Solid-State Sensing Modules For Teleguard

Low-cost circuits you build to enhance the operation of the Teleguard security system

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If you built the Teleguard security system described in the May and June issues, you will almost certainly want to build and use the solid-state sensing modules described here with it. The modules presented here have been specifically designed to be used with Teleguard to enhance system operation.

The sensing circuits will respond to such parameters as temperature, light and the presence of fluid (specifically water) to detect fire, thieves, water seepage, and heating system and refrigeration failure. Each circuit is low in cost, easy to build from readily available components, and provides state-of-the-art protection.

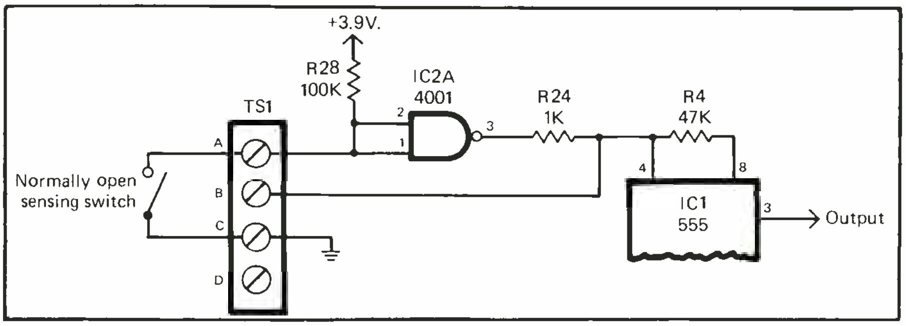

Fig. 1. Simplified schematic diagram of sensing circuit and controlling oscillator inside Teleguard, using a normally open protective circuit.

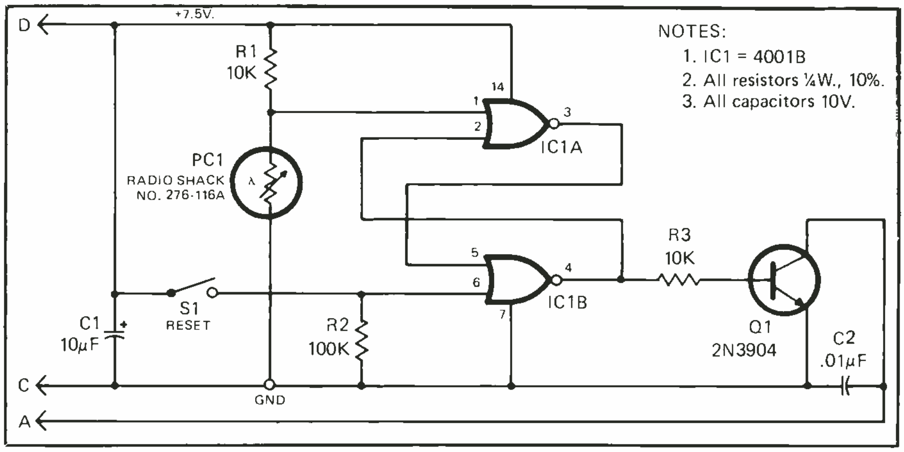

Fig. 2. This latching-type light-activated sensing module uses a photocell and light beam to monitor doorways and passageways to detect intruders.

Teleguard's Sensing Circuit

In Fig. 1 is shown a simplified schematic diagram of the sensing circuit and controlling oscillator inside Teleguard that uses the normally open protective circuit connected between terminals A and C of terminal strip *TS1*. With the external sensing switch open, the logic-0 fed to pin 4 of *IC1* holds the voltage at this point to zero by the inverting action of *IC2A*. This prevents *IC1* from oscillating and maintains Teleguard in its standby mode. When the sensing switch closes, 3.9 volts appears at pin 4 of *IC1*, allowing oscillation to occur and teleguard to dial out its stored telephone number.

Control of Teleguard can be accomplished with ordinary passive switches, thermostats, etc. However, a more reliable—if not more elegant—way to do this is to use solid-state circuitry to control the logic level at terminal A of *TS1*.

When triggering of Teleguard is to occur, the sensing modules described below will control the logic level by shorting terminal A to ground through a switching transistor. When the circuit is in standby, the transistor will be cut off, allowing terminal A to rise to logic 1 by means of pull-up resistor *R28* in Teleguard's circuitry.

To power the sensing modules, it is necessary to provide a source of dc power. This can be obtained from Teleguard itself, rather than from a separate supply. The Parts List for Teleguard specified a four-contact terminal strip for *TS1*, though in implementing the circuit only three contacts were used (labeled A, B and C). The fourth contact, which we identify as D, can be used to provide 7.5 volts dc to the sensing modules. Simply connect a wire from the positive end of *C4* to the unused lug on *TS1*. Thereafter, whenever you run wires from Teleguard to the sensor modules, simply include an extra one for the power line.

Since Teleguard's input sensing circuit has a high impedance, you should use two-conductor shielded cable to make connections between it and any sensing modules that are more than about 2 feet away. Connect the shield to terminal C. Also, since Teleguard's ground connection is not isolated from the telephone line, be sure to use an insulated shielded wire so that terminal C does not become accidentally grounded to anything else.

Light-Activated Sensing Modules

A latching-type light-activated sensing module is shown schematically in Fig. 2. This module will cause Teleguard to transmit an emergency call to the preprogrammed telephone number when light to photocell *PC1* is interrupted for even a fraction of a second. When this occurs, the logic level fed to terminal A on Teleguard's terminal strip is set to transmit and will remain so even if the light beam to *PC1* is restored.

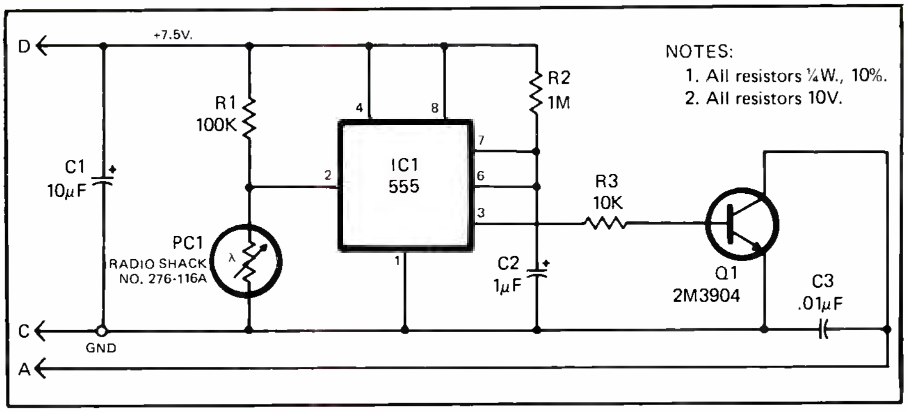

Fig. 3. This nonlatching light-activated sensing module is designed to monitor a normally closed and dark room, such as a storeroom or a vault.

A practical application of the Fig. 2 circuit would be to sense the passage of an intruder through a doorway or a passageway. The sensing module would be located on one side of the doorway or passageway, the light source on the other side and aimed so that it illuminates the sensitive surface of *PC1*. An unauthorized person passing through the protected portal will then break the beam and trigger the circuit.

Operation of the circuit in Fig. 2 is as follows: *IC1A* and *IC1B* NOR gates are wired in a bistable (latching) multivibrator configuration. This circuit can assume either of two logic states, depending upon the last logic-1 level placed on either of the input terminals at pin 1 of *IC1A* or pin 6 of *IC1B*.

When the circuit is in standby and light is directed onto *PC1*, the voltage at pin 1 of *IC1A* is near zero (logic 0). Similarly, the voltage at pin 6 of *IC1B* is also at logic 0, the result of the open contacts of RESET switch *S1* and *R2*. You preset the logic state of the output terminal at pin 4 of *IC1B* after power is applied to the circuit when you press and release momentary-action switch *S1*. This sets the circuit to its inactive mode. At this point, pin 4 of *IC1B* is at logic 0, cutting off *Q1* and putting Teleguard in its standby mode.

As long as light falls on *PC1*, the circuit will be armed and in standby. Interrupting the light beam causes pin 4 of *IC1B* to go to logic 1, turning on *Q1* and activating Teleguard. Should the light beam be restored, pin 4's logic level will remain high and Teleguard will continue to transmit its emergency call. Only when *S1* is operated will the circuit return to standby and cancel the call.

A simple modification can reverse the Fig. 2 circuit's operation such that it holds Teleguard in standby with no light falling on *PC1* and triggers it when light is detected. To obtain this method of operation, simply connect *R3* to pin 3 of *IC1A* instead of to pin 4 of *IC1B*. This operating scheme is possible because the outputs of the latch circuit at pins 3 and 4 are always at opposite logic states. To put the modified circuit in the standby mode, you simply press and release *S1* as before.

A nonlatching light-activated sensing module is shown schematically in

Fig. 3. With this circuit, the transmit signal is produced by Teleguard only when light falls on *PC1*. Should *PC1* go dark after some light has been detected, the transmit signal will be canceled and Teleguard will return to standby. With the circuit shown, light must continuously fall on *PC1* for at least 30 seconds for Teleguard to dial out its stored telephone number and the call to be answered.

A practical application of the Fig. 3 circuit is protection of a normally closed and dark room. Should a thief break in and turn on a light, the transmit signal will trigger Teleguard into making its telephone call.

A common 555 timer, connected as a monostable (one-shot) multivibrator is used in the Fig. 3 circuit. The pin-2 trigger input of *IC1* is held to about 7 volts when *PC1* is dark. This inhibits *IC1* from operating and maintains the pin-3 output at 0 volt. It also keeps *Q1* in cutoff and places a logic 1 on terminal A of *TS1*.

When light strikes *PC1, IC1* is triggered into operation with a one-shot period of about 1 second. Since *IC1* is a retriggerable multivibrator, light continuing to fall on *PC1* causes the pin-3 output to remain at about 7 volts. This forward-biases *Q1* and shorts terminal A of *TS1* to ground to initiate the telephone call.

Since the Fig. 3 circuit is nonlatching, the emergency call will be made only if light shines on *PC1* long enough for Teleguard to outpulse the number. If desired, you can increase the time constant of the circuit to about 45 seconds by changing the value of *C2* to 47 microfarads. This will assure that at least one telephone call will be made by Teleguard should light strike *PC1,* even if only momentarily.

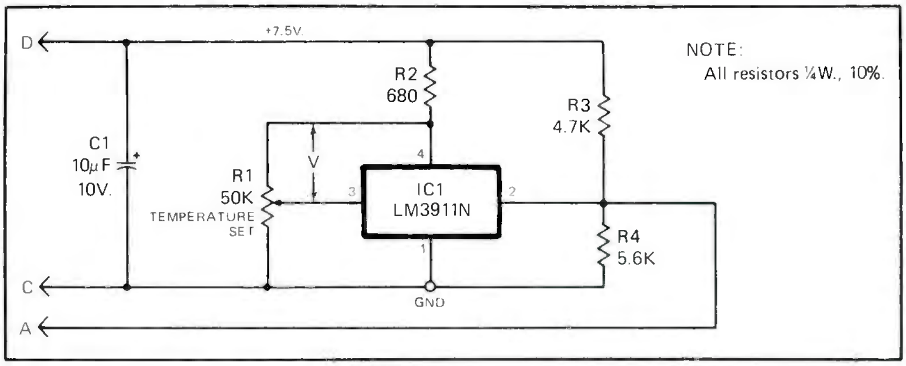

Fig. 4. This temperature-sensing module triggers Teleguard when a rise in temperature is detected. Use it as a fire or refrigeration failure monitor.

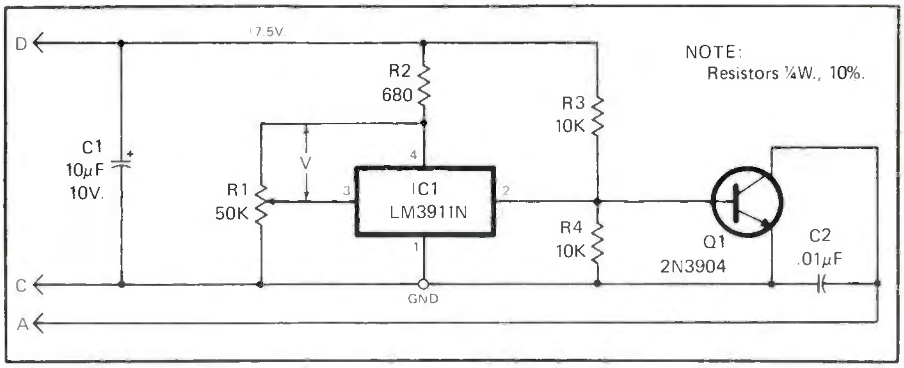

Fig. 5. This temperature-sensing circuit detects a fall in temperature. Use it to monitor for heating system failure or danger of frost damage.

Temperature-Activated Sensing Modules

Monitoring the temperature of your home or office—or a refrigeration system—is a practical way to alert you that an emergency exists in your absence. With temperature used as the sensing parameter, you can have Teleguard detect fire and heating system, refrigeration, air-conditioning or freezer failure. You could even use such a detector in a greenhouse to warn you when delicate plants might be ruined by a killing frost.

At the heart of the temperature-sensing modules shown schematically in Figs. 4 and 5 is a low-cost specialized IC that reacts to changes in temperature. This precisely calibrated IC can be used to set the desired temperature switching point, using a simple dc voltage measurement between pins 3 and 4 of the LM3911N used for *IC1* in both circuits.

Since a heat emergency, such as a fire, requires opposite logic from a sensor designed for heating system failure, two slightly different circuits are required to monitor the two different conditions. The Fig. 4 circuit will cause Teleguard to transmit its emergency call when a rise in temperature is detected and would be used to protect against fire or refrigeration failure. The Fig. 5 circuit, on the other hand, detects a fall in temperature and can be used to alert you when a heating system fails or when there is a threat of frost. Both circuits are provided with potentiometer controls (*R1*) to let you set the switching point to that temperature that is correct for your application.

The circuits in Figs. 4 and 5 operate in much the same manner. Sensor *IC1* contains a 6.8-volt reference circuit, an operational amplifier and a switching transistor. The last con-

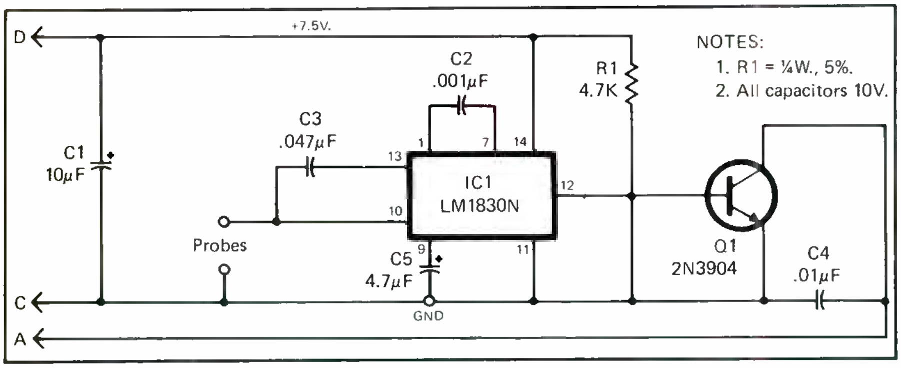

Fig. 6. Use this fluid-detecting module with Teleguard to alert you to take remedial action when water seepage threatens to damage your home or business.

ducts when temperature rises above the trigger point set by *R1*. The temperature at which the on-chip transistor turns on is defined by a simple equation that relates voltage to degrees centigrade.

The output transistor in *IC1* serves as a switching control for terminal A on Teleguard for any application that requires the emergency call to be transmitted when temperature rises in the monitored area. The circuit for this mode of operation is shown in Fig. 4. If you wish the system to respond to a fall in temperature, an additional transistor external to *IC1 (Q1)* must be used to invert the output signal.

The voltage between pins 3 and 4 at which *IC1* switches can easily be calculated for the desired temperature in °C as follows: volts = 2.73 + (0.01 × °C). If you do not know the °C equivalent for any temperature expressed in °F, simply convert as follows: °C = [5(°F − 32)/9].

Suppose you wanted to build a sensor that will alert you when a fire breaks out. You would use the Fig. 4 circuit. Now assume you want Teleguard to make its call when the temperature in the protected area rises above 105°F (40.6°F). Using the voltage formula, you would determine that 3.14 volts would be required between pins 3 and 4 of *IC1*. Should you wish to be alerted in the event of a heating system failure, you would use the Fig. 5 circuit and set the circuit to trigger at, say, 50°F (10°C), which requires a potential between pins 3 and 4 of *IC1* of 2.83 volts.

Connect the temperature-sensing module to Teleguard using terminals A, C and D of *TS1* (do not use terminal B). Connect a dc voltmeter between terminals 3 (negative) and 4 (positive) of *IC1*. Apply power to Teleguard and adjust *R1* for the desired voltage. Use a fairly accurate (20,000 ohms/volt or greater) voltmeter when making this measurement to ensure that switchover temperature is as accurate as possible.

Fluid-Activated Sensing Module

Water seepage as the result of a heavy rainfall or spring thaw can cause a lot of damage if it is not caught in time to take remedial action. Using a solid-state fluid detector to trigger Teleguard is an ideal way to guard against water damage. Such a sensor is shown schematically in Fig. 6.

At the heart of the Fig. 6 circuit is a low-cost LM1830N IC that can detect the presence or absence of a conductive fluid bridging two metallic probes connected to its input. Any *conductive* fluid can be detected with this arrangement.

Inside the LM1830N used for *IC1* in the Fig. 6 circuit is an oscillator, a detector and an on-chip output transistor. This circuitry triggers on when the resistance between the probes is greater than the built-in reference resistor. Since the normal condition for the Fig. 6 circuit is an absence of fluid, the on-chip transistor normally conducts. Therefore, pin 12 of *IC1* will be at ground potential and *Q1* will be off.

When a fluid bridges the probes, the potential at pin 12 of *IC1* rises to the 7.5-volt supply level and forward-biases *Q1*, shorting terminal A on Teleguard to ground and causing Teleguard to start the dialing sequence.

Note in Fig. 6 that one of the sensing probes is connected to circuit common (ground) and is not isolated from the telephone line. *Under no circumstances should either probe be allowed to contact any conductive object.* To prevent this from happening, mount the probes on an insulated base, such as perforated board, to maintain good isolation between them. Secure the assembly so that the probes touch nothing but the fluid being monitored.

In Summary

Once you have installed your Teleguard security system, you will find that it requires very little attention. Your only real concern will be to perodically check to make sure that the OK LED is on. The security provided by the system will give you peace of mind that your home and/or business is protected from intruders, fire, water damage, etc.—even while you are away. You will also discover that the solid-state sensing modules described here greatly expand upon the type of monitoring provided by the usual switch- and tape-type sensors used in other surveillance systems. In fact, if you wish, you can supplement the solid-state sensors with those passive sensors to achieve both local-area and full-perimeter monitoring with Teleguard. **ME**