover, enclosure rear	1
18	90008-199	Liquid Tight Connector Set	1
19	90011-178	Screw #4x.62 Phil SS Blk	4
20	90011-177	Screw #2x.25 L Phil St	2
21	76001-299	Tubing connector seal	1
22	90006-605	Gasket, sensor mount seal	1

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5.0 Installation
5.1 Wiring Connections

On sensor mounted units, the output signal wires must be installed through the back panel using a second liquid-tite connector (included). To install the connector, remove the circular knock-out. Trim the edge if required. Install the extra liquid-tite connector.

On panel or wall mounted units, wiring may be installed through the enclosure bottom or through the back panel. See below.

KNOCK-OUT ½" diameter

Power Input

Rear view
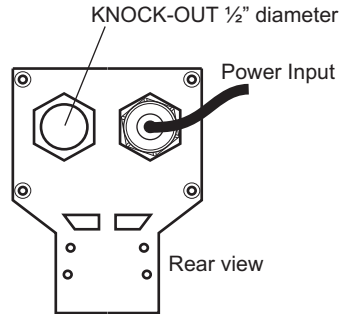
5.2 Circuit Board Connections

Programming disable jumper (un-installed).
Install on both pins to disable programming.

Alarm output
Open Collector
30 VDC max
50mA max

2K
(+)—WWW—→
2K ohm pull up
resistor required   (-) —→

(+)—→
(-)—→

CIRCUIT
BOARD

Power input (+ 9-28 Vdc)
Power input (ground)
Sensor input (+) RED
Sensor input (signal) BARE
Sensor input (-) BLACK

Pulse output
Digital sq. Wave
5 VDC high
<.25 VDC low
50% duty cycle

Front panel touch pad
ribbon cable connection

5.3 Flow Verification Output Signal

When connected to external equipment such as a PLC, data logger, or Blue-White metering pump, the pulse output signal can be used as a flow verification signal. When used with Blue-White metering pumps, connect the positive (+) terminal on the Micro-Flow circuit board to the pump's yellow signal input wire and the negative (-) terminal to the black input wire.

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5.4 Panel or wall mounting

Wiring through enclosure
bottom for dry applications

Through panel wiring
for water resistant
applications

Panel or wall
mounting screw
locations

Recommended panel or
wall mounting cut-out
for wire connection opening

1.75 in
[45 mm]
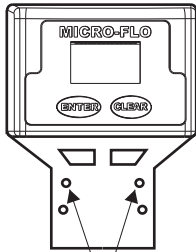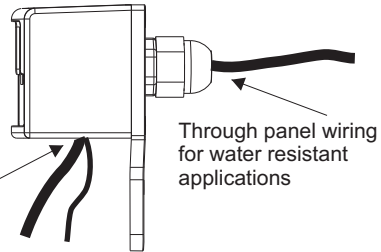
1.00 in
[25 mm]
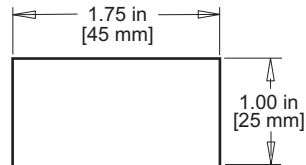
6.0 Operation

6.1 Theory of operation

The Micro-Flo flowmeter is designed to measure the flow rate and accumulate the total volume of a fluid. The unit contains a paddle wheel that has six (6) through holes to allow infrared light to pass through, a light-detecting circuit and a LCD-display electronic circuit.

As fluid passes through the meter body, the paddle wheel spins. Each time the wheel rotates a DC square wave is output from the sensor. There are six (6) compete DC cycles induced for every revolution of the paddle wheel. The frequency of this signal is proportional to the velocity of the fluid in the conduit. The generated signal is then sent into the electronic circuit to be processed.

The meter is factory programmed for the correct K-factor of the body size included with the meter.

The Micro-flo flowmeter includes the following features:
- Displays either the flow rate or the accumulated total flow.
- Provides a pulse output signal that is proportional to the flow rate.
- Provides an open collector alarm output signal. Active low at flow rates above the user programmed value.
- Provides user selectable, factory preset calibration k-factors.
- Provides a field calibration procedure for more precise measurement.
- Front panel programming can be disabled by a circuit board jumper pin.

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6.2 Control Panel

Enter Button (right arrow) -

- **Press and release** - Toggle between Rate, Total, and Calibrate screens in the run mode. Select program screens in the program mode.

- **Press and hold 2 seconds -** Enter and exit program mode. (Automatic exit program mode after 30 seconds of no inputs).

Clear/Cal (up arrow) -

- **Press and release** - Clear total in the run mode. Scroll through and Select options in the program mode.

6.3 Flow stream requirements

- The Micro-flo flowmeter can measure fluid flow in either direction.

- The meter must be mounted so that the paddle axle is in a horizontal position - up to 10° off the horizontal is acceptable.

- The fluid must be capable of passing infra-red light.

- The fluid must be free of debris. A 150 micron filter is recommended - especially when using the smallest body size (S1), which has a 0.031" through hole.

6.4 Run mode display

Body size/range
0 = Field calibrate
1 = 30-300 ml/min
2 = 100-1000 ml/min
3 = 200-2000 ml/min
4 = 300-3000 ml/min
5 = 500-5000 ml/min
6 = 700-7000 ml/min

Field Calibration indicator
Cal (steady) = active
Cal (flashing) = calibrating
none = factory cal. active

Flow units indicator
ML = Milliliters
OZ = Ounces
GAL = Gallons
LIT = Liters

Display Value

Function indicator
R = Flow rate indicated
T = Flow total indicated

Alarm indicator
SetP (steady) = active
SetP (flashing) = alarm
none = not programmed

Rate time base indicator
Min = Rate per minute
Hr = Rate per hour
Day = Rate per day

6.5 Run mode operation
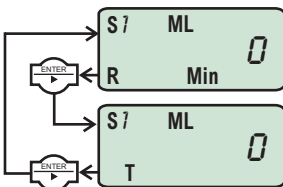
FLOW RATE DISPLAY - Indicates rate of flow, **S1** = body size/range #1, **ML** = units displayed in milliliters, **MIN** = time units in minutes, **R** = flow rate displayed.

FLOW TOTAL DISPLAY - Indicates accumulated total flow, **S1** = body size/range #1, **ML** = units displayed in milliliters, **T** = total accumulated flow displayed.

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6.6 Viewing the K-factor (pulses per unit)

51   ML
0
R   Min

While in the run mode, Press and hold ENTER then press and hold CLEAR to display the K-factor.

51
181336
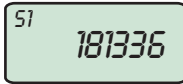
Release ENTER and CLEAR to return to run mode.

Body Size	Flow Range (ml/min)	Pulses per Gallon	Pulses per Liter
1	30-300	181,336	47,909
2	100-1000	81,509	21,535
3	200-2000	42,051	13,752
4	300-3000	25,153	6,646
5	500-5000	15,737	4,157
6	700-7000	9,375	2,477

Useful formulas

60 / K = rate scale factor

rate scale factor x Hz = flow rate in
                          volume per minute

1 / K = total scale factor

total scale factor x n pulses = total volume

7.0 Programming

The Micro-Flo flowmeter uses a K-factor to calculate the flow rate and total. The K-factor is defined as the number of pulses generated by the paddle per volume of fluid flow. **Each of the six different body sizes have different operating flow ranges and different K-factors. The meter is factory programmed for the correct K-factor of the body size included with the meter.**

The meter's rate and total displays can be independently programmed to display units in milliliters (ML), ounces (OZ), gallons (GAL), or liters (LIT). Rate and total can be displayed in different units of measure. The factory programming is in milliliters (ML).

The meter's rate display can be independently programmed to display time base units in minutes (Min), Hours (Hr), or Days (Day). The factory programming is in minutes (Min).

For greater accuracy at a specific flow rate, the meter can be field calibrated. This procedure will automatically over-ride the factory K-factor with the number of pulses accumulated during the calibration procedure. The factory default settings can be re-selected at any time.

7.1 Field Calibration

Any body size/range can be field calibrated. Calibration will take into account your specific application's fluid properties, such as viscosity and flow rate, and increase the accuracy of the meter in your application.

The Body Size/Range must be set for "S0" to enable the calibration mode. Follow the programming instructions on pages 10 & 11 to reset the Body Size/Range and perform the calibration procedure.

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7.2 Programming for body size/ranges S1through S6 -

Press and Hold ENTER to initiate the programming mode.

S1

BODY SIZE/RANGE - Select your body size. Selected body size flashes.

CLEAR CAL/▲ **Press and release** to select. **S1 > S2 > S3 > S4 > S5 > S6 > S0**
Note: Select S0 for field calibrating any body size range.*

1 ML **0** **R Min**

RATE UNIT OF MEASURE - current unit of measure setting flashes

CLEAR CAL/▲ **Press and release** to select. **ML > OZ > GAL > LIT**

2 ML **0** **R Min**

RATE DECIMAL LOCATION - current decimal display setting flashes.

CLEAR CAL/▲ **Press and release** to select. **0 > 0.0 > 0.00 > 0.000 > 0.0000**

3 ML **0** **R Min**

RATE TIME BASE - current time base unit of measure setting flashes.

CLEAR CAL/▲ **Press and release** to select. **Min > Hr > Day**

1 ML **0** **T**

TOTAL UNIT OF MEASURE - current unit of measure setting flashes

CLEAR CAL/▲ **Press and release** to select. **ML > OZ > GAL > LIT**

2 ML **0** **T**

TOTAL DECIMAL LOCATION - current decimal display setting flashes.

CLEAR CAL/▲ **Press and release** to select. **0 > 0.0 > 0.00 > 0.000 > 0.0000**

3 RST **Y** **T**

TOTAL RESET ENABLE - current Y (yes) or N (no) setting flashes.

CLEAR CAL/▲ **Press and release** to select. **Y > N**

1 OFF **R SetP**

ALARM SETPOINT ENABLE - current ON or OFF setting flashes.

CLEAR CAL/▲ **Press and release** to select. **ON > OFF**

If "on" → **2 000000 R SetP**

ALARM SETPOINT VALUE - current value setting flashes.

CLEAR CAL/▲ **Press and release** to select the digit to change.

ENTER CLEAR CAL/▲ **Press and hold ENTER then press CLEAR**
to change the selected digit.

If "off"

d 000.000 R SetP

ALARM VALUE DECIMAL LOCATION - current decimal
display setting flashes.

CLEAR CAL/▲ **Press and release** to select. **0 > 0.0 > 0.00 > 0.000
> 0.0000**

If range "S0" is selected, continue to field calibration procedure, next page. ⟶

**If range S1 through S6 is selected, return to program screen or
press and hold ENTER to exit the programming mode.**

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7.3 Field calibration size/range setting S0 - Continuation of programming sequence when range "S0" is selected.

The meter should be installed as intended in the application.

The amount of fluid that flows through the meter during the calibration procedure must be measured at the end of the calibration procedure.

Allow the meter to operate normally, in the intended application, for a period of time. A test time of at least one minute is recommended. Note - the maximum number of pulses possible is 52,000. Pulses will accumulate in the display. After the test time period, Stop the flow through the meter. The pulse counter will stop.

Determine the amount of fluid that passed through the meter using a graduated cylinder, scale, or other method. The measured amount must be entered in calibration screen #4 "MEASURED VALUE INPUT."

CALIBRATION "RUN" REQUEST - Current N (no) setting flashes.

Press and release to select. **Y > N**

If "yes"

If "no"

CALIBRATION READY - Zeros flash.

Press and release to start calibration counter. Start flow through the meter. Begin measuring fluid. Pulses will begin to accumulate. (CAL icon blinks).

CALIBRATION COMPLETE - Pulse count displayed.

Stop flow through the meter. Press and release to stop calibration counter. (CAL icon stops blinking).

VOLUME UNITS - current units setting flashes.

Press and release to select units of measure used in the calibration . **ML > OZ > GAL > LIT**

MEASURED VALUE INPUT - Input the amount of fluid measured. The selected digit blinks.

Press and release to select the digit to change.

Press and hold ENTER then press CLEAR to change the selected digit.

MEASURED VALUE DECIMAL LOCATION - current decimal display setting flashes.

Press and release to select. **0 > 0.0 > 0.00 > 0.000 > 0.0000**