OPERATION MANUAL

TH3411/TH3421/TH3422

Digital Power Meter

Tonghui Electronic Co.,Ltd.

www.tonghui.com.cn

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Declaration

The descriptions contained in this manual may not cover all information about this instrument. Introductions to the improvements of the instrument in performance, function, internal structure, outer appearance, accessories, packing material, etc. are subject to change without notice. If you find any inconformity of this manual with our instruments, please contact us for further consultation by the address listed on the cover.

Chapter 1 Introduction

Thank you for your purchase and use of our products! This chapter will introduce the basic instrument performance, which is followed by notes of unpacking and installing.

1.1 Introduction to Instrument

TH34XX series multi-channel digital power analyzer (digital power meter) uses high-speed 32-bit processor and professional DSP digital signal processor. Being equipped with an embedded operating system, it is a new generation of digital power analyzer with fast speed, wide frequency bandwidth, complete function, compact structure, stable test, simple operation and good human-machine interface. The main parameters that can be measured are: voltage and current RMS, voltage and current AC component, voltage and current DC component, active power, reactive power, apparent power, energy timing integral, power factor, frequency, voltage and current peak factor, voltage and current peak-to-peak value and harmonic analysis function.

The contents of this manual cover the TH3411/TH3421/TH3422 three instruments (the common points of the three instruments indicated by TH34XX in the below introduction and the specific models are marked when having different points), all of which belong to the multichannel power analyzer. The advantages of the input bandwidth (45~420Hz) cover most of the power supply on the market. In addition to the basic electrical parameter measurements, the three instruments also provide a comparatively intuitive input waveform display as well as the HANDLER interface, RS232C/ RS485 interface and USBTMC, LAN interface and WIFI drive, supplying conditions for the instrument to be used for automatic sorting system and computer remote operation; the difference between different models is mainly in the current measurement range and the number of channels. The maximum test current is 20A with stable accuracy. The specific difference can be seen in the following instrument model comparison table.

The main features of the instrument:

- Multi-channel combination, providing 5 kinds of wire system combinations can be set; for 4-channel instruments, it can be combined in pairs;
- 7-inch 24-bit LCD liquid crystal display (resolution 800*480);
- Equipped with embedded operating system, human-computer interaction is more friendly;
- Soft power switch;
- Chinese and English optional operation interface;
- Input frequency range (45~420Hz);
- Range automatic / manual is controllable;
- The maximum test current is 20A (depending on the model), and the minimum current can be up to 1uA (depending on the model);
- Controllable synchronous trigger source;
- Provide 5kHz line filter switch;
- Flexible energy integration control;
- Parameter comparison and Handler programmable 8-channel output function;

● Harmonic analysis function;
● Waveform display function and power waveform display in the integration state;
● Vector analysis function;
● Support U disk file storage, upgrade the instrument program through U disk;
● Serial interface: RS-232C/RS485, USB virtual serial port and local area network LAN port provide great convenience for serial communication between instruments and peripherals. Peripherals can set various functions and parameters of the instrument through this interface, which can basically replace the function of the panel keyboard; the interface commands are uniformly written using two optional protocols: SCPI format and ModBus, which greatly facilitates user programming;
● Handler interface: this interface is used for external trigger test and external control input;

1.2 Unpacking

Inspect the shipping container for damage after unpacking it. It is not recommended to power on the instrument in the case of a damage container.
If the contents in the container do not conform to the packing list, notify us or your dealer.
The instrument model and basic functions are compared as shown in Table 1-1 below:

Model	Difference and function description
TH3411	3-channel, 600V/20A, with harmonic, waveform and vector analysis function
TH3421	4-channel, 600V/20A, with harmonic, waveform and vector analysis function
TH3422	4-channel, 600V/2A, with harmonic, waveform and vector analysis function

Table 1-1 Instrument model and basic function comparison table

Note: It is best to keep the packing box of the instrument after unpacking, so as to avoid unnecessary damage to the instrument during the transportation process due to the unsuitable packing.

Note: Since the 3-channel instrument does not have the 4th channel, the parameters related to CH4, P4, PS2, U4, I4 and other parameters in the manual below are not applicable to the 3-channel instrument. The special summary description is given here.

1.3 Power Connection

1) Power supply: 200~240VAC
2) Power supply frequencies: 47~63Hz
3) Power supply power range: ≤50VA
4) L (line wire), N (neutral wire) and E (earth ground wire) of the power supply input socket should correspond to the power plug of the instrument.
5) The instrument has been specially designed for decreasing noise jamming caused by the input in AC power terminal, but it is also recommended to use it in the environment of low noise. If noises cannot be avoided, install a power source filter please.

WARNING: To avoid injury to personnel and damage to the instrument resulting from

electric shock, do sure that the earth ground wire is safely grounded.

1.4 Fuse

The fuse is a standard configuration, so use the included custom fuse please.

1.5 Environment

- Normal working temperature: 0℃ to 40℃, humidity: 20～80%RH
- Reference operating temperature: 20 ℃ ±8 ℃, humidity: < 80% RH
- Transportation environment temperature: 0℃～55°C, humidity: ≤93%RH
- Do not store or use the instrument where it could be exposed to many dusts, great vibration, direct sunshine and corrosive gas.
- For high accuracy, do not block the left air vent so as to ensure good ventilation.
- The instrument has been specially designed for decreasing noise jamming caused by the AC power input, but it is also recommended to use it in the environment of low noise. If noise cannot be avoided, install a power filter please.
- If the instrument is not used for a long time, please store it in the original box or similar box in a ventilated room with a temperature of 5℃ ~ 40℃ and a relative humidity of not more than 85%RH. The air should not contain corrosive harmful impurities and should avoid direct sunlight.

1.6 Warm-up

1) For accurate measurement, the warm-up time should not be less than 30 minutes.
2) Do not turn on or off the instrument frequently. This may cause internal data confusion.

1.7 Other Features

1) Consumption: ≤50VA
2) Machine dimension (W*H*D): 215mm*132mm*441mm;
3) Outline dimension (W*H*D): 236mm*154mm*475.5mm;
   This dimension is the final packaging size.
4) Weight: Approx. 8.1kg

Chapter 2 Introduction to Front and Rear Panels

This chapter will describe the basic operation of TH33XX. Before using the instrument, please read this chapter carefully.

2.1 Introduction to Front Panel

Figure 2-1 shows the front panel of TH33XX.

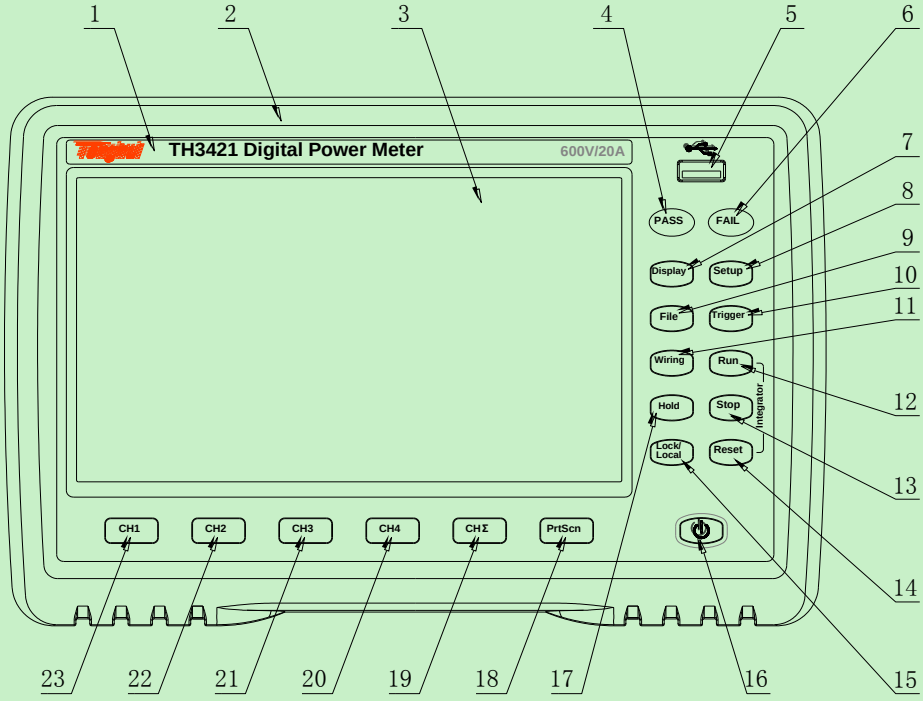


Figure 2-1 Front Panel

Mark	Name	Usage
1	Trademarks and Models	Indicate the instrument model and test range
2	Front panel rubber sleeve	Beautiful, bump-proof
3	LCD display	7-inch LCD touch screen, used to display test results and human-computer interaction
4	PASS light	Comparison PASS indicator, green
5	USB HOST	USB HOST interface, used for USB storage and upgrade

6	FAIL light	Comparison FAIL indicator, red
7	Display key	Test module button, used to enter the test module
8	Setup key	Setting module button, used to enter the parameter setting module
9	File key	File module button, used to enter the file management module
10	Trigger key	Manual trigger key, when the trigger mode is manual (MAN) mode, press this key once to perform a trigger measurement
11	Wiring key	Shortcut key for selection of line system combination, pop out the dialog box to select line system mode
12	Run key	Energy integration start button, the red LED light is on during energy integration operation, and the LED is off when the integration stops
13	Stop key	Energy integration stop button. If you press Run again in the stopped state, the last timekeeping and result will continue to run. If you reset the last timekeeping and result, you need to press the Reset button in the stopped state.
14	Reset key	Press this button after the integral timer stops, the energy accumulation returns to zero, and the timer resets.
15	Lock/Local key	Used to lock or unlock the key functions, the panel keys are locked, the LED light is on, the panel keys are unlocked, and the LED light is off.
16	Power switch	Power switch, the key is green when the instrument is turned on, and the key is red when it is off.
17	Hold key	After pressing, the corresponding LED light is on, and the test result is not refreshed; after pressing it again, the LED light is off, and the measurement lock state is released.
18	PrtScn key	It is used to save the current interface screenshot. If there is an external USB storage, it will be stored in the external USB first, otherwise it will be stored in

		the files directory of the instrument's internal files, all in the corresponding PIC folder;
19	CHΣ key	Used to switch between the wire system combination test page and the normal test page
20	CH4 key	Used to enlarge the switch between the corresponding channel display page and the normal test page
21	CH3 key	
22	CH2 key	
23	CH1 key	
Table 2-1 Front panel description		

2.2 Introduction to Rear Panel

Figure 2-2 shows the rear panel of TH33XX.

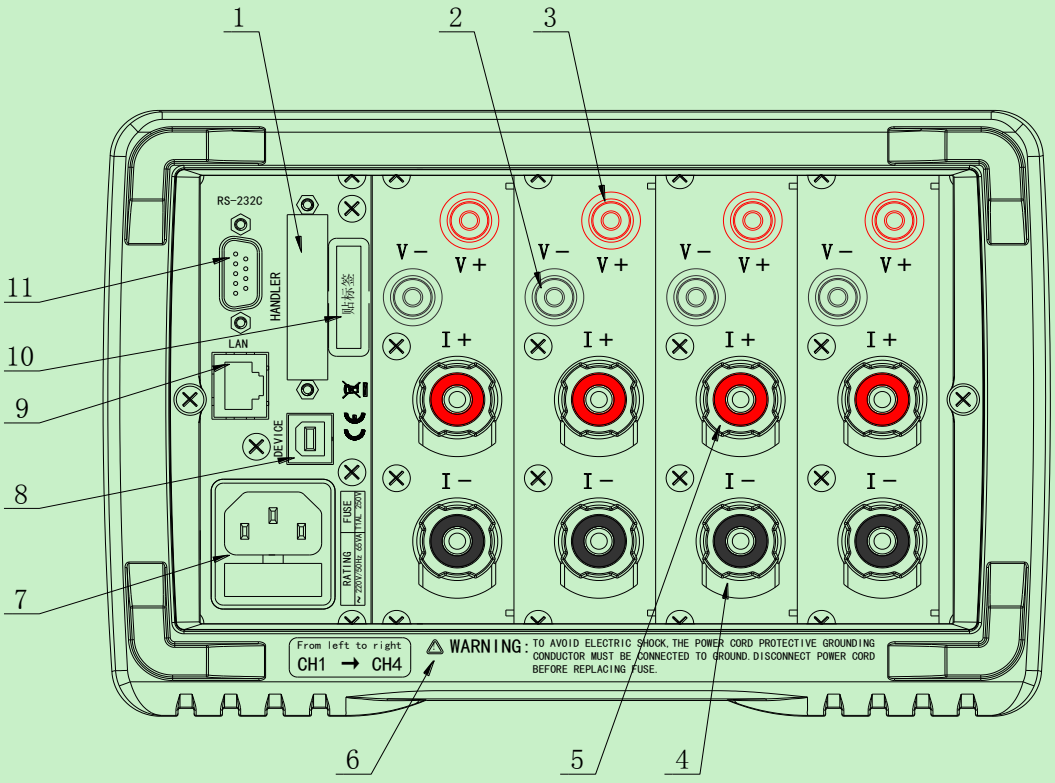


Figure 2-2 Rear Panel

1	HANDLER interface	Through the HANDLER interface, an automatic test system can be easily formed to realize automatic testing. The instrument outputs the comparison result signal through this interface, and at the same time obtains the "external trigger" signal through this interface.
2	V- input terminal	Negative terminal of voltage measurement input terminal
3	V+ input terminal	Positive terminal of voltage measurement input terminal
4	I- input terminal	Negative terminal of current measurement input terminal
5	I+ input terminal	Positive terminal of current measurement input terminal
6	Call tag	Indicates the warning information of the instrument
7	Power socket and fuse	Used to input AC 220V/50Hz power supply
8	USB Derive	The communication between the computer and the instrument can be realized through the USB DEVICE interface
9	LAN interface	Wired LAN interface for LAN communication
10	S/N label	Used to indicate the specific S/N number of the instrument
11	RS232C/485 interface	Serial communication with host computer
Table 2-2 Rear panel description		

2.3 Starting Up

Plug in the AC 220V/50Hz three-wire power plug to ensure the reliable connection of the power ground wire. The instrument automatically starts up and displays the startup screen. The startup is divided into two steps. The first step is to start the embedded operating system, and the second step is to start the application program. This makes the text information displayed on the startup screen different.

Figure 2-3 Start-up screen of the system, the display text includes the modification date of the system, the series name corresponding to the instrument, and the company information to which the instrument belongs, etc.;

(Figure 2-3 System startup screen)

Figure 2-4 Application startup screen, the display text includes some product information such as instrument model, version number, and company information to which the instrument belongs.

(Figure 2-4 Application startup screen)

2.4 Screen Display

TH34XX series uses a 24-bit color 7-inch color LCD resistive touch screen with a resolution of 800*480. The main test page has two display styles to choose from, which can be switched on the system setting page. The content displayed on the screen is divided into three parts. At the top is the title page bar; the middle part is the measurement result display and parameter setting area; the bottom column is the status bar, display instrument status information, including range, wire system, U disk, etc.

Chapter 3 Overview of Instrument Functions

TH34XX series instruments use phase-locked frequency multiplication sampling technology on the input signal to accurately sample the entire cycle of the input signal synchronously. The test data of each measurement function is calculated from these sampled data, so as to obtain the numerical data displayed on the screen. And waveform data, etc.

For the description of measurement parameter symbols and related calculation formulas, see 8.1 Basic Principles.

The conventional setting and operation methods of TH34XX series instruments are as follows:

Switch the 3 main modules through the [Disp] key, [Setup] key and [File] key;

【Disp】key ---- switch to the test page;

【Setup】key ---- switch to the setup page;

【File】key-----switch to the file management page;

Then select and operate the touch screen according to the control name on each page to adjust the parameter settings and display.

3.1 Independent channel measurement function

The basic functions of each channel can be divided into two categories: conventional measurement function and integral measurement function.

3.1.1 General Parameter

That is, the measurement function can be completed in the normal trigger state after the instrument is powered on. The measurable parameters are shown in Table 3-1:

Parameter symbol	Parameter meaning description	Parameter symbol	Parameter meaning description
U_{RMS}	True rms value of voltage	$\mathbf{I}_{RMS}$	True rms value of current
U_{AC}	Effective value of voltage AC component	$\mathbf{I}_{AC}$	Effective value of current AC component
U_{DC}	DC component of voltage	$\mathbf{I}_{DC}$	DC component of current
U_{PK+}	Positive peak voltage	$\mathbf{I}_{PK+}$	Positive peak current
U_{PK-}	Negative peak voltage	$\mathbf{I}_{PK-}$	Negative peak current
U_{PP}	Peak-to-peak voltage	$\mathbf{I}_{PP}$	Peak-to-peak current
U_{CF}	Voltage crest factor	$\mathbf{I}_{CF}$	Current crest factor

P	Active power	λ(PF)	Power Factor
S	Total power (apparent power)	φ(phase)	Phase difference between voltage and current
Q	Reactive power (reactive power)	F_{REQ}	Frequency of voltage or current

Table 3-1 Description of the meanings of general parameters

3.1.2 Integral measurement function

That is, after the instrument is powered on, it needs to cooperate with the necessary integral control to complete the test function in the normal trigger state.
The measurable parameters are shown in Table 3-2:

Parameter symbol	Parameter meaning description	Unit
W_{P+}	Positive active power integral (consumption)	Wh
W_{P-}	Negative active power integral (feedback)	Wh
W_P	Integral of active power	Wh
W_S	Total power integration	VAh
W_Q	Reactive power integration	varh
q	Current integral	Ah
P_{AVG}	Average power during integration time	W

Table 3-2 Description of the meaning of integral parameters

3.2 Wiring group ∑ measurement function

TH34XX series instruments provide 5 optional wiring group modes, The test parameters involved in the wiring unit are shown in Table 3-3:

Parameter symbol	Parameter meaning description	Unit
$\sum U_{RMS}$, $\sum U_{AC}$, $\sum U_{DC}$	The average value of the corresponding voltage in the wire system combination	V
$\sum I_{RMS}$, $\sum I_{AC}$, $\sum I_{DC}$	The average value of the corresponding current in the wire system combination	A
$\sum P$	Active power in wire system combination	W
$\sum S$	Apparent power in wire system combination	VA
$\sum Q$	Reactive power in wire system combination	var
$\sum P_F$	Power factor in wire system combination	
η	Energy efficiency within the wire system	
$\sum W_P$	Integral of active power in wire system combination	Wh
Table 3-3 ∑ parameter meaning description		

3.3 Measurement comparison and output function

The number of comparison output channels involves the number of external Handler ports. TH34XX comes standard with 8 external output ports and 1 external trigger signal;
That is, up to 8 signals can be selected to participate in the comparison, and the result of the comparison is output through a relay. The specific output mode is a user-programmable mode. Programmable output methods include:
Qualified conduction output, unqualified conduction output, qualified pulse output, unqualified pulse output, closed output;
Refer to the chapter of comparison parameter selection for details on the comparison of optional parameters:

3.4 Harmonic analysis function

TH34XX provides the 50th harmonic analysis function and the display form is optional with list and bar graph.
The test results include the analysis results of voltage and current signals:
Since TH34XX involves 3 channel and 4 channel models, there are 6 and 8 optional parameters, namely (U1, I1, U2, I2, U3, I3, U4, I4), and each signal can be selected ON or OFF:
The test results of the effective value of each harmonic;
The component percentage result of each harmonic;

The percentage component of the total harmonic;
Harmonic calculation standards are optional: IEC, CSA;
The analysis of the voltage and current parameters of each channel can be switched independently;

3.5 Waveform display function

The waveform display of TH34XX series is divided into two types, namely U&I (voltage and current waveform) and Power (active power waveform), and the display abscissa is limited to 256 points.

● **Voltage and current waveform**

Since TH34XX involves the 3-channel and 4-channel models, there are 6 and 8 optional signal waveforms, namely (U1, I1, U2, I2, U3, I3, U4, I4), each signal can be selected to ON or OFF;
The lock signal of the waveform display is based on the state of the open signal, and the priority order of selection is (U1, I1, U2, I2, U3, I3, U4, I4), for example: when only U1 and I2 are in the open state, the waveform is locked The phase of the waveform is referenced by the U1 bit; when only I2 and I4 are in the open state, the phase of the waveform lock is referenced by the I2 bit.
Note: This waveform display function is only for the user to check the overall status of the input signal of the viewing port. In principle, only the waveform status within one cycle (256 points) is displayed. According to the phase lock reference waveform, the input signal frequency of each channel is different, Multi-period waveform display may also appear; in addition, the waveform will not change the original phase difference of the signal.

● **Power waveform**

Since TH34XX involves 3 channel and 4 channel models, there are 3 and 4 optional signal waveforms, namely (P1, P2, P3, P4), and each signal can be selected to ON or OFF;
The waveform display area will display the calculated average power. The average power is calculated by the data after the tool integration starts, and the power waveform only displays the latest 256 data before the current moment, that is, the data before 256 points are also involved in the calculation of the average power. This may be reflected in the relative stability of the waveform and the calculated average power. This is a normal phenomenon.

3.6 Vector analysis function

Through the vector diagram and the test results, you can intuitively see the phase relationship between the various signals of the 3-phase input. Understand the balance of the three phases.

3.7 Basic communication functions

TH34XX series are equipped with standard RS232/RS485, USBTMC, LAN, WLAN (only support control chip RTL8192 and MT7601) related communication methods. Among them, RS232/RS485 is optional (choose one of the two, RS232 is standard without special selection instructions);
The communication protocol of the TH34XX series adopts the standard SCPI command standard

by default, which increases the readability and convenient practicality of the command; at the same time, it also provides optional ModBus command protocol (this protocol analysis is only valid for the RS232/RS485 interface), which is convenient for PLC and other related Communication control of electrical equipment.

Chapter 4 Measurement parameter setting and description

Step1: If it is not on the setting function page, press the [Setup] key to enter the setting related page.
Setting related pages have measurement setting, comparison setting, and system setting functions optional;
The set function classification is shown in the following table 4-1:

Set parameter classification	Description
Measurement setup	Mainly related to basic test related parameters
Compare setup	Mainly related to the relative parameters of the comparison parameter limit, function
Harmonic setup	Mainly related to harmonic parameters (see harmonic test page)
Waveform setup	Mainly related to waveform related parameters (see waveform test page)
System setup	Mainly related to system-related parameters
Table 4-1 Set parameter classification description	

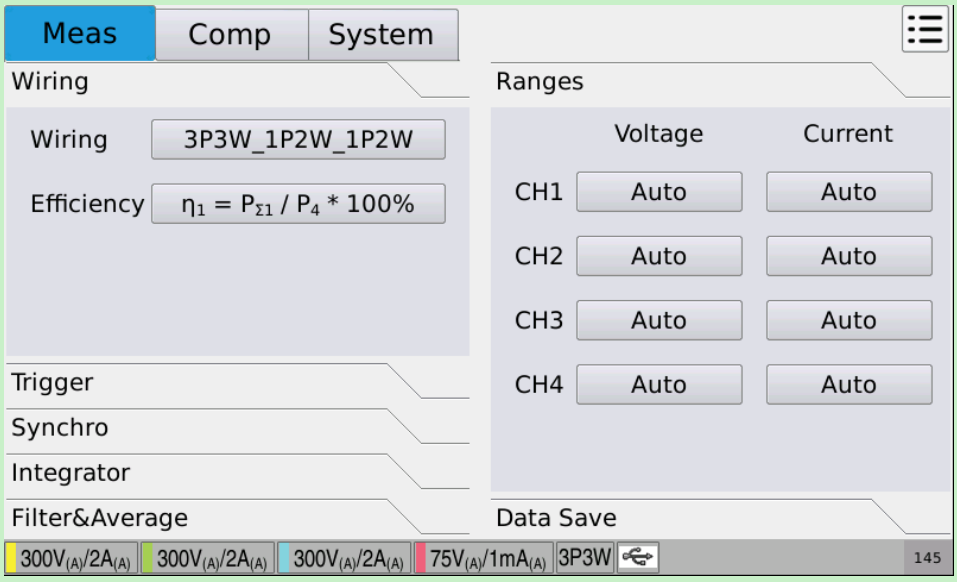
The classification of the setting page mainly includes measurement setting, comparison setting, and system setting. Other settings are not enough to open a single page because there are fewer settings, so the corresponding settings are implemented on the corresponding test page;
Step2: According to the content of the page display, touch to select the corresponding page to enter the page to be set.

4.1 Measurement Setup

The settings under this page mainly involve the adjustment and setting of the setting parameters related to the basic test. The main categories of the settable parameters are shown in the following table 4-2:

Set parameter classification	Description
Wire system setting	Selection of wire system and user programming of efficiency formula
Trigger setting	Trigger mode selection and trigger delay time setting
Sync setting	Synchronization source settings for each channel
Integral setting	Integral control method and integral limit time setting
Filtering and averaging settings	The choice of hardware filter and the setting of the average number of tests
Range setting	Setting of the voltage and current range of each channel
Data saving setting	Used to control the opening and closing of data saving operations
Table 4-2 Classification and description of measurement setting parameters	

The page display of measurement settings is shown in Figure 4-1 below



(Figure 4-1 Measurement setting page)

4.1.1 Wiring setup

For the description and meaning of the wiring system, please refer to the wiring method chapter in Chapter 8.

4.1.1.1 Wiring selection

TH34XX provides 5 kinds of wire combination systems for external wiring:

One-phase two-wire (1P2W), one-phase three-wire (1P3W), three-phase three-wire (3P3W), three-phase four-wire (3P4W), three-voltage three-current (3V3A);

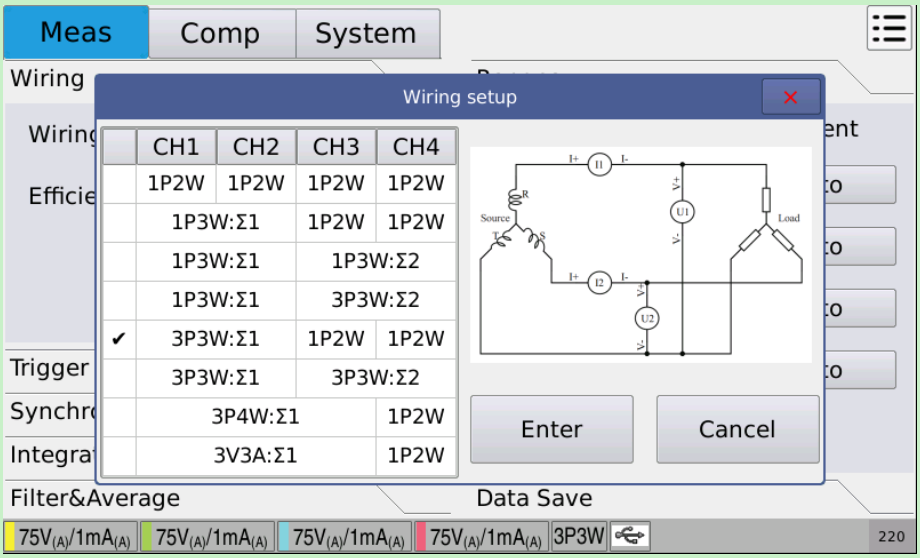
The setting of the wire system determines the wiring method of the external channel and the calculation method of the wiring group Σ (voltage, current, active power, apparent power, reactive power, power factor, conversion efficiency, etc.). Refer to the Σ parameter in Chapter 8 for details.

Setting method:

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the wire system setting tab, and click on the touch screen to select the desired wire system combination setting;

In addition, you can see the [Wiring] button on the panel, which is a shortcut key to enter the wire system selection.

The wire system tab is shown in Figure 4-2:



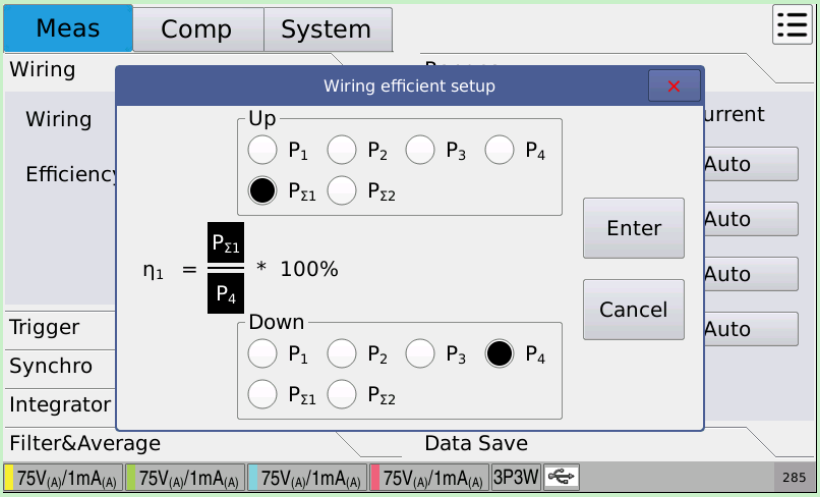
(Figure 4-2 Wire system option window)

Each row on the left side of the tab represents a selection of a wire system. The combined state of the cell indicates the distribution of the current wire system to the channel usage. The right side is the recommended principle wiring circuit schematic diagram, which is convenient for users to use and connect. Check the connection status of the wire system.

For a 4-channel instrument, considering that only two test channels are used in the wired system, and the remaining two channels are considered sufficiency in use, the possibility of combining them into a second line system is given. For specific effects, see the layout of the tabs can be seen. For a 3-channel instrument, there are only 5 basic options for the wire system options here.

4.1.1.2 Wiring efficient setup

In a non-1P2W wire system, the efficiency formula of the wire system is programmable. Touch and click the corresponding button to edit the formula for calculating the efficiency. The formula editing window is shown in Figure 4-3:



(Figure 4-3 Efficiency formula setting window)

After selecting the numerator and denominator corresponding to the formula, press the Enter key to complete the modification.

4.1.2 Trigger setup

Trigger setup include trigger mode settings and trigger delay settings;

The trigger mode refers to the trigger mechanism of the instrument test, that is, the test execution of the instrument will only execute a test work after the trigger signal is obtained.

4.1.2.1 Trigger Source

TH34XX series have the following 4 trigger sources, as shown in the following table 4-3:

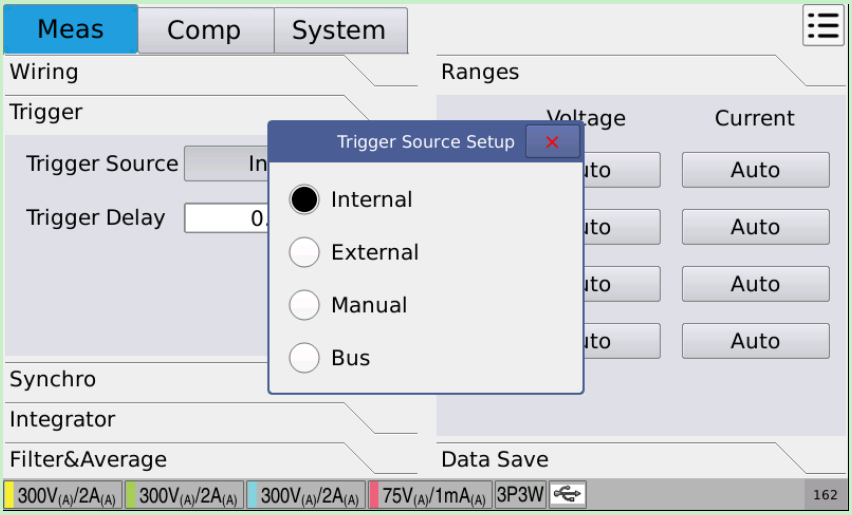
Trigger source	Description
Internal	Automatic testing inside the instrument
Manual	Press the [Trigger] key on the front panel to execute a test. After a test, it will enter the idle state and wait for the next trigger of the [Trigger] key;
External	After receiving the "trigger" signal from the outside through the Handler port on the rear panel (usually a falling edge and cannot be modified), perform a test, and the test will enter the idle state at the end of the test, waiting for the next trigger;
Bus	The trigger test is executed through the bus command; for the specific command description, please refer to the relevant chapters of the command description.

Table 4-3 Description of the meaning of trigger source

Setting method:

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the Trigger tab, and then touch the button corresponding to the Trigger Source item, the Trigger Source Setup window will pop up, and click the desired trigger source in the measurement setting window.

The Trigger Source Setup window is shown in Figure 4-4;



(Figure 4-4 Trigger Source selection window)

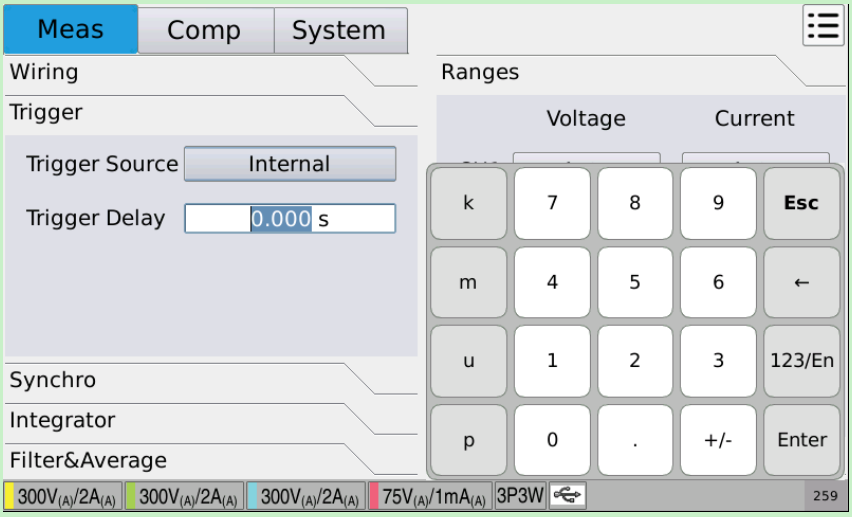
4.1.2.2 Trigger Delay

That is, the waiting time setting from after the trigger to the execution of the test.

The value range is 0.000s~60.00s, the minimum resolution is 1ms, and the factory default setting is 0.000s.

Setting method:

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the Trigger tab, and then double-click the Trigger Delay setting window, the system keyboard will pop up, and you can enter the specific value to be set in the system's numeric keyboard. The system keyboard window is shown in Figure 4-5 (the system keyboard will not be displayed in screenshots if it is used elsewhere);



(Figure 4-5 System numeric keyboard window)

Note: The leftmost of the numeric keyboard is the corresponding order of magnitude, and the confirmation operation can also be completed by clicking on the corresponding order of magnitude.

4.1.3 Synchro Setup

Set the synchronization signal source required for the test for each channel. The signals in the same wire system combination can only be synchronized on the same trigger signal.

4.1.3.1 Function declaration

Select voltage input or current input as the synchronization source. Please select the input signal with small distortion and stable input level and frequency as the synchronization source. Only by accurately detecting the zero-crossing signal of the synchronization source can the correct measurement value be obtained. When the frequency of the synchronization source (voltage or current signal) cannot be measured, the system will temporarily lock the synchronization source on the power frequency signal of the AC power supply (This practice helps to test DC signals faster). Therefore, in order to obtain the test results of the input signal accurately and stably, a suitable synchronization source signal needs to be selected. For all channels, theoretically there are 7 (3-channel instruments) or 9 (4-channel instruments) synchronization settings for each channel. The main options are shown in Table 4-4:

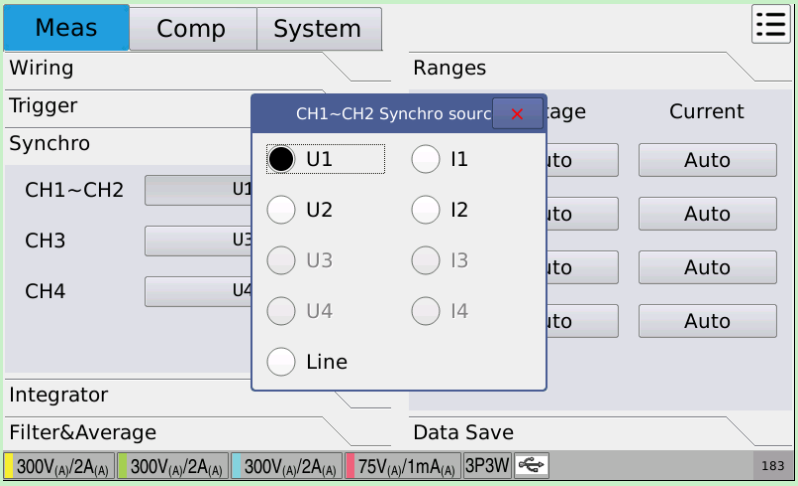
Synchronization source	Description
U1, I1	Voltage and current signal of channel 1
U2, I2	Voltage and current signal of channel 2
U3, I3	Voltage and current signal of channel 3
U4, I4	Voltage and current signal of channel 4
Line	AC power supply signal

Table 4-4 Description of synchronization source options

4.1.3.2 Setting method

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the Synchro tab, the settable items displayed in the tab will be adjusted according to the different wire system selections, and the main reason is to merge the components in the same wiring group. The channel synchronization setting makes each channel in the combination can only be synchronized to the same optional signal. However, due to the effectiveness of the synchronization signal, some signals will be shielded as optional (that is, visible but not optional). In principle, if the channel board is not broken, each channel in the same wiring system can only be synchronized to the input signal or power supply in the combination, and the signal of other channel boards outside the combination cannot be selected as its own synchronization signal;

Note: If the test result is obviously unstable, please check whether the corresponding synchronization source selection is reasonable. The setting window is shown in Figure 4-6 below:



(Figure 4-6 Sync signal selection window)

4.1.3.3 Setting instructions and suggestions

If the set synchronization signal input is pure DC or the frequency is too low (for example, lower than 40Hz), in order to speed up the measurement, the system will temporarily switch the synchronization source to the "Line" frequency (50/60Hz), which is good for testing DC signals. If a valid AC signal is suddenly input at the input, the system will synchronize back to the specified signal source for synchronization;

If the input source is used in parallel with the line power supply (instrument AC power supply), in order to speed up the test stabilization speed, it is recommended to set the synchronization source to "Line" synchronization (50/60Hz), in this way, when the device under test changes, the phase-locked loop will not lose lock due to signal loss, so that the phase-locked loop inside the instrument is in a stable working state at all times;

For special system tests, it may involve abnormal signal test due to distortion of voltage or current signal. Here, a synchronization channel lock setting is provided. For example, when testing some motors, the voltage signal will be deformed, while the current signal is relatively in line with the standard sine wave, Synchro Source can be locked on the current channel; for example, when testing inverters and other related equipment, the current will be deformed, and the voltage signal is relatively in line with the standard, and Synchro Source can be locked on the corresponding available voltage channel.

4.1.4 Integrator Setup

It mainly involves setting the related settings of energy integration, including the control mode of integration and the limit time of integration.

4.1.4.1 Control mode

The control mode mainly affects the timing mode and stop mode of the integral.

The value range is shown in Table 4-5:

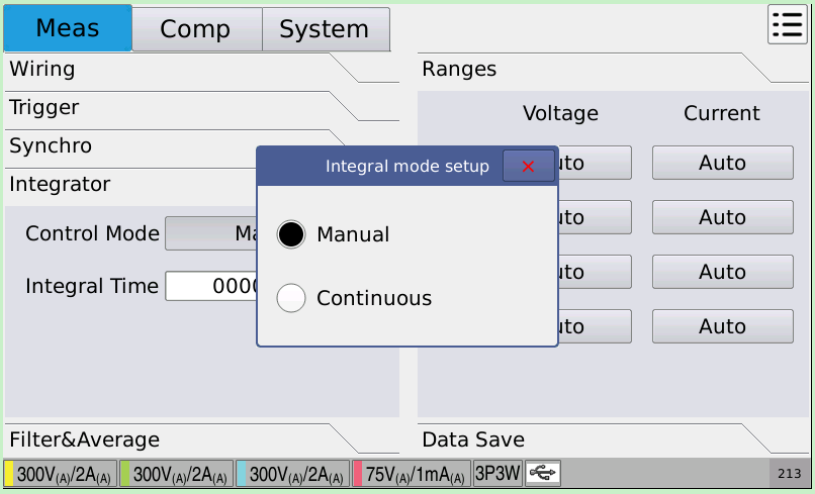
Control mode	Description
Manual	In manual control mode, the integration time setting will be invalid, and the start or stop of integration is fully controlled manually, and the timing method adopts positive timing;
Continuous	In the continuous control mode, after the integral is running, according to the size of the set integral time, the timing method adopts countdown, and the integral stops after the timing ends;
Table 4-5 Integral control mode description	

Function Description:

- Manual control means to manually press the [Run] key to start the energy integration function, and at the same time the integral timing clock (positive timing) is displayed in the dialog box, and it will not stop until the [Stop] key is manually pressed;
- Continuous control means that the energy integration function is started after the [Run] key is manually pressed, and the integration timer clock (countdown) is displayed in the dialog box, and the integration function is stopped when the set integration time is up or the [Stop] key is pressed. Stop;
- Only after the integral control stops, can you press the [Reset] key to reset the integral result to count the result.

Setting method:

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the Integrator tab, and touch the Control Mode button to display the integral mode selection window, as shown in Figure 4-7:



(Figure 4-7 Integral control mode selection window)

4.1.4.2 Integral Time

When the integral mode is in the continuous control mode, the effective time of integral is provided for the integral, which is used as the starting value of the countdown. After the timing ends, the integral stops working.

Value range: 0~9999:59:59

It is used to set the countdown time in the energy continuous integral control mode. The factory default setting is the maximum time, which is 0000 hours, 00 minutes, and 00 seconds.

Setting method:

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the integration setting tab, and double-click the integration time setting window, the system keyboard will pop up, and you can enter the specific value to be set in the system's numeric keyboard.

4.1.5 Filter and Average

4.1.5.1 Line Filter

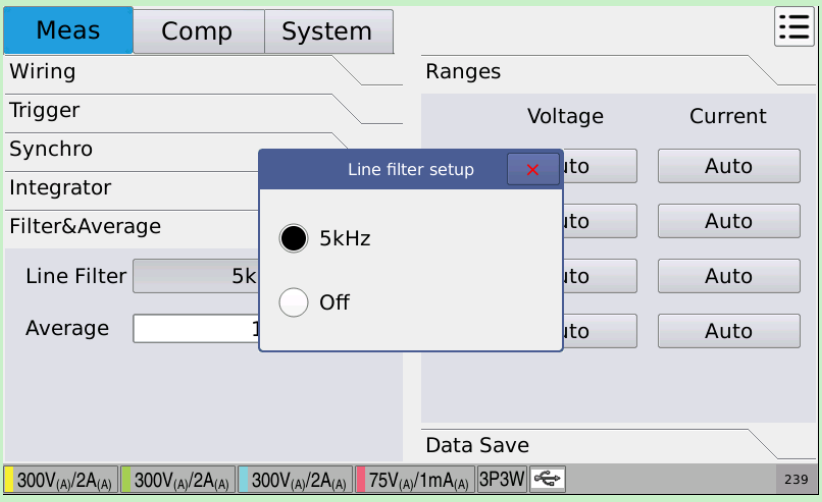
The test sampling circuit provides a 5kHz filter on the hardware. Since the calibration of the test data is completed when the filter is turned on, the filter is turned on by default under normal circumstances.

If you need to see the harmonic status of the non-power frequency signal input, you need to consider turning off this filter, otherwise the harmonic signal may be attenuated seriously. (Note: The maximum number of harmonic analysis of non-power frequency signals cannot reach the 50th order, and the highest analysis of the 50th harmonic is only for power frequency signals);

Setting method:

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the Filter & Average tab, touch the Line Filter button, and display the line filter selection window.

As shown in Figure 4-8: There are two states to choose from, choosing 5kHz means turning on the 5kHz filter, choosing OFF means turning off the filtering function of this filter.



(Figure 4-8 Line filter selection window)

4.1.5.2 Average

It is used to set the number of averages required for sampling, that is, the average is calculated after sampling N times as the result of one display.

Value range: 1~32;

The factory default setting is 1.

Setting method:

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the Filter & Average tab, and double-click the Average setting window, the system keyboard will pop up,

and you can enter the specific value to be set in the system's numeric keyboard.

4.1.6 Measurement Range

The voltage range is divided into 4, see the table below for details:

TH34XX series have the same voltage range:				
Voltage range number	0	1	2	3
Voltage range	75V	150V	300V	600V

The current range is divided into 7 and the details are shown in the table below:

Range No. / Range/A	0	1	2	3	4	5	6
TH34xx(20A)	10mA	30mA	100mA	400mA	1.5A	5A	20A
TH34xx(2A)	1mA	3mA	10mA	40mA	150mA	500mA	2A

Note: If you are measuring in a fixed range, you must select a suitable range, otherwise the measurement accuracy and precision will be affected.

Factory default settings:

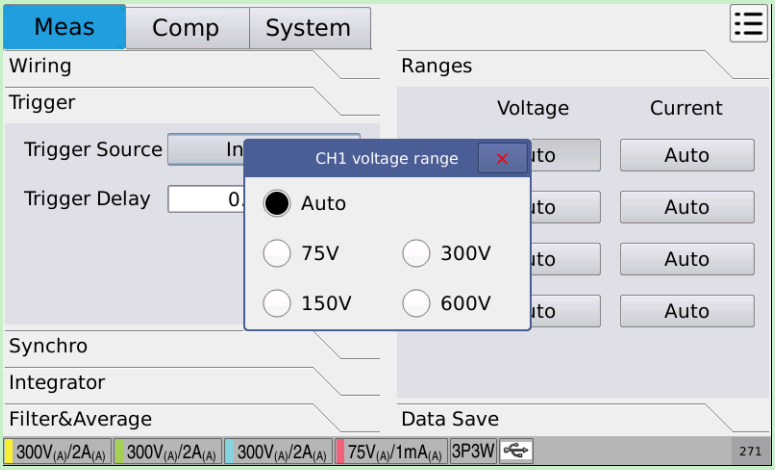
The voltage is in the maximum voltage range (600V);

The current is in the maximum current range (20A/2A), corresponding to the instrument model;

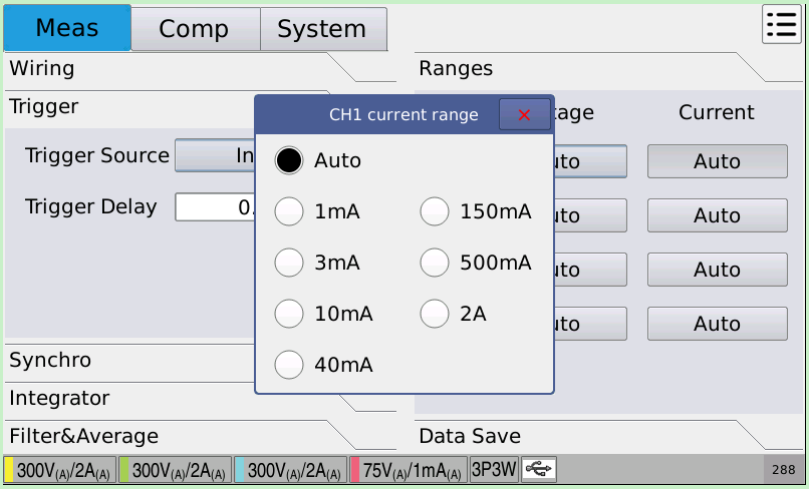
Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the Ranges setting tab, the expanded range setting tab is shown on the right side of Figure 4-1, and then touch and click the corresponding setting item to pop up the corresponding voltage or current setting window of the channel, touch and click to complete the corresponding selection.

The voltage setting window is shown in Figure 4-9,

The current setting window is shown in Figure 4-10:



(Figure 4-9 Voltage range selection window)



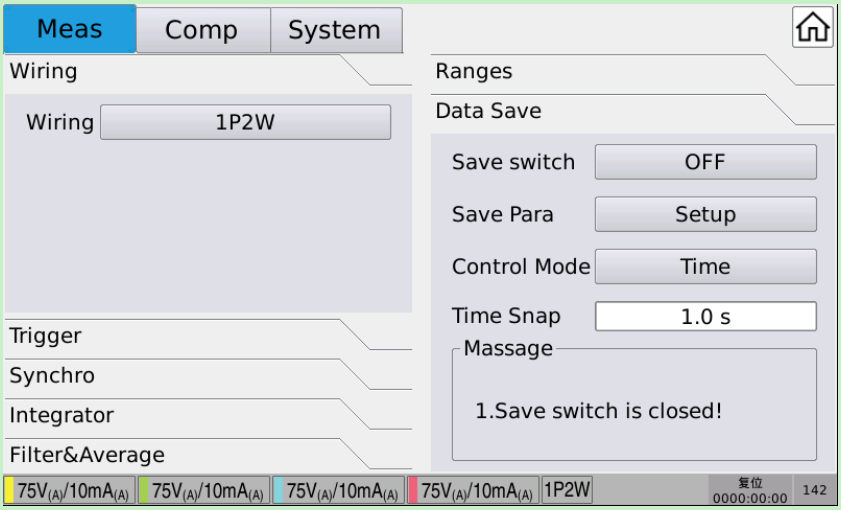
(Figure 4-10 Current range selection window)

4.1.7 Data Save

It is used to set the related functions of test data saving, mainly related to the parameters as shown in the figure, namely

Setting item	Value and description
Save switch	ON----currently in the open state; OFF----currently in closed state; This setting will not be saved after shutting down, and it will be turned off by default;
Save Para	After touching the parameter selection dialog box will pop up, click the required parameter to save it to the U disk;
Control Mode	Time---control the recording of data with time intervals; Times---control the recording of data with times intervals;
Count Snap	When the control mode is count control, the setting value here determines after how many times of test to record one data, the value range is 1~999 times;
Time Snap	When the control mode is time control, the setting value here determines how often to record one data afterwards, the value range is 0.2s~60.0s;
Introduction of parameter saving related setting items	

The setting display is shown in Figure 4-11:



(Figure 4-11 Data save setup display)

Setting method:

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the Data Save tab, touch the corresponding button of the Save switch to switch the data save switch operation, as shown in Figure 4-11:

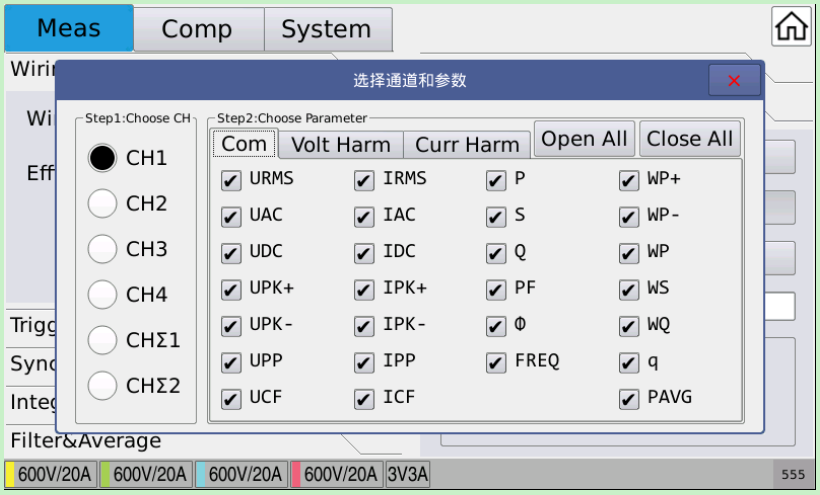
For most of the data that can be tested by the instrument, you can independently choose whether to save it to the USB flash drive. For specific operations, touch the corresponding button behind the save parameter to open the corresponding setting selection dialog box, as shown in Figure 4-11-a;

Note: If the setting requires more data to be saved or the saving lasts for a relatively long time, it may involve a larger file for data saving. Therefore, the instrument divides the data saved file into multiple file records in a certain size. In addition, Turning on the data saving function will inevitably affect the test speed, please select the specific parameters to be saved according to your needs;

When the state corresponding to the save switch is on, the test data starts to perform the save operation;

If you do not need to save the data, you need to go to this window to change the state of the save switch to the off state. The file name for saving the data is named in the format of "DATAx.csv", and x is the file serial number added to avoid duplication.

Note: The default save path is the root directory of the external USB flash drive, that is, if there is no USB flash drive inserted, the file saving operation cannot be performed.

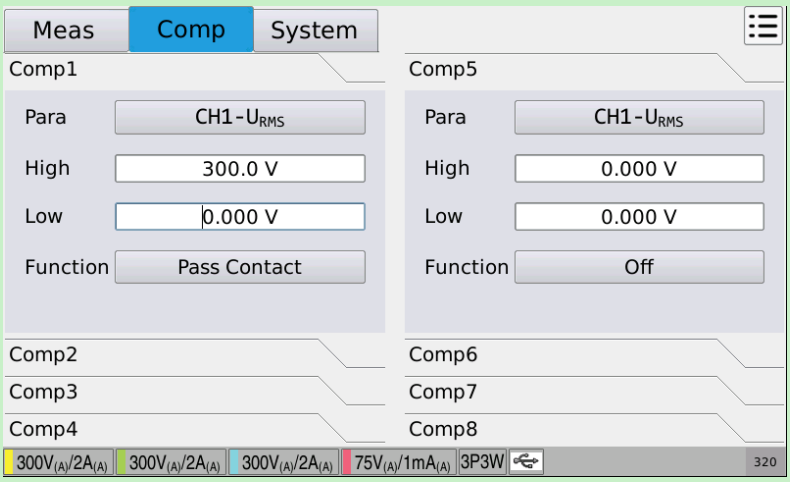


(Figure 4-11-a Dialog box display for saving parameter settings)

Note: Since the independent switch state of the data record involves many data items, the relevant state written into the storage memory file will be written uniformly after the dialog box is closed, to avoid writing once every time the state of a parameter is modified and improve the service life of the memory, so when the dialog box exits, due to the need to execute this data memory, there will be a frustration of nearly a few hundred milliseconds.

4.2 Compare setup

Press the [Setup] key on the panel, touch to enter the comparison setting page, as shown in Figure 4-12.



(Figure 4-12 Compare setting page)

As shown in the figure above, the compare setting page mainly involves the relevant settings of the comparison parameters of the 8 comparison channels. Each comparison channel mainly includes the comparison parameters of the comparison channel, the upper limit of the parameter comparison, the lower limit of the parameter comparison, and the selection of the comparison function.

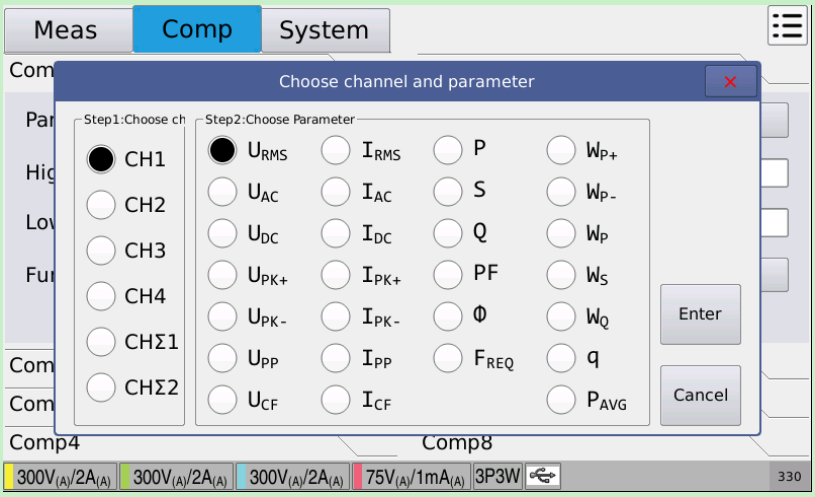
In addition, the beeper output of the comparison result is integrated into the system setting page. Please refer to the description of the beeper comparison chapter in Chapter 6 System Setting.

The 8 comparison channels correspond to the 8 outputs of the Handler board on the rear panel, and

the function selection of the comparison parameters corresponds to the realization of its programmable output. For details, please refer to the introduction in the Handler chapter later.

4.2.1 Comparison parameter selection

Press the [Setup] key on the panel, touch to enter the comparison setting page, expand the comparison channel page card that needs to be set, and click the button behind the parameter to pop up the corresponding parameter selection window, as shown in Figure 4-13:



(Figure 4-13 Comparison parameter selection window)

After selecting the designated channel and the parameters in the channel respectively, press the confirm key in the window to complete the corresponding settings. TH34XX series instruments provide more options for comparison, and users can freely select the required parameters to participate in the comparison and control the external output.

4.2.2 Compare upper/lower limit

It mainly provides a comparison condition for the comparison of comparison parameters, and the test result is considered as qualified if the test result is within the upper and lower limits, otherwise it is regarded as unqualified;

The factory default settings are all 0;

Setting method:

Press the [Setup] key on the panel, touch to enter the comparison setting page, expand the comparison channel page card that needs to be set, double-click the input box behind the upper limit or the lower limit to pop up the system keyboard, and then enter the desired setting in the system's numeric keyboard accurate value.

Note: Considering that the setting value has useful value, there are some basic setting requirements when setting the upper and lower limits:

◆ The value of the lower limit must not be greater than the value of the upper limit;

◆ If the lower limit value is greater than the upper limit value, the system will automatically exchange the upper limit and lower limit values after the input is completed to ensure the validity of the comparison limit.

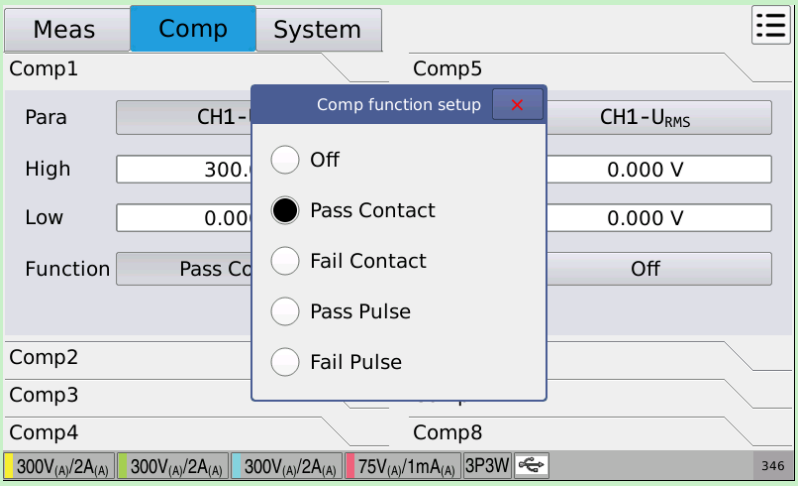
4.2.3 Compare function

The comparison function mainly involves the output function of the Handler port corresponding to the comparison result. The optional functions are shown in the following table 4-6:

Compare function	Description
OFF	The comparison function of the current comparison channel is closed, that is, it does not participate in the comparison.
Pass Contact	When the comparison result of the current comparison channel is qualified, control the two output pins of the corresponding Handler port to be in the conducting state.
Fail Contact	When the comparison result of the current comparison channel is unqualified, control the two output pins of the corresponding Handler port to be in the conducting state.
Pass Pulse	When the comparison result of the current comparison channel is qualified, the two output pins of the corresponding Handler port are controlled to be turned on for 5ms and then disconnected. The default is in the disconnected state.
Fail Pulse	When the comparison result of the current comparison channel is unqualified, the two output pins of the corresponding Handler port are controlled to be disconnected for 5ms and then turned on. The default is in the conducting state.
Table 4-6 Handler output programming instructions of the comparison function	

Setting method:

Press the [Setup] key on the panel, touch to enter the comparison setting page, expand the comparison channel page card that needs to be set, and click the button behind the function to pop up the corresponding parameter selection window, as shown in Figure 4-14:



(Figure 4-14 Comparison function selection window)

4.2.4 Handler interface specification

4.2.4.1 Circuit principle

After the Handler output, the circuit adopts the relay isolation output method, the principle is shown in Figure 4-15:

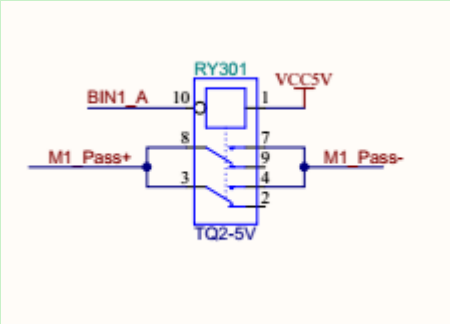


Figure 4-15 Schematic diagram of Handler input port

The comparison result controls the action state of the coil of the relay. After the two ends of the relay switch correspond to the pair of outputs of the Handler on the rear panel, this design not only plays the role of signal isolation, but also greatly increases the flexibility and diversity of users. The user only needs to connect a simple pull-up resistor or pull-down resistor to become a level signal or edge signal.

4.2.4.2 Port Definition

The rear panel of TH34XX series power meter provides users with a 25-pin D_type terminal for various external trigger signals and external switch interfaces. This interface is mainly used to output the comparison results of the instrument. The pin definition is shown in the following table 4-7:

Pin	Definition	Pin	Definition	Pin	Definition	Pin	Definition	Pin	Definition
1	+5V	6	M7-	11	M5-	16	M3+	21	M8-
2	M4+	7	M2+	12	M6+	17	/EXT.TRIG	22	M1-
3	reserve	8	M8+	13	+5V	18	M7+	23	M5+
4	M3-	9	M1+	14	EXTV	19	NULL	24	GND
5	GND	10	GND	15	M4-	20	M2-	25	M6-

(Table 4-7 Handler pin definition)

4.2.4.3 Description of the specific meaning of the port

◆ +5V: internal power supply, +5V;

◆ GND: internal power supply, ground;

◆ EXTV: External power supply. If you use an external power supply instead of the internal power supply of the instrument, you need to remove the boot shell and change a jumper on the Handler board to the other side. The voltage input range is +5V~+30V;

Note: It can be seen that the external power supply is not equipped with external GND. When the external power supply is selected, the high end of the external power supply and /EXT.TRIG form a loop to provide a trigger signal to the instrument;

◆ /EXT.TRIG: External trigger pin, edge trigger, high level by default, falling edge trigger valid, use this function to change the trigger mode in the measurement settings to "external trigger (EXT)" mode;

◆ Mx+ and Mx-: corresponding to the control output pins of the Handler port, which are the two contacts of the Relay single-gate output. When the comparison result controls the Relay to be turned on, the Relay output will be short-circuited, that is, Mx+ and Mx- are connected. The specification of the factory relay is: 30VDC/2A MAX;

◆ Reserve: the system reserved pin;

◆ NULL: empty foot;

4.2.4.4 Handler timing diagram

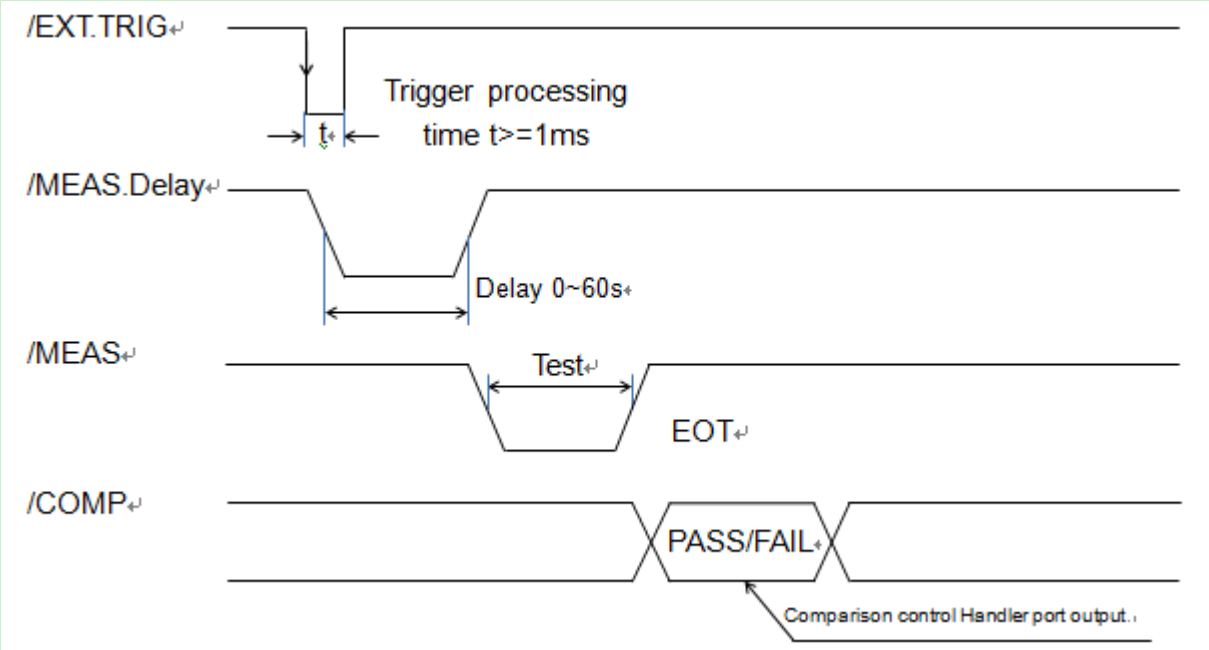


Figure 4-16 Handler timing diagram

Handler timing description:

◆ The external trigger pin only accepts falling edge trigger

◆ The delay time after the trigger is the trigger delay time interval that can be set by the user, which can be set from 0.000s to 60s

◆ Start a test after the trigger delay is over, and get relevant data for a test

◆ There are 8 channels available for comparison output, and each of the 8 channels has independent output control conditions, that is, the comparison results of the 8 comparison channels.

4.3 Harmonic settings

Harmonic related parameters mainly involve the following aspects, as shown in Table 4-8:

Harmonic setting item	Description
Display form	For the display form of the harmonic results, you can select list and bar graph;
Data mode	The display format of the data content in the list display form, optional % (percentage), Δ (absolute value);
Calculation standard	Calculation standard for harmonic analysis results, IEC, CSA can be selected;
Parameter selection	The specific signal parameters that need to be analyzed can be selected;

Table 4-8 Harmonic related parameters

Note: Due to the relatively few parameters related to harmonics, it is not enough to open a harmonic setting page alone. Therefore, the relevant parameter settings can be seen on the harmonic test page. You can directly set the relevant parameters on the harmonic test page.

4.3.1 Display form

It is used to set the display form of the harmonic analysis result display. The factory default setting is List display. The optional functions are shown in Table 4-8:

Harmonic display form options	Description
List	The layout of the list display is related to the number of selected parameters. The data displayed in the list has a percentage mode and an absolute value mode according to the options of the data mode;
Bar	The data sources displayed by the bar graph are all the percentage values of the harmonic analysis. The layout will be adjusted according to the number of selected parameters;
Table 4-8 Harmonic display form description	

Setting method:

Press the [Disp] key on the panel, touch to enter the harmonic page, the display form options are visible on the right side of the display, just touch the single selection.

4.3.2 Data Mode

It is used to set the data display format under the list display form, the factory default setting is% (percentage mode); the optional functions are shown in the following table 4-9:

Harmonic data mode option	Description
%(percentage)	The calculation of the numerical result in % mode depends on the setting result of the calculation standard, that is, the data result in the percentage mode will be different if the calculation standard is different.
Δ(absolute value)	
Table 4-9 Harmonic data mode description	

Setting method:

Press the [Disp] key on the panel, touch to enter the harmonic page, and you can see the Data Mode options on the right side of the display, just touch the single selection.

4.3.3 Calculation standard

It is used to provide different calculation standards for total harmonic calculation and harmonic percentage numerical result calculation. The factory default setting is IEC. The optional functions are shown in Table 4-10:

Harmonic calculation standard option	Description
IEC	For detailed calculation methods and calculation formulas, please refer to the chapter introduction of basic principles of calculation formulas.
CSA	
Table 4-10 Harmonic calculation standard description	

Setting method:

Press the [Disp] key on the panel and touch to enter the harmonic page. The calculation standard options are visible on the right side of the display, just touch the single selection.

4.3.4 Parameter Selection

It is used to set the channel and object for the harmonic analysis. The factory default setting is the voltage of channel 1 (U1). The optional parameters are shown in Table 4-11:

Harmonic analysis parameter options	Description
U1, I1	Voltage and current of channel 1
U2, I2	Voltage and current of channel 2
U3, I3	Voltage and current of channel 3
U4, I4	Voltage and current of channel 4
Table 4-10 Harmonic analysis parameter description	

Setting method:

Press the [Disp] key on the panel, touch to enter the harmonic page, the Parameter Selection options are visible on the right side of the display, touch to select (multiple selections are possible).

4.4 Waveform Setup

The waveform-related parameters mainly involve the following aspects, as shown in Table 4-11:

Waveform setting item	Description
Wave type	Optional voltage & current waveform or power waveform
Wave parameter	Depending on the waveform type, the options are different
Table 4-11 Harmonic related parameters	

Note: Due to the relatively few waveform-related parameters, it is not enough to open a single waveform setting page. Therefore, the relevant parameter settings can be seen on the waveform test page. You can directly set the relevant parameters on the waveform test page.

4.4.1 Waveform type

It is used to set the parameter type of the waveform display, the factory default setting is voltage and current (U&I). The optional functions are shown in Table 4-12:

Wave type options	Description
U&I	Indicates that the data source for waveform drawing is the voltage or current of each channel;
POWER	Indicates that the data source for waveform drawing is the power of each channel;
Table 4-12 Waveform type description	

Setting method:

Press the [Disp] key on the panel, touch to enter the waveform page, the waveform type options are visible on the right side of the display, just touch the single selection.

4.4.2 Waveform parameter

The optional parameters of U&I waveform are shown in Table 4-13:

Waveform type	Optional parameter	Meaning
U&I waveform	U1, I1	Voltage and current corresponding to channel 1
	U2, I2	Voltage and current corresponding to channel 2
	U3, I3	Voltage and current corresponding to channel 3
	U4, I4	Voltage and current corresponding to channel 4
Power waveform	P1, P2, P3, P4	Corresponding to the power of each channel

Table 4-13 Description of the meanings of optional parameters of the waveform

4.5 System Setup

For details, see Chapter 6 System Settings.

Chapter 5 Measurement Display and Description

This chapter mainly describes the function introduction of each display page of the test function. The method to enter the test page is as follows:

Step1: If you are not on the test function page, press the [DISP] key to enter the test related page. The categories of measurement display pages are shown in Table 5-1:

Measurement display page classification	Description
Meas	Mainly related to conventional measurement display
Comp	Mainly related to the result status display of parameter comparison
Harm	Mainly related to the display of harmonic test results and related parameter settings
Wave	Mainly related to the graphic display of the waveform test and related parameter settings
Vector	Mainly suitable for vector display of three-phase test system
Figure 5-1 Measurement display page description	

Step2: According to the content of the page title, touch to select the corresponding page to enter different test pages.

5.1 Test display page

The measurement display page is classified by display effect, and the display content can be set as described in Table 5-2:

Measurement display page classification	Description
Balanced display of each channel	All channels are displayed in a balanced manner, and each channel displays 4 optional parameters;
Highlight effect of the designated channel	Highlight the full-parameter test results of the designated channel, and zoom out the other channels on the right side (only the effective values of voltage and current are displayed);
Wire combination test display	Highlight the test results in the wire system combination, and zoom out on the right to display all channels in the corresponding combination

	(only display the effective value of voltage and current);
Table 5-2 Description of the display effect classification on the measurement page	

Switching method:

Press the channel button at the bottom of the display screen to switch, and the effect will be displayed in equalization on each channel by default after power on

Press【CH1】~【CH4】keys, the designated corresponding channel will be highlighted and the corresponding key light will be on;

Press the [CHΣ] button to select the wire system combination measurement display, and the corresponding [CHΣ] button light is on;

If the corresponding button light of [CH1]~[CHΣ] is lit, press the corresponding button again to return to the balanced display effect of each channel;

Note: This display effect setting button will only respond when it is pressed on the measurement display page.

5.1.1 Balanced display of each channel

It is the default display page after power-on. TH34XX series instruments are related to the 3-channel instrument model and the 4-channel instrument model, the layout of the balanced display of each channel is different, that is, the 3-channel display adopts the "川" font distribution, as shown in Figure 5-1. As shown; the 4-channel display adopts the "田" type distribution, as shown in Figure 5-2;

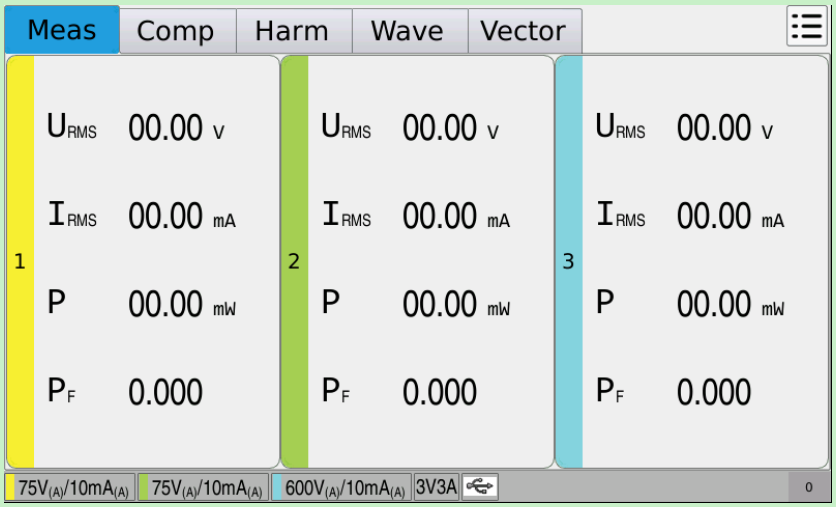


Figure 5-1 3-channel instrument balance display page effect

Figure 5-2 Balanced display page effect of 4-channel instrument

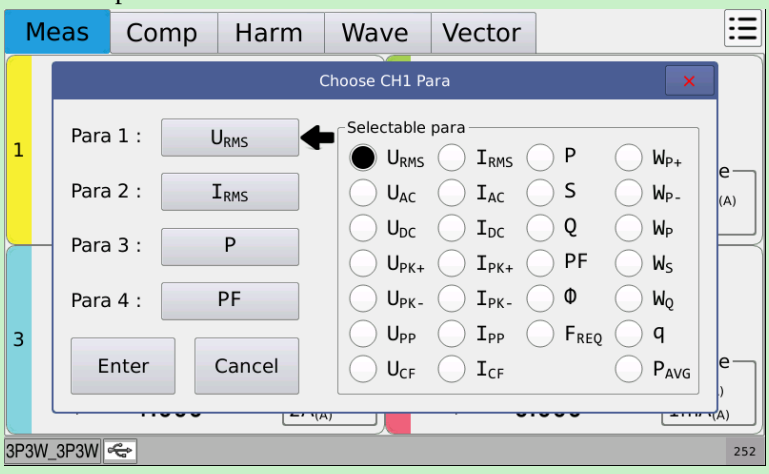
As shown in the figure above, the display description of each channel is as follows:

The corner mark in the upper left corner indicates the channel number to which the current channel belongs;

The parameters displayed in the channel are the 4 common parameters displayed in the current channel test. These 4 common parameters can be set and replaced at will, that is, the setting method of modifying the common parameters of the channel test is as follows:

Double-click any position in the corresponding area of the channel, and the parameter selection window of the corresponding channel will pop up, as shown in Figure 5-3. The title indicates the currently set channel. The 4 parameter buttons on the left side of the window correspond to the 4 of the current channel. Common parameter setting buttons, the radio buttons on the right are the options of the corresponding parameters;

Click the 4 buttons on the left that need to be modified, select the required parameters in the radio box on the right, and finally click the confirm button on the bottom left to complete the replacement of common parameters.

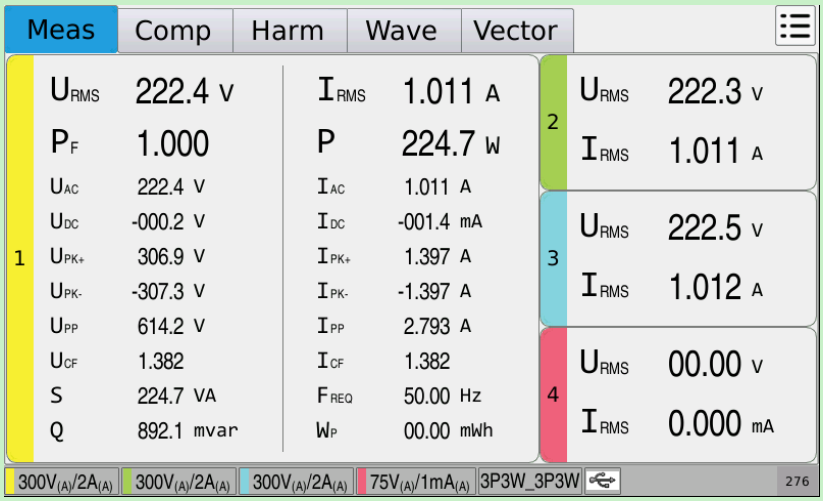


(Figure 5-3 Channel common display parameter setting window)

5.1.2 Highlight effect of the designated channel

The purpose of highlighting the designated channel is to enlarge the display window of the designated channel, reduce the display window of other channels, to display more test parameter

results in the designated enlarged channel window, and you can also view it in the small window on the right. The current basic test status of other channels, as shown in Figure 5-4:

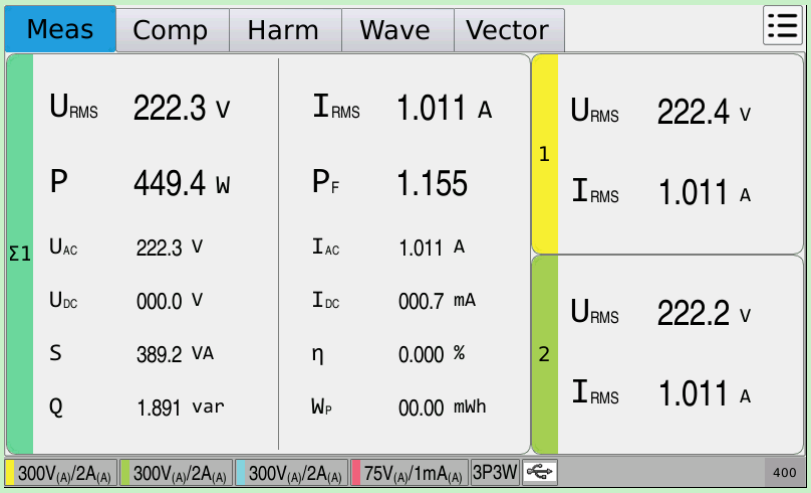


(Figure 5-4 Highlight effect of designated channel 1)

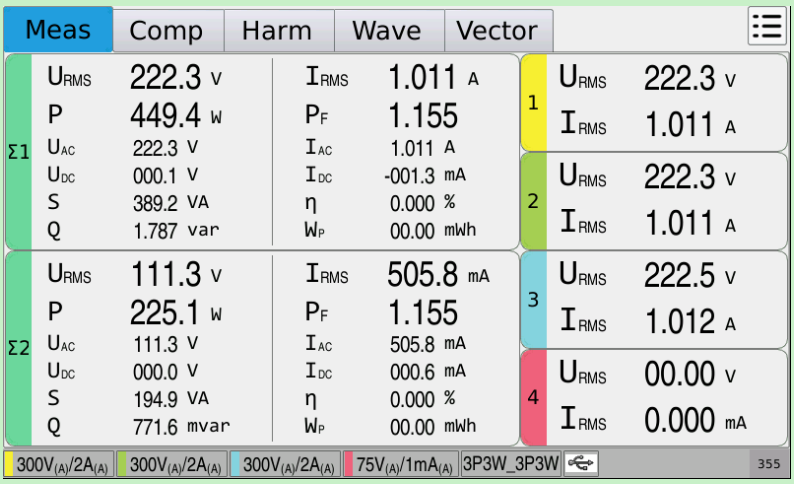
5.1.3 Wire system combination test display

In the optional wire system combination, although 1P2W is one of the wire system options, 1P2W does not do any wire system calculations, because 1P2W uses all channels as independent test channels. There is no combination effect, so in the case of 1P2W, there is no display effect of the wire system combination test;

In the case of other wire system combinations, you can view the test results of the relevant parameters under the wire system combination through this display effect. For a 4-channel instrument, since there are two sets of optional wire system options for the wire system combination, when the selected line If there is only 1 set of wire system combinations, the display layout effect is the same as that of a 3-channel instrument, as shown in Figure 5-5. If there are 2 sets of wire system combinations at the same time, the display layout of this page will be adjusted to display 2 sets of lines at the same time, as shown in Figure 5-6:



(Figure 5-5 Display effect of only one set of line system combination)

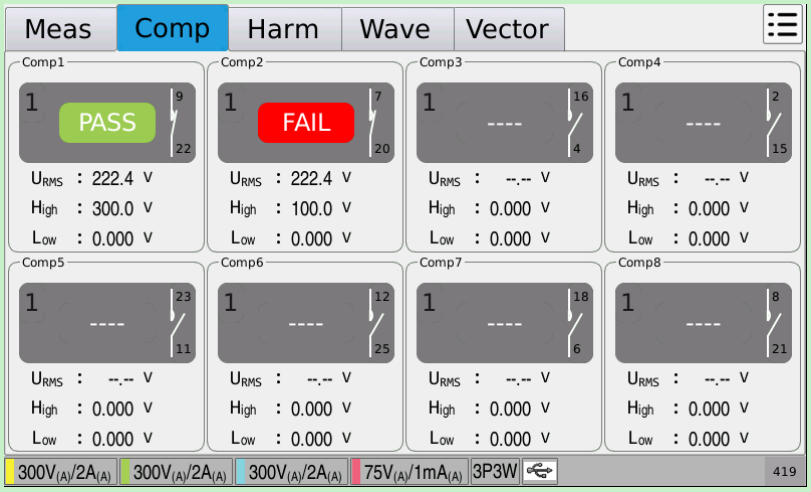


(Figure 5-6 Display effect of 2 sets of wire system combinations simultaneously)

Note: The small channel display on the right side of the display has a certain corresponding relationship with the display on the left side, that is, it indicates the used channels that make up the current line system.

5.2 Compare display interface

Press the [Disp] key on the panel and touch the page title above the display to enter the comparison page, as shown in Figure 5-7:



(Figure 5-7 Comparison display page)

According to the number of output channels to be compared, the entire comparison page is neatly divided into 8 comparison windows, namely Comp1~Comp8. The meaning of each component in the individual comparison window is described in the following table 5-3:

1	Channel number	Indicates the channel to which the parameter currently being compared belongs
2	Compare result	PASS/FAIL ---- indicates that the result status of the comparison is qualified, unqualified, or not compared
3	Relay symbol	Indicates the relay switch status of the output port corresponding to the current comparison channel
4	Compare parameter	Indicate the current comparison parameters and test results
5	High	Indicates the upper limit setting value of the current comparison parameter
6	Low	Indicates the lower limit setting value of the current comparison parameter
Table 5-3 Description of the meaning of the comparison window		

5.2.1 Compare output description

Description of the comparison result for PASS and FAIL judgment:

◆ There are one or more unqualified comparison results among the parameters involved in the comparison, that is, the overall comparison result is unqualified, and the red FAIL light on the panel is on;

◆ The comparison results of the parameters involved in the comparison are all qualified, that is, the overall comparison result is qualified, and the green PASS light on the panel is on;

Comparison result light output description:

◆ When all the parameters involved in the comparison are qualified, the green PASS light on the panel is on;

◆ When there is no parameter to participate in the comparison, the PASS light and FAIL light on the panel will not be on;

◆ When at least one of the parameters involved in the comparison is unqualified, the red FAIL light on the panel is on;

Comparison result buzzer output description:

◆ When all the parameters involved in the comparison are qualified, it is recorded as qualified, and at least one parameter is unqualified, it is recorded as unqualified, and then according to the status of this qualified and unqualified to match the setting result of the comparison signal under the system setting page, the state of the buzzer will be obtained;

◆ The comparison result is unqualified. If "PASS" is selected for the "Key sound" at this time, it means that the corresponding buzzer will be output only when all are qualified. At this time, it is unqualified status (the buzzer does not sound); if "FAIL" is selected for "Key sound" at this time, it means that if there is a disqualification, there will be a corresponding beeper output. At this time,

it is unqualified status (the buzzer will sound once);

◆ The result of the comparison is qualified. If "PASS" is selected for the "Key sound" at this time, it means that the corresponding buzzer will be output only when all are qualified. At this time, it is in a qualified state (the buzzer will sound once); if "FAIL" is selected for "Key sound" at this time, it means that if there is a disqualification, there will be a corresponding buzzer output. At this time, it is in a qualified state (the buzzer does not sound);

Remarks: If the "Key Sound" selects "OFF", the buzzer has no output response.

5.3 Harmonic display page

Press the [Disp] key on the panel and touch the page title above the display to enter the harmonic page. The layout of the harmonic display page is divided into left and right parts. The left side is the harmonic result display area, and the right side is the harmonic-related parameter setting area; The harmonic result display area has 2 display forms, namely list display, bar display, and factory default setting is list display;

For the setting and description of related parameters in the harmonic parameter setting area, please refer to the harmonic setting in Chapter 4.

Harmonic analysis function introduction: use phase-locked loop circuit to synchronize with the fundamental frequency, mainly analyze the harmonic distortion of the power frequency signal (ie 50/60Hz) voltage or current, and provide two commonly used harmonic distortion calculation standards, namely IEC And CSA; the maximum number of analysis reaches 50 harmonics;

For non-power frequency signals, TH34XX series instruments do not mention accuracy indicators. If you want to check the harmonic distortion status of non-power frequency signals, it is recommended to turn off the line filter on the measurement setting page before viewing.

5.3.1 Harmonic list display

After pressing this **System Reset** soft key, the system will restart.

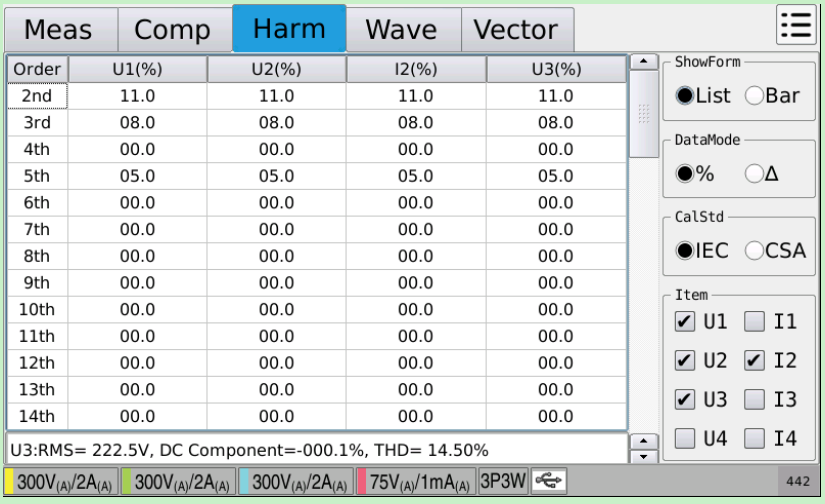


Figure 5-8 Harmonic list display effect

Figure 5-8 shows the harmonic list display effect, the result display area on the left is displayed in

the form of a table, listing the 50th harmonic analysis results of the corresponding parameters, and the cells in the bottom row of the list display the specific results corresponding to the specified parameters (including Effective value, DC component, total harmonic size, etc.), the parameter specifying method of the specific result here is:

After touching the list display area, the touch point recognized by the system corresponds to the parameter of the list title;

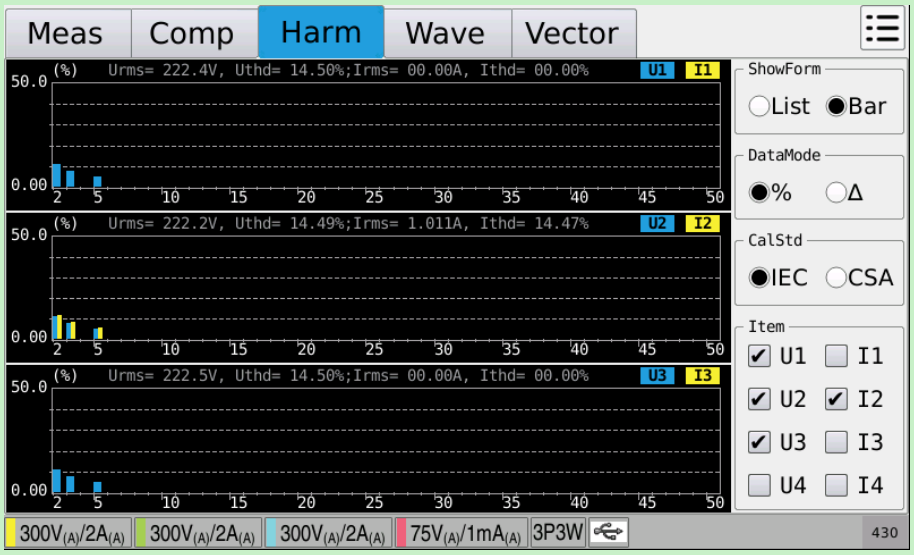
If the touch point is within the U1 area of the list, it indicates that you need to see the specific result of U1;

If the touch point is within the I1 area of the list, it indicates that you need to see the specific result of I1.

In addition, if the data mode is % (percentage) mode, the results displayed in the list will be slightly different due to different calculations and calibrations;

The number of parameter selections is different; the sorting effect of the list will be adjusted.

5.3.2 Harmonic bar display



(Figure 5-9 Harmonic bar display effect)

Figure 5-9 shows the harmonic bar display effect. The result display area on the left is used to display the bar graph drawn according to the percentage of each harmonic in the harmonic analysis. The abscissa is the enumerated harmonic order and the value range is It is 2~50, the ordinate is the percentage size corresponding to each harmonic, and the specific test results such as voltage, current effective value and total harmonic size are displayed on the top of the bar graph;

The bar graph display effect supports zooming operation, that is, single-point touch the bar graph area to select.

The layout of the bar graph display is related to the number of parameters selected for analysis, that is, appropriate layout adjustments will be made according to the number of selected parameters.

The voltage and current harmonic analysis bar graphs of the same channel will be displayed in the same coordinate system, distinguished by color, as shown in the upper right corner of the bar graph coordinates;

The parameter bar graphs of different channels will be displayed in different coordinate windows;

5.4 Waveform display page

Press the [Disp] key on the panel and touch the page title above the display to enter the waveform page. The layout of the waveform display page is divided into left and right parts. The left side is the waveform drawing display area, and the right side is the waveform-related parameter setting area; Waveforms are classified by waveform type, as shown in the following table 5-4:

Waveform type	Description
U&I (Voltage & current waveform)	Display the input voltage and current waveform, you can choose U1, I1, U2, I2, U3, I3, U4, I4;
Power (Power waveform)	Display power waveform, you can choose P1, P2, P3, P4; Note: The integral function is valid after running.
Table 5-4 Description of waveform parameter classification	

Note: The waveform display is only a basic source data information provided to the user. The display details of the waveform cannot be compared with the oscilloscope, hereby declare.

5.4.1 U&I Waveform

U&I waveform (voltage & current waveform) is displayed as shown in Figure 5-10:

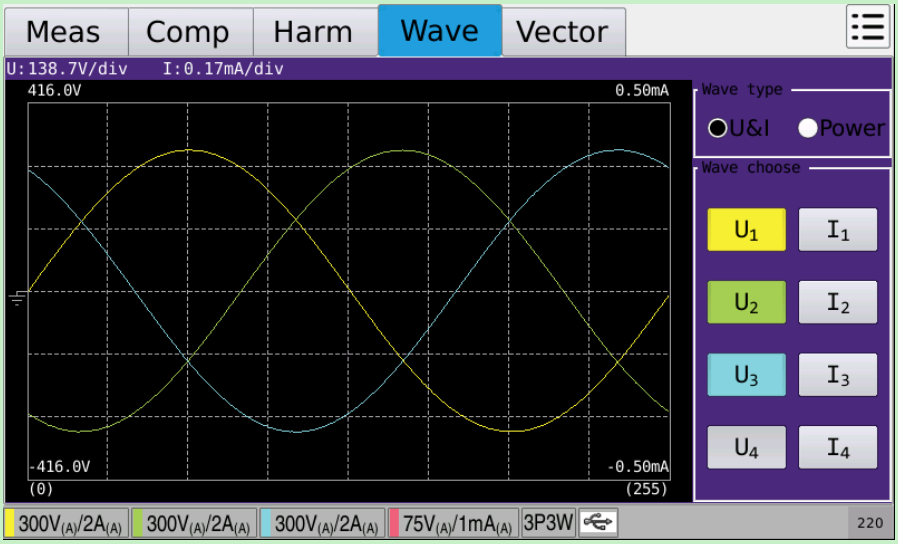


Figure 5-10 U&I waveform display effect

The optional waveform parameters on the right are U1, I1, U2, I2, U3, I3, U4, I4; the selection method is to touch and select, and the color of the selected button corresponds to the display color of the waveform;

The state above the waveform display indicates the resolution of the coordinate axis, that is, the corresponding value of each grid;

5.4.1.1 Waveform display description

- The result of the waveform display is to display the data (256 points) in one source period;
- The data sources that can be displayed on the waveform include the voltage or current data of each channel, namely (U1, I1, U2, I2, U3, I3, U4, I4), which can be multiple choices;

Special note: The more data sources the waveform scan selects, the refresh speed will also be affected to varying degrees.

- Multiple waveform designs are displayed in a coordinate system, the left side is set as Y axis, the right side is set as Z axis, and the Y axis and Z axis are defined as voltage axis and current axis respectively;
- If the waveform is clipped, it means that the measurement data is over the range. If the voltage or current range is automatic, the corresponding label will be automatically adjusted with the change of the range. Generally, this phenomenon does not occur.
- The result of the waveform display is after the zero point synchronization adjustment, but the original phase difference of the voltage and current will not be changed; **if the input voltage and current are both DC, the waveform data will not be displayed;**
- The trigger signal priority of waveform lock is (U1, I1, U2, I2, U3, I3, U4, I4);

5.4.1.2 Waveform display with harmonics

When the input has harmonic components, turn on the waveform display and you will see the waveform effect with harmonic input, which is for reference only, as shown in Figure 5-11 above.

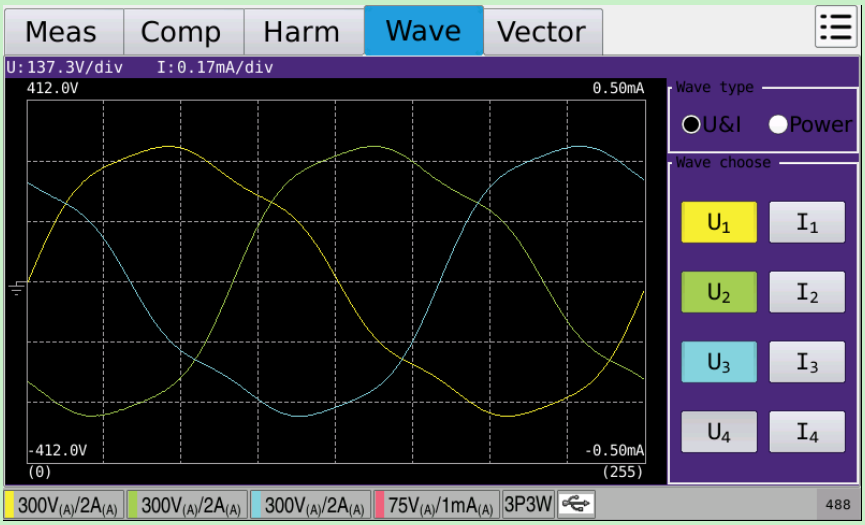


Figure 5-11 U&I input waveform effect with harmonics

Note: This type of waveform is that the input of the input source has harmonic components, which is not necessarily related to whether the harmonic analysis function of this instrument is turned on.

5.4.2 Power waveform

The power waveform (power waveform) display effect is shown in Figure 5-12:

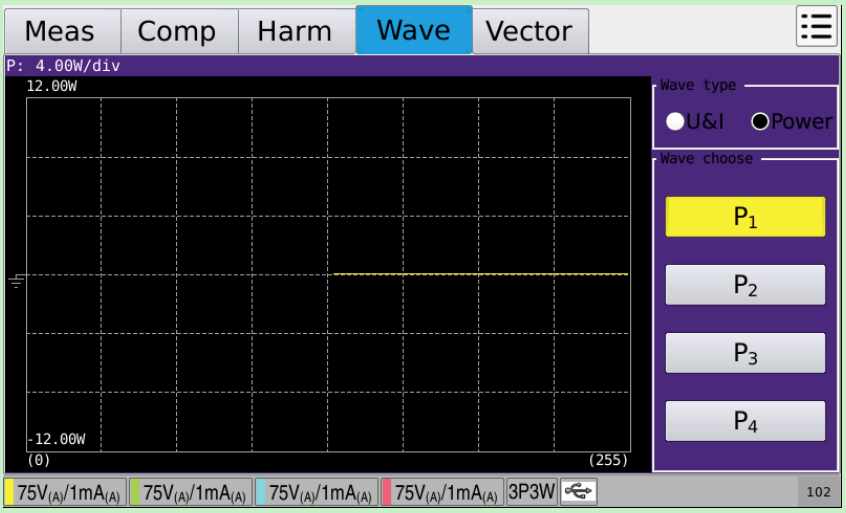


Figure 5-12 Power waveform display effect

The optional parameters of power waveform are P1, P2, P3, P4, which can be multiple choices. The selection method is to directly touch the button to select. The color of the selected button is the color corresponding to the waveform display;

The main purpose of the power waveform is to view the change curve of the power. The waveform dots are displayed in a loop overlay mode, that is, the latest 256 power points are always displayed, and the previous data will be removed from the left side of the display;

Note: The power waveform is only valid after the integral function is running; otherwise the display will not be refreshed.

5.5 Vector display page

The vector diagram display page mainly provides a vector display page for the three-phase test, which more intuitively displays the vector size of each signal in each three-phase combination, that is, the phase angle relationship, as shown in Figure 5-13.

The left side displays the polar coordinate system of the vector, and the right side displays the basic test results; the vector diagram only needs to display the voltage and current vector information diagram of each signal, and the color corresponds to the background color of the parameter on the right. The values above the vector diagram respectively indicate the values of the parameters corresponding to the outer circle which corresponds to the polar coordinates.

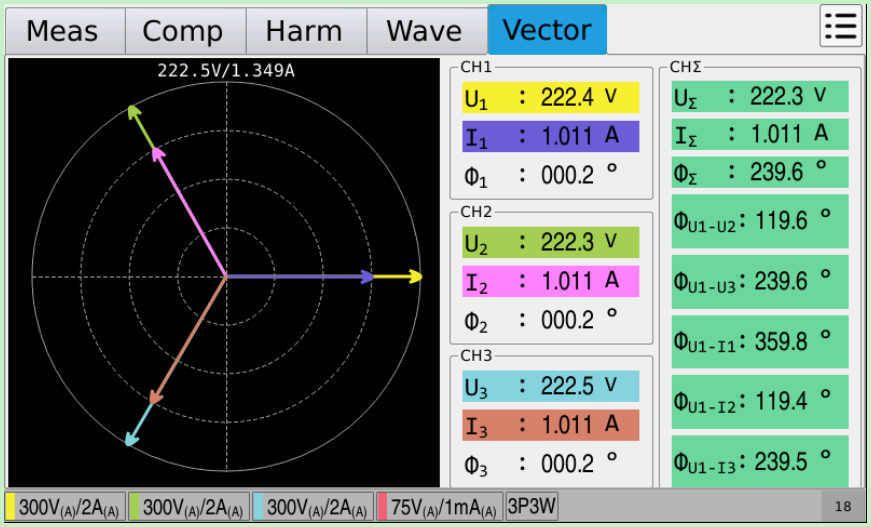


Figure 5-13 Vector display effect

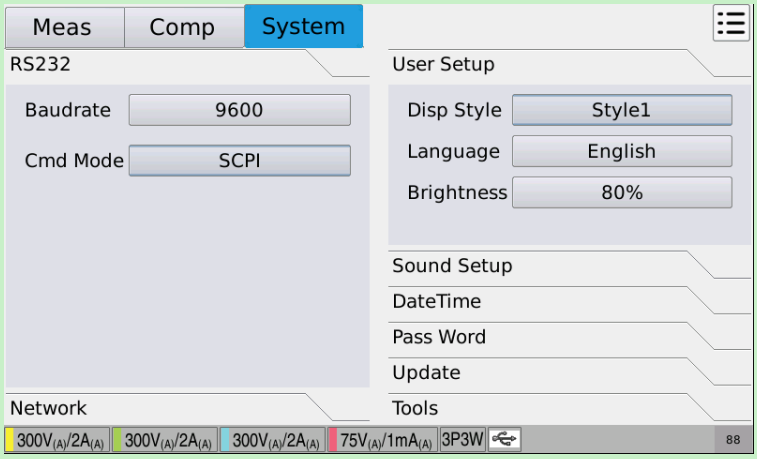
Chapter 6 System Setup

The system settings mainly involve the related settings of the instrument system. Generally does not affect the measurement;

The method to enter the system settings is as follows:

Step1: If it is not on the setting function page, press the [Setup] key to enter the setting related page.

Step2: According to the content displayed on the page, touch to select the system setting page to enter, as shown in Figure 6-1:



(Figure 6-1 System Setting Page)

The main setting items included in the system settings are shown in Table 6-1:

System parameter classification	Description
RS232/RS485 serial port settings	Including serial port related settings
LAN settings	Including LAN related settings
User settings	Including user-related operating environment settings
Date Time	Including system date and time settings
Pass word	Involving the password modification of the instrument
Update	Involving the operations related to the upgrade of instrument by using soft keys
Tools	Including system commonly used tool options

Table 6-1 System parameter classification description

6.1 RS232/RS485 serial port settings

The serial port setting mainly involves the general setting of the serial port, including the communication speed, command mode, bus address and other parameters of the serial port. For the introduction of the interface and related specific principles, please refer to the remote control chapter of Chapter 10;

The communication type of the serial port is divided into RS232 and RS485. This is the hardware selection (choose one of the two at the factory). The factory default is equipped with RS232. If the user does not need RS232 but needs to use RS485 communication, you need to confirm the installation in advance;

The communication speed is the baud rate, 4800, 9600, 38400, 115200 are available; other default fixed configurations are: 8 data bits, 1 stop bit, no parity, and no data flow control;

Command mode provides standard SCPI protocol and ModBus protocol optional;

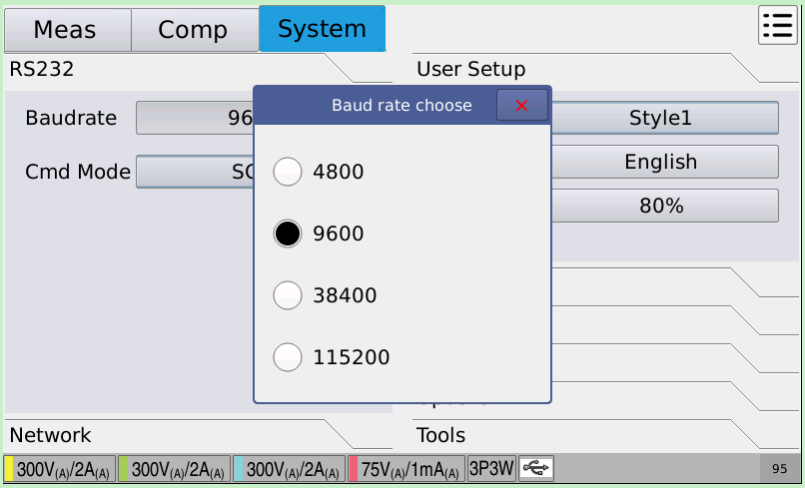
The bus address is used for the communication local address under RS485 type instrument or ModBus protocol, it can be set to 1~32;

6.1.1 Baud rate setting

Provide the baud rate setting selection of serial communication;

Setting method:

Press the [Setup] key on the panel, touch to enter the system setting page, expand the RS232 or RS485 tab, and then touch the Baud rate button, the baud rate setting window will pop up, and click the desired setting in the window and the window is shown in Figure 6-2:



(Figure 6-2 Baud rate selection window)

6.1.2 Local address setting

Address application requirements: RS485 communication address and ModeBus protocol

communication address.

It is used to set the bus address for serial communication of the machine, that is, to control and display the bus address of the current instrument. The setting range is 1～32.

Address 0 belongs to the broadcast address and cannot be set;

Setting method:

Press the [Setup] key on the panel, touch to enter the system setting page, expand the RS232 or RS485 tab, and then double-click the bus address setting window, the system keyboard will pop up, and you can enter the specific value to be set in the system's numeric keyboard. Just enter a value within the value range;

Note: There is no bus address setting item in the SCPI command analysis mode of RS232 communication.

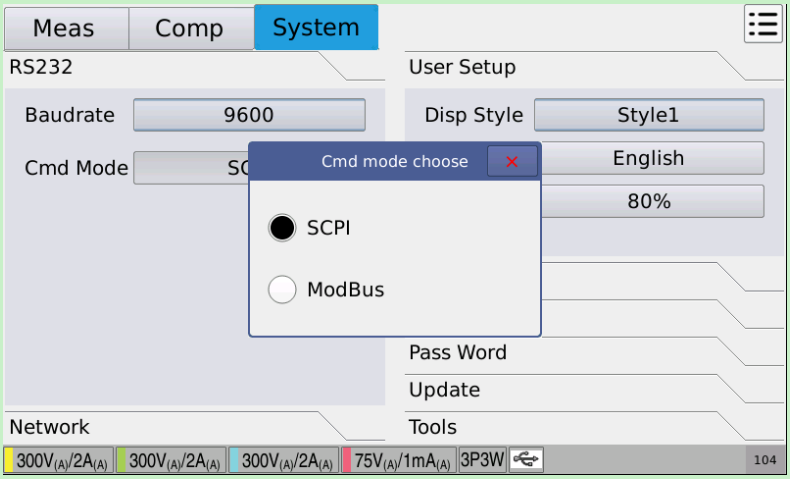
6.1.3 Command mode setting

The command mode can be set with SCPI command, ModeBus command protocol.

For related introduction, please refer to Chapter 11 Communication Command Reference Chapter;

Setting method:

Press the [Setup] key on the panel, touch to enter the system setting page, expand the RS232 or RS485 tab, and then touch the Cmd Mode button, the command mode setting window will pop up, and click the desired setting option in the window. Then, the window is shown in Figure 6-3:



(Figure 6-3 Command mode selection window)

6.2 LAN settings

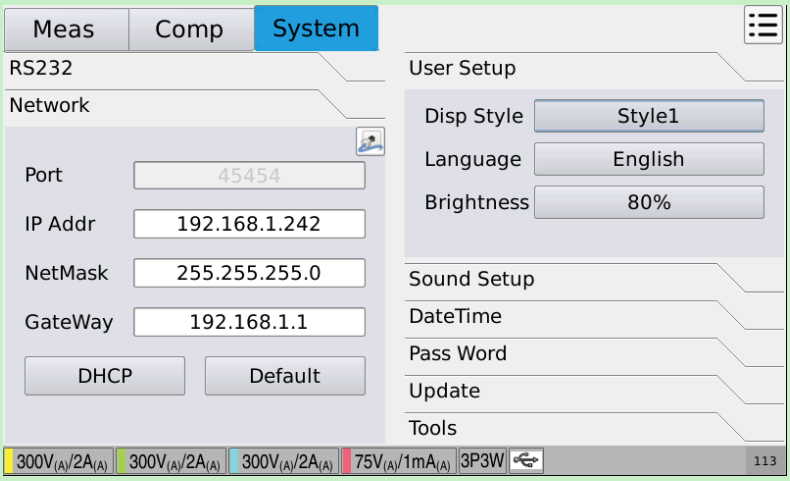
The command parsing protocol used by the local area network is the standard SCPI command protocol;

In addition to providing wired LAN, the TH34XX series also provides a driver and setting interface for wireless LAN connection. If you need to use wireless Wifi to connect to the LAN, you need to purchase the wireless network card specified by this instrument before you can use it. Currently, it supports RTL8192CU controller as the core wireless network card.

The default network port number in the LAN settings is 45454, and no modification is provided.

6.2.1 Wired LAN Settings

The wired network connection is used by default when starting up, and the configuration setting page is shown in Figure 6-4 below:



(Figure 6-4 Wired LAN configuration window)

Configure the corresponding address parameters according to the specific attributes of the connected LAN, and plug in the network cable on the rear panel to use the network port for communication.

If you need to modify the relevant address parameters, you can directly double-click the corresponding address display window to pop up the numeric keyboard, enter the correct network configuration on the numeric keyboard, and click OK to exit the keyboard to complete the modification;

If the connected networking equipment (router or switch) supports the automatic IP allocation function, you can directly click the automatic configuration button in the display window to try the automatic configuration. The configuration takes a few seconds. Do not operate the machine during the configuration process; if it does not support it You need to manually assign the setting address; if the automatic configuration fails, you may get the loopback IP address of the machine, that is, 127.0.0.1; at this time, you can click the default setting button in the display window to restore the default configuration, and then start again on the basis of the default configuration. Just make fine adjustments, and you can consult the company's network technical engineer to obtain the address parameters of the network configuration.

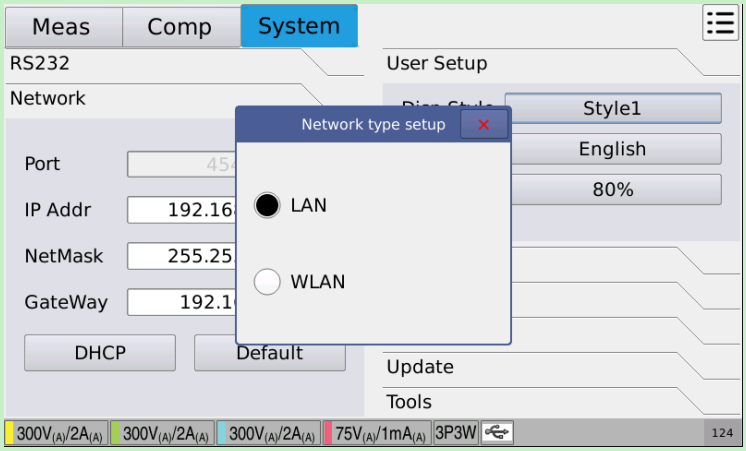
6.2.2 Wireless LAN Settings

The wireless WLAN function of the TH34XX series only provides the man-machine setting window for wireless configuration and the specified hardware driver support. To use this function, the user needs to purchase the specified wireless network card of this series of instruments and insert it into the USB host interface on the front panel. It can be used.

The currently supported wireless network card control chips are RTL8192 series;

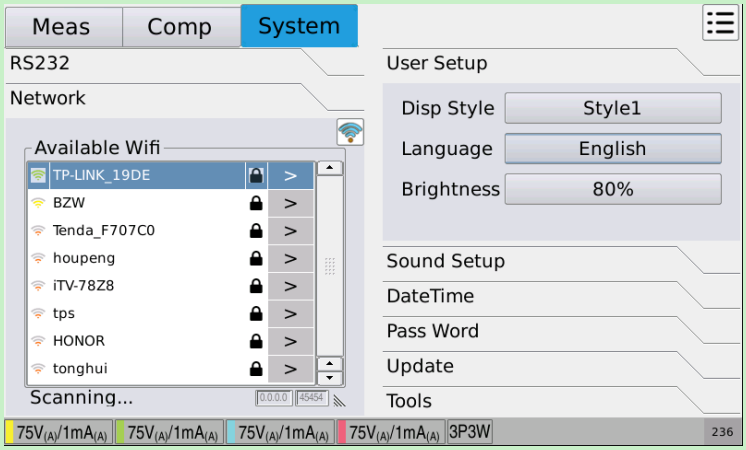
Wireless local area network means wifi connection to wireless local area network. There is a status button for network status selection in the upper right corner of the LAN setting window. After

touching it, the network type selection window will pop up, as shown in Figure 6-5:



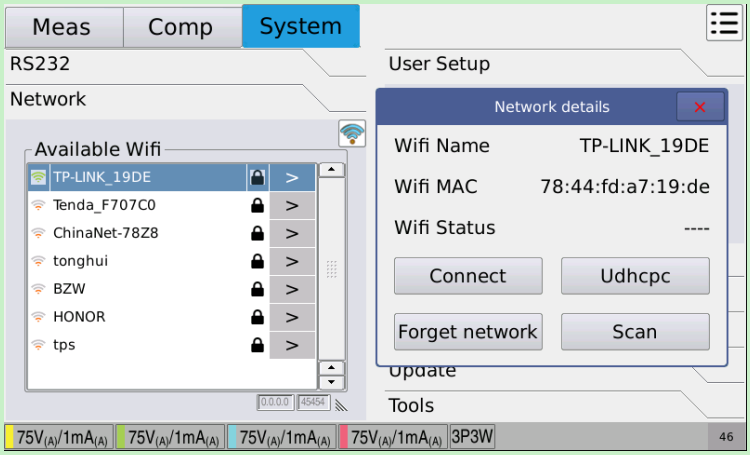
(Figure 6-5 Network type selection window)

After selecting WLAN (wireless network), the hotspot scanning operation will be performed automatically. If there is a saved wireless hotspot configuration in the scanned hotspot, it will automatically connect to the saved network with the strongest signal. After the connection is successful, the allocation will be displayed at the bottom of the window. The IP address and the corresponding hotspot name are shown in Figure 6-6 below:



(Figure 6-6 Configuration window of wireless network WLAN)

Touch the arrow in the last column of the available list to pop up the related information of the hotspot and related operation tools of the wireless network, as shown in Figure 6-7 below:



(Figure 6-7 Wireless network WLAN tool window)

6.3 User settings

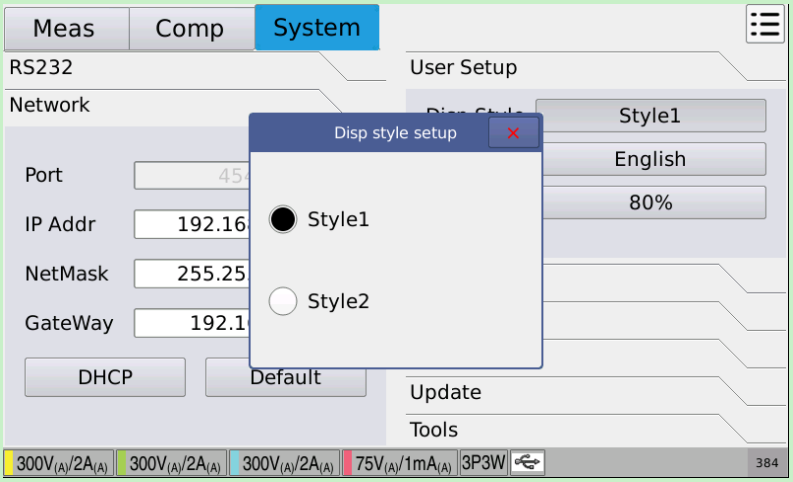
It involves the conventional user settings, including display style, system language, backlight brightness, etc. can be set.

6.3.1 Display style

The system provides users with two optional display styles for the main test page display, the default style 1.

Setting method:

Press the [Setup] key on the panel, touch to enter the system settings page, expand the User Setup tab, and then touch the button corresponding to the display style setting item, the display style setting window will pop up, and click the desired setting option in the window, as shown in Figure 6-8:



(Figure 6-8 Display style selection window)

6.3.2 System language

The language mode is used to control the operation interface of the instrument.

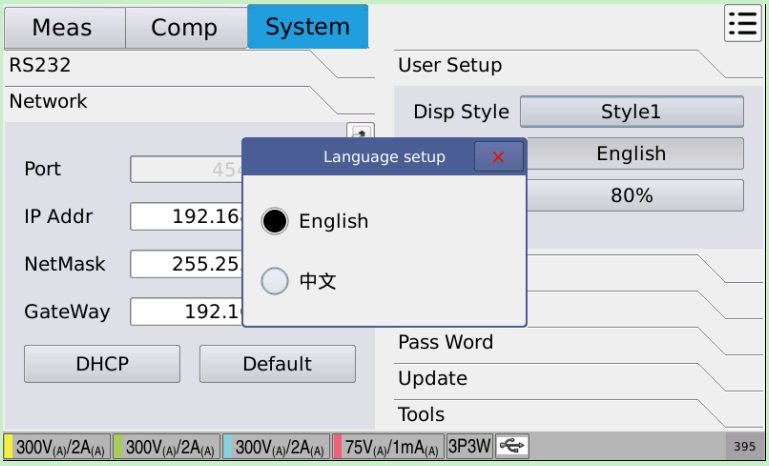
Parameter options are: English, Chinese

Language mode status	Description
English	English page display;
Language	Chinese page display;
Table 6-4 Description of language mode status	

Setting method:

Press the [Setup] key on the panel, touch to enter the system settings page, expand the user settings tab, and then touch the Language Setup button, the system language setting window will

pop up, and click the desired setting option in the window, as shown in Figure 6-9:



(Figure 6-9 Language mode selection window)

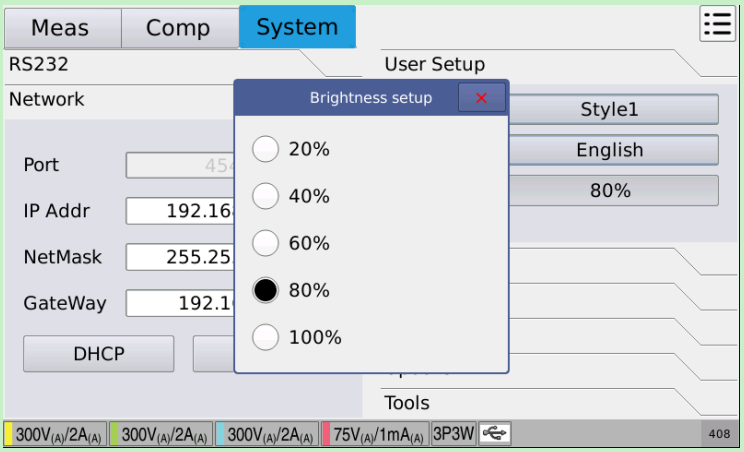
6.3.3 Backlight adjustment

LCD backlight brightness adjustment;

Parameter options are: 20%, 40%, 60%, 80%, 100%

Setting method:

Press the [Setup] key on the panel, touch to enter the system settings page, expand the user settings tab, and then touch the Brightness Setup button, the backlight brightness setting window will pop up, and click the desired setting option in the window, as shown in Figure 6-10:



(Figure 6-10 Backlight brightness selection window)

6.4 Sound settings

It involves the buzzer sound settings related to the instrument, including key sound switch settings, comparison sound switch settings, etc.;

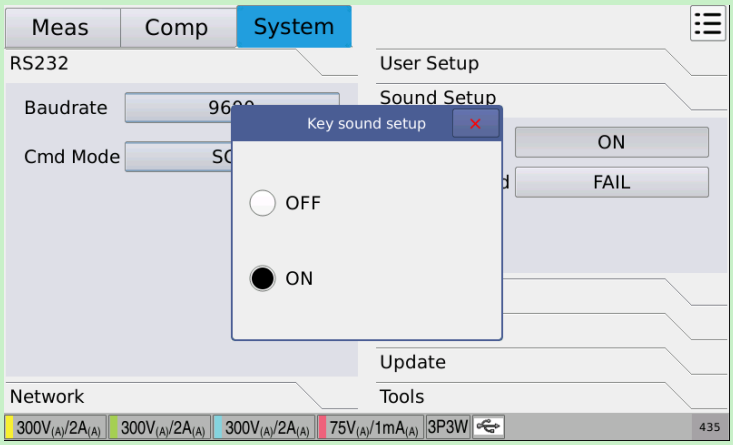
6.4.1 Key Sound

It is used to control the turning on and off of the key sound, and the factory default setting is turned on. The parameter options are shown in the following table:

Key sound Status	Description
ON	Key sound is turned on
OFF	Key sound is turned off
Table 6-2 key sound status description	

Setting method:

Press the [Setup] button on the panel, touch to enter the system settings page, expand the user settings tab, and then touch the Key sound button and the button sound setting window will pop up, click the desired setting in the window and the window is shown in Figure 6-11:



(Figure 6-11 Key sound selection window)

6.4.2 Compare Sound

It is used to control the sound signal output function for comparison function.

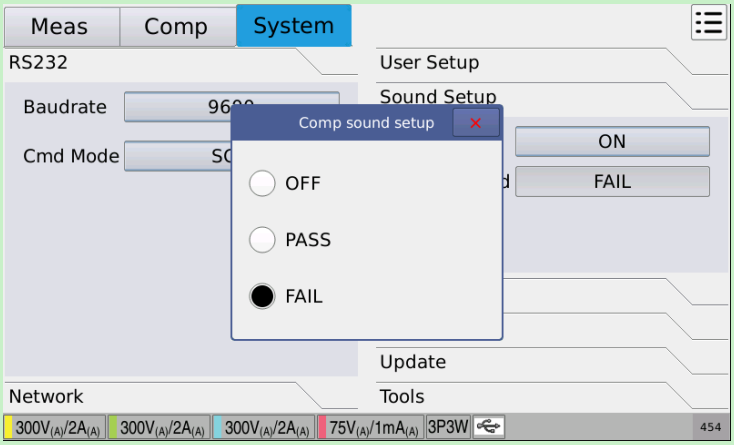
The parameter options are shown in the following table:

Compare Sound Status	Description
PASS	The buzzer sounds when the compare is PASS
FAIL	The buzzer sounds when the compare is FAIL
OFF	Turn off the buzzer output function of the comparison result.
Table 6-3 compare sound status description	

Setting method:

Press the [Setup] key on the panel, touch to enter the system settings page, expand the user settings tab, and then touch the Compare Sound button and the compare sound setting window

will pop up, and click the option that needs to be set in the window, as shown in Figure 6-12:



(Figure 6-12 Compare sound selection window)

6.5 Date Time

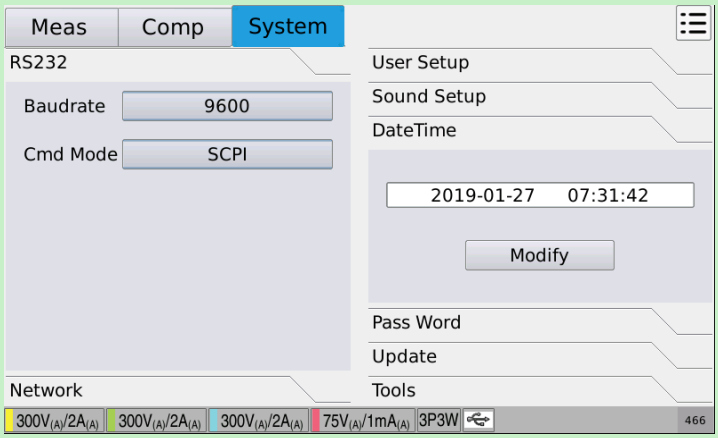
Press the modify key to obtain the modification authority. Double-click the control and the soft keyboard will pop up. Press the enter key after completing the input.

It is used to set the time in the local time zone.

Such as: August 15, 2018 at 9:13:25 in the morning

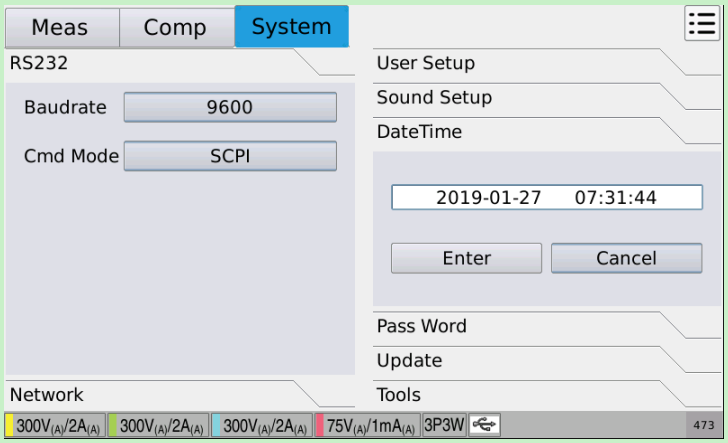
The display format is: 2018-08-15 09:13:25.

The window is shown in Figure 6-13:



(Figure 6-13 Date and time modification window 1)

The window after clicking the Modify button is displayed, as shown in Figure 6-13-2 below:



(Figure 6-13-2 Date and time modification window 2)

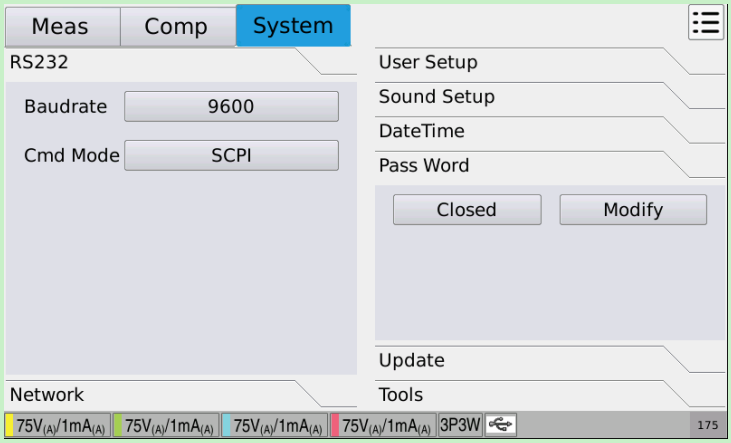
Then double-click the input window and enter the specific date and time in the pop-up soft keyboard and press the Enter key to complete the modification.

6.6 Pass Word

It is used to control the password protection mode of the instrument.

At present, the password protection function is applied: when the instrument needs to be unlocked, if the password protection is turned on, the instrument can be unlocked only after the password verification is passed;

Press the [Setup] key on the panel, touch to enter the system setting page, expand the password tab, and the password setting window will pop up, click the option of the desired setting in the window, as shown in Figure 6-14 :



(Figure 6-14 Password setting window)

Closed/Open: Indicate the current switch status of the password protection function;

Modify: used to enter the password to modify the settings;

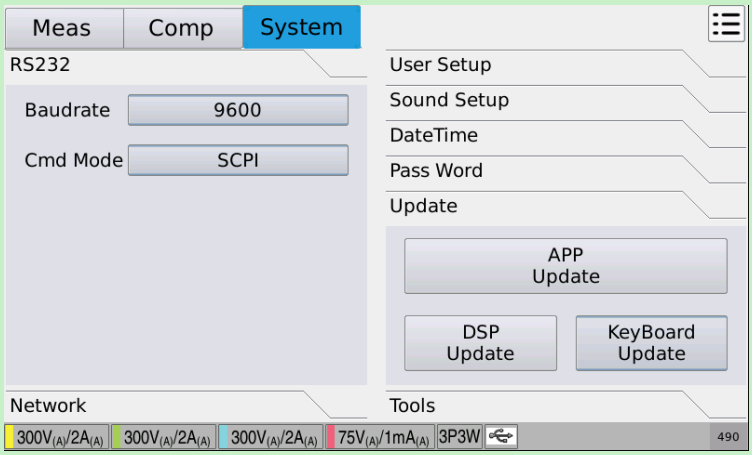
Note: The factory default password is the instrument model (0000), and it is closed by default

6.7 Update

It provides software upgrade operations used by the instrument, mainly related to applications

(APP upgrade), channel board (DSP upgrade), front panel (key board upgrade) and other related operations;

The window is shown in Figure 6-15:



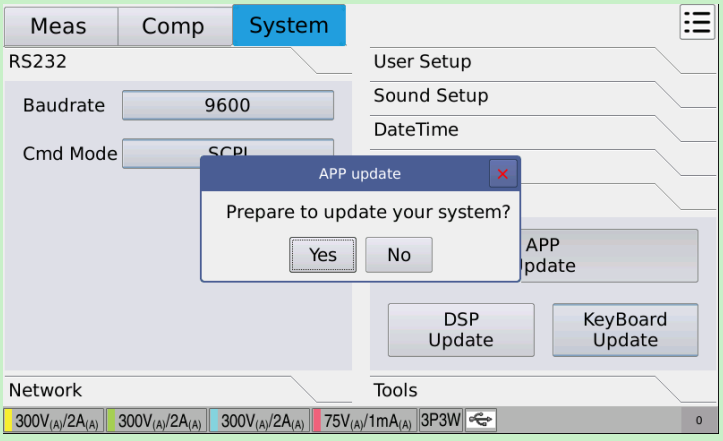
(Figure 6-15 Software upgrade setting window)

The designated storage path for the upgrade files: All the upgrade files involved in the TH34XX series instruments need to be in the update34files folder in the root directory of the U disk, otherwise the required files cannot be found.

6.7.1 APP update

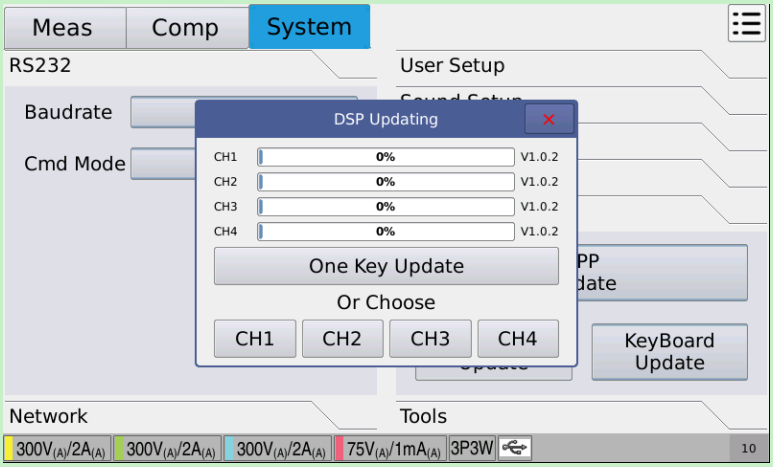
Need the support of upgrade files and upgrade scripts;

APP upgrade and keypad upgrade only need to select Yes in the confirmation dialog box and wait for the operation to be completed; After the upgrade button is selected, a secondary confirmation dialog box will pop up, as shown in Figure 6-16:



6.7.2 DSP Update

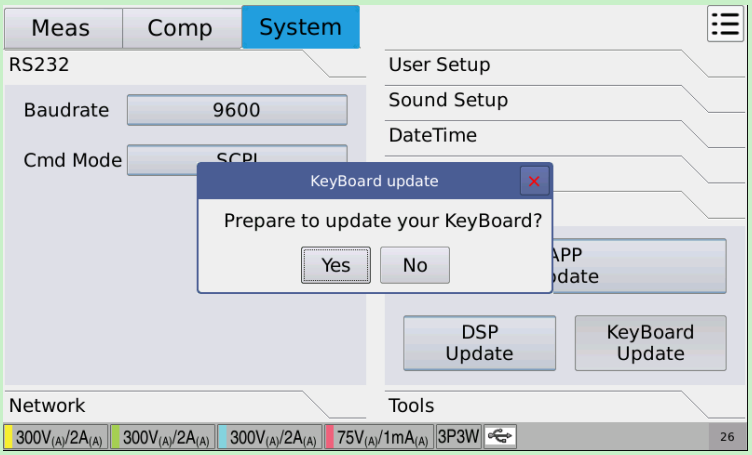
DSP upgrade involves the selection of specific channel boards. In the pop-up box, you can select all channels for one-click upgrade or specify a specific channel board for upgrade. The operation window is shown in Figure 6-17:



(Figure 6-17 DSP upgrade setting window)

6.7.3 KeyBoard Update

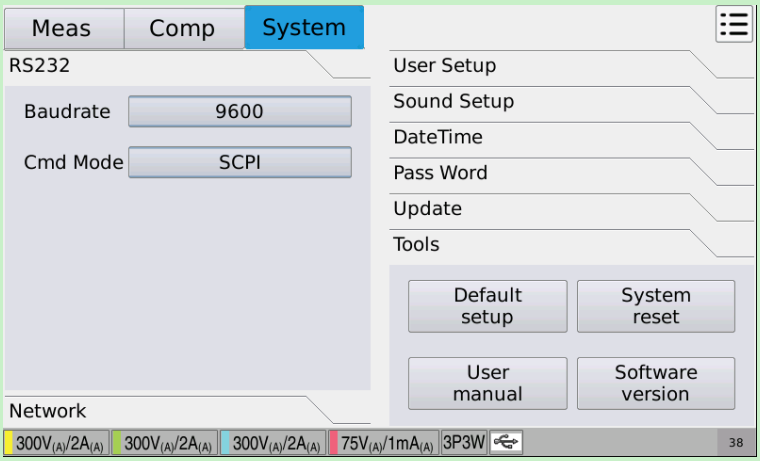
Keypad and front panel. After selecting, select Yes in the secondary confirmation dialog box to perform the upgrade operation of the keypad. The confirmation window is shown in Figure 6-18:



(Figure 6-18 KeyBoard upgrade confirmation window)

6.8 Tools

It involves the auxiliary tool options that the system needs to use, including functions such as default settings, system reset, user manuals, and software versions. As shown in Figure 6-19:



(Figure 6-19 Tool display window)

6.8.1 Default setting

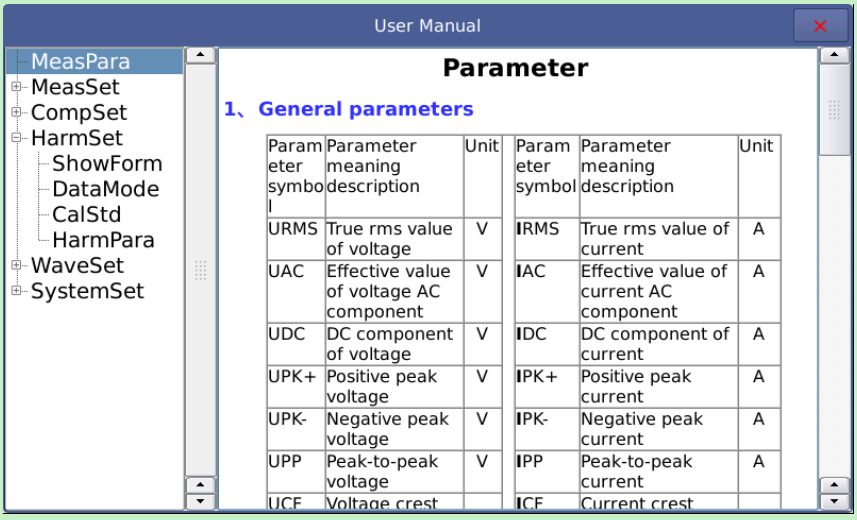
It is used to restore all settable parameters to the factory default settings.

6.8.2 System reset

It is used to restart the system to allow the system to complete the reset and restart.

6.8.3 User Manual

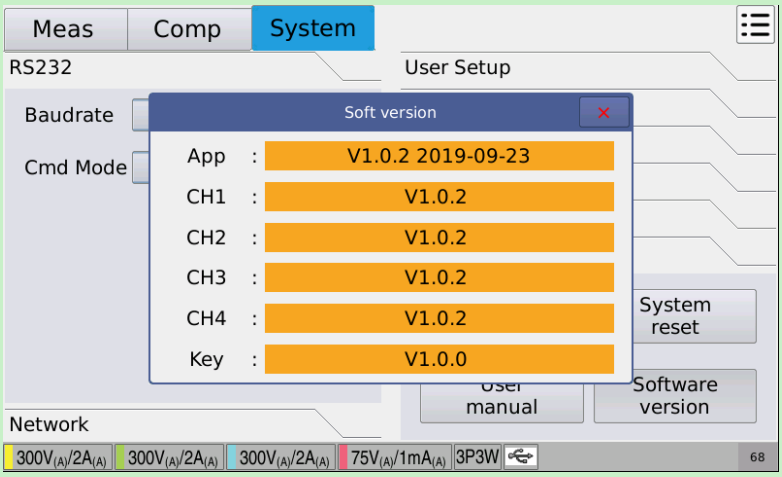
Provide necessary user help documents, you can directly open to view the corresponding function introduction, or long press some setting buttons to automatically open and jump to the specified chapter to view; the display is shown in Figure 6-20,



(Figure 6-20 User manual display window)

6.8.4 Software Version

To view the software version of the current instrument; as shown in Figure 6-21:



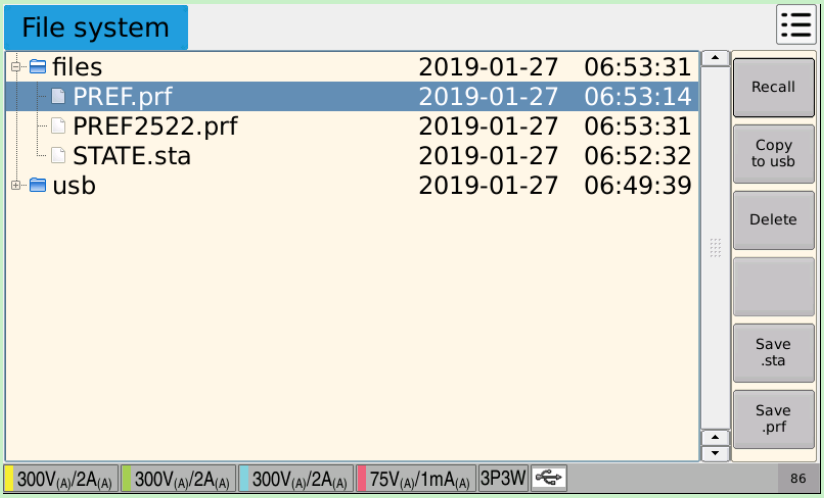
(Figure 6-21 Software version display window)

Chapter 7 File Management

TH34XX series instruments can store the parameters set by the user in the internal memory of the instrument in the form of a file. When the same setting is to be used next time, the user does not need to reset these parameters, just load the corresponding file to get the last set parameters.

7.1 File management function interface

If you are not on the file management page, press the [File] key on the front panel to enter the file management page. As shown in Figure 7-1:



(Figure 7-1 File management page display effect)

7.2 Introduction to Store/Recall Function

This section will introduce information about the store/recall function. Through the storage/recall function, the user can save the instrument configuration information to the internal Flash or external U disk of the instrument, and recall it from the internal Flash or external U disk of the instrument. The test results and screenshots can only be saved in the external U disk.

Symbol Description:

◆ files: internal files

◆ usb: external file

The storage methods and uses are introduced. The following table 7-1 describes the available storage methods and their uses:

Save method		Whether can be called	Usage
Type	File format		
System configuration save	*.prf	YES	Save the system configuration status of the instrument

Measurement configuration save	*.sta	YES	Save the test configuration state of the instrument
Screenshot save	*.png	NO	Save a screenshot of the instrument
Test data	*.csv	NO	Save test data
Table 7-1 Storage method and purpose			

7.3 Folder/File Structure

File system of TH34XX series:
For the saving of configuration files, it will automatically choose whether to save in the root directory of the internal file or the root directory of the U disk according to the position of the current file cursor index;
For screenshot files, when there is a USB flash drive, the PIC file saved in the root directory of the USB flash drive will be automatically added first. If the USB flash drive is not available, it will be automatically saved to the PIC directory of the internal file;
For the saving of test data, the data saving function can only be used when the U disk is available. A few test data can only be saved in the root directory of the U disk;
Pay attention to the following points when using U disk on TH34XX series:
◆ Before connecting the USB flash drive to the TH34XX series, it is recommended that the user back up the data saved on the USB flash drive. Tonghui Company is not responsible for the loss of data in the USB storage device when the USB storage device is used with this instrument.
◆ In order to save the instrument data to the U disk efficiently, it is recommended that there are not too many files or folders in the U disk.
◆ Due to the limited internal storage space, it is recommended that the files stored in the instrument be copied to the U disk in time and the internal files should be cleaned and deleted accordingly;

7.4 File management operation steps

The various operations on the file are as follows:
Click to select the file name to be operated and the operation can be performed as follows according to the toolbar on the right side of the screen:
◆ **Save measurement settings**
When the focus of the file list is under the files path, the measurement setting file will be saved in the root directory with the files file after the file name is entered;
◆ **Save system settings**
When the focus of the file list is under the files path, the system setting file will be saved in the root directory with the files file after the file name is entered;
◆ **Copy to usb**
When the cursor is under the path corresponding to files, copy the file or folder corresponding to the cursor to the USB root directory; Note: If the file to be copied is a file, it will overwrite the file in the usb path when there is a file with the same name in the usb; if the file to be copied is a

folder, please make sure that there is no folder with the same name in the USB root directory, otherwise it will cause Copy failed

◆ **Delete**

The instrument will delete the file where the cursor is.

◆ **Load**

Load the setting file specified by the file index to reconfigure the parameter settings of the instrument.

7.5 Data save operation

Please perform the data saving operation when the U disk is available!

Press the [Setup] key on the panel, touch to enter the measurement setting page, expand the data save tab, and click the touch screen to complete the corresponding state switch settings; see the measurement setting data save setting chapter for detailed settings.

The data save switch is turned off by default when it is turned on, and manually turned on when needed. After turning on the data, the data will be recorded and saved. At the same time, the status bar will display the status picture of the write operation, indicating that the test data is being recorded;

To stop the data recording, it needs to be closed manually. In order to ensure the reading and writing speed of the U disk, please master the time interval of data recording by yourself.

Chapter 8 Correct Measurement

8.1 Wire connection method

TH34XX provides 3-channel and 4-channel instruments to choose from, both of which support the basic wire system combination mode, which has a direct relationship with the wiring mode; the combination mode is as follows:

One-phase two-wire (1P2W), one-phase three-wire (1P3W), three-phase three-wire (3P3W), three-phase four-wire (3P4W), three-voltage three-current (3V3A);

Note: 3V3A is also 3P3W in theory. Due to the difference between using 2 channels and 3 channels, the industry uniformly refers to 3P3W using 3 channels as 3V3A;

The relationship between the wiring combination Σ and the number of channels used for wiring is as follows:

The corresponding relationship between the number of instruments used in the wire system combination Σ and the channel numbers used is shown in Table 8-1:

<table>
<tr><td rowspan="2">Wire system (3-channel instrument)</td><td colspan="3">Channel usage</td></tr>
<tr><td>CH1</td><td>CH2</td><td>CH3</td></tr>
<tr><td>1P2W</td><td>1P2W</td><td>1P2W</td><td>1P2W</td></tr>
<tr><td>1P3W or 3P3W</td><td colspan="2">Σ (1P3W or 3P3W)</td><td>1P2W</td></tr>
<tr><td>3P4W or 3V3A</td><td colspan="3">Σ (3P4W or 3V3A)</td></tr>
<tr><td colspan="4">Table 8-1 Wire System Combination Channel Usage of 3-Channel Instrument</td></tr>
</table>

Considering that 1P3W and 3P3W only need to use 2 channels, for a 4-channel instrument, in order to make full use of the remaining CH3 and CH4 channels under the combination of these two wire systems, the 4-channel instrument also provides the following two channels With the combination of 2 channels, namely 1P3W_1P3W, 1P3W_3P3W and 3P3W_3P3W, the channel combinations are shown in the following table 8-2:

Wire system (4-channel instrument)	Channel usage			
	CH1	CH2	CH3	CH4
1P2W	1P2W	1P2W	1P2W	1P2W
1P3W_1P2W or 3P3W_1P2W	Σ1（1P3W or 3P3W）		1P2W	1P2W
3P4W_1P2W or 3V3A_1P2W	Σ1 (3P4W or 3V3A)			1P2W
1P3W_1P3W	Σ1 （1P3W）		Σ2 （1P3W）	
1P3W_3P3W	Σ1 （1P3W）		Σ2 （3P3W）	
3P3W_3P3W	Σ1 （3P3W）		Σ2 （3P3W）	

Table 8-2 Wire System Combination Channel Usage of 4-Channel Instrument

8.1.1 1P2W wiring

Whether it is a single-phase system or a multi-phase system, the wiring of each channel can refer to the basic wiring of 1P2W, and the combination can become a multi-phase test system.

1P2W is a choice of wire system, but because all channels work independently in this wire system mode, it can be regarded as a single-channel digital power meter, so no wire system combination is used in this wire system mode, that is, pressing the [CHΣ] button on the panel will not display the result of the wire system test;

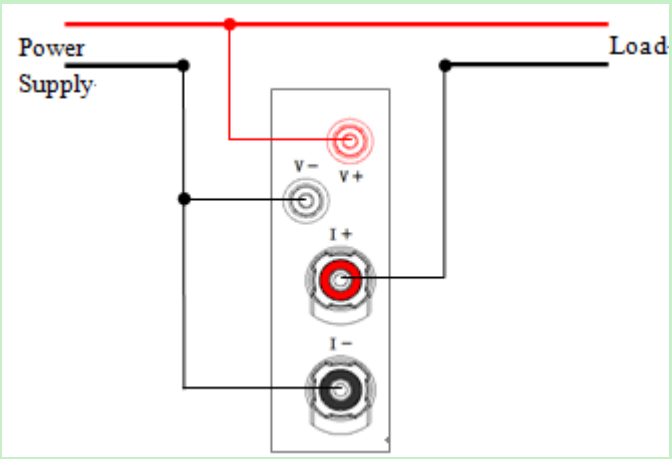
Each channel of the TH34XX series instrument provides four test wiring input terminals, namely high voltage end, low voltage end, high current end, and low current end.

Since the voltage and current are all floating inputs, there are many combinations of test wiring methods, and the corresponding test circuit can be changed for different applications. Here are two typical recommended wiring methods for the measurement circuit, that is, the internal connection of the ammeter Method and external method of ammeter.

Tip: Considering the existence of distributed capacitance may have an impact on the test, in order to reduce the impact of distributed capacitance on the test circuit, it is recommended to make the current test terminal as close as possible to the ground of the input source, that is, connect the current terminal to the test circuit Low-end.

8.1.1.1 Internal connection of ammeter

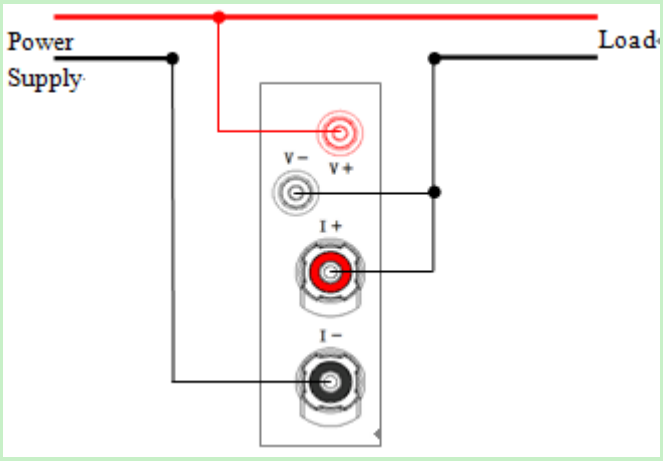
This method is suitable for low-power testing, that is, it is recommended to use when the test current is relatively small, so that the current test is more accurate, and the voltage measurement will cause a small error due to the voltage drop caused by the current flowing on the ammeter (this error can be ignored). The wiring is shown in Figure 8-1:



(Figure 8-1 Internal connection of ammeter-suitable for small current connection)

8.1.1.2 External connection of ammeter

This method is suitable for high-power load testing, that is, it is recommended to use the test current is relatively large, so that the voltage test is more accurate, and the current measurement will cause a small error due to the shunt of the voltmeter (this error can be ignored). The wiring method and brief principle are shown in Figure 8-2:



(Figure 8-2 External connection method of ammeter-suitable for large current connection)

8.1.1.3 Principle basis for internal/external connection of ammeter

The internal and external principles of the ammeter are introduced, and the schematic description is shown in Figure 8-3:

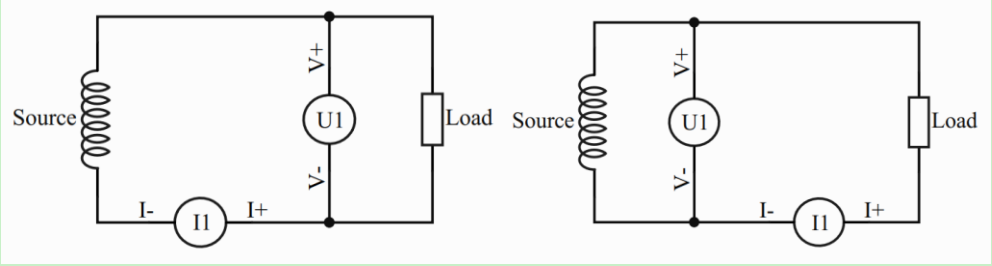


Figure 8-3 External connection of ammeter (left), internal connection of ammeter (right)-schematic diagram

Internal connection of the ammeter: the ammeter is connected in series with the load and then connected in parallel with the voltmeter, that is, the ammeter is internally connected within the test range of the voltmeter;

External connection of the ammeter: the voltmeter is connected in parallel with the load and then connected in series with the ammeter, that is, the current is connected outside the test range of the voltmeter;

Since both the voltmeter and the ammeter have internal resistance, for TH34XX series of instruments, the input impedance of the voltage end is 3MΩ, and the input impedance of the current end is 2mΩ or 200mΩ, etc.;

When the load impedance is relatively small (assuming that the impedance of the load is similar to that of the ammeter), if the ammeter is internally connected, the result measured by the voltmeter is the sum of the voltage drop of the ammeter itself and the load voltage drop. The impedance of the voltmeter is similar to that of the ammeter, that is, nearly half of the result of the voltmeter test is the partial voltage on the ammeter. At this time, the internal calculation of the instrument still regards the result of the voltmeter test as the voltage on the load. It can be seen that the error is It is quite large. In this case, it means that the internal connection of the ammeter is inappropriate, and the external connection method of the ammeter needs to be adopted. In this way, since the impedance of the load is much smaller than the impedance of the voltmeter, the current is basically on the load, so the result of the ammeter test is basically the load current, and the error at this time can be minimized.

Conversely, when the load impedance is relatively large (assuming that the impedance of the load is similar to the impedance of the voltmeter), that is, the impedance of the load is much greater than the impedance of the current, that is, when the ammeter is connected to an external connection, only nearly half of the test result of the ammeter flows through the load. So the error is relatively large, it is more appropriate to switch to the internal connection of the ammeter, so that the test result of the ammeter is the same as the current flowing through the load, and the test result of the voltmeter can basically ignore the partial pressure effect of the ammeter, so the overall error will be reduced to a minimum.

8.1.1.4 Recommended procedure for cleverly connecting test leads:

1) First connect the current terminal in series with the load (connect it into a loop, and connect the negative terminal of the current to the neutral line);

2) Then connect the voltage terminal to the two ends of the load or the two ends of the input source according to the demand.

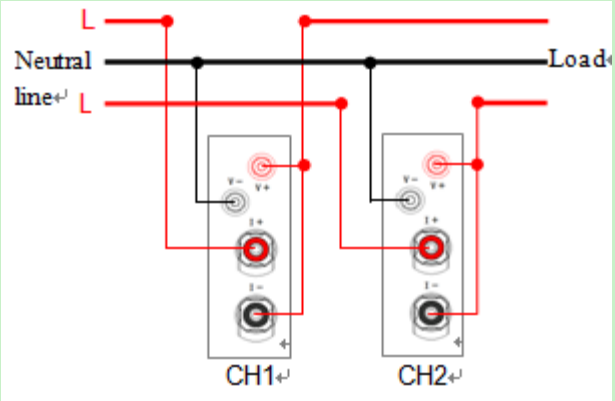
That is, the positive terminal of the voltage is connected to the live wire; the negative terminal of voltage is connected to the positive terminal of current (external connection method of ammeter) or negative terminal of current (internal connection method of ammeter);

3) Wiring confirmation check

That is, confirm that the live wire of the input source is connected to the positive terminal of the voltage, and the neutral wire of the input source is connected to the negative terminal of the current.

8.1.2 1P3W wiring

For an instrument with only 3 channels, channel 1 and channel 2 are used to form 1P3W, while for a 4-channel instrument, depending on the wiring options, channels 3 and 4 can be used to form a 1P3W test system. The recommended wiring diagram and principle of 1P3W testing are shown in the figure below:



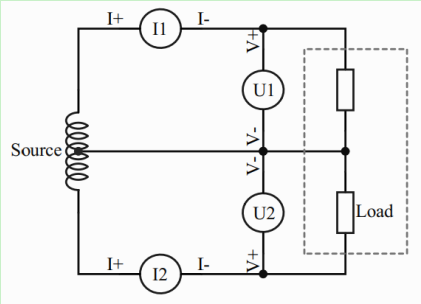
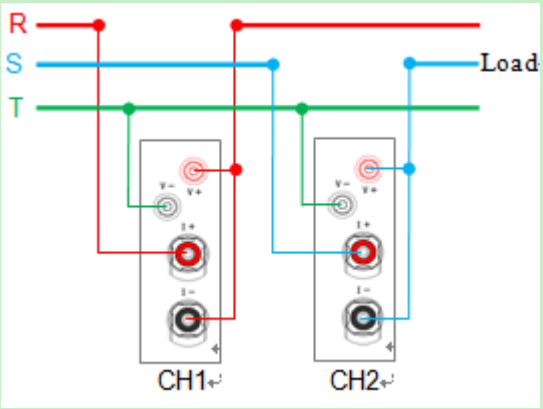


Figure 8-4 Schematic diagram of 1P3W

8.1.3 3P3W wiring

For instruments with only 3 channels, channel 1 and channel 2 are used to form 3P3W, while for 4-channel instruments, depending on the wire system option, you can switch to channel 3 and channel 4 to form a 3P3W test system. The recommended wiring diagram and principle of 3P3W testing are shown in the figure below:



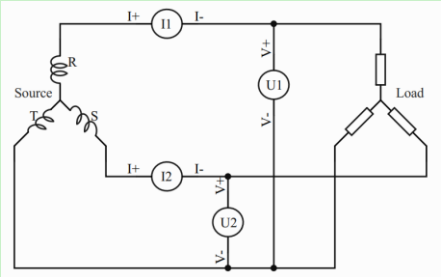


Figure 8-5 Schematic diagram of 3P3W

8.1.4 3P4W wiring

For 3P4W, 3 channels need to be used, so for 3 channel and 4 channel instruments, 3P4W is composed of channel 1, channel 2 and channel 3. The recommended wiring diagram and principle description of 3P4W test are shown in the following figure:

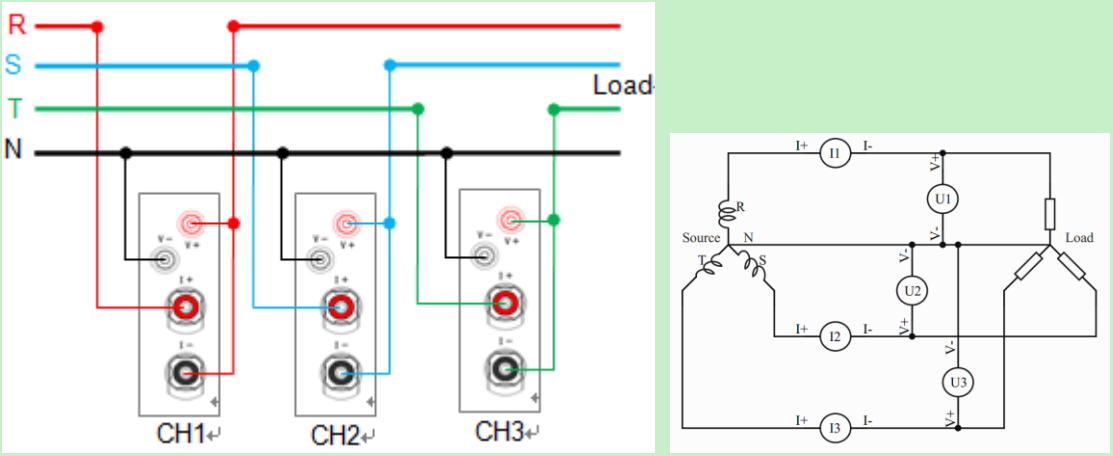


Figure 8-6 Schematic diagram of 3P4W

8.1.5 3V3A wiring

For 3V3A, 3 channels need to be used, so for 3-channel and 4-channel instruments, both channels 1, 2 and 3 are used to form 3V3A. The recommended wiring diagram and principle description of 3V3A test are shown in the following figure:

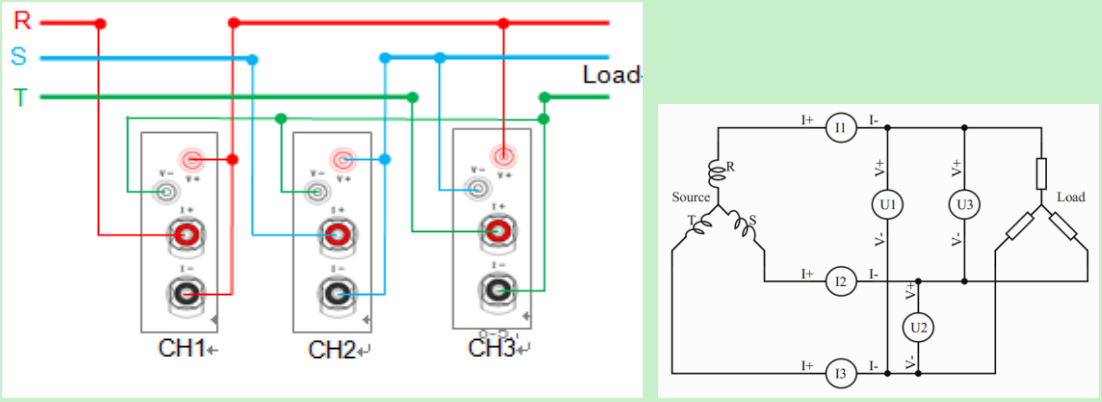


Figure 8-7 Schematic diagram of 3V3A

8.2 Test conditions

8.2.1 Conventional test conditions

Confirm the range (auto can be selected);
Confirm the trigger mode (by default, internal trigger is selected, and the trigger delay time is set to 0s);
Confirm whether the wiring system setting and wiring system are correct;
Confirm whether the synchronization source of each channel is appropriate;
Generally, the factory default settings can complete the setting of the basic test conditions.

8.2.2 Comparison test conditions

Set the parameters to be compared in the comparison settings, as well as the corresponding upper and lower limits, and finally select the corresponding function options.

8.2.3 Harmonic test conditions

Harmonic analysis is mainly for low-frequency signals, namely (power frequency signals). Turn on the 5kHz filter on the measurement setting page, return to the harmonic display page, and set the corresponding harmonic analysis options on the right.

8.2.4 Waveform test conditions

Since the waveform test is divided into voltage & current waveform test and power waveform test, for U&I waveform test, you only need to select the corresponding waveform to be displayed; for power waveform, it depends on the start time and end time of the integration function, that is, the integration function is not available. If it is turned on, the function waveform is not displayed. If the integral function is turned on, the power parameters to be displayed can be selected accordingly.

8.2.5 Vector test conditions

The vector diagram display does not require special setting of conditions. It is worth reminding that the vector diagram is mainly designed for the 3-phase test system, and it has relative significance mainly for the 3P4W and 3V3A wire system.

Chapter 9 Basic Principles and Technical Specifications

9.1 Basic principles

9.1.1 System composition

The main structure of TH34XX series multi-channel digital power meter is to connect the multi-channel voltage and current of the equipment under test to the corresponding multi-channel input terminal of the instrument. The electrical parameters corresponding to the channels and the wire system test results after the channel combination, in addition to the result display of the instrument itself, the instrument provides a variety of external communication interfaces, which is convenient for users to use the upper computer to program and control.
System composition, as shown in Figure 9-1:

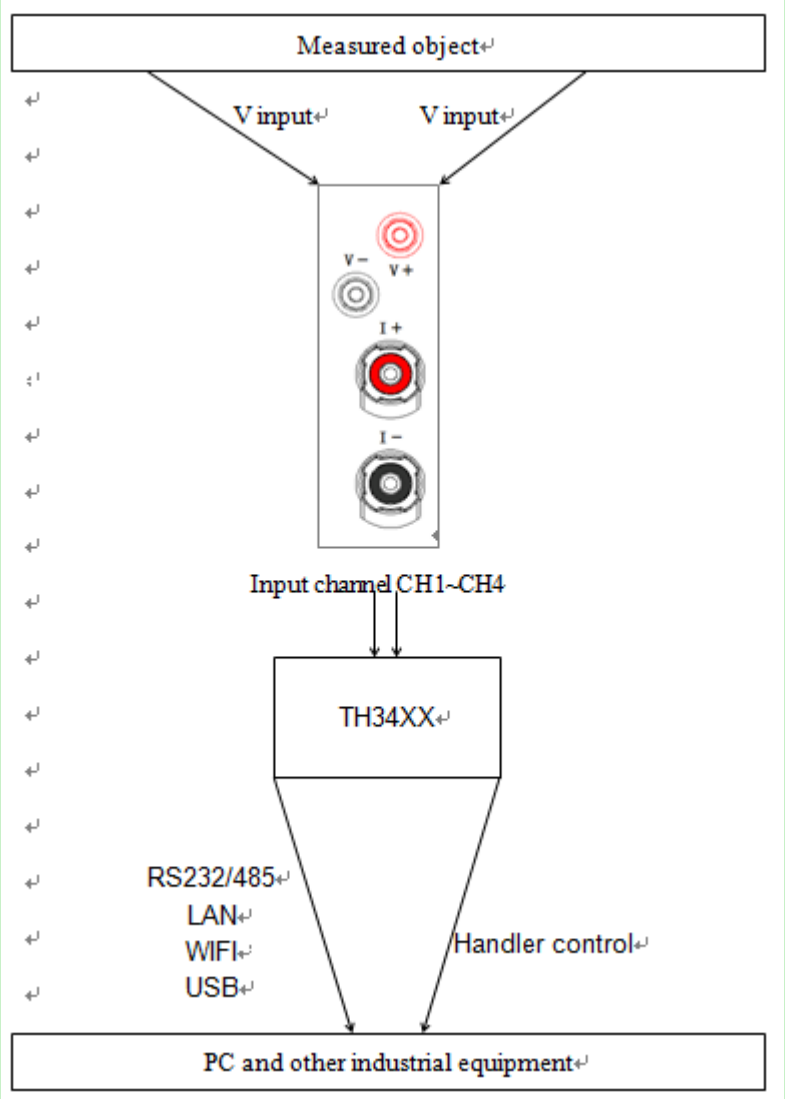


Figure 9-1 System structure

9.1.2 Principle block diagram

The main principle structure of TH34XX series multi-channel digital power meter is a test system composed of multi-channels. After connecting the multi-channel voltage and current of the equipment under test to the corresponding multi-channel input terminal of the instrument, it undergoes differential amplification and digital Filtering, phase-locked frequency multiplication sampling, synchronous AD conversion, that is, the analog signals of voltage and current are converted into digital quantities Ui and Ii after synchronous sampling, and then the CPU uses the method of discrete integration to obtain the voltage RMS, current RMS, and active power Parameters such as power and power factor are sent to the LCD display.

The sign of the power calculation result represents the direction of power flow (respectively representing the energy provided by the power supply to the load or the energy fed back by the load to the power supply).

Power factor is the ratio of active power to apparent power (total power). In theory, there is no sign of power factor, but in the application of power meters, the sign is used to judge the phase

relationship between voltage and current, and the value is -1 Between ~+1, the positive value represents the voltage leading the current, and the negative sign represents the voltage lagging the current.

The multi-channel test results are integrated and processed to obtain multi-phase electrical parameter test results according to the wire system combination status of the wiring. For the display and storage of test results, the instrument provides a variety of communication interfaces and U disk storage functions, which is convenient for users to directly on the PC side. Control and read the results of the instrument. In addition to the basic test parameter display, the instrument itself also provides rich human-computer interaction such as waveform display, vector diagram display, harmonic list display after FFT calculation, and histogram display.

9.1.3 Measurement parameter symbols and calculation formula

9.1.3.1 General parameters

Parameter symbol description:

Parameter symbol	Parameter meaning description	Unit		Parameter symbol	Parameter meaning description	Unit
U_{RMS}	True rms value of voltage	V		$\mathbf{I}_{RMS}$	True rms value of current	A
U_{AC}	Effective value of voltage AC component	V		$\mathbf{I}_{AC}$	Effective value of current AC component	A
U_{DC}	DC component of voltage	V		$\mathbf{I}_{AC}$	DC component of current	A
U_{PK+}	Positive peak voltage	V		$\mathbf{I}_{PK+}$	Positive peak current	A
U_{PK-}	Negative peak voltage	V		$\mathbf{I}_{PK-}$	Negative peak current	A
U_{PP}	Peak-to-peak voltage	V		$\mathbf{I}_{PP}$	Peak-to-peak current	A
U_{CF}	Voltage crest factor			$\mathbf{I}_{CF}$	Current crest factor	
P	Active power	W		P_F	Power factor	
S	Total power (apparent power)	VA		**φ**(phase)	Voltage and current to phase difference	°
Q	Reactive power (reactive power)	var		F_{REQ}	Frequency of voltage or current	Hz
	Table 9-1 Description of the meanings of general parameters					

Calculation formula:

Measured parameter	Calculation formula/ calculation method	Measured parameter	Calculation formula/ calculation method
U_{RMS}	$\sqrt{\frac{1}{T}\int_0^T u^2(t)dt}$	I_{RMS}	$\sqrt{\frac{1}{T}\int_0^T i^2(t)dt}$
U_{DC}	$\frac{1}{T}\int_0^T u(t)dt$	I_{DC}	$\frac{1}{T}\int_0^T i(t)dt$
U_{AC}	$\sqrt{U_{RMS}^2 - U_{DC}^2}$	I_{AC}	$\sqrt{I_{RMS}^2 - I_{DC}^2}$
U_{PK+}	Maximum value in a sampling period $u(t)$	I_{PK+}	Maximum value in a sampling period $i(t)$
U_{PK-}	The minimum value in a sampling period $u(t)$	I_{PK-}	The minimum value in a sampling period $i(t)$
U_{PP}	$U_{PK+} - U_{PK-}$	I_{PP}	$I_{PK+} - I_{PK-}$
U_{CF}	$\max(\lvert U_{PK+}\rvert, \lvert U_{PK-}\rvert) / U_{RMS}$	I_{CF}	$\max(\lvert I_{PK+}\rvert, \lvert I_{PK-}\rvert) / I_{RMS}$
P	$\frac{1}{T}\int_0^T u(t)i(t)dt$	λ(PF)	$\frac{P}{S}$
S	$U_{RMS} * I_{RMS}$	φ(phase)	$\cos^{-1}(\frac{P}{S})$
Q	$\sqrt{S^2 - P^2}$	F_{REQ}	Zero-crossing detection result
Table 9-2 General parameter calculation formula			

9.1.3.2 Integration parameters

Parameter symbol description:

Parameter symbol	Parameter meaning description	Unit
W_{P+}	Positive active power integral (consumption)	Wh
W_{P-}	Negative active power integral (feedback)	Wh
W_P	Integral of active power	Wh
W_S	Total power integration	VAh
W_Q	Reactive power integration	varh
q	Current integral	Ah
P_{AVG}	Average power during integration time	W

Table 9-3 Description of the meaning of integral parameters

Calculation formula:

Measured parameter	Calculation formula/ calculation method	Measured parameter	Calculation formula/ calculation method
W_{P+}	$\int_{t1}^{t2} Pdt, (P \geq 0)$	W_S	$\int_{t1}^{t2} Sdt$
W_{P-}	$\int_{t1}^{t2} Pdt, (P < 0)$	W_Q	$\int_{t1}^{t2} Qdt$
W_P	$\int_{t1}^{t2} Pdt$	q	$\int_{t1}^{t2} I_{RMS} dt$
P_{AVG}	$\frac{1}{t2-t1}\int_{t1}^{t2} I_{RMS} dt$	Note: t1 represents the start time of integration, and t2 represents the end time of integration, which is determined by the control of the user's integration function.	

Table 9-4 Calculation formula of integral related parameters

9.1.3.3 ∑ parameter

Parameter symbol	Parameter meaning description	Unit
∑URMS, ∑UAC, ∑UDC	The average value of the corresponding voltage in the wire system combination	V
∑IRMS, ∑IAC, ∑IDC	The average value of the corresponding current in the wire system combination	A
∑P	Active power in wire system combination	W
∑S	Apparent power in wire system combination	VA
∑Q	Reactive power in wire system combination	var
∑PF	Power factor in wire system combination	
η	Energy efficiency within the wire system	
$\sum W_P$	Integral of active power in wire system combination	Wh

Table 9-5 Description of the meaning of ∑ parameter

Calculation formula:

Measured parameter	Calculation formula/ calculation method			
	1P3W	3P3W	3V3A	3P4W
URMS∑, UAC∑, UDC∑	$(U_1+U_2)/2$		$(U_1+U_2+U3)/3$	
IRMS∑, IAC∑, IDC∑	$(I_1+I_2)/2$		$(I_1+I_2+I3)/3$	
P∑	P_1+P_2			$P_1+P_2+P_3$
S∑	S_1+S_2	$\frac{\sqrt{3}}{2}(S_1+S_2)$	$\frac{\sqrt{3}}{3}(S_1+S_2+S3)$	S_1+S_2+S3
Q∑	Q_1+Q_2			Q_1+Q_2+Q3

$\lambda\sum$	$\frac{P\sum}{S\sum}$
η	The calculation formula is programmable by the user, such as $\frac{P\sum}{S\sum}$
$W_P\sum$	$\int_{t1}^{t2} P_{\sum} dt$
Table 9-6 $\sum$ Related parameter calculation formula	

9.1.3.4 Harmonic parameters

The total harmonics of voltage and current are mainly related to the magnitude of each harmonic. The total harmonic is represented by the symbol THD, and the magnitude of each harmonic is represented by a table or bar graph. The symbol is not shown in the instrument, but for the convenience of the description of the following calculation formula, the harmonic related symbols are explained in the following table:

Parameter symbol	Parameter meaning description
THD_u	Voltage total harmonic size (%)
THD_i	Current total harmonic size (%)
U_{h_n}	Each harmonic of voltage, n takes a value of 2~50
I_{h_n}	Each harmonic of current, n takes a value of 2~50
Table 9-7 Harmonic related parameter meaning description	

Harmonic calculations are based on the differences between the International Electrotechnical Commission (IEC standard) and the Canadian Standards Association (CSA standard). Two calculation methods are given (optional on the harmonic setting page). The introduction is as follows:

IEC standard: Calculate the ratio (%) of the root mean square of the effective value of the second to the 50th harmonic component to the effective value of the fundamental wave (ie, the first harmonic). The calculation formula is as follows:

Total harmonic: $THD = \sqrt{\sum_{k=2}^{n} (C_k)^2} \Big/ C_1$

Percentage components of each harmonic: $C_{h\_k} = C_k / C_1 * 100\%$

CSA standard: Calculate the ratio (%) of the root mean square of the effective value of the 2nd to 50th harmonic components to the root mean square of the 1st to 50th effective value, the calculation formula is as follows:

$$THD=\sqrt{\sum_{k=2}^{n}\left(C_k\right)^2}\Big/\sqrt{\sum_{k=1}^{n}\left(C_k\right)^2}$$

Percentage components of each harmonic: $C_{\mathrm{h\_k}}=C_k\Big/\sqrt{\sum_{k=1}^{n}\left(C_k\right)^2}*100\%$

Explanation of the meaning of the characters used in the above formula:

C_1：The effective value of the fundamental wave (ie the first harmonic) of U (voltage) or I (current);

C_k：The effective value of the k-th harmonic of U (voltage) or I (current), calculated by FFT;

$C_{\mathrm{h\_}k}$：The percentage component of the k-th harmonic of voltage or current

k ： Harmonic order index, 2~50

n ：The maximum harmonic coefficient, namely 50.

9.1.3.5 Vector parameters

Parameter symbol	Parameter meaning description
$\mathbf{\Phi}_{\mathrm{U1\text{-}U2}}$	Phase angle of U2 relative to U1
$\mathbf{\Phi}_{\mathrm{U1\text{-}U3}}$	Phase angle of U3 relative to U1
$\mathbf{\Phi}_{\mathrm{U1\text{-}I1}}$	Phase angle of I1 relative to U1
$\mathbf{\Phi}_{\mathrm{U1\text{-}I2}}$	Phase angle of I2 relative to U1
$\mathbf{\Phi}_{\mathrm{U1\text{-}I3}}$	Phase angle of I3 relative to U1
Table 9-8 Description of the meaning of vector related parameters	

9.2 Performance parameters

9.2.1 Overview of overall parameters

Model/Name	Digital Power Meter		
	TH3411	TH3421	TH3422
Basic Features	AC/DC, 3 channels, 600V/20A, harmonic analysis, waveform display, vector analysis, power test	AC/DC, 4 channels, 600V/20A, harmonic analysis, waveform display, vector analysis, power test	AC/DC, 4 channels, 600V/2A (micro current), harmonic analysis, waveform display, vector analysis, power test
Display	7 inch color TFT resistive touch screen monitor		
Measured parameters	Basic data, integral data, waveform graph, histogram, vector diagram		
Basic measurement accuracy	0.15% reading + 0.2% range + 1 digit		
Voltage range	5V~600V, minimum resolution 0.01V		
Current range	0.5mA~20A minimum resolution 10uA		0.05mA~2A minimum resolution 1uA
Power range	5mW-12kW		0.5mW-1.2kW
Frequency range	Fundamental frequency range: DC/45Hz-420Hz, bandwidth: 21kHz, filter 5kHz		
Power factor range	-1.000~1.000		
Electric energy integration range	0~99999kWh		
Lock function	data lock		
Range mode	Auto/Manual		
Test speed	DC 5 times/second, AC 7 times/second (50Hz), harmonic/waveform function on: 4 times/second (50Hz)		
Input impedance	3MΩ		
Comparator output	Over-limit sound and light alarm, relay output		
Communication mode	RS232C/RS485, USB, LAN, setting file storage		
Power supply	AC220V ±10%, 50/60Hz ±5%, soft power switch		
Volume and weight	215mm*132mm*441mm (W*H*D); shelf size		

	236mm*154mm*475.5mm (W*H*D); including the packing size (8.1kg)

9.2.2 Specific input indicators

Item	Voltage	Current			
	All models	TH3411/TH3421		TH3422	
Range	75V/150V/300V/600V	10mA/30mA/100mA/400mA	1.5A/5A/20A	1mA/3mA/10mA/40mA	150mA/500mA/2A
Input impedance	3MΩ	200mΩ	4mΩ	2Ω	200mΩ
1s instantaneous maximum allowable input	1000V	40A		4A	
Continuous maximum allowable input	700V	30A		3A	
| Maximum display |	Range*110%				

9.3 Accuracy index

9.3.1 Voltage test accuracy

Model：TH34XX			
Range	Minimum resolution	Basic accuracy (one year)	
		DC, 45~75Hz	75~420Hz
75V	0.01V	±(0.15% reading + 0.2% range + 1 digit)	±(0.3% reading + 0.2% range + 1 digit)
150V	0.1V		
300V			
600V			

9.3.2 Current test accuracy

Model: TH3422 (micro current type 2A)			
Range	Minimum resolution	Basic accuracy (one year)	
		DC, 45~75Hz	75~420Hz
1mA/3mA/ 10mA/40mA	0.001mA	±(0.15% reading + 0.2% range + 1 digit)	±(0.3% reading + 0.2% range + 1 digit)
150mA	0.01mA		
500mA/2A	0.1mA		

Model：TH3411/TH3421(Conventional type 20A)					
Range	Resolution	Basic accuracy (one year)			
		DC, 45~75Hz		75~420Hz	
10mA/30mA 100mA	0.01mA	±(0.15% reading +0.2% range +30 digits)		±(0.3% reading +0.2% range +30 digits)	
400mA	0.1mA	±(0.15% reading +0.2% range +10 digits)		±(0.3% reading +0.2% range +10 digits)	
1.5A		<1A	±(0.15% reading +0.2% range +10 digits)	<1A	±(0.3% reading +0.2% range +10 digits)
		>=1A	±(0.15% reading +0.2% range +1digit)	>=1A	±(0.3% reading +0.2% range +1digit)
5A/20A		±(0.15% reading +0.2% range+1digit)		±(0.3% reading +0.2% range +1digit)	

9.3.3 Test accuracy of other parameters

Model：TH34XX				
Parameter	Test range	Minimum resolution	Basic accuracy (one year)	
			DC, 45~75Hz	75~420Hz
Active power	U*I*PF	0.01mW	±(0.2% reading + 0.3% range)	
Power factor	0.1~1.000	0.001	±0.01	
Frequency	45~420	0.01	0.1% reading +1digit	0.1% reading +1digit
Energy accumulation	0~99999kWh	0.001Wh	±(0.2% reading +0.3% range)	
Electric energy timing	0~9999:59:59	1 second	±0.05%	
Harmonic test	2~50 times		±(5% reading +0.3% range)	No

Remarks: Voltage and current overload limit is 1.1 times full scale; power factor measurement accuracy requires voltage amplitude to be higher than 10% of range and current amplitude to be higher than 1% of range; frequency test requires voltage amplitude to be higher than 10% of range or current amplitude higher than 1% of range.

Chapter 10 Remote Control

10.1 RS232C interface description

RS-232 standard, also called as asynchronous serial communication standard, has already been widely used for data communication between computers, computer and external equipment. RS is the English abbreviation of Recommended Standard; 232, the standard number. This standard is issued by EIA in 1969, which rules to send one bit in a data line every time.

As most serial interfaces, the serial interface of TH33XX is also not strictly based on RS-232 standard but only uses the smallest subset of this standard. The signals are listed in the following table.

Signal	Code	Connector Pin Number
Transmitted Data	TXD	2
Received Data	RXD	3
Signal Ground Common	GND	5

Table 10-1 RS-232 Signal and Pin Connector

The reason is that the use of three lines is much more inexpensive and much simpler than that of five lines or six lines, which is the biggest advantage of using serial interface for communication.

The connection of the instrument with PC is shown in figure 10-2.

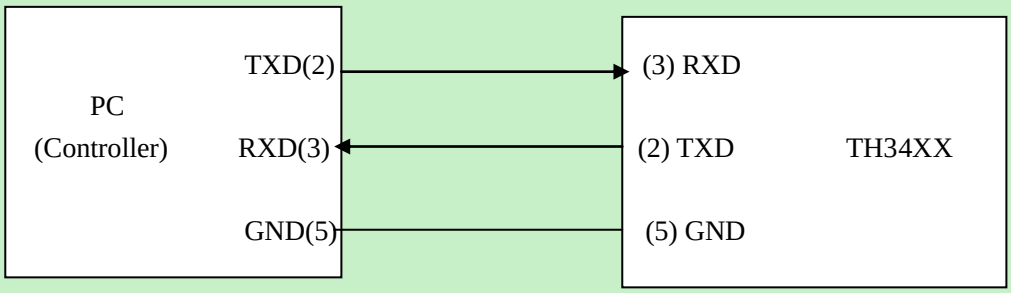


Figure 10-2 Connection of the instrument with PC

Figure 8-1 shows that the serial interface pin definition of this instrument is different from that of 9 pin connector used in the computer. User can purchase the serial interface cable from our company.

RS232 interface characterizes with a baud rate ranging from 9600 to 115200, no parity, 8-bit data bit, 1-bit stop bit.

The instrument command conforms to the SCPI standard. When the command string is sent to the instrument, it needs to send LF (hexadecimal: 0x0A, escape character'\n') as the end character. The maximum number of SPCI command string bytes that the instrument can receive at one time is

128 Bytes.
For result data formats transmitted to a PC from the instrument, see Commands Reference.

10.1.1SCPI (Standard Commands for Programmable Instruments)

SCPI is a new general command based on the IEEE488.2-1987 standard. (SCPI is the same as TMSL, a system language for measurement testers adopted by HP.)

10.2 RS485 Interface Description

RS485 interface adopts a combination of balanced driver and differential receiver, which has enhanced anti-common-mode interference capability, that is, good anti-noise interference. In addition, RS485 signal transmission distance (about 1219m) is farther than RS232, and a bus generally supports up to 32 nodes. If a special 485 chip is used, the number of mountable nodes will increase.
The interface comparison is shown in Table 10-2.

Signal	abbreviation	Connector pin number
Data+	485+	1
Data-	485-	4

Table 10-2 Instrument RS485 signal and pin comparison

RS485 uses two-wire connection method and shares an external interface with RS232, which is easy to use and does not interfere with each other.
TH34XX series instrument has a hardware decoder which can transfer 485 to 232. If the user customizes the instrument with 485 communication protocol, the baud rate, parity bit, data bit, stop bit and other related configurations required for communication should be configured before the specific communication.

10.3 USBTMC Remote Control System

USB (Universal Serial Bus) remote control system controls the instrument through the USB interface. This connection conforms to USBTMC-USB488 and USB2.0 protocols.

10.3.1 System Configuration

Connect the USB interface on the rear panel of the TH34XX series instrument to the USB interface on PC via a USB cable.

10.3.2 Install the Driver

When TH34XX is first connected to a PC through a USB cable, the prompt information –Found New Hardware will show on the right bottom of the computer desktop, as is shown below:

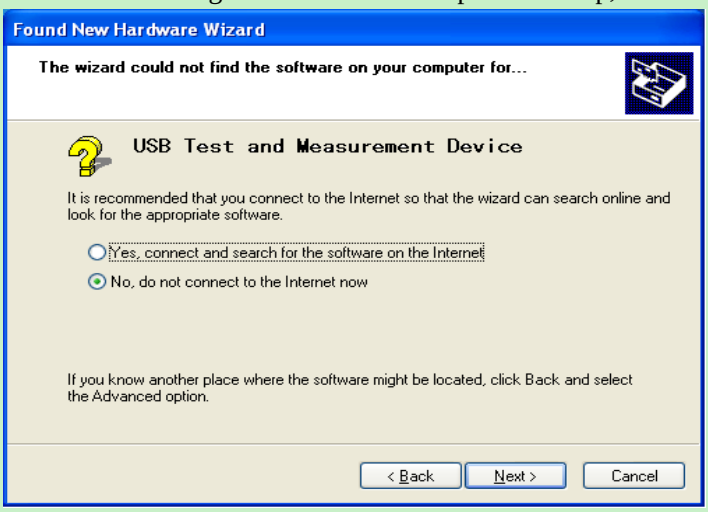


Figure 10-3 Procedure 1 of Installing USB Driver

Click “NEXT”, dialogue 10-4 will pop up. Choose “Install the software automatically (recommended)”.

Figure 8-3 Procedure 2 of Installing USB Driver

Figure 10-4 Step 2 of installing the USB driver

When the installation of driver is finished, user can see “USB test and measurement device” in the device manager of PC, as is shown in the following figure.

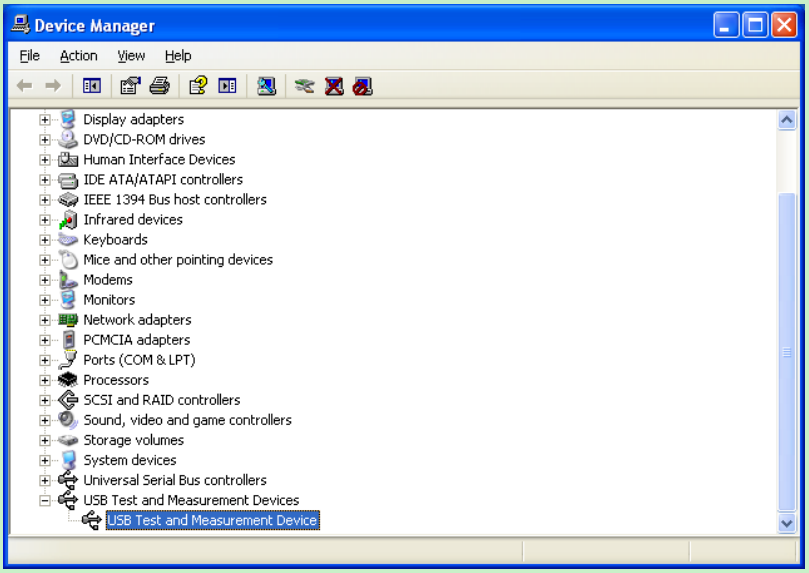


Figure 10-5 USBTMC Display of PC Device Manager

When user is using USBTMC interface, labview software can be used to access the instrument.

Chapter 11 SCIP Command Reference

The communication commands of TH34XX series of instruments have SCPI command standards and ModBus command standards to choose from. The ModBus command protocol is only applicable to RS232C/RS485 communication interfaces, and other communication interfaces only parse standard SCPI commands.

11.1 SCPI Command

You can log in to the company website www.tonghui.com.cn for reference.
SCPI (Standard Command for Programmable Instruments) is an ASCII-based instrument command language used in test and measurement instruments. SCPI commands are based on a hierarchical structure (also known as a tree system). In this system, related commands are grouped under a common node or root, thus forming a subsystem.
According to the command syntax, most commands (and some parameters) are represented by a mixture of uppercase and lowercase letters. Uppercase letters indicate the abbreviation of the command. For shorter program lines, you can send commands in abbreviated format. If you want better program readability, you can send long format commands.
Note: In order to avoid misunderstanding of instruction abbreviations, the TH34XX series try to avoid too many abbreviations in instruction descriptions. Most of the instruction descriptions will be described directly in abbreviations.
Grammatical conventions:
[SOURce[1|2]:]VOLTage:UNIT {VPP|VRMS|DBM}

[SOURce[1|2]:]FREQuency:CENTer {<frequency>|MINimum|MAXimum|DEFault}
Note: Command syntax conventions:

- The braces ({ }) contain the parameter options for the given command string. Braces are not sent with the command string.
- A vertical bar (|) separates multiple parameter selections for a given command string. For example, in the above command, {VPP|VRMS|DBM} means you can specify "VPP", "VRMS" or "DBM". The bars are not sent with the command string.
- The angle brackets (< >) in the second example indicate that you must specify a value for the parameter inside the parentheses. For example, in the above syntax statement, the parameter in angle brackets is <frequency>. Angle brackets are not sent with the command string. You must specify a value for the parameter (for example "FREQ: CENT 1000") unless you choose another option (such as "FREQ: CENT MIN") that appears in the syntax.
- Some syntax elements (such as nodes and parameters) are enclosed in square brackets ([ ]). This means that the element is optional and can be omitted. Angle brackets are not sent with the command string. If no value is specified for the optional parameter, the instrument will choose the default value. In the above example, "SOURce[1|2]" means that you can refer to source channel 1 by "SOURce" or "SOURce1", or "SOUR1" or "SOUR". Also, since the entire SOURce node is optional (in square brackets), you can also refer to channel 1 by

completely omitting the SOURce node. This is because channel 1 is the default channel for the SOURce language node. On the other hand, to refer to channel 2, you must use "SOURce2" or "SOUR2" in the program line.

- ^END: The EOI (end) signal of the IEEE-488 bus.

11.1.1 IEEE488.2 Common Command

Standard SCPI command:

●*IDN ●*TRG ●*RST

Note: This machine mainly uses three commonly used instructions.

***IDN?**

Description: Read product information.

Syntax: *IDN?

The query returns: {string 1}, {string 2}, {string 3} <^END>

Read the data information as follows: "Product Model", "Product Serial Number", "Software Version Number"

{string 1} Model number (TH3411/TH3421/3422).

{string 3} Software version number. (Ver 1.0.0)

{string 2} Product serial number, which is the SN number.

Example:

*IDN?

Return data: such as TH3421, Ver 1.0.0, 1234567890

***TRG**

Description: When the instrument's trigger mode is set to bus (BUS) mode trigger, this command triggers the instrument to perform a measurement and the instrument actively returns the measurement data after performing this measurement..

Syntax:

*TRG

Return data: For the format, refer to the ":FETCh?" command, which returns the test results of the voltage and current RMS values of all channels.

***RST**

Description: Reset the machine to the factory default state, including the value set by the parameter. Automatically restart after reset is complete.

Syntax:*RST

Example:

*RST

11.1.2 DISPlay Subsystem Commands

It mainly involves switching instructions for each display page.

11.1.2.1 Page switch

● Description: Control page switching

Syntax:

:DISPlay:page?

:DISP:PAGE <PageName>

Parameters: The meaning of the value of PageName is shown in the following table 10-1:

PageName value	Meaning
MEAS	Measurement page
COMP	Compare page
HARM	Harmonic wave page
WAVE	Waveform page
VECTOR	Vector diagram page
MEASSET	Measurement setup page
COMPSET	Compare setup page
SYSTEM	System setup page
FILE	File management page
Table 10-1 Meaning of PageName	

Example:

:DISP:PAGE MEAS ---- Enter the measurement page;

:DISP:PAGE MEASSET ---- Enter the measurement setup page;

:DISP:PAGE? ----Return to the currently displayed page.

Refer to the value of PageName;

11.1.2.2 Main display channel switch

● Description: main display channel switch of the control measurement page

Syntax:

:DISP:PAGE:MEAS?

:DISP:PAGE:MEAS <CH1|CH2|CH3|CH4|CHS>

Parameters: the meaning of the value is shown in the following table 10-2:

CH1	Enlarge or reduce display channel 1
CH2	Enlarge or reduce display channel 2
CH3	Enlarge or reduce display channel 3
CH4	Enlarge or reduce display channel 4, some models do not have CH4
CHS	Enlarge or reduce display channel∑
Table 10-2 Meaning of channel	

Example:
:DISP:PAGE:MEAS? ----Return to the main display channel information of the test page;
:DISP:PAGE:MEAS CH1 ----Enlarge or reduce display channel 1
:DISP:PAGE:MEAS CH2 ----Enlarge or reduce display channel 2
:DISP:PAGE:MEAS CH3 ----Enlarge or reduce display channel 3
:DISP:PAGE:MEAS CH4 ----Enlarge or reduce display channel 4
:DISP:PAGE:MEAS CHS ----Enlarge or reduce the display channel∑

11.1.2.3 Data update display function switch

● Description: Test data update display function switch
Syntax:
:DISP:SWIT?
:DISP:SWIT <ON | OFF>
Parameters:
ON ----that is, the measurement results will be updated and displayed synchronously
OFF----that is, the measurement result will not be refreshed after the test is over, which is equivalent to the 【Hold】key on the panel
Examples:
:DISP:SWIT? ----Return to measurement data display function status;
:DISP:SWIT ON ----Turn on the measurement data display function;
:DISP:SWIT OFF ----Turn off the measurement data display function;

11.1.3 FUNCtion Subsystem Commands

It mainly involves querying and setting the relevant parameters in the measurement display page and measurement setting page.

11.1.3.1 Wire system combination status

● Description: query and setup of the wire system combination status
Syntax:
:FUNC:WIRING?
:FUNC:WIRING <para_list>
Parameter: The value and meaning of para_list are shown in the following table 10-3:

para_list value	Meaning
1P2W	Set all channels to be used as independent 1P2W
1P3W	Set the combination of the first 2 channels as wire system 1P3W
3P3W	Set the combination of the first 2 channels as wire system 3P3W
3P4W	Set the combination of the first 3 channels as wire system 3P4W
3V3A	Set the combination of the first 3 channels as the wire system 3V3A
The following parameter items are only for 4-channel instruments	
1P3W_1P3W	Set the combination of the first 2 channels as the wire system 1P3W

	Set the combination of the last 2 channels as the wire system 1P3W
1P3W_3P3W	Set the combination of the first 2 channels as the wire system 1P3W Set the combination of the last 2 channels as the wire system 3P3W
3P3W_3P3W	Set the combination of the first 2 channels as the wire system 3P3W Set the combination of the last 2 channels as the wire system 3P3W
Table 10-3 Description of the meaning of wire system parameters	

Example:
:FUNC:WIRING? ----Return to the current wire system combination status;
:FUNC:WIRING 3P3W ----Set the current 3P3W system;
:FUNC:WIRING 1P3W_3P3W ----Set the current 1P3W_3P3W system;

- Description: query and setup of the efficiency calculation formula in the wire system combination

Syntax:
:FUNC:WIRING:EFFI?
:FUNC:WIRING:EFFI {<group_num>,<up_para>,<down_para>}
Parameter:
group_num: the value is 1|2, which means that the efficiency formula under the first line system combination is being set, the 3-channel instrument has only one line system combination state, so the value can only be 1; the 4-channel instrument may have two wire system states, so the value is 1 or 2;
up_para represents the molecular part,
down_para represents the denominator part;
The values and meanings of up_para and down_para are shown in the following table 10-4:

up_para and down_para value	Meaning
P1, P2, P3, P4	Active power of channel 1/2/3/4
PS	Active power of combination 1
PS1	
PS2	Active power of combination 2
Note: P4 and PS2 are optional parameters for 4-channel instruments, and are not applicable for 3-channel instruments; PS and PS1 have the same meaning, and both represent the active power under the first wire system combination;	
Table 10-4 Description of the efficiency formula under the wire system combination	

Examples:
:FUNC:WIRING:EFFI? ----Returns the efficiency formula under all wire systems;
:FUNC:WIRING:EFFI 1,P1,PS ----Set η1= P_1/P_∑ *100%;
:FUNC:WIRING:EFFI 2,P1,PS2 ----Set η2 = P_1/P_(∑2) *100%;

11.1.3.2 Line filter function switch

● Description: query and setup of the test line 5kHz filter function
Syntax:
:FUNCtion:linefilt?
:FUNCtion:linefilt {?|ON|OFF}
Parameters: ON/OFF ---- respectively represent the "ON/OFF" status of the test filtering function
Example:
:FUNC:linefilt? ----Return to the current 5kHz filtering state (ON or OFF)
:FUNC:linefilt ON ----Turn on the 5kHz filtering function of the test
:FUNC:linefilt OFF ----Turn off the 5kHz filtering function of the test

11.1.3.3 Average time

● Description: setup and query of the average number of measurements
Syntax:
:FUNC:AVG?
:FUNC:AVG {NUM}
Parameters: NUM takes values from 1 to 32
Example:
:FUNC:AVG? ----Return to the current average number of measurements (1~32)
:FUNC:AVG 1 ----Set the average number of measurements to 1;
:FUNC:AVG 8 ----Set the average number of measurements to 8;

11.1.3.4 Synchronization

● Description: Synchronization source setting and query of channel test
Syntax: :FUNC:SYNC?
:FUNC:SYNC:CH1?
:FUNC:SYNC:CH2?
:FUNC:SYNC:CH3?
:FUNC:SYNC:CH4?
:FUNC:SYNC:CH1 {U1|I1|U2|I2|U3|I3|U4|I4|LINE}
:FUNC:SYNC:CH2 {U1|I1|U2|I2|U3|I3|U4|I4|LINE}
:FUNC:SYNC:CH3 {U1|I1|U2|I2|U3|I3|U4|I4|LINE}
:FUNC:SYNC:CH4 {U1|I1|U2|I2|U3|I3|U4|I4|LINE}
Parameters: CH1, CH2, CH3, CH4 indicate the channel mark to be set;
The meanings of U1, I1, U2, I2, U3, I3, U4, I4, and LINE are as follows:

U1, I1	Voltage and current signal of channel 1
U2, I2	Voltage and current signal of channel 2
U3, I3	Voltage and current signal of channel 3
U4, I4	Voltage and current signals of channel 4, some models do not have CH4
LINE	Line power signal (power frequency 50Hz/60Hz)
Table 10-5 Channel meaning description	

Examples:
:FUNC:SYNC? ----Return to the synchronization status of all channels;
:FUNC:SYNC:CH1? ----Return to the synchronization status of channel 1;
:FUNC:SYNC:CH1 U1 ----Set the synchronization of channel 1 to the U1 signal;
:FUNC:SYNC:CH1 I2 ----Set the synchronization of channel 1 to the I2 signal;
:FUNC:SYNC:CH1 LINE ----Set the synchronization of channel 1 to the LINE signal;
Other parameters of other channels can be deduced by analogy;
Note: Since this setting is related to the current wire system combination status, some settings may not take effect, which means that this setting is restricted by the current wire system situation, that is, the setting conflicts.

11.1.3.5 Energy integral control

● Description: Set the energy integral control method
Syntax:
:FUNC:ECMODE?
:FUNC:ECMODE {MAN|CONT}
Parameters: MAN | CONT respectively stands for "Manual / Continue" control
Example:
:FUNC:ECMODE? ----Return to energy integral control mode;
:FUNC:ECMODE MAN ----Set the energy integral control mode to manual control;
:FUNC:ECMODE CONT ----Set the energy integral control mode to continue control;

● Description: Set the energy integral time
Syntax:
:FUNC:ETIME?
:FUNC:ETIME {<ehour,emin,esec>}
Parameters: ehour, emin, esec represent "hour, minute, second" control
ehour value range: 0~9999
emin, esec value range: 0~59
Example:
:FUNCtion: ETIME? ----Query and return the current energy integration limit time
:FUNCtion: ETIME 1,22,33 ----Set the energy integration limit time to 1 hour 22 minutes 33 seconds

● Description: Control energy integration running status

Syntax:

:FUNCtion:ENERGY?

:FUNC:ENERGY {RUN | STOP | RESET}

Parameters:

RUN ---- start running

STOP ---- stop running

RESET ---- cumulative result and cumulative time reset

Example:

:FUNCtion: ENERgy ? ----Query and return the current energy integration running status

:FUNCtion: ENERgy run ----Start running energy score

:FUNCtion: ENERgy stop----Stop running energy score

:FUNCtion: ENERgy reset----Reset energy integration result and timing status

11.1.3.6 Voltage range

● Description: Query and control the voltage ranges of all channels at the same time

Syntax:

:FUNC:VOLT:RANG? ----Return to the voltage range of all channels;

:FUNC:VOLT:RANG {0|1|2|3} ----Control the voltage range of all channels;

Parameter:

{0|1|2|3} corresponds to the voltage range of the instrument, and the meaning is explained in the following table 10-6:

Range number	Meaning
0	75V
1	150V
2	300V
3	600V

Table 10-6 Description of the meaning of voltage range numbers

Examples:

:FUNC:VOLT:RANG? ----Returns the voltage range of all channels;

:FUNC:VOLT:RANG 0 ----Set the voltage range of all channels to No.0;

:FUNC:VOLT:RANG 1 ----Set the voltage range of all channels to No.1;

:FUNC:VOLT:RANG 2 ----Set the voltage range of all channels to No.2;

:FUNC:VOLT:RANG 3 ----Set the voltage range of all channels to No.3;

● Description: The voltage range setting and query of the specified channel

Syntax:

:FUNC:VOLT:RANG:CH<1|2|3|4>? ---Return to the voltage range of the specified channel;

:FUNC:VOLT:RANG:CH<1|2|3|4> {0|1|2|3} ----Set the voltage range of the specified channel;

Parameters:

CH<1|2|3|4> indicates the number of channels of the instrument

{0|1|2|3} corresponds to the voltage range of the instrument, the meaning is shown in Table 10-6:
Examples:
:FUNC:VOLT:RANG:CH1? ----Return to the current voltage range of channel 1;
:FUNC:VOLT:RANG:CH2? ----Return to the current voltage range of channel 2;
:FUNC:VOLT:RANG:CH3? ----Return to the current voltage range of channel 3;
:FUNC:VOLT:RANG:CH4? ----Return to the current voltage range of channel 4;
:FUNC:VOLT:RANG:CH1 0 ----Set the voltage range of channel 1 to switch to No.0;
:FUNC:VOLT:RANG:CH1 1 ----Set the voltage range of channel 1 to switch to No.1;
:FUNC:VOLT:RANG:CH1 2 ----Set the voltage range of channel 1 to switch to No.2;
:FUNC:VOLT:RANG:CH1 3 ----Set the voltage range of channel 1 to switch to No.3;
Note: The settings of other channels can be deduced by analogy;

● Description: Automatic voltage range setting and query of all channels
Syntax:
:FUNC:VOLT:RANG:AUTO? ---Return to the automatic state of the voltage range of all channels;
:FUNC:VOLT:RANG:AUTO {ON|OFF} ----Set the automatic state of the voltage range of all channels;
Parameters: {ON|OFF} the switch corresponding to the automatic range;
Examples:
:FUNC:VOLT:RANG:AUTO? ----Return to the automatic state of the voltage range of all channels;
:FUNC:VOLT:RANG:AUTO ON ----Set the voltage range of all channels to be automatic;
:FUNC:VOLT:RANG:AUTO OFF---Set the voltage range of all channels is not automatic;

● Description: The voltage automatic range setting and query of the specified channel
Syntax:
:FUNC:VOLT:RANG:CH<1|2|3|4>:AUTO? ---Return to the automatic state of the voltage range of the specified channel;
:FUNC:VOLT:RANG:CH<1|2|3|4>:AUTO {ON|OFF} ----Set the automatic state of the voltage range of the specified channel;
Parameters:
CH<1|2|3|4> indicates the number of channels of the instrument
{ON|OFF} corresponds to the ON/OFF state of the automatic range;
Examples:
:FUNC:VOLT:RANG:CH1:AUTO? ----Return to the voltage range automatic stateof channel 1;
:FUNC:VOLT:RANG:CH2:AUTO? ----Return to the voltage range automatic stateof channel 2;
:FUNC:VOLT:RANG:CH3:AUTO? ----Return to the voltage range automatic stateof channel 3;
:FUNC:VOLT:RANG:CH4:AUTO? ----Return to the voltage range automatic stateof channel 4;
:FUNC:VOLT:RANG:CH1:AUTO ON ----Set the voltage range of channel 1 to be automatic;
:FUNC:VOLT:RANG:CH1:AUTO OFF---Setting the voltage range of channel 1 is not automatic;
Note: The settings of other channels can be deduced by analogy;

11.1.3.7 Current range

● Description: Query and control the current ranges of all channels at the same time

Syntax:

:FUNC:CURR:RANG? ----Return to the current range of all channels;

:FUNC:CURR:RANG {0|1|2|3|4|5|6} ----Control the current range of all channels;

Parameter: {0|1|2|3|4|5|6} corresponds to the current range of the instrument, and the meaning is described in the following table 10-7:

Range number	Meaning	
	2A	20A
0	Current range1mA	Current range 10mA
1	Current range 3mA	Current range 30mA
2	Current range 10mA	Current range 100mA
3	Current range 40mA	Current range 400mA
4	Current range 150mA	Current range 1.5A
5	Current range 500mA	Current range 5A
6	Current range 2A	Current range 20A

Table 10-7 Description of the meaning of current range numbers

Examples:

:FUNC:CURR:RANG? ----Return to the current range of all channels;

:FUNC:CURR:RANG 0 ----Set the current range of all channels to No. 0;

:FUNC:CURR:RANG 1 ----Set the current range of all channels to No. 1;

:FUNC:CURR:RANG 2 ----Set the current range of all channels to No. 2;

:FUNC:CURR:RANG 3 ----Set the current range of all channels to No. 3;

:FUNC:CURR:RANG 4 ----Set the current range of all channels to No. 4;

:FUNC:CURR:RANG 5 ----Set the current range of all channels to No. 5;

:FUNC:CURR:RANG 6 ----Set the current range of all channels to No. 6;

● Description: The current range setting and query of the specified channel

Syntax:

:FUNC:CURR:RANG:CH<1|2|3|4>? ---Return to the current range of the specified channel;

:FUNC:CURR:RANG:CH<1|2|3|4> {0|1|2|3} ----Set the current range of the specified channel;

Parameters:

CH<1|2|3|4> indicates the number of channels of the instrument

{0|1|2|3} corresponds to the current range of the instrument, the meaning is shown in Table 10-7:

Examples:

:FUNC:CURR:RANG:CH1? ----Return to the current current range of channel 1 ;

:FUNC:CURR:RANG:CH2? ----Return to the current current range of channel 2;

:FUNC:CURR:RANG:CH3? ----Return to the current current range of channel 3;

:FUNC:CURR:RANG:CH4? ----Return to the current current range of channel 4;
:FUNC:CURR:RANG:CH1 0 ----Set the current range of channel 1 to switch to No.0;
:FUNC:CURR:RANG:CH1 1 ----Set the current range of channel 1 to switch to No.1;
:FUNC:CURR:RANG:CH1 2 ----Set the current range of channel 1 to switch to No.2;
:FUNC:CURR:RANG:CH1 6 ----Set the current range of channel 1 to switch to No.6;
Note: The settings of other channels can be deduced by analogy;

● Description: Automatic current range setting and query of all channels
Syntax:
:FUNC:CURR:RANG:AUTO? ---Return to the automatic state of the current range of all channels;
:FUNC:CURR:RANG:AUTO {ON|OFF} ----Set the automatic state of the current range of all channels;
Parameters: {ON|OFF} corresponds to the ON/OFF state of the automatic range;
Examples:
:FUNC:CURR:RANG:AUTO? ----Return to the automatic state of the current range of all channels;
:FUNC:CURR:RANG:AUTO ON ----Set the current range of all channels to be automatic;
:FUNC:CURR:RANG:AUTO OFF---Set the current range of all channels is not automatic;

● Description: The current automatic range setting and query of the specified channel
Syntax:
:FUNC:CURR:RANG:CH<1|2|3|4>:AUTO? ---Return to the automatic state of the current range of the specified channel;
:FUNC:CURR:RANG:CH<1|2|3|4>:AUTO {ON|OFF} ----Set the automatic state of the current range of the specified channel;
Parameters:
CH<1|2|3|4> indicates the number of channels of the instrument
{ON|OFF} corresponds to the ON/OFF state of automatic range;
Examples:
:FUNC:CURR:RANG:CH1:AUTO? ----Return to the current range automatic state of channel 1;
:FUNC:CURR:RANG:CH2:AUTO? ----Return to the current range automatic state of channel 2;
:FUNC:CURR:RANG:CH3:AUTO? ----Return to the current range automatic state of channel 3;
:FUNC:CURR:RANG:CH4:AUTO? ----Return to the current range automatic state of channel 4;
:FUNC:CURR:RANG:CH1:AUTO ON ----Set the current range of channel 1 to be automatic;
:FUNC:CURR:RANG:CH1:AUTO OFF---Setting the current range of channel 1 is not automatic;
Note: The settings of other channels can be deduced by analogy;

11.1.3.8 Basic measurement parameters (4)

● Description: Basic measurement page settings and query 4 measurement parameters of each channel
Syntax:
:FUNC:PARA:CH<1|2|3|4>?
:FUNC:PARA:CH<1|2|3|4> {<S1>,<S2>,<S3>,<S4>}

Parameters:

CH<1|2|3|4> means the specified channel number

S1~S4 represents the names corresponding to the 4 parameters in the channel, and the values are shown in the following table 10-8:

For the meaning description, please refer to the parameter description chapter.

Value of S1~S4	
URMS、UAC、UDC、UPK+、UPK-、UPP、UCF、 IRMS、 IAC、 IDC、 IPK+、 IPK-、 IPP、 ICF、 P、S-VA、Q-VAR、PF、PHASE、FREQ、WP+、WP-、WP、WS、WQ、q、PAVG	
Table 10-8 Optional names of basic parameters	

Examples:

:FUNC:PARA:CH1? ----Returns the 4 basic parameter names corresponding to channel 1;

:FUNC:PARA:CH2? ----Returns the 4 basic parameter names corresponding to channel 2;

:FUNC:PARA:CH3? ----Returns the 4 basic parameter names corresponding to channel 3;

:FUNC:PARA:CH4? ----Returns the 4 basic parameter names corresponding to channel 4;

:FUNC:PARA:CH1 URMS, IRMS, P, PF ----Set the 4 basic parameters of channel 1;

:FUNC:PARA:CH2 URMS, IRMS, P, PF ----Set the 4 basic parameters of channel 2;

Note: The settings of other channels can be deduced by analogy;

11.1.4 COMPare Subsystem Commands

It mainly involves the query and modification of related parameters in the comparison function.

11.1.4.1 Compare parameters

● Description: Set query comparison parameters

Syntax::COMP:COMP<1|2|3|4|5|6|7|8>:PARA?

:COMP:COMP<1|2|3|4|5|6|7|8>:PARA {CH<1,2,3,4>,STR}

:COMP:COMP<1|2|3|4|5|6|7|8>:PARA {CHS<1,2>,STR2}

Parameters:

COMP<1|2|3|4|5|6|7|8> corresponds to 8 comparison items in turn;

CH<1,2,3,4> means 4 optional channels

CHS<1,2> means optional 2 wire system combination grouping

STR is the parameter name corresponding to each channel, and the values are shown in the following table 10-9:

STR2 is the parameter name in the wire system group, and the values are shown in the following table 10-9:

STR value	URMS、UAC、UDC、UPK+、UPK-、UPP、UCF、IRMS、IAC、 IDC、 IPK+、 IPK-、 IPP、 ICF、P、S-VA、 Q-VAR、PF、PHASE、FREQ、WP+、WP-、WP、WS、 WQ、q、PAVG
STR2 value	URMS、UAC、UDC、IRMS、IAC、IDC、P、S-VA、 Q-VAR、PF、WP、EFFiciency
	Table 10-9 Optional names of basic parameters

Example:
:COMP:COMP1:PARA? ----Returns the parameter set by comparison 1;
:COMP:COMP1:PARA CH1,URMS ----Set the parameter of comparison 1 to the URMS of channel 1;
:COMP:COMP1:PARA CHS,URMS ----Set the parameter of comparison 1 to the URMS of wire system combination 1;
:COMP:COMP1:PARA CHS1,URMS ----The meaning is the same as above;
:COMP:COMP1:PARA CHS2,URMS ----Set the parameter of comparison 1 to the URMS of wire system combination 2;
Note: The settings of other items can be deduced by analogy;

11.1.4.2 Comparison lower limit

● Description: Set to query the lower limit of the current parameter of the comparison channel
Syntax::COMP:COMP<1|2|3|4|5|6|7|8>:LOW?
:COMP:COMP<1|2|3|4|5|6|7|8>:LOW {float}
Parameters:
COMP<1|2|3|4|5|6|7|8> corresponds to 8 comparison items in turn;
float represents the size of floating-point data
Example:
:COMP:COMP1:LOW? ----returns the lower limit of comparison 1;
:COMP:COMP1:LOW 200.2 ----Set the lower limit of comparison 1 to 200.2;
Note: The settings of other items can be deduced by analogy;

11.1.4.3 Comparison upper limit

● Description: Set to query the upper limit of the current parameter of the comparison channel
Syntax::COMP:COMP<1|2|3|4|5|6|7|8>:HIGH?
:COMP:COMP<1|2|3|4|5|6|7|8>:HIGH {float}
Parameters:
COMP<1|2|3|4|5|6|7|8> corresponds to 8 comparison items in turn;
float represents the size of floating-point data
Example:
:COMP:COMP1:HIGH? ----returns the upper limit of comparison 1;
:COMP:COMP1:HIGH 200.2 ----Set the upper limit of comparison 1 to 200.2;
Note: The settings of other items can be deduced by analogy;

11.1.4.4 Compare function status

● Description: Set to query the function status of the current parameter of the comparison channel

Syntax:

:COMP:COMP<1|2|3|4|5|6|7|8>:FUNC?

:COMP:COMP<1|2|3|4|5|6|7|8>:FUNC {STR}

Parameters:

COMP<1|2|3|4|5|6|7|8> corresponds to 8 comparison items in turn;

STR is the parameter name corresponding to each channel, and the values are shown in the following table 10-10:

STR value	Meaning
OFF	Turn off the comparison function of the corresponding comparison channel
FAILCOUNT	Unqualified conduction output
PASSCOUNT	Qualified conduction output
FAILPULSE	Unqualified pulse output
PASSPULSE	Qualified pulse output

Table 10-10 Description of the meaning of the comparison function

Example:

:COMP:COMP1:FUNC? ----Return to the function status of comparison 1;

:COMP:COMP1:FUNC failcont ----Set comparison 1 unqualified conduction output;

:COMP:COMP1:FUNC passcont ----Set compare 1 qualified conduction output;

:COMP:COMP1:FUNC failpulse ----Set comparison 1 unqualified pulse output;

:COMP:COMP1:FUNC passpulse ----Set compare 1 qualified pulse output;

Note: The settings of other items can be deduced by analogy;

11.1.5 HARMonic Subsystem Commands

11.1.5.1 Calculation standard

● Description: Set the calculation standard of harmonic analysis data

Syntax:

:HARM:calstd?

:HARM:calstd {IEC | CSA}

Parameters:

IEC|CSA means "International Electrotechnical Commission/Canadian Standards Association" two calculation standards respectively

Examples:

:HARM:calstd? ----Returns the calculation standard of harmonic analysis data

:HARM:calstd IEC ----Set the calculation standard of harmonic analysis to IEC standard

:HARM:calstd CSA ----Set the calculation standard of harmonic analysis to CSA standard

11.1.5.2 Display form

● Description: Set the display form of harmonic analysis results

Syntax:

:HARM:form?

:HARM:form {LIST | BAR}

Parameters:

LIST | BAR stand for "list/histogram" respectively

Examples:

:HARM:form? ----Returns the display form of the current harmonic analysis result

:HARM:form LIST ----Set the display of harmonic analysis results as list form

:HARM:form BAR ----Set the display of harmonic analysis results as a bar graph form

11.1.5.3 Data Mode

● Description: Set the data mode corresponding to the harmonic analysis data

Syntax:

:HARM:DATAmode?

:HARM:DATAmode {ABS | PER}

Description: Set the data mode corresponding to the harmonic analysis data

Parameters: ABS | PER respectively represent " absolute value mode/percentage mode"

Examples:

:HARM:DATAmode? ----Return to the data mode of harmonic analysis

:HARM:DATAmode PER ----Set the harmonic data mode to percentage

:HARM:DATAmode ABS ----Set the harmonic data mode to absolute value mode

11.1.5.4 Analysis parameter items

● Description: Set to query the status of the harmonic analysis parameter items of all channels

Syntax:

:HARM:ITEM?

:HARM:ITEM {ON | OFF}

Parameters: {ON | OFF} indicates the state of the switch;

Examples:

:HARM:item? ----returns the parameter enumeration of the on-off state of the harmonic analysis;

:HARM:item ON ----Set the harmonic calculation of all channels to ON;

:HARM:item OFF ----Set the harmonic calculation of all channels to OFF;

Note: If all the parameters are turned on, the result of the query should be "U1,I1,U2,I2,U3,I3" or "U1,I1,U2,I2,U3,I3,U4,I4";

if part is opened, part enumeration will be returned, all closed, no return or return "null";

● Description: Set to query the status of harmonic analysis parameter items

Syntax:

:HARM:ITEM:<STR>?

:HARM:ITEM:<STR> {ON | OFF}

Parameter:

<STR> represents the name corresponding to the analyzable item, the value is shown in the

following table 10-11:
{ON | OFF} indicates the state of the switch;

STR value	Meaning
U1, I1	Voltage and current corresponding to channel 1
U2, I2	Voltage and current corresponding to channel 2
U3, I3	Voltage and current corresponding to channel 3
U4, I4	Voltage and current corresponding to channel 4
Table 10-11 Explanation of the meaning of harmonic analysis parameters	

Examples:
:HARM:item:U1? ----Return to the on-off state of harmonic analysis of U1;
:HARM:item:I1? ----Return to the on-off state of harmonic analysis of I1;
:HARM:item:U1 ON ----Set the harmonic calculation of U1 to ON;
:HARM:item:U1 OFF ----Set the harmonic calculation of U1 to OFF;
Note: The settings of other items can be deduced by analogy;

11.1.6 WAVE Subsystem Commands

● Description: Set to query the waveform type
Syntax: :WAVE:TYPE?
:WAVE:TYPE {UI | POWER}
Parameters: UI represents voltage and current waveform
POWER represents power waveform
Examples:
:WAVE:TYPE? ----Returns the waveform type;
:WAVE:TYPE UI ----Set the waveform type to UI waveform;
:WAVE:TYPE POWER ----Set the waveform type to power waveform;

● Description: Set the status of query waveform display parameter items
Syntax:
:WAVE:ITEM:<STR>?
:WAVE:ITEM:<STR> {ON | OFF}
Parameter:
<STR> represents the name corresponding to the analyzable item, the value is shown in the following table 10-12:
{ON | OFF} indicates the state of the switch;

STR value	Meaning
U1, I1	Voltage and current corresponding to channel 1
U2, I2	Voltage and current corresponding to channel 2
U3, I3	Voltage and current corresponding to channel 3
U4, I4	Voltage and current corresponding to channel 4
P1, P2, P3, P4	Power of each channel
Table 10-12 Description of the meanings of optional parameters of the waveform	

Example:
:WAVE:item:U1? ----Return to the on-off state of U1 waveform display;
:WAVE:item:I1? ----Return to the on-off state of I1 waveform display;
:WAVE:item:P1? ----Return to the switch state of P1 waveform display;
:WAVE:item:U1 ON ----Set the display status of U1 to ON;
:WAVE:item:U1 OFF ----Set the display status of U1 to OFF;
:WAVE:item:P1 ON ----Set the display status of P1 to ON;
Note: The settings of other items can be deduced by analogy;

11.1.7 SYSTem Subsystem Commands

11.1.7.1 Button beeper

● Description: Set the button beeper on-off state
Syntax:
:SYSTEM:BEEP?
:SYSTEM:BEEP {ON|OFF}
Parameters:
ON|OFF stands for "ON/OFF" respectively
Examples:
:SYSTEM: BEEP? ----Return to the button beeper on-off state;
:SYSTEM: BEEP ON ----Set the button beeper switch to ON;
:SYSTEM: BEEP OFF ----Set the key buzzer switch to OFF;

11.1.7.2 Comparison beeper

● Description: Set the comparison beerper on-off state
Syntax:
:SYSTEM:BEEP:COMP?
:SYSTEM:BEEP:COMP {PASS | FAIL | OFF}
Parameters:
{PASS | FAIL | OFF} stands for "PASS ON / FAIL ON / OFF"
Examples:
:SYSTEM:BEEP:COMP? ----Return to the status of the comparison beeper;

:SYSTEM:BEEP:COMP PASS ----Set the comparison beeper as PASS ON;
:SYSTEM:BEEP:COMP FAIL ----Set the comparison beeper as FAIL ON;
:SYSTEM:BEEP:COMP OFF ----Set the comparison beeper as OFF;

11.1.7.3 System language

● Description: Set the system language
Syntax:
:SYSTEM:LANG?
:SYSTEM:LANG {EN|CH}
Parameters: EN | CH stands for "English/Chinese" respectively
Examples:
:SYSTEM:LANG? ----Return to the current system language
:SYSTEM:LANG CH ----Set the system language to Chinese
:SYSTEM:LANG EN ----Set the system language to English

11.1.7.4 LCD backlight brightness

● Description: Set the brightness of the LCD backlight
Syntax:
:SYSTEM:LIGHT?
:SYSTEM:LIGHT {20 | 40 | 60 | 80 | 100}
Parameters: {20 | 40 | 60 | 80 | 100} indicates the percentage value of brightness
Examples:
:SYSTEM:LIGHT? ----Returns LCD backlight brightness percentage
:SYSTEM:LIGHT 20 ----Set the brightness of the LCD backlight to 20%
:SYSTEM:LIGHT 40 ----Set the brightness of the LCD backlight to 40%
:SYSTEM:LIGHT 60 ----Set the LCD backlight brightness to 60%
:SYSTEM:LIGHT 80 ----Set the LCD backlight brightness to 80%
:SYSTEM:LIGHT 100 ----Set the LCD backlight brightness to 100%

11.1.7.5 Touch screen calibration

● Description: Touch screen calibration
Syntax:
:SYSTEM:TOUCH
Parameters:
Examples:
:SYSTEM:TOUCH----The calibration interface appears, it is best to restart the instrument manually after calibration

11.1.7.6 System date and time

● Description: Set the system date and time at the same time
Syntax:
:SYSTEM:DATETIME?
:SYSTEM:DATETIME {year,month,date,hour,minute,sec}
Parameter: See the independent command above for the range of values

Examples:
:SYSTEM:DATETIME? ----Return the date and time, such as: 2019-12-18 08:30:20
:SYSTEM:DATETIME 2019,12,12,8,30,20 ----Set the date and time to 2019-12-18 08:30:20

● Description: Set the system date----year
Syntax:
:SYSTEM:year?
:SYSTEM:year {NUM}
Parameters: NUM value range is 2018~2999
Examples:
:SYSTEM:year? ----Returns the year, such as 2019
:SYSTEM:year 2019 ----Set the date to 2019

● Description: Set the system date ---- month
Syntax:
:SYSTEM:MONTH?
:SYSTEM:MONTH {NUM}
Parameters: NUM value range 1~12
Examples:
:SYSTEM:MONTH? ----Returns the month
:SYSTem:MONth 1 ---- Modify the setting date to January

● Description: Set the system date----day
Syntax:
:SYSTEM:DATE?
:SYSTEM:DATE {NUM}
Parameters: NUM value range 1~31
Examples:
:SYSTEM:DATE? ----Return date information
:SYSTEM:DATE 1 ----Modify the setting date to 1

● Description: Set the system time ---- hour
Syntax:
:SYSTEM:HOUR?
:SYSTEM:HOUR {NUM}
Parameters:
NUM value range 0~23
Examples:
:SYSTEM:HOUR? ---- Return hour
:SYSTEM:HOUR 12 ---- Modify the setting date to 12 o'clock

● Description: Set the system time ---- minute
Syntax:
:SYSTEM:MINUTE?

:SYSTEM:MINUTE {NUM}
Parameters: NUM value range 0~59
Examples:
:SYSTEM:MINUTE? ----Return minute
:SYSTEM:MINUTE 12 ---- Modify the setting date to 12 minutes

● Description: Set the system time ---- second
Syntax:
:SYSTEM:SEC?
:SYSTEM:SEC {NUM}
Parameters: NUM value range 0~59
Examples:
:SYSTEM:SEC? ----Returns second
:SYSTEM:SEC 12 ---- Modify the setting date to 12 seconds

11.1.7.7 Serial port settings

● Description: Set the serial port baud rate
Syntax:
:SYSTEM:RS232:BAUD?
:SYSTEM:RS232:BAUD {4800 | 9600 | 38400 | 115200}
Parameters: Provide 4 settable baud rates
Examples:
:SYSTEM:RS232:BAUD? ----Returns the baud rate
:SYSTEM:RS232:BAUD 4800 ----Set the baud rate to 4800
:SYSTEM:RS232:BAUD 9600 ----Set the baud rate to 9600
:SYSTEM:RS232:BAUD 38400 ----Set the baud rate to 38400
:SYSTEM:RS232:BAUD 115200 ----Set the baud rate to 115200
Note: The other configuration of the serial port adopts the conventional configuration, that is, data bit (8), stop bit (1), no parity, no data flow control;

● Description: Set the local address of serial communication
Syntax:
:SYSTEM:RS232:ADDR?
:SYSTEM:RS232:ADDR {NUM}
Parameters: {NUM}, value 1~32
Examples:
:SYSTEM:RS232:ADDR? ----Returns the serial port communication address of the machine
:SYSTEM:RS232:ADDR 1 ----Set the serial port communication address of this machine to 1
:SYSTEM:RS232:ADDR 32 ----Set the serial port communication address of this machine to 32
Note: The settings of other items can be deduced by analogy;

● Description: Set the command mode of serial communication (ie analysis protocol)
Syntax:
:SYSTEM:RS232:CMDMODE?

:SYSTEM:RS232:CMDMODE {SCPI | MODBUS}
Parameters: {SCPI | MODBUS}, two commonly used command parsing protocols are available
Examples:
:SYSTEM:RS232:CMDMODE? ----Return to command mode
:SYSTEM:RS232:CMDMODE SCPI ----Set the command parsing protocol to SCPI protocol
:SYSTEM:RS232:CMDMODE MODBUS ----Set the command parsing protocol to ModBus protocol

11.1.7.8 Wired LAN Settings

● Description: Set the IP address of the LAN Syntax:
:SYSTEM:LAN:IPAD?
:SYSTEM:LAN:IPAD {X.X.X.X}
Parameter: {X.X.X.X}, the general format of the network address, the value of X is 0~255
Examples:
:SYSTEM:LAN:IPAD? ----Return to the local IP address
:SYSTEM:LAN:IPAD 192.168.1.242 ----Set the IP address to 192.168.1.242

● Description: Set the LAN port number
Syntax:
:SYSTEM:LAN:PORT?
:SYSTEM:LAN:PORT {NUM}
Parameters: {NUM}, the theoretical port number range is 0~65535, and the factory default is 45454;
Examples:
:SYSTEM:LAN:PORT? ----Return the port number
:SYSTEM:LAN:PORT 45454 ----Set the port number to 45454
Note: The setting of the network port number needs to avoid the well-known port (0~1023).After the modification, the communication appears abnormal, please contact the network management to confirm whether the set port number is occupied.

● Description: Set the LAN subnet mask
Syntax:
:SYSTEM:LAN:SMASk?
:SYSTEM:LAN:SMASk {X.X.X.X}
Parameter: {X.X.X.X}, the general format of the network address, the value of X is 0~255
Examples:
:SYSTEM:LAN:SMASk? ----Return to subnet mask
:SYSTEM:LAN:SMASk 255.255.255.0 ----Set the subnet mask to 255.255.255.0

● Description: Set the LAN gateway address
Syntax:
:SYSTEM:LAN:GATeway?
:SYSTEM:LAN:GATeway {X.X.X.X}
Parameter: {X.X.X.X}, the general format of the network address, the value of X is 0~255

Examples:
:SYSTEM:LAN:GATeway? ----Return to the gateway address
:SYSTEM:LAN:GATeway 192.168.1.0 ----Set the gateway address to 192.168.1.0

● Description: Set the LAN host name
Syntax:
:SYSTEM:LAN:HOSTname?
:SYSTEM:LAN:HOSTname {X.X.X.X}
Parameter: {X.X.X.X}, the general format of the network address, the value of X is 0~255
Examples:
:SYSTEM:LAN:HOSTname? ----Returns the host name
:SYSTEM:LAN:HOSTname VIC ----Set the host name to VIC

● Description: Query the MAC address of the LAN
Syntax:
:SYSTEM:LAN:MAC?
Parameters: none
Examples:
:SYSTEM:LAN:MAC? ----returns the LAN MAC address

11.1.7.9 USB address query

● Description: Query the ID of USBTMC
Syntax:
:SYSTEM:USB:ID?
Parameters: none
Examples:
:SYSTEM:USB:ID? ----Returns the ID of USBTMC

11.1.8 TRIGger Subsystem Commands

● Description: Perform a bus trigger test
Syntax::TRIG
Parameter:
Examples:
:TRIG ----In the bus touch state, perform a bus trigger test

● Description: Set the trigger mode
Syntax:
:TRIG:SOUR?
:TRIG:SOUR {INT | EXT | BUS | MAN}
Parameters: INT | EXT | BUS | MAN respectively means "internal/external/bus/manual"
Examples:
:TRIG:SOUR? ----Return to the trigger mode of system measurement
:TRIG:SOUR INT ----Set the measurement trigger mode to internal trigger

:TRIG:SOUR EXT ----Set the measurement trigger mode to external trigger
:TRIG:SOUR BUS ----Set the measurement trigger mode to bus trigger
:TRIG:SOUR MAN ----Set the measurement trigger mode to manual trigger

● Description: Set the trigger delay time
Syntax:
:TRIG:DELAY?
:TRIG:DELAY {NUM}
Parameters: NUM value range: 0.000~60.00 seconds
Examples:
:TRIG:DELAY? ----Return to measurement trigger delay time
:TRIG:DELAY 0.001 ----Set the measurement trigger delay time to 1ms

11.1.9 FETCh Subsystem Commands

11.1.9.1 Query basic test data
● Description: Query and return 4 basic results of all channels
Syntax:
:FETCH?
Parameters:
Examples:
:FETCH? ----Returns 4 basic data of each channel
Return data sequence: data of channel 1~channel 4 (3), there are fixed 4 data in each channel

● Description: Query the test results of the specified parameters of all channels
Syntax:
:FETCH <para>
Parameter: See Table 10-8 for the value of <para>
Return: return the test result
Examples:
:FETCH URMS ----Returns the effective voltage value of all channels
:FETCH IRMS ----Returns the effective value of current of all channels
:FETCH FREQ ----Returns the signal frequency of all channels
:FETCH PF ----Returns the power factors of all channels
Note: other parameters can be deduced by analogy, multiple return values are separated by ",";

● Description: Automatic return setting of measurement data
Syntax:
:FETCH:auto?
:FETCH:auto {ON | OFF}
Parameter:
ON ----that is, the data will automatically return to the host computer after each test, and the return is the same as above ":FETCH?"

OFF ----that is, set to close the automatic return function of measurement data;
Examples:
:FETCH:auto? ----Return to the current automatic data return function state
:FETCH:auto ON ----Set the data to automatically return to the host computer after each test
:FETCH:auto OFF ----Set the automatic return function of measurement data to OFF

11.1.9.2 Query the test results of parameters in the channel

● Description: Query the test result of the specified parameter of the specified channel
Syntax:
:FETCH:CH<1|2|3|4> <para>
Parameters: CH<1|2|3|4> corresponds to the specified channel number
See Table 10-8 for the value of <para>
Return: return the test result
Examples:
:FETCH:CH1 URMS ----Returns the voltage effective value of channel 1
:FETCH:CH1 IRMS ----Returns the current effective value of channel 1
:FETCH:CH1 FREQ ---- Return the signal frequency of channel 1
:FETCH:CH1 PF ----Return the power factor of channel 1
:FETCH:CH1 ALL ---- Return all parameters of channel 1
Note: Other parameters can be deduced by analogy;

● Description: Query the test results of all parameters of the specified channel
Syntax:
:FETCH:CH<1|2|3|4> ALL
Parameters: CH<1|2|3|4> corresponds to the specified channel number
Return: return the test result
Example:
:FETCH:CH1 ALL ----return all parameters of channel 1
:FETCH:CH2 ALL ---- return all parameters of channel 2
:FETCH:CH3 ALL ---- return all parameters of channel 3
:FETCH:CH4 ALL ---- return all parameters of channel 4
Note: The sequence of parameters corresponding to the returned result is as follows (29):
FREQ, URMS, UAC, UDC, UPK+, UPK-, UPP, UCF,
IRMS, AC, IDC, IPK+, IPK-, IPP, ICF,
P, S, Q, PF, PHASE,
WP+, WP-, WP, PAVG,
q+, q-, q, WS, WQ

11.1.9.3 Query the test result of the specified parameter in the wire system combination

● Description: Query the test result of the specified parameter in the wire system combination
Syntax:
:FETCH:CHS[1|2] <para>
:FETCH:CHS[1|2] ALL
Parameters: CHS[1|2] corresponds to the specified channel combination number 10-13
See Table 10-14 for the value of <para>

CHS[1|2] value	Meaning
CHS	Refers to a 3-channel instrument
CHS1	The first wire system combination of a 4-channel instrument, same as CHS
CHS2	The second wire combination for 4-channel instruments
Table 10-13 CHS[1|2] parameter meaning description	

STR value	
URMS、UAC、UDC、IRMS、 IAC、 IDC、P、S-VA、Q-VAR、PF、WP、EFFiciency	
Table 10-14 Optional names of parameters in the wire system combination	

Return: return the test result

Examples:

3-channel instrument:

:FETCH:CHS URMS ----Returns the voltage effective value in the wire system combination

:FETCH:CHS IRMS ----Returns the current effective value in the wire system combination

:FETCH:CHS P ----Returns the active power in the wire system combination

:FETCH:CHS S-VA ----Returns the total power in the wire system combination

:FETCH:CHS Q-VAR ----Returns the virtual power (reactive power) in the wire system combination

:FETCH:CHS PF ----Return to the power factor in the wire system combination

:FETCH:CHS WP ----Returns the integral of the active power of the wire system combination

:FETCH:CHS EFF ----Returns the efficiency result of the wire system combination

4-channel instrument:

:FETCH:CHS URMS ----Returns the voltage effective value in the wire system combination 1

:FETCH:CHS IRMS ----Returns the current effective value in wire system combination 1

:FETCH:CHS1 P ----Returns the active power in wire system combination 1

:FETCH:CHS1 S-VA ----Returns the total power in the wire system combination 1

:FETCH:CHS2 Q-VAR ----Returns the virtual power (reactive power) in the wire system combination 2

:FETCH:CHS2 PF ----Return to the power factor in the wire system combination 2

:FETCH:CHS2 WP ----Returns the integral of active power in wire system combination 2

:FETCH:CHS2 EFF ----Returns the efficiency result of the wire system combination 2

Note: Other parameters can be deduced by analogy;

:FETCH:CHS ALL ----Returns all results in the wire system combination 1

:FETCH:CHS1 ALL ----Returns all results in the wire system combination 1

:FETCH:CHS2 ALL ----Returns all results in the wire system combination 2

Note: The sequence of the returned ALL parameters is as follows (12):

URMS, UAC, UDC,
IRMS, IAC, IDC",
P, S, Q,
PF, WP, η

11.1.9.4 Query harmonic analysis data

● Description: Query the harmonic analysis data of the specified order

Syntax:

:FETCH:HARM:<para>:RANGE {low,high}

Parameters: <para> takes the value "U1, I1, U2, I2, U3, I3, U4, I4", that is, the voltage and current signals of each channel;

{low,high} takes the harmonic data of the specified order interval, low<=high, and the value range is between 2~50

Examples:

:FETCH:HARM:U1:RANGE 2,50 ----Returns 2~50th U1 harmonic data

:FETCH:HARM:U1:RANGE 6,10 ----Returns the 6~10th U1 harmonic data

:FETCH:HARM:U1:RANGE 2,2 ----Returns the second U1 harmonic data

:FETCH:HARM:I1:RANGE 2,50 ----Returns 2~50th I1 harmonic data

:FETCH:HARM:I1:RANGE 6,10 ----Returns 6~10th I1 harmonic data

:FETCH:HARM:I1:RANGE 2,2 ----Returns the second I1 harmonic data

Note: Other parameters can be deduced by analogy;

● Description: Query the component size of the total harmonics of voltage and current

Syntax:

:FETCH:HARM:THD {U1 | I1 | U2 | I2 | U3 | I3 | U4 | I4}

Parameters:

{U1 | I1 | U2 | I2 | U3 | I3 | U4 | I4} refers to the voltage and current signals of each channel

Examples:

:FETCH:HARM:THD U1 ----Returns the total harmonic size of U1

:FETCH:HARM:THD I1 ----Returns the total harmonic size of I1

:FETCH:HARM:THD U2 ----Returns the total harmonic size of U2

:FETCH:HARM:THD I2 ----Returns the total harmonic size of I2

:FETCH:HARM:THD U3 ----Returns the total harmonic size of U3

:FETCH:HARM:THD I3 ----Returns the total harmonic size of I3

:FETCH:HARM:THD U4 ----Returns the total harmonic size of U4

:FETCH:HARM:THD I4 ----Returns the total harmonic size of I4

11.1.9.5 Query Waveform Data

● Description: Query waveform data

Syntax:

:FETCH:wave {U1 | I1 | U2 | I2 | U3 | I3 | U4 | I4}

Parameters: {U1 | I1 | U2 | I2 | U3 | I3 | U4 | I4} refers to the voltage and current signals of each channel

Examples:

:FETCH:wave U1 ----Returns the waveform data of U1
:FETCH:wave I1 ----Returns the waveform data of I1
:FETCH:wave U2 ----Returns the waveform data of U2
:FETCH:wave I2 ----Returns the waveform data of I2
:FETCH:wave U3 ----Returns the waveform data of U3
:FETCH:wave I3 ----Returns the waveform data of I3
:FETCH:wave U4 ----Returns the waveform data of U4
:FETCH:wave I4 ----Returns the waveform data of I4
Note: Due to the relatively large amount of waveform data, only 128 points of waveform data are returned here. The source of the 128 points of data is the even-numbered point data sampled in one cycle, which is enough to describe the waveform.

11.1.9.6 Query comparison results

● Description: Query the comparison results of 8 comparison parameters
Syntax:
:FETCH:COMP?
Parameters:
Examples:
:FETCH:COMP ?----Returns 8 comma-separated comparison results
Return such as: "PASS,PASS.FAIL,NULL.NULL.NULL,NULL.NULL"
Where, PASS means qualified, FAIL means unqualified, NULL means not compared;

11.1.9.7 Query vector angle results

● Description: Query the relative angle size of the displayed parameters in the vector diagram
Syntax:
:FETCH:VECTOR:DEG?
Parameters:
Examples: :FETCH:VECTOR:DEG?---- returns 6 comma-separated angle results
Note: The order of returned results is as follows:
The reference angle of U1 is 0, the angle of I1 relative to U1,
The angle of U2 relative to U1, the angle of I2 relative to U1,
The angle of U3 relative to U1, the angle of I3 relative to U1.

11.2 ModeBus commands

11.2.1 Writing Command format

➢ **Sending format**

Instrument address	Function code	High address	Low address	High registers	Low registers	Total number of bytes	Data byte 1	… …	Data byte n	CRC Low	CRC High

➢ **Return format**

Instrument address	Function code	High address	Low address	High registers	Low registers	CRC Low	CRC High

a) Instrument address

It refers to the local address of the instrument, which can be set in the bus address of the instrument's system setting interface. The value range is: 1~31

b) Function code: 0x10

This command can write one data or multiple data, so its code is: 0x10

c) High address and low address

It refers to the storage address of the data in the instrument, which can be a real storage address or a mapped address.

d) High registers and low registers

It indicates that the number of registers written in this operation and the size of each register is 2 bytes.

e) Total number of bytes

It represents the total number of bytes written in this operation.

f) Data byte 1~data byte n

Write these data content to the instrument.

g) CRC high and CRC low

CRC 16-bit check, we use the look-up table method for CRC check.

➢ Example: The specific instruction and function setting relationship is detailed in the Appendix Table ModeBus command function comparison table (Section 11.2.3);

Set the voltage range, set to Range 2 (ie 300V), the storage address of voltage range parameter in the instrument is 0x0003, the instrument bus address is 8.

Then the command is:

0x08	0x10	0x30	0x00	0x00	0x00	0x01	0x02	D5	CD

Where, the countdown 3rd is corresponding to 20% index value of voltage, the type is char and accounting for 1 byte.

The return information is as follows:

0x08	0x10	0x30	0x00	0x00	0x00	0xCF	0x90

11.2.1.1 Reading the command

➢ **Sending format**

Instrument address	Function code	High address	Low address	High registers	Low registers	CRC Low	CRC High

➢ **Return format**

Instrument address	Function code	Total number of bytes	Data byte 1	……	Data byte n	CRC Low	CRC High

The function code is: 0x03

➢ Example: The specific instruction and function setting relationship is detailed in the Appendix

Table ModeBus command function comparison table (Section 11.2.3);

To read the test value of the voltage in the current mode, the storage address is 0x3000, the instrument number is 8.

Then the command is:

0x08	0x03	0x30	0x00	0x00	0x00	0x4A	0x53

The return information is as follows:

0x08	0x03	0x04	0x02	0x02	0x02	0x02	0x43	0xEA

11.2.2 CRC16 calculation method - look-up table method

a) First define two 256-byte checklists

// CRC high byte value table

```
const BYTE chCRCHTalbe[] =                    // CRC high byte value table
{
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40
};
```

// CRC low byte value table

```
const BYTE chCRCLTalbe[] =
{
0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7,
0x05, 0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E,
0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09, 0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9,
0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC,
0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32,
0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D,
0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38,
0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF,
0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26,
0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1,
0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4,
0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB,
0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA,
0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5,
0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0,
0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97,
0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C, 0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E,
0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89,
0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83,
0x41, 0x81, 0x80, 0x40
};
```

b) then calculate

```
WORD CRC16(BYTE* pchMsg, WORD wDataLen)
{
    BYTE chCRCHi = 0xFF; // High CRC byte initialization
    BYTE chCRCLo = 0xFF; // Low CRC byte initialization
    WORD wIndex;         // Index in the CRC loop
while (wDataLen--)
    {
        // Calculate CRC
        wIndex = chCRCLo ^ *pchMsg++ ;
        chCRCLo = chCRCHi ^ chCRCHTalbe[wIndex];
        chCRCHi = chCRCLTalbe[wIndex] ;
    }
 return ((chCRCHi << 8) | chCRCLo) ;
}
```

11.2.3 Command function comparison table

Instrument bus address	Function code	Command address	Number of data bytes	Data Number	Data byte	Instruction function meaning
Instrument address	Read/ write	High + low	High + low	Data Number	The setting value corresponding to the address	
1~31	R	0x0000				Query the instrument IDN
	R/W	0x1000	0x0001	1	0x01	Measurement display
	R/W	0x0002	0x0001	1	0x01	Compare display
					0x02	Harmonic display
					0x03	Waveform display
					0x04	vector diagram display
					0x05	Measurement setup
					0x06	Compare setup
					0x07	System setup
					0x08	File management
	R/W	0x1001	0x0001	1	0x00	Turn off the display refresh, equivalent to HOLD function is OFF
					0x01	Turn on the display refresh, equivalent to HOLD function is ON
	R/W	0x1002	0x0001	1	0x00	Turn ON/OFF the highlight display of channel 1
					0x01	Turn ON/OFF the highlight display of

						channel 2
					0x02	Turn ON/OFF the highlight display of channel 3
					0x03	Turn ON/OFF the highlight display of channel 4
					0x04	Turn ON/OFF the highlighted display of the line test
	R/W	0x2000	0x0001	1	num	Wiring system setting
						For 3-channel instruments, NUM value (0x00 ~ 0x04), represent 1P2W, 1P3W, 3P3W, 3P4W, 3V3A respectively; For 4-channel instruments, NUM value (0x00 ~ 0x07), indicate 1P2W, 1P3W, 1P3W_1P3W, 1P3W_3P3W, 3P3W, 3P3P_3P3W, 3P4W, 3V3A respectively.
	R/W	0x2001	0x0002	2	up down	Line system related efficiency settings
						The data range of up and down are as follows: For 3-channel instruments:0x00~0x04(no 0x03) For 4-channel instruments: 0x00~0x05 Where, 0x00~0x03 corresponds to P1~P4; 0x04,0x05 corresponds to P_{Σ} ($P_{\Sigma 1}$), $P_{\Sigma 2}$
	R/W	0x2002	0x0001	1	0x00	Turn on the line 5KHz filter
					0x01	Turn off the line 5KHz filter
	R/W	0x2003	0x0001	1	0x01~0x20	Average number of tests
	R/W	0x2004	0x0001	1	0x00~0x08	The test synchronization signal of channel 1, 0x00~0x07, respectively represents U1, I1, U2, I2, U3, I3, U4, I4; 0x08 represents the Line signal;
	R/W	0x2005	0x0001	1	0x00~0x08	The test synchronization signal of channel 2, 0x00~0x07, respectively represents U1, I1, U2, I2, U3, I3, U4, I4; 0x08 represents the Line signal;
	R/W	0x2006	0x0001	1	0x00~0x08	The test synchronization signal of channel 3, 0x00~0x07, respectively represents U1, I1, U2, I2, U3, I3, U4, I4; 0x08 represents the Line signal;
	R/W	0x2007	0x0001	1	0x00~0x08	The test synchronization signal of channel 4, 0x00~0x07, respectively represents U1, I1, U2, I2, U3, I3, U4, I4; 0x08 represents the Line signal;

	R/W	0x2008	0x0001	1	0x00	Set energy integral to manual control
					0x01	Set energy integral to continuous control
	R/W	0x2009	0x0004	3	int+char+char	Set energy integration time interval (int hour, char minute, char second)
	R/W	0x200A	0x0001	1	0x00	Run energy integration
					0x01	Stop energy integration
					0x02	Reset energy integration
	R/W	0x200B	0x0004	4	a+b+c+d	Set the 4 basic display parameters of channel 1 The parameter value ranges from 0 to 28, and the corresponding parameters are: F_{REQ}, U_{RMS},U_{AC},U_{DC},U_{PK+},U_{PK-},U_{PP},U_{CF}, I_{RMS},I_{AC},I_{DC},I_{PK+},I_{PK-},I_{PP},I_{CF}, P,S,Q,PF,P_{HASE}, W_{P+},W_{P-},W_P,P_{AVG}, reserved, reserved, q, WS, WQ
	R/W	0x200C	0x0004	4	a+b+c+d	Set the 4 basic display parameters of channel 2 The description of the parameter value range is the same as above
	R/W	0x200D	0x0004	4	a+b+c+d	Set the 4 basic display parameters of channel 3 The description of the parameter value range is the same as above
	R/W	0x200E	0x0004	4	a+b+c+d	Set the 4 basic display parameters of channel 4 The description of the parameter value range is the same as above
	R/W	0x3000	0x0001	1	num	Set the voltage range of all channels at the same time, the value of num is: 0x00 means 75V 0x01 means 150V 0x02 means 300V 0x03 means 600V
	R/W	0x3001	0x0001	1		Set the voltage range of channel 1 independently
	R/W	0x3002	0x0001	1		Set the voltage range of channel 2 independently
	R/W	0x3003	0x0001	1		Set the voltage range of channel 3 independently
	R/W	0x3004	0x0001	1		Set the voltage range of channel 4 independently
	R/W	0x3005	0x0001	1	auto	Set the voltage range of channel 1 to be AUTO, the value of auto is: 0x00 means not automatic 0x01 means automatic

	R/W	0x3006	0x0001	1		Set the voltage range of channel 2 automatically, the value is the same as above
	R/W	0x3007	0x0001	1		Set the voltage range of channel 3 automatically, the value is the same as above
	R/W	0x3008	0x0001	1		Set the voltage range of channel 4 automatically, the value is the same as above
	R/W	0x4000	0x0001	1	num	Set the current range of all channels at the same time. The value of num is: 0x00~0x06, which means 7 current ranges from small to large, please refer to 4.1.6 Test Range
	R/W	0x4001	0x0001	1		Set the current range of channel 1 individually
	R/W	0x4002	0x0001	1		Set the current range of channel 2 individually
	R/W	0x4003	0x0001	1		Set the current range of channel 3 individually
	R/W	0x4004	0x0001	1		Set the current range of channel 4 individually
	R/W	0x4005	0x0001	1	auto	Set the current range of channel 1 to be AUTO, the value of auto is: 0x00 means not automatic 0x01 means automatic
	R/W	0x4006	0x0001	1		Set the current range of channel 2 automatically, and the value is the same as above
	R/W	0x4007	0x0001	1		Set the current range of channel 3 automatically, and the value is the same as above
	R/W	0x4008	0x0001	1		Set the current range of channel 4 automatically, and the value is the same as above
	W	0x5000	0x0001	1	0x00	Perform a bus trigger test
	R/W	0x5001	0x0001	1	0x00	Internal trigger
					0x01	External trigger
					0x02	Manual trigger
					0x03	Bus trigger
	R/W	0x5002	0x0004	1	float	Trigger delay time, float value is 0~60.00 seconds
	R/W	0x8000	0x0001	1	0x00	Turn off button beeper
					0x01	Turn on button beeper

	R/W	0x8001	0x0001	1	0x00	Turn off compare beeper
					0x01	Set compare beeper as PASS beeper
					0x02	Set compare beeper as FAIL beeper
	R/W	0x8002	0x0001	1	0x00	Set the system language to English
					0x01	Set the system language to Chinese
	R/W	0x8003	0x0001	1	0x14	Set the display backlight brightness to 20%
					0x28	Set the display backlight brightness to 40%
					0x3C	Set the display backlight brightness to 60%
					0x50	Set the display backlight brightness to 80%
					0x64	Set the display backlight brightness to 100%
	R/W	0xC000	0x0001	1	0x00	Set the harmonic calculation standard to IEC
					0x01	Set the harmonic calculation standard to CSA
	R/W	0xC001	0x0001	1	0x00	Set the harmonic display form to list
					0x01	Set the harmonic display form to bar graph (histogram)
	R/W	0xC002	0x0001	1	0x00	Set the harmonic data format to percentage
					0x01	Set the harmonic data format to absolute value
	R/W	0xC003	0x0002	2	P,S	Set the state of harmonic analysis parameters, P is the parameter, S is the state; P value 0~7 corresponds to U1, I1, U2, I2, U3, I3, U4, I4; S value 0, 1 corresponds to OFF and ON
	R/W	0xD000	0x0001	1	0x00	Set the waveform type to UI waveform
					0x01	Set the waveform type to Power waveform
	R/W	0xD001	0x0002	2	P,S	Set the state of UI waveform parameters, P is the parameter, S is the state; P value 0~7 corresponds to U1, I1, U2, I2, U3, I3, U4, I4; S value 0, 1 corresponds to OFF and ON
	R/W	0xEx00	0x0002	2	Ch,para	Set the parameters under the comparison channel, The parameter address can be changed to a value of 0~7 corresponding to 8 comparison channels, such as 0xE100, etc.; Ch is the test channel, and para is the corresponding parameter item under the test channel; The value of Ch is 0~3, corresponding to CH1, CH2, CH, CH4; The value of para is 0~28, corresponding to FREQ, URMS, UAC, UDC, UPK+, UPK-, UPP, UCF, IRMS, IAC, IDC,

						IPK+, IPK-, IPP, ICF, P,S,Q,PF,PHASE, WP+,WP-,WP,PAVG, Reserved, Reserved, q, WS, WQ
	R/W	0xEx01	0x0004	4	float	Set the upper limit corresponding to the comparison parameter under the current comparison channel, the address description is the same as above
	R/W	0xEx02	0x0004	4	float	Set the lower limit corresponding to the comparison parameter under the current comparison channel, the address description is the same as above
	R/W	0xEx03	0x0001	1	Func	Set the comparison function corresponding to the comparison parameter under the current comparison channel, the address description is the same as above; The values of Func are as follows: 0x00 corresponds to OFF; 0x01 corresponds to PASS conduction; 0x02 corresponds to FAIL conduction; 0x03 corresponds to PASS pulse; 0x04 corresponds to FAIL pulse;
	R	0xF020~ 0xF02C	0x000C 或 0x0010			Read the test results of the corresponding parameters of all channels, the lower 8 bits of the address take values from 0 to 28, corresponding to FREQ, URMS, UAC, UDC, UPK+, UPK-, UPP, UCF, IRMS, IAC, IDC, IPK+, IPK-, IPP, ICF, P,S,Q,PF,PHASE, WP+,WP-,WP,PAVG, Reserved, reserved, q, WS, WQ The length of the returned data is 12 or 16;
	R	0xF000~ 0xF01C	0x0004			Read the test parameter result of channel 1, the lower 8 bits of the address take the value 0~28, corresponding FREQ, URMS, UAC, UDC, UPK+, UPK-, UPP, UCF, IRMS, IAC, IDC, IPK+, IPK-, IPP, ICF, P,S,Q,PF,PHASE, WP+,WP-,WP,PAVG, Reserved, reserved, q, WS, WQ
	R	0xF100~ 0xF11C	0x0004			Read the test parameter result of channel 2, the lower 8 of the address is described as above
	R	0xF200~ 0xF21C	0x0004			Read the test parameter result of channel 3, the lower 8 of the address is described as above
	R	0xF300~	0x0004			Read the test parameter result of channel 4,

		0xF31C				the lower 8 of the address is described as above
	R	0xF400~ 0xF40B	0x0004			Read the test parameter results under the first wire system combination. The lower 8 bits of the address range from 0 to 11, corresponding to 12 calculation results, namely URMS, UAC, UDC, IRMS, IAC, IDC, P, S, Q, PF, WP, η
	R	0xF500~ 0xF50B	0x0004			Read the test parameter result under the second wire system combination. The lower 8 bits of the address ranges from 0~11, corresponding to 12 calculation results, namely URMS, UAC, UDC, IRMS, IAC, IDC, P, S, Q, PF, WP , η
	R	0xFx01~ 0xFx01	0x0004			Read the total harmonics corresponding to the parameters. Bit8~bit11 of the address ranges from 6~13, corresponding to parameters U1, I1, U2, I2, U3, I3, U4, I4;
	R	0xFx02~ 0xFx32	0x0004			Read the harmonic result of the specified times corresponding to the parameter, Bit8~bit11 of the address ranges from 6~13, corresponding to parameters U1, I1, U2, I2, U3, I3, U4, I4; The address bit0~bit7 ranges from 2~50, corresponding to the 2~50th harmonic result of the parameter
	R	0xFE00~ 0xFE07	0x0200			Read 128 points of waveform data. Bit0~bit7 of the address ranges from 0~7, corresponding to parameters U1, I1, U2, I2, U3, I3, U4, I4;
	R	0xFF00	0x0008			Read all the comparison results of the comparison parameters, that is, the 8-byte number is returned; Return 0 corresponds to PASS; Return 1 corresponds to FAIL; Return 2 corresponds to no comparison;