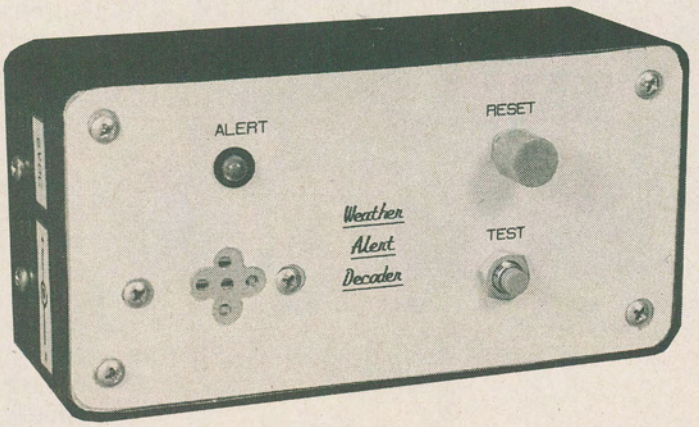
Weather Alert Decoder



Catch all the latest weather bulletins transmitted by the NOAA with this easy-to-build circuit that alerts you to impending NOAA broadcasts.

BY KEITH RAWLINSON

NOAA Weather Radio is a function of the National Oceanic and Atmospheric Administration (NOAA). The NOAA service provides the latest weather information directly from the National Weather Service offices. According to NOAA, about 90% of the U.S. population is within the broadcasting range of at least one of the nearly 380 stations operated in the United States; there are even stations operating across much of southern Canada.

NOAA Weather Radio consists of a network of FM stations broadcasting on one of seven frequencies: 162.40 MHz, 162.425 MHz, 162.45 MHz, 162.475 MHz, 162.50 MHz, 162.525 MHz, and 162.55 MHz. During severe weather, National Weather Service forecasters can interrupt regular programming and insert a special 1050-Hz tone (that lasts for several seconds), which activates specially designed receivers prior to an emergency announcement. It is that "alert tone" that activates the *Weather Alert Decoder* described in this article.

Once triggered, the decoder sounds a warning for several minutes, alerting you to listen to the upcoming message, and lights an "alert received" LED that stays lit until it's reset. The decoder can be used with any scanner or other receiver capable of receiving NOAA weather broadcasts to alert you to a weather emergency.

Circuit Description. Figure 1 shows a schematic diagram of the Weather Alert Decoder. The circuit—built around two IC's, a couple of additional semiconductors, and a handful of support components—connects to your scanner via a plug selected to mate with the scanner's earphone jack. A resistor (R7), connected across the input to the circuit, provides a DC load for the scanner. The value assigned to that unit (1k) worked well with the author's equipment, but since its value is not critical to the rest of the circuit, feel free to make substitutions to accommodate your receiver.

The incoming signal is capacitively coupled to the base of Q1 (configured as a buffer amplifier), which is biased for a gain of around 2 by R1, R2, and R8. The buffer also prevents strong audio signals from damaging U1 by limiting such signals to the 6-volt supply level. The output of the buffer is capacitively coupled through C2 to pin 3 of U1 (a 567 tone decoder). The operating frequency of U1 (1050 Hz in our case) is set by R9, R10, and C4 , and is adjustable via R9.

When the frequency of the signal applied to pin 3 matches the preset operating frequency of U1, pin 8 goes low. That low is coupled through R3 to pin 2 of U2 (a 555 oscillator/timer), triggering it into operation. At the same time, the low output of U1 at pin 8 causes C7 to discharge through R3, providing a delay of about 2 seconds. Since the "Alert Tone" falls within the range of the human voice, the system would trigger each time any incoming voice happened to hit the operating frequency if it weren't for the delay.

Any correspondence for NOAA Weather Radio can be addressed to: National Weather Service (Attn. W/OM11), National Oceanic and Atmospheric Administration, Silver Spring, MD 20910

Once U2 is triggered, its pin 3 output goes high and stays high for a time determined by R6, R12, and C8 (or about three to four minutes depending on component tolerances for the values shown).

The output of U1 divides along two paths: In one path, the signal is used to sound a buzzer, BZ1; in the other path, the signal is fed to the gate of SCR1 through D1 (which helps isolate the SCR's gate from the buzzer) and R13 (which limits the SCR's gate current to a safe level). Capacitor C9 is placed across the output of U2 to bypass any transition spikes, which might upset circuit operation, to ground.

The entire system can be manually reset at any time by pressing S2. Although a single SPDT switch is shown, it could be replaced by two separate pushbutton switches (one normally-open and one normally-closed) if you find the single pushbutton unit difficult to locate. The circuit can be powered by any reasonably well filtered 6-volt DC power supply. Capacitor C3 is included in the circuit to provide additional filtering of the supply voltage at the circuit-board level. Be advised that the 567 is rated for a maximum supply voltage of 9 volts DC. Whatever supply you use, be sure not to exceed that value.

Switch S1 provides a means of testing the circuit from the output of U1 on. TP1 is a test point to be used later in tuning up the system.

Construction. Aside from keeping leads as short as possible, there is nothing critical about the construction of the Weather Alert Decoder, a printed-circuit board is, however, recommended. Figure 2 shows a template of the PC-board pattern used by the author in the construction of his prototype.

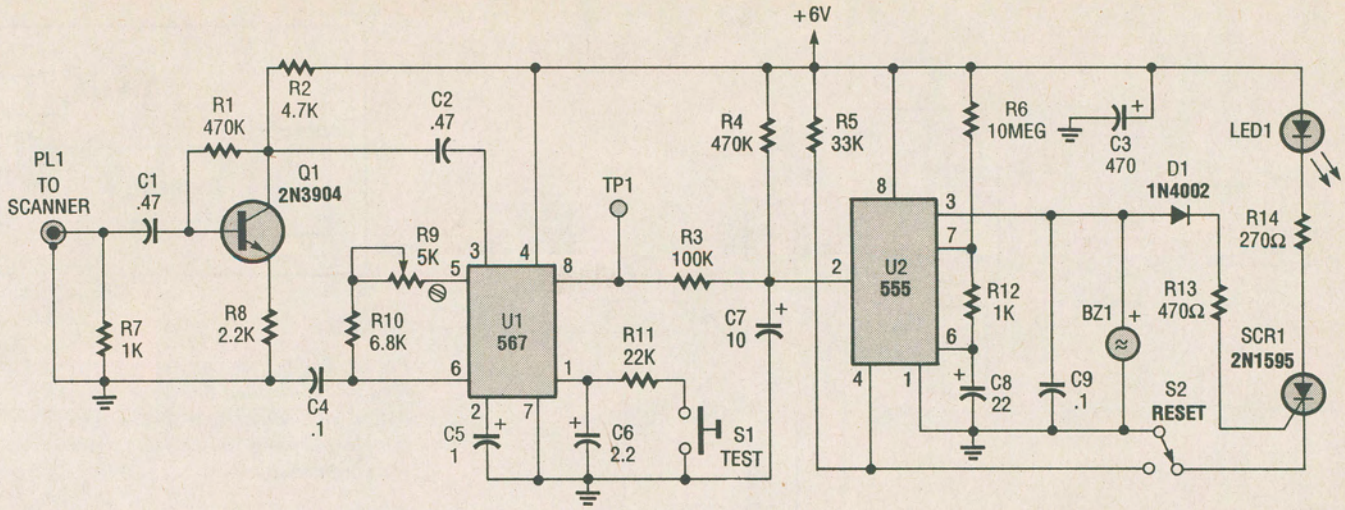


Fig. 1. The Weather Alert Decoder is built around two IC's, a couple of additional semiconductors, and a handful of support components. The heart of the circuit is the U1 (567 tone decoder), which locks onto any signal within its preset capture range.

A parts-placement diagram for the printed-circuit board is shown in Fig. 3. Note that, in the interest of space, R5, R7, and R11–R14, as well as D1, are vertically mounted. Also note that C3, C5, and C6 each have extra mounting holes in the PC board. That's to allow the use of either axial- or radial-lead capacitors (whichever you happen to have). TP1 can be any piece of wire soldered into place and protruding a quarter inch or so above the board. SCR1 can be any SCR with a low enough holding current and sensitive enough gate to operate at the low current levels used in the circuit.

Some of the pads and traces in the layout are close together, so be careful not to bridge them with solder during assembly. The circuit can be housed in any suitable enclosure.

Setup and Use. Once the circuit has been assembled and inspected for construction errors—solder bridges, cold solder joints, and improperly placed components—it's time to tune it up and put it to use. The easiest way to tune the circuit is to connect a frequency counter or oscilloscope to pin 6 of the U1 and adjust R9 for a frequency of 1050 Hz.

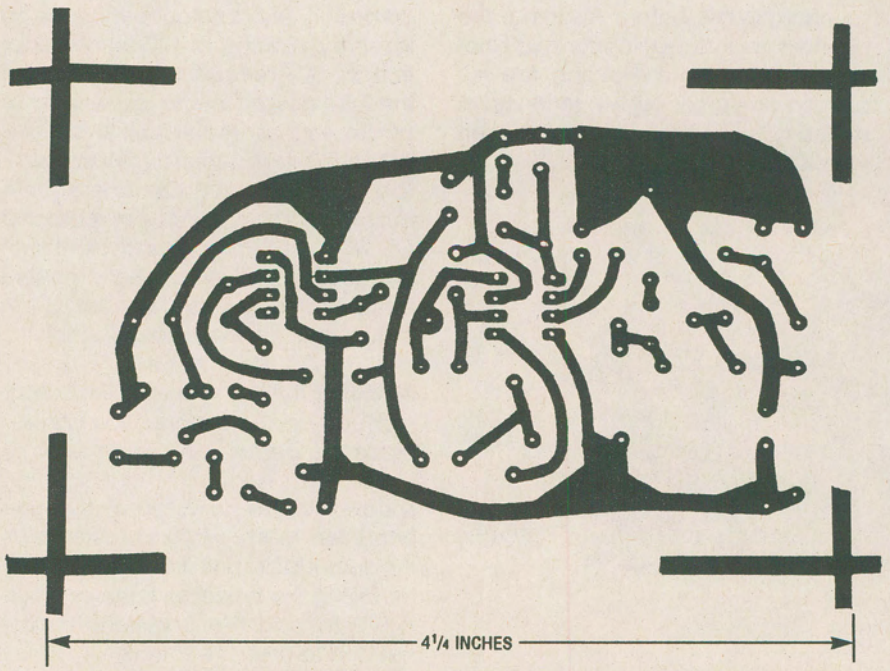


Fig. 2. While there is nothing critical about the construction of the Weather Alert Decoder, it is recommended that the circuit be assembled on printed-circuit board. Here is a template of the PC-board pattern used by the author.

PARTS LIST FOR THE WEATHER ALERT DECODER

SEMICONDUCTORS

U1—567 tone decoder, integrated circuit
U2—555 oscillator/timer, integrated circuit
Q1—2N3904 general-purpose, NPN silicon transistor
SCR1—2N1595 silicon-controlled rectifier, or equivalent, see text
D1—1N4002 1-amp, 100-PIV, general-purpose, rectifier diode
LED1—Jumbo LED

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1, R4—470,000-ohm
R2—4700-ohm
R3—100,000-ohm
R5—33,000-ohm
R6—10-megohm
R7, R12—1000-ohm
R8—2200-ohm
R9—5000-ohm, 10-turn trimmer potentiometer
R10—6800-ohm
R11—22,000-ohm
R13—470-ohm
R14—270-ohm

CAPACITORS

C1, C2—0.47-µF, ceramic-disc
C3—470-µF, 25-WVDC, electrolytic
C4, C9—0.1-µF, ceramic disc
C5—1-µF, 50-WVDC, tantalum
C6—2.2-µF, 25-WVDC, electrolytic
C7—10-µF, 35-WVDC, electrolytic
C8—22-µF, 15-WVDC, tantalum

ADDITIONAL PARTS AND MATERIALS

S1—Normally open, momentary-contact, pushbutton switch
S2—SPDT non-locking pushbutton switch
BZ1—6-volt DC buzzer
Printed-circuit board materials, phone plug, enclosure, IC sockets, 6-volt DC power supply, wire, solder, hardware, etc.

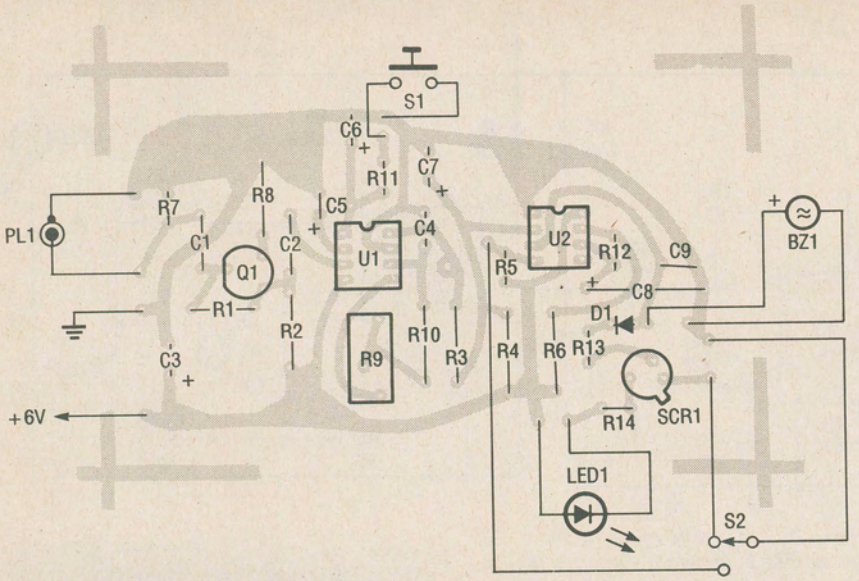
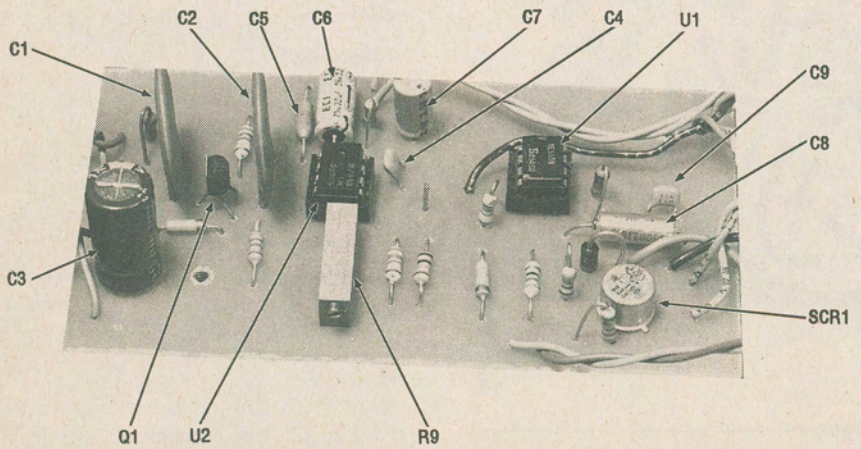


Fig. 3. Use this parts-placement diagram as a guide when assembling the Weather Alert Decoder's printed-circuit board. Note that R5, R7, and R11–R14, as well as D1, are vertically mounted, and that C3, C5, and C6 each have extra mounting holes to allow the use of either axial- or radial-lead capacitors.

If a scope or frequency counter is not available, a signal generator can also be used with only slightly more difficulty. First, solder a 470-ohm resistor to the cathode of an extra LED. Then solder a wire to the LED's anode and connect the other end to the plus supply. Then, connect the remaining lead of the 470 ohm resistor to TP1. Set the signal generator to 1050 Hz at about 0.1 volt and connect it to the input of the circuit. Finally, with R9 fully counterclockwise, rotate R9 slowly clockwise until the LED at TP1 just lights; then, rotate R9 another ¾ turn.

If you're really a glutton for punishment, the circuit can be set up without any extra equipment. NOAA weather radio often broadcasts a test signal at certain times during the week; if you write to NOAA at the address given elsewhere in this article you can find out when the tests are broadcast. Connect an LED to TP1 as described above and wait for the test signal. During the test, quickly plug the unit into your receiver and rotate R9 until the LED at TP1 lights. If you fail to get it before the test ends, you'll have to wait for the next test time and continue from where you left off.

Once set up, the circuit will monitor the NOAA broadcast until the alert tone is sent out, and sounds the buzzer for several minutes before resetting; the LED stays on until reset to inform you that an alert went out. Holding the TEST button down for about two seconds will set the system off manually, so you can check it.



Here is the fully assembled printed-circuit board prior to being mounted in its enclosure. Note that five resistors (R5, R7, R11, R13, and R14) and diode D1 are vertically mounted to the board.

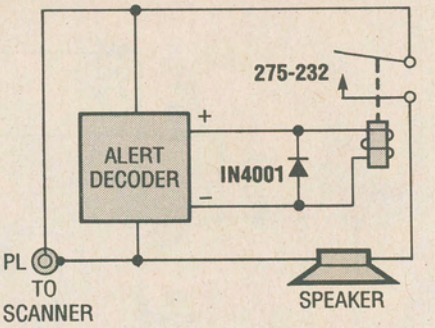


Fig. 4. The buzzer can be replaced by a reed relay provided that your receiver's output jack can drive a speaker directly, thereby allowing you to listen to the warning message.

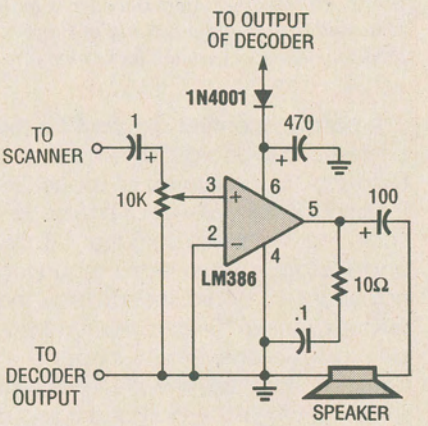


Fig. 5. If your receiver's output can't drive a speaker directly, this circuit will enable you to feed the receiver's output to a speaker.

Troubleshooting. If the LED indicator comes on, but goes out without being reset, try placing a 470-ohm resistor from the SCR anode to the LED anode. If the LED doesn't come on when the buzzer sounds, make sure that D1 is properly installed, then try reducing R13 to 270 ohms. If the buzzer doesn't time out after five or six minutes, try replacing C8 with the highest quality tantalum capacitor you can find. Bear in mind that any noisy signal with a lot of hiss may trigger the decoder constantly.

Modifications. If your receiver output jack can drive a speaker, you can replace the buzzer with a reed relay as shown in Fig. 4. Instead of a buzzer, the speaker will be activated so that you can listen to the warning message. If the output jack can't drive a speaker, try replacing the buzzer with the circuit in Fig. 5 to add the additional boost needed to drive the speaker.

With a little imagination, this circuit could be put to other uses. Just experiment and have fun. ■