TEMPERATURE MEASURING CIRCUIT BORROWS POWER AND REFERENCE FROM DPM

by Jim Hayes*

The AD2006† line-operated digital panel meter (DPM), introduced in *Analog Dialogue* 7-2, was designed with some interesting features that facilitate the design of measurement systems in which it might become involved. Two of its features make it especially ideal for the design of simple instruments:

1. It has dc power outputs of ±15V @ 10mA and ±5VDC @ 50mA. These dc power outputs allow the meter to power external circuitry associated with it, such as op amps or an instrumentation amplifier, without calling for an additional power supply. It is obvious that such an amplifier might be used to scale up small-amplitude inputs for measurement by the AD2006, in a small, self-contained measurement system.

2. The meter's reference voltage is available as the source of excitation for a transducer, generally via an amplifier stage that provides gain or attenuation (and power boost, in any event). The meter's reference-input terminal, normally used with its own reference voltage, can also be connected to an external reference source, for example, the excitation voltage for a bridge-type transducer. Either way, since the DPM's reading is proportional to the *ratio* of the input to the reference, it will be independent of variations of the reference with time, temperature, etc., to the degree that the transducer output is proportional to the reference voltage.

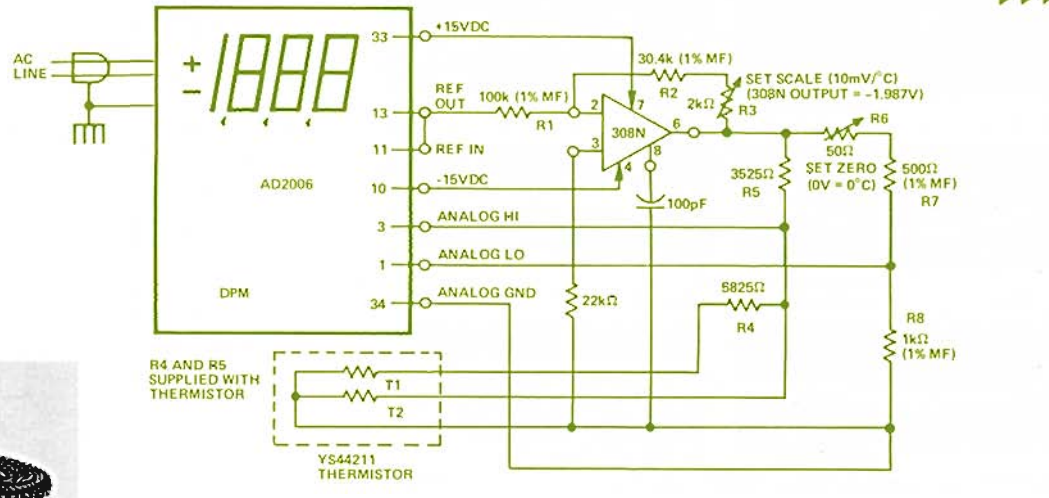
It is feasible, then, to build a complete measuring system, for some applications, making use of the DPM and just a few external components. The schematic diagram illustrates a practical *ad hoc* instrumentation application that works.

DIGITAL THERMOMETER

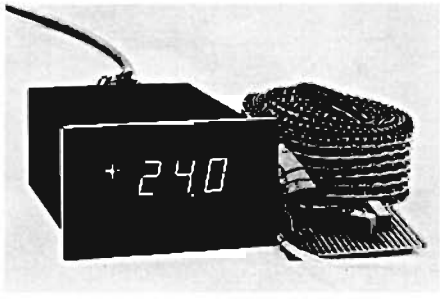
We needed an accurate temperature-measuring instrument for use in our engineering labs for testing new products. It was decided to use a thermistor in a bridge circuit, with the excitation voltage developed from the DPM's reference, and the output read differentially by the DPM.

The thermistor network chosen is a Yellow Springs YSI-44211. In order to supply a stable 2V of excitation, the internal reference output of the AD2006 was used, scaled and buffered by an AD308N op amp, to ensure that the loading of the reference would not greatly affect its stability. The AD308N is, of course, powered by the ±15V outputs of the AD2006. Trims were included for calibrating the circuit, so that the meter would read 00.0 at 0°C and 50.0 at +50°C (i.e., a 10mV/°C calibration). If calibration is desired in degrees Fahrenheit, the caption describes the necessary changes, in order to obtain 10mV/°F and 00.0 at 0°F.

The final result is a thermometer with a resolution of 0.1°C and accuracy error of ±1°C, typically reading temperatures in the range -55°C to +85°C to 1/10 of a degree. It has been in use in the laboratories at Analog Devices during the past year. Not only did it provide us with an accurate temperature-measurement tool and confirm the power-output and ratiometric aspects of the AD2006, but it has also given us another (albeit small) increment of life-testing history: one year, several such circuits built, no failures, many experiments expedited at low cost as a result of the circuit's usefulness.



Complete Electrical Thermometer Circuit. Readout is in °C. For readout in °F, R_2 = 54.9kΩ, R_3 is 5kΩ, R_6 is 100Ω, and R_7 is 1.05kΩ. For 10mV/°F scaling, set the AD308N output to 3.576V. Adjust R_6 for zero output at 0°F. The thermistor is manufactured by Yellow Springs Instrument Co., Yellow Springs, Ohio, 45387. It is available from many major distributors.



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†For complete information on the AD2006, request **L13**.