UNI-T®

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Signal Analyzer

User Manual

I/Q (In-phase and Quadrature) Mode

The manual applies to:

UTS5000A series

UTS3000A series

V1.0

July 15th, 2024

Foreword

Dear Users,

Hello! Thank you for choosing this brand-new UNI-T instrument. To ensure safe and correct usage, please read this manual thoroughly, especially the Safety Requirements part.

After reading this manual, it is recommended to keep the manual at an easily accessible place, preferably close to the device, for future reference.

Copyright Information

Trademark

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Statement

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- UNI-T reserves the rights to any product specification and pricing changes.
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If the product is proved to be defective within the warranty period, UNI-T reserves the rights to either repair the defective product without charging of parts and labor or exchange the defective product to a working equivalent product (determined by UNI-T). Replacement parts, modules and products may be brand new or perform at the same specifications as brand-new products. All original parts, modules, or products which were defective become the property of UNI-T.

The “customer” refers to the individual or entity that is declared in the guarantee. To obtain the warranty service, “customer” must inform the defects within the applicable warranty period to UNI-T and perform appropriate arrangements for the warranty service.

The customer shall be responsible for packing and shipping the defective products to the individual or entity that is declared in the guarantee. In order obtain the warranty service, customer must inform the defects within the applicable warranty period to UNI-T and perform appropriate arrangements for the warranty service. The customer shall be responsible for packing and shipping the defective products to the designated maintenance center of UNI-T, paying the shipping cost, and provide a copy of the purchase receipt of the original purchaser. If the product is shipped to the location of the UNI-T service center, UNI-T shall pay the return shipping fee. If the product is sent to any other location, the customer shall be responsible for all shipping, duties, taxes, and any other expenses.

This warranty shall not apply to any defects or damages caused by accidental, machine parts' wear and tear, improper use, and improper or lack of maintenance. UNI-T under the provisions of this warranty has no obligation to provide the following services:

a) Any repair damage caused by the installation, repair, or maintenance of the product by non-UNI-T service representatives.

b) Any repair damage caused by improper use or connection to an incompatible device.

c) Any damage or malfunction caused using a power source which does not conform to the requirements of this manual.

d) Any maintenance on altered or integrated products (if such alteration or integration leads to an increase in time or difficulty of product maintenance).

This warranty is written by UNI-T for this product, and it is used to substitute any other express or implied warranties. UNI-T and its distributors do not offer any implied warranties for merchant ability or applicability purposes.

For violation of this guarantee, regardless of whether UNI-T and its distributors are informed that any indirect, special, incidental, or consequential damage may occur, UNI-T and its distributors shall not be responsible for any of the damages.

1. User Guide

- Inspect Packing List
- Safety Instruction
- Environmental Requirements
- Connecting Power Supply
- Electrostatic Protection
- Preparation Work
- Usage Tips
- Touch Operations
- Remote Control
- Help Information
- Operation Modes

This chapter introduces the safety instructions and basic information about using the spectrum analyzer.

Inspect Packing List

When you received the instrument, please inspect the packaging and packing list as follows,

- Inspect the packaging box for any damage or scratches caused by external forces and check the instrument's appearance for any damage. If you have any questions or issues with the product, please contact the distributor or local office.
- Carefully take out the goods and check them against the packing list.

Safety Instruction

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

Safety Precautions

Warning	**Please follow these guidelines to avoid possible electric shock and risk to personal safety.**
	Users must follow the following conventional safety precautions in the operation, service and maintenance of this device. UNI-T will not be liable for any personal safety and property loss caused by the users' failure following the safety precautions. This device is designed for professional users and responsible organizations for measurement purposes.
	Do not use this device in any way not specified by the manufacturer. This device is only for indoor use unless otherwise specified in the product manual.

Safety Statements

Warning	"Warning" indicates the presence of a hazard. It warns users to pay attention to a certain operation process, operation method or similar. Personal injury or death may occur if the rules in the "Warning" statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions stated in the "Warning" statement.
Caution	"Caution" indicates the presence of a hazard. It warns users to pay attention to a certain operation process, operation method or similar. Product damage or loss of important data may occur if the rules in the "Caution" statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions stated in the "Caution" statement.
Note	"Note" indicates important information. It reminds users to pay attention to procedures, methods and conditions, etc. The contents of "Note" should be highlighted if necessary.

Safety Signs

	**Danger**	It indicates danger of electric shock, which may cause personal injury or death.
	**Warning**	It indicates that some factors you should be careful to personal injury or product damage.
	**Caution**	It indicates danger, which may cause damage to this device or other equipment if you fail to follow a certain procedure or condition. If the "Caution" sign is present, all conditions must be met before you proceed to operation.
	**Note**	It indicates potential problems may cause failure to this device if you

		fail to follow a certain procedure or condition. If the “Note” sign is presented, all conditions must be met before this device will function properly.
	**AC**	Alternating current of device. Please check the region’s voltage range.
	**DC**	Direct current of device. Please check the region’s voltage range.
	**Grounding**	Frame and chassis grounding terminal.
	**Grounding**	Protective grounding terminal.
	**Grounding**	Measuring grounding terminal.
	**OFF**	Main power off.
	**ON**	Main power on.
	**Power Supply**	Standby power supply: when the power switch is turned off, this device is not completely disconnected from the AC power supply.
CAT I		Secondary electrical circuit connected to wall sockets through transformers or similar equipment, such as electronic instruments and electronic equipment. Electronic equipment with protective measures, and any high-voltage and low-voltage circuits, such as the copier in the office.
CAT II		Primary electrical circuit of the electrical equipment connected to the indoor socket via the power cord, such as mobile tools, home appliances, etc. Household appliances, portable tools (e.g., electric drill), household sockets, sockets more than ten meters away from CAT III circuit or sockets more than 20 meters away from CAT IV circuit.
CAT III		Primary circuit of large equipment directly connected to the distribution board and circuit between the distribution board and the socket (three-phase distributor circuit includes a single commercial lighting circuit). Fixed equipment, such as multi-phase motor and multi-phase fuse box; lighting equipment and lines inside large buildings; machine tools and power distribution boards at industrial sites (workshops).
CAT IV		Three-phase public power unit and outdoor power supply line equipment. Equipment designed to “initial connection”, such as power distribution system of power station, power instrument, front-end overload protection, and any outdoor transmission line.
	**Certification**	CE indicates a registered trademark of EU.
	**Certification**	UKCA indicates a registered trademark of United Kingdom.

	Certification	Conforms to UL STD 61010-1, 61010-2-030, Certified to CSA STD C22.2 No. 61010-1, 61010-2-030.
	Waste	Do not place equipment and accessories in the trash. Items must be properly disposed of in accordance with local regulations.
	EEUP	This environment-friendly use period (EFUP) mark indicates that dangerous or toxic substances will not leak or cause damage within this indicated time period. The environmentally friendly use period of this product is 40 years, during which it can be used safely. Upon expiration of this period, it should enter the recycling system.

Safety Requirements

Warning	
Preparation before use	Please connect this device to AC power supply with the power cable provided. The AC input voltage of the line reaches the rated value of this device. See the product manual for specific rated value. The line voltage switch of this device matches the line voltage. The line voltage of the line fuse of this device is correct. Do not use it to measure mains circuit.
Check all terminal rated values	Please check all rated values and marking instructions on the product to avoid fire and the impact of excessive current. Please consult the product manual for detailed rated values before connection.
Use the power cord properly	You can only use the special power cord for the instrument approved by the local and state standards. Please check whether the insulation layer of the cord is damaged, or the cord is exposed, and test whether the cord is conductive. If the cord is damaged, please replace it before using the instrument.
Instrument grounding	To avoid electric shock, the grounding conductor must be connected to the ground. This product is grounded through the grounding conductor of the power supply. Please be sure to ground this product before it is powered on.
AC power supply	Please use the AC power supply specified for this device. Please use the power cord approved by your country and confirm that the insulation layer is not damaged.
Electrostatic prevention	This device may be damaged by static electricity, so it should be tested in the anti-static area if possible. Before the power cable is connected to this device, the internal and external conductors should be grounded briefly to release static electricity. The protection grade of this device is 4 kV for contact discharge and 8 kV for air discharge.

Measurement accessories	Measurement accessories are of lower class, which are not applicable to main power supply measurement, CAT II, CAT III, or CAT IV circuit measurement. Probe assemblies and accessories within the scope of IEC 61010-031, and current sensors within the scope of IEC 61010-2-032 shall meet the requirements thereof.
Use the input / output port of this device properly	Please use the input / output ports provided by this device in a proper manner. Do not load any input signal at the output port of this device. Do not load any signal that does not reach the rated value at the input port of this device. The probe or other connection accessories should be effectively grounded to avoid product damage or abnormal function. Please refer to the product manual for the rated value of the input / output port of this device.
Power fuse	Please use the power fuse of specified specification. If the fuse needs to be replaced, it must be replaced with another one that meets the specified specifications by the maintenance personnel authorized by UNI-T.
Disassembly and cleaning	There are no components available for operators inside. Do not remove the protective cover. Maintenance must be conducted by qualified personnel.
Service environment	This device should be used indoors in a clean and dry environment with ambient temperature from 0 °C to + 40 °C. Do not use this device in explosive, dusty or humid air.
Do not operate in humid environment	Do not use this device in a humid environment to avoid the risk of internal short circuit or electric shock.
Do not operate in flammable and explosive environment	Do not use this device in a flammable and explosive environment to avoid product damage or personal injury.
Caution	
Abnormity	If this device may be faulty, please contact the authorized maintenance personnel of UNI-T for testing. The relevant personnel of UNI-T. must do any maintenance, adjustment, or parts replacement
Cooling	Do not block the ventilation holes at the side and back of this device. Do not allow any external objects to enter this device via ventilation holes. Please ensure adequate ventilation and leave a gap at least 15 cm on both sides, front and back of this device.

Safe transportation	Please transport this device safely to prevent it from sliding, which may damage the keys, knobs, or interfaces on the instrument panel.
Proper ventilation	Poor ventilation will cause temperature rise of device, even damage to this device. Please keep proper ventilation during use, and regularly check the vents and fans.
Keep clean and dry	Please take actions to avoid dust or moisture in the air affecting the performance of this device. Please keep the product surface clean and dry.
Note	
Calibration	The recommended calibration period is one year. Calibration should only be conducted by qualified personnel.

Environmental Requirements

This instrument is suitable for the following environment:

- Indoor
- Pollution degree: Class 2
- For overvoltage: This product should be powered from a mains supply that complies with Overvoltage Category II, which is a typical requirement for connecting equipment via power cords and plugs.
- Operating: Altitude below 3,000 meters; non-operating: Altitude below 15,000 meters
- Unless otherwise specified, the operating temperature is 0 to +40°C; storage temperature is -20 to +70 °C.
- Operating: Humidity at temperatures below +35°C, ≤ 90% RH.; non-operating: Humidity at temperatures from +35 °C to 40 °C, ≤ 60% RH.

Note

There are ventilation outlets on the rear and side panels of the instrument, please keep the air ventilation in the outlet of housing. To prevent excessive dust from blocking the vents, clean the instrument housing regularly. The housing is not waterproof; please cut off the power supply first and then wipe the housing with a dry cloth or a slightly moistened soft cloth.

Connecting Power Supply

The specification of the AC power supply is as shown in the following table.

Voltage Range	Frequency
100-240 VAC (±10% fluctuations)	50/60 Hz
100-120 VAC (±10% fluctuations)	400 Hz

Please use the attached power cable to connect to the power port.

Connecting to the service cable:

This instrument is a Class I safety product. The supplied power cables have reliable performance in terms of case grounding. This spectrum analyzer is equipped with a three-prong power cable that meets international safety standards. It provides good case grounding performance for the specifications of your country or region.

Please install the AC power cable as follows:

- Ensure the power cable is in good condition.
- Leave enough space for connecting the power cord.
- Plug the attached three-prong power cable into a well-grounded power socket.

Electrostatic Protection

Electrostatic discharge may cause damage to components. Components can be invisibly damaged by electrostatic discharge during transportation, storage, and use.

The following measures can reduce the damage caused by electrostatic discharge:

- Test in an antistatic area as far as possible.
- Before connecting the power cable to the instrument, briefly ground the inner and outer conductors of the instrument to discharge static electricity.
- Ensure all instruments are properly grounded to prevent the accumulation of static.

Preparation Work

1. Connect the power cable and insert the power plug into a protective grounding outlet.
2. Press the switch to enter the standby mode.
3. Press the soft switch and the spectrum analyzer powers on.

It takes about 30 seconds to initialize the boot, and then the spectrum analyzer enters the analysis mode of system default. To ensure optimal performance, it is recommended to warm up the spectrum analyzer for 45 minutes after powering on.

Usage Tips

Use an External Reference Signal

If users want to use an external signal source 10 MHz as a reference, please connect the signal source to the **10 MHz In** port on the rear panel. "**Freq Ref: Ext**" indication will be displayed on the measuring bar, on the top side of screen.

Activate the I/Q option

To activate the I/Q option, you need to enter a secret key. Please contact the UNI-T office to purchase the key.

Refer to the following steps to activate the option you purchased:

1. Save the secret key into a USB drive and insert it into the spectrum analyzer.
2. Press the **[System]** key > **System Information** > **Add Token**.
3. Select the purchased secret key and press the **[ENTER]** key to confirm.

Touch Operations

The spectrum analyzer provides multipoint touch screen for various gesture operations, which include:

- Tap the top right of the screen to enter the main menu.
- Tap parameters or menus on the screen to select or edit.
- Turn on and move the cursor.
- Use auxiliary quick keys to perform common operations.
- Use the **[Touch/Lock]** key to turn on/off the touch screen function.

Help Information

The spectrum analyzer's built-in help system provides help information of each functional key and menu control key on the front panel.

- Tap the "  ", on the lower left side of screen, and a help dialog box will pop out in the center of the screen. Tap the support function to get more detailed help descriptions.
- After the help information is displayed in the center of the screen, tap "×" or any other keys to close the dialog box.

Operation Modes

The spectrum analyzer offers various operating mode, press the **Mode** key to select it.

- Spectrum Analysis
- I/Q Analysis (see chapter 3 for details) (Option)
- EMI (Option)
- Analog Demodulation (Option)
- Vector Signal Analysis (Option)
- Real-time Spectrum Analysis (Option)
- Vector Network Analysis (Option)
- Phase-Noise Analysis (Option)
- Mode Presetting

Mode Presetting: Each operation mode has its own preset mode.

The options include IQ analysis, EMI, analog demodulation, vector signal analysis, and phase analysis, which require purchase to activate.

In different operation modes, the functional keys on the front panel may differ. This manual is specialized for I/Q Analysis Mode, UI, and functional keys

2. User's Interface

Figure 2-1 User's Interface

1. **Operating Mode**: Spectrum analysis, I/Q analysis, EMI, analog demodulation, vector signal analysis, real-time spectrum analysis, vector network analysis, and phase noise analysis.
2. **Sweep/Measurement**: Tap switch icon to quickly step through the sweep mode, single, or continuous.
3. **Measurement Bar**: Displays measurement settings (attenuation, trigger type, center frequency, resolution bandwidth, average | hold, average type, and pre-amplification). Tap the icon to quickly switch.
4. **Panel Menu:** Current functional buttons and items, includes frequency, amplitude, bandwidth, sweeping, markups, measurement settings, and other functional displays.
5. **Spectrum Window**: Spectrum window is the basic window used in complex spectrum measurement. It displays amplitude and frequency (or, at zero sweep-width, amplitude, and time information).
6. **I/Q Waveform Window**: The window is used for I/Q waveform measurement, showing I and Q traces of the input signal in the time domain.
7. **Spectrum Window** - Window Name: Display the name of the current window.

8. **Spectrum Window** - Display Scale: Display scale value.
9. **Spectrum Window** - Measurement Results Marked: includes frequency and amplitude.
10. **Spectrum Window** - Grid Display Area: includes trace display, cursor point, etc.
11. **Spectrum Window** - Reference Level: Display reference level values.
12. **Spectrum Window** - Data Display: includes center frequency and sweep width.
13. **I/Q Waveform Window** - Window Name: Display the name of current window.
14. **I/Q Waveform Window** - Display Scale: Display scale value.
15. **I/Q Waveform Window** - Reference Level: Displays reference level values.
16. **I/Q waveform Window** - Grid Display Area: includes trace display, cursor point, etc.
17. **I/Q Waveform Window** - Data Display: includes start time, end time, acquisition time.
18. **I/Q Waveform Window** - Measurement Results Marked: includes time, real part, and unreal part.
19. **Functional Settings:** Quick Screenshot, File System, Setup System, Help System, and File Storage.
    - Quick Screenshot  : Take a screenshot and save it to the default folder. If external storage exists, it will be saved to external storage first.
    - File System  : In a file system, users can save trace state, status, measurement data, or other files to internal or external memory and can make calls. View, create, delete, copy, and move files.
    - System Information  : View basic information and options.
    - Help System  : Open the Help Navigation.
    - File Storage  : Import and export status, trace + status, and measurement data.
20. **Log Dialog Box of System**: Click the blank part on the right side of file storage to enter the system logs and view information such as local running logs, alarms, and tips.
21. **Connection Type**: Display connection status including mouse, USB flash drive, screen lock and other connection conditions.
22. **Date & Time:** Display the date and time.
23. **Full Screen ON/OFF:** Open the full screen display, the screen is elongated horizontally, and the button on the right side is automatically hidden.

3. Key Measurement (I/Q)

- Frequency (FREQ)
- Amplitude (AMPT)
- Bandwidth (BW)
- Sweep
- Trace
- Marker
- Peak
- Measurement (Meas)
- Measurement/Setup (Meas/Setup)
- Single
- Default Setup (Default)
- System Setup (System)
- File Storage (Save)
- Touch/Lock
- Mode

Note

- The key description is for the spectrum analysis I/Q mode.
- For different devices, the parameter configuration and functions may differ. Refer to the data sheet of each device for specific parameter configurations.

Frequency (FREQ)

Press the **[FREQ]** key to enter the frequency function menus. The numerical values of center frequency and sweep width are displayed at the bottom of the screen.

Center Frequency: Activate this function to set a specific frequency value at the center of the

screen. Use the numeric keys, rotary knob, arrow keys, or by touching panel menu to change the center frequency.

When modifying the center frequency, keep the sweep width unchanged. For I/Q analysis, all measured center frequency was set identically, which was a global parameter.

Sweep Width: Used to enter the range value of sweep width. Users can change the sweep width value by numeric keypad, rotary knob, arrow keys, or touching panel menus. Changing the sweep width will change the frequency range symmetrically as per the center frequency. The reading of sweep width is the total display frequency range. To ensure the sweep width of each horizontal scale division, the above sweep width should be divided by 10.

Note

- In the process of sweep width adjustment, keep the center frequency unchanged, the start frequency and stop frequency will be changed.
- Minimum sweep width is up to 100 Hz, and the maximum is 40 MHz.

Amplitude (AMPT)

Press the **[AMPT]** key to activate the reference level function and enter the amplitude setting menus. By adjusting the amplitude parameters, the measured signal can be displayed in the current window in a way to be observed and with minimal measurement error. The reference level and scale values are displayed on the top side of Spectrum window and I/Q Waveform window. The amplitude parameters of each trace window are independent of each other. When selecting a trace window, each amplitude parameter of trace window can be modified under the amplitude menu.

Reference Level: Sets the reference level by pressing the **[AMPT]** key to enable this function. The reference level is the power or voltage value displayed on the top of the screen. The reference line is located at the top and center of grid, depending on the reference window. Users can adjust the reference level by the numeric keypad, rotary knob, arrow keys, or touching the panel menu.

When selecting the Spectrum window, the reference level is the power represented by the grid line at the top of the window, in dBm unit.

When selecting the I/Q Waveform window, the reference level is the value represented by the grid line in the center of the Y-axis of window, in V unit.

The reference level controls are only applied to the selected window.

Scale/Division: Set a value corresponding to one grid division in the vertical direction of the screen. The users can change the scale value by numeric keypad, rotary knobs, arrow keys, or touching the panel menu.

When selecting the Spectrum window, the scale represents a grid value in the vertical direction, in dBm unit.

When selecting the I/Q Waveform window, the scale represents a grid value in the vertical direction, in V unit.

The reference level controls are only applied to the selected window.

Reference Position: Locate the reference level at the top, center, or bottom of the Y scale display. According to the reference position, adjust the vertical position of the currently selected trace on the screen. Changing the reference position does not change the reference level.

Input Attenuation (Auto/Manual): Sets the RF front-end attenuator to allow the big signal to pass through the mixer with low distortion (small signals with low noise). Input attenuation can be switched between Automatic and Manual modes. When Auto mode is selected, the input attenuation value is linked to the reference level. When Manual mode is selected, the user can change the input attenuation value by numeric keypad, rotary knobs, arrow keys, or touching the panel menu.

Note

- When the maximum mixer level and reference level are determined, the minimum input attenuation of the spectrum analyzer should meet the following formula: Reference Level ≤ Input Attenuation - Pre-amplification -10 dBm.

Preamplifier: This switch controls the instrument's internal preamplifier. Turn it on to produce a gain to compensate for the preamplifier, ensuring that the amplitude value reading is the actual value of input signal. When the preamplifier is turned on, the measurement bar area of the screen displays "**Preamp: on**."

Bandwidth (BW)

Press the **[BW]** key to enable the resolution bandwidth (RBW) function and set the BW parameters.

RBW (Auto/Manual): Set the resolution bandwidth to distinguish two signals in similar frequency. In Manual mode, the user can change the resolution bandwidth value within range of 10 Hz-10 MHz by numeric keys, rotary knob, arrow keys, or touching the panel menu.

If the input value is outside this range, select the available bandwidth value closest to the input value.As the resolution bandwidth decreases, the system corrects the sweep time to maintain the calibration of the amplitude. The resolution bandwidth is also related to the sweep width. The resolution width decreases along with the decreasing of sweep width.

FFT Window Type Filters: There are five filter options: Hanning, Flat-top, Gaussian, Blackman,

and Blackman-Harris. Users can select the appropriate filter type according to the actual measurement requirements, please refer to the following table.

Window Function	Spectrum Leakage	Amplitude Accuracy	Frequency Resolution
Hanning	Good	Good	Medium
Flattop	Good	Excellent	Bad
Gaussian	Medium	Good	Medium
Blackman	Excellent	Good	Medium
Blackman-Harris	Good	Excellent	Medium

Sweep

Press the **[Sweep]** key to enter the sweep setting menu and set the sweep parameters.

Sweep/Measurement (Single/Continuous): Set the sweep mode to single and continuous. The default is continuous. The corresponding status is displayed at the top of the screen according to the selected mode.

- **Continuous**: The icon  indicates continuous mode. The system automatically sends the trigger initialization signal and enters the part of trigger condition judgment directly after each sweep.
- **Single**: The icon  indicates single mode. If the current system is in continuous sweep mode, press the "**Sweep/Measurement (Single/Continuous)**" key to enter the single sweep mode, and the backlight of Single key lights up. Press the **Single** key to enter the single sweep and runs a sweep measurement.

Trace

Press **[Trace]** key to enter the trace setting menu and set the trace parameters of Spectrum window.

Spectrum Trace Display: Set the trace in Spectrum window to be on/off. This function is only reflected on the display, the actual spectral trace is still present, and even if the current trace is in an off-state, the trace is just not visible.

Marker

Press the **[Marker]** key to access the panel menu with cursor function, to select the cursor type

and quantity. The cursor point is a rhombic icon, as shown in Figure 3-2.

Figure 3-1 Marker

Select Markers: A total of 4 markers are available, with Marker 1 (indicated by a cursor on the screen) selected by default. After selecting a cursor, the user can set parameters such as cursor type, the trace to marker, etc. The activated cursor will be displayed on the selected trace, and readings of the current activated cursor will be showed on the top right side of the screen.

Marker Modes: Set the marker type, including Normal, Delta, Fixed, and OFF.

1. **Normal:** This mode is used for measuring X (frequency or time) and Y (amplitude) values at a specific point on the trace. After selecting Normal mode, a cursor identified by its number (e.g., "1") will appear on the trace. Note the following points when using this mode:
   - If no cursor is currently activated, a cursor will be activated at the center frequency of the current trace.
   - The reading of the current cursor will be displayed in the upper right corner of the screen.
   - The resolution in reading of X-axis (time or frequency) is related to the sweep width; reducing the sweep width can achieve a higher reading of resolution.
2. **Delta** △: Measure the difference between "reference cursor" and "a cursor on the trace": X (frequency or time) and Y (amplitude) values. After selecting "Difference," a pair of cursors will appear on the trace: the reference cursor (marked with "×") and the difference cursor (marked with "△").

3. **Fixed**: After selecting the "Fixed" cursor, set the X and Y values of cursors directly or indirectly, and their positions remain unchanged. The Y value does not change as the trace change. The fixed cursor is generally used as the reference cursor for the difference cursor and is marked with "×".
4. **OFF**: Turn off the selected cursor. The cursor information displayed on the screen and the related function will also be closed.

Trace Marker: Select the trace marked by the current cursor as Spectrum, Spectrum Avg, Real(I), Imaginary(Q).

Frequency/Time Marker: Mark the frequency point or time point on the trace. The user can change the frequency value by numeric keys, rotary knob, arrow keys, or touching the panel menu. When the marked trace is set to Spectrum or Spectrum Avg, the marker indicates the frequency. When the marked trace is set to Real (I) or Imaginary (Q), the marker acts as a Time Cursor.

Relative To: Used for measuring the difference between two cursors. These two cursors can be marked on different traces at the same time.

All Markers OFF: Closes all cursor points

Marker->: Use the value of the current cursor to set other system parameters in the spectrum analyzer (such as center frequency, reference level, etc.). If no cursor is available currently, pressing the **Cursor** menu will activate a cursor automatically.

->Center Frequency: Set the center frequency of the spectrum analyzer to the frequency of the current cursor.

- When the "Normal" cursor is selected, the center frequency is set as the frequency of the cursor.
- When the "Difference" cursor is selected, the center frequency is set to the frequency of the difference cursor.
- In zero span mode, this function does not work.

->Reference Level: Set the reference level of spectrum analyzer as an effective amplitude cursor and move the cursor point to the reference level (on the top of the grid).

- When the "Normal" cursor is selected, set the cursor amplitude of spectrum analyzer as the amplitude of the current reference level.
- When the "Difference" cursor is selected, set the reference level as the amplitude difference between cursors.

Functional Markers: Noise, Power-in-Band, and Density-in-Band.

1. **Noise Mark:** Mark the noise using the selected cursor and read the power density value of

normalized noise at the cursor.

If the currently selected cursor is off in the **Marker** menu, pressing "Noise Mark" will automatically turn it on to the "Normal" type. This measures the average noise level of the frequency point at the cursor and normalizes it to the 1 Hz bandwidth, compensating for different detection methods and trace types. The noise cursor measurement can be more accurate when using "RMS Average" or "Sampling" methods.

2. **Power-in-Band Mark:** In non-zero span mode, it calculates the total power of signals within a certain bandwidth range. In zero span mode, it calculates the average power within a specific time range.
3. **Density-in-Band Mark:** In non-zero span mode, the density in-band refers to the total power in bandwidth to be measured divided by the measurement bandwidth. In zero span mode, the density in-band refers to the measured power in-band divided by Bn (Bn is the noise bandwidth of RBW filter).

Peak

Press the **[Peak]** key to access the setting menu of peak search and perform a peak search function.

Frequency Marker: Mark the frequency point on the trace. The user can change the frequency value by numeric keys, rotary knob, arrow keys, or touching the panel menu.

Marker ->: Refer to "Marker ->" in the panel menu.

Peak Search: Use the normal cursor mode to search for the highest amplitude in the trace and display the frequency and amplitude value. Press to perform the peak search function once.

Next Peak: Search the peak on the trace that has the second highest amplitude after the current peak and meets the search criteria. Mark it with the cursor. If this peak does not exist, the cursor will not move.

Next Peak on the Left: Search the current peak on the left side and search for the closest peak that meets the search criteria on the trace. Mark it with the cursor.

Next Peak on the Right: Search the current peak on the right side and search for the closest peak that meets the search criteria on the trace. Mark it with the cursor.

Minimum Peak: Search the minimum amplitude value on the trace and mark it with the cursor.

Peak-to-Peak Search: Perform a peak search and a minimum search simultaneously. The result of the peak search is indicated by the "Reference" cursor, while the result of the minimum search is indicated by the "Difference" cursor.

Continuous Peak Search (ON/OFF): Turn on/off continuous peak search. The default setting is OFF. When continuous peak search is turned on, the spectrum analyzer automatically performs a peak search after each sweep for measured signal track.

Search Criteria: Threshold line, peak threshold, and peak offset.

Threshold Line (ON/OFF): Set whether to display the peak threshold and peak offset indicator line, the threshold line displays the peak offset value, and the default setting is OFF.

Threshold (Man/Auto): Specify the minimum peak amplitude manually or automatically. Only peaks which are greater than the peak threshold can then be peaks. The user can change the threshold by numeric keys, rotary knob, arrow keys, or touching the panel menu.

Threshold Offset (Man/Auto): Automatically or manually specify the difference between the peak and the minimum amplitude on the left and right sides. Only if the difference is greater than the peak offset, can the peak be a peak. The user can change the offset by numeric keys, rotary knob, arrow keys, or touching the panel menu.

Measurement (Meas)

Press the **[Meas]** key to open the measurement options menu,

Complex Spectrum Measurement: This mode enables wideband spectrum analysis using FFT (Fast Fourier Transform) and digital signal processing (DSP). The instrument samples the input signal, converts it to I and Q components, and then transforms it into the frequency domain. After tuning to a fixed center frequency, the instrument digitizes the samples at high speed, processes them with DSP hardware, and applies FFT software to convert the data into the frequency domain. In this mode, the instrument automatically adds an I/Q window, displaying the I and Q signal waveforms for voltage and time. The I/Q view in spectrum measurement provides the advantage of visualizing the complex components of the signal without altering any settings or measurements.

I/Q Waveform Measurement: It is a time-domain measurement that can view the envelope, real, and imaginary components of RF or baseband signal. In many respects, it is similar to the zero-sweep measurements in conventional spectrum analysis but provides direct access to I/Q pairs of signals, such as those found in modern communication signals. It can also be used to perform high-precision universal power measurements to check the RF envelope (amplitude) of signals.

I/Q Waveform Window shows the voltage and time variation of I and Q signal waveforms, to reveal the voltage of complex modulated waveforms containing digital signals, measuring the phase of waveforms and their magnitude, statistical average power, current power, and display, see Figure 3-2.

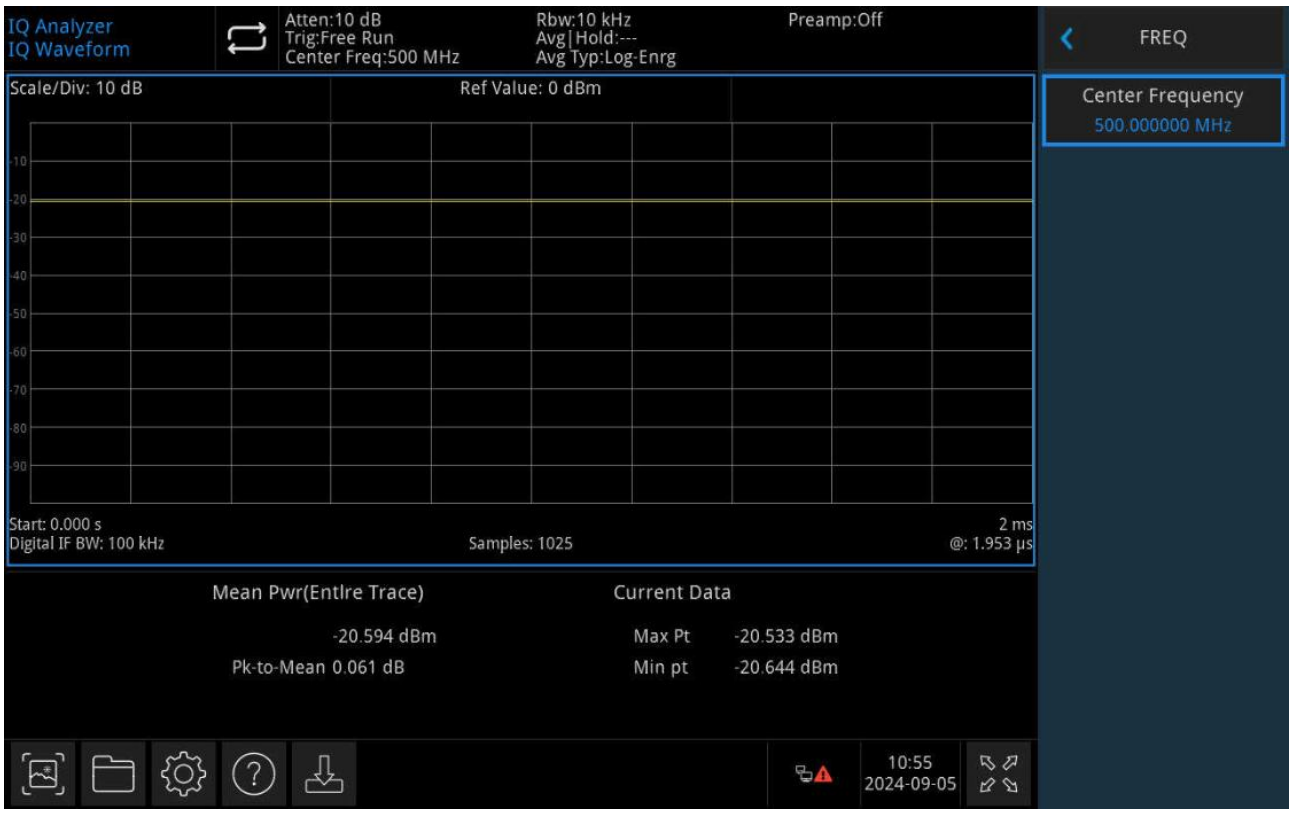

Figure 3-2 I/Q Waveform Window

Measurement Setting (Meas/Setup)

Press the **[Meas/Setup]** key to open the parameter setting panel, in measurement options of **[Meas]** function key. It includes the following settings:

Average/Hold Count: Set the average times for the trace. The user can change the average times by numeric keys, rotary knob, arrow keys, or touching the panel menu. Multiple averages can reduce the influence from noise or other random signals and highlight the stable characteristics of signals. The more the average times you get, the smoother the trace will be.

Average Mode: Toggles between the averaging modes: Exponential and Repeat. This averaging mode determines how the signal analyzer processes data after the specified number of averaging scans has been completed.

- **Exponential Average**: In this mode, after reaching the specified number of averaging scans, each channel trace data is weighted exponentially, combined with the previous average, and then averaged. The weight of the new data is greater than that of the old data, which is advantageous for tracking slowly changing signals. The averaging result is displayed at the end of each scan.
- **Repeat Average**: In this mode, once the specified number of averaging scans is reached, all previous data is cleared, and a new scan is performed.

Average Type:

1. Log-Power Averaging: It averages the logarithmic amplitude values (in dB) of the signal envelope measured within a signal collection unit. The average detection type will be changed to video detection. For random noise, logarithmic averaging = power averaging - 2.5 dB = voltage averaging - 1.45 dB. Therefore, it reduces the displayed level of noises (not the true noise level) and is suitable for observing low-energy narrowband signals, especially those close to noises.
2. Power Averaging: It averages the power of signals (the square of amplitude). The average detection type will be changed to RMS (power) detection. Power averaging provides the true power for noises and is most suitable for measuring the real-time power of complex signals.
3. Voltage Averaging: It averages the voltage values of the signal envelope measured in a signal collection unit. The average detection type will be changed to voltage detection. Voltage averaging still provides a linear display, making it suitable for observing the rise and fall conditions of AM signals or pulse-modulated signals (e.g., radar, TDMA transmitters).

Measurement Reset: Reset the measurement in current mode/Set the parameters to factory default.

Single

Pressing **[Single]** key is the quick way to enter the sweep mode. For more details, refer to "Sweep".

Default Settings (Default)

Press the **[Default]** key to provide a convenient start condition for measurement.

Press **[Default] > Reset** to restore to the factory settings:

1. Reset the I/Q parameters of spectrum analyzer.
2. Enter the frequency menu.
3. Set the default parameter for some environments.
4. Perform a processor test without affecting the correction data.
5. Delete the input and output caches and all trace data.
9. The state is directly set to 0.

See followings for default values of key parameters after resetting:

Menu	Parameter Name	Default Value
FREQ (Frequency)	Center Frequency	50 MHz
FREQ (Frequency)	Sweep Width	10 MHz
AMPT (Amplitude)	Reference Level	0 dBm
AMPT (Amplitude)	Scale	10 dB
AMPT (Amplitude)	Input Attenuation	10 dB
AMPT (Amplitude)	Pre-amplify	OFF
BW (Bandwidth)	VBW (Video Bandwidth)	100 kHz
Sweep	Sweep Mode	Continuous
Cursor	Select Marker	Cursor 1
Marker	Marker Modes	OFF
Marker	Frequency Marker	50 MHz
Marker	Trace Marker	Spectrum Trace
Meas/Setup	Average Hold Times	100
Meas/Setup	Average Mode	Index
Meas/Setup	Average Type	Logarithmic Power

Note: The above table shows the reset parameters of UTS3000A

System Setting (System)

Press the **[System]** key to enter the settings menu, allowed to access to the system information, general settings, and network settings of spectrum analyzer.

System Information: Enter the System Information panel menu to check general and options information.

1. Basic Information: Displays the product name, manufacturer, product model, serial number, software version No., medium frequency hardware version No., radio frequency hardware version No., medium frequency logical version No., radio frequency logical version No., etc.

Options Information: Check the version No. and states.

Setting: Enter the settings menu to configure the basic and network settings.

1. General Settings
   - Language: Chinese (Simplified), English, and German
   - Time Format: 12-hour and 24-hour.
   - Date/Time: Touch this area to pop out the setting dialog box, swipe up and down to modify the digitals. After setting, tap “√” to confirm and close the setting dialog box.
   - Picture Format: Set the format of screenshots, with “bmp,” “jpeg,” and “png” options.

- Power-on Parameters: Set the loaded system parameter settings after power on, with options of default, previous, and preset.
- Backlight: Swipe the scroll bar to adjust the screen backlight.
- Volume: Swipe the scroll bar to adjust the sound volume.
- HDMI Output: HD multimedia interface, tap "□" to tick it, indicating the interface is on.
- Screenshot Inverse: Set the inverse color of screenshot pictures.
- User Preset: In power-on default setting, when the power-on parameter is set to be preset, this configuration file will be used to set the parameters when the instrument powers on.
- Shutdown Confirmation: When selecting it, a confirmation dialog box will pop up when press Switch key to power off.

2. Network Settings

- Adapter: This is the LAN switch. Tap "□" to tick it, indicating that LAN is enabled.
- DHCP: Tap "□" to tick it, indicating that the network configuration is automatically acquired. If no "□" tapping, needs to be manually set.
- IPv4 Address: The format of IP address is "nnn.nnn.nnn.nnn". The first "nnn" range is 1–223, and the other three "nnn" ranges are 0–255. It is recommended to consult a network administrator for an available IP address.
- IP Mask: The format of subnet mask is "nnn.nnn.nnn.nnn", where "nnn" ranges from 0 to 255. It is recommended to consult a network administrator for an available subnet mask address.
- Gateway: The format of gateway is "nnn.nnn.nnn.nnn." The first "nnn" range is 1–255, and the other three "nnn" ranges are 0–255. It is recommended to consult a network administrator for an available gateway address.
- MAC Address: The physical address, also called the hardware address, confirms the location of a network device. The length is 48 bits (6 bytes) and consists of hexadecimal digits, including the first 24 digits and the last 24 digits, in the format of "XX-XX-XX-XX-XX-XX". The first 24 bits are called organization-unI/Que identifiers, while the last 24 bits are assigned by the manufacturer and are called extended identifiers.
- Interface Settings

  Web Login Username: Set the username for browser login. The web address format is http://IP, and IP is the IPv4 address set by network, e.g. http://192.168.20.117.

  Web Login Password: Set the password for browser login. When successfully login, users can control the instrument, perform SCPI commands, set network, etc.

After setting the web username and password, users can use a PC or mobile web browser to remotely control the device. It mimics the clickable display function of touchscreen/mouse, just like a physical instrument. The operation steps are as follows:

(1) Access Local Area Network

The computer and spectrum analyzer should share the same LAN. Check the local IP address through the **UTILITY** menu of spectrum analyzer, and then the browser accesses the spectrum analyzer using http://ip port.

Example:

- Computer IP: 192.168.20.3
- Spectrum Analyzer IP: 192.168.20.117
- PC browser using 192.168.20.117 to access the spectrum analyzer can check the basic information and operate the instrument control, internet settings, password settings, and SCPI control, as shown in Figure 3-3.

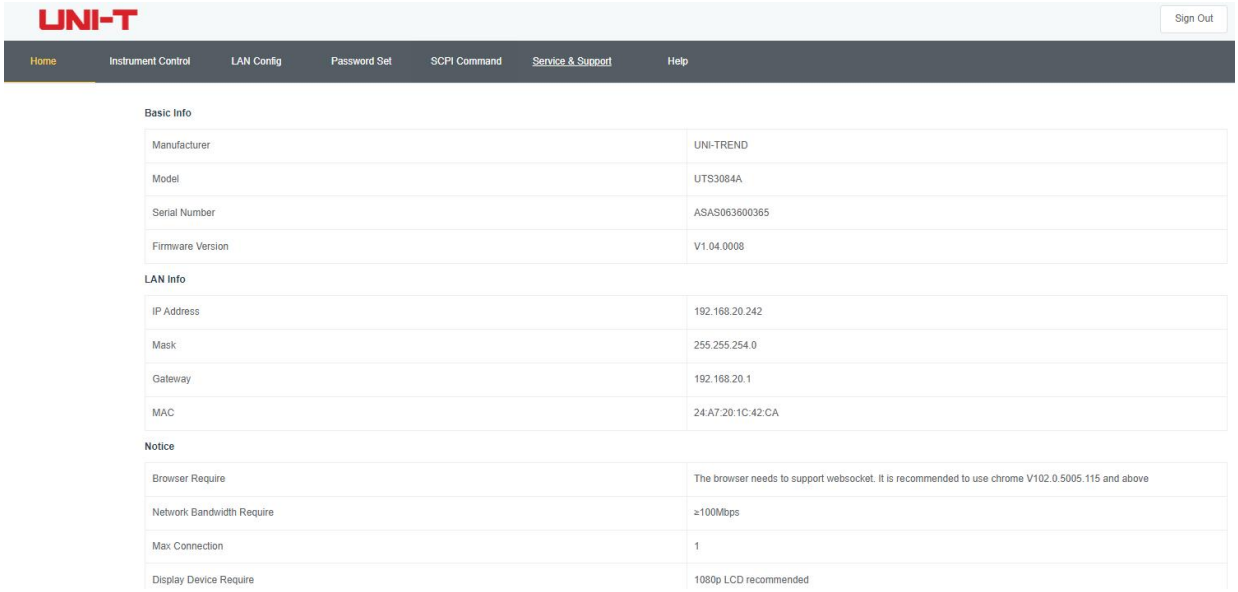

Figure 3-3 Web Basic Information

Log in to check the instrument settings, internet settings, passwords settings and SCPI control. The web username and password can be found in interface settings. After login, users can view and control the spectrum analyzer, as shown in Figure 3-4.

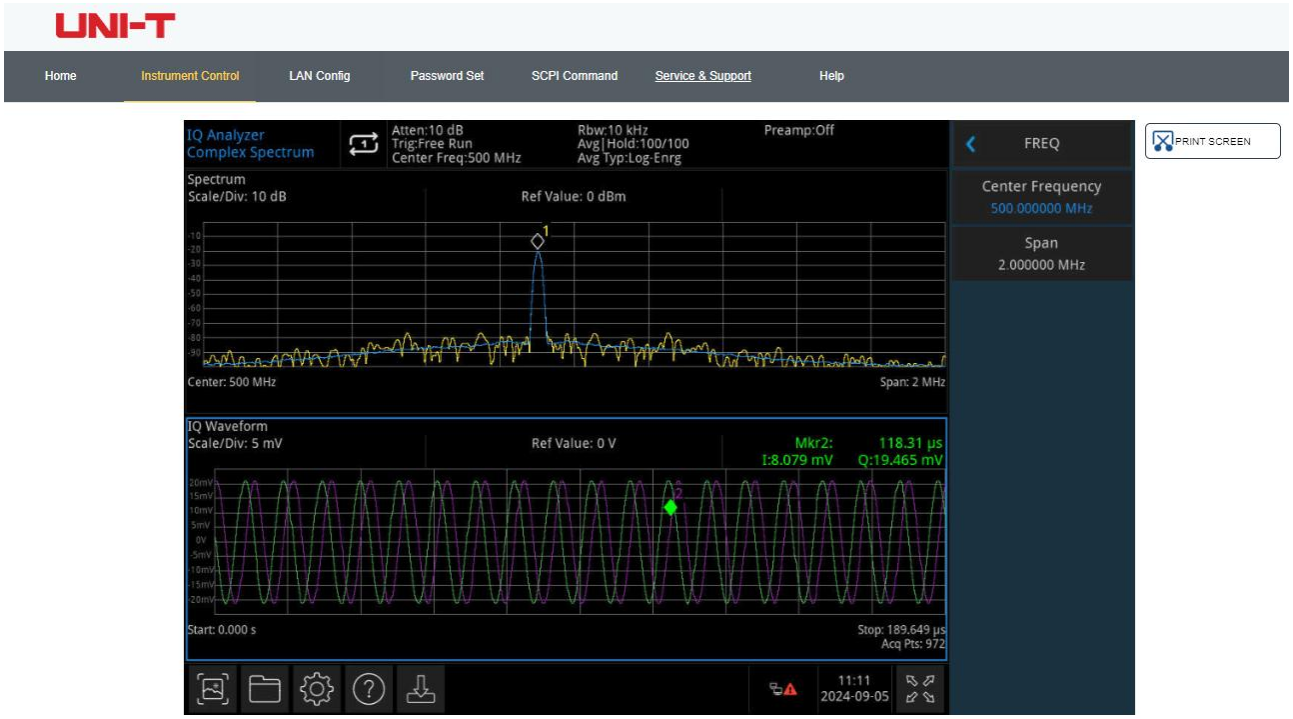

Figure 3-4 Web Control for Instrument

The operations can be performed on the touchscreen of a physical instrument, such as selecting the menu panel, clicking the function key, inputting digitals and characters, and dragging the cursor. This Web page and PrintScreen can be operated.

(2) Access Outer Network

a. Ensure the network cable is plugged into the spectrum analyzer and that internet access is available.

b. Turn on the frp proxy service on the server.

c. Configure the frp proxy service and IP port of the spectrum analyzer.

d. Accessing the port http://IP:web_port via browser, which will allow you to control the spectrum analyzer, the access interface is same as above mentioned.

Note

This instrument uses a way of frp (Fast Reverse Proxy) intranet penetration to access the outer network. The frp version is 0.34.0. The instrument carries a FRP-0.34.0 client port, required with a server to run, with frp sever opened. The client connects to the FRP server port 7000, so the server configuration must include “bind_port = 7000”.

(3) Network Settings

Modify the internet information and frp service settings of spectrum analyzer as shown in Figure 3-5.

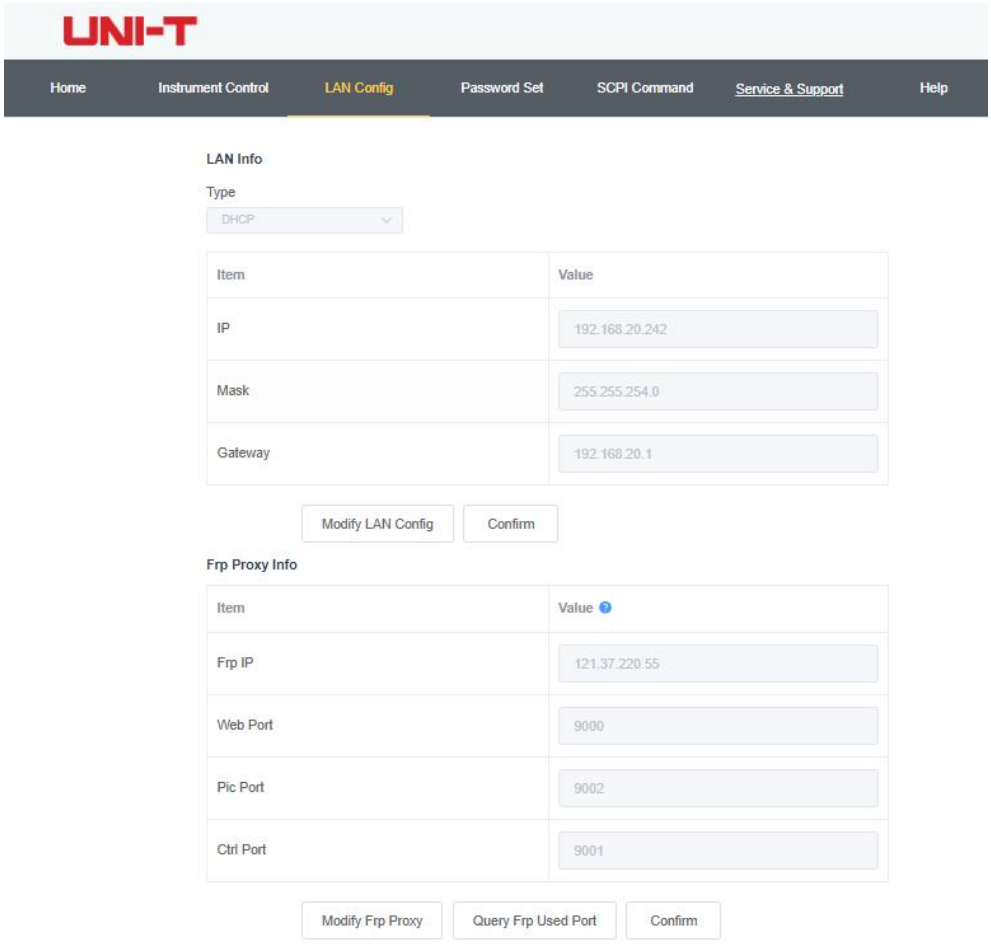

Figure 3-5 Web Network Settings

(4) Password Settings

Modify the web password of spectrum analyzer, as shown in Figure 3-6. The original password can be found by navigating to Physical Instrument -> System -> Setting -> Port Setting.

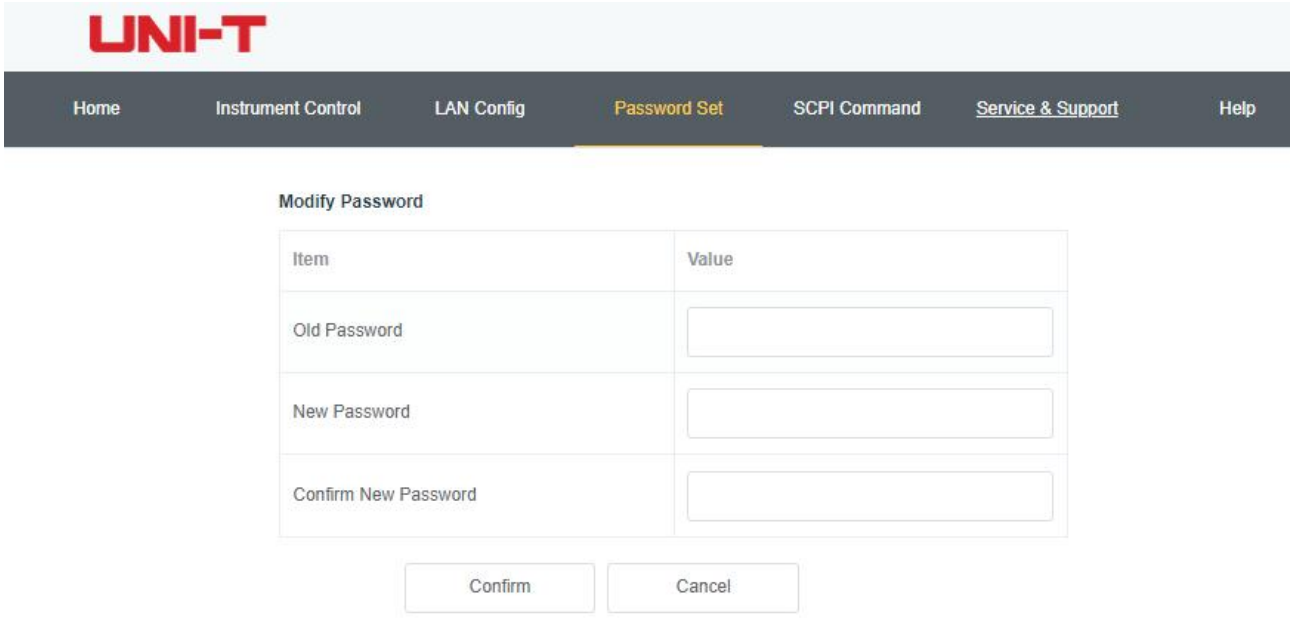

Figure 3-6 Web Password Settings

(5) SCPI

Execute SCPI commands as shown in Figure 3-7. Input the command in the edit box and click the **Send** key. The executed result will be displayed in the report frame below.

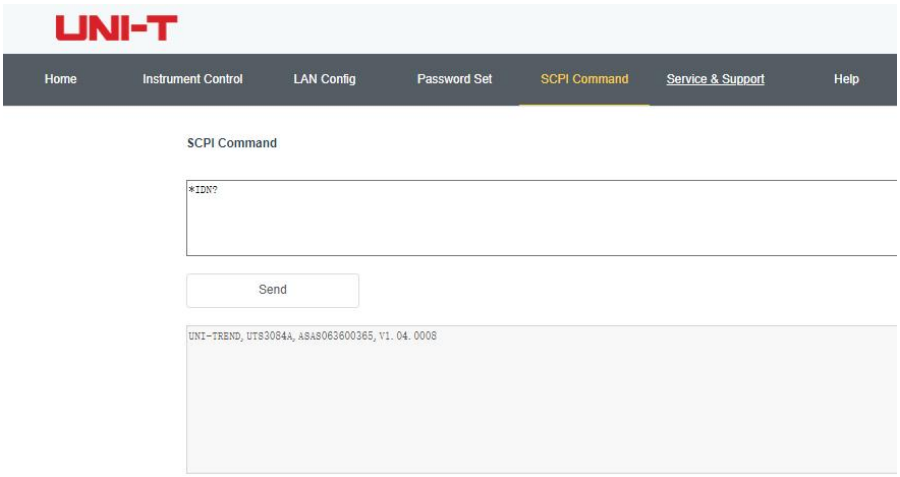

Figure 3-7 SCPI Control

Restore Defaults: Enter the restore default menu to perform this function.

1. Restore the system settings: The system settings of spectrum analyzer will be restored to the default state.
2. Clear data: All data stored in spectrum analyzer will be deleted.
3. Restore all settings: All settings of spectrum analyzer will be restored to the default state, and data will be cleared.

File Storage (Save)

Press **[Save]** key to enter the save menu. The types of files can be saved as state, trace + state, measurement data.

State: Press the State panel menu to enter the state save menu. Save the state into the instrument.

1. Press the **Export** key. The instrument will save the current state using default filename or a user-defined filename.
2. After the state file is selected, press the **Import** key to read the current state file.

Trace + State: Press the Trace + State panel menu to enter the trace and state save menu. Save the instrument state and selected trace into a file.

Trace Selection: There are five traces available.

1. Press the **Export** key. The instrument will save the current state and trace, using default filename or a user-defined filename.
2. After selecting the state file, press the **Import** key to read the current files of trace + state.

Measurement Data: Press the Measurement Data panel menu to access the measurement data save menu. The selected measurement data type (such as trace) can be saved into the specified file. The instrument will save the corresponding data in CSV (comma-separated values) format for data analysis using Excel tool.

1. Press the **Export** key. The instrument will save the current measured data, using default filename or a user-defined filename.
2. After selecting the file, press the Import key to read the current measured data.

Export: Export the current selected file type.

Import: Import the current selected file data. (This key is hidden when no file is selected).

Touch Lock

Press the **[Touch/Lock]** key, turning green indicates the Touch function is locked, light off indicates Touch function is enabled, and press the **[Esc]** to exit the Screen Lock.

Mode

Press the **[Mode]** key to open the Mode window with options of I/Q analysis, EMI, analog demodulation, vector signal analysis, real-time sweep frequency analysis, vector network analysis, and phase noise (some options may require additional activation). Please download the required instructions from the official website.

Note

- The key is designed for UTS3000A series. For UTS5000A series, **[Mode]** and **[Meas]** keys can be combined as one key, press the **[Mode/Meas]** key to open Mode Select window. Multiple work modes: I/Q analysis, EMI, analog demodulation, vector signal analysis, real-time spectrum analysis, vector network analysis, and phase noise analysis.
- For different work modes, there are detailed measurements. In spectrum analysis mode, channel power, time domain power, occupied bandwidth, third-order cross modulation, adjacent channel power, spectrum monitoring, carrier-to-noise ratio and harmonic measurement. In I/Q analysis mode, complex spectrum and I/Q waveform measurement. In EMI mode, optional spectrum sweep. In analog demodulation mode, AM, FM and phase. In real-time spectrum analysis mode, spectrum and PvT. In vector network analysis mode, S11 and S12.

4. Appendix

Maintenance and Cleaning

(1) General Maintenance

Keep the instrument away from the direct sunlight.

Caution

Keep sprays, liquids and solvents away from the instrument or probe to avoid damaging the instrument or probe.

(2) Cleaning

Check the instrument frequently according to the operating condition. Follow these steps to clean the external surface of the instrument:

a. Please use a soft cloth to wipe the dust outside the instrument.

b. When cleaning the LCD screen, please pay attention and protect the transparent LCD screen.

c. When cleaning the dust screen, use a screwdriver to remove the screws of the dust cover and then remove the dust screen. After cleaning, install the dust screen in sequence.

d. Please disconnect the power supply, then wipe the instrument with a damp but not dripping soft cloth. Do not use any abrasive chemical cleaning agent on the instrument or probes.

WARNING

Please confirm that the instrument is completely dry before use, to avoid electrical short-circuit or even personal injury caused by moisture.

Contact Us

If you experience any issues with this product and are in mainland China, you can contact UNI-T directly. Our service support is available from 8 a.m. to 5:30 p.m. (UTC+8), Monday to Friday, or via email at infosh@uni-trend.com.cn.

For product support outside mainland China, please contact your local UNI-T distributor or sales center. Many UNI-T products offer options for extended warranty and calibration periods; please contact your local UNI-T dealer or sales center for more information.

To obtain the address list of our service centers, please visit our website at:

http://www.uni-trend.com.