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MFM 32

Non-Isolated Mass Flow Module

Instruction Manual

1.0 INTRODUCTION

These instructions refer to the above model. Supplementary sheets are attached if the unit has special options or features. For detailed specifications, see page 4 or refer to the Data Bulletin. All ADTECH instruments are factory calibrated and supplied with a label detailing the calibration. Adjustments are normally not necessary. A simple check should be performed to verify calibration before installation to ensure that it matches the field requirement.

2.0 GENERAL DESCRIPTION

The ADTECH MFM 32 is a Non-Isolated Mass Flow Module that accepts three process input signals of 1-5 vdc or 4-20 ma dc and performs a temperature and static pressure correction of a flow measurement and provides a standard control signal output such as 4-20 ma dc. Option 0 44 provides an additional pulse output.

The computation performed is $Mass\ Flow = K\sqrt{(P\Delta P)/T}$ where P and DP are the absolute static pressure and the differential pressure and T is the absolute temperature. Both P and T signals are internally converted to absolute units.

Power Option P-1 Non-Isolated 24 vdc provides negative output signal and negative DC power common rail connection.

The output is a true current source and provides process signals such as 4-20 ma, 0-1 ma, 0-10 ma, 1-5 ma and 10-50 ma dc or alternatively, a voltage signal of 5 vdc full scale. Other current and voltage Inputs/Outputs (I/O) are available as specified on the Data Bulletin.

3.0 INSTALLATION

The instrument is supplied in a general purpose enclosure as standard. NEMA 4, 7 or 12 and plug in chassis enclosures are optionally available. Installation area/location must agree with the supplied instruments including operating temperature and ambient conditions.

Mounting

Refer to the appropriate outline drawing for mounting and clearance dimensions. The instrument is surface mounted with two #10-32 screws on 8.00 inch centers.

Electrical Connections

The wire used to connect the instrument to the control system I/O should be a twisted pair(s) and sized according to normal practice. Shielded cable is not normally necessary (if used, the shield must be grounded at the input negative of the ADTECH instrument and left floating at the sensor).

A 12 position barrier terminal block with #6-32 screws and 3/8" spacing is provided for I/O and power connection. A housing ground terminal marked G is also provided.

Controls

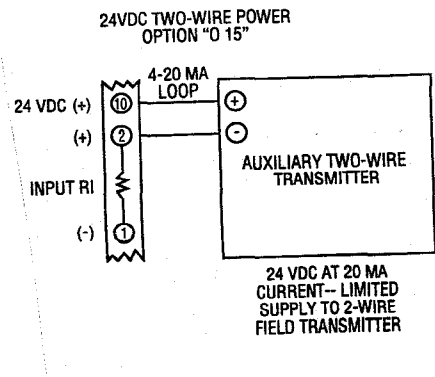
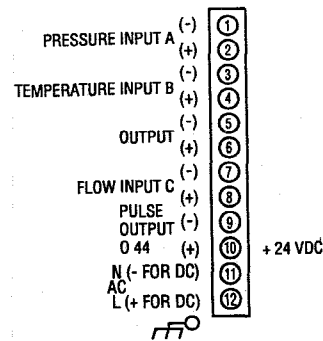
Multiturn OUTPUT ZERO, KA, KB, KC, ZA, ZB, ZC and Optional RATE controls are provided to calibrate the instrument. The multiturn controls are accessible through the instrument front panel and are clearly marked for ease of use. Three Internal INPUT SPAN multiturn controls are also provided.

4.0 MAINTENANCE

These instruments are electronic and require no maintenance except periodic cleaning and calibration verification. If the unit appears to be mis-operating it should be checked as installed per section 6.0 or removed for a bench check per sections 6.0-7.0. MOST problems are traced to field wiring and/or associated circuits. If the problem appears to be with the instrument, proceed to sections 6.0 and 7.0.

5.0 CONNECTIONS

Standard connections are shown below and on the instrument face plate, Data Bulletin or on attached supplementary sheets.



6.0 CALIBRATION

To perform a calibration check or re-calibration of the instrument follow this procedure.

- A. Refer to the Mass Flow computation equation on page 4 and identify all the variables given. Compute the values of constants K1 through K6 and Kc.
- B. Remove the instrument from the housing to gain access to the test points TP1, TP2, TP3, VREF, etc. following normal safety and equipment precautions.
- C. Make sure the unit I/O wiring is properly connected and that the correct power source per the label is also connected. The instrument must be at normal power for a minimum of 2 minutes before proceeding to D.
- D. The input signal source(s) must be adjustable from 0 to 100% in steps of 10% or at least 25%. The source(s) should either be precalibrated or an accurate meter must be used to monitor the input(s).
- E. The output may be monitored either as a direct voltage for a voltage output signal or as a current that can be represented as a voltage across a resistor shunt.
- F.* Set input sources A, B and C to the minimum calibrated input (e.g.) 4.00 ± 0.01 ma dc and adjust per:

| Input | Multiturn potentiometer marked | From Term #1 to T.P. # | Adjust to vdc |
|-------|--------------------------------|------------------------|---------------|
| A | ZA | TP1 | 0.000 |
| B | ZB | TP2 | 0.000 |
| C | ZC | TP3 | 0.000 |

- G*. Set input sources A, B and C to the maximum input span (e.g.) 20.00 ± 0.01 ma dc and adjust per:

| Input | Multiturn potentiometer marked | From VREF to T.P. # | Adjust to vdc |
|-------|--------------------------------|---------------------|---------------|
| A | R32 | TP1 | 0.000 |
| B | R29 | TP2 | 0.000 |
| C | R28 | TP3 | 0.000 |

- H. To set the bias and scaling for the inputs A and B, use the calculated values of K1 through K6 (from step A) and adjust per :

| Input | % input value | Multiturn potentiometer marked | From Term #1 to T.P. # | Adjust to vdc |
|-------|---------------|--------------------------------|------------------------|------------------|
| A | 0.000 | KA | VA | $K3 \times VREF$ |
| B | 0.000 | KB | VB | $K6 \times VREF$ |

where VREF is the dc voltage value at T.P. VREF from Terminal #1.

- I. Adjust the multiturn potentiometer marked KC fully CCW. Set flow input source 'C' to the minimum calibrated input and sources A and B at the full span input. Adjust the multiturn potentiometer marked OUT-ZERO to the minimum calibrated output (e.g.) 4.00 ± 0.01 ma dc.
- J. Set input sources A, B and C at the values corresponding to the full span output and adjust the multiturn potentiometer marked Kc to provide full scale output (e.g.) 20.00 ± 0.01 ma dc.

7.0 FIELD TROUBLE SHOOTING GUIDE

This section offers a simple, first level trouble-shooting aid for an apparent instrument malfunction.

SYMPTOM

CORRECTIVE ACTION

No output

1. Check the input and output connections carefully.
2. Check that the power supply polarity is correct and that power is present on the instrument terminals.
3. Check that the input source(s) is correct and that it changes magnitude between zero and full scale values when so adjusted.
4. If the output is a current signal (4-20 ma, etc.), make sure the output loop is complete and that the correct meter range is selected.

All external checks are complete. Problem seems to be internal.

The following information is provided for a qualified technician or serviceman as check points for use in internal troubleshooting.

| CHECKPOINT/ COMPONENT | VOLTAGE/ RANGE |
|--------------------------|--------------------|
| (across) C21 | 11 ± 0.6 vdc |
| (across) C25 | 26 ± 4 vdc |
| (across) VR1 | 6.9 ± 0.35 vdc |
| (across) R26 | 0.2 - 1 vdc |

- K. The output should now be checked at 25-50-75% of the input flow, pressure and temperature—one at a time—per the computation equation on page 4.

L. This completes the analog output calibration.

- M. If the pulse output (Option O 44) is provided, follow the supplement Option O 44 for calibration.

*Repeat F and G until within $\pm .006$ V

8.0 TABLES, PCB LAYOUT

INPUT TABLE

| INPUT SIGNAL FULL SCALE | INPUT SHUNT RI |
|----------------------------|-------------------|
| 50 ma dc | 100 ohm, 1/2 W |
| 20 ma dc | 250 ohm, 1/2 W |
| 10 ma dc | 499 ohm |
| 1 ma dc | 4.99K ohm |
| 10 vdc | See Note 1 |
| 5 vdc | None |

All selected resistors are 1%, M.F., 1/4 W, 50 PPM, unless otherwise noted.

NOTE 1: Input A: R61 = 110 K, R60 = 100 K
 Input B: R64 = 110 K, R62 = 100 K
 Input C: R67 = 100 K, R65 = 100 K

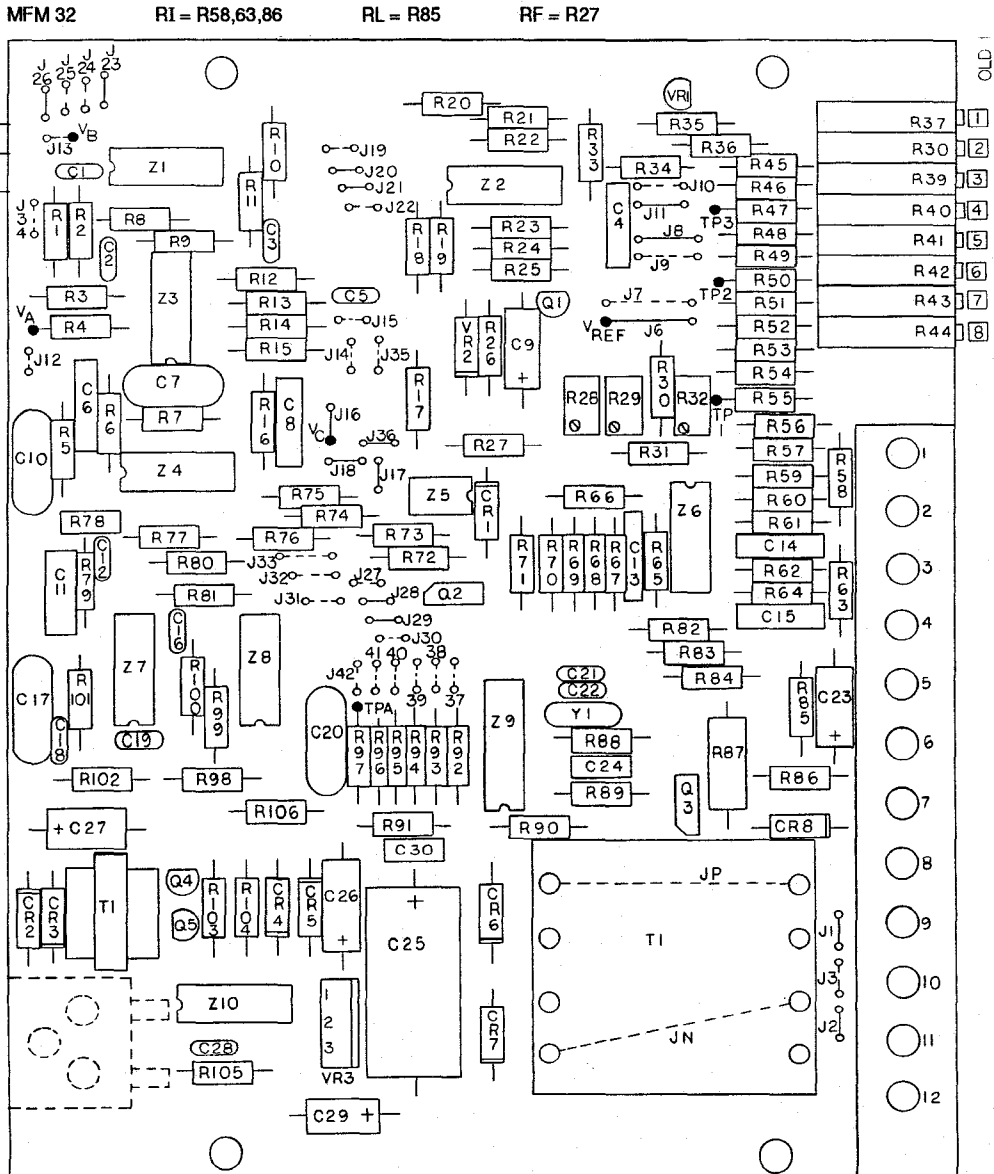
NOTE 2: For true zero inputs delete R57, R51, R70 as applicable

OUTPUT TABLE

| OUTPUT SIGNAL FULL SCALE | OUTPUT SHUNT RL | FEEDBACK RES RF |
|-----------------------------|--------------------|--------------------|
| 50 ma dc | NONE | 20 ohm |
| 20 ma dc | NONE | 49.9 ohm |
| 10 ma dc | NONE | 100 ohm |
| 1 ma dc | NONE | 1K ohm |
| 10 vdc | 604 ohm, 1/4 W | 49.9 ohm |
| 5 vdc | 250 ohm, 1/2 W | 49.9 ohm |

All selected resistors are 1%, M.F., 1/4 W, 50 PPM, unless otherwise noted.

NOTE A: Components as shown may or may not be present on the p.c. board due to design updates or options.



MASS FLOW EQUATIONS

$$\text{Mass Flow } M = K0 + Kc \sqrt{\frac{C K1 (K2 A + K3)}{K4 (K5 B + K6)}}$$

*no square root sign for linear input flow variable

where M = Compensated mass flow (e.g. lbs//minute)
 $K0$ = Live zero output (4.00 ma dc or 1.000 vdc)
 Kc = Overall gain factor (see below)
 A = Input gage pressure — variable
 B = Input temperature — variable
 C = Input flow — variable

Constants K1 through K6 are defined as follows:

$$K1 = \frac{P_{fsg} + 14.7}{P_{rg} + 14.7}$$

where P_{fsg} = full scale gage pressure
 P_{rg} = reference gage pressure

$$K2 = \frac{P_{fsg} - P_{zg}}{P_{fsg} + 14.7}$$

where P_{zg} = low end range value of gage pressure

$$K3 = 1 - K2$$

Note: K2 is same as multiturn control KA

$$K4 = \frac{T_{fs} + 460}{T_r + 460} \quad (\text{see note below})$$

where T_{fs} = full scale temperature
 T_r = reference temperature

$$K5 = \frac{T_{fs} - T_z}{T_{fs} + 460} \quad (\text{see note below})$$

where T_z = low end value of temperature range

$$K6 = 1 - K5$$

Note: K5 is same as multiturn control KB

16 for 4-20 ma output
 $Kc = 4$ for 1-5 vdc output
 40 for 10-50 ma output

Note: For degrees C use 273 instead of 460

9.0 SPECIFICATIONS

INPUT/OUTPUT

INPUT SIGNALS

- 4-20 ma dc (Z in 250 ohms)
- 10-50 ma dc (Z in 100 ohms)
- 0-1 ma dc (Z in 5K ohms)
- 0-10 ma dc (Z in 500 ohms)
- 1-5 vdc (Z in 10 megohms)
- 0-5 vdc (Z in 10 megohms)
- 0-10 vdc (Z in 100K ohms)
- Other zero based current and voltages available
- Low impedance current inputs, 1/10 standard (Option I 18)

OUTPUT SIGNALS/OUTPUT DRIVE

| | AC Power | DC Power |
|----------------|--------------------|--------------------|
| a. 4-20 ma dc | 0-1000 ohms max. | 0-900 ohms max. |
| b. 10-50 ma dc | 0-400 ohms max. | 0-350 ohms max. |
| c. 0-1 ma dc | 0-20,000 ohms max. | 0-18,000 ohms max. |
| d. 1-5 vdc | 250 ohms Z out | 250 ohms Z out |
| e. 0-10 vdc | 500 ohms Z out | 500 ohms Z out |

Zero based current and voltages in the above ranges are standard (e.g.) 0-20 ma, 0-5 vdc. Other voltage and currents optional.

PERFORMANCE

- Repeatability:** $\pm 0.1\%$ referred to input
- Linearity:** $\pm 0.1\%$ maximum, $\pm 0.04\%$ typical
- Repeatability:** $\pm 0.05\%$ maximum
- Temperature Stability:** $\pm 0.01\%/^{\circ}\text{F}$ maximum, $\pm 0.004\%/^{\circ}\text{F}$ typical
- Load Effect:** $\pm 0.01\%$ zero to full load
- Output Ripple:** 10 mv P/P maximum
- Response Time:** 150 milliseconds
- Temperature Range:** 0° to 140°F (-18° to 60°C) operating
 -40° to 185°F (-40° to 85°C) storage
- Power Supply Effect:** $\pm 0.05\%$ for a $\pm 10\%$ power variation

Note: All accuracies are given as a percentage of span

POWER

- 115 vac: $\pm 10\%$, 50/60 Hz, 3 watts, 0.7 Pf (standard)
- 24 vac: $\pm 10\%$ non-isolated, 3 watts (Option P1)
- 24 vdc: $\pm 10\%$ isolated, 3 watts (Option P2)
- 48 vdc: $\pm 10\%$ isolated, 3 watts (Option P3)
- 125 vdc: Nominal (105-140 vdc) isolated, 3 watts (Option P4)
- 230 vac: $\pm 10\%$, 50/60 Hz, 3 watts, 0.7 PF (Option P5)

10.0 OUTLINE & MOUNTING

