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Ham's Handy Heat Hunter

Let this temperature probe take your shack's temperatures.

Every ham shack should be equipped with a means for measuring equipment temperature. Too often we ignore the heat rise in our equipment. Building the probe assembly described here is a very practical way to deter a heat rise condition and to detect heat stresses imposed on our ham gear.

Fig. 1 shows the schematic of a Digital Multimeter Temperature Measurement Adapter that is ideal for measuring temperatures from –40 degrees to +230 degrees Fahrenheit. A few uses for this circuit include monitoring indoor and outdoor air temperature, water temperature, freezer temperature, radio and power supply heat sinks, or any other application requiring accurate temperature readings.

The temperature probe (refer to **Fig. 2**) is plugged into J1 and a digital multimeter set on DC volts is connected to J2 and J3 on the adapter. The circuit drives a multimeter directly. This is especially useful when a temperature measurement is needed only occasionally. Using the multimeter to display temperatures eliminates the cost and need for a dedicated display.

Temperature is displayed at 10 mV per degree Fahrenheit. For example, a meter reading of 2.12 volts corresponds to a temperature of 212 degrees. Similarly, a voltage of 0.325 V represents a temperature of 32.5 degrees and a measurement of –0.401 V denotes a temperature of –40.1 degrees Fahrenheit. Typical accuracy at room temperature is ± 0.8 degrees F. Over the entire temperature range, expected accuracy is ± 1.6 degrees F.

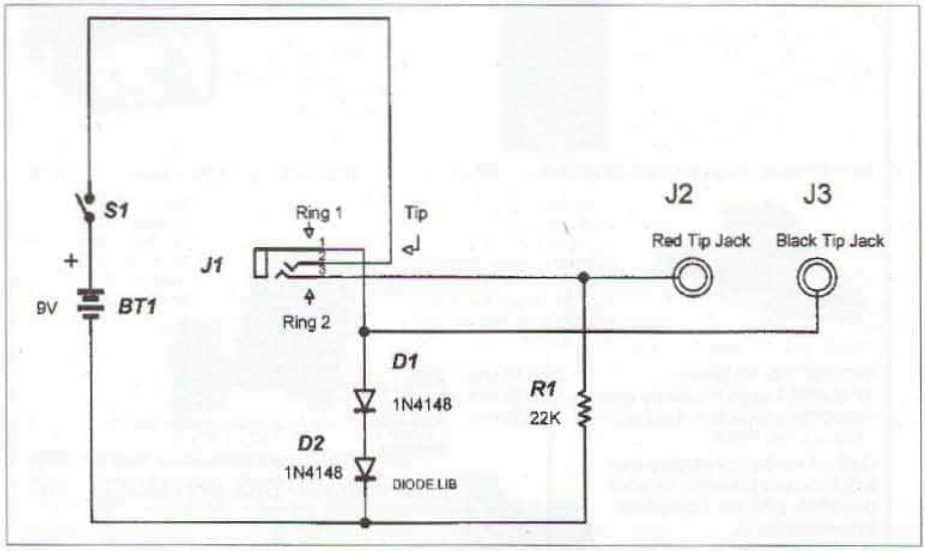

Fig. 1. Schematic of a Digital Multimeter Temperature Measurement Adapter.

The circuit utilizes the LM34CZ temperature sensor from National Semiconductor. As stated above, it is capable of measuring temperatures from –40 to +230 degrees. If a temperature measurement range of -50 to +300 degrees F. is required, an LM34 may be substituted for the LM34C. When the temperature measured is between +32 and +212 degrees, a less expensive sensor (the LM34D) may be used in the temperature probe assembly. If more accuracy is desired, an "A" suffix part may be used (LM34A or LM34CA). These parts have a room temperature expected accuracy of ± 0.4 degrees F and a ± 0.8 degrees F tolerance over the whole temperature range.

Construction

First, construct the temperature probe assembly. Take the 6 ft. stereo cable and cut off one end near the connector.

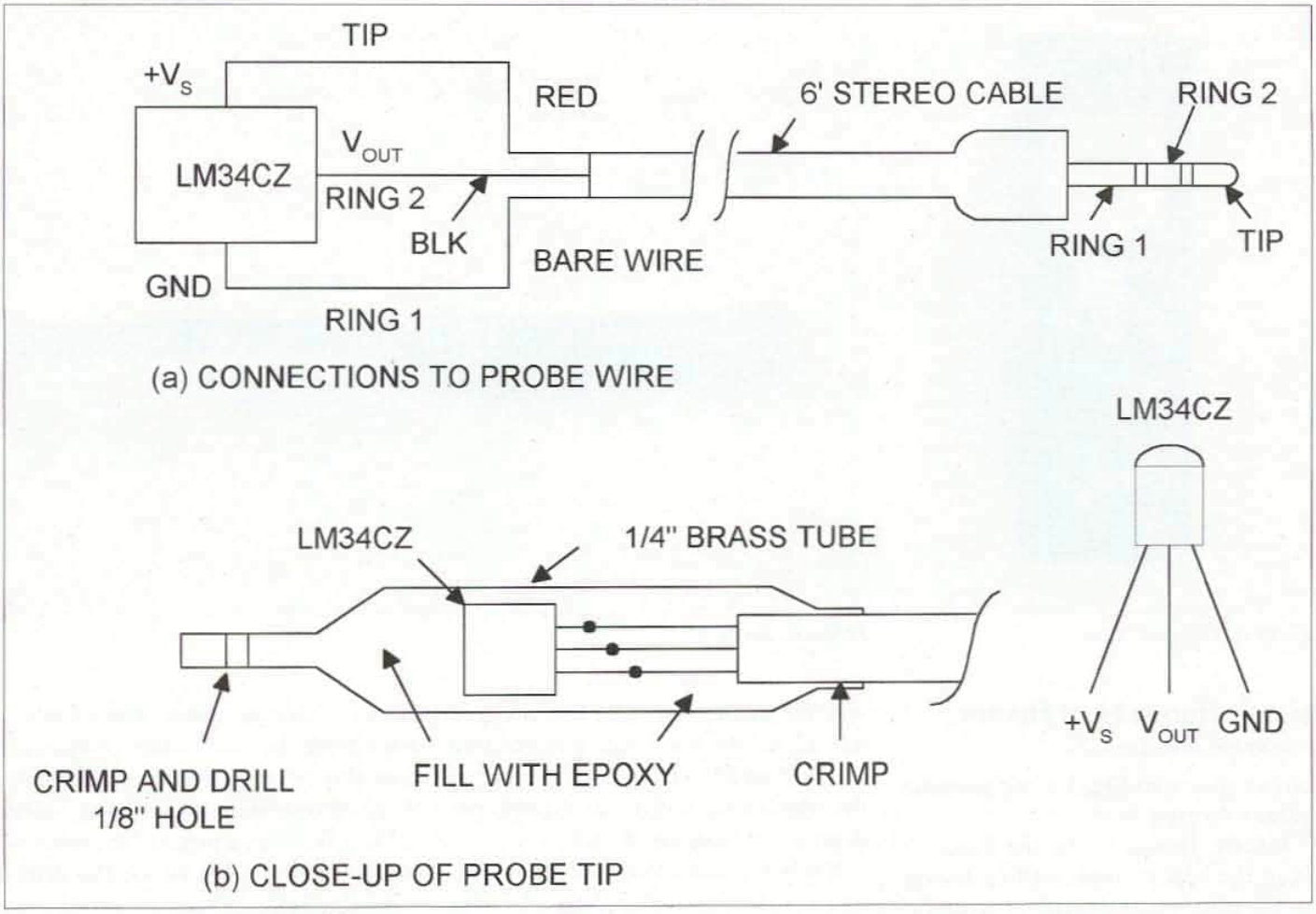

Fig. 2. *Temperature probe assembly.*

Strip the sleeve back about 1 inch. Attach the wires to the LM34CZ temperature sensor as illustrated in **Fig. 2a**. Stagger the solder connections as shown in **Fig. 2b**. Use a small piece of electrical tape to insulate the center wire of the sensor from the other two wires and use another piece of tape to wrap around all three leads. Next, cut a 1-3/4-inch-long piece of 1/4-inch-diameter brass (or copper) tubing. The tubing can be obtained at most hobby stores. Fill the tube with epoxy and insert the temperature sensor. Crimp the brass tube around the cable and crimp the other end flat.

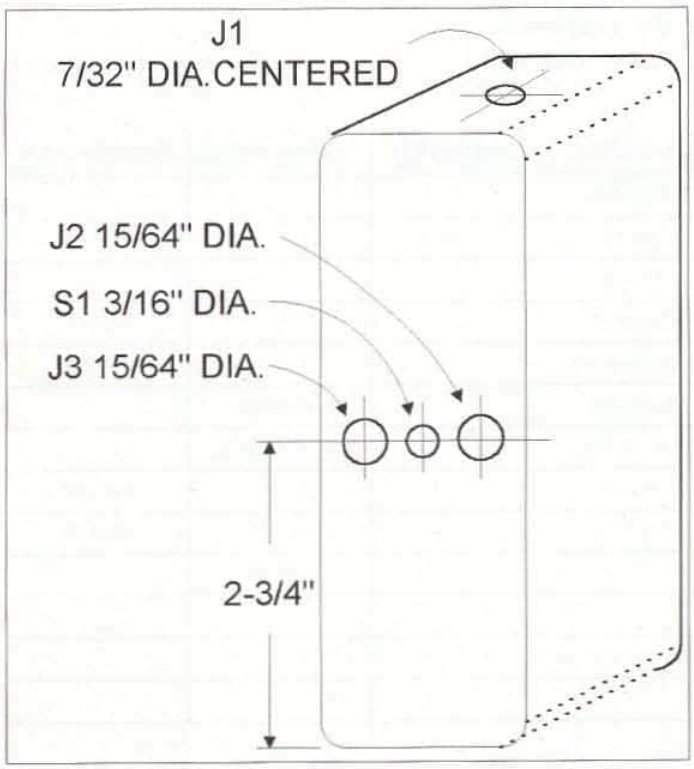

Fig. 3. *Case hole locations.*

After the epoxy has set, drill a 1/8-inch hole in the flat end of the probe assembly. This hole makes it easier to attach the temperature probe to the surface where the temperature is to be measured.

Drill holes in the case for J1, J2, J3, and S1 (see **Fig. 3**). J2 and J3 are red and black tip jacks. The jacks specified in the component list (**Table 1**) are the correct size for the tip plugs on most multimeter test leads. Banana jacks may be used instead of tip jacks. To use the banana jacks, larger mounting holes will be needed. If you make this substitution, be sure that there is still room to mount the power switch S1.

Utilizing banana jacks will require two test leads with banana plugs at each end to connect the multimeter to the Digital Multimeter Temperature Measurement Adapter. Mount J2, J3, and S1 to the case. Refer to the back of the phone jacks packaging for J1's terminal designations. Assemble the

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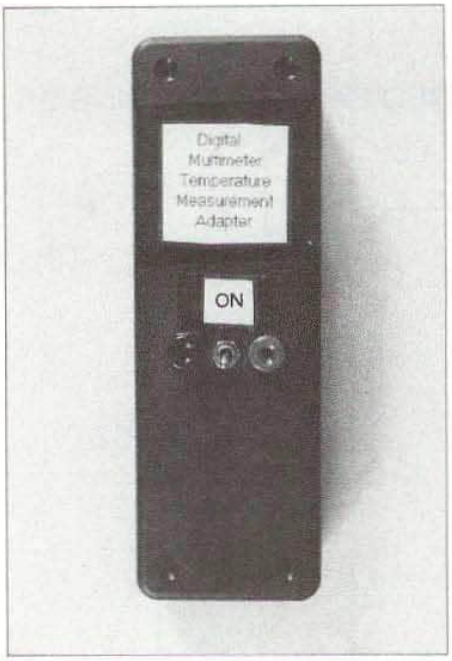

Photo A. Exterior view.

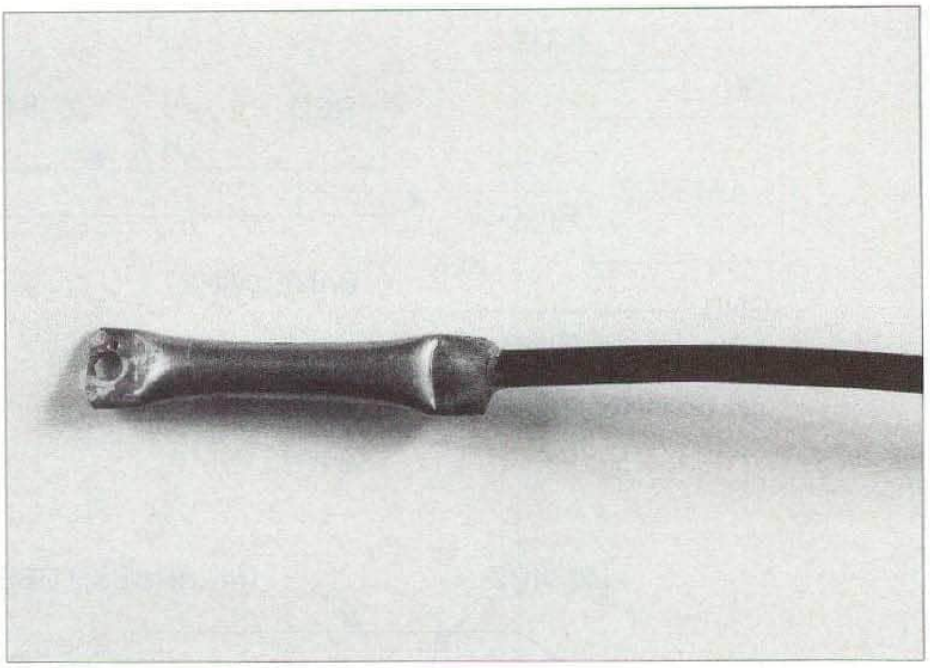

Photo C. Probe tip.

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circuit shown in **Fig. 1** using point-to-point soldering.

Finally, mount J1 to the case. To keep the battery from rattling around in the case, place a piece of foam between the battery and the case. Next, attach the lid to the case with the screws provided.

Use

Plug the temperature probe into J1 with the multimeter's red lead plugged into J2 and the black lead plugged into J3. Turn on S1. The voltage reading of the multimeter will be at 10 mV per degree F as mentioned earlier.

If it is necessary to measure temperature constantly, a digital panel meter can be used in place of a digital multimeter. Don't expose the temperature probe to conditions that are harmful to the brass tube or cable insulation.

In order to determine if the environment is harmful to the temperature probe assembly, save the one-inch piece of cable insulation obtained when assembling the temperature probe. Expose this piece of plastic to determine if the environment is damaging to the cable. Likewise, a piece of the remaining brass tubing can be used to determine if the environment is corrosive to the brass. If it is determined that the temperature probe assembly can be damaged by the environment, it may be necessary to use a cable rated for these conditions.

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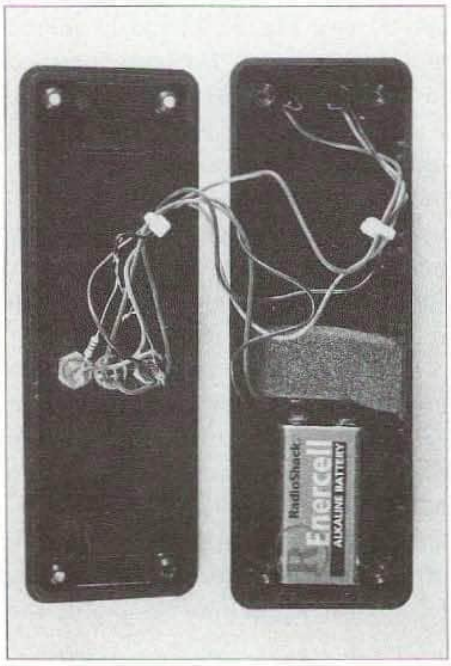

Photo B. Inside view.

Part	Description	Jameco P/N	Mouser P/N	Radio Shack P/N
R1	22k 5% 1/4W			
U1	LM34CZ	107094		
D1, D2	1N1418			
S1	SPST switch			275-624
J1	Stereo phone jack			274-249
J2	Red tip jack		530-105-0802-1	
J3	Black tip jack		530-105-0803-1	
Case	6x2x1			270-1804
Stereo cable	6 ft.			42-2387A
9 V battery clip			123-6006	
9 V battery				
Brass tube	1/4-inch diam. brass tube			
Hookup wire				
Epoxy				

***Table 1.** Component reference.*

available at the perfume counter of most department stores.

Solder a three-conductor cable suitable for the probe assemblies environment to the temperature sensor. In order to use a different cable, the temperature sensor's leads are connected to the stereo plug as illustrated in **Fig. 2**. Fill the glass vial with epoxy, keeping air bubbles to a minimum. Next, insert the sensor into the vial. When the epoxy cures, this sensor can be used in almost any environment.

Now you have a simple way to measure temperature accurately — the Digital Multimeter Temperature Measurement Adapter. 73

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Modifications

Instead of a brass tube to house the LM34CZ, a glass vial may be used. Glass (as well as epoxy) is resistant to almost every environmental condition. However, care must be taken that the vial is not exposed to rapidly changing temperatures, as this could fracture the glass. These vials are commonly used to contain perfume samples and are