MOTOROLA

MC34161
MC33161

Advance Information

Universal Voltage Monitors

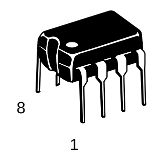
UNIVERSAL VOLTAGE MONITORS

SEMICONDUCTOR TECHNICAL DATA

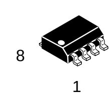
The MC34161/MC33161 are universal voltage monitors intended for use in a wide variety of voltage sensing applications. These devices offer the circuit designer an economical solution for positive and negative voltage detection. The circuit consists of two comparator channels each with hysteresis, a unique Mode Select Input for channel programming, a pinned out 2.54 V reference, and two open collector outputs capable of sinking in excess of 10 mA. Each comparator channel can be configured as either inverting or noninverting by the Mode Select Input. This allows over, under, and window detection of positive and negative voltages. The minimum supply voltage needed for these devices to be fully functional is 2.0 V for positive voltage sensing and 4.0 V for negative voltage sensing.

Applications include direct monitoring of positive and negative voltages used in appliance, automotive, consumer, and industrial equipment.

- Unique Mode Select Input Allows Channel Programming
- Over, Under, and Window Voltage Detection
- Positive and Negative Voltage Detection
- Fully Functional at 2.0 V for Positve Voltage Sensing and 4.0 V for Negative Voltage Sensing
- Pinned Out 2.54 V Reference with Current Limit Protection
- Low Standby Current
- Open Collector Outputs for Enhanced Device Flexibility

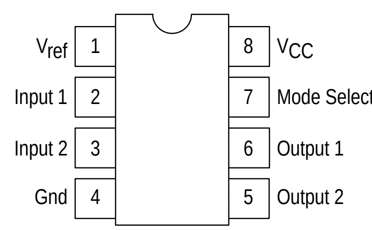


P SUFFIX
PLASTIC PACKAGE
CASE 626



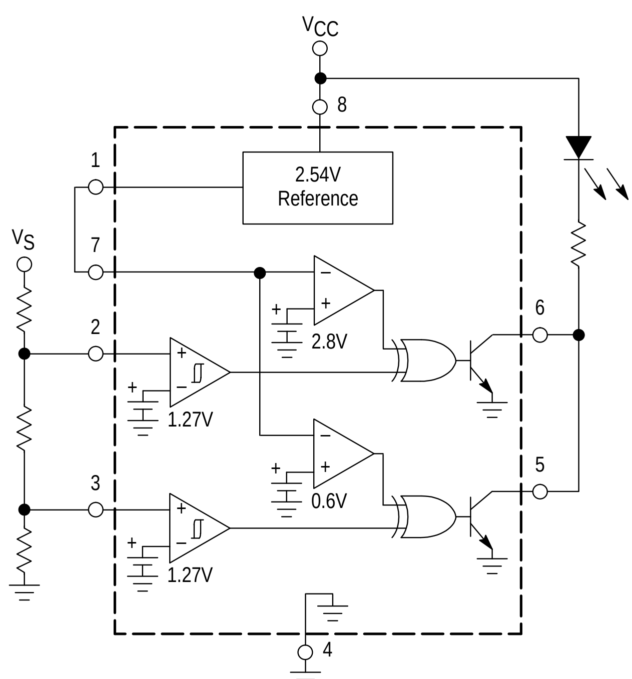
D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO–8)

PIN CONNECTIONS



(TOP VIEW)

Simplified Block Diagram
(Positive Voltage Window Detector Application)



ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC34161D	T_A = 0° to +70°C	SO–8
MC34161P		Plastic DIP
MC33161D	T_A = –40° to +85°C	SO–8
MC33161P		Plastic DIP

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Input Voltage	V_{CC}	40	V
Comparator Input Voltage Range	V_{in}	– 1.0 to +40	V
Comparator Output Sink Current (Pins 5 and 6) (Note 1)	I_{Sink}	20	mA
Comparator Output Voltage	V_{out}	40	V
Power Dissipation and Thermal Characteristics (Note 1) P Suffix, Plastic Package, Case 626 Maximum Power Dissipation @ T_A = 70°C Thermal Resistance, Junction–to–Air D Suffix, Plastic Package, Case 751 Maximum Power Dissipation @ T_A = 70°C Thermal Resistance, Junction–to–Air	 P_D $R_{\theta JA}$ P_D $R_{\theta JA}$	 800 100 450 178	 mW °C/W mW °C/W
Operating Junction Temperature	T_J	+150	°C
Operating Ambient Temperature (Note 3) MC34161 MC33161	T_A	 0 to +70 – 40 to +85	°C
Storage Temperature Range	T_{stg}	– 55 to +150	°C

ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 V, for typical values T_A = 25°C, for min/max values T_A is the operating ambient temperature range that applies [Notes 2 and 3], unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
COMPARATOR INPUTS					
Threshold Voltage, V_{in} Increasing (T_A = 25°C) (T_A = T_{min} to T_{max})	V_{th}	1.245 1.235	1.27 –	1.295 1.295	V
Threshold Voltage Variation (V_{CC} = 2.0 V to 40 V)	ΔV_{th}	–	7.0	15	mV
Threshold Hysteresis, V_{in} Decreasing	V_H	15	25	35	mV
Threshold Difference $\lvert V_{th1} – V_{th2}\rvert$	V_D	–	1.0	15	mV
Reference to Threshold Difference ($V_{ref} – V_{in1}$), ($V_{ref} – V_{in2}$)	V_{RTD}	1.20	1.27	1.32	V
Input Bias Current (V_{in} = 1.0 V) (V_{in} = 1.5 V)	I_{IB}	– –	40 85	200 400	nA
MODE SELECT INPUT					
Mode Select Threshold Voltage (Figure 5) Channel 1 Channel 2	$V_{th(CH\ 1)}$ $V_{th(CH\ 2)}$	V_{ref}+0.15 0.3	V_{ref}+0.23 0.63	V_{ref}+0.30 0.9	V
COMPARATOR OUTPUTS					
Output Sink Saturation Voltage (I_{Sink} = 2.0 mA) (I_{Sink} = 10 mA) (I_{Sink} = 0.25 mA, V_{CC} = 1.0 V)	V_{OL}	– – –	0.05 0.22 0.02	0.3 0.6 0.2	V
Off–State Leakage Current (V_{OH} = 40 V)	I_{OH}	–	0	1.0	µA
REFERENCE OUTPUT					
Output Voltage (I_O = 0 mA, T_A = 25°C)	V_{ref}	2.48	2.54	2.60	V
Load Regulation (I_O = 0 mA to 2.0 mA)	Reg_{load}	–	0.6	15	mV
Line Regulation (V_{CC} = 4.0 V to 40 V)	Reg_{line}	–	5.0	15	mV
Total Output Variation over Line, Load, and Temperature	ΔV_{ref}	2.45	–	2.60	V
Short Circuit Current	I_{SC}	–	8.5	30	mA
TOTAL DEVICE					
Power Supply Current (V_{Mode}, V_{in1}, V_{in2} = Gnd) (V_{CC} = 5.0 V) (V_{CC} = 40 V)	I_{CC}	– –	450 560	700 900	µA
Operating Voltage Range (Positive Sensing) (Negative Sensing)	V_{CC}	2.0 4.0	– –	40 40	V

NOTES: 1. Maximum package power dissipation must be observed.
2. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.
3. T_{low} = 0°C for MC34161, –40°C for MC33161; T_{high} = +70°C for MC34161, +85°C for MC33161

Figure 1. Comparator Input Threshold Voltage

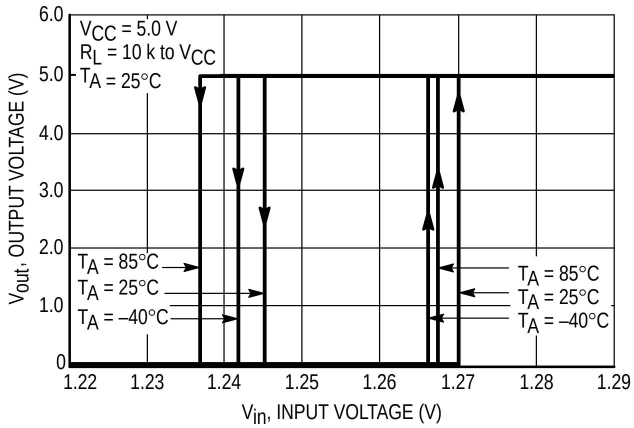


Figure 2. Comparator Input Bias Current versus Input Voltage

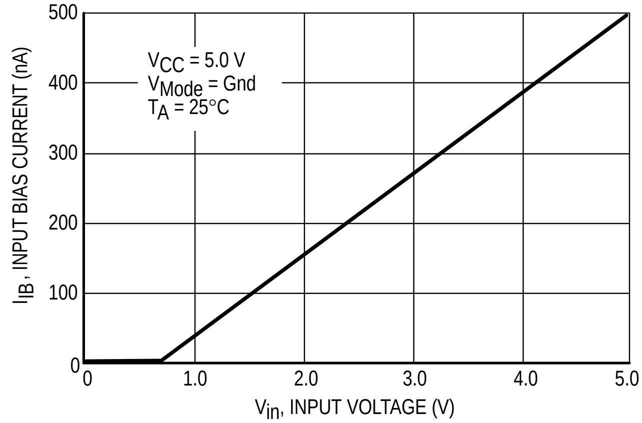


Figure 3. Output Propagation Delay Time versus Percent Overdrive

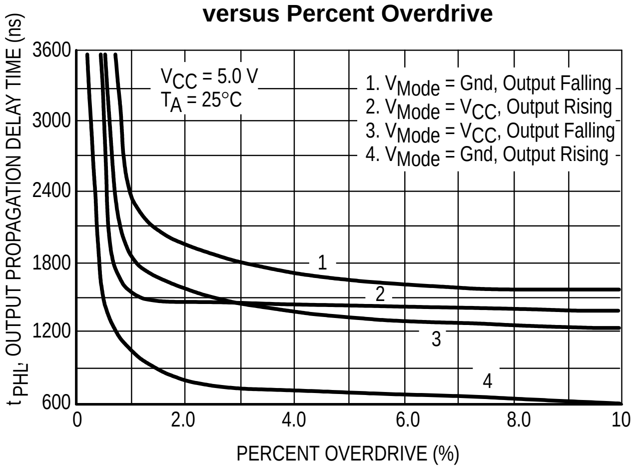


Figure 4. Output Voltage versus Supply Voltage

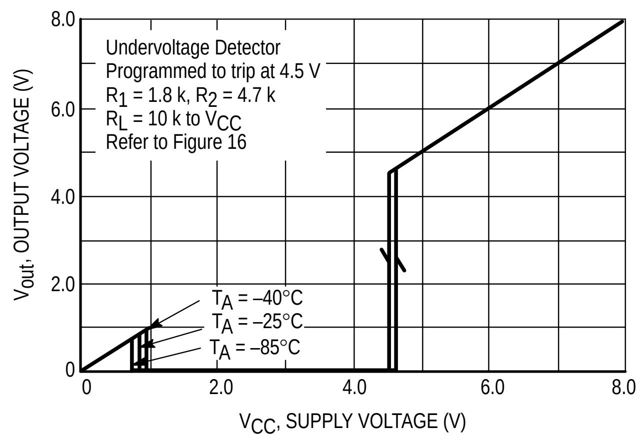


Figure 5. Mode Select Thresholds

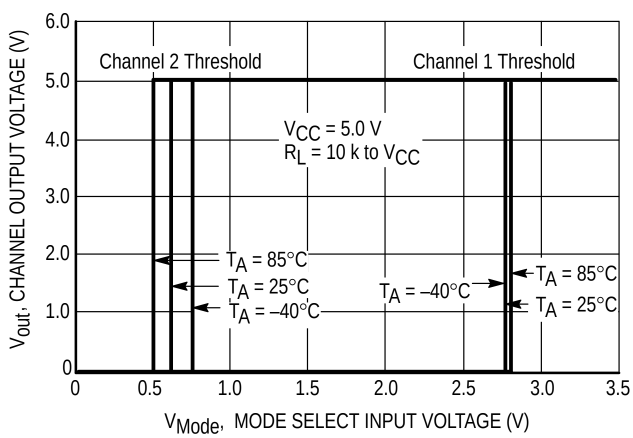


Figure 6. Mode Select Input Current versus Input Voltage

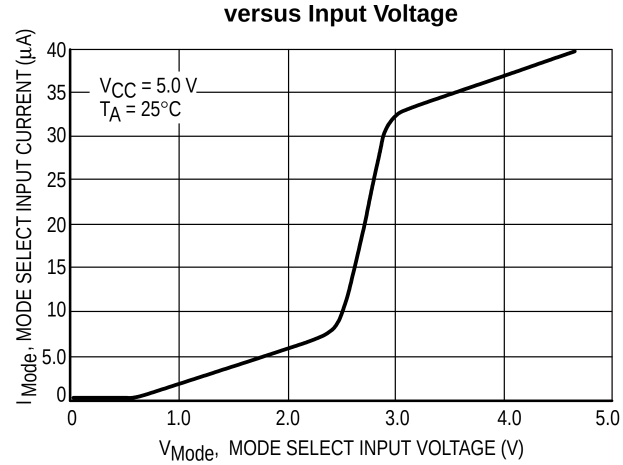


Figure 7. Reference Voltage versus Supply Voltage

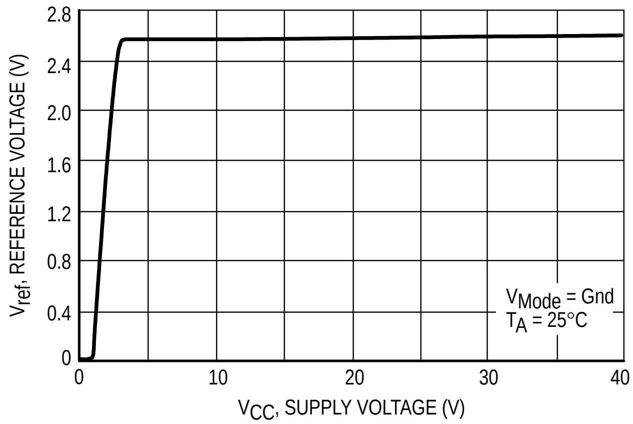


Figure 8. Reference Voltage versus Ambient Temperature

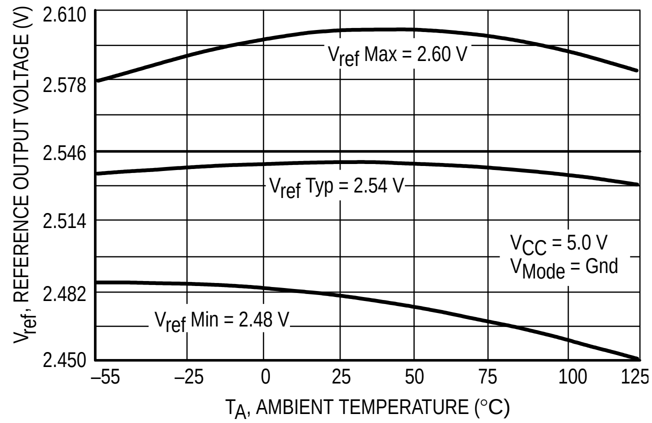


Figure 9. Reference Voltage Change versus Source Current

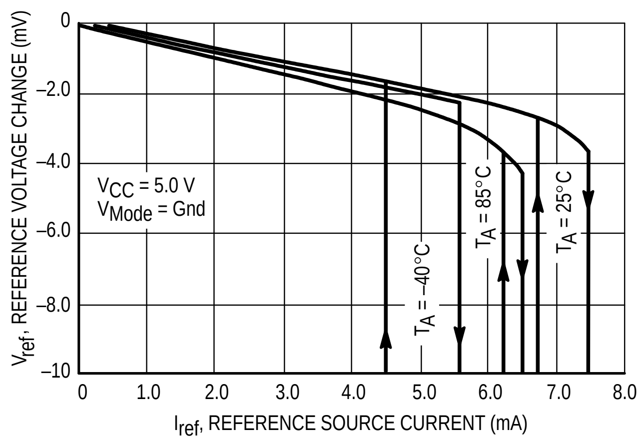


Figure 10. Output Saturation Voltage versus Output Sink Current

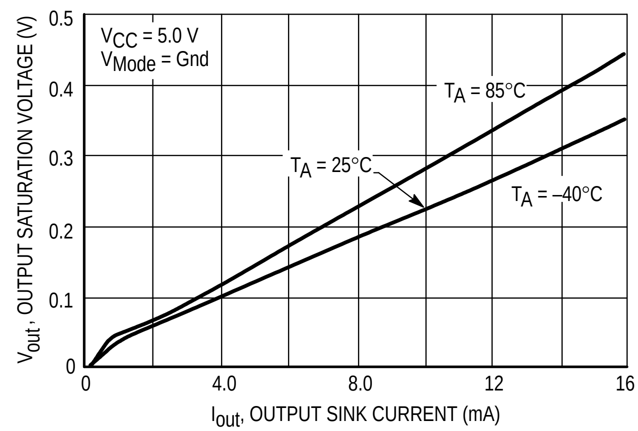


Figure 11. Supply Current versus Supply Voltage

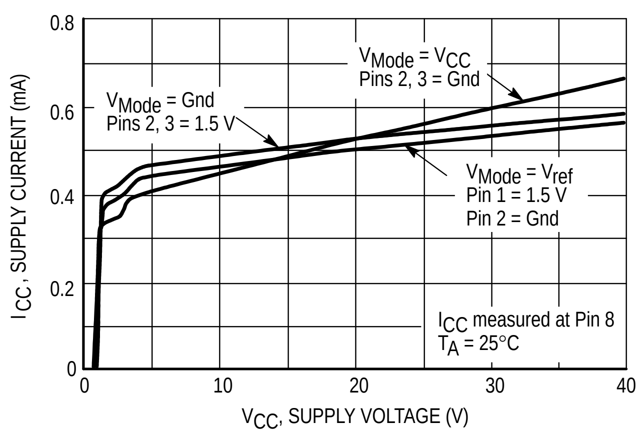


Figure 12. Supply Current versus Output Sink Current

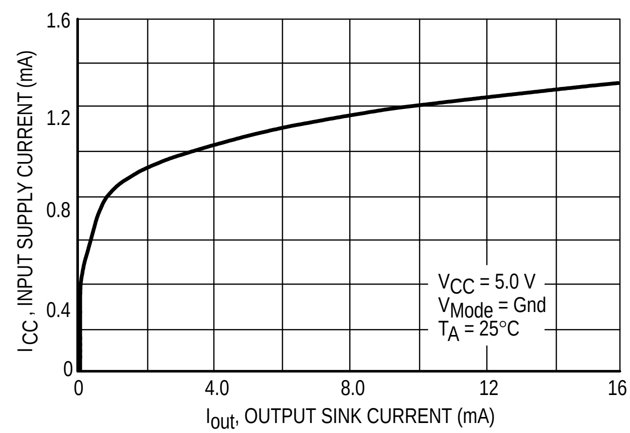


Figure 13. MC34161 Representative Block Diagram

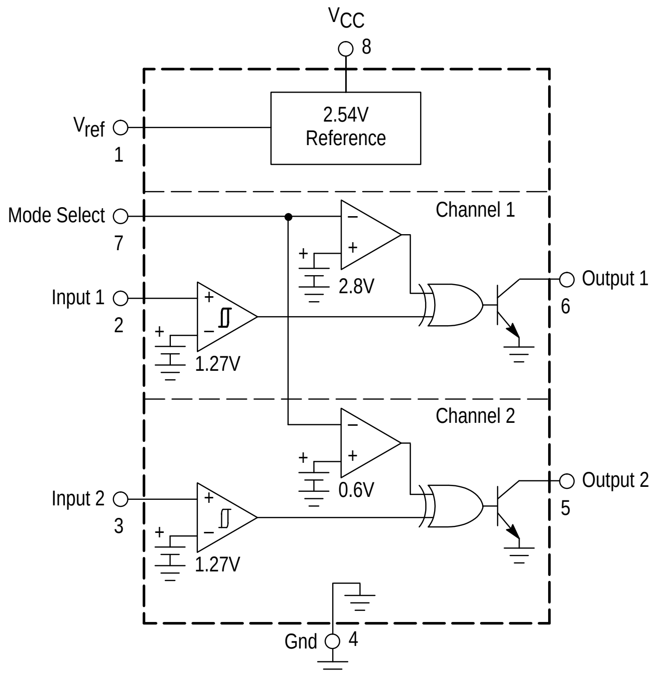


Figure 14. Truth Table

Mode Select Pin 7	Input 1 Pin 2	Output 1 Pin 6	Input 2 Pin 3	Output 2 Pin 5	Comments
GND	0 1	0 1	0 1	0 1	Channels 1 & 2: Noninverting
V_{ref}	0 1	0 1	0 1	1 0	Channel 1: Noninverting Channel 2: Inverting
V_{CC} (>2.0 V)	0 1	1 0	0 1	1 0	Channels 1 & 2: Inverting

FUNCTIONAL DESCRIPTION

Introduction

To be competitive in today's electronic equipment market, new circuits must be designed to increase system reliability with minimal incremental cost. The circuit designer can take a significant step toward attaining these goals by implementing economical circuitry that continuously monitors critical circuit voltages and provides a fault signal in the event of an out–of–tolerance condition. The MC34161, MC33161 series are universal voltage monitors intended for use in a wide variety of voltage sensing applications. The main objectives of this series was to configure a device that can be used in as many voltage sensing applications as possible while minimizing cost. The flexibility objective is achieved by the utilization of a unique Mode Select input that is used in conjunction with traditional circuit building blocks. The cost objective is achieved by processing the device on a standard Bipolar Analog flow, and by limiting the package to eight pins. The device consists of two comparator channels each with hysteresis, a mode select input for channel programming, a pinned out reference, and two open collector outputs. Each comparator channel can be configured as either inverting or noninverting by the Mode Select input. This allows a single device to perform over, under, and window detection of positive and negative voltages. A detailed description of each section of the device is given below with the representative block diagram shown in Figure 13.

Input Comparators

The input comparators of each channel are identical, each having an upper threshold voltage of 1.27 V ±2.0% with 25 mV of hysteresis. The hysteresis is provided to enhance output switching by preventing oscillations as the comparator thresholds are crossed. The comparators have an input bias current of 60 nA at their threshold which approximates a 21.2 MΩ resistor to ground. This high impedance minimizes loading of the external voltage divider for well defined trip points. For all positive voltage sensing applications, both comparator channels are fully functional at a V_{CC} of 2.0 V. In order to provide enhanced device ruggedness for hostile industrial environments, additional circuitry was designed into the inputs to prevent device latch–up as well as to suppress electrostatic discharges (ESD).

Reference

The 2.54 V reference is pinned out to provide a means for the input comparators to sense negative voltages, as well as a means to program the Mode Select input for window detection applications. The reference is capable of sourcing in excess of 2.0 mA output current and has built–in short circuit protection. The output voltage has a guaranteed tolerance of ±2.4% at room temperature.

The 2.54 V reference is derived by gaining up the internal 1.27 V reference by a factor of two. With a power supply voltage of 4.0 V, the 2.54 V reference is in full regulation, allowing the device to accurately sense negative voltages.

Mode Select Circuit

The key feature that allows this device to be flexible is the Mode Select input. This input allows the user to program each of the channels for various types of voltage sensing applications. Figure 14 shows that the Mode Select input has three defined states. These states determine whether Channel 1 and/or Channel 2 operate in the inverting or noninverting mode. The Mode Select thresholds are shown in Figure 5. The input circuitry forms a tristate switch with thresholds at 0.63 V and V_{ref} + 0.23 V. The mode select input current is 10 µA when connected to the reference output, and 42 µA when connected to a V_{CC} of 5.0 V, refer to Figure 6.

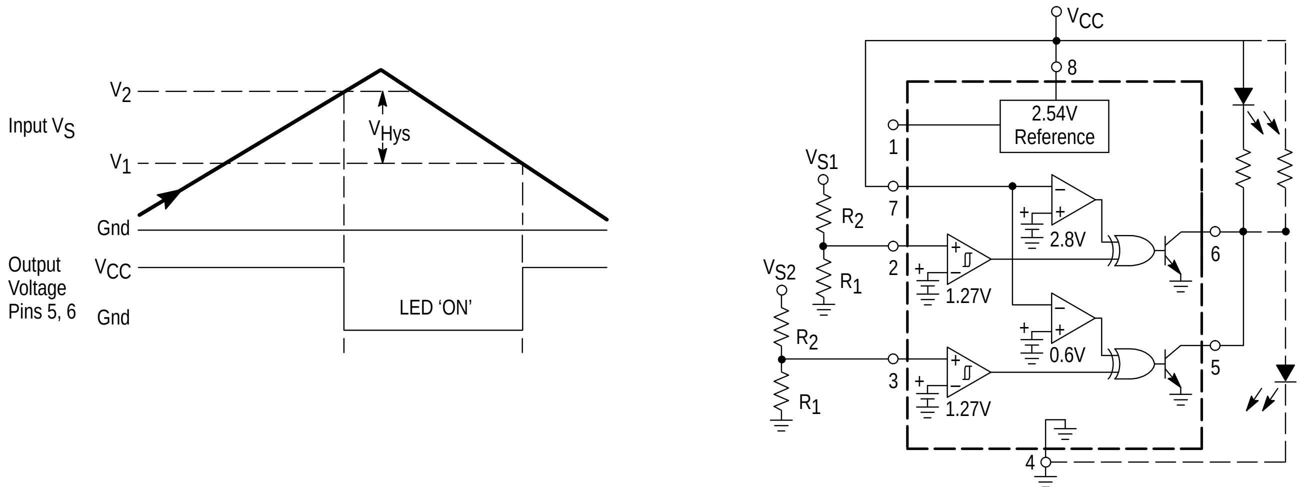
Output Stage

The output stage uses a positive feedback base boost circuit for enhanced sink saturation, while maintaining a relatively low device standby current. Figure 10 shows that the sink saturation voltage is about 0.2 V at 8.0 mA over temperature. By combining the low output saturation characteristics with low voltage comparator operation, this device is capable of sensing positive voltages at a V_{CC} of 1.0 V. These characteristics are important in undervoltage sensing applications where the output must stay in a low state as V_{CC} approaches ground. Figure 4 shows the Output Voltage versus Supply Voltage in an undervoltage sensing application. Note that as V_{CC} drops below the programmed 4.5 V trip point, the output stays in a well defined active low state until V_{CC} drops below 1.0 V.

APPLICATIONS

The following circuit figures illustrate the flexibility of this device. Included are voltage sensing applications for over, under, and window detectors, as well as three unique configurations. Many of the voltage detection circuits are shown with the open collector outputs of each channel connected together driving a light emitting diode (LED). This 'ORed' connection is shown for ease of explanation and it is only required for window detection applications. Note that many of the voltage detection circuits are shown with a dashed line output connection. This connection gives the inverse function of the solid line connection. For example, the solid line output connection of Figure 15 has the LED 'ON' when input voltage V_S is above trip voltage V_2, for overvoltage detection. The dashed line output connection has the LED 'ON' when V_S is below trip voltage V_2, for undervoltage detection.

Figure 15. Dual Postive Overvoltage Detector



The above figure shows the MC34161 configured as a dual positive overvoltage detector. As the input voltage increases from ground, the LED will turn 'ON' when V_{S1} or V_{S2} exceeds V_2. With the dashed line output connection, the circuit becomes a dual positive undervoltage detector. As the input voltage decreases from the peak towards ground, the LED will turn 'ON' when V_{S1} or V_{S2} falls below V_1.

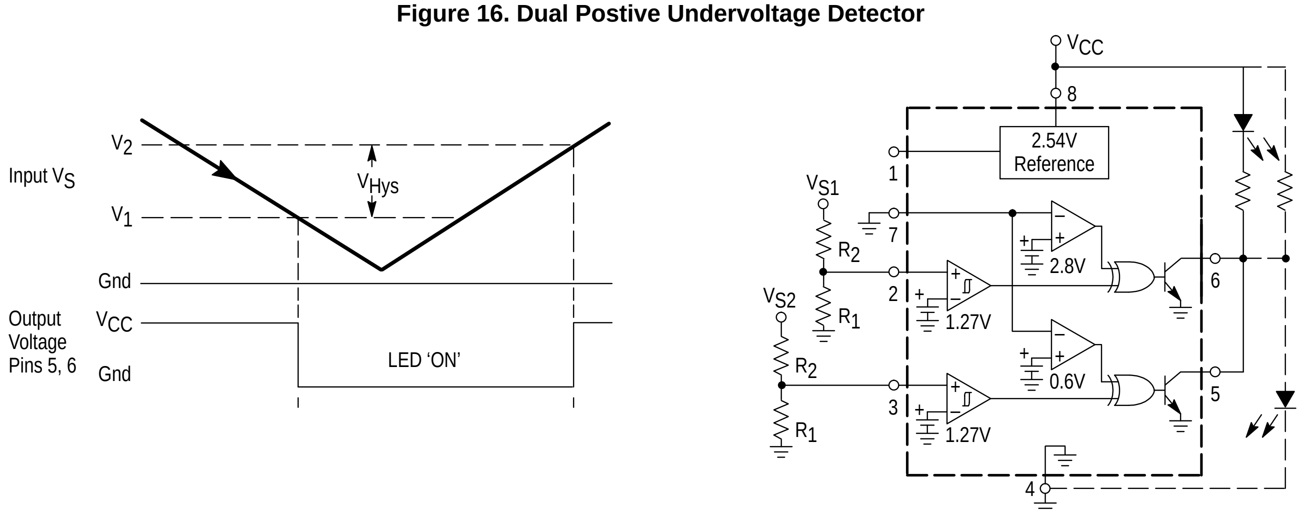
For known resistor values, the voltage trip points are:

$$V_1 = (V_{th} - V_H)\left(\frac{R_2}{R_1} + 1\right) \qquad V_2 = V_{th}\left(\frac{R_2}{R_1} + 1\right)$$

For a specific trip voltage, the required resistor ratio is:

$$\frac{R_2}{R_1} = \frac{V_1}{V_{th} - V_H} - 1 \qquad \frac{R_2}{R_1} = \frac{V_2}{V_{th}} - 1$$

Figure 16. Dual Postive Undervoltage Detector



The above figure shows the MC34161 configured as a dual positive undervoltage detector. As the input voltage decreases towards ground, the LED will turn 'ON' when V_{S1} or V_{S2} falls below V_1. With the dashed line output connection, the circuit becomes a dual positive overvoltage detector. As the input voltage increases from ground, the LED will turn 'ON' when V_{S1} or V_{S2} exceeds V_2.

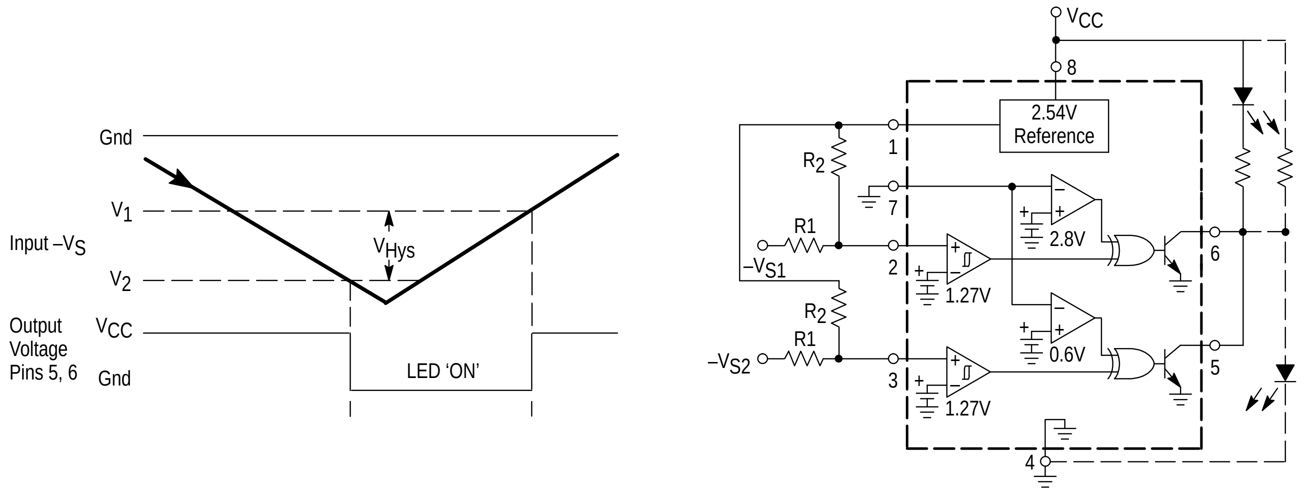
For known resistor values, the voltage trip points are:

$$V_1 = (V_{th} - V_H)\left(\frac{R_2}{R_1} + 1\right) \qquad V_2 = V_{th}\left(\frac{R_2}{R_1} + 1\right)$$

For a specific trip voltage, the required resistor ratio is:

$$\frac{R_2}{R_1} = \frac{V_1}{V_{th} - V_H} - 1 \qquad \frac{R_2}{R_1} = \frac{V_2}{V_{th}} - 1$$

Figure 17. Dual Negative Overvoltage Detector



The above figure shows the MC34161 configured as a dual negative overvoltage detector. As the input voltage increases from ground, the LED will turn 'ON' when $-V_{S1}$ or $-V_{S2}$ exceeds V_2. With the dashed line output connection, the circuit becomes a dual negative undervoltage detector. As the input voltage decreases from the peak towards ground, the LED will turn 'ON' when $-V_{S1}$ or $-V_{S2}$ falls below V_1.

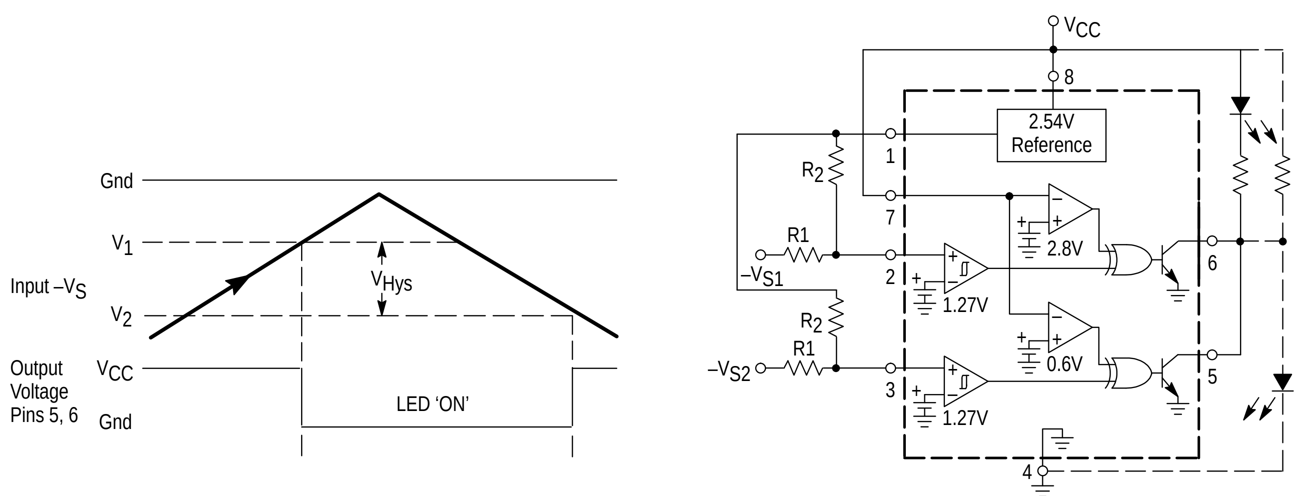
For known resistor values, the voltage trip points are:

$$V_1 = \frac{R_1}{R_2}(V_{th} - V_{ref}) + V_{th} \qquad V_2 = \frac{R_1}{R_2}(V_{th} - V_H - V_{ref}) + V_{th} - V_H$$

For a specific trip voltage, the required resistor ratio is:

$$\frac{R_1}{R_2} = \frac{V_1 - V_{th}}{V_{th} - V_{ref}} \qquad \frac{R_1}{R_2} = \frac{V_2 - V_{th} + V_H}{V_{th} - V_H - V_{ref}}$$

Figure 18. Dual Negative Undervoltage Detector



The above figure shows the MC34161 configured as a dual negative undervoltage detector. As the input voltage decreases towards ground, the LED will turn 'ON' when $-V_{S1}$ or $-V_{S2}$ falls below V_1. With the dashed line output connection, the circuit becomes a dual negative overvoltage detector. As the input voltage increases from ground, the LED will turn 'ON' when $-V_{S1}$ or $-V_{S2}$ exceeds V_2.

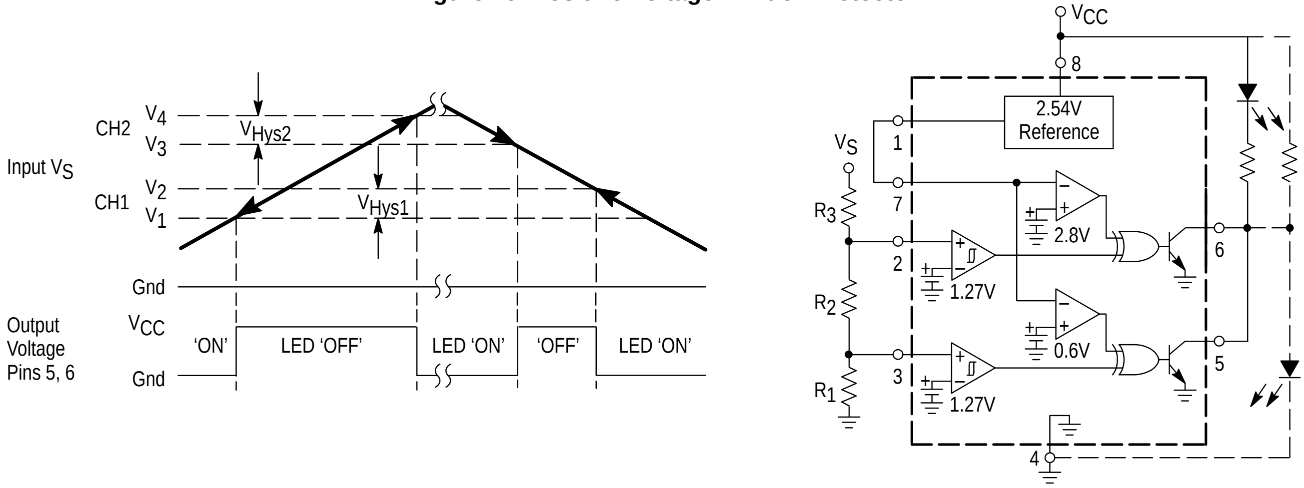
For known resistor values, the voltage trip points are:

$$V_1 = \frac{R_1}{R_2}(V_{th} - V_{ref}) + V_{th} \qquad V_2 = \frac{R_1}{R_2}(V_{th} - V_H - V_{ref}) + V_{th} - V_H$$

For a specific trip voltage, the required resistor ratio is:

$$\frac{R_1}{R_2} = \frac{V_1 - V_{th}}{V_{th} - V_{ref}} \qquad \frac{R_1}{R_2} = \frac{V_2 - V_{th} + V_H}{V_{th} - V_H - V_{ref}}$$

Figure 19. Positive Voltage Window Detector



The above figure shows the MC34161 configured as a positive voltage window detector. This is accomplished by connecting channel 1 as an undervoltage detector, and channel 2 as an overvoltage detector. When the input voltage V_S falls out of the window established by V_1 and V_4, the LED will turn 'ON'. As the input voltage falls within the window, V_S increasing from ground and exceeding V_2, or V_S decreasing from the peak towards ground and falling below V_3, the LED will turn 'OFF'. With the dashed line output connection, the LED will turn 'ON' when the input voltage V_S is within the window.

For known resistor values, the voltage trip points are:

$$V_1 = (V_{th1} - V_{H1})\left(\frac{R_3}{R_1 + R_2} + 1\right) \qquad V_3 = (V_{th2} - V_{H2})\left(\frac{R_2 + R_3}{R_1} + 1\right)$$

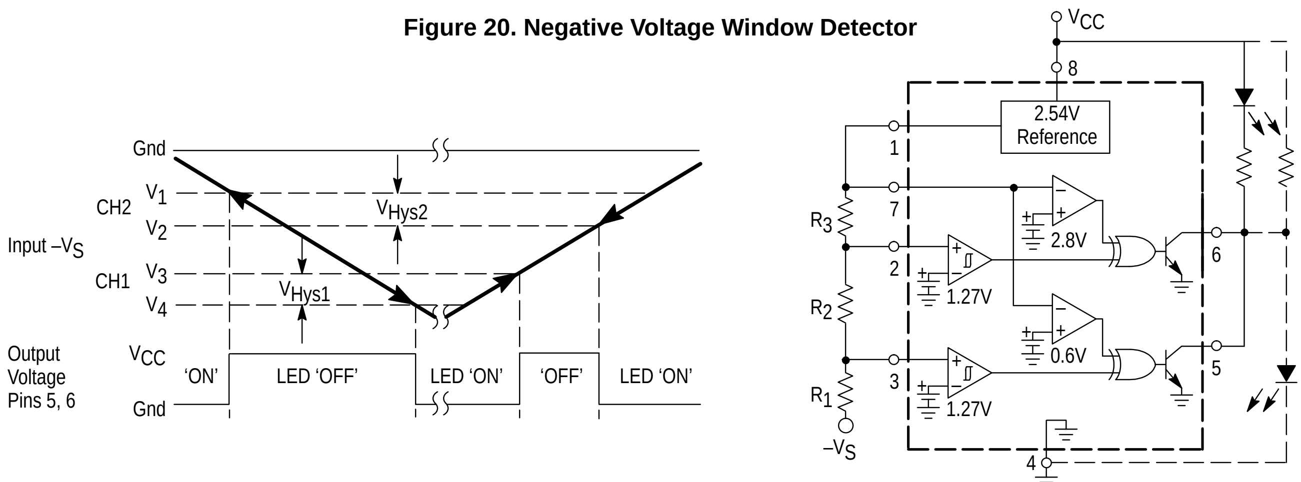
$$V_2 = V_{th1}\left(\frac{R_3}{R_1 + R_2} + 1\right) \qquad V_4 = V_{th2}\left(\frac{R_2 + R_3}{R_1} + 1\right)$$

For a specific trip voltage, the required resistor ratio is:

$$\frac{R_2}{R_1} = \frac{V_3(V_{th2} - V_{H2})}{V_1(V_{th1} - V_{H1})} - 1 \qquad \frac{R_3}{R_1} = \frac{V_3(V_1 - V_{th1} + V_{H1})}{V_1(V_{th2} - V_{H2})}$$

$$\frac{R_2}{R_1} = \frac{V_4 \times V_{th2}}{V_2 \times V_{th1}} - 1 \qquad \frac{R_3}{R_1} = \frac{V_4(V_2 - V_{th1})}{V_2 \times V_{th2}}$$

Figure 20. Negative Voltage Window Detector



The above figure shows the MC34161 configured as a negative voltage window detector. When the input voltage $-V_S$ falls out of the window established by V_1 and V_4, the LED will turn 'ON'. As the input voltage falls within the window, $-V_S$ increasing from ground and exceeding V_2, or $-V_S$ decreasing from the peak towards ground and falling below V_3, the LED will turn 'OFF'. With the dashed line output connection, the LED will turn 'ON' when the input voltage $-V_S$ is within the window.

For known resistor values, the voltage trip points are:

$$V_1 = \frac{R_1(V_{th2} - V_{ref})}{R_2 + R_3} + V_{th2}$$

$$V_2 = \frac{R_1(V_{th2} - V_{H2} - V_{ref})}{R_2 + R_3} + V_{th2} - V_{H2}$$

$$V_3 = \frac{(R_1 + R_2)(V_{th1} - V_{ref})}{R_3} + V_{th1}$$

$$V_4 = \frac{(R_1 + R_2)(V_{th1} - V_{H1} - V_{ref})}{R_3} + V_{th1} - V_{H1}$$

For a specific trip voltage, the required resistor ratio is:

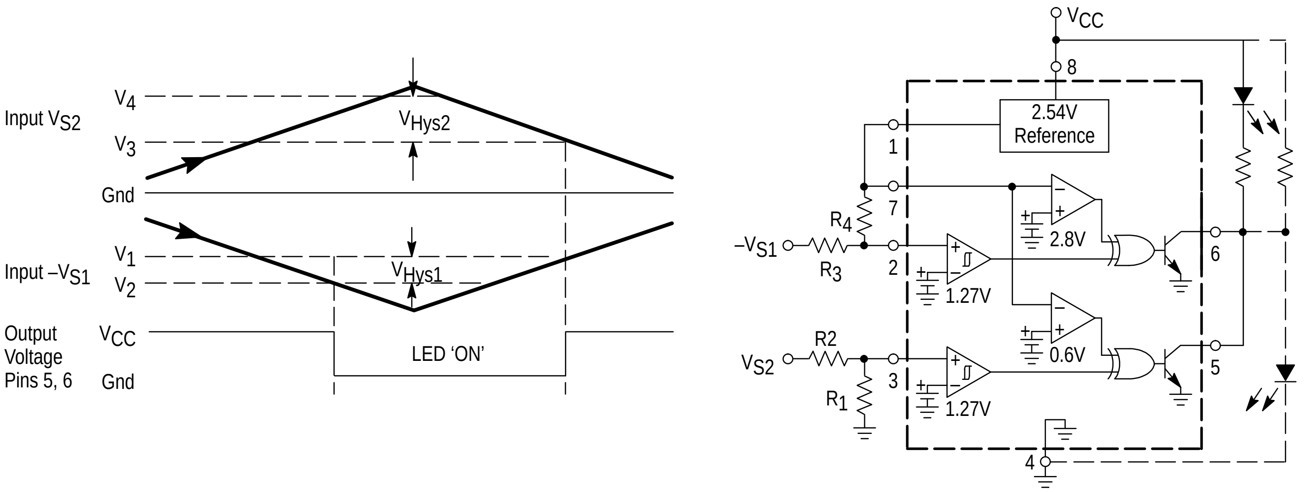
$$\frac{R_1}{R_2 + R_3} = \frac{V_1 - V_{th2}}{V_{th2} - V_{ref}}$$

$$\frac{R_1}{R_2 + R_3} = \frac{V_2 - V_{th2} + V_{H2}}{V_{th2} - V_{H2} - V_{ref}}$$

$$\frac{R_3}{R_1 + R_2} = \frac{V_{th1} - V_{ref}}{V_3 - V_{th1}}$$

$$\frac{R_3}{R_1 + R_2} = \frac{V_{th1} - V_{H1} - V_{ref}}{V_4 + V_{H1} - V_{th1}}$$

Figure 21. Positive and Negative Overvoltage Detector



The above figure shows the MC34161 configured as a positive and negative overvoltage detector. As the input voltage increases from ground, the LED will turn ‘ON’ when either $–V_{S1}$ exceeds V_2, or V_{S2} exceeds V_4. With the dashed line output connection, the circuit becomes a positive and negative undervoltage detector. As the input voltage decreases from the peak towards ground, the LED will turn ‘ON’ when either V_{S2} falls below V_3, or $–V_{S1}$ falls below V_1.

For known resistor values, the voltage trip points are:

$$V_1 = \frac{R_3}{R_4}(V_{th1} - V_{ref}) + V_{th1}$$

$$V_2 = \frac{R_3}{R_4}(V_{th1} - V_{H1} - V_{ref}) + V_{th1} - V_{H1}$$

$$V_3 = (V_{th2} - V_{H2})\left(\frac{R_2}{R_1} + 1\right)$$

$$V_4 = V_{th2}\left(\frac{R_2}{R_1} + 1\right)$$

For a specific trip voltage, the required resistor ratio is:

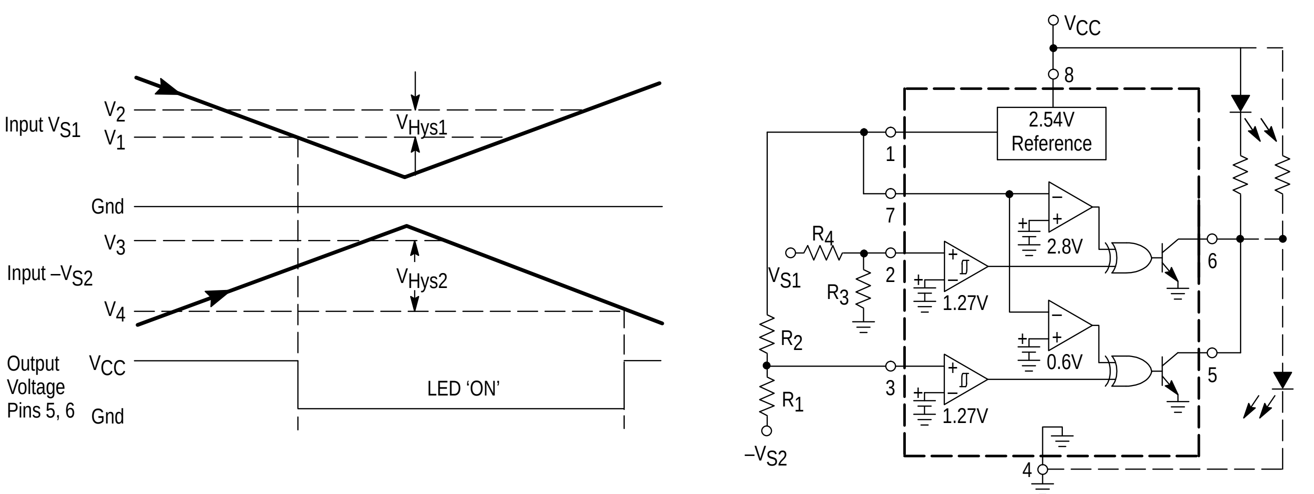
$$\frac{R_3}{R_4} = \frac{(V_1 - V_{th1})}{(V_{th1} - V_{ref})}$$

$$\frac{R_3}{R_4} = \frac{(V_2 - V_{th1} + V_{H1})}{(V_{th1} - V_{H1} - V_{ref})}$$

$$\frac{R_2}{R_1} = \frac{V_4}{V_{th2}} - 1$$

$$\frac{R_2}{R_1} = \frac{V_3}{V_{th2} - V_{H2}} - 1$$

Figure 22. Positive and Negative Undervoltage Detector



The above figure shows the MC34161 configured as a positive and negative undervoltage detector. As the input voltage decreases toward ground, the LED will turn ‘ON’ when either V_{S1} falls below V_1, or $–V_{S2}$ falls below V_3. With the dashed line output connection, the circuit becomes a positive and negative overvoltage detector. As the input voltage increases from the ground, the LED will turn ‘ON’ when either V_{S1} exceeds V_2, or $–V_{S1}$ exceeds V_1.

For known resistor values, the voltage trip points are:

$$V_1 = (V_{th1} - V_{H1})\left(\frac{R_4}{R_3} + 1\right)$$

$$V_2 = V_{th1}\left(\frac{R_4}{R_3} + 1\right)$$

$$V_3 = \frac{R_1}{R_2}(V_{th} - V_{ref}) + V_{th2}$$

$$V_4 = \frac{R_1}{R_2}(V_{th} - V_{H2} - V_{ref}) + V_{th2} - V_{H2}$$

For a specific trip voltage, the required resistor ratio is:

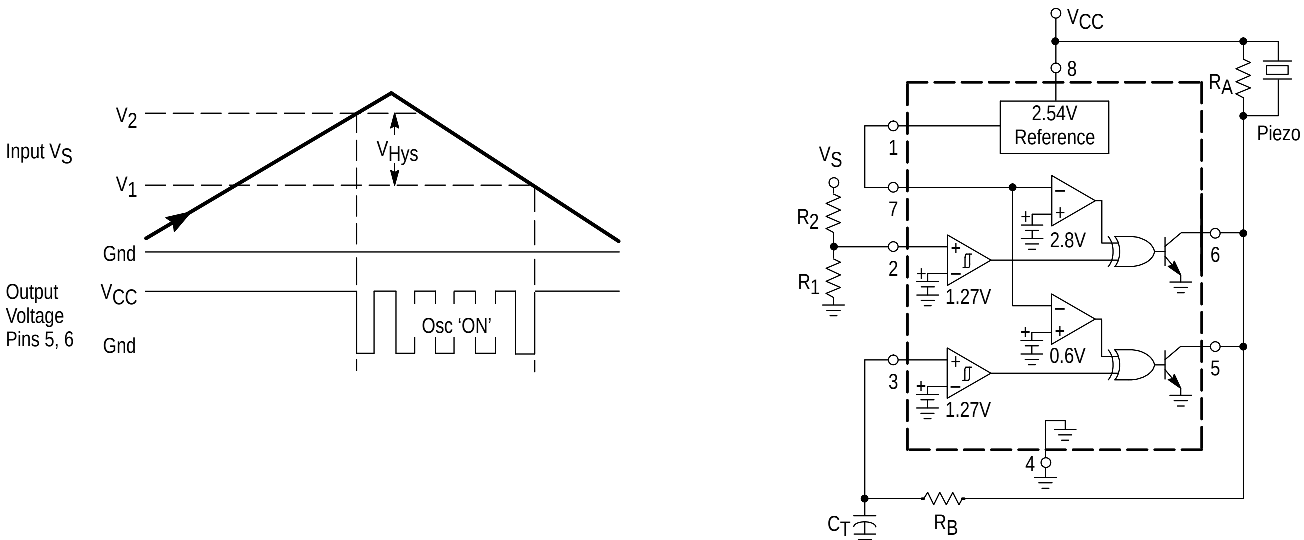
$$\frac{R_4}{R_3} = \frac{V_2}{V_{th1}} - 1$$

$$\frac{R_4}{R_3} = \frac{V_1}{V_{th1} - V_{H1}} - 1$$

$$\frac{R_1}{R_2} = \frac{V_4 + V_{H2} - V_{th2}}{V_{th2} - V_{H2} - V_{ref}}$$

$$\frac{R_1}{R_2} = \frac{V_3 - V_{th2}}{V_{th2} - V_{ref}}$$

Figure 23. Overvoltage Detector with Audio Alarm



The above figure shows the MC34161 configured as an overvoltage detector with an audio alarm. Channel 1 monitors input voltage V_S while channel 2 is connected as a simple RC oscillator. As the input voltage increases from ground, the output of channel 1 allows the oscillator to turn 'ON' when V_S exceeds V_2.

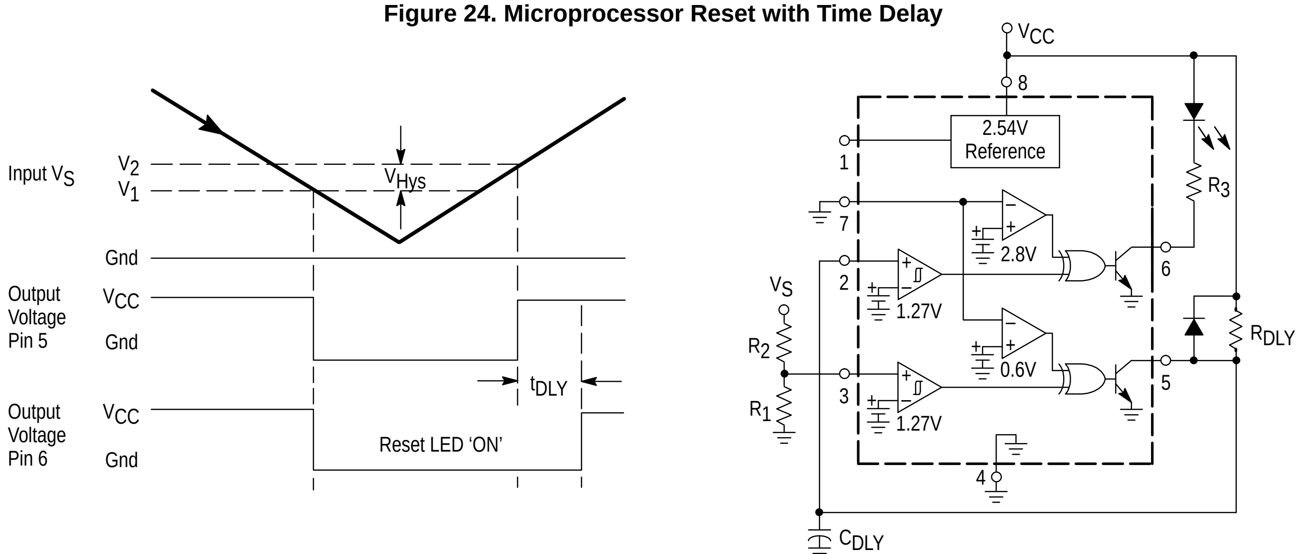
For known resistor values, the voltage trip points are:

$$V_1 = (V_{th} - V_H)\left(\frac{R_2}{R_1} + 1\right) \quad V_2 = V_{th}\left(\frac{R_2}{R_1} + 1\right)$$

For a specific trip voltage, the required resistor ratio is:

$$\frac{R_2}{R_1} = \frac{V_1}{V_{th} - V_H} - 1 \qquad \frac{R_2}{R_1} = \frac{V_2}{V_{th}} - 1$$

Figure 24. Microprocessor Reset with Time Delay



The above figure shows the MC34161 configured as a microprocessor reset with a time delay. Channel 2 monitors input voltage V_S while channel 1 performs the time delay function. As the input voltage decreases towards ground, the output of channel 2 quickly discharges C_{DLY} when V_S falls below V_1. As the input voltage increases from ground, the output of channel 2 allows R_{DLY} to charge C_{DLY} when V_S exceeds V_2.

For known resistor values, the voltage trip points are:

$$V_1 = (V_{th} - V_H)\left(\frac{R_2}{R_1} + 1\right) \quad V_2 = V_{th}\left(\frac{R_2}{R_1} + 1\right)$$

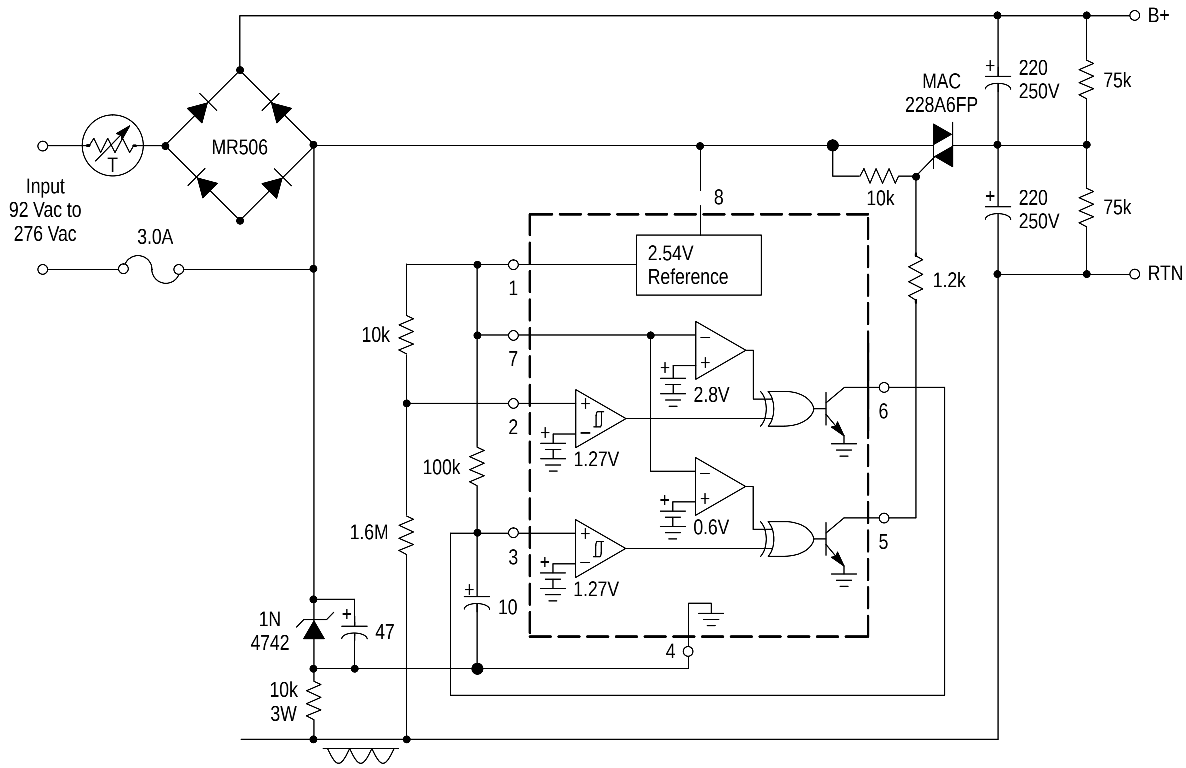
For a specific trip voltage, the required resistor ratio is:

$$\frac{R_2}{R_1} = \frac{V_1}{V_{th} - V_H} - 1 \qquad \frac{R_2}{R_1} = \frac{V_2}{V_{th}} - 1$$

For known R_{DLY} C_{DLY} values, the reset time delay is:

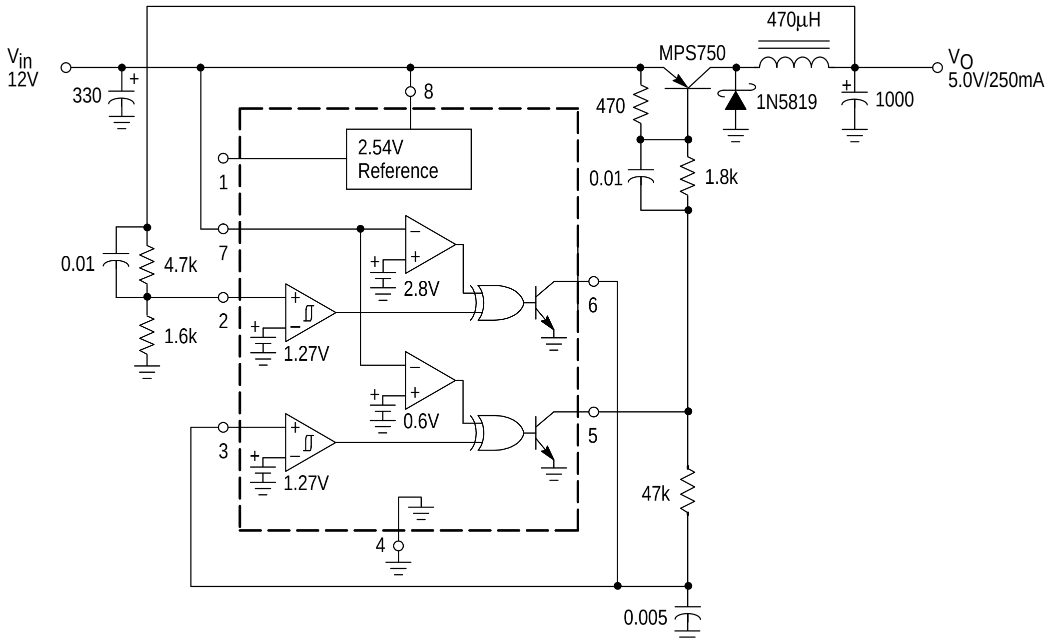
$$t_{DLY} = R_{DLY}C_{DLY} \ln\left(\frac{1}{1 - \frac{V_{th}}{V_{CC}}}\right)$$

Figure 25. Automatic AC Line Voltage Selector



The above circuit shows the MC34161 configured as an automatic line voltage selector. The IC controls the triac, enabling the circuit to function as a fullwave voltage doubler or a fullwave bridge. Channel 1 senses the negative half cycles of the AC line voltage. If the line voltage is less than150 V, the circuit will switch from bridge mode to voltage doubling mode after a preset time delay. The delay is controlled by the 100 kΩ resistor and the 10 μF capacitor. If the line voltage is greater than 150 V, the circuit will immediately return to fullwave bridge mode.

Figure 26. Step–Down Converter

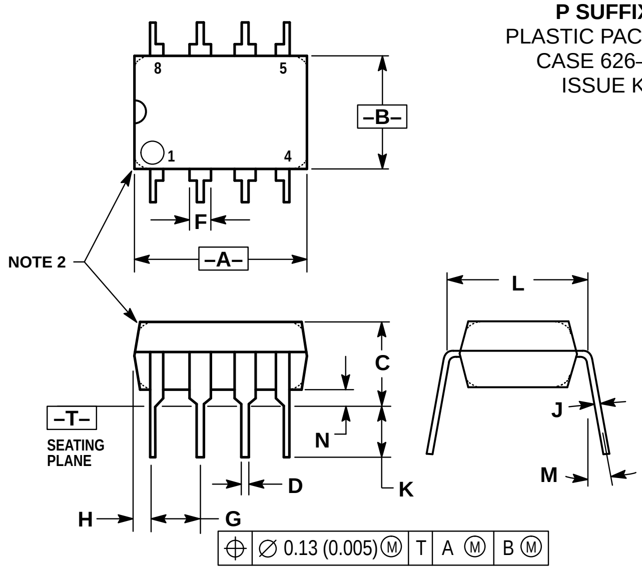


Test	Conditions	Results
Line Regulation	V_{in} = 9.5 V to 24 V, I_O = 250 mA	40 mV = ±0.1%
Load Regulation	V_{in} = 12 V, I_O = 0.25 mA to 250 mA	2.0 mV = ±0.2%
Output Ripple	V_{in} = 12 V, I_O = 250 mA	50 mVpp
Efficiency	V_{in} = 12 V, I_O = 250 mA	87.8%

The above figure shows the MC34161 configured as a step–down converter. Channel 1 monitors the output voltage while Channel 2 performs the oscillator function. Upon initial power–up, the converters output voltage will be below nominal, and the output of Channel 1 will allow the oscillator to run. The external switch transistor will eventually pump–up the output capacitor until its voltage exceeds the input threshold of Channel 1. The output of Channel 1 will then switch low and disable the oscillator. The oscillator will commence operation when the output voltage falls below the lower threshold of Channel 1.

OUTLINE DIMENSIONS

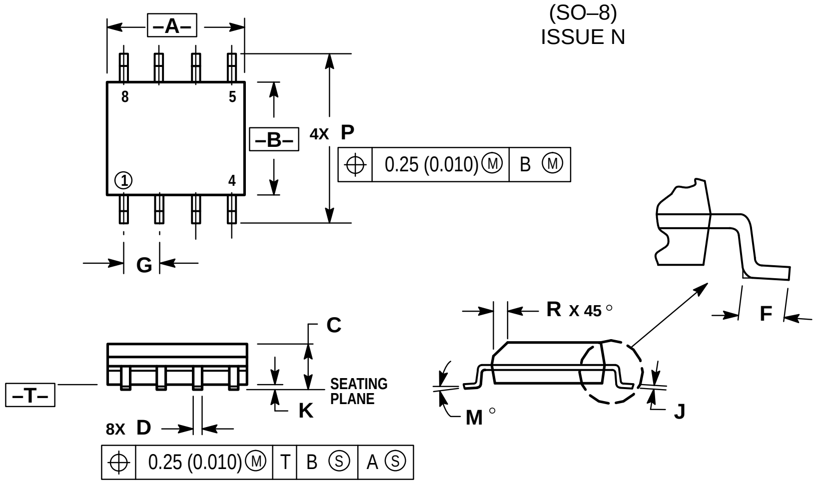
P SUFFIX
PLASTIC PACKAGE
CASE 626–05
ISSUE K



NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	—	10°	—	10°
N	0.76	1.01	0.030	0.040

D SUFFIX
PLASTIC PACKAGE
CASE 751–05
(SO–8)
ISSUE N



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.18	0.25	0.007	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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