

# Graphical Source Measure Unit

## IT2800 Series User Manual



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## Safety Notices

### CAUTION

A CAUTION sign denotes a hazard. It calls attention to an operating procedure or practice that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

### WARNING

A WARNING sign denotes a hazard. It calls attention to an operating procedure or practice that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.



### Note

A NOTE sign denotes important hint. It calls attention to tips or supplementary information that is essential for users to refer to.

## Quality Certification and Assurance

We certify that series instrument meets all the published specifications at time of shipment from the factory.

## Warranty

ITECH warrants that the product will be free from defects in material and workmanship under normal use for a period of one (1) year from the date of delivery (except those described in the Limitation of Warranty below).

For warranty service or repair, the product must be returned to a service center designated by ITECH.

- The product returned to ITECH for warranty service must be shipped PRE-PAID. And ITECH will pay for return of the product to customer.
- If the product is returned to ITECH for warranty service from overseas, all the freights, duties and other taxes shall be on the account of customer.

## Limitation of Warranty

This Warranty will be rendered invalid in case of the following:

- Damage caused by circuit installed by customer or using customer own products or accessories;
- Modified or repaired by customer without authorization;
- Damage caused by circuit installed by customer or not operating our products under designated environment;
- The product model or serial number is altered, deleted, removed or made illegible by customer;
- Damaged as a result of accidents, including but not limited to lightning, moisture, fire, improper use or negligence.

## Safety Symbols

	Direct current		ON ( power)
	Alternating current		OFF ( power)
	Both direct and alternating current		Power-on state
	Chassis (earth ground) symbol.		Power-off state
	Earth ( ground) terminal		Reference terminal
	Caution		Positive terminal
	Warning ( refer to this manual for specific Warning or Caution information)		Negative terminal
	A chassis terminal	-	-

## Safety Precautions

The following safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or specific warnings elsewhere in this manual will constitute a default under safety standards of design, manufacture and intended use of the instrument. ITECH assumes no liability for the customer's failure to comply with these precautions.

**WARNING**

- **Do not use the instrument if it is damaged. Before operation, check the casing to see whether it cracks. Do not operate the instrument in the presence of inflammable gasses, vapors or dusts.**
  - **The instrument is provided with a power cord during delivery and should be connected to a socket with a protective earth terminal, a junction box or a three-phase distribution box. Before operation, be sure that the instrument is well grounded.**
  - **Please always use the provided cable to connect the instrument.**
  - **Check all marks on the instrument before connecting the instrument to power supply.**
  - **Ensure the voltage fluctuation of mains supply is less than 10% of the working voltage range in order to reduce risks of fire and electric shock.**
  - **Do not install alternative parts on the instrument or perform any unauthorized modification.**
  - **Do not use the instrument if the detachable cover is removed or loosen.**
  - **To prevent the possibility of accidental injuries, be sure to use the power adapter supplied by the manufacturer only.**
  - **We do not accept responsibility for any direct or indirect financial damage or loss of profit that might occur when using the instrument.**
  - **This instrument is used for industrial purposes, do not apply this product to IT power supply system.**
  - **Never use the instrument with a life-support system or any other equipment subject to safety requirements.**
-

**WARNING**

- **SHOCK HAZARD Ground the Instrument.** This product is provided with a protective earth terminal. To minimize shock hazard, the instrument must be connected to the AC mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet or distribution box. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in injury or death.
  - **Before applying power, verify that all safety precautions are taken.** All connections must be made with the instrument turned off, and must be performed by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage.
  - **SHOCK HAZARD, LETHAL VOLTAGES** This product can output the dangerous voltage that can cause personal injury, and the operator must always be protected from electric shock. Ensure that the output electrodes are either insulated or covered using the safety covers provided, so that no accidental contact with lethal voltages can occur.
  - **Never touch cables or connections immediately after turning off the instrument.** Verify that there is no dangerous voltage on the electrodes or sense terminals before touching them.
  - **After using the device, turn off the power switch of the device before unplugging the power cord or disassembling the terminals.** Do not touch the cable or the terminal immediately. Depending on the model, the dangerous voltage at the plug or terminal is maintained for 10 seconds after the device is switched off. Make sure that there is no dangerous voltage before touching them.
- 

**CAUTION**

- **Failure to use the instrument as directed by the manufacturer may render its protective features void.**
  - **Always clean the casing with a dry cloth. Do not clean the internals.**
  - **Make sure the vent hole is always unblocked.**
- 

## Environmental Conditions

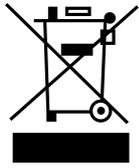
The instrument is designed for indoor use and an area with low condensation. The table below shows the general environmental requirements for the instrument.

Environmental Conditions	Requirements
Operating temperature	0°C ~ 40°C
Operating humidity	20% ~ 80%( non-condensation)
Storage temperature	-10°C ~ 70 °C
Altitude	Operating up to 2,000 meters
Installation category	II
Pollution degree	Pollution degree 2

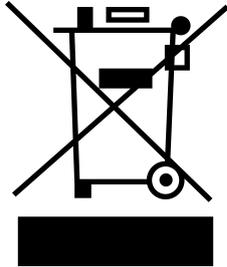

**Note**

In order to ensure the accuracy of measurement, it is recommended to operate the instrument half an hour after start-up.

## Regulation Tag

	The CE tag shows that the product complies with the provisions of all relevant European laws (if the year is shown, it indicates that the year when the design is approved).
	The UKCA tag shows that the product complies with the provisions of all relevant United Kingdom laws (if the year is shown, it indicates that the year when the design is approved).
	This instrument complies with the WEEE directive (2002/96/EC) tag requirements. This attached product tag shows that the electrical/electronic product cannot be discarded in household waste.
	This symbol indicates that no danger will happen or toxic substances will not leak or cause damage in normal use within the specified period. The service life of the product is 10 years. The product can be used safely within the environmental protection period; otherwise, the product should be put into the recycling system.

## Waste Electrical and Electronic Equipment (WEEE) Directive



Waste electrical and electronic equipment (WEEE) directive, 2002/96/EC

The product complies with tag requirements of the WEEE directive (2002/96/EC). This tag indicates that the electronic equipment cannot be disposed of as ordinary household waste. Product Category

According to the equipment classification in Annex I of the WEEE directive, this instrument belongs to the "Monitoring" product.

If you want to return the unnecessary instrument, please contact the nearest sales office of ITECH.

## Compliance Information

Complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:

- Electromagnetic Compatibility (EMC) Directive 2014/30/EU
- Low-Voltage Directive (Safety) 2014/35/EU

Conforms with the following product standards:

### EMC Standard

IEC 61326-1:2012/ EN 61326-1:2013 <sup>123</sup>

#### Reference Standards

CISPR 11:2015+A1:2016 Ed 6.1

IEC 61000-3-2: 2018 RLV

IEC 61000-3-3: 2013+A1:2017

IEC 61000-4-2:2008

IEC 61000-4-3 2006+A1:2007+A2:2010/ EN 61000-4-3 A1:2008+A2:2010

IEC 61000-4-4:2012

IEC 61000-4-5:2014+A1:2017

IEC 61000-4-6:2013+cor1:2015

IEC 61000-4-11:2004+A1:2017

1. The product is intended for use in non-residential/non-domestic environments. Use of the product in residential/domestic environments may cause electromagnetic interference.
2. Connection of the instrument to a test object may produce radiations beyond the specified limit.
3. Use high-performance shielded interface cable to ensure conformity with the EMC standards listed above.

### Safety Standard

IEC 61010-1:2010+A1:2016

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# 1 Quick Reference

This chapter briefly introduces the front panel, rear panel, keyboard button functions and front panel display functions of this series instrument to ensure a quick understanding of the appearance, structure and key usage features of the instrument before operating the instrument. This chapter does not introduce each operating characteristic in detail. It is just a quick reference guide to help you quickly learn the operating characteristics of the instrument.

- ◆ [Brief Introduction](#)
- ◆ [Front-Panel Overview](#)
- ◆ [Home-Screen Overview](#)
- ◆ [Icon Reference](#)
- ◆ [Rear-Panel Overview](#)
- ◆ [Menu Overview](#)
- ◆ [Models and Options](#)

## 1.1 Brief Introduction

The IT2800 Series are compact and cost-effective bench-top Source Measure Units (SMUs) with the capability to source and measure both voltage and current. These capabilities make the IT2800 Series ideal for a wide variety of IV (current versus voltage) measurement tasks that require both high resolution and accuracy.

Performance and functions:

- 5 inch touch display supports both graphical and numerical view modes.
- Combining the capabilities of six devices in one: Voltage Source, Current Source, 6 ½ Digital Multimeter (DCV,DCI, ohms), Battery Simulator, electronic load and Pulse Generator
- Integrating 4-quadrant sourcing & measuring capabilities, and supporting Two-wire & Four-wire measurement
- Resolution up to 10fA/100nV, sampling rate up to 10us.
- Built-in battery simulator function, suitable for IOT low power precision measurement
- Sweep Capability: Linear/Log/ Pulsed-line AR/Pulsed-Log and LIST
- Multi-channel and simultaneous operation design, with parallel testing capability
- Built-in resistance, power, and Math measurement features
- With GUARD output function, suitable for low current measurement

- Front USB port used for data storage, screen capture, or test configuration import
- Built-in Digital IO/USB/LAN communication interface

## 1.2 Front-Panel Overview

The detailed front panel of the IT2800 series instruments is described below.

- IT2801



- IT2806

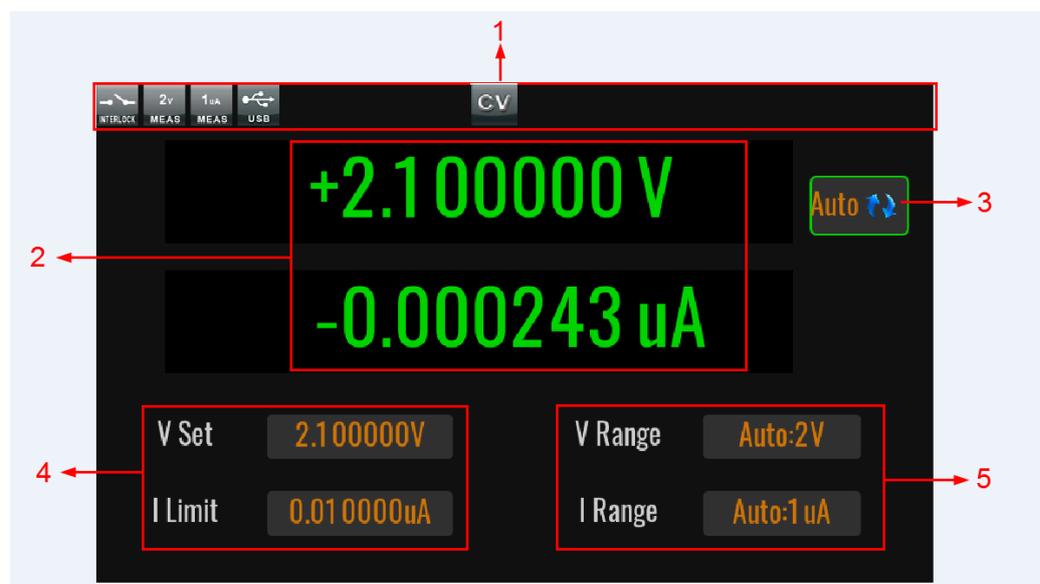


Name	Description
USB-A port	Saves reading buffer data and screen snapshots to a USB flash drive ( <b>Menu</b> → <b>System</b> → <b>Communication</b> → <b>USB Type</b> must be set to <b>Host</b> ). The flash drive must be formatted as a FAT32 drive. After disconnecting the USB memory, wait 10 seconds before connecting it again or new one. <b>Turning the instrument off while the USB memory is being accessed may damage the device.</b>
<b>[View]</b>	Used to change the display mode. Press the <b>[View]</b> key to enter the oscilloscope interface. Press the <b>[View]</b> key again to enter the Meter measurement interface.
<b>[Trig]</b>	Manually trigger function keys. When the trigger source is changed to Manual, you can start a single measurement or trigger Sweep to run.
<b>[Menu]</b>	Menu function button.
Power Switch	Turn on or off the power switch of the instrument.
Touchable display	The 5-inch touch screen can display source meter settings, measurement results, status information, etc. Operations involving parameter setting or selection can be set by clicking on the touch screen, or by using the function buttons on the right side combined with the knob.
<b>[On/Off]</b>	Turns the power output on or off. When this button is lit, the output is on.
<b>[Shift]</b> key	Composite function keys that combine with other keys to achieve the function labeled above the key.
<b>[V-set]</b> (Config)	<ul style="list-style-type: none"> <li>• Voltage setting button.</li> <li>• Key combination. Use the <b>[Shift]</b> then <b>[V-set]</b> keys to access the Config menu.</li> </ul>
<b>[I-set]</b> (Sweep)	<ul style="list-style-type: none"> <li>• Current setting button.</li> <li>• Key combination. Use the <b>[Shift]</b> then <b>[I-set]</b> keys to enter Sweep interface.</li> </ul>
<b>[Esc]</b> (Local)	<ul style="list-style-type: none"> <li>• Exit / Undo key</li> <li>• Key combination. In remote programmable operation, use the <b>[Shift]</b> then <b>[Esc]</b> keys to switch the instrument to local operation mode.</li> </ul>
<b>[Enter]</b> (Print)	<ul style="list-style-type: none"> <li>• Confirm button</li> </ul>

Name	Description
	<ul style="list-style-type: none"> <li>Key combination. Use the <b>[Shift]</b> then <b>[Enter]</b> keys to take a screenshot and save the image as a bmp file.</li> </ul>
Pressable knob	<ul style="list-style-type: none"> <li>Turn the knob to adjust the voltage or current value, or turn the page to display the menu item. Turn clockwise to increase the set value and counterclockwise to decrease the set value; after entering the menu interface, turn the knob to turn the page to display the menu items.</li> <li>Press the knob. Equivalent to the <b>[Enter]</b> key.</li> </ul>
Left and right arrow keys	Use the left and right arrow keys to move the cursor below a number, or to move to select a setting item.
Output / Measurement terminals	Terminals for SMU channel. High Force, Low Force, High Sense, Low Sense, Guard, and chassis ground. For details, see <a href="#">2.5 Connecting the Device Under Test (DUT)</a> . <b>Attention: Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the instrument.</b>

## 1.3 Home-Screen Overview

IT2800series SMUs run a self-test automatically when it is powered on. If the self-test finishes with no errors, the screen below is displayed.



No.	Name	Description
1	Status display area	Displays information such as the instrument's measurement range or status.
2	Measured value display area	The measured values are displayed in real time. The upper row is for the primary measurement data and the lower row is for the secondary measurement data.
3	Measurement trigger mode (Auto/Manual)	<ul style="list-style-type: none"> <li>Continue &amp; Measure (Auto): Automatically and continuously refreshes the Meter value.</li> <li>Manual Trigger Mode (Manual): Manual triggering is required, and the trigger signal of the Trig button must be received before refreshing the Meter value.</li> </ul>
4	Setting value editing area	Set the voltage value and current value. You can change these values by pressing the <b>[V-set]</b> and <b>[I-set]</b> keys on the front panel.
5	Range selection area	Select the measurement range.

## 1.4 Icon Reference

This series of instruments provides detailed prompt information during operation to facilitate users to understand the instrument functions during use.

- **Icon Introduction**

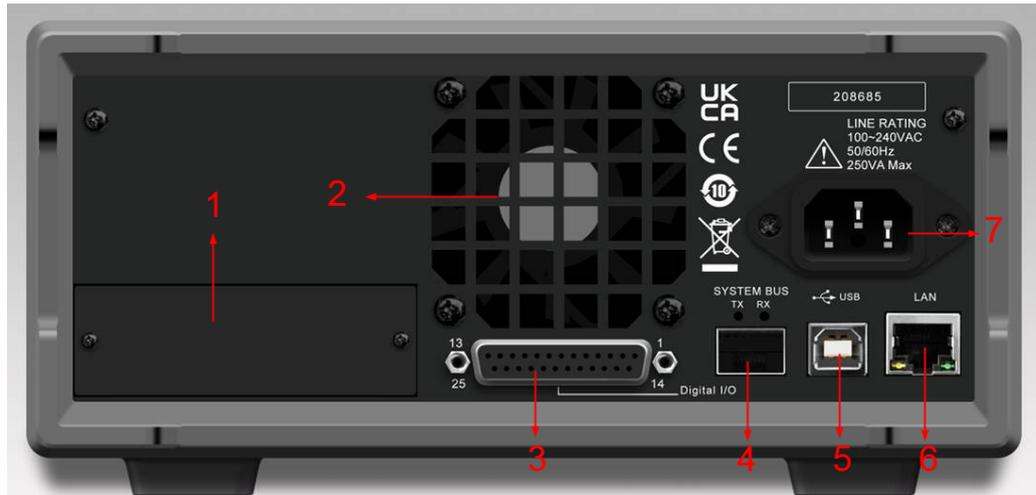
Icon	Description	Icon	Description
	Output off state		The output is on and in CV constant voltage mode.
	The output is on and in CC constant current mode.		<b>Config</b> configuration menu
	Battery simulation function is enabled		Sense function is turned on
	Recorder function is turned on		Resistance measurement function is turned on

Icon	Description	Icon	Description
	Composite limit test function is turned on		Math calculation function is turned on
	Pulse mode is turned on		Waiting for the trigger to run Sweep
	Sweep is running		The interlock terminal is open. At this time, the voltage setting value is less than or equal to $\pm 42V$ , and cannot be set greater than $\pm 42V$ .
	Interlock terminal short-circuit state. The voltage setting can exceed $\pm 42V$ at this time, up to the rated voltage value.		The instrument is under remote control.
	The instrument recognizes that the USB flash drive is inserted.		High capacitance mode is turned on.
	Multi-master fault indication		Fiber optic communication anomaly
	Disable output. This fault indication pops up when the output is greater than 42V and the Interlock becomes open.		Overcurrent protection status
	Over temperature protection status		Overvoltage protection status
	Sense abnormal protection status		Communication command error
	Voltage measurement in the 1000V range (- only IT2801 models are available)		Voltage measurement in the 200V range
	Voltage measurement in the 20V range		Voltage measurement in the 2V range

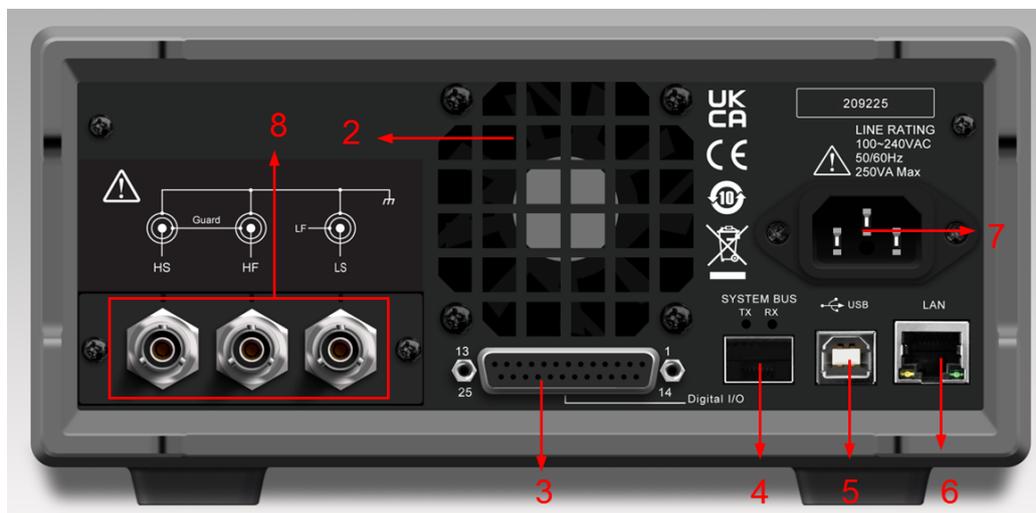
Icon	Description	Icon	Description
	Voltage measurement in the 200mV range		Current measurement in 10A range (only IT2806 available)
	Current measurement in 3A range		Current measurement in 1A range
	Current measurement in 100mA range		Current measurement in 10mA range
	Current measurement in 1mA range		Current measurement in 100uA range
	Current measurement in 10uA range		Current measurement in 1uA range
	Current measurement in 100nA range		Current measurement in 10nA range
	Resistance measurement in the 200MΩ range		Resistance measurement in the 20MΩ range
	Resistance measurement in the 2MΩ range		Resistance measurement in the 200kΩ range
	Resistance measurement in the 20kΩ range		Resistance measurement in the 2kΩ range
	Resistance measurement in the 200Ω range		Resistance measurement in the 20Ω range
	Resistance measurement in the 2Ω range	-	

## 1.5 Rear-Panel Overview

The IT2800 Series SMU detailed rear panel description is shown below.



The detailed rear panel introduction of IT2800R series SMU is as follows.



No.	Name	Description
1	Optional expansion slot	Optional interfaces: (The baffle is installed by default when the user does not purchase the interface.) <ul style="list-style-type: none"> <li>IT-E176: GPIB communication card</li> </ul> <b>Note: IT2800R series does not support this communication board.</b>
2	Smart fan outlet	This is the cooling fan outlet, please do not cover or block it.
3	Digital I/O terminals	Rear panel digital IO terminals. For detailed pin function descriptions, see <a href="#">Digital I/O instruction</a> .
4	Fiber optic socket interface (TX and RX)	For communication between multiple SMUs, suitable for multi-channel and synchronous operation.

No.	Name	Description
5	USB-B communication interface	USB-B type interface, supporting both USBTMC and USBVCP options. And, the <b>Menu</b> → <b>System</b> → <b>Communication</b> → <b>USB Type</b> must be set to <b>Device</b> .
6	LAN communication interface	Used for LAN communication.
7	AC power input interface	The AC power cord is connected to this outlet and supports 100~240VAC input.
8	BNC terminals on the rear panel of IT2800R series	Used to connect low-leakage triax cable IT-E801C-1.5 or IT-E802C-1.5. <b>Note: Only available in IT2800R series.</b>

## Digital I/O instruction

The pins of Digital I/O are described as follows.



Pin	Description
1~16	Digital I/O pins, specific function reference <a href="#">1.6.8 System</a> .
17~20	GND
21 and 22	Inter Lock Control (output interlock terminal), shorting these 2 pins, the device can set and output more than $\pm 42V$ ; otherwise, it only supports setting and outputting $\pm 42V$ and below.
23~25	+5V reference voltage pin. Can be used to provide 5V high level control signal to Digital I/O pins 1~16.

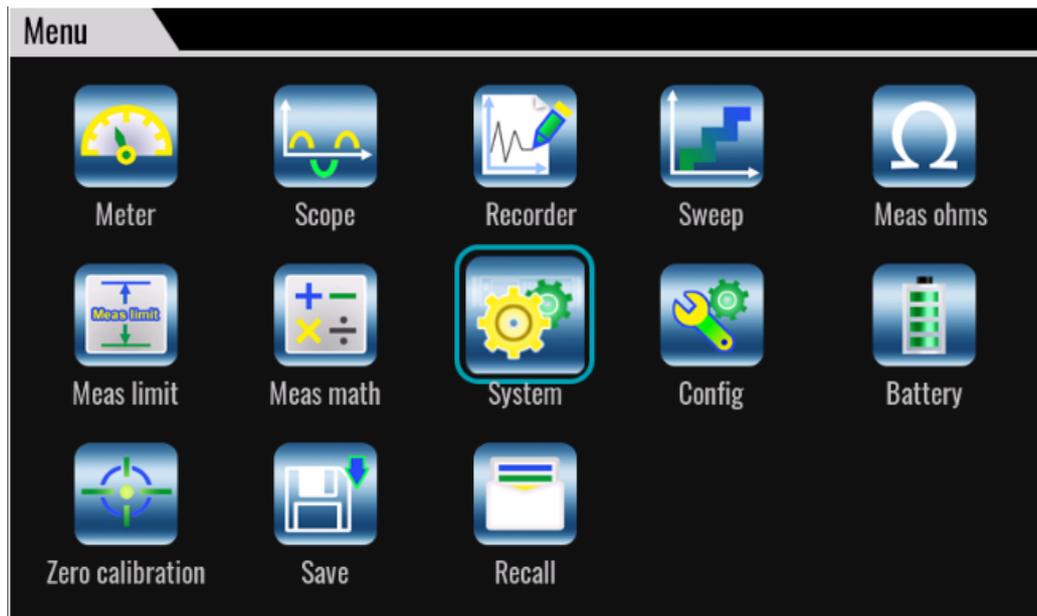
## Digital IO Characteristics

Maximum input voltage	15V	Pin1-pin16 : Digital I/O
Typical input voltage	5V	
Minimum input voltage	0V	

Minimum logic high level	2V	
Maximum logic low level	0.8V	
Maximum output current	0.5mA @Vout = 0V	
Maximum sink current	20mA@Vout = 5V	
IO high level fall time	less than 1us	
IO low level rising time	less than 5us	
IO minimum output pulse width (trig out)	10us	
IO minimum detection pulse width (trig in)	10us	
+5V	500mA	pin23-pin25: +5V reference voltage pin

## 1.6 Menu Overview

When the **[Menu]** button in the lower left corner of the instrument is pressed, the button lights up and the screen displays as follows.



## 1.6.1 Meter

### Function Introduction

For an introduction to the interface, see [1.3 Home-Screen Overview](#).

The IT2800 supports the following measurement parameters. The measurement parameters displayed in the actual interface are associated with the settings of **Menu**→**Config**→**Measure**→**View Type**.

- Current
- Voltage
- Resistance
- Power

Resistance data is given by  $\text{Resistance} = V_{\text{meas}}/I_{\text{meas}}$ .

Power data is given by  $\text{Power} = V_{\text{meas}} * I_{\text{meas}}$ .

In the above formula,  $V_{\text{meas}}$  is the voltage measurement data, and  $I_{\text{meas}}$  is the current measurement data.

### Parameter Setting

The Meter interface also supports the setting of voltage and current values, as well as the selection of voltage and current ranges.

#### Voltage value setting:

Based on the **Menu**→**Config**→**Source Mode** setting is **Volts** (Voltage source mode) or **Amps** (Current source mode), the Meter interface will display the voltage setting as **V-set** or **V Limit**.

The setup method is as follows.

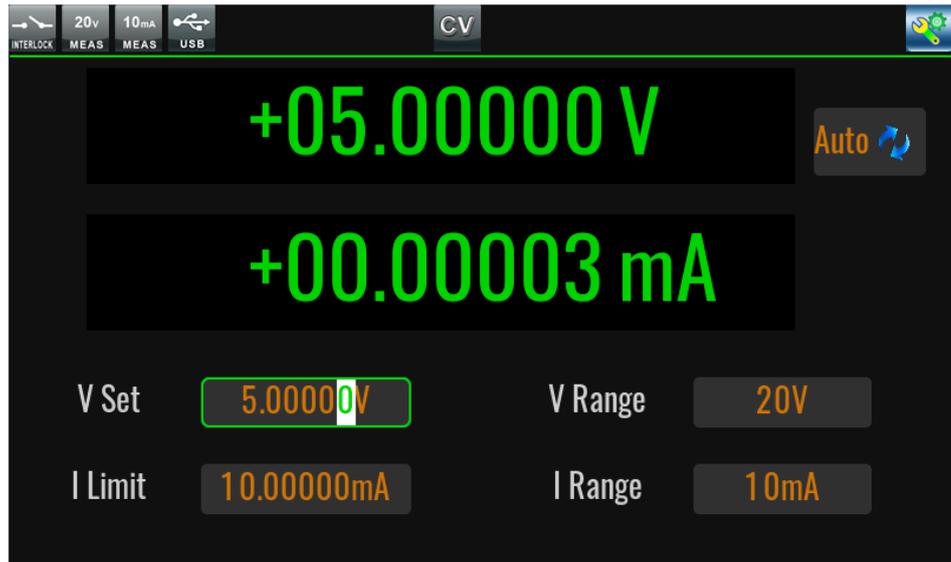
- Method 1: Set by knob and button combination
  1. Turn the knob or press the left/right key in the Meter screen until the parameter area is selected.
  2. Press the **[Enter]** key.

The cursor flashes at this point, indicating that the parameter is in the state to be modified, as shown in the following figure.



3. Press the left/right key to move the cursor position and turn the knob to adjust the value.
  4. Press the **[Enter]** key to confirm the setting.
- Method 2: Setting by tapping the touch screen
    1. Touch the voltage value setting area next to **V-set** or **V Limit** with your finger.

The cursor flashes at this point, indicating that the parameter is in the state to be modified, as shown in the following figure.



2. Touch the area again with your finger.

The screen pops up with the soft keyboard screen for voltage setting as shown in the following figure.



3. Touch the number on the screen with your finger to set it.
4. Touch the **[Enter]** key on the screen with your finger to confirm the setting.

#### Current value setting.

Based on the **Menu**→**Config**→**Source Mode** setting is **Volts** (Voltage source mode) or **Amps** (Current source mode), the Meter interface will display the current setting as **I Limit** or **I-set**.

The setup method is as follows.

- Method 1: Set by knob and button combination

1. Turn the knob or press the left/right key in the Meter screen until the parameter area is selected.
2. Press the **[Enter]** key.

The cursor flashes at this point, indicating that the parameter is in the state to be modified, as shown in the following figure.



3. Press the left/right key to move the cursor position and turn the knob to adjust the value.
  4. Press the **[Enter]** key to confirm the setting.
- Method 2: Setting by tapping the touch screen

1. Touch the current value setting area next to **I-set** or **I Limit** with your finger.

The cursor flashes at this point, indicating that the parameter is in the state to be modified, as shown in the following figure.



2. Touch the area again with your finger.

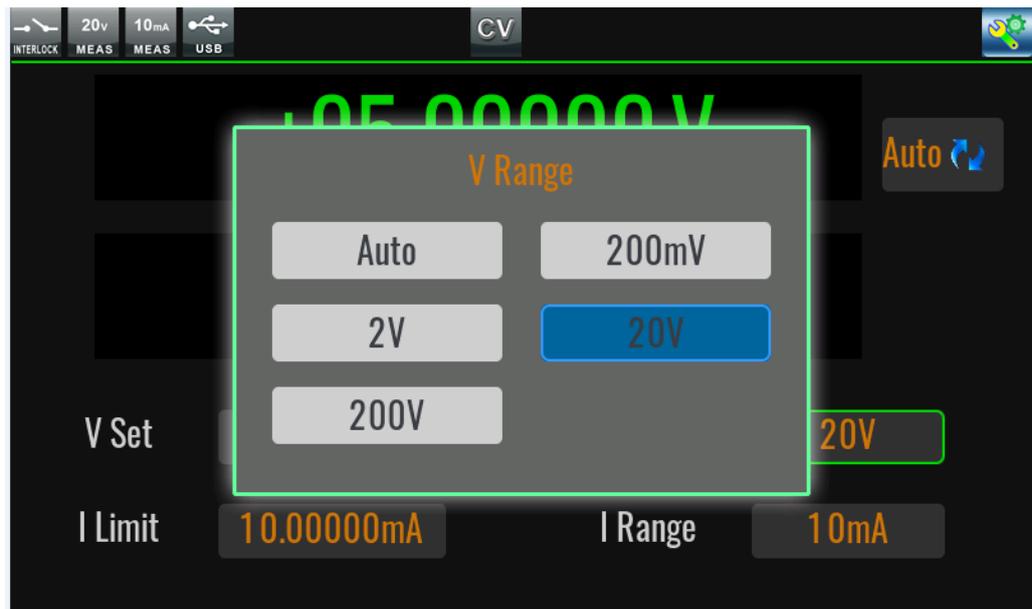
At this time, the screen pops up the soft keyboard interface for current setting, as shown in the following figure.



3. Touch the number on the screen with your finger to set it.
4. Touch the **[Enter]** key on the screen with your finger to confirm the setting.

#### Voltage range selection:

Touch the corresponding area with your finger or turn the knob to select the corresponding area and then press **[Enter]**, the screen will be displayed as shown below. The user can select the corresponding range according to the test requirements.

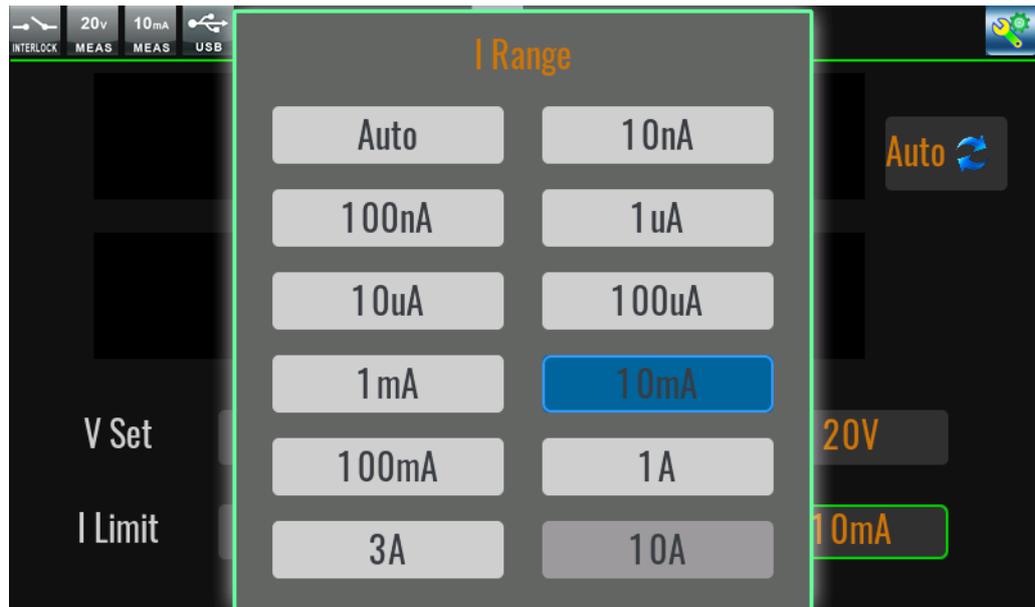



**Note**

The range options displayed vary from model to model.

**Current range selection:**

Touch the corresponding area with your finger or turn the knob to select the corresponding area and then press **[Enter]**, the screen will be displayed as shown below. The user can select the corresponding range according to the test requirements.


**Note**

The range options displayed vary from model to model.

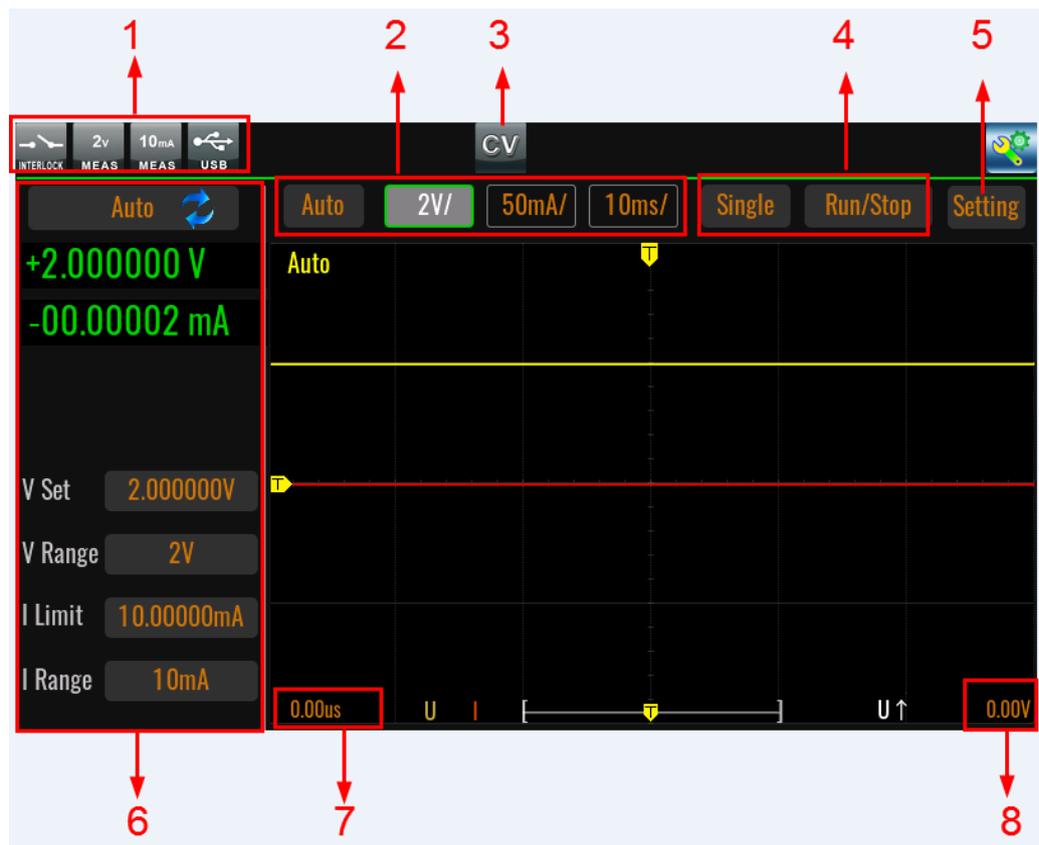
## 1.6.2 Scope

Scope interface is used to capture voltage and current data in real time during high-speed operation and plot these data into waveform curves, which supports generating .csv format files and exporting to a USB flash drive.

To access the Scope interface:

- Press the **[View]** key on the left side of the instrument.
- Press the **[Menu]** key to enter **Menu**→**Scope**.

The interface features are described as follows.



1. Display the voltage range, current range, interlock status, U disk identification status
2. Adjusts the resolution of the X or Y axis oscilloscope function.
  - Auto: Changes graph scale to fit the trace in the graph automatically. Pressing the **[Auto]** key at the touch screen will adaptively display the waveform and restore the X and Y axis offset values to 0, which is where Figure Note 7 and Figure Note 8 are.
  - 2V/ and 1A/: Y-axis scale per division V/div., A/div.
  - 10ms: X-axis scale per division ms/div.

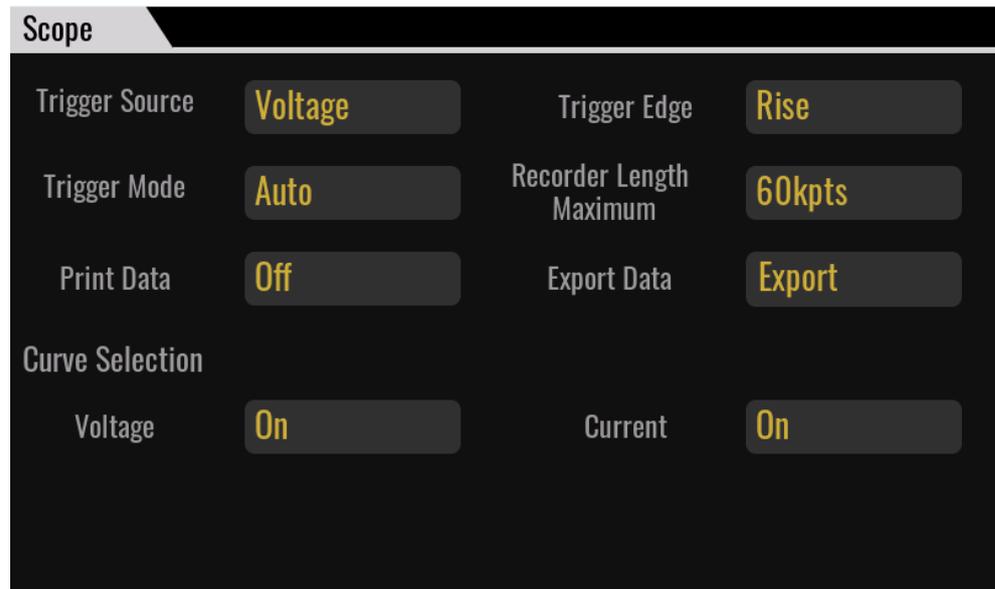
### Note

You can also zoom in and out on the X-axis by dragging the touch screen with two fingers inward or outward at the same time. Once the default X-axis scale per division 50ms/div is modified, the yellow Auto status in the upper left corner is replaced with Roll.

Setting method: Press the corresponding area of the touch screen (or turn the knob until the area is selected and then press **[Enter]**) to put the parameter into the state to be set, as shown below, then turn the knob or press the left/right arrow keys to adjust it, and then press **[Enter]** to confirm.



3. Output status display
4. Measurement method of the oscillometric function:
  - Single: Single measurement
  - Run / Stop: Continuous measurement
5. Setting: Press the corresponding area of the touch screen (or turn the knob until the icon is selected and then press **[Enter]**) to display the screen as follows.



- Trigger Source: Select the trigger source for the oscilloscope function

Item	Description
Volt	Voltage triggered
Current	Current triggered
Manual	<b>[Trig]</b> key triggered
Bus	* <b>TRG</b> command triggered
Trigger-1	Digital I/O Trigger-1 triggered (Default 0V low level in effect)
Trigger-2	Digital I/O Trigger-2 triggered (Default 0V low level in effect)
Fiber-1	Fiber optic triggered (multi-channel use)

- Trigger Edge: Trigger edge
- Trigger Mode: Trigger mode

- In Normal mode: voltage range, current range, time base, time offset, configured according to user set values.
- Auto mode: Setting the **Trigger Mode** to **Auto** means that the trigger is automatically generated according to the **Time Div** timing.
- Recorder Length Maximum: the maximum acquisition depth
- Print Data: Under the oscilloscope interface, select the file format for saving measurement data to a USB flash drive.
  - Off: Press **[Shift]** then **[Enter]** (Print) keys to save the data as a screenshot file in .bmp format to a USB flash drive.
  - Raw: Press **[Shift]** then **[Enter]** (Print) keys to save the data to the U disk in .csv and .bmp format files.
- Export Data: Insert the USB disk, set **Print Data** to **Raw**, select **Export Data** as **Enter**, confirm according to the interface prompts, and you can export the acquisition data to U disk. Exporting to .csv format file is supported. The file is as shown below.

A	B	C	D
volt div:1.000000V			
curr div:0.000001A			
time div:0.010000s			
delay:0.000000s			
sample interval:10.0us			
trigger index:3000			
No	U	I	
0	2.09809	1.56E-10	
1	2.09982	-7.00E-12	
2	2.1002	-2.24E-10	
3	2.09817	8.33E-11	
4	2.10012	1.11E-11	
5	2.10084	-1.88E-10	
6	2.09952	-9.73E-11	
7	2.0993	1.01E-10	
8	2.10121	-1.52E-10	
9	2.10039	-6.12E-11	
10	2.0996	1.38E-10	
11	2.10159	-7.93E-11	
12	2.10163	-2.60E-10	
13	2.09907	1.92E-10	
14	2.09926	1.74E-10	
15	2.10137	-3.86E-10	
16	2.09922	-2.24E-10	

- Curve Selection: Choose to display the waveform type as voltage, current or voltage and current.

Select On to display the corresponding waveform, and select Off to not display it.

6. Same as Meter interface for parameter setting and measurement value display.
7. X-axis offset value

The yellow T icon displayed on the X-axis indicates the trigger moment.

To set: Press the corresponding area of the touch screen (or turn the knob until the area is selected and then press **[Enter]**), and then turn the knob to adjust.

8. Y-axis offset value

The yellow T icon on the Y-axis indicates the voltage or current trigger value.

To set: Press the corresponding area of the touch screen (or turn the knob until the area is selected and then press **[Enter]**), and then turn the knob to adjust.



#### Note

Adjusting this parameter is supported only when the **Scope**→**Setting**→**Trigger Source** is selected as **Volt** or **Current**.

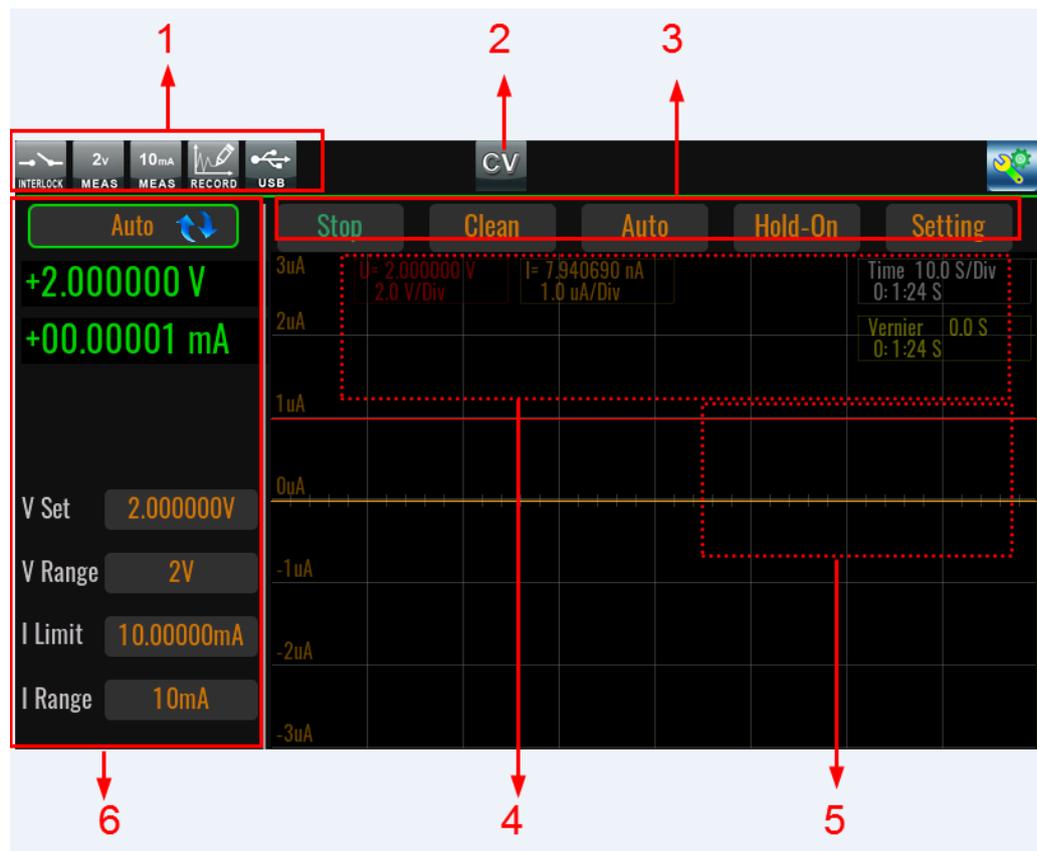
## 1.6.3 Recorder

This function is used to record the voltage measurement value, current measurement value, power measurement value, resistance measurement value, source output value, and mathematical calculation value during the test operation, and draw these data into easy-to-observe curves or generate .csv / The file in .tdms format is exported to the U disk.

To access the Recorder interface:

Press the **[Menu]** key, enter **Menu**→**Recorder**.

The interface features are described as follows.



1. Display voltage range, current range, interlock status, Recorder run/stop status, U disk recognition status
2. Output status display
3. Recorder function menu bar.
  - Run / Stop: Runs or stops data logging. After running the Recorder function, a status marker for the start of data recording will appear at the top left of the screen.

**Note**

Click Stop to stop recording and then Run, the screen will clear the data first and then redraw the curve.

- Clean: Clear the currently drawn graph (the original data still exists). If Clean is executed during Run, recording will automatically restart.
- More: More settings. After entering More interface, the parameters are introduced as follows.

**Recorder**

Viewing | Advanced Setting

Curve1	On	Item	Volts	Mode	DC
Curve2	On	Item	Amps	Mode	DC
Curve3	Off	Item	Power	Mode	DC
Curve4	Off	Item	Ohms	Mode	DC

**Recorder**

Viewing | Advanced Setting

Measure Interval	Time	Time	1.00000s
Measure Speed	Aperture	Aperture	800.00ms
Recorder Mode	Cycle		
File Format	Tdms		
Export To Udisk	Enter		

Save To Udisk Real-time

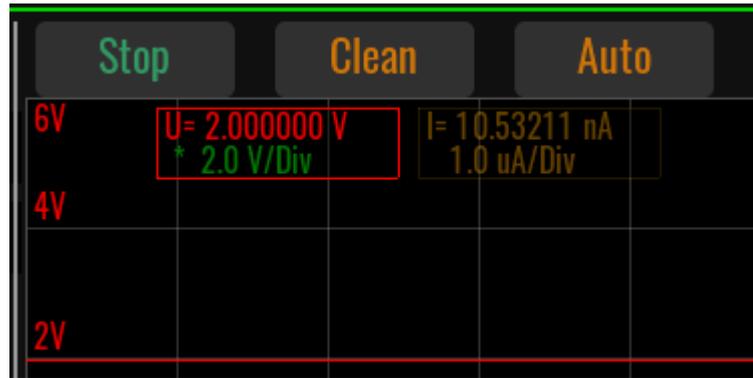
Off

Parameter	Description
Curve 1/2/3/4	Select the curve type under Recorder function, support up to 4 curves simultaneously.
Item	The type of curve plotting/data logging.
Mode	Set the display mode of the curve, DC or AC can be selected. <ul style="list-style-type: none"> <li>DC mode: The curve scale is displayed centered on 0.</li> </ul>

Parameter	Description
	<ul style="list-style-type: none"> <li>AC mode: The curve scale takes the lowest value of a waveform as the scale Base value. The corresponding value of the display scale is Base + Div.</li> </ul>
Measure Interval	<p>Set the measurement interval, i.e. the setting of the sampling rate.</p> <ul style="list-style-type: none"> <li>Manual Plc: When <b>Manual Plc</b> option is selected, the screen pops up with PLC parameter setting, unit: PLC.                             <ul style="list-style-type: none"> <li>50Hz: 0.005PLC-100.00PLC</li> <li>60Hz: 0.006PLC-120.00PLC</li> </ul> </li> <li>Manual Speed: When <b>Manual Speed</b> option is selected, the screen pops up the Speed setting, the setting range: 100us~2s.</li> </ul> <p><b>Note: This parameter cannot be set after the Recorder is running.</b></p>
Measure Speed	<p>Set the speed of the measured data, i.e. the duration of a single measurement.</p> <ul style="list-style-type: none"> <li>Manual Plc: When <b>Manual Plc</b> option is selected, the screen pops up with PLC parameter setting, setting range: 0.0005~6.4, unit: PLC.</li> <li>Manual S: When <b>Manual S</b> option is selected, the screen pops up with Speed setting, the setting range: 0.00001s – Max s.</li> </ul> <p><b>Max = Measure Interval *80% ; Measure Interval - Measure Speed &gt; 40us</b></p>
Recorder Mode	<p>Set the mode of data recording, you can choose Cycle or Once.</p> <p>When Cycle is selected, the Point Number setting item is hidden. By default, the maximum number of sampling points is 1,000,000. After the maximum number of sampling points is reached, it will be cyclically covered.</p>

Parameter	Description
	When selecting Once, you can set the Point Number item.
Point Number	Set the depth of data logging, that is, the number of collected data points. When the Recorder starts running and the collection quantity reaches the set number, it will automatically stop recording. Setting range: 1~1000000.
File Format	The formats of the files exported to the USB drive: Tdms or csv formats.
Export To Udisk	Select whether to export the acquired data to a USB flash drive.
Save To Udisk Real-time	<p>Select whether to export to a USB flash drive in real time.</p> <ul style="list-style-type: none"> <li>• Off: This function is turned off.</li> <li>• On: This function is turned on.</li> </ul> <p>After the Recorder function Run, there is no limit to the amount of data acquired when saving the real-time acquired data to a USB flash drive, but it is recommended to set the acquisition speed <b>Manual S</b> is 1ms or more.</p>

- Hold-On / Hold-Off: Pause / Resume data recording or curve plotting.
  - Auto: Self-adaptive function. The screen will automatically adjust the drawing height according to the actual measurement data.
4. Setting of X-axis (time) and Y-axis (voltage, current) resolution
    - a. Touch the corresponding area with your finger to enter the pending edit state, as shown in the following figure.



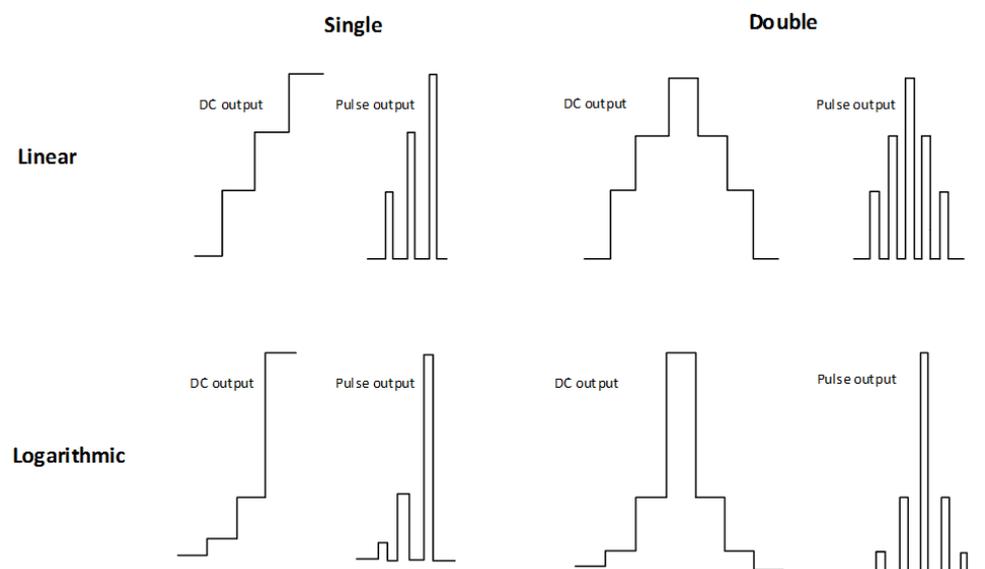
- b. Turn the knob or press the left / right key to adjust.
5. After clicking **Run**, the voltage curve and current curve are drawn during the data recording process.

The color of the curve drawn in the Recorder is only related to the selection of the curve, and has nothing to do with the selected data type.

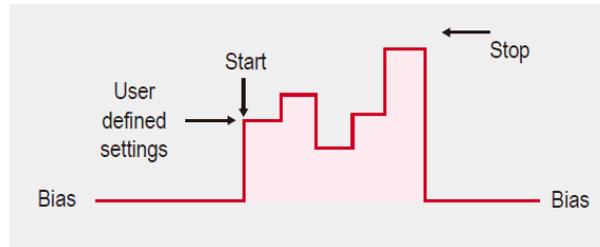
## 1.6.4 Sweep

Sweep mode supports scanning output of multiple waveforms, as shown in the figure below. Not only does it perform sweep output, but it also performs measurements for each step.

- Linear and logarithmic sweep



- User-defined (List)



To access the Sweep interface:

Press the **[Menu]** key, enter **Menu**→**Sweep**.



- Run / Stop: Runs or stops Sweep. After running Sweep, a status marker will appear at the top of the screen that Sweep is started and waiting to be triggered to run. Also, **[On/Off]** must be turned on before Sweep can be started.

#### CAUTION

**Sweep and Recorder are not supported to be started at the same time, for example, if Recorder is already running, Sweep cannot be started.**

- U-I / I-U / Data List: Display of measurement data types during Sweep function operation.
  - U-I: Current-voltage curve, with the Y-axis representing voltage and the X-axis representing current.
  - I-U: Voltage-current curve (voltammetric characteristic curve), with the Y-axis indicating current and the X-axis indicating voltage.
  - Data List: The list of measurement data.

- Auto: Automatically adjusts the scale of the curve display on the X and Y axes so that the user can see the complete curve.
- Clear: Clear the history curve, the curve being drawn will not be cleared.
- Setting: Enter Sweep waveform parameter setting mode.

If Sweep is running at this time, all settings in the Setting screen will be grayed out and parameter settings cannot be modified.

- 0.000V / 0.000A: Starting value for X and Y coordinate axes (voltage and current)
- 10.000V / 1.000A: Ending value for X and Y coordinate axes (voltage and current)



#### Note

The end value must be greater than the start value.



- : Sweep / List running status display. The progress bar and percentage at the top of the screen indicate the total number of steps in Sweep / List and how many steps have been run. The Step below indicates the set value of a single step.

## How to Use

1. Press the **Setting** key to enter the parameter setting interface in Sweep mode.
2. Set **Common Setting**→**Mode**, different options correspond to different waveform parameters.
3. Select **Trigger Setting**→**Start Trigger Source** to set the triggering method.
4. After the parameters are set, turn on the **[On/Off]**.
5. Press **[Run]** from the Sweep main screen.
6. Triggers Sweep to run according to the triggering source that has been set.

## 1.6.5 Meas ohms

IT2800 supports resistance measurement. When the resistance measurement function is turned on, the source/measure unit (SMU) automatically sets the current source and voltage measurement operation to perform resistance measurement.

To access the Meas ohms interface:

Press the **[Menu]** key, enter the **Menu→Meas ohms**.

Parameter	Description
Ohms	<ul style="list-style-type: none"> <li>On: Resistance measurement function is turned on</li> </ul>  <b>Note</b> At this time, the <b>I Set, I Range, V Limit, V Range</b> parameters cannot be modified. <ul style="list-style-type: none"> <li>Off: Resistance measurement function is turned off</li> </ul>
Range	Selecting the range for resistance measurement
R Compen	Resistance compensation (R Compen) is effective for performing low resistance measurements accurately. If R Compen is set to ON, the channel performs measurement twice and returns the compensated measurement result given by the following formula. This technique is effective for reducing the thermal EMF. $R_{\text{compen}} = (V_2 - V_1) / (I_2 - I_1)$ $V_1$ is the measurement results at the 0 A source condition, and $I_1$ is the measurement results at the 0 V source condition.

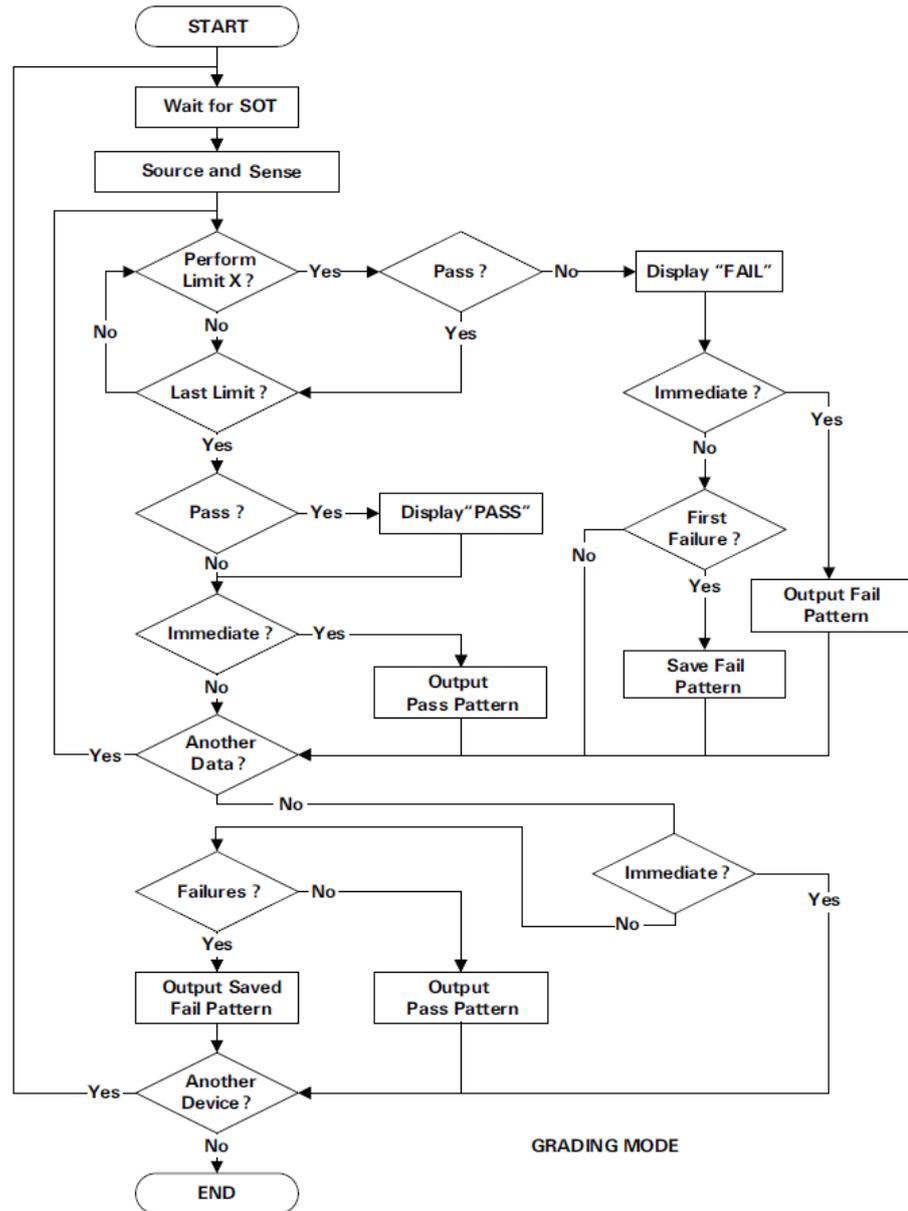
## 1.6.6 Meas limit

Limit test is a pass/fail judgement performed for a measurement data or math result data obtained by a SMU channel. Maximum of twelve limit tests can be defined and used for the bins of composite limit test.

Composite limit test supports the following two operation modes.

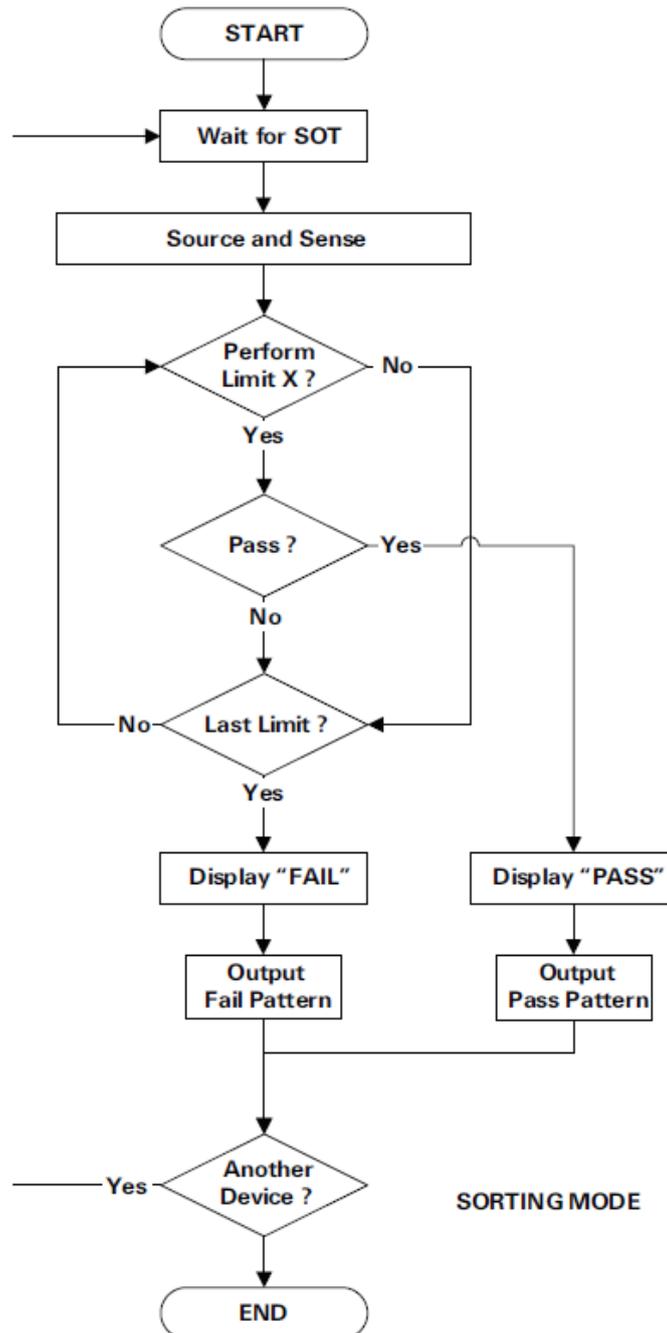
- Grading mode

Performs limit test for up to 12 test limits (bins) until a failure is detected. See the figure below for an example flowchart.



- Sorting mode

Performs limit test for up to 12 test limits (bins) until a pass is detected. See the figure below for an example flowchart.

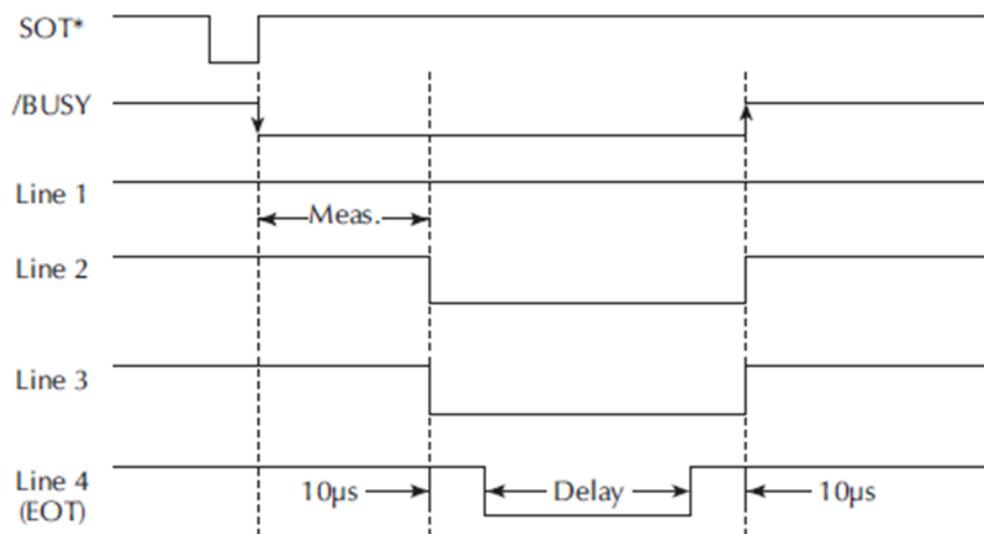


The individual pins used by Digital IO in the limit test function are defined as follows.

- Pattern bit: pin1-pin12
- SOT (Start Of Test): pin13
- Busy: pin14
- EOT (End Of Test): pin15

The diagram of each state is shown below.

### Digital output auto-clear timing example



The **Setting** interface parameters are described as follows.

Tab	Parameter	Description
Common Setting	Mode	The mode of limit testing. <ul style="list-style-type: none"> <li>• Grading</li> <li>• Sorting</li> </ul>
	Feed Data	The type of data used for the pass/fail judgment of the limit test. <ul style="list-style-type: none"> <li>• Volts: Voltage measurement data</li> <li>• Amps: Current measurement data</li> <li>• Ohms: The resistance data specified by <math>R = V_{meas}/I_{meas}</math>. If the resistance compensation function is turned on, the compensated resistance value is used.</li> <li>• Math: Calculated result data for mathematical expressions</li> </ul>
	Limits	Set the number of limit tests, the setting range is 1~12. For example, if 12 times is selected, each value is tested up to 12 times.
	Components	The number of test data. Setting range: 0~50000. When the setting value is 0, it means infinite test until <b>Stop</b> key is pressed.

Tab	Parameter	Description
	Update	This parameter setting is only available in Grading mode. <ul style="list-style-type: none"> <li>• Immediate: Output the result immediately when test fail and stop this test; output the result immediately when test pass and stop this test.</li> <li>• End: When testing fail, if it is the first fail, save the fail pattern and retest. If it is not the first time to fail, directly retest until the number of times specified by <b>Repeat Counts</b> is finished. After multiple tests, if all pass, output the result as pass, otherwise output the first fail pattern.</li> </ul>
	Repeat Counts	This parameter is set only when <b>Update</b> is set to <b>End</b> . Indicates the number of times to repeat the test if the test fails under the same test. Setting range: 2~1000.
	All Pass / Fail Pattern	Setting range: 0~4095. In Grading mode, all tests pass the output pattern. This pattern will be output to digital IO, pin1-pin12. Output according to 000000000000b. Pin12 is the highest bit. In Sorting mode, all test fail output pattern. This pattern will be output to pin1-pin12 of digital IO. Default: 0xff
	Start of Test	The signal source to start the test. <ul style="list-style-type: none"> <li>• Digital IO: Triggered by IO pin13</li> <li>• Manual: Triggered by the front panel <b>[Trig]</b> key</li> <li>• Bus: Triggered by command</li> </ul>
	Auto Clear	Automatic clearing of test results. <ul style="list-style-type: none"> <li>• On: Automatically clear the test result (pass or fail status, IO Pattern level) with a delay time of EOT Delay.</li> <li>• Off: Keeps the test results displayed until the next <b>Start of Test</b> signal arrives.</li> </ul>

Tab	Parameter	Description
	EOT Delay	Used to indicate the delay time for outputting Digital signal after the test is finished. The EOT signal is output to pin15 of Digital IO. Setting range: 30us~60s (adjustment step is 10us)
Limit Setting ( Grading Mode )	Limit X	Not editable. Corresponds to the number settings of <b>Common Setting</b> → <b>Limits</b> . How many quantities are set in <b>Limits</b> , the corresponding numbers will be displayed here.
	Limit 1	<ul style="list-style-type: none"> <li>• Compliance: compliance check. Compare with Limit under Config.  Select this mode and set the following parameters.  Fail On: Applicable to compliance check only. OUT or IN can be selected. <b>In</b> means the measured value is within the limit; <b>Out</b> means the measured value exceeds the limit. Fail on=IN determines that the limit test has failed if the channel goes into compliance, and Fail on=OUT determines that it has succeeded. If the channel is not in compliance, Fail on=OUT will determine that the limit test failed.  Fail Pattern: Bit pattern for the limit test fail state. Setting range: 0~4095.</li> <li>• Limit: Composite limit test  Select this mode and set the following parameters.  High Limit: Limit test upper limit  Low Limit: Limit test lower limit  Fail Pattern: Bit pattern for the limit test fail state. Setting range: 0~4095.</li> </ul> <p> <b>Note</b> Only Limit 1 can select Limit / Compliance mode, all others default to Limit.</p>

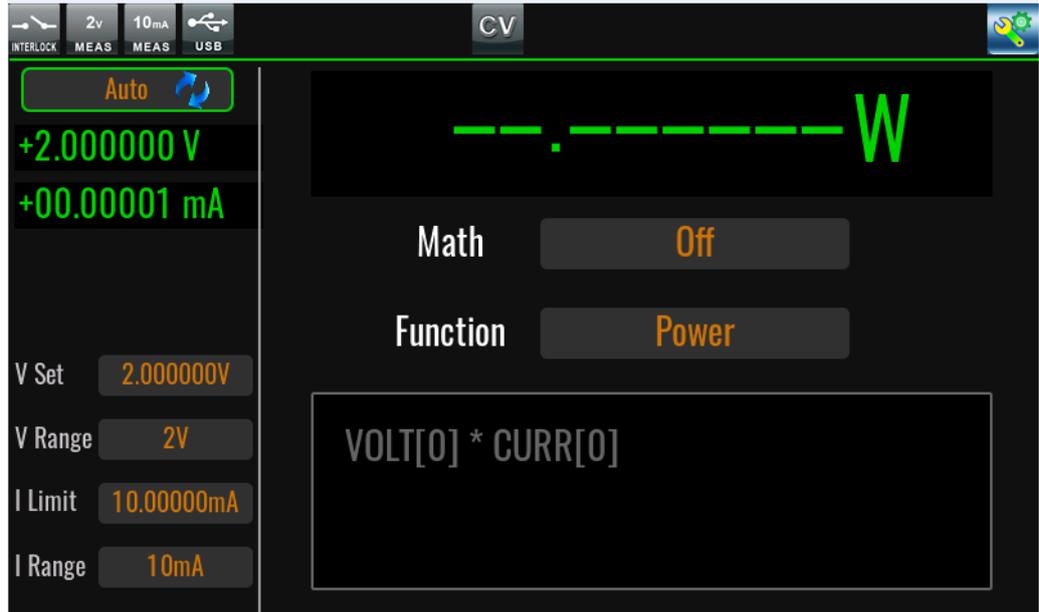
Tab	Parameter	Description
Limit Setting ( Sorting Mode )	Start Value	The starting value of the limit test
	LimitX Value	Indicates the limit test value. Corresponds to the number settings of <b>Common Setting</b> → <b>Limits</b> . How many quantities are set in <b>Limits</b> , the corresponding numbers will be displayed here.
	Pass Pattern	Bit pattern for the limit test pass state. Setting range: 0~4095.
Data Save	Export Data	Export the test data to a USB flash drive.
	Save to Udisk Real-time	Set to On to indicate that the test data is automatically saved to the USB flash drive in real time after Run.
Setting Save	Recall / Save / Delete	Used to recall/save/delete the configured <b>Meas Limit</b> function parameters. Saves all configured parameters under <b>Common Setting</b> and <b>Limit Setting</b> .

## 1.6.7 Meas math

The SMU provides a math function for performing calculations using the measurement result data. The calculation result can be displayed and used for the limit test and trace statistics. The predefined math expressions are not cleared by the power off and on operations.

To access the Meas math interface:

Press the [**Menu**] key, enter **Menu**→**Meas math**.



Parameter	Description
State	<ul style="list-style-type: none"> <li>On: Turn on the math expression calculation function</li> </ul>  <b>Note</b> When this function is turned on, the instrument first calculates the voltage and current values in the Meter through expressions and then fills the calculated data results into the cache module.
Function	<ul style="list-style-type: none"> <li>Power: POWER                              Calculates power using the following formula.  <math display="block">\text{Power} = \text{Volt} * \text{Curr}</math> </li> <li>Off-Comp-Ohm: Offset Compensated Ohms                              Calculates offset compensated ohms (resistance) using the following formula.  <math display="block">\text{OFFCOMPOHM} = (\text{VOLT}[1] - \text{VOLT}[0]) / (\text{CURR}[1] - \text{CURR}[0])</math>                             where, VOLT[0] and CURR[0] are the data measured with a current output level, and VOLT[1] and CURR[1] are the data measured with a different current output level or zero output.                              This function is effective for reducing measurement errors in low resistance measurements.                         </li> <li>Alpha: Varistor Alpha                              Calculates varistor alpha using the following formula.  <math display="block">\text{VARALPHA} = \log(\text{CURR}[1] / \text{CURR}[0]) / \log(\text{VOLT}[1] / \text{VOLT}[0])</math>                             where, CURR[0] and VOLT[0] are the measurement data at a point on a varistor's non-linear I-V characteristics curve, and CURR[1] and VOLT[1] are the data at the another point.                         </li> <li>Volt-Coef: Voltage Coefficient                              Calculates voltage coefficient using the following formula.  <math display="block">\text{VOLTCOEF} = (\text{RES}[1] - \text{RES}[0]) / (\text{RES}[1] * (\text{VOLT}[1] - \text{VOLT}[0])) * 100 \%</math>                             where, RES[0] and RES[1] are the resistance measurement data at the first and second measurement points, respectively, and VOLT[0] and VOLT[1] are the voltage                         </li> </ul>

Parameter	Description
	<p>measurement data at the first and second measurement points, respectively.</p> <p>The voltage coefficient is known as the ratio of the fractional change for a resistor whose resistance varies with voltage.</p> <ul style="list-style-type: none"> <li>• User-Define: Custom formula mode. For detailed function introduction, see .</li> </ul>

## 1.6.8 System

Press **[Menu]**→**System** to enter the system menu.

General	General Settings	
	PLC	The power line frequency must be set properly for the AC power at your site. Press the following function keys to set the frequency to 50 Hz or 60 Hz.
	Digits	<p>Displays the following softkeys for specifying the data display resolution.</p> <ul style="list-style-type: none"> <li>• 3.5: Sets 3½ digit resolution.</li> <li>• 4.5: Sets 4½ digit resolution.</li> <li>• 5.5: Sets 5½ digit resolution.</li> <li>• (Default) 6.5: Sets 6½ digit resolution.</li> </ul>
	Key Sound	<p>Set the key sound switch.</p> <ul style="list-style-type: none"> <li>• On (default): On</li> <li>• Off: Off</li> </ul>
	Protection Alarm	<p>The buzzer alarm function when the instrument fails and protection occurs.</p> <ul style="list-style-type: none"> <li>• On (default): On</li> <li>• Off: Off</li> </ul>
	Brightness	Set the screen brightness. The setting range is 1~10. Default value: 3.
	Factory Default	Press <b>[Enter]</b> to confirm restoring the factory settings. This operation restores all parameters in the <b>Menu</b> to the factory values, but does not include the saved data in the non-volatile memory.
	Power-on State	<ul style="list-style-type: none"> <li>• Reset: Initialize some settings and power output status when powering up again.</li> <li>• Last: When powering up again, the instrument maintains the settings (including range and setting values) and power output status before powering down.</li> </ul>

		<ul style="list-style-type: none"> <li>• Last+Off: When re-powered, the instrument maintains the settings before power off, but the power output status is off.</li> </ul>
	Multichannel mode Role	Multi-channel function setting. <ul style="list-style-type: none"> <li>• Master: Master mode</li> <li>• Single (default): Single mode</li> <li>• Slave: Slave mode</li> </ul>
	Immediate update by knob State	Sets whether the knob adjustment takes effect immediately. <ul style="list-style-type: none"> <li>• On: This function is turned on.</li> <li>• Off (default): This function is off.</li> </ul>
Communi- cation	Set the communication parameters between the instrument and the computer (e.g. insert the optional communication board to automatically display the corresponding interface information)	
	USB Type	Set the USB port type. <ul style="list-style-type: none"> <li>• Device (default): Select this item, the rear panel USB-B interface of the instrument is used to connect to the computer for communication. The USB-A interface on the front panel of the instrument is not available, even if the U disk is inserted, it cannot be recognized at this time.</li> <li>• Host: Select this item, the USB-A interface on the front panel of the instrument is used to connect to the U disk to store data or take screenshots, and the USB-B interface on the back panel of the instrument cannot be used as the communication interface at this time. And, the <b>USB Device</b> cannot be set.</li> </ul>
	USB Device	Used to set the communication method of the USB-B interface on the rear panel of the instrument. Valid only when <b>USB Type</b> is set to <b>Device</b> . <ul style="list-style-type: none"> <li>• VCP (default): Virtual serial communication method. When the computer is Win 7 version operating system, you need to install the corresponding virtual serial driver, please download it from ITECH official website or contact ITECH support to get it, Win 10 and above professional version systems do not need to install the driver.</li> <li>• TMC: TMC communication method. You need to download the VISA driver from the NI official website to match the computer OS version.</li> </ul>
	LAN Config	Set the network port communication parameters. <ul style="list-style-type: none"> <li>• Mode: Set LAN communication mode Manual or DHCP. If select Manual, you need to set IP, Mask and Gateway manually. If select DHCP, then IP, Mask and Gateway cannot be set.</li> <li>• IP: Set IP address Default: 192.168.200.100</li> <li>• Mask: Set the subnet mask</li> <li>• Gateway: Set the gateway address</li> <li>• Port: Set the port number, the setting range is 10000-60000.</li> </ul>

	GPIB config	GPIB communication interface configuration (only displayed when the IT-E176 interface card is inserted). Addr: Set GPIB address. Setting range: 1~30. Default: 25.	
I/O			
	Digital IO-1: Trigger1 ... Digital IO-8: Trigger8	IO pins 1~8 with Trigger signal. Each pin has the same function definition, and the following is an example of one pin.	
		Reverse	Whether to toggle the pin input/output level between high and low signals.
		Off	Not converted. <ul style="list-style-type: none"> <li>• Trig-out: The pin outputs a low level/pulse signal after receiving a trigger signal from a <b>[Trig]</b> key or command.</li> <li>• Trig-in: Generate a trigger when the pin receives a 0V low level/pulse signal.</li> <li>• Output: When <b>Set</b> is set to <b>Off</b>, the pin outputs 5V high level; when <b>Set</b> is set to <b>On</b>, the pin outputs a 0V low level.</li> <li>• Input: Pin is used to receive level/pulse signal, when the pin receives 5V high level, <b>Status</b> is displayed as <b>Off</b>; when the pin receives 0V low level, <b>Status</b> is displayed as <b>On</b>.</li> </ul>
		On	Converted <ul style="list-style-type: none"> <li>• Trig-out: The pin outputs a high level/pulse signal after receiving a trigger signal from a <b>[Trig]</b> key or command.</li> <li>• Trig-in: Generate a trigger when the pin receives a 5V high level/pulse signal.</li> <li>• Output: When <b>Set</b> is set to <b>Off</b>, the pin outputs 0V low level; when <b>Set</b> is set to <b>On</b>, the pin outputs 5V high level.</li> <li>• Input: Pin is used to receive level/pulse signal, when the pin receives 0V low level, <b>Status</b> is displayed as <b>Off</b>; when the pin receives 5V high level, <b>Status</b> is displayed as <b>On</b>.</li> </ul>
		Function	Specifies the function of the pin.
		Trig-in	(Default) The pin is used to receive the trigger signal. Valid only when the <b>Config</b> → <b>Advanced Setting</b> → <b>Trigger</b> → <b>Source</b> is set as <b>Trigger</b> .

			Trig-out	The pin is used to output the trigger signal. Valid only when the <b>Config</b> → <b>Advanced Setting</b> → <b>Trigger</b> → <b>Source</b> is set to a trigger method other than <b>Trigger</b> . For example, if it is set to <b>Manual ([Trig] key trigger)</b> , the pin will output a pulse signal when the key is pressed once.
			Pulse width	Set the pulse width, range: 30us~10ms.
			Input	Indicates the input level of the pin.
			Output	Output level/pulse signal.
			Set	Set the pin to output 0V or 5V.
	Digital IO-9 ... Digital IO-12 Digital IO-16	Digital IO pins without trigger function, the parameter function is the same as Pin1~Pin8 above.		
	Digital IO-13: /SOT	Start of Test (SOT) input (for component handlers) Only <b>Reverse</b> settings are supported, <b>Function</b> and <b>Set</b> cannot be specified.		
	Digital IO-14: /Busy	Busy status output (for component handlers) Only <b>Reverse</b> settings are supported, <b>Function</b> and <b>Set</b> cannot be specified.		
	Digital IO-15: /EOT	End of Test (EOT) output (for component handlers) Only <b>Reverse</b> settings are supported, <b>Function</b> and <b>Set</b> cannot be specified.		
Fiber	Fiber synchronous trigger function in multi-device mode. Trigger functions can be mapped to fiber optic pins. Settings are only supported in multi-device mode.			
	<ul style="list-style-type: none"> <li>• Trigger1_in -&gt; fiber25</li> <li>• Trigger2_in -&gt; fiber26</li> <li>• Trigger3_in -&gt; fiber27</li> <li>• Trigger4_in -&gt; fiber28</li> <li>• ManualTrigger -&gt; fiber29</li> <li>• GpibTrigger -&gt; fiber30</li> <li>• BusTrigger -&gt; fiber31</li> <li>• ScopeTrigger -&gt; fiber32</li> </ul>			
Information	View system information			
	Product Model	Model of the instrument		
	SN	Serial number of the instrument		
	Software Version	Software firmware version number		
	MAC Address	MAC Address		

	Ctrl Version 1	Control program 1 version
	Ctrl Version 2	Control program 2 version
	Disp Version	Display board program version

## 1.6.9 Config

Press **[Menu]**→**Config** to enter the configuration interface.

Source	Source parameter configuration			
	Pulse	Pulse output mode		
		State	Whether to turn on the pulse output.	
		Priority	Sets the start level of the pulse. Supports selecting the voltage or current defined by Base, or selecting the voltage or current defined by Peak (i.e. <b>V Set</b> or <b>I Set</b> in Meter interface).	
		Base	Set the Base level.	
		Delay	Set the pulse delay time. After the delay time following the trigger delay, the pulse source changes the output level from the base value to the peak value. Range: 100us~1000s.	
		Width	Set the pulse width. Range: 100us~1000s.	
		General	Common output mode	
			Mode	Selects the voltage source or current source output mode.
			V Set / I Set	Set the output voltage or current value according to the selected voltage source or current source.
			V Range / I Range	Set the voltage range or current range according to the selected voltage source or current source.
			I Limit / V Limit	Set the current upper limit value or voltage upper limit value according to the selected voltage source or current source.
			I Range / V Range	Set the range of the upper limit current or the range of the upper limit voltage according to the selected voltage source or current source.
			Serial Resistance	Set the output resistance. Setting range: 0~100Ω. <b>Setting this parameter is only supported in voltage source mode.</b>
		Output Filter	Output filter ON or OFF Set the filter ON to obtain clean source output without spikes and overshooting. Note, however, that using a filter may increase the SMU settling time. When set to On, the following parameters need to be set.	

		Auto Filter	Automatic filter ON or OFF Set the function ON to automatically set the output filter which provides the best filter characteristics and cutoff frequency. When set to Off, the following parameters need to be set.
			Time Constant      Filter time constant, 10us to 10ms
	Output Connection	Output Status Setting	
		Output-off State	The output is turned off with a choice of high impedance (High-Z) or zero volts (Zero). <ul style="list-style-type: none"> <li>High-Z: High impedance Output relay: off (open or break); Voltage source and current source setup is not changed.</li> <li>Zero: Quick zeroing. Output relay: on (closed); Output voltage: 0 V; The measuring range remains the same.</li> </ul>
		Over V/I Protect	Over-voltage or over-current protection. Turn off the output when the channel output reaches the compliance limit (Limit).
		Auto Output-on	If this function is enabled, the source/measure unit (SMU) automatically turns the channel output ON just before the trigger system is initiated by an SCPI command, not by a front panel operation.
		Auto Output-off	If this function is enabled, the SMU automatically turns the channel output OFF immediately when all trigger system changes the status from busy to idle.
Measure	Measurement parameter configuration		
	General	Common output mode	
		View Type	Measurement type selection, the following types are supported. Volts&Amps/Volts&Ohms/Volts&Watts/Amps&Volts/Amps&Ohms/Amps&Watts/Ohms&Volts/Ohms&Amps/Ohms&Watts/Watts&Volts/Watts&Amps/Watts&Ohms If you select Volts&Amps, the first line of the Meter interface shows the voltage and the second line shows the current.
		Sensing Type	Whether to turn on the Sense function. Select 2-wire connection (Sense off) or 4-wire connection (Sense on).
		Measure Unit	Set the measurement unit, i.e. the measurement speed. <ul style="list-style-type: none"> <li>Aperture: Take time as the unit, set the measurement speed, range: 10us~2s.</li> </ul>
		Aperture / NPLC	<ul style="list-style-type: none"> <li>NPLC: In PLC (power line cycles, number of power line cycles per measurement). The setting range is as follows.                     <ul style="list-style-type: none"> <li>50Hz: 0.0005~100PLC</li> </ul> </li> </ul>

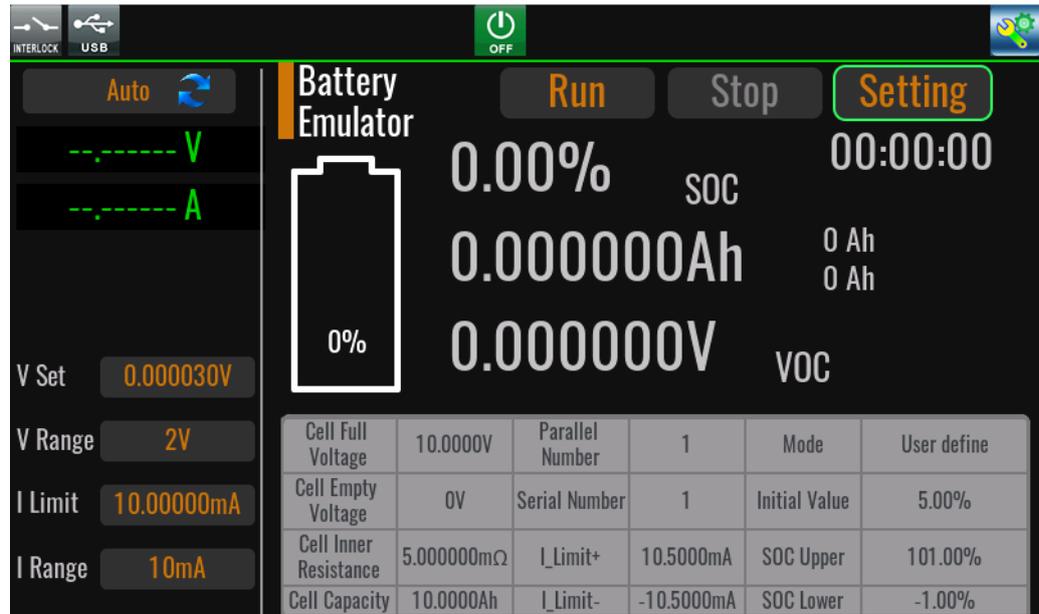
			<ul style="list-style-type: none"> <li>60Hz: 0.0005~120PLC</li> </ul>
	Auto Range Low-limit	The minimum limit of Auto range for voltage or current.	
		Volts	Sets the minimum limit for the voltage Auto range.
		Amps	Sets the minimum limit for the current Auto range.
Advanced Setting	Other settings		
	Wait Control Source	This function provides the following parameters for setting the source wait time. The source wait time is defined as the time the source channel cannot change the output after the start of a DC output or the trailing edge of a pulse. If set to On, the following parameters need to be set. If set to Off, the wait time = 0.	
		Automatic	Automatic wait time ON or OFF <ul style="list-style-type: none"> <li>If set to On, the Gain parameter needs to be set. See the following formula.  <math display="block">\text{wait time} = \text{Gain} \times \text{initial wait time} + \text{Offset}</math>                     The initial wait time is automatically set by the instrument, and cannot be changed.</li> <li>If set to Off, see the following formula.  <math display="block">\text{wait time} = \text{Offset}</math> </li> </ul>
			Gain      Gain coefficient, range: 0~100.
		Offset	Offset value, range: 0~1s.
	Wait Control Measure	This function provides the following parameters for setting the measurement wait time. The measurement wait time is defined as the time the measurement channel cannot start measurement after the start of a DC output or the trailing edge of a pulse. If set to On, the following parameters need to be set. If set to Off, the wait time = 0.	
		Automatic	Automatic wait time ON or OFF <ul style="list-style-type: none"> <li>If set to On, the Gain parameter needs to be set. See the following formula.  <math display="block">\text{wait time} = \text{Gain} \times \text{initial wait time} + \text{Offset}</math>                     The initial wait time is automatically set by the instrument, and cannot be changed.</li> <li>If set to Off, see the following formula.  <math display="block">\text{wait time} = \text{Offset}</math> </li> </ul>
			Gain      Gain coefficient, range: 0~100.
		Offset	Offset value, range: 0~1s.
	Trigger	Setting the trigger source	

	Source	<ul style="list-style-type: none"> <li>Auto: Trigger source best suited for the present operating mode is automatically selected by the internal algorithms.</li> <li>Manual: Triggered by the <b>[Trig]</b> key.</li> <li>Bus: Triggered by a command, such as <b>*TRG</b>.</li> <li>Trigger: Triggered by Digital IO1~IO8 pins.</li> <li>Fiber: Triggered by Fiber 1~32.</li> </ul> <p>Fiber optic trigger requires optional fiber optic module and fiber optic cable.</p> <p>Except the Auto option, the other trigger methods support setting the Delay time, range: 0~100s.</p>
	Trigger Output	<p>Set the output mode of the trigger signal.</p> <ul style="list-style-type: none"> <li>Off: No output</li> <li>Trigger: Trigger output by Digital IO1~IO8 pins.</li> <li>Fiber: Trigger output by Fiber 1~32.</li> </ul>
	Source	Trigger output for source mode
	Sense	Trigger output for measurement mode
	Limit 1 / Limit 2	To Set Individual Limit Tests Measurement results are displayed on the right side of the Home page (Pass/Fail)
	State	On: Enable the function; Off: Disable the function.
	Feed Data	<p>The type of data used for pass/fail judgments for individual limit tests, including: Volts/Amps/Ohms/Watts/Math.</p> <ul style="list-style-type: none"> <li>MATH: Calculation result data of math expression</li> <li>VOLTS: Voltage measurement data (Vmeas)</li> <li>AMPS: Current measurement data (Imeas)</li> <li>OHMS: Resistance data (= Vmeas/Imeas)</li> <li>WATTS : Power data (= Vmeas*Imeas)</li> </ul>
	High Value	Upper limit for the pass/fail judgement. Above this value, it is Fail.
	Low Value	Lower limit for the pass/fail judgement. Below this value, it is Fail.
	Auto Clear	<p>Whether or not to automatically clear the results of TestFail.</p> <p>On: When enabled, fail messages are automatically cleared.</p> <p>Off: After Fail alarm, it is not cleared automatically and must be cleared manually. Click <b>pass or fail clear</b> to clear it manually.</p>

		Beep	Whether to generate a beep when Fail. When set to On, it means sound is generated when abnormal alarm is generated.
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### 1.6.10 Battery

This series SMU supports battery simulation function, enter **Menu**→**Battery** interface. The introduction is as follows.



Click [**Setting**] to enter the battery simulation editing interface, and the parameters are described below.

Open File	Open a battery simulation file that has been saved in the instrument memory (Local) or saved on a USB flash drive (recall of USB flash drive files is only supported in Curve mode).
New File	<p>Create a new battery simulation file.</p> <p><b>User define</b> mode sets the following parameters.</p> <ul style="list-style-type: none"> <li>• Cell Full Voltage: The full voltage of a cell</li> <li>• Cell Empty Voltage: Empty voltage of a cell</li> <li>• Cell Inner Resistance: The internal resistance of a cell</li> <li>• Cell Capacity: The capacity of a cell</li> <li>• Parallel Number: The number of parallel connections of cells</li> <li>• Serial Number: The number of series connections of cells</li> <li>• I_Limit+: The maximum discharge current of the battery as a whole</li> </ul>

	<ul style="list-style-type: none"> <li>• <b>I_Limit-</b>: The maximum charge current of the battery as a whole</li> </ul> <p><b>Curve</b> mode sets the following parameters.</p> <ul style="list-style-type: none"> <li>• Curve edit: Define <b>Cell SOC</b> (initial capacity of a cell), <b>Cell Voltage</b> (cell voltage), <b>Cell Res</b> (cell internal resistance value) for each <b>Point</b>, up to 10000 Points.</li> <li>• Common edit: Define <b>Cell Capacity</b>, <b>Parallel Number</b>, <b>Serial Number</b>, <b>I_Limit+</b> (maximum discharge current of the battery as a whole), <b>I_Limit-</b> (maximum charge current of the battery as a whole)</li> </ul>
Save	Save the edited battery simulation file. Only displayed in User define mode.
Save As	Save the edited battery simulation file to the instrument memory (Local) or to a USB flash drive (Save to USB flash drive is supported in Curve mode only). This function supports editing the name of the saved file.
Delete File	Delete the battery simulation file from the instrument memory (-Local) or from the USB flash drive (deleting the USB flash drive file is only supported in Curve mode).
Mode	<ul style="list-style-type: none"> <li>• User define: User-defined mode</li> <li>• Curve: Curve mode</li> </ul>
Initial Value	Initial battery charge percentage (0%-100%)
SOC Upper	The upper limit (maximum value) of the charging capacity. Setting range: 100% - 110%, default:101%
SOC Lower	The lower limit (minimum value) of the discharge capacity. Setting range: 0%-(-10%), default:-1%
End Type	<ul style="list-style-type: none"> <li>• Hold: When charging to the upper capacity limit or discharging to the lower capacity limit, the capacity is held.</li> <li>• Off: When charging to the upper capacity limit or discharging to the lower capacity limit, the output is turned off.</li> </ul>

### Edit and run battery simulation files (User define)

1. Select **Mode** as **User define**.
2. Click **New File** to enter the battery simulation file editing interface.

3. Click on the screen to set parameters such as **Cell Full Voltage**.
4. Click **Save** to save the file.
5. Click **Open File** to select a file.
6. Press the **[Esc]** key to return to the main screen of the battery simulation.
7. Press the **[On/Off]** key to turn on the output.
8. Click **Run** to run the battery simulation.

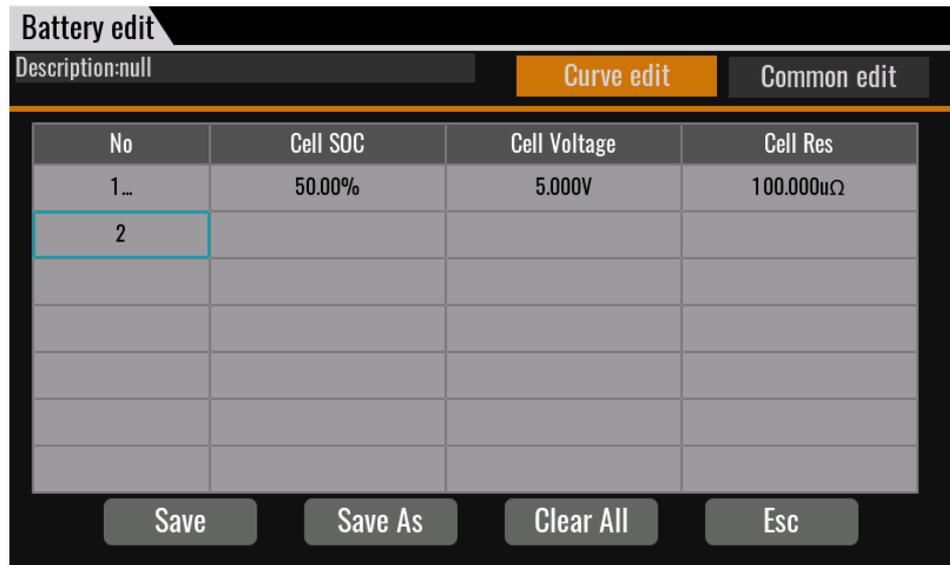
During the running of battery simulation, you can click **Stop** to stop it.

### Edit and run battery simulation files (Curve)

1. Select **Mode** as **Curve**.
2. Click **New File** to enter the battery simulation file editing interface.
3. Click on the screen to set the **Curve edit** and **Common edit** parameters in the interface.

The setup method is as follows.

- a. Click on the screen to set a Point, as shown below.



No	Cell SOC	Cell Voltage	Cell Res
1...	50.00%	5.000V	100.000uΩ
2			

Buttons: Save, Save As, Clear All, Esc



#### Note

After setting any of the parameters Cell SOC / Cell Voltage / Cell Res and pressing **[Enter]**, a record of Point (one line of data) is automatically generated.

- b. Set up multiple Points in the same way, up to 10,000.
- c. Edit the parameters in **Common edit**.
- d. Click **Save** to save the file.

- e. Click **Esc** to exit the file editing.
4. Click **Open File** to select a file.
5. Press the **[Esc]** key to return to the main screen of the battery simulation.
6. Press the **[On/Off]** key to turn on the output.
7. Click **Run** to run the battery simulation.

During the running of battery simulation, you can click **Stop** to stop it.

## 1.6.11 Save / Recall

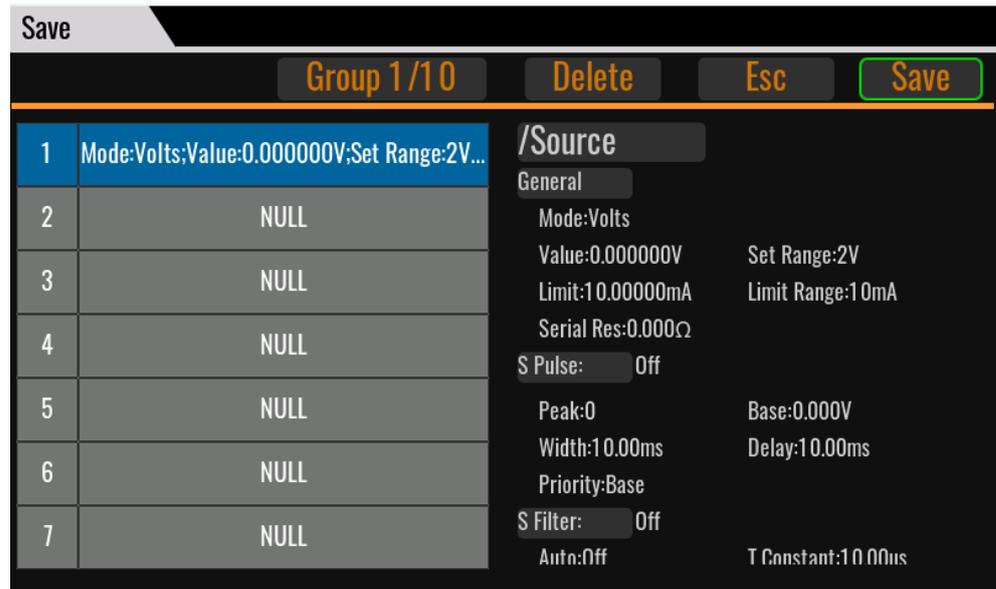
This series of SMUs supports saving some commonly used Config configuration parameters in 10 groups (number: 1~10) of non-volatile memory, for users to take out conveniently and quickly. A total of 10 groups, each group can save 10 pieces of information, a total of 100 pieces of information can be saved.

The store/recall operation on the storage area can be implemented in the following way.

- Click **Menu**→**Save / Recall**
- SCPI commands: **\*SAV**, **\*RCL**.  
Command setting range: 1~100.
  - The first group: 1~10
  - The second group: 11~20
  - .....
  - Tenth Group: 91~100

### Save

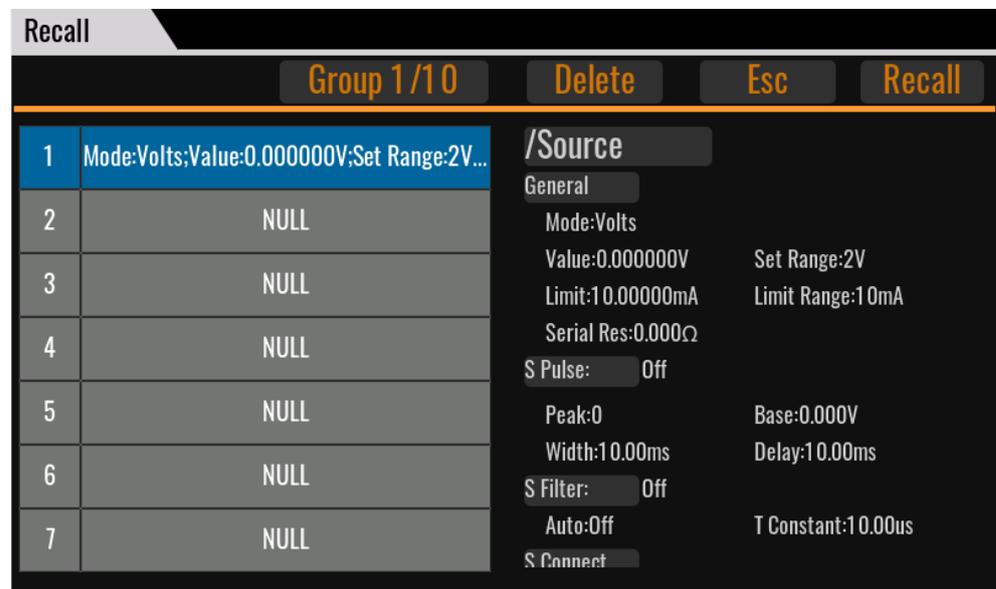
1. Set the parameters in the SMU's **Menu**→**Config** menu to the desired values.
2. Click the screen **Menu**→**Save** to enter the parameter save screen, as shown below.



- Click on the numbers 1~10 on the left side of the screen and select one of the addresses to save.
- Click **Save** at the top of the screen to confirm that the parameters are saved.

## Recall

- Click the screen **Menu**→**Recall** to enter the parameter recall screen, as shown below.



- Click on the numbers 1~10 on the left side of the screen to select one of the addresses where the existing data is saved.
- Click **Recall** at the top of the screen to confirm the parameter recall.

## 1.7 Models and Options

**IT2800 Series Selection Table**

Model	Voltage	Current	Pulse current	Power	Number of channels
IT2801 / IT2801R	1000V	1A	—	20W	One
IT2805 / IT2805R	200V	1.5A	—	20W	One
IT2806 / IT2806R	200V	3A DC / 10.5A Pulse	10.5A	20W DC	One



**Note**

IT2801R, IT2805R, IT2806R are models with channel terminals on the front and rear panels.

### Optional Accessories

Users can additionally purchase accessories to accompany this series of instruments, including the following categories and models.

- **Test Leads or Fixtures**

Model	Description
IT-E801A	Banana to triaxial adapter. Suitable for IT2805, IT2806. See <a href="#">2.5 Connecting the Device Under Test (DUT)</a> for details.
IT-E802A	Banana to triaxial adapter. Suitable for IT2801. See <a href="#">2.5 Connecting the Device Under Test (DUT)</a> for details.
IT-E801C-1.5	Low leakage triaxial cables. Length is 1.5m, suitable for IT2805, IT2806.
IT-E802C-1.5	Low leakage triaxial cables. Length is 1.5m, suitable for IT2801.
IT-E601	Kelvin (4-wire) test cable. 300V banana to pin plug (- Crown Round Tip) connection cable (black), suitable for IT2805, IT2806.

Model	Description
IT-E601H	Kelvin (4-wire) test cable. 1000V banana to pin plug (- Crown Round Tip) connection cable (black), suitable for IT2801.
IT-E602	Kelvin (4-wire) test cable. 300V banana to alligator clip connection cable (black), suitable for IT2805, IT2806.
IT-E602H	Kelvin (4-wire) test cable. 1000V banana to alligator clip connection cable (black), suitable for IT2801.
IT-E603	Kelvin (4-wire) test cable. 300V banana to pin plug (- Cone Tip) connection cable (black), suitable for IT2805, IT2806.
IT-E603H	Kelvin (4-wire) test cable. 1000V banana to pin plug (- Cone Tip) connection cable (black), suitable for IT2801.
IT-E604	Kelvin (4-wire) test cable. 300V banana to universal pin and alligator clip connection cable (black), suitable for IT2805, IT2806.
IT-E604H	Kelvin (4-wire) test cable. 1000V banana to universal pin and alligator clip connection cable (black), suitable for IT2801.

- **Extended Interface**

The rear panel provides interface expansion slots for flexible expansion according to the user's needs, which can be inserted into the IT-E176 GPIB communication interface board.

**WARNING**

**It is strictly forbidden to directly insert and remove the communication card when the instrument is powered. Power off the instrument before installing the communication card. After the communication card is installed, power on the instrument. At this time, the instrument takes about 30 seconds to update the communication board automatically.**



- **Cabinet Installation**

This series of instruments can be mounted on a standard 19-inch cabinet. ITECH has prepared a special bracket as a mounting kit for users. For the installation method, refer to "IT-E158 User Manual".

Model	Installation Location	Description
IT-E158A	Two instruments mounted side-by-side. For fixing the front of the equipment to the cabinet.	It can be used with IT-E158B and adapted to ITECH cabinet.
IT-E158B	Two instruments mounted side-by-side. For fixing the rear of the equipment to the cabinet.	It can be used with IT-E158A and adapted to ITECH cabinet.
IT-E158C	Installation of a single instrument into a cabinet. For fixing the front of the equipment to the cabinet.	Used in conjunction with IT-E158D. For use in cases where only one instrument is installed on one floor.
IT-E158D	Installation of a single instrument into a cabinet. For fixing the rear of the equipment to the cabinet.	Used in conjunction with IT-E158C. For use in cases where only one instrument is installed on one floor.

- **Multi-channel Cascade**

IT-E168: For multi-channel synchronization or fiber optic triggering. Includes an optical module and two fiber optic cables of 1.5m and 0.3m length respectively.

# 2 Inspection and Installation

- ◆ Verifying the Shipment
- ◆ Instrument Size Introduction
- ◆ Rack Installation
- ◆ Connecting the Power Cord
- ◆ Connecting the Device Under Test (DUT)

## 2.1 Verifying the Shipment

Unpack the box and check the contents before operating the instrument. If wrong items have been delivered, if items are missing, or if there is a defect with the appearance of the items, contact the dealer from which you purchased the instrument immediately.

The package contents include:

Item	Qty.	Remarks
Graphical Source Measure Unit	1	Please refer to <a href="#">1.7 Models and Options</a> for the detailed models.
Power Cord	1	Power cord that matches the specifications of power socket used in the area. See the Section <a href="#">2.4 Connecting the Power Cord</a> for details.
Test Cables	1	Two-wire red and black test cables.
USB communication cable	1	It is used to connect to a computer for communication.
Ex-Factory Test Report	1	It is the test report of the instrument before delivery.



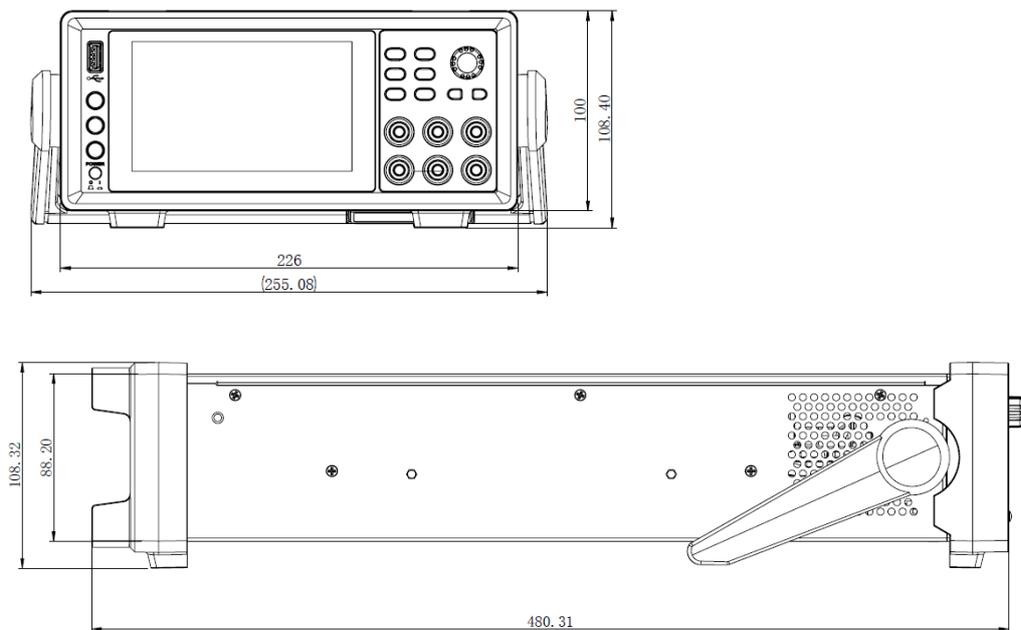
### Note

Upon verification of the shipment, keep the package and relevant contents thereof in a safe place. When returning the instrument for warranty service or repair, the specified packing requirements shall be met.

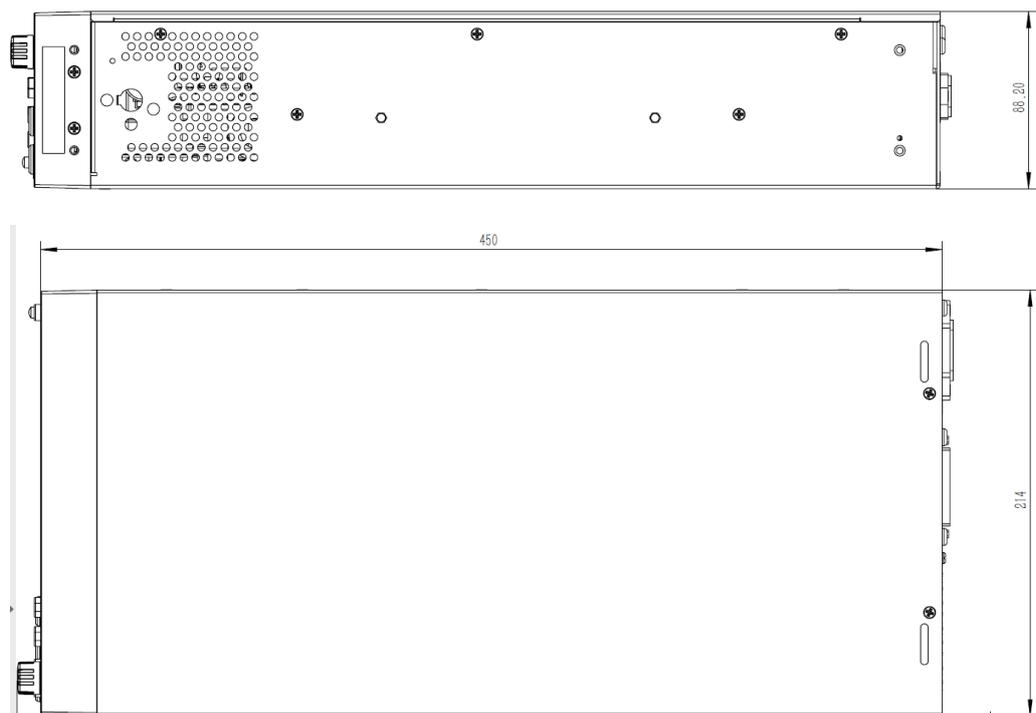
## 2.2 Instrument Size Introduction

The instrument should be installed at well-ventilated and rational-sized space. Please select appropriate space for installation based on the instrument size.

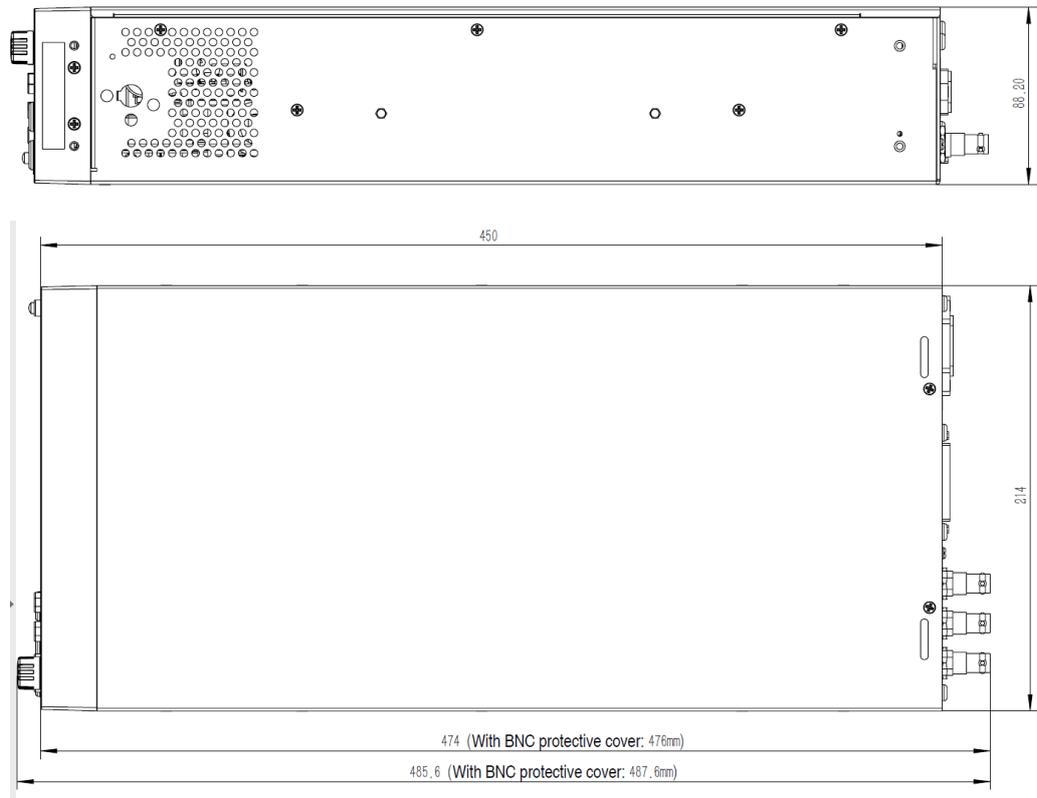
The dimensions of this series of SMU including the handle and rubber protective cover are shown in the figure below. Unit: mm.



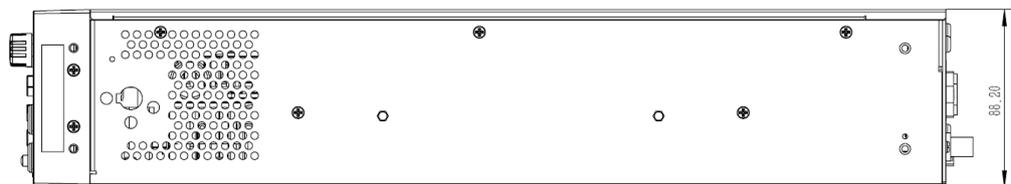
The dimensions of IT2801, IT2805, and IT2806 models after removing the handle and rubber protective cover are shown in the figure below:

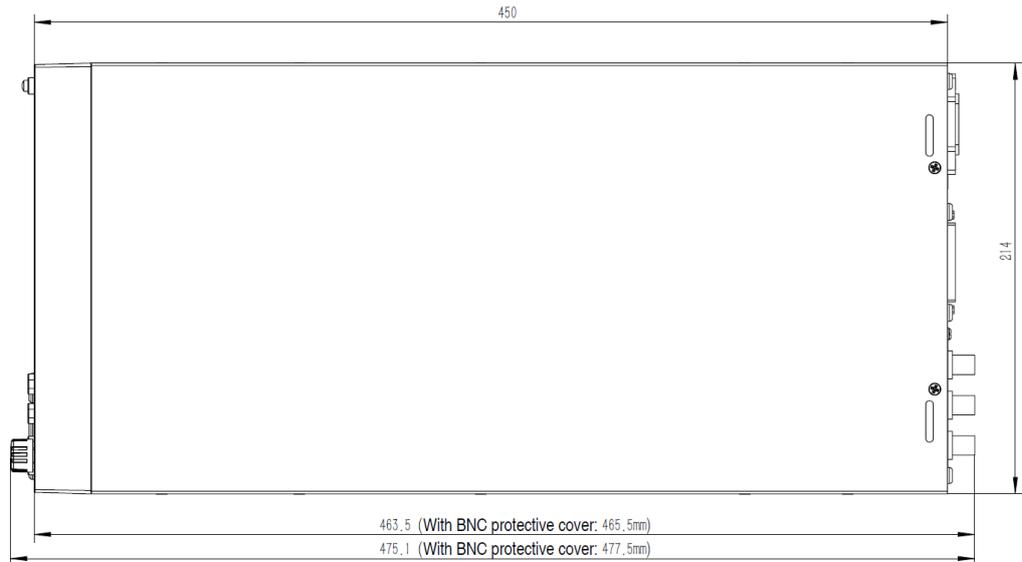


The size of the IT2801R model after removing the handle and rubber protective cover is shown in the figure below:



The dimensions of IT2805R and IT2806R models after removing the handle and rubber protective cover are shown in the figure below:





## 2.3 Rack Installation

The IT2800 series SMU can be installed on standard 19-inch rack. ITECH provides user with optional mount kit IT-E158. The detailed operation please refer to the *IT-E158 User Manual*.

Remove the front and rear rubber bumpers and the handle before rack mounting the IT2800.

### WARNING

**Do not block the air intake at the sides and the exhaust at the rear of the IT2800.**

### Removing the Bumper

Stretch a corner of the rubber bumper and slide it off.

### Removing the Handle

1. Grab the handle by the sides and pull outward. This will allow you to rotate the handle.
2. Rotate the handle to a vertical position. Then, position the instrument horizontally.
3. Pull outward and then lift the handle upward.

**CAUTION**

When reattaching the handle, pay attention to its direction. Incorrect attachment may damage the hardware.

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## 2.4 Connecting the Power Cord

### Precautions

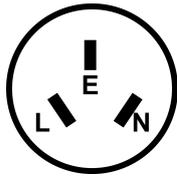
To prevent electric shock and damage to the instrument, observe the following precautions.

**WARNING**

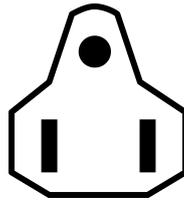
- The power cords supplied with this product is certified for safety. In case the supplied lines assembly needs to be replaced, or an extension lines must be added, be sure that it can meet the required power ratings of this product. Any misuse voids the warranty of this product.
  - Before connecting power cord, be sure to confirm that the power voltage matches with the rated voltage.
  - Before connecting power cord, be sure to switch off the instrument. Power switch is in Off position.
  - To avoid fire or electric shock, make sure to use the power cord supplied by ITECH.
  - Do not use an extended power cord without protective grounding, otherwise the protection function will fail.
  - Be sure to connect the main power socket to the power outlet with protective grounding. Do not use terminal board without protective grounding.
- 

### Categories of Power Cords

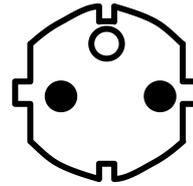
The standard power cord types are as follows. Please select appropriate power cords appropriate to local voltage based on the specifications of power cords below. If purchased model fails to meet local voltage requirements, please contact distributor or factory for change.



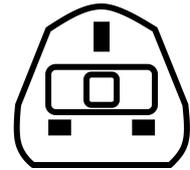
China  
IT-E171



United States &  
Canada & Japan  
IT-E172



Europe  
IT-E173



England  
IT-E174

## AC Power Input Level

The AC input on the back of your instrument is a universal AC input. It accepts nominal line voltages in the range of 90 to 260VAC. A frequency of 50 Hz or 60 Hz is required.

## Setting the Power Line Frequency

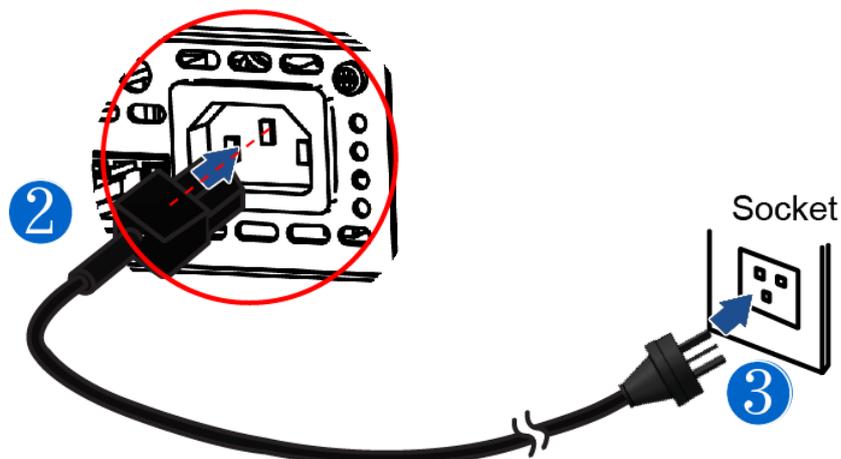
The power line frequency must be set properly for the AC power at your site. Press the following function keys to set the frequency to 50 Hz or 60 Hz.

- For setting to 50 Hz: Menu > System > PLC > 50 Hz
- For setting to 60 Hz: Menu > System > PLC > 60 Hz

## Connecting the Power Cord

To connect the power cord:

1. Make sure that the front-panel power switch is in the OFF position.
2. Connect the female end of the power cord to the AC receptacle on the rear panel.
3. Connect the plug of the power cord to a grounded AC outlet.



## 2.5 Connecting the Device Under Test (DUT)

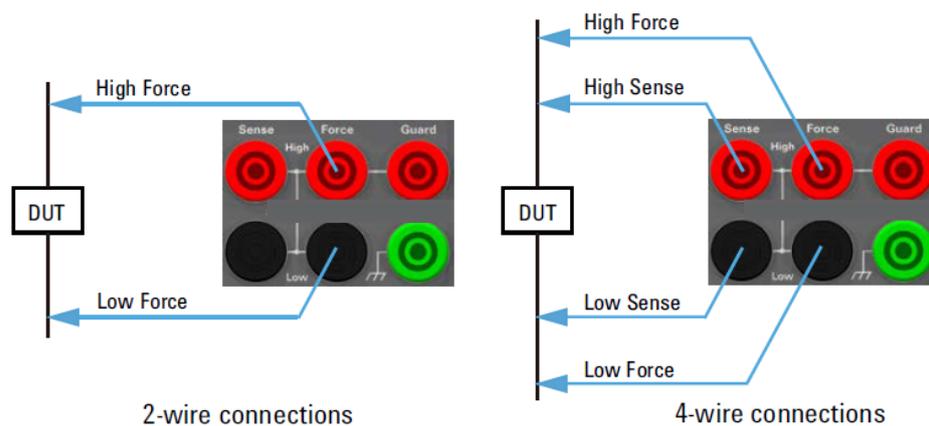
When connecting a DUT, you can choose the connection type either 2-wire connections or 4-wire connections.

If you want to simplify the connections, use 2-wire connections by connecting the Force terminals only **and opening the Sense terminals**. The Force terminals can be used to apply and measure DC voltage or current.

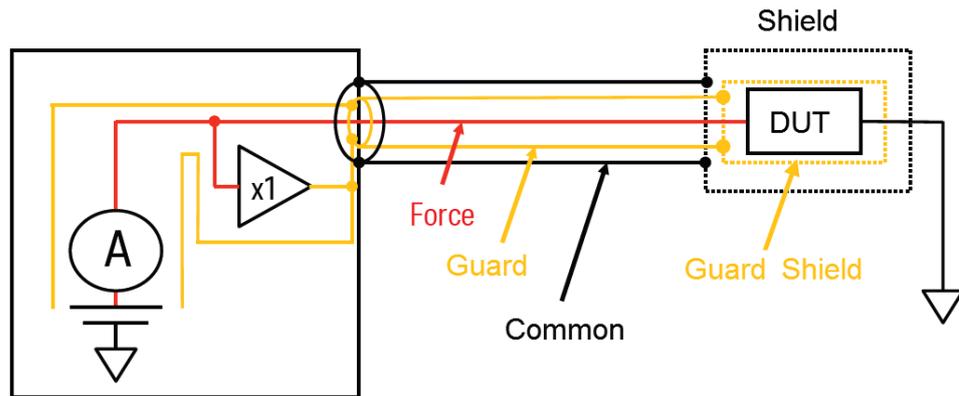
If you want to use "remote measurement", after connecting the test cables, be sure to turn on the Sense function. The specific method is: set

**Menu**→**Config**→**Measure** →**Sensing Type** to **4 – Wires**.

To make 4-wire connections, remote sensing, well known as Kelvin connections, use both Force and Sense terminals. Connecting the Force and Sense cables together at the terminal of the DUT minimizes the measurement error caused by the residual resistance of the test leads or cables. This connection is effective for low resistance measurements and high current measurements.



Low current measurements ( $<1\text{nA}$ ) require additional protection to prevent current leakage through the measurement cable. The following schematic diagram provides a brief overview of the guarding technique. Guarded measurements require the use of a triaxial cable. A (x1) follower buffer amplifier keeps the guard conductor at the same potential as the center conductor. Since there is no voltage difference, no current flows from the center conductor to the guard conductor. **Note: In this example, even the test fixture is equipped with a protective shield to prevent leakage in the test fixture.**



## Precautions

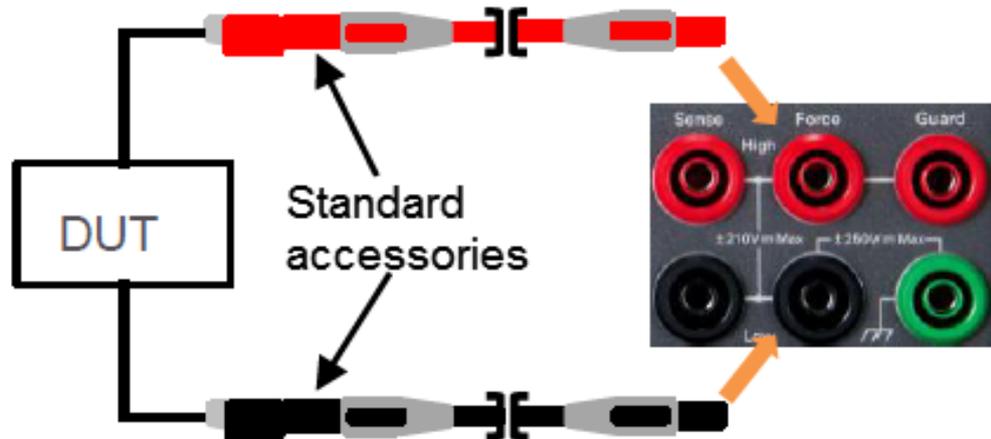
To prevent electric shock and damage to the instrument, observe the following precautions.

### WARNING

- **Before connecting test cables, be sure to switch off the power supply. Power switch is in Off position, otherwise touching the output terminals may result in personal injury or death due to electric shock.**
- **To avoid electrical shock, before testing, please make sure the rating values of the testing cables, and do not measure the current that higher than the rating value. All test cables shall be capable of withstanding the maximum short circuit output current of the power supply without causing overheat.**
- **If several loads are provided, each pair of load wires shall safely withstand the rated short circuit output current of the power supply under full load.**
- **To avoid battery short circuit, be sure to check that the test cable end is not connected when connecting or disassembling the test cable. When the test cable end is connected with battery, short circuit may cause severe accident.**
- **Please check that the test cables can withstand maximum current.**
- **During wiring, check that the anode and cathode of the test cables are properly and tightly connected; anode ON and cathode OFF are prohibited.**

## Test cables introduction

This series SMU comes standard with a set of red and black test leads (- including probes) that can be connected for testing using the 2-Wires method, as shown in the figure below.



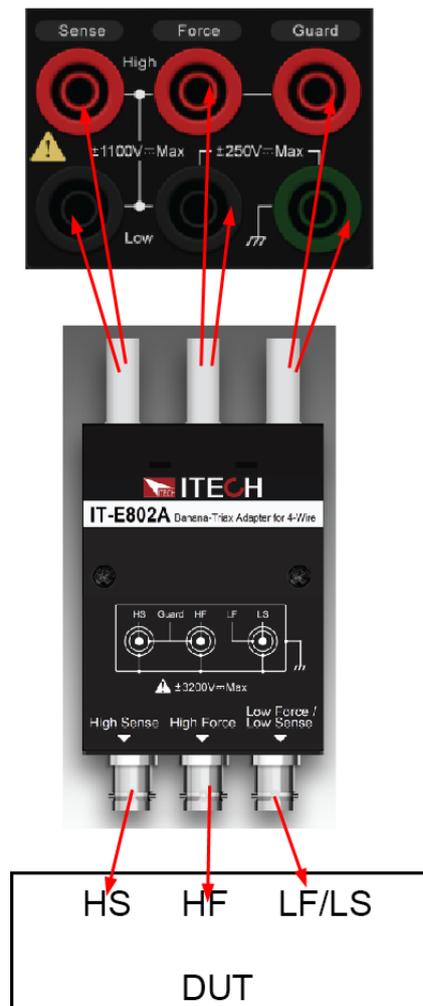
For scenarios with higher testing requirements, please purchase the following options separately:

Model	Description
IT-E801A	Banana to triaxial adapter. Suitable for IT2805, IT2806. See <a href="#">2.5 Connecting the Device Under Test (DUT)</a> for details.
IT-E802A	Banana to triaxial adapter. Suitable for IT2801. See <a href="#">2.5 Connecting the Device Under Test (DUT)</a> for details.
IT-E801C-1.5	Low leakage triaxial cables. Length is 1.5m, suitable for IT2805, IT2806.
IT-E802C-1.5	Low leakage triaxial cables. Length is 1.5m, suitable for IT2801.
IT-E601	Kelvin (4-wire) test cable. 300V banana to pin plug (- Crown Round Tip) connection cable (black), suitable for IT2805, IT2806.
IT-E601H	Kelvin (4-wire) test cable. 1000V banana to pin plug (- Crown Round Tip) connection cable (black), suitable for IT2801.
IT-E602	Kelvin (4-wire) test cable. 300V banana to alligator clip connection cable (black), suitable for IT2805, IT2806.
IT-E602H	Kelvin (4-wire) test cable. 1000V banana to alligator clip connection cable (black), suitable for IT2801.
IT-E603	Kelvin (4-wire) test cable. 300V banana to pin plug (Cone Tip) connection cable (black), suitable for IT2805, IT2806.

Model	Description
IT-E603H	Kelvin (4-wire) test cable. 1000V banana to pin plug (- Cone Tip) connection cable (black), suitable for IT2801.
IT-E604	Kelvin (4-wire) test cable. 300V banana to universal pin and alligator clip connection cable (black), suitable for IT2805, IT2806.
IT-E604H	Kelvin (4-wire) test cable. 1000V banana to universal pin and alligator clip connection cable (black), suitable for IT2801.

### How to use adapter + tri-coax cable

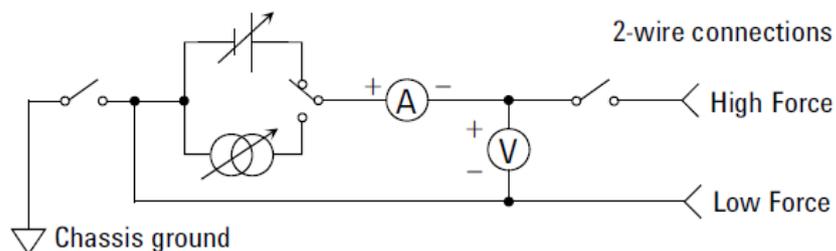
Take the IT2801 model as an example and use the IT-E802A with 3 IT-E802C-1.5 cables. Refer to the diagram below for connection.



## Connecting the interlock circuit

The IT2801 model of the IT2800 series SMU has a maximum output voltage of up to 1000VDC. To maximize the safety of the DUT as well as the user's personal safety, the IT2800 provides an interlock function to prevent the user from receiving an electrical shock from high voltages over  $\pm 42\text{VDC}$ . If the Digital I/O interlock terminal (Pin21 and Pin22) is open, IT2800 cannot apply a high voltage. The IT2800 can only output the rated voltage after the Interlock terminals (Pin21 and Pin22) are shorted.

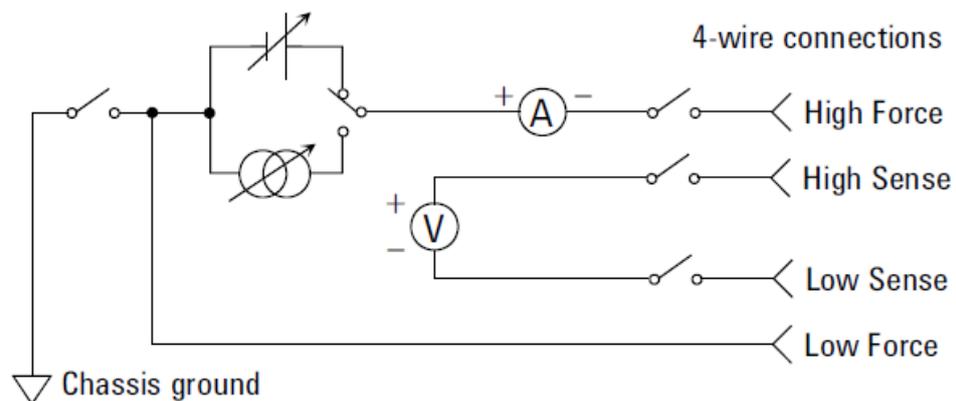
### 2-Wire Connections



#### Note

In order to ensure the accuracy of measurement, it is recommended to operate the instrument an hour after start-up.

### 4-Wire Connections



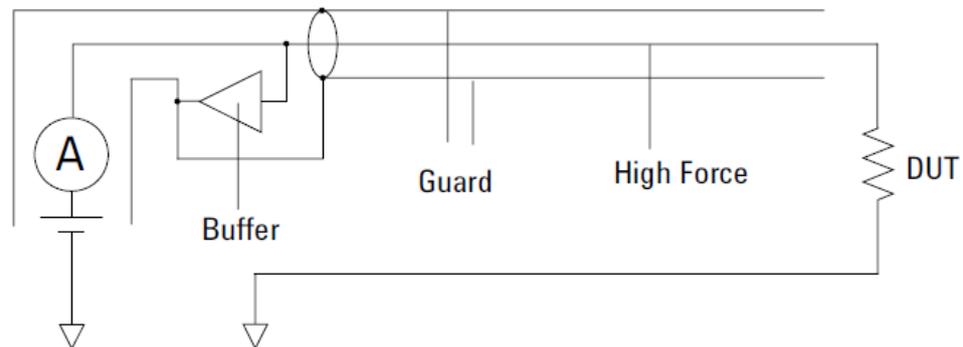
#### Note

In order to ensure the accuracy of measurement, it is recommended to operate the instrument an hour after start-up.

## Guarding

Guarding reduces the leakage current between the instrument and a DUT. This is important when you measure a low current.

The figure below shows the theory of guarding. The buffer amplifier (X1) keeps the potential of the Guard conductor at the same potential as the High Force conductor, so that the current does not flow between the High Force and Guard conductors. Therefore, the current measured by the instrument is the same as the current at the DUT terminal because no current is leaked.



### WARNING

**Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the IT2800.**

# 3 Function Details

This chapter will describe in detail the functions and features of the instrument. It will be divided into the following sections:

- ◆ Scope Mode
- ◆ Recorder Mode

## 3.1 Scope Mode

### Function Introduction

The waveform display function is used to capture voltage and current data during high-speed operation and plot these data into easy-to-observe curves. The captured data can also be exported in CSV file format to a U disk storage device.

### Parameters

#### Scope display parameters

Parameter	Description	Range
State	Scope operating status indication	Stop: Scope running stop. Color: Red
		Ready: Scope enters the waiting state. Color: Yellow
		Roll: Enter scanning mode when the time base is greater than or equal to 50ms. Color: Yellow
		Auto: Auto mode automatically generates a trigger at regular intervals when no external Trig is received. Color: Yellow
		Trig'd: in trigger state. Color: Green
Curve Selection State	Display curve status	U: Voltage curve. Color: Yellow
		I: Current curve. Color: Red

Parameter	Description	Range
Trigger State Mode	Displays the trigger source and the trigger edge	U: The trigger source is the voltage.
		I: The trigger source is current.
		↑: Rising edge triggered.
		↓: Falling edge triggered.
		↑↓: Both rising/falling edges can be triggered.
		M: The trigger source is manual trigger.
		B: The trigger source is command trigger.
		T1: The trigger source is Trigger-1.
		T2: The trigger source is Trigger-2.
		F1: The trigger source is Filber-1.
Navigation display	Displays the data length in equal proportions, as well as the trigger point.	White interval: Narrowed by 1:3 ratio with the waveform display interval.
		White horizontal line: the data length is displayed equivalently in the interval.
		Yellow icon T: Equivalent display of the trigger time position.

### Scope setting parameters

Parameter	Description	Range
Voltage Div V/	Voltage amplitude per cell	(1,2,5,10,20,50,100,200,500) in increasing order
		Unit: change in order of uV/mV/V/kV
Current Div A/	Current amplitude per cell	(1,2,5,10,20,50,100,200,500) in increasing order
		Unit: change in order of pA/nA/uA/mA/A
Time Div S/	Time amplitude per cell	(1,2,5,10,20,50,100,200,500) in increasing order

Parameter	Description	Range
		Unit: change according to ms/s
Trigger Source	Setting the trigger source	Trigger source: Voltage/ Current/ Manual/ Bus/ Trigger-1/ Trigger-2/ Fiber-1
		Voltage: Voltage trigger.
		Current: Current trigger.
		Manual: Manual trigger. (Trigger by pressing <b>Trig</b> key)
		Bus: Command triggered ( <b>*TRG</b> command triggered)
		Trigger-1: Digital IO1 trigger.
		Trigger-2: Digital IO2 trigger.
		Fiber-1: Fiber optic trigger
Trigger Rise	Set edge trigger	Rise: Rising edge trigger.
		Fall: Falling edge trigger.
		Both: Triggered by rising and falling edges.
Trigger Mode	Setting the trigger mode	Auto and Normal can be selected
		Normal: voltage range, current range, time base, time offset, configured to generate trigger according to user set values.
		Auto: The trigger is automatically generated according to the Time Div timing.
Recorder Length Maximum	Set the maximum data length	IT2801/IT2806: 600kpts/60kpts/6kpts/0.6kpts
		IT2805: 300kpts/60kpts/6kpts/0.6kpts
Print Data	Set (Shift +Enter) keys to export data	Off: Press (Shift+Enter) in the Scope screen to take a screenshot only without exporting data.
		Raw: Press (Shift+Enter) in the Scope screen to take a screenshot and export the raw data at the same time.

Parameter	Description	Range
Export	Exporting raw data from Scope runs	File naming format: IT28XX_scope_raw_data0000XX
Trigger Delay	Trigger time setting	Trigger time setting range: ( -3*Time Div ~ 3*Time Div )
Trigger Value	Set the trigger value when the trigger mode is Voltage or Current	Trigger range when Trigger Source is Voltage: ( -2 *Voltage Div ~ 2*Voltage Div )  Trigger range when Trigger Source is Current: ( -2*Current Div ~ 2*Current Div )
Auto	Automatically set the appropriate waveform interval	Automatic adjustment of Voltage Div /Current Div.  Time Div is set to 10ms.  Trigger Delay is set to 0us.  Trigger Source is changed to Voltage.  Trigger Value is set to 0V.  Trigger Edge is changed to Rise.  Trigger Mode is changed to Auto.  Run/Stop is set to Run.
Single	Set single trigger.	
Run/Stop	Set Scope running status	When Scope operation is stopped, Run/Stop is displayed in red and the status indication turns to Stop.

### Export file format

<b>Model</b>	<b>IT2801</b>
Sn	XXXXXXXXXXXXXXXXXX
Voltage div	0.500000V
Current div	1.000000A

Time div	0.010000s	
Delay	0.000000s	
Sample interval	10us	
Trigger index	300	
<b>No</b>	<b>Voltage(V)</b>	<b>Current(A)</b>
0	0.410344	4.16E-11
1	0.392644	1.13E-10
2	0.410344	-1.90E-10
3	0.410344	-1.20E-11
4	0.410344	1.66E-10
5	0.410344	2.37E-11
6	0.410344	-4.05E-10
7	0.410344	-1.37E-10
8	0.428045	2.74E-10
9	0.445746	-1.01E-10
10	0.445746	-4.58E-10
11	0.374943	3.27E-10
...	...	...

### Display data length calculation

IT2801 and IT2806 Fastest Sample Rate = 10us; IT2805 Fastest Sample Rate = 20us.

Scope takes the total time to display each screen of data, Full Time = Time Div \*6.

Sample Interval= Full Time/ Recorder Length Maximum; If Sample Interval is less than 10us, Sample Interval defaults to 10us.

When the user uses the export data function, the total length of the original data displayed Data Length can be calculated according to the following formula:

Data Length = Full Time/ Sample Interval

**Example:** Model IT2801

**Condition 1:** Time Div = 1ms; Recorder Length Maximum = 600kpts

**Calculation 1:** Full Time = 6ms; Sample Interval = 6ms/600kpt < 10us; Therefore, Sample Interval = 10us ; Data Length = 6ms/10us = 600;

**Condition 2:** Time Div = 1s; Recorder Length Maximum = 60kpts

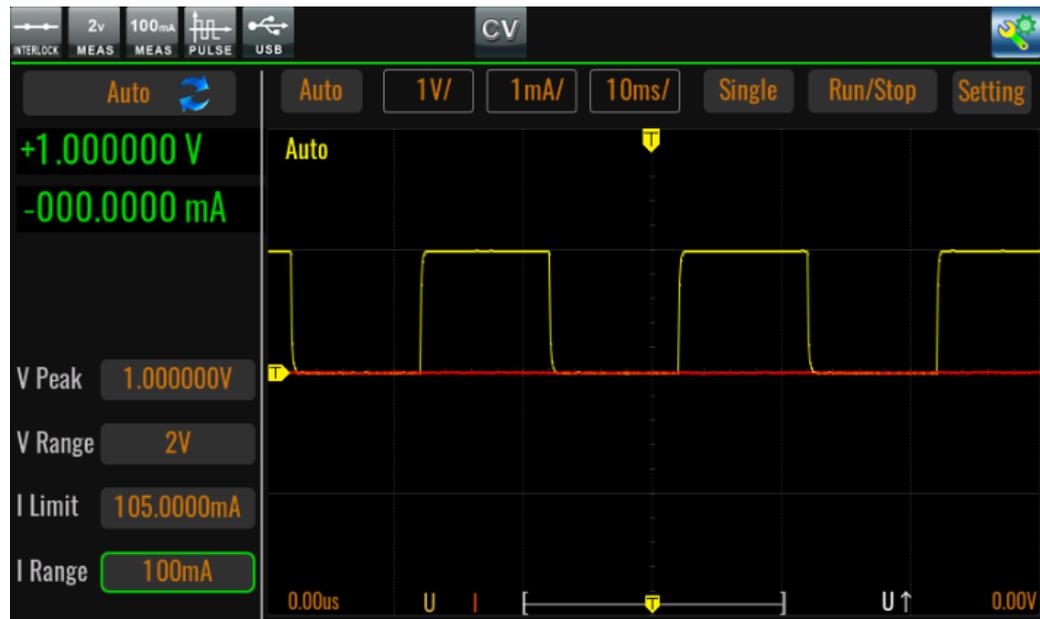
**Calculation 2:** Full Time = 6s; Sample Interval = 6s/60kpt = 100us; Data Length = 6s/100us = 60000;

## Interface Operation Introduction

**Waveform display setting interface:**



- Set Trigger Source to Voltage / Current to set Trigger Edge. When other trigger source is selected, Trigger Edge is not editable.
- Trigger Mode: User-defined setting of trigger mode and maximum data length for recording.
- Print Data selects whether you want to export the raw data.
- Curve Selection sets the voltage and current curve status.



1. Set Voltage Div, Current Div, Time Div according to the actual demand, and click Run.
2. Set the Trigger Delay, if the trigger source is voltage or current, you can set the Trigger Value parameter.
3. For a single trigger, click the Single button and wait for the Trigger Value to be reached.
4. When Time Div is set greater than or equal to 50ms, it enters the scan state and the Scope status indication shows Roll.
5. When the Scope is stopped you can drag the waveform to scale the waveform, at which time the navigation icons will also be scaled isometrically at the same time.

## 3.2 Recorder Mode

### Function Introduction

The data logging function is mainly used to record data such as voltage, current, power, resistance, and calculation during SMU operation, and plot these data into easily observable curves. At the same time, the data can be exported to a USB flash drive by configuring the corresponding parameters.

### Parameters

#### Recorder display parameters

Parameter	Description	Range
Line1/Line2/ Line3	Each curve represents its selected data source, and up to 4 curves can be displayed.	Each curve display box contains the data Meter and the resolution of each cell of the curve.
Line4		Example of voltage represented by a curve: $U = 20V \ 20V/Div$
		$U=20V$ : Present voltage value. $20V/Div$ : Voltage plotting accuracy, check the presented edit box to adjust the parameter by knob.
		Div range: in 1/2/5/10/20/50/100/500 increments, in units depending on the present device gear. Cannot exceed the maximum value of the present data source.
Time	Time display accuracy	Change the parameters in order of 0.01s, 0.02s, 0.05s, 0.1s, 0.2s, 0.5s, 1s, 2s, 5s, 10s, 20s, 50s, 100s, 200s, 500s, 1000s, 2000s
Vernier	Cursor	Used to observe the moment of data appearance

### Recorder setting parameters

Parameter	Description	Range
Run/Stop	Start/Stop Recorder function	Note: Run or stop data logging. When data logging is running, Measure Mode is forced to Continue Measure mode.  When you click the Stop function and then Run, the UI will clear the data to redraw the curve.
Clean	Clear recorded data	Clear the present curve and redraw it.
Auto	Automatic adjustment of plot height based on data.	
Hold-On	Hold-On: Pause	Note: When Hold-On is started, only the graph stops drawing and the data is

Parameter	Description	Range
	drawing and hold. Hold-Off: Continue drawing the graph.	still running normally. When Hold-Off is clicked again, the data during the pause will continue to be drawn.
Curve1/Curve2 /Curve3/Cure4	Curve state selection	Off/On
Item	Curve data source selection	Volts/Amps/Power/Ohms/Source
Mode	Set the display mode of the curve, DC or AC can be selected.	<ul style="list-style-type: none"> <li>DC mode: The curve scale is displayed with the 0 value as the center.</li> <li>AC mode: The curve scale takes the lowest value of a waveform as the scale Base value. The corresponding value of the display scale is Base + Div.</li> </ul>
Measure Interval	Measurement Gap That is, how often the data is measured at intervals. NPLC /Time	When NPLC is selected, it can be set by NPLC item in plc. <ul style="list-style-type: none"> <li>50Hz: 0.005PLC-100.00PLC</li> <li>60Hz: 0.006PLC-120.00PLC</li> </ul> When Time is selected, the unit of time is s (100us-2.00s). <b>Note: Parameters cannot be set after Recorder is run.</b>
Measure Speed	Set measurement data speed NPLC/ Aperture	When NPLC is selected, it can be set by NPLC item in plc. When Aperture is selected, the time is measured in seconds.

Parameter	Description	Range
		(0.00001s – Max s) Note: Max = Measure Interval * 80% Measure Interval - Measure Speed > 40us <b>Note: Parameters cannot be set after Recorder is run.</b>
Recorder Mode	Cycle: cycle mode, can cycle sampling Once: Single sampling	When Cycle is selected, the Point Number setting item is hidden. Default is the maximum number of samples, and the maximum number of samples is 1000000. When you select Once, you can set the Point Number item. <b>Note: Parameters cannot be set after Recorder is run.</b>
Point Number	Number of sampled data	When recording is started and the number of recorded data is reached, recording will be stopped automatically. Range: (1-1000000) <b>Note: Parameters cannot be set after Recorder is run.</b>
File Format	Save file format: Tdms/Csv	Save file format: IT28XX_recorder_Manual_00XXXX <b>Note: Parameters cannot be set after Recorder is run.</b>
Export To Udisk	Exporting data to a USB flash drive	When the Enter button is pressed, the recorded data is saved to a USB flash drive in Tdms or Csv format.
Save To Udisk Real-time	On: Function on Off: Function off	Save data to USB flash drive in real time. Show when U disk exists, hide this function when U disk does not exist.

Parameter	Description	Range
		<b>Note: Parameters cannot be set after Recorder is run. Real-time save U disk function, the number of data can be infinitely long. But the recording speed must be greater than 1ms.</b>

**Export data file format**

Model	IT2801					
Sn	XXXXXXXXXXXXXXXXXXXX					
Measure Interval	2.00000s					
Measure Speed	1.60000s					
Time(s)	Volt(V)	Curr(A)	Res (Ohms)	Power (W)	Math (-)	Source(V)
2.31049	1.00E+00	2.63E-08	3.80E+07	2.63E-08	0.00E+00	1.00E+00
4.31048	1.00E+00	2.82E-08	3.54E+07	2.82E-08	0.00E+00	1.00E+00
6.31048	1.00E+00	3.30E-08	3.03E+07	3.30E-08	0.00E+00	1.00E+00
8.31048	1.00E+00	3.30E-08	3.03E+07	3.30E-08	0.00E+00	1.00E+00
10.3104-8	1.00E+00	2.97E-08	3.37E+07	2.97E-08	0.00E+00	1.00E+00
12.3104-8	1.00E+00	2.16E-08	4.64E+07	2.16E-08	0.00E+00	1.00E+00
14.3104-8	1.00E+00	2.53E-08	3.95E+07	2.53E-08	0.00E+00	1.00E+00
16.3104-8	1.00E+00	2.67E-08	3.75E+07	2.67E-08	0.00E+00	1.00E+00
18.3104-8	1.00E+00	2.48E-08	4.03E+07	2.48E-08	0.00E+00	1.00E+00

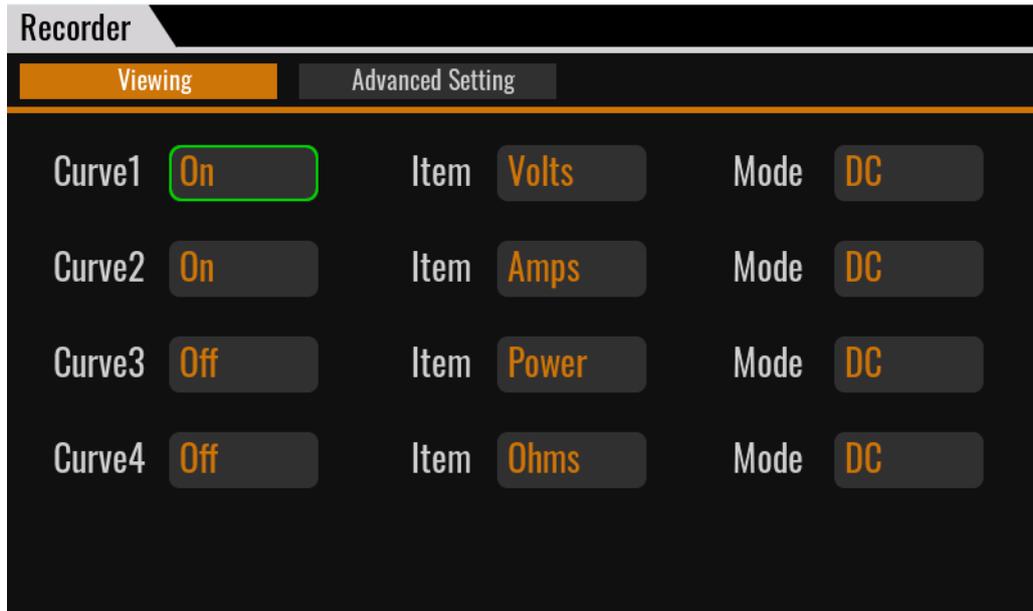
20.3104- 8	1.00E +00	2.87E- 08	3.48E +07	2.87E- 08	0.00E +00	1.00E+00
22.3104- 8	1.00E +00	2.80E- 08	3.57E +07	2.80E- 08	0.00E +00	1.00E+00
24.3104- 8	1.00E +00	2.76E- 08	3.62E +07	2.76E- 08	0.00E +00	1.00E+00
26.3104- 8	1.00E +00	2.92E- 08	3.43E +07	2.92E- 08	0.00E +00	1.00E+00
28.3104- 8	1.00E +00	3.02E- 08	3.31E +07	3.02E- 08	0.00E +00	1.00E+00
30.3104- 8	1.00E +00	3.01E- 08	3.32E +07	3.01E- 08	0.00E +00	1.00E+00
32.3104- 8	1.00E +00	2.57E- 08	3.89E +07	2.57E- 08	0.00E +00	1.00E+00
...	...	...	...	...	...	...

Note:

1. After the recorder function is running, the manual trigger function in Normal mode cannot be used, and the continuous trigger function under Normal is timed to trigger the Measure interval time under Recorder.
2. The Measure Speed time under Configure screen is invalid. The measurement time is the Measure Speed under Recorder.
3. Recorder function off, restore the configuration parameters under Config.

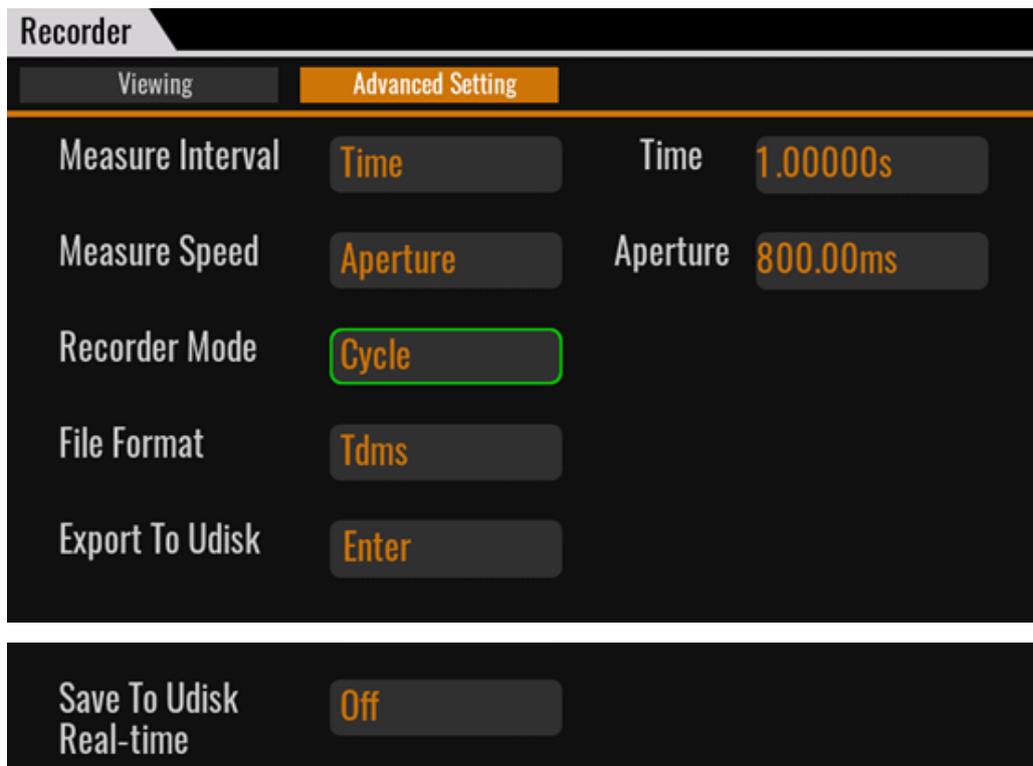
## Interface operation introduction

Viewing settings screen:



- Set Curve1/Curve2/Curve3/Curve4 ON/OFF status.
- Set the corresponding curve data source.

#### Advanced Setting interface:



- Sets the Measure Interval type and the sample interval specific parameters.
- Set the Measure Speed parameter type and the sample speed specific parameters.

- Set the operation mode, set to Cycle, and the default Point Number is the maximum value. To set the mode to Once, you need to set the Point Number, and refer to the related parameter item for the Point Number setting.
- Set the file storage format, and the Save To Udisk Real-Time item to select the real-time storage status.
- When Recorder is running, you can export the data via the Export to Udisk.

#### Recorder main interface operation:



1. Click Run to run the data logging function, the current tab will show Stop, click Stop again will stop running, at this time the tab will show Run, wait for running again.
2. Adjust the parameter display accuracy adjustment, such as voltage, current, power, resistance and other parameters, as in the figure,  $I=24.04\text{nA}$  is the current measurement value,  $100.0\text{nA/Div}$  indicates the size of each frame. When the measured value increases and exceeds the range that can be displayed on the front panel, press Auto at this time, the size of each cell will be automatically adjusted according to the maximum value of the displayed parameters to ensure that the waveform of the data can be completely displayed on the interface.
3. Adjust the time display accuracy Time to increase or decrease the display accuracy to fit the overall waveform display.
4. When you want to observe the data at a certain moment, you can choose the Hold-On function to pause the graph drawing, and use the cursor function to view the data corresponding to the moment. During the Hold-On process, the data will not be lost, and after clicking Hold-Off, the data will be drawn to the latest moment.
5. Click Clean to clear the waveform and plot the curve based on the latest moment data.

# 4 Technical Specification

This chapter will introduce the main technical parameters of the SMU, such as rated voltage/current/power and so on. Besides, we will introduce the working environment and storage temperature.

- ◆ [Main Specification](#)
- ◆ [Supplemental Characteristics](#)

## 4.1 Main Specification

### 4.1.1 IT2801

#### Basic Parameters

Working temperature	0~40°C
Altitude	0~2000M
AC input voltage	90~260V
AC input frequency	50/60Hz
AC input apparent power	250VA
Cooling style	fans
External dimensions (without rubber bumper and handle)	450mm (D) x 214mm (W) x 88.2mm (H)
Weight	6.7kg
Maximum output power	20W
Maximum output voltage	1050V
Maximum output current	1.05A
Communication interface	Standard: USB and LAN Optional: GPIB

System Bus	Fiber optic
Digital I/O	DB25
Command response time	1ms

### Electrical performance parameters

Test conditions
1. Temperature: 23°C±5°C
2. Humidity: 30%~80% relative humidity
3. Use after 60 minutes for warming up the device
4. Calibration period: 1 year
5. Measuring speed: 1 PLC (power line cycle)

Voltage accuracy				
Range	Source / Measure Resolution	Setting accuracy	Measurement accuracy	Noise (peak to peak) (<10Hz)
±200mV	100nV	0.015%+300μV	0.015%+300μV	≤25μV
±2V	1μV	0.015%+300μV	0.015%+300μV	≤25μV
±20V	10μV	0.015%+1mV	0.015%+1mV	≤200μV
±200V	100μV	0.015%+10mV	0.015%+10mV	≤2mV
±1000V	1mV	0.02%+50mV	0.02%+50mV	≤10mV

Current accuracy				
Range	Source / Measure resolution	Setting accuracy	Measurement accuracy	Noise (peak to peak) (<10Hz)
±1μA	1pA	0.025%+300pA	0.025%+300pA	≤8pA
±10μA	10pA	0.025%+700pA	0.025%+700pA	≤80pA

$\pm 100\mu\text{A}$	100pA	0.025%+6nA	0.025%+6nA	$\leq 800\text{pA}$
$\pm 1\text{mA}$	1nA	0.025%+60nA	0.025%+60nA	$\leq 8\text{nA}$
$\pm 10\text{mA}$	10nA	0.025%+600nA	0.025%+600nA	$\leq 80\text{nA}$
$\pm 100\text{mA}$	100nA	0.025%+6 $\mu\text{A}$	0.025%+6 $\mu\text{A}$	$\leq 800\text{nA}$
$\pm 1\text{A}$	1 $\mu\text{A}$	0.03%+500 $\mu\text{A}$	0.03%+500 $\mu\text{A}$	$\leq 30\mu\text{A}$

Resistance accuracy (4-wire measurement, 2V range)				
Range	Resolu- tion	Test current	Current range	Measurement accuracy
2 $\Omega$	1 $\mu\Omega$	1A	1A	0.1%+300 $\mu\Omega$
20 $\Omega$	10 $\mu\Omega$	100mA	100mA	0.055%+3m $\Omega$
200 $\Omega$	100 $\mu\Omega$	10mA	10mA	0.055%+30m $\Omega$
2K $\Omega$	1m $\Omega$	1mA	1mA	0.055%+300m $\Omega$
20K $\Omega$	10m $\Omega$	100 $\mu\text{A}$	100 $\mu\text{A}$	0.055%+3 $\Omega$
200K $\Omega$	100m $\Omega$	10 $\mu\text{A}$	10 $\mu\text{A}$	0.055%+30 $\Omega$
2M $\Omega$	1 $\Omega$	1 $\mu\text{A}$	1 $\mu\text{A}$	0.07%+300 $\Omega$
20M $\Omega$	10 $\Omega$	100nA	1 $\mu\text{A}$	0.35%+3k $\Omega$

Derating accuracy with PLC setting < 1 PLC (additional accuracy deviation, i.e., a percentage of the following range needs to be added to the existing accuracy deviation)						
PLC	1 $\mu\text{A}$ ~1- 0 $\mu\text{A}$	100 $\mu\text{A}$ ~- 100mA	1A	200- mV	2V	20V~1000V
0.1PLC	0.01%	0.01%	0.02%	0.02- %	0.01- %	0.01%
0.01PLC	0.08%	0.05%	0.03%	0.05- %	0.05- %	0.02%
0.001PL- C	0.50%	0.50%	0.20%	0.20- %	0.10- %	0.05%

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**Supplemental Characteristics**

## Supplemental Characteristics

1. Temperature coefficient (0 to 18 °C and 28 to 50 °C):  $\pm 0.15 \times$  accuracy/°C

2. Noise 10 Hz to 20 MHz (V source): 30mV p-p, 3mV rms

3. Voltage output stabilization time.

The time required to reach within 0.1% of the final value under open circuit conditions.

Stepping from 10% to 90% of the range

200mV: < 450 $\mu$ s

2V: < 700 $\mu$ s

20V: < 250 $\mu$ s

200V: < 300 $\mu$ s

1000V: < 5ms

4. Slew rate

Stepping from 10% to 90% of the range under no-load condition.

200mV: 2mV/ $\mu$ s

2V: 20mV/ $\mu$ s

20V: 200mV/ $\mu$ s

200V: 1.8V/ $\mu$ s

1000V: 1V/ $\mu$ s

5. Current output stabilization time.

The time required to reach within 0.1% of the final value under short-circuit conditions.

Stepping from 10% to 90% of the range

1 $\mu$ A: < 1.5ms

10 $\mu$ A: < 1ms

100 $\mu$ A: < 300 $\mu$ s

1mA: < 300 $\mu$ s

10mA: < 300 $\mu$ s

100mA: < 300 $\mu$ s

1A: < 300 $\mu$ s

6. V source overshoot: <(0.1%+10mV)

Step is 10%~90% of the range, resistive load.

7. I source overshoot: <0.1%.

Step is 10%~90% of the range, resistive load.

8. Voltage source range change overshoot: <250mV. 100K load, 20 MHz bandwidth

9. Current source range change overshoot: < 250mV/R load, 20 MHz bandwidth
10. Maximum capacitive load: 0.01 $\mu$ F
11. DC floating voltage: Max  $\pm$ 250 V DC between low force and chassis ground
12. Guard offset voltage (V source): < 1mV
13. GUARD output impedance: >10K $\Omega$  Typical
14. Common mode isolation: > 1G $\Omega$ , < 4700pF
15. Max voltage between High Force and High Sense: 4V  
Max voltage between Low Force and Low Sense: 4V

## 4.1.2 IT2805

### Basic Parameters

Working temperature	0~40°C
Altitude	0~2000M
AC input voltage	90~260V
AC input frequency	50/60Hz
AC input apparent power	250VA
Cooling style	fans
External dimensions (without rubber bumper and handle)	450mm (D) x 214mm (W) x 88.2mm (H)
Weight	6.7kg
Maximum output power	20W
Maximum output voltage	210V
Maximum output current	1.515A

Communication interface	Standard: USB and LAN Optional: GPIB
System Bus	Fiber optic
Digital I/O	DB25
Command response time	1ms

### Electrical performance parameters

Test conditions
1. Temperature: 23°C±5°C
2. Humidity: 30%~80% relative humidity
3. Use after 60 minutes for warming up the device
4. Calibration period: 1 year
5. Measuring speed: 1 PLC (power line cycle)

Voltage and Current		
	Voltage	Current
DC and Pulse	200V	0.1A
	20V	1A
	6V	1.5A

Voltage accuracy					
Range	Setting resolution	Setting accuracy	Measurement resolution	Measurement accuracy	Noise (-peak to peak) (<10Hz)
±200mV	1μV	0.015% +300μV	100nV	0.015% +300μV	≤ 8 μV

±2V	10μV	0.015% +300μV	1μV	0.015% +300μV	≤ 10 μV
±20V	100μV	0.015%+1mV	10μV	0.015%+1mV	≤ 80 μV
±200V	1mV	0.015%+10mV	100μV	0.015% +10mV	≤ 800μV

Current accuracy					
Range	Setting resolution	Setting accuracy	Measurement resolution	Measurement accuracy	Noise (peak to peak) (<10Hz)
±10nA	100fA	0.1%+50pA	10fA	0.1%+50pA	≤ 2pA
±100nA	1pA	0.06% +100pA	100fA	0.06% +100pA	≤ 3 pA
±1μA	10pA	0.025% +300pA	1pA	0.025% +300pA	≤ 10 pA
±10μA	100pA	0.025% +700pA	10pA	0.025% +700pA	≤ 60 pA
±100μA	1nA	0.02%+6nA	100pA	0.02%+6nA	≤ 600pA
±1mA	10nA	0.02%+60nA	1nA	0.02% +60nA	≤ 6nA
±10mA	100nA	0.02% +600nA	10nA	0.02% +600nA	≤ 60 nA
±100mA	1μA	0.02%+6μA	100nA	0.02%+6μA	≤ 600 nA
±1A	10μA	0.05% +500μA	1μA	0.05% +500μA	≤ 10μA
±1.5A	10μA	0.05% +1.5mA	1μA	0.05% +1.5mA	≤ 30μA

Resistance accuracy (4-wire measurement, 2V range)				
Range	Resolution	Test current	Current range	Measurement accuracy

2Ω	1μΩ	1A	1A	0.1%+300μΩ
20Ω	10μΩ	100mA	100mA	0.055%+3mΩ
200Ω	100μΩ	10mA	10mA	0.055%+30mΩ
2KΩ	1mΩ	1mA	1mA	0.055%+300mΩ
20KΩ	10mΩ	100μA	100μA	0.055%+3Ω
200KΩ	100mΩ	10μA	10μA	0.055%+30Ω
2MΩ	1Ω	1μA	1μA	0.07%+300Ω
20MΩ	10Ω	100nA	100nA	0.2%+3kΩ
200MΩ	100Ω	10nA	10nA	0.7%+30kΩ

Derating accuracy with PLC setting < 1 PLC (additional accuracy deviation, i.e., a percentage of the following range needs to be added to the existing accuracy deviation)		
PLC	200mV	2V~200V
0.1PLC	0.01%	0.005%
0.01PLC	0.05%	0.01%
0.001PLC	0.3%	0.10%

PLC	10nA	100nA	1μA~10μA	100μA~100mA	1A-1.5A
0.1PLC	0.30%	0.03%	0.01%	0.01%	0.01%
0.01PLC	1.00%	0.10%	0.05%	0.02%	0.03%
0.001PLC	3.00%	1.00%	0.30%	0.20%	0.20%

## Supplemental Characteristics

### Supplemental Characteristics

1. Temperature coefficient (0 to 18 °C and 28 to 50 °C):  $\pm 0.15 \times$  accuracy/°C

2. Noise 10 Hz to 20 MHz (V source): 30mVp-p / 4mVrms (1A range and below)

3. Voltage output stabilization time.

The time required to reach within 0.1% of the final value under open circuit conditions.

Stepping from 10% to 90% of the range

200mV: < 100 $\mu$ s (1.5A range)

2V: < 120 $\mu$ s (1.5A range)

20V: < 250 $\mu$ s (1A range)

200V: < 400 $\mu$ s (100mA range)

4. Slew rate

Stepping from 10% to 90% of the range under no-load condition.

200mV: 3mV/ $\mu$ s (3A range)

2V: 24mV/ $\mu$ s (3A range)

20V: 140mV/ $\mu$ s (1A range)

200V: 0.6V/ $\mu$ s (100mA range)

5. Current output stabilization time.

The time required to reach within 0.1% of the final value under short-circuit conditions.

Stepping from 10% to 90% of the range

100nA: < 5ms

1 $\mu$ A: < 600 $\mu$ s

10 $\mu$ A: < 350 $\mu$ s

100 $\mu$ A: < 200 $\mu$ s

1mA: < 150 $\mu$ s

10mA: < 150 $\mu$ s

100mA: < 150 $\mu$ s

1A: < 300 $\mu$ s

1.5A: < 100 $\mu$ s

6. V source overshoot: < (0.1%+10mV)

Step is 10%~90% of the range, resistive load.

7. I source overshoot: < 0.1%

Step is 10%~90% of the range, resistive load.

8. Voltage source range change overshoot: < 250mV. 100K load, 20 MHz bandwidth

9. Current source range change overshoot: < 250mV/R load, 20 MHz bandwidth

10. Maximum capacitive load: 0.01 $\mu$ F (Normal mode), 50 $\mu$ F (High capacitance mode)

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11. DC floating voltage: Max  $\pm 250$  V DC between low force and chassis ground
12. Guard offset voltage (V source):  $< 1$  mV
13. GUARD output impedance:  $> 10$  K $\Omega$  Typical
14. Common mode isolation:  $> 1$  G $\Omega$ ,  $< 4700$  pF
15. Max voltage between High Force and High Sense: 4V  
Max voltage between Low Force and Low Sense: 4V

### Pulse source supplemental characteristics

Minimum programmable pulse width: 100 $\mu$ s

Pulse width programming resolution: 10 $\mu$ s

	Max voltage	Max peak current	Max base current	Max pulse width	Max duty cycle
DC or pulsed	6V	1.5A	1.5A	Unlimited	100%
	20	1A	1A	Unlimited	100%
	200	0.1A	0.1A	Unlimited	100%

## 4.1.3 IT2806

### Basic Parameters

Working temperature	0~40 $^{\circ}$ C
Altitude	0~2000M
AC input voltage	90~260V
AC input frequency	50/60Hz
AC input apparent power	250VA
Cooling style	fans

External dimensions (without rubber bumper and handle)	450mm (D) x 214mm (W) x 88.2mm (H)
Weight	6.7kg
Maximum output power	20W
Maximum output voltage	210V
Maximum output current	3.03A DC / 10.5A Pulse
Communication interface	Standard: USB and LAN Optional: GPIB
System Bus	Fiber optic
Digital I/O	DB25
Command response time	1ms

### Electrical performance parameters

Test conditions
1. Temperature: 23°C±5°C
2. Humidity: 30%~80% relative humidity
3. Use after 60 minutes for warming up the device
4. Calibration period: 1 year
5. Measuring speed: 1 PLC (power line cycle)

Voltage and Current		
	Voltage	Current
DC and Pulse	200V	0.1A
	20V	1A
	6V	3A

Pulse	200V	1A
	12V	10A

Voltage accuracy				
Range	Resolution	Setting accuracy	Measurement accuracy	Noise (peak to peak) (<10Hz)
±200mV	100nV	0.015%+300μV	0.015%+300μV	≤ 8μV
±2V	1μV	0.015%+300μV	0.015%+300μV	≤ 10μV
±20V	10μV	0.015%+1mV	0.015%+1mV	≤ 80μV
±200V	100μV	0.015%+10mV	0.015%+10mV	≤ 800μV

Current accuracy				
Range	Source / Measure resolution	Setting accuracy	Measurement accuracy	Noise (peak to peak) (<10Hz)
±10nA	10fA	0.1%+50pA	0.1%+50pA	≤ 2pA
±100nA	100fA	0.06%+100pA	0.06%+100pA	≤ 3 pA
±1μA	1pA	0.025%+300pA	0.025%+300pA	≤ 10 pA
±10μA	10pA	0.025%+700pA	0.025%+700pA	≤ 60 pA
±100μA	100pA	0.02%+6nA	0.02%+6nA	≤ 600pA
±1mA	1nA	0.02%+60nA	0.02%+60nA	≤ 6nA
±10mA	10nA	0.02%+600nA	0.02%+600nA	≤ 60 nA
±100mA	100nA	0.02%+6μA	0.02%+6μA	≤ 600 nA
±1A	1μA	0.05%+500μA	0.05%+500μA	≤ 10μA
±3A	10μA	0.05%+1.5mA	0.05%+1.5mA	≤ 30μA
±10A (*1)	10μA	0.4%+25mA (*2)	0.4%+25mA (*2)	-

\*1 Pulse mode

\*2 Measurement speed: 0.01 PLC

Resistance accuracy (4-wire measurement, 2V range)				
Range	Resolu- tion	Test current	Current range	Measurement accuracy
2Ω	1μΩ	1A	1A	0.1%+300μΩ
20Ω	10μΩ	100mA	100mA	0.055%+3mΩ
200Ω	100μΩ	10mA	10mA	0.055%+30mΩ
2KΩ	1mΩ	1mA	1mA	0.055%+300mΩ
20KΩ	10mΩ	100μA	100μA	0.055%+3Ω
200KΩ	100mΩ	10μA	10μA	0.055%+30Ω
2MΩ	1Ω	1μA	1μA	0.07%+300Ω
20MΩ	10Ω	100nA	100nA	0.2%+3kΩ
200MΩ	100Ω	10nA	10nA	0.7%+30kΩ

Derating accuracy with PLC setting < 1 PLC (- additional accuracy deviation, i.e., a percentage of the following range needs to be added to the existing accuracy deviation)		
PLC	200mV	2V-200V
0.1PLC	0.01%	0.005%
0.01PLC	0.05%	0.01%
0.001PLC	0.3%	0.1%

PLC	10nA	100nA	1μA~10μA	100μA~100m- A	1A~3A
0.1PLC	0.30%	0.03%	0.01%	0.01%	0.01%

0.01PLC	1.00%	0.10%	0.05%	0.02%	0.03%
0.001PL-C	3.00%	1.00%	0.30%	0.20%	0.20%

## Supplemental Characteristics

1. Temperature coefficient (0 to 18 °C and 28 to 50 °C):  $\pm 0.15 \times$  accuracy/°C
2. Noise 10 Hz to 20 MHz (V source): 30mVp-p / 4mVrms (1A range and below)
3. Voltage output stabilization time.  
The time required to reach within 0.1% of the final value under open circuit conditions.  
Stepping from 10% to 90% of the range  
200mV: < 100 $\mu$ s (3A range)  
2V: < 120 $\mu$ s (3A range)  
20V: < 250 $\mu$ s (1A range)  
200V: < 400 $\mu$ s (100mA range)
4. Slew rate  
Stepping from 10% to 90% of the range under no-load condition.  
200mV: 3mV/ $\mu$ s (3A range)  
2V: 24mV/ $\mu$ s (3A range)  
20V: 140mV/ $\mu$ s (1A range)  
200V: 0.6V/ $\mu$ s (100mA range)
5. Current output stabilization time.  
The time required to reach within 0.1% of the final value under short-circuit conditions.  
Stepping from 10% to 90% of the range  
100nA: <5ms  
1 $\mu$ A: < 600 $\mu$ s  
10 $\mu$ A: < 350 $\mu$ s  
100 $\mu$ A: < 200 $\mu$ s  
1mA: < 150 $\mu$ s  
10mA: < 150 $\mu$ s  
100mA: < 150 $\mu$ s  
1A: < 300 $\mu$ s  
3A: < 80 $\mu$ s
6. V source overshoot: < (0.1%+10mV)

Step is 10%~90% of the range, resistive load.

7. I source overshoot: < 0.1%

Step is 10%~90% of the range, resistive load.

8. Voltage source range change overshoot: < 250mV. 100K load, 20 MHz bandwidth

9. Current source range change overshoot: < 250mV/R load, 20 MHz bandwidth

10. Maximum capacitive load: 0.01 $\mu$ F (Normal mode), 50 $\mu$ F (High capacitance mode)

11. DC floating voltage: Max  $\pm$ 250 V DC between low force and chassis ground

12. Guard offset voltage (V source): < 1mV

13. GUARD output impedance: > 10K $\Omega$  Typical

14. Common mode isolation: > 1G $\Omega$ , < 4700pF

15. Max voltage between High Force and High Sense: 4V  
Max voltage between Low Force and Low Sense: 4V

### Pulse source supplemental characteristics

Minimum programmable pulse width: 100 $\mu$ s

Pulse width programming resolution: 10 $\mu$ s

	Max voltage	Max peak current	Max base current	Max pulse width	Max duty cycle
DC or pulsed	6V	3A	3A	Unlimited	100%
	20	1A	1A	Unlimited	100%
	200	0.1A	0.1A	Unlimited	100%
Pulse	12V	10A	0.5A	1ms	2.50%
	200	1A	50mA	2.5ms	2.50%

## 4.1.4 IT2801R

### Basic Parameters

Working temperature	0~40°C
Altitude	0~2000M
AC input voltage	90~260V
AC input frequency	50/60Hz
AC input apparent power	250VA
Cooling style	fans
External dimensions (without rubber bumper and handle)	450mm (D) x 214mm (W) x 88.2mm (H)
Weight	6.7kg
Maximum output power	20W
Maximum output voltage	1050V
Maximum output current	1.05A
Communication interface	USB/LAN
System Bus	Fiber optic
Digital I/O	DB25
Command response time	1ms

### Electrical performance parameters

Test conditions
1. Temperature: 23°C±5°C
2. Humidity: 30%~80% relative humidity

3. Use after 60 minutes for warming up the device
4. Calibration period: 1 year
5. Measuring speed: 1 PLC (power line cycle)

Voltage accuracy				
Range	Source / Measure Resolution	Setting accuracy	Measurement accuracy	Noise (peak to peak) (<10Hz)
±200mV	100nV	0.015%+300μV	0.015%+300μV	≤25μV
±2V	1μV	0.015%+300μV	0.015%+300μV	≤25μV
±20V	10μV	0.015%+1mV	0.015%+1mV	≤200μV
±200V	100μV	0.015%+10mV	0.015%+10mV	≤2mV
±1000V	1mV	0.02%+50mV	0.02%+50mV	≤10mV

Current accuracy				
Range	Source / Measure resolution	Setting accuracy	Measurement accuracy	Noise (peak to peak) (<10Hz)
±1μA	1pA	0.025%+300pA	0.025%+300pA	≤8pA
±10μA	10pA	0.025%+700pA	0.025%+700pA	≤80pA
±100μA	100pA	0.025%+6nA	0.025%+6nA	≤800pA
±1mA	1nA	0.025%+60nA	0.025%+60nA	≤8nA
±10mA	10nA	0.025%+600nA	0.025%+600nA	≤80nA
±100mA	100nA	0.025%+6μA	0.025%+6μA	≤800nA
±1A	1μA	0.03%+500μA	0.03%+500μA	≤30μA

Resistance accuracy (4-wire measurement, 2V range)				
Range	Resolution	Test current	Current range	Measurement accuracy

2Ω	1μΩ	1A	1A	0.1%+300μΩ
20Ω	10μΩ	100mA	100mA	0.055%+3mΩ
200Ω	100μΩ	10mA	10mA	0.055%+30mΩ
2KΩ	1mΩ	1mA	1mA	0.055%+300mΩ
20KΩ	10mΩ	100μA	100μA	0.055%+3Ω
200KΩ	100mΩ	10μA	10μA	0.055%+30Ω
2MΩ	1Ω	1μA	1μA	0.07%+300Ω
20MΩ	10Ω	100nA	1μA	0.35%+3kΩ

Derating accuracy with PLC setting < 1 PLC (additional accuracy deviation, i.e., a percentage of the following range needs to be added to the existing accuracy deviation)						
PLC	1μA~1-0μA	100μA~-100mA	1A	200-mV	2V	20V~1000V
0.1PLC	0.01%	0.01%	0.02%	0.02-%	0.01-%	0.01%
0.01PLC	0.08%	0.05%	0.03%	0.05-%	0.05-%	0.02%
0.001PL-C	0.50%	0.50%	0.20%	0.20-%	0.10-%	0.05%

## Supplemental Characteristics

### Supplemental Characteristics

1. Temperature coefficient (0 to 18 °C and 28 to 50 °C):  $\pm 0.15 \times$  accuracy/°C
2. Noise 10 Hz to 20 MHz: 4mVrms
3. Voltage output stabilization time.  
The time required to reach within 0.1% of the final value under open circuit conditions.  
Stepping from 10% to 90% of the range  
200mV: < 450μs  
2V: < 700μs

20V: < 250 $\mu$ s

200V: < 300 $\mu$ s

1000V: < 5ms

#### 4. Slew rate

Stepping from 10% to 90% of the range under no-load condition.

200mV: 2mV/ $\mu$ s

2V: 20mV/ $\mu$ s

20V: 200mV/ $\mu$ s

200V: 1.8V/ $\mu$ s

1000V: 1V/ $\mu$ s

#### 5. Current output stabilization time.

The time required to reach within 0.1% of the final value under short-circuit conditions.

Stepping from 10% to 90% of the range

1 $\mu$ A: < 1.5ms

10 $\mu$ A: < 1ms

100 $\mu$ A: < 300 $\mu$ s

1mA: < 300 $\mu$ s

10mA: < 300 $\mu$ s

100mA: < 300 $\mu$ s

1A: < 300 $\mu$ s

#### 6. V source overshoot: <(0.1%+10mV)

Step is 10%~90% of the range, resistive load.

#### 7. I source overshoot: <0.1%.

Step is 10%~90% of the range, resistive load.

8. Voltage source range change overshoot: <250mV. 100K load, 20 MHz bandwidth

9. Current source range change overshoot: < 250mV/R load, 20 MHz bandwidth

10. Maximum capacitive load: 0.01 $\mu$ F

11. DC floating voltage: Max  $\pm$ 250 V DC between low force and chassis ground

12. Guard offset voltage (V source): < 1mV

13. GUARD output impedance: >10k $\Omega$  Typical

14. Common mode isolation: > 1G $\Omega$ , < 4700pF

15. Max voltage between High Force and High Sense: 4V

Max voltage between Low Force and Low Sense: 4V

## 4.1.5 IT2805R

### Basic Parameters

Working temperature	0~40°C
Altitude	0~2000M
AC input voltage	90~260V
AC input frequency	50/60Hz
AC input apparent power	250VA
Cooling style	fans
External dimensions (without rubber bumper and handle)	450mm (D) x 214mm (W) x 88.2mm (H)
Weight	6.7kg
Maximum output power	20W
Maximum output voltage	210V
Maximum output current	1.515A
Communication interface	USB/LAN
System Bus	Fiber optic
Digital I/O	DB25
Command response time	1ms

**Electrical performance parameters**

Test conditions
1. Temperature: 23°C±5°C
2. Humidity: 30%~80% relative humidity
3. Use after 60 minutes for warming up the device
4. Calibration period: 1 year
5. Measuring speed: 1 PLC (power line cycle)

Voltage and Current		
	Voltage	Current
DC and Pulse	200V	0.1A
	20V	1A
	6V	1.5A

Voltage accuracy					
Range	Setting resolution	Setting accuracy	Measurement resolution	Measurement accuracy	Noise (-peak to peak) (<10Hz)
±200mV	1μV	0.015%+300μV	100nV	0.015%+300μV	≤ 8 μV
±2V	10μV	0.015%+300μV	1μV	0.015%+300μV	≤ 10 μV
±20V	100μV	0.015%+1mV	10μV	0.015%+1mV	≤ 80 μV
±200V	1mV	0.015%+10mV	100μV	0.015%+10mV	≤ 800μV

Current accuracy					
Range	Setting resolution	Setting accuracy	Measurement resolution	Measurement accuracy	Noise (peak to peak) (<10Hz)
±10nA	100fA	0.1%+50pA	10fA	0.1%+50pA	≤ 2pA
±100nA	1pA	0.06%+100pA	100fA	0.06%+100pA	≤ 3 pA
±1μA	10pA	0.025%+300pA	1pA	0.025%+300pA	≤ 10 pA
±10μA	100pA	0.025%+700pA	10pA	0.025%+700pA	≤ 60 pA
±100μA	1nA	0.02%+6nA	100pA	0.02%+6nA	≤ 600pA
±1mA	10nA	0.02%+60nA	1nA	0.02%+60nA	≤ 6nA
±10mA	100nA	0.02%+600nA	10nA	0.02%+600nA	≤ 60 nA
±100mA	1μA	0.02%+6μA	100nA	0.02%+6μA	≤ 600 nA
±1A	10μA	0.05%+500μA	1μA	0.05%+500μA	≤ 10μA
±1.5A	10μA	0.05%+1.5mA	1μA	0.05%+1.5mA	≤ 30μA

Resistance accuracy (4-wire measurement, 2V range)				
Range	Resolution	Test current	Current range	Measurement accuracy
2Ω	1μΩ	1A	1A	0.1%+300μΩ
20Ω	10μΩ	100mA	100mA	0.055%+3mΩ
200Ω	100μΩ	10mA	10mA	0.055%+30mΩ
2KΩ	1mΩ	1mA	1mA	0.055%+300mΩ
20KΩ	10mΩ	100μA	100μA	0.055%+3Ω
200KΩ	100mΩ	10μA	10μA	0.055%+30Ω

2MΩ	1Ω	1μA	1μA	0.07%+300Ω
20MΩ	10Ω	100nA	100nA	0.2%+3kΩ
200MΩ	100Ω	10nA	10nA	0.7%+30kΩ

Derating accuracy with PLC setting < 1 PLC (additional accuracy deviation, i.e., a percentage of the following range needs to be added to the existing accuracy deviation)		
PLC	200mV	2V~200V
0.1PLC	0.01%	0.005%
0.01PLC	0.05%	0.01%
0.001PLC	0.3%	0.10%

PLC	10nA	100nA	1μA~10μA	100μA~100mA	1A-1.5A
0.1PLC	0.30%	0.03%	0.01%	0.01%	0.01%
0.01PLC	1.00%	0.10%	0.05%	0.02%	0.03%
0.001PLC	3.00%	1.00%	0.30%	0.20%	0.20%

## Supplemental Characteristics

### Supplemental Characteristics

1. Temperature coefficient (0 to 18 °C and 28 to 50 °C):  $\pm 0.15 \times$  accuracy/°C
2. Noise 10 Hz to 20 MHz (V source): 4mVrms (1A range and below)
3. Voltage output stabilization time.  
The time required to reach within 0.1% of the final value under open circuit conditions.  
Stepping from 10% to 90% of the range  
200mV: < 100μs (1.5A range)  
2V: < 120μs (1.5A range)  
20V: < 250μs (1A range)

200V: < 400 $\mu$ s (100mA range)

4. Slew rate

Stepping from 10% to 90% of the range under no-load condition.

200mV: 3mV/ $\mu$ s (3A range)

2V: 24mV/ $\mu$ s (3A range)

20V: 140mV/ $\mu$ s (1A range)

200V: 0.6V/ $\mu$ s (100mA range)

5. Current output stabilization time.

The time required to reach within 0.1% of the final value under short-circuit conditions.

Stepping from 10% to 90% of the range

100nA: <5ms

1 $\mu$ A: < 600 $\mu$ s

10 $\mu$ A: < 350 $\mu$ s

100 $\mu$ A: < 200 $\mu$ s

1mA: < 150 $\mu$ s

10mA: < 150 $\mu$ s

100mA: < 150 $\mu$ s

1A: < 300 $\mu$ s

1.5A: <100 $\mu$ s

6. V source overshoot: < (0.1%+10mV)

Step is 10%~90% of the range, resistive load.

7. I source overshoot: < 0.1%

Step is 10%~90% of the range, resistive load.

8. Voltage source range change overshoot: < 250mV. 100K load, 20 MHz bandwidth

9. Current source range change overshoot: < 250mV/R load, 20 MHz bandwidth

10. Maximum capacitive load: 0.01 $\mu$ F (Normal mode), 50 $\mu$ F (High capacitance mode)

11. DC floating voltage: Max  $\pm$ 250 V DC between low force and chassis ground

12. Guard offset voltage (V source): < 1mV

13. GUARD output impedance: > 10k $\Omega$  Typical

14. Common mode isolation: > 1G $\Omega$ , < 4700pF

15. Max voltage between High Force and High Sense: 4V

Max voltage between Low Force and Low Sense: 4V

### Pulse source supplemental characteristics

Minimum programmable pulse width: 100 $\mu$ s

Pulse width programming resolution: 10 $\mu$ s

	Max voltage	Max peak current	Max base current	Max pulse width	Max duty cycle
DC or pulsed	6V	1.5A	1.5A	Unlimited	100%
	20	1A	1A	Unlimited	100%
	200	0.1A	0.1A	Unlimited	100%

## 4.1.6 IT2806R

### Basic Parameters

Working temperature	0~40°C
Altitude	0~2000M
AC input voltage	90~260V
AC input frequency	50/60Hz
AC input apparent power	250VA
Cooling style	fans
External dimensions (without rubber bumper and handle)	450mm (D) x 214mm (W) x 88.2mm (H)
Weight	6.7kg
Maximum output power	20W
Maximum output voltage	210V

Maximum output current	3.03A DC / 10.5A Pulse
Communication interface	USB/LAN
System Bus	Fiber optic
Digital I/O	DB25
Command response time	1ms

### Electrical performance parameters

Test conditions
1. Temperature: 23°C±5°C
2. Humidity: 30%~80% relative humidity
3. Use after 60 minutes for warming up the device
4. Calibration period: 1 year
5. Measuring speed: 1 PLC (power line cycle)

Voltage and Current		
	Voltage	Current
DC and Pulse	200V	0.1A
	20V	1A
	6V	3A
Pulse	200V	1A
	12V	10A

Voltage accuracy				
Range	Resolution	Setting accuracy	Measurement accuracy	Noise (peak to peak) (<10Hz)
±200mV	100nV	0.015%+300μV	0.015%+300μV	≤ 8μV

±2V	1μV	0.015%+300μV	0.015%+300μV	≤ 10μV
±20V	10μV	0.015%+1mV	0.015%+1mV	≤ 80μV
±200V	100μV	0.015%+10mV	0.015%+10mV	≤ 800μV

Current accuracy				
Range	Source / Measure resolution	Setting accuracy	Measurement accuracy	Noise (peak to peak) (<10Hz)
±10nA	10fA	0.1%+50pA	0.1%+50pA	≤ 2pA
±100nA	100fA	0.06%+100pA	0.06%+100pA	≤ 3 pA
±1μA	1pA	0.025%+300pA	0.025%+300pA	≤ 10 pA
±10μA	10pA	0.025%+700pA	0.025%+700pA	≤ 60 pA
±100μA	100pA	0.02%+6nA	0.02%+6nA	≤ 600pA
±1mA	1nA	0.02%+60nA	0.02%+60nA	≤ 6nA
±10mA	10nA	0.02%+600nA	0.02%+600nA	≤ 60 nA
±100mA	100nA	0.02%+6μA	0.02%+6μA	≤ 600 nA
±1A	1μA	0.05%+500μA	0.05%+500μA	≤ 10μA
±3A	10μA	0.05%+1.5mA	0.05%+1.5mA	≤ 30μA
±10A (*1)	10μA	0.4%+25mA (*2)	0.4%+25mA (*2)	-

\*1 Pulse mode

\*2 Measurement speed: 0.01 PLC

Resistance accuracy (4-wire measurement, 2V range)				
Range	Resolu- tion	Test current	Current range	Measurement accuracy
2Ω	1μΩ	1A	1A	0.1%+300μΩ

20Ω	10μΩ	100mA	100mA	0.055%+3mΩ
200Ω	100μΩ	10mA	10mA	0.055%+30mΩ
2KΩ	1mΩ	1mA	1mA	0.055%+300mΩ
20KΩ	10mΩ	100μA	100μA	0.055%+3Ω
200KΩ	100mΩ	10μA	10μA	0.055%+30Ω
2MΩ	1Ω	1μA	1μA	0.07%+300Ω
20MΩ	10Ω	100nA	100nA	0.2%+3kΩ
200MΩ	100Ω	10nA	10nA	0.7%+30kΩ

Derating accuracy with PLC setting < 1 PLC (- additional accuracy deviation, i.e., a percentage of the following range needs to be added to the existing accuracy deviation)		
PLC	200mV	2V-200V
0.1PLC	0.01%	0.005%
0.01PLC	0.05%	0.01%
0.001PLC	0.3%	0.1%

PLC	10nA	100nA	1μA~10μA	100μA~100mA	1A~3A
0.1PLC	0.30%	0.03%	0.01%	0.01%	0.01%
0.01PLC	1.00%	0.10%	0.05%	0.02%	0.03%
0.001PLC	3.00%	1.00%	0.30%	0.20%	0.20%

### Supplemental Characteristics

1. Temperature coefficient (0 to 18 °C and 28 to 50 °C):  $\pm 0.15 \times$  accuracy/°C
2. Noise 10 Hz to 20 MHz (V source): 4mVrms (1A range and below)

3. Voltage output stabilization time.

The time required to reach within 0.1% of the final value under open circuit conditions.

Stepping from 10% to 90% of the range

200mV: < 100 $\mu$ s (3A range)

2V: < 120 $\mu$ s (3A range)

20V: < 250 $\mu$ s (1A range)

200V: < 400 $\mu$ s (100mA range)

4. Slew rate

Stepping from 10% to 90% of the range under no-load condition.

200mV: 3mV/ $\mu$ s (3A range)

2V: 24mV/ $\mu$ s (3A range)

20V: 140mV/ $\mu$ s (1A range)

200V: 0.6V/ $\mu$ s (100mA range)

5. Current output stabilization time.

The time required to reach within 0.1% of the final value under short-circuit conditions.

Stepping from 10% to 90% of the range

100nA: <5ms

1 $\mu$ A: < 600 $\mu$ s

10 $\mu$ A: < 350 $\mu$ s

100 $\mu$ A: < 200 $\mu$ s

1mA: < 150 $\mu$ s

10mA: < 150 $\mu$ s

100mA: < 150 $\mu$ s

1A: < 300 $\mu$ s

3A: < 80 $\mu$ s

6. V source overshoot: < (0.1%+10mV)

Step is 10%~90% of the range, resistive load.

7. I source overshoot: < 0.1%

Step is 10%~90% of the range, resistive load.

8. Voltage source range change overshoot: < 250mV. 100K load, 20 MHz bandwidth

9. Current source range change overshoot: < 250mV/R load, 20 MHz bandwidth

10. Maximum capacitive load: 0.01 $\mu$ F (Normal mode), 50 $\mu$ F (High capacitance mode)

11. DC floating voltage: Max  $\pm$ 250 V DC between low force and chassis ground

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12. Guard offset voltage (V source): < 1mV
13. GUARD output impedance: > 10kΩ Typical
14. Common mode isolation: > 1GΩ, < 4700pF
15. Max voltage between High Force and High Sense: 4V  
Max voltage between Low Force and Low Sense: 4V

### Pulse source supplemental characteristics

Minimum programmable pulse width: 100μs

Pulse width programming resolution: 10μs

	Max voltage	Max peak current	Max base current	Max pulse width	Max duty cycle
DC or pulsed	6V	3A	3A	Unlimited	100%
	20	1A	1A	Unlimited	100%
	200	0.1A	0.1A	Unlimited	100%
Pulse	12V	10A	0.5A	1ms	2.50%
	200	1A	50mA	2.5ms	2.50%

## 4.2 Supplemental Characteristics

State storage capacity: 10 sets

Recommended calibration frequency: once a year

Cooling style: fans

# 5 Routine Maintenance

This chapter describes the general maintenance items and maintenance methods of the IT2800 series SMU.

- ◆ Instrument Self-Test
- ◆ Cleaning and Maintenance
- ◆ Contact of ITECH Engineers
- ◆ Return for Repair

## 5.1 Instrument Self-Test

IT2800 series SMU provides the self-test function to check the operation. The self-test is automatically performed when the instrument is powered on. It is recommended to perform the self-test for the following condition or purpose. Before performing the self-test, turn the channel output off and disconnect test leads and cables from the terminals.

- If a channel is in the lock condition due to over temperature

In this condition, the Emergency dialog box is displayed on the screen. And the ERR indicator turns on and the **[On/Off]** switch is not effective. Perform the self-test to unlock the channel. The channel can be used soon if the self-test does not report any problem.

- If you feel that the instrument may be defective
- For preventive maintenance

## 5.2 Cleaning and Maintenance

To ensure the safety function and performance of the instrument, please clean and maintain the instrument properly.

### WARNING

- **To prevent electrical shock, disconnect the instrument from AC mains power and disconnect all test leads before cleaning.**
  - **Do not use detergent or solvents.**
  - **Do not disassemble the instrument and attempt to clean internally.**
-

Clean the outside and the front panel screen of the instrument using a soft, lintfree, cloth slightly dampened with water. Use a brush to clean the dust on the vent and cooling fans.

## 5.3 Contact of ITECH Engineers

This section describes operations to be carried out by the user in case of failure of the instrument.

### Preparation before contact

When the instrument fails, you should make the following preparations before returning the instrument to ITECH for repair or contacting engineers.

- Check all the items listed in the [Self-inspection of equipment faults](#) and confirm whether there are still some problems.
- Collect the SN of the instrument.  
For details, see [Collect the SN number](#).

If there are still some problems, carefully read the **Warranty** and **Limitation of Warranty** in the preface of the manual. Confirm that your instrument complies with warranty service conditions. If after your warranty expires, ITECH offers repair services at competitive prices.

### Self-inspection of equipment faults

When the instrument fails, make the following checks to ensure that the failure is in the instrument rather than any external connections. If the instrument failure can be eliminated via simple inspection, the maintenance cost and time can be saved.

- Check whether the AC power cord is securely connected to the instrument and to a powered outlet.
- Check whether the front-panel Power On switch has been pushed.
- Check whether self-inspection of the instrument is successful and whether the specifications and performance are within the indicator ranges.
- Check whether the instrument displays error information.
- Use other instruments instead of this instrument for confirmation.

### Collect the SN number

ITECH will constantly improve the product performance, availability and reliability. All relevant information is marked uniquely according to the serial

number of each instrument. The equipment returned for repair must adopt the SN number as the tracking ID.

When you contact the engineer, the effective SN number of the instrument will be the effective guarantee for effective service and complete information. You can obtain the SN number of the instrument by the following ways:

1. Press the **[Menu]**→**System** key to enter into the system menu interface.
2. Use left and right keys or rotate the knob to select **System Info** and press **[Enter]** key.
3. Check the SN number.

Please record the SN number and provide SN information when doing maintenance service.

### How to contact ITECH engineers

Access ITECH official website [www.itechate.com](http://www.itechate.com).

## 5.4 Return for Repair

If your instrument fails during the warranty period, ITECH will repair or replace it under the terms of your warranty. After your warranty expires, ITECH offers repair services at competitive prices. Also you can purchase an extended maintenance service contract that exceeds the standard warranty period.

### Get Repair Service

To get the service for your instrument, choose the easiest way to contact the ITECH engineers. ITECH will arrange for repair or replacement of your instrument or provide warranty and repair cost information (if applicable).

### Repackaging for Shipment

#### **CAUTION**

**Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the instrument or prevent it from shifting in the carton. Styrene pellets cause the instrument damage by generating static electricity and by lodging in the rear panel.**

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ITECH recommends that you retain the original shipping carton for return shipments and always insure shipments. To ship the unit to ITECH for service or repair:

1. Download the ITECH maintenance service application from our website, complete it and place it in the box with the instrument.
2. Place the unit in its original container with appropriate packaging material.

If the original shipping container is unavailable, use a container that will ensure at least 10 cm (4 in.) of compressible packaging material around the entire instrument. Use static-free packaging materials.

3. Secure the container with strong tape or metal bands.

## Connect with us

Thank you for purchasing ITECH products. Any questions, pls. feel free to let us know.



You can chat with us on ITECH website



For more information, pls. visit [www.itechate.com](http://www.itechate.com)



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