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NE555 timer sparks low-cost voltage-to-frequency converter

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In 1971, Signetics—later Philips (www.philips.com)—introduced the NE555 timer, and manufacturers are still producing more than 1 billion of them a year. By adding a few components to the NE555, you can build a simple voltage-to-frequency converter for less than 50 cents. The circuit contains a Miller integrator based on a TL071 along with an NE555 timer (**Figure 1**). The input voltage in this application ranges from 0 to -10V, yielding an output-frequency range of 0 to 1000 Hz. The current of C_1 is the function of input voltage: $I_C = -V_{IN}/(P_1+R_1)$.

As the voltage on C_1 reaches two-

thirds of V_{CC}, the 555's internal discharge transistor opens, and the voltage on C_1 returns to one-third the voltage of V_{CC}, the lower comparator threshold. At one-third this voltage, the discharge transistor switches off, and C_1 again starts charging. The NE555's output is high while C_1 is charging and low while C_1 is discharging. The product of the input voltage and the charging time of C_1 is constant. Because the discharge time is shorter than the charging time, the following **equation** results for the output frequency: $f_{OUT} \sim V_{IN}/(P_1+R_1) \times C_1 \times 1/3V_{CC}$.

P_1 calibrates the relationship between the output frequency and the

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input voltage. Because the discharge interval is approximately 30 μsec, the accuracy of the voltage-to-frequency conversion decreases as the frequency increases. If you assign 100 Hz to -1V and 1000 Hz to -10V, the error of conversion ranges from 0.3 to 3%. If you use P_1 to calibrate the output frequency in the middle of the input-voltage range at -5V, then the conversion error will be less than 1.3% over the entire range. To improve performance, C_1 should have a low dissipation factor. You can diminish temperature dependence if R_1 has a low temperature coefficient and P_1 is a multiturn, ceramic-metal potentiometer.**EDN**
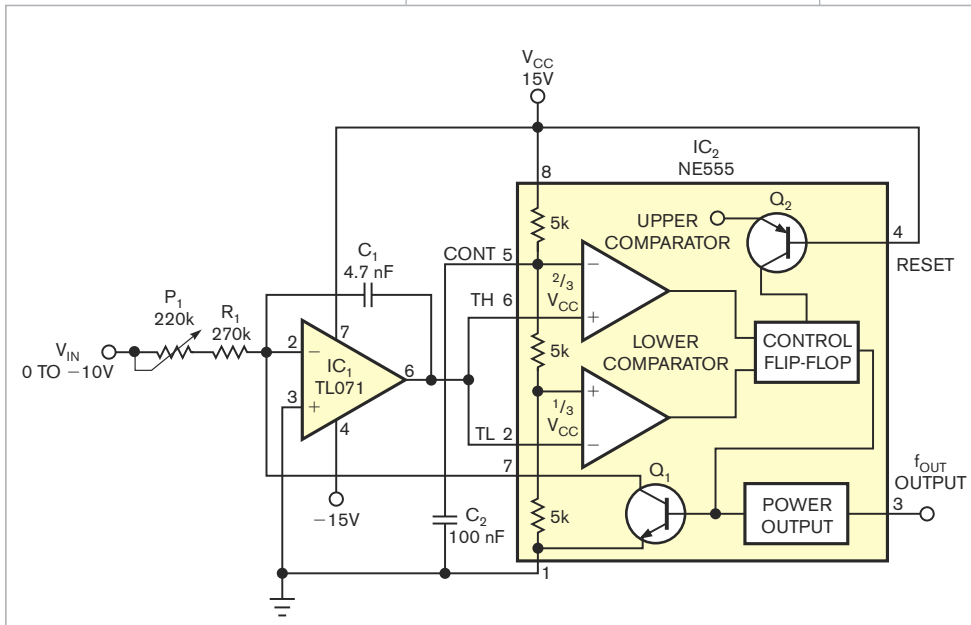

Figure 1 Preceding an NE555 timer with a Miller integrator yields a voltage-to-frequency converter that costs less than 50 cents.