Simple circuit measures optocoupler's response time

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You can use the circuit in this Design Idea to measure the attack and release times of photoresistor-type optocouplers (**Figure 1**). Such devices often find use in audio compressors or volume-control circuits. The design uses an oscillating Schmitt trigger with the optocoupler DUT (device under test) in the feedback loop. The photoresistor and resistor R_1 form a voltage divider that controls the input of the Schmitt trigger. The optocoupler's LED connects to the trigger output. You can measure the duration of the output pulses with an oscilloscope or a digital meter. The duration of the negative output pulses is equal to the switching on-time, or attack time. The duration of the positive pulses is equal to the switching off-time, or release time. The attack and release times depend on the value of R_1; you can

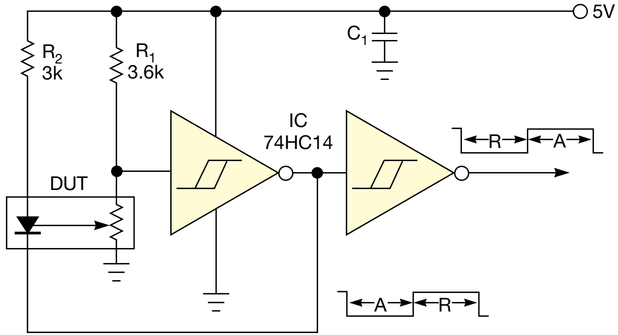

Figure 1 You can determine an optocoupler's rise and fall times by incorporating a photoresistor in the feedback loop of an oscillator circuit.

observe both by varying the value of R_1. With the component values in **Figure 1**, the durations of the output pulses are a 0.15-msec attack time and a 2.7-msec release time.

During oscillation, the resistance of the photoresistor sweeps in from R_{P1} to R_{P2}. The circuit sweeps these photoresistor values according to R_1, the power-supply voltage, and the Schmitt-trigger thresholds, as the following **equations** show: $R_{P1}=R_1\times V_{T2}/(V_{CC}-V_{T2})$, and $R_{P2}=R_1\times V_{T1}/(V_{CC}-V_{T1})$, where V_{T1} is the positive-going threshold voltage and V_{T2} is the negative-going threshold voltage of the Schmitt trigger.

In the case of the 74HC14 logic family, you can determine the thresholds from the data sheet and your power-supply voltage, according to the following **equations**, which yield typical values: $V_{T1}=0.53\times V_{CC}$, and $V_{T2}=0.31\times V_{CC}$. Using 5V as a power-supply voltage and solving the following **equations**, you can determine the photoresistor range: $R_{P1}=0.45\times V_{R1}$, and $R_{P2}=1.13\times V_{R1}$.

This approach lets you pick a value for R_1 so that the photoresistor range is suitable for your device. You can also vary the value of resistor R_2 to observe the LED-current-to-attack-time characteristic of the DUT but not affect the release time. Note that R_2 limits the current through the LED; if its value is too large, oscillation will not occur.

Using this circuit allows you to match custom optocouplers comprising green, superbright LEDs and an MPY7P photoresistor. A recent Design Idea, although thorough, lacked data on response time (**Reference 1**).EDN

REFERENCE

1 Foit, Julius, and Jan Novák, "Photoresistor provides negative feedback to an op amp, producing a linear response," *EDN*, May 27, 2010, pg 49, http://bit.ly/oPQMfo.