

Square Array vs. Linear Array Four Point Probe



The square array four point probe has some differences to consider when compared to the much more commonly used linear array four point probe:

When measuring a **thin film** using a square array probe, the voltage signal is one-half of the voltage compared to a linear array probe. Therefore when using a square array probe, you cannot use the ohms/square button on the RM3000 to provide a valid sheet resistance. To calculate an ohms-per-square value, the formula is $4.5324 \times 2V/I$ (rather than V/I), however, by using a suitable current, the math involved can be minimized. Square array probes are not usually used on bulk materials (e.g., ingots) since the main advantage is the smaller footprint which allows the four tips to fit on a smaller material. The rule of the voltage signal being 50% of that when using a linear array does **NOT apply when measuring bulk materials**. For further information about using a square array probe on bulk materials, please see the article by S. B. Catalano, "Correction factor curves for square-array and rectangular-array four-point probes near conducting or nonconducting boundaries". (http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?reload=true&arnumber=1473476).

1. The wiring arrangement for square layout produces a negative voltage in the FWD direction and a positive voltage in the REV direction. This does not mean there is a fault and the sign can be discounted to compare the FWD and REV values.
2. Square and rectangle arrays can only be built with needle spacing from 0.635mm up to 1.591mm, not close needle spacing of 0.5mm.
3. The Jandel probe models that can be built using the square array are the Cylindrical probe, Six-Way probe (both CDE and KLA-Tencor/Prometrix models), Four-Pin probe, and the Cartridge with Lead probe. The smaller footprint allows smaller samples to be measured. When probing onto wafers, the use of a square array probe allows the user to measure closer to the edge of a sample before a correction factor is required. The smaller voltage signal must be taken into account when using four point probing electronics and software that are designed to calculate sheet resistance and to read-out directly in ohms-per-square based upon the assumption that a linear array probe is being used.

Jandel references these papers related to square array probes in their various instruction manuals:

Small slice at centre:

A. Marcus and J. J. Oberly, IEEE Trans. Electron. Devices, ED-3, 161 (1956)

Small slice along a radius:

L. J. Swartzendruber, National Bureau of Standards Technical Note 199 (1964)

Square sample:

M. G. Buehler, Solid State Electronics, 10, 801 (1967)

Thick sample near boundary:

S. B. Catalano, IEEE Trans. Electron. Devices, ED-10, 185 (1963)

Thin infinite sheet:

M. G. Buehler, Solid State Electronics, 10, 801 (1967)