

# University of Minnesota Nano Fabrication Center

## Standard Operating Procedure

**Equipment Name:** Four Point Probe

**Coral Name:** four-point-probe

**Model:** Veeco FPP5000

**Location:** Bay 1

**Revision Number:** 2

**Revisionist:** Tony Whipple

**Date:** 20 Mar 2020

### 1 Description

The four point probe measures thin film or doped silicon surface resistance values. This can measure small samples to whole 4 " ( 100 mm) wafers.

### 2 Safety

The safety item beyond the normal electrical hazards as this system does use electrical power.

### 3 Restrictions/Requirements

All Trained users can use the system.

### 4 Required Facilities

The systems us electrical power.

### 5 Definitions

Four point probe equation:  $p = RT$   
Where:  $p$  = slice resistivity (ohm-cm)  
 $R$  = sheet resistivity (ohm/sq.)  
 $T$  = thickness (mils, m, A)

### 6 Setup

Power up:

1. Turn on power switch on the rear of the machine.
2. Press CLEAR after the display lights up

### 7 Operating Instructions

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### To make a measurement:

1. Place sample in holder face down
2. Place the holder on the stage with the portion to be measured over the probes (small hole).
3. Close the lid and gently press down until the measurement is complete.

### Processing Results:

-If you want to find resistance ( $V/I$ ), depress the  $V/I$  switch and just close the lid to get the readout.

-If you want to find the sheet resistivity ( $R = \rho/T$ ), depress the SHEET switch and close the lid to get the readout.

-If you want to find the slice resistivity ( $\rho = RT$ ), programming IS NECESSARY and you must input the thickness as a constant. Start off by finding the sheet resistivity and then follow below. a) Depress **SLICE** switch

- b) Depress **PROG** switch
- c) Enter the thickness and the units
- d) Depress **STORE** switch
- e) Depress **PROG** switch and that is your answer

-If you want to find the thickness ( $T = \rho/H$ ), programming IS NECESSARY and you must input the slice value as a constant. Start off by finding sheet resistivity and then follow below. a) Depress **THICK** switch

- b) Depress **PROG** switch
- c) Enter the slice resistivity and the units
- d) Depress **STORE** switch
- e) Depress **PROG** switch

### Programming of constants (Standard Procedure):

1. Press option to be used
2. Press **PROG** 3. Enter constant (don't forget exponent or units).
4. Press **STORE**
5. Press **PROG**

### System. Power Down

1. Return the sample holder to the case and put the case away.
2. Turn off the power switch.

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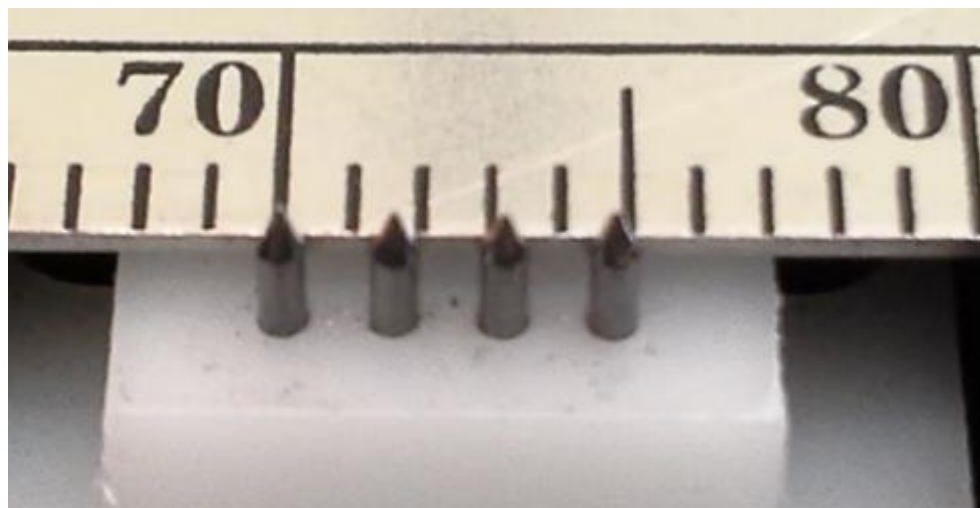
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### 7 Problems/Troubleshooting

1. A value that is not a useful number, check to see if it is an error code.  
Most likely you can just re-try again, making sure your sample is making contact with all of the four probe tips.

### Appendix

| <u>Metal</u> | <u>Resistivity ( <math>\mu\text{Ohm-cm}</math> )</u> |
|--------------|------------------------------------------------------|
| Aluminum     | 2.6548                                               |
| Chromium     | 12.9                                                 |
| Copper       | 1.6730                                               |
| Gold         | 2.35                                                 |
| Lead         | 20.648                                               |
| Molybdenum   | 5.2                                                  |
| Nickel       | 6.84                                                 |
| Palladium    | 10.8                                                 |
| Platinum     | 10.6                                                 |
| Silver       | 1.59                                                 |
| Tantalum     | 12.45                                                |
| Tin          | 11.0                                                 |
| Titanium     | 42.0                                                 |
| Tungsten     | 5.65                                                 |
| Zinc         | 5.916                                                |



Tip spacing is set at 62.5 mils ( 1587.5  $\mu\text{m}$  )

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| Error Code        | Description                                                                  | Display After Clear                    |
|-------------------|------------------------------------------------------------------------------|----------------------------------------|
| E 01              | Retest Attempted while probe interlock is open                               | Previous Reading                       |
| E 02              | Probe interlock is opened while a measurement in progress                    | Display read five 8's                  |
| E 03              | Display Exponent overflow or underflow exponent greater 9 or exponent less 9 | Cannot Clear Error Code                |
| E 04              | Store attempted without completing entry of the new constant in PRGM mode    | Previously programmed constant         |
| E 05              | Penetrate Switch Depressed while Penetrate Mode internally disabled          | Previous Reading                       |
| E 06              | Normal and Reverse V/I Disagree by more than 10%                             | Normal V/I Sheet, Slice, and Thickness |
| E 07              | Arithmetic Error produced as a result of a geometric correction measurement  | Cannot Clear Error Code                |
| E 21 Thru<br>E 40 | Electronic Failure while attempting to make a measurement                    | Display reads five 8's                 |
| E 51 Thru<br>E 57 | Self Test Errors                                                             | Display reads five 8's                 |

Error code list from the manufacture – Error E 06 is common, try remeasuring if needed.