LCR2000 Series Digit Electric Bridge

User Manual

For product support, visit:www.owon.com.hk/download

※：The illustrations, interface, icons and characters in the user manual may be slightly different from the actual product. Please refer to the actual product.

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Fujian LILLIPUT Optoelectronics Technology Co., Ltd.
No. 19, Heming Road
Lantian Industrial Zone, Zhangzhou 363005 P.R. China

Tel: +86-596-2130430 **Fax:** +86-596-2109272

Web: www.owon.com **E-mail:** info@owon.com.cn

General Warranty

We warrant that the product will be free from defects in materials and workmanship for a period of 2 years from the date of purchase of the product by the original purchaser from the our Company. The warranty period for accessories such as probes, adapter is 12 months. This warranty only applies to the original purchaser and is not transferable to a third party.

If the product proves defective during the warranty period, we will either repair the defective product without charge for parts and labour, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by our company for warranty work may be new or reconditioned like new. All replaced parts, modules and products become the property of our company.

In order to obtain service under this warranty, the customer must notify our company of the defect before the expiration of the warranty period. Customer shall be responsible for packaging and shipping the defective product to the designated service centre, a copy of the customers proof of purchase is also required.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. We shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than our company representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of not our supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

Please contact the nearest Sales and Service Offices for services.

Excepting the after-sales services provided in this summary or the applicable warranty statements, we will not offer any guarantee for maintenance definitely declared or hinted, including but not limited to the implied guarantee for marketability and special-purpose acceptability. We should not take any responsibilities for any indirect, special or consequent damages.

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1. Safety Information

1.1 Safety Terms and Symbols

Safety Terms

Terms in this manual. The following terms may appear in this manual:

Warning: Warning indicates the conditions or practices that could result in injury or loss of life.

Caution: Caution indicates the conditions or practices that could result in damage to this product or other property.

Terms on the product. The following terms may appear on this product:

Danger: It indicates an injury or hazard may immediately happen.

Warning: It indicates an injury or hazard may be accessible potentially.

Caution: It indicates a potential damage to the instrument or other property might occur.

1.2 General Safety Requirements

Before any operations, please read the following safety precautions to avoid any possible bodily injury and prevent this product or any other products connected from damage. In order to avoid any contingent danger, this product is only used within the range specified.

Use Proper Power Cord. Use only the power cord supplied with the product and certified to use in your country.

Product Grounded. This instrument is grounded through the power cord grounding conductor. To avoid electric shock, the grounding conductor must be grounded. The product must be grounded properly before any connection with its input or output terminal.

Limit operation to the specified measurement category, voltage, or amperage ratings.

Check all Terminal Ratings. To avoid instrument damage and the risk of electric shock, check all the Measurement Limits and markers of this product. Refer to the user's manual for the Measurement Limits before connecting to the instrument. Do not exceed any of the Measurement Limits defined in the following section.

Do not operate without covers. Do not operate the instrument with covers or panels removed.

Use Proper Fuse. Use only the specified type and rating fuse for this instrument.

Avoid exposed circuit. Be careful when working on exposed circuitry to avoid risk of electric shock or other injury.

Do not operate if any damage. If you suspect damage to the instrument, have it inspected by qualified service personnel before further use.

Use your Oscilloscope in a well-ventilated area. Make sure the instrument installed with proper ventilation, refer to the user manual for more details.

Do not operate in wet conditions. In order to avoid short circuiting to the interior of the device or electric shock, please do not operate in a humid environment.**Do not operate in an explosive atmosphere.**

Keep product surfaces clean and dry.
Only the qualified technicians can implement the maintenance.

2. Unpacking and Preparation

Thank you for purchasing our products. Please read this chapter carefully before use.
In this chapter you will learn the following:

- Packing List
- Power Requirements
- Operating Environment
- Cleaning

2.1 Packing List

Before using the instrument, please:
1. Check appearance of the product whether there is damage, scratches, etc.;
2. Check the instrument packing list if there are any missing items.
If there is any damage or insufficient accessories, please contact Applent Instruments Sales or distributor immediately.

2.2 Power Requirements

Only be used in the following power conditions:

Voltage:100V-240VAC

Power: up to 15W

Warning: To prevent electric shock, please connect the power ground. If users replace power cord, make sure that the ground of the power cord is securely connected.

2.3 Operating Environment

Must be used under the following environmental conditions:

Temperature:0°C～55°C

Humidity: < 70% RH at 23℃

2.4 Cleaning

To prevent the risk of electric shock, unplug the power cord before cleaning.
Use a dry cloth or a cloth slightly dipped in water to clean the casing. Do not attempt to clean the instrument internally.
Note：Don't Use Organic Solvents (such as alcohol or gasoline) to clean the instrument.

2.5 Instrument Handle

Instrument handle can be adjusted. Hold both sides of the handle with both hands, gently pull it to the sides, and then rotate the handle. The handle can be adjusted to four positions as shown below:

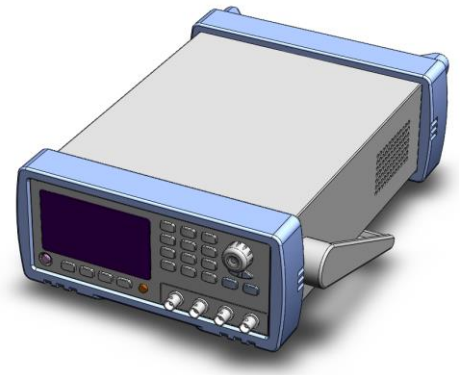
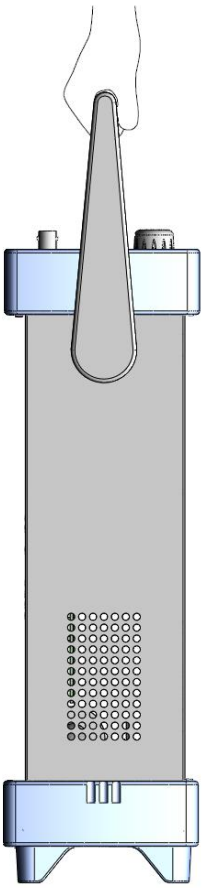


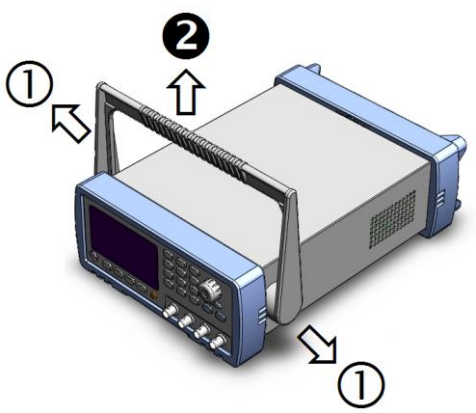
Figure 2-1 Instrument handle

Position 1 [Hands hold both sides of the handle at the same time, gently pull it to the sides until it can rotate freely, then switch to the Position 2]



Handheld position

position 2 [hold both sides of the handle at the same time, gently pull it to the sides until it can rotate freely, then switch to the handheld position]



Remove handle position. (Pull to both sides until the handle is removed.)

3. Overview

This chapter contains general information about the instrument. The information is organized as follows：

- Introduction
- Measurement Function
- Signal Source
- Main Functions

3.1 Introduction

Thank you for purchasing LCR digit electric bridge.

This instrument is precision LCR meter that uses a fully automated real-time inspection micro-desktop instrument controlled by high-performance 32-bit ARM microprocessor. The instrument can select any test frequency between 10Hz and 300 kHz, and can select test signal level between 0.01V and 2.00V with 0.01V steps. Built-in -2.5V~+2.5V programmable DC bias automatically measures inductance L, capacitance C, resistance value R, complex impedance Z, quality factor Q, loss tangent value D, phase angle θ (degrees), phase θ (radian), and DC resistance DCR.

The primary and secondary parameters are displayed in all six digits; there are two monitoring displays at the same time. One of Z, D, Q, θr, θd, R, X, G, B, Y, Vac, Iac, Δ and Δ% can be displayed at the same time. With an accuracy of up to 0.05%, the instrument can meet requirements of accurate testing and mass production by various component manufacturers, schools, research institutes and metrological quality inspection departments.

The instrument has a professional sorting function, with 10 sets of storage files, programmable 9 qualified file, 1 auxiliary file (secondary-parameter unqualified), 1 unqualified file and primary parameter HI/IN/LO file, can set percentage points or absolute value sorting, equipped with Handler interface and RS-232C interface, used in automatic sorting system to complete automatic pipeline testing. An optional USB memory interface allows users to save setup data and measurement data to an external mover.

The instrument supports two kinds of communication protocols: computer remote control instruction is compatible with SCPI (Standard Command for Programmable Instrument standard command set) and Modbus communication protocol, remote control and data acquisition functions are efficiently completed.

3.2 Measurement Function

3.2.1 Measurement Parameters

Measurement parameters：Cs-Rs, Cs-D, Cp-Rp, Cp-D, Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, G-B, R-X, Z- θ r, Z- θ d and DCR.

Among them：

L: Inductance C: Capacitance R: Resistance Z: Impedance X: Reactance

B: Density G: Conductance D: Loss θ: Phase angle Q: Quality factor

DCR：DC resistance

The subscript **s** indicates serial equivalent, **p** indicates parallel equivalent.

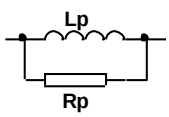
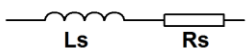
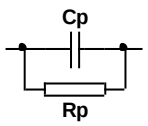
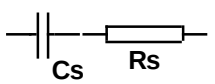
3.2.2 Equivalent Method

Series, Parallel.

The actual capacitance, inductance, and resistance are not ideal for pure reactance and purely resistive components. They usually have both resistance and reactance components. An actual impedance component can be modeled in series or parallel by an ideal resistor and an ideal reactor (inductor or capacitor).

It can be mathematically converted using a formula, but the two forms are different, inconsistency depends on the quality factor Q (or loss D).

Table 3-1 Series-parallel equivalent circuit

Circuit Form		Loss D	Equivalent Conversion
L		$D=2\pi FLp/Rp=1/Q$	$Ls=Lp/(1+D^2)$ $Rs=RpD^2/(1+D^2)$
		$D=Rs/2\pi FLs=1/Q$	$Lp=(1+D^2)Ls$ $Rp=(1+D^2)Rs/D^2$
C		$D=1/2\pi FCpRp=1/Q$	$Cs=(1+D^2)Cp$ $Rs=RpD^2/(1+D^2)$
		$D=2\pi FCsRs=1/Q$	$Cp=Cs/(1+D^2)$ $Rp=Rs(1+D^2)/D^2$

Definition for Q、D、Xs is：$Q=Xs/Rs$，$D=Rs/Xs$，$Xs=1/2\pi FCs=2\pi FLs$

Suggestion：

Generally, a series equivalent circuit is used for components having a low impedance value Z (for example, a high value capacitor and a low value inductor); a parallel equivalent circuit is used for a component having a large impedance value Z (low value capacitor and high value inductor).

At the same time, equivalent circuit must be determined according to the actual use of component, such as capacitors, series equivalent circuit is used for power supply filtering, parallel equivalent circuit is used for LC oscillation circuits.

3.2.3 Range

Use 9-range test, auto, lock and nominal.

Nominal range (Applent new term definition): The instrument automatically selects the best range based on nominal value.

3.2.4 Measurement Speed

The instrument is divided into four speeds: slow speed, medium speed and fast speed.
FAST speed: 40 times / sec
MED speed: 10 times / sec
SLOW speed: 3 times / sec
At the same time, 1-256 programmable average times can be performed to improve reading stability.

3.2.5 Trigger Mode

Internal, external, manual, and remote trigger.

3.2.6 Basic Accuracy

LCR2300 0.05%
LCR2200 0.05%
LCR2100 0.05%
LCR2020 0.05%

3.2.7 Measurement Display Range

Table 3-2 Display range

Parameter	Measurement display range
L	0.00001μH ～ 9999.99H
C	0.00001pF ～ 9.99999mF
R、X、Z	0.00001Ω ～ 99.9999MΩ
B、G	0.01nS ～ 999.999S
D	0.00001 ～ 9.99999
Q	0.00001 ～ 99999.9
θd	-179.999° ～179.999°
θr	-3.14159 ～ 3.14159
%	-999.999% ～ 999.999%

3.3 Signal Source

3.3.1 Test Frequency

LCR2300：10Hz～300kHz continuous test frequency
LCR2200：10Hz～200kHz continuous test frequency
LCR2100：10Hz～100kHz continuous test frequency
LCR2020：10Hz～20kHz continuous test frequency

3.3.2 Test Signal Level

ACV：10.00mV~2.00V, Accuracy：10%，CV mode accuracy：6%

ACI：100.0μA~20.00mA，Accuracy：10%，CC mode accuracy：6% @2Vmax

DCR：±1VDC（2Vpp）square wave，3Hz Maximum

0.033A（Max），output impedance30Ω

3.3.3 Constant Voltage Source Internal Resistance

Can be set to 30Ω、50Ω and 100Ω

3.3.4 Test Signal Level Monitoring

Table 3-3 Test signal accuracy

Mode	Range	Accuracy
Voltage	$10mV_{RMS}$ - $2.00V_{RMS}$ $0.01mV_{RMS}$ - $10mV_{RMS}$	±（3%×reading+0.5mV） ±（12%×reading+0.1mV）
Current	$100\mu A_{RMS}$ - $66mA_{RMS}$ $0.001\mu A_{RMS}$ - $100\mu A_{RMS}$	±（3%×reading+5μA） ±（12%×reading+1μA）

3.3.5 DC bias

-2.5V~+2.5V

Accuracy：0.5%（±0.005V）

3.4 Main Functions

3.4.1 Correction Function

Open clear zero: Eliminate effects of stray impedance on the test side and the instrument.
The instrument can perform single-point, three-point frequency open circuit clear zero or sweep frequency (all typical frequency) open circuit clear zero.
Short-circuit clear zero: Eliminate effects of series resistance and inductance of the leads.
The instrument can perform single point, three-point frequency short circuit clear zero or sweep frequency (all typical frequency) short circuit clear zero.

3.4.2 Comparator Function (Sorting Function)

The instrument can perform multiple sorting, sorting is based on the measured values, regardless of deviation mode.
PASS file (BIN1-BIN9): indicates that both of primary and secondary parameters are qualified;
Auxiliary file (AUX): indicates that primary parameter is qualified but secondary parameter is unqualified when the auxiliary file is opened;
FAIL (OUT): The primary parameter is unqualified, or the primary parameter is qualified but the secondary parameter is unqualified when the auxiliary file is closed.

HI/IN/LO: More detailed comparison results of primary parameters, HI: primary parameters are high, LO: primary parameters are low, IN: primary parameters are qualified.

- **Comparison Method:**

Absolute tolerance ±TOL sorting: The absolute deviation of measured value from nominal value is compared with the limit of each bin.

Percentage tolerance %TOL sorting: The percentage deviation of measured value from nominal value is compared to the limit of each bin.

Sequential comparison sorting: The measured value is directly compared with the upper and lower limits.

- **Bin count:**

Each bin corresponds to a bin counter, the counting range: 0～999999.

- **Bin display：**

There is a bin display page and a bin count display page.

All comparator results have corresponding IO port outputs on the Handler interface.

3.4.3 List Sweep

List sweep can be performed up to 10 points frequency or 10 points voltage.

List sweep comparator: Each list sweep point can output HI/IN/LO (high/pass/low) discrimination.

The list sweep limit sets are the upper and lower limit values.

3.4.4 File Function

There are 10 files in the instrument's internal flash memory that users can use to save instrument data. These data include:

1. All parameters in <Settings> page.
2. Setting data in <Comparator Setting> page.
3. Setting data in <Setup List Sweep> page.

3.4.5 System Settings

1. Keyboard lock function.
2. Administrator and user accounts, which can set passwords for administrators.

3.4.6 Interface

USB Host Interface：

Used to save screen images, save setup parameters and measurement data on a USB flash drive.

RS-232 Remote Control：

Supports baud rate up to 115200bps, compatible with SCPI protocol and Modbus RTU protocol.

Handler Interface

Full optocoupler isolation, input and output ports with built-in pull-up resistors.

Supports up to 30V external power supply.

Input: trigger signal;

Output: All sorting comparison result signals and list sweep comparison result signals; measurement synchronization signals (IDX, EOM).

4. Startup

In this chapter you will learn the following:

- Front panel – including the introduction of buttons and test terminals.
- Rear panel – describes the power and interface information.
- Power on—including poweron self-test process, instrument defaults, and instrument warm-up time.
- Display information – information about the prompts that will be encountered during startup and use of the instrument.
- Start testing - including how to connect to the test side.

4.1 Front Panel

4.1.1 Front Panel Description

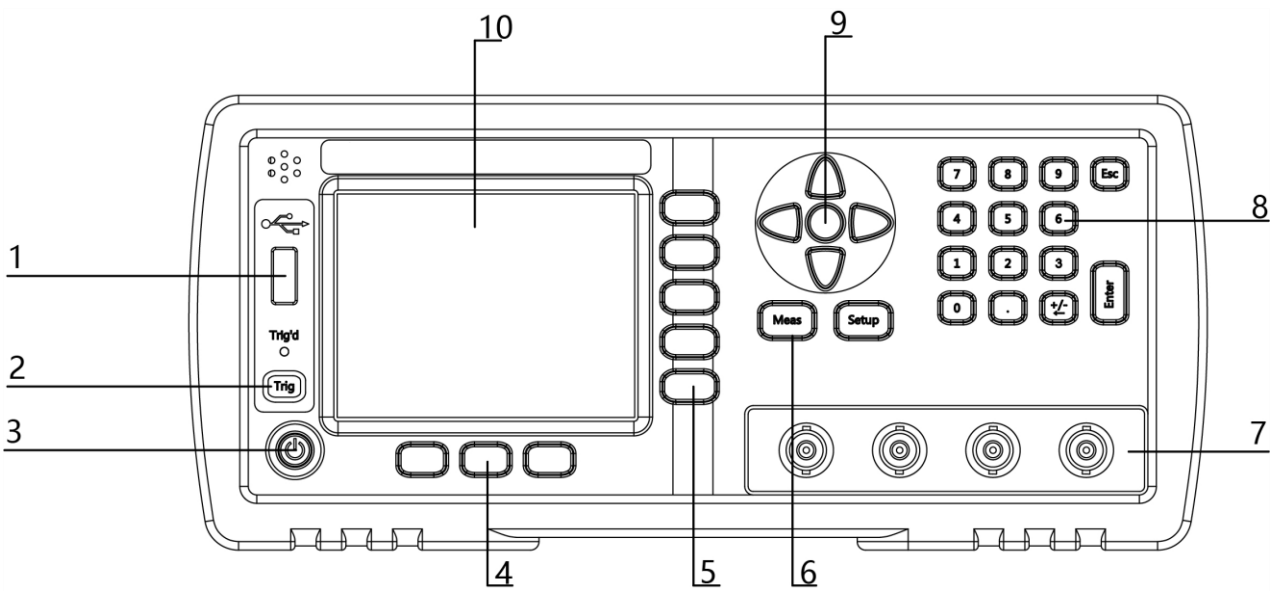


Figure 4-1 Front panel

Table 4-1 Front Panel Description

No.	Description
1	USB Disk Port (USB-Host).
2	Manual trigger button, and manual or remote trigger indicator.
3	Power switch. Touch button. ⚠Warning: In order to ensure the safety of power supply inside the machine, the instrument needs to wait 2 seconds after the power is turned off to allow it to start again.
4	System softkey, including files, systems, keyboard locks, etc.
5	Function softkey.
6	Main softkey: measurement and setting.

7	Test terminal: The input is used to connect a four-terminal test fixture or Kelvin clip. Hcur——high terminal - current side; Hpot——high terminal - voltage side; Lpot——low terminal - voltage side; Lcur——low terminal - current side.
8	Numeric keypad.
9	Cursor key.
10	LCD Display.

4.1.2 Rear Panel

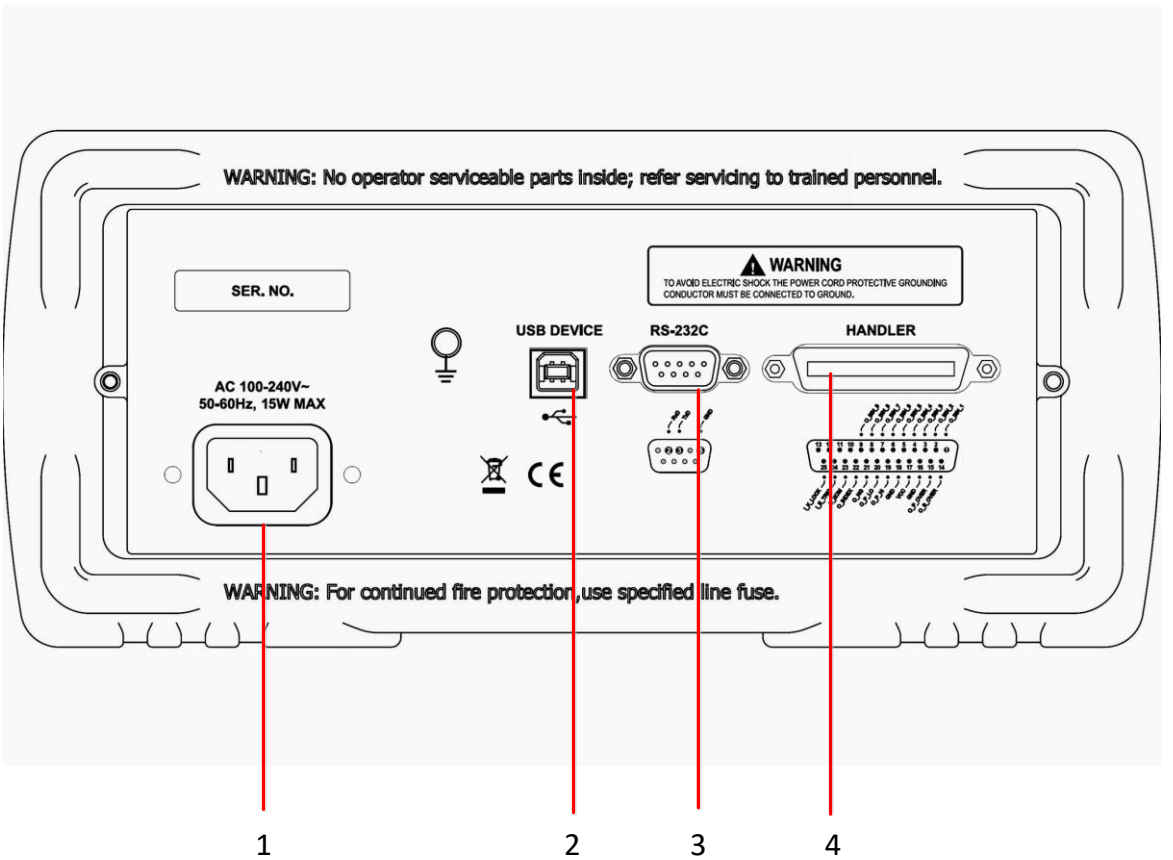


Figure 4-2 rear panel

1. Power Cable Receptacle(Outlet).
2. USB communication interface.
3. RS-232 interface.
4. HANDLER interface.

4.2 Power On

4.2.1 Power On

Power switch at the bottom left of the panel. The button is a touch button, press the power button for 1s, the instrument will start or shut down.

In order to ensure the safety of power supply inside the machine, the instrument needs to wait 2 seconds after the power is turned off to allow it to start again.

4.2.2 Warm-up Time

In order to achieve the accuracy rating, warm up the instrument for at least 30 minutes.

4.3 Connect to Device under Test (DUT)

If using Kelvin test clip provided along with the instrument, connect to the instrument test terminal as follows.

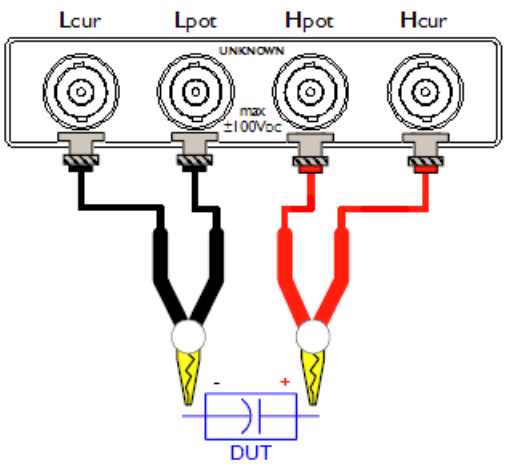


Figure 4-3 Connect to DUT

Warning:

Do not apply DC voltage or current to the test terminal, otherwise the instrument will be damaged.

If test a charged device, make sure that its charge is removed before measuring.

- **Test fixtures and cables：**

We recommend that users use our test fixtures or test cables, if using test fixtures or cables made by user or other company may result in incorrect measurements.

Our test fixture contact reeds are silver plated or gold plated. In long-term work (for example, 1~2 years), the plating surface will be worn. It is recommended to replace the new fixtures when there are obvious deviations in several tests.

Connect test fixture or test cable to four test terminals of Hcur, Hpot, Lcur, and Lpot on the front panel of the instrument.

Note: When the test fixture or test cable is not installed, instrument will display unstable measurement.

5. [Meas] Page

This section includes the following information:

- MEAS DISPLAY page
- BIN MEAS page
- BIN COUNT page
- LIST SWEEP page

5.1 <MEAS DISPLAY> Page

Press [Meas] key to enter <MEAS DISPLAY> page.

<Meas Display> page mainly highlights measurement results and displays the current sorting result in small characters.
The following 6 common functions can be set on this page

- LOG – Record test data in a USB disk file
- FUNC - Measurement function
- RANGE - Measurement range, range number and automatic/manual test.
- FREQ - Measurement frequency
- TRIG - Trigger Setup
- LEVEL - Test signal level
- SPEED – Test speed

The primary and secondary test results are displayed in this area in large characters, monitor area is displayed in small characters.
In the lower part of the screen, some measurement-related settings are displayed in this area, and the currently tested comparator results are also displayed here.

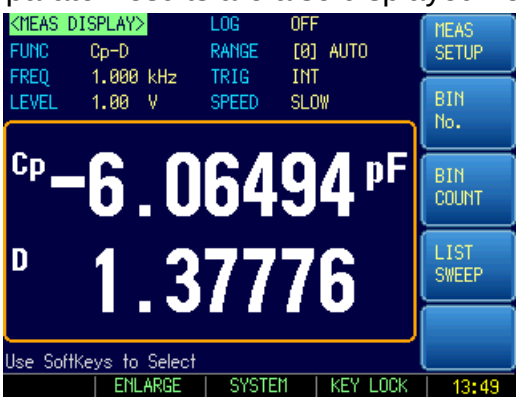


Figure 5-1 <MEAS DISPLAY> Page

5.1.1 Measurement Function [FUNC]

Instrument simultaneously measures four components of the complex impedance (parameters) in a measurement cycle. These include primary parameter, secondary parameter and two monitor parameters.

Note：The monitor parameters need to be set in [Setup] page.The monitor parameters are initially set to OFF.

- Types of measurement parameters:

Table 5-1 The combinations of measurement parameters

Cs-Rs	Cs-D	Cp-Rp	Cp-D
Lp-Rp	Lp-Q	Ls-Rs	Ls-Q
Rs-Q	Rp-Q	R-X	DCR
Z-θr	Z-θd	Z-D	Z-Q

- Monitor parameters：

Table 5-2 The combinations of monitor parameters

Z	D	Q	
Vac	Iac	Δ	Δ%
θr	θd	R	X
G	B	Y	

- Parameter descriptions：

Table 5-3 Measurement and Monitor parameter descriptions

Parameter	Description
Cs	Capacitance value measured using the series equivalent circuit model
Cp	Capacitance value measured using the parallel equivalent circuit model
Ls	Inductance value measured using the series equivalent circuit model
Lp	Inductance value measured using the parallel equivalent circuit model
Rs	Series equivalent resistance
Rp	Parallel equivalent resistance
DCR	DC resistance
Z	Absolute value of impedance
Y	Absolute value of admittance
G	Conductance
B	Sustenance
R	Resistance (=Rs)
X	Reactance
D	Dissipation factor
Q	Quality factor(=1/D)
θr	Phase radian
θd	Phase angle
Vac	Test signal Voltage
Iac	Test signal Current
Δ	Absolute deviation value
Δ%	Relative deviation value

- Procedure for setting the measurement function [FUNC]

Step 1 Press [Meas] to enter Meas page;
Step 2 Press [Meas Display] key to switch to the <Meas Display> page;
Step 3 Use cursor keys to select the [FUNC] field;
Step 4 Use softkeys to select the combination of primary and secondary parameters.

5.1.2 Impedance Range [RANGE]

Table 5-4 Impedance range mode

Mode	Function overview	Advantage	Disadvantage
Auto Range	The instrument automatically selects the best test range based on impedance value. The range number in range field is automatically set.	Users do not need any participation	Auto range requires predictive range and test speed will be lower than the manual range mode, which is especially noticeable at low frequencies (below 1 kHz).
Hold Range	Measurement is performed with a fixed impedance range	Test speed is the fastest.	Users need to participate in the range selection
Nominal Range	The instrument sets the optimum range depending on the nominal value.	The best way for sort test. Speed is the fastest.	Valid only in the sorting mode.

■ Available impedance range：

The instrument has 9 ranges, they includes: 10Ω，30Ω，100Ω，300Ω，1kΩ，3kΩ，10kΩ，30kΩ，100kΩ.

During the test, the instrument selects appropriate range according to impedance of the device under test.

Table 5-5 Range and corresponding test range

Range No.	Range Definition	Impedance Measuring Range
8	10Ω	0 ～ 10Ω
7	30Ω	10Ω ～ 100Ω
6	100Ω	100Ω ～ 316Ω
5	300Ω	316Ω ～ 1kΩ
4	1kΩ	1kΩ ～ 3.16kΩ
3	3kΩ	3.16kΩ ～ 10kΩ
2	10kΩ	10kΩ ～ 31.6kΩ
1	30kΩ	31.6kΩ ～ 100kΩ
0	100kΩ	100kΩ ～ ∞

■ Procedure for setting the impedance range [RANGE]:

Step 1 Press [Meas] to enter Meas page;
Step 2 Press [Meas] key to enter <MEAS DISPLAY> page;
Step 3 Use the cursor keys to select [RANGE] field;

Step 4 Use softkeys to select the AUTO、MANUAL or another range.

softkey	Function
AUTO RANGE	The instrument will automatically select the range.
HOLD RANGE	The instrument is locked on the current range.
NORMINAL RANGE	The instrument will select the best range based on the nominal value.
INCR +	Increase range number while the range is changed to be locked.
DECR -	Decrement range number while the range is changed to be locked.

Note：

- When range is automatic, the instrument will perform range prediction for each measurement cycle, so test speed will be slightly slower than hold range. Moreover, frequent changes in the range during automatic measurement can slow down the response. Usually, when instrument is used as a sorting measurement, auto range method is not suitable.
- For the sorting user, please select nominal range mode.

5.1.3 Measurement Frequency [FREQ]

LCR2300：10Hz～300kHz continuous test frequency

LCR2200：10Hz～200kHz continuous test frequency

LCR2100: 10Hz～100kHz continuous test frequency

LCR2020: 10Hz～20kHz continuous test frequency

Table 5-6 frequency resolution

Frequency range(F)	Resolution
10.0000Hz~99.9999Hz	0.0001Hz
100.0000Hz~999.999Hz	0.001Hz
1.00000kHz~9.99999kHz	0.01Hz
10.0000kHz~99.9999kHz	0.1Hz
100.000kHz~300.000kHz	1Hz

Frequency accuracy：0.01%

■ Procedure for setting the test frequency：

Step 1 Press [Meas] to enter Meas page;

Step 2 Press [Meas] key to enter <MEAS DISPLAY> page;

Step 3 Use cursor keys to select [Frequency] field;

Step 4 You can do the following：

Use function keys to increase or decrease frequency;

Input data directly, function key input unit.

softkey	Function
INCR +	Frequently used frequency list
DECR -	Frequently used frequency list

■ The most commonly used frequency list

Table 5-7 LCR2300 the most commonly used frequency list

INCR +/ DECR -				
10Hz	50Hz	60Hz	100Hz	120Hz
1kHz	10kHz	20kHz	40kHz	50kHz
100kHz	200kHz	250kHz	300kHz	

Table 5-8 LCR2200 the most commonly used frequency list

INCR +/ DECR -				
10Hz	50Hz	60Hz	100Hz	120Hz
1kHz	10kHz	20kHz	40kHz	50kHz
100kHz	200kHz			

Table 5-9 LCR2100 the most commonly used frequency list

INCR +/ DECR -				
10Hz	50Hz	60Hz	100Hz	120Hz
1kHz	10kHz	20kHz	40kHz	50kHz
100kHz				

Table 5-10 LCR2020 the most commonly used frequency list

INCR +/ DECR -				
10Hz	50Hz	60Hz	100Hz	120Hz
1kHz	10kHz	20kHz		

5.1.4 Trigger Mode [TRIG]

The instrument has 4 trigger modes:
Internal trigger, manual trigger, external trigger and remote trigger.

Trigger Mode	Description
INT	Also called continuous test, the trigger signal is continuously tested by the internal period of the instrument according to the inherent period.
MAN	Each time the [Trig] key is pressed, the instrument performs a measurement cycle, and the instrument is in a waiting state at other times.
EXT	A rising edge pulse is received from the rear panel Handler interface and the instrument performs a measurement cycle. At other times the instrument is in a waiting state. Please refer to the Handler interface
BUS	After receiving the RS232 trigger command, the instrument performs a measurement cycle, at other times the instrument is in a waiting state.

■ Procedure for setting the trigger mode：

Step 1 Press [Meas] to enter Meas page;
Step 2 Press [Meas] key to enter <MEAS DISPLAY> page;
Step 3 Use cursor keys to select [TRIG] field;

Step 4 Use softkeys to select the trigger mode.

softkey	Function
INT	Internal Trigger Mode
MAN	Manual Trigger Mode
EXT	External Trigger Mode
BUS	Remote Trigger Mode

5.1.5 Test Signal Voltage Level [LEVEL]

Test level of the instrument is set with the true RMS value of the sine wave signal. The frequency of the sine wave signal is the test frequency and is generated by the internal oscillator of the instrument.

The output impedance of the instrument source can be set to 30Ω, 50Ω or 100Ω. Usually an output impedance of 30Ω is suitable.

If users do not require a level, please specify a 1V level for testing.

The test voltage and test current of the instrument can be set according to the specifications. If the constant level function is turned on, "*" is added as the mark at the end of the level setting value.

■ Procedure for setting the test signal：

Step 1 Press [Meas] to enter Meas page;

Step 2 Press [Meas] key to enter <MEAS DISPLAY> page;

Step 3 Use the cursor keys to select [Level] field;

Step 4 You can do the following：

Use the function keys to increase or decrease the level;

Direct input data, function key select voltage or current unit.

softkey	Function
INCR +	The most commonly used level list
DECR -	The most commonly used level list
ALC ON	
ALC OFF	

■ The most commonly used level list:

Table 5-11 The most commonly used level list

INCR +/ DECR -（V）						
0.01	0.10	0.30	0.50	1.00	1.50	2.00
INCR +/ DECR -（A）						
0.0001	0.0005	0.001	0.005	0.01	0.02	

5.1.6 Measurement Speed [SPEED]

The instrument offers 3 test speeds (slow, medium and fast). The slower the test speed, the more accurate and stable the test results are.

■ Procedure for setting the test speed:

Step 1 Press [Meas] to enter Meas page;

Step 2 Press [Meas] key to enter <MEAS DISPLAY> page;

Step 3 Use the cursor keys to select [SPEED] field;

Step 4 Use softkeys to select

softkey	Function
SLOW	The measurement period is the longest, about 3 times / sec
MED	Moderate, about 20 times / sec
FAST	The fastest measurement, about 40 times / sec

Note：

The measurement speed refers to the time when Handler interface is triggered to the end of measurement (EOM) output.

Page: <BIN MEAS> Page

Range: Hold range or nominal range

Average: 1

DC Bias: OFF

Automatic LCZ parameters: OFF

Monitor 1: OFF

Monitor 2: OFF

ALC: OFF

（ms）	Test frequency (Hz)								
Speed	10	20	100	1k	2k	10k	100k	300k	DCR
SLOW	1600	800	483	342	336	332	332	332	333
MED	1600	800	160	94	91	88.5	88.5	88.5	171
FAST	1600	800	160	30	26.5	24.5	24.5	24.5	48

5.1.7 [LOG] Data

The instrument can record 10,000 sets of test data through the internal data buffer. These data are saved in an external USB disk in (.csv) file format. These files can be opened on a PC using a Windows Excel.

■ Procedure for setting recording data

Step 1 Press [Meas] to enter Meas page;

Step 2 Press [Meas] key to enter <MEAS DISPLAY> page;

Step 3 Use the cursor keys to select [Record] field;

Step 4 The option before recording is not enabled:

softkey	Function
START LOG	Start a new measurement data record.

Step5 Press [START LOG] softkey to start recording data to internal buffer of the instrument.

Options after the start of recording:

softkey	Function
SAVE & STOP	The current record is stopped and the data is saved to a USB disk file.
CLEAR & STOP	The current record is stopped, the buffer is cleared, but the data is not saved to the USB disk.

Step6 If press the softkey [SAVE & STOP] or [CLEAR & STOP], the current recording is terminated.
Or wait for the buffer to be full, press [SAVE to USB] button to save data to the USB disk.

softkey	Function
SAVE to USB	Save data to a USB disk file
CLEAR BUFFER	The buffer is cleared and the current data is invalid.

Note:

- Before using the saved data, insert the USB disk on the interface of front panel.
- The saved file is in the DATA subfolder in the same folder as the USB disk. The file name is: 001.CSV For example: F:\AT3818\DATA\001.CSV
- Up to 1000 files can be saved (from 001.CSV to 999.CSV)
- The buffer size can be modified in the [DATA BUFFER] field on the [SYSTEM CONFIG] page. (maximum 10000 data)

5.1.8 <MEAS DISPLAY>Information

Underneath the test results, the device provides some measurement-related information that can be modified on the <Setup> main page. These additional details serve as a reference in this section.
In addition to the information mentioned earlier, we also display comparator results and calibration information in the information bar.
The status information bar also includes a line of help information. When using the cursor keys for selection, the help information provides relevant prompts to assist you.

5.2 <BIN MEAS> Page

Press [Meas] key and use softkey to enter the [BIN MEAS] page.

Figure 5-2 <BIN MEAS> page

Setting Bar: The setting area of bin number display page is roughly same as the [Meas Display] page. These settings include the following 8 item:

- Function [FUNC]
- Range [RANGE]
- Frequency [FREQ]

- Trigger [TRIG]
- Level [LEVEL]
- Speed [SPEED]
- Comparator [COMP]
- Auxiliary bin [AUX]

Comparator results are displayed here using large characters, primary and secondary test results are displayed in this area as small characters.
In the lower half of the screen, some settings related to comparator are displayed in this area.

5.2.1 Comparator Function ON/Off [COMP]

The built-in comparator can sort devices into 9 sets of primary parameters and 1 set of secondary parameters, and classify them into up to 10 kinds of bins (BIN 1~BIN 9 and OUT OF BIN). In addition, a device which primary parameter is within limits, but secondary parameter is not, can be sorted into an auxiliary BIN (AUX).
The comparator is allowed to be turned off.

■ Comparator Workflow:

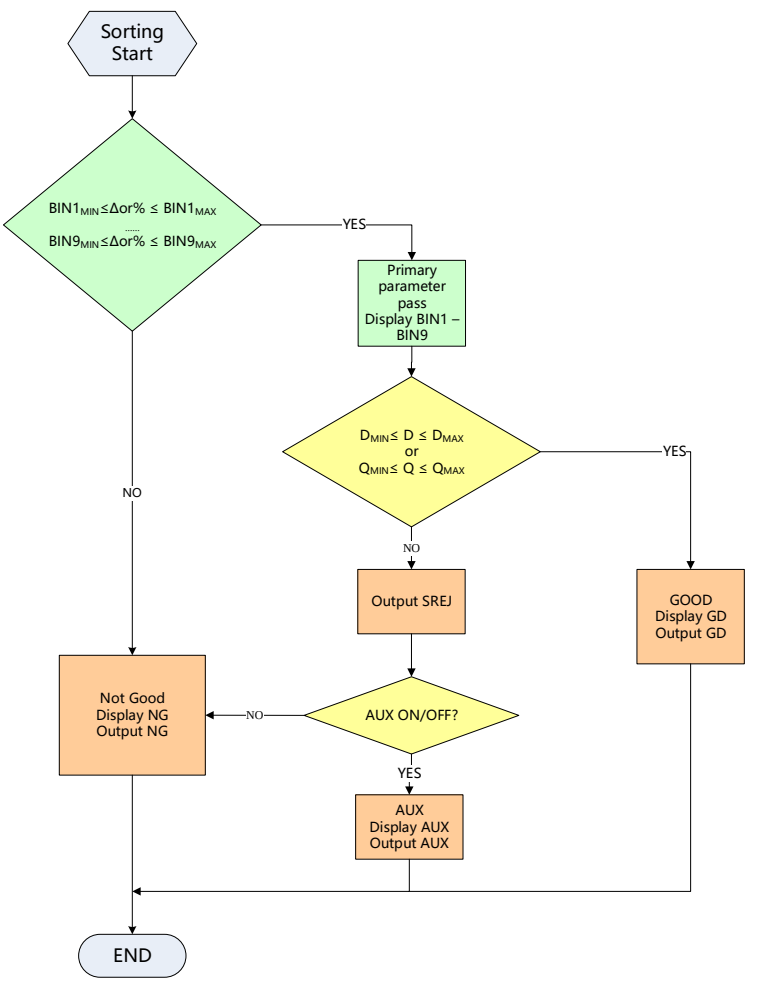


Figure 5-3 Comparator Workflow

■ Procedure for setting the comparator function [COMP]：

Step1 Press the [Meas] key;

Step2 Press the <BIN MEAS> softkey;

Step3 Use the cursor key to select [COMP] field;

Step4 Use the softkeys to turn on/off the comparator

softkey	Function
OFF	The comparator is turned off and the measurement bar is displayed OFF.
ON	The comparator is turned on and the measurement bar shows sorting result of the current measurement.

5.2.2 Auxiliary Bin [AUX] ON/OFF

If you don't need to sort secondary parameters, the auxiliary bin (AUX) can be turned off. After being turned off, the secondary parameter limit will not be determined during the measurement.

■ Procedure for turning on/off auxiliary bin:

Step1 Press the [Meas] key

Step2 Press the [BIN MEAS] softkey

Step3 Use the cursor key to select [AUX] field

Step4 Use the softkeys to turn on/off the auxiliary bin

softkey	Function
OFF	Auxiliary bin if turned off.
ON	Auxiliary bin if turned on.

5.2.3 <BIN MEAS>Information

The information bar displays comparator-related settings, including nominal value, comparator mode, secondary parameter limits, and range limits for scale 1.
Meanwhile, calibration information will also be displayed in the information bar.

5.3 <BIN COUNT> Page

When press [Meas] key and [BIN COUNT] softkey, the <BIN COUNT> page appears.

Figure 5-4 <BIN COUNT> page

The <BIN COUNT> page will display the count result of the comparator.

Settings bar:

- Bin count

Information Bar:

The following count values are monitored in the information bar:

- Bin1~Bin9 count value
- 2nd secondary parameter failure number [AUX]
- Unqualified number [OUT]

If the condition is set, it needs to be modified in <BIN TABLE> page.

5.3.1 Counter Function [COUNT]

The instrument counts to the bin pass or fail, the maximum count is 999999, the counting operation stops and the overflow message "------" appears when this value is reached.

■ **Set the Counter：**

Step1 Press the [Meas] key

Step2 Press the [BIN COUNT] softkey to enter <BIN COUNT> page

Step3 Use the cursor key to select [COUNT] field

Step4 Use the softkeys to set counter function

softkey	Function
COUNT ON	
COUNT OFF	
-	
-	
RESET COUNT	All counts are reset to 0.

5.4 <LIST SWEEP> Page

The <LIST SWEEP> page will display when you press the [Meas] key and [LIST SWEEP] softkey.

Figure 5-5 <LIST SWEEP> page

<List Sweep> cycle sweeps 10 groups of frequencies or levels and compare them with the set values to get the comparison result.

On <List Sweep> page, the instrument scans according to the trigger mode.

During a sweep, an asterisk mark (*) will appear on the left side of the sweep point currently being measured and the measurement will be highlighted.

Under this page, users can make the following settings:

- TRIG - Trigger mode
- MODE - Sweeping method
- RANGE - Measurement range
- LOG - data record

5.4.1 Sweep Trigger Mode [TRIG]

The instrument sweeps according to the trigger mode. The trigger mode usually uses manual triggering. Therefore, when entering the page, trigger mode is set to manual by default, and it is automatically swept once.

Table 5-12 Sweep trigger mode

Trig Mode	Function
INT	Internal Trigger. All ten sweep points are swept continuous.
MAN	Manual Trigger. Each time the instrument is triggered by [Trig] key, the sweep points are swept one by one.
EXT	External Trigger. Each time the instrument is triggered by the handler trigger pin, the sweep points are swept one by one.
BUS	Remote trigger, the instrument receives a trigger command from the RS232 interface to scan a test point.

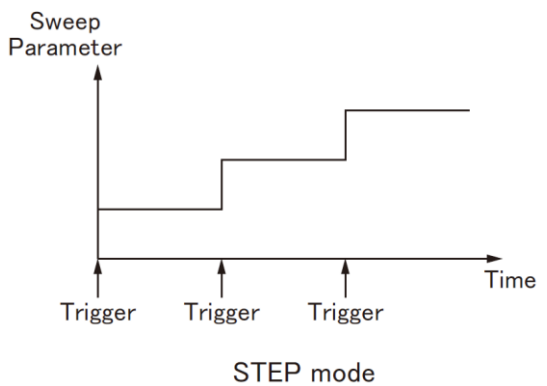


Figure 5-6 Sweep Mode

5.4.2 Sweep [MODE] Setting

The <List Sweep> page completes the scan frequency or level value test of up to 10 list points.

When the test [Method] is set to sequence and [TRIG] is set to manual, the sweep function will automatically execute each test step on the list in sequence until the last step. Users will wait for the trigger button to be pressed.

When the test [MODE] is set to SEQ step and [TRIG] is set to MAN (manual), the sweep function will automatically execute the first test step, then stop and wait for the trigger button to execute the next step.

The instrument sweeps according to the trigger mode. The trigger mode usually uses manual triggering.

Table 5-13 sweep method

softkey	Function
SEQ	Trigger will scan all test points at a time.
STEP	Trigger only scans one test point at a time.

5.5 <ENLARGE DISPLAY> Page

The full screen display only shows primary and secondary parameters, monitor parameters, and comparator results.

Figure 5-7 <ENALARG DISPLAY> Page

■ To enter Measure Full Screen Display page：

Step 1 Press the [Meas] key;

Step 2 Press the bottom softkey [ENLARGE] to switch to <ENLARGE DISPLAY> page

6. [Setup] Key

In this chapter users will learn about all the setup features：

- MEAS SETUP page
- CORRECTION page
- BIN TABLE page (Comparator setup)
- LIST TABLE page

You can press the [Setup] key to open the <MEAS SETUP> page.

6.1 <MEAS SETUP> Page

All measurement related settings are operated in the <MEAS SETUP> page.
In <MEAS SETUP> page, the Instrument does not display test result and sorting result, but testing still in progress.
These settings include the following parameters:

- [FUNC] – Measurement Function
- [RANGE] – Impedance Range
- [FREQ] – Measurement Frequency
- [TRIG] – Trigger Mode
- [LEVEL] – Measurement Level
- [SPEED] – Measurement Speed
- [SRC RES] - Source Output Impedance
- [AVG] – Averaging Factor
- [BIAS] – DC voltage bias
- [MON 1] – Monitor parameter 1
- [AUTO LCZ] - Automatic LCZ Function
- [MON 2] – Monitor parameters 2
- [DELAY] – Delay time after trigger and before measurement
- [ALC] – Automatic Level Control
- [NOMINAL] – Nominal value of comparator

Some settings can be set in <MEAS DISPLAY> page and <BIN MEAS> page.
Please refer Sector 错误!未找到引用源。<MEAS DISPLAY> Page to set.

Figure 6-1 <MEAS SETUP> Page

6.1.1 Source Output Impedance [SRC RES]

The source internal resistance is also called the output impedance.

The Source output impedance can be set to 30Ω, 50Ω or 100Ω.

After the test level Vs is set, the test current is flowing through the device under test (DUT) will be determined by the impedance Zx=Rx+jXx of the DUT and the source internal resistance Rs, namely:

$$Is = \frac{Vs}{|Rs + Rx + jXx|}$$

Since some measured components such as high-permeability magnetic core inductors will vary in the magnitude of the test current, that is, they have current sensitivity, different internal resistances will inevitably lead to measurement results at the same test level. Output internal resistance selectable function is to facilitate get relatively consistent measurement results for current sensitive devices. The instrument uses two low source output internal resistances, with a default value of 100Ω.

The internal resistance of KEYSIGHT's LCR meter (e.g. E4980A) is 100Ω. Users who need to compare with such instruments need to change the internal resistance of the instrument to obtain data uniformity.

For non-current sensitive, especially low impedance test objects, we recommend using 30Ω source internal resistance.

■ Procedure for setting source output impedance:

Step 1 Press the [Setup] key to enter <MEAS SETUP> page.

Step 2 Use the cursor key to select [SRC RES] field.

Step 3 Use the softkeys to set source output impedance.

softkey	Function
30Ω	30Ω source output impedance, if there is no requirement for source output impedance, it is recommended to use 30Ω.
50Ω	50Ω source output impedance.
100Ω	100Ω source output impedance.

6.1.2 Averaging Factor [AVG]

Taking "average" is the most common type of digital filter, the "number" is the depth of the

filter. The purpose is to perform multiple measurements and take the average result as the final display value, which can improve the stability and reliability of the measurement results. You can specify the averaging factor from integer 1 to integer 256.

■ To set up the averaging factor：

Step1 Press the [Setup] key.

Step2 Use the cursor key to select [AVG] field.

Step3 Use the softkeys or number keys to enter averaging factor.

softkey	Function
INCR +	Increments the averaging factor in steps of 1, 2, 4, 8, 16, 32, 64, 128 and 256.
DECR -	Decrements the averaging factor in steps of 1, 2, 4, 8, 16, 32, 64, 128 and 256.

6.1.3 DC Bias Voltage [BIAS]

The instrument has built-in -2.5V~2.5V DC bias.

This feature can superimposes a DC bias voltage on the AC signal.

■ Procedure for setting DC Bias Voltage：

Step1 Press the [Setup] key to enter <MEAS SETUP> page.

Step2 Use the cursor key to select [BIAS] field.

Step3 Use the softkeys to select DC bias voltage.

softkey	Function
OFF	DC Bias Voltage is turned off
2.00V	Signal source superimposed 2V DC bias
1.50V	Signal source superimposed 1.5V DC bias
-1.50V	Signal source superimposed -1.5V DC bias
-2.00V	Signal source superimposed -2V DC bias

6.1.4 Auto LCZ Function [AUTO LCZ]

Auto LCZ Function can help you to select a proper measurement parameter, the best equivalent circuit mode, if range is set to AUTO range, the instrument is completely in the smart test state.

■ To set up the Auto LCZ Function：

Step 1 Press the [Setup] key to enter <MEAS SETUP> page.

Step 2 Use the cursor key to select [AUTO LCZ] field.

Step 3 Use the softkeys to turn on/off the Auto LCZ Function.

softkey	Function
OFF	Turn off the Auto LCZ Function
ON	Turn on the Auto LCZ Function. When Auto LCZ Function is set to ON, “AUTO-LCZ” will display on [FUNC] field.

Note： The Auto LCZ Function will be turned off after users reset the measurement function.

6.1.5 Monitor 1 and Monitor 2 Parameter Selection

The instrument can monitor the other two parameters.

Note：

Additional monitoring parameters do not increase instrument processing time.

The instrument defaults to "Off".

The monitoring parameters are only displayed on the [Meas Display] page.

See Table 5-3 for nouns explanation of the monitoring parameters.

■ Procedure for setting monitor parameters (monitor 1 and monitor 2 same procedure)

Step1 Press the [Setup] key to enter <MEAS SETUP> page.

Step2 Use the cursor key to select [MON 1] or [MON 2] field.

Step3 Use the softkeys to choose a parameter.

softkey	Function
OFF	Turn off the monitor
Z	Absolute value of impedance
D	Dissipation factor
Q	Quality factor(=1/D)
Vac	Test signal Voltage
Iac	Test signal Current
Δ	Absolute deviation value
Δ%	Relative deviation value
θr	Phase angle (radian)
θd	Phase angle
R	Resistance (=Rs)
X	Reactance
G	Conductance
B	Density
Y	Admittance

6.1.6 Measurement [DELAY]

The instrument can set the delay time before each test by testing [Delay] timer, and wait for the station to be ready before testing.

The maximum delay time is 60s, the minimum delay time is 1ms.

6.1.7 Auto Level Control [ALC]

The ALC function adjusts the voltage and current across the DUT to match the preset voltage and current values. A constant level will be obtained on the device under test without being affected by source internal resistance.

■ Procedure for setting ALC：

Step 1 Press the [Setup] key to enter <MEAS SETUP> page.

Step 2 Use the cursor key to select [ALC] field.

Step 3 Use the softkeys to set constant level.

softkey	Function
OFF	Turn off the ALC function.
ON	Turn on the ALC function.

Note： When the constant level is turned on, '*' is added at the end of the level setting value, indicating that the constant level function is turned on.

6.1.8 [NOMINAL] Value Setting

For the convenience of setting, when the [Monitor 1] or [Monitor 2] function is set to Δ or Δ%, the nominal value field is displayed on <Setup> page.
This standard value is synchronized with the standard value save of <BIN TABLE> page.

6.2 <CORRECTION> Page

When you press [Setup] key and [CORRECTION] softkey, the <CORRECTION> page appears.
In this page, the OPEN/SHORT for correcting the stray admittance and residual impedances can be performed.

Note：

In order to achieve the accuracy specified by the technical specifications, open circuit clear zero and short circuit clear zero are necessary.
Load calibration refers to the linear correction of the instrument using a known standard, which is usually not required by user.
If replace test fixture or test cable, please re-perform open and short-circuit clear zero.
When the temperature changes dramatically, please perform open circuit and short circuit clear zero in time.
Small range greatly rely on open-circuit clear zero, large range greatly rely on short-circuit clear zero.
The correction function has two kinds of correction methods:

- Calibration based on all frequency points. This calibration provides full open and short circuit correction for all frequency points in the entire frequency range.
- Based on the calibration of specified frequency point, it supports open circuit correction, short circuit correction and load calibration for 3 user point frequencies.

In <CORRECTION> page, you can configure each of the following controls with the cursor placed in the corresponding field:

- [OPEN TEST]– including full frequency point open circuit correction.
- [SHORT TEST] – including full frequency point short circuit correction.
- [SPOT 1] – including open circuit and short circuit correction.
- [SPOT 2] – including open circuit and short circuit correction.
- [SPOT 3] – including open circuit and short circuit correction.

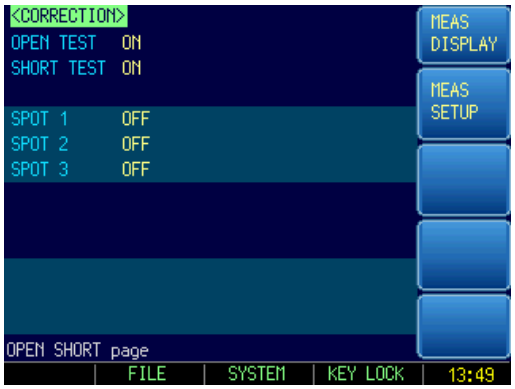


Figure 6-2 <CORRECTION> Page

6.2.1 Open Correction [OPEN]

The instrument open circuit calibration function compensates for any stray admittance (G, B) that may exist between the calibration surface determined by the length of the test cable and the connection point of the device under test.

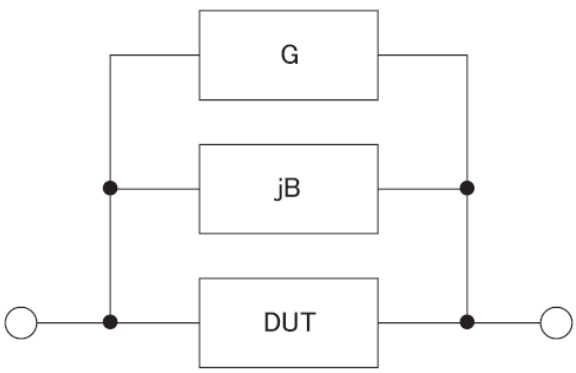


Figure 6-3 Stray Admittance

[Open] correction will completely correct the typical frequency of the instrument. These frequency points vary depending on the instrument version:

For these typical frequencies, please refer to the test frequency "List of frequently used frequencies".

■ To perform open correction

Step1 Press the [Setup] key, then press [CORRECTION] to enter <CORRECTION> page.

Step2 Use the cursor key to select [OPEN TEST] field

Step3

softkey	Function
OFF/ON	Disables/enables open correction. The clear value does not participate in the measurement operation.
MEAS OPEN	Perform open correction for full frequency and DCR
DCR OPEN	Perform DCR open correction only.

Step4 Press [MEAS OPEN] softkey, a dialog message display “Open-circuit the test terminals”.

Step5 Please leave the test fixture or test cable open and do not place any test

piece on it or come into contact with any object.

Step6 After pressing [OK], the instrument starts to perform correction.
When correcting, there will be a progress bar prompt at the bottom of the page, and the “Trig'd” indicator will flash.
After the correction is completed, the progress bar disappears.

Step7 Press [Open] to activate the open circuit zeroing function.

6.2.2 Short Correction [SHORT]

The short correction feature of the AT381x compensates for any residual impedances (R,X) that may exist within the interval from the calibration plane, which is determined by the selected cable length, to the DUT connecting points. (See Figure)

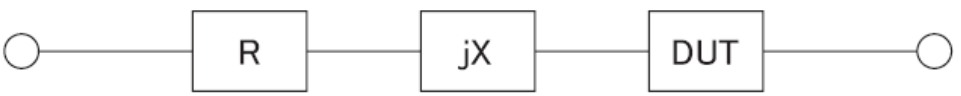


Figure 6-4 Residual Impedances

■ To perform short correction:

Step1 Press the [Setup] key, then press [CORRECTION] to enter <CORRECTION> page.

Step2 Use the cursor key to select [SHORT] field.

Step3

softkey	Function
OFF/ON	Disables/enables short correction. The clear value does not participate in the measurement operation.
MEAS SHORT	Perform short correction for full frequency and DCR
DCR SHORT	Perform DCR short correction only.

Step4 Press [MEAS SHORT] softkey, a dialog message display “Short-circuit the test terminals”.

Step5 Please leave the test fixture or test cable open and do not place any test piece on it or come into contact with any object.

Step6 After pressing [OK], the instrument starts to perform correction.
When correcting, there will be a progress bar prompt at the bottom of the page, and the “Trig'd” indicator will flash.
After the correction is completed, the progress bar disappears.

Step7 Press [Open] to activate the open circuit zeroing function.

6.2.3 Frequency Correction

Correction based on specified frequency spots involves performing open/short/load correction at user-specified frequency points. There are 3 frequency spots you can specify.

In addition to the commonly used open circuit and short circuit calibration functions, this device also offers a load calibration function. This feature enables users to perform load calibration at specified frequency points by using transfer functions that are determined based

on the proportional relationship between known standard values and actual measured values. Load correction can compensate for errors that cannot be compensated by open circuit/short circuit correction.

Users can perform open circuit/short circuit/load calibration at specified frequency points. Please provide values for the A and B fields to specify the standard values.

■ To specify frequency spots open and perform correction

Step 1 Press the [Setup] key, then press [CORRECTION] to enter <CORRECTION> page.

Step 2 Use the cursor key to select [SPOT 1] [SPOT 2] [SPOT3] field

Step 3 Use the softkeys to select or directly enter the frequency value, frequency that is not within the instrument's characteristic frequency will be approximated to the typical frequency.

If the current frequency point is is turned off before:

softkey	Function
ON	Enable this frequency correction point.
CURRECT FREQ	Specify the frequency being used as the current frequency spot value.

If the current frequency point is is turned on before:

softkey	Function
OFF	Disable this frequency correction point.
CURRECT FREQ	Specify the frequency being used as the current frequency point value.
MEAS OPEN	Individually perform open correction for this set frequency.
MEAS SHORT	Individually perform short correction for this set frequency.

Step4 Press [MEAS OPEN] softkey, a dialog message display “Open-circuit the test terminals”.

Step5 Please leave the test fixture or test cable open and do not place any test piece on it or come into contact with any object.

Step6 After pressing [OK], the instrument starts to perform correction.

When correcting, there will be a progress bar prompt at the bottom of the page, and the “Trig'd” indicator will flash.

After the correction is completed, the progress bar disappears.

During correction, users can cancel the correction at any time by pressing the [Abort] button.

■ To specify frequency spots short and perform correction

Step 1 Press the [Setup] key, then press [CORRECTION] to enter <CORRECTION> page.

Step 2 Use the cursor key to select [SPOT 1] [SPOT 2] [SPOT3] field

Step 3 Use the softkeys to select or directly enter the frequency value, frequency

that is not within the instrument's characteristic frequency will be approximated to the typical frequency.

If the current frequency point is is turned off before:

softkey	Function
ON	Enable this frequency correction point.
CURRECT FREQ	Specify the frequency being used as the current frequency spot value.

If the current frequency point is is turned on before:

softkey	Function
OFF	Disable this frequency correction point.
CURRECT FREQ	Specify the frequency being used as the current frequency point value.
MEAS OPEN	Individually perform open correction for this set frequency.
MEAS SHORT	Individually perform short correction for this set frequency

Step4 Press [MEAS SHORT] softkey, a dialog message display “Short-circuit the test terminals”.

Step5 Please leave the test fixture or test cable open and do not place any test piece on it or come into contact with any object.

Step6 After pressing [OK], the instrument starts to perform correction.

When correcting, there will be a progress bar prompt at the bottom of the page, and the “Trig'd” indicator will flash.

After the correction is completed, the progress bar disappears.

During correction, users can cancel the correction at any time by pressing the [Abort] button.

■ To specify frequency spots load and perform correction

Step 1 Press the [Setup] key, then press [CORRECTION] to enter <CORRECTION> page.

Step 2 Use the cursor key to select [SPOT 1] [SPOT 2] [SPOT3] field

Step 3 Use the softkeys to select or directly enter the frequency value, frequency that is not within the instrument's characteristic frequency will be approximated to the typical frequency.

Step4 Use the cursor keys to select [Standard A] and enter the value for the current standard device. The entered value should be the primary parameter value indicated by the [Function] field.

For example, if the current [Function] is Cs-D, please enter the known value of Cs for [Standard A].

Step5 Move the cursor keys to select [Standard B] and enter the secondary parameter value for the standard device.

For example, if the current [Function] is Cs-D, please enter the known

value of D for [Standard B].

Step6 Connect the standard device to the measured end.

Step7 Move the cursor keys to this frequency.

softkey	Function
OFF	Disable this frequency correction point.
CURRECT FREQ	Specify the frequency being used as the current frequency point value.
MEAS OPEN	Individually perform open correction for this set frequency.
MEAS SHORT	Individually perform short correction for this set frequency

Step8 After pressing [Load Calibration], the instrument will begin zeroing.

During calibration, there will be a progress bar at the bottom of the screen and the "Trig'd" indicator will blink.

After calibration is complete, the progress bar will disappear, and the message [Calibration Complete] will be displayed in the help prompt line. The current test results will be shown in the [Measurement A] and [Measurement B] fields. These results will be used to calculate the load ratio value.

During calibration, users can press the [Abort] key at any time to cancel the calibration process.

6.3 <BIN TABLE> Page

Press [Setup] key and press [COMP setup] softkey to open <BIN setup> page.

This page allows you to configure the instrument built-in comparator.

Instrument built-in comparator can sort DUTs into a maximum 11 levels (BIN1 through BIN9, AUX and OUT) using up to nine sets of primary parameter limits along with one set of secondary parameter limits.

In addition, the comparator has a bin count function that counts up to 999,999 DUTs.

To take full advantage of the comparator, the instrument was equipped a handler interface for use in conjunction with the comparator, all of these bins signal can output to yours PLC via the handler interface.

In the <COMP Setup> page, you can configure each of the following controls with the cursor placed in the corresponding field：

- [FUNC] - Select to set the primary and secondary parameters
- [COMP] - Comparator ON/OFF
- [NOM] - The nominal value
- [BEEP] - Beep feature
- [MODE] - Absolute value comparison, percentage comparison or direct reading comparison
- [AUX] - Auxiliary bin (2nd parameter) ON/OFF

- [#-BINS] – Select the total bins
- Number of Qualified Levels
- Enter the upper and lower limit data for each level.

Figure 6-5 <BIN TABLE> page

6.3.1 Measurement Function [FUNC]

The instrument can be independently set up for all test functions and stored in internal memory space.

Before setting the comparator parameters, select the consistent test [FUNC] according to the parameters set in the <MEAS DISPLAY> page.

6.3.2 Comparator Function ON/OFF [COMP]

The instrument built-in comparator can sort devices into a maximum of 10 bins (BIN1 to BIN9 and OUT OF BIN) using a maximum of nine pairs of primary parameter limits and one pair of secondary parameter limits. In addition, a device which primary parameter is within limits, but secondary parameter is not, can be sorted into an auxiliary bin (AUX).

The comparator is allowed to be turned off.

■ Procedure for turning on/off the comparator function [COMP]:

Step 1 Press the [Setup] key

Step 2 Press the [BIN TABLE] softkey and then enter <BIN TALBE> Page.

Step 3 Use the cursor key to select [COMP] field

Step 4 Use the softkeys to turn on/off the comparator.

softkey	Function
OFF	The comparator is turned off and the measurement bar is displayed OFF
ON	The comparator is turned on and the measurement bar shows the sorting result of the current measurement.

NOTE： The comparator is turned off and the bin count is stopped, regardless of whether the bin count is on or off.

6.3.3 Compare【Mode】

The compare mode is only for the primary parameters.

There are three compare modes for the built-in comparators:

- Absolute value Δ
- Relative value Δ%
- Direct reading value SEQ

■ Absolute value Δ and relative value Δ% mode：

Absolute value Δ and relative value Δ%mode is called tolerance mode. Its principle is as follows:

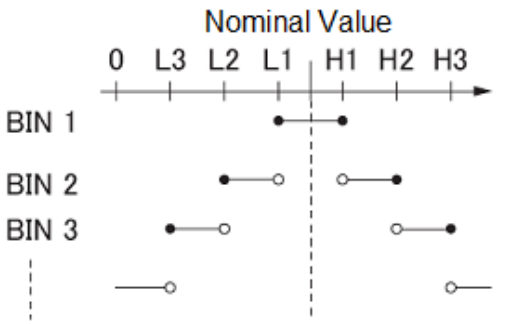


Figure 6-6 Tolerance mode

Among them：

Nominal value: The tolerance mode requires input of the nominal value.

- ● Includes this point
- ○ Excludes this point

Absolute value Δ = measured value – nominal value

Percent Δ% =(measured value - nominal value) / nominal value × 100%

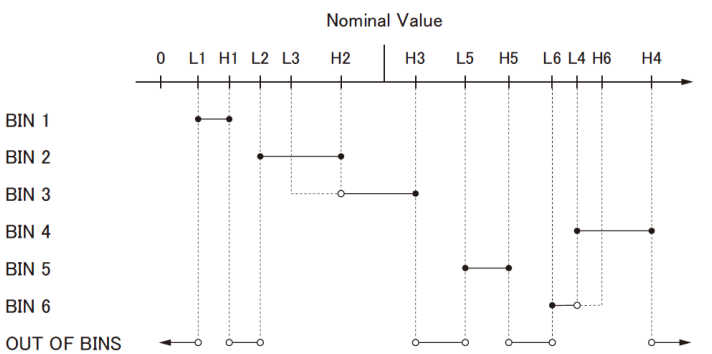


Figure 6-7 Example of sorting in tolerance mode

- ● Includes this point
- ○ Excludes this point

■ Sequential mode：

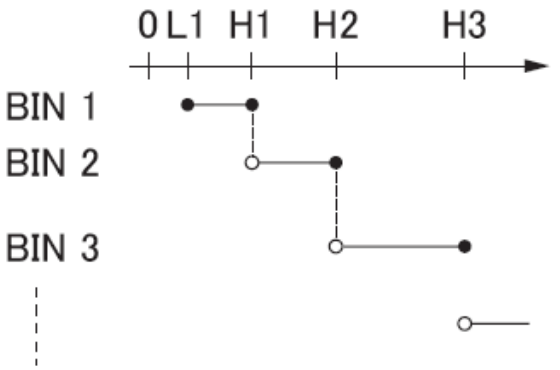


Figure 6-8 Sequential mode

● Includes this point

○ Excludes this point

In sequential mode, the comparison uses the direct reading measurement value to compare with the upper and lower limit ranges of the bin. The nominal value does not need to participate in operation.

■ To set up the compare mode：

Step 1 Enter the <BIN TABLE> page.

Step 2 Use the cursor key to select [MODE] field

Step 3 Use the softkeys to select comparator mode

softkey	Function
ABS	Absolute parameter values
PER	Deviation percentages.
SEQ	Sequential mode.

6.3.4 Nominal Value for tolerance Mode [NOM]

In sequential mode the nominal value does not affect sorting. In sequential mode you can configure nominal value or not.

NOTE：

● When using negative nominal values, be sure to set the lower limit to a value higher than the upper limit because when they are converted to absolute values, the lower limit becomes higher than the upper limit.

● The nominal value entered corresponds to the primary parameter of the test [Function].

■ To enter the nominal value:

Step1 Enter the <BIN TABLE> page.

Step2 Use the cursor key to select [MODE] field

Step3 Use the numeric keys to enter data, the unit is selected by using softkeys.

6.3.5 Auxiliary Bin ON/OFF [AUX]

If the user does not need to sort the secondary parameters, the auxiliary bin (AUX) can be turned off.

After shutting it down, the secondary parameter limit will not be determined during the measurement.

■ To turn on/off auxiliary bin：

Step 1 Enter the [BIN TABLE] Page

Step 2 Use the cursor key to select [AUX] field

Step 3 Use the softkeys to turn on/off auxiliary bin

softkey	Function
OFF	Auxiliary bin is off
ON	Auxiliary bin is on

6.3.6【BEEP】Feature

The beep feature allows for a GD beep, NG beep, or beep OFF

■ To set up the beep feature

Step 1 Enter the <BIN TABLE> page.

Step 2 Use the cursor key to select [Beep] field

Step 3 Use the softkeys to set up beep feature

softkey	Function
OFF	Beep is off
PASS	Beep when the comparator sorting result is OK
FAIL	Beep when the comparator sorting result is NG

6.3.7 Total Number of Bins [#-BINS]

The instrument specify nine bins (1-BINS to 9-BINS). Please set number of bins according to your own requirements and close the extra bins.

Step 1 Enter the <BIN TABLE> page.

Step 2 Use the cursor key to select [#-BIN] field

Step 3 Use the softkeys to set up total number of bins

softkey	Function
Total 1 bin	Only 1 bin for OK bin
……	
Total 9 bins	Turn on all 9 OK bins

6.3.8 Lower and Upper Limits Setup

The instrument built-in comparator can sort DUTs into a maximum 10 bins using up to nine sets of primary parameter limits alone with one set of secondary parameter limits.

Please enter the absolute value of the primary parameter for the "absolute value (Δ)" comparison mode, the unit is the primary parameter unit.

Please enter the relative value of the primary parameter for the "relative value (Δ%)" comparison mode, the unit is %.

Please enter the sequential mode of the primary parameter for the sequential value SEQ comparison mode, the unit is the primary parameter unit.

The upper and lower limits of the secondary parameters are always sequential g values, regardless of the comparison mode.

■ Enter the limit value by using the entry keys

Step 1	Enter the <BIN TABLE> Page.
Step 2	Use the cursor key to select [1] [LOWER] field;
Step 3	Input value Relative value Δ% mode does not need to select unit magnification, please enter a percentage value. Absolute value Δ and sequential value SEQ mode use the softkeys to select the unit.
Step 4	Use the cursor key to select [1] [UPPER] field;
Step 5	Input value
Step 6	Repeat 2~5 to complete the data input of other bins.

NOTE：

- The instrument prepares independent storage space for the three comparison modes, so the comparator data in each comparison mode is independent of each other.In order to be able to sort properly, increase the Bin1 to Bin9 intervals in the tolerance mode. Please increase the Bin1 to Bin9 data range in sequential mode.
- After all settings are completed, if you want to use it for a long time, please enter the [File] page to save the data in the file.
- The instrument does not judge whether the data input by users is reasonable. For example, the lower limit is higher than the upper limit, or the bin between bin is overlapped. Please check the setting result carefully to prevent the sorting error.

6.4 <LIST TABLE> Page

Press the [Setup] key and press [LIST TABLE] softkey to open the <LIST TABLE> page. The list sweep feature of AT381x can perform automatic or manual sweep measurement by sweeping the frequency, signal level through a maximum 10 groups of frequencies or levels. Before using list sweep feature, you have to configure the sweep list.

In the <LIST TABLE> page, you can configure each of the following list sweep measurement controls with the cursor placed in the corresponding field:

- Sweep Function [FUNC]
- Sweep mode [MODE]
- Sweep parameter selection [FREQ[Hz], LEVEL[V]]
- Sweeping point setup
- Limit parameter ([LMT]) selection (primary parameter [A], secondary parameter [B], no comparison [-])
- Input lower and upper limits [LOWER] [UPPER]

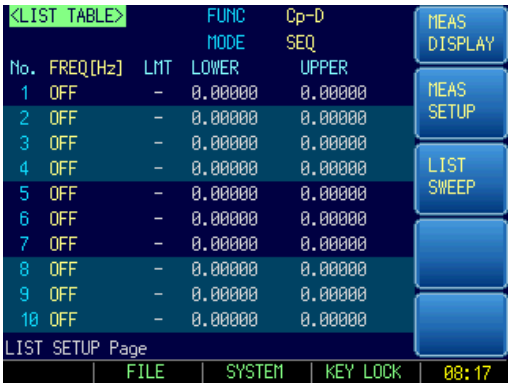


Figure 6-9 <LIST TABLE> Page

6.4.1 Sweep Mode [MODE]

The instrument sweeps according to the trigger mode.

Table 6-1 Sweep mode description

Trig Mode	Function
INT	Internal Trigger. All ten sweep points are swept continuous.
MAN	Manual Trigger. Each time the instrument is triggered by [Trig] key, the sweep points are swept one by one.
EXT	External Trigger. Each time the instrument is triggered by the handler trigger pin, the sweep points are swept one by one.
BUS	Remote trigger, the instrument receives a trigger command from the RS232 interface to scan a test point.

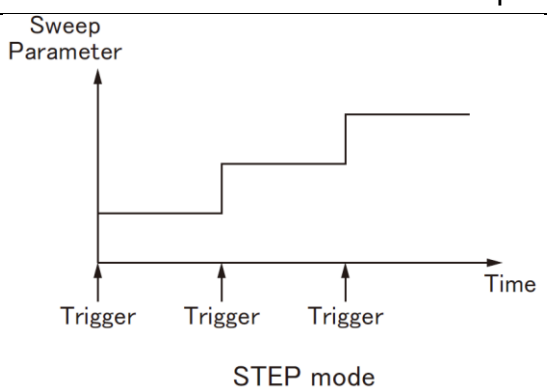


Figure 6-10 Sweep Mode

6.4.2 List Sweep Parameters Setup

The sweep parameter used in list sweep measurement can be measurement frequency and signal level. Use the sweep point field to specify the list sweep measurement parameter.

■ To select the list sweep measurement parameter

Step 1 Enter the [LIST TABLE] page.

Step 2 Use the cursor key to select FREQ[Hz] or LEVEL[V] field;

Step 3 Use the softkeys to select list sweep parameter.

softkey	Function
FREQ	Uses frequency as the list sweep parameter.
VOLT	Uses voltage as the list sweep parameter.

CURR	Uses current as the list sweep parameter.

6.4.3 Configure the Sweep Points

The instrument List sweep measurement feature supports up to 10 sweep points as well as measurement limit values. Each of sweep point can be turned on or off.

■ To configure the sweep points

Step 1 Enter the [LIST TABLE] page.

Step 2 Use the cursor key to select any sweep point from 1~9;

Step 3 Turn sweep points on or off or enter sweep point data (frequency or level)

softkey	Function
ON	Turn on current point
OFF	Turn off current point

6.4.4 Limit parameters [LMT] selection

The instrument can compare the primary parameter or the secondary parameter limit while sweeping, and give a PASS or FAIL conclusion.

■ Procedures for limit setting

Step 1 Enter the [LIST TABLE] page.

Step 2 Use the cursor key to select [CMP] of any sweep point from 1~10; Note that the current sweep point needs to be turned on.

Step 3 Use the softkeys to select

softkey	Function
Primary parameter [A]	Uses the primary parameter as the comparison parameter
Secondary parameter [B]	Uses secondary parameter as comparison parameter
Not compare [-]	Do not compare

6.4.5 Input [LOWER] and [UPPER] Limits Value

Each sweeping point has a set of upper and lower limits, which may be a sequential range of the primary parameter A or the secondary parameter B.

NOTE： The primary parameter A and secondary parameter B multiplex the same storage space to store upper and lower limits.

■ Procedures for setting [Lower] and [Upper] Limits:

Step 1 Enter the [LIST TABLE] page

Step 2 Use the cursor key to select [Lower] and [Upper] Limits of any sweep point from 1~10; Note that the current sweep point needs to be turned on.

Step 3 Use the softkeys to select the unit

NOTE：

- The instrument prepares separate memory for the sweep parameters, so the sweep list data for frequency and level are independent of each other.
- After all settings are completed, if you want to use it for a long time, please enter the [File] page to save the data in the file.

7. System Configurations

This section includes the following information:

- SYSTEM CONFIG page
- SYSTEM INFO page
- SYSTEM SERVICE page

When press the [Meas] or [Setup] key followed by [SYSTEM] bottom softkey, the <SYSTEM CONFIG> page appears.

7.1 <SYSTEM CONFIG> Page

Under the [Meas] or [Setup] page, press [System] to enter the <SYSTEM CONFIG> page. Following information can be configured in the <SYSTEM CONFIG> page.：

- LANGUAGE
- System date and time configuration
- Account settings
- Key Beep setting
- Beep tone
- Remote Communication
- DATA BUFFER – Set the maximum cache value for the data logging function

All settings in <SYSTEM CONFIG> page will be automatically saved in the system and will be automatically loaded next time when the instrument is turned on.

Figure 7-1 <SYSTEM CONFIG> Page

7.1.1 System Language [LANGUAGE]

Two languages (ENGLISH and CHINESE) were supported by the instrument.

■ To change languages

Step 1 Press the [Meas] or [Setup key] and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [LANGUAGE] field

Step 3 Use the softkeys to select a language you understand.

softkey	Function
CHS	Chinese Language
ENGLISH	English Language

7.1.2 Setting the system date and time

The instrument features a built-in 24-hour clock.

■ To change the date：

Step 1 Press the [Meas] or [Setup key] and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [DATE] field

Step 3 Use the softkeys to set date.

softkey	Function
YEAR INCR+	Increases the year in steps of 1.
YEAR DECR-	Decreases the year in steps of 1.
MONTH INCR+	Increases the month in steps of 1.
DAY INCR+	Increases the day in steps of 1.
DAY DECR-	Decreases the day in steps of 1.

■ To change the time：

Step 1 Press the [Meas] or [Setup key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [TIME] field

Step 3 Use the softkeys to set time.

softkey	Function
HOUR INCR+	Increases the hour in steps of 1.
HOUR DECR-	Decreases the hour in steps of 1.
MINUTE INCR+	Increases the minute in steps of 1.
MINUTE INCR+	Decreases the minute in steps of 1.
SECOND DECR-	Increases the second in steps of 1.
SECOND DECR-	Decreases the second in steps of 1.

7.1.3 Account Setting [ACCOUNT]

The instrument has two accounts, administrator and user：

- Administrator: All functions can be configured by administrator except <SYSTEM SERVICE> page.
- User: All functions can be configured by user except < SYSTEM SERVICE> page and <FILE> page.

■ To Change Account：

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [ACCOUNT] field

Step 3 Use the softkeys to set.

softkey	Function
ADMIN	Administrator
USER	User

■ To Change Administrator's Password：

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [ACCOUNT] field

Step 3 Use the softkeys to set.

softkey	Function
CHANGE PWD.	Input password (less than 9 numbers，passwords consist only of numbers and symbols).
DELETE PWD.	The password will be removed.

7.1.4 Key Beep Setting [KEY BEEP]

■ The key beep can be turned off.

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [KEY BEEP] field

Step 3 Use the softkeys to set.

softkey	Function
ON	Turn on the key beep feature
OFF	Turn off the key beep feature.

7.1.5 Beep Tone Setting [TONE]

The beep tone setting allows beep tone to be set LOW or HIGH volume.

■ To set up the beep tone

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [TONE] field

Step 3 Use the softkeys to select.

softkey	Function
HIGH	Beep tone is set to high volume (louder)
LOW	Beep tone is set to low volume (softer)

7.1.6 RS-232 Baud Rate Setting [BAUD]

The instrument has built-in RS-232 interface. After sensing the signal conversion of the RS-232 interface, the instrument immediately communicates with the host at the set baud rate, and the keyboard is locked.

Before you can control the instrument by issuing RS-232 commands from built-in RS-232 controller connected via its DB-9 connector, you have to configure the RS-232 baud rate. If host computer and the instrument's baud rate is different, it will not be able to communicate correctly.

RS-232 configuration is as follows:：

- Data bits: 8-bit
- Stop bits: 1-bit
- Parity: none
- Baud Rate：configurable

■ To set up the baud rate：

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [BAUD] field

Step 3 Use the softkeys to select.

softkey	Function
9600	
19200	
38400	
57600	
115200	Recommend, system default.

7.1.7 [Remote Communication]Settings

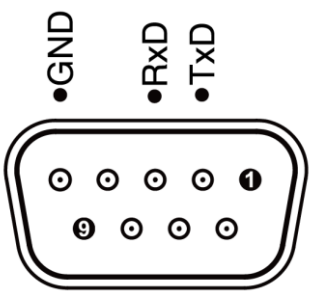
The instrument supports two communication protocols: RS232 and USB.

■ To set up the communication protocol：

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [PROTOCOL] field

Step 3 Use the softkeys to select.

softkey	Function
RS232	The RS232 communicates using the DB9 interface on the rear panel, using three of the pins: P2: TxD P3: RxD P5: GND  Support SCPI and Modbus protocol.
USB	USB-232 interface,use the USB port on the rear panel for communication; Support SCPI and Modbus protocol.

7.1.8 Communication Protocol Settings [PROTOCOL]

The instrument supports two communication protocols: SCPI and Modbus (RTU).

SCPI: Standard instrument communication protocol, ASCII transmission, suitable for host computers, advanced equipment such as computer and industrial computer.
MODUBS: Industrial field bus protocol, binary transmission, suitable for host PLC and touch screen devices.

■ To set up the communication protocol:

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [PROTOCOL] field

Step 3 Use the softkeys to select.

softkey	Function
SCPI	ASCII transmission
MODBUS	Binary transmission

7.1.9 SCPI [TERMINATOR] Setting

The instrument supports multiple terminators: LF（ASCII： 0x0A）， CR（ASCII：0x0D）,CR+LF(ASCII: 0x0D 0x0A).

The host data received by the instrument may not use the terminator, and the data sent by the instrument to the host will always end with the specified terminator.

NOTE：

- The instrument allows the host to send instructions without a terminator, but it is recommended to add a terminator at the end of the command. Otherwise, it will cause a timeout wait after each command is received (the command timeout is 10ms~50ms depending on the baud rate).
- This setting is valid only under the SCPI protocol.

■ To set up the terminator：

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] to enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [Terminator] field

Step 3 Use the softkeys to select.

softkey	Function
LF	ASCII: 0x0A
CR	ASCII: 0x0D
CR+LF	ASCII: 0x0D 0x0A

7.1.10 SCPI [HANDSHAKE] ON/OFF

After the handshake is turned on, the instrument will return all the received data to the host as it is.

■ To set up the command handshake ON/OFF：

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] TO enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [Command Handshake] field

Step 3 Use the softkeys to select.

softkey	Function
OFF	
ON	

NOTE： This setting is valid only under the SCPI protocol.

7.1.11 SCPI [ERROR CODE] ON/OFF

When the error code is turned on, the AT381x will return the execution result of each instruction to the host.

When the instruction is a query, the execution will return the result of the query correctly, and the execution error will return an error code.

When the instruction does not need to return a value, the execution will return *E00 correctly, and the execution error will return an error code.

Table 7-1 SCPI error code

Error code	Description	Explanation
*E00	NO ERROR	No error
*E01	BAD COMMAND	Command error
*E02	PARAMETER ERROR	Parameter error
*E03	MISSING PARAMETER	Missing parameters, With parameter commands, no parameters are provided
*E04	INPUT BUFFER OVERRUN	Receive buffer overflow, the maximum buffer of the AT381x is 1000 bytes
*E05	SYNTAX ERROR	Syntactic error
*E06	INVALID SEPARATOR	Invalid separator
*E07	INVALID MULTIPLIER	Invalid multiplier
*E08	BAD NUMERIC DATA	Value error
*E09	VALUE TOO LONG	The value is too long, the numeric parameter exceeds 20 bytes
*E10	INVALID COMMAND	Invalid command, the command is invalid under certain conditions
*E11	UNKNOWN ERROR	Other unknown errors except the above errors

■ To set up the error code ON/OFF

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] TO enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [Error Code] field

Step 3 Use the softkeys to select.

softkey	Function
OFF	Will not return error code
ON	Return an error code

NOTE： This setting and function is valid only under the SCPI protocol.

7.1.12 SCPI [RESULT] Setting

When the result sending function is set to automatic, the data for each measurement is automatically sent to the host.

■ To set up the result send：

Step 1 Press the [Meas] or [Setup] key and then press [SYSTEM] TO enter <SYSTEM CONFIG> page

Step 2 Use the cursor key to select [Result Send] field

Step 3 Use the softkeys to select.

softkey	Function
FETCH	
AUTO	

NOTE：This setting and function is valid only under the SCPI protocol.

7.1.13 [DATA BUFFER]

Set the maximum data buffer value for the data logging function. The INSTRUMENT can set up to 10000 sets of buffer data. After the cache setting value is reached, the data record will stop. This data can be saved into the external USB disk.
Please refer to the [LOG] field in the <MEAS DISPLAY> page.

7.1.14 Restore to [DEFAULT SET]

[DEFAULT SET] setting option allow user settings to be restored to factory settings.

7.2 System Information Page

Press [Meas] or [Setup] key, press the [SYSTEM] key at bottom to enter the <SYSTEM CONFIG> page, press the softkey to select [SYSTEM INFO].
There are no configurable options in the system information page.

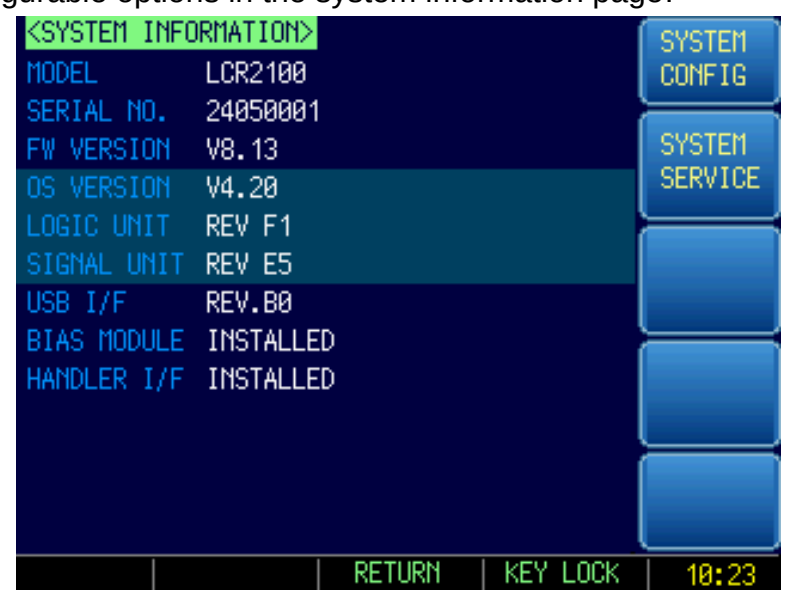


Figure 7-2 < SYSTEM INFORMATION> page

8. File Operation

This chapter provides information on the file operation of the instrument.

The instrument has built-in non-volatile memory, users can save system configuration data and user data in this memory. The system's built-in memory can save 10 configuration files. If you have the USB memory interface option installed, the data can also be saved in an external USB memory. With USB memory, you can save up to 999 measurement results files in addition to 10 sets of configuration files.

8.1 <FILE> Page

When press the [Meas] or [Setup] key followed by [FILE] softkey at bottom, the <FILE> page appears.

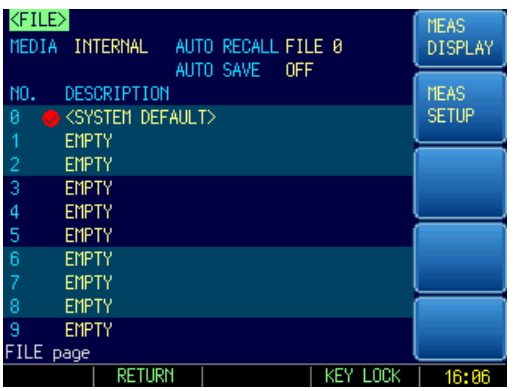


Figure 8-1 <FILE> Page

In <FILE> page, users can set the following functions:

- [MEDIA] selection – internal memory or external USB memory
- [AUTO RECALL] – Recall file 0 or last used file at boot
- [AUTO SAVE] on/off – Save the modified data to the current file automatic.
- File operation
- softkey [SAVE] - Save the current setting data to the current file immediately
- softkey [RECALL] - Load current file data into the system immediately
- softkey [ERASE] – Erase current file data and restore to factory settings.
- softkey [MODIFY DES] – Rename the file description.

8.1.1 [MEDIA] Selection

Select internal memory or external USB storage.

USB memory function cannot be enabled if the USB memory interface is not installed.

■ Procedures for selecting [MEDIA]:

Step 1 Press the [Meas] or [Setup] key followed by [FILE] softkey at bottom and then enter <FILE> page.

Step 2 Use the cursor key to select [MEDIA] field

Step 3 Use the softkeys to select.

softkey	Function
INT MEMORY	Internal flash memory
USB MEMORY	USB storage

8.1.2 Recall a File at Startup [AUTO RECALL]

Users can recall file 0 or current file at the instrument starts up by setting the [AUTO RECALL] field.

■ To select auto recall file：

Step 1 Press the [Meas] or [Setup] key followed by [FILE] softkey at bottom and then enter <FILE> page.

Step 2 Use the cursor key to select [AUTO RECALL] field

Step 3 Use the softkeys to select.

softkey	Function
File 0	The data of file 0 is always loaded when startup.
Current file	The data of the current file is loaded when startup.

8.1.3 Auto save data to last file [AUTO SAVE]

You can save the modified data into last used file when the instrument power key is pressed.

■ To turn on/off the AUTO SAVE function

Step 1 Press the [Meas] or [Setup] key followed by [FILE] softkey at bottom and then enter <FILE> page.

Step 2 Use the cursor key to select [AUTO SAVE] field

Step 3 Use the softkeys to select.

softkey	Function
ON	Auto save function will be enabled. The data will be saved after the power key pressed.
OFF	Turn off the auto save function.

8.1.4 File operation

■ To choose a file to operate

Step 1 Press the [Meas] or [Setup] key followed by [FILE] softkey at bottom and then enter <FILE> page.

Step 2 Use the cursor key to select [FILE] field

Step 3 Use the softkeys to select.

softkey	Function
SAVE	Save user configuration data into current selected file.
RECALL	Load current file data into the system
ERASE	Delete all data of the current file, and the file is also cleared at the same time.

NOTE：Deleted files, if automatically recalled at startup, the system will create a file with factory settings.

9. Handler Interface

This chapter provides information of AT381x's built-in handler interface. Include：

- Pin Assignment
- Circuit Diagram
- Timing Chart

The instrument provides user with a full-featured processor interface that includes 14 bins sorting output, IDX (AD conversion end signal), EOM (test completion signal), TRIG (external trigger start) input, comparator record number input signal, etc. Through this interface, the instrument can easily perform automatic control functions with user system control components.

9.1 Pin Assignment

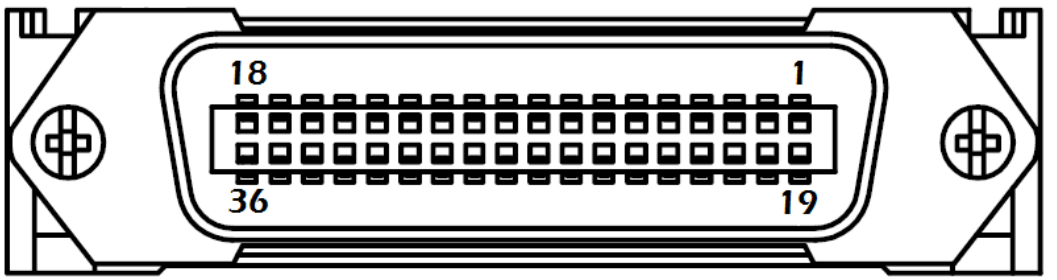


Figure 9-1 Pin Assignment

■ Output Terminal（All signals are valid low level）

Table 9-1 Description of Handler Interface Output Signals

Pin	Pin Name	Signal Description	Level State
1	O_BIN_1	BIN1 Output (OK)	Active low
2	O_BIN_2	BIN2 Output (OK)	Active low
3	O_BIN_3	BIN3 Output (OK)	Active low
4	O_BIN_4	BIN4 Output (OK)	Active low
5	O_BIN_5	BIN5 Output (OK)	Active low
6	O_BIN_6	BIN6 Output (OK)	Active low
7	O_BIN_7	BIN7 Output (OK)	Active low
8	O_BIN_8	BIN8 Output (OK)	Active low
9	O_BIN_9	BIN9 Output (OK)	Active low
14	O_S_OVER	Secondary parameter output (NG)	Active low , AUX function is turned on
15	O_P_OVER	Primary parameter output (NG)	Active low
19	O_P_HI	Main measuring output (over higher limit)	Active low

20	O_P_LO	Main measuring output (over lower limit)	Active low
21	O_NG	BUS output (NG)	Active low
22	O_INDEX	ADC in conversion	Active high
23	O_EOM	Measurement in conversion	Active high

■ Input Terminal

Table 9-2 Description of Handler Interface Input Signals

Pin	Name	Signal Description
24	I_E_TRIG	External input, valid rising edge
25	I_K_LOCK	Keyboard lock signal. Low level keyboard locked, high level or floating unlocked.

■ Power Rating

Table 9-3 Description of Handler Interface Power Rating Signals

Pin	Name	Signal Description
32-36	ISO-COM	Common ground end, do not allow to float. Ensure a reliable connection to the COM of the external controller (such as a PLC).

9.2 How to Connection

■ Use external power supply (recommended)

Built-in fully isolated power supply, no external power supply, but must be shared ISO-COM：ISO-COM：P32~P36

■ Electrical Characteristics

Output signal：Optocoupler isolated Darlington collector output.Active low.

Maximum voltage：3V~30V,Suggestion 24V.

Input signal：Optocoupler isolation.Active low.

Maximum current：50mA

Note: To avoid damage to the interface, do not exceed the power supply voltage requirements.

To avoid damage to the interface, wire the instrument after it has been turned off.

If the output signal is used by users to control the relay, the output optocoupler can only push the small signal relay. The relay must use the reverse energy release diode. If you need to push the high power relay, please increase the triode to push.

9.2.1 Input terminal schematic

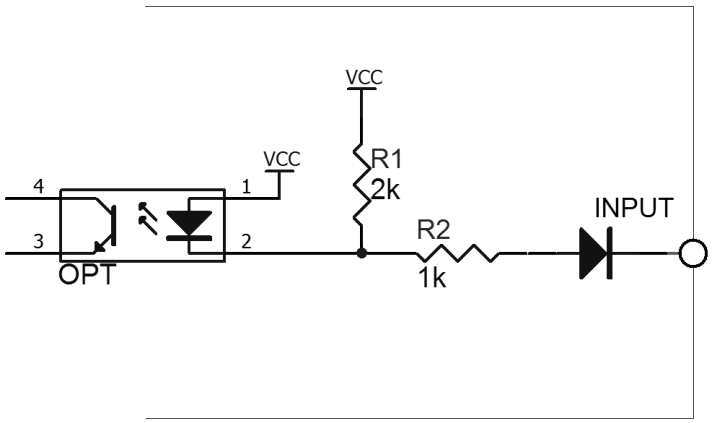


Figure 9-2 Input schematic diagram（Trig）

9.2.2 Output terminal schematic

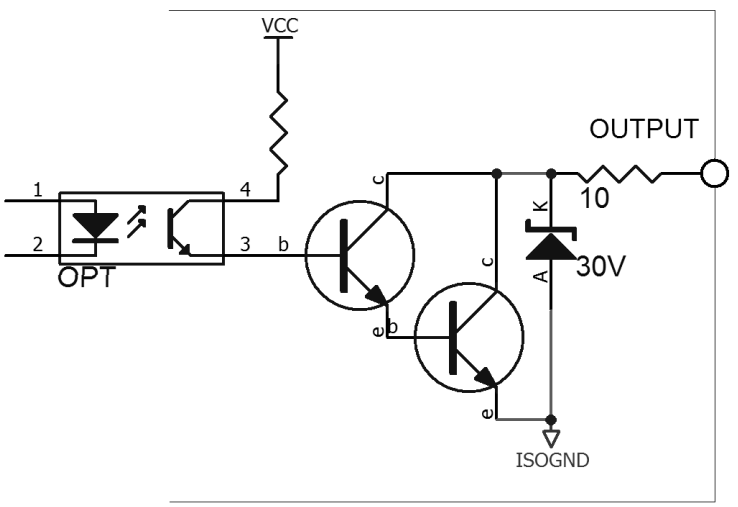


Figure 9-3 Schematic diagram of the output（sorting，IDX，EOM）

9.2.3 Input circuit connection method

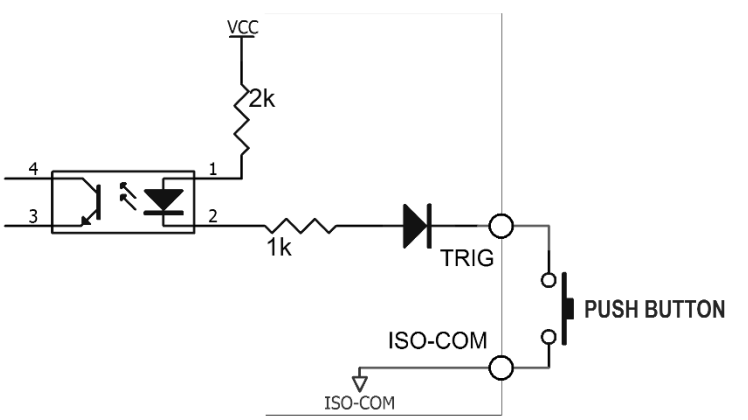


Figure 9-4 Connection to the switch

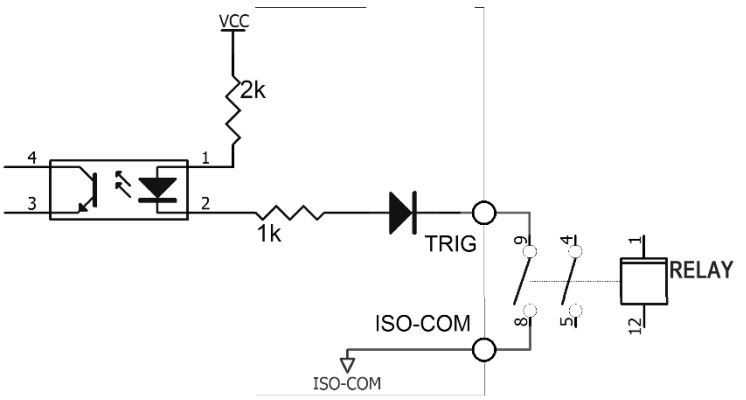


Figure 9-5 Use relay control

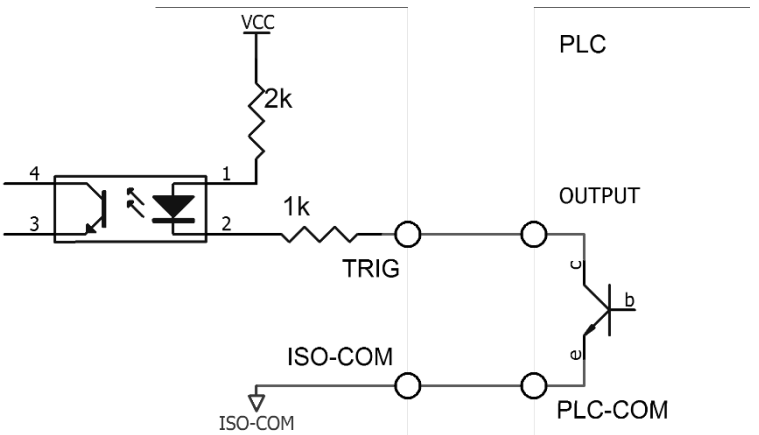


Figure 9-6 PLC negative common terminal control is used

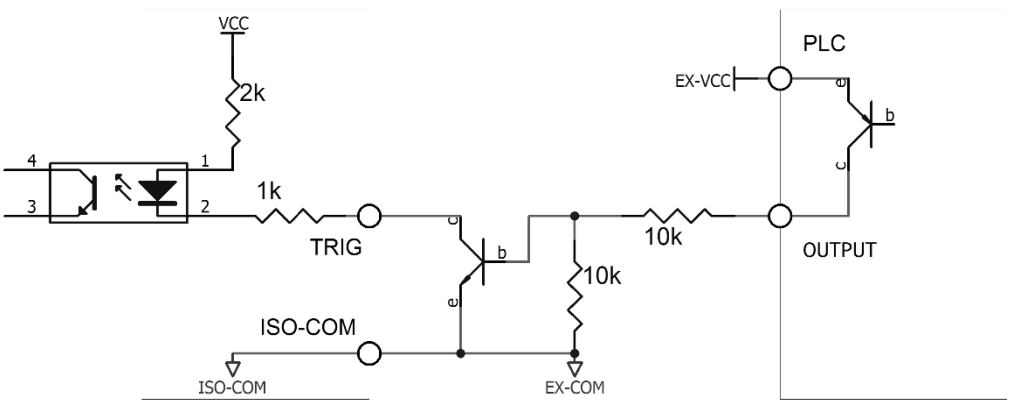


Figure 9-7 PLC positive common terminal control is used

9.2.4 Output circuit connection mode

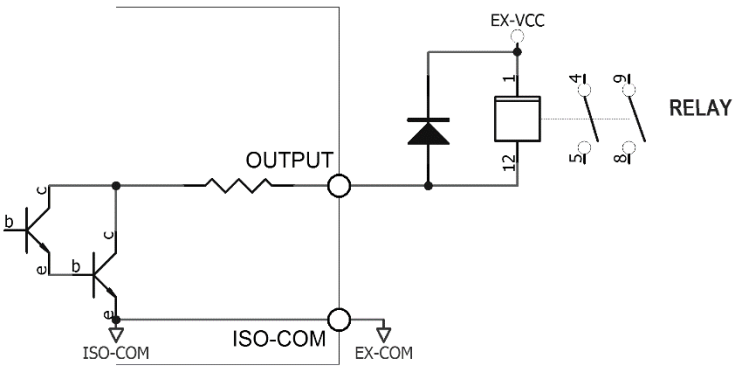


Figure 9-8 Control relay

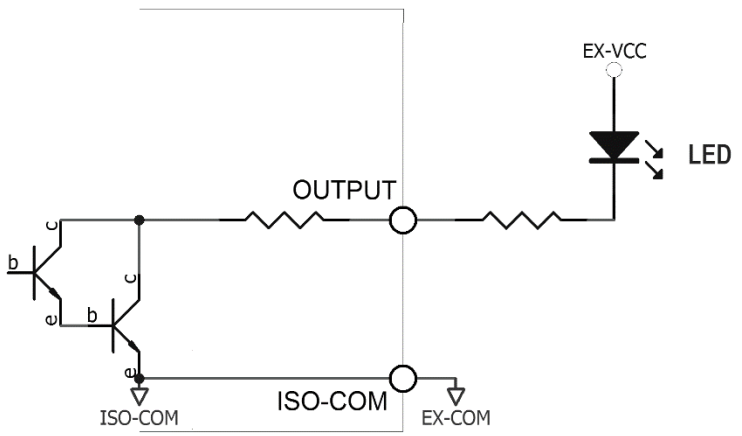


Figure 9-9 Control leds or optocouplers

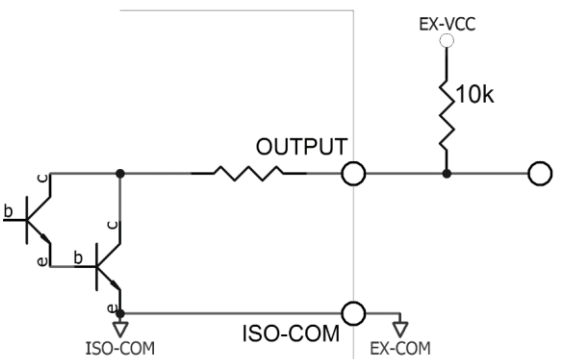


Figure 9-10 Negative logic output

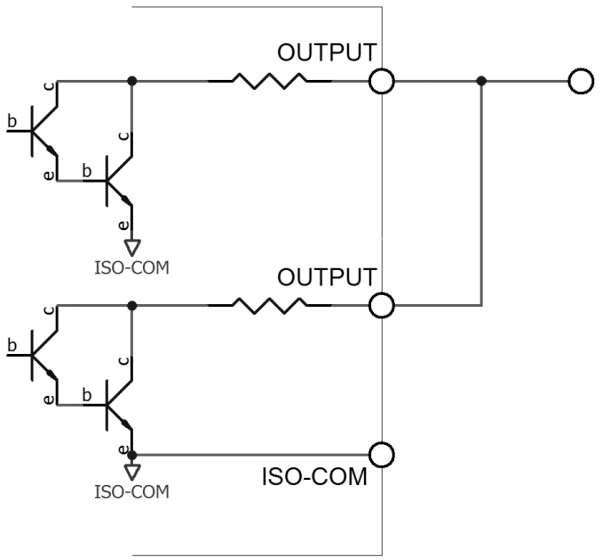


Figure 9-11 The two-port outputs form a logic or circuit

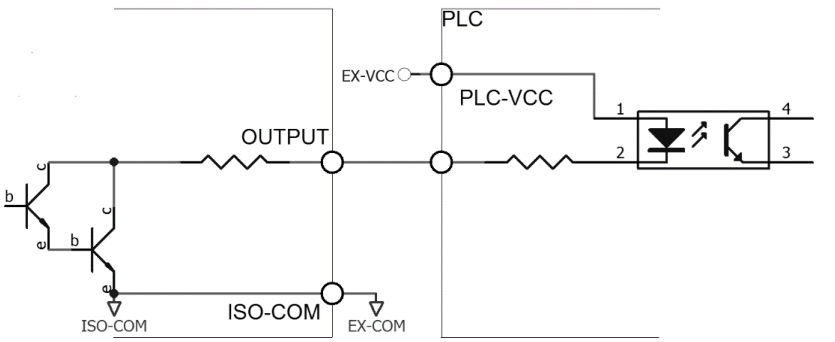


Figure 9-12 The output is to the PLC negative common terminal

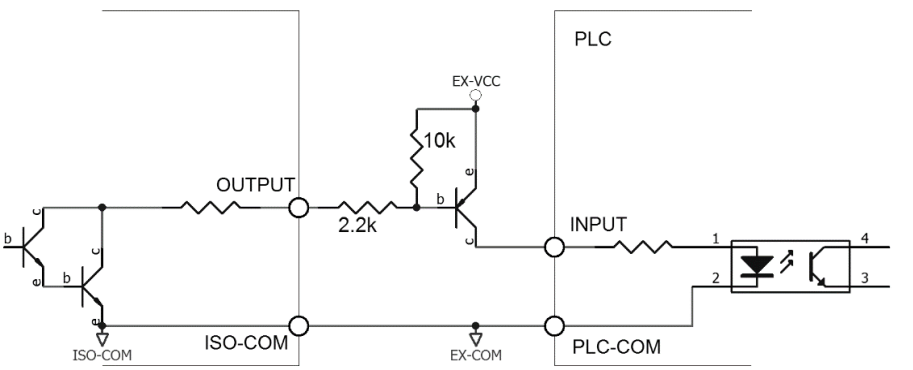


Figure 9-13 The output is to the PLC positive common terminal

9.3 Timing Chart

■ **Recommended signal input and output timing chart**

The instrument completes one sampling and is completely controlled by an external device (PLC, etc.).

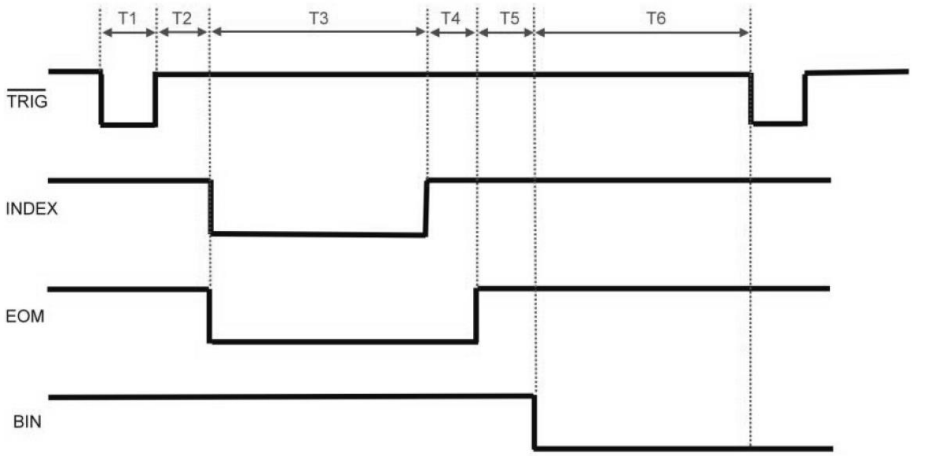


Figure 9-14 Signal timing chart

Table 9-4 Timing

Time	Description		Minimum
T1	Trigger pulse width		1ms
T2	Measurement cycle	Trigger delay time	<10 μs
T3		ADC time	(Related to measurement speed)
T4		Operation time	1ms
T5		Comparator result delay time	200 μs
T6	Await next trigger		0 μs

10. Performance test

In this section, you will learn about the definition of accuracy and test errors of instruments, and how to perform performance tests on instruments.This chapter includes the following：

- Accuracy
- Accuracy Factor
- Performance test

Measurement accuracy includes errors such as measurement stability, temperature coefficient, linearity, measurement repeatability, etc.

The accuracy of the instrument measurement must be checked under the following conditions:

Warm-up time: ≥ 20minutes.

After warming up, open circuit and short circuit correction are performed.

The instrument is in Auto range.

10.1 Accuracy

10.1.1 Accuracy for L, C, R, |Z|

Accuracy for L, C, R, |Z|Ae are expressed by the following formula：

A_e = ±[A+（K_a+K_b）×100]×K_c [%]

A： Basic measurement accuracy

K_a：Impedance scale factor

K_b：Impedance scale factor)

K_c：Temperature factor

L，C Accuracy conditions：D_x（D measuring value）≤0.1

R Accuracy conditions：Q_x（Q measuring value）≤0.1

When Dx ≥ 0.1, for L, C accuracy factor A_e should be multiplied by $\sqrt{1+D_x^2}$

When Q_x≥0.1，for R accuracy factor A_e should be multiplied by $\sqrt{1+Q_x^2}$

10.1.2 D Accuracy

D accuracy D_e are given by the following formula：

$$D_e = \pm\frac{A_e}{100}$$

The above formula is only used when D_x≤ 0.1.

When D_x>0.1, D_e should be multiplied by (1+Dx)

10.1.3 Q Accuracy

Q accuracy are given by the following formula：

$$Q_e = \pm \frac{Q_x \times D_e}{1 \mp Q_x \times D_e}$$

Here, Q_x is the measured Q value.
D_e is accuracy of D
Condition of the above formula is $Q_x \times D_e < 1$

10.1.4 θ Accuracy

θ accuracy are given by the following formula：

$$\theta_e = \frac{180}{\pi} \times \frac{A_e}{100} \qquad [deg]$$

10.1.5 Rp Accuracy

When D_x (measured D value) ≤ 0.1
R_p accuracy are given by the following formula：

$$R_p = \pm \frac{R_{px} \times D_e}{D_x \mp D_e} \qquad [\Omega]$$

Here, R_{px} is the measured Rp value [S].
D_x is the measured D value [F].
D_e is accuracy of D.

10.1.6 Rs Accuracy

When D_x (measured D value) ≤ 0.1
R_s accuracy are given by the following formula：

$R_{se} = X_x \times D_e \qquad [\Omega]$

$$X_x = 2\pi f L_x = \frac{1}{2\pi f C_x}$$

Here，
X_x is the measured X value [S].
C_x is the measured C value [F].
L_x is the measured L value [H].
D_e is accuracy of D
F is test frequency

10.2 Accuracy Factor

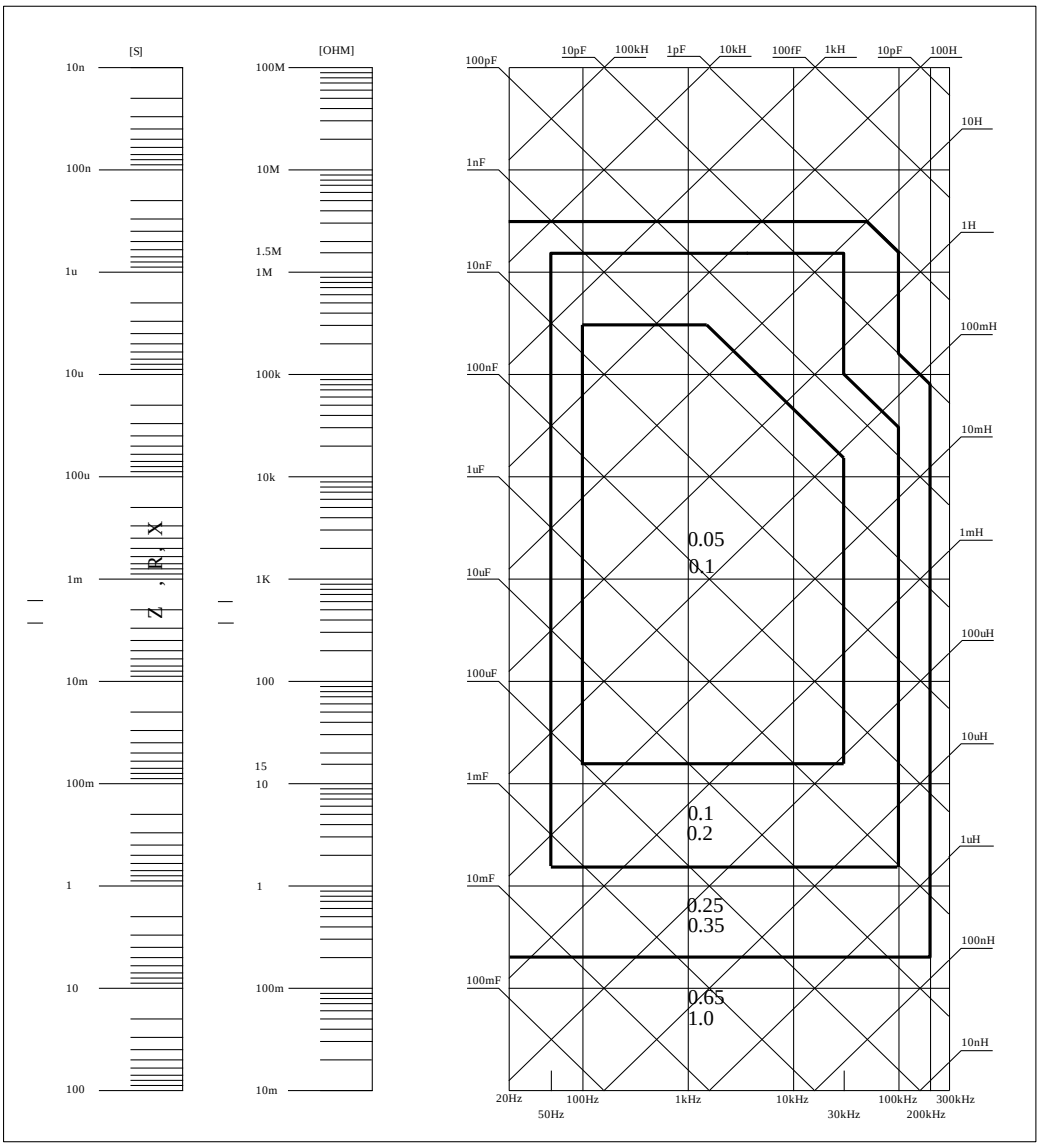


Figure 10-1 Accuracy Factor

Figure 10-1 select a smaller value on the boundary line.

The basic accuracy A value selection method is as follows:

0.05 ---- When 0.4Vrms ≤ Vs ≤ 1.2Vrms, the measurement speed is medium speed, slow-speed A value.

0.1 ---- When 0.4Vrms ≤ Vs ≤ 1.2Vrms, the measurement speed is A value of medium speed and fast speed.

When Vs<0.4Vrms or Vs>1.2Vrms, A value is calculated as: selected A according to the current measurement speed, and then the accuracy correction coefficient Ar is selected according to the current test signal voltage (see Figure 6-2), A is multiplied by Ar getting the current basic measurement accuracy A. Here, Vs is the test signal voltage.

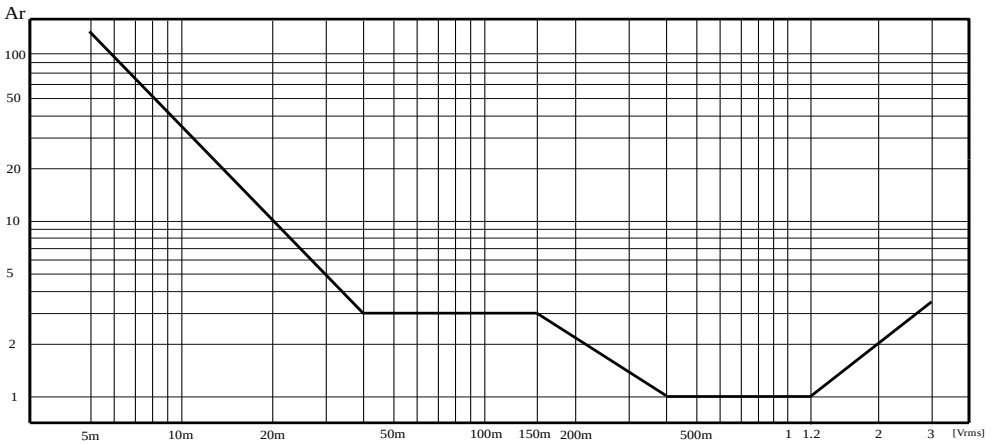


Figure 10-2 Basic accuracy correction curve

Table 10-1 Impedance scale factor Ka, Kb

Speed	Frequency	K_a	K_b
Medium 1 Medium 2 Slow	fm＜100Hz	$(\frac{1\times10^{-3}}{\lvert Z_m\rvert})(1+\frac{200}{V_s})(1+\sqrt{\frac{100}{f_m}})$	$\lvert Z_m\rvert(1\times10^{-9})(1+\frac{70}{V_s})(1+\sqrt{\frac{100}{f_m}})$
	100Hz≤fm≤100kHz	$(\frac{1\times10^{-3}}{\lvert Z_m\rvert})(1+\frac{200}{V_s})$	$\lvert Z_m\rvert(1\times10^{-9})(1+\frac{70}{V_s})$
	fm ＞ 100kHz	$(\frac{1\times10^{-3}}{\lvert Z_m\rvert})(2+\frac{200}{V_s})$	$\lvert Z_m\rvert(3\times10^{-9})(1+\frac{70}{V_s})$
Fast	fm＜100Hz	$(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert})(1+\frac{400}{V_s})(1+\sqrt{\frac{100}{f_m}})$	$\lvert Z_m\rvert(2\times10^{-9})(1+\frac{100}{V_s})(1+\sqrt{\frac{100}{f_m}})$
	100Hz≤fm≤100kHz	$(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert})(1+\frac{400}{V_s})$	$\lvert Z_m\rvert(2\times10^{-9})(1+\frac{100}{V_s})$
	fm>100kHz	$(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert})(2+\frac{400}{V_s})$	$\lvert Z_m\rvert(6\times10^{-9})(1+\frac{100}{V_s})$

In this table,

fm: test frequency [Hz]

Zm: impedance of the device under test [ ]

Vs: test signal voltage [mVrms]

When the impedance is ＜ 500Ω, K_a is used, K_b is invalid.

When the impedance is ＞500Ω, K_b is used, and K_a is invalid.

Table 10-2 Temperature factor Kc

Temperature（℃）	5	8	18	28	38
Kc	6	4	2	1	2	4

Table 10-3 Calibration interpolation factor Kf

Test frequency	K_f
Typical frequency (direct correction)	0
Atypical frequency (interpolation correction)	0.0003

Table 10-4 Cable length factor

Test signal level	Cable length		
	0m	1m	2m
≤1.5V_{rms}	0	$2.5x10^{-4}(1+0.05f_m)$	$5x10^{-4}(1+0.05f_m)$
>1.5V_{rms}	0	$2.5x10^{-3}(1+0.016f_m)$	$5x10^{-3}(1+0.05f_m)$

In the table, fm is the test signal frequency [kHz].

10.3 Performance Test

Each test shall be carried out under the following working conditions.
Warm-up time: ≥ 20 minutes.
After warming up, open circuit and short circuit correction are performed.
The instrument range works at “AUTO” to select the correct measurement range.
This test is only included in the test of main specifications. Other parameters not listed, users can test under the specified conditions according to the specifications listed in this manual. If the test result is found to beyond scope, please contact our maintenance department immediately for repair.

10.3.1 Devices and Equipment Used for Performance Test

Table 10-5 Devices and equipment used for performance testing

No.	Equipment Name		Technical Requirements
1	Standard capacitor	100pF	0.02％ Loss D known
		1000pF	
		10000pF	
		10nF	
		0.1μF	
		1μF	
2	AC standard resistor	10Ω	0.02％
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
3	Standard inductor	100μH	0.02%
		1mH	
		10mH	
		100mH	
4	Frequency meter		（0～1000）MHz

5	Digital multimeter	0.5%

10.3.2 Function check

Each softkey, display, terminal, etc. of the instrument should work normally, and all functions are correct.

10.3.3 Test signal level accuracy test

Place the digital multimeter on the AC voltage range with one test probe connected to the HD side of the meter and the other test probe connected to ground. Change the level to: 0.1V, 0.3V, 1V should meet the requirements in Appendix A.

10.3.4 Frequency accuracy test

Connect the ground terminal of the frequency meter to the ground of the instrument. The test terminal of the frequency meter is connected to HD terminal of the instrument test terminal. Change the frequency to: 20Hz, 100Hz, 1kHz, 10kHz, 100kHz, the reading of the frequency meter should meet the requirements in the specification.

10.3.5 Capacitance C, loss D accuracy test

Parameter Cp-D
Test frequency 100Hz 1kHz 10kHz 100kHz test separately
Level 1V
Range AUTO
Speed Slow
Short circuit and open circuit correction should be performed before testing. Connect standard capacitors 100pF, 1000pF, 10000pF, 10nF, 0.1uF, 1uF, change the frequency, the error capacitance C between the instrument reading and the standard value should be within the allowable error range specified in 6.1, and the loss D should be allowed in 6.1. Within the error range.

10.3.6 Inductance L accuracy test

Parameter Ls-Q
Test frequency 100Hz 1kHz 10kHz 100kHz test separately
Level 1V
Range AUTO
Speed Slow
Short circuit and open circuit correction should be performed before testing. Connect the standard inductors 100μH, 1mH, 10mH, 100mH, change the frequency, the error between the instrument reading and the standard value should be within the allowable error range specified in 6.1.

10.3.7 Impedance Z accuracy test

Parameter Z-θ
Test frequency 100Hz, 1kHz, 10kHz, 100kHz test separately
Level 1V

Range	AUTO
Speed	Slow

Short circuit and open circuit correction should be performed before testing. Connect the AC standard resistors 10Ω, 100Ω, 1kΩ, 10kΩ, 100kΩ, change the frequency, and the error between the instrument reading and the standard value should be within the allowable error range specified in 6.1.

11. Measurement steps and Examples

This section describes the basic test procedures and basic LCR theory, and gives examples of how to make measurements. This chapter mainly explains:

- Basic measurement procedures
- Examples of measurement methods

11.1 Basic Measurement Procedure

The following flow chart shows the basic procedures used to measure the impedance of capacitors, inductors, resistors, and other components. Follow the procedures to perform impedance measurements while referring to the items noted to the right side of each step.

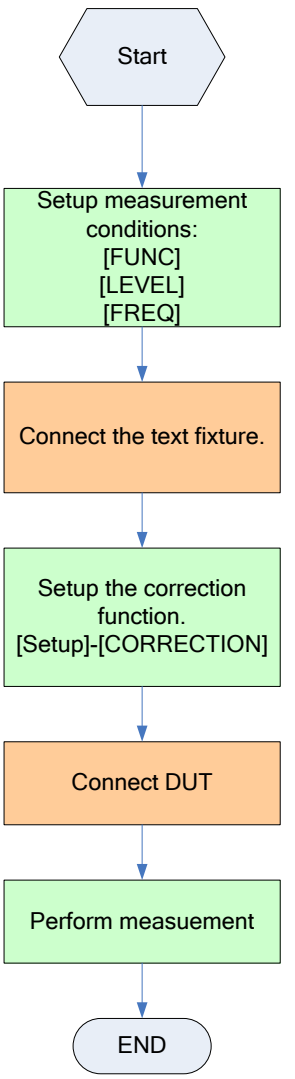


Figure 11-1 Measurement flow chart

11.2 Example

In this section, we take a measurement of a thin film ceramic capacitor as an example to show how to measure the capacitance value.
In this example, a ceramic capacitor is measured under the following conditions.

- Sample (DUT) Ceramic capacitor
- Function: Cp-D
- Test Frequency:100kHz
- Test Signal Level:1V

Step 1 Turn the instrument ON, AT381x enter enter Meas page

Step 2 Use the cursor key to select
[FUNC]: Press softkey to select Cp-D
[FREQ]: Input 100kHz
[LEVEL]: Input 1V

Step 3 Connection test fixture

Step 4 Run correction function
Press [Setup] key
Press [Setup] key to enter [CORRECTION] page
Move to the OPEN field by using the cursor keys
Set [Open] to [On]
Don't connect any DUT to ATL601 as shown like this:

Press the [Open Full Correction] button until the progress box reaches 100% and disappears automatically. The word “Calibration finished” is displayed at the bottom of the screen.
Move to the SHORT field by using the cursor keys.
Set [Short] to [On]
Connect a shorting bar to the ATL601.
Press the [Short Full Correction] button until the progress box reaches 100% and disappears automatically. The word “Calibration finished” is displayed at the bottom of the screen.
Correction is finished, users does not need to perform point frequency correction.

Step 5 Press【Meas】key to return to <Meas Display> page

Step 6 Connect DUT to the test fixture as shown like this:

Step 7 View test results

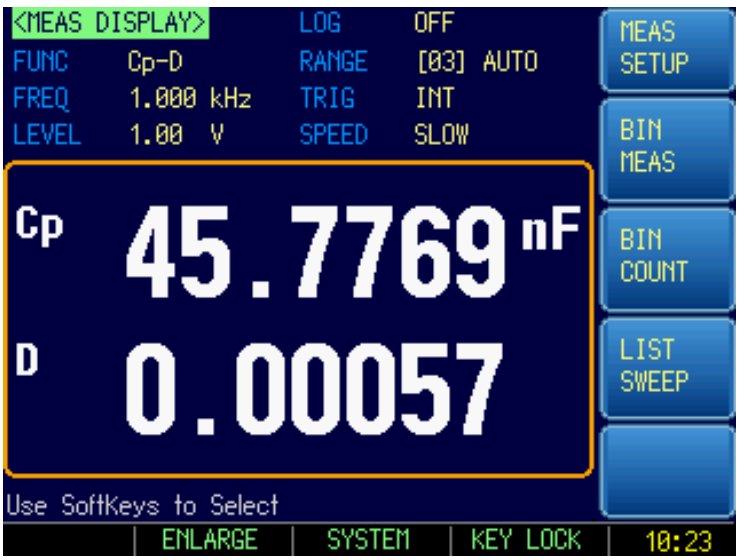


Figure 11-2 Capacitor test results

12. Specification

This chapter includes the following information:

- Specifications
- General specification
- Dimension

12.1 Specification

Accuracy is defined as meeting all of the following conditions.：

Temperature:23℃±5℃

Humidity:<65% R.H.

Zeroing: Open and Short Correction

Warm up time: >60minutes

A 1-year calibration cycle

Test signal level:10%

Test frequency accuracy: 0.01%

Parameter Test Basic Accuracy:0.05%

12.2 General Specification

Display：True color TFT-LCD, Size: 3.5”

Test Function：Cs-Rs, Cs-D, Cp-Rp, Cp-D, Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, Rs-Q, Rp-Q, R-X, DCR, Z-θr, Z-θd, Z-D, Z-Q

Monitor Parameter：（2 sets）Z, D, Q, Vac, Iac, Δ, Δ%, θr, θd,R, X, G, B, Y

Basic Accuracy：LCR2300/LCR2200/LCR2100/LCR2020 0.05%（within basic range）

Test Frequency：

LCR2300：10Hz～300kHz continuous test frequency

LCR2200：10Hz～200kHz continuous test frequency

LCR2100: 10Hz～100kHz continuous test frequency

LCR2020: 10Hz～20kHz continuous test frequency

Frequency range(F)	Resolution
10.0000Hz~ 99.9999Hz	0.0001Hz
100.0000Hz ~ 999.999Hz	0.001Hz
1.00000kHz ~ 9.99999kHz	0.01Hz
10.0000kHz ~ 99.9999kHz	0.1Hz
100.000kHz ~ 300.000kHz	1Hz
10.0000kHz ~ 99.9999kHz	0.1Hz

100.000kHz ~ 200.000kHz	1Hz

Frequency Accuracy：0.01%

Typical frequency point:（LCR2200，unit:Hz）

10	12	15	20	25	30	40	50	60	80
100	120	150	200	250	300	400	500	600	800
1k	1.2k	1.5k	2k	2.5k	3k	4k	5k	6k	8k
10k	12k	15k	20k	25k	30k	40k	50k	60k	80k
100k	120k	150k	200k	250k	300k				

Test Level： ACV：10.00mV~2.00V, accuracy: 10%，CV mode accuracy:6%

ACI：100.0μA~20.00mA，accuracy: 10%，CC mode accuracy: 6% @2Vmax

DCR：±1VDC（2Vpp）square wave，3Hz maximum

0.033A（Max），output impedance 30Ω

Display digits:Primary parameter 6 digits; secondary parameter 6 digits, auxiliary parameter 6 digits

Display Range

Parameter	Display Range
L	0.00001nH ～ 9999.99H
C	0.00001pF ～ 9999.99mF
R、X、Z	0.00001Ω ～ 99.9999MΩ
B、G	0.01nS ～ 999.999S
D	0.00001 ～ 9.99999
Q	0.00001 ～ 99999.9
θd	-179.999° ～179.999°
θr	-3.14159 ～ 3.14159
%	-999.999% ～ 999.999%
θd	-179.99° ～179.99°
θr	-3.1416 ～ 3.1416
%	-99.999% ～ 999.99%

Measurement Speed： Fast：40 times/s，Medium：10 times/s，Slow：3 times/s

Output Impedance： 30Ω、50Ω and100Ω

Max. Reading： 999999

Ranging： Auto, Hold and Nominal range.

Equivalent Circuit： Series and Parallel

DC bias： -2.50V~+2.50V

Correction Function： OPEN/SHORT

3-point frequency open circuit, short circuit and load calibration

Files： 10 sets of built-in files and USB storage.

Beep Feature： OFF/PASS/FAIL and HIGH/LOW tone.

Trigger Mode： Internal, Manual, External and Remote Trigger.

Built-in Interface： Handle）interface, RS232 interface

Programming language：SCPI and Modbus（RTU）

Environment：

Indicator: Temperature 18℃~28℃ Humidity<65% RH

Operation: Temperature 10℃~40℃ Humidity10~80% RH

Storage: Temperature -10℃~70℃ Humidity10~90% RH

Power Supply：100V-240VAC，50Hz~60Hz

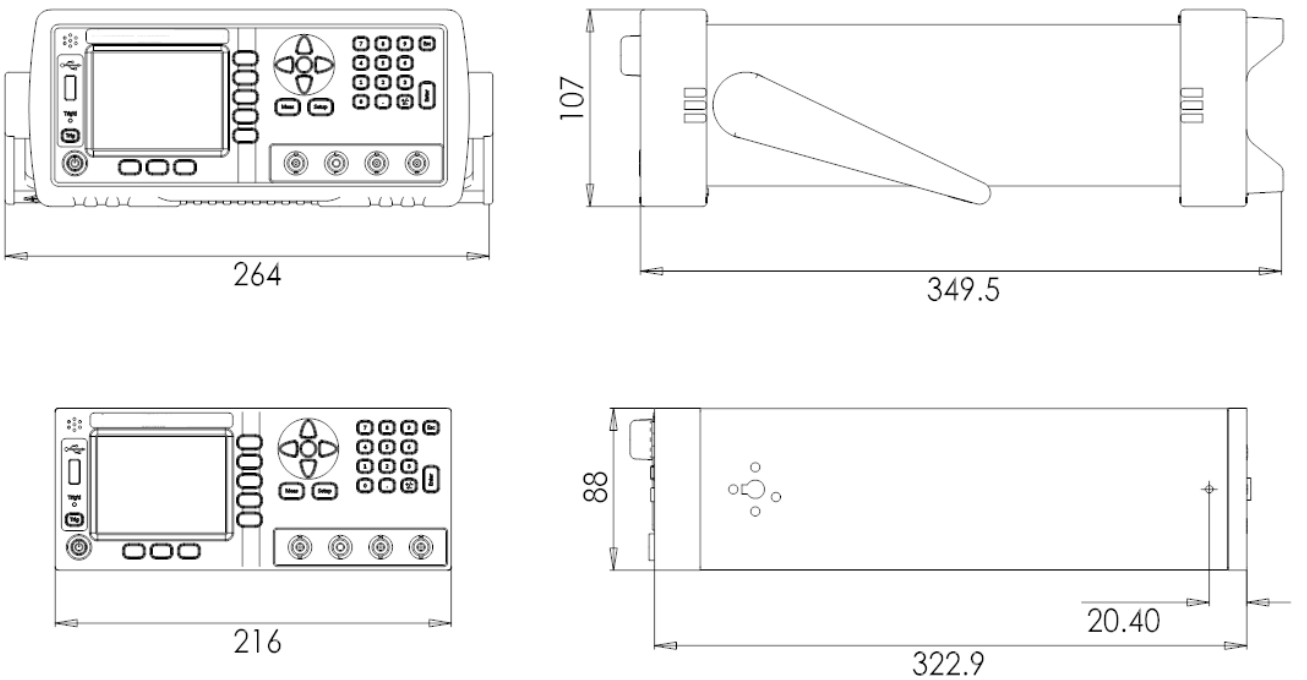
Fuse：250V 3A Slow-Blow

Maximum rated power：Maximum 15VA

Weight：3, net

12.3 Dimensions

(Dimensions)



13. Appendix

13.1 Appendix A：Enclosure

（The accessories subject to final delivery.）

Standard Accessories:

Power Cord

Manual

USB Cable

T10Test Fixture

Test Leads

Short-circuit foil

F10 SMD Test Clips（Only for LCR2200、LCR2300）

Options:

F11 SMD Test Clips

F12 SMD Test Clips