Chroma Turnkey Test & Automation Solution Provider

APPLICATION NOTE

How to use Chroma 17010 to execute IEC 61960 test items

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1. Objective

IEC 61960 is an international standard for testing lithium-ion secondary battery cells on portable devices. The objective is to evaluate the performance of battery cell and battery for capacity, cycle performance and internal resistance. At present, this standard has been used as the reference for proposed test plan in the relevant specifications of battery cell or battery in Japan, China, and other countries. This article focuses on introducing the related electrical tests in the IEC 61960:2011 specification and explains how to implement the test plan through the Chroma 17010 charge and discharge test system.

2. Hardware Specification Requirement

The IEC 61960 defines the electrical equipment accuracy specification as shown in Table 1. And it explains the selection of equipment for all test procedures, both output and measurement accuracy of the selected equipment must meet the defined specification and list in the test report. Full range of models in the Chroma 17010 test solution can meet the requirements of voltage, current, capacitance and time, also ensure that the entire test conforms to the standard specifications when a suitable chamber is in use.

Table 1. IEC 61960 Electrical testing accuracy requirements of related equipment

Measurement/ output items	Accuracy spec.
Voltage	± 1%
Current	± 1%
Capacitance	± 1%
Temperature	± 2℃
Time	± 0.1%

3. Electrical Testing Item

1. General test instructions:

1.1 Test environment:

The electrical testing process is performed in a closed environment. The ambient temperature for most test items is defined at 20±5℃ with some of them require different temperatures such as 40°C or -20°C. It is recommended to use chamber testing to maintain the consistency and stability of the test object's ambient temperature.

1.2 Definition of current and rated capacitance:

The definition of charge and discharge current in IEC 62391 uses I_t A as the ratio unit which is equivalent to C-rate. The rated capacitance is the capacitance obtained when fully discharged with 0.2C, and the expression is "C_5 Ah".

1.3 Charging procedure:

Control the ambient temperature at 20±5°C for testing. Before charging, it is necessary to constant current discharge of 0.2C to cut-off voltage, and then full charge to DUT according to the user-defined charging method.

Tips. Use Chroma Battery Lab Expert to edit the steps of charging procedure.

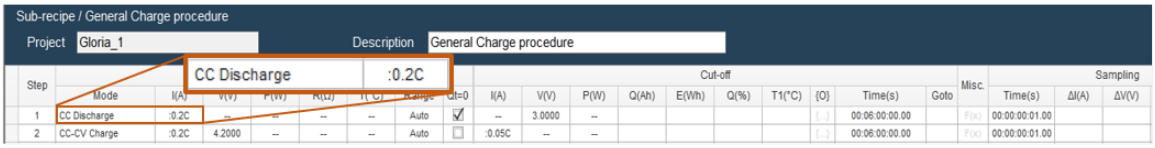

Figure 1 Charging Procedure

2. Discharge performance at 20°C:

2.1 Test environment: The entire process is controlled at 20±5°C ambient temperature for testing.

2.2 Test procedure: Execute 1.3 charging procedure ➔ rest for 1~4 hours ➔ 0.2C constant current discharge to cut-off voltage ➔ calculate the discharge capacity ➔ repeat 1 to 4 times based on the requirement.

2.3 Verification item: The calculated capacity should not be less than 100% of the rated capacity.

Tips. Use Chroma Battery Lab Expert to compose a recipe structure.

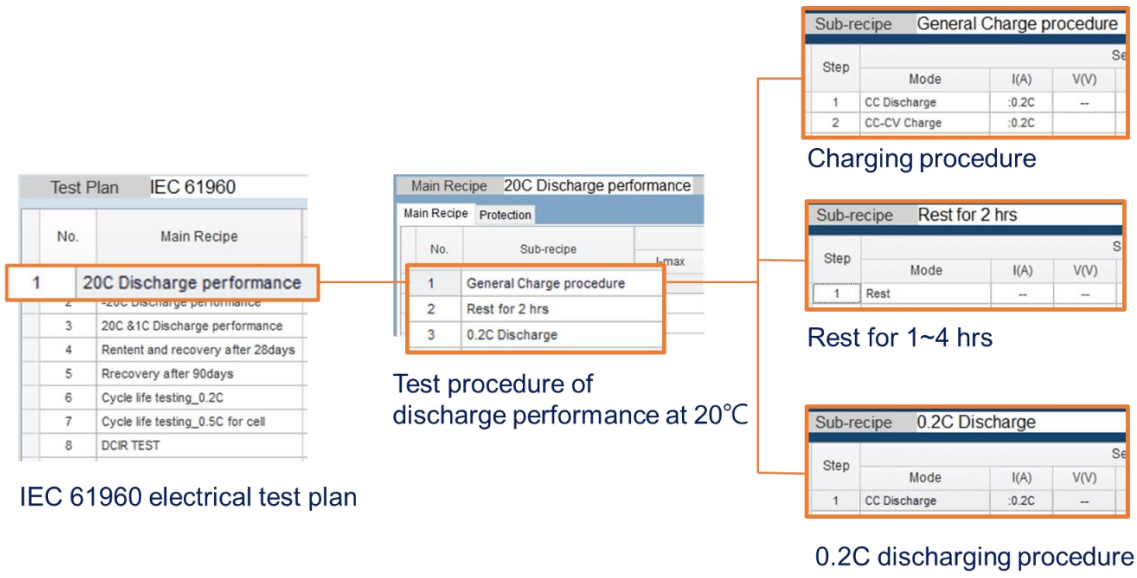

Figure 2 Steps Editing for Discharge Performance Verification at 20°C

3. Discharge performance at -20°C:

3.1 Test environment: Rest and discharge steps must be controlled at -20±2°C ambient temperature for testing.

3.2 Test procedure: Execute 1.3 charging procedure➔ rest for 16~20 hours at -20±2°C ambient temperature ➔ 0.2C constant current discharge to cut-off voltage ➔ calculate the discharge capacity.

3.3 Verification item: The calculated capacity should not be less than 30% of the rated capacity.

Tips. Use Chroma Battery Lab Expert to control chamber. **※Integrate the specified chamber model.**

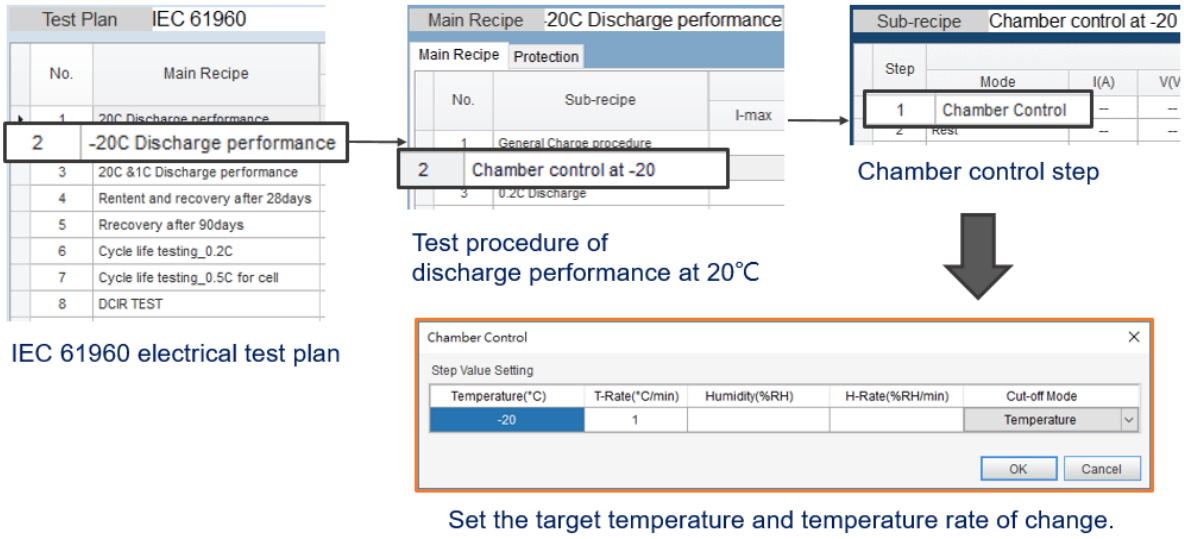

Figure 3 Temperature Control Example for Discharge Performance Verification at -20°C

4. High magnification discharge performance at 20°C:

4.1 Test environment: The entire process is controlled at 20±5°C ambient temperature for testing.

4.2 Test procedure: Execute 1.3 charging procedure ➔ rest for 1~4 hours ➔ 1C constant current discharge to cut-off voltage ➔ calculate the discharge capacity.

4.3 Verification item: If the test object is a battery cell, the calculated capacity should not be less than 70% of the rated capacity.

If the test object is a battery, the calculated capacity should not be less than 60% of the rated capacity.

5. Charge(Capacity) retention and recovery after a short-term (28 days) storage:

5.1 Test environment: The entire process is controlled at 20±5°C ambient temperature for testing.

5.2 Test procedure: Execute 1.3 charging procedure ➔ store for 28 days ➔ 0.2C constant current discharge to cut-off voltage ➔ calculate the discharge capacity1 as an indicator of capacity retention ➔ execute 1.3 charging procedure again within 24 hours ➔ rest for 1~4 hours ➔ 0.2C constant current discharge to cut-off voltage ➔ calculate the discharge capacity2 as an indicator of capacity recovery.

5.3 Verification item:

A. Capacity retention:

If the test object is a battery cell, the calculated capacity1 should not be less than 70% of the rated capacity

If the test object is a battery, the calculated capacity1 should not be less than 60% of the rated capacity.

B. Capacity recovery:

The calculated capacity2 should not be less than 85% of the rated capacitance.

6. Charge(Capacity) recovery after a long-term (90 days) storage:

6.1 Test environment: The storage remains at 40±2°C with the rest of test conditions are controlled at 20±5°C ambient temperature.

6.2 Test procedure: Execute 1.3 charging procedure ➔ 0.2C constant current discharge for 2.5 hours ➔ store for 90 days ➔fully charge according to user-defined steps ➔ rest for 1~4 hours ➔ 0.2C constant current discharge to cut-off voltage ➔ calculate the discharge capacity

6.3 Verification item: The calculated capacity should not be less than 50% of the rated capacity.

7. Cyclic test verification:

7.1 Test environment: The entire process is controlled at 20±5°C ambient temperature for testing.

7.2 Test procedure: 0.2C constant current discharge to cut-off voltage ➔ **[fully charge within 0~1 hours according to user-defined steps ➔ 0.2C constant current discharge to cut-off voltage]**➔ repeat executing discharge and charge cycles stated in **[ ]** brackets until the discharge capacity is less than 60% of rated capacity ➔ calculate the number of cycle times.

7.3 Verification item:

If the test object is a battery cell, the calculated number of cycles should not be less than 400 times.

If the test object is a battery, the calculated number of cycles should not be less than 300 times.

7.4 Accelerated test procedures:

Increase the discharge current from 0.2C to 0.5C without changing the rest. Perform 300 and 400 cycles respectively based on types of test objects, and verify the discharge capacity of the last cycle which should not be less than 60% of the rated capacity.

8. DC internal resistance verification:

8.1 Test environment: The entire process is controlled at 20±5°C ambient temperature for testing.

8.2 Test procedure: Execute 1.3 charging procedure ➔ rest for 1~4 hours ➔ 0.2C constant current discharge for 10 seconds and record the cut-off voltage1 ➔ 1C constant current discharge for 1 second and record the cut-off voltage 2➔ calculate the internal resistance (Ohm)

[DCIR = (cut-off voltage1 - cut-off voltage2) / (1C current - 0.2C current)].

8.3 Verification item: The calculated DC internal resistance should not be larger than the claimed specification of the test object.

Tips. Use Chroma Battery Lab Expert to perform DCIR test.

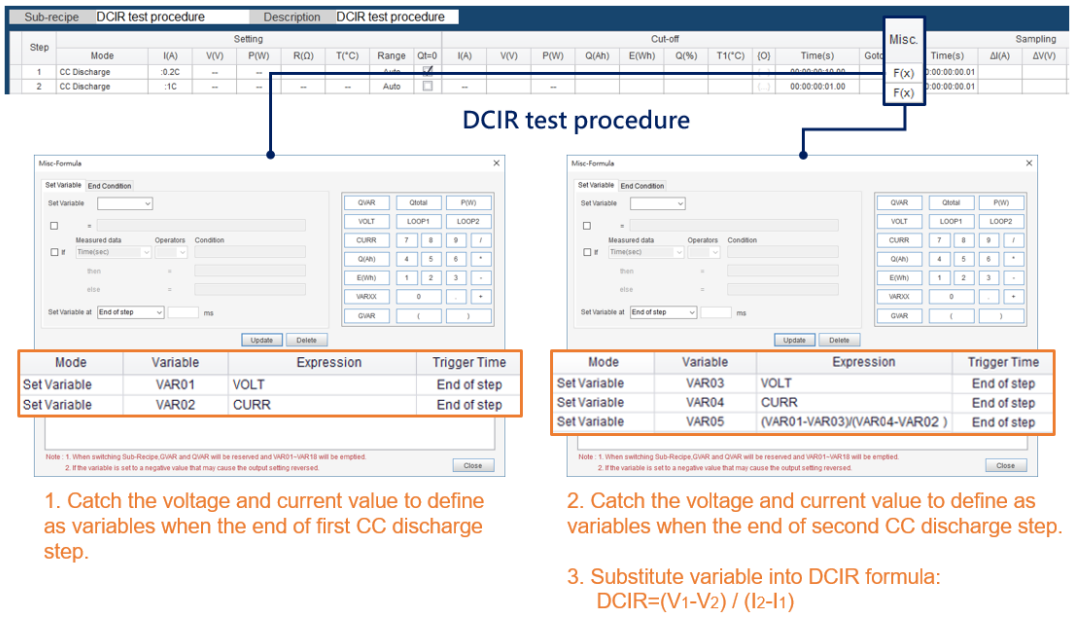

Figure 4 Functions Editing Examples for DCIR

4. Reference documents

[1] IEC 61960:2011

[2] Chroma 17010 Battery Charge and Discharge Test System Software User's Manual