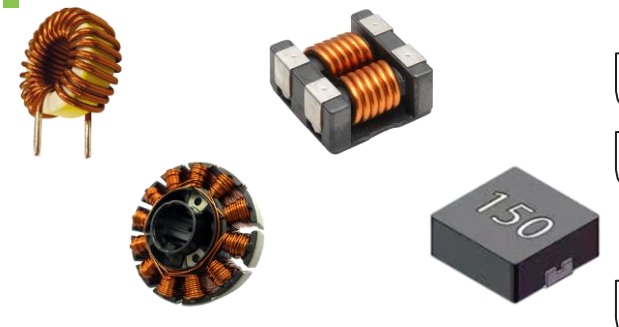
MICROTEST

# 7750 Impulse Winding Tester

## Enhancing insulation reliability of winding components through Impulse Test

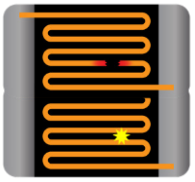

7750 VIDEO

## Non-destructive pulse high-voltage measurement is utilized to ensure the insulation performance reliability of winding components in compliance with safety regulations.




**The enamel wire is broken**

**The enamel wire is tinned**

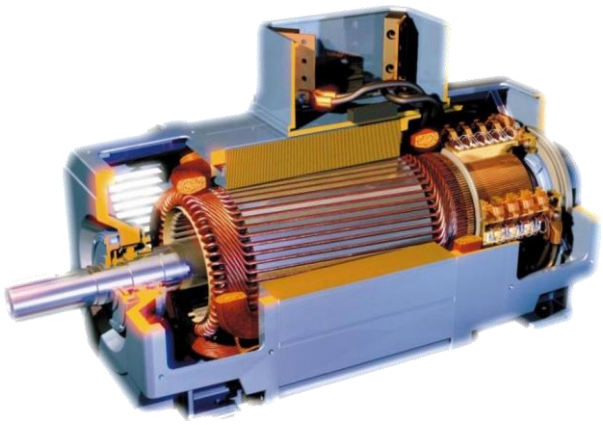


**Temperature performance deteriorates**

With the growing influence of the new energy vehicle, photovoltaic energy storage, and power drive industries, the quality requirements for winding components such as transformers, inductors, and motors have become more stringent. These requirements include higher efficiency, lower losses, and particularly, the insulation performance that directly impacts product safety. While most component manufacturers use withstand voltage testers to inspect voltage resistance and insulation capability, they often overlook the issue of interlayer short circuits caused by defects in enameled wire.

In the case of phenomena such as scratches or incomplete short circuits in the enameled wire, the withstand voltage tester, despite applying a high test voltage, operates at a frequency of 50/60Hz. This voltage applied to the ends of the test coil is equivalent to a short circuit condition and cannot detect interlayer short circuit defects. Furthermore, general LCR meters, due to their low measuring voltage, cannot easily identify significant abnormalities based on resistance, capacitance, and inductance values. Non-destructive pulse high-voltage testing techniques are necessary to detect inter-turn short circuit faults. By analyzing the waveform, it becomes possible to observe subtle discharge phenomena caused by inter-turn short circuits and detect faulty components, thereby ensuring the reliability of wiring elements.

During the process of wiring, including wire routing, insertion, organization, bundling, handling, and assembly of components, improper handling by personnel can result in damage to the insulation of the wire-wound components. This can lead to defects such as complete or partial short circuits between the same winding or between different windings. These faulty wiring components may experience corona discharge or spark discharge, weakening their insulation capability and reducing the reliability of the electric vehicle system. Over time, the accumulation of moisture and dust in pinholes or cracks of the wire insulation may cause motor or transformer failures. In severe cases, it can lead to burning and affect driving safety.



In simple terms, when a portion of the motor winding is short-circuited, it prevents the induction effect. This leads to an asymmetrical magnetic field, causing the remaining coils to experience higher current. As a result, the motor exhibits increased vibrations, higher current, and a relative decrease in output power. Over time, this can lead to noise, overheating, and even motor burnout.

## To meet the requirements of high and low volume wiring component pulse testing, the optimal choice for automated production is high-speed testing at 10 times per second.

| | |
|---|---|
| 200V-10000V | ≥20μH |
| 100V-5200V | ≥10μH |
| 10V-1200V | ≥0.1μH |

# 7750 IMPULSE WINDING TESTER

**USB HOST** **USB Device** **RS-232** **Remote** **LAN** **GPIB** **Option**

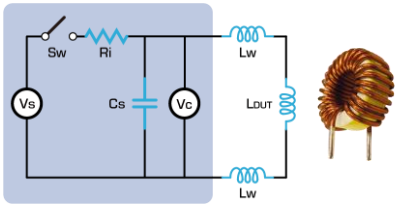
The MICROTEST 7750 Interlayer Short Circuit Tester is designed for reliable insulation quality testing of high- and low-winding components. It utilizes non-destructive pulse voltage for waveform sampling and comparison, effectively detecting insulation issues in motors, transformers, BL inductors, and other components.

It supports pulse voltage outputs of 1200V, 5200V, and 10000V respectively, and employs 200MHz high-speed sampling technology to analyze subtle discharge faults. It offers six analysis and comparison modes, including total area comparison, area difference comparison, corona number comparison, jitter number comparison, second derivative comparison, and waveform comparison mode. With a testing speed of up to 10 times per second, it is the optimal choice for automatic production lines of winding components.

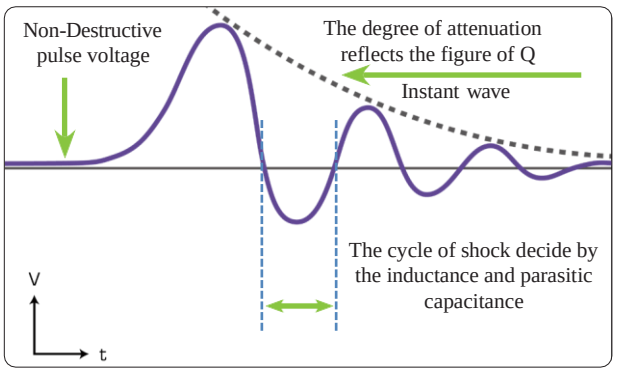
| Model | 7750-5E | 7750-5H | 7750-5S | 7750-1S | 7750-10S |
|---|---|---|---|---|---|
| Impulse Voltage | 100V~ 5200V | 100V~ 5200V | 100V~ 5200V | 10V~ 1200V | 200V~ 10000V |
| Lowest Inductance | ≥1μH | ≥1μH | ≥1μH | ≥0.1μH | ≥20μH |
| Sampling Rate | 50MHz/ 9 bit | 100MHz/ 9 bit | 200MHz/ 9 bit | 200MHz/ 9 bit | 200MHz/ 9 bit |

## The 7750 utilizes non-destructive high-voltage, high-speed pulse measurement technology. The 200MHz high-speed sampling captures dampened waveform, effectively detecting coil short circuit and insulation defects.

By applying a pulse voltage to the terminals of the winding coil, a damped oscillation waveform is generated through L/C resonance without damaging the test object. This allows for the comparison of instantaneous waveforms between a standard reference and the test object, enabling the early detection of faults such as interturn short circuits, internal coil defects, or insulation flaws in the magnetic core. This method ensures the quality and longevity of the product.



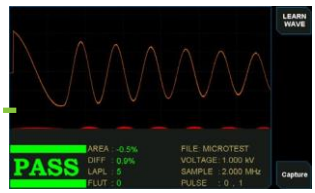

- The internal capacitor Cs of the instrument is connected in parallel with the external test object inductance Lr.
- The instrument outputs a set of high-speed pulse voltages to the parallel circuit.
- This generates a resonance between the inductance L and the capacitor C



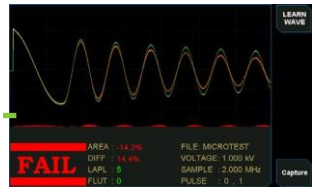

Comparative analysis of the damping attenuation waveforms

The 7750 interlayer short circuit tester ensures reliable testing of wound components by detecting issues like electrode welding, short circuits between winding layers, and inadequate insulation of magnetic cores.

Choose quality standard components in mass production.




Analyze and compare tested products with standard components.

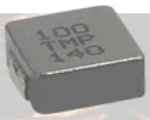



**The following electrical characteristics have changed as a result of the defective product:**

- Inductance of the coil
- Quality factor (Q value)
- Difference in coil turns (voltage difference)
- Variations in magnetic core material
- Short-circuits between windings inside the coil

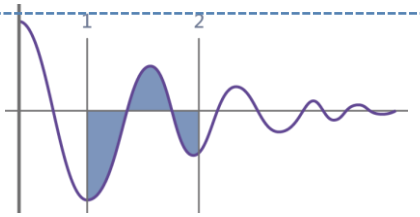
Impulse testing is conducted to detect insulation faults in wound components.

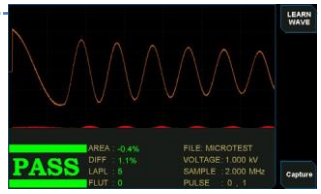
| Inductor | Inverter-Transformer | Motor |
|---|---|---|
| • Detecting short circuits between layers.<br>• Detecting short circuits between wires.<br>• Detecting decreased sensitivity due to insulation defects. | • Detecting poor slot insulation in high-voltage coils.<br>• Detecting wire hooking issues in high-voltage coils.<br>• Detecting inadequate soldering of outgoing wires in high-voltage coils.<br>• Detecting faulty coil bending in high-voltage coils.<br>• Detecting short circuits between layers.<br>• Detecting short circuits between wires. | • Detecting leakage issues caused by short circuits between layers.<br>• Detecting the frequency of arcs caused by interlayer defects.<br>• Detecting short circuits between layers.<br>• Detecting short circuits between wires. |



## It supports six analysis and comparison modes, enabling the analysis and detection of insulation short-circuit issues in different winding components.

### Total area comparison

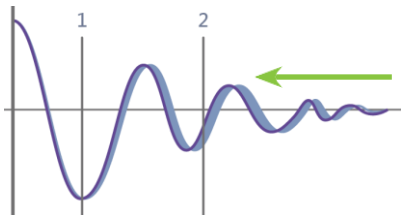



Show by percentage

In the range from 1 to 2 as shown in the diagram, a comparison of the waveform area of the test coil is performed. When an interlayer short-circuit occurs in the test object, the energy loss of the coil increases, causing the damping coefficient of the resonance to increase. As a result, the resonance amplitude decreases, and the total area also decreases. This is the fundamental parameter for detecting interlayer short-circuits.

### Differential area comparison

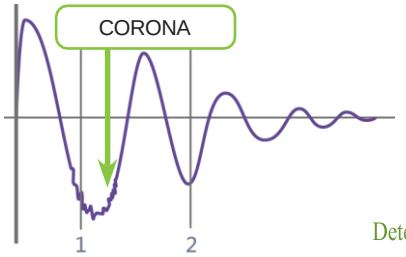


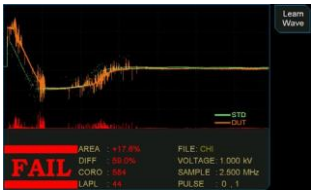

By calculating and comparing the deference of area between golden sample and DUT. To determine the degree of waveform overlap.

Compare the inductance by this mode

The difference between the point-to-point waveform areas of the standard sample and the test product is referred to as the "area difference." When an inter-turn short-circuit occurs in the test object, the inductance decreases (similar to when the secondary winding of a transformer is short-circuited, the inductance of the primary winding decreases), resulting in a change in the oscillation frequency of the latter part of the waveform and a shift in the phase of the resonant waveform. Consequently, the area difference also changes.

### Corona comparison

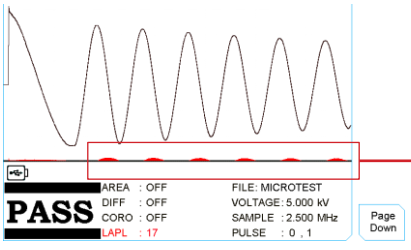


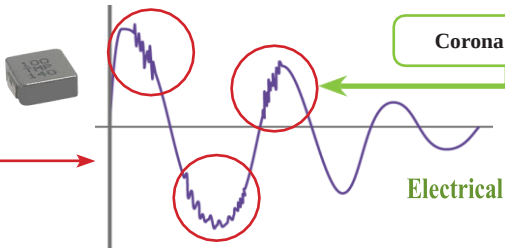




Detect the discharge phenomenon on the coil

During high-voltage pulse testing of the winding coil, if the insulation system of the coil itself is damaged, it can lead to the occurrence of sharp discharges. By observing the corona phenomenon in the discharge waveform, this functionality can count the occurrences of corona and make judgments based on the deviation level.

### LAPLACIAN Compariso




Electrical discharge or poor electrode welding

In the case of poor insulation quality of the coil, discharges occur under high-voltage impulses, causing rapid changes in the oscillation waveform. By utilizing the second-order differentiation algorithm of the MICROTEST 7750, the highest discharge level can be obtained. This effectively detects quality issues such as leakage due to faulty solder joints in integrated molded inductors.

## COMP Comparison


By setting an allowable waveform range for the standard wave, this feature can simultaneously determine the amplitude and phase of the resonant wave. It enhances the detection capability of inter-turn short circuits.

## FLUT Comparison


When there is inter-turn discharge in the winding coil, the waveform will exhibit tremors or fluctuations. Therefore, the instrument quantifies the degree of waveform tremors into numerical values for comparison.

# 7750 offers powerful features and capabilities.

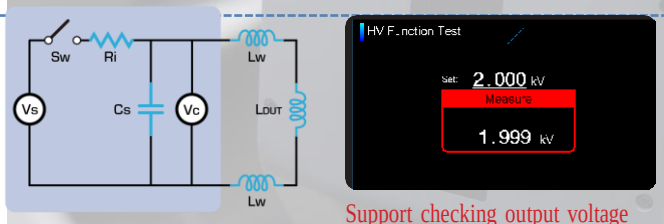
### Breakdown Voltage Analysis


Step voltage: adjustable to 1% of the initial voltage

The MICROTEST 7750 supports breakdown voltage analysis function, which allows setting:
1. Start voltage 2. End voltage 3. Minimum percentage of voltage rise from the start voltage
In the second-order derivative and corona discharge ratio comparison mode, it determines whether the measured values exceed the set standard value, validating the withstand voltage strength of the tested winding component.

### Voltage Compensation Function

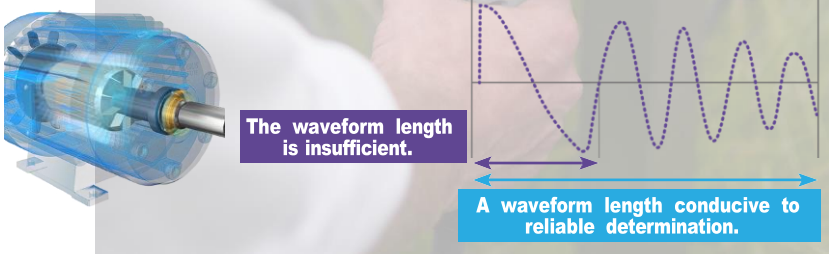
$$V_{DUT} \approx V_C \times \frac{L_{DUT}}{L_{DUT} + 2L_W}$$




Support checking output voltage

In order to mitigate the voltage division caused by high wiring impedance during automatic line testing, which leads to the actual output voltage being lower than the set voltage value and raises concerns about the quality of missed defect products, the 7750 supports voltage compensation functionality. This feature enhances detection accuracy and reduces the risk of false judgments.

### 200MHz/9bit High Impulse Test Sampling Rate

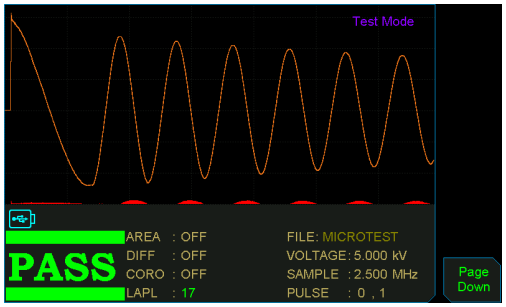



The 200MHz high-speed sampling technology allows for analyzing the momentary changes caused by subtle discharges in greater detail.

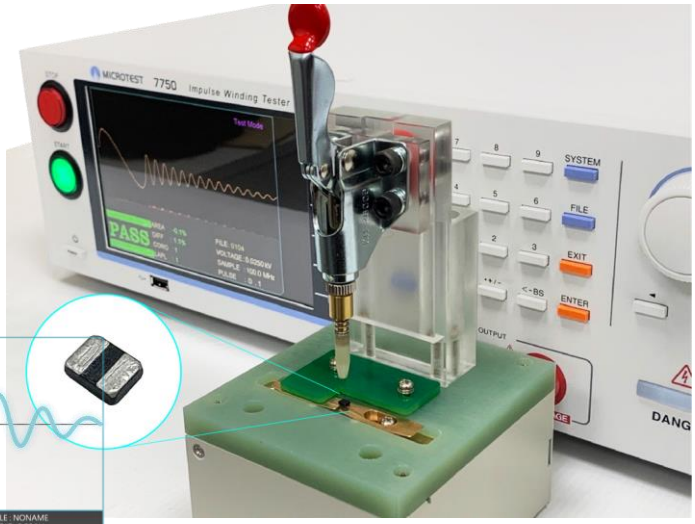
# Test Selection and Evaluation Plan

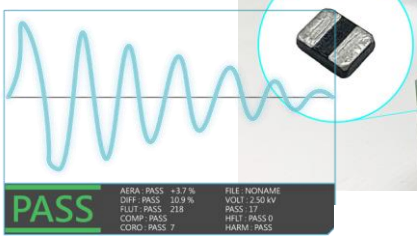
## Molding Power inductors (Molding Choke)

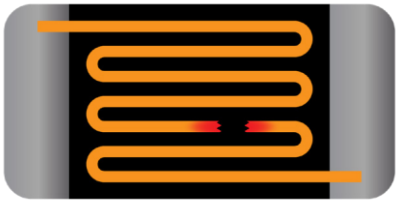
Molding Power inductors are commonly used in energy storage and filtering circuits of EV motor drive systems. They provide stable power supply and suppress electromagnetic interference for high-frequency current pulses. During the manufacturing process of integrated molded inductors, there can be issues such as conductor or magnetic powder material overflow into unintended structures, causing interlayer short circuits. Uneven electroplating of the conductor material can also result in abnormal conducting paths and interlayer short circuits. By utilizing the second-order differentiation algorithm of the 7750, the highest discharge level can be obtained, effectively detecting quality issues such as leakage caused by faulty solder joints in integrated molded inductors.

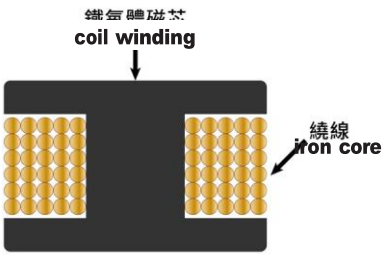



LAPLACIAN Comparison



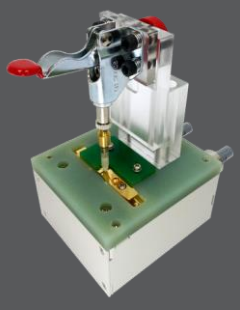



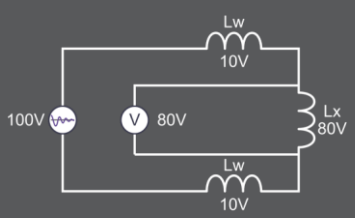




# Impulse Winding Test For Low inductance-Selection Plan

| | |
|---|---|
| Impulse Winding Tester | 7750-1S |
| Fixture Model | FX-IM0001 |
| Impulse Voltage | 10V-1200V |
| Lowest Inductance | ≥0.1μH |
| Measurement method | 4-wire |



FX-IM0001 SMD Component
Impulse Test Fixture

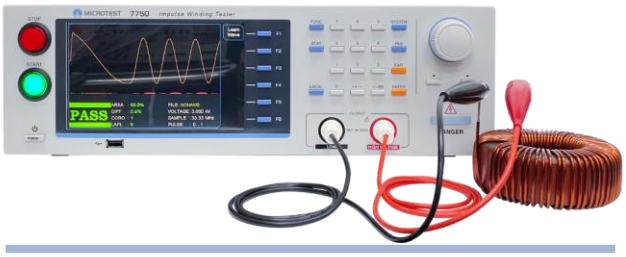


# Test Selection and Evaluation Plan

## Winding components such as motors and transformers.

With the increasing frequency of household electrical power sources, winding components in long-term operation may experience localized discharge due to poor internal insulation or incomplete short circuits within the coil. This can lead to a deterioration in the insulation performance of components such as motors and transformers. Prolonged exposure to severe localized discharge can even result in breakdown risks.

Therefore, relying solely on short-duration withstand voltage tests in the manufacturing process is insufficient to truly evaluate the reliability of winding components. It is necessary to conduct partial discharge testing using a non- destructive pulse voltage method. This involves generating a damped waveform through resonance between the inductance (L) and capacitance (C). By analyzing and comparing the waveforms, interlayer short circuit defects can be detected.




High-power choke coil


Transformer


Inductor


Motor Stator/Rotor Winding Coil

Interlayer short circuit: When current flows through the coils of a winding, each coil wrapped with its own insulation layer, defects in the insulation can lead to a shortened path for the current, resulting in an undesired electrical short circuit.

## Impulse Winding Test -Selection Plan

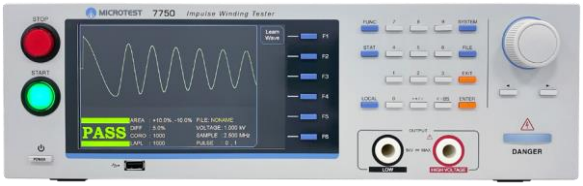
| Impulse Winding Tester | 7750-5E | 7750-5H | 7750-5S | 7750-10S |
|---|---|---|---|---|
| Impulse Voltage | 100V~5200V | 100V~5200V | 100V~5200V | 200V~10000V |
| Lowest Inductance | ≥1μH | ≥1μH | ≥1μH | ≥20μH |
| Sampling Rate | 50MHz/ 9 bit | 100MHz/ 9 bit | 200MHz/ 9 bit | 200MHz/ 9 bit |
| Application | Transformer, Motor Coil | | | Inverter-Transformer, High-voltage ignition coil |

# Impulse Winding Tester

## 7750

### Features

- Lowest Inductance ≥ 0.1μH
- Voltage Compensation Function
- 200MHz/ 9bits High Impulse Test Sampling Rate
- Programmable Impulse voltage
- Built-in storage 128 sets testing waveform
- Total Area Comparison
- Differential Area Comparison
- LAPLACIAN Comparison
- CORONA Comparison
- WAVEFORM Comparison
- FLAT Comparison
- Support USB Host/Device, RS-232, SIGNAL I/O




RS-232 | SIGNAL I/O | USB Host/Device

### Applications

Low inductance coil, High power inductance, Relay, Transformer, Motor stator, Motor rotor, Winding component

### Order Information

7750 Impulse Winding Tester series

- 7750-1 (Impulse Voltage 10V-1200V)
- 7750-5 (Impulse Voltage 100V-5200V)
- 7750-10 (Impulse Voltage 200V-10000V)

7750 Standard Accessories/ Fixture

- Power Cord
- 2 terminal HV test cable
- SIGNAL I/O

7750 Optional Items

- RS-232 cable
- Remote control cable
- GPIB
- FX-IM0001 SMD Component Test Fixture
- PC Link software

### Specifications

| Model | 7750-5E | 7750-5H | 7750-5S | 7750-1 | 7750-10S |
|---|---|---|---|---|---|
| Impulse Voltage | 100V~5200V | | 100V~5200V | 10V~1200V | 200V~10000V |
| Voltage Resolution | 1V | | 1V | 0.1V | 5V |
| Test Inductance Range | ≥1μH | | ≥1μH | ≥0.1μH | ≥20μH |
| Impulse Voltage Accuracy | ± (1% of setting + 10V) | | ± (1% of setting + 10V) | ± (1% of setting + 5V) | ± (1% of setting + 20V) |
| Pulse Number | Max 32 | | | | |
| Sampling Rate | 50MHz/9 bit | 100MHz/9 bit | 200MHz/9 bit | | |
| Test Time | 10 times/ Sec | | | | |
| Input Impedance | 20MΩ | | | | |
| Waveform Comparison | AREA Comparison | | | | |
| | DIFF Comparison | | | | |
| | CORONA Comparison | | | | |
| | WAVEFORM Comparison | | | | |
| | FLAT Comparison | | | | |
| | - | LAPLACIAN Comparison | | | |
| Breakdown Voltage | - | - | ● | ● | ● |
| Measurement Statistics | ● | | | | |

## General

| | |
|---|---|
| SIGNAL I/O Control | START/ STOP |
| SIGNAL I/O Output | PASS/ FAIL/ TEST/ READ/ HV ON |
| Safety Switch | When testing, you need to short-circuit the INTER LOCK on the rear of the instrument to output the test voltage |
| Built-in Storage | 128 |
| Interface | RS-232, SIGNAL I/O, USB Host/ Device (GPIB Option) |
| Power Supply | Voltage: 100Vac-240Vac |
| | Frequency: 47-63Hz |
| Power consumption | 45W |
| Display | 7"TFT (800*480) |
| Environment | Temperature: 0℃-40℃, Humidity: 20-80%RH |
| Dimension(W*H*D) | 430×132×370 mm(W*H*D) |
| Weight | 7Kg |

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