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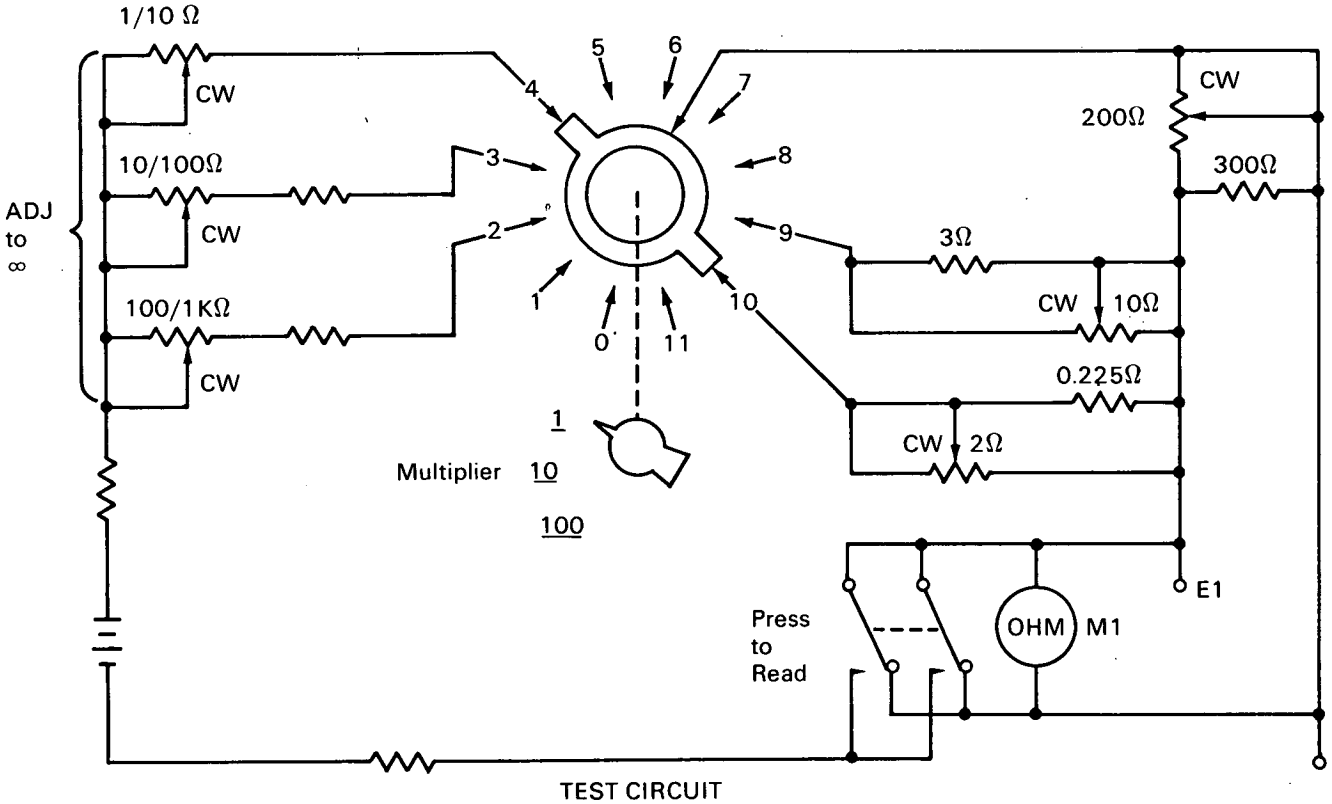
Low Energy Ohmmeter Can Be Used To Test Sensitive Circuits, Other Meters



TEST CIRCUIT

The problem:

To develop an ohmmeter of sufficiently low energy output that it may be used to test extremely sensitive circuits (such as explosive switches or other meters) safely, reliably, and accurately.

The solution:

A hazardous circuit ohmmeter measures resistance from 0.01 to 500 ohms on three ranges with an energy level of 31.25 microwatts delivered to the external circuit when a 0.2 ohm resistance is measured on the 1× range. The energy is lower for all other measurements by a factor of the range multiplier on the other ranges.

How it's done:

A 1.34-volt mercury cell provides the power for the test circuit, shown in the schematic. The possibility of damage to the item being tested from overvoltage or

(continued overleaf)

overcurrent as a result of component failure is minimized in two ways: (1) limiting resistors are installed in the circuit at each end of the cell, and (2) the meter, which is connected directly to the ohmmeter terminals, is paralleled by at least two resistors. The test circuit for each range is a resistance network which, including the resistance of the meter, is equal to the center scale value. A rheostat is provided in each network so that it may be adjusted precisely to that value for each of the three ranges. The battery also has a rheostat in the circuit which permits the current to be set for full-scale deflection of the meter for each range. The three ranges, times 1, times 10, and times 100, are selected by changing the resistance network, including the resistance of the meter, by the factor of the multiplier and increasing the control resistance to provide full-scale deflection of the meter.

The safety of the design is ensured by two or more resistors on all series and parallel resistor circuits to preclude the danger of short circuit failure. The coil of the meter is in parallel to avoid the possibility of excessive voltage being applied to the terminals because of an open resistor. Since the meter is connected directly to the terminals of the ohmmeter, a check for "set to infinity" performed before each test will indicate any component failure before the unit is connected to the unknown resistance. Therefore, the only hazard is failure of a component between the set-to-infinity check and the actual test.

Reliability is achieved by using a ruggedized, taut band meter and packaging the assembly in a shock-absorbing carrying case to protect it against vibration, shock, dust, and moisture. In addition, all components except the meter are operated at less than 25 percent of their rating. The set-to-infinity check verifies reliability because failure of any component will make it impossible to adjust to infinity.

A 2-percent meter with 0.5-percent scale linearity and an ohmmeter scale can be tested for accuracy with a scale calibration chart. The network rheostat assures further accuracy. Additional information, including maximum and typical error charts, are available from Sandia Corporation.

Notes:

1. A polyurethane-foam-lined aluminum case provides protection for the unit assembly. Its dimensions are approximately 9 by 13 by 7 inches, and its weight is about 12 pounds.
2. The highest currents on the three ranges with a 5-millivolt meter and a low range resistance of 0.2 ohm at midscale are 25 milliamps on the 1× range, 2.5 milliamps on the 10× range, and 0.25 milliamp on the 100× range, all delivered at zero ohms. The highest voltage delivered to the external circuit is 5 millivolts at infinity on any range.
3. Inquiries concerning this innovation may be directed to:

   Sandia Office of Industrial Cooperation
   Org. 3413
   Sandia Corporation
   Post Office Box 5800
   Albuquerque, New Mexico 87115
   Reference: B68-10269

Patent status:

No patent action is contemplated by AEC or NASA.

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(SAN-10013)