

Inductance Impulse Tester

IPT1000



Shenzhen Zhiyong Electronics Co., Ltd.

Safety Requirement

There will be DC impulse voltage up to 400V on output port, testing cable, clamp and EUT of this device during operation. Please carefully read the following safety instruction and follow related safety precautions.

- Only the cable with safety plug and clamp with insulation protection provided by original company can be used as testing cable and clamp.
- Platform used for testing must have insulated surface to prevent high voltage leakage.
- During the testing, the display interface will show the following warning sign as shown below. **Do not touch any cable or clamp** when this sign is up. Only connect or disconnect cable and clamp when the sign disappears.



- **Do not dismantle and repair** the device on your own, please contact us to solve any irregular phenomenon.
- Only well-trained technician should be allowed to operate the device, and it should be managed under specially assigned staff.

1、Preface

The test on inductor today is usually based on LCR meter. Digitalized meter is realized by applying a high frequency voltage signal on inductor under test. By the auto balancing theory of the meter, any parameter of the inductor including inductance value, or the quality factors can be measured. Because the voltage under test is just an AC voltage less than 10V, the current through inductor will be lower than tens m, and the meter will measure the inductor parameter under small signal. This method is usually used on the measurement of inductor component from a small signal analog circuit.

Since inductor is a non-linear component, the inductance parameter has strong relationship with the magnetization of the inductor's magnetic material caused by the current flowing through. The LCR meter + DC Bias Unit measurement method applied today is essentially measuring through a high frequency small signal accumulated on a constant DC current. This traditional system is not only expensive, but also large and hard to handle, with a maximum limit of 200A. It is far behind the development of the modern power electronics.

With the high-speed development of the large power electronics and new energy product, the current rating of the power inductor increases day by day. Our IPT1000 can solve the following problems engineers most worry about: 1. Whether the inductance attenuation of the power inductor under large current can fulfill the design requirement; 2. Whether the power inductor will saturate and how much is the saturation. These problems are critical for the creation of a reliable and cheap power electronics or new energy problem.

2、Specification of IPT1000

- ✧ Measure the incremental inductance and secant inductance.
- ✧ Range up to 1000A.
- ✧ Fast and easy measurement.
- ✧ Measurable range varies from 0.1A to 1000A.

3、Measurement theory

The basic theory of $\frac{di}{dt}$ method is to apply constant DC impulse voltage to the inductor and calculate the corresponding parameter like inductance through measuring the $\frac{di}{dt}$ change of the inductor. Formula is shown below.

$$U=L\frac{di}{dt}$$

The diagram shown below is the flux linkage to current curve of the inductor. When the current reached the preset maximum current I_B , test ended. Secant inductance L_{sec} and incremental inductance L_{inc} will change correspondingly according to the change of operating point A on magnetization curve with change of current.

We define the incremental inductance (dynamic inductance or small signal inductance) as L_{inc}

$$L_{inc} = \frac{\Delta\Psi_{mA}}{\Delta I_A}$$

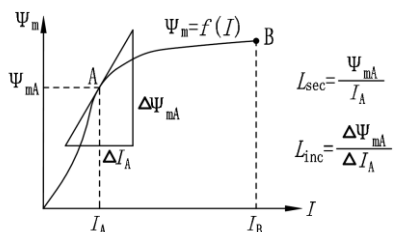
The physical meaning of the incremental inductance is actually the same as the inductance we gained by normal LCR meter.

IPT1000 calculate incremental inductance for a sect of DC magnetization curve. LCR meter + DC BIAS Unit method is measuring incremental inductance by accumulating a small AC Hysteresis loop on DC magnetization curve.

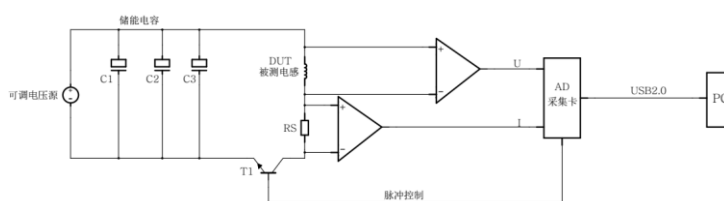
Accumulating an AC magnetization curve on a DC bias current is exactly how filter inductor work in power electronics field. Incremental inductance is the key users concern for.

And Secant inductance or large signal inductance L_{sec} is defined as below, which cannot be measured by LCR meter.

$$L_{sec} = \frac{\Psi_{mA}}{I_A}$$



Secant inductance L_{sec} and
Incremental inductance L_{inc}



IPT 1000 basic theory diagram

Comparing to DC bias unit method, IPT1000 has outstanding advantages:

- Because of the single pulse measurement, large bias current can be produced by discharging the inductor up to thousands ampere.
- Because the measurement condition is in accordance with the actual application, IPT1000 will generate result much more similar to reality.

4、Accessories

Choosing the proper clip and connecting cable is very important for testing inductor. To fulfill different test requirements in different cases, IPT1000 is provided with three types of clips and two different connecting cables. Using proper accessories can improve the accuracy of the measurement result.

- **CK-306:** Double end banana plug: Use for voltage test and current test below 100A.



- **CK-307:** Used for current ranging from 101 to 1000A.

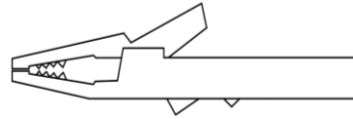
Attention: Non-banana plug contains auto-lock structure. When plugged into the 1000A range of the device, a click will indicate locking on. Insert the plug to the deepest before pulling it out, or the lock will stop it.



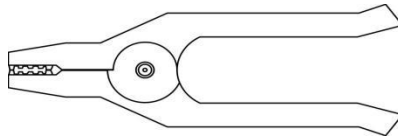
- **CK-261:** Used for voltage test or current test within 10A.



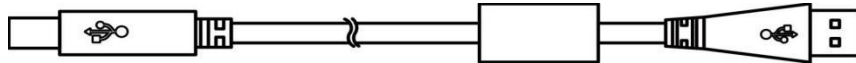
- CK-263:** Used for current test within range of 100A.



- **CK-264:** Stronger occlusal force and more contact surface. Usually used for current test ranging from 101 to 1000A.



- **CK-315:** USB data transfer cable, used for data transfer between IPT1000 and the PC software.



- **CK-318:** 220V power connecting cable



5、 How to use IPT1000

Please carefully read the following safety instruction before actual operation.

- **IPT1000 will generate DC pulse voltage up to 400V on output port, test cable, clamp and component under test. Please strictly follow the safety precautions.**
- **Only the cable with safety plug and clamp with insulation protection provided by original company can be used as testing cable and clamp.**
- **The platform used for testing must contain insulated surface to prevent high voltage leakage.**

1) Connecting PC

First of all, connect IPT1000 to PC through the USB port, and switch on before running the software.

Turn on the machine through the switch on front panel, the power LED will be lighted, blinking for 2 to 3 sec, and display the operation preparation status.

2) Connecting Testing Component

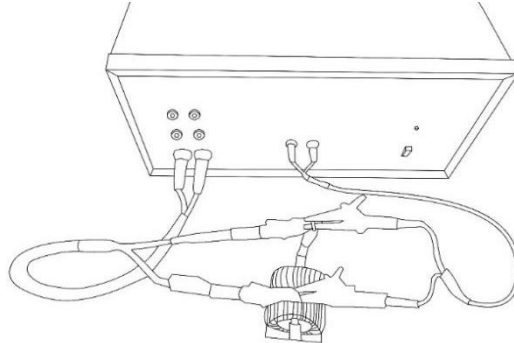
There're 8 sockets on the front panel, used to connect the test component.

✧ Voltage Test Cable

Voltage measurement cable need to connect to the pair of sockets named Voltage Probe in the middle of front panel. Voltage test cable must be directly connected to the test component to measure the actual voltage of the component.

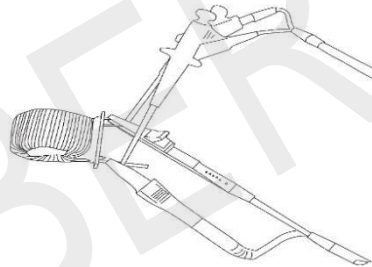
❖ Current Output Cable

The three sockets on left of the front panel are align with the three measurement ranges of the output current measured. The test component must be connected to one of those three output sockets according to measurement range.



Test Connection Diagram

The diagram shown above represents the correct method to connect four line when using the test components' standard cable suite. The voltage test cable and the current output cable must be connected to the port of each test component. It's not permitted to connect these two lines together and use the same shared terminal. The contact between test probe and resistor will influence the result.



The diagram above represents an example of setup, which can provide best result with least inductive coupling. If the connection of the test component is setup correctly, the influence on inductance measurement can be ignored.

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3) Operation and Software

Please carefully read through the instruction on software installation and the system requirement in appendix in this manual.

❖ Select Measuring Parameter

IPT1000 provide two different operation mode:

- Voltage will be applied on test component under preset current level is reached. (The measurement impulse will be ended when current break the limit). This is the normal mode.
- Apply the voltage onto test component until reach the preset time limit.

After activated the software, the following parameter must be set before measurement.

✚ Maximum Current

Make sure your maximum current is within the range test component connected to, or you must change the port. There're three ranges available.

	Range 1	Range 2	Range 3
Current Range	1~10A	11~100A	101~1000A

✚ Measurement Voltage

Input the value corresponding to the voltage level of the test component. The voltage on test component can be adjusted ranging from 10V to 400V.

Because of the measurement theory, the voltage under measurement must be higher than actual operation voltage. For instance, when measuring a 24 VDC electromagnet, you should select 40-60V for range. The measurement theory always requires enough voltage drop at the inductor of impedance, or the current transfer ratio $\frac{di}{dt}$ will converge to zero, unable to evaluate.

✚ Measurement Time (Maximum duration of measurement impulse.)

When reaching this value, the measurement impulse will be stopped as long as the maximum current level is not reached. A useful setup that can be related to the transformer or the inductor's voltage time integral. The maximum duration of the measurement impulse can be preset ranging from 100μs to 70ms when needed. Maximum limit is 70ms.

Besides these, the name of the test component and tester need to be inputted.

✧ Measurement

✚ Start Measurement

- Press the command button <Start Measurement> to start with.
- Select <Resistance> single option to measure resistance only.
- Select <Inductance + Resistance> button to measure resistance first and inductance after.

The resistance range for these two selections should be within 3Ω, if the resistance of the inductor is over 3Ω, only <Inductance> single option should be selected, and type in the resistance value on your own. (by using another device ahead)

During the testing, the display interface will show the following warning sign as shown below. Do not touch any cable or clamp when this sign is up. Only connect or disconnect cable and clamp when the sign disappears.



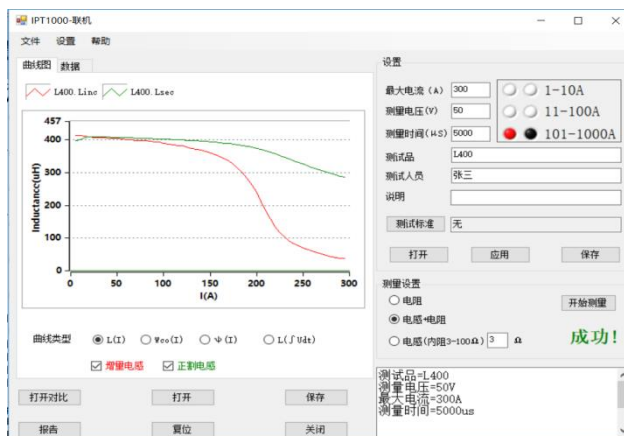
✚ Status display

- The software interface will display the current executing operation, please keep an eye on it.
- There'll be detailed warning tip when the device is used incorrectly. (Including wrong connection or wrong parameter)

✚ Measurement Diagram

Select one of the parameter $L[I]$, $L[\int Udt]$, $\psi[I]$ or $Wco[I]$ to display measurement result diagram.

Below the measurement diagram, the curve will be displayed in the form of {current/inductance} and corresponding {time voltage integral/ inductance}. The results of every small current ahead of range may be inaccurate and thus will probably not be displayed.



Main Interface

➤ Inductance $L[I]$

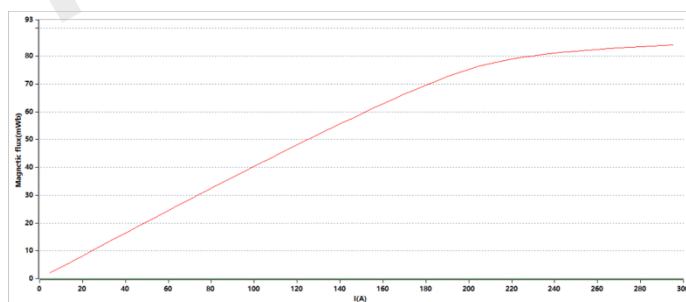
Normally will display the $L[I]$ diagram, which is the function that will display inductance L as current I .

Selecting incremental inductance and secant inductance, these two curves can be displayed. Definition can be found in appendix of this manual.

➤ Inductance $L[\int Udt]$

In some cases, the voltage time integral function $\int U(t) dt$ applying inductance to the test component will be useful.

➤ Flux Linkage $\psi[I]$

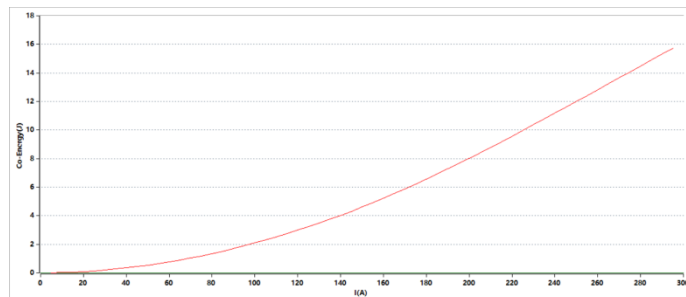


Flux Linkage Diagram

The Flux Linkage is in direct proportion to the voltage time integral of the device under test. If the number of turns and the cross section of the iron core is known, the flux density can be determined through flux linkage.

➤ Magnetic Co-energy $Wco(i)$

The magnetic co-energy $Wco(i)$ is corresponsive to the integral of the flux linkage $\psi(i)$ with respect to current, as a function of current. It can be helpful for the design, for instance, reluctance motors.



Magnetic Co-energy Diagram

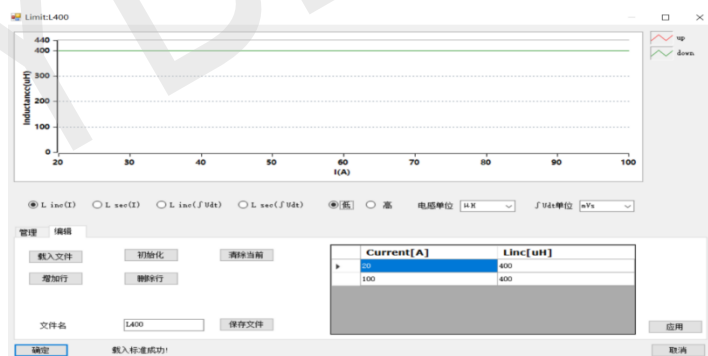
a) Loading and Saving Measuring Parameter

If necessary, the Save button on the upper right corner of the main interface can be used to save the parameter of certain component under test, and the same parameter can be reloaded using the Open button. This will make the quality control and checking in a series of production process much easier. Besides the parameter, the name of the component under test, name and annotation (if limit curve is requested) of the tester will be saved.

b) Testing Limit Curve

If necessary, the limit curve of the maximum and minimum permissible inductance can be defined (<Limits>). The limit curves are then set via interpolation points (value pairs, {current value / inductance value}), which are themselves linearly interpolated. Please pay attention to select the right units for the inductance (μH , mH , H) and the time-voltage integral (μVs , mVs , Vs) respectively.

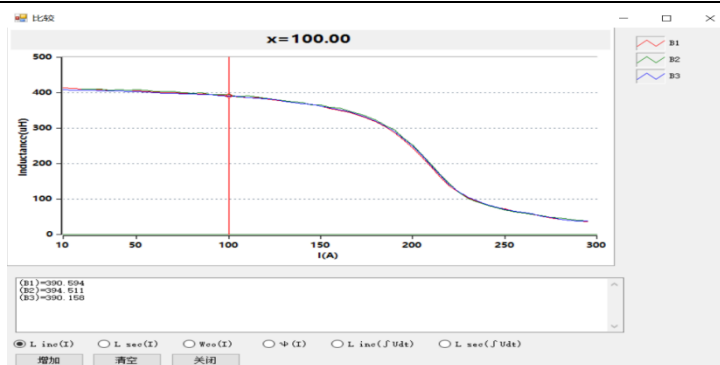
If the measured inductance curve is within the range of limit curve, the test component pass, otherwise it will be failed.



Limit Curve

c) Comparing multiple inductance curves

To easily compare different measurement curve, multiple curves can be displayed in single diagram. Using the Menu Function\Compare to open a new window, and open multiple curves saved before to compare.



Comparing Measurement Curve

You can clear the curves from diagram and add more whenever you need them.

Display the hardware version and serial number of the program through menu Help\About.

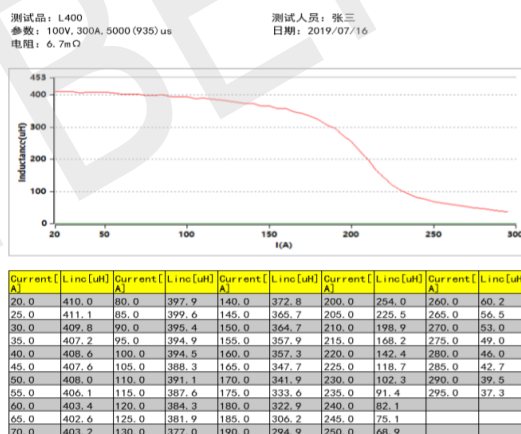
d) Saving Measurement Result

The measurement result of IPT1000 will be saved in file with extended name .ipt.

e) Generate Report

Use the command button Report to create the measurement contract in PDF form. It will include measurement diagram, data form, measuring parameter and comments.

电感测试报告 (Linc [I])



4) Operating Precaution

IPT1000 contains shortage protection and further safety self-inspection function. If the shortage protection is triggered or the self-inspection failed, the LED (power) on the front panel will blink, and the device need to be restarted before next operation. If the malfunction happened again after restart, the device must be sent to manufacturer for further check.

IPT1000 is designed for indoor environment temperature ranging from 0 °C to 50°C and pollution level of 1. If the device has to be used in damp or condensation environment, there must be a 2-hour adaptive phase before usage.

- If there's any irregular phenomenon, please do not try to dismantle and repair on your own. Please contact our company.
- This device must be operated by trained technician and managed by specially assigned staff.

6、 Technical Specification

AC input voltage	220V ±10%	Measurable inner impedance	0Ω~3000mΩ
Output voltage	10V~400V	Maximum output energy	1100 J
Output current	1A ~10A	Basic inductance measurement precision	±2%
(3 Range optional)	11A~100A	Communication Port	USB2.0
	101A~1000A	Dimension	420 (W) x 360 (L) x 210 (H) mm
Pulse setup time	100us~70ms	Weight	9.3 KG
Operating Temperature	0~50°C		

7、 Packing List

Packing List			
IPT1000	1	R&B Alligator Clip (CK-261)	2
Power Supply Cable (CK-318)	1	R&B Alligator Clip (CK-263)	1
USB Data Line (CK-315)	1	R&B Alligator Clip (CK-264)	1
R&B Connecting Cable (CK-306)	2	Instruction Manual	1
R&B Connecting Cable (CK-307)	1	Test Report and Warranty Card	1 for each

Appendix 1: Software Installation

➤ System requirement

Operation system: Windows 7 (32 bit or 64 bit) or Windows 10 (32 bit or 64 bit)

Display resolution: 800*600 or above

➤ Install software

Please execute file Setup.exe and follow the instruction. PC need to be restarted about installation complete.

➤ Update

Please uninstall the software through control panel before installing latest version. After that please follow the previous instruction.

➤ All data, setting and configuration will be saved under File\Cybertek\TPR menu.

CYBERTEK

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