Effective: September 2006 (Replaces October 2002) **EX-1711**

KING-GAGE®

4-20 mA Process Control

Multi-Point™ Process Switch
Single-Channel Analog

Start-Up/Operation Instructions

KING ENGINEERING CORPORATION
Since 1937

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The information contained in this manual was accurate at the time of release. Specifications are subject to change without notice.

Warranty - All King Engineering products are guaranteed to be free from defects in material and workmanship for one year from the date of purchase. Any product or part found to be defective under normal use within one year of purchase will be repaired or replaced at no charge if returned to the company at Ann Arbor, Michigan within ten days of discovery of the defect. No other warranties, whether expressed, implied or statutory, including the warranties of fitness for a particular purpose or merchantability, are given by this agreement.

The exclusive remedy for nonconformity of these goods shall be repair and/or replacement of the nonconforming goods or parts.

Seller will not be liable for consequential damages resulting from breach of this agreement. The term "consequential damages" shall include but shall not be limited to damage to all machines, equipment and goods other than the goods sold hereby, interruption of production, loss of profits, delays of any kind, administrative expense and overhead.

Revisions:

(A) October, 1989 – Original Release.
(B) December, 1989 – Revised Deadband Range
(C) April, 1995 – Revised/Redrawn per ECR No. 3397
(D) October, 2002 - Logo w/ web address (cover)
(E) September, 2006 - Heading (cover), logo (back)

Contents:

Specifications

Power Requirements
nominal 115 Vac./60 Hz. (unregulated)
3.45 W/0.03 A - fused @ 1/2 A

Temperature Range (Environmental)
32°F to 158°F / 0°C to 70°C operating
(-40°F to 158°F / -40°C to 70°C storage)

Input
dc current: 4-20 milliamperes

Current Limiting (Overload)
70 mAdc maximum; automatic trip/reset using PTC resistor (positive temperature coefficient) circuit

Input Impedance
132 ohm resistance (3 Vdc drop @ 20 mAdc)

Set-Points
(4) four independent user set-points; continuously adjustable over full input range. Front panel LED status indicator gives visual confirmation when set-point value has been exceeded.

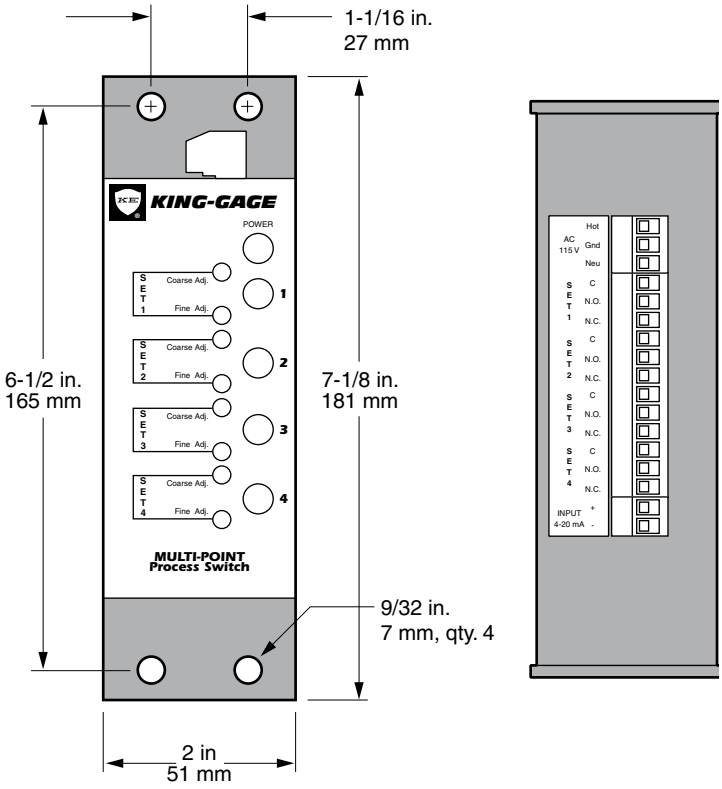
Sensitivity (Adjustment)
Set-points can be adjusted to better than 0.05% FS/0.008 mAdc

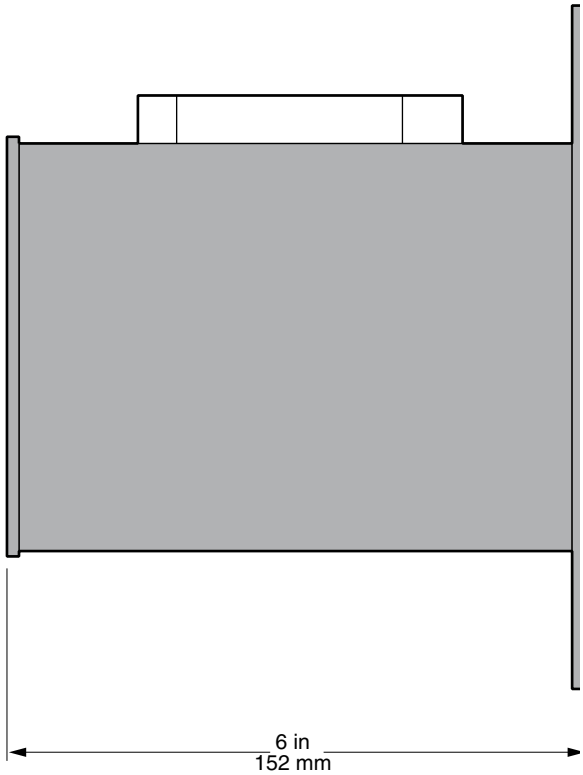
Repeatability
Set-point settings are repeatable to better than 0.05% FS
(Long-Term Repeatability: better than 0.1% FS)

Deadband
Single deadband potentiometer controls all four set-point settings. Deadband adjustable from 1.0% - 12.5% FS. (Factory preset to 1% FS.)

Output
(4) independent SPDT (form-C) relays; maximum 3.0 A @ 115 Vac. Rated for minimum 100,000 cycle life at rated load.

Size/Weight
7.125"H x 2"W x 6.125"D / 181mm x 51mm x 155mm 22 oz./624 g.





Terminal Connections

Electrical Power

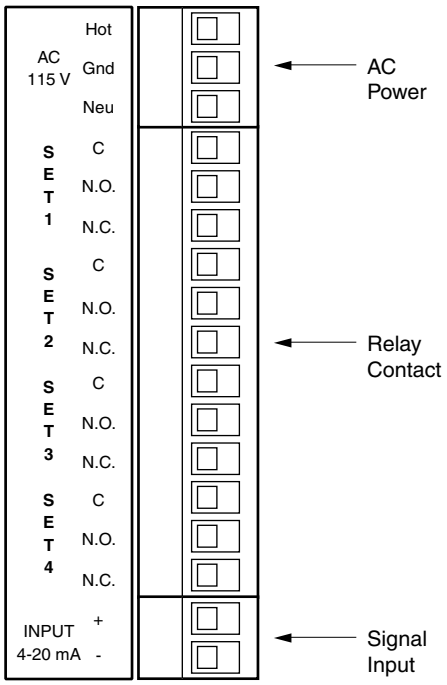
The Process Switch requires nominal 115 Vac/60 Hz. (single-phase) power for operation. Connections should be made using approved 3-conductor, source grounded cabling.

Proper polarity must be maintained for optimum performance of the unit. See illustration that details the terminal connections located at the top of the housing.

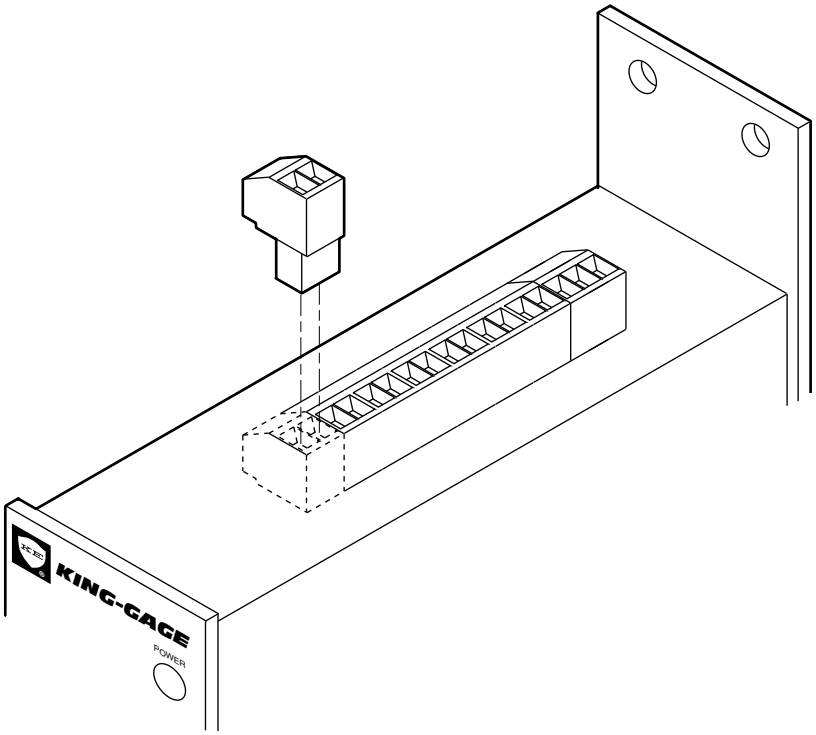
Plug Type Connectors

Terminal blocks plug into a mating socket on the Process Switch housing. Three (3) individual terminal blocks are provided...

1. 3-terminal **AC Power** block
2. 12-terminal **Relay Contact** block
3. 2-terminal **Signal Input** block



Connections Detail

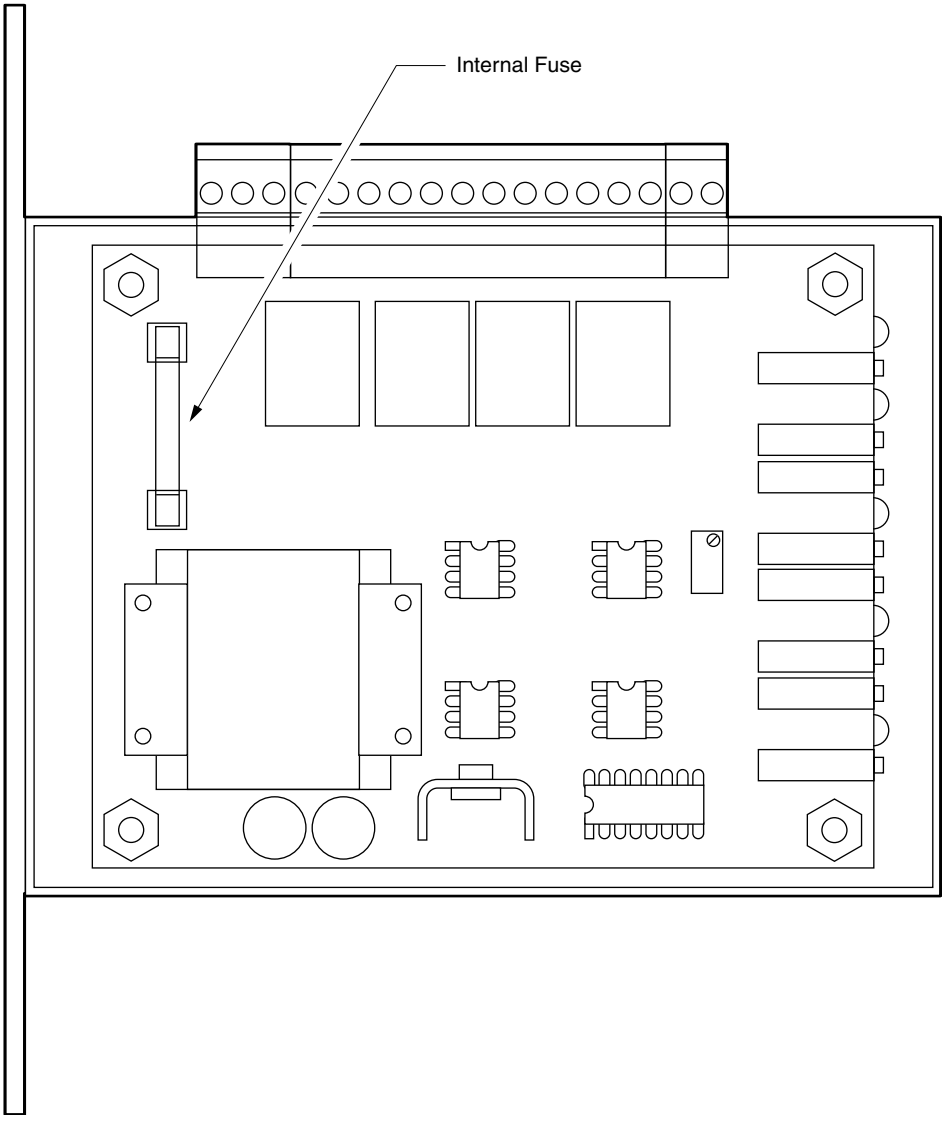


Internal Fuse

The AC Power input of the Process Switch is internally fused using a 0.5 Amp/250 Volt non-time delay fuse. To replace this fuse, remove the side panel from the housing. This is held in place by four (4) phillips-head screws.

CAUTION: Disconnect AC power prior to opening housing or replacing fuse assembly!

Replacement Fuse - Order No. 7469-21-0, 1/2 Amp FAST-BLO, 5-pack (Equivalent to BUSS AGC 1/2)



4-20 mA Input Signal

The Multi-Point Process Switch is a single channel analog set-point control. It provides continuous monitoring of a typical process loop with four (4) independent set-points that are user adjustable over the full input range. The Process Switch accepts any proportional, externally-powered two-wire 4-20 mAdc current loop from any typical process transmitter (level, pressure or temperature).

Unit must be wired in series with transmitter to maintain proper polarity at the + and - terminals. See Diagram.

Internal input resistance of the Process Switch is 132 ohms (nominal) during normal operation.

Input Current Limiting

A positive temperature coefficient (PTC) resistor circuit is incorporated into the Process Switch for protection against overcurrent situations. This thermal resistor undergoes increased orders of magnitude in resistance when an input current ◘ 70.0 mAdc heats it above a certain point. In the switched state, a latched high-resistance limits current to no more than a few milliamps.

The resistor circuit resets automatically, permitting normal current flow once the input drops below 70 mAdc. (NOTE - Protective resistor circuit is rated for 30 trip/cycles max.)

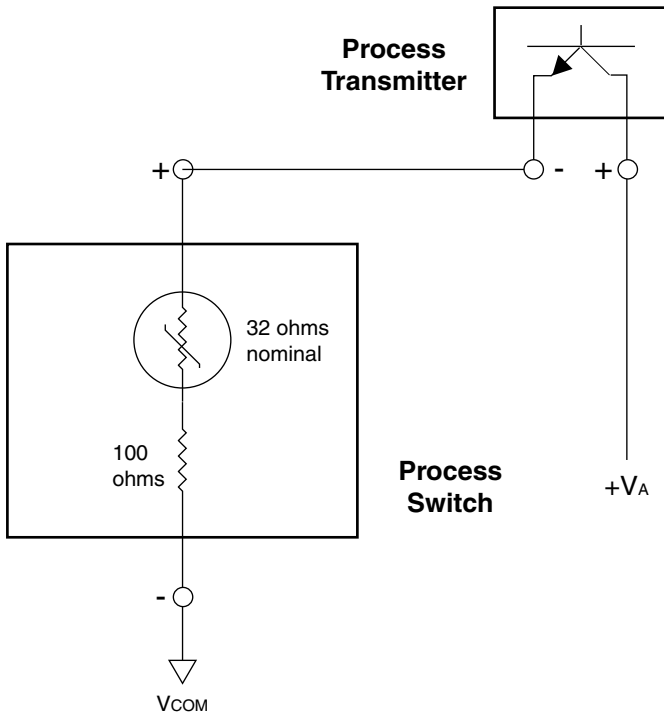


Diagram of Typical Process Loop
Voltage supply ($+V_A$) provides power to process transmitter which outputs 4-20 mA signal through the loop.

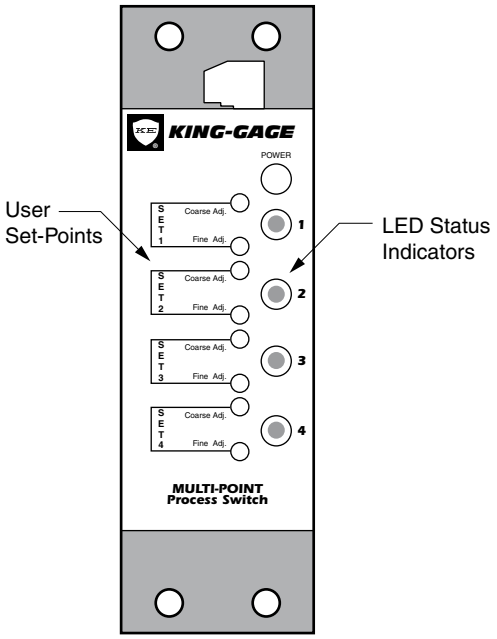
Process Switch is wired into loop to receive signal. Internal PTC resistor provides overcurrent protection by limiting input through high-resistance.

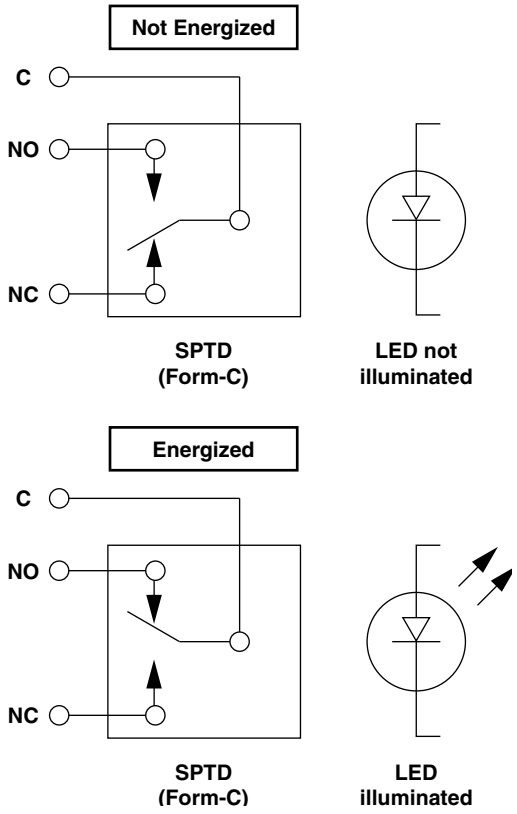
(See "**Input Current Limiting**")

Adjustable Set-Points

The Process Switch has four (4) user set-points that can be adjusted to control continuous process operations, provide fail-safe limiting or alarm functions.

Front Panel - LED Status Indicators are located on the front panel of the Process Switch. Each of the four (4) LEDs correspond to "SET1, SET2, SET3, SET4" adjustments and output relays. When illuminated, the LED indicates that the set-point has been reached and corresponding relay energized.





SPDT (Form-C) Output Relays

Four (4) independent SPDT (single-pole/double-throw) relays are provided on the Process Switch. Form-C configuration includes normally-open (N.O.), normally-closed (N.C.) and common (C) relay contacts. Rated for 3.0 Amps maximum @ nominal 115 Vac.

Relay is energized when corresponding set-point milli-amp value is exceeded.

Set-Points/Deadband Adjustments

Set-Points

The Process Switch has four (4) user set-points which are continuously adjustable over the full 4-20 mAdc input range. Each set-point can be adjusted to within 0.008 mAdc (or 0.05% FS).

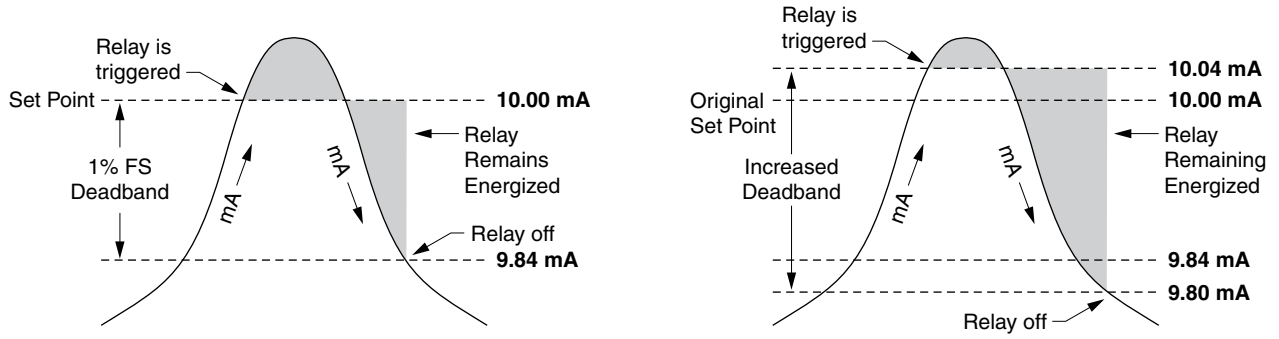
Coarse Adjustment - 20-turn potentiometer/each complete turn yields approximately 1.0 mA change.

Fine Adjustment - 20-turn potentiometer/each complete turn yields approximately 0.005 mA change.

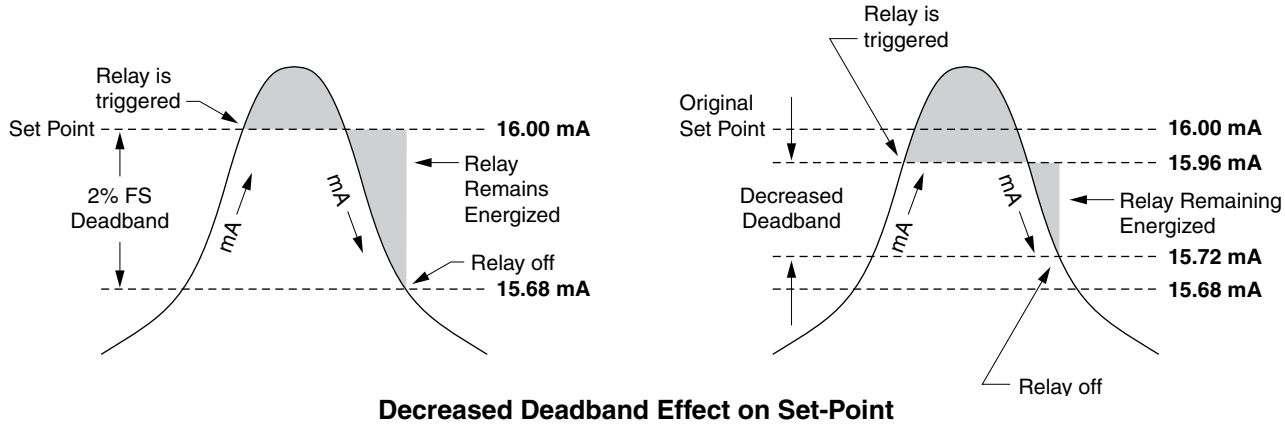
Deadband

A master deadband adjustment controls all four set-points. The deadband adjustment range is 1.0% -12.5% FS. (Process Switch is factory-preset with a nominal 1.0% FS deadband.)

Deadband can be used to eliminate cycling due to fluctuations within the 4-20 mA input signal. Resetting the deadband will also shift the set-point accordingly. Refer to diagrams below:



Increased Deadband Effect on Set-Point



Decreased Deadband Effect on Set-Point

Adjustment Procedure

The LED status indicators are used when adjusting the individual set-points. When illuminated, they indicate the set-point has been reached and corresponding relay energized.

One method of adjusting set-points is to input a simulated 4-20 mA signal. By slowly varying the milliamp signal, the precise value of the existing setting (including deadband) can be determined prior to making any adjustments. This procedure requires a very high precision meter and milliamp source.

Generally, however, set-points are adjusted in-process. Assuming the Process Switch is receiving the desired milliamp (mAdc) input signal from the transmitter...

1. If the LED status indicator is not illuminated, turn the **Coarse** potentiometer clockwise (CW). As soon as the LED is illuminated, slowly turn in the opposite direction until it goes out. Very slowly turn potentiometer clockwise but not so much as to trigger LED. (It may be necessary to repeat this procedure to acheive the "coarse" adjustment.)

   If the LED status indicator is illuminated, turn the **Coarse** potentiometer counter-clockwise (CCW) until it goes off. Very slowly turn potentiometer clockwise but not so much as to trigger LED. (It may be necessary to repeat this procedure to achieve the "coarse" adjustment.)

2. Turn FINE potentiometer clockwise (CW) very slowly and stopping immediately as soon as LED is illuminated.

Warning!
If deadband is adjusted, all existing set-points will shift accordingly. This will generally require re-adjustment of all set-points. The deadband adjustment controls all set-points.

Deadband Adjustment

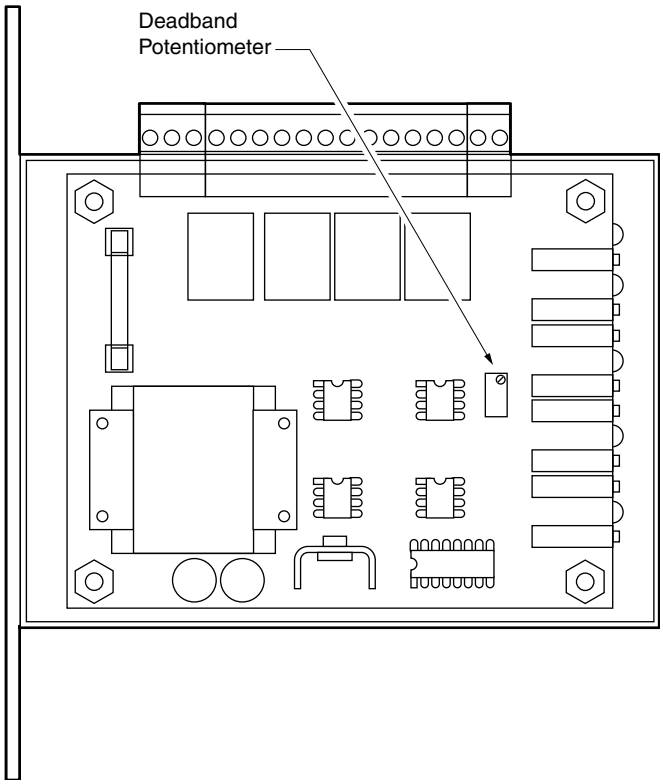
The MULTI-POINT Process Switch has been factory-adjusted with a 1% FS deadband (0.16 mA). This represents the range through which the input signal can be varied without initiating a response at the output relays.

Deadband is adjustable up to 12.5% FS for applications when greater tolerance of input fluctuation is required. When deadband is adjusted, set-points will shift accordingly.

Note - Deadband should be adjusted only by a skilled technician. High-precision meters and signal generators are required to accurately adjust the deadband setting.

Deadband Potentiometer

The adjustment pot for deadband settings is located inside of the housing. See below.



Preliminary Troubleshooting

Relay does not energize...LED indicator is not illuminated -

Disconnect 115 Vac power from MULTI-POINT Process Switch and check internal fuse. If fuse is blown, replace (see Page 6).

Check that 115 Vac power is properly connected to input terminals and power circuit is "on".

Relay remains energized...LED indicator does not turn off -

Relays and LEDs remain energized whenever input signal (mAdc) is greater than the set-point value. If a low level set-point is required to actuate a pump or to close a valve, re-wire circuit at relay using the N.C. (normally-closed) switch contact.

Unusually high load resistance (RL) at Process Switch -

Possible short-circuit in signal loop. If signal current exceeds 70 mAdc, an overcurrent-limiting PTC (PTC - positive temperature coefficient) resistor restricts current levels through the entire loop to only a few milliamps.

Relay remains energized too long -

Deadband is adjustable over an extremely wide bandwidth (1.0%-12.5% FS). An adjustment to the deadband may create a situation where the relays will remain energized much longer than desired. (See Page 9)

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