Phone-Controlled Nite Lite

Ends fumbling in the dark when you reach to answer your telephone

By Anthony J. Caristi

When a telephone rings while you're asleep at night, you no longer need to fumble around for the instrument, probably knocking objects on your night table to the floor while doing so. The telephone-controlled light described here, dubbed the Nite Lite, will save the day (night?), automatically lighting up your night table with a lamp of your choice every time the telephone rings.

As long as the ringing continues or you keep the receiver off the hook, the lamp will remain on. Then a few seconds after you hang up, the light goes off. Everything works automatically!

The Nite Lite is so useful and easy to build, you might want to build a few to give as gifts. For a professional touch, the project can be concealed inside an existing table lamp; it won't interfere with normal operation of the lamp being used.

How It Works

At the heart of the Telephone Nite Lite shown schematically in Fig. 1 is telephone ring detector integrated circuit *IC1*. This specialty IC contains a bridge rectifier and regulator that are powered by the 90-volt, 20-Hz signal that appears across the telephone line when the phone rings.

A normally off switching transistor inside *IC1* is biased into conduction each time the telephone rings, causing the output of *IC1* at pin 2 to go to 0 volt. At all other times, pin 2 is biased to about 8 volts by means of a voltage divider network consisting of *R7* and *R8*.

The output of *IC1* goes to the trigger input of retriggerable one-shot multivibrator *IC3*, which has a timing cycle of about 10 seconds. Since

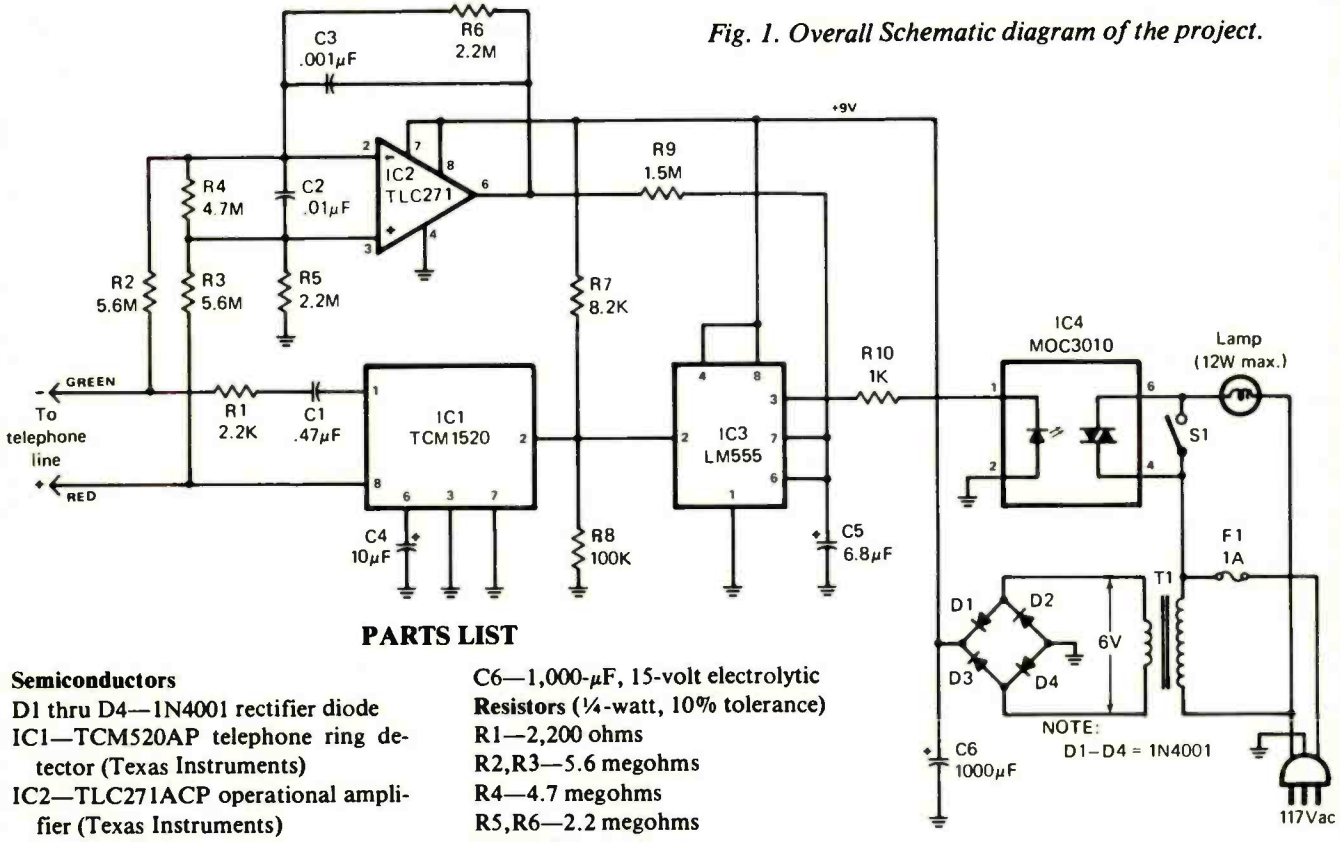

Fig. 1. Overall Schematic diagram of the project.

PARTS LIST

Semiconductors

D1 thru D4—1N4001 rectifier diode
IC1—TCM520AP telephone ring detector (Texas Instruments)
IC2—TLC271ACP operational amplifier (Texas Instruments)
IC3—LM555 timer
IC4—MOC 3010 optoisolator (Radio Shack Cat. No. 276-134)
Q1—2N6342 or similar 6-ampere triac and Radio Shack Cat. No. 276-1363 heat sink (optional; see text)

Capacitors

C1—0.47-μF, 200-volt ceramic or tubular
C2—0.01-μF ceramic
C3—0.001-μF ceramic
C4—10-μF, 15-volt electrolytic
C5—6.8-μF, 15-volt electrolytic
C6—1,000-μF, 15-volt electrolytic

Resistors (¼-watt, 10% tolerance)

R1—2,200 ohms
R2,R3—5.6 megohms
R4—4.7 megohms
R5,R6—2.2 megohms
R7—8,200 ohms
R8—100,000 ohms
R9—1.5 megohms
R10—1,000 ohms
R11—180 ohms (optional; see text)

Miscellaneous

F1—1-ampere slow-blow fuse
S1—Existing lamp switch (or separate spst switch; see text)
T1—6.3-volt, 300-mA transformer (Radio Shack Cat. No. 273-1384 or similar)
Suitable enclosure (see text); chassis-mount ac receptacle (optional; see text); perforated board and soldering hardware or printed-circuit board; 3-conductor line cord with plug; machine hardware; hookup wire; solder; etc.

Note: The following are available from A. Caristi, 69 White Pond Rd., Waldwick, NJ 07463: etched-and-drilled pc board for $7.50; IC1 for $4.50; IC2 for $3.00; Q1 for $3.00. Please add $1 P&H.

the normal telephone ring signal is on for 2 seconds and off for 4 seconds, *IC3* continues to be active as long as the ring signal is present. During this time, output pin 3 of *IC3* remains at about 9 volts. This 9 volts, fed through current-limiting resistor *R10*, turns on a LED inside optoisolator *IC4*. When the LED lights, it triggers into conduction a triac, also internal to *IC4*, which in turn turns on the night light connected in series with it and the ac line.

If the incoming call is not answered and ringing ceases, *C5* charges up through *R9*. Then 10 seconds after the output of *IC3* goes to 0 volt, the lamp extinguishes.

Differential amplifier *IC2* senses the – 48 volts that appears across the telephone line when the phone is on the hook. As a result, the output of *IC2* remains at 9 volts and provides the current to charge *C5* through *R9*. Answering a call causes the potential across the telephone line to drop to about 6 volts. This causes the output of *IC2* to go low, depriving *C5* of sufficient current to charge up and keeping the output of *IC3* high. Hence, the lamp remains on as long as the call is in progress. Then 10 seconds after you hang up, *C5* charges up and the lamp extinguishes.

The triac inside *IC4* can drive only low-power loads rated at up to 12 watts, which is sufficient for most night lights. If you wish to operate lamps of greater wattage, you must

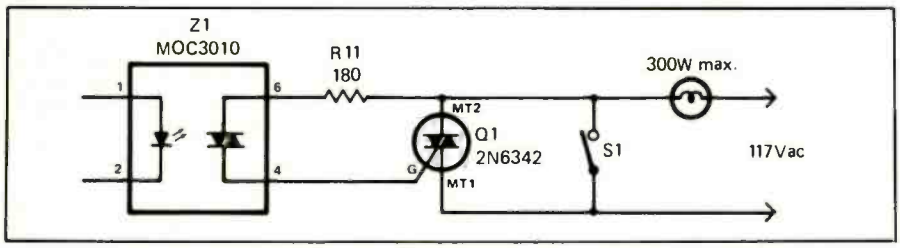

Fig. 2. Modification for high-power lamp-driver capability.

add a resistor and an external triac of sufficient current rating to safely handle the load current. This modification is shown in Fig. 2, with *Q1* identifying the external triac and *R11* the gate biasing resistor.

With the Fig. 2 modification installed, the triac inside the *IC4* optoisolator switches on and off the external triac. In turn, the latter handles the heavier current required by the load. Using the specified external triac, the project can safely switch lamps rated at up to 300 watts, which is more than adequate for any incandescent table lamp.

Construction

Owing to the circuit's relatively simple design, you can choose any method or construction that suits you. For example, you can use perforated board and appropriate soldering hardware, as shown in the lead photo, or Wire Wrap the circuit. Alternatively, you can assemble the project on a printed-circuit board. If you choose pc-board wiring, you can fabricate your own board using the actual-size etching-and-drilling guide shown in Fig. 3 or purchase one

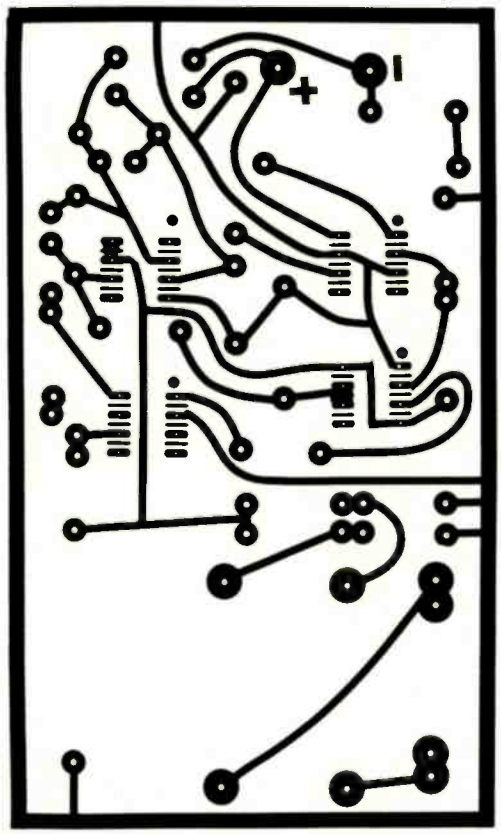

Fig. 3. Actual-size printed-circuit board etching-and-drilling guide.

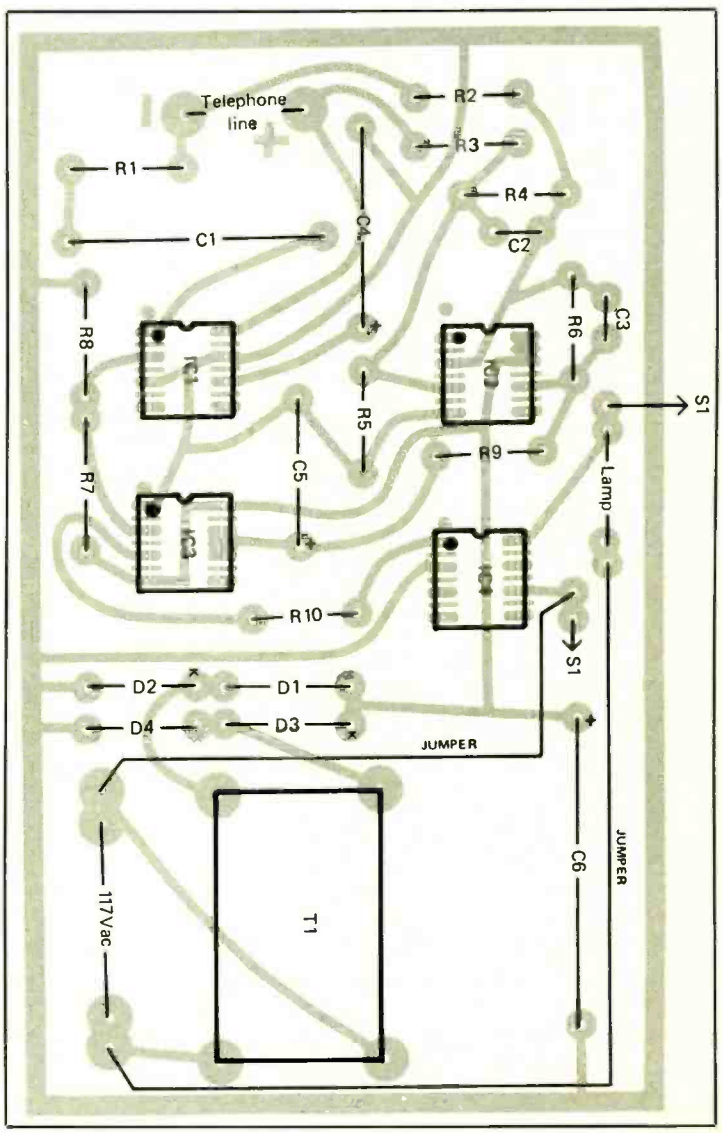

Fig. 4. Components placement and orientation diagram for pc board.

ready to wire from the source given in the Parts List.

Note that the pc guide in Fig. 3 has provisions for only the basic circuit, including a 12-watt incandescent lamp. If you plan to use the optional high-power external triac, delete the two jumper wires shown and solder *R11* to the board in place of the 12-watt lamp. Then finish wiring the circuit in accordance with Fig. 5.

Whichever wiring method you choose, Fig. 4 shows a good layout to follow. Use sockets for the ICs and optoisolator. Although *IC4* has only six pins, an 8-pin DIP socket can be used (Fig. 3 has the extra holes to accommodate the socket). Pins 1 and 6 of *IC4 must* plug into pins 1 and 8, respectively, of the socket so that no pins of *IC4* plug into pins 4 and 5 of the socket. A good way to assure that none of *IC4*'s pins plug into the socket's pins 4 and 5 is to plug the ends of a short length of solid hookup wire into these socket pins to eliminate any possibility of anything else being plugged in here.

Wire the circuit board exactly as shown in Fig. 4, starting with the resistors, capacitors, IC sockets, external triac *Q1* (if used), etc., finishing up with installation of the ICs and optoisolator in their respective sockets. Make certain that you observe proper orienting of the electrolytic capacitors, diodes, ICs, optoisolator and external triac if the last is used.

Once the circuit is fully wired, mount it directly in the base of the lamp with which it is to be used. Make sure, however, that the 117-volt ac line portions of the circuit do not come in contact with any exposed metal on the lamp. If you are using the external triac, it must be equipped with a heat sink (see Parts List) or be bolted to the metal base of the lamp. The metal mounting tab is *not* electrically isolated from the leads of the triac. Therefore, it is *very* important that you use an insulating washer between triac and heat sink or ensure that the heat sink is electrically isolated from any metal part of the lamp. (Some triacs are supplied with a mica insulator and shoulder washer that can be used to isolate the triac from the heat sink.)

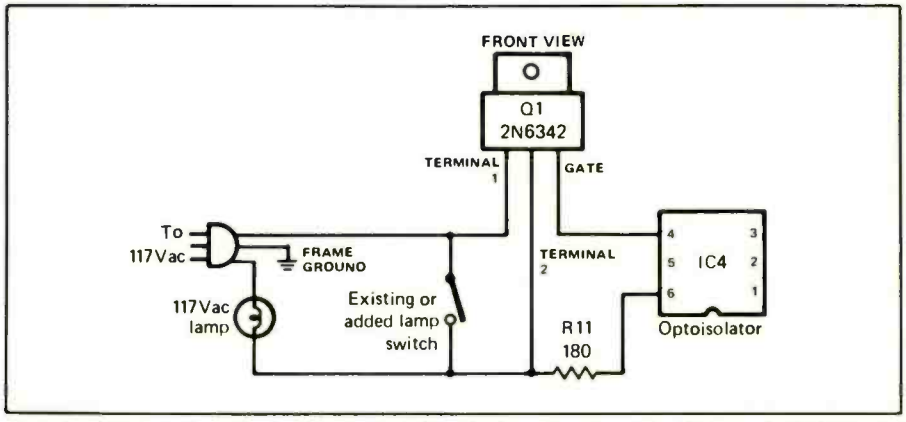

Fig. 5. Wiring details for lamps with switches that are not integral with screw base to permit the lamp to be switched on and off in the usual manner.

To provide positive insurance against possible shock hazard, replace the lamp's two-conductor line cord with a three-conductor grounding type, wiring its green conductor to the metal frame of the lamp.

When you have finished mounting the triac and heat sink, use an ohmmeter to check for electrical isolation between the tab of the triac and the heat sink. You should obtain an infinity reading on the highest range.

If your lamp has a separate on/off switch (not integral with the bulb's screw base assembly), follow the wiring guide shown in Fig. 5, which illustrates how a separate switch is used to operate the lamp in the normal manner. If the lamp switch is integrated with the screw-base assembly, you will have to add a single-pole, single-throw (spst) switch to the lamp and set the original switch permanently to its on position.

Keep in mind, too, that since the 90-volt rms ring signal from the phone line must pass through *C1*, it is important that this capactior have a rating of at least 200 working volts. Do *not* use the low-voltage types commonly employed in solid-state circuits. If you do, the capacitor is likely to become short-circuited, in which case, *IC1* will be damaged.

As with all ancillary equipment connected to the telephone line, you should use a modular connector to tie the project to the line. This is an FCC requirement. Also, it is important that the polarity of the connection to the phone line be correct, as detailed in Fig. 1. If it is not, the project will not work. If you use a standard modular plug and cord, the red and green wires of the cord give you the correct polarity. The yellow and black wires are not used. If you have any doubt about the polarity of your telephone line, plug the cord into your modular socket and check the polarity of the red and green wires with a dc voltmeter set to measure 50 volts or more.

Checkout

Before attempting to operate your Telephone-Controlled Nite Lite, remove the ICs and optoisolator from the board and apply 117 volts ac power to the circuit via its 3-conductor line cord. With the project plugged into the ac line, avoid touching any of the wiring to *T1*'s primary, *IC4*'s socket and, if used, *Q1*. Measure the potential across *C6*; this

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should be about 9 volts, with positive on the + side of the capacitor. If you obtain the correct reading, disconnect ac power from the project and allow sufficient time for the charge to bleed off *C6*. Otherwise, troubleshoot the circuit and correct the problem before proceeding.

You can check operation of *IC2* by plugging it into its socket and connecting the project to the telephone line via the modular cable. With ac applied to the project, the potential between pin 6 of *IC2* and circuit ground should be about 8 volts dc when the telephone is on the hook. Lift the handset off the hook and once again measure the voltage at pin 6; it should now be about 2 volts or less. If you do not obtain this response, check the polarity of your telephone line, making sure that the negative side feeds to *R2*. Then check the wiring of the *IC2* circuit.

Power down the project and wait for the charge to bleed off *C6*. Then plug *IC3* and *IC4* into their respective sockets and reapply line power. With your telephone on the hook, momentarily short pin 2 of *IC3* to circuit ground and note that the lamp turns on and remains on for about 10 seconds and then extinguishes.

Power down the project and once again wait until the charge bleeds off *C6*. Then plug *IC1* into its socket and reapply line power. Call a friend and have him or her call back and hang up after one or two rings. The lamp should go on at the first ring and remain on for about 10 seconds after ringing stops. If everything works okay, call your friend back and tell him or her about your new circuit!

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