Qumtrix®

USER MANUAL

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VLF-TD 34 kV & 45 kV

Very Low Frequency Test System — User Manual

Very low frequency sine-wave testing, DC testing and dielectric loss (tan δ) measurement for cables up to 34 kV and 45 kV

OUTPUT VOLTAGE
0 – 34 kV / 0 – 45 kV (sine)

DC OUTPUT
±1 – 34 kV / ±1 – 45 kV

OUTPUT CURRENT
0 – 14 mA

MAX. CAPACITANCE LOAD
0.5 µF … 8 µF



VLF-TD test set

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About This Manual

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This document is the user manual for the VLF-TD 34 kV and 45 kV very low frequency test system, re-issued in the Qumtrix documentation format. It replaces the previously supplied manual for the same product revision; the technical content follows that source.

This equipment generates hazardous voltages. Installation, operation and maintenance may only be carried out by authorised and trained personnel.

The arrangement of information in this document is to the best of our knowledge and belief. Qumtrix / Ennfu Scientific assumes no guarantee for the accuracy or completeness of the contents of this document and cannot be made liable for consequential damages arising from erroneous or incomplete information.

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1 Safety Suggestions

1.1 General Description

Safety Precautions: This manual contains basic instructions for commissioning and operating the VLF-TD (34&45kV). Therefore, it is important to ensure that the manual is always available for authorized and trained personnel only. Any personnel using these devices should read the manual thoroughly. The manufacturer will not be held liable for any injury or damage to personnel or property resulting from failure to follow the safety precautions outlined in this manual.

Local applicable regulations must be observed.

Safety Labeling Instructions: Important instructions concerning personal, operational, and technical safety are marked in the text as follows:

Symbol	Description
Warning	Indicates a potential danger that may lead to fatal or serious injury.
Caution	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or material damage.
Note	These notes contain important information and useful tips for using the system. Failure to observe them may render the measurement results invalid.

Warning

Caution

- It is essential to observe the general electrical regulations of the country where the equipment will be installed and operated, as well as the current national accident prevention regulations and internal company rules (work, operating, and safety regulations).
- Use genuine accessories to ensure the system's safety and reliable operation.
- The use of other accessories may void the warranty, and replacement parts may not be allowed.

Operator

Operator Requirements: This system and its peripheral equipment may only be operated by personnel who are professionally trained or have received work instructions. Unauthorized personnel must be kept away from the work area.

Installation Requirements: The installation of the system must be performed by an authorized electrician with the appropriate qualifications.

Qualification Basis: The skills and qualifications of relevant personnel should meet the national standards for electrical work and safety. Qualified electricians should possess the necessary expertise and practical experience, be familiar with the scope of work and relevant regulations, and be able to accurately identify electrical hazards and take effective preventive measures.

Reference Standards: The electrical safety testing equipment of this system complies with the series of standards GB/T 26852 "Electrical Testing and Test Equipment - Electrical Safety Testing Equipment." Operational safety requirements refer to the relevant provisions on personnel qualifications and work responsibilities in GB/T 26860-2011 "Power Safety Work Regulations - Electrical Parts of Power Plants and Substations."

1.2 General Notes and Warnings

Intended Application

Safe operation can only be achieved when the equipment is used for its intended purpose (see Chapter 2.1). Using the equipment for other purposes may pose a risk of personal injury or damage to related equipment. The limits specified in the technical data must not be exceeded. Operating products in a condensing environment using the megohmmeter may lead to flashovers, danger, and damage to instruments. The equipment should only be operated under the specified conditions. It is prohibited to operate the equipment in direct contact with moisture, water, or in proximity to corrosive substances.

This product does not contain chemicals, explosive gases, or fumes.

Five Safety Rules

The following five safety rules must always be followed when handling high voltage (HV):

1. Disconnect power
2. Prevent re-energizing
3. Confirm the absence of voltage
4. Ground and short-circuit
5. Cover or isolate adjacent live parts

Use of cardiac pacemakers

The physical processes during high voltage operation may endanger individuals wearing a cardiac pacemaker or certain protective equipment/clothing.

A cardiac pacemaker may be affected when near these high voltage facilities.

Firefighting in electrical installations

- According to regulations, carbon dioxide (CO_2) must be used as the extinguishing agent for firefighting in electrical installations.
- Carbon dioxide is electrically non-conductive and does not leave any residue. It is safe to use, provided the minimum distance is maintained, and can be used in energized facilities. A carbon dioxide fire extinguisher must always be available within electrical installations.
- If the regulations are violated and any other extinguishing agent is used, it may result in damage to the electrical installation. The company disclaims any responsibility for such damage. Additionally, when using a powder fire extinguisher near highly flammable materials, there is a risk of electric shock for the operator due to voltage flashovers (caused by powder dust) near electrical equipment.
- It is crucial to adhere to the safety instructions for the extinguishing agent.
- The applicable standard is DIN VDE 0132.

Hazards during high voltage operation

Special attention and safety-conscious behavior are required when operating high

voltage equipment, particularly non-stationary equipment. The regulations governing

this are VDE 0104, regarding the setup and operation of electrical testing equipment, in compliance with EN 50191. Additionally, specific national regulations and

standards must be followed.

- The VLF-TD 34kV/45kV generates dangerous test voltages of up to 卤 24/31.8kV RMS during operation. This is supplied to the test object via high-voltage cables.
- The test system must be operated under supervision.

- Operation requires at least two people, with the second person being able to activate the emergency switch in case of danger.
- Safety facilities must not be bypassed or deactivated.
- To avoid hazardous electric charges on nearby metal parts, all metal components must be grounded.
- Check for any unsecured live systems or components near the test system that you or the system might accidentally come into contact with. This is especially important for components carrying high voltage or when the voltage is unknown. Use insulating covers to protect these components. If it is technically impossible to do so, switch them off or, after consulting with the responsible person, ensure this is done on-site during your work. Make sure this is properly carried out.

2 Technical Description

2.1 Overview

Functional Description

The VLF-TD test system is capable of testing medium-voltage cables in accordance with the relevant standards of the European Committee for Electrotechnical Standardization (CENELEC) harmonization documents HD 620 S1:1996 and HD 621 S1:1996.

A 0.1Hz sine wave voltage of up to 24kV RMS. With this type of cable testing, faults in the insulation, especially water tree damage, can be reliably detected in both polyethylene (PE)/cross-linked polyethylene (XLPE) cables as well as paper-insulated cables, causing flashover. The testing procedure will not damage fault-free insulation. Cables can also be tested for dielectric breakdown strength using both positive and negative DC voltages, as well as trapezoidal AC voltage (rectangular wave voltage). The slew rate of the rectangular wave voltage depends on the cable capacitance and is automatically adjusted. Additional leakage current measurement in DC mode allows for evaluating the relative quality of the cable insulation. The sine wave shape of the system's test voltage can also be used to directly measure the cable's dielectric loss factor, thereby determining the degree of deterioration in the cable's loss factor. For a detailed description of this application, please refer to the relevant manuals.

Features

The VLF-TD test system combines the following features and functions:

- Full AC voltage testing up to 24/31.8 kV RMS (sine wave voltage)
- Integrated ultra-low-frequency withstand voltage and dielectric loss factor testing
- Additional output voltage waveforms of DC and rectangular waves
- Sheath testing and pinpointing up to 10 kV
- Leakage current measurement
- Manual and automatic frequency adjustment
- Voltage breakdown detection with automatic disconnection of the high-voltage connection
- Logging to internal memory, exportable to a computer via USB stick for generating test reports
- Firmware updates via USB

Scope of Delivery: The scope of delivery for the test system includes the following components:

- Test main unit
- Main power cable, 2.5 meters
- Grounding cable, 4 meters
- High-voltage connection cable, 5 meters
- USB stick
- Accessory bag

2.2 Technical Data

Parameter	VLF-34 kV	VLF-45 kV
Output Voltage		
Output voltage (sine wave)	max. 24 kV_{RMS} (34 kV_{peak})	max. 31.8 kV_{RMS} (45 kV_{peak})

DC voltage	±1 – 34 kV	±1 – 45 kV
Resolution	0.001 kV	0.001 kV
Accuracy	1 %	1 %
Max. capacitance load	0.1 Hz @ 0.5 µF → 24 kV rms / 34 kV peak 0.05 Hz @ 1.0 µF → 24 kV rms / 34 kV peak 0.01 Hz @ 8.0 µF → 18 kV rms / 25 kV peak	0.1 Hz @ 0.5 µF → 31.8 kV rms / 45 kV peak 0.05 Hz @ 1.0 µF → 31.8 kV rms / 45 kV peak 0.01 Hz @ 5.0 µF → 22 kV rms / 31 kV peak
Output Current		
Measurement range	0 – 14 mA	0 – 14 mA
Resolution	1 µA	1 µA
Accuracy	1 %	1 %
Dielectric Loss Factor Measurement (VLF TD)		
VLF sine measurement voltage	1 – 24 kV rms	1 – 31.8 kV rms
Load range	1 nF – 8 µF	1 nF – 5 µF
Resolution	1×10^{-5}	1×10^{-5}
Accuracy	1×10^{-4}	1×10^{-4}
Measurement range (tan δ)	1×10^{-4} – 9999.9×10^{-4}	1×10^{-4} – 9999.9×10^{-4}
Measurement frequency	0.1 Hz	0.1 Hz
General Information		
Power consumption	max. 300 VA	max. 400 VA
Reverse voltage protection	13 kV	15 kV
Data interface	USB 2.0	
Dimensions (W × H × D)	Peli Case 1430, 430 × 240 × 340 mm	
Weight	22 kg	
Ambient temperature (operating)	−10 to +50 °C	
Storage temperature	−20 to +60 °C	
Safety and electromagnetic compatibility (EMC)	Complies with CE standards, Low Voltage Directive (2014/35/EC), Electromagnetic Compatibility Directive (2014/30/EC), Environmental Impact EN 60068-2 and subsequent versions	
User interface languages	Provides multiple languages: English, Chinese (Simplified), Russian, Spanish, etc.	

Table 1 — Technical data of the VLF-TD 34 kV and 45 kV test systems, as published in the source manual.

The VLF test system is defined by the following technical parameters

2.3 Testable Cable Capacities

The following charts (Figures 1 and 2) show the relationship between the test frequency, the connected load capacitance, and the set test voltage.

If the set test frequency cannot be used due to the limitations shown here, the system will prompt for overcurrent protection, and the user can switch to the next available frequency.

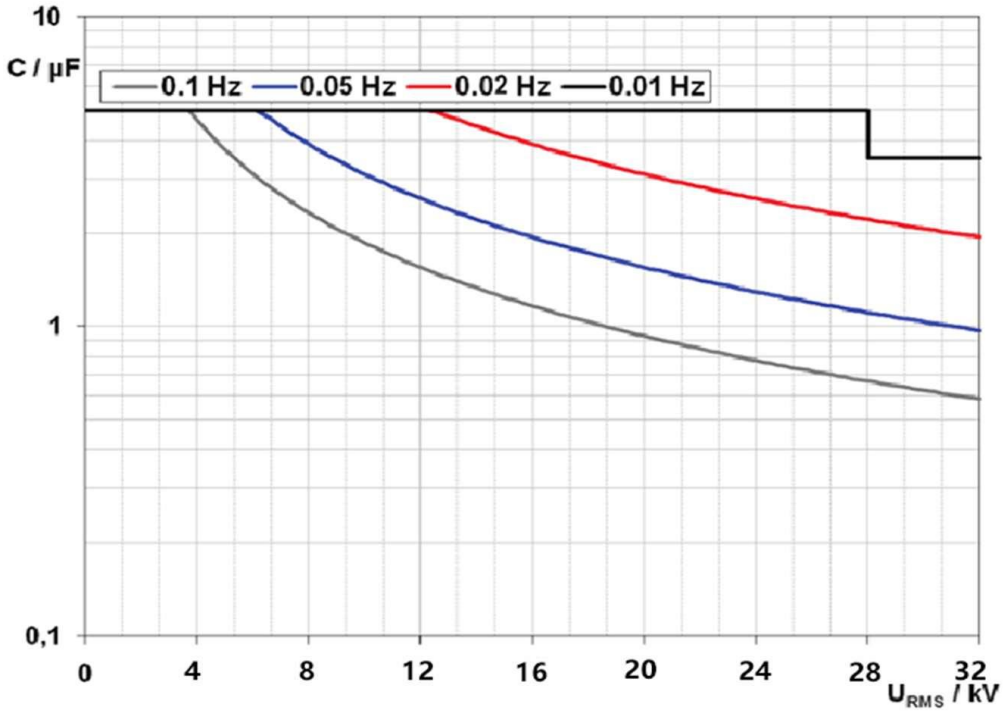


Figure 2 — Capacitance / test-voltage characteristic

2.4 Connections and Controls

The system has the following connectors and control components: Element Description

- LCD Display
- High-voltage Output Indicator
- USB 2.0 Interface
- Rotary Encoder
- Emergency Stop Button
- High-voltage Output Lock



Figure 3 — Connections and controls



Figure 4 — Front panel overview

3 System Settings

Installation Safety Instructions

- Choose a location that is capable of bearing the system's weight and size and ensures that it stands securely.
- When setting up the test system, ensure that it does not interfere with the function of any other systems or components. If modifications to other systems and components are required to set up and operate the test system, be sure to restore them to their original state after the work is completed. Always take into account the special requirements of these systems and components, and only operate them after consulting and obtaining approval from the responsible party.
- Install protective equipment (such as railings, chains, or fences) near the test object to prevent personnel from entering the danger zone and to avoid the risk of touching live components.
- The ventilation slits on both sides must not be blocked.
- If there is a large temperature difference between the storage and installation locations (from cold to warm), condensation may form on components carrying high voltage (condensation effect). To avoid any risk of damage to personnel and components caused by voltage arc-overs, the equipment must be acclimated for about half an hour in the "on" state (with fans running) before high-voltage operation can begin.

3.1 Electrical Connection

- Before connecting the test object, be sure to follow the safety instructions in Chapter 1, especially the five safety rules.
- The test system may only be connected or disconnected from the test object when the test object is de-energized and grounded.
- Since the voltage applied to the test object may reach values that pose a risk of incidental contact, the cable ends must be shielded according to VDE 0104 to prevent this. Be sure to consider all cable branches when doing so.
- After granting clearance to the test object, ensure that dangerous voltages cannot reach unprotected areas or technical equipment.
- The discharge switch installed in the device is only used for safely discharging the capacitance and is not a grounding and short-circuiting device as described in VDE 0104.
- Before operating the system, all existing voltage transformers must be disconnected from the test object.
- All cables that are not in operation and not connected to the test system must be short-circuited and grounded.

Connection Diagram

The following figure shows the simplified connection diagram:

Connection Sequence: Please connect the system in the following order:

Step	Action
1	The grounding cable should be fastened to the system's grounding connection and then connected to a suitable point on the station's protective grounding system.
2	Connect the high-voltage connection cable to the system's high-voltage output, as shown in the figure below.
3	The inner conductor of the high-voltage connection cable must be connected to either the phase or the shield of the cable under test using appropriate connection accessories.

4	The shield of the high-voltage connection cable must be connected to a grounding bar near the cable termination (system ground).
5	Insert the supplied power cable into the system's power connection and connect it to a power outlet.

When working in sheath testing or sheath pinpointing mode, the cable's shield must not be grounded at both ends of the cable. Also, ensure that there is no indirect contact with the ground, such as through joints.

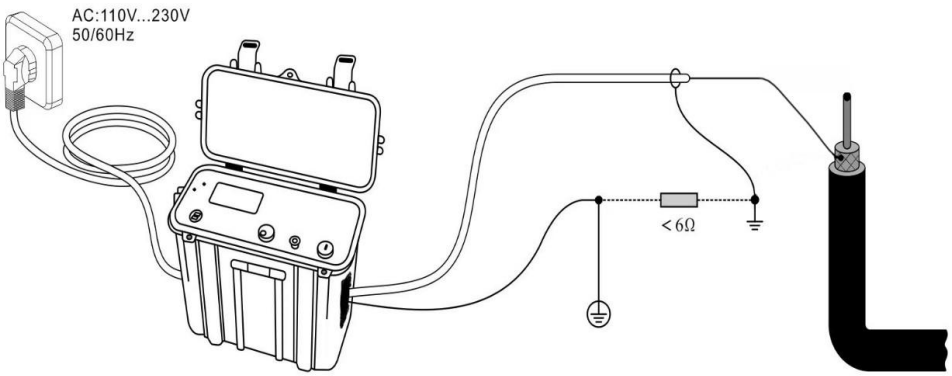


Figure 5 — Simplified connection diagram



Figure 6 — Test connection, single-phase

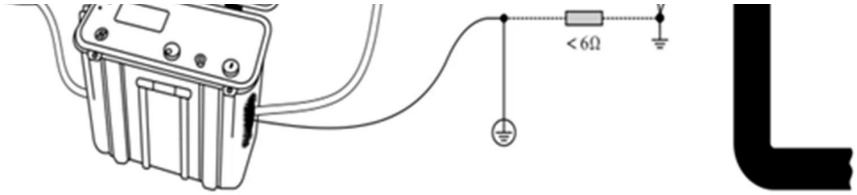


Figure 7 — Test connection, three-phase

3.2 Power on the System

The device is in the "Out of Service" state before the power switch is pressed. After pressing the power switch, the system enters the "Ready for Operation" state. The screen lights up to indicate that the system is ready. The control functions are activated, and after a brief booting phase, the setup interface appears. The high-voltage power supply is turned off, and no high voltage is output. Once the boot process is complete, the system directly enters the setup menu, displaying the parameters from the last test (Figure 6).

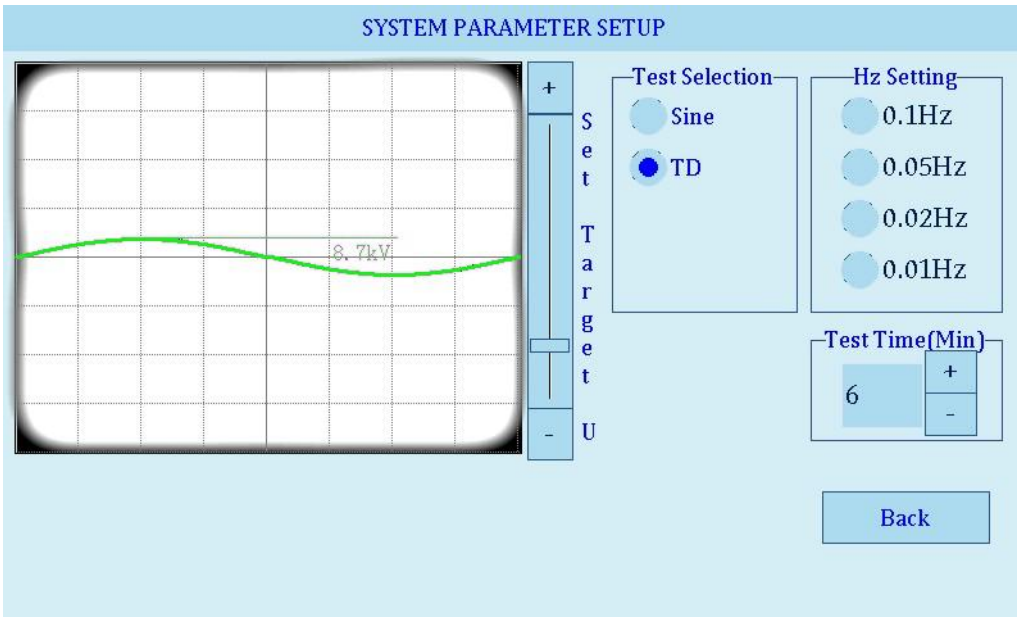


Figure 8 — System parameter setup screen

If performing dielectric loss testing, select the radio button in the test function, set the rated voltage U0 of the hied. The dielectric loss test duration is preset in the system, with each test taking approximately 3 minutes and 30 seconds. After completing the settings, press "Back" to enter the "Start Test" interface (Figure 7). Before starting the test, ensure that the safety lock and emergency stop switch have been released. Otherwise, there will be a corresponding prompt at the bottom left corner of the screen. After completing the above steps, click the "Start" button. The interface will ask for confirmation to begin the test (Figure 8). After confirmation, the test will begin, and the system will perform a self-check before outputting high voltage.

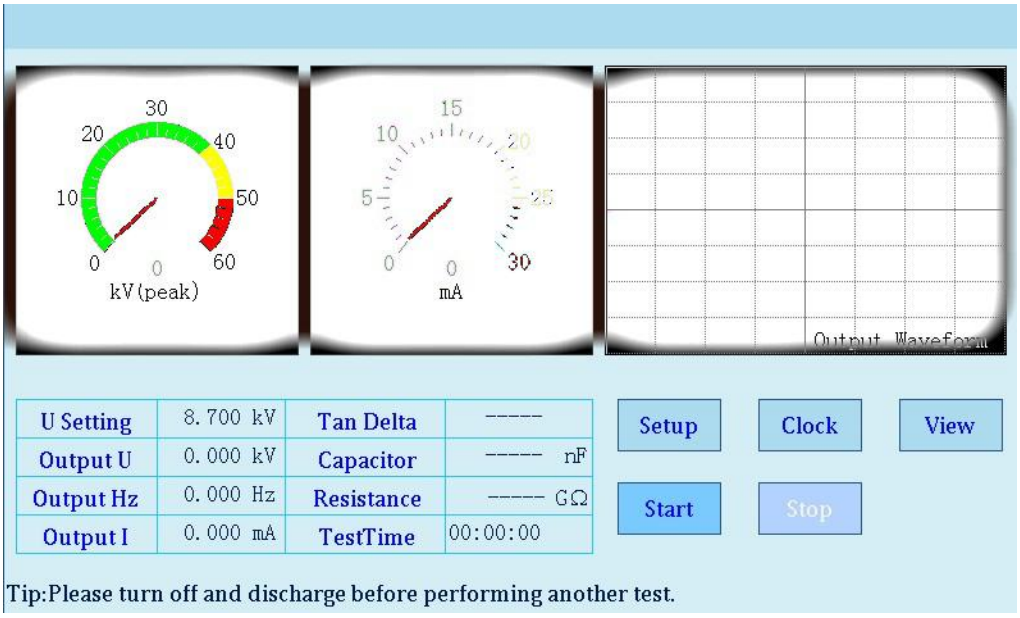


Figure 9 — Live measurement screen

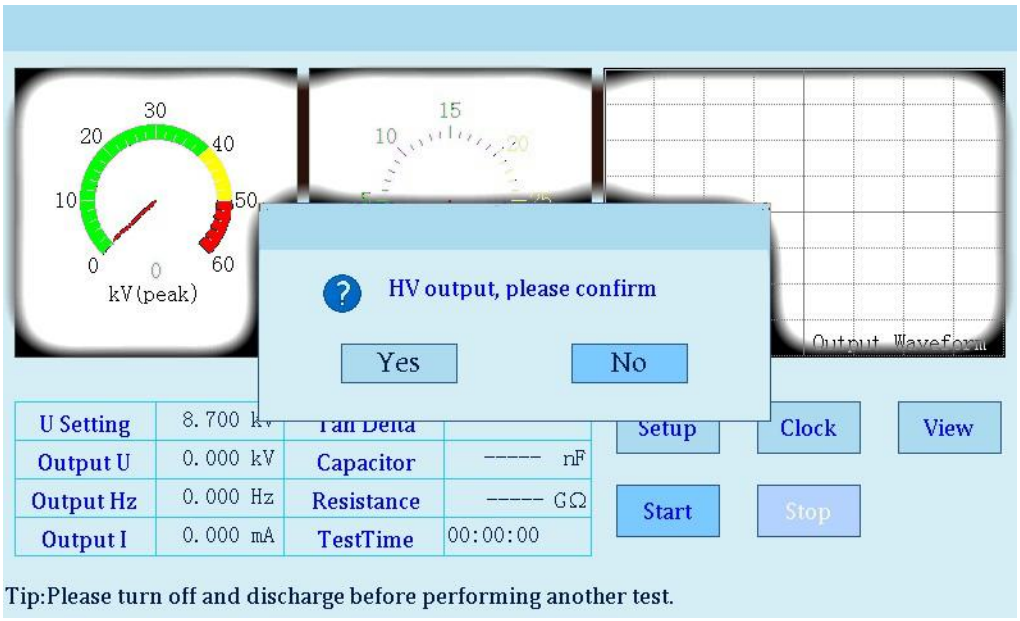


Figure 10 — HV output confirmation prompt

After starting the test, the system display shows the real-time peak voltage and current, the waveform window displays the real-time waveform, and the table shows the set voltage and frequency values as well as the output voltage and current RMS values. When testing the dielectric loss, the timer starts immediately; for withstand voltage testing, the timer starts only when the voltage reaches the set value. The dielectric loss test is fully automated. The system first conducts several cycles of testing at 0.5 times U0, then automatically switches to U0 for several cycles of testing, and finally tests at 1.5 times U0 for several cycles. After the test is complete, the results are automatically saved, and the cable is discharged. Once the process is complete, a prompt appears in the bottom left corner. You can then click the "View" button to enter the historical test file list interface (Figure 10).

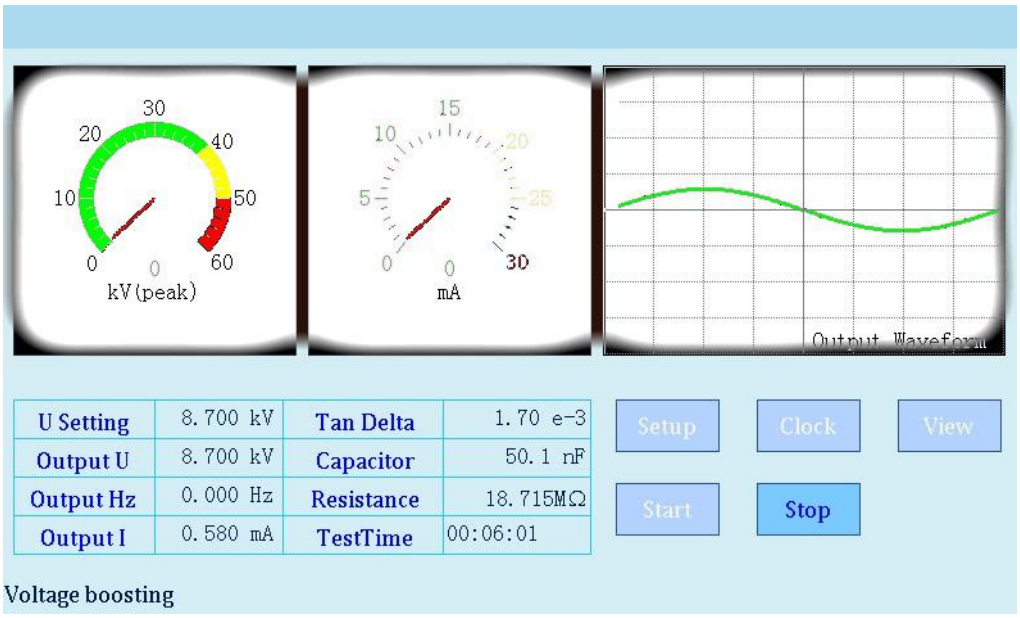


Figure 11 — Measurement screen with parameter table

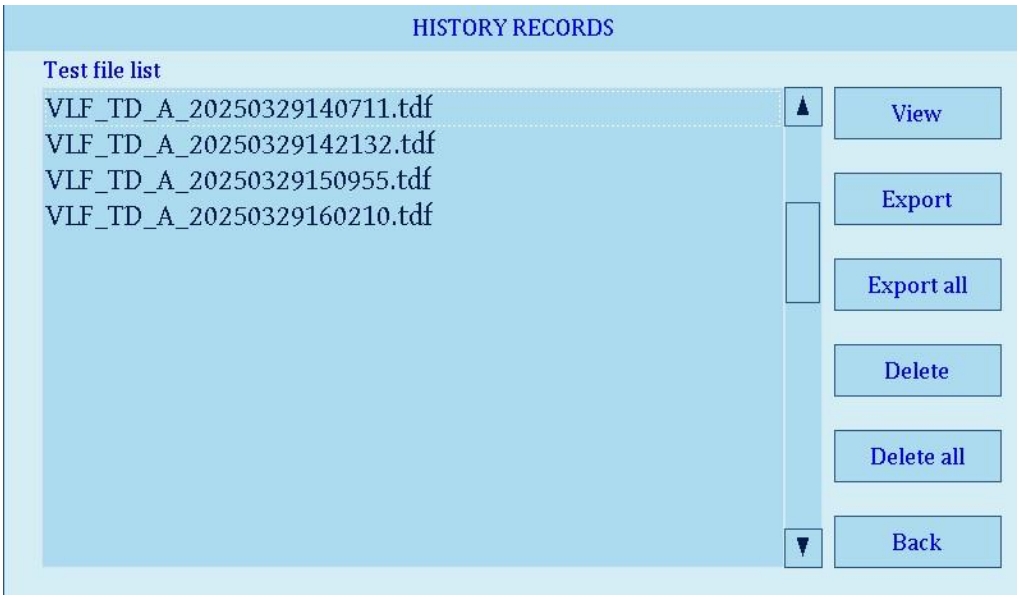


Figure 12 — Parameter set-up screen

This list automatically sorts all test results, displaying the most recent test record at the top for easy viewing. You can select one or multiple files to export or delete. To view a specific file, select it and then click the "View" button to enter the test report viewing interface (Figure 11).

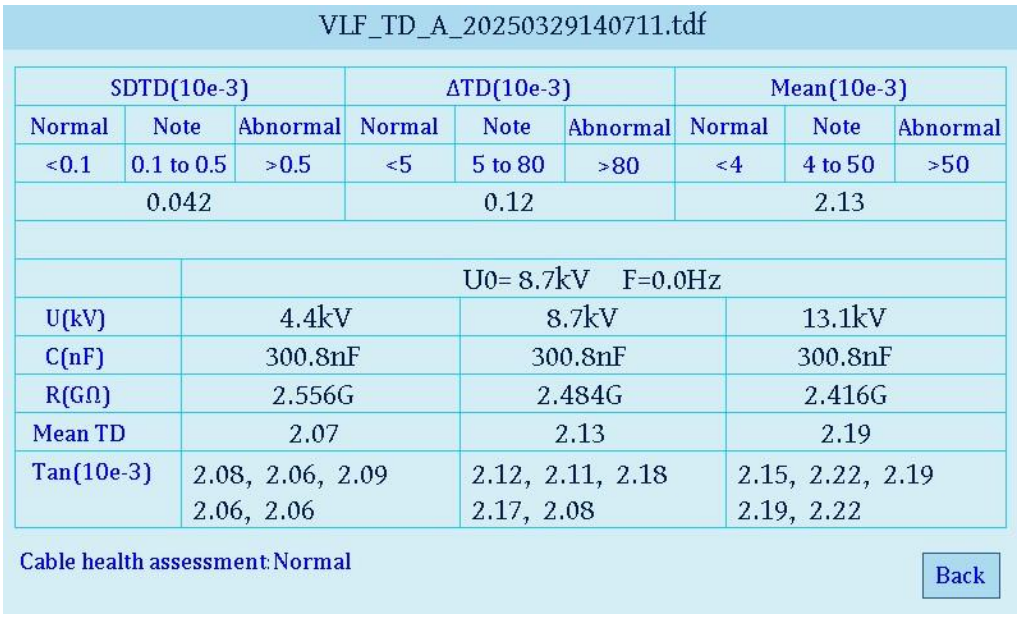


Figure 13 — Automatic test report list

The interface in Figure 10 displays detailed data from the test as well as the

evaluation results. It also provides the value ranges used for judgment. The three columns of detailed data correspond to the capacitance, resistance, dielectric loss average, and real-time dielectric loss values for 0.5U0, 1.0U0, and 1.5U0. The bottom row shows the cable evaluation grade and maintenance measures. Finally, the test records in the file list can be fully or partially exported to a USB stick. Only USB 2.0 sticks are supported, and it is recommended to use the USB stick provided in the factory accessories. After exporting the files, use the dedicated test file viewing software to generate the test report.

Figure 12

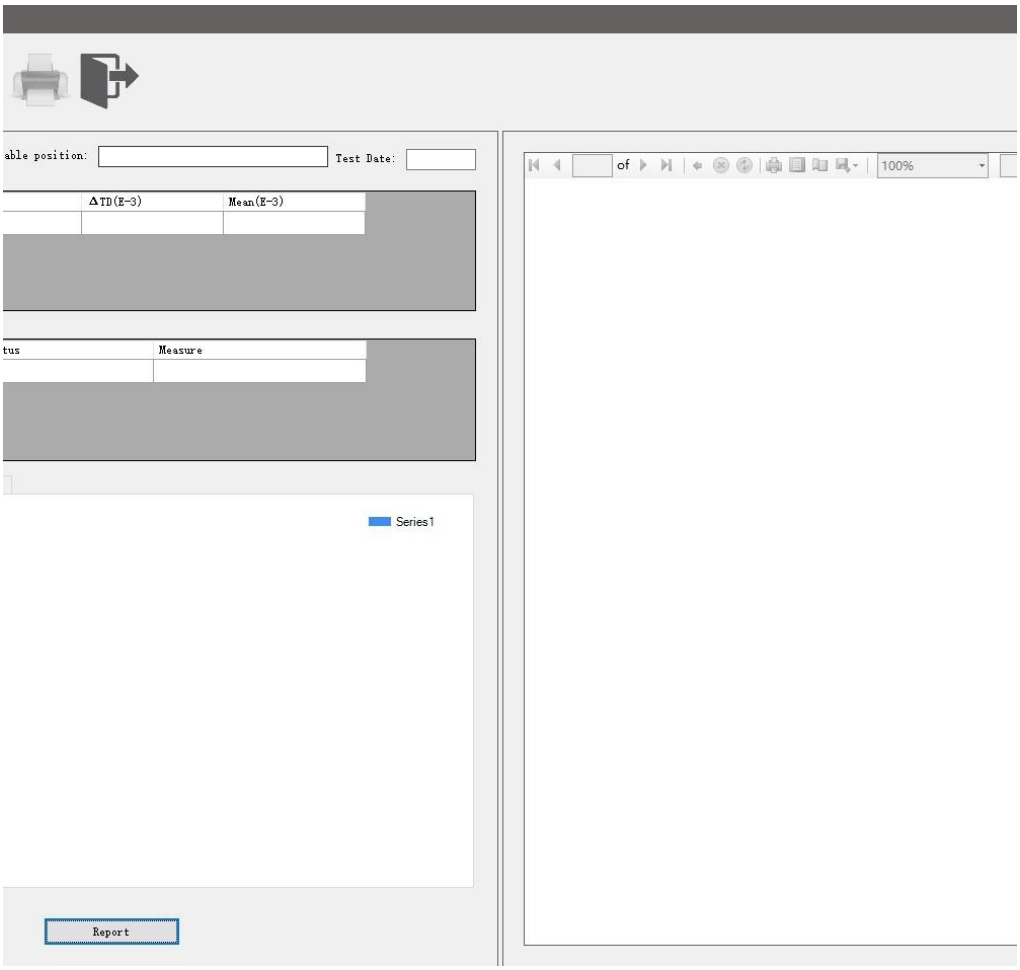


Figure 14 — Test report detail

This software supports opening one to three files at a time, corresponding to the test records for phases A, B, and C. After opening the files, you can view the test results and dielectric loss curve in the table. After clicking "Generate Report," you can see the detailed data and waveforms of the test process. The results can be exported and printed directly. The printed results are shown in Figures 13 and 14.

VLF TD test report

User: Position: Test date: 2025-11-21 10:08:43

	SDTD(10e-3)			ΔTD(10e-3)			Mean(10e-3)		
Phase	Normal	Note	Abnormal	Normal	Note	Abnormal	Normal	Note	Abnormal
	<0.1	0.1 to 0.5	>0.5	<5	5 to 80	>80	<4	4 to 50	>50
A	0.005			0.03			0.15		
B	0.0141			0.11			0.25		
C	0.2775			1.92			24.57		

Status and Measures:

	Cable status	Measure
A	Normal	
B	Normal	
C	Note	Regular testing is recommended

Figure 15 — Dielectric-loss trend

TD:

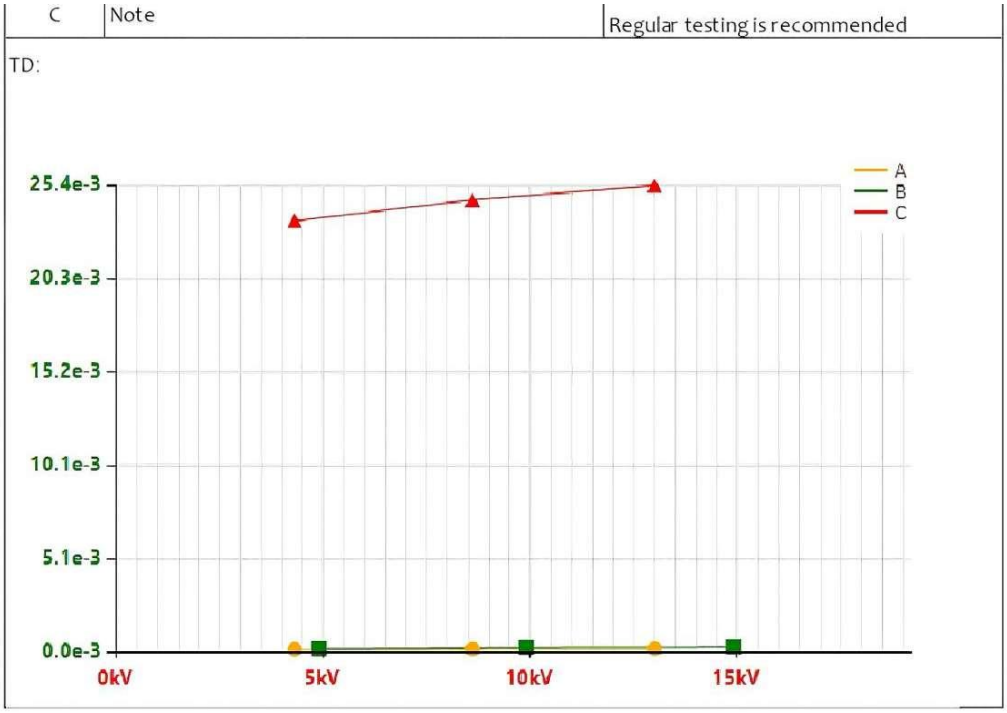


Figure 16 — Measurement curves

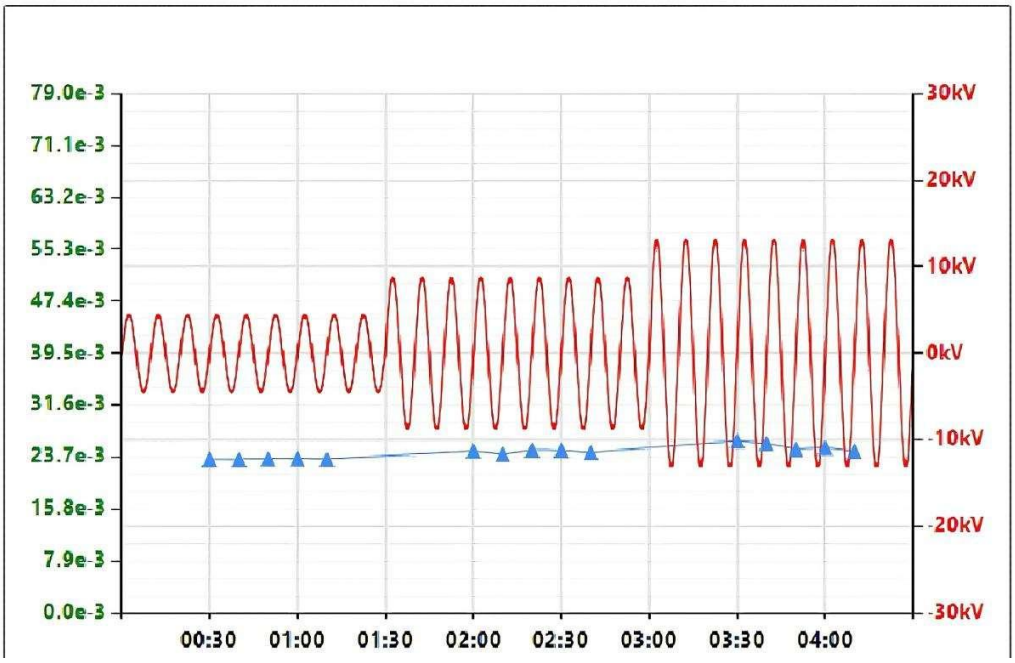


Figure 17 — Voltage and current trace

Voltage rating Uo	8.7 kV		
Frequency	0.1 Hz	Step	3
Phase	C	Date & time	2025-11-21 10:08:43
Voltage	4.4 kV	8.7 kV	13.1 kV
Factor Uo	0.5	1	1.5
C	1 nF	1 nF	1 nF
R	67.929 GΩ	64.778 GΩ	62.784 GΩ
Mean	23.43	24.57	25.35
SDTD	0.0485	0.2775	0.6518
tanδ (10e-3)	23.38;23.39; 23.47;23.49; 23.42;	24.68;24.15; 24.83;24.75; 24.43;	26.21;25.81; 24.95;25.19; 24.6;

Figure 18 — Test report summary