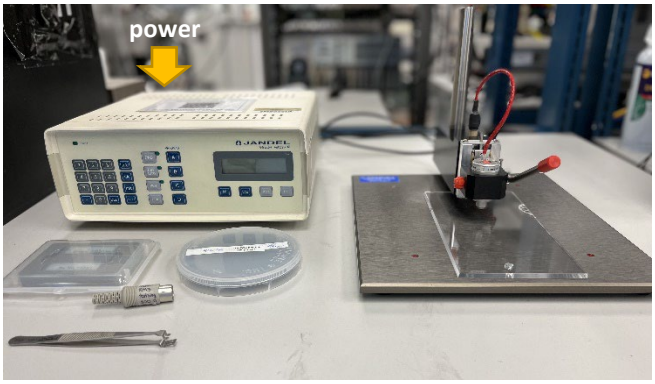
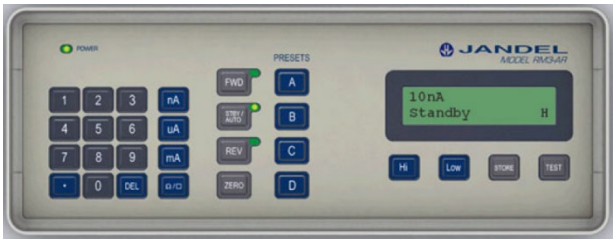
Jandel RM3-AR with Multi Height Probe - Standard Operating Procedure



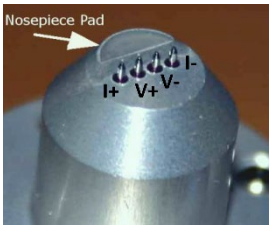
Samples should be 0.5 – 1mm thick.
They are placed atop the ¼" thick clear acrylic plate for proper height. If your sample is out of this range, talk with BRK staff (Neil Dilley, ndilley@purdue.edu).
Do not make any system height adjustments.

1. Enable system in iLab (see QR code for kiosk) and remove the cover from unit.
2. Turn power switch on (rear left-hand side). Wait for it to do startup tests and get into "Standby" mode, and for most accurate measurements wait 15 min. for the electronics to warm up.
3. Make sure the probe arm is at top of travel.
4. Using the tweezers, put the sample on the ¼" acrylic plate and slide it under the probe head.
    a. Recommended for all: first check health of the unit with the reference film "12.80 ohms/sq" in box kept next to the Jandel, using 10 mA. Problems with this sample? Find BRK staff before proceeding.
5. Carefully lower the probe arm fully, which should do the following:
    a. the 4 probe tips will compress behind the nosepiece.
    b. the contact switch on the right of the arm closes (a click will be heard).
6. Enter a test current between 10 nA and 100 mA using keypad or by pressing a preset (A=10 nA; B=1 uA; C=1 mA; D = 10 mA)



7. if you're unsure, pressing the STBY/AUTO button to use autorange mode: this increases current from 10 nA in decade increments until it gets a signal between 10 – 100 mV, and beeps when autoranging is done.
8. With your desired current set on the display, press FWD to pass current through sample in the forward direction. The readback should be in Volts so that you can understand the signal levels. If it is reading "Ω/□" then you can toggle back to Volts by pressing the Ω/□ button.
    a. System starts in High Resolution mode ("H" on display) which goes up to 150 mV and will give the most precise measurements. If your sample resistance is very large (R/□ > 10 mega-ohms/sq.) try Low Res ("Low" button) which allows voltage up to 1.2 V.
9. Problems getting a reading?
    a. Errors "Out of Range" or "Contact Limit" indicate overvoltage → reduce current, try Low Res.
    b. voltage very low (<mV): increase current; check that contact switch closes, get BRK staff if not.
10. Performance: a quick bench test showed noise level (Hi Res mode) is ~ 2 uV, accuracy ~ 10 uV.
11. After getting a forward reading, press REV to pass current in opposite direction. You should see a similar voltage with negative sign. For signals below 10 mV, there will be noticeable offsets which can be corrected by pressing the ZERO button while the current is on.
12. Once you have stable and consistent FWD/REV readings, press Ω/□ to get the reading in ohms/sq.
13. Raise the probe arm fully when done testing. Test at several places near middle of sample.
14. See next page for Ω/□ correction factors if sample diameter < 30 mm or thickness > 0.6mm .

More about the Jandel



General information

The in-line probes each have a 1 mm separation, where current is injected/extracted from outer probes while voltage is measured along the inner pair, see picture. The nosepiece pad ensures proper compression of the probe springs.

Testing the RM3-AR independently of the cylindrical probe: use the 100 ohm test fixture (consult BRK staff first) kept by the system. See photo of the demonstration samples and 100 ohm fixture at the bottom of page.

Calculation of Resistivity

Sheet resistance for wafers and films: **Rs = 4.532 * V**[V] **/ I**[A] [Ω/□] "ohms per square"

Bulk resistivity for wafers and films: ρ **= Rs * t = 4.532 * V * t / I** [Ω-cm]

where t is the thickness in cm.

Assumptions: the above equations for Rs and ρ will have 1% accuracy if the wafer is much wider (diameter d) and thinner (thickness t) than the Jandel probe spacing **s = 1 mm**. Specifically:

diameter d > 30 mm
thickness t < 0.6 mm

For smaller diameters and larger thicknesses than these, see the tables below for correction factors to use in calculating Rs = (V/I) * C_1 * C_2

As thickness and diameter of the planar sample both go to infinity ("semi-infinite volume"), the bulk resistivity becomes :

ρ **= (2** π **s** $\times$ **V) / I** ohm-cm

FPP Correction Factors for Sample Thickness t		FPP Correction Factors for sample diameter d	
t/s	C_1 (t/s)	d/s	C_2 (d/s)
0.3	1.0000	10	4.1712
0.4	0.9995	20	4.4364
0.5	0.9974	30	4.4892
0.6	0.9919	40	4.5080
0.7	0.9816	50	4.5167
0.8	0.9662	60	4.5215
0.9	0.9459	70	4.5244
1.0	0.9215	80	4.5262
1.2	0.8643	90	4.5275
1.4	0.8026	100	4.5284
1.6	0.7419	200	4.5314
1.8	0.6852	∞	4.5320
2.0	0.6337		

Derivations: https://fabweb.ece.illinois.edu/gt/equations/fpp.aspx

Setting up the system heights

bottom of arm block to platform = 17mm ;
top of cylindrical probe to housing = 9mm;
This works when using the 1/4" thick acrylic plate.