Low-Cost Electronic Thermometer

INDICATES LOCAL OR REMOTE TEMPERATURES FROM FREEZING TO 302°F

BY JAMES R. SQUIRES

ELECTRONIC thermometers have proven to be not only more accurate than the old-fashioned mercury types; they are also far more versatile. They can have more than one sensor and the sensors can be mounted almost anywhere within reason with a cable connected to the readout.

A circuit for a good, low-cost electronic thermometer is shown below. The unit has both local and remote sensing and can operate between 32° and 302°F in two ranges.

Thermistors are used as the temperature sensing elements so keep in mind that these devices have a thermal hysteresis effect. That is, if you measure the ambient temperature, then immerse the thermistor in boiling water, after cooling, it will indicate slightly higher than the ambient.

The two scales on the thermometer (X1 and X10) are equivalent to currents of 1 mA and 10 mA through the meter, as determined by the setting of S2. The X1 range is roughly equivalent to a temperature range of 0° to 50°C (32° to 122°F), while the X10 range covers 0° to 150°C (32° to 302°F).

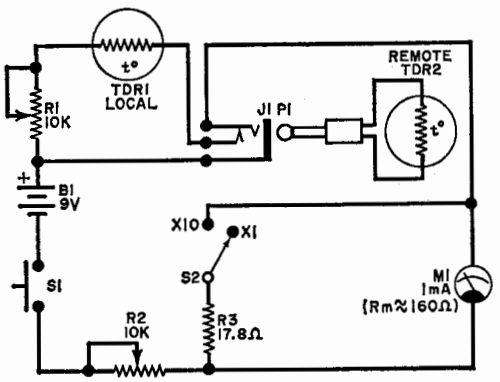
In the circuit, most of the components are in series. The value of *R3* is chosen so that the 1-mA meter will indicate 10 mA. For the meter used in the prototype, a value of 17.8 ohms was required for *R3*. Odd values of resistance for *R3* can be made by paralleling higher values.

Any method of construction can be used (perf board, point-to-point wiring, etc.). Local thermistor *TDR1* can be mounted so that it just protrudes (about ⅛") from the chassis. The remote sensor is attached to the end of a length of two-conductor cable, with *P1* on the other end. The remote sensor is not necessary, of course, if you don't want to use it.

With S2 in the X1 position, plug the remote sensor into *J1*, depress *S1* and adjust *R2* until the meter indicates about half scale. Remove the remote sensor, and adjust *R1* for a center scale indication with the local sensor. Hold the local sensor between your thumb and forefinger and note that the meter indicates upscale. Do the same with the remote sensor. The two changes should be similiar in value and any deviation will be due to slightly different resistance-temperature curves of the two thermistors.

The meter scale is calibrated by immersing the thermistors in ice water (32°F) and adjusting the appropriate potentiometer for the proper indication on the meter. Use boiling water (212°F) for the upper mark. To calibrate the remainder of the scale, keep the two thermistors in the hot water, along with a good mercury thermometer. Stir the water, and mark the other points on the scale as the water cools. Switch *S1* should be operated only when a temperature measurement is to be made. This conserves the battery and minimizes any self-heating of the thermistors due to current flow. ◈

Resistance of either thermistor determines current flow through the meter.



PARTS LIST

B1—9-volt battery
J1—Miniature phone jack, normally closed
M1—1-mA meter
P1—Miniature phone plug to fit J1
R1,R2—10,000-ohm potentiometer
R3—See text
S1—Normally open pushbutton switch
S2—Spdt switch
TDR1,TDR2—Thermistor (Fenwall GB41P2)
Misc.—Suitable chassis, two-conductor cable, mounting hardware, etc.