User's Manual

SPA3100
SPA3200

Content

Name and Use of Components

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·Data update indicator light
·Voltage and current range warning light
·Measurement mode state display lamp
·Maximum hold function indicator light

Measuring channel indicator light
·Function switch key
·Unit switch key

Navigation key
·Up, down, left and right keys
·OK key

SPA3200 Digital Power Meter

Wiring 3P4W   Voltage Range 150 V   Current Range 500 mA

Urms1   0.0382   V

Irms1   0.0878   mA

P1   3.0382   mW

P1(0)   2.0787   mW

Range setting
Automatic range indicator light
Range setting key

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·1P3W (single-phase three-wire system)
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·3P4W (three-phase four-wire system)
·3V3A (three-voltage and three-current meter method)

Front Panel

D / A connector

Voltage input end

External current sensor input end

Current input end

Type B USB interface

GP-IB/RS-232 connector

Ethernet interface
Ground pole

ELEMENT1   ELEMENT2   ELEMENT3

Power port and control switch

Rear Panel

1.2 Brief introduction of key function

Brief introduction of key function

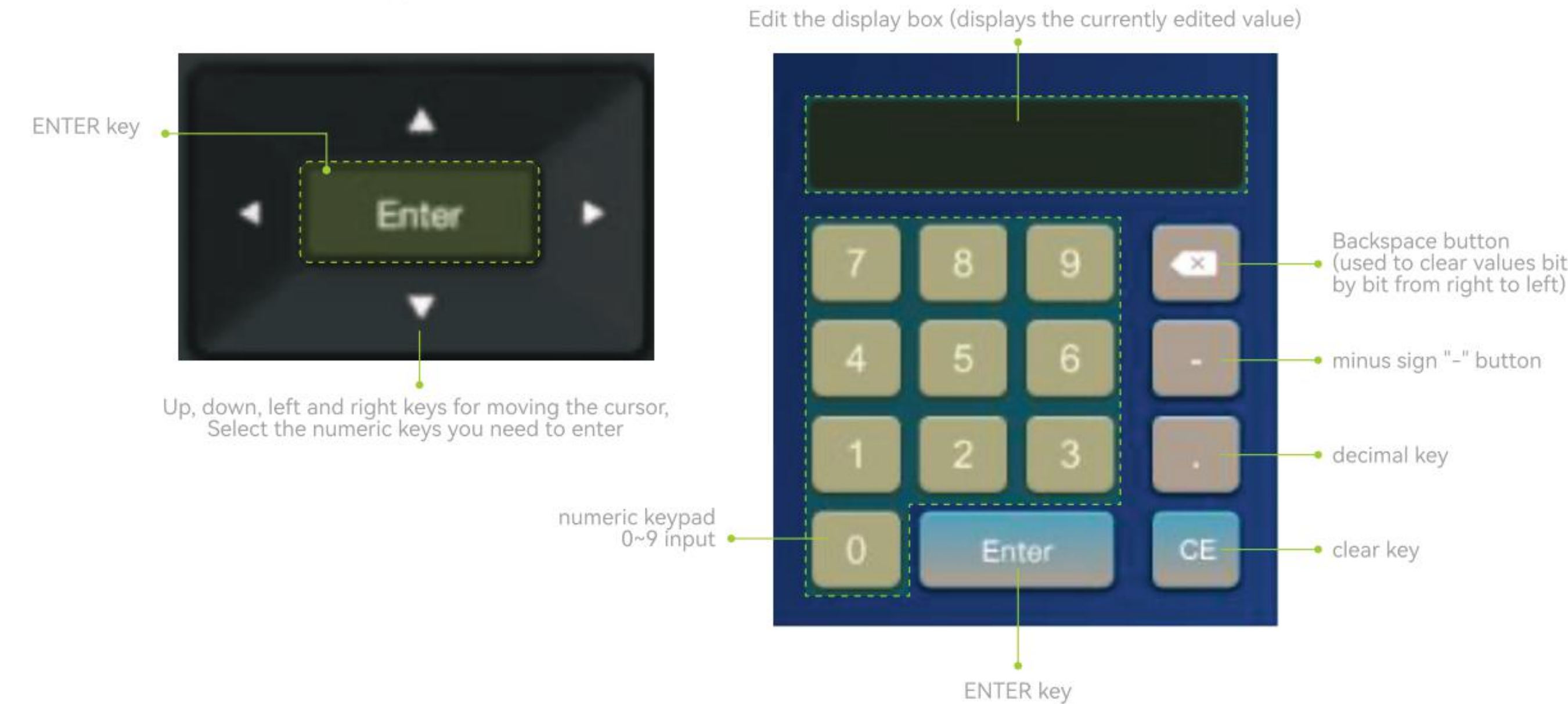| No.	Key name	Description
01	Menu key	This button calls the following settings menu: Values, system settings, Setup settings, harmonics, storage, integration, etc.
	Numeric key	Numerical function key
	Integrator key	Integral function key
02	Setup key	Press this key to invoke the following settings menu: Measurement mode, wiring mode, data update rate, Peak factor, synchronous source, filter setting, average function, scale setting, operation function
	Utility key	Press this key to invoke the following settings menu: Remote Control, System Information, Initialization Settings, Initialization Settings, Zeroing Settings, Zero setting, self-test function, D/A output setting
	Harmonics key	Harmonic function key
03	Store key	storage function key
04	Voltage key	Voltage measurement range adjustment; when the range is set to "Auto", the voltage "Auto" indicator lights up.
05	Current key	Current measurement range adjustment; when the range is set to "Auto", the current "Auto" indicator lights up.
06	EXT key	External current sensor on key
07	Hold/ESC keys	Press the Hold/ESC key under the measurement value display interface, the Hold/ESC key indicator lights up, the data stops updating, and the display data is maintained. Press Hold/ESC again, the Hold/ESC key is off, and the updated value is displayed again. Under the setting interface, the Hold/ESC key function is equivalent to the ESC key, press to exit the setting interface.
08	Single key	Press this key while the measurement data is being held to perform a measurement at a specified update cycle. After the measurement data is updated, it is displayed again.Each time you press the Single key, the update rate indicator lights up once.
09	Local/Lock keys	❶ If you are not connected remotely, press the Local/Lock key for a long time to lock or unlock the key. ❷ Forced disconnection of the remote connection when connecting remotely. Press and hold the Local/Lock key to perform the remote control function. Do not perform locking or unlocking functions.
10	Navigation key	–

1.3 Input numbers

All values that need to be set in the instrument are entered in two ways:

❶ Move the cursor to the setting box and press Enter; ❷the system can display the number keyboard by touch-click, and enter values by mouse click or touch-screen

Edit the display box (displays the currently edited value)

ENTER key

Up, down, left and right keys for moving the cursor,
Select the numeric keys you need to enter

numeric keypad
0~9 input

Backspace button
(used to clear values bit
by bit from right to left)

minus sign "-" button

decimal key

clear key

ENTER key

1.4 Instrument display

Open the instrument, under normal circumstances, the instrument screen will display the instrument's current status information and real-time measurement information, detailed interpretation as shown in the figure:

Area A: Status display area I

Area C: Work display area

Urms1 0.0382 V

Irms1 0.0878 mA

P1 3.0382 mW

P1(0) 2.0787 mW

Area B: Status display area II

ℹ️ Note:

Area A: from left to right display the main menu button, output unit over-range status, proportion, average value, line filter, frequency filter on, Input unit selected status, voltage/current real-time range.

Area B: Display the number of measurement packets (update rate), storage status, integration status and time, and the current date and time of the system from left to right.

Area C: Instrument working area, display measurement data or instrument setting area.

Instrument non-numerical display

When the measurement function cannot display the measured value normally, the system will display different characters according to different situations, as shown in the table below

Display character	Status	Description
OL	over-range display	Display "-OL-" when the conventional measurement item exceeds the range Rules: When CF3, the value of the input measurement is greater than 140% of the range; For CF6 or 6A, the value of the input measurement is greater than 280 percent of the range.
OF	over-range display	"OF" when S, Q, phase angle and power factor exceed the range
0	below range display	To judge by the effective value, as long as the effective value is lower than a certain ratio of the range, the rest are displayed "0". Rules: In CF3, the input measurement term is less than three-thousandths of the range; For CF6 or 6A, the input measurement is less than six thousandths of the range.
ERR	error display	fU or fI low-frequency display and display under low-frequency parameter set to Error
INF	Out-of-Range Display	numerical infinity or infinity hour
NAN	When it is impossible to measure	If a value is divided by zero
- - - - - -	empty value	When measurement items have no data

Before Starting Measurement

2.1 Instructions for Use

Safety Instructions

- To ensure that you use this instrument safely and correctly, you shall read the following safety warnings carefully.
- If the instrument is not operated in the correct way, it may cause damage to the instrument.
- The Company shall not be liable for any damage caused by operating instruments without observing the following safety warnings.

Correct operation

- In order to prevent electric shock or fire, you shall use the power line provided by the Company. The power plug must be connected to the power socket with protective grounding.
- It is necessary to ensure that the connected supply voltage is consistent with the rated voltage of the instrument, and the supply voltage cannot exceed the maximum rated voltage of the power line.

Check grounding protection

- Before connecting, it is necessary to check whether the protective grounding terminals and fuses inside and outside the instrument are in good condition. If any abnormality is found, you shall not use the instrument, otherwise it will be dangerous.
- Before starting up, it is necessary to check whether all protective grounding is connected in good condition, and confirm it again and again before starting up normally for use.
- It is not allowed to directly touch the connecting circuit with hands. If necessary, you shall cut off the power supply and wear safety gloves for operation.
- It is not allowed to disassemble the machine shell except the maintenance personnel of the Company, so as to prevent the danger of internal high-voltage electric shock.

Security environment confirmation

- In order to ensure the personal safety of operators, it is not allowed to use this instrument in the environment containing flammable and explosive gases or liquids, otherwise there will be danger.
- In order to ensure accurate measurement, it is necessary to ensure that this instrument is used in a suitable working environment (temperature: 5℃~40℃; Humidity: 20% RH ~ 80% RH).

2.2 Connect the power cord

Check before connecting

Please carefully check the following contents before safely connecting the power supply :

❶ Check that the outside of the equipment is in good condition and there are no assembly defects, such as loose and falling screws, etc.;

❷ Check whether the randomly matched power line is intact or not;

❸ Check whether the type, model and quantity of random accessories are complete;

Please contact the Sales Department of the Company directly if the above inspection is inconsistent with the description of the purchase contract.

Connect the power cord

❶ Confirm that the power switch of this instrument is in a closed state.

❷ After confirming that the supply voltage is within the rated voltage range of this instrument, the distributed power cord is connected to the power input port of the instrument.

❸ Instrument power interface parameters are as follows

Item	Specification
Nominal supply voltage	AC100 ~ 240V
Allowable voltage fluctuation range	AC90 ~ 264V
Rated power supply frequency	50/60Hz
Allowable frequency fluctuation range	48 ~ 63Hz
Maximum power consumption	50VA

2.3 Turn the power on/off

Operation when turning on the power

- As shown in the schematic diagram of the front panel in Section 1.1, the front power switch key and the rocker switch on the back of the instrument together form a power double switch design.
- When the rocker switch on the back is not closed, and the indicator light of the power key is not on, the instrument is not charged.
- After the rocker switch on the back is closed, the instrument is powered on, the indicator light of the power key is red, and the instrument is in standby state. At this time of pressing the power switch key, the instrument starts, the indicator light of the power key is green, and the instrument enters the running state.
- When the instrument is running, the power switch key is pressed for up to 2 seconds, the instrument stops running and enters the standby state, the digital tube is turned off, and the indicator light of the power key turns red at the same time.

Precautions when making accurate measurements

- The power switch is turned on to enable the instrument preheat for more than 30 minutes.
- Please set it to zero after preheating.

Operation when turning off power

- Please turn off the power switch first and then the rocker switch when the instrument needs to be turned off after use. When the instrument is completely uncharged, it is regarded as normal shutdown.
- If the instrument is abnormally powered off and shut down, the instrument starts automatically when it is powered on again. Please try to use the normal shutdown process to close the equipment. Please wait for more than 2S to power on and start the instrument again in case of abnormal shutdown.

2.4 Measurement circuit connecting direct input

The measurement cable from the measurement circuit is connected directly to the voltage or current input terminal.

Connect voltage input terminal

- For a safety banana jack with a terminal of 4mm, the safety connector (the wire is not exposed) is inserted into the voltage input terminal.

**Connect current input terminal**

- It is not allowed to touch the current sensor input interface when introducing the voltage of the measurement circuit into the current input terminal. Because these ports are electrically connected internally, they are very dangerous.

⚠ **Note:**

- Please make sure that there is no foreign matter on the contact surface between the current input terminal and the crimp terminal when connecting.
- It is necessary to regularly check whether the knob of the current input terminal is loose, and whether there is foreign matter on the contact surface between the current input terminal and the crimp terminal.
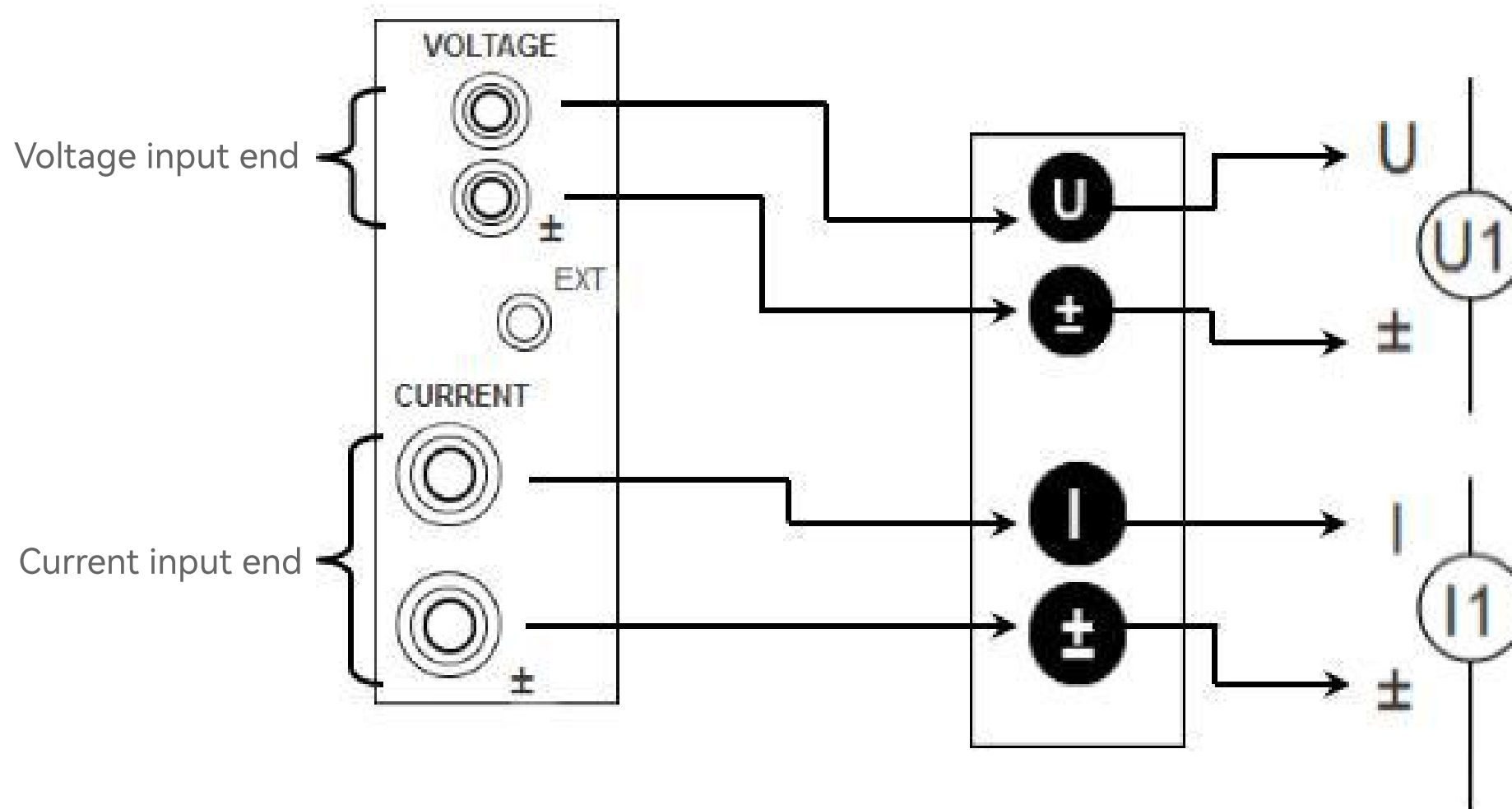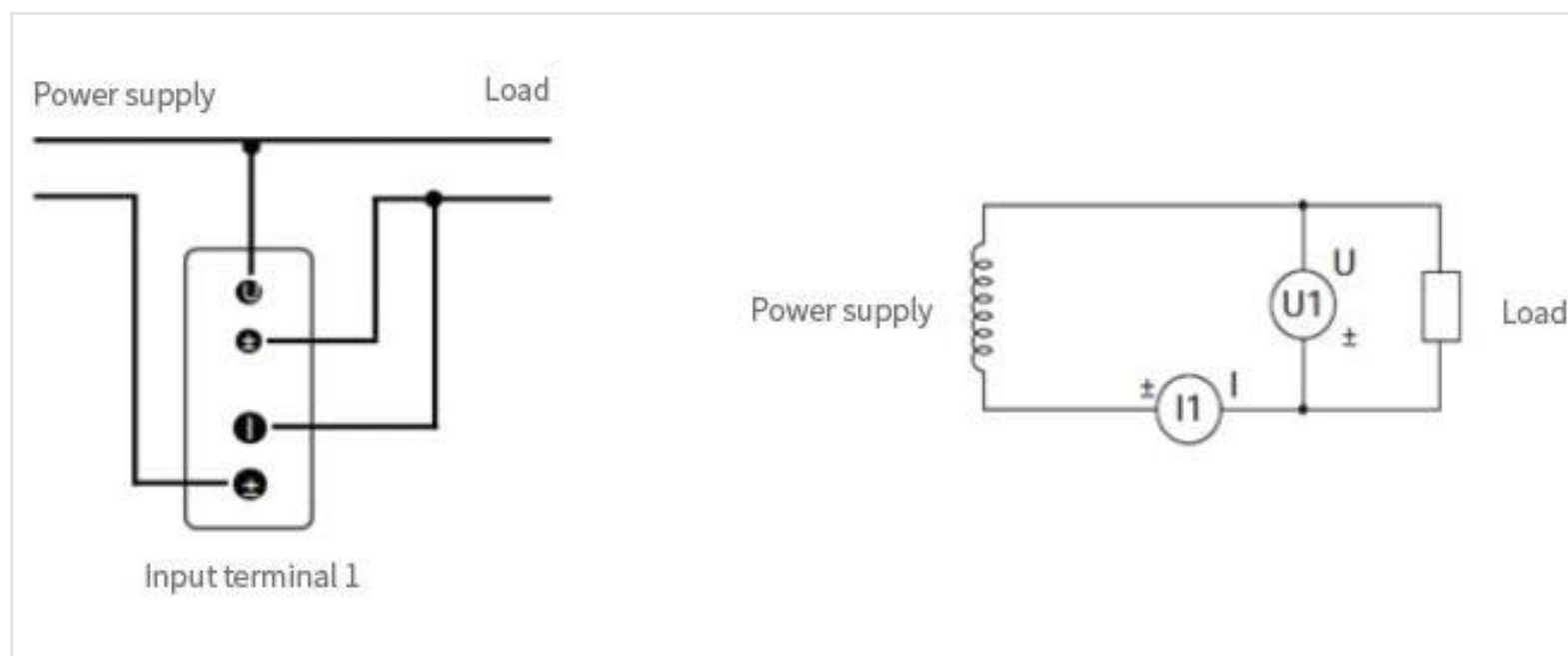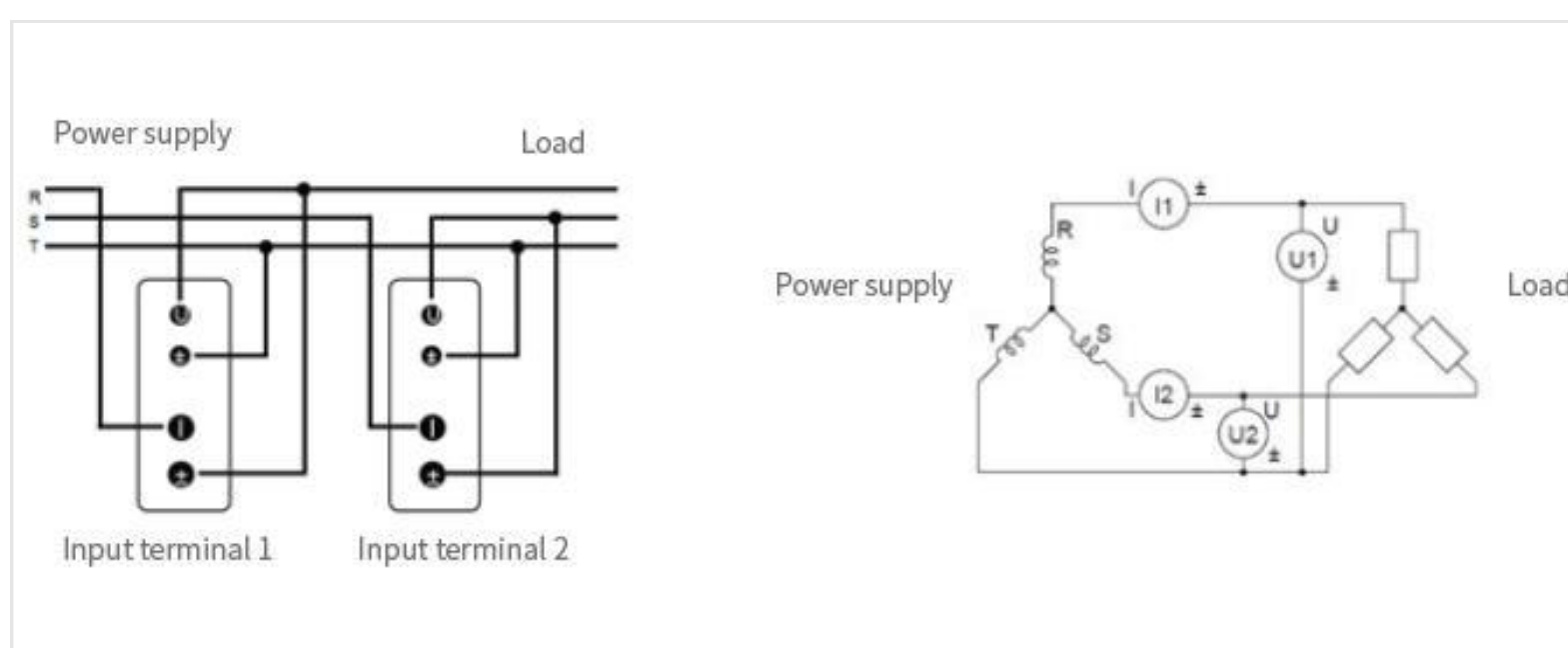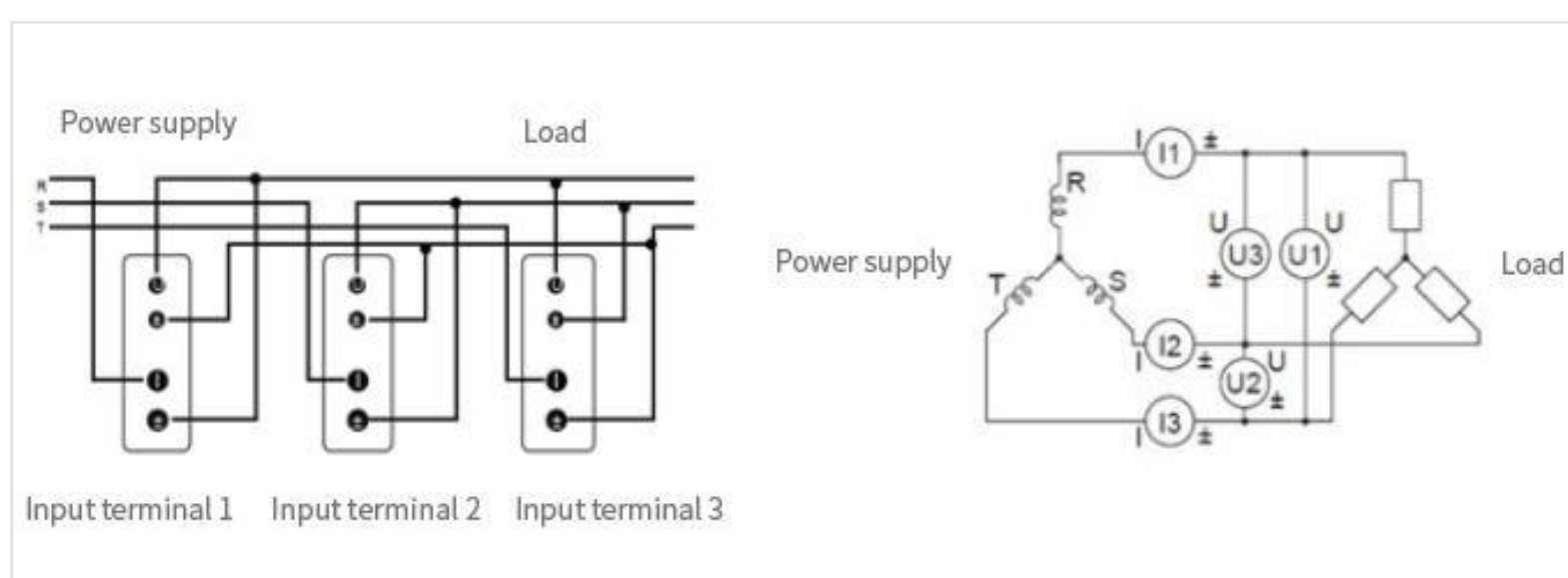
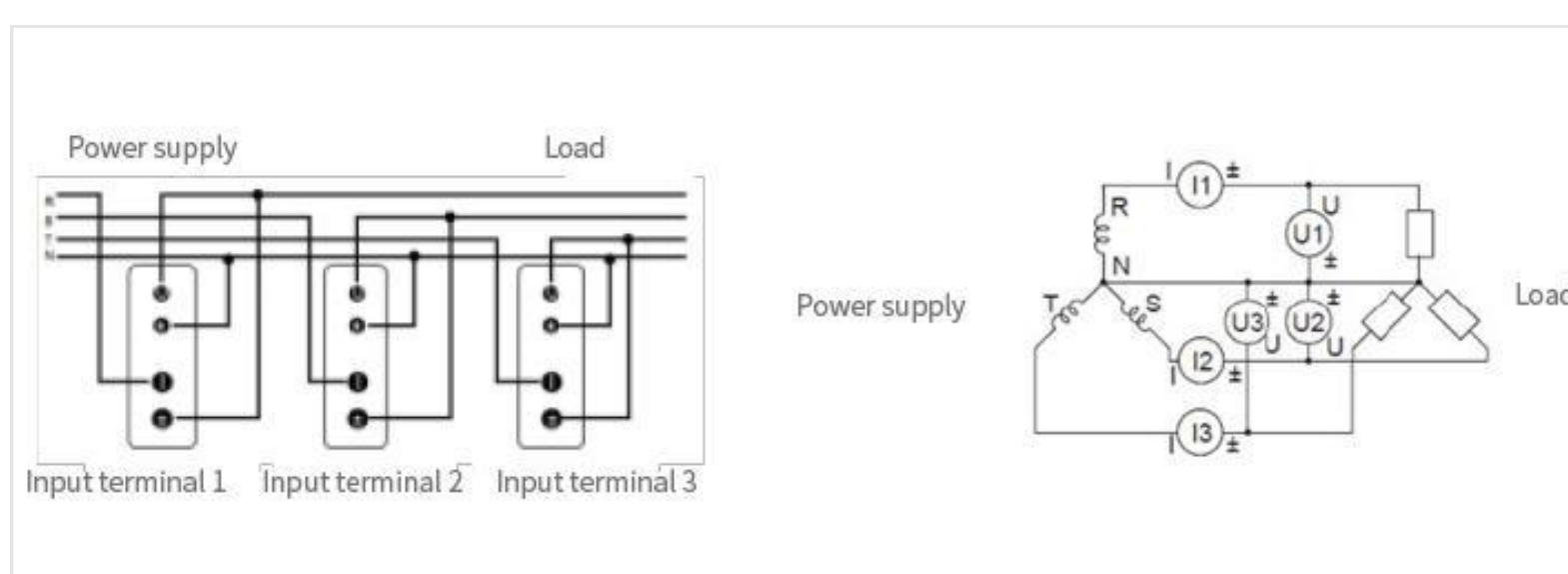**Single-phase two-wire system (1P2W),**
directly input wiring example
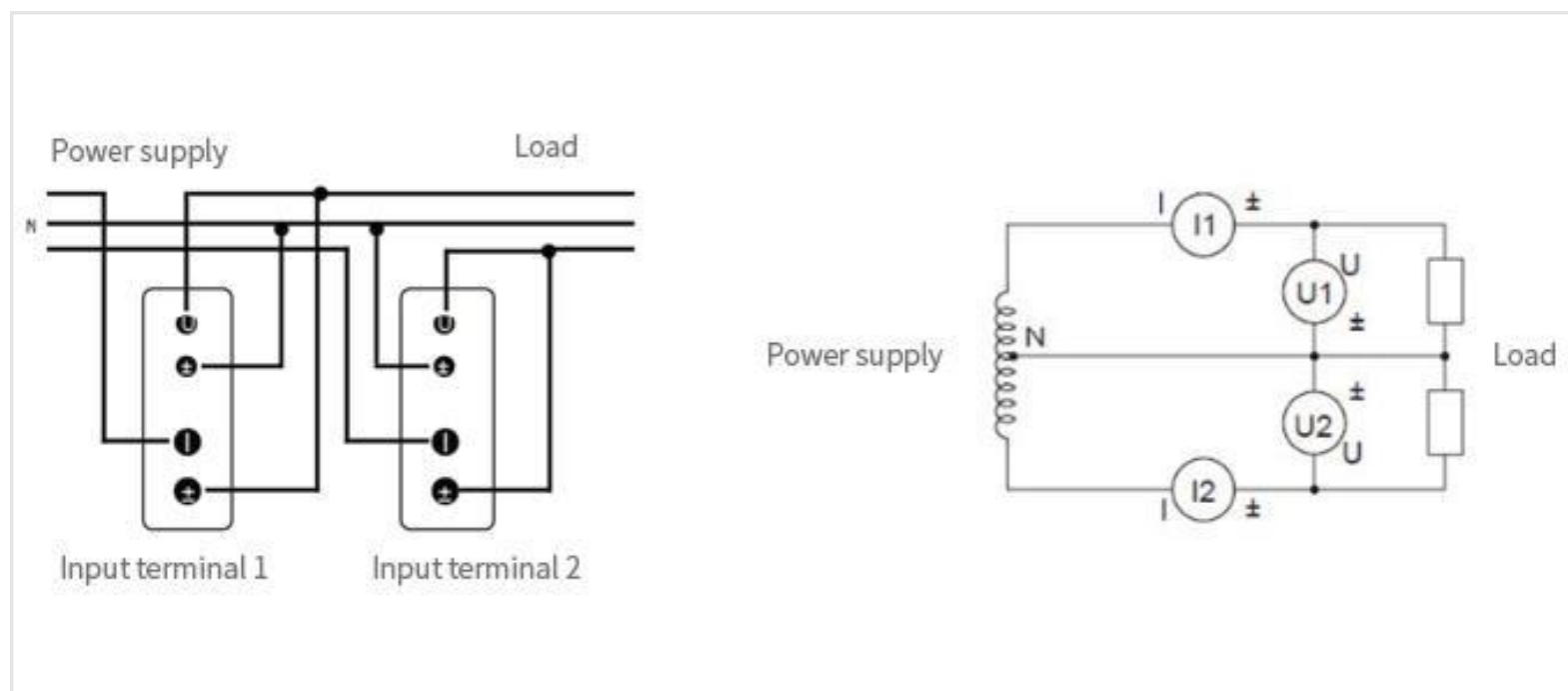
Single-phase three-wire system (1P3W),
directly input wiring example

**Three-phase three-wire system (3P3W),**
directly input wiring example

**Three-phase three-wire
(three-voltage three-current) system
3P3W (3V3A),**
directly input wiring example

Three-phase four-wire (3P4W),
directly input wiring example

2.5 Measurement circuit connecting external sensor input

When the maximum current of the measurement circuit exceeds the maximum range of the input unit (as described below), an external current sensor can be connected to the current sensor input interface to measure the current. The simplified connection mode of the input unit, voltage input terminal and external current sensor input connector of the digital power meter is shown in the figure.
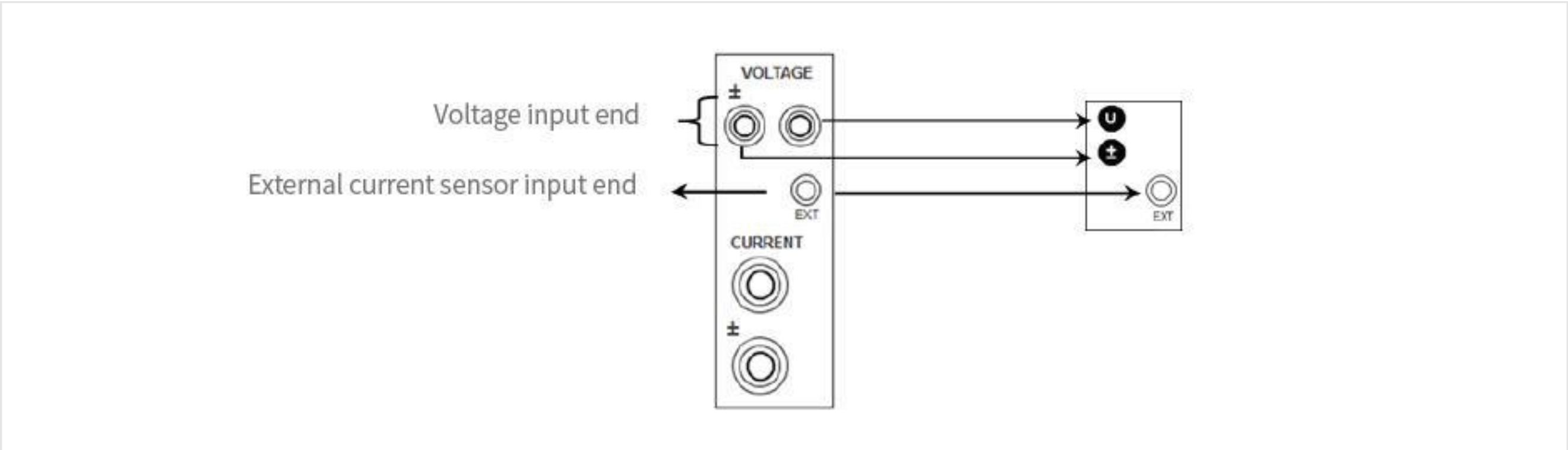

Output type of current sensor

External current sensors can be divided into shunt current sensor and voltage output clamp current sensor.

2.5.1 Connection mode of current sensor

The shunt current sensor is connected to power ground.
If the sensor must be connected to a non-ground terminal, it is necessary to use wire with conducting layer between the sensor and the instrument to reduce the influence of common-mode voltage. Attention shall be paid to electricity safety when connecting external current sensor cables.
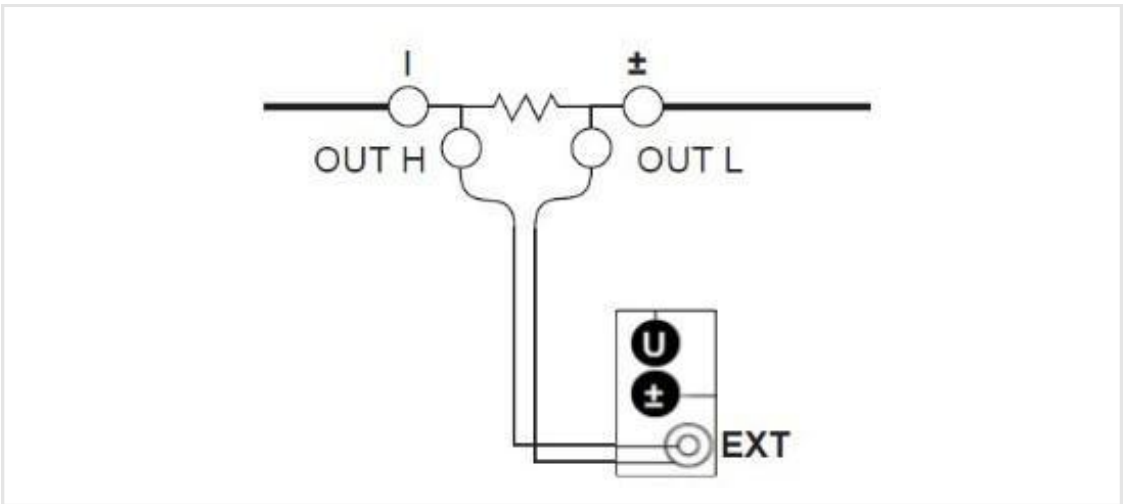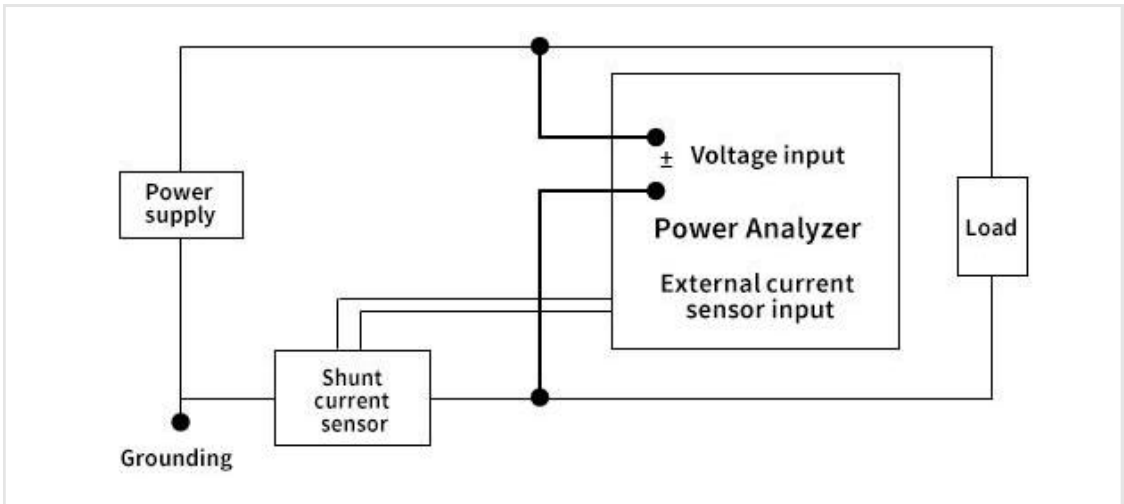
When the tested circuit is not grounded, the signal frequency is high or the power is high, the influence of the inductance of the shunt current sensor cable becomes greater. In this case, the measurement is performed using an isolated sensing (CT, DC-CT, or clamp type).
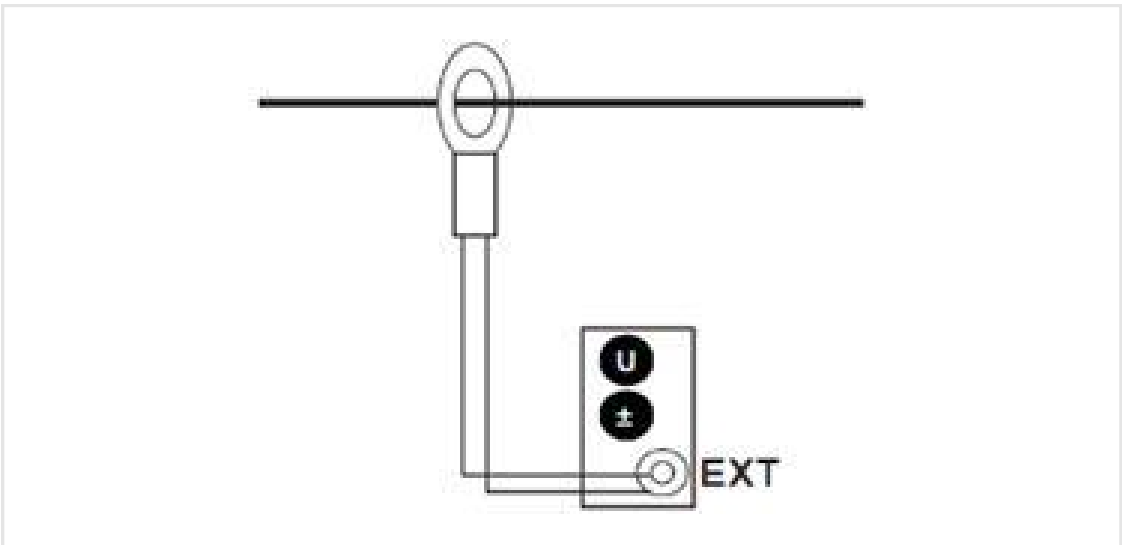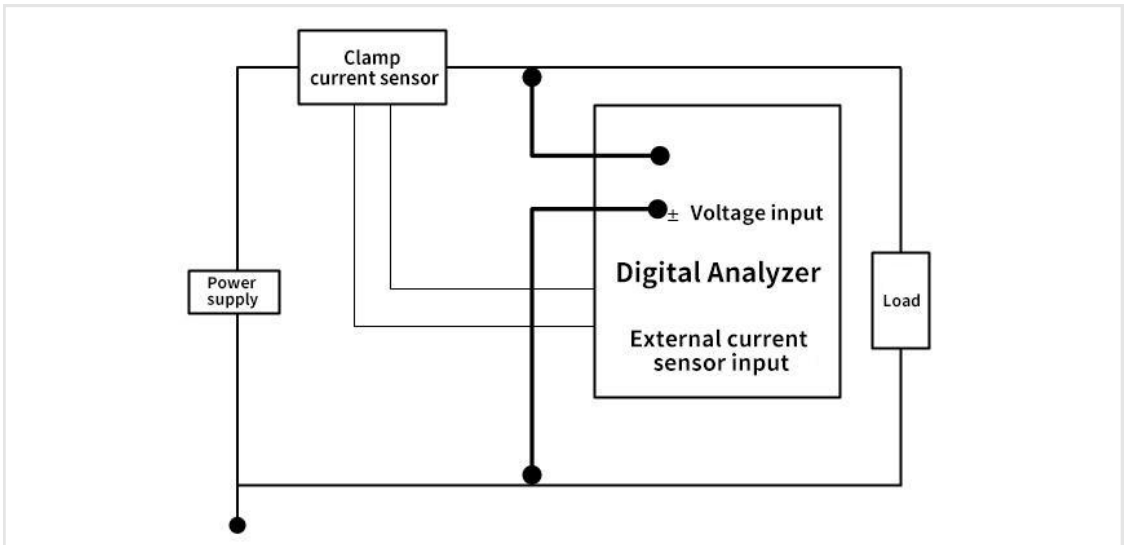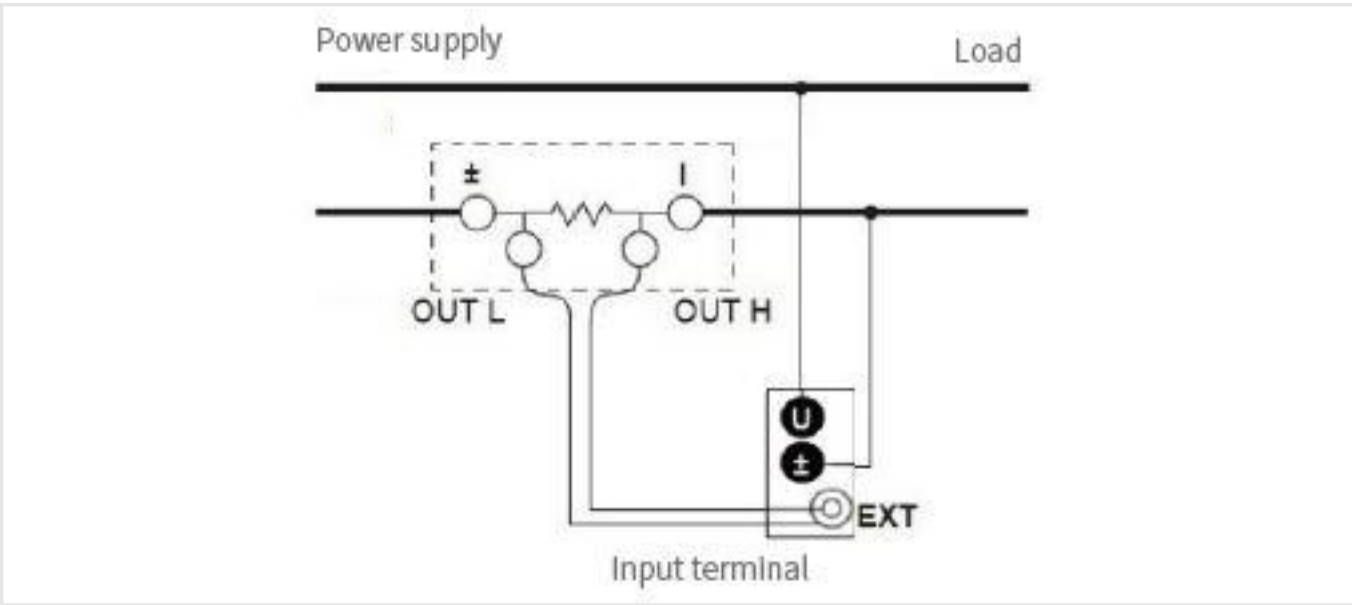
Wiring example :

● **Single-phase two-wire system (1P2W),**
directly input wiring example
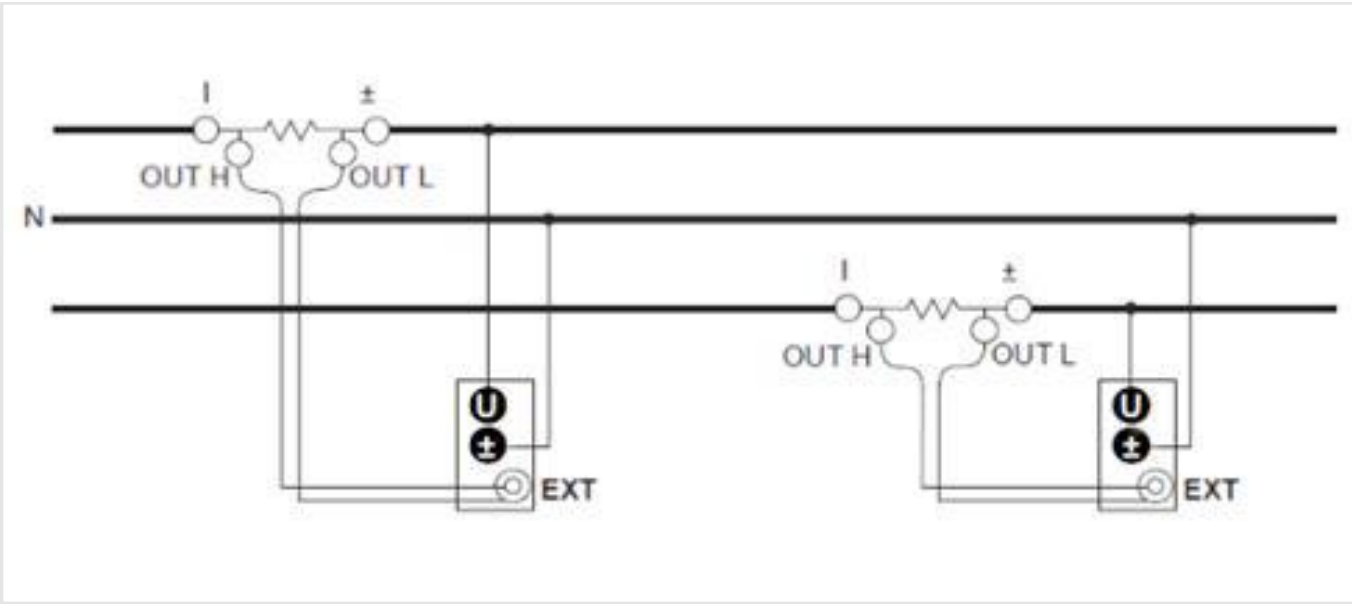
● **Single-phase three-wire system (1P3W),**
example of wiring by using shunt current sensor
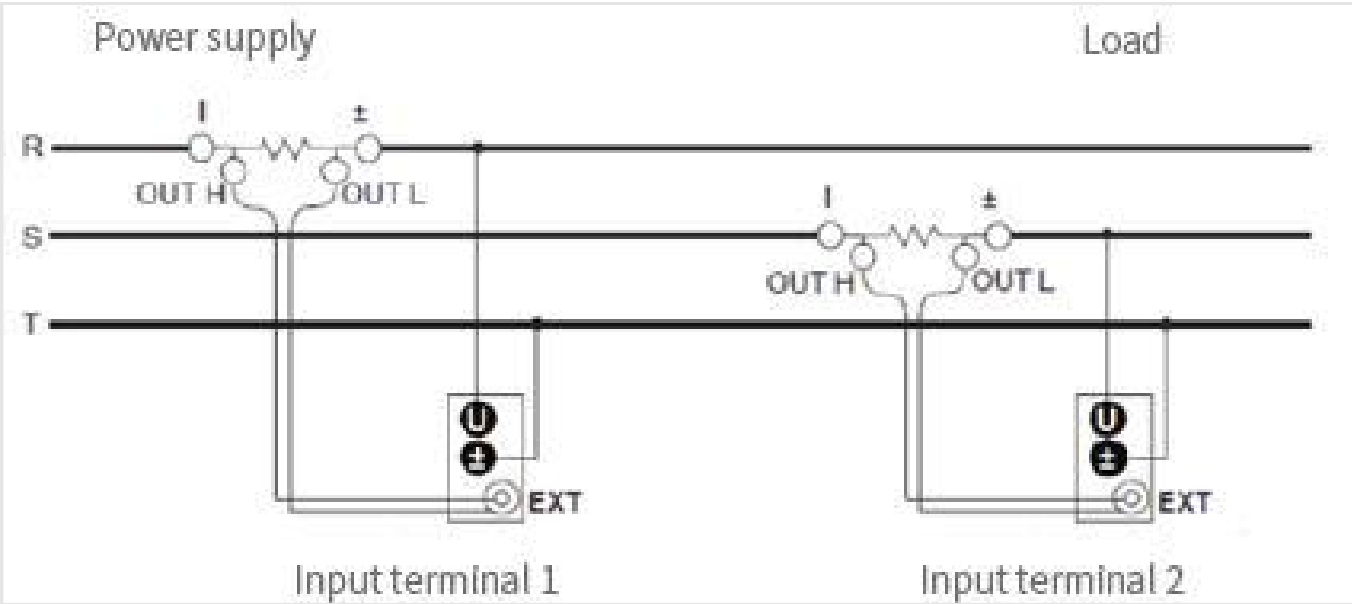
● **Three-phase three-wire system (3P3W),**
example of wiring by using shunt current sensor
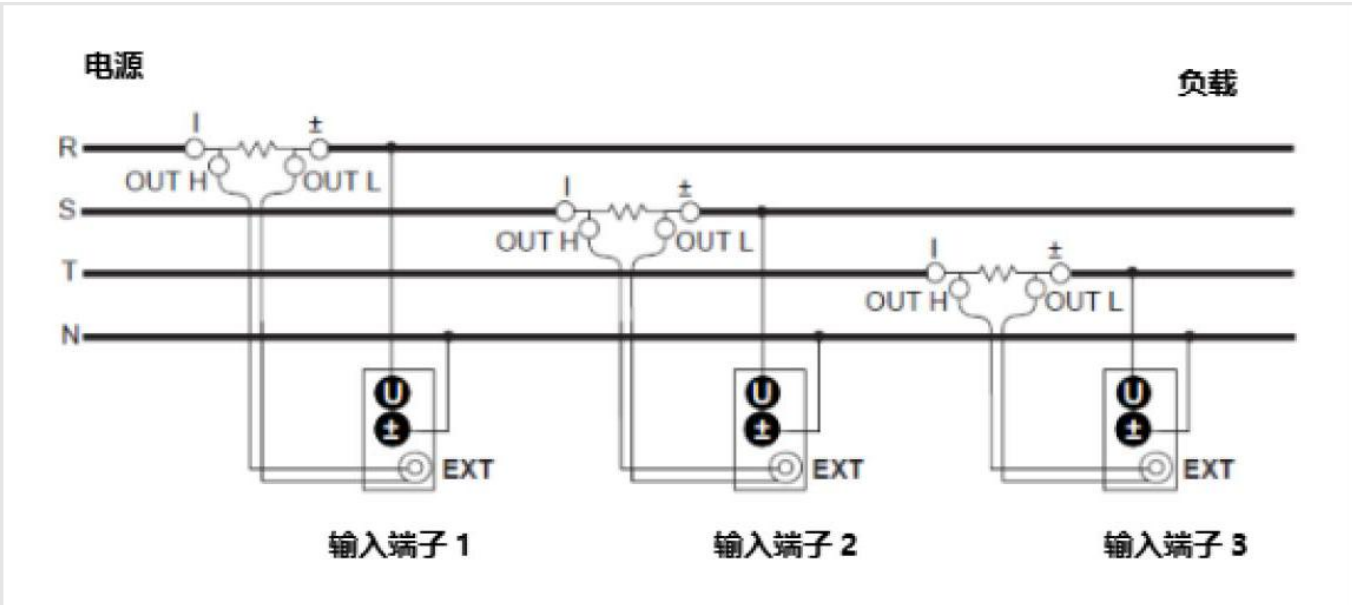
● **Three-phase three-wire (three-voltage three-current) system 3P3W (3V3A),**
example of wiring by using shunt current sensor
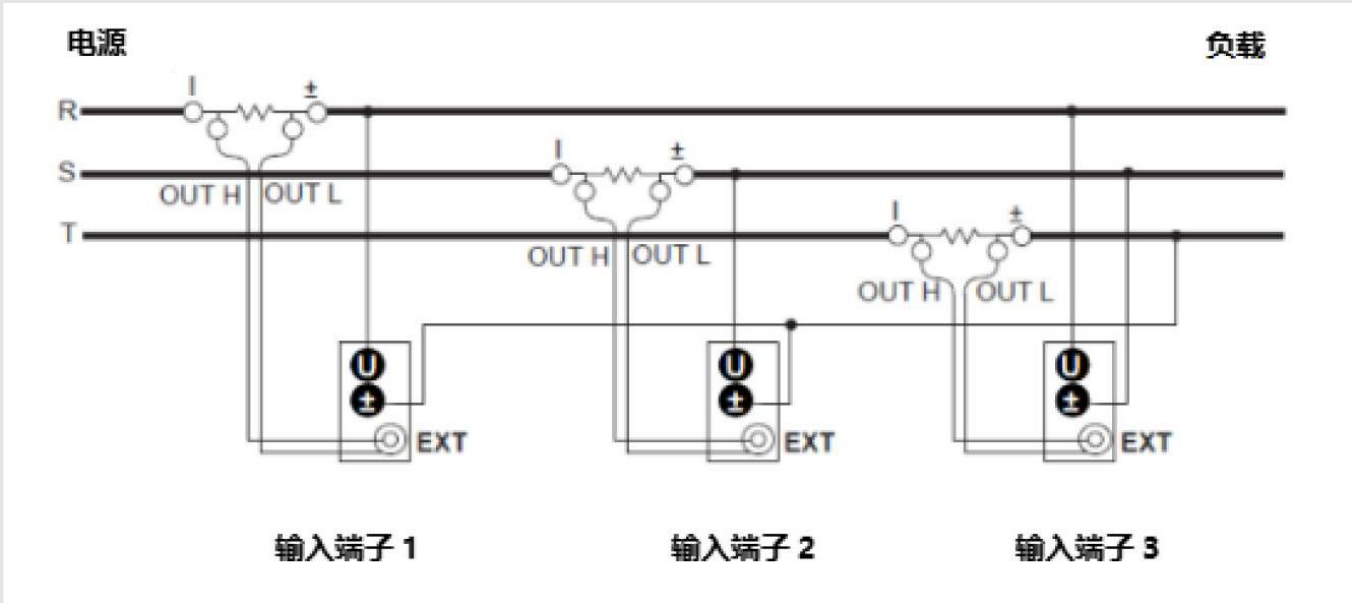
● **Three-phase four-wire system (3P4W),**
example of wiring by using shunt current sensor

Connection mode of voltage and current transformers (VT/CT)

When the current exceeds the range, a current output sensor or CT (Current Transformer) can be connected to expand the range. When it is connected through the sensor, the current input terminal shall be connected.

When the voltage exceeds the range, a voltage sensor or VT (Voltage Transformer) can be connected to expand the range. When it is connected through the sensor, the voltage input terminal shall be connected.

Single-phase two-wire system (1P2W),
example of wiring by using transformer (VT/CT)
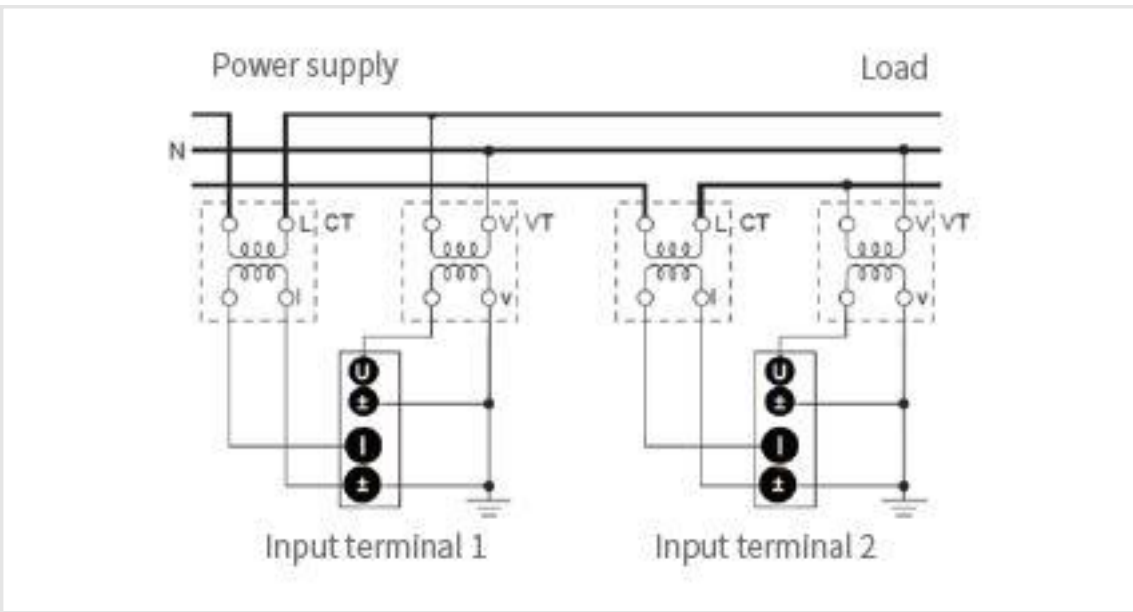
Single-phase three-wire system (1P3W),
example of wiring by using transformer (VT/CT)
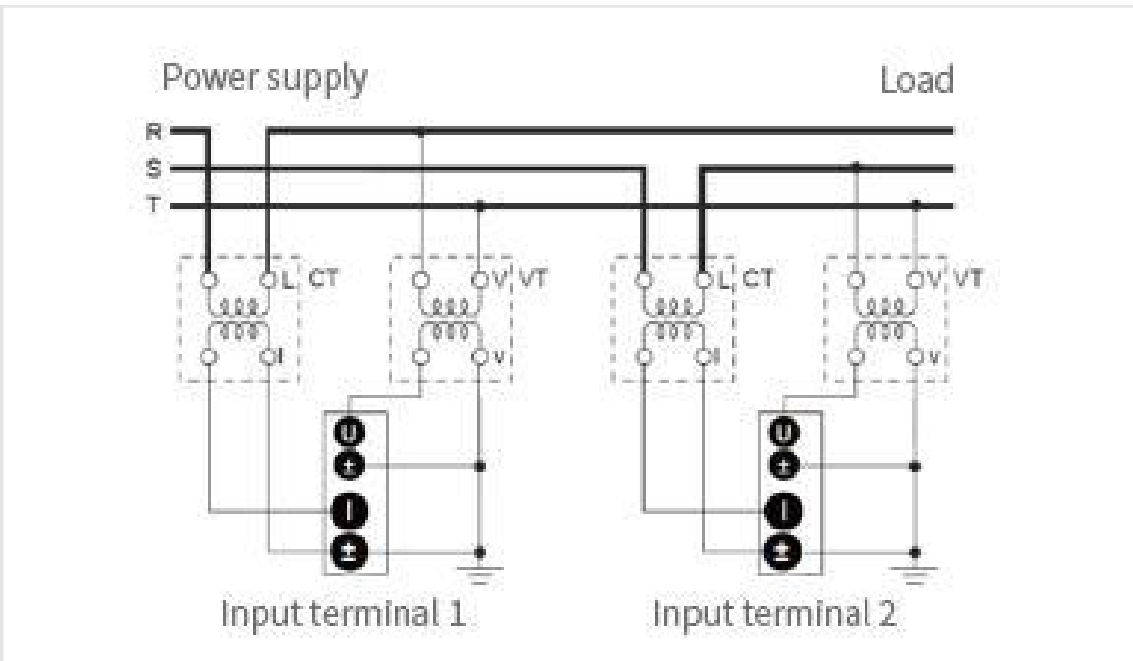
Three-phase three-wire system (3P3W),
example of wiring by using transformer (VT/CT)
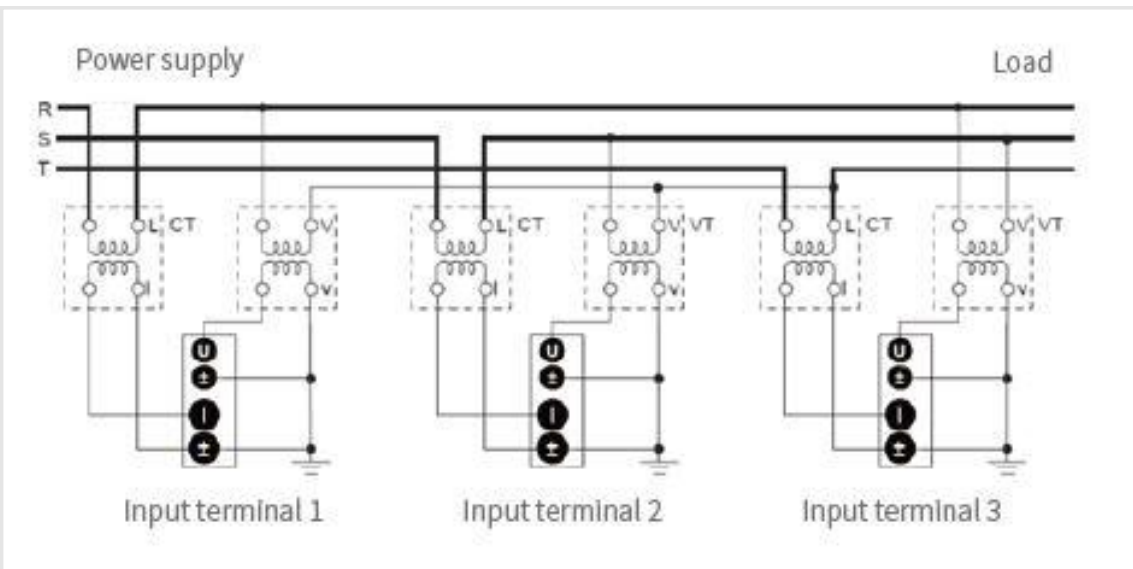
Three-phase three-wire (three-voltage three-current) system 3P3W (3V3A),
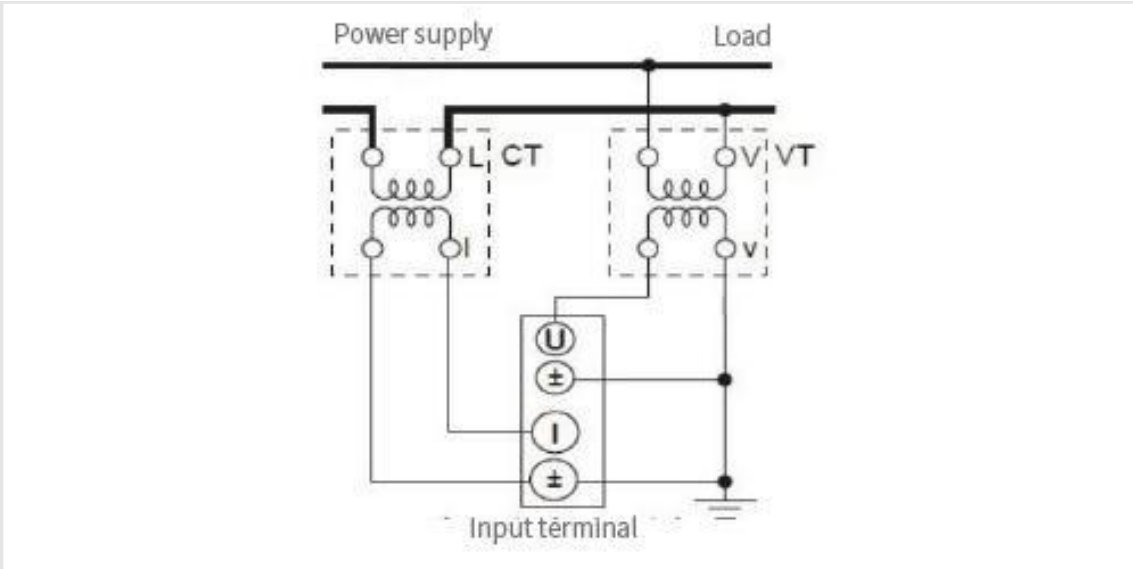example of wiring by using transformer (VT/CT)
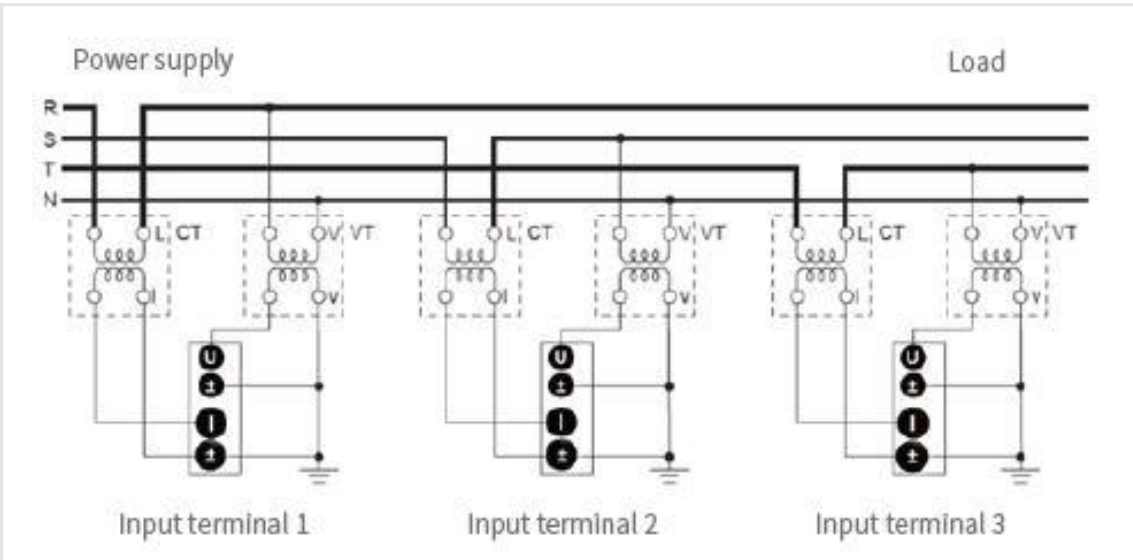
Three-phase four-wire system (3P4W),
example of wiring by using transformer (VT/CT)

Chapter III

Setting of Measurement Conditions

Operating steps

3.1 Measurement mode setting

1. Press the Setup key;

2. Select the "Mode" menu;

3. Setup Menu is as follows:
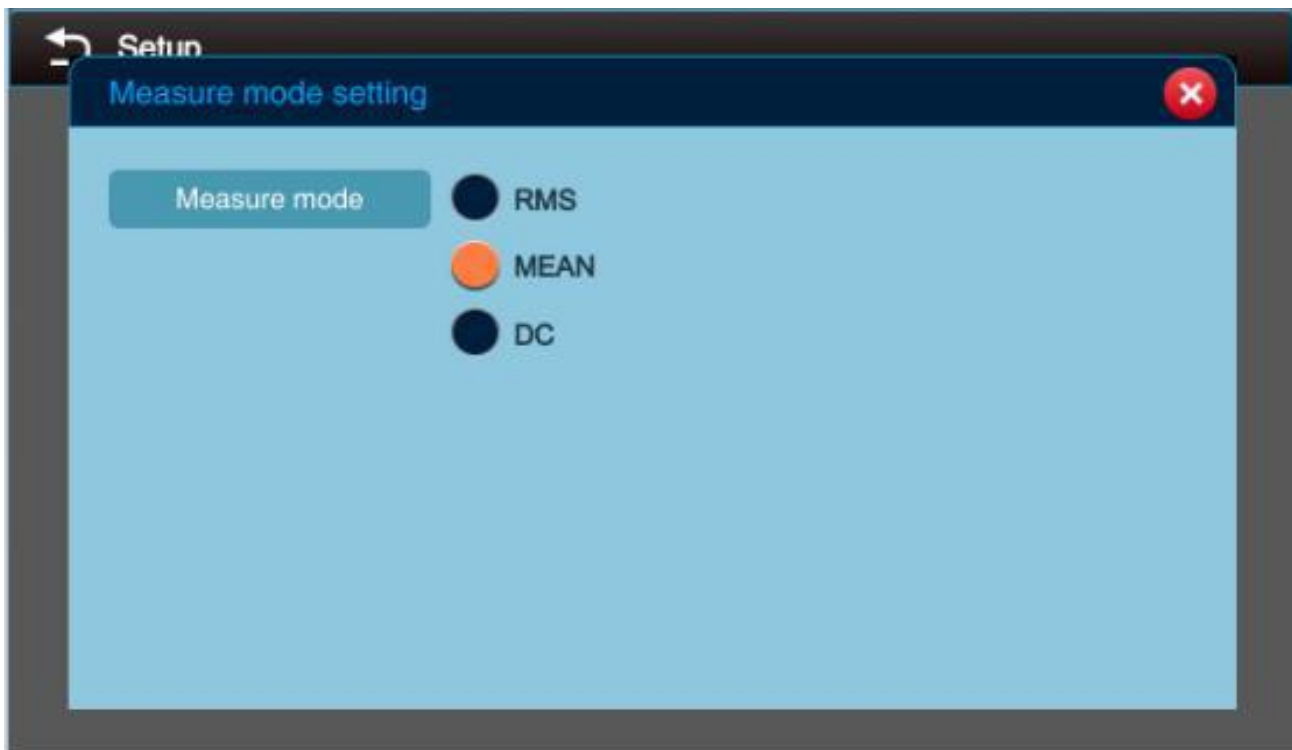
※ Description of measurement mode

One of the following measurement modes can be selected for voltage and current measurement,
and the default setting is RMS.

Indicator light	Voltage	Current
RMS	True RMS	True RMS
MEAN	Rectified average calibrated to RMS	Rectified average calibrated to RMS
DC	Simple average	Simple average

When RMS mode is set, the true RMS of voltage and current are displayed, and the apparent power (S), reactive power (Q), power factor (λ) and phase angle (Φ) are calculated and displayed in Urms*Irms.

When the Voltage Mean mode is set, the rectified average value of the voltage and current RMS is displayed, and the apparent power (S), reactive power (Q), power factor (λ) and phase angle (Φ) are calculated and displayed in Umean*Irms.

When DC mode is set, DC voltage and current are displayed, and apparent power (S), reactive power (Q), power factor (λ) and phase angle (Φ) are calculated and displayed in Udc*Idc.

3.2 Wiring mode setting

This instrument can be equipped with 1P2W (single-phase two-wire system), 1P3W (single-phase three-wire system), 3P3W (three-phase three-wire system), 3V3A (three-voltage three-current meter method), and 3P4W (three-phase four-wire system) wiring modes.

1. Press the **Wiring mode.**

2. Setup Menu is as follows:
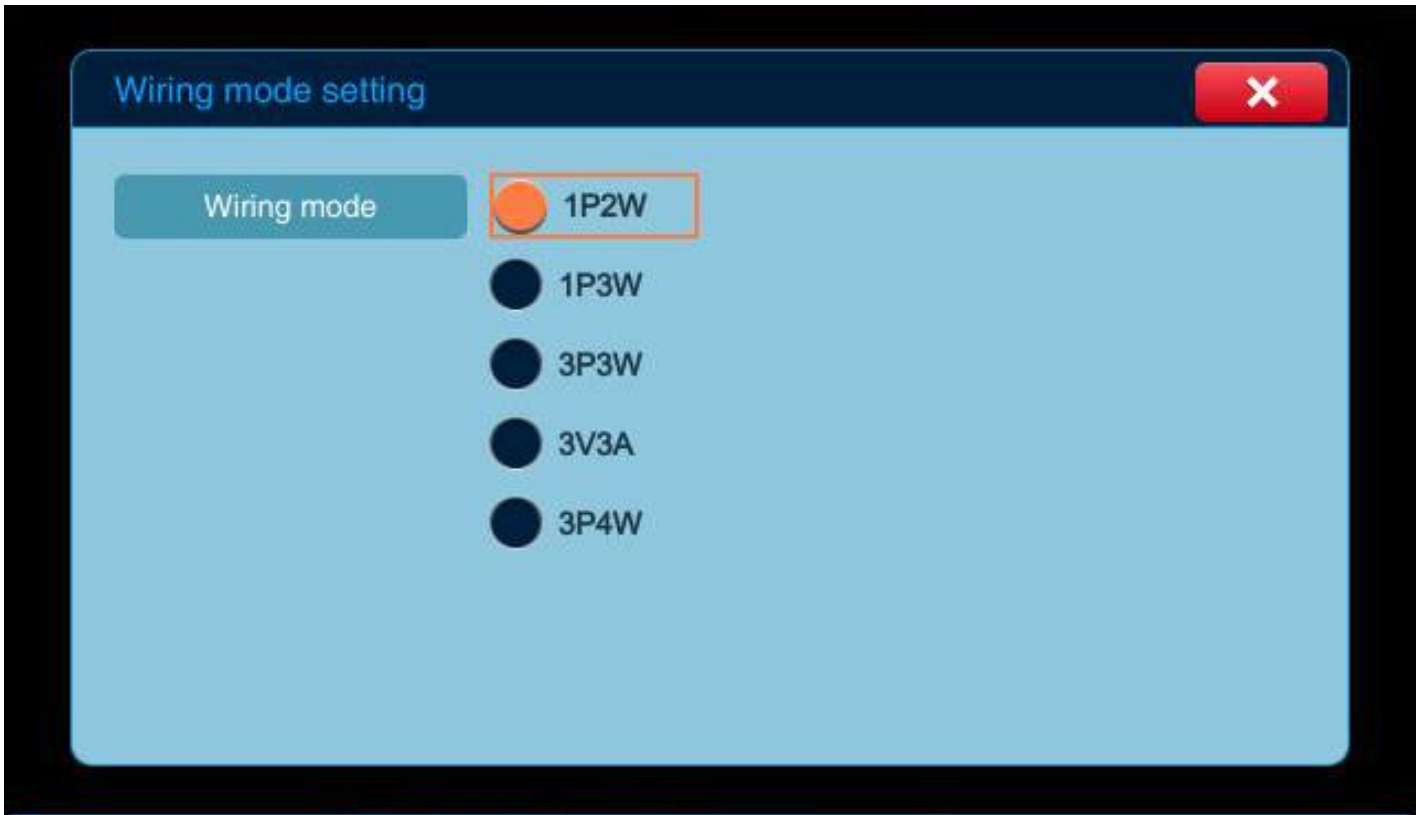
※ Description

When the integral or storage is running, pressing the Wiring key can display the error message "Error" in Column D. At this time, the wiring mode cannot be set.

3.3 Data update rate setting

1. Press **Utility key,** Select the "**Update rate**"

2. Setup Menu is as follows:
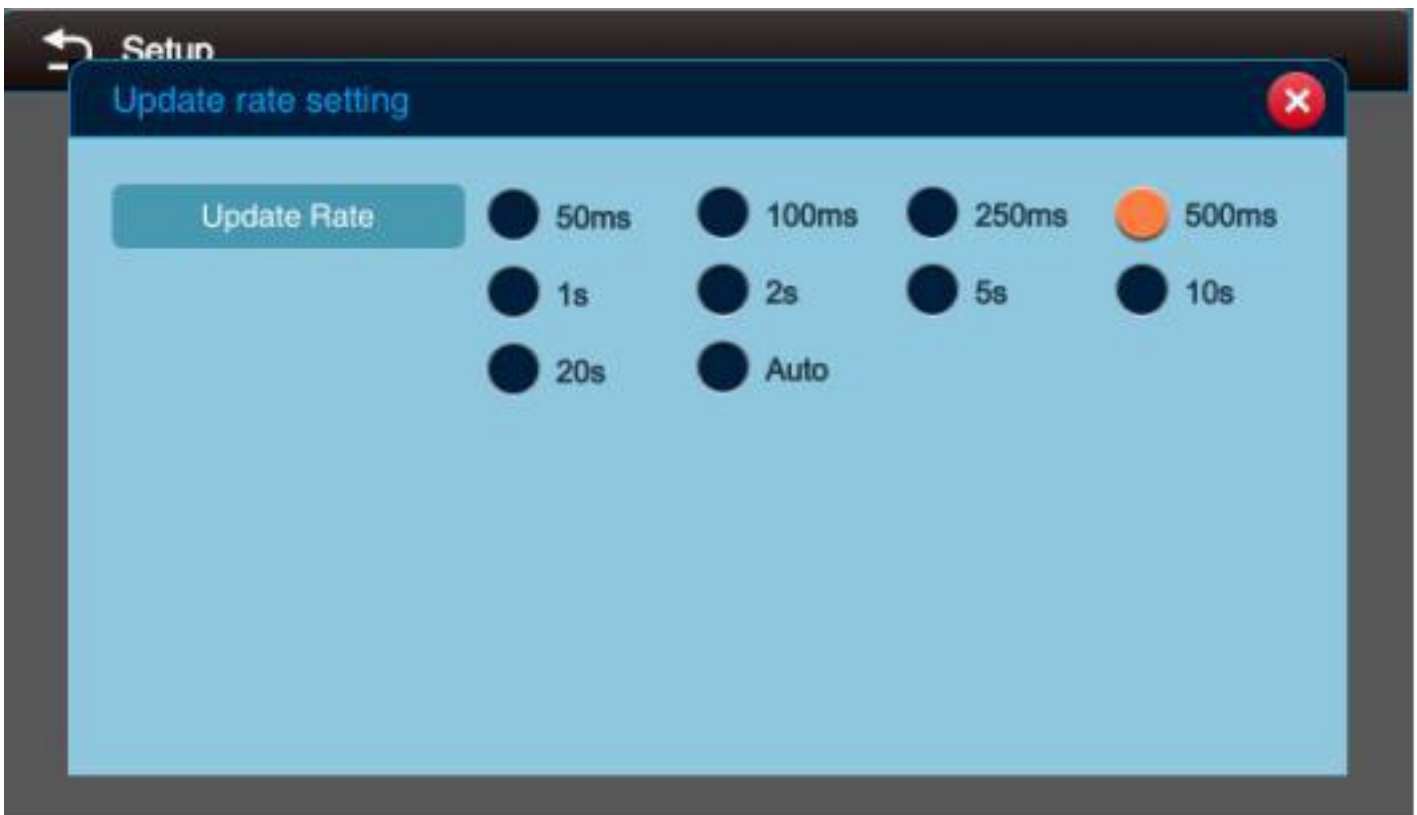
※ Description

The data update rate options supported by the instrument are 0.1 s, 0.25 s, 0.5 s, 1 s, 2 s, 5 s and Auto. After the update rate is set, the "Update" indicator light on the panel will flash according to the set update period. When the "Auto" option is selected, the instrument automatically selects the matching update rate according to the frequency of the input signal, and the "Update" indicator light flashes according to the self-matching update period. When the frequency of the input signal cannot be detected, the automatic update rate is updated by default according to the time-out period.

▲ The update display area shows the system automatically sets the matching update rate.

3.4 Crest factor setting

Under different crest factors, the measurement range options of corresponding voltage, current and external current sensors are different

1. Press the **Setup**，Select the"**Crest factor**"
2. Setup Menu is as follows:
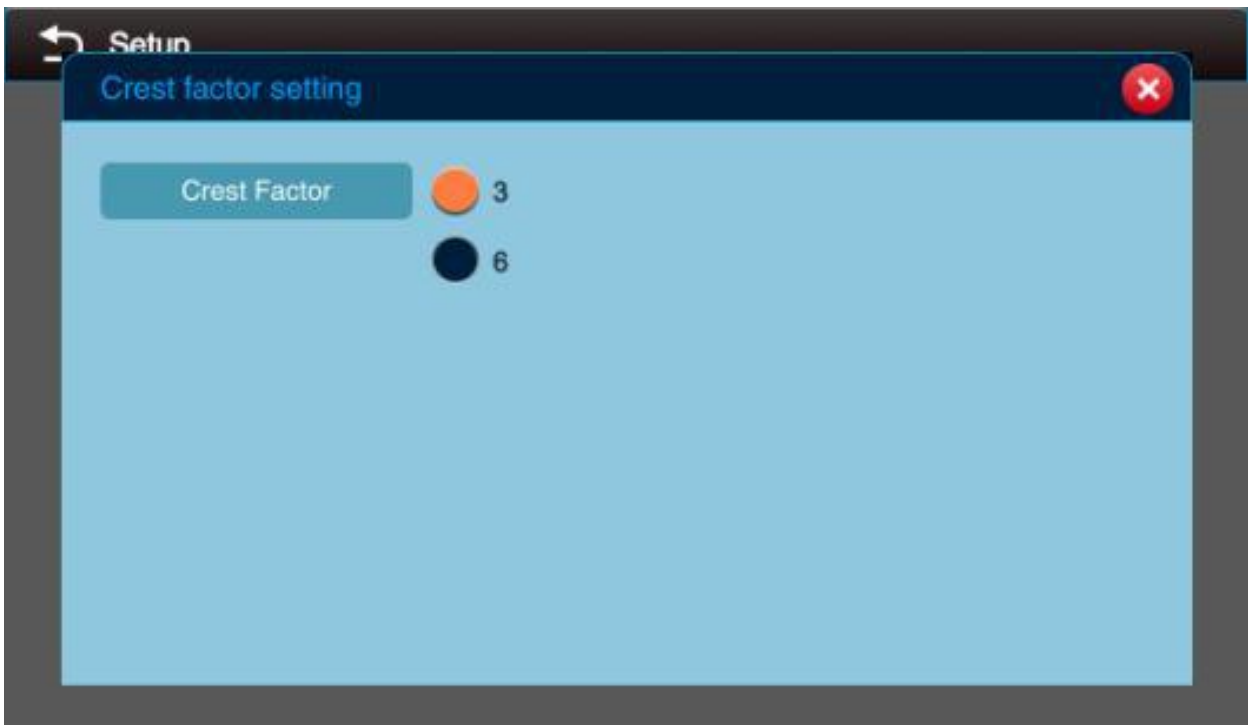
3.5 Sync source setting

The measurement interval is determined by the reference input signal (synchronization source). The interval from the initial point of the rising slope (or the falling slope) passing through the zero point (the intermediate value of the amplitude) to the last point of the rising slope (or the falling slope) passing through the zero point (the intermediate value of the amplitude) in the data update period is defined as the measurement interval. The period of the input signal is detected from voltage and current signals, thus the synchronization source can be set as a Voltage or Current signal.

1. Press the **Setup**，Select the"**Sync source**"
2. Setup Menu is as follows:
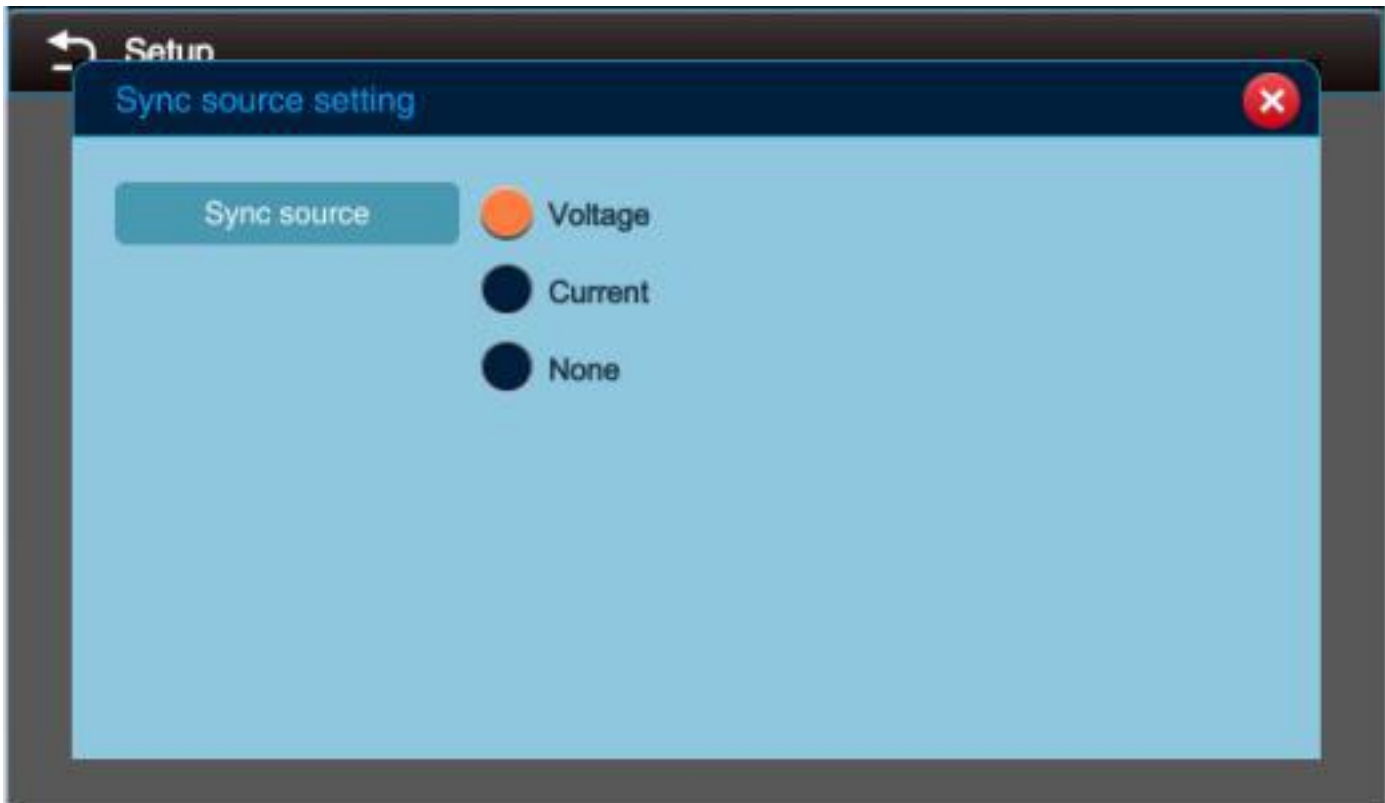
※ Description of Synchronization Source Options

VOLT	The period of the voltage signal is preferentially detected, and the voltage signal is used as a synchronization source. The voltage signal of each unit is used as the synchronization source of the respective unit. When the period of the voltage signal cannot be detected, the current signal is used as the synchronization source. If the period of the current signal cannot be detected, the measurement interval will be set to the whole data update period.
CURR	The period of the current signal is preferentially detected, and the current signal is used as a synchronization source. The current signal of each unit is used as the synchronization source of the respective unit. When the period of the current signal cannot be detected, the voltage signal is used as the synchronization source. If the period of the voltage signal cannot be detected, the measurement interval will be set to the whole data update period.
NONE	The measurement is not performed synchronously with the voltage or current signal, and the whole data update period is selected as the measurement interval

NOTE : The measurement interval for calculating peak voltage or current is always the whole data update period.

3.6 Filter setting

1. Press the **Setup**，Select the"**Filter**"
2. Setup Menu is as follows:
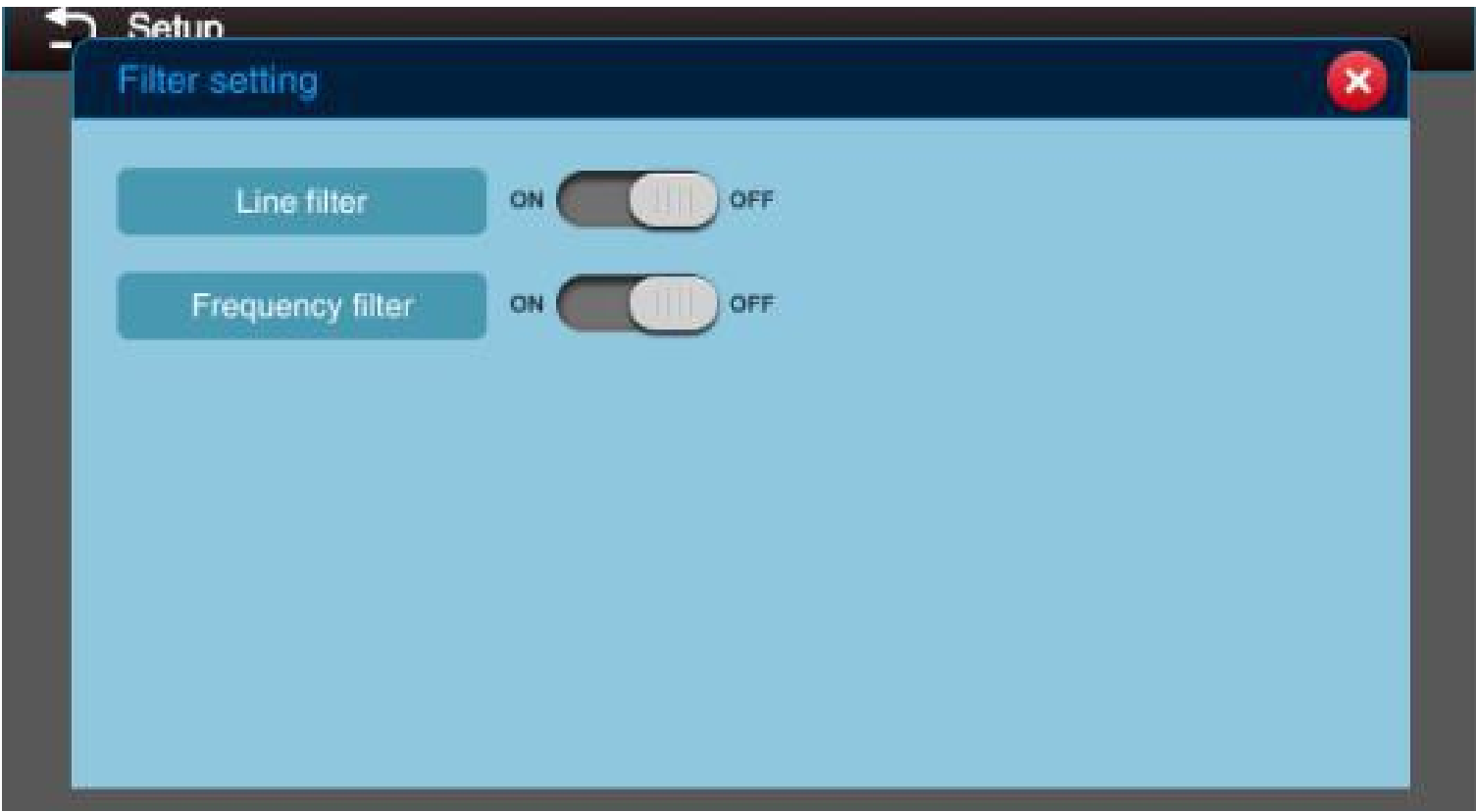
● Frequency filter

The frequency filter is inserted in the frequency measurement circuit, which affects not only the frequency measurement, but also the voltage, current and power measurement. Therefore, it is also used to accurately detect zero crossing. Since the filter is not inserted in the voltage and current measurement circuit, even if it is turned on, the measured value will contain high frequency components.

⚠ **Note:**

ON is set to turn on the frequency filter. When it is turned on, the default cutoff frequency is 500Hz, and the "Freq" indicator light on the panel is on.
Setting OFF indicates that the frequency filter is disabled, and the indicator light is off.

● Line filter

The line filter is inserted in the voltage and current measurement circuit, thus it will directly affect the measurement of voltage, current and power. When the line filter is turned on, the measured value does not contain high frequency components, thus the noise from the frequency converter or distorted waveform can be removed to measure the voltage, current and power.

3.7 Average function setting

1.Press the **Setup**，Select the"**Average function**"

2.Setup Menu is as follows:

Set switch

Select the "ON" or "OFF" option to turn on the scaling function, and the "Scaling" indicator on the panel is on.

Average type: Exponential and linear averages can be used, exponential averages need to set attenuation constants, and linear averages need to set average numbers.

Number of settings

Set the number of linear averages (8, 16, 32, 64) or the attenuation constant of exponential averages (8, 16, 32, 64)

※ Average function description and limitations

At the beginning of the integration, the average function is not available.Even if the average is turned on, the average is automatically turned off when the integration starts.For harmonic measurements, only exponential averages take effect.

3.8 Scaling function setting

1. Press the **Setup**，Select the"**Scaling function**"

2. Setup Menu is as follows:

※ Description of scaling function

VT ratio：When the secondary output of VT is connected to the voltage input terminal, the VT ratio is set. The voltage range is then set based on the maximum value of the VT output. The setting range is 0.001 ~ 9999.

CT ratio：When the secondary output of the CT or the output of the current sensor is connected to the current input terminal, the CT ratio (or the conversion ratio of the current output type current sensor) is set. Then, the current range is set according to the maximum value of CT or current sensor output. The setting range is 0.001 ~ 9999.

※ Power factor

By setting the power factor (SF), the active, apparent, and reactive power measurements multiplied by the factor can be displayed. The setting range is 0.001 ~ 9999.

※ Description of sensor conversion ratio

The output of the voltage output current sensor is connected to the external sensor input interface (EXT), and the conversion ratio in mV/A used to measure this signal is set . Setting the number of mV (conversion ratio) output by the sensor per ampere of current can convert the numerical data and waveform display data after the current is directly input to the current input terminal. The setting range of sensor conversion ratio is 0.001 ~ 9999.

⚠ **Note:**

If VT, CT and SF of Channel 1 are all set to 10, the current, voltage and power of Channel 1 are amplified by 10 times, 10 times and 1,000 times respectively (VT*CT*SF).

The scale is set, and the current and voltage range will not change.

3.9 Operation function setting

The instrument supports four operation functions, which can be used to display the value of efficiency, peak factor, arithmetic results and average active power. The default setting is efficiency function.

Set operation item

1. Press the **Setup**，Select the"**Operation function**"

2. Setup Menu is as follows:

◆ Operation function display

When the "Math" function indicator light is on on the left side of Display Bar C, it indicates that the value of the set operation function is displayed in Display Bar C at this time. When displaying the Math function value, the "Element" key operation is invalid, with no unit indication.
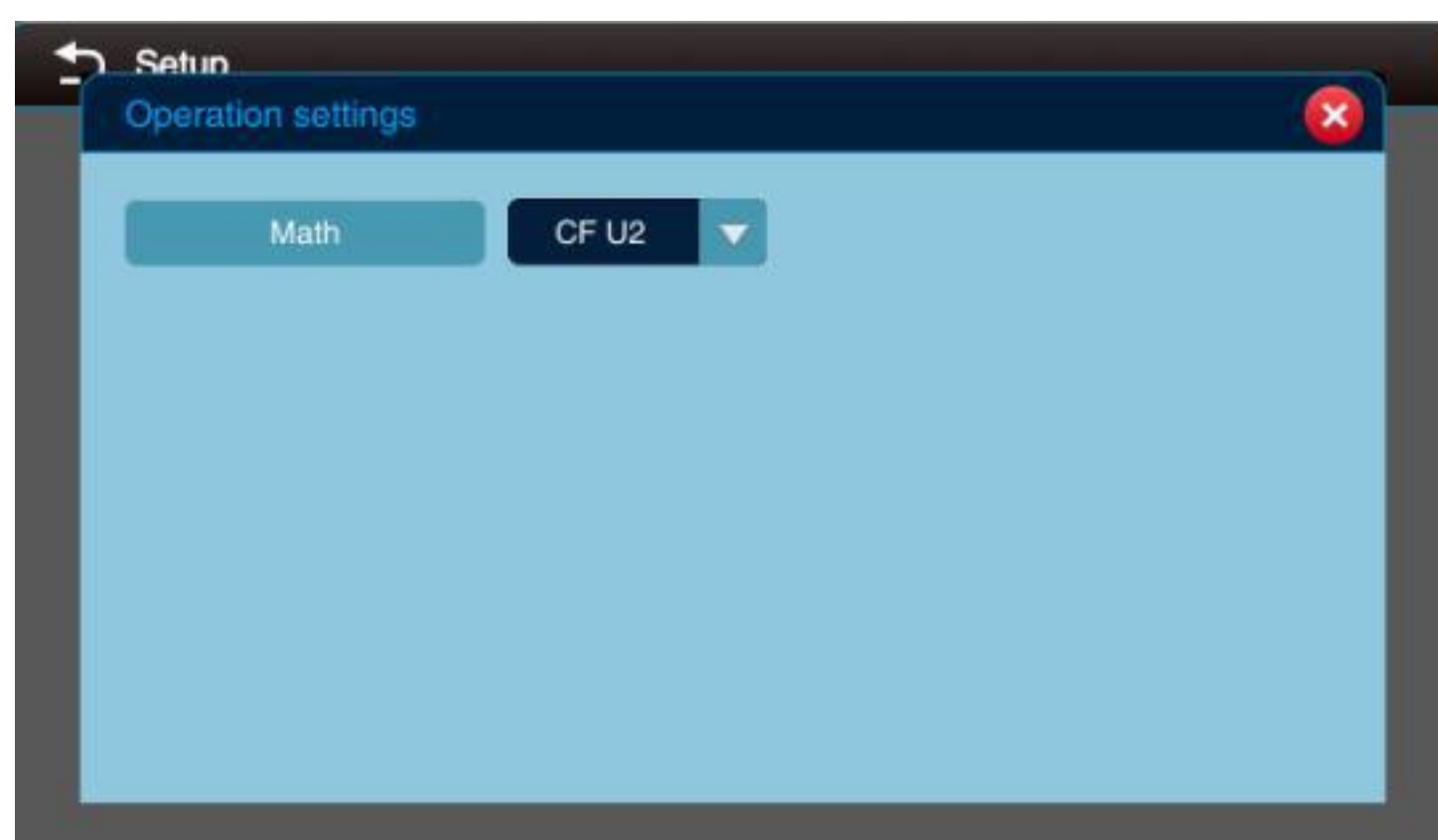
Click on the [Math] drop-down box to select the function

Description of operation function

◆ Efficiency

Definition: The active power P2 measured by Unit 2 is taken as the active power input on the primary side of the converter, and the active powers P1 and P3 measured by Units 1 and 3 are taken as the power consumed on the secondary side of the converter to calculate the efficiency.
Efficiency formula: Efficiency = (P1+P3) /P2*100%

If the denominator in the formula is less than or equal to 0.0001% of the rated range, the efficiency is displayed as "ERROR".

◆ Crest factor

Symbols: CF U1, CF U2, CF U3, CF I1, CF I2, CF I3.
Definition: Represent the ratio operation results of peak value and RMSof signals U1/U2/U3/I1/I2/I3, respectively.

When the RMS falls to 0.5% or less (peak factor 6 falls to 1% or less), the peak factor will be displayed as "Error" (see Section 9.7 of this book for details). The peak factor can be calculated even if the measurement mode is MEAN or DC.

◆ Arithmetic operation

Symbol expression: A+B, A-B, A*B, A/B, A 2 /B, A/B 2
The values of Display Bar A and Display Bar B are taken as operation items, with the operation results displayed in Display Bar C. During operation, Display Bar C only displays the numerical value and the quantity level of units, and the data in Display Bar A and Display Bar B need to be operated according to units. If the operation formula is set to A+B, 100mA is displayed in Display Bar A, and 1V is displayed in Display Bar B, the operation result in Display Bar C is 1.1.

When the function displayed in Display Bar A is integral elapsed time (TIME), the calculation result will be displayed as "----", with no data. When dividing, the operation value is displayed as "Error" if the value of the display function in Display Bar B is equal to 0 or no data is displayed,.

◆ Integral average active power

Symbols: AV P1/ AV P2/ AV P3/ AV P4
Definition: AV P1: Display the result of the division of watt-hour (WP1) of Unit 1 by the integral time.
AV P2: display the result of the division of watt-hour (WP2) of unit 2 and integral time.
AV P3: display the result of the division of watt-hour (WP3) of unit 3 and integral time.
AV P4: display the result of the division of watt-hour (WPΣ) of unit Σ and integral time.

The value of watt-hour WPΣ depends on the wiring mode. This operation function is only useful during integral period (integral operation or integral pause). If the integral is reset, the values of watt-hour and integral time will become zero, and the result shows "------" without any data.
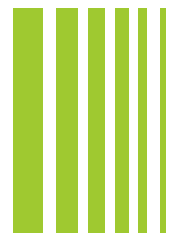
Range Settings

4.1 Voltage range setting

1.Operation steps; way ❶: press the Voltage key, menu selection range; way ❷: click on the top right corner of the page [voltage range], menu selection range

2. When the peak factor is 3, the setting interface is as follows:

Fixed voltage range

When the peak factor is set to 3, the optional voltage range includes 15V, 30V, 60V, 150V, 300V, 600V and 1000V.

When the peak factor is set to 6, the optional voltage range includes 7.5V, 15V, 30V, 75V, 150V, 300V and 500V.

Automatic voltage range

The instrument supports automatic voltage range mode, and the automatic range options are consistent with the fixed range options. The operation method is the same as that of above fixed range settings. When switching in Display Bar C, select "Auto" option and press "Enter" key to confirm. At this time, the voltage has been set to automatic range mode, and the voltage "Auto" indicator light on the main panel is on.

4.2 Current range setting

1.Operation steps; method ❶: press the Current key, menu selection range; method ❷: click on the top right corner of the page [current range], menu selection range

2. When the peak factor is 3, the setting interface is as follows:
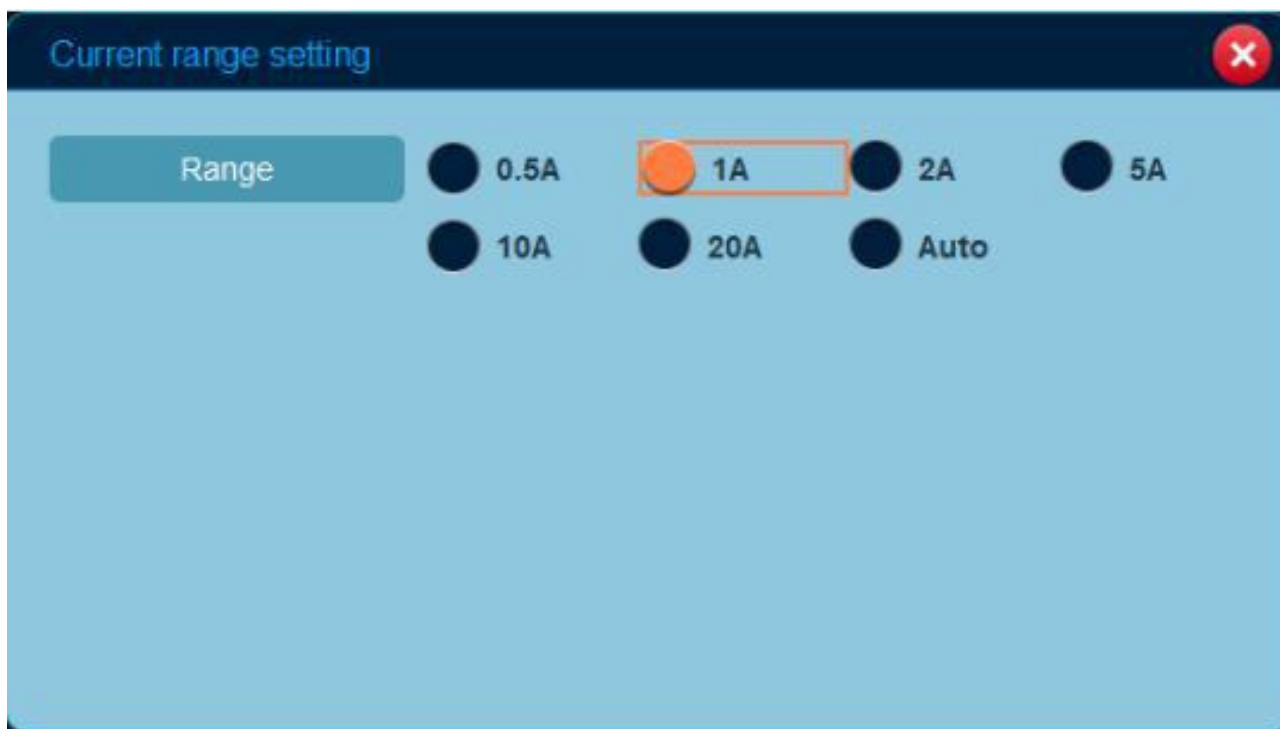
Fixed current range

When the peak factor is set to 3, the optional current range includes 0.5A, 1A, 2A, 5A, 10A and 20A.

When the peak factor is set to 6, the optional current range includes 0.25A, 0.5A, 1A, 2.5A, 5A and 10A.

Automatic current range

The instrument supports automatic current range, and the automatic range options are consistent with the fixed range options. The operation method is the same as that of above fixed range settings. When switching in Display Bar C, select "Auto" option and press "Enter" key to confirm. At this time, the current has been set to automatic range mode, and the current "Auto" indicator light on the panel is on.

4.3 Power range

The measuring range of active power (power range) is determined by the wiring mode, voltage range and current range. The details are as follows.

Wiring mode	Power range calculation
1P2W	Voltage range*current range
1P3W	
3P3W	Voltage range*current range*2
3V3A	
3P4W	Voltage range*current range*3

⚠ **Note:**

When the result of voltage range × current range reaches or exceeds 1,000W, the display unit becomes "kW". When it exceeds 1,000kW, the unit becomes "MW".

4.4 External current sensor range setting

1. Operation step: Press EXT key to set the current range to external sensor, EXT key light on Method ❶: press the Current key, menu selection range; method ❷: click on the top right corner of the page [current range], menu selection range

2. When the peak factor is 3, the setting interface is as follows:
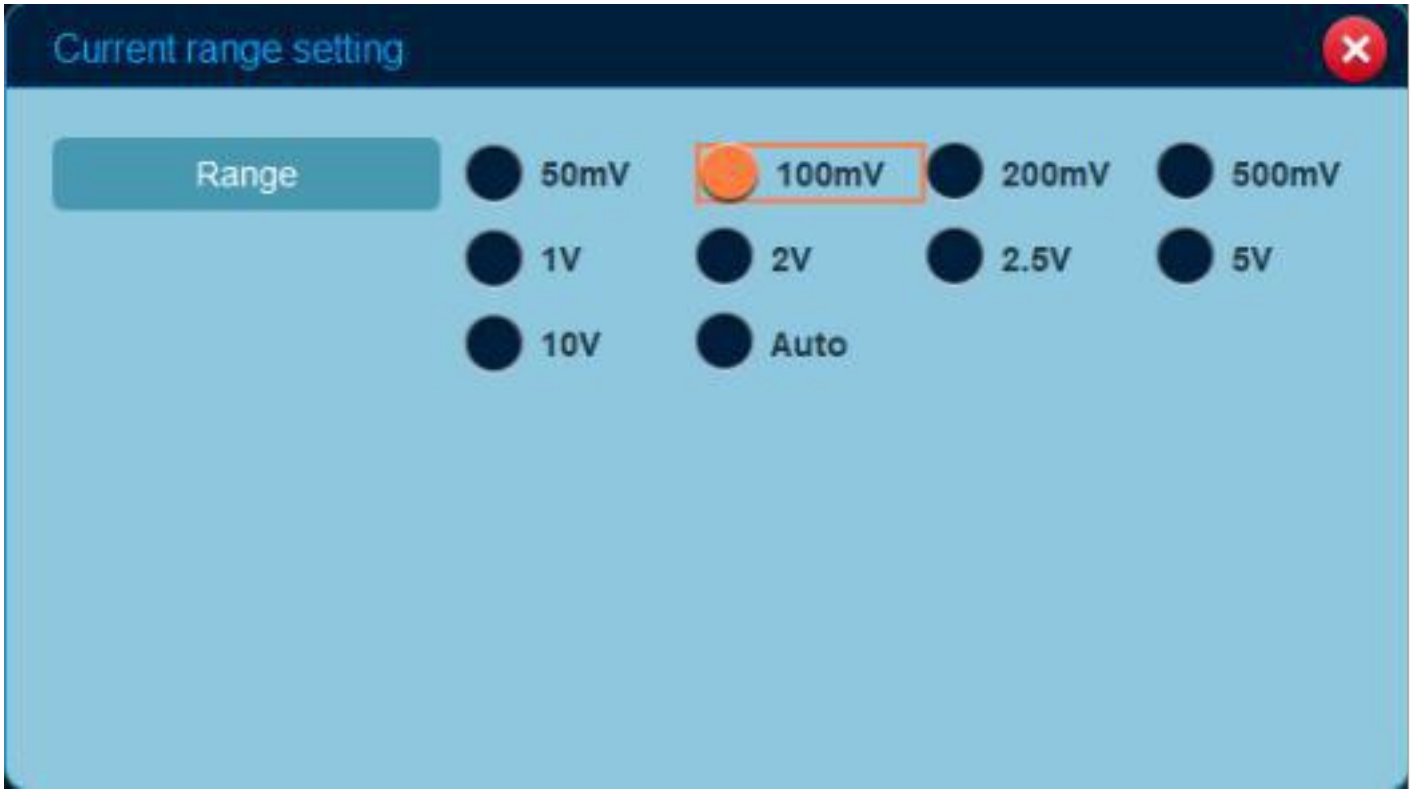
4.5 Automatic range switching

Turn on the automatic range mode, in which the range will be automatically switched according to the following rules.

Range upshift condition – the range upshift occurs when any one of the following conditions is met :

● Urms or Irms exceeds 110% of the currently set range

● The Upk or Ipk value of input signal exceeds 330% of the currently set range (660% when the peak factor is 6)

Range downshift condition – the range downshift occurs when all of the following conditions are met :

● Urms or Irms is less than or equal to 30% of the currently set range

● The Upk or Ipk value of input signal is less than 300% of the lower range (600% when the peak factor is 6)
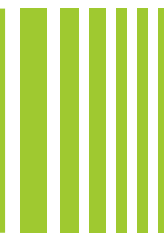
Harmonic Measurement Setting

The measurement interval is determined by the reference input signal (source).The interval between the initial point of the rising slope (or falling slope) through zero (middle value of amplitude) and the last point of the rising slope (or falling slope) through zero (middle value of amplitude) is used as a measurement interval.This section introduces the setting method of synchronous source and PLL source during harmonic measurement.

5.1 Harmonic display

5.2 Harmonic setting

Set the PLL (Phase Locked Loop) for determining the fundamental frequency; frequency synchronization source, and the fundamental frequency is the reference for the number of harmonic measurements. Selecting the input signal with less distortion or fluctuation as PLL source can make harmonic measurement more stable.

1. Operating path: Press Harmonics key to enter the harmonic setting.
2. The settings page is as follows:
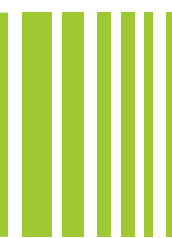
Integral Setting

6.1 Integral Setting

1. Operation path: Press Integrator key to enter the integration

2. Setup Menu is as follows:

Integral mode

NOR mode

In normal integral mode, the integral starts after Start key is pressed and stops until the specified stop time is
reached or the stop key is pressed, and the integral time and integral value will be held.

CONT mode

Cyclic integral mode, in which the integral starts after Start key is pressed. When it reaches the time specified
by the timer, the integral will reset and restart automatically, and the cycle will continue.

Set Integration Timer

Integration timer setting range: 00:00:00~10000:00:00.The set time of the actual integration timer is related to the
data update rate and must be greater than or equal to the update rate cycle, otherwise the setting is invalid.

Set integrated D/A timer

Setting range of integral D/A timer： 00:00:00~10000:00:00.

6.2 Integral Execution

1. Operation path: Press Integrator key to enter the integration page

2. The settings page is as follows:

Integral start & stop

Integral start and integral indicator light display： Press the Start/Stop key, it flashes and the integral starts. The integral value or average active power (operation function) during integral is displayed in Display Bar C, and the integral time is displayed in Display Bar A.

When integral is in progress, press this key again, the key light will stay on, the integral will be paused, and the displayed integral value and integral time will be held.

Set/Reset: press the key when integral is paused to reset it. The Start/Stop light will be off and the integral display item will be cleared.

Conditions of integral stop

1) It reaches the integral time specified by integral timer during normal integral.

2) The integral time reaches the maximum.

3) The integral value reaches the maximum or minimum display value.

Integral display function

Press the Function key of Display Bar A or Display Bar C to display Time (integral time), WH/WH± (integral power), AH/AH± (current) or Math (average active power during integral). The display functions are switched in a certain order every time the Function is pressed.

(See Section 1.4 of this volume for details)

⚠ **Note:**

▲ Ensure that the Points status bar is displayed as "Points: Ready" before you start.

▲ If the integration time is not reached and the integration is artificially suspended, the integration can be started again.

6.3 Integral function limitations

When the integral is in progress

※ The following settings cannot be made:

Measurement mode, wiring mode, measurement range, peak factor, synchronous source setting, input filter, data update rate, number of harmonic measurement, operational formula of harmonic measurement distortion rate, PLL source setting, integral mode, integral timer setting, integral start action and integral reset.

※ Functions cannot be executed:

Proportion function setting, average function setting, BIT operation, Math operation function, zero level compensation function, configuration file saving and loading function.

When the integral is paused

※ The following settings cannot be made:

Measurement mode, wiring mode, measurement range, peak factor, synchronous source setting, input filter, data update rate, number of harmonic measurement, operational formula of harmonic measurement distortion rate, PLL source setting, integral mode, integral timer setting and integral stop action.

※ Functions cannot be executed:

Proportion function setting, average function setting, BIT operation, Math operation function, zero level compensation function, configuration file saving and loading function.

Chapter VII
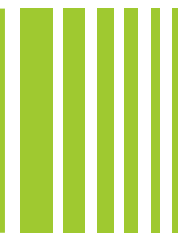
Storage of Measurement Data

7.1 Storage interval setting

1. Operation path: Press Store key to enter the storage operation page
2. The settings page is as follows:

Setting range of storage interval is 00:00:00~99:59:59

7.2 Storage Execution

Turn on/off the storage function

ON: turn on the storage function, the Store indicator light on the panel is on, and the setting interface returns to the previous menu.

OFF: turn off the storage function, the Store indicator light on the panel is off, and the setting interface returns to the previous menu.

7.3 Description of storage function

Storage items

Storage items include all conventional measurement data, harmonic measurement data (when the harmonic measurement data display is turned on), operation data, integral data and frequency (voltage and current). When the harmonic data display is turned off, the harmonic data will not be stored.

When the maximum hold function is turned on, the display values of U (voltage), I (current), P (active power), S (apparent power), Q (reactive power), U+pk/U–pk (voltage peak), I+pk/I–pk (current peak) and P+pk/P–pk (power peak) will hold the maximum values. The stored measurement data also holds the maximum value.

When the storage is running, if the "Hold" key is pressed to hold the display, the measurement operation and the storage interval time count will be held (paused), and the data storage will also be held (paused). Press the Hold key again to keep the storage running.

Storage limitations

When the storage is being executed, the following settings cannot be made : measurement mode, wiring mode, measurement range, peak factor, synchronous source setting, input filter, data update rate, number of harmonic measurement, operational formula of harmonic measurement distortion rate, PLL source setting, storage time interval setting and zero setting.

Functions cannot be executed : proportion function setting, average function setting, BIT operation, Math operation function, zero level compensation function, configuration file saving and loading function.

Chapter VIII
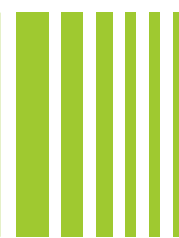
System Settings

The user can perform or set the following system functions on the instrument: remote control settings, view system information, perform initialization, zero adjustment, zero return, self-test, save and load configuration files, set D/A output, etc.

8.1 Remote control settings

To use RS-232 interface to communicate with PC, the equipment of both sides must negotiate a set of rules to ensure the correct transmission of data. Such negotiation is called a handshake. Since there are many handshake modes between the instrument and PC, it must be ensured that both the instrument and PC shall select the same method.

GP-IB bus setting

The remote control function of the instrument can be realized through GP-IB bus communication. When connecting to PC, it is required to set the address of the instrument in GP-IB system, which is unique and can be set between 1~30.

1.Operation path: Press Utility key and select "Remote Control" menu – GPIB
2.Set the interface as follows:

⚠ **Note:**

The instrument does not support setting the same GPIB address in GPIB cascade mode.

RS-232 interface setting

1.Operation path: Press Utility key and select "Remote Control" menu – RS232

2.Set the interface as follows:

※ configuration note

◆ Handshake mode

To use RS-232 interface to communicate with PC, the equipment of both sides must negotiate a set of rules to ensure the correct transmission of data. Such negotiation is called a handshake. Since there are many handshake modes between the instrument and PC, it must be ensured that both the instrument and PC shall select the same method.

Handshake mode	Data transmission control (transmit data to PC)			Data receiving control (receive data from PC)		
	Software handshake	Hardware handshake		Software handshake	Hardwar handshake	
	Stop sending when X-OFF is received, and resume sending when X-ON is received	Stop sending when CB (CTS) is wrong; resume sending when it is correct	No handshake	Send X-OFF when the receive buffer is 3/4 full; send X-ON when it is full.	Set CA (RTS) to false when the receive buffer is 3/4; set CA (RTS) to 1/4 full.	No handshake
Hand0	–	–	●	–	–	●
Hand1	●	–	–	●	–	–
Hand2	–	●	–	–	●	–

◆ Data format

Data format includes the format of start bit, data bit, parity bit and stop bit. The instrument allocates four formats for the data format.

Data format	Start bit	Data bit	Parity bit	Stop bit
Form0	1	8	NONE	1
Form1	1	7	ODD	1
Form2	1	7	EVEN	1
Form3	1	7	NONE	2

◆ Baud rate

Baud rate refers to the data transmission rate sent from one device to another. In unit of bits per second, the baud rate can be set by the instrument includes 1200, 2400, 4800, 9600, 19200, 38400 and 57600.

◆ Terminal mode

Terminal mode refers to the terminal characters used at the end of sending data. When sending data from the instrument, "CR", "LF" and "CR+LF" can be used as terminators. When sending data to the instrument, "LF" and "CR+LF" can be used as terminators.

Ethernet setting

1.Operation path: Press Utility key and select "Remote Control" menu – Ethemet

2.Set the interface as follows:

⚠ **Description :**

- The default IP address of the instrument is 000.000.000.000, and the setting range is 000.000.000.000~255.255.255.255. Initialization settings do not reset the IP address.
- The default gateway address of the instrument is 000.000.000.000, and the setting range is 000.000.000.000~255.255.255.255. Initialization settings do not reset the gateway address.
- The default subnet mask address of the instrument is 000.000.000.000, and the setting range is 000.000.000.000~255.255.2 55.255. Initialization settings do not reset the subnet mask address.

8.2 System information

1.Operation path: Press the Utility key and select the "System info" menu

2.Set the interface as follows:

8.3 Initialization setting

1.Operation path: Press the Utility key and select the "Init setting" menu

2. Confirmation box is as follows:
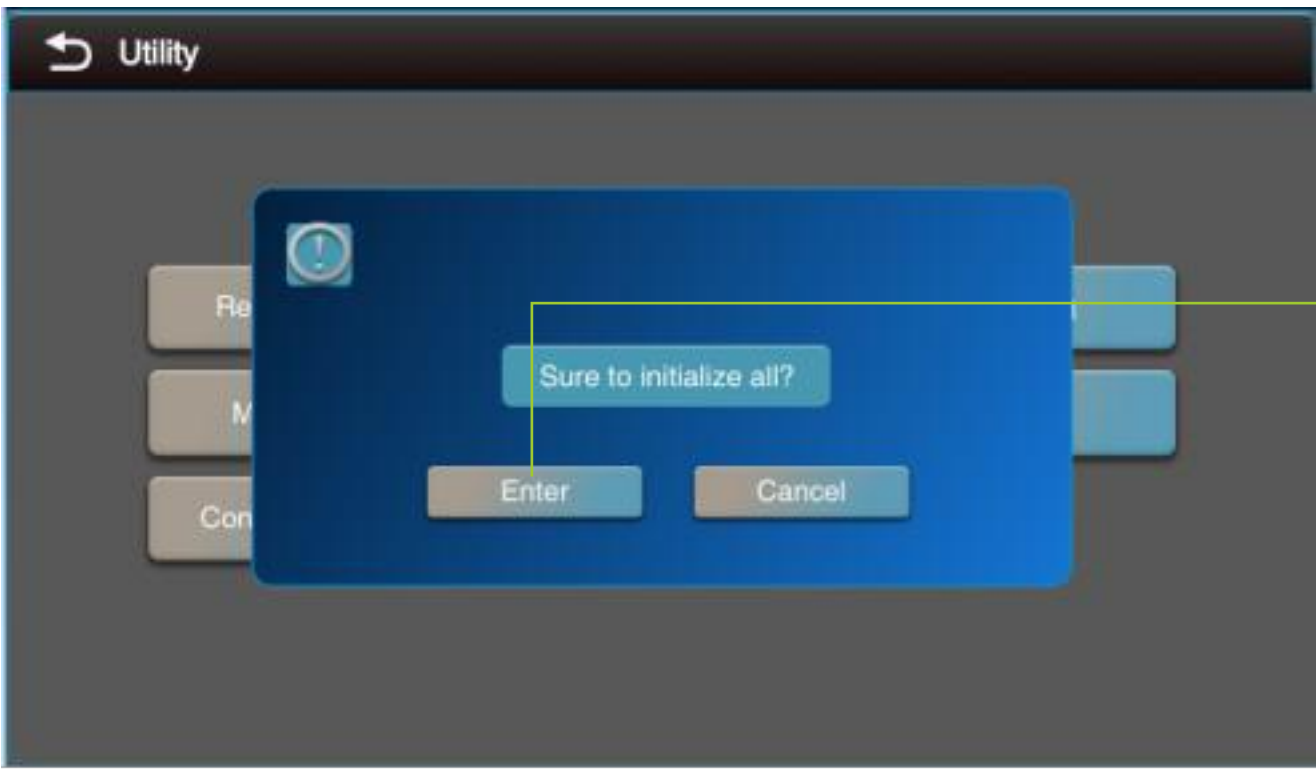
※ **Description**

Click "Enter" to start the initialization setup,
When the initialization is complete, the instrument
returns to the default page immediately.
Displays the default status.

initialization restriction

⚠ **Note :**

▲ Please confirm that you need to initialize the settings before performing the initialization operation.

▲ Once the initialization is performed, the previous parameter settings cannot be restored.

8.4 Zero function

1.Operation path: Press the Utility key and select the "Manual Zero" menu

2. Confirmation box is as follows:
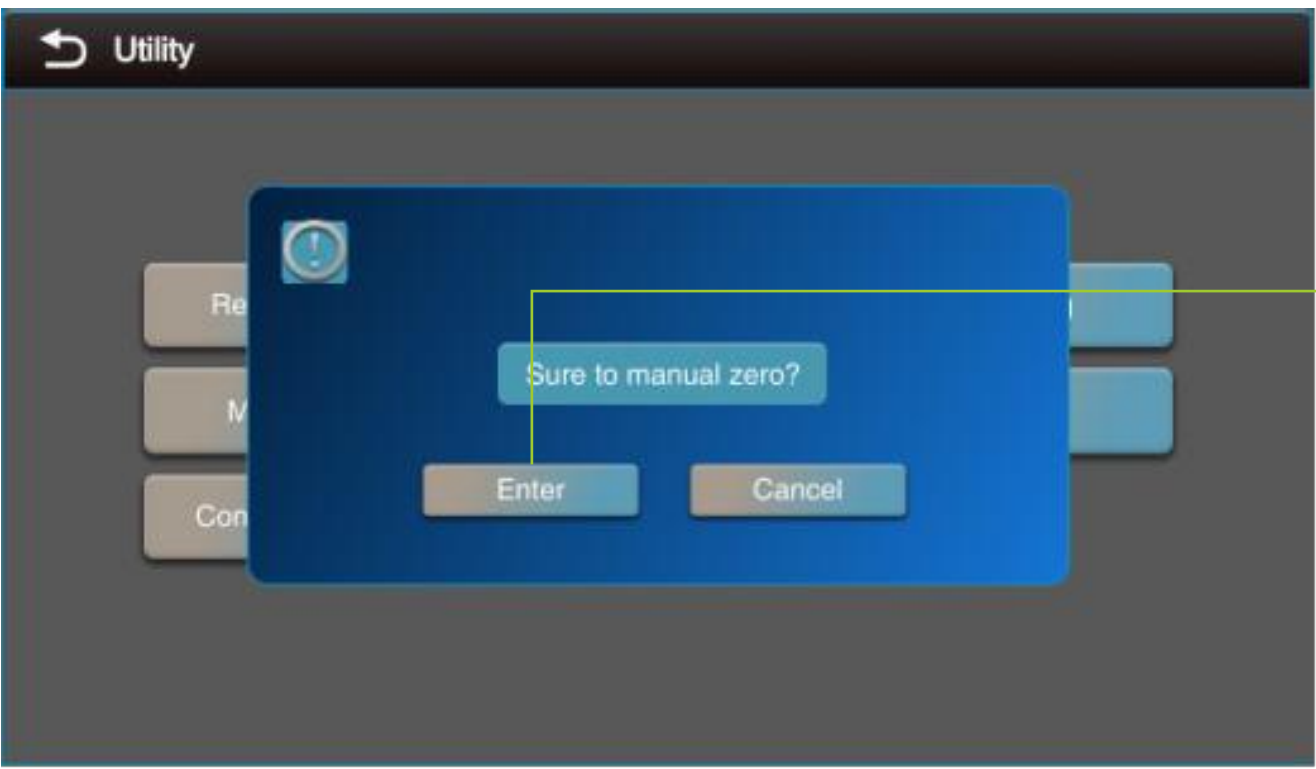
※ **Description**

Click **"Enter"** to start zeroing.

※ zero setting function description

◆ manual zeroing

Zeroing can be performed manually by following the above steps.

◆ automatic zeroing

Turn on the instrument, and when manually changing the range or initializing, the instrument will perform automatic zeroing.

8.5 Zero function execution

1.Operation path: Press Utility key and select "Make zero" menu

2. The settings page is as follows:
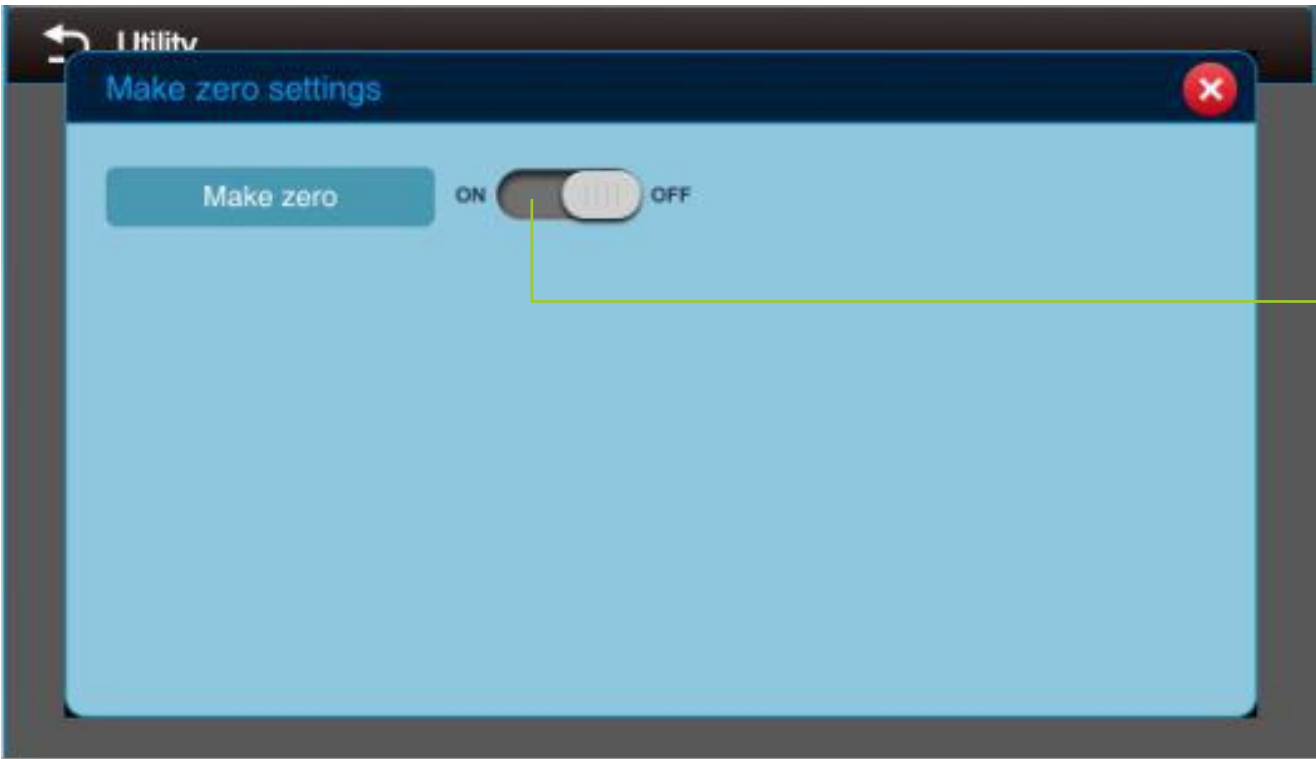
※ **Description**

The switch setting ON turns on to zero.

※ **Function specifications**

◆ Zero switch is turned on, and too small voltage and current measurement is displayed

CF=3, measurement ≤ 0.5% of rated range (CF=6, ≤1%):

Voltage, current or other measured values related thereto will be displayed as "0.000" or "0.0000";

The phase angle and power factor will be displayed as "Error";

◆ Zero switch is turned off, zero is not implemented for the measurement, and actual test value is displayed.

8.6 Configuration file save and load

The parameter setting file of the instrument can be saved in the internal memory of the instrument. A total of four sets of parameter configurations can be saved, and File1, File2, File3 and File4 are used respectively to represent the storage destination of the configuration file. The configuration file shall be saved, so that the configuration will be loaded quickly when encountering similar measurement environment in the later period, and the time for users to set the parameters again shall be reduced.

1. Operation path: Press Utility key and select "Configuration"

2. The settings page is as follows:
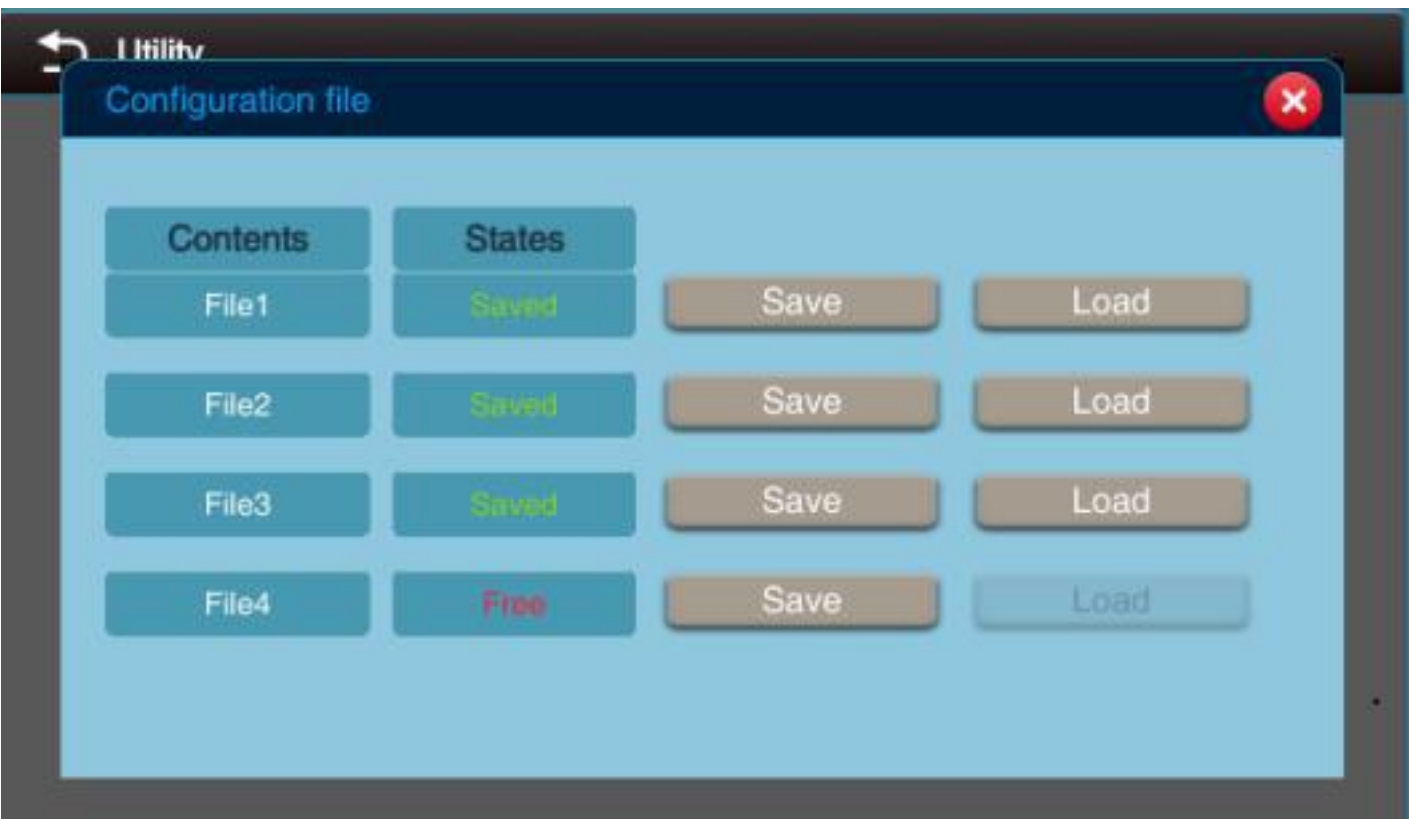
※ **Description of information in Display Bar D**

◆ If "Saved" is displayed, it means that the configuration parameters have been saved in the file. If the saving operation is executed again, the system will overwrite the previous parameters.

◆ If "Free" is displayed, it means that the configuration parameters have not been saved in the file.

※ **Description of configuration file**

The saved setting parameters include current and voltage range, all settings in the Utility menu, all settings in the Setup menu, display settings in Display Bar A, B, C and D, holding, wiring settings, harmonic settings, integral settings, etc.

When integral and storage are in progress, an error prompt will appear when saving the configuration file. After initialization, the configuration file will not be deleted.

8.7 D/A output setting

The instrument can output voltage, current, active power, apparent power, reactive power, power factor, phase angle, frequency, voltage peak, current peak and integral value with DC analog voltage of ±5VFS. The system allocates 12 item channels for the output items, and each channel can select to output different measured values.

Fixed Output Mode – Conventional Measurement

D/A output mode

1) DFLT–N is the preset conventional measured value, and the output item of each channel is fixed as follows

Channel	Item		Channel	Item		Channel	Item
CH1	U1		CH5	I1		CH9	P1
CH2	U2		CH6	I2		CH10	P2
CH3	U3		CH7	I3		CH11	P3
CH4	U4		CH8	I4		CH12	P4

⚠ **Note :** Among them, U4, I4 and P4 represent the measured values of the wiring group.

Fixed Output Mode – Integral Measurement

Channel	Item
CH1	P1
CH2	P2
CH3	P3
CH4	P4

Channel	Item
CH5	WP1
CH6	WP2
CH7	WP3
CH8	WP4

Channel	Item
CH9	q1
CH10	q2
CH11	q3
CH12	q4

Customized output mode

⚠️ **Explanation**

When setting the data mode of D/A custom output, select "SEL" in the above step 4 to enter the custom setting interface. It is required to set output item (including output function and unit number) for each output channel in turn.

Output item

The output items can be set to U (voltage U), I (current I), P (active power P), VA (apparent power S), Var (reactive power Q), PF (power factor λ), Deg (phase angle Φ), UFrq (voltage frequency fU), IFrq (current frequency fI), UP (voltage peak Upk), IP (current peak Ipk), PH (sum of watt-hours Wp), PH+ (positive watt-hours Wp+), PH– (negative watt-hours Wp–), AH (sum of ampere-hours q), AH+ (positive ampere-hours*q+), AH–(negative ampere-hours*q–), Math (operation), and ----(0V D/A output; cell-free setting).

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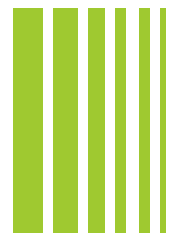
Graphic function

9.1 Waveform display
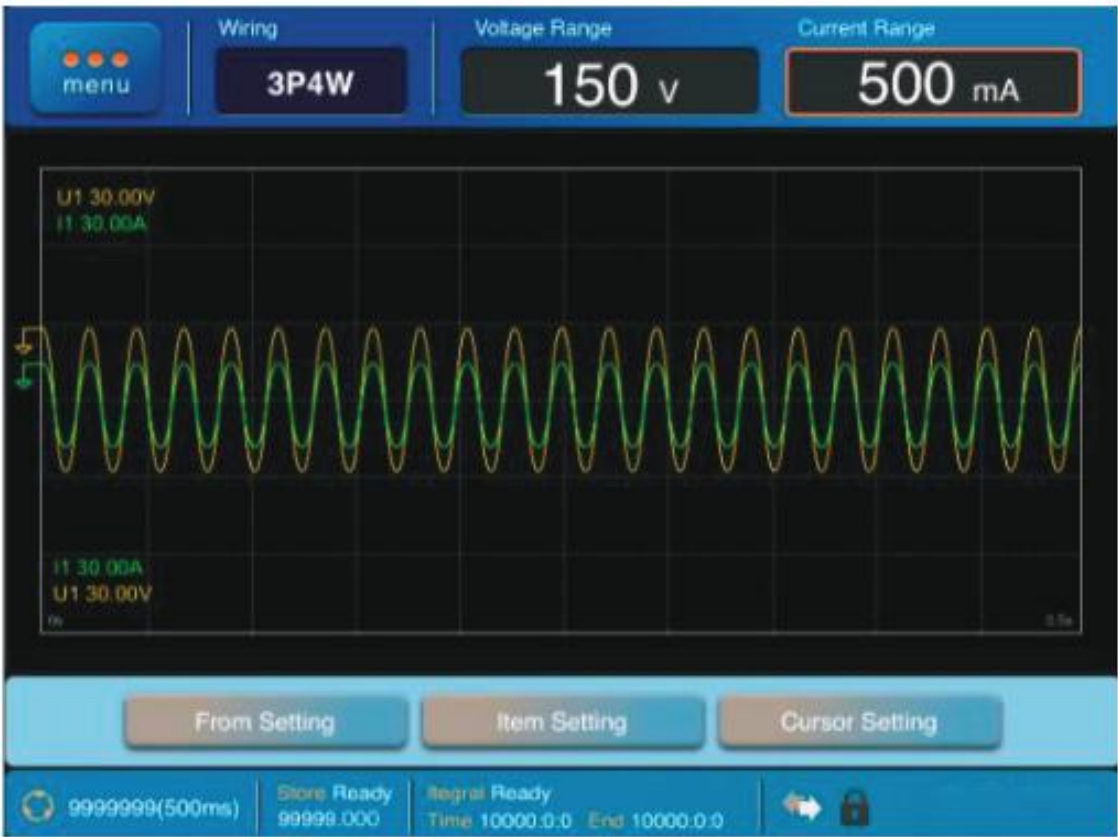
Waveform display setting

Path: Wave menu, then press the Form Setting key to enter

————• Description: Integration storage on, timeline, tilt, trigger source, trigger level unavailable •————

Waveform display item Setting

Path: Wave menu, then press Item Setting to enter

Cursor setting for waveform

Path: Wave menu, then press Cursor Setting to enter
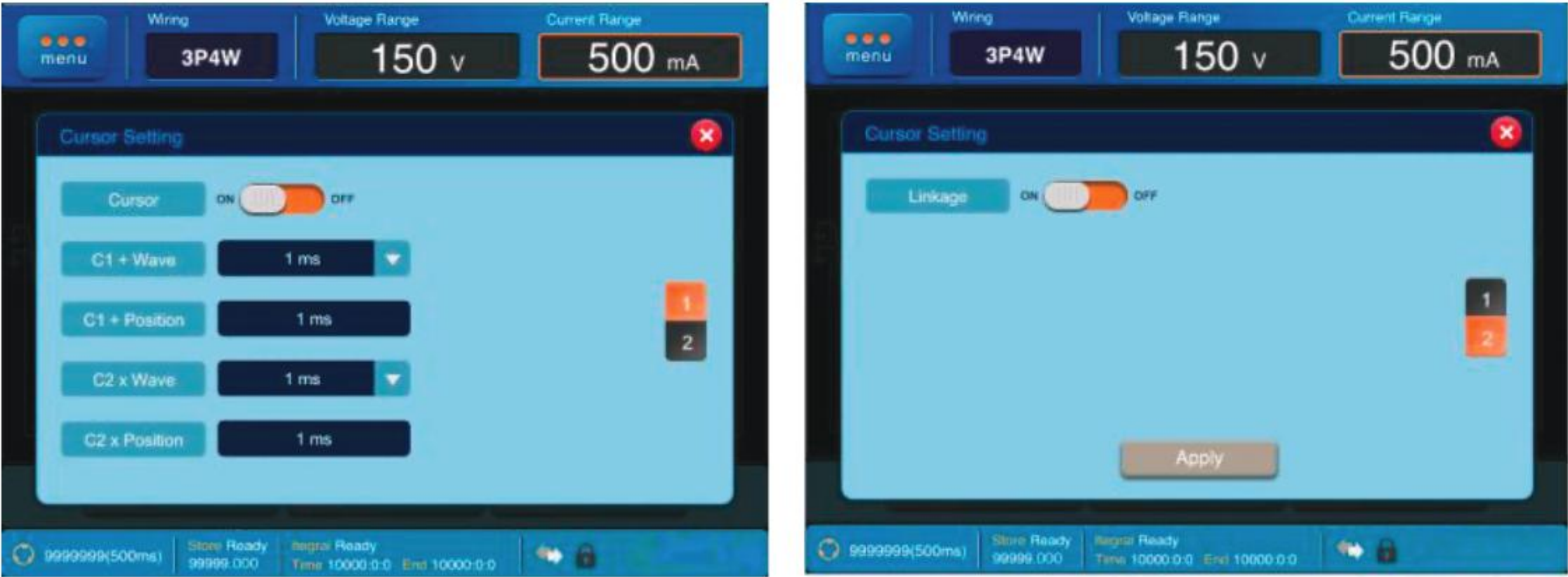
9.2 Vector display

Vector display setting

Path: Vector menu, then press the Form Setting key to enter

Set vector split-screen format

Open/Close Vector Tags
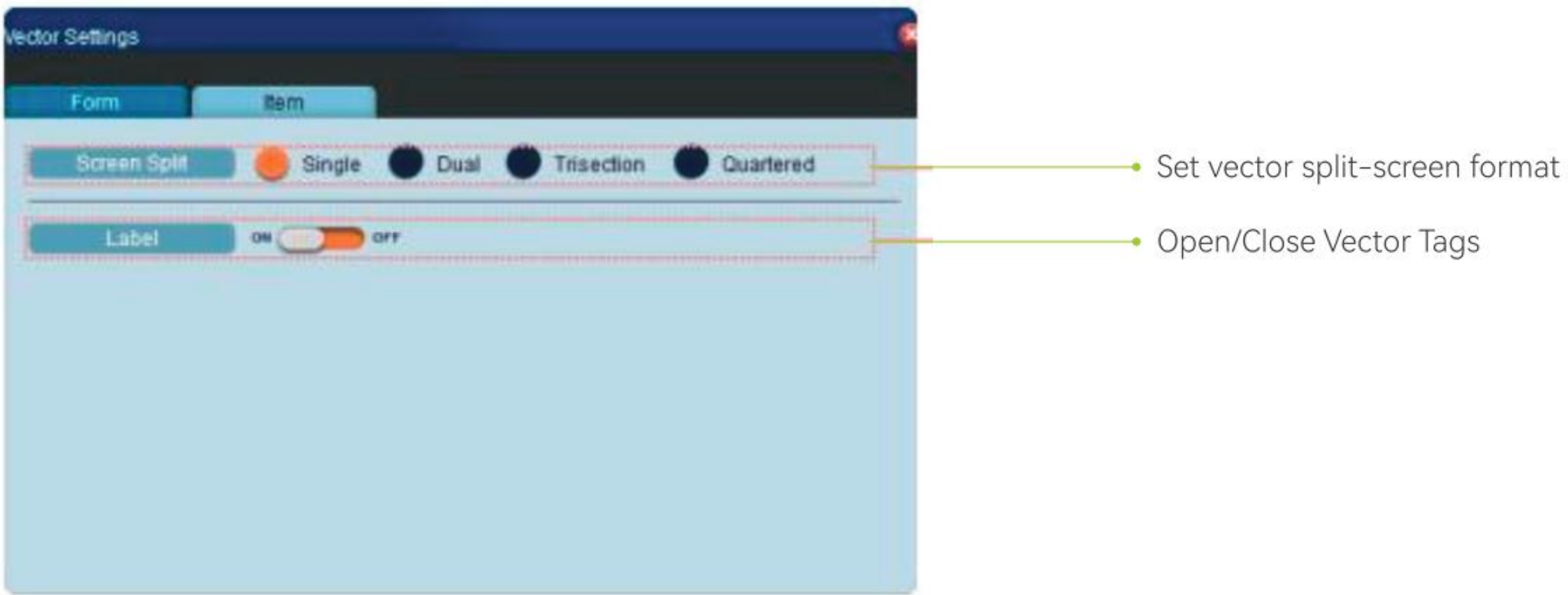
Vector display item setting

Path: Vector menu, then press Item Setting to enter

- Set vector display view
- Set vector display unit
- Turn on/off synchronization settings
- Set UI scaling ratio, range: 0.1~100.0

9.3 Bar display

Bar display form setting

Path: Bar menu, then press the Form Setting key to enter
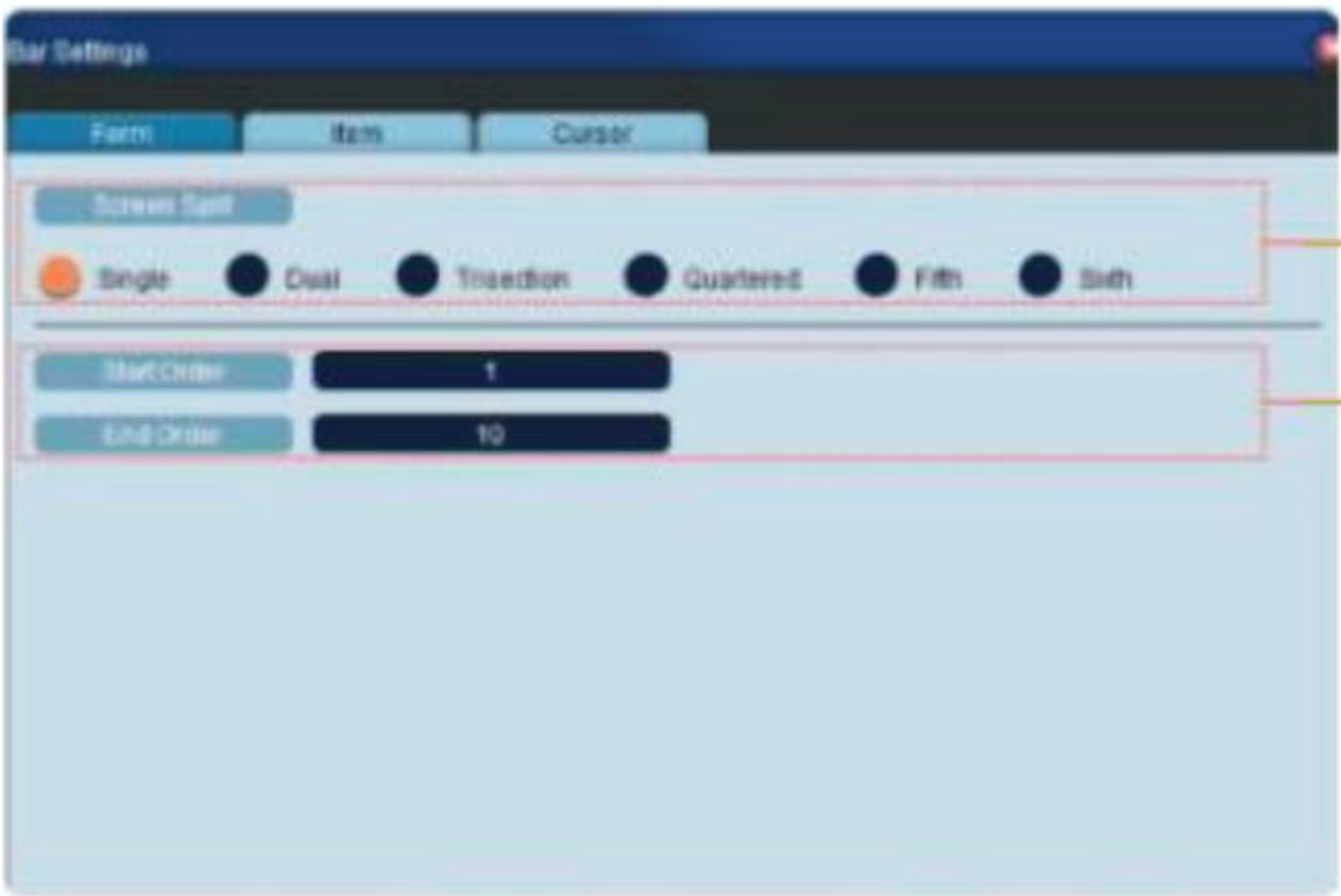
- Set the bar chart split screen format
- Set the number of start and end harmonics,
  The starting harmonics must be less than the ending harmonics
  and a difference of at least 10 in order to set up successfully,
  Otherwise, the setting is invalid.

Bar display item setting

Path: Bar menu, then press Item Setting to enter

- Set the bar graph display
- Set the bar-graph function (U, I, P, S, Q, λ, φ, φU, φI)

- Set the bar graph display unit
  Turn the sorting ON/OFF
- Scale mode (Auto/Manual)
- Vertical scale (Linear/Log)
- X axis scale (Bottom/Center)
- Upper limit of scale

Cursor setting for bar display

Path: Bar menu, then press Cursor Setting to enter
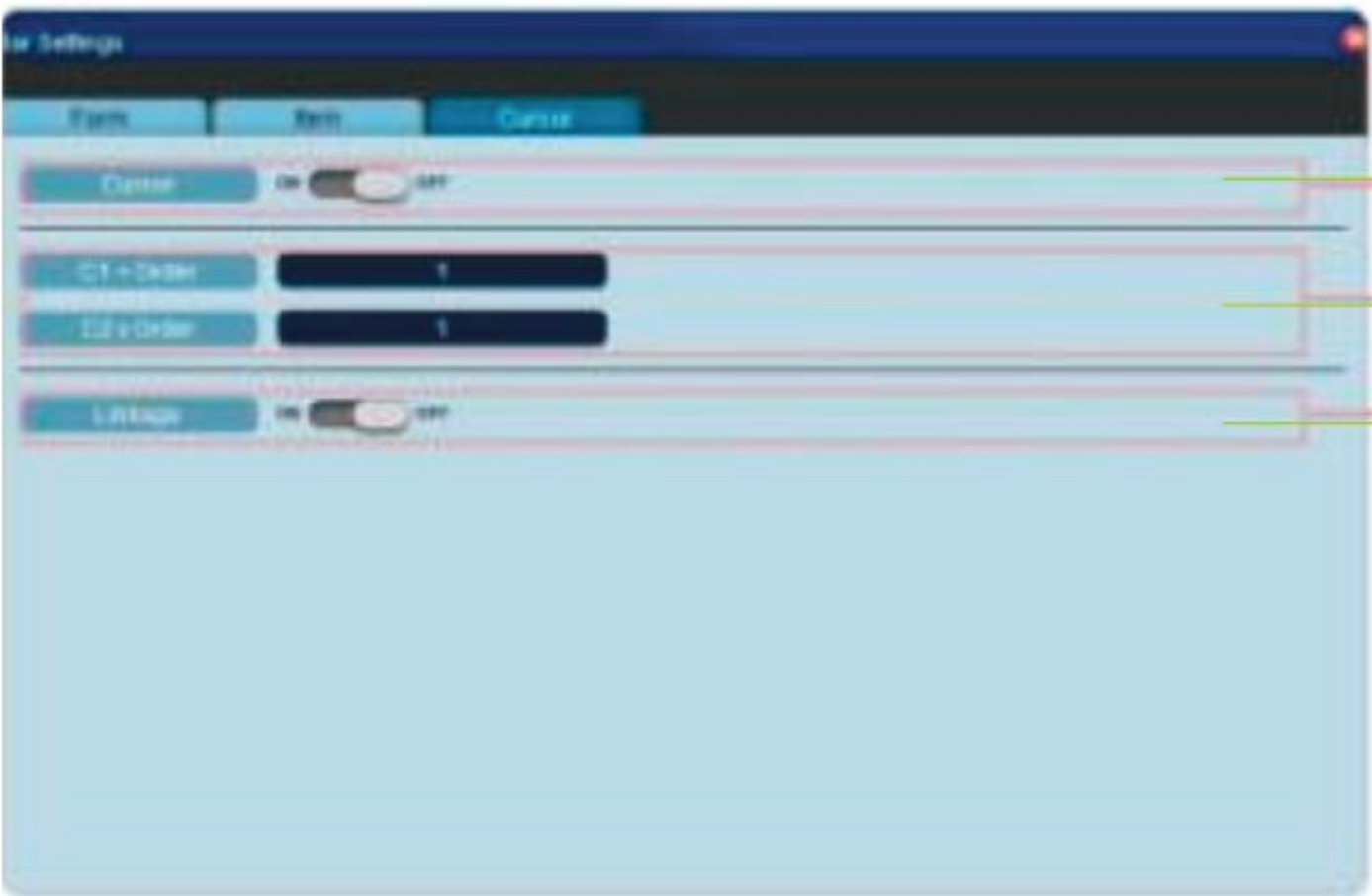
urn the cursor display of the bar graph ON/OFF

Set the number with C1+ and C2x1-50

Set the linkage function ON/OFF

9.4 Trend display

Trend display form setting

Path: Trend menu, then press the Form Setting key to enter
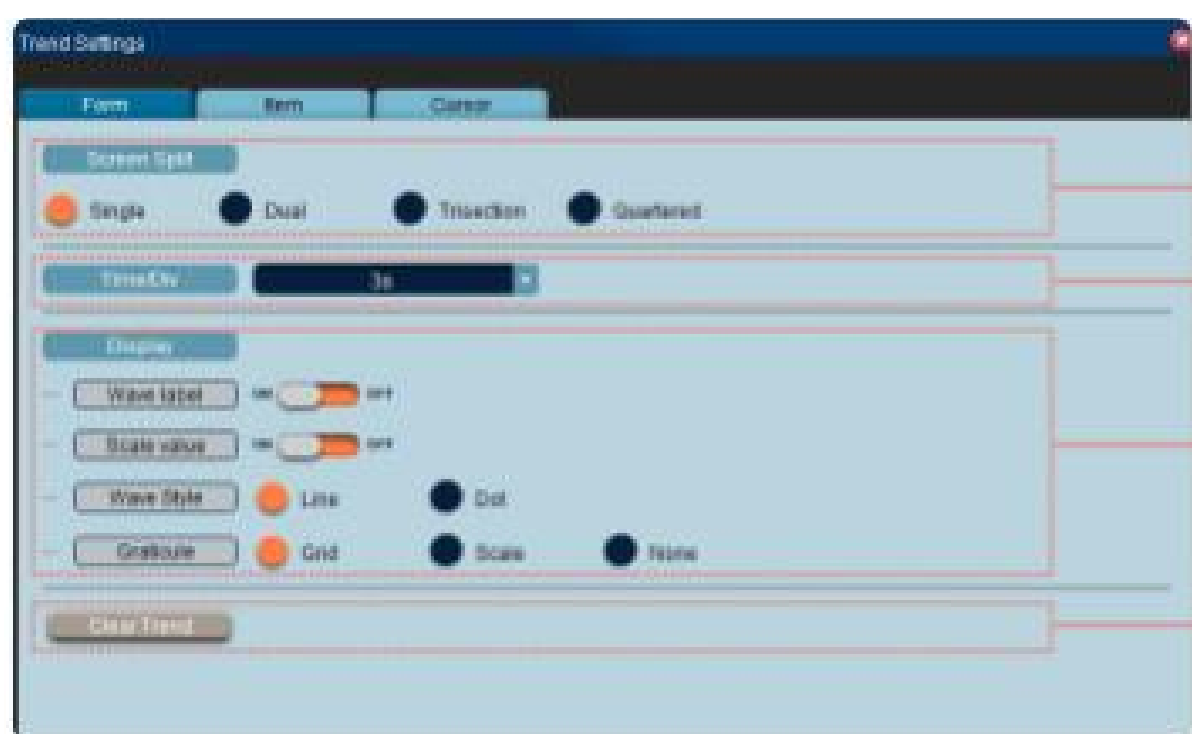
Set the trend screen split display

Set the trend timeline

Set the trend display:

Switch wave label ON/OFF

Switch ON/OFF the interpolation setting of scale value (Line/Dot)

Set graticule (Grid/Scale/None)

Clear trend

Trend display item setting

Path: Trend menu, then press Item Setting key to enter

Quick setting of the trend display: ALL ON or ALL OFF

Trend display items setting: display ON, display items, element, harmonics order (to set the harmonics order by harmonics measuring items), scaling and upper/lower scale

⚠ **Note:**

◆ When the upper/lower scales of –0.000 are set, the setting will automatically become 0.000.

◆ In manual mode, the upper/lower scales cannot be set the same. If the settings are judged to be the same, the setting will be invalid.

◆ When "error" appears in the numerical measuring item, the upper/lower scales are displayed as: 1.000 and –1.000 respectively.

◆ The numerical difference between the upper/lower scales shall be greater than 0.500. This setting is invalid when the difference is not me

Trend display cursor setting

Path: Trend menu, then press Cursor Setting to enter
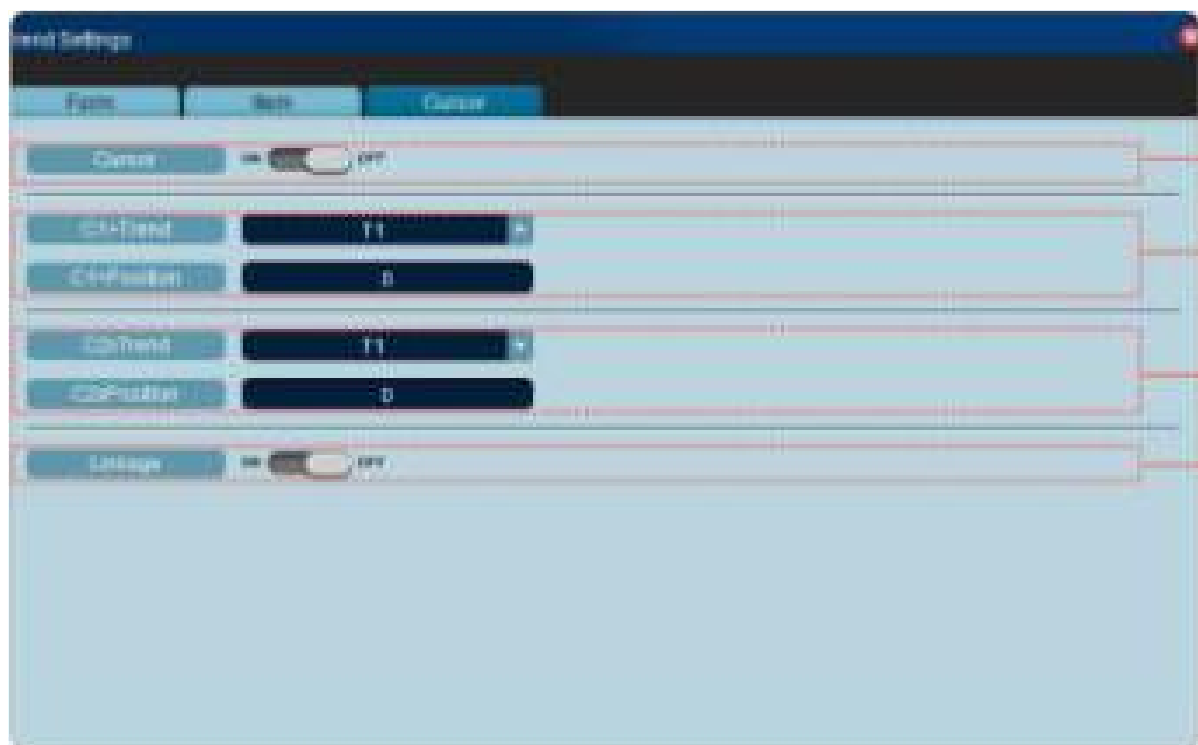
Switch the cursor display of the waveform ON/OFF

Set the trend and position of cursor C1+, with the range of 0~900

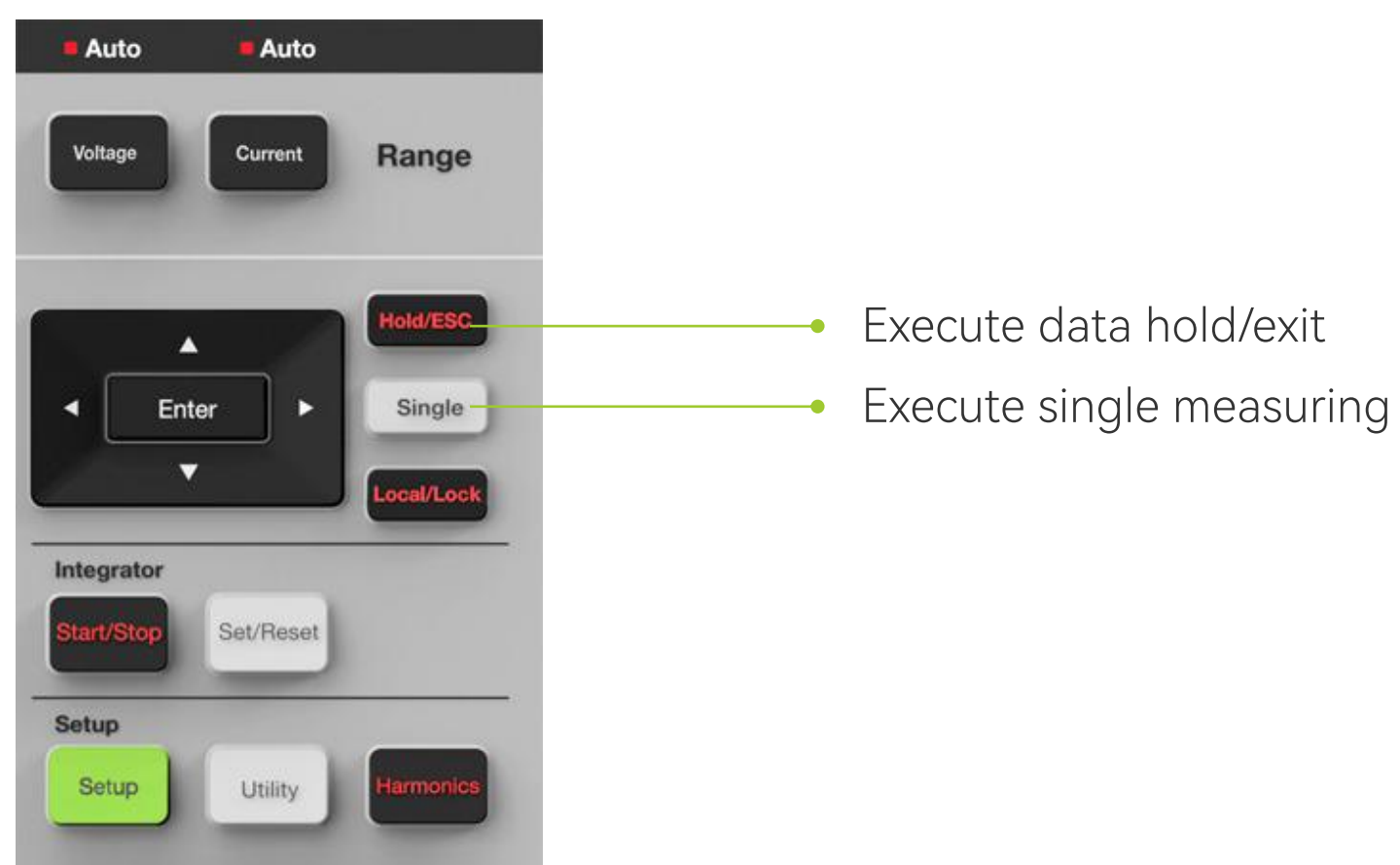Set the waveform and position expressed by the cursor C2x

Switch the linkage function displayed by the cursor ON/OFF

Chapter X

Other Functions

10.1 Holding measured values and executing a single measurement

Execute data hold/exit

Execute single measuring

※ **Description of data hold**

In the main interface (measured value is displayed), press the "Hold/ESC" key, the "Hold/ESC" key indicator light is on, and the current measured value is held. When the data is held, the data update stops, and the "Update" indicator light on the panel is off. When the measured value is in the hold state, press the "Hold/ESC" key again, the Hold/ESC" key indicator light is off, and the hold state is released. The measuring display value continues to update, and the "Update" indicator light on the panel is on again.

When the integral is held, press the "Hold/ESC" key, the integral display will not update, but the integral continues to execute inside the instrument. The Update indicator light will flash as the internal data is updated. When the holding of display value is released, the integral results (integral value and integral time) at the release time point will be displayed.

When storing data, if the "Hold/ESC" key is pressed to hold the display, the measurement operation and the storage interval time count will be held (paused), and the data storage will also be held (paused). Press the "Hold/ESC" key again to release the holding, and the storage will continue.

※ **Description of executing single measuring**

When the measured value is in the hold state, press the "Single" key, the measurement will be executed once at the current data update rate and the display data will be updated, and then it returns to the data hold state again. The "Update" indicator light is lit once every time the data measurement is executed. When there is no hold state, press the "Single" key and then start the measurement again from this point.

10.2 Maximum hold function

The instrument has the function of holding the maximum value. When the function is enabled, the maximum value of measurement will be held. If the measured value is larger than the current holding value, the larger value will be held. Measurement functions that can hold the maximum values include: U (voltage), I (current), P (active power), S (apparent power), Q (reactive power), U+pk/U–pk (peak voltage), I+pk/I–pk (peak current) and P+pk/P–pk (peak power).

1. Operational path: Operational path: Press the Setup key to select Max Hold maximum value retention function

2. The settings page is as follows:
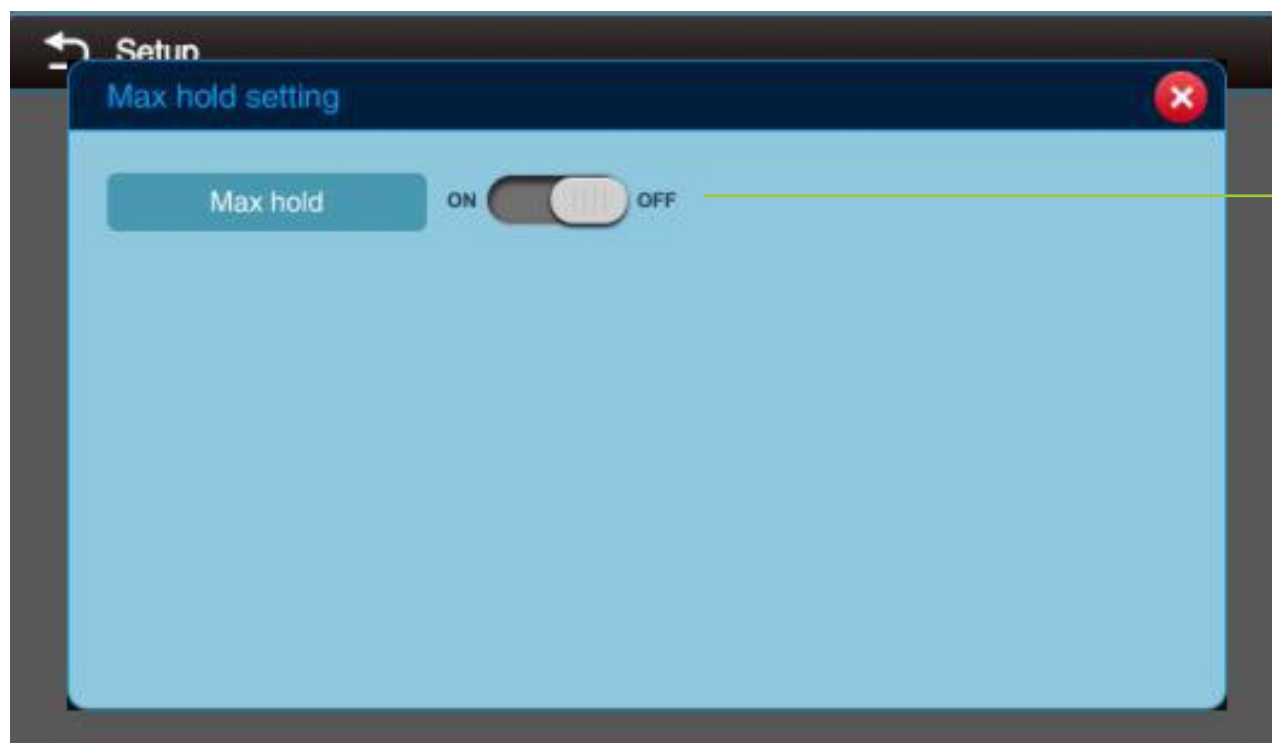
Follow the above steps to set whether to turn on the maximum hold function. When the Display Bar C is confirmed as "ON", it means that the maximum hold function is enabled, and the Max hold indicator light on the panel is on. When the Display Bar C is confirmed as "OFF", it means that the maximum hold function is disabled, and the Max hold indicator light is off.

10.3 Key lock / unlock function
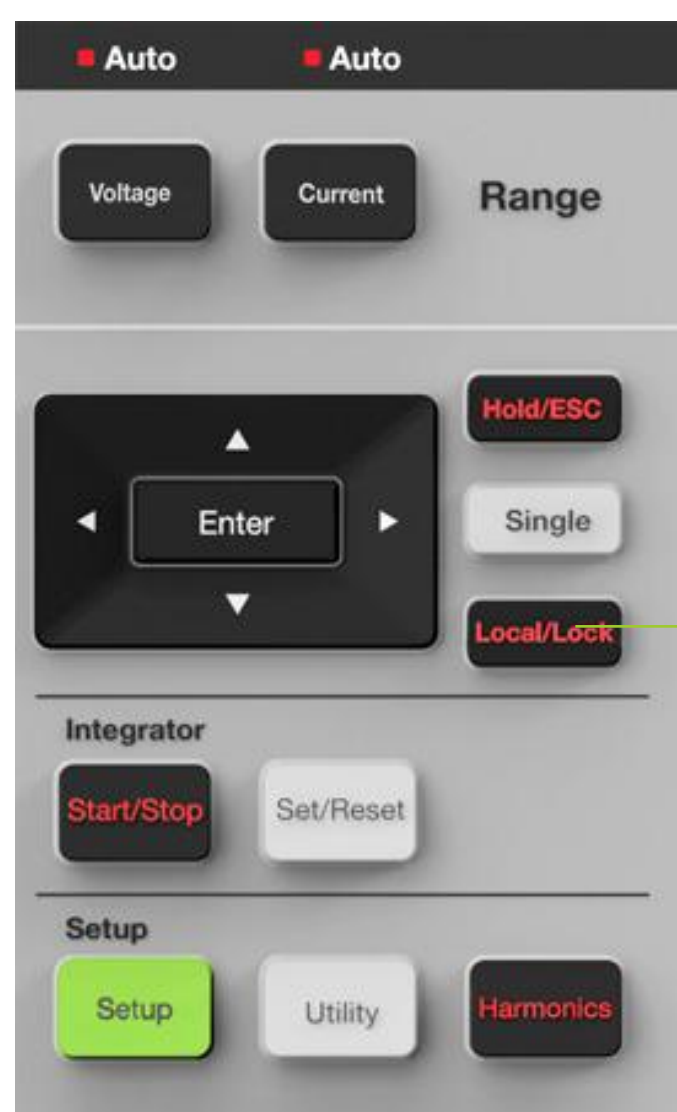
Operation method:

Press and hold the "Local/Lock" key

※ Function specifications

◆ Key locking

After pressing and holding the "Local/Lock" key, the indicator light of the "Local/Lock" key is on. At this time, the key has been locked, and the "Key Protect" indicator light on the panel is on. At this time, except for the power switch and "Local/Lock" key, other key operations are invalid.

◆ Key unlocking

In the key locking state, press and hold the "Local/Lock" key to unlock the key locking state. At this time, the "Local/Lock" key indicator light and the "Key Protect" indicator light are off at the same time. After the key is unlocked, all key operations resume to take effect.

Appendix

Appendix

Appendix I Symbols and definitions of measurement function

Conventional measurement

The panel indicator indicates the unit of measured value and the item being measured. It is on the left or right side of the 7-segment LED screen used for displaying measurement data.

Voltage

Measurement function (symbol)	Panel indicator lights up	Meaning	Input unit support	Wiring group support
U(RMS)	V	True effective value of voltage	Yes	Yes
U(Mean)	V	Rectified average calibrated to RMS of voltage	Yes	Yes
U(DC)	V	Simple average of voltage	Yes	Yes
U+PK	Vpk+	Maximum value of voltage	Yes	No
U–PK	Vpk–	Minimum value of voltage	Yes	No
CF U	MATH	Peak factor of voltage	Yes	No

⚠ **Note**： The CFU function can be set through the MATH function.

Current

Measurement function (symbol)	Panel indicator lights up	Meaning	Input unit support	Wiring group support
I(RMS))	A	True effective value of current	Yes	Yes
I(DC)	A	Simple average of current	Yes	Yes
I+PK	Apk+	Maximum value of current	Yes	No
I-PK	Apk–	Minimum value of current	Yes	No
CF I	MATH	Peak factor of current	Yes	No

⚠ **Note**： The CFI function can be set through the MATH function.

Power

Measurement function (symbol)	Panel indicator lights up	Meaning	Input unit support	Wiring group support
P	W	Active power	Yes	Yes
S	VA	Apparent power	Yes	Yes
Q	var	Reactive power	Yes	Yes
λ	PF	Power factor	Yes	Yes
φ	°	Phase difference	Yes	Yes
P+PK	Wpk+	Maximum value of power	Yes	No
P–PK	Wpk–	Minimum value of power	Yes	No

Frequency

Measurement function (symbol)	Panel indicator lights up	Meaning	Input unit support	Wiring group support
FU	VHz	Voltage frequency	Yes	No
FI	AHz	Current frequency	Yes	No

Integral power (watt-hour)

Measurement function (symbol)	Panel indicator lights up	Meaning	Input unit support	Wiring group support
TIME	TIME	Integral time	Yes	Yes
WP	WH	Sum of positive and negative watt-hours	Yes	Yes
WP±	WH±	Positive or negative watt-hours	Yes	Yes
q	AH	Sum of positive and negative ampere-hours	Yes	Yes
q±	AH±	Positive or negative ampere-hours	Yes	Yes
AV P	MATH	Average active power during integral	Yes	Yes

⚠ **Note**： The AV P function can be set through the MATH function.

Efficiency

Measurement function (symbol)	Panel indicator lights up	Meaning
EFFI	MATH	Efficiency

⚠ **Note**： The EFFI function can be set through the MATH function.

Arithmetic operation

Measurement function (symbol)	Panel indicator lights up	Meaning
A+B	MATH	A+B
A–B	MATH	A–B
A×B	MATH	A×B
A÷B	MATH	A÷B
A÷B^2	MATH	A÷B^2
A^2÷B	MATH	A^2÷B

⚠ **Note**： It can be set through the MATH function.

Harmonic measurement

Harmonic measurement function

Measurement function (symbol)	Panel indicator lights up	Meaning
U(K)	V	Effective value of K number of harmonic voltage
I(K)	A	Effective value of K number of harmonic current

Measurement function (symbol)	Panel indicator lights up	Meaning
P(K)	W	Active power of K number of harmonics
λ(K)	PF	Power factor of one harmonics
Φ(K)	V° or A°	Phase difference between fundamental voltage and fundamental current
UTHD	V%	Total harmonic voltage distortion
ITHD	A%	Total harmonic current distortion
UHDF(K)	V%	Harmonic distortion factor of K number of harmonic voltage
IHDF(K)	A%	Harmonic distortion factor of K number of harmonic current
PHDF(K)	W%	Harmonic distortion factor of K number of harmonic power
ΦU(K)	V°	Phase difference between K number of harmonic voltage and fundamental voltage
ΦI(K)	A°	Phase difference between K number of harmonic current and fundamental current

⚠ **Note**：K represents harmonic number, which is displayed in display A.

Number of harmonic measurement function

The harmonic number that can be specified is shown in the following table.

Measurement function (symbol)	Panel indicator lights up	Total value (total effective value)	1 (fundamental wave)	Harmonic wave
U(K)	V	Yes	Yes	2~50
I(K)	A	Yes	Yes	2~50
P(K)	W	Yes	Yes	2~50
λ(K)	PF	No	Yes	No
Φ(K)	V° or A°	No	Yes	No
UTHD	THD V%	Yes	No	No
ITHD	THD A%	Yes	No	No
UHDF(K)	V%	No	Yes	2~50
IHDF(K)	A%	No	Yes	2~50
PHDF(K)	W%	No	Yes	2~50
ΦU(K)	V°	No	No	2~50
ΦI(K)	A°	No	No	2~50

⚠ **Note**：TK represents harmonic number.

Appendix II Initialization configuration list

Item	Content

Display A	Display function: V, input unit: 1
Display B	Display function: A, input unit: 1
Display C	Display function: W, input unit: 1
Display D	Display function: PF, input unit: 1
Display bits	5
Data update cycle	0.5s
Zero	ON
Line filter	OFF
Frequency filter	OFF
Measuring synchronous source	Volt (voltage)
Current range	Auto
Voltage range	Auto
Current sensing range	2V/10V
Measuring mode	RMS
Wiring mode	1P2W
Hold	OFF
Maximum hold	OFF
Ratio	Ratio switch: OFF VT: 1.000 CT: 1.000 SF: 1.000
External sensor conversion ratio	Sensor conversion ratio switch:OFF ALL: 1000 Ele1: 1000 Ele2: 1000 Ele3: 1000
Average	Average switch: OFF Type: Ep (exponential average) Average coefficient: 8
Peak factor	3
MATH formula	Efficiency EFFI
Frequency	Voltage frequency and current frequency of input unit 1
Integral	Integral mode: nor Integral timer: 10000:00:00 Integral DA timer: 10000:00:00
Harmonic measurement	Harmonic display: OFF THD formula: IEC Maximum harmonic number of measurement: 50 PLL source: U1
Storage	Storage function switch: OFF Interval: 00:00:01
D/A output item	Item dflt–n
GP–IB address	addr 1
RS–232	Handshake mode: hand0 Data format: form0 Baud rate: 19200 Terminator: Cr+Lf