TECHNICAL NOTE

*A MINIATURE, PORTABLE TIMER AND AUDIBLE
SIGNAL-GENERATING DEVICE*

Procedures for obtaining reliable measures of observer-defined behaviors are necessary prerequisites to the development of a viable technology for behavior modification. Recording procedures in which observers note the occurrence or non-occurrence of a behavior during each of a series of time intervals (*cf.*, Allen, Hart, Buell, Harris, and Wolf, 1964), are being used by a number of investigators.

The present device generates an audible signal as a time-base for observers using such a recording procedure. This device, which is small enough to fit into a shirt pocket, eliminates the need for the observer visually to monitor a stopwatch, *etc.*, which detracts from his observance and recording of behavior.

The timer (Fig. 1) consists of two astable multivibrators and a transistor switch. The first multivibrator consists of transistors Q1 and Q2. When S1 is closed, Q1 and Q2 begin conducting alternately. Q1 conducts for a period of time set by the values of capacitor C1, potentiometer R2, and resistor 9, which controls the time interval. When Q1 goes off, or "times out", Q2 conducts, or goes on, and activates the second astable multivibrator, consisting of transistors Q4 and Q5, which begin to oscillate at an audible frequency for as long as Q2 is on. Q2 goes off after an interval

set by C2 and R3. Q3 acts as a switch to prevent the tone from tapering off at the end. Q3 is on when Q1 is on and effectively short-circuits the audio multivibrator. The combination, then, of Q2 going off and Q3 going on, cuts the tone off discretely. With the indicated values of C1, R2, and R9 and C2 and R3, adjustments of the potentiometer R2 will provide time-bases from 0.5 sec to 20 sec with the tone on for 0.25 sec. The duration of the tone can be increased by increasing R3 and/or increasing C2. The indicated values of R6, R7, C3, and C4 produce a tone of approximately 1000 Hz. The frequency (pitch) of the tone can be lowered by increasing R6 and R7 and/or increasing C3 and C4.

A solid state signaling device, Sonalert Signal Device (Mallory #SC628) may be substituted directly for the second astable-multivibrator circuit simply by removing all components to the right of points A and B in Fig. 1, and connecting the negative lead of Sonalert to Point A and the positive lead to B. The Sonalert will generate a 2000-cycle tone when Q2 goes on and will eliminate the need for the relatively bulky transformer and speaker.

Parts layout is not critical and can be dictated by the packaging requirements. Units have been con-

Fig. 1. Schematic diagram and parts list for an audible timer.

structed on 2.5- by 3-in. sheets of circuit board and mounted in an aluminum box or in a discarded transistor radio chassis. The latter housing is particularly suitable since the speaker is already mounted, and the output transformer and printed circuit board are suitable for a timer circuit. The 500-mfd capacitor and potentiometer R2 were selected for size. A capacitor with a 15-v rating, and a trimpot potentiometer were used in the circuit to conserve space.

The parts can be obtained from most electronic supply catalogues. They cost approximately \$9.00, using the speaker output, and \$11.00 using the Sonalert option. The Sonalert unit (\$4.95) is the most expensive item. The transformer, a miniature audio-output unit measuring $\frac{3}{4}$ by $\frac{3}{4}$ -in. with a 500-ohm primary and 8-ohm secondary, was purchased from Olson Electronics, Inc. (part #T-231) for 79 cents. Satisfactory results have been obtained with transformer primaries as high as 4000 ohm, so the impedance match need not be perfect. The transistors specified for Q1 and Q2 are 2N414's, although 2N396's can be substituted directly. Q4 and Q5 are 2N35's, but 2N1308's, 2N1306's or 2N388's will work as well. Q3 is a 2N1308, but the same substitutions apply as for Q4 and Q5.

Three units were operating at the time of writing (with their original batteries), one of them with the Sonalert option. One of the speaker-type units has been operated for eight 12-min sessions, daily, for the past three months. The other speaker unit and the

Sonalert unit have about 30 and 48 hr, respectively, of operating time spread over about 45 days. Tone interval repeatability, as measured with a stop watch, remains essentially constant.

A fourth unit, assembled for testing purposes, was set for 10-sec intervals and operated continuously for 11 hr. At the end of that time, the battery was substantially discharged and output voltage was reduced to about half its original value, with a noticeable drop in the intensity of the tone, and a 10% deterioration in the timing interval. These preliminary findings indicate that the unit will generate highly reliable signals for many hours when used intermittently, but will show some deterioration in the reliability of the interval when exposed to sustained, continuous operation.

REFERENCE

- Allen, K. E., Hart, B. M., Buell, J. S., Harris, F. R., and Wolf, M. M. Effects of social reinforcement on isolate behavior of a nursery school child. *Child Development*, 1964, 35, 511-518.

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