

# Models 940 and 945 DC Transmitters

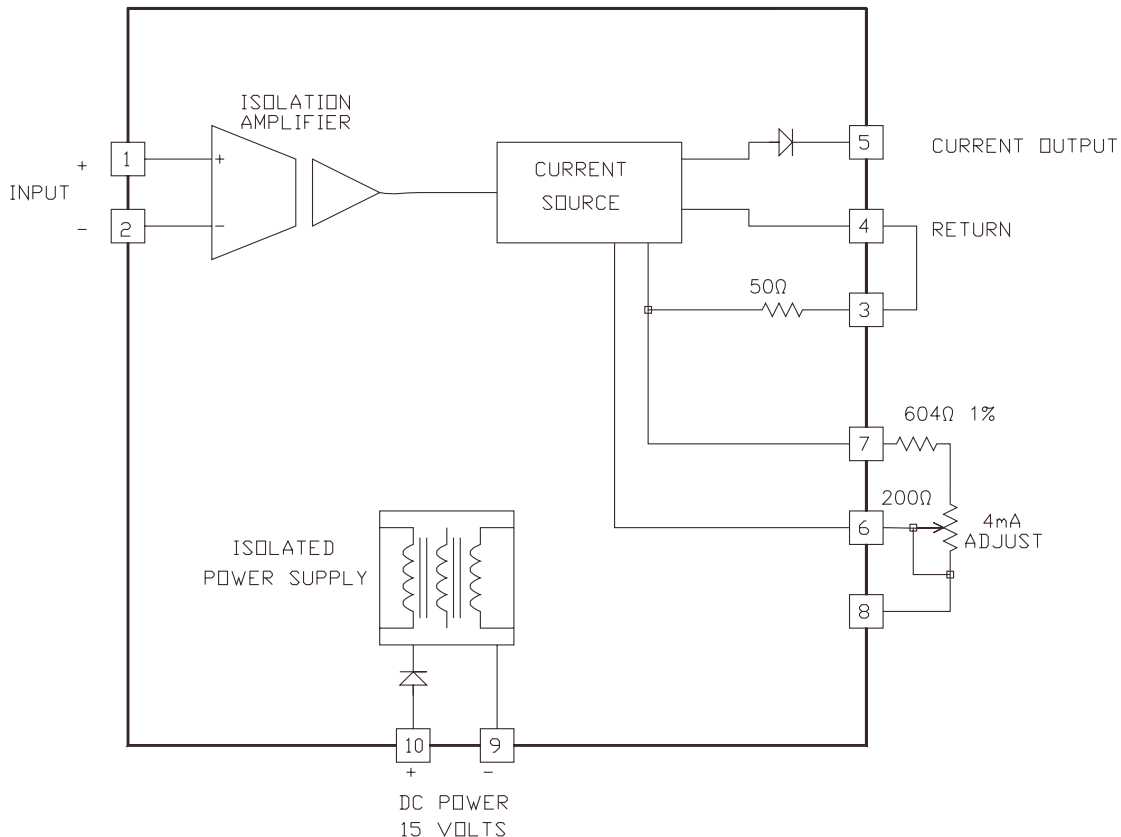
## Features

- 4 to 20mA Output
- 0 to +10V Input - Model 940
- 0 to 50 mV Input - Model 945
- 700 Volts DC Isolation
- PC Board Mount Modular Design for OEM Applications
- Convenient Mounting Kit Available for End User Applications
- Powered by 14 to 16 Volts
- 24 VDC Operation Available

## Description

The CALEX Model 940 and 945 are fully DC isolated voltage to current transmitters. They are ideal for eliminating ground loops and common mode problems in data acquisition and process control systems. The 20 Volt maximum output compliance voltage allows a loop resistance of up to 1000 ohms. The isolation input to output is 700 Volts DC. The input and output are also isolated from the unregulated +14 to +16 VDC power source.

Model 940 and 945 Block Diagram



# Models 940 and 945 DC Transmitters

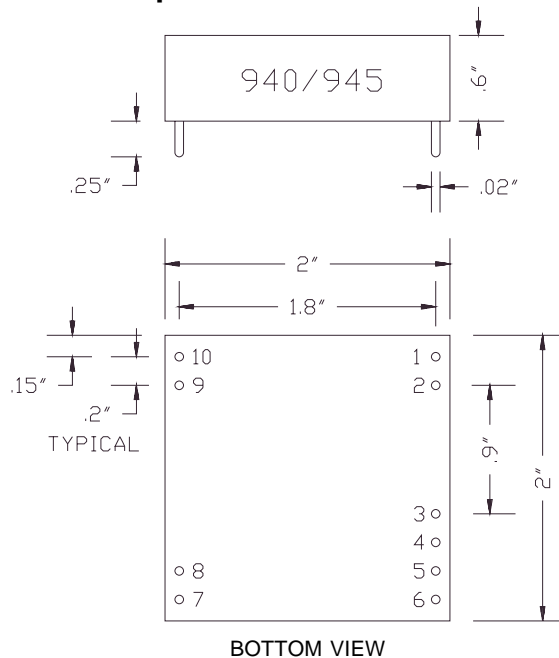
## Specifications

| Input  | 940                             | 945        |
|--|---------------------------------|------------|
| Voltage  | 0 to +10 Volts                  | 0 to 50 mV |
| Resistance   | 10 megohm minimum               |            |
| <b>Output</b>  |                                 |            |
| Current  | 4 to 20 mA                      |            |
| Load Resistance  | 0 to 1000 ohm                   |            |
| Compliance   | 20 Volts maximum                |            |
| Frequency Response   | 400 Hz @ 3 dB                   |            |
| Rise Time  | 0.9 ms                          |            |
| Settling Time to 0.1%  | 2.5 ms                          |            |
| Noise  | 1 $\mu$ A P-P<br>50 $\mu$ A P-P |            |
| Power Supply Sensitivity   | 5 $\mu$ A/Volt<br>0.005%/Volt   |            |
| <b>Accuracy @ 25°C</b>   | 0.1% of Full Scale              |            |
| Linearity  | 0.05% of Full Scale             |            |
| Temperature Coefficient  | 0 to 55°C                       |            |
| Zero   | 0.0035%/°C of Full Scale        |            |
| Span   | 0.0035%/°C of Full Scale        |            |
| <b>Isolation - Input to Output</b>   |                                 |            |
| or Power Supply  | 700 Volts DC                    |            |
| Capacitance  | 25 pF                           |            |
| <b>Power Requirements</b>  |                                 |            |
| DC Voltage   | 14 to 16 Volts DC               |            |
| Current  | 125 mA                          |            |
| <b>Zero Set</b>  |                                 |            |
| External Cermet Potentiometer Required to set 4mA Zero current.<br>External Pot may be used to set output current 0 to 20mA. |                                 |            |
| <b>Environment</b>   |                                 |            |
| Package  | Encapsulated Plastic Module     |            |
| Size (inches)  | 2" x 2" x 0.6"                  |            |
| Weight   | 2.5 oz.                         |            |

## Operation

For 4 to 20 mA operation, a 200 ohm external cermet potentiometer is required to set 4 mA Zero Current. Connect the wiper to pins 6 and 8. Connect one end terminal to pin 7 with a 604 ohm 1% resistor in series. Connect the other end terminal to pin 8. Tie pin 4 to pin 3. Reference Model 940 Block Diagram.

## Mechanical Specifications



| Pin Assignments |                                       |
|-----------------|---------------------------------------|
| 1               | +INPUT                                |
| 2               | -INPUT                                |
| 3               | RETURN                                |
| 4               | RETURN                                |
| 5               | CURRENT OUTPUT                        |
| 6               | Reference Model 940/945 Block Diagram |
| 7               | Reference Model 940/945 Block Diagram |
| 8               | Reference Model 940/945 Block Diagram |
| 9               | -DC POWER                             |
| 10              | +DC POWER                             |

# Models 940 and 945 DC Transmitters

## Mounting Kit

The MK940 mounting kit is an optional printed circuit board that provides the necessary potentiometers and a connector for a complete turnkey system.

The 940/MK940, when ordered as a combination, is shipped from the factory configured as a 0 to +10 Volt input, 4 to 20mA output, isolated transmitter. The 945/MK940, when ordered as a combination, is shipped from the factory configured as a 0 to 50 mV input, 4 to 20 mA output, isolated transmitter. Note

in the schematic, Figure 1, that C1, R1, R2, R3, and R5 are included on the board. The other designated components are user supplied for other applications. Also note that R8 through R11 are not connected to the rest of the circuit. For 24 VDC operation, add a "-24" to the MK940, i.e. 945/MK940-24

Figure 2 shows the outline of the MK940 card and the lettered pin assignments. The card includes a Model 015 connector with edge guides and has eyelets for soldering wires. The components described as jumpers are wire connections although they have a ceramic body the size of a 1/4W resistor.

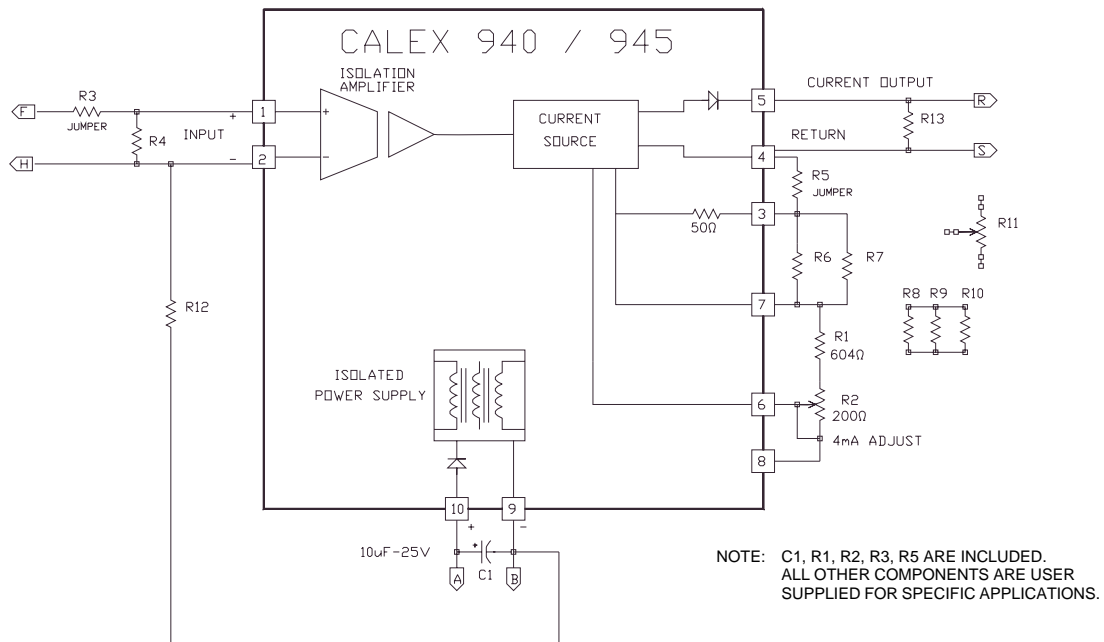


FIGURE 1. MK940 Schematic

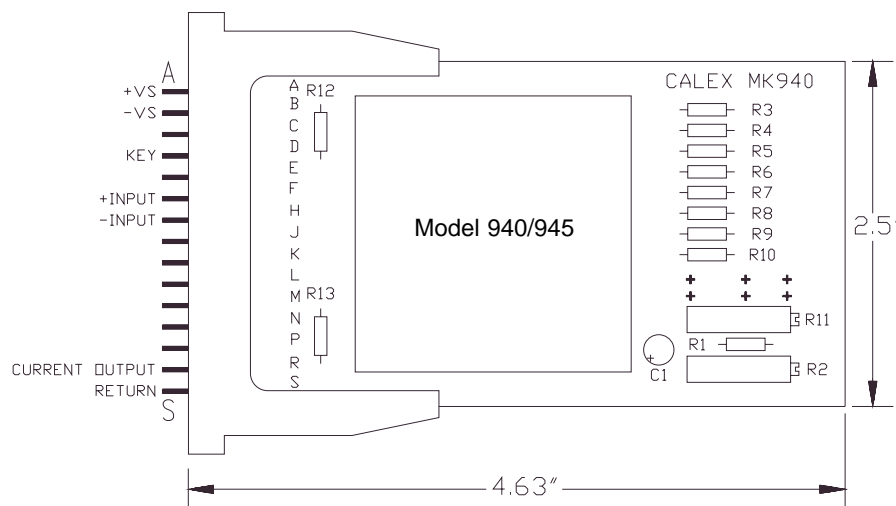


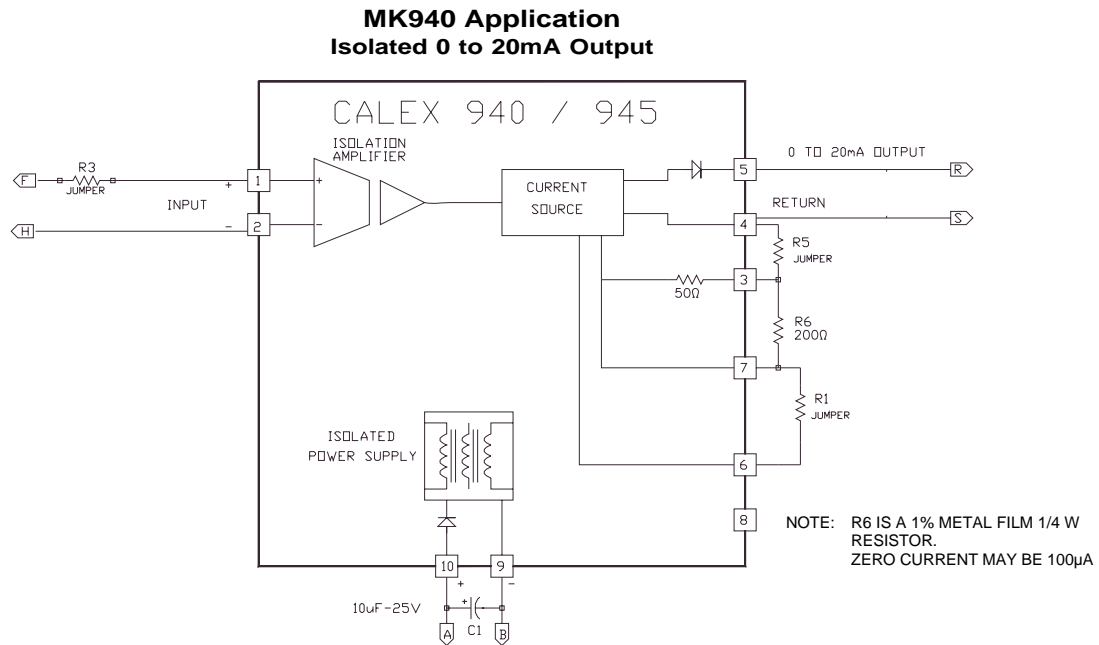
FIGURE 2. MK940 Card

# Models 940 and 945 DC Transmitters

## Applications

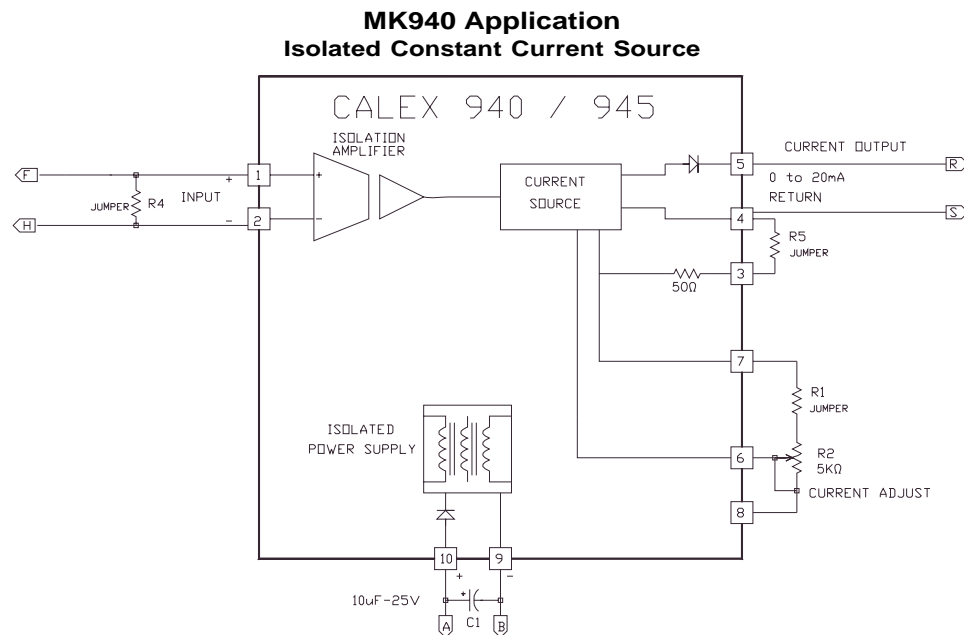
The 940/MK940 may be configured for 4 to 20mA output, as a constant current source, as a 0 to 1mA current source, 0 to 5V output, voltage input and 1 to 5V output, or an isolated voltage input and 4 to 20V output with a single pole 10Hz input filter. Figures 3 through 8 illustrate these configurations with the Model 940/945 and MK940 mounting kit. The R-numbers

refer to locations labeled on the MK940. All fixed value resistors should be metal film 1% type. Where a potentiometer is shown, use a multiturn trim pot with a CERMET resistance element. The hole pattern is for industry standard potentiometers such as Bourns "3006Y", Spectrol "43", and Beckman "89" series.



**FIGURE 3.**

Shows an isolated 0 to 20mA current loop. In this application the ZERO pot is not used and is replaced by a wire jumper. R6 parallels an internal 50 ohm resistor to change the scale factor. The zero current may be from 10nA to 100μA. Zero current must be checked with a short between pins F and H, or 0 Volts input. Do not leave the input open.

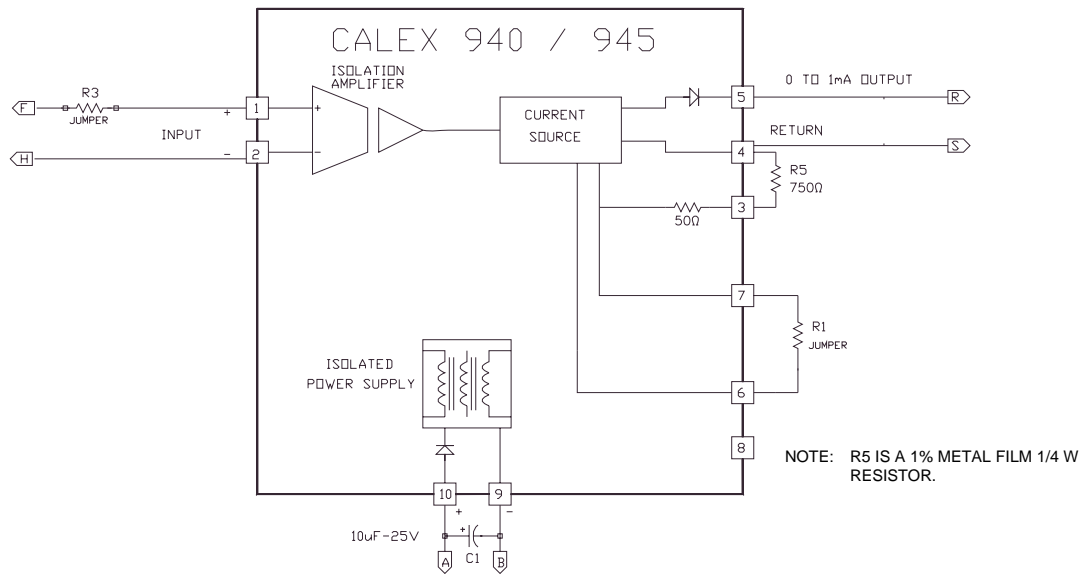


**FIGURE 4.**

Is a potentiometer adjust 0 to 20mA constant current source which is isolated from the power supply. The jumper in place of R4 ensures that the input is zero volts. Do not apply any control voltage to the input. The output will drive zero to 1000 ohms with a 15 volt power supply.

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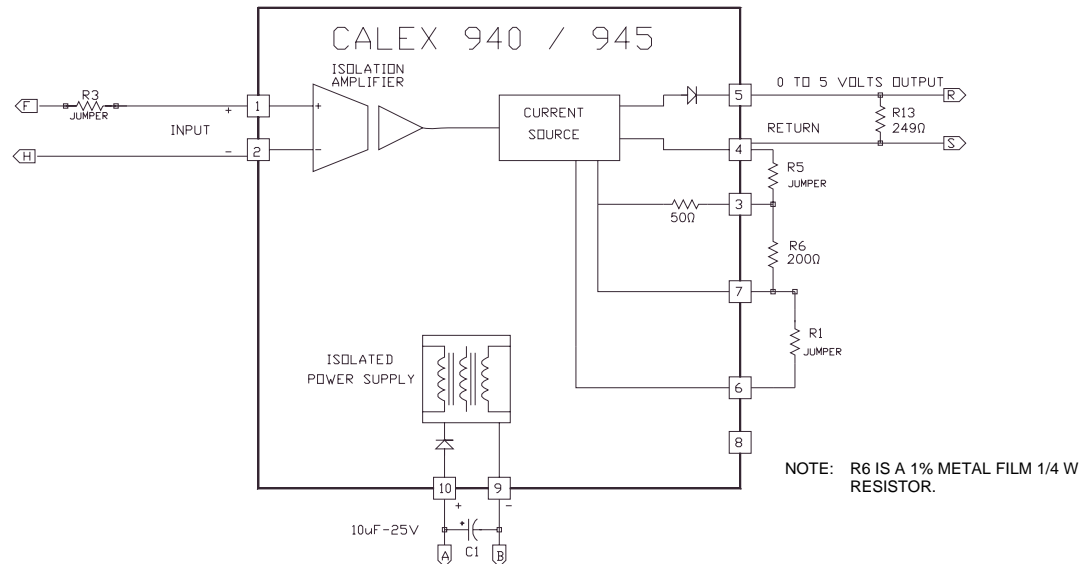
## MK940 Application Isolated 0 to 1mA Current Source



**FIGURE 5.**

Zero to 1mA current source. The load resistance may be 0 to 20,000 ohms. Other values of full scale current may be set by changing R5. The maximum output current is determined by  $0.8V/(R5+50)$  and is limited to 20 mA.

## MK940 Application Isolated 0 to 5 Volts Out

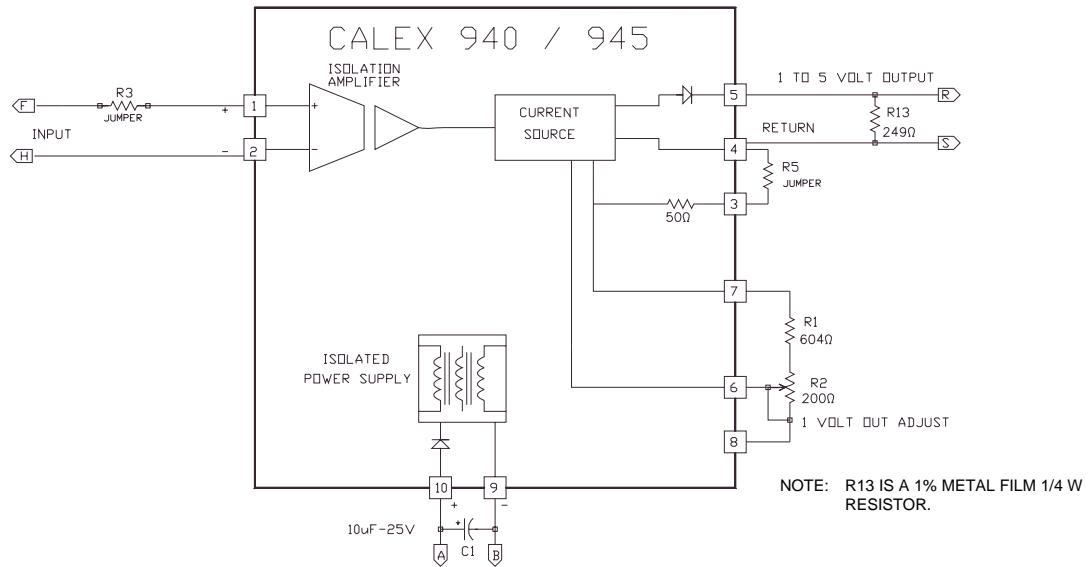


**FIGURE 6.**

Shows a voltage to voltage transmitter. Note that this configuration will have a 249 ohm output source resistance which will produce an error of 2.5% if driving a 10,000 ohm load or 0.25% if driving a 100,000 ohm load. R6 parallels the internal 50 ohms to produce 20mA output with full scale input. There will be 0.8 Volts between pins 7 and 4 with full scale input.

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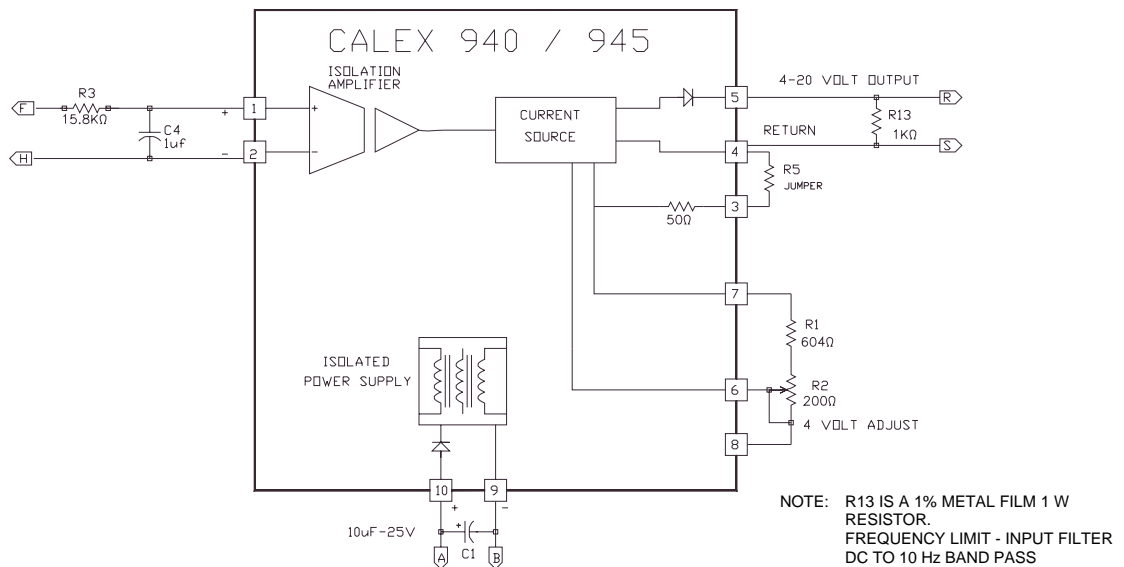
## MK940 Application Isolated Voltage In - 1 to 5 Volts Out



**FIGURE 7.**

Is similar to Figure 6 except R1 and R2 are used to set 4mA, or 1 Volt at the output with zero Volts input. Also R5 is zero ohms.

## MK940 Application Isolated Voltage In - 4 to 20 Volts Out with Single Pole 10Hz Input Filter



**FIGURE 8.**

Shows how to add a low pass filter at the input where the 400Hz bandpass may be too high and is causing noise problems. C4 should be a low dielectric absorption capacitor such as a X7R ceramic or a film capacitor. As discussed in Figure 6, R13 is the output source resistance and in this case would produce a 10% error when driving a 10,000 ohm load, and a 0.01% error when loaded by a 10 Megohm input digital voltmeter.