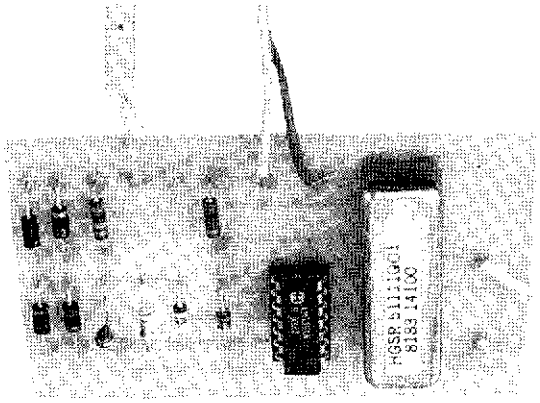


PHONE LINE MONITOR

A cut telephone line can trigger your home security system into action.

JAMES MELTON

MANY SECURITY SYSTEMS CAN AUtomatically call a central monitoring station to report a problem. But what do you do if the burglar, who is always trying to stay one step ahead of technology, walks up to your telephone line at the side of your home and cuts the wires? Access to most phone lines can be accessed and cut easily. Consider the degree of freedom given to the utility meter reader who records your meters' readouts for gas, water or electricity. The thief has the same opportunity for access. Here's a new twist: With the new telephone interface used in overhead lines, the burglar can easily unplug the central office line to your home without cutting a wire! No matter how you slice it, the phone line is vulnerable.

The Phone Line Monitor is an easy-to-build electronic gadget that will detect when the phone line has been cut. It ignores normal phone signals such as the phone being off hook and the ringing voltage. The Monitor is designed to work with virtually any security system, and will provide a signal to your home alarm system any time the phone service is interrupted.

The circuit

A typical phone line from telephone company's central office has from 24 to 48 volts DC on it when all telephones are on hook. When you take a phone off hook (pick up the phone), loop current flows in the circuit and the line voltage drops to between 7 and 14 volts. This is the voltage the telephone set uses to dial out and power any extras (such as a speakerphone) while you are talking.

When you receive a call, an AC voltage of approximately 90 volts at 20-30 Hz is impressed on the DC voltage. For this reason, any monitor you build for your phone line must be able to ignore the ringing voltage, otherwise you will get false alarms every time someone calls you.

Figure 1 is the schematic diagram of the Phone Line Monitor. Note that 12-volt DC power is connected to the unit via solder pads C (positive) and G (ground) on the PC board. This power should be supplied from your home security system, since it will have battery backup and thus will be as reliable as your base security system. The input from the telephone line is fed to pads A and B. Polarity is not important to the monitor because the input is rectified by the full-wave bridge rectifier formed by diodes D3-D6. Connecting the phone line to the Phone Line Monitor in no way diminishes

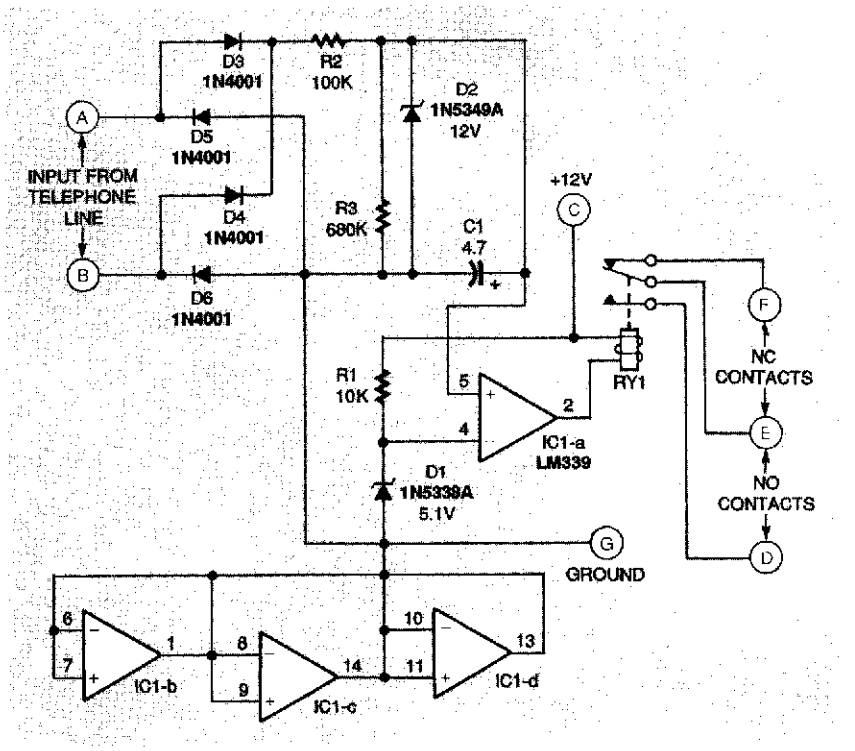


FIG. 1—SCHEMATIC DIAGRAM for the Phone Line Monitor. Notice that three of the unused comparators have their inputs and outputs connected together and then to ground.

A Small View of Telephone History

Until the 1970's, there was only one instrument you could connect to the telephone line—the telephone supplied and installed by the phone company. As technology advanced, the phone company would interconnect an acceptable telephone answering machine. That was about it. Then, equal access and the breakup of the phone company produced two extremely significant events: Modular wiring, and competition. Not enough good words can be written to cover how handy, reliable and versatile the modular wiring concept has become. From voice grade analog basic telephone service to the 100-150 megabit and higher ATM (asynchronous transfer mode) digital service being proposed, one basic style of connector can handle it all!

Then there was the concept of equal access. Not only did other big companies have equal access to providing you long distance or even local access service, but local independent companies had the right to provide you with home or office wiring. You could even do the wiring yourself! No one who has grown up after the concept of equal access took root can realize how jealously the telephone company guarded its phone lines before that time.

Equal access had one other significant benefit for the consumer at home: Other companies could sell you equipment you could attach to the phone system (modular plugs to the rescue again) and, as long as the equipment did not cause interference to the central office equipment, everyone was happy. Now, commercial equipment manufacturers have some strict rules they must adhere to in the area of protection and interference.

Most of the rules require that the equipment does not do any harm to the phone company equipment. Here's the legal loophole: If you are not making equipment commercially, and you are using a self-made project for your own home, you are within the limits of the rules as long as the equipment does no damage.

If the project you made or purchased and attached to the telephone line creates a problem with the circuit, the telephone company will ask you to remove it. You are obligated to do so. If you do not, the telephone company will disconnect your phone service, so you might as well do what is required and fix the offending gadget or appliance. Ω

PARTS LIST

C1—4.7μF, 25V aluminum electrolytic
D1—1N5338A Zener diode, 5.1 volt, 5 watt, axial leads
D2—1N5349A Zener diode, 12 volt, 5 watt, axial leads
D3-D6—1N4001 silicon diode, 50 V, 1A
IC1—LM339N quad comparator
R1—10,000-ohm, ¼-watt, 5% resistor
R2—100,000-ohm, ¼-watt, 5% resistor
R3—680,000-ohm, ¼-watt, 5% resistor
RY1—Relay, mercury-wetted, 12-VDC coil, (Claire HGJJM5111 p00, or equivalent)
A complete kit of parts including the mercury-wetted relay is available from SolarWorks, PO Box 541132, Grand Prairie, TX 75054-1132 for $69.95. Add $3.00 for postage and handling per order.

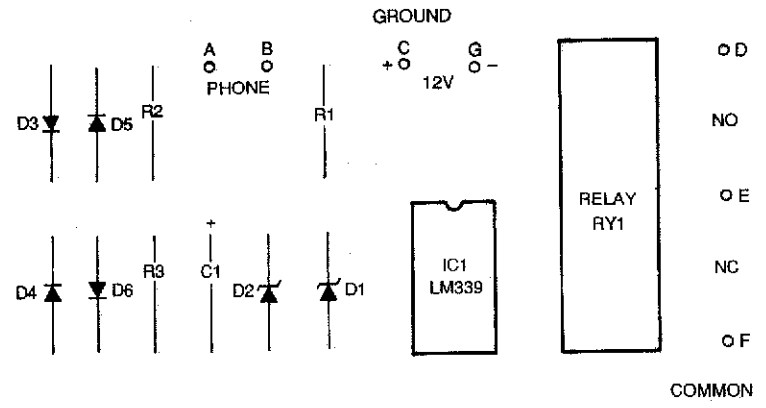
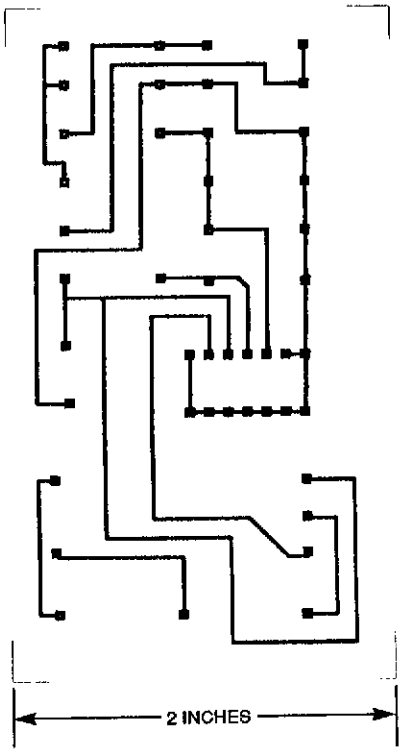


FIG. 2—PC BOARD SILK SCREEN diagram on the non-foil side of the board locates placement and polarization of parts. Location of pads for external connections are pin pointed.



FOIL SIDE VIEW of the printed circuit board shown same size.

phone service and its presence on the line will be unnoticed by you and those who call you.

The rectified or polarized voltage from the bridge rectifier is fed to a long time-constant filter formed by R2 and C1. This filter includes a Zener diode (D2) that limits the voltage maximum charge on C1 to 12 volts during normal operation. Resistor R3 provides a high-resistance shorting path to drain the charge from C1 when there is no input voltage. This is the resistor that sets the time delay for activating the alarm.

The trigger voltage for comparator IC1-a is generated by R1 and D1. Diode D1 is a 5.1 volt Zener whose output is fed to the inverting input (pin 4) of IC1-a. With the inverting input at 5.1 volts, any voltage above 5.1 on the non-inverting input (pin 5) will cause the output of the comparator to go high. Since the output of IC1 is tied to the relay

Continued on page 124

PHONE LINE MONITOR

continued from page 47

coil of RY1, and the other end of the relay is tied to +12 volts DC, the relay coil is not energized. When the voltage from the input filter drops below 5.1 volts, the output of IC1-a goes low and energizes the relay. The contacts of RY1 (either the normally-open set or the normally-closed set) could also be used to trigger the home's security system.

Construction

Wire wrapping or point-to-point wiring could be used to assemble the project, but using a PC board promotes neatness, compactness and increased success in first-time testing. An appropriate PC pattern is provided. Note that a relatively expensive mercury-wetted relay is called for in the Parts List. These relays are extremely reliable at low voltages, and since this is a security device, the best available relay should be used. From the circuit's parts placement diagram (Fig. 2) you can see that the mercury relay must be positioned with one end up. This is necessary so the mercury will be in the correct position relative to the contacts inside the relay. False alarms or no alarms may result if the relay is lying on its side.

The Phone Line Monitor can be housed in any type of metal or plastic utility box. It might be possible to install the Phone Line Monitor in the housing of your current home security system, provided there is ample space. This type of installation will make the 12-volt DC power supply and alarm point connections easier to achieve.

Operation

The Phone Line Monitor requires no calibration. To hook the Monitor to the phone line, you will need to obtain an RJ-11 jack from an electronics or hardware store, and wire it in parallel to the phone line. In most home wiring (I have found no exceptions yet) the live pair from the central office is the two center conductors of the hook-up wire, and these are generally the red/green pairs.

To test for proper operation, unplug the telephone jack from the monitor, and verify that you get an alarm within ten seconds to the security system. That is all that is required to test your unit.

Consider the following very carefully. When your phone line is cut, your alarm system won't be able to call you or the central monitoring station. Therefore, you should use the output of the Phone Line Monitor to drive some kind of house-wide alert, such as a siren or blinking lights throughput the house. Let everyone on the outside know that you phone line has been disconnected and a burglar might be at work. Alternately you might want to install a cellular phone to your alarm system so that an alarm can be transmitted to the central monitoring station or elsewhere without the use of the phone line. The alarm will be transmitted even before forced entry is begun, giving the police an opportunity to catch the thieves! Ω