

OPERATION MANUAL

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OPERATION MANUAL

Impulse Winding Tester

Contents

Chapter 1 Overview	1
WARNING!	1
1.1 Product Introduction	1
1.2 Principles of Impulse Winding Test	2
1.3 Operation Environment.....	3
1.3.1 Power Supply	3
1.3.2 Environment Temperature and Humidity.....	3
1.4 Dimensions and Weight	3
Chapter 2 General Specifications.....	4
2.1 Specifications.....	4
2.2 Comparison Methods.....	5
2.2.1 Area Size Comparison.....	5
2.2.2 Differential Area Comparison.....	6
2.2.3 Corona Discharge Comparison.....	6
2.2.4 Differential Phase Comparison.....	7
Chapter 3 Panels and Display Instruction.....	8
3.1 Front Panel Instruction.....	8
3.2 Rear Panel Instruction.....	10
3.3 Display Area Definition	11
Chapter 4 Operation.....	12
4.1 Measurement display page.....	12
4.1.1 Meas Display	12
4.1.2 Std Samp	13
4.1.3 Quick Test.....	15
4.1.4 Comparator	15
4.1.5 Meas Func.....	16
4.1.6 Tool.....	17
4.1.7 Imp Volt.....	18
4.1.8 Samp Rate	18
4.1.9 Time and Pos.....	18
4.2 Statistics display pages	19
4.2.1 Stat. Display	19
4.2.2 Stat. Func	19
4.2.3 Curr Winding	19
4.3 Measurment Setup page.....	20
4.3.1 Winding Type (only for Multi-channel instrument)	20
4.3.2 Working Mode (only for Multi-channel instrument).....	20
4.3.3 Std Mode (only for Multi-channel instrument)	21
4.3.4 Test Winding (only for Multi-channel instrument)	21
4.3.5 Curr Winding (only for Multi-channel instrument).....	21
4.3.6 Imp Volt.....	22
4.3.7 Test Imp	22
4.3.8 Dummy Imp.....	22
4.3.9 Samp Rate	22

4.3.10	Volt Adj	23
4.3.11	Wave Disp	23
4.3.12	Trig Mode.....	23
4.3.13	Delay Time	24
4.3.14	Break Test.....	24
4.3.15.1	BDV Imp.....	24
4.3.15.2	Stop Mode	25
4.3.15.3	Start Volt and End Volt.....	25
4.3.15.4	Step Volt.....	25
4.3.15	Comparator	25
4.3.15.1	Com Mode (only for Multi-channel instrument).....	26
4.3.15.2	Status	26
4.3.15.3	Position (Area, Dif-Area, Corona).....	26
4.3.15.4	Position (Phase-Dif).....	27
4.3.15.5	Limit.....	27
4.4	System Setup page	27
4.4.1	System Setup.....	28
4.4.2	Tool	28
4.4.3	Brightness.....	28
4.4.4	Skin.....	28
4.4.5	Pass/Fail.....	28
4.4.6	Pass Alarm and Fail Alarm.....	29
4.4.7	Key Sound	29
4.4.8	Language.....	29
4.4.9	Password.....	29
4.4.10	Save Type.....	30
4.4.11	Date and Time	30
4.4.12	HDL Trig Edge	30
4.4.13	HDL Output Mode	30
4.4.14	HDL Output Delay	30
4.4.15	Bus Mode	30
4.4.16	Bus Addr	30
4.4.17	Baud Rate.....	30
4.5	File List page	31
Chapter 5	Remote Control	32
5.1	RS232C Interface Operation.....	32
5.1.1	RS232C Connection	32
5.1.2	Communication with PC.....	33
5.2	GPIB Interface Operation	34
5.2.1	GPIB Bus.....	34
5.2.2	GPIB Interface Capability.....	37
5.2.3	GPIB Addressing	38
5.2.4	GPIB Bus Commands	38
Chapter 6	Handler Interface	39
6.1	Basic Information	39
6.2	Electrical Characteristics	40

6.2.1	DC Isolated Output.....	40
6.2.2	DC Isolated Input.....	41
6.3	Jumper Setup on HNADLER Interface	42
Chapter 7	Package Contents and Warranty	45
8.1	Package Contents	45
8.2	Warranty.....	45

Chapter 1 Overview

Thank you for your use of our products. Before the use of it, please locate the items listed in this manual to ensure nothing is missing. If in the case that any item is missing, please contact us immediately.

It is necessary to read this manual carefully before your proper use of impulse winding tester

WARNING !

- 1) Operation
Do not put heavy objects on the tester.
There is a cooling fan on the rear side of this instrument, so any block of the air inlet is prohibited.
- 2) Rigid Power Input
The stability of high voltage depends on stable power input. Be sure to provide rated AC power or corrected power.
- 3) Grounding
For the safety of personnel and instrument, ensure the grounding terminal, designed in power cord, be grounded correctly.
- 4) Test Cable
To avoid electrical shock hazard, do not touch test terminals and test samples. The reason is that a high voltage test cable is connected to the front panel of this instrument, thus when testing, the cable and test samples connected will carry a high voltage.
- 5) DO NOT Open Case Unauthorized!
To avoid the injury to personnel and damage to the instrument, do not open the case unauthorized due to the existence of high voltage in instrument.
- 6) Carry or Move
Before moving the instrument, unplug the AC power sockets and remove high voltage test line or external control line.
- 7) Maintenance
In non-use state, the instrument should be covered with a plastic or cloth cover. To clean the tester, wipe the dirty parts with a soft cloth soaked with diluted neutral detergent. Do not use the following chemicals to clean the instrument: diluent, benzene or organic solvent with similar chemical property with above materials.
- 8) Location
Do not locate the instrument in the environment of high temperature, direct sunlight or poor ventilation. In addition, the instrument will generate high voltage, so it must be used at room temperature and in the absence of much dust.

2.1 Product Introduction

Due to the influence of wire material, magnetic material, framework and manufacture technics, winding products such as transformers, motor windings may have defects of low insulation between winding layers, circles and leads. Impulse Winding Tester, adopting the high-speed sampling technique, is a new generation test instrument for insulation performance of winding products.

The meter compares the standard waveform stored in the non-volatile memory with the current tested waveform. The meter provides the PASS or FAIL comparison result according to AREA SIZE,

DIFFERENTIAL AREA, CORONA DISCHARGE or DIFFERENTIAL PHASE. With its strong functions, accurate comparison methods, easy operation and various interfaces, the meter series can provide a perfect test solution for most winding products.

2.2 Principles of Impulse Winding Test

The impulse winding tester tests the electrical characteristics of coil winding without damaging the DUT. The prerequisite condition is to test the quality of a coil at just a glance. The detection is carried out when the same electric impulse, as used in the standard coil and here discharged by a capacitor, is applied to the DUT. The voltage attenuation wave is generated in response to the impulse, related to the Q-factor and inductance of the coil. In this sense, the tester can detect turn& layer short, the differences in the number of turns and the material of the core. If high impulse voltage is applied, the poor insulation will appear as a corona or layer discharge.

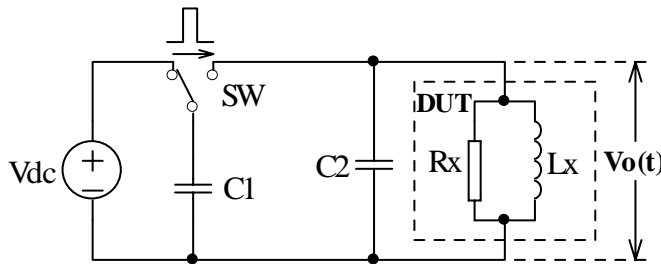


Figure 1-1 Simplified Diagram for Principles of Impulse Winding Test

In figure 1-2, the self-oscillation attenuation wave has a close relation with the inductance L and quality factor Q , while L and Q depend on the number of turn, manufacture technology, properties of iron core material and whether it has air-coils. What' more, the applied voltage is a high impulse voltage, thus, it is easy to observe the short circuit, partial short of turns and layers or turns discharge phenomenon caused by insulation damage.

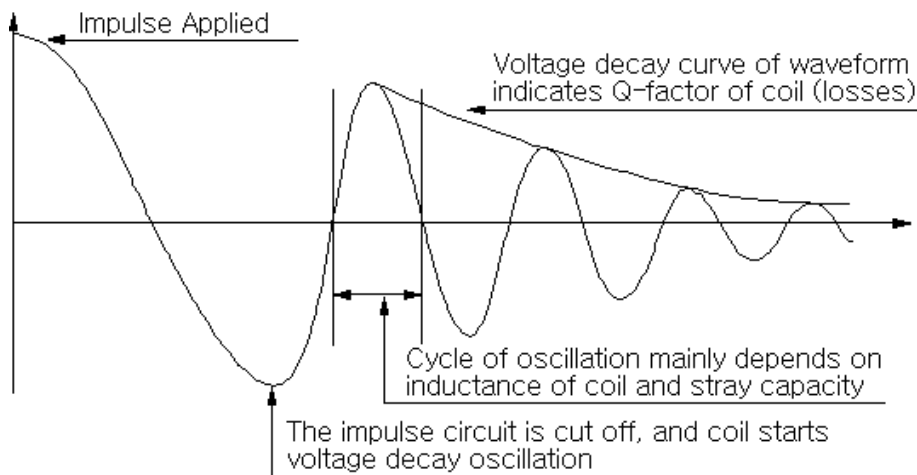


Figure 1-2 Typical Self-attenuation oscillation Wave

2.3 Operation Environment

3.1.1 Power Supply

Voltage: 198V-242V AC or 99V-121V AC

Frequency: 47.5Hz-63Hz

Consumption: $\leq 50\text{VA}$

3.1.2 Environment Temperature and Humidity

Normal Working Temperature: $0^{\circ}\text{C}\sim 40^{\circ}\text{C}$, Humidity: $\leq 90\%RH$

Referential Working Temperature: $20^{\circ}\text{C}\pm 8^{\circ}\text{C}$, Humidity: $\leq 80\%RH$

Transferring Environment Temperature: $0^{\circ}\text{C}\sim 50^{\circ}\text{C}$, Humidity: $\leq 93\%RH$

3.1.3 Dimensions and Weight

Dimensions (W*H*D): 400mm×132mm×350mm

Weight (Weight): Approx. 5.0kg

Chapter 2 General Specifications

2.1 Specifications

Specifications		
Output for Impulse Voltage	100V~5000V 10V steps 5%±10V	
Inductance Test Range	More than 10μH	
Impulse Energy	Max 250mili-Joules	
LCD Display Resolution Waveform Display Area Contents	800 x 480 dot-matrix LCD 650×250 dot-matrix(Support 1.5 times amplification display) Setup parameters, standard wave and test wave, comparison result, file information, etc.	
Sample Wave	Sampling rate: Max. 100MSPS, 10 grades(adjustable) Resolution: 8bits Memory depth: 6500 Bytes	
Input Impedance	10MΩ	
Test Speed	Single-channel test: 15 times/sec Multi-channels test: 2 times/sec	
Averaging Rate	Number of test impulse	1 to 32 averaging rate programmable
	Number of demagnetizing impulse	0 to 8 averaging rate programmable
Measurement Function	Voltage, Time and Frequency	
Trigger Mode	Internal, Manual(Foot), External and Bus	
Comparison Method	Area Size Comparison Differential Zone Comparison Corona Discharge Comparison Differential Phase Comparison	
Area Size Measurement Accuracy	±1%	
Area Difference Measurement Accuracy	±1%	
Comparison Output	PASS/FAIL display Beeper alarm and Light alarm	

Beep Mode		Long High, Long Low, Single Short, Double Short tone and OFF
Memory	Built-in	300 files
	USB disk	600 files (standard waveforms and measurement settings)
Interface		Handler (START,STOP,PASS,FAIL ,BUSY,EOC) RS232C USB Device (support USB TMC and USB CDC) USB Host (support FAT16 and FAT32, BMP、GIF、PNG、CSV files, support firmware upgrade) GPIB (option)

2.2 Comparison Methods

2.2.1 Area Size Comparison

As shown in figure 2-1, when comparison method is set to AREA SIZE, the area sizes of both standard waveform and the tested waveform are calculated (integration method) between A and B. The percent deviation is the ratio of the area size difference to the area size of the standard waveform between A and B, expressed as a percentage.

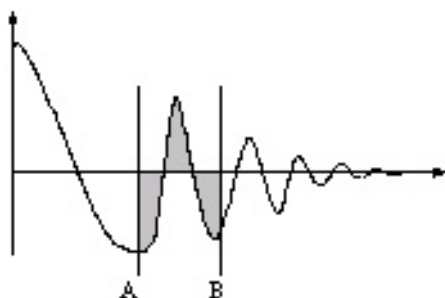


Figure 2-1 Area Size Comparison

The area size of the waveform is nearly proportional to the energy loss in the winding. When a sample winding has a short circuit between layers, the short circuit area is reflected as an increase of energy loss.

2.2.2 Differential Area Comparison

When comparison method is set to Differential Area, the METER calculates the area size of differential portion between the standard waveform and the tested waveform from A to B. (The differential portion area size is indicated as the shaded part in Figure 2-2.) The percent deviation is the ratio of the differential portion area size to the area size of the standard waveform between A and B, expressed as a percentage.

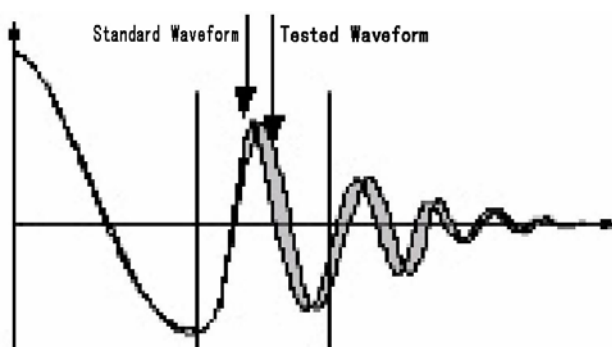


Figure 2-2 Differential Area Comparison

The differential area size reflects the value of inductance and total energy loss. This method is especially effective to detect the differences of inductance L between the standard winding and the tested winding.

2.2.3 Corona Discharge Comparison

When comparison method is set to Corona Discharge, the METER detects the high frequency energy of corona discharge from A to B as shown in Figure 2-3. When the corona evaluation value is less than the corona difference limit, then the comparison result will be PASS. When the corona evaluation value is more than the corona difference limit, then the comparison result will be FAIL. The corona evaluation value and difference limit are both expressed as an integer.

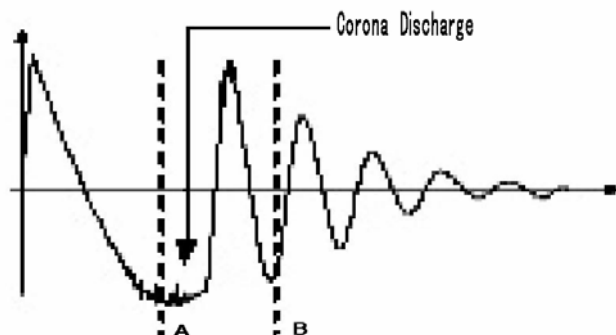


Figure 2-3 Corona Discharge Comparison

User can sample some coil samples (e.g. 10 samples) to set an effective corona discharge value. First, applying an impulse voltage to each coil will gain the corona discharge value of each coil. Then, a new effective value can be set by adding 20% to the maximum corona discharge value. In order to ensure the

correctness of the new value, user can test these coils once more and observe the corona PASS or FAIL.

2.2.4 Differential Phase Comparison

User can specify a zero-crossing point to compare. The instrument will judge the zero-crossing offset between the tested waveform and standard waveform and then compare the oscillation period between the two waveforms. The percentage of the two values will be taken as the judging criterion and the reference is set by percentage. As is shown in figure 2-4, A~B is the offset and C~D is the oscillation period of standard waveform. The third zero-crossing point of the compared waveform is to set.

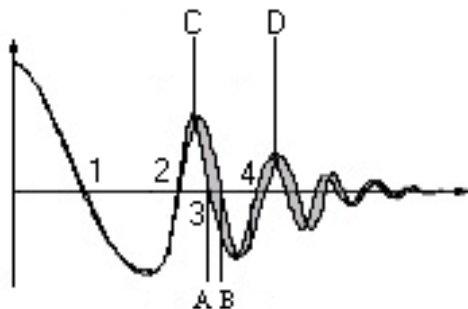
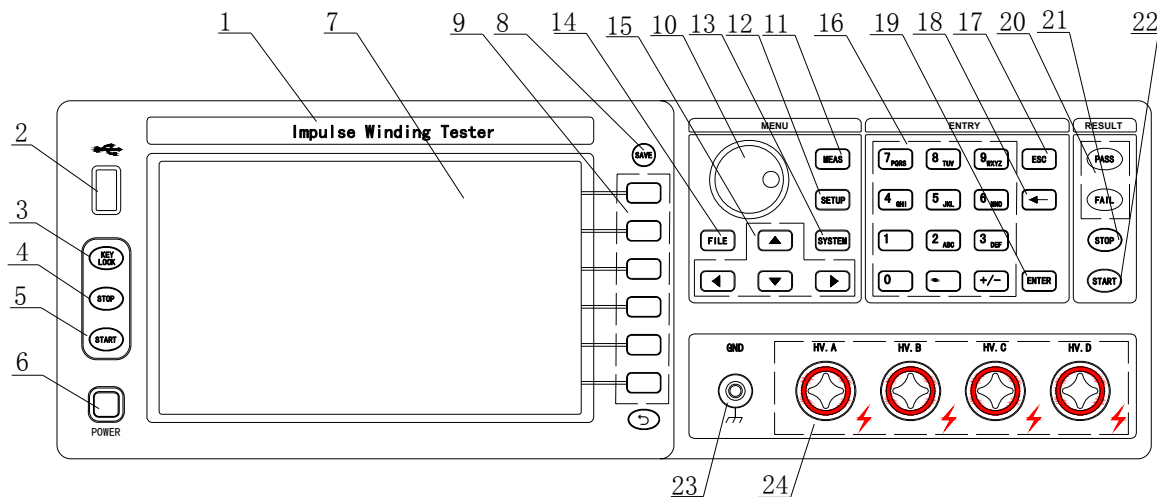


Figure 2-4 Phase Differential Comparison

NOTE: The tester can only set zero-crossing points from 2 to 10. The first zero-crossing point cannot reflect the actual performance of coils, so it is not necessary to set the first point. In real phase differential comparison, there are four results generated: PASS, FAIL, FAIL1 and FAIL2. PASS is up to standard; FAIL, below standard. While FAIL1 means the zero-crossing point has not been found, that is to say, it is unable to find the set zero-crossing point on the waveform of the tested coil; FAIL2 indicates that a complete period cannot be found on the standard waveform. As is shown in figure2-4, the third zero-crossing point must be present in the waveform to ensure the normal operation of phase differential comparison.

Chapter 3 Panels and Display Instruction

3.1 Front Panel Instruction

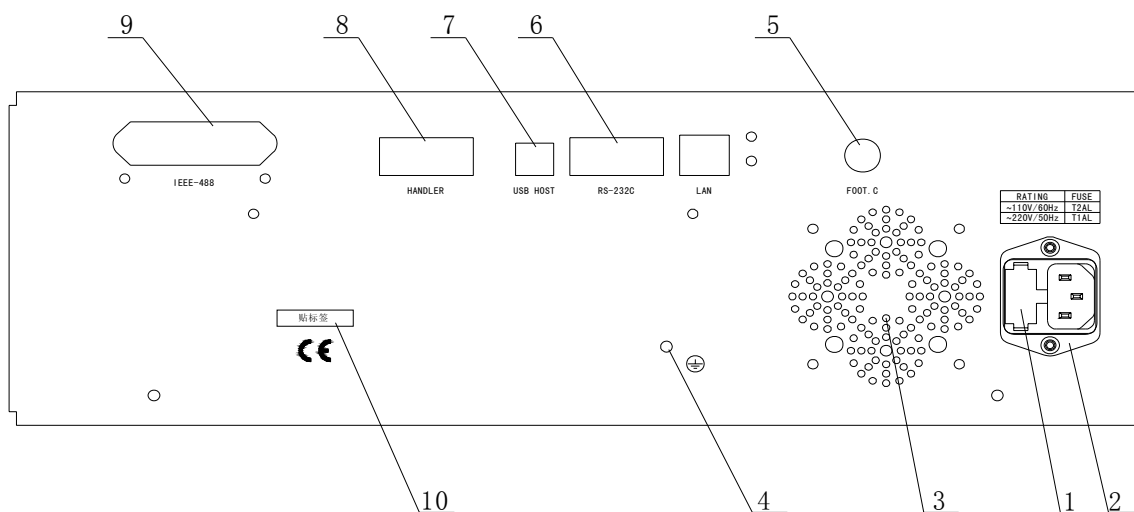


Serial Number	Name	Instruction
1	Brand and Model	
2	USB Interface	An USB disk can be connected for standard waveforms, test waveforms and measurement conditions storage.
3	LOCK/LOCAL key	
4/21	STOP key	Press STOP key to stop measuring for all trigger modes
5/22	START key	Press the START key to start a measurement. In the process of test, pressing the key will terminate the measurement.
6	POWER key	Switch on or off the main power
7	LCD	800×600 dot-matrix LCD displays measurement waveform, test conditions and system configurations, etc.
8	SAVE key	Press SAVE key to save the image file (BMP, GIF, PNG) and waveform file(CSV) to the USB disk
9	SOFT KEY	The five keys' functions are not fixed and have different functions in different menus. Five soft keys are used to select control and parameter functions. Current function of each soft key is displayed along its left side.
10	Roller	Used to adjust and modify parameters

11	MEAS menu key	Press MEAS menu key to enter the <MEAS DISP> page.
12	SETUP menu key	Press SETUP menu key to enter the <MEAS SETUP> page.
13	SYSTEM menu key	Press SYSTEM menu key to enter the <SYSTEM SETUP> page.
14	FILE menu key	Press FILE menu key to enter the <FILE LIST> page
15	CURSOR keys	The CURSOR keys are used to move the field select cursor from field to field on the LCD display page. When the cursor is moved to a field, the field changes to an inverse video image of the original field.
16	NUMBER keys	The NUMBER keys are composed of the digits 0 to 9, a period ., a minus sign -. The number keys are used to enter numeric data into the METER.
17	ESC key	ESC key is used to cancel the enter of numbers or characters.
18	BACKSPACE key	The function of BACKSPACE key is to delete numbers or characters wrongly entered.
19	ENTER key	ENTER key terminates numeric input data and enters the displayed value on the data input line (bottom line of the LCD screen).
20	Pass/ Indicator Fail	When PASS indicator flashes, the comparison result is up to standard; while FAIL , below indicator. Valid only in comparison function.
23	Ground Terminal	The terminal is used to connect the instrument to the ground, thus to protect the operating personnel.
24	High Voltage Indicator (HV)	High Voltage Indicator indicates that the METER is outputting dangerous impulse test voltage to the HV terminal on the rear panel.

Table 3-1 Front Panel Instruction

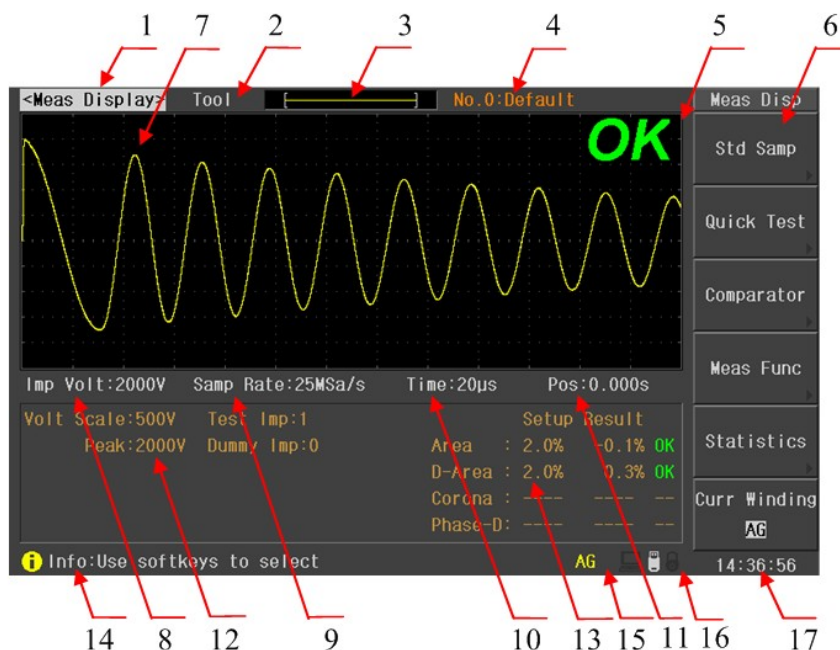
3.2 Rear Panel Instruction



Serial Number	Name	Instruction
1	Fuse Holder	Fuse holder is used to protect the instrument. 220V/1A
2	Line Input Receptacle	AC power cord receptacle
3	Cooling Fan	Make sure that sufficient space must be kept around the METER to avoid obstructing the air flow of the cooling fans.
4	Ground Terminal	Connect the case with the ground.
5	FOOT CONTROL	A footswitch can be used to start a measurement instead of pressing the START key from the front panel.
6	RS232C Interface	RS232C Communication Interface can be connected to a computer for remote control and operation.
7	USB interface	Support USB TMC and USB CDC
8	HANDLER Interface	This is the HANDLER Interface connector used when operation with an external handler to fully automate testing, comparing, and quality control data processing. Comparison results are output via the handler interface. You can also start or stop a test through the interface.
9	IEEE488 Interface (option)	IEEE488 general purpose interface bus can be connected to a computer for remote control and operation.
10	Serial Number	Used to provide the information of date, model, serial number.

Table 3-2 Rear Panel Instruction

3.3 Display Area Definition



Specific definition for each area:

Serial Number	Instruction
1	This is the display page area. This area identifies the current display page.
2	Some special controls which cannot be set on a display page's fields are made available
3	Indicate the waveform location in the memory
4	Show the serial number and name of the current file, No.0 is default file. Starting from no.1 is stored in the internal or USB disk.
5	Show the final measurement result
6	Main menu for soft key, show the corresponding function and parameter of each soft key.
7	In this area, test and standard waveforms, peaks of impulse voltage and comparison results are displayed
8	Show the current set impulse voltage. This voltage can be changed by the soft key, numeric key or the roller.
9	Show the sampling rate of the current waveform, which can be altered by the soft key and the roller.
10	Time base display area, supports waveform 4-class zoom. This time base can be changed by the soft key and the roller to check the details of the waveform.
11	The starting position of waveform. This position can be changed by the soft key and the roller to view the details of waveform.
12	The test parameter display area, the voltage scale indicates the vertical scale voltage value, the peak voltage indicates the value of test waveform, the test pulse and degaussing pulse is the current number of pulses.
13	Four comparison results and their final display results
14	Information display area.
15	Additional information display area, such as display the current coil name or the destruction test information.
16	Show the state of interface selecting, availability of U disk, key lock, etc.
17	Display the real time

Chapter 4 Operation

This chapter describes how to use the instrument keys and roller to operate, contains the operation of Measurement display page, Measurement setup page, System setup page and File list page.

Basic operation: use the Menu key to select the desired display page, move the cursor to the desired position using the cursor arrow key, and then set the parameter or select function by using the soft keys, roller or numeric keypad according to the message.

4.1 Measurement display page

Press the DISP menu key to enter the <Meas Display> page. In this page, measurements are taken and the test waveform is displayed. You can also set some measurement parameters and function settings such as impulse voltage(Imp volt), sampling rate(Samp Rate), time base(Time),waveform position(Pos),standard sampling(Std Samp), quick test(Qucik Test), comparison setting(Comparator), measurement function(Meas Func), statistic fuction(Statistics),current winding(Curr Winding),etc. Figure 4-1 shows the measurement display page.

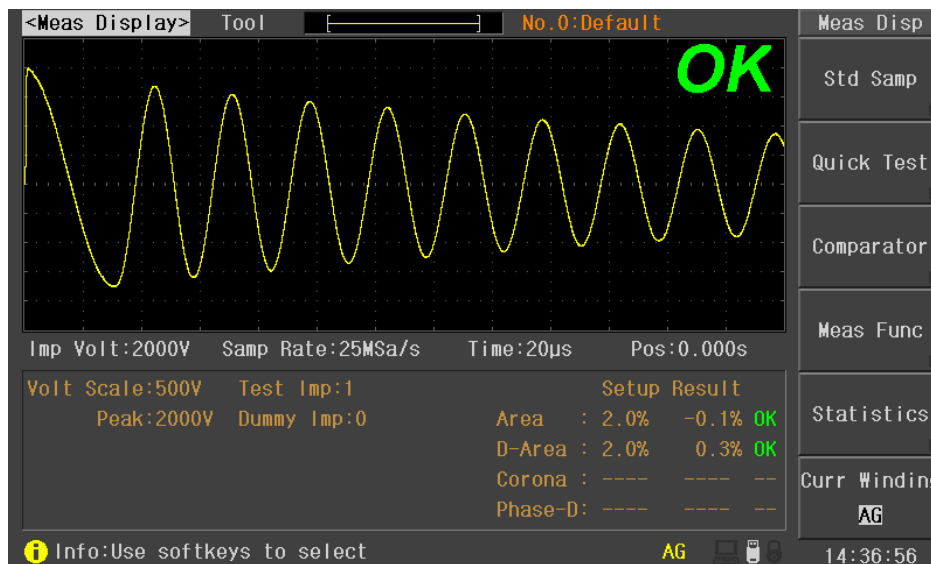
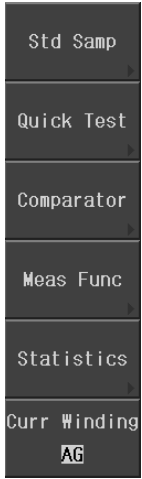


Figure 4-1 Measurement display page

4.1.1 Meas Display

When the anti-white bars in this area, the user can use the soft keys to select the appropriate action, including the standard sampling (Std Samp), quick test (Quick Test), comparing set (Comparator), measurement function (Meas Func) and statistical functions (Statistics).Description shows in table 4-1.

Table 4-1 Measurement display page



Function Menu	Description
Std Samp	Press the soft key to enter the standard acquisition menu, you can choose manual collection, automatic collection and recycling collection three standard acquisition modes.
Quick Test	Press the soft key to enter the quick test function, the instrument perform continuous acquisition test, the impulse voltage and sampling rate can be modified during the measurement, providing similar simulation turns effect.
Comparator	Press the soft key to enter the comparison set menu, set the parameter of Area Size Comparison, Differential Area Comparison, Corona Discharge Comparison and Phase Differential Comparison.
Meas Func	Press the soft key to enter the measurement function menu; you can measure the voltage, time and frequency.
Statistics	Press the soft key to enter the statistics page, view and save the statistical results.
Curr Winding	Used to switch the current coil display (only for multi-channel instrument).


4.1.2 Std Samp

The instrument provides three standard waveform acquisition modes: Manual, Automatic and Loop. Each menu description is shown in Table 4-2 ,Table 4-3 and Table 4-4.

In the Manual mode, the standard waveform is acquisition at the current sampling rate, also support the sample average test.

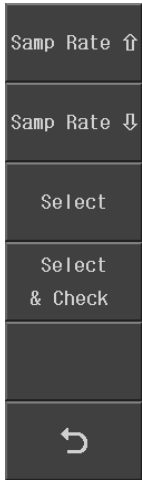
Table 4-2 Manual standard menu



Function Menu	Description
Complete	Press the soft key to end the standard waveform acquisition. The current waveform data is saved as a standard waveform. The number is the average times of sample, instrument support up to 32 times, when the number is reach to 32, the instrument automatically executed to complete the operation.
Undo Last	Revoke the previous standard data acquisition
Undo All	Revoke all of the standard data acquisition
	Return to Std Samp menu.

In the Auto mode, at each frequency, the instrument automatically samples a standard wave on the sample. Finally, a wave at an appropriate frequency will be selected. the user can also choose the standard waveform demand (adjust the sampling rate).

Table 4-2 Auto standard menu



Function Menu	Description
Samp Rate ↑	Increase the sampling rate
Samp Rate ↓	Reduce the sampling rate
Select	Select the sample waveform at the current frequency as the standard waveform.
Select & Check	Compare the sample wave with the standard wave at the current frequency, if the compare result is within the error range, choose the sample wave at the current frequency as the standard wave and return to the main menu; if the compare result is beyond the error range, an error information will prompt and the instrument will keep in the wait state to Start a new sample.
	Return to Std Samp menu.

In the loop Mode, the instrument will test each sampling rate of standard waveform cycle, and will wait for a period of time between the two tests, waiting for the user's actions.

Table 4-3 Loop standard menu



Function Menu	Description
Select	Select the sample waveform at the current frequency as the standard waveform.
Select & Check	Compare the sample wave with the standard wave at the current frequency, if the compare result is within the error range, choose the sample wave at the current frequency as the standard wave and return to the main menu; if the compare result is beyond the error range, an error information will prompt and the instrument will keep in the wait state to Start a new sample.
	Return to Std Samp menu.

4.1.3 Quick Test

In quick test mode, when press start, the instrument test the sample coil continuously, the user can modify the impulse voltage and sampling rate during the testing.

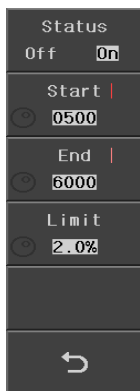


Table 4-4 Quick test menu

Function Menu	Description
Imp Volt ↑	Increase the impulse voltage
Imp Volt ↓	Reduce the impulse voltage
Samp Rate ↑	Increase the sampling rate
Samp Rate ↓	Reduce the sampling rate
Ok As Std	After stop the acquisition, save the current waveform as a standard waveform
↶	Return to Meas Disp menu

4.1.4 Comparator

The meter provides four kinds of compare methods as follows: Area Size Comparison, Differential Area Comparison, Corona Discharge Comparison and Phase Differential Comparison. The instrument collects the waveform data of 6500 points, thus user can select the comparison area between the start position and 65000.



Press the **Comparator** soft key to enter the main menu of it. Four compare methods can be set under this menu.

Table 4-6 Comparator setting menu (Area/Dif-Area/Corona)

Function Menu	Description
Status	Switch Comparison Status: Open, Close.
Start	Set the starting position of the comparison
End	Set the end position of the comparison
Limit	Set the limit of the comparison
↶	Return to Comparator menu

Note: set the start, end, or the limit data, first press the corresponding soft key, then use the roller to adjust the data. The attention point applies to all of the following operations.

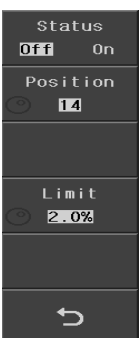


Table 4-7 Comparator setting menu (Phase-Dif)

Function Menu	Description
Status	Switch Comparison Status: Open, Close.
Position	Set the zero-crossing position and the value ranges from 2 to 20.
Limit	Set the limit of the comparison
↶	Return to Comparator menu

4.1.5 Meas Func

Measurement function is used to measure impulse voltage, time and frequency.

Note: When a function is selected and the roller is enabled, two lines will be displayed in the waveform display zone. The differential value of the two lines corresponds to the value showing on the second soft key.



Table 4-8 Voltage measurement menu

Function Menu	Description
Upper	Press the soft key, and then revolve the roller to change the position of the high limits.
Lower	Press the soft key, and then revolve the roller to change the position of the low limits.
ΔVolt	The voltage differential value between the high and the low limits
	Return to Meas Func menu



Table 4-9 Time and Frequency measurement menu

Function Menu	Description
Start	Press the soft key, and then revolve the roller to change the position of the high limits.
End	Press the soft key, and then revolve the roller to change the position of the low limits.
ΔTime	The time differential value between the high and the low limits
Freq	The frequency between the high and the low limits
	Return to Meas Func menu

4.1.6 Tool

Move the highlight bar to the tool area, the user can set the functions of zoom waveform, corona display or grid display.

Table 4-10 Tool menu

Function Menu	Description
File Load	Switch ON/OFF the starting-up load function. When File Load is ON and turned on the instrument, it will call the last file (internal document only), otherwise use the default file (document file support parameters in real time saved, but there is no standard waveform data).
Grid Disp	Switch ON/OFF the waveform grid display.
Wave Enlarge	Switch ON/OFF the waveform zoom display. Shows in Figure 4-2 and Figure 4-3.
Core Disp	Switch ON/OFF the corona display. Shows in Figure 4-4 and Figure 4-5.
Clear Std	Cancel all acquisition data for standard waveform.

Note: At the Meas Display page, Key **[]** can switch ON/OFF the waveform zoom display function, Key **[/]** can switch ON/OFF the corona display function.

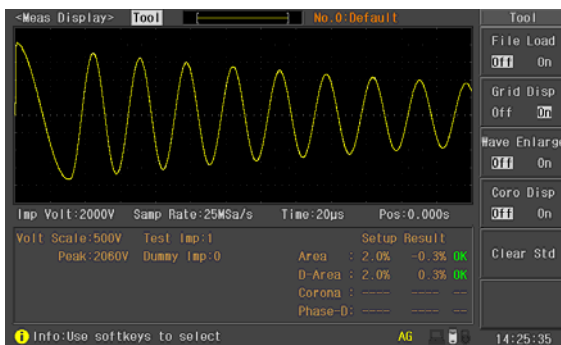


Figure 4-2 Waveform normal display

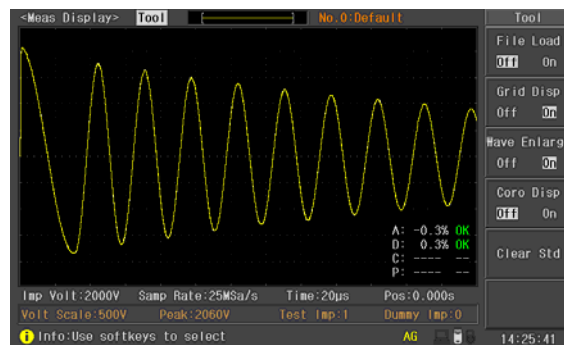


Figure 4-3 Waveform zoom display

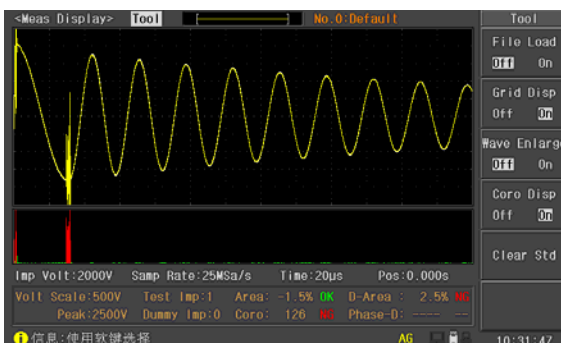


Figure 4-4 Corona display with waveform normal display

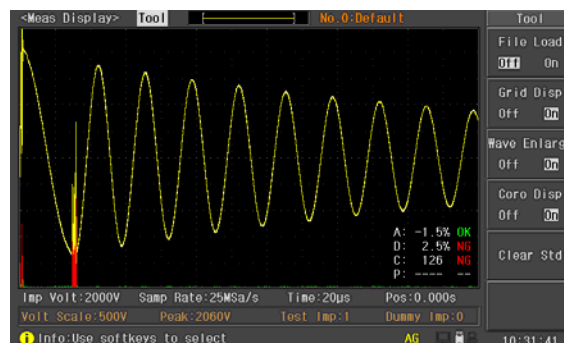


Figure 4-5 Corona display with waveform zoom display

Note: Corona display need switch ON both corona comparator and corona display. Corona display in red when it beyond the limit, otherwise display in green.

4.1.7 Imp Volt

Move the highlight bar to the impulse voltage area, then you can use the soft keys, roller or numeric keypad to set the value of impulse voltage.



Table 4-11 Impulse voltage menu

Function Menu	Description
↑(++)	Increase with 100V
↑(+)	Increase with 10V
↓(-)	Decrease with 10V
↓(--)	Decrease with 100V

Note: Changed the impulse voltage, the standard waveform will be cleared. You must recollect the standard waveform before comparison operation. If the voltage return to the original value, the original standard waveform will be effective.

4.1.8 Samp Rate

Move the highlight bar to the sampling rate, and then use the soft keys or the roller to set the sampling rate. The optional sampling rate is 10 points from 100kSa / s to 100MSa / s.

Note: Changed the sampling rate, the standard waveform will be invalid. If the sampling rate is reset to the original value, the original standard waveform will be effective.

4.1.9 Time and Pos

Move the highlight bar to the time base or location, and then use the soft key or knob to set time base or location. Each sampling rate contains 4 groups time base to display the waveform retractable, the user also can move the waveform position to view waveforms details.

4.2 Statistics display pages

On <Meas Display> page, press **Statistics**, enter into the statistics display pages. On this page, the user can view, clear and save the results of statistics.



4.2.1 Stat. Display

- **Clear** Clear the current statistic results.
- **Save** Save the current statistic data to external U disk. The default format is CSV.

When statistics function is turned on, the comparisons results will be saved into the internal memory each time, the memory can record max. 20,000 group's data. More than 20, 000,it will start at zero again.

CSV file Format:

```
Date,      Time,      Area ,   Dif-Area, Corona,  Phase-Dif,  Judge
2012-1-1,  10:02:15,  -0.2,   1.1,      2,         0.5,        OK
```

4.2.2 Stat. Func

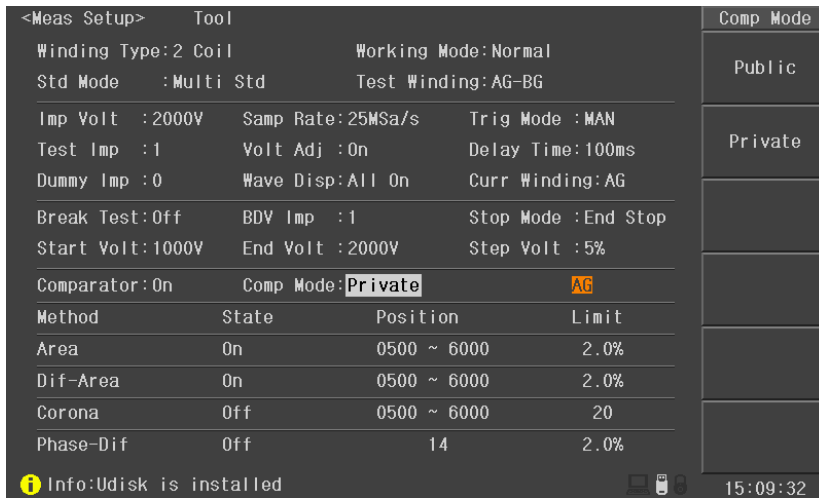
- **On** Open the statistics function.
- **Off** Close the statistics function.

4.2.3 Curr Winding

This parameter is used only for multi-channel instrument. It is used to select the currently displayed statistics results.

4.3 Measurement Setup page

Press **SETUP** key to enter into <Meas Step> page.



4.3.1 Winding Type (only for Multi-channel instrument)

The two-channel instrument can select 1 Coil or 2 Coil modes. The four-channel instrument can select 1 Coil, 2 Coil, 3 Coil, 4 Coil, 3-Phase 3-Wire or 3-Phase 4-Wire mode.

- 1 Coil
- 2 Coil
- 3 Coil
- 4 Coil
- 3-Phase 3-Wire
- 3-Phase 4-Wire

Table 4-12 Winding Type menu

Function Menu	Description
1 Coil	Test single coil
2 Coil	Test two coils
3 Coil	Test three coils
4 Coil	Test four coils
3-Phase 3-Wire	Test three-phase three-wire motor
3-Phase 4-Wire	Test three-phase four-wire motor

The three-phase three-wire and three-wire four-wire is a special three-winding test, they only use one standard waveform test.

4.3.2 Working Mode (only for Multi-channel instrument)

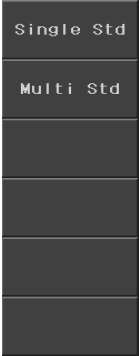
It is used to set the multi-channel instrument test mode: Normal test and Balance test.

- Normal
- Balance

Function Menu	Description
Normal	If the instrument saved the standard waveform, the tested waveforms compared with standard waveforms. If the instrument don't save the standard waveform, only acquire and display the test waveform (the corona can be calculated).
Balance	Only for multi-winding coil, in this mode, the instrument check the consistency of the coils, not need to acquire the standard waveform.

4.3.3 Std Mode (only for Multi-channel instrument)

For multi-channel instrument, if you select the working type as 2 coil, 3 coil or 4 coil and the working mode as Normal, the instrument can offer the independent standard waveform with different voltage and sampling rate for each winding.



Function Menu	Description
Single Std	All of the windings use the same standard waveform.
Multi Std	All of the windings use the independent standard waveform with different voltage and sampling rate.

4.3.4 Test Winding (only for Multi-channel instrument)

It used to set the type of the test windings.

Four-channels instrument:

Normal Working Mode:

- 1 Coil: AG、BG、CG、DG
- 2 Coil: AG-BG、CG-DG、AB-CD
- 3 Coil: AG-BG-CG、AB-BC-AC
- 2 Coil: AG-BG-CG-DG
- 3-Phase 4-Wire: AG-BG-CG
- 3-Phase 3-Wire: AB-BC-AC

Balance Working Mode:

- 1 Coil: Not support
- 2 Coil: AG-BG、CG-DG、AB-CD
- 3 Coil: AG-BG-CG、AB-BC-AC
- 4 Coil: AG-BG-CG-DG
- 3-Phase 4-Wire: AG-BG-CG
- 3-Phase 3-Wire: AB-BC-AC

Four-channels instrument:

Normal Working Mode:

- 1 Coil: AG、BG
- 2 Coil: AG-BG、AG-BG-AB

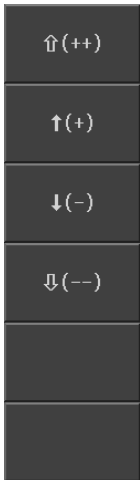
Balance Working Mode:

- 1 Coil: Not support
- 2 Coil: AG-BG

4.3.5 Curr Winding (only for Multi-channel instrument)

It used to select the current winding, then the impulse voltage and sampling rate can be set to the correspond to the winding.

4.3.6 Imp Volt



Function Menu	Description
↑(++)	Increase the voltage by a resolution of 100V.
↑(+)	Increase the voltage by a resolution of 10V.
↓(-)	Decrease the voltage by a resolution of 10V.
↓(--)	Decrease the voltage by a resolution of 100V.

Note: User can directly input the desired voltage by numerical keys. In the state of inputting numbers, soft keys are unavailable. When the number is input, **ENTER** can be used to end inputting and the default unit is volt (V).

4.3.7 Test Imp

The number of tested impulses can be set from 1 to 32. Move the cursor to this zone, the number can be adjusted by the soft key or the roller.

Note: User can directly input the desired number by numerical keys. In the state of inputting numbers, soft keys are unavailable. **ENTER** can be used to terminate inputting.

4.3.8 Dummy Imp

The number of erase impulses can be set from 0 to 8. Move the cursor to this zone, the number can be adjusted by the soft key or the roller.

Note: User can directly input the desired number by numerical keys. In the state of inputting numbers, soft keys are unavailable. **ENTER** can be used to terminate inputting.

4.3.9 Samp Rate

The sample rate can be set from 100kSa/s to 100MSa/s, there is total 10 points. Move the cursor to this zone, the number can be adjusted by the soft key or the roller.

4.3.10 Volt Adj

For different load on each DUT, when a given impulse voltage is applied across them, the actual voltage applied on each DUT may also be different. User can turn on the voltage adjust function to automatically change the output voltage, thus making all voltages applied across all DUT identical.

Note: This function is particularly suitable for a small inductance of the coil.

4.3.11 Wave Disp

All On	Function Menu	Description
Std	All On	Both the standard waveform and the test waveform will be displayed on the screen at the same time. For the consumption of display time, the test speed will be decreased. This display will bring convenience for user to observe waveforms.
Test	Std	In the phase of measurement, only the standard waveform will be displayed on the screen, so the measurement will be taken at the fastest speed. This way is suitable for users only needing the comparison result.
All Off	Test	In this mode, only the test waveform is displayed thus it will take some time to refresh the tested waveforms after each test and the test speed will be decreased.
	All Off	With the exception of comparison result, none waveforms will be displayed, therefore the test speed is the fastest in this mode.

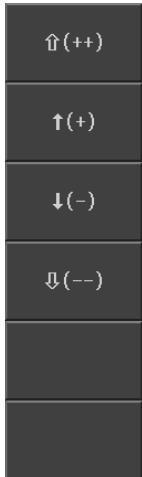
Ⓢ **Note: In the latter two modes, when SEQ CYCLE or SINGLE CYCLE is selected, the standard waveform will disappear; when SINGLE SAMPLE is selected, none waveforms will be displayed. Thus it is highly recommended for user to turn on standard waveform.**

4.3.12 Trig Mode

MAN	Function Menu	Description
EXT	MAN	This is the default trigger mode. Pressing START or using the foot switch to start a measurement.
INT	EXT	Via HANDLER interface, input a negative TTL pulse (more than 1μs) from external to the instrument, the rising edge of which will form a trigger impulse.
BUS	INT	When the trigger mode is set to this mode, it starts a measurement once START is pressed on the MEAS DISP page, and then the instrument will continuously repeat measurements until MEAS EXIT soft key is pressed.
	BUS	TRIGGER commands are sent to instrument via RS232SC, USBTMC, USB CDC or LAN interface.

4.3.13 Delay Time

Delay time refers to the time between the end of a measurement and the start of the next measurement. The delay function is only available when trigger mode is set to INT trigger mode. The trigger delay time can be set from 0ms to 60s by 1ms steps.



Function Menu	Description
↑(++)	Increase the delay time by 100ms
↑(+)	Increase the delay time by 1ms
↓(-)	Decrease the delay time by 1ms
↓(--)	Decrease the delay time by 100ms

4.3.14 Break Test

Break Test is a test method for turn-to-turn insulation test. Starting from Start Volt and ending at End Volt by a resolution of Volt Step, the test is finally done by comparing with four comparison methods.

4.3.15.1 BDV Imp

In Break Test mode, the instrument uses the BDV impulse to alternative the test impulse. The BDV Imp can be set from 1 to 8. Move the cursor to this zone, the number can be adjusted by the soft key or the roller.

Note: User can directly input the desired number by numerical keys. In the state of inputting numbers, soft keys are unavailable. ENTER can be used to terminate inputting.

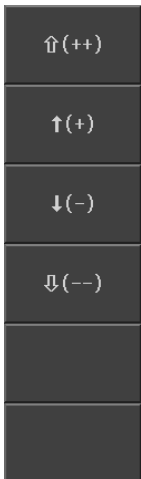
4.3.15.2 Stop Mode

Stop Mode is used to set the stop time after the Break Test started。



Function Menu	Description
Fail Stop	Stop the test at the result of the comparison is Fail
End Stop	Stop the test after termination voltage test

4.3.15.3 Start Volt and End Volt



Function Menu	Description
↑(++)	Increase with 100V
↑(+)	Increase with 10V
↓(-)	Decrease with 10V
↓(--)	Decrease with 100V

4.3.15.4 Step Volt

Volt Step ranges from 1% to 50%. 1%~50%, it can be set by the soft key, roller and the numeric keypad,

↑(++)、↓(--): They are coarse soft keys used to change Volt Step by a resolution of 5%.

↑(+)、↓(-): They are fine soft keys used to change Volt Step by a resolution of 1%.

4.3.15 Comparator

The comparator function allows you to set all comparators to ON or OFF. Once the comparator is turned off, the instrument cannot make any comparisons, but the test wave or the standard wave is also displayed on the measurement display page.

4.3.15.1 Com Mode (only for Multi-channel instrument)



Function Menu	Description
Public	All of the test windings using the same comparison parameters
Private	The different test windings use different comparison parameter

4.3.15.2 Status



Function Menu	Description
Off	Turn off the comparator of Area or Dif-Area or Corona or Phase-Diff.
On	Turn On the comparator of Area or Dif-Area or Corona or Phase-Diff.

4.3.15.3 Position (Area, Dif-Area, Corona)

Set the comparison ranges for AREA SIZE, DIFF ZONE and CORONA that range from 0 to 6500 (the value of the end position must be larger than that of the start position.). It can be set by the soft key, roller or the numeric keypad.



Function Menu	Description
↑(++)	Increase the value of position by 10
↑(+)	Increase the value of position by 1
↓(-)	Decrease the value of position by 1
↓(--)	Decrease the value of position by 10

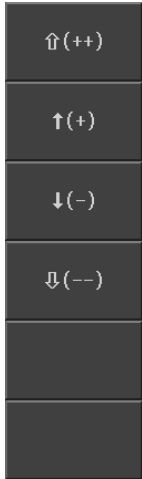
4.3.15.4 Position (Phase-Dif)

Set the zero-crossing position for PHASE DIFF that is to select a zero-crossing position for the comparison of phase difference. The zero-crossing position ranges from 2 to 20. It can be set by the soft key, roller or the numeric keypad.

↑(+), ↓(-): They are fine adjustment soft keys used to change the zero-crossing position by 1 dot.

4.3.15.5 Limit

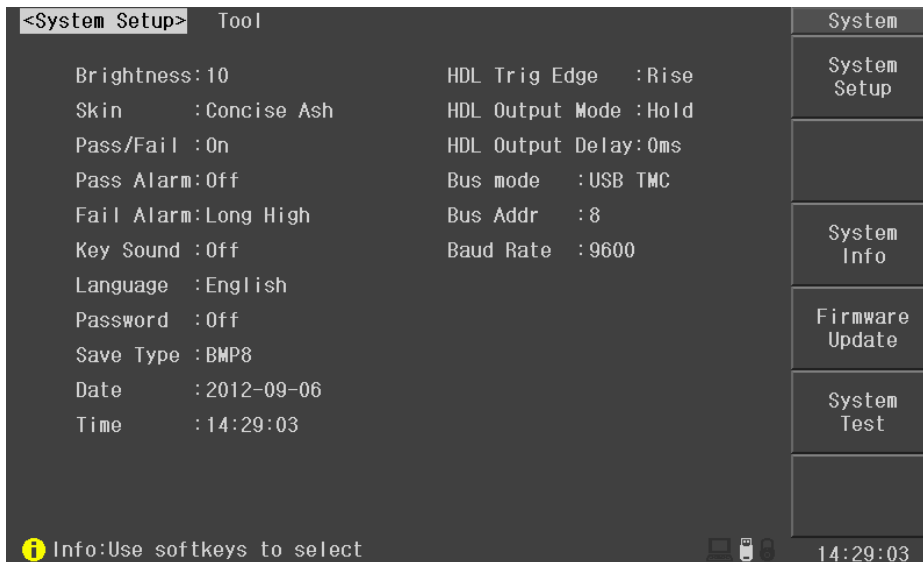
Set the limit values for comparison methods of Area, Dif-Area, Phase-Dif which range from 0.1% to 99.9% by a resolution of 0.1%. Set the limit values for comparison methods of Corona which range from 1 to 255 by a resolution of 1 dot. It can be set by the soft key, roller or the numeric keypad.



Function Menu	Description
↑(++)	Increase the value of limit by 1% or 10
↑(+)	Increase the value of limit by 0.1% or 1
↓(-)	Decrease the value of limit by 0.1% or 1
↓(--)	Decrease the value of limit by 1% or 10

4.4 System Setup page

Press **SYSTEM** key to enter into <System Setup> page.



4.4.1 System Setup

When the anti-white bars in this area, the user can use the soft keys to select the appropriate action including system information, Firmware Update, System Test.

Function Menu	Description
System Setup	Press the key enter into the system setup page
System Info	Press the key to check the system information
Firmware Update	Press the key to update the firmware with U disk
System Test	Press the key to do the test of screen and keyboard

Note: Using Firmware Update function, you need to copy the upgrade file in the root directory of the U disk. During the upgrade process, the instrument should be powered continuously.

4.4.2 Tool

Move the cursor to this zone, following soft keys will be displayed.

- **Default Setting** Load the default settings, need to enter into the password.
- **System Reset** Restart the instrument.

4.4.3 Brightness

The LCD brightness can be adjusted from 1 to 20. Move the cursor to this zone, following soft keys will be displayed. It also can be adjusted by the roller.

- **↑(+)** Increase the LCD display
- **↓(-)** Decrease the LCD display

4.4.4 Skin

The instrument provides 6 kinds of theme. User can select by the soft key.

4.4.5 Pass/Fail

Move the cursor to this zone, following soft keys will be displayed.

- **On** Turn on Pass/Fail display function.
- **Off** Turn off Pass/Fail display function.

4.4.6 Pass Alarm and Fail Alarm



Function Menu	Description
Off	Turn off the alarm sound
Long High	Select the alarm sound as long and high sound
Long Low	Select the alarm sound as long and low sound
Single Short	Select the alarm sound as single short sound
Double Short	Select the alarm sound as dual short sound

4.4.7 Key Sound

Move the cursor to this zone, following soft keys will be displayed.

- Off Turn off the key sound.
- On Turn on the key sound.

4.4.8 Language

Move the cursor to this zone, following soft keys will be displayed.

- English Choose English as the display and operation language.
- 中文 Choose Chinese as the display and operation language.

4.4.9 Password



Function Menu	Description
Off	Turn off the password function.
Key lock	When users unlock the instrument, it is required to input the password.
System	When users turn on the instrument, it is required to input the password.
File	When users enter into the file page, it is required to input the password.
Modify	Modify the password.

Note: The default password is 123456.

4.4.10 Save Type

The instrument supports GIF、8-bit BMP、24-bit BMP and PNG format picture and CSV format waveform file.

4.4.11 Date and Time

Date and time can be set at this zone by the soft key, roller and the numeric keypad.

4.4.12 HDL Trig Edge

Move the cursor to this zone, following soft keys will be displayed

- **Rise** The instrument is triggered by the rising edge of the start signal.
- **Fall** The instrument is triggered by the falling edge of the start signal.

4.4.13 HDL Output Mode

Move the cursor to this zone, following soft keys will be displayed:

- **Hold** The Pass/Fail signal is held on till the next output Pass/Fail signal.
- **Pulse** The Pass/Fail signal is reset after a period of time which is set by the HDL Output Delay time.

4.4.14 HDL Output Delay

Handler output delay time can be set from 0 to 60s with a resolution of 1ms.

4.4.15 Bus Mode

The instrument provide following bus mode: GPIB (Option)、RS232C、USB CDC and USB TMC.

☞ **Note:** The interface protocol is refer to “Programming Manual”.

4.4.16 Bus Addr

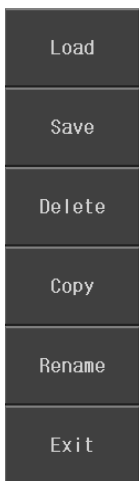
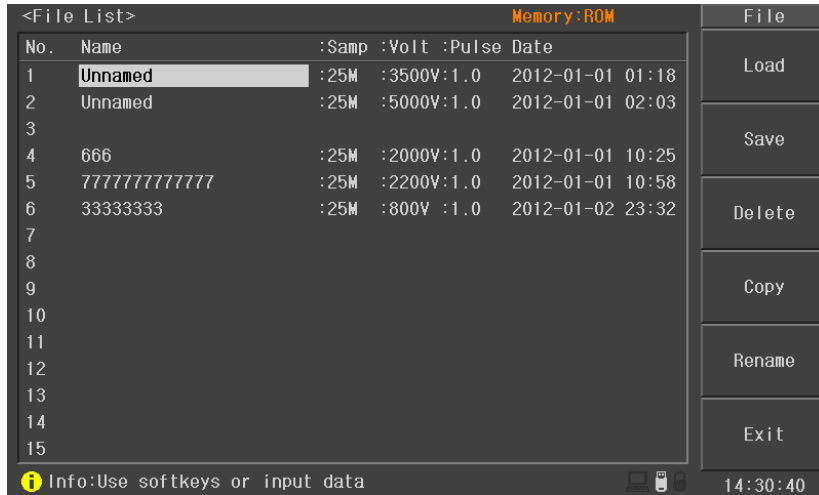
The bus address can be set from 0 to 30 by the soft key, roller or the numeric keypad.

4.4.17 Baud Rate

The instrument provides: 4800、9600、19200、38400、57600 and 115200。

4.5 File List page

Press **FILE** key to enter into <File List> page. User can save the parameters that are set by user to the internal non-volatile memory or U disk in file format. User can load the file to use these parameters instead of resetting.



Function Menu	Description
Load	Press this key to load a file stored in the internal non-volatile memory or in U disk. Use the arrow key or the roller can select the needed file. Press LOAD to load the file. If the selected file is needed to load, press YES ; otherwise, press NO .
Save	Press this key to save a file. Move the arrow key to choose the catalog to store the file. Press the SAVE soft key to store the file and then YES for confirmation (Choose NO to give up the save operation.) The file can be save after entering a file name and pressing the ENTER button. If user press the ENTER button without entering the file name, the file will be saved as the default name-<Unnamed>. Pressing ESC can exit the operation of saving file.
Delete	Delete stored files. Press the Delete soft key and then choose YES to confirm this operation or NO to give up.
Copy	Copy files. First, enter the number of the original file; and then enter the number of the target file; then enter the number you need to copy.
Rename	Rename the selected files.
Exit	Exit the File list page.

Enter rules: Pressing a numeric key, the corresponding letters or characters will be displayed on the screen. If user wants to input a number, the numeric key should be pressed again. While a letter or character is needed, then the soft key corresponding to the letter or the character should be pressed.

- ☞ **Note:** If the file already exists, the new file will overwrite the original file.
- ☞ **Note:** Press **ENTER** key can switch files between the inner memory and U disk.
- ☞ **Note:** Press left or right arrow key to perform the flip operation.

Chapter 5 Remote Control

Besides the front panel control, METER supports RS232C serial interface (standard) and GPIB parallel interface (optional) for remote control. User can use only one interface at a time. Standard Commands for Programmable Instrument (SCPI) is fully supported by the RS-232 and GPIB interfaces, however they use different hardware configurations and communication protocols. The operation method is dealt with in this chapter; the use for interface commands refer to “Programming Guid”.

5.1 RS232C Interface Operation

5.1.1 RS232C Connection

RS232 standard, also called as asynchronous serial communication standard, has already been widely used for data communication between computers, computer and external equipment. RS is the English abbreviation of Recommended Standard; 232, the standard number. This standard is issued by EIA in 1969, which rules to send one bit in a data line every time.

Configurations of most serial interfaces are not strictly based on RS-232 standard. A 25 pin connector is used on each terminal (IMBAT uses a 9 pin connector). The most frequently used RS-232 signals are as follows:

Function	Code	25 Pin Connector Pin Number	6 Pin Connector Pin Number
Request To Send	RTS	4	7
Clear To Send	CTS	5	8
Data Set Ready	DSR	6	6
Data Carrier Detect	DCD	8	1
Data Terminal Ready	DTR	20	4
Transmitted Data	TXD	2	3
Received Data	RXD	3	2
Signal Ground Common	GND	7	5

As most serial interfaces, the serial interface of METER is also not strictly based on RS-232 standard but only uses the smallest subset of this standard. The signals are listed in the following table.

Function	Code	Pin connector Pin Number
----------	------	-----------------------------

Transmitted Data	TXD	2
Received Data	RXD	3
Signal Ground Common	GND	5

The reason is that the use of three lines is much more inexpensive and much simpler than that of five lines or six lines, which is the biggest advantage of using serial interface for communication.

ⓘ NOTE: The definition for serial interface pin used by the instrument is different from that of standard 9 pin connector.

RS232C used on this instrument applies 9-pin DB socket, and the sequence of pin is as follow.

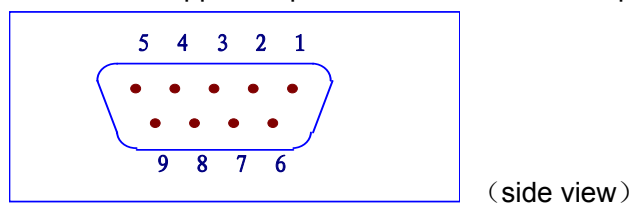


Figure 5-1 Serial Interface Connector

Use standard 9-pin DB plug to connect the connector.

ⓘNOTE: Before connect or disconnect the connector, please power off the instrument to avoid electrical shock hazard.

ⓘNOTE: Do not short the output terminal or case so as to avoid damage to the DUT.

5.1.2 Communication with PC

◆ The connection of the instrument with PC is shown in figure 5-2.

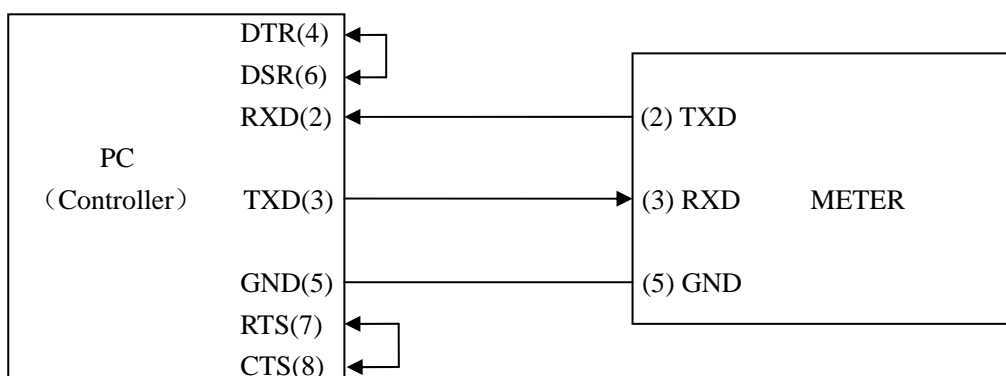


Figure 5-2 Connection of the instrument with PC

Figure 5-2 shows that the serial interface pin definition of this instrument is different from that of 9 pin connector used in IMB AT compatible computer. User can make three-wire connection cable by using double-core shielding lines or purchase the serial interface cable from our company.

When making connection cable, please short the 4th pin and the 6th pin, the 7th pin and the 8th pin.

- ◆ Connect the instrument with PC through serial interface. Set the bus mode firstly, and the operation sequence is as follow.

Press the **SYSTEM** menu key and then move the cursor to **BUS MODE** to select the **RS232C** soft key. Move the cursor to **BAUD RATE** to select the desired communication rate.

- ◆ Serial Interface Specifications

Transmitting Mode	Full Duplex Asynchronous Communication containing start bit and stop bit.
Baud Rate	9600/19200/38400 bps
Data Bits	8 BIT
Stop Bits	1 BIT
Parity Bits	None
Terminal Character	NL (Line Break, ASCII Code 10)
Handshake Mode	Software handshake
Connector	DB 9 pin

- ◆ Software Protocol

For the instrument cannot use hardware for handshake and RS232C serial communication is quite simple, the following protocols should be strictly conducted to program PC communication software. Thus data lose or error, occurred in communication, can be greatly reduced.

1. For command syntax and format, refer to "Chapter 6 SCPI Command Reference".
2. The controller transmits the command in ASCII code with <NL> as the terminal character (New Line, ASCII code is 10). The instrument executes the command after the terminal character <NL> is received.
3. Once a query command is received, METER will send the query response information immediately even if the rest commands have not been finished. So if the command includes two queries, the controller should read the query responses twice. One query is recommended to be included in a single command.
4. A query response is sent out in ASCII codes with <NL> as the terminal character.
5. Several query responses will be sent continuously with 1ms interval. The controller should be ready to receive the responses; otherwise the response information will be lost.
6. The query response of waveform data is sent out in ASCII codes with <NL> as the terminal character. If <NL> is received as the first ASCII code, this means that there is no waveform data available.
7. If the communication software is programmed by DOS application software, the software should be operated in pure DOS environment, instead of WINDOWS environment, that supports serial interface.

5.2 GPIB Interface Operation

5.2.1 GPIB Bus

IEEE488 (GPIB) is an international bus interface standard used on intelligent instruments. IEEE is the English abbreviation of Institute of Electrical and Electronics Engineers, and 488 is the standard number. Through this interface, METER can communicate with PC or others intelligent equipments and meanwhile can make up automatic test system with the other test equipments. Two or more equipments can be connected on a same bus. METER applies IEEE488.2 and the interface plate can be optionally purchased

by user. Control command system is open so that user can use the PC operation interface provided by METER or take measurements by the control command system. The control command system supports most functions of the instrument, that is to say, user can execute almost all operations on PC. Thus remote control to the instrument is realized.

When configuring a GPIB system, the following restrictions must be adhered to.

1. The total length of cable in one bus system must be less than or equal to two meters times the number of devices connected on the bus (the GPIB controller counts as one device) and the total length of cable must not exceed 20 meters.
2. A maximum of 15 devices can be connected on one bus system.
3. There are no restrictions on how the cables are connected together. However, it is recommended that no more than four piggyback connectors be stacked together on any one device.

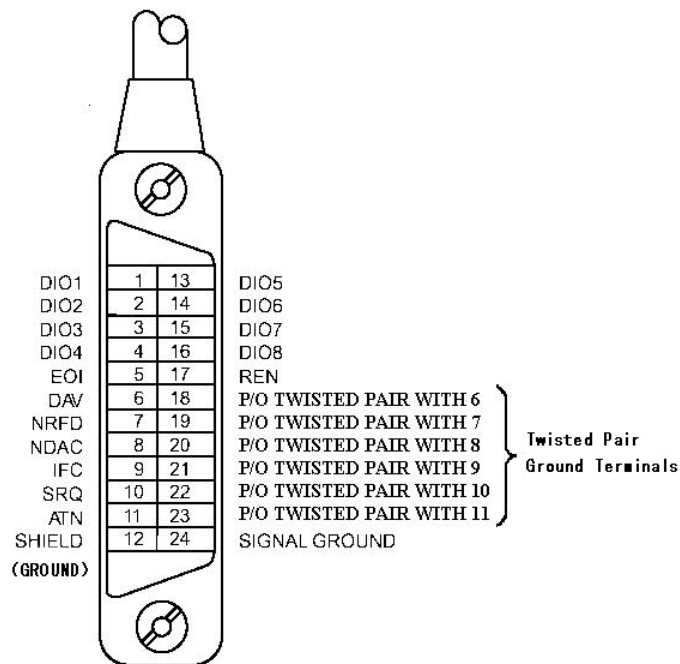


Figure 5-1 GPIB Connector/Pin Structure

GPIB System Interconnection-1:

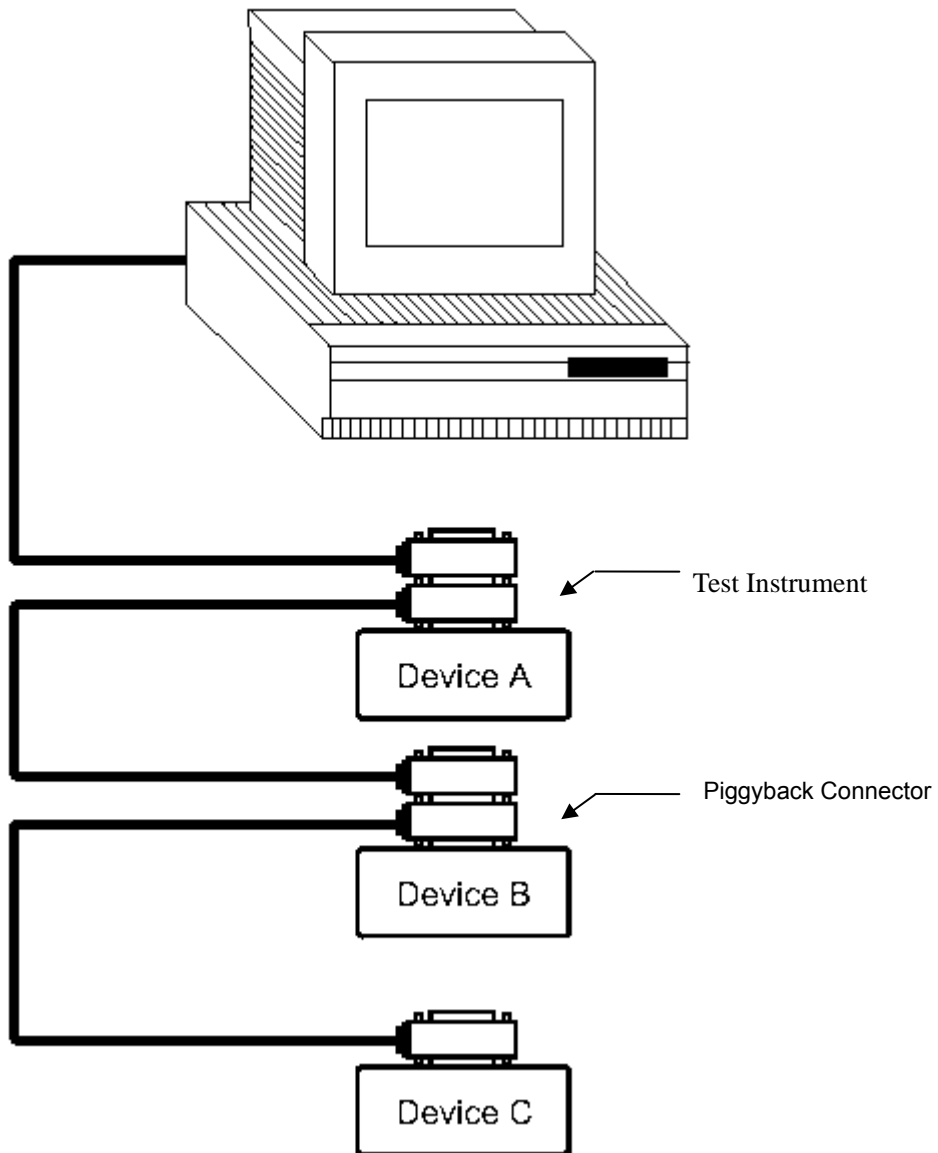


Figure 5-2 Typical GPIB System Interconnection-1

GPIB System Interconnection-2:

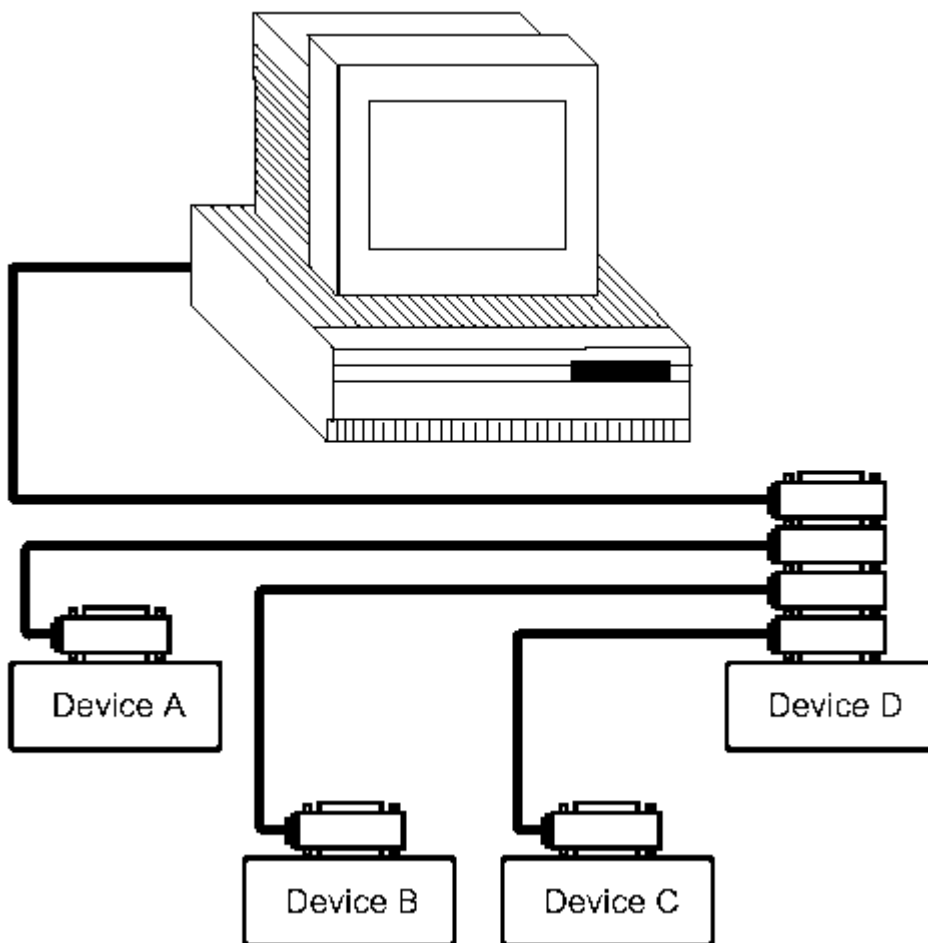


Figure 5-3 Typical GPIB System Interconnection

5.2.2 GPIB Interface Capability

The following table provides the METER’s GPIB capabilities and functions.

Code	Function
SH1	Complete Data Source Handshake capability
AH1	Complete Acceptor Handshake capability
T5	Basic Talker; Talk-Only; Unaddressed if MLA; no serial poll.
L4	Basic Listener; Unaddressed if MTA; no Listen Only.
RL1	Remote/Local capability
DC1	Device Clear capability
DT1	Device Trigger capability
C0	No controller capability
E1	Drivers are open-collector

5.2.3 GPIB Addressing

The addressing mode provided by METER is single address. METER is shipped from the factory with a GPIB address of 8. User can set the address to a value of 0 to 30 and the address is saved in the non-volatile memory. For more details about address setup, please refer to 4.2.4.11 BUS ADDR.

5.2.4 GPIB Bus Commands

METER will respond to the following bus commands.

- ABORT I/O (IFC)
- DEVICE CLEAR (SDC or DCL)

As soon as this command is received, the instrument will clear input and output buffer and GPIB interface will be in ready status.

- LOCAL (GTL)

LOCAL returns local control and buttons on the front panel will be valid.

- LOCAL LOCKOUT (LLO)

LOCAL LOCKOUT disables the LOCAL operation of all devices on the bus. After this command is sent you will be unable to operate The instrument from the front panel including the soft key LOCAL. Execute the LOCAL command to undo LOCAL LOCKOUT.

- REMOTE (RMT)

REMOTE sets The instrument to the remote mode. When this command is sent, front panel with the exception of LOCAL soft key will be disabled.

- TRIGGER (GET)

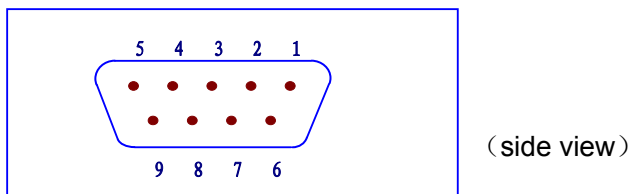
This command is used to trigger the METER and METER will send tested waveform data to the output buffer. This command is equal to the command TRIG + FETCh:TWAVE? or the common command *TRG.

For SCPI commands please refer to next Chapter: SCPI Command reference.

Chapter 6 Handler Interface

6.1 Basic Information

The handler interface employs a 9-pin DB connector. Pin sequence is as follow.



The signal definitions for each pin are described as follows.

① NOTE: The / (back slash) in the signal name means that the signal is asserted when low.

PIN1 EXGND: Common for external voltage source EXV.

When METER uses the internal voltage as the power supply for handler interface, METER' circuit common will be connected to EXGND.

PIN2 /EOC: End of conversion

/EOC signal is asserted when the A/D conversion is completed and METER is ready for the next DUT to be connected to the test terminals. The measurement data, however, is not valid until BUSY is asserted to low.

PIN3 BUSY: METER is in the test state. When calculation, comparison and display are all completed, this signal is asserted to low.

PIN4 /PASS: Pass signal output.

PIN5 /FAIL: Fail signal output.

PIN6 EXV: External DC voltage.

DC voltage supply pins for DC isolated open collector outputs, /EOC, /START, /STOP, /PASS, /FAIL, /EOM. The setting of internal jumpers must be changed when using the internal voltage supply.

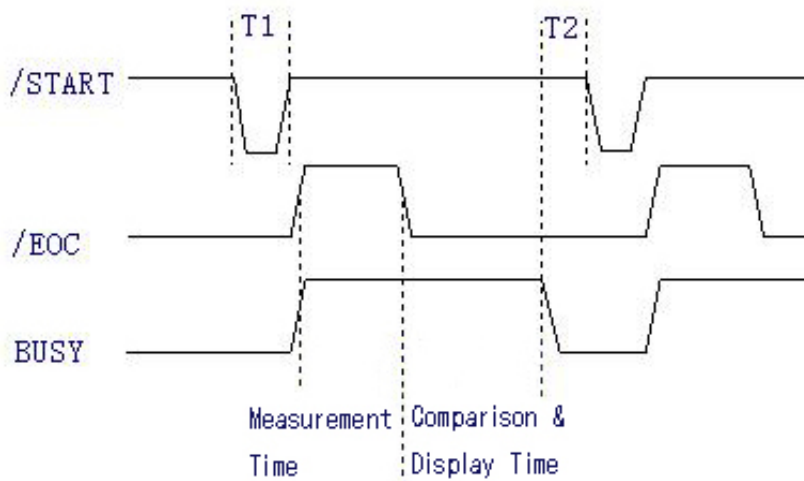
PIN7 /START: External Trigger Signal.

METER is triggered on the rising edge of a pulse applied to this pin when the trigger mode is set to EXT mode.

PIN8 /STOP: External Stop Signal.

Test is interrupted on the rising edge of a pulse applied to this pin.

PIN9 VCC: Internal voltage source supply(+5V). Internal source is not recommended for user to use. Make sure the current is lower than 0.1A and keep the signal line be away from interference source when use.



The timing diagram for handler interface is displayed in above figure, T1 is the trigger pulse width and the minimum pulse width is 1us. T2 is the delay time, after the foregoing measurement completed, to next trigger signal; its minimum pulse width is 0us. /PASS and /FAIL signal are asserted after the measurement completed, till next trigger. The request of the /STOP pulse signal is the same as /START pulse signal.

6.2 Electrical Characteristics

6.2.1 DC Isolated Output

Each DC output (pins 2 through 5) is the collector output of the built-in pull-up resistor and isolated by an opto-coupler. The output voltage of each line is set by a pull-up resistor on the handler interface board. The pull-up resistors can be connected to the internally supplied voltage (+5V), or to an externally applied voltage (EXV: +5V to +24V) by setting jumpers. Table 6-1 shows the electrical characteristics of the DC isolated outputs.

Output Signal	Voltage Output Rating		Maximum Current	Circuit Common
	Low	High		
/EOC BUSY /PASS /FAIL	≤0.5V	+5V~ +24V	6mA	Internal pull-up voltage: METER circuit common (GND) External voltage(EXV): EXGND

Table 6-1 DC Isolated Output Electrical Characteristics

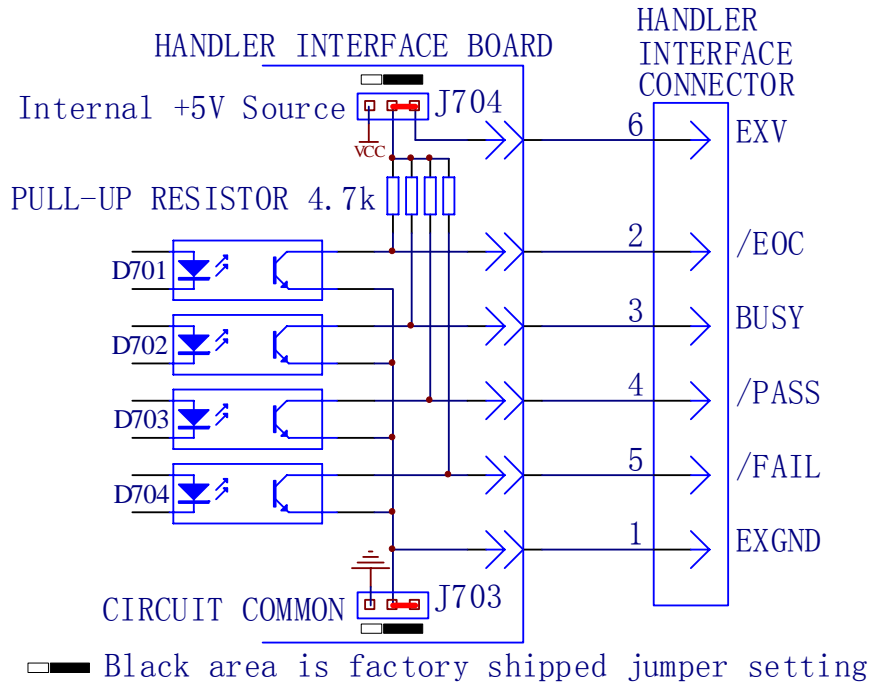


Figure 6-1 Simplified Diagram of the Output Signals

A simplified diagram of the output signals is shown in Figure 6-1. * is the default jumper setting when shipped from factory. That is to say, the default jumper setting is to use external voltage source. Refer to the next section Jumper Setup.

6.2.2 DC Isolated Input

The /START signal (pin 7) and the /STOP signal (pin 8) are connected to the cathode of the LED in an opto-coupler. METER is triggered on the rising edge of the /START pulse and stopped on the rising edge of the /STOP pulse. The anode of the LED can be connected to the internal +5V, or an external voltage source EXV (the same external voltage source used for output signal).

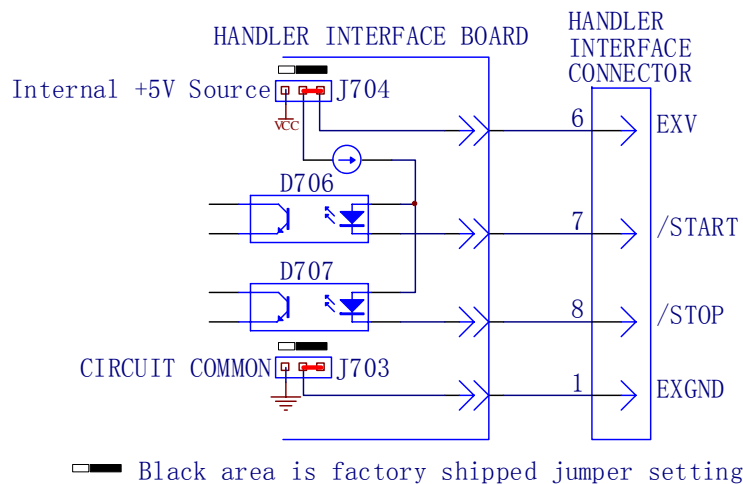


Figure 6-2 Simplified Diagram of the Input Signal

In the Figure 6-2, the default jumper setting is to use external voltage source. Actually, the input signals and the output signals use the same external voltage source together. The CURRENT-LIMITTING RESISTOR is used to limit current and the default resistor is only suitable for external voltage source range from 5V to 8V. If the external voltage source is higher than 8V, you should replace the CURRENT-LIMITTING RESISTOR to avoid damaging circuit components. Current-limiting resistors R712 and R713 should be both replaced. The detailed replacement information about CURRENT-LIMITTING RESISTOR is listed in Table 6-2.

CURRENT-LIMITTING RESISTOR	Range of external voltage source
680Ω	5V to 8V
1.2KΩ	8V to 15V
2.2KΩ	15V to 24V

Table 6-2 Current Limiting Resistors for Different Voltages

6.3 Jumper Setup on HNADLER Interface

There are two jumpers on the Handler Interface Board. The two jumpers are used to select the internal voltage source or external voltage source for the output signal and input signal. Their locations are shown in Figure 6-3.

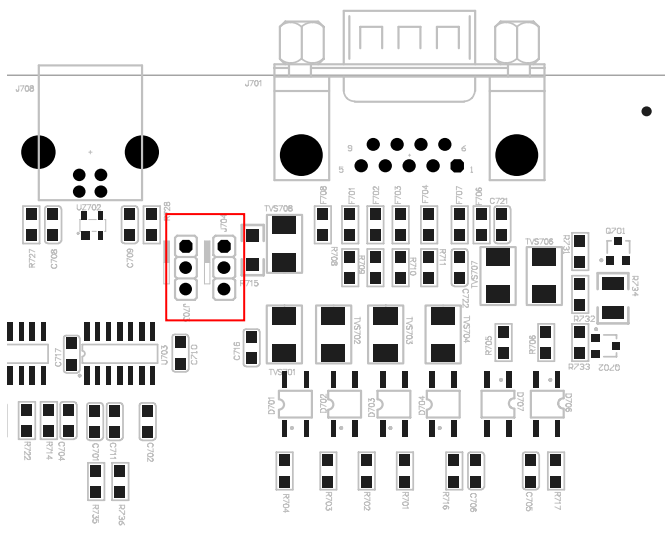


Figure 6-3 Jumper Position on the Handler Interface Board

As above figure shown, when shipped from the factory, both jumpers are set at the upper position. If you want to apply the internal power supply, you must set both jumpers at the lower position. Likewise, when using external power supply to substitute the internal power supply, the two jumpers should be set at the same time.

⚠Warning: Make sure the instrument has been powered off and the plug has been removed before opening the case to alter jumper setting.

Chapter 7 Package Contents and Warranty

7.1 Package Contents

Following items should be contained in the package.

Serial Number	Name	Quantity
1	Impulse Winding Tester	1
2	26022 High-voltage Test clip leads	1
3	26023 Foot Switch	1
4	Three-Wire power line	1
5	fuse of 1A	2
6	Operational Manual	1

Verify that you have received all above items and any optional accessories you may have ordered. If any one is missing, please contact us without delay.

IEEE-488 interface is optional component.

7.2 Warranty

This instrument product is warranted against defects in material and workmanship for a period of two years from the date of shipment. You should supply us with the warranty card before you enjoy the free maintenance service. This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. We will, without charge, repair or replace, at its option, defective product or component parts.

The maintenance for this instrument should be performed by professional maintenance personnel. Do not substitute the internal components unauthorized when maintaining. In order to ensure the measurement accuracy, the instrument must be measured and corrected after maintenance. You should bear the maintenance expense for damages caused by unauthorized repairing or substituting components.

The instrument should not be placed in the environment present direct sunlight and moisture.

Place the instrument in the original package box if you do not use it for a long time.