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from the pattern generator. The pattern is composed of two frequencies given in either an ABA or a BAB sequence, selectable remotely. The ON times for the t_1 , t_3 , and t_5 tone bursts are individually adjustable from 0.1 to 1.0 sec. The OFF times, t_2 and t_4 , are also adjustable within the same range as described above. The intercycle interval, t_6 , was designed to be adjustable from 0.2 to 2.0 sec. The two pure tones are generated by two oscillators not included in the pattern generator.

Figure 2 shows a schematic of the circuit design for the device. The individual ON and OFF durations, t_1 through t_6 are produced by a closed loop composed of six one-shot multivibrators, labeled OS₁ through OS₆ in the schematic. Commercially available circuit modules (Type EM 5011, Electronic Modules Corp., Timonium, Md.), chosen for their ease of mounting and small size, were incorporated in the device, although any other one-shot multivibrator having identical characteristics (e.g., OS-204 BRS-Foringer, Beltsville, Md.) can be used successfully. The inset in Fig. 2 labeled A shows the connections around the one-shot and gives the values of the RC network required to provide the necessary dwell times.

The design of the generator employs diode-relay logic throughout its construction. All relays used are ordinary 24-V types with the exception of those used in conjunction with the switching of pure tones (RD₁ and RD₂). These relays are of the 6-V variety and have mercury-wetted contacts to insure against switching transients. Relays RY₁ and RY₂ are spike-suppressed by Diodes D₄ and D₅, respectively. Any diode with a minimum breakdown voltage of 200 V is satisfactory. The requirements for Diodes D₁, D₂, and D₃ can be less stringent than those for D₄ and D₅. The C₁, a 50-microF 50-V capacitor provides a time delay for RY₁, which helps insure a chatter-free switching of

An inexpensive pure-tone pattern generator

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A low-cost sound pattern generator that is remotely programmable has been developed to produce pure-tone auditory patterns. The device, which is compatible with relay programming equipment, can generate either of two auditory patterns in the sequence ABA or BAB. The generator features an independently settable range of ON and OFF durations (0.1 to 1.0 sec) for pure-tone bursts and a selectable range (0.2 to 2.0 sec) of intercycle intervals. The inexpensive construction cost coupled with the flexibility of the timing characteristics of the generator should make it of interest to a wide variety of auditory researchers.

This report describes a low-cost remotely programmable sound pattern

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generator developed to investigate auditory pattern discrimination in pigeons¹ (Krasnegor, 1971). Because the device is so inexpensive to construct and has a flexible range of ON and OFF times, it should be of wide interest to auditory researchers. Figure 1 depicts two full output cycles

Fig. 1. Typical pattern generator output. The tracing shows Pattern ABA above and Pattern BAB below. In this example, the ON and OFF durations are 1 sec in length; intercycle interval duration is 2 sec.

Fig. 2. Circuit diagram for the pattern generator. The values of the capacitors used to obtain the range of values for the ON and OFF durations (0.1-1.0 sec) and the intercycle interval durations (0.2-2.0 sec) are 25 and 50 microF, respectively.

that relay, especially when the triggering of the generator is done with a pushbutton.

Relay Drivers RD₁ and RD₂ incorporate the final tone-switching relays. For the sake of economy and compactness of construction, we designed our own relay drivers; however, commercially available modules or cards (e.g., RY-205 BRS-Foringer, Beltsville, Md.) can just as readily be used with success. The

insert in Fig. 2 labeled B shows the schematic design of the relay driver circuit. The transistors used are not at all critical and almost any PNP, NPN type will work satisfactorily. All that is required is a minimum beta of 20 and a V_{BE} with a minimum of 15 V.

Patterns are generated when -28 V are applied to either of the two input studs provided. When -28 V are applied to the ABA input, only relay RY₁ is energized, but when the

opposite pattern is initiated by applying -28 V to the BAB stud, both Relays RY₁ and RY₂ are energized, RY₁ through Diode D₃ and RY₂ directly. No matter which pattern is generated, the proper sequencing of tone bursts is provided by the relay drivers which receive inputs from the one-shot multivibrators, OS₁, OS₃, and OS₅ through Diodes D₁ and D₂ and the contacts of Relay RY₂.

To provide for the necessary -12 and +6 V used in the one-shot multivibrators and the relay drivers, the 28-V relay rack supply is split by means of a 50-ohm 5-W resistor and a 6- and a 12-V 10-W Zener diode. These three components are mounted, electrically, but not thermally, insulated, on a heat sink.

Total components cost is approximately \$90.

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NOTE

1. In conducting the research described in this report, the investigators adhered to the "Guide for Laboratory Animal Facilities and Care" as promulgated by the Committee on the Guide for Laboratory Animal Facilities and Care of the Institute of Laboratory Animal Resources, National Academy of Sciences-National Research Council.