Overrange indicator can enhance frequency meter

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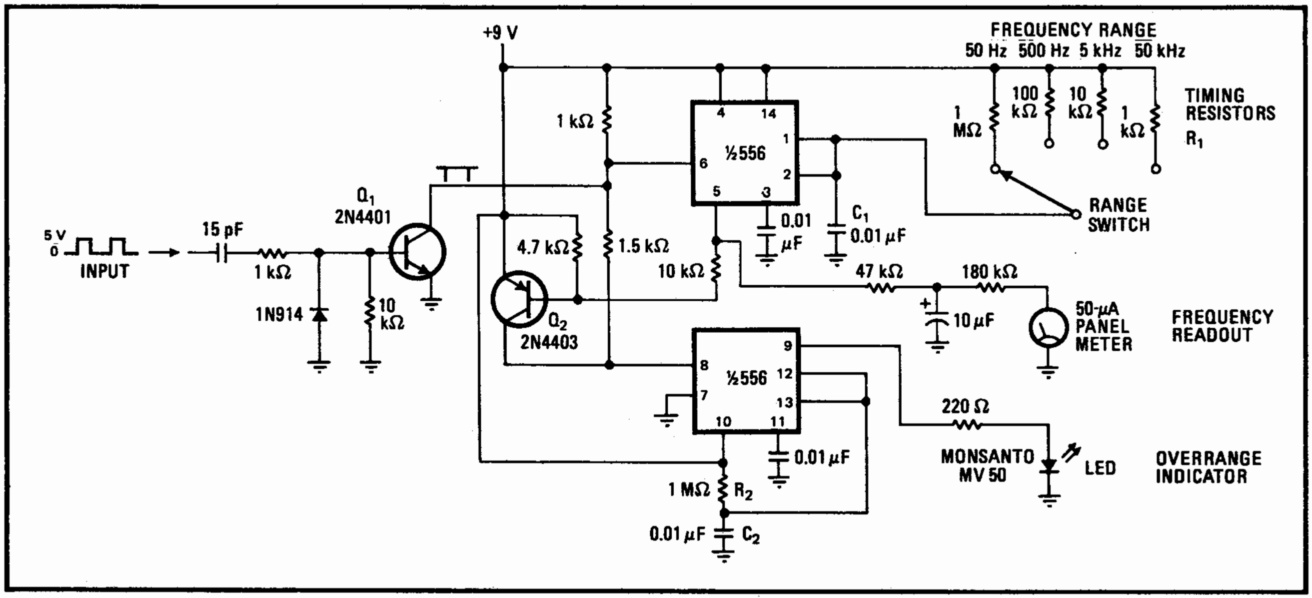
By making use of a 556 integrated circuit, which is composed of two 555 timers in a single package, an overrange indicator can be economically added to an analog frequency meter. A 555 can be used alone as a monostable multivibrator that is triggered by the frequency to be measured. To provide unambiguous measurements, however, the meter described here uses a second timer to flash a warning light whenever the input exceeds the maximum frequency setting. Although the technique of using monostables in analog frequency meters is not new, the use of new circuit developments makes the design economical and easy to implement.

When the range switch on this meter is set to the 50-hertz range, any input frequency from near dc to 50 Hz causes a panel meter to read correctly; e.g., a frequency of 42 Hz produces a meter reading of 42 microamperes. However, the meter reading is incorrect when the input



Unambiguous. Addition of overrange indicator to analog frequency meter warns when switch is set to wrong frequency range. Transistor Q_2 allows input signal to trigger LED monostable whenever input frequency is greater than meter range. Inexpensive and reliable circuit shown is useful from near dc to well over 20 kHz.

frequency exceeds 50 Hz, and therefore a light-emitting-diode overrange indicator flashes. If the range switch is then moved to a setting higher than the frequency, the LED stops flashing and the meter again indicates correctly. For example, a 300-Hz signal would be measured on the 500-Hz range, and the meter would show 30 microamperes.

In the meter diagramed here, the upper portion of the circuit measures the frequency and has the 50-μA panel meter as its readout. The lower portion provides the overrange indication and has the LED as its warning light. These two portions of the circuit are driven by a common input.

The input signal is a rectangular pulse train; the pulses are differentiated to produce the negative spikes that are needed to trigger the timer. For a sine-wave or sawtooth input signal, a Schmitt trigger might be used to generate the negative impulses.

When pin 6 of the frequency-measurement monostable is triggered, pin 5 goes high. It stays high and delivers current for a time equal to $1.1R_1C_1$. This positive output pulse appears once for every cycle of the input frequency (unless the trigger impulse arrives while the output at pin 5 is already high). The current pulses, smoothed by the 10-microfarad capacitor, provide an average value that is shown on the microammeter.

At low frequencies, the output pulses are well separated, so the average current is low. At higher frequencies, however, they are closely spaced and approach a duty factor of about 95% at the upper frequency limit set by the range switch. Average current thus increases as the frequency increases. Resistors in the output circuit are chosen so that the average current is 50 μA at the maximum frequency in each range.

If the input frequency exceeds the meter range, a trigger spike arrives while the output is already high. As a result, that input cycle is not counted, so the frequency meter indication is erroneous.

To warn that trigger impulses are arriving while pin 5 is high, pin 5 is also connected to the base of pnp transistor Q_2. When pin 5 is low, Q_2 conducts and holds pin 8 high, thus preventing the warning-indicator monostable from being triggered. But when pin 5 is high, Q_2 is turned off; a negative input spike that reaches pin 8 therefore can trigger an output from pin 9 that flashes the LED. The duration of the flash is $1.1R_2C_2$. □