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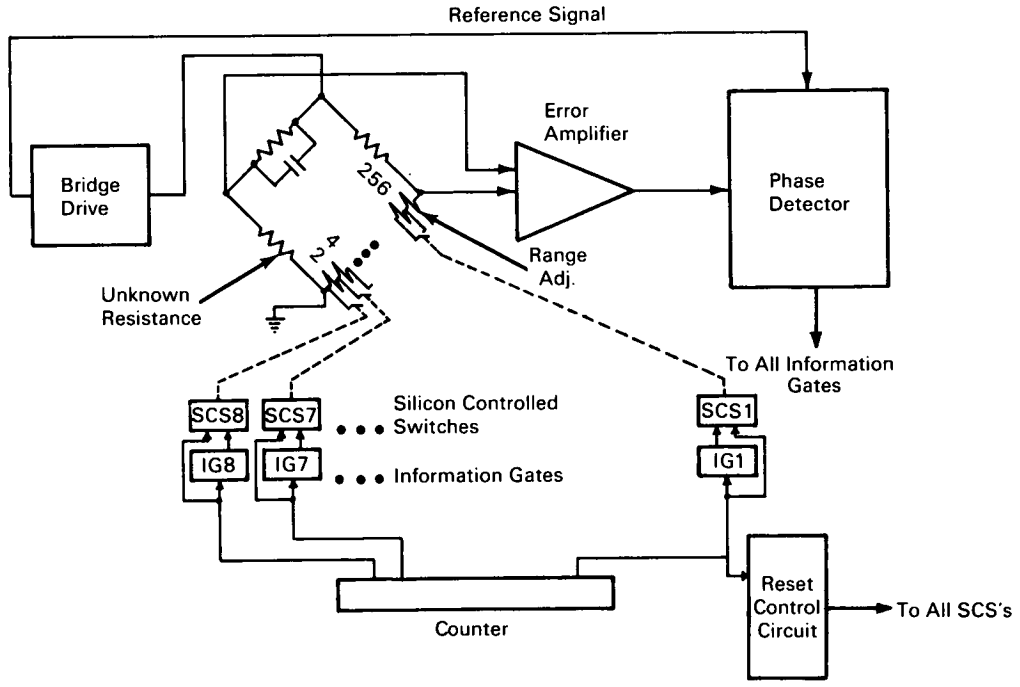
Brief 65-10274

NASA TECH BRIEF

Electronic Ohmmeter Provides Direct Digital Output



The problem: Designing an all-electronic digital-readout ohmmeter. Electromechanical ohmmeters with analog-to-digital converters (incorporating servo motors, precision gear boxes, and precision potentiometers) have excess size and weight and are costly to manufacture. In addition, the electromechanical systems have relatively high power requirements and must be used in controlled environments to ensure efficient long-life operation.

The solution: A self-balancing Wheatstone bridge circuit in which the unknown resistance (e.g., a platinum wire temperature sensor) comprises one leg, and an automatically adjustable, binary-valued resistance comprises another leg. Automatic adjustment for bridge balancing is achieved by successive approximations.

How it's done: The eight resistors in the adjustable leg of the bridge are binary valued (2 ohms, 4 ohms,..., 256 ohms). Each resistance is in parallel with a reed relay contact which, when closed, shorts out the resistance. Initially, all of the contacts are open so that the adjustable resistance assumes its maximum value. A square-wave signal is applied to the bridge from the drive oscillator, so that if the bridge is not balanced an error signal is sent to the error amplifier and on to the phase detector where it is compared with the

(continued overleaf)

bridge-drive reference signal. The output from the phase detector is sent to all of the information gates (IG_1,..., IG_8). The combination of the error signal from the phase detector and the output from the counter circuit operates the silicon controlled switch for the largest binary resistor and shorts it out. Depending on the type of error signal then produced, the resistor will either remain shorted out or the switch will open and place it back in the circuit. This type of resistance sampling is then sequentially repeated for the remaining resistors. An output from each silicon controlled switch that indicates the condition of the switch is used for binary readout of the unknown resistance. Reset to place all of the relays in an open position occurs at the start of the sampling pulse for the largest binary resistance.

Notes:

1. Higher orders of accuracy can be derived from this circuit by increasing the number of bits and by altering the bridge ratio.
2. A major limitation of this circuit is its relatively low encoding speed. Another limitation is the range of unknown resistances which can be accommodated. The lower limit is set by relay contact resistance and the upper limit by stray capacitance effects.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
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   Reference: B65-10274

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: John Semyan
(GSFC-363)