TECHNICAL NOTE

AN INEXPENSIVE 10-DIGIT PRINTOUT COUNTER

When solid-state or electromechanical modules are used to control and record experimental events, it is sometimes desirable to permanently print data in order to optimize the use of digital counters. This is especially true when latencies, interresponse times, responses per trial, and other noncumulative data are collected. This paper describes a simple method for using an inexpensive desk calculator (Texas instruments Model 5130, about \$60.00) as a printout counter.

Briefly, the method consists of controlling the 1, +, PRINT, and CLEAR functions of the calculator with four general-purpose relays. Under the keyboard of most calculators, including the one described here, is a grid of lines, printed on a circuit board, that are differentially interconnected by keystrokes. Each legal connection activates a function of the calculator, which can be identified by systematically touching pairs of lines with a jumper wire. As shown in Figure 1, removing the top cover of the calculator gives access to a ribbon cable connecting the keyboard with the main printed circuit. By interconnecting some of the lines in the cable, the functions of the keyboard can be obtained. Thus, keystrokes can be simulated by relay operations. Figure 1 also shows how the lines of the ribbon cable can be accessed by soldering thin wire to the soldered joints of the keyboard's printed circuit. Detailed connections for the model specified above are as follows: Holding the calculator with the keyboard nearest to you, identify lines 2, 3, 8, 10, 12, and 15 from left to right. Now, in order to obtain each function, a specific pair of lines must make contact as indicated in Table 1. When one line is connected to the common contact of a relay and the other is connected to the normally open con-

Fig. 1. Calculator with the top cover removed, showing the soldered joints where the lines of the keyboard can be accessed.

tact, operations of the relay will produce the function in the calculator.

To be operated, the calculator must be turned on and the PRINT switch in the keyboard must be set to off. In order to count events, the 1 function must be activated once, and then the + function must be activated for every event. If a cumulative count is desired after a PRINT operation or if the count is cleared, the 1 function must be activated once again before adding new events to the count.

The 1, +, and CLEAR operations can be reliably executed with rates up to 15 pulses per second. The PRINT function takes 0.4 s, but because the calculator has a 10-keystroke buffer, it can accept up to 10 PRINT operations in 1 s or

Table 1

Line connections and the corresponding functions activated.

<i>Lines</i>	<i>Function</i>
8 and 15	1
10 and 15	+
2 and 12	PRINT
3 and 12	CLEAR

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several add operations while printing. Therefore, the calculator is also speed compatible with electromechanical equipment. Because there are no electrical connections between the calculator and the rest of the equipment, the system is noise immune and the calculator may be used inde-

pendently. We have been using this device for more than a year with excellent results.

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