Telephone-Activated Lamp Timer

Device automatically turns on lamp when it is dark and a phone call is received

By Steve Lympany

Anyone who has ever stumbled around in the dark trying to find his telephone to answer its ring will appreciate our Telephone-Activated Lamp Timer. The Telephone-Activated Lamp Timer turns on a lamp when your phone rings and keeps it on while you are conversing and for a period of time after you hang up. The last feature is adjustable to allow you to get back to bed before the project extinguishes the lamp. The time-out period is adjustable over a range of from about 2 to 75 seconds, which should be more than sufficient to suit just about any situation. Additionally, if you want to turn off the lamp before the time-out cycle has completed, simply push a button on the Lamp Timer. If you are not around to answer the telephone when it rings, the lamp will remain on for the time-out period after the last ring burst from the incoming call.

Two ac receptacles are provided on the Lamp Timer to allow you to connect a lamp and any other ac-powered device you might find appropriate in this application. One receptacle is manually switchable to allow you to set the lamp to constant-on so that you can use it for reading or other purposes before you retire. But do not forget to switch the Lamp Timer back to its automatic mode before lights out.

About the Circuit

As shown in the block diagram in Fig. 1, required functions of the Telephone-Activated Lamp Timer are ring detection, off-hook detection, variable timing and relay drive. The circuit that provides these functions is shown schematically in Fig. 2.

When a ring signal is detected by the Timer on the green and red conductors of the telephone line, the "tip" and "ring" lines, respectively, of RJ11 jack *J1*, it is divided down by *R1, R2* and *R3*. It is then coupled through *C1* to pins 1 and 2 of optical coupler *IC2*. (Note: The pinouts and internal details of the ICs used in this project are shown in Fig. 3.) The presence of this signal causes pin 5 of *IC2* to be pulled low. This high-to-low transition is ac coupled through *C2* to pin 3 of *IC2*. The resulting negative-going edge causes timer *IC3* to begin its timing cycle.

The output signal at pin 3 of *IC3* is used with *IC4* to switch on relay driver *Q1*. The timing period is reinitiated each time the telephone rings.

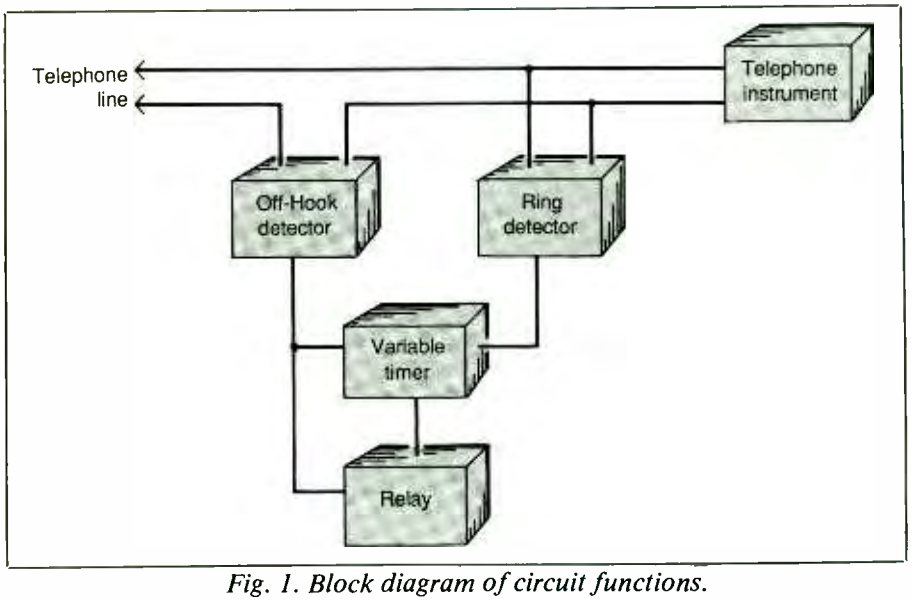


Fig. 1. Block diagram of circuit functions.

Therefore, relay *K1* remains energized during the ring bursts and for the time-out period following the occurrence of the last ring signal.

Lifting the receiver of the telephone instrument creates an off-hook condition so that the current flowing through the instrument is sensed by optoisolator *IC1*. (This allows for bidirectional line-current sensing so that off-hook detection occurs independently of line polarity.) This causes pin 5 of *IC1* to be pulled low. When this condition is passed through *IC4*, *Q1* conducts and energizes the relay and holds it that way during the period of time the telephone instrument is off-hook. Hanging up the telephone (putting it back on-hook) causes pin 5 of *IC1* to go high. This signal is inverted at pin 4 of *IC4*, and the resulting negative-going edge is coupled through *C2* and *D2* to trigger *IC3* into operation. Timer *IC2*'s output then drives *K1* for the time-out period. Hence, *K1* will remain energized for the time-out period after you hang up.

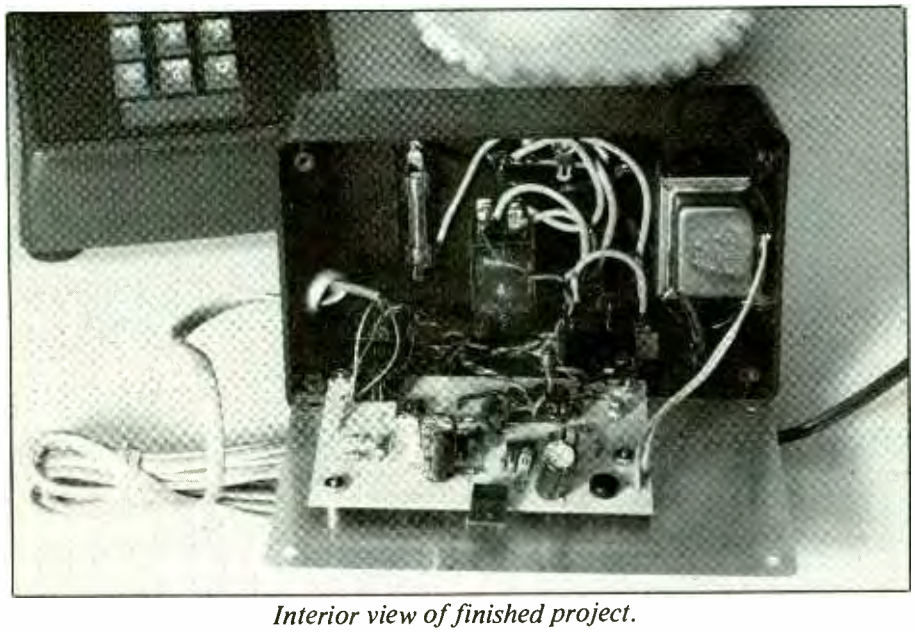
Potentiometer *R8* provides the means for adjusting the time-out period as desired. The time-out period of the 555 timer used for *IC3* is calculated from the formula: $T_O = 1.1(RC)$, where T_O is the time-out period in seconds, *C* is the value of *C3* and *R* is the sum of the values of *R7* and *R8*. Therefore, with the value of *C8* being 68 microfarads and *R* being adjustable between 20,000 and 20M ohms, the resulting time-out period adjustment range is from about 1.5 to 76 seconds. Of course, you can substitute other values of *R* and *C* to increase or decrease the time-out period as desired.

If you would like to extinguish the lamp before the timer completes its time-out cycle, you can press and release momentary pushbutton switch *S2* to reset the Timer and arm the circuit so that it is ready for the next incoming call.

A double-pole, double-throw (dpdt) relay was used for *K1* in this project basically because it was readily available. However, if a second ac outlet is not needed, a single-pole, double-throw (spdt) relay can be substituted, making the project's cost a bit lower.

Also shown in Fig. 2 is the schematic diagram of the ac power supply used to power the Telephone-Activated Lamp Timer. This is a simple full-wave dc supply that delivers regulated 12 volts dc to the Timer circuits. After stepping down the incoming 117 volts ac to 12.6 volts ac, the supply rectifies it to pulsating dc with bridge rectifier *RECT1* and then filters it to dc with *C8*, after which it electronically regulates it at 12 volts dc with *IC5*.

TIMER/BYPASS switch *S1* is a convenience feature. With this switch in the circuit, you can bypass the Tim-



Interior view of finished project.

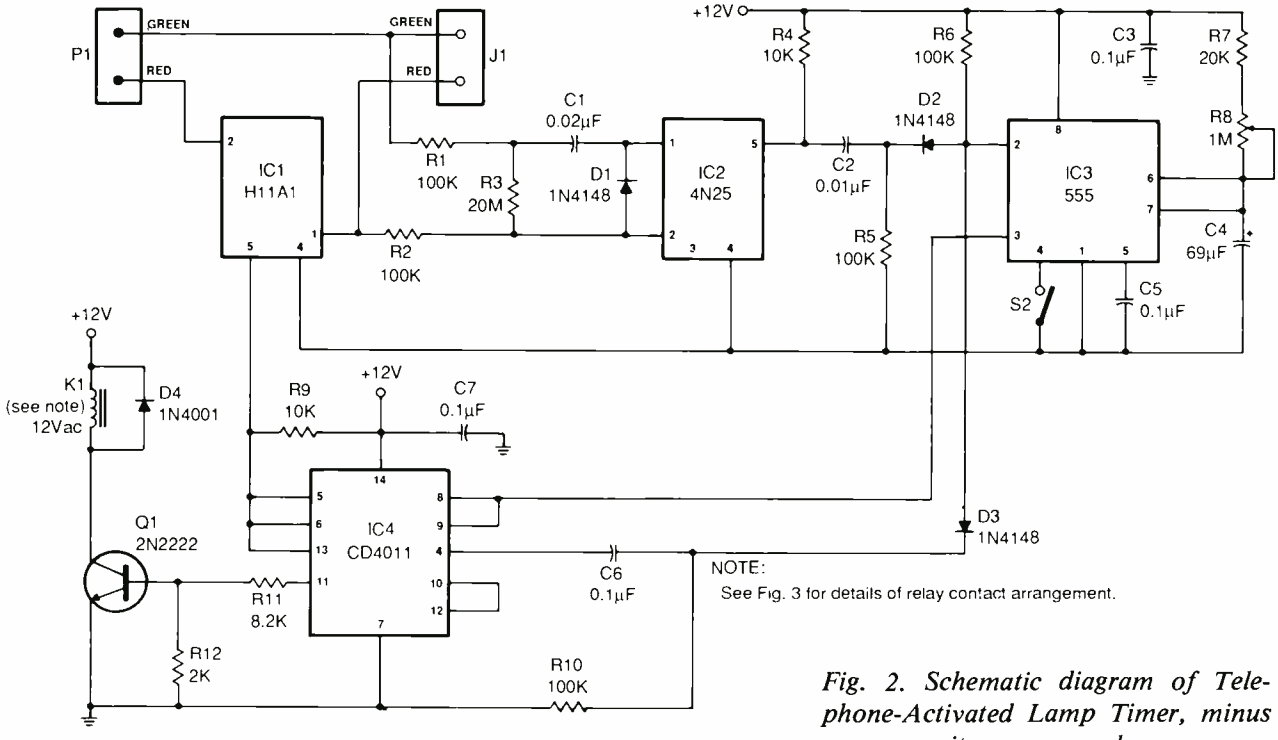


Fig. 2. Schematic diagram of Telephone-Activated Lamp Timer, minus its power supply.

er's relay so that ac receptacle *SO1* can be manually switched on and off. This allows you to use the lamp the project controls as a reading lamp when the switch is set to the BYPASS position.

Construction

This is a very simple project to build. A printed-circuit board is recommended for wiring the circuit, through you can use perforated board and suitable soldering or Wire Wrap hardware if you wish. In either case, it is a good idea to use sockets for *IC3* and *IC4*. You can also use sockets for *IC1* and *IC2*, though you will have to use standard 8-pin DIP sockets for these 6-pin ICs and make arrangements on the board for the extra pins (or remove the pins from the sockets altogether). Also, plug up the holes for the unused socket

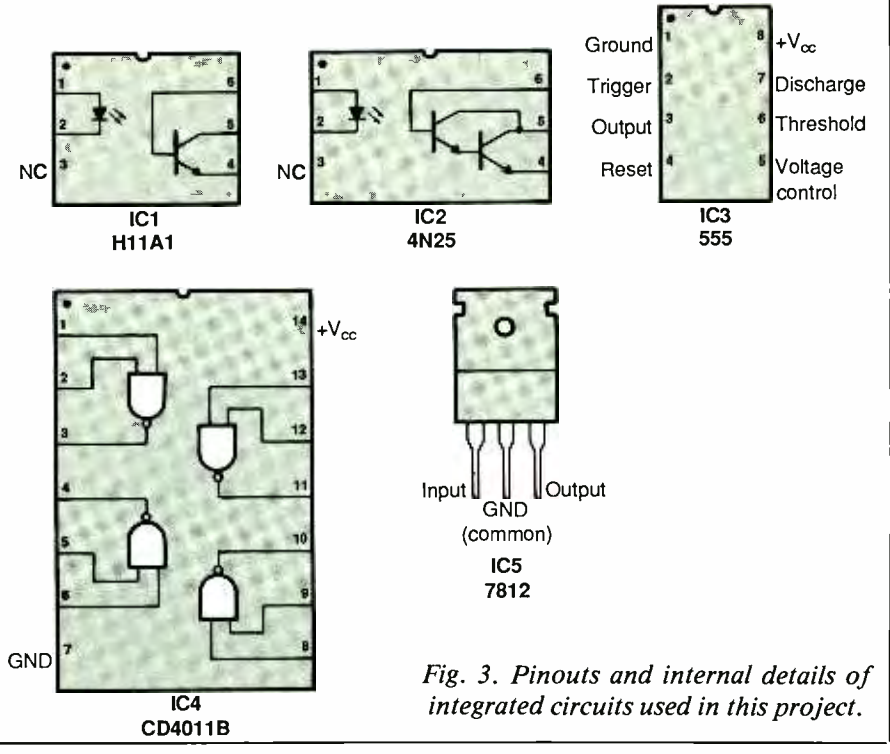


Fig. 3. Pinouts and internal details of integrated circuits used in this project.

PARTS LIST

Semiconductors
D1,D2,D3—1N4148 switching diode
D4—1N4004 rectifier diode
IC1—H11A1 ac optical isolator
IC2—2N45 optical isolator
IC3—555 timer
IC4—CD4011 CMOS quad NAND gate
IC5—7812 + 12-volt regulator
Q1—2N2222A npn transistor
RECT1—100-PIV bridge rectifier (Radio Shack Cat. No. 276-1152 or similar)

Capacitors
C1—0.02-μF, 250-volt electrolytic
C2,C6—0.01-μF, 50-volt disc
C3,C5,C7—0.1-μF, 50-volt disc
C4—68-μF, 35-volt electrolytic
C8,C9—150-μF, 35-volt electrolytic

Resistors (1/4-watt, 10% tolerance)
R1,R2,R5,R10—100,000 ohms
R3—20 megohms
R4,R6,R9—10,000 ohms
R7—20,000 ohms
R11—2,000 ohms
R8—1-megohm potentiometer

Miscellaneous
F1—0.5-ampere slow-blow fuse
J1—RJ11 (6-position) modular telephone jack
K1—12-volt dc, 3-ampere dpdt relay (Radio Shack Cat. No. 275-206 or similar; see text)
P1—Telephone line cord with modular plug
S1—3-ampere spst slide or toggle switch
S2—Spst momentary action pushbutton switch
SO1,SO2—Chassis-mount ac receptacle
T1—12.6-volt, 250-mA power transformer
Printed-circuit board or perforated board and suitable soldering or Wire Wrap hardware; ac line cord with plug; fuse holder; control knob for potentiometer; suitable enclosure (see text); small rubber grommet or plastic strain relief for line cord; ½" spacers; machine hardware; hookup wire; solder; etc.

Note: The following items are available from Steve Lympany, P.O. Box 51281, Raleigh, NC 27609: 4N24 optoisolator for $1.50; H11A1 optical isolator for $4.00; bridge rectifier for $1.50; telephone line cord with connector for $1.50; and RJ11 modular telephone jack for $2.25. Add $1.50 for P&H. North Carolina residents, please add state sales tax.

pins to prevent the optoisolators from being plugged in wrong.

You can fabricate a printed-circuit board with the aid of the actual-size etching-and-drilling guide shown in Fig. 4. Once the board is ready, wire it exactly as shown in Fig. 5, taking care to properly orient all electrolytic capacitors, diodes, integrated circuits, bridge rectifier and the transistor. (If you are point-to-point wiring the circuit on perforated board, follow the layout shown in Fig. 5 for component placement.)

Start wiring the board by installing and soldering into place first the IC sockets. Follow with the resistors, capacitors, rectifier assembly, diodes and transistor. Do not install the ICs in their sockets until after you have performed the voltage checks upon completion of wiring.

Note in Fig. 5 that power transformer *T1*, switches *S1* and *S2*, ac receptacles *SO1* and *SO2*, relay *K1* and fuse *F1* and its holder mount off the circuit board. This being the case, prepare 14 5" lengths of hookup wire by stripping ¼" of insulation from each end of all of them. Plug one end of these wires into all vacant board holes, except those for *T1*, and solder them into place.

You can use any size metal or plastic enclosure that will accommodate the circuit-board assembly and all off-the-board components without crowding. Machine the selected enclosure to provide mounting holes for the circuit-board assembly, power transformer, relay, switches, fuse holder and potentiometer and for entry of the ac line and telephone cords. Then cut slots and drill mounting holes for the chassis-mount ac receptacles.

If you are using a metal enclosure, deburr all holes and line the entry

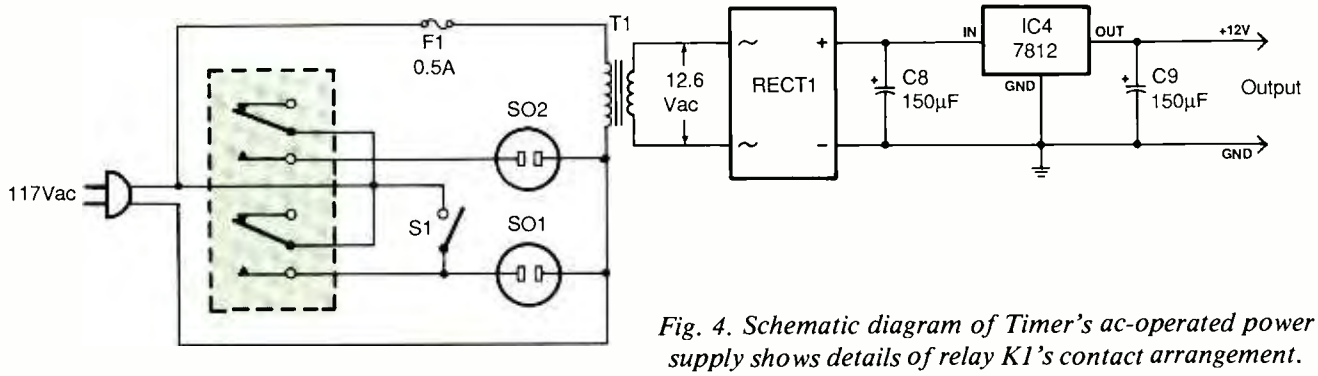


Fig. 4. Schematic diagram of Timer's ac-operated power supply shows details of relay K1's contact arrangement.

holes for the ac line cord and telephone cord with rubber grommets.

Mount the circuit-board assembly on the floor of the enclosure with ½" spacers and 4-40 × ¾" machine screws, nuts and lockwashers. Then mount all off-the-board components in their respective holes and cutouts. Pass the ac line cord and the telephone cord through their rubber grommets and tie a knot in each about 5" from the free ends inside the enclosure to serve as strain reliefs. Twist together the fine wires in each cord's conductors and sparingly tin with solder. Interconnect all components and wiring, referring to Figs. 2 and 5 for details.

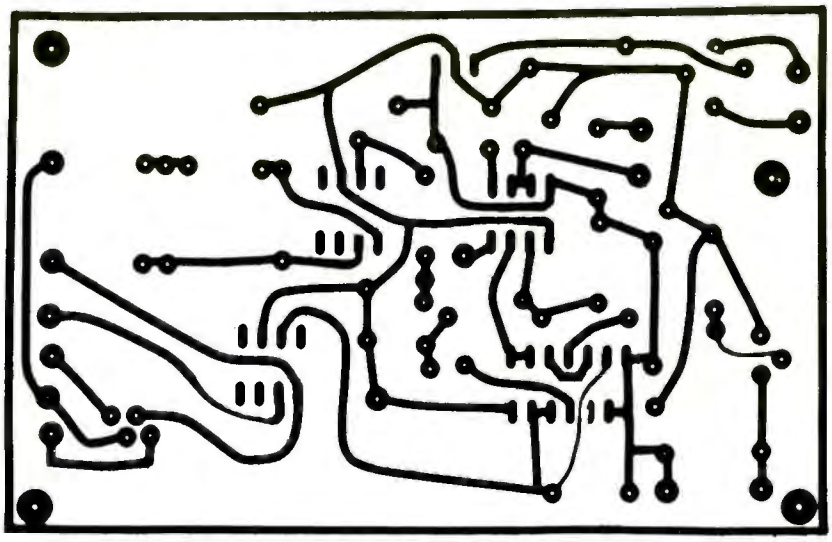


Fig. 5. Actual-size etching-and-drilling guide for fabricating a printed-circuit board for the project.

Checkout & Final Assembly

Once the project has been fully wired (the only IC that should be installed at this time is voltage regulator *IC5*), plug its line cord into an ac receptacle. Connect the common lead of a dc voltmeter set to read 12 volts or greater to circuit ground. (*Warning:* Dangerous ac line voltage appears at various portions of the circuit. Therefore, exercise caution when making the voltage checks to avoid touching these portions of the circuit.) Measure the voltages at pin 3 of *IC5*, pin 8 of *IC3*, pin 14 of *IC4* and the cathode of *D4*. In all cases, you should obtain a reading of + 12 volts. If not, power down the circuit and double check all wiring and components orientations and locations. Do not proceed until you have cleared up the problem.

Once the voltages check out, power down the project and allow the charge on *C4, C8* and *C9* to bleed off. Then install the ICs in their respective sockets. Make certain that the ICs go into the correct sockets, in the proper orientations (see Fig. 5) and that no pins overhang their socket or fold under between IC and socket as you seat the ICs.

Plug the Timer's line cord into an ac receptacle and momentarily short together pins 2 and 5 of *IC2* with a short length of hookup wire while listening for the relay to energize (you should hear a click as the relay's contacts snap closed). After the Timer has timed out, the relay should deenergize, again with a click. Repeat this test with *R8* adjusted to different settings throughout its range. You should hear the relay energizing and deenergizing in each case, but the time-out period (time between on and off clicks) should be different at each setting.

Once the tests show that the circuit is operating properly, you can put your Telephone-Activated Lamp Timer into service. To do this, plug *P1* into the telephone wall jack and the telephone instrument into *J1*. Then plug a switched-on lamp into *SO1*. Your Telephone-Activated Lamp Timer is now ready to light your way to your telephone when it rings after lights out. **ME**

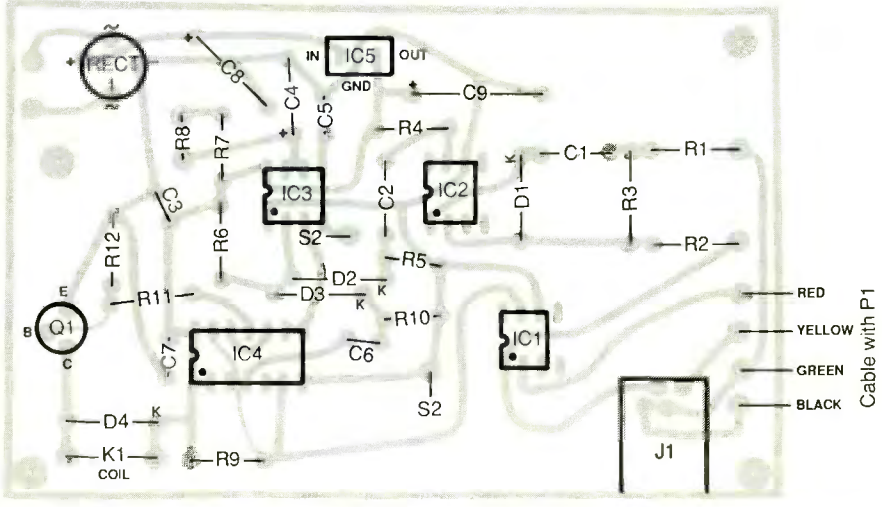


Fig. 6. Wiring guide for pc board. Use this layout if you wire the project on perforated board.