An electronic audio switch¹

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This article describes an electronic switch that allows presentation of sine wave stimuli without the often undesirable transient thump, thud, or click usually caused by ordinary electromechanical switches.

It is often desirable to present tone stimuli in a manner that eliminates the transient click or thud that accompanies the rapid tone onset and offset caused by conventional electromechanical switching of these tones. von Békésy (1960, p. 215) describes an electronic switch that accomplishes this by providing a relatively slow rise and decay time for the sine wave that it controls. The present paper describes a similar device developed at the University of Missouri for use in studies of auditory stimulus generalization with pigeons. Use over a period of several months indicates that this is a reliable circuit.

Basically, the circuit (see Fig. 1) is a one-stage preamplifier, to be hooked between an audio sine wave oscillator and a power amplifier. It is turned on and off by the discharging and charging, respectively, of Capacitor C1 with a negative voltage that exceeds the cutoff voltage of the preamplifier tube. This on-off is gradual rather than abrupt due to the gradual loss and accumulation of charge on C1 through Resistors R1 and R2, respectively. The envelope shapes for rise and decay times are, respectively, negatively accelerated increasing and negatively accelerated decreasing functions of time. Thus, where linear rise and decay envelopes are required, the circuit is inappropriate.

It may prove desirable to mount the operation switch, S1, at a position other than on the chassis of the electronic switch. This is because of the microphonic action of the high gain amplifiers. Otherwise, a slight pick-up of the mechanical vibration resulting from using the operating switch may be found to modulate the sine-wave signal. Care must be taken to prevent exposure of these switch contacts as they contain relatively high voltages; they should not be connected through the studs of an ordinary open-face panel relay. Another precaution made necessary by the high gain requires isolating the circuit from ac fields (i.e., power transformers).

Input levels are on the order of 1 V or less. The input voltage should be kept as low as is consistent with the level of sound intensity desired from the system. Sound-intensity levels possible with systems using this electronic switch will depend upon the gain and power output of the power amplifier as well as on the power handling and frequency response characteristics of the speaker.

The tone rise and decay times are adjusted by R1 and R3, respectively. There is an interaction between the settings of these two controls. Both times should be checked after adjusting either control. Greater changes in rise and decay time may be effected by changing the value of C1, greater capacity providing longer

Fig. 1. Circuit diagram of the electronic audio switch.

time values. The circuit, as shown, is used to give rise and decay times on the order of 50 msec. Rise and decay times should be observed with an oscilloscope for both shape and duration. Distortion introduced into the sine wave for the range over which the circuit has been used (200-5,000 Hz) is about 1% or less. Distortion level varies with input voltage level, input sensitivity setting, rise time, and decay time; it should be checked after any of these parameters are changed. Once adjusted, this circuit has been found to be stable over a period of several weeks to a few months.

Parts List

All resistors are 1/2-W rating; values shown are in ohms.
All capacitors are 200-V rating or higher; values shown are in microfarads. The input and output capacitors (.01 mF) are disk, ceramic type; all other capacitors are tubular type.
Potentiometers are 2-W, linear taper, screw driver adjust.
S1: SPST toggle switch (or relay contacts), 200-V rating or higher.
Misc: Input and output connectors, tube socket, tube shield, chassis, wire, power cord and plug, nuts, bolts, and washers.

All other component values are indicated on the circuit diagram.

REFERENCES

von BÉKÉSY, G. *Experiments in hearing*. New York: McGraw-Hill, 1960.

NOTES

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