

# Süss PM8 Probe Station + Keithley 4200A

Version of 2018-08-03. Get the latest one at

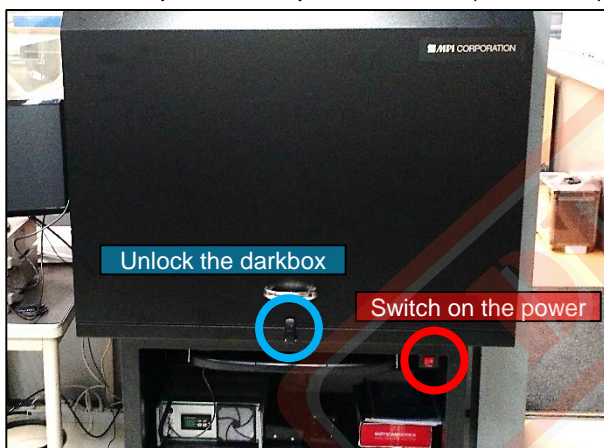
[http://ps-irrad.web.cern.ch/assets/doc/extra/Prober\\_IRRAD\\_manual.pdf](http://ps-irrad.web.cern.ch/assets/doc/extra/Prober_IRRAD_manual.pdf)

## 1. Introduction

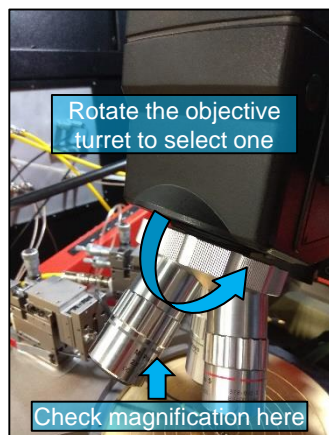
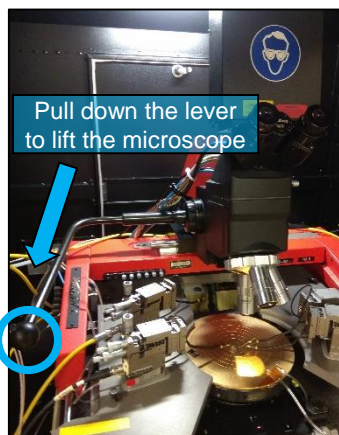
This user manual explains how to operate the **Süss PM8 probe station** together with the **Keithley 4200A Semiconductor Parameter Analyzer** to perform electrical characterization of your wafers and devices.

## 2. Power-On & System Preparation

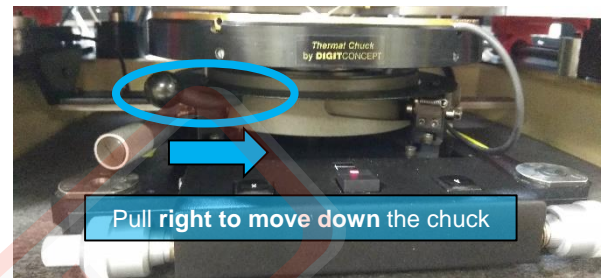
- Open the lid of the darkbox to access the probe station (blue circle) and switch on the general switch to power the probestation (red circle).



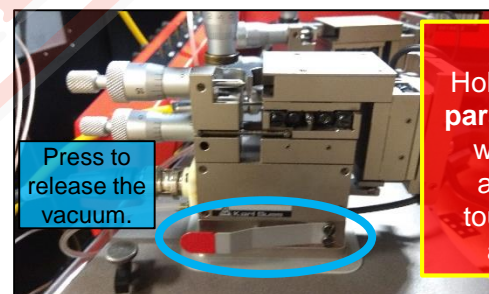
- Before starting, make sure the smallest magnification objectives is selected (2X magnification, objective with white color). To change magnification, hold the microscope head fully up using the left hand lever. Turn the turret and move microscope head slowly down.



- Move the chuck at lower position with the "Up/Down" lever located under and on the left of the chuck.



- Slide the micro-probes with precautions until the tips are located under the light spot. The micro-probes are held by vacuum which can be individually released by pressing the side lever.

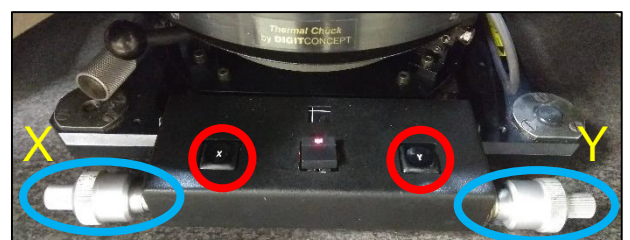


**WARNING!**  
Hold the manipulator parallel to the platen while moving it to avoid the needle touching the chuck and damaging!

- Move the tip of each micro-probe up using the z-axis knob to make sure the tip will not touch the wafer chuck (see next section for the detailed description of micro-probes).

## 3. Wafer Loading & Probing

- Unlock fast chuck translation using "X" and "Y" Buttons (in red), and slide chuck fully to front. Fine table movements can be done using the x- and y-axis knobs (in blue).



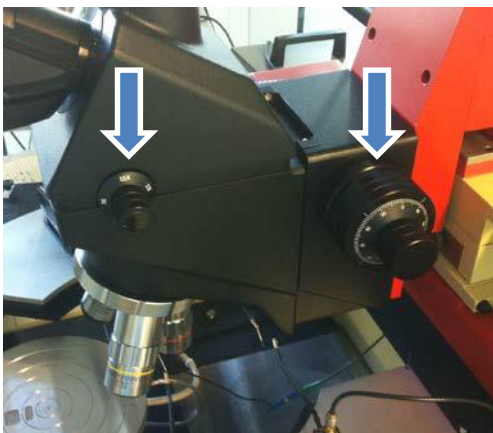
- Load the wafer/sample at the center of the chuck.



- Switch the wafer vacuum ON. By default only the center hole is used but vacuum rings can be activated if necessary by replacing the axial screw in the chuck.

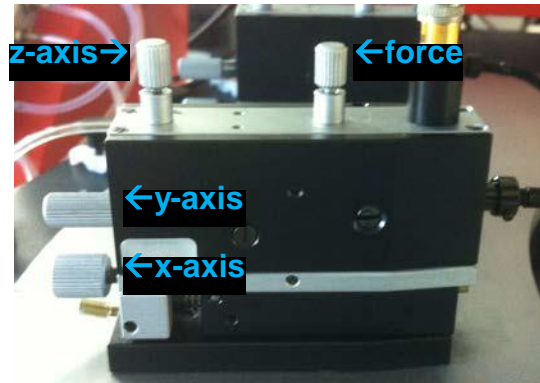


- Center the chuck, the microscope and tips so that the first contact pad can be seen on the screen.
- Move chuck at upper position with the "Up/Down" lever. Adjust focus and zoom onto the sample. Coarse and fine focus (z) and zoom (1x-2x) are located on the right side of the microscope.



- Move the x- and y-axis on the micro-probes to find the correct position above the contact pad.
- Move and center the microscope with the right hand lever. Each button unlocks one axis.

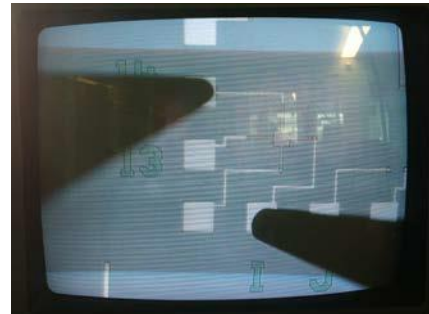
Micro-probe movements:



**WARNINGS:**

- The screw close to the electrical connector adjusts the contact force (middle position is optimal). Do not use it for z-movement!
- Never switch the electrical connectors of the micro-probes. Configurations are down with a switching box (see next section).

- Once x- and y-axis are correctly positioned, move the tip down with the z-axis. The landing on the pad occurs when the tip position starts moving laterally (small backlash). Do not push too hard!



**WARNING:** Tungsten probe tips can easily get damaged. These are consumables and should be changed regularly. Make sure to contact CMi staff if one tip is broken!

- Move the objective position to the next pads and repeat the tip landing operation.

**4. Probe Connections Set-up**

The Agilent 4155C parameter analyser features 4 Source/Measure Units (SMU) for signal input or output. These are labelled SMU1 to SMU4. A switching box with 6 positions is available to manage the connections between the probes and the SMUs, which allows rapid switching of predefined software configurations/applications.



**Position I: Field effect transistor, with substrate contact on top (probe tip)**

| <b>FET</b> | BNC7            | BNC8           | BNC9               | BNC10 | BNC11        |
|------------|-----------------|----------------|--------------------|-------|--------------|
| SMU1       |                 |                | Source<br>(Common) |       |              |
| SMU2       | Drain<br>(Var1) |                |                    |       |              |
| SMU3       |                 | Gate<br>(Var2) |                    |       |              |
| SMU4       |                 |                |                    |       | SUB<br>(Pot) |

**Position II: Field effect transistor, with substrate contact on the chuck (conductive substrate)**

| <b>FET</b> | BNC7            | BNC8           | BNC9               | BNC10        | BNC11 |
|------------|-----------------|----------------|--------------------|--------------|-------|
| SMU1       |                 |                | Source<br>(Common) |              |       |
| SMU2       | Drain<br>(Var1) |                |                    |              |       |
| SMU3       |                 | Gate<br>(Var2) |                    |              |       |
| SMU4       |                 |                |                    | SUB<br>(Pot) |       |

**Position III: Diode VF-ID, 2-points resistance**

| <b>RES2</b> | BNC7           | BNC8 | BNC9            | BNC10 | BNC11 |
|-------------|----------------|------|-----------------|-------|-------|
| SMU1        | High<br>(Var1) |      |                 |       |       |
| SMU2        |                |      |                 |       |       |
| SMU3        |                |      | Low<br>(Common) |       |       |
| SMU4        |                |      |                 |       |       |

**Position IV: General 4-points measurement**

| <b>RES4</b> | BNC7                        | BNC8             | BNC9                          | BNC10 | BNC11             |
|-------------|-----------------------------|------------------|-------------------------------|-------|-------------------|
| SMU1        |                             |                  | I <sub>High</sub><br>(Common) |       |                   |
| SMU2        | I <sub>High</sub><br>(Var1) |                  |                               |       |                   |
| SMU3        |                             | V <sub>Low</sub> |                               |       |                   |
| SMU4        |                             |                  |                               |       | V <sub>High</sub> |

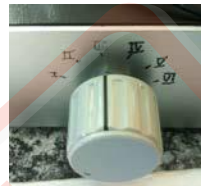
**Position V: Bipolar transistor, with substrate contact on the chuck (conductive substrate)**

| <b>BPT</b> | BNC7                | BNC8           | BNC9                | BNC10        | BNC11 |
|------------|---------------------|----------------|---------------------|--------------|-------|
| SMU1       |                     |                | Emitter<br>(Common) |              |       |
| SMU2       |                     | Base<br>(Var2) |                     |              |       |
| SMU3       | Collector<br>(Var1) |                |                     |              |       |
| SMU4       |                     |                |                     | SUB<br>(Pot) |       |

**Position VI: Bipolar transistor, with substrate contact on top (probe tip)**

| <b>BPT</b> | BNC7                | BNC8           | BNC9                | BNC10 | BNC11        |
|------------|---------------------|----------------|---------------------|-------|--------------|
| SMU1       |                     |                | Emitter<br>(Common) |       |              |
| SMU2       |                     | Base<br>(Var2) |                     |       |              |
| SMU3       | Collector<br>(Var1) |                |                     |       |              |
| SMU4       |                     |                |                     |       | SUB<br>(Pot) |

- Select the correct configuration with the knob in front of the switching box. Check the list above for available configurations.



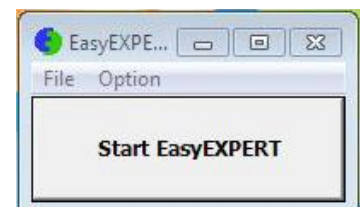
- Connect all BNC cables to number indicated in the above configuration list. Pay attention to the color code to identify each contact:

- yellow, orange, red, white : micro-probes
- green : chuck contact



**5. EasyEXPERT Software Set-up**

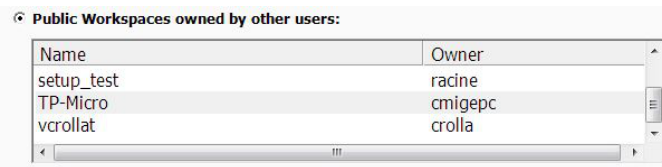
- Login on the PM8 computer. Username: cmigepec / Password: 7-Salles-Blanches
- The Agilent 4155C parameter analyser is controlled with the Desktop EasyEXPERT software. Start the program by clicking the icon, and then "Start EasyEXPERT".



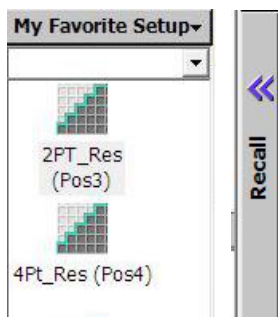
Note: The advanced operation manual for EasyEXPERT can be found here:

[http://cmi.epfl.ch/metrology/files/Prober\\_PM8/EasyExpert\\_Manual.pdf](http://cmi.epfl.ch/metrology/files/Prober_PM8/EasyExpert_Manual.pdf)

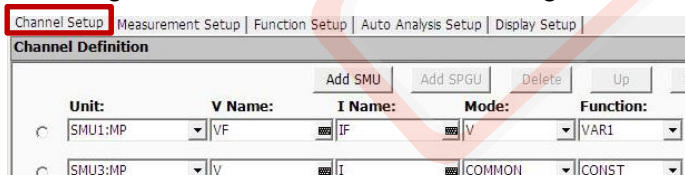
- Select the public workspace named “setup\_test” and click on continue...



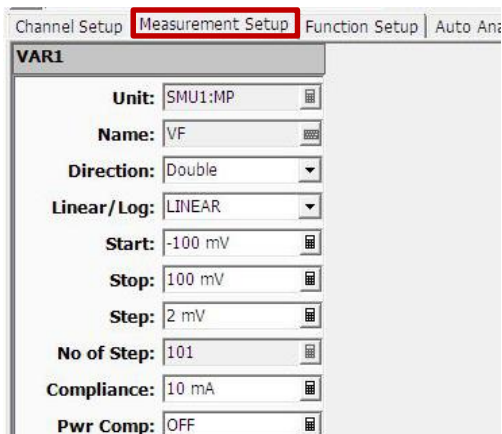
- In the “My Favorite Setup” list, select the correct measurement configuration and click on “Recall”.



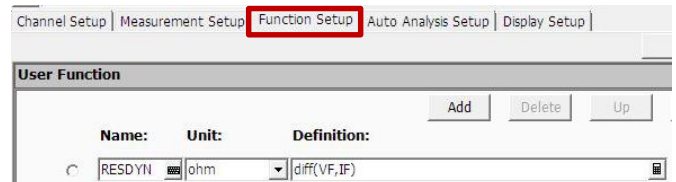
- The “Channel Setup” tab let users define the function of each SMUs. By default, this configuration will match the 6 standard configurations and should not be changed.



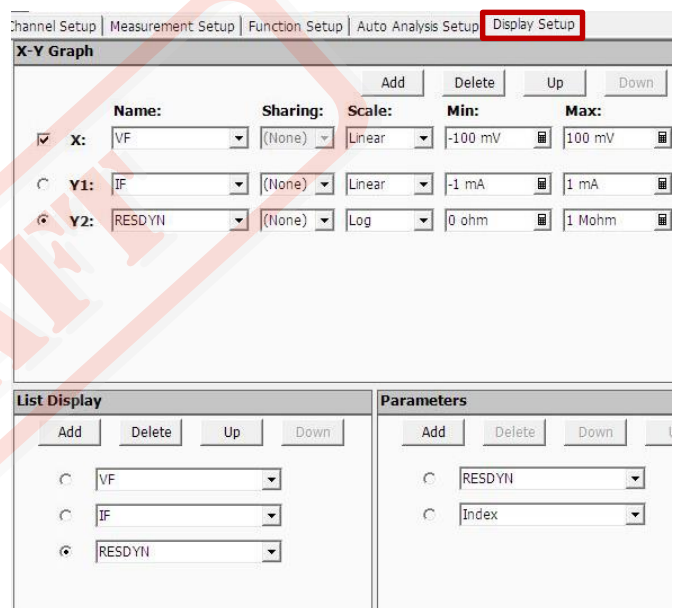
- The “Measurement Setup” tab let users define the measurement (scan range and step) for each variable (VAR1, VAR2,...) selected in the previous tab.



- The “Function Setup” tab let users define additional parameters that will be calculated from variables or measured data. For instance, in the case of resistive measurements, “RESDYN” is defined as the differential of V(I).



- The “Display Setup” tab let users define how to display the measurement’s result. Two options will be shown: an X-Y graph and a list of values.



## 6. Taking & Saving Measurements

- Once the parameter analyser is correctly set, the measurements are taken using the green “start” button:



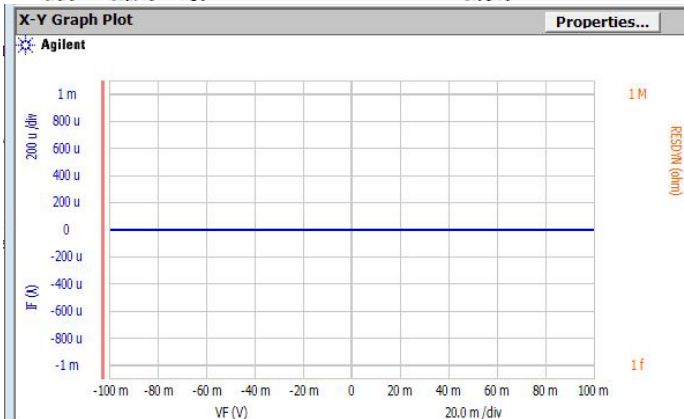
Alternatively, measurements can be appended to previous ones or ran continuously using the following buttons:



- The measurement window will show up, with graph, list and parameters windows (see below).

| Index | VF        | IF      | RESQYN            |
|-------|-----------|---------|-------------------|
| 1     | -100.0 mV | -8.2 pA | 425.5319149 M...  |
| 2     | -98.0 mV  | -3.5 pA | 888.8888889 M...  |
| 3     | -96.0 mV  | -3.7 pA | -1.600000000 G... |
| 4     | -94.0 mV  | -6.0 pA | 10.00000000 G...  |
| 5     | -92.0 mV  | -3.3 pA | 3.076923077 G...  |
| 6     | -90.0 mV  | -4.7 pA | 615.3846154 M...  |
| 7     | -88.0 mV  | 3.2 pA  | -769.2307692 M... |
| 8     | -86.0 mV  | -9.9 pA | -816.3265306 M... |
| 9     | -84.0 mV  | -1.7 pA | 930.2325581 M...  |

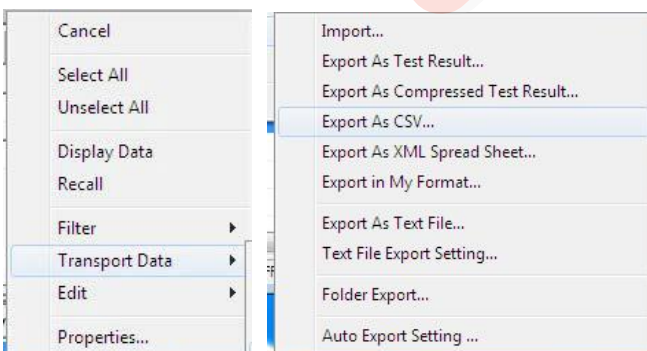
- Move the chuck at lower position with the "Up/Down" lever located under and on the right of the chuck.
- Unlock fast chuck translation using "X" and "Y" buttons, and slide chuck fully to front.
- Unload the wafer.
- Turn off all electronic equipment (Agilent 4155C parameter analyser, the Panasonic CCD camera and monitor, and the microscope lamp)
- Logout off "Suss PM8 – Manual prober" with CAE on zone 16 (CMI+1 corridor) accounting computer.



- Graph scaling is done in the menu "view/autoscale"
- All measurements are stored in the software database. Each measurement can be loaded from the bottom "results" tab, by selecting the correct line, right clicking, and selecting the "display data" option.

| Flag | Setup Name     | Date                | Count |
|------|----------------|---------------------|-------|
|      | 2PT_Res (Pos3) | 12/08/2016 10:53:01 | 1     |
|      | 2PT_Res        | 19/07/2016 14:44:57 | 1     |
|      | 2PT_Res        | 19/07/2016 14:38:32 | 2     |
|      | 2PT_Res        | 19/07/2016 14:35:38 | 1     |
|      | 4Pt_Res        | 14/06/2016 16:10:40 | 22    |

- Exporting options are accessed by right clicking on the line and going to "Transport Data".



- Exported data should be transferred outside of CMI using email/dropbox/network options.

## 7. Logout

- At the end of the measurement session, close the EasyEXPERT software.
- Move the micro-probe tips up.