MONROE ELECTRONICS

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Application Note APNE-0002 Practical Volume Resistivity Measurements With Model 272A Portable Surface Resistivity/Resistance Meter

Included with Model 272A is a P/N 96117-1/22A specimen support plate. This support plate provides a durable finish on the insulated side and also provides a smooth metallic surface on the opposite side for volume resistivity or bulk resistance measurements of materials.

The combination of this plate, the P/N 96101A-1 probe and the Model 272A instrument meets the guidelines set forth in ASTM D-257 and IEC 93 Standards for guarded-ring testing of volume resistivity of solid, homogeneous electrical insulating materials, generally in sheet form. Connections for guarded measurements are shown in Figures 3 and 4.

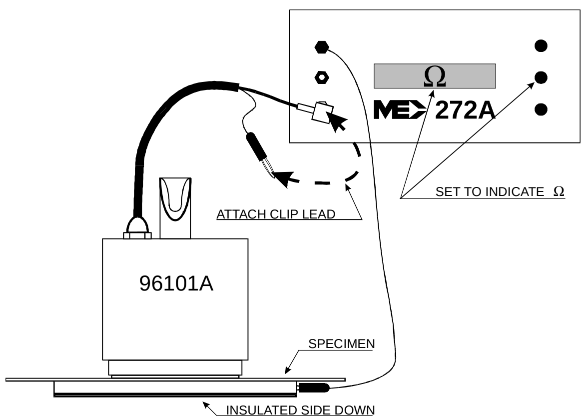

Figure 3

Setup for <u>Guarded</u> Measurement of Volume Resistivity

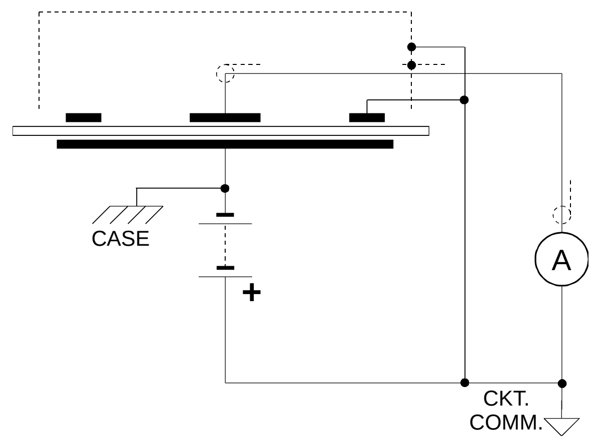

Figure 4

Schematic Representation

Volume resistivity, ρ_v, must always be calculated because the thickness of the test specimen is one of the measurement variables. The ASTM D-257 (or IEC 93) formula for ρ_v is:

$$\rho_v = \frac{A}{t} R_m \ ohm \bullet cm$$

where:

A = Effective area of measuring electrode in cm^2

t = Thickness of test specimen in cm

R_m = Measured resistance in ohms

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For the 96101A-1 probe the effective area of the measuring electrode is 14.9 cm^2 (based on the general formula for calculation of effective area given in both of the standards), thus:

$$\rho_v = \frac{14.9}{t} R_m \ ohm \bullet cm$$

Appendix X2 in the ASTM standard further addresses the modification of the effective area of the measuring electrode in the guarded ring configuration.

The above information is presented as an overview of some of the complications involved in the use of the concentric or guarded ring type electrode. Either of the standards should be consulted for further details.

SIMPLIFIED METHOD

Most materials commonly being tested in today's world of ESD awareness are intended not to be electrically insulative. For specimens that have negligible surface leakage, an unguarded measurement based on the actual area of the (1.2" dia.) center electrode greatly simplifies the calculations. For material samples less than 0.060" thick, the errors introduced into an unguarded measurement are usually small enough to be negligible. Connections for unguarded measurements are given in Figure 5. Factors for converting meter readings (in Ω) directly to volume resistivity (unit Ω•cm) are presented in Table 1.

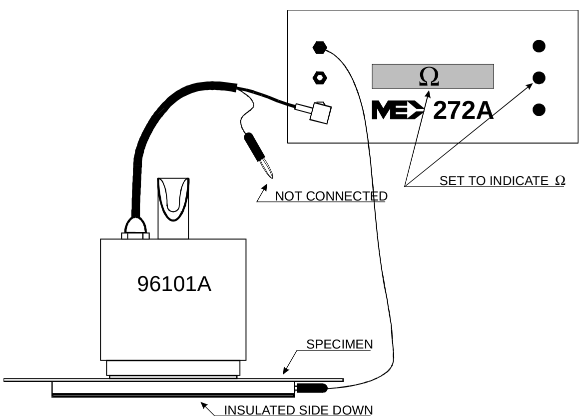

Figure 5

Connections for Un-guarded Measurement of Volume Resistivity

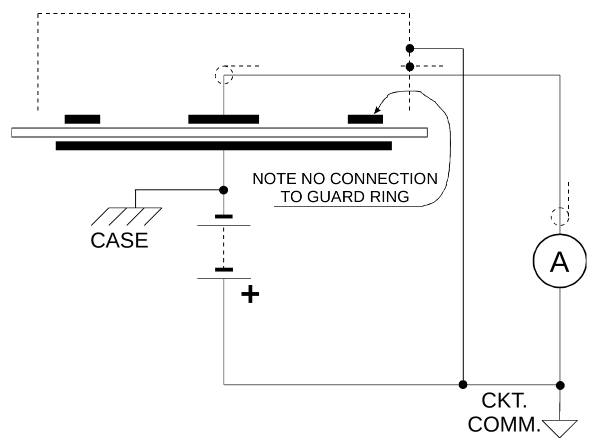

Figure 6

Schematic Representation

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Material Thickness	*Factor*	*Material Thickness*	*Factor*
0.005" (0.13mm)	575	0.035" (0.89mm)	82
0.010" (0.25mm)	287	0.040" (1.02mm)	72
0.015" (0.38mm)	192	0.045" (1.14mm)	64
0.020" (0.51mm)	144	0.050" (1.27mm)	57
0.025" (0.64mm)	115	0.055" (1.40mm)	52
0.030" (0.76mm)	96	0.060" (1.52mm)	48

Table 1

TO USE THIS TABLE—

1. Arrange test setup as in Figure 5.
2. Set Model 272A to "ON".
3. Select "OHMS". The "Ω " symbol will appear in the display.
4. Select measuring voltage (10V or 100V).
5. Record the reading and the material thickness.
6. Multiply the reading by the factor given in the table for the value of volume resistivity in Ω•cm.