

**Introduction**

Window comparators, or limit comparators as they are sometimes called, determine when the input voltage is within a pre-selected range. The output voltage usually goes to a TTL high when the input voltage is within the pre-selected range. A typical window comparator circuit normally consists of two comparators with two reference adjustments: one for the low trip level, and one for the high trip level. If the reference voltages are derived from the same resistor divider string, hysteresis can not be added without having the trip levels interact. If the reference voltages are independently derived they can drift in different directions causing the window to widen or possibly disappear.

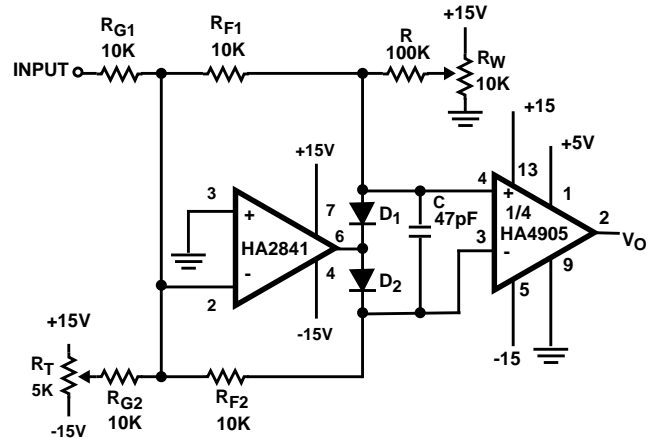
The window comparator shown in Figure 1 circumvents these problems with independent trip and window adjustments. The HA2841 op amp (selected because it has high speed and low input currents) adds the input signal to the trip voltage developed by  $R_T$ . The window width voltage  $R_W$  is summed into the output of the op amp as an offset voltage. The op amp has two feedback loops each of which contains a steering diode,  $D_1$  or  $D_2$ . The high open loop gain of the op amp insures that one diode will always be forward biased unless  $R_W$  supplies the feedback current, thus when the sum of the input voltages (closed loop gain is one) and  $I_{R_W}$  passes through zero the current flow switches from one diode to the other. The output comparator senses the polarity switch across the diodes, and the comparator output voltage changes.

The HA4905 comparator has inputs that can work from the 15V supplies, thus the input voltage swing is matched to the op amp's output voltage swing. Even though the input section of the HA4905 is connected to 15V, the output section can be connected from +5V to ground, thus offering a TTL compatible output voltage.

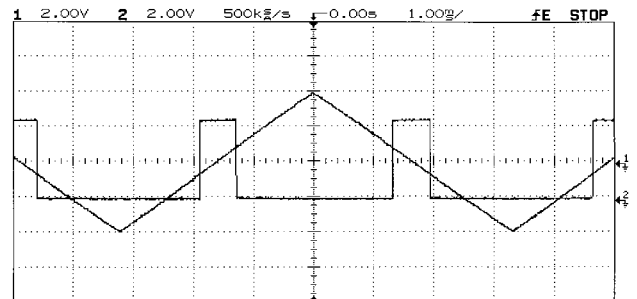
$R_T$  sets the trip point anywhere between the power supplies, and  $R_W$  sets the window width from zero, when the center tap voltage is zero, to about 90 percent of the input waveform. The trip point should be set first, then the window can be set to the desired width. Since the adjustments do not interact, the trip point stays constant as the window width is changed.

There might be a temptation to change the comparator to an op amp. This is poor practice for any circuit which requires high speed performance because the op amp output would saturate causing uncontrolled time delays. The comparator is subject to multiple switching caused by high frequency noise riding on slow rising input signals. The multiple switching is eliminated by the capacitor, C, which is placed across its input leads. Effectively, C couples the high frequency noise onto both comparator leads enabling it to be rejected by the comparator's common-mode rejection capability. Notice in the waveform that there is no multiple switching taking place.

This circuit yields a window comparator with independent adjustments, temperature stability, wide voltage range compatibility, and TTL compatibility.



**FIGURE 1. WINDOW COMPARATOR WITH INDEPENDENT ADJUSTMENTS**



**FIGURE 2.**

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