A delay timer for presenting auditory and visual probes

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A circuit designed to present auditory or visual probes is described. The circuit allows the probes to be delayed by a specified amount of time, and the volume (for auditory probes) or intensity (for visual probes) may also be adjusted. The circuit may be triggered by any device capable of emitting an electronic pulse—such as a computer or a tachistoscope.

Many researchers use a subject's response to a secondary probe stimulus as a measure of performance or cognitive activity (see Kerr, 1973, for a review). In this paradigm, a probe, which is usually a short-duration (typically 100 msec or less) auditory or visual stimulus, is embedded in a primary task. The subject's response to the probe is used as a measure of the cognitive demands of the primary task. For example, Inhoff and Flemming (1989) found that when a visual or auditory probe was presented while people read, probe-detection times (i.e., reaction times) were longer for those who were reading difficult text than for those reading easier text. Wickens, Kramer, Vanasse, and Donchin (1983) found that event-related brain potential responses to auditory and visual probes decreased as the difficulty of the primary task increased. Both of these studies demonstrate the usefulness of secondary probe methodologies.

Prior to the widespread use of microcomputers as primary data-collection devices, the hardware implementation of such probes was often system- or project-specific. Computers can be programmed to present such probes, but it is not always easy to control the timing and presentation of a probe precisely. The programming required can be complex. (See Brysbaert, Bovens, D'Ydewalle, & Van Calster, 1989, for an example of the complexity of timing routines using Turbo Pascal.) In this paper, we describe a simple circuit for presenting auditory and visual probes; it can be used with a wide variety of experimental laboratory systems.

The circuit generates probes of a fixed duration, and it allows the probes' onsets to be delayed by specified amounts of time. The circuit has three primary benefits: First, it may be used with any device capable of emitting an electronic pulse to act as a trigger (e.g., a computer, a tachistoscope, or any other special-purpose digital system). Second, this system can present probes without the use of complex timing routines within a computer pro-

gram. Third, once the delay control is calibrated, the probe delay interval can be increased or decreased quickly and without any modification of software.

Circuit Description

The circuit contains an operational amplifier and three timer ICs (integrated circuits), and it requires a ± 12 V power supply (see Figure 1). A parts list for the circuit is provided in Table 1. The amplifier (Type 741), configured as a differential amplifier, allows the circuit to be triggered by a signal even if it is not referenced to ground (such as the signal across the internal speaker of an IBM AT computer). The amplifier has a gain factor of 10 and is used to increase the input signal to a level suitable for triggering the first timer IC.

The first timer IC (Type 555) is configured as a monostable or one-shot—that is, upon being triggered, it produces a single, fixed-duration pulse—and it produces the probe-onset delay period. The trailing edge of this pulse triggers the next IC in the circuit. Connection of the output of the first timer to an oscilloscope allows measurement of the delay interval. A precision digital readout potentiometer is used to control the duration of the delay. The maximum delay is a function of the maximum value of the potentiometer and the capacitor between pin 7 and ground on the timer. Increasing the value of the capacitor increases the maximum delay. As configured, the maximum delay is 2,000 msec, and the minimum delay is 0 msec.

The second timer IC (Type 555) is also configured as a one-shot. Output from this timer is a positive pulse, the duration of which determines the duration of the probe. Probe duration can be altered by changing the resistor between pin 7 and $+12$ V. The duration of the probe may be reduced or increased by using a smaller or a larger value resistor. As configured, probe duration is 100 msec. The output of this IC may also be used to drive a visual probe, such as a light-emitting diode (LED). A variable resistor is placed in the circuit to control the intensity of the LED output.

The third timer IC (Type 555) is configured as an oscillator. The frequency of the output is in part controlled

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quire a probe of constant duration and constant delay across a set of trials. The simplicity, low cost, and ease and speed of delay adjustment provide a useful alternative to complicated programs and expensive equipment.

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