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User Manual

UTE323 Digital Power Meter

REV.0

30th July, 2025

Table of Contents

Foreword

Thank you for choosing this UNI-T instrument. For safe and proper use this instrument, please read this manual carefully, especially the safety instructions section.

After reading this manual, it is recommended to keep the manual in a convenient location, preferably near the device, for future reference.

Chapter 1 Safety Instructions

This chapter contains information and warnings that must be observed. Ensure that the instrument is operated under the safe conditions. In addition to the safety precautions indicated in this chapter, you must also follow accepted safety procedures.

Safety Precautions		
Warning	Please follow these guidelines to avoid possible electric shock and risk to personal safety.	
	Users must adhere to standard safety precautions during the operation, servicing, and maintenance of this device. UNI-T will not be liable for any personal safety and property loss caused by the user's failure following the safety precautions. This device is designed for professional users and responsible organizations for measurement purposes. Do not use this device in any manner not specified by the manufacturer. This device is intended for indoor use only, unless otherwise stated in the product manual.	
Warning	"Warning" indicates the presence of a hazard. It warns users to pay attention to a certain operation process, operation method or similar. Personal injury or death may occur if the rules in the "Warning" statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions stated in the "Warning" statement.	
Caution	"Caution" indicates the presence of a hazard. It warns users to pay attention to a certain operation process, operation method or similar. Product damage or loss of important data may occur if the rules in the "Caution" statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions stated in the "Caution" statement.	
Note	"Note" indicates important information. It reminds users to pay attention to procedures, methods, and conditions, etc. The contents of "Note" should be highlighted if necessary.	
Safety Signs		
	Danger	It indicates danger of electric shock, which may cause personal injury or death.
	Warning	It indicates that there are factors you should be cautious of to prevent personal injury or product damage.

	Caution	It indicates danger, which may cause damage to this device or other equipment if you fail to follow a certain procedure or condition. If the "Caution" sign is present, all conditions must be met before you proceed to operation.
	Note	It indicates potential problems, which may cause failure of this device if you fail to follow a certain procedure or condition. If the "Note" sign is present, all conditions must be met before this device will function properly.
	AC	Alternating current of device. Please check the region's voltage range.
	DC	Direct current device. Please check the region's voltage range.
	Grounding	Frame and chassis grounding terminal
	Grounding	Protective grounding terminal
	Grounding	Measurement grounding terminal
	OFF	Main power off
	ON	Main power on
	Power	Standby power supply: When the power switch is turned off, this device is not completely disconnected from the AC power supply.
CAT I		Secondary electrical circuit connected to wall sockets through transformers or similar equipment, such as electronic instruments and electronic equipment; electronic equipment with protective measures, and any high-voltage and low-voltage circuits, such as the copier in the office.
CAT II		Primary electrical circuit of the electrical equipment connected to the indoor socket via the power cord, such as mobile tools, home appliances, etc. Household appliances, portable tools (e.g., electric drill), household sockets, sockets more than 10 meters away from CAT III circuit or sockets more than 20 meters away from CAT IV circuit.
CAT III		Primary circuit of large equipment directly connected to the distribution board and circuit between the distribution board and the socket (three-phase distributor circuit includes a single commercial lighting circuit). Fixed equipment, such as multi-phase motor and multi-phase fuse box; lighting equipment and lines inside large buildings; machine tools and power distribution boards at industrial sites (workshops).
CAT IV		Three-phase public power unit and outdoor power supply line equipment. Equipment designed to "initial connection," such as power distribution system of power station, power instrument, front-end overload protection, and any outdoor transmission line.
	Certification	CE indicates a registered trademark of EU.
	Certification	UKCA indicates a registered trademark of United Kingdom.
	Certification	Conforms to UL STD 61010-1 and 61010-2-030. Certified to CSA STD C22.2 No.61010-1 and 61010-2-030.
	Waste	Do not place equipment and accessories in the trash. Items must be properly disposed of in accordance with local regulations.
	EEUP	This environment-friendly use period (EFUP) mark indicates that dangerous or toxic substances will not leak or cause damage within this indicated time period. The environmentally friendly use period of this product is 40 years,

		during which it can be used safely. Upon expiration of this period, it should enter the recycling system.
Safety Requirements		
Warning		
Preparation before use		Please connect this device to AC power supply with the power cable provided. The AC input voltage of the line reaches the rated value of this device. See the product manual for specific rated value. The line voltage switch of this device matches the line voltage. The line voltage of the line fuse of this device is correct. This device is not intended for measuring the main circuit.
Check all terminal rated values		Please check all rated values and marking instructions on the product to avoid fire and the impact of excessive current. Please consult the product manual for detailed rated values before connection.
Use the power cord properly		You can only use the special power cord for the instrument approved by the local and state standards. Please check whether the insulation layer of the cord is damaged, or the cord is exposed, and test whether the cord is conductive. If the cord is damaged, please replace it before using the instrument.
Instrument Grounding		To avoid electric shock, the grounding conductor must be connected to the ground. This product is grounded through the grounding conductor of the power supply. Please be sure to ground this product before it is powered on.
AC power supply		Please use the AC power supply specified for this device. Please use the power cord approved by your country and confirm that the insulation layer is not damaged.
Electrostatic prevention		This device may be damaged by static electricity, so it should be tested in the anti-static area if possible. Before the power cable is connected to this device, the internal and external conductors should be grounded briefly to release static electricity. The protection grade of this device is 4 kV for contact discharge and 8 kV for air discharge.
Measurement accessories		Measurement accessories designated as lower-grade, which are not applicable to main power supply measurement, CAT II, CAT III, or CAT IV circuit measurement. Probe subassemblies and accessories within the range of IEC 61010-031 and current sensors within the range of IEC 61010-2-032 can meet its requirements.
Use the input / output port of this device properly		Please use the input / output ports provided by this device in a proper manner. Do not load any input signal at the output port of this device. Do not load any signal that does not reach the rated value at the input port of this device. The probe or other connection accessories should be effectively grounded to avoid product damage or abnormal function. Please refer to the product manual for the rated value of the input / output port of this device.
Power fuse		Please use a power fuse of exact specification. If the fuse needs to be replaced, it must be replaced with another one that meets the specified specifications by the maintenance personnel authorized by UNI-T.
Disassembly and cleaning		There are no components available for operators inside. Do not remove the protective cover. Qualified personnel must conduct maintenance.
Service environment		This device should be used indoors in a clean and dry environment with ambient temperature from 0 ℃ to +40 ℃. Do not use this device in explosive, dusty, or high humidity conditions.
Do not operate in humid environment		Do not use this device in a humid environment to avoid the risk of internal short circuit or electric shock.
Do not operate in flammable and		Do not use this device in a flammable and explosive environment to avoid product damage or personal injury.

explosive environment	
Caution	
Abnormality	If this device may be faulty, please contact the authorized maintenance personnel of UNI-T for testing. Any maintenance, adjustment or parts replacement must be done by the relevant personnel of UNI-T.
Cooling	Do not block the ventilation holes at the side and back of this device. Do not allow any external objects to enter this device via ventilation holes. Please ensure adequate ventilation and leave a gap of at least 15 cm on both sides, front and back of this device.
Safe transportation	Please transport this device safely to prevent it from sliding, which may damage the buttons, knobs, or interfaces on the instrument panel.
Proper ventilation	Insufficient ventilation will cause the device temperature to rise, thus causing damage to this device. Please keep proper ventilation during use, and regularly check the vents and fans.
Keep clean and dry	Please take actions to avoid dust or moisture in the air affecting the performance of this device. Please keep the product surface clean and dry.
Note	
Calibration	The recommended calibration period is one year. Calibration should only be conducted by qualified personnel.

⚠ Warning

The UTE323 and UTE323G digital power meters support the measurement of power supplies under CAT II (600V) overvoltage conditions (up to 600VAC); the UTE333H, UTE333HG, UTE333H-2K and UTE333HG-2K can measure power supplies under CAT II (1000V) overvoltage conditions (up to 1000VAC).

Always operate the power meter strictly within this specified measurement environment to ensure safety and prevent equipment damage.

1.2 Environmental Requirements

The UTE323 series digital power meter is designed for indoor use only and must be operated in environments with low condensation levels.

Environmental Conditions	
Operating Temperature	5°C to 40°C, 20% RH to 80% RH (non-condensing)
Accuracy Guarantee (Temperature/Humidity Range)	23°C ± 5°C, 30% to 75% RH
Storage Temperature	-10°C to 50°C, 20% RH to 80% RH (non-condensing)
Operating Altitude	≤ 2000 meters

⚠ Note

For optimal measurement accuracy, allow the power meter to warm up for at least 30 minutes before use. This ensures that internal components reach a stable operating state, thereby enhancing the reliability and consistency of test results.

Chapter 2 Packing List

2.1 General Inspection

Before use, carefully check the contents against the packing list. If there are any missing components or abnormalities in the power meter or its accessories, please contact the seller or manufacturer for assistance.

Product

Model	Item	Dimensions (Width x Height x Depth)	Quantity
UTE323/UTE323G UTE333H/UTE333HG UTE333H-2K/UTE333HG-2K	Digital power meter	225 mm x 158 mm x 400 mm	1

Accessories and Manual

No.	Item	Quantity	Remarks
1	Nation standard 3-prong power cord	1	
2	Double Bannan test leads	3 pairs	UT-L0110-BB (Stacking plug) /10A/1m
3	Bannan-U type test leads	3 pairs	UT-L0110-BU(Stacking plug U type)/ 10A/1m
4	Fork-shaped pre-insulated cold-press wiring terminal	6 pairs	Six red terminals and six black terminals (for user-defined connections)

Note: After checking that all packaging contents are complete and in good condition, store the packaging and related items properly. When returning the power meter for service, the packaging must meet the specified requirements.

Options

In addition to the accessories mentioned above, the following options are available for selection.
Sold separately; not included in the instrument's packaging.

Current Clamp (Option)

No.	Brand Name	Model	Sensor Type	Current	Transformation Ratio	Accuracy	Bandwidth	Jaw Capacity	Interface	Appearance
1	ZhiYong	ZCP20	AC/DC current clamp	20 Arms	0.1 V/A	0.30 %	1 MHz	20 mm	12-pin	
2	ZhiYong	ZCP200	AC/DC current clamp	200 Arms	10 mV/A	0.30 %	500 kHz	20 mm	12-pin	
3	ZhiYong	ZCP500	AC/DC current clamp	500 Arms	4 mV/A	0.30 %	100 kHz	50 mm	12-pin	
4	ZhiYong	ZCP1000	AC/DC current clamp	1000 Arms	2 mV/A	0.30 %	20 kHz	50 mm	12-pin	
5	CA	C116	AC current clamp	1000 Arms	1 mV/A	0.30 %	30 Hz-10 kHz	52 mm	Banana plugs 4 mm	
6	CA	C112	AC current clamp	1000 Arms	1 mV/A	0.30 %	30 Hz-10 kHz	52 mm	Banana plugs 4 mm	

Current Sensor (Option)

IN Series High Precision Current Sensor

No.	Brand Name	Model	Sensor Type	Current	Transformation Ratio	Accuracy	Bandwidth	Jaw Capacity	Interface	Appearance
1	LEM	IN 500-S	AC/DC sensor	AC/DC: 500 A	1:750	0.0018%	520 kHz	38.2 mm	DB9	
2	LEM	IN 1000-S	AC/DC sensor	AC/DC: 1000 A	1:1500	0.0018%	440 kHz	38.2 mm	DB9	
3	LEM	IN 1200-S	AC/DC sensor	AC/DC: 1200 A	1:1500	0.0018%	440 kHz	38.2 mm	DB9	
4	LEM	IN 2000-S	AC/DC sensor	AC/DC: 2000 A	1:2000	0.0018%	140 kHz	70 mm	DB9	

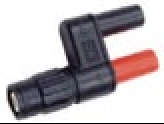
AIT Series High Precision Current Sensor

No.	Brand Name	Model	Sensor Type	Current	Transformation Ratio	Accuracy	Bandwidth	Jaw Capacity	Interface	Appearance
1	Hangzhi	AIT3000-D90	AC/DC sensor	DC:3000 A AC:2121A	1: 3000	0.0050 %	300 kHz	90 mm	Current terminal	
2	Hangzhi	AIT5000-D160	AC/DC sensor	DC:5000 A AC:3535A	1: 5000	0.0050 %	300 kHz	160 mm	Current terminal	
3	Hangzhi	AIT8000-D120	AC/DC sensor	DC:8000 A AC:5600 A	1: 4000	0.0050 %	300 kHz	120 mm	Current terminal	
4	Hangzhi	AIT10000-D120	AC/DC sensor	DC:10000 A AC:7072A	1: 5000	0.0050 %	200 kHz	120 mm	Current terminal	

LEM Series Low Precision Current Sensor

No.	Brand Name	Model	Sensor Type	Current	Transformation Ratio	Accuracy	Bandwidth	Jaw Capacity	Interface	Appearance
1	LEM	LF205-S/SP3	AC/DC sensor	100 Arms (DC/AC)	1: 1000	±0.5%	100 kHz	15.5 mm	3-pin	
2	LEM	LF205-S	AC/DC sensor	200 Arms (DC/AC)	1: 2000	±0.5%	100 kHz	15.5 mm	3-pin	
3	LEM	LF505-S	AC/DC sensor	500 Arms (DC/AC), Max.800 A	1: 5000	±0.6%	100 kHz	32.2 mm	3-pin	
4	LEM	LF1005-S	AC/DC sensor	1000 Arms	1: 5000	±0.4%	150 kHz	40.5 mm	3-pin	

Cable and Plug (Option)

No.	Specifications	Brand Name	Appearance
1	BNC to 4 mm Banana Adapter (Safety Type), rated voltage 1000 V	MC	
2	DB9 Interface Current Sensor Cable (for IN series sensors) -0: bare cable -4: 4mm plug	/	
3	3-pin Interface Current Sensor Cable (for LF series sensors)-0: bare cable -4: 4mm plug	/	
4	Motor Test Lead Safety rating: CAT II (600 V), CAT III (300 V) Cable length: 0.65 m	STAUBLI	

Chapter 3 Product Overview

3.1 UTE323 Overview

With the continuous implementation of new energy efficiency standards, many manufacturers are engaged in intense competition to enhance the energy-saving performance of their products. This trend is particularly evident in the R&D and production of household appliances (such as white goods) and industrial equipment (such as large-scale air conditioners). Consequently, power measurement instruments are essential for evaluating the energy-saving performance of such equipment. These instruments must deliver high precision, ultra-low standby power consumption, a wide measurement range, and adaptability to diverse measurement scenarios.

The UTE323 series digital power meters include six models: UTE323, UTE323G, UTE333H, UTE333HG, UTE333H-2K, and UTE333HG-2K. These are high-precision, high-performance, programmable three-phase digital power meters with a current measurement range of 5 mA to 50 A, suitable for applications ranging from production lines to R&D environments.

Typical applications include:

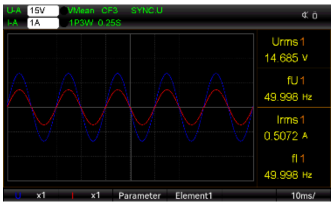
- Measurement of DC, 1P2W (Single-Phase Two-Wire), 1P3W (Single-Phase Three-Wire), 3P3W (Three-Phase Three-Wire), and 3P4W (Three-Phase Four-Wire)
- Power measurement of high-power household appliances such as air conditioners and induction cookers
- Power measurement of office equipment such as monitors and printers
- Power measurement of energy-related equipment such as LEDs, power supplies, and batteries
- Energy-saving performance evaluation of industrial equipment such as frequency converters and large-scale air conditioners
- Efficiency measurement of inverters

3.2 Functional Features

The main functional features of the UTE323 series digital power meters are as follows.

Intuitive Display Interface: Equipped with a 5-inch high-definition LCD screen for clear and intuitive data display.

Oscilloscope Function: Enables real-time observation of voltage, current, frequency, and waveform variations.



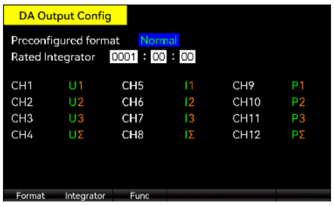
Simultaneous Multi-Unit Measurement: Enables simultaneous measurement of voltage, current, power, and power factor across three channels.

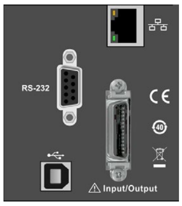
Harmonic Measurement (IEC 61000-4-7): Provides harmonic analysis of signals including voltage, current, power, and phase angle, with measurement results displayed up to the 50th order.

Mathematical Functions: Supports arithmetic operations (addition, subtraction, multiplication, division) on measured parameters of each channel.

Current and Power Integration: Supports integration of parameters including q, q+, q-, WP, WP+, WP-, with selectable standard integration mode or repetitive integration mode.

D/A Conversion Output: Equipped with 12 D/A output channels for proportional scaling and output of measured parameters such as voltage, current, and power.





Communication Interfaces: Provides USB, RS-232, GPIB, and Ethernet ports for remote control and data acquisition.

Auto Rang: Automatically switches to the appropriate range within the specified measurement range.

External Storage: Supports external USB storage devices for long-term data recording (voltage, current, power, and harmonics).

Built-in Filters: Includes line and frequency filtering functions.
Line filter cutoff frequency is selectable from 500 Hz to 100 kHz.
Frequency filtering suppresses noise and unneeded harmonics during carrier wave measurements.\

PC Analysis Software: Dedicated software for remote control, configuration, data acquisition, display, harmonic analysis, waveform analysis, and data storage.

Maximum Hold Function: Stores maximum values of RMS/peak voltage, RMS/peak current, active power (P), reactive power (Q), and apparent power (S).

Sampling Rate: 300 kSa/s

Bandwidth: DC, 0.1 Hz to 300 kHz

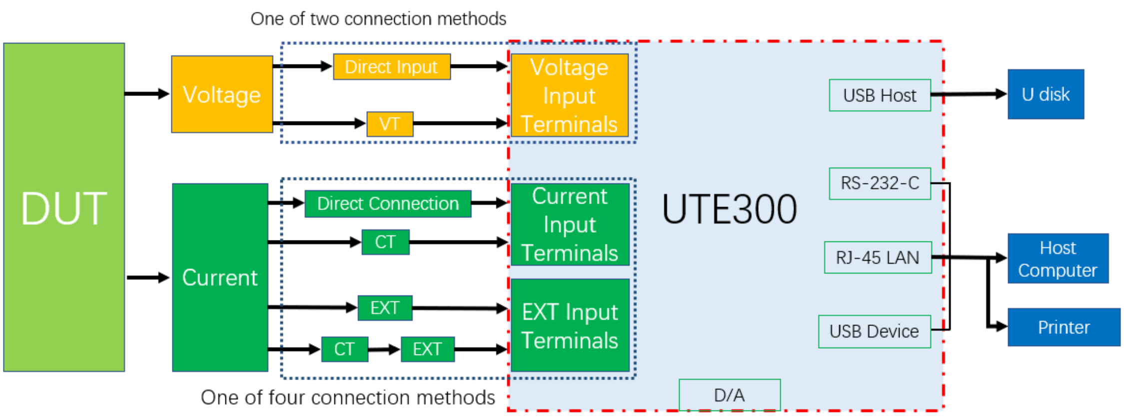
Low-Current Measurement: Minimum measurable current of 5 mA

Wide Current Sensor Input Range: 50 mV to 10 V, compatible with a broad range of sensors, ideal for measuring power consumption of intermittently operating equipment.

Data Update Rate: Up to 0.1 s at maximum speed, with selectable update intervals of 0.1 s, 0.25 s, 0.5 s, 1 s, 2 s, 5 s, 10 s, 20 s, or Auto to suit different signal frequencies.

3.3 Application System

The application system block diagram of the UTE323 series digital power meter is shown in the figure below.



3.4 Technical Specifications

f: Frequency (in error calculation formulas, the unit is kHz)

Rate: Data update interval

CF: Crest factor (peak factor)

rdg.: Reading

F.S.: Measurement range (full scale)

λ/PF: Power factor

□: Phase difference

Ext: External current sensor input

S: Apparent power

Q: Reactive power

Model	UTE323, UTE323G		UTE333H, UTE333HG UTE333H-2K, UTE333HG-2K	
Bandwidth	DC, 0.1 Hz to 300 kHz		DC, 0.1 Hz to 300 kHz	
Sample Rate	300 kSa/s		300 kSa/s	
Voltage Range	CF = 3	CF=6 or 6 A	CF = 3	CF=6 or 6 A
	15 V	7.5 V	15 V	7.5 V
	30 V	15 V	30 V	15 V
	60 V	30 V	60 V	30 V
	150 V	75 V	150 V	75 V
	300 V	150 V	300 V	150 V
	600 V	300 V	600 V	300 V
	/	/	1000V	500V
	/	/	2000V (Applicable only to UTE333H-2K and UTE333HG-2K)	1000V (Applicable only to UTE333H-2K and UTE333HG-2K)
	Note: The rated range of voltage is: 1% - 130% (the maximum display is 140%. 1000V range and 500V range,the maximum is 100%) The maximum AC input for the 1000V range is 1000Vrms, and the maximum DC input is 1500Vdc The maximum AC input for the 2000V range is 1100Vrms, and the maximum DC input is 2050Vdc			
Voltage Resolution	0.001 V, 0.01 V	0.0001 V, 0.001 V, 0.01 V	0.001 V, 0.01 V, 0.1 V	0.0001 V, 0.001 V, 0.01 V

Model	UTE323, UTE323G		UTE333H, UTE333HG UTE333H-2K, UTE333HG-2K	
Voltage Accuracy	DC, 0.1 Hz to 45 Hz: ±(0.1% rdg.+ 0.2% F.S.)		DC, 0.1 Hz to 45 Hz: ±(0.1% rdg.+ 0.2% F.S.)	
	45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)		45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)	
	66 Hz to 1 kHz: ±(0.1% rdg.+ 0.2% F.S.)		66 Hz to 1 kHz: ±(0.1% rdg.+ 0.2% F.S.)	
	1 kHz to 10 kHz: ±[(0.07 * f)% rdg.+ 0.3% F.S.]		1 kHz to 10 kHz: ±[(0.07 * f)% rdg.+ 0.3% F.S.]	
	10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg.		10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg.	
	Note: For input levels between 110% and 130% of the rated range, add 50% of the specified reading error to the above accuracy.			
Current Range	CF = 3	CF=6 or 6 A	CF = 3	CF=6 or 6 A
	500 mA	250 mA		
	1 A	0.5 A	1 A	0.5 A
	2 A	1 A	2 A	1 A
	5 A	2.5 A	5 A	2.5 A
	10 A	5 A	10 A	5 A
	20 A	10 A	20 A	10 A
			50 A	25 A
	The rated range of the current is: 1% to 130% (the maximum display range is 140%, and for the 50A range, it is 100%)			
Current Resolution	0.01 mA, 0.1 mA, 1 mA		0.1 mA, 1 mA	0.01 mA, 0.1 mA, 1 mA
Direct Input Current Accuracy	DC: ±(0.1% rdg.+ 0.2% F.S.)		DC: ±(0.2% rdg.+ 0.2% F.S.)	
	0.1 Hz to 45 Hz: ±(0.1% rdg.+ 0.2% F.S.)		0.1 Hz to 45 Hz: ±(0.1% rdg.+ 0.2% F.S.)	
	45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)		45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)	
	66 Hz to 1 kHz: ±(0.1% rdg.+ 0.2% F.S.)		66 Hz to 1 kHz: ±(0.1% rdg.+ 0.2% F.S.)	
	1 kHz to 10 kHz: ±[(0.07 * f)% rdg.+ 0.3% F.S.]		1 kHz to 10 kHz: ±[(0.07 * f)% rdg.+ 0.3% F.S.]	
	10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg.		10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg.	
	Note: For input levels between 110% and 130% of the rated range, add 50% of the specified reading error to the above accuracy.			
External Current Sensor Input (Ext1)	CF = 3	CF=6 or 6 A	CF = 3	CF=6 or 6 A
	2.5 V	1.25 V	2.5 V	1.25 V
	5 V	2.5 V	5 V	2.5 V
	10 V	5 V	10 V	5 V
External Current	50 mV	25 mV	50 mV	25 mV
	100 mV	50 mV	100 mV	50 mV

Model	UTE323, UTE323G		UTE333H, UTE333HG UTE333H-2K, UTE333HG-2K	
Sensor Input (Ext2)	200 mV	100 mV	200 mV	100 mV
	500 mV	250 mV	500 mV	250 mV
	1 V	0.5 V	1 V	0.5 V
	2 V	1 V	2 V	1 V
External Current Sensor Input Accuracy	DC, 0.1 Hz to 45 Hz: ±(0.1% rdg.+ 0.2% F.S.)		DC, 0.1 Hz to 45 Hz: ±(0.1% rdg.+ 0.2% F.S.)	
	45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)		45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)	
	66 Hz to 1 kHz: ±(0.1% rdg.+ 0.2% F.S.)		66 Hz to 1 kHz: ±(0.1% rdg.+ 0.2% F.S.)	
	1 kHz to 10 kHz: ±[(0.07 * f)% rdg.+ 0.3% F.S.]		1 kHz to 10 kHz: ±[(0.07 * f)% rdg.+ 0.3% F.S.]	
	10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg.		10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg.	
Line Filter (ON)	f < 45Hz: The voltage and current errors increase the reading by 1%. 45Hz ≤ f < 66Hz：The voltage and current errors increase the reading by 0.3%.			
Frequency Measuring Range	Data Update Interval	Measurement Range	Data Update Interval	Measurement Range
	0.1 s	20 Hz ≤ f ≤ 300 kHz	0.1 s	20 Hz ≤ f ≤ 300 kHz
	0.25 s	10 Hz ≤ f ≤ 300 kHz	0.25 s	10 Hz ≤ f ≤ 300 kHz
	0.5 s	5.0 Hz ≤ f ≤ 300 kHz	0.5 s	5.0 Hz ≤ f ≤ 300 kHz
	1 s	2.0 Hz ≤ f ≤ 300 kHz	1 s	2.0 Hz ≤ f ≤ 300 kHz
	2 s	1.0 Hz ≤ f ≤ 300 kHz	2 s	1.0 Hz ≤ f ≤ 300 kHz
	5 s	0.5 Hz ≤ f ≤ 300 kHz	5 s	0.5 Hz ≤ f ≤ 300 kHz
	10 s	0.2 H z≤ f ≤ 300 kHz	10 s	0.2 H z≤ f ≤ 300 kHz
	20 s	0.1 Hz ≤ f ≤ 300 kHz	20 s	0.1 Hz ≤ f ≤ 300 kHz
	Auto	0.1 Hz ≤ f ≤ 300 kHz	Auto	0.1 Hz ≤ f ≤ 300 kHz
Frequency accuracy	Accuracy: ±(0.06% of the reading) Note: When the crest factor is 3, the input signal level must be greater than or equal to 30% of the measurement range (for crest factors of 6 or 6A, it must be greater than or equal to 60%); furthermore, when the frequency of the measured voltage or current is less than or equal to 200Hz, the frequency filter must be turned on.			
Active Power Accuracy (Direct Input Current, PF = 1)	DC: ±(0.1% rdg.+ 0.2% F.S.)		DC: ±(0.3% rdg.+ 0.2% F.S.)	
	0.1 Hz to 45 Hz: ±(0.3% rdg.+ 0.2% F.S.)		0.1 Hz to 45 Hz: ±(0.3% rdg.+ 0.2% F.S.)	
	45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)		45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)	
	66 Hz to 1 kHz: ±(0.2% rdg.+ 0.2% F.S.)		66 Hz to 1 kHz: ±(0.2% rdg.+ 0.2% F.S.)	
	1 kHz to 10 kHz: ±(0.1% rdg.+ 0.3% F.S.)±{0.067*(f-1)}% rdg.		1 kHz to 10 kHz: ±(0.1% rdg.+ 0.3% F.S.)±{0.067*(f-1)}% rdg.	
	10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.)±{0.07*(f-10)}% rdg.		10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.)±{0.07*(f-10)}% rdg.	

Model	UTE323, UTE323G	UTE333H, UTE333HG UTE333H-2K, UTE333HG-2K
Active Power Accuracy (External Current Sensor Input, PF = 1)	DC: ±(0.1% rdg.+ 0.2% F.S.)	DC: ±(0.1% rdg.+ 0.2% F.S.)
	0.1 Hz to 45 Hz: ±(0.3% rdg.+ 0.2% F.S.)	0.1 Hz to 45 Hz: ±(0.3% rdg.+ 0.2% F.S.)
	45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)	45 Hz to 66 Hz: ±(0.1% rdg.+ 0.05% F.S.)
	66 Hz to 1 kHz: ±(0.2% rdg.+ 0.2% F.S.)	66 Hz to 1 kHz: ±(0.2% rdg.+ 0.2% F.S.)
	1 kHz to 10 kHz: ±(0.1% rdg.+ 0.3% F.S.) ± {0.067*(f-1)}% rdg.	1 kHz to 10 kHz: ±(0.1% rdg.+ 0.3% F.S.) ± {0.067*(f-1)}% rdg.
	10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.) ± {0.07*(f-10)}% rdg.	10 kHz to 100 kHz: ±(0.5% rdg.+ 0.5% F.S.) ± {0.07*(f-10)}% rdg.
Power Range	750 mW to 12000 W	15 W to 50 kW
Influence of Power Factor	When λ=0: 45 Hz ≤ f ≤ 66 Hz: 0.2% of ± S When f up to 100 kHz: ± {(0.2+0.2 x f) % of S}, as reference value, the unit of f is kHz. When 0<λ<1: (Power reading) x [(Power reading error%) + (Power range error%) x ($\frac{\text{Power range}}{\text{Indicated apparent power value}}$) + {tanø x (Influence of power factor when λ=0)%}]	
Apparent Power (S) Accuracy	Voltage accuracy + Current accuracy	
Reactive Power (Q) Accuracy	Apparent power accuracy + ($\sqrt{(1.0004-\lambda^2)} - \sqrt{(1-\lambda^2)}$) x 100% of range	
Power Factor (λ) Accuracy	± [$\left(\lambda - \frac{\lambda}{1.0002}\right)$ + |cosø-cos{ø+$sin^{-1}(Influence\ of\ power\ factor\ when\ \lambda = 0)$%/100}|] ± 1 digit At rated voltage and current, ø represents the phase difference between voltage and current.	
Phase Difference (ø) Accuracy	± [|ø-$cos^{-1}\left(\frac{\lambda}{1.0002}\right)$| + sin^{-1}{(Influence of power factor when λ=0) %/100}]	

Harmonic accuracy (when the line filter is turned off)	Frequency	Voltage	Current	Power
	10Hz≤f<45Hz	±(0.15% rdg.+0.35% F.S.)	±(0.15% rdg.+0.35% F.S.)	±(0.15% rdg.+0.50% F.S.)
	45Hz≤f≤440Hz	±(0.15% rdg.+0.35% F.S.)	±(0.15% rdg.+0.35% F.S.)	±(0.25% rdg.+0.50% F.S.)
	440Hz<f≤1kHz	±(0.20% rdg.+0.35% F.S.)	±(0.20% rdg.+0.35% F.S.)	±(0.40% rdg.+0.50% F.S.)
	1kHz<f≤2.5kHz	±(0.80% rdg.+0.45% F.S.)	±(0.80% rdg.+0.45% F.S.)	±(1.56% rdg.+0.60% F.S.)
	2.5kHz<f≤5kHz	±(3.05% rdg.+0.45% F.S.)	±(3.05% rdg.+0.45% F.S.)	±(5.77% rdg.+0.60% F.S.)
	Note: The above accuracy is applicable when CF = 3 and PF = 1. The power above 1.2 kHz is the reference value.			

Model	UTE323, UTE323G	UTE333H, UTE333HG UTE333H-2K, UTE333HG-2K
Temperature coefficient	Add ±0.03% of reading/°C within the range 5 to 18°C or 28 to 40°C	
Waveform Display	Voltage and current waveforms	
Line Filter	Standard	
Frequency Filter	Standard	
Efficiency Measurement	Support	
Math Operation	Standard	
Harmonic Measurement	Maximum 50th order	
Integration Function	Average active power integral, current integral	
D/A Output	12CH for digital-to-analog conversion	
Communication Interface	LAN, USB, RS-232 (Option: GPIB, When selecting GPIB, the models are UTE323G, UTE333HG or UTE333HG-2K.)	

Notes:

- The accuracy values for voltage, current, and power in the table are specified at CF = 3.
- For CF = 6 or 6 A, the range error is twice that at CF = 3.
- When measuring frequency, the RMS value of voltage or current must be greater than 30% of the measurement range.

3.5 Front Panel Overview

The front panel of the UTE323 series digital power meters is equipped with a USB port for connecting a USB flash drive, allowing measurement data to be saved directly to external storage. This section uses UTE323 as an example to describe the front panel layout and button functions.

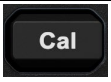
UTE323

Note: The panel layout and functions of the UTE323, UTE323G, UTE333H, UTE333HG, UTE333H-2K, and UTE333HG-2K are identical, differing only in the model designation on the nameplate.

3.5.1 Button Functions on Front Panel

Button	Functional Description
	**Power On/Off Button:** "I" indicates power on, and "O" indicates power off. **Note:** The interval between powering off and on must be greater than 5 seconds.
	**General Function Button (F1–F6):** Perform functions depending on the parameters displayed on the screen. For ease of reference, these six buttons are referred to as F1 to F6 from left to right (not labeled on the actual panel).
	**Up/Down Selection Buttons:** Used to select the previous ▲, next ▼ item when setting parameters.
	**Left/Right Selection Buttons:** Used to navigate left ◀ or right ▶ between items when setting parameters. Common functions include moving the editing cursor during value entry, enabling/disabling functions, and adjusting brightness.

Button	Functional Description
Enter	**Confirm Button (Enter):** Saves current settings and exits the setup menu.
Esc Local	**Exit/Local Button:** Exits the current setup menu and returns to the previous screen. When in remote control mode, pressing this button switches back to local operation.
Wiring	**Wiring Mode Selection Button:** Selects wiring modes including 1P3W (Single-Phase Three-Wire), 3P3W (Three-Phase Three-Wire), 3P4W (Three-Phase Four-Wire), and 3V3A (Three-Voltage Three-Current).
Mode	**Measurement Mode Button:** Press and release to select between RMS, VMean, and DC measurement modes. *Long press to capture the current screen.*
Meter	**General Parameter Measurement Button:** Cycles through four different display modes. Each mode contains four display pages; pages can be changed using ▲ / ▼. Up to 24 parameters can be displayed simultaneously.
Harmonic	**Harmonic Measurement Button:** Provides two display modes for harmonics: bar chart and list view.
Wave	**Waveform Display Button:** Displays voltage and current waveforms, with four user-defined measurement parameters.
Integ	**Integration Function Button:** Integrates average active power for each channel, current integration, as well as total power and current under different wiring modes.
Lock Long Push	**Key Lock:** Disables all other key operations. Long-press (approx. 1s) to unlock.
Voltage	**Voltage Range Button:** Select the desired voltage range using ▲ / ▼, then press Enter to confirm and exit. Press Esc to exit without saving.
Current	**Current Range Button:** Select the desired current range using ▲ / ▼, then press Enter to confirm and exit. Press Esc to exit without saving.
Max Hold	**Maximum Value Hold Button:** Holds the maximum measured value; updates automatically if a new maximum is detected.
Hold	**Data Hold Button:** Holds the currently measured data from the input terminals.
Start	**Integration Start Button:** Press this button to start the integration process.
Stop	**Integration Stop Button:** Press this button to stop the ongoing integration.
Reset	**Integration Reset Button:** When integration is stopped or an error occurs, press this button to reset both the integration results and the integration status.
Single	**Single Button** (Single Measurement Function): When the data hold function is enabled, press the Single button once to refresh and update the measurement data.
Setup	**Setup Button** (Measurement-Related Function Setting): Provides access to settings such as synchronization source, line filter, frequency filter, crest factor,

Button	Functional Description
	data update interval, averaging filter, external current sensor, transformation ratio, range hopping, and D/A (Digital-to-Analog) conversion.
	**System Menu Button:** Opens submenus including system information, general settings, serial port settings/GPIB settings, network settings, and USB flash drive settings.
	**Zero Calibration Button:** Press this button to perform zero potential calibration.

3.5.2 Display Contents

Display Contents	Description
U-R 15 V /30 V /150 V /300 V /600 V /1000 V /2000V	**U-R (Voltage Range):** Indicates that the voltage is set to a fixed range of 15 V, 30 V, 150 V, 300 V, 600 V, 1000 V or 2000V. (When CF = 6 or 6 A, each range is halved.)
U-A 15 V /30 V /150 V /300 V /600 V /1000 V/2000V	**U-A (Auto Voltage Range):** Indicates that the voltage is set to an auto range of 15 V, 30 V, 150 V, 300 V, 600 V, 1000 V or 2000V. (When CF = 6 or 6 A, each range is halved.)
I-R 500 mA /1 A /2 A /5 A /10 A /20 A /50 A	**I-R (Current Range):** Indicates that the current is set to a fixed range of 500 mA,1 A, 2 A, 5 A, 10 A, 20 A, or 50 A. (When CF = 6 or 6 A, each range is halved.)
I-A 500 mA /1 A /2 A /5 A /10 A /20 A /50 A	**Auto Current Range:** Indicates that the current is set to an auto range of 500 mA,1 A, 2 A, 5 A, 10 A, 20 A, or 50 A. (When CF = 6 or 6 A, each range is halved.)
EXT1	**EXT1 (External Current Sensor 1):** Indicates that the EXT1 sensor channel is used for current measurement input.
EXT2	**EXT2 (External Current Sensor 2):** Indicates that the EXT2 sensor channel is used for current measurement input.
I-RANGE 2.5 V /5 V /10 V	**I-RANGE (EXT1 Current Range):** Indicates that the current measurement (EXT1 channel) is set to a fixed range of 2.5 V, 5 V, or 10 V. (When CF = 6 or 6 A, each range is halved.)
I-AUTO 2.5 V /5 V /10 V	**I-AUTO (EXT1 Auto Current Range):** Indicates that the current measurement (EXT1 channel) is set to an auto range of 2.5 V, 5 V, or 10 V. (When CF = 6 or 6 A, each range is halved.)
I-R 50 mV /100 mV /200 mV /500 mV /1 V /2 V	**I-R (EXT2 Current Range):** Indicates that the current measurement (EXT2 channel) is set to a fixed of 50 mV, 100 mV, 200 mV, 500 mV, 1 V, or 2 V. (When CF = 6 or 6 A, each range is halved.)

Display Contents	Description
I-A 50 mV /100 mV /200 mV /500 mV /1 V /2 V	**I-A (EXT2 Auto Current Range):** Indicates that the current measurement (EXT2 channel) is set to an auto range of 50 mV / 100 mV, 200 mV, 500 mV, 1 V, or 2 V. (When CF = 6 or 6 A, each range is halved.)
SCALE	**SCALE (Transformation Ratio):** Indicates that the transformation ratio function is enabled.
500 Hz /1 kHz /2 kHz /3 kHz /4 kHz /5 kHz /5.5 kHz /6 kHz /7 kHz /8 kHz /9 kHz /10 kHz /20 kHz /30 kHz /40 kHz /50 kHz /60 kHz /70 kHz /80 kHz /90 kHz /100 kHz	**Line Filter (ON):** Indicates that the line filter is enabled, with the cutoff frequency selectable from 500 Hz, 1 kHz, 2 kHz, 3 kHz, 4 kHz, 5 kHz, 5.5 kHz, 6 kHz, 7 kHz, 8 kHz, 9 kHz, 10 kHz, 20 kHz, 30 kHz, 40 kHz, 50 kHz, 60 kHz, 70 kHz, 80 kHz, 90 kHz, or 100 kHz.
F.F	**Frequency Filter (ON):** Indicates that the frequency filter is enabled.
RMS DC VMean	**RMS DC VMean (Measurement Mode):** Indicates the current measurement mode is RMS (Root Mean Square), DC (Direct Current), or VMean (Voltage Mean).
SYNC.OFF	**SYNC.OFF (Sync Source):** Indicates that no synchronization source is set.
SYNC.U	**SYNC.U (Sync Source: Voltage):** Indicates that voltage is selected as the synchronization source.
SYNC.I	**SYNC.I (Sync Source: Current):** Indicates that current is selected as the synchronization source.
1P3W /3P3W /3P4W /3V3A	**1P3W /3P3W /3P4W /3V3A (Wiring Method):** Indicates the wiring mode 1P3W (Single-Phase Three-Wire), 3P3W (Three-Phase Three-Wire), 3P4W (Three-Phase Four-Wire), and 3V3A (Three-Voltage Three-Current).
P.V 1 2 3	**P.V 1 2 3 (Peak Voltage Over Range):** Indicates that the peak voltage has exceeded the measurement range for Channel 1, 2, or 3.
P.I 1 2 3	**P.V 1 2 3 (Peak Current Over Range):** Indicates that the peak current has exceeded the measurement range for Channel 1, 2, or 3.
fault.1	**Indicates a channel failure**
 	**Key Sound (ON/OFF):** Indicates whether the key sound is enabled  or disabled .
	**Remote Control Mode:** Indicates that the power meter is operating in remote control mode.
	**USB Detection:** Indicates that a USB flash drive is inserted.

3.6 Rear Panel Overview

The rear panel of the UTE323 series digital power meters integrates multiple interfaces and terminals, including voltage, current, and sensor input terminals (for three measurement units), instrument power socket, D/A (Digital-to-Analog) output and control interfaces, RS-232/GPIB communication interfaces, USB communication interface, and Ethernet communication interface.

For illustration, the rear panel layout of the UTE323/UTE323G models is shown below.

The key differences are as follows:

Communication interface

- UTE323G, UTE333HG and UT333HG-2K models are equipped with a GPIB interface.
- UTE323, UTE333H and UT333H-2K models are equipped with an RS-232 interface.

Measurement range:

The maximum allowable direct input for UTE323 / UTE323G is **600V / 20A**.

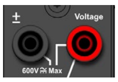
The maximum allowable direct input for UTE333H/UTE333HG is **1500V / 50A**.

The maximum allowable direct input for UTE333H-2K/UTE333HG-2K is **2000V / 50A**.

UTE323 Rear Panel

UTE323G Rear Panel

Functions on Real Panel

No.	Rotary/Interface	Functional Description
1		Voltage Input Terminals (per unit): UTE323/UTE323G: maximum measuring voltage 600 V UTE333H/UTE333HG: maximum measuring voltage 1500 V UTE333H-2K/UTE333HG-2K: maximum measuring voltage 2000 V
2		Current Input Terminals (per unit): UTE323/UTE323G: maximum allowable input current 20 A UTE333H/UTE333HG UTE333H-2K/UTE333HG-2K: maximum allowable input current 50 A
3		External Current Sensor Input Interfaces (per unit): Ext1: maximum allowable input voltage 10 V Ext2: maximum allowable input voltage 2 V
4		RS-232 Communication Interface: The UTE323, UTE333H and UTE333H-2K models are equipped with this interface.
5		GPIB Communication Interface: The UTE323G, UTE333HG and UTE333HG-2K models are equipped with this interface.

No.	Rotary/Interface	Functional Description
6		**D/A Output and Control Interfaces:** For analog signal output and instrument control signal transmission.
7		**USB Communication Interface:** Enables data transfer and basic remote operation with a computer.
8		**LAN (Ethernet) Communication Interface:** Supports remote control of the power meter via a local area network.
9		**3-Wire Power Input Socket:** For AC power supply connection (AC 100 V–240 V, 50/60 Hz).

Chapter 4 Operation Preparation and Wiring

4.1 Pre-Operation Preparation

4.1.1 Confirm Power Supply and Measurement Range

The instrument operates with an AC voltage of 100 V–240 V (50/60 Hz). Ensure that the power supply is within the rated voltage range, the instrument is properly grounded, and the voltage and current under test are within the allowable range of the power meter.

⚠ Warning

1. Always confirm that the supply voltage matches the rated voltage before turning on the instrument; otherwise, the instrument may be damaged.
2. Use the instrument only under recommended operating conditions. Do not operate the instrument in environments containing flammable or explosive materials, as using any electronic device in such conditions may result in safety hazards.
3. Only one of the Current Terminal or External Sensor interface may be used at a time. When using one interface, ensure that the other interface has no connections; otherwise, abnormal test results or other malfunctions may occur.

4.2 Wiring Method

The UTE323 series digital power meter support four wiring modes: 1P3W (Single-Phase Three-Wire), 3P3W (Three-Phase Three-Wire), 3P4W (Three-Phase Four-Wire), and 3V3A (Three-Voltage Three-Current). Refer to the following wiring diagrams to select the appropriate wiring mode and perform correct wiring.

Notes

1. For single-phase two-wire measurement (1P2W), any one of the connection modes can be used to measure by using any one of the units for connection.
2. The different colors shown in the wiring diagrams are only for distinguishing phase lines. Actual phase wire colors should comply with local standards and regulations.
3. Load current flows through the thicker wires shown in the diagrams. Ensure that these wires have sufficient current-carrying capacity to prevent overheating or damage.
4. Always turn off the power supply of both the load and the power meter before wiring at the load terminal to ensure operator safety and avoid damage caused by transient currents.
5. When measuring high current/voltage or signals containing high-frequency components, take precautions against mutual interference and noise. Use shielded cables or twisted pairs when necessary.
6. Keep test wires as short as possible to minimize the influence of stray capacitance on measurement accuracy.
7. To reduce distributed capacitance to ground, keep test wires and ground wires as far away from the power meter housing as possible.

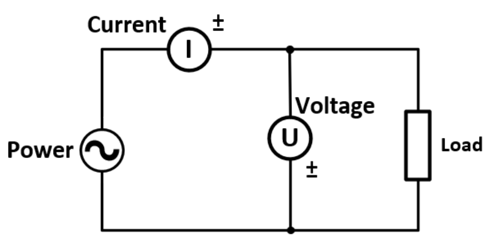
4.2.1 1P2W Wiring Connection

Single-phase two-wire (1P2W) systems are commonly used in DC applications, household lighting, and chargers, involving only the live (L) and neutral (N) wires.

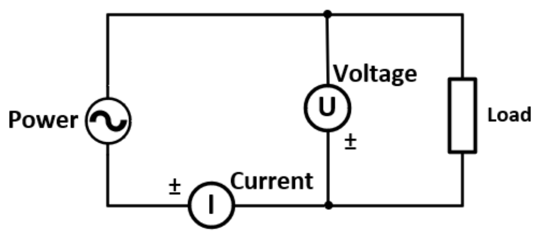
When measuring the power of a 1P2W device with the UTE323 digital power meter, select any mode and connect any one measurement unit for wiring. To achieve more accurate measurements, the following factors should be considered during the measurement process: the position of the terminal connections, the influence of stray capacitance, and the magnitude of voltage and current.

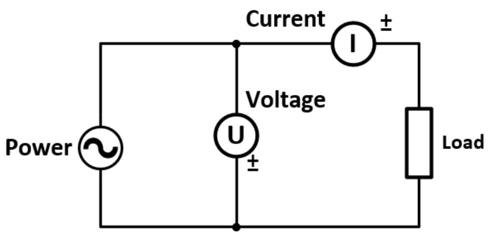
(1) **Impact of stray capacitance:** When measuring 1P2W devices, connect the instrument's current input terminal to the side closer to the power supply ground. This reduces the effects of stray capacitance on measurement results. The wiring diagram is shown below.

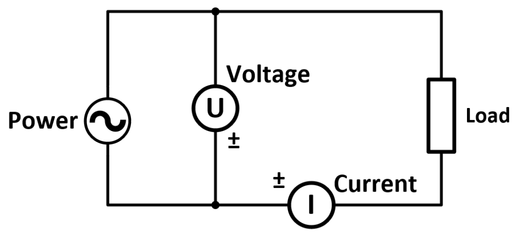
Easily Affected



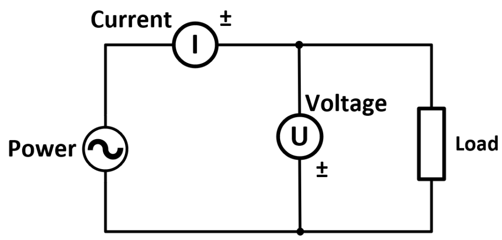
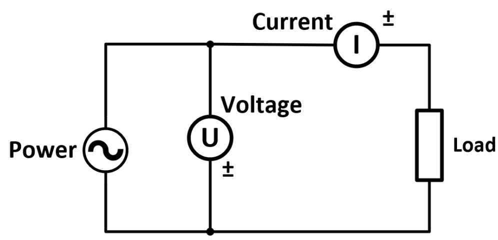
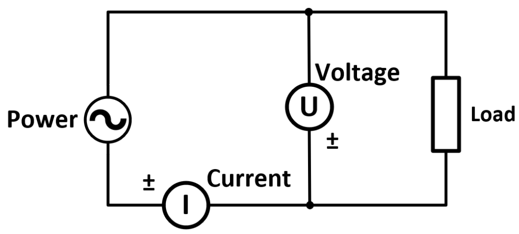
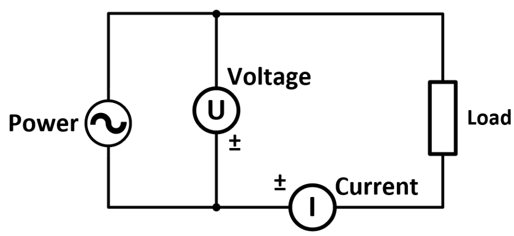
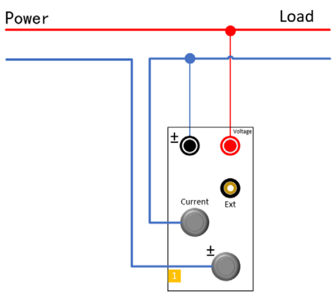
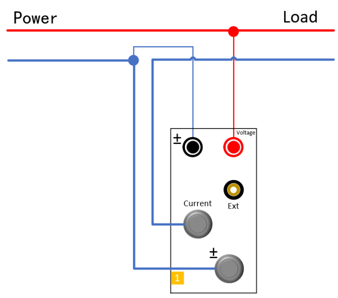
Not Easily Affected







(2) Impact of the magnitude of current:

	High Current Wiring Method	Low Current Wiring Method
Easily Affected		
Not Easily Affected		
Wiring Diagram		

When using the high-current wiring method for measurement, the voltage is measured at the load end, ensuring accurate voltage measurement. However, due to the leakage current of the multi-measurement voltmeter, the measured load current may be higher than the actual value.

The power error introduced by this wiring method is:

$$P_{LOS}=\frac{U^2}{2000000\Omega}$$

U indicates the voltage measured by the voltmeter, expressed in volts (V).

When using the low-current wiring method for measurement, the voltage is measured at the power supply end, while the current measurement is accurate. However, due to the voltage division characteristic of the multi-measurement ammeter, the measured load voltage may be higher than the actual value.

The power error introduced by this wiring method is:

$$P_{LOS}=I^2 x 0.002\Omega$$

I indicates the current measured by the ammeter, expressed in amperes (A).

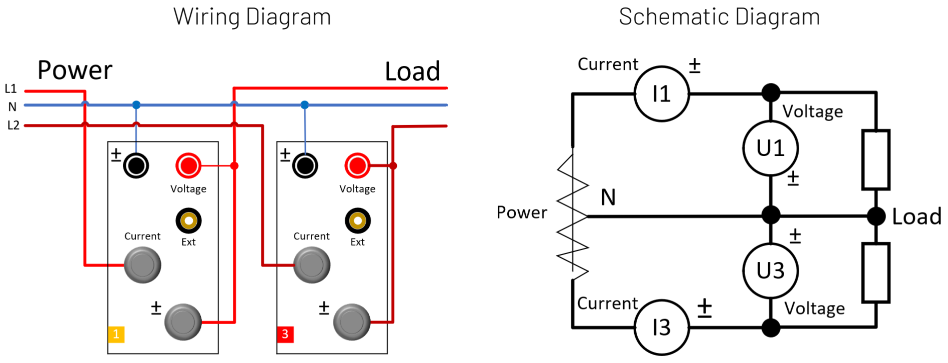
4.2.2 1P3W Wiring Connection

The single-phase three-wire (1P3W) system is commonly used in power supply systems with two live wires (L1, L2) and one neutral wire (N).

When measuring using the 1P3W wiring method:

- Use Unit 1 of the power meter to measure the circuit between the L1 wire and the N wire.
- Use Unit 3 of the power meter to measure the circuit between the L2 wire and the N wire.

The wiring diagram is shown below.



4.2.3 3P3W Wiring Connection

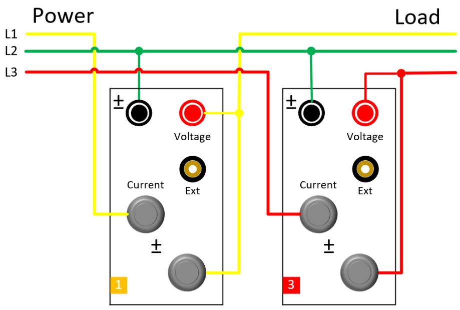
The three-phase three-wire (3P3W) system consists of three phase wires: L1 (yellow), L2 (green), and L3 (red). This system does not include a neutral (N) or protective earth (PE) wire and is suitable only for three-phase balanced loads, such as three-phase asynchronous motors (e.g., water pump motors, fan motors, compressors, conveyor belt motors), machine tool equipment, and air compressors.

When measuring using the 3P3W wiring method:

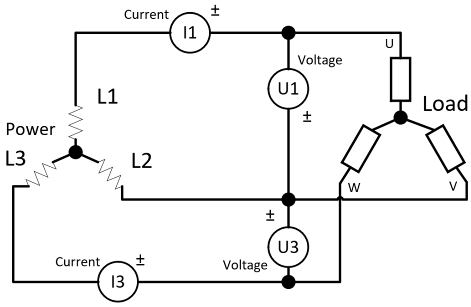
- Take the L2 wire as the reference phase.
- Use Unit 1 of the power meter to measure the circuit between the L1 wire and the L2 wire.
- Use Unit 3 of the power meter to measure the circuit between the L3 wire and the L2 wire.
- After wiring, connect the L1, L2, and L3 phases to the U, V, and W phases of the load, respectively.

The wiring diagram is shown below.

Wiring Diagram



Schematic Diagram



Warning

- Ensure that the three-phase load is balanced.
- Verify the phase sequence before applying power.
- This power supply system does not provide ground wire protection. To prevent electric shock caused by live equipment enclosures due to load leakage, properly ground the load casing. The grounding resistance must be ≤ 4 Ω.

4.2.4 3V3A Wiring Connection

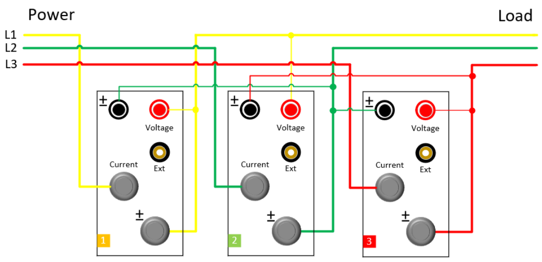
The three-voltmeter three-ammeter (3V3A) wiring method is suitable for three-phase power supply systems and is used when line voltages need to be measured phase by phase.

When using the 3V3A wiring method:

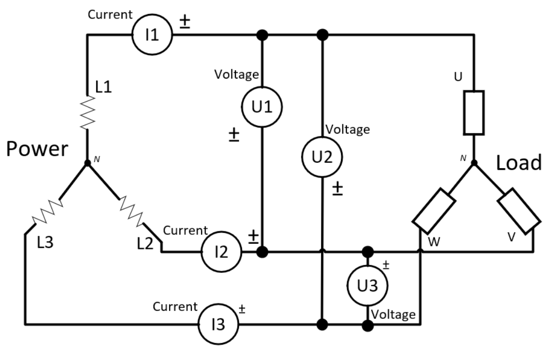
- Use Unit 1 of the power meter to measure the line voltage between L1 and L2.
- Use Unit 2 to measure the line voltage between L1 and L3.
- Use Unit 3 to measure the line voltage between L3 and L2.

The wiring diagram is shown below.

Wiring Diagram



Schematic Diagram



4.2.5 3P4W Wiring Connection

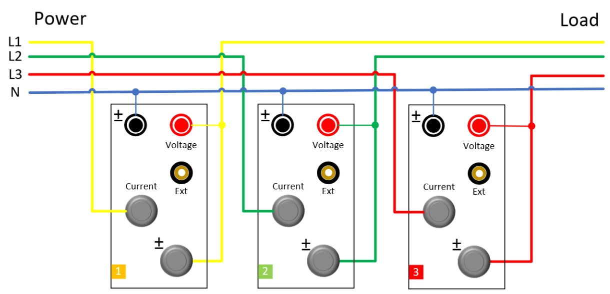
The three-phase four-wire system consists of three phase wires L1 (yellow), L2 (green), L3 (red), and one neutral wire N (light blue). It is used to measure the phase voltages of a three-phase four-wire power system.

This configuration can simultaneously provide three-phase 380 V and single-phase 220 V outputs and is widely used in industrial, commercial, and residential power distribution.

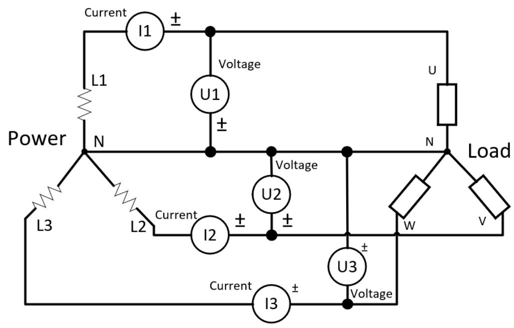
When the three phases are balanced, the current in the neutral wire is close to zero. If the three phases are unbalanced, the neutral wire carries the unbalanced current.

The wiring diagram is shown below.

Wiring Diagram



Schematic Diagram



Notes

- The instrument casing must be properly grounded during measurement.
- The grounding resistance must be ≤ 4 Ω.

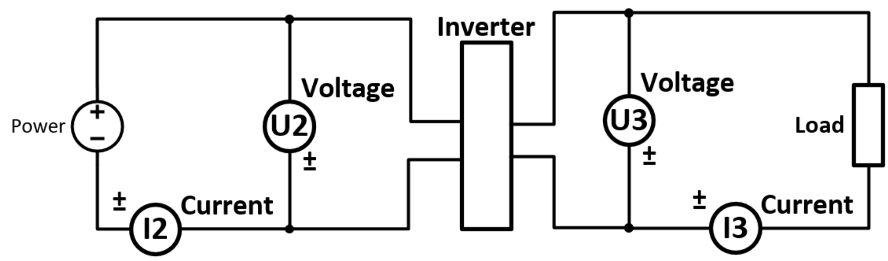
4.2.6 Wiring Connection for Single-Input Signle-Output Efficiency Measurement

When using the single-input single-output efficiency method:

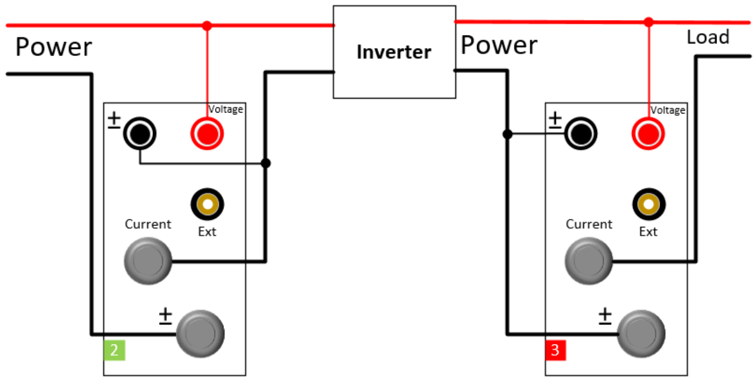
- Connect Unit 2 of the power meter to the DUT input to measure input power.
- Connect Unit 1 or Unit 3 of the power meter to the DUT output to measure output power.

When measuring efficiency using this method, for the first and third units, when using one unit, it is necessary to ensure that the other unit is not connected to any measuring equipment.

Schematic Diagram



Wiring Diagram

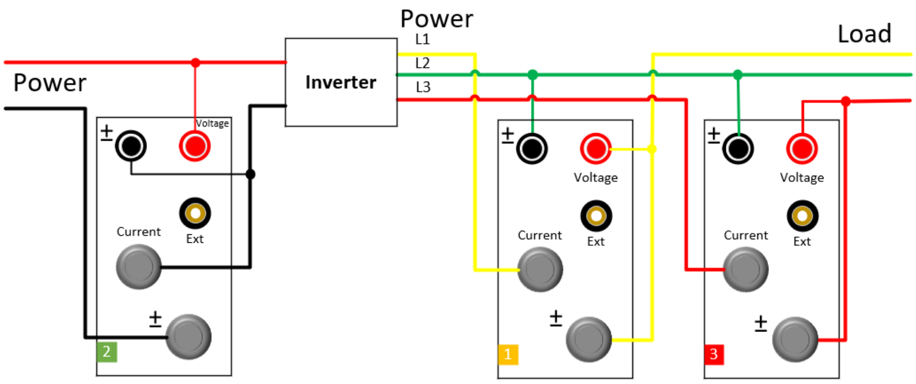


4.2.7 Wiring Connection for Single-Input Three-Output Efficiency Measurement

When using the single-input three-output efficiency method:

- Connect Unit 2 of the power meter to the DUT input to measure input power.
- Connect Unit 1 and Unit 3 of the power meter to the DUT output to measure output power.

The wiring diagram is shown below.



4.3 Wiring Connection for External Current Sensor Measurement

When the current in the measurement circuit exceeds the maximum allowable input current of the input unit (channel), an external current sensor can be connected to the current sensor input terminals to measure the current.

4.3.1 Wiring Method and Precautions

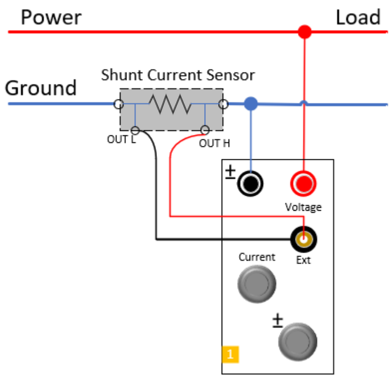
Before connecting the measurement cable from the external current sensor to the current sensor input terminals, unplug any cable connected to the current input terminals. The current sensor input interface and the current input port are internally connected. If both cables are connected simultaneously, this may cause measurement errors (due to signal interference) or even instrument malfunction.

When applying voltage from the measurement circuit to the external current sensor input interface, do not touch the current input terminals. These terminals are electrically connected internally. Touching them under this condition may result in electric shock.

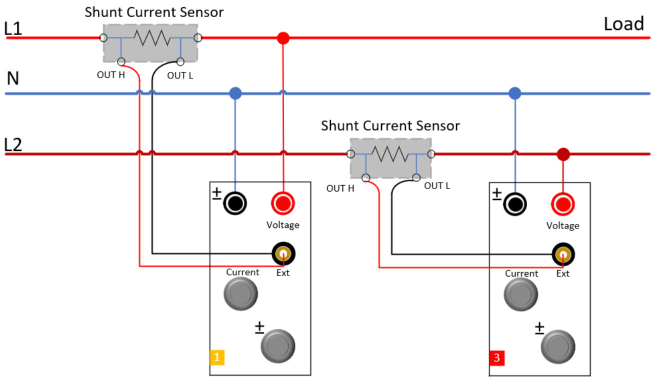
⚠ Warning

- **Do Not Use Exposed Sensors:** Using exposed sensors is extremely dangerous, as accidental contact may result in electric shock. Always ensure that the sensor is enclosed in a protective housing. The energized parts of the sensor must be insulated from the housing and have sufficient voltage rating to withstand the operating voltage of the measurement circuit.
- **Perform Wiring Only When Power Is Off:** Never wire a shunt or sensor while the measurement circuit is energized, this is highly hazardous. A shunt carries voltage when energized, so avoid touching it. Ensure the power supply of the measurement circuit is completely turned off before wiring.
- **Do Not Touch Cables During Measurement:** When using the external sensor input terminals, do not touch the current input terminals or any connected measurement cables with your hands. Once the measurement circuit is powered, voltage may be present on the current input terminals, posing a significant electric shock risk.
- **Use Safe Sensors and Connectors:** Connect external sensors to the instrument's input terminals using connectors with safe interface designs. If a connector accidentally detaches, exposed conductive parts may become energized, creating a hazard. Before using clamp-on current sensors, fully understand the voltage of the measurement circuit, as well as the specifications and operating instructions of the sensor. Verify that no hazards (such as electric shock risks) exist before proceeding with measurements.

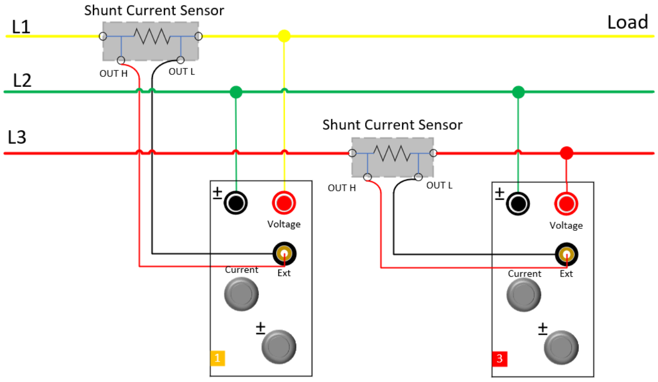
4.3.2 1P2W Wiring Connection Using Shunt-Type Sensors



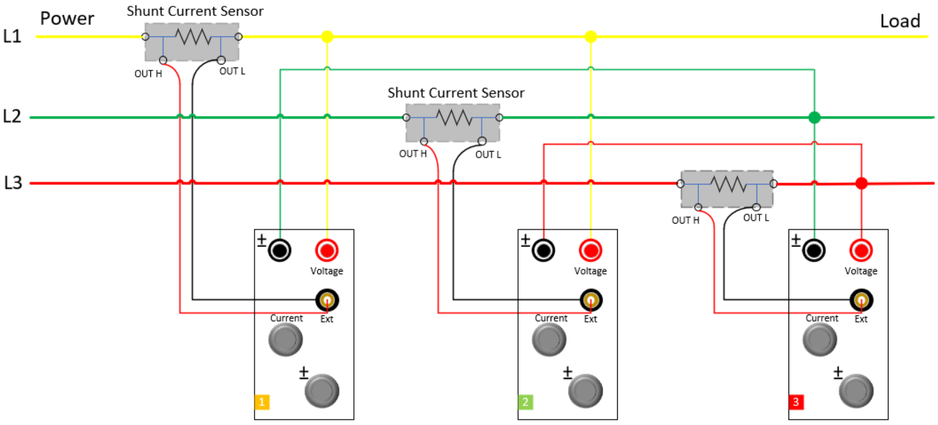
4.3.3 1P3W Wiring Connection Using Shunt-Type Sensors



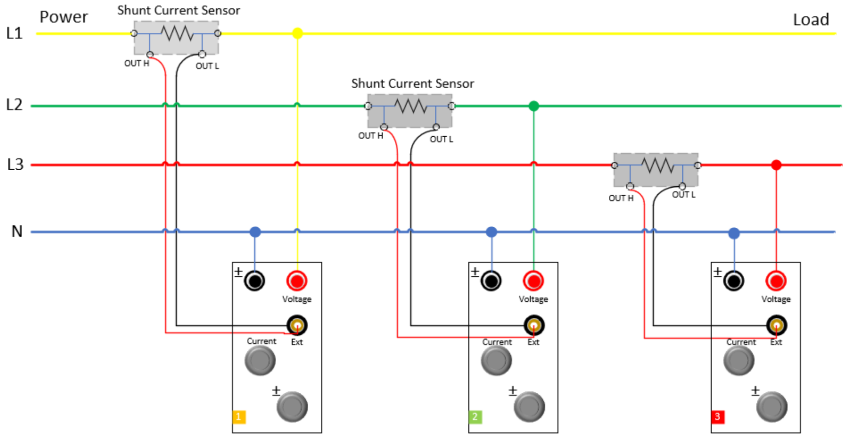
4.3.4 3P3W Wiring Connection Using Shunt-Type Sensors



4.3.5 3V3A Wiring Connection Using Shunt-Type Sensors



4.3.6 3P4W Wiring Connection Using Shunt-Type Sensors



4.4 Wiring Connection for VT/CT Measurement

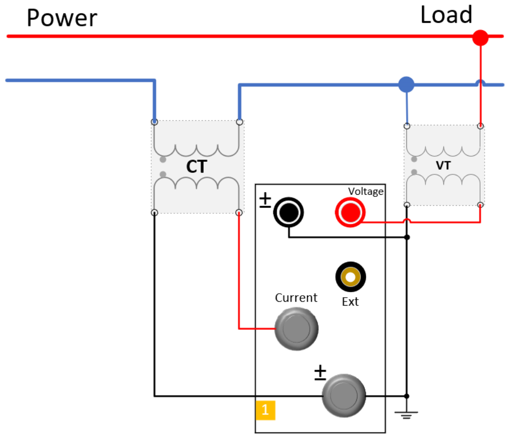
When the voltage or current of the DUT exceeds the power meter's maximum allowable input, a VT (Voltage Transformer) or CT (Current Transformer) can be used to step down the voltage or current to levels within the meter's input range.

Wiring Steps

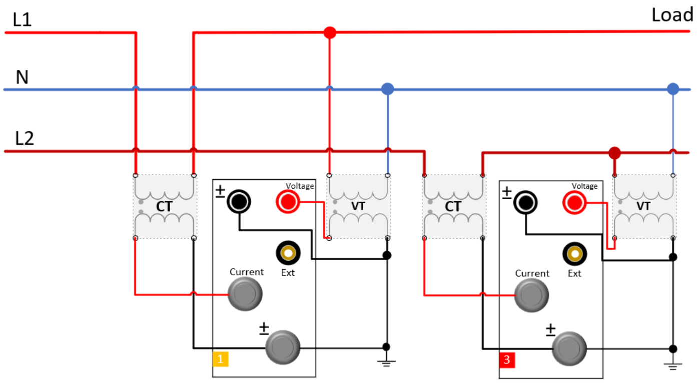
1. Connect the secondary side of the VT to the power meter's voltage input terminals.
2. Connect the secondary side of the CT to the power meter's current input terminals.
3. Enable the transformation ratio function on the power meter and set the correct VT/CT ratio. This ensures that the power meter calculates the actual voltage or current of the DUT by compensating for the transformation.

⚠ **Note:** Always ground the secondary side of the VT and/or CT.

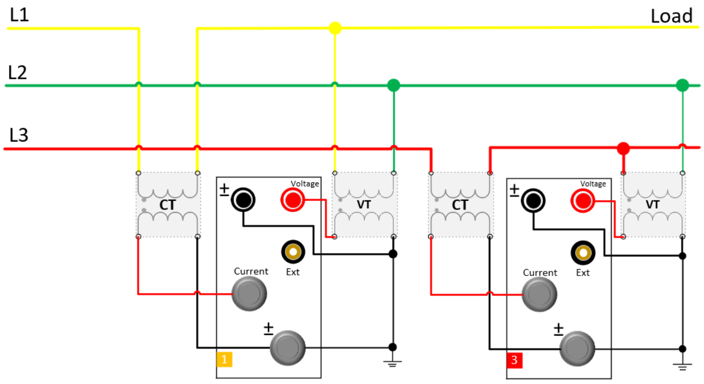
4.4.1 1P2W Wiring Connection Using VT/CT Measurement



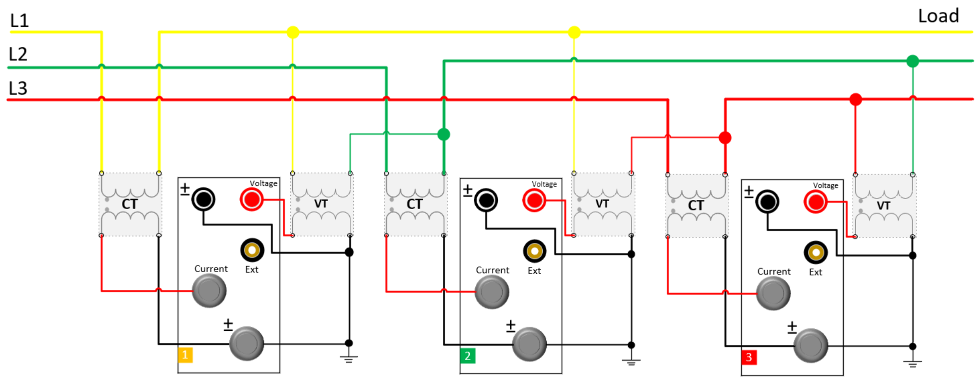
4.4.2 1P3W Wiring Connection Using VT/CT Measurement



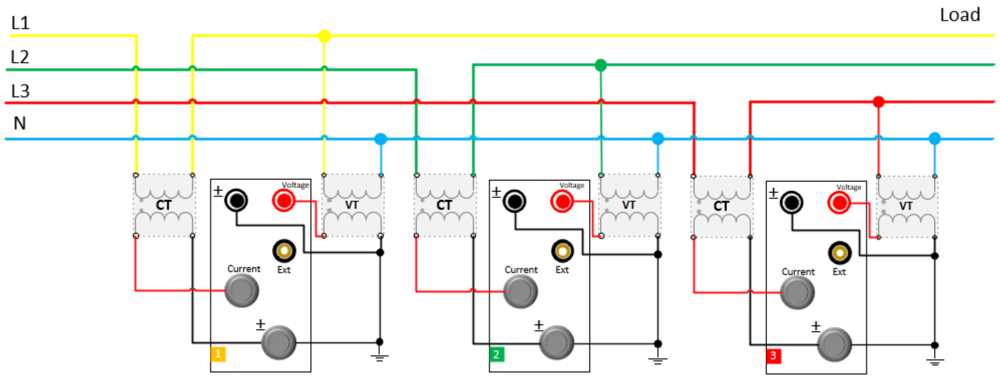
4.4.3 3P3W Wiring Connection Using VT/CT Measurement



4.4.4 3V3A Wiring Connection Using VT/CT Measurement



4.4.5 3P4W Wiring Connection Using VT/CT Measurement



Chapter 5 General Measurement Configuration

5.1 Range Settings

5.1.1 Voltage Range Settings

Setting Steps

1. When the integration function is not enabled, press the Voltage button on any measurement interface to move the cursor to the voltage range position (highlighted in blue).
2. Press the up ▲ or down ▼ keys to select the desired voltage range.
3. Press the Enter button to save the selected voltage range, or press the Esc button to exit the setting.

Notes:

UTE323/UTE323G voltage range (CF = 3): Auto,15 V, 30 V, 60 V, 150 V, 300V, 600 V (CF = 3)

UTE333H/UTE333HG voltage range (CF = 3): Auto, 15 V, 30 V, 60 V, 150 V, 300 V, 600 V, 1000 V

UTE333H-2K/UTE333HG-2K voltage range (CF = 3): Auto, 15 V, 30 V, 60 V, 150 V, 300 V, 600 V, 1000 V, 2000 V

When CF = 6 or 6 A, all ranges are halved.

UTE323/UTE323G voltage range (CF = 6 or 6 A): Auto, 7.5 V, 15 V, 30 V, 75 V, 150 V, 300 V

UTE333H/UTE333HG voltage range (CF = 6 or 6 A): Auto, 7.5 V, 15 V, 30 V, 75 V, 150 V, 300V , 500 V

UTE333H-2K/UTE333HG-2K voltage range (CF = 6 or 6 A): Auto, 7.5 V, 15 V, 30 V, 75 V, 150 V, 300V , 500 V, 1000 V

Auto indicates the auto range mode.

Maximum display range (CF = 3): 0.5% to 140% of the range

When CF is set to 3, the crest factor of the 1000V range is 1.8, the maximum effective input is 1000V, and the maximum peak input is 1800V;

When CF is set to 6, the crest factor of the 500V range is 3, the maximum effective input is 500V, and the maximum peak input is 1800V;

The maximum effective input of the 1000 range of UTE333H/UTE333HG is 1000Vrms, and the maximum effective DC input supports 1500Vdc.

The maximum allowable AC input of the 2000V range of UTE333H-2K/UTE333HG-2K is 1100Vrms, and the maximum allowable DC input is 2050Vdc.

5.1.2 Current Range Settings

Setting Steps

1. When the integration function is not enabled, press the Current button on any measurement interface to move the cursor to the voltage range position (highlighted in blue).
2. Press the up ▲ or down ▼ keys to select the desired current range.
3. Press the Enter button to save the selected current range, or press the Esc button to exit the setting.

Notes:

UTE323/UTE323G current range (CF = 3): Auto, 500 mA, 1 A, 2 A, 5 A, 10 A, 20 A

UTE333H/UTE333HG/ UTE333H-2K/UTE333HG-2K current range (CF = 3): Auto, 1 A, 2 A, 5 A, 10 A, 20 A, 50 A

When CF = 6 or 6 A, all ranges are halved.

UTE323/UTE323G current range (CF = 6 or 6 A): Auto, 250 mA, 500 mA, 1 A, 2.5 A, 5 A, 10 A

UTE333H/UTE333HG/ UTE333H-2K/UTE333HG-2K current range (CF = 6 or 6 A): Auto, 500 mA, 1 A, 2.5 A, 5 A, 10 A, 25 A

Auto indicates the auto range mode.

Maximum current display range (CF = 3): 0.5% to 140% of the range. For the 50A range, it is 0.5% to 100%.

Current Range Setting for External Current Sensor Channels

When measuring with external current sensor channels (Ext1 / Ext2), the available current ranges vary depending on the channel type and CF setting.

Ext1 (CF = 3): Auto, 2.5 V, 5 V, 10 V

Ext2 (CF = 3): Auto, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V

When CF = 6 or 6 A, all ranges are halved.

Ext1 (CF = 6 or 6 A): Auto, 1.25 V, 2.5 V, 5 V

Ext2 (CF = 6 or 6 A): Auto, 25 mV, 50 mV, 100 mV, 250 mV, 500 mV, 1 V

Auto indicates the auto range mode.

5.1.3 Range Switching

Manual (Fixed) Range

When set to manual range, the selected range remains fixed and does not change, even if the input signal level varies.

Auto Range

When set to auto range, the power meter automatically switches ranges according to the input signal level.

Auto Voltage Range Increase

The voltage range will automatically increase when any of the following conditions are met.

1. CF = 3 or 6

   The measured voltage value Urms exceeds 130% of the rated range.

2. CF = 6 A

   The measured voltage value Urms exceeds 260% of the rated range.

3. CF = 3

   The instantaneous sampling voltage or voltage peak value Upk exceeds approximately 300% of the rated range.

4. CF = 6 or 6 A

   The instantaneous sampling voltage or voltage peak value Upk exceeds approximately 600% of the rated range.

Auto Voltage Range Decrease

The voltage range will automatically decrease when any of the following conditions are met.

5. CF = 3

   Urms ≤ 30% of the rated range and less than 125% of the previous range, while Upk ≤ 300% of the previous range.

6. CF = 6 or 6 A

   Urms ≤ 30% of the rated range and less than 125% of the previous range, while Upk ≤ 600% of the previous range.

Auto Current Range Increase

The current range will automatically upscale when any of the following conditions are met.

7. CF = 3 or 6

   The measured current value Irms exceeds 130% of the rated range.

8. CF = 6 A

   The measured current value Irms exceeds 260% of the rated range.

9. CF = 3

   The instantaneous sampling current or current peak value Ipk exceeds approximately 300% of the rated range.

10. CF = 6 or 6 A

    The instantaneous sampling current or current peak value Ipk exceeds approximately 600% of the rated range.

Auto Current Range Decrease

The current range will automatically decrease when any of the following conditions are met.

11. CF = 3

    Irms ≤ 30% of the rated range and less than 125% of the previous range, while Ipk ≤ 300% of the previous range.

12. CF = 6 or 6 A

    Irms ≤ 30% of the rated range and less than 125% of the previous range, while Ipk ≤ 600% of the previous range.

5.2 Measurement Mode

The UTE323 digital power meter provides three measurement modes, which can be configured according to the type of signal being measured or the values that need to be displayed.

In the display interface, the parameter positions for U (Voltage), I (Current), S (Apparent Power), and Q (Reactive Power) will update dynamically based on the selected measurement mode.

For example, in DC mode, U is displayed as Udc (DC Voltage); in RMS mode, U is displayed as Urms (Voltage RMS).

Setting Steps

1. Press and release the Mode button; the measurement mode changes each time the key is pressed.
2. Repeat step 1 to cycle through the three modes: RMS, DC, VMean.

Display Types

The display types for voltage and Current vary depending on the selected measurement mode, as provided in the table below.

Measurement Mode	Voltage	Current
RMS	True RMS value	True RMS value
DC	Linear average	Linear average
VMean	Rectified mean value calibrated to the RMS value	True RMS value

Calculation Formula

RMS: Select this mode to display the true RMS values of voltage and current. The calculation formula is as follows.

$$\sqrt{\frac{1}{T}\int_0^T f(t)^2 \mathrm{dt}}$$

f (t): Input signal

T: The period of input signal

DC: Select this mode, when the input voltage or current is DC. The input signal is linearly averaged, calculation formula is as follows.

$$\frac{1}{T}\int_0^T f(t)\mathrm{dt}$$

f (t): Input signal

T: The period of input signal

VMean: Select this mode to display the voltage as a rectified mean value calibrated to the RMS value. The calculation formula is as follows.

$$\frac{\pi}{2\sqrt{2}} \times \frac{1}{T}\int_0^T |f(t)|\mathrm{dt}$$

f (t): Input signal

T: The period of input signal

5.3 Display Mode

The general measurement parameters of the UTE323 power meter are designed to offer four display modes: simple display, standard display, multi-channel display, and display of calculation results. Each of these display modes consists of four display pages, labeled as "Page:1", "Page:2", "Page:3", and "Page:4". The parameters and channel numbers displayed on each display page can be customized. This section mainly introduces the switching of these four display modes and the parameter switching within each display mode.

5.3.1 Simple Display Mode

The simple display mode shows the measurement results of four primary parameters on the screen. During measurement, users can cycle through different display modes by pressing the Meter button. This mode provides four display pages, which can be switched using the up or down keys.

Page 1: Channel 1 parameters U1 (Voltage 1), I1 (Current 1), P1 (Active Power 1), PF1 (Power Factor 1).

Page 2: Channel 2 parameters U2 (Voltage 2), I2 (Current 2), P2 (Active Power 2), PF2 (Power Factor 2).

Page 3: Channel 3 parameters U3 (Voltage 3), I3 (Current 3), P3 (Active Power 3), PF3 (Power Factor 3).

Page 4: Total parameters of all channels UΣ (Total Voltage), IΣ (Total Current), PΣ (Total Active Power), PFΣ (Total Power Factor).

The figure below shows the default display content of each page in simple display mode.

Page 1

Page 2

Page 3

Page 4

Parameter Settings

In addition to the default parameters, the display content on each page can be customized. The steps to set parameters are as follows.

1. On the desired display page, press the function key F1 (labeled Parameter).
2. Use the up or down keys to move the cursor to the parameter position you want to change.
3. Press the function key F2 (labeled Element) to switch between channels.
4. Press the Enter key to open the list of selectable parameters, as shown in the figure below.

5. Use the arrow keys to navigate to the desired parameter, then press Enter again to confirm, as shown in the figure below.

6. Press the Esc button to exit cursor mode.

5.3.2 Standard Display Mode

The standard display mode shows the measurement results of two primary parameters and eight secondary parameters on the screen. During measurement, users can cycle through different display modes by pressing the Meter button. This mode provides four display pages, which can be switched using the up or down keys.

Page 1: Channel 1 parameters U1, I1, P1, PF1, S1, Q1, fU1, fI1, THDU1, THDI1.

Page 2: Channel 2 parameters U2, I2, P2, PF2, S2, Q2, fU2, fI2, THDU2, THDI2.

Page 3: Channel 3 parameters U3, I3, P3, PF3, S3, Q3, fU3, fI3, THDU2, THDI3.

Page 4: Total parameters of all channels UΣ, IΣ, PΣ, PFΣ, SΣ, QΣ, PHIΣ, P2, MATH, EFFi

The figure below shows the default display content of each page in standard display mode.

Page 1

Page 2

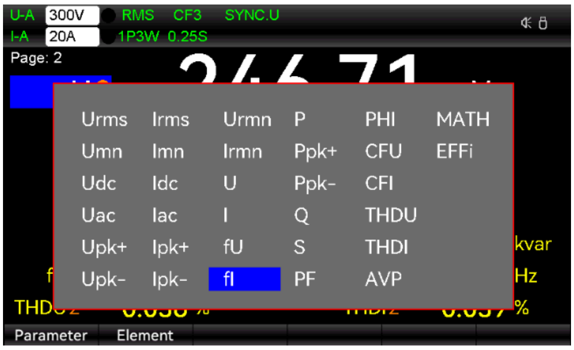
Page 3

Page 4

Parameter Settings

In addition to the default parameters, the display content on each page can be customized. The steps to set parameters are as follows.

1. On the desired display page, press the F1 button (Parameter).
2. Use the arrow keys ▲ ▼ ◀ ▶ to move the cursor to the parameter position you want to change.
3. Press the **F2 (Element)** button to switch between channels.
4. Press the Enter button to open the list of selectable parameters, as shown in the figure below.



5. Use the arrow keys ▲ ▼ ◀ ▶ to navigate to the desired parameter, then press Enter again to confirm, as shown in the figure below.

6. Press the Esc button to exit cursor mode.

5.3.3 Multi-Channel Display Mode

The multi-channel display mode shows the measurement results of three channels simultaneously, with each channel displaying eight parameters on the screen. During measurement, users can cycle through different display modes by pressing the Meter button. This mode provides four display pages, which can be switched using the up or down keys.

The figure below shows the default display content of each page in multi-channel display mode.

Page 1

Page 2

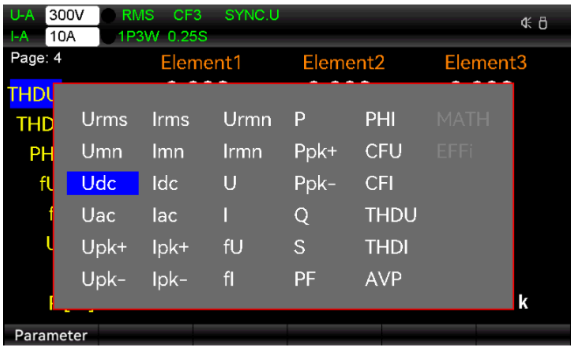
Page 3

Page 4

Parameter Settings

In addition to the default parameters, the display content on each page can be customized. The steps to set parameters are as follows.

1. On the desired display page, press the function button F1 (Parameter).
2. Use the arrow keys to move the cursor to the parameter position you want to change.
3. Press the Enter button to open the list of selectable parameters, as shown in the figure below.



4. Use the arrow keys to navigate to the desired parameter, then press Enter again to confirm, as shown in the figure below.

5. Press the Esc button to exit cursor mode.

5.3.4 Sum Total Display Mode

The sum total display mode builds on the multi-channel display mode by adding an extra column to show the total sum of parameters across all units. Importantly, this total sum is not a simple arithmetic sum of the individual channel values; the calculation formula for Σ (sum) depends on the selected wiring mode.

The calculation formulas for different wiring modes are summarized in the table below.

Wiring Method	1P3W	3P3W	3V3A	3P4W
UΣ [V]	$\frac{U_1+U_3}{2}$	$\frac{U_1+U_3}{2}$	$\frac{U_1+U_2+U_3}{3}$	$\frac{U_1+U_2+U_3}{3}$
IΣ [V]	$\frac{I_1+I_3}{2}$	$\frac{I_1+I_3}{2}$	$\frac{I_1+I_2+I_3}{3}$	$\frac{I_1+I_2+I_3}{3}$
PΣ [V]	P_1+P_3	P_1+P_3	P_1+P_3	$P_1+P_2+P_3$
SΣ [V]	S_1+S_3	$\frac{\sqrt{3}}{2}(S_1+S_3)$	$\frac{\sqrt{3}}{2}(S_1+S_2+S_3)$	$S_1+S_2+S_3$
QΣ [V]	Q_1+Q_3	Q_1+Q_3	Q_1+Q_3	$Q_1+Q_2+Q_3$
λΣ/ PF	$\frac{P\Sigma}{S\Sigma}$	$\frac{P\Sigma}{S\Sigma}$	$\frac{P\Sigma}{S\Sigma}$	$\frac{P\Sigma}{S\Sigma}$
ΦΣ/PHI[°]	$\cos^{-1}(\frac{P\Sigma}{S\Sigma})$	$\cos^{-1}(\frac{P\Sigma}{S\Sigma})$	$\cos^{-1}(\frac{P\Sigma}{S\Sigma})$	$\cos^{-1}(\frac{P\Sigma}{S\Sigma})$

Note: In all formulas, subscripts indicate the channel number. For example, U_2 represents the voltage of Channel 2.

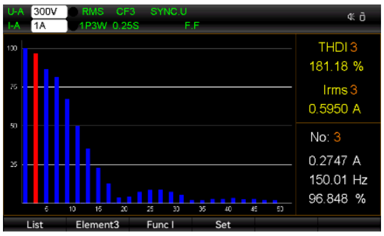
5.4 Harmonic Measurement Interface

The UTE323 series power meters provide a harmonic measurement function fully compliant with the international standard IEC 61000-4-7:2002. Based on the carrier frequency, the power meter can measure up to the 50th harmonic for voltage, current, and power. Key measurements include total harmonic distortion (THD), carrier component, harmonic component of each order, phase difference, and harmonic distortion factor.

The synchronization source can be set to any of U1, U2, U3, I1, I2, or I3, depending on the measurement scenario. The upper limit of harmonic analysis orders can be freely configured between 1 and 50. For applications with specific THD calculation requirements, the power meter can perform calculations accordingly.

Notes: The IEC 61000-4-7:2002 standard specifies precise harmonic calculation methods (e.g., time window, synchronization, and window functions) and performance requirements for standard-compliant measuring instruments.

The power meter provides two display modes for harmonic measurement: histogram and list. The default mode is the histogram, as shown in the figure below.



Histogram Display Mode

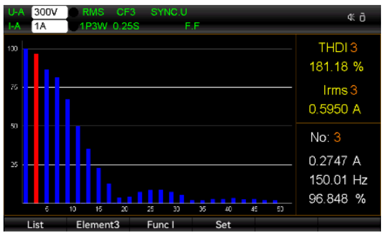
List Display Mode

In list display mode, if there is no input signal or if harmonic measurement is abnormal (for unanalyzed orders), the corresponding harmonics are shown as "------". For example, in IEC mode, harmonics from the 41st to the 50th order are displayed as "------", while the remaining orders are displayed based on actual measurement results.

5.4.1 Harmonic Display in Histogram

On the harmonic measurement interface, pressing the **F1** button toggles the display between histogram mode and list mode. In histogram mode, the following parameters are available for each harmonic order: RMS value, frequency, harmonic distortion factor (harmonic ratio), and total harmonic distortion (THD). Within the same interface, pressing the **F3** button to switch the display between voltage harmonics and current harmonics. Use the ◀ and ▶ keys to select the desired harmonic order or harmonic frequency. The harmonic corresponding to the selected order is highlighted in red on the histogram, as shown in the figure below.

Voltage Harmonics



Current Harmonics

5.4.2 Harmonic Display in List

In list mode, the following parameters can be displayed: RMS values of the 1st to 50th harmonics, harmonic distortion factor, total harmonic distortion (THD), and the phase angle of voltage and current.

The harmonic order can be switched using the ◀ and ▶ keys. The displayed unit can be changed by pressing the **F2** button, as shown in the figure below.

Order	U(V)	I(A)	P(W)	U(%)	I(%)	P(%)	U(°)	I(°)
1	246.11	0.2880	70.48	100.00	100.00	100.00	D6.1	D6.1
2	0.22	0.0070	0.00	0.090	2.423	0.001	155.4	65.5
3	3.81	0.2790	-0.23	1.548	96.887	-0.330	55.7	140.1
4	0.31	0.0067	-0.00	0.126	2.316	-0.001	149.3	-136.3
5	7.59	0.2491	1.67	3.083	86.499	2.363	-5.6	-64.2
6	0.08	0.0054	0.00	0.031	1.861	0.000	-6.2	23.7
7	6.57	0.2356	0.15	2.671	81.812	0.217	45.9	87.6

5.4.3 Harmonic Settings

In the harmonic settings menu, uers can configure the synchronization source, harmonic mode, THD calculation formula, and the maximum harmonic analysis order. Press the **F4** (Set) button on the harmonic measurement interface to access the settings.

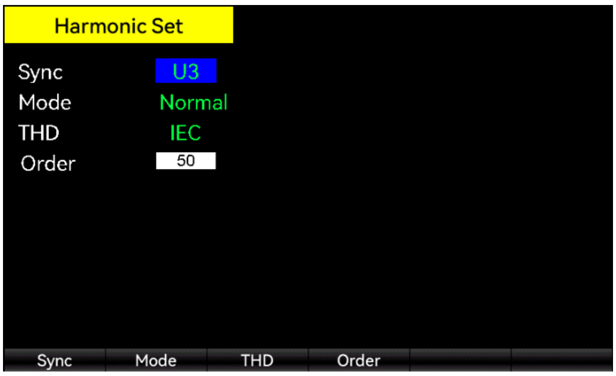
Synchronization Source

To perform harmonic measurements, uers must select the correct synchronization source. the reference for all harmonic calculations. This source determines the fundamental frequency, which serves as the reference for all harmonic calculations.

The synchronization source can be set to U1, U2, U3, I1, I2, or I3, depending on the measurement unit in use.

Setting Steps

1. On the harmonic settings interface, press the **F1** button or use the ▲ and ▼ keys to move the cursor to the Sync field, as shown in the figure below.



2. Use the ◀ and ▶ keys to select the desired synchronization source.
3. Press the Esc button to return to the harmonic measurement interface.

Notes:

Following these guidelines ensures accurate and stable harmonic measurement.

- The signal cycle of the selected synchronization source must match the signal being measured for harmonic measurement.
- Select the input signal with the lower distortion as the synchronization source.
- If the voltage frequency is stable, select the system voltage as the synchronization source.
- If the current frequency is more stable than the voltage, use the current as the synchronization source.

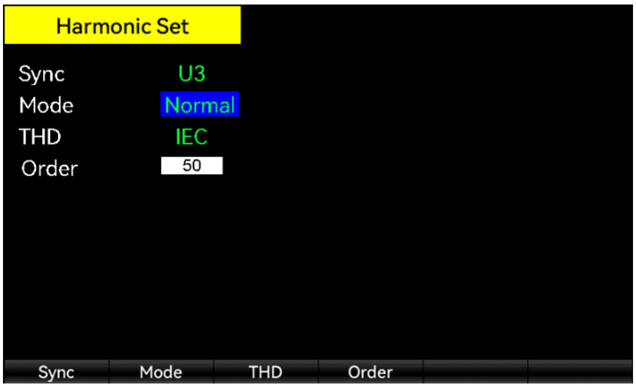
Harmonic Mode Setting

Users can select either Normal Mode or IEC Mode.

In different harmonic measurement modes, the measurement time window and the number of FFT (Fast Fourier Transform) calculation points vary. These parameters directly determine the accuracy, response speed, and compliance of the harmonic measurement results.

Setting Steps

1. On the harmonic settings interface, press the F2 button or use the ▲ and ▼ keys to move the cursor to the Mode field, as shown in the figure below.



2. Use the ◀ and ▶ keys to select the desired harmonic mode.
3. Press the Esc button to return to the harmonic measurement interface.

Normal Mode: Normal Mode applies a fixed 1024-point FFT calculation. Based on the fundamental frequency, the measurement method and the maximum harmonic analysis order are determined, as provided in the table below.

Fundamental Frequency (f)	Sample Rate	Widnow Width	Upper Limit of Analysis Orders
10 Hz ≤ f < 75 Hz	f×1024	1	50
75 Hz ≤ f < 150 Hz	f×512	2	32
150 Hz ≤ f < 300 Hz	f×256	4	16
300 Hz ≤ f < 600 Hz	f×128	8	8
600 Hz ≤ f ≤ 1200 Hz	f×64	16	4

IEC Mode: (IEC mode measures in accordance with the IEC 61000-4-7:2002 standard): A 200 ms time window is used for FFT calculation, with the maximum order for THD calculation being 40. The measurement methods are as shown in the table below.

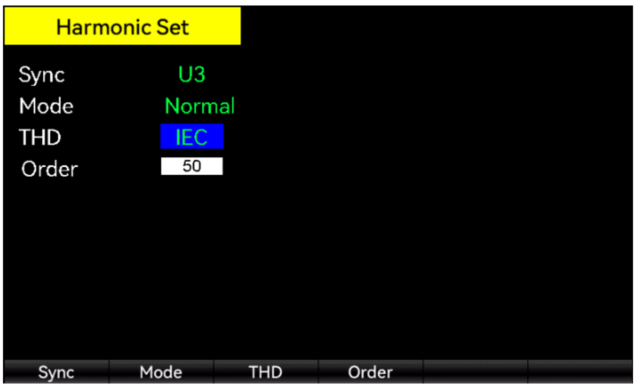
Signal	Sample Rate	Widnow Width	Upper Limit of Analysis Orders
50 Hz	f×512	10	40
60 Hz	f×512	12	40

THD (Total Harmonic Distortion)

The power meter provides two calculation formulas for the total harmonic distortion factor (THD): IEC and CSA, with IEC as the default. The THD results will vary depending on the selected calculation mode.

Setting Steps

1. On the harmonic settings interface, press the **F3** button or use the ▲ and ▼ keys to move the cursor to the THD field, as shown in the figure below.



2. Use the ◀ and ▶ keys to select the calculation formula IEC or CSA.
3. Press the Esc button to return to the harmonic measurement interface.

IEC: The IEC formula calculates THD as the ratio of the RMS values of the 2nd to 50th harmonic components to the RMS value of the fundamental frequency.

The calculation formula is as follows.

$$THD=\frac{\sqrt{\sum_{k=2}^{n}(C_k)^2}}{C_1}$$

CSA: In the CSA method, the THD is calculated as the ratio of the RMS value of the 2nd to 50th harmonic components to the RMS value of the 1st to 50th harmonic components.

The calculation formula is as follows.

$$THD=\frac{\sqrt{\sum_{k=2}^{n}(C_k)^2}}{\sqrt{\sum_{k=1}^{n}(C_k)^2}}$$

C_1: Fundamental frequency component

C_k: Fundamental frequency and harmonic components

k: Measured harmonic order

n (Upper limit of measured harmonic order): The maximum harmonic order that can be measured. This value depends on the fundamental frequency of the PLL (Phase-Locked Loop) source.

Harmonic Order

Users can select the upper limit of measured harmonic order. The setting range is from the 1st to the 50th order. The maximum harmonic order depends on the fundamental frequency:

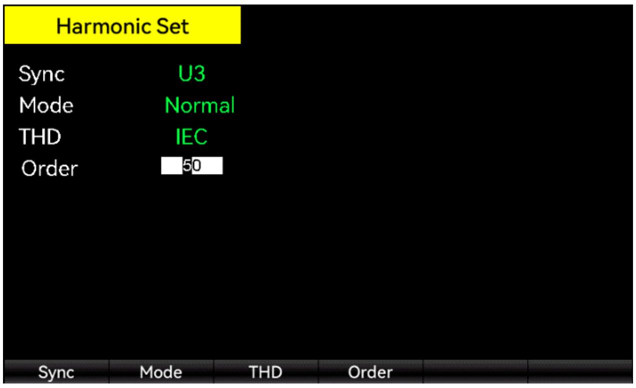
- When the fundamental frequency is 50 Hz, the maximum harmonic analysis order is 50.
- When the fundamental frequency is 1.2 kHz, the maximum harmonic analysis order is 4.

The steps to configure the maximum harmonic analysis order are as follows.

Setting Steps

1. On the harmonic settings interface, press the F4 button or use the and keys to move the cursor to the Order field, as shown in the figure below.

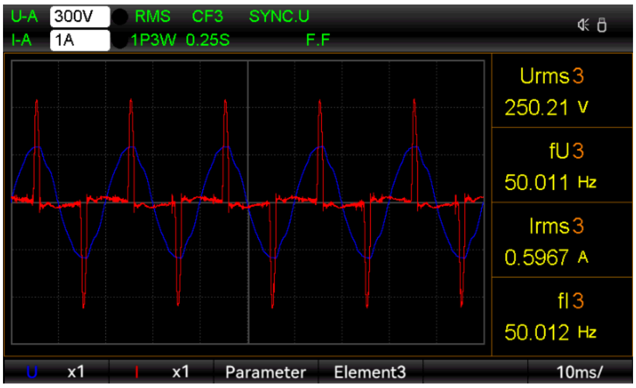
2. Press the Enter button to enter value editing mode.



3. Use the ◀ and ▶ keys to move the editing position, and use the ▲ and ▼ keys to adjust the value.
4. Press the Esc button to exit the value editing mode.
5. Press the Esc button again to return to the harmonic measurement interface.

5.5 Waveform Display

The power meter features a waveform display function, allowing visual representation of voltage and current waveforms. In this mode, key measurement parameters can also be displayed alongside the waveforms, as shown in the figure below.



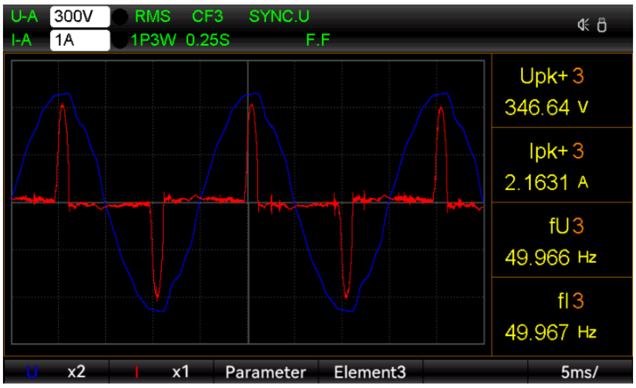
5.5.1 Time Base Adjustment

The time base controls the horizontal scale of the waveform display, allowing the user to observe multiple cycles of the input signal. Adjusting the time base facilitates analysis of waveform characteristics over different time periods.

Press the F6 button repeatedly or use the ◀ and ▶ keys to change the time base.

Time base settings: 100 μs/div, 200 μs/div, 500 μs/div, 1 ms/div, 2 ms/div, 5 ms/div, 10 ms/div, 25 ms/div, 50 ms/div, 100 ms/div, 200 ms/div, 500 ms/div, and 1 s/div.

Example: For a 50 Hz signal, set the time base to 5 ms/div. The full screen represents 50 ms, displaying 2.5 cycles of the signal waveform, as shown in the figure below.



5.5.2 Vertical Axis Adjustment

The vertical axis scale determines how waveform amplitudes are displayed relative to the selected measurement range. By default, one division corresponds to the full range, but the scale can be manually adjusted. The minimum setting is 1/3 of the full range per division.

To change the vertical scale of voltage or current, press the F1 or F2 button repeatedly on the waveform display interface to cycle through the available options.

Range Settings:

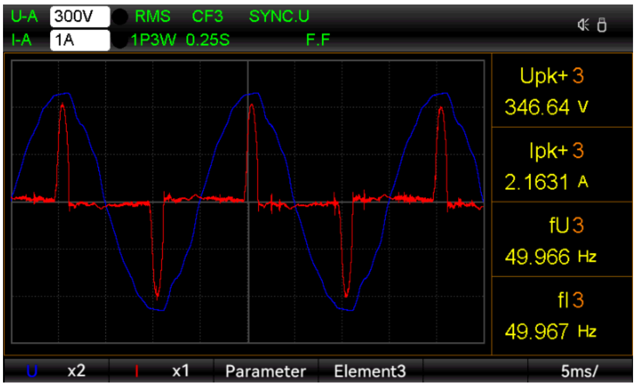
- x1: Each division equals the full range.
- x2: Each division equals half of the range.
- x3: Each division equals one-third of the range.
- OFF: Disables waveform display.

Example: In the figure below, the blue waveform represents voltage, and the red waveform represents current.

Voltage vertical scale: x2 of the range (150 V)

Current vertical scale: x1 of the range.

The displayed waveform corresponds directly to the measured values.



5.6 Integration Interface

The power meter supports integration for the following parameters: WP, WP+, WP-, q, q+, and q-. Integration is performed simultaneously on all units. When a numeric follows a parameter (e.g., WP1), it represents the integration value of the corresponding channel (e.g., WP1 = Channel 1 integration). When the symbol **Σ** follows a parameter (e.g., WPΣ), it represents the total integration value. The total integration value depends on the selected wiring mode.

The calculation methods for integration under different wiring modes are provided in the table below.

Wiring Method	1P3W	3P3W	3V3A	3P4W
WPΣ (Wh)	WP1 + WP3	WP1 + WP3	WP1 + WP3	WP1 + WP2 + WP3
WP+Σ (Wh)	WP+1 + WP+3	WP+1 + WP+3	WP+1 + WP+3	WP+1 + WP+2 + WP+3
WP-Σ (Wh)	WP-1 + WP-3	WP-1 + WP-3	WP-1 + WP-3	WP-1 + WP-2 + WP-3
qΣ (Ah)	q1 + q3	q1 + q3	q1 + q3	q1 + q2 + q3
q+Σ (Ah)	q+1 + q+3	q+1 + q+3	q+1 + q+3	q+1 + q+2 + q+3
q-Σ (Ah)	q-1 + q-3	q-1 + q-3	q-1 + q-3	q-1 + q-2 + q-3

The integration interface consists of five display pages: integration data of channel 1, integration data of channel 2, integration data of channel 3, total integration data (sum of all channels), and all integration parameters displayed simultaneously.

Switch between pages: Press the **F2 (Element)** button cyclically while in the integration interface.

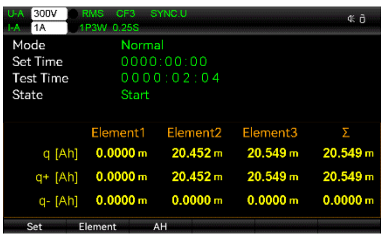
Switch displayed parameters (WP/q): Press the **F3** button to toggle between WP and q.

The five display pages are illustrated in the figure below.

WP integration of Unit 1

q integration of Unit 2

q integration of Unit 3



WP total integration All integration parameters of q

5.6.1 Integration Method

The method of calculating integration values depends on the selected measurement mode.

DC Mode (Direct Current): Integration is performed on the instantaneous values of power and current.

RMS Mode (Root Mean Square): Integration is performed on the current values measured within each data update interval.

The table below summarizes the integration calculation methods for different measurement modes.

Power Integration	RMS VMean, DC	$\sum_{i=1}^{n} Ui \times Ii$
Current Integration	RMS VMean	$\sum_{I=1}^{N} I_I$
	DC	$\sum_{i=1}^{n} Ii$

Ui: Instantaneous voltage value
Ii: Instantaneous current value
I_I: Measured current for each data update interval
n: Number of samples
N: Number of data updates

5.6.2 Integration Operations

1. Start Integration

   Press the Start button to begin integration. The **start** status indicator illuminates, and the measurement interface displays the status as *Start*.

2. Stop Integration

   Integration stops under either of the following conditions: The Stop button is pressed manually; the set integration time is reached (in Normal integration mode).

   When integration stops, the **start** status indicator light turns off; the **stop** status indicator illuminates; the measurement interface displays the status as *Stop*.

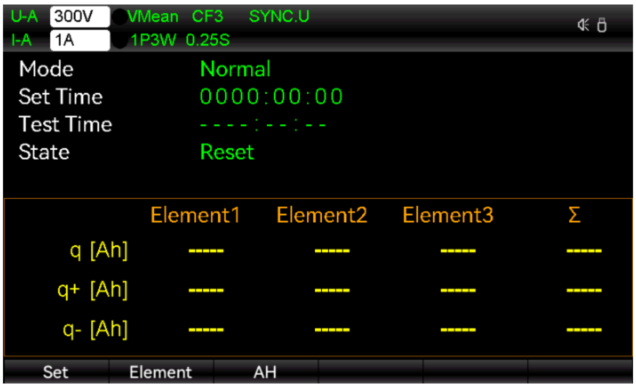
   The integration value and elapsed integration time recorded just before stopping remain on the display.

3. Reset Integration

   After integration has stopped, press the **Reset** button to clear the integration value and time, and prepare for a new measurement.

   When the status is *Stop* and the **Reset** button is pressed, the **stop** status indicator turns off; the measurement interface displays the status as *Reset*.

   Both the integration value and integration time are cleared, as shown in the figure below.



5.6.3 Integration Settings

Before configuring integration, ensure that the integration status is reset. If not, relevant settings cannot be applied.

Integration Mode Settings

1. Press the Set key on the integration interface.
2. Use the ▲ and ▼ keys to move the cursor to the Mode field, as shown in the figure below.

3. Use the ◄ and ► keys to select eithe Continuous or Normal mode.
4. Press the Esc button to exit the integration mode settings.

Continuous (Continuous integration): To enable integration, the integration time must be set to a value greater than zero. When the preset integration time is reached, integration restarts automatically and continues until it is stopped manually.

Normal (Standard integration): If no integration time is set, integration must be stopped manually. If an integration time is set, integration automatically stops when the time is reached, and the integration value is retained.

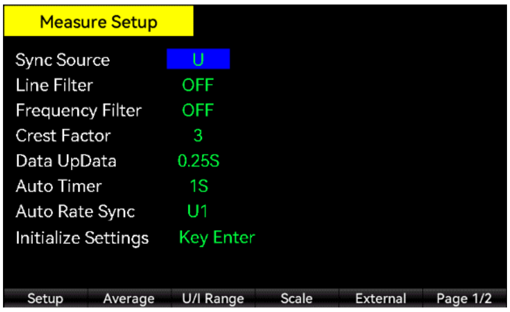
Chapter 6 Functional Configuration

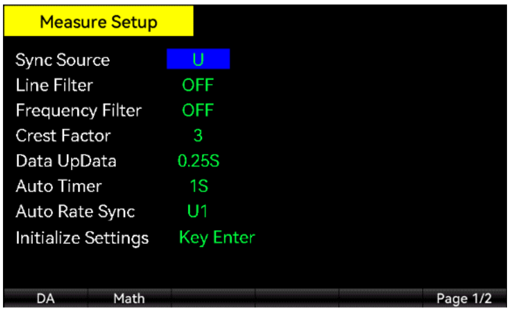
6.1 Measurement Configuration

The measurement settings menu provides configuration options for various measurement-related parameters, including sync source (synchronization source), line filter, frequency filter, crest factor, data update interval, auto timer (automatic update interval), auto rate sync (auto synch source), average filtering, range configuration, transformation ratio, external sensor, D/A output, and mathematics functions.

Press the **Setup** button on any measurement interface to enter the measurement settings menu. Use the arrow keys to select and switch between different settings.

The measurement settings menu is divided into two pages, as shown in the figure below.

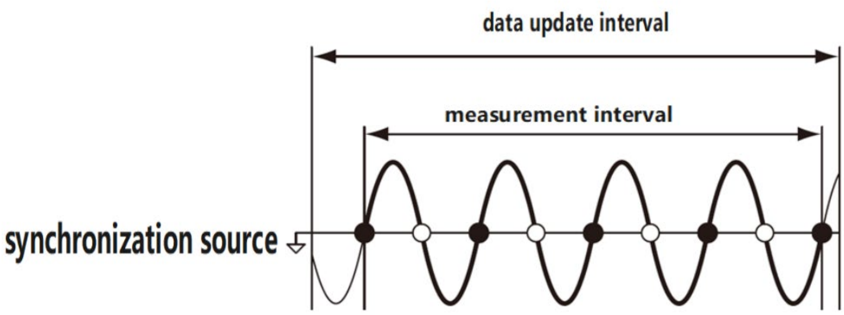




6.1.1 Synchronization Source

The synchronization source is critical for accurate measurement and data processing. It ensures system stability and consistency, improves performance and reliability, and simplifies data analysis. Correct selection of the synchronization source helps obtain more stable and reliable measurement data.

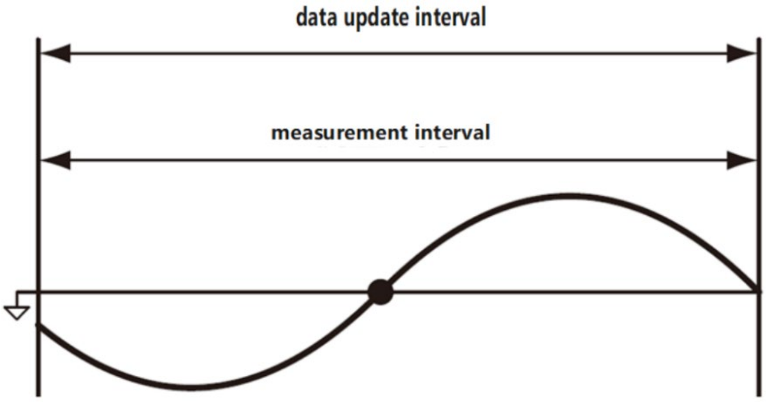
The synchronization source defines the measurement interval of the input signal during calculation. Within each data update period, the interval begins at the initial point where the signal's rising or falling slope crosses the zero point and ends at the final point where the slope crosses zero, as shown in the figure below.



●: Rising slope crosses the zero point

○: Falling slope crosses the zero point

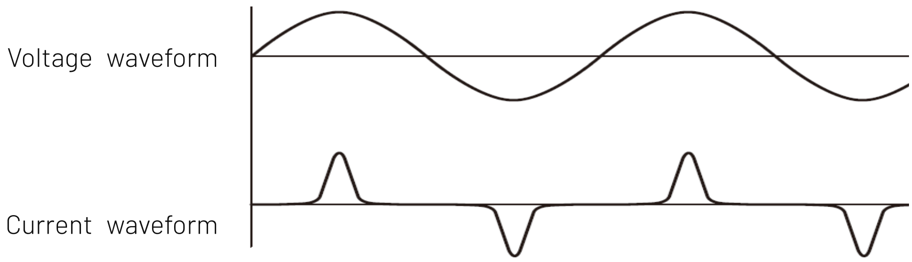
If no rising or falling slopes, or only a single rising/falling slope occur within a data update period, the entire data update period is used as the measurement interval.



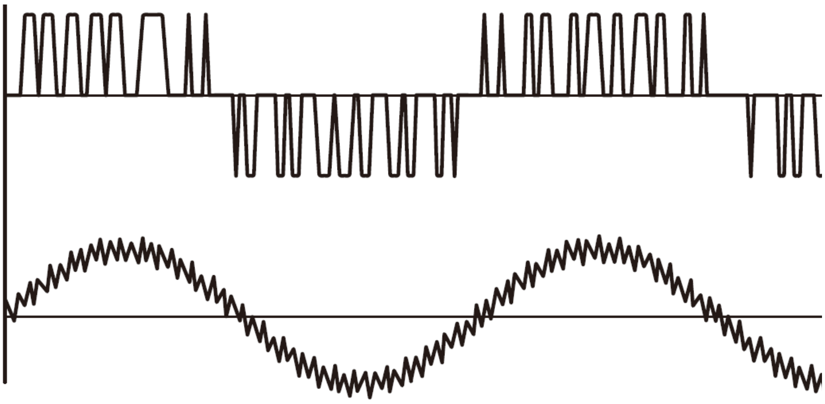
The digital power meter calculates measurement data by averaging sampled data within the measurement interval. The input signal period can be detected from either voltage or current signals, and users can set voltage, current, or none as the synchronization source.

Voltage as Sync Source: The power meter detects the period of the voltage signal and sets it as the synchronization source for all input units. After selection, the SYNC.U indicator appears at the top of the display. If the voltage signal period cannot be detected, the current signal will be used as the sync source.

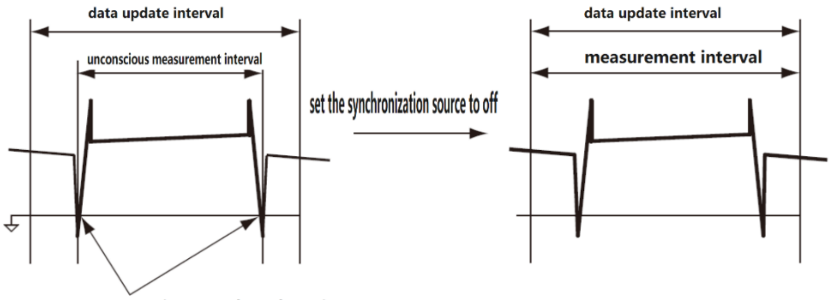
Application Example: When measuring a switching power supply, the voltage waveform typically exhibits less distortion than the current waveform, as shown in the figure below. Selecting voltage as the synchronization source provides more stable measurement readings.



Current as Synchronization Source: The power meter detects the period of the current signal and sets it as the synchronization source for all input units. After selection, the SYNC.I indicator appears at the top of the display. If the current signal period cannot be detected, the voltage signal will be used as the sync source.



Off (No Synchronization Source): For DC signals, setting a synchronization source may cause small pulse noise to be falsely detected as zero crossings, resulting in incorrect measurement intervals and unstable readings. When synchronization is turned off, the meter averages sampled data over the entire data update period, eliminating false detections and ensuring stable DC voltage and current measurements.



Sync Source Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement menu.
2. Use the ▲ and ▼ keys to move the cursor to the Sync Source field.
3. Use the ◄ and ► keys to select the desired option:
   Voltage (SYNC.U), Current (SYNC.I), or OFF (SYNC.OFF). The corresponding indicator is shown at the top of the screen.
4. Use the ▲ and ▼ keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.1.2 Line Filter

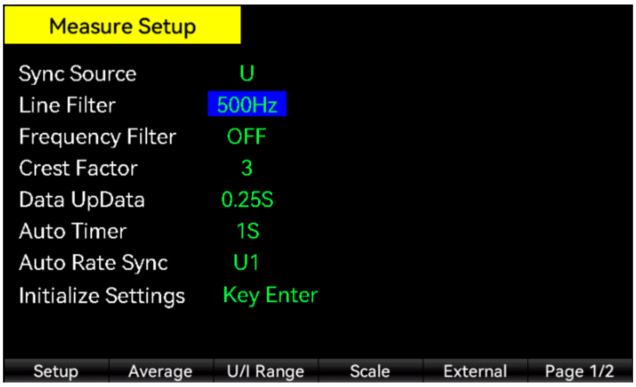
The line filter removes high-frequency components from the measurement circuit. It is specifically integrated into the voltage, current, and power measurement circuits of the power meter. When enabled, the line filter ensures that the measured values exclude high-frequency components.

Activate the line filter to suppress unwanted noise and harmonic components.

Particularly useful when measuring small signals below 200 Hz, as it helps achieve more stable measurement results.

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement menu.
2. Use the and keys to move the cursor to the Line Filter field.
3. Use the and keys to select the cutoff frequency. For example, if 500Hz is selected, the cutoff frequency will be displayed at the top of the screen, as shown in the figure below.



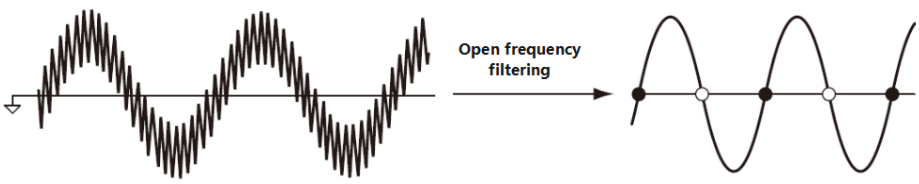
Notes:

- Cutoff frequency range: 500 Hz, 1 kHz, 2 kHz, 3 kHz, 4 kHz, 5 kHz, 5.5 kHz, 6 kHz, 7 kHz, 8 kHz, 9 kHz, 10 kHz, 20 kHz, 30 kHz, 40 kHz, 50 kHz, 60 kHz, 70 kHz, 80 kHz, 90 kHz, 100 kHz.
- Except for 500 Hz, all other options use a digital filter.

4. Use the and keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.1.3 Frequency Filter

The frequency filter in the power meter is built into the frequency detection circuit with a cutoff frequency of 500 Hz. Its primary function is to accurately detect the zero-crossing points of the synchronization source signal, which determines the measurement interval. Therefore, the frequency filter affects both frequency measurements and the detection of measurement intervals for voltage, current, and power.



Notes: The frequency filter is not applied to the voltage or current measurement circuits. Even when the frequency filter is enabled, the measured voltage and current values still contain high-frequency components.

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement menu.
2. Use the and keys to move the cursor to the Frequency Filter field.
3. Use the and keys to select the OFF (disable the frequency filter) or ON (enable the frequency filter). When the frequency filter is enabled, F.F icon will be displayed at the top of the screen.
4. Use the and keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.1.4 Crest Factor

The crest factor of a signal is defined as the ratio of its peak value to its effective (RMS) value, indicating how many times the peak can reach the rated range. The formula is as follows.

$$\text{Crest Factor} = \frac{\text{Peak Value}}{\text{RMS}}$$

The power meter allows users to select a crest factor of 3, 6, or 6 A. Different crest factor settings affect the measurement range and the conditions for automatic range switching. The default setting is 3.

For the same rated range, the input range with a crest factor set to 6 A is larger than when set to 6. When measuring distorted waveforms in automatic range mode, setting the crest factor to 6 A can reduce frequent range switching.(Refer to Section *5.1.3 Range Switching* for details.)

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement menu.
2. Use the ▲ and ▼ keys to move the cursor to the Crest Factor field.
3. Use the ◀ and ▶ keys to select the crest factor to 3, 6, or 6 A.
4. Use the ▲ and ▼ keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.1.5 Data Update Interval

The data update period is the interval at which the power meter updates sampled data for measurement functions. During each update period, the data is updated, stored, converted to an analog output signal, or transmitted via a communication interface.

Data update interval range: 0.1 s, 0.25 s, 0.5 s, 1 s, 2 s, 5 s, 10 s, 20 s, and Auto. The factory default is 0.25 s.

For fast-changing signals, a shorter update period improves measurement responsiveness.

For slowly varying signals, a longer update period is more suitable to ensure measurement stability.

The measurable frequency range depends on the selected data update period, as sshown in the table below.

Data Update Interval	Frequency Measurement Range
0.1 s	DC, 20 Hz to 300 kHz
0.25 s	DC, 10 Hz to 300 kHz
0.5 s	DC, 5 Hz to 300 kHz
1 s	DC, 2 Hz to 300 kHz
2 s	DC, 1 Hz to 300 kHz
5 s	DC, 0.5 Hz to 300 kHz
10 s	DC, 0.2 Hz to 300 kHz

20 s	DC, 0.1 Hz to 300 kHz
Auto	DC, 0.1 Hz to 300 kHz

Notes:

- Selecting a slower update rate allows the power meter to capture low-frequency signals.
- Selecting a faster update rate enables accurate measurement of rapidly fluctuating signals, such as fast-changing loads in power systems.
- If the input signal exhibits significant periodic variations, the data update interval can be set to Auto.

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement menu.
2. Use the and keys to move the cursor to the Data Update Interval field.
3. Use the and keys to select the data update interval to 0.1 s, 0.25 s, 0.5 s, 1 s, 2 s, 5 s, 10 s, 20 s, or Auto.
4. Use the and keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.1.6 Auto Timer (Automatic Update Interval)

The automatic update time defines the maximum time the power meter allows for detecting the input signal waveform when the data update interval is set to AUTO. If the input signal frequency is too low to determine the synchronization source period within this time, the frequency measurement may exceed the instrument's range, resulting in an error.

During standard measurements, the power meter uses the entire period up to the automatic update interval as the measurement interval to calculate the measured value. The automatic update time effectively sets the lower limit of detectable frequency for the input signal.

The lower-limit frequencies corresponding to different automatic update interval are listed in the table below.

Auto Timer	Lower Limit of Frequency Measurement Range
1 s	2.0 Hz
5 s	0.5 Hz
10 s	0.2 Hz
20 s	0.1 Hz

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement menu.
2. Use the and keys to move the cursor to the Auto Timer field.
3. Use the and keys to select the auto timer to 1 s, 5 s, 10 s, or 20 s.
4. Use the and keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.1.7 Auto Rate Sync (Auto Sync Source)

The automatic synchronization source is available only when the data update interval is set to AUTO.

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement menu.
2. Use the ▲ and ▼ keys to move the cursor to the Auto Rate Sync field.
3. Use the ◄ and ► keys to select the auto sync source as U1, U2, U3, I1, I2, or I3.
4. Use the ▲ and ▼ keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.1.8 Initialize Settings

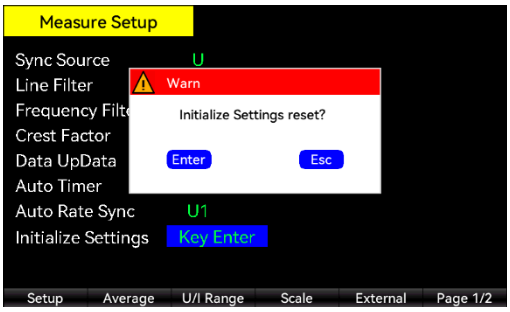
The initialization function applies only to measurement-related settings and does not affect system functions such as communication interfaces. After initialization, all measurement parameters are restored to their factory defaults.

The status of each parameter after initialization is listed in the table below.

Parameter	Status after Initialization
Measurement Range	Auto
Measurement Mode	RMS
Sync Source	U
Line Filter	OFF
Frequency Filter	OFF
Crest Factor	3
Data Update Interval	0.25 s
Auto Timer	1 s
Auto Rate Sync	U1
Average	OFF
Sensor	OFF
Transformation Ratio	OFF
Range Configuration	OFF
Integration Mode	Normal
Integration Status	Reset

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement menu.
2. Use the ▲ and ▼ keys to move the cursor to the Initialize Settings field.
3. Press the Enter button to enter the initialization interface, as shown in the figure below.



4. Press the Enter button to confirm the initialization, or press the Esc to exit the setting.
5. Use the and keys to scroll through other options, or press the Esc button to return to the measurement interface.

Note: Communication settings are not affected by initialization.

6.2 Average Filtering

The average filtering function helps reduce fluctuations in measured data caused by sudden changes in power supply, load, or low-frequency input signals. The power meter supports two averaging methods exponential averaging and moving averaging.

Exponential Averaging: Applies weighted smoothing, giving more importance to recent samples.

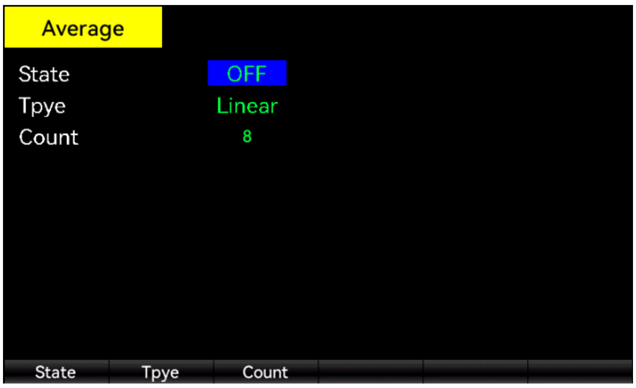
Moving Averaging: Computes the average over a set number of recent samples.

Supported Parameters: Voltage (U), Current (I), Active Power (P), Apparent Power (S), Reactive Power (Q)

Other parameters, such as PF, CFU, and CFI are calculated based on the averaged values of Urms, Irms, P, S, and Q.

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement settings menu.
2. Press **F2** button to select the average state (ON/OFF), average type, and number of averages.
3. Use the and keys or press **F1**, **F2**, and **F3** buttons to move the cursor to the corresponding parameter.
4. Use the and keys to ajust the averaging filter settings, as shown in the figure below.



6.2.1 Average Mode

Setting Steps

1. On the average interface, press the ▲ or ▼ keys or press F1 button to move the cursor to State field.
2. Use the ◀ and ▶ keys to turn the average mode to on or off.

   When the average mode is enabled (ON), AVG-8 will be displayed (indicates the average count is 8).
3. Use the ▲ and ▼ keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.2.2 Average Type

Setting Steps

1. On the average interface, press the ▲ or ▼ keys or press F2 button to move the cursor to Type field.
2. Use the ◀ and ▶ keys to select the average type to Linear or EP.
   - Linear: Uses the *moving average* method to compute linear averages according to the formula below

$$D_n = \frac{M_{n-(m-1)} + M_{n-(m-2)} + M_{n-2} + M_{n-1} + M_n}{m}$$

cc

D_n: Displayed value of the linear average of m items of numeric data from the n-(m-1)th to the nth time

M: Average count

$M_{n-(m-1)}$: Numeric data at the n-(m-1)th time

$M_{n-(m-2)}$: Numeric data at the n-(m-2)th time

M_{n-2}: Numeric data at the n-2th time

M_{n-1}: Numeric data at the n-1th time

M_n: Numeric data at the nth time

   - EP: Uses exponential averaging with a specified attenuation constant. More recent data is given higher weight, while older data gradually decreases in influence. The formula is as follows.

$$D_n = D_{n-1} + \frac{M_n + D_{n-1}}{K}$$

Where,

D_n: Displayed value of the exponential average at the nth

D_{n-1}: Displayed value that has been exponentially averaged n-1 times

M_n: Numeric data at the nth time

K: Average count (Attenuation constant)

3. Use the ▲ and ▼ keys to scroll through other options, or press the Esc button to return to the

measurement interface.

6.2.3 Average Count

Setting Steps

1. On the average interface, press the or keys or press **F2** button to move the cursor to Count field.
2. Use the and keys to select the average count to 8, 16, 32, or 64.
3. Use the and keys to scroll through other options, or press the Esc button to return to the measurement interface.

6.3 Range Configuration

The power meter provides multiple voltage and current ranges. In automatic range mode, the power meter sequentially switches through the available ranges until it identifies the appropriate one. However, this sequential switching can introduce delays in certain situations, such as: When the input signal amplitude is very large, when the input signal suddenly changes from a high amplitude to a much lower amplitude.

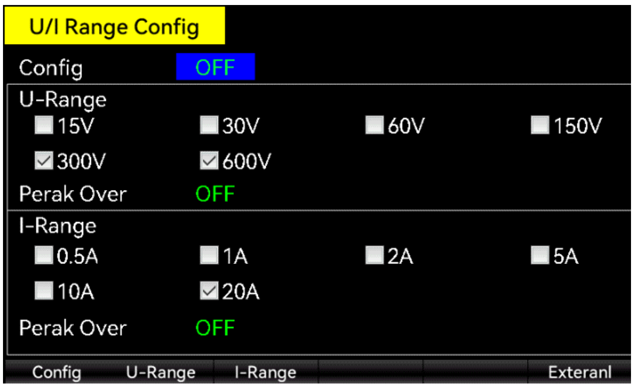
During such delays, important measurement data may be lost.

To address this, users can enable range configuration to preselect only the ranges required for measurement. When this function is enabled, the power meter skips unused ranges, reducing the risk of data loss caused by sequential switching. By default, the function is disabled, and all ranges remain active.

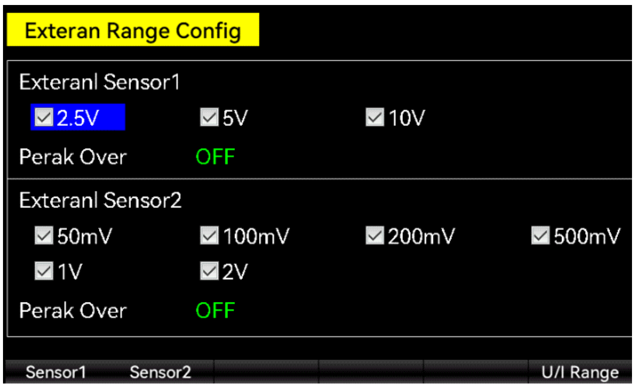
If the peak value of the measured signal exceeds 300% of the rated range (or 600% when CF = 6 or 6 A), the power meter will jump directly to the closest preset range among the configured ranges. If the jumped-to range is still unsuitable, the power meter will continue switching until the optimal range is reached.

Setting Steps

1. On any measurement interface, press the **Setup** button to enter the measurement settings menu.
2. Press the **F3** button to open the Range Configuration interface. Use the and keys to turn the range configuration to on or off, as shown in the figure below.



Voltage/Current Range Configuration Interface



Sensor Range Configuration Interface

6.3.1 Voltage Range Configuration

Setting Steps

1. On the range configuration interface, press **F2 (U-Range)** button to move the cursor to the first voltage range in the selection box.
2. Use the or keys to move the cursor between different ranges.
3. Press the Enter button to check or cancel the selected range.
4. Press another functional button to access its corresponding settings, or press the Esc button to return to the pervious menu.

Notes:

- When the cursor is on the Peak Over field, use the and keys to select the range to which the power meter should jump if the peak value exceeds the current range.
- This jump range can only be selected from the ranges that are already enabled (checked).
- Select OFF disables the peak over-range jump function for voltage range configuration.

6.3.2 Current Range Configuration

Setting Steps

1. On the range configuration interface, press the **F3 (I-Range)** button to move the cursor to the first current range in the selection box.
2. Use the or keys to move the cursor between different ranges.
3. Press the Enter button to check or cancel the selected range.
4. Press another functional button to access its corresponding settings, or press the Esc button to return to the pervious menu.

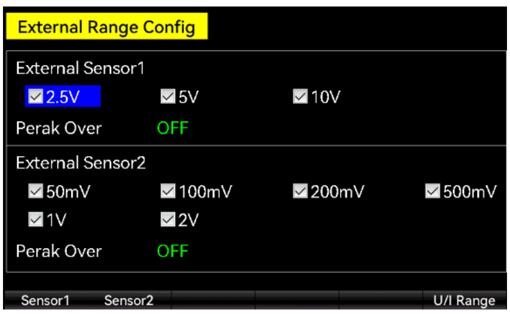
Notes:

- When the cursor is on the Peak Over field, use the and keys to select the range to which the power meter should jump if the peak value exceeds the current range.
- This jump range can only be selected from the ranges that are already enabled (checked).
- Select OFF disables the peak over-range jump function for current range configuration.

6.3.3 External Sensor Channel Range Configuration

Setting Steps

1. On the range configuration interface, press **F6 (Extrenal)** button to enter the external sensor range configuration interface, as shown in the figure below.



2. Press the **F1 (Sensor1)** or **F2 (Sensor2)** button to configure external sensor channel 1 or channel 2.
3. Use the ▲ or ▼ keys to move the cursor between different ranges.
4. Press the **Enter** button to check or cancel the selected range.
5. Press **F6** button back to the voltage/current range configuration, or press the **Esc** button to return to the pervious menu.
6. Press another functional button to access its corresponding settings, or press the **Esc** button to return to the pervious menu.

Notes:

- When the cursor is on the Peak Over field, use the ◄ and ► keys to select the range to which the power meter should jump if the peak value exceeds the current range.
- This jump range can only be selected from the ranges that are already enabled (checked).
- Select OFF disables the peak over-range jump function for the external sensor channel.

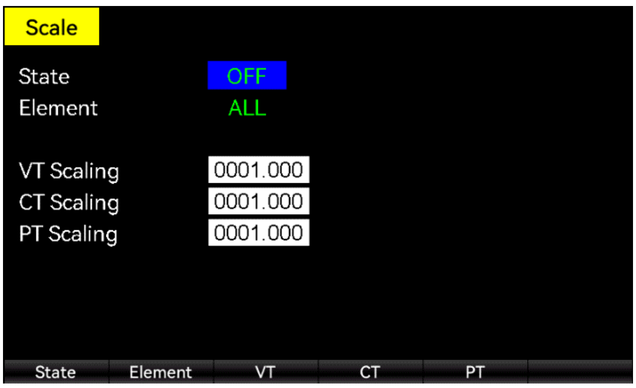
6.4 Transformation Ratio

When the voltage or current to be measured exceeds the instrument's maximum allowable input and the sensor channel cannot directly handle the measurement, the signal can be scaled down using a transformer according to its ratio before measurement.

During measurement, connect the secondary side of the Voltage Transformer (VT) and Current Transformer (CT) to the instrument's voltage and current input terminals. By configuring the VT and CT ratios, the power meter can automatically calculate and display the actual circuit voltage and current.

Setting Steps

1. Press the **Setup** button on any measurement interface to enter the measurement settings menu.
2. Press the **F4** button to enter the transformation ratio interface, as shown in the figure below.



6.4.1 Transformation Ratio State

Setting Steps

1. On the range configuration interface, press F1 or the ▲ or ▼ keys to the State field.
2. Use the ◄ and ► keys to turn the transformation ratio to on or off.

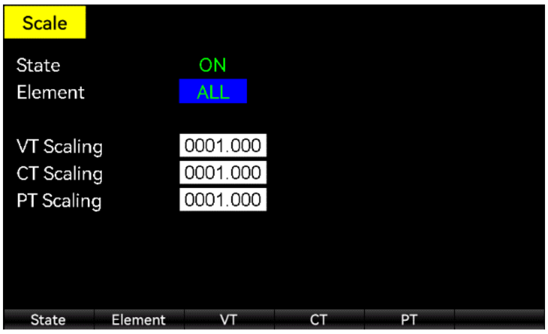
When the transformation ratio is enabled (ON), SCAL icon will be displayed on the screen.

3. Press another functional button to access its corresponding settings, or press the Esc button to return to the pervious menu.

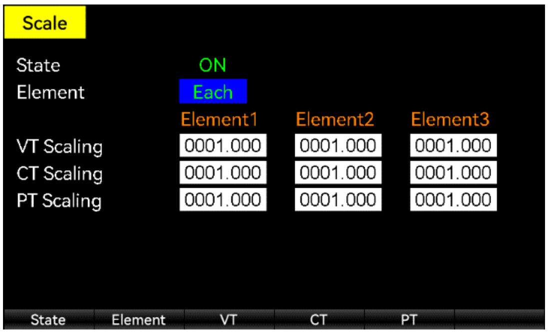
6.4.2 Scale Settings

Setting Steps

1. Confirm the units for which the ratio needs to be set. The default setting is ALL, indicating that all units are set simultaneously. If changed to Each, the VT, CT, or PT ratio can be configured individually, as shown in the figure below.



All Units Set simultaneously



Each Unit Set Individually

2. On the transformation ratio interface, press F3, F4, F5 or the ▲ or ▼ keys move the cursor to the ratio value box of VT, CT, or PT.
3. Press Enter button at the desired ratio field to enter value editing mode.
4. Use the ◄ and ► keys to select the digit to edit, then use the ▲ or ▼ keys to adjust the value.
5. Press the Enter button to confirm the setting or press the Esc button to cancel and exit.
6. Repeat steps 2-5 to configure additional items.
7. Press the Esc button to return to the pervious menu.

Notes:

- Voltage ratio: Refers to the transformation ratio of the Voltage Transformer (VT).
- Current ratio: Refers to the transformation ratio of the Current Transformer (CT).
- The ratio value can be set with three decimal places, within the range 0000.001 to 9999.999.

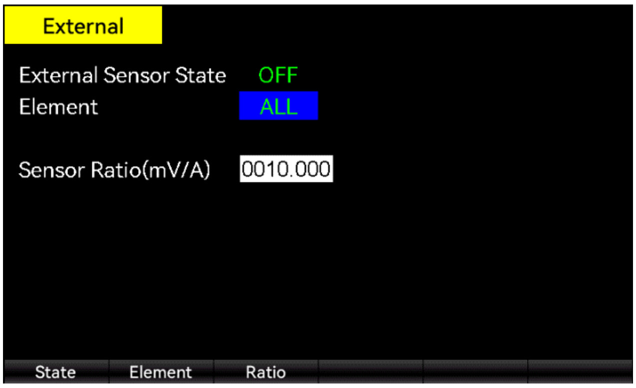
6.5 External Sensor

This section explains the configuration of the external current sensor channel. When the current to be measured exceeds the instrument's maximum allowable input, the external sensor channel can be activated to measure high currents safely.

The external sensor converts the large current into a smaller voltage signal. The instrument then detects this voltage signal through the sensor channel and converts it to display the actual measured current.

Setting Steps

1. Press the Setup button on any measurement interface to enter the measurement settings menu.
2. Press the **F5 (External)** button to access the external sensor setup interface.
3. Use **F1**, **F2**, and **F3** buttons, or the arrow keys to move the cursor to the corresponding parameter, as shown in the figure below.



6.5.1 External Sensor Channel

Setting Steps

1. On the external sensor interface, press **F1 (State)** button or the keys to move the cursor to the State field.
2. Use the and keys to select OFF, EXT1, or EXT2.
   When EXT1 or EXT2 is selected, indicating that the external sensor channel is enabled, the corresponding icon of EXT1 or EXT2 will be displayed on the screen.
3. Press another functional button to access its corresponding settings, or press the Esc button to return to the pervious menu.

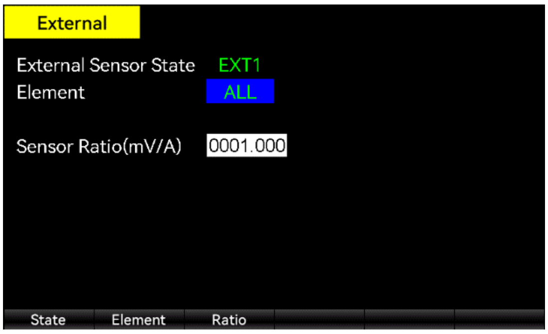
6.5.2 Sensor Ratio

The sensor ratio is a key parameter used to convert the small voltage signal output by an external current sensor into the actual current value of the measured circuit. Its unit is mV/A (millivolts per ampere), which directly corresponds to the conversion ratio of the external sensor in use.

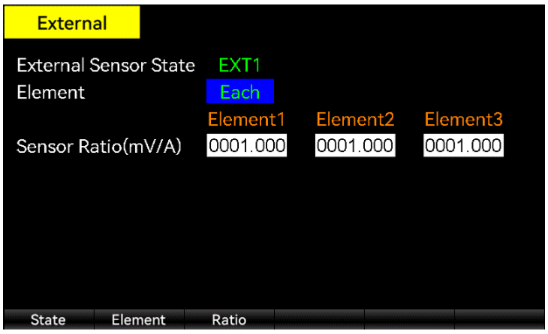
Correctly setting the sensor coefficient ensures that the power meter displays the true current in the measured circuit, preventing measurement errors caused by mismatched parameters.

Setting Steps

1. Before setting the ratio, confirm the unit to be configured. Set the ratio for all three units simultaneously, or configure the ratio for each unit individually.
2. On the external sensor channel interface, press **F2 (Element)** or the keys to move the cursor to the Element field.
3. Use the and keys to select the All or Each, as shown in the figure below.



All Units Set simultaneously



Each Unit Set Individually

Setting Steps

1. On the external sensor channel interface, press **F3 (Ratio)** or the ▲ ▼ keys to move the cursor to the Sensor Ratio field.
2. Press Enter button at the desired ratio field to enter value editing mode.
3. Use the ◄ and ► keys to select the digit to edit, then use the ▲ or ▼ keys to adjust the value.
4. Press the Enter button to confirm the setting or press the Esc button to cancel and exit.
5. Repeat steps 2-5 to configure additional items.
6. Press the Esc button to return to the pervious menu.

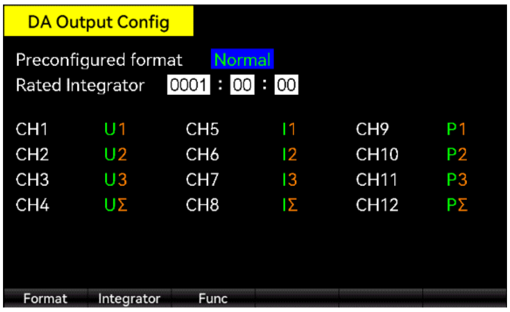
6.6 D/A Output Function

The power meter is equipped with a 12-channel D/A function, providing twelve ±5 Vrms DC analog voltage outputs. These outputs can be used to output the parameter of voltage, current, active power, apparent power, reactive power, power factor, phase angle, voltage frequency, current frequency, voltage peak value, current peak value, power integral value, and current integral value.

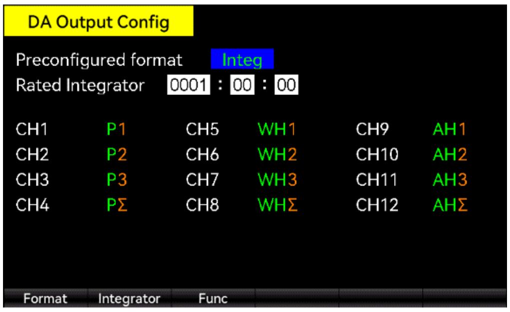
The D/A interface is located on the rear panel of the power meter. It connects to the D/A terminals via a D/A cable for parameter output or instrument control. For detailed pin assignments, refer to Section 8.1.1. *D/A Interface Pin Definition*

Setting Steps

1. Press the Setup button on any measurement interface to enter the measurement settings menu.
2. Press the **F6 (Page1/2)** button to access the measurement interface on page 2.
3. Press the **F1(D/A)** button to access the D/A settings menu, as shown in the figure below.



Preset Format: Normal Output Mod



Preset Format: Integration Output Mode

6.6.1 D/A Output Preset Formats

Users can quickly select from two pre-configured output formats: Normal and Integration. In these formats, both the output parameters and output units for each D/A channel are fixed. When other output parameters are required, users can configure each channel manually using the functional button and the arrow keys ▲ ▼ ◀ ▶.

The preset output parameters for each channel in the normal and integration formats are listed in the table below.

Preset Formats	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11	CH12
Normal	U1	U2	U3	UΣ	I1	I2	I3	IΣ	P1	P2	P3	PΣ
Integration	P1	P2	P3	PΣ	WH	WH	WH	WHΣ	AH	AH	AH	AHΣ

6.6.2 D/A Output Settings

In addition to the two preset output formats described in Section 6.6.1, users can configure each channel individually to output different parameters as needed. The selectable parameters are listed in the table below.

CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11	CH12
U, I, P, S, Q, PF, PHI, FU, FI, UPK, IPK, WH, WHP, WHM, AH, AHP, AHM, CFU, CFI, AVP, EFFi, MATH, OFF											

Note: When OFF is selected, the corresponding channel will not output any parameter.

Setting Steps

1. On the D/A output configuration interface, press **F3** button or the ▲ or ▼ keys to move the cursor to the desired channel.
2. Use the ◀ and ▶ keys to select the output parameter. Press **F4 (Element)** button to switch the unit. When switched to **Σ**, the output represents the sum total, which depends on the wiring method (see Sections 5.3.4 and 5.6).
3. If the selected parameter is related to integration, continue with steps 4-8; otherwise, skip directly to step 8.
4. Press F2 button and the ▲ ▼ keys to move the cursor to the integration time field.
5. Press the Enter button to enter value editing mode for the integration time.
6. Use the ◀ and ▶ keys to select the digit to edit, then use the ▲ or ▼ keys to adjust the value.
7. Press the Enter button to confirm the setting or press the Esc button to cancel and exit.
8. Press the Esc button to return to the pervious menu.

6.7 Mathematical Operations

Users can perform various operations through the Math menu. The calculation results will be displayed on the measurement interface. The following operation formulas are supported: A+B, A-B, AxB, A÷B, $A \div B^2$, $A^2 \div B$, as shown in the figure below.

6.7.1 Operation Settings

Setting Steps

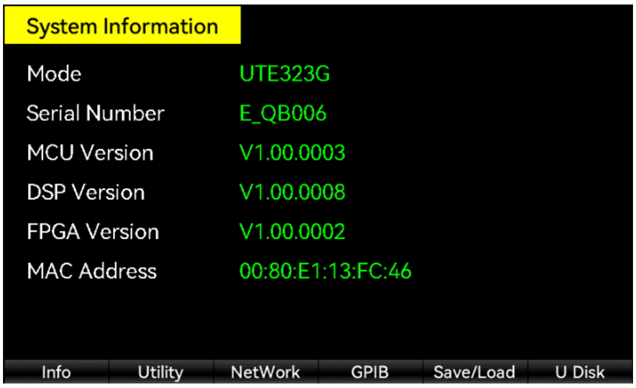
1. On any measurement interface, press the **Setup** button to enter the measurement settings menu.
2. Press the **F6** button to switch to page 2 of the measurement settings Menu.
3. Press the **F2 (Math)** button to opent the Math interface.
4. On the math interface, press the **F1(Computation)** button or the ▲ or ▼ keys to move the cursor to the Computation field.
5. Use the ◀ and ▶ keys to select the desired operation formula.
6. Press the **F2, F3** or the ▲ ▼ keys to move the cursor to the Item A and Item B field.
7. Use the ◀ and ▶ keys to select the required parameter.
8. Press the **F4 (Element)** button to select the unit.

Chapter7 System Settings

7.1 System Information

The system function menu provides access to the following functions: system information, display brightness, key sound, power-on state of integration, system language, USB storage, network settings, serial port settings, GPIB settings, save and load system parameters, and USB flash drive settings.

Press the **System** button on any measurement interface to enter the system settings menu. Use the arrow keys ▲ ▼ ◀ ▶ to select and switch between different settings, as shown in the figure below.



Model: UTE323, UTE323G, UTE333H, UTE333HG, UTE333H-2K, or UTE333HG-2K

Serial Number: A unique code assigned to each device in the factory system

DSP Version: Firmware version of the DSP controller

FPGA Version: Version of the FPGA processing program

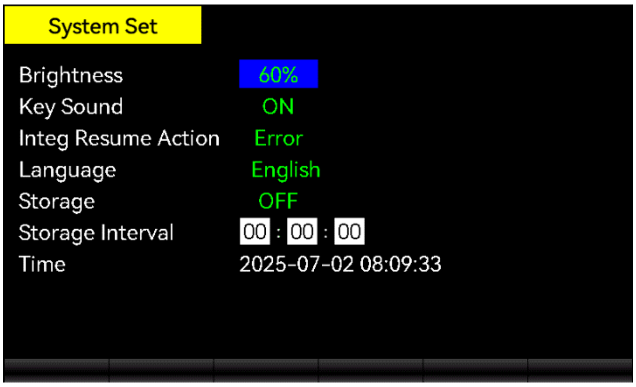
MCU Version: Firmware version of the MCU controller

MAC Address: Unique physical address

7.2 General Settings

The general settings interface is shown in the figure below. Users can perform the following operations: display brightness, key sound, power-on state of integration, system language, and USB storage.

Press the **F2** button to access the general settings menu, as shown in the figure below.



7.2.1 Backlight Brightness

Set the backlight brightness according to the ambient light of the measurement environment. On the general settings interface, use the keys to move the cursor to backlight brightness field, then use the keys to adjust the brightness. The configurable range is from 10% (minimum) to 100% (maximum).

7.2.2 Key Sound

On the general settings interface, use the keys to move the cursor to the key sound field, then use the keys to turn the instrument's key sound to on or off.

OFF: No sound is produced during any keypad operation.

7.2.3 Power-On State of Integration

This function defines the behavior of the integrator when the device is powered off and then restarted while integration is active. It can be set to Start, Stop, or Error.

Start: Integration data before power-off is saved. Upon restart, the integration operation automatically resumes from where it left off.

Stop: After power-off and restart, integration enters a stopped state. The displayed integration data reflects the value saved at the time of power loss.

Error: Upon restart, the integrator enters a stopped state, and both the Start and Stop indicator lights are illuminated. The integration interface displays the data at the time of power loss. Press Reset to clear the integrator.

7.2.4 System Language

The power meter supports multiple languages. Users can configure the device according to their language preferences, enabling operation in their native language. This provides a more intuitive and efficient user experience.

Currently, the instrument supports Simplified Chinese, English, and German.

Setting Steps

1. On the general settings interface, use the ▲ ▼ keys to move the cursor to the Language field.
2. Use the ◀ ▶ keys to select English, Simplified Chinese, or Deutsch.
3. Press the Esc button to return to the pervious menu, or use the ▲ ▼ keys to select another settings.

7.2.5 USB Storage

After enabling the storage function, the power meter can save measurement data to an external storage device (e.g., a USB flash drive). When storage is active, a red STO indicator appears on the display interface.

Users can configure which measurement data are exported. To export data beyond the default items:

- Connect to the upper computer software for configuration, or
- Use the corresponding commands in the *UTE323 Programming Manual* to set the number of data items and select the specific numerical data for output.

Setting Steps

1. On the general settings interface, use the ▲ ▼ keys to move the cursor to the Storage field.
2. Use the ◀ ▶ keys to turn on the storage function to on or off.

Data Format

Saved measurement data are stored in .csv format. For example, if storage starts at 10:40:30 on July 2, 2025, the power meter automatically creates:

- A folder: UTE323_APA9999999999_20250702/H_10
- A file: UTE323_4030.csv

Users can import the stored data into software such as Microsoft Excel for analysis and editing, enabling efficient evaluation of measurement results.

Notes

- The storage function can only be enabled when a USB flash drive is inserted.
- Recommended USB requirements: Capacity should not be excessively large. Must be formatted as FAT32. Use genuine USB flash drives to ensure stable operation. Avoid saving other large files on the USB flash drive in use.
- If the exported numerical data items include Σ (Sigma), it will appear as Sigma in the header of the stored .csv file. For example, U[Σ] will appear as U[Sigma] in the stored file.

7.2.6 Storage Interval

The storage interval defines the time between consecutive data records during the data storage process. Users can set this interval according to their data recording requirements. The storage interval can be preset before enabling the storage function. The default storage interval is 00:00:00 (hours:minutes:seconds). In this case, data is stored according to the data update cycle—each time the data updates, it is recorded. When the storage interval is greater than 0 seconds, the power meter saves data at the user-defined interval.

Setting Steps

1. On the system settings interface, use the ▲ ▼ keys to move the cursot to the Storage Interval field.
2. Use the ◄ and ► keys to select the digit to edit.
3. Press Enter button to enter value editing mode.
4. Use the ▲ or ▼ keys to adjust the value.
5. Press the Enter button to confirm the setting or press the Esc button to cancel and exit.

The meaning of each digit in the time display is as follows.

00	:	00	:	00
Hour		Minute		Second

Notes:

- For harmonic measurements, users can specify the harmonic orders to be stored. For example, only the 1st, 3rd, and 29th voltage harmonics can be recorded. If harmonic mode is disabled, specifying harmonic orders will produce meaningless data.
- If the Hold key is active, measurement operations are temporarily paused, and the held data will be stored.
- For single measurements, the updated data is stored immediately.
- During maximum value hold operation, the stored data corresponds to the currently held maximum value.

7.2.7 System Time

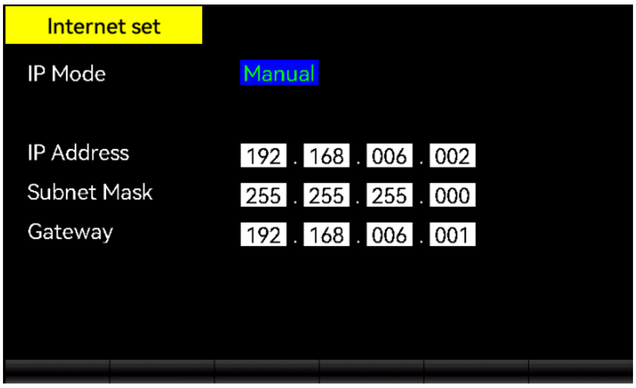
Users can view the system time; the time is calibrated at the factory before delivery. The system time cannot be adjusted manually; it can only be set via SCPI commands.

The meaning of each digit in the time display is as follows.

2025	-	07	-	02		11	:	16	:	41
Year		Mon th		Day		Tim e		Min ute		Sec ond

7.3 Network Settings

用户可通过 RJ-45 以太网通信接口向功率计发送 SCPI 或 Modbus 指令，功率计接收到相关指令后执行相应的功能，其他设备与通信时，需要先设置好 IP 信息，包含 IP 模式，IP 地址，子网掩码，网关，若 IP 信息设置不正确将无法正常通信。



Setting Steps

1. On the network settings interface, use the keys to move the cursot to the IP Mode field.
2. If IP Mode is set to Manual, follow steps 3-7; if set to Auto (DHCP), skip to step 7.
3. Use the arrow keys to move the cursot to the IP Address, Subnet Mask, or Gateway field.
4. Press Enter button to enter value editing mode.
5. Use the and keys to select the digit to edit.
6. Use the or keys to adjust the value.
7. Press the Enter button to confirm the setting or press the Esc button to cancel and exit.
8. Press the Enter button to return to the pervious menu.

7.3.1 IP Mode

The power meter supports two modes for obtaining IP information.

Manual: Users must configure the IP parameters manually, including IP Address, Subnet Mask, and Gateway.

DHCP (Dynamic Host Configuration Protocol): No manual configuration is required. The DHCP server automatically assigns an IP address and other network parameters when the instrument connects to a network with a DHCP server.

Notes: If the instrument is connected to a network with a DHCP server, select Auto (DHCP) mode to allow automatic network configuration. If Manual mode is selected, users are required to enter all IP parameters manually.

7.3.2 IP Address

The IP Address uniquely identifies a device on a network and distinguishes it from other devices. When IP Mode is set to Manual, users must configure the IP Address manually, ensuring that no two devices share the same address to avoid conflicts.

7.3.3 Subnet Mask

The Subnet Mask works alongside the IP Address to:

- Differentiate between the Network ID (network identifier) and Host ID (host identifier).
- Indicate whether the IP Address belongs to a Local Area Network (LAN) or a Wide Area Network (WAN).

Note: When IP Mode is set to Manual, the Subnet Mask must be configured manually.

7.5.4 Gateway

The gateway defines the communication path for data transmission between the local network and other networks. When IP Mode is set to Manual, the Gateway address must also be entered manually.

7.4 Serial Port

The serial port provides an interface for serial communication, transmitting data bit by bit in sequence.

Key parameters for serial communication: baud rate, data bits, parity bit, and stop bit, must match the settings of the connected control terminal to enable successful remote communication.

The UTE323 ,UTE333H and UTE333H-2K models are factory-equipped with an RS-232 communication interface. These parameters can be configured via the serial port interface, as shown in the figure below.

Baud Rate: Number of bits transmitted per second, in baud. Default: 115200.

Data Bits: Number of data bits per data packet. Common settings: 7 or 8 bits. Default: 8 bits.

Parity Bit: Used for error detection. Can be set to odd or even parity. Default: None.

Stop Bit: Used for synchronization at the end of each data packet. Can be set to 1 or 2 bits.

7.4.1 Communication Protocol

The power meter supports two command protocols for instrument control: SCPI and Modbus, with Modbus available in two variants: Modbus_RTU and Modbus_ASC. When using Modbus, each device must be assigned a unique address to ensure proper communication.

7.5 GPIB Settings

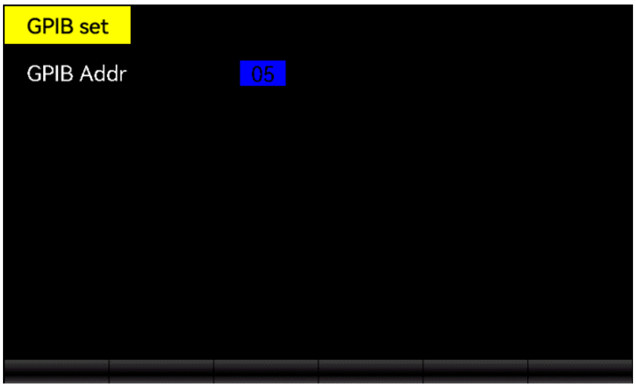
GPIB (General Purpose Interface Bus) is a standard interface for communication between electronic test instruments and computers or other control devices.

Using GPIB, users can:

- Remotely control the instrument
- Acquire measurement data
- Integrate the instrument into automated test systems

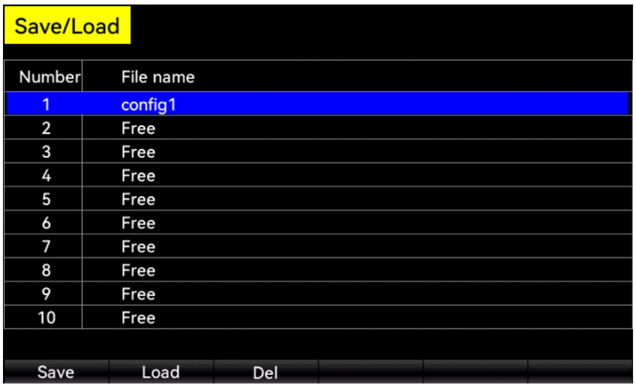
Each device on the GPIB bus requires a unique address for identification. The address is typically assigned by the master controller or configured manually through the instrument. Communication occurs via the device's GPIB address.

The UTE323G and UTE333G models feature a GPIB interface. Before use, the GPIB address for each device must be correctly configured, with an address range of 1–30, as shown in the figure below.



7.6 Save and Load

The power meter provides 10 user-configurable memory slots for storing measurement configuration parameters. Users can save different sets of parameters in these slots and quickly load them when needed, streamlining setup and improving efficiency. The interface is shown in the figure below.



Note: Only parameters within the Setup Measurement Setup Menu are supported for saving and loading.

7.6.1 Saving Parameter Configuration

On the system Interface, press the **F5 (Save/Load)** button to enter the Save and Load Interface. Follow the following steps to complete the parameter saving process.

Setting Steps

1. Use the keys to select the save path.
2. Use the arrow keys to select a number or character.

3. Press the Enter button to add the selected number or character to the filename.
4. Press the **F6 (Delete)** button to remove any incorrect or unwanted numbers or characters.
5. Repeat steps 2-3 to create the desired filename.
6. Press the **F5 (Confirm)** button to save the configuration.
7. Press the Enter button to return to the pervious menu.

7.6.2 Loading or Deleting Parameter Configuration

On the system Interface, press the **F5 (Save/Load)** button to enter the Save and Load Interface. Follow the following steps to complete the loading or deleting parameters process.

Setting Steps

1. Use the ▲ ▼ keys to select the parameter configuration to load. By default, the filename is unassigned and available.
2. Press the **F2, F3** button to open the load or delete message box.
3. Press the Enter button to confirm Load/Delete.
4. Press the Esc button to exit the current setting.
5. Repeat steps 2-3 to load or delete other saved parameter configurations.
6. Press the **F5 (Confirm)** button to save the configuration.
7. Press the Enter button to return to the pervious menu.

7.7 USB Flash Drive

When a USB flash drive is inserted, the following operations are available:

1. **Store Measurement Data:** Save measurement data to the USB flash drive. For detailed storage methods, refer to *Section 7.2.5 and Section 7.2.6.*
2. **Capture and Save Screen Content:** Capture the current display and save it as an image on the USB flash drive.
3. **Browse Files:** View the file status on the USB flash drive. This allows browsing some folders and files, but opening them is not supported.

Chapter 8 Remote Control

The power meter supports remote control through multiple interfaces, including D/A, USB, LAN, and

GPIB/RS-232. This chapter introduces the features and configuration procedures of these communication interfaces.

Note: When using the LAN interface, only local area network (LAN) control is supported.

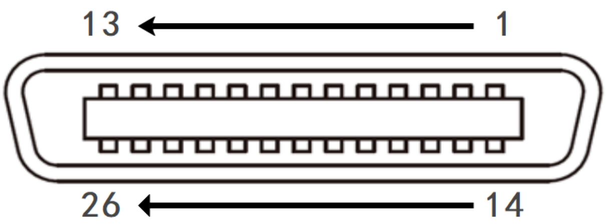
8.1 D/A Interface

The power meter series is equipped with a standard 12-channel D/A interface.

This section focuses on the electrical properties of the pins and the timing requirements for control signals.

8.1.1 D/A Interface Pin Definition

The D/A interface is located on the rear panel of the power meter and uses a 26-pin male SCSI connector. Users can connect to the power meter via a matching female SCSI cable. The pin arrangement of the D/A interface is shown in the figure below.



Pin Definition

Pin	Description	Pin	Description	Pin	Description
1	GND	10	CH 3 (Output)	19	CH 10 (Output)
2	EXTI HOLD (Input)	11	CH 1 (Output)	20	CH 8 (Output)
3	EXTI START (Input)	12	GND	21	CH 6 (Output)
4	EXTI RESET (Input)	13	GND	22	CH 4 (Output)
5	NC	14	EXTI TRIG (Input)	23	CH 2 (Output)
6	CH 11 (Output)	15	EXTI STOP (Input)	24	GND
7	CH 9 (Output)	16	INTEG BUSY(Output)	25	NC
8	CH 7 (Output)	17	NC	26	NC
9	CH 5 (Output)	18	CH 12 (Output)	/	/

⚠ Notes

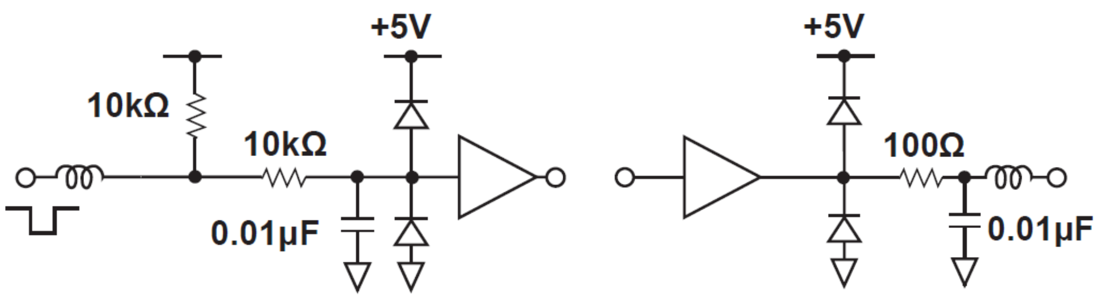
- **Avoid Short-Circuiting:** Do not short-circuit the D/A output pins or apply external voltages, as this may damage the instrument.
- **Correct Pin Connections:** Ensure correct pin connections when linking the D/A output to other devices. Misconnections can create abnormal current loops, potentially damaging both the power meter and the connected equipment.

- **Voltage Range Limit:** Do not apply voltages outside the 0–5 V range to the remote control pins, as this may damage the instrument.
- **Power Off Before Wiring:** Always turn off the power meter before connecting or disconnecting the D/A cable.

8.1.2 Remote Control Signals

In addition to outputting measurement data as ±5 V analog signals, the D/A interface of the power meter also supports remote control of the integration and data-hold functions via external signals. The figure below illustrates the DA12 remote control input and output circuit, showing the signal path and connection logic between the D/A interface and external control devices.

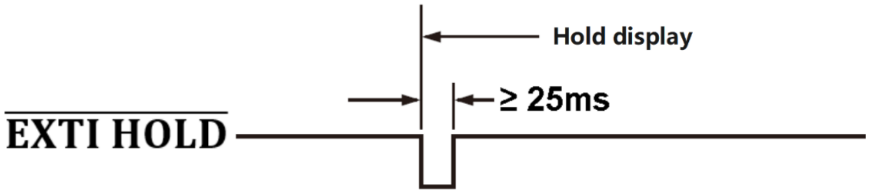
Input Circuit Output Circuit



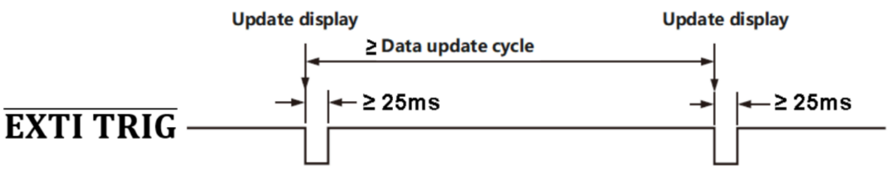
Low Level: 0 V to 1 V
High Level: 4 V to 5 V

Low Level: 0 V to 1.5 V (8 mA)
High Level: 0 V to 1.5V (-8 mA)

- **EXTI HOLD** (Hold Measurement Data Signal)
  As shown in the figure below, applying the EXTI HOLD signal remotely will hold the current measurement data.



- **EXTI TRIG** (Updated Held Display Data Signal)
  As shown in the figure below, applying the EXTI TRI signal remotely updates the currently held measurement data.



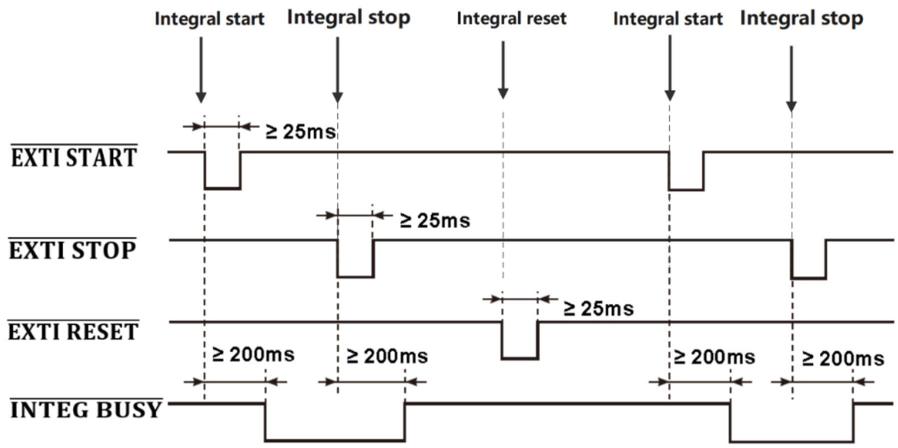
- Remote Control Integration
  EXTI START (Start integration)

EXTI STOP (Stop integration)

EXTI RESET (Reset integration)

INTEG BUSY (Integral indicator: the power meter continuously outputs this signal while the integration process is in progress.)

The timing diagram for remote integration control is shown below.



Note:

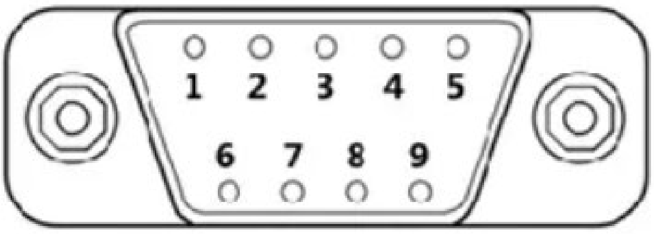
When integration starts, the **INTEG BUSY** signal is at a low level. In all other cases, the signal is at a high level. Users can monitor this signal directly to determine the status of the integration process.

8.2 RS-232 Interface

The RS-232 interface is a widely used serial communication standard, originally developed by the Electronic Industries Alliance (EIA) in 1962 to define the electrical and mechanical characteristics for serial binary data exchange between data communication devices.

The RS-232 standard supports connectors with either 25 or 9 pins. The power meter uses a 9-pin RS-232 connector. Users can remotely send SCPI or Modbus commands from a PC through this interface. Upon receiving the commands, the power meter executes the corresponding front-panel functions and can return measurement data, calculated values, parameter settings, control panel status bytes, error codes, and more.

The RS-232 communication interface is a DB9 male header, with pin definitions shown in the figure below.



9-pin Definition

1	NC (Not connection)

2	RXD (RS-232 data input)
3	TXD (RS-232 data output)
4	NC
5	GND (RS-232 signal ground)
6	NC
7	NC
8	NC
9	NC

Notes:

Before performing any communication operations, ensure that the power meter's parameters match those of the control host.

(1) Baud Rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps

(2) Data Bits: 7 or 8 bits

(3) Parity Bit: Odd, even, or none

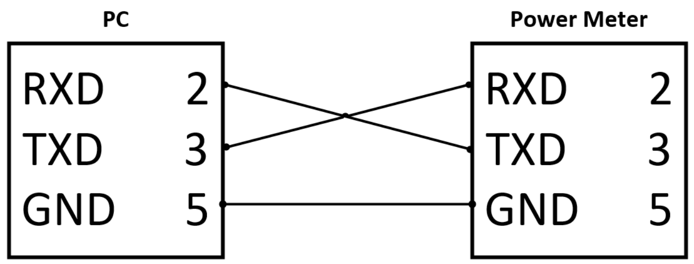
(4) Stop Bits: 1 or 2 bits

8.2.1 RS-232 Interface Settings

Communication Protocol: Configure the communication protocol to either SCPI or Modbus according to the application requirements. When using Modbus, assign a unique device address to the power meter to distinguish it from other devices on the same communication bus and prevent command conflicts.

Baud Rate: Adjust the power meter's baud rate to match that of the control host.

8.2.2 PC Connecting to Power Meter Via RS-232



Notes

- **Ensure Stable Communication:** When using the RS-232 interface, do not use other communication interfaces simultaneously.
- **Pin Number Description:** In the block diagram, pins 2, 3, and 5 of the DB9 connector are used; all other pins are not required.

- **Standard Cable:** Use a cross-over serial cable when connecting the PC to the power meter.
- **Wiring Method:** This wiring method applies only to PCs with an RS-232 interface. If the PC lacks an RS-232 port, use a USB-to-RS-232 adapter cable to connect the PC to the power meter.

8.3 GPIB Interface

GPIB (General Purpose Interface Bus), also known as IEEE 488, is a standardized interface designed for connecting computers with programmable test and measurement instruments.

The GPIB bus supports the simultaneous connection of up to 15 devices on the same bus and enables communication with a computer, making it particularly suitable for automated testing and data acquisition workflows.

For this power meter series, the GPIB interface is optional, only the UTE323G and UTE333G models are equipped with the GPIB interface.

When equipped with the GPIB option, the power meter can receive commands from the GPIB bus. After processing the commands, the instrument executes the corresponding front-panel functions and returns data to the connected computer, such as measurement data, calculated data, control panel settings, status bytes, and error codes.

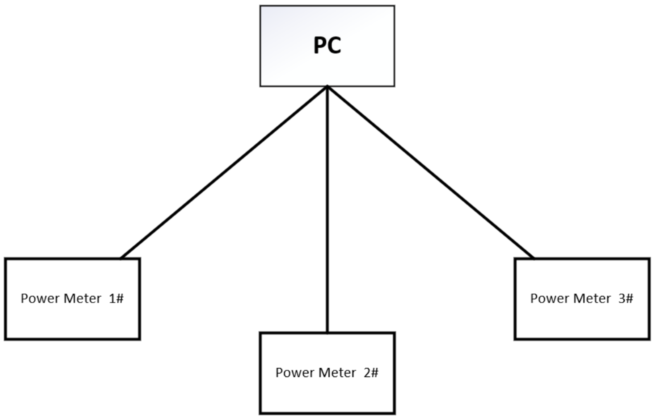
Compatible Models	PCI-GPIB or PCI-GPIB+, PCIe-GPIB or PCIe-GPIB+ PCMCIA-GPIB or PCMCIA-GPIB+ (not supported on Windows Vista or Windows 7) GPIB-USB-HS (requires NI-488.2M Ver. 2.8.1 or a later version)
Electrical and Mechanical Specifications	IEEE 488-1978 (JIS C 1901-1987)

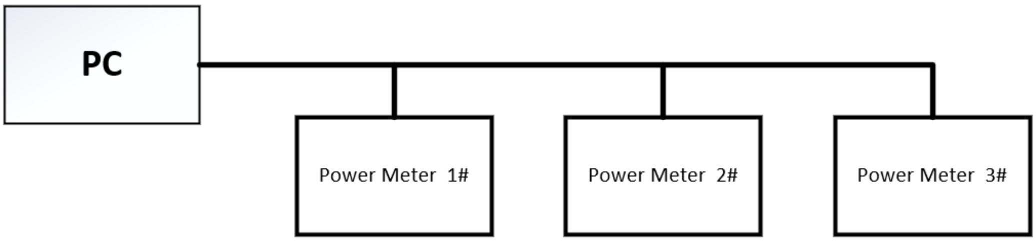
Notes:

- **Ensure Stable Communication:** IEEE 488 specifies strict requirements for GPIB cable characteristics. Use only standard-compliant cables to maintain signal integrity and reliable communication.
- **Specified GPIB Address:** Each GPIB device must have a unique address to avoid conflicts on the bus. Before using the power meter's GPIB interface, configure its GPIB address to ensure proper identification and communication.

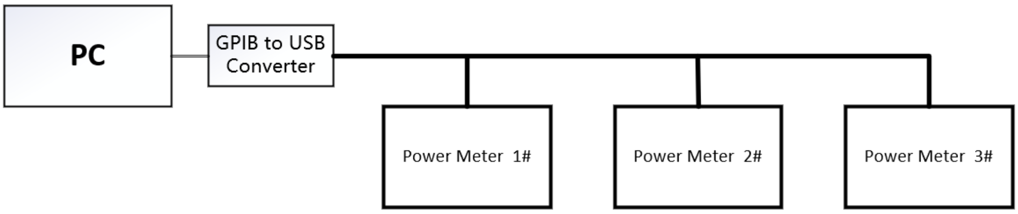
8.3.1 PC Connecting to Power Meter Via GPIB

When using the GPIB interface, use a standard GPIB communication cable. The cable length should be kept as short as possible to ensure reliable communication. The wiring connection is shown below.





Under normal conditions, PCs are not equipped with a built-in GPIB interface. To establish GPIB communication between a PC and the power meter, use a GPIB-to-USB adapter, as shown below.



Notes:

- **Ensure Stable Communication:** When using the GPIB interface, do not use other communication interfaces simultaneously.
- **Pin Number Description:** The numbers in the above block diagram represent either the pin numbers of the PC's USB port or the standard 24-pin GPIB connector. Only the labeled pins are used for the connection; unlabeled pins remain unused.
- **Standard GPIB Cables:** Always use standard, IEEE 488-compliant GPIB cables. Non-standard or poor-quality cables may have inadequate shielding or incorrect wiring, which can cause interference, reduce communication stability, or prevent data exchange.

8.4 Ethernet Interface

The Ethernet interface is a standard physical connection used to link network devices to a Local Area

Network (LAN). It typically adopts an RJ-45 connector, an 8-pin modular plug designed for twisted-pair cabling. Most devices with an Ethernet port include status indicators (LEDs) to display link connectivity and network activity.

Ethernet is one of the most widely used LAN technologies. It defines both the physical and electrical transmission characteristics of a LAN and the Media Access Control (MAC) method, which regulates how devices share network access.

The power meter is equipped with an Ethernet interface. It can receive commands from the Ethernet interface. After processing the commands, the instrument executes the corresponding front-panel functions and returns data to the connected computer, such as measurement data, calculated data, control panel settings, status bytes, and error codes.

Number of Ports	1
Connector Type	RJ-45 connector
Electrical and Mechanical Specifications	IEEE802.3
Transmission System	Ethernet (100BASE-TX, 10BASE-T)
Communication Protocol	TCP/IP
Baud Rate	Max. 100 Mbps
Supported Services	DHCP, remote control

8.4.1 Network Settings

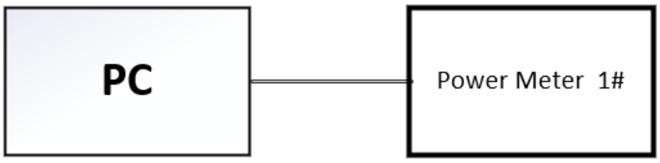
Communication Protocol: Configure the communication protocol to either SCPI or Modbus according to the application requirements.

IP Mode: Auto or manual

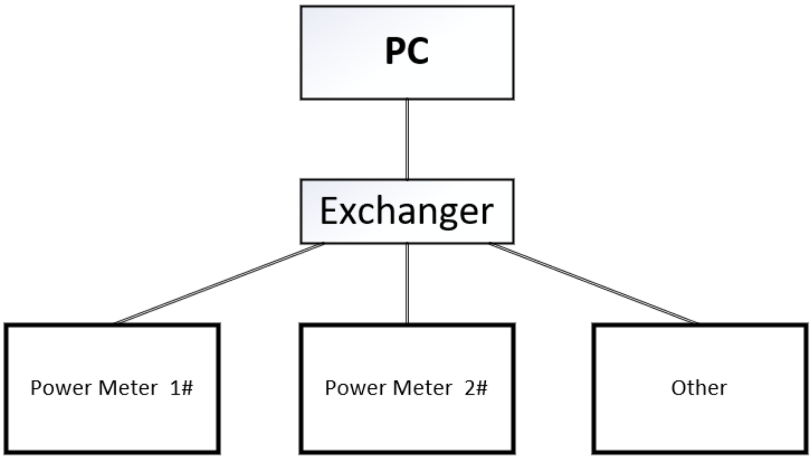
Note: When the power meter's IP mode is set to Manual, users must correctly configure the IP address, subnet mask, and gateway to ensure proper Ethernet communication.

8.4.2 PC Connecting to Power Meter Via Ethernet Interface

The power meter can be directly connected to a PC using an Ethernet cable. For this direct connection, a crossover Ethernet cable is required: one end wired according to the T568A standard and the other end according to the T568B standard.



A more common method is to connect via a network switch, which allows communication with multiple devices. Each power meter must have a specified IP address to ensure proper network communication, as shown in the figure below.



Note:

Ensure Stable Communication: When using the Ethernet interface, do not use other communication interfaces simultaneously.

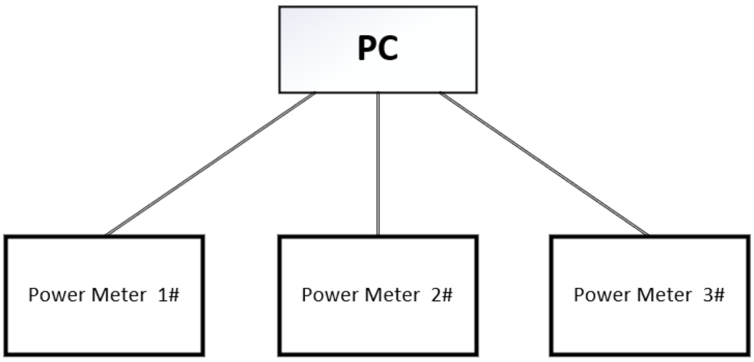
8.5 USB Interface

When communicating through the USB interface, there is no need to configure USB parameters on the instrument. The electrical specifications of the power meter's USB interface are shown in the table below.

Number of Ports	1
Connector Type	Type B USB connector (socket)
Electrical and Mechanical Specifications	USB 2.0
Transmission Rate	FS (full speed;12 Mbps)
Communication Protocol	User-defined
PC System	A PC with a USB port, running the English or Simplified Chinese version of Windows 7 (32-bit/64-bit), Windows Vista (32-bit/64-bit), or Windows XP (32-bit, SP2 or later)

8.5.1 PC Connecting to Power Meter Via USB

Multiple power meters can be connected simultaneously via the USB interface. Before connecting, ensure that the corresponding device driver is installed. The required driver for the power meter will be automatically installed when the power meter's upper computer software is installed.



Notes:

- **Ensure Stable Communication:** When using the USB interface, do not use other communication interfaces simultaneously.
- **Secure Connection:** The USB data cable must be firmly and reliably connected to both the instrument and the PC.
- **Multiple Devices:** If multiple devices are connected to the PC via USB, connect this power meter to the USB port closest to the PC.

Chapter 9 Storage and Calibration

9.1 Storage Precautions

- Store the instrument only in the environment specified in the user manual. For details, refer to Section

1.2 *Environmental Requirements*. Do not store the instrument in locations with high temperature, high humidity, rapid temperature changes, or condensation risk. The recommended storage environment is dry, at approximately 26 °C.

- Retain the product's packaging materials (such as cartons, padding, and plastic bags) for future transportation. Using the original packaging helps protect the instrument from sudden temperature changes, shocks, and vibrations, and prevents damage during delivery.
- Do not store the instrument in environments containing dust, fumes, or chemical gases.
- Avoid direct exposure to sunlight.

9.2 Troubleshooting

No.	Problem	Solution
1	No display when pressing the power switch	1. Ensure the power cable is properly connected. 2. Verify that the power supply is within the specified range. 3. Check that the fuse is not blown.
2	Incorrect or abnormal measurement data	1. Confirm that the operating temperature and humidity are within the allowable range. 2. Ensure the display is free from noise interference. 3. Verify that the test leads are properly connected. 4. Check that the wiring method is correct. 5. Ensure the data display is not in Hold state. 6. Restart the instrument and check if the measurement returns to normal.
3	Key function failure	1. Check whether any key is stuck. 2. Check whether the power meter is in remote control.
4	Communication failure	1. Verify that the communication cable is properly connected and that the correct cross/straight cable type is used. 2. Ensure the instrument's address, communication mode, and baud rate match the settings of the host computer.

9.3 Calibration

Verification and Calibration

The reference power meter used for calibration should have an accuracy class at least one grade higher than the meter under test. The calibration source must remain stable throughout the procedure.

Before calibration, power on all instruments for at least 15 minutes to allow them to stabilize. Then, gradually adjust the output voltage or current of the standard AC power source. Use the power meter under test to obtain the corresponding reading, and record both the standard meter data and the UTE323 data once the values are stable. The measurement error is then calculated to determine whether it falls within the specified tolerance.

The environmental requirements for verification and calibration are shown in the table below.

Item	Reference Value or Range	Reference Value or Range
Environmental temperature ℃	23	±5
Environmental humidity % RH	45-75	
Barometric pressure KPa	86-106	
AC power supply voltage (V)	100-240	±2%
AC power supply frequency (Hz)	50/60	±1%
Ac power supply waveform	Sine waveform	ß= 0.05
External electromagnetic field interference	Avoid	
Ventilation	Well-condition	
Sunlight	Avoid direct sunlight	

Note: The inspection equipment must comply with the specifications of regular metrological verification, and the calibration/verification cycle is one year.

Appendix 1 Measurement Accuracy and Measurement Error

Measurement Function (Unit)	Operational Formula	Description
Voltage TRMS (Urms /V)	$\text{Urms} = \sqrt{\frac{1}{N} \cdot \sum_{n=1}^{N} u(n)^2}$	u(n): Instantaneous voltage value i(n): Instantaneous current value N: Instantaneous current value θ: Phase difference between voltage and current
Voltage Calibrated Average Value (Umn /V)	$\text{Umn} = \frac{\pi}{2\sqrt{2}} \text{x} \frac{1}{N} \cdot \sum_{n=1}^{N} \lvert u(n) \rvert$	
Voltage DC Component (Udc /V)	$\text{Udc} = \frac{1}{N} \cdot \sum_{n=1}^{N} u(n)$	
Voltage AC Component (Uac /V)	$\text{Uac} = \sqrt{\text{Urms}^2 - \text{Udc}^2}$	
Current TRMS (Irms /A)	$\text{Irms} = \sqrt{\frac{1}{N} \cdot \sum_{n=1}^{N} i(n)^2}$	
Current Calibrated Average Value (Imn /A)	$\text{Imn} = \frac{\pi}{2\sqrt{2}} \text{x} \frac{1}{N} \cdot \sum_{n=1}^{N} \lvert i(n) \rvert$	
Current DC Component (Idc /A)	$\text{Idc} = \frac{1}{N} \cdot \sum_{n=1}^{N} i(n)$	
Current AC Component (Iac /A)	$\text{Iac} = \sqrt{\text{Irms}^2 - \text{Idc}^2}$	
Active Power (P /W)	$P = \frac{1}{N} \cdot \sum_{n=1}^{N} [u(n) * i(n)]$	
Apparent Power (S /VA)	S=Urms · Irms	
Reactive Power (Q /var)	Q=$-\sqrt{S^2 - P^2}$,或Q=$\sqrt{S^2 - P^2}$	
Power Factor (PF)	$\text{PF} = \frac{P}{\text{Urms} \cdot \text{Irms}}$	
Frequency (fU, fI /Hz)	Use zero-crossing detection to measure the voltage frequency (fU) and the current frequency (fI)	
Crest Factor (CFU, CFI)	$\text{CFU} = \frac{\text{UPK}}{\text{Urms}}$, $\text{CFI} = \frac{\text{IPK}}{\text{Irms}}$	UPK: The larger value between |Upk+| or |Upk-| IPK: The larger value between |Ipk+| or |Ipk-|

Appendix 2 Measurement Accuracy and Measurement Error

Measurement instruments have specified requirements for measurement accuracy and measurement error. The measurement accuracy of the UTE323 digital power meter varies depending on the frequency of the measured signal.

For example, the voltage and current accuracy in the frequency range of 45 Hz to 66 Hz is: ±(0.1% of reading+0.05% of range)

Measurement Error of Voltage and Current

Example 1: Using the 1 A range to measure a 60 Hz, 1 A current

- Reading error: 1×0.1%=0.001 A
- Range error: 1×0.05%=0.0005 A
- The display error when measuring a 1 A current is the sum of the reading error and the range error, totaling ±0.0015 A; thus, any displayed value between 0.9985 A to 1.0015 A falls within the allowable error range and considered a normal measurement result.

Example 2: Using the 5 A range to measure a 60 Hz, 1 A current

- Reading error: 1×0.1%=0.001 A
- Range error: 5×0.05%=0.0025 A
- The display error when measuring a 1 A current is the sum of the reading error and the range error, totaling ±0.0035 A; thus, any displayed value between 0.9965 A to 1.0035 A is within the allowable error range and considered a normal measurement result.

Example 3: Using the 1 A range to measure a 60 Hz, 0.5 A current

- Reading error: 0.5×0.1%=0.0005 A
- Range error: 1×0.05%=0.0005 A
- The display error when measuring a 1 A current is the sum of the reading error and the range error, totaling ±0.0010 A; thus, any displayed value between 0.4990 A to 0.5010 A is within the allowable error range and considered a normal measurement result.

Measurement Error of Power

When the input signal frequency is within 45 Hz–66 Hz, the active power accuracy of the UTE323 is: ±(0.1% of reading + 0.05% of range).

Example 4: Using the 150 V,1 A range to measure power 800 W (100 V, 0.8 A, 60 Hz)

Power range = voltage range × current range, i.e,150 V × 1 A = 150 W

1. When λ (Crest Factor) = 1:
    - Reading error: 80 × 0.1% = 0.08 W

- Range error: 150 × 0.05% = 0.075 W
- The measurement error for an 80 W power reading is the sum of the reading error and the range error, totaling ±0.155 W, which rounds to ±0.16 W; thus, any measured value between 79.84 W and 80.16 W is within the allowable error range and considered a normal measurement result.

2. **When λ (Crest Factor) = 0 (phase difference Φ = 90°):**

   Theoretical measured values:

   - Active power P = 0 W
   - Apparent power S = 80.00 VA
   - Reactive power Q =80 var
   - When λ = 0, power error formula of the UTE323 is as follows.

     Within the frequency range of 45Hz ≤ f ≤ 66Hz, the measurement accuracy of apparent power is 0.1% of ±S, i.e, ± (80 VA × 0.1% = 0.08 VA).

     Thus, any displayed apparent power value between 79.92 VA and 80.08 VA is within the allowable error range and considered a normal measurement result.

3. **When 0 < λ < 1, e.g., λ = 0.5 (phase difference Φ = 60°) :**

   Theoretical measured values:

   - Apparent power S = 80.00 VA
   - Active power P = 40.00 W
   - Reactive power Q = 69.28 var
   - When 0 < λ < 1, power error formula of the UTE323 is as follows.

     (Power reading) × { (Percentage of power reading error) + (Percentage of power range error) × (Power range / Apparent power indicated value) + [tanΦ × (Influence at λ=0) %] }

     i.e,

     $$P = 40 * \{0.1\% + 0.05\% * \frac{150}{80} + [\tan 60^{\circ} * 0.1\%]\}$$
     $$= 40 * \{0.1 + 0.05 * 1.875 + \sqrt{3} * 0.1\}\%$$
     $$= 40 * 0.367\%$$
     $= 0.1468\ \mathrm{W}$, rounded to two decimal places, is 0.15 W.

     Thus, any displayed apparent power value between 39.85 W and 40.15 W is within the allowable error range and considered a normal measurement result.

Limited Warranty and Liability

UNI-T guarantees that the Instrument product is free from any defect in material and workmanship within three years from the purchase date. This warranty does not apply to damages caused by accident, negligence, misuse, modification, contamination, or improper handling. If you need a warranty service within the warranty period, please contact your seller directly. UNI-T will not be responsible for any special, indirect, incidental, or subsequent damage or loss caused by using this device. For the probes and accessories, the warranty period is one year. Visit instrument.uni-trend.com for full warranty information.

Learn more at: www.uni-trend.com

Register your product to confirm your ownership. You will also get product notifications, update alerts, exclusive offers and all the latest information you need to know.

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