Adapting Analog Water Stage Recorders to Digital Data Acquisition Systems

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The volume of data needed from experimental areas requires more efficient collection methods. These must minimize the time required in data compilation and reduction . . .

Using analog chart recorders requires the interpretation and reduction of data from strip charts. Many man-hours can be eliminated by converting these analog chart recorders to supply a signal output compatible with digital data acquisition systems.

This simple inexpensive method converts two types of analog chart water stage recorders to produce an analog voltage output compatible with digital data acquisition systems. The adaptation was performed on the Friez FW-1 and FD-4 recorders; however other recorders could be converted.

A 5K, 10-turn linear (+ .05 percent) wire-wound potentiometer with a temperature coefficient of +130 ppm/C° and starting torque of 3 oz-in. was mounted directly on the base (Fig. 1) of the water stage recorder. The shaft of the potentiometer was connected to the float drive shaft of the water stage recorder through a system of clock gears. Using the clock gears provides positive mechanical drive with low friction and low hysteresis.

Using a 4:7 gear ratio gave adequate float wheel travel of the recording instruments that record water table elevation changes. This gear ratio activated the potentiometer to give a full-scale deflection of 17.5 ft.
A voltage change of 3.63 mv from this system delineated a 0.01 ft change in water table elevation. Linearity was calculated at 0.00875 ft using the linearity tolerance specified by the manufacturer. Linearity was checked throughout a complete traverse with the potentiometer mounted on the water stage recorder. It was well within experimental error. Calibration was by rotating the float wheel of the recorder in 1 ft increments over the entire traverse distance. The line in Fig. 2 may be expressed by the general equation:

\[ y = mx + b \]

or more specifically,

\[ E_0 = 363.1x + 0.009 \]

where

- \( E_0 \) = voltage (millivolts)
- \( m \) = slope (millivolts/foot)
- \( b \) = voltage at 0 elevation (feet)
- \( x \) = elevation (feet)

The voltage source in Fig. 3 was used to supply a constant voltage to a number of water stage recorders. \( E_z \) and \( E_0 \) are the zener voltage and output voltage, respectively. The circuit for the voltage source is described in the Handbook and Catalog of Operational Amplifiers, L1-227, 1969, Burr-Brown Research Corp., Tucson, Ariz. The complete system is shown in Fig. 4.

This adaptation provides a digital readout with these advantages: the data processing time is reduced drastically, a series of recorders oriented to the same time base permits a more valid comparison of the timing among separate recorders, and a dual recording system is possible because the potentiometer providing the digital output does not interfere with the normal operation of the analog chart recording mechanism.