COX INSTRUMENTS
FLOW MEASUREMENT
Proven Performance for Over 50 Years

TURBINE METER PREAMPLIFIER

INSTALLATION AND MAINTENANCE MANUAL

MODEL NO. PA422

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GENERAL INSTRUCTIONS

- Cox Instrument designs, manufactures, and tests its products to meet many national and international standards. However, for these products to operate within their normal specifications, you must properly install, use and maintain these products. The following must be adhered to and integrated with your safety program when installing, using, and maintaining Cox Instrument products.

- Read and save all instructions prior to installing, operating, and servicing the product.

- If you do not understand any of the instructions, contact your Cox Instrument representative for clarification.

- Follow all warnings, cautions, and instructions marked on and supplied with the product.

- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.

- Install your equipment as specified in Cox Instrument site planning/installation instructions and per applicable local/national codes. Connect all products to the proper electrical and/or pressure sources.

- Handle, move, and install each product using the appropriate number of personnel and moving devices/equipment (dolly, forklift, crane, etc.). Failure to do so could cause serious personal injury.

- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.

- When replacement parts are required, ensure that the qualified service technician uses replacement parts specified by Cox Instrument.

- **WARNING! This equipment may contain static sensitive devices. Failure to comply with the proper handling procedures may result in damage to the equipment. Unauthorized substitutions may result in fire, electrical shock, other hazards, or improper equipment operation.**

- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified personnel, to prevent electrical shock and personal injury.

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PA422 Turbine Meter Pre-Amplifier

1. INTRODUCTION

This field mounted analog amplifier is an amplifying device for use in remote and/or hazardous areas.

It converts the low level pulses from a turbine meter reluctance pickup coil to a 4 to 20 mA analog output signal that may be transmitted over long wires to a receiving device. The PA422 uses the two wire 4 to 20 mA system.

2. INSTALLATION

2.1 Mounting

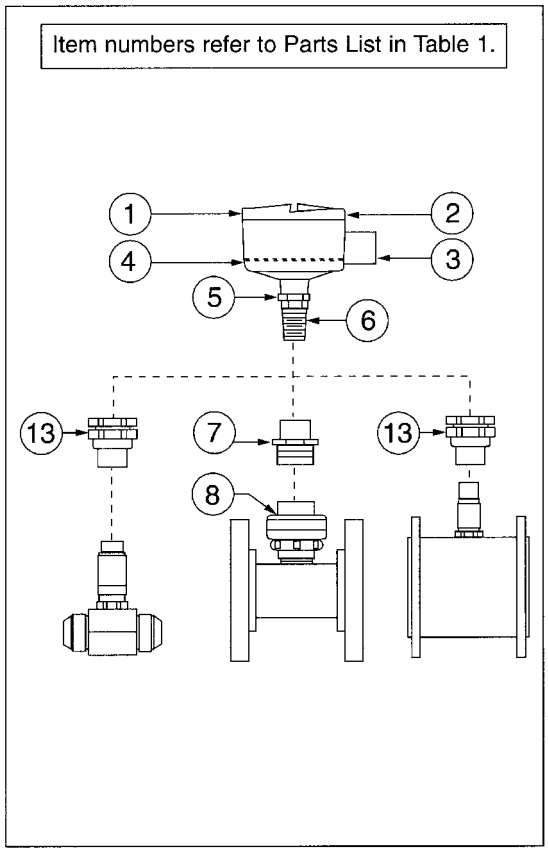


Figure 1. Mounting on Turbine Meter

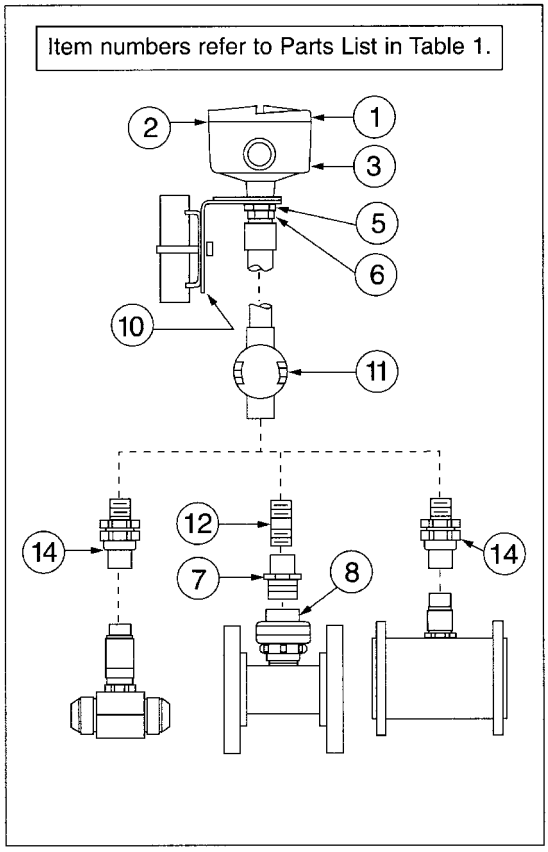


Figure 2. Surface or Pipe Mounting

2.2 Wiring

CAUTION: Protective Grounding Terminal.

A green-colored hexagonal head screw is provided which must be connected to earth ground prior to making any other connections to the equipment. This grounding screw is located inside the amplifier housing and under the printed circuit board. To access the protective ground screw, first remove the amplifier housing cover, item 1. Second, remove the two screws which hold the printed circuit board, item 4, to the housing. The printed circuit board, item 4, may now be removed from the housing. Reassemble in the reverse order using caution to insure that the O-Ring seal, item 2, is properly seated in the groove in the housing cover.

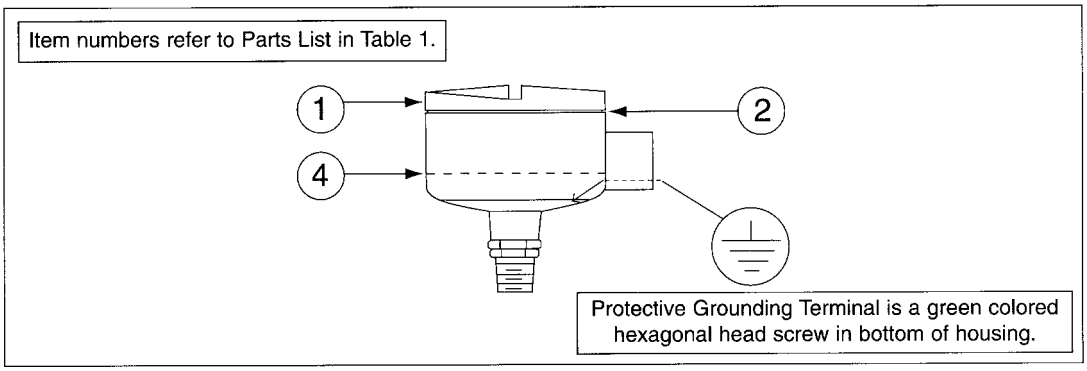


Figure 3. Protective Grounding Terminal

The PA422 uses a two wire system. These two wires are the power and signal interconnection between the amplifier and receiver. There are a total of four wires which are connected to the amplifier, two from the turbine meter pickup coil and two from the receiver. Wiring connections to the amplifier are made to a terminal block, no lugs are required. Access to the terminal block is by removing the threaded round cover, item 1.

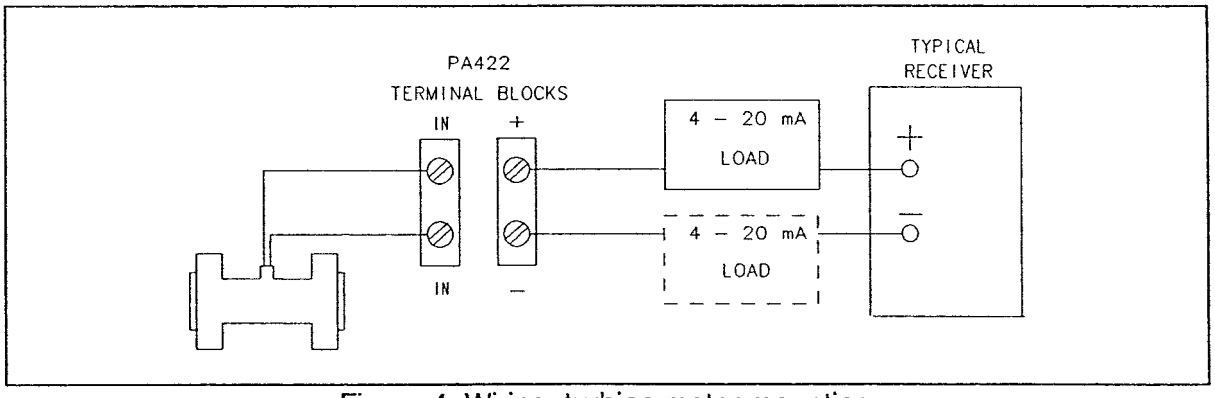


Figure 4. Wiring, turbine meter mounting.

A remote mounted amplifier which is within three feet of the turbine meter may be wired directly to the turbine meter using the wires provided with the meter. A remote mounted amplifier which is greater than three feet from the meter is connected using 18 AWG shielded cable. This type of installation will also require a junction box, item 11.

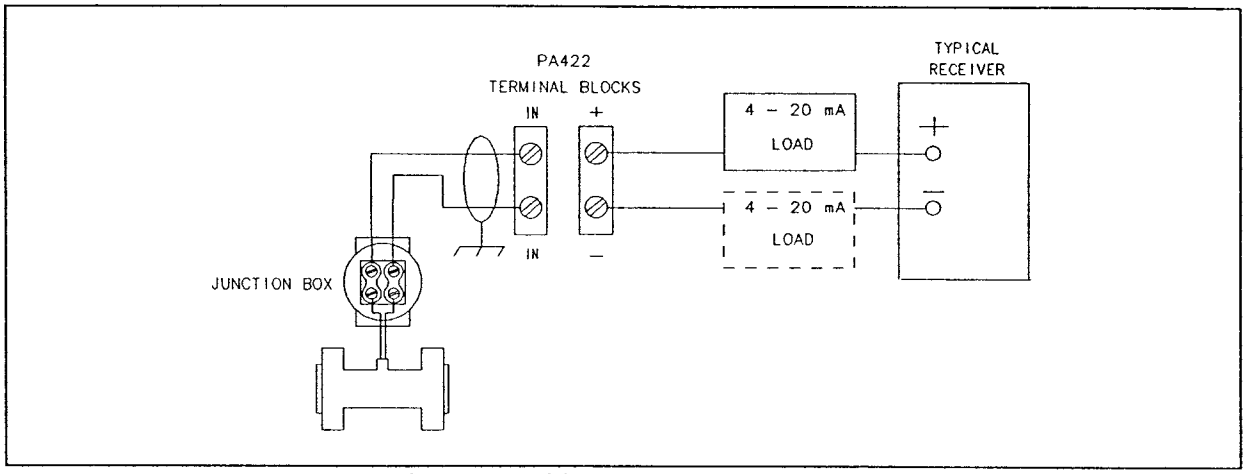


Figure 5. Wiring, remote mounting.

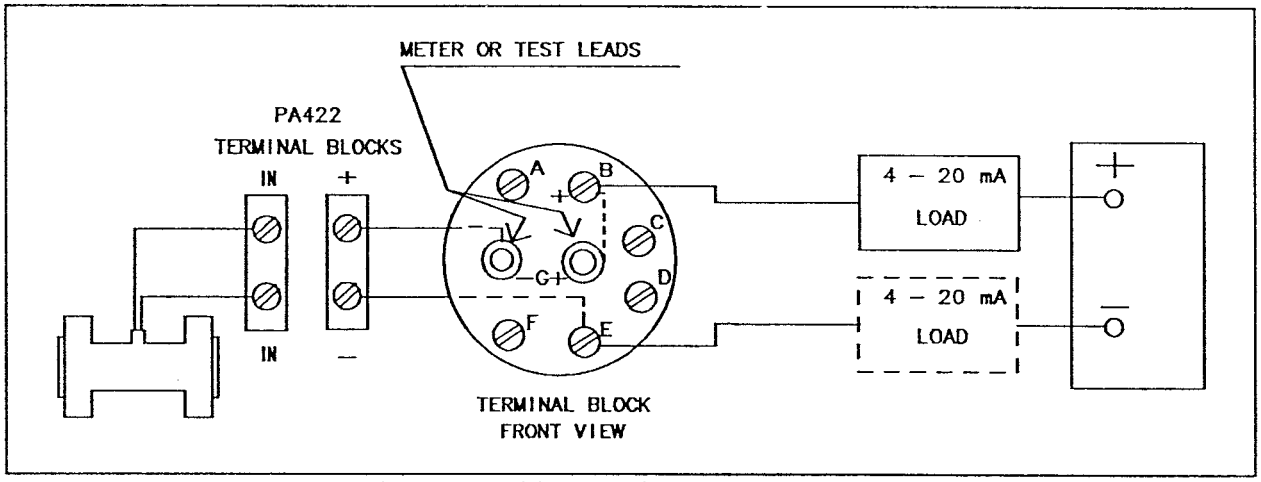


Figure 6. Wiring, optional analog meter.

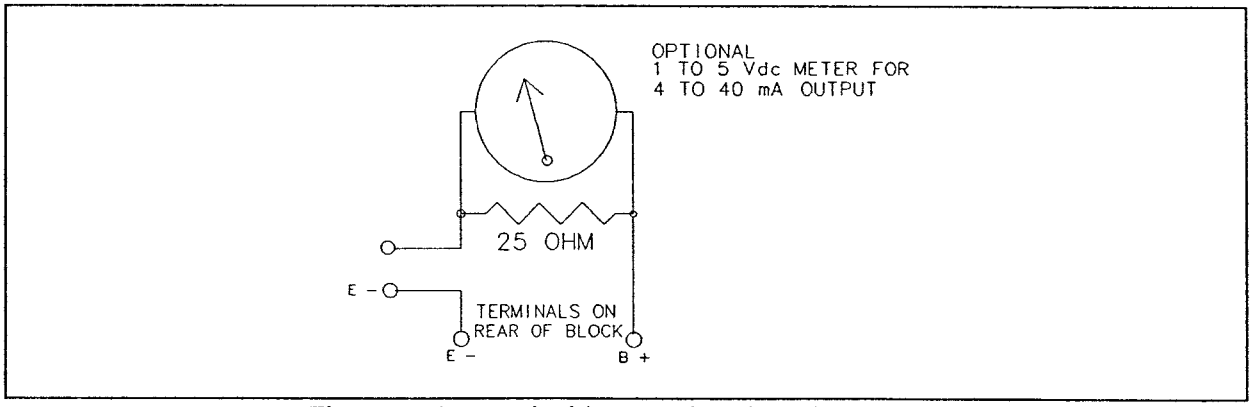


Figure 7. Internal wiring, optional analog meter.

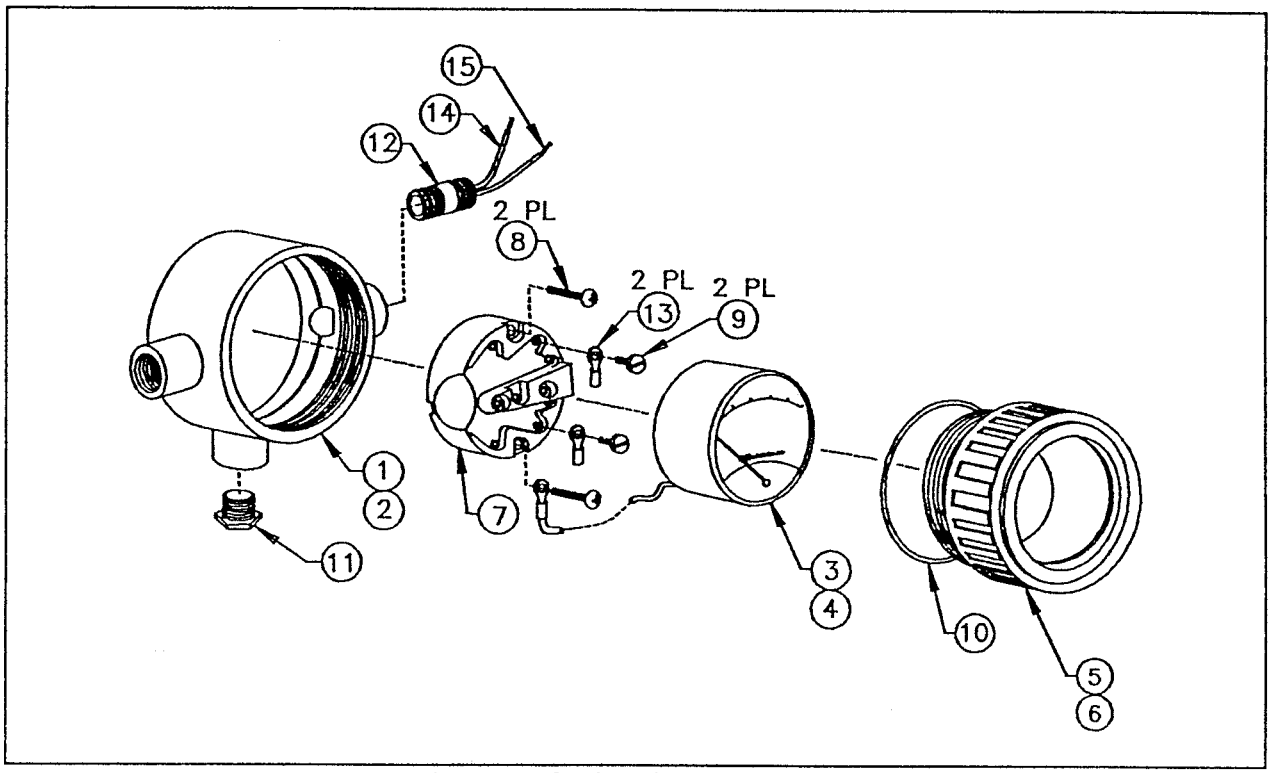


Figure 8. Optional analog meter.

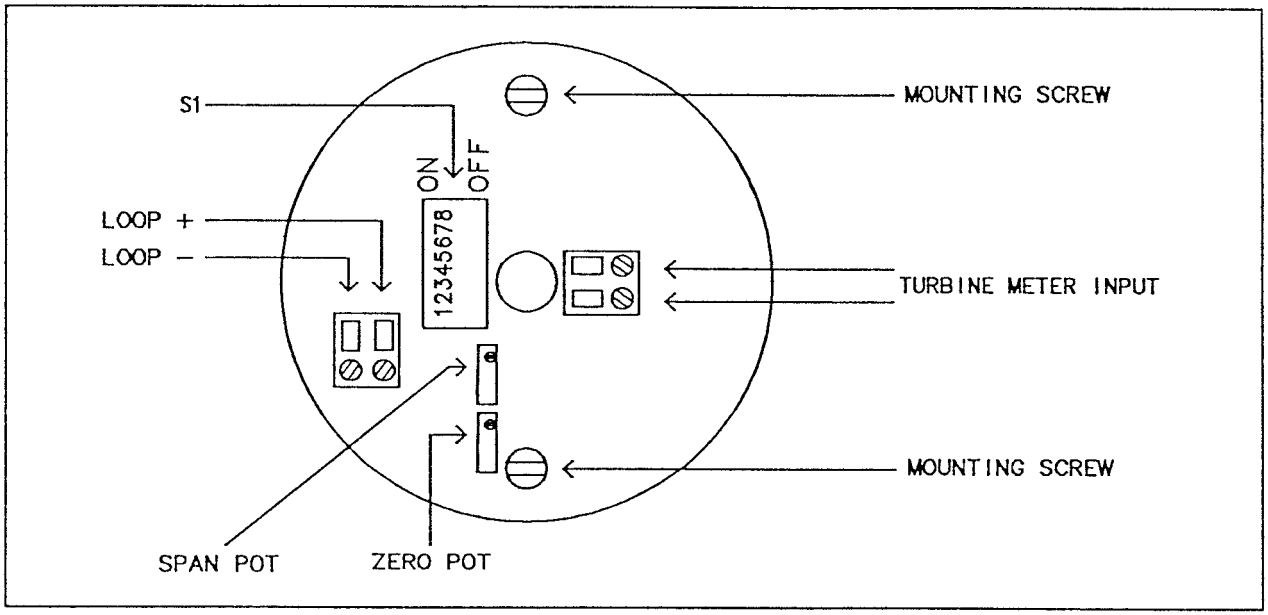


Figure 9. PA422 printed wiring board.

3. PARTS LIST

Item	Description	Part Number
1	Cover, color violet Cover, color blue	A2054VA A2054VB
2	O-ring	A2054UZ
3	Housing, color violet Housing, color blue	A2055CB A2055CC
4	Printed Wiring Assembly (PA422* A) Printed Wiring Assembly (PA422* B)	A2053EK A2053GQ
5	Nut 0.75 – 16	B0116TW
6	Coupling	N0143SE
7	Adaptor, female	A2054FF
8	Union, female, 1.25 inch NPT	A2055TQ
9	Connector	A2020FZ
10	Mounting kit, DN50 / 2 inch pipe	A2021BZ
11	Junction Box	A2055TR
12	Nipple	A2054GJ
13	Union, female	A2053WR
14	Union, male-female	A2053WJ

Table 1. Parts List

Item	Description	Part Number
1	Housing, color violet	A2054DK
2	Housing, color blue	N0151KJ
3	Millivolt meter assembly, % Output, for blue housing	N0143TR
4	Millivolt meter assembly, % Output, for violet housing	A2054DL
5	Cover, color violet	A2055 CL
6	Cover, color blue	A2055 CK
7	Terminal block	N0151KE
8	Screw	0034476
9	Screw	X0100PZ
10	O-ring	A2054UZ
11	Plug	B0107SF
12	Nipple	A2054GJ
13	Lug	C3282LB
14	Wire, green	A2054LE
15	Wire, red	A2054LF

Table 2. Analog Meter Parts List

4. DEINSTALLATION PROCEDURE

1. Remove cover from top works.

2. Disconnect five wires from the internal terminal block. Hold the top works from rotating as the union, on turbine meter mounting units, or the lock nut, on remote mounted units, is unthreaded. Remove the top works.

3. If the PA422 is being returned to the OEM for repair/calibration and the printed circuit board is removed from the housing, then the F=XXXX information as printed on the data label must be included with the shipment.

5. OPERATIONAL CHECK

1. Connect the PA422 and the test equipment as shown in Figure 10.

2. Determine the span frequency by one of the following steps.

   A. If the amplifier under test is being used with the original turbine meter for which the factory calibration was performed, then the span frequency printed on the data label as F=XXXX, should be used as the span frequency in step 6.

   B. If the amplifier is being used with a turbine meter other than the one used for the original factory calibration, then determine the span frequency by multiplying the K factor of the turbine meter times the maximum flow rate. This is the number to be used for the span frequency in step 6.

3. Determine the S1 range switch settings per Table 3 or Table 4.
   Example: for a PA422*A, if the span frequency as determined in step 2 is 1400 Hz, then S1 switches 1-4-7-8 would be set to the ON position and S1 switches 2-3-5-6 would be set to the OFF position.

4. Set the oscillator output amplitude to 0. The oscillator output must be floating.

5. The PA422 output signal as measured on the DVM should be 2.000 $\pm$ 0.1 Vdc.

6. Set the oscillator frequency to the frequency as determined in step 2. Set the oscillator amplitude to 200 mV peak to peak.

7. The PA422 output signal as measured on the DVM should be 10.000 $\pm$ 0.5 Vdc.

8. If the unit under test fails the tolerance of step 5 and/or 8, then the CALIBRATION PROCEDURE should be performed.

9. After successful completion of this test, if the PA422 fails to operate properly when connected to the turbine meter, the pick up coil in the turbine meter should be tested per the Master Instruction for the turbine meter.

6. CALIBRATION

Prior to attempting to calibrate the unit under test, the OPERATIONAL CHECK DESCRIBED on the previous page should be performed.

(1) Connect the PA422 and the test equipment as shown in Figure 10.
(2) Set the oscillator amplitude to 0.
(3) The PA422 output signal as measured on the DVM should be 2.000 ± 0.0006 Vdc. Adjust the zero pot if required for this reading. See Figure 9 for zero pot location.
(4) Set the oscillator frequency to the span frequency as determined in step 2 of the OPERATIONAL CHECK.
(5) Set the oscillator amplitude to 200 mVdc.
(6) The PA422 output signal as measured on the DVM should be 10.000 ± 0.03 Vdc. Adjust the span pot if required for this reading. See Figure 9 for span pot location. Readjustment of the zero pot setting should not be required, as span adjustment does not affect the zero setting. However, zero adjustment does affect the span setting; therefore span must be the last adjustment made.

7. THEORY OF OPERATION

Figure 11 is the block diagram of the PA422 amplifier.

7.1 Power supply.

The input amplifier, switch driver and output buffer circuits are provided with dc power from a current limited voltage regulator. A diode in series with the negative power connection provides reverse polarity protection.

7.2 Input amplifier.

The input amplifier receives the input signal from the pickup coil to the turbine meter. With an increasing flow rate through the turbine meter, the signal from the pickup coil increases in frequency and amplitude. Feedback circuits around the input amplifier cause the gain of this stage to decrease with frequency at the same rate that the signal amplitude from the pickup coil increases with frequency. This configuration minimizes the possibility of noise pickup causing false triggering of the following circuit.

7.3 Switch driver/Analog switch

The switch driver receives the signal from the input amplifier. Positive feedback around this circuit generates a schmitt trigger action. When the amplitude of the signal received by the switch driver exceeds the hysteresis window, the signal at the switch driver output changes state. This signal is, therefore, a square wave and is used as the drive signal to the analog switch. The conversion from frequency to current is achieved by the charge dump technique, a capacitor (C charge) is alternately charged to a reference

voltage (VREF) and then discharged into a holding capacitor (C hold). The average value of charge current "dumped" into the holding capacitor is determined by the value of C charge (value selected by S1 setting), reference voltage (adjusted by span pot) and the switching frequency determined by the input frequency (input). The output loop current is converted to a multiple of this average value of charge current by the output buffer.

7.4 Transient protection.

The amplifier inputs, voltage regulator power input and buffer output are protected from damage due to application of over voltages. This protection is provided by diode clamps.

Span Frequency - Hz	S1 Switches ON (all others are OFF)
1500 to 2000	1-4-7
1000 to 1500	1-4-7-8
750 to 1000	1-3-7
500 to 750	1-3-7-8
375 to 500	1-3-5-7
250 to 375	1-3-5-7-8
188 to 250	2-3-5-6
125 to 188	2-3-5-6-8
100 to 125	3-5

Table 3. S1 Switch Settings for PA422 Style A

Span Frequency - Hz	S1 Switches ON (all others are OFF)
1540 to 2150	1-2-4-6-7-8
1100 to 1540	1-2-3-6-7
780 to 1100	1-2-3-6-7-8
560 to 780	2-3-7
400 to 560	2-3-7-8
280 to 400	2-3-5-7
200 to 280	2-3-5-7-8
140 to 200	3
100 to 140	3-8
70 to 100	3-5
50 to 70	3-5-8

Table 4. S1 Switch Settings for PA422 Style B

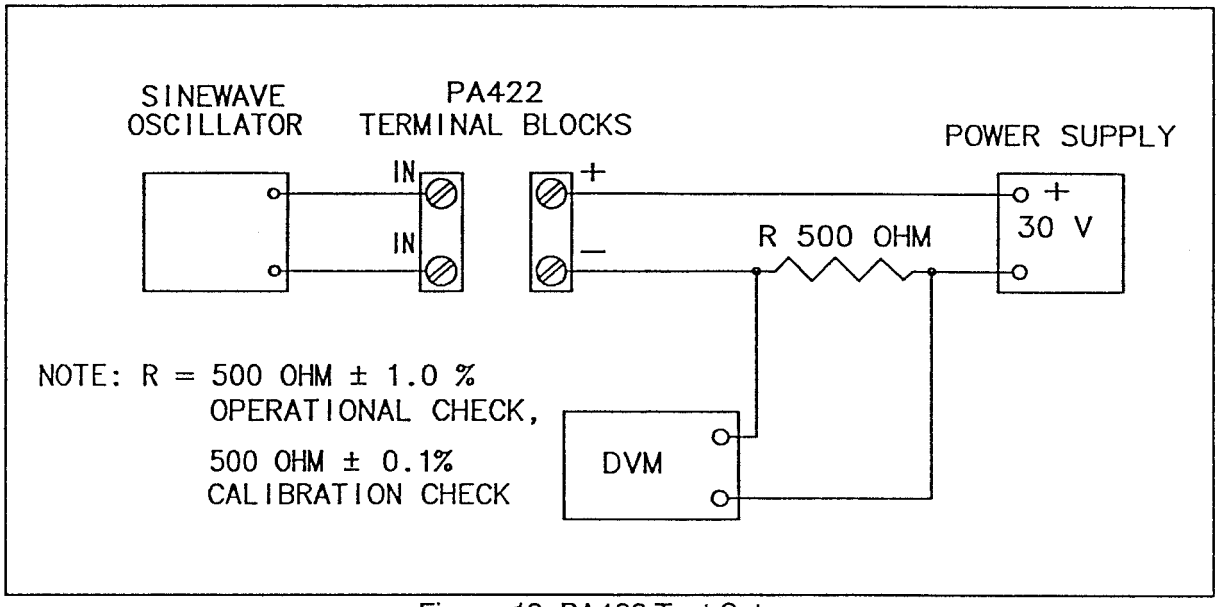


Figure 10. PA422 Test Setup.

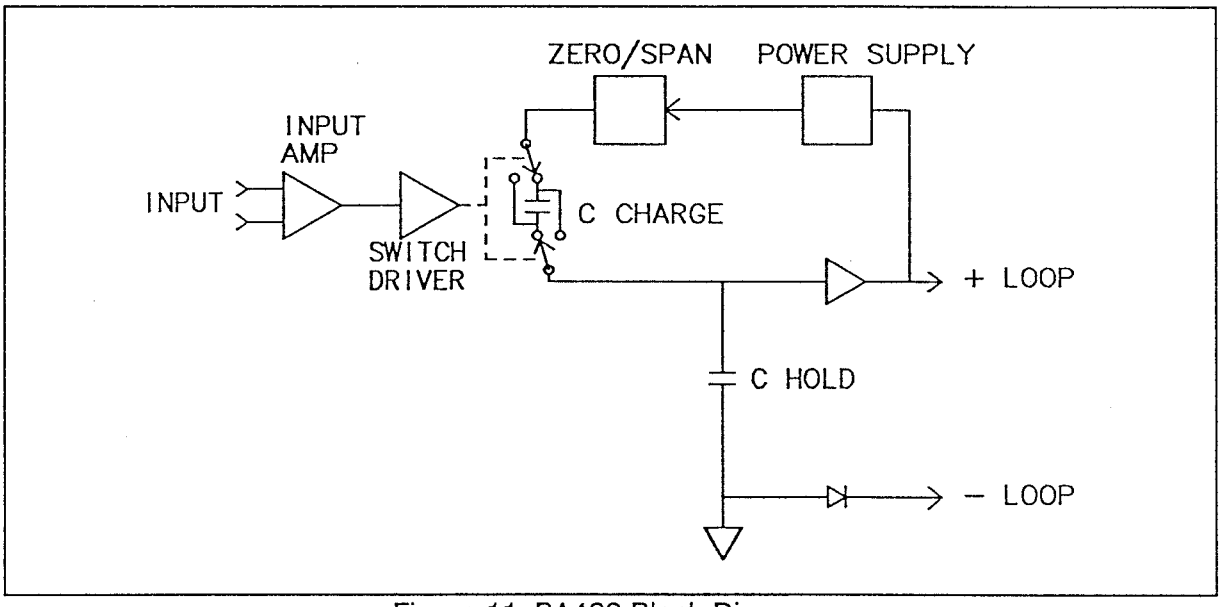
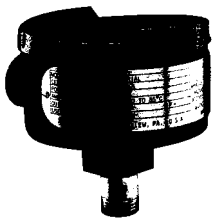


Figure 11. PA422 Block Diagram.



PA422 Analog Amplifier

Model Code

PA422 = Analog Amplifier (Specify mounted or not mounted on Turbine Flowmeter.)

Optional Output Indicator
A =Analog meter, Linear Scale, 0 to 100
C=Analog meter, Linear Scale, Custom
D=Digital indicator, user scalable.

Input Signal: from pickup coil of turbine flowmeter. 20mV to 10V, 10 to 2000 pps

Output Signal: 4 to 20 mA dc two-wire system. (Power is supplied over signal wires.)

Input-output relationship: The output current is 4 mA at an input frequency of 1 pps and increases linearily with input frequency.

Adjustability: Unit is field adjustable to provide full scale output of 20 mA for any input frequency between 50 and 2000 pps.

Operating Temperature: -40 to +85C (-40 to +185 F)

Supply Voltage: Supply voltage requirements depend on total external loop resistance. Refer to Figure 1.

Accuracy: ±0.25% of span.

Repeatability: ±0.1% of span.

Drift: (over 6 month period): Maximum of ±0.1% of reference span.

Hysteresis: 0.05% of span

Ambient Temperature Effect: Maximum error in percent of span for a 55 C (100 F) change in ambient temperature:

Zero (4 mA dc): ±0.25%
Span (20 mA dc) : ±1.0%

Relative Humidity Effect: No effect with housing cover and seals properly in place.

Supply voltage effect: ±0.1% of span for a power supply voltage change from 12.5 to 40 V dc.

Housing: NEMA 4 cast aluminum housing.

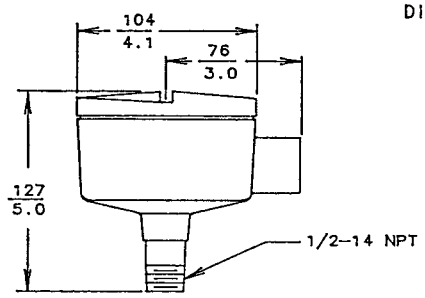
Mass: 1 kg (2.2 lbs) approx. (without output indicator).

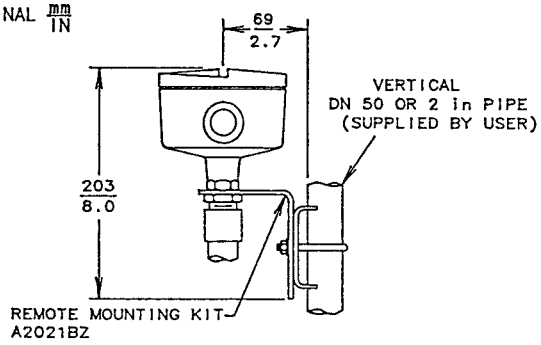
Dimensional Print

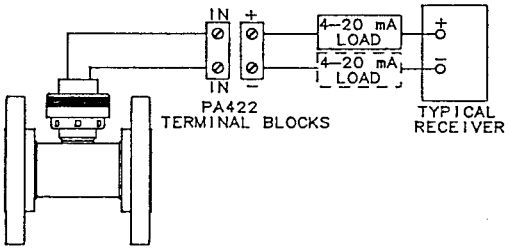
DP
XO-103DP
FEB 1, 1993
SHEET 1 of 1

PA422 FIELD MOUNTED ANALOG AMPLIFIER (2-WIRE SYSTEM)

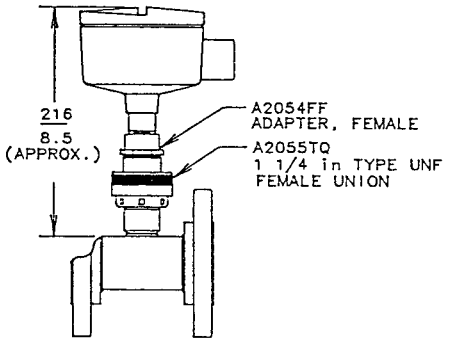
DIMENSIONS-NOMINAL mm / IN



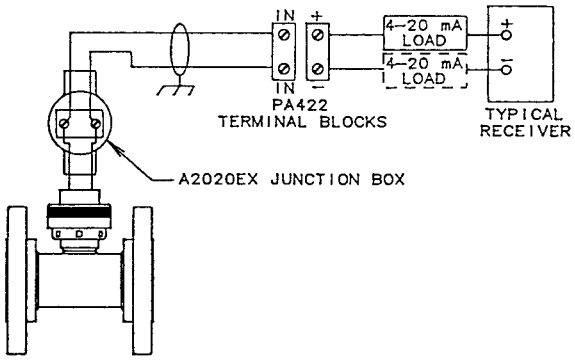




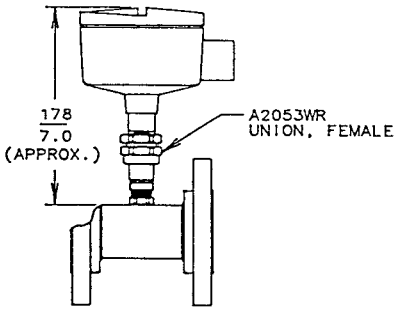
WIRING, PREAMPLIFIER MOUNTED ON TURBINE FLOWMETER.



TURBINE FLOWMETER WITH COIL BOSS



WIRING, PREAMPLIFIER REMOTE MOUNTED.



TURBINE FLOWMETER WITHOUT COIL BOSS

(NOT FOR CONSTRUCTION UNLESS CERTIFIED)

CUSTOMER _____ I.R. _____

CUSTOMER ORDER _____ ORDER _____

ITEM-TAG _____

_____

_____

CERTIFIED BY _____ DATE _____

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