Sheet resistance measurement using Square Array Probe

1. Square probe

This name is derived from the fact that the electrodes form a square shape and are equally spaced. In standard sheet resistance measurement of electronic materials, the four-point method with electrode tips in series is used, but here we provide information on sheet resistance measurement using square probes with electrode tips arranged in a square shape.

Details of NPS Square Probe (NP-SQ-XX)

- Needle spacing : 1.00mm □ Pitch
- Needle tip: 40μR (01), 100μR (02), 200μR (04), 400μR (05)*
- Needle pressure : ~90g±/0.5mm per needle (with 300g load)
- Needle material : Tungsten carbide
- Needle length : approx. 1.5mm

Measurement can be performed by connecting to a dedicated stage and measuring instrument. *Specifications are selected according to sample type.

NPS,INC.

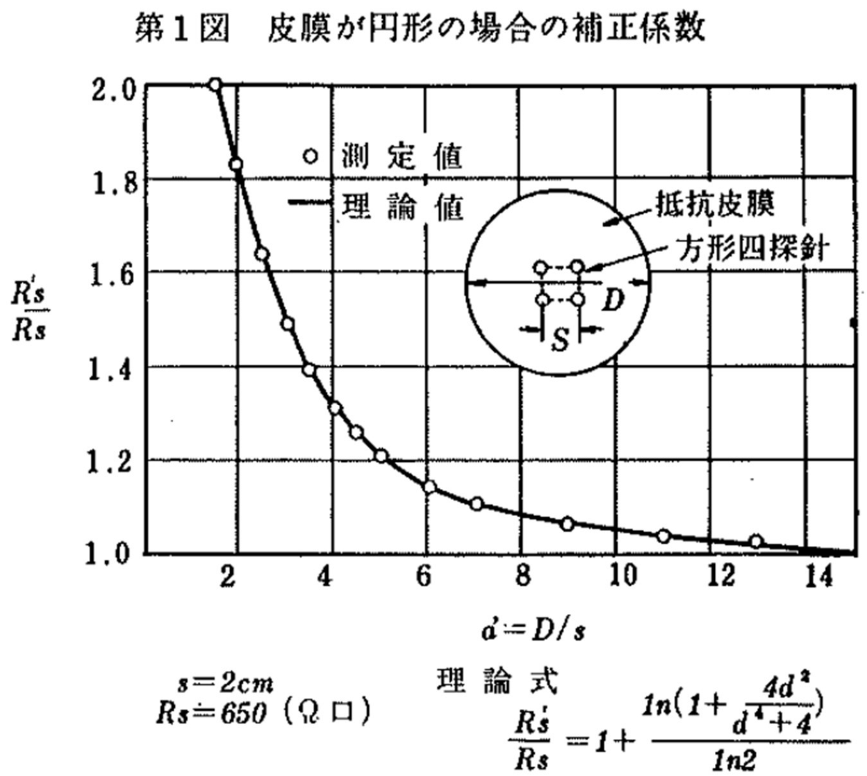
2. correction factor by dimension

The condition for obtaining the true sheet resistance value is that the size of the object to be measured is assumed to be infinite, but in reality, the size of the object to be measured is often a small piece. If these small pieces are simple shapes (circle, square, etc.), a value close to the true value can be obtained by correcting the coefficient of the value obtained in the measurement.

The correction coefficients for a circle of the shape of the object to be measured are shown in Figure 1.

If the diameter D of the circle is sufficiently larger than the tip spacing S, the obtained value can be used as the direct reading resistance. In this case, if D≦13S, the error will be less than 3%.

Figure 1: Correction coefficients for a circular object to be measured



3. **Edge correction factor**

When the square probe is placed near the end line MN of the EUT as shown in Figure 2, the distribution density of the current and potential lines is affected (usually increased) and the resistance of the EUT is apparently changed (usually to a higher value). In this case, the correction factor can be obtained by considering the case where the mirror image electrode A'B' of electrode AB is placed on a wider specimen with the original electrode AB, as shown in Figure 2(b), relative to the end line MN of the specimen.

The ratio of the apparent measurement value R's obtained near the edge line of the specimen to the true resistance value Rs (the resistance when the electrode system is moved away from the edge of the specimen) is shown in Figure 3, using the ratio (L/S) between the distance L from the farthest end to the center of the four probe tips and the shortest distance S between the tip electrodes as a variable. From this figure, it can be seen that the resistance value Rs can be assumed to be indicated within an error of 2% if it is contained from the farthest end of the linearly cut workpiece to the point where L = 3.5 S. For example, if S is 4 mm, the resistance value Rs is indicated within an error of 2%.

For example, if 4mm S is used, the measured value can be judged to indicate the true resistance Rs if it is 14mm from the end of the straightest line. Therefore, if you want to know the resistance value Rs especially in the area close to the end of the straight line, you can divide it by the correction factor of the corresponding dimension in Fig. 3.

Figure 2 Edge correction factor

第2図　端部補正係数

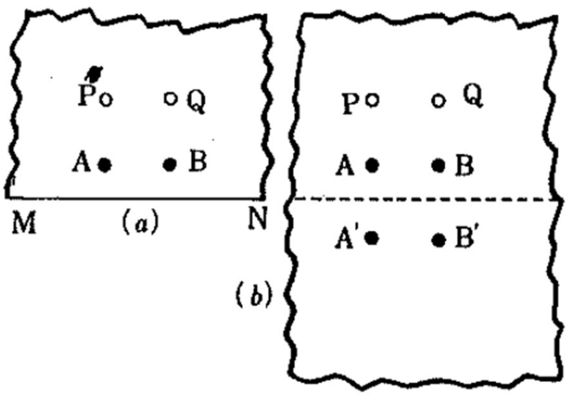
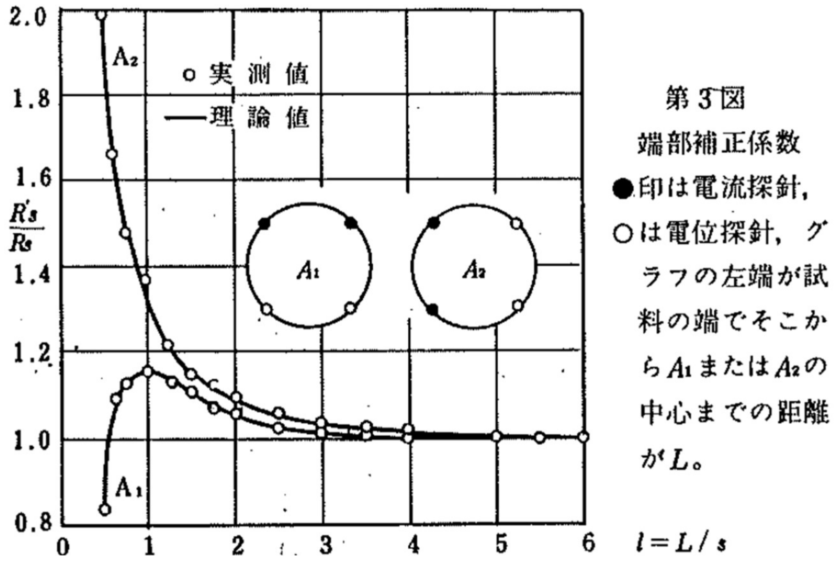


Figure 3 Correction coefficients for the edge ● mark is for the current probe and ○ mark is for the potential probe. The left end of the graph is the edge of the sample, and the distance from there to the center of A_1 or A_2 is L

第 3 図　端部補正係数

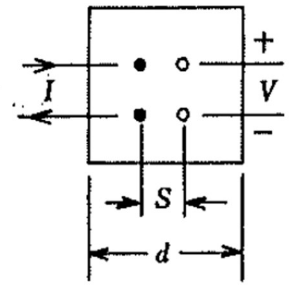


4. correction factor for square object to be measured

The correction coefficients for the case where the object to be measured is close to a square are shown in the table in Figure 4. The square probe shall be measured at the center of the sample.

Figure 4. Theoretical equation

第 4 図　　　理 論 式



$$\rho s = K \cdot \frac{V}{I} \ \Omega/\square$$

係数表　　　係数表

d/s	K	d/s	K
1	0.89126	12	8.78537
2	3.61937	14	8.86956
3	5.72588	16	8.90620
4	6.92586	18	8.93900
5	7.60583	20	8.96171
6	8.01462	50	9.04739
7	8.27641	∞	9.06472
8	8.45247		
9	8.57613		