INSTRUCTION MANUAL

272-5X5 ANALOG TRANSMITTER
(210 SERIES FLOW METERS)

272-5X7 ANALOG TRANSMITTER
(220/240 SERIES FLOW METERS)

272-5X8 BIDIRECTIONAL TRANSMITTER
(210/240 SERIES FLOW METERS)

TABLE OF CONTENTS

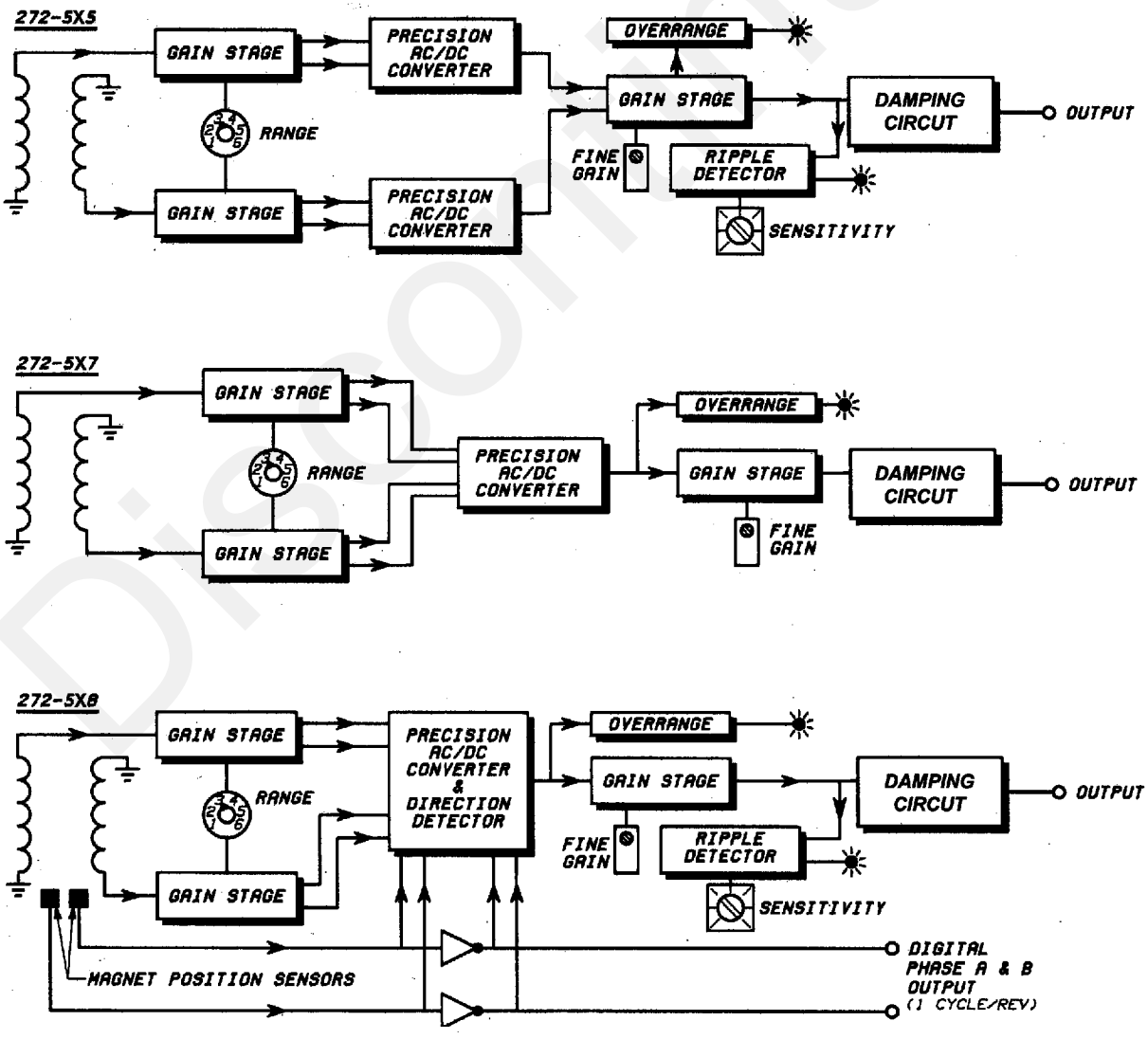
GENERAL DESCRIPTION

The 272 Series Transmitters convert the rotary motion of a flow meter into a voltage proportional to flow. A magnet sealed within the flow meter housing rotates in step with the metering elements. The varying magnetic field is sensed by an external stator with a two phase winding. The resulting AC voltage is scaled and converted to DC.

The 272-5X8 Transmitters use two Hall Effect sensors in addition to the stator coil to measure the position of the magnet as well as its velocity. This allows bidirectional flow rate monitoring with a ± 10V output.

The electronics utilize low current, chopper stabilized op amps for stable and extremely accurate results over widely varying environmental conditions.

The Model 272 transmitter's flow monitoring technique results in a quick response to flow changes with negligible mechanical drag on the metering elements. Since the sending magnet is totally sealed within the flow meter, problems associated with dynamic seals are eliminated.



SPECIFICATIONS

Output Voltage Range

272-5X5	0 to 10V	Typical
272-5X7	0 to 10V	Typical
272-5X8	0 to ±10V	Typical
	13.5 V	Maximum

Accuracy

Linearity (input RPM vs Output Voltage)	0.05%	Typical
	0.10%	Maximum
Zero Offset (Referred to Output: 0 to 10 V)	3mV	Typical
	5mV	Maximum

Temperature Range

272-5X5 and 272-5X7

Electronics:

Operating	-10°C to 65°C
Storage	-40°C to 70°C
Stator	-40°C to 130°C

272-5X8

Electronics:

Operating	-10°C to 65°C
Storage	-40°C to 70°C
Stator	-40°C to 90°C

Temperature Coefficients

Flow Meter Magnet	0.5% per 100°C
Transmitter	0.2% per 100°C
Zero (Referred to Output: 0 to 10 V)	1 Mv per 100°C

Supply Voltage and Current *

272-5X5	±15V±5% @ 5.9mA
272-5X7	±15V±5% @ 23mA
272-5X8	±15V±5% @ 26mA

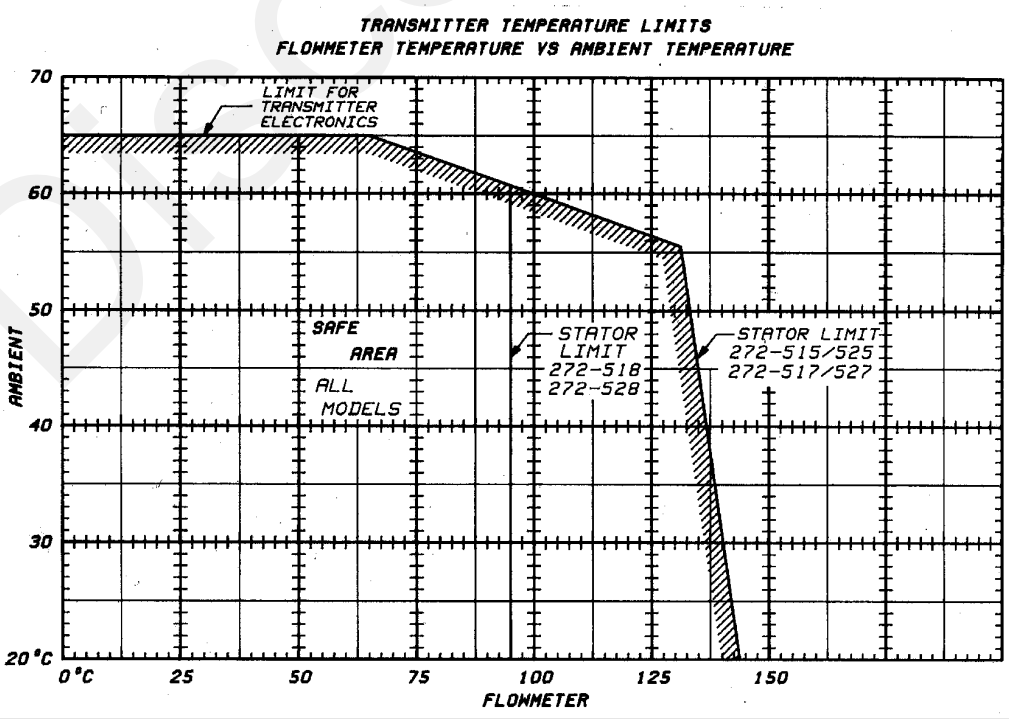
***** Substitution of op amps will increase current consumption slightly. See schematic tables.

Mounting: The Model 272 transmitter screws on and off of the flow meter. Because of the random location of the starting point of the threads, one transmitter will probably not line up with the "in" and "out" ports of the flow meter like another will. The electrical outlet of the transmitter can be rotated clockwise or counter clockwise **one turn** by loosening the clamping screw at the base of the transmitter housing.

Two flats are provided for screwing the transmitter on to the flow meter. **Care should be taken when slipping the transmitter on and off.** The wire of the stator is fine gauge and is easily damaged.

Moisture Protection: The weather tight version of the transmitter has its electronic circuitry enclosed in a liquid and vapor tight enclosure. All joints are sealed by welding or by "O"-rings. If this sealed condition is to be maintained, the conduit connection to the enclosure should be made liquid and vapor tight by using pipe dope or a potting fitting. If a transmitter is located outside and this precaution is not taken, moisture may form inside the housing. This will cause the circuitry to give an inaccurate output or possibly no output at all. In the long run it will cause corrosion and failure. The amphenol connector 272 Models offer moderate protection from moisture and dust, but are not totally sealed.

Temperature Considerations: High ambient temperatures (120°F/50°C) should be avoided if possible. It is a good idea to locate the transmitter away from hot spots such as steam pipes, ovens and heaters. The electronics of the 272 Series Transmitters are rated for operation up to 65°C or 150°F. **Because some heat travels from the flow meter to the transmitter electrical enclosure, the temperature the electronics see is a function of both the ambient and the flow meter temperature.** Figure 3 shows the relationship between the aximum ambient transmitter temperature and the fluid temperature through the flow meter.

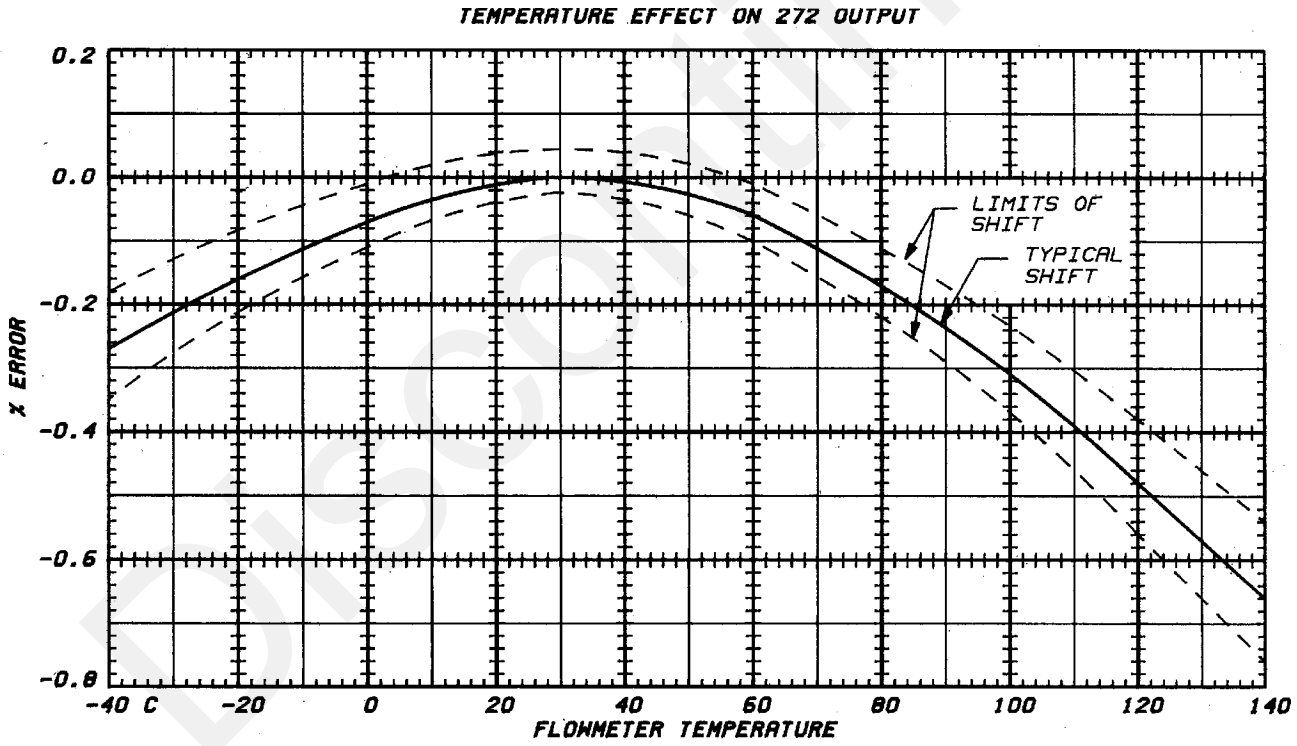


Temperature Considerations: (continued)

The stator of the Model 272 transmitters is insulated with an epoxy that is rated to 125°C. This limits the maximum flow meter fluid temperature to 130°C when using the Models 272-5X5 or 272-5X7. The 272-5X8 bidirectional transmitter uses Hall effect devices that are rated to 90°C. This is the maximum fluid temperature when using the Model 272-5X8.

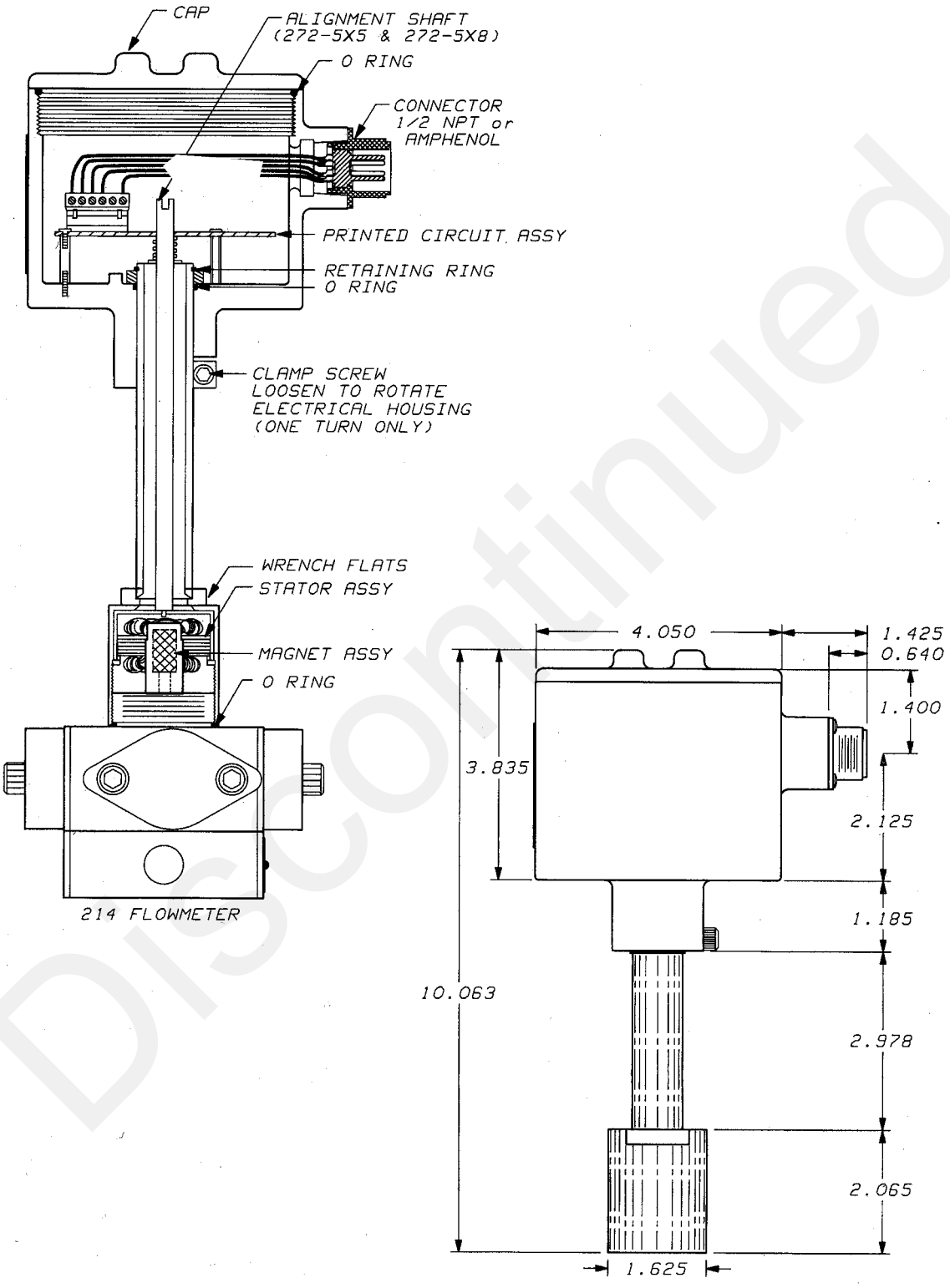
Transmitter (Maximum: 65°C)	**Maximum Flow Meter Fluid Temperature** @ Ambient of 50°C
272-5X5	130°C
272-5X7	130°C
272-5X8	90°C

The output of the Model 272 will be affected by changes in the temperature of the flow meter. This is because the magnet that generates the voltage in the stator is affected slightly by temperature. Fig. 4 shows typical percentages of error.



Electronic Protection: Diodes have been placed in the input and output circuits to guard against excessive or reversed voltages in the event connections are made incorrectly. The diodes are rated at 1/2 amp and will take one amp for a few seconds. If the sourcing current exceeds this amount, the diodes will eventually fail, and damage to the transmitter may result.

Dimensions:

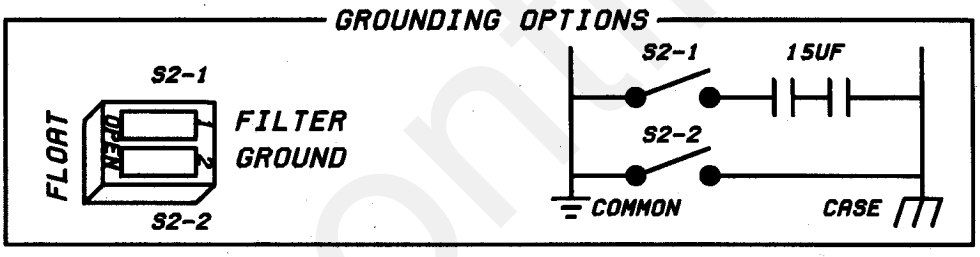


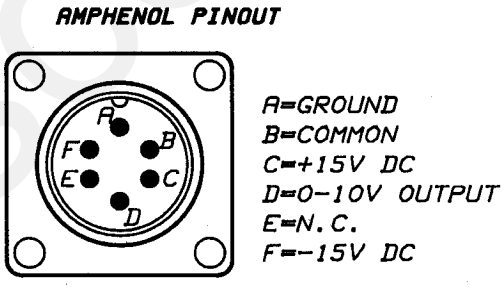
Transmitters calibrated at the factory with a flow meter are shipped with a calibration sheet and will not require further adjustment. Transmitters shipped alone will have to be phased to the flow meter and wet calibrated.

Grounding Switches: S2-1: This switch connects circuit common to the transmitter case through two back to back 15 µF @ 20V capacitors. S2-2: This switch connects common and case ground directly together.

By using either S2-1 or S2-2 the effects of electrical noise on the transmitter can be reduced. Excessive electrical noise can result in a zero offset of the output signal and a reduction of accuracy. It is good practice to have a circuit directly connected to ground at one point. This will probably be at the indicator or receiving end of the signal.

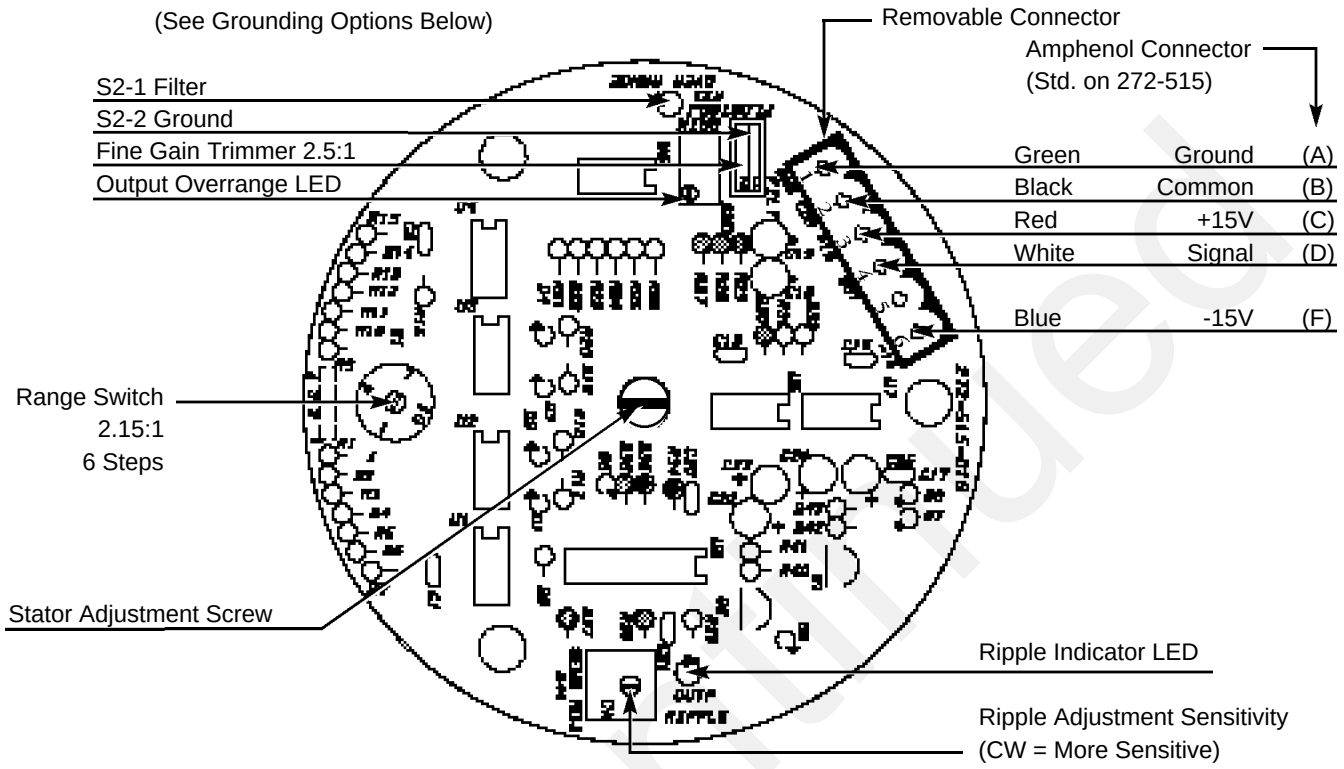
By activating S2-1, electrical noise between the case and the circuitry of the transmitter can be considerably reduced, without causing ground loop problems. If the system is not grounded at the indicator or if the flow meter is not physically grounded through its plumbing, use S2-2. To activate either switch, depress the side of the switch that is numbered.





Amphenol Connectors (See above) are use on Transmitter Models 272-5X5, 5X7 & 5X8.

Information for 272-5X5 transmitters:



Output Voltage Span Adjustments: These adjustments are used to match the specific flow meter and flow range to provide the optimum output signal; and to make the indicator read in engineering units if required.

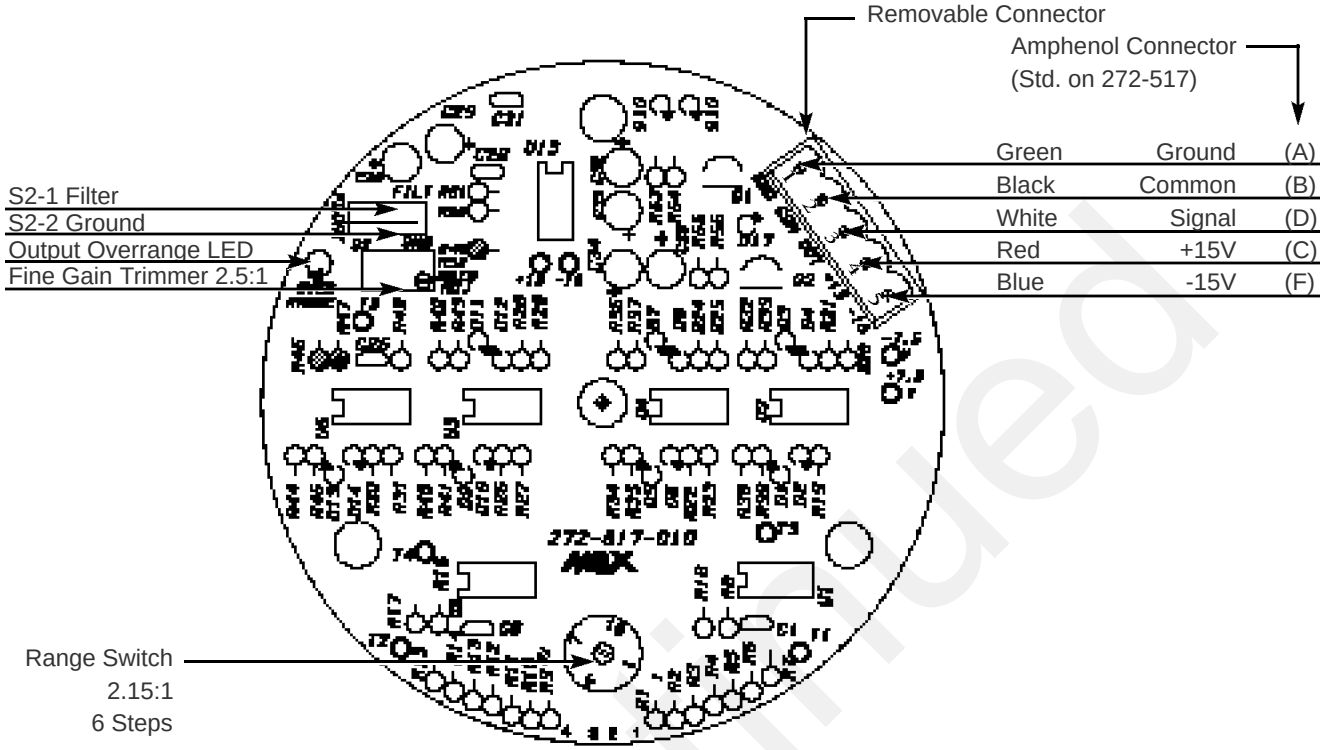
Range Switch: This switch changes the output voltage by steps of 2.15 to 1. It is used to set the output voltage to the approximate value desired.

Fine Gain Adjustment: This is a 20 turn potentiometer that is used to precisely adjust the output voltage of the Model 272. The adjustment range is 2.5 to 1.

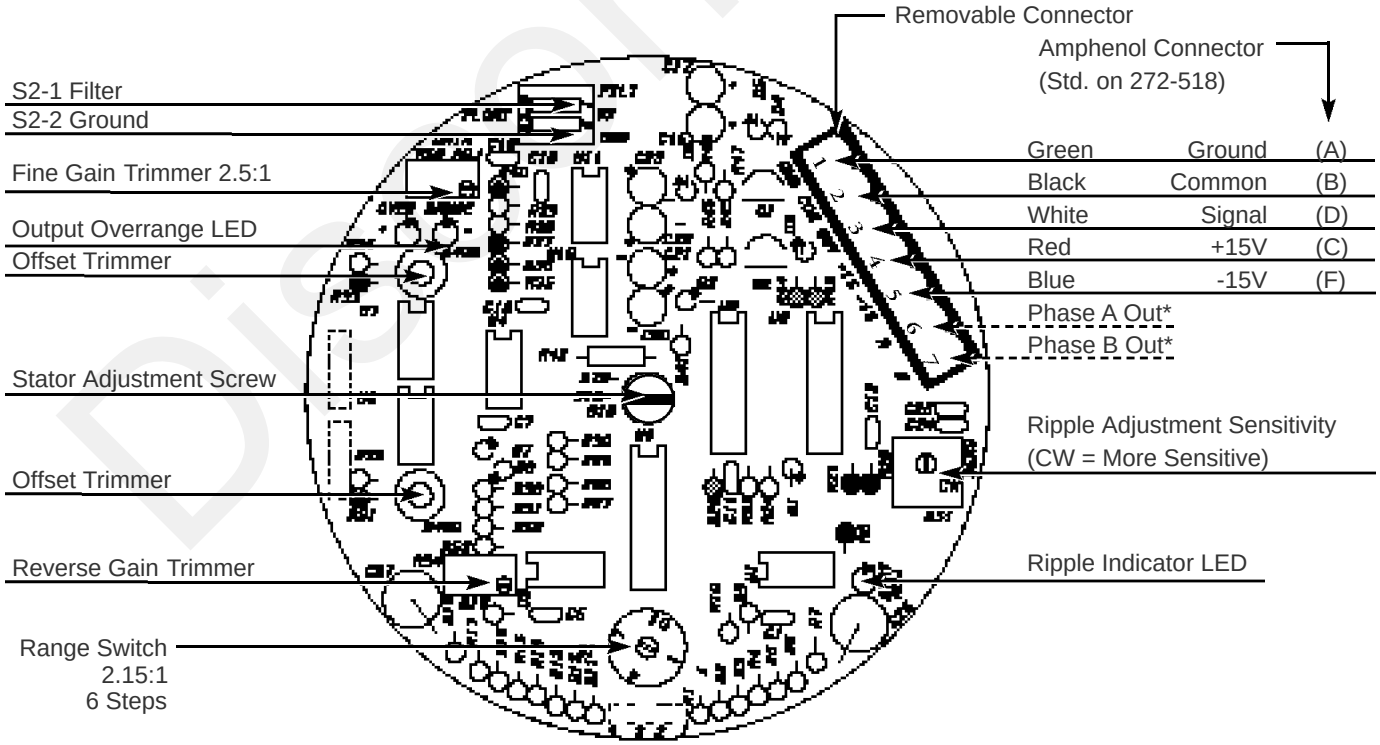
Reverse Gain Trimmer: Sets the output voltage in reverse flow to equal the voltage at the same forward flow rate.

Any full scale voltage can be used. One volt, two volts or 8.888 will work just as well as 10.000. If the Model 272 is operating a digital voltmeter directly, the span can be adjusted to make the voltmeter read directly in engineering units. In such a case, some RC damping will be required.

Information for 272-5X7 transmitters:



Information for 272-5X8 transmitters:



* 1 CYCLE PER FLOW METER REVOLUTION +/- 7.5V SQUARE WAVE (NOT REQUIRED BY MAX INDICATORS.)

Table I list the approximate volumetric displacements of flow meters that can be used with the 272 transmitters. Use this table to calculate the RPM of the flowmeter at maximum flow.

TABLE 1: METER MAXIMUM FLOW AND DISPLACEMENT

FLOWMETER	MAXIMUM FLOW		DISPLACEMENT PER REVOLUTION	
MODEL	CC/MIN	GAL/MIN	CC	GALLONS
213	1,800	0.48	0.870	.00023
214	10,000	2.64	10.5	.00285
215	40,000	10.6	47.6	.0128
216	100,000	26.4	169.5	.0446
220	10,000	2.64	9.12	.0024
221	55,000	14.5	23.5	.0062
222	75,000	19.8	47.4	.0125
241	189,000	50.0	62.1	.0164
251	189,000	50.0	62.1	.0164
242	540,000	143.0	182.0	.0480
243	1,400,000	370.0	574.0	.152
244	3,500,000	925.0	1700.0	.456
245	8,000,000	2114.0	6060.0	1.60

FOR EXAMPLE: THE MODEL 213 MAXIMUM RPM IS: 1800 CC/MIN ÷ 0.870 CC/REV = 2069 RPM.

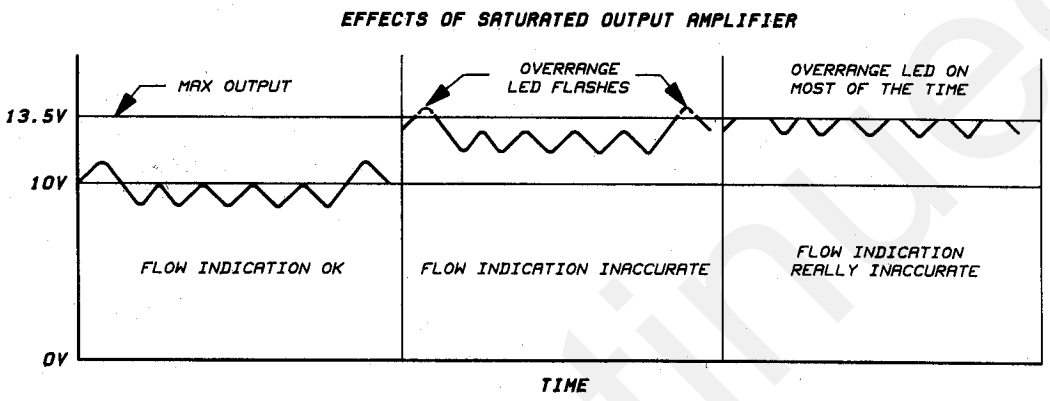
Table II list the RPM range of each Range Switch setting for all three 272 transmitters. Use this table to estimate the correct range position.

TABLE 2: RPM RANGE VS SWITCH POSITION

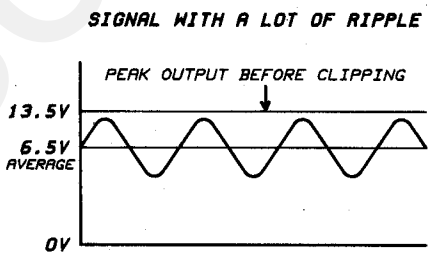
	(RPM AT 10V OUT)					
	272-5X5		**272-5X7**		**272-5X8**	
SWITCH POSITION	MAX GAIN	MIN GAIN	MAX GAIN	MIN GAIN	MAX GAIN	MIN GAIN
1	1985	5559	2197	6157	1985	5559
2	794	2224	879	2460	794	2224
3	318	889	351	984	318	889
4	127	356	141	394	127	356
5	51	142	36.3	117	51	142
6	20.3	57	21	53	20.3	57

Output Over Range Indication: This LED will start to blink if the transmitter output amplifier begins to saturate (clip). This happens when the flow rate or gain is too high and will cause the output voltage to be less than it should be. Figure 9 shows what happens as output saturation occurs.

The diagram below shows what happens as output saturation occurs.



The flow rate in a system may have as much as 50% to 100% ripple. This may be caused by the pump, by lots of air in the line and a slightly sticky flow meter, or by other reasons. The maximum output voltage of the Model 272 must be kept low enough so that the output is not saturated. This may mean that the average full scale output voltage will have to be much less than 10 V to avoid clipping the peaks in the output signal (See Fig. 10).



Ripple Adjustment (272-5X5 and 272-5X8 Transmitters Only)

This adjustment will have to be made if the transmitter is unscrewed from the flow meter.

The 272-5X5 and the 272-5X8 are made to compensate for the non uniform rotational rate of the 210 series piston meters. To take advantage of this feature, the stator of the Model 272 must be positioned correctly for each meter it is mated to.

If this is not done, the electrical output of a meter and its transmitter will have as much as 50% ripple superimposed on the DC component of the output signal. The frequency of this ripple will be four times the RPM of the meter. Such a situation will require more damping than otherwise and will result in a slower responding system.

Ripple Adjustment Sensitivity: Increases and decreases the sensitivity of the ripple detection circuit.

Ripple Indication : *LED*

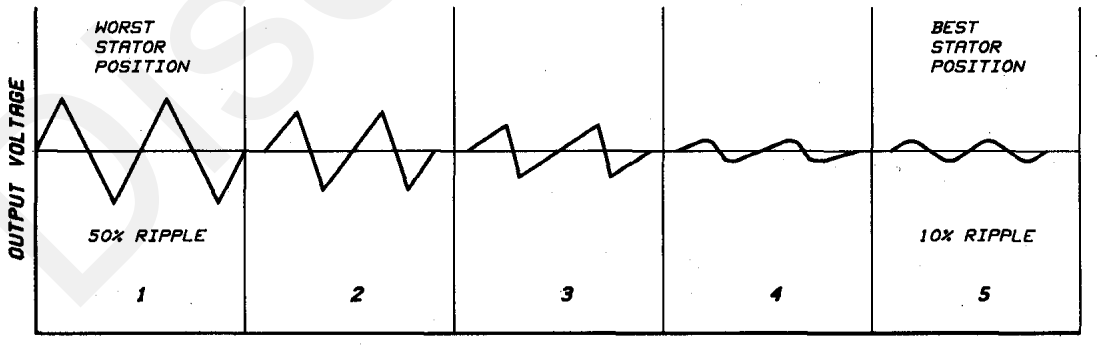
Stator Adjustment Screw: Rotates the transmitter pickup coil.

The flow meter must have a flow through it for this adjustment to be useful. It is advisable to adjust the ripple at the lower end of the flow range; although if the flow rate is less than 2% of the flow meter's full scale capability you may have problems with this procedure. An oscilloscope attached to the output signal of the Model 272 can also be used.

Increase the Sensitivity Adjustment (cw) just until the Ripple LED next to it starts to turn on. Then turn the Stator Adjustment Screw in a direction that decreases the brightness or turns off the Ripple LED. Once again increase the Sensitivity potentiometer until the LED just comes on and again turn the stator adjustment in a direction that minimizes the LED. Repeat this process until any further change in the position of the stator screw causes the LED brightness to increase rather than decrease.

The figure 11 shows the effect of the stator position on output ripple. There are four best and four worst positions for the stator per revolution. This means that it will take a maximum of 45° on the Stator Adjustment Screw to find the best location.

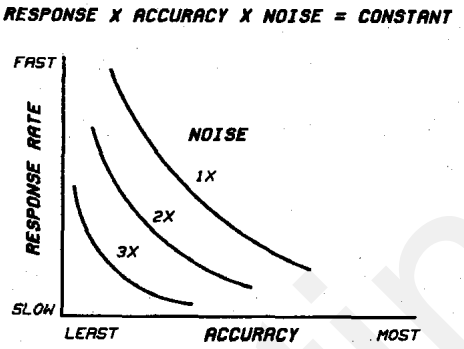
FIGURE 11 OUTPUT RIPPLE VS STATOR POSITION



Response Rate & Accuracy:

There is always a trade off in a metering system between response rate, accuracy and noise. The three are related such that their product equals a constant. If any one of them is made smaller, the others can be made larger.

In most metering systems, response rate and accuracy are desirable characteristics. To maximize one or both of these parameters, noise should be reduced to a minimum. Once noise has been minimized, there is a trade off between accuracy and response rate.



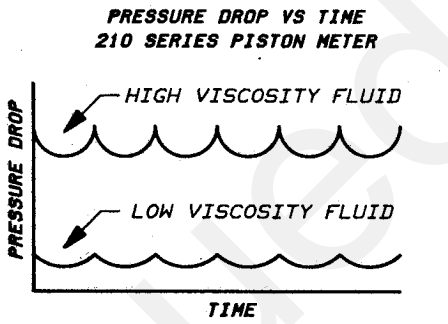
Response Rate: When discussing response rate there are three facets to consider. They are: the response of the flow to a change in the system setpoint, the correction of the flow to an error induced in it, and the response of the flow rate display to a change in flow rates. These responses are all purposely slowed down by filtering or damping so the system only reacts to meaningful flow changes and not to such things as pump pulsations or flow meter ripple. More damping means slower response.

Accuracy: There are three topics to consider when looking at accuracy. The first being the display; which can typically have anywhere from two digits (1 to 99) to 4-1/2 digits (19,999) of information. This equals a resolution of 1% to a maximum of 0.005%, respectively. The display steadiness is also directly related to it's accuracy. For instance, a display that jitters from 95 to 105 in a meaningless way is not accurate to one part in 100 (1%) but only to about 10 parts in 100 (10%).

The basic accuracy of the flow meter is a prime consideration. Typically, the accuracy of a positive displacement meter is not as good for a fraction of its cycle as it is for one or more complete cycles. If a system is dampened so that the response rate is longer than the period of one revolution of the meter, the accuracy of the display is increased. The accuracy of the system can never be better than that of the flow meter.

Nosie:

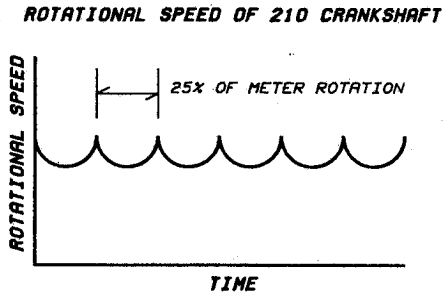
Noise can be defined as any change in either the fluid flow or the electrical system that is not a meaningful change in the flowlow or th electrical system that is not a meaningful change in the flow rate. For instance, the ripple induced in the flow by a gear or piston pump is noise. The system will typically have to be dampened so that its' response time is longer than the tooth to tooth period of the pump. Piston pumps with fewer than three pistons create a particularly large amount of bothersome ripple and result in a very slowly reponding system.



All positive displacement flow meters add noise to a flow metering system. The noise is typically of two origins. As the elements of the meter rotate, they require varying amounts of pressure to move (See Fig. 13).

This induces pressure fluctuations between the pump (or control valve) and the flow meter. If there is any air trapped in the line, the fluid flow will vary as the air compresses and expands. This will be sensed as a changing flow by the flow meter and the output will contain unwanted ripple or noise. Plumbing in a flow system should be sized and laid out to avoid air being trapped between the flow meter and the flow controlling device (a pump or valve).

The second type of noise that must be considered is a result of flow meter geometry and design. Because of features such as an oval gear, or a piston/crankshaft configuration, or due to manufacturing tolerances, the rotation of the metering elements is not completely uniform. For example, the 210 series meters utilize four pistons connected to a crankshaft. The varying rotational speed of the crankshaft is shown in Fig. 14.



To obtain the smoothest output signal, the transmitter (272-5X5 or 272-5X8) for these meters can be adjusted to minimize this characteristic. Additionally, some amount of damping is usually necessary at the indicator.

The electronic converter of any meter will add its share of noise. For instance, DC transmitters produce some ripple in their output due to the sinusoidal nature of the induced voltage in the armature coils.

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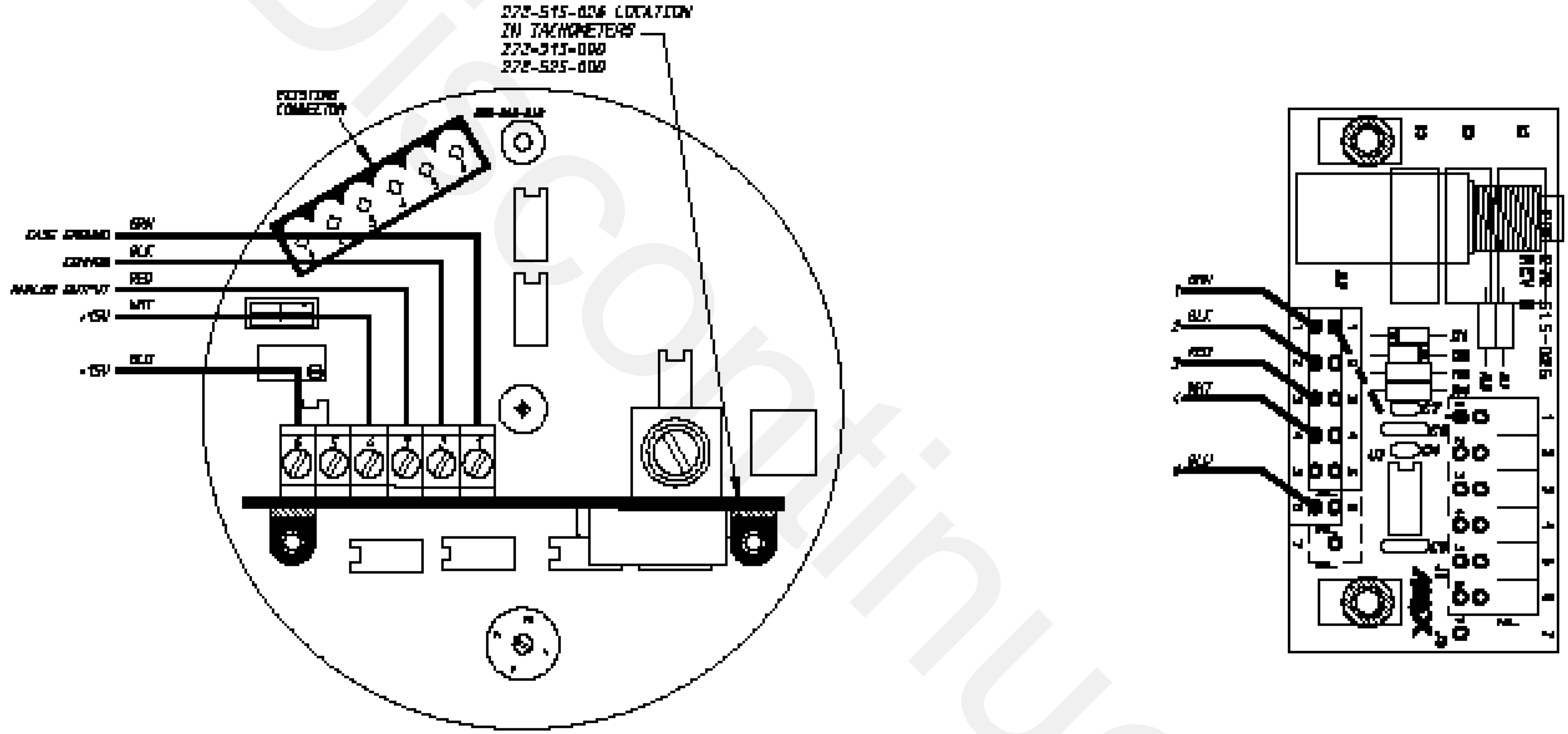
A	1	2000/08/25	NEW DRAWING	DRA



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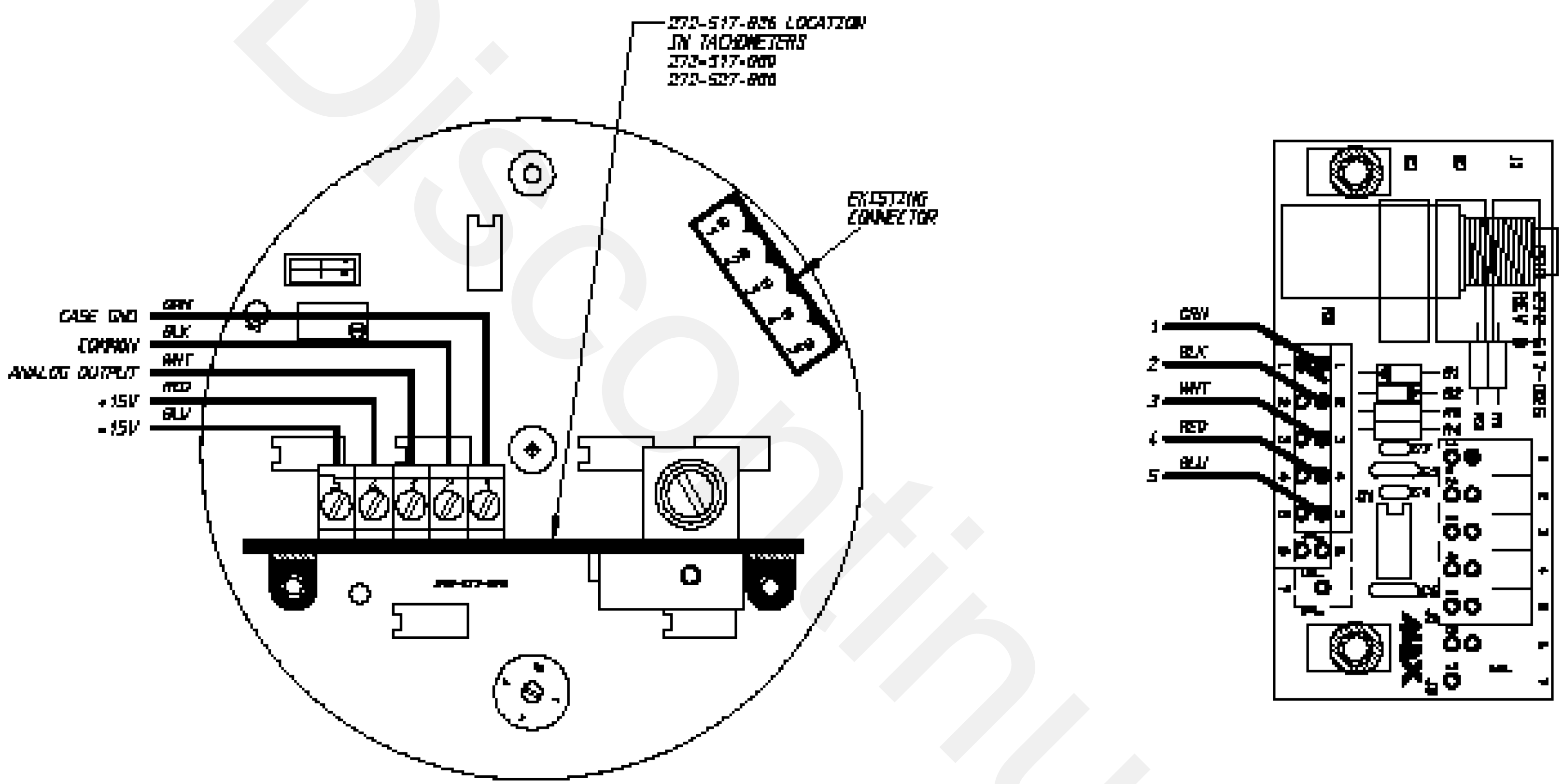

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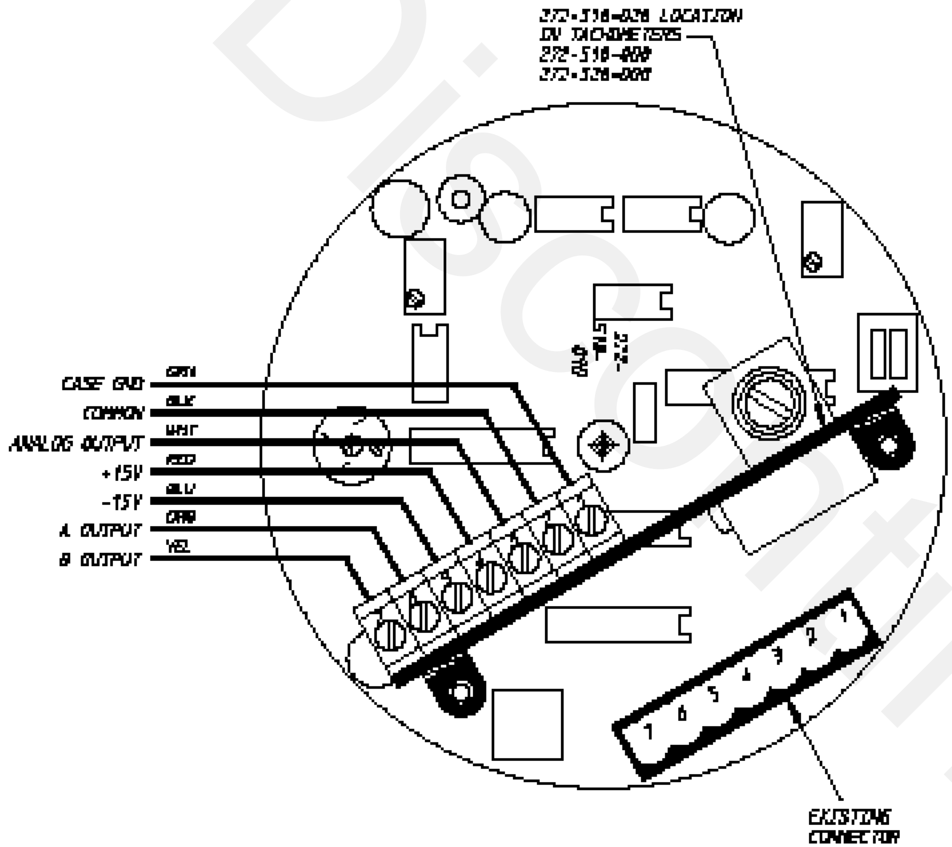

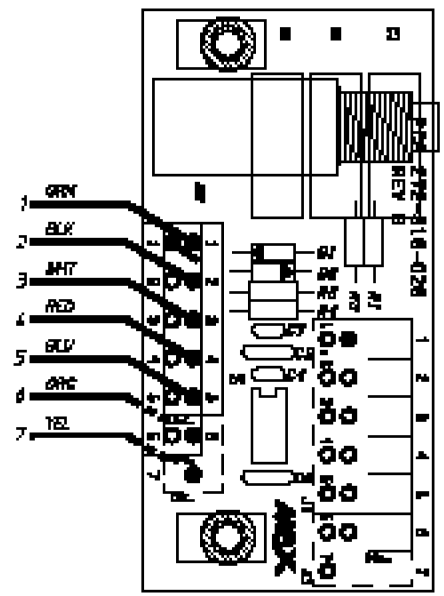

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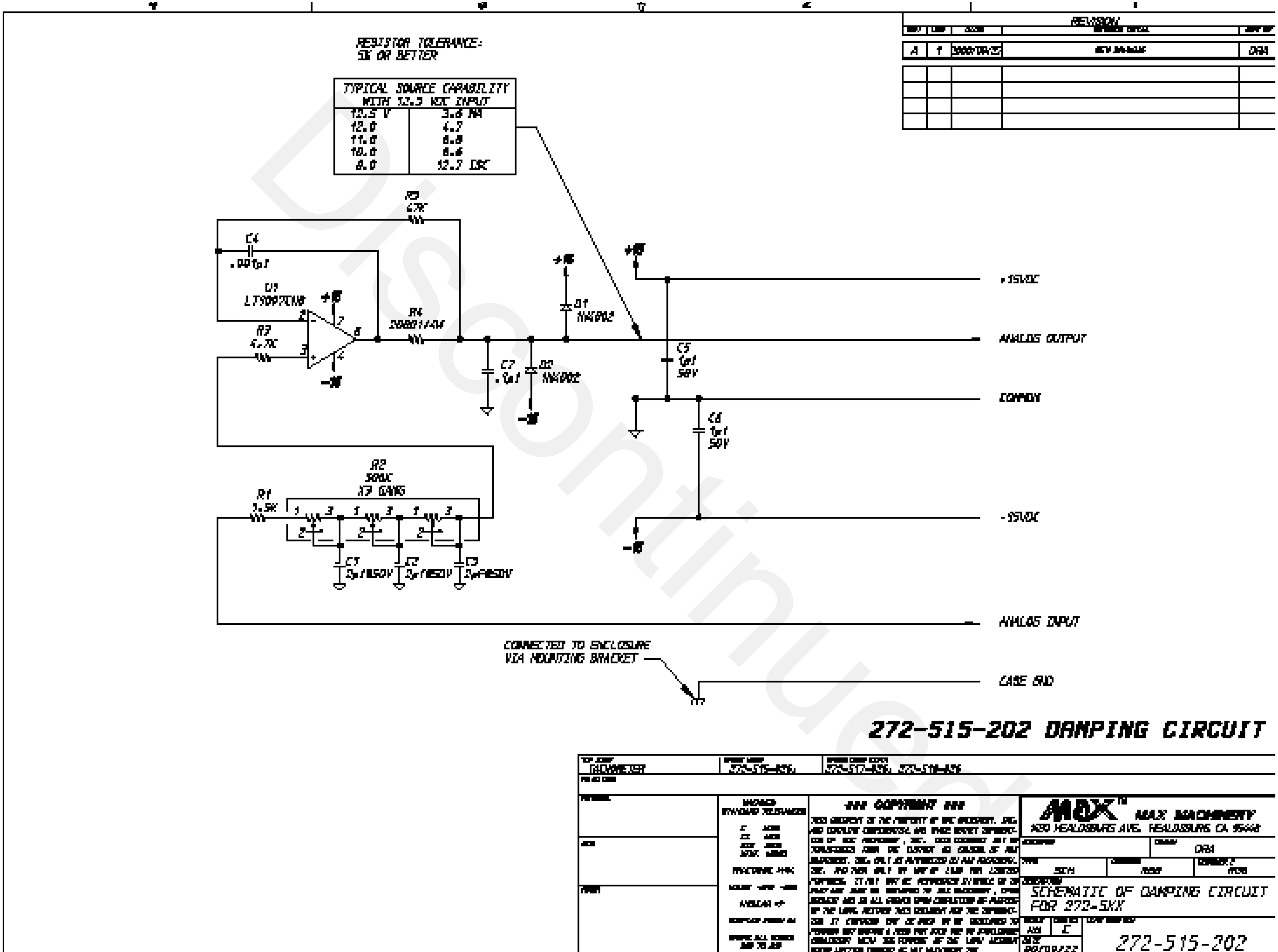
RESISTOR TOLERANCE:
5% OR BETTER
TYPICAL SOURCE CAPABILITY
WITH 12.5 VDC INPUT
12.5 V 3.6 MA
12.0 4.7
11.0 6.8
10.0 8.6
8.0 12.7 DISC
R5 47K
C4 .001µf
U1
R4
R3 4.7K
C7 .1µf
D1
D2
C5 1µf 50V
C6 1µf 50V
R2 500K X3 GANG
R1 1.5K
C1
C2
C3
+15VDC
ANALOG OUTPUT
COMMON
-15VDC
ANALOG INPUT
CONNECTED TO ENCLOSURE
VIA MOUNTING BRACKET
CASE GND
REVISION
272-515-202 DAMPING CIRCUIT
MAX MACHINERY
SCHEMATIC OF DAMPING CIRCUIT
FOR 272-5XX
272-515-202