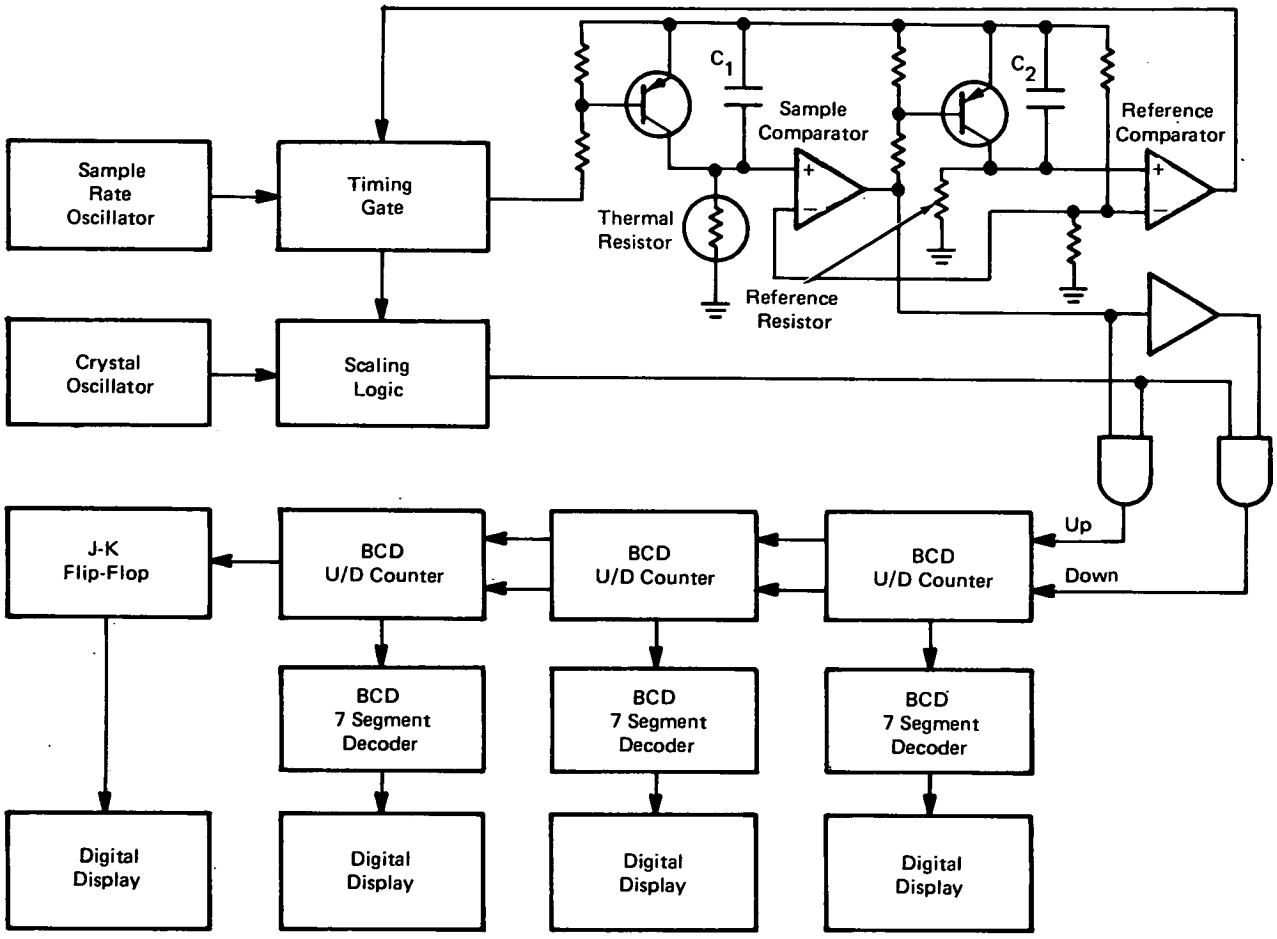
# NASA TECH BRIEF

*Manned Spacecraft Center*



## A Compact Battery Powered Digital Thermometer




### The problem:

One of the useful tools for field engineers and technicians working in chemical installations is a thermometer which can be used for trouble shooting and equipment maintenance applications. Such a thermometer should be portable and provide quick, accurate temperature readings.

### The solution:

A compact battery powered digital thermometer has been developed that is suitable for field applications.

### How it's done:

The thermometer uses a thermal resistance probe as a temperature-to-resistance transducer. The probe (thermal resistor), which changes resistance in proportion to

(continued overleaf)

the temperature, supplies charge current to a fixed capacitor, $C_1$ (see figure). With this capacitor initially discharged, the resulting time needed to reach a predetermined charge level is proportional to probe resistance and, therefore, to temperature. A fixed reference resistor-capacitor ($C_2$) circuit generates a reference time increment for comparison with the temperature-dependent time duration.

The measurement cycle is initiated by a sample rate oscillator. First, the capacitor $C_1$ is allowed to charge and generate a "sample" time. At the end of the sample time (when capacitor $C_1$ reaches the required charge level), the reference charge cycle is initiated.

The voltage level across each capacitor (proportional to the charge) is detected by an associated (sample or reference) comparator. Both comparators share the same comparison voltage level applied to their negative inputs.

A precision crystal-controlled oscillator generates a pulse train which steps an up-down counter. These pulses are gated into the counter only during the RC generated time increments. The temperature dependent sample gate feeds the "up" counter input and the reference time gate controls the "down" input.

Because of the binary coded decimal (BCD) counter configuration, the counter state which results after each up-down cycle is displayed in decimal form with standard seven segment decoder and light emitting diode (LED) display devices.

The thermometer is designed to operate within −400 to 200°F range. It is powered by a rechargable Ni-Cad 4.8V battery and measures approximately 8.9 by 6.4 by 1.6 cm (3.5 by 2.5 by 0.625 in.).

## Note:

Requests for further information may be directed to:

Technology Utilization Officer
Manned Spacecraft Center
Code JM7
Houston, Texas 77058
Reference: TSP72-10545

## Patent status:

NASA has decided not to apply for a patent.

Source: George Zivley of
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