Model 540 Voltsensor

Features

- Rugged reliable solid state replacement for meter relays.
- Uses almost any power source from +5 to +32 VDC or ±5 to ±16 VDC.
- Withstands shock, vibration and other environmental hazards.
- Ignores input noise using variable dead band (hysteresis)
- Handles a wide variety of loads with output source current or current sinking of 100 mA.
- Ready to use with convenient mounting kits.
- Easy to mount 16 pin DIP package.

Description

The Model 540 Voltsensor is a low-cost voltage comparator in an encapsulated, DIP-compatible package. This rugged unit is versatile-it can be operated from a single supply of +5V to +32V or from ±15V supplies, and the output can be connected to sink or source current. Provision is made for optional external adjustment of hysteresis, and the unit can be connected for latching. The hysteresis and latching functions are independent of the output hook-up. Whether you're driving a relay, lighting a lamp, or driving logic circuitry, you can easily connect the Model 540 for hysteresis or latching functions.

The combination of a high-performance IC comparator with a versatile power-transistor output stage provides a low-cost comparator ideally suited to industrial use. The inputs are protected against over-voltage and the output is protected against reverse voltage or overcurrents.

The Model 540 is easy to use. The unit is 1.4" x 0.6" x 0.5" high with a pin configuration compatible with standard 16-pin DIP sockets. Mounting kits are also available consisting of one or more Model 540 Voltsensors mounted on a PC card with various combinations of pots and relays. With the Model MK218 Mounting Kit and two Model 540 units, high and low set-point limits can be adjusted to provide a window comparator for GO/NO-GO comparison.

Applications

The Model 540 has been designed for use in alarm, test and control circuits. Applications well-suited for this unit are:

- Adjustable trip point for alarm circuits
- Process control and counting
- Weight loading devices
- Power supply voltage monitor
- Production testing and quality control for GO/NO-GO limits

In the application below, the Model 540 is connected for single supply operation in the current-sinking mode. When the input signal is more positive than the set-point input, a relay or lamp load will be switched to the energized position.

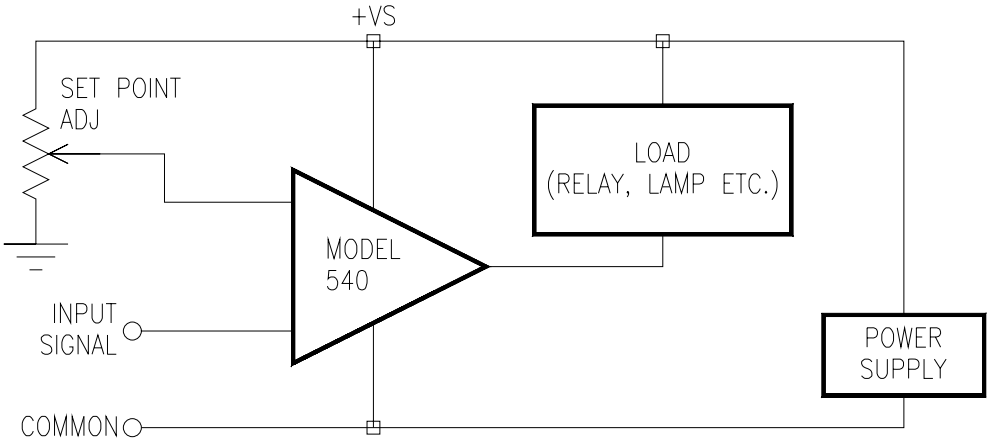


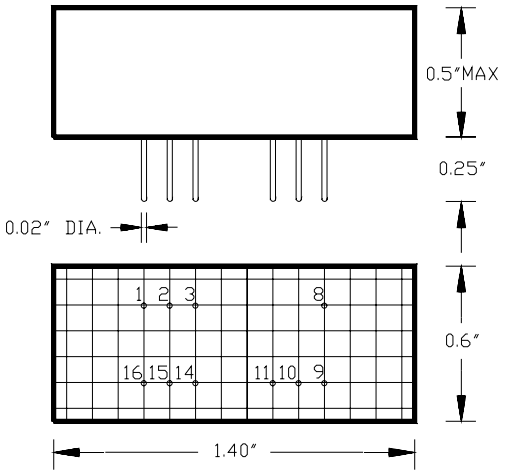
Figure 1. Model 540 Connected for Single Supply Operation.

Specifications

Mode of Operation	+5V to +32V		±5V to ±16V	
Power Supply Connection	Single Supply ($+V_S$)		Dual Supply ($\pm V_S$)	
Output Connection	Current - Sinking Mode	Current - Sourcing Mode	Current - Sinking Mode	Current - Sourcing Mode
Input				
Trip Point Range at min. Supply Level at max. Supply Level	 +0.5V to +3.0V +0.5V to +30.0V		 -4.5V to +3.0V -15.5V to +14.0V	
Trip Point Stability	±40 µV/°C		±40 µV/°C	
Sensitivity & Repeatability	1 mV		1 mV	
ON/OFF Differential (Hysteresis)	+ V_S /1000, min.		$+V_S$ /1000, min.	
Input Impedance (1)	1 megohm		1 megohm	
Max. Input Voltage	±100V		±100V	
Input Bias Current	500 nA		500 nA	
Input Offset Current	50 nA		50 nA	
Input Offset Voltage	±10 mV		±10 mV	
Output				
Output Voltage High State	 $+V_S$	 $+V_S$ -3.5V	 $+V_S$	 $+V_S$ -3.5V
Low State	+0.7V max. at +100 mA	+50 mV max.	+0.7V max. at +100 mA	+50 mV max.
Output Impedance High State	 Open Collector with 1 µA max. leakage	 10 ohm	 Open Collector with 1 µA max. leakage	 10 ohm
Low State	Sat. Transistor 7 ohm max. imp.	10 ohm	Sat. Transistor 7 ohm max. imp.	10 ohm
Output Current Rating	+100 mA	+100 mA	+100 mA	+100 mA
Overcurrent Protection	+140 mA	+140 mA	+140 mA	+140 mA
Response Time				
Operating Time	1 µs		1 µs	
Output Rise & Fall Time	0.25 µs		0.25 µs	
Power Requirements				
Supply Voltage Range ($\pm V_S$)	+5V to +32V		±5V to ±16V	
Quiescent Current Drain Positive Supply	 +5 mA to +16 mA		 +5 mA to +16 mA	
Negative Supply	n/a		-5 mA	
Temperature Range	0°C to +70°C			

(1) Impedance into non-inverting input drops to 120k ohm for negative input signals if the hysteresis pot is connected externally as shown in Figure 15.

Mechanical Specifications



BOTTOM VIEW (0.1" Grid)

Pin Assignments

Pin Assignments	
1	OUTPUT (Sinking)
2	COMPARATOR OUTPUT
3	+Vs
8	INVERTING INPUT
9	NON-INVERTING INPUT
10	-Vs
11	LATCHING INPUT
14	HYSTERESIS (Dead Band)
15	COMMON
16	OUTPUT (Source)

Operation

The Model 540 consists of a protected IC input stage and a power transistor output stage. The set-point input, or comparison voltage, can be applied to either input (pin 8 or pin 9). The varying input signal is applied to the other input. When the voltage at pin 9 is more positive than the voltage at pin 8, the IC comparator output switches to the high logic state and applies a positive drive to the output power transistor Q1. When the voltage at pin 9 is negative with respect to the voltage at pin 8, the IC comparator will switch to the low logic state, which is near zero volts. If the output is connected as a current sink, (pin 16 connected to common and the load connected between pin 1 and a positive voltage), then positive drive from the output of the IC comparator will cause Q1 to saturate. With Q1 switched on, the output sink can accept up to +100 mA. A relay or lamp load at the output will be switched to the energized condition when Q1 saturates. When the IC comparator goes to the low state, Q1 is cut off and no current will flow. The Voltsensor output will then rise to the positive supply lead. A relay or lamp load would then be de-energized.

If the output is connected as a current source (pin 1 connected to $+V_S$ and the output load connected between pin 16 and common), then positive drive from the output of the IC comparator will cause Q1 to go to a high output state. In this mode of operation, Q1 is used as an emitter follower and it will essentially follow the voltage output of the IC comparator. When the IC comparator switches to the low state, the Voltsensor output (output source, pin 16) will drop to nearly zero volts (+50 mV maximum).

The input diodes protect the IC comparator for a maximum input voltage of ±100V. The output stage is current limited to 140 mA in the event of a short circuit. The diode between output source and common offers transient protection when a relay is used as a load in the current-source mode.

External connections for the two modes of operation current sinking and current sourcing, are shown below.

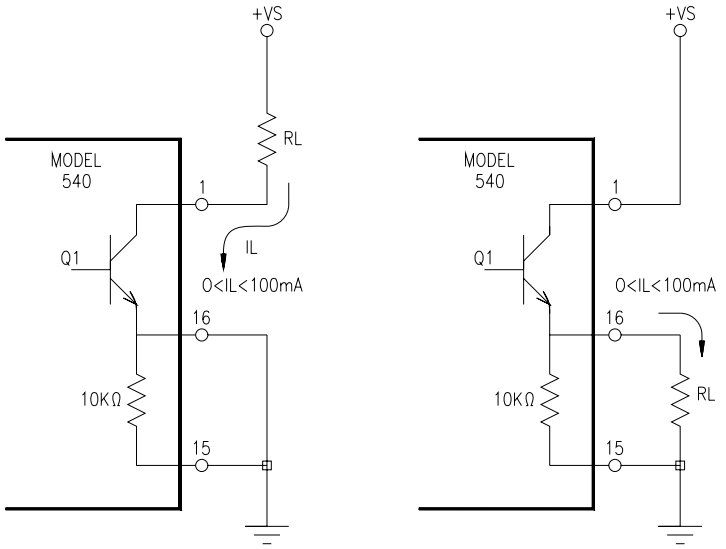


FIGURE 2.

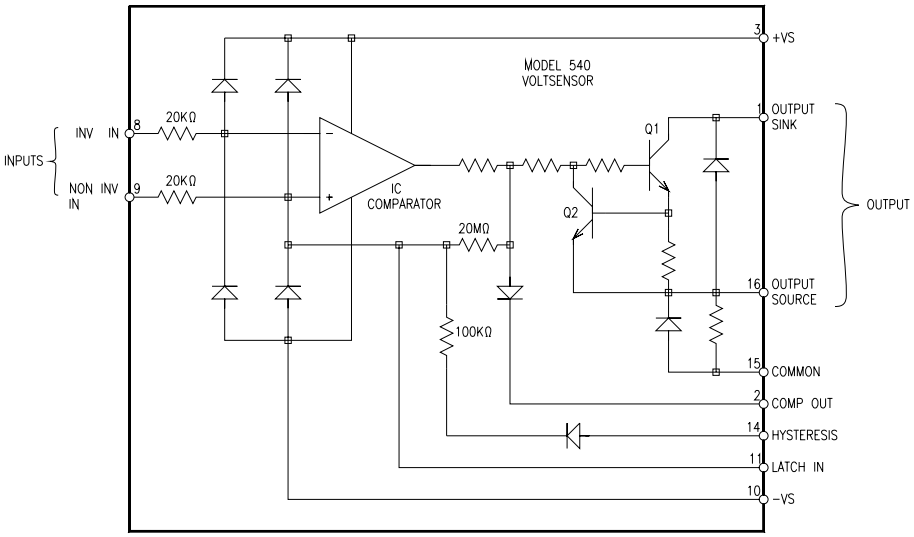


FIGURE 3.

Applications

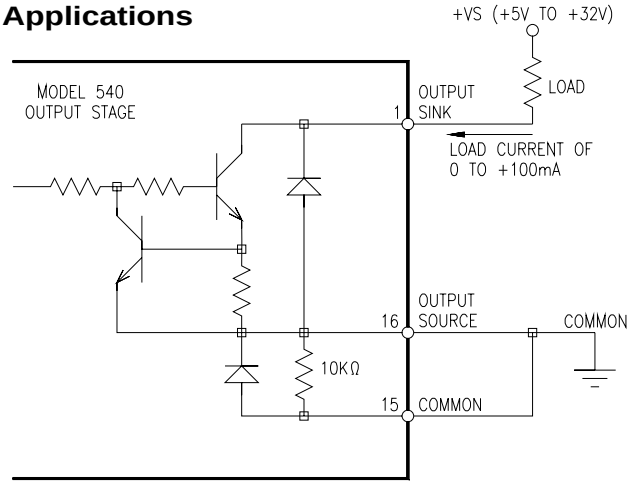


FIGURE 4. Model 540 Connected For Current-Sinking Mode

The connections for current-sinking operation are shown above in Figure 4. In this mode the Model 540 is short-circuit protected and current-limited at 140 mA. The diode across the output transistor protects the transistor against possible back bias. Of the two output modes, current-sinking is more desirable because there is less power dissipation in the low output state. When the voltage at the NON INVERTING input is more positive than the voltage at the INVERTING input, the IC comparator switches to the high logic state. This causes the output transistor to saturate, which will then energize the load. Figure 5 is a graph of output voltage versus load current for the saturated output transistor. Output leakage does not exceed 1 µA.

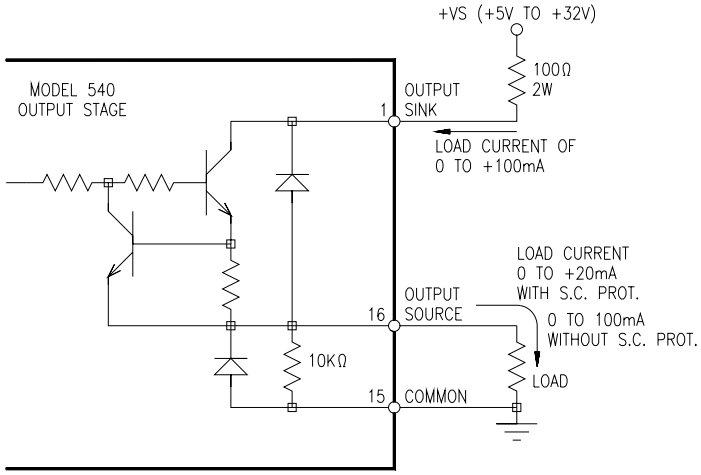


FIGURE 6. Model 540 Connected For Current-Sourcing Mode

Figure 6 shows the connections for current-source operation. In this mode the Model 540 is short-circuit protected for $+V_S$ of +5V to +15V. If short-circuit and current limiting protection is desired for $+V_S$ of +16V to +32V, a 100Ω 2W resistor should be connected between +Vs and pin 1. Output voltage in the current-source mode is $+V_S$ - (3.5V + 10 ΩI_L). Figure 7 is a graph of output voltage versus load current for current source operation. Output leakage does not exceed 1 µA.

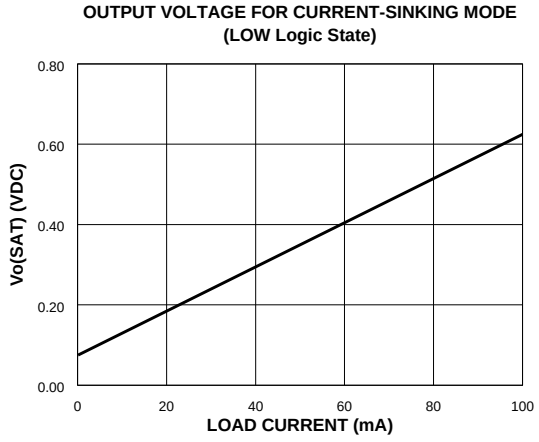


FIGURE 5.

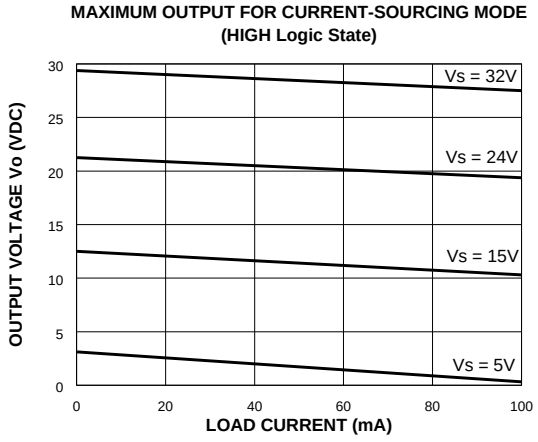
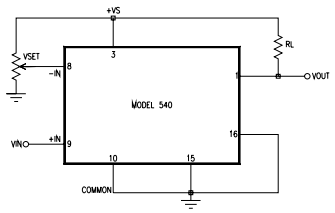


FIGURE 7.

Applications



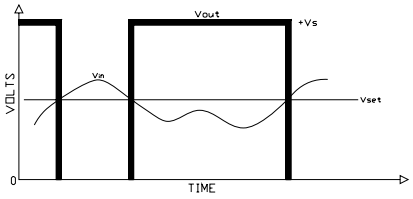
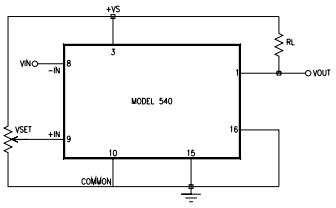


FIGURE 8.

Single Supply, Current-Sinking Mode, Resistive Load, V_{in} to +In Terminal



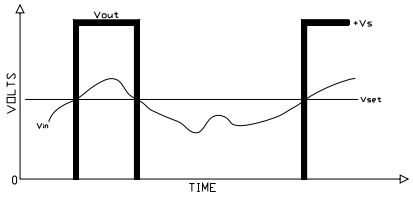
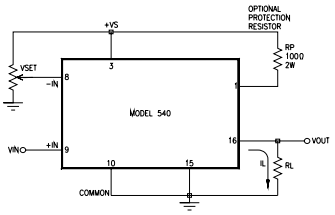


FIGURE 9.

Single Supply, Current-Sinking Mode, Resistive Load, V_{in} to -In Terminal



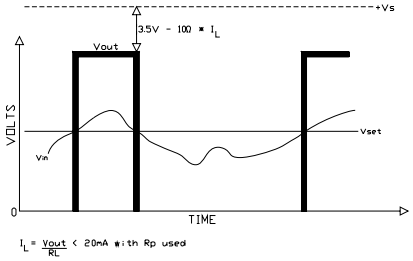
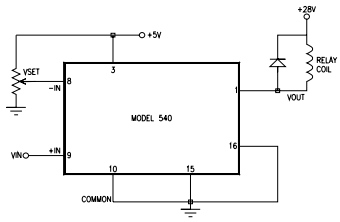


FIGURE 10.

Single Supply, Current-Sourcing Mode, Resistive Load, V_{in} to +In Terminal



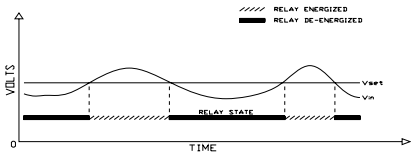
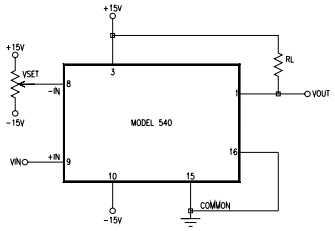


FIGURE 11.

Single +5V Supply, Current-Sinking Mode, 28V Relay as Load, V_{in} to -In Terminal



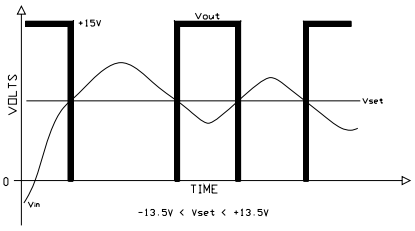
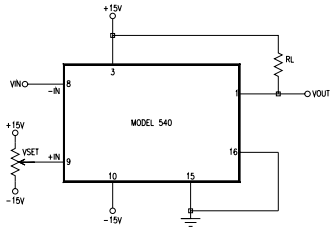


FIGURE 12.

Dual Supply, Current-Sinking Mode, Resistive Load, V_{in} to +In Terminal



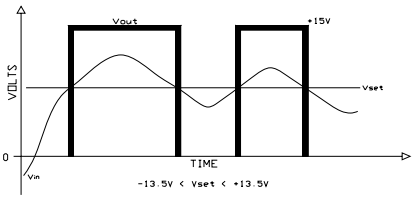
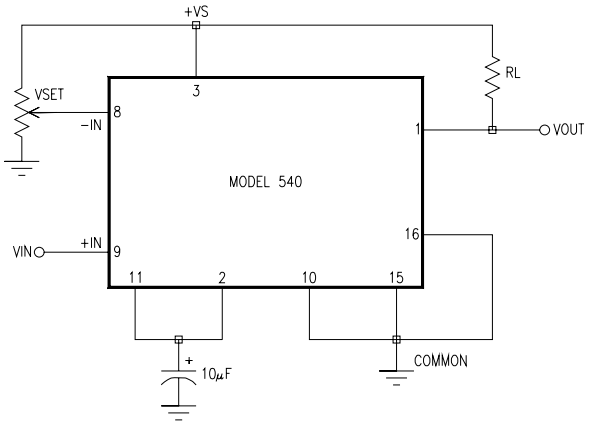


FIGURE 13.

Dual Supply, Current-Sinking Mode, Resistive Load, V_{in} to -In Terminal



Single Supply, Current-Sinking Mode, Latching Output, Resistive Load, V_{in} to +In Terminal

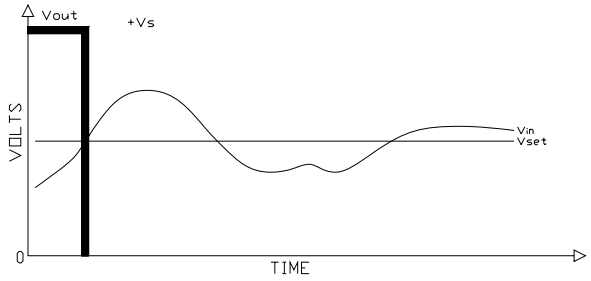
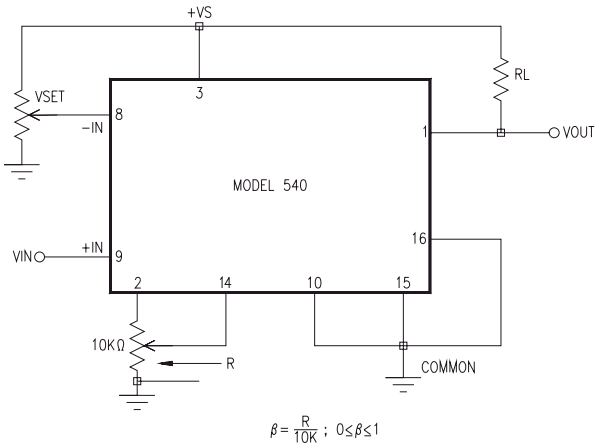


FIGURE 14.



Single Supply, Current-Sinking Mode, Variable Hysteresis, Resistive Load, V_{in} to +In Terminal

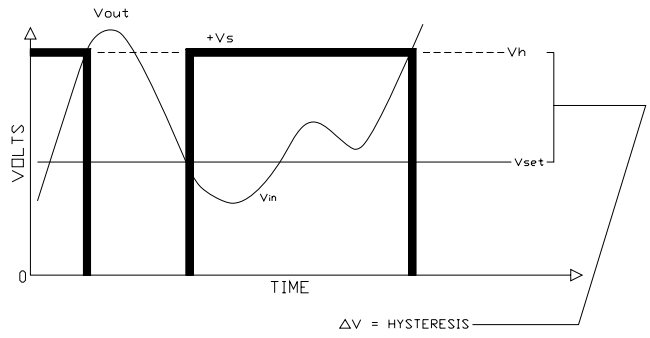


FIGURE 15.

Applications

Latching

For latching applications the hysteresis potentiometer must be removed from the mounting kit. A latching output is obtained by connecting the Model 540 as in Figure 14. As shown in the graph, the output voltage latches low when the input is more positive than the set voltage for at least 10 ms in the current-sinking mode. The load would be energized, and remain so, even if the input voltage becomes more negative than the set voltage. If input and set voltages are reversed, the output volts will latch low when the input is more negative than the set voltage. In the current-sourcing mode, the output voltage latches high when the input is more positive than the set voltage, providing the input is applied to pin 9 (non inverting input). Because of the internal protection circuitry, the unit will not latch in either output mode when the set voltage is negative. Once the Model 540 has latched, it will stay latched until the positive supply voltage (pin 3) is interrupted for more than 100 ms to reset the unit. The 10 µF capacitor prevents the unit from latching immediately after it is reset.

ON/OFF Differential (Hysteresis)

ON/OFF differential, or hysteresis, is a difference in switching point depending on input signal direction. Unlike many IC comparators, the hysteresis of the Model 540 can be varied independently of the output stage operation. Hysteresis of the Model 540 is factory set to a maximum of $+V_S/1000$ where V_S is the positive supply voltage (pin 3). The hysteresis can also be increased externally. The magnitude of hysteresis needed depends upon the application. Increasing the hysteresis improves noise immunity, but also increases the “dead zone.”

Hysteresis can be varied externally by two means: (1) Putting a resistor between pins 2 and 14, or (2) Connecting a potentiometer divider between pins 2 and 14 as shown in Figure 15. Using either method, the response of a Model 540 with V_{in} connected to +IN, V_{set} to -IN, and the output connected for current sinking, is shown in Figure 15. The voltage V_T at which the unit trips will be within ±10 mV of the set voltage V_{set}. The hysteresis voltage will be approximately

$$V_H \sim \frac{20\ k\Omega}{100\ k\Omega + R_H}(V_S - 3 - V_T) + \frac{V_S}{1000}$$

where R_H is the external resistance connected between pins 2 and 14. V_H must be positive.

With a potentiometer divider as shown in Figure 15, the hysteresis is approximately

$$V_H \sim 0.2\,[\beta\,(V_S - 2.4 - V_T)] + \frac{V_S}{1000},\ V_H > 0$$

Both of these equations apply only to positive input signals; the hysteresis is larger with negative input signals. Source impedance of the input signal also affects hysteresis when the input is applied to the +IN input. As can be seen from Figure 3, connecting the hysteresis pot externally will lower the input impedance at the +IN input to 120 kΩ for negative inputs, but the diode to pin 14 prevents loading for positive inputs. If the signal source impedance is very large, it is best to apply the signal to the -IN input and the set voltage to the +IN input.

Mounting Kits

There are eight mounting kits for the Model 540. All mounting kits consist of a PC card, 15-pin mating connector, and necessary pots. The use of this type connector makes rack mounting, vertical chassis mounting on rails, or angle bracket mounting a convenient method of constructing an instrumentation system. To order the Model 540 on a mounting kit, simply add the mounting kit number to 540 with a slash. For example, 540/MK217-28 would be the Model 540 mounted on a MK217-28 mounting kit, which consists of 2 pots, a 28 VDC relay, and a 15-pin connector.

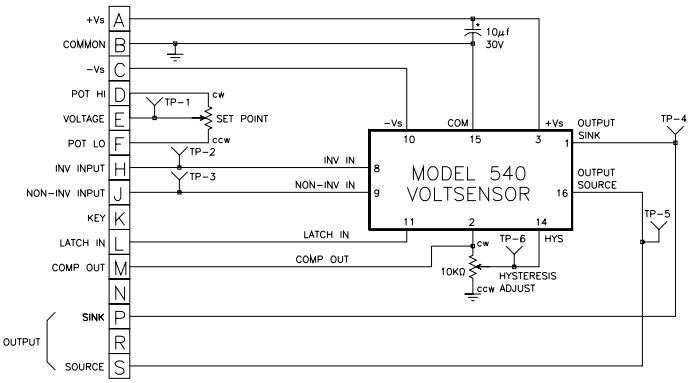


FIGURE 16. Model 540/MK216

Model Number	Description	Size (W x L x H)
MK216	Accepts one unit plus 2 pots (Set & Hys.)	3.2" x 1.9" x 0.8"
MK217-5	Accepts one unit plus 2 pots (Set & Hys.) and Low-Profile 5V Relay	3.2" x 2.6" x 0.8"
MK217-15	Accepts one unit plus 2 pots (Set & Hys.) and Low-Profile 15V Relay	3.2" x 2.6" x 0.8"
MK217-28	Accepts one unit plus 2 pots (Set & Hys.) and Low-Profile 28V Relay	3.2" x 2.6" x 0.8"
MK218	Accepts two units plus 4 pots (2 Set & 2 Hys.)	3.2" x 3.2" x 0.8"
MK218-5	Accepts two units plus 4 pots (2 Set & 2 Hys.) and 5V Relay	3.2" x 3.2" x 0.8"
MK218-15	Accepts two units plus 4 pots (2 Set & 2 Hys.) and 15V Relay	3.2" x 3.2" x 0.8"
MK218-28	Accepts two units plus 4 pots (2 Set & 2 Hys.) and 28V Relay	3.2" x 3.2" x 0.8"

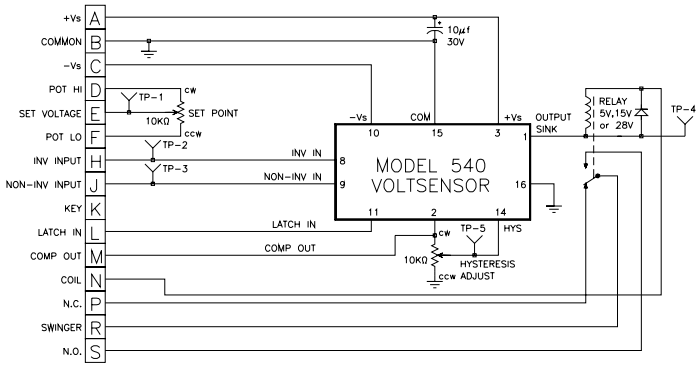


FIGURE 17. Models 540/MK217-5
540/MK217-15
540/MK217-28

Mounting Kit Model Number	Coil Voltage (min. - max.)	Coil Resistance
MK217-5 MK218-5	4.0V to 7.5V	75 ohm
MK217-15 MK218-15	10.0V to 18.0V	440 ohm
MK217-28 MK218-28	20.0V to 28.0V	1500 ohm

Configuration: SPDT

Contact Rating: 1A @ 26 VDC, 0.5A @ 115 VAC (Resistive)

Response Time: 10 ms

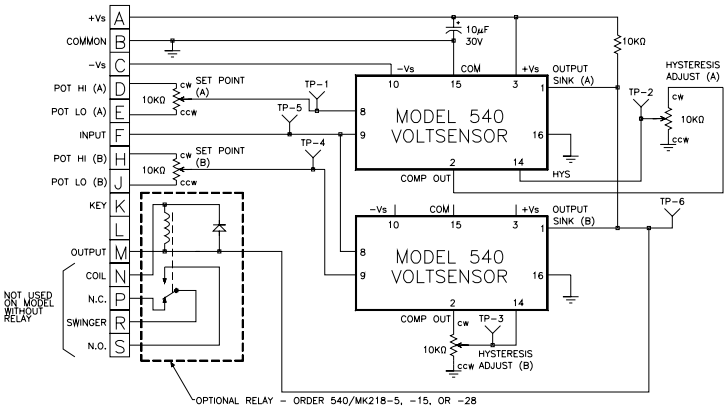


FIGURE 18. Models 540/MK218 (No Relay)
540/MK218-5 (5V Relay)
540/MK218-15 (15V Relay)
540/MK218-28 (28V Relay)