

INSTALLATION, OPERATION AND MAINTENANCE

Threaded and Wafer Style Flowmeters

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Wafer Style Flowmeter
Figure 1

1.

Principle of Operation

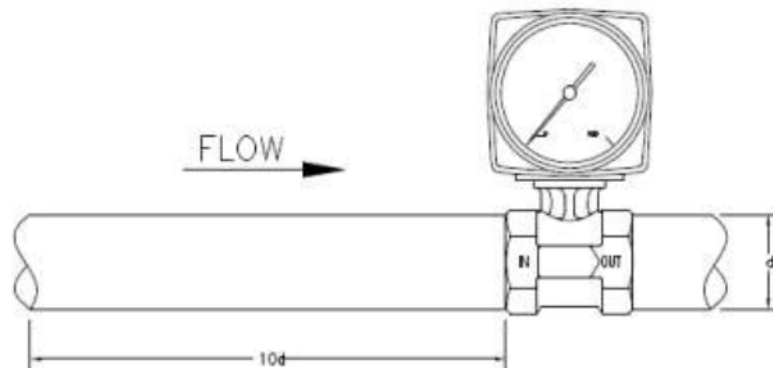
These threaded and wafer style flowmeters measure flow rate by sensing the pressure differential created across the flow nozzle which is machined into the body of the flowmeter. A pair of matched, opposed bellows sense the differential pressure and drive a mechanical linkage to indicate flow rate directly on the dial. (When fitted with a blind transmitter or digital display readout, the bellows and mechanical linkage are replaced with a solid state differential pressure sensor).

2.

Installation Planning and Site Selection

Select a site which is convenient for viewing and which provides service access to the front and rear of the flowmeter. Note that the dial can be ordered in any orientation at 90 degree increments and can be easily re-oriented in the field. See [Changing the Dial Orientation](#) in the installation section. The site selected should provide at least 10 pipe diameters of straight meter size pipe between the flow meter inlet and any upstream fitting such as elbow, tee or valves. There are no special requirements for the downstream connections to the meter.

Note that the flow meters are calibrated based on schedule 40 pipe connections. Tubing and hoses do not have the same ID as pipe and should be transitioned to pipe at least 10 pipe diameter upstream of the flowmeter to achieve rated accuracy.



Installation Conditions
Figure 2

Avoid placing the flow meter where it will be subjected to water hammer and mount the flowmeter rigidly to minimize shock or vibration.

Flow meters installed outdoors or exposed to splashing liquids should be ordered with a gasketed case.

Protect from freezing liquids.

3.

Installation

3.1 Safety Considerations

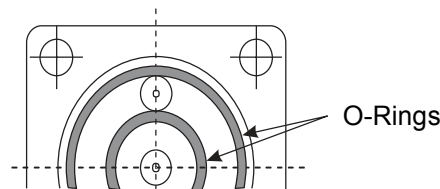
Do not exceed the pressure and temperature limits marked on the nameplate of the flow meter. Although each flow meter is pressure tested to 150% of nameplate rating, overpressure may cause injury, leaking or flow meter damage.

Temperature ratings are determined by the effects on the mechanical linkage, elastomer seals and electronics (if electronics are fitted). If temperature ratings are exceeded, the flow meter may be damaged or fail. Contact the factory for application assistance for expanded temperature operation.

3.2 Changing the Dial Orientation

Note the flow direction arrows on the body. If necessary, change the dial facing direction by removing the four screws holding the body to the housing. **Do not remove the two screws holding the housing to the cell block assembly.**

Position the housing at any 90 degree position. Replace the four screws taking care not to pinch the o-ring seals.



O-Ring Installation
Figure 3

3.3 Changing from Horizontal to Vertical or Vertical to Horizontal

ABS Housing

Remove the lens by rotating counter-clockwise by hand. **Do not remove the pointer.** Move the dial forward gently by prying with a small knife at the 12:00 o'clock position. Rotate the dial to the desired viewing position and push the dial into position. There are 4 locating indents on the dial edge and housing to position the dial at 90 degree increments.

Aluminum Housing

Using a small screwdriver blade to lift the end of the retainer ring up and out of the housing recess, remove the retainer ring and dial crystal. **Do not remove the pointer.** Remove the two screws holding the dial and rotate the dial to the desired viewing position. Reinstall the screws to hold the dial in position. It may be necessary to shorten the screws to approximately 1/8 (3mm) to avoid contact with gear movement.

Either Housing

Rezero the flow meter using the FINE ADJUSTMENT procedure.

3.4 Threaded Bodies

Make up thread joints using a suitable sealant. Be sure threads are clean and free of burrs before making up joint.

3.5 Wafer Style Bodies

Install the flow meter between mating flanges. Take care to center the gaskets so that they do not protrude at all into the pipeline which will cause significant error.

4.

Operation and Maintenance

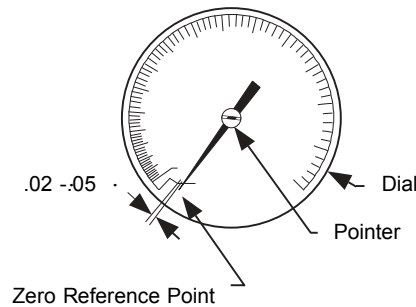
4.1 Preventative Maintenance

The flow meter does not require routine lubrication or service of any kind. Keep the interior of the flow meter housing clean and free of dust, moisture, oils or corrosive materials. Protect the flow meter from dripping or splashing corrosives or solvents which may attack meter exterior and eventually damage the internal mechanism.

4.2 Checking Zero

Water hammer or pressure surges can displace the bellows and cause the zero to shift. If the pointer does not return to the zero reference point when flow through the meter is zero, or if the pointer does not move away from the zero reference point at 12-15% of full scale flow, then check the zero adjustment as follows:

- Stop flow.
- Remove the lens
- Observe the position taken by the pointer. When properly adjusted, the pointer should point to the zero reference point as shown in Figure 4.
- If the pointer is positioned within 1/2 (12mm) of zero reference point, then follow FINE ADJUSTMENT procedure to re-zero flow meter.
- If the pointer is positioned more than 1/2 (12mm) from the zero reference point, then follow the COARSE ADJUSTMENT procedure.



Zero Reference Point

Figure 4



Pointer Preload

Figure 5

4.3 Checking the Pointer Preload

If the fine adjustment has been performed repeatedly, the pointer return spring preload should be checked. Manually rotate the pointer CCW toward full scale. The pointer should stop at full scale. If the pointer goes beyond full scale, adjust with the cam nut following the COARSE ADJUSTMENT procedure. Otherwise, go to the FINE ADJUSTMENT procedure.

4.4 Coarse Zero Adjustment

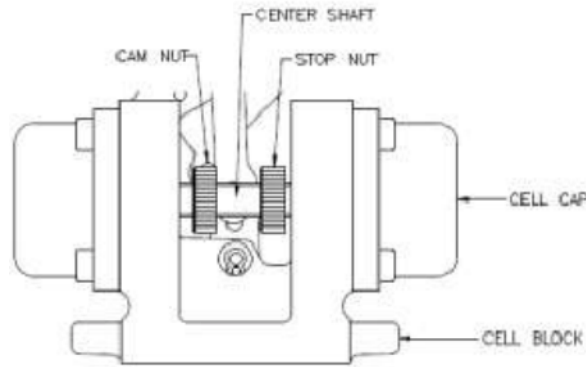
If necessary to restore spring preload, place a small screwdriver in the slotted pointer hub. Grip the pointer close to the hub on both sides of the hub and rotate the hub approximately one-quarter turn clockwise with respect to the pointer. Check preload by rotating the pointer CCW toward full scale. When properly adjusted, the pointer should stop at full scale.

4

Operation and Maintenance (Continued)

Release the pointer. Using the cam nut, adjust the lever so that the pointer points to the zero reference point.

Check the position of the stop nut. Applying force to the stop nut, manually move the center shaft to the right (as seen from the rear) and make certain that the stop nut contacts the cell block when the pointer stops. If necessary, adjust the stop nut to stop the pointer near the 6 o'clock position. The factory set point is the 4 in USA .



Cam Nut and Stop Nut

Figure 6

IMPORTANT: The stop nut must stop the center shaft movement before the bellows hit the cell cap. If the bellows hit the cell cap, the bellow or cap can be damaged causing leaking or meter error.

Adjust the cam nut until the pointer points at the zero reference point. Gently tap the flow meter housing to overcome residual friction while making the adjustment.

Test for freedom of the pointer movement by rotating the pointer approximately 30 degrees and releasing. Pointer should return quickly to the zero reference point. Clean and reinstall the lens.

4.5 Fine Zero Adjustment

Note: if fitted with 4-wire transmitter or with reed switches, do not use this procedure. Do all adjustments with the coarse zero adjustment. Adjustment of the zero using this method will require recalibration of the reed switches or transmitter.

Grip the pointer close to the hub on both sides of the hub and rotate the hub with respect to the pointer. The pointer should aim directly at the zero reference point printed on the dial as shown in figure 4.

Gently tap the flow meter housing to overcome residual friction while making the adjustment. Test for freedom of pointer movement by rotating the pointer approximately 30 degrees and releasing. Pointer should return quickly to zero reference. Clean and reinstall lens.

4.6 Flow Calibration

The orifice has been factory adjusted to provide the proper differential pressure for accurate flow meter operation. NIST traceable certifications are available when ordered prior to shipment or may be obtained by returning the flow meter for recalibration. Field calibration may be verified using the following procedure:

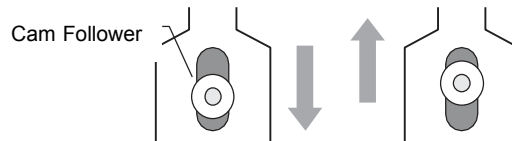
Check the zero adjustment of the pointer. Cycle the flow rate from zero to full scale three to four times and observe the pointer motion. Pointer should return to zero smoothly.

4.

Operation and Maintenance

Establish a known flow rate through the flow meter corresponding to approximately 90% of full scale and observe the flow meter indication. Move the camfollower up to decrease the pointer indication or down to increase the pointer indication.

To move the cam follower up, rest a screwdriver on the cell block with the blade between the cell block and center shaft. Pry gently up on the cam follower. To move the cam follower down, place the screwdriver on top of the cam follower. With the blade resting against the case press gently down. Take care not to put excessive forward pressure on the cam follower to prevent the G clip on the pivot shaft from coming off. Re-zero the flow meter using the cam nut.



Cam Follower Adjustment

Figure 7

Check flow meter indication at 50% of full scale. The flow meter should indicate actual flow rate within 3% of full scale. If meter does not indicate actual flow, consult factory.

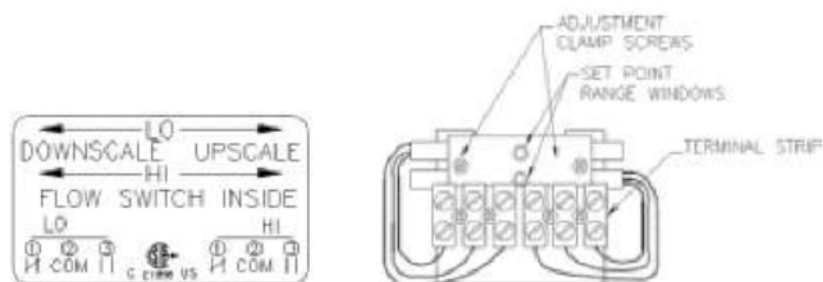
4.7 Cleaning of Pressure Ports

Remove the flow meter housing from the body by removing the 4 screws. Remove the pulsation snubbers from the body by inserting a small wood screw into the hole in the pulsation snubbers and gently pull them out. Clean the passages in the body and snubbers and reassemble. If you are unable to clean without further disassembly, the flow meter should be returned to the factory for service.

Reassemble the flow meter housing to the body in the desired viewing position. Take care to properly seat the inner and outer o-rings before tightening screws.

4.8 Adjustment of Reed Switches

Check the flow meter zero and correct if necessary using the coarse or fine zero procedure before proceeding. Connect continuity tester to N.O. contact. Loosen the switch clamp. Establish the desired flow rate for switch tripping. Slide the switch to the left most position. Range window should show a partial or complete green mark. Slowly slide to the right while monitoring N.O. contact. Switch will close. Continue to slide to the right. Switch will open (false trigger). Continue to slide to right until switch closes again. Adjust by sliding to the right to raise set point, left to lower. Tighten clamp. Note: Tiny adjustments may be required to reach the desired set point.



Reed Switch Adjustment

Figure 8

5.

Trouble-shooting

5.1 Pointer Fluctuation

Mechanical fluctuation of the pointer is usually a symptom of excessive turbulence in the pipeline. This is frequently caused by valves or fittings installed too close to the flow meter inlet. If moving the meter is not practical, snubbers with smaller holes (heavy duty snubbers) can be installed to increase the mechanical dampening of the flow meter. (Pulsation snubbers are installed standard on all gas flowmeters and on liquid flow meters unless ordered with viscosity correction).

5.2 Zero Shift

The need to frequently re-zero the flow meter is an indication of excessive water hammer. Piping or operating procedures should be changed to reduce water hammer in order to prolong the life of the flowmeter.

5.3 Sluggish Meter Response

Sluggish flow meter response can be caused by inadequate pointer return spring preload or by clogging of the pressure passages with debris. To check spring preload, see CLEANING OF PRESSURE PORTS.

6.

Correction Factors

6.1 Liquid Service

If the specific gravity of the fluid being metered differs from the value marked on the flowmeter dial, a correction factor, J, must be applied to the flow meter reading to obtain the actual flow rate.

Actual flow rate = J x flow meter reading

where:

$$J = \sqrt{\frac{S_c}{S_a}}$$

S_c = Specific Gravity for which the flow meter is calibrated

S_a = Actual specific gravity of the fluid being metered.

Example:

Flow meter, calibrated for water (specific gravity = 1.0) reads 12.5 GPM for a lubricating oil with a specific gravity of 0.85. What is the actual flow rate?

$$J = \sqrt{\frac{1.0}{0.85}} = \sqrt{1.1765} = 1.085$$

Therefore, actual flow = 1.085 x 12.5 = 13.56 GPM

6.

Correction Factors (Continued)

6.2 Compressed Gas Service

If the gas pressure or temperature varies from the values marked on the flow meter dial, then a correction factor, K, must be applied to the flow meter reading to obtain the actual flow rate.

Actual flow rate = K x flow meter reading

where:

$$K = \sqrt{\left(\frac{(P_a + 14.7)}{(P_c + 14.7)}\right) \left(\frac{(T_c + 460)}{(T_a + 460)}\right)}$$

P_a = Actual gas pressure at inlet to flow meter, psig

P_c = Calibrated gas pressure marked on the flow meter dial, psig

T_a = Actual gas temperature at inlet to flow meter, F

T_c = Calibrated gas temperature marked on the flow meter dial, F

Example:

Flow meter calibrated for compressed gas air at 100 F and 80 psig, reads 100 SCFM at an actual temperature of 70 F and pressure of 85 psig. What is the actual flow rate?

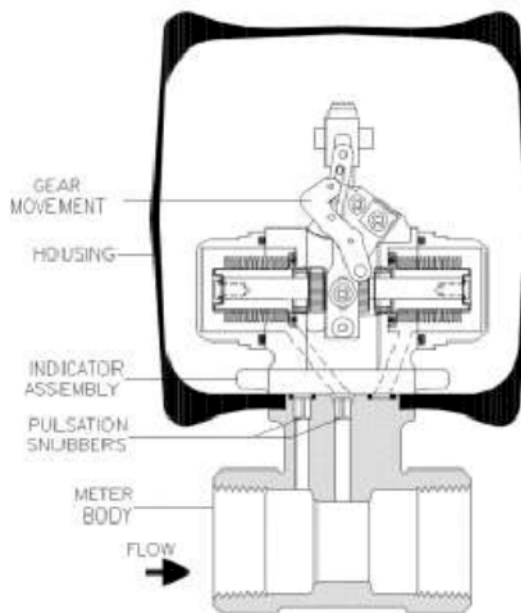
$$K = \sqrt{\left(\frac{(85 + 14.7)}{(80 + 14.7)}\right) \left(\frac{(100 + 460)}{(70 + 460)}\right)}$$

$$K = \sqrt{(1.05)(1.06)} = 1.05$$

Therefore, actual flow rate = 1.05 x 100 = 105 SCFM

7.

Cutaway View



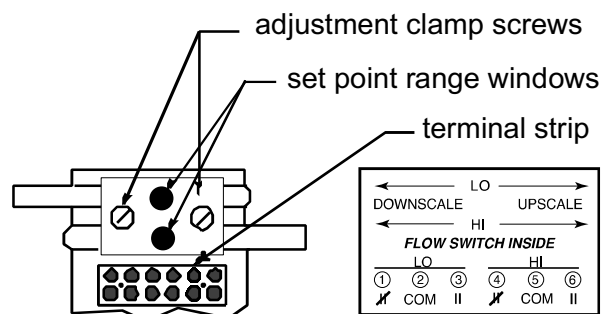
Cutaway View Front
Figure 9

Instructions for Setting Reed Switches

Option 1S2 or 2S2

1. Check the meter zero. Pointer should point at zero reference point with no flow. See Installation, Operation, and Maintenance Manual (M-1) page 4.
2. Remove the back coverplate to gain access to the reed switches and loosen the adjustment clamp screws.
3. Connect a continuity tester to the common and the normally open or normally closed terminal on the terminal strip.
4. Move the pointer to the desired flow rate either by moving the lever with your fingertip or by establishing the desired flow rate through the meter.
Caution: Do not flex the lever forward or backward as this will distort the set point.
5. With the pointer at the desired set point, slide the reed switch until the tester changes state. The set point range window should indicate a partial or complete green mark. (When viewed from the rear, move switch to right for upscale and left for downscale.)
6. Check new set point by moving lever to verify that switching occurs at the desired flow rate. Minor adjustments of the switch may be necessary to “fine tune” to the desired set point.
7. Tighten the adjustment clamp screws taking care not to overtighten as overtightening may break the switch.
8. Replace the back coverplate.

(See reverse for recommended reed switch electrical protection.)



Reed Switch Contact Protection

When switching inductive loads such as relays, solenoids and transformers, reed switch contacts require protection in order to ensure long, dependable life. When contacts open, the inductance or electrical inertia of the load generates a large high frequency voltage which appears across the switch contacts. If the voltage is large enough, it can arc, causing the contacts to burn, weld together or stick. The purpose of protecting the circuit is to prevent arcing by shorting this voltage through an alternate path.

Important:

- Don't be misled by the resistive rating of the switch. Most applications involve inductive loads.
- Don't be misled by the wattage ratings of the load. Low wattage loads are often high inductive devices, making contact protection important.

D.C.

A 1N4004 diode (or equivalent) should be connected in series with the reed switch as shown in figure 1.

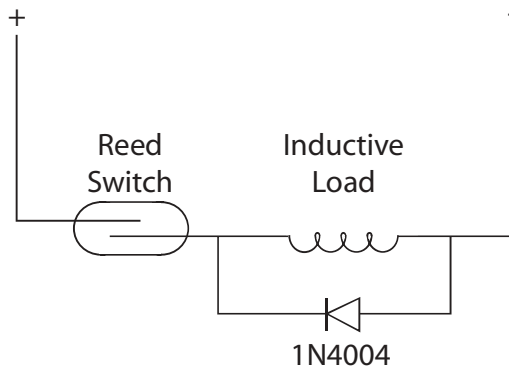


Figure 1
DC Contact Protection

A.C.

Connect a resistor and capacitor in parallel with the switch.

Transient suppressors or varistors may also be used to dissipate the transient and protect the switch contacts.

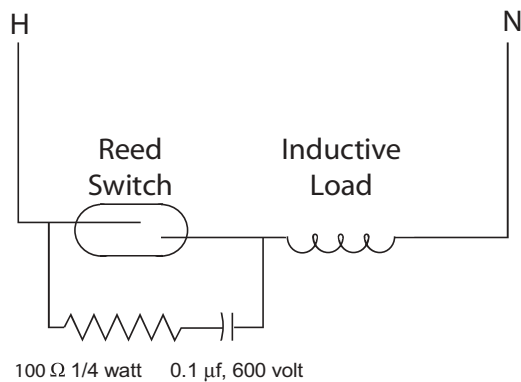


Figure 2
AC Contact Protection

WIRING AND CALIBRATION

Transmitter Options W,X,Y & Z

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1

Installation & Wiring

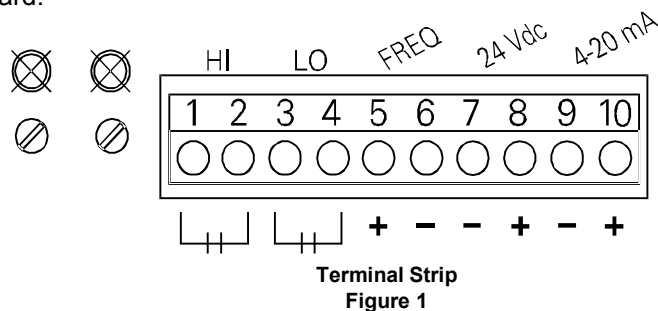
1.1 General

The transmitter board is fitted inside the enclosure of either the threaded or wafer style flowmeter. Option W provides a 4-20 mA dc, option Y provides a 0-1000 Hz frequency, option X provides set point switching and option Z combines W, X & Y.

The position of the gear lever is detected using a pair of magnets mounted on the lever and a solid state Hall effect sensor mounted on the circuit board. The output of the transmitter is linear with flow. The transmitter is powered by an external 24 volt dc power supply provided by the user. A rated capacity of 100 mA is required to power all options.

1.2 Precautions

The power supply used to power the transmitter **MUST BE ISOLATED**. This means that the power supply ground and the input signal grounds must **NOT** be common. Some batch controllers and counters have auxiliary power supplies which are not isolated. Use of these non-isolated power supplies will cause a failure of the power supply and/or the transmitter board.



Important. Do not connect terminals 7 and 9 together. Damage will result. The installation must be 4-wire. One pair of wires supplies 24 Vdc to pins 7 and 8 and one pair carries the 4-20 mA signal to the peripherals.

2

Interfacing the frequency output

2.1 Frequency output interfacing

The frequency output is always factory set to 1000 Hz at full scale flow. To count total flow from the frequency output, it is necessary to scale this output. The scaling factor, K is derived as follows:

$$K = \frac{1000 \text{ pulses / sec} \times 60 \text{ sec / min}}{\text{full scale flow rate (units / min)}}$$

The table below was computed from the above equation and is presented for your convenience.

Scale	K-factor	Scale	K-factor	Scale	K-factor	Scale	K-factor
1	60000	20	3000	120	500	600	100
2	30000	25	2400	150	400	800	75
3	20000	30	2000	200	300	1000	60
4	15000	40	1500	240	250	2000	30
6	10000	50	1200	250	240	3000	20
8	7500	60	1000	300	200	4000	15
10	6000	80	750	400	150	6000	10
15	4000	100	600	500	120		

K-factor Table
Figure 2

The frequency output is a square wave with an amplitude of 5 Vp (into a 10 K ohm or greater impedance). The on time is controlled at 270 microseconds ± 30 microseconds.

The frequency output falls to 0 Hz. whenever the flow rate falls below approximately 20% F.S.

Important. Do not connect terminals 6 and 7 together. Damage will result. The installation must be 4 wire. One pair of wires supplies 24 V dc to pins 7 and 8 and one pair of wires carries the frequency signal to the peripherals. If the current option is fitted, an additional pair of wires is required to carry the current output.

3

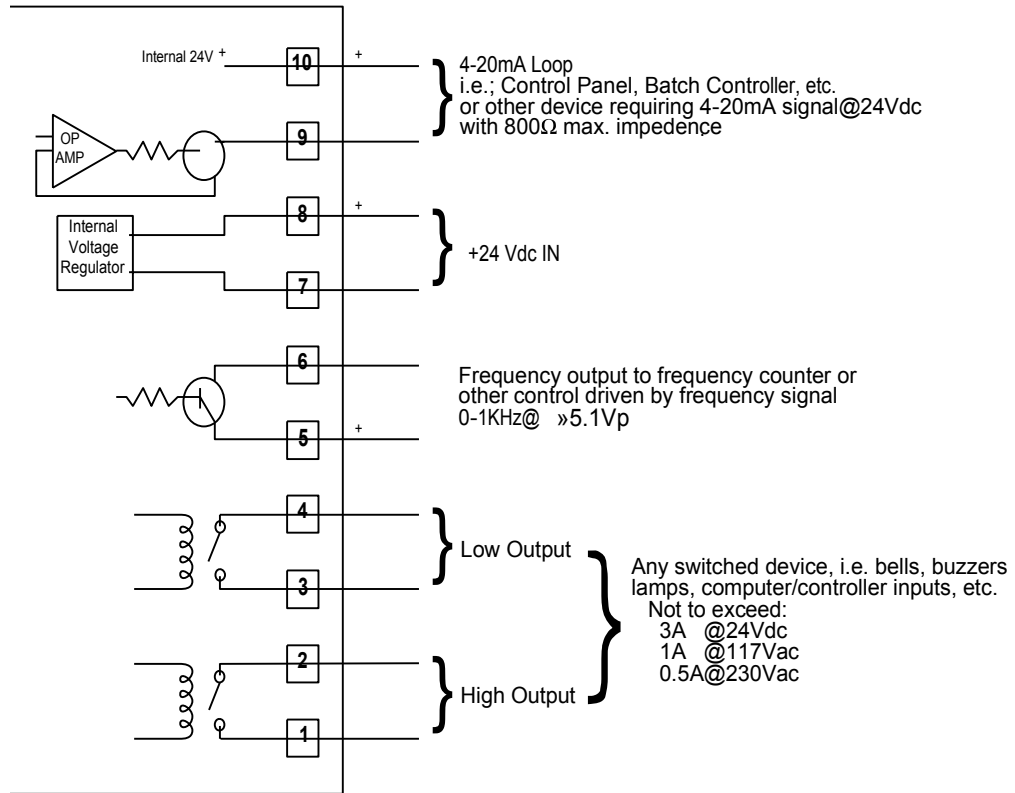
Interfacing the limit switches

3.1 Limit switch interfacing

Power is required to the transmitter board in order for the limit switches to operate. When no power is available, both switches are open and do not close regardless of the flow rate.

- | | |
|-----------|---|
| LO Switch | When power is applied at zero flow, the LO switch closes. As flow increases to the set point, the LO switch opens. |
| HI Switch | When power is applied at zero flow, the HI switch remains open. As flow increases to the set point, the HI switch closes. |

Each switch can be independently set to anywhere in the range. Therefore, the terminology of HI or LO is purely arbitrary. The user can achieve the desired fail safe system wiring by reversing the convention if necessary. As a result the relays can be wired to suit most system or alarm applications.



NOTE: ALL GROUNDS, +24Vdc in, 4-20 mA, and frequency output **MUST** be isolated from each other.

Transmitter Connections
Figure 3

4

Field Calibration (4-20 mA dc)

4.1 Test equipment

Fluke 9600A digital multimeter or equivalent
Non-metallic screwdriver

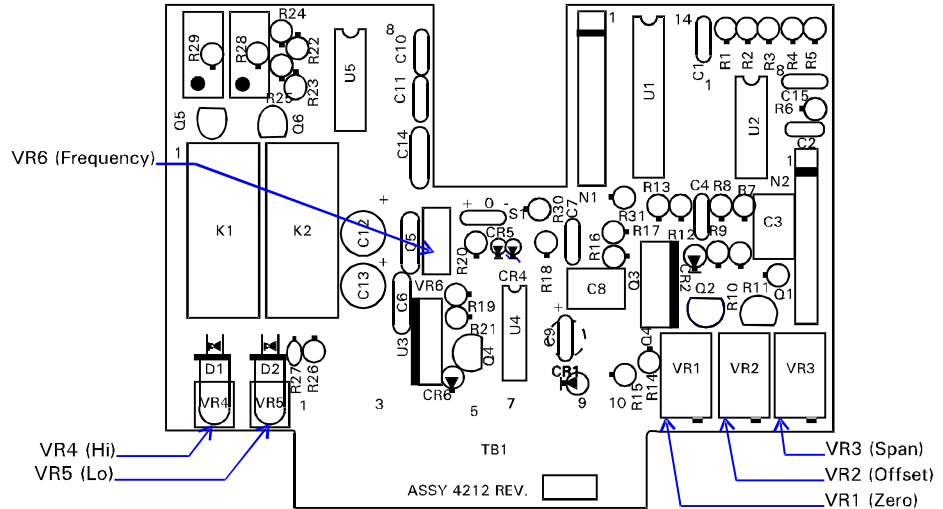
4.2 Setup

Remove the back cover plate to gain access to the adjustment pots and the mechanical parts of the flowmeter. (Refer to the Installation, Operation and Maintenance Manual for the Series 7000 and Series 8000 Flo-Gage if necessary.) Remove the housing lens to gain access to the pointer. Make all mechanical adjustments before proceeding. **DO NOT APPLY POWER UNTIL ALL CONNECTIONS ARE MADE.**

Connect 24 V dc power supply positive to terminal 8 and negative to terminal 7. Set multimeter to milliamp scale and connect to terminal 9 and 10. Turn power on. Observe current output reading.

4

Field Calibration (4-20 mA dc) (Continued)



Transmitter Board
Figure 4

4.3 Adjustment pot location

Pots VR1, VR2 and VR3 are located just to the right of the terminal strip when viewing the meter from the rear. VR1 is adjacent to terminal 10, VR2 is the center pot and VR3 is the rightmost. See Figure 4.

4.4 Calibration

Note: The easiest way to set the pointer for calibration of the transmitter is with the vertical lever. By manipulating this lever, the pointer can be driven up/down scale to the desired location, simulating the flowrate at any given point. (Take care not to flex this lever front to back as calibration will be affected.)

Adjust zero pot VR1 fully CCW. Adjust 4 mA output pot VR2 to 4.00 mA. Set pointer to 30%. Adjust zero pot VR1 to 8.8 mA ± 0.2 mA. Set pointer to 95%. Adjust span pot VR3 to 19.2 mA ± 0.2 mA. Repeat zero (VR1) and span (VR3) adjustments until both adjust within specifications.

5

Field calibration 0-1000 Hz

5.1 Field Calibration

If the transmitter is fitted with current output, adjust current output first. With the pointer at 95% F.S. set VR6 span pot for 950 Hz ± 30 Hz. If current output is not fitted, the meter *MUST* be returned to the factory for calibration.

WIRING AND CALIBRATION

2-Wire Transmitter Options W2 and W3

1.1 General

The transmitter board is fitted inside the enclosure of the flow meter, Option W2 provides a 4-20mA dc output in addition to a local mechanical analog indicator. Option W3 operates identically, but omits the local indication.

The transmitter measures differential pressure directly with a solid state strain gauge. The differential pressure measured is independent of the mechanical measurement provided by the local mechanical indicator. The output of the transmitter is linear with differential pressure. The output must be linearized in the receiving device to provide a flow measurement. The transmitter is powered by an external 24 volt dc power supply provided by the user. A rated capacity of 25mA minimum is required.

1.2 Installation

For NEMA-4, 4X or IP66 installation (Option D). Use CSA / UL approved watertight conduit or cable gland (not included)

For EMC (Electromagnetic Compatibility) installation (Option EM). Use AWG 18, 2 conductor shielded cable with drain wire. **Important:** Terminate shield inside outer housing but outside inner shield housing. See figure 3 for details.

For IS installation (Option IS). Option IS includes Option D and a locking screw on the lens. This screw must be loosened 1/2 turn to obtain access to the dial and pointer. See IS installation drawing #6440 for wiring and barrier installation. Atex installation must comply with EN 60079-14.

CSA / NRTL: Ex ia IIC T3
Class I, Division I, Groups A, B, C, D
Class II, Division I, Groups E, F, G

GENELEC / LCIE: EEx ia IIC 1G
T3, Ta = 0 to 50°C
Atex Directive 94/9/EC, EN 13980:2002

Startup: Pressurize the pipeline and check the zero. Adjust the zero pot if necessary.

2.1 Test Equipment

Fluke 9600A digital multimeter or equivalent. All flow meters are factory calibrated. Connect multimeter in series with current loop. **WARNING:** Do not adjust span unless you are certain that the meter is reading incorrectly.

2.2 Procedure

With pipeline pressurized, adjust zero pot until current reads 4.00mA ± 0.02mA at no flow. Establish a known flow rate through the flow meter as close to 95% of F.S. as practical. Set span, span is set using the following formula: $I = 16 Q^2 + 4.00$; where I = current output in mA, Q = decimal % of full scale.

<u>% FS</u>	<u>Current Output</u>	<u>% FS</u>	<u>Current Output</u>
20	4.64	70	11.84
30	5.44	80	14.24
40	6.56	90	16.96
50	8.00	95	18.44
60	9.76	100	20.00

1.

Installation & Wiring

2.

Field Calibration (4-20mA dc)

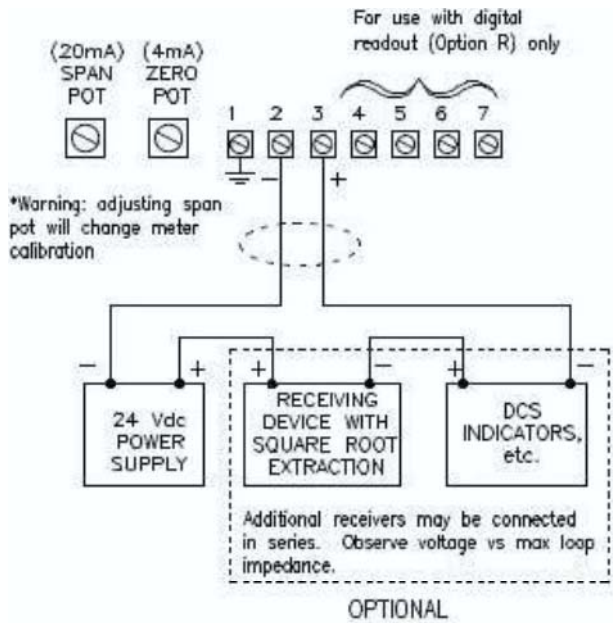


Figure 1
Connection Diagram

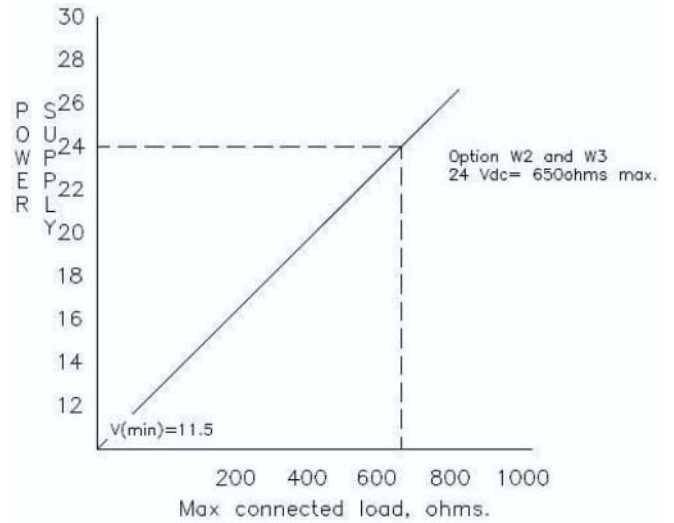
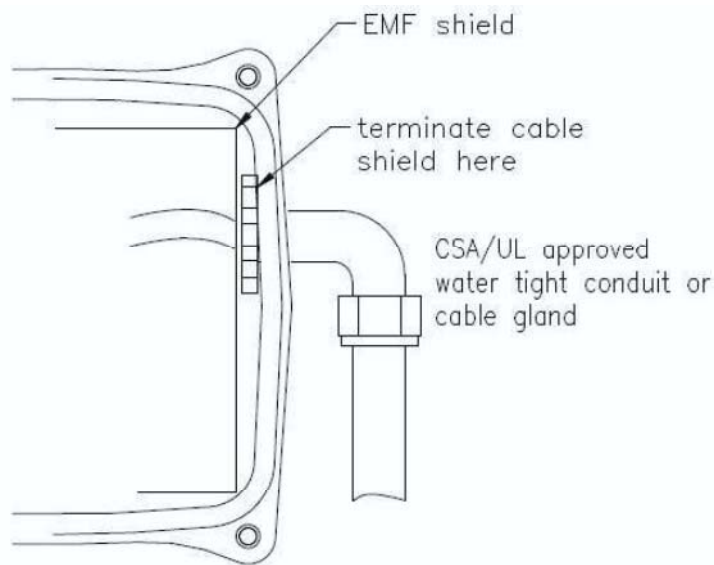


Figure 2
Loop Impedance versus Power Supply Voltage



Housing with rear cover removed
(rear view)

Figure 3
Conduit and Shield Connection Details
for IS and EM Options

WIRING AND PROGRAMMING

Digital Display Option RW3
Digital Display Accessory DR-1

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1.1 General

This manual covers the wiring and programming of the digital display which is installed in the flow meter housing (Option RW3) and accessory digital display remote mounting (Option DR-1). See page 5 "Output to Flow Chart" for transmitter output (Options W2, W3 and RW3) and M2 Manual for transmitter (Option W).

The display provides up to 4 1/2 digits for rate and 8 digits for totalization. The display incorporates a microprocessor for scaling and selectable square root extraction. An isolated, scaled open collector output is included for operating a remote contact closure for remote totalization. See figure 3 to convert this output to a voltage output.

The remote digital display (DR-1) requires a 4-20mA signal which is provided by transmitter Options W2, W3 or W. The W2, W3 and RW3 are a 2 wire loop powered (square root function) and the W option is a 4 wire transmitter (linear output signal). An external 24Vdc power supply is required (Option PS-24).

1.

Installation & Wiring

1.

Installation & Wiring

(Continued)

1.2 Wiring built-in digital readout

WARNING - ADJUSTING SPAN POT
WILL CHANGE METER CALIBRATION

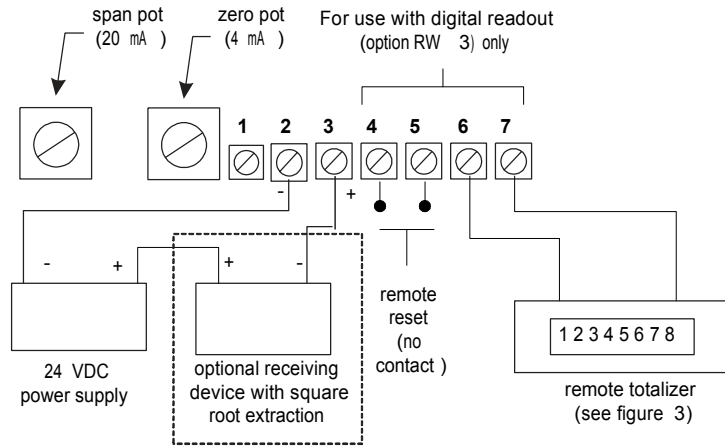


Figure 1

1.3 Wiring remote digital readout

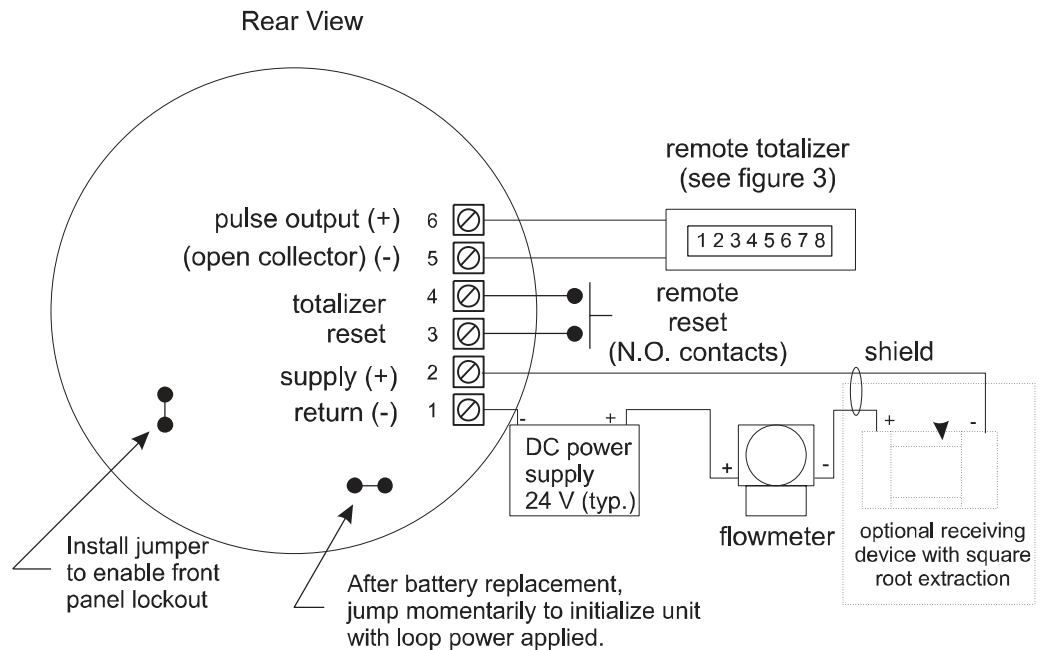


Figure 2

1.

Installation & Wiring (Continued)

1.4 Wiring the pulse output

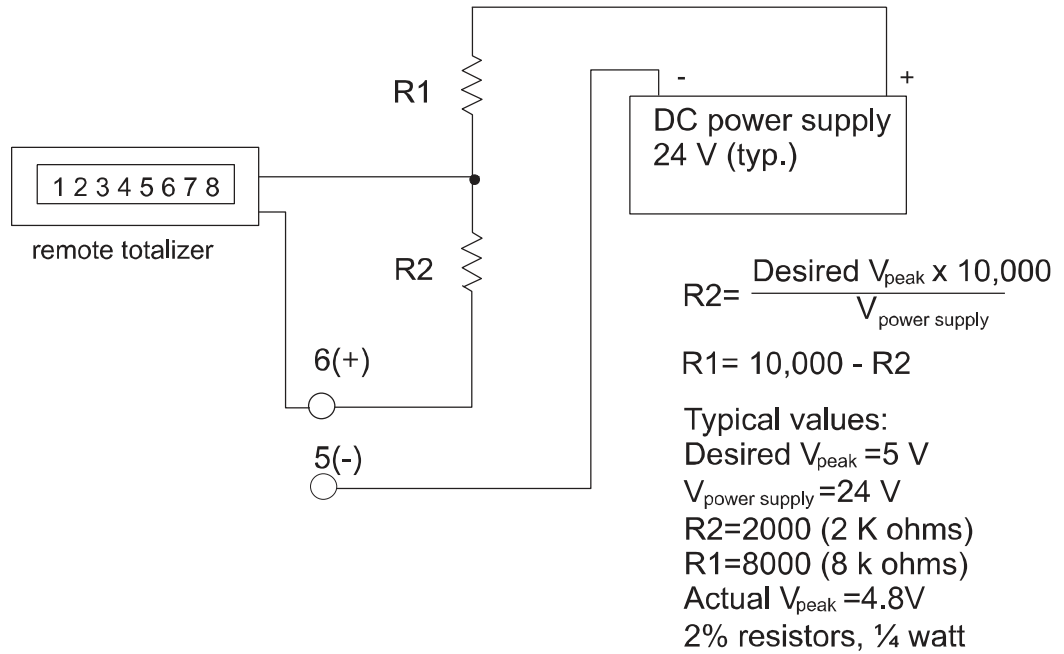


Figure 3
Obtaining a Voltage Pulse Output

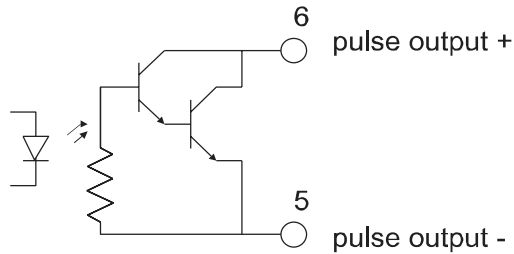


Figure 4
Pulse Output Schematic

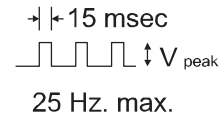


Figure 5
Pulse Shape

Caution: Observe proper polarity when connecting the pulse output. The pulse output circuitry can be damaged by reverse polarity or by voltages exceeding 30 volts.

2.

Definitions

Ent CodE: (enter code) This prompt will only appear if the panel lock is ON. Enter the password code to enter the program menu. Press the ▲ key to increment each digit code. Press the ◀ key to step to the next digit to the left. Press the E key to enter the 4 digit code. If the entered code is correct, the display will advance to the next menu prompt (Clr tot). If incorrect, the display will return to the run mode. To override the lock code or if you forgot your password enter 2910 to access the menu or change password.

Clr tot: (clear total) Clears (resets) totalizer. Press the E key to clear the total and return to the run mode. Press the M key to skip and advance to the next menu selection.

3 or 4: (3.5 or 4.5 digits) Choose between 3.5 or 4.5 digit rate display. Press the ▲ key to step to the desired choice. Press the E key to enter the displayed choice (factory set at 4.5).

dEC Loc: (decimal location for ratemeter) Sets the decimal location for the ratemeter and the rAtE Lo & rAtE Hi settings. Press the ◀ key to move the decimal. Press the E key to enter the displayed decimal location.

tDEC: (totalizer decimal) Sets the decimal location for the totalizer. The totalizer decimal is not a dummy decimal and will scale the totalizer display accordingly. (i.e. if the tdec is set in the tenths position (1234567.8), 100 will be displayed as 100.0). The location of the decimal point allows for greater resolution of both the totalizer display and the pulse output. The pulse output advances at a rate dependent on the least significant digit of the totalizer. The totalizer decimal location is restricted to a maximum of 4 places (1234.5678).

tot dESC: (totalizer descriptor) This allows you to illuminate one of the available descriptors on the display (GAL, LIT, FT3, M3 or "blank"). Press the ▲ key to select the descriptor. Press the E key to enter the selected descriptor (Based on flow meter model number).

rAt dESC: (ratemeter descriptor / scaling) Sets the rate readout. Choose rate per hour, minutes, seconds or "blank" (when no descriptor is selected the unit assumes that the rate lo and rate hi are entered in units per second). Press the ◀ key to step to the desired choice. Press the E key to enter the illuminated descriptor (Based on flow meter model number).

inPut: (input type) Choose linear (Lin) for transmitter (Option "W") or square root extraction (59.u) for transmitter Options W2, W3 or RW3). Press the ▲ key to step to the desired input type. Press the E key to enter the displayed choice (Based on flow meter model number).

rAtE Lo: (rate low) Sets the low setting for the 4-20mA analog input. Key in the low rate value which corresponds to the 4mA input (factory setting is 0000). Press the ▲ key to increment each digit. Press the ◀ key to step to the next digit to the left. Press the E key to enter the displayed rate lo value.

rAtE Hi: (rate high) Sets the high setting for the 4-20mA analog input. Key in the high rate value which corresponds to 20mA input (Based on flow meter model number full scale flow rate). Press the ▲ key to increment each digit. Press the ◀ key to step to the next digit to the left. Press the E key to enter the displayed rate hi value.

Lo Cut: (low cutoff) Percent of input (0.1 to 9.9) below which all inputs will assume the rate lo value. (i.e. With Lo Cut set 9.9 and rAtE Lo set at 0, all inputs below 5.6mA will read 0). Factory set at 2.2 to reflect lowest reading possible approximately 15% of full scale.

PuLSEout: (pulse out divider) This allows the unit to output a pulse for each least significant total count divided by the selected divider. The pulse out can be divided by 1 (d1), 10 (d 10), 100 (d 100) or off (oFF). With the divider set at 1, the unit will give a pulse out for every increment of the LCD displayed.

2.

Definitions (Continued)

CAL: (calibrate; yes or no) Select Yes to calibrate the unit, select NO to skip the calibration procedure. Press the ▲ key to select YES or NO. Press the E key to enter the displayed selection.

IMPORTANT: The factory calibrates all flow meters based on the flow meter model number calibration can only be performed with a known flow standard that corresponds to the full scale flow rate of the flow meter.

CAL Lo: (calibrate low) Apply an accurate 4mA signal at (no flow) to the input and Press the E key. If the calibration is successful the unit will display "donE CAL Lo". If the calibration is not successful the display will read "donE CAL Err" see error codes page 8. Press the M key to continue.

CAL Hi: (calibrate high) apply an accurate 20mA signal (full scale flow rate) to input and Press the E key. If the calibration is successful the unit will display "donE CAL Hi". If the calibration is not successful the display will read "donE CAL Err" see error codes page 8. Press the M key to continue.

LoC CodE: (lock code) Sets the 4 digit lock code to be entered when the unit prompts Ent CodE. This allows the user to gain access to the menu when the unit is locked. Press the ▲ key to increment each digit. Press the ◀ key to step to the next digit to the left. Press the E key to enter the displayed code.

Record this number here for later use! LOCK CODE_____ (Override Code: 2910)

LoC unit: (lock unit) Sets the panel lock ON or OFF. Press the ▲ key to select YES (ON) or NO (OFF). Press the E key to enter the displayed selection.

NOTE: A hardware jumper menu lockout is also available (see figure 2). The hardware jumper does not inhibit contact closure reset at terminals 3 and 4.

Output to Flow Chart

Connect multimeter in series with the current loop. With pipeline pressurized, adjust zero pot until current output reads 4.00 mA ± 0.02 mA at no flow. Establish a known flow rate through the flow meter as close to 95% of full scale as practical. Set span using the formula below.

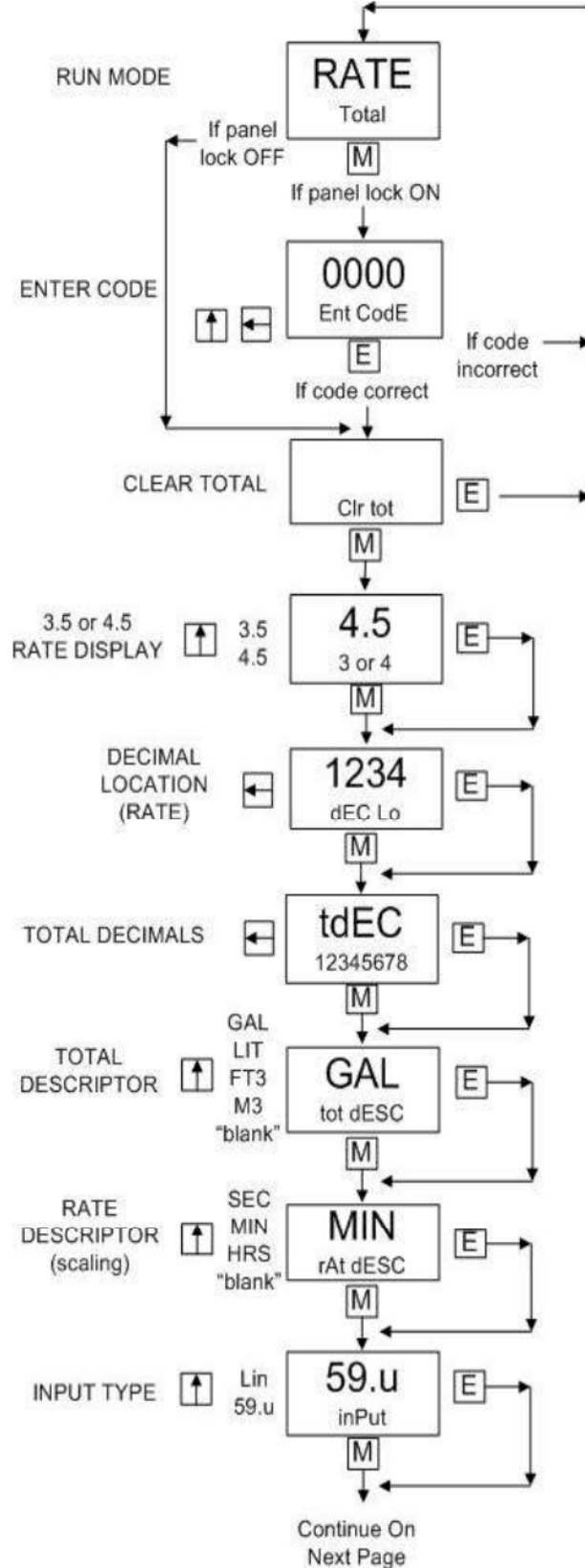
Set span, span is set using the following formula: $I = 16 Q^2 + 4.00$; where I = current output in mA, Q = decimal % of full scale. Click [here](#) to access calculator.

<u>% FS</u>	<u>Current Output</u>	<u>% FS</u>	<u>Current Output</u>
20	4.64	70	11.84
30	5.44	80	14.24
40	6.56	90	16.96
50	8.00	95	18.44
60	9.76	100	20.00

3.

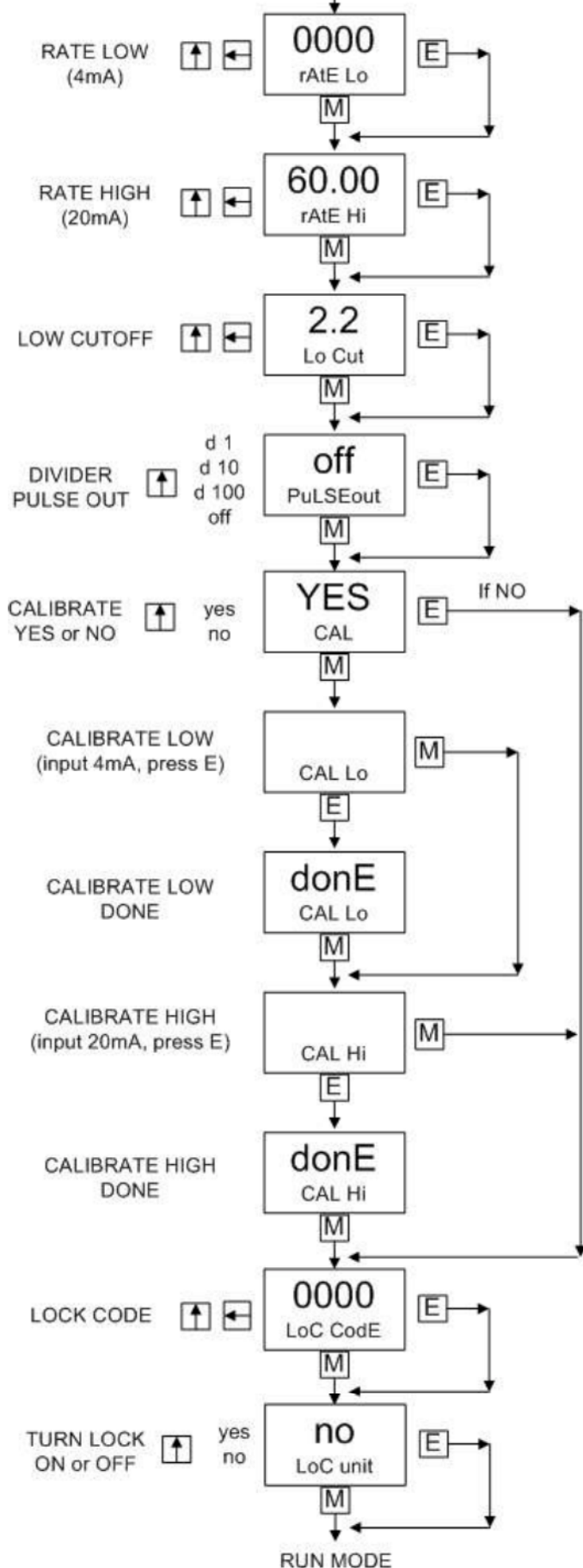
Programming Flowchart

NOTE: All menu selections are saved upon exiting the program menu and returning to the run mode. When making menu changes, do not remove loop power until returning to the run mode.
Example: 1 1/2- 71- VUR- 60- ARW3 (Option RW3 - 2 wire loop powered transmitter 4-20mA.)



Press the **M** key to enter the programming menu.
 If the panel lock is ON, you must enter the 4 digit lock code to gain access to the menu.
 Press the **▲** key to increment each individual digit of the code.
 Press the **◀** key to advance to the next digit. Press the **E** key to enter the displayed code. If the code is correct, display advances to "CLr tot", if not, display returns to run mode. Press the **E** key to clear the totalizer and return to the Run Mode.
 Press the **M** key to skip and go to next menu item.
 Press the **▲** key to step to the desired number of digits for the rate display. Press the **E** key to enter the displayed choice.
 Press the **M** key to skip and keep the existing choice.
 Press the **◀** key to step the decimal to the next digit.
 Press the **E** key to enter the displayed decimal location.
 Press the **M** key to skip and keep the existing choice.
 Press the **◀** key to step the decimal to the next location.
 Press the **E** key to enter the displayed decimal location.
 Press the **M** key to skip and keep the existing decimal location.
 Press the **▲** key to step to the desired totalizer descriptor.
 Press the **E** key to enter the displayed descriptor.
 Press the **M** key to skip and keep the existing descriptor.
 Press the **▲** key to step to the desired rate descriptor.
 Press the **E** key to enter the displayed descriptor.
 Press the **M** key to skip and keep the existing descriptor.
 Press the **▲** key to step to the desired input type.
 Press the **E** key to enter the displayed choice.
 Press the **M** key to skip and keep the existing input type.

Continue From Previous Page



Press the ▲ key to increment each individual digit of the rate.
 Press the ◀ key to advance to the next digit.
 Press the E key to enter the displayed value.
 Press the M key to skip and go to next menu item.

Press the ▲ key to increment each individual digit of the rate high setting.
 Press the ◀ key to advance to the next digit.
 Press the E key to enter the displayed value.
 Press the M key to skip and keep the existing value.

Press the ▲ key to increment each individual digit of the low cutoff setting.
 Press the ◀ key to advance to the next digit.
 Press the E key to enter the displayed value.
 Press the M key to skip and keep the existing value

Press the ▲ key to step to the desired divider for the pulse output.
 Press the E key to enter the displayed divider.
 Press the M key to skip and keep the existing divider.

Press the ▲ key to step to cal YES or cal NO.
 Press the E key to enter the displayed choice.
 Press the M key to skip and proceed to loc code.

Press the E key when 4mA is supplied to the input.
 Press the M key to skip and proceed to cal hi.

"Done" will appear to signal that the cal lo was successful.
 Press the M key to advance to cal hi.

Press the E key when 20mA is supplied to the input.
 Press the M key to skip and proceed to loc code.

"Done" will appear to signal that the cal hi was successful.
 Press the M key to advance to loc code.

Press the ▲ key to increment each individual digit of the lock code.
 Press the ◀ key to advance to the next digit.
 Press the E key to enter the displayed code.
 Press the M key to skip and keep the existing code.

Press the ▲ key to step to the desired lock setting.
 Press the E key to enter the displayed lock setting.
 Press the M key to skip and keep the existing setting.

ERROR CODE

4.

Error Codes

0000

rAtE Err

This error message is displayed when the "RATE LO" value is set equal to or higher than the "RATE HI" value. Press the **M** to re-enter the "RATE LO" and "RATE HIGH" values.

donE

CAL Err

This error message is displayed when the "CAL LO" or "CAL HI" input is set at a value which is out of range (see "CAL LO" and "CAL HI" in programming section for calibrating input range). Press **M** to re-enter the "CAL LO" and/or "CAL HI" procedure.

E bAttrY

If a low battery / invalid memory condition is detected, the display will flash and the "BAT" descriptor will come on. Press **M** to acknowledge the condition. E BATTERY will be displayed. Replace the battery with loop power connected, the unit must be recalibrated if loop power was not maintained.

E PuLSE

This error message is displayed when the total is advancing at a speed greater than the pulse output capability. Choose a greater pulse divider or select "OFF".

5.

Battery Replacement

Recommended battery: Panasonic BR2330 3V 250mA-H Lithium (2 yr, standby life)

The polarity of the battery must be correct. Plus (+) must be on top as indicated on the conductor arm.

Note: Power the unit from the 4-20mA loop while the battery is being replaced to avoid the need to recalibrate the unit. If the loop power was not maintained the unit will return to the default settings, all menu items must be re-entered. Return to section 3 and follow the programming example to re-enter all menu items based on your model number (see nameplate label for model number details).

6.

Dimensions

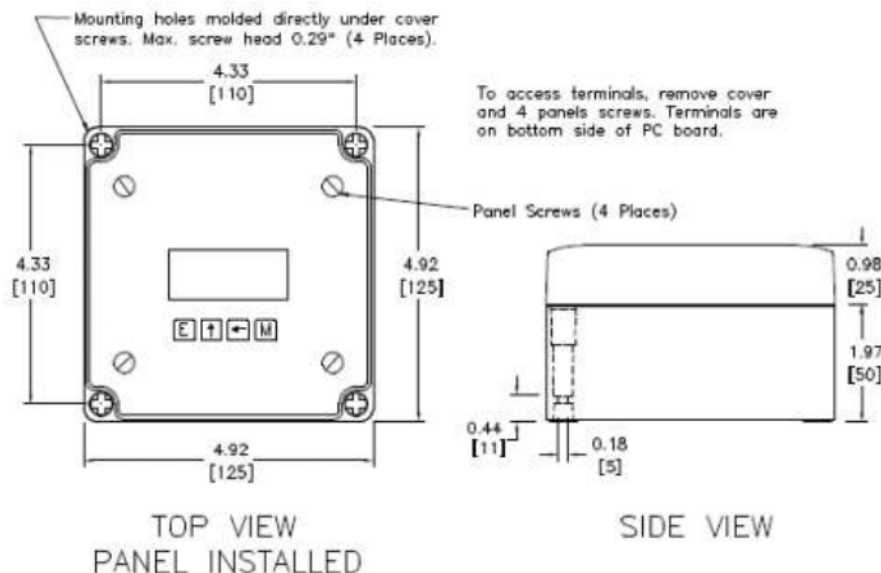


Figure 6

Dimensions - Remote Readout DR-1

Keypad: 4 tactile feedback keys



Specifications

Description:

Featuring up to 4 1/2 digits of rate and 8 digits of total, the digital indicator is a loop powered indicator capable of accepting either a linear or square root 4-20mA inputs. An isolated scaled pulse output is available for hook up to a remote totalizer. Numeric password protection prevents unauthorized access to menu.

Specifications:

Power Input:

100mA, 24Vdc power supply (Not Included)
Internal Battery (Setup & totalizer memory storage only)
3 V 250mA -H Lithium (2 yr. Standby life)

Display:

Rate Display: (selectable decimal)
3.5 or 4.5 Digits (selectable), 0.35" High,
Display updates once every two seconds.
Rate Descriptor: /SEC, /MIN, /HR, or Blank
Totalizer Display: (selectable decimal)
8 Digit (99999999), 0.2" High
Totalizer Descriptors: GAL, LIT, FT3, M3
or "blank"
Low Battery Error Detection: "BAT"
descriptor
Under / Over range Indication: Flashing
display

Environmental:

Operating Temperature
-4°F (-20°C) to +158°F (70°C)
Humidity
0-90% Noncondensing

Accuracy:

0.1% Full Scale Resolution, ± 1 Count
Temperature Drift:
50 ppm/°C Typical
200 ppm/°C Worst Case

Listing: CE Compliant

Inputs:

Signal Inputs:
Full Scale Range: 4 to 20 mA DC
Loop Voltage Drop: 6 Volts Maximum
Reverse Polarity Protection
Over Current Protection to 60 mA
16 Bit resolution; 1 sample every 2
seconds
Low cutoff supplied to inhibit indications
at low
flow rates
Reset Inputs:
Internal Pullup Resistor: 100 k Ω to ± 3
VDC
High (logic 1): Open or 3-30 VDC
Low (logic 0): Less than .5 VDC
Minimum On: 25 msec

Pulse Output:

The pulse output advances with the least
significant digit of the totalizer
Type: Opto-isolated open collector
transistor
Max. voltage (off state): 30 VDC
Current (on state): 5 mA @ .9 V drop, .1
mA @
0.7 drop
Pulse Duration: 15 msec
Pulse Output Rate: 25 CPS max.
Pulse output divider: User selectable. \div
1, $\div 10$,
 $\div 100$ or off

Calibration & Operation:

Input Scaling: Via front keypad
Decimal Point: Via front keypad
Reset Input: Via front keypad or remote
dry contact closure

Lockout:

Password: Unauthorized menu changes can be prevented by entering a user selectable password (5 digit number). If you forgot the password you can access the menu by using the override password 2910.

Jumper: An internal jumper shunt is provided for applications requiring a sealed menu and totalizer lockout. Install the jumper to enable the lock. (see Typical Wiring, Pg. 2)

Installation and Startup Instructions

Option R2 and R3 with KT-1 and KT-3

1.

Install the body in the piping system according to the Installation, Operation and Maintenance Manual (M1).

2.

2.1 ABS Housing Installation

Remove the back cover plate screws. Mount the housing assembly to the wall, panel or bracket using #6 screws in from the front through the back cover plate and into the wall. (These screws and other hardware are NOT INCLUDED).

Caution: Do not over tighten the mounting screws, damage may result.

3.

3.1 Piping Installation

Connect the housing assembly and body with ¼ tubing or piping suitable for the process condition. Accessory kits provide suitable fittings (KT-1 Brass or KT-3 316 SST). *Tubing not included.*

Close ball valve at the flow meter body. Open the equalizing valve. Pressurize the system by establishing flow. Open the ball valve and check for leaks. Purge the air from the system until steady flow is attained (1-2 minutes). Close the equalizing valve to complete the installation.

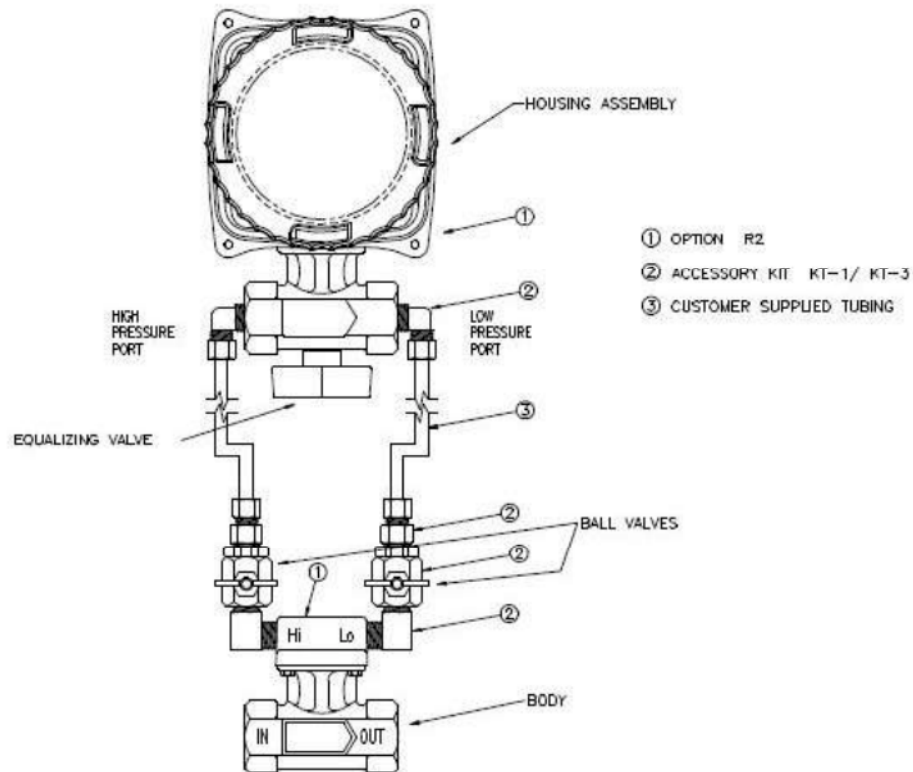


Figure 1
Remote Mount ABS Housing

4.

4.1 Aluminum Housing Installation

Remove the back cover plate screws. Mount the housing assembly to a bracket or panel using #8-32X3/8 Pan HD screws. (These screws and other hardware are NOT INCLUDED).

Installing the aluminum housing may require an additional custom fabricated bracket to mount to a wall or rigid surface.

Caution: Do not over tighten screws as damage may result.

Be sure to check proper connection before startup with respect to high and low pressure ports, reversing the connection may result in damage to the indicator assembly.

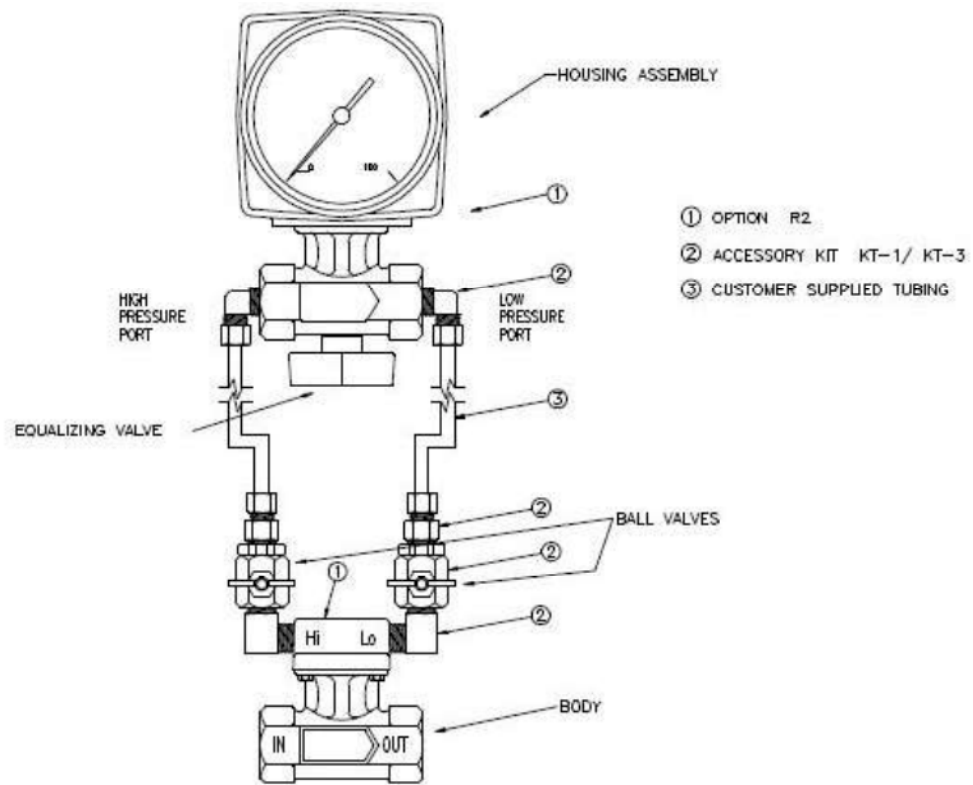
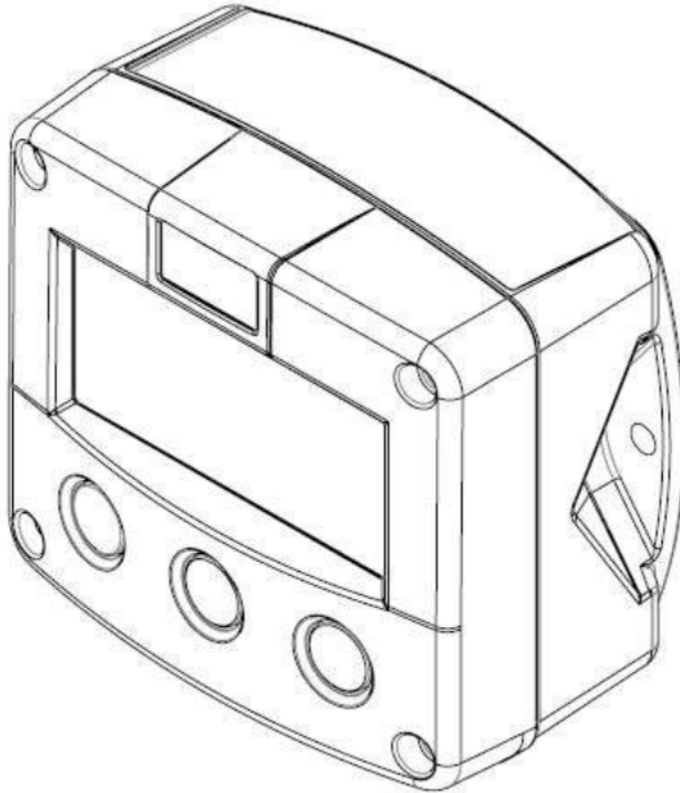


Figure 2
Remote Mount Aluminum Housing

Wiring & Programming Instruction Manual

(Options: RW3 & DR-1)

FLOWRATE INDICATOR / TOTALIZER WITH SCALED PULSE OUTPUT



Signal input flowmeter: 4-20mA
Output: One scaled pulse ref. accumulated total
Optional: Backlighting Amber and Green



SAFETY INSTRUCTIONS

Any responsibility is lapsed if the instructions and procedures as described in this manual are not followed.

LIFE SUPPORT APPLICATION: The digital display is not designed for use in life support appliances, devices, or systems where malfunction of the product can reasonably be expected to result in a personal injury. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify the manufacturer and supplier for any damages resulting from such improper use or sale.

Electro static discharge does inflict irreparable damage to electronics! Before installing or opening the unit, the installer has to discharge himself by touching a well grounded object.

This unit must be installed in accordance with EMC guidelines (Electro Magnetic Compatibility).

Do connect a proper grounding as indicated if the digital display has been supplied with an aluminum casing. The green / yellow wire between the back-casing and removable terminal-block may never be removed.

DISPOSAL

At the end of its life this product should be disposed of according to local regulations regarding waste electronics equipment. If a battery is present in this product it should be disposed of separately. The separate collection and recycling of your waste equipment will help to conserve natural resources and ensure that it is recycled in a manner that protects the environment.

SAFETY RULES AND PRECAUTIONARY MEASURES

The manufacturer accepts no responsibility whatsoever if the following safety rules and precautions instructions and procedures as described in this manual are not followed. Modifications of the digital display implemented without preceding written consent from the manufacturer, will result in immediate termination of product liability and warranty period. Installation, use, maintenance and servicing of this equipment must be carried out by authorized technician.

Check the mains voltage and information on the manufacturers' plate before installing the unit. Check all connections, settings and technical specifications of the various peripheral devices with the digital display supplied.

Open the casing only if all leads are free of potential. Never touch the electronic components (ESD sensitivity). Never expose the system to heavier conditions than allowed according to the casing classification.

If the operator detects errors or dangers, or disagrees with the safety precautions taken, then inform the owner or principal responsible.

The local labor and safety laws and regulations must be adhered to.

ABOUT THE OPERATION MANUAL

This operations manual is divided into two main sections:
The daily use of the unit is described in chapter 2 “Operations”. These instructions are meant for users.

The following chapters and appendices are exclusively meant for electricians/technicians. These provide a detailed description of all software settings and hardware installation guidance.

This operation manual describes the standard unit as well as any option available. For additional information, please contact your supplier.

A hazardous situation may occur if the digital display is not used for the purpose it was designed for or is used incorrectly. Please carefully note the information in this operating manual indicated by the pictograms:



A “warning” indicates actions or procedures which, if not performed correctly, may lead to personal injury, a safety hazard or damage of the digital display or connected instruments.



Caution !

A “caution” indicates actions or procedures which, if not performed correctly may, lead to personal injury or incorrect functioning of the digital display or connected instruments.



Note !

A “note” indicates actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.

Contact your supplier if you require additional information regarding the digital display installation requirements and application suitability. Carefully read this manual prior to installation.

Hardware version: FB03.03xx
Software version: 03.02xx
Manual: M4 Rev F Wiring & Programming Instructions Option RW3 & DR-1
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1. INTRODUCTION

1.1 SYSTEM DESCRIPTION

Functions and features

The flowrate / totalizer is a microprocessor driven instrument designed to display flowrate, total and accumulated total as well as to generate a scaled pulse according to the accumulated total.

Flowmeter input:

This manual describes the unit with an analog 4-20mA input from flowmeter.

One flowmeter with a passive or active 4-20mA signal output can be connected to the display. The display is powered by a 2 wire loop powered transmitter and 24Vdc supply 24Vdc supply not included use option PS-24.

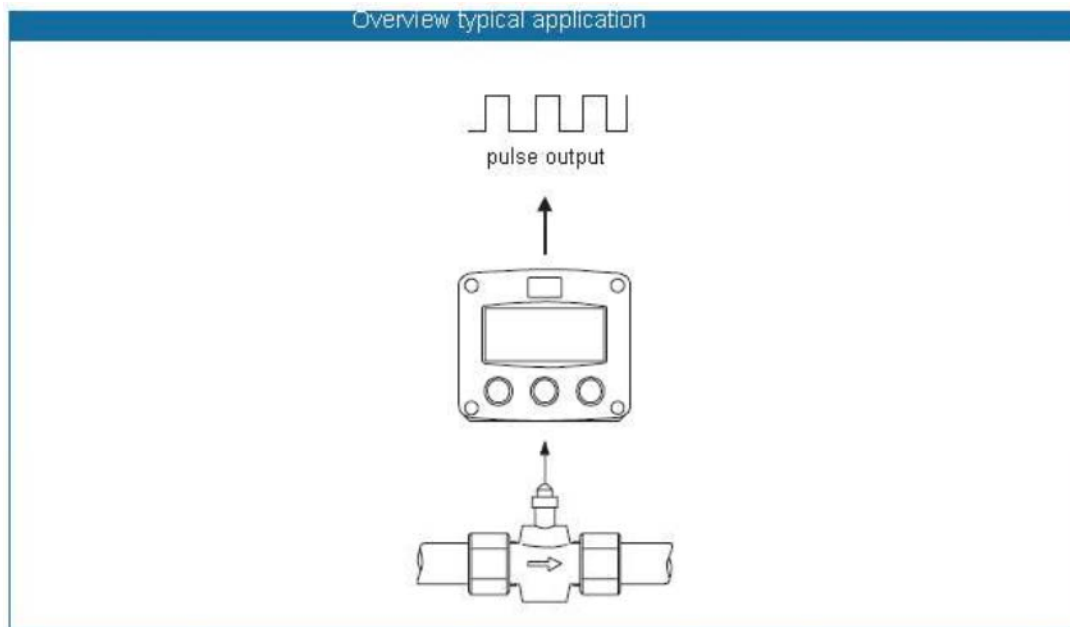


Fig. 1: Typical application

Configuration of the unit:

The display has been designed to be implemented in many types of applications. All settings are stored in EEPROM memory and will not be lost in the event of power failure.

Display information:

The unit has a large transfective LCD with all kinds of symbols and digits to display measuring units based on application specification when ordered.

Flowrate and total can be displayed either with the small 8mm digit or with the 17mm digits. A backup of the total and accumulated total in EEPROM memory is made every minute.

2. OPERATIONAL

2.1 GENERAL



Caution !

The digital display may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed. Take careful notice of the "Safety rules, instructions and precautionary measures" in the front of this manual.

This chapter describes the daily use of the display. This instruction is meant for users / operators.

2.2 CONTROL PANEL

The following keys are available:



Fig.2: Control Panel

Functions of the keys:



This key is used to program and save new values or settings. It is also used to gain access to SET-UP-level; read chapter 3.



This key is used to SELECT accumulated total. The arrow-key ▲ is used to increase a value after PROG has been pressed or to configure the unit; please read chapter 3.



Press this key twice to CLEAR the value for the total. The arrow-key ► is used to select a digit after PROG has been pressed or to configure the unit; please read chapter 3.

2.3 OPERATOR INFORMATION AND FUNCTIONS

In general, the display will always act at Operator level. The information displayed depends upon the SETUP-setting. The signal processed by the connected flowmeter is measured by the display in the background, whichever screen refresh rate setting is chosen. After pressing a key, the display will be refreshed quickly for 30 seconds, after which it will slow-down again.



Fig. 3: Example of display information during process

For the Operator, the following functions are available:

Display flowrate / total or flowrate

This is the main display information. After selecting any other information, it will always return to this main display automatically.

Total is displayed on the upper-line of the display and flowrate on the bottom line. It is possible to display flowrate only with the large 17mm digits; in this instance press the SELECT-key to read the total.

When “_____” is shown, then the flowrate value is too high to be displayed. The arrows ▲▼ indicate the increase / decrease of the flowrate trend.

Clear total

The value for total can be re-initialized. To do so, press CLEAR twice. After pressing CLEAR once, the flashing text “PUSH CLEAR” is displayed. To avoid re-initialization of total DOES NOT influence the accumulated total.

Display accumulated total

When the SELECT-key is pressed, total and accumulated total are displayed. The accumulated total cannot be re-initialized. The value will count up to 99,999,999,999. The unit and number of decimals are displayed according to the configuration settings for total.

Low-battery alarm

When the battery voltage drops, it must be replaced. At first “low-battery” will flash, but as soon as it is displayed continuously, the battery must be

replaced shortly after! Only original batteries supplied by the manufacturer may be used, or else the guarantee and liability will be terminated. The remaining lifetime after the first moment of indication is generally several days up to some weeks.



Fig. 4: Example of low-battery alarm

Range error

As soon as the input value is 5% outside the calibrated measuring range, "ALARM" will be displayed. Meanwhile, the calibrated value will be displayed. After pressing the SELECT key, the reason of the alarm will be displayed: "LO RANGE" or "HI RANGE".

Alarm 01-03

When "ALARM" is displayed, press the SELECT key to display the reason of the alarm: 1-3. Please Appendix B: problem solving.

3. CONFIGURATION

3.1 INTRODUCTION

This and the following chapters are exclusively meant for electricians and non-operators. In these, an extensive description of all software settings and hardware connections are provided.



Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions. The display may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed. Ensure that the measuring system is correctly wired up according to the wiring diagrams. The housing may only be opened by trained personnel. Take careful notice of the “Safety rules, instructions and precautionary measures” in the front of this manual.

3.2 PROGRAMMING SETUP-LEVEL

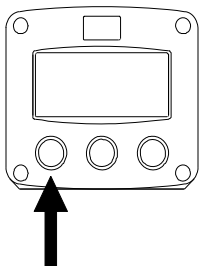
3.2.1 GENERAL

Configuration of the display is done at SETUP-level. SETUP-level is reached by pressing the PROG/ENTER key for 7 seconds; at which time, both arrows ▲▼ will be displayed. In order to return to the operator level, PROG will have to be pressed for three seconds. Alternately, if no keys are pressed for 2 minutes, the unit will exit SETUP automatically. SETUP can be reached at all times while the display remains fully operational.



Note: A pass code may be required to enter SETUP. Without this pass code access to SETUP is denied. All digital display is pre-calibrated from the factory per model selected no additional calibration is required. Contact the factory for calibration details if required.

To enter SETUP-level:

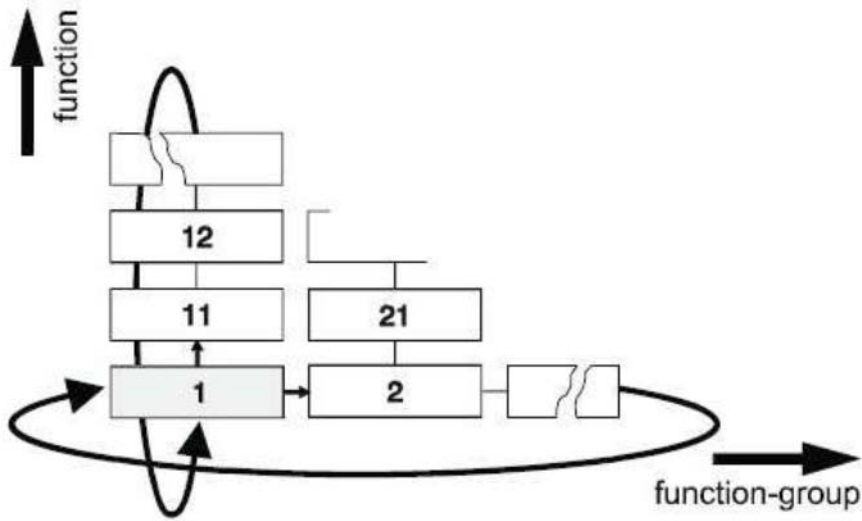


Press



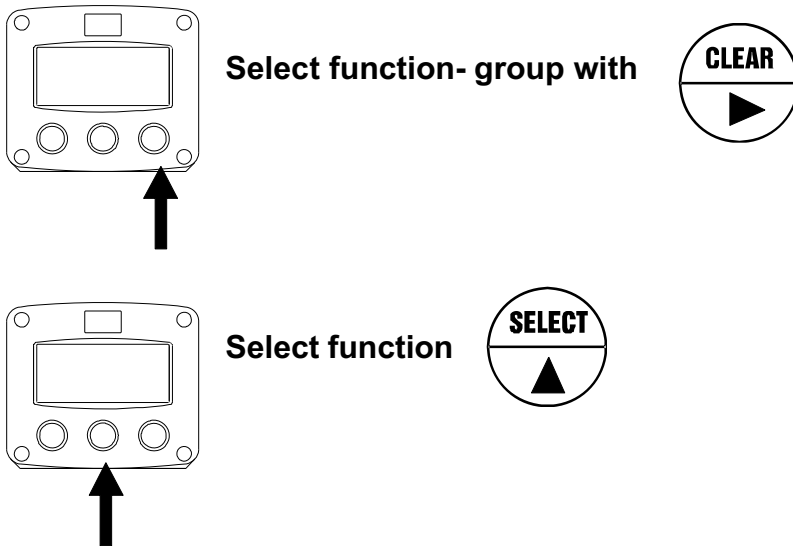
for 7 seconds

3.2.2. Matrix structure SETUP-level:



SCROLLING THROUGH SETUP-LEVEL

Selection of function-group and function:



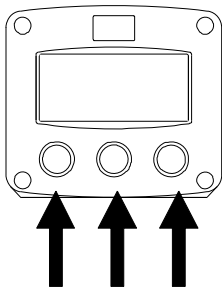
SETUP is divided into several function groups and functions.

Each function has a unique number, which is displayed below the word "SETUP" at the bottom of the display. The number is a combination of two figures. The first

figure indicates the function-group and the second figure the sub-function. Additionally, each function is expressed with a keyword.

After selecting a sub-function, the next main function is selected by scrolling through all "active" sub-functions (e.g. 1 ▲, 11 ▲, 12 ▲, 13 ▲, 14 ▲, 1 ►, 2 ►, 3 ►, 31 etc.). The "CLEAR" button can be used to jump a step back if you missed the desired function.

To change or select a value:



a) Press briefly:  PROGRAM will start to flash

b) Select or enter value  with and / or 

c) Press  to continue the value / selection

To change a value, use ► to select the digits and ▲ to increase that value. If the new value is invalid, the increase-sign ▲ or decrease-sign ▼ will be displayed while you are programming.

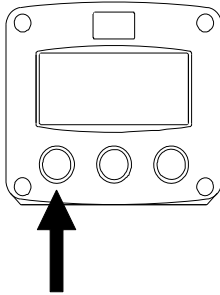
To select setting, ▲ is used to select in one direction and ► can be used to select in the other direction.

When data is altered but ENTER is not pressed, then the alteration can still be cancelled by waiting for 20 seconds or by pressing ENTER for 3 seconds: the PROG-procedure will be left automatically and the former value reinstated.



Note: alterations will only be set after *ENTER* has been pressed! Otherwise the former value will be reinstated.

To return to OPERATOR-level:



Press  for 3 seconds

In order to return to the operator level, PROG will have to be pressed for 3 seconds. Also, when no keys are pressed for 2 minutes, SETUP will be left automatically.

SETUP FUNCTIONS AND VARIABLES		
1	TOTAL	
11	UNIT	L – m ³ – kg – lb – GAL – USGAL – bbl – no units
12	DECIMALS	0 – 1 – 2 – 3 (Ref: displayed value)
13	SPAN	0.000001- 9,999,999 unit / second
14	DECIMALS SPAN	0 – 6
2	FLOWRATE	
21	UNIT	mL – L – m ³ – mg – g – kg – ton – GAL – bbl – lb – cf – REV- no unit – scf – Nm ³ – NL – P
22	TIME UNIT	sec – min – hour – day
23	DECIMALS	0 – 1 – 2 – 3 (Ref: displayed value)
24	SPAN	0.000001- 9,999,999 unit / time unit
25	DECIMALS SPAN	0 – 6
3	DISPLAY	
31	FUNCTION	total-flowrate
32	BACKLIGHT (optional)	off – green – amber
33	BL BRIGHTNESS	1-5
4	POWER MANAGEMENT	
41	LCD UPDATE	fast – 1 sec – 3 sec – 15 sec – 30 sec – off
42	BATTERY MODE	operational-shelf
5	FLOWMETER	
51	FORMULA	interpolation, square root
52	FILTER	00 – 99
53	CUT-OFF	0.0 – 99.9%
54	CALIBRATE LO	default – calibrate – calibrate set
55	CALIBRATE HI	default – calibrate – calibrate set
6	PULSE OUTPUT	
61	PULSE WIDTH	0.001 – 9.999 sec
62	DECIMALS	0 – 1 – 2 – 3
63	IMPULSE PER	X – quantity
7	OTHERS	
71	TYPE / MODEL	N/A
72	SOFTWARE	N/A
73	SERIAL NO.	N/A
74	PASS CODE	0000 – 9999
75	TAG NUMBER	0000000 – 9999999

1 – TOTAL	
MEASUREMENT UNIT 11	<p>SETUP- 11 Determines the measurement unit for total, accumulated total and pulse output. The following units can be selected:</p> <p style="text-align: center;">L – m3 – kg – lb – GAL – USGAL – bbl – no units</p> <p>Alteration of the measurement unit will have consequences for operator and SETUP-level values. Please note that the Span has to be adapted as well; the calculation is not done automatically.</p>
DECIMALS 12	<p>The decimal point determines for total and accumulated total the number of digits following the decimal point. The following can be selected:</p> <p style="text-align: center;">0000000 – 111111.1 – 22222.22 – 3333.333</p>
SPAN 13	<p>With the span, the flowmeter signal is converted to a quantity. The <u>span</u> for Total is determined on the basis of the measurement unit (setting 11) and the <u>flowrate per second</u> at 20mA. Enter the span in whole numbers (decimals are set with SETUP 14). The more accurate the span, the more accurate the functioning of the system will be:</p> <p>Example 1 Calculating the Span. <i>Let us assume that the flowmeter generates 20mA at a rate of 652.31 USGAL per hour, the Selected unit is barrels. There are 42 gallons In one barrel; so the rate is 652.31/42 is 15.53119 barrels/hour. This is 0.0043142 barrels/second, which is the Span. Enter for SETUP-13: "004314" and for SETUP-14 "6".</i></p> <p>Example 2 Calculating the Span. <i>Let us assume that the flowmeter generates 20mA at a flowrate of 2,481.3 Liters/minute and The selected unit is "cubic meter/m3". The rate per second is 2,481.6÷60 is 41.355 L/sec. This is 0.041355 m3/sec., which is the span. Enter for SETUP- 13: "041355" and for SETUP-14-decimals span "6".</i></p>
DECIMALS SPAN 14	<p>This setting determines the number of decimals for the Span. (SETUP 13). The following can be selected:</p> <p style="text-align: center;">0 – 1 – 2 – 3 – 4 – 5 – 6</p> <p>Please note that this function influences the accuracy of the Span indirectly. This setting has NO influence on the displayed number of digits for total (SETUP 12)!</p>

2 – FLOWRATE

The settings for total and flowrate are entirely separate. In this way, different units of measurement can be used each e.g. cubic meters for total and liters for flowrate.
The display update time for flowrate is one second or more.

MEASUREMENT UNIT 21	<p>SETUP- 21 determines the measurement unit for flowrate. The following units can be selected:</p> <p>mL – L – m3 – mg – g – kg – ton – GAL – bbl – lb – cf – REV- no unit – scf – Nm3 – NL – P</p> <p>Alteration of the measurement unit will have consequences for operator and SETUP-level values. Please note that the Span has to be adapted as well; the calculation is not done automatically.</p>
TIME UNIT 22	<p>The flowrate can be calculated per second (SEC), minute (MIN), hour (HR) or day (DAY).</p>
DECIMALS 23	<p>The decimal point determines for total and accumulated total the number of digits following the decimal point. The following can be selected:</p> <p style="text-align: center;">000000 – 111111.1 – 22222.22 – 3333.333</p>
SPAN 24	<p>With the span, the flowmeter signal is converted to a quantity. The <u>span for flowrate</u> is determined on the basis of the <u>selected measurement unit and time unit</u> at 20mA. Enter the span in whole numbers (decimals are set with SETUP 25). The more accurate the span, the more accurate the functioning of the system will be:</p> <p>Example 1 Calculating the span for flowrate. <i>Let us assume that the flowmeter generates 20mA at a flowrate of 2,481.3 Liters/minute, the selected unit is "Liters" and time unit "minute". The span is 2481.3. enter for SETUP- 24: "2481.3" And for SETUP- 25 – decimals span "2".</i></p> <p>Example 2 Calculating the span for flowrate. <i>Let us assume that the flowmeter generates 20mA at a flowrate of 652.31 USGAL per hour, the Selected unit is USG and the time unit is minute. The span is 652.31/60 minutes is 10.87183 (GPM). Enter for SETUP- 24: "108718" and for SETUP-25 "4".</i></p>
DECIMALS SPAN 25	<p>This setting determines the number of decimals for the Span. (SETUP 24). The following can be selected:</p> <p style="text-align: center;">0 – 1 – 2 – 3 – 4 – 5 – 6</p> <p>Please note that this function influences the accuracy of the Span indirectly. This setting has NO influence on the displayed number of digits for total (SETUP 23)!</p>

3 – DISPLAY

FUNCTION 31	The large 17mm digits can be set to display total or flowrate. When “total” is selected, both total and flowrate are displayed simultaneously. When “flowrate” is selected, only flowrate will be displayed with its measuring unit while total will be displayed after pressing SELECT.
The functions below will only affect the optional backlight.	
BACKLIGHT (OPTION) 32	If a LED backlight has been supplied, the color can be selected. Following selections are available: OFF – GREEN – AMBER
BRIGHTNESS (OPTION) 33	The density of the backlight can be set in following range: 1 – 5 One is the minimum and five is the maximum brightness.

4 – POWER MANAGEMENT

When used with the internal battery option, the user can expect reliable measurement over a long period of time. The display has several smart power management functions to extend the battery life time significantly. Two of these functions can be set:

LCD NEW 41	<p>The calculation of the display-information influences the power consumption significantly. When the application does not require a fast display update, it is <u>strongly advised</u> to select a slow refresh rate. Please understand that NO information will be lost; the input signal will be processed and the output signal will be generated in the normal way. The following can be selected:</p> <p style="text-align: center;">FAST – 1 sec – 3 sec – 15 sec – 30 sec – off</p> <p>Example battery life-time: <i>Battery life-time with FAST update: about 3 years</i> <i>Battery life-time with 1 sec update: about 5 years</i></p> <p>Note: after a button has been pressed by the operator – the display refresh rate will always switch to FAST for 30 seconds. When “OFF” is switched on as soon as a button has been pressed.</p>
BATTERY-MODE 42	The unit has two modes: operational or shelf. After “shelf” has been selected, the unit can be stored for several years; it will not process the sensor signal; the display is switched off but all settings and totals are stored. In this mode, the power consumption is extremely low. To wake up the unit again, press the SELECT-key twice.



Note !

5 – FLOWMETER

SIGNAL 51	<p>The display can process the 4-20mA signal in two ways:</p> <p>Interpolation: the signal is processed linear</p> <p>R = S x I</p> <p>Square root: for differential pressure</p> <p>R = S √ I</p> <p>Where:</p> <p>R = Rate: the calculated flowrate</p> <p>S = Span: the maximum flowrate at 20mA. The span is programmed with setting 24 for flowrate and setting 13 for total.</p> <p>I = Input: the scaled analog value; in these formulas value 0 (zero) for 4mA and 1 (one) for 20mA.</p>			
FILTER 52	<p>The analog output signal of a flowmeter does mirror the actual flow. This signal is measured several times a second by the display. The value measured is a “snap-shot” of the real flow as it will be fluctuating. With the help of this filter a stable and accurate reading can be obtained while the filter level can be set to a desired value. The filter principal is based on three input values: the filter level (01-99), the last measured analog value and the last average value. The higher the filter level, the longer the response time on a value change will be. Below, several filter levels with there response times are indicated:</p>			
FILTER VALUE	RESPONSE TIME ON STEP CHANGE OF ANALOG VALUE TIME IN SECONDS			
	50% Influence	75% Influence	90% Influence	99% Influence
01	filter disabled	filter disabled	filter disabled	filter disabled
02	0.3 seconds	0.5 seconds	1.0 seconds	1.8 seconds
03	0.5 seconds	1.0 seconds	1.5 seconds	3 seconds
05	1.0 seconds	1.8 seconds	2.8 seconds	5.3 seconds
10	1.8 seconds	3.5 seconds	5.6 seconds	11 seconds
20	3.5 seconds	7.0 seconds	11 seconds	23 seconds
30	5.3 seconds	10 seconds	17 seconds	34 seconds
50	8.8 seconds	17 seconds	29 seconds	57 seconds
75	13 seconds	26 seconds	43 seconds	86 seconds
99	17 seconds	34 seconds	57 seconds	114 seconds
Continued next page >>>>				

5 – FLOWMETER (CONTINUED)

CUT-OFF 53		<p>To ignore e.g. leakage of the flow or vibration, a low-flow cut-off can be set as percentage over the full range of 20mA. When the analog value is less then required with this setting, the signal will be ignored. The cut-off value cab be programmed is the range 0.0-99.9%.</p> <p>Examples:</p>		
Function (setup 51)	Span (setup 13/24)	Required Cut-off	Cut-Off (setup 53)	Required Output
interpolation	450 L/min	25 L/min	$25/450 \times 100\% = 5.5\%$	$16mA \times 5.5\% + 4mA = 4.88mA$
square root	450 L/min	25 L/min	$(25/450)^2 \times 100\% = 0.3\%$	$16mA \times 0.3\% + 4mA = 4.05mA$
TUNE MIN/4mA 54		<p>With this setting it is possible to calibrate the input value for 4mA as the signal from the flowmeter might not be exact 4.0mA at flowrate zero.</p> <p>This function will measure the real output value at flow zero.</p> <p><i>Warning: be very sure that the offered signal is correct before the calibration is executed as this function has major influences on the accuracy of the system!</i></p> <p>After pressing PROG, three settings can be selected: CALIBRATE: with this setting, the input will be calibrated with the actual 4mA value. After pressing enter, CAL SET will be displayed as soon as the calibration is completed. From that moment, the analog value must be more than the calibrated value before the signal will be processed. DEFAULT: with this setting, the manufacturer's value is re-installed. CAL SET: to select the last calibrated value.</p>		
TUNE MAX/20mA		<p>With this setting it is possible to calibrate the input value for 20mA as the signal from the flowmeter might not be exact 20.0mA at maximum flowrate.</p> <p>This function will measure the real output value at maximum flow.</p> <p><i>Warning: be very sure that the offered signal is correct before the calibration is executed as this function has major influences on the accuracy of the system!</i></p> <p>After pressing PROG, three settings can be selected: CALIBRATE: with this setting, the input will be calibrated with the actual 4mA value. After pressing enter, CAL SET will be displayed as soon as the calibration is completed. From that moment, the analog value must be more than the calibrated value before the signal will be processed. DEFAULT: with this setting, the manufacturer's value is re-installed. CAL SET: to select the last calibrated value.</p>		

6 – PULSE OUTPUT

One transistor or relay output is available as scaled pulse output according to the accumulated total.

PULSE WIDTH 61	<p>The pulse width determines the time that the output will be switched; in other words the pulse length. The minimum time between the pulse is as long as the period time (50/50 duty cycle).</p> <p>The pulse width is set in milliseconds in the range 0.001-9.999 sec. Value “zero” disables the pulse output.</p> <p>Note: <i>If the frequency should go out of range-when the flowrate increases for example-an internal buffer will be used to “store the missed pulses”: as soon as the flowrate slows down, the buffer will be “empted”. It might be that pulses will be missed due to a buffer-overflow, so it is advised to program this setting within its range!</i></p>
DECIMALS 62	<p>This setting determines the decimal position for setting 63.</p> <p>Note: <i>the measuring unit is according to setting 11 (for total)</i></p>
IMPULSE PER 63	<p>A pulse will be generated every X-quantity. Enter this quantity here while taking the displayed decimal position and measuring unit into account.</p>



7-OTHERS

TYPE OF MODEL 71	N/A
VERSION SOFTWARE 72	N/A
SERIAL NO. 73	N/A
PASS CODE 74	<p>All SETUP-value can be pass code protected.</p> <p>This protection is disabled with value 0000 (zero).</p> <p>Up to and including 4 digits can be programmed, for example 1234.</p>
TAGNUMBER 75	N/A

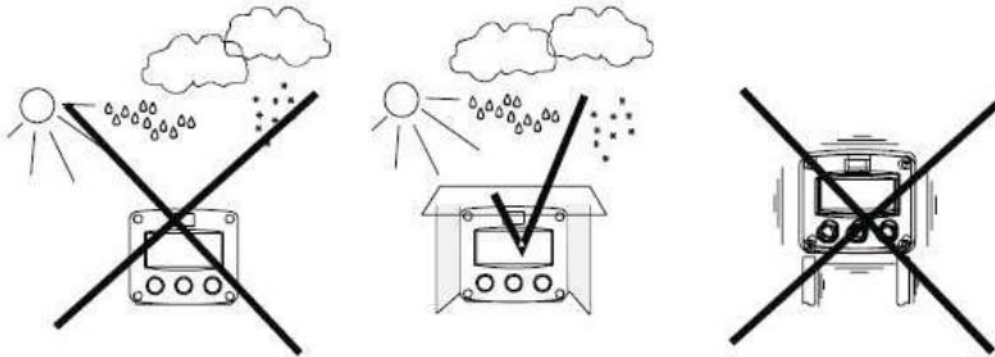
4. INSTALLATION

4.1 GENERAL DIRECTIONS



Mounting, electrical installation, start-up and maintenance of this instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions. The digital display may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed. Ensure that the measuring system is correctly wired up according to the wiring diagram. Protection against accidental contact is no longer assured when the housing cover is removed or the panel cabinet has opened (danger from electrical shock). The housing may only be opened by trained personnel. Take careful notice of the “Safety rules, instructions and precautionary measures” at the front of this manual.

4.2 INSTALLATION / SURROUNDING CONDITIONS



Take the relevant IP classification of the casing into account. Even an IP67 (NEMA4X) casing should NEVER be exposed to strongly varying (weather) conditions. When panel-mounted, the unit is IP65 (NEMA4X)! When used in very cold surroundings or varying climatic conditions, take the necessary precautions against moisture by placing a dry sachet of silica gel, for example, inside the instrument case.

Mount the display on a solid structure to avoid vibration. Select a site which is convenient for viewing. Note that the display can be ordered in any orientation at 90 degree increments and must be returned if the orientation needs to be changed for proper viewing. The site selection should provide at least 10 pipe diameters of straight meter size pipe between the flow meter inlet and any upstream fittings such as elbows, tee and valves. There are no special requirements for the downstream connection to the flow meter.



Note: Avoid placing the flow meter where it will be subjected to water hammer. Take care when removing the display from the back cover wires are connected between the display and flow transmitter. The digital display is powered by an external 24Vdc power supply provided by the user.



Note: That the flow meters are calibrated based on schedule 40 pipe ID connection. Tubing and hoses do not have the same ID as pipe and should be transitioned to pipe at least 10 pipe diameters upstream of the flow meter to achieve rated accuracy. **Important: Protect from freezing liquids**

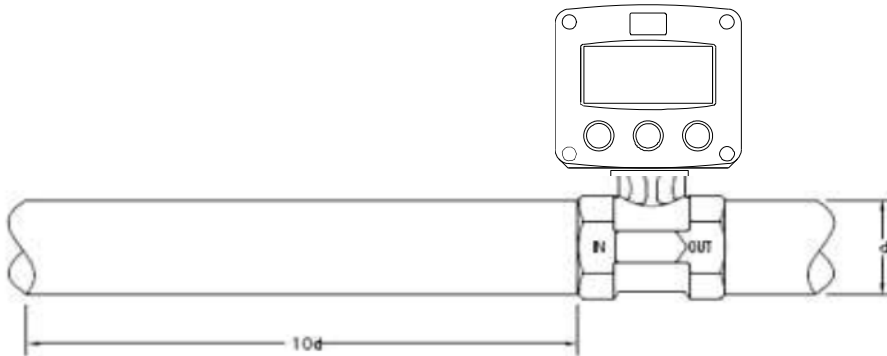


Fig. 5: Installation and straight run requirements

4.3 INSTALLING THE HARDWARE

Electro static discharge does inflict irreparable damage to electronics! Before installing or opening the unit, the installer has to discharge himself by touching a well grounded object.



This unit must be installed in accordance with the EMC guidelines (Electro Magnetic Compatibility).

Separate cable glands with effective IP67 (NEMA4X) seals for all wires. Unused cable entries: ensure that you fit IP67 (NEMA4X) plugs to maintain ratings.

4.3.1 TERMINAL CONNECTION WITH POWER SUPPLY

The following terminal connectors are available:

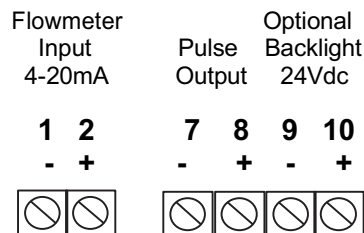


Fig. 6: Overview of terminal connectors and options
(Optional Backlighting requires 24Vdc supply)

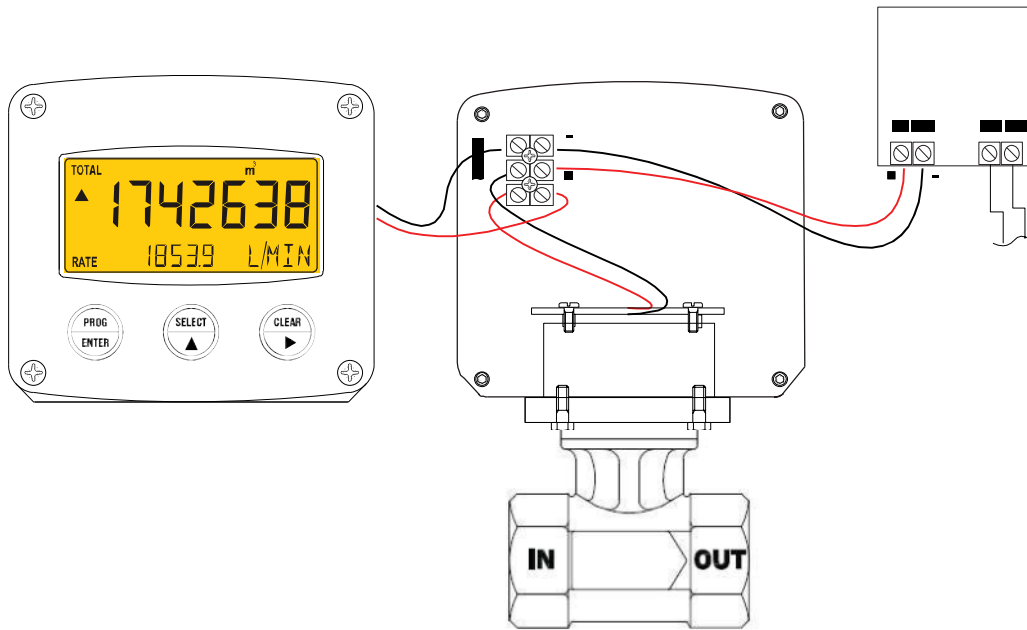


Fig. 7: Wiring connection for RW3 option

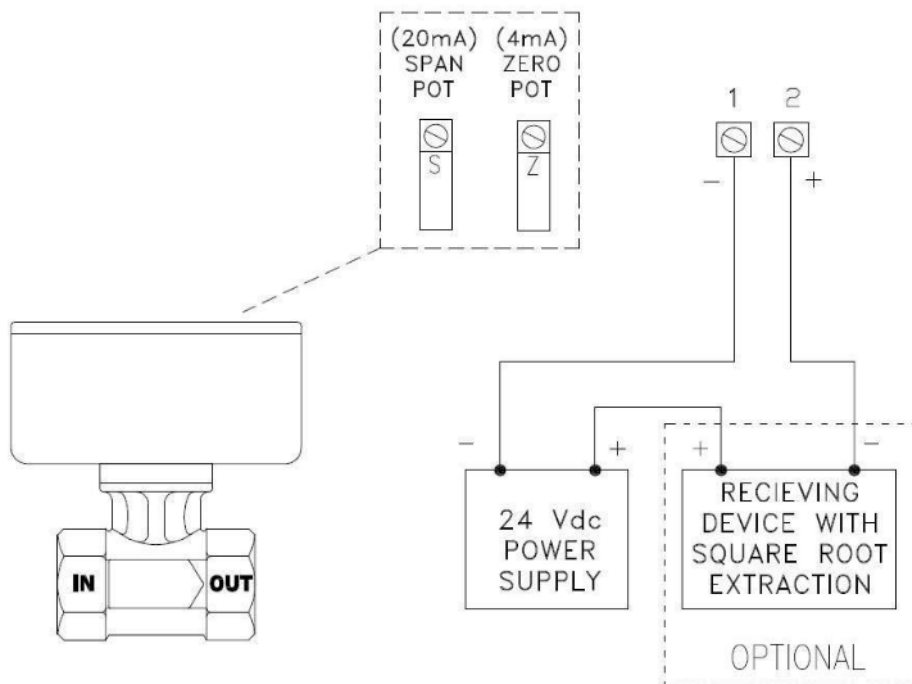


Fig. 8: Wiring connection for W2 / W3 options
(W3 option & DR-1 Remote Digital Display shown)

5. MAINTENANCE

5.1 GENERAL DIRECTIONS

The display does not require special maintenance unless it is used in low-temperature applications or surroundings with high humidity (above 90% annual mean). It is the users responsibility to take all precautions to dehumidify the internal atmosphere of the display in such a way that no condensation will occur, for example by placing dry silica-gel sachet in the casing just before closing it. Furthermore, it is required to replace or dry the silica-gel periodically as advised by the silica-gel supplier.

Check Periodically:

The condition of the casing, cable glands and front panel.

The input/output wiring for reliability and aging symptoms.

The process accuracy. As a result of wear and tear re-calibration of the flowmeter might be necessary. Do not forget to re-enter any subsequent span alterations check factory programming against model number.

The indication for low battery will be displayed.

5.2 REPAIR

This product cannot be repaired by the user and must be replaced with an equivalent certified product. Repairs should only be carried out by the manufacturer. To return meter for repair contact your supplier for an RMA.

5.3 TEST EQUIPMENT

Using a Fluke 9600A digital multimeter or equivalent. Connect multimeter in series with current loop. WARNING: Do not adjust span unless you are certain that the meter is reading incorrectly. Adjustment pots are marked Z (zero) and S (span).

5.4 CALIBRATION PROCEDURE – OUTPUT CALCULATION

With pipeline pressurized, adjust zero pot (Z) until current reads $4.00\text{mA} \pm 0.02\text{mA}$ at no flow. Establish a known flow rate through the flow meter as close to 95% of F.S. as practical. Set span pot (S), span is set using the following formula:

$I = 16 Q^2 + 4.00$; where I = current output mA, Q = decimal % of full scale.

% Flow to Output Chart

<u>% FS</u>	<u>Current Output</u>	<u>% FS</u>	<u>Current Output</u>
20	4.64	70	11.84
30	5.44	80	14.24
40	6.56	90	16.96
50	8.00	95	18.44
60	9.76	100	20.00

Fig. 9

APPENDIX A: TECHNICAL SPECIFICATIONS

GENERAL	
Display	
Type	High intensity reflective numeric and alphanumeric LCD, UV-resistant
Digits	Seven 17mm (0.67") and eleven 8mm (0.31") various symbols and measuring units.
Refresh rate	User definable: 8 times/sec – 30 secs.
Backlight (optional)	Bi-color configurable LED-Backlight-green or amber. Intensity adjustable from keyboard.

Enclosure	
General	GRP (Glass Reinforced Polyamide) enclosure with polycarbonate window, silicone and EPDM gaskets. UV stabilized and flame retardant material.
Control Keys	Three industrial micro-switch keys. UV-resistant silicone keypad.

Operating Temperature	
Operational	-40°C to +80°C (-40°F to +178°F)

Power Consumption	
Type	Input loop powered from 4-20mA signal input. Voltage drop max. 2.6Vdc.
Power Supply	20-30Vdc Power consumption max. 1 Watt

Terminal Connection	
Type	Removable plug-in terminal, wire max. 1.5mm and 2.5mm

Data Protection	
Type	EEPROM backup of all settings. Data retention at least 10 years.
Pass Code	Configuration settings can be pass code protected.

Environment	
Electromagnetic Compatibility	Compliant ref: EN 61326 (1997), EN 61010-1 (1993)
Low voltage directive	Compliant ref: EN 60950

INPUT	
Flowmeter	
Type	4-20mA with signal calibration feature output based on differential pressure

OUTPUT	
Pulse Output	
Function	Scaled pulse output – max frequency 500Hz.
	One passive transistor output – not isolated. Load max. 50V DC – 300mA.

OPERATIONAL	
Operator Functions	
Displayed Functions	Total and/or flowrate Total and accumulated total Total can be reset to zero by pressing CLEAR-key twice

Total	
Digits	7 digits
Units	L, m3, GAL, USGAL, KG, lb, bbl, no unit
Decimals	0 – 1 – 2 or 3
Note	Total can be reset to zero by pressing CLEAR-key twice

Accumulated Total	
Digits	7 digits
Units / Decimals	According to selection for total

Flowrate	
Digits	7 digits
Units	mL, L, m3, GAL, KG, Ton, lb, bl, cf, RND, ft3, scf, Nm3, NI, ical – no units
Decimals	0 – 1 – 2 or 3
Time Units	/sec - /min - /hr - /day

APPENDIX B: PROBLEM SOLVING

In this appendix, several problems are included that can occur when the display is going to be installed or while it is in operation.

Flowrate displays “0 / zero” while there is flow (total is counting):

Check:

SETUP 22 / 25: are the span and time unit correct.

The pass code is unknown:

If the pass code is not 1234, there is only one possibility left: call your supplier.

Range error

Range error (LO RANGE or HI RANGE): the input value is at least 5% above or below the calibrated measurement range SETUP 54, 55. Do recalibrate the input if desired.

Alarm

When the flag starts to blink an internal alarm condition has occurred. Press the “select button” several times to display the 4-digit error code. The codes are:

0001: irrecoverable display-data error: data on the display might be corrupted.

0002: irrecoverable data-storage error: the programming cycle might have gone wrong: check programmed values.

0003: error 1 and error 2 occurred simultaneously

The alarm condition will almost certainly be handled internally and if all mentioned values still appear correct, no intervention by the operator is needed. If the alarm occurs more often or stays active for a longer time, please contact your supplier.

Output malfunction

If the display does not indicate a rate and total the problem maybe a plugged pressure which prevents the differential pressure sensor (transducer) from providing the 4-20mA signal to the display. If the pressure sensor is plugged the unit will need to be returned for extensive cleaning and/or replacement.

Pressure Port Cleaning

Remove the housing from the body by removing the four screws. Remove the pulsation snubbers from the body by inserting a wood screw into the hole in the pulsation snubbers and gently pull out. Clean the passages in the body and snubbers using a probe and/or compressed air to free debris and sediment. If you are unable to clean without further disassembly, the flow meter should be returned to the supplier for repair.

Reassemble the flow meter housing to the body. Take care to properly seat the two inner o-rings before tightening the screws. Improper assembly can result in a leak and possible damage to the electronics.

The meter does not require routine lubrication or service of any kind. Keep the interior of the meter housing clean and free of dust, moisture, oils or corrosive materials which may attack the exterior and eventually damage the internal components. Contact the supplier for an RMA number if the unit needs to be returned for evaluation and/or repair.

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Actual settings	28	Low current	18
Backlight	16	Low battery	7, 8
Color	16	Main-function	10
Density	16	Maintenance	23
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Measuring unit	15	Setup-level	9
Span	15	Software version	3
Time unit	15	Sub function	10
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Span	14	IP classification	20

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LIST OF CONFIGURATION SETTINGS

SETTING	DEFAULT	DATE:	DATE:
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TOTAL	Enter factory settings here		
11 unit	L		
12 decimals	0000000	22222.22	
13 span	0001600 / sec	/ sec	/ sec
14 decimals span	0		

FLOWRATE	Enter factory settings here		
21 unit	L		
22 time unit	/ min		
23 decimals	0000000	22222.22	
24 span	0001600 / min	/ unit	/ unit
25 decimals span	0	0	

DISPLAY	Enter factory settings here		
31 function	total	total	
32 backlight	off	off	
33 brightness	5	5	

POWER MANAGEMENT	Enter factory settings here		
41 LCD-new	1 sec.	1 sec	
42 mode	operational	operational	

FLOWMETER	Enter factory settings here		
51 formula	interpolation	square root	
52 filter	01 (off)	01 (off)	
53 cut-off %	00.0%	15%	
54 cal. low-4mA	Default	4.00mA	
55 cal. high-20mA	Default	20.0mA	

PULSE OUTPUT	Enter factory settings here		
61 pulse width	0.000 sec	off	
62 decimals	0000000	off	
63 pulse per	1000 L	off	

OTHERS	Enter factory settings here		
71 model			
73 serial number			
74 pass code	0000		