



INSTRUCTION MANUAL

Si-MEASURING INSTRUMENT

Contents	page
1. General	2
1.1 Product Conten	2
1.2. Setup	3
1.3. Activation	4
1.4. Operation advice	4
2. Main menu	5
3. Resistivity Test	5
4. Resistor measuring manual	8
5. P-N Type Test	9
6. Storeg Data	10
6.1. Data Transfer via USB	12
7. Display light	13
8. Settings	13
8.1. Probe Spacing	14
8.2. Calibration	14
8.3. Resetting Data	14
8.4. Date / time	14
8.5. Signal Sound	15
9. Accumulator charging	15
10. Live Measurement Display on	
Computer screen	16
11. Information / Rights	18



1. Generalities

The Si is designed to be an trasportable inspection unit, suitable for measurements of relevant characteristics of doped silicon.

➔ Resistivity (Ω/cm^3)

➔ Conduvtivity (P / N – Type)

1.1. Product Content

1 Si V1b23



Si V1b23

2 Type Test Prods



heated



not heated

3 4-Point Probe Head / Mini Din Connector



4-Point Probe Head / Test Prods



4-Point Probe Head / Mini Din Connector

4 Power supply Unit/ USB cable



Power supply Unit



USB cable

1.2. Setup

- **Resistivity**

Resistivity is determined by use of the 4 – point method. The Probe head is furnished with 4 test prods, arranged in a row. The first and the last implant a constant current into the material, the two inner test prods measure the voltage. The resistivity value is calculated in correlation of the distance between the test prods and the thickness of the to be measured probe.

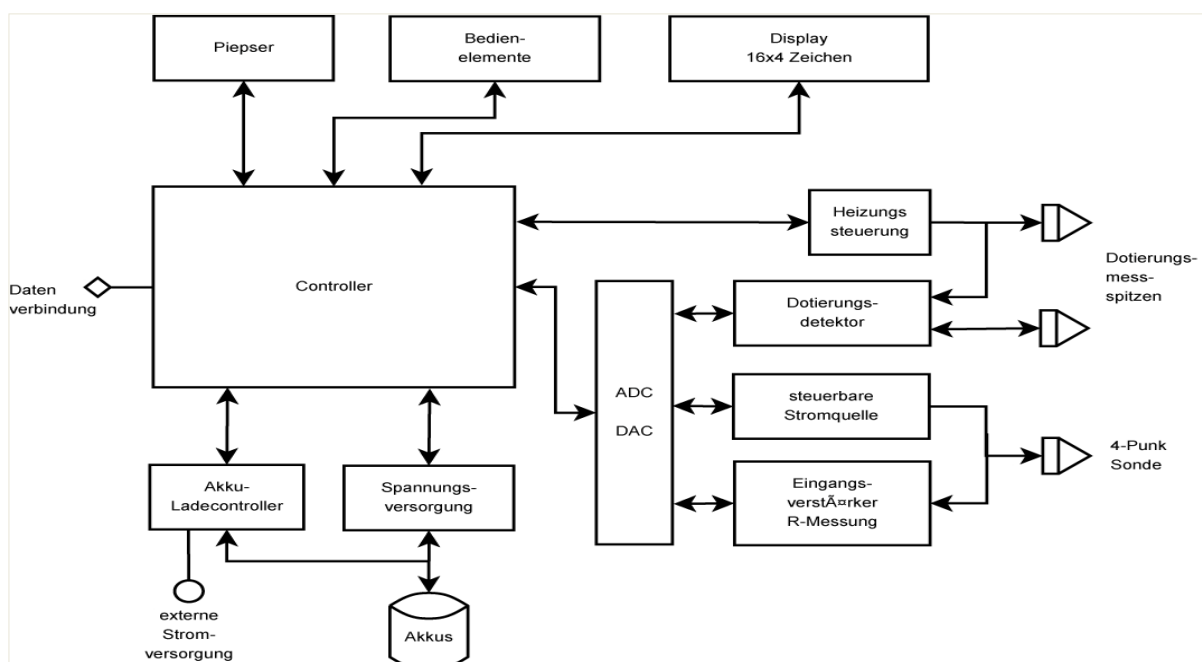
- **Conductivity**

The determination of the conductivity takes place by measuring the electrical potential between the two conductivity test prods whereby one of them is heated.

The alignment of the voltage gives information about the conductivity of the probe.

Before we get to the closer description of the operating, the internal setup of the tool shall be annotated.

Block diagram



This picture shows the single functional blocks.

The controller is the main part, and responsible for the controlling and regulation of the entire execution. Next to the controller, there are four function blocks which are responsible for adaption of the test prods. This part mainly consists of Signal converters, to enable measuring with A/D converters, while the A/D converters convert the analogue electrical signals into digital values.

Also the display must be controlled, and the entries of the key pad must be evaluated by the controller. To enable the duty without power adaptor, the charging application for the integrated accumulator is required.

The stored data can be transferred to computer via usb interface. Further information on the data transfer in chapter 5.1.

1.3. Activation

On top of the case are four attaching sockets:



- 4-Point-probe head (Mini Din connector)
- Unheated PN-Sensor
- USB
- Heated PN-Sensor

1.4. Operating advice

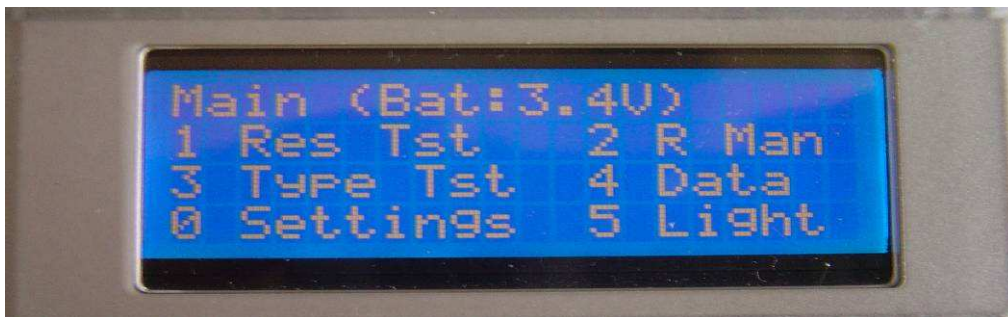
The service of the measuring instrument follows exclusively over the keyboard. In most cases the service is shown in the announcement field. In the main menu the



corresponding figures about which the choice is to be carried out stand e.g. before the entries.

- “↔” turn on
- “↕” turn off (Turn off is only possible from the Main Menu, to avoid unintended torn off while measuring)
- “ ESC “ returns from the Sub Menu back to the Main Menu

2. Main menu



In the main menu the following menu points stand for the choice:

- **1 Resistivity Test** (Here one reaches to the resistance measurement, point 3)
- **2 Resistivity Manual** (Here one reaches to the manual resistance measurement, point 4)
- **3 Type Test** (Here one reaches to the PN-Test, point 5)
- **4 Data View** (In this menu stored dates can be looked or be transferred via USB to the PC, point 6)
- **5 Display light** (Here one can connect the lighting of the display, point 7)
- **0 Settings** (In this menu various settings can be carried out, point 8)

3. Resistivity Test

Press Nr. „1“ in the Main Menu to start the resistivity test.



Before the resistivity test can be started, the thickness of the probe must be adjusted, so that the Value can be calculated correctly.

To adjust the thickness press Nr. „1“ in the resistivity test mode, following sight appears.



Adjust the thickness of the probe (unit = mm, whereby 1mm = 1000μm), then confirm the entered value by pressing enter, press the „del“ button to delete in case of wrong entries, then re-enter the correct value and confirm with Enter button, the display returns to the resistivity mode.

To start the resistivity test, put the four point probe head on the to be measured probe, you can read the result in the third row, marked with R for Resistivity.

Its strongly recommended to chose a flat part of the probes surface for measuring, the test prods shall build a ankle of 90° together with the surface of the probe, to decrease the risk of test prod breakage.

Informations (Remarks):

- ➔ Material thickness > 4 mm (= 4000 μm) don't require further adjustments, as - by the use of 1mm distance between the four test prods - they can not be further distinguished from 4 mm.
- ➔ The test prods shall get in contact with the material in a 90 ° angle, to avoid the test prods breakage.
- ➔ Depending of the conditions of the probe, it can take one or more seconds until the right measurement range is chosen. In special very high resistivity values can require more then second to determinate the result. In most cases the required time is clearly below one second.

The measured data can be saved on the intern hard disc by typing button Nr. 2 in the resistivity mode. The data storage display appears.



Every record receives a number and can be saved to hard disc. The assignement (Number / record) can not be changed to ensure consistence of the stored data.

Below that the thickness of the prople and the according resistivity value is listed. The data can be saved by typing the „Enter“ button on the key pad. By typing the „Del“ button, display returns into the resistivity mode.

Besides that the following additional data gets stored:

- ➔ Thickness
- ➔ Resistivity
- ➔ Implanted current
- ➔ Measured voltage
- ➔ Date and Time

4. Resistor measuring manual

4.1. Basics of Resistivity measuring

Resistivity measuring is based on the „4 Point Method“.

4 Needle tips are arranged in a row with a defined distance between each other. For determination of the specific resistivity the two outer points implant a current into the Material. This current must be kept constant to an defined value (desired value), this happens by use of complex electric circuits.

Silicon is a very hard Material, if the needle tips contact the silicon the contacting isn't ideal. The contact area is very small, and due to oxidation on the surface the contact resistivities might be quite high and are subject to fluctuations anyway. These inconstant contact resistivity must be compensated while measuring to achieve a constant current through the sample.

The powersource can be imagined as follows. First a Voltage is set on the two outside needle tips,

the current which flows through this on way can be measured.

If contacting a material a current flows through it, if this current is higher than the desired value, the voltage must be so far reduced, that the measured current meets the desired value. In case the current is too low, the voltage must be increased until the measured current meets the desired value.

So the current is regulated by variable voltage.

In case of a sample with higher resistivity, the voltage must be increased as well, in order to implant the same current. The resistivity of the sample is added to the contact resistivity. These are not insignificant, and can amount to a multiple of the resistivity of the actual sample. But the voltage can not be increased infinitely, with increasing resistivities. If the maximum voltage is reached, and no sufficient current flows through the material, the measured current does not reach the desired value.

If the current is compensated, meaning it has reached the desired value, the two inner needle tips measure the voltage. This voltage is seized with an analogue – digital converter. To achieve a precise measurement, the voltage must be kept between 5 and 55mV (Millivolt), then the result is sufficient exact. For sufficient precise measurement the voltage between the inner two needle tips must be kept between 5mV and 55mV.

If both conditions are fulfilled, the specific resistivity can be calculated.

4.2. Praktik Resistivity Measuring

Main menu to the manual resistance measurement. As with the automatic resistance measurement the correct thickness of the test should be stopped, see in addition segment 3. In addition, the measuring electricity can be set up with the manual measurement of the resistance. This measuring electricity is regulated in 4 areas and must be adapted to the material to be measured. For this choice the key “↑” must be pressed.

The following areas are available for measurements:

- 20uA
- 200uA
- 2mA
- 20mA

For the choice of the right measuring area the tension is decisive between internal both contacts of the 4-sharp probes of head.

If a tension is reached between 5mV and 55 mV, a correct measured value can be read. Condition is that the measuring electricity flows completely by the test.

In addition the measuring electricity can be read in the display in the left lower corner. If the electricity with the preset value flows and the measuring tension lies in the optimum area, a correct measured value can be read.

Higher streams (to 20 mA) are suitable for tests with small specific resistance. For very high resisted tests the measuring area with 20uA is suitable. If the measured tension is too high (greater 55mV), the afterwards higher measuring area must be chosen.

Details:

- For unknown tests should be begun with the measuring area 20uA. If flows the electricity which is too small tension, however, the afterwards higher measuring area must be chosen.
- If no electricity flows even with 20uA by the test, this is either very high resisted or the contact between measuring probe and test is too low.

5. PN-Type Test

By selecting number „2“ from the main menu, the Type Test programm gets started.



The type test gets realized by the use of two conductivity test prods, while one of them is heated. After starting the type test program, the heated test prod needs some time to get the operating temperature, the item „temp“ in the second row of the display gives information about the status of the heating process. When display switch from „wait“ to „ok“ the type test can be started. Therefore just press both conductivity test prods on the probe.

The latest measured conductivity is posted in the third row, and the fourth row gives information about the last measured conductivity.

The according result can be stored by typing „2“ on the key pad.



Besides the Conductivity type the advice saves additional data, just like the saving of the resistivity data. In pricipal there is no relation between the storages.

In case no result applies, please change the position of the test prods, edges and broken spots would be applicable for test.

6. Stored Data

Entering Number „3“ in the Main Menu opens the Data Menu.



By pressing number „1“ the stored resistivity values can be reviewed, as well as the according date and time.

The arrow buttons “↔” and “↕” allow to skip between the stored values.



If you choose number „2“ in the Data Menu, the saved data from type test can be reviewed, the arrow buttons “↔” and “↕” allow to skip through the according data.



6.1. Data Transfer via USB

The third Menu Point in the data mode opens the data send mode, this allows to export the stored data via usb to a computer. Therefore the Measurement tool must be connected with the computer. To export the data, the driver must be installed.

The driver is available for download on the following website.

<http://www.ftdichip.com/Drivers/CDM/CDM%202.02.04%20WHQL%20Certificate.zip>

The driver furnishes a virtual „COM“ port, the data can be viewed with the terminal application of your choice

➔ **9600Bit/s**

➔ **8 Databit**

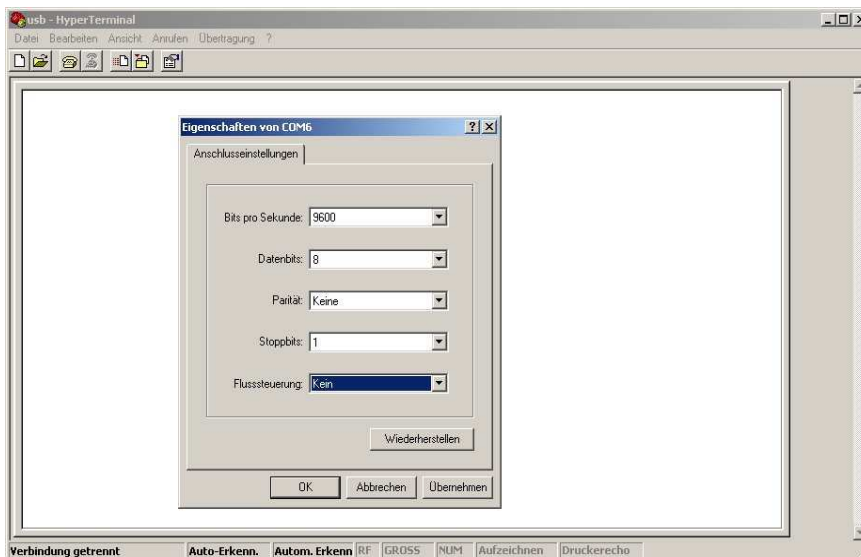
➔ **1 Stopbit**

➔ **No Parity**

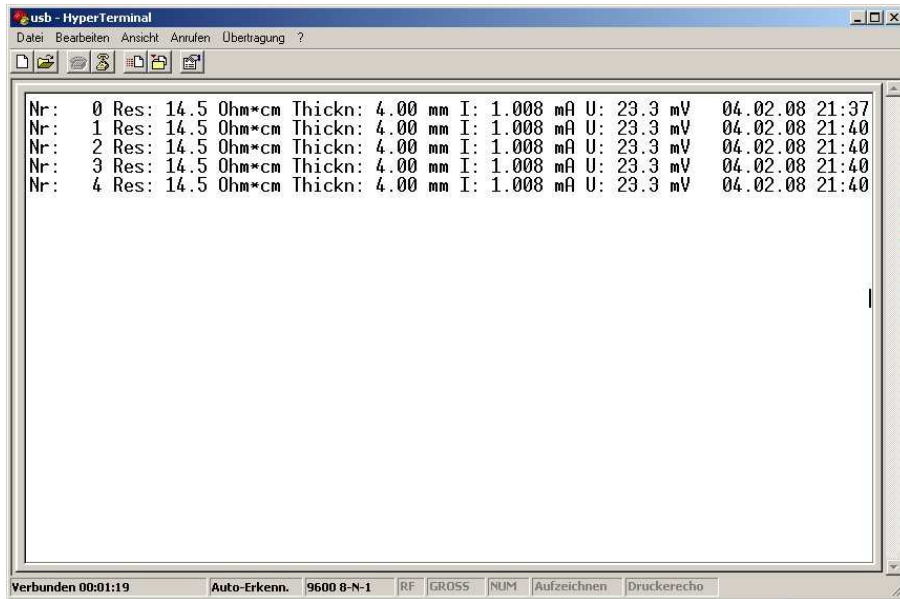
➔ **No Flow Control**

The below posted screenshots show data transfer while using Hyperterminal. The Stored Data will be transferred by entering Number „3“ from the Data Menu. The Data appears on the screen in text form, so the evaluation can be easily done, by the use of calculator applications like for example microsoft excel, or open office calc.

Data Transfer 1:



Data Transfer 2:



7. Display light.

The displaylight can be switched on and of by entering Number „4“ in the Main Menu.

7.1 Probehead - Probe spacing

Choosing Menupoint 1 allows to adjust the distance between. The predefined default distance is 1 mm.

8. Settings

By entering „0“ in the Main Menu, the Settings Menu appears, it allows to undertake the below stated adjustments.



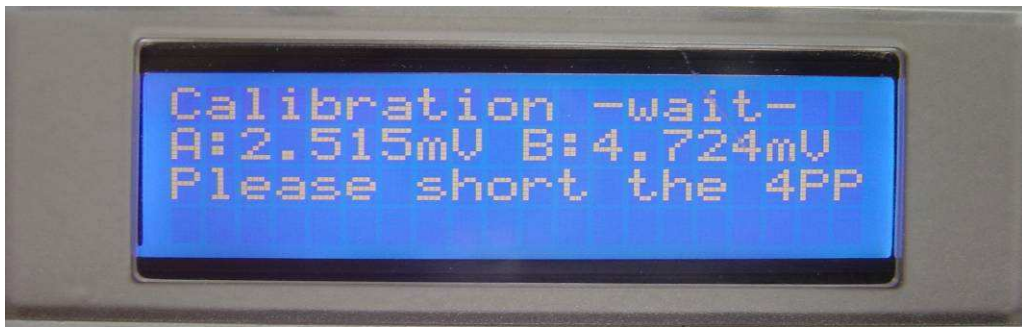
8.1. Probe Spacing

By choosing Number „1“ from the Settings Menu, the distance between the test prods of the four point probe head can be adjusted. Standard is 1 mm.



8.2 Calibration

By choosing Number „2“ from the Settings Menu, the internal calibration starts, while calibration process the four Point probe head must be set on a probe, the rest happens automatically.



8.3 Resetting Data

Entering Number „3“ in the Settings Menu resets the internal hard disc and deletes the saved data, of resistivity and type tests.

8.4 Date / Time

Number „4“ in the Settings Menu allows to adjust date and time, the following format must be used, DDMMYYhhmm (0402082212, für den 04.02.08 22:12).

In case of incomplete entering, adjustments don't apply.



8.5 Signal Sound

By Entering Number „5“ a threshold value can be chosen, i case the measured resistivity is below the threshold value, an acoustic signal will be released.



9. Accumulator Charging

The charging process starts as soon as the connection to USB or an electrical socket is established. Some Computers require installation of the driver to provide electricity via USB.

The voltage of the Accumulator is shown in the first row of the Main Menu, this information is temprature sensitive which and given an orientation regarding the remaining power of the Accumulator. The Exact state of charge can not be determinated by the use of this accu type.

The complete Charging procedure takes approx. 14 hours, due to the fact that the state of charge can not be determinated, a 14 hour timer gets started by establishing connection between the unit and an energy source,

so the shown percentages aren't necessarily the real state of charge. The device can be disconnected from the chosen energy source at any time.



10. Live Measurement Display on Computer Screen.

10.1 Function

The USB slot at the upper end of the Measurement tool allows to display the Measurement results on the Computer Screen., by use of an emulation of the serial interface.

To use this function the installation of the according software and driver is required.

10.2 Installation of the Software

10.2.1 Driver

The following driver provides a virtual COM – port. The driver must be installed according to the FTDI. Driver and installation manual can be downloaded from the following website:

<http://www.ftdichip.com/Drivers/VCP.htm>

10.2.2 Java

The software is written in Javascript. The execution make use of the

Java-virtual-Machiene. In most cases the Java environment is allready installed, in case it inst installed, the Java Environment can be installed from the following website:

<http://java.sun.com/javase/downloads/index.jsp>

(Java SE Runtime Environment)

To communicate with the installed driver, an additional plug in is required, therefore the folder in which Java environment is installed must be determined. In most cases you will find it here:

C:\Program Files\Java\jre1.6.0_xx

Add both of the following files to the folder

**rxtxSerial.dll to-> C:\Program
Files\Java\jre1.6.0_xx\jre\bin**

**RXTXComm.jar to -> C:\Program
Files\Java\jre1.6.0_xx\jre\lib\ext**

The according files are available on the USB stick which is part of the delivery content.

10.2.3 Visualization Software „Magnifier“

The visualization Software Magnifier doesn't requires extra installation, just download (or copy from the USB stick) the file **Magnifier.jar** and run it.

10.3 Usage

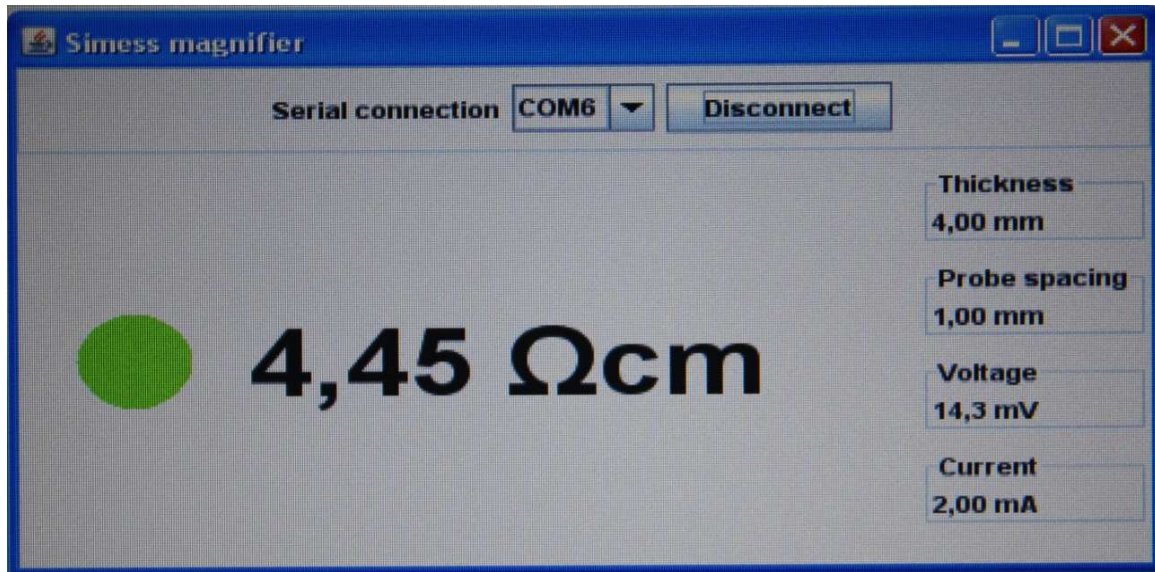
Please execute the following steps.

- Connect the Measurement tool via USB cable with the computer.
- Run the programm „Magnifier“.
- Choose the COM Port (in most cases the last)
- Start the transfer by pressing the „ Connect“ Button.
- Choose on the Measurement tool between Menu 1, 2 or 3.

Data will be tranferred to the screen automatically. On the left side you can see a coloured circle, which gives information about the validity of the displayed result. In case the circle is green coloured the result is valid.

In the middle you see the measured value.

Depending on the Parameter which had been inspected you will see the Resistivty value or the information wether the material is P or N type.



11. Information / Rights

The development and conversion followed after the best knowledge and conscience. Mistakes can still appear. For perhaps appearing shortages of mistakes or damages of every kind which originate, e.g., from improper use no liability can be assumed. The use, follows on own danger and reason.