A Remote Alarm Reporting System

If you’re going to have a home-control system, it helps to have a convenient medium for checking the data the system gathers. In October’s issue of *Circuit Cellar*, Bruce Winter designed a response system that broadcasts information over a home audio system. In November’s issue of *Circuit Cellar*, Mike Baptiste’s Embedded Living column will explain how he designed a TV module that enables him to view information from his home-control system on his television screen.

If you’re not sure about a talking house or don’t want to be interrupted while watching your favorite shows, you might be interested in a multichannel microprocessor-controlled remote event/alarm reporting system that can contact you via cellular phone, numeric pager, or computer. Designed to monitor up to eight different alarm or event conditions from various types of sensors and report the particular channel that was activated, the Tele-Alert can be configured to monitor voltage levels, temperature changes, movement, windows, doors, safes, and perimeters, as well as computer equipment.

Because the system is used with your existing telephone line, no additional charges are added to your monthly phone bill. The Tele-Alert can be programmed to call you on your cellular phone (or a friend, relative, etc. on theirs). Simply reprogramming the Tele-Alert will convert it to notify you via a numeric pager instead of your cellular phone.

A modem daughterboard currently under development will permit the Tele-Alert to call your PC and report different alarm messages based on the input channel activated. In this mode, each Tele-Alert system is coded so a number of different reporting stations can call into a central PC. The Tele-Alert kit contains the PC board, resistors, capacitors, diodes, integrated circuits, resonator, PIC controller, reset switch, IC sockets and headers, and software. The kit does not include an enclosure, but does include the cellular phone and pager programs and is expandable for future applications.

The Tele-Alert is compact as well as expandable. All you have to do is attach a 9-V power supply, connect your telephone line and the sensor connections, and you’re ready to go. There are three optional enhancement modules currently being developed. The optional motion module allows the Tele-Alert to detect movement. The motion module also contains two normally open and two normally closed alarm loop channels so a number of alarm sensors/switches can also be used.

The optional temperature/voltage level module allows your Tele-Alert to monitor up to four temperature or voltage level presets, and report the changes via your cellular phone or pager. The optional listen-in module enables you to listen in to the area being protected for up to two minutes. These optional enhancement modules can turn your Tele-Alert into a multi-
faceted alarm system that protects your home, cottage, or office.

UNDER THE HOOD

The Tele-Alert multichannel alarm reporting system begins with the circuit diagram shown in Figure 1. The heart of the Tele-Alert is the PIC16C57 chip, which emulates the Basic Stamp II computer. The PIC16C57 is preloaded with a BASIC interpreter much like the Parallax Basic Stamp II (BS2).

The PIC16C57 is a much less expensive approach to solving the problem but requires a few more external parts than the Basic Stamp II. The PIC16C57 requires little in the way of support chips to make it function—basically only two support chips, a 24LC16B EEPROM for storage and a MAX232 for communication. Only a few extra components are needed to form a functional microprocessor with serial input/output. A 20-MHz ceramic resonator, a few resistors, and a diode are all you need to use the processor in its simplest form.

In order to turn the BS2 look-alike into a Tele-Alert, a few extra components must be added to the basic configuration. First, you need to configure pins 10–17 as inputs, for a total of eight inputs that can be used to sense events or alarm conditions (see Table 1).

The first four input pins are brought out to the terminal block for easy access. These first four inputs (IN1–IN4) are used when the microprocessor is configured in cellular phone (Cell-Alert) or modem (Data-Alert) modes. When the circuit is used in pager (Page-Alert) mode, a second set of four inputs can be used for a total of eight input pins.

The second four input pins are shown at IN5–IN8. Note the resistors placed across each of the input pins. Pins 18–25 are configured as output pins. Pin 18 activates or enables the microphone in the listen-in module. Pin 19 drives the solid-state relay at U4. The microprocessor activates the LED in U4, which closes the relay contacts at pin 4 and 6 of the relay, which essentially shorts out blocking capacitor C11 and allows the phone to dial your cell phone or pager.

Pins 20 and 21 of U1 are audio output pins. Pin 20 of U1 outputs the touchtone signals needed to dial the phone when an alarm condition is sensed. Pin 21 outputs the tone sequences that are used to indicate via your cell phone which event/alarm channel has been activated.

The capacitors at C9 and C10 are used to couple the touchtones and the alarm sequence tones to the coupling transformer network formed by T1 and the associated components. Capacitor C10 is placed across T1 while Zener diodes D2 and D3 are used as voltage-clamp diodes at the input of the transformer.

Transformer T1 couples the audio from the Tele-Alert to the phone line, once the unit has been triggered. Resistor R9 is used to couple one side of the transformer to the phone line at J6, and also acts to hold the phone line. The other secondary transformer lead is coupled to the phone line via C11, which is a blocking capacitor that keeps the phone “off the hook” until an alarm condition occurs.

The solid-state relay at U4 acts to short out C11 when an event or alarm condition occurs, thus coupling the T1 to the phone line. Resistor R16 is an MOV and is used to protect the circuit from high voltage spikes. Pins 22 and 23 may be used as auxiliary outputs to drive local alarm sirens or outdoor lights if desired, while pin 24 is left for further expansion.

Pin 25 of U1 is used as a status indicator, when the microprocessor is configured as a Page-Alert. The 20-MHz ceramic resonator is connected between pins 26 and 27 to establish the clock reference for the BASIC interpreter chip at U1. Pin 28 resets the microprocessor via S1 if the system locks up. The serial 16-KB EEPROM memory is coupled to the microprocessor via pins 6 and 7.

The microprocessor communicates via U3, a MAX232 serial communication chip. The MAX232 is coupled to the microprocessor through pins 8 and 9 (i.e., an input pin and an output pin). Four capacitors are all that are required to animate the MAX232 serial communication chip. These capacitors are required as a charge pump to create a minus voltage for the serial chip. The MAX232 is coupled to a 9-pin serial connector for serial communication with a laptop or personal computer for programming purposes.

The Tele-Alert circuit is powered via the regulator at U5, which provides 5 V to U1, U2, and U3. A 9-V DC wall wart power supply can be used to provide power to the Tele-Alert circuit.
The 9-V power supply is also used to provide power to optional enhancement modules.

BUILDING THE TELE-ALERT

Construction of the Tele-Alert is quite straightforward (see Photo 1). First, you’ll need to line up the circuit board with the parts layout diagram. Be sure the circuit board is facing you with the component side facing up as you begin placing parts into the circuit board. This is an important step, so take your time and make sure you are placing the components on the correct side of the circuit board before you begin soldering parts to the double-sided circuit board.

You can begin by placing the resistors and capacitors on the board. Be sure to observe the correct polarity when installing the capacitors or the circuit will not work correctly. Integrated circuit sockets were installed for the ICs in the event the circuit needs to be serviced at some point in time. These sockets can now be installed.

Next, you can install the diodes and the LED. Once again, be sure to observe the correct polarity of the diodes when installing them. Now install the ceramic resonator and the MOV, followed by the transformer and regulator U5. Please note the orientation of the semiconductors before installing them. The integrated circuits usually have either a cut out or notch taken from the top of the chip or a small circle cutout at the top of the chip. Generally pin #1 is just to the left of the circle or cutout. Now install the male communication header J5, and the two optional enhancement female headers, J1 and J2.

Last, install the reset switch. The Tele-Alert circuit board measures 4 x 2.5” and can be housed in a suitable plastic enclosure. Note that the basic Tele-Alert is only about 0.5” high, but if you intend to add optional modules, you should consider a taller enclosure to accommodate the optional circuit boards.

PUTTING IT TO WORK

Operating the Tele-Alert is simple. First you will need to connect a 9-V power supply to the circuit via the two power input pins at the top of the board. Then you will need to make up a serial communication or programming cable that connects the Tele-Alert header J5 to the serial port of your programming computer (see Figure 1). Fire up your PC and load the supplied disk into your computer. Make a directory called TELE and dump the contents of the disk into that directory. Once the communication cable has been attached, you will need to load the STAMP2X program. This is the editor program you will use to load the Tele-Alert programs into the microprocessor.

You should see both the Cell.BS2 program, which is used to operate the system as Cell-Alert, and the Page.BS2, which makes the microprocessor function as Page-Alert. Start the STAMP2X program and press ALT-L, then scroll through the list and highlight the Cell-Alert program, titled Cell.BS2. Press Enter and the program should now be displayed on the screen.

Scroll down the displayed program and look for the simulated phone number and replace it with your own phone number. Remember a digit 10 is programmed by a zero. If you want to dial a long-distance number just add the full sequence of numbers. If you wish to dial out from a PBX telephone system, you will need to first put in the access number such as an 8 or 9 followed by a comma then the actual phone number. Next, press ALT-R to load the program into the Tele-Alert circuit. Note that the procedure for changing the simulated phone is the same when programming the circuit as a Page-Alert.

Your Tele-Alert is now programmed and ready to operate. At last, you can connect your event or alarm inputs to the set of solder pads at the far edge of the circuit board, just below the phone-line connection. Remember, you must use normally open circuit switches for the alarm inputs unless you are using the optional motion module, which provides both normally open and normally closed inputs. Connect your phone line via the phone jack and your Tele-Alert is now ready for action.

You can test the circuit in one of two ways. A simulated approach is to con-
nect a crystal headphone across the secondary of T1 at J6, with the Tele-Alert disconnected from the phone line. Apply power to the circuit and connect a normally open switch across input IN1. Activate the switch at IN1 and you should begin hearing activity at the crystal headphone. First you should hear the touchtone sequences followed by the alarm tone sequence. If this test checks-out, you can move on to a real test by connecting the Tele-Alert to the phone line and repeating the same test over again. This time your cell-phone should ring.

The main Tele-Alert circuit board has two 10-position female header jacks (i.e., J1 and J2) near the input terminal solder pads. These 10-pin headers enable you to add the optional enhancement modules. The listen-in module and the Data-Alert modem plug in to the first header socket near the input terminals at J1 and the temperature/voltage module (TVL) or the motion module plug into the second header row pins J2. These optional modules will soon be available as low-cost kits.

CUSTOMIZING YOUR TELE-ALERT SYSTEM

The Tele-Alert system can be used in a number of different alarm configurations such as monitoring safes, doors, windows, floor mats, computers, movement, temperature and voltage changes, as well as smoke and fire sensors. The system can even monitor existing local alarms by using the Tele-Alert as a multichannel dialer. With the motion module you can protect a vacation house or cabin using the existing phone line. You can even monitor an overheating computer or UPS failure. With a little imagination, you can implement the system in almost any alarm configuration from multi-zoned alarm systems to simple multi-event annunciator. The Tele-Alert can even drive a siren or flashing outdoor lights to create a local alarm if desired.

Figure 2 illustrates optional local alarm connections. Relay 1 can be used to drive small loads such as an electronic Sonalert or, with the addition of Relay 2, you can drive larger loads such as motor sirens or flashing outdoor lamps. You can drive two external loads from OT-1 and OT-2. Output OT-3 is left for future expansion, which could include X-10 appliance activation.

With the Tele-Alert system, you can be notified of an alarm condition anytime and anywhere. The Tele-Alert can dial multiple phone numbers or repeatedly dial the same number as desired. If a second party is notified, the condition can be verified and the police could be called depending upon the severity of the alarm condition. Rover may bark at things that go bump in the dark, but even with the best obedience school training, he won’t be able to call your cell phone or pager to tell you what’s going on. Build a Tele-Alert system and you’ll get a full-time personal sentinel, not to mention some peace of mind.

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SOFTWARE

The Cell.BS2 and Page.BS2 programs, as well as a parts list for the Tele-Alert kit, are available for download on the Circuit Cellar web site.