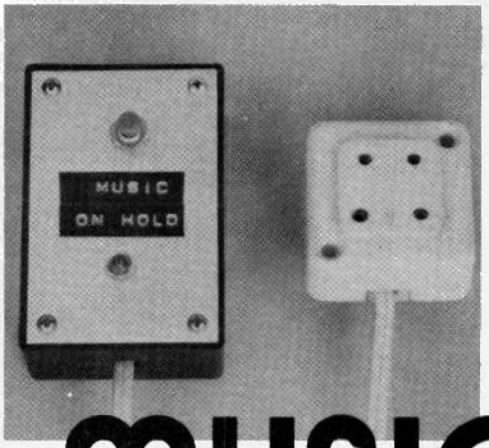

MUSIC-ON-HOLD TELEPHONE ACCESSORY

Add this feature to your telephone and entertain your callers while you are tending the roast in the oven or calling Little Johnny from play. You need only eight components plus a recorder.

JULES H. GILDER

IF YOU'VE EVER PHONED A DOCTOR'S OFfice and been told to hang on for a minute, the chances are that as you were waiting you suddenly heard some background music to entertain you and help you pass the time. Now you also will be able to place your callers on hold and even let them listen to music until you get back to them. And all this can be yours in a device you can build for less than $10.

With this music-on-hold device, you can answer the phone in one room, place the caller on hold, and then pick up the phone again at another location. When you pick up the phone the second time, you automatically deactivate the music-on-hold feature and can continue your conversation.

This construction project requires a direct connection to the telephone line. Some telephone companies object to customers making such a direct connection, fearing that this could introduce high voltages that could be harmful to telephone company employees or equipment. The music-on-hold device does not use such voltages; but, if you are in doubt as to your telephone company's position, you should check before making any direct connections to the line.

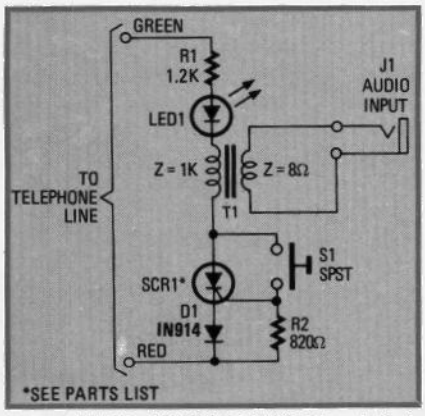

FIG. 1—MUSIC-ON-HOLD DEVICE is relatively simple and is built using standard components.

How it works

The circuit (shown in Fig. 1) is relatively simple to build. It contains a total of seven electronic components, and can be assembled in less than an hour, even by a novice.

The basic operation of any hold push-button requires placing a high resistance—about 1200 ohms—across the telephone line while it is in use. This resistance prevents you from disconnecting the telephone line when you hang up the receiver.

If part of this high resistance is formed by the secondary of an inversely connected transistor-output transformer, then an audio signal can be coupled into the telephone line that can be heard by the caller being kept on hold.

In operation, this eight-component circuit is connected in parallel with the telephone line. When the telephone receiver is lifted off the hook, the voltage on the telephone line is about 5 volts. Even if hold pushbutton S1 is depressed, this voltage is too low to activate the circuit. But if the pushbutton is pressed and the receiver is hung up, the voltage on the telephone line rises to about 48 volts DC. At this point, R1, T1 and LED1 momentarily form a voltage divider with R2. This allows part of the line voltage to be applied to the gate of the SCR and triggers it into its conducting (low-resistance) mode.

The triggered SCR acts as a short circuit and thus connects the resistor, LED, transformer, SCR, and diode series circuit across the phone line. The resistance of the series circuit is between 1200 and 1500 ohms, placing the line on hold. In addition, if an audio signal, such as that obtained from a radio or tape recorder, is fed into the 8-ohm primary of the transformer, the signal is coupled onto the telephone line and the person waiting on hold hears it. (Select an inobtrusive type of music for your recorder or other sound source and keep the volume low. You don't want to offend your caller nor the telephone company.—*Editor*)

When the telephone or any extension is subsequently picked up, the line voltage drops again to about 5 volts and the SCR is current-starved. This current starvation (the equivalent of opening the anode circuit) causes the SCR to stop conducting, effectively opening the circuit and disconnecting the phone line from the hold mode and the audio signal source.

Construction

As mentioned earlier, the minimal number of components required makes construction quick and easy. The whole unit can be built into a 3 × 2 × 1-inch plastic enclosure. Because of the circuit's simplicity, no PC board is needed. In fact, if you want, you can glue the transformer to the lid of the box and mount the remaining components via their connections to the switch or to the LED. Figure 2 shows the layout.

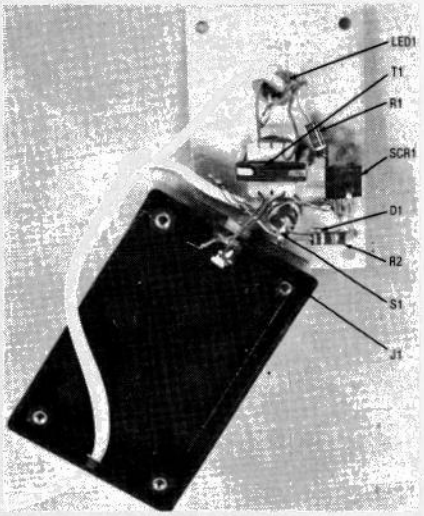

FIG. 2—LAYOUT shows how all the components fit easily into a 3 × 2 × 1-inch enclosure.

PARTS LIST

LED1—Light-emitting diode
D1—1N914
R1—1200 ohms, 1/2 watt (see text)
R2—820 ohms, 1/2 watt
T1—1000-ohm to 8-ohm audio output transformer
SCR1—276-1920 (Radio Shack)
S1—SPST momentary-contact pushbutton
J1—miniature open-circuit phone jack

There are a few simple but important details you must pay attention to. The first is the polarity of the LED. Connect the LED so its anode goes to R1 which in turn is connected to the positive (green) wire of the telephone. The other wire of the music-on-hold device goes to the red wire of the telephone. Next, you must watch out for the polarity of diode D1. The cathode of D1 must go to the red wire of the telephone, along with one side of the 820-ohm resistor.

Component values are not critical, and you can use almost any kind of silicon diode for D1. The same holds true for the SCR and the LED. Resistor R1 may need some adjustment to compensate for different values of SCR conduction current.

Installation and operation

There are two methods in which the music-on-hold device can be connected to your telephone. If you want, you can wire the unit directly to your wall jack; or a more convenient, although slightly more expensive, approach is to use a jack/plug combination. The latter method makes it possible to quickly disconnect the unit whenever you wish and move it from one location to another. Make sure that the red and green wires are properly connected.

To test out the unit, have a friend call you. Tell him you will put him on hold for a minute, but you will be right back. Next, depress the HOLD pushbutton and hang up the phone while pressing the button down. If you have previously connected an audio signal to the transformer, then the moment you press the pushbutton you should hear the audio signal in the telephone receiver. This means that the signal is successfully being coupled into the telephone line.

The person on hold will continue to hear the music until you pick up the receiver again. The LED glows brightly all the time just to remind you that someone is being kept on hold. The LED extinguishes as soon as you pick up the phone again. **R-E**

MUSIC ON HOLD

I read the article, "Music on Hold," by Jules Gilder, in your November 1979 issue, with much interest and would like to make some constructive suggestions.

Ffrst: As it is described, the unit will not work on many phone systems—namely, those that employ switching methods that cause the line voltages described to be reversed in polarity upon connection of the calling number to the called number. Diodes D2 through D5 in Fig. 1 perform the required switching function, to allow the basic circuit to peform properly, regardless of the polarity.

Second: The device resistance is too high for many phone systems. To hold the line properly, the device must have a low enough resistance actually to access the line if the phone were in the hung-up mode. Normally, that would require a value of 100 ohms or less to be placed across the line—or whatever value of resistance would be required to reduce the 48 volts normally present on the line to approximately half that value.

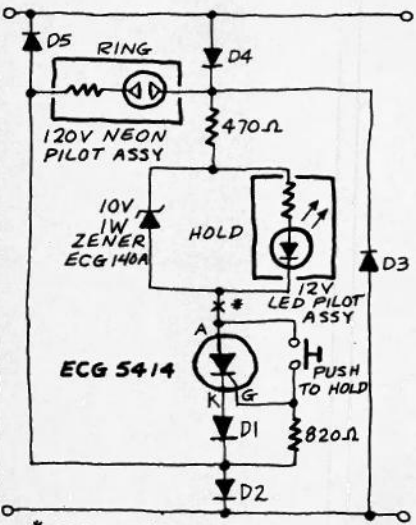

FIG. 1

With typical 48-volt, 70-mA systems, the resistance would be 800 to 850 ohms. Mr. Gilder's circuit would not be capable of such a low resistance without additional circuitry to prevent damage to the LED. I

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LETTERS

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have accounted for that problem in the enclosed diagram through the use of a LED pilot-lamp assembly shunted by an appropriate Zener diode. The series resistance of 470 ohms produces a total device resistance of 850 ohms. A neon 120-volt pilot-lamp assembly is included to indicate incoming calls, in the event that the phone-ringer is switched off. We have employed the described circuit for some time, with excellent results.

Third: While our circuit does not employ an audio-injection feature, it would be compatible with Mr. Gilder's idea. Should a transformer be include in the circuit, the DC resistance of its wiring should be measured; and that value should be subtracted from the 470-ohm series resistor.

BRUCE L. MACKEY
Cortland, NY

Mr. Mackey is correct. The music-on-hold circuit will, indeed, fail to operate on any telephone system that employs switching methods which cause the line voltages to be reversed in polarity upon connection of the calling number to the called number.

His second suggestion looks as if it will work well, although I have not experienced any difficulties with the resistance value indicated. His approach, however, will certainly work on systems that I have encountered, and on systems that require lower hold resistances.

JULES H. GILDER

TELEPHONE SYSTEMS

Telephone-construction projects, such as the music-on-hold telephone accessory, and telephone convenience items like automatic telephone dialers (both in the November 1979 issue) are becoming very popular. Part 68 of the FCC Rules addresses "network harm," but fails to outline necessary terminal device "characteristics." The result is that most of those devices will work in most circumstances—but not universally.

A few suggestions are offered for the authors and hobbyists. Telephone systems vary. While most modern systems maintain a constant battery potential, some older systems reverse that polarity to the caller during conversations. A diode bridge can be added if needed. 1200 ohms will hold the line in most cases, but that resistance may be too high. A telephone is nominally 200 ohms (±50 percent or more). The hold coil should be slightly higher in resistance than the telephone, so that it will release when the telephone is lifted. A hold value of 400 ohms gives much more assur-

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ance of holding the telephone system than 1200 ohms. (I don't know what effect the lower resistance would have on the hold circuit published.)

Upon reading the article, I made a simple test. My telephone system measured 50 volts open circuit and 40 mA shortcircuited. That computes to 1250 ohms resistance. With an additional 1250-ohm hold circuit, the current would be about 20 mA. There is no voltage polarity reversal. The published circuit should work in that case.

The telephone system generally supplies 50 volts through a resistive and inductive network and through wires (resistance) into the home. The R-L network is usually a relay coil—often 400 ohms. The relay pull-in current is generally 20 mA or greater. The hold current may range from 10 mA to near the pull-in current, depending on the relay (or electronics) characteristics. A simple drop-out test can be made with a variable resistance and an mA meter.

One final note: Sometimes modern ancillary electronic devices are used in telephone systems that have non-standard characteristics. There is a high probability that the music-on-hold would not work (as published) with such ancillary devices.

NAME WITHHELD