Low-speed counter uses low-priced calculator chip

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A totalizing counter that runs at less than 40 hertz makes novel use of an inexpensive calculator IC, one of several now available. The IC in the illustrated counter is the MM 5736, a six-digit calculator chip that can directly drive the segments of small common-cathode light-emitting-diode displays. Because of this capability, the single IC replaces many discrete counter and decoder ICs; only a few extra logic chips are required.

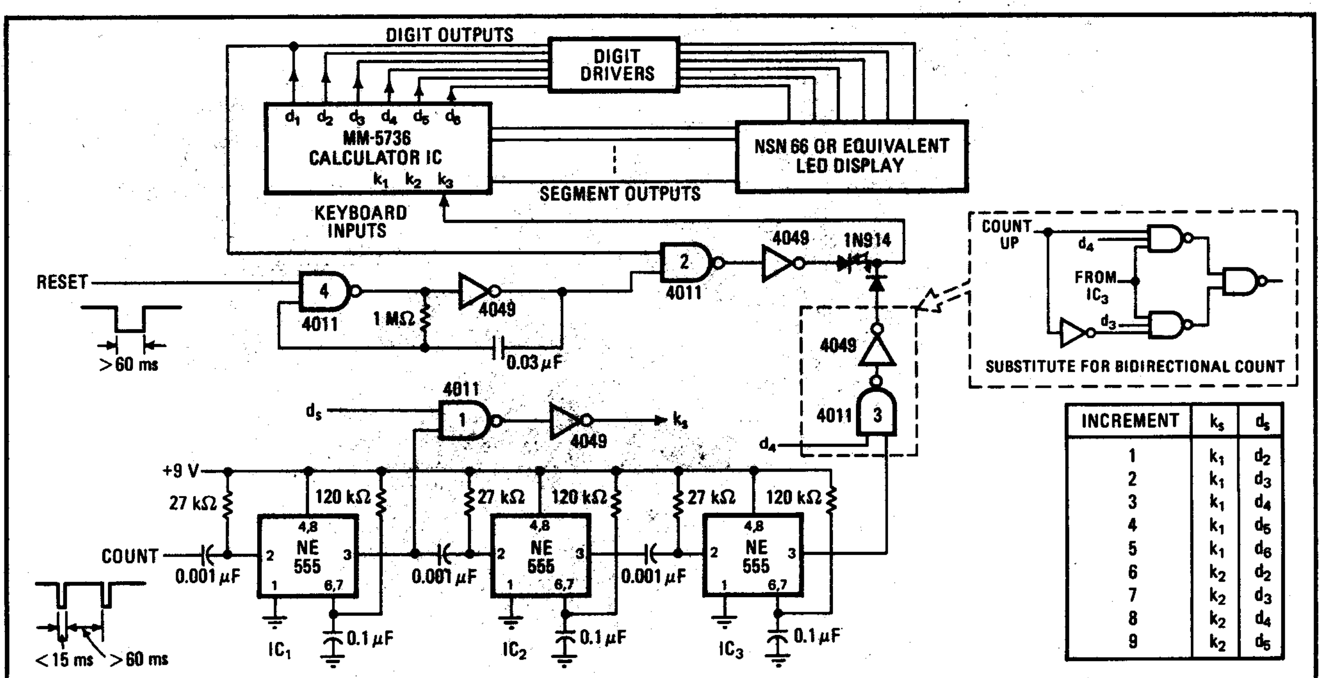
The MM 5736 has seven segment outputs, six digit outputs, and three keyboard inputs. In normal usage, the segment outputs drive the individual segments of all digits in a conventional display. The digit outputs drive the digits of the display, scanning rapidly from one to the next in synchronism with the segment outputs so that individual numerals are illuminated. These digit outputs also scan the keyboard. If any key is depressed, a connection is made from one digit output to one of the three keyboard inputs, uniquely identifying that key. The logic circuits in the chip respond to that input to display a digit or to begin an arithmetic operation.

The logic that is added in lieu of a keyboard includes three 555 timers, four two-input NAND gates, four inverters, and a few discrete components. The calculator chip and this logic together count events as signaled by an external count pulse, incrementing the display by 1, 2, or any integer up to 9.

The negative-going leading edge of each count pulse triggers a 555 timer connected as a monostable multivibrator, generating a pulse about 15 milliseconds long. This is long enough for the six digit outputs of the chip to complete many full scans, connecting what looks to the calculator like a key depression to one of the keyboard inputs. (In normal operation, a key depression is usually much longer than 15 ms because of human reaction time, and the corresponding digit entry is made in the calculator chip many times.) The "key" in this case is a hard-wired connection from one of the digit outputs to a NAND gate-inverter combination, and another is a hard-wired connection from the inverter to one of the keyboard inputs, in accordance with the table. By this means, the counting increment is entered into the calculator.

The end of the 15-ms pulse triggers a second timer that forces a delay during which the calculator can become stable after receiving the "key depression." (In normal operation, this delay is created as the user moves a finger from one key to another.) At the end of this delay, the third timer is triggered to produce a pulse that gates the digit output d_4 into the keyboard input k_3 to enter what the calculator sees as an instruction to add. Thus, for every incoming count pulse, the calculator chip adds the wired-in increment to the previous total and displays the result.

Normally, to clear this calculator, the clear button on the keyboard is pressed twice. To provide time to clear



INCREMENT	k_s	d_s
1	k_1	d_2
2	k_1	d_3
3	k_1	d_4
4	k_1	d_5
5	k_1	d_6
6	k_2	d_2
7	k_2	d_3
8	k_2	d_4
9	k_2	d_5

Calculator counter. Logic blocks take the place of a keyboard to provide appropriate signals for the single-chip calculator, MM 5736, to serve as a simple counter. It costs less than the collection of discrete devices that otherwise would be required.

power is restored, the capacitor C_2 begins to recharge. This takes time—the recharge path is through the 10-kilohm resistor, and the time constant is 100 milliseconds. The output of A_2 stays low until the capacitor voltage reaches 4.0 V, as shown in Figs. 2 and 3. This condition can be used as a reset pulse, and the transition to the high level when the capacitor voltage passes 4 V can generate a start pulse.

For a longer or shorter reset time, the 10-kilohm and 10-microfarad values can be changed. □