Analog Engineer's Circuit
Window Comparator Circuit

Design Goals

| Input		Output		Supply		
V_{iMin}	V_{iMax}	V_{oMin}	V_{oMax}	V_{cc}	V_{ee}	V_{ref}
0 V	5 V	0 V	36 V	5 V	0 V	2.5 V

V_L (Lower Threshold)	V_H (Upper Threshold)	Upper to Lower Threshold Ratio
1.66 V	3.33 V	2

Design Description

This circuit utilizes two comparators in parallel to determine if a signal is between two reference voltages. If the signal is within the window, the output is high. If the signal level is outside of the window, the output is low. For this design, the reference voltages are generated from a single supply with voltage dividers.
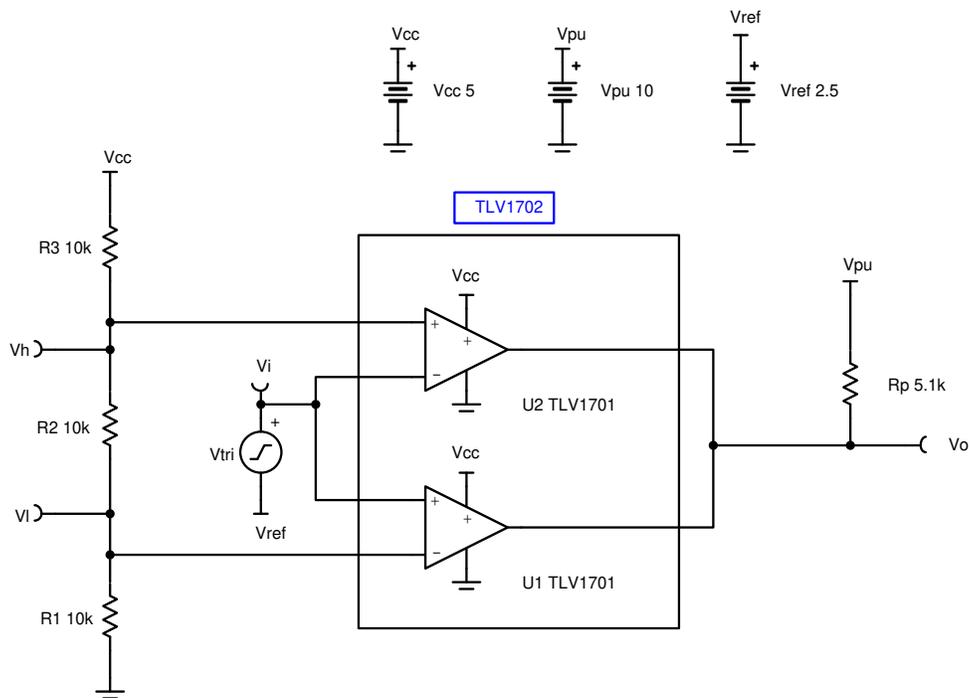
Design Notes

1. The input should not exceed the common mode limitations of the comparators.
2. If higher pullup voltages are used, R_p should be sized accordingly to prevent large current draw. The TLV1701 supports pullup voltages up to 36 V.
3. Comparator must be open-drain or open-collector to allow for the ORed output.

Design Steps

1. Define the upper (V_H) and lower (V_L) window voltages.

$$V_H = V_{cc} \times \frac{R_1 + R_2}{R_1 + R_2 + R_3} = 3.33 \text{ V}$$

$$V_L = V_{cc} \times \frac{R_1}{R_1 + R_2 + R_3} = 1.66 \text{ V}$$

$$\frac{V_H}{V_L} = 1 + \frac{R_2}{R_1} = \frac{3.33V}{1.66V} = 2$$

2. Choose resistor values to achieve the desired window voltages.

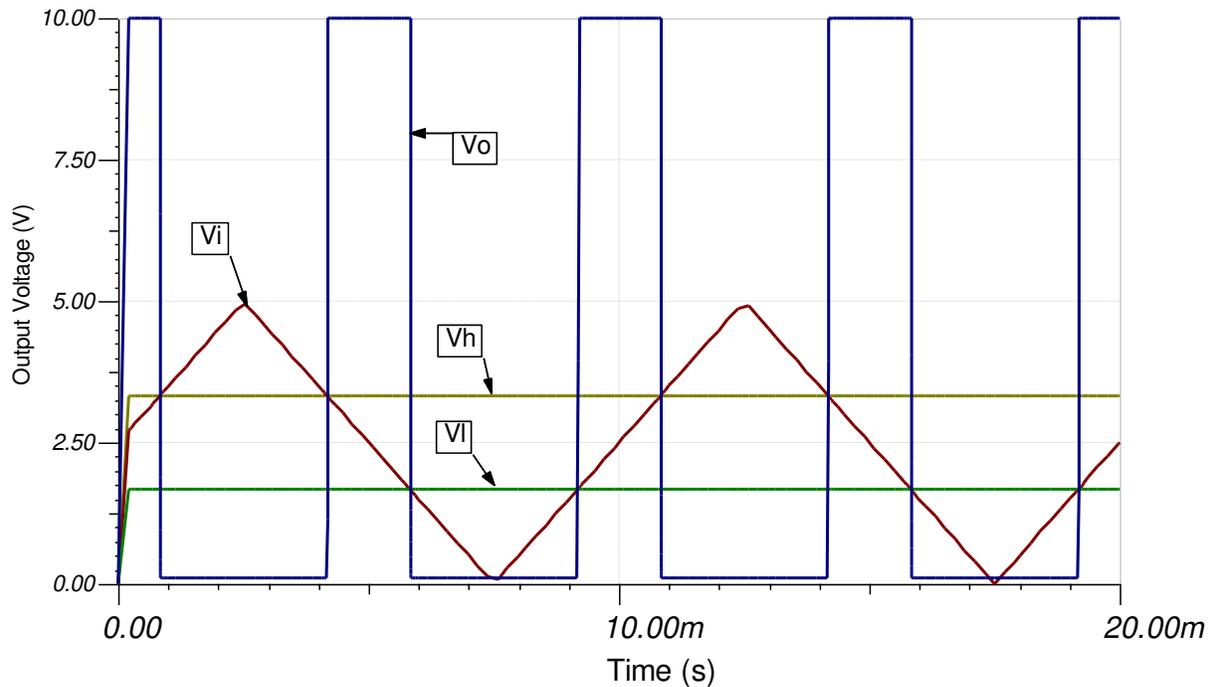$$\frac{V_H}{V_L} = 1 + \frac{R_2}{R_1} = 2, \text{ so } R_2 = R_1$$

$$R_1 = R_2 = 10k\Omega \text{ (Selected standard values)}$$

$$R_3 = \frac{R_1 \times V_{cc}}{V_L} - \left(R_1 + R_2\right)$$

$$R_3 = \frac{10k\Omega \times 5V}{1.66V} - 20k\Omega = 10.12 \text{ k}\Omega \approx 10k\Omega \text{ (Standard Value)}$$

Design Simulations

Transient Simulation Results

Design References

See *Analog Engineer's Circuit Cookbooks* for TI's comprehensive circuit library.

See the circuit SPICE simulation file SBOC516.

See TIPD178.

Design Featured Op Amp

TLV1702	
V_{cc}	2.2 V to 36 V
V_{inCM}	Rail-to-rail
V_{out}	Open Collector (36 V Maximum)
V_{os}	2.5 mV
I_q	75 µA/Ch
I_b	15 nA
Rise Time	365 ns
Fall Time	240 ns
#Channels	1, 2, and 4
TLV1702	

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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