



MICROTEST

7750series

Impulse Winding Tester

1200V / 5200V / 10000V

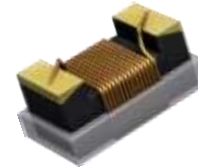


What Is Layer Short ?

A magnetic component with coil windings can cause layer-short when the insulation between different layers of winding has a problem. These shorts are often a sign of insulation degradation and, if not detected in time, can lead to more significant damage over time.



When winding-short happens, the magnetic field of the coil will change and this affects the efficiency and reliability of the component as well as the whole system.



Why does short happen between coil windings ?



Coating process of enameled wire.

Improper coating process may cause weak insulation of the wire.

Pinhole or blister on enameled wire coating.

Winding Process.

Excessive, insufficient or uneven tension of winding may easily damage coating insulation

Improper core-alignment of winding

Tin attached during soldering

Insulation Material aging.

Electric: Insulation material deteriorated under high voltage operation

Heat: Insulation material deteriorated under high temperature operation

Environment: UV, Salt, Acid, Base in the environment cause Insulation failure



7750 Technology to Detect Layer-Short

In a LC resonate circuit, the insulation damage between different layers of DUT(inductor) will cause inductance(L) change, impedance(X_L) change and therefore the LC resonate waveform change.

By comparing the difference between Golden Sample resonate waveform and DUT resonate waveform, the insulation defect can be detected.

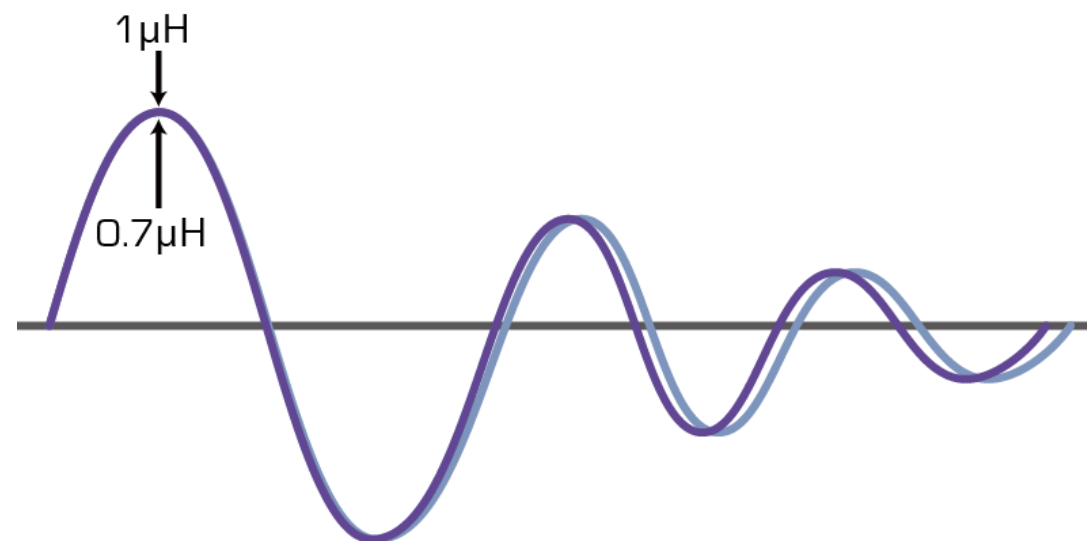
When the LC circuit resonance occurs, the inductive reactance and capacitive reactance are equal in magnitude.

$$X_L = X_C$$

$$X_L = 2\pi f_0 L ; X_C = 1/2\pi f_0 C$$

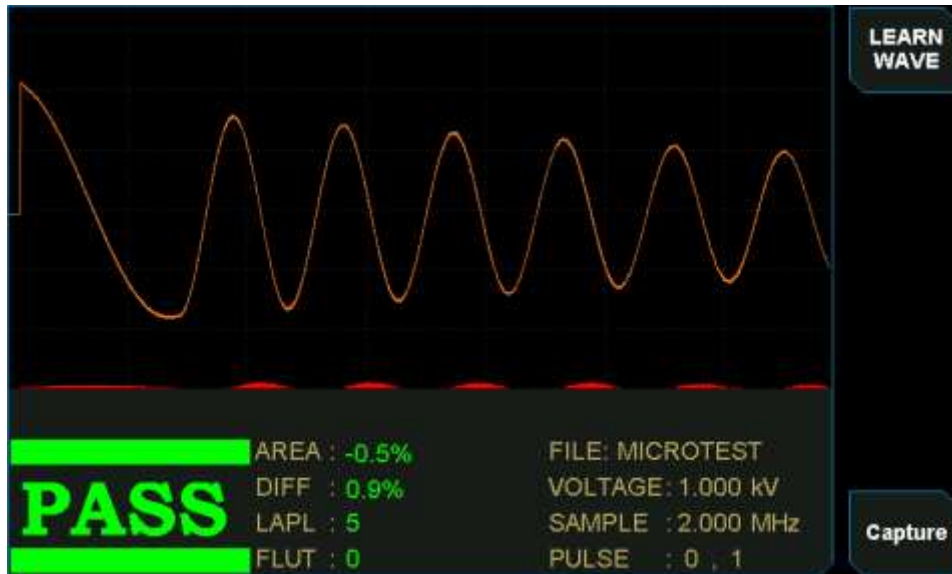
$$\text{The resonate frequency } f_0 = 1 / (2\pi\sqrt{LC})$$

Difference of damping L/C resonate waveforms comes from the characteristic change of the defective coil.



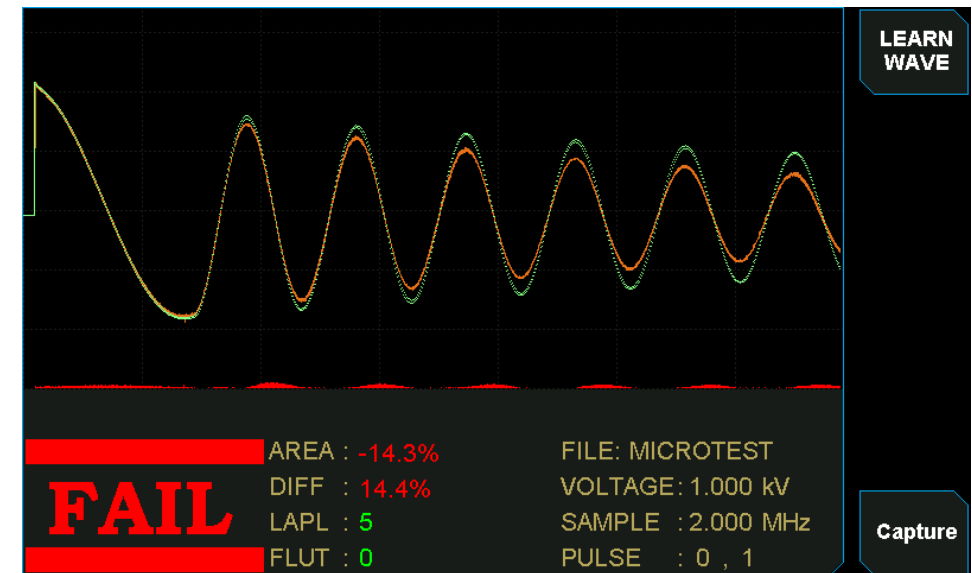
Comparing DUT waveform with Golden sample waveform

AC Source charges the internal capacitor, and the capacitor along with the DUT inductor forms a LC resonate circuit



The compliant DUT waveform coincides with the Golden Sample waveform

Golden Sample



The defective DUT waveform deviates from the Golden sample waveform

DUT



Layer-short troubles of a Motor



Overheat/Burn

Big current passes the coil will cause temperature rise and possible burn-out.

Noise

The layer short coil will cause vibration and noise.

Torque Reduction

The uneven current will reduce the torque.

Fail to start

Serious short may cause system failing to start.

Impulse tester for motor/transformer production



The small defect of a coil is hard to find at a low voltage LCR test station in the production line. As the DUT goes to the final assembly test, the defect will then show up. The late detection of a fault will increase the production cost.

Before functional test of a product, an Impulse Winding Tester in the production line can prevent transformer malfunction or Motor burnout, which usually occurs when the product is under high voltage operation.

Impulse Test= Quality and Product Reliability Test

LCR Meter/DMM vs. Impulse Winding Tester



When short happens on a coil, it may slightly change the parameters of inductance, capacitance, and resistance under low voltage measurements. However, the insulation damage can mostly be discovered under high voltage operation, which significantly downgrades the coil performance and reliability.

Without high voltage testing, the defect is hard to be found.

It's hard to find the hidden problem of layer-short by measuring the differences of inductance, capacitance and resistance using a Low voltage measurement device such as LCR Meter or DMM.

Hi-pot Tester vs. Impulse Winding Tester



7630 Hi-pot Tester

While Hi-pot Testers assess the overall insulation integrity between windings and ground, impulse winding testers simulate real-world voltage surges and analyze the resulting waveforms to pinpoint weaknesses that could lead to severe failures.

A Hi-pot Tester can't replace an Impulse Winding Tester to do layer-short detection of a coil

It is impossible to identify the small current leakage between internal windings using a Hi-pot Tester.

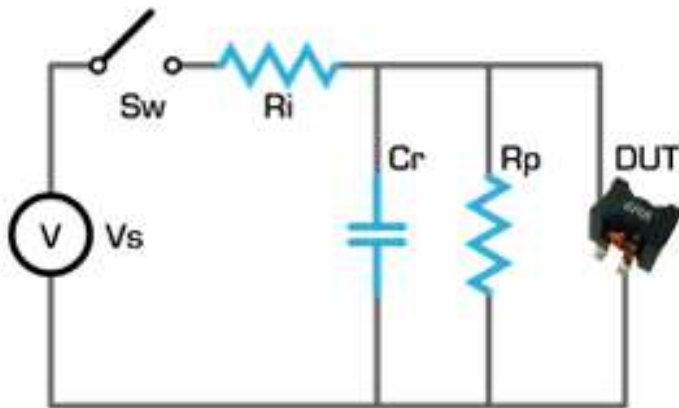


7750 Impulse Winding Tester

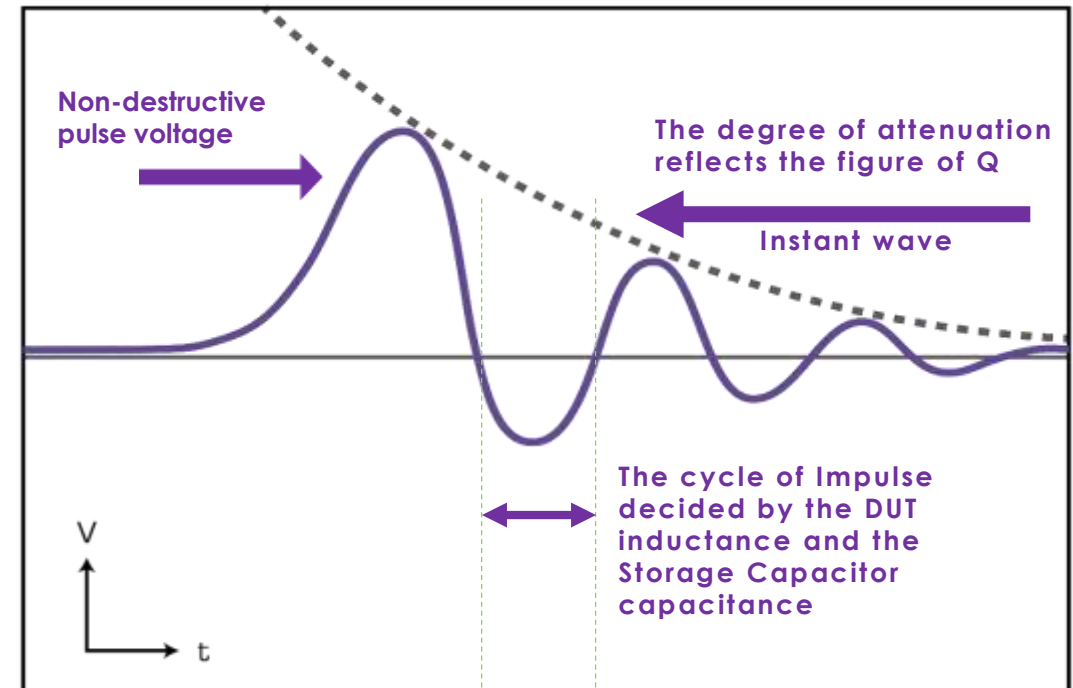
Technology of Detecting Layer Short

“Impulse Voltage with Waveform Comparison” is the way 7750 detects layer-short.

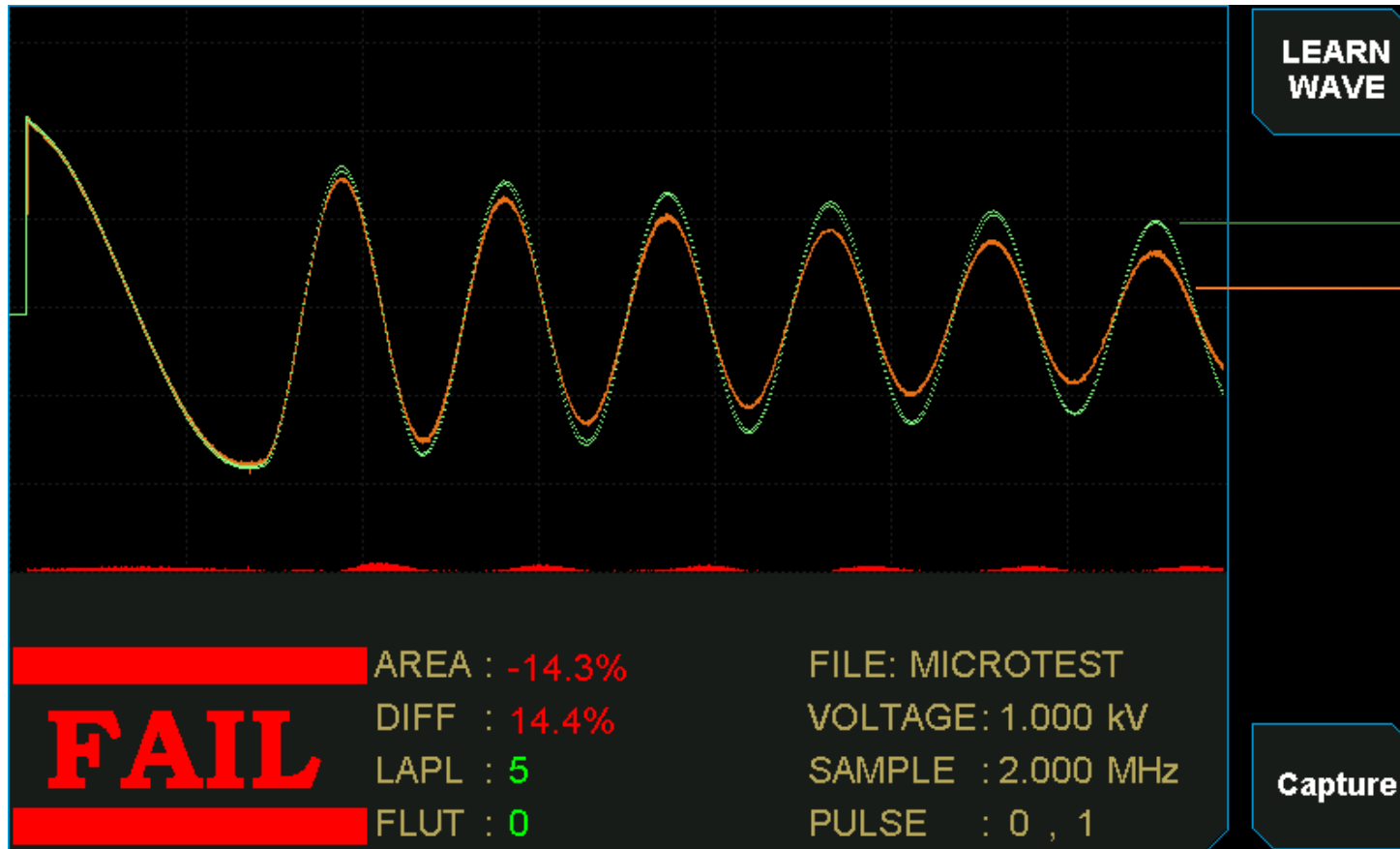
The impulse voltage is a non-destructive/instant voltage that applies on both sides of a winding coil and detects the DUT's fault without damaging it. By comparing the DUT waveform with the golden sample's, we can judge the DUT's performance.



V_s	High Voltage Source
Sw	Control Switch
R_i	Current Limiter
C_r	Storage Capacitor
R_p	Parasitic Resistor
DUT	DUT Inductor



Different damping wave due to different Characteristics



Green(Golden Sample)
Orange(DUT)

Besides coil layer-short, different damping wave of LC resonance can also come from the changes of other characteristics of the coil.

Changes to cause waveform difference

1. Inductance of coil
2. Q rate
3. Turn ratio of coil(voltage difference
4. Different material of core
5. Layer short in the coil

Which 7750 model should be selected?

Test Voltage Setting — 80% of Coil Breakdown Voltage

Turn on 7750 **Corona function**, raise the voltage until the display shows **FAIL**, then minus 20% as the Impulse testing voltage.



Factors to consider when setting voltage

- 1.Characteristic of enameled wire
- 2.Space between each turn
- 3.Partial pressure on each turn
- 4.Other insulation limit

Range	Rated Voltage	Power Frequency Voltage	Testing Voltage
Rated Output<1KW Rated Voltage<100V	0~50V	500~600V	700~800V
	50~100V	600~700V	840~980V
Rated Output <100000KW	0~250V	1500V	2100
	250~400V	1500~1800V	2100~2520V
	400~600V	1800~2200V	2520~3080V
	600~800V	1800~2600V	2520~3640V
	800~1000V	2600~3000V	3640~4200V
	1000~1500V	3000~4000V	4200~5600V

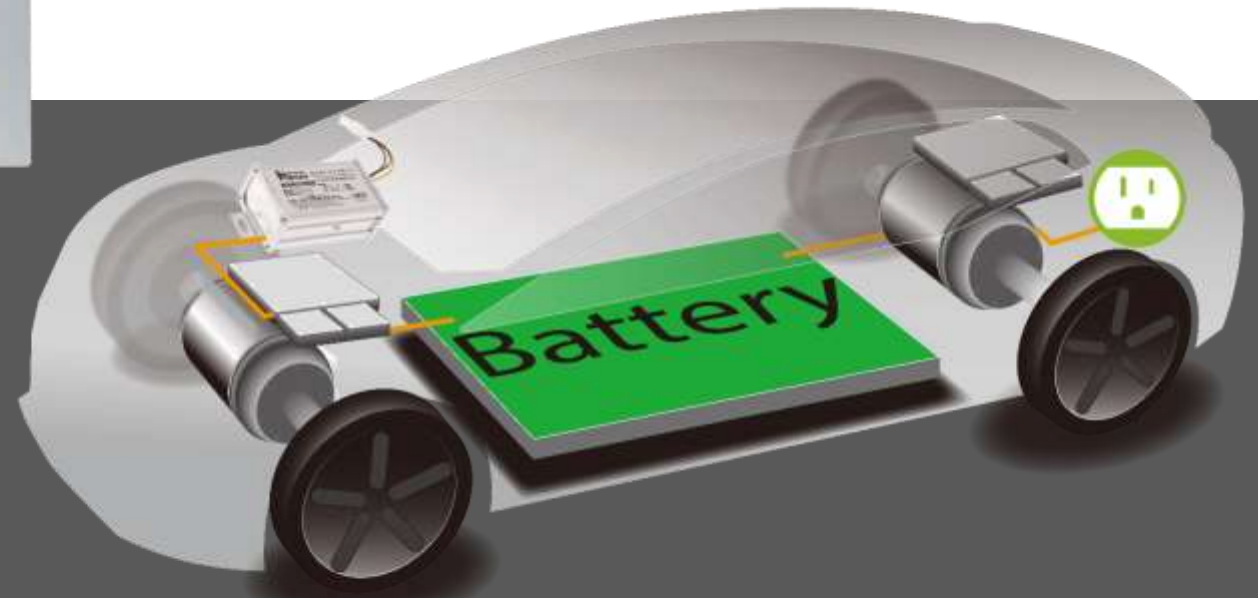
NEW

7750

Impulse Winding Tester

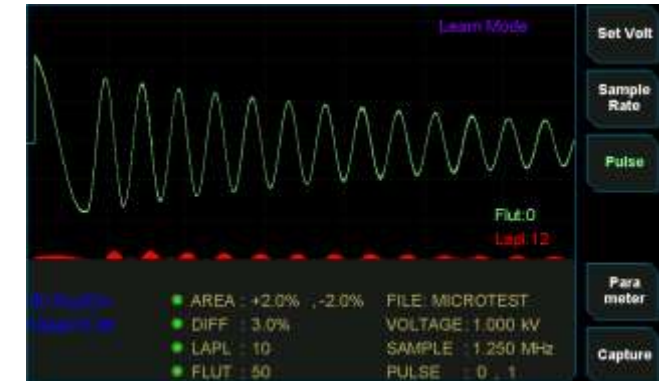
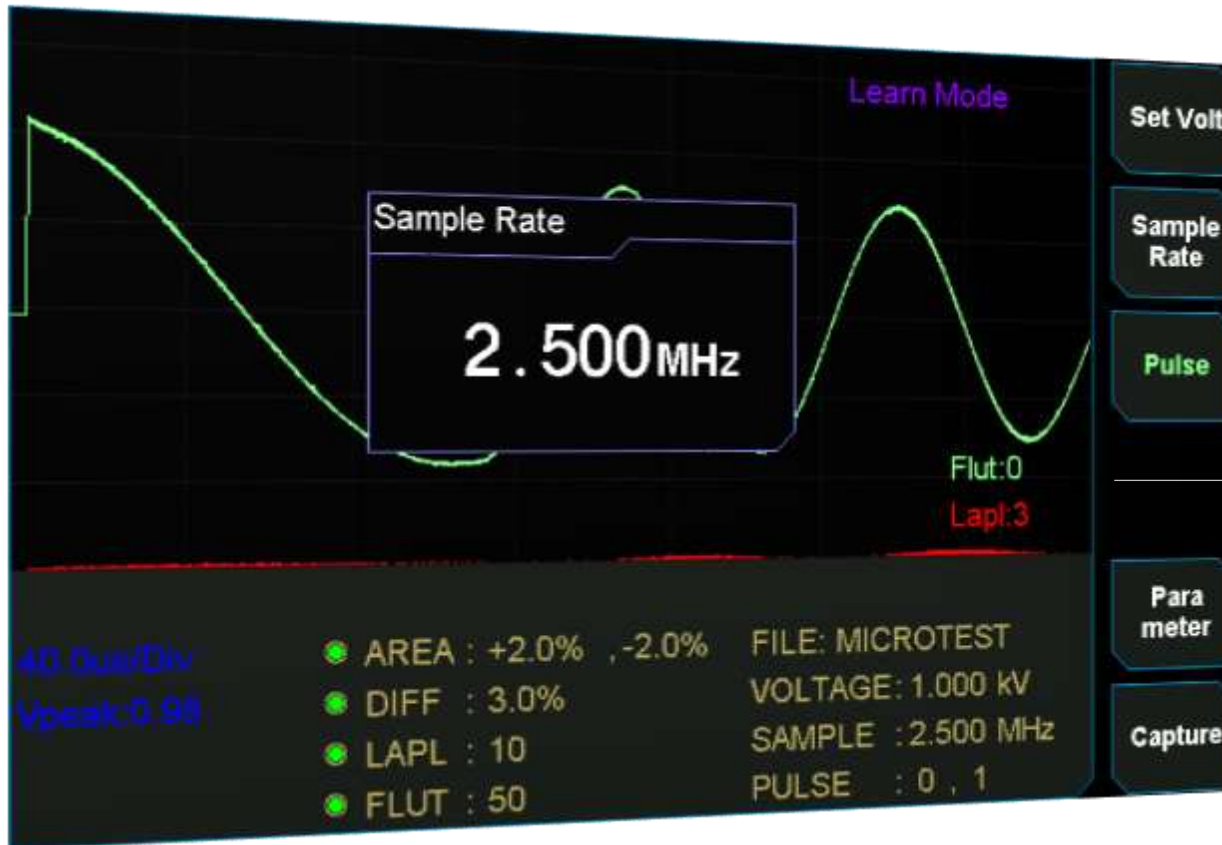
1200V / 5200V / 10000V

EV Traction Motor Inter-turn Short Circuit Testing



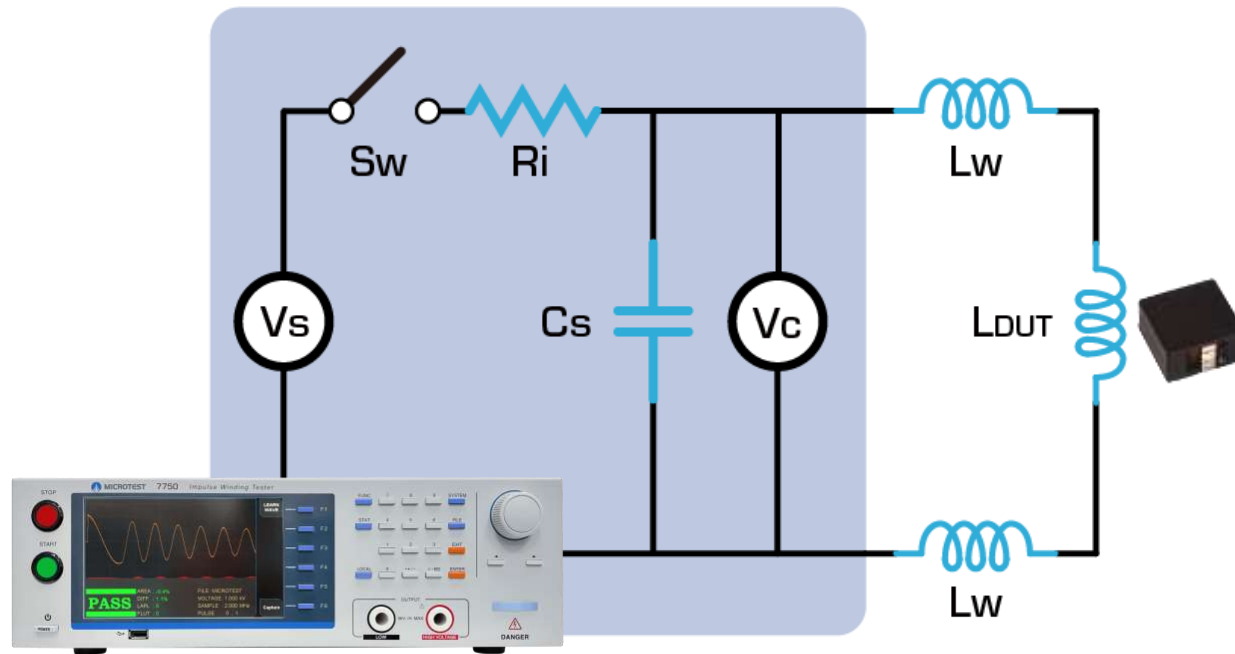
200MHz/9bit High Sampling Rate for Impulse Testing

Pulse Number:32



Voltage Compensation Function

MICROTEST 7750 features the Voltage Compensation Function. In order to reduce the possibility of misjudgment.



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

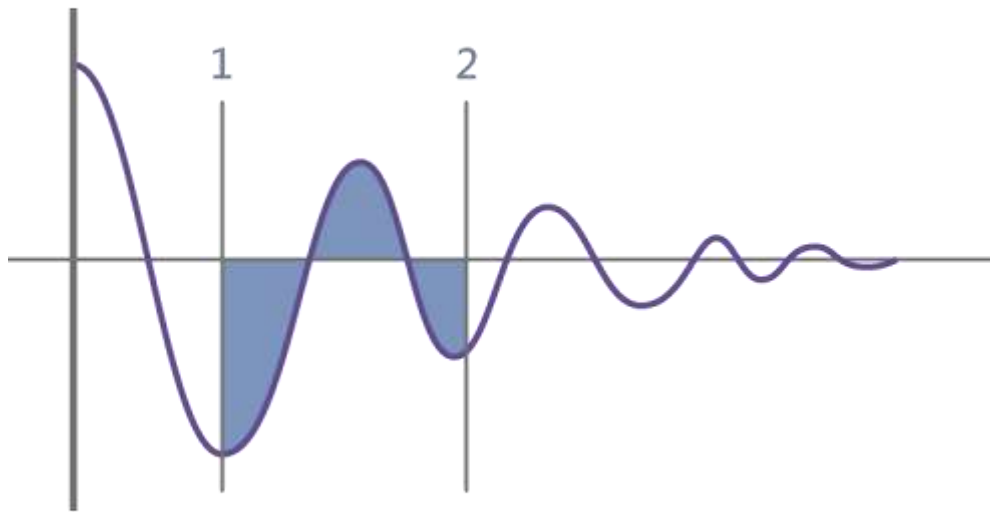


Support checking output voltage

7750 Area Comparison

When layer short happens, the power on the DUT coil reduces, the resonance damping coefficient increases, therefore the resonance amplitude decreases, which causes the total waveform area decrease. The area shrink is the basic parameter we analyze layer short.

By comparing and calculating the deference of waveform areas to detect insulation fault.



Analysis the power loss by this data.



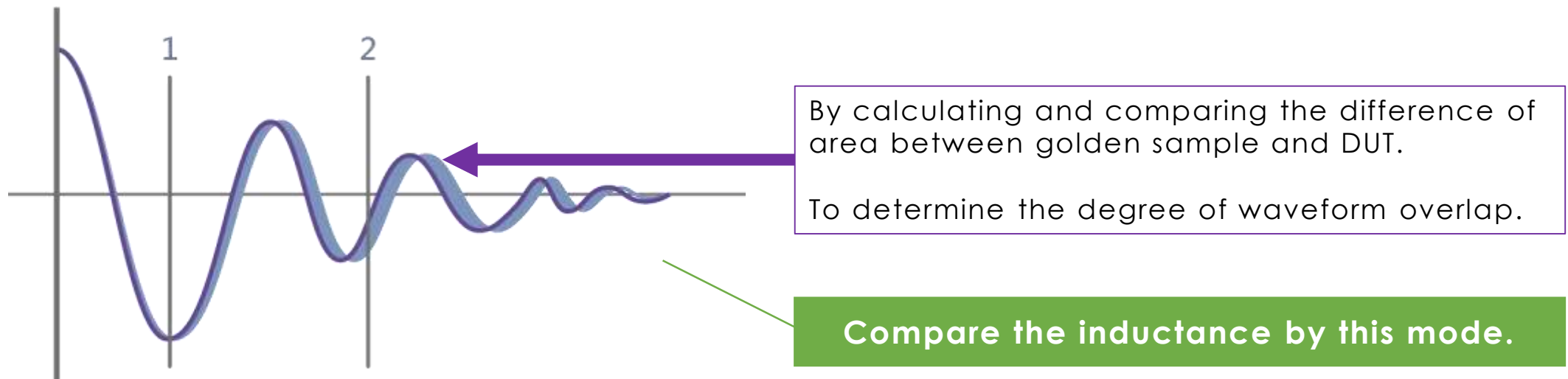
7750 Area Differential Comparison

Calculating the area-difference between Sample waveform and DUT waveform is called “Area differential”

When layer-short happens, the inductance decreases, the wave phase changes and the waveform shape also changes. The screen shows “fail” as the test result.

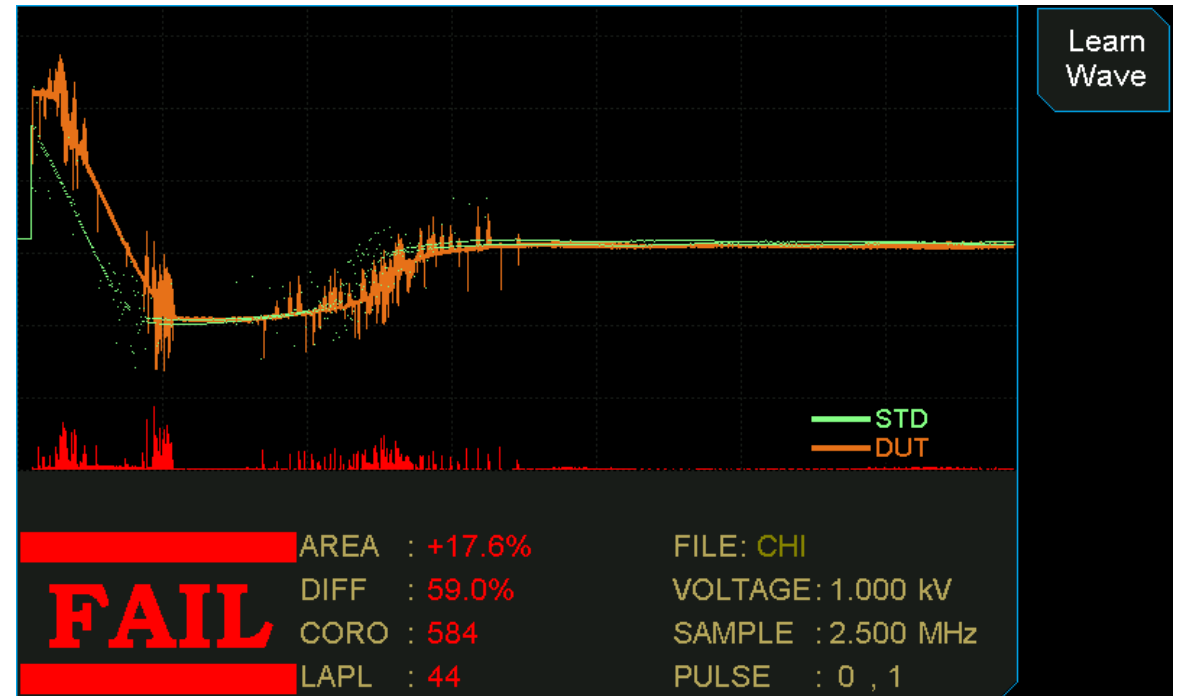
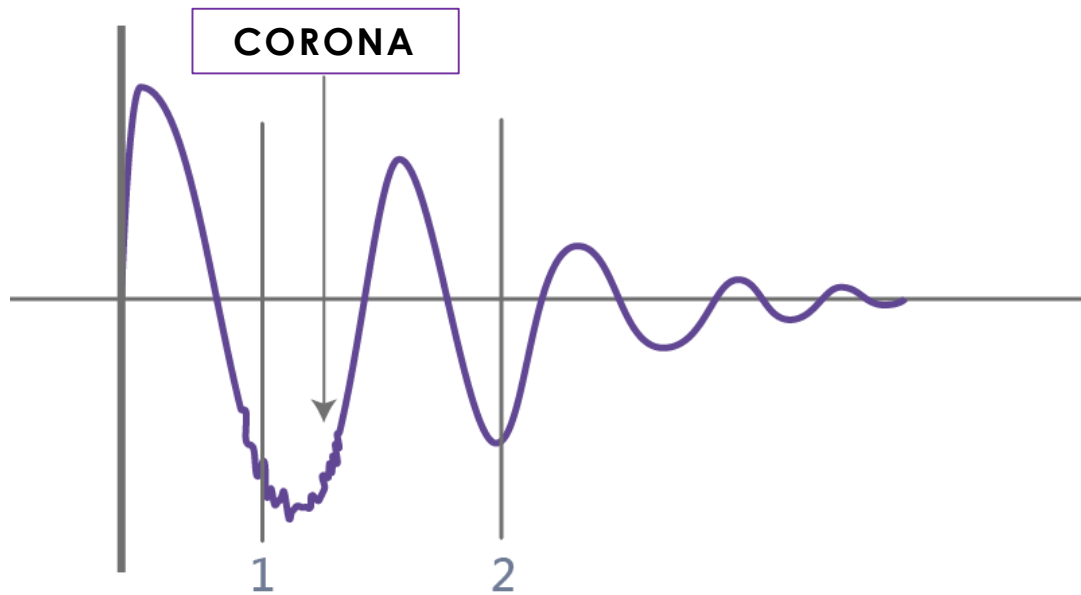
However, the test result might be different because of the deviation of inductance and resonance phase shift.

(Silicon steel product such as motor and traditional transformer is not suitable)



7750 CORONA Comparison

In pulse test, the insulation defect will cause discharge and create corona. This function is able to count the times that corona happened base on the degree of deviation.

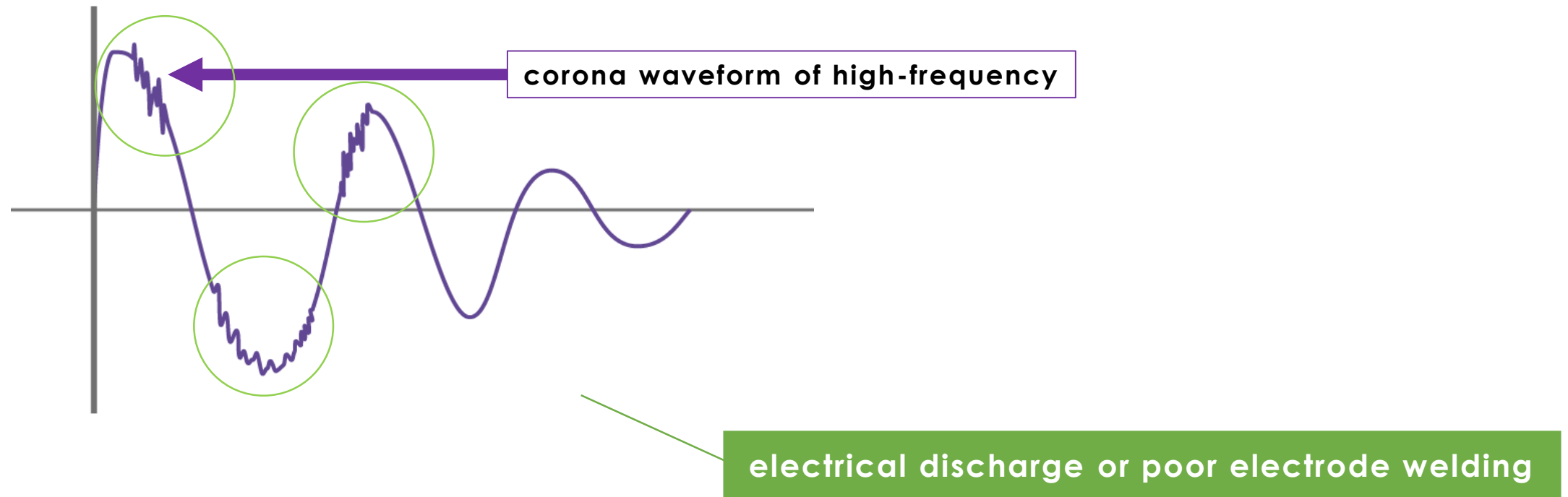


Detect the discharge phenomenon on the coil.

7750 LAPLACIAN Comparison

Use the second derivative to calculate the Laplacian value.

By the corona waveform of high-frequency to know more about the insulating property of products.



7750 Impulse Winding Tester Spec

Impulse Tester 7750			
Model	7750-1	7750-5	7750-10
Impulse Voltage	10V-1200V	100V-5200V	200V-10000V
Voltage Resolution	0.1V	1V	5V
Test Inductance Range	$\geq 0.2\mu\text{H}$	$\geq 10\mu\text{H}$	$\geq 20\mu\text{H}$
Pulse Energy	0.028 joule	0.5 joule	2 joule
Pulse Number	Max. 32		
Sampling Rate	200MHz/9 bit		
Test Time	7 times/second		
Comparison Mode	AREA		
	DIFF		
	CORANA		
	LAPLACIAN		
Breakdown Voltage	●		
Interface	USB Host/Device 、 RS-232 、 REMOTE 、 (Option GPIB 、 LAN)		
Display	7" TFT (800*480)		



MICROTEST

THANK YOU

