Voice-Operated Switch for your Tape

WITH ONE HAND YOU DELICATELY BALance the tip of your scope probe on the tiny pin of an IC while your other hand fiddles with the scope's sync knob. Suddenly, the long-sought-after trace shows itself in all it's detailed glory! Now you can see the rise time, the overshoot, the pulse width, the DC level and all the other data needed to get the job done. But now what do you do? The notebook is across the room and you'll never remember all those precious numbers if you go get it.

You could dictate the readings to your secretary—if you had one. You could also lock the trace in your storage scope—if you had one. There has to be a better way. Let's see, your hands are full so you can't write—but you can talk! What's needed is cheap, hands-off recording gadget that would only record when spoken to, and would shut down during those long periods of utter silence when you are completely baffled by the peculiarities of your designs.

The answer is a voice-operated switch for a cassette tape recorder built from parts from your junkbox!

That is actually how the project came about. There was a real need to improve

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If you've ever found your hands "tied" when you needed to record an important piece of data, you'll appreciate the usefulness of this simple device.

Recorder

efficiency while doing design work and troubleshooting; in those instances stopping to write down data is usually inefficient or impossible. After a little reflection, it's easy to see that a voice-operated switch could be useful in a number of other situations such as taking verbal notes while studying, unattended monitoring of CB or ham receivers, etc.

For about $20.00, providing you have a well-stocked junkbox, you can build a voice-activated switch that will detect speech and turn a recorder on in response to it. It will also turn the recorder off in response to periods of silence that last over three seconds. That three-second interval is provided to allow for the pauses in normal speech.

No modification of the recorder or its microphone is required. The voice-operated switch simply takes the place of the ON-OFF switch found on most recorder's mikes.

Operating the device is quite simple. Simply plug the cassette recorder's microphone into the jacks on the automatic switch's front panel, set the microphone's ON-OFF switch to the OFF position, plug the automatic switch's cable into the recorder, and set the recorder up to RECORD. The only other thing you need to do is to set the switch's RANGE control so that it will be triggered by your speech, but not by random noises. At highest sensitivity the author's unit would trigger on noises as far as 10 feet from the mike.

Due to the start-up time of the tape transport, sometimes the first syllable of a message may be lost. That does not usually cause any serious problems, but if it bothers you, preface your comments with something like "hey" or some nonsense syllable.

Circuit operation

The device, whose schematic is shown in Fig. 1, is designed around a LM324N quad op-amp. Housed in a 14-pin package, that op-amp requires but one supply voltage and is especially useful for battery-powered circuits.

One of the op-amps in the device (IC1-a) is configured as a very high-gain amplifier. With the values shown for R1 and R3, the gain of the amplifier is about 1000. Capacitor C1 couples the audio signal to the op-amp's inverting input while blocking any DC that might be present at the recorder's mike input. Resistors R2 and R4 bias the non-inverting input so that the DC output of the op-amp is set to approximately ½ of the supply voltage. Capacitor C2 bypasses any AC that might appear at the inverting input. That is important here due to the extremely high-gain of the amplifier. If it were not done, AC signals at the inverting input would show up in the amplifier's output and cause oscillation.

The amplified audio signal is coupled to the second stage through C3 and is applied to the inverting input of IC1-b. Resistors R6 and R10 bias that stage so that, with no signal input, the output from the amplifier is zero. Resistors R5 and R9, and potentiometer R8, allow us to set a DC voltage at the non-inverting input to which the audio signal at the inverting input can be compared.

The biasing of IC1-b is arranged so that only the negative-going half-cycles of the audio signal are detected. By adjusting the RANGE control (R8), we can set the detection level of the amplifier. Resistor R7 is used to limit the gain of that stage.

The presence of an audio signal produces positive pulse-like signals at the output of IC1-b that are coupled through R11 to the base of Q1. The collector of that transistor is tied to a time-constant circuit formed by R13 and C4. When Q1 conducts due to the signal from IC1-b, C4 is discharged through D1 and the transistor. That causes the inverting input of IC1-c to go more negative than the non-inverting input (the positive input of IC1-c is held at a reference level by resistors R14 and R15) and the amplifier's output goes positive. That positive output op-

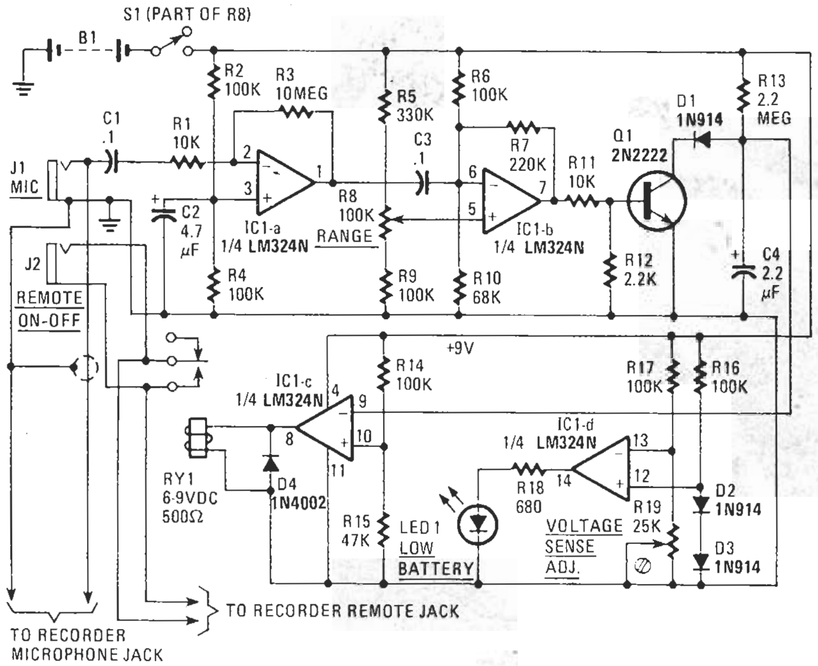

FIG. 1—A VOICE-ACTIVATED SWITCH. This simple circuit is capable of turning a device such as a tape recorder on and off in response to your voice.

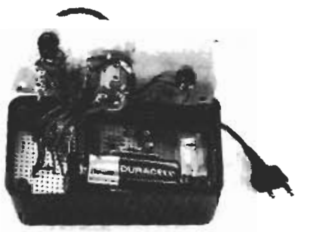

FIG. 2—THE PROJECT IS HOUSED in a small project box with an aluminum front panel. Note the lead to the recorder at the right; it was taken from a defective microphone (see text).

erates relay RY1 and it's contacts close, turning the recorder on. Diode D4 protects the amplifier's output stage from being damaged by inductive kickback when the relay coil is de-energized. As long as audio signals are being detected, Q1 continues to discharge C4 and the relay is held in.

If no audio signals are detected by IC1-b, the R-C time-constant circuit charges up and the voltage at the inverting input to IC1-C goes more positive than the reference input. That drives the output to zero, de-energizing RY1 and turning the recorder off. With the values used in the prototype, the delay is about 3 seconds.

The fourth op-amp, IC1-d, is used as a low-battery-voltage detector. Configured as a comparator, IC1-d will light an LED on the front panel when the battery voltage falls to a selectable limit (more on that in a moment). Taking advantage of the relatively constant voltage drop across a forward-biased diode, we develop our reference voltage via R16, D2, and D3. The reference voltage is applied to the non-inverting input of IC1-d while a portion of the battery voltage, as determined by voltage divider R17 and R19, is tied to the inverting input. When the battery has discharged enough to allow the inverting input to fall below the non-inverting (reference) input, the output of the op-amp goes positive and drives the LED on through current-limiting resistor R18. Resistor R19 allows us to adjust the trip point of the low-voltage detector; that point should be set at around 7.5-volts DC.

Construction

Building the switch should make a nice two-evening project. The author's unit

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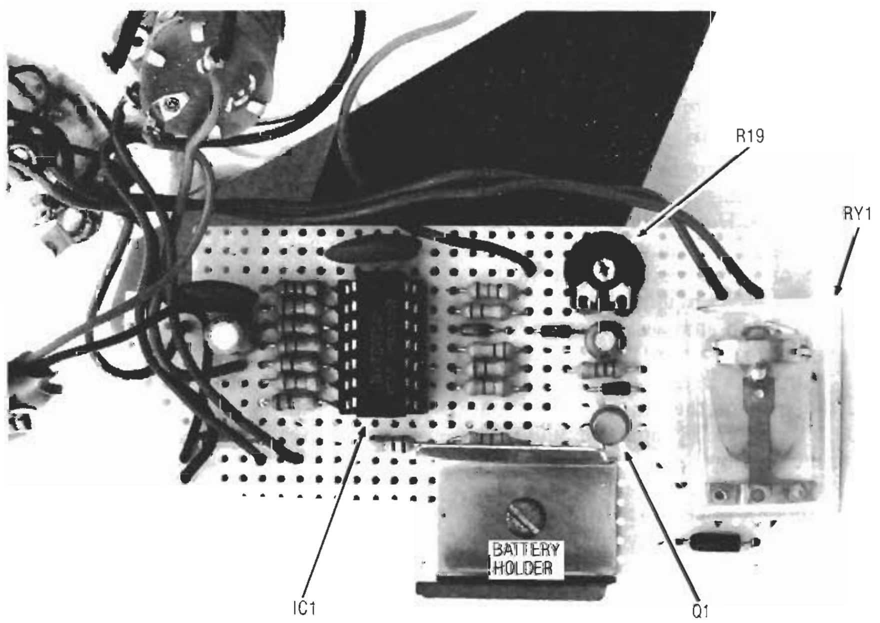

FIG. 3—MOST OF THE CIRCUIT can be mounted on a small piece of perforated construction board.

PARTS LIST

All resistors ¼-watt, 5%, unless otherwise specified
R1, R11—10,000 ohms
R2, R4, R6, R9, R14, R16, R17—100,000 ohms
R3—10 megohms
R5—330,000 ohms
R7—220,000 ohms
R8—100,000 ohms, potentiometer, audio taper
R10—68,000 ohms
R12—2200 ohms
R13—2.2 megohms
R15—47,000 ohms
R18—680 ohms
R19—25,000 ohms, trimmer potentiometer
Capacitors
C1, C3—0.1µF, 50 volts, ceramic disc
C2—4.7µF, 35 volts, electrolytic
C4—2.2µF, 35 volts, low-leakage electrolytic, Radio Shack 272-1420 or equivalent
Semiconductors
IC1—LM324N quad op-amp
Q1—2N2222 NPN transistor
D1-D3—1N914
D4—1N4002
LED1—Red LED with snap-in holder, Radio Shack 276-018 or equivalent
S1—SPDT switch (part of R8)
J1—miniature phone jack
J2—subminiature phone jack
RY1—miniature relay, 6–9-volts DC, 500 ohms, Radio Shack 275-004 or equivalent
B1—9-volt battery
Miscellaneous: Perforated construction board, project box, battery holder and clip, IC socket, wire, cable, solder, etc.

VOICE OPERATED SWITCH

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was built into a 4×2×1½-inch plastic "experimenter's box" with an aluminum front-panel (see Fig. 2), but any enclosure will do. The box we chose was, admittedly, almost too small, so positioning the battery, relay, and RANGE control had to be done with care.

Most of the components were mounted on a piece of perforated construction-board as shown in Fig. 3 and point-to-point wiring was used. A small piece of foam rubber was glued to the backside of the front panel so that it would press against the battery when the panel was screwed down. That was sufficient to hold the circuit board in place.

There is one thing you must watch for if you use a metal panel. You *MUST* insulate J2 from the panel. For most cassette recorders, remote switching is done in the positive supply, making both terminals of J2 "hot." Thus, if you do not insulate J2, you will cause a direct short across the recorder's supply. Of course, the easiest way to solve the problem would be to mount J2 somewhere on the plastic part of the box.

Little about the wiring is critical, with the exception bringing the output leads to the recorder. As you can see in Fig. 2, we used the cable from a defective mike for that. As an alternative, you can make up a couple of cables and terminate them with the appropriate miniature and subminiature plugs. That should work just as well provided that you use shielded cable for the mike lead.

You can, of course, modify the unit to suit your particular needs. For instance, you could mount a microphone cartridge directly in the box, making the whole thing even more compact unit. If your cassette recorder does not have a remote jack, you can easily add one by mounting a closed-circuit subminiature jack in a convenient place in the recorder's case and wiring it in series with the positive battery lead. **R-E**

Sound-activated AC switc

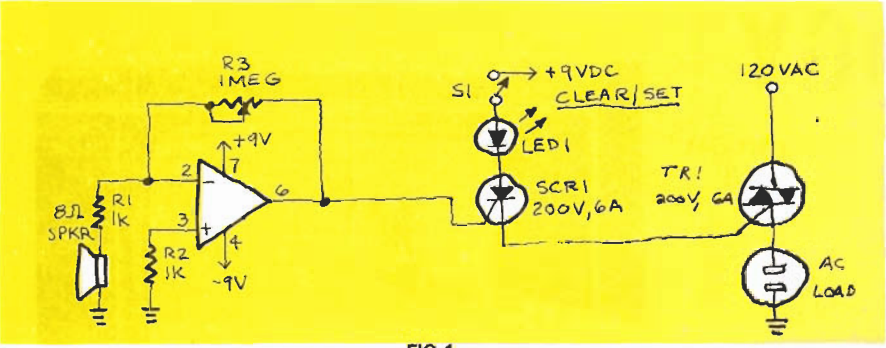

FIG. 1

WHILE LOOKING THROUGH SEVERAL REFerence books and periodicals for various switching methods, I not only found very little concerning sound-activated switches in general, but there was almost a complete absence of sound-activated switches that would directly switch an AC load. Switching on such a load is a fairly easy problem that could be handled by a (mechanical) relay system. But I've found that it's just as easy to put together an inexpensive, reliable, non-mechanical sound-activated AC switch.

The circuit, shown in Fig. 1, uses a 741 op-amp operating as an inverting amplifier. It amplifies the voltage produced by an 8-ohm speaker. That speaker is used here to detect any sounds. The feedback resistor, R3, a 1-megohm potentiometer can be used to vary the gain of the amplifier—it determines the sensitivity of the circuit.

When S1 is closed in the (SET position) and a sound is applied to the speaker, the silicon-controlled rectifier (SCR1) is turned on. It will remain in conduction until the anode voltage is removed by opening S1—putting it in its RESET position. (Once an SCR is turned on, the gate or trigger has no control over the circuit.) As long as the SCR conducts, the Triac, TR1, will remain on and supply voltage to the load.

The ratings of the components shown in the schematic should be sufficient for most household uses, but you can change them if you want to control a larger load. The unit should be mounted in a case for safety, and a standard AC socket should be mounted in the front panel.

The circuit in Fig. 1 is fairly simple and it can be adapted for any number of uses. You can try a lowpass or highpass filter system at the input of the op-amp so that the switch will respond only to certain frequencies—a whistle, perhaps. The best thing about this circuit is that it can help you to understand better how to use the Triac and SCR in control applications.—*Jeffery N. Krumm*