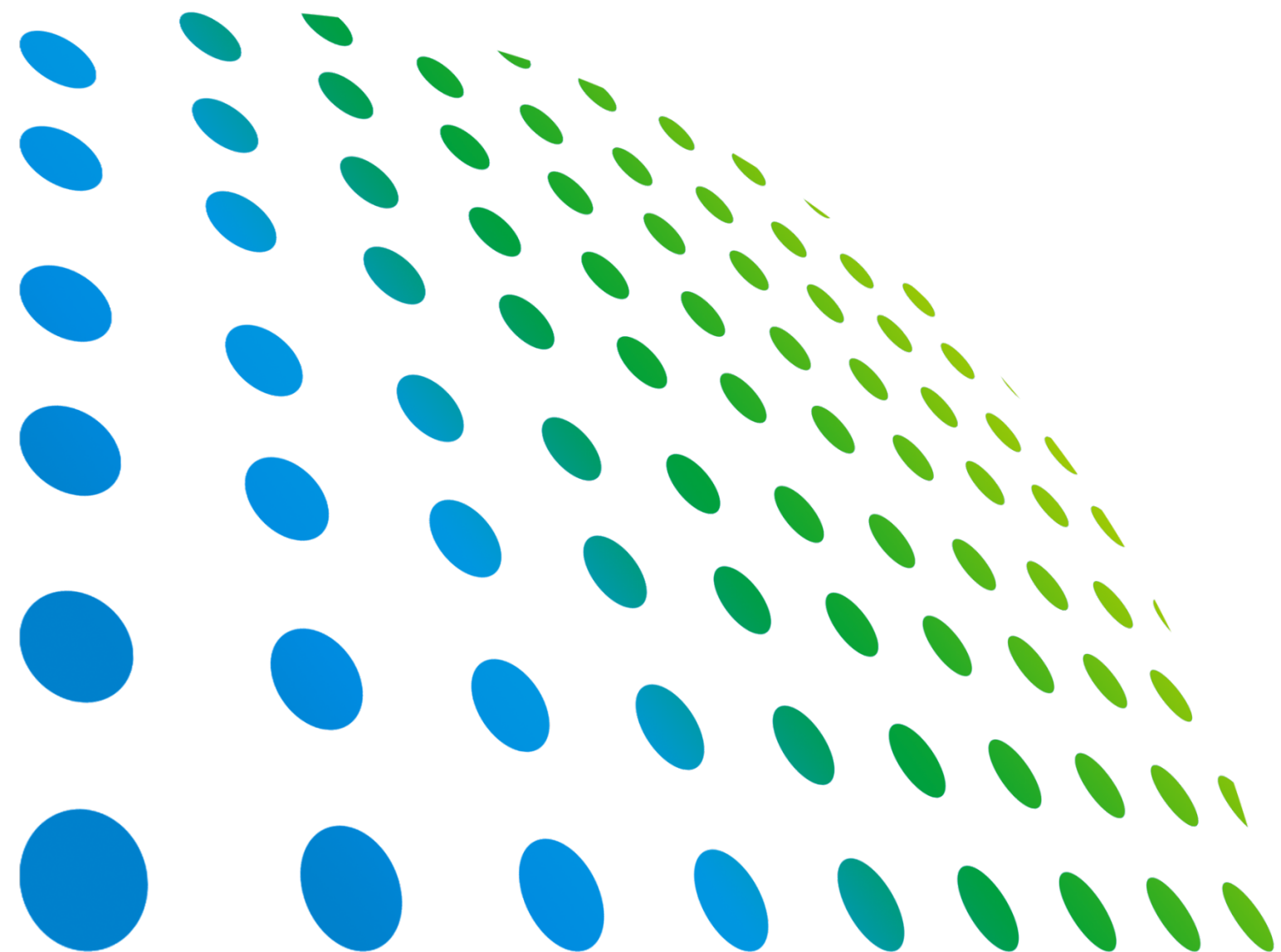


Chroma

Battery Cell Insulation Tester

11210

User's Manual



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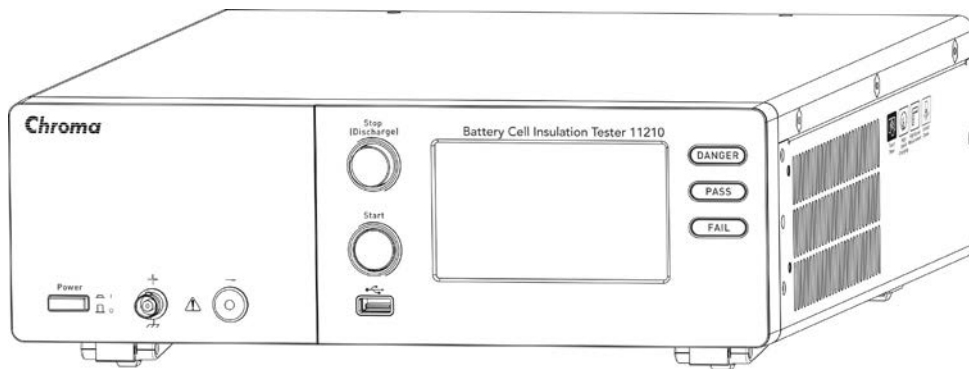
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Battery Cell Insulation Tester 11210 User's Manual



Version 1.1
September 2019

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CHROMA ATE INC.

66 Huaya 1st Road, Guishan, Taoyuan 33383, Taiwan

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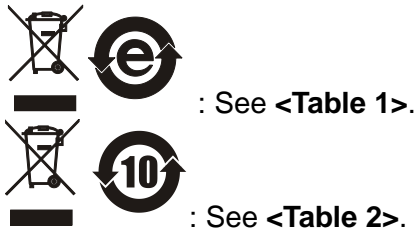
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<http://www.chromaate.com>

Material Contents Declaration

The recycling label shown on the product indicates the Hazardous Substances contained in the product as the table listed below.



<Table 1>

Part Name	Hazardous Substances					
	Lead	Mercury	Cadmium	Hexavalent Chromium	Polybrominated Biphenyls/ Polybromodiphenyl Ethers	Selected Phthalates Group
	Pb	Hg	Cd	Cr ⁶⁺	PBB/PBDE	DEHP/BBP/DBP/DIBP
PCBA	○	○	○	○	○	○
CHASSIS	○	○	○	○	○	○
ACCESSORY	○	○	○	○	○	○
PACKAGE	○	○	○	○	○	○

“○” indicates that the level of the specified chemical substance is less than the threshold level specified in the standards of SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

“×” indicates that the level of the specified chemical substance exceeds the threshold level specified in the standards of SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

Remarks:

1. The CE marking on product is a declaration of product compliance with EU Directive 2011/65/EU.
2. This product is complied with EU REACH regulation and no SVHC in use.

Disposal

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new one, the retailer is legally obligated to take back your old appliances for disposal at least for free of charge.



<Table 2>

Part Name	Hazardous Substances					
	Lead	Mercury	Cadmium	Hexavalent Chromium	Polybrominated Biphenyls/ Polybromodiphenyl Ethers	Selected Phthalates Group
	Pb	Hg	Cd	Cr ⁶⁺	PBB/PBDE	DEHP/BBP/DBP/DIBP
PCBA	×	○	○	○	○	○
CHASSIS	×	○	○	○	○	○
ACCESSORY	×	○	○	○	○	○
PACKAGE	○	○	○	○	○	○

“O” indicates that the level of the specified chemical substance is less than the threshold level specified in the standards of SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

“×” indicates that the level of the specified chemical substance exceeds the threshold level specified in the standards of SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

1. Chroma is not fully transitioned to lead-free solder assembly at this moment; however, most of the components used are RoHS compliant.
2. The environment-friendly usage period of the product is assumed under the operating environment specified in each product's specification.
3. This product is complied with EU REACH regulation and no SVHC in use.

Disposal

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new one, the retailer is legally obligated to take back your old appliances for disposal at least for free of charge.





www.chromaate.com



Declaration of Conformity

For the following equipment :

Battery Cell Insulation Tester

(Product Name/ Trade Name)

11210, A112100, A112101

(Model Designation)

CHROMA ATE INC.

(Manufacturer Name)

66 Huaya 1st Road, Guishan, Taoyuan 33383, Taiwan

(Manufacturer Address)

Is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Laws of the Member States relating to Electromagnetic Compatibility (2014/30/EU) and Low Voltage Directive (2014/35/EU). For the evaluation regarding the Directives, the following standards were applied :

EN 61326-1:2013 Class A, EN 61326-2-1:2013

EN 61000-3-2:2014, EN 61000-3-3:2013

EN 61326-1:2013(industrial locations)

**EN 61000-4-2:2009, EN 61000-4-3:2006+A1:2008+A2:2010, EN 61000-4-4:2012,
EN 61000-4-5:2014, EN 61000-4-6:2014, EN 61000-4-8:2010, EN 61000-4-11:2004**

EN 61010-1:2010

The equipment describe above is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

The following importer/manufacturer or authorized representative established within the EUT is responsible for this declaration :

CHROMA ATE INC.

(Company Name)

66 Huaya 1st Road, Guishan, Taoyuan 33383, Taiwan

(Company Address)

Person responsible for this declaration:

Mr. Vincent Wu

(Name, Surname)

T&M BU Vice President

(Position/Title)

Taiwan

(Place)

2018.06.22

(Date)

(Legal Signature)

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or specific WARNINGS given elsewhere in this manual will violate safety standards of design, manufacture, and intended use of the instrument. *Chroma* assumes no liability for the customer's failure to comply with these requirements.



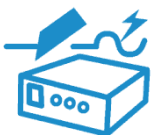
BEFORE APPLYING POWER

Verify that the power is set to match the rated input of this power supply.



PROTECTIVE GROUNDING

Make sure to connect the protective grounding to prevent an electric shock before turning on the power.



NECESSITY OF PROTECTIVE GROUNDING

Never cut off the internal or external protective grounding wire, or disconnect the wiring of protective grounding terminal. Doing so will cause a potential shock hazard that may bring injury to a person.



FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse holders. To do so could cause a shock or fire hazard.



DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE














Do not operate the instrument in the presence of flammable gases or fumes. The instrument should be used in an environment of good ventilation.



DO NOT REMOVE THE COVER OF THE INSTRUMENT

Operating personnel must not remove the cover of the instrument. Component replacement and internal adjustment can be done only by qualified service personnel.

Safety Symbols


	DANGER – High voltage.
	Explanation: To avoid injury, death of personnel, or damage to the instrument, the operator must refer to the explanation in the instruction manual.
	High temperature: This symbol indicates the temperature is hazardous to human beings. Do not touch it to avoid any personal injury.
	Protective grounding terminal: This symbol indicates that the terminal must be connected to ground before operation of the equipment to protect against electrical shock in case of a fault.
	Functional grounding: To identify an earth (ground) terminal in cases where the protective ground is not explicitly stated. This symbol indicates the power connector does not provide grounding.
	Frame or chassis: To identify a frame or chassis terminal.
	Alternating Current (AC)
	Direct Current (DC) / Alternating Current (AC)
	Direct Current (DC)
	Push-on/Push-off power switch
	The WARNING sign highlights an essential operating or maintenance procedure, practice, condition, statement, etc., which if not strictly observed, could result in injury to, or death of, personnel or long term health hazards.
	The CAUTION sign highlights an essential operating or maintenance procedure, practice, condition, statement, etc., which if not strictly observed, could result in damage to, or destruction of, equipment.
	The Notice sign highlights an essential operating or maintenance procedure, condition, or statement.

Hazardous Operating Conditions

1. Do not touch the test area when the Tester's output is enabled. Electrical shock could result in physical injury or death.

Be sure to observe the following rules:

- Insure the earth ground is properly connected and use a standard power cord.
 - Do not touch the output terminal.
 - Do not touch the test wire that is connected to the terminal under test.
 - Do not touch any unit under test.
 - Do not touch any component that is connected to the output terminal for charging.
 - Do not touch the test unit right after the test has ended or when the output has just been turned off. It can take several seconds for the high voltage to bleed off.
2. Shock accidents usually occur under the following conditions:
 - The earth terminal of the Tester is not properly connected.
 - Insulating gloves are not used during testing.
 - Touching the test unit immediately after the test is done.
 3. The high voltage output can be remotely controlled via an external control signal. When the Tester is being remotely controlled, follow the safety guidelines below:
 - Do not allow any accidental high voltage output to cause any danger.
 - Do not allow any operator or other personnel to touch the DUT, test cable, or probe output when high voltage is being output from the scanner.
 - Remote control is generally controlled by the high voltage test bar; however, other control circuits can also be used to control it instead. The test bar is the switch for controlling high voltage output, so the connected control wire should not be near the high voltage site and test cable to avoid causing any hazard.

 **CAUTION** For the precautions and dangerous operating details, please refer to the section "Precautions before Use and Installation" in Chapter 3.

Storage, Freight, Maintenance, and Cleaning

Storage

When not in use, pack the device properly and store in a suitable environment.

Freight

Pack the device carefully before moving it. If any of the original packing material is missing, use suitable alternative material and mark it “fragile” and “keep away from water” to avoid damaging the product. This product is a piece of precision test equipment; do not drop or hit it.

Maintenance

In case of any malfunction or abnormality, refer to the manual, or contact your local distributor for prompt service. Do not touch any parts inside the instrument to avoid any danger to yourself or damage to the product.

The device requires periodical maintenance and calibration to ensure it meets the product specifications. The suggested calibration period is 12 months.

Cleaning

Be sure to unplug the input power cord from the device and remove all other connected wires before cleaning. Use a brush to clean the dust off the machine surface. If the stain on the chassis is unable to be cleaned by a brush, use volatile liquids such as cleaning naphtha to wipe the chassis. Do not use corrosive liquid to avoid damaging the chassis. A low pressure air gun is required to clean the dust inside the device or you can send it to your local distributor for cleaning.

Revision History

The following lists the additions, deletions and modifications in this manual at each revision.

Date	Version	Revised Sections
Dec. 2018	1.0	Complete this manual.
Sep. 2019	1.1	Update the following: <ul style="list-style-type: none">- “<i>Checking before Use</i>” section in “<i>Preface</i>” chapter- “<i>Partial Discharge (PD Function)</i>” section in “<i>Specification</i>” chapter- “<i>Power Line Connection</i>” and “<i>Fuse</i>” sections in “<i>Precautions before Use and Installation</i>” chapter- “<i>Setting for Operation</i>” chapter- “<i>Common Command</i>” section in “<i>SCPI Command</i>” chapter Add the following: <ul style="list-style-type: none">- “<i>Hazardous Operating Conditions</i>” and “<i>Storage, Freight, Maintenance, and Cleaning</i>” description- “<i>Precautions before Use</i>” section in “<i>Precautions before Use and Installation</i>” chapter- “<i>A112101 PD Analyzer Function Card (Option)</i>” chapter- “<i>A112102 PD Test Checking Kit (Option)</i>” chapter

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1. Preface

1.1 Overview

The insulation tests inside of traditional battery cell are all tested the leakage current at the last stage for judging whether the internal insulation states are in good condition. The traditional test method doesn't detect whether Partial Discharge (PD) is occurred during the entire test procedure. The Chroma 11210 Battery Cell Insulation Tester conducts Partial Discharge detection for Charge, Dwell and Test during the entire test and combines the final measured result of Leakage Current for customers control occurred discharge condition as the criteria to define the battery cell quality.

The test functions equipped with this device contains LC, IR, Contact Check and Partial Discharge (option), which are perfect functions for the production line and quality assurance.

The Chroma 11210 Battery Cell Insulation Tester has multiple remote interface options. LAN, Handler, USB (B-Type) and RS-232C remote interfaces come standard for software or hardware control of test conditions, measurement trigger, judge test results, and collect measured data. There also has USB (A-Type) interface for saving device setting and measured by external trigger instrument via Handler interface to transmit the measured result to the external device.

The Chroma 11210 Battery Cell Insulation Tester was designed with many enhancements and key features to make it the best choice to meet the demands of modern component characterization analysis and high speed testing for automated production line or incoming/outgoing inspection applications.

1.2 Summary of Specification

- (1) Measurement Parameter:
LC (Leakage Current)
IR (Insulation Resistance)
- (2) Basic Accuracy:
LC : $\pm 0.3\%$
- (3) Measurement Range:
LC : 0.00nA ~ 20.00mA
- (4) Test Voltage/Current:
Test Voltage Range: 1.0V ~ 1000V
Limit Current Range: 0.5mA ~ 50mA
- (5) Compensation Function: LC Null
- (6) Contact Check
- (7) Interface: RS-232, LAN, Handler, USB Flash Drive (A-Type), USB (B-Type) and Interlock

(8) Partial Discharge Function (Option)

Partial Discharge Tester: Partial Discharge Voltage/Current Level & Times Test

Partial Discharge Analyzer: Partial Discharge Voltage/Current Curve Plotting & Analysis

Partial Discharge Tester Checking Kit

1.3 Checking before Use

Before shipment, this instrument was inspected and found to be free of mechanical and electrical defects. As soon as the instrument is unpacked, inspect for any damage that may have occurred in transit. Save all packing materials in case the instrument has to be returned. If damage is found, please file claim with carrier immediately. Do not return the instrument to Chroma without prior approval.

Upon receipt of the instrument, please check on the following items:

- (1) If there are any damages or scratches on the product surface.
- (2) The standard and optional accessories came with the instrument as listed in *Table 1-1*.

Item	Qty	Description
WIRE BANA.PLUG/Alligator Clip to Red High Voltage Cable for 90 CM	1	A test cable
Test Cable BNC + Alligator Clip 1M	1	A test cable
Slow Blow Fuse 4A	2	For power supply AC 230V use
Slow Blow Fuse 8A	2	For power supply AC 115V use
User's Manual CD	1	CD for user's manuals in English, Traditional Chinese and Simplified Chinese
11210 Quick Start Guide	1	Traditional Chinese

Table 1-1 Model 11210 Standard Accessories

Item	Qty	Description
A11200/A112101 Quick Start Guide	1	Traditional Chinese

Table 1-2 Model A112100 Standard Accessories

Item	Qty	Description
A11200/A112101 Quick Start Guide	1	Traditional Chinese

Table 1-3 Model A112101 Standard Accessories

Item	Qty	Description
XHM-5000 Red High Voltage Cable 15 CM	1	Test cable
BNC (M-M) 18 CM	1	Test cable
Slow Blow Fuse 2.5A	2	For power source use
A112102 Quick Start Guide	1	Traditional Chinese

Table 1-4 Model A112102 Standard Accessories

Note | Only name item is required when ordering any of the accessories.

Optional Accessory

Item	Qty	Description
A112100 PD Tester Function Card	1	Tester Card
A112101 PD Analyzer Function Card	1	Analyzer Card
A112102 PD Test Checking Kit	1	Test Kit
A112103 Handler Interface Converter Box	1	Converter Box
B112100 Cable (SMA – BNC Transform Cable)	1	For A112100 / A112101 use
B112102 Test Cable (3M Test Cable)	1	For automated equipment connection
11210 Quick Start Guide	1	English
A112100/A112101 Quick Start Guide	1	English
A112102 Quick Start Guide	1	English
Power cord (US) AL-211+AL-503	1	Applicable for Taiwan, Japan and USA
Power cord (CN) PHS-301+PHP-304R	1	Applicable for China
Power cord (EUR) AL301+AL501	1	Applicable for Netherlands, Germany and France

2. Specification

2.1 L.C. Test

2.1.1 Measurement Parameter

LC (Leakage Current) Unit: mA, uA, nA
 IR (Insulation Resistance) Unit: KΩ, MΩ, GΩ, TΩ

2.1.2 Test Signal

Test voltage: DCV = 1.0V~100V, step 0.1 V
 Accuracy: $\pm(0.5\% \text{ Setting} + 1\% \text{ Range})$
 DCV = 101V~1000V, step 1 V
 Accuracy: $\pm(0.5\% \text{ Setting} + 0.5\% \text{ Range})$

Limit current range: Charge Current = 0.5mA~50 mA; step 0.1mA
 Accuracy: $\pm(1.5\% \text{ Setting} + 1.5\% \text{ Range})$

Output impedance: $R_o=200\Omega$
 $C_p=0.1\mu\text{F}$

2.1.3 Measurement Accuracy

- Within 1 year of factory calibration.
- Temperature: $23^\circ\text{C} \pm 5^\circ\text{C}$
- Relative humidity: 75% maximum
- Warm up: 30 minutes minimum
- Measurement speed: 500ms

Measurement accuracy of leakage current

Range	Accuracy
20.00nA	$\pm(5.0\% \text{ Reading} + 5.0\% \text{ Range})^{*1}$
200.0nA	$\pm(1.0\% \text{ Reading} + 1.0\% \text{ Range})^{*1}$
2.000uA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})^{*1}$
20.00uA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})^{*1}$
200.0uA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})^{*1}$
2.000mA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})^{*1}$
20.00mA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})^{*1}$

Accuracy of voltage measurement

Range	Accuracy
1.0V~100V	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})^{*1}$
101~1000V	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})^{*1}$

*1: Basic Measurement Accuracy

- Within 1 year after factory calibrated

- Temperature: 23°C ± 5°C
- Relative Humidity: 75% maximum
- Warm up: 30 minutes minimum
- Test condition for accuracy specification: measurement speed with integration time of 500ms.
- Guarantee only for the tests on pure resistive DUT.

Accuracy of IR measurement:

It is calculated based on the accuracy of leakage current measurement and voltage measurement. For detailed descriptions, see *Appendix B IR Accuracy*.

2.1.4 Display Range

Parameter	Range
Leakage Current	00.00 nA ~ 20.00 mA
Insulation Resistance	0.01 KΩ ~ 10 TΩ

2.1.5 Measurement Time

Line Frequency Setting	Integration Time					
50Hz	1 ms	4 ms	1PLC(20 ms)	100 ms	500 ms	5ms ~ 9.999s
60Hz	1 ms	4 ms	1PLC(17ms)	100 ms	500 ms	5ms ~ 9.999s

2.1.6 Test Time

Test Condition	Test Time Setting
Charge	0.005s ~ 99.999s, step 0.001s
Dwell	0.005s ~ 99.999s, step 0.001s
Test	0.005s ~ 99.999s, step 0.001s

Accuracy <1 ms

2.1.7 LC Null

It eliminates the leakage current of the entire measuring loop to add the measurement accuracy before connecting DUT for test.

2.1.8 Contact Check

Make sure the leakage current test end of the tester and DUT are connected.

2.1.9 BDV (Breakdown Voltage Test)

It performs the breakdown or withstand voltage tests on components.

2.2 Interface

- **RS-232 interface** : Standard RS-232C interface
- **USB interface (A-Type)** : Standard FLASH MEMORY interface
- **Handler interface** : Output signal of test result and I/O interface of external trigger
- **Interlock interface** : It is used with the fixture with protection or instrument.
- **LAN interface** : 10/100 type network interface
- **USB interface (B-Type)** : Compatible with USBTMC

2.3 Partial Discharge (PD Function)

2.3.1 Partial Discharge Tester

PD Detection (with option of A112100) (*option)	
Magnitude detected	Level 0 ~ 99
Number of occurrence	0 ~ 99
Type of PD occurrence	VPD (PD occurred in CC mode) CPD (PD occurred in CV mode)
Judgement criteria	Magnitude or the number of occurrence or both

2.3.2 Partial Discharge Analyzer

PD Analyzer (with option of A112101) (*option)	
Waveform display	Both voltage and current waveform
Quick shot (image) of PD occurrence	Up to 10 shots (image) per test can be recorded
Max. Sampling Rate	5MHz

2.3.3 Partial Discharge Test Checking Kit

PD Test Checking Kit (A112102) (*option)	
PD voltage range	50V ~ 950V (typical)
PD interval time	0.1s ~ 1s (typical)
PD behavior mode	Single / Multiple

2.4 Others

Power: (1) 100 V ~ 120 V AC 50Hz/60Hz, power consumption max (VA) 400 VA
(2) 200 V ~ 240 V AC 50Hz/60Hz, power consumption max (VA) 400 VA

Environment: Operation -- Temperature 0°C ~ 40°C, relative humidity 10 ~ 90%
Storage -- Temperature 0°C ~ 50°C, relative humidity 10 ~ 90%

Dimension: 320(width) x 100(height) x 400(depth)

Weight: Approx. 10.5 kg

3. Precautions before Use and Installation

3.1 Precautions before Use

The Tester can output up to 1kV high voltage for external test. Accidents may occur or even cause death if using this Tester incorrectly or in the wrong way. Thus for safety sake, be sure to read the precautions in this chapter to avoid any accidents from happening.

1. Electric shock

To prevent the incident of electric shock from occurring, it is suggested to wear the insulated rubber gloves before using the Tester for electricity related tasks.

2. Grounding

A safety ground terminal is located at the rear of the Tester chassis; please use a proper tool to ensure it is grounded accurately. If not it would be very dangerous when the power circuit or the connection cable of any device shorts with ground terminal as the chassis may contain high voltage. Anyone who touches the device in this case may cause electric shock. Therefore, it is necessary to connect the safety ground terminal to earth properly as the arrow shows in *Figure 3-1*.

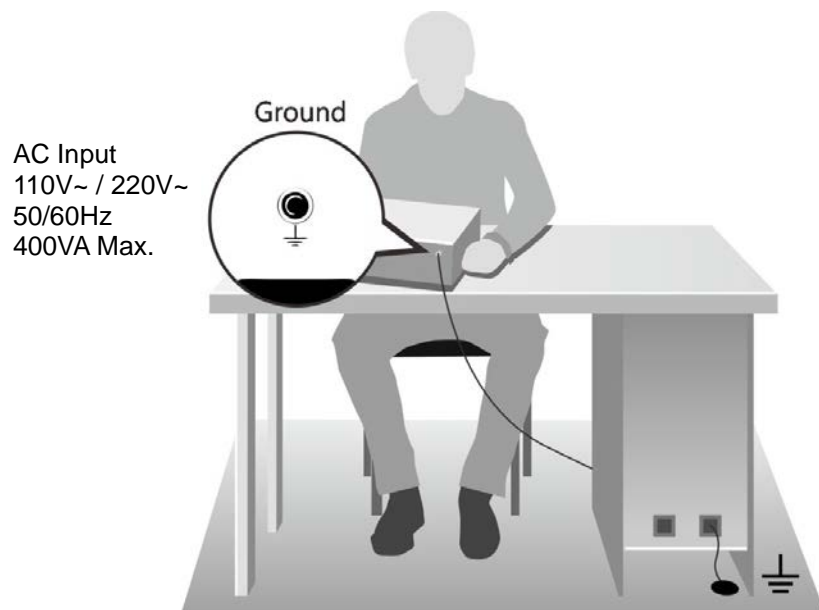


Figure 3-1 Safety Grounding Diagram

3. The Tester's LCD panel is fragile

Do not press or touch the LCD panel with a sharp object that may cause the LCD panel to be broken or display abnormally.



4. Connecting test cable to high voltage output terminal

When the test cable is connected to HV (+) (BNC terminal), follow the steps below to connect the test cable to HV (-) (red concave terminal).

- Press **STOP**.
- Ensure the DANGER indicator is off.
- Make sure the screen shows voltage 0V in real time (no voltage output).
- First connect the test cable to HV (+) (BNC terminal) and then connect the test cable to HV (-) (red concave terminal).

5. Connecting test cable to HV (-) (red concave terminal)

When using the Tester, always check if the test cable is properly connected to the HV (-) (red concave terminal) and is not loosened or fallen. When using a test cable to connect the test object, be sure to use the high voltage test cable to connect the DUT (Device Under Test) first. It is very dangerous if the HV (-) (red concave terminal) or HV (+) (BNC terminal) test cable is not firmly connected or fallen as the entire DUT may fill with high voltage.

6. End of test

When the test is end or the Tester is not in use or is in use but needs to leave it unattended for a while, it is necessary to toggle the power switch to OFF (i.e. to shut off the power) as *Figure 3-2* shows.

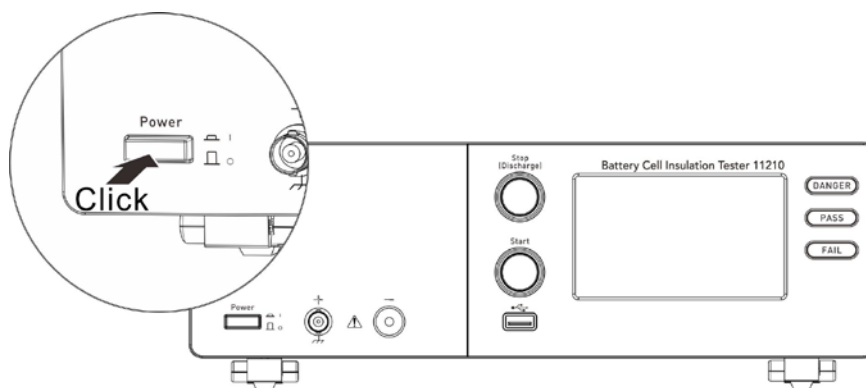


Figure 3-2 Power Off

7. Do not touch the hazard areas when the Tester is in test mode

When the Tester is in use or the DANGER indicator is blinking, touching the object with high voltage such as UUT, test cable, probe and output terminal is very dangerous.

⚡ CAUTION Do not touch the tip of dolphin clip on the test cable as it may have high voltage output during test as shown in *Figure 3-3*.

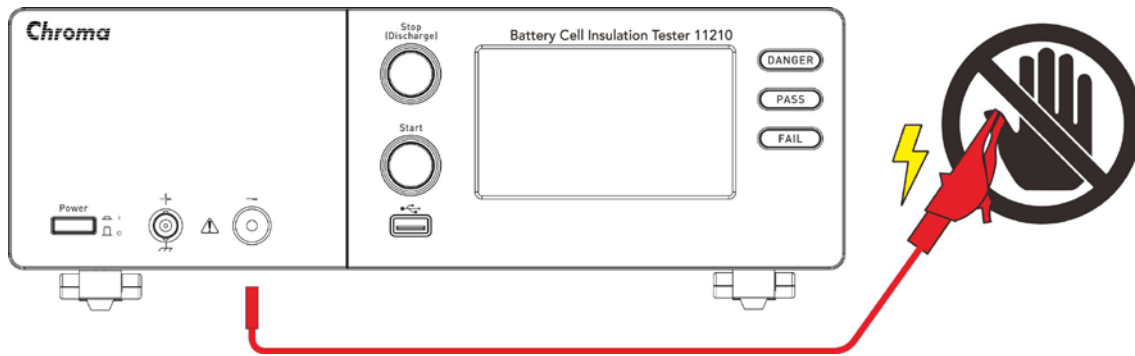


Figure 3-3 Do Not Touch Here During High Voltage Output

<<< Warning! When the output is cut off >>>

8. Ensure the test is done

Sometimes users might need to touch the high voltage objects such as UUT, high voltage test cable or output terminal etc. due to configuration or test required change. In that case, please ensure the power has been turned off.

9. Remote controlling the Tester

The Tester can be remote controlled generally for high voltage output via external control signal. When performing it, it is necessary to follow the control guidelines for safety and precautions.

- Do not allow any accidental high voltage output that may cause hazard.
- When there is high voltage output from the Tester, do not allow any operator or other personnel to touch the UUT, test cable or probe output and etc.

※ Caution ※

10. Turning on or off the power switch

Once the power switch is turned off, it needs to wait for a few seconds to turn it on again. Do not power it on and off continuously to avoid occurring errors. It is very dangerous to power it on and off continuously when in high voltage output state in particular. **When turning on or off the power, the high voltage output terminal cannot connect to any object to avoid the hazard caused by abnormal high voltage output.**

11. Other notices

Do not short-circuit the output line, grounding wire, communication cable or other device's grounding wire or AC power to avoid charging the entire Tester to dangerous voltage. To short-circuit the high voltage output of HV(-) (red concave terminal) and HV(+) (BNC terminal), it is necessary to ground the Tester chassis to earth properly first.

<<< Emergency Case >>>

12. Process for emergency case

To avoid causing bigger hazard when in emergency situations like electric shock, UUT or Tester burnout, please perform the steps below:

- First cutoff the power switch.
- Second unplug the power cord.

<<< Resolving Problems >>>

13. Problems occurred

Problems occurred in the following situation are very dangerous. The output terminal may still have high voltage output even the **STOP** key is pressed; therefore, users should be extremely careful when dealing with it.

- The DANGER LED indicator keeps on when **STOP** key is pressed.
- The DANGER LED indicator is on but the voltage meter has no readings.


When the above situation occurs, shut down the power and unplug the AC power cord immediately. Do not use the device again as failure is awfully hazardous. Please send the hardware back to Chroma or its distributor for repair service.

14. DANGER Indicator failure

When pressing the **START** key the voltage meter has readings but the DANGER LED indicator is still off, it means the indicator may be broken. Please power off the hardware and replace it with another device, then send the broken one back to Chroma or its distributor for repair service.

15. Tester uses 110Vac / 220Vac, 50 / 60 Hz for AC INPUT

The fuse should be changed when the power cord is not plugged in to avoid electric shock. When replacing, use a flat screwdriver to pry the fuse holder inside the power socket and remove the fuse to replace with a new one by pushing it in gently, and then push the power socket back to its position.

 **WARNING** : Be sure to use the fuse with correct specification or it may cause hazard.

16. Tester is normally operated under AC power

Unstable power supply may cause the device to work inaccurately or abnormally. Thus, please use appropriate equipment such as a power supply regulator to convert it to a suitable one.

17. Storage

The temperature and humidity for the Tester is 0°C~40°C, 10%~90% RH in normal. The operation may malfunction if exceeding the range. Do not mount the Tester to a fixed place in case it needs to be removed. The storage temperature for the Tester is from -0°C to 50°C, ≤ 90%RH. If it is not in use for a long time, please pack it with its original package for storage. For proper test and safety measures, do not place the Tester under direct sunlight, high temperature, vibrated, humid or dusty area.

18. Warming up

The tester is activated when power is on; however, in order to meet the specifications for accuracy please warm it up for 30 minutes or above.

19. Keep test cable away from the panel

Please keep the high voltage cable or the DUT away from the panel at least 15 cm during operation to avoid the display interference caused by high-voltage discharge.

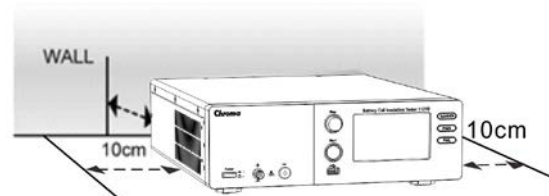
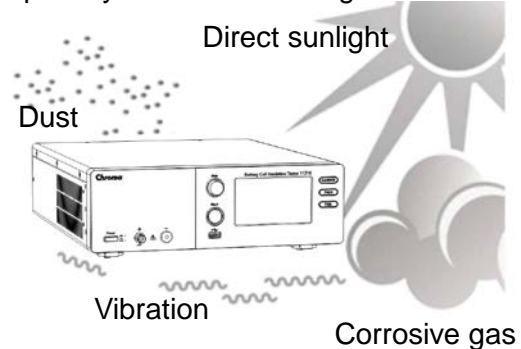
20. Notices for connecting automated device

- The grounding system of the device and the automated station should be connected together.
- The high voltage cable must be separate from the control cable.
- The high voltage cable must keep proper distance from the Tester panel.

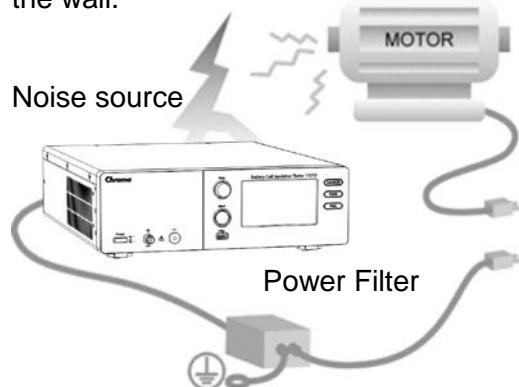
3.2 Ambient Environment

- (1) Do not use the tester in a dusty or vibrating location. Do not expose it to sunlight or corrosive gas. Be sure that the ambient temperature is 0 ~ 40°C and that the relative humidity is below 90%.
- (2) The rear of the meter is equipped with a cooling fan to keep the internal temperature down, so adequate ventilation should be ensured. The tester should be located at least 10cm from any object or wall behind it. Do not block the left and right ventilation holes to keep the tester in good precision.
- (3) The tester has been carefully designed to reduce the noise from the AC power source. However, it should be used in a noise-free or as low as possible environment. If noise is inevitable, please install a power filter.
- (4) The meter should be stored within the temperature range 0°C ~ 50°C. If the unit is not to be used for a long time, please store it in the original or similar package and keep it from direct sunlight and humidity.

Keep away from the following conditions:



Place the object at least 10cm away from the wall.



Install a power filter in case of interference from high power noise.

3.3 Power Line Connection

Before plugging in the power cord, make sure the power switch is off and the voltage selector on the rear panel meets the required voltage (115 or 230V). Please use the power supply frequency of 50Hz or 60Hz.

11210 power spec.: 100 V~120 V A/200 V~240 V AC 50/60Hz, max. power consumption (VA) 400VA.

A112102 power spec.: 100V~240V AC 50/60Hz, max. power consumption (VA) 20VA.

3.4 Fuse

There is one fuse installed in the rear panel, please be aware of the following when replacing it:

1. First turn off the power and unplug the power cord before changing the fuse.
2. The specification of fuse:

11210	AC 100 V~120 V → T8.0 A, 250 V
	AC 220 V~240 V → T4.0 A, 250 V
A112102	AC 100 V~240 V → T2.5 A, 250 V

For safety and noise reduction, it is necessary to use a 3-pin power cord to connect the power inlet on the rear panel for AC line input and to ground the GUARD terminal on the front panel as *Figure 3-4* shows below.

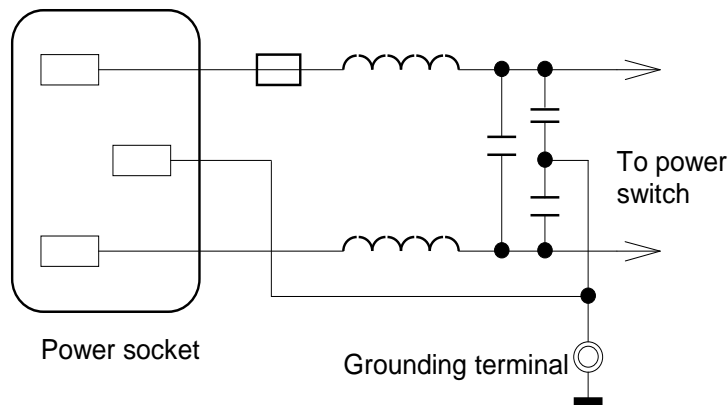


Figure 3-4 Line Input Configuration

3.5 Power Regulation

As this instrument is a precision electronic test device, the accuracy might be severely influenced by the undulated input power after tested. There is $\pm 10\%$ changeable power even in the laboratory, so it is suggested to use a regulator between the power sources and test devices. This is the best way to eliminate the variation of measured data caused by the unstable power voltage.

3.6 Connecting the Device Under Test (DUT) for Leakage Current Test

Connect the UNKNOWN (LEAKAGE CURRENT) test terminal on the front panel to the DUT for leakage current test. Be sure that the DUT polarity is connected correctly, where the DUT's negative terminal is connected to the **HV (-)** red concave end of 11210 and the positive terminal is connected to the **HV (+)** BNC end of 11210 as shown in *Figure 3-5*.

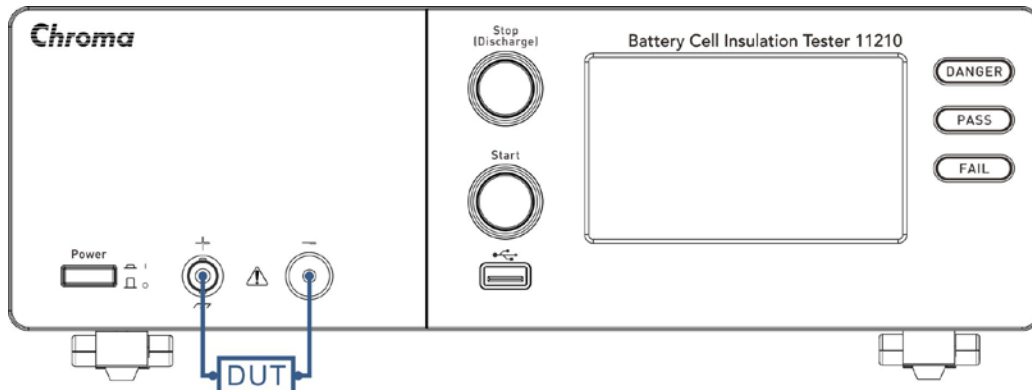


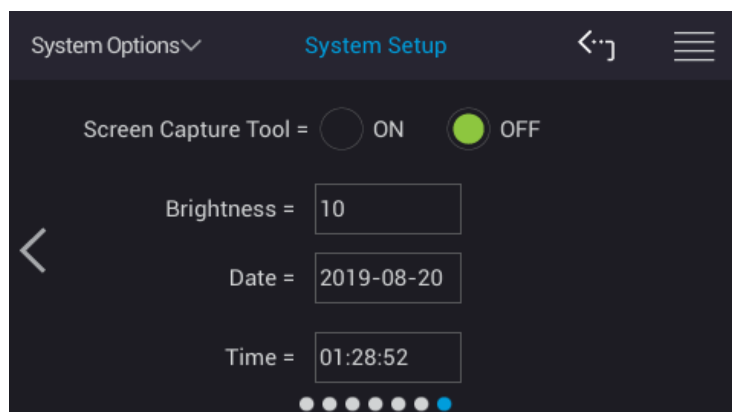
Figure 3-5 DUT Connection for Leakage Current Test

WARNING

Be aware of the high voltage hazard as the maximum output from the UNKNOWN (LEAKAGE CURRENT) is DC 1000V. Do not touch the UNKNOWN (LEAKAGE CURRENT) terminal, the test cable and the DUT during test to avoid electric shock. Do not remove the DUT before it is fully discharged as it may contain the voltage that could cause any danger.

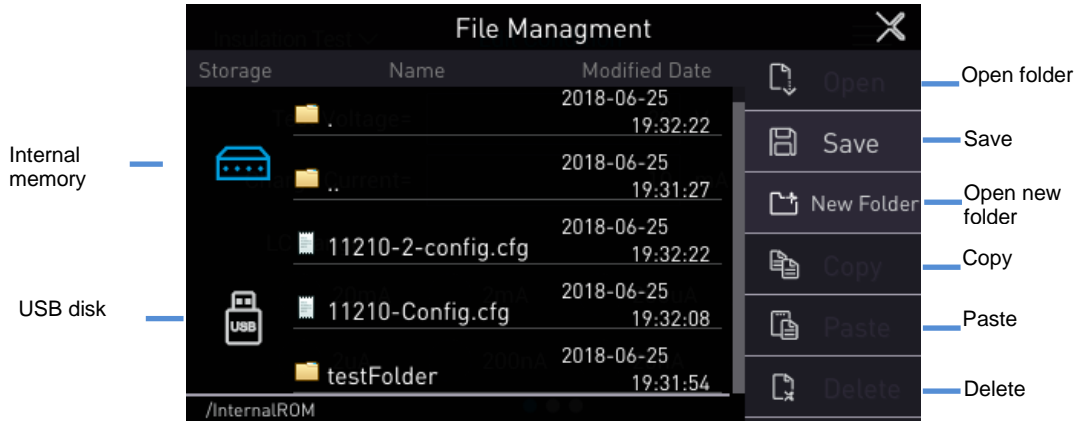
3.7 Contrast Adjustment of Display



To adjust the contrast of touch monitor via the menu at upper left side of main screen, select System Options and System Setup after returning main menu. Next switch the setup screen to the 6th page and select Brightness setting. Be careful that the adjusting should be depended on personal acceptable brightness.



3.8 File Management

Click [☰] at upper right corner of any setting parameter screen to enter File Management Area in order to process open, save, add, copy and delete file operations.

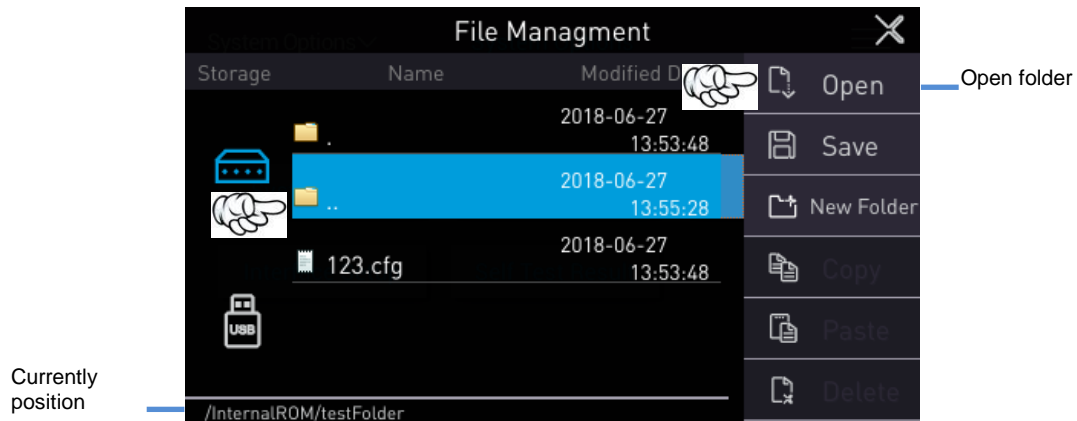


According to the screen to select “” or “”: It selects “Internal memory” or “External USB disk”. Click the menu at the right side of screen to access the file as required.

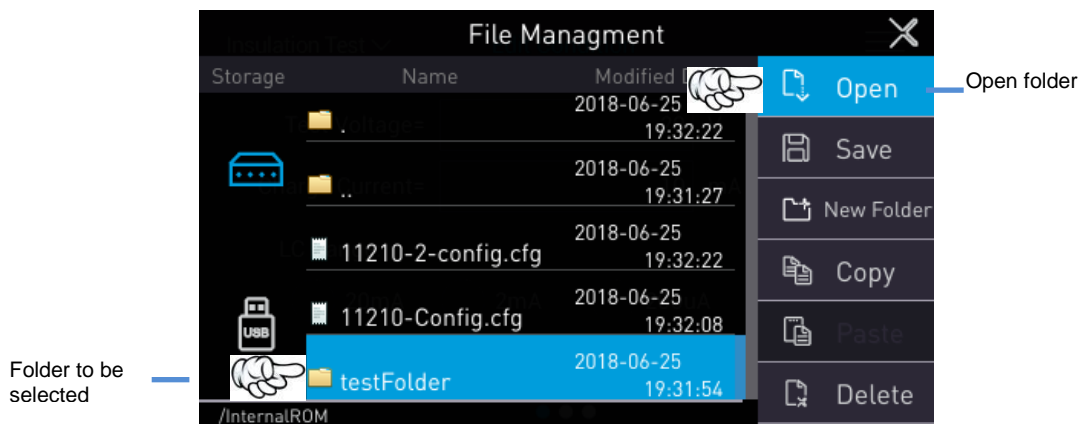
⚡ CAUTION : Naming convention for file and folder as listed following:
 : (1) The character limitation is 64.
 : (2) Special character limitations are as the table listed below.

Table 1 Special Character Limit

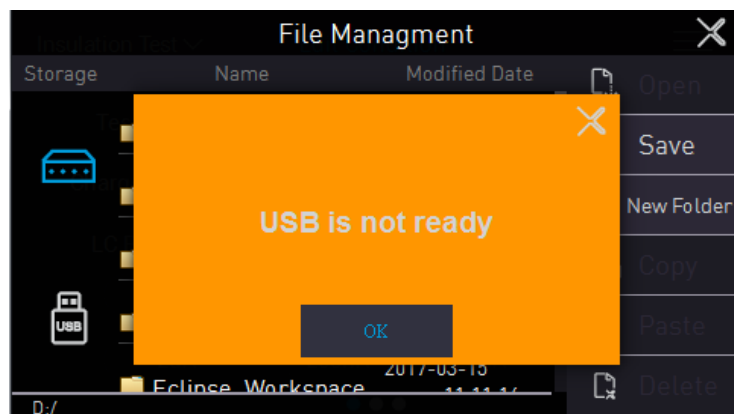
Special Character	Description	Whether the file name is allowed?	Whether the folder name is allowed?
@	At sign	Yes	Yes
#	Number sign	Yes	Yes
\$	Dollar sign	Yes	Yes
%	Percent sign	Yes	Yes
&	Ampersand	Yes	Yes
-	Dash/Minus/Hyphen	Yes	Yes
+	Plus	Yes	Yes
(Open parenthesis	Yes	Yes
)	Close parenthesis	Yes	Yes
!	Exclamation point	Yes	Yes
;	Semicolon	Yes	Yes
,	Comma	Yes	Yes
*	Asterisk	No	No
"	Quote	No	No
'	Single quote	No	No
:	Colon	No	No
/	Slash	No	No
?	Question mark	No	No



Back to the upper level folder: Touch “..” and “Open” to back to the upper level folder.



Enter the folder: Select the folder to be entered, touch “Open” to enter the selected folder.



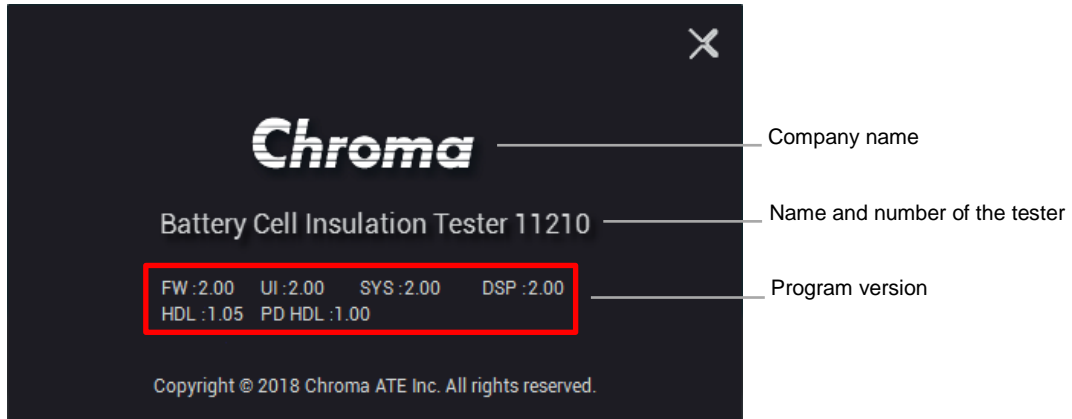
CAUTION

Troubleshooting:

1. When the external memory (USB) is selected and the warning message is shown on the screen, make sure whether a USB disk has inserted into the USB interface on front panel.
2. If the inserted USB disk has confirmed but the warning message still has occurred, replace it with another USB disk for confirmation. If the warning message is still occurred, please contact the agent or our customer service to send the tester for repair.

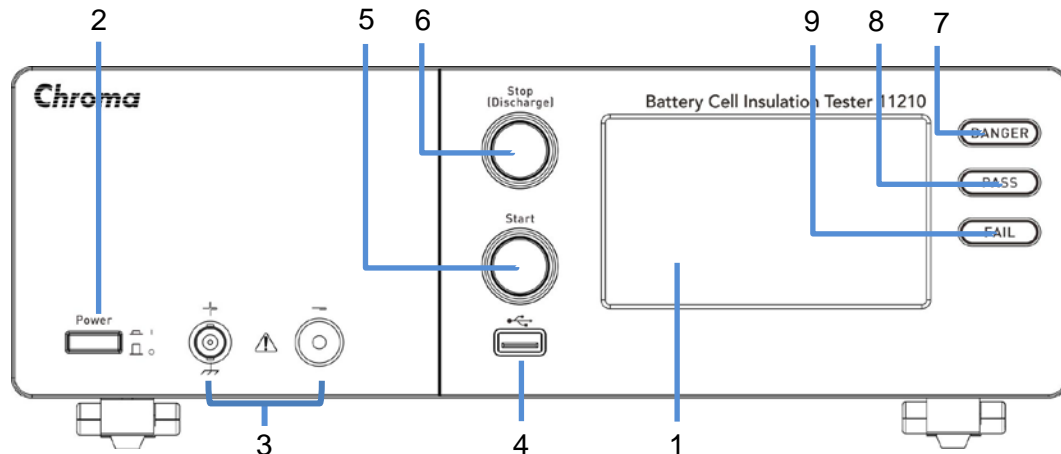
3.9 Query Version

Query the related version can via ABOUT in main menu; the screen is shown as below. The information in the below screen users can get model name, number and program version.



4. Description of Panel

4.1 Front Panel



(1) Touch Panel Display

The display of this tester is a 480RGB X 272 Touch Panel Display. All function setting options can click or scroll on touch panel display for selection, all measurements and settings can be clearly displayed and seen.

(2) Power Switch

It switches the power to on or off. This key pressed means power on and unpressed means power off.

(3) LEAKAGE CURRENT Terminal

The leakage current test terminal is composed of one notch type terminal and BNC connector, and is connected DUT directly by a test cable. Be sure that the meter is in stop testing or discharge mode when connecting or disconnecting it to a DUT as the output voltage of its negative terminal (red notch type terminal) is pretty high [V(DC) = 0V ~ -1000V].

⚠ WARNING : Don't touch the test terminal or DUT while test status LED lights or blinking.

(4) USB Interface (A-Type)

Standard FLASH MEMORY HOST interface can save and read test procedure and data as well as image capture for saving PD Analyzer in the file format of PNG. The maximum capacity only can support USB disk with 128GB and in the format of FAT32.

(5) START Key

Press this key to start testing.

(6) STOP Key

The tester will return to standby test status immediately and cut off the output once pressing this key. It also can be utilized to clear the warning message.

(7) Danger LED

The tester is under testing status when the LED is lit or blinking, the test terminal contains voltage and current output.

WARNING Don't touch the test terminal or DUT while test status LED lights or blinking.

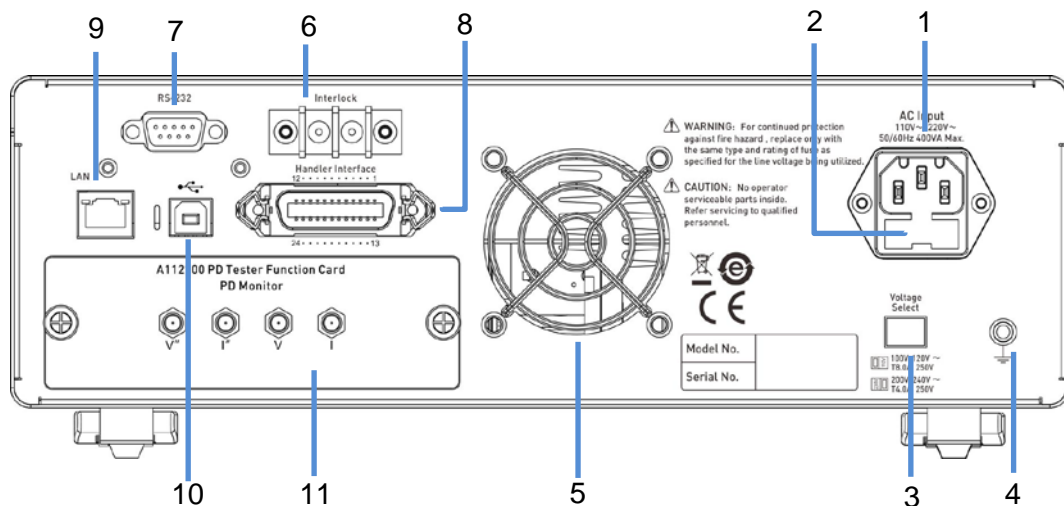
(8) Pass LED

It indicates DUT judged as Pass when the LED is lit.

(9) Fail LED

It indicates the test result under the status judged as Fail when the LED is lit.

4.2 Rear Panel



(1) AC Line Socket

(2) Fuse

An 8A or 4A slow blow fuse is used to prevent the over current from occurring when the instrument power is in 100 ~ 120V or 200 ~ 240V.

(3) Power Voltage Switch

Be sure to power off the instrument before switching the voltage. Use a small flat screwdriver to switch the power voltage to the proper position.

(4) Ground Terminal

This terminal connects the cover of this instrument directly, and then connects to the ground to avoid exterior obstruction that makes instrument connection uncompleted and influences the safety.

(5) Fan

It is equipped with the function of temperature detection adjusting the fan speed. The fan speed will be accelerated when the temperature risen, whereas the fan speed will be decelerated when the temperature dropped.

(6) INTERLOCK Connector

It is mainly for the fixture or instrument with protection device used, these two ends need to be short-circuited thus the test terminal can output voltage and current. Use the short-circuit plate to short-circuit it if the single unit is utilized.

(7) RS-232 Connector

Standard RS-232C connector

(8) HANDLER Connector

I/O connector for test result output signal and external trigger

(9) USB Connector (B-Type)

Compatible with USBTMC standard

(10) LAN Connector

10/100 type LAN connector

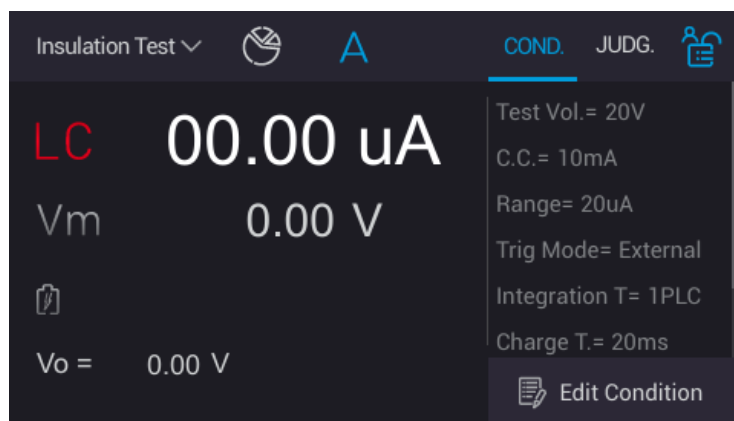
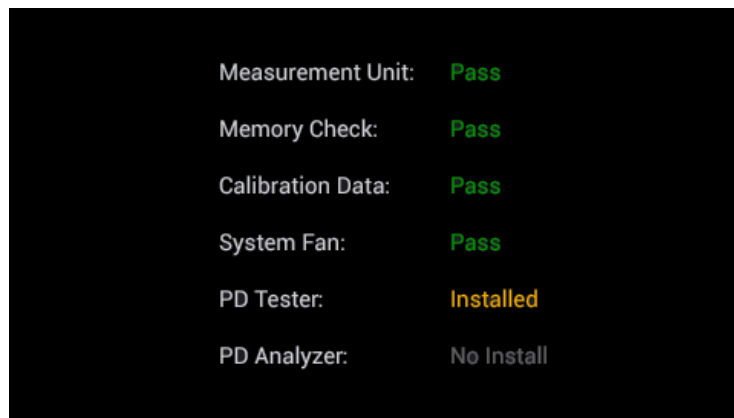
(11) PD Tester / PD Analyzer Function Card Slot (Option)

It is the slot for interface card. Remove the two screws on the cover in advance and put the optional interface card and next to lock the hand screw on the interface card tightly if put PD Tester or PD Analyzer interface card is required.

5. Setting for Operation

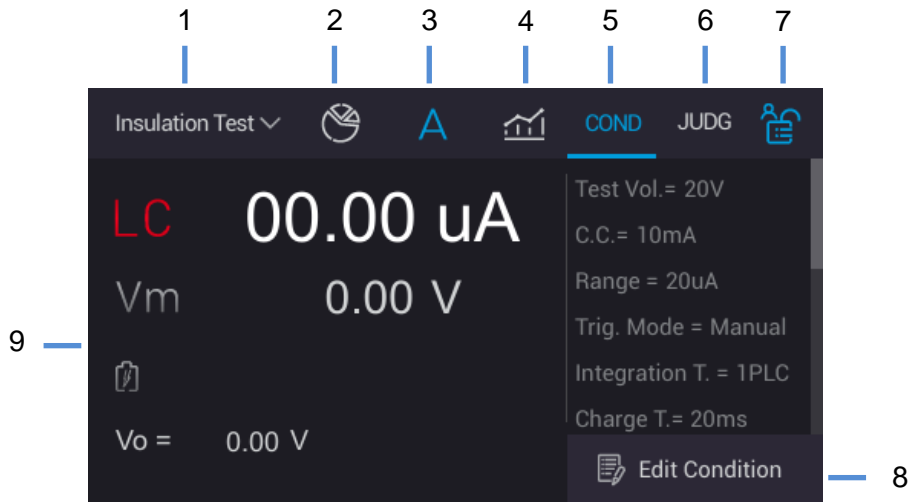


Power-on self-test screen pops up after about 10 seconds. Enter Insulation Test measurement main menu after about 10 seconds as the figure below shows.



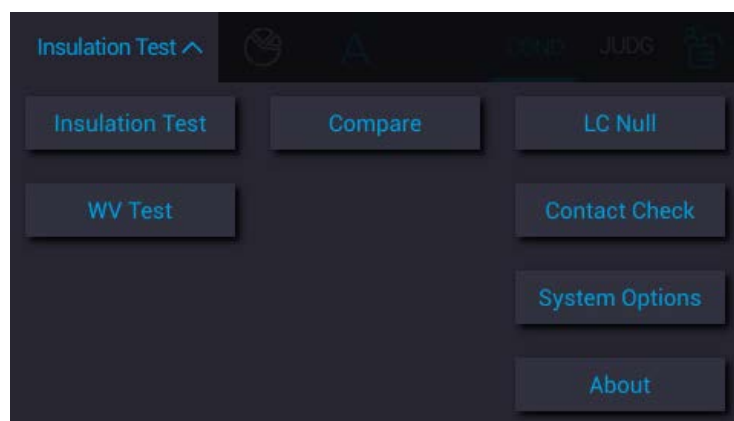
5.1 Function & Setup Menu

There are 8 items provided for users' setup/review after powered-on to enter main menu.



1. Function selection menu
2. Measurement statistical information
3. Measurement result
4. Partial discharge measurement analysis chart
5. Test condition setup review area
6. Judgment condition setup review area
7. Monitor lock key
8. Test condition setup edit area
9. Measurement result review area

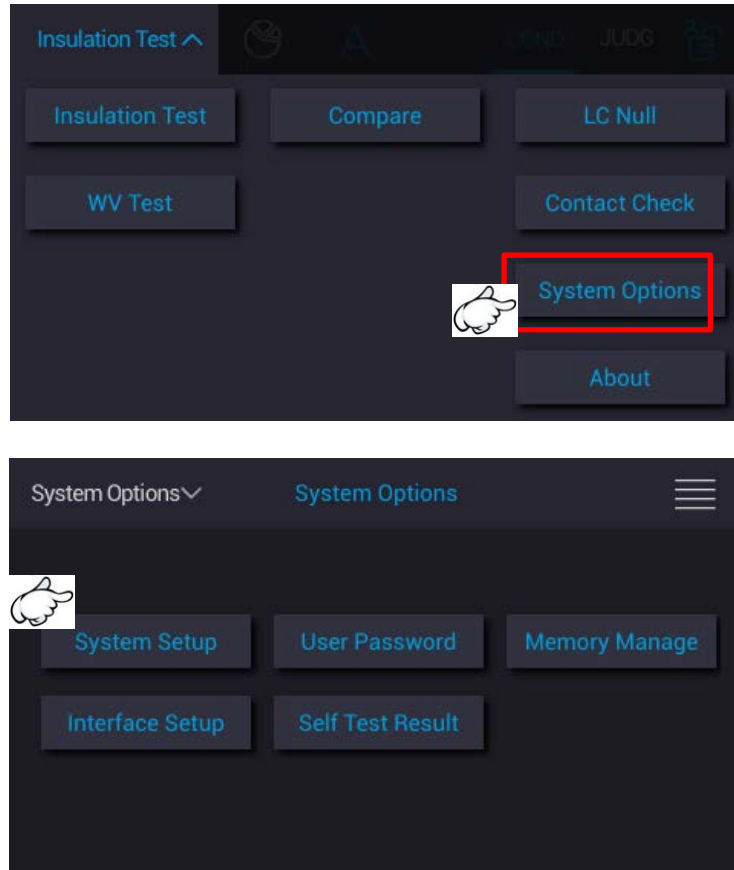
Touch the selection menu on the upper left of main screen and return to the main menu as the figure shown below.



1. Insulation Test
2. Compare
3. LC Null
4. WV Test
5. Contact Check
6. System Options
7. About

5.2 System Options

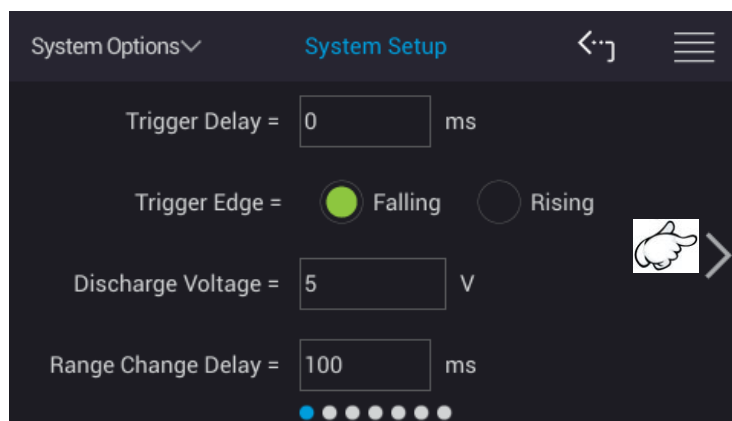
1. Press System Options on main menu to enter System Setup screen as the figure below shows.



2. Description for system setup as below shows:
 - (1) System Setup:
System parameter operation setup doesn't contain test status parameter. For detail description, see *section 5.2.1*.
 - (2) User Password:
It is for setting user password. For detail description, see *section 5.2.2*.
 - (3) Memory Management:
It is for managing memory. For detail description, see *section 5.2.3*.
 - (4) Interface Setup:
It is for setting interface. For detail description, see *section 5.2.4*.
 - (5) Self Test Result:
It is the function for self-test. For detail description, see *section 5.2.5*.

5.2.1 System Setup

Touch the selection at upper left side of main screen and return to main menu. Touch System Options and System Setup, the options as the following will be provided for users processing setting.



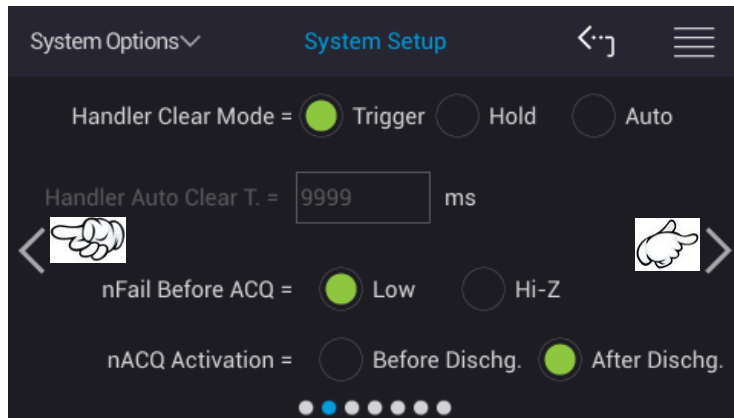
- (1) **Trigger Delay:**
It is to adjust the time delayed for measurement when the tester receives the trigger signal. The range is from 0 to 9.999s, and the factory default is 0ms.
- (2) **Trigger Edge:**
It sets the RISING and FALLING edge trigger. The factory default is FALLING edge trigger.
- (3) **Discharge Voltage:**
It judges the level of discharge voltage. The range is from 0.5V to 10V, and the factory default is 5V.
- (4) **Range Changing Delay:**
Wait signal stable required delay time after changing auto measurement range. The range is from 5ms to 9.999s, and the factory default is 100ms.

Range	20mA	2mA	200uA	20uA	2uA	200nA	20nA
Rseries	1Ω	10Ω	10Ω	1kΩ	1kΩ	100kΩ	1MΩ

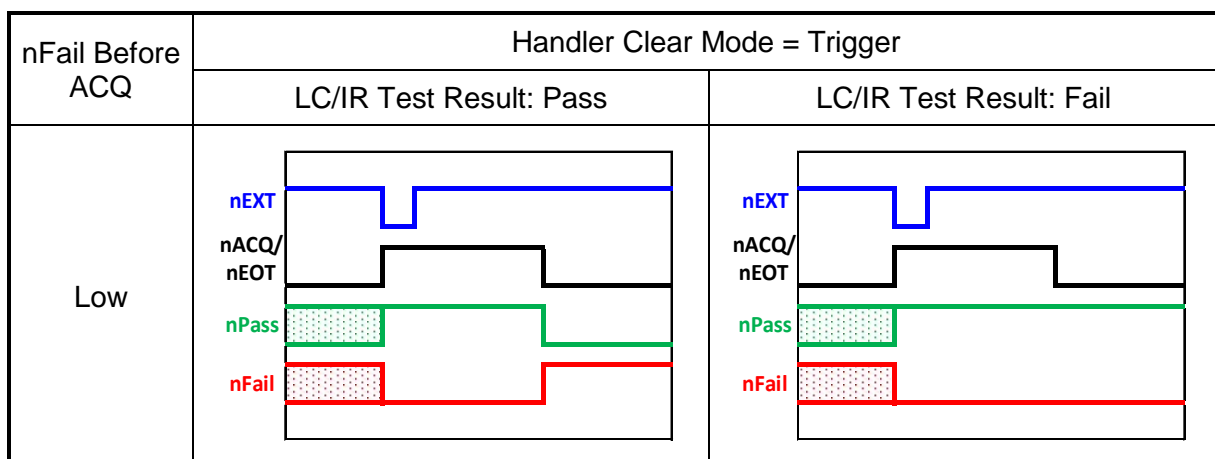
Delay Time = $3 \times ((C_{DUT} + 0.1\mu F) \times R_{series})$

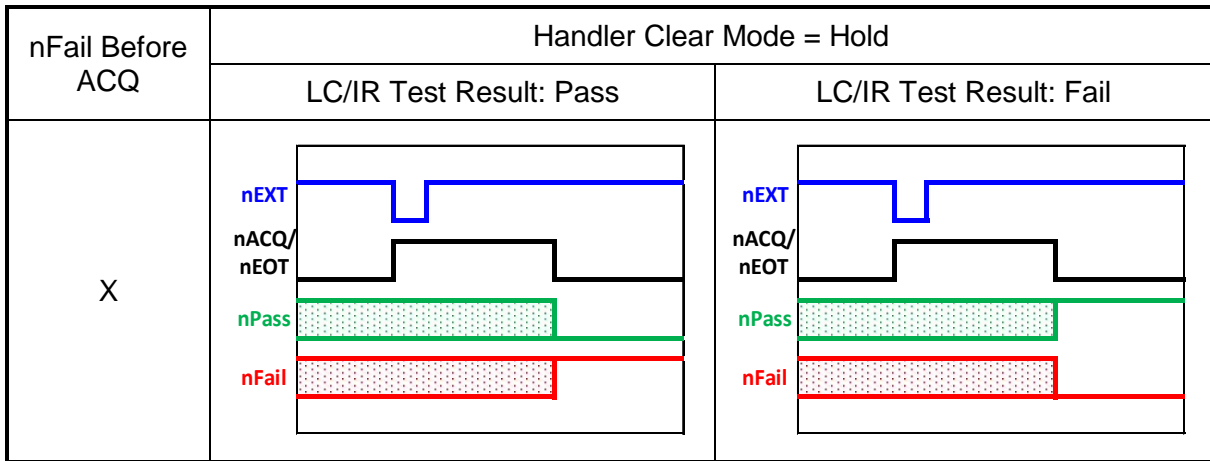
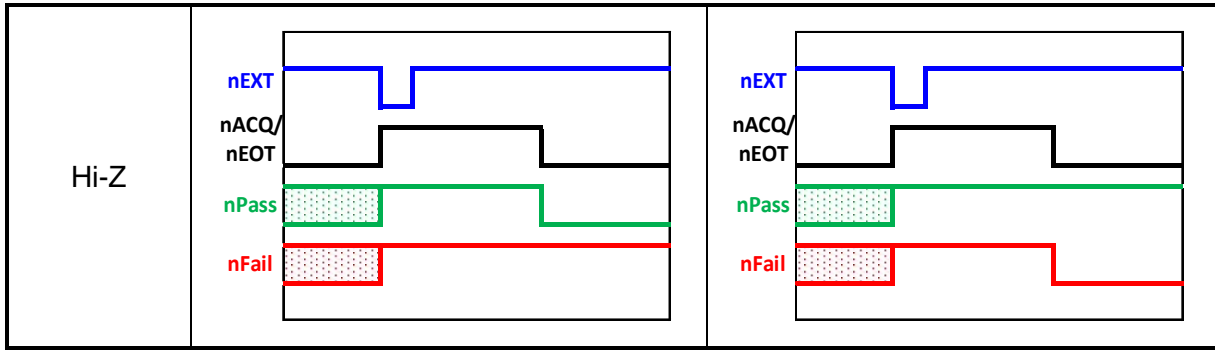
Ex.: Cap. of DUT = 0.1uF,

Delay Time = $3 \times (0.2\mu F \times 1M\Omega) = 0.6\text{sec}$, Delay Time sets to 0.6s.

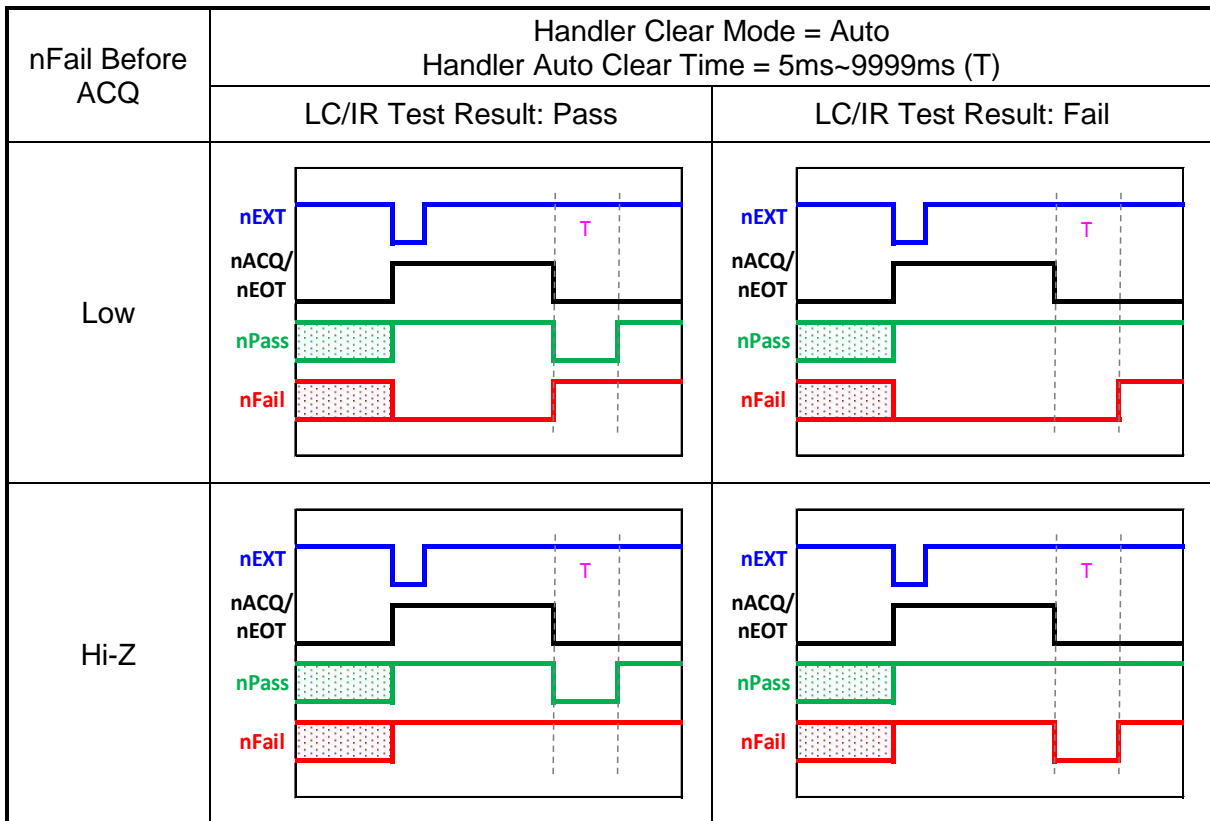


- (5) **Handler Clear Mode:**
 Signal clear time setting of handler measurement result contains three modes of Trigger, Hold and Auto. The factory default value is Trigger.
Trigger : When the Handler interface is in use, it will clear the output signal (PASS or FAIL) of previous tested result before measuring.
Hold : When the Handler interface is in use, the output signal (PASS or FAIL) of tested result will be remained until the next time with different test results to change the state.
Auto : It is used with "Handler Auto clear Time" setup. Start the timer until the time set is up after EOT signal is ended. Next to clear Handler signal and all signals restore to the default value.
- (6) **Handler Auto Clear Time:**
 It can be set only when Handler Clear Mode is Auto mode. How long does it take to clear the Handler signal once Handler Mode is Clear mode and EOT signal is end? All signals restore to default value waiting the next time to trigger measurement. The range is from 5ms to 9.999s and the factory default value is 9999ms.
- (7) **nFail Before ACQ:**
 nFail default setting before transmitting ACQ signal which contains two modes of Low level and Hi-Z for selection. The factory default value is Low.
Low : It will clear the output signal (nFAIL) of previous tested result before measuring.
Hi-Z : The output signal (nFAIL) of tested result will be remained until the next time with different test results to change the state.

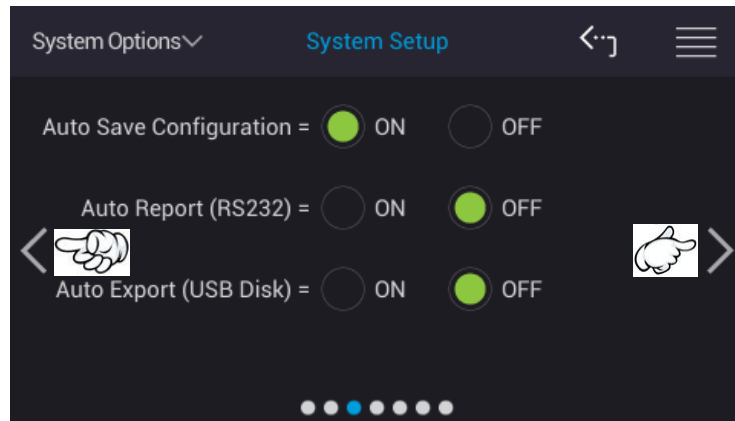




Note X: Handler Clear Mode doesn't use with nFail Before ACQ setting when it sets to Hold.



- (8) nACQ Activation:
 ACQ signal is transmitted before or after discharging. There are two modes of Before Dischg. and After Dischg. for selection. The factory default is After Dischg.
 Before Dischg.: Transmit ACQ signal before discharging.
 After Dischg.: Transmit ACQ signal after discharging.



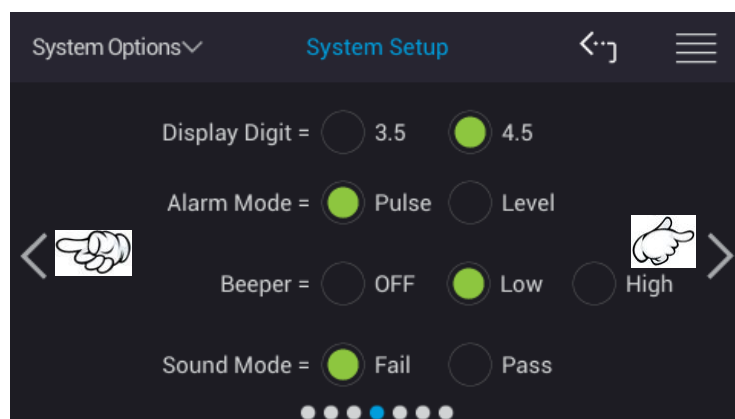
- (9) Auto Save Configuration:
 Auto save configuration consists of system setting, test condition related parameters. It has two modes of ON and OFF. The factory default value is ON.

⚡ CAUTION : When the [Default RAM] in Memory Management restores to default, the Auto Save Configuration is set to OFF.

- (10) Auto Report (RS232):
 Auto report measurement result can via RS232 interface to output measuring data result automatically. It has two modes of ON and OFF. The factory default is OFF.

- (11) Auto Report (USB Disk):
 Auto reports measurement result to USB disk which contains two modes of ON and OFF. The factory default is OFF.

⚡ CAUTION : To ensure storage integrity for test data, waiting for 5 seconds to remove USB Disk once the test is stopped.



- (12) Display Digit:
 L.C. display digit 3.5 and 4.5 for selection. The factory default is 4.5.

(13) Alarm Mode:

The warning sound format needs to use with activated Beeper function and Sound Mode setting while judging good and no good product. There are two modes of two short sounds (Pulse) and one long sound (Level). The factory default value is Pulse.

Pulse: The warning sound sets to two short sounds once the tester judging good/no good product.

Level: The warning sound sets to one long sound once the tester judging good/no good product.

(14) Beeper

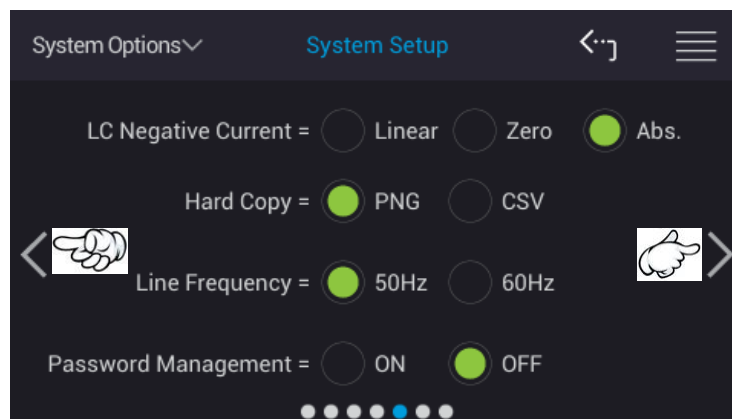
It sets the warning beep volume to OFF, LOW, and HIGH. The factory default setting is LOW.

(15) Sound Mode:

The warning sound format contains two modes of PASS and FAIL when comparing the measurement. The factory default setting is FAIL.

FAIL: It beeps when detected no good product during performing the measurement of COMPARE.

PASS: It beeps when detected good product during performing the measurement of COMPARE.



(16) LC Negative Current:

LC negative current display includes three modes of Linear, Zero and Abs. The factory default is Abs.

Linear : It is the actual measurement current value with positive and negative values for operation directly.

Zero : All negative current values are modified to 0 for operation.

Abs. : All negative current values take absolute value to modify to positive value for operation.

(17) Hard Copy:

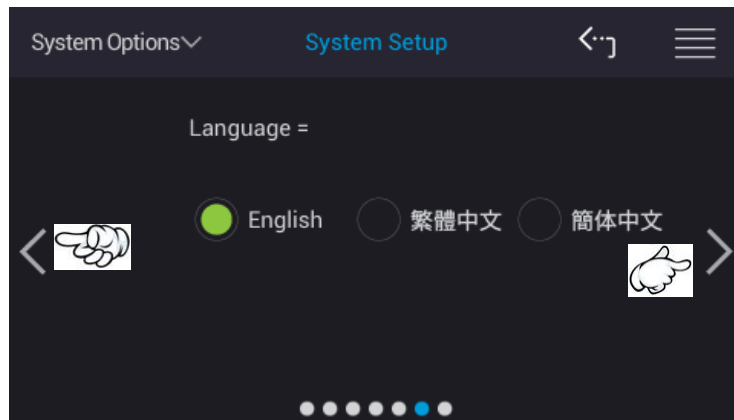
It saves PD Analyzer measured waveform or data with export format contains two modes of PNG and CSV. The factory default is PNG. PD Analyzer function is applied.

(18) Line Frequency:

It sets the line frequency to 50Hz or 60Hz for AC110V/220V power source. The factory default is 50Hz.

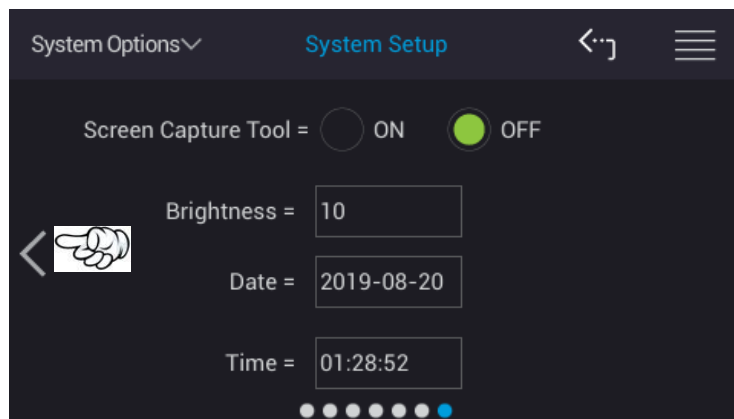
(19) Password Management:

It enables password management system with two modes of ON and OFF. The factory default is OFF and refers to *section 5.2.2* for password setup.



(20) Language:

Language selections contain English, Traditional Chinese and Simplified Chinese. The factory default is English.



(21) Screen Capture Tool:

It is the screen capture function. It has ON and OFF two modes with default set to OFF. The captured file format is PNG.

(22) Brightness:

It sets monitor brightness. The range can be adjusted from 1 to 15. The numeral 1 indicates darkest and numeral 15 indicates brightest. The factory default is 10.

(23) Date:

The date of the system is running now. The factory default is actual year/month/date in the format of yyyy-mm-dd.

(24) Time:

The time of the system is running now. The factory default is actual time in the format of hh:mm:ss.

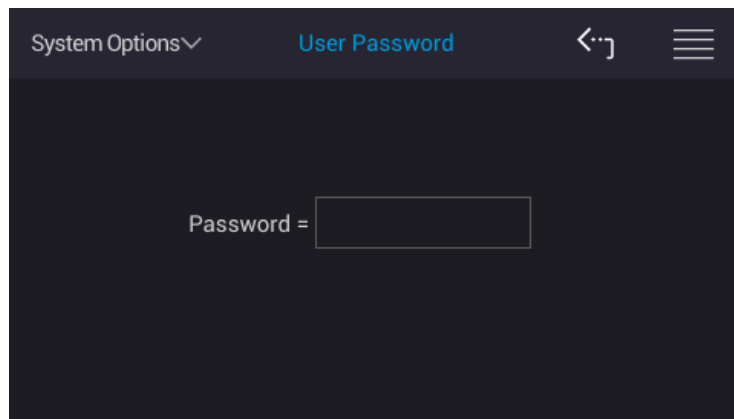
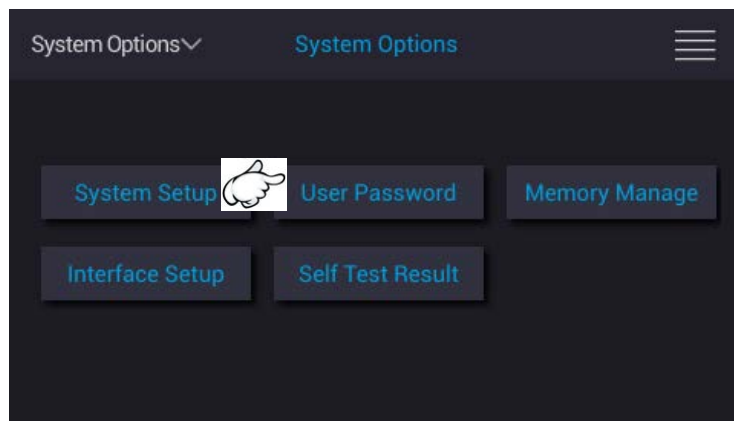
5.2.2 User Password

5.2.2.1 Password Setup

User password setup is divided into two levels, one is Standard User Password and another is Administrator Password.

Standard User Password authority: It is the password for the standard user which is for processing measurement function only.

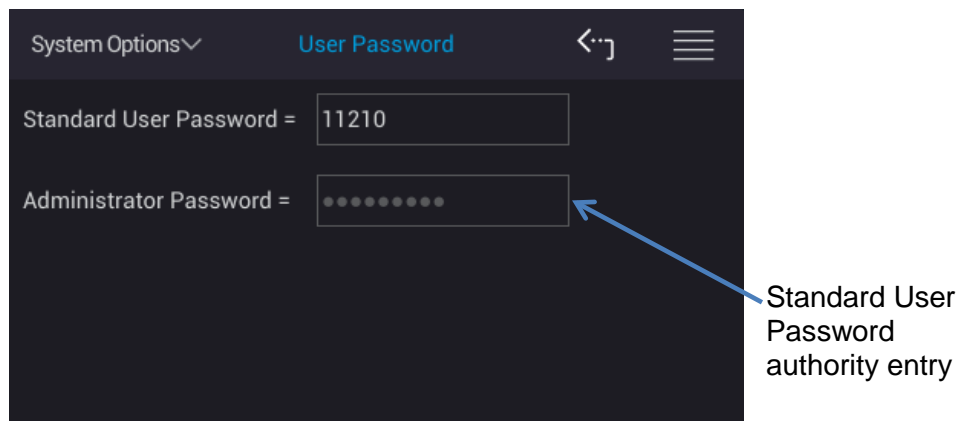
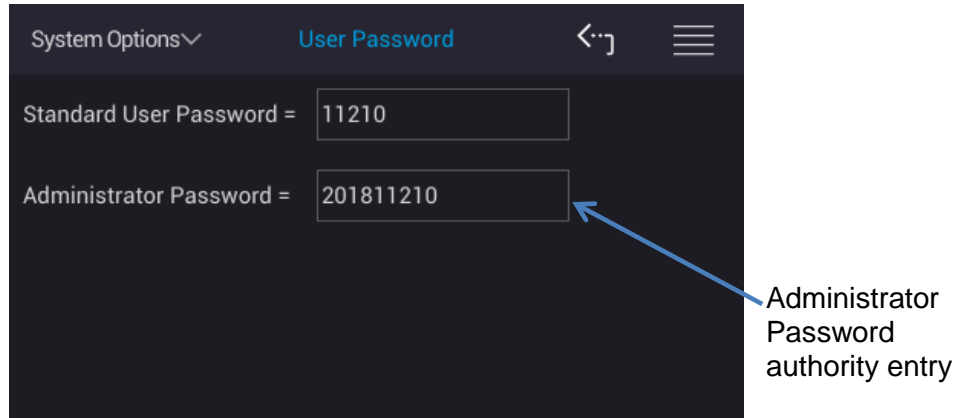
Administrator Password authority: It is the system administrator to process system parameter modification except for measurement function.



Touch the selection at upper left side of main screen and return to main menu. Touch System Options and User Password, the input password window as the figure above shows. Please type in the corresponded Password to enter the setting.


The initial setting dedicated Administrator Password is 201811210, Standard User Password is 11210.

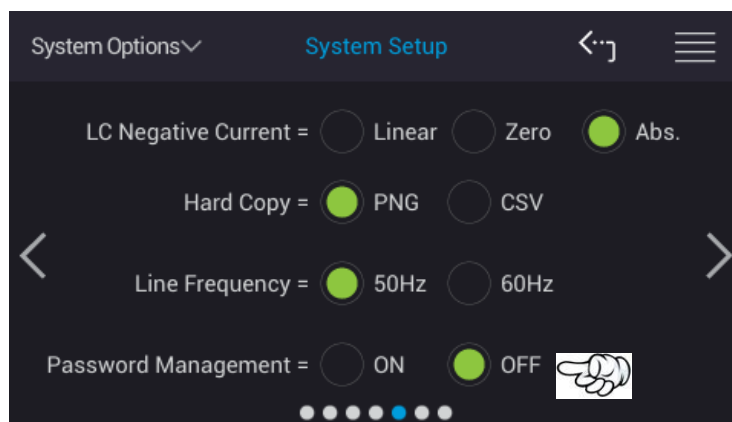
It follows the input password to modify the password setup with various authorities. The length of password at least 1 character and at most 10 characters include decimal point and 10 basic numerals (0 ~ 9). The password in the following is default setting that we recommend users to change it at first time use.

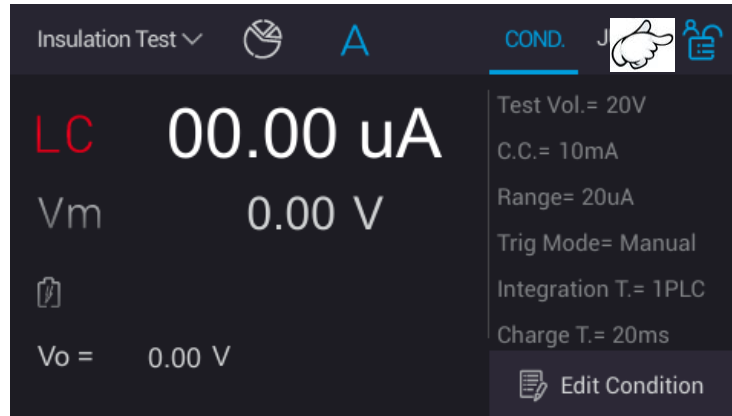



⚡ CAUTION If the Password is lost, the instrument needs to be returned to Chroma for reset.





5.2.2.2 Screen Lock Function


It is based on Password Management setting under System Options of main menu which coordinates with  at upper right corner of main screen for long press and performs tester operation authority control.











Password Management is set to OFF and used with :

Long press  at upper right corner of measurement main screen, the icon will turn into  that indicates the monitor already locked and is unable to do any modification except for processing measurement procedure. Meanwhile, only long press  to unlock and the icon will turn into .




Password Management is set to ON and used with :

Long press  at upper right corner of measurement main screen, the icon will turn into  and long press  for inputting password. Meanwhile, provide different operation function authorities based on the password inputted.

Input Standard User Password:

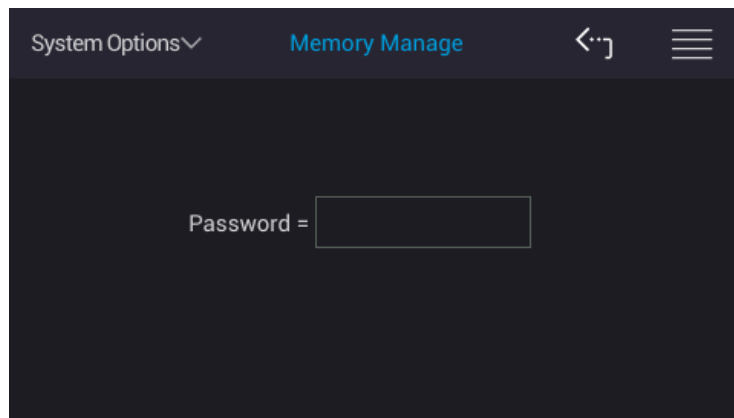
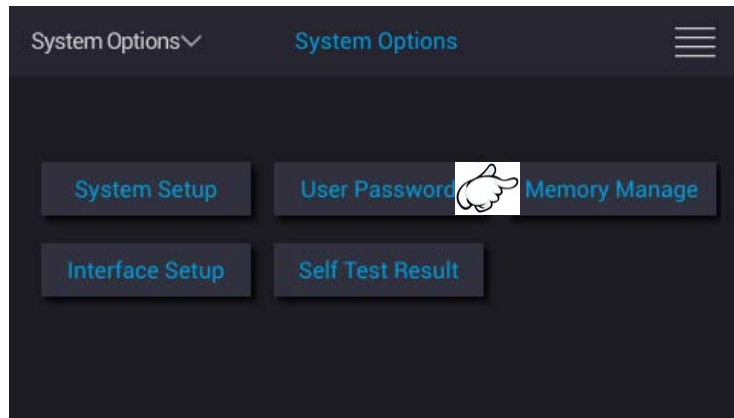
The icon  at upper right corner indicates the standard operator only for processing measurement function. Next to long press , the icon will turn into  the monitor will be locked. The measurement screen will be changed until the monitor is unlocked.

Input Administrator Password:

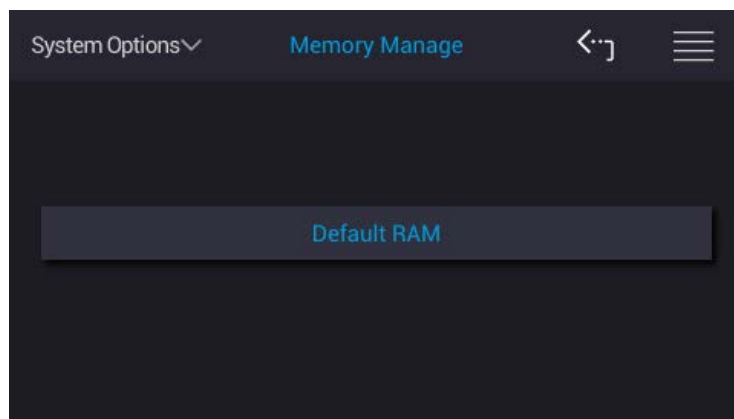
The icon  at upper right corner indicates the system administrator can process measurement function and parameter setup modification. Next to long press , the icon will turn into  the monitor will be locked. The screen will be changed until the monitor is unlocked.

5.2.3 Memory Management

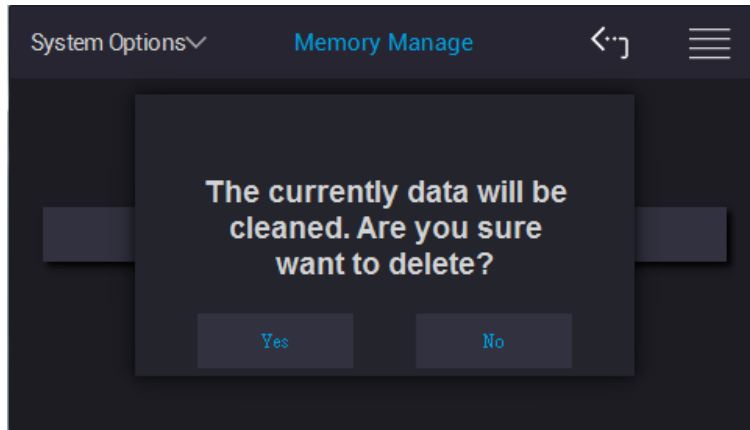
Memory initialization, all operation settings will return to default value but Standard User Password and Administrator Password still remain the original setting. The test files saved in the tester won't be deleted.



Touch the selection at upper left side of main screen and return to main menu. Touch System Options and Memory Management, the input password window as the figure above shows. Please type in Administrator Password as the figure below shows.



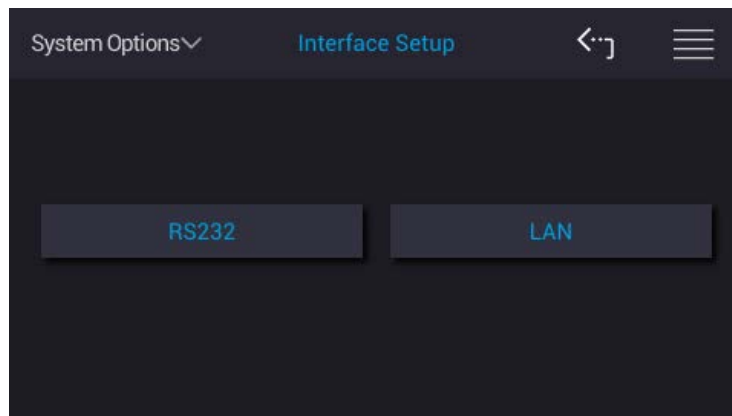
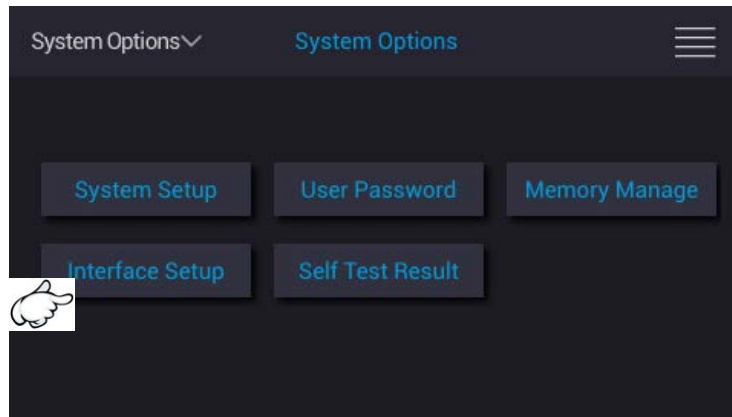
“The currently data will be cleaned. Are you sure want to delete” window pops up as operating Default RAM. Click “YES” to delete it, otherwise click “NO”.



⚡ CAUTION When the [Default RAM] is restored to default, the Auto Save Configuration is set to OFF.

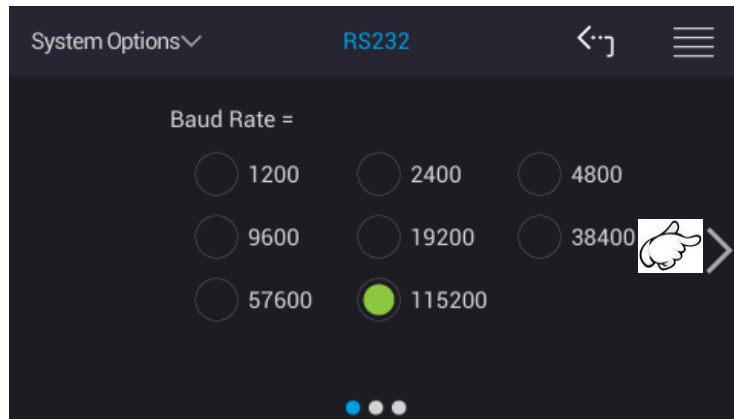
5.2.4 Interface Setup

Interface parameter setup consists of RS232 and LAN.



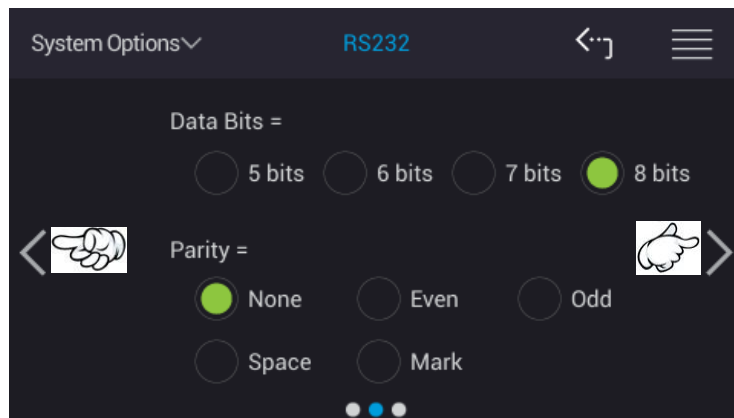
5.2.4.1 RS232 Setting

Select RS232 and display the screen, the parameter and setting are as the following.



Baud Rate:

Baud rate setting, there are 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 for selection with factory default to 115200 when shipped.



Data Bits:

Data Bits contain four selections of 5 bits, 6 bits, 7 bits and 8 bits with the factory default to 8 bits when shipped.

Parity:

There are None, Even, Odd, Space and Mark for selection with factory default set to None when shipped.

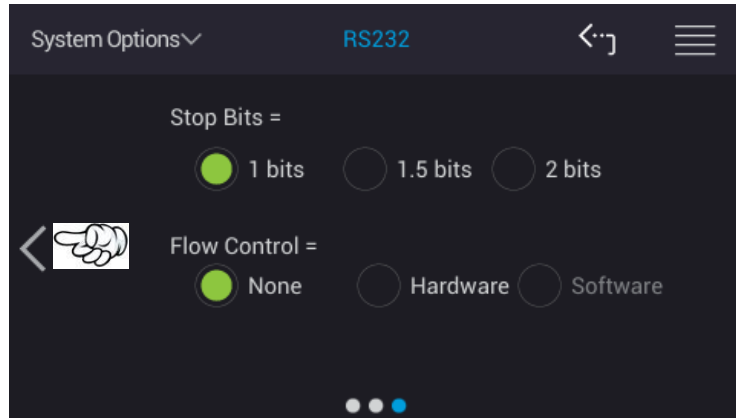
None : Don't transmit Parity Bit.

Even : To transmit 1 to add as even number when the Data Bit has odd number of 1.

Odd : To transmit 1 to add as odd number when the Data Bit has even number of 1.

Space : It always transmits 0 to be Parity Bit.

Mark : It always transmits 1 to be Parity Bit.



Stop Bits:

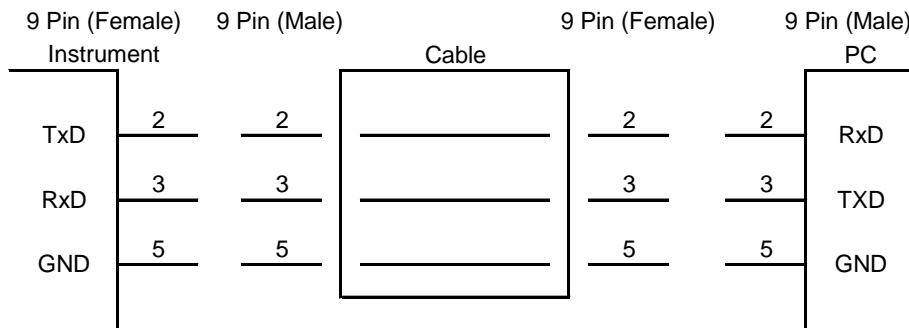
Stop bits contain three selections of 1 bit, 1.5 bits and 2 bits with factory default to 1 bit when shipped.

Flow Control:

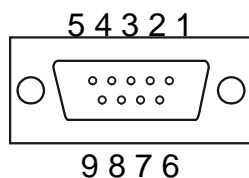
There are None, Hardware and Software for selection with factory default to None when shipped.

⚡ CAUTION : The baud rate setting should be same as the RS-232C interface card, otherwise there may have data transmission problem.

Connection of RS-232C signal line:



RS-232C connector of the tester is a 9-pin female connector, the table of RS-232C signal line and pin as below shows.



Pin No.	Description
1	* Not use
2	TxD Transmitting data
3	RxD Receiving data
4	* Not use
5	GND Grounding wire
6	* Not use
7	* Not use
8	* Not use
9	* Not use

⚡ CAUTION When the instrument is connected via RS232 and PC, it is recommended both use the same system power voltage. This is for avoiding burn down the instrument or component inside PC terminal interface.

5.2.4.2 LAN Setting

Select LAN, the parameters of displayed screen as below shows.

The screenshot displays the LAN configuration interface. At the top, it shows 'System Options' with a dropdown arrow, 'LAN' in blue text, and navigation icons. The 'TCP/IP Mode' section has two radio buttons: 'DHCP' (unselected) and 'Manual' (selected). Below this, there are four input fields: 'IP Address' (192.168.1.100), 'PORT' (60000), 'Subnet Mask' (255.255.255.255), and 'Gateway' (192.168.1.1). A 'Confirm' button is located at the bottom center.

Transmission Control Protocol (TCP) and Internet Protocol (IP) setting methods
 The tester includes two modes of Automatic (DHCP) and Manual. If Automatic mode is selected, a DHCP (Dynamic Host Configuration Protocol) server needs to be set up on network. The tester will get IP Address, Subnet Mask and Gateway settings from DHCP server automatically. After getting the settings, please press Confirm for confirmation. If Manual mode is selected, set IP Address, Subnet Mask and Gateway by users. After the setting is completed, please press Confirm for confirmation. The factory default is Manual when shipped.

IP Address:

It is the communication protocol address of internet. PORT is fixed for using 60000.

Subnet Mask:

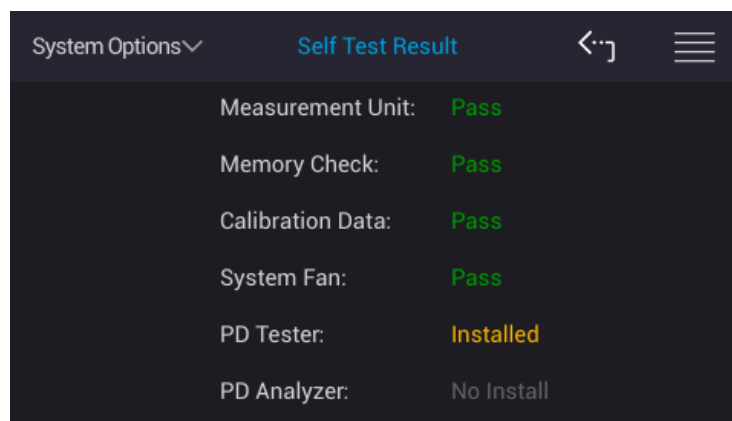
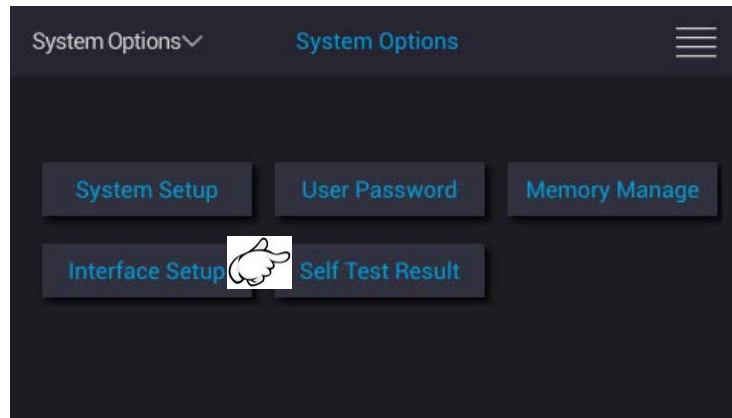
It is for subnet mask.

Gateway:

Communication gateway

5.2.5 Self Test Result

Power-on self test result



Once entering power-on self test screen, display if the currently status of tester and calibration data inside the tester is operating normally.

Test Item	Description	Pass/Installed	Fail/No Install
Measurement Unit	Measurement unit check	Function normally	Function abnormally, user can't conduct measurement.
Memory Check	Memory check	Memory normally	Memory abnormally, measurement module can't be used.
Calibration Data	Calibration data check	Calibration data normally	Calibration data read back abnormally, it will cause serious error when measuring and should be returned to Chroma for calibration as soon as possible. But it still can perform measurement.
System Fan	Fan operation aging check	Fan operation normally	The fan has an aging phenomenon and should be returned to Chroma as soon as possible, but it still can be used.
PD Tester	PD test functions	Installed	No install
PD Analyzer	PD analysis functions	Installed	No install

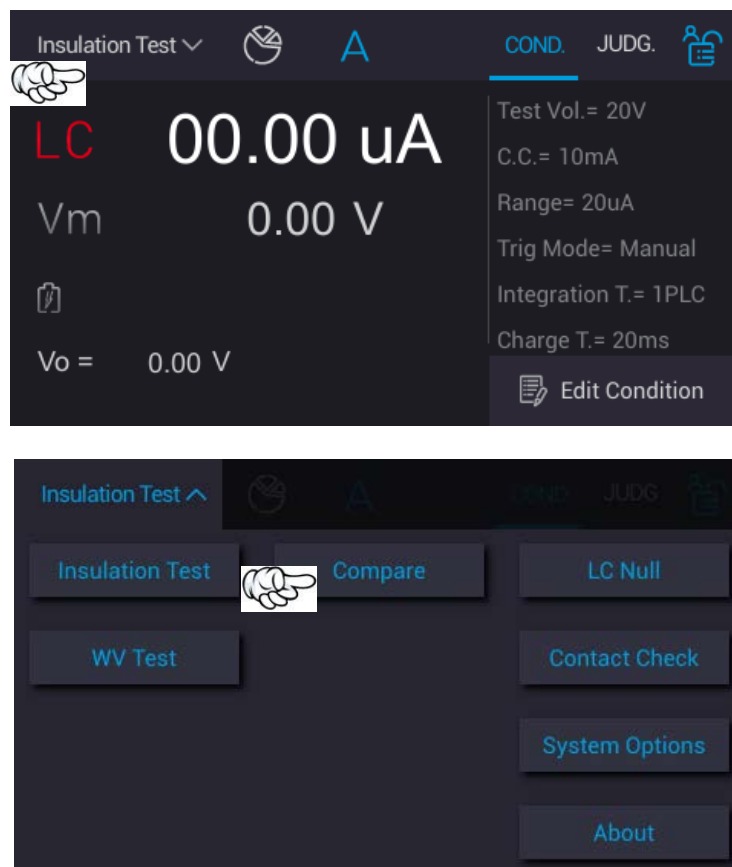
⚡ CAUTION The calibration data should be displayed as PASS. If it is displayed as FAIL, please contact the distributor to send the tester for calibration.

5.3 Insulation Test

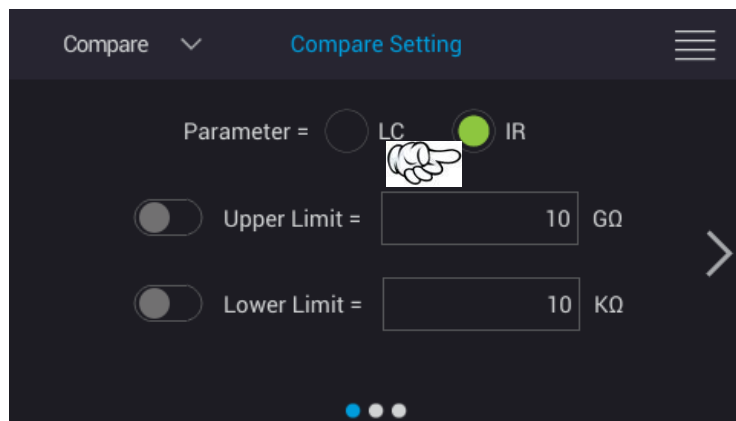
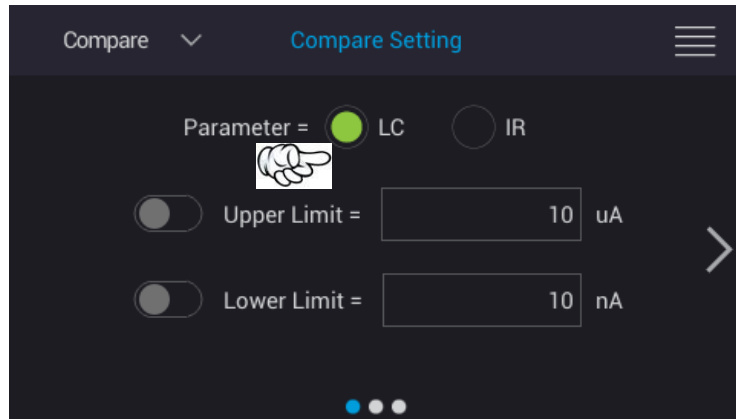
Insulation resistance tester can apply manual or remote mode for operation. Remote mode performs the control via HANDLER, LAN, RS-232 or USB (B-Type) interface. Remote mode related commands will be explained in *chapter 9 and 10*. The chapter will describe manual mode to input test condition and process operation via touch panel, and make sure the resistance of DUT.

5.3.1 LC/IR Parameter Setup

Select “IR/LC Compare” in main menu to enter Edit Parameter Page.

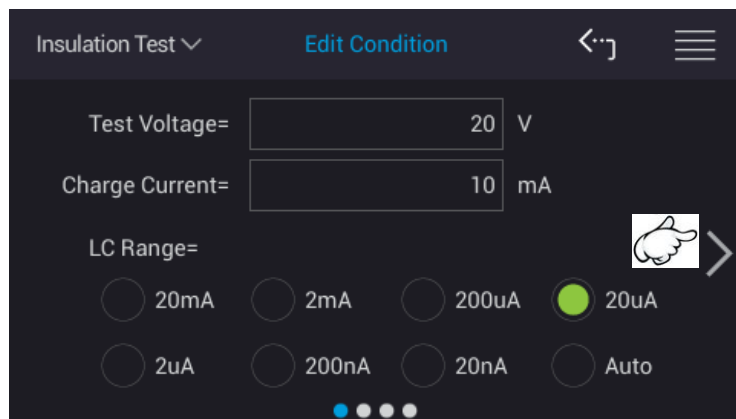


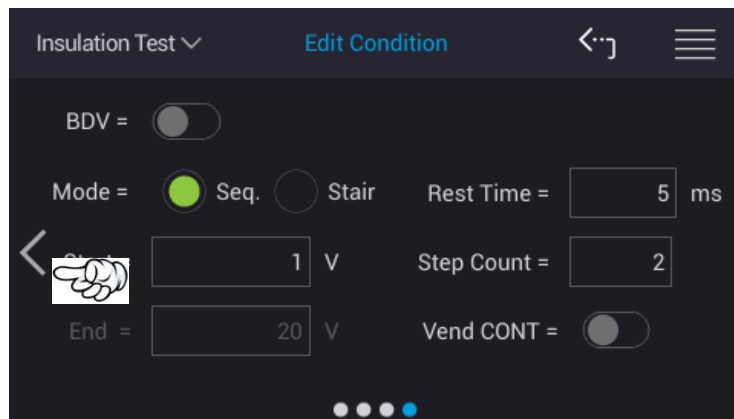
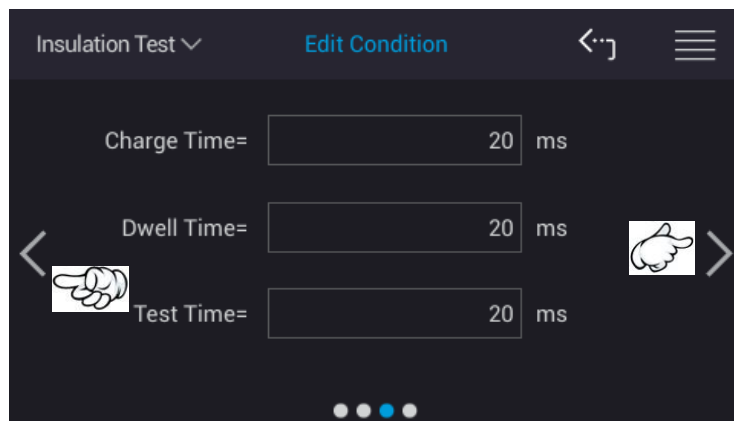
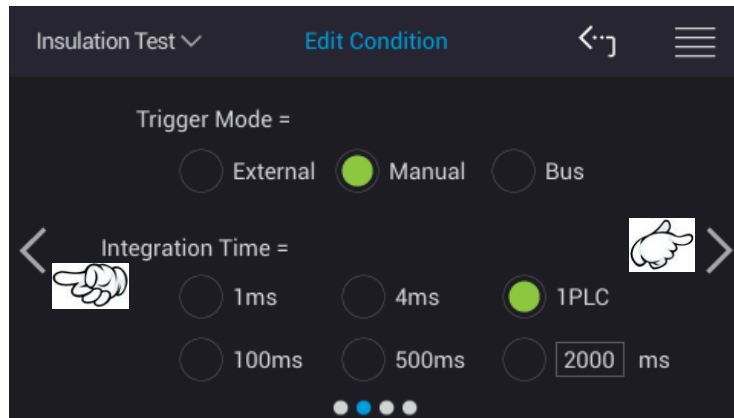
Measurement result displays IR measurement value if IR option is selected, measurement result displays LC measurement value if LC option is selected.



5.3.2 Test Parameter Setup

Select “Edit Condition” to enter edit parameter page once power-on is completed and entered main page. The measured parameters in 11210 are divided into four pages, page selection method can via screen scrolling or touch “>” and “<” at two sides of screen for selecting switch page.



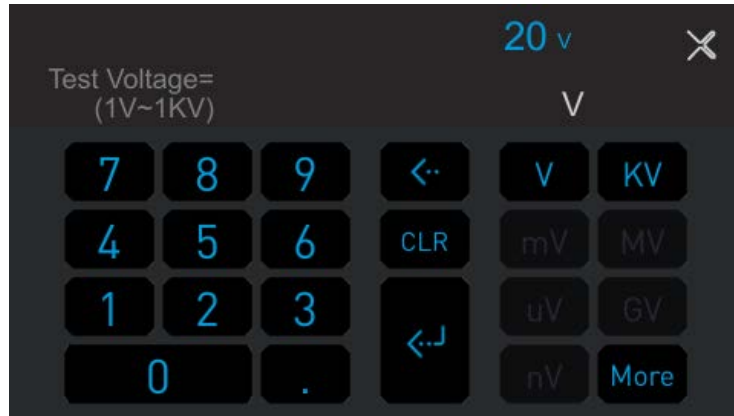


There are total 8 measurement parameters in the first three pages for user to set when performing the measurement.

(1) Test Voltage:

Test voltage setting, the range is from 1V to 1000V. The factory default is 20V when shipped.

Touch Test Voltage to input voltage column, a touch keypad will be appeared:



[0~9,.]: Set the input required numerals and decimal point under setting status.

[←]: Backward key

[CLR]: Clear the inputted value.

[V, KV]: It sets voltage unit.

[→]: To input the setting value after confirmed.

(2) Charge Current:

It sets charge current with the range from 500uA to 50mA. The factory default is 10mA when shipped.

[mA, uA]: It sets current unit.

(3) LC Range:

It sets LC measurement range for selecting required range directly via touch monitor. There are 8 ranges for selection: 20mA, 2mA, 200uA, 20uA, 2uA, 200nA and 20nA seven fixed ranges along with Auto range. The factory default value is 20uA when shipped.

- ⚡ CAUTION**
1. The DUT is larger IR value ($> G\Omega$) or smaller LC value ($< \mu A$) when auto range measurement is enabled. To obtain more accurate and stable measurements, it is recommended users to select larger Integration Time parameter or self define longer time parameter.
 2. The PD Features and BDV mode are not supported when auto range is enabled.

(4) Trigger Mode:

It sets trigger mode which includes External, Manual and BUS for selection. The factory default value is Manual when shipped.

External : External trigger uses Handler to trigger and to transmit the mapped trigger command for completing the trigger.

Manual : Manual trigger uses green Start button to complete the trigger.

BUS : Remote control trigger transmits the mapped command via RS-232, USB (B-Type) or LAN device to complete the trigger.

(5) Integration Time:

It sets integration time which includes 1ms, 4ms, 1PLC, 100ms, 500ms and self-defined time for selection. The factory default is 1PLC when shipped.

The table below lists the relation of Line Frequency and integration time.

Line Frequency	Integration Time					
	50Hz	1 ms	4 ms	1PLC* (20 ms)	100 ms	500 ms
60Hz	1 ms	4 ms	1PLC* (17 ms)	100 ms	500 ms	Self-defined Time ** 1ms~9.999s

*PLC: Power line cycle

** Self-defined time: According to five kinds of fixed integration time to read several times of measurements on Test Time phase. For getting more accurate, stable measurement, "Self-defined Time" method is provided to process measurement reading.

- (6) Charge Time:
It sets charge time with the range from 5ms to 99.999s. The factory default is 20ms when shipped.
- (7) Dwell Time:
It sets dwell time with the range from 5ms to 99.999s. The factory default is 20ms when shipped.

Range	20mA	2mA	200uA	20uA	2uA	200nA	20nA
Rseries	1Ω	10Ω	10Ω	1kΩ	1kΩ	100kΩ	1MΩ

Dwell Time= $10 \times ((C_{DUT} + 0.1\mu F) \times R_{series})$

Ex.: $C_{DUT} = 1\mu F$ Range = 20uA

Dwell Time = $10 \times (1.1\mu F \times 1k\Omega) = 0.011\text{sec}$

Dwell Time setting is 0.011sec.

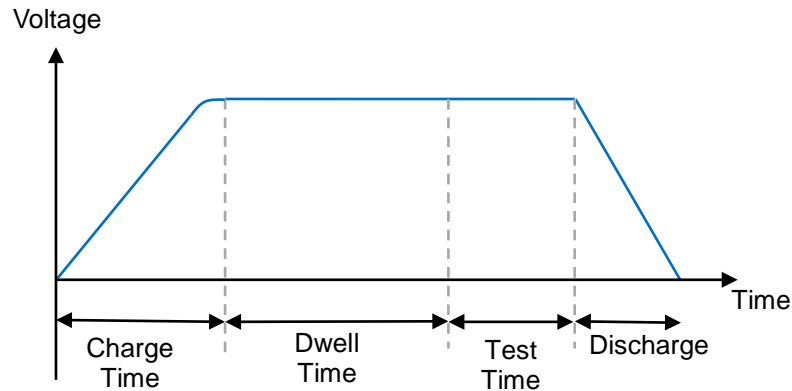
When the calculated Dwell Time is less than 5ms, it is always set to 5ms.

- (8) Test Time:
It sets the range of test time from 5ms to 99.999s or 0ms (continue tests). The factory default is 20ms when shipped.



CAUTION

- When Test Time is set to 0ms, it means continuous test without time limit (∞). The test will be stopped in the following conditions. (1) Measurement abnormality occurred during DUT measurement period. (Ex.: Compare fail, Contact check fail or Partial discharge detection fail.) Press STOP key on the panel, stop the test manually.
- When the PD Analyzer card is in use with BDV function enabled, the analysis chart can provide a maximum of 300s test time.
Total Test Time = [(Charge Time + Dwell Time + Test time) + Rest Time] * (Step Count)

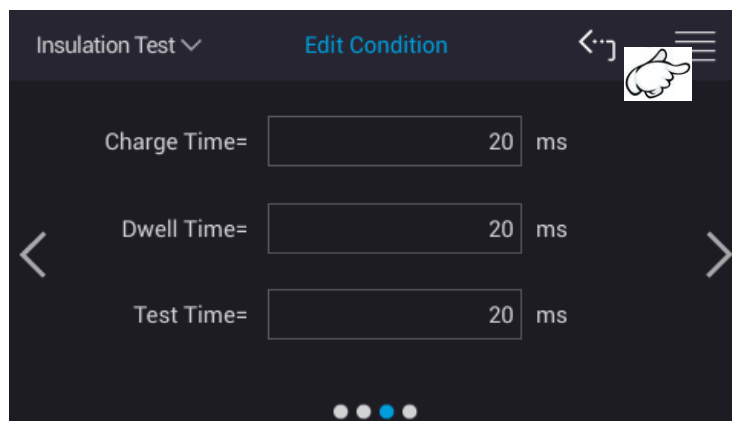


CAUTION

Relation between Integration Time and Test Time.

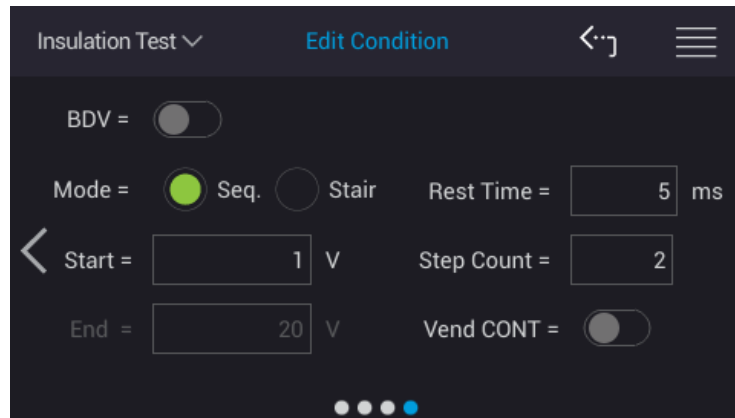
1. To perform multiple measurements by single Integration Time speed within Test Time.
2. Example 1: Test Time=100ms, Integration Time=20ms, $N=100\text{ms}/20\text{ms}=5$, it means to conduct 5 times of measurement during test time.
3. Example 2: Test Time=50ms, Integration Time=20ms, $N=50\text{ms}/20\text{ms}=2.5$, it means to conduct 3 times of measurement during test time.
4. When multiple measurements are in progress, any one of the measurement abnormality occurred will exit from the measurement process and enter the discharge procedure.

After the settings above described are modified, the value will be saved automatically once changing setting item. Touch the icon at upper right corner on the screen as the figure shown below to enter into File Management. It can set the parameters to save or import to different setup files. See section 3.8 for detailed description.



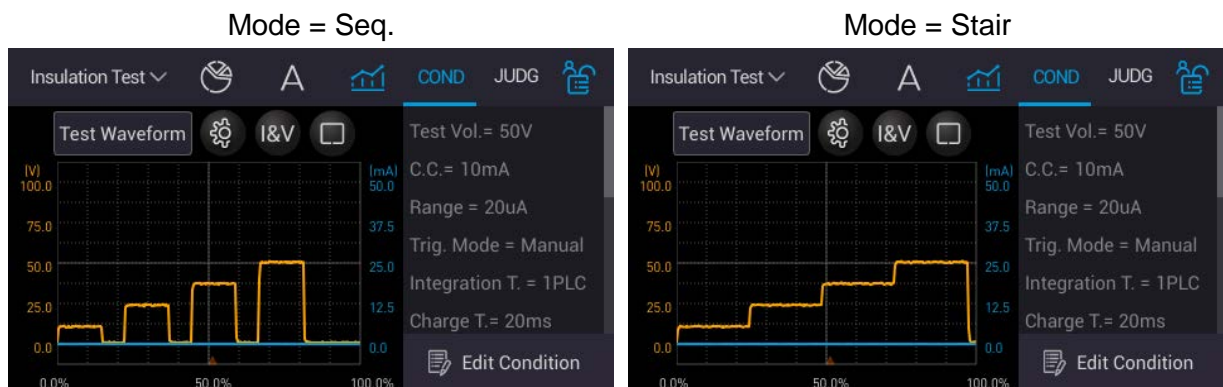
5.3.3 BDV (BREAKDOWN VOLTAGE) Setup

Select "Edit Condition" to enter into the parameter editing page from the main menu after powered on. The measured parameters in 11210 are divided into four pages, and scroll the screen or touch ">" and "<" at two sides of screen to switch it to the forth page.



BDV: Breakdown voltage test. Touch the [Slider] to enable or disable the function. Green: Enable the test function, Grey: Disable the test function.

- (1) Mode
There are two test modes, Seq. and Stair, and the default is Seq.
Seq. Mode: Tests every step from charge, test to discharge.
Stair Mode: Tests every step from charge to test but only performs discharge at the last step.
- (2) Start
It sets the start test voltage. The range is 1V~1000V, and the factory default is 1V.
- (3) End
The end test voltage which is the same as the Test Voltage parameter in page 1 that cannot be set.
- (4) Rest Time
It sets the interval time. The range is 5ms~9.999s, and the factory default is 5 ms.
- (5) Step Count
It sets the step count in the range of 2~1001 steps, and the factory default is 2.
- (6) Vent CONT (It does not support PD Analyzer for use.)
It sets to continue testing by maintaining the test voltage infinitely (∞) with no time limit when the last step of test ends. Touch the [Slider] to enable or disable it. Green: Enable continuous test, Grey: Disable continuous test.



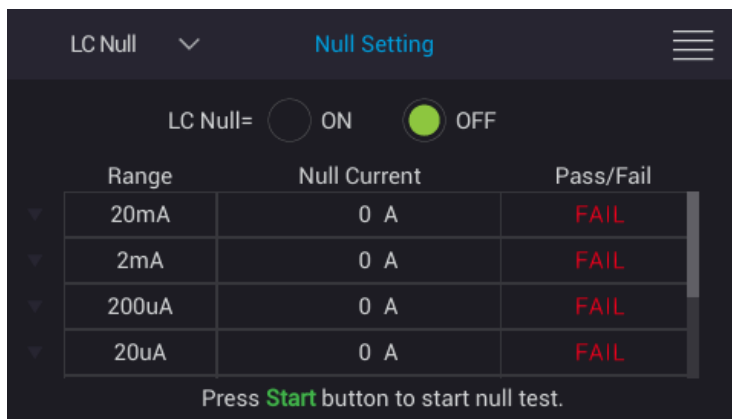
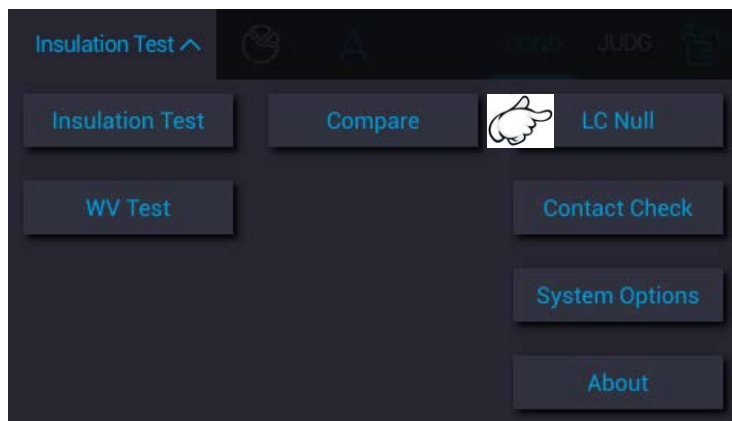
⚡ CAUTION When the Vent CONT is enabled, it means the test continues infinitely without any time limit (∞) except in the following conditions: (1) Errors occurred when measuring the DUT (ex. Compare fail, Contact check fail or Partial discharge detection fail.) (2) STOP key on the panel is pressed to manually stop the testing.

5.3.4 LC Open Circuit

5.3.4.1 LC Null Measurement

LC Null is for clearing open circuit, the operation for zeroing function on various ranges overall circuit of leakage current as the following.

Touch “LC Null” after returning to main menu to select the function.



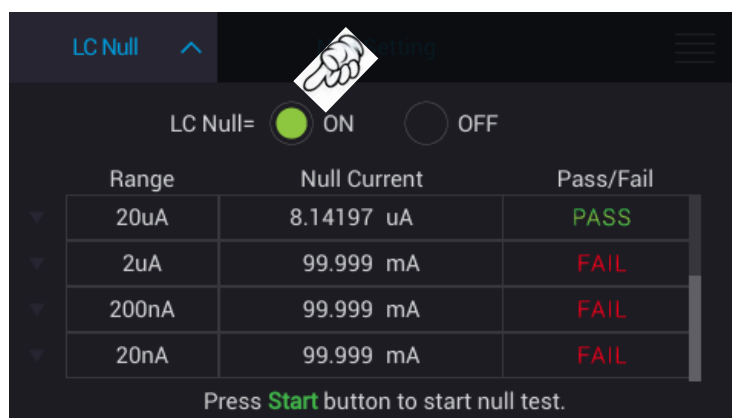
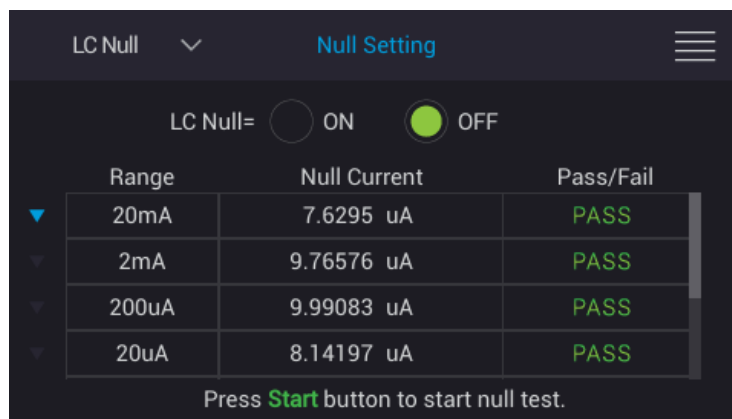
LC Null: It has ON and OFF two selections. The factory default is OFF when shipped. Press the green Start button on the panel under open-circuit status after the test cable is connected. Read the leakage current of various ranges on overall circuit, open or close LC Null function by required.

5.3.4.2 LC Null Example

For example: Simulate $LC \approx 8\mu A$ to be deducted, perform measurement in Insulation Test screen after DUT is connected.

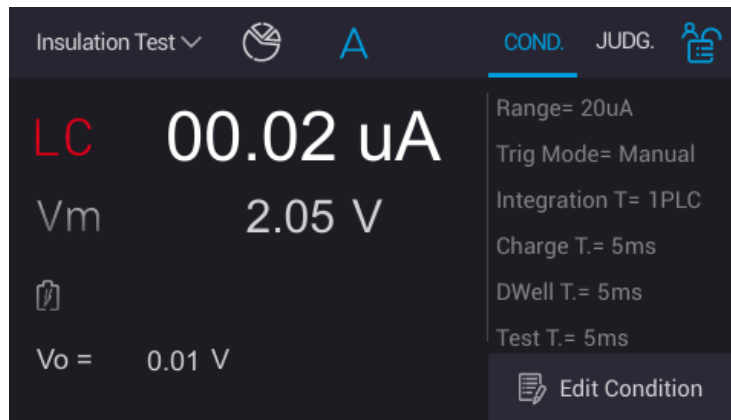


Perform LC Null to do various ranges leakage current reading on overall circuit, measurement result as below shows.

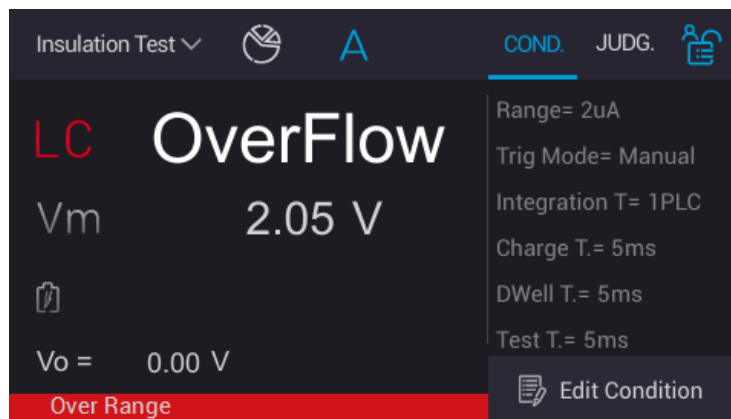


The ranges are based on measurement result to display the range measured value and test result. The measured value displays 99.999mA and FAIL if the range over the scope can be measured and is unable to be deducted.

The measured LC range is set to 20uA. To enable LC Null function and return to Insulation Test screen. It follows the selected range to do deduction once the previous DUT process measuring. The test value will approach to 0.



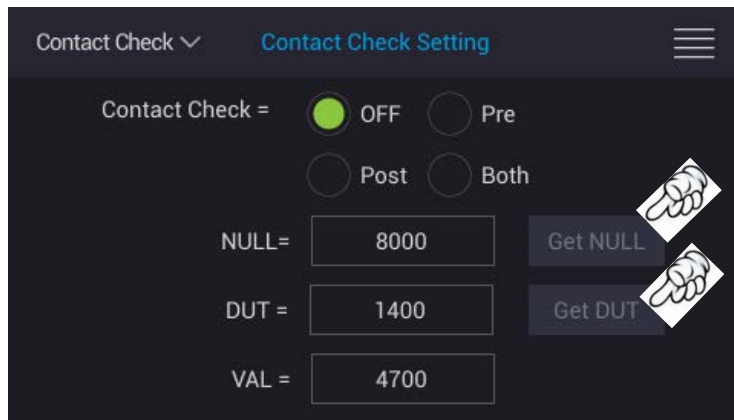
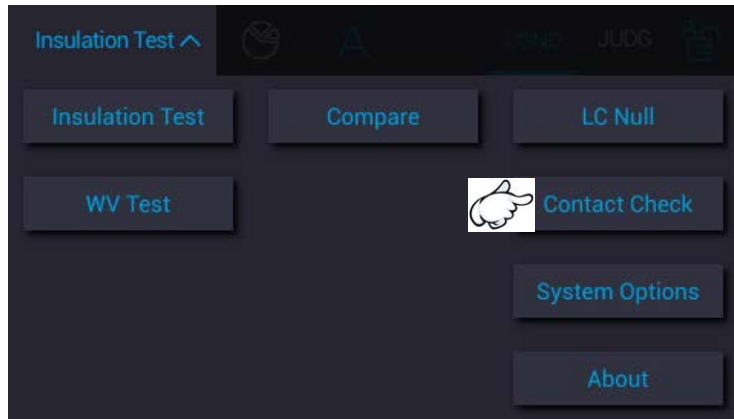
The measured LC range is set to 2uA. It returns to Insulation Test screen if test result of LC Null range is FAIL. The test value will display OverFlow and unable to measure once the previous DUT doing measurement. The lower of monitor shows error message "Over Range".



5.3.5 Contact Check

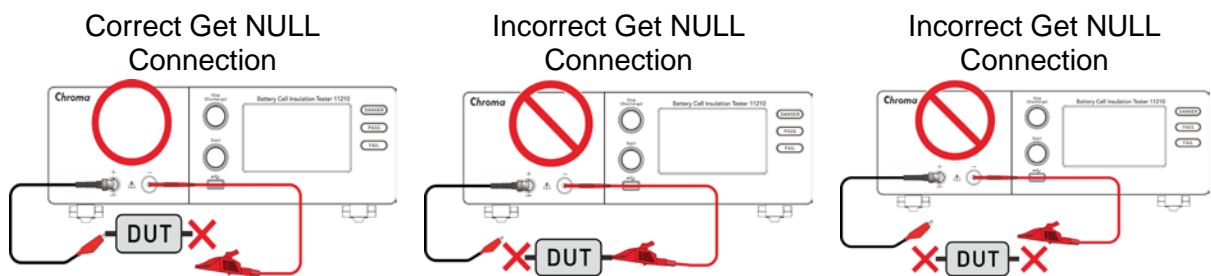
Contact Check is mainly used for judging connection status between DUT and instrument, the operation method as below shows.

Touch the menu at upper left corner of the main screen to return to main menu and touch "Contact Check" the selections below popped up to provide users to do setting.

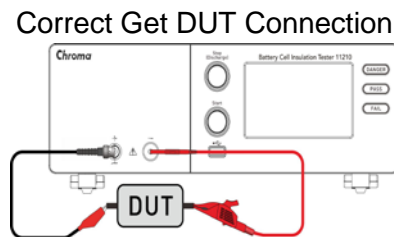


Contact Check: It selects test stage of contact check function which includes four selections of OFF, Pre, Post and Both. The factory default value is OFF when shipped.

NULL: Test value. Click "Get NULL" to read test value under test terminal open-circuit status.



DUT: Condition value. Click "Get DUT" to read condition value under the tester connecting test cable and test terminal connecting DUT status.



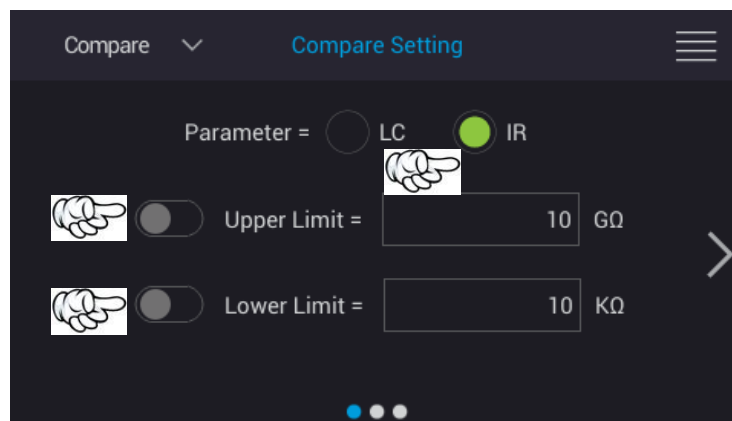
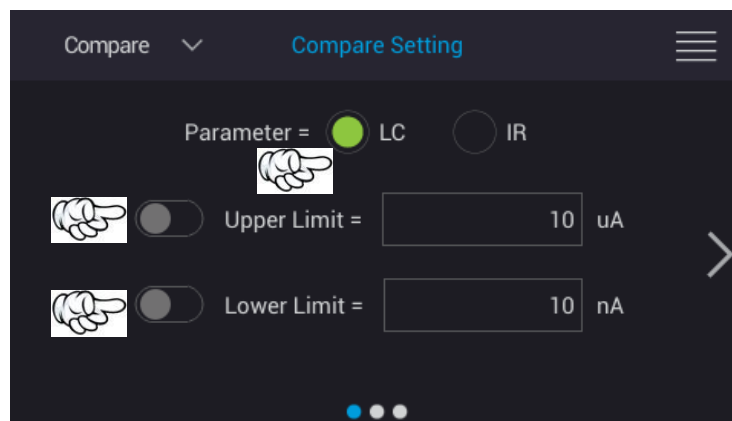
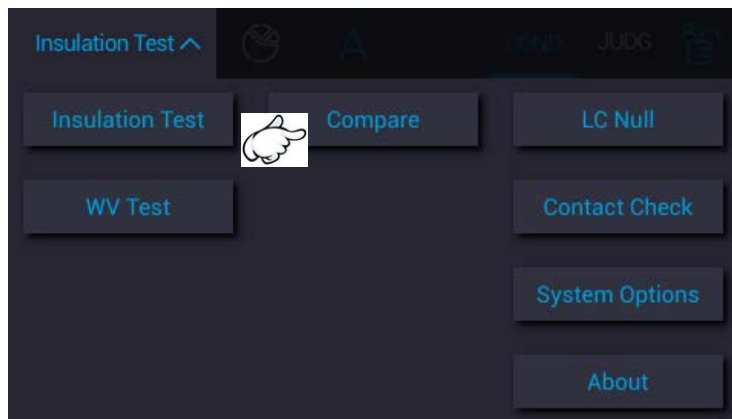
VAL: Actual judgement value is read based on NULL and DUT. The default is to take the middle value of the two as the basis for judging whether to contact. When measuring,

the test value of contact inspection is greater than judgment value which is bad contact or no contact. Conversely, when measuring, the test value of contact inspection is less than judgment value which is good contact or real contact.

5.3.6 Compare

Compare is mainly used for setting insulation resistance or leakage current compare condition, the operation method as below shows.

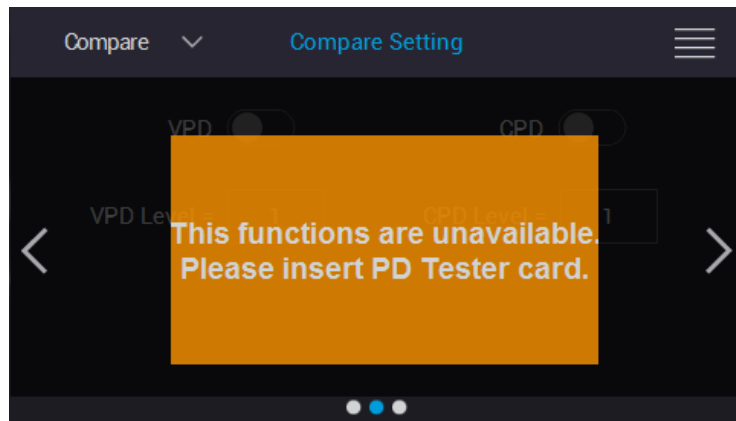
Touch "Compare" after returning main menu, the selections below has popped up to provide users to do setting.



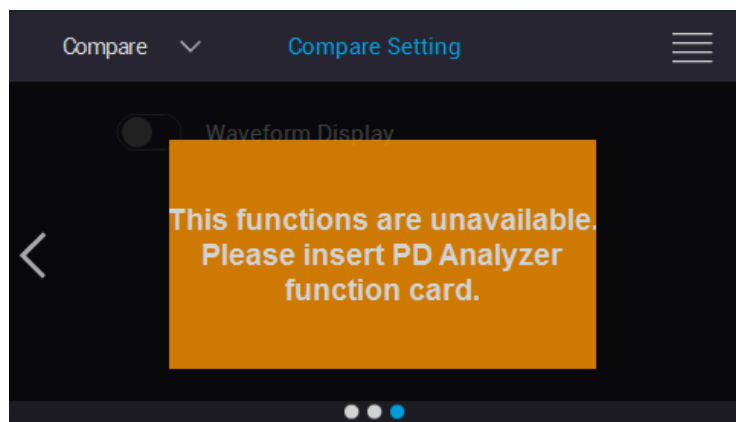
Parameter: Measurement parameter has two selections of Leakage Current (LC) and Insulation Resistance (IR). The factory default value is LC when shipped.

Upper Limit: It sets the upper limit value of compare via touching scroll wheel button. The scroll wheel button turns into green that indicates judgment function enabled and gray indicates judgment function disabled.

Lower Limit: It sets the lower limit value of compare via touching scroll wheel button. The scroll wheel button turns into green that indicates judgment function enabled and gray indicates judgment function disabled.



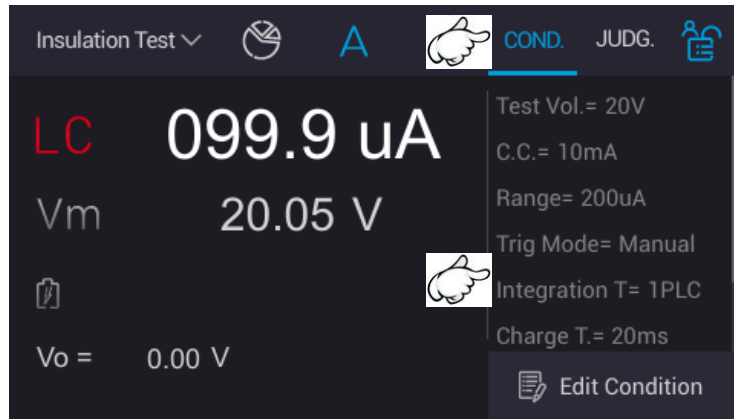
⚡ CAUTION It does not support PD Test judgment function and does not insert PD Tester Card.



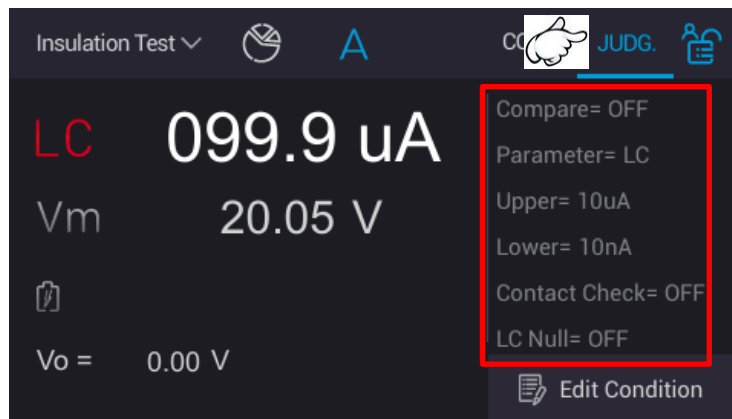
⚡ CAUTION It does not support PD Analyzer judgment function and does not insert PD Analyzer Card.

5.3.7 IR/LC Test Parameter and Judgment Setup

Return to the main menu and touch “Insulation Test”, the measurement main screen pops up to touch “COND” menu and the display area below shows setup parameter specification. It also can via scrolling screen up and down on display area to confirm the parameter specification.



Touch “JUDG.” menu, the display area at the lower side shows the settings of judgment function.



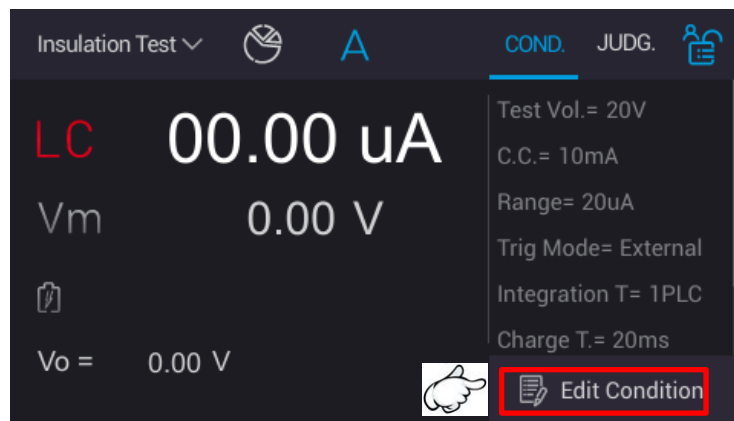
5.3.8 Operation for Insulation Test

5.3.8.1 Example for Insulation Test

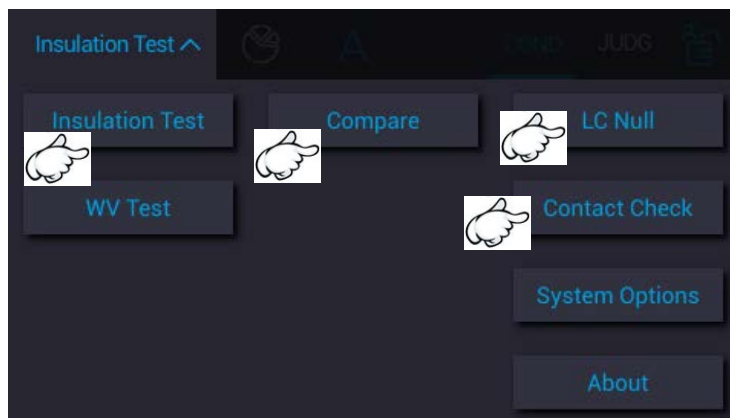
Operation Example

Take LC measurement as an example, measurement and setup procedures are as the following.

- (1) Test condition setting (LC/IR): Select “Edit Condition” on main page to enter measurement parameter setup (see *section 5.3.2*).



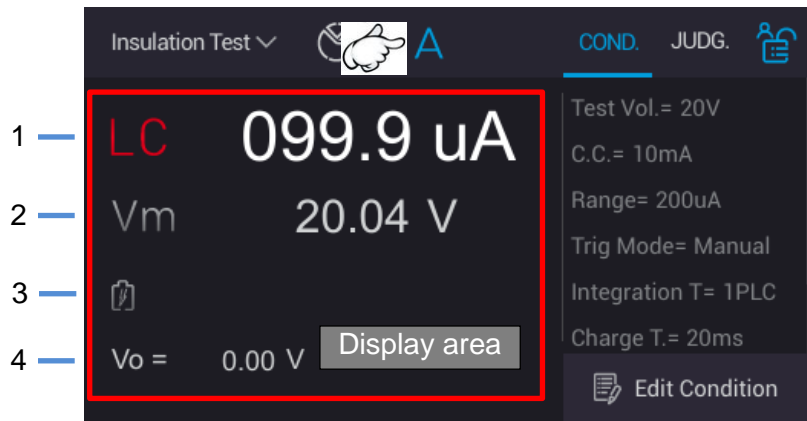
- (2) It returns to main menu, according to actual requirement to process LC Null (see *section 5.3.3*), Contact Check (see *section 5.3.5*) and Compare (see *section 5.3.6*) function settings.




- (3) Select “Insulation Test” to enter Insulation Test measurement screen after system configuration is set and returns to main menu.
- (4) Press green “START” button on the panel to start measuring after DUT and test cable are connected exactly. Test result shows at the lower display area after the measurement is ended. There are two display methods: one is single execution result to show the test value and another is statistical information result to show statistical result.


5.3.8.2 Single Execution Result

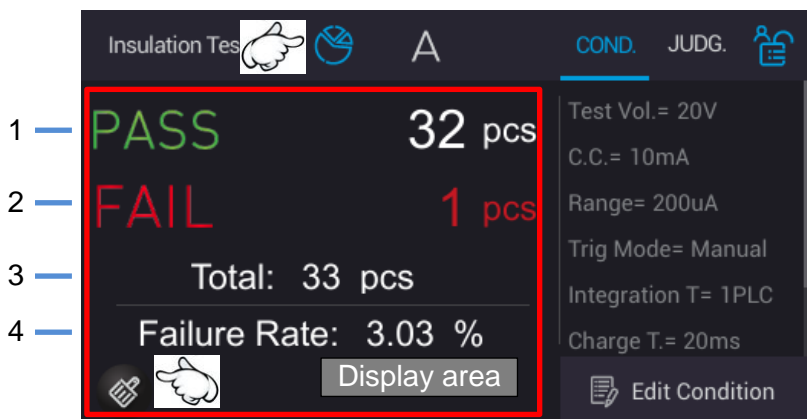
Select “A (Single Execution Measurement)” on measurement screen and press green START button on the panel. The display area at the lower side shows measurement procedure and test result at this time after the measurement is done.



1. LC/IR: Leakage current/insulation resistance measurement value
2. Vm: Measurement voltage value for Test Time phase
3. : It displays the current measurement for Charge/Dwell/Measure phase.
4. Vo: It displays real time voltage.

5.3.8.3 Statistical Information Result

Touch “ PIE icon (statistical information)” menu after the main screen is measured and press green START button on the panel. The display area at the lower side shows “PASS” and “FAIL” total accumulated count after the measurement is done.



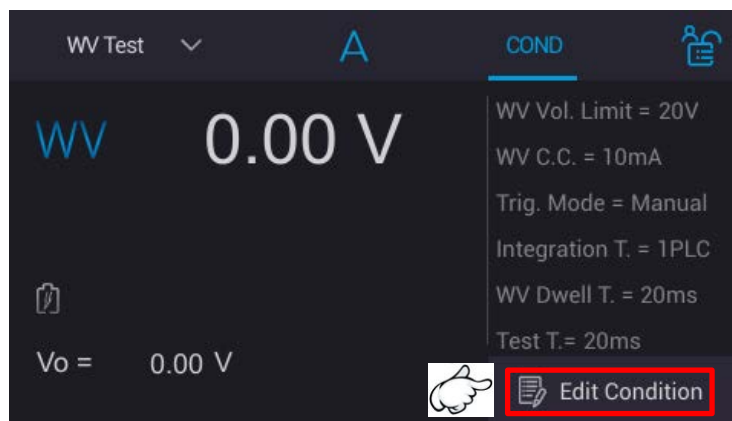
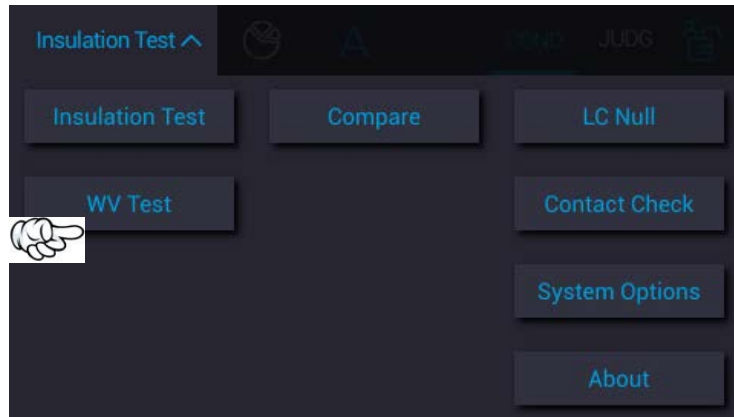
1. PASS: DUT “good product” accumulated count
2. FAIL: DUT “no good product” accumulated count
3. Total: It displays the test completed DUT total count.
4. Failure Rate: It displays DUT’s failure rate.

Note | Long press for 1 second : All statistical counts are zeroed.

5.4 WV Test

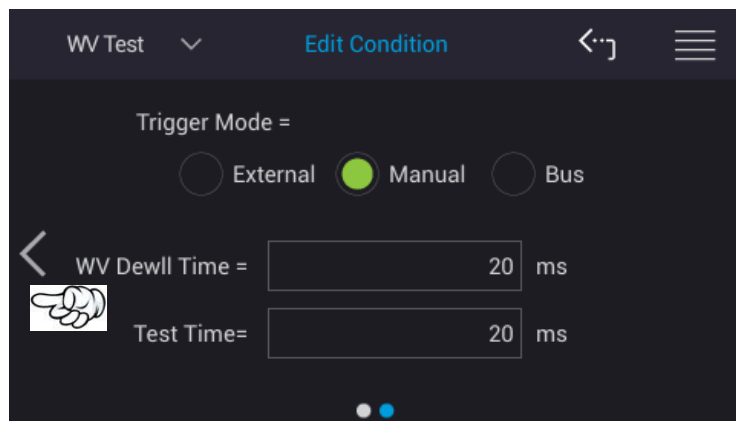
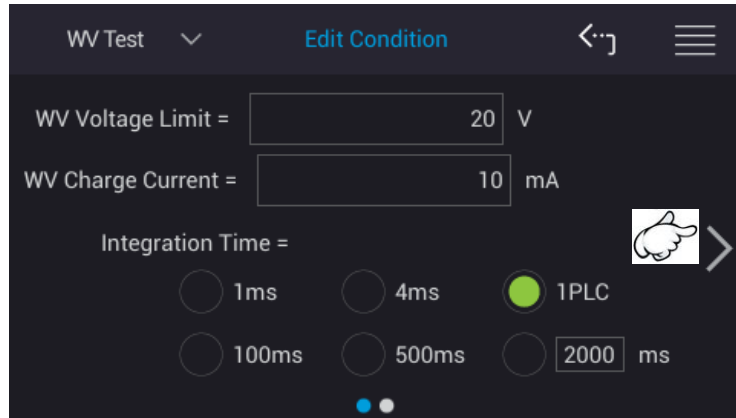
Use the set charging current to charge the DUT and when the DUT leakage current is equal to the charging current, the voltage will be limited to a certain level that is the WV Test.

Operating method: In the main menu, touch “WV Test” to enter into the page for setting.



5.4.1 Test Parameters Setup

Select “Edit Condition” when in WV Test page, and there are two pages of measurement parameters for setting. Scroll the screen or touch the “>” and “<” at the screen two sides to switch the page.

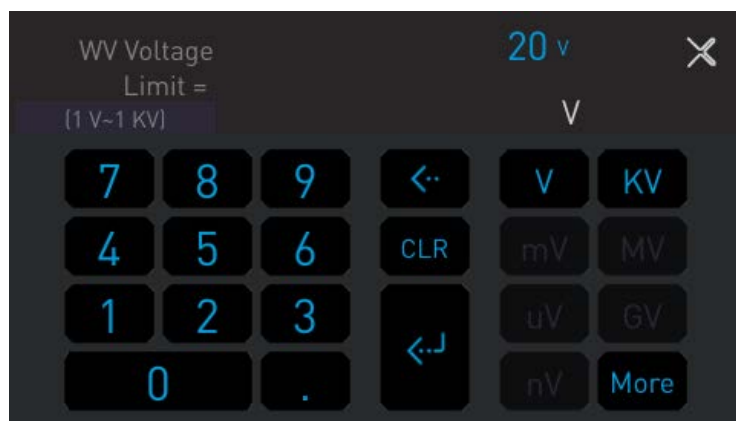


There are 6 measurement parameters for test setting.

(1) WV Voltage Limit:

It sets the maximum WV test voltage. The range is 1V~1000V and the factory default is 20V.

Touch the WV Voltage Limit input voltage column and a touch keypad will appear.



[0~9,.]: Set the input required value with decimal point.

[<←>]: Backward key

[CLR]: Clear the inputted value.

[V, KV]: It sets voltage unit.

[<→>]: Confirm the input setting value.

- (2) **WV Charge Current:**
It sets the WV charging current. The range is 500uA~50mA, and the factory default is 10 mA.
[mA, uA]: Set the current unit.
- (3) **Integration Time: (Shared with Insulation Test parameter)**
It sets the integration time. There are 1ms, 4ms, 1PLC, 100ms, 500ms, and self defined 6 types of speed for selection. The factory default is 1PLC.


The table below lists the relationship between line frequency and integration time.

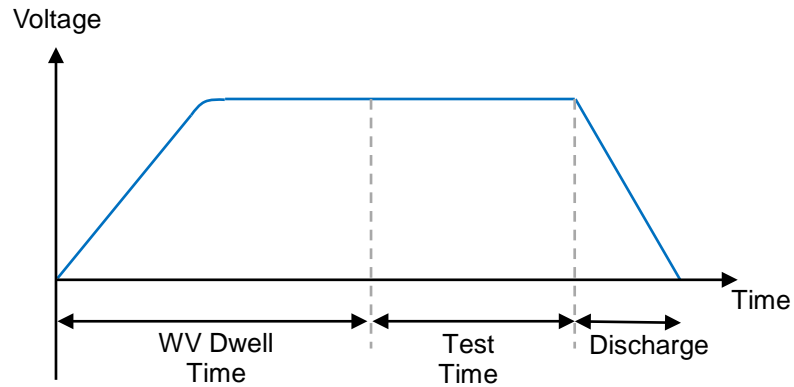
Line Frequency	Integration Time					
	1 ms	4 ms	1PLC*	100 ms	500 ms	Self-defined**
50Hz	1 ms	4 ms	1PLC* (20 ms)	100 ms	500 ms	Self-defined** 1ms~9.999s
60Hz	1 ms	4 ms	1PLC* (17 ms)	100 ms	500 ms	Self-defined** 1ms~9.999s

*PLC: Power line cycle

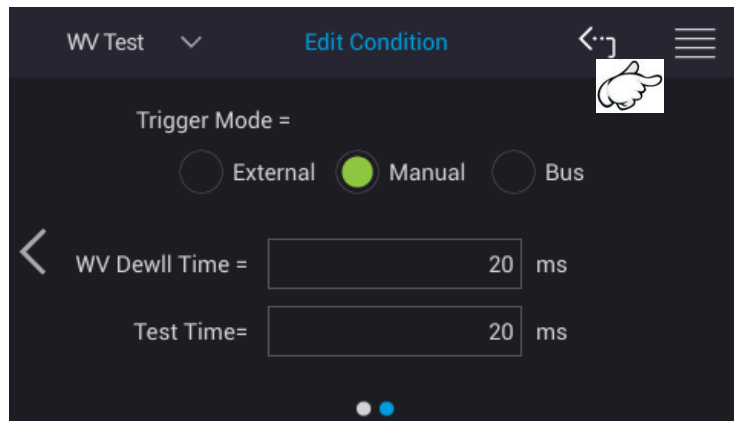
**Self-defined: The measured value will be read several times based on the fixed integration time selected during Test Time period. To get more precision and stable measurement, [Self-defined] is provided to read the measured value.

- (4) **Trigger Mode: (Shared with Insulation Test parameter)**
The trigger mode has External, Manual, and BUS (remote control) 3 settings for selection. The factory default is Manual.
External: External trigger uses Handler to send the command for triggering.
Manual: Manual trigger uses the [Green Start] button on the front panel for triggering.
BUS: Remote control trigger uses RS-232 ,USB (B-Type) or LAN to send the command for triggering.
- (5) **WV Dwell Time:**
It sets the WV delay time for measurement. The range is 5ms~99.999s and the factory default is 20ms.
- (6) **Test Time: (Shared with Insulation Test parameter)**
It sets the test time. The range is 5ms~99.999s or 0ms (continue tests), and the factory default is 20ms.

 **CAUTION** When Test Time is set to 0ms, it means the test continues infinitely without time limit (∞) except the STOP key on the front panel is press to stop testing manually.



When settings are modified by the above parameters, they will automatically be saved. Touching the icon at the upper right corner as the figure shown below can enter into File Management to save the set parameters and load the setting files. See *section 3.8* for detailed description.



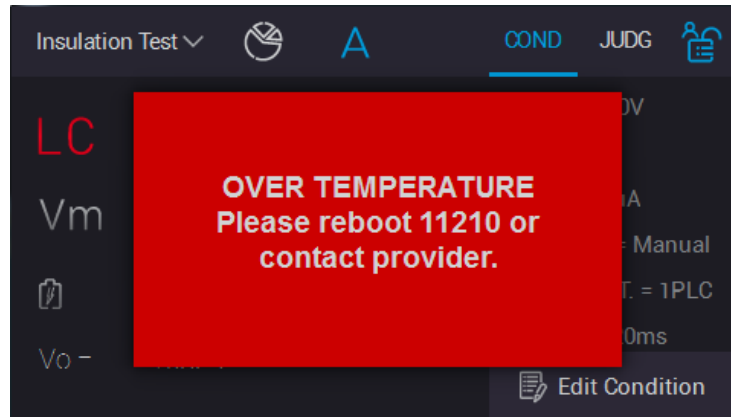
5.4.2 Contact Check

See section 5.3.5 for contact check setting.

5.5 Warning Function

5.5.1 OTP Protection

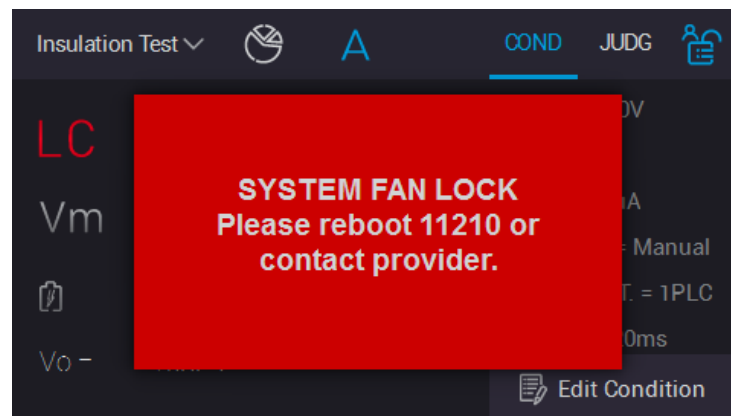
The temperature of outlet is over 80°C and the over temperature warning message as below figure shows. The tester can't be operated and outputted at the same time, only can power off and wait the temperature dropped to power on again.



- ⚡ CAUTION**
1. Troubleshooting:
 - (1) When OTP protection is occurred, please power off the tester and then reboot to observe if it is caused by over temperature.
 - (2) If OTP is occurred again, please contact the distributor or Chroma's service department for service.
 2. After powering on the tester and start operating, please keep ventilation at left/right side and rear panel of tester at least 10cm.

5.5.2 Fan Lock Protection

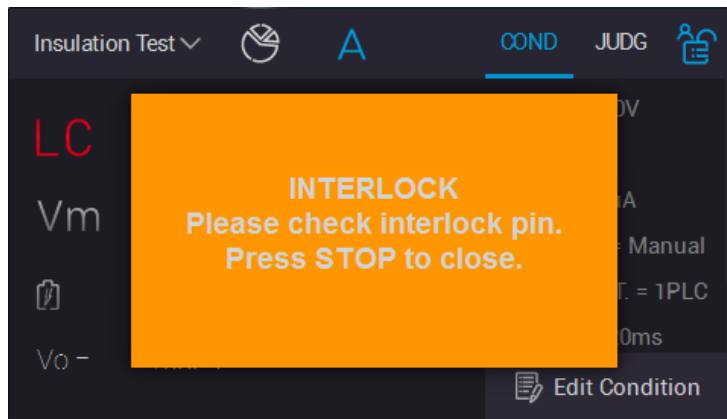
In order to be efficient to keep internal heat dissipation and getting the stable measurement, FAN LOCK protection will be occurred if there is fan failure or foreign material invasion. The tester can't be operated and outputted at the same time; operation screen shows the protection message as below.



- ⚡ CAUTION**
1. Troubleshooting:
 - (1) When FAN LOCK protection is occurred, please power off the tester and then reboot to observe if it is caused by error action.
 - (2) If FAN LOCK is occurred again, please contact the distributor or Chroma's service department for service.
 2. After powering on the meter and start operating, please keep ventilation at left/right side and rear panel of tester at least 10cm.

5.5.3 Interlock Protection

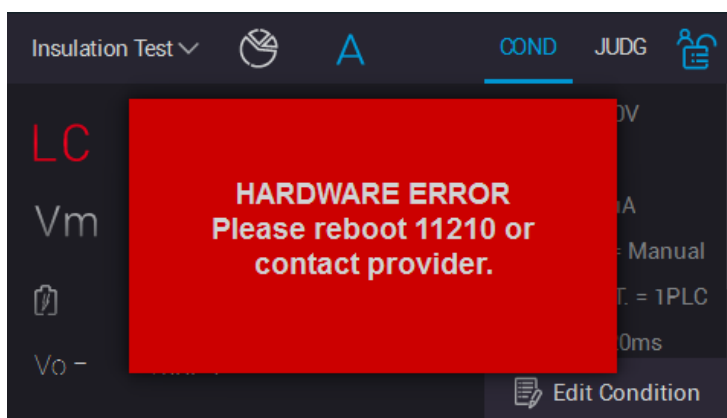
Safety protection device is via using electricity signal to make sure the integrity of connected high voltage system. It is mainly used on the fixture with protection device such as the cover plate opened for detecting.



- ⚡ CAUTION** Troubleshooting:
1. When Interlock protection is occurred, press “STOP” button on panel to clear the hint message and check if two ends of “INTERLOCK interface” on rear panel is short-circuited, if not, use the short-circuited plate to short-circuit it.
 2. If INTERLOCK happens again, be sure to contact your local agent or Chroma service center for repair.

5.5.4 Circuit Warning for Hardware Measurement

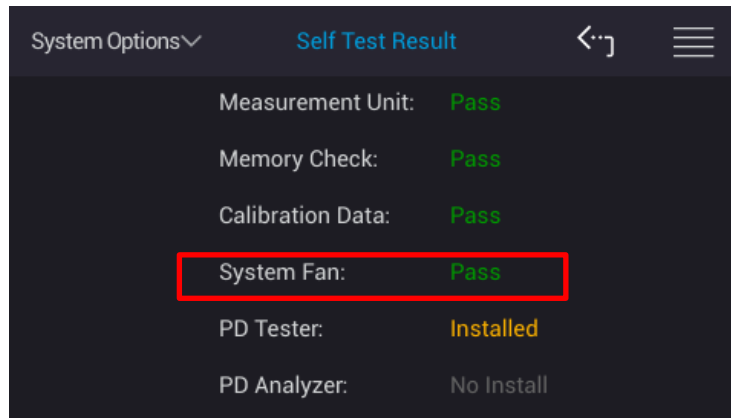
The hardware measures circuit and self test, the monitor displays the warning message as the figure below shows. The tester can't be operated and outputted at the same time. The operation screen shows the protection message as below.



- ⚡ CAUTION** Troubleshooting:
1. When Hardware Error signal is occurred, please power off the tester and then reboot to observe if it is caused by error action.
 2. If Hardware Error occurs again, please contact the distributor or Chroma service center for repair.

5.5.5 Smart Fan Test

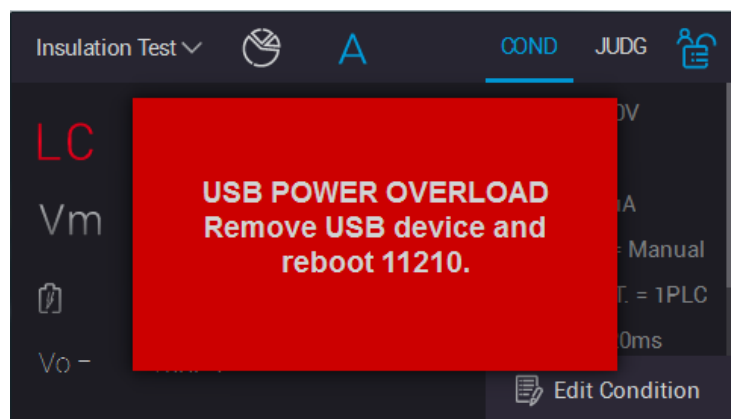
Detect the fan aging status when the tester is powering on and based on the temperature inside the tester to adjust the fan speed. The fan status only is shown during self-test when the tester is powering on.



- ⚡ CAUTION** Troubleshooting:
 When Fail appears on System Fan, it means the fan is aged and should return to Chroma for replacement; however, it can still be used.

5.5.6 USB Overload Warning

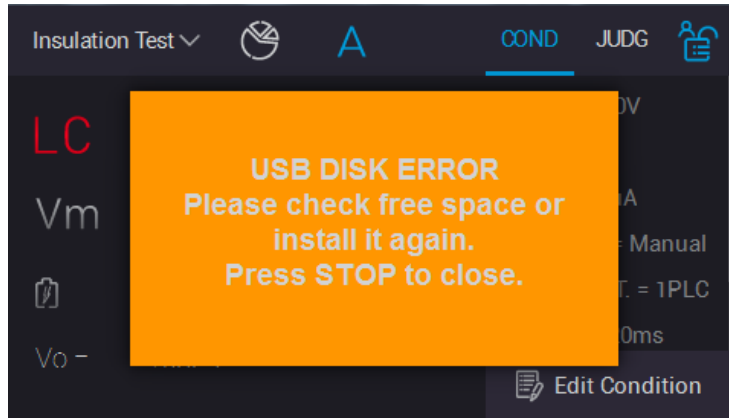
USB on front panel power overload warning. When users misconnect USB connector on front panel to “mobile power pack charging”, “mobile charging” or “current requirement over 1A”, the monitor shows the warning message as the below figure. The tester is unable to operate and output at the same time, operation screen will show protection message as the following screen.



- ⚡ CAUTION** Troubleshooting:
 When USB overload signal is occurred, turn the power off and remove USB device which is connected to front panel and reboot the 11210.

5.5.7 USB Auto Storage Warning

A warning for USB on front panel power is full or USB Disk isn't inserted. When "Auto Report (USB Disk)" function in System Setup is enabled and saved the measured data into USB Disk, the monitor shows the warning message as the below figure. The tester is unable to operate and output at the same time, operation screen shows protection message as the screen below.



CAUTION

Troubleshooting:

1. Whether the USB Disk is inserted normally.
2. Make sure whether the capacity of USB Disk is full. Please replace a new one if yes.
3. Make sure whether the USB Disk is accessed normally.

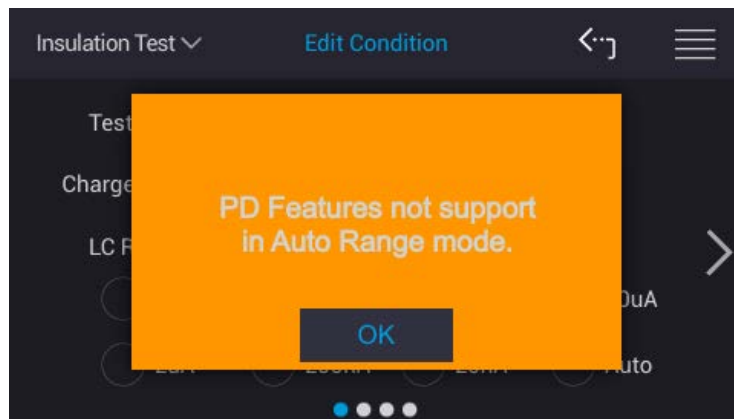
6. A112100 PD Tester Function Card (Option)

The DUT adds partly discharge test function except for measuring leakage current or insulation resistance.

6.1 IR/LC Measurement Setup

For IR/LC measurement related settings and measurement parameter, see *section 5.3.1*、*5.3.2.* and *5.3.3.*

- ⚡ CAUTION**
1. It does not support PD Test measurement function when LC Range is set to Auto.
 2. Troubleshooting: Modify LC Range to fixed range when the below warning window is occurred.



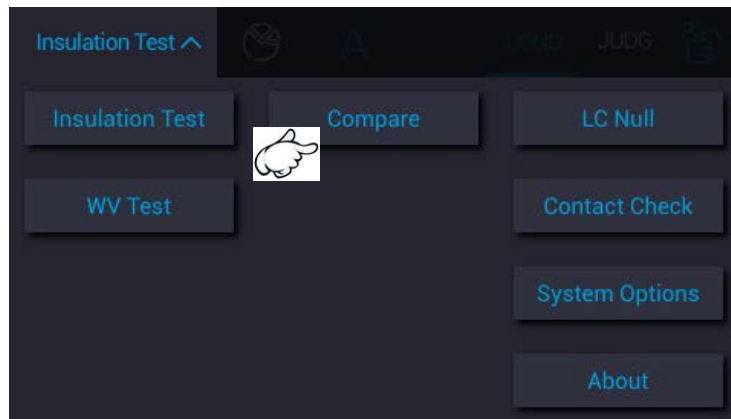
6.2 LC Null

LC Null is for clearing open circuit, for zeroing function on various ranges overall circuit of leakage current see *section 5.3.3.*

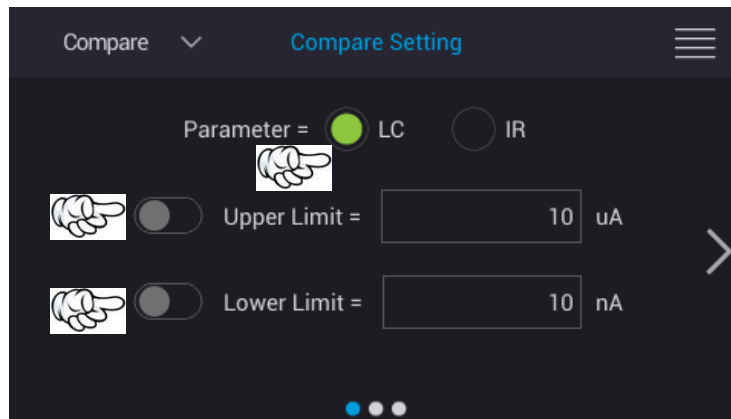
6.3 Contact Check

For contact check setting, see *section 5.3.5.*

6.4 Compare



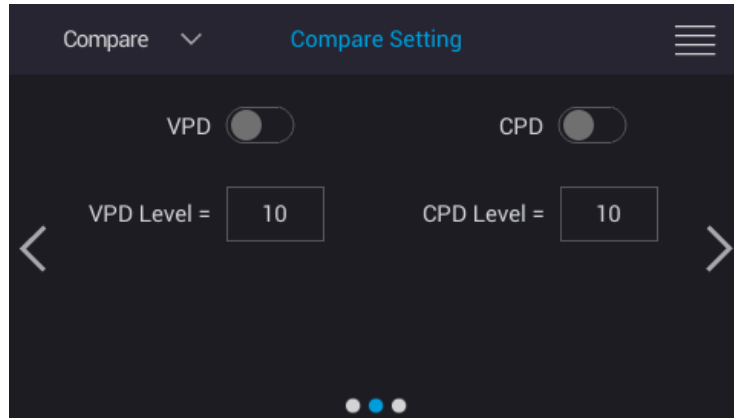
6.4.1 LC/IR Compare Setting



For IR/LC compare condition setting, see *section 5.3.6*.

6.4.2 PD Compare

PD Compare is for setting partial discharge judgment and its operation as below shows. Touch "Compare" after returning main menu, change it to the 2nd page the menu as below provides users to process VPD and CPD detection setting.



VPD: PD is occurred during CC (Constant Current, Charge Mode) procedure via touching scroll wheel button to enable or disable judgment function. The test condition (VPD Level) is used to evaluate the PD occurrence. When the level is higher than the setting, it means the PD is occurred.

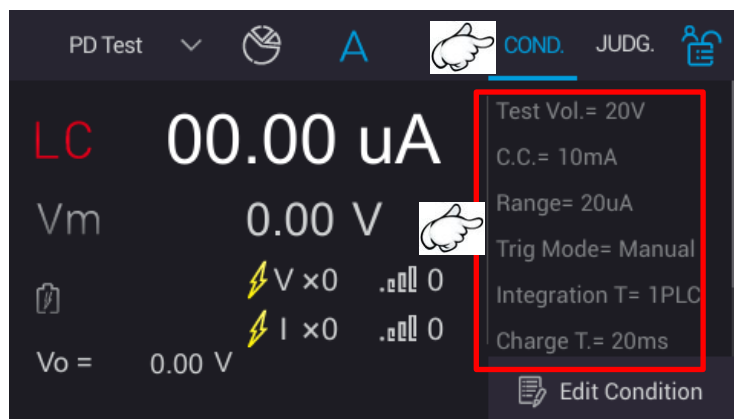
VPD Level: PD occurrence level, range: 1~99. The factory default value is Level=10 when shipped.

CPD: PD is occurred during CV (Constant Voltage, Test Mode) procedure via touching scroll wheel button to enable or disable judgment function. The test condition (CPD Level) is used to evaluate the PD occurrence. When the level is higher than the setting, it means the PD is occurred.

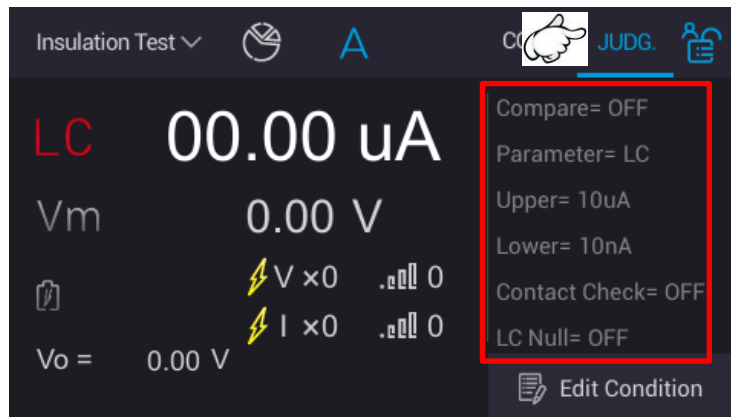
CPD Level: PD occurrence level, range: 1~99. The factory default value is Level=10 when shipped.

6.5 PD Test Measurement Parameter and Judgment Function Setup Display

Touch "Insulation Test" after returning main menu and touch "COND." menu, the display area at the lower side is the parameter specification for setting. It also can via scrolling screen up and down on display area to confirm the parameter specification.



Touch "JUDG." menu, the display area at the lower side shows the settings of judgment function.



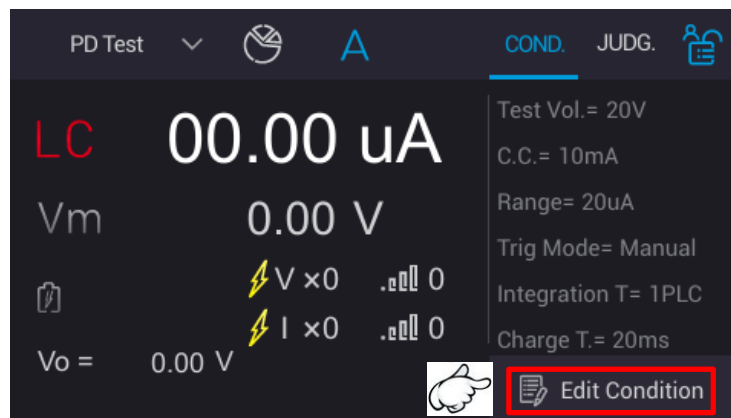
6.6 PD Test Result Display

6.6.1 Operation Example for PD Test

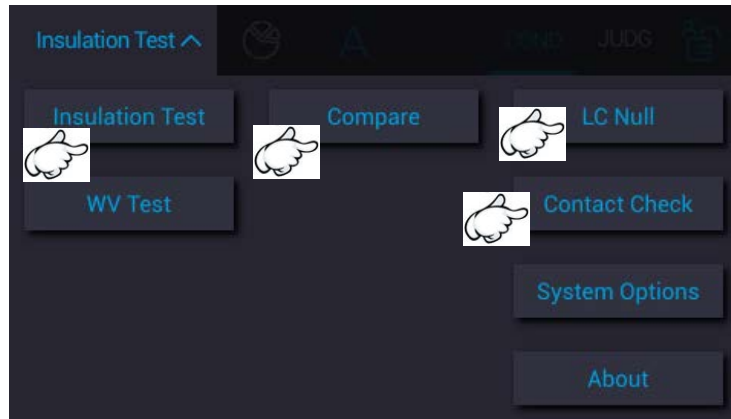
Operation Example

Take LC measurement as an example, measurement and setup procedures are as the following.

- (1) Test condition setting (LC/IR): Select "Edit Condition" on main page to process test parameter setup (see *section 5.3.2*).



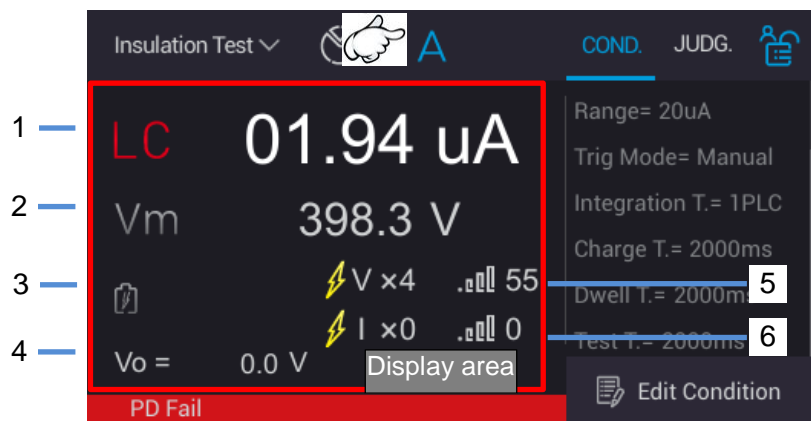
- (2) It returns to main menu, according to actual requirement to process LC Null (see *section 5.3.3*), Contact Check (see *section 5.3.5*, IR/LC Compare (see *section 5.3.6* and PD Compare (see *section 6.4.2*) function settings.



- (3) Select “Insulation Test” to enter Insulation Test measurement screen after system configuration is set and returns to main menu.
- (4) Press green “START” button on the panel to start measuring after DUT and test cable are connected exactly. Test result shows at the lower display area after the measurement is ended. There are two display methods: one is single execution result to show the test value and another is statistical information result to show statistical result.


6.6.2 Single Execution Result

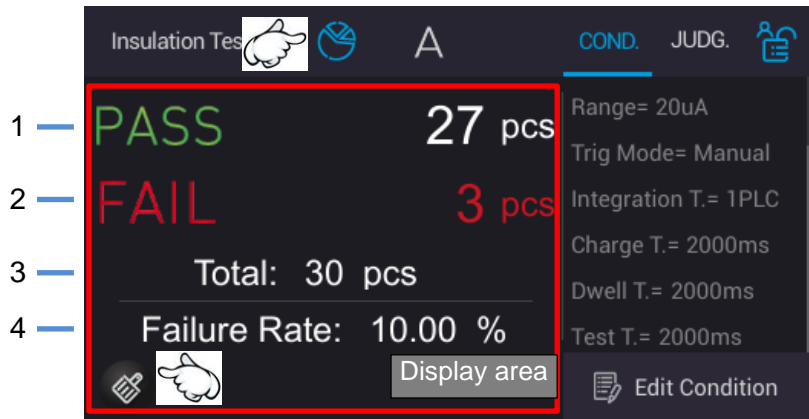
Select “A (Single Measurement)” on measurement main screen and press green START button on the panel for measuring. The display area at the lower side show measurement procedure and test result at this time.



1. LC/IR: Leakage current/insulation resistance measurement value
2. Vm: Measurement voltage value for Test Time phase
3. : It displays the current measurement for Charge/Dwell/Measure phase.
4. Vo: It displays real time voltage.
5. V x: VPD times, : VPD level
6. I x: CPD times, : CPD level

6.6.3 Statistical Result

Select “ PIE icon (statistical report)” menu under measurement main screen and press green START button on the panel for measuring. The display area at the lower side shows “PASS” and “FAIL” total accumulated count.



1. PASS: DUT “good product” accumulated count
2. FAIL: DUT “no good product” accumulated count
3. Total: It displays the test completed DUT total count.
4. Failure Rate: It displays DUT’s failure rate.

Note | Long press for 1 second  : All statistical counts are zeroed.

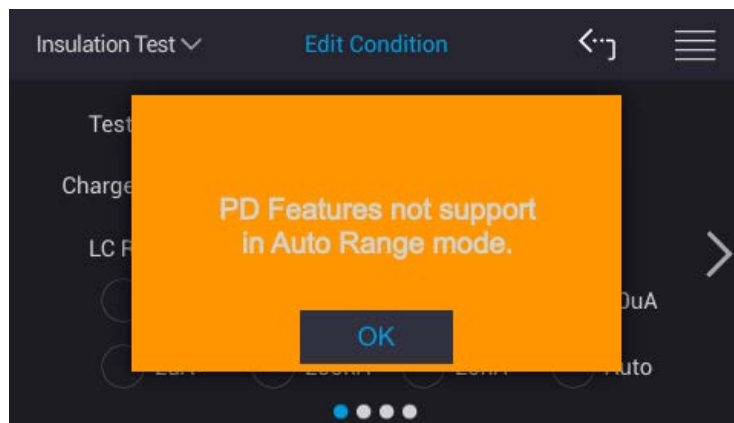
7. A112101 PD Analyzer Function Card (Option)

This is an optional function. Besides measuring the leakage current or insulation resistance on the DUT, it has additional partial discharge detection and waveform analysis function.

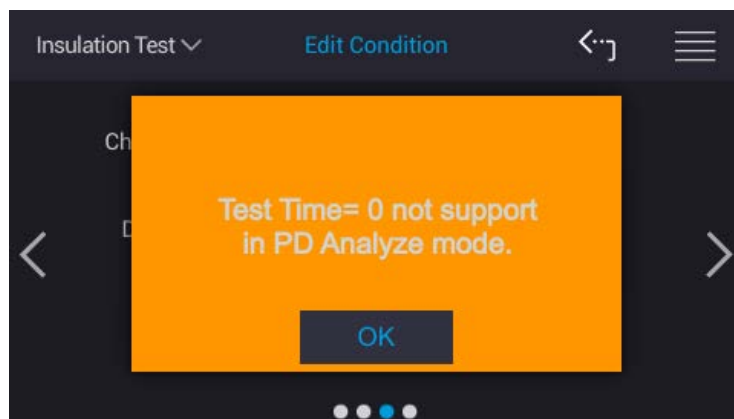
7.1 IR/LC Test Condition Setup

See section 5.3.1, 5.3.2 and 5.3.3 for the R/LC test settings and parameters.

- ⚡ CAUTION**
1. When the LC Range is set Auto, it does not support the PD measurement function.
 2. Troubleshooting: When the following warning window appears, please change the LC Range to fixed range.

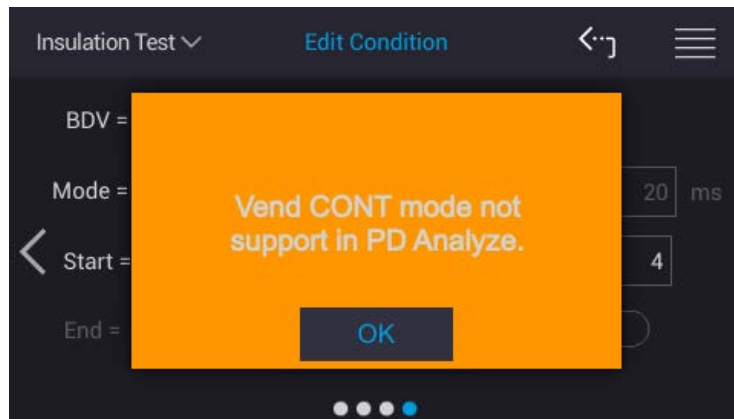


- ⚡ CAUTION**
1. When the Test Time is set to 0 ms (continuous test mode), it does not support PD analysis mode and BDV mode.
 2. Troubleshooting: When the following warning window appears, please modify the Test Time to greater than or equal to 5ms (general test mode).





- ⚡ CAUTION**
1. In BDV function, it does not support PD analysis mode when Vend CONT is enabled.
 2. Troubleshooting: When the following warning window appears, please turn off the Vend CONT function.



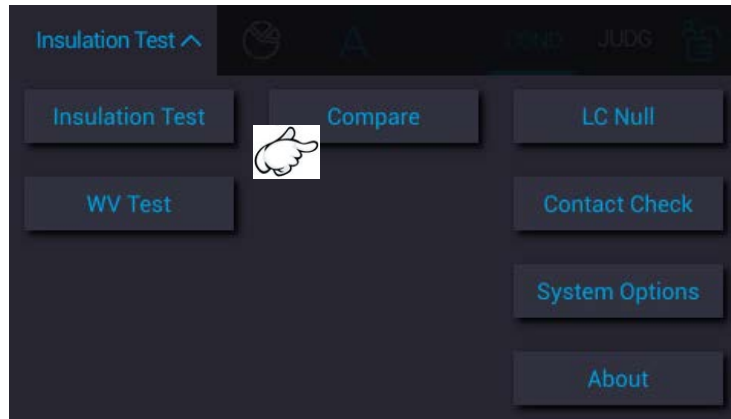
7.2 LC Null

LC Null is used to eliminate the offset function on overall circuit for leakage current ranges during open circuit. See *section 5.3.4* for detailed description.

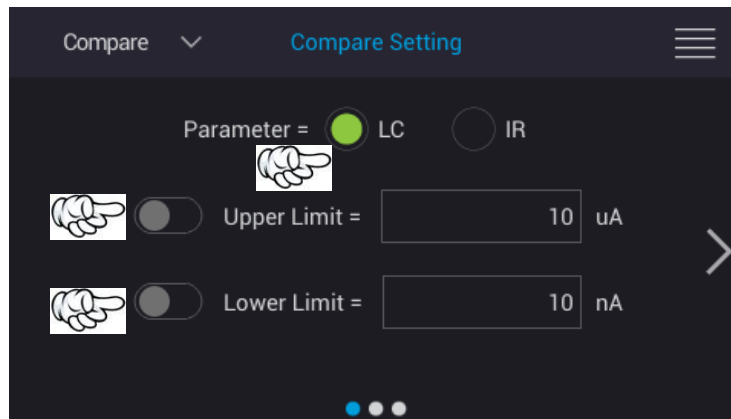
7.3 Contact Check

See *section 5.3.5* for setting contact check.

7.4 Compare

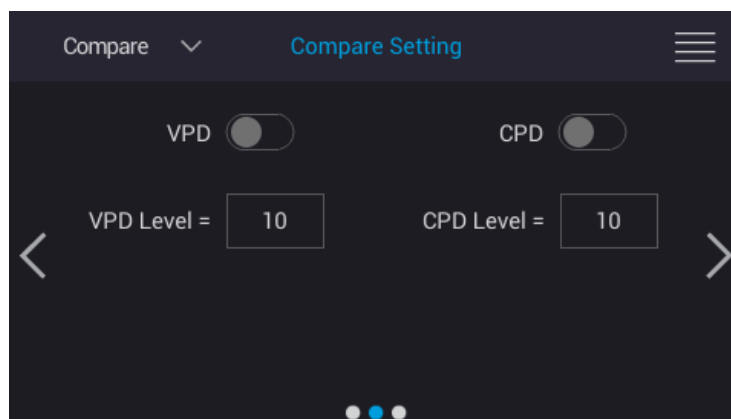


7.4.1 LC/IR Compare Setting



See *section 5.3.6* for setting IR/LC compare.

7.4.2 PD Compare

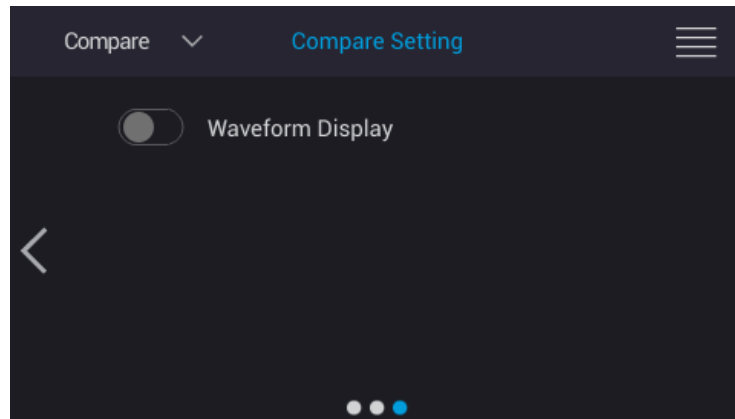


See *section 6.4.2* for setting PD Compare.

7.4.3 PD Analyzer

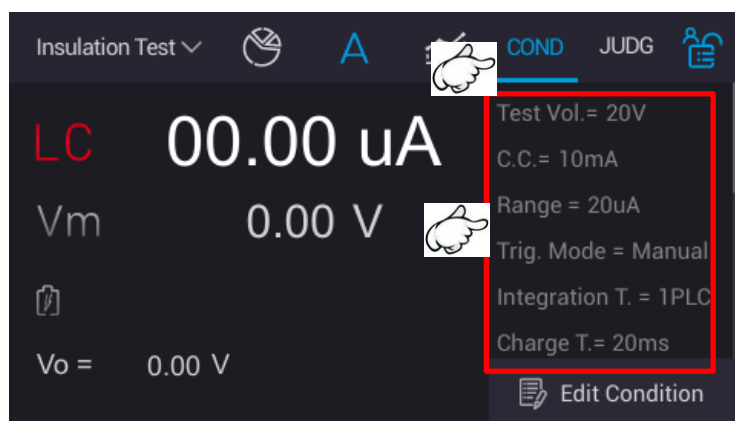
The PD Analyzer is an analysis chart to detect partial discharge via the way described below:

Touch [Compare] in the main menu and switch to page 3. The following menu appears for users to perform Waveform Display setting by touching the “slider” to enable or disable the analysis chart.

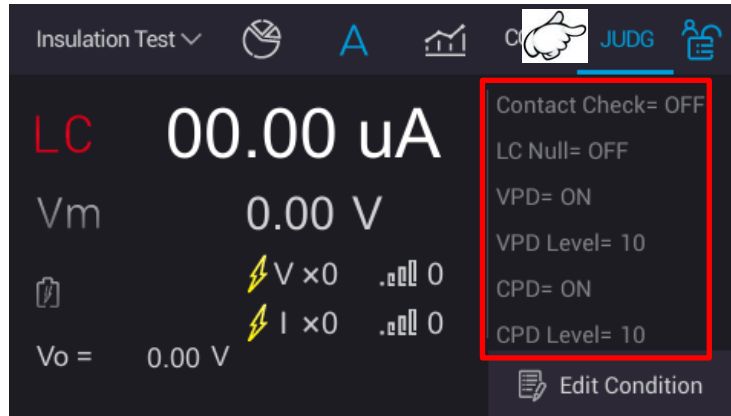


7.5 PD Analyzer Parameters and Judgment Function Setup Display

Touch [Insulation Test] in the main menu and a measurement main window appears. Touch “COND” and a menu of set parameters are displayed. Scroll the display area up and down to confirm the parameter settings.



Touch “JUDG” and the menu of set judgment functions are displayed.



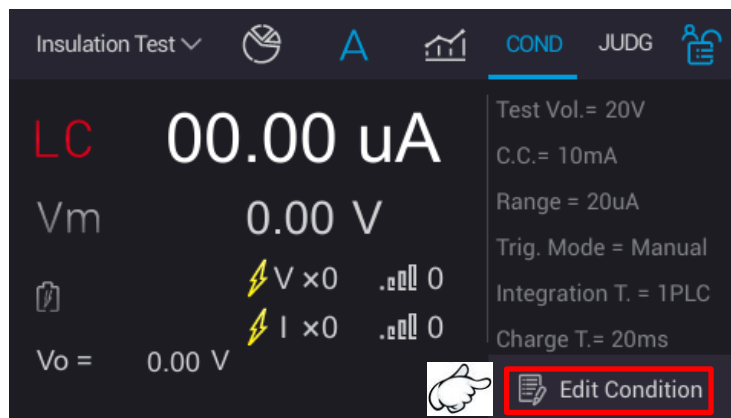
7.6 PD Analyzer Result Display

7.6.1 Operating PD Analyzer

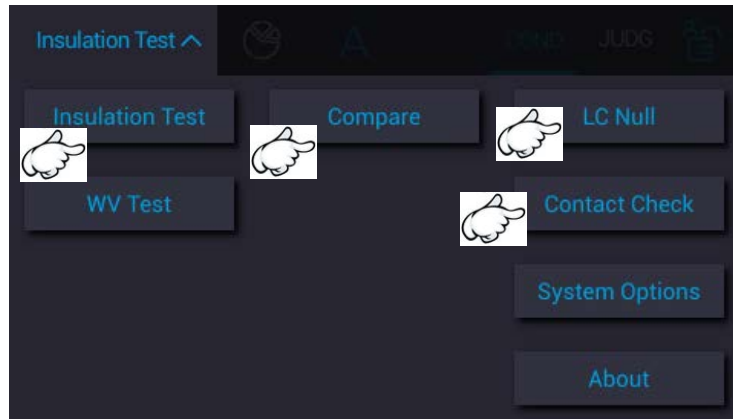
Operating example:

Measuring LC for example, the measurement and setting steps are as follows:

- (1) Set the test condition (LC/IR): Select [Edit Condition] in the menu to set the test parameters (see section 5.3.2).



- (2) Return to the main menu to perform the settings of LC Null (see section 5.3.4.1), Contact Check (see section 5.3.5), IR/LC Compare (see section 5.3.7), PD Compare (see section 6.4.2), and PD Analyzer (see section 7.4.3) according to the actual requirements.



- (3) When the system environment settings are done, return to main menu and select [Insulation Test] to enter into its test screen.
- (4) When the DUT is properly connected to the test cable, press the green “START” button on the panel to start measurement. When done, the test result will show in the display area below. There are 3 ways to display the result, single execution result, statistical result and waveform analysis result.


7.6.2 Single Execution Result

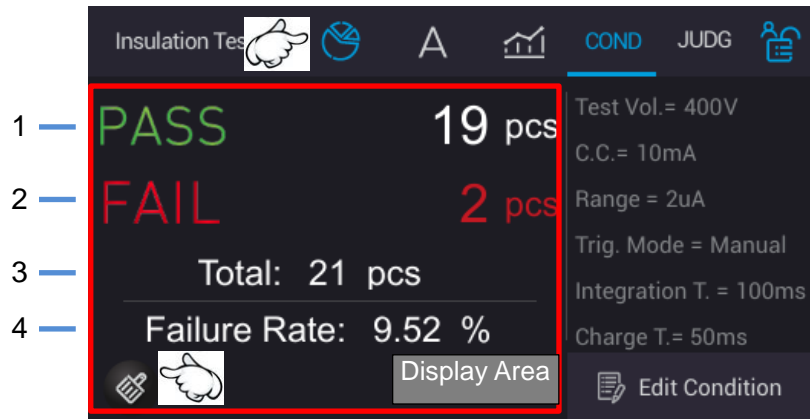
Select “A (single measurement)” in the main menu and press the green “START” button on the panel to perform measurement. The display area below shows the measurement process phase and test results at present.



1. LC/IR: Leakage current/insulation resistance measurement value
2. Vm: Measured voltage value for Test Time phase
3. : Displays the measurement phase to be Charge/Dwell/Measure/BDV Display at present
4. Vo: It displays real-time voltage
5. : VPD times, : VPD level
6. : CPD times, : CPD level

7.6.3 Statistical Result


Select “ PIE chart (statistical report)” in the main menu and press the green “START” button on the panel to perform measurement. The display area below shows the “PASS” and “FAIL” counts.

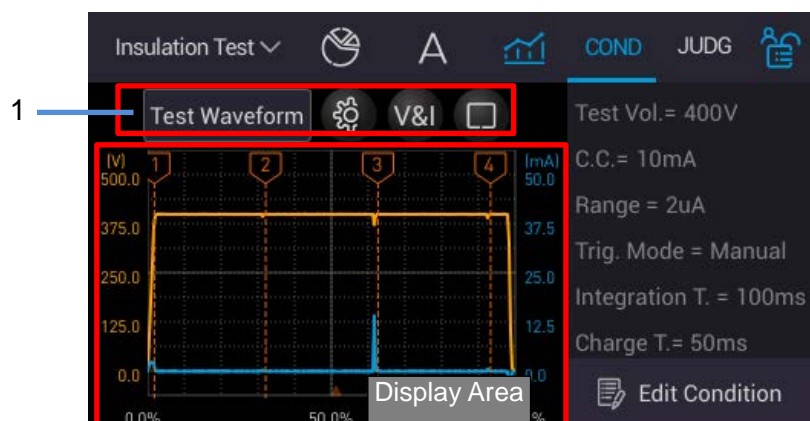


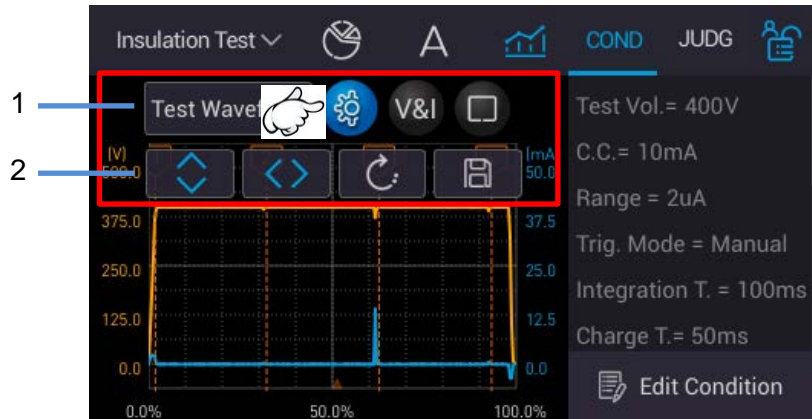
1. PASS: DUT “good product” accumulated count
2. FAIL: DUT “no good product” accumulated count
3. Total: It displays the test completed DUT total count
4. Failure Rate: It displays DUT’s failure rate

Note | Long press for 1 second : All statistical counts are zeroed.

7.6.4 Waveform Result

Select “ run chart (analysis graph)” in the main menu and press the green “START” button on the panel to perform measurement. The display area below shows the entire measured waveform result (including voltage and current).



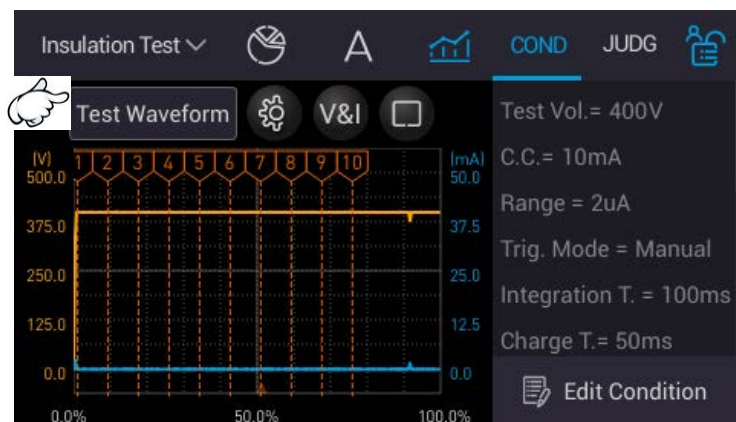


1. : Graph operation key
 - i. : Test waveform menu (including PD abnormal waveform), providing complete graph + PD abnormal waveform (maximum 10).
 - ii. : Waveform display mode menu.
 - iii. / / : “Simultaneously display test voltage/output current waveform”, “Display output current waveform”, and “Display test voltage waveform” menu.
 - iv. : Enlarge the test graph to full screen.
2. : The menu appeared after selected .
 - i. : Graph zoom in and out direction, up/down (Y-axis) or left/right (X-axis)
 - ii. : Return to the graph original scale.
 - iii. : Save the entire screen.

7.6.4.1 Analysis Chart (Standard Screen)

1. : Test waveform menu.

Touch it to prompt a measurement waveform selection menu. Select a waveform as required (Test Waveform, PD #1 ~ PD #10).

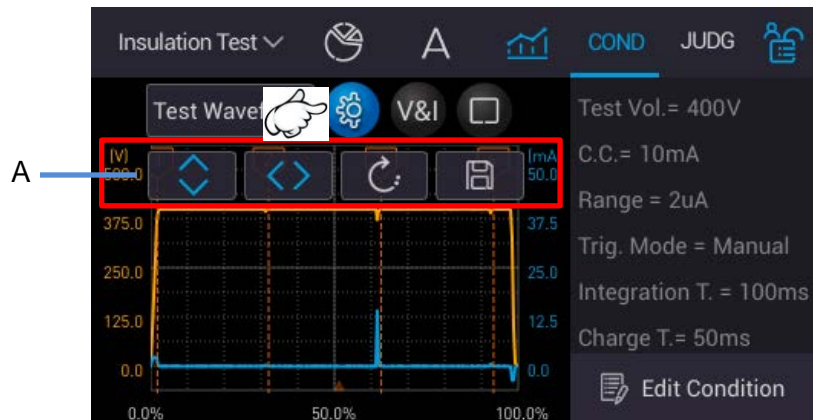




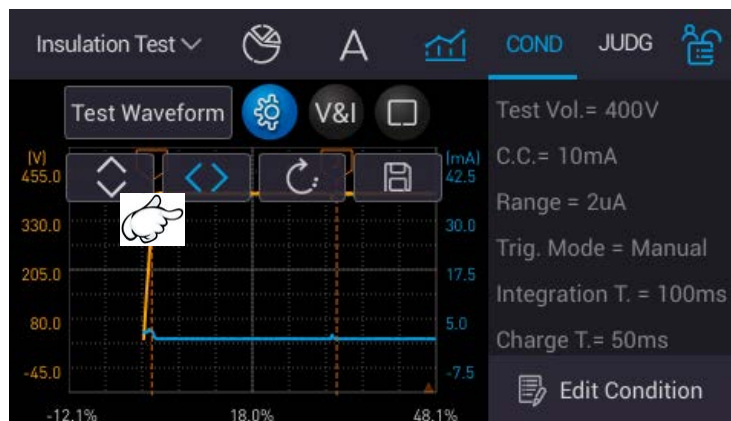
A: Complete measurement waveform

2. : Waveform display mode menu.

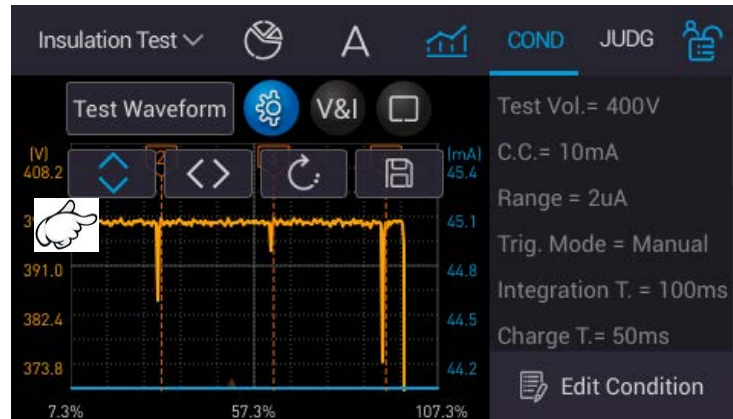
Touch to prompt an operating menu.



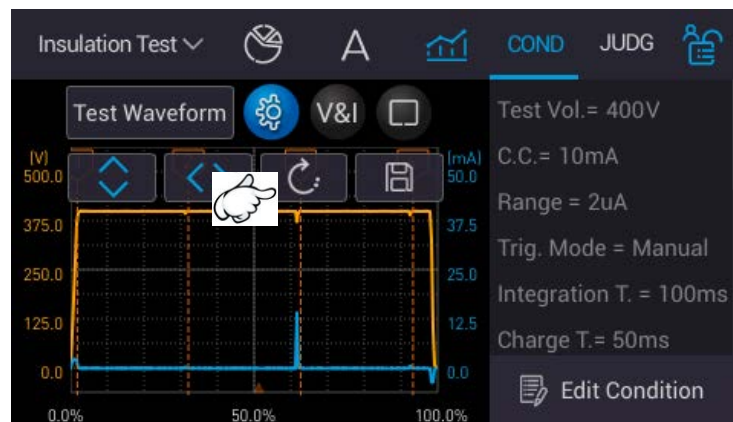
Select : The chart scales up and down towards the X and Y axes in an equal ratio.




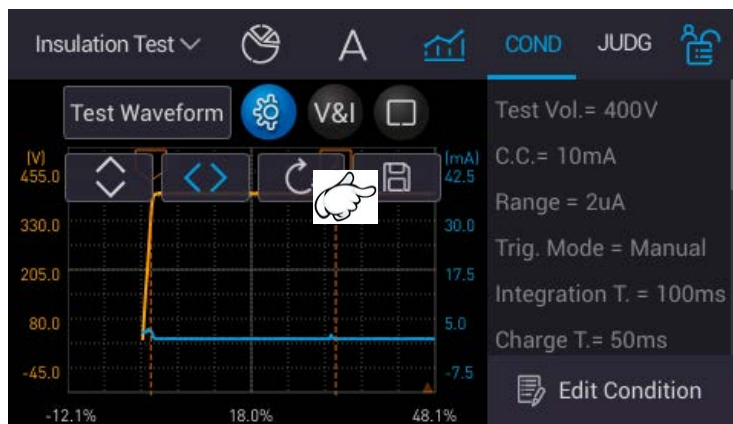
The graph is scaled left and right (X-axis direction).



The graph is scaled up and down (Y-axis direction).



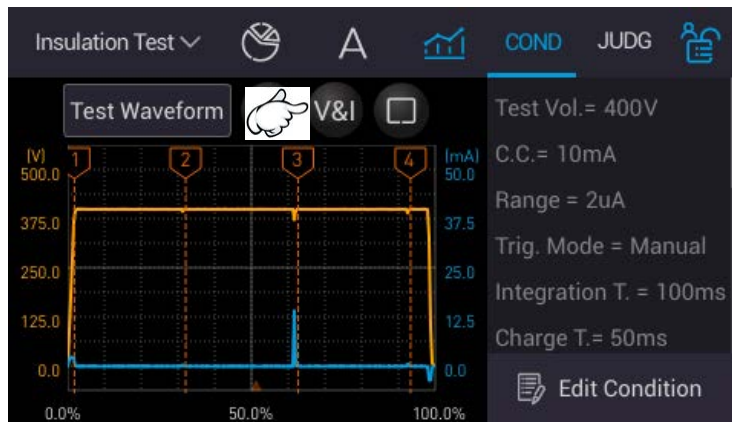
Select : Return to its original graph.



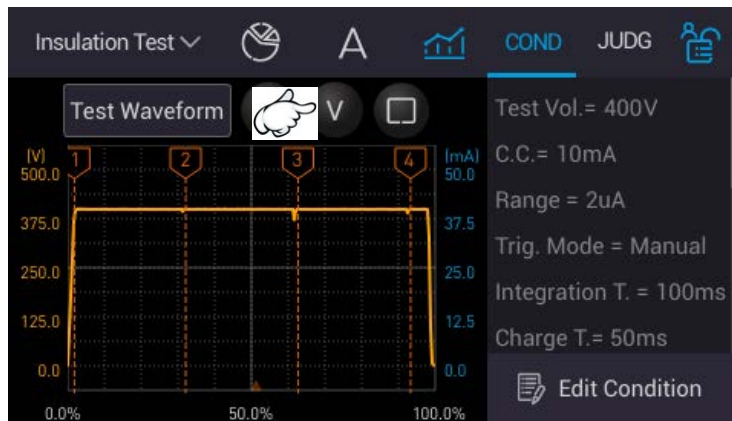
Select : Save the entire screen.

The “Hard Copy” in System Setup has PNG and CSV two formats for selection.

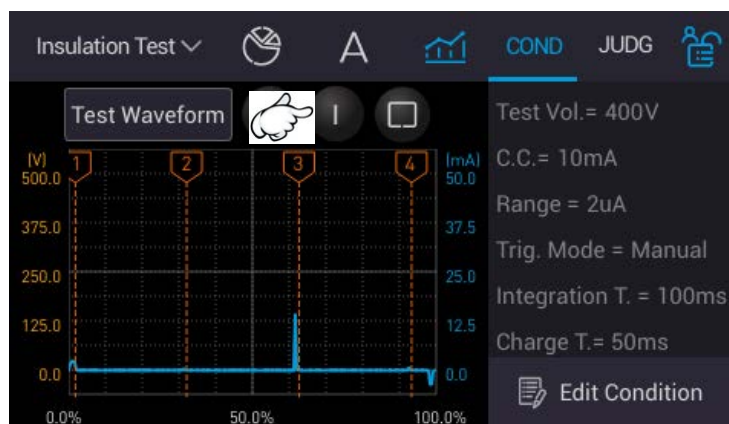
3. **I&V** / **I** / **V**: Display the test voltage/output current waveform menu to be selected in cycle.




Select **I&V**: Show the test voltage and output current waveform concurrently.

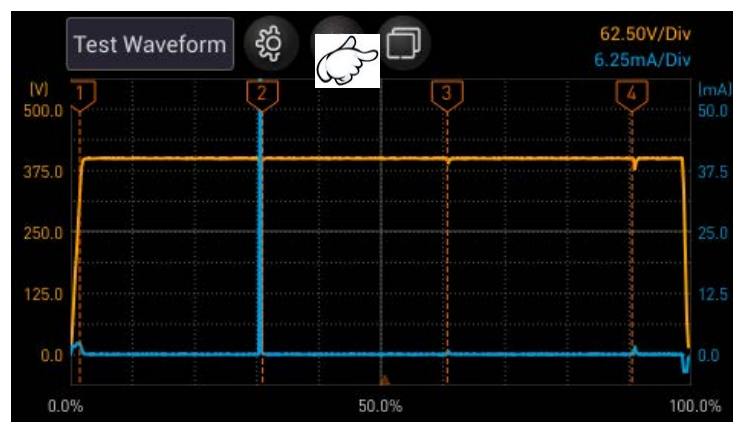
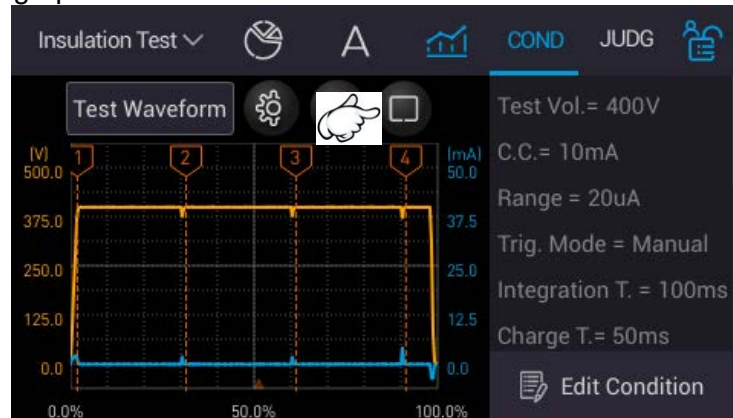



Select **V**: Display the test voltage waveform.




Select **I**: Display output current waveform.

4. : Enlarge the test graph to full screen.

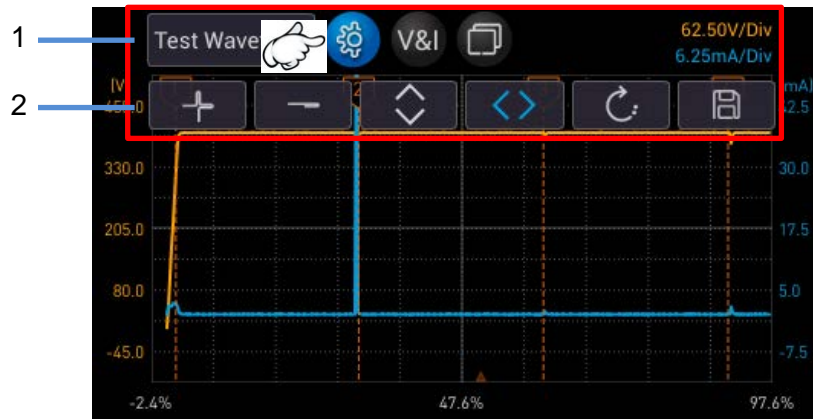

























Select : Full screen display.

Select : Return to standard screen display.

Note | The resolution of full screen is higher than standard screen. Since the resolutions are different, it is normal to have different waveform display.

7.6.4.2 Using Run Chart (Full Screen)



1.    : Graph operation key
 - i. : Test waveform menu (including PD abnormal waveform), providing complete graph + PD abnormal waveform (maximum 10).
 - ii. : Waveform display mode menu.
 - iii.  /  / : “Simultaneously display test voltage/output current waveform”, “Display output current waveform”, and “Display test voltage waveform” menu.
 - iv. : Return test chart to standard screen.
2.      : The menu appeared after selected .
 - i.  : The graph scales up and down in an equal ratio.
 - ii.  : Graph zoom in and out direction, up/down (Y-axis) or left/right (X-axis)
 - iii. : Return to the graph original scale.
 - iv. : Save the entire screen.

8. A112102 PD Test Checking Kit (Option)

This is an optional module. The A112102 is a PD Test Checking Kit that can be set to simulate abnormal discharge of different levels when the Model 11210 Battery Cell Insulation Tester is equipped with PD Tester Function Card (A112100) or PD Analyzer Function Card (A112101) for testing. It can also perform routine check on the Model 11210 for the embedded partial discharge detection function when other standard DUTs are in use.

8.1 Connection for PD Simulation

The A112102 front panel has 4 voltage input terminals that are composed of two equipotential BNC terminals and two equipotential concave terminals. The lower connectors can use the enclosed test cables to connect to the 11210 leakage current test terminals while the other two connectors can connect to the DUT. **Make sure that the DUT polarity is correctly connected.** The DUT negative terminal should connect to the A112102 HV(-) red concave terminal, and the positive terminal should connect to the A112102 HV(+) BNC terminal as shown in *Figure 8-1*.

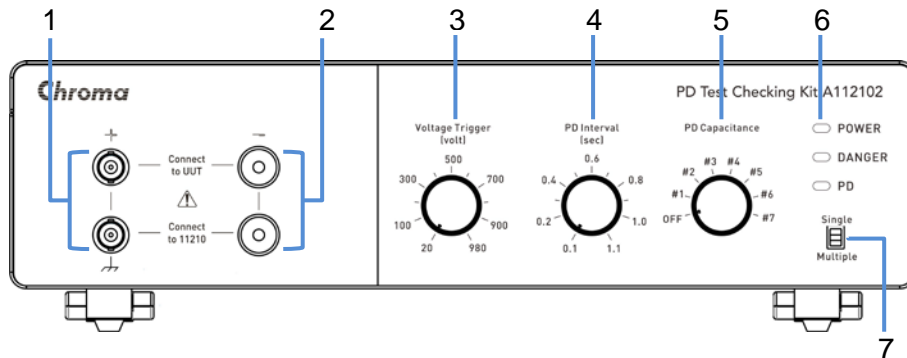


Figure 8-1 Connection for PD Simulation

⚡ CAUTION Be aware of high voltage output hazard as the voltage input terminal can be up to DC 1000V. Do not touch the voltage input terminal, test cables and DUT especially during testing to avoid electric shock. Do not remove the DUT before the 11210 test procedures are completed as voltage may exist on the DUT and cause danger.

8.2 Panel Description

8.2.1 Front Panel



(1) Voltage Input Terminal (+)

There are two equipotential BNC terminals where the lower one connects to the 11210 current test terminal and the upper one connects to the DUT. See *Figure 8-1* for the cable connecting diagram.

(2) Voltage Input Terminal (-)

There are two equipotential concave terminals where the lower one connects to the 11210 current test terminal and the upper one connects to the DUT. See *Figure 8-1* for cable connecting diagram. As the terminal input voltage is very high [V (DC) = 0V ~ -1000V], be aware of high voltage hazard

WARNING Do not touch the test terminal or the DUT when the light of testing status is on or blinks.

(3) Voltage Trigger Rotary Knob

It sets the triggering voltage ranged from 20V to 980V. When the 11210 output voltage is set higher than the set trigger voltage, the A112102 will start sending out partial discharge simulation signals. In the meantime, the orange PD LED light on the front panel will blink. If the 11210 output voltage is lower than the set trigger voltage, the A112102 does not act but there is still high voltage input and the DANGER LED red light on the panel will be always on.

CAUTION When the A112102 PD LED blinks but the 11210 does not show any PD measurements and PD fail messages, it means the A112102 has sent out the partial discharge simulation signal, but the signal level is smaller than the 11210 PD Compare setting (see section 6.4.2), thus no PD relate info is displayed.

(4) PD Interval Rotary Knob

It sets the partial discharge time interval ranged in the range of 0.1sec ~1.1sec. The user can use time interval and test time to count the total partial discharge numbers. This knob is invalid when the PD mode sets to Single.

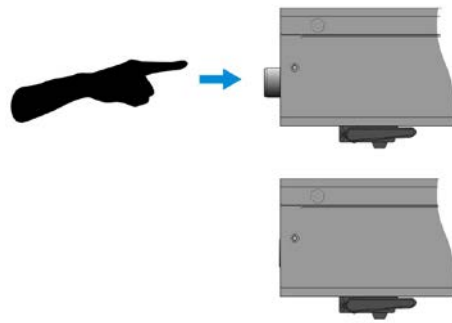


Figure 8-2 Hiding Rotary Knob Diagram

Notice

1. When the settings are done, the Voltage Trigger and PD Interval rotary knobs can be pressed down to hide them inside the device as shown in *Figure 8-2* to reduce the chance of wrong touch.
2. Press the rotary knob again and it will return to its initial state for reset.

(5) PD Capacitance Rotary Knob

It sets the level for partial discharge. The range is OFF, #1~#7. When it is set to OFF, the A112102 will not send out partial discharge simulation signals even if the 11210 output voltage is higher than the trigger voltage. When setting to #1~#7, the levels are from small to large under the same test conditions; however, the level sizes of partial discharge are varied based on different test conditions.

(6) Status indicators: There are 3 LED lights.

- POWER: When the **green** light is on, it means the A112102 is running normally.
- DANGER: When the **red** light is on, it means inputting high voltage for testing. **Do not touch the voltage input terminal at this time.**
- PD: When the **orange** light blinks, it means the 11210 output voltage is higher than the set triggering voltage, and the A112102 sends out partial discharge signal.

WARNING

Do not touch the test terminal or the DUT when the light of testing status is on or blinks.

(7) Partial Discharge Mode Switch

It adjusts the A112102 partial discharge signal sending out mode to Single and Multiple.

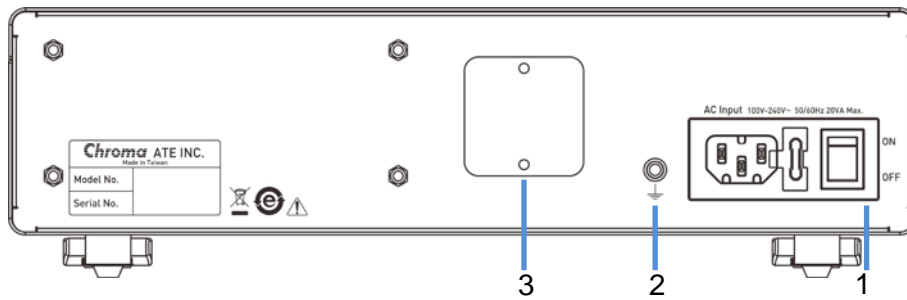
When set to Single,

- Only one partial discharge is occurred during the entire test. If the PD level is higher than the PD Compare set by 11210 (see section 6.4.2 *PD Compare*), the 11210 panel will show VPD times 1 when the test ends.
- DANGER light is always on during testing while the PD light only blinks once.

When set to Multiple,

- The A112102 will follow the PD interval set to send out PD simulation signal continuously, and the 11210 panel will show multiple VPD and CPD measurement results when the test ends.
- DANGER light is always on while the PD light blinks continuously.

8.2.2 Rear Panel



(1) Power Inlet (AC Line)

(2) Grounding Terminal

This terminal directly connects the kit case to the ground preventing external interference and avoiding floating contact on the kit to affect its safety.

(3) Bipolar Input Switch (Engineering mode)

This function is for engineering development use. When the cover on the rear panel is unlocked, there is a switch inside as *Figure 8-3* shows. **It could cause the A112102 and input source to be damaged** if the switch type is changed arbitrary and non 11210 input source is used. To use this function, please contact Chroma for assistance.

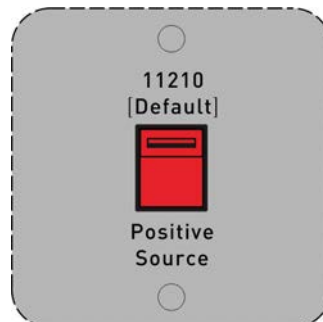


Figure 8-3 Bipolar Input Switch



WARNING This function is for engineering use and may cause damage to the kit if used arbitrarily. To use this function, please contact Chroma for assistance.

8.3 Example of Integration Test

The 11210 needs to install A112100 or A112101 interface card to connect with the A112102. See cable connection shown in Figure 8-1.

	Test Parameter	Parameter	Default Value
11210	Insulation Test	Test Voltage ^{*1}	100V / 500V / 1000V
		Charge Current	1mA
		LC Range	20mA
		Trigger Mode	Manual
		Integration Time	1PLC
		Charge Time	2000ms
		Dwell Time	2000ms
		Test Time	2000ms
	PD Compare	VPD Level	1
		VPD Level	1
A112102	PD Simulation Test	Voltage Trigger	20V
		PD Interval	0.4s
		PD Capacitance ^{*2}	#1~#7
		Partial Discharge	Multiple

^{*1} Test Voltage = 100V / 500V / 1000V

^{*2} PD Capacitance = #1~#7

Typical values of measured level (Connect to DUT: The equivalent capacitance is about 0.1uF.)



PD	11210 Test Voltage	#1	#2	#3	#4	#5	#6	#7
VPD	100V	NA	NA	NA	NA	NA	NA	4~9
	500V	NA	NA	4~9	9~15	13~19	20~27	31~38
	1000V	4~10	8~13	11~17	21~28	28~32	41~51	60~76
CPD	100V	NA	NA	NA	NA	NA	NA	4~9
	500V	NA	NA	4~9	9~15	12~19	19~27	34~41
	1000V	4~10	8~13	11~17	21~29	30~37	46~56	69~85

Table 8-1 Connect to DUT 0.1uF - Typical Values of PD Occurrence Level

Typical values of measured level (Not connect to DUT):



PD	11210 Test Voltage	#1	#2	#3	#4	#5	#6	#7
VPD	100V	NA	NA	NA	NA	3~8	6~11	10~15
	500V	4~9	8~12	11~16	20~26	27~33	42~48	63~73
	1000V	11~17	17~24	24~31	44~49	58~63	NA	NA
CPD	100V	NA	NA	NA	NA	3~8	6~11	10~15
	500V	4~9	8~12	11~16	20~26	27~33	43~53	69~76
	1000V	11~17	17~24	24~31	46~53	60~70	NA	NA

Table 8-2 Not Connect to DUT - Typical Values of PD Occurrence Level

- ⚡ CAUTION**
- The PD measurement function of 11210 is to detect the voltage and current change. When the DUT is connected, the voltage and current change on the line is more moderate during open circuit. In general test, the DUT equivalent capacitance can be measured is about 0.1uF to 10uF. The above mapping table shows the Level typical values of DUT in 0.1uF capacitance and without connecting to it.
 - DUT specification: Polypropylene Film (PP) Capacitor 0.1uF/1000Vdc/5%.

8.3.1 11210 and A112102 Setup

Assuming the test voltage is 500V when not connected to DUT, the expected PD simulation signal level is about 30. From Table 8-2, we know the capacitance is #5 as the VPD and CPD level is about 27~33.

8.3.1.1 Setting Test Parameters

For the IR/LC measurement related settings and parameters, please see section 5.3.1, 5.3.2 and 5.3.3. See section 6.4 and 6.4.2 for setting PD Compare parameters.

	Test Parameter	Parameter	Default Value
11210	Insulation Test	Test Voltage	500V
		Charge Current	1mA
		LC Range	20mA
		Trigger Mode	Manual
		Integration Time	1PLC
		Charge Time	2000ms
		Dwell Time	2000ms
		Test Time	2000ms
	PD Compare	VPD Level	1
		VPD Level	1

8.3.1.2 Setting A112102 Parameters

	Test Parameter	Parameter	Default Value
A112102	PD Simulation Test	Voltage Trigger	20V
		PD Interval	0.4s
		PD Capacitance	#5
		Partial Discharge	Multiple

Setting Voltage Trigger:

Since the test voltage is 500V, the A112102 will send out PD simulation signals as long as the voltage trigger is set to less than the test voltage (500V). In this example, the trigger is set to **20V**.

Setting PD Capacitance:

For 500V test voltage, select #5 as the mapping capacitance that has 27~33 of occurrences.

Setting PD Interval:

The times of PD simulation signal is related to the PD Interval. VPD is the PD signals occurred within Charge Time while CPD is the PD signal occurred in Dwell Time and Test Time. The PD simulation signal occurrence times can be calculated following this rule.

$$\text{VPD times} = (\text{Charge Time}) / \text{PD Interval} + 1$$

$$\text{CPD times} = (\text{Dwell Time} + \text{Test Time}) / \text{PD Interval}$$

This example set the PD Interval to **0.4s**, thus the number of times is computed as below:

VPD: $(2s / 0.4s) + 1 = 6$ times
 CPD: $(2s + 2s) / 0.4 = 10$ times

8.3.2 Results of Integration Test Example

	Parameter	Default Value	Result
11210	Test Voltage	500V	11210 measure: VPD Times = 6 VPD Level = 27~33 CPD Times = 10 VPD Level = 27~33 Note: $\text{VPD Times} = \frac{\text{Charge Time}}{\text{PD Interval}} + 1$ $\text{CPD Times} = \frac{\text{Dwell Time} + \text{Test Time}}{\text{PD Interval}}$
	Charge Current	1mA	
	LC Range	20mA	
	Trigger Mode	Manual	
	Integration Time	1PLC	
	Charge Time	2000ms	
	Dwell Time	2000ms	
	Test Time	2000ms	
	VPD Level	1	
	VPD Level	1	
A112102	Voltage Trigger	20V	
	PD Interval	0.4s	
	PD Capacitance	#5	
	Partial Discharge	Multiple	

9. Handler Interface

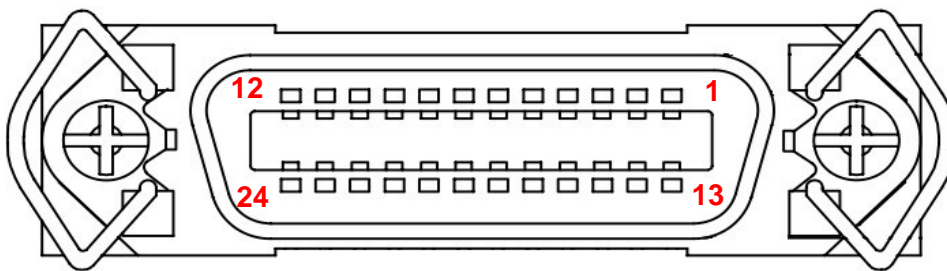
It is connected to external unit by Handler interface. The connector is 24-pin, and its pin assignment is described as below.

9.1 Specification

9.1.1 Driving Capability

It provides external DC source to +Vext terminal with input voltage range +5V~+24V while executing automated measurement. Use GND pin for low voltage terminal of external DC voltage input & input/output signal. The maximum output current of output signal terminal is 5mA. The inside of the tester provides a set of +5V DC voltage which supports 50mA output current maximally.

9.1.2 Pin Assignment



Pin No.	Signal	Input/Output	Default Value	Description
1	/EXT	Input (I/P)	X	It turns from HIGH to LOW when external input is START signal. The detail description as <i>Figure 9-1</i> shows.
2	/RESET	Input (I/P)	X	1. Reset output is OFF status. 2. Reset O/P PIN returns to default value.
3	/TEST	Output (O/P)	Hi-Z	Test in process
4	Reserved signal # 1	Output (O/P)	X	Reserved output signal # 1
5-8	GND	-	X	External DC source grounding
9	Reserved signal # 2	Output (O/P)	X	Reserved output signal # 2
10	VEXT	Input (I/P)	X	External DC voltage power input, input voltage range is from +5Vdc to 24Vdc.
11	Vext_5V	Output (O/P)	X	External DC voltage +5V (maximum output current is 50mA)
12,13	X	-		N.C
14	/C_CHK_FAIL	Output (O/P)	Low	Contact check fail
15	/PASS	Output (O/P)	Hi-Z	Total PASS contains Compare pass, Contact check pass, Charge/Discharge pass and

				Partial discharge detection pass.
16	/PD_Fail	Output (O/P)	Low	Partial discharge detection fail
17	/FAIL	Output (O/P)	Low	Total FAIL contains Compare fail, Contact check fail, Charge/Discharge fail or Partial discharge detection fail.
18	/EOT	Output (O/P)	Low	End of Test
19	/HI	Output (O/P)	Low	<ol style="list-style-type: none"> LC test value is higher than the high limit; IR test value is lower than the low limit. The test voltage is abnormal or the measured current is out of the measurement range in test time during test procedure. The WV actual voltage is larger than the set voltage.
20,24	X	-		N.C
21	/LO	Output (O/P)	Low	LC test value is lower than the low limit; IR test value is higher than the high limit.
22	/ACQ	Output (O/P)	Low	Analog acquisition end, move the next DUT to test terminal of 11210. Refer nACQ Activation setting in SYSTEM CONFIG.
23	/FAIL_CHG_D ISCHG	Output (O/P)	Low	<ol style="list-style-type: none"> Charge or discharge fails WV discharge fails

Table 9-1 I/O Interface Control Signal Table

9.2 Reference Table of Handler Interface Signal Result

	/PASS	/FAIL	/HI : (L.C. High) (I.R. Low)	/LO (L.C. Low) (I.R. High)	/FAIL_CHG _DISCHG	/C_CHK FAIL	/PD_FAIL	Reserve
Total Pass	●	○	○	○	○	○	○	○
Charge Fail	○	●	○	○	●	○	○	○
Overload	○	●	●	○	○	○	○	○
High	○	●	●	○	○	○	○	○
Low	○	●	○	●	○	○	○	○
Contact Check Fail	○	●	○	○	○	●	○	○
Partial Discharge Fail	○	●	○	○	○	○	●	○
AUTO RANGE Fail	○	●	○	○	○	○	○	○

9.3 Example of External Control Circuit

HANDLER control interface mainly includes two types - Input Port (I/P) and Output Port (O/P).

9.3.1 HANDLER Control Interface- Input Port (I/P)

Example of Input Port (I/P) circuit applies the general connection as *Figure 9-1* shows. Take control circuit application of external input START signal as an example. The trigger is done when external input START signal trigger activating ($/EXT$ is Low) and the optical coupler inside of the machine is ON. The inner action principle transmitted control signal of conduction state is through optical coupler. The level is LOW when it is with action and the level is high when it is without action.

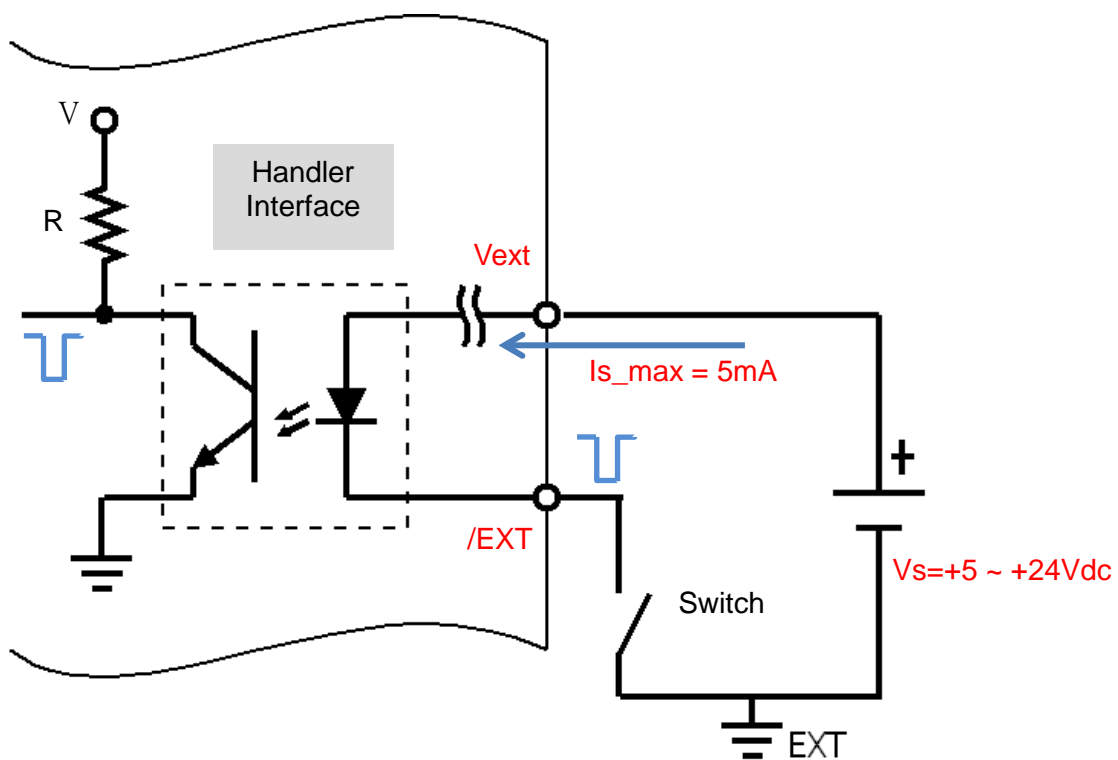


Figure 9-1 Example of $/EXT$ Control Circuit

9.3.2 HANDLER Control Interface - Output Port (O/P)

Example of Output Port (O/P) circuit applies the general connection as *Figure 9-2* shows. The typical I_o current is 5mA. The selection of external resistance (R_{o-ext}) will be varied by external DC voltage source V_s . Take +5Vdc and +24Vdc as example in below figure, the selected resistances are 1k Ω and 4.8k Ω .

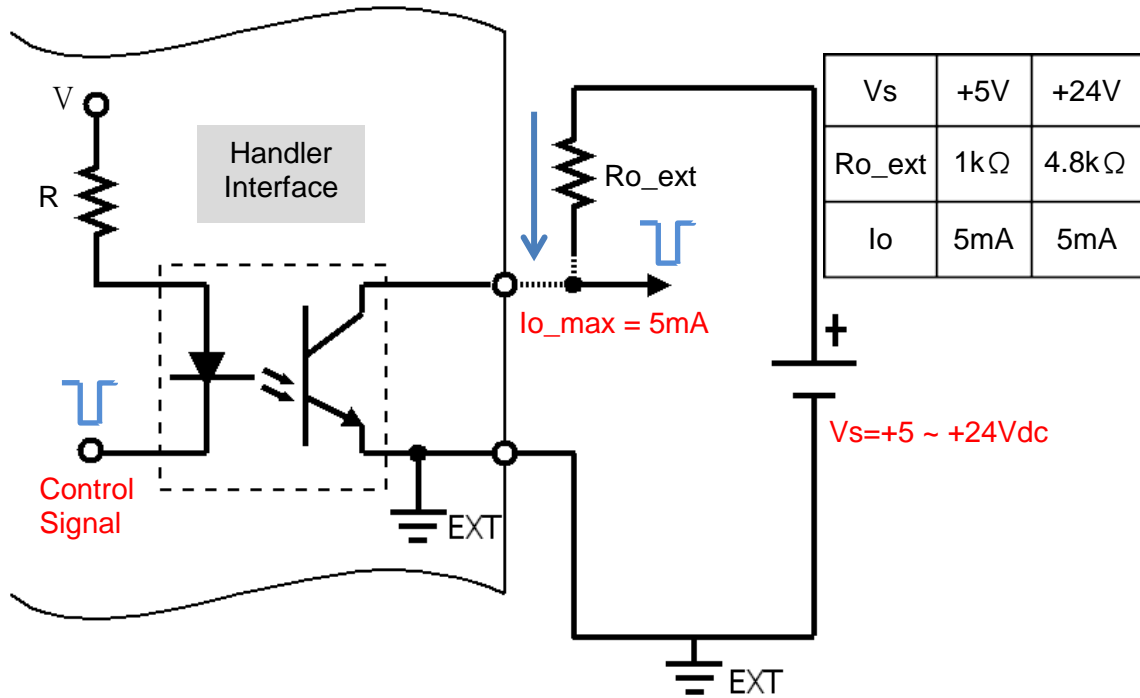
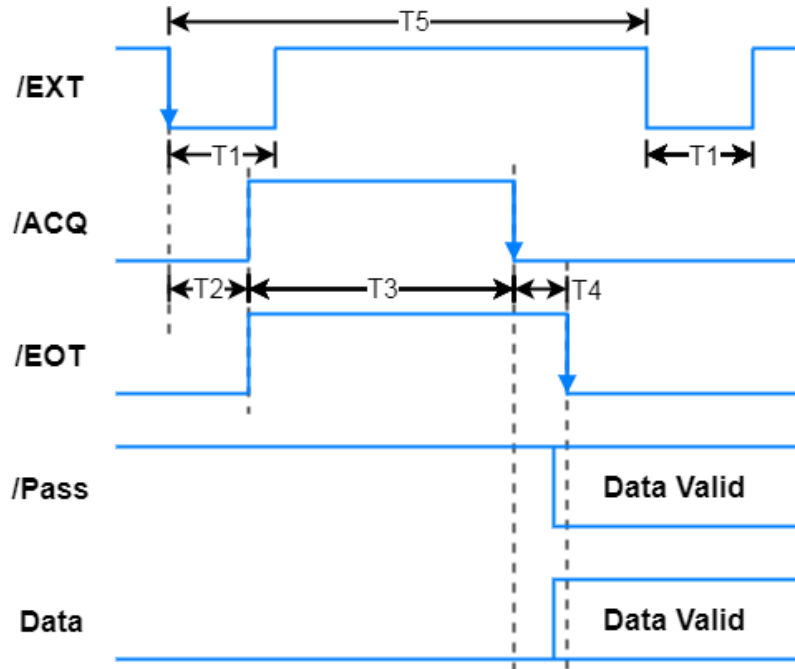


Figure 9-2 Example of HANDLER Interface Output Circuit

9.4 Pin Timing Diagram of Handler Interface

Test conditions: Test Voltage 1000V, C.C. 50mA, Hold Range 20mA, Charge Time 5ms, Dwell Time 5ms, Integration Time 1ms



Descriptions for various signals are as the following:

T1: Pulse width of trigger signal

T2: Measurement delay time

T3: Required time for measuring an entry of test value

T4: Data transfer time

T5: Measurement the shortest interval time between two entries of test values

Data: It includes judgment signals of /FAIL, /C_CHK FAIL, /PD_Fail, /HI, /LO, /FAIL_CHG_DISCHG, etc.

Contact Check	PD Detection	T1 (min)	T2 (Typ.)	T3 (Typ.)	T4 (Typ.)	T5 (Typ.)
OFF	ON/OFF	2ms	1.8ms	26ms	2ms	35ms
ON	ON/OFF	2ms	1.8ms	29ms	2ms	40ms

10. SCPI Command

10.1 Data Format

Frequently used symbols are given as below table.

Name	Symbol	Description
Angle brackets	< >	The item in angle brackets is parameter format abbreviation. Ex.: INPut[:STATe] <Boolean> indicates that the command can accept the parameter with Boolean format.
Straight line		Straight line separates the parameters which can be replaced.
Square brackets	[]	The item in square brackets is a selection one. Ex.: INPut[:STATe] <Boolean> indicates that STATe can be omitted.
Curly brackets	{ }	Curly bracket indicates that the parameter can be repeated. <A> {<, B>} is noted at the right column which indicates parameter "A" to be inputted, whereas parameter "B" can be omitted or input for once or several times.

The parameter format abbreviation can be accepted by the command are given as below table.

Parameter Format Abbreviation	Description	Example
Character parameter	The character parameter is with long/short two kinds of format. The written method is the first half with uppercase character and the second half with lowercase character. The lowercase omitted is short format. For example, long format of MINimum parameter is MINIMUM and short format is MIN.	MAXIMUM, MAX
NR1	The value is without a decimal point. The decimal point is at the right side of the last significant figure.	123, 0123
NR2	The value includes decimal point.	12.3, 0.123
NR3	The value includes decimal point and exponent.	1.23E+2
NRf	Flexible decimal format, NR1, NR2 and NR3 are included.	123, 12.3, 1.23E+3
NRf+	Expanded decimal format, NRf, MINimum and MAXimum are included. MINimum and MAXimum are minimum and maximum limit of the parameter.	123, 12.3, 1.23E+3, MIN, MAX
Boolean	Boolean variable. It can accept character format of ON, OFF and digital format of 1 (ON), 0 (OFF).	ON, 1, OFF, 0

All commands and response messages are transmitted in ASCII code format. Before sending the new command, the response message needs to be read totally. Otherwise, the remaining response message will be disappeared and a query interrupted error will be generated.

Every program message needs to add termination character at last, it represents to end program message. The termination character is ASCII new line character (line feed), ASCII code byte is 0Ah (line feed). The device response message will use 0Ah as the end of response message.

10.2 Command List

10.2.1 IEEE-488.2

```
*CLS
*ESE <NR1>
*ESE?
*ESR?
*IDN?
*OPC
*OPC?
*RST
*SRE <NR1>
*SRE?
*STB?
```

10.2.2 SCPI

```
:DISPlay
|---:STATe?
|---:LCTest
|---:WVTest
|---:CONtact
|---:NULL
:ABORt
:TRIGger
|---:IMMEDIATE
|---:SOURce <NR1>
|---:DELay <NR2>
|---:EDGE <NR1>
:LCTest
|---:SOURce
|---|---:VOLTage <NRf>
|---|---:CURRent <NRf>
|---:CONFigure
|---|---:SPEed <NRf>
|---|---|---:CUSTomize <NRf>
|---|---:RANGe <NRf>
|---|---:TIME
|---|---|---:CHG <NR2>
|---|---|---:DWELL <NR2>
|---|---|---:TEST <NR2>
|---|---:BDV
|---|---|---:ENABle <NR1>
|---|---|---:MODE <NR1>
|---|---|---:VENDCONT <NR1>
|---|---|---:SOURce
|---|---|---|---:START <NRF>
|---|---|---|---:END?
|---|---|---:TIME
|---|---|---|---: REST <NRF>
```

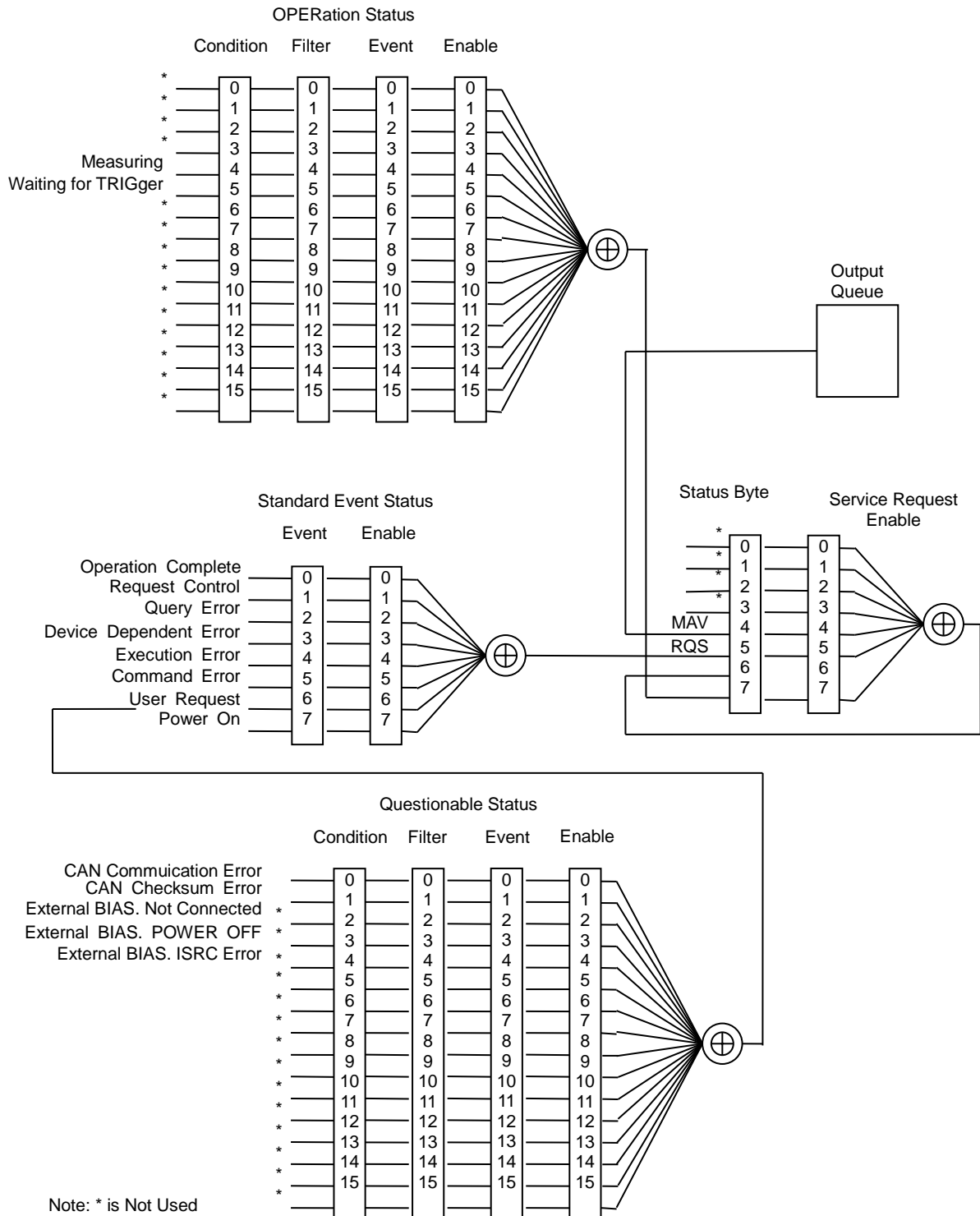
```

|---|---|---:STEP          <NR1>
|---:MEASure
|---|---:STATe?
|---|---:FETCh?
|---|---:IR?
|---|---:LC?
|---|---:VMON?
|---|---:VMEAS?
|---|---:PDV?
|---|---:PDI?
|---:DISPlay
|---|---:STATIStic
|---|---|---:CLEAr
:WVTest
|---:SOURce
|---|---|---:VOLTage      <NRF>
|---|---|---:CURRent     <NRF>
|---:CONFigure
|---|---:SPEed           <NR1>
|---|---|---:CUSTomize   <NRF>
|---:TIME
|---|---:DWELL           <NRF>
|---|---:TEST            <NRF>
|---:CONFigure
|---:MEASure
|---|---:STATe?
|---|---:FETCh?
|---|---:VMON?
|---|---:VMEAS?
:CORRection
|---:CONTact
|---|---:STATe
|---|---:NULL
|---|---|---[:IMMEDIATE]
|---|---:DUT
|---|---|---[:IMMEDIATE]
|---|---:VAL
|---|---:DATA?
|---:NULL
|---|---[:IMMEDIATE]
|---|---:STATe
|---|---:DATA?
|---|---:RES?
:CALCulate
|---|---:FORMat
|---:CLEAr
|---:RESult
|---:CONDition
|---|---[:LCT]
|---|---|---:LOWer
|---|---|---|---:DATA     <NRf>
|---|---|---|---:ENABle
|---|---|---:UPPer
|---|---|---|---:DATA     <NRf>

```

```
|---|---|---|---:ENABle
|---|---:PDV
|---|---|---:ENABle
|---|---|---:LEVEL
|---|---|---|---:DATA <NR1>
|---|---|---:TIMES
|---|---|---|---:DATA <NR1>
|---|---:PDI
|---|---|---:ENABle
|---|---|---:LEVEL
|---|---|---|---:DATA <NR1>
|---|---|---:TIMES
|---|---|---|---:DATA <NR1>
|---|---:WAVE
|---|---|---:ENABle
:SYSTem
|---:ALARM
|---:BEEPer
|---|---:IMMediate
|---|---:STATe
|---:CONTRast
|---:DISCHarge
|---|---:VOLTage
|---:LFrequency
|---:HANDler
|---:KLOCK
|---:DIGIts
|---:SOUND <NR1>
|---:DELTASTOP <NR1>
|---|---:VOLTage <NRf>
|---:PRESet
|---:ERRor
|---:CONFigure
|---|---:DATE <NRST>
|---|---:SAVE <NR1>
|---:AREPort
|---:MODule
|---:PROTection
|---|---:STATe
|---|---:LOG
|---|---|---:COUNT
|---|---:CLEar
:STATUS
|---:OPERation
|---|---:CONDition
|---|---:ENABle
|---|---:NTRansition
|---|---:PTRansition
|---:PRESet
|---:QUEStionable
|---|---:CONDition
|---|---:ENABle
:STORE
:RECALL
```


10.2.3 STATUS Configuration



10.3 Command Description

10.3.1 Common Command

***CLS**

It clears status data, actions need to be executed as the following.

- Clear error queue
- Clear standard event status register
- Clear status byte register

Set command format: *CLS

***ESE**

It sets standard event status enable register.

Set command format: *ESE <NR1>

Parameter: 0~255.

Query command format: *ESE?

Return data: <NR1>

***ESR?**

It queries standard event status register, clear the register after executed.

Query command format: *ESR?

Return data: <NR1>

***IDN?**

It queries the device basic data. The return data is separated by comma. The four fields are manufacturer, device model, serial number or 0, firmware version.

Query command format: *IDN?

Return data: manufacturer, model number, serial number or 0, firmware revision

***OPC**

Operation completion command. When *OPC command is performed and all operations are completed, OPC bit (bit 0) of standard event status register will be set.

Set command format: *OPC

***OPC?**

It queries operation completion command. When *OPC command is performed and all operations are completed, 1 will be returned.

Query command format: *OPC?

Return data: 1

***RST**

Device reset command, and the action needs to be executed as the following.

It enforces ABORt command.

It clears setting data to return to booting status.

Set command format: *RST

***SRE**

It sets service request enable register.

Set command format: *SRE <NR1>

Parameter: 0~255.

Query command format: *SRE?

Return data: <NR1>

***STB?**

It queries service request status register.

Query command format: *STB?

Return data: <NR1>

DISPlay Subsystem**DISPlay:STATe?**

It queries the display location currently.

Parameter: None

Return data: LC Test / Contact Check / LC Null

DISPlay:LCTest

It sets function screen to LC Test mode.

Set command format: DISPlay:LCTest

Parameter: None

Return data: None

DISPlay:WVTest

It sets the function screen to WV Test mode.

Set command format: DISPlay:WVTest

Parameter: None

Return data: None

DISPlay:CONtact

It sets function screen to Contact Check.

Set command format: DISPlay:CONtact

Parameter: None

Return data: None

DISPlay:NULL

It sets function screen to LC Null.

Parameter: None

Return data: None

Set command format: DISPlay:NULL

ABORt Subsystem**ABORt**

It aborts measurement procedure and enters DISCHARGE mode directly.

Set command format: ABORt

Parameter: None

Return data: None

TRIGger Subsystem**TRIGger:IMMediate**

It follows the mode on the screen currently to start measurement procedure.

Set command format: TRIGger:IMMediate

Parameter: None

Return data: None

TRIGger:SOURce

It sets or queries measurement trigger source currently.

Set command format: TRIGger:SOURce <NR1>

Parameter: <NR1>, 0(EXT), 1(MAN) and 2(BUS) are acceptable.

Return data: 0(EXT), 1(MAN) and 2(BUS)

TRIGger:DELAy

It sets or queries delay time of measurement trigger currently.

Set command format: TRIGger:SOURce {<NRf>|MIN|MAX}

Parameter: <NRf >, the range is from 0 to 9.999 with the unit of S. MIN and MAX are acceptable.

Return data: <NR2> is in the unit of S.

TRIGger:EDGE

It sets or queries measurement trigger edge currently (rising, falling edge), only in EXT trigger mode is valid.

Set command format: TRIGger:EDGE {<NR1>|FALL|RISI}

Parameter: <NR1>, 0(FALL) and 1(RISI) are acceptable.

Return data: 0(FALL) and 1(RISI)

LCTest Subsystem

LCTest:SOURce:VOLTage

It sets or queries output voltage.

Set command format: LCTest:SOURce:VOLTage {<NRf>|MIN|MAX}

Parameter: <NRF>, the range is from 1 to 1000V.

MAX: 1000V and MIN: 1V are acceptable.

Return data: <NR2> is in the unit of V.

LCTest:SOURce:CURREnt

It sets or queries output current.

Set command format: LCTest:SOURce:CURREnt {<NRf>|MIN|MAX}

Parameter: <NRF>, the range is from 0.5 to 50 (mA).

MAX:50mA and MIN:0.5mA are acceptable.

Return data: <NR2> is in the unit of mA.

LCTest:CONFigure:SPEEd

It sets or queries measurement integration time.

Set command format:

LCTest:CONFigure:SPEEd {<NR1>|1ms|4ms|1PLC|100ms|500ms}

Parameter: <NR1>, 0(1ms), 1(4ms), 2(1PLC), 3(100ms), 4(500ms) and 5(CUST) are acceptable.

Return data: <NR1>

LCTest:CONFigure:SPEEd:CUSTomize

It sets or queries customized measurement integration time.

Set command format: LCTest:CONFigure:CUSTomize {<NRf>|MIN|MAX }

Parameter: <NRf>, the range is from 0 to 9.999 with the unit of S. MIN and MAX are acceptable.

Return data: <NR2> is in the unit of S.

LCTest:CONFigure:RANGe

It sets or queries measurement current range.

Set command format:

LCTest:SOURce:RANGe {<NR1>|20mA|2mA|200uA|20uA|2uA|200nA|20nA}

Parameter: <NR1>, 0(20mA), 1(2mA), 2(200uA), 3(20uA), 4(2uA), 5(200nA), 6(20nA) and 7(AUTO) are acceptable.

Return data: 0(20mA), 1(2mA), 2(200uA), 3(20uA), 4(2uA), 5(200nA), 6(20nA) and 7(AUTO).

LCTest:CONFigure:RANGe:AUTO

It sets or queries auto measurement current range.

Set command format:

LCTest:CONFigure:RANGe:AUTO {<NR1>|ON|OFF}

Parameter: <NR1> 0:OFF and 1:ON

Return data: <NR1> 0:OFF and 1:ON

LCTest:CONFigure:TIME:CHG

It sets or queries charge time during measurement procedure.

Set command format: LCTest:CONFigure:TIME:CHG {<NRf>|MIN|MAX}

Parameter: <NRF>, the range is from 0.005 to 9.999 s.

MAX: 9.999s and MIN:0.005s are acceptable.

Return data: < NRF > is in the unit of S.

LCTest:CONFigure:TIME:DWELL

It sets or queries dwell time during measurement procedure.

Set command format: LCTest:CONFigure:TIME:DWELL {<NRf>|MIN|MAX}

Parameter: <NRF>, the range is from 0.005 to 9.999 s.

MAX: 9.999s and MIN: 0.005s are acceptable.

Return data: < NRF > is in the unit of S.

LCTest:CONFigure:TIME:TEST

It sets or queries test time during measurement procedure.

Set command format: LCTest:CONFigure:TIME:TEST {<NRf>|MIN|MAX}

Parameter: <NRF>, the range is from 0.005 to 9.999 s.

MAX: 9.999s and MIN:0.005s are acceptable.

Return data: < NRF > is in the unit of S.

LCTest:CONFigure:BDV:ENABLE

It sets or queries the enablement status of LC BDV function.

Set command format: LCTest:CONFigure:BDV:ENABLE {<NR1>|ON|OFF}

Parameter: <NR1> 0:OFF, 1:ON

Return data: <NR1> 0:OFF, 1:ON

LCTest:CONFigure:BDV:MODE

It sets or queries the LC BDV function mode.

Set command format: LCTest:CONFigure:BDV:MODE{<NR1>}

Parameter: <NR1> 0: Sequence, 1: Stair

Return data: <NR1> 0: SEQ., 1: STAIR

LCTest:CONFigure:BDV:VENDCONT

It sets or queries the enablement status of LC BDV Vend continuous mode.

Set command format: LCTest:CONFigure:BDV:VENDCONT{<NR1>|ON|OFF}

Parameter: <NR1> 0: OFF, 1: ON

Return data: <NR1> 0: OFF, 1: ON

LCTest:CONFigure:BDV:SOURce:START

It sets or queries the start voltage of BDV mode.

Set command format: LCTest:CONFigure:BDV:SOURce:START {<NRf>|MIN|MAX}

Parameter: <NRf>, the range is 1~1000V.

MAX: 1000V and MIN: 1V are acceptable.

Return data: <NR2> the unit is V.

LCTest:CONFigure:BDV:SOURce:END?

It queries the end voltage of BDV mode (linked with LCTest Voltage Set).

Query command format: LCTest:CONFigure:BDV:SOURce:END?

Return data: <NR2> the unit is V.

LCTest:CONFigure:BDV:TIME:REST

It sets or queries the step rest time in Sequence mode during BDV measurement.

Set command format: LCTest:CONFigure:TIME:TEST {<NRf>|MIN|MAX}

Parameter: <NRf>, the range is 0.005 ~ 9.999s.

MAX: 9.999s and MIN: 0.005s are acceptable.

Return data: <NRf> the unit is S

LCTest:CONFigure:BDV:STEP

It sets or queries the step number during BDV measurement.

Set command format: LCTest:CONFigure:BDV:STEP {<NR1>|MIN|MAX}

Parameter: <NR1>, the range is 2 ~ 1001s.

MAX:2 steps and MIN:1001 steps are acceptable.

Return data: <NR1> the unit is step.

LCTest:CONFigure?

It sets or queries all parameters of measurement function.

Set command format: LCTest:CONFigure?

Parameter: None

Return data: There are 22 entries of parameters, refer return method of individual command for parameter return format. Test Voltage, Charge Current, Range, Trigger Mode, Integration Time, Customize Integration Time, Charge Time, Dwell Time, Test Time, Compare High Enable, Compare Low Enable, Compare Parameter, Upper Value, Lower Value, Contact Check Enable, Null Enable, BDV Enable, BDV Mode, BDV Step times, BDV Rest time, BDV Start Voltage, BDV Vend Continue.

LCTest:MEASure:STATe?

It queries the state of measurement procedure currently.

Set command format: LCTest: MEASure:STATe?

Parameter: None

Return data: IDLE, CHG, DWELL, TEST

LCTest:MEASure:FETCh?

It queries measurement result of measurement procedure currently.

Set command format: LCTest:MEASure:FETCh?

Parameter: None

Return data:

When measuring under LC mode and PD Tester function is disabled.

<NR3> DUT Test Voltage, unit: V

<NR3> LC Test Result, unit: mA

<NR3> Reserved

<NR1> Measurement Condition ID, in decimal format, ID definition as follows

When measuring under IR mode and PD Tester function is disabled.

<NR3> DUT Test Voltage, unit: V

<NR3> IR Test Result, unit: Ohm

<NR3> Reserved

<NR1> Measurement Condition ID, in decimal format, ID definition as follows.

When measuring under LC mode and PD Tester function is enabled.

<NR3> DUT Test Voltage, unit: V

<NR3> LC Test Result, unit: mA

<NR3> Reserved

<NR1> PDV Level, unit: None

<NR1> PDV Times, unit: Times

<NR1> PDI Level, unit: None

<NR1> PDI Times, unit: Times

<NR1> Measurement Condition ID, in decimal format, ID definition as follows

When measuring under IR mode and PD Tester function is enabled.

<NR3> DUT Test Voltage, unit: V

<NR3> IR Test Result, unit: Ohm

<NR3> Reserved

<NR1> PDV Level, unit: None

<NR1> PDV Times, unit: Times

<NR1> PDI Level, Unit: None

<NR1> PDI Times, Unit: Times

<NR1> Measurement Condition ID, in decimal format, ID definition as follows

Measurement Condition	Condition ID	Measurement Condition	Condition ID
Total PASS	0	/Discharge Fail	1
Charge Fail	2	Contact Check Fail	3
LC Low / IR High	4	LC High / IR Low	5
LC Over Range	6	Auto Range Fail	7
PD Fail	8	Trigger Stop	9

LCTest:MEASure:IR?

It queries insulation resistance value of LC measurement result currently.

Set command format: LCTest:MEASure:IR?

Parameter: None

Return data: <NR2>, the unit: Ohm

LCTest:MEASure:LC?

It queries leakage current value of LC measurement result currently.

Set command format: LCTest:MEASure:LC?

Parameter: None

Return data: <NR2>, the unit: mA

LCTest:MEASure:VMEAS?

It queries DUT maximum voltage of LC measurement result currently.

Set command format: LCTest:MEASure:VMEAS?

Parameter: None

Return data: <NR2>, the unit: V

LCTest:MEASure:VMON?

It queries the 11210 output voltage currently.

Set command format: LCTest:MEASure:VMON?

Parameter: None

Return data: <NR2>, the unit: V

LCTest:MEASure:PDV?

It queries the currently level and times of VPD test result.

Set command format: LCTest:MEASure:PDV?

Parameter: None

Return data: <NR1>, the unit: Times, <NR1>, the unit: Level

LCTest:MEASure:PDI?

It queries the currently level and times of CPD test result.

Set command format: LCTest:MEASure:PDI?

Parameter: None

Return data: <NR1>, the unit: Times, <NR1>, the unit: Level

LCTest:DISPlay:CLEar

It clears the statistics data on the screen (including PASS amount, FAIL amount, total measured number and fail rate).

Set command format: LCTest:DISPlay:CLEar

Parameter: None

Return data: None

WVTest Subsystem

WVTest:SOURce:VOLTage

It sets or queries the output voltage limit.

Set command format: WVTest:SOURce:VOLTage {<NRf>|MIN|MAX}

Parameter: <NRf>, the range is 1~1000V.

MAX: 1000V and MIN: 1V are acceptable.

Return data: <NR2> the unit is V.

WVTest:SOURce:CURREnt

It sets or queries the output current.

Set command format: WVTest:SOURce:CURREnt {<NRf>|MIN|MAX}

Parameter: <NRf>, the range is 0.5 ~ 50 (mA).

MAX: 50mA and MIN: 0.5mA are acceptable.

Return data: <NR2> the unit is mA.

WVTest:CONFigure:SPEed

It sets or queries the measurement integration speed (linked with LCTest parameter).

Set command format: WVTest:SOURce:SPEed

{<NR1>|1ms|4ms|1PLC|100ms|500ms}

Parameter: <NR1>, 0(1ms), 1(4ms), 2(1PLC), 3(100ms), 4(500ms), and 5(CUST) are acceptable.

Return data: <NR1>

WVTest:CONFigure:SPEed:CUSTomize

It sets or queries the customized measurement integration speed (linked with LCTest parameter).

Set command format: WVTest:CONFigure:CUSTomize {<NRf>|MIN|MAX }

Parameter: <NRf>, the range is 0~9.999, unit: S. MIN and MAX are acceptable.
Return data: <NR2> the unit is S.

WVTest:CONFigure:TIME:DWELL

It sets or queries dwell time during measurement.
Set command format: WVTest:CONFigure:TIME:DWELL {<NRf>|MIN|MAX}
Parameter: <NRF>, the range is 0.005 ~ 99.999s.
MAX: 99.999s and MIN: 0.005s are acceptable.
Return data: <NRF> the unit is S.

WVTest:CONFigure:TIME:TEST

It sets or queries the test time during measurement.
Set command format: WVTest:CONFigure:TIME:TEST {<NRf>|MIN|MAX}
Parameter: <NRF>, the range is 0.005 ~ 99.999s.
MAX:99.999s and MIN:0.005s are acceptable.
Return data: <NRF> the unit is S.

WVTest:CONFigure?

It queries all parameters of measurement function.
Set command format: WVTest:CONFigure?
Parameter: None
Return data: There are 9 parameters, WV Voltage Limit , WV Charge Current, Trigger Mode, Integration Time, Customize Integration Time, Dwell Time, Test Time, and Contact Check Enable. Refer to each command for its return format.

WVTest:MEASure:STATe?

It queries the measurement status at present.
Set command format: WVTest:MEASure:STATe?
Parameter: None
Return data: IDLE, CHG, DWELL and TEST

WVTest:MEASure:FETCh?

It queries the measured result during measurement.
Set command format: WVTest:MEASure:FETCh?
Parameter: None
Return data:
<NR3> DUT Test Voltage, unit: V
<NR3> Reserved
<NR1> Measurement Condition ID, in decimal format, ID definition as follows:

Measurement Condition	Condition ID	Measurement Condition	Condition ID
Total PASS	0	/Discharge Fail	1
Voltage Limit Fail	6	Trigger Stop	9

WVTest:MEASure:VMEAS?

It queries the DUT highest voltage of LC measured result.
Set command format: WVTest:MEASure:VMEAS?
Parameter: None
Return data: <NR2>, unit: V

WVTest:MEASure:VMON?

It queries the 11210 output voltage at present.

Set command format: WVTest:MEASure:VMON?

Parameter: None

Return data: <NR2>, unit: V

CORRection Subsystem

CORRection:CONtact:STATe

It sets or queries Contact Check enabled state.

Set command format: CORRection:CONtact:STATe {<NR1>|ON|OFF}

Parameter: <NR1> 0:OFF, 1:ON

Return data: <NR1> 0:OFF, 1:ON

CORRection:CONtact:NULL[:IMMediate]

It enables measurement Contact Check NULL.

Set command format: CORRection:CONtact:NULL

Parameter: None

Return data: <NR1>

CORRection:CONtact:DUT[:IMMediate]

It enables measurement Contact Check DUT.

Set command format: CORRection:CONtact:DUT

Parameter: None

Return data: <NR1>

CORRection:CONtact:VAL

It sets Contact Check VAL.

Set command format: CORRection:CONtact:VAL {<NR1>|MIN|MAX}

Parameter: <NR1>, None, MAX: 32768 acceptable, MIN:0

Return data: < NR1> no unit

CORRection:CONtact:DATA?

It queries Contact Check Null, DUT and calculated Contact Check judgment value (VAL).

Set command format: CORRection:CONtact:DATA?

Parameter: None

Return data: <NR1>, <NR1>, <NR1> NULL, DUT, VAL

CORRection:NULL:STATe

It sets or queries LC Null enabled state.

Set command format: CORRection:NULL:STATe {<NR1>|ON|OFF}

Parameter: <NR1> 0: OFF, 1: ON

Return data:<NR1> 0: OFF, 1: ON

CORRection:NULL

It conducts LC Null measurement.

Set command format: CORRection:NULL

Parameter: None

Return data: None

CORRection:NULL:DATA?

It queries measurement result of each LC Null range.

Set command format: CORRection:NULL:DATA?

Parameter: None

Return data: <NR1> 0: PASS, 1: FAIL
I/O Condition, in decimal format, bit definition as follows:

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

CORRection:NULL:RESult?

It queries measurement data of each LC Null range.
Set command format: CORRection:NULL:RESult?
Parameter: None
Return data: <NRf>,<NRf>,<NRf>,<NRf>,<NRf>,<NRf>,<NRf>, the unit: mA.

CALCulate Subsystem

CALCulate:LIMit:FORMat

It sets or queries basis parameter (IR/LC) for judging Pass/Fail.
Set command format: CALCulate:LIMit:FORMat {<NR1>|IR|LC}
Parameter: <NR1> 0: LC, 1: IR
Return data: <NR1> 0: LC, 1: IR

CALCulate:CLEar

It clears measured and compared judgment result.
Set command format: CALCulate:CLEar
Parameter: None
Return data: None

CALCulate:RESult?

It displays measured and compared judgment result.
Set command format: CALCulate:RESult?
Parameter: None
Return data: <NR1> 0: No Result, 1: FAIL, 2: PASS

CALCulate:CONDition[:LCT]:LOWer:ENABLE

It sets or queries enabled compare function (lower limit).
Set command format: CALCulate:CONDition[:LCT]:LOWer:ENABLE
{<NR1>|ON|OFF}
Parameter: <NR1> 0: OFF, 1: ON
Return data: <NR1> 0: OFF, 1: ON

CALCulate:CONDition[:LCT]:LOWer:DATA

It sets or queries the lower limit of compare function.
Set command format: CALCulate:CONDition[:LCT]:LOWer:DATA {<NRf>}
Parameter: <NRf>, when IR mode the range is 1 ~ 1P(Ω) or
when LC mode the range is 1nA ~ 20mA
Return data: < NRF > The unit is in Ω when it is under IR mode and the unit is in mA
when it is under LC mode.

CALCulate:CONDition[:LCT]:UPPer:ENABLE

It sets or queries enabled compare function (upper limit).
Set command format:
CALCulate:CONDition[:LCT]:UPPer:ENABLE {<NR1>|ON|OFF}
Parameter: <NR1> 0: OFF, 1: ON
Return data: <NR1> 0: OFF, 1: ON

CALCulate:CONDition[:LCT]:UPPer:DATA

It sets or queries the upper limit of compare function.

Set command format: CALCulate:CONDition[:LCT]:UPPer:DATA {<NRf>|MIN|MAX}

Parameter: <NRf>, when IR mode the range is 1 ~ 1P(Ω) or
when LC mode the range is 1nA ~ 20mA

Return data: < NRf > The unit is in Ω when it is under IR mode and the unit is in mA
when it is under LC mode.

CALCulate:CONDition:PDV:ENABLE

It sets or queries enabled compare PDV function.

Set command format: CALCulate:CONDition:PDV:ENABLE {<NR1>|ON|OFF}

Parameter: <NR1> 0:OFF, 1:ON

Return data: <NR1> 0:OFF, 1:ON

CALCulate:CONDition:PDV:LEVEL:DATA

It sets or queries percentage threshold of PDV compare function.

Set command format: CALCulate:CONDition:PDV:LEVEL:DATA {<NR1>|MIN|MAX}

Parameter: <NR1>, Level, MAX:99 and MIN:1 are acceptable.

Return data: < NR1 > Level

CALCulate:CONDition:PDI:ENABLE

It sets or queries enabled compare PDI function.

Set command format: CALCulate:CONDition:PDI:ENABLE {<NR1>|ON|OFF}

Parameter: <NR1> 0: OFF, 1: ON

Return data: <NR1> 0: OFF, 1: ON

CALCulate:CONDition:PDI:LEVEL:DATA

It sets or queries percentage threshold of PDI compare function.

Set command format: CALCulate:CONDition:PDI:LEVEL:DATA {<NR1>|MIN|MAX}

Parameter: <NR1>, Level, MAX:99 and MIN:1 are acceptable.

Return data: < NR1 > Level

SYSTEM Subsystem

SYSTEM:DISCHarge:VOLTage

It sets or queries Discharge voltage threshold.

Set command format: SYSTEM:DISCHarge:VOLTage {<NRf>|MIN|MAX}

Parameter: <NRf>, the range is from 0.5 to 10V, MAX: 10V and MIN: 0.5V are
acceptable.

Return data: < NRf > the unit is V.

SYSTEM:ALARM

It sets or queries beeper alarm mode.

Set command format: SYSTEM:ALARM <NR1>

Parameter: < NR1 > 0 (PULSe) and 1 (CONTinuous) are acceptable.

Return data: 0 or 1

SYSTEM:BEEPer:STATE

It sets or queries beeper volume.

Set command format:SYSTEM:BEEPer:STATE {<NR1>|OFF|LOW|HIGH}

Parameter: < NR1 >, 0 (OFF), 1 (LOW) and 2(HIGH) are acceptable.

Return data: < NR1 >

SYSTem:SOUND

It sets or queries measurement hint sound.

Set command format: SYSTem:SOUND {<NR1>}

Parameter: <NR1>, 0 and 1 are acceptable. 0 indicates to clear it to Low and 1 means to keep Hi-Z.

Return data: < NR1 >

SYSTem:CONTRast

It sets or queries LCD panel brightness.

Set command format: SYSTem:CONTRast <NR1|MIN|MAX >

Parameter: < NR1>, 1~15, MAX:15 and MIN:1 are acceptable.

Return data: < NR1>

SYSTem:LFREQuency

It sets or queries Line Frequency.

Set command format: SYSTem:LFREQuency {< NR1>|50|60}

Parameter: < NR1>, 0 (50) and 1 (60) (Hz) are acceptable.

Return data: < NR1>

SYSTem:HANDler

It sets or queries Handler setting parameter.

Set command format: SYSTem:HANDler {< NR1>|CLEAR|HOLD}

Parameter: < NR1>, 0 (CLEAR) and 1 (HOLD) are acceptable.

Return data: < NR1>

SYSTem:KLOCK

It sets or queries LCD key lock.

Set command format: SYSTem:KLOCK {<NR1>|OFF|ON}

Parameter: < NR1>, 0 (ON) and 1 (OFF) are acceptable.

Return data: < NR1> 0 or 1

SYSTem:DIGIts

It sets or queries displayed digit of measurement current (LC).

Set command format: SYSTem:DIGIts <NR1>

Parameter: < NR1>, 0 and 1 are acceptable. 0 indicates 3.5 digits and 1 means 4.5 digits.

Return data: < NR1> 0 or 1

SYSTem:RANGe:CHANGe:DELAY

It sets or queries range change delay time when auto ranging.

Set command format:

SYSTem:RANGe:CHANGe:DELAY {<NRf>|MIN|MAX}

Parameter: <NRF>, the range is from 0.005 to 9.999 s. MAX: 9.999s and MIN: 0.005s are acceptable.

Return data: < NRF >, the unit is S.

SYSTem:HANDler:CLEar:TIME

It sets or queries auto clear time of Handler state after measuring.

Set command format: SYSTem:HANDler:CLEar:TIME {<NRF>|MIN|MAX}

Parameter: <NRF>, the range is from 0.005 to 9.999 s, MAX: 9.999s and MIN: 0.005s are acceptable.

Return data: < NRF >, the unit is S.

SYSTEM:HANDler:BEFOre:ACQ

It sets or queries Handler Fail signal state before ACQ activating.

Set command format: SYSTEM:HANDler:BEFOre:ACQ {<NR1>}

Parameter: <NR1>, 0 and 1 are acceptable. 0 indicates to clear as Low and 1 means to keep Hi-Z.

Return data: < NR1 >

SYSTEM:ERRor?

It queries the first error message of Error Queue.

Query command format: SYSTEM:ERRor[:NEXT]?

Return data: <NR1>,"<String>"

Example: +0,"No error"

SYSTEM:CONFigure:DATE

It sets or queries system RTC date.

Set command format: SYSTEM:CONFigure:DATE ""

Parameter: <string>

Example: SYSTEM:CONFigure:DATE "2016-08-12 16:31:00"

Query command format: SYSTEM:CONFigure:DATE?

SYSTEM:CONFigure:SAVE

It sets or queries Auto Save Configuration state.

Set command format: SYSTEM:CONFigure:SAVE {<NR1>|OFF|ON}

Parameter: < NR1>, 0 (ON) and 1 (OFF) are acceptable.

Return data: < NR1> 0 or 1

SYSTEM:AREPORT

It sets or queries Auto Report state.

Set command format: SYSTEM:AREPORT {<NR1>|OFF|ON}

Parameter: < NR1>, 0 (ON) and 1 (OFF) are acceptable.

Return data: < NR1>, 0 or 1

SYSTEM:MODule?

It sets or queries submodule function and version of system currently.

Set command format: SYSTEM:MODule?

Parameter: None

Return data: <NRF>

SYSTEM:REMOTE

It sets or queries RS232/Ethernet/USB Device connection state.

Set command format: SYSTEM:REMOTE <Boolean>

Parameter: <Boolean>, 0 (ON), 1 (OFF), ON or OFF are acceptable.

Query command format: SYSTEM:REMOTE?

Return data: 0 or 1

SYSTEM:PRESet

It sets system parameter to return to preset state.

Set command format: SYSTEM:PRESet

Parameter: None

Query command format: None

Return data: None

SYSTEM:PROTECTION:STATUS?

It queries system protection signal (OTP, Fan Lock, InterLock, System) state currently.

Query command format: SYSTEM:PROTECTION:STATUS?

Return data: 0~63, use bit to represent signal status.

BIT0: (It is always 0 and is invalid for this model.)

BIT1: OTP (0: normal, 1: abnormal)

BIT2: FAN LOCK (0: normal, 1: abnormal)

BIT3: INTER Lock (0: normal, 1: abnormal)

BIT4: SYSTEM (0: normal, 1: abnormal)

BIT5: (It is always 0 and is invalid for this model.)

BIT6: (It is always 0 and is invalid for this model.)

BIT7: (It is always 0 and is invalid for this model.)

SYSTEM:PROTECTION:LOG[:MESSAGE]:COUNT?

It queries system occurred error message count.

Query command format: SYSTEM:PROTECTION:LOG[:MESSAGE]:COUNT?

Example: SYSTEM:PROTECTION:LOG:COUNT 20

Return data: <NR1> data entry of error occurred

SYSTEM:PROTECTION:LOG[:MESSAGE]? <NR1>

It queries system occurred error message log (date, time, error status).

Query command format: SYSTEM:PROTECTION:LOG[:MESSAGE]? <NR1>

Parameter: <NR1> It queries the entry data of record, the range is 1~1000.

Example: SYSTEM:PROTECTION:LOG 1

Return data: <NR1>, "<String>", <NR1> message code, <String> message occurred time and state

Example: +0, "No error" error message unrecorded

+101,"2016-08-12 16:31:05 OTP" OTP occurred

SYSTEM:PROTECTION:LOG:CLEAR

It clears error message information of system record.

Set command format: SYSTEM:PROTECTION:LOG:CLEAR

STATUS Subsystem**STATUS:OPERATION:CONDITION?**

It queries operation condition register.

Query command format: STATUS:OPERATION:CONDITION?

Return data: <NR1>

STATUS:OPERATION:ENABLE

It sets operation enable register.

Set command format: STATUS:OPERATION:ENABLE <NR1>

Parameter: <NR1>, the range is 0~32767.

Query command format: STATUS:OPERATION:ENABLE?

Return data: <NR1>

STATUS:OPERATION?

It queries operation message register.

Query command format: STATUS:OPERATION[:EVENT]?

Return data: <NR1>

STATUS:OPERation:NTRansition

It sets negative transition register of operation. If the register is set to 1, the status register of operation is from 1 changed to 0 thus signal register of operation will be set. Please refer STATUS:OPERation:PTRansition command.

Set command format: STATUS:OPERation:NTRansition <NR1>

Parameter: <NR1>, the range is 0~32767.

Query command format: STATUS:OPERation:NTRansition?

Return data: <NR1>

STATUS:OPERation:PTRansition

It sets positive transition register of operation. If the register is set to 1, the status register of operation is from 0 changed to 1 thus signal register of operation will be set. Please refer to STATUS:OPERation:NTRansition command.

Set command format: STATUS:OPERation:PTRansition <NR1>

Parameter: <NR1>, the range is 0~32767.

Query command format: STATUS:OPERation:PTRansition?

Return data: <NR1>

STATUS:OPERation:PRESet

It sets various registers of operation to preset status; the settings of various registers are given as the following.

Set ENABLE bit to 0's.

Set PTRansition bit to 1's.

Set NTRansition bit to 0's.

Set command format: STATUS:PRESet

STATUS:QUEStionable:CONDition?

It queries questionable condition register.

Query command format: STATUS: QUEStionable:CONDition?

Return data: <NR1>

STATUS:QUEStionable:ENABLE

It sets questionable enable register.

Set command format: STATUS:QUEStionable:ENABLE <NR1>

Parameter: <NR1>, the range is 0~32767.

Query command format: STATUS:OPERation:ENABLE?

Return data: <NR1>

STATUS:QUEStionable?

It queries questionable event register.

Query command format: STATUS:QUEStionable [:EVENT]?

Return data: <NR1>

Bit Position	15-8	7	6	5	4	3	2	1	0
Condition	Reserved, unused	Reserved, unused	Reserved, unused	Reserved, unused	System Error	Inter Lock Error	FAN Lock Error	OTP Error	

STATUS:QUEStionable:NTRansition

It sets negative transition register of questionable. If the register is set to 1, the status register of questionable is from 1 changed to 0 thus signal register of questionable will be set. Please refer to STATUS: QUEStionable:PTRansition command.

Set command format: STATUS:QUEStionable:NTRansition <NR1>

Parameter: <NR1>, the range is 0~32767

Query command format: STATUs:QUEStionable:NTRansition?
Return data: <NR1>

STATUS:QUEStionable:PTRansition

It sets positive transition register of questionable. If the register is set to 1, the status register of questionable is from 0 changed to 1 thus signal register of questionable will be set. Please refer to STATUs:QUEStionable:NTRansition command.

Set command format: STATUs:QUEStionable:PTRansition <NR1>

Parameter: <NR1>, the range is 0~32767

Query command format: STATUs:QUEStionable:PTRansition?

Return data: <NR1>

STATUS:QUEStionable:PRESet

It sets various registers of questionable to preset status; the settings of various registers are given as the following.

Set ENABle bit to 0's.

Set PTRansition bit to 1's.

Set NTRansition bit to 0's.

Set command format: STATUs:QUEStionable:PRESet

Store/Recall Subsystem

STORE

It stores the present operating settings and measurement parameters. The path of store function is the same as in File Manager.

Query command format: STORE <NR1>,"<STRING>"

Parameter: <NR1>, the range is 0 or 1. 0 means to save to the 11210 internal memory while 1 means to save to external USB disk.

<STRING>, the storage path and filename (without ".cfg")

Example: STORE 0,"Chroma_Test1", it means to save the set parameters to the internal memory of 11210 in the file of Chroma_Test1.cfg which can also be viewed in File Manager on the 11210 menu under /InternalROM.
STORE 0,"/Folder1/Chroma_Test2", it saves the setting files to the 11210 internal memory. The Chroma_Test2.cfg file can also be viewed under /InternalROM/Folder1/ directory.

STORE 1,"/FolderA/Chroma_Test3", it saves the setting files to the USB disk. The Chroma_Test3.cfg file can also be viewed under /USBdisk/FolderA/ directory. Be sure to check the USB disk is installed correctly before storing.

Return data: None

RECALL

It recalls the present operating settings and measurement parameters. The path of recall function is the same as in File Manager.

Query command format: RECALL <NR1>,"<STRING>"

Parameter: <NR1>, the range is 0 or 1. 0 means to recall from the 11210 internal memory while 1 means to load from the external USB disk.

<STRING>, the recall path and filename (without ".cfg")

Example: RECALL 0,"Chroma_Test1", it means to recall the Chroma_Test1.cfg setting file from the 11210 internal memory. The file can also be viewed in File Manager on the 11210 menu under /InternalROM.

RECALL 0,"/Folder1/Chroma_Test2", it means to recall the Chroma_Test2.cfg setting file from the 11210 internal memory under /InternalROM/Folder1/ directory.

RECALL 1,"/FolderA/Chroma_Test3", it means to recall the Chroma_Test3.cfg setting file from USB disk under /USBDisk/FolderA/ directory. B sure to check the USB disk is installed correctly before recalling.

Return data: None

Appendix A Specification Verification Procedure

The specification calibration procedure described in this chapter is providing the 11210 Battery Cell Insulation Tester for using function specification verification. The procedure is applicable to verification of new purchased instrument, verification after troubleshooting and instrument calibration periodically.

To conduct the specification verification procedure in this chapter should be a qualified verification personnel who has the relevant power measurement expertise and need to familiar with the test device used in this chapter. To avoid the damage caused by electric shock during operation.

⚡ CAUTION : Only the qualified personnel can execute procedures described in this chapter to verify the tester to avoid electric shock.

A.1 Hardware Requirement

This section required test equipment are listed as below:

Test Device	Recommended Product Model	Remark
Digit Multimeter 6 1/2	Keysight 34461A or Agilent 34401A	
Digit Multimeter 8 1/2	Keysight 3458A	Can be measured under 1nA
Test cable	11210 standard accessory (BNC test cable + HV test cable)	
Guard line	Use with Keysight 3458A measuring line	
LC resistance fixture	200MΩ / 20MΩ / 2MΩ / 200kΩ / 20kΩ / 2kΩ	

⚡ CAUTION : If there is no identical test device, at least the same level or above is configured.

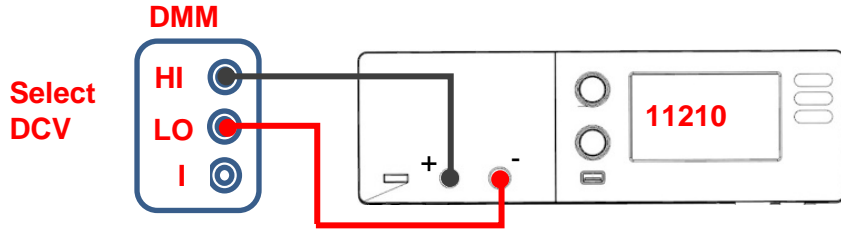
A.2 DCV (Voltage Source and Voltage Meter)

Specification verification for voltage source and voltage list:

Output Specifications		
Output Voltage	1.0V ~ 100V, step 0.1V Accuracy: ±(0.5% Setting + 1% Range) 101V ~ 1000V, step 1V Accuracy: ±(0.5% Setting + 0.5% Range)	
Measurement Display Range- Basic Measurement Accuracy		
V _{mea}	100V	±(0.3% Reading + 0.3% Range)
	1000V	±(0.3% Reading + 0.3% Range)

Step:

1. Connect the positive/negative output terminal on the 11210 panel to voltage measured input terminal of Agilent 34401A(or Keysight 34461A) and change the range of DMM measurement function to “DCV” as the figure below shows.



2. Click “Edit Condition” on main screen to enter edit parameter page and set the parameters in sequence as follows. After the setting is done, return to the measurement main page.

Page 1		Page 2		Page 3	
Parameter	Default Value	Parameter	Default Value	Parameter	Default Value
Test Voltage:	100V	Trigger Mode	Manual	Charge Time	5S
Charge Current	0.5mA	Integration Time	1PLC.	Dwell Time	20ms
LC Range	20mA	-	-	Test Time	20ms

3. Press green “START” key on panel to process measurement and record Vm and DMM voltage values on the screen into the table.
4. Repeat step 2~3 and set DC Voltage Test in column “Test Voltage” of “Edition condition” to measure and record it.

11210 test result of voltage measurement:

DC Voltage Test	Model	Spec(V)	Test Value(V)
100 V	DMM	98.5 ~ 101.5	Vo_a
	11210	Vo_a ± (0.3%* Vo_a +0.3)	
1,000 V	DMM	990.0 ~ 1,010.0	Vo_b
	11210	Vo_b ± (0.3%* Vo_b +3)	

⚠ WARNING UNKNOWN (LEAKAGE CURRENT) contains DC 1000V output maximum, please be aware of high voltage output hazard. Especially when measuring, do not touch the UNKNOWN (LEAKAGE CURRENT) end and test cable to avoid electric shock.

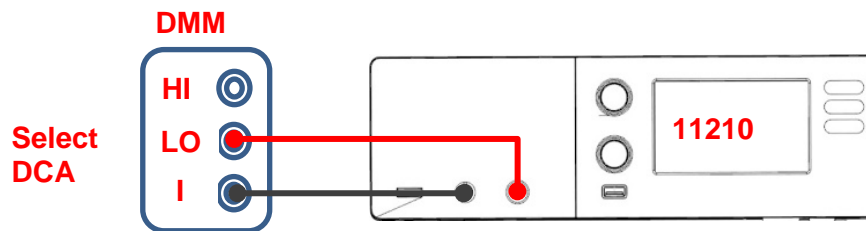
A.3 DCA (Constant Current Source)

Specification verification for constant current source:

Output Specifications	
Charging Current	0.5mA ~ 50mA, step 0.1mA Accuracy: $\pm(1.5\% \text{ Setting} + 1.5\% \text{ Range})$

Step:

1. Connect the positive/negative output terminal on the 11210 panel to current measured input terminal of Agilent 34401A (or Keysight 34461A) and change the range of DMM measurement function to "DCA" as the figure below shows.



2. Click "Edit Condition" on main screen to enter edit parameter page and set the parameters in sequence as follows. After the setting is done, return to the measurement main page.

Page 1		Page 2		Page 3	
Parameter	Default Value	Parameter	Default Value	Parameter	Default Value
Test Voltage:	100V	Trigger Mode	Manual	Charge Time	5S
Charge Current	50mA	Integration Time	1PLC.	Dwell Time	20ms
LC Range	20mA	-	-	Test Time	20ms

3. Press the green "START" key on panel to process measurement and record DMM current value into the table.

11210 test result of current measurement:

DC Current TEST	Spec	Test Value(mA)
50 mA	48.50 ~ 51.50 mA	

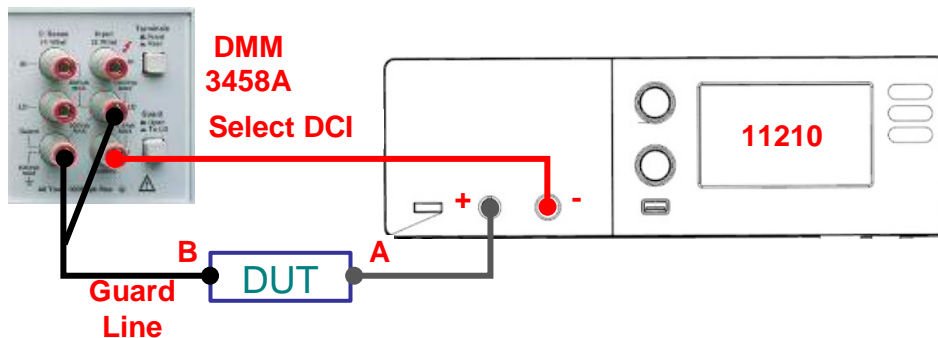
A.4 LC (Leakage Current)

Specification verification for leakage current:

Basic Measurement Accuracy		
LC	20.00nA	$\pm(5.0\% \text{ Reading} + 5.0\% \text{ Range})$
	200.0nA	$\pm(1.0\% \text{ Reading} + 1.0\% \text{ Range})$
	2.000uA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})$
	20.00uA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})$
	200.0uA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})$
	2.000mA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})$
	20.00mA	$\pm(0.3\% \text{ Reading} + 0.3\% \text{ Range})$

Step:

1. Connect negative output terminal on 11210 panel to DMM (Keysight 3458A) current measurement input terminal (-), connect positive output terminal on 11210 panel to DUT A end in LC fixture. DUT B end in LC fixture is connected to Guard and LO end simultaneously. Change DMM measurement function to range DCI and its sampling status NPLC is 50.



2. Click “Edit Condition” on main screen to enter edit parameter page and set the parameters in sequence as follows. After the setting is done, return to the measurement main page.

Page 1		Page 2		Page 3	
Parameter	Default Value	Parameter	Default Value	Parameter	Default Value
Test Voltage:	20V	Trigger Mode	Manual	Charge Time	20ms
Charge Current	50mA	Integration Time	500ms	Dwell Time	20ms
LC Range	20mA	-	-	Test Time	5s

3. Press green “START” key on panel to process measurement L.C. value, record DMM and 11210 L.C. values separately into the table.
4. Repeat step 2~3, modify column “Test Voltage” and “LC Range” under “Edition condition” in sequence and change DUT to measure and record it.

11210 test result of leakage current measurement:

LC Range	Condition	Tolerance (B) - (C)	DMM(nA) (B)	Test Value(nA) (C)
20 nA	2V / 200MΩ	± (5%* lmeas_1 +1) (nA)	lmeas_1	
200 nA	2V / 20MΩ	± (1%* lmeas_2 +2) (nA)	lmeas_2	
LC Range	Condition	Tolerance (B) - (C)	DMM(μA) (B)	Test Value(μA) (C)
2 μA	20V / 20MΩ	± (0.3%* lmeas_3 +0.006) (μA)	lmeas_3	
20 μA	20V / 2MΩ	± (0.3%* lmeas_4 +0.06) (μA)	lmeas_4	
200 μA	20V / 200kΩ	± (0.3%* lmeas_5 +0.6) (μA)	lmeas_5	
LC Range	Condition	Tolerance (B) - (C)	DMM(mA) (B)	Test Value(mA) (C)
2 mA	20V / 20 kΩ	± (0.3%* lmeas_6 +0.006) (mA)	lmeas_6	
20 mA	20V / 2 kΩ	± (0.3%* lmeas_7 +0.06) (mA)	lmeas_7	

Appendix B IR Accuracy

The IR accuracy is calculated based on the leakage current measurement accuracy of instrument measured and voltage measurement accuracy.

This chapter provides IR accuracy calculated formula and example.

$$\% IR_{\text{reading}} = \% \text{ Reading of Vmea Range}^{*1} + \% \text{ Reading of LC Range}^{*1} \\ + \frac{V_{os}^{*2} \text{ of Vmea Range}^{*1}}{V_{mea}} (\%) + \frac{I_{os}^{*2} \text{ of LC Range}^{*1}}{\left(\frac{V_{mea}}{IR_{\text{reading}}}\right)} (\%)$$

*1. For measured accuracy of leakage current and voltage, see the table in *section 2.1.3*.

*2. Vos and Ios are represented for range error (offset error) of Vmea and LC Range.

DUT: Insulation resistance IR: 100.0MΩ / test voltage 100V

Measured Result: 100V / 100.0MΩ (1.000uA)

Measured Range: Range Vmea: 100V / range LC: 2.0uA

Calculation example:

% Reading of Vmea Range: 0.3% (check the table in *section 2.1.3*, 100V Range)

% Reading of LC Range: 0.3% (the table in *section 2.1.3*, 2.0uA Range)

Vos of Vmea Range=0.3%*100.00V=0.30V (the table in *section 2.1.3*, 100V Range)

$$\frac{V_{os} \text{ of Vmea Range}}{V_{mea}} = \frac{0.30V}{100.0V} = 0.3\%$$

Ios of LC Range=0.3%*2.000uA=0.006uA (the table in *section 2.1.3*, 2.0uA Range)

$$\frac{V_{mea}}{IR_{\text{reading}}} = \frac{100.0V}{100.0M\Omega} = 1.000uA$$

$$\frac{I_{os} \text{ of LC Range}}{\left(\frac{V_{mea}}{IR_{\text{reading}}}\right)} = \frac{0.006uA}{1.000uA} = 0.6\%$$

Calculating % IR_{reading} = % Reading of Vmea Range + % Reading of LC Range

$$+ \frac{V_{os} \text{ of Vmea Range}}{V_{mea}} (\%) + \frac{I_{os} \text{ of LC Range}}{\left(\frac{V_{mea}}{IR_{\text{reading}}}\right)} (\%) \\ = 0.3\% + 0.3\% + 0.3\% + 0.6\% = 1.5\%$$

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