FLUKE®

NORMA 6003/NORMA 6003+/ NORMA 6004/NORMA 6004+

Power Analyzer

User Manual

July 2019 Rev 1

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Introduction

Product Overview

The Fluke NORMA 6003/NORMA 6003+/NORMA 6004/NORMA 6004+ Power Analyzers (the Product or Analyzer) are portable, precision wideband power analyzers. Use the product with the Fluke current clamp 80i-2010s and High Voltage Differential Probe U1500s for a broad range of electrical loads including those with electronic switching (inverter type).

The Product has these benefits:

- Up to 4 voltage and 4 current channels for one single unit.
- Motor Speed and Torque measurements (NORMA 6003+, NORMA 6004+)
- 0.1 % accuracy, 500 kHz bandwidth, 200 kHz sample rate.
- The channels are isolated (basic insulation) with the measurement category of CAT III 1000V/CAT IV 600V.
- Flexible configurations according to the measuring requirements, synchronize 2 Analyzers to configure 6 to 8 channels.
- 9.6 cm thickness makes it easy to use in tight spaces.
- 5000 mAh Li-ion battery for 10 hours continuous operation with one single charge.
- CAT rating: CAT III 1000 V, CAT IV 600 V
- 100 ms to 1 s configurable update rate, 32 GB storage available for continuous logging.
- Main functions: Meter, Scope, Harmonic, Phasor and Trend.
- USB and RS485 interface with open communication protocol support user defined system integration and software.
- Simplified UI for better operation experience, suitable for in-field application.
- PC software (Fluke Power Analyzer Software) for online measuring, data downloading, and analysis.

How to Contact Fluke

To contact Fluke, call one of the following telephone numbers:

- Technical Support USA: 1-800-44-FLUKE (1-800-443-5853)
- Calibration/Repair USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31 402-675-200
- Japan: +81-3-6714-3114
- Singapore: +65-6799-5566
- China: +86-400-810-3435 (service) or +86-400-921-0835 (repair)
- Brazil: +55-11-3530-8901
- Anywhere in the world: +1-425-446-5500

To register your product, view, print, or download the latest manual or manual supplement, visit cn.fluke.com (Chinese) or www.fluke.com (English).

Safety

Warning and Cautions

A **Warning** identifies hazardous conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury and for safe operation of the Product:

- **Read all safety information before you use the Product.**
- **Use the Product only as specified, or the protection supplied by the Product can be compromised.**
- **Comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame-resistant clothes) to prevent shock and arc blast injury where hazardous live conductors are exposed.**
- **Examine the case before you use the Product. Look for cracks or missing plastic. Carefully look at the insulation around the terminals.**
- **Do not use the Product around explosive gas, vapor, or in damp or wet environments.**
- **Use Product-approved measurement category (CAT), voltage, and amperage rated accessories (probes, test leads, and adapters) for all measurements.**
- **Do not use test leads if they are damaged. Examine the test leads for damaged insulation and measure a known voltage.**
- **Do not use the Product if it is damaged.**
- **Do not use the Product if it operates incorrectly.**
- **The battery door must be closed and locked before you operate the Product.**
- **Remove all probes, test leads, and accessories before the battery door is opened.**
- **Do not work alone.**
- **Use only the external mains power supply included with the Product.**
- **Do not exceed the Measurement Category (CAT) rating of the lowest rated individual component of a Product, probe, or accessory.**
- **Do not touch voltages >30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Do not apply more than the rated voltage between the terminals or between each terminal and earth ground.**
- **Measure a known voltage first to make sure that the Product operates correctly.**
- **Disable the Product if it is damaged.**

Symbols

Table 1 lists the symbols that can be used on the Product or in this document.

Table 1. Symbols

Symbol	Description
	WARNING. RISK OF DANGER.
	WARNING. HAZARDOUS VOLTAGE. Risk of electric shock.
	Consult user documentation.
	Fuse
	AC (Alternating Current)
	DC (Direct Current)
	Double Insulated
	Conforms to European Union directives.
 Li Ion	Lithium battery
	Application around and removal from uninsulated hazardous live conductors is permitted.
	Earth
	Certified by CSA Group to North American safety standards.
	Conforms to EMC standard in Korea.
	Conforms to Australian safety and EMC standards.
CAT III	Measurement Category III is applicable to test and measuring circuits connected to the distribution part of the building's low-voltage MAINS installation.
CAT IV	Measurement Category IV is applicable to test and measuring circuits connected at the source of the building's low-voltage MAINS installation.
 Li-ion	This Product contains a lithium-ion battery. Do not mix with the solid waste stream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler per local regulations. Contact your authorized Fluke Service Center for recycling information.
	This product complies with the WEEE Directive marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product. Do not dispose of this product as unsorted municipal waste.

Preparation

Standard Packaging

To prevent damage during shipment, the Product is shipped in a specially designed package. Please check the Product carefully and inform the carrier of any damage.

Figure 1 and *Table 2* list the standard equipment of the Product. For specific information on each part and more accessories, See *Accessories and Options*.

Unpack the Product and check the standard equipment in *Table 2* and check the other ordered parts listed on the packing list. If there is any shortage of parts, please inform the nearest Fluke Technical Service Center or the place of purchase.

If you need to reship the Product, please use the original package case. If the original package is not available, a new package can be ordered from Fluke according to the Product's model and serial number.

Figure 1. Standard Equipment

Table 2. Standard Equipment

Item	Description	Quantity	
		NORMA 6004/6004+	NORMA 6003/6003+
❶	**Main unit, including battery BP291: 3894688**	1	1
❷	**Power Supply Adapter (18V DC, CAT IV 600V Adapter)**	1	1
❸	**Power line cord (for China): 4894155** **Power line cord (for international): 4894137** **Mains Adapter set (for international): 4894143**	1	1
❹	**Test lead set** **4-channel model:** **Test leads, 1.5 m, (4) red, (4) black, (8) blue** **Alligator clips, (4) red, (4) black, (8) blue** **3-channel model:** **Test leads, 1.5 m, (3) red, (3) black, (6) blue** **Alligator clips, (3) red, (3) black, (6) blue**	1	1
❺	**USB (mini B) cable**	1	1
❻	**RS-485/synchrony adapter (3.81mm, black, 3 pin)**	1	1
❼	**Speed / torque adapter (3.81mm, black, 6 pin)**	None/1	None/1
❽	**USB Flash Drive for PC SW and User Manual**	1	1
❾	**Soft case**	1	1
Not shown	**Getting Started Manual**	1	1
	Product Warranty and Certification (China only)	1	1
	Calibration Report	1	1
	QC certificate (for China only)	1	1

Stand and Hand Strap

The Analyzer is portable and equipped with a tilt stand that allows the Analyzer to be placed on a flat surface for users to view the screen from a certain angle, as shown in *Figure 2.*

Note

Please pay attention to the sign  *on the stand and do not use the tilt stand to carry the Product.*

Figure 2. Use the tilt stand

In addition, you can install the supplied hand strap on the left side of the Product. Adjust the handstrap as shown in *Figure 3.*

Figure 3. Install the hand strap

You can hold the Product in one hand when working and use the hand strap to carry the Product when the product is not in use.

Connect to the Power Supply

Connect the Analyzer to a standard AC power supply according to *Figure 4* and turn on the Analyzer:

1. Connect the connector end of the power cord to the power adapter/charger and insert the plug into a standard wall outlet.
2. Open the protective cover and insert the power adapter/charger plug into the power jack on the Analyzer.
3. Push the on/off button on the Analyzer's front panel to turn on the Analyzer.

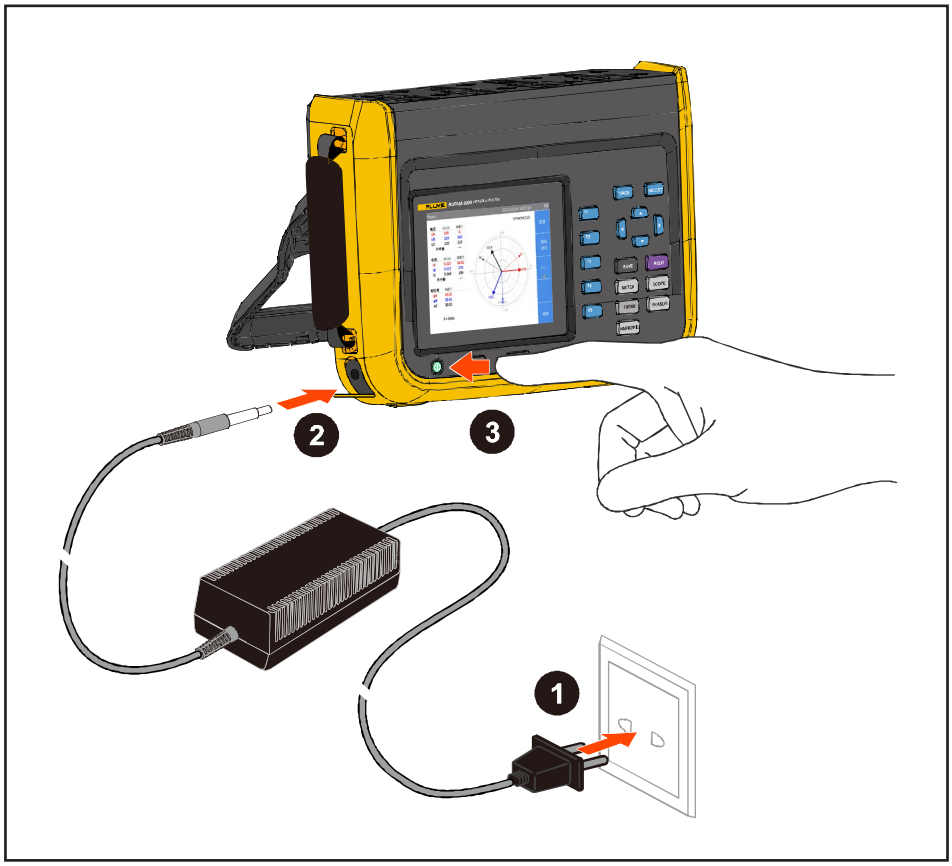


Figure 4. Connect to the Power Supply

When the Analyzer is turned on for the first time, the menu interface for setting interface language, date and time options shows automatically.

⚠⚠Warning

To prevent electric shock, connect the Product to a standard outlet using a factory-supplied power cord.

Battery Charging

To get enough battery power, you must first charge the Product.

When powered by a battery, the battery symbol at the top of the screen indicates the condition of the battery. Symbol  indicates low battery power, please charge the battery immediately.

To charge the battery and power the instrument, connect the power adapter as shown in *Figure 5*. To increase the battery charging speed turn off the Analyzer.

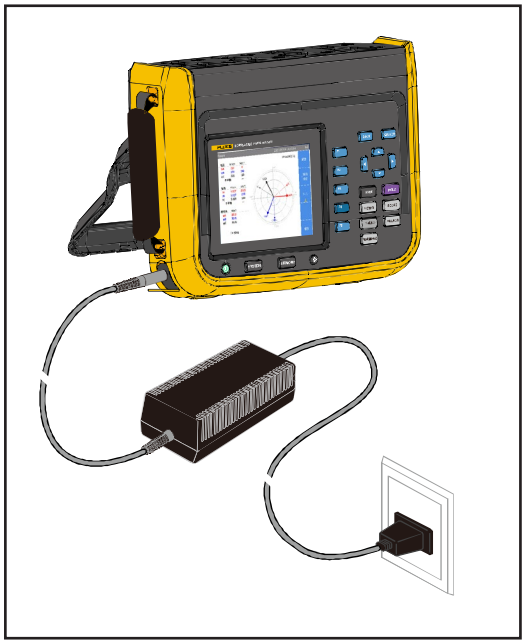


Figure 5. Battery Charging

⚠ Caution

To prevent overheating of the battery during charging, do not charge in extremely hot or cold environments. If the battery is charged under extreme temperatures, the battery capacity may be reduced. Please refer to charging temperature specifications.

Note

Charge the Product for a two-hour minimum at three-month intervals for maximum battery life. When not in use, the full charged battery will self-discharge in approximately six months. Batteries stored for long periods will need two to ten charging cycles for full capacity.

The Product

This section describes the operation panel of the Product and the location and function of the display. Please read this section carefully before operating the Product. Refer to *Control Panel* for instructions on the front panel of the Product; See *Connect the Computer* for remote operation instructions.

This manual is applicable to many models. As different models have different features, some of the information in this manual may not be applicable to your product.

Model Comparison Table

Table 3 Lists functional comparison of different models.

Table 3. Product Features Table

Feature	NORMA 6003	NORMA 6003+	NORMA 6004	NORMA 6004+
Number of channels for voltage / current	3/3	3/3	4/4	4/4
Motor speed / torque measurement	-	Yes.	-	Yes.
Basic accuracy	0.1%			
Bandwidth	500kHz (High voltage/current range)			
Sample rate	200 kHz			
Channel-to-channel isolation	Yes.			
Meter (V / I / P / η etc.)	Yes.			
Waveform	Yes.			
Trend	Yes.			
Harmonic	Yes.			
Phasor	Yes.			
CAT rating	CAT III 1000V, CAT IV 600V			
Ingress protection	IP50			
Color screen	5.7”, backlight, 4:3			
Lithium battery	10.8 V/5000 mAh, 54 Wh			
Charging indication when power off	Charging: power indicator is orange; fully charged: power indicator is green			
Charger	Charging/powering			
PC software	Yes.			
USB (device) – Mini B	Yes.			
485 / sync interface	Yes (up to 921,600 bps)			
Low battery indicator	Yes.			

Operation Features

This section describes the Analyzer's control panel and the functions and locations of the various interfaces and ports. Please read this section carefully before operating the Product.

Control Panel

Figure 6 and *Table 4.* list the features and functions of each component on the control panel.

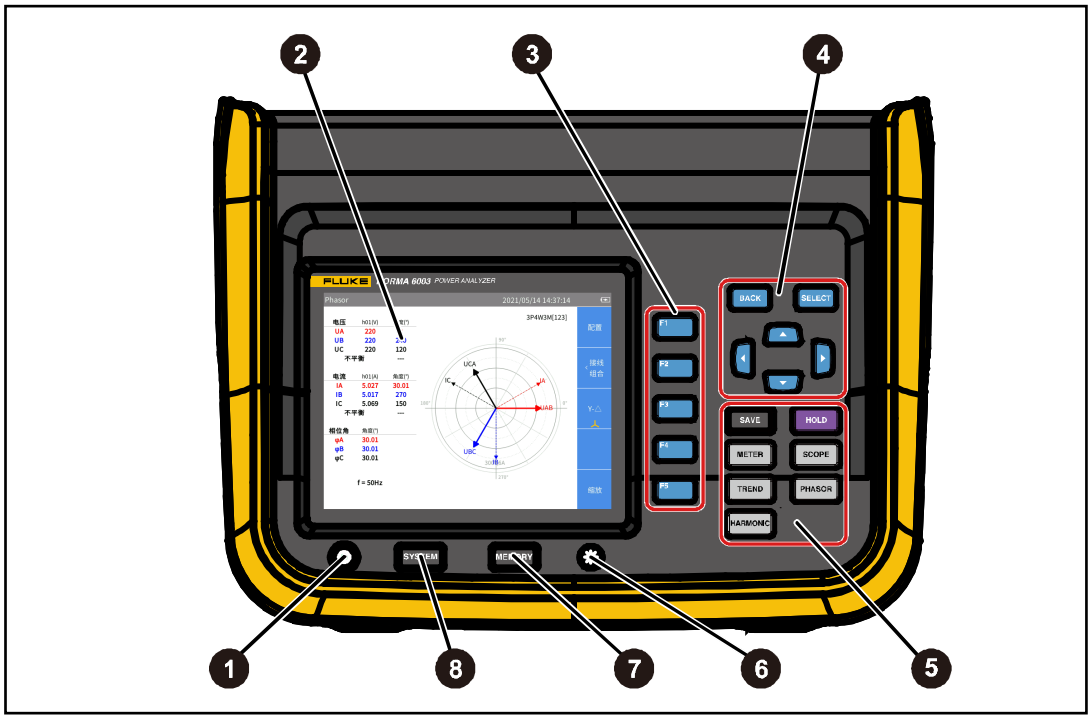
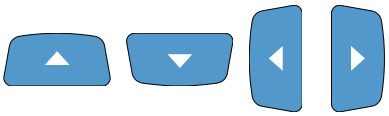


Figure 6. Control Panel

Table 4. Components on the Control Panel

Item	Description
❶	 **Power button** The power button is also indicates the AC power connection. If the indicator light is lit, when the Product is off, that indicates that AC power is connected. The button is orange when the battery is being charged; and green when the battery is fully charged. - Push to turn on/off the Analyzer. - Push and hold for 15 seconds to force the Analyzer to shut down.
❷	**Screen** 5.7” TFT LCD screen, 640×480 pixels. See *Display Screen*.
❸	 **Function keys** The F1 to F5 function keys correspond to the soft keys from top to bottom on the right next to the screen, the corresponding function keys are equivalent to the soft keys. The label of the soft key varies depending on the function and interface.
❹	 **Back key** Push **BACK** to exit the current screen and return to the previous screen or the previous menu.  **Select key** When a function on the screen is selected (highlighted in yellow), push **SELECT** to select or enter the function.  **Arrow keys (up, down, left, and right)** Push the keys to go through all selectable functions on the screen and select one of them, the currently selected function is highlighted in yellow.

Item	Description
❺	**Interface buttons** HOLD **Hold/Run** Push **HOLD,** the Product freezes the reading on the screen and the screen will not refresh until you push **HOLD** again. Although the screen is frozen, the Product continues to measure. SAVE **Save/Logger** - **Short push**: Save the current data or settings of the Analyzer. - **Push and hold for 2 seconds**: Enter the logger mode to continuously log the measurements of the current screen (for Meter mode only). See *Data Management* for details. METER **Meter** Enter Meter Mode. See *Meter* for details. SCOPE **Scope** Enter Scope Mode. See *Scope* for details. TREND **Trend** Enter Trends Mode. See *Trend* for details. PHASOR **Phasor** Enter Phasor Mode. See *Phasor* for details. HARMONIC **Harmonic** Enter Harmonics Measurement Mode. See *Harmonic* for details.

Item	Description
❻	**Backlight** - **Short push:** adjust the brightness of the backlight, which can be adjusted in multiple levels. - **Push and hold for 2 seconds**: capture the current screen and save it as a PNG format.
❼	MEMORY **Memory operation** Manage data stored in internal memory. See *Logger Memory* for details.
❽	SYSTEM **System setting buttons** Instrument information, instrument settings, communication settings. See *System Settings* for details.

Display Screen

The display is shown in *Figure 7.*

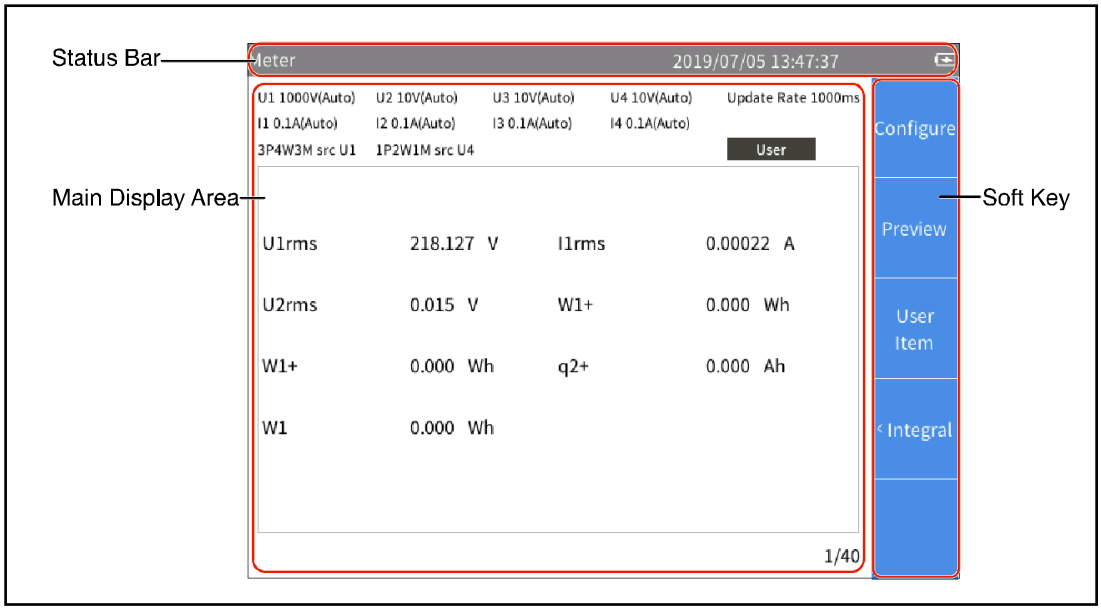


Figure 7. Screen

Status Bar

Table 5.Status bar

Item	Description
1	**Menu navigation** Displays the menu path of the current screen, for example: **Configure** > **Wiring**.
2	**Clock** Shows the current date and time of the Analyzer.
3	**Integration identifier** When integrating, the status bar shows the integral indicator. See *Integration* for details.
4	**or RS485** Indicates that the communication is connected.
5	**Battery status** Displays battery status. - : the charging indicator, this shows that the Product is connected to the main power. - : the main power is not connected, and the vertical bar in the icon indicates the battery level.

Main Display Area

The main display area is the main display area of the screen for displaying various setting options, current measurements, charts and lists.

The main display area displays different content depending on the current interface mode and location, as detailed in the relevant sections below.

Soft Keys

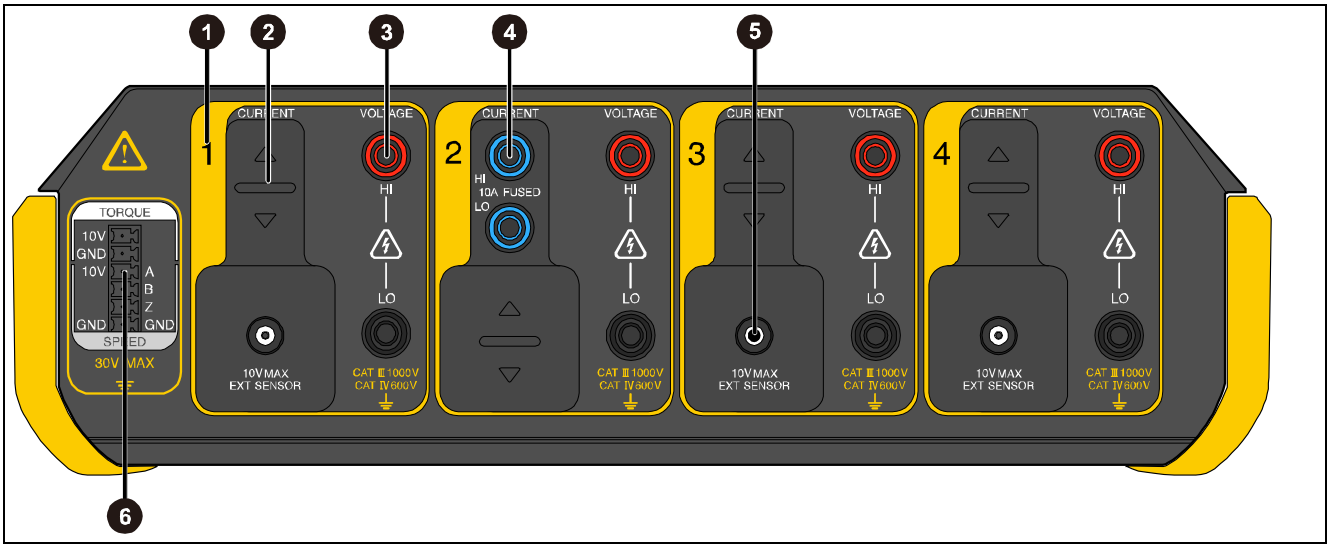
The soft keys at the right side of the display, have labels that will vary depending on the functions and interfaces. The soft keys correspond to the function keys (F1 to F5) on the right side of the screen.

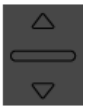
If a soft key has no label, the key has no function.

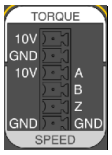
Except for the main screen, the first menu item for the main measurement screens, F1 is **Configure**, which is used for global configuration. Therefore, the function of the F1 (Configure) key is not described again in the menus.

Interface Panel

Table 6. Connector Panel



Item		Description
1		**Voltage/current input channel number**
2		**Current port protection cover** The protective cover can slide back and forth. When the protective cover slides forward, the external current sensor input port is exposed; when the protective cover slides back, the current input port is exposed.
3		**Voltage input port**
4		**Current input port**
5		**Input port for external current sensor**

<table>
<tr><th colspan="2">Item</th><th>Description</th></tr>
<tr><td>❻</td><td> 
</td><td>Input port for motor speed / torque signal
<table>
<tr><th>Pin</th><th>Signal</th></tr>
<tr><td>1</td><td>Input for torque analog quantity, 10 V range</td></tr>
<tr><td>2</td><td>Common port for torque input</td></tr>
<tr><td>3</td><td>Input for speed analog quantity, 10 V range; or input for speed pulse, A pulse</td></tr>
<tr><td>4</td><td>Input for speed pulse, pulse B</td></tr>
<tr><td>5</td><td>Input for speed pulse, pulse Z</td></tr>
<tr><td>6</td><td>Common port for speed input</td></tr>
</table></td></tr>
</table>

Operation

Global Configuration

Under all view modes (Meter, Scope, Trend, Phasor and Harmonic), the soft key F1 is **Configure**. The Configure soft key is global configuration and is applied to all other modes.

Use the **Configure** menu to set the Analyzer's range for each channel, timing synchronization, wiring, formula, zero and formula editing.

This section explains in detail the functions and operation of the Configure menu.

Enter the Configure Menu:

- From the Main screen of any view mode select F1 (**Configure**).

The functions in the Configure menu are as shown in *Table 7*.

Table 7. Global Configuration

Item	Description
Range	F1 Sets the voltage/current range for each channel, ratio, filter, and selects whether to use an external sensor. NORMA 6003+ and NORMA 6004+ can also set the mode and ratio of the motor torque/speed measurement. See *Set Range* for details
Wiring	F2 Sets the wiring selection and the synchronization source of each wiring group. For detailed information, see *Set the Wiring Selection*.
Timing Sync	F3 Sets the sync source of each wiring group. For detailed information, see *Set Sync Source and Update Rate.*
Zero	F4 Eliminates the Analyzer's input offset by zeroing. See *Zero.*
Formula	F5 Defines the efficiency formula and the formula for some numerical calculation. See *Define Calculation Formula* for details.

Set Range

1. From the Main screen of any view mode, select F1 (**Configure**) > F1 (**Range**) >F1 (**CH1**).
2. The Configuration interface of channel 1 is as shown in *Table 8.*

Table 8. Range Configuration

Item	Description
Vol. Range	**Voltage range options:** - Auto: Autorange. The Analyzer automatically selects the voltage measurement range with the best resolution. - 10 V - 100 V - 1000 V
Vol. Ratio (V/V)	Scale of an external voltage sensor (PT). After setting the scale of the external voltage sensor correctly, the Analyzer automatically calculates the actual voltage value of the measured signal based on the voltage scale and the measured value. The Vol. Ratio represents the voltage ratio of the external sensor. For example, when connecting the U1500s high-voltage probe with a voltage ratio of 4mV/V, which represents a voltage ratio of 4:1000, the Vol. Ratio (V/V) on the Analyzer should be set to 0.004. **⚠⚠Warning** **If the voltage input terminal is not connected to an external voltage divider in series, set the scale to 1, otherwise the measured voltage will not not consistent with the actual voltage, there is a danger of electric shock.** **If the voltage input terminal is connected with an external voltage divider in series, the actual voltage will be calculated according to the set scale.**
Vol. Line Filter	**Voltage signal filter options:** - **OFF**: No filter is used. - **650 Hz:** Automatically turn on the line filter, and the cutoff frequency is 650 Hz. Use to observe the synthesis frequency signal of the frequency conversion system. - **10 kHz:** Automatically turn on the line filter, and the cutoff frequency is 10 kHz. Use for anti-aliasing. Inserting a voltage measurement circuit has a direct impact on the measurement of voltage and power. When the line filter is turned on, the measurements do not contain high frequency components. Noise from the frequency inverter or distorted waveform can be removed.

Item	Description
Cur. Range	**Current range options:** - **Shunt:** Auto, 0.1A, 1A, 10A (when "Ext. Sensor" is not selected) - **Ext. Sensor:** Auto, 0.1V, 1V, 10V (when "Ext. Sensor" is selected)
Ext. Sensor	Choose whether to use an external sensor. When the external sensor is selected/deselected, you must reset the current range. If an external sensor is not selected, the current signal is directly connected to the current channel of 10A, and the current is measured via the internal shunt; If an external sensor is selected, the current is measured by connecting the current signal of external sensor output to the BNC interface.
Cur. Ratio (A/A)	Scale of an external current sensor (CT). After setting the scale of the external current sensor correctly, the Analyzer automatically calculates the actual current value of the measured signal based on the current scale and the measured value. The ratio settings are, A/A and mV/A. If the internal shunt is selected, the current scale represents the ratio of the actual current (A) to the input current (A) on the shunt (that is A/A). If an external sensor (BNC) is selected, the current ratio represents input voltage (V) on the BNC port to the ratio of the actual current (A) of the connected sensor (expressed as mV/A). For example, when connecting a current sensor probe with an output sensitivity of 1 mV/A, which represents a 1:1000 ratio, the Cur. Ratio (A/A) on the Analyzer should be set to 0.001.
Cur. Line Filter	**Current signal filter options:** - **Off**: No current filter is used. - **650 Hz:** Automatically turn on the line filter, and the cutoff frequency is 650 Hz. Use to observe the synthesis frequency signal of the frequency conversion system. - **10 kHz:** Automatically turn on the line filter, and the cutoff frequency is 10 kHz. Use for anti-aliasing. **Inserting a current measurement circuit has a direct impact on current and power measurements. When the line filter is turned on, the measurements do not contain high frequency components. Noise from the frequency inverter or distorted waveform can be removed.**

3. **Vol. Range** is selected by default in the Configuration interface.
4. Push SELECT (**Select**) on the control panel and use the up and down arrow (▼ ▲) keys to select the corresponding option. Then push SELECT (**Select**) again to confirm the option.
5. Use the up and down arrow (▼ ▲) keys to move the cursor to **Scale. Volt.**. Then push SELECT (**Select**).

6. An input keyboard appears. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor over the corresponding character on the keyboard, then push SELECT (**Select**) to enter the value into the input box at the top. Repeat until all characters are entered.

Note

For the characters on the keyboard:

k = ×10³； m = ×10⁻³； μ = ×10⁻⁶； M = ×10⁶。

<-- *is the backspace key, which deletes a character before the cursor.*

7. Use the up and down arrow (▼ ▲) keys to highlight **Ok** on the keyboard, then push SELECT (**Select**) to confirm the input value. To abandon your changes, select **Exit** on the keyboard and push SELECT (**Select**); or simply push BACK (**Back**) directly on the control panel.
8. Use the up and down arrow (▼ ▲) keys to move the cursor to the **Vol. Line Filter** and push SELECT (**Select**) on the control panel.
9. Use the up and down arrow (▼ ▲) keys to select the corresponding option. Then push SELECT (**Select**) again to confirm the option.
10. Use the up and down arrow (▼ ▲) keys to move the cursor to **Cur. Range**.
11. Repeat step *4* to set the current range.
12. Use the up and down arrow (▼ ▲) keys to move the cursor to the **Ext. Sensor**.
13. At this point, each push of SELECT (**Select**) toggles between selected (“X” is shown) and not selected (blank) external sensors.

Note

The nameplate of the shunt or probe is usually marked with its parameter settings. Please refer to the relevant information of the external sensor if necessary.

⚠⚠Warning

Please set the parameters strictly according to the scale of external voltage divider, current shunt and current clamp. Otherwise, the measurement will not reflect the actual signal and there is danger of electric shock.

14. Use the up and down arrow (▼ ▲) keys and SELECT (**Select**) to complete the configuration of the remaining items.
15. Push BACK (**Back**) on the control panel to go back to the previous menu.
16. Push F2 (**CH2**) to F4 (**CH4**) directly to set channel 2 to 4.
17. Push BACK (**Back**) on the control panel repeatedly to go back to the main screen.

Note

The 10 kHz anti-aliasing filter is in the measurement channel. The anti-aliasing filter is necessary to analyze Fast Fourier Transform (FFT) data correctly and can be used to ensure that the measurement bandwidth is much less than 1⁄2 sample rate to avoid signal aliasing.

650 Hz low-pass filtering is implemented by a digital filter that helps distinguish the synthesis frequency and carrier signals of the variable frequency system. Turn on this filter to easily observe the synthesis frequency of the frequency conversion system.

If measuring a 3-phase system, Fluke recommends that the line filter settings for each channel in the 3-phase system should be consistent.

The filter is off by default.

Motor Speed / Torque Channel Configuration

1. From the Main screen of any view mode select F1 (**Configure**) > F1 (**Range**) > F5 (**Motor**).
2. The Configuration interface of Motor Speed / Torque is as shown in *Table 9*.

Table 9. Motor Speed / Torque Channel Configuration

Item	Description
Speed	
Mode	**Speed signal mode options:** - **10V** (default): Use for speed sensor for analog voltage output. If the sensor uses current, frequency or other analog output, it must be converted to voltage before input. - **A:** For encoders with single pulse, only the speed value is measured and recorded, the direction of rotation is not measured and recorded. - **AB:** For encoders with AB double-pulse, both speed value and direction are measured and recorded. - **ABZ:** For ABZ absolute encoder, both speed value and direction are measured and recorded.
Ratio	Speed sensor ratio. When "**Mode**" is set to "**10V**", the ratio is in V/rpm, which indicates that how much voltage (V) it is related to the motor speed (rpm). The formula for the Analyzer to calculate the actual speed is as follows: Speed = Voltage/ Ratio When "**Mode**" is set to another option, the unit of the ratio is the number of pulses per revolution (PPR). The formula for the Analyzer to calculate the actual speed is as follows: Speed (rpm) = Pulses per Minute / Ratio

Item	Description
Torque	
Mode: The torque input is 0 V to 10 V the supported input signals must be conditioned to operate within these limits. If the sensor has a current output this must be converted using a shunt resistor before applying to the input.	
Ratio	Torque sensor ratio. The formula for the Analyzer to calculate the actual torque is: Torque = Voltage / Ratio

3. The "**Mode**" is selected by default in the configuration interface (the drop-down menu is highlighted in yellow).
4. Push SELECT (**Select**) and use the up and down arrow (▼ ▲) keys to select the corresponding option. Then push SELECT (**Select**) again to confirm the option.
5. Use the up and down arrow (▼ ▲) keys to move the cursor to the "**Ratio**" option. Then push SELECT (**Select**).
6. Enter the correct values on the keyboard by using the up and down arrow (▼ ▲) keys and pushing SELECT (**Select**) on the control panel.
7. Use the up and down arrow (▼ ▲) keys to highlight the **Ok** button on the keyboard, then push SELECT (**Select**) to confirm the input value.
8. For the "**Ratio**" option of the torque, repeat step *5* to *7* to configure the torque ratio in V/Nm.
9. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the **Apply** button and push SELECT (**Select**). The settings are not saved to the device if you do not select **Apply**.
10. Push BACK (**Back**) repeatedly to go back to the main screen.

Set the Wiring Selection

To measure the power of various single-phase or three-phase power, different wiring selections are required, and multiple channel combinations are used.

The Analyzer provides these basic wiring selections:

- 1P2W1M, 1-phase 2-wire 1-meter
- 3P3W2M, 3-phase 3-wire 2-meter
- 3P4W3M, 3-phase 4-wire 3-meter
- 3P3W3M, 3-phase 3-wire 3-meter

Note

In the abbreviation of the wiring selection, letter "P" indicates "Phase"; letter "W" indicates "Wire"; letter "M" indicates "Meter", that is power meter (includes one set of voltmeter and ammeter).

1P2W1M

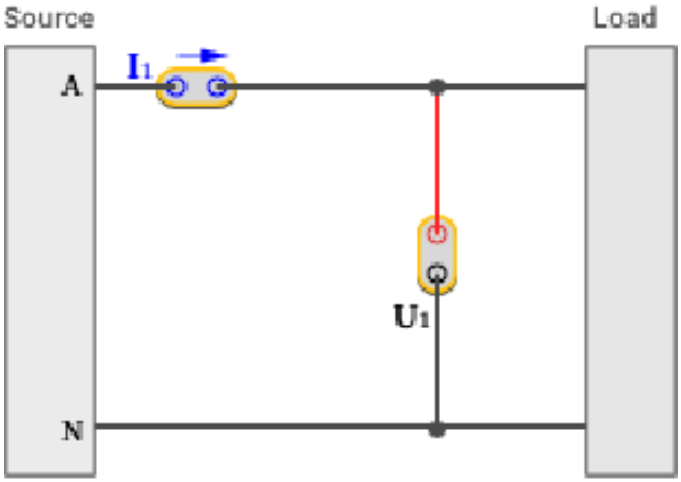


Figure 8. 1P2W1M Wiring

For 1P2W1M wiring, connect a voltage measurement channel between the phase line and the zero line; connect a current measurement channel in series with the phase line or the zero line (note the direction) or clamped on the phase line or the zero line with a current sensor.

3P4W3M

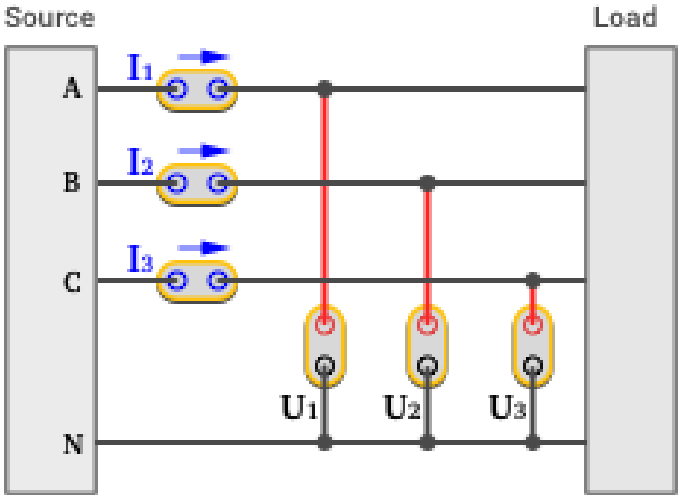


Figure 9. 3P4W3M Wiring

For 3P4W3M wiring, 3 voltage measurement channels are respectively connected between each phase line and the zero line; 3 current measurement channels are respectively connected in series with each phase line or clamped on each phase line with a current sensor.

For systems without zero lines, connect 3 voltage measurement channels between the 3 phase lines and the common ground line. For a 3P5W system, you can use a wiring group of 3P4W3M to measure the phase and zero line. You can select one channel and configure it as 1P2W1M to

measure the parameters between the zero and ground line (NORMA 6004/6004+ only). If the ground and zero lines do not exist, connect the common ends of the 3 channels together and suspend, and the total power measured is still valid.

For this wiring system:

1. The wiring system has the same impedance characteristics for 3 phases, a balanced measurement system can be established.
2. The wiring system has a terminal for zero or ground, the common mode component input to the instrument is small, which reduces the effect of common mode components on the measurement results.
3. The phase voltage is directly measured, and the line voltage is calculated by Δ. It is more suitable for measuring systems of star connections.

3P3W3M

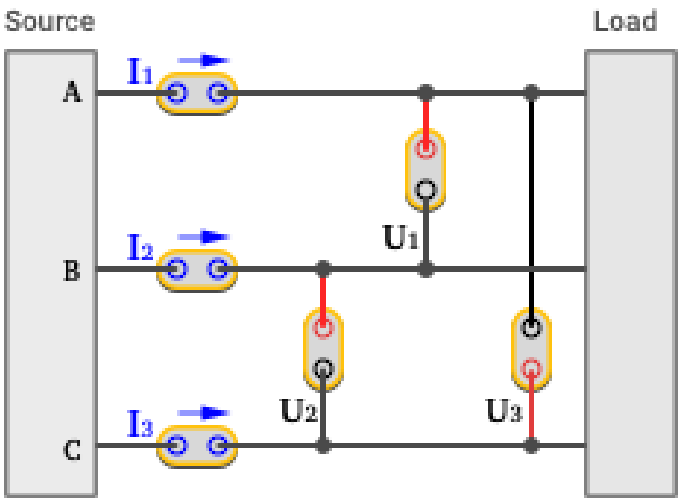


Figure 10. 3P3W3M Wiring

For 3P3W3M wiring, 3 voltage measurement channels are respectively bridged between 2 phase lines; 3 current measurement channels are respectively connected in series with each phase line or clamped on each phase line with a current sensor.

For this wiring system:

1. This wiring system has the same impedance characteristics for 3 phases, a balanced measurement system can be established.
2. When measuring the frequency conversion system with the power frequency input, this wiring system can appropriately eliminate the power frequency component in the frequency conversion signal, which is conducive to more accurately capturing the conversion frequency.
3. The line voltage is directly measured, and the phase voltage is calculated by Δ. It is more suitable for measuring systems of Δ connections.

4. The zero line current can be measured by summing 3 current channel, but the zero line voltage cannot be measured. When the zero line voltage/zero line current is present, the total power measured is also inaccurate.

3P3W2M

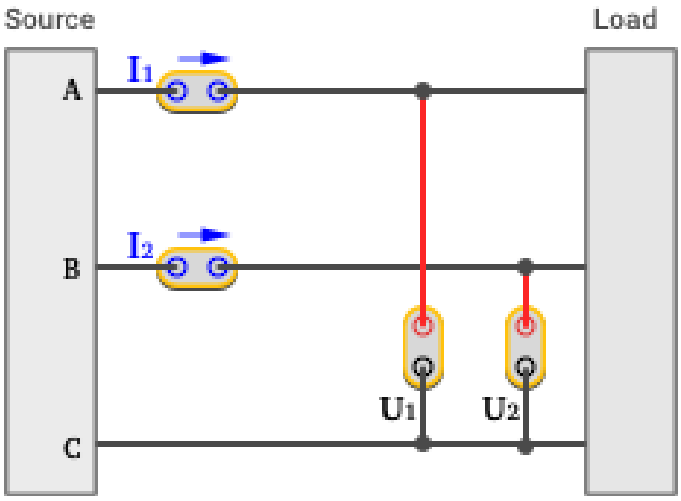


Figure 11. 3P3W2M wiring

For 3P3W2M wiring, 1 phase line (C) is used as a common line, 2 voltage measurement channels are respectively bridged between the other 2 phase lines and this phase line; 2 current measurement channels are respectively connected in series to the other 2 phase lines, or a current sensor is clamped on the other 2 phase lines (Also known as two-wattmeter method or Aron method).

For this wiring system:

1. The wiring system can measure 3-phase system with only 2 channels, and 1-2 channels can be reserved for measuring DC, single-phase AC or 3-phase AC (simultaneous measurement of 2-channel 3-phase AC is only availalbe for NORMA 6004/6004+).
2. When measuring the frequency conversion system with the power frequency input, this wiring system can appropriately eliminate the power frequency component in the frequency conversion signal, which is conducive to more accurately capturing the conversion frequency.
3. The system impedance for the 3 phases is different; the phase voltage and part of the line voltage are calculated by Δ; in addition, this wiring system cannot measure the voltage and current of the zero line. When the zero line voltage/zero line current is present, the total power measured is also inaccurate.

Wiring System Comparison

	3P4W3M	3P3W3M	3P3W2M
Number of channels occupied	3	3	2
Balanced test impedance	Yes	Yes	No
The power frequency components of frequency conversion systems can be eliminated	No	Yes	Yes
Phase voltage	Direct measurement	Indirect calculation	Indirect calculation
Line voltage	Indirect calculation	Direct measurement	Partial direct measurement
Common mode interference voltage inputted	Low	Moderate	High
Zero line current measurement	Yes	Yes	No

Note

*Where the current is measured may have some effect on the measurement results. To mitigate this effect, consider where the voltage and current are measured. For a signal with high voltage and low current, the voltage channel should be connected to the side that is closest to the source, the current channel should be connected in series (or the sensor should be placed) to the side that is closest to the load (as shown in the wiring diagrams); for a signal with low voltage and high current, connect the voltage channel to the side that is closest to the load, and connect the current channel in series (or the sensor should be placed) to the side that is closest to the source. Please refer to the appendix "*Measurement Error Caused by the Channel Resistance**".*

Wiring Group

When you select a specific wiring selection, use a combination of 2 or more channels, which is called a wiring group.

For example, when the wiring selection of channel 1 is set to 3P3W2M, channel 1 and channel 2 form a wiring group.

Enter the Wiring Selection Configuration:

1. From the Main screen of any view mode select F1 (**Configure**) > F2 (**Wiring**).
2. The Configuration interface of wiring selection is as shown in *Figure 12*.

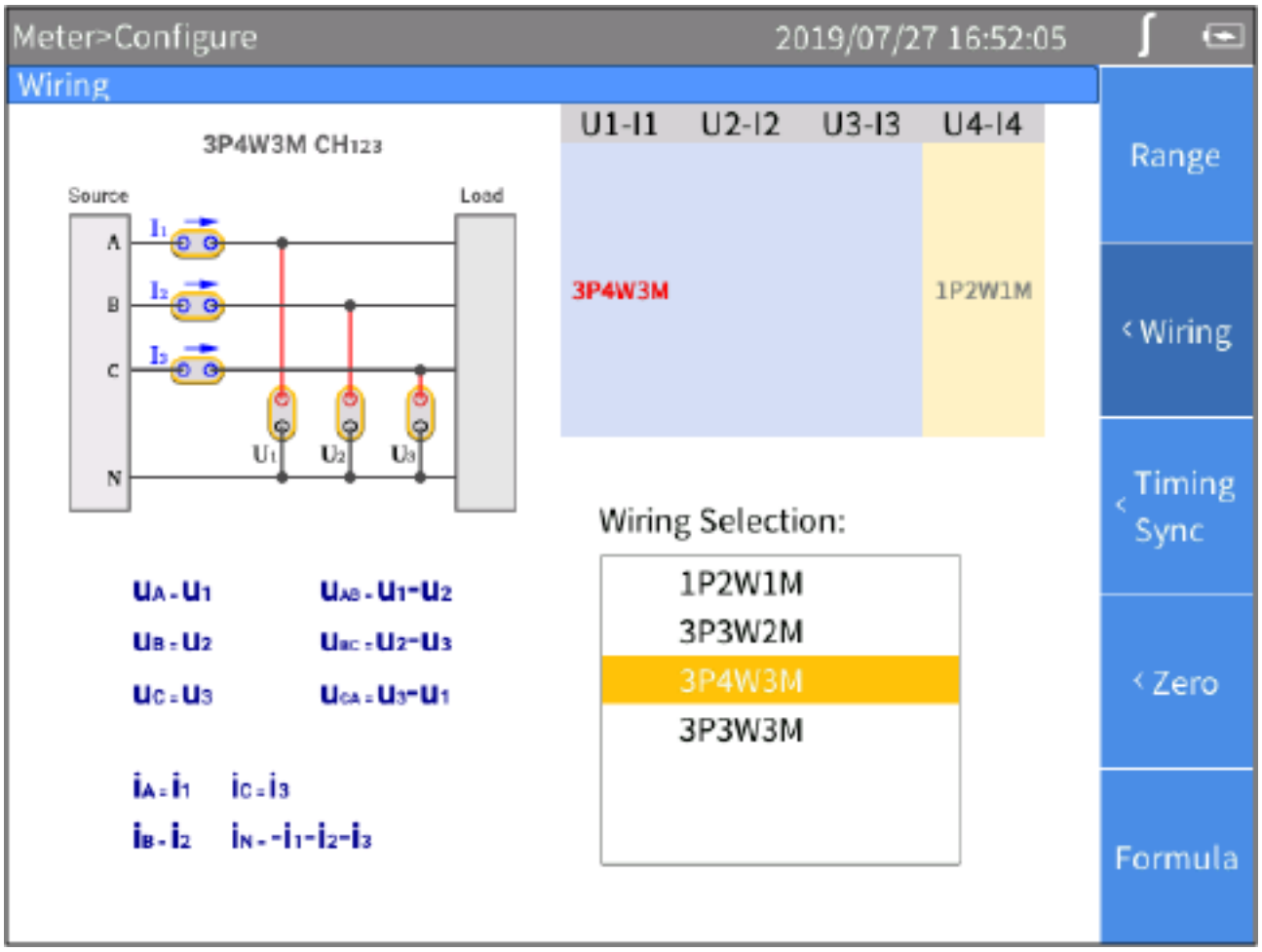


Figure 12. Wiring

Note

The optional wiring selection is related to the number of channels equipped with the Analyzer, and the interface of wiring selection will be different. Proper selection of wiring is conducive to ensuring more accurate measurements.

The wiring Configuration interface is generally divided into these parts:

- **Channel selection**: The upper right part shows the wiring group configuration of all 3/4 channels. Different wiring groups can be selected by using the left and right arrow (◧ ◨) keys on the control panel. The name of the selected wiring group is highlighted in red.
- **Wiring selection**: The lower right part shows the wiring options supported by the currently selected channel. Use the up and down arrow (◒ ◓) keys on the control panel to select the wiring mode of the corresponding channel.
- **Wiring diagram**: The upper left part shows the wiring diagram of the currently selected wiring mode in the "**Wiring Selection**".
- **Formula:** The lower left part shows the parameter calculation method of the currently selected "**Wiring Selection**".

Make a Wiring Selection:

1. In the Wiring screen (*Figure 12*), use the left and right arrow (▶ ◀) keys to select a channel or wiring group in “**Channel Configuration**”. The wiring selection of the selected channel/wiring group is highlighted.
2. Use the up and down arrow (▼ ▲) keys to select the appropriate wiring mode in "**Wiring Selection**".
3. Push SELECT (**Select**) on the control panel.
4. Repeat step *1* to *3* to complete the configuration of all channels.
5. Push BACK (**Back**) to go back to the previous menu; push the button continuously to go back to the main screen

Set Sync Source and Update Rate

The sync source is a reference input signal, and the time interval of the measurement is determined according to the frequency of the selected sync source signal, and the sample values in this interval are used to generate measurements such as voltage, current and power, thereby ensuring calculation with the signal of the entire cycle to avoid measurement errors due to signal truncation.

1. From the Main screen of any view mode select F1 (**Configure**) > F3 (**Timing Sync**).
2. The setup interface of Timing/Sync is as shown in *Table 10.*

Table 10. Timing & Sync

Item	Description
Update rate	The time interval at which the DSP calculates the data values. 100 ms 200 ms 500 ms 1 s
Source	The sync source of each wiring group. All channels in each wiring group can only share the same sync source. The available sync sources include voltage and current signals for all channels in the wiring group.

Note

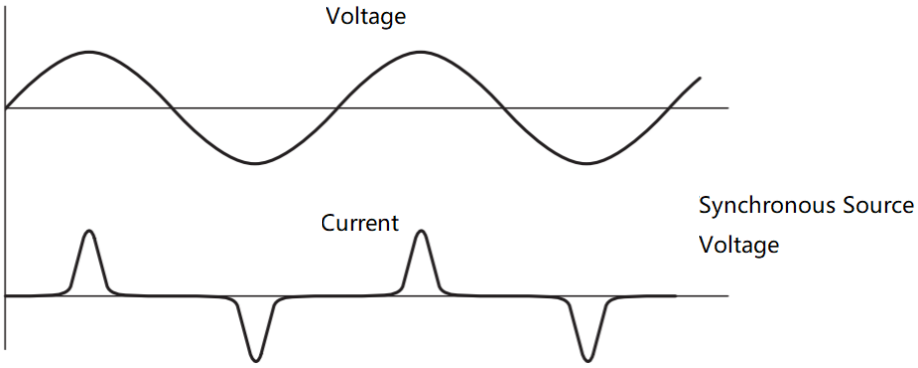
The wiring groups that can be configured in the interface depends on the wiring selection. See Set the Wiring Selection *for details.*

3. Use the up and down arrow (▼ ▲) keys to move the cursor to “**Update Rate**”.
4. Push SELECT (**Select**) and use the up and down arrow (▼ ▲) keys to select the corresponding option. Then push SELECT (**Select**) again to confirm the option.
5. Use the up and down arrow (▼ ▲) keys on the control panel to move the cursor to the first wiring group in “**Source**”.

6. Push SELECT (**Select**) and use the up and down arrow (▼ ▲) keys to select the corresponding option. Then push SELECT (**Select**) again to confirm the option.
7. Use the left and right arrow (▶ ◀) keys to select each of the remaining wiring groups one by one and repeat the step *6*.
8. Push BACK (**Back**) on the control panel to go back to the previous menu; push the button continuously to go back to the main screen

Set Sync Source

When the Analyzer measures AC signals, most of the measurements are calculated using the full-cycle sampling method to reduce the truncation error. In this case, a channel needs to be selected as the sync source to determine the length of the entire cycle.



For each wiring group, you can select a sync source, and the voltage or current of any channel in the wiring group can be selected as the sync source. In general, the voltage of the power frequency system is more stable than the current. Fluke recommends using the voltage as the sync source. The voltage of the frequency conversion system has a large high-frequency component, while the high-frequency component of the current is relatively small. Therefore, when the current is relatively stable, the current can be selected as the sync source; however, if the current value is small or it is not stable, then the voltage should be selected as the sync source.

Zero

The function of zeroing is to reset the current value of the specified channel to calibrate the the zero position of the Analyzer itself and the external sensor. The Analyzer supports zeroing each module.

1. From the Main screen of any view mode select F1 (**Configure**) > F4 (**Zero**).
2. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the option you want to zero, then push SELECT (**Select**), the selection box of the current item turns yellow and a black “×” symbol shows, indicating that it has been selected. If you push SELECT (**Select**) again, the selection box will be restored to blank, indicating that it is not selected.
3. Repeat step *2* for each channel you want to zero.
4. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the **Zero** button and push SELECT (**Select**) on the control panel.

Define Calculation Formula

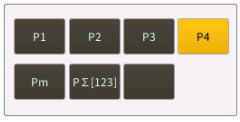
The Analyzer allows the user to define efficiency and some numerical calculation formulas.

Define Efficiency Calculation Formula

The Analyzer allows the user to edit the efficiency calculation formula. The user can set the input and output power source of the system to be measured and calculate the efficiency.

1. From the Main screen of any view mode select F1 (**Configure**) > F5 (**Formula**) > F1 (**η**)。
2. The interface of calculation formula definition is as shown in *Table 11*.
3. Use the up and down arrow (▼ ▲) keys to move the cursor to the numerator of the efficiency (η) formula. When the numerator portion turns yellow, push SELECT (**Select**).

Table 11. Define Calculation Formula

Item	Description
❶	 **Measured parameters from main unit** This part of the keyboard lists all measurable power symbols for the Analyzer's current wiring selection. For the specific meaning of each parameter, refer to section "*Measurement Calculation Method*" in the appendix.
❷	 **Measured parameters from the slave** - The measured parameters of the remote slave unit in the dual-unit interconnection mode. - In single unit mode, this part is gray and cannot be selected. For the specific meaning of each parameter, refer to section "*Measurement Calculation Method*" in the appendix.

Item	Description
❸	**Operators and buttons** [+] [-] **Operators of addition and subtraction** <-- **Delete key** Delete a symbol before the cursor. Clear **Clear key** Clear all characters in the input box. Ok **OK key** Accept the current input and go back. Exit **Exit key** Go back and ignore this modification.

4. A keyboard shows on the screen.
   The keyboard is divided into 3 parts: the top area shows all the measured parameters of the main unit; the middle "**Remote**" area shows the measured parameters of the remote slave unit in the dual-unit interconnection mode (in single unit mode, this area is gray and not selectable); the bottom area contains operators and buttons.
5. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor over the corresponding character on the keyboard, then push SELECT (**Select**) to enter the value into the input box at the top.
6. Repeat step *5* to enter an expression that conforms to the efficiency calculation rule in the input box.

Note

During input process, if the input does not conform to the rules, the Analyzer will indicate the input is incorrect. Please double check that the input conforms to the efficiency calculation expression rules.

7. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to **OK** and push SELECT (**Select**).
8. For the denominator of the efficiency (η) formula, repeat step *3* to *7*.
9. Push SELECT (**Select**) to go back to the main screen.

Define hvf/hcv Calculation

hvf/hcv is a numerical measurement item used for measuring rotating motors according to IEC60034. It is necessary to configure the type of motor and rated voltage/current according to the actual test requirements.

1. From the Main screen of any view mode select F1 (Configure) > F5 (**Formula**) > F3 (**hvf/hcf**).
2. The interface of calculation formula definition is as shown in *Figure 13*.
   In the hvf/hcv calculation page, the upper part is used to calculate hvf, and the lower part is used to calculate hcf.

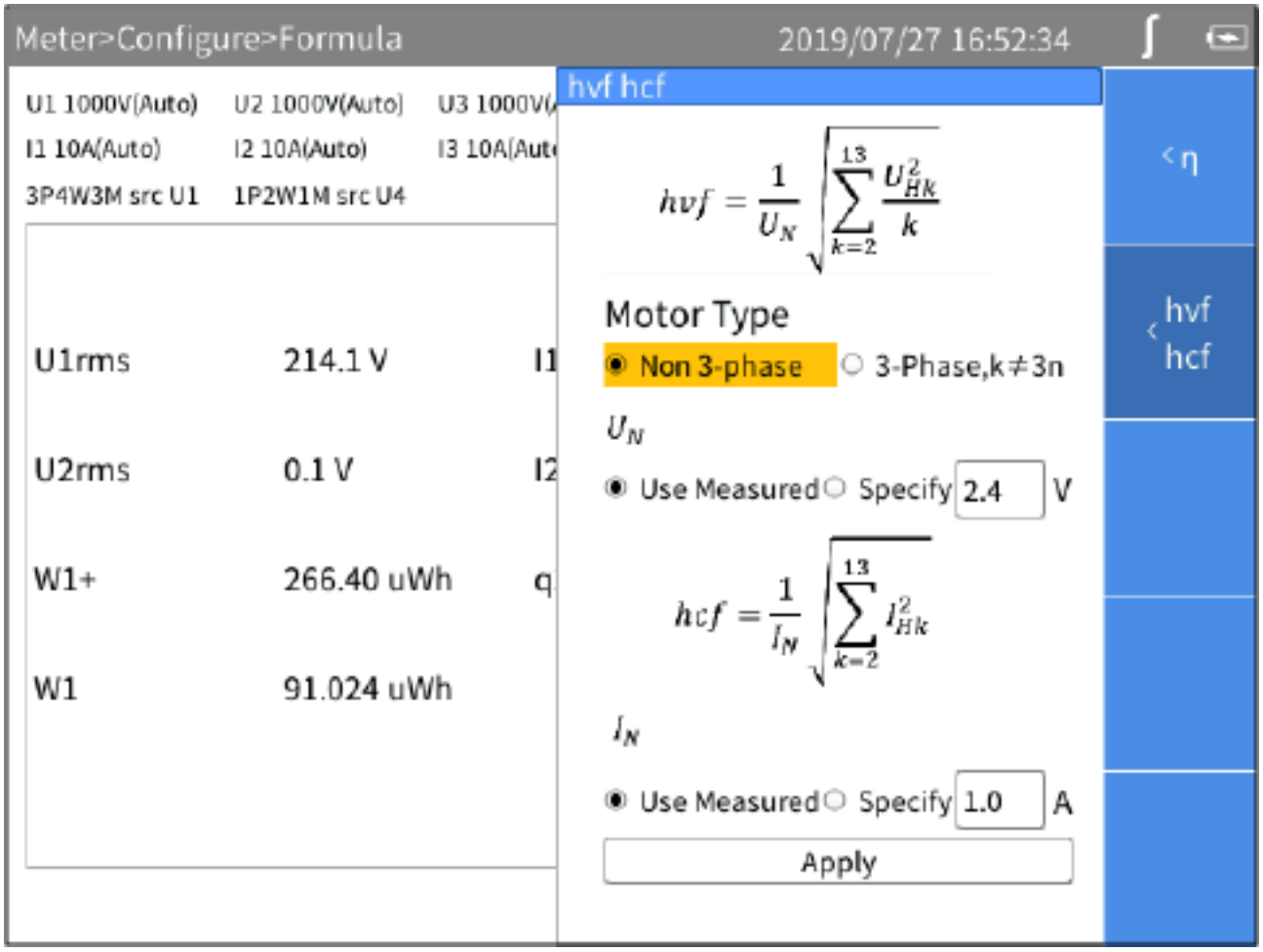


Figure 13. hvf/hcf Calculation Formula

3. Use the arrow (◄ ▲ ► ▼) keys to move the cursor to “Motor Type”, select **Non 3-phase** or **3-phase, k≠3n** and then push SELECT (**Select**).
4. Use the arrow (◄ ▲ ► ▼) keys to move the cursor to “U_N” (rated voltage)， select **Use Measured** or **Specify** and then push SELECT (**Select**) on the control panel.
   If **Use Measured** is selected, the measured voltage fundamental amplitude is used as the rated voltage; if **Specify** is selected, you can specify the rated voltage. Move the cursor to the

corresponding input box, then push SELECT (**Select**), and input the corresponding value using the on-screen keyboard, then move the cursor to **OK** key on the keyboard, and push SELECT (**Select**).

5. Repeat step *3* to *4* for hcf settings.
   For I_N, if **Use Measured** is selected, the measured current fundamental amplitude is used as the rated current; if **Specify** is selected, the rated current can be specified.
6. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the **Apply** button and push SELECT (**Select**). The settings are not saved to the device if you do not select **Apply**.
7. Push BACK (**Back**) on the control panel to go back to the previous menu; press the button continuously to go back to the main screen

Meter

After the Analyzer is turned on, it defaults to the **Meter** mode, and the current measurements are displayed in a list on the main screen.

You can also enter the **Meter** mode by pushing METER (**Meter**) on the control panel.

Table 12 lists the items displayed on the screen.

Table 12. Meter Screen

Item	Description
❶	Status Bar See *Status Bar* for details.
❷	Range configuration information Current range information for each module - The representation with (Auto) indicates auto range, which automatically switches the range according to the signal size. - The representation without (Auto) indicates that the current range is fixed, the range of the value displayed and the range will not change with the signal;
❸	Wiring configuration information Current wiring selection for each wiring group
❹	**Update rate** The current update rate of the Analyzer. Please see *Set Sync Source and Update Rate*.
❺	Current state - **Preview**: Currently in Preview mode. - **User Item**: Currently in User Item mode. - **HOLD**: Currently in data hold state. The value displayed in the value list area does not change with the actual signal.
❻	Value List The measurement items are displayed in a list according to the user's settings. See *Preview* and *User Item View* for details.

Item	Description
❼	Soft Keys F1 (**Configure**): Global configuration, see *Global Configuration*. F2 (**Preview**): Enter Preview mode, see *Preview*. F3 (**User Item**): Enter User-defined Mode, see *User Item View*. F4 (**Integral**): Integration Operation, see *Integration*.
❽	Bottom Bar **Displays the current page number or prompts the user for an action to take.**

Preview

In Preview mode, all currently available measurements are shown in a certain order on the screen.

Enter Preview Mode:

- From the Main screen of Meter select F2 (**Preview**).

The Preview screen is as shown in *Table 13* and the state label shows **"Preview**".

Table 13. Meter Screen – Preview

Item	Description
Sort by Func.	F1 **Sort by functions** Sort the measurements list by functions. Push F1 (**Sort by Func.**) to sort the measurements by functions. The label of Sort by Func. is highlighted in dark blue.
Sort by Channel	F2 **Sort by channels** Sort the measurements list by channels. Push F2 (**Sort by CHANNEL**) to sort the measurements by channels.
Display	F3 **Displays the number of items** The number of measurements shown on each screen, up to 20 measurements: - 4 - 8 - 12 - 16 - 20

Item	Description
▲	F4 **Page up key** When the number of measurements available exceeds the number of items displayed on each screen, the ▲ and ▼ keys can be used to scroll forward or backward to display more measurements. The page number of the current screen is displayed in the prompt bar at the bottom. “1/40” shown in *Figure 20* means there are 40 pages in total, and the current screen is page 1.
▼	F5 **Page down key** Page down key for scrolling backward to display next page.

User Item View

The number of measurements can be very large depending on different wiring selection and the number of channels. Even if the maximum number of measurements is displayed on each screen, there could be dozens of screen pages.

The Analyzer features a User Item view function, which allows users to select up to 20 most interesting measurements and display them on a single screen, thus avoiding frequent use of the ▲ and ▼ keys.

Enter User Item View:

- From the main screen of Meter select F3 (**User Item**).

The User Item view is as shown in *Table 14* and the data source label shows “**User Item**”

Table 14. Meter Screen – User Item View

Item	Description
Edit	F1 **Edit the current item** Change the item selected at the current location.
Add	F2 **Add measurements** Add measurements at the end of the list. Up to 20 measurements can be added.
Del	F3 **Delete the current item** Delete the item at the current location.
▲	F4 **Move forward the currently selected item** Moves the currently selected measurement forward by one position in the list. If the currently selected measurement is already at the top of the list, no action is taken when the button is pushed.

Item	Description
	F5 **Move backward the currently selected item** Moves the currently selected measurement forward by one position in the list. If the currently selected measurement is already at the end of the list, no action is taken when the button is pushed.

Note

When you enter the User Item view for the first time, the screen is blank, there are no measurements in the list. Users can add up to 20 measurements to the list.

The Analyzer can remember the User Item views. Even if the Analyzer is turned off, the list defined last time will be automatically displayed when you enter the User Item view next time.

Add Measurement Items

1. From the main screen of Meter select F3 (**User Item**) >F2 (**Add**).
2. All available measurement items are listed by categories in a tree structure. See *Measurement Calculation Method* for details of measurement items.
3. Use F1 through F4 to select category.
4. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor over the corresponding item.

In most cases, there are 2 dialog boxes displayed in the measurement tree menu, the one on the left lists measurement items, and the one on the right lists the supported channels or wiring groups. The yellow block represents the cursor position, and the yellow box indicates the corresponding branch in the current tree structure.

Note

Under Dual-Unit Interconnection mode, "Remote" option will appear in this menu. See Dual-Unit Interconnection *for details.*

5. Push SELECT (**Select**) to add the current option to the end of the list.
   If the left and right dialogs are displayed, first select the name of the measurement item in the left dialog box, then select the channel or wiring group to be added in the right dialog box, and finally push SELECT (**Select**) to confirm.
6. Repeat step *3* to *5* until all required measurements have been added. Totally up to 20 measurements can be added.
7. Push BACK (**Back**) on the control panel repeatedly to go back to the main screen of Meter.

Delete Measurement Items

1. From the main screen of Meter select F3 (**User Item**).
2. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the measurement item you want to delete.
3. Push F3 (**Del**).
4. Repeat step *2* to *3* until you delete all the measurement items you want to delete.
5. Push BACK (**Back**) on the control panel to go back to the main screen of Meter.

Edit the Current Measurement Item

1. From the main screen of Meter select F3 (**User Item**) > F1 (**Edit**).
2. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the measurement item you want to edit.
3. Select the measurement item by following the operation similar to section *Add Measurement Item*.

Unlike the section *Add Measurement Item*, the measurement items added will directly replace the measurement items at the cursor position, instead of adding the newly added measurement to the end of the list.

Change the Position of the Measurement Item

Users can sort the measurement items displayed in the User Defined view:

1. From the main screen of Meter select F3 (**User Item**).
2. Use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the measurement you want to move.
3. Push F4 (▲) or F5 (▼). Each time you push F4 (▲) or F5 (▼), the item at the cursor position moves forward or backward by one position.
4. Repeat step *2* to *3* for each measurement item whose position you want to change.
5. Push BACK (**Back**) on the control panel to go back to the main screen of Meter.

Integration

The Analyzer supports the integration of active power, current and mechanical power to measure electrical energy, electric quantity and mechanical energy.

Enter the Integral Interface:

- From the main screen of Meter select F4 (**Integral**).

The Integral interface is as explained in *Table 15*.

Table 15. Integral

Item	Description
Start	F1 Starts integration. Integration will start immediately after the button is pushed.
Stop	F2 Stops integration. Integration will stop immediately after the button is pushed. (This label does not display anything when the integral is not in progress.)
Reset	F3 Clears the integral values and integral time.

Integration

1. From the main screen of Meter select F4 (**Integral**) > F1 (**Start**).
2. The symbol ∫ appears on the title bar to indicate that integration is in progress.
3. Push BACK (**Back**) on the control panel to go back to the main screen of Meter.

After integration starts, push F2 (**Stop**) to stop integration at any time.

Note

A settling time is required during the automatic range switching, and the sampled value during this time is not accurate, which will cause integral error. Therefore, in order to obtain accurate integration results, it is recommended to set the channel used for integration to manual range, and the size of the range should cover the instantaneous voltage and current.

Harmonic

In HARMONIC mode, the user can analyze the signals in the form of a table/bar/FFT.

Enter Harmonic Mode

- From the main screen of current measurement screen select HARMONIC (**HARMONIC**).

Table 16 lists the items displayed on the screen.

Table 16. Harmonic Screen

Item	Description
❶	**Status Bar** See *Status Bar* for details.
❷	**Items** The name of the currently selected items depends on the options in "Item". See *Select the Harmonics to Display* for details.
❸	**Basic Frequency** The fundamental frequency (Hz) of the reference signal (sync source).

Item	Description
❹	**Total Harmonic Distortion** Total harmonic distortion of the voltage or current of the currently item, U_{THD} or I_{THD}. The unit is%。
❺	**Fundamental Content** Fundamental content of the voltage or current of the currently selected Item, U_{fc} or I_{fc}. The unit is %.
❻	**Harmonic Content** Harmonic content of the voltage or current of the currently selected Item, U_{hc} or I_{hc}. The unit is%.
❼	**Harmonic Voltage/Current Factors** Harmonic voltage or current factor of the currently Item, *hvf* or *hcf*.
❽	**Table or Graph** Displays table, bar or FFT depending on the selected display mode. See the *Harmonic* Table, *Harmonic Bar* and *FFT*.
❾	**Soft Keys** F1 (**Configure**): Global configuration, see *Global Configuration*. F2 (**Item**): Select the harmonic items displayed on the screen , see *Select the Harmonics to Display*. F3 (**Mode**): Harmonic display mode. You can push this button to cycle through harmonic table, bar and FFT. See *Harmonic* Table, *Harmonic Bar* and *FFT*. F4 (**/Axis**): Page Up key or Axis Setup key. It is the Page Up key under the table display mode, and it is the Axis Setup key under the bar and the FFT mode. See *Linear and Logarithmic Axis*. F5 ( ): Page Down, is used to scroll down the page to display more content.
❿	**Bottom Bar** Displays the current page or prompts the user for an action to take.

Change View Mode

- From the main screen of HARMONIC select F3 (**Mode**). Cycle through the table, bar and FFT.

Select the Harmonics to Display

1. From the main screen of HARMONIC select F2 (**Item**).

The "**Item**" menu lists all currently available parameters, including voltage and current.

2. Use the arrow ( ) keys to move the cursor over the corresponding item.
3. Push SELECT (**Select**) on the control panel.

Harmonic Table

Table 17 lists the items shown in the table.

Table 17. Harmonic Table

Item	Description
Harmonic Order	**Harmonic Order**
Magnitude	Harmonic magnitude, absolute value, in V or A.
Percentage	Harmonic percentage, relative to fundamental wave.
Phase	Harmonic phase angle, relative to fundamental wave.
Soft Keys	F1 (**Configure**): Global configuration, see *Global Configuration*. F2 (**Item**): Select the harmonics displayed on the screen, see *Select the Harmonics to Display*. F3 (**Mode**): Harmonic display mode. You can push this button to cycle through harmonic table, bar and FFT. See *Harmonic* Table, *Harmonic Bar* and *FFT*. F4 (▲): Page up key. Each page can display 10 harmonics. When you need to view more harmonic data, you can use the PG UP and PG DN keys to scroll page up or down. F5 (▼): Page Down key, it is used to scroll down the page to display more content.

Harmonic Bar

The harmonic bar is as shown in *Figure 14* where the horizontal axis represents the harmonic order and the vertical axis represents the harmonic amplitude in V or A.

The harmonic bar of each screen shows 50th harmonics. The pages can be turned forward or backward through F5 (PG DN) button to display more harmonic bar.

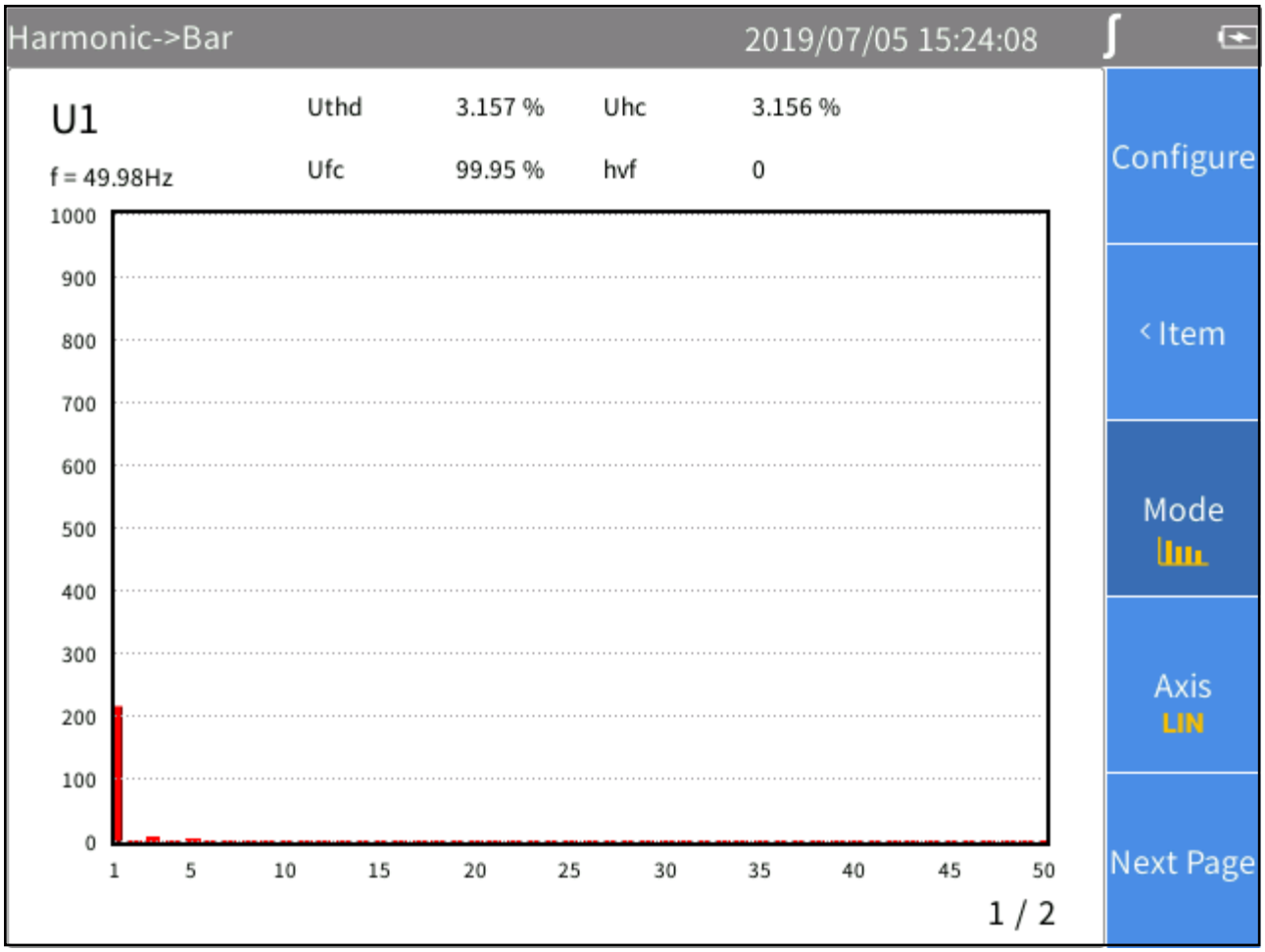


Figure 14. Harmonic – Bar

FFT

The harmonic FFT is as shown in *Figure 15*, where the horizontal axis represents frequency and the vertical axis represents magnitude.

Use the left and right arrow (◗◖) keys to scroll the horizontal axis to see FFT curves at more frequencies.

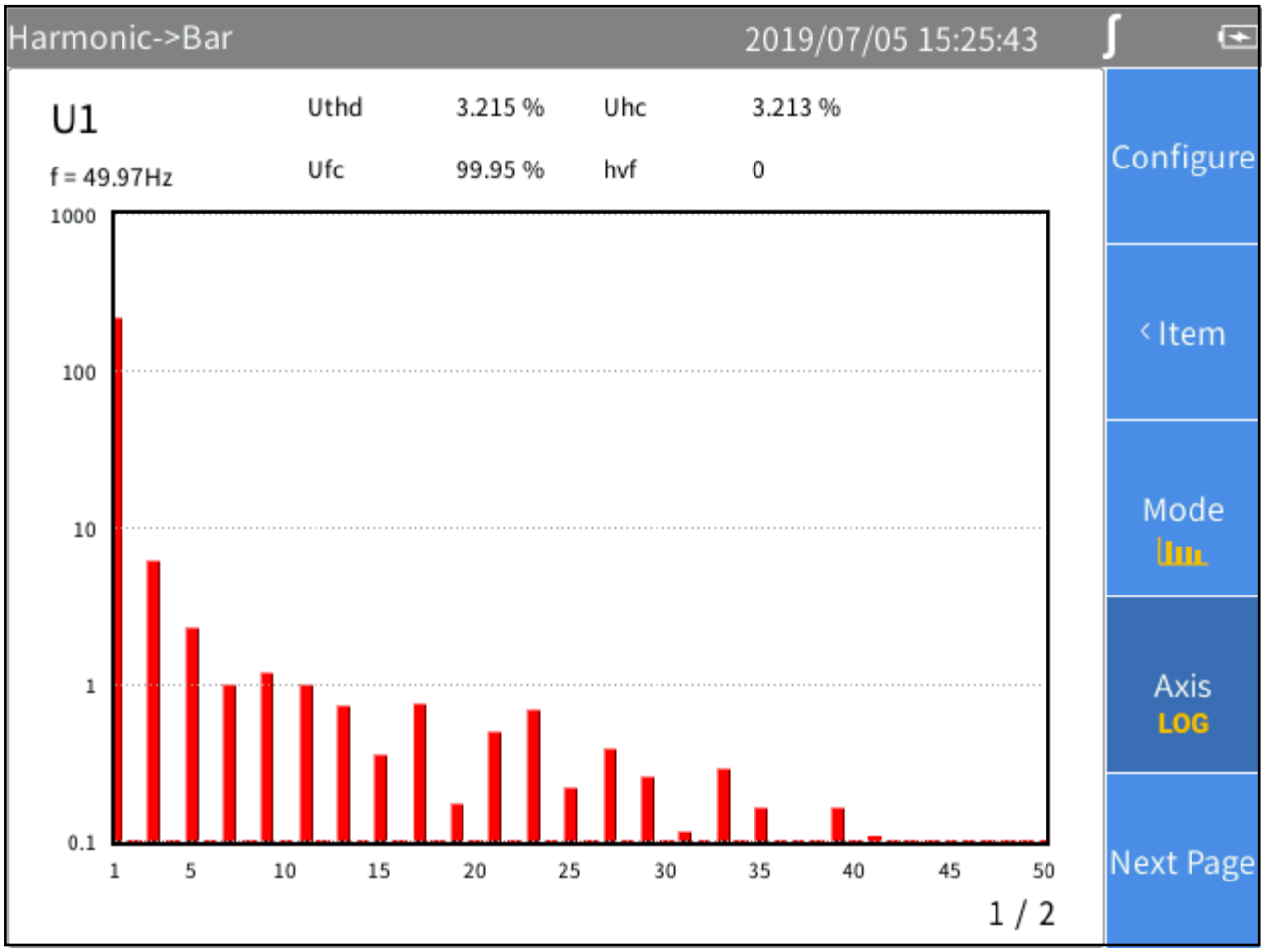


Figure 15. Harmonic – FFT

Linear and Logarithmic Axis

In the harmonic bar and FFT view, use F4 (**AXIS**) button to switch the vertical axis to linear (LIN) or logarithmic axis (LOG).

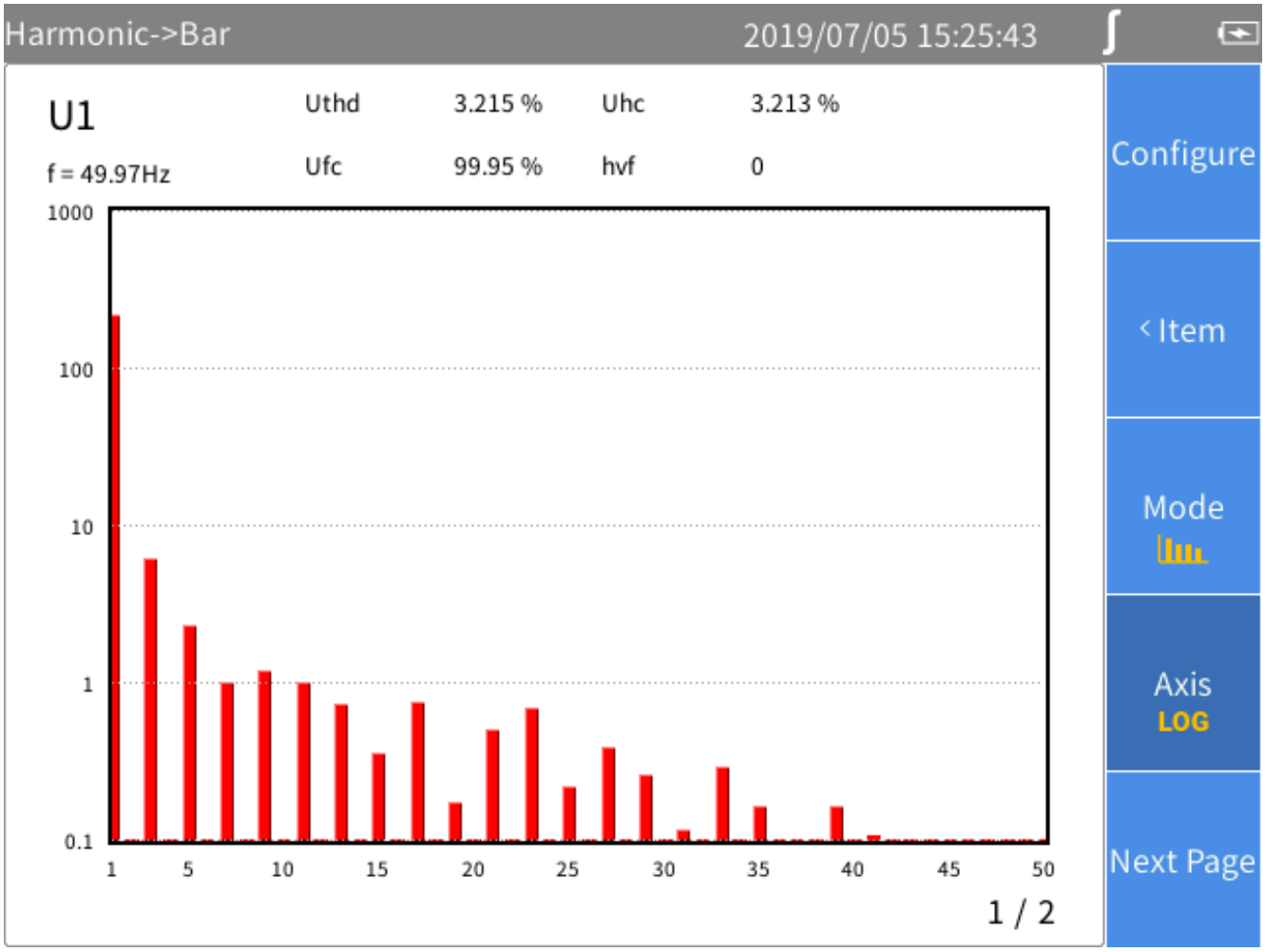


Figure 16. Harmonic – Logarithmic Axis

Phasor

The Phasor mode displays the magnitude and phase relationship of the voltage and current of each phase in the selected wiring group in tabular and graphical form.

Enter Phasor Mode:

- From the Current measurement screen select PHASOR (Phasor)

The phasor screen shown in *Figure 17* is divided into left and right parts, the left part is a phasor table, and the right part is a phasor graph. The content displayed in the table on the left will be displayed synchronously in the graph on the right.

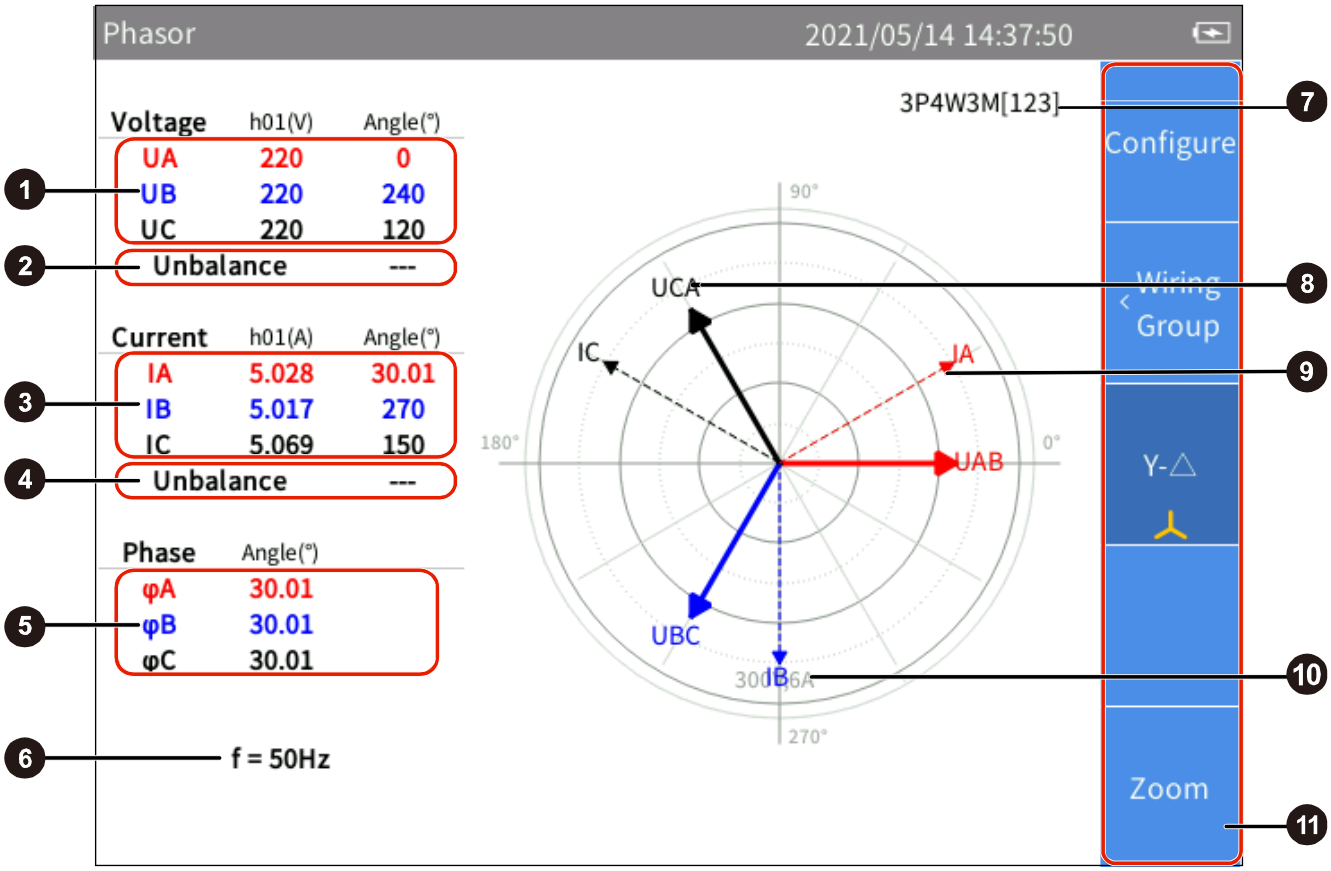


Figure 17. Phasor Screen

Table 18. Phasor Screen

Item	Description
Table	
❶	**Voltage phasor information** The voltage phasor information of each phase or line in the selected wiring group, including fundamental amplitude and phase angle relative to sync source. See *Set the Wiring Selection* for information on wiring group.

Item	Description
❷	**Voltage unbalance** The 3-phase voltage unbalance of the currently selected wiring group.
❸	**Current phasor information** The current phasor information of each phase in the selected wiring group, including fundamental amplitude and phase angle relative to sync source. See *Select the Phasor Data to Display* for details. See *Set the Wiring Selection* for information on wiring group.
❹	**Current unbalance** The 3-phase current unbalance of the currently selected wiring group.
❺	**Phase information** The relative phase angle between the voltage and current of each phasor in the currently selected wiring group, the unit is degrees (°).
❻	**Frequency** The frequency of the sync source signal in the currently selected wiring group. See *Set Sync Source and Update Rate* for details.
Phasor diagram	
❼	**Wiring Selection** The wiring selection of the selected wiring group. The current interface data shows the corresponding wiring group, and to switch the wiring group use F2 (**Wiring Group**).
❽	**Voltage phasor** The voltage phasor of the selected wiring group. The right side of the horizontal axis is the reference and the phase angle of the reference signal is 0°.
❾	**Current phasor** The current phasor of the selected wiring group. The right side of the horizontal axis is the reference and the phase angle of the reference signal is 0°.
❿	**Voltage and current scale** For ease of reading, only the outermost circle scale is marked in the phasor graph.
⓫	**Soft Keys** F1 (**Configure**): Global configuration, see *Global Configuration*. F2 (**Wiring Group**): Select a wiring group for measurement, see *Set the Wiring Selection*. F3 (**Y-Δ**): Switch the circuit connection (Y/Δ).  represents a star connection;  represents a triangle connection. See *Select Circuit Type*. F5 (**ZOOM**): Zoom in/ out phasor, see *Zoom Phasor*.

Select the Phasor Data to Display

Only phasor data of one wiring group is displayed on the phasor screen at the same time. The user can select a group from the currently active wiring groups to display its phasor data on the phasor screen.

Enter Wiring Group Menu

- From the main screen of Phasor select F2 (**Wiring Group**).

Select the Phasor Data to Display

1. In **Wiring Group**, use the left and right arrow (◗ ◖) keys to select a channel or wiring group in **Channel Configuration**. The wiring selection of the selected channel/wiring group is highlighted. As you move the cursor, you can observe that the data displayed in the Phasor screen is updated instantly according to the current options.
2. Push BACK (**Back**) on the control panel to go back to the main screen of Phasor.

Note

The wiring group currently available for display depends on the wiring selection. See Set the Wiring Selection *for details.*

Select Circuit Type

1. From the main screen of Phasor select F3 (**Y-Δ**).
2. Push F3 (**Y-Δ**) to switch between the star (Y) and the triangle (Δ) connection. The current connection type is displayed on the tab page.

Note

The Y-Δ option is only valid when a 3-phase wiring group is selected. When Y is selected, the phasor table displays the voltage of each phase, and the phasor diagram is plotted in in the form of Y. When Δ is selected, the phasor table displays the voltage of each line, and the phasor diagram is plotted in the form of Δ.

Zoom Phasor

In the Phasor screen, the Analyzer automatically determines the magnitude of each phasor in phasor diagram based on the current measurements. However, the user can also manually zoom the phasor diagram of the voltage and current for ease of viewing.

Enter the Zoom Menu:

- From the main screen of Phasor select F5 (**Zoom**).

The options are as shown in *Table 19*.

Table 19. Zoom In/Out Vector

Item	Description
ZOOM U/I	F1 **Select the Phasor to Zoom** Push F1 (ZOOM) to cycle through the currently selected phasor, namely U or I. The currently selected phasor is displayed under the "**ZOOM**" softkey, such as U, which means the currently selected phasor is voltage.
	F3 F4 **Zoom in/out phasor** Each time you push F3 (**zoom in**) or F4 (**zoom out**), the currently selected phasor is zoomed in or out by a certain step. The steps to zoom in/out the coefficient are: 1, 2, 5, 10.
Auto	F5 **Auto zoom** When the button is pushed, the AUTO mode is entered, and the system automatically determines the most appropriate display scale. All manual zooming settings are ignored. Auto zoom features: ● The largest phasor does not exceed the outermost circle in polar coordinates ● Clearly display each phasor direction point in polar coordinates ● Clearly display the name of each phasor

Zoom Phasor:

1. The main screen of Phasor —> F5 (**Zoom**).
2. Push F1 (**ZOOM**) to display U or I below its label as needed.
3. Push F3 ( ) or F4 ( )to zoom in or out the currently selected phasor.
4. To restore to default Auto Zoom, push F5 (**Auto**).
5. Push BACK (**Back**) on the control panel to go back to the main screen of Phasor.

Scope

The Scope mode is used to view the waveform of the signal under measurement. The supported signals include voltage and current etc. Up to 4 signals can be selected simultaneously for waveform display.

In addition, the Product provides cursor measurement function that can be used for various measurements or calculations of waveforms. See *Measure with The Cursor* for details.

Enter Scope Mode:

- From the Current measurement screen select SCOPE (**Scope**)

The Scope screen is shown in *Figure 18. Table 20* lists the items displayed on the screen.

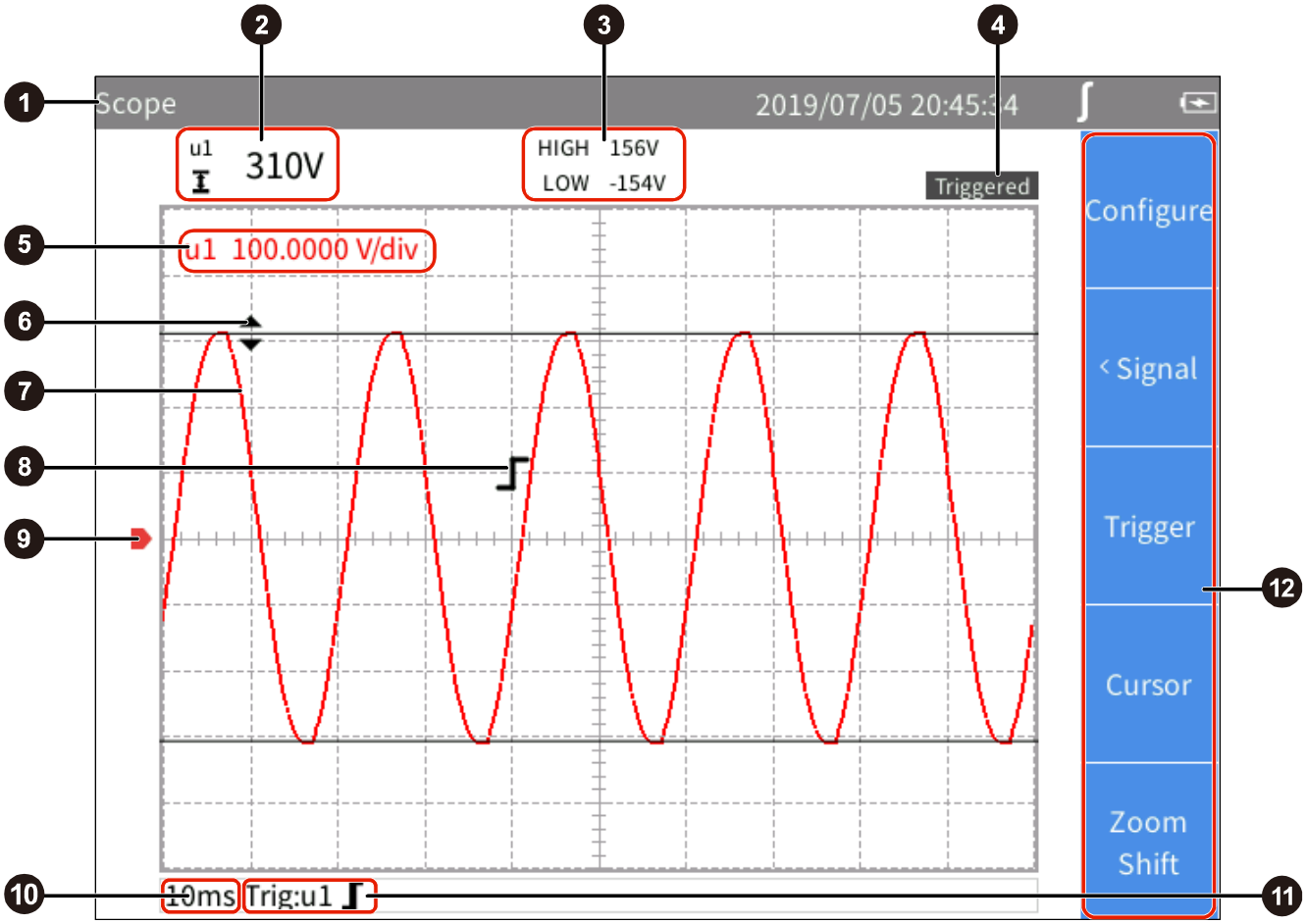


Figure 18. The Main Screen of Scope

Table 20. Scope Screen

Item	Description
❶	Status Bar See *Status Bar* for details.
❷	Difference between cursors / average at cursor - The difference between the 2 cursors is displayed when the double horizontal cursors are activated. - The average value of the cursor position is displayed when the single vertical line cursor is activated. - The difference between the 2 cross points of the 2 cursors and waveform is displayed when the double vertical cursors are activated. - If the cursor is off, no values are displayed in this area. See *Measure with The Cursor* for details.
❸	Value at cursor /time difference - The values of the 2 cursors show separately when the double horizontal cursors are activated. HIGH: Value of the upper cursor; LOW: Value of the lower cursor. - The maximum and minimum values of the cursors show when the single vertical cursor is activated. MAX: Maximum value; MIN: Minimum value. - The time difference (t) between 2 cursors and the frequency value (1/t) calculated accordingly are shown when the double vertical cursors are activated. - If the cursor is off, no values are shown in this area.
❹	Trigger Status Displays the current trigger status. See *Trigger Setup* for details.
❺	Vertical Axis Scale Displays the vertical axis scale of each waveform on the current screen, which is the value represented by each grid. The left side is the parameter symbol, and the right side is the vertical axis scale of the parameter. The specific unit depends on the corresponding waveform. The color of the scale depends on the color of the corresponding waveform.
❻	Cursor Cursor mode includes single vertical line, double vertical lines and double horizontal lines. See *Measure with The Cursor* for details.
❼	**Waveform** Up to 4 user-selectable waveforms can be shown simultaneously on the screen. See *Select the Waveform to Display* for details.
❽	**Trigger Identifier** Indicates the trigger position and level. The shape of the trigger identifier depends on the current trigger mode. See *Trigger Setup* for details.
❾	**Ground Level** Represents the ground potential

Item	Description
⑩	**Horizontal Axis Scale** Horizontal axis (the time axis) scale, the length of time represented by each grid Horizontal axis supports manual zoom. See *Zoom* and Shift the Waveform for details.
⑪	**Trigger Source and Trigger Mode** Current trigger setting, showing the current trigger source and trigger mode. See *Trigger Setup* for details.
⑫	Soft Keys F1 (**Configure**): Global configuration, see *Global Configuration*. F2 (**Signal**): Select the waveform displayed on the screen, see *Select the Waveform to Display*. F3 (**Trigger**): Trigger settings, see *Trigger Setup*. F4 (**Cursor**): Turn cursor on/off and set cursor mode, see *Measure with The Cursor*. F5 (**Zoom/Shift**: Zoom and shift waveform, see *Zoom* and Shift the Waveform.

Select the Waveform to Display

Up to 4 waveforms can be displayed simultaneously on the screen, and the user can select 1 to 4 items from all available items for display.

Enter the Signal Menu:

- From the main screen of Scope select F2 (**Signal**).

The "**Signal**" menu lists all currently available parameters, including voltage and current for example..The specific parameters depend on the current system configuration. See *Set the Wiring Selection*.

Select the Waveform to Display:

1. In the "**Signal**" menu, use the arrow (▼ ▲ ▶ ◀) keys to move the cursor over the corresponding item.
2. Push SELECT (**Select**), the selection box of the current item turns yellow and a black "×" symbol is appears, indicating the selection. To remove a selection, push SELECT (**Select**) again, the selection box will be cleared.
   When a parameter is selected or cleared, the state is reflected in the waveform screen.
3. Repeat step *1* to *2*, up to 4 parameters can be selected.
4. Push BACK (**Back**) to go back to the main screen of Scope.

Note

If 4 signals are selected, all not selected signals are grayed out. When you push the arrow (▼ ▲ ▶ ◀) keys, the cursor can only move among the selected 4 signals. To select a different signal, you must clear 1 of the 4 signals and then add a new one.

Trigger Setup

Use Trigger to determine when the Analyzer should start displaying waveforms on the screen so that the waveforms displayed by each refresh can be aligned. Once the set trigger condition is met, the screen is triggered, the waveform displayed on the screen is aligned at that point.

The Analyzer offers a variety of trigger methods to support multiple trigger sources and trigger modes.

Enter the Trigger Setup Menu:

- From the main screen of Scope select F3 (**Trigger**).

The options are as shown in *Table 21*.

Table 21. Trigger Setup

Source	F1 **Source** Push F1 (Source) to cycle through the current trigger sources. The currently selected trigger source is shown under the "**Source**" label with a color block of the same color as the waveform. The selectable trigger sources are the selected signal in the "**Signal**" menu, which is the signal displayed on the "**Vertical Axis Scale**" of the screen, see *Select the Waveform to Display*.
Trigger Option	F2 **Trigger Option** Configure trigger mode and trigger edge. - **Method**: optioins are "**Auto**", "**Normal**" and "**Single Shot**". The default is "**Auto**" mode. - **Slope**: options are ⌐ Positive, ¬ Negative and X Dual. The default is ⌐ Positeve.
▲ ▼	F4 F5 **Trigger Level** The up and down arrow keys increase or decrease the trigger level. Each time the key is pushed, the trigger mark on the screen moves in the up/down direction.

Note

If the trigger level is not set properly, under the "Auto" mode, the starting point of the waveform displayed (signal level at the left side of the screen) may be unstable, it will jitter left and right; the waveform may not be displayed at all under "Normal" mode.

Trigger Setup:

1. From the main screen of Scope select F3 (**Trigger**).
2. Push F1 (**Source**) until the block with the same color as the waveform of the trigger signal is shown.
3. Push F2 (**Method**).
4. Use the up and down arrow (▼ ▲) keys to move the cursor to the **Type** drop down box and push SELECT (**Select**) on the control panel.
5. Use the up and down arrow (▼ ▲) keys to select the appropriate option and push SELECT (**Select**).
6. Use the up and down arrow (▼ ▲) keys to move the cursor to the **Slope** drop down box and push SELECT (**Select**) on the control panel.
7. Use the up and down arrow (▼ ▲) keys to select the appropriate option and push SELECT (**Select**).
8. Push BACK (**Back**).
9. Use F4 (**Level ▲**) and F5 (**Level ▼**) to adjust the trigger level as needed.

Measure with The Cursor

Use the cursor to measure the waveform digitally.

Enter the Cursor Setup Menu:

- From the main screen of Scope select F4 (**Cursor**).

The options are as shown in *Table 22*.

Table 22. Cursor Setup

Item	Description
Select	F1 **Select the measured signal** Push F1 (**Select**) to cycle through the current measured signal. The currently selected signal is shown under the "**Select**" label with a color block of the same color as the signal waveform. The selectable signals are the selected signal in the "**Select**" menu, which is the signal shown on the "**Vertical Axis Scale**" of the screen, see *Select the Waveform to Display*.
Type	F2 **Measurement type** P**ush** F2 to cycle through and select the cursor measurement types. Cursor Measurement types include single vertical line, double vertical lines and double horizontal lines. -  (single vertical line) -  (double vertical lines) -  (double horizontal lines)

Item	Description
Move	F3 **Move the cursor** Each time you push F3, the currently selected cursor will be cycled through. The selected cursor is indicated in yellow and is displayed below the "**Move**" label. After selecting a cursor, use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the corresponding position on the waveform.
Cursor	F4 **Turn the cursor on/off** Push F4 to turn the cursor function on or off.

Use the Cursor

The following content uses the double vertical lines as an example to introduce the use of the cursor, which is similar to the use of the cursor of a single vertical lines and double horizontal lines.

1. From the main screen of Scope select F4 (**Cursor**).
2. Push F4 (**Cursor**) until "ON" is shows on the Softkey label.
3. Push F2 (**Type**) until  shows on the Softkey label.
4. Push F1 (**Select**) to select the signal to be measured.

The difference between the crossing points of the two cursors and the signal under measurement is shown in the upper left corner of the screen, such as "204.7V"; the time difference (426ms) between the two cursors and the frequency (2.347 Hz) calculated are displayed in the upper part of the screen.

5. Push F3 (**Move**) until  shows on the Softkey label, indicating that the left cursor is selected and a diamond mark is displayed on the left cursor.
6. Use the left and right arrow (▶ ◀) keys to move the left cursor to the appropriate position.
7. Push F3 (**Move**) until  shows on the Softkey label, indicating that the right cursor is selected and a diamond mark is displayed on the right cursor.
8. Use the left and right arrow (▶ ◀) keys to move the right cursor to the appropriate position.
9. Read the difference, time difference and frequency value at the top of the screen.

Zoom and Shift the Waveform

The Scope supports horizontal and vertical zooming and shifting. You can select a singe waveform independently for vertical zooming and shifting and the waveforms are not affected by each other.

Enter the Zoom Menu:

- From the main screen of Scope select F5 (**Zoom/Shift**).

The options are as shown in *Table 23*.

Table 23. Zoom In/Out the Waveform

Item	Description
Select	F1 **Select** Push F1 (Select) to cycle through the current selected signal. The currently selected signal is displayed under the "**Select**" label with a color block of the same color as the signal waveform. The selectable signals are the selected signal in the "Select" menu, which is the signal displayed on the "**Vertical Axis Scale**" of the screen, see *Select the Waveform to Display*.
DIR	F2 **Zoom direction** **Push** F2 to cycle through and select the zoom direction. Horizontal and vertical zooming of waveforms are supported. The currently selected zoom direction is displayed below the "**DIR**" softkey label, indicated by a horizontal or vertical two-way arrow. - (horizontal): Zooms the time axis of all signal waveforms in step of 1, 2, 5 and 10. - (Vertical): Zooms the currently selected signal vertically.
	F3 F4 **Zoom in/out waveform** Each time you push F3 (zoom in) or F4 (zoom out), the waveform is zoomed in or out in a certain step in the horizontal or vertical direction. (Vertical zooming will be applied to the selected waveform. Horizontal zooming will be applied to all waveforms currently displayed.)
Auto	F5 **Auto zoom** Push F5 to enter the Auto Zoom mode, the system automatically zooms all displayed waveforms to the appropriate scale. All manual zooming settings are ignored.
	Shift waveform In the menu, use the up and down arrow ( ) keys on the control panel to move the currently selected waveform up and down on the screen.

Trend

The Trend mode displays and records the trend of numerical measurements. Any numerical measurement item can be displayed as a trend, up to 4 trend curves can be displayed simultaneously on the screen.

When the trend function is activated, the Analyzer continuously records the digital reading of the measurements and displays it as a graph. Like a paper chart recorder, the trend graph can be scrolled from right to left.

The bottom of the screen shows the recording time since it starts.

Enter Trend Mode:

- From the Current measurement screen select TREND (Trend)

The Trend screen is as shown in *Error! Reference source not found. Table 24.* lists the items displayed on the screen.

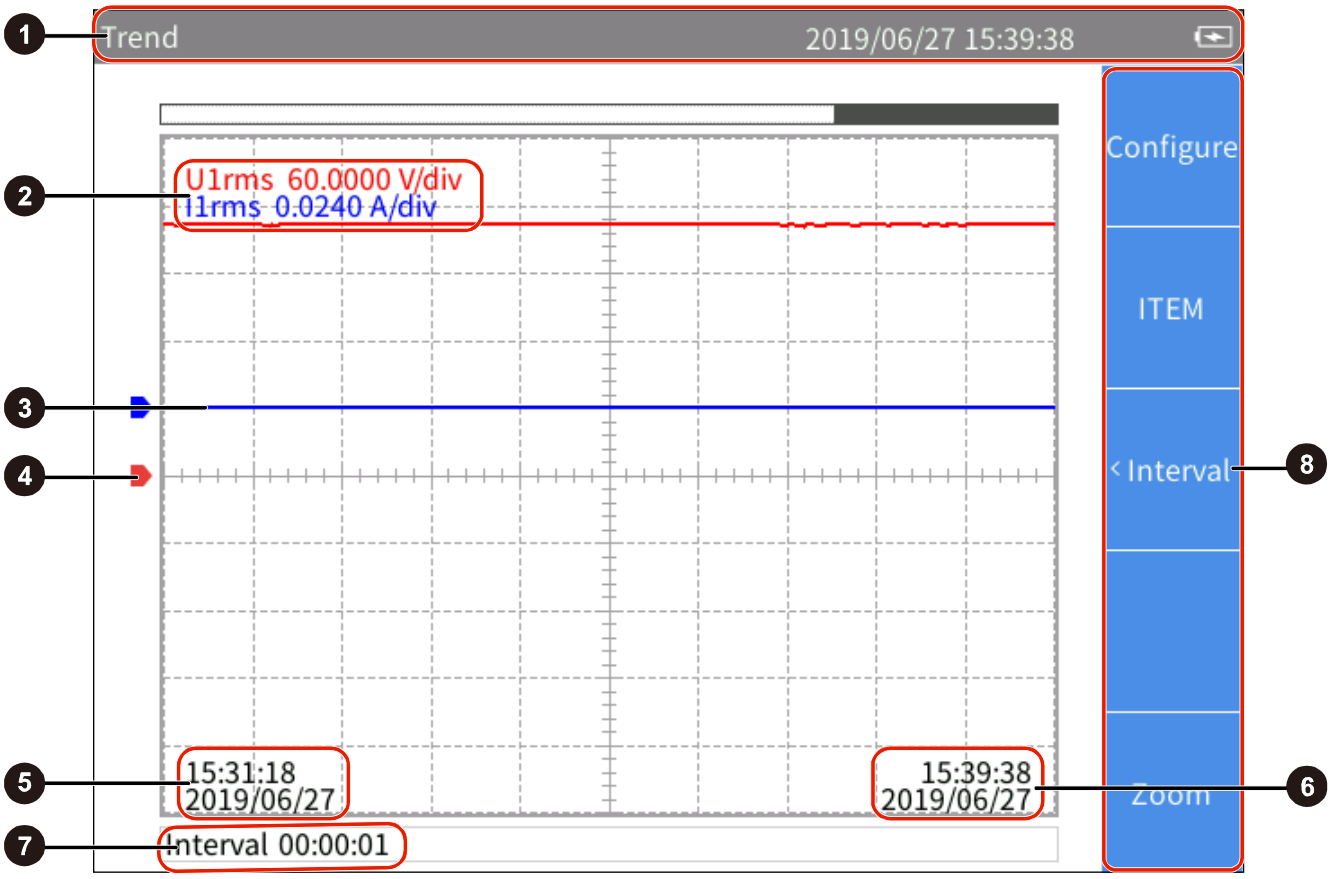


Figure 19. The Main Trend Screen

Table 24. Trend Screen

Item	Description
❶	**Status Bar** See *Status Bar* for details.
❷	**Vertical Axis Scale** Displays the vertical axis scale of each trend waveform on the current screen, which is the value represented by each grid. The left side is the item symbol, and the right side is the vertical axis scale of its trend curve. The specific unit depends on the corresponding item. The color of the scale depends on the color of the corresponding trend curve.
❸	**Trend Curve** Up to 4 user-selectable trend curves can be displayed simultaneously on the screen. See *Select the Trend to Display* for details.
❹	**Zero Position** Indicates the zero position of the trend curve.
❺	**Time on the Left of the Screen** Start time of the trend graph on current screen.
❻	**Current Time** End time of the trend graph on current screen.
❼	**Interval** Sampling interval used to draw the current trends.
❽	**Soft Keys** F1 (**Configure**): Global configuration, see *Global Configuration*. F2 (**Item**): Select trend items displayed on the screen, see *Select the Trend to Display*. F3 (**Interval**): Set the acquisition interval of the trend curve. See *Set Measurement Period*. F5 (**Zoom/Shift**): Zoom / shift trends, see *Zoom and Shift the Trend.*

Select the Trend to Display

Up to 4 Trend curves can be displayed simultaneously on the screen, and the user can select 1 to 4 items from all available items for display.

Enter the Item menu:

- From the main screen of Trend select F2 (**Item**).

The Item menu is as shown in *Table 25*.

Table 25. Select the Trend to Display

Item	Description
Display	F1 Set the trend curve currently displayed. You can choose from up to 4 trend curves. All 4 trend curves are displayed by default.
Add	F2 Add items to plot trend curves and up to 4 collection items can be added.
Del	F3 Delete the trend item that is currently added.

Display/hide Trend Curve:

1. From the main screen of Trend select F2 (**Item**) > F1 (**Display**).
2. In **Display** dialog, use the up and down arrow (▼ ▲) buttons to move the cursor over the trend curve you want to display/hide.
3. Push SELECT (**Select**) to select or deselect the current item depending on its previous state. When a trend curve is selected or deselected, it will immediately be reflected in the trend screen to display or hide the trend curve.
4. Push BACK (**Back**) to go back to the main screen of Trend.

Note

The Display menu is equivalent to a buffer that can hold up to 4 items. Use F2 (Add) and F3 (Del) to add the 4 most commonly used items to the buffer. Then select the trend data to show/hide the trend curve through the Display menu. This avoids frequently using the cumbersome F2 (Add) and F3 (Del) keys to switch the displayed trend curve.

Add Trend Item:

1. From the main screen of Trend select F2 (**ITEM**)> F2 (**Add**).

The Add menu is shown. All available items are listed by categories in a tree structure. The available trend items contain the most measurement items under Meter function.

2. Use F1 to F4 button to enter the category.
3. Use the navigation arrow (▼ ▲) keys to move the cursor over the corresponding item.

In most cases, there are 2 dialog boxes displayed in the measurement tree menu, the one on the left lists the names of items, and the one on the right lists the supported channels or wiring groups. The yellow block represents the cursor position, and the yellow box indicates the corresponding branch in the current tree structure.

4. Push SELECT (**Select**) to enter its sub-menu (if any).
5. Use the arrow (▼ ▲) keys to move the cursor over the corresponding item.
6. Push SELECT (**Select**) to add the current item. The item will be highlighted in yellow.

After the item is added successful, you will be straight back to the top-level parameter menu.

7. Repeat step *3* to *6* until all required items have been added (up to 4).
8. Push BACK (**Back**) repeatedly to go back to the main screen of Trend.

Note

If there are already 4 trend items in the "Display" menu, you cannot add a 5th item regardless of whether they are all displayed on the trend screen. You must delete one or more trend items and then add other items.

Delete Trend Item:

1. From the main screen of Trend select F2 (**ITEM**) —> F2 (**Del**).
2. In "Del" dialog, use the up and down arrow (▼ ▲) buttons to move the cursor over the item to be delete.
3. Push SELECT (**Select**) on the control panel to delete the current item from the "**Dispaly**" menu.
4. Go back directly to "**ITEM**" screen.

Note

When deleting trend data, remove an item from the "Display" menu by using "Del" menu even if its trend curve is not displayed on the screen.

Set Measurement Period

The measurement period is the time interval used to plot the trends and provides two modes of "**Update Rate**" and "**Interval**". In the "**Update Rate**" mode, the interval of the trends is the update rate of the Analyzer, which can achieve accurate evenly spaced acquisition, which is suitable for analyzing the process of rapid change; in the "**interval**" mode, the interval of the trends is determined by the trend function itself, which is not as accurate as the Update Rate mode, but it can record the trends for a long time.

Enter the Measurement Period Setup Menu:

- From the main screen of Trend select F3 (**Interval**).

The measurement period setup dialog is shown in *Table 26*.

Table 26. Measurement Period Setup

Update rate	**By update rate** The measurement period is the same as the update rate of the Analyzer by default. The update rate is a kind of global configuration of the Analyzer. See *Set Sync Source and Update Rate* for information on update rate.
Interval	**Customize sampling interval** You can customize sampling interval as measurement period. The minimum interval is 1 second and the maximum is 24 hours - **H**: Customize the Hour value of the interval. - **M**: Customize the Minute value of theinterval. - **S**: Customize the Minute value of the interval.

Customize the Interval

1. From the main screen of Trend select F3 (**Interval**).
2. If "**Update Rate** is selected, use the up and down arrow (▼ ▲) keys on the control panel to move the cursor to "**Interval**". Push SELECT (**Select**) on the control panel. Then "**Interval**" option is selected.
3. Use the up and down arrow (▼ ▲) keys on the control panel to move the cursor to **H** (Hour) input box.
4. Use the left and right arrow (▶ ◀) keys on the control panel to adjust the Hour value.
5. Push SELECT (**Select**) on the control panel.
6. Repeat step *3* to *5* to adjust the Minute and Second values respectively.
7. Push BACK (**Back**) on the control panel to go back to the main screen of Trend.

Zoom and Shift the Trend

The Trend supports vertical and horizontal shifting as well as vertical zooming. Each trend graph can be shifted and zoomed vertically independently, and they are not affected by each other.

Enter the Zoom Menu:

- From the main screen of Trend select F5 (**Zoom/Shift**).

The options are as shown in *Table 27*.

Table 27. Zoom the Trend

Item	Description
Select	F1 **Select the trend** Push F1 (Select) to cycle through the currently selected trend. The currently selected trend is displayed under **Select** with a color block of the same color as the trend curve. The available trend is the selected items in the "**ITEM**" menu, which is the items displayed on the "**Vertical Axis Scale**"of the screen, see *Select the Trend to Display.*
	F3 F4 **Zoom in/out waveform** Each time you push F3 (zoom in) or F4 (zoom out) button, the selected waveform will be zoomed in or out vertically by a certain step.
Restore	F5 **Restore auto zoom** When this button is pushed, it will restore to the display scale automatically determined by the system.
	**Shift waveform** In the interface of this menu, use the navigation arrow () keys on the control panel to shift the currently selected trend up and down on the screen, and the left and right movement will be applied to all displayed trends.

Data Management

The Analyzer can save the measurement data and the current configuration of the Analyzer in the internal memory, or log the data displayed on the current screen in Meter mode for a long time. The data can be downloaded to a PC by using the Fluke Power Analyzer software. For more information, please refer to the instructions for using the PC software.

Use MEMORY (**Memory**) to manage the data stored in the internal memory.

Save Data

On any measurement screen, push SAVE (**Save**) and the Save dialog box will show on the screen.

Push F1 (**Data**) to save all valid measurements at the current time to the internal memory. When it is saved successfully, a prompt message containing the name of the file will show on the screen.

Push F2 (**Settings**) to save the current system settings and the configuration of all measurement functions. When the save is successful, a message containing the name of the file shows on the screen.

Note

The Analyzer automatically creates the file name based on the category of the saved data and system time. To modify the file name, after it is saved, push MEMORY *(Memory) and follow the prompt. (See* Logger Memory*)*

Logger

In Meter mode, push and hold SAVE (**Save**) for more than 2 seconds, to show the Logger menu on the screen. Then push F1 (**Start Logger**) to manually start the logger.

The Analyzer will log all measurements currently shown on the screen in the Meter mode.

During logging, the user cannot switch screens and perform other measurement functions. If the user tries to perform other operations, a message will appear on the screen: "Please stop logger first!".

To stop logging, push F2 (**Stop Logger**) in the logger interface, and the screen will prompt you that create log file successfully, including the name of the log file.

Note

The logger function is available in the Meter mode only. In other modes, when you push and hold SAVE *(Save), the Analyzer will show a message that indicates the Logger is only available in Meter mode.*

Note

Even in Meter mode, the logger function is not supported if the user freezes the display with the HOLD *(Hold) button. You must exit the Hold mode first before you can use the Logger function.*

Logger Memory

Push MEMORY (**Memory**) to enter "**Logger Memory**" interface. The functions in the menu are shown in _Table 28_.

Table 28. Memory Data Management

Item	Description
Data	F1 View and manage saved data files.
Logger Sessions	F2 View and manage Logger items.
Screen Captures	F3 View and manage saved screenshot files.
Settings	F4 View and manage saved settings files.

In the operation interface, the user can manage data files, logger session files, screenshot files and setting files stored in the internal memory and operations include deleting, deleting all and renaming. Please see _Figure 20_ and _Table 29_. After entering the specific file menu, the operations that can be performed are exactly the same. "**Data**" file is taken as an example in _Figure 20_ and _Table 29_, and other types of files are not described again.

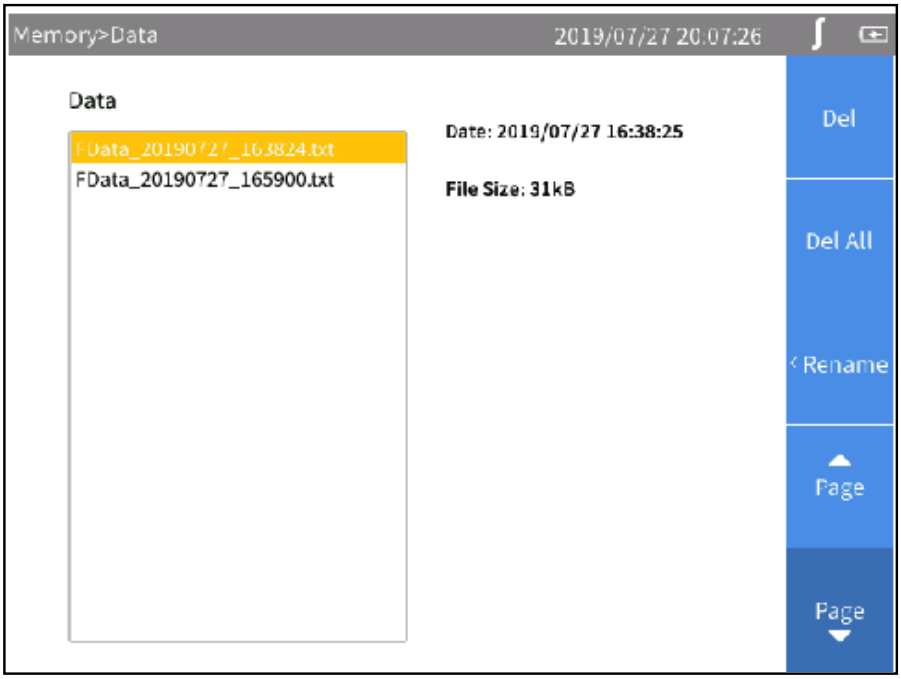


Figure 20. Memory File Operation

Table 29. Memory File Operation

Item	Description
Del	F1 Delete a file
Del All	F2 Delete all files of the current type.
Rename	F3 The Analyzer uses an automatic naming method when saving files. With this function key, the user can rename each file to a name that is easy to remember.
	F4 **Page up key** When the number of files available exceeds the number of items displayed on each screen, the  and  keys can be used to scroll forward or backward to display more files.
	F5 **Page down key** Page down key for scrolling backward to display next page.

Note

When you select "Delete" and "Delete All", the Analyzer deletes the selected files or deletes all files of the current category without any prompts; the files deleted by these operations cannot be restored locally. Please operate with caution.

Dual-Unit Interconnection

The Analyzer supports Dual-Unit Interconnection, that is, 2 Analyzers work synchronously in host/slave mode to realize 6-channel or 8-channel channel configuration.

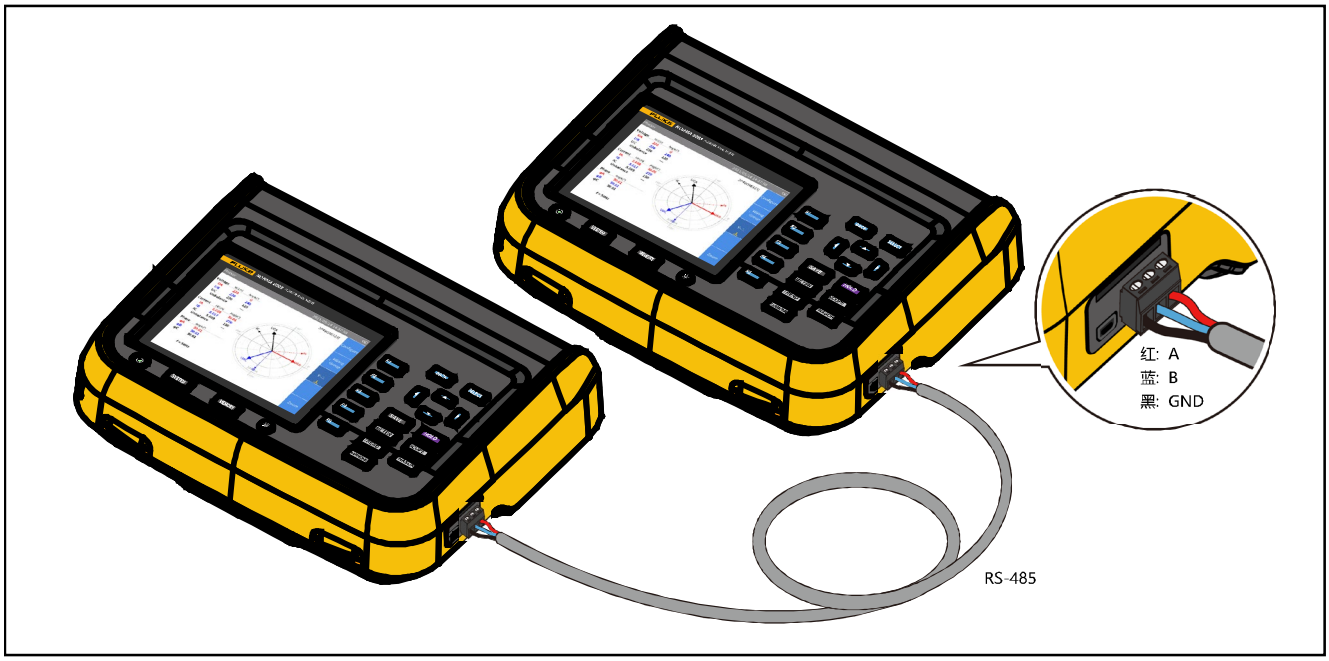


Figure 21. Dual-Unit Interconnection

Dual-Unit Interconnection Connection

2 Analyzers are connected in a point-to-point manner by using the RS-485/sync adapter provided with the Analyzer to connect the RS-485 communication ports on the right side of the 2 Analyzers, which are 3-pin connector sockets, as shown in the *Figure 21*.

For the 2 Analyzers, one works as a host and the other works as a slave.

Note

The host can only add user defined measurement items that have been added in the slave. See User Item View *for more information on user defined measurement items.*

Dual-Unit Interconnection Measurement

After 2 Analyzers are connected via the RS-485 port, follow the these steps to make measurements:

1. Set RS-485 communication parameters of the slave.
   a) From the main screen in any operating mode of the slave, select SYSTEM (**SYSTEM**) > F2 (**Comm.**), and then select the RS-485 connection method follow the instructions in *Set Communication Parameters*.
   b) Push BACK (**Back**) repeatedly to go back to the main screen of the Meter.
2. Set RS-485 communication parameters of the host:
3. On the host, push SYSTEM (**SYSTEM**), then push F3 (**Remote**) to enter the "**Remote**" menu. The host's screen will prompt that the remote device is being searched, and the host will automatically scan the connected device.
4. After the Analyzer as a slave is searched by the host the connected device will be show in the "Available devices list", such as "Address 2.
5. On the host, push F1 (**Connect**) to enter the "**Remote**" menu. If the connection succeeds, the label for softkey F2 will change to "**Disconnected**".
6. Push BACK (**Back**) on the host's control panel repeatedly to go back to the main screen of the System. Follow the instructions in section *User Item View* to enter the interface of Add Measurement Items.
   Notice that the 5th item F5 (**Remote**) is added to the category of "Add" measurement items.
7. On the host, push F5 (**Remote**).
   All user defined measurement items selected on the slave will be listed on the host's screen.
8. On the host, use the arrow (▼ ▲ ▶ ◀) keys to move the cursor to the corresponding measurement item and push SELECT (**Select**).
   The corresponding measurement items show in the list of user defined measurement items on the host (the measurement item name has the suffix "*").

Note

If the desired measurement item is not listed in the Remote interface on the host, exit the Dual-Unit interconnection mode and add the measurement items on the slave. See User Item View for details.

Note

Under the Dual-Unit interconnection mode,the slave will be locked for remote operation and the buttons on the control panel will be locked (except for (F1 (Local)) and no other operations can be performed.

9. To exit Dual-Unit interconnection mode:
   On the host, push SYSTEM (**System**) > F3 (**Remote**) > F2 (**Disconnect**).
   Or
   On the slave, push F2 (**Local**).

Connect the Computer

The Fluke Power Analyzer software is a software that communicates between the Analyzer and PCs via RS-485 or mini-USB interfaces. With this software, data can be controlled and summarized simply and quickly via the PC.

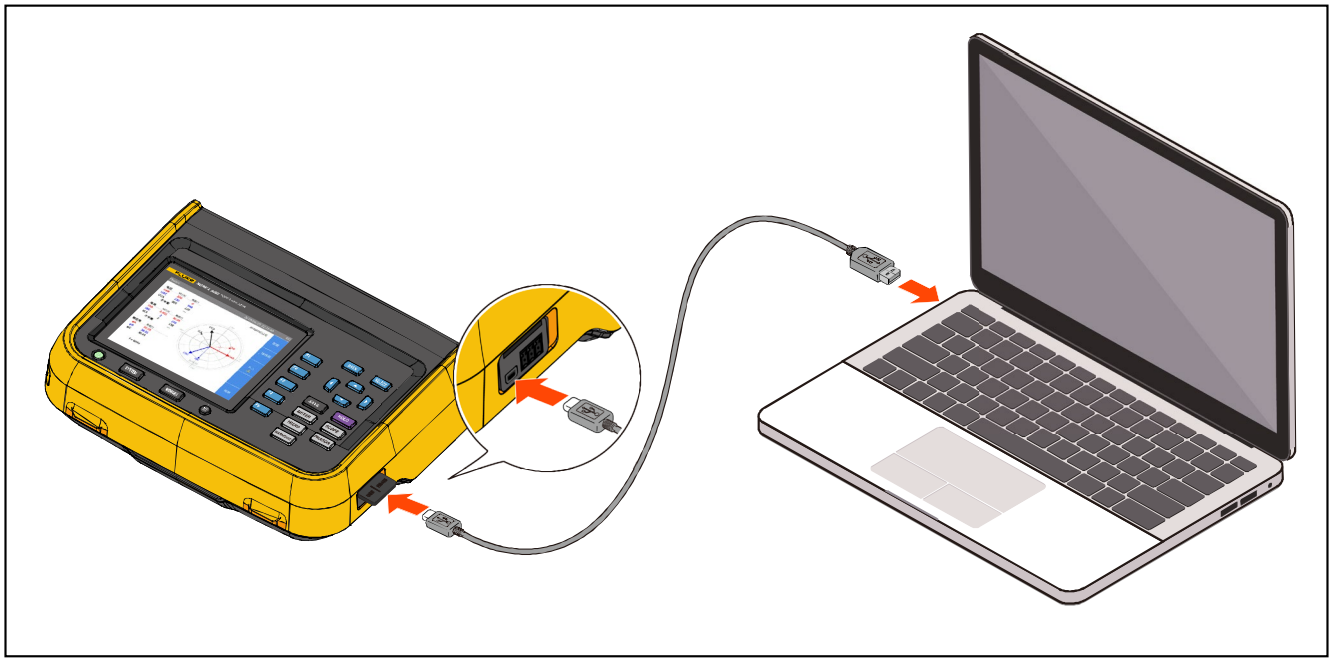


Figure 22. Connect the Computer

Using the Fluke Power Analyze software:

- The PC screen shows the measurements, waveforms, phasors, harmonics and trends from the Analyzer. It can be freely selected from all measurements such as voltage, current, power and harmonics.
- Instrument settings: The settings of the connected Analyzer can be changed in the PC software.
- Files in the Analyzer memory can be downloaded to a PC and analyzed. The measurement data of a certain period of time can be saved to a CSV file and the screenshot files can be downloaded.
- Operating system required: Windows 10 / Windows 8 / Windows 7 (32bit/64bit).

For more information about using the Analyzer with the PC software, please refer to the instructions for using the PC software.

System Settings

The System Settings function provides the system level setup options, including general settings, communication parameter settings, local/remote control, as well as the test of the Analyzer itself.

Enter the System Settings Function:

- From the main screen in any operating mode select SYSTEM (**SYSTEM**) button.

All information listed in the work area of the System screen is reference information and cannot be changed. This information is useful for troubleshooting and maintenance.

Note

Please have this information ready when contacting Fluke for technical support.

Table 30. System Information

Item	Description
Description	Product name, such as Power Analyzer.
Model Name	Product model, for example Norma 6004+
Serial No.	The unique serial number of the product, which may be requested when contacting Fluke Customer Service.
Calibration Date	Last calibration date of the Product. See *Calibration* for information on calibration.
Firmware Version	The version number of the internal firmware of the Product.
DSP Version	The version numbers of the Digital Signal Processing (DSP) device in the Product.
FPGA Version	The version number of the FPGA in the Product.
BuildTime:	The build time of the firmware of the Product.
Soft Keys	F1 (**Settings**): Sets general options for the Analyzer, see *General Settings.* F2 (**Comm.**): Sets the serial communication parameters of the Analyzer, see *Set Communication Parameters*. F3 (**Remote**): Connects remote analyzer, see *Remote*. F4 (**Maint.**): Diagnoses and tests the LCD and buttons/keys of the Analyzer, see *Instrument Maintenance*.

General Settings

The Settings screen contains some general instrument settings such as interface language, time and date, date format, log storage settings, as well as firmware upgrades and factory resets.

Enter the Settings screen:

- From the Main screen in any operating mode select SYSTEM (**SYSTEM**) > F1 (**Settings**).

The options listed on the Settings screen include:

- Language
- Time date
- Date format
- Firmware upgrade
- Factory default
- Logger memory

See *Firmware Upgrade* for the operation of firmware upgrade.

Language

Users can select the language supported by this unit.

Change UI Language:

1. In the Settings screen, use the up and down arrow (▼ ▲) keys to move the cursor to the "**Language** " option (the drop-down menu is highlighted in yellow).
2. Push SELECT (**Select**) and use the up and down arrow (▼ ▲) keys to select the corresponding option. Then push SELECT (**Select**) again to confirm the option.
3. Push BACK (**Back**) on the control panel repeatedly to go back to the main screen of the "**Settings**".

Set Time and Date

1. In the Settings screen, use the up and down arrow (▼ ▲) keys to move the cursor to the "**Date Time**" option (the drop-down menu is highlighted in yellow).
2. In the "**Time Date**" dialog box, use the left and right arrow (▶ ◀) keys to select the year, month, day, hour and minute, and use the up and down arrow (▼ ▲) keys to adjust the value.
3. Push BACK (**Back**) on the control panel repeatedly to go back to the main screen of the "**Settings**".

Logger Memory

The user can select the operation mode of the Analyzer when the memory is full, which can be set to stop the logging by the system, to manually clear log files saved in the Product by the user, or to automatically overwrite the old files by the system.

1. In the Settings screen, use the up and down arrow (▼ ▲) keys to move the cursor to the "**Logger Memory**" option (the drop-down menu is highlighted in yellow).
2. Push SELECT (**Select**) and use the up and down arrow (▼ ▲) keys to select the corresponding option. Then push SELECT (**Select**) again to confirm the option.
3. Push BACK (**Back**) on the control panel repeatedly to go back to the main screen of the "**Settings**".

Set Communication Parameters

The Analyzer supports communication via USB virtual serial port and RS-485. Host/slave communication is realized by RS-485 communication in the dual-unit interconnection mode. For details, see *Dual-Unit Interconnection*.

In order to ensure normal communication, the communication port of the Product needs to be set up correctly.

Enter the "Comm." Setup Interface:

- From the Main screen in any operating mode select SYSTEM (**SYSTEM**) > F2 (**Comm.**).

The "Comm." settings screen is shown, the items that can be set for USB virtual serial port and RS-485 port are as shown in *Table 31*. When selecting different communication protocols, some of the options may not be applicable and will be grayed out.

Table 31. Communication Parameters

Item	Option
Connect	USB (virtual serial) port RS-485
Parity	O: Odd parity E: Even parity N: No parity

Item	Option
Baud Rate	9600 19200 38400 57600 115200 230400 460800 576000 921600
EOL	CR LF CRLF
Data Bits	7 Bits 8 Bits
Stop Bits	1 Bits 1.5 Bits 2 Bits
Device address	1 to 9

Note

To ensure proper communication between the host/slave Analyzer, you must configure both Analyzers correctly. Please refer to Dual-Unit Interconnection*.*

Remote

The Analyzer support Dual-Unit interconnection. This menu allows 2 Analyzers to be configured in host/slave mode for 6 or 8 channels configurations. See *Dual-Unit Interconnection* for details.

Instrument Maintenance

The Analyzer provides a self-diagnosis function that allows the user to test the button/key and display screen of the Product.

Enter Diagnosis:

- From the Main screen in any operating mode select SYSTEM (**SYSTEM**) > F4 (**Maint.**)

Table 32. Diagnosis

Item	Description
LCD Test	F1 Push ▼, the screen will show alternately full-screen of solid colors of blue, black, white, red and green. Push BACK (**Back**) to go back to the test menu.
Keys Test	F2 Test if each key is valid. All the keys on the control panel are shown on the screen. The original function of all the keys on the control panel will be disabled. Each time a physical key on the control panel is pushed, the corresponding key on the screen changes from white to yellow. Pushing BACK will not take you back to the main menu. The screen will automatically go back to the "**Maint.**" menu only after all physical buttons/keys on the control panel have been tested.

Calibration

The Analyzer has a calibration procedure. For more information on the calibration, please refer to the Product's *Calibration Manual*.

Maintenance

There are no parts requiring users to repair and maintain inside the Product, and no special maintenance is needed. The only required maintenance is to replace the battery regularly and to replace the fuse, if necessary.

Cleaning

Clean the case with a damp cloth and a weak soap solution. Do not use abrasives, isopropyl alcohol, or solvents to clean the case.

⚠⚠ Warning

Before cleaning the Analyzer, please be sure to unplug the power adapter/charger from the power jack and disconnect all test leads.

Change the Battery

The battery is charged in the Analyzer, the battery maybe changed if a freshly charged battery is required for extended battery power operation or the battery is no longer keeping charge. Charge the Analyzer every three months if the Analyzer is not in use.

To order the spare battery, please see *How to Contact Fluke* and *Accessories and Options.*

⚠⚠ Warning

To prevent electric shock, remove all probes, test leads and accessories before the battery compartment cover is opened.
Be sure to use a Fluke specified battery for replacement.

Please refer to *Figure 23*.

Figure 23. Change the Battery

To Change the Battery:

1. Turn off the Product, unplug the power adapter/charger from the power jack, and disconnect all test leads.
2. Place the Product's operating panel face down on a flat table and lift the stand or remove it from the Product.
3. Use a slotted screwdriver to rotate the 2 snap bolts on the battery compartment cover by 180° so that the arrow on the cover points toward the unlock mark and then remove the battery compartment cover.
4. Use the drawstring on one end of the battery to lift one side of the battery and then remove the battery completely.
5. Install new batteries and reinstall and fix the battery compartment cover and stand in the reverse order of the above.

⚠ Caution

Do not incinerate the product and/or the battery.

Change the Fuse

Please refer to *Figure 24*.

Figure 24. Change the Fuse

⚠ Caution

To prevent damage to the instrument, use only the fuses specified by Fluke. See *How to Contact Fluke* and *Accessories and Options*.

To change the fuse:

1. Turn off the Product, unplug the power adapter/charger from the power jack, and disconnect all test leads.
2. Place the Product's operating panel face down on a flat surface and fold the tilt stand or remove it from the Product.
3. Use a Phillips screwdriver to remove the 2 screws from the fuse compartment cover and remove the cover.
4. Insert a flat screwdriver into the gap to the right of the fuse holder and gently pry it until it is possible to hold the fuse by one hand and take it out.
5. Install new fuses and reinstall and fix the fuse cover and stand in the reverse order of the above.
6. Check the circuit before reconnecting to ensure the current does not blow the fuse again.

Firmware Upgrade

The firmware upgrade of the Product is very convenient and can be completed by using the USB memory containing the new firmware.

Please download the last firmware package from www.fluke.com, then extract and copy the files to a USB memory. For more details, please refer to the documentation provided with the firmware package.

Please refer to *Figure 25*.

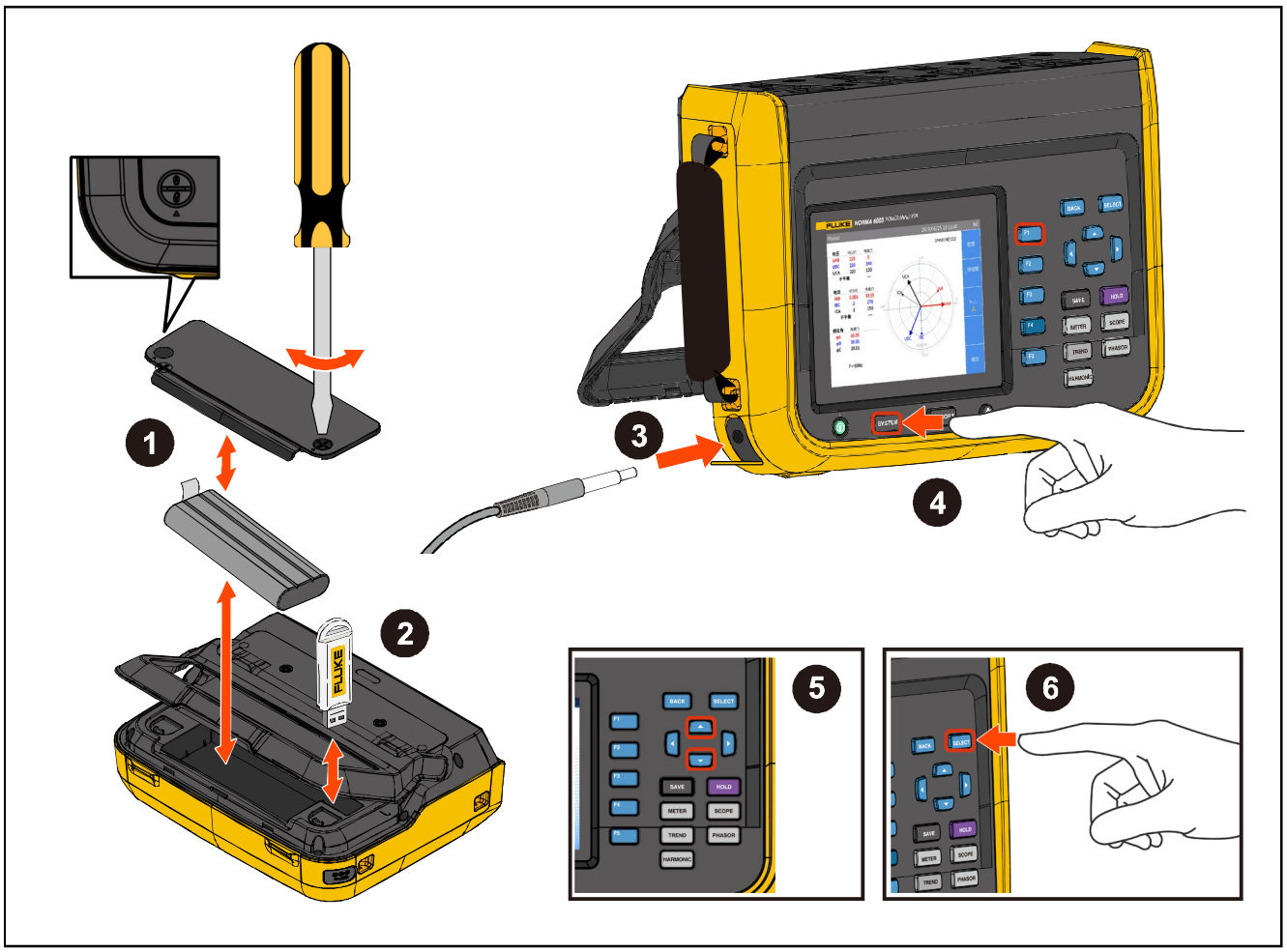


Figure 25. Firmware Upgrade

1. Open the cover of the battery compartment as specified in the section *Change the Battery.*
2. There is a USB port on the upper right side of the battery compartment. Plug the USB memory containing the new firmware into the USB port.
3. During the upgrade, please ensure that the battery is in good contact and can power the unit normally, and the USB connection is reliable.
4. After the instrument is powered on, select SYSTEM (**SYSTEM**) > F1 (**Settings**).
5. Use the up and down arrow (▼ ▲) keys to move the cursor to the "**Firmware Upgrade**" option (the drop-down menu is highlighted in yellow).
6. Push SELECT (**Select**) on the control panel.

Note

If the USB memory is not inserted, the Product will prompt:to insert the USB.. Please follow the steps above to insert the USB memory. Or check if the USB memory is connected securely.

7. The upgrade will take a few minutes, please wait. The Analyzer will automatically restart after the upgrade.

Note

To ensure the success of the upgrade, the battery must be installed during the firmware upgrade and the battery level must be at least 50%. The power adapter must be connected.

Please find the latest firmware on www.fluke.com.

Accessories and Options

Table 33. Accessories and Options

Description	Fluke Product Number
Power Adapter (CAT IV 600V)	4829014
Power cord (for Chinese models)	4894155
Power cord (for international)	4894137
Mains Adapter set (for international)	4894143
USB (mini B) cable	5126257
RS-485/synchrony adapter (3.81mm, black, 3 pin)	5094687
Speed / torque adapter (3.81mm, black, 6 pin)	5094693
USB Flash Drive for PC SW and User Manual	4739818
Soft case	5101220
Getting Started Manual (Chinese)	5101235
Getting Started Manual (English)	5130608
Fluke-NORMA6000 kit (8018): Test lead set, (1) red, (1) black, (2) blue, CAT III 1000V/CAT IV 600V	5098516
Fluke-NORMA6000 kit (8019): Alligator clip set, (1) red, (1) black, (2) blue, CAT III 1000V/CAT IV 600V	5098525
Teat lead set, NORMA 6004/6004+ kit Test leads, 1.5 m, (4) red, (4) black, (8) blue Alligator clips, (4) red, (4) black, (8) blue	5098494
Teat lead set, NORMA 6003/6003+ kit Test leads, 1.5 m, (3) red, (3) black, (6) blue Alligator clips, (3) red, (3) black, (6) blue	5098502
Battery (BP291)	3894688
Fuse, 11A	803293

Specifications

General Specifications

Size (HxWxL)..... 298 mm x 215 mm x 96 mm

Weight ..... 3.5 kg

Display ..... 5.7" TFT LCD, 640x480 pixels

Maximum voltage between any Terminal
and Earth Ground…..... 1000 V

Temperature

Operating Temperature..... 0 °C to 40 °C (with power adapter)
-10 °C to + 50 °C (battery only)

Storage Temperature..... -30 °C to 60 °C (Without battery)
-20 °C to 60 °C (With battery)

Operating Humidity..... Non-condensing (<10 °C)
≤90 % RH (10 °C 至 30 °C)
≤75 % RH (30 °C 至 40 °C)
≤45 % RH (40 °C 至 50 °C)

Altitude

Operating..... 2000 m

Storage..... 12 000 m

Ingress Protection..... IEC 60529: IP50 (terminals mated)

Battery

Type ..... Li-ion, BP 291, 10.8V/5000 mAh, 54 Wh IEC 62133, UN 38.3

Battery life..... 10 hours (Typical)

Safety

General..... IEC 61010-1: Pollution Degree 2

Measurement..... IEC 61010-2-030: CAT IV 600/CAT III 1000 V

Electromagnetic Compatibility (EMC)

International..... IEC 61326-1: Industrial Electromagnetic Environment;
IEC 61326-2-2，CISPR 11: Group 1, Class A

Group 1: Equipment has intentionally generated and/or uses conductively-coupled radio frequency energy that is necessary for the internal function of the equipment itself.

Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Emissions that exceed the levels required by CISPR 11 can occur when the equipment is connected to a test object.

Korea (KCC) ..... Class A Equipment
(Industrial Broadcasting & Communication Equipment)

Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user

should take notice of it. This equipment is intended for use in business environments and not to be used in homes.

USA (FCC) ..... 47 CFR 15 subpart B.
This product is considered an exempt device per clause 15.103.

Electrical Specifications

Modules

- NORMA 6003 ..... 3 Voltage + 3 Current
- NORMA6003+ ..... 3 Voltage + 3 Current + 1 Motor
- NORMA 6004 ..... 4 Voltage + 4 Current
- NORMA 6004+ ..... 4 Voltage + 4 Current + 1 Motor

Sample Rate ..... 200 kHz

Data Update Rate ..... 100 ms, 200 ms, 500 ms, 1 s

Voltage

Range ..... 10 V, 100 V, 1000 V

Crest Factor ..... CF ≤ 2

Overload Capacity ..... 10 % overload

Input Impedance ..... 2 MΩ / 10 pF (Typical)

Temperature Coefficient ..... 0.05 x (Spec)/K @ <18°C or >28°C

Bandwidth ..... 1000 V range: 500 kHz
100 V range: 200 kHz
10 V range: 100 kHz

Accuracy

Accuracy
(% reading + % range)

Range	DC	AC	
		10 Hz to 1 kHz	10 kHz
1000 V	0.1 + 0.1	0.1 + 0.1	5 + 0.5
100 V	0.1 + 0.1	0.1 + 0.1	5 + 0.5
10 V	0.1+0.2	0.1 + 0.2	5 + 0.5

Current

Shunt

Range..... 0.1 A, 1 A, 10 A

Crest Factor ..... CF ≤ 2

Overload Capacity ..... 10 % overload

Input Impedance ..... 0.025 Ω (Typical)

Temperature Coefficient ..... 0.05 x (Spec)/K

Bandwidth ..... 10 A range: 500 kHz
1A range: 200 kHz
0.1A range: 100 kHz

BNC

Range ..... 0.1 V, 1 V, 10 V

Crest Factor ..... CF ≤ 2

Overload Capacity ..... 10 % overload

Input Impedance ..... 100 kΩ / 100 pF

Temperature Coefficient ..... 0.05 x (Spec)/K

Bandwidth ..... 10 V range: 500 kHz
1 V range: 200 kHz
0.1 V range: 100 kHz

Accuracy

Accuracy
(% reading + % range)

Range		DC	AC	
			10 Hz to 1 kHz	10 kHz
Shunt	**10 A**	0.1 + 0.2	0.1 + 0.1	5 + 1
	1 A	0.1 + 0.5	0.1 + 0.2	5 + 1
	0.1 A	0.1+2	0.1 + 1	5 + 1
BNC	**10 V**	0.1 + 0.1	0.1 + 0.1	5 + 1
	1 V	0.1 + 0.2	0.1 + 0.1	5 + 1
	0.1 V	0.1 + 1	0.1 + 0.5	5 + 1

Motor (NORMA 6003+、NORMA 6004+)

Voltage Range..... ±10 V dc, 10 % overload

Voltage Channels 2

Input Impedance..... 1.1 MΩ (Typical)

Temperature Coefficient ..... 0.05 x (Spec)/K

Accuracy @ DC ..... 0.1 % reading + 0.1 % range

Pulse Channels 3

Pulse logic high threshold ..... 2 V (Typical)

Pulse logic low threshold ..... 0.8 V (Typical)

Maximum pulse frequency ..... 100 kHz

Frequency Domain Measurement

Frequency Accuracy..... 0.05 % range + 0.05 % reading
(3 ranges: 1 Hz to 10 Hz, 10 Hz to 400 Hz, 400 Hz to 100 kHz)

Harmonics ..... 100 order, up to 6 kHz

Appendix

Measurement Calculation Method

Measurement Function	Calculation Formula	
RMS	$U_{rms} = \sqrt{\overline{u^2}}$ $U_{\Sigma} = \frac{U_A + U_B + U_C}{3}$	$I_{rms} = \sqrt{\overline{i^2}}$ $I_{\Sigma} = \frac{I_A + I_B + I_C}{3}$
DC component	$U_{DC} = \overline{u}$	$I_{DC} = \overline{i}$
AC component	$U_{AC} = \sqrt{{U_{rms}}^2 - {U_{DC}}^2}$	$I_{AC} = \sqrt{{I_{rms}}^2 - {I_{DC}}^2}$
Rectified Mean	$U_{rm} = \overline{\lvert u \rvert}$	$I_{rm} = \overline{\lvert i \rvert}$
Corrected Rectified Mean	$U_{rmc} = \frac{\pi}{2\sqrt{2}} U_{rm}$	$I_{rmc} = \frac{\pi}{2\sqrt{2}} I_{rm}$
Peak+	$U_{p+} = MAX(u)$	$I_{p+} = MAX(i)$
Peak-	$U_{p-} = MIN(u)$	$I_{p-} = MIN(i)$
Peak to Peak	$U_{pp} = U_{p+} - U_{p-}$	$I_{pp} = I_{p+} - I_{p-}$
Crest Factor	$U_{cf} = \frac{MAX(\lvert U_{p+} \rvert, \lvert U_{p-} \rvert)}{U_{rms}}$	$I_{cf} = \frac{MAX(\lvert I_{p+} \rvert, \lvert I_{p-} \rvert)}{I_{rms}}$
Form Factor	$U_{ff} = \frac{U_{rm}}{U_{rms}}$	$I_{ff} = \frac{I_{rm}}{I_{rms}}$
Fundamental Amplitude	$U_{H01} = \lvert U(1) \rvert$	$I_{H01} = \lvert I(1) \rvert$

Measurement Function	Calculation Formula	
Fundamental Phase	$\varphi U_{H01} = \arg[U(1)]$ Relative to the sync source	$\varphi I_{H01} = \arg[I(1)]$ Relative to the sync source
THD	$U_{THD} = \frac{\sqrt{{U_{rms}}^2 - {U_{H01}}^2}}{U_{H01}}$	$I_{THD} = \frac{\sqrt{{I_{rms}}^2 - {I_{H01}}^2}}{I_{H01}}$
Fundamental Content	$U_{fc} = \frac{U_{H01}}{U_{rms}}$	$I_{fc} = \frac{I_{H01}}{I_{rms}}$
Harmonic Content	$U_{hc} = \frac{\sqrt{{U_{rms}}^2 - {U_{H01}}^2}}{U_{rms}}$	$I_{hc} = \frac{\sqrt{{I_{rms}}^2 - {I_{H01}}^2}}{I_{rms}}$
hvf	$hvf = \frac{1}{U_N}\sqrt{\sum_{k=2}^{13}\frac{U_{Hk}^2}{k}}, (k \neq 3n \ \ for \ \ 3-phase \ \ motor)$	
hcf	$hcf = \frac{1}{I_N}\sqrt{\sum_{k=2}^{13} I_{Hk}^2}$	
Active Power	$P = \overline{u \cdot i}$ $P_\Sigma = \overline{u_A \cdot i_A + u_B \cdot i_B + u_C \cdot i_C}$ Assume I_N = 0 for 3P3W3M	
Fundamental Active Power	$P_{H01} = U_r(1)I_r(1) + U_j(1)I_j(1)$	

Measurement Function	Calculation Formula
Reactive Power	$Q = s\sqrt{S^2 - P^2}$ s = +1 when inductive； s = -1 when capacitive $Q_\Sigma = \sqrt{S_\Sigma^2 - P_\Sigma^2}$
Fundamental Reactive Power	$Q_{H01} = U_j(1)I_r(1) - U_r(1)I_j(1)$
Apparent Power	$S = U_{rms} \cdot I_{rms}$ $S_\Sigma = U_A \cdot I_A + U_B \cdot I_B + U_C \cdot I_C$
Fundamental Apparent Power	$S_{H01} = \sqrt{{P_{H01}}^2 + {Q_{H01}}^2}$
Power Factor	$\lambda = \frac{P}{S}$ $\lambda_\Sigma = \frac{P_\Sigma}{S_\Sigma}$
Fundamental Power Factor	$\lambda_{H01} = \frac{P_{H01}}{S_{H01}}$
Phase Shift	$\varphi = atan2(\mathrm{Q}, \mathrm{P})$ $\varphi_\Sigma = \cos^{-1}(\lambda_\Sigma)$
Fundamental Phase Shift	$\varphi_{H01} = atan2(Q_{H01}, P_{H01})$
Power Fundamental Content	$P_{fc} = \frac{P_{H01}}{P}$
Efficiency	$\eta = \frac{\sum P_{out}}{\sum P_{in}}$
Impedance	$\mathrm{Z} = \frac{{U_{rms}}^2}{S}$

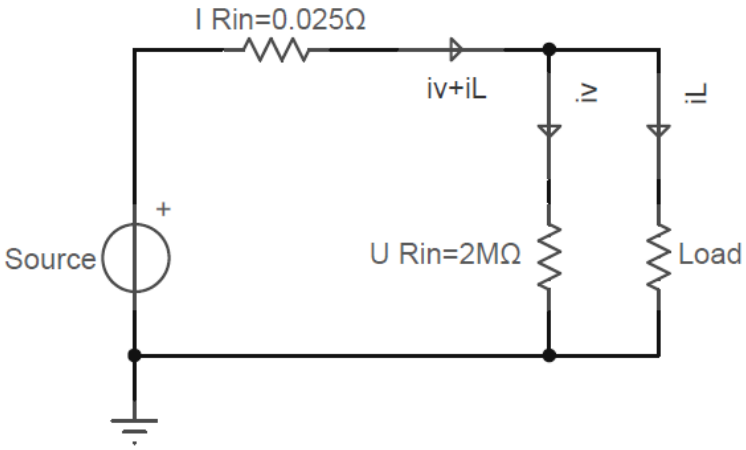
Measurement Function	Calculation Formula	
Fundamental Impedance	$\mathrm{Z}_{H01} = \frac{{U_{H01}}^2}{S_{H01}}$	
Impedance Series Equivalence	$\mathrm{R}_s = \frac{P}{{I_{rms}}^2}$	$\mathrm{X}_s = \frac{Q}{{I_{rms}}^2}$
Fundamental Impedance Series Equivalence	$\mathrm{R}_{sH01} = \frac{P_{H01}}{{I_{H01}}^2}$	$\mathrm{X}_{sH01} = \frac{Q_{H01}}{{I_{H01}}^2}$
Impedance Parallel Equivalence	$\mathrm{R}_p = \frac{{U_{rms}}^2}{P}$	$\mathrm{X}_p = \frac{{U_{rms}}^2}{Q}$
Fundamental Impedance Parallel Equivalence	$\mathrm{R}_{pH01} = \frac{{U_{H01}}^2}{P_{H01}}$	$\mathrm{X}_{pH01} = \frac{{U_{H01}}^2}{Q_{H01}}$
Electriccal Energy (Wh)	$W = \frac{1}{3600}\int_0^{t_\int} p dt$ $W_\Sigma = \frac{1}{3600}\int_0^{t_\int} p_\Sigma dt$	
Electric Energy +/-	$W_{update} = \frac{1}{3600}\int p dt$ in each update cycle $if\ \ W_{update} > 0, \quad W_+ = W_+ + W_{update}$ $if\ \ W_{update} < 0, \quad W_- = W_- + W_{update}$	
Electric Quantity	$q = \frac{1}{3600}\int_0^{t_\int} i dt$	
Electric Quantity +/-	$q_{update} = \frac{1}{3600}\int i dt$ in each update cycle $if\ \ q_{update} > 0, \quad q_+ = q_+ + q_{update}$ $if\ \ q_{update} < 0, \quad q_- = q_- + q_{update}$	
Torque	$T = \overline{torque}$	
Rotation Speed	$n = \overline{speed}$	

Measurement Function	Calculation Formula
Mechanical Power	$P_M = \frac{2\pi}{60}\overline{torque \cdot speed}$
Mechanical Energy	$E_M = \frac{1}{3600}\int_0^{t_{sr}} P_M dt$

How to Make More Accurate Measurements

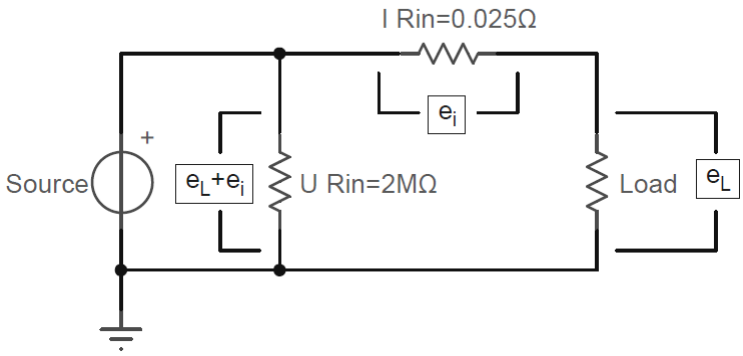
Measurement Error Caused by the Channel Resistance

By wiring a circuit to match the load, you can minimize the effects of power loss on measurement accuracy. The wiring of the source and load is discussed in this section.



Appendix Figure 1.

Connect the voltage measurement circuit near the load (as shown in *Appendix Figure 1*). The current measurement circuit measures the sum of i_L and i_V. i_L (desired current) is the current flowing through the load of the circuit under measurement, and i_V (error current) is the current flowing through the voltage measurement circuit. Because the current flowing through the circuit under measurement is i_L, only i_V reduces measurement accuracy. The input resistance of the voltage measurement circuit of the Analyzer is approximately 2 MΩ. If the input voltage is 1000 V, i_V is approximately 0.5 mA (1000 V/2 MΩ). Only when the load current i_L is 0.5 A or more, the effect of i_V on the measurement accuracy is 0.1% or less.



Appendix Figure 2.

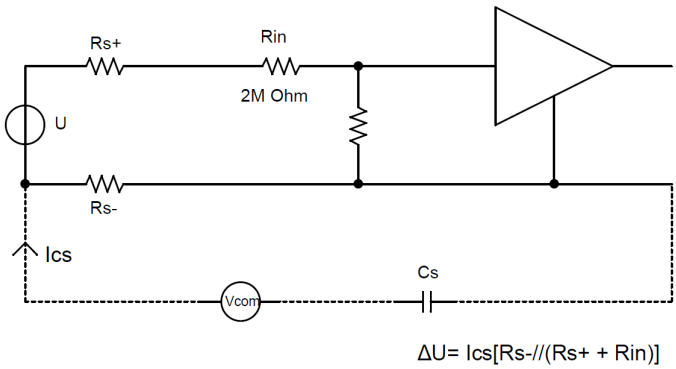
Connect the voltage measurement circuit near the source (as shown in *Appendix Figure 2*). The voltage measurement circuit measures the sum of e_L and e_I. e_L (desired voltage) is the load voltage, and e_I (error voltage) is the voltage drop across the current measurement circuit. The input resistance of the current measurement circuit of the Analyzer, I Rin is approximately 0.025Ω. If the input current is 10A, the effect of e_I on the measurement accuracy is approximately 0.25V (10A×0.025Ω). Only

when the load voltage e_L is 250V or more, the effect on the measurement accuracy is less than 0.1%. In summary, when measuring low voltage and large current, it is recommended to use the wiring method of the figure above; when measuring high voltage and small current, it is recommended to use the wiring method of the figure below.

Effects of Leakage Capacitance

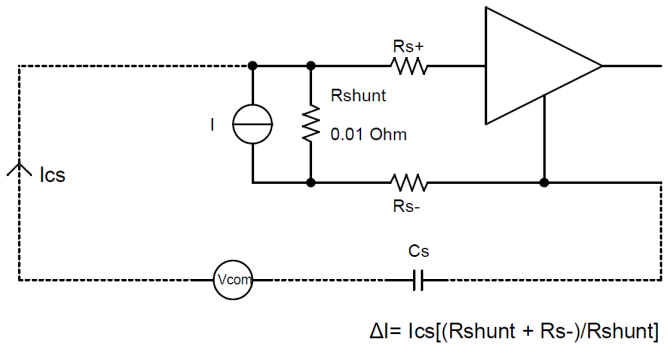
Each measurement channel of the Analyzer is isolated from each other. However, these isolated channels still have a leakage capacitance C_s relative to the earth, which consists of the distributed capacitance of the instrument itself, the isolation capacitance of the power adapter, and the anti-interference capacitance inside the instrument. In general, the test object of the Analyzer has a higher voltage relative to the earth, and we call this voltage common mode voltage V_{com}. The common mode voltage can generate a current i_{cs} through the leakage capacitance C_s. This current i_{cs} will have a certain impact on the measurement results of the Analyzer.

As shown in *Figure 1*, during voltage measurement, the current i_{cs} is coupled to the measurement circuit through R_{s+}, R_{s-} and R_{in}. R_{s+} and R_{s-} are internal resistances of the power supply under measurement and R_{in} is the test internal resistance of the power analyzer. The effect on the measurement voltage is: $\Delta U = i_{cs}[R_{S-}//(R_{S+} + R_{in})]$. Because R_{in} is larger, internal resistance of the power supply under measurement R_{s-} has the main impact. R_{s-} is connected to the common terminal (black terminal) of the measurement circuit.



Appendix Figure 3. Effects of Leakage Current on Voltage Measurement

During current measurement, the current i_{cs} flows through the test resistance R_{shunt}, and the internal resistance of the test resistance and the common terminal of the measurement circuit R_{s-} and forms a voltage, that is coupled into the measurement circuit. The effect on the measurement current: $\Delta I = i_{cs}[(R_{Shunt} + R_{S-})/R_{Shunt}]$, the voltage drop of i_{cs} in R_{Shunt} and internal resistance R_{s-} can cause measurement errors.



Appendix Figure 4. Effects of Leakage Current on Current Measurement

Methods to Reduce the Effect of Leakage Capacitance

1. High frequency components more easily generate current on the leakage capacitance than low frequency components. When measuring the small current with the built-in current channel, if you do not pay attention to the high-frequency components of the current, it is recommended to turn on the 650Hz line filter to effectively reduce the effect of leakage capacitance.
2. Connecting the built-in current channel to terminal N or ground can effectively reduce the effect of leakage capacitance.
3. Disconnecting the power adapter and using battery only can reduce the effect of leakage capacitance.
4. When measuring voltage, if the 2 terminals of the voltage source under measurement do not have the same impedance to the ground, it is recommended to connect the black terminal to the terminal with lower impedance (to avoid leakage current flowing through the internal resistance of the voltage source under measurement).

Broadband Measurement

The Analyzer has a bandwidth of up to 500kHz and a sample rate of 200kHz. When the measurement bandwidth is greater than half of the sample rate, aliasing may be caused, the observed waveform is not the real waveform, and the measured frequency is not the real frequency.

To measure a time-based digital quantity, such as RMS, AC and DC components, the results of the measurement after aliasing are still accurate. However, note that if the signal frequency is close to or equal to the sample frequency and its multiples, the measurement results are probably invalid.

If the signal under measurement has a frequency component higher than 100 kHz, and it is not desired to be measured under aliasing, the line filter of the corresponding channel can be turned on according to the required bandwidth.