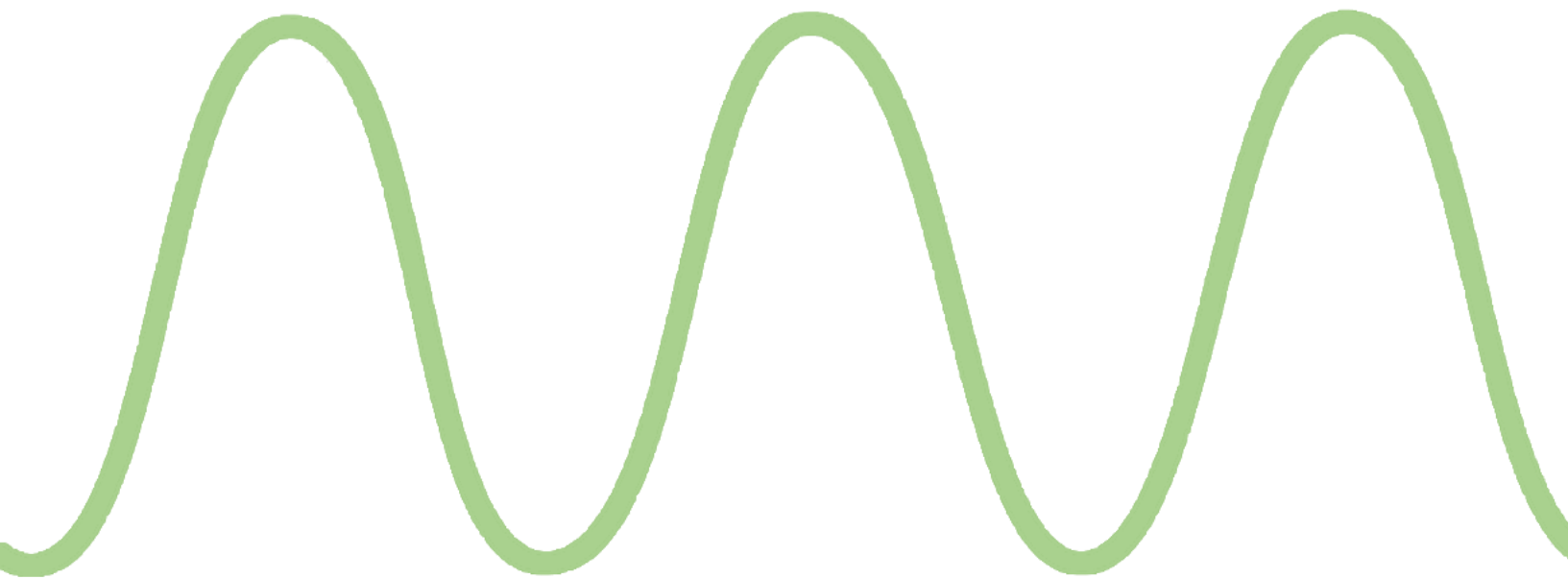


Donart Electronics
ERT1 Electrical Resistivity Manual



User's Guide

Contents

LIMITED EXPRESS WARRANTY	i
SOFTWARE LIMITED WARRANTY AND DISCLAIMER LIABILITY	i
SOFTWARE LICENSE	ii
SAFETY PRECAUTIONS	ii
AMBIENT TEMPARTURE	ii
1 Getting Started	1
Introduction.....	1
2 Installation	2
ERT1 Overview.....	2
ERT1 Test Frame Overview	3
ERT1 Setup.....	4
3 Operation	6
System Turn on	6
ERT Software.....	9
Main Screen.....	9
Test Data Section	10
Controls section.....	11
Measurements Section.....	12
Buttons Section.....	13
Settings Menu.....	14
Calibration Menu	16
Save Files.....	16
4 Maintenance	17
Test.....	17

5 Specifications	17
Measurable Materials.....	17
Test Data Reported	17
Repeatability.....	17
Measurement Range	17
Sample Size.....	17
Measurement time.....	17
Operating Voltage	17
Fuses	17
Operating temperature	17
Dimensions	17

LIMITED EXPRESS WARRANTY

Seller will at its option repair or replace (FOB Seller's place of business) any part of the goods sold hereunder which it determines to be defective within one year of the date of shipment by the Seller. This warranty is subject to the following conditions: (a) that Seller is notified by Purchaser of such defect within ten days of the discovery of the same, (b) that the goods and/or components have been properly installed, maintained, and operated under normal conditions and in accordance with the recommendations of the Seller and standard industry practice: (c) that this warranty shall extend only to the original direct purchaser from Seller and to no other person. Such reworking or replacement will be performed at Seller's factory, provided that Purchaser shall pay all charges with respect to the removal, transportation and reinstallation of the goods. Correction of any nonconformity in the manner and for the period of time provided above shall constitute complete fulfillment of all liabilities of Seller under the foregoing warranty. EXCEPT FOR THE FOREGOING LIMITED EXPRESS WARRANTY, SELLER MAKES NO OTHER REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. Seller shall not be liable to Purchaser or any third party in contract, in tort (including negligence) or otherwise for any direct, indirect contingent, special, consequential or incidental damages, arising out of any operation of defects in the goods sold hereunder, or any matter or thing relating to this agreement or Seller's performance hereunder. Seller's liability on any claim of any kind, including claims based upon Seller's negligence or Seller's warranty as described above, for any damages arising out of this contract, or from the manufacturer, sale, repair or use of any goods furnished under this contract shall in no case exceed the purchase price allocable to the goods or part thereof which gives rise to the claim.

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You must return the defective item postpaid within sixty (60) days of the software's original delivery to you, and we must receive it within seventy-five (75) days of delivery. You must either insure the defective item being returned or assume the risk of loss or damage in transit. Address all warranty claims to: Don art Electronics, Inc., P. O. Box 27, McDonald, PA 15057 USA.

OTHER CONDITIONS:

This warranty allocates risks of product failure between you and DONART. DONART'S software

pricing reflects this allocation of risk and the limitations of liability contained in this Warranty. The warranty set forth above is in lieu of all other express warranties, whether oral or written. The agents, employees, distributors and dealers of DONART are not authorized to make modifications to this warranty, or additional warranties binding on DONART. Accordingly, additional statements such as dealer advertising or presentations, whether oral or written, do not constitute warranties by DONART and should not be relied upon.

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This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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In accepting this system and software, it is agreed that the purchaser will maintain the design of both hardware and software confidential except as necessary to train operators and operate the system.

COMMERCIAL SOFTWARE SUPPLIED WITH THIS SYSTEM

All commercially supplied software, if accepted, shall bind the user to the terms of the licensing agreement supplied by this software. Donart has purchased and supplied such software as was considered necessary or convenient for proper system operation. Such software has been supplied complete with instructions and license.

SAFETY PRECAUTIONS

The test console is a complex measuring system composed of a number of independent instruments and devices operated directly from or through appropriate transformers connected to a main AC power line source. Internal wiring as well as components and wiring internal to the various instruments represent potential electrical shock hazard to personnel. The instrument should not be installed or operated until all personnel concerned with installation, operation and maintenance are made aware of these potential hazards. In addition to the suggestions contained herein, all local electrical and mill codes should be carefully adhered to by properly trained personnel concerning the installation, operation and maintenance.

HAZARDOUS VOLTAGES

The exact reaction to an electrical shock can range from mild annoyance or discomfort to death. Effects of an electrical shock depend on the source of the shock, the physical condition of the individual encountering the shock, the length of time encountered, how good the electrical contact is and the individual's natural reaction to the shock among other variables. In addition to the hazard of the shock to the person receiving it, there is also the possibility of personal injury due to the physical reaction in attempting to quickly escape from the contact. As an example, voluntary or involuntary reaction to the shock can cause an individual to strike his head or other parts of his body against a cabinet or physical obstruction causing physical injury or death in addition to the specific damage caused by the shock.

In general, persons wearing pacemakers or other electrical or electronic life aid devices should not perform maintenance or operate equipment using line voltage as a primary power source. Since even mild electrical shocks can disrupt the bodies normal nerve messages, persons with nervous disorders or heart conditions should not maintain or operate this equipment.

ABOVE NORMAL BODY TEMPERATURES

Under normal operating conditions, only a few of the components in the instrument are hot enough to be uncomfortable to touch or possibly cause burns. Jerking away or

otherwise reacting to contact with these parts could cause injury to parts of the body coming in contact with the cabinet or other physical obstructions. Allow the instrument to cool before performing maintenance.

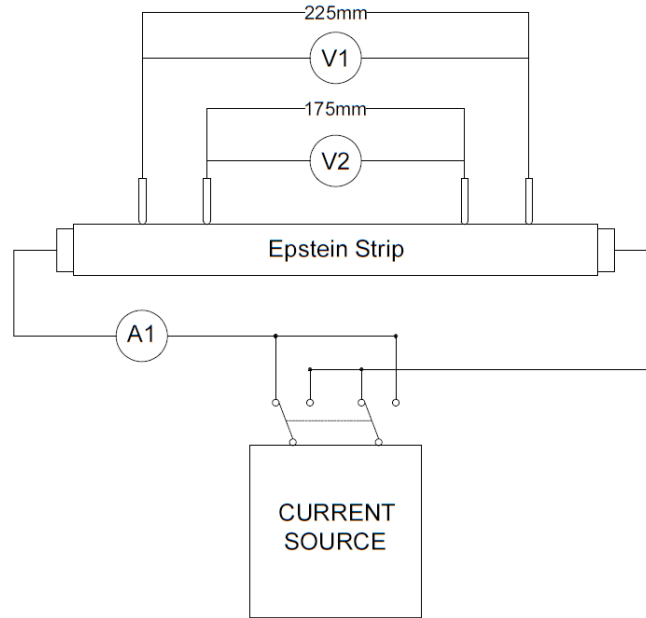
In general, both transformers and motors operate normally at higher than normal temperatures and contact with these without proper thermal protection should be avoided. In the event of equipment malfunctions or failure of parts, higher than normal temperatures could result in not only the above-named components, but additionally in wires, resistors and other normally cool parts. In the case of equipment malfunctions, exercise extra care to avoid the possibility of contact with above body temperature parts.

AMBIENT TEMPARTURE

The test console contains electronic circuitry; some portions of which are by nature temperature sensitive. The system will not maintain its full accuracy over a large temperature range. The ideal location for the unit is in an air-conditioned room. It is recommended that an attempt be made to maintain the ambient temperature at 72°F (22.2° C), plus or minus 2°F (1.0°C). The instrument should be turned on for at least 1 hour for stabilization prior to any measurement.

1 Getting Started

Introduction



The tester consists of four gold plated measurement probes aligned on the length of the strip to measure voltages V1 and V2 as seen in figure 1. The probes for V1 are spaced 225mm apart to conform with IEC specifications and the probes for V2 being spaced 175mm apart to conform with ASTM specifications. Current is supplied to the strip by 4 gold plated probes along the width of the strip and are feed to a reversible and adjustable constant current source.

The test consists of sweeping a DC current between 1-5A while measuring V1, V2 and A1 using a precision shunt. The current will then be reversed and swept again taking the same measurements. Resistance for IEC and ASTM specifications will be calculated by taking an average of each sampled voltage and corresponding current measurement from both DC current sweeps. *Equation 1.*

$$\overline{R1} = \frac{1}{N} \sum_{i=1}^N \frac{V1_i}{A1_i} \quad \overline{R2} = \frac{1}{N} \sum_{i=1}^N \frac{V2_i}{A2_i}$$

Equation 1: Mean resistances

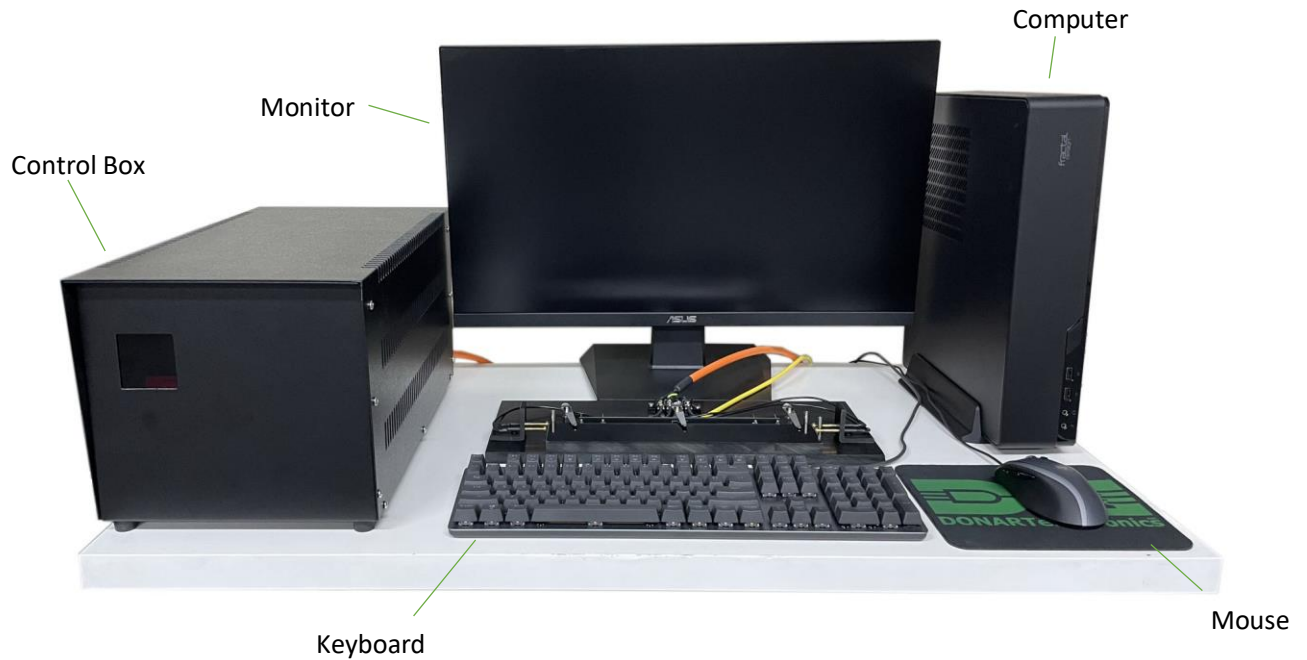
Using these average resistances, resistivity ρ will then be calculated using *Equation 2* and reported through software.

$$\rho1 = \frac{R * b * d}{l_e} = \frac{\overline{R1} * .03 * d}{.225} \quad \rho2 = \frac{R * b * d}{l_e} = \frac{\overline{R2} * .03 * d}{.175}$$

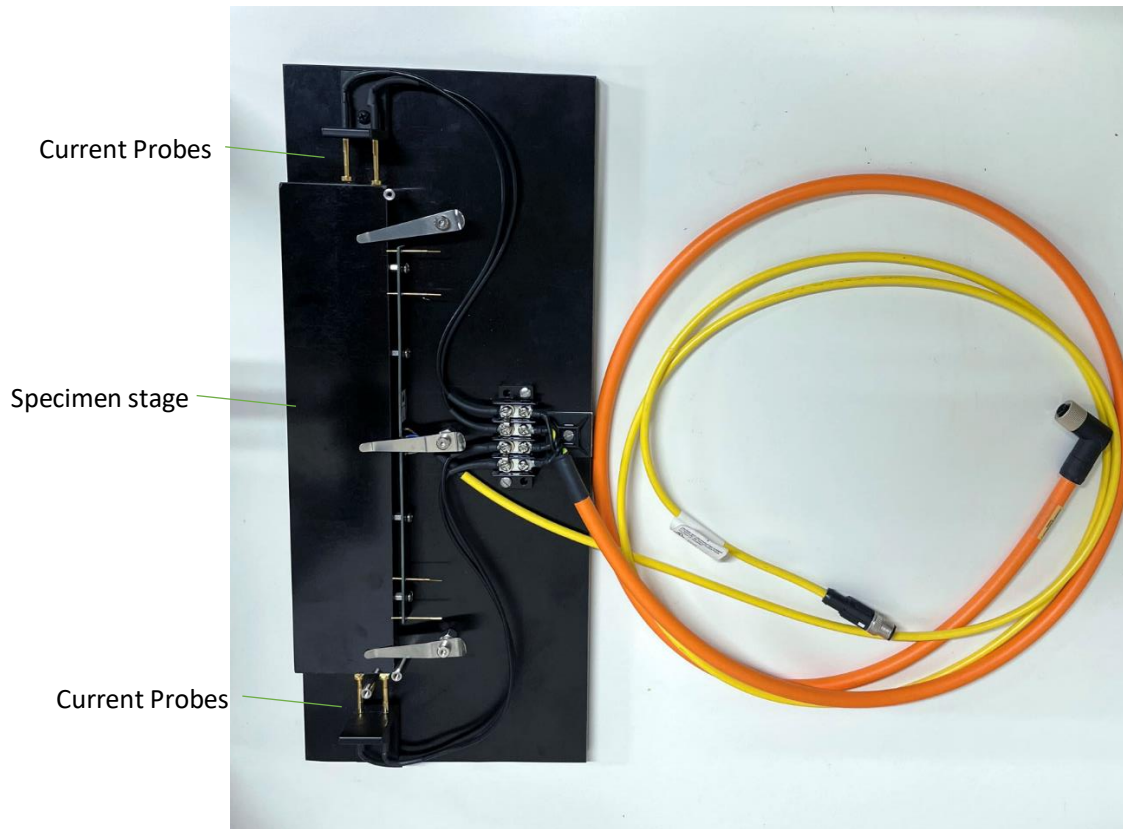
2 Installation

The ERT1 Electrical Resistivity Tester comes assembled so the only installation is to install the computer system, connect testing frame and power to tester and read the following overview to identify system components.

ERT1 Overview

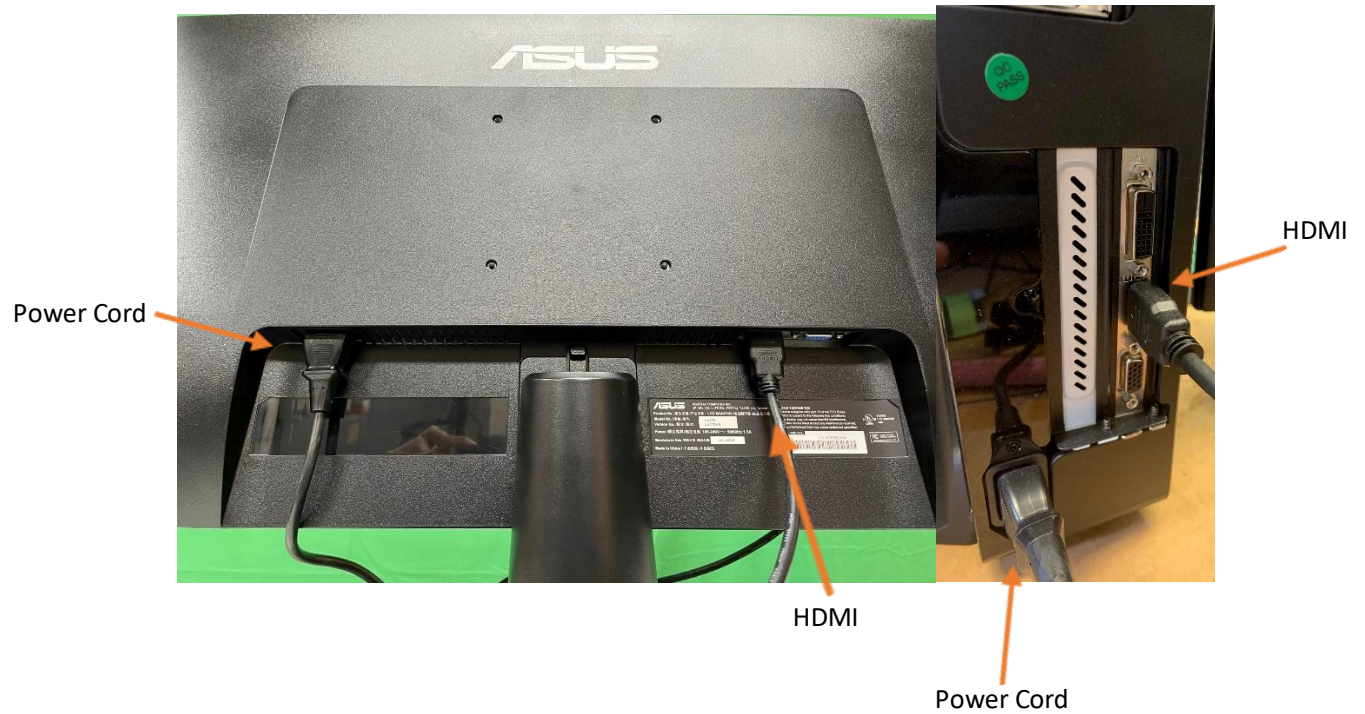


ERT1 Test Frame Overview



ERT1 Setup

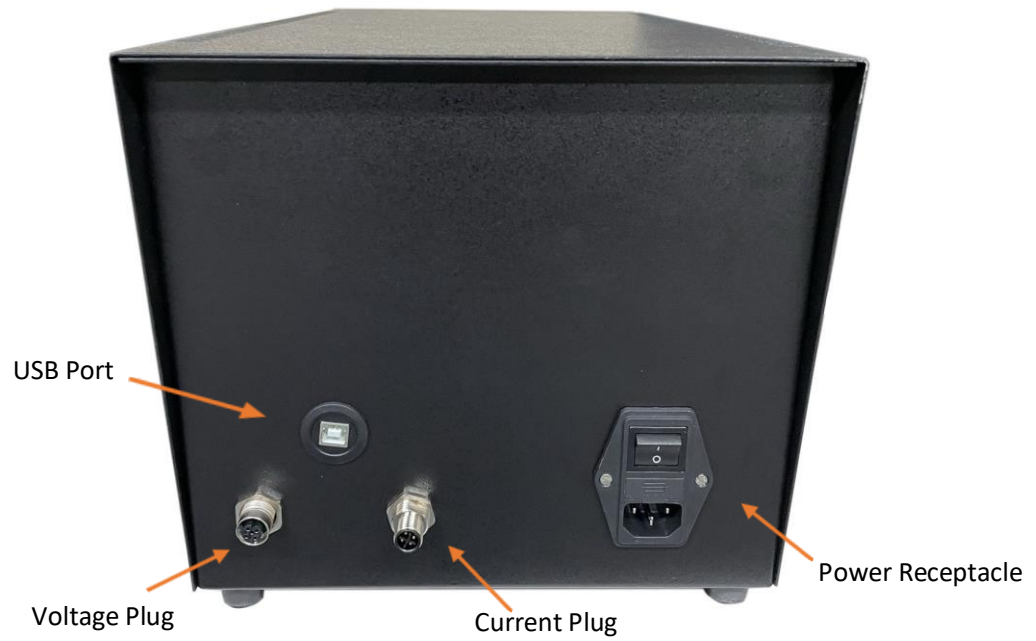
1. Set up the computer by connecting power and the HDMI cable to the monitor and then plugging the other end of the HDMI to the video card on the computer.



2. Plug the mouse/keyboard receiver into the front of the computer and then plug one end of the USB B cable into the rear of the computer in an open USB slot.



3. Plug the other end of the USB-B cable into the ERT1 Control Box, along with the power cable. Plug the current and voltage cables into their respective plugs. Power must be 120/220 VAC.



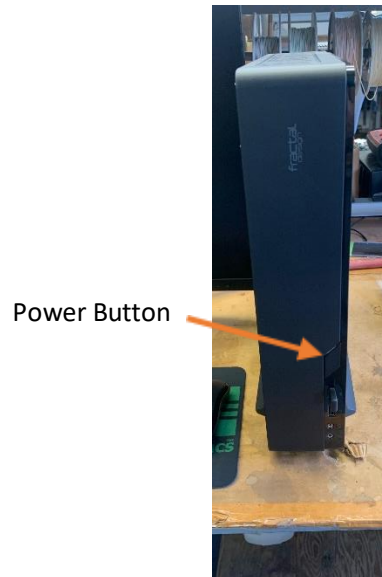
3 Operation

System Turn on

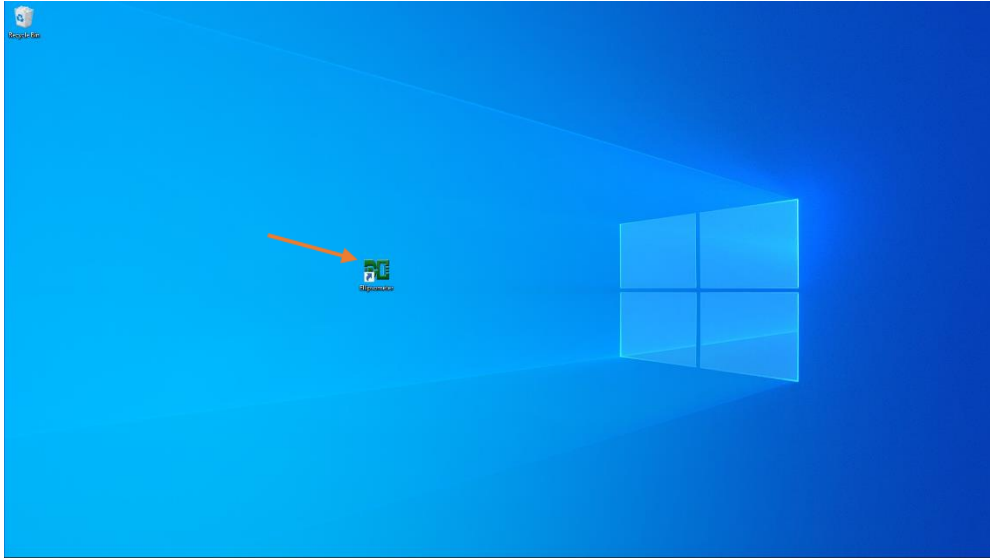
1. Flip the power switch to the on position on the back of the ERT.



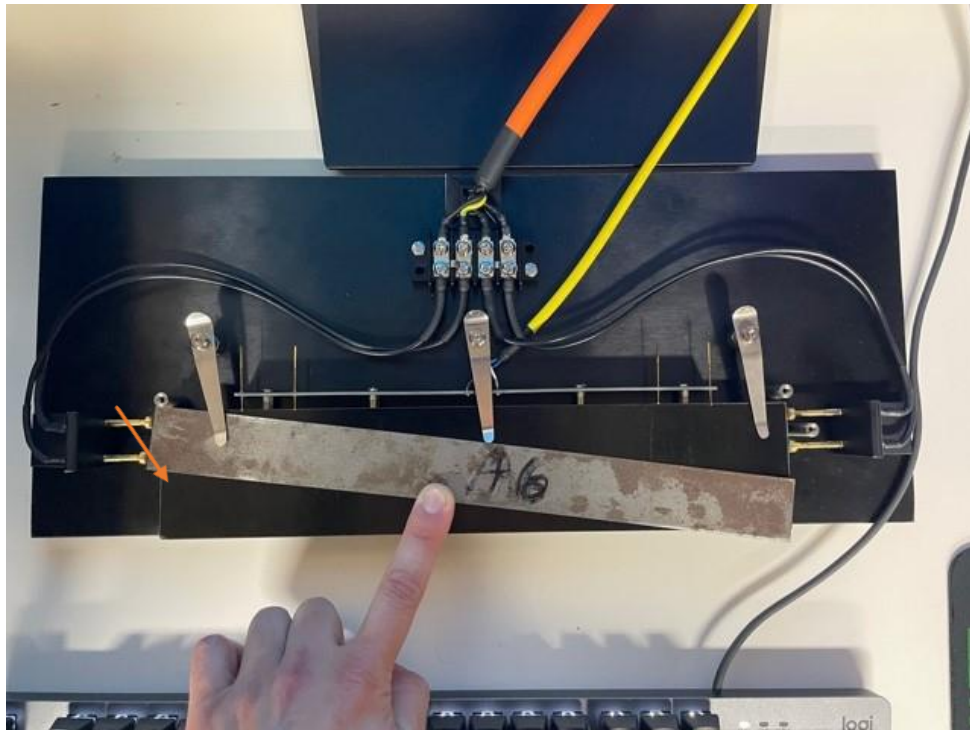
2. Press the power switch on front of the computer to turn it on.



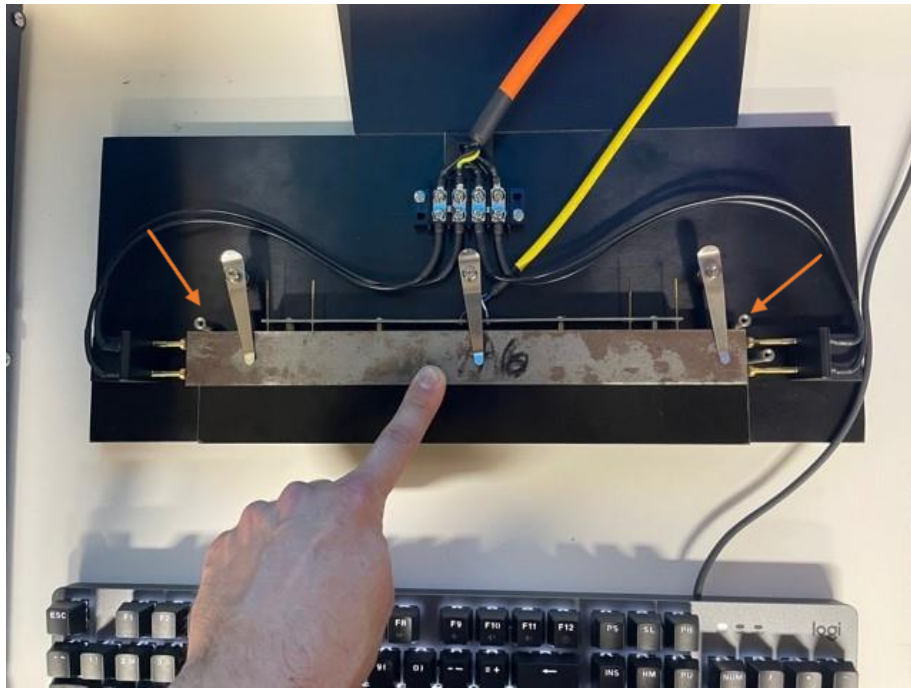
3. Select the Donart ERT program from the desktop to load the program.



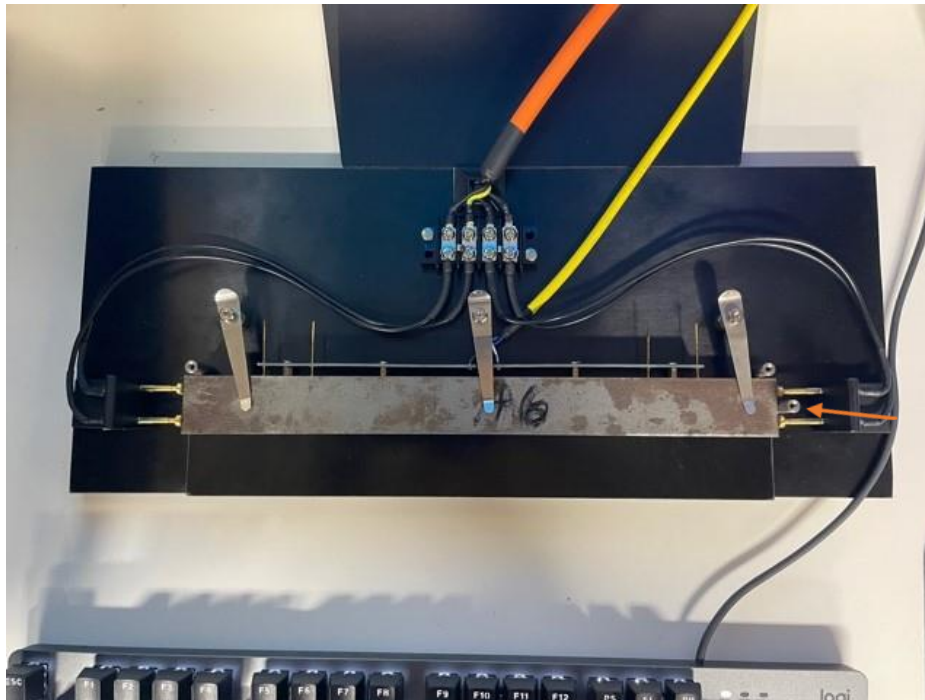
4. Insert sample by inserting Epstein strip and pushing in on the left probes.



5. Swing the Epstein in towards until it makes contact with the rear position pins.



6. Push the Epstein strip towards the right position pin

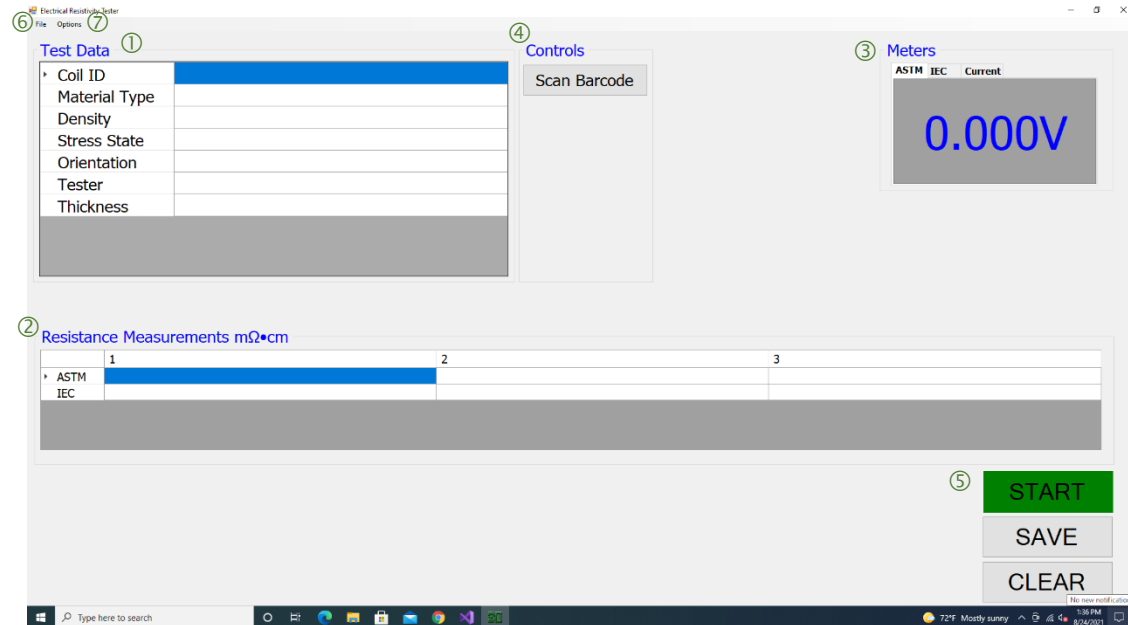


7. Testing can now begin and be initiated from the ERT software.

ERT Software

The ERT software allows the user to control the tester and make resistivity measurements from a personal computer. The software automatically calculates resistivity as well as allows saving of data locally and over a network.

Main Screen



① Test Data

Allows the user to enter test data for each sample being tested

② Measurements

Section for obtaining a number of resistivity measurements for a sample

③ Meters

Allows user to view voltage and current measurements during testing

④ Controls Menu

Controls for testing such as scanning barcode to enter test data

⑤ Buttons

Used for starting test, saving and clearing of data

⑥ File Menu

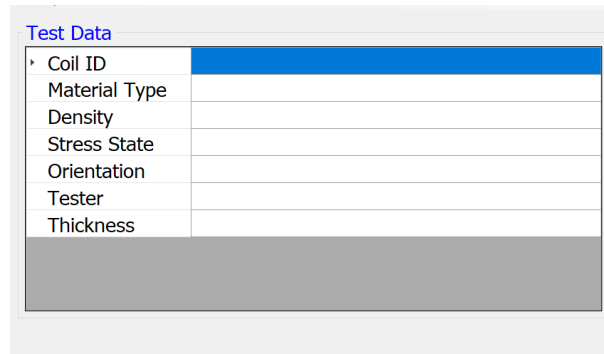
For exiting and saving

⑦ Options Menu

For settings and calibration menus

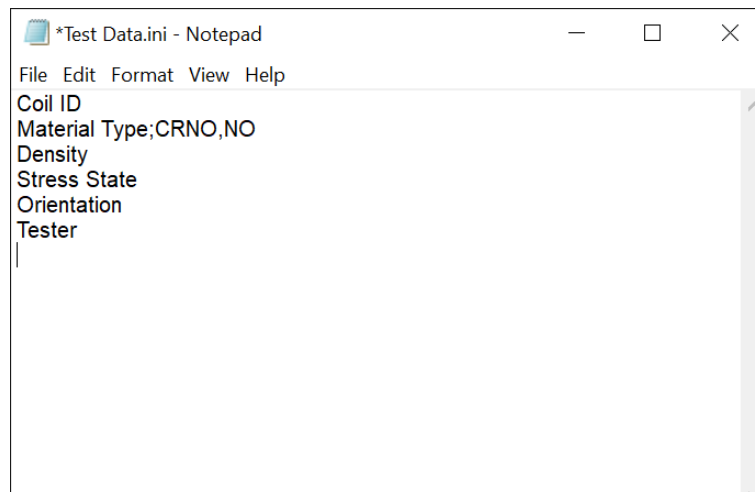
Test Data Section

The test data section allows the user to enter informational data for the sample being tested. This test data is saved along with measurements from the current sample.



Coil ID	
Material Type	
Density	
Stress State	
Orientation	
Tester	
Thickness	

The test data can be customized by editing the testdata.ini file in the program file folder. (“C:\Donart Electronics\ERT Software\Test Data.ini”)



```
*Test Data.ini - Notepad
File Edit Format View Help
Coil ID
Material Type;CRNO,NO
Density
Stress State
Orientation
Tester
|
```

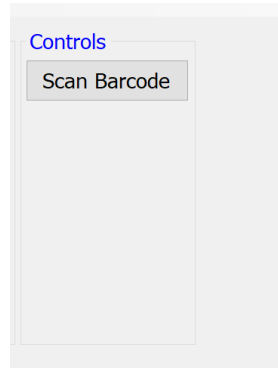
For text data entries, simply enter your row name line by line.

For drop down box entries. Enter your row name followed by a semicolon and then enter each drop-down selection separated by commas. You can see an example of this in the image above for material type.

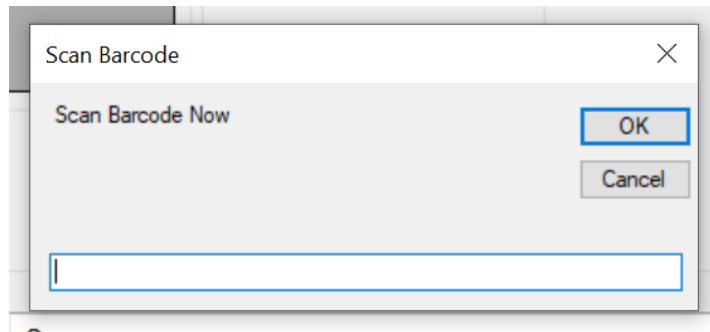
Please note that if using the barcode scanning option, you will have to set up your test data info to match your barcode or else barcode scanning will not work.

Thickness will always be automatically added at the end of your test data since it is required for the test.

Controls section



The controls section allows the user to scan barcodes for test data info. When scan barcode is clicked a pop-up window will appear.



A barcode can now be scanned and test data will automatically be entered from the barcode.

Measurements Section

Measurements $\mu\Omega\cdot\text{cm}$			
	1	2	3
▶ ASTM			
IEC			

The measurements section allows the user to perform a number of resistivity measurements for a sample. Data is automatically populated during the test in each cell.

Measurements $\mu\Omega\cdot\text{cm}$			
	1	2	3
▶ ASTM			
IEC			

To populate a cell with a measurement, click the cell to highlight it and then click the start button. The tester will begin testing and once the test is finished, the highlighted cell will be populated and then the next cell to the right will be highlighted.

Measurements $\mu\Omega\cdot\text{cm}$			
	1	2	3
▶ ASTM	50.698	50.702	
IEC	50.588	50.590	

Measurements $\mu\Omega\cdot\text{cm}$			
	1	2	3
▶ ASTM	50.698	50.700	
IEC	50.588	50.589	

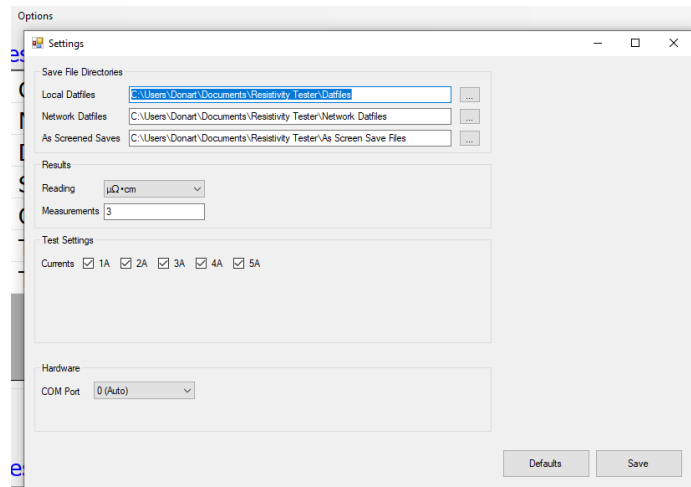
A measurement can be changed in the same manner. To retest a measurement, simply click the measurement you want to change and click start button. Once test is finished, the measurement will be updated and the next blank cell or last measurement will be highlighted.

Buttons Section



- Start/Abort
Starts test. Once clicked it will turn to an abort button to cancel test.
- Save
Saves Test data and measurements locally and over network
- Clear
Clears all entered test data, measurements and statistics

Settings Menu



The settings screen can be accessed by clicking options from the menu bar and then clicking settings.

Save File Directories

The save file directories section allows the user to change the following save file locations.

- Local Datfile Save File Location
Changes the save file location for local datfile strings
- Network Datfile Save File Location
Changes the save file location for network datfile strings
- As Screened Save File Location
Changes the save file location for as screen save files

To revert settings back to default. Click the defaults button then click save

Results

The results section allows the user to change the following results settings

- Reading
Changes results to be displayed in $\mu\Omega\cdot\text{cm}$ or $\text{m}\Omega\cdot\text{cm}$
- Measurements
Will change the number of measurements to be taken for each sample

Test Settings

Allows user to select currents run during a test. Click the checkbox by each current you want to run. The results of all currents ran are averaged at the end of the test.

Hardware

The hardware section allows the user to change settings for tester hardware

- COM Port

Changes the COM port for the Ellipsometer stepper motor. The default value (0) will automatically select the correct COM port. Only change this setting if you are experiencing problems with detecting the stepper motor.

Calibration Menu

The calibration menu can be accessed by clicking options from the menu bar and then clicking calibration/manual controls. This menu is password protected and meant only for Donart Technicians or authorized users.

The calibration menu contains all necessary instructions and procedures for calibration of ERT1.

Save Files

The ERT Software saves two different types of files. Files are saved with the data being formatted for easy reading which are referred to as “as screened save files”. The other types are known as “dat files”. Dat files are saved as comma delimited string files that can be saved locally and over the network, so they can be parsed and entered into a database, excel, etc.

As screened Save Files

As screened save files are text files that are easily readable containing all measurements and test data. These files can be opened in any text editor program. The save file location can be edited in ERT settings

Local and Network Datfiles

Datfiles are saved in two locations which can be edited in the ERT software settings. They are comma delimited and can be parsed as follows.

1	2	...	2+x	3+x	8	9	...	8+x	9+X
Test Data info 1	Test Data Info 2	...	Test Data Info x	Thickness	ASTM Measurement 1	IEC Measurement 1	...	ASTM Measurement x	IEC Measurement x

4 Maintenance

Test

Periodically check the voltage test probes for bent or broken pins/heads

5 Specifications

Measurable Materials	Non-Oriented and Grain Oriented Electrical Steels
Test Data Reported	$\mu\Omega\cdot\text{cm}$ or $\text{m}\Omega\cdot\text{cm}$
Repeatability	$\pm 0.01 \mu\Omega\cdot\text{cm}$
Measurement Range	0 – 10 Ω (total measurement resistance)
Sample Size	3cm x 30cm Epstein Strip
Measurement time	<10 Secs
Operating Voltage	120/220 VAC
Fuses	Cartridge Fuses 250 V 6A 5x20mm Fast Acting
Operating temperature	70°F \pm 10°F
Dimensions	Control Box 10.0" x 9.0" x 18.0" (HxWxD) Test Frame 1.5" x 10.0" x 7.0"