

ResTest v1

User Instruction Manual



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Introduction

The ResTest is a combined constant current source and digital voltmeter, which has been designed to be used with four point probe equipment to produce resistivity measurements. The unit supplies a constant current and can display resultant voltage sheet resistance and volume resistivity.

Electrical Specification

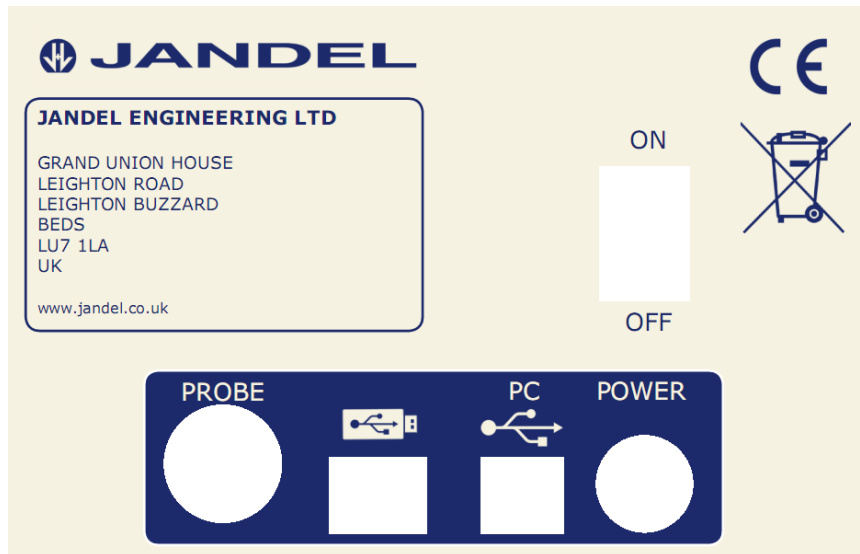
| | Min | Max |
|--|-----|--------------|
| Voltage range (1x Gain) | 0v | 4v |
| Voltage range (100x Gain) | 0v | 0.040mV |
| Applied Current | 1uA | 10mA |
| Accuracy | | |
| Ohms / \square | | |
| No of Measurement Results (Internal) | 0 | 99 |
| No of Measurement Results (External USB) | 0 | No set limit |

Unpacking

You will find the follow upon unpacking your new ResTest unit:

- A ResTest Unit
- An external power supply
- USB lead
- A CD-ROM containing USB driver and PC software for result capture

Connections/Interface



On the back of the ResTest unit you will find all of the external connections. The USB A socket is intended for memory stick use only. Memory sticks must be formatted with FAT16 or FAT32 filing systems, NTFS or other file systems are not supported.



There are three multi function push buttons under the screen. The action performed by pressing a button varies, each screen will display a text above the button, pressing it performs that action.

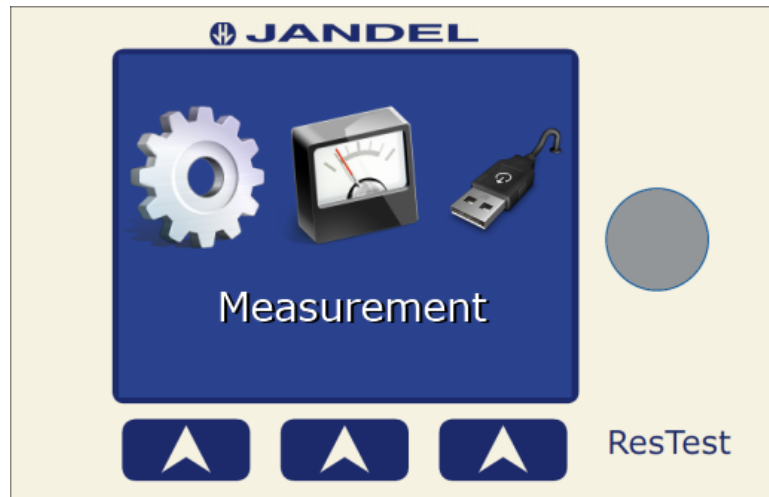
In addition there is a rotary dial which can be rotated clockwise and anti clock wise without limit. The rotary dial also acts as a button and can be pushed in. The action performed when pushing the rotary dial in varies but is generally used for changing the active selection or modifying values.

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Setup Instructions

- Plug your ResTest unit in to the power supply
- Attach your Jandel 4 point probe
- Power up the device using the power switch on the rear of the unit

Whilst powering up the ResTest it will perform its own self calibration and test against its internal precision reference resistors. While it is doing this you will hear a series of relay clicks, once the splash screen has disappeared the unit will display the main menu and is ready to use.



Main menu screen

Settings

The ResTest has 6 option screens; each option screen is selected using the rotary dial.

Set time

The ResTest has an internal real time clock and calendar. This setting screen lets you set the clock and switch the date format between UK and USA.

To set the clock, press the "Set" button. A green up & down arrow will flash above the part of the date/time you can modify. To modify the value operate the rotary dial clockwise to increment and anti-clockwise to decrement. To move on to the next value push the rotary dial in. When the time and date are correct press the "Save" button.

Please note the calendar will account for leap years and the number of days in a month but doesn't auto adjust for daylight savings time and you will have to adjust the clock manually.

Factory Defaults

Restore the unit to factory default settings

Set Brightness

Change the brightness of the screen, operate the rotary dial to increase and decrease the brightness. When you're happy with the brightness level press the "Save" button.

Wafer thickness

Used to change the default wafer thickness that will be used. To modify the wafer thickness press the button "Change" now operate the rotary dial to modify the value, pressing the button "Next Unit" allows smaller adjustment. Once you have the thickness you require press the "Accept" button.

Probe type

There are 6 different probe spacing configurations to choose from:
0.500mm , 0.635mm , 1.000mm , 1.016mm , 1.270mm & 1.591mm

Operate the rotary encoder to select the default spacing of you probe. Using the "Probe Type" button you can switch between "Linear Array" and "Square Array".

When complete press the "Accept" button.

Correction factor

You can add a correction factor to the measured voltage using this screen. The measured voltage is multiplied by this value before calculating the results.

Press the “Change” button to begin modifying the correction value using the rotary encoder. Each press of the “Next unit” button allows finer adjustment of the correction factor. When complete press the “Accept” button.

Measurement Setup

There are 4 types of measurement

- Sheet Resistance – Primary measurement value is display in Ohms/Square
- Wafer Resistivity – Primary measurement value is display in Ohms/Cm
- Volume Resistivity – Primary measurement value is display in Ohms/Cm
- Ohms Resistance – Primary measurement value is display in Ohms

All four perform the same measurement but present the most appropriate result unit for the type of measurement you are performing.

When selecting a “Wafer Resistivity” the ResTest will ask for the wafer thickness of the sample you are about to measure. By default the ResTest will use the value you have defined under the settings menu. You can modify this by pressing the “Change” button and operating the rotary dial.

For “Volume Resistivity” measurement the ResTest will ask for the wafer thickness and the probe spacing. To select the probe spacing use the rotary dial, press the “Accept” button when done. The next screen lets you set the wafer thickness as before.

These settings are not remembered and each time you start a measurement the defaults set up via the settings menu are used.

While in measurement mode the rotary dial changes the applied current, pushing it in changes the applied current range. There are 3 current ranges,

- 0.5mA to 10mA
- 10uA to 100uA
- 1uA to 10uA

Each push of the rotary dial jumps to the next current range.

Measuring a Sample

Upon selecting measurement the system enters measurement- standby mode, in this state no current is applied to the probe but you are free to dial in the current you will require. By pressing the “Activate” button current will be applied across the probe giving you a measurement value on the screen.

Whilst active the middle button cycles around the available options and the 3 button selects the current option. These options are:

- Reverse (-/+) – This will reverse the polarity of the current being applied to the probe. The voltage measured will also be shown as negative
- Gain 1x / 100x – if you have a very small voltage you can obtain higher measurement accuracy by using the 100x gain function.
- Save – This will save the result to the ResTest’s internal memory
- Save USB – Will only appear if a USB memory stick is present, this will save the result directly to the memory stick, appending it to the results.csv file
- Standby – Will turn off the applied current
- ReZero – Removes internal offsets (Performed automatically when switching from standby to active).

While measuring you may see the following messages:

“Contact Limit” - This can mean two things:

You either have no connection to the item you are measuring, or the measured voltage is far too high. Check the probe connections and reduce the applied current.

“Out of Range” – The measured voltage has exceeded our input range, reduce the applied current down until it is within range.

“Out of Range Remove Gain” – The same as above, but you also have gain enabled which reduces the input range. Disable the gain and/or reduce the applied current.

Measurement Tips

- The ResTest performs best with a larger input voltage so if possible increasing the current to get a higher voltage.
- For low resistance samples where the measured voltage is very low on the highest current setting, enable 100x gain to give you a more accurate and stable result.

Download

The ResTest unit can store up to 99 results internally, by using the download screen these results can be saved to the PC or direct to a USB memory stick. To download directly to your PC you will need to install the Jandel PC application.

The download screen can be accessed via the main screen by selecting the USB lead icon. On the download screen you have 2 options PC download and USB memory stick. The USB stick option will be greyed out if no suitable USB memory stick is found.

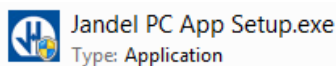


The rotary dial is used to choose between the PC download or the USB memory stick. When saving to a USB memory stick a file named “Results.csv” is created if not already there and results appended. If it already exists results are appended to the end of it.

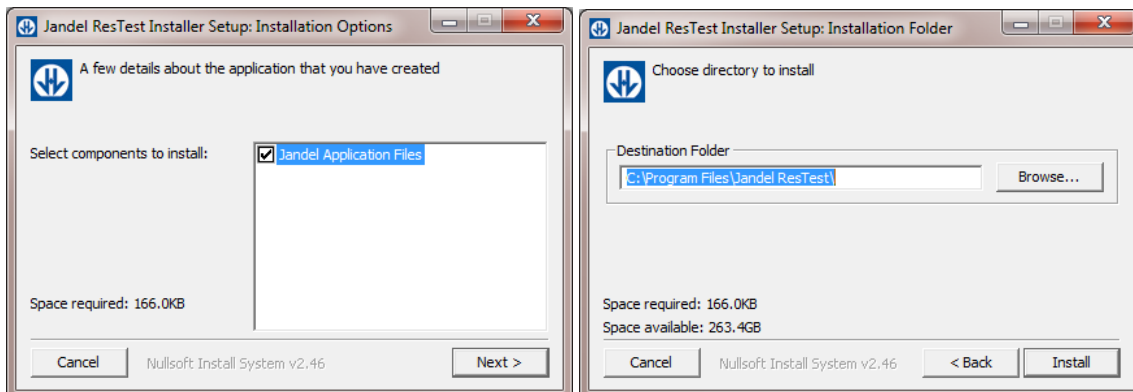
From the download screen you also have the option to delete the results stored on the unit.

Installing the Jandel PC application

Insert the CD supplied with you new ResTest Unit in to your PC. Locate the PC application installer:



Double click the “Jandel PC App Setup.exe”, click next, select the install directory and click install.

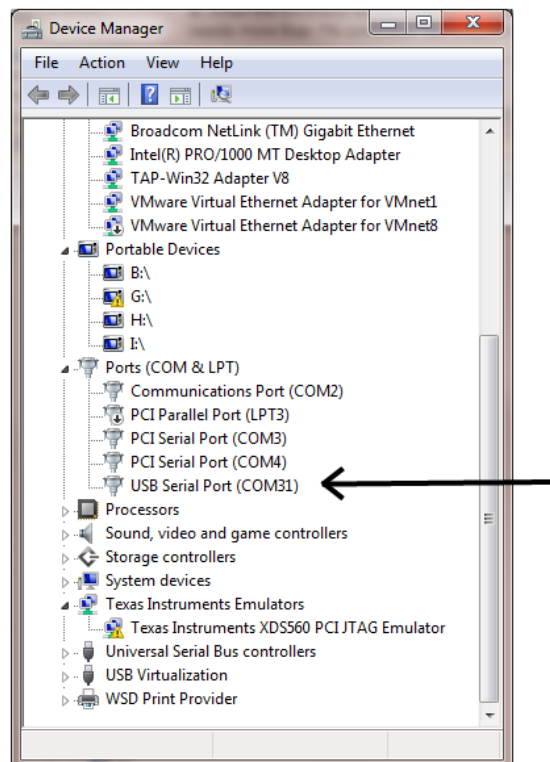


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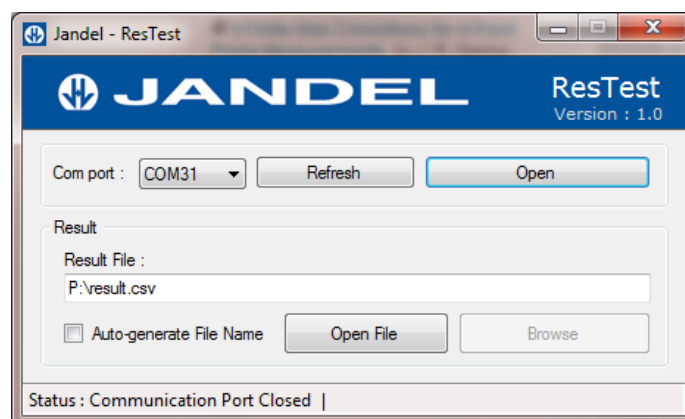
When finished you can find the application shortcut in the start menu in the Jandel folder.

Before starting the PC application, please ensure you have attached the Jandel unit to you PC and you have installed the USB driver, which can also be found on the PC.

To check that your driver has successful install go to the window Device Manager and look for a “USB Serial Port”. Make a note of the COM port number next to the USB serial port. You will need to know this before running the Jandel PC application. If there is a red mark next to the USB serial port you will need to resolve the driver issue before continuing.



Now Start the PC application



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Select the COM port number that matches the one found in the device manager and press open. The browse button can be used to select where you would like result file saved. To transfer results from the ResTest unit to the PC navigate to the Download screen and select "Save to PC"

Clicking the Auto-Generate check box will create a new file in the selected directory every time you press the download button on the ResTest.

Once the download is complete you will have a .CSV file which can be opened in excel, notepad or many other applications for analysis. Using the open file button will execute the .csv file with the default program registered with windows, in most cases this would be Excel.

Trouble Shooting

Why are my measurements double what I would expect them to be?

There are two possible reasons, you either have the wrong probe type (square instead of linear) selected or you have a correction factor set.

The unit is ignoring my first button press

When left for a period of time the unit will go to sleep and reduce the screen brightness, the first button press wakes the unit up but is then ignored.

I cannot see any COM ports in the Jandel application

Check the windows device manager for a "USB serial port" if it has a red symbol over it try updating the driver with the one supplied on the CD.

I have opened the COM port but nothing happens when I press download on the ResTest

You could have selected the wrong COM port if you have multiple ports on your system. Unplug the USB lead to the ResTest. Open the windows device manager, navigate to the Ports Section if it is there. Make a note of the COM ports that already exists, now plug the ResTest in and the new COM port that appears is your ResTest unit.

I hear clicking when the ResTest powers up or during operation

This is normal behaviour.

Useful Equations

Sheet resistance (SR):

$$= 4.5324 \times V/I \quad \Omega/\square$$

Bulk Resistivity for a wafer:

$$= 4.5324 \times t \times V/I \quad \Omega\text{cm}$$

Where t is wafer thickness in cm

Bulk resistivity:

$$= 2 \times \pi \times s \times V/I \quad \Omega\text{cm}$$

Where s is the probe spacing in cm

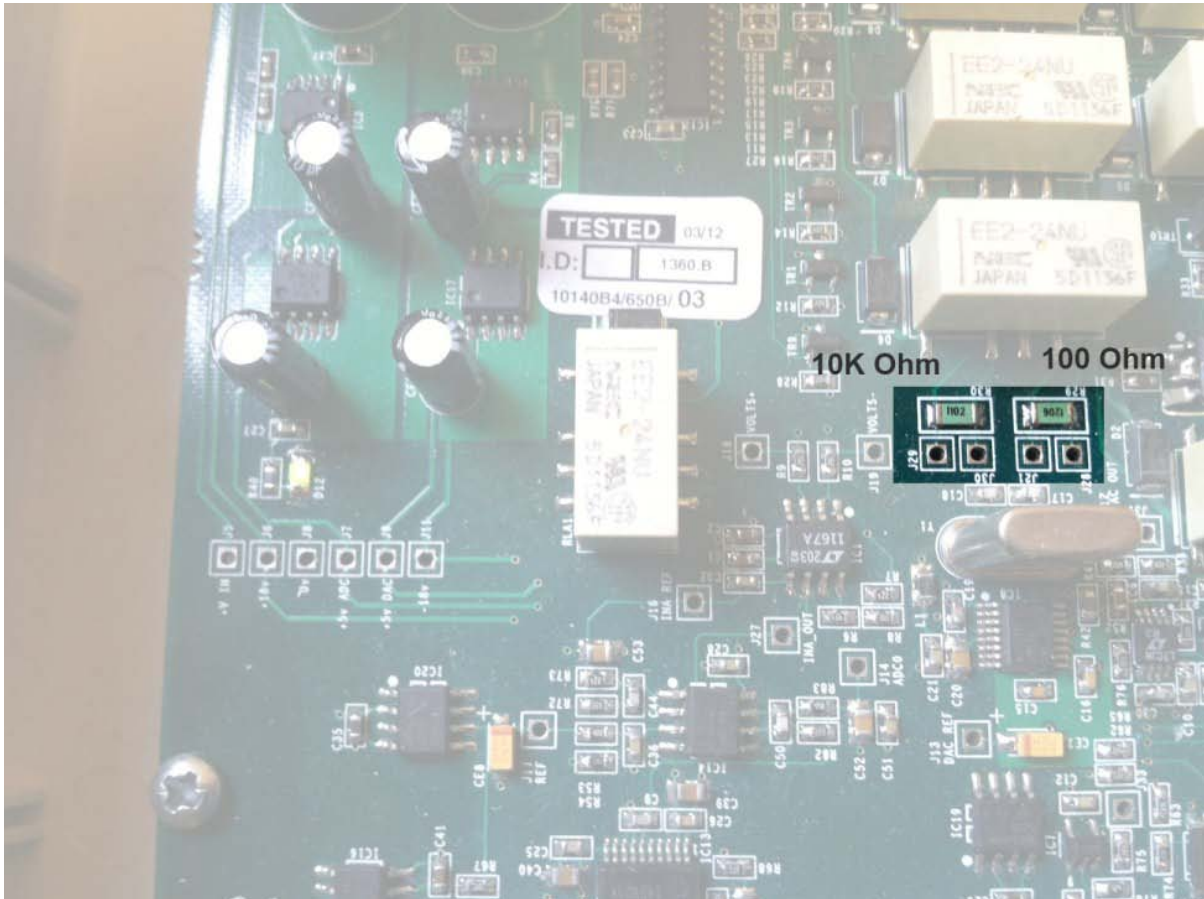
Correction factors are required for probing close to an edge of a sample or for an unusual/intermediate shapes and sizes of sample can mean that correction factors are required. A broad range of correction factors have been determined by Haldor Topsoe. At <http://www.jandel.co.uk/topsoe.html> you can find all of the pages from the 1966 (revised 1968) Haldor Topsoe book, "Geometric Factors in Four Point Resistivity Measurement", with each page available as an individual PDF.

Calibration

The ResTest intelligently calibrates offsets and its input analog electronics every time you power it up. It does this calibration against 2 high precision reference resistors. To Improve confidence in the units accuracy further, these reference resistors can be measured and the software given the actual value of the reference resistor. All measurements and calibration are a ratio of measurements across these references.

Before proceeding calibration must only be performed by qualified personnel, accidental damage caused whilst calibrating is not covered by the warranty.

To access the calibration mode, you first must remove the cover by unscrewing the four screws on the bottom of the unit and lifting the lid off. Plug power in and power up the unit. Once at the main screen press the button on the back of the vertically mounted PCB the screen should switch to show the calibration screen.



There are 2 reference resistors on the horizontally mount board that are used to self calibrate when taking a measurement, a 10K Ω and 100 Ω . This screen lets you dial in the measured resistance of these 2 references. The 2 reference resistors can only be measured whilst you are modifying the value of that reference on the screen as the relays have to be operated to isolate them and allow measurement.

Set up your resistance meter and connect your probes across J21 and J28 to measure the 100 Ω .

Press the “Change” button to start, using the rotary dial you can modify the value on the screen to match the value you have measured the reference to be.

Each subsequent press of the “Next unit” button changes how much the reference is modified by the rotary dial.

Once you’re done modifying the 100 Ω value the unit switches to isolate the 10K Ω , move your probes to J29 and J30, repeat the procedure and modify the value on the screen to match your reading.

You can keep pressing this button to go back around and modify the values. When you are finished press the “Accept” button to save the calibration values to the unit.

Technical – PC Communication Result Format

Result download format

Serial data: 115200 baud 8 Data bits 1 Stop bit over a USB virtual COM port (CDC)

The PC USB port is used for debugging logs and result downloading. When downloading results the data will look like this:

Results Start

Date, Volts, Ohms, uA, Probe Spacing, Wafer Thickness, OhmsSq, OhmsCm, OhmsCmVol, Probe type, Correction Ratio

02/03/2013 20:32:08, 1.000737, 100.073746, 10000, 0.100000, 0.065000, 453.574249, 29.482325, 62.878189, Linear, 0.00

02/03/2013 20:33:22, 8.497849, 999.746948, 8500, 0.100000, 0.065000, 4531.252930, 294.531433, 628.159546, Linear, 9.99

30/05/2012 12:57:00, 1.000751, 100.075104, 10000, 0.100000, 0.065000, 453.580414, 29.482725, 62.879040, Linear, 0.00

30/05/2012 12:57:00, 1.000751, 100.075058, 10000, 0.100000, 0.065000, 453.580200, 29.482712, 62.879017, Linear, 0.00

Results End

“Results Start” indicates results are to follow, the next line details what data is contained in each column. The data is then sent line by line comma separated, when complete the string “Results End” is sent.