

INSTRUCTION MANUAL: BATTERY CELL TESTING

Contents

Audience	1
Objective	1
Tools, materials, and equipment needed.....	1
Test Procedure Instructions.....	1
Instructions for voltage check.....	1
Instructions for the battery impedance meter	2
Instructions for the Capacity Test with the DT50W-128	4
Appendix 1: Detailed Instructions for Operating the DT50W-128	5
Software Installation & Connection of the machine.....	5
Work Steps setup.....	5
Matching Setting.....	5
Battery Connection & Step Startup	5
Checking Cells Matching	6
Test Results and Data Analysis.....	6

Audience

The battery testing instruction manual is for technicians with a basic knowledge in electrical circuit design for storage systems, safe use of electrician tools and measuring instruments and safety precautions associated with handling lithium-ion batteries.

Objective

The aim of this manual is to give clear instructions on cell testing process flow.

Tools, materials, and equipment needed.

Test	Instrument	Features
Voltage check	Voltmeter	
EIS, IR measurement	Hioki Battery Impedance Meter	
Capacity Test	DT50W-128: Grading and Matching Detection	128 channels Customizable program steps

Test Procedure Instructions

Instructions for voltage check

- Switch on the multimeter.

- Turn the function knob to DC Voltage.
- Connect the multimeter to the battery terminal respecting the polarity:
 - V terminal connected to the positive end of the battery cell via the red lead and
 - COM terminal connected to the negative end of the battery cell with the black lead.
- Record the read value in the inventory system.

Instructions for the battery impedance meter

As per the instruction manual of the BT4560 Battery Impedance Meter

The procedure to measure the internal resistance at a given frequency is as follow:

- Prepare the meter.
 - Install the application software.
 - Connect the power cord, measurement probe and the temperature sensor to the meter.
 - Turn the power on
- Set the measurement conditions if needed for a test.
 - choose which set of parameters are measured.
 - Select the measurement range.
 - Set the measurement speed.
 - Set the measurement frequency.
 - Perform the zero adjustment.
- Measure
 - Connect the measurement probes and temperature sensor to the cell being measured.
 - Click on TRIG to make the measurement

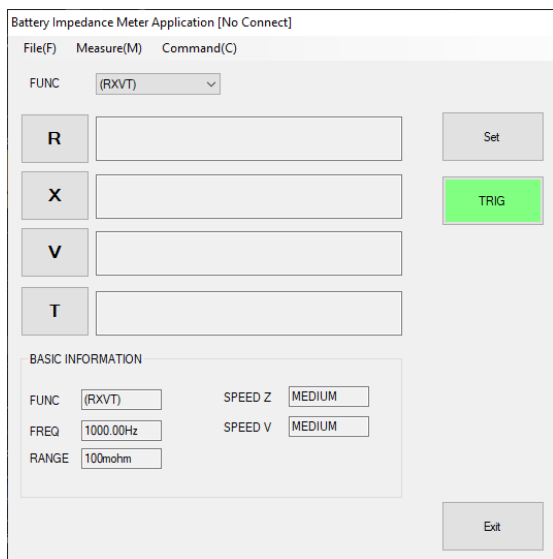


Figure 1: single measurement window

The steps to take an EIS measurement are as follow:

- Start the Impedance Meter application
- Select the interface through which the meter is connected to the computer, namely RS-232C or USB.
- Choose the Mode Measure. RMT (remote) appears on the meter screen to confirm that the computer-meter connection is successfully established.
- In the window that pops up, click on the menu **Measure(M)**, choose **Sweep Measurement (W)**
- For the sweep Point, choose the **Auto Setup** with 41 data count starting at 1000 and stopping at 0.1.
- Customize the Start delay time as needed.
- Set the Output to a preferred file format.
- After connecting the measurement probes to the cell, **Start Measuring**.
- Save the file with the name of label of the cell being measured.

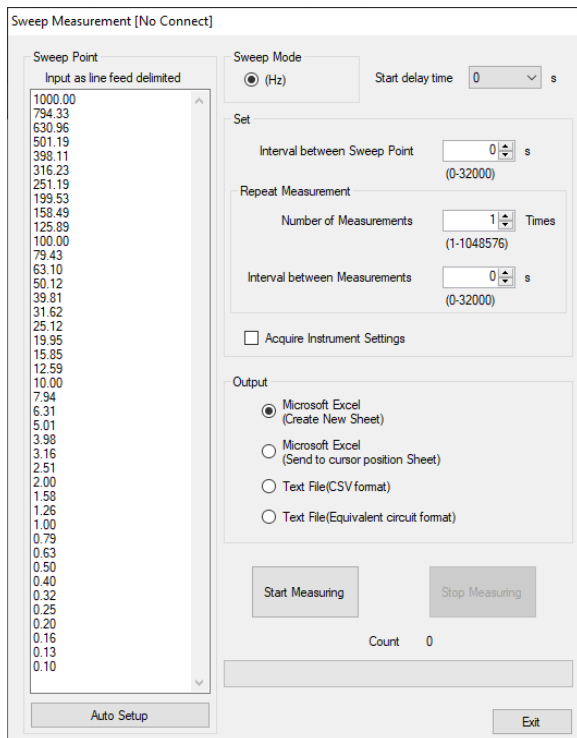


Figure 2: sweep measurement window screenshot

Instructions for the Capacity Test with the DT50W-128

Using the DT50W-128 Lithium-ion battery detection and matching machine involves:

- Starting up with Software Installation & Connection of the machine.
- Enrolling a new battery cell, go to Work Steps setup for entering the settings corresponding to that cell ratings. Figure 3 depicts the step settings recommended for a standard charge and discharge:
 - charge 1300 mAh to 4.2 V cutting off 2.5h or 0.05C and
 - discharge 0.2C, 2.75V discharge.
- Testing an already enrolled cell: the procedure details are in the section Battery Connection & Step Startup.
- Checking whether tested cells match conditions to be connected in the same battery: the section *Checking Cells Matching* describes the process.
- Manipulating data & visualizing tested cells results within the DT50W application: the section Test Results and Data Analysis describes the procedure.

Number	Step Name	Time(mins)				
1	Set Aside	2.0				
2	Con-C&V Charge	180.0	4200.0	1300.0	0.0	130.0
3	Set Aside	5.0				
4	Con-C Discharge	0.0	2750.0	520.0	0.0	
5	Set Aside	5.0				
6	Stop					

Save data

TimeInterval(s) V-Interval(mV) C-Interval(mA)

export import save cancel

add up down edit delete

New Program

- ICR18650-26J_3.63V 2600mAh
- 50%Charge LongStorage ICR18650-26J

Figure 3: Screenshot of the Step Settings for the standard (dis)charge.

Appendix 1: Detailed Instructions for Operating the DT50W-128

Software Installation & Connection of the machine

- 1.1. Locate the installation file and open it.
- 1.2. Follow the installation instructions.
- 1.3. At the end of the installation, open the DT50W application once the installation is complete.
- 1.4. Connect the machine and computer with the provided network cable. For multiple machines connecting to a single computer as is the case for the DT50W-128, a switch/router converges all into a single computer.
- 1.5. Turn on the machine that flashes then settles to red LEDs only.
- 1.6. Click Connect button on the software.
- 1.7. Add the machine(s) via the Network Search option, each with an individual IP and confirm.
- 1.8. The Machine appears in the left “onglet”, double-click to show its properties.

Work Steps setup

- 2.1. Click on the **Step** icon.
- 2.2. Use the default login credentials admin for username and 123 for the password.
- 2.3. Click **New Program** in right-up corner of the Step Setting window.
- 2.4. Name the New Program with easy to identify name.
- 2.5. Select the program you have just created and **add** a step.
- 2.6. In the Add Step window, select the **Step Name** from the dropdown menu which option list contains Con-C Charge, Con-V Charge, Con-P Discharge, Con-R Discharge, Cycle Step, Con-C&V Charge, Con-C Discharge, Set Aside)
- 2.7. For instance, for lithium-ion battery, choose **Con-C&V Charge** for the 1st step.
- 2.8. Fill in the necessary details and leave empty the information to get.
- 2.9. For the 2nd step, choose the option **Set Aside**.
- 2.10. Set the Time(min) to a minimum of 5 minutes!
- 2.11. For the 3rd step, choose **Con-C Discharge**
- 2.12. Fill in the Limited-V(mV) and Con-C(mA) with the manufacturer’s recommended cut-off voltage and discharge current, respectively.
- 2.13. Leave the Time(min) and Capacity(mAh) empty as these are values we are searching for.

Matching Setting

- 3.1. Click on Match Setting
- 3.2. Create **New Program** for the match checking and name it accordingly.
- 3.3. Under the created program, **Add Condition**.
- 3.4. The Add Conditions dialog box let you choose the **Cycle Number** and **Step Number** for which you want to set the condition, plus either the TimeRange, CapacityRange or VoltageRange that has been set as condition. Each condition should have only one criterion.
- 3.5. Set the indicator lamps on the channels that meet the condition criteria by clicking UpperLamp and/or UnderLamp and choosing the colour and frequency of the light.
- 3.6. Save the Matching setting added conditions.

Battery Connection & Step Startup

- 4.1. Adjust the probe height for the cell not to be too loose or too tight.

- 4.2. Insert the cell vertically between 2 probes by pressing the lower probe with the cell body against the negative flat terminal surface.
- 4.3. Open the DT50W software Read the voltage display of the channel corresponding to the connected cell.
- 4.4. You can STOP the testing and CONTINUE it upon resuming.

Checking Cells Matching

- 5.1. Select all and choose the matching program to be applied.
- 5.2. Met conditions are marked V, unmet conditions are marked X.
- 5.3. Filter conditions and corresponding values of each channel
- 5.4. Export the test data.
- 5.5. Display Volt, Current, Capacity curves by right-click option on selected channels:
- 5.6. Use a professional internal resistance meter for accurate value of IR.

Test Results and Data Analysis

- 6.1. Select all channels or only the channels you want to view results.
- 6.2. Choose the matching program to be applied.
- 6.3. Cells that meet the set conditions will have their channel green tick; unmet conditions are marked with a red cross.
- 6.4. Filter conditions and corresponding values of each channel
- 6.5. Export the test data.
- 6.6. Display Volt, Current, Capacity curves by right-click option on selected channels: