Frequency-counter design minimizes number of parts

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A handful of commonly available complementary-MOS integrated circuits can be made into a simple digital frequency counter capable of 100-hertz accuracy at 5 megahertz. The circuit uses only (N + 1) IC packages for an N-digit display. It dispenses with display latches, extra logic for generating a count-reset pulse, and current-limiting resistors for the seven-segment light-emitting-diode display.

As the diagram shows, the frequency to be measured is applied to a series of cascaded CD4026 decade counter/decoders. The counters count incoming cycles for 10 milliseconds and then drive LEDs to display the count for another 10 ms. Thus the display is updated every 20 ms and appears to be continuously on.

The element that controls the alternate counting and displaying is a CD4047 astable multivibrator, which generates a square wave with 20-ms periodicity. When the multivibrator's output, Q, is low, the clock inputs of the counter/decoders are enabled, their displays are disabled, but the counters count. When Q goes high, the clock inputs are disabled, and the count is displayed.

The counters are reset at the end of each 10-ms display interval by the positive pulse obtained by differentiating the rising $\overline{Q}$ output from the CD4047. The negative pulses are clamped to ground by diode D.

With values of C_1 and R_1 chosen to give a counting interval of 10 ms, the least significant digit in the display indicates hundreds of hertz because 100 pulses per second × 10 ms gives one pulse. Thus, a display of 246 indicates a frequency of 24,600 Hz, or 24.6 kilohertz. The counter is calibrated by adjusting R_1 for proper reading with an input signal of known frequency.

Supply voltage V_{DD} may have any value from 3 to 15 volts. The higher the supply voltage, the greater is the range of input voltages and the faster the counting—and the brighter but more current-consuming the display. The values of C_2 and R_2 should be chosen to give a reset-pulse duration of at least 250 nanoseconds. Diode D can be any general-purpose diode with a peak reverse voltage of at least $2V_{DD}$.

The same circuit can be used with a counting time of 100 ms to obtain frequency resolution to 10 Hz, but at such a long multivibrator periodicity, the display's 50% on/off duty cycle causes objectionable blinking. □

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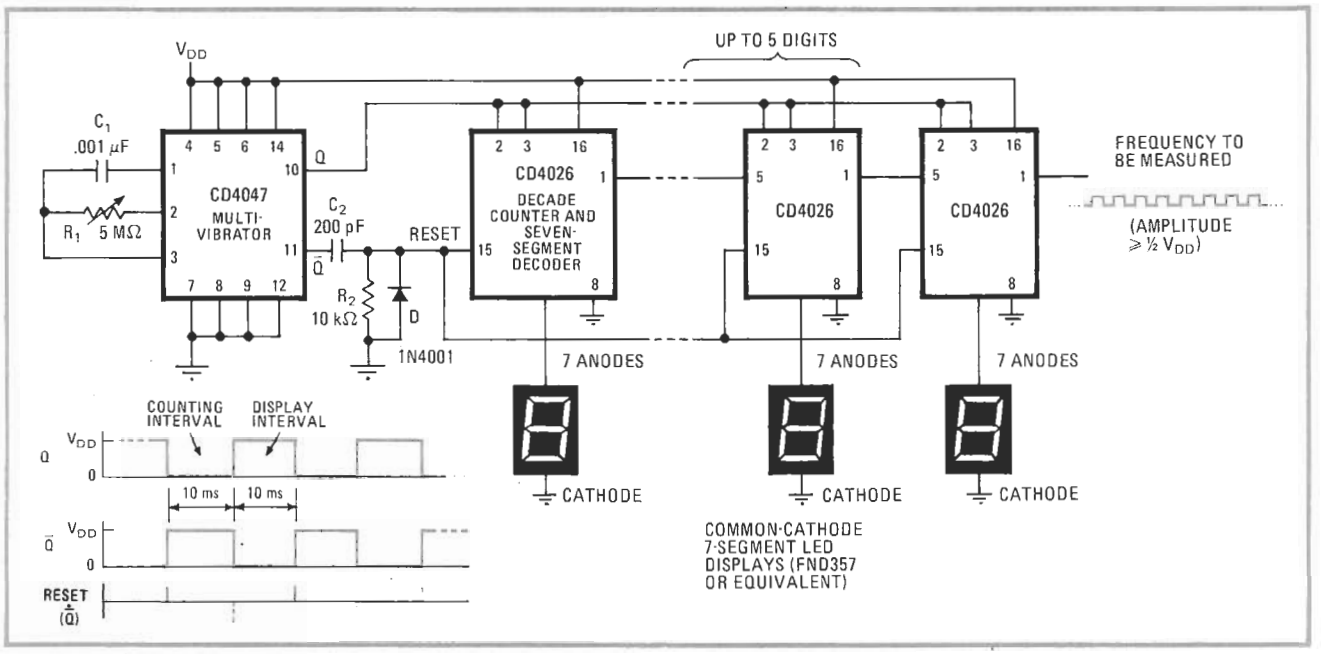

Reads out frequency. Frequency is measured in this circuit by counting the total number of incoming pulses in a 10-ms interval. That total is then displayed for the next 10 ms. This cycle, repeated every 20 ms, produces a flicker-free display. The multivibrator output determines the timing intervals and supplies reset signals to erase the counters every period. The C-MOS devices shown are RCA types or equivalents.