User Manual

User's Guide

Rev. A10

Firmware Description:

Applicable to the main program Rev.C1.02 and above

AT527 series

Battery Tester

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Safety Notice

⚠WARNING ⚠DANGER：When you find the following abnormal situations occur, please stop the operation immediately and disconnect the power cord. Immediately contact the Anbai Technology Sales Department for maintenance. Failure to do so will result in a fire or a potential electric shock hazard to the operator.

- The instrument is operating abnormally.
- The instrument produces unusual noises, odors, smoke or flashes during operation.
- During operation, the instrument generates high temperature or electric shock.
- Damaged power cord, power switch, or power outlet.
- Impurities or liquids flow into the instrument .

Security Information

⚠WARNING ⚠HAZARD： To avoid possible electrical shock and personal safety, follow these guidelines .

Disclaimer	Before starting to use the instrument, please read the following safety information carefully. Anbai Technology will not assume any responsibility for the personal safety and property loss caused by the user's failure to comply with the following terms.
Instrument ground	To prevent the danger of electric shock, please connect the power ground wire.
not allowed Using the instrument in an explosive atmosphere	Do not use the instrument in a flammable and explosive gas, vapor or dusty environment. Using any electronic device in such an environment is a risk to personal safety.
not allowed Open the instrument case	Non-professional maintenance personnel should not open the instrument case in an attempt to repair the instrument. The instrument may still have undischarged charges for a period of

time after it is turned off, which may cause an electric shock hazard to persons.

Not allowed Using a damaged instrument	If the instrument has been damaged, the danger will be unpredictable. Please disconnect the power cord, do not use it again, and do not attempt to repair it yourself.
Not allowed Using an instrument that is not working properly	If the instrument is not working properly and its danger is unpredictable, disconnect the power cord, do not use it, and do not attempt to repair it yourself.
Not allowed Use the instrument in ways other than those specified in this manual	Beyond the range, the protection provided by the instrument will be invalid.

LIMITED WARRANTY AND LIMITATION OF LIABILITY

Changzhou Anbai Precision Instrument Co., Ltd. (hereinafter referred to as Anbai) guarantees that every AT527 you buy is fully qualified in quality and measurement. This warranty does not cover fuses and damage caused by negligence, misuse, contamination, accidental or abnormal use. THIS WARRANTY APPLYS ONLY TO THE ORIGINAL PURCHASER AND IS NOT TRANSFERABLE.

From the date of shipment, Anbai offers a ninety (90) day replacement and two-year free warranty, which also includes VFD or LCD . For damages caused by improper operation of the user during the period of 90 days warranty, the warranty terms will be terminated. During the two-year warranty period, the instrument is damaged due to improper operation by the user, and the maintenance cost shall be borne by the user. After two years and until the life of the instrument, Anbai will provide maintenance for a fee. For VFD or LCD replacement, the fee is charged at the current cost price.

If the product is found to be damaged, please contact Anbai for information on agreeing to return or exchange. After that, please send this product to the seller for return. Be sure to state the reason for the damage to the product, and prepay postage and insurance to the destination. For repairs or replacements of products within the warranty period, Anbai will be responsible for return shipping costs. For the repair of non-guaranteed products, Anbai will estimate the repair cost, and only carry out the repair under the premise of obtaining your consent. All costs incurred by the repair will be borne by the user, including the return shipping cost.

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People's Republic of China
Jiangsu Province
Changzhou Anbai Precision Instrument Co., Ltd.
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1.Installation and Setup Wizard

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

- Main Feature Packing List
- Power requirements
- Operating environment
- cleaning

1.1 Packing List

Before using the instrument, please:

1. Check the appearance of the product for damage, scratches and other undesirable phenomena;

2. Check for missing instrument accessories against the instrument packing list .

If it is damaged or the accessories are insufficient, please contact the sales department or distributor of Anbai Instruments immediately.

1.2 Power Requirements

The AT527 can only be used under the following power conditions:

Voltage: 85VAC ~ 2 50VAC

Frequency: 50Hz~400Hz

Warning: To prevent the danger of electric shock, please connect the power ground wire

If the user replaces the power cord, make sure that the power cord is securely connected to the ground.

1.3 Operating environment

AT527 must be used under the following environmental conditions:

Temperature: 0°C ~ 55°C,

Humidity: less than 23°70 %RH at C

1.4 cleaning

To prevent electric shock hazard, unplug the power cord before cleaning.

Please use a clean cloth dipped in a little water to clean the case and panel.

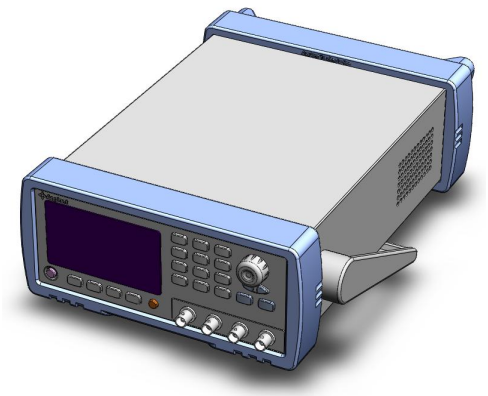
Do not clean the inside of the instrument.

Note: Do not use solvents (alcohol or gasoline, etc.) to clean the instrument.

1.5 Instrument handle

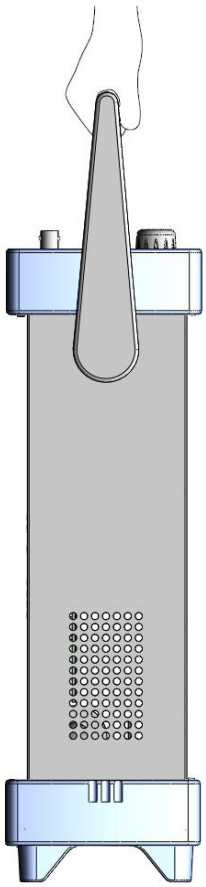
The handle of the instrument can be adjusted, hold both sides of the handle at the same time with both hands, gently pull to the sides, and then rotate the handle. The handle can be adjusted to four positions, as shown below:

Figure 11 Instrument handle - (schematic diagram, panel graphics do not match the actual)

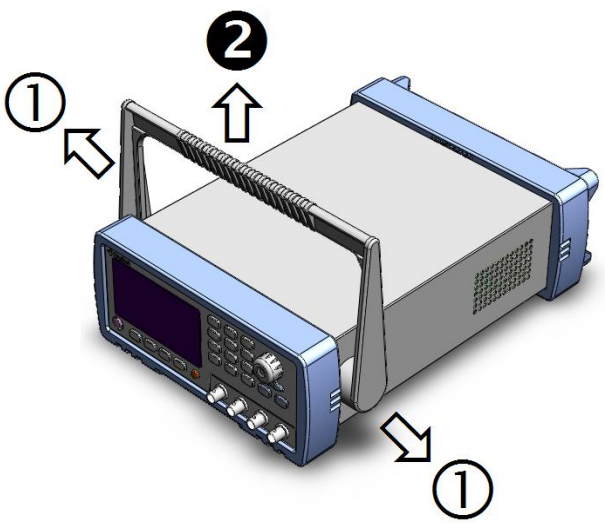


Visual position 1 [Hold both sides of the handle with both hands at the same time, gently pull to both sides until it can rotate freely, then switch to visual position 2]

Visual position 2 [Hold both sides of the handle with both hands at the same time, gently pull to both sides until it can rotate freely, then switch to the hand-held position]



Portable position



Remove handle position. (Pull to both sides ① until the handle is removed.)

2. Overview

In this chapter you will learn about:

- introduction
- The main function

2.1 introduction

Thank you for purchasing the AT527 series battery tester .

AT527 adopts high-performance 32-bit ARM microprocessor-controlled miniature benchtop instrument for automatic real-time detection . The instrument uses a 4.3 -inch true- color LCD display, which is operated by full touch , providing a brand-new instrument interaction experience .

The instrument can test the resistance of 0.0001 mΩ~ 3.3kΩ , the DC voltage of 0.00001V~ 800.000 V, the maximum display digits of resistance are 33000 , and the maximum display digits of voltage are 800000 . AT527 has the characteristics of high precision, high resolution and ultra-high-speed measurement at the same time , providing 0.5 % resistance accuracy and 0.01% voltage accuracy , and the maximum measurement speed can reach 55 times /second .

The instrument is used for professional sorting function. It is equipped with a Handler (PLC) interface as standard , and independently outputs resistance HIGH/ IN/ LOW signal and voltage HIGH/IN/LOW signal , which can fully cope with high - speed automatic sorting system to complete automatic assembly line test. , while the enhanced IO signal can directly drive power relays and signal relays .

The instrument has built-in RS - 232 C interface and USB -232 interface. The instrument comes standard with general data acquisition software, with its own database function and Excel export function , which can be effectively used for remote control and data acquisition and analysis.

The instrument uses Anbai Instruments to enhance the computer remote control command set, compatible with SCPI (Standard Command for Programmable Instrument Standard Command Set), and efficiently completes the remote control and data acquisition functions.

new and improved AC resistance test principle can be used for the internal resistance test of almost all batteries, including the assembly line inspection of various batteries such as lithium batteries, lead-acid batteries, and button batteries .

model	Accuracy	Measuring range	Test speed	interface
AT 527	Resistance : 0.5 % Voltage: 0.01 %	Resistance : 0.00 0 1 mΩ~3kΩ Voltage : 0.00001 ~400.000V	55 times /sec	RS232 /USB Handler
AT 527A _	Resistance : 0.5 % Voltage: 0.01 %	Resistance : 0.00 0 1 mΩ~3kΩ Voltage : 0.00001 ~200.000V	55 times /sec	RS232 /USB Handler
AT 527L _	Resistance : 0.5 % Voltage: 0.01 %	Resistance : 0.00 0 1 mΩ~30Ω Voltage : 0.00001 ~60.0000V	55 times /sec	RS232 /USB Handler
AT 527B _	Resistance : 0.5 % Voltage: 0.01 %	Resistance : 0.00 0 1 mΩ~ 3.3 kΩ Voltage : 0.00001 ~800.000V	55 times /sec	RS232 /USB Handler
AT 527H _	Resistance : 0.5 % Voltage: 0.01 %	Resistance : 0.00 0 1 mΩ~ 3.3 kΩ Voltage : 0.00001 ~1000.00V	55 times /sec	RS232 /USB Handler

See also : See Chapter 10 for complete technical specifications.

2.2 The main function

2.2.1 Test frequency

1 kHz, frequency stability : 20 ppm

2.2.2 range

AT52 7:
Resistance: Use 7 ranges to test, 3 mΩ ~ 3kΩ.
Voltage: 400 VDC

Range auto , manual and nominal .
Range nominal: The instrument will automatically select the best range according to the nominal value.

2.2.3 Test speed

The instrument has four speeds: slow , medium , fast , and high .
All channels open, and manual range mode:
Slow: 4 times/sec

Medium speed: 8 times/sec
Fast: 20 times/sec
High speed: 55 times/sec

2.2.4 Trigger method

Internal, external (including manual and remote triggering) .

2.2.5 basic accuracy

Resistance: 0.5 % Voltage: 0.01%

2.2.6 maximum reading

Resistance : 3 1,000 _
Voltage : 6 0 0,000

2.2.7 Calibration function

Full-scale short circuit clear to "0": Eliminate the influence of lead resistance and stray voltage.

2.2.8 Comparator function (sort function)

The instrument has a sorting function.
RHI/RNG/RLO output.
VHI/VNG/VLO output.
Total NG/OK output
Compare by:
Absolute value tolerance ± TOL sorting: The absolute deviation of the measured value and the nominal value is compared with the limit of each grade.
Percentage tolerance %TOL sorting: The percentage deviation between the measured value and the nominal value is compared with the limit of each grade.
Sorting by sequential comparison: the measured value is directly compared with the upper and lower limits

2.2.9 system settings

1. Data Hold (DH) function
2. Beeper settings
3. Keyboard lock function
4. Administrator and user accounts, passwords can be set for administrators

2.2.10 interface

RS-232 /USB-232 Remote Control:
Support maximum baud rate of 115200bps, compatible with SCPI protocol, ASCII transmission.
Handler interface
Full optocoupler isolation, built-in pull-up resistor input and output ports.
Supports internal 5V and external maximum 35V power supply.
Input: Trigger signal,
Output: all sorting and comparison result signals; measurement synchronization signal (EOC); high current drive output , direct drive relay .

3. Start

In this chapter you will learn about:

- Get to know the front panel - including an introduction to the buttons and test terminals.
- Rear Panel - Introduces power and interface information.
- Power-on start - including power-on self-test process, instrument default value and instrument warm-up time.
- Start testing - including how to connect to the test side

3.1 Getting to know the front panel

3.1.1 Front Panel Description

Figure 3 - 1 Front Panel

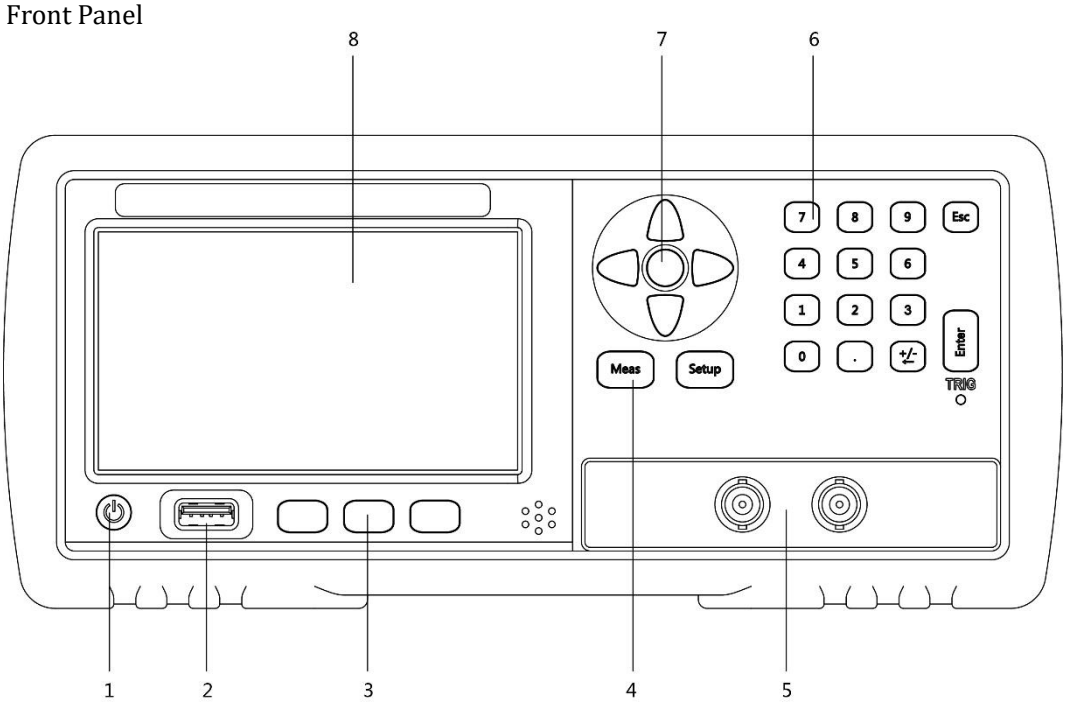


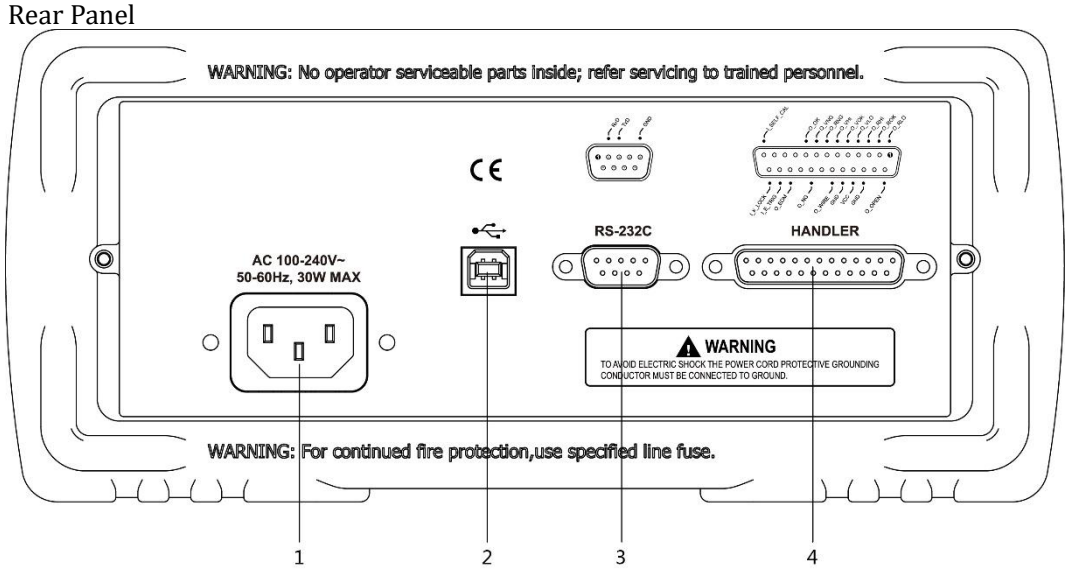
Table 3 - 1 Front panel function description

serial number	Function
1	Power switch (touch switch)
2	USB disk interface
3	System function keys, including system, keyboard lock, etc.
4	Main function keys: measure and set
5	test end
6	Numeric keypad
7	Cursor keys

8	4.3 inch TFT-LCD liquid crystal display window

3.1.2 know the rear panel

Figure 3 - 2 Rear Panel



1. Power socket (fuse not included, the fuse is inside the instrument).
2. USB communication interface
3. RS-232C interface
4. HANDLER interface

3.2 Power on

3.2.1 boot

The button marked " +" at the bottom left of the panel is the power switch, the instrument uses a program-controlled power switch, and the power switch is a light touch electronic switch. The indicator light is on, indicating that the instrument is powered on.

3.3 Test side connection

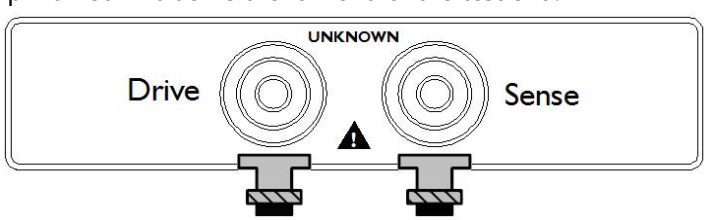
If you use the supplied " Kelvin " test clip for testing, please connect it to the test terminal of the instrument according to the following method.

The tuner does not distinguish between Drive and Sense, and the instrument will automatically switch.

measuring :

The test clip marked in red is the high end of the test end.

The test clip marked in black is the low end of the test end.



To ensure the accuracy that the instrument can achieve, please use the "Kelvin" test clips provided with the instrument for testing.
Warning: It is strictly forbidden to connect the AC current source and voltage source directly to the test terminal.

4. [Meas] Measurement display page

measurement page includes the following :

- Related settings on the <Measurement display > page
- Data logging setup and display

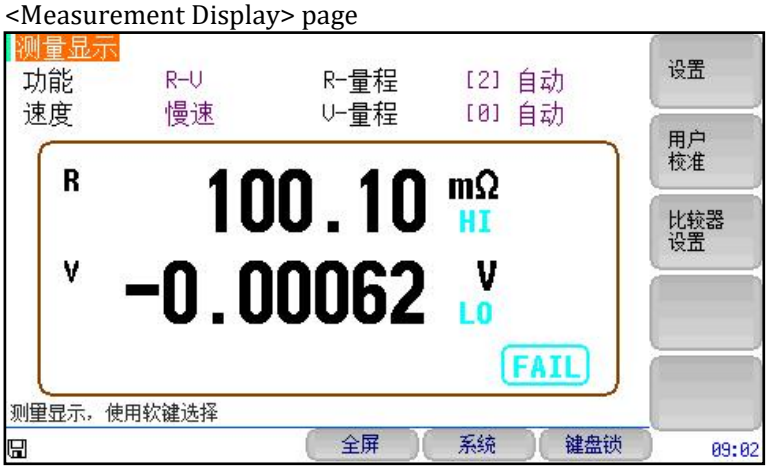
4.1 <Measurement display> page

Press【 Meas 】key to enter【Measurement Display】page.
SCPI Command: `DISP:PAGE MEAS`

The <measurement display> page is mainly used to display the measurement results and sorting results
At the same time , 4 common functions can be set on this page , they include:

- Function – Measure the displayed parameter
- Range – resistance and voltage range setting and display
- speed – test speed
- Data logging and statistics – Please refer to the chapter " Data logging and statistics "

Figure 4 - 1 <Measurement Display> page



Press the bottom button [Full Screen] to enter the full screen display page:

4.1.1 Measurement 【Function】

SCPI Command: `FUNCtion { RV , RESistance (R) , VOLTage (V) }`
SCPI Query Command: `FUNC?`

The instrument has 3 measurement functions :

Function	describe
R -V	Simultaneous measurement and display of resistance and voltage values
R	Measure and display resistance values only
V	Only measure and display voltage values

■ **set up the measurement function :**

step 1 Press【 Meas 】key to enter the measurement main page;

Step 2 Use the cursor keys or touch screen to select the [Function] field;

Step 3 the function keys on the right side of the screen to select the measurement function .

function keys	Function
R -V	Simultaneous measurement and display of resistance and voltage values
R	Measure and display resistance values only
V	Only measure and display voltage values

4.1.2 【R - range】

Resistance range setting
SCPI Command: `RES istance: RANGe <0 to 3100>`
SCPI Command: `RES istance:RANGe :No {<range number: 0 -6 >, min,max }`
SCPI Command: `RES istance : RANGe:MODE { AUTO,HOLD,NOMinal }`
SCPI Query Command: `RES istance : RANGe ?`
SCPI Query Command: `RES istance : RANGe:NO ?`
SCPI Query Command: `RES istance : RANGe:MODE ?`

The AT52 7 resistor has 7 ranges, and the variation range of each range is as follows:

Table 4 - 1 Range of Variation

Range number	Range name	Scope
6	3kΩ _ _	0.3200kΩ to 3.3000kΩ _ _ _ _ _

5	300Ω _ _	32.00Ω ~ 330.00Ω _ _ _ _
4	30Ω	3.200Ω ~ 33.000Ω _ _ _ _
3	3Ω	0.32 0 0 Ω to 3.3000 Ω _
2	300 mΩ _	3.200 mΩ ~ 330.00 mΩ
1	30mΩ	3.200mΩ ~ 3 3.000mΩ _ _ _ _
0	3mΩ	0.0001 mΩ ~ 3.0000 mΩ

There are 3 range modes:

Table 4 - 2 Test range description

Range method	describe	advantage	shortcoming
automatic	The instrument automatically selects the best test range according to the nominal resistance value, and the range number in the range field will be automatically set.	Users do not need any involvement	Auto-ranging requires a predictive range, and the test speed will be lower than the manual-ranging method.
manual	The instrument will always use the user-specified range for testing	The test speed is the fastest.	The user needs to participate in the selection of the range
Nominal	The instrument will automatically select the best range for testing based on the nominal value.	The best way to sort test. The fastest speed.	Only suitable for sorting tests.

Notice!

If set to NOM mode , the instrument will set the range according to the comparator mode:
When the comparator mode is SEQ, the range will be set according to the upper limit of the comparator ;
When the comparator mode is ABS and PER , the range will be set according to the nominal value.

■ **To set the resistance range:**

step 1 Press【 Meas 】key to enter measurement page or press【Setup】key to enter setup page;

Step 2 Touch or use the cursor keys to select the [R - Range] field;

Step 3 Use the function keys to select range auto, manual or select range

function keys	Function
automatic	The instrument will automatically select the range
manual	The instrument is locked on the current range
Nominal	The instrument will select the best range based on the nominal value
increase+	Increment the range number while the range is changed to lock
reduce-	Decrease the range number while the range is changed to lock

Note!

When the range is automatic, the instrument will predict the range in each measurement cycle, so the test speed will be slightly slower than the locked range. Moreover, during automatic measurement, frequent changing of the range will cause the response to slow down. Usually, when the instrument is used for sorting measurement, the auto-ranging method is not suitable.
For sorting users, please select the nominal range method.

4.1.3 【 V- range】

Voltage range setting
SCPI Command: `VOLTage :RANGe <-300 to 300>`
SCPI Command: `VOLTage :RANGe :No {<range number: 0 -2 >, min,max }`
SCPI Command: `VOLTage: RANGe:MODE { AUTO, HOLD, NOMinal }`
SCPI Query Command: `VOLTage: RANGe ?`
SCPI Query Command: `VOLTage: RANGe: NO ?`
SCPI Query Command: `VOLTage: RANGe: MODE ?`

The AT52 7 voltage has 3 ranges, and the variation range of each range is as follows:

Table 4 - 3 Range Variation Range

Range number	Scope
2	0.000 1 V~ MAX
1	0.0001~80.8000V
0	0.00001~8.08000V

There are 3 voltage ranges:

Table 4 - 4 test range description

Range method	describe	advantage	shortcoming
automatic	The instrument automatically selects the best test range according to the nominal voltage value, and the range number in the range field will be automatically set.	Users do not need any involvement	Auto-ranging requires a predictive range, and the test speed will be lower than the manual-ranging method.
manual	The instrument will always use the user-specified range for testing	The test speed is the fastest.	The user needs to participate in the selection of the range
Nominal	The instrument will automatically select the best range for testing based on the nominal value.	The best way to sort test. The fastest speed.	Only suitable for sorting tests.

■ **To set the voltage range:**

step 1 Press【 Meas 】key to enter measurement page or press【Setup】key to enter setup page;

Step 2 Touch or use the cursor keys to select the [V - Range] field;

Step 3 Use the function keys to select range auto, manual or select range

function keys	Function
automatic	The instrument will automatically select the range
manual	The instrument is locked on the current range
Nominal	The instrument will select the best range based on the nominal value
increase+	Increment the range number while the range is changed to lock
reduce-	Decrease the range number while the range is changed to lock

4.1.4 test [speed]

SCPI Command: `SAMPle : RATE { SLOW,MEDium,FAST,EXFast }`

SCPI Query Command: `SAMP le:RATE ?`

AT 527 offers 3 test speeds (slow, medium, fast). The slower the speed, the more accurate and stable the test results are.

In the RV function and manual range mode, the sampling time of the comparator open is as follows:

Slow: 4 times/sec

Medium speed: 20 times/sec

Fast: 55 times/sec

■ **To set the test speed:**

step 1 Press【 Meas 】to enter the measurement page or press【Setup】to enter the setup page;

Step 2 Touch or use the cursor keys to select the [Speed] field;

Step 3 Use the function keys to select

function keys	Function
slow	
medium speed	
fast	
high speed	

5. [Setup] tab

In this chapter you will learn about all measurement related settings

At any time, you only need to press the [Setup] key, and the instrument will enter the setup page.

SCPI Command: `DISP:PAGE SETUP`

5.1 Measurement settings

All measurement-related settings are operated on the <Settings> page.

In the <Settings> page, the instrument does not display the test results or comparator results, but the instrument test is still in progress.

These settings include the following parameters:

- Function – Measure function parameters
- Ranges – Resistance and Voltage Ranges
- speed – test speed
- Average – Average number of measurements
- Delay – delay before external trigger measurement
- monitoring – displays monitoring parameters
- Self-calibration – whether the instrument performs a calibration procedure at regular intervals
- Nominal Value – Allows modification of the nominal value when monitoring is enabled
- Current – test current output mode

The [Function], [Range] and [Speed] settings can also be set on the <Measurement Display> page. For the setting of these parameters, please refer to the [Meas] measurement main page chapter.

Figure 5 - 1 < Settings> page

5.1.1 【Trigger】Method

SCPI Command: `TRIGger:SOURce {INT,EXT}`
SCPI Query Command: `TRIGger:SOURce ?`

The instrument has 2 trigger modes:
Internal trigger, manual trigger, external trigger and remote trigger.

Trigger method	describe
internal	Also known as continuous test, the trigger signal is continuously tested by the instrument according to the inherent cycle.
external	1. Each time the [Trig] key is pressed, the instrument will execute a measurement cycle, and the instrument will be in a waiting state at other times. 2. When a rising edge pulse is received from the Handler interface on the rear panel, the instrument performs a measurement cycle. At other times the instrument is in a waiting state. Please refer to the Handler interface. 3. Send the command TRG, measure once and return the measured value

■ **Steps to set the trigger method:**

step 1 Press【 Meas 】key to enter the measurement main page;
Step 2 Use the cursor keys or touch screen to select the [Trigger] field;
Step 3 Use the function keys to select the trigger method.

function keys	Function
internal	Internal trigger method
external	External trigger mode, including manual/remote/HANDLER

5.1.2 【Average】Number of times

SCPI Command: `SAMPle : AVERage <integer 0~256>`
SCPI Query Command: `SAMP le:AVER age ?`
Taking the "average" is the most commonly used type of digital filter, and 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. The range of the average number of times is a positive integer from 1 to 256.

■ **To set the average number of times:**

step 1 Press【Setup】key to enter the main setup page;
Step 2 Use the cursor keys or touch screen to select the [Average] field;
Step 3 Use the function keys to select, or use the keyboard to directly enter the value

function keys	Function
increase+	Increase average times in steps of 1 , 2 , 4 , 8 , 16 , 32, 64, 128, 256.
reduce-	Decrease the number of averages in steps of 256, 128, 64, 32, 16, 8, 4, 2, 1.

5.1.3 Trigger 【Delay】

SCPI Command: `TRIGger: DELay :STATe {ON(1),OFF(0)}`
SCPI Command: `TRIGger: DELay <1 ms-10.000s> }`
SCPI Query Command: `TRIG:DELay ?`
SCPI Query Command: `TRIG:DELay:STATe ?`

The instrument can set the delay time before each test by triggering the [Delay] timer, which is used to wait for the station to be ready before the test.
The maximum delay time is 10s, and the minimum delay time is 1ms.

■ **Steps to set [Delay]:**

step 1 Press【Setup】key to enter the main setup page;
Step 2 Use the cursor keys or touch screen to select the [Delay] field;
Step 3 Use the function keys to select

function keys	Function
Open	Turn on the delay function
closure	

Step 4 _ After the delay function is turned on, use the numeric keyboard to input the delay time .

5.1.4 【Self- calibration 】switch

SCPI Command: `SYSTem: CAL ibration`

The self-calibration function removes the offset voltage and gain drift of the internal circuit of the instrument to improve the measurement accuracy.
The instrument will always perform a self-calibration at slow speed , regardless of whether this switch is on.
the speed is above the medium speed, if the [Self-calibration] switch is turned on, the instrument will automatically perform a calibration every 30 minutes .

■ **to set the [Self-calibration] switch:**

step 1 Press【Setup】key to enter the main setup page;
Step 2 Use the cursor keys or touch screen to select the [Self-calibration] field;
Step 3 Use the function keys to select

function keys	Function
closure	Turn off self-calibration
Open	Self-calibration is turned on , the instrument will perform self-calibration every 30 minutes

Notice! When a self-calibration is performed, the instrument measurements are briefly paused in response to the self-calibration.
A self-calibration will take 40ms. When measuring at high speed, you need to turn off the self-calibration and use the external IO control line for self-calibration.
To ensure accuracy, the instrument performs a self-calibration each time it is powered on.

In addition to periodically performing self-calibration, it is also possible to

1. Using the HANDLER signal nCAL A self-calibration can also be performed .
2. Use the communication command [SYST: CALib ration] to perform a self-calibration.

5.1.5 Measurement [current] output method

SCPI Command: `SYSTem:CURRent {CONTinuous,PULSe}`
SCPI Query Command: `SYSTem:CURRent?`

multiple identical instruments measure in parallel at the same time , the measurement signals will interfere with each other, resulting in sudden changes in the measured values. In order to prevent measurement errors, the instrument can set the [Current] output mode , set the current output mode to [Measurement] , and turn off the current signal source after the test is completed to minimize multi-machine interference.

■ **set the [Current] output mode :**

step 1 Press【Setup】key to enter the main setup page;

Step 2 Use the cursor keys or touch screen to select the [Current] field;

Step 3 Use the function keys to select

function keys	Function
continued	Current continuous output
When measuring	Only output the current during measurement, and turn off the signal source when finished .

5.1.6 【Monitor】parameter

SCPI Command: `FUNCtion:MONitor { OFF,RABS,RPER,VABS,VPER}`
SCPI Command : `FUNCtion : MONitor ?`
The instrument can monitor one parameter while measuring the main and auxiliary parameters.

Note :

Additional monitoring parameters do not increase instrument processing time.
The instrument default value is "Off".
Since the monitoring parameter is related to the nominal value , once the monitoring parameter is turned on, the [Nominal Value] field will be displayed on the screen. This field is the same as the [Nominal Value] in the [Comparator Settings] page, and the nominal value must be entered .

■ **To set monitoring parameters**

step 1 Press【Setup】key to enter the main setup page;

Step 2 Use the cursor keys or touch screen to select the [Monitor] field;

Step 3 Use the function keys to select

function keys	Function
close	Monitoring parameters off
RΔ	Resistance absolute deviation value (RΔ = Rx - Rnom)
R%	Resistance relative deviation (R% = (Rx- Rnom) / Rnom * 100)
VΔ	Resistance absolute deviation value (VΔ = Vx - Vnom)

V%	Resistance relative deviation value (R% = (Vx-Vnom) / Vnom * 100)

Among them ,

Rx is the measured resistance value , Rnom is the nominal value of the resistance

V x is the measured voltage value , Vnom is the nominal value of the voltage

5.2 file management

Press the bottom function key [File] to enter the <File Management> page.

File management allows users to save settings into 10 files for easy access at startup or when changing specifications.

On the <File Management> page, you can set the following:

- 【Start-up call】- Specifies the file to be called at startup
- 【Auto save】- Parameters that are allowed to be modified are saved in the current file in real time
- 【document】 - Specifies to save, read, or delete files.

Figure 5 - 2 < File Management> page

5.2.1 【Start-up call 】

The boot call option can specify the file to be called at boot time.

■ **Steps to set up power-on invocation:**

step 1 Enter the <File Management> page

Step 2 Use the cursor keys to select the [Power-On Call] field;

Step 3 Use the function keys to select

function keys	Function
file 0	Load the settings of file 0 at boot
current file	Load the setting value of the current file number at startup

5.2.2 【Auto save 】

When the auto-save option is enabled, the parameters set by the user will be automatically saved to the current file.

■ **Steps to set up auto save:**

step 1 Enter the <File Management> page

Step 2 Use the cursor keys to select the [Auto Save] field;

Step 3 Use the function keys to select

function keys	Function
allow	The parameters set by the user will be automatically saved to the current file
prohibit	The parameters set by the user can only be saved in the file manually by the user, otherwise the parameters will be lost after the next power-on.

5.2.3 【File 0】~【File 9】

Users can specify 10 files from 0 to 9 to save, load and delete.

■ **Steps to set up the file:**

step 1 Enter the <File Management> page

Step 2 Use the cursor keys to select the [File 0]~[File 9] fields;

Step 3 Use the function keys to select

function keys	Function
save	Save all settings to the current file
read	Read the parameters of the file into the system
delete	file data will be deleted

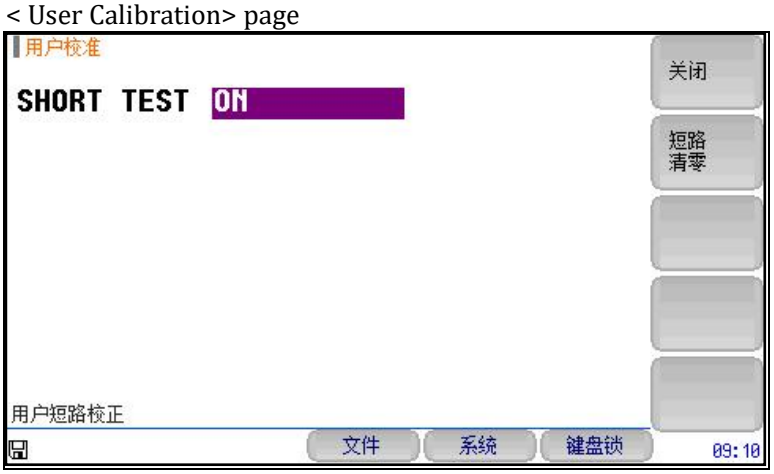
6. User calibration

In this chapter you will learn how to perform user calibration .

Press the [M eas] key, and then touch the screen on the right function key to select [User Calibration] to enter the user calibration page.

SCPI Command: `DISP:PAGE CSET`

Figure 6 - 1 < User Calibration> page



testing , be sure to perform a short-circuit reset to remove stray resistance and bias caused by test leads and external environmental factors .

In order to achieve the specified technical specifications of the instrument , short-circuit clearing must be performed .

addition to performing on the user calibration page , short-circuit clearing can be performed by the following methods :

1. Using communication commands

   Communication Command: `ADJust`

2. Using HANDLER nSHORT Signal

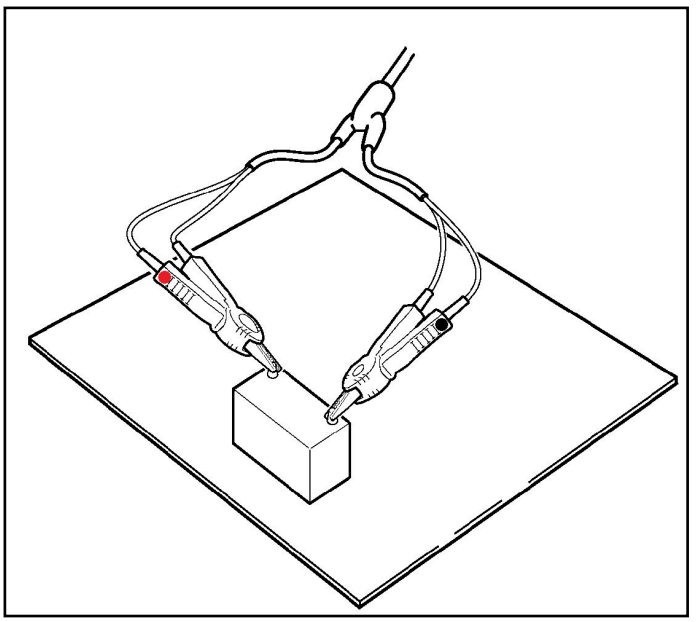
6.1 short circuit clear

Since the measurement resistance is very small (3 mΩ and 30 mΩ range), after the test current flows through the resistance , the generated voltage signal will be very weak (only a few mV at most) . Measurements matter . Usually , where we measure, we also need to clear the corresponding position.

For example :

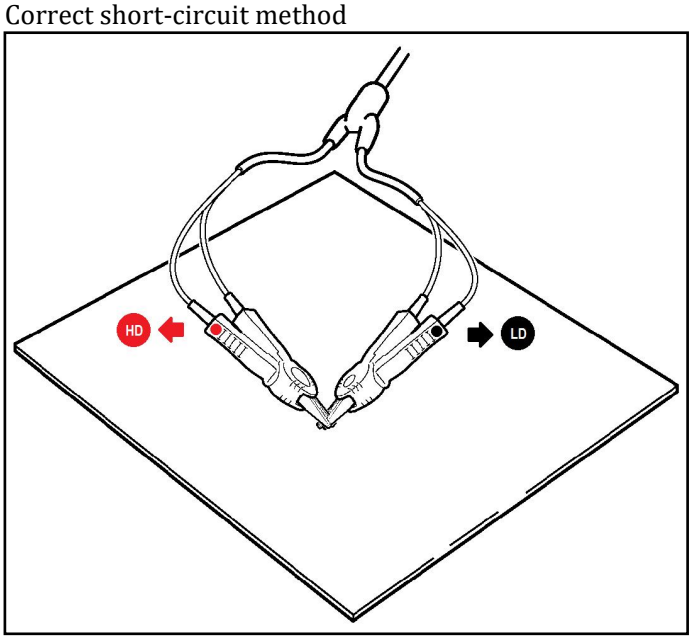
When measuring:

Figure 6 - 2 ready to clear



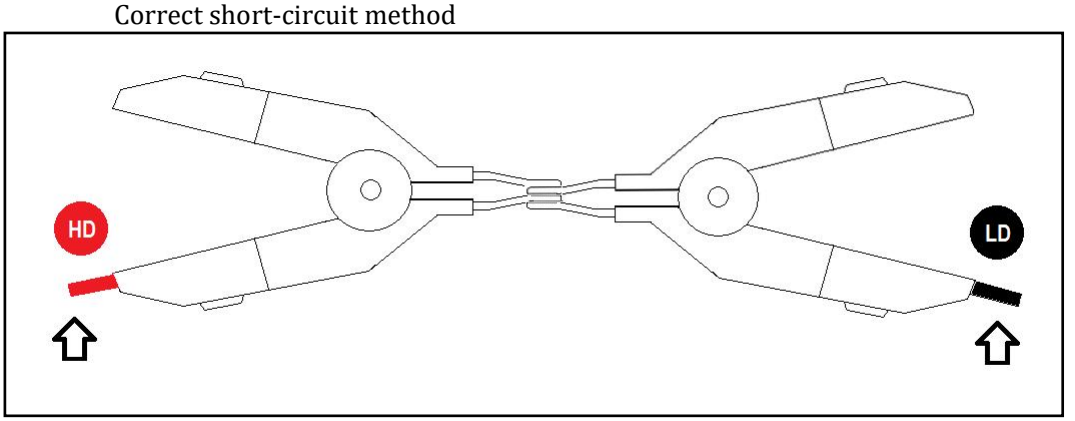
clearing , be sure to keep the position consistent , especially in the range of 30 mΩ and below.

Figure 6 - 3 Correct short-circuit method



Before clearing, please short-circuit the test clip as follows:

Figure 6 - 4 Correct short-circuit method



■ **short circuit clearing**

step 1 Press【 Mea s 】key to enter the measurement page, then touch the screen to select 【 User Calibration】 to enter the user calibration page

Step 2 Arrow keys or touch screen to select [SHORT TEST] field

Step 3 If it is OFF (OFF) before , please touch the screen to select [ON].

function keys	**Function**
Open	

Step 4 The new function keys are then displayed :

function keys	**Function**
closure	Turn off short-circuit clearing, and the clearing value is not used during testing.
short circuit clear	Perform short circuit clear

Step 5 Return to the setting page after clearing

7. Comparator settings

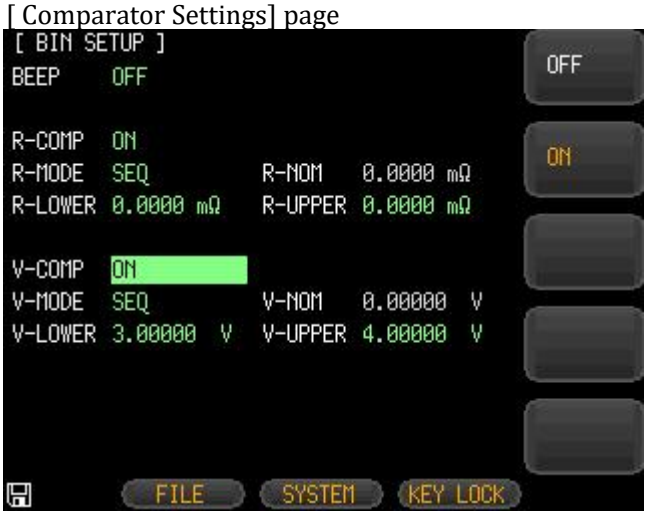
In this chapter you will learn about the comparator setup functions :

- Beeper settings
- Resistor /Voltage Comparator On /Off

Press 【 Meas 】 or 【 Setup 】 key, then touch the screen on the right function key to select 【 Comparator】to enter the user calibration page .

SCPI Command: `DISPlay:PAGE BSET`

Figure 7 - 1 [Comparator Settings] page



7.1.1 【 Beep】setting

SCPI Command: `CALC:LIMIT:BEEP { OFF , IN(PASS),HL(FAIL) }`

SCPI Query Command: `CALC:LIMIT:BEEP?`

beeper function is only valid when the comparator function is turned on.

Beeper settings allow pass beeps, fail beeps, or turn off beeps.

■ **Set the beeper**

step 1 Enter the <Measurement Display > page

Step 2 Use the cursor keys to select the [Beep] field;

Step 3 Use the function keys to select

function keys	Function
close	Beeper is turned off
Qualified beeper	When the sorting result is qualified (PASS), the buzzer will sound.
Unqualified sound	The buzzer sounds when the sorting result is FAIL.

7.1.2 Comparator settings

SCPI Command: `RES istance :LMT < lower,upper >`
SCPI Command: `VOLTAGE:LMT < lower,upper >`

The instrument can compare resistance and voltage simultaneously or separately.
There are 3 comparison methods to choose from:
Absolute value comparison (Δ)
Percentage Comparison (Δ%)
Sequential comparison (SEQ)

absolute valueΔ = measured value – nominal value
Percentage Δ% = (measured value - nominal value) / nominal value × 100%
The direct reading value SEQ comparison uses the direct reading measurement value to compare with the upper and lower limit ranges of the gear, so the nominal value does not need to be involved in the calculation.

■ **Steps to set up the comparator:**

step 1 Enter the <Settings> page
Step 2 Use the cursor keys to select the [Resistance Comparison] or [Voltage Comparison] field;
Step 3 Use the function keys to select

function keys	Function
closure	Comparator for current parameter off
absolute valueΔ	Switch the comparator to absolute value comparison mode
Relative value Δ%	Switch the comparator to relative value comparison mode
Direct reading value SEQ	Switch the comparator to direct reading value comparison mode

7.1.3 【Nominal value】input

SCPI Command: `RES istance :LiMiT:NOMinal <float>`
SCPI Command: `VOLTage:LiMiT:NOMinal <float>`

The absolute value and relative value comparison method must enter the nominal value. The nominal value of the direct reading value comparison method does not participate in the calculation, but in the [nominal] range mode, the nominal value of the resistance will participate in the range selection. Correct resistor nominal value.

■ **Enter the nominal value:**

step 1 Enter the <Settings> page
Step 2 Use the cursor keys to select the [Resistance Nominal] or [Voltage Nominal] field;
Step 3 Use the numeric keys to input data, and use the function keys to select the unit.

7.1.4 【Lower Limit】and 【Upper Limit】settings

SCPI Command: `RES istance :LMT < lower,upper >`

SCPI Command: `VOLTAGE:LMT < lower,upper >`

■ **Enter limit value**

step 1 Go to the <Comparator> page

Step 2 Use the cursor keys to select the [Lower Resistance Limit] or [Lower Voltage Limit] field;

Step 3 Enter data using the numeric keypad

relative value Δ% method does not need to select the unit magnification, please input the percentage value.

absolute value Δand direct reading value SEQ mode, please use the function keys to select the unit.

Step 4 Use the cursor keys to select [Resistance Upper Limit], [Resistance Lower Limit];

Step 5 Enter data using the numeric keypad

Step 6 Repeat 2~5 to complete the data input of other files.

Note The instrument shares the same storage space for the three comparison modes, so you need to reset the comparator data after switching the comparison mode.

8. Data logging and statistics

this chapter you will learn how to activate the data logging function and how to perform statistics .

The instrument allows to record the measurement data and perform statistical calculations . The data logging function can only be run and displayed on the <Measurement Display > page .

8.1 Enable data logging

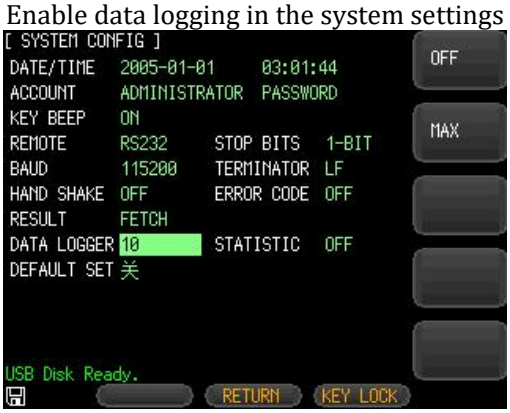
SCPI Command: `LOG [: STATe ] {ON(1),OFF(0)}`

SCPI Command: `LOG ger: S IZE {<1~10000>,max}`

The instrument has the function of [Data Recording] , which can record 10000 groups of data and perform statistical operations .

[Data Statistics] function can be enabled separately, and the [Data Statistics] function can be set only after the [Data Recording] function is enabled .

Figure 8 - 1 Enable data logging in the system settings page



set 【Data Record 】:

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the 【Data Record 】field;

Step 3 can be selected using the function keys

function keys	Function
OFF	Data logging is turned off. After closing , the [Record] field will not appear on the <Measurement Display > page .
M AX	data logging function is turned on, and the data logging buffer is set to the maximum: 10000 groups. enabled , the [Record] field will appear at the top of the <Measurement Display > page .

Step 4 You can also directly use the numeric keyboard to input the required buffer size.

For example : 100 <Enter > sets the buffer size to 100 groups .

Once entered , the [Record] field will appear at the top of the <Measurement Display > page .

8.2 Data logging function

Through the data recording function , the measurement data can be stored in the instrument buffer in real time, and these data can be sent to the computer through the communication interface, or directly saved in CSV format text to the USB disk.

8.2.1 start recording

data logging function is turned on , the logging fields are displayed on the <Measurement Display> page :

Figure 8 - 2 Start recording

Internal triggering and external triggering start data logging differently :

1. When the trigger mode is internal :
   a. Use the function key [START LOG] to start continuous logging .
   b. Use the SC PI command `LOG:START ON` to start continuous logging.
2. When the trigger mode is external , data logging starts automatically :
   a. Use the TRIGGER key on the front panel to perform a recording .
   b. Use the HANDLER external trigger input port to perform a recording .
   c. Use the SCPI command `TRIGGER` or `TRG` to perform a recording .

Note

Once data logging is started, the measurement page will be locked and cannot be switched to other pages.

In the external trigger state, before switching to other pages, the data recording must also be closed first. If you switch to the <Measurement Display > page from other pages , the data recording will start automatically .

8.2.2 stop recording

data logging is automatically started , you can use the function keys to stop the current recording or use the SC PI command `LOG:START OFF` to stop the recording at any time .

Figure 8 - 3 is recording

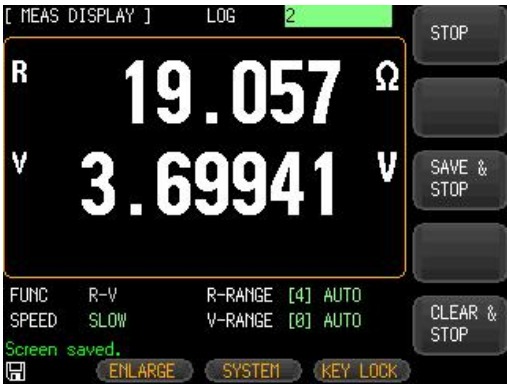
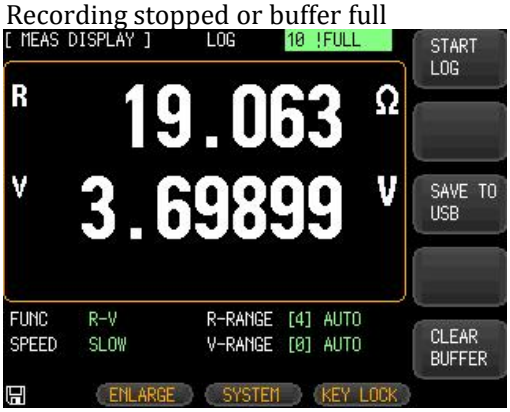


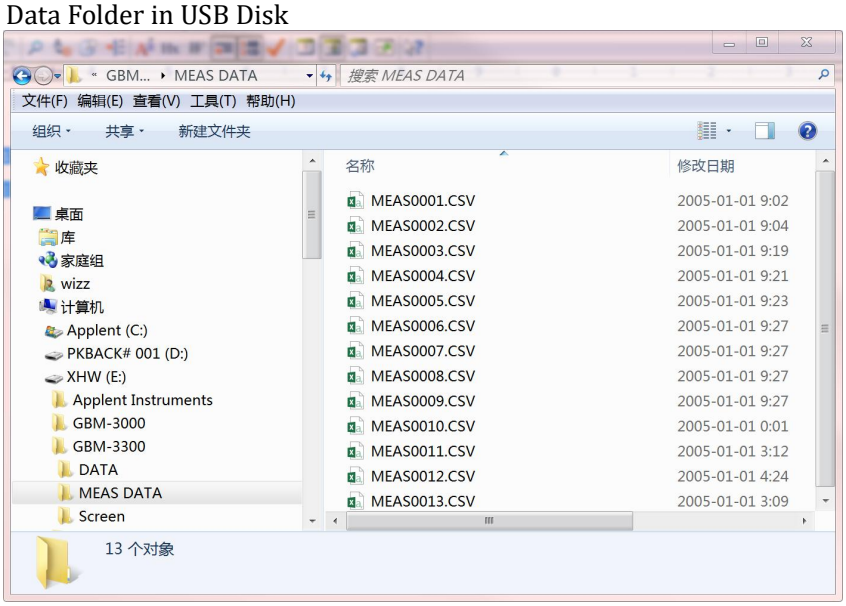
Figure 8 - 4 Recording stopped or buffer full



8.2.3 Save data to USB disk

data logging is turned on , data can be saved to a USB disk at any time.

Figure 8 - 5 Data Folder in USB Disk



saved file is text in CSV format .

On Windows OS, open the file with a text editor :

line number	document content	illustrate
1	"MEAS DATA"	
2		blank line
3	"File name","MEAS0013.CSV"	file name

4		blank line
5	"Model","GBM-3300","REV A1.01"	Model and version
6		blank line
7	"Log Time","2005-01-01 03:03:37"	Starting time
8		blank line
9	"FUNC","RV"	Measurement parameters
10		blank line
1 1	" No","R (OHM)","V(V)"	Data serial number, resistance value, voltage value
12	1,+19.069E+0,+3.69906E+0	data
13	2,+19.067E+0,+3.69957E+0	
14	3,+19.069E+0,+3.69916E+0	
15	4,+19.070E+0,+3.69952E+0	
16	5,+19.079E+0,+3.69905E+0	
17	6,+19.070E+0,+3.69960E+0	
18	7,+19.068E+0,+3.69932E+0	
19	8,+19.069E+0,+3.69951E+0	
20	9,+19.071E+0,+3.69932E+0	
twenty one	10,+19.070E+0,+3.69958E+0	
twenty two		end line , blank line

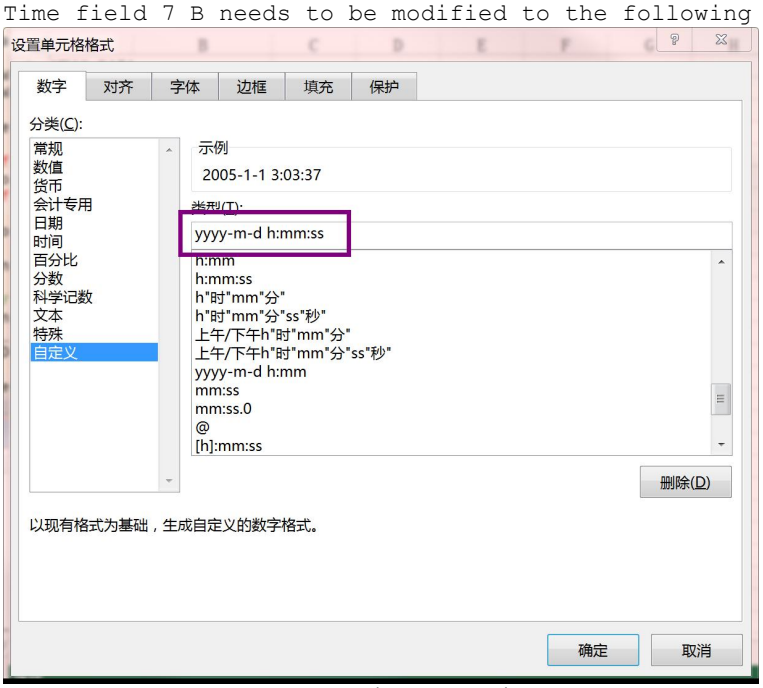
In Windows OS, use Excel to open the file:

Figure 8 - 6 Using Excel to open the record file

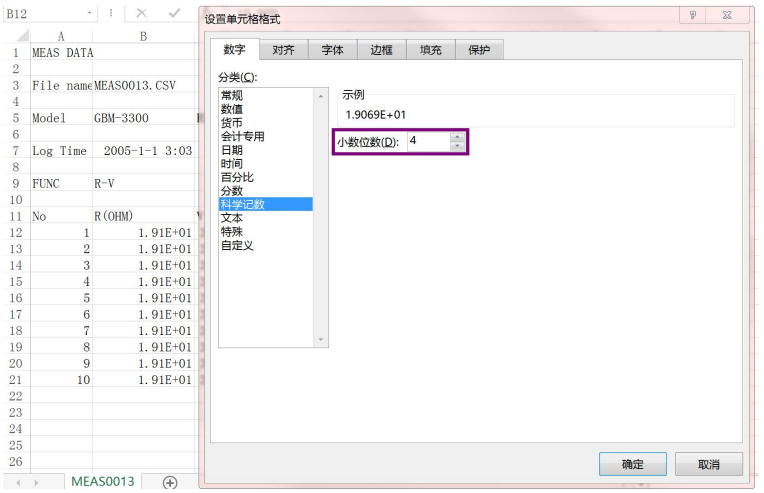
	A	B	C	D
1	MEAS DATA			
2				
3	File name	MEAS0013.CSV		
4				
5	Model	GBM-3300	REV A1.01	
6				
7	Log Time	2005-1-1 3:03	→ 1	
8				
9	FUNC	R-V		
10				
11	No	R(OHM)	V(V)	
12	1	1.91E+01	3.70E+00	
13	2	1.91E+01	3.70E+00	
14	3	1.91E+01	3.70E+00	
15	4	1.91E+01	3.70E+00	→ 3
16	5	2 1.91E+01	3.70E+00	
17	6	1.91E+01	3.70E+00	
18	7	1.91E+01	3.70E+00	
19	8	1.91E+01	3.70E+00	
20	9	1.91E+01	3.70E+00	
21	10	1.91E+01	3.70E+00	
22				

Due to the default format of Excel , you need to modify the cell properties correctly to display the data correctly

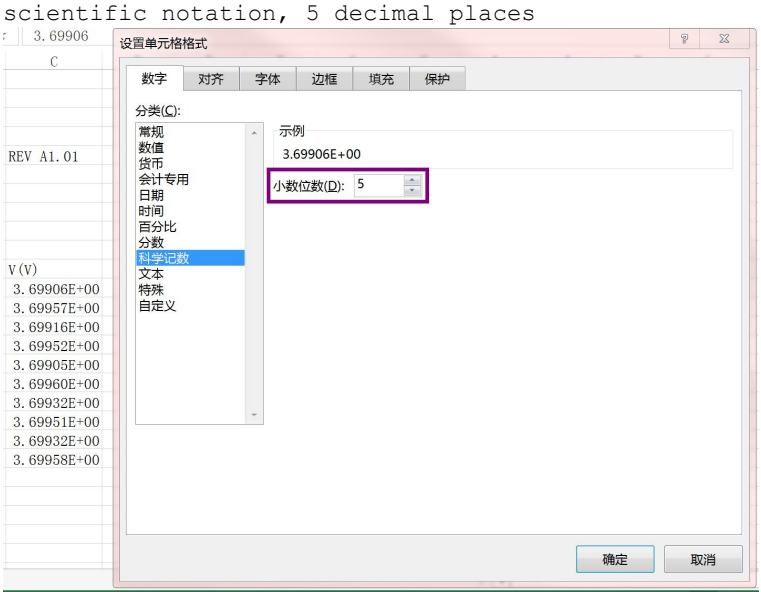
1. Time field 7 B needs to be modified to the following format:



2. You need to select the resistance field and set the cell properties to : scientific notation, 4 decimal places



3. You need to select the voltage field and set the cell properties to : scientific notation, 5 decimal places



Adjusted Excel table:

	A	B	C	D
1	MEAS DATA			
2				
3	File name	MEAS0013.CSV		
4				
5	Model	GBM-3300	REV A1.01	
6				
7	Log Time	2005-1-1 3:03:37		
8				
9	FUNC	R-V		
10				
11	No	R(OHM)	V(V)	
12	1	1.9069E+01	3.69906E+00	
13	2	1.9067E+01	3.69957E+00	
14	3	1.9069E+01	3.69916E+00	
15	4	1.9070E+01	3.69952E+00	
16	5	1.9079E+01	3.69905E+00	
17	6	1.9070E+01	3.69960E+00	
18	7	1.9068E+01	3.69932E+00	
19	8	1.9069E+01	3.69951E+00	
20	9	1.9071E+01	3.69932E+00	
21	10	1.9070E+01	3.69958E+00	
22				

8.2.4 send data to computer

Through SCPI commands, all or single data stored in the buffer can be sent to the computer. For detailed commands, please refer to the SCPI Command Reference - < Logger Subsystem> section .

8.3 Data statistics function

The instrument can perform real-time statistics on the data in the data record, which is convenient for quality control .

8.3.1 Process Capability Index

Process capability, also known as process capability and process capability , refers to the ability to meet the processing quality in process processing. It is a measure of the internal consistency of process processing and the smallest fluctuation in the most steady state. When the process is in a steady state, 99.73% of the quality characteristic values of the product are scattered in the interval [μ-3σ, μ+3σ], (where μ is the overall mean value of the product characteristic value, σ is the overall standard deviation of the product characteristic value), that is, Almost all product characteristic values fall within the range of 6σ. Therefore, 6σ is usually used to represent process capability, and the smaller the value, the better.

usually,

Cp , CpK > 1.33 Process capability is sufficient

1.00 < C p, Cp K ≤ 1.33 Process capability is appropriate

Cp, CpK ≤ 1.00 Insufficient process capability

Process capability index and some related formulas :

1. Mean _ _ _

$$\overline{x} = \frac{\sum_{n=1}^{n} x}{n}$$

2. Parent standard deviation σ n

$$\sigma_n = \sqrt{\frac{\sum (x-\overline{x})^2}{n}} = \sqrt{\frac{\sum x^2 - n\overline{x}^2}{n}}$$

3. Sample standard deviation s(= σ n-1)

$$s = \sigma_{n-1} = \sqrt{\frac{\sum (x-\overline{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - n\overline{x}^2}{n-1}}$$

4. Process Capability Index (Deviation) C p

$$Cp = \frac{|Hi - Lo|}{6\sigma_{n-1}}$$

5. Process Capability Index (Offset) CpK

$$CpK = \frac{|Hi - Lo| - |Hi + Lo - 2\overline{x}|}{6\sigma_{n-1}}$$

Among them , in the above formula ,

a. n Represents valid data, that is, excluding overflow and open circuit values, as long as the data that can display numbers on the screen is regarded as valid values.

b. Cp and CpK The Hi and Lo variables in the formula are the actual values of the upper and lower limits of the comparator . When PER and ABS are compared, the actual value will be converted from the nominal value. This value participates in the operation whether or not the comparator is turned on .

c. Sample standard deviation σ n-1 = 0 , Cp = 99.99 , CpK = 99.99

d. CpK < 0 , CpK = 0

8.3.2 on statistics

SCPI Command: `CALCulate : STATistic [: STATe ] {ON(1),OFF(0)}`

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Data Log] field and set the maximum buffer size.

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

Step 4 _ Use the function keys to select

function keys	Function
close	No statistical calculations are performed .
open	Turn on data statistics operations.

Note

The data statistics function can only be set after [Data Record] is turned on .

data statistics function is turned on, the instrument needs to perform multi- parameter complex operations , and the measurement speed will decrease slightly .

8.3.3 Statistics show

statistics function is enabled, the < Measurement Display> page will display statistical values, and fields such as parameter settings will be hidden and not allowed to be modified .

SCPI Query Command:

Statistics : `CALCu late:STATistic:RESistance:NUMBer ?`
`CALCu late:STATistic: VOLTage :NUMBer ?`

Mean: `CALCu late:STATistic:RESistance: MEAN ?`
`CALCulate:STATistic:VOLTage:MEAN?`

Max: `CALCulate:STATistic:RESistance:MAXimum?`
`CALCulate:STATistic:VOLTage:MAXimum?`

Min: `CALCulate:STATistic:RESistance:MIMimum?`
`CALCulate:STATistic:VOLTage:MIMimum?`

Count: `CALCulate:STATistic:RESistance:LIMit?`
`CALCu late:STATistic: VOLTage : LIMit ?`

Standard deviation value : `CALCu late:STATistic:RESistance: DEViation ?`
`CALCu late:STATistic: VOLTage : DEViation ?`

Process capability index : `CALCu late:STATistic:RESistance: CP ?`
`CALCu late:STATistic: VOLTage : CP ?`

Figure 8 - 7 Statistics display

Among them ,

Field [R - No], [V-NO] is a valid quantity .

Fields【R - CpK 】、 【 V - CpK 】 are statistical parameter settings

Set statistical parameters

step 1 On the <Measurement Display > page

Step 2 Use the cursor keys to select the [R - CpK] or [V- CpK] field .

Step 3 Use the function keys to select statistical parameters

function keys	Function
M EAN ($\bar{x}$)	average value
M AX	maximum value
MIN	minimum
σ	maternal standard deviation
s	sample standard deviation
C p	Process Capability Index (Deviation)
C pK	Process Capability Index (Offset)

9. System Configuration

In this chapter you will learn about the system configuration of the instrument :

- System Configuration Page
- system information page

At any time, you only need to press the [Meas] or [Setup] key, and the [System] key will appear at the bottom of the main page.

SCPI Command: `DISP:PAGE SYSTEM`

9.1 System Configuration Page

Under the [Meas] or [Setup] main page, press [System] to enter the <System Configuration> page.

All settings on the system configuration page will be automatically saved in the system and will be automatically loaded the next time the system is powered on.

Figure 9 - 1 < System Configuration> page

9.1.1 Change the system language [LANGUAGE]

SCPI Command: `SYSTem:LANGuage {ENGLISH,CHINESE,EN,CN}`

The instrument supports both Chinese and English languages.

■ **Steps to change the language**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select 【LANGUAGE 】 .

Step 3 Use the function keys to select the language:

function keys	Function
Chinese [CHN]	
ENGLISH	English

9.1.2 Modified date and time

SCPI Command: `SYSTem:TIME <YEAR>,<MONTH>,<DAY>,<HOUR>,<MINUTE> ,<SECOND>`

SCPI Query Command: `SYSTem:TIME ?`

The instrument uses a 24-hour clock.

- **Change date:**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Date] field.

Step 3 To set the date using the function keys:

function keys	Function
Year+	+1 year
year-	-1 year
month+	+1 month
day+	+1 day
day-	-1 day

- **Change the clock:**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Clock] field.

Step 3 To set the clock using the function keys:

function keys	Function
time+	+1 hour
Time-	-1 hour
points+	+1 minute
Minute-	-1 minute
seconds+	+1s
Second-	-1 second

9.1.3 account setting

The instrument has two user modes to choose from:

- Administrator – Except the [System Services] page, other functions are open to the administrator, and the parameters set by the administrator are saved in the system memory after a delay of 5 seconds, which is convenient for loading after the next boot.
- User - Except the [System Services] and [File] pages, users can operate other functions. The data modified by the user will be restored to the value set by the administrator after the next boot.

- **Change account:**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Account] field.

Step 3 Use the function keys to change:

function keys	Function

administrator	All functions except the [System Services] page are open If you forget your password, please call our sales department.
user	Except for the functions of the [System Services] page and the [File] page, which can be operated, the set data is not allowed to be saved.

■ **Administrator password settings:**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Account] field.

Step 3 Use the function keys to select:

function keys	Function
change the password	Enter a numeric password of up to 9 digits, including only numbers and symbols.
remove password	Admin will not be password protected

9.1.4 【Key tone 】setting

SCPI Command: `SYSTEM:BEEP {OFF (0) , ON(1) }`

SCPI Query Command: `SYST em : BEEPer ?`

■ **Set key tone**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the 【Key Tone 】field;

Step 3 Use the function keys to select

function keys	Function
closure	key tone on
Open	key tone off

9.1.5 【Remote Communication】setting

The instrument has built-in RS-232 interface and USB communication interface . The instrument only supports one of these interfaces, and 【Remote Communication】 allows you to choose one of them.

If the RS232 interface is selected, please insert the communication cable into the RS-232C interface on the rear panel of the instrument .

If the USB interface is selected , please insert the communication cable into the USB interface on the rear panel of the instrument .

■ **Select remote communication interface type**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Remote Settings] field;

Step 3 Use the function keys to select

function keys	Function
RS232	R S-232 interface
USB	USB communication interface

9.1.6 【Stop Bit 】and 【 Baud Rate 】 settings

The instrument has built-in RS-232 and USB-232 interfaces. After the instrument senses that the RS-232 or USB interface has signal conversion, it immediately communicates with the host at the set baud rate, and the keyboard is locked at the same time.

In order to communicate correctly, please confirm whether the baud rate and stop bit are set correctly, otherwise the host computer cannot communicate correctly.

The RS-232 configuration is as follows:

- Data bits: 8 bits
- Stop Bits: Configurable
- Parity: none
- Baud rate: configurable

Usually communicate with PC, use 1 stop bit.

■ **Set stop bits :**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Stop Bit] field;

Step 3 Use the function keys to select

function keys	Function
1 person	Usually 1 stop bit
2 digits	

■ **Set the baud rate:**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Baud Rate] field;

Step 3 Use the function keys to select

function keys	Function
1200	Use this baud rate if you are using a communications converter with optocoupler isolation.
9600	
38400	
57600	
115200	It is recommended that you use this high-speed baud rate for communication with the host computer.

9.1.7 【Communication Protocol】Select

The instrument supports two communication protocols: SCPI and Modbus (RTU) protocol. Usually, it is more convenient to use SCPI to communicate with a computer, and to communicate with industrial control equipment such as PLC, the Modbus protocol is easier to use.

Select communication protocol:

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Communication Protocol] field;

Step 3 Use the function keys to select

function keys	Function
SCPI _	
Modbus _	

9.1.8 Modbus【Station No.】Select

If you use Modbus (RTU) protocol, you need to set the station number address of the machine .

Select Modbus Station No:

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Station No.] field;

Step 3 Use the function keys to select

function keys	Function
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	
13	
14	
15	

In order to facilitate the simultaneous operation of multiple identical instruments , the instrument is allowed to use station number 00 for broadcast communication, and station number 00 for communication, the instrument only receives commands , but cannot return response codes.

9.1.9 SCPI【Terminator】、【Instruction Handshake 】 、 【 Error Code 】 setting

The instrument RS-232 is programmed using the SCPI language.

use the SCPI protocol, please make SCPI related settings first .

Terminator: There must be a terminator in the communication command between the instrument and the host , so as to facilitate mutual identification of the end of the command .

Instrument supports 3 types of terminators :

terminator _	ASCII name	ASCII hex	number of bytes	illustrate
LF(0x0A)	newline	0x0A _	1 byte	Instrument default
CR (0x0D)	carriage return	0x0D _	1 byte	
CR +LF	carriage return + line feed	1st byte 0 x 0D 2nd byte 0x0A	2 bytes	
NUL (0x00)	null character	0 x 0 0	1 byte	

Instruction handshake:

After the command handshake is turned on, all commands sent by the host to the instrument will be returned to the host as they are, and then the data will be returned.

Commands sent by the host to the instrument will be processed immediately after the command handshake is turned off.

SCPI Command: `SYSTem: SHAKhand { ON,OFF,0,1}`

SCPI Query Command: `SYSTem: SHAKhand ?`

Error code :

SCPI Command: `SYSTem: CODE {ON,OFF,0,1}`

SCPI Query Command: `SYSTem: CODE ?`

error code is turned on, the instrument will return an error code after receiving the command . If it is a query command, an error code will be returned only if the command is wrong .

error code is closed, the host can send the command by ERR? Query the error code generated by the last command execution .

■ **set terminator**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Terminator] field;

Step 3 Use the function keys to select

function keys	**Function**
LF(0x0A)	newline
CR (0x0D)	carriage return
C R+LF	carriage return + line feed

■ **Steps to set up the command handshake:**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Command handshake] field;

Step 3 Use the function keys to select

function keys	**Function**
close	No instruction handshake is used. There is no special requirement, please set Command Handshake to Off.

open	

■ **error code setting :**

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to select

function keys	Function
close	Error codes are not automatically returned.
open	error code returns the execution error code after executing the single-line instruction .

9.1.10 SCPI [result sending] method

SCPI Command: `SYSTem: RESult {FETCH,AUTO}`

SCPI Query Command: `SYST: RESult ?`

The instrument supports the function of automatically sending data to the host. The data will be automatically sent to the host after each test, without the host sending a FETCH ? command.

The instrument sends the test results and comparator results to the host after each test. Please refer to the Fetch? subsystem for the format .

Steps to set [Result Send]:

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the 【Result Send】field;

Step 3 Use the function keys to select

function keys	Function
FETCH	Use the command FETCH? Get all measurement data
automatic	Automatically sent to the host after each test is completed

9.1.11 [Data Record] and [Data Statistics] functions

The instrument has the function of [Data Recording] , which can record 10000 groups of data and perform statistical operations .

These data can be sent to a computer through the communication interface, or directly saved in CSV format text to a USB disk.

[Data Statistics] function can be enabled separately, and the [Data Statistics] function can be set only after the [Data Recording] function is enabled .

detailed data statistics description, please refer to the data statistics chapter.

set 【Data Record 】:

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the 【Data Record 】field;

Step 3 can be selected using the function keys

function keys	Function

OFF	Data logging is turned off. After closing , the [Record] field will not appear on the <Measurement Display > page .
M AX	data logging function is turned on, and the data logging buffer is set to the maximum: 10000 groups. enabled , the [Record] field will appear at the top of the <Measurement Display > page .

Step 4 You can also directly use the numeric keyboard to input the required buffer size.
For example : 100 <Enter > sets the buffer size to 100 groups .
Once entered , the [Record] field will appear at the top of the <Measurement Display > page .

■ **【Data Statistics 】 function settings :**

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Data Statistics] field;

Step 3 Use the function keys to select

function keys	**Function**
close	No statistical calculations are performed .
open	Turn on data statistics operations.

Note

The data statistics function can only be set after [Data Record] is turned on .
data statistics function is turned on, the instrument needs to perform multi- parameter complex operations , and the measurement speed will decrease slightly .

9.1.12 【Power frequency filter】Select

The measurement stability of the instrument depends on the power frequency. Please select it according to the power frequency of the current region. If you cannot determine it, please select AUTO, and the instrument will automatically set the power frequency of the current region.

Select line frequency filter:

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Power Frequency Filter] field;

Step 3 Use the function keys to select

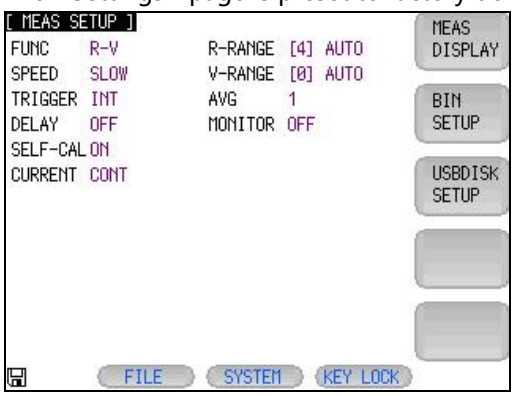
function keys	**Function**
A UTO	auto configuration
50Hz _	Set to 50Hz power frequency, China's power frequency is 50Hz
60Hz _	Set to 60 Hz power frequency

9.1.13 【Factory setting 】

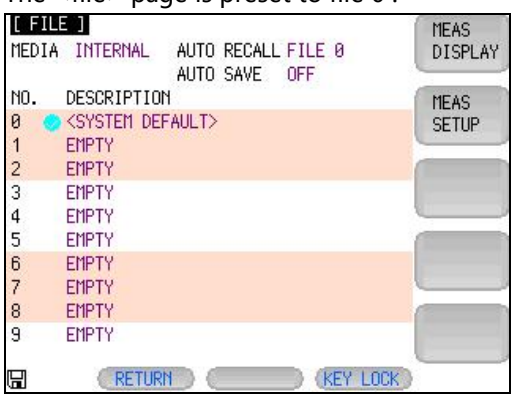
performing the factory settings, all settings of the instrument will be restored to the parameters preset at the factory , including:

1. All settings on the <System Settings> page are restored to factory defaults:

2. The <Settings> page is preset to factory defaults :



3. The <file> page is preset to file 0 :



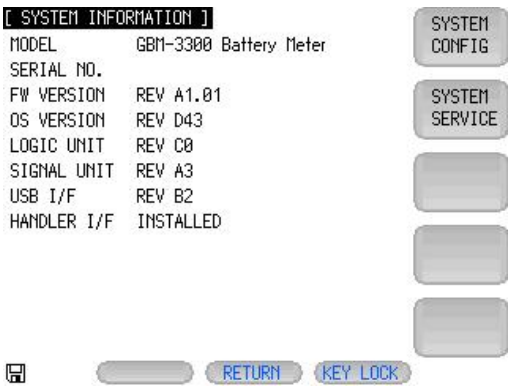
9.2 system information page

Press 【 Meas 】or【Setup】 to enter the main page, press【System】key in the task bar at the bottom to enter the <System Configuration> page, press the function key to select【System Information】.

SCPI Command: `DISP:PAGE SYSTEMINFO`

The system information page has no user-configurable options.

Figure 9 - 2 < System Information> page


[SYSTEM INFORMATION]
MODEL GBM-3300 Battery Meter
SERIAL NO.
FW VERSION REV A1.01
OS VERSION REV D43
LOGIC UNIT REV C0
SIGNAL UNIT REV A3
USB I/F REV B2
HANDLER I/F INSTALLED
SYSTEM CONFIG
SYSTEM SERVICE
RETURN
KEY LOCK

10. Handler interface

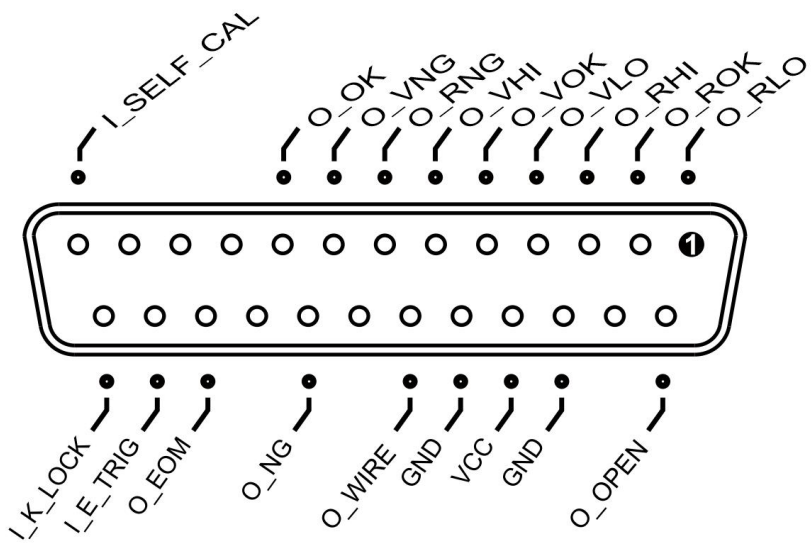
You will learn the following:

- Terminals
- How to connect and interface the schematic

The instrument provides users with a fully functional processor interface, which includes qualified sorting output, HI/IN/LO, EOC (test completion signal), TRIG (external trigger start) input and other signals. Through this interface, the instrument can easily complete the automatic control function with the user's system control components.

10.1 Terminals and Signals

Figure 10 - 1 Terminals



- Output (all signals are active low)

Table 10 - 1 output pin definition

pin	name	illustrate
1	O_RLO	0 : RLO
2	O_ROK	0: ROK
3	O_RHI	0: RHI
4	O_VLO	0 : VLO
5	O_VOK	0: VOK
6	O_VHI	0 : VHI
7	O_RNG	0: RNG
8	O_VNG	0: VNG

9	O_OK	0: RVOK
14	O_OPEN	0: OPEN
21	O_NG	0: RVNG
23	O_EOM	1: ON MEASING 0: READY

■ ??

Table 10 - 2 input pin definition

pin	name	illustrate
13	SELF-CAL	0: Self-calibration
twenty four	T RIG	Active on rising edge.
25	KEYLOCK	0: KEYLOCK 1: UNLOCK

■ power supply

Table 10 - 3 power supply pin definition

pin	name	illustrate
16,18 _	GND	External power GND terminal
17	***VCC***	***Positive terminal of internal VCC power supply (5 V, 1 A)***

10.2 Connection method

■ The instrument has a built-in fully isolated power supply, and there is no need to provide the positive terminal of the power supply externally.

Please connect the external power supply to the following pins at the same time: Pins
16 and 18: External power supply GND
17 feet: floating.

10.2.1 Use internal power

In the case of unknown or uncertain power, the internal power supply cannot be used, otherwise the meter will not work properly.
In known low-power applications, you can use the internal power supply to work, but may make the instrument less immune to interference.

Internal power supply: 5V max 1A.
Using the internal power supply:
17 : VCC (5V)
16 and 18: GND

10.2.2 Electrical parameters

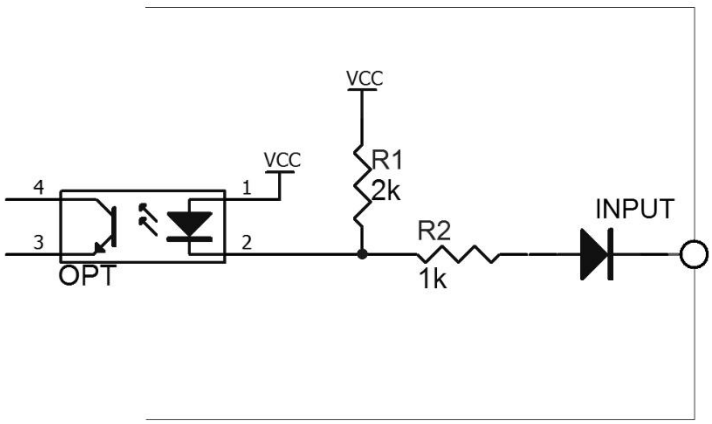
Power Requirements: +3.3V~30VDC
Output signal: Darlington collector output with built-in pull-up resistor. optocoupler isolation. Active low.
Maximum voltage: 30 VDC with built-in 30V clamp circuit.
Input signal: optocoupler isolation. Active low.

Maximum current: 50mA

Note: To avoid damage to the interface, the power supply voltage should not exceed the power requirements.
To avoid damaging the interface, wire the instrument with the instrument turned off.
The instrument adopts Darlington-driven output, which can drive low-power relays and signal relays , and reverse diodes have been integrated inside the instrument .

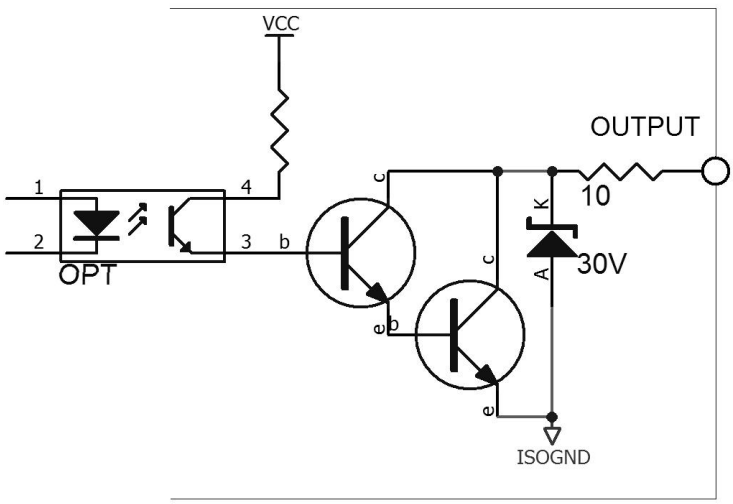
10.2.3 Input Schematic

Figure 10 Schematic diagram of - 2 input terminals (Trig)



10.2.4 Schematic of the output terminal

Figure 10 Schematic diagram of - 3 output terminals



10.2.5 Input circuit connection method

Figure 10 - 4 Connection with switch

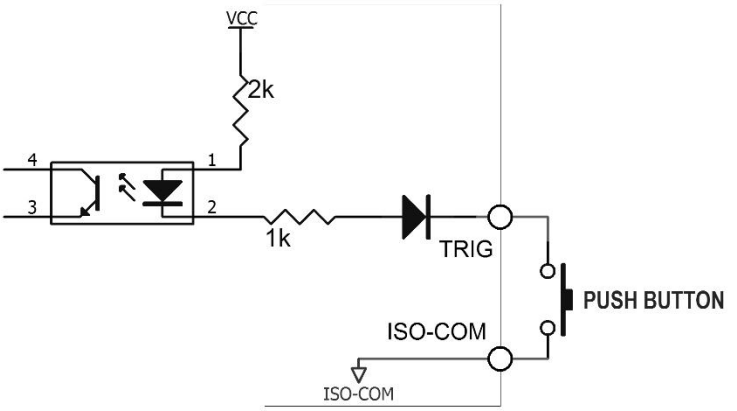


Figure 10 - 5 Using Relay Control

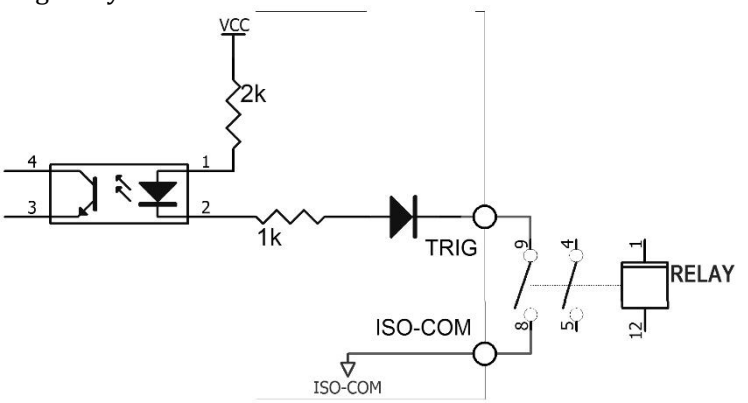


Figure 10 - 6 Use PLC negative common terminal to control

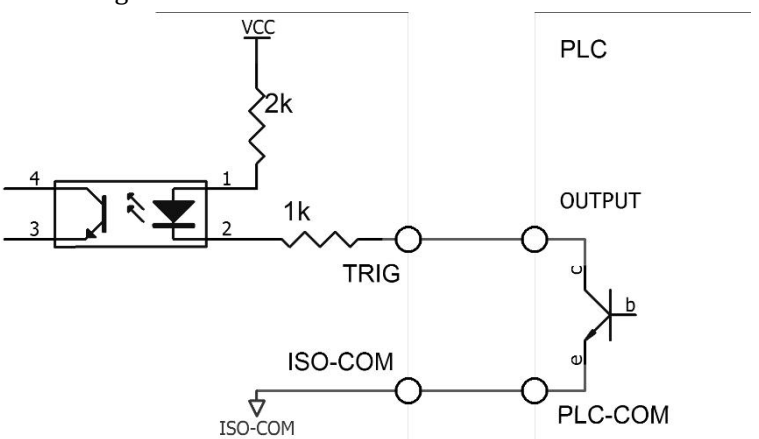
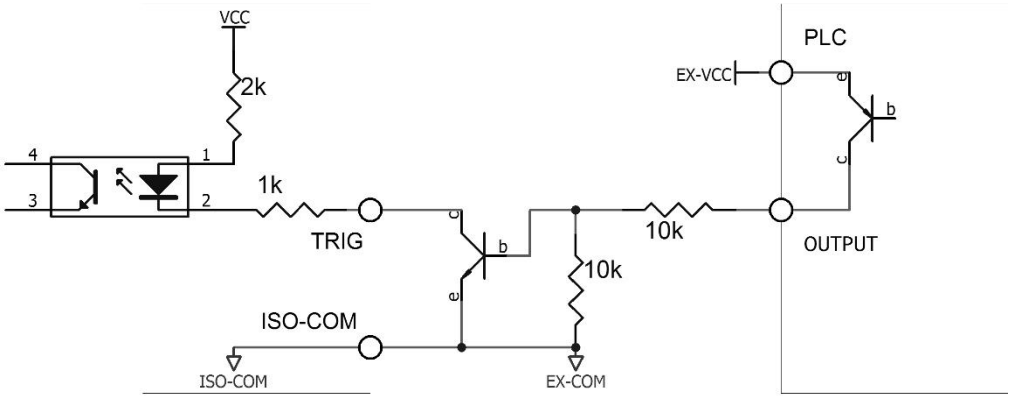


Figure 10 - 7 Use PLC positive common terminal to control



10.2.6 Output circuit connection

Figure 10 - 8 Control Relay

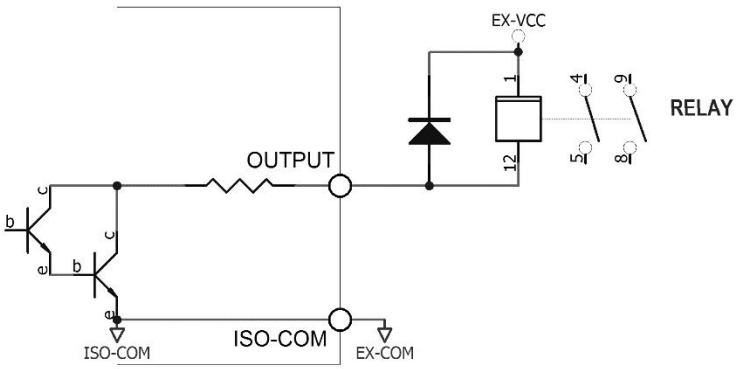


Figure 10 - 9 Controlled LED or optocoupler

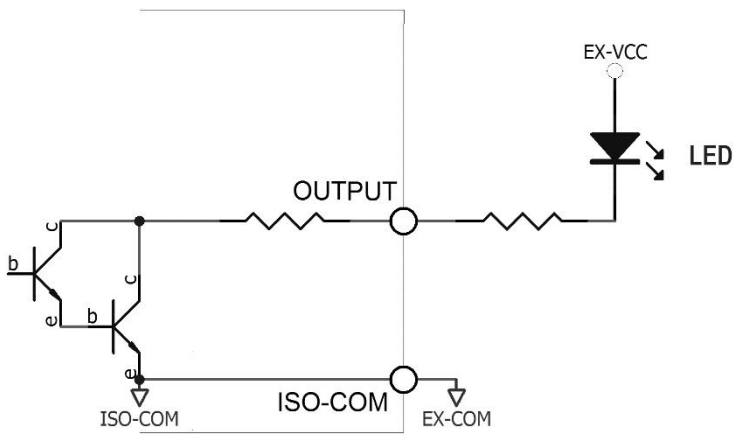


Figure 10 - 10 Negative Logic Output

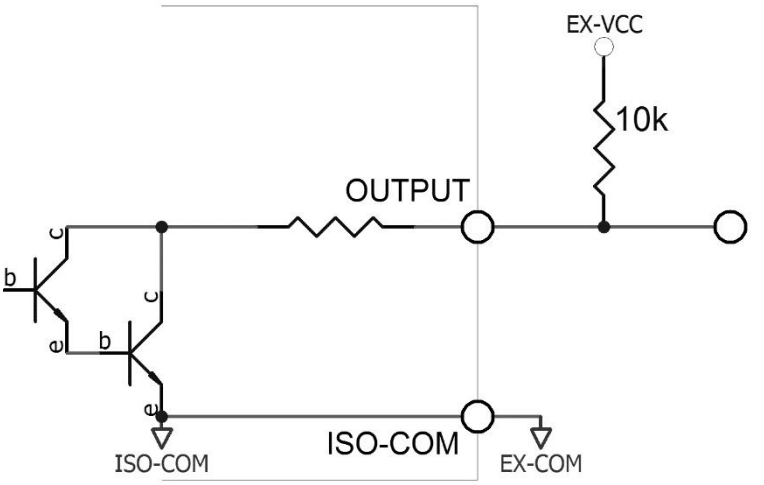


Figure 10 - 11 dual-port output constitutes a logic OR circuit

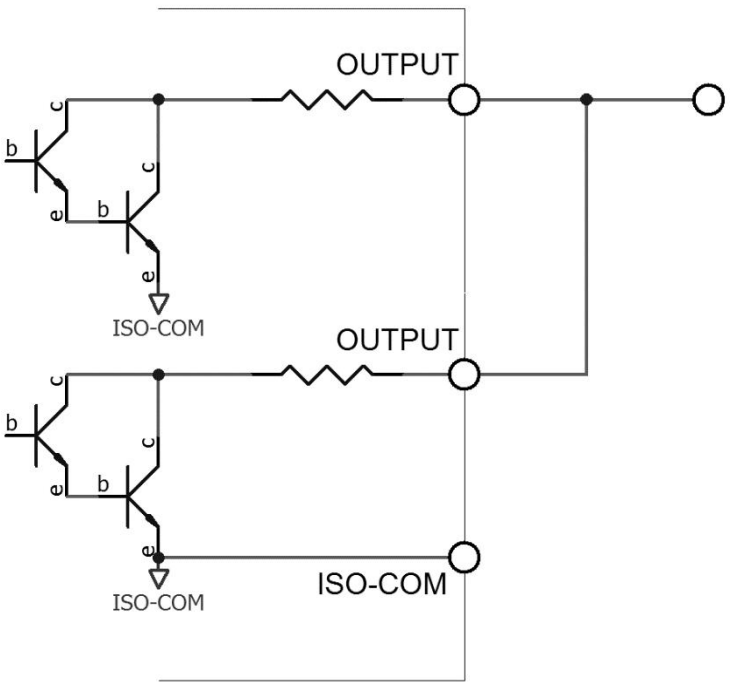


Figure 10 - 12 output to PLC negative common terminal

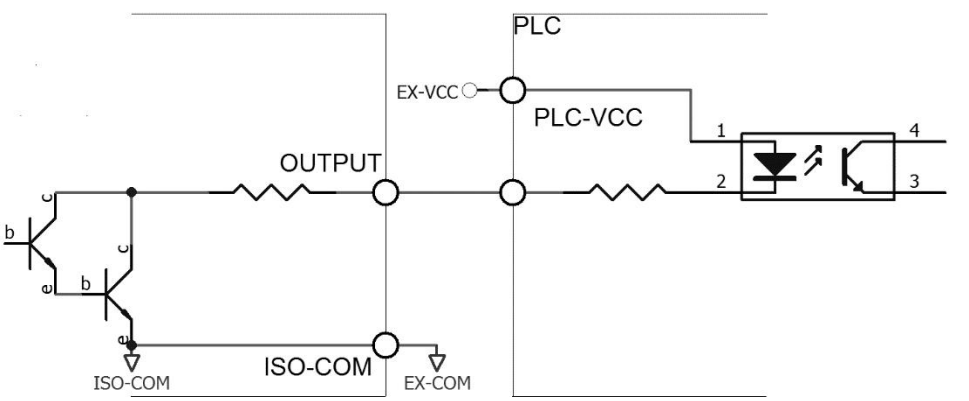
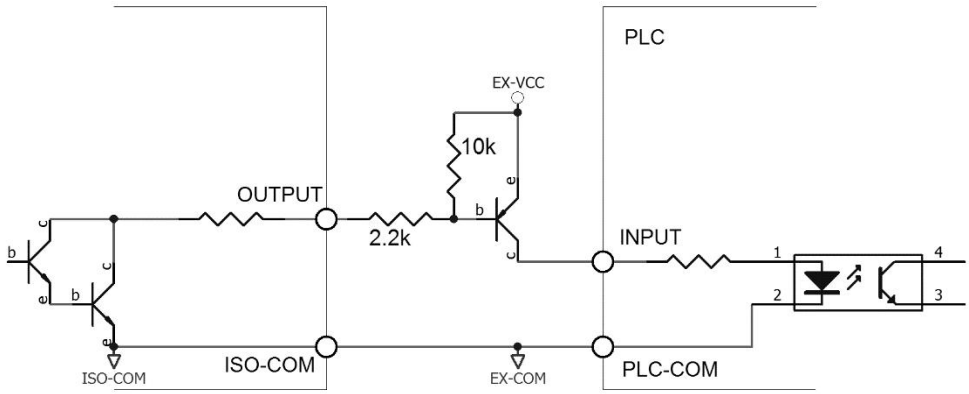


Figure 10 - 13 output to PLC positive common terminal



10.3 Periodic Table

Figure 10 - 14 Periodic Table

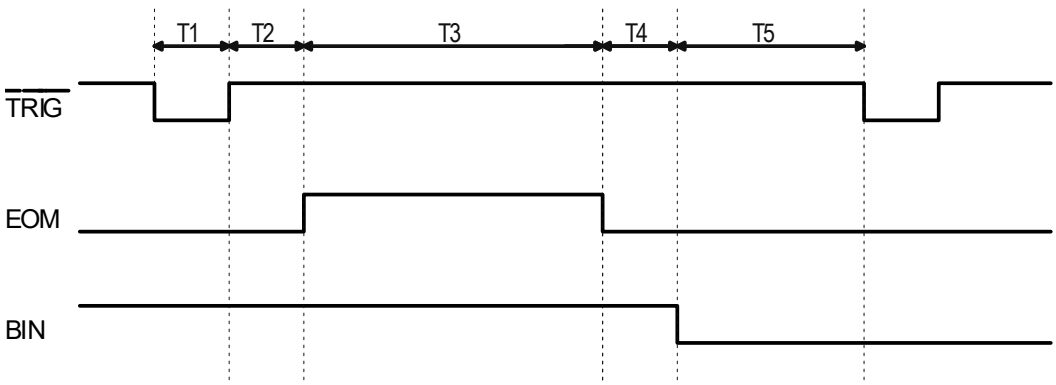


Table 10 - 4 Schedule

describe			minimum
T1	Trigger pulse width		1ms
T 2	Measurement period	Trigger delay	< 10 μs
T3 _		measure time	related to settings
T4 _		BIN output delay	200 μs
T5 _	wait time after trigger		0 s

11. remote communication

You will learn the following:

- Introducing the RS-232 Interface
- RS-232 connection.
- Select the baud rate .
- Software Agreement.

The instrument uses the RS-232 interface (standard configuration) to communicate with the computer to complete all instrument functions. Through standard SCPI commands, users can also easily program various collection systems suitable for themselves.

11.1 RS-232C

RS-232 is a serial communication standard widely used at present, also known as an asynchronous serial communication standard, which is used to realize data communication between computers and between computers and peripherals. RS is the English abbreviation of "Recommended Standard", and 232 is the standard number. This standard is a standard officially announced by the Electronic Industries Association (EIA) in 1969. It stipulates that one bit at a time is transmitted through a data line.

Most serial port configurations are usually not strictly based on the RS-232 standard: 25-pin connectors are used on each port (most modern computers use 9-pin connectors). The most commonly used RS-232 signals are shown in the table:

Table 11 - 1 Commonly used RS-232 signals

Signal	symbol	25 pin connector pin number	9-pin connector pin number
request to send	RTS	4	7
clear to send	CTS	5	8
data setup preparation	DSR	6	6
data carrier sounding	DCD	8	1
data terminal preparation	DTR	20	4
send data	TXD	2	3
Receive data	RXD	3	2
ground	GND	7	5
request to send	RTS	4	7

In addition, RS232 also has a minimum subset, which is also the connection method used by the instrument.

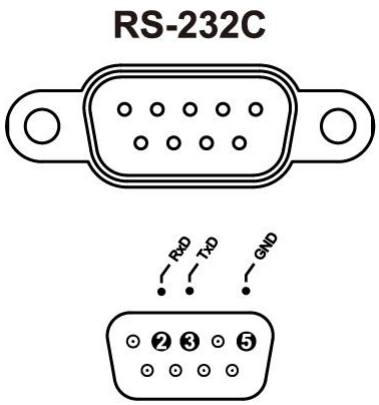
Table 11 - 2 Minimum subsets of the RS-232 standard

Signal	symbol	9-pin connector pin number
send data	TXD	2
Receive data	RXD	3

ground	GND	5

11.1.1 RS 232Cinterface

Figure 11 - 1 RS-232 interface on the rear panel [male]



Recommendation: To avoid electrical shock, turn off the power of the instrument when plugging or unplugging the connector .

- Instrument default communication settings:

Transmission mode: full-duplex asynchronous communication with start bit and stop bit

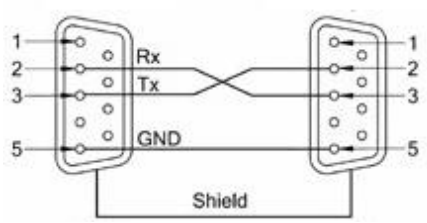
Data bits: 8 bits

Stop bit: 1 bit

Check Digit: None

11.1.2 Connection method

Figure 11 - 2 RS-232 interface on the rear panel [male]



The RS-232 serial interface can be interconnected with the serial interface of a controller (eg, a personal computer or industrial computer) through a 2-3 crossover DB-9 cable. Protocol

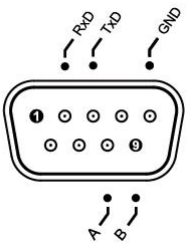
11.2 RS485 interface

Since the instrument version number is Rev C1.02 , the instrument comes standard with an RS485 interface.

RS 485 is a communication interface that supports multi-machine communication, which can be connected in parallel with multiple slave machines through one host .

detailed RS485 specification is not the focus of this user manual, please refer to https://en.wikipedia.org/wiki/RS-485

instrument 's RS485 interface and RS232 interface share the same DB9 terminal:



pin	Function
8	A
9	B

11.3 USB interface _

On some newer computers and laptops, the RS 232 interface has been eliminated, and a USB interface is required for communication. The instrument has a built-in USB -232 interface, which can be directly used in the computer to virtualize the USB as an RS 232 port. This virtual port can achieve the same function as RS 232 .

11.3.1 Enable the USB function in the instrument

/RS232 option on the [System Settings] page of the instrument . Before using the USB interface for communication, please set it to USB :

enable USB :

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the [Remote Control] field;

Step 3 Use the function keys to select

function keys	**Function**
USB _	USB interface is valid
RS 232	RS 232 (DB9) interface available

11.3.2 Install the driver on the computer

USB interface requires drivers to be installed on the computer to work properly.

install the USB driver:

step 1 Plug the USB cable into the computer and instrument:

Step 2 In the device manager of the computer, it will prompt as

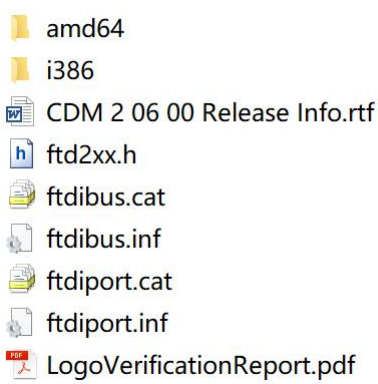
other devices

Drivers need to be installed at this point.

Step 3 Insert the supplied CD-ROM.

The folder is:

FTDI Driver

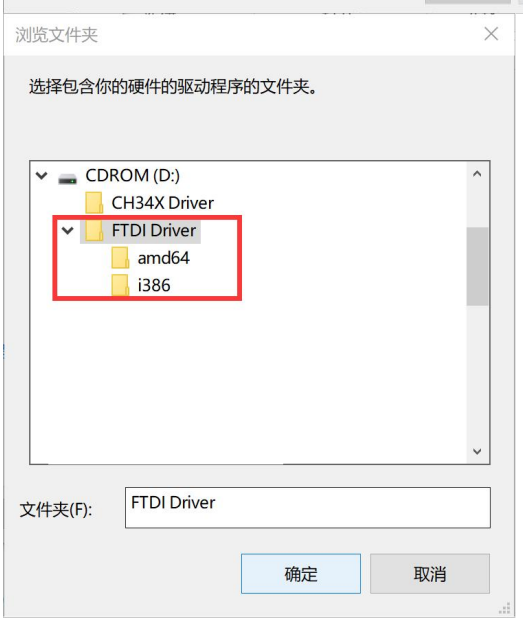


Step 4 Use the right mouse button to click on the USB Serial Port

Select: Update Driver:

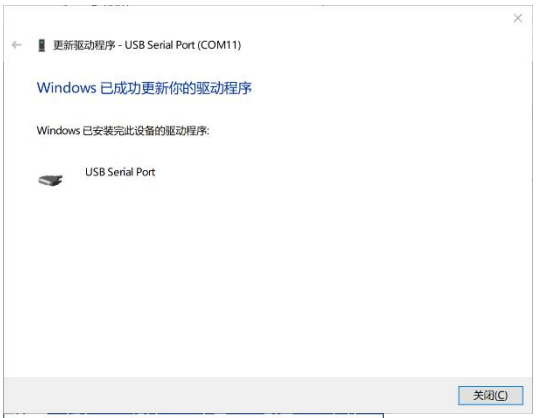
Select **Browse my computer for driver software**

Step 5 Select Browse on the pop-up window that follows:



Select to the CD ROM drive letter, click F TDI D river.

Step 6 Wait for the installation to complete:



Step 7

Step 8 Windows 10 , the driver installation is complete.

but in Windows Installing the driver on some older operating systems such as XP may require repeating the steps from step 2 again to be fully completed.

You need to record this port number, you need to use it when programming.

So far, so the SCPI commands and Modbus Instructions can be operated through this port.

11.4 Protocol

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

SCPI protocol :

It is the abbreviation of English Standard Commands for Programmable Instruments: SCPI. The SCPI protocol defines a standard set of syntax and commands for controlling programmable test and measurement instruments. SCPI commands are transmitted using ASCII strings to the instrument via the physical transport layer. Commands consist of a series

of keywords, and some also need to include parameters. In the protocol, commands are specified in the form: CONFigure . In use, either the full name or the abbreviation containing only capital letters can be written. The instrument's feedback to the query command is also ASCII code. In fact, for simple applications (such as PLCs), it is only necessary to translate the instructions into HEX bytes and transmit them byte by byte.

Modbus (RTU) protocol

Modbus protocol is a general language applied to electronic controllers, mainly used for bus protocols in industrial fields. It is the communication standard of industrial control equipment such as PLC and touch screen.

12. S CPI Command Reference

This chapter covers the following areas :

- Command Parser - Learn some rules of command parser .
- Command syntax - rules for writing command lines
- Query syntax - writing rules for query commands
- query response - the format of the query response
- Command Reference

This chapter provides all SCPI commands used by the instrument, through which all functions of the instrument can be fully controlled.

12.1 handshake protocol

Since the instrument uses the smallest subset of the RS-232 standard and does not use hardware handshake signals, in order to reduce possible data loss or data errors in communication, the instrument can enable software handshakes. Advanced language software engineers should strictly follow the following handshakes Protocol, for the preparation of computer communication software:

- The instrument command parser only accepts ASCII format, and the command response also returns ASCII code.
- **The command string sent by the host must end with a terminator, and the instrument command parser starts executing the command string after receiving the terminator** .
- The instrument can set the command handshake: `every time the instrument receives a character, it immediately sends the character back to the host, and the host can only continue to send the next character after receiving the echo character.`

Tip: If the host cannot receive the data returned by the instrument, you can use the following methods to try to solve the problem:

1. Software handshake is disabled, please refer to the instrument <System Settings> page to enable it.
2. Serial port connection failure, please check cable connection.
3. The communication format of the high-level language program on the computer side is incorrect. Please try to check if the serial port number, the communication format is correct and if the baud rate is the same as the instrument setting.
4. If the instrument is parsing the last command and the host cannot receive a response from the instrument, please try again later.

<The problem still cannot be solved, please consult the technical engineer of Anbai Instruments immediately>

12.2 terminator

Instrument supports 4 types of terminators :

LF (hex : 0x0A)

CR (hex : 0x0 D)

CR+LF (hex : 0x0D 0x0A)

N UL (hex : 0x0 0)

terminator can be selected in the system configuration page, and the instrument defaults to LF.

Notice:

The instrument allows the command sent by the host without a terminator, but it is recommended to add a terminator at the end of the command, otherwise it will increase the timeout after each command is received (depending on the baud rate, the command timeout is 10ms ~ 50ms).

12.3 command string parsing

The host can send a string of commands to the instrument, and the instrument command parser starts parsing after catching a terminator (\n) or an input buffer overflow.

E.g: Valid command strings:

AAA:BBB CCC;DDD EEE;:FFF

The instrument command parser is responsible for all command parsing and execution, and you must first understand its parsing rules before writing a program.

12.3.1 Command Parsing Rules

1. command parser only parses and responds to ASCII data.
2. **The SCPI command string must end with NL (' \n ' ASCII 0x0A)** , and the command parser will start executing the command string after receiving the terminator or buffer overflow.
3. If the command handshake is turned on, the command parser will send the character back to the host immediately after receiving the character, and the host can only continue to send the next character after receiving the echo character.
4. After the command parser finds an error, it immediately terminates the parsing, and the current command is invalid.
5. After the command parser parses the query command, it terminates the parsing of the command string, and then the string is ignored.
6. The parsing of command strings by the command parser is not case-sensitive.
7. The command parser supports command abbreviations, and the abbreviation specifications are described in the following chapters.

12.3.2 Notational Conventions and Definitions

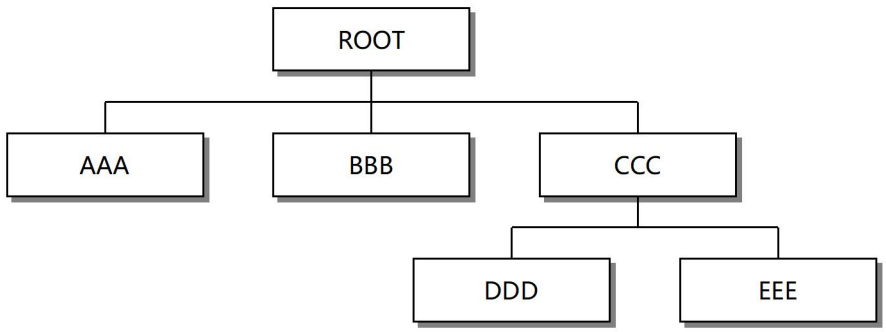
This chapter uses some symbols that are not part of the command tree, but are used for better understanding of command strings.

< >	The text in angle brackets indicates the parameters of the command
[ ]	Text in square brackets indicates optional commands
{}	When braces contain several parameter items, it means that only one item can be selected.
( )	The abbreviated form of the parameter is enclosed in parentheses. Abbreviated form of uppercase command.

12.3.3 command tree structure

tree structure is used for SCPI commands , which can go down to three levels (note: the command parser of this instrument can parse down to any level) , and the highest level is called subsystem command here. This subordinate command is valid only when a subsystem command is selected . SCPI uses a colon (:) to separate high-level and low -level commands.

Figure 12 - 1 Command tree structure



for example

ROOT:CCC:DDD ppp

ROOT subsystem command

CCC Level 2

DDD Level 3

ppp parameter

12.4 Commands and Parameters

A command tree consists of **commands and [parameters]** , separated by a space (ASCII: 20H).

for example

AAA:BBB 1.234

command [parameters]

12.4.1 Order

The command word can be in the long command format or the abbreviated form. Using the long format is convenient for engineers to better understand the meaning of the command string; the abbreviated form is suitable for writing.

12.4.2 parameter

- Single command word command, no parameters.
  For example: AAA:BBB
- Arguments can be strings, and their abbreviation rules still follow the "Command Abbreviation Rules" in the previous section.
  For example: AAA:BBB 1.23
- Arguments can be in numeric form
  - < *integer* > integer 123, +123, -123
  - < *floa t*> floating point number
    1. < fixfloat >: Fixed-point float: 1.23, -1.23

2. < Sciloat >: Scientific floating point number: 1.23E+4, +1.23e-4

3. < mpfloat >: floating point number represented by magnification: 1.23k, 1.23M, 1.23G, 1.23u

Table 12 - 1 magnification abbreviation

Numerical value	magnification
1E18 (EXA)	EX
1E15 (PETA)	PE
1E12 (TERA)	T
1E9 (GIGA)	G
1E6 (MEGA)	MA
1E3 (KILO)	K
1E-3 (MILLI)	M
1E-6 (MICRO)	U
1E-9 (NANO)	N
1E-12 (PICO)	P
1E-15 (PEMTO)	F
1E-18 (ATTO)	A

Tip: The magnification is not case-sensitive, and its writing is different from the standard name.

12.4.3 delimiter

The instrument command parser accepts only allowed delimiters, otherwise the delimiter command parser will generate an "Invalid separator " error. These delimiters include:

; semicolon, used to separate two commands.

For example: AAA:BBB 100.0 ; CCC:DDD

: colon, used to separate command trees, or command tree restarts.

For example: AAA : BBB : CCC 123.4; : DDD : EEE 567.8

? Question mark, used for query.

For example: AAA ?

□ Space, used to separate parameters.

For example: AAA:BBB□1.234

12.4.4 error code

The instrument will temporarily store the processing result of each received command in the buffer. Before the next command is sent, can it pass the ERR? command to get the status. If the error code function is enabled in [System Configuration], the instrument will automatically return the processing result after processing the command.

Table 12 - 2 SCPI error codes

error code	illustrate	explain
* E00	N O ERROR	no errors
* E01	B AD COMMAND	command error
* E02	PARAMETER ERROR	Parameter error
*E 03	M ISSING PARAMETER	Missing parameters,

		Command with parameters, no parameters provided
*E 04	I NPUT BUFFER OVERRUN	Receive buffer overflow, instrument maximum buffer is 1000 bytes
*E 05	S YNTAX ERROR	Grammatical errors
*E 06	I NVALID SEPARATOR	invalid delimiter
*E 07	I NVALID MULTIPLIER	Invalid magnification unit
*E 08	BAD N UMERIC DATA	Numerical error
*E 09	V ALUE TOO LONG	value is too long, the value parameter exceeds 20 bytes
*E 10	I NVALID COMMAND	Invalid command, the command is invalid under certain conditions
* E11	U NKNOWN ERROR	unknown errors other than the above errors

12.5 Display display page subsystem

DISPlay subsystem can be used to switch between different display pages or to display a string of text on the page prompt bar.

Figure 12 - 2 DISPlay subsystem tree

DISPlay	**:PAGE**	**{MEASurement,ENLArge,SETUp(MSET), BinSETup (BSET) ,CORR ection , CATAlog,SYSTem,SYSTEMINFO(SINF)}**
	:LINE	**<string>**

12.5.1 DISPlay:PAGE

DISP:PAGE is used to switch to the specified page.

Command syntax: **DISPlay : PAGE <page name>**

parameter:

< page name > includes:

MEASurement	measurement display page
ENL Arge	full screen page _
SETUp (MSET)	setup page
BinSETup (BSET)	Comparator Setup Page
CORR ection (CSET)	short circuit clear page
CAT A log (FILE)	file page
SYSTem	system configuration page
SYSTEMINFO (SINF)	system information page

E.g: send **> disp : page setup** <NL> // Switch to the setup page

Query syntax: **DISP:PAGE?**

Query response:

<page name> abbreviation
meas
enla
mset
bset
cset
cata
syst
sinf

E.g: send **> disp:page ?**

Return **> meas**

send **> disp:page meas;page ?**

Return **> meas**

12.5.2 DISP lay :LINE

DISP:LINE is used to display a string of text in the tooltip at the bottom of the page. The text can display up to 30 characters and the text will stay for 10 s.

Command syntax:	**DISPlay : LINE < *string* >**
parameter:	**<string>** up to 30 characters
E.g:	Send > **DISP:LINE " This is a Comment. "**
Query syntax:	**DISPlay : LINE ?**
Query response:	-screen tooltip text , or NULL if the tooltip is empty.

12.6 FUNCtion Measurement Function Subsystem

Figure 12 - 3 FUNCtion subsystem tree

FUNCtion	**{ RV,RESistance (R) , VOLTage (V)}**	
	:MON	**{RABS,RPER,VABS,VPER,OFF}**

12.6.1 FUNCtion _ Measurement parameter settings

Command syntax:	**FUNCtion { RV , RESistance (R) , VOLTage (V) }**
parameter:	**RV** resistance and voltage measurement capabilities **RESistance** or **R** only resistance measurement function **VOLTage** or **V** only voltage measurement function
E.g:	Send > **FUNC RES** // Select resistance measurement function Send > **FUNC R** // Select resistance measurement function Send > **FUNC V** // Select the voltage measurement function send > **FUNC RV** // select resistance + voltage measurement function
Query syntax:	**FUNCtion ? _**
Query response :	**RV** **RESistance** **VOLTage**
E.g:	send > **FUNC?** receive > **RESISTANCE**

12.6.2 FUNCtion: MONitor Monitoring parameter settings

Command syntax:	**FUNCtion:MONitor { OFF,RABS,RPER,VABS,VPER}**
parameter:	**OFF** monitoring function is turned off **RABS** resistance absolute deviation (R Δ) value **RPER** resistance relative deviation (R%) value **vABS** voltage absolute deviation (VΔ) value **vPER** voltage relative deviation (V %) value
E.g:	Send > **FUNC:MON RPER** // The monitoring parameter is set to the resistance relative deviation value (R%)
Query syntax:	**FUNCtion : MONitor ?**
Query response :	**{OFF,RABS,RPER,VABS,VPER}**
E.g:	send > **FUNC:MON?** receive > **OFF**

12.7 RESistance Resistor Setting Subsystem

图 12- 4 RESistance 子系统树

RESistance	**:RANGE**	**<0~3.1k>**	
		:NO	**{0,1,2,3,4,5,6}**
		:MODE	**{AUTO,NOM,HOLD}**

	:LIMiT	:STATE	{ON,OFF}
		:MODE	{SEQ,PER,ABS}
		:NOMinal	<float>
		:SEQ	<lower>,<upper>
		:PER	<lower>,<upper>
		:ABS	<lower>,<upper>
		<lower>,<upper>	

12.7.1 RES istance: RANGe Resistance range setting

according to the resistance value.

Command syntax: **RES istance: RANGe <0 to 3100>**

parameter: <0-3100> Resistance value represented by floating point number

E.g: send > **:RES:RANG 100E-3** //Select the range where 100 mΩ is located

send > **:RES:RANG 10m** //Select the range where 10 mΩ is located

Query syntax: **: RES istance: RANGe ?**

Query response: Return to test range:
3.0000 E-3, 3 0 .000 E-3, 300 . 00 E-3, 3.0000 E+0 , 30 . 000 E+0, 300 . 00 E+0, 3 . 0000 E+3

E.g: send > **RES : RANG?**

receive > **300.00E-3**

send > **RES:100m; RANG?** // Set the range and query the result

receive > **300.00E-3**

12.7.2 RES istance:RANGe :No Resistance range number setting

RES:RANG : NO is used to set the range number

Command syntax: **RES istance:RANGe :No {<range number>, min,max }**

parameter: Among them, < range number > **0~6**
min min range **= 0**
max max range **= 6**

E.g: send > **RES : RANG : NO 3** <NL> // Switch to 3 range (3Ω)

Query syntax: **RES:RANG :NO ?**

Query response: Range number **0~6**

E.g: send > **RES :RANGE :NO ?**

return > **5**

send > **RES :RANGE :NO 2;NO?** // Send command and query result

Return > **2**

12.7.3 RESistance :RANGe:MODE Set the resistance comparison method

RES: RANG:MODE is used to set the range mode

Command syntax: **RES istance : RANGe:MODE { AUTO,HOLD,NOMinal }**

E.g: send > **RES :RANG:MODE AUTO** // Switch to automatic range mode

Query syntax: **RES :RANG:MODE?**

Query response: **{AUTO,HOLD,NOM}**

E.g: send > **RES :RANGE :MODE ?**

Back > **AUTO**

send> **RES :RANGE :MODE AUTO;MODE?** // Send command and query result

Return> **AUTO**

Note : If set to NOM mode , the instrument will set the range according to the comparator mode:
When the comparator mode is SEQ, the range will be set according to the upper limit of the comparator ;
When the comparator mode is ABS and PER , the range will be set according to the nominal value.

12.7.4 RESistance :LiMiT Set resistance limit

Set the upper and lower limits of resistance in the current comparison mode.

Command syntax: **RES istance :LiMiT < lower,upper >**
RES istance :LMT < lower,upper >

parameter:
lower: upper limit floating point number
upper: lower limit floating point number
data value corresponds to the currently used comparison method, the direct reading comparison (SEQ) and the absolute value (ABS) represent the resistance value (Ω) , and the percentage (PER) comparison represents the percentage value (%).

E.g:
send > **RES:LMT 1 ,10**
send > **RES:LMT 10m ,10 0m**
send > **RES:LMT 1e-3,1e-2**

Query syntax: **RES istance :LiMiT ?**

Query response: <lower>,<upper> The current data value corresponds to the upper and lower limit values in the current comparison mode .
Data format : ± #.####E ± #
The total number of bits of each data is 10 bits , the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, only E-3(m) , E+0, E+3 (k) are used in the exponent part . and other formats with the corresponding magnification unit value.

E.g:
Send > RES:LMT?
receive> +1.0000E-3,+10.000E - 3
Send > RES:LMT 10m,12m;LMT?
receive> +10.000E-3,+12.000E - 3

12.7.5 RESistance:LiMiT:STAT e Resistor Comparator Status Setting

Resistor comparator on or off setting .

Command syntax: **RES istance: LiMiT:STATe {ON/1,OFF/0}**

E.g: send > RES:LMT:STAT OFF

Query syntax: **RES istance: LiMiT:STATe ?**

Query response: { on, off }

E.g:
Send > RES:LMT:STAT?
receive > on

12.7.6 RESistance:LiMiT:MODE Resistance comparison method

Voltage comparison mode setting .

Command syntax: **RES istance :LiMiT :MODE {SEQ,PER,ABS}**

parameter:
SEQ: Upper and lower limit direct reading comparison method
PER : Percentage comparison method (relative deviation comparison)
ABS: Absolute deviation comparison (Δ)

E.g: send> RES:LMT:MODE PER // percentage comparison

Query syntax: **RES istance :LiMiT :MODE ?**

Query response: { SEQ,PER,ABS}

E.g:
Send > RES:LMT:MODE?
Receive > SEQ

12.7.7 RESistance :LiMiT:NOMinal Resistance nominal value setting

the nominal value of the resistance . The nominal value is only involved in the calculation in ABS and PER modes .

Command syntax: **RES istance :LiMiT:NOMinal <float>**

parameter: `float:` nominal value floating point number, unit (Ω)

E.g: send > **RES:LMT : NOM 12.345m**
send > **RES:LMT : NOM 12.345e -3**

Query syntax: **RES istance :LiMiT:NOMinal ?**

Query response: <float>
Data format : ±#.####e ± #
The total number of bits of each data is 10 bits , the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, only E-3 , E+0, Formats such as E+3 correspond to unit values.

E.g: Send > RES:LIM : NOM?
Receive > + 100.00e-3 //100.00m Ω
Send > RES:LIM : NOM 100 . 00m;NOM? // Set the nominal value and query
Receive > + 100.00e-3 //100.00m Ω

⑥ If the current resistance range is set to the nominal range (N OM RANGE), and the resistance comparison method is PER or ABS , the resistance range will be switched to the best range according to the nominal value . However , when the resistance comparison method is SEQ, the range will not be switched according to the nominal value. (In SEQ, the range will be selected according to the upper limit.)

12.7.8 RESistance :LiMiT:SEQ Resistance direct reading limit

Set the upper and lower limits of resistance in the current direct-reading comparison mode .

Command syntax: **RESistance:LiMiT:SEQ < lower,upper >**

parameter: lower: upper limit floating point number
upper: lower limit floating point number
Set the upper and lower limit values of direct reading comparison (SEQ) .

E.g: send > **RES : LMT: SEQ 1m , 10m**
send > **RES : LMT: SEQ 1e-3 , 1 0e-3**

Query syntax: **RESistance:LiMiT:SEQ ?**

Query response: <lower>,<upper>
Data format : ±#.####E ± ##
The total number of digits of each data is 1 1 , the first digit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, only E-03, E+00, Formats such as E+03 correspond to unit values.

E.g: Send > RES:LMT:SEQ?
Receive > + 1.0000e-03,+10.000e-03
Send > RES:LMT:SEQ 10m,100m;SEQ? // Set the nominal value and query
Receive > + 100.00e-3 //100.00m Ω

⑥ CALCulate:LIMit:RESistance :SEQ The resistance comparison mode will be forced to switch to the SEQ mode .

However , CALCulate:LIMit:RESistance :SEQ ? The instruction does not switch the comparison method .

12.7.9 RESistance :Li MiT: ABS Resistance Absolute Value Limit

Set the upper and lower limits of resistance in the current absolute value comparison mode .

Command syntax: **RES istance :LiMiT:ABS < lower,upper >**

parameter: lower: upper limit floating point number
upper: lower limit floating point number
Set the upper and lower limit values of absolute value comparison (ABS) .

E.g: send > **RES : LMT:ABS -1.23m , 1.23m**
send > **RES : LMT: ABS -1.23e-3 , 12.3e-3**

Query syntax: **RES istance :LiMiT:ABS ?**

Query response: < lower >,<upper>

Data format : ± #.####E ± #

The total number of bits of each data is 10 bits , the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, only E-03, E+00, Formats such as E+03 correspond to unit values.

E.g:

Send > RES:LMT:ABS?

receive> -1.2300e-3,+12.300e - 3

Send > RES:LMT:ABS -1.23m,12.3m;ABS?

receive> -1.2300e-3,+12.300e - 3

CALCulate:LIMit:RESistance :ABS The resistance comparison method is forcibly switched to the ABS method .

But, : CALCulate:LIMit:RESistance :ABS ? The instruction does not switch the comparison method .

12.7.10 RESistance :LiMiT:PER Resistance percentage upper and lower limits

Set the upper and lower limit percentage values of resistance in the current percentage comparison mode .

Command syntax: **RES istance :Li MiT: PER < lower,upper >**

parameter:

lower: upper limit floating point number
upper: lower limit floating point number
Sets the upper and lower percentage values for the percentage comparison (PER) .

E.g: send **> RES : LMT:PER -10.1,1 0.1 _**

Query syntax: **RES istance :Li MiT: PER ?**

Query response: < lower >,<upper>

Data format : ±#.####E +0

The total number of bits of each data is 10, the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, the exponent part only uses the E+0 format.

E.g:

Send > RES:LMT:PER?

receive> -10.000E+0,+10.000E+0

Send > RES:LMT:PER -10,10;PER? // Set and query return

receive> -10.000E+0,+10.000E+0

CALCulate:LIMit:RESistance :PER The resistance comparison mode is forcibly switched to the PER mode .

CALCulate:LIMit:RESistance :PER ? The instruction does not switch the comparison method .

12.8 VOL Tage Voltage Setting Subsystem

Figure 12 - 5 VOLTage subsystem tree

VOLTage	**:RANGE**	**< -30 0~ 300 >**	
		:NO	**{0,1,2}**
		:MODE	**{AUTO,NOM,HOLD}**
	: LIM iT	**:STATE**	**{ON,OFF}**
		:MODE	**{SEQ,PER,ABS}**
		: NOMinal	**< float>**
		:SEQ	**<lower>,<upper>**
		:PER	**<lower>,<upper>**
		:ABS	**< lower>,<upper>**
		<lower>,<upper>	

12.8.1 VOLTage:RANGe Voltage range setting

Voltage range setting .

Command syntax:	**VOLT a ge :RANGe <-300 to 300>**
parameter:	<0-3100> Voltage value represented by floating point number
E.g:	send **> :VOLT:RANG 10** //Select the range where 10 V is located
Query syntax:	**: VOLTage : RANGe ?**
Query response:	Return to test range: 6.000 0 0 E+0 , 60.00 0 0 E+0 , 3 00 . 0 0 0 E+0
E.g:	send **> VOLT : RANG?** receive **> 60.0000E+0** send **> VOLT :RANG 3 ?**

12.8.2 VOLTage:RANGe :No Resistance range number setting

VOLT:RANG : NO is used to set the range number

Command syntax:	**VOLTage :RANGe :No {< 0~2 >, min,max }**
parameter:	Among them, < range number > **0~2** **min min** range **= 0** **max max** range **= 2**
E.g:	send **> VOLT :RANG :NO 1** // Switch to 1 range
Query syntax:	**VOLTage :RANG e:NO ?**
Query response:	Range number **0~ 2**
E.g:	send **> VOLT :RANG :NO ?** Return **> 1** send **> VOLT :RANGE :NO 1;NO?** // Send command and query result Return **> 1**

12.8.3 VOLTage :RANGe:MODE

VOLT: RANG:MODE is used to set the range mode

Command syntax:	**VOLTage: RANGe:MODE { AUTO, HOLD, NOMinal }**
E.g:	send **> VOLT :RANG:MODE AUTO** // Switch to automatic range mode
Query syntax:	**VOLTage :RANG e :MODE ?**
Query response:	**{AUTO,HOLD,NOM}**
E.g:	send > **VOLT :RANGE :MODE ?** Back > **AUTO** send> **VOLT :RANGE :MODE AUTO;MODE? // Send command and query result** Return> **AUTO**
Note :	If set to NOM mode , the instrument will set the range according to the comparator mode: When the comparator mode is SEQ, the range will be set according to the upper limit of the comparator ; When the comparator mode is ABS and PER , the range will be set according to the nominal value.

12.8.4 VOLTage :LiMiT Set resistance limit

Set the upper and lower voltage limits in the current comparison mode .

Command syntax:	**VOLTage:LiMiT < lower,upper >**
parameter:	lower: upper limit floating point number upper: lower limit floating point number data value corresponds to the currently used comparison method, the direct reading comparison (SEQ) and the absolute value (ABS) represent the voltage value (V) , and the percentage (PER) comparison represents the percentage value (%).
E.g:	send **> VOLTage:LMT 10 , 2 0**
Query syntax:	**VOLTage:LiMiT ?**
Query response:	<lower>,<upper> The current data value corresponds to the upper and lower limit values in the current comparison mode .

Data format : ± #.#####E + 0

The total number of bits of each data is 11 bits, the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, the exponent part only uses the E+0 format to correspond to the multiplication unit value.

E.g:
Send > VOLT:LMT?
receive> +10.0000E+0,+20 . 0000E+0
Send > VOLT:LMT 10,20;LMT?
receive> +10.0000E+0,+20 . 0000E+0

12.8.5 VOLTage:LiMiT:STAT e Voltage comparator status setting

Voltage comparator on or off setting .

Command syntax: **VOLTage : LiMiT:STATe {ON/1,OFF/0}**

E.g: send > VOLT:LMT:STAT OFF

Query syntax: **VOLTage : LiMiT:STATe ?**

Query response: { on, off }

E.g:
Send > VOLT:LMT:STAT?
receive > on

12.8.6 VOLTage:LiMiT:MODE resistance comparison method

Voltage comparison mode setting .

Command syntax: **VOLTage:LiMiT :MODE {SEQ,PER,ABS}**

parameter:
SEQ: Upper and lower limit direct reading comparison method
PER : Percentage comparison method (relative deviation comparison)
ABS: Absolute deviation comparison (Δ)

E.g: send> VOLT:LMT:MODE PER // percentage comparison

Query syntax: **VOLTage:LiMiT :MODE ?**

Query response: { SEQ,PER,ABS}

E.g:
Send > VOLT:LMT:MODE?
Receive > SEQ

12.8.7 VOLTage:LiMiT:NOMinal Resistance nominal value setting

the nominal value of the voltage . The nominal value is only involved in the calculation in the ABS and PER modes .

Command syntax: **VOLTage:LiMiT:NOMinal <float>**

parameter: float: nominal value floating point number, unit (V)

E.g: send > **VOLT:LMT : NOM 10.1234**

Query syntax: **VOLTage:LiMiT:NOMinal ?**

Query response:
<float>
Data format : ±#.#####e +0
The total number of bits of each data is 11 bits, the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, the exponent part only uses the E+0 format to correspond to the unit value.

E.g:
Send > VOLT:LIM : NOM?
Receive > + 10.0000E+0 //10.0000
Send > VOLT:LIM : NOM 3.6;NOM? // Set the nominal value and query
Receive > +3.600 00E+0

If the current voltage range is set to the nominal range (N OM RANGE), and the voltage comparison method is PER or ABS , the voltage range will be switched to the best range according to the nominal value .
However , when the voltage comparison method is SEQ, the range will not be switched according to the

nominal value. (In SEQ, the range will be selected according to the upper limit.)

:

_

12.8.8 VOLTage:Li MiT :SEQ Voltage direct reading value limit

Command syntax: **VOLTage : LiMiT :SEQ < lower,upper >**

parameter:
lower: upper limit floating point number
upper: lower limit floating point number
Set the upper and lower limit values of direct reading comparison (SEQ) .

E.g: send **> VOLT:LMT: SEQ 1.23456 , 3.45678**

Query syntax: **VOLTage : LiMiT :SEQ ?**

Query response: <lower>,<upper>

Data format : ± #.######E + 0

The total number of bits of each data is 11 bits, the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, the exponent part only uses the E+0 format.

E.g:
Send > VOLT:LMT:SEQ?
Receive > + 1.23456E+0,+3.45678E+0
Send > VOLT:LMT : SEQ 3.5 , 4.2 ;SEQ? // Set and query the setting value
Receive > + 3.50000E+0,+4.20000E+0

CALCulate:LIMit: VOLTage:SEQ **The** voltage comparison mode will be forced to switch to the SEQ mode .

_ CALCulate:LIMit : VOLTage:SEQ ? The instruction does not switch the comparison method .

12.8.9 VOLTage:LiMiT:ABS Voltage absolute value limit

Command syntax: **VOLTage:LiMiT:ABS < lower,upper >**

parameter:
lower: upper limit floating point number
upper: lower limit floating point number
Set the upper and lower limit values of absolute value comparison (ABS) .

E.g: send **> VOLTage:LiMiT:ABS -1.2 , 1.2**

Query syntax: **VOLTage:LiMiT:ABS ?**

Query response: <float>,<float>

Data format : ± #.######E+0

The total number of bits of each data is 11 bits, the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other equipment, the exponent part only uses the E+00 format.

E.g:
Send > VOLT:LMT:ABS?
receive> -1.23456E+0,+1.23456E+0
Send > VOLT:LMT:ABS -12 ,12 ;ABS? // Set and query the setting value
Receive > - 12.0000E+0,+12.0000E+0

VOLTage:LiMiT:ABS The voltage comparison mode is forcibly switched to the ABS mode .

_ VOLTage :LiMiT:ABS ? The instruction does not switch the comparison method .

12.8.10 VOLTage: LiMiT:PER Voltage percentage upper and lower limits

Command syntax: **VOLTage:LiMiT:PER < lower,upper >**

parameter:
lower: upper limit floating point number
upper: lower limit floating point number
Sets the upper and lower percentage values for the percentage comparison (PER) .

E.g: send **> :CALC:LIM : VOLT : PER -1 , 1**

Query syntax: **VOLTage:LiMiT:PER ?**

Query response: <float>,<float>

Data format : ± #.#####E+0

The total number of bits of each data is 11 bits, the first bit is the sign bit, and the decimal position is not fixed. In order to be compatible with PLC and other devices, the exponent part only uses the E+00 format to correspond to the unit value.

E.g:

```
Send > VOLT:LMT:PER?
receive> -10.0 000E+00,+ 10.0000E +00
Send > VOLT:LMT:PER -10 , 10;PER?    // Set and query the setting value
Receive > - 10.0000E+00,+10.0000E+00
```

12.9 A UTorange Autoranging Subsystem*

(* Not recommended for new designs)

12.9.1 AUTOrange auto range setting *

Auto range setting , this command sets the voltage and resistance range modes at the same time . To set the range mode individually , please refer to the RES:RANG:MODE and VOLT:RANG:MODE commands .

Command syntax: **AUTOrange { 1,0,ON , OFF}**

E.g: send **> AUT ON** // Switch to auto range mode

Query syntax: **AUT orange ?**

Query response: **{ ON, OFF }**

12.10 ADJ ust clear subsystem

12.10.1 ADJust: CLEAr cancels the clearing function

Turn off the clear function.

Command syntax: **: ADJust :CLEAr**

E.g: send **> :ADJ:CLEA**

12.10.2 ADJust performs clearing

sending this command.

Command syntax: **ADJust**

response:

```
{ 0,1 }
0 : Cleared successfully
1: Failed to clear
```

E.g: send **> :ADJ** // Start executing clear

receive **> 0** // cleared successfully

Query syntax: **: ADJust ?**

Query response:

```
{ 0 ,1 }
0 : The last reset was successful
1: The last reset failed
```

Clearing takes a certain amount of time, and all return values take a while to return. It takes about 6 s to clear in autoranging .

12.11 SAMPle sampling subsystem

SAMPLE	**:RATE**	**{ SLOW,MEDium ,FAST,EXFAST }**
	: AVERage	**<integer 0~256>**

12.11.1 SAMPle :RATE Test speed settings

Command syntax: **SAMPle : RATE { SLOW,MEDium,FAST,EXFast }**

parameter:
SLOW: slow
MED ium : medium speed
FAST: fast
EXFAST: high speed

E.g: send > **SAMP: RATE MED**

Query syntax: **SAMP le:RATE ?**

Query response: {SLOW,MEDIUM,FAST,EXFAST}

E.g:
send> SAMP: RATE?
receive> FAST
send> SAMP:RATE MED;RATE?
receive> MED

12.11.2 SAMPle :AVERage Average times settings

Average times settings .

Command syntax:
SAMPle : AVERage <integer 0~256>
SAMPle : AVG <integer 0~256>

parameter: 0 or 1: Averaging will be turned off

E.g:
send > **SAMP: AVER 10**
send > **SAMP:AVG 5**

Query syntax:
SAMP le:AVER age ?
SAMP le:AV G ?

Query response: {0~256}

E.g:
send> SAMP:AVER?
receive> 0 // =OFF
send > SAMP:AVER 2;AVER?
send > 2

12.12 CALCulate operator subsystem

Figure 12 - 6 C ALCulate subsystem tree

CALCulate	*: AVERage **	*<integer 0 ~ 256 >*	
		: STATe	*{ OFF}*
	:LIMit	*:STATE*	*{ON,OFF}*
		:BEEPer	**{OFF,HL,IN}**
		:RESistance	*:MODE* *{HL,REF,ABS}*
			:UPPer *float <integer>*
			:LOWer *<integer>*
			:REFerence *<integer>*
			:PERCent *<lower,upper>*
		:VOLTage	*:MODE* *{HL,REF,ABS}*
			:UPPer *float <integer>*
			:LOWer *<integer>*
			:REFerence *<integer>*
			:PERCent *<lower,upper>*
		:ABS	*{ON(0),OFF(1)}*
	:STATistics	**:[STATe]**	**{ON(1),OFF(0)}**
		:RESistance	**:NUMBer?(:NO?)**
			:MEAN?

			:MAXimum?
			:MINimun?
			:LIMit?(LMT?)
			:DEViation?
			:CP?
		:VOLTage	:NUMBer?(:NO?)
			:MEAN?
			:MAXimum?
			:MINimun?
			:LIMit?(LMT?)
			: DEViation ?
			:CP?

(* Not recommended for new designs)

12.12.1 CALC ulate :AVERage:STAT e Average function*

(* Not recommended for new designs)

Turn off the averaging function, the instrument averaging times will be set to 1, this command recommends using SAMP le:AVERage 0 instead .

Command syntax: **CALCulate : AVERage :STAT e {OFF}**

parameter: {OFF}
When set to OFF , the average number of times is 1

E.g: send > **:CALC:AVER:STAT OFF**

Query syntax: **CALCulate:AVERage:STATe ?**

Query response: {ON,OFF}
ON : Average times > 1
OFF: Average times = 1

This command has no open function, that is, CALC:AVER:STAT ON has no effect . To enable the averaging function, please use SAMP:AVER <2~256> instead .

12.12.2 CALC ulate :AVERage set average*

(* Not recommended for new designs)

This directive recommends using SAMPle :AVERage instead.

Command syntax: **CALCulate : AVERage <0 to 256 >**

parameter: Integer, enter the average number of times from 1 to 256
When set to 1 , the averaging function will be turned off

E.g: send > **CALC:AVER 10**

Query syntax: **CALCulate:AVERage ?**

Query response: {0~256}
0 means the averaging function is off

12.12.3 CALC ulate : LIMit : STATe comparator master switch setting*

(* Not recommended for new designs)

Comparator switch settings , this command sets both voltage and resistance comparator switches .

Command syntax: **CALCulate : LIMit :STATe {0,1,ON,OFF}**

parameter: ON(1): Both the resistor comparator and the voltage comparator are turned on and set to SEQ mode.
OFF(0): Both the resistor comparator and the voltage comparator are turned off.

E.g: send > **CALC:LIM :STAT OFF**

Query syntax: **CALCulate:LIMit:STATe ?**

Query response: {ON,OFF}
Returns OFF when the resistor comparator is set to OFF and the voltage

comparator is set to OFF at the same time

E.g: send > CALC:LIM :STAT?
Receive > ON

CALCulate : LIMit :STATe The voltage and resistance comparators are turned on or off at the same time .
If you need to turn off the resistor or voltage comparator individually , use **RES : LMT :STATe** and **VOLT:LMT :STATe** instructions.

12.12.4 CALC ulate : LIMit : BEEPer beeper setting _

Comparator beep setting .

Command syntax: **CALCulate : LIMit : BEEP er {0/OFF,HL/NG/FAIL,IN/OK/PASS)}**

parameter:
0/OFF : Beeper off
HL /NG/FAIL: Unqualified sound , buzzer sounds when unqualified
IN/OK/PASS: Qualified beep , buzzer beeps when qualified

E.g:
send **> CALC:LIM :BEEP HL** // Unqualified sound
send **> CALC:LIM :BEEP OK** // qualified beeper

Query syntax: **CALCulate:LIMit:BEEPer ?**

Query response: { OFF, HL, IN }

E.g: Send > CALC:LIM : BEEP ?
Receive > IN

12.12.5 CALC ulate : LIMit : RESistance:MODE Resistance comparison method *

(* Not recommended for new designs)
Resistance comparison mode setting . This command recommends using RES :LMT: MODE instead .

Command syntax: **CALCulate : LIMit : RES istance:MODE {HL,REF,ABS}**

parameter:
HL /SEQ: direct reading comparison method of upper and lower limits
REF/PER : Percentage comparison method (relative deviation % comparison)
ABS: Absolute deviation comparison (Δ)

E.g:
send **> CALC:LIM : RES:MODE HL** // Comparison of upper and lower limit direct reading values
send **> CALC:LIM : RES:MODE REF** // Percentage comparison

Query syntax: **CALCulate : LIMit : RES istance:MODE ?**

Query response: { HL,REF,ABS}

E.g: Send > CALC:LIM : RES:MODE?
Receive > HL

12.12.6 CALCulate:LIMit:RESistance :UPPer Resistance upper limit setting *

(* Not recommended for new designs)
recommended to use the instruction RES:LMT which supports floating -point input instead .

Command syntax: **CALCulate : LIMit : RES istance :UPPer < 0-99999 >**

parameter:
<0-99999>: Positive integer value , over 99999 is forced to 99999, sign is ignored.
Decimals and units are related to the current range :

range	decimal places	unit	illustrate
0 (3mΩ)	4	mΩ	12345 = 1.2345mΩ
1 (30mΩ)	3	mΩ	12345 = 12.345mΩ
2 (300mΩ)	2	m Ω	12345 = 123.45mΩ
3 (3Ω)	4	Ω	12345 = 1.2345 Ω

4 (30Ω)	3	Ω	12345 = 12.345Ω
5 (300Ω)	2	Ω	12345 = 123.45Ω
6 (3 kΩ)	4	Ω	12345 = 1 .2345Ω

: send **> CALC:LIM : RES : UPPer 12345** // According to the above table to get the corresponding value, the range 1 represents 1.2345 m Ω

Query syntax: **CALCulate : LIMit : RES istance :UPPer ?**

Query response: <positive integer> #####
digits is 5 , without sign and decimal point

E.g: Send > CALC:LIM : RES:UPP?
receive> 1234 // When the range is 0, it represents 0.1234 mΩ
Send > CALC:LIM : RES:UPP 12345;UPP?
receive> 12345 // When the range is 1 , it represents 12.34 5mΩ

this command is related to the range , RES:LMT <lower>,<upper> Actual floating point values can be entered directly .

CALC:LIM : RES:UPP The resistance comparison method will be set to the SEQ method.

12.12.7 C ALCulate:LIMit:RESistance :LOWer Resistance lower limit setting *

(* Not recommended for new designs)
recommended to use the instruction RES:LMT which supports floating -point input instead .

Command syntax: **CALCulate : LIMit : RES istance : LOWer < 0-99999 >**

parameter: <0-99999>: positive integer value , more than 99999 is forced to 99999
Decimals and units are related to the current range :

range	decimal places	unit	illustrate
1 (3mΩ)	4	mΩ	12345 = 1.2345mΩ
2 (3 0mΩ)	3	mΩ	12345 = 12.345mΩ
3 (300 mΩ)	2	m Ω	12345 = 123.45mΩ
4 (3Ω)	4	Ω	12345 = 1.2345 Ω
5 (30Ω)	3	Ω	12345 = 12.345Ω
6 (300Ω)	2	Ω	12345 = 123.45Ω
7 (3 kΩ)	4	Ω	12345 = 1.2345Ω

E.g: send **> CALC:LIM : RES : LOWer 1000** // According to the above table to get the corresponding value, the range 4 represents 0. 1000 Ω

Query syntax: **CALCulate : LIMit : RES istance : LOWer ?**

Query response: <positive integer> #####
5 total digits , without sign and decimal point

E.g: Send > :CALC:LIM : RES:LOW?
receive> 1000 // The return value varies according to the range

this command is related to the range , RES:LMT <lower>,<upper> Actual floating point values can be entered directly .

CALC:LIM:RES:UPP The resistance comparison method will be set to the SEQ method.

12.12.8 CALCulate:LIMit:RESistance :REFerence Resistor Nominal Value Setting *

(* Not recommended for new designs)
recommended to use the instruction RES:LMT :NOM which supports floating -point input instead .

Command syntax: **CALCulate : LIMit : REFerence < 0-99999 >**

Parameters : <0-99999>: positive integer value , more than 99999 is forced to 99999
Decimals and units are related to the current range :

range	decimal places	unit	illustrate

0 (3mΩ)	4	mΩ	12345 = 1.2345mΩ
1 (30mΩ)	3	mΩ	12345 = 12.345mΩ
2 (300mΩ)	2	mΩ _	12345 = 123.45mΩ
3 (3Ω)	4	Ω	12345 = 1.2345 Ω
4 (30Ω)	3	Ω	12345 = 12.345Ω
5 (300Ω)	2	Ω	12345 = 123.45Ω
6 (3 kΩ)	4	Ω	12345 = 1 .2345Ω

:

```
send > :CALC:LIM : REF 10000          // According to the above table to get the corresponding value, the range 4 represents 1.0000 Ω
```

Query syntax:

```
: CALCulate : LIMit : RES istance : REFerence ?
```

Query response:

```
<positive integer> #####
5 total digits , without sign and decimal point
```

E.g:

```
Send > :CALC:LIM : RES:REF?
receive> 10000 // The return value is different according to the range , when the range is 1, it means 1.0000m Ω
```

12.12.9 CALCulate:LIMit:RESistance :PERCent Resistance Percentage Limit*

(* Not recommended for new designs)

recommended to use the instruction RES:LMT:PER which supports floating -point input instead .

Command syntax:

```
CALCulate : LIMit : RES istance : PERCent < % >
```

parameter:

```
%:      percentage value
Sets the percentage value for the percentage comparison ( PER ) .
```

E.g:

```
send > :CALC:LIM : RES : PERC 1.1    // Set the percentage limit to -1.1%, 1.1%
```

Query syntax:

```
CALCulate : LIMit : RES istance : PERCent ?
```

Query response:

```
<float> #.###
The total number of bits is a 4-bit floating point number , unsigned .
```

E.g:

```
Send > :CALC:LIM : RES:PERC?
receive> 1.100
Send > :CALC:LIM : RES:PERC?
receive> 1.100
```

?

CALCulate:LIMit:RESistance:PERC **The** voltage comparison mode will be forced to switch to the PER mode .

CALCulate:LIMit:RESistance:PERC ? The instruction does not switch the comparison method .

12.12.10 CALC ulate : LIMit : VOLTage:MODE Voltage comparison method *

(* Not recommended for new designs)

Voltage comparison mode setting . This command recommends using VOLT:LMT: MODE instead .

Command syntax:

```
CALCulate : LIMit : VOLTage :MODE {OFF,HL/SEQ,REF/PER,ABS}
```

parameter:

```
OFF: The    voltage comparator is turned off
HL :        Direct reading comparison method of upper and lower limits
REF :   Percentage comparison method (relative deviation comparison )
ABS:    Absolute deviation comparison ( Δ )
```

E.g:

```
send> :CALC:LIM : VOLT:MODE HL              // Comparison of upper and lower limit direct reading values
send> :CALC:LIM : VOLT:MODE OFF             // resistor comparator off
send> :CALC:LIM : VOLT:MODE REF             // Percentage comparison
send> :CALC:LIM : VOLT:MODE PER             // percentage comparison
```

Query syntax:

```
CALCulate : LIMit : VOLTage :MODE ?
```

Query response: { OFF,HL,REF,ABS}

E.g: Send > :CALC:LIM : VOLT:MODE?
Receive > HL

Note : : CALCulate:LIMit: VOLTage:PER **The** voltage comparison mode will be forced to switch to the PER mode .
? : CALCulate:LIMit : VOLTage:PER ? The instruction does not switch the comparison method .

12.12.11 : CALCulate:LIMit: VOLTage:UPPer Voltage upper limit setting *

(* Not recommended for new designs)

This command recommends using VOLT :LMT <lower >,<upper> instead.

Command syntax: **: CALCulate : LIMit : VOLTage:UPPer < 0-999999 >**

parameter: <0-999999>: positive integer value , more than 9999 9 9 is forced to 99 9 999, the sign is ignored.
Decimals and units are related to the current range :

range	decimal places	illustrate
0 (8V)	5	12345 6 = 1.23456V
1 (80V)	4	12345 6 = 12.3456V
2 (400V)	3	12345 6 = 123.456V

E.g: send > **: CALC:LIM : VOLT : UPPer 123456** // According to the above table to get the corresponding value, the range 1 represents 1.2345 6V

Query syntax: **: CALCulate : LIMit : VOLTage:UPPer ?**

Query response: <positive integer> ######
maximum number of digits is 6 , without sign and decimal point

E.g: Send > :CALC:LIM : VOLT:UPP?
receive> 123456 // When the range is 2, it represents 123.4 56V
Send > :CALC:LIM : VOLT:UPP 12345 ;UPP ?
receive> 12345 // When the range is 2, it represents 12 .3 4 5V

this command is related to the range , VOLT:LMT <lower>,<upper> Actual floating point values can be entered directly .

⑥ _ CALC:LIM : VOLT:UPP The voltage comparison mode will be set to SEQ mode.

12.12.12 : CALCulate:LIMit: VOLTage:LOWer Voltage lower limit setting *

(* Not recommended for new designs)

This command recommends using VOLT :LMT <lower >,<upper> instead.

Command syntax: **: CALCulate : LIMit : VOLTage:LOWer < 0-999999 >**

parameter: <0-999999>: positive integer value , more than 9999 9 9 is forced to 99 9 999, the sign is ignored.
Decimals and units are related to the current range :

range	decimal places	illustrate
0	5	12345 6 = 1.23456V
1	4	12345 6 = 12.3456V
2	3	12345 6 = 123.456V

E.g: send > **:CALC:LIM : VOLT : LOW 100000** // According to the above table to get the corresponding value, the range 1 represents 1.00000 V

Query syntax: **: CALCulate : LIMit : VOLTage:LOWer ?**

Query response: <positive integer> #######
digits is 6 , without sign and decimal point

E.g: Send > :CALC:LIM : VOLT:LOW?
receive> 100000 // When the range is 1, it represents 1.00000V

this command is related to the range , VOLT:LMT <lower>,<upper> Actual floating point values can be entered directly .

CALC:LIM : VOLT:LOW The voltage comparison mode will be set to SEQ mode.

12.12.13 : CALCulate:LIMit: VOLTage:REFerence Voltage nominal value setting *

(* Not recommended for new designs)

This command recommends using VOLT :LMT :NOM instead

Command syntax: **: CALCulate : LIMit : VOLTage:REFerence < 0-999999 >**

parameter: <0-999999>: positive integer value , more than 9999 9 9 is forced to 99 9 999, the sign is ignored.

Decimals and units are related to the current range :

range	decimal places	illustrate
0	5	12345 6 = 1.23456V
1	4	12345 6 = 12.3456V
2	3	12345 6 = 123.456V

E.g: send **> :CALC:LIM : VOLT : REF 100000** // According to the above table to get the corresponding value , the range 2 represents 10.0000 V

Query syntax: **: CALCulate : LIMit : VOLTage:REFerence ?**

Query response: <positive integer> #######
digits is 6 , without sign and decimal point

E.g: Send > :CALC:LIM : VOLT:REF?
receive> 100000 // When the range is 2, it represents 1 0.0000V

12.12.14 : CALCulate:LIMit: VOLTage:PERCent Voltage Percentage Limit*

(* Not recommended for new designs)

This command recommends using VOLT :LMT :PER <lower >,<upper> instead.

Command syntax: **: CALCulate : LIMit : VOLTage:PERCent < float >**

parameter: %: percentage value
Sets the percentage value for the percentage comparison (PER) .

E.g: send **> :CALC:LIM : VOLT : PERC 0.3** // Set the percentage limit to -0.3%,0.3 %

Query syntax: **: CALCulate : LIMit : VOLT:PERCent ?**

Query response: <float>
##.### Without sign bit, the upper limit value corresponding to the current data value

E.g: Send > :CALC:LIM : VOLT:PERC?
receive> 0.300

: CALCulate:LIMit: VOLTage:PERC **The** voltage comparison mode will be forced to switch to the PER mode .

: CALCulate:LIMit : VOLTage:PERC ? The instruction does not switch the comparison method .

12.12.15 : CALCulate:LIMit: ABS voltage absolute deviation comparison method *

(* Not recommended for new designs)

This command is not recommended, use the equivalent command VOLT:LMT : MODE ABS

Command syntax: **: CALCulate : LIMit:ABS {ON(1),OFF(0)}**

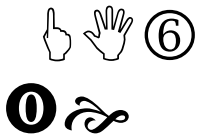
parameter: ON: Set as absolute deviation comparison mode
OFF: Set as the relative deviation (percentage) comparison method.

E.g: send **> :CALC:LIM : ABS ON** // Set as ABS comparison mode

Query syntax: **: CALCulate : LIMit : ABS ?**

Query response: { on, off }
on: absolute deviation method
off: other comparison methods (may be OFF, SEQ, or PER)

E.g: Send > :CALC:LIM : ABS?
receive> OFF



This command has the same function as VOLT:LMT:MODE ABS .
This command is only valid for voltage .

12.12.16 : CALCulate: STATistics [: STATe] Statistical function

Turn statistics on or off.

Command syntax: **CALCulate : STATistic [: STATe] {LOG,STAT}**

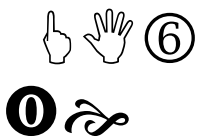
parameter: ON: Turn on the statistics function
OFF: Statistics function is off

E.g: send **> CALC:STAT LOG**

Query syntax: **CALCu late:STATistic [:STAT]?**

Query response: {LOG,STAT}

E.g: Send > CALC:STAT LOG;STAT?
Receive > LOG



If the current trigger mode is internal , use LOG :START ON Instruction execution records and statistical operations are performed.
If the current trigger mode is external, use the TRIG button to perform recording and statistics.

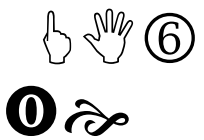
12.12.17 CALCulate: STATistics:RES istance :NUMBer ? resistance statistics

Query resistance statistics.

Query syntax: **CALCu late:STATistic:RESistance:NUMBer ?**
CALCu late:STATistic:RESistance:NUM ?
CALCu late:STATistic:RESistance:NO ?

Query response: <total number (integer)>,<valid number (integer) >

E.g: Send > CALC:STAT :RES:NUM?
receive> 10,8 // A total of 10 values are recorded , 8 values are valid and used for statistics



Valid quantity: Excluding the quantity of overflow (OF) or error (FAULT), the data is considered valid as long as the value can be displayed on the screen .

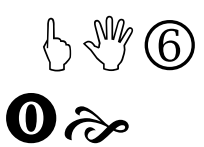
12.12.18 CALCulate: STATistics:RES istance :MEAN ? Average

Average query .

Query syntax: **CALCu late:STATistic:RESistance: MEAN ?**

Query response: <Average (float)>

E.g: Send > CALC:STAT :RES: MEAN ?
receive> **+1.2568E-3**



average value $\bar{x} = \frac{\sum x}{n}$

12.12.19 CALCulate: STATistics:RES istance :MAX imum ? Maximum value

Maximum value query .

Query syntax: **CALCu late:STATistic:RESistance: MAX imum ?**

Query response: <maximum value (float)>, <bit number>

E.g:
Send > CALC:STAT :RES: MAX ?
receive> +354.76E+0,2 // The second data is the maximum value

12.12.20 CALCulate: STATistics:RES istance :MIN imum ? Minimum value

Minimum query .

Query syntax: **CALCu late:STATistic:RESistance: MIM imum ?**

Query response: <minimum value (float)> ,< bit number>

E.g:
send > CALC:STAT :RES: MIN ?
receive> +354.33E+0,7 //The 7th data is the minimum value

12.12.21 CALCulate: STATistics:RES istance :LIMit ? file count

Query count value .

Query syntax: **CALCu late:STATistic:RESistance: LIMit ?**
CALCu late:STATistic:RESistance: LMT ?

Query response: < HI count> ,<OK count>,< LO count>,<FAULT count>

E.g:
Send > CALC:STAT :RES: LMT ?
receive> 10,0,0,0 //10 pieces of data are unqualified
Send > CALC:STAT :RES: LIM ?
receive> 0,10 , 0,0 // 10 data qualified

⑥

querying the comparator bin count , please make sure the comparator function is enabled, otherwise the data will return 0,0,0,0

12.12.22 CALCulate: STATistics:RES istance :DEViation ?

Query the standard deviation value .

Query syntax: **CALCu late:STATistic:RESistance: DEViation ?**

Query response: <Maternal standard deviation σ $_{n}$ > ,< sample standard deviation σ $_{n-1}$ >

E.g:
Send > CALC:STAT :RES: DEV ?
receive> 0.0016, 0.0017 // σ $_{n}$ =0.0016 s=0.0017

⑥

Maternal standard deviation:$\sigma_n = \sqrt{\frac{\sum (x-\bar{x})^2}{n}} = \sqrt{\frac{\sum x^2 - n\bar{x}^2}{n}}$

Sample standard deviation:$\sigma_{n-1} = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - n\bar{x}^2}{n-1}}$

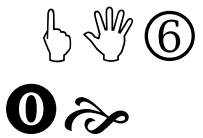
12.12.23 CALCulate: STATistics:RES istance :Cp ?

Query the process capability index (C p / Cp k).

Query syntax: **CALCu late:STATistic:RESistance: CP ?**

Query response: <Process Capability Index (Deviation) C p > ,< Process Capability Index (Offset) C pk >

E.g:
Send > CALC:STAT :RES: CP ?
Receive > 99.85, 75.56 //C p = 99.85, Cpk = 75.56



Process Capability Index (Deviation)$Cp = \frac{|Hi-Lo|}{6\sigma_{n-1}}$

Process Capability Index (Offset)$CpK = \frac{|Hi-Lo|-|Hi+Lo-2\bar{x}|}{6\sigma_{n-1}}$

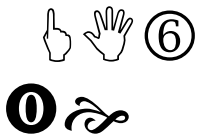
12.12.24 CALCulate: STATistics:VOLTage:NUMBer ? Voltage statistics

Query resistance statistics.

Query syntax:
```
CALCu late:STATistic: VOLTage :NUMBer ?
CALCu late:STATistic: VOLTage :NUM ?
CALCu late:STATistic: VOLTage :NO ?
```

Query response:
```
<total number (integer)>,<valid number ( integer ) >
```

E.g:
```
Send > CALC:STAT :VOLT:NUM?
receive> 10,10              // A total of 10 values are recorded , and 10 values are valid and used for statistics
```



Valid quantity: Excluding the quantity of overflow (OF) or error (FAULT), the data is considered valid as long as the value can be displayed on the screen .

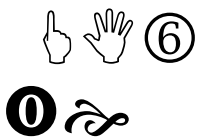
12.12.25 CALCulate: STATistics:VOLTage:MEAN ? Average

Average query .

Query syntax:
```
CALCu late:STATistic:VOLTage:MEAN ?
```

Query response:
```
<Average (float)>
```

E.g:
```
Send > CALC:STAT :VOLT: MEAN ?
receive> +3.70601E+0
```



average value$\bar{x} = \frac{\sum x}{n}$

12.12.26 CALCulate: STATistics:VOLTage:MAX imum ? Maximum value

Maximum value query .

Query syntax:
```
CALCu late:STATistic:VOLTage: MAX imum ?
```

Query response:
```
<maximum value (float)>, <bit number>
```

E.g:
```
Send > CALC:STAT :VOLT: MAX ?
receive> +3.70890E+0,4            // The 4th data is the maximum value of 3.70890V
```

12.12.27 CALCulate: STATistics:VOLTage:MIN imum ? Minimum value

Minimum query .

Query syntax:
```
CALCu late:STATistic: VOLTage : MIM imum ?
```

Query response:
```
<minimum value (float)> ,< bit number>
```

E.g:
```
Send > CALC:STAT :VOLT: MIN ?
receive> +3.70566E+0,4            //The 4th data is the minimum value of 3.70566V
```

12.12.28 CALCulate: STATistics:VOLTage:LIMit ? file count

Query count value .

Query syntax: **CALCu late:STATistic: VOLTage : LIMit ?**
CALCu late:STATistic: VOLTage : LMT ?

Query response: < HI count> ,<OK count>,< LO count>,<FAULT count>

E.g: Send > CALC:STAT :VOLT: LMT ?
receive> 0,10 , 0,0 // 10 data qualified

querying the comparator bin count , please make sure the comparator function is enabled, otherwise the data will return 0,0,0,0

12.12.29 CALCulate: STATistics:VOLTage:DEViation ?

Query the standard deviation value .

Query syntax: **CALCu late:STATistic: VOLTage : DEViation ?**

Query response: <Maternal standard deviation σ n > ,< sample standard deviation σ n-1 >

E.g: Send > CALC:STAT :VOLT: DEV ?
receive> 0.0002, 0.0002 // σ n =0.0002 s=0.0002

Maternal standard deviation:$\sigma_n = \sqrt{\frac{\sum(x-\overline{x})^2}{n}} = \sqrt{\frac{\sum x^2 - n\overline{x}^2}{n}}$

Sample standard deviation:$\sigma_{n-1} = \sqrt{\frac{\sum(x-\overline{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - n\overline{x}^2}{n-1}}$

12.12.30 CALCulate: STATistics:VOLTage:Cp ?

Query the process capability index (C p / Cp k).

Query syntax: **CALCu late:STATistic: VOLTage : CP ?**

Query response: <Process Capability Index (Deviation) C p > ,< Process Capability Index (Offset) C pk >

E.g: Send > CALC:STAT : VOLT : CP ?
Receive > 72.110 , 8.6692 //C p = 72.110 , Cpk = 8.6692

Process Capability Index (Deviation)$Cp = \frac{|Hi-Lo|}{6\sigma_{n-1}}$

Process Capability Index (Offset)$CpK = \frac{|Hi-Lo|-|Hi+Lo-2\overline{x}|}{6\sigma_{n-1}}$

12.13 LOGger (MEMory) subsystem

LOGger (MEMory) subsystem is used to set and read data buffer data .

Figure 12 - 7 LOGger (MEMory) subsystem tree

LOGger MEMory	**[: STATe]**	**< LOG , STAT >**
	:START	**<ON(1),OFF(0)>**
	:SIZE	**{<1~10000>,max}**
	:COUNT?	**<0~10000>**
	:DATA?	**< 1 ~10000>**

12.13.1 LOG ger [: STATe] or MEMory [: STATe] data logging and statistics mode

LOG ger :STATe or MEMory:STATe Data logging (LOG) or data statistics (STAT) modes can be set .

Command syntax:
```
LOG ger [ : STATe ] {LOG,STAT}
MEMory [ : STATe ] {LOG,STAT}
```

parameter:
```
LOG : data logging mode
STAT: data statistics mode
```

E.g: send **> LOG:STAT STAT**

Query syntax:
```
LOGger [ : STATe ] ?
MEMory [: STATe ]?
```

Query response:
```
{ LOG,STAT}
```

E.g:
```
send > LOG:STAT?
receive> LOG
Send > LOG?
receive> LOG
```

12.13.2 LOG ger : STA R T or MEMory: STA R T data logging started

LOG ger :STA R T or MEMory:STA R T Start/ stop data logging.

Command syntax:
```
LOG ger: START {ON(1),OFF(0)}
MEMory : START {ON(1),OFF(0)}
```

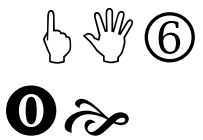
parameter:
```
ON: start recording
OFF: stop recording
```

E.g: send **> LOG:START ON**

Query syntax:
```
LOGger :STA R T ?
MEMory:START ?
```

Query response:
```
{ on, off }
```

E.g:
```
send > LOG:START?
receive> OFF
```



This command is only valid after the [Data logging] function is turned on. Please confirm the status of [Data Logging] on the <System Configuration > page .

If the current page is not on the <Measurement Display > page , this command will automatically switch to the <Measurement Display > page .

12.13.3 LOG ger:SIZE or MEMory:S IZE data logging buffer size setting

Command syntax:
```
LOG ger: S IZE {<1~10000>,max}
MEMory : S IZE {<1~10000>,max}
```

parameter:
```
<1~10000>: Integer, numbers less than 1 are forced to 1
max: buffer will be set to 10000
```

E.g: send **> LOG:SIZE max**

send **> MEM :SIZE 1000**

Query syntax:
```
LOGger :SIZE ?
MEMory:STATe ?
```

Query response:
```
{1~10000}
```

E.g:
```
send > LOG:SIZE 100 ;SIZE?
receive> 100
Send > MEM:SIZE?
receive> 200
```

12.13.4 LOG ger:COUNt ? or MEMory: COUNt ? The total number of records in the data buffer

Query syntax:
```
LOGger : COUNt ?
MEMory:COUNt ?
```

Query response: {0~10000}
0, means the buffer is empty

E.g: Send > LOG:COUN?
receive> 10
Send > MEM:COUN?
receive> 0

12.13.5 LOG ger:DATA ? or MEMory: DATA ? data buffer data

Query syntax 1: **LOG ger: DATA ? <1~10000>**
MEMory : DATA ? <1~10000>

parameter: <1~10000>: integer, greater than the total number of records in the buffer or less than 1 , return 0 .

E.g: send **> LOG:DATA? 1**
receive> 1 , +123.45E-03,+12.3456E+00

Query syntax 2: **LOGger : DATA ?**
MEMory:DATA ?

Query response: <COUNT>;
1,<RESISTANCE1>,<VOLTAGE1>;
2,<RESISTANCE2>,<VOLTAGE2> ;
…

E.g: send > LOG:DATA?
receive> 3 ;
1 , +123.45E-03,+12.3456E+00;
2, +123.44E-03,+12.3455E+00;
3,+123.45E-03,+12.3456E+00;

1. There is no line break in the actual return value. The line break is added here for the convenience of writing.
2. The total number of digits is 5 digits, and spaces are used when insufficient.
3. data records , the time to return data is longer .
4. the specified index exceeds the buffer size , the data returns 0.

12.14 SYSTem subsystem

SYSTem subsystem is used to set system-related parameters.
SYSTem subsystem will not be saved inside the instrument.

Figure 12 - 8 SYSTem subsystem tree

SYStem	**: LANGuage**	**{ENGLISH,CHINESE,EN,CN}**	
	:TIME	**<YEAR>,<MONTH>,<DAY>,<HOUR>,<MINUTE> ,<SECOND>**	
	: KEYLock (KLOC)	**{ON(1),OFF(0)}**	
	: BEEP	**[:STATE]**	**{ON(1),OFF(0)}**
	: SHAKEHAND(SHAK)	**{ON(1),OFF(0)}**	
	*: HEADer **	*{ON(1),OFF(0)}*	
	:CODE	**{ON(1),OFF(0)}**	
	: CURRent	**{ CONTinuous,PULSe }**	
	: CALibration	*(NO PARAMETER)*	
		:AUTO	**{ON(1),OFF(0)}**
	*: DATAout **	*{ OFF(0), ON(1) }*	
	: RESult	**{ FETCh, AUTO }**	
	*: BACKup **		

(* Not recommended for new designs)

12.14.1 SYSTem:LANGuage system language

Instrument language setting.

Command syntax: `SYSTem:LANGuage {ENGLISH,CHINESE,EN,CN}`

E.g: send > `SYST:LANG EN` // set to English display

Query syntax: `SYST:LANG?`

Query response: `{ENGLISH,CHINESE}`

12.14.2 SYSTem: TIME System time settings

Command syntax: `SYSTem:TIME <YEAR>,<MONTH>,<DAY>,<HOUR>,<MINUTE> ,<SECOND>`

E.g: Send > `SYST: TIME 2016,12,30,11,18,31 //2016-12-30 11:18:31`

Query syntax: `SYSTem:TIME ?`

Query response: `<YEAR> - <MONTH> - <DAY> <HOUR> : <MINUTE> :<SECOND>`

E.g: send > `SYST: TIME?`
receive > `2016-12-30 11:18:31`

12.14.3 SYSTem: KEYLock or SYST em :KLOCk Keypad lock settings

Command syntax: `SYSTem: KEYLock { ON,OFF,0,1}`
`SYSTem: KLOCk { ON,OFF,0,1}`

E.g: send > `SYST: KEYL OFF` // Keyboard unlock

Query syntax: `SYSTem: KEYLock ?`
`SYSTem: KLOCk ?`

Query response: `{ on, off }`

12.14.4 SYSTem: CODE error code return

SYST em :CODE is turned on , it is allowed to return an error code every time a command is received.

The corresponding error codes are as follows:

error code	illustrate
*E00	No error
*E01	Bad command
*E02	Parameter error
*E03	Missing parameter
*E04	buffer overrun
*E05	Syntax error
*E06	Invalid separator
*E07	Invalid multiplier
*E08	Numeric data error
*E09	Value too long
*E10	Invalid command
*E11	Unknown error

If the error code function is disabled, the host can obtain the error code by sending the ERR? command.

Command syntax: `SYSTem: CODE {ON,OFF,0,1}`

E.g: Send > `SYST: CODE ON`

Query syntax: `SYSTem: CODE ?`

Query response: `{ on, off }`

12.14.5 SYSTem: BEEPer key tone

This command **does not** affect the comparator beep.

Command syntax: `SYSTem: BEEPer { OFF,ON,0 ,1}`

parameter:
```
{OFF,ON,0,1}
OFF/0: key tone off
ON/1: key tone off
```

E.g: Send > `SYST: BEEP OFF`

Query syntax: `SYST em : BEEPer ?`

Query response: `{ OFF, ON }`

12.14.6 SYSTem: SHAKhand or SYST em : HEADer Communication handshake command (data header return)

communication handshake is turned on , the instrument will return the received command to the host as it is, and then return the data.

Command syntax:
```
SYSTem: SHAKhand { ON,OFF,0,1}
SYSTem:HEADer { ON,OFF,0,1}
```

E.g: Send > `SYST: SHAK ON`

send > `SYST: HEAD ON`

Query syntax:
```
SYSTem: SHAKhand ?
SYSTem:HEADer ?
```

Query response: `{ on, off }`

12.14.7 SYSTem: CURRent Current output settings

Set the current output mode of the instrument. When multiple instruments are used at the same time, using the current pulse output method helps to prevent crosstalk between multiple instruments . When a single instrument is working, please use the continuous output method.

Command syntax: `SYSTem: CURRent { CONTi nuous,PULSe }`

parameter:
```
CONTinuous : Current continuous output
PULS e : Current is only output during measurement
```

E.g: send > `SYST:CURR PULS`

Query syntax: `SYST em :CURRent ?`

Query response: `{ continuous, pulse }`

12.14.8 SYSTem: CALibration Instrument self-calibration function

Perform a self-calibration.

Command syntax: `SYSTem: CAL ibration`

E.g: send > `SYST: CAL`

Notice! A self-calibration will take 40ms, and after this command is sent, the next command can be delayed at least 40ms .
the measurement speed is slow , this command will be ignored.

12.14.9 SYSTem: CALibration: AUTO Instrument Self-Calibration Switch

Set the instrument self-calibration switch .

Command `SYSTem: CAL ibration: AUTO {ON,OFF,1,0}`

syntax:	
parameter:	ON/1: The instrument will self- calibrate every 30 minutes . OFF/0 : The instrument self-calibration is turned off.
E.g:	Send > **SYST: CAL:AUTO ON**
Query syntax:	**SYSTem: CAL ibration: AUTO ?**
Query response:	**{ on, off }**

12.14.10 SYSTem: RESult Send test results

SYST em : RESult can set the data sending method: automatic or FETCH command.

Command syntax:	**SYSTem: RESult {FETCH,AUTO}**
parameter:	{FETC H,AUTO} FETCH: The data needs to be returned to the host through the command fetch?, and the instrument sends it passively. AUTO: After each test is completed, the test results are automatically sent to the host, and the instrument actively sends them.
E.g:	Send > **SYST: RES AUTO** // set to send automatically
Query syntax:	**SYST: RESult ?**
Query response:	**{FETCH,AUTO}**

12.14.11 SYSTem: DATAout Send test results*

(* Not recommended for new designs)

SYST em :DATAout Both with SYST em : RESult can set the data sending mode: automatic or FETCH command, but the parameters are different.

Command syntax:	SYSTem: DATAout { OFF,ON,0 ,1}
parameter:	{OFF,ON,0,1} OFF/0: The data needs to be returned to the host through the command fetch?, and the instrument is sent passively. ON/1: After each test is completed, the test result is automatically sent to the host, and the instrument sends it actively .
E.g:	send > SYST: DATA ON // set to send automatically
Query syntax:	SYST:DATA out ?
Query response:	{ OFF, ON }

12.14.12 SYSTem: BACKup Save measurement parameters to current file *

(* Not recommended for new designs)

Please refer to the FILE:SAVE command .

Command syntax:	**SYSTem: BACKup**
E.g:	send > **SYST: BACKUP**

12.14.13 SYSTem: RESet factory settings

This command will reset all settings to factory settings. This command does not affect calibration data.

Command syntax:	**SYSTem: RESet**
E.g:	Send > **SYST: RESET** //The buzzer beeps 2 times

12.15 TRIGger subsystem

Figure 12 - 9 TRIGger subsystem tree

TRIGger	[: IMMediate]		
	: SOURce	{INT,EXT}	
	: DELay	< 1 ms~10s>	
		: STATe	{ON(1),OFF(0)}
TRG(*TRG)			

TRIGger is used to set the trigger source and generate a trigger.

12.15.1 TRIGger [: IMMediate]

TRIG[:IMM] will generate a trigger when the trigger source is set to BUS, but will not return the trigger test data. If you want to return data, you need to use the TRG instruction.

Command syntax: `TRIGger [ IMMediate ]`

E.g: send > `TRIG` // instrument stops after one test

12.15.2 TRIGger:SOURce

TRIG:SOUR is used to set the trigger source.

Command syntax: `TRIGger:SOURce {INT,EXT}`

E.g: Send > `TRIG:SOUR EXT` // Set to external trigger mode.

Query syntax: `TRIG ger :SOUR ce ?`

Query response: `<INT,EXT>`

12.15.3 TRIGger: DELay

TRIG:DELay is used to set the trigger delay timer value .

Command syntax: `TRIGger: DELay <1ms-10.000s>`

E.g: Send > `TRIG: DEL 10m` // set 10ms, if the trigger delay function is not enabled, the command will turn it on first

Query syntax: `TRIG:DELay ?`

Query response: `<0.001-10.000>` // Unit seconds

12.15.4 TRIGger: DELay :STATe

TRIG:DELay :STATe is used to enable /disable the trigger delay function.

Command syntax: `TRIGger: DELay :STATe {ON(1),OFF(0)}`

E.g: Send > `TRIG: DEL:STAT ON` // trigger delay function is on

Query syntax: `TRIG:DELay:STATe ?`

Query response: `< on,off >`

12.15.5 TRG

EXT , TRG generates a trigger and returns the data that triggers the test.

Command syntax: `TRG`

E.g: send > `TRG` // instrument test once and return full test data

Return > `__21.993E+0,_3.70088E+0,OK,HI,FAIL,RPER : +2.18930e+04`

//Resistance value, voltage value, resistance file, voltage file, total qualified , monitoring name and value

Notice! If the current page is not on the <measurement display > page or the <full screen display > page , the command will first switch to the <measurement display > page , and then trigger and return data.

12.16 FETCh and READ subsystem

Figure 12 - 10 FETCh ? subsystem tree

FETCh ?	*NO PARAMETER*
	: FULL

Figure 12 - 11 READ ? Subsystem tree

READ?	*NO PARAMETER*
	: FULL

The FETCh is similar to the READ subsystem . FETCh returns the last measurement data, while READ returns the latest measurement data. Therefore, READ will wait for a complete measurement cycle before returning the data , which is slightly less efficient in slow measurement .

12.16.1 FETCh ? or READ ? to acquire measurement data

FETCh ? Used to acquire test data. Before using this command, you need to set the [Result Send] field under the <System Configuration> page to [FETCH] .

FETC h ? command and READ ? will return the main test data .

Query syntax: **FETCh ?**

Query response:
```
According to the measurement parameters:
RV: <resistance> ,< voltage>
R : <resistance>
V: < voltage>
```

E.g: Send **> FETC?**

Return **> □□ 22.005E+0, □ 3.69943E+0** //resistance value, voltage value

Notice! If the current page is not in the <measurement display > page or the <full screen display > page , the command will first switch to the <measurement display > page , and then return to the data.

12.16.2 FETCh:FULL ? or READ:FULL? for complete measurement data

FETCh:FULL ? Or READ :FULL? to obtain complete test data, including measurement data , comparison results , and monitoring data . Before using this command, you need to set the [Result Send] field under the <System Configuration> page to [FETCH] .

Query syntax: **FETCh:FULL ?**

Query response:
```
<resistance> ,< voltage> ,< resistance HI/OK/LO>,< voltage HI,OK,LO>,<PASS/FAIL/WIRE/OPEN>
```

E.g: Send **> FETC:FULL?**

send **> READ :FULL?**

Return **> □□□ 22.005E+0, □ 3.69943E +0,--,--, □□□□ //** --indicates that the comparator is not enabled

Return **> □□ 21.990E+0, □ 3.70120E+0, OK, HI, FAIL** //resistance value, voltage value, resistance file, voltage file, total qualified

Return **> □□ 21.993E+0, □ 3.70088E+0, OK, HI, FAIL, RPER : +2.18930e+04**
//Resistance value, voltage value, resistance file, voltage file, total qualified , monitoring name and value

Notice! If the current page is not in the <measurement display > page or the <full screen display > page , the command will first switch to the <measurement display > page , and then return to the data.

12.17 CORRection subsystem

CORRection The subsystem is used to perform a short-to-zero calibration.

Figure 12 - 12 SYSTem subsystem tree

CORRect	**: SHORt**	

12.17.1 CORRection:SHORt

Query syntax: `CORRection:SHORt`

E.g: send > `CORRection:SHOR`
Return to > `Short Clear Zero Start.`.
Back > `PASS`

Note : Be sure to short the test terminals before sending commands .

12.18 FILE(MMEM) subsystem

The FILE(MMEM) subsystem is used to manage files and can be used to save user parameters to the internal flash memory , or to read flash files into the system.

Figure 12 - 13 FILE(MMEM) subsystem tree

FILE MMEM	: SAVE _	< no parameter > or <file number 0-9 >
	: LOAD	< no parameter > or <file number 0-9 >
	: DELete	<file number 0-9 >

12.18.1 FILE:SAVE save file

FILE:SAVE can save the current settings to the current file or the specified file.

Command syntax:
```
FILE:SAVE
FILE:SAVE <File No. 0-9>
```

E.g: send > `FILE:SAVE` // save to the current file
send > `FILE:SAVE 1` // save to file 1

12.18.2 FILE:LOAD read file

FILE:LOAD can read file data into the system.

Command syntax:
```
FILE:LOAD
FILE:LOAD <File No. 0-9>
```

E.g: send > `FILE:LOAD` // Read the current file data into the system
send > `FILE:SAVE 1` // Read the data of file 1 to the system

12.18.3 FILE:DELete deletes the specified file

FILE: DELete can delete the data of the specified file.

Command syntax: `FILE:DEL ete <File No. 0-9>`

E.g: send > `FILE:DELete 1` // delete file 1

Note : Deleting the current file will not affect the parameters of the system

12.19 IDN? Subsystem

The IDN? subsystem is used to return the version number of the instrument.

Received an IDN? command, the instrument buzzer will beep once, indicating that the data has been received, and the result has been returned.
Usually when debugging communication , use this command to test online.

Query syntax: `IDN? or *IDN ?`

Query response: `<Manufacturer > , < MODEL >,<SN>,<Revision>`
`Manufacturer , Model, Serial Number, Instrument Version`

E.g: Send > `IDN?`.
Return> `Anbai Instruments , AT527,000000,REV C1. 0` // The instrument buzzer will beep

12.20 ERRor subsystem

The error subsystem is used to obtain information about the last error that occurred

Query syntax:	**ERRor ?**
Query response:	**Error string**
E.g:	send **> ERR?** return > **no error.**

The corresponding error codes are as follows:

error code	illustrate
*E00	No error
*E01	Bad command
*E02	Parameter error
*E03	Missing parameter
*E04	buffer overrun
*E05	Syntax error
*E06	Invalid separator
*E07	Invalid multiplier
*E08	Numeric data error
*E09	Value too long
*E10	Invalid command
*E11	Unknow error

12.21 SAV 子系统

SAV subsystem is used to save all modified settings to the instrument internal disk.

Query syntax:	**SAV**
Query response:	**OK**
E.g:	send **> SAV** Return> **OK**

13. Modbus (RTU) communication protocol

This chapter covers the following areas :

- Data Format - Learn about the Modbus communication format .
- Function
- Variable area
- function code

13.1 Data Format

We follow the Modbus (RTU) communication protocol, the instrument will respond to the command of the upper computer and return a standard response frame.

See also : You can contact the sales department of our company to obtain the communication test tool of Anbai Instrument, which contains the Modbus communication debugging method. Contains CRC - 16 calculator and floating point conversion to Modbus floating point format.

13.1.1 command frame

Figure 13 - 1 Modbus command frame

Table 13 - 1 instruction frame description

	A squelch interval of at least 3.5 character time is required
Slave address	1 byte Modbus Can support 00~ 0 x 63 slaves Specify 00 for unified broadcast In instruments without the RS 485 option, the default slave address is 0x01
function code	1 byte 0 x 03 : read multiple registers 0 x 04 := 03 H, not used 0 x 06 : write a single register, can be replaced with 10H 0x08 : _ _ Echo test (for debugging only) 0 x 10 : write to multiple registers
data	Specify register address, quantity and content
CRC- 16	2 bytes, LSB first Cyclic Redun dancy Check Calculate all data from the station address to the end of the data to

	get the CRC 16 check code
	A squelch interval of at least 3.5 character time is required

13.1.2 CRC-16 calculation method

1. Set the initial value of the CRC-16 register to 0x FFFF .
2. XOR the CRC-16 register and the first byte data of the message , and return the result to the CRC register.
3. Fill the MSB with 0 , while right-shifting the CRC register by 1 bit.
4. If the bit shifted from the LSB is " 0 ", repeat step (3) (processing the next shift) . If the bit shifted from the LSB is ' 1 ', XOR the CRC register with 0x A001 and return the result to the CRC register.
5. Repeat steps (3) and (4) until you move 8 bits.
6. If the information processing has not ended, XOR operation is performed on the CRC register and the next byte of the information, and the CRC register is returned, and the execution is repeated from step (3) .
7. the result of the calculation (the value of the CRC register) to the message from the lower byte.

The following is a CRC calculation function in VB language:

```
Function CRC16(data() As Byte) As Byte()
Dim CRC16Lo As Byte, CRC16Hi As Byte 'CRC register
Dim CL As Byte, CH As Byte 'Polynomial code&HA001
Dim SaveHi As Byte, SaveLo As Byte
Dim i As Integer
Dim flag As Integer
CRC16Lo = &HFF
CRC16Hi = &HFF
CL = &H1
CH = &HA0
For i = 0 To UBound (data)
CRC16Lo = CRC16Lo Xor data( i ) 'Each data is XORed with the CRC register
For flag = 0 To 7
          SaveHi = CRC16Hi
          SaveLo = CRC16Lo
CRC16Hi = CRC16Hi \ 2 'The high bit is shifted to the right by one
CRC16Lo = CRC16Lo \ 2 'The low bit is shifted to the right by one
If (( SaveHi And &H1) = &H1) Then 'If the last bit of the high-order byte is
1
CRC16Lo = CRC16Lo Or &H80 'The lower byte is shifted to the right and the front
is filled with 1
End If 'Otherwise add 0 automatically
If (( SaveLo And &H1) = &H1) Then 'If LSB is 1, XOR with polynomial code
CRC16Hi = CRC16Hi Xor CH
CRC16Lo = CRC16Lo Xor CL
End If
Next flag
Next i
Dim ReturnData (1) As Byte
   ReturnData (0) = CRC16Hi 'CRC high bit
   ReturnData (1) = CRC16Lo 'CRC low bit
CRC16 = ReturnData
   End Function
```

See also : Our company's "Anbai Instrument Communication Test Tool" contains Modbus communication debugging method. It includes CRC- 16 calculator.

Calculated CRC - 16 data needs to be appended to the end of the command frame, for example: 1 234H :

Figure 13 - 2 Modbus Append CRC - 16 value

13.1.3 response frame

Unless it is a 0 0 H slave address broadcast command, other slave address devices will return response frames.

Figure 13 - 3 normal response frame

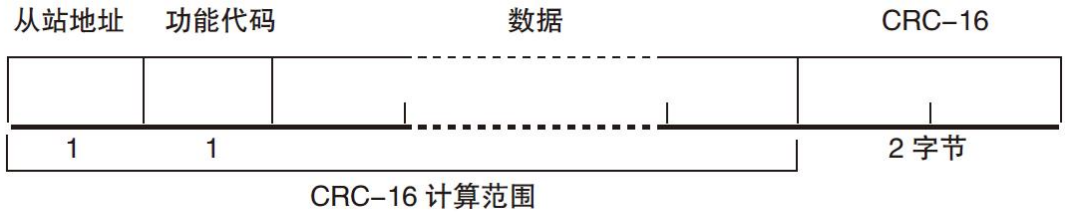


Figure 13 - 4 Abnormal Response Frame

Table 13 - 2 Abnormal response frame description

Slave address	1 byte The slave address is returned as it is
function code	1 byte The function code of the instruction frame is logically ORed (OR) on BIT 7 (0x8 0), for example: 0x 03 OR 0 x 80 = 0 x83
error code	Exception code: 0x 01 Function code error (function code not supported) 0 x 02 register error (register does not exist) 0 x 03 Data error 0 x 04 Execution error
CRC- 16	2 bytes, LSB first Cyclic Redun dancy Check Calculate all data from the station address to the end of the data to get the CRC 16 check code

13.1.4 No response

In the following cases, the instrument will not perform any processing and will not respond, resulting in a communication timeout.

1. Slave address error
2. transmission error
3. CRC- 16 error
4. The number of digits is wrong, for example: the total digits of function code 0x03 must be

8, and the received digits are less than 8 or more than 8 bytes.

5. When the slave address is 0x 00 , it represents the broadcast address and the instrument does not respond.

13.1.5 error code

Table 13 - 3 Error code description

error code	name	illustrate	priority
0x 01	Function code error	Function code does not exist	1
0x 02	register error	register does not exist	2
0x03 _ _	data error	wrong number of registers or number of bytes	3
0x 04	execution error	The data is illegal, the written data is not within the allowed range	4

13.2 function code

The instrument only supports the following function codes, other function codes will respond to error frames.

Table 13 - 4 function codes

function code	name	illustrate
0x 03	read multiple registers	Read multiple consecutive register data
0x04 _ _	same as 0x 03	replace with 0x 03
0x08 _ _	echo test	The received data is returned as it is
0x 10	write to multiple registers	Write to multiple consecutive registers

13.3 register

The number of registers of the instrument is in 2-byte mode, that is, 2 bytes must be written each time, for example: the speed register is 0x 3002 , the data is 2 bytes, and the value must be written 0x 0001

data:

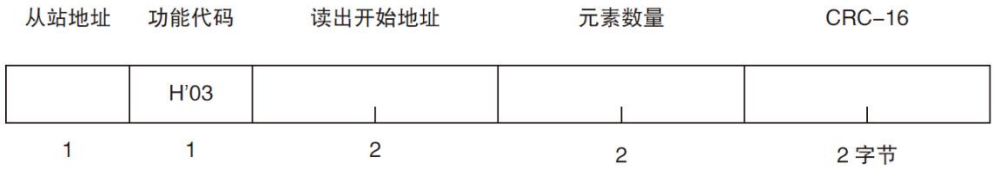
The instrument supports the following values:

1. 1 register, double-byte (1 6 -bit) integer, for example: 0x6 4 → 00 64
2. 2 registers, four-byte (32 -bit) integers, eg: 0 x 12345678 → 12 34 56 78
3. 2 registers, four-byte (3 2 -bit) single-precision floating-point numbers, 3. 14 → 40 48 F5 C3

See also : Our company's "Anbai Instrument Communication Test Tool" contains Modbus communication debugging methods. It includes floating point converters.

13.4 read multiple registers

Figure 13 - 5 Read multiple registers (0x0 3)

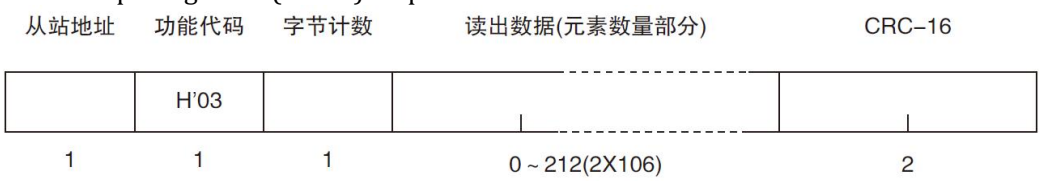


The function code for reading multiple registers is 0 x 03 .

Table 13 - 5 Read multiple registers

name	name	illustrate
	Slave address	no RS 485 address is specified, the default is 0 1
0x03 _ _	function code	
	initial address	Register start address, please refer to Modbus Instruction Set
	Number of read registers 000 1~ 006 A (1 06)	Number of registers to read consecutively. Please refer to Modbus instruction set to ensure that these register addresses are present, otherwise an error frame will be returned.
C RC-16	check code	

picture 13 - 6 read multiple registers (0x0 3) response frame



name	name	illustrate
	Slave address	return as is
0x03 _ _ or 0x 83	function code	No exception: 0x 03 Error code : 0x83
	number of bytes	= number of registers x 2 For example: 1 register returns 0 2
	data	read data
C RC-16	check code	

13.5 write to multiple registers

Figure 13 - 7 Write to multiple registers (0x 1 0)

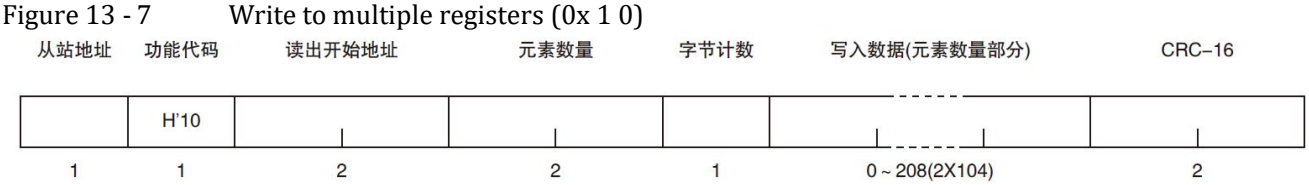
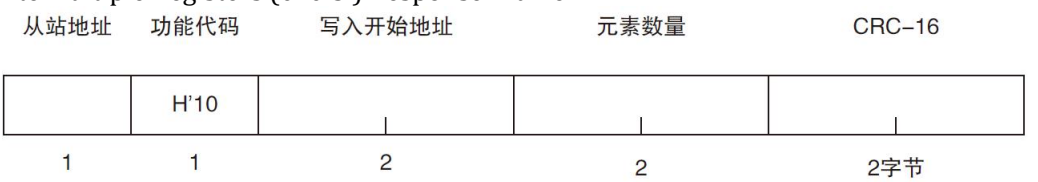


Table 13 - 6 Writes to Multiple Registers

name	name	illustrate
	Slave address	no RS 485 address is specified, the default is 0 1
0x10 _ _	function code	
	initial address	Register start address, please refer to Modbus Instruction Set
	Number of write registers 000 1~ 0068 (1 04)	Number of registers to read consecutively. Please refer to Modbus instruction set to ensure that these register addresses are present, otherwise an error frame will be returned.
	number of bytes	= number of registers x 2
C RC-16	check code	

Figure 13 - 8 Write Multiple Registers (0x0 3) Response Frame

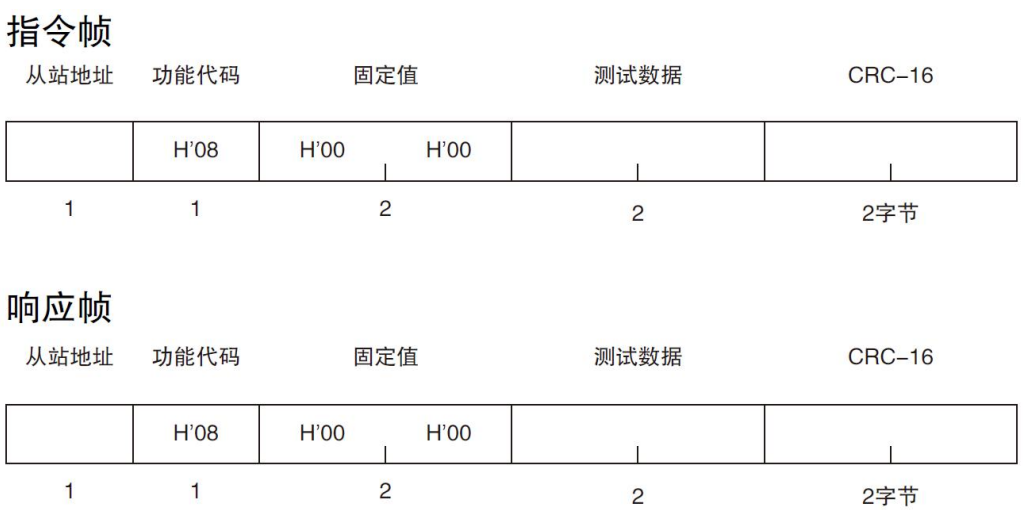


name	name	illustrate
	Slave address	return as is
0x10 _ _ or 0x 90	function code	No exception: 0x 10 Error code : 0x90
	initial address	
	Number of registers	
	C RC-16 check code	

13.6 echo test

Echo test function code 0x 08 , used to debug Modbus.

Figure 13 - 9 echo test (0x0 8)



name	name	illustrate
	Slave address	return as is
0x08 _ _	function code	
	Fixed value	0 0 00
	Test Data	Any number: e.g. 12 34
	C RC-16 check code	

E.g:

Assuming the test data is 0 x 1234 :

指令：	01	08	00 00	12 34	ED 7C(CRC–16)
响应：	01	08	00 00	12 34	ED 7C(CRC–16)

14. Modbus (RTU) instruction set

This chapter covers the following areas :

- register address

See also : Be sure to contact the sales department of our company to obtain the communication test tool of Anbai Instrument, which has the Modbus communication debugging method. Contains CRC - 16 calculator and floating point conversion to Modbus floating point format.

Note: Unless otherwise specified, the values of the command and response frames in the following description are all hexadecimal data.

14.1 Register overview

by the instrument are listed below, any address not in the table will return error code 0x02 .

Table 14 - 1 register overview

register address	name	Numerical value	illustrate
2 000	Read resistance measurements	4-byte floating point number	Read-only register, data occupies 2 registers
2002	Read voltage measurements	4-byte floating point number	Read-only register, data occupies 2 registers
2004	get comparator result	2 -byte integer	Read-only register, data occupies 1 register
0000	Read instrument version number	4-byte ASCII	Read-only register, data occupies 2 registers
3000	function register	0000 : R -V 0 001 : R 0 002 : V	Read and write registers, 2-byte integers
3001	Resistance range	0000 ~ 0006	Read and write registers, 2-byte integers
3 002	Voltage range	0 000 ~ 0002	Read and write registers, 2-byte integers
3 003	Resistance range method	0 000 : Range auto 0 001 : Manual range 0 002 : Nominal range	Read and write registers, 2-byte integers

3 004	Voltage range method	0 000 : Range auto 0 001 : Manual range 0 002 : Nominal range	Read and write registers, 2-byte integers
300 5	Test speed	0000: slow 0001 : medium speed 0002 : fast 0003 : high speed	Read and write registers, 2-byte integers
3 006	Average times	0 000 : invalid 0 001 ~ 0 x 0100 (1~ 256)	Read and write registers, 2-byte integers
3 007	Trigger method	0 000 : Internal 0 001 : External	Read and write registers, 2-byte integers
3 008	Trigger delay	0 000 : off 0 001 ~ 0 x 2710 (1~ 10000)	Read and write registers, 2-byte integers Unit ms
3 009	trigger edge	0 000 : rising edge trigger 0 001 : falling edge trigger	Read and write registers, 2-byte integers
300A _	self-calibration	0 000 : off 0 001 : On	Read and write registers, 2-byte integers
3 00B	current mode	0 000 : Continuous 0 001 : Pulse	Read and write registers, 2-byte integers
300C _	file boot call	0000: file 0 0001 : current file	Read and write registers, 2-byte integers
300 D	auto save	0000: Forbidden 0001 : Allowed	Read and write registers, 2-byte integers
300 E	system language	0000 : English 0001 : Simplified Chinese	Read and write registers, 2-byte integers
3100	Resistor Comparator Status	0000 : Comparator off 0001 : Comparator on	Read and write registers, 2-byte integers
310 1	Voltage Comparator Status	0000 : Comparator off 0001 : Comparator on	Read and write registers, 2-byte integers
310 2	Resistor comparator method	0000: SEQ 0001 : PER	Read and write registers, 2-byte integers

		0002 : A BS	
310 3	Voltage comparator method	0000: SEQ 0001 : PER 0002 : A BS	Read and write registers, 2-byte integers
3 1 0 4	beep	0000: close 0001 : Qualified beeper 0002 : Unqualified beep	Read and write registers, 2-byte integers
31 10	Resistance nominal value	4-byte floating point number	Read and write registers, data occupies 2 registers
3 112	Voltage nominal value	4-byte floating point number	Read and write registers, data occupies 2 registers
311 4	Resistance lower limit	4-byte floating point number	Read and write registers, data occupies 2 registers
3116	Resistance upper limit value	4-byte floating point number	Read and write registers, data occupies 2 registers
31 8 4	Voltage lower limit	4-byte floating point number	Read and write registers, data occupies 2 registers
31 8 6	Voltage upper limit	4-byte floating point number	Read and write registers, data occupies 2 registers
4000	Save settings to current file	Fixed value: 0001	Write-only register, data 2 bytes
400 8	Read current file data	Fixed value: 0001	Write-only register, data 2 bytes
40 10	Save settings to specified file	000 0 ~ 0009	Write-only register, data 2 bytes
40 18	Read the specified file data	0000~ 0009	Write-only register, data 2 bytes
5000	execute clear register read clear status	Write fixed value: 0001 Read: 0001 clearing 0000 Cleared successfully F FFF clear failed	Read and write registers, data occupies 1 register Once the clear function is executed, Modbus will inhibit the execution of the write command and only allow the register to be read.

14.2 Get measurement data

14.2.1 Get measurement results

Registers 2000~ 2003 are used to obtain instrument measurement data.

instruction:

1	2	3	4	5	6	7	8
01	03	2000		0002		CRC-16	
Slaves	read	register		Number of		check code	

			registers	

response

1	2	3	4	5	6	7	8	9
01	03	byte	single precision floating point number				CRC-16	

- **Get resistance measurements:**

send:

1	2	3	4	5	6	7	8
01	03	20	00	00	02	CF	CB
Slaves	read	register		Number of registers		check code	

response:

1	2	3	4	5	6	7	8	9
01	03	04	4E	6E	6B	28	A3	E8
01	03	byte	single precision floating point number				CRC-16	

Among them, B4~B6 are measurement data: 4E6E6B28 represents 1E 9 (low order first)

- **Get voltage measurement results**

send:

1	2	3	4	5	6	7	8
01	03	20	0 2	00	02	6E	0B
Slaves	read	register		Number of registers		check code	

response:

1	2	3	4	5	6	7	8	9
01	03	04	50	15	02	F9	3B	D5
01	03	byte	single precision floating point number				CRC-16	

Among them, B4~B6 are measurement data: 501502F9 represents 1 E10 (low order first)

- **Obtain resistance and voltage measurements**
- send:

1	2	3	4	5	6	7	8
01	03	20	0 2	00	0 4	4F	C9
Slaves	read	register		Number of registers		check code	

- response:

1	2	3	4	5	6	7	8	9	10	11	12	13
01	03	0 8	3F	B 1	69	A8	41	0C	2A	56	54	08

Resistor: B4 ~ B7 : 3 FB169A8 = 1.3860

Voltage: B 8 ~B 11 : 4 10C2A56 = 8.7603

14.2.2 Get the comparator result [2 0 04]

Register 2 004 records the voltage and resistance comparator results

Example: 2203

1 6 -bit storage domain:

Among them: BIT 15 ~ BIT12 represent voltage range 0 : VOK 1 : V LO 2 : V HI

BIT11~BIT8 represent resistance range 0 : R OK 1 : R LO 2 : R HI

BIT7~BIT4 are invalid

BIT3~BIT0 total qualified file 0 : R VOK 3 : R VNG

send:

1	2	3	4	5	6	7	8
01	**03**	**twenty one**	**0 4**	**00**	**01**	**CE**	**0B**
Slaves	read	register		Number of registers		check code	

response:

1	2	3	4	5	6	7
01	**03**	**0 2**	**twenty two**	**03**	**E0**	**E5**

14.3 parameter settings

14.3.1 Function register【300 0 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**00**	**00**	**01**	**02**	**00**	**00**	**96**	**53**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**00**	**00**	**01**	**AF**	**09**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**00**	**00**	**0 1**	**8B**	**0A**
	read	register		Number of registers		CRC	

response:

1	2	3		4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**	

		byte	data	CRC

where the data values are:

data	Function	illustrate
0 000	R -V	Simultaneous measurement of resistance and voltage
0 001	R	Resistance measurement and display only
0 002	V	Voltage measurement and display only

14.3.2 Resistance range register【300 1 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**01**	**00**	**01**	**02**	**00**	**01**	**56**	**42**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**01**	**00**	**01**	**5F**	**09**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**01**	**00**	**0 1**	**DA**	**CA**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Range 0	3mΩ
0 001	Range 1	30mΩ _ _
0 002	Range 2	300mΩ _ _
0 003	Range 3	3Ω
0 004	Range 4	30Ω _ _
0 005	Range 5	300Ω _ _
0 006	Range 6	3kΩ

14.3.3 Voltage range register【300 2 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**02**	**00**	**01**	**02**	**00**	**02**	**16**	**70**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**02**	**00**	**01**	**A F**	**09**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**02**	**00**	**0 1**	**DA**	**CA**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**02**	**39**	**85**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Range 0	8V _
0 001	Range 1	80V
0 002	Range 2	400V

14.3.4 Resistance range mode register【300 3 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**03**	**0 0**	**01**	**02**	**00**	**01**	**57**	**A 0**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 3**	**00**	**01**	**FE**	**C9**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**03**	**00**	**0 1**	**7B**	**0A**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7

01	03	02	00	01	79	84
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Autoranging	
0 001	Hold range	
0 002	Nominal range	Select range based on nominal value

14.3.5 Voltage range mode register【300 4 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**04**	**0 0**	**01**	**02**	**00**	**01**	**56**	**17**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 4**	**00**	**01**	**4F**	**08**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**04**	**00**	**0 1**	**CA**	**CB**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Autoranging	
0 001	Hold range	
0 002	Nominal range	Select range based on nominal value

14.3.6 Test speed register【3 005 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**05**	**00**	**01**	**02**	**00**	**01**	**56**	**71**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8

01	**10**	**30**	**05**	**00**	**01**	**1 E**	**C8**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**05**	**00**	**0 1**	**9 B**	**0B**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	slow	
0 001	medium speed	
0 002	fast	
0 003	high speed	

14.3.7 Average times register【300 6 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**06**	**0 0**	**01**	**02**	**00**	**01**	**57**	**F5**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 6**	**00**	**01**	**EE**	**C8**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**06**	**00**	**0 1**	**6B**	**0B**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 001~0100	Average 0~ 256	mean 0 = mean 1

14.3.8 Trigger mode register【300 7 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**07**	**0 0**	**01**	**02**	**00**	**01**	**56**	**twenty four**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 6**	**00**	**01**	**B F**	**08**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**07**	**00**	**0 1**	**3A**	**CB**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Internal trigger	
0 001	External trigger	Use Trigger key, Handler Trig or remote trigger

14.3.9 Trigger delay register【300 8 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**08**	**0 0**	**01**	**02**	**00**	**0A**	**56**	**twenty four**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 8**	**00**	**01**	**B F**	**08**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**08**	**00**	**0 1**	**0A**	**C8**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Delay off	
0 001 ~ 2710	1 ~0x2710 (10000)	Decimal 1ms~ 10000 ms Unit ms

14.3.10 Trigger edge register【300 9 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**09**	**0 0**	**01**	**02**	**00**	**00**	**96**	**C A**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 9**	**00**	**01**	**DE**	**CB**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**09**	**00**	**0 1**	**5B**	**08**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	rising edge trigger	Default setting
0001	falling edge trigger	

14.3.11 Self-calibration switch register [300A]

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0A**	**0 0**	**01**	**02**	**00**	**01**	**2E**	**CB**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 A**	**00**	**01**	**2E**	**CB**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**0A**	**00**	**0 1**	**A B**	**08**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**7 9**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Self-calibration off	
0 001	Self-calibration on	Default setting

14.3.12 Current Mode Register [300 B]

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0B**	**0 0**	**01**	**02**	**00**	**00**	**97**	**28**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 B**	**00**	**01**	**7F**	**0B**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**0B**	**00**	**0 1**	**FA**	**C8**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**0 0**	**B8**	**44**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Continuous current output	Default setting
0 001	Pulse current	

	output	

14.3.13 File boot call register [300C]

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0C**	**0 0**	**01**	**02**	**00**	**01**	**FA**	**C8**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0 C**	**00**	**01**	**CE**	**CA**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**0C**	**00**	**0 1**	**4B**	**09**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**0 1**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	file 0	Default setting
0 001	current file	

14.3.14 Auto save【30 0 D】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0D**	**0 0**	**01**	**02**	**00**	**01**	**56**	**8 E**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0D _**	**00**	**01**	**9F**	**0A**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**30**	**0D**	**00**	**0 1**	**79**	**84**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**0 1**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	closure	Default setting
0 001	Open	

14.4 Comparator settings

Comparator parameter register addresses start at 3100.

14.4.1 Resistor Comparator Status Register [3 100]

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**00**	**0 0**	**01**	**02**	**00**	**01**	**47**	**5 3**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**00**	**00**	**01**	**0 F**	**35**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**0 0**	**00**	**0 1**	**8A**	**F6**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**0 1**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	Resistor comparator off	Default setting
0 001	Resistor comparator on	

14.4.2 Voltage Comparator Status Register [3 101]

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**01**	**0 0**	**01**	**02**	**00**	**01**	**46**	**82**
	Write	register		Number of		byte	data		CRC	

			registers			

response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**01**	**00**	**01**	**5E**	**F5**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**0 1**	**00**	**0 1**	**DB**	**36**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**0 1**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	voltage comparator off	Default setting
0 001	voltage comparator on	

14.4.3 Resistor Comparator Mode Register【3 102 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**02**	**0 0**	**01**	**02**	**00**	**01**	**46**	**B 1**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**02**	**00**	**01**	**AE**	**F5**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**0 2**	**00**	**0 1**	**2B**	**36**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**0 1**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate

0 000	SEQ _	direct reading
0 001	P ER	Relative deviation comparison
0 002	A BS	Absolute deviation comparison

14.4.4 Resistor Comparator Mode Register【3 103 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**03**	**0 0**	**01**	**02**	**00**	**01**	**47**	**B 1**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**03**	**00**	**01**	**F F**	**35**
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**0 3**	**00**	**0 1**	**7A**	**F6**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**0 1**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	SEQ _	direct reading
0 001	P ER	Relative deviation comparison
0 002	A BS	Absolute deviation comparison

14.4.5 Beep register【3 104 】

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**04**	**0 0**	**01**	**02**	**00**	**01**	**46**	**D 7**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**04**	**00**	**01**	**4E**	**F4**
		register		Number of		CRC	

			registers	

- read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**0 4**	**00**	**0 1**	**CB**	**37**
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**0 1**	**79**	**84**
		byte	data		CRC	

where the data values are:

data	Function	illustrate
0 000	OFF _	closure
0 001	PASS _	Qualified beeper
0 002	F AIL	Unqualified sound

14.4.6 Resistor nominal value register [31 10]

Resistor nominal values use 2 registers, 31 10 and 31 11 . Notice! Reading 31 10 alone has no effect.

- write

100E-3 (single precision floating point number: 0x 3DCCCCCD)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	31	1 0	00	02	04	3D	CC	CC	CD	F2 _	34
	Write	register		Number of registers		byte	data				CRC	

response:

1	2	3	4	5	6	7	8
01	10	31	1 0	00	02	4E	F1
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	03	31	1 0	00	02	CB	32
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7	8	9
01	03	0 4	3D	CC	CC	CD	A3	35
		byte	Data 100E-3				CRC	

14.4.7 Voltage nominal value register [31 12]

Resistor nominal values use 2 registers, 31 10 and 31 11 . Notice! Reading 31 10 alone has no effect.

- write

3.6000 (single-precision floating point number: 0x 40666666)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	31	1 2	00	02	04	40	66	66	66	74	B E
	Write	register		Number of registers		byte	data				CRC	

response:

1	2	3	4	5	6	7	8
01	10	31	1 2	00	02	EF	31
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	03	31	1 2	00	02	6A	F2
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7	8	9
01	03	0 4	4 0	66	66	66	A4	66
		byte	data				CRC	

14.4.8 Resistance limit value register [31 14 - 3117]

Resistor limits start at 311 4 , using 2 registers for the lower limit and 2 registers for the upper limit, for a total of 4 registers.

The lower limit and upper limit can be set separately or at the same time.

- write

Lower limit: 1E-3, Upper limit: 1 0E - 3

1	2	3~ 4	5	6	7	8 ~11	12 ~15	1 6 ~ 17
01	10	31 1 4	00	02	04	3 A 83 12 6F	3 C 23 D7 0A	0 1 8E
						lower limit	upper limit	

response:

1	2	3	4	5	6	7	8
01	10	31	1 4	00	04	8F	32

- read

1	2	3	4	5	6	7	8
01	03	31	1 4	00	04	0A	F1

response

1	2	3~ 4	5~8	9 ~ 12	13 ~ 14
01	0 3	31 1 4	3 A 83 12 6F	3 C 23 D7 0A	51 61
			lower limit	upper limit	

14.4.9 Voltage limit value register [31 84 - 3187]

Resistor limits start at 311 4 , using 2 registers for the lower limit and 2 registers for the upper limit, for a total of 4 registers.

The lower limit and upper limit can be set separately or at the same time.

- write

Lower limit: 3.0000, Upper limit: 4.0000

1	2	3~ 4	5	6	7	8 ~11	12 ~15	1 6 ~ 17
01	10	3184	00	02	04	4 0 40 00 00	40 80 00 00	57 66
						lower limit	upper limit	

response:

1	2	3	4	5	6	7	8
01	10	31	84	00	04	8F	1F

- read

1	2	3	4	5	6	7	8
01	03	31	84	00	04	0A	DC

response

1	2	3~ 4	5~8	9 ~ 12	13 ~ 14
01	0 3	31 1 4	4 0 40 00 00	40 80 00 00	51 61
			lower limit	upper limit	

14.5 file operations

Since the instrument settings are stored in the file, after all the Modbus commands are set, the data cannot be stored in the internal FlashRom in real time, which will cause the register data before the next power-on to restore to the value of the original file.

The user can operate the register with the file to store all the setting values in the current or specified file. At the same time, the specified file data can also be called into the setting register.

14.5.1 Save to the current file [4 000]

Send the value 0001 to 4 000 register, the instrument will perform the file write operation, and all settings will be saved to the current file.

This register cannot be read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**4 0**	**00**	**0 0**	**01**	**02**	**00**	**01**	**26**	**54**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**00**	**00**	**01**	**14**	**09**
		register		Number of registers		CRC	

where the data values are:

data	Function	illustrate
0 001	allow operation	Fixed value

14.5.2 Save to the specified file [4 008]

Send the file number to the 4 008 register, the instrument will execute the file write operation, all settings will be saved to the specified file, and the specified file will be used as the current file of the system.

This register cannot be read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**4 0**	**08**	**0 0**	**01**	**02**	**00**	**09**	**26**	**D A**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**00**	**00**	**01**	**95**	**CB**
		register		Number of registers		CRC	

where the data values are:

data	Function	illustrate
0 000~0009	file 0~ 9	

14.5.3 Reload the current file [4 010]

Send the fixed value 0 001 to 4 010 registers, the instrument loads the current file data into the system.

This register cannot be read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**4 0**	**1 0**	**0 0**	**01**	**02**	**00**	**01**	**twenty four**	**C 4**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**10**	**00**	**01**	**15**	**CC**
		register		Number of registers		CRC	

where the data values are:

data	Function	illustrate
0 001	Fixed value	

14.5.4 Load the specified file [4 018]

Send the file number to the 4 018 register, the instrument will load the settings of the specified file into the system, and the specified file will be used as the current file of the

system.

This register cannot be read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**4 0**	**18**	**0 0**	**01**	**02**	**00**	**00**	**E 4**	**4C**
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**1 8**	**00**	**01**	**94**	**0E**
		register		Number of registers		CRC	

Error response:

The file is empty, the instrument will respond with error code: 0 4

1	2	3	4	5
01	**90**	**04**	**4D**	**C3**
		error code	**C RC**	

where the data values are:

data	Function	illustrate
0 000~0009	file 0~ 9	

14.6 Clear【5000】

Write 0001 to register 5000, the instrument will start to perform short circuit clear operation. Before performing the reset, be sure to short the test leads, otherwise the reset will fail.

Since the clearing process takes several seconds, during this period, any write operations will be ignored and only read operations will be opened. After clearing is completed, the write command is normally opened.

During the clearing execution or after the clearing is completed, the clearing status can be obtained by reading the 5000 register:

0000 reset successfully

Failed to clear FFFF

0001 is being cleared

- write

Please write a fixed value to the 5000 register: 00 01

Send: 01 10 5000 0001 02 0001 3795

Response: 01 10 5000 0 0 01 10C9

- read

During the execution of clearing, you can determine whether the clearing is complete by reading the register data

Send: 01 03 5000 0001 950A

Response: 01 03 02 FFFF B9F4

Returns FFFF, which means clearing failed

Notice:

When clearing, try not to read the clearing state frequently, as continuous interruption will easily cause the instrument to fail to clear.

Since the clearing time is fixed, it is recommended that after issuing the clearing command, the host must wait for the clearing time to pass before obtaining the clearing result.

15. Specification

You will learn the following:
technical indicators.
General Specifications .
Dimensions .

15.1 Technical indicators

The following data were measured under the following conditions:
Temperature condition: 23°C ± 5°C
Humidity Conditions: ≤65% RH
Zero adjustment: short circuit clear before test
Warm-up time: >60 minutes
Calibration time: 12 months

Test current accuracy : 10 %
Test current frequency accuracy: 1kHz (1 ±20Hz), 5ppm
AC resistance index:

Table 15 - 1 resistance index

RANGE No.		0	1	2	3	4	5	6
RANGE		3mΩ _	30mΩ	300mΩ	3 Ω	30Ω	300Ω	3kΩ
Maximum Dispalyed Values		3.1000 m	31.000m	310.00m	3.1000	31.000	310.00	3200.0
Resolution		0.1μΩ	1μΩ	10μΩ	100μΩ	1mΩ	10mΩ	100mΩ
Measured Current		100mA	100mA	10mA	1mA	100μA	10μA	10μA
ACCURACY	SLOW	±0.5%rdg. ±10dgt	±0.5% rdg. ±5 dgt					
	MEDIUM	±0.5%rdg. ±15dgt	±0.5% rdg. ±10 dgt					
	FAST	±0.5%rdg. ±20dgt	±0.5% rdg. ±10 dgt					
	EX.FAST	±0.5%rdg. ±40dgt	±1% rdg .±20 dgt					
Temperature coefficient		(±0.05 %rdg. ±1 dgt .)/℃	(±0.05 % rdg . ± 0.5 dgt .)/℃					

DC voltage index:

Table 15 - 2 Voltage Specifications

RANGE No.		0	1	2
Max imum _ Dispalyed Values		± 8.08000	±80.8000	±202.000【AT527A】 ±404.000【AT527】 ±808.000【AT527B】 ±1000.000【AT527H】
Resolution		10μV	100μV	1mV
ACCURACY	SLOW	±0.01%rdg. ±5dgt		
	MEDIUM	±0.01 %rdg. ± 7dgt		
	FAST	±0.05 %rdg. ± 7dgt		
	EX.FAST	±0.1 % rdg. ±10dgt		
Temperature coefficient		(±0.001 %rdg. ± 0.5dgt .)/℃		

15.2 General Specifications

Screen: TFT-LCD true color display , with touch screen, screen size 4.3 inches .

Test speed: manual range mode:

Slow: 4 times/sec

Medium speed: 8 times/sec

Fast: 20 times/sec

High speed: 55 times/sec

Range mode: automatic , manual and nominal

Calibration: Short circuit full scale clear

Test terminal: four- terminal test method

Comparators : ABS, PER and SEQ

Handler : resistance HI/IN/LO, voltage HI/IN/LO total unqualified level

Beep: Off, Pass, Fail.

Triggering: Internal, external (manual and remote) triggering.

Interface: Handler interface

RS232 interface and USB-232 interface

Programming Language: SCPI and Modbus (RTU)

Accessibility: Keypad lock

15.3 Environmental requirements

Environment: Indicator: Temperature 18℃~28℃ Humidity ≤65%RH

Operation: Temperature 10℃~40℃ Humidity 10~8 0% RH

Storage: Temperature 0℃~50℃ Humidity 10~90% RH

Power: 85VAC~ 240VAC

Fuse: 250V 1 A slow blow

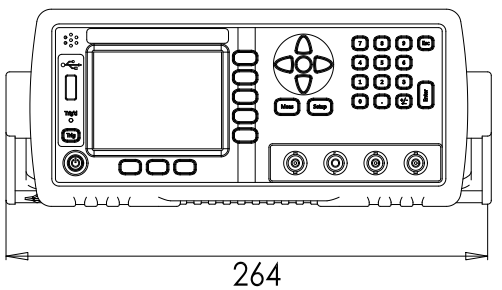
Power: Max 20VA

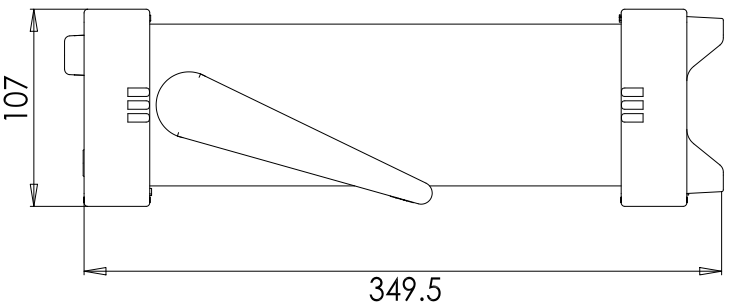
Weight: about 3.5 kg.

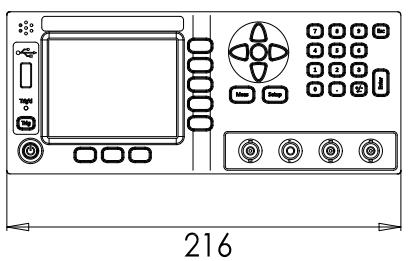
15.4 Dimensions

(schematic)

Table 15 - 3 Dimensions







-AT527 Instruction Manual-

Simplified Chinese version

Anbai Instruments Ltd. _