ONMEAS®

Rev.A0

AT2527/A/B/H/L/K/S

Battery Internal Resistance Tester



User Manual

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Operation Video

Safety Precautions

Warning DANGER: If any of the following abnormalities occurs, stop operation immediately and disconnect the power cord. Contact the ONMEAS sales department for repair. Otherwise, a fire or potential electric shock hazard to the operator may result.

- The instrument operates abnormally.
- The instrument produces abnormal noise, odor, smoke, or flash during operation.
- The instrument generates high temperature or electric shock during operation.
- The power cord, power switch, or power socket is damaged.
- Foreign matter or liquid enters the instrument.

Safety Information

Warning DANGER: To avoid possible electric shock and personal injury, follow these guidelines when operating the instrument.

Disclaimer	Users should read the following safety information carefully before using the instrument. ONMEAS shall not be liable for any personal injury or property damage caused by failure to comply with the following terms.
Instrument Grounding	To prevent electric shock, connect the ground wire of the power cord properly.
Never Using the Instrument in Explosive Gas Environments	Do not use the instrument in environments containing flammable or explosive gases, vapors, or excessive dust. Using any electronic device in such an environment poses a risk to personal safety.
Never Opening the Instrument Enclosure	Do not open the instrument enclosure to attempt repairs unless you are qualified maintenance personnel. For some time after power-off, the instrument may retain a charge that has not been fully discharged, which could pose an electric shock hazard to persons.
Do Not Using a Damaged Instrument	If the instrument has been damaged, the resulting hazard is unpredictable. Disconnect the power cord, do not use it again, and do not attempt repairs yourself.
Do Not Using a Malfunctioning Instrument	If the instrument does not operate properly, the hazard is unpredictable. Disconnect the power cord, do not use it again, and do not attempt repairs yourself.
Do Not Using the Instrument Other Than as Specified in This Manual	exceed the specified range; otherwise the protection provided by the instrument will be impaired.

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1. Installation and Setup Guide

Thank you for purchasing our product! Please read this chapter carefully before use. This chapter covers the following:

- Main Features Packing List
- Power Requirements
- Operating Environment
- Cleaning

1.1 Packing List

Before using the instrument, first:

1. Check the product appearance for damage, scratches or other defects;

2. Check the instrument accessories against the Packing List for any missing items.

If damage or missing accessories are found, contact the ONMEAS instrument sales department or your dealer immediately.

1.2 Power Requirements

AT2527 can only be used under the following power conditions:

Voltage: 85VAC~250VAC

Frequency: 50Hz~400Hz



WARNING: To prevent shock hazard, connect the power ground wire properly
If the power cord is replaced, ensure that its ground is reliably connected.

1.3 Operating Environment

AT2527 must be used under the following environmental conditions:

Temperature: 0C~55C,

Humidity: below 70%RH at 23C

1.4 Cleaning

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

Use a clean cloth dampened with a small amount of water to clean the enclosure 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 instrument handle is adjustable. Grip both sides of the handle with both hands, pull gently outward, and then rotate the handle. The handle can be adjusted to four positions, As shown in the figure below:

Fig. 1-1 Instrument Handle (Schematic; panel graphic differs from actual product)



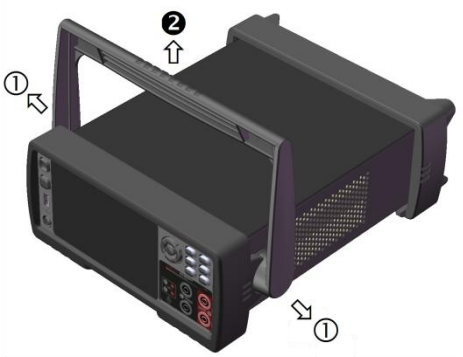
Viewing Position 1 [Grip both sides of the handle with both hands and pull gently outward until it rotates freely, then switch to Viewing Position 2]



Viewing Position 2 [Grip both sides of the handle with both hands and pull gently outward until it rotates freely, then switch to Carrying Position]



Carrying Position



Handle removal position. (Pull to both sides at 1 until the handle can be removed, then remove it upward at 2)

2. Overview

This chapter covers the following:

- Introduction
- Main Features

2.1 Introduction

Thank you for purchasing the AT2527 series battery tester.

The AT2527 is a compact bench-top instrument with fully automatic real-time detection, controlled by a new-generation high-performance 32-bit ARM microprocessor. The instrument uses a 5-inch high-resolution true-color LCD with an integrated capacitive touch screen, full-touch operation, and a brand-new interactive experience.

The instrument can test resistance of 0.0001mΩ~3.3kΩ and DC voltage of 0.00001V~2000.00V (AT2527S), with maximum resistance display digits of 33000 and maximum voltage display digits of 800000. AT2527 also offers high precision, high resolution and ultra-high-speed measurement characteristics, providing 0.5% resistance accuracy and 0.01% voltage accuracy, with a maximum measurement speed of 55 times/s.

The instrument provides a professional sorting function with a standard Handler (PLC) interface, outputting resistance HIGH/IN/LOW signals and voltage HIGH/IN/LOW signals, fully capable of handling high-speed automatic sorting systems for fully automated production line testing, while the enhanced IO signals can directly drive power relays and signal relays.

The instrument has a built-in RS-232C interface, RS-485 interface, LAN interface and USB-VCOM interface. The standard general-purpose data acquisition soft-ware has built-in database and Excel export functions, and can be effectively used for remote control, data acquisition and analysis.

The instrument uses the ONMEAS enhanced computer remote control command set and is compatible with SCPI (Standard Command for Programmable Instrument), efficiently performing remote control and data acquisition. For easier application to automated equipment, the instrument also supports the Modbus protocol and can be controlled via RS485.

The newly improved AC resistance test principle can be used for internal resistance testing of almost all batteries, including lithium batteries, lead-acid batteries, coin cells and other batteries for production line inspection.

Model	Accuracy	Measurement Range	Test Speed	Interface
AT2527L	Resistance: 0.5% Voltage: 0.01%	Resistance: 0.0001mΩ~3kΩ Voltage: 0.00001~60.000V	55 times/s	RS232/RS485/USB-VCOM/LAN Handler
AT2527	Resistance: 0.5% Voltage: 0.01%	Resistance: 0.0001mΩ~3kΩ Voltage: 0.00001~400.000V	55 times/s	RS232/RS485/USB-VCOM/LAN Handler
AT2527A	Resistance: 0.5% Voltage: 0.01%	Resistance: 0.0001mΩ~3kΩ Voltage: 0.00001~200.000V	55 times/s	RS232/RS485/USB-VCOM/LAN Handler

AT2527B	Resistance: 0.5% Voltage: 0.01%	Resistance: 0.0001mΩ~3.3kΩ Voltage: 0.00001~800.000V	55 times/s	**RS232/RS485/USB-VCOM/LAN** Handler
AT2527H	Resistance: 0.5% Voltage: 0.01%	Resistance: 0.0001mΩ~3.3kΩ Voltage: 0.00001~1000.00V	55 times/s	RS232/RS485/USB-VCOM/LAN Handler
AT2527K	Resistance: 0.5% Voltage: **0.01%**	Resistance: 0.0001mΩ~3.3kΩ Voltage: 0.00001~1500.00V	55 times/s	RS232/RS485/USB-VCOM/LAN Handler
AT2527S	Resistance: 0.5% Voltage: 0.01%	Resistance: 0.0001mΩ~3.3kΩ Voltage: 0.00001~2000.00V	55 times/s	RS232/RS485/USB-VCOM/LAN Handler

See: 

For complete technical specifications, see Chapter 10.

2.2 Main Features

2.2.1 Test Frequency

1kHz, frequency stability: 20ppm

2.2.2 Range

Resistance: tested using 7 ranges, 3mΩ~3kΩ.

Ranges: auto, manual and nominal.

Nominal range: the instrument automatically selects the best range according to the nominal value.

2.2.3 Test Speed

The instrument has four test speeds: slow, medium, fast and extra fast.

All channels on and in manual range mode:

Slow: 4 times/s

Medium: 8 times/s

Fast: 20 times/s

Extra fast: 55 times/s

2.2.4 Trigger Mode

Internal, external (including manual and remote triggering).

2.2.5 Basic Accuracy

Resistance: 0.5% Voltage: 0.01%

2.2.6 Maximum Reading

Resistance: 31,000

Voltage: 600,000

2.2.7 Calibration

Full-range short-circuit "0" clearing: eliminates the effects of lead resistance and stray voltage.

2.2.8 Comparator Function (Sorting Function)

The instrument has a sorting function.

RHI/RNG/RLO outputs.

VHI/VNG/VLO outputs.

Total NG/OK output

Comparison mode:

Absolute tolerance ±TOL sorting: the absolute deviation of the measured value from the nominal value is compared with the limits of each bin. Percentage tolerance TOL sorting: the percentage deviation of the measured value from the nominal value is compared with the limits of each bin. Sequential comparison sorting: the measured value is compared directly 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; a password can be set for the administrator

2.2.10 Interface

RS-232/RS-485 remote control:

Supports a maximum baud rate of 115200bps, compatible with SCPI protocol, ASCII transmission.

USB-VCOM remote control:

No setting required; serial port parameters are automatically adapted.

LAN remote control

100M Ethernet port, TCP.

Handler interface

Input/output port with full optocoupler isolation and built-in pull-up resistor.

Supports internal 5V and external power supply up to a maximum of 35V.

Input: trigger signal,

Output: all sorting comparison result signals; measurement synchronization signal (EOC); high-current drive output that directly drives relays.

3. Getting Started

This chapter covers the following:

- Getting to know the front panel - describes the keys and test terminals.
- Rear panel - describes power and interface information.
- Power-on startup - includes the power-on self-test process, instrument default values and instrument warm-up time.
- Starting a test - includes how to connect to the test terminal

3.1 Front Panel Overview

Front Panel Description

Fig. 3-1 Front Panel

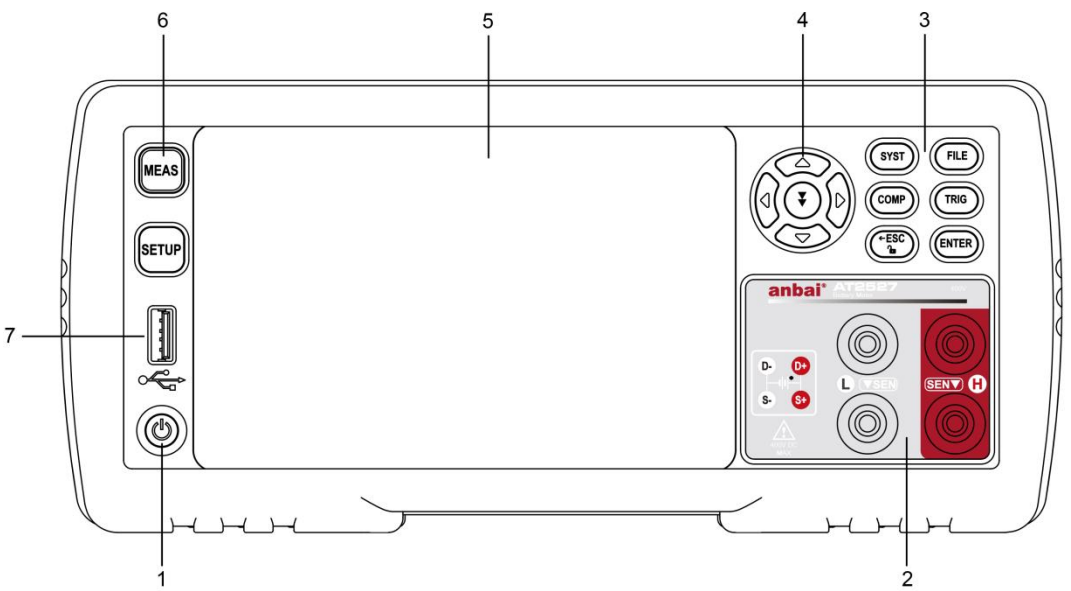
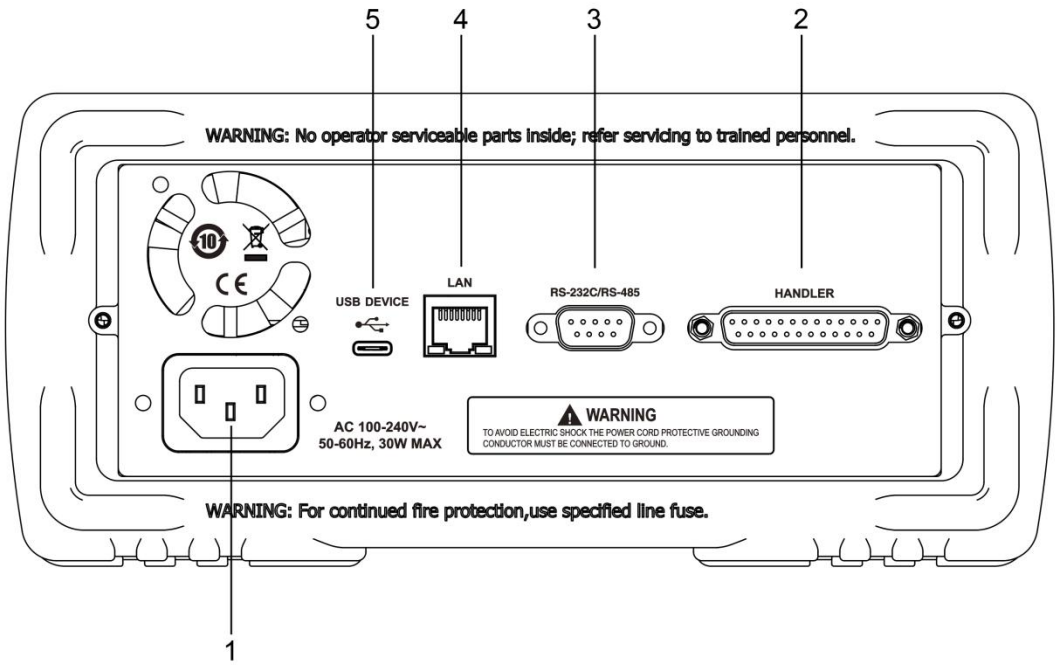


Table 3-1 Front Panel Functions

No.	Function
1	Power switch (tact switch; orange in standby state, green in working state)
2	Test terminal
3	Page shortcut keys, including SYST (system), FILE (file), COMP (comparator), keyboard lock, etc.
4	Cursor keys
5	5-inch TFT-LCD with capacitive touch screen
6	Main page shortcut keys: MEAS (measurement) and SETUP (setup)
7	USB disk port

Rear Panel Overview

Fig. 3-2 Rear Panel



1. Power socket (fuse not included; the fuse is inside the instrument).
2. HANDLER interface
3. RS-232C/RS-485 interface
4. LAN Interface
5. USB-VCOM (TYPE-C) interface

3.2 Power-On

3.2.1 Power On

The key marked "+" at the lower left of the panel is the power switch. The instrument uses a programmable power switch; the power switch is a tactile electronic switch. The indicator lights up, indicating that the instrument power is on.

3.3 Test Terminal Connections

If you use the supplied "Kelvin" test clips for testing, connect them to the test terminal of the instrument as follows.

Fig. 3-3 Test Lead Connection



Connect the test leads as shown in the figure above; note that SENSE is at the bottom.

The red-marked test clip is the high terminal of the test terminal.

The black-marked test clip is the low terminal of the test terminal.

To ensure the accuracy the instrument can achieve, use the supplied "Kelvin" test clips for testing.
WARNING: Connecting an AC current source or voltage source directly to the test terminal is strictly prohibited.

4. [Meas] Measurement Display Page

The main measurement page includes the following:

- Settings related to the <Measurement Display> page
- Data Logging Settings and Display

4.1 <Measurement Display> Page

Press the [Meas] key to enter the [Measurement Display] page.

SCPI Command: `DISP:PAGE MEAS`

The <Measurement Display> page is mainly used to display measurement results and sorting results

In addition, 4 common functions can be set on this page, including:

- Function - the parameter displayed by the measurement
- Range - resistance and voltage range settings and display
- Speed - test speed
- Data logging - refer to the "Data Logging" chapter

Fig. 4-1 <Measurement



4.1.1 Measurement [Function]

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

SCPI Query Command: `FUNC?`

The instrument has 3 measurement functions:

Function	Description
R-V	Measure and display both resistance and voltage values
R	Measure and display resistance value only
V	Measure and display voltage value only

■ **Steps for setting the measurement function:**

Step 1 Press the [Meas] key to enter the main measurement page;

Step 2 Touch the screen to select the [Function] field;

Step 3 Select the measurement function with the function keys on the right side of the touch screen.

Function Key	Function
R-V	Measure and display both resistance and voltage values
R	Measure and display resistance value only
V	Measure and display voltage value only

4.1.2 [R-Range]

Resistance Range Settings

SCPI Command: `RESistance:RANGe <0 to 3100>`

SCPI Command:RESistance:RANGe:No{<Range No.: 0-6>,min,max}

SCPI Command: `RESistance:RANGe:MODE {AUTO,HOLD,NOMinal}`

SCPI Query Command: `RESistance:RANGe?`

SCPI Query Command: `RESistance:RANGe:NO?`

SCPI Query Command: `RESistance:RANGe:MODE?`

The AT2527 resistance has 7 ranges, The variation range of each range is as follows:

Table 4-1 Range Variation Range

Range No.	Range Name	Range
6	3kΩ	0.3200 kΩ~3.3000kΩ
5	300Ω	32.00Ω~330.00Ω
4	30Ω	3.200Ω~33.000Ω
3	3Ω	0.3200Ω~3.3000Ω
2	300mΩ	3.200 mΩ~ 330.00 mΩ
1	30mΩ	3.200 mΩ~33.000 mΩ
0	3mΩ	0.0001mΩ ~ 3.3000 mΩ

There are 3 range modes:

Table 4-2 Test Range Description

Range Mode	Description	Advantages	Disadvantages
Auto	The instrument automatically selects the best test range according to the resistance nominal value, and the Range No. in the range field is set automatically.	No user involvement is required	Auto range requires predicting the range, so the test speed is lower than in the manual range mode.
Manual	The instrument always uses the range specified by the user for testing.	The test speed is the fastest.	The user needs to participate in range selection.
Nominal	The instrument automatically selects the best range for testing according to the nominal value.	This is the best method for sorting tests. The speed is the fastest.	Only suitable for sorting tests.

Note!

If set to NOM mode, the instrument sets the range according to the comparator mode:
When the comparator mode is SEQ, the range is set according to the comparator upper limit;
When the comparator mode is ABS or PER, the range is set according to the nominal value.

■ **Steps for setting the resistance range:**

Step 1 Press [Meas] to enter the measurement page or press [Setup] to enter the Setup Page;

Step 2 Tap to select the [R-Range] field;

Step 3 Use the function keys to select the range: Auto, Manual or Nominal.

Function Key	Function

Auto	The instrument selects the range automatically
Manual	The instrument is locked on the current range
Nominal	The instrument selects the best range according to the nominal value
Increase +	Increases the Range No. and changes the range to Locked
Decrease -	Decreases the Range No. and changes the range to Locked

Note! When the range is Auto, the instrument performs range prediction in every measurement cycle, so the test speed is slightly slower than with a locked range. Moreover, in auto measurement, frequent range changes will cause slower response. Usually, when the instrument is used for sorting measurement, the auto range mode is unsuitable. For sorting applications, please select the nominal range mode.

4.1.3 [V-Range]

Voltage Range Settings

SCPI Command: `VOLTage:RANGe <-300 to 300>`

SCPI Command:VOLTage:RANGe:No{<Range No.: 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 AT2527 series voltage has 3 ranges. The variation range of each range is as follows:

Table 4-3 Range Variation Range

AT2527L

Range No.	Range Name	Range
1	60V	0.0001V~60.6000V
0	6V	0.00001~6.06000V

AT2527A

Range No.	Range Name	Range
2	200V	0.001V~202.000V
1	80V	0.0001V~80.8000V
0	**8V**	**0.00001~8.08000V**

AT2527

Range No.	Range Name	Range
2	400V	0.001V~404.000V
1	80V	0.0001V~80.8000V
0	8V	0.00001~8.08000V

AT2527B

Range No.	Range Name	Range
2	800V	0.001V~808.000V
1	80V	0.0001V~80.8000V
0	8V	0.00001~8.08000V

AT2527H

Range No.	Range Name	Range
2	1000V	0.001V~1100.00V
1	**80V**	**0.0001V~80.8000V**

0	**8V**	**0.00001~8.08000V**

AT2527K

Range No.	Range Name	Range
2	1.5kV	0.001V~1550.00V
1	80V	0.0001V~80.8000V
0	8V	0.00001~8.08000V

AT2527S

Range No.	Range Name	Range
2	2kV	0.001V~2050.00V
1	**80V**	**0.0001V~80.8000V**
0	8V	0.00001~8.08000V

There are 3 voltage range modes:

Table 4-4 Test Range Description

Range Mode	Description	Advantages	Disadvantages
Auto	The instrument automatically selects the best test range according to the resistance nominal value, and the Range No. in the range field is set automatically.	No user involvement is required	Auto range requires predicting the range, so the test speed is lower than in the manual range mode.
Manual	The instrument always uses the range specified by the user for testing.	The test speed is the fastest.	The user needs to participate in range selection.
Nominal	The instrument automatically selects the best range for testing according to the nominal value.	This is the best method for sorting tests. The speed is the fastest.	Only suitable for sorting tests.

■ **Steps for setting the voltage range:**

Step 1 Press [Meas] to enter the measurement page or press [Setup] to enter the Setup Page;

Step 2 Tap to select the [V-Range] field;

Step 3 Use the function keys to select the range: Auto, Manual or Nominal.

Function Key	Function
Auto	The instrument selects the range automatically
Manual	The instrument is locked on the current range
Nominal	The instrument selects the best range according to the nominal value
Increase +	Increases the Range No. and changes the range to Locked
Decrease -	Decreases the Range No. and changes the range to Locked

4.1.4 Test [Speed]

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

SCPI Query Command: `SAMPle:RATE?`

The AT2527 provides 3 test speeds (Slow, Medium, Fast). The slower the speed, the more accurate and stable the test results. The sample times for the R-V function, manual range mode and comparator On are as follows:

Slow: 4 times/s

Medium: 20 times/s

Fast: 55 times/s

■ **Steps for setting the test speed:**

Step 1 Press [Meas] to enter the measurement page or press [Setup] to enter the Setup Page;

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

Step 3 Use the function keys to select

Function Key	Function
Slow	
Medium	
Fast	
ExFast	

5. [Setup] Setup Page

In this chapter you will learn about all measurement-related settings

At any time, just press [Setup] and the instrument will enter the Setup Page.

SCPI Command: `DISP:PAGE SETUP`

5.1 Measurement Settings

All measurement-related settings are made on the <Setup> page.

On the <Setup> page, the instrument does not display test results or comparator results, but the instrument is still testing.

These settings include the following parameters:

- Function - measurement function parameter
- Range - resistance and voltage ranges
- Speed - test speed
- Average - average count of measurement results
- Delay - delay before measurement on external trigger
- Monitor - display monitor parameters
- Self-Calibration - whether the instrument executes the calibration program periodically
- Nominal Value - the nominal value can be modified when monitor is enabled
- Current - test current output mode

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

Fig. 5-1 <Setup>



5.1.1 [Averaging] Count

SCPI Command: `SAMPle:AVERage <integer 0~256>`

SCPI Query Command: `SAMPle:AVERage?`

Averaging is the most commonly used type of digital filter; the "count" is the filter depth. The purpose is to take multiple measurements and use the average result as the final displayed value, which improves the stability and reliability of the measurement results. The average count range is positive integers 1~256.

■ **Steps for setting the average count:**

Step 1 Press [Setup] to enter the Setup main page;

Step 2 Tap to select the [Average] field;

Step 3 Use the function keys to select, or enter the value directly with the keyboard

Function Key	Function
Increase +	Increases the average count in steps of 1, 2, 4, 8, 16, 32, 64, 128, 256.
Decrease -	Decreases the average count in steps of 256, 128, 64, 32, 16, 8, 4, 2, 1.

5.1.2 [Self-Calibration] Switch

SCPI Command: `SYSTem:CALibration`

The self-calibration function removes the offset voltage and gain drift of the instrument's internal circuits to improve measurement accuracy. At Slow speed, the instrument always performs self-calibration, regardless of whether this switch is On. At Medium speed or above, if the [Self-Calibration] switch is On, the instrument automatically performs a calibration every 30 minutes.

■ **Steps for setting the [Self-Calibration] switch:**

Step 1 Press [Setup] to enter the Setup main page;

Step 2 Tap to select the [Self-Calibration] field;

Step 3 Use the function keys to select

Function Key	Function
Off	Turns off self-calibration
On	Self-calibration On: the instrument performs a self-calibration every 30 minutes

Note! When self-calibration executes, instrument measurement pauses briefly in response to the self-calibration.
A self-calibration takes 40ms. For high-speed measurement, turn off self-calibration and use the external IO control line for self-calibration. To ensure accuracy, the instrument performs a self-calibration at every power-on.

Besides periodic self-calibration, you can also

1. use the HANDLER signal nCAL to perform a self-calibration.
2. use the communication command [SYST:CALibration] to perform a self-calibration.

5.1.3 Measurement [Current] Output Mode

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

SCPI Query Command: `SYSTem:CURRent?`

When multiple identical instruments perform parallel measurement simultaneously, the measurement signals interfere with each other, causing abrupt changes in the measured values. To prevent measurement errors, the instrument can set the [Current] output mode to [During measurement], so that the current signal source is turned off after the test is completed, minimizing inter-unit interference to the greatest extent.

■ **Steps for setting the [Current] output mode:**

Step 1 Press [Setup] to enter the Setup main page;

Step 2 Tap to select the [Current] field;

Step 3 Use the function keys to select

Function Key	Function

Continuous	Current is output continuously
During measurement	Outputs current only during measurement; the signal source is turned off after completion.

5.1.4 [Trigger] Mode

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 Mode	Description
Internal	Also called continuous test; the trigger signal is generated internally and the instrument tests continuously at a fixed interval
External	1. Each press of the [Trig] key makes the instrument execute one measurement cycle; at other times the instrument is in the waiting state. 2. Upon receiving a rising-edge pulse from the Handler interface on the rear panel, the instrument executes one measurement cycle. At other times the instrument is in the waiting state. See the Handler interface. 3. Sends the TRG command, measures once and returns the measured value

■ **Steps for setting the trigger mode:**

Step 1 Press the [Meas] key to enter the main measurement page;

Step 2 Use the cursor keys or tap to select the [Trigger] field;

Step 3 Use the function keys to select the trigger mode.

Function Key	Function
Internal	Internal trigger mode
External	External trigger mode, including manual/remote/HANDLER

5.1.5 Trigger [Delay]

SCPI Command: `TRIGger:DELay:STATe {ON(1),OFF(0)}`

SCPI Command: `TRIGger:DELay <1ms-10.000s>}`

SCPI Query Command: `TRIG:DELay?`

SCPI Query Command: `TRIG:DELay:STATe?`

The instrument can set the delay time before each test with the trigger [Delay] timer, used to wait for the workstation to be ready before testing. The maximum delay is 10s, and the minimum delay is 1ms.

■ **Steps for setting the [Delay]:**

Step 1 Press [Setup] to enter the Setup main page;

Step 2 Tap to select the [Delay] field;

Step 3 Use the function keys to select

Function Key	Function
On	Turns on the delay function
Off	

Step 4 With the delay function On, use the numeric keypad to enter the delay time.

5.1.6 [Monitor] Parameters

SCPI Command: `FUNCtion:MONitor {OFF,RABS,RPER,VABS,VPER}`

SCPI Command: `FUNCtion:MONitor?`

The instrument can monitor 1 parameter while measuring the main and secondary parameters.

Note: The additionally monitored parameter does not increase instrument processing time.
The instrument default is "Off".

Since the monitor parameters relate to the nominal value, once the monitor parameters are turned On, the screen will display the [Nominal Value] field. This field is the same as the [Nominal Value] on the [Comparator Settings] page; be sure to enter the nominal value.

■ **Steps for setting the monitor parameters**

Step 1 Press [Setup] to enter the Setup main page;

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

Step 3 Use the function keys to select

Function Key	Function
Off	Monitor parameters Off
RΔ	Resistance absolute deviation (RΔ = Rx-Rnom)
R%	Resistance relative deviation (R% = (Rx-Rnom)/Rnom * 100)
VΔ	Voltage absolute deviation (VΔ = Vx-Vnom)
V%	Voltage relative deviation (R% = (Vx-Vnom)/Vnom * 100)

where:

Rx is the resistance measurement value, Rnom is the resistance nominal value

Vx is the voltage measurement value, Vnom is the voltage nominal value

5.1.7 [Nominal Value] [Lower Limit] [Upper Limit] Parameters

If the [Monitor] field is On, the Nominal Value, Lower Limit and Upper Limit fields can be set. These 3 parameters share the comparator data, so after modification, the corresponding comparator parameters will also be modified.

■ **Enter the nominal value:**

Step 1 Tap to select the [Resistance Nominal] or [Voltage Nominal] field;

Step 2 Press the sidebar [Input] key or press the shortcut key ⓥ An input box pops up; tap to enter the data, and use the function keys to select the unit.

■ **Enter the limit value**

Step 1 Tap to select the [Lower Limit] or [Upper Limit] field;

Step 2 Press the sidebar [Input] key or press the shortcut key ⓥ An input box pops up; tap to enter the data, and use the function keys to select the unit.

The relative value % mode does not require selecting a unit multiplier; enter the percentage value.

For absolute value and direct reading SEQ modes, use the function keys to select the unit.

i Note: the monitor parameters must be set according to the comparison mode in the comparator. For example, if [Resistance Ratio] is set to [Percentage] in the comparator page, the corresponding monitor field should be set to R%; otherwise the monitored data will be meaningless.

5.2 File Management

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

File Management allows the user to save settings into 10 files, convenient for loading at power-on or when changing specs.

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

- [Power-On Load] - specifies the file to be loaded at power-on
- [Auto Save] - modified parameters are saved to the current file in real time
- [File] - specifies saving, loading or deleting files.

Fig. 5-2 <File Management> Page



5.2.1 [Memory]

The memory option allows the settings file to be stored in the internal Flash or on an external USB disk.

■ **Steps for setting the memory:**

Step 1 Enter the <File Management> page

Step 2 Tap to select the [Memory] field;

Step 3 Use the function keys to select

Function Key	Function
Internal	Stored in the internal Flash memory
USB memory	Stored in the external USB memory

i Note: when using the USB memory, be sure to insert the USB disk into the front-panel USB port. If the USB disk is not inserted at power-on, the data of File 0 will be loaded.

5.2.2 [Power-On Recall]

The power-on load option allows specifying the file to be loaded at power-on.

■ **Steps for setting the power-on load:**

Step 1 Enter the <File Management> page

Step 2 Tap to select the [Power-On Load] field;

Step 3 Use the function keys to select

Function Key	Function
File 0	Loads the settings of File 0 at power-on
Current File	Loads the settings of the current file No. at power-on

i If the current file is File 10~19, the USB disk must be inserted at power-on; otherwise the data of File 0 will be loaded automatically.

5.2.3 [Auto Save]

When the auto save option is Allowed, user-set parameters are automatically saved to the current file.

■ **Steps for setting auto save:**

Step 1 Enter the <File Management> page

Step 2 Tap to select the [Auto Save] field;

Step 3 Use the function keys to select

Function Key	Function
Allowed	User-set parameters are automatically saved to the current file

Disable	User-set parameters are saved only when the user manually saves them to a file; otherwise they will be lost at the next power-on.

5.2.4 [File 0]~[File 9]

The user can specify 10 files, 0~9, for saving, loading and deleting.

■ **Steps for Setting Up Files:**

Step 1 Enter the <File Management> page

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

Step 3 Use the function keys to select

Function Key	Function
Save	Saves all settings to the current file
Load	Reads the file parameters into the system
Delete	File data will be deleted

5.2.5 [File 10]~[File 19]

If a USB disk is inserted, the 10 files File 10~19 will be saved to the USB disk.

6. User Calibration

This chapter describes how to perform User Calibration.

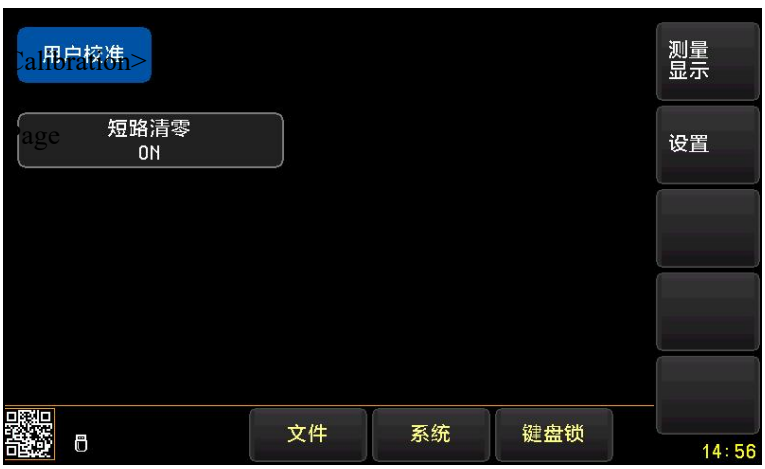
Press the [Meas] key, then touch-select [User Calibration] on the Function Keys on the right to enter the User Calibration page.

SCPI Command: `DISP:PAGE CSET`

Fig. 6-1 <User Calibration> Page

6.1 User Calibration Page

Fig. 6-2 <User



Before testing, make sure to perform short-circuit zeroing once to remove the stray resistance and offset voltage caused by the test leads and the ambient environment. To meet the specified technical specifications of the instrument, short-circuit zeroing must be performed.

Besides being performed on the User Calibration page, short-circuit zeroing can also be performed by the following methods:

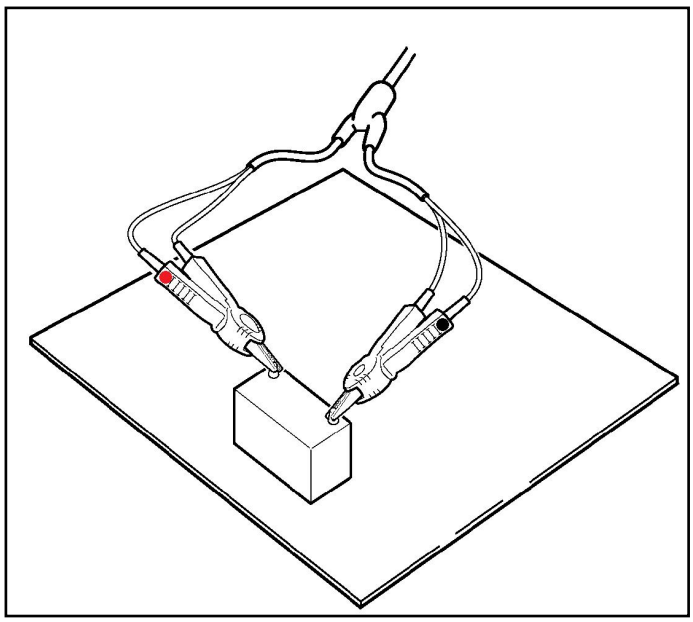
1. Using the Communication Command

   Communication command: ADJust

6.2 Preparing for Zeroing

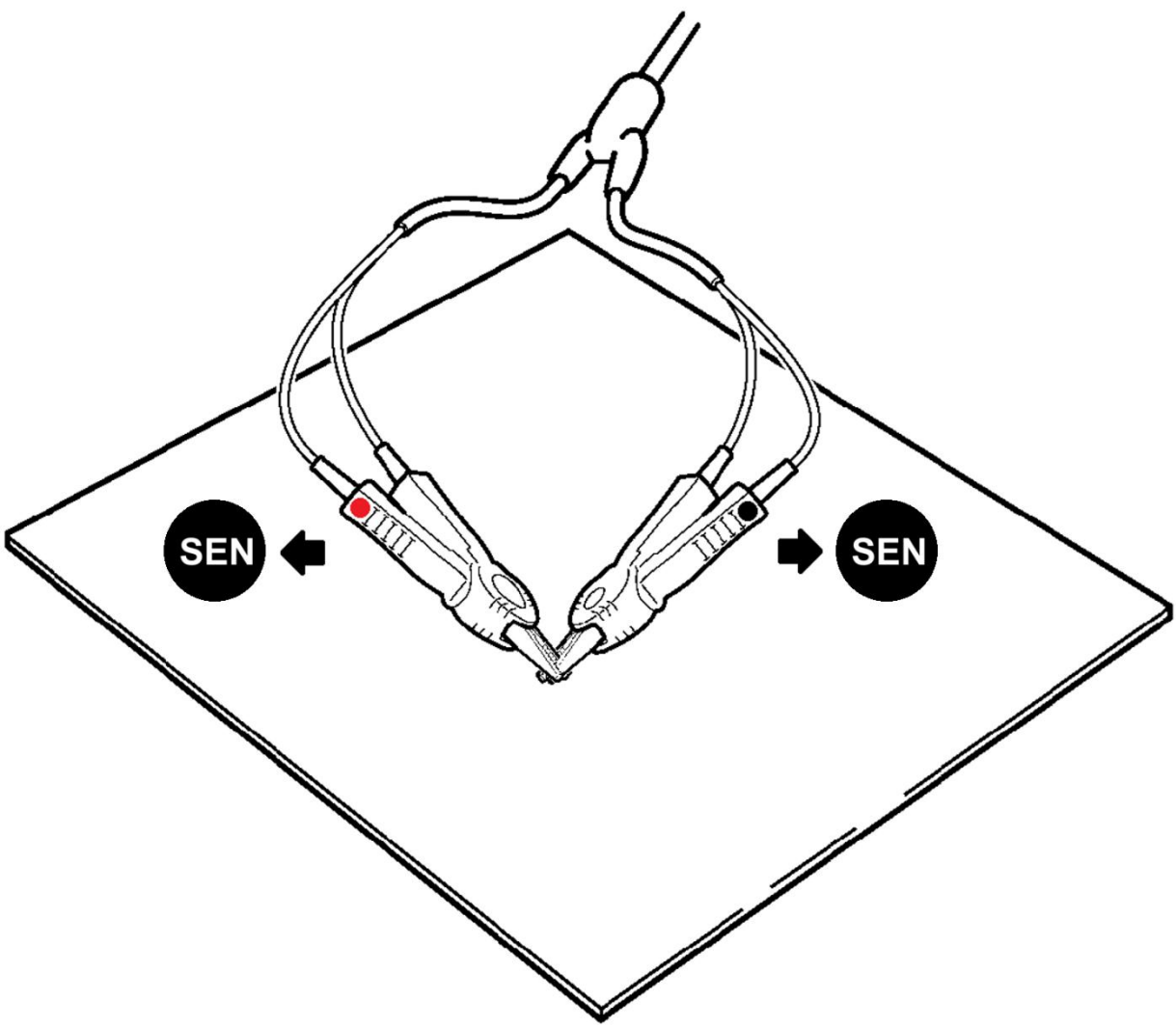
When measuring very small resistance values (3mΩ and 30mΩ ranges), the voltage signal generated after the test current flows through the resistance is very weak (only a few mV at most), so the position, length and shape of the test leads all affect the measurement. Usually, wherever the measurement is made, zeroing must also be performed at the corresponding position. For example: During measurement:

Fig. 6-3 Preparing for Zeroing



When zeroing, make sure to keep the position consistent; pay special attention on the 30mΩ and lower ranges.

Fig. 6-4 Correct Shorting Method



6.3 Zeroing Method

■ **Short-Circuit Zeroing Method**

Step 1 Press the [Meas] key to enter the measurement page, then touch-select [User Calibration] to enter the User Calibration page

Step 2 Use the arrow keys or touch to select the [SHORT TEST] field

Step 3 If it was previously in the Off (OFF) state, touch-select [On].

Function Key	Function
On	

Step 4 Afterwards, new function keys will be displayed:

Function Key	Function
Off	Turns off short-circuit zeroing; the zeroing value is not used during testing.
Short Zero	Performs short-circuit zeroing

Step 5 Returns to the setup page after zeroing is completed

7. Comparator Settings

This chapter describes the Comparator Settings functions:

- Beeper Settings
- Resistance/Voltage Comparator On/Off

Press the [Meas] or [Setup] key, then touch-select [Comparator Settings] on the Function Keys on the right to enter the User Calibration page. Or press the shortcut key [COMP] to directly enter the Comparator Settings page.

SCPI Command: `DISPlay:PAGE BSET`

Fig. 7-1 Comparator Settings Page



7.1.1 [Beeper] Settings

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

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

The beeper function works only after the comparator function is turned on.

Beeper settings allow a PASS beeper, a FAIL beeper, or turning off the beeper.

■ **Setting the Beeper**

Step 1 Enter the <Comparator Settings> page

Step 2 Touch-select the [Beeper] field;

Step 3 Use the function keys to select

Function Key	Function
Off	The beeper is turned off.
PASS Beeper	The beeper sounds when the sorting result is PASS.
FAIL Beeper	The beeper sounds when the sorting result is FAIL.

7.1.2 Comparator Settings

SCPI Command: `RESistance:LMT:STAT {ON/OFF}`

SCPI Command: `VOLTAGE:LMT:STAT {ON/OFF}`

The resistance and voltage comparators are set separately.

■ **Steps for Setting the Comparator On/Off:**

Step 1 Enter the <Comparator Settings> page

Step 2 Touch-select the [R-Compare] or [V-Compare] field;

Step 3 Use the function keys to select

Function Key	Function
Off	Turns off the comparator of the current function.
On	Turns off the comparator of the current function.

7.1.3 Resistance [Comparison Mode] and Voltage [Comparison Mode] Settings

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

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

The instrument can compare resistance and voltage simultaneously or separately.

There are 3 comparison modes available:

Absolute Value Comparison (Δ)

Percentage Comparison (Δ%)

Sequential Comparison (SEQ)

Absolute ValueΔ = Measured value - Nominal value

Percentage % = (Measured value - Nominal value) / Nominal value x 100%

Direct reading SEQ comparison uses the direct reading measured value compared with the upper and lower limits of the range, so the nominal value does not take part in the calculation.

■ **Steps for Setting the Comparator:**

Step 1 Enter the <Setup> page

Step 2 Touch-select the [Comparison Mode] field of the corresponding measurement parameter;

Step 3 Use the function keys to select

Function Key	Function
Absolute ValueΔ	Switches the comparator to absolute value comparison mode
Percentage %	Switches the comparator to percentage comparison mode
Direct Reading SEQ	Switches the comparator to direct reading comparison mode

7.1.4 [Nominal Value] Input

SCPI Command: `RESistance:LiMiT:NOMinal <float>`

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

Absolute value and percentage comparison modes require a nominal value. In direct reading comparison mode, the nominal value does not take part in the calculation, but in the [Nominal] range mode, the resistance nominal value takes part in range selection, so in the [Nominal] range, no matter which comparison mode is used, the correct resistance nominal value must be entered.

■ **Enter the nominal value:**

Step 1 Enter the <Comparator Settings> page

Step 2 Tap to select the [Resistance Nominal] or [Voltage Nominal] field;

Step 3 Press the sidebar [Input] key or press the shortcut key ⓥ An input box pops up; tap to enter the data, and use the function keys to select the unit.

7.1.5 [Lower Limit] and [Upper Limit] Settings

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

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

■ **Enter the limit value**

Step 1 Enter the <Comparator Settings> page

Step 2 Touch-select the [Resistance Lower Limit], [Resistance Upper Limit] or [Voltage Lower Limit], [Voltage Upper Limit] fields;

Step 3 Press the sidebar [Input] key or press the shortcut key ⓧ An input box pops up; tap to enter the data, and use the function keys to select the unit.

The relative value % mode does not require selecting a unit multiplier; enter the percentage value.

For absolute value and direct reading SEQ modes, use the function keys to select the unit.

8. System Configuration

This chapter describes the system configuration of the instrument:

- System Configuration Page
- System Information Page

At any time, just press the [Meas] or [Setup] key, and the [System] key will appear at the very bottom of the main page.

SCPI Command: `DISP:PAGE SYSTEM`

8.1 System Configuration Page

On the [Meas] or [Setup] main page, press [System], or press the shortcut key [SYST] directly to enter the <System Configuration> page.

All settings on the System Configuration page are automatically saved in the system and automatically loaded at the next power-on.

Fig. 8-1 <System Configuration Page>



8.1.1 Changing System Language [LANGUAGE]

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

The instrument supports both Chinese and English.

■ **Steps for Changing the Language**

Step 1 Enter the <System Configuration> page

Step 2 Use the cursor keys to select [LANGUAGE].

Step 3 Use the Function Keys to select the language:

Function Key	Function
Chinese [CHN]	
ENGLISH	English

8.1.2 Changing 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.

■ **Changing the Date:**

Step 1 Enter the <System Configuration> page

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

Step 3 Use the Function Keys to set the date:

Function Key	Function
Year+	+1 year
Year-	-1 year
Month+	+1 month
Day+	+1 day
Day-	-1 day

■ **Changing the Clock:**

Step 1 Enter the <System Configuration> page

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

Step 3 Use the Function Keys to set the clock:

Function Key	Function
Hour+	+1 hour
Hour-	-1 hour
Minute+	+1 minute
Minute-	-1 minute
Second+	+1 second
Second-	-1 second

8.1.3 [Key Tone] Settings

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

SCPI Query Command: `SYSTem:BEEPer?`

■ **Setting the Key Beep**

Step 1 Enter the <System Configuration> page

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

Step 3 Use the function keys to select

Function Key	Function
Off	Key beep is turned off.
On	Key beep is turned on.

8.1.4 [Beeper Volume] Settings

The instrument allows the beeper volume to be set to Strong or Weak.

■ **Setting the Beeper Volume**

Step 1 Enter the <System Configuration> page

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

Step 3 Use the function keys to select

Function Key	Function
Strong	Volume Strong
Weak	Volume Weak

8.1.5 [Remote Control] Settings

The instrument has built-in RS-232/USB/RS485 and LAN interfaces. Only one interface can be used at a time.

If the RS232 interface is selected, plug the communication cable into the DB9-2/3/5 pins on the rear panel of the instrument.

If the RS485 interface is selected, plug the communication cable into the DB9-8/9 pins on the rear panel of the instrument.

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

If the LAN interface is selected, plug the communication cable into the LAN interface on the rear panel of the instrument.

> *i* LAN interface settings need to be configured in [LAN Configuration].

■ **Selecting the Remote Communication Interface Type**

Step 1 Enter 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 Key	Function
RS232	RS-232 Interface
USB	USB Communication Interface
RS485	RS-485 Interface
LAN	LAN Interface

8.1.6 [Baud Rate] Settings

The instrument's RS-232 requires baud rate settings before it can communicate with the host.

To ensure correct communication, make sure the baud rate and stop bits are set correctly; otherwise the host computer cannot communicate properly. RS-232 configuration:

- Data bits: 8
- Stop bits: 1
- Parity: None
- Baud rate: configurable

> *i* The built-in USB-VCOM interface of the instrument can create a virtual serial port on a computer.
> VCOM can auto-adapt to the serial port parameters; the baud rate, stop bits, etc. do not need to be set.

■ **Setting the Baud Rate:**

Step 1 Enter 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 Key	Function
9600	
19200	
38400	
57600	
115200	For communication with a computer host, it is recommended to use this high-speed baud rate.

8.1.7 [Communication Protocol] Selection

The instrument supports 2 communication protocols: SCPI and Modbus (RTU). SCPI is usually more convenient for communication with a computer, while Modbus is easier to use for communication with industrial control devices such as PLCs.

Selecting the Communication Protocol:

Step 1 Enter the <System Configuration> page

Step 2 Touch-select the [Communication Protocol] field;

Step 3 Use the function keys to select

Function Key	Function
SCPI	
Modbus	

8.1.8 Modbus [Station Address] Selection

If the Modbus (RTU) protocol is used, the station number address of this unit must be set correctly.

Selecting the Modbus Station Number:

Step 1 Enter the <System Configuration> page

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

Step 3 Use the function keys to select

Function Key	Function
01	
02	
03	
04	
05	
06	
07	
08	
09	
0A	
0B	
0C	
0D	
0E	
0F	

8.1.9 SCPI [Terminator], [Command Handshake], and [Error Code] Settings

The instrument can be programmed using the SCPI language through any of its interfaces.

To use the SCPI protocol, first perform the SCPI-related settings.

Terminator: A terminator is required in the communication commands between the instrument and the host so that they can recognize the end of a command. The instrument supports 3 types of terminators:

Terminator	ASCII name	ASCII hex	Number of bytes	Description
LF(0x0A)	LF	0x0A	1 byte	Instrument default
CR(0x0D)	CR	0x0D	1 byte	
CR+LF	CR+LF	1st byte 0x0D 2nd byte 0x0A	2 bytes	
NUL(0x00)	Null character	0x00	1 byte	

Command handshake:

When the command handshake is on, all commands sent from the host to the instrument are returned to the host as-is, and then the data is returned. When the command handshake is off, commands sent from the host to the instrument are processed immediately.

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?`

When the error code is on, the instrument returns the error code after receiving a command. For a query command, an error code is returned only when the command is in error. When the error code is off, the host can send the ERR? command to query the error code generated by the last command execution.

■ **Setting the Terminator**

Step 1 Enter the <System Configuration> page

Step 2 Touch-select the [Terminator] field;

Step 3 Use the function keys to select

Function Key	Function
LF(0x0A)	LF
CR(0x0D)	CR
CR+LF	CR+LF

■ **Steps for Setting the Command Handshake:**

Step 1 Enter the <System Configuration> page

Step 2 Touch-select the [Command Handshake] field;

Step 3 Use the function keys to select

Function Key	Function
Off	Does not use command handshake. Unless there are special requirements, set the command handshake to
Off. On	

■ **Steps for Setting the Error Code:**

Step 1 Enter 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 Key	Function
Off	Error codes are not returned automatically.
On	After a single-line command is executed, the execution error code is returned.

8.1.10 SCPI [Upload] Mode

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

SCPI Query Command: `SYST:RESult?`

The instrument supports automatically sending data to the host. After each test is completed, the data is sent to the host automatically without the host sending the FETCH? command.

After each test is completed, the instrument sends the test result and comparator result to the host; refer to the Fetch? subsystem for the format.

Steps to set [Result Send]:

Step 1 Enter the <System Configuration> page

Step 2 Touch the [Result Send] field;

Step 3 Use the function keys to select

Function Key	Function
FETCH	Use the FETCH? command to fetch all measurement data
Auto	Sent to the host automatically after each test is completed

8.1.11 [Data Buffer] Function

The instrument has a [Data Buffer] function that can record 10000 sets of data and perform statistical calculations. This data can be sent to a computer via the communication port, or saved directly as CSV text to a USB drive.

Steps to set [Data Buffer]:

Step 1 Enter the <System Configuration> page

Step 2 Touch the [Data Buffer] field;

Step 3 You can use the function keys to select

Function Key	Function
Input	A dialog box pops up for entering the data buffer size.
MAX	The data record buffer is set to the maximum: 10000 sets.

Step 4 You can also enter the desired buffer size directly using the numeric keypad.

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

After input, a [Record] field will appear at the top of the <Measurement Display> page.

8.1.12 [Power-Line Frequency Filter] Selection

The measurement stability of the instrument depends on the power line frequency. Select it according to the power line frequency of the current region; if uncertain, select AUTO. The instrument will be set automatically to the power line frequency of the current region. Select the power frequency filter:

Step 1 Enter the <System Configuration> page

Step 2 Touch the [Power Frequency Filter] field;

Step 3 Use the function keys to select

Function Key	Function
AUTO	Auto
50Hz	Sets 50Hz power frequency; the power frequency in China is 50Hz
60Hz	Sets 60Hz power frequency

8.1.13 [Factory Defaults]

After Factory Settings is performed, all instrument settings will be restored to the factory preset parameters. System Information Page Press [Meas] or [Setup] to enter the main page, press the [System] key in the task bar at the very bottom to enter the <System Configuration> page, then press the functionkey to select [System Information].

SCPI Command: `DISP:PAGE SYSTEMINFO`

8.2 LAN Configuration Page

Fig. 8-2 <LAN



Using the LAN interface for communication requires setting the LAN parameters, including:

IP address, port, subnet mask and default gateway.

8.2.1 DHCP Settings

If the local IP address cannot be determined, it can be set via DHCP. With DHCP On, the instrument will contact the LAN router, and the IP address will be assigned automatically by the router.

■ **To enable DHCP:**

Step 1 Touch the [DHCP] field;

Step 2 Use the function keys to select

Function Key	Function
OFF	DHCP Off
ON	With DHCP On, the instrument will automatically fetch the IP address, subnet mask and default gateway from the router

8.2.2 IP Address, Subnet Mask, and Default Gateway Settings

With DHCP Off, the IP address, subnet mask and default gateway need to be configured manually according to the current LAN. Network settings may require the assistance of the network administrator; a duplicate IP will prevent other devices such as computers from communicating.

■ IP address, subnet mask and default gateway settings:

Step 1 Touch the [IP Address] field;

Step 2 Press the sidebar [Input] key or press the shortcut key A dialog box pops up; enter the data on the touch screen.

i For the IP address, subnet mask and default gateway, entered values cannot exceed 255.

8.2.3 Port Settings

Besides the IP address, subnet mask and default gateway, the port must also be set to establish communication with the host. The port can be any number between 0~65535.

■ Port Settings

Step 1 Touch the [Port] field;

Step 2 Press the sidebar [Input] key or press the shortcut key A dialog box pops up; enter the IP data on the touch screen.

8.2.4 LAN Communication Settings

To establish communication with the host smoothly, configure the following settings:

1. Protocol type: TCP-Client
2. Remote host address: local IP, e.g. 10.0.0.129
3. Remote host port: local port, e.g. 2000
4. Receive and send: ASCII
5. Instrument communication protocol: SCPI

A free network debugging assistant can be used to communicate with the instrument.

Fig. 8-3 Network Debug Assistant



8.3 System Information Page

The System Information Page has no user-configurable options.

Fig. 8-4 <System



9. Data Logging

In this chapter you will learn how to start the data record function.

The instrument allows recording of measurement data. The data record function can only run and be displayed on the <Measurement Display> page.

9.1 Setting the Data Buffer

SCPI Command: `LOGger:SIZE {<1~10000>,max}`

The instrument has a [Data Record] function that can record 10000 sets of data.

Fig. 9-1 Setting the Data Buffer on the System Settings Page



Steps to set [Data Record]:

Step 1 Enter the <System Configuration> page

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

Step 3 You can use the function keys to select

Function Key	Function
Input	Use the input box to enter the buffer value
MAX	The data record function is turned on, and the data record buffer is set to the maximum: 10000 sets. Once enabled, a [Record] field will appear at the top of the <Measurement Display> page.

Step 4 You can also enter the desired buffer size directly using the numeric keypad.

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

9.2 Data Logging Function

With the data record function, measurement data can be stored into the instrument buffer in real time; this data can be sent to a computer, or saved directly as CSV text to a USB drive.

9.2.1 Starting Logging

After the data record function is turned on, a record field will be displayed on the <Measurement Display> page:

Fig. 9-2 Starting Logging



Internal and external triggers start data recording in different ways:

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

Note

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

In the external trigger state, data recording must also be turned off before switching to another page; if you switch to the <Measurement Display> page from another page, data recording will start automatically.

9.2.2 Stopping Logging

After data recording starts automatically, you can use the function key at any time to stop the current recording, or use the SCPI command LOG:STARTOFF to stop recording.

Fig. 9-3 Logging in Progress



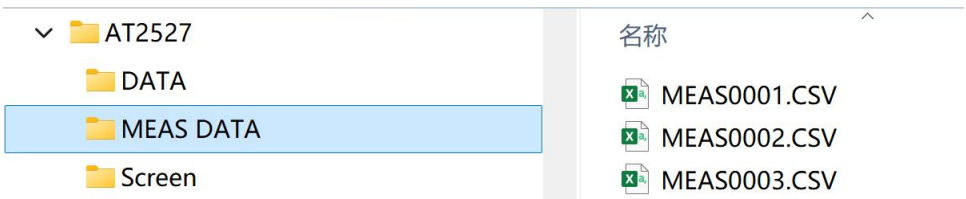
Fig. 9-4 Logging Stopped or Buffer Full



9.2.3 Saving Data to the USB Disk

After data recording is turned on, data can be saved to a USB drive at any time.

Fig. 9-5 Data Folder in USB Disk



The saved file is CSV text.

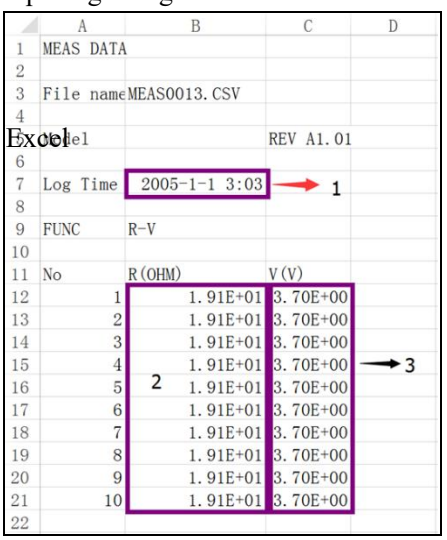
In the Windows operating system, open the file with a text editor:

Line number	File content	Description
1	"MEAS DATA"	
2		Blank line
3	"File name","MEAS0013.CSV"	File name
4		Blank line
5	"Model","AT2527","REV A1.00"	Model and version
6		Blank line
7	"Log Time","2005-01-01 03:03:37"	Start time
8		Blank line
9	"FUNC","R-V"	Measurement parameters
10		Blank line
11	"No","R(OHM)","V(V)"	Data index, 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	

21	10,+19.070E+0,+3.69958E+0	
22		End line, blank line

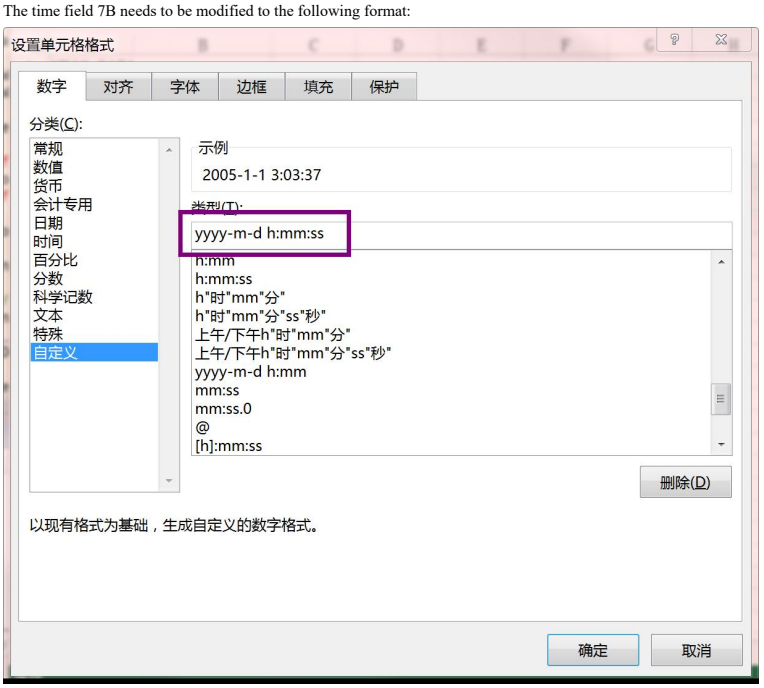
In the Windows operating system, open the file with Excel:

Fig. 9-6 Opening a Log File in Excel

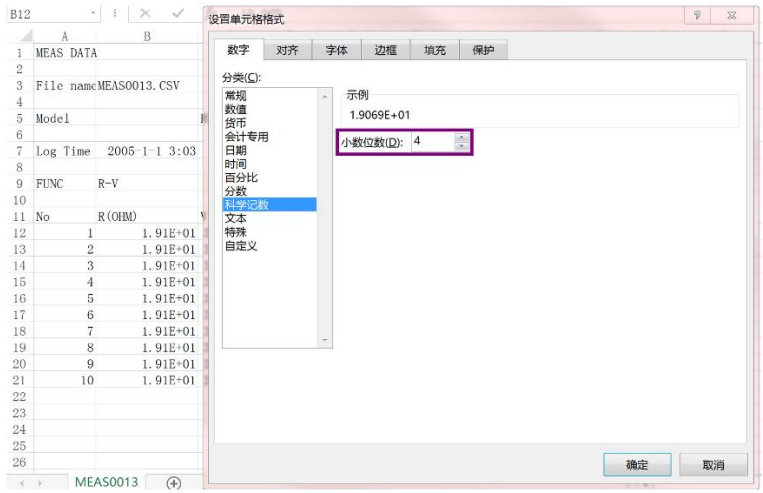


Due to the Excel default format, cell properties must be modified correctly for the data to display correctly

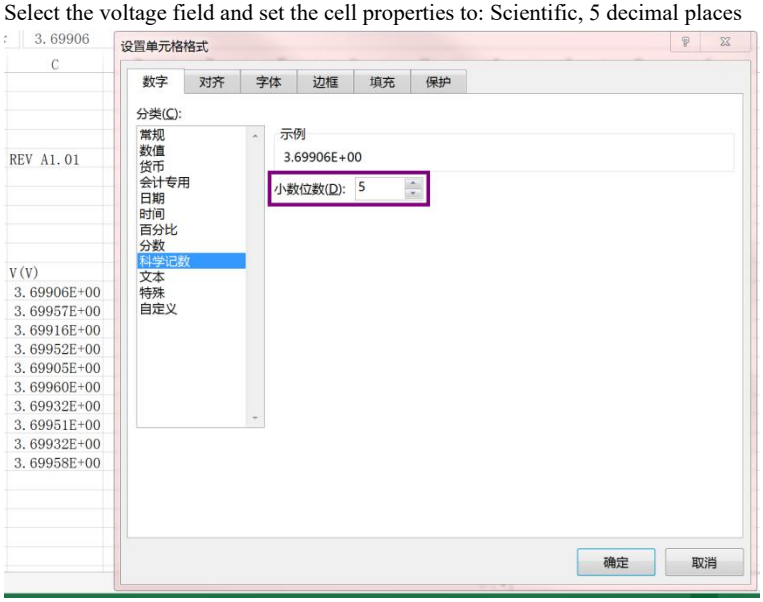
1. The time field 7B needs to be modified to the following format:



2. Select the resistance field and set the cell properties to: Scientific, 4 decimal places



3. Select the voltage field and set the cell properties to: Scientific, 5 decimal places



Adjusted Excel sheet:

	A	B	C	D
1	MEAS DATA			
2				
3	File name	MEAS0013.CSV		
4				
5	Model		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				

9.2.4 Sending Data to the Computer

With SCPI commands, the data stored in the buffer can be sent to the computer in full or individually; for detailed commands, refer to the SCPI Command Reference - <Logger Subsystem> section.

10. Handler Interface

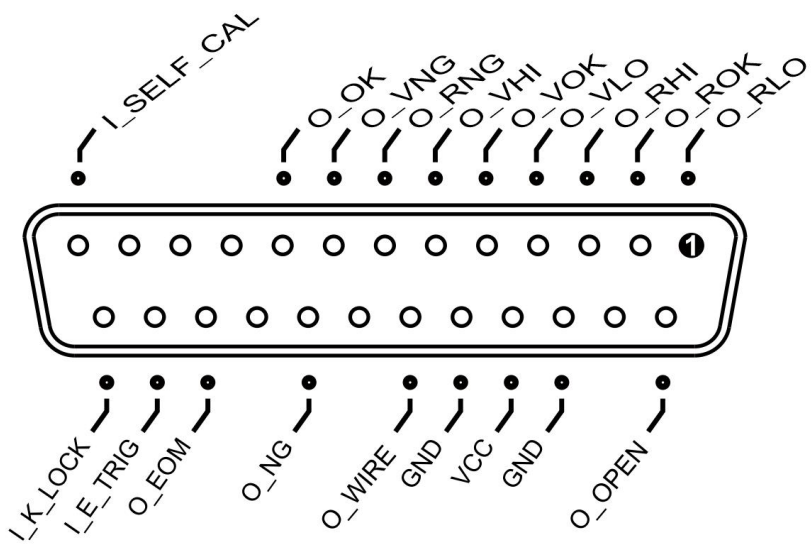
You will learn the following:

- Terminals
- How to Connect and Interface Schematics

The instrument provides users with a fully-featured handler interface, including binning (pass/fail sort) outputs, HI/IN/LO, EOC (test complete) signal, TRIG (external trigger start) input, etc. Through this interface, the instrument can conveniently perform automatic control functions with the user's system control components.

10.1 Terminal Block and Signals

Fig. 10-1 Terminal Block



■ Output (all signals are active low)

Table 10-1 Output Terminal Pin Definitions

Pin	Name	Description
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

■ Input

Table 10-2 Input Terminal Pin Definitions

Pin Name	Description	
13	**SELF-CAL**	0: self-calibration
24	TRIG	Rising edge active.
25	KEYLOCK	0: KEYLOCK 1: UNLOCK

■ Power terminal

Table 10-3 Power Terminal Pin Definitions

Pin	Name	Description
16,18	GND	External power GND terminal
17	***VCC***	**Internal VCC power positive terminal (5V, 1A)**

10.2 Connection Method

■ The instrument has a built-in fully isolated power supply; no external positive power terminal is required.

Connect the external power supply to the following pins at the same time:

Pins 16 and 18: external power GND

Pin 17: left floating.

10.2.1 Using Internal Power

In unknown or uncertain power applications, do not use the internal power supply, otherwise the instrument will not work properly. In known low-power applications, you can use the internal power supply, but the anti-interference capability of the instrument may be degraded.

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 resistors. Optocoupler isolation. Active low.

Maximum voltage: 30VDC, with built-in 30V clamp circuit.

Input signal: Optocoupler isolation. Active low.

Maximum current: 50mA

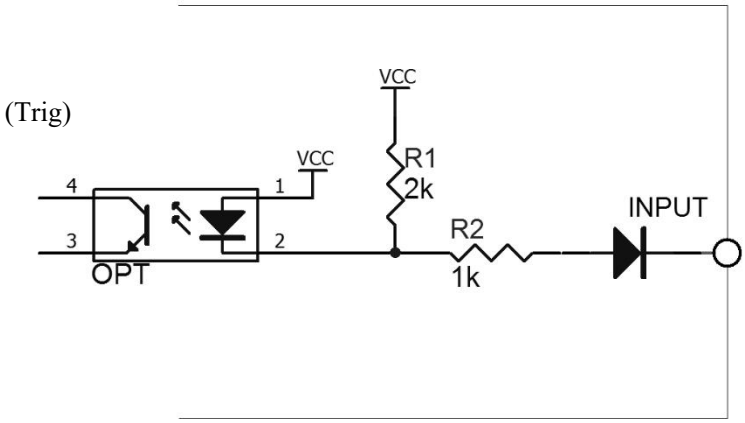
Note: To avoid damaging the interface, do not let the power supply voltage exceed the power requirements.

To avoid damaging the interface, connect the wiring only after the instrument is turned off.

The instrument outputs use Darlington drivers and can drive low-power relays and signal relays; reverse diodes are already integrated in the instrument.

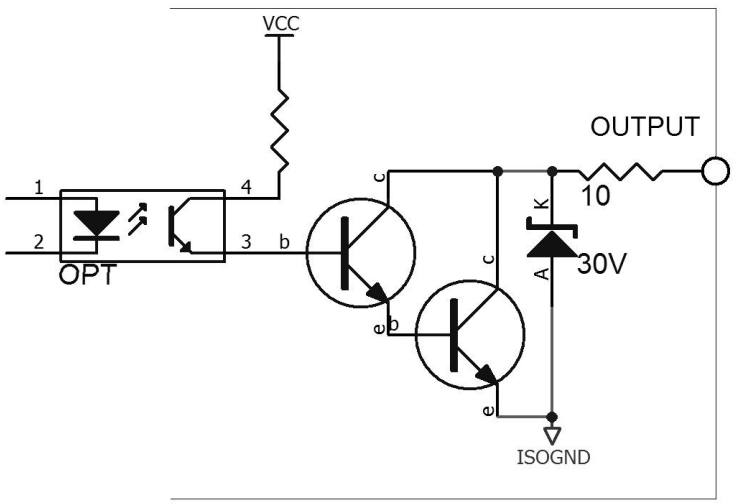
Input Terminal Schematic

Fig. 10-2 Input Circuit Schematic



Output Terminal Schematic

Fig. 10-3 Output Terminal Schematic



Input Circuit Connection Method

Fig. 10-4 Connection to a Switch

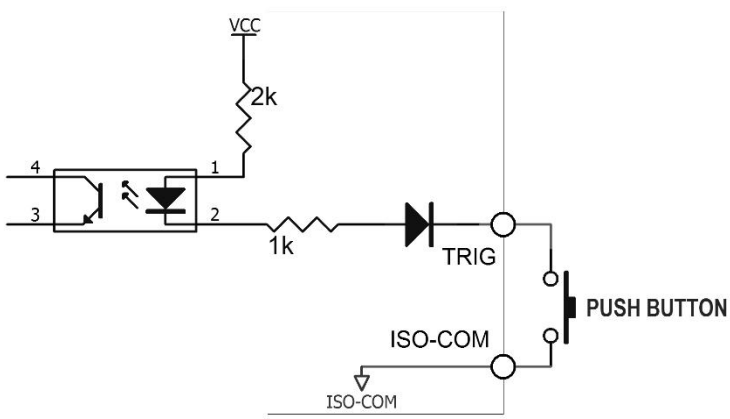


Fig. 10-5 Control via Relay

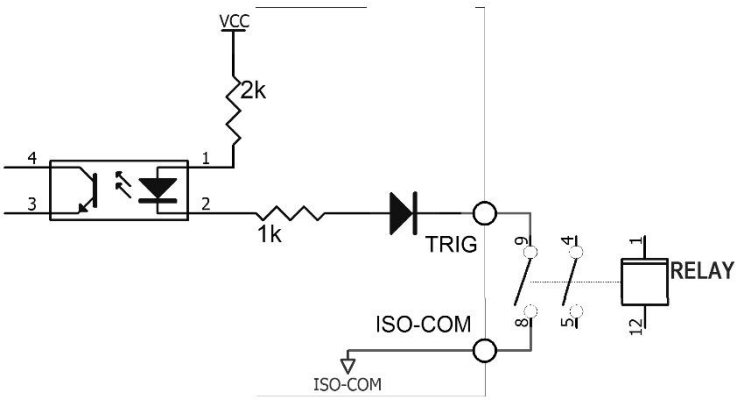


Fig. 10-6 Control via PLC Negative

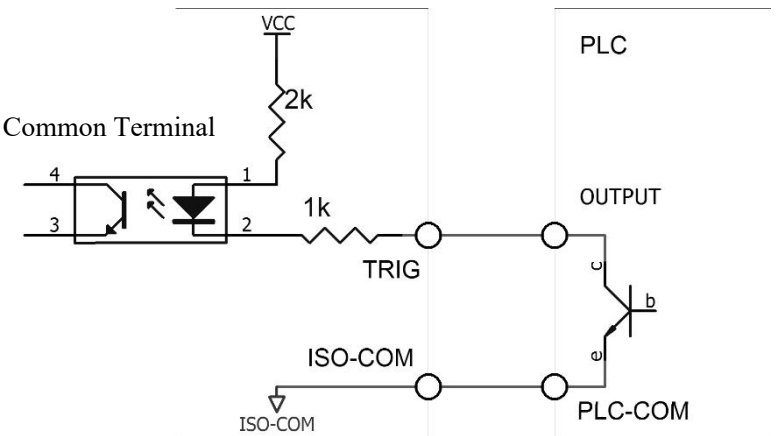
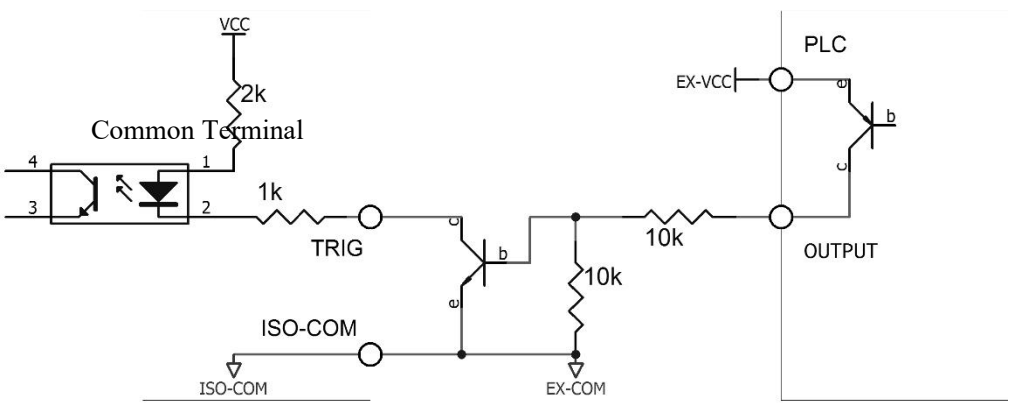


Fig. 10-7 Control via PLC Positive



Output Circuit Connection Method

Fig. 10-8 Driving a Relay

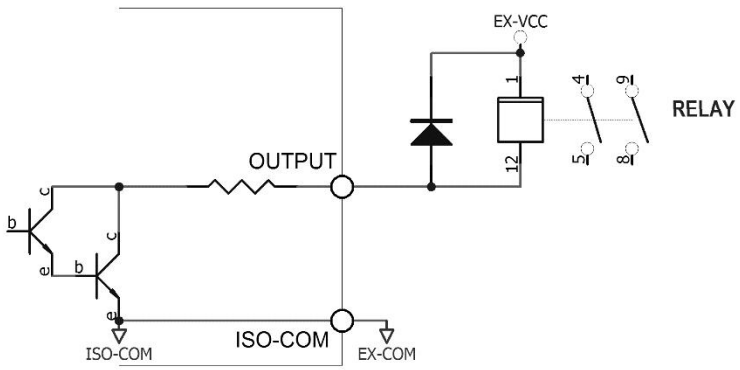


Fig. 10-9 Driving an LED or Optocoupler

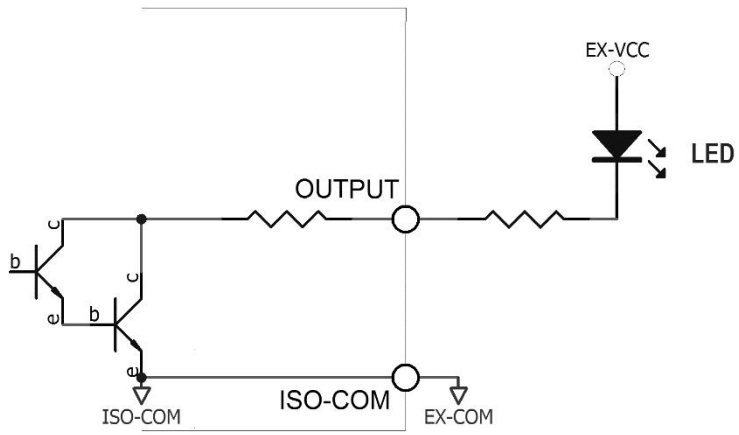


Fig. 10-10 Negative-Logic Output

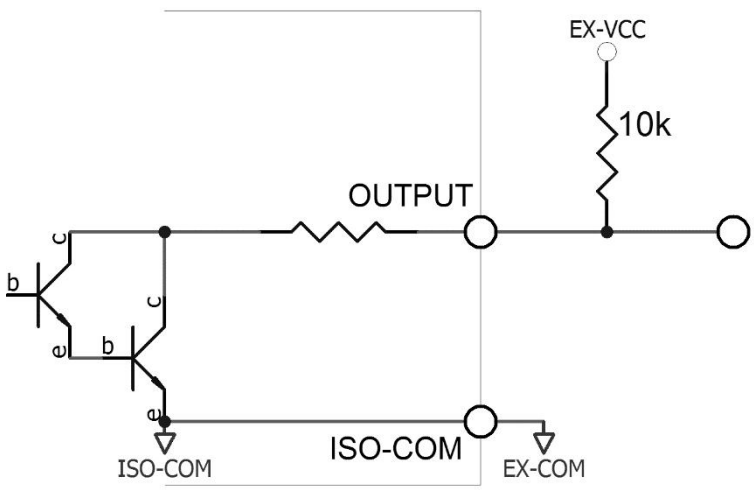


Fig. 10-11 Two Outputs Wired as Logic OR

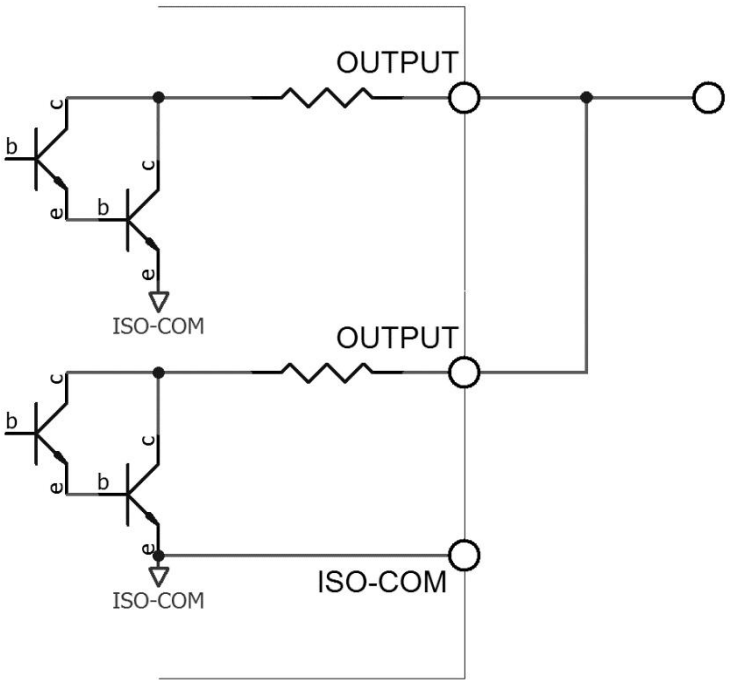


Fig. 10-12 Output to PLC Negative

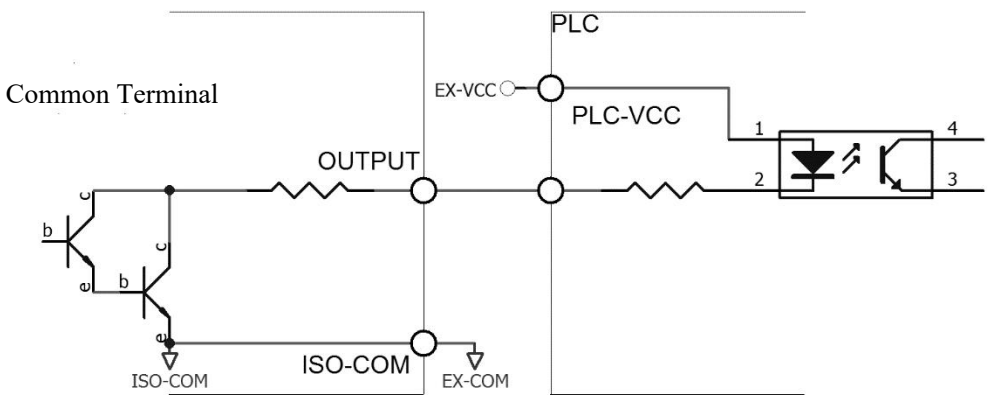
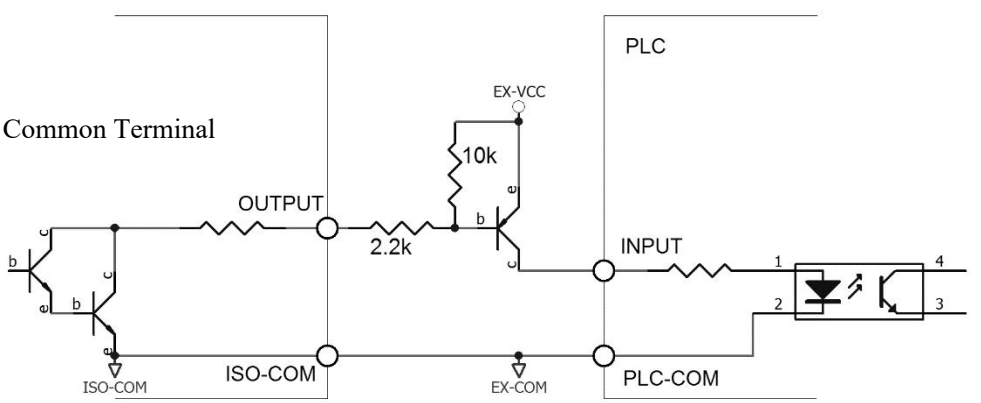


Fig. 10-13 Output to PLC Positive



10.3 Timing Diagram

Fig. 10-14 Timing Diagram

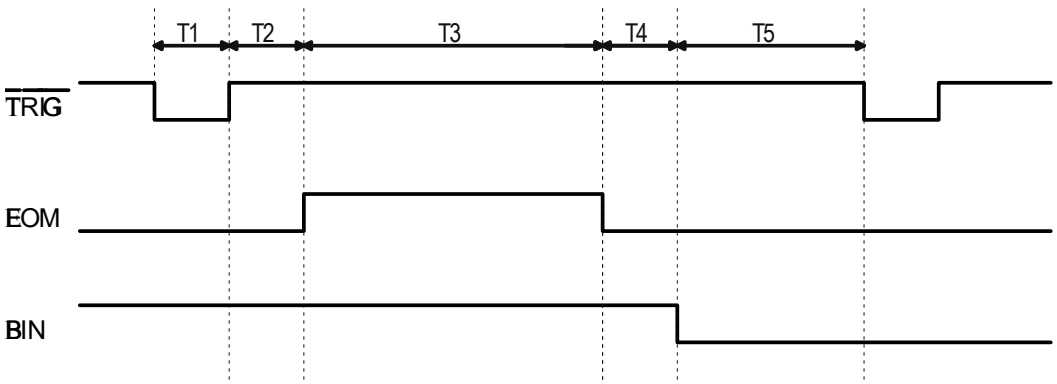


Table 10-4 Timing Table

Description			Minimum
T1	Trigger pulse width		1ms
T2	Measurement cycle	Trigger delay	<10μs
T3		Measurement time	Depends on settings
T4		BIN output delay	200μs
T5	Wait time after trigger		0s

11. Remote Communication

You will learn the following:

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

The instrument uses the RS-232 interface (standard configuration) to communicate with a computer and perform all instrument functions. With standard SCPI commands, users can also easily develop various data acquisition systems suited to their own needs.

11.1 RS-232C

RS-232 is a widely used serial communication standard, also called the asynchronous serial communication standard, used for data communication between computers and between computers and peripherals. RS is the abbreviation of "Recommended Standard", and 232 is the standard number, officially published in 1969 by the US Electronic Industries Association (EIA). It specifies sending data one bit at a time over a single data line.

Most serial port configurations are usually not strictly based on the RS-232 standard: each port uses a 25-pin connector (today's computers basically use a 9-pin connector). The most common RS-232 signals are shown in the table:

Table 11-1 Common 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 Set Ready	DSR	6	6
Data Carrier Detect	DCD	8	1
Data Terminal Ready	DTR	20	4
Transmitted Data	TXD	2	3
Received Data	RXD	3	2
Ground	GND	7	5
Request To Send	RTS	4	7

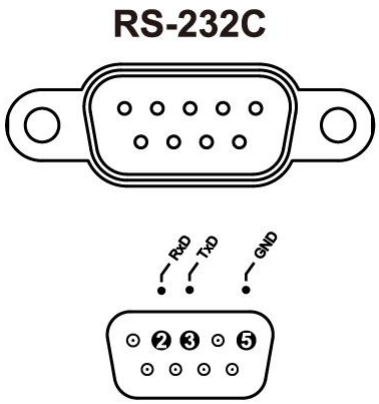
In addition, RS232 also has a minimal subset, which is the connection method adopted by this instrument.

Table 11-2 RS-232 Minimal Subset

Signal	Symbol	9-pin connector pin number
Transmitted Data	TXD	2
Received Data	RXD	3
Ground	GND	5

RS232C Interface

Fig. 11-1 RS-232 Connector on Rear Panel [Male]



Suggestion: To avoid electric shock, turn off the instrument power when plugging or unplugging the connector.

- Default communication settings of the instrument:

Transmission mode: Full-duplex asynchronous communication with start and stop bits

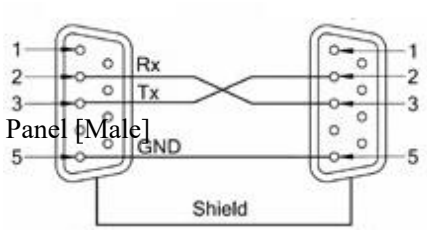
Data bits: 8

Stop bits: 1

Parity: None

Connection Method

Fig. 11-2 RS-232 Connector on Rear Panel [Male]

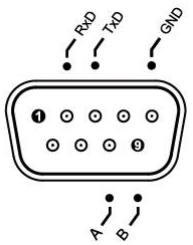


The RS-232 serial interface can be interconnected with the serial interface of a controller (e.g. a personal computer or an industrial computer) through a 2-3 crossed DB-9 cable to for interconnection. Communication protocol

11.2 RS485 Interface

From instrument version Rev C1.02 onwards, the instrument comes standard with an RS485 interface.
RS485 is a communication interface that supports multi-device communication; a single host can be connected in parallel with multiple slaves. The detailed RS485 specifications are not the focus of this user manual; please refer to https://en.wikipedia.org/wiki/RS-485

The RS485 interface of the instrument shares the same DB9 terminal as the RS232 interface:



Pin	Function
8	A
9	B

11.3 USB Interface

On some newer computers and laptops, the RS232 interface has been removed, and the USB interface is needed for communication. The instrument has a built-inUSB-232 interface, which can directly virtualize USB as an RS232 port on the computer. This virtual port can provide the same functions as RS232.

11.3.1 Enabling the USB Function on the Instrument

The [System Settings] page of the instrument has a USB/RS232 option. Before using the USB interface for communication, set it to USB: Steps for enabling USB:

Step 1 Enter 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 Key	Function
USB	USB interface enabled
RS232	RS232(DB9) interface enabled

11.3.2 Installing the Driver on the Computer

The USB interface requires a driver to be installed on the computer to work properly.

Steps for installing the USB driver:

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



Step 2 It will appear in the Device Manager on the computer as

Other devices

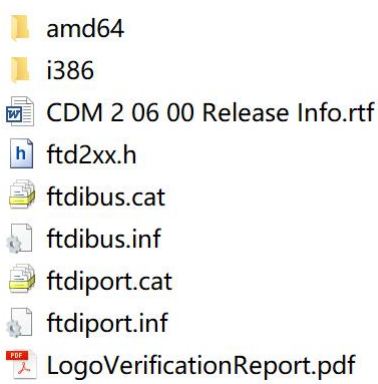


At this point, the driver needs to be installed.

Step 3 Insert the supplied CD-ROM.

The folder is:

FTDI Driver



Step 4 Right-click on USBSerial Port

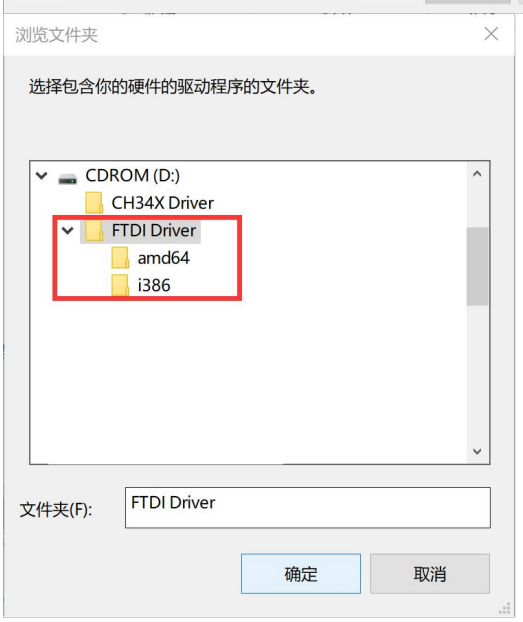
Select: Update driver:



Select Browse my computer for driver software

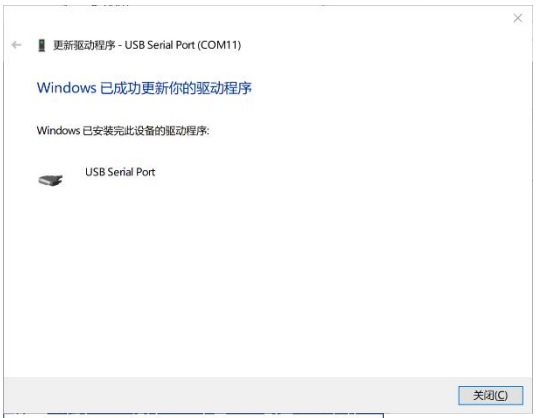
Step 5 In the pop-up window, select Browse:





Select the CDROM drive and click FTDI Driver.

Step 6 Wait for the installation to complete:



Step 7



Step 8 On Windows 10, the driver installation is complete up to this point.

However, on some older operating systems such as Windows XP, installing the driver may require repeating the steps starting from Step 2 to fully complete the installation. You need to note down this port number, which is required for programming.

11.4 LAN Interface

The instrument has a built-in 100M network interface and communicates with the host using the TCP-Client protocol. Communication works by simply connecting a network cable to the computer or a router.

At this point, all SCPI commands and Modbus commands can be operated through this port.

Fig. 11-3 LAN Configuration Page



After setting the IP address and other parameters on the LAN Configuration Page, you can communicate with the instrument. For details, refer to Chapter 8 System Configuration.

Please configure according to the following settings:

1. Protocol type: TCP-Client
2. Remote host address: local IP, e.g. 10.0.0.129
3. Remote host port: local port, e.g. 2000
4. Receive and send: ASCII
5. Instrument communication protocol: SCPI

11.5 Communication Protocol

The instrument supports 2 communication protocols: SCPI and Modbus (RTU).

SCPI protocol:

It is the abbreviation of Standard Commands for ProgrammableInstruments: SCPI. The SCPI protocol defines a set of standard syntax and commands for controlling programmable test and measurement instruments. SCPI commands are transmitted as ASCII strings and enter the instrument through the physical transport layer. A command consists of a series of keywords, and some also need to include parameters. In the protocol, a command is specified in the following form:

CONFigure. In actual use, you can write either the full name or an abbreviation containing only the uppercase letters. The response of the instrument to a query command is also ASCII code. In fact, for simple applications (e.g. PLC), you only need to translate the command into HEX bytes and transmit byte by byte to use it. Modbus(RTU) protocol

The Modbus protocol is a common language applied to electronic controllers, mainly a bus protocol used in the industrial field. It is the communication standard for PLCs, touch screens and other industrial control devices.

12. SCPI Command Reference

This chapter covers the following topics:

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

This chapter provides all SCPI commands used by the instrument; with these SCPI commands, all functions of the instrument can be fully controlled.

12.1 Handshake Protocol

Since the instrument uses the minimum subset of the RS-232 standard and does not use hardware handshake signals, in order to reduce possible data loss or data errors during communication, the instrument can enable software handshake. High-level language software engineers should strictly follow the handshake protocol below when writing the communication software:

- The command parser of the instrument only accepts ASCII format, and command responses also return ASCII code.
- **The command string sent by the host must end with a terminator, and the command parser of the instrument starts executing the command string only after the terminator is received.**
- The instrument can enable command handshake: after each character is received, the instrument immediately sends the character back to the host, and the host can only continue to send the next character after receiving this echoed character.

Tip: If the host cannot receive the data returned by the instrument, you can try the following methods to solve it: 1. The software handshake is disabled. Refer to the <System Settings> page of the instrument to enable it. 2. Serial port connection fault; check the cable connection. 3. The communication format of the high-level language program on the computer side is wrong. Try checking whether the serial port number and the communication format are correct, and whether the baud rate is the same as that set on the instrument.

4. If the instrument is still parsing the previous command, the host cannot receive the response of the instrument; please wait and try again. <If the problem still cannot be solved, consult the ONMEAS instrument technical engineer immediately>

12.2 Terminator

The instrument supports 4 terminators:

LF (hex: 0x0A)

CR(hex: 0x0D)

CR+LF (hex: 0x0D 0x0A)

NUL(hex: 0x00)

The terminator can be selected on the system configuration page; the factory default of the instrument is LF.

Note:

The instrument allows the host to send commands without a terminator, but it is recommended to add a terminator at the end of the command, otherwise it will cause A timeout wait is added after each received command (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 capturing the terminator (\n) or an input buffer overflow.

For example:

Valid command strings:

AAA:BBB CCC;DDD EEE;:FFF

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

12.3.1 Command Parsing Rules

1. The command parser only parses and responds to ASCII code data.
2. The SCPI command string must use NL('\n' ASCII 0x0A) as the terminator, and the command parser starts executing the command string only after receiving the terminator or when the buffer overflows.
3. If command handshake is enabled, the command parser sends each received character back to the host immediately, and the host can only continue to send the next character after receiving this echoed character.
4. After parsing an error, the command parser terminates parsing immediately, and the current command is invalidated.
5. After parsing a query command, the command parser terminates the parsing of the current command string, and the characters after it are ignored.
6. The command parser parses command strings case-insensitively.
7. The command parser supports abbreviated command forms; see later chapters for the abbreviation rules.

12.3.2 Symbol Conventions and Definitions

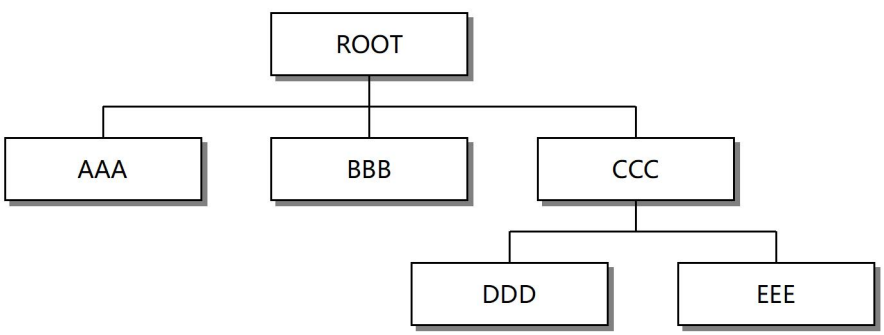
This chapter uses some symbols that are not part of the command tree; they only help better understand the command strings.

< >	Text in angle brackets represents a parameter of the command
[ ]	Text in square brackets represents an optional command
{}	When braces contain several parameter items, only one of them can be selected.
( )	The abbreviated form of a parameter is placed in parentheses.
Uppercase letters	the abbreviated form of a command.

12.3.3 Command Tree Structure

SCPI commands use a tree structure that can go down three levels (note: the command parser of this instrument can parse down any number of levels). Here the highest level is called the subsystem command. Only after the subsystem command is selected is its lower-level command valid. SCPI uses the colon (:) to separate upper-level commands and lower-level commands.

Fig. 12-1 Command Tree Structure



Example

ROOT:CCC:DDD ppp

ROOT Subsystem command

CCC Second level

DDD Third level

ppp Parameters

12.4 Commands and Parameters

A command tree consists of a command and [parameter], separated by 1 space (ASCII: 20H).

Example

AAA:BBB 1.234

Command [parameter]

12.4.1 Command

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

12.4.2 Parameters

- A single command word with no parameter.

  For example: AAA:BBB

- The parameter can be a string, and its abbreviation still follows the "command abbreviation rules" in the previous section.

  For example: AAA:BBB 1.23

- The parameter can be a numeric value
  - *<integer>* Integer 123, +123, -123
  - ***<float>*** Floating point

    1.<fixfloat>: fixed-point floating point: 1.23, -1.23

    2.<Scifloat>: floating point in scientific notation: 1.23E+4, +1.23e-4

    3.<mpfloat>: floating point with multiplier: 1.23k, 1.23M, 1.23G, 1.23u

Table 12-1 Metric Prefixes

Value	Multiplier
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 multiplier is case-insensitive, and its writing differs from the standard name.

12.4.3 Separator

The instrument command parser only accepts the allowed separators. Any other separator will cause the error "Invalid separator(illegal separator)" error. These separators include:

; Semicolon, used to separate two commands.

For example: AAA:BBB 100.0;CCC:DDD

: Colon, used to separate command trees or restart the command tree.

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 Codes

The instrument temporarily stores the processing result of each received command in the buffer. Before the next command is sent, the ERR? command can be used to get the status. If the error code function is turned on in [System Configuration], the instrument automatically returns the processing result after processing the command.

Table 12-2 SCPI Error Codes

Error Codes	Description	Explanation
*E00	NO ERROR	No error
***E01**	**BAD COMMAND**	Command error
*E02	PARAMETER ERROR	Parameter error
*E03	MISSING PARAMETER	Missing parameter, command with parameter, but no parameter provided
*E04	INPUT BUFFER OVERRUN	Receive buffer overflow, the maximum buffer of the instrument is 1000 bytes
*E05	SYNTAX ERROR	Syntax error
*E06	INVALID SEPARATOR	Invalid separator
*E07	INVALID MULTIPLIER	Invalid multiplier unit
*E08	BAD NUMERIC DATA	Numeric value error
***E09**	**VALUE TOO LONG**	Numeric value too long, the numeric parameter exceeds 20 bytes
*E10	INVALID COMMAND	Invalid command, the command is invalid under specific conditions
*E11	UNKNOWN ERROR	Other unknown errors not listed above

12.5 Display Display Page Subsystem

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

Fig. 12-2 DISPlay Subsystem Tree

DISPlay		{MEASurement,ENLArge,SETUp(MSET),BinSETup(BSET),CORRection,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>**

Parameters: <page name> includes:

MEASurement	Measurement Display Page
ENLArge	Full-Screen Display Page
SETUp(MSET)	Settings Page

	BinSETup(BSET)	comparator settings page
	CORRection(CSET)	short-circuit zero page
	CATAlog(FILE)	File Page
	SYSTem	System Configuration Page
	SYSTEMINFO(SINF)	System Information Page
For example:	Send>disp:pagesetup<NL>	//Switch to the Settings Page
Query syntax:	DISP:PAGE?	
Query response:	**<page name> abbreviation** meas enla mset bset cset cata syst sinf	
For example:	Send>disp:page? Return>meas Send>disp:pagemeas;page? Return>meas	

12.5.2 DISPlay:LINE

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

Command syntax:	DISPlay:LINE <string>
Parameters:	<string> is up to 30 characters
For example:	Send>DISP:LINE"ThisisaComment."
Query syntax:	DISPlay:LINE?
Query response:	The prompt bar text on the screen; if the prompt bar is empty, NULL is returned.

12.6 FUNCtion Measurement Function Subsystem

Fig. 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),V**OLTage(V)}**	
Parameters:	RV	Resistance and voltage measurement function
	RESistance or R: resistance measurement function only	
	VOLTage or V	voltage measurement function only
For example:	Send>FUNCRES	//Select the resistance measurement function
	Send>FUNCR	//Select the resistance measurement function
	Send>FUNCV	//Select the voltage measurement function
	Send>FUNCRV	//Select the resistance + voltage measurement function
Query syntax:	FUNCtion?	
Query response:	RV RESistance VOLTage	
For example:	Send>FUNC? Receive> RESISTANCE	

12.6.2 FUNCtion:MONitor Monitor Parameter Settings

Command syntax: `FUNCtion:MONitor {OFF,RABS,RPER,VABS,VPER}`

Parameters:

OFF	Monitor function off
RABS	Resistance absolute deviation (RΔ) value
RPER	Resistance relative deviation (R%) value
vABS	Voltage absolute deviation (VΔ) value
vPER	Voltage relative deviation (V%) value

For example: Send>FUNC:MONRPER //Set the monitor parameter to resistance relative deviation value (R%)

Query syntax: `FUNCtion:MONitor?`

Query response: `{OFF,RABS,RPER,VABS,VPER}`

For example: Send>FUNC:MON?

Receive> OFF

12.7 RESistance Resistance Setting Subsystem

Fig.12-4 RESistance Subsystem Tree

RESistance		<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 RESistance:RANGe Resistance Range Setting

Sets the range according to the resistance value.

Command syntax: **`RESistance:RANGe <0 to 3100>`**

Parameters: <0-3100> resistance value expressed as a floating-point number

For example: Send>:RES:RANG100E-3 //Select the range containing 100mΩ

Send>:RES:RANG10m //Select the range containing 10mΩ

Query syntax: `:RESistance:RANGe?`

Query response: Returns the test range:

`3.0000E-3, 30.000E-3, 300.00E-3, 3.0000E+0, 30.000E+0, 300.00E+0, 3.0000E+3`

For example: 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 RESistance:RANGe:No Resistance Range Number Setting

RES:RANG:NO sets the range number

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

Parameters: Where <range number> is 0~6

min: minimum range=0

max: maximum range=6

For example: Send>RES:RANG:NO3<NL> //Switch to range 3 (3Ω)

Query syntax: `RES:RANG:NO?`

Query response: Range number 0~6

For example:
Send>RES:RANGE:NO?
Return>5
Send>RES:RANGE:NO2;NO? //Send the command and query the result
Return>2

12.7.3 RESistance:RANGe:MODE Resistance Comparison Mode Setting

RES:RANG:MODE sets the range mode

Command syntax: `RESistance:RANGe:MODE {AUTO,HOLD,NOMinal}`

For example: Send>RES:RANG:MODEAUTO //Switch to auto range mode

Query syntax: `RES:RANG:MODE?`

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

For example:
Send>RES:RANGE:MODE?
Return>AUTO
Send>RES:RANGE:MODEAUTO;MODE?//Send the command and query the result
Return>AUTO

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

12.7.4 RESistance:LiMiT Resistance Limit Setting

Sets the resistance upper and lower limits under the current comparison mode.

Command syntax:
`RESistance:LiMiT <lower,upper>`
`RESistance:LMT <lower,upper>`

Parameters:
`lower:` Upper limit floating-point number
`upper:` Lower limit floating-point number
The data values correspond to the current comparison mode: for direct (SEQ) and absolute (ABS) comparison they represent resistance values (Ω); percentage (PER) comparison, they represent the percentage value (%).

For example:
Send>RES:LMT1,10
Send>RES:LMT10m,100m
Send>RES:LMT1e-3,1e-2

Query syntax: `RESistance:LiMiT?`

Query response: <lower>,<upper> The current data values correspond to the upper and lower limit values under the current comparison mode. Data format: ±#.####E±#
Each data value has a total of 10 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses formats such as E-3(m), E+0, and E+3(k) to match the multiplier unit values.

For example:
Send>RES:LMT?
Receive> `+1.0000E-3,+10.000E-3`
Send>RES:LMT10m,12m;LMT?
Receive> `+10.000E-3,+12.000E-3`

12.7.5 RESistance:LiMiT:STATe Resistance Comparator State Setting

Sets the resistance comparator on or off.

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

For example: Send>RES:LMT:STATOFF

Query syntax: `RESistance:LiMiT:STATe?`

Query response: `{on,off}`

For example:
Send>RES:LMT:STAT?
Receive> on

12.7.6 RESistance:LiMiT:MODE Resistance Comparison Mode

Sets the voltage comparison mode.

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

Parameters:
SEQ: Upper and lower limit direct comparison mode
PER: Percentage comparison mode (relative deviation comparison)
ABS: Absolute deviation comparison (Δ)

For example: Send>RES:LMT:MODEPER //Percentage comparison

Query syntax: RESistance:LiMiT:MODE?

Query response: {SEQ,PER,ABS}

For example:
Send>RES:LMT:MODE?
Receive> SEQ

12.7.7 RESistance:LiMiT:NOMinal Resistance Nominal Value Setting

Sets the resistance nominal value. The nominal value is only used in calculations in ABS and PER modes.

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

Parameters: float: Nominal value floating-point number, unit (Ω)

For example:
Send>RES:LMT:NOM12.345m
Send>RES:LMT:NOM12.345e-3

Query syntax: RESistance:LiMiT:NOMinal?

Query response: <float>
Data format: ±#.####e±#
Each data value has a total of 10 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses formats such as E-3, E+0, and E+3 to match the unit values.

For example:
Send>RES:LIM:NOM?
Receive> +100.00e-3 //100.00mΩ
Send>RES:LIM:NOM100.00m;NOM? //Set the nominal value and query
Receive> +100.00e-3 //100.00mΩ

Note:
If the current resistance range is set to the nominal range (NOM RANGE) and the resistance comparison mode is PER or ABS, the resistance range will Switches to the optimal range according to the nominal value.
However, when the resistance comparison mode is SEQ, the range will not be switched according to the nominal value. (In SEQ mode, the range is selected according to the upper limit.)

12.7.8 RESistance:LiMiT:SEQ Resistance Direct Read Value Limit

Sets the resistance upper and lower limits under the current direct comparison mode.

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

Parameters:
lower: Upper limit floating-point number
upper: Lower limit floating-point number
Sets the upper and lower limit values for direct comparison (SEQ).

For example:
Send>RES:LMT:SEQ1m,10m
Send>RES:LMT:SEQ1e-3,10e-3

Query syntax: RESistance:LiMiT:SEQ?

Query response: <lower>,<upper>
Data format: ±#.####E±##
Each data value has a total of 11 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses formats such as E-03, E+00, and E+03 to match the unit values.

For example:
Send>RES:LMT:SEQ?
Receive> +1.0000e-03,+10.000e-03
Send>RES:LMT:SEQ10m,100m;SEQ?//Set the nominal value and query
Receive> +100.00e-03 //100.00mΩ

Note: CALCulate:LIMit:RESistance:SEQ forcibly switches the resistance comparison mode to SEQ.
However, the CALCulate:LIMit:RESistance:SEQ? command does not switch the comparison mode.

12.7.9 RESistance:LiMiT:ABS Resistance Absolute Value Limit

Sets the resistance upper and lower limits under the current absolute value comparison mode.

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

Parameters:
`lower:` Upper limit floating-point number
`upper:` Lower limit floating-point number
Sets the upper and lower limit values for absolute value comparison (ABS).

For example:
Send>RES:LMT:ABS-1.23m,1.23m
Send>RES:LMT:ABS-1.23e-3,12.3e-3

Query syntax: `RESistance:LiMiT:ABS?`

Query response: `<lower>,<upper>`
Data format: ±#.####E±#
Each data value has a total of 10 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses formats such as E-03, E+00, and E+03 to match the unit values.

For example:
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

Note: CALCulate:LIMit:RESistance:ABS forcibly switches the resistance comparison mode to ABS.
However, the :CALCulate:LIMit:RESistance:ABS? command does not switch the comparison mode.

12.7.10 RESistance:LiMiT:PER Resistance Percentage Upper/Lower Limits

Sets the resistance upper and lower limit percentage values under the current percentage comparison mode.

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

Parameters:
`lower:` Upper limit floating-point number
`upper:` Lower limit floating-point number
Sets the upper and lower limit percentage values for percentage comparison (PER).

For example:
Send>RES:LMT:PER-10.1,10.1

Query syntax: `RESistance:LiMiT:PER?`

Query response: `<lower>,<upper>`
Data format: ±#.####E+0
Each data value has a total of 10 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses the E+0 format.

For example:
Send>RES:LMT:PER?
Receive> -10.000E+0,+10.000E+0
Send>RES:LMT:PER-10,10;PER? //Set and query the return value
Receive> -10.000E+0,+10.000E+0

Note: CALCulate:LIMit:RESistance:PER forcibly switches the resistance comparison mode to PER.
The CALCulate:LIMit:RESistance:PER? command does not switch the comparison mode.

12.8 VOLTage Voltage Setting Subsystem

Fig.12-5 VOLTage Subsystem Tree

VOLTage		<-300~300>	
		:NO	{0,1,2}
		: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>	

12.8.1 VOLTage:RANGe Voltage Range Setting

Sets the voltage range.

Command syntax: `VOLTage:RANGe <-MAX to +MAX>`

where:

AT2527L MAX = 60
AT2527A MAX = 200
AT2527 MAX = 400
AT2527B MAX = 800
AT2527H MAX = 1000
AT2527K MAX = 1500

Parameters: <0-MAX> voltage value expressed as a floating-point number

For example: Send>:VOLT:RANG10 //Select the range containing 10V

Query syntax: **:VOLTage:RANGe?**

Query response: Returns the test range:
`6.00000E+0, 60.0000E+0, 300.000E+0`

For example: Send>VOLT:RANG?
Receive> `60.0000E+0`
Send>VOLT:RANG3?

12.8.2 VOLTage:RANGe:No voltage range number setting

VOLT:RANG:NO sets the range number

Command syntax: `VOLTage:RANGe:No {<0~2>,min,max}`

Parameters: Where <range number> is 0~2
min: minimum range=0
max: maximum range=2(AT2527L max=1)

For example: Send>VOLT:RANG:NO1 //Switch to range 1

Query syntax: `VOLTage:RANGe:NO?`

Query response: Range number 0~2

For example: Send>VOLT:RANG:NO?
Return>1
Send>VOLT:RANGE:NO1;NO? //Send the command and query the result
Return>1

12.8.3 VOLTage:RANGe:MODE

VOLT:RANG:MODE sets the range mode

Command syntax: `VOLTage:RANGe:MODE {AUTO,HOLD,NOMinal}`

For example: Send>VOLT:RANG:MODEAUTO //Switch to auto range mode

Query syntax: `VOLTage:RANGe:MODE?`

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

For example: Send>VOLT:RANGE:MODE?
Return>AUTO
Send>VOLT:RANGE:MODEAUTO;MODE? **//Send the command and query the result**
Return>AUTO

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

12.8.4 VOLTage:LiMiT Resistance Limit Setting

Sets the voltage upper and lower limits under the current comparison mode.

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

Parameters:
`lower:` Upper limit floating-point number
`upper:` Lower limit floating-point number
The data values correspond to the current comparison mode: for direct (SEQ) and absolute (ABS) comparison they represent voltage values (V); percentage (PER) comparison, they represent the percentage value (%).

For example: Send>VOLTage:LMT10,20

Query syntax: `VOLTage:LiMiT?`

Query response: <lower>,<upper> The current data values correspond to the upper and lower limit values under the current comparison mode. Data format: ±#.#####E+0
Each data value has a total of 11 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses the E+0 format to match the multiplier unit values.

For example:
Send>VOLT:LMT?
Receive> +10.0000E+0,+20.0000E+0
Send>VOLT:LMT10,20;LMT?
Receive> +10.0000E+0,+20.0000E+0

12.8.5 VOLTage:LiMiT:STATe Voltage Comparator State Setting

Sets the voltage comparator on or off.

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

For example: Send>VOLT:LMT:STATOFF

Query syntax: `VOLTage:LiMiT:STATe?`

Query response: `{on,off}`

For example:
Send>VOLT:LMT:STAT?
Receive> on

12.8.6 VOLTage:LiMiT:MODE Voltage Comparison Mode

Sets the voltage comparison mode.

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

Parameters:
`SEQ:` Upper and lower limit direct comparison mode
`PER:` Percentage comparison mode (relative deviation comparison)
`ABS:` Absolute deviation comparison (Δ)

For example: Send>VOLT:LMT:MODEPER //Percentage comparison

Query syntax: `VOLTage:LiMiT:MODE?`

Query response: `{SEQ,PER,ABS}`

For example:
Send>VOLT:LMT:MODE?
Receive> SEQ

12.8.7 VOLTage:LiMiT:NOMinal Voltage Nominal Value Setting

Sets the voltage nominal value. The nominal value is only used in calculations in ABS and PER modes.

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

Parameters: `float:` Nominal value floating-point number, unit (V)

For example: Send>VOLT:LMT:NOM10.1234

Query syntax: `VOLTage:LiMiT:NOMinal?`

Query response: `<float>`

Data format: ±#.#####e+0

Each data value has a total of 11 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses the E+0 format to match the unit values.

For example: Send>VOLT:LIM:NOM?

Receive> +10.0000E+0 `//10.0000`

Send>VOLT:LIM:NOM3.6;NOM?//Set the nominal value and query

Receive> +3.60000E+0

Note: If the current voltage range is set to the nominal range (NOM RANGE) and the voltage comparison mode is PER or ABS, the voltage range will Switches to the optimal range according to the nominal value.

However, when the voltage comparison mode is SEQ, the range will not be switched according to the nominal value. (In SEQ mode, the range is selected according to the upper limit.)

12.8.8 VOLTage:LiMiT:SEQ Voltage Direct-Read Value Limit

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

Parameters: `lower:` Upper limit floating-point number

`upper:` Lower limit floating-point number

Sets the upper and lower limit values for direct comparison (SEQ).

For example: Send>VOLT:LMT:SEQ1.23456,3.45678

Query syntax: `VOLTage:LiMiT:SEQ?`

Query response: `<lower>,<upper>`

Data format: ±#.######E+0

Each data value has a total of 11 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses the E+0 format.

For example: Send>VOLT:LMT:SEQ?

Receive> +1.23456E+0,+3.45678E+0

Send>VOLT:LMT:SEQ3.5,4.2;SEQ?//Set and query the set value

Receive> +3.50000E+0,+4.20000E+0

Note: CALCulate:LIMit:VOLTage:SEQ forcibly switches the voltage comparison mode to SEQ.

The CALCulate:LIMit: VOLTage:SEQ? command does not switch the comparison mode.

12.8.9 VOLTage:LiMiT:ABS Voltage Absolute Value Limit

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

Parameters: `lower:` Upper limit floating-point number

`upper:` Lower limit floating-point number

Sets the upper and lower limit values for absolute value comparison (ABS).

For example: Send>VOLTage:LiMiT:ABS-1.2,1.2

Query syntax: `VOLTage:LiMiT:ABS?`

Query response: `<float>,<float>`

Data format: ±#.######E+0

Each data value has a total of 11 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses the E+00 format.

For example: Send>VOLT:LMT:ABS?

Receive> -1.23456E+0,+1.23456E+0

Send>VOLT:LMT:ABS-12,12;ABS? //Set and query the set value

Receive> -12.0000E+0,+12.0000E+0

Note: VOLTage:LiMiT:ABS forcibly switches the voltage comparison mode to ABS.

The VOLTage:LiMiT:ABS? command does not switch the comparison mode.

12.8.10 VOLTage:LiMiT:PER Voltage Percentage Upper/Lower Limits

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

Parameters: lower: Upper limit floating-point number

upper: Lower limit floating-point number

Sets the upper and lower limit percentage values for percentage comparison (PER).

For example: Send>:CALC:LIM:VOLT:PER-1,1

Query syntax: VOLTage:LiMiT:PER?

Query response: <float>,<float>

Data format: ±#.#####E+0

Each data value has a total of 11 digits, the first being the sign; the decimal point position is not fixed. For compatibility with PLCs and similar devices, the exponent part only uses the E+00 format to match the unit values.

For example: Send>VOLT:LMT:PER?

Receive> -10.0000E+00,+10.0000E+00

Send>VOLT:LMT:PER-10,10;PER? //Set and query the set value

Receive> -10.0000E+00,+10.0000E+00

12.9 AUTorange Auto Range Subsystem*

(*Not recommended for new designs)

12.9.1 AUTorange Auto Range Setting*

Auto range setting. This command sets both the voltage and resistance range modes. To set a range mode individually, refer to RES:RANG:MODE and VOLT:RANG:MODE commands.

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

For example: Send>AUTON //Switch to auto range mode

Query syntax: AUTorange?

Query response: {ON,OFF}

12.10 ADJust Zeroing Subsystem

12.10.1 ADJust:CLEAr Cancel Zeroing Function

Disables the zeroing function.

Command syntax: :ADJust:CLEAr

For example: Send>:ADJ:CLEA

12.10.2 ADJust Performing Zeroing

Before sending this command, the test clips must be short-circuited.

Command syntax: ADJust

Response: {0,1}

0: Zeroing successful

1: Zeroing failed

For example: Send>:ADJ //Start zeroing

Receive>0 //Zeroing successful

Query syntax: :ADJust?

Query response: {0,1}

0: The most recent zeroing was successful

1: The most recent zeroing failed

Note

Zeroing takes some time; allow a short wait before all return values come back. Zeroing under auto range takes about 6s.

12.11 SAMPle Sample Subsystem

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

12.11.1 SAMPle:RATE Test Speed Setting

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

Parameters: SLOW: Slow

MEDium: medium speed

FAST: Fast

EXFAST: high speed

For example: Send>SAMP:RATEMED

Query syntax: SAMPle:RATE?

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

For example: Send>SAMP:RATE?

Receive> FAST

Send>SAMP:RATEMED;RATE?

Receive> MED

12.11.2 SAMPle:AVERage Averaging Count Setting

Average count setting.

Command syntax: SAMPle:AVERage <integer **0~256>**
SAMPle:AVG <integer 0~2**56>**

Parameters: 0 or 1: The averaging function will be turned off

For example: Send>SAMP:AVER10

Send>SAMP:AVG5

Query syntax: SAMPle:AVERage?
SAMPle:AVG?

Query response: {0~256}

For example: Send>SAMP:AVER?

Receive> 0 //=OFF

Send>SAMP:AVER2;AVER?

Send>2

12.12 CALCulate Calculation Subsystem

Fig. 12-6 CALCulate Subsystem Tree

CALCula**te**		<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 CALCulate:AVERage:STATe Averaging Function*

(*Not recommended for new designs)

Turning averaging off sets the instrument average count to 1; use SAMPle:AVERage 0 instead of this command.

Command syntax: `CALCulate:AVERage:STATe {OFF}`

Parameters: {OFF}

When set to OFF, the average count is 1

For example: Send>:CALC:AVER:STATOFF

Query syntax: `CALCulate:AVERage:STATe?`

Query response: {ON,OFF}

ON: average count > 1

OFF: average count = 1

Note: This command has no turn-on function, i.e. CALC:AVER:STAT ON has no effect. To turn on averaging, use SAMP:AVER <2~256> instead.

12.12.2 CALCulate:AVERage Average Value Setting*

(*Not recommended for new designs)

Use SAMPle:AVERage instead of this command.

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

Parameters: Integer, enter an average count from 1 to 256

When set to 1, averaging is turned off

For example: Send>CALC:AVER10

Query syntax: `CALCulate:AVERage?`

Query response: {0~256}

0: averaging is off

12.12.3 CALCulate:LIMit:STATe Comparator Master Switch Setting*

(*Not recommended for new designs)

Comparator switch setting; this command sets the voltage and resistance comparator switches simultaneously.

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

Parameters: ON(1): Both the resistance comparator and the voltage comparator are turned on and set to SEQ mode.

OFF(0): Both the resistance comparator and the voltage comparator are turned off.

For example: Send>CALC:LIM:STATOFF

Query syntax: CALCulate:LIMit:STATe?

Query response: {ON,OFF}

Returns OFF when both the resistance comparator and the voltage comparator are set to OFF

For example: Send>CALC:LIM:STAT?

Receive> ON

Note

CALCulate:LIMit:STATe turns the voltage and resistance comparators on or off simultaneously.

To turn off the resistance or voltage comparator individually, use the RES:LMT:STATe and VOLT:LMT:STATe commands.

12.12.4 CALCulate:LIMit:BEEPer beeper setting

Comparator beeper setting.

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

Parameters: 0/OFF: beeper off

HL/NG/FAIL: fail beeper, the buzzer beeps on fail

IN/OK/PASS: pass beeper, the buzzer beeps on pass

For example: Send>CALC:LIM:BEEPHL //fail beeper

Send>CALC:LIM:BEEPOK //pass beeper

Query syntax: CALCulate:LIMit:BEEPer?

Query response: {OFF,HL,IN}

For example: Send>CALC:LIM:BEEP?

Receive> IN

12.12.5 CALCulate:LIMit:RESistance:MODE Resistance Comparison Mode*

(*Not recommended for new designs)

Resistance comparison mode setting. Use RES:LMT:MODE instead of this command.

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

Parameters: HL/SEQ: Upper and lower limit direct comparison mode

REF/PER: Percentage comparison mode (relative deviation % comparison)

ABS: Absolute deviation comparison (Δ)

For example: Send>CALC:LIM:RES:MODEHL //upper/lower limit direct-reading comparison

Send>CALC:LIM:RES:MODEREF //Percentage comparison

Query syntax: CALCulate:LIMit:RESistance:MODE?

Query response: {HL,REF,ABS}

For example: Send>CALC:LIM:RES:MODE?

Receive> HL

12.12.6 CALCulate:LIMit:RESistance:UPPer Resistance Upper Limit Setting*

(*Not recommended for new designs)

Use RES:LMT, which supports floating-point input, instead.

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

Parameters: <0-99999>: Positive integer; values above 99999 are forced to 99999; the sign is ignored.

Decimals and unit depend on the current range:

Range	Decimal places	Unit	Description
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 (3kΩ)	4	Ω	12345 = 1.2345Ω

For example: Send>CALC:LIM:RES:UPPer12345 //value from the table above, represents 1.2345mΩ at range 1

Query syntax: `CALCulate:LIMit:RESistance:UPPer?`

Query response: <positive integer>#####

Up to 5 digits, no sign or decimal point

For example: Send>CALC:LIM:RES:UPP?
Receive> 1234 //at range 0, represents 0.1234mΩ
Send>CALC:LIM:RES:UPP12345;UPP?
Receive> 12345 //at range 1, represents 12.345mΩ

Note The value sent with this command depends on the range; RES:LMT<lower>,<upper> allows entering the actual floating-point value directly.
CALC:LIM:RES:UPP sets the resistance comparison mode to SEQ.

12.12.7 CALCulate:LIMit:RESistance:LOWer Resistance Lower Limit Setting*

(*Not recommended for new designs)

Use RES:LMT, which supports floating-point input, instead.

Command syntax: **`CALCulate:LIMit:RESistance:LOWer <0-99999>`**

Parameters: `<0-99999>:` Positive integer; values above 99999 are forced to 99999

Decimals and unit depend on the current range:

Range	Decimal places	Unit	Description
1 (3mΩ)	4	mΩ	12345 = 1.2345mΩ
2 (30mΩ)	3	mΩ	12345 = 12.345mΩ
3 (300mΩ)	2	mΩ	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 (3kΩ)	4	Ω	12345 = 1.2345Ω

For example: Send>CALC:LIM:RES:LOWer1000 //value from the table above, represents 0.1000Ω at range 4

Query syntax: `CALCulate:LIMit:RESistance:LOWer?`

Query response: <positive integer>#####

5 digits in total, no sign or decimal point

For example: Send>:CALC:LIM:RES:LOW?
Receive> 1000//return value varies with range

Note The value sent with this command depends on the range; RES:LMT<lower>,<upper> allows entering the actual floating-point value directly.
CALC:LIM:RES:UPP sets the resistance comparison mode to SEQ.

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

(*Not recommended for new designs)

Use RES:LMT:NOM, which supports floating-point input, instead.

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

Parameters: `<0-99999>:` Positive integer; values above 99999 are forced to 99999

Decimals and unit depend on the current range:

Range	Decimal places	Unit	Description
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 (3kΩ)	4	Ω	12345 = 1.2345Ω

For example: Send>:CALC:LIM:REF10000 //value from the table above, represents 1.0000Ω at range 4

Query syntax: `:CALCulate:LIMit:RESistance:REFerence?`

Query response: <positive integer>#####

5 digits in total, no sign or decimal point

For example: Send>:CALC:LIM:RES:REF?

Receive> 10000//return value varies with range, represents 1.0000mΩ at range 1

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

(*Not recommended for new designs)

Use RES:LMT:PER, which supports floating-point input, instead.

Command syntax: **`CALCulate:LIMit:RESistance:PERCent <%>`**

Parameters: `%:` Percentage value

Sets the percentage value for percentage comparison (PER).

For example: Send>:CALC:LIM:RES:PERC1.1 //set percentage limits to -1.1%,1.1%

Query syntax: `CALCulate:LIMit:RESistance:PERCent?`

Query response: `<float> #.###`

4-digit floating-point number in total, no sign.

For example: Send>:CALC:LIM:RES:PERC?

Receive> 1.100

Send>:CALC:LIM:RES:PERC?

Receive> 1.100

CALCulate:LIMit:RESistance:PERC force-switches the voltage comparison mode to PER.

The CALCulate:LIMit:RESistance:PERC? command does not switch the comparison mode.

12.12.10 CALCulate:LIMit:VOLTage:MODE Voltage Comparison Mode*

(*Not recommended for new designs)

Voltage comparison mode setting. Use VOLT:LMT:MODE instead of this command.

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

Parameters: `OFF:` Voltage comparator off

`HL:` Upper and lower limit direct comparison mode

`REF:` Percentage comparison mode (relative deviation comparison)

`ABS:` Absolute deviation comparison (Δ)

For example: Send>:CALC:LIM:VOLT:MODEHL //upper/lower limit direct-reading comparison

Send>:CALC:LIM:VOLT:MODEOFF //resistance comparator off

Send>:CALC:LIM:VOLT:MODEREF //Percentage comparison

Send>:CALC:LIM:VOLT:MODEPER //Percentage comparison

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

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

For example: Send>:CALC:LIM:VOLT:MODE?
Receive> HL

Note: :CALCulate:LIMit:VOLTage:PER force-switches the voltage comparison mode to PER.
:CALCulate:LIMit: VOLTage:PER? does not switch the comparison mode.

12.12.11 :CALCulate:LIMit:VOLTage:UPPer Voltage Upper Limit Setting*

(*Not recommended for new designs)

Use VOLT:LMT<lower>,<upper> instead of this command.

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

Parameters: <0-999999>: Positive integer; values above 999999 are forced to 999999; the sign is ignored.

Decimals and unit depend on the current range:

Range	Decimal places	Description
0 (8V)	5	123456 = 1.23456V
1 (80V)	4	123456 = 12.3456V
2 (400V)	3	123456 = 123.456V

For example: Send>:CALC:LIM:VOLT:UPPer123456 //value from the table above, represents 1.23456V at range 1

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

Query response: <positive integer>######

Up to 6 digits, no sign or decimal point

For example: Send>:CALC:LIM:VOLT:UPP?
Receive> 123456 //at range 2, represents 123.456V
Send>:CALC:LIM:VOLT:UPP12345;UPP?
Receive> 12345 //at range 2, represents 12.345V

Note: The value sent with this command depends on the range; VOLT:LMT<lower>,<upper> allows entering the actual floating-point value directly.
CALC:LIM:VOLT:UPP sets the voltage comparison mode to SEQ.

12.12.12 :CALCulate:LIMit:VOLTage:LOWer Voltage Lower Limit Setting*

(*Not recommended for new designs)

Use VOLT:LMT<lower>,<upper> instead of this command.

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

Parameters: <0-999999>: Positive integer; values above 999999 are forced to 999999; the sign is ignored.

Decimals and unit depend on the current range:

Range	Decimal places	Description
0	5	123456 = 1.23456V
1	4	123456 = 12.3456V
2	3	123456 = 123.456V

For example: Send>:CALC:LIM:VOLT:LOW100000//value from the table above, represents 1.00000V at range 1

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

Query response: <positive integer>#######

Up to 6 digits, no sign or decimal point

For example: Send>:CALC:LIM:VOLT:LOW?
Receive> 100000 //at range 1, represents 1.00000V

Note

The value sent with this command depends on the range; VOLT:LMT<lower>,<upper> allows entering the actual floating-point value directly.

CALC:LIM:VOLT:LOW sets the voltage comparison mode to SEQ.

12.12.13 :CALCulate:LIMit:VOLTage:REFerence Voltage Nominal Value Setting*

(*Not recommended for new designs)

Use VOLT:LMT:NOM instead of this command

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

Parameters: <0-999999>: Positive integer; values above 999999 are forced to 999999; the sign is ignored.

Decimals and unit depend on the current range:

Range	Decimal places	Description
0	5	123456 = 1.23456V
1	4	123456 = 12.3456V
2	3	123456 = 123.456V

For example: Send>:CALC:LIM:VOLT:REF100000//value from the table above, represents 10.0000V at range 2

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

Query response: <positive integer>#######

Up to 6 digits, no sign or decimal point

For example: Send>:CALC:LIM:VOLT:REF?

Receive> 100000 //at range 2, represents 10.0000V

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

(*Not recommended for new designs)

Use VOLT:LMT:PER <lower>,<upper> instead of this command.

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

Parameters: %: Percentage value

Sets the percentage value for percentage comparison (PER).

For example: Send>:CALC:LIM:VOLT:PERC0.3 //set percentage limits to -0.3%,0.3%

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

Query response: <float>

##.### without sign, the upper limit corresponding to the current data value

For example: Send>:CALC:LIM:VOLT:PERC?

Receive> 0.300

Note

:CALCulate:LIMit:VOLTage:PERC force-switches the voltage comparison mode to PER.

:CALCulate:LIMit: VOLTage:PERC? does not switch the comparison mode.

12.12.15 :CALCulate:LIMit:ABS Voltage Absolute Deviation Comparison Mode*

(*Not recommended for new designs)

This command is not recommended; use the equivalent command VOLT:LMT:MODEABS

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

Parameters: ON: sets absolute-deviation comparison mode

OFF: sets relative deviation (percentage) comparison mode.

For example: Send>:CALC:LIM:ABSON //set to ABS comparison mode

Query syntax: :CALCulate:LIMit:ABS?

Query response: {on,off}

on: absolute-deviation mode

off: other comparison mode (possibly OFF, SEQ, or PER)

For example: Send>:CALC:LIM:ABS?
Receive> OFF

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

12.12.16 :CALCulate:STATistics[:STATe] Statistics Function

Turns the statistics function on or off.

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

Parameters: ON: turns on the statistics function
OFF: statistics function off

For example: Send>CALC:STATLOG

Query syntax: CALCulate:STATistic[:STAT]?

Query response: {LOG,STAT}

For example: Send>CALC:STATLOG;STAT?
Receive> LOG

Note: If the current trigger mode is internal, use the LOG:START ON command to perform logging and statistics.
If the current trigger mode is external, use the TRIG key to perform logging and statistics.

12.12.17 CALCulate:STATistics:RESistance:NUMBer? Resistance Statistics Count

Queries the resistance count.

Query syntax:
```
CALCulate:STATistic:RESistance:NUMBer?
CALCulate:STATistic:RESistance:NUM?
CALCulate:STATistic:RESistance:NO?
```

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

For example: Send>CALC:STAT:RES:NUM?
Receive> 10,8 //10 values recorded in total, 8 valid and used for statistics

Note: Valid count: excludes readings that are overflow (OF) or error (FAULT); a value is considered valid as long as it can be displayed on the screen.

12.12.18 CALCulate:STATistics:RESistance:MEAN? Mean Value

Queries the mean.

Query syntax: **CALCulate:STATistic:RESistance:MEAN?**

Query response: <mean (floating point)>

For example: Send>CALC:STAT:RES:MEAN?
Receive> +1.2568E-3

Note: Mean $x = \frac{\sigma}{}$

12.12.19 CALCulate:STATistics:RESistance:MAXimum? Maximum

Queries the maximum.

Query syntax: **CALCulate:STATistic:RESistance:MAXimum?**

Query response: <maximum (floating point)>,<bin number>

For example: Send>CALC:STAT:RES:MAX?
Receive> +354.76E+0,2 //the 2nd data is the maximum

12.12.20 CALCulate:STATistics:RESistance:MINimum? Minimum

Queries the minimum.

Query syntax: **CALCulate:STATistic:RESistance:MINimum?**

Query response: <minimum (floating point)>,<bin number>

For example:
Send>CALC:STAT:RES:MIN?
Receive> +354.33E+0,7 //the 7th data is the minimum

12.12.21 CALCulate:STATistics:RESistance:LIMit? Bin Count

Query the count.

Query syntax:
```
CALCulate:STATistic:RESistance:LIMit?
CALCulate:STATistic:RESistance:LMT?
```

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

For example:
Send>CALC:STAT:RES:LMT?
Receive> 10,0,0,0 //10 data failed over upper limit
Send>CALC:STAT:RES:LIM?
Receive> 0,10,0,0 //10 data passed

Note When querying the comparator bin counts, make sure the comparator function is enabled; otherwise the data returns 0,0,0,0

12.12.22 CALCulate:STATistics:RESistance:DEViation?

Query the standard deviation.

Query syntax:
```
CALCulate:STATistic:RESistance:DEViation?
```

Query response: <population standard deviation σn>,<sample standard deviation σn-1>

For example:
Send>CALC:STAT:RES:DEV?
Receive> 0.0017 //σ_n=0.0016 s=0.0017

Note
Population standard $\sqrt{\frac{\sum(x-\bar{x})^2}{n}} = \sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$

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

12.12.23 CALCulate:STATistics:RESistance:Cp?

Query the process capability index (Cp/Cpk).

Query syntax:
```
CALCulate:STATistic:RESistance:CP?
```

Query response: <process capability index (deviation) Cp>,<process capability index (shift) Cpk>

For example:
Send>CALC:STAT:RES:CP?
Receive> //Cp = 99.85, Cpk = 75.56

Note
Process capability index (deviation) $Cp = \frac{|USL - LSL|}{6\sigma_{n-1}}$

Process capability index (shift) $Cpk = \frac{|USL - LSL|}{6\sigma_{n-1} + |\bar{x} - M|}$

12.12.24 CALCulate:STATistics:VOLTage:NUMBer? Voltage Statistics Count

Queries the resistance count.

Query syntax:
```
CALCulate:STATistic:VOLTage:NUMBer?
CALCulate:STATistic:VOLTage:NUM?
CALCulate:STATistic:VOLTage:NO?
```

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

For example:
Send>CALC:STAT:VOLT:NUM?
Receive> 10,10 //10 values recorded in total, 10 valid and used for statistics

Note Valid count: excludes readings that are overflow (OF) or error (FAULT); a value is considered valid as long as it can be displayed on the screen.

12.12.25 CALCulate:STATistics:VOLTage:MEAN? Mean

Queries the mean.

Query syntax:	**CALCulate:STATistic:VOLTage:MEAN?**
Query response:	<mean (floating point)>
For example:	Send>CALC:STAT:VOLT:MEAN? Receive>+3.70601E+0
Note	Mean x = $\bar{x}$ σ

12.12.26 CALCulate:STATistics:VOLTage:MAXimum? Maximum

Queries the maximum.

Query syntax:	**CALCulate:STATistic:VOLTage:MAXimum?**
Query response:	<maximum (floating point)>,<bin number>
For example:	Send>CALC:STAT:VOLT:MAX? Receive> +3.70890E+0,4 //The 4th value is the maximum 3.70890V

12.12.27 CALCulate:STATistics:VOLTage:MINimum? Minimum

Queries the minimum.

Query syntax:	**CALCulate:STATistic:VOLTage:MIMimum?**
Query response:	<minimum (floating point)>,<bin number>
For example:	Send>CALC:STAT:VOLT:MIN? Receive> +3.70566E+0,4 //The 4th value is the minimum 3.70566V

12.12.28 CALCulate:STATistics:VOLTage:LIMit? Bin Count

Query the count.

Query syntax:	CALCulate:STATistic:VOLTage:LIMit? CALCulate:STATistic:VOLTage:LMT?
Query response:	<HI count>,<OK count>,<LO count>,<FAULT count>
For example:	Send>CALC:STAT:VOLT:LMT? Receive> 0,10,0,0 //10 data passed
Note	When querying the comparator bin counts, make sure the comparator function is enabled; otherwise the data returns 0,0,0,0

12.12.29 CALCulate:STATistics:VOLTage:DEViation?

Query the standard deviation.

Query syntax:	**CALCulate:STATistic:VOLTage:DEViation?**
Query response:	<population standard deviation σn>,<sample standard deviation σn-1>
For example:	Send>CALC:STAT:VOLT:DEV? Receive> 0.0002 // σ_n=0.0002 s=0.0002
Note	Population standard $\sqrt{\frac{\sigma(x-\bar{x})^2}{n}} = \sqrt{\frac{\sigma x^2}{n} - \bar{x}^2}$ Sample standard deviation: $\sqrt{\frac{\sigma(x-\bar{x})^2}{n-1}} = \sqrt{\frac{\sigma x^2}{n-1} - \frac{n\bar{x}^2}{n-1}}$

12.12.30 CALCulate:STATistics:VOLTage:Cp?

Query the process capability index (Cp/Cpk).

Query syntax:	**CALCulate:STATistic:VOLTage:CP?**
Query response:	<process capability index (deviation) Cp>,<process capability index (shift) Cpk>
For example:	Send>CALC:STAT:VOLT:CP? Receive> 72.110 , 8.6692 //Cp = 72.110, Cpk = 8.6692

Note

Process capability index (deviation) Cp = $\frac{|i-Lo|}{6\sigma_{n-1}}$

Process capability index (shift) Cpk = $\frac{|Hi-Lo|-|Hi+Lo-2\bar{x}|}{6\sigma_{n-1}}$

12.13 LOGger (MEMory) subsystem

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

Fig. 12-7 LOGger (MEMory) Subsystem Tree

LOGger MEMory		<ON(1),OFF(0)>
	:SIZE	{<1~10000>,max}
	:COUNT?	<0~10000>
	:DATA?	<1~10000>

12.13.1 LOGger:START or MEMory:START Starting Data Logging

LOGger:START or MEMory:START start/stop data logging.

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

Parameters: ON: start logging

OFF: stop logging

For example: Send>LOG:STARTON

Query syntax:
```
LOGger:START?
MEMory:START?
```

Query response: `{on,off}`

For example: Send>LOG:START?

Receive> OFF

Note This command is valid only after a value is set in [Data Cache]. Check the [Data Cache] status on the <System Config> page. If the current page is not the <Measurement Display> page, this command automatically switches to the <Measurement Display> page.

12.13.2 LOGger:SIZE or MEMory:SIZE Data Logging Buffer Size Setting

Command syntax:
```
LOGger:SIZE {<0~10000>,max}
MEMory:SIZE {<0~10000>,max}
```

Parameters: <0~10000>: integer

0: logging disabled

max: buffer set to 10000

For example: Send>LOG:SIZEmax

Send>MEM:SIZE1000

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

Query response: `{0~10000}`

For example: Send>LOG:SIZE100;SIZE?

Receive> 100

Send>MEM:SIZE?

Receive> 200

12.13.3 LOGger:COUNt? or MEMory:COUNt? Total Number of Records in Data Buffer

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

Query response: `{0~10000}`

0, buffer empty

For example: Send>LOG:COUN?

Receive> 10

Send>MEM:COUN?

Receive> 0

12.13.4 LOGger:DATA? or MEMory:DATA? Data Buffer Data

Query Syntax 1:
```
LOGger:DATA? <1~10000>
MEMory:DATA? <1~10000>
```

Parameters: <1~10000>: integer, a value greater than the total recorded in the buffer or less than 1 returns 0.

For example:
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>;
...
```

For example:
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;

Note
1. The actual returned value has no line break; it is added here for convenience.
2. The total length is 5 digits, padded with spaces if fewer.
3. When there is a lot of logged data, it takes longer to return the data.
4. If the specified index is beyond the buffer size, the data returns 0.

12.14 SYSTem Subsystem

The SYSTem subsystem is used to set system-related parameters.

Data set by the SYSTem subsystem is not saved inside the instrument.

Fig. 12-8 SYSTem Subsystem Tree

SYSTem		{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

Set the instrument language.

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

For example:
Send>SYST:LANGEN //Set to English display

Query syntax:
```
SYST:LANG?
```

Query response:
```
{ENGLISH,CHINESE}
```

12.14.2 SYSTem:TIME System Time Setting

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

For example: Send>SYST:TIME2016,12,30,11,18,31 **//2016-12-30 11:18:31**

Query syntax: `SYSTem:TIME?`

Query response: `<YEAR>-<MONTH>-<DAY> <HOUR>:<MINUTE>:<SECOND>`

For example: Send>SYST:TIME?
Receive>2016-12-3011:18:31

12.14.3 SYSTem:KEYLock or SYSTem:KLOCk Keyboard Lock Setting

Command syntax: `SYSTem:KEYLock {ON,OFF,0,1}`
`SYSTem:KLOCk {ON,OFF,0,1}`

For example: Send>SYST:KEYLOFF //Unlock the keyboard

Query syntax: `SYSTem:KEYLock?`
`SYSTem:KLOCk?`

Query response: `{on,off}`

12.14.4 SYSTem:CODE Error Code Return

When SYSTem:CODE is enabled, an error code can be returned after each received command.

The corresponding error codes are as follows:

Error Codes	Description
*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

If the error code function is off, the host can obtain the error code by sending the ERR? command.

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

For example: Send>SYST:CODEON

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}`

Parameters: `{OFF,ON,0,1}`
OFF/0: key tone off
ON/1: key tone off

For example: Send>SYST:BEEPOFF

Query syntax: `SYSTem:BEEPer?`

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

12.14.6 SYSTem:SHAKhand or SYSTem:HEADer Communication Handshake Command (Data Header Return)

When the communication handshake is enabled, the instrument returns the received command as-is to the host and then returns the data. Command syntax:

```
SYSTem:HEADer {ON,OFF,0,1}
```

For example: Send>SYST:SHAKON

Send>SYST:HEADON

Query syntax:

```
SYSTem:SHAKhand?
SYSTem:HEADer?
```

Query response: {on,off}

12.14.7 SYSTem:CURRent Current Output Setting

Sets the instrument current output mode. When multiple instruments are used at the same time, pulse current output helps prevent crosstalk between instruments; when a single instrument is working, use the continuous output mode.

Command syntax: **SYSTem:CURRent {CONTinuous,PULSe}**

Parameters: CONTinuous: continuous current output

PULSe: current is output only during measurement

For example: Send>SYST:CURRPULS

Query syntax: SYSTem:CURRent?

Query response: {continuous,pulse}

12.14.8 SYSTem:CALibration Instrument Self-Calibration Function

Perform one self-calibration.

Command syntax: SYSTem:CALibration

For example: Send>SYST:CAL

Note! One self-calibration takes 40ms; wait at least 40ms after sending this command before sending the next one. This command is ignored at slow measurement speed.

12.14.9 SYSTem:CALibration:AUTO Instrument Self-Calibration Switch

Set the instrument self-calibration switch.

Command syntax: **SYSTem:CALibration:AUTO {ON,OFF,1,0}**

Parameters: ON/1: the instrument self-calibrates every 30 minutes.

OFF/0: instrument self-calibration off.

For example: Send>SYST:CAL:AUTOON

Query syntax: SYSTem:CALibration:AUTO?

Query response: {on,off}

12.14.10 SYSTem:RESult Sending Test Results

SYSTem:RESult sets the data sending mode: automatic or the FETCH command.

Command syntax: SYSTem:RESult {FETCH,AUTO}

Parameters: {FETCH,AUTO}

FETCH: data is returned to the host only via the fetch? command; the instrument sends it passively.

AUTO: after each test is completed, the test result is automatically sent to the host; the instrument sends it actively.

For example: Send>SYST:RESAUTO//Set to auto send

Query syntax: SYST:RESult?

Query response: {FETCH,AUTO}

12.14.11 SYSTem:DATAout Sending Test Results*

(*Not recommended for new designs)

Both SYSTem:DATAout and SYSTem:RESult can set the data sending mode: automatic or the FETCH command, but the parameters are different.

Command syntax: `SYSTem:DATAout {OFF,ON,0,1}`

Parameters: `{OFF,ON,0,1}`

`OFF/0:` FETCH: data is returned to the host only via the fetch? command; the instrument sends it passively.

ON/1: after each test is completed, the test result is automatically sent to the host; the instrument sends it actively.

For example: Send>SYST:DATAON //Set to auto send

Query syntax: `SYST:DATAout?`

Query response: `{OFF,ON}`

12.14.12 SYSTem:BACKup Saving Measurement Parameters to the Current File*

(*Not recommended for new designs)

Refer to the FILE:SAVE command.

Command syntax: `SYSTem:BACKup`

For example: Send>SYST:BACKUP

12.14.13 SYSTem:RESet Factory Defaults

This command resets all settings to factory reset. This command does not affect calibration data.

Command syntax: `SYSTem:RESet`

For example: Send>SYST:RESET//The buzzer beeps twice

12.15 TRIGger Subsystem

Fig. 12-9 TRIGger Subsystem Tree

TRIGger	[:IMMediate]	
	:SOURce	{INT,EXT}
	:DELay	<1ms~10s>
		:STATe {ON(1),OFF(0)}
TRG(*TRG)		

TRIGger sets the trigger source and generates one trigger.

12.15.1 TRIGger[:IMMediate]

When the trigger source is set to BUS, TRIG[:IMM] generates one trigger but does not return the triggered test data. If data needs to be returned the TRG command must be used.

Command syntax: `TRIGger[IMMediate]`

For example: Send>TRIG //The instrument performs one test and stops

12.15.2 TRIGger:SOURce

TRIG:SOUR sets the trigger source.

Command syntax: `TRIGger:SOURce {INT,EXT}`

For example: Send>TRIG:SOUREXT//Set to external trigger mode.

Query syntax: `TRIGger:SOURce?`

Query response: `<INT,EXT>`

12.15.3 TRIGger:DELay

TRIG:DELay sets the trigger delay timer value.

Command syntax: `TRIGger:DELay <1ms-10.000s>`

For example: Send>TRIG:DEL10m //Set 10ms; if trigger delay is not enabled, this command enables it first

Query syntax: `TRIG:DELay?`

Query response: <0.001-10.000>//unit: seconds

12.15.4 TRIGger:DELay:STATe

TRIG:DELay:STATe turns the trigger delay function on/off.

Command syntax: `TRIGger:DELay:STATe {ON(1),OFF(0)}`

For example: Send>TRIG:DEL:STATON //Trigger delay enabled

Query syntax: `TRIG:DELay:STATe?`

Query response: `<on,off>`

12.15.5 TRG

When the trigger source is set to EXT, TRG generates one trigger and returns the triggered test data.

Command syntax: `TRG`

For example: Send>TRG //The instrument performs one test and returns the complete measurement data

Return> ___21.993E+0,_3.70088E+0,OK,HI,FAIL,RPER:+2.18930e+04

//Resistance value, voltage value, resistance bin, voltage bin, overall pass, monitor name and value

Note! If the current page is not the <Measurement Display> or <Enlarged Display> page, this command first switches to the <Measurement Display> page, then triggers and returns the data.

12.16 FETCh and READ Subsystem

Fig. 12-10 FETCh? Subsystem Tree

FETCh?	
	:FULL

Fig. 12-11 READ? Subsystem Tree

READ?	NO PARAMETER
	:FULL

The FETCh and READ subsystems are similar: FETCh returns the previous measurement data, while READ returns the latest measurement data, so READ waits for a complete measurement cycle before returning data, which is slightly less efficient at slow measurement speeds.

12.16.1 FETCh? or READ? Reading Measurement Data

FETCh? is used to read test data. Before using this command, set the [Result Send] field on the <System Config> page to [FETCH].

The FETCh? command and READ? return the main measurement data.

Query syntax: **FETCh?**

Query response: Depending on the measurement parameters:

RV:<resistance>,<voltage>

R:<resistance>

V:<voltage>

For example: Send>FETC?

Return>□□22.005E+0,□3.69943E+0 //resistance value, voltage value

Note! If the current page is not the <Measurement Display> or <Enlarged Display> page, this command first switches to the <Measurement Display> page and then returns the

data.

12.16.2 FETCh:FULL? or READ:FULL? Reading Complete Measurement Data

FETCh:FULL? or READ:FULL? is used to read complete test data, including measurement data, comparison results and monitor data. Before using this command, set the [Result Send] field on the <System Config> page to [FETCH].

Query syntax: **FETCh:FULL?**

Query response: <resistance>,<voltage>,<resistance HI/OK/LO>,<voltage HI,OK,LO>,<PASS/FAIL/WIRE/OPEN>

For example:
Send>FETC:FULL?
Send>READ:FULL?
Return>□□22.005E+0,□3.69943E+0,--,--,□□□□//-- means the comparator is not enabled
Return>□□21.990E+0,□3.70120E+0,OK,HI,FAIL//resistance value, voltage value, resistance bin, voltage bin, overall pass
Return>□□21.993E+0,□3.70088E+0,OK,HI,FAIL,RPER:+2.18930e+04
//Resistance value, voltage value, resistance bin, voltage bin, overall pass, monitor name and value

Note! If the current page is not the <Measurement Display> or <Enlarged Display> page, this command first switches to the <Measurement Display> page and then returns the data.

12.17 CORRection Subsystem

The CORRection subsystem is used to perform one short-circuit zero calibration.

Fig. 12-12 SYSTem Subsystem Tree

CORRect		

12.17.1 CORRection:SHORt

Query syntax: `CORRection:SHORt`

For example:
Send> `CORRection:SHOR`
Return> `Short Clear Zero Start.`
Return> `PASS`

Note: Be sure to short the test terminals before sending the command.

12.18 FILE(MMEM) Subsystem

The FILE (MMEM) subsystem is used to manage files; it can save user settings to the internal flash, or read flash files into the system.

Fig. 12-13 FILE(MMEM) Subsystem Tree

MMEM		**<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 Saving a File

FILE:SAVE saves the current settings to the current file or a specified file.

Command syntax:
```
FILE:SAVE
FILE:SAVE <File No. 0-9>
```

For example:
Send>FILE:SAVE //Save to the current file
Send>FILE:SAVE1 //Save to file 1

12.18.2 FILE:LOAD Reading a File

FILE:LOAD reads file data into the system.

Command syntax:
```
FILE:LOAD
FILE:LOAD <File No. 0-9>
```

For example:	Send>FILE:LOAD //Read the current file data into the system Send>FILE:SAVE1 //Read file 1 data into the system

12.18.3 FILE:DELete Deleting a Specified File

FILE:DELete deletes the data of the specified file.

Command syntax:	`FILE:DELete <File No. 0-9>`
For example:	Send>FILE:DELete1//Delete file 1
Note:	Deleting the current file does not affect the system parameters

12.19 IDN? Subsystem

The IDN? subsystem returns the instrument version number.

Upon receiving the IDN? command, the instrument buzzer beeps once to indicate that data was received and the result has been returned. This command is usually used for an online test when debugging communication.

Query syntax:	**IDN? or *IDN?**
Query response:	`< Manufacturer>,<MODEL>,<SN>,<Revision>` Manufacturer, model, serial number, instrument version
For example:	Send>IDN? Return>ONMEASInstruments,AT2527,000000,REVC1.0 (the instrument buzzer beeps once)

12.20 ERRor Subsystem

The ERRor subsystem is used to obtain information about the most recent error

Query syntax:	`ERRor?`
Query response:	`Error string`
For example:	Send>ERR? Return> noerror.

The corresponding error codes are as follows:

Error Codes	Description
*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 Subsystem

The SAV subsystem saves all modified settings to the instrument's internal disk.

Query syntax:	SAV
Query response:	OK
For example:	Send>SAV Return> OK

13. Modbus (RTU) Communication Protocol

This chapter covers the following topics:

- Data format - understand the Modbus communication format.
- Function
- Variable area
- Function Codes

13.1 Data Format

We follow the Modbus (RTU) communication protocol. The instrument responds to the host's commands and returns a standard response frame.

See: You can contact our sales department to obtain the ONMEAS instrument communication test tool, which includes Modbus communication debugging methods. It contains CRC-16 calculator and float converter to Modbus float format.

Command Frame

Fig. 13-1 Modbus



Table 13-1 Command Frame Description

	An idle interval of at least 3.5 character times is required
Slave address	1 byte Modbus supports 00~0x63 slaves Set to 00 for global broadcast For instruments without the optional RS485 module, the default slave address is 0x01
Function Codes	1 byte 0x03: read multiple registers 0x04: =03H, not used 0x06: write single register; 10H can be used instead 0x08: echo test (for debugging only) 0x10: write multiple registers
Data	Specified register address, count and content
CRC-16	2 bytes, low byte first Cyclic Redundancy Check All data from the slave address to the end of data is calculated to obtain the CRC16 checksum
	An idle interval of at least 3.5 character times is required

13.1.2 CRC-16 Calculation

1. Set the initial value of the CRC-16 register to 0xFFFF.
2. XOR the CRC-16 register with the first byte of the message and store the result back in the CRC register.
3. Fill the MSB with 0 and shift the CRC register 1 bit to the right.
4. If the bit shifted out from the LSB is "0", repeat step (3) (process the next shift). If the bit shifted out from the LSB is "1", then XOR the CRC register with 0xA001 and store the result back in the CRC register.
5. Repeat steps (3) and (4) until 8 bits have been shifted.
6. If the message has not been fully processed, XOR the CRC register with the next byte of the message and store the result back in the CRC register, then repeat from step (3).
7. Append the calculated result (the CRC register value) to the message, starting from the low-order byte.

The following is a CRC calculation function written in VB:

```
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=CRC16LoXordata(i)'Each data byte is XORed with the CRC register
        For flag = 0 To 7
            SaveHi = CRC16Hi
            SaveLo = CRC16Lo
            CRC16Hi = CRC16Hi \ 2       'Shift high byte right by 1 bit
            CRC16Lo = CRC16Lo \ 2       'Shift low byte right by 1 bit
            If((SaveHiAnd&H1)=&H1)Then'If the last bit of the high byte is 1
                CRC16Lo = CRC16Lo Or &H80    'then shift the low byte right and fill 1 at the front
            End If              'otherwise 0 is filled automatically
            If((SaveLoAnd&H1)=&H1)Then'If LSB is 1, XOR with the 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 byte
    ReturnData(1) = CRC16Lo       'CRC low
    CRC16 = ReturnData
    End Function
```

See: Our "ONMEAS Instrument Communication Test Tool" includes Modbus communication debugging methods, including a CRC-16 calculator.

The calculated CRC-16 data must be appended to the end of the command frame, for example: 1234H:

Fig. 13-2 Modbus Frame with CRC-16 Appended



13.1.3 Response Frame

Except for commands broadcast to slave address 00H, the instrument returns a response frame for all other slave addresses.

Fig. 13-3 Normal Response Frame

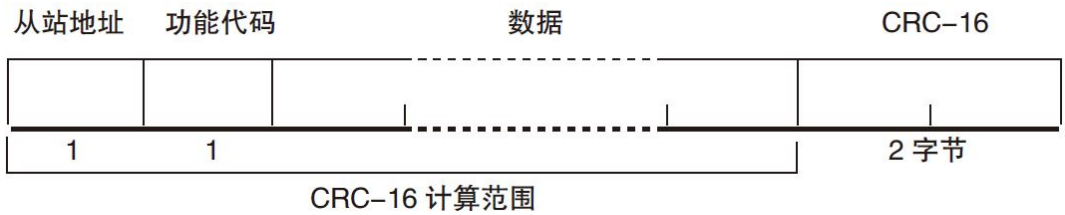


Fig. 13-4 Exception Response Frame



Table 13-2 Exception Response Frame Description

Slave address	1 byte Slave address returned as is
Function Codes	1 byte The function code of the command frame is logically ORed with BIT7 (0x80), for example: 0x03 OR 0x80 = 0x83
Error Codes	Exception code: 0x01 Function code error (function code not supported) 0x02 Register error (register does not exist) 0x03 Data error 0x04 Execution error
CRC-16	2 bytes, low byte first Cyclic Redundancy Check All data from the slave address to the end of data is calculated to obtain the CRC16 checksum

13.1.4 No Response

In the following cases, the instrument performs no processing and gives no response, causing a communication timeout.

1. Slave address error
2. Transmission error
3. CRC-16 error
4. Bit count error, for example: the total number of bits for function code 0x03 must be 8, but the received number is less than 8 or greater than 8 bytes.
5. A slave address of 0x00 is the broadcast address; the instrument does not respond.

Error Codes

Table 13-3 Error Code Description

Error Codes	Name	Description	Priority
0x01	Function code error	Function code does not exist	1
0x02	Register error	Register does not exist	2
0x03	Data error	Incorrect number of registers or bytes	3

0x04	Execution error	Invalid data: the written data is outside the allowed range	4

13.2 Function Codes

The instrument supports only the following function codes; for any other function code it responds with an error frame.

Table 13-4 Function Codes

Function Codes	Name	Description
0x03	Read Multiple Registers	Read data of multiple consecutive registers
0x04	Same as 0x03	Use 0x03 instead
0x08	Loopback Test	Received data returned as is
0x10	Write Multiple Registers	Write multiple consecutive registers

13.3 Register

The register count of the instrument is in 2-byte mode, i.e. 2 bytes must be written each time, for example: the register for speed is 0x3002 and the data is 2 bytes, value must be written as 0x0001

Data:

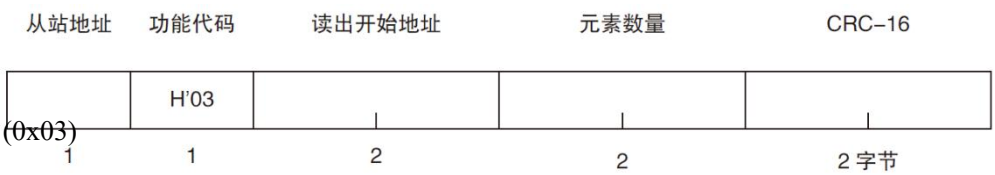
The instrument supports the following data types:

1. 1 register, double-byte (16-bit) integer, for example: 0x64→00 64
2. 2 registers, four-byte (32-bit) integer, for example: 0x12345678→12 34 5678
3. 2 registers, four-byte (32-bit) single-precision float, 3.14→4048 F5 C3

See: Our "ONMEAS Instrument Communication Test Tool" includes Modbus communication debugging methods, including a float converter.

13.4 Read Multiple Registers

Fig. 13-5 Read Multiple Registers

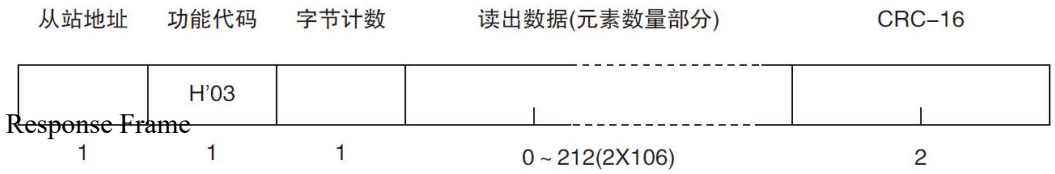


The function code for reading multiple registers is 0x03.

Table 13-5 Read Multiple Registers

Name	Name	Description
	Slave address	Defaults to 01 if no RS485 address is specified
0x03	Function Codes	
	Start Address	Register start address, refer to the Modbus Command Set
	No. of Registers to Read 0001~006A (106)	Number of registers to read consecutively. Refer to the Modbus Command Set to ensure these register addresses all exist; otherwise an error frame will be returned.
CRC-16	Checksum	

Fig. 13-6 Read Multiple Registers (0x03)



Response Frame

Name	Name	Description
	Slave address	Returned as is
0x03 or 0x83	Function Codes	No exception: 0x03 Error code: 0x83
	Number of bytes	= No. of Registers x 2 for example: 1 register returns 02
	Data	Data read
CRC-16	Checksum	

13.5 Write Multiple Registers

Fig. 13-7 Write Multiple Registers



(0x10)

Table 13-6 Write Multiple Registers

Name	Name	Description
	Slave address	Defaults to 01 if no RS485 address is specified
0x10	Function Codes	
	Start Address	Register start address, refer to the Modbus Command Set
	No. of Registers to Write 0001~0068 (104)	Number of registers to read consecutively. Refer to the Modbus Command Set to ensure these register addresses all exist; otherwise an error frame will be returned.
	Number of bytes	= No. of Registers x 2
CRC-16	Checksum	

Fig. 13-8 Write Multiple Registers (0x03)



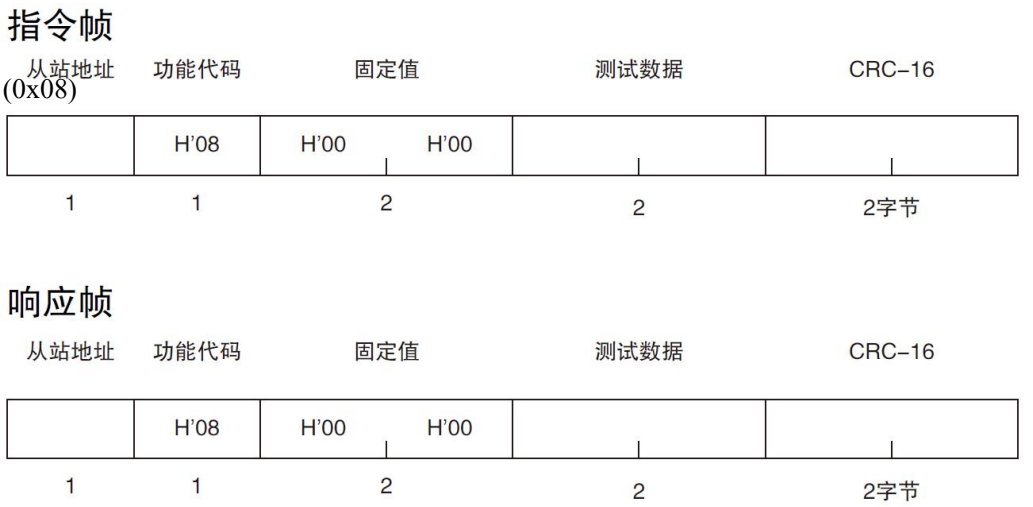
Response Frame

Name	Name	Description
	Slave address	Returned as is
0x10 or 0x90	Function Codes	No exception: 0x10 Error code: 0x90
	Start Address	
	No. of Registers	
	CRC-16 checksum	

13.6 Loopback Test

Loopback test, function code 0x08, used to debug Modbus.

Fig. 13-9 Loopback Test



Name	Name	Description
	Slave address	Returned as is
0x08	Function Codes	
	Fixed value	00 00
	Test data	Any value: e.g. 12 34
	CRC-16 checksum	

For example:

Assume the test data is 0x1234:

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) Command Set

This chapter covers the following topics:

- register address

See: Be sure to contact our sales department to obtain the ONMEAS Instrument Communication Test Tool; it includes Modbus communication debugging methods, a CRC-16 calculator and float converter to Modbus float format.

Note: unless otherwise specified, the values in the command and response frames described below are hexadecimal data.

14.1 Register Overview

The following lists all register addresses used by the instrument; any address not in the table returns error code 0x02.

Table 14-1 Register Overview

register address	Name	Value	Description
2000	Read resistance measurement byte order (DDCCBBAA)	4-byte float	read-only register, data occupies 2 registers
2002	Read voltage measurement byte order (DDCCBBAA)	4-byte float	read-only register, data occupies 2 registers
2004	Read comparator result	2-byte integer	read-only register, data occupies 1 register
2100	Read resistance measurement byte order (BBAADDCC)	4-byte float	read-only register, data occupies 2 registers
2102	Read voltage measurement byte order (BBAADDCC)	4-byte float	read-only register, data occupies 2 registers
2104	=2004		
0000	Read instrument version	4-byte ASCII	read-only register, data occupies 2 registers
3000	function register	0000: R-V 0001: R 0002: V	read/write register, 2-byte integer
3001	resistance range	0000~0006	read/write register, 2-byte integer
3002	voltage range	0000~0002	read/write register, 2-byte integer
3003	resistance range mode	0000: range auto 0001: range manual 0002: nominal range	read/write register, 2-byte integer
3004	voltage range mode	0000: range auto 0001: range manual	read/write register, 2-byte integer

		0002: nominal range	
3005	Test Speed	0000: slow 0001: medium 0002: fast 0003: extra fast	read/write register, 2-byte integer
3006	average count	0000: invalid 0001~0x0100 (1~256)	read/write register, 2-byte integer
3007	Trigger Mode	0000: internal 0001: external	read/write register, 2-byte integer
3008	Trigger delay	0000: off 0001~0x2710 (1~10000)	read/write register, 2-byte integer Unit: ms
3009	trigger edge	0000: rising edge 0001: falling edge	read/write register, 2-byte integer
300A	self-calibration	0000: off 0001: on	read/write register, 2-byte integer
300B	current mode	0000: continuous 0001: pulse	read/write register, 2-byte integer
300C	power-on file recall	0000: File 0 0001: current file	read/write register, 2-byte integer
300D	auto save	0000: forbidden 0001: allowed	read/write register, 2-byte integer
300E	system language	0000: English 0001: Simplified Chinese	read/write register, 2-byte integer
3100	resistance comparator state	0000: comparator off 0001: comparator on	read/write register, 2-byte integer
3101	voltage comparator state	0000: comparator off 0001: comparator on	read/write register, 2-byte integer
3102	resistance comparator mode	0000: SEQ 0001: PER 0002: ABS	read/write register, 2-byte integer
3103	voltage comparator mode	0000: SEQ 0001: PER 0002: ABS	read/write register, 2-byte integer
3104	beeper	0000: off 0001: PASS beep 0002: FAIL beep	read/write register, 2-byte integer
3110	resistance nominal value	4-byte float	read/write register, data occupies 2 registers
3112	voltage nominal value	4-byte float	read/write register, data occupies 2 registers
3114	resistance lower limit	4-byte float	read/write register, data occupies 2 registers
3116	resistance upper limit	4-byte float	read/write register, data occupies 2 registers
3184	voltage lower limit	4-byte float	read/write register, data occupies 2 registers

3186	voltage upper limit	4-byte float	read/write register, data occupies 2 registers
4000	save settings to current file	Fixed value: 0001	write-only register, 2-byte data
4008	Read current file data	Fixed value: 0001	write-only register, 2-byte data
4010	save settings to specified file	0000~0009	write-only register, 2-byte data
4018	Read specified file data	0000~0009	write-only register, 2-byte data
5000	zeroing register Read zeroing status	Write fixed value: 0001 Read: 0001 zeroing in progress 0000 zeroing succeeded FFFF zeroing failed	Read/Write register, data occupies 1 register Once the zeroing function is executed, write commands via Modbus are disabled; only register reads are allowed.

14.2 Reading Measurement Data

14.2.1 Reading Measurement Results

Registers 2000~2001 are used to read the instrument's resistance measurement data, byte order DDCCBBAA.
Registers 2100~2101 are used to read the instrument's resistance measurement data, byte order BBAADDCC.
Registers 2002~2003 are used to read the instrument's voltage measurement data, byte order DDCCBBAA.
Registers 2102~2103 are used to read the instrument's voltage measurement data, byte order BBAADDCC.

Command:

1	2	3	4	5	6	7	8
01	03	2000		0002		CRC-16	
Slave	Read	Register		No. of Registers		Checksum	

Response

1	2	3	4	5	6	7	8	9
01	03	bytes	Single-Precision Float				CRC-16	

- **Read resistance result:**

Send:

1	2	3	4	5	6	7	8
01	03	20	00	00	02	CF	CB
Slave	Read	Register		No. of Registers		Checksum	

Response:

1	2	3	4	5	6	7	8	9
01	03	04	4E	6E	6B	28	A3	E8
01	03	bytes	Single-Precision Float				CRC-16	

where B4~B6 are the measurement data: 4E6E6B28 represents 1E9 (low byte first)

- **Read voltage result**

Send:

1	2	3	4	5	6	7	8

01	03	20	02	00	02	6E	0B
Slave	Read	Register		No. of Registers		Checksum	

Response:

1	2	3	4	5	6	7	8	9
01	03	04	50	15	02	F9	3B	D5
01	03	bytes	Single-Precision Float				CRC-16	

where B4~B6 are measurement data: 501502F9 represents 1E10 (low order first)

- **Get resistance and voltage measurement results**
- Send:

1	2	3	4	5	6	7	8
01	03	20	02	00	04	4F	C9
Slave	Read	Register		No. of Registers		Checksum	

- Response:

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**03**	**08**	**3F**	**B1**	**69**	**A8**	**41**	**0C**	**2A**	**56**	**54**	**08**

Resistance: B4~B7: 3FB169A8 = 1.3860

Voltage: B8~B11: 410C2A56 = 8.7603

14.2.2 Reading Comparator Results [2004][2104]

Register 2004 records the comparator results for voltage and resistance; [2104] and

Example: 0x2203

16-bit storage field:

where:	BIT15~BIT12	represents voltage bin	0: VOK	1: VLO	2: VHI
	BIT11~BIT8	represents resistance bin	0: ROK	1: RLO	2: RHI
	BIT7~BIT4	Invalid			
	BIT3~BIT0	Overall PASS bin	0: RVOK	3: RVNG	

Send:

1	2	3	4	5	6	7	8
01	**03**	**21**	**04**	**00**	**01**	**CE**	**0B**
Slave	Read	Register		No. of Registers		Checksum	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**22**	**03**	**E0**	**E5**

14.3 Parameter Settings

14.3.1 Function Register [3000]

- 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		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8

01	10	30	00	00	01	AF	09
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	03	30	00	00	01	8B	0A
	Read	Register		No. of Registers		CRC	

Response:

1	2	3		4	5	6	7
01	03	02	00	00	B8	44	
		bytes		Data		CRC	

where data values:

Data	Function	Description
0000	R-V	Resistance and voltage measured simultaneously
0001	R	Resistance measurement and display only
0002	V	Voltage measurement and display only

14.3.2 Resistance Range Register [3001]

- 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		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	30	01	00	01	5F	09
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	03	30	01	00	01	DA	CA
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	03	02	00	01	79	84
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Range 0	3mΩ
0001	Range 1	30mΩ
0002	Range 2	300mΩ
0003	Range 3	3Ω
0004	Range 4	30Ω
0005	Range 5	300Ω
0006	Range 6	3kΩ

14.3.3 Voltage Range Register [3002]

- 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		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**02**	**00**	**01**	**AF**	**09**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**02**	**00**	**01**	**DA**	**CA**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**02**	**39**	**85**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Range 0	8V
0001	Range 1	80V
0002	Range 2	400V

14.3.4 Resistance Range Mode Register [3003]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**03**	**00**	**01**	**02**	**00**	**01**	**57**	**A0**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**03**	**00**	**01**	**FE**	**C9**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**03**	**00**	**01**	**7B**	**0A**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Auto range	

0001	Hold range	
0002	Nominal range	Select range according to nominal value

14.3.5 Voltage Range Mode Register [3004]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**04**	**00**	**01**	**02**	**00**	**01**	**56**	**17**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**04**	**00**	**01**	**4F**	**08**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**04**	**00**	**01**	**CA**	**CB**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Auto range	
0001	Hold range	
0002	Nominal range	Select range according to nominal value

14.3.6 Test Speed Register [3005]

- 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		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**05**	**00**	**01**	**1E**	**C8**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**05**	**00**	**01**	**9B**	**0B**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Slow	
0001	Medium	
0002	Fast	
0003	ExFast	

14.3.7 Averaging Count Register [3006]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**06**	**00**	**01**	**02**	**00**	**01**	**57**	**F5**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**06**	**00**	**01**	**EE**	**C8**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**06**	**00**	**01**	**6B**	**0B**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0001~0100	Average 0~256	Average 0 = Average 1

14.3.8 Trigger Mode Register [3007]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**07**	**00**	**01**	**02**	**00**	**01**	**56**	**24**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**06**	**00**	**01**	**BF**	**08**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**07**	**00**	**01**	**3A**	**CB**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**

		bytes	Data	CRC

where data values:

Data	Function	Description
0000	Internal trigger	
0001	External trigger	Use Trigger key, Handler Trig or remote trigger

14.3.9 Trigger Delay Register [3008]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**08**	**00**	**01**	**02**	**00**	**0A**	**56**	**24**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**08**	**00**	**01**	**BF**	**08**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**08**	**00**	**01**	**0A**	**C8**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Delay off	
0001~2710	1~0x2710 (10000)	Decimal 1ms~10000ms Unit: ms

14.3.10 Trigger Edge Register [3009]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**09**	**00**	**01**	**02**	**00**	**00**	**96**	**CA**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**09**	**00**	**01**	**DE**	**CB**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**09**	**00**	**01**	**5B**	**08**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	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**	**00**	**01**	**02**	**00**	**01**	**2E**	**CB**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0A**	**00**	**01**	**2E**	**CB**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**0A**	**00**	**01**	**AB**	**08**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		**CRC**	

where data values:

Data	Function	Description
0000	Auto calibration off	
0001	Auto calibration on	Default setting

14.3.12 Current Mode Register [300B]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0B**	**00**	**01**	**02**	**00**	**00**	**97**	**28**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0B**	**00**	**01**	**7F**	**0B**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**0B**	**00**	**01**	**FA**	**C8**

	Read	Register	No. of Registers	CRC

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Continuous current output	Default setting
0001	Pulsed current output	

14.3.13 Power-On File Recall Register [300C]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0C**	**00**	**01**	**02**	**00**	**01**	**FA**	**C8**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0C**	**00**	**01**	**CE**	**CA**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**0C**	**00**	**01**	**4B**	**09**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	File 0	Default setting
0001	Current File	

14.3.14 Auto Save [300D]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0D**	**00**	**01**	**02**	**00**	**01**	**56**	**8E**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0D**	**00**	**01**	**9F**	**0A**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**30**	**0D**	**00**	**01**	**79**	**84**

	Read	Register	No. of Registers	CRC

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Off	Default setting
0001	On	

14.4 Comparator Settings

Comparator parameter register addresses start from 3100.

14.4.1 Resistance Comparator State Register [3100]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**00**	**00**	**01**	**02**	**00**	**01**	**47**	**53**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**00**	**00**	**01**	**0F**	**35**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**31**	**00**	**00**	**01**	**8A**	**F6**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Resistance comparator off	Default setting
0001	Resistance comparator on	

14.4.2 Voltage Comparator State Register [3101]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**01**	**00**	**01**	**02**	**00**	**01**	**46**	**82**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**01**	**00**	**01**	**5E**	**F5**

		Register	No. of Registers	CRC

- Load

1	2	3	4	5	6	7	8
01	**03**	**31**	**01**	**00**	**01**	**DB**	**36**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	Voltage comparator off	Default setting
0001	Voltage comparator on	

14.4.3 Resistance Comparator Mode Register [3102]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**02**	**00**	**01**	**02**	**00**	**01**	**46**	**B1**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**02**	**00**	**01**	**AE**	**F5**
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	**03**	**31**	**02**	**00**	**01**	**2B**	**36**
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	SEQ	Direct reading value
0001	PER	Relative deviation comparison
0002	ABS	Absolute deviation comparison

14.4.4 Resistance Comparator Mode Register [3103]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**03**	**00**	**01**	**02**	**00**	**01**	**47**	**B1**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8

01	10	31	03	00	01	FF	35
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	03	31	03	00	01	7A	F6
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	03	02	00	01	79	84
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	SEQ	Direct reading value
0001	PER	Relative deviation comparison
0002	ABS	Absolute deviation comparison

14.4.5 Beeper Register [3104]

- Write

1	2	3	4	5	6	7	8	9	10	11
01	10	31	04	00	01	02	00	01	46	D7
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	04	00	01	4E	F4
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	03	31	04	00	01	CB	37
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7
01	03	02	00	01	79	84
		bytes	Data		CRC	

where data values:

Data	Function	Description
0000	OFF	Off
0001	PASS	PASS Beeper
0002	FAIL	FAIL Beeper

14.4.6 Resistance Nominal Value Register [3110]

The resistance nominal value uses 2 registers, 3110 and 3111. Note! Reading 3110 alone is invalid.

- Write

100E-3 (single-precision floating point: 0x3DCCCCCD)

1	2	3	4	5	6	7	8	9	10	11	12	13

01	10	31	10	00	02	04	3D	CC	CC	CD	F2	34
	Write	Register		No. of Registers		bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	10	00	02	4E	F1
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	03	31	10	00	02	CB	32
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	03	04	3D	CC	CC	CD	A3	35
		bytes	Data 100E-3				CRC	

14.4.7 Voltage Nominal Value Register [3112]

The resistance nominal value uses 2 registers, 3110 and 3111. Note! Reading 3110 alone is invalid.

- Write

3.6000 (single-precision floating point: 0x40666666)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	31	12	00	02	04	40	66	66	66	74	BE
	Write	Register		No. of Registers		bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	12	00	02	EF	31
		Register		No. of Registers		CRC	

- Load

1	2	3	4	5	6	7	8
01	03	31	12	00	02	6A	F2
	Read	Register		No. of Registers		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	03	04	40	66	66	66	A4	66
		bytes	Data				CRC	

14.4.8 Resistance Limit Register [3114-3117]

Resistance limits start from 3114; the lower limit uses 2 registers, the upper limit uses 2 registers, 4 registers in total.

The lower limit and upper limit can be set separately or simultaneously.

- Write

Lower limit: 1E-3, upper limit: 10E-3

1	2	3~4	5	6	7	8~11	12~15	16~17
01	10	3114	00	02	04	3A 83 12 6F	3C 23 D7 0A	01 8E
						Lower limit	Upper limit	

Response:

1	2	3	4	5	6	7	8
01	10	31	14	00	04	8F	32

- Load

1	2	3	4	5	6	7	8
01	**03**	**31**	**14**	**00**	**04**	**0A**	**F1**

Response

1	2	3~4	5~8	9~12	13~14
01	03	31 14	3A 83 12 6F	3C 23 D7 0A	51 61
			Lower limit	Upper limit	

14.4.9 Voltage Limit Register [3184-3187]

Resistance limits start from 3114; the lower limit uses 2 registers, the upper limit uses 2 registers, 4 registers in total. The lower limit and upper limit can be set separately or simultaneously.

- Write

Lower limit: 3.0000, upper limit: 4.0000

1	2	3~4	5	6	7	8~11	12~15	16~17
01	10	3184	00	02	04	40 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

- Load

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	03	31 14	40 40 00 00	40 80 00 00	51 61
			Lower limit	Upper limit	

14.5 File Operations

Since the instrument settings are stored in files, after all settings are made via Modbus commands, the data cannot be stored in the internal FlashRom in real time, which will cause the register data to revert to the values of the original file before the next power-on. Users can use the file operation registers to store all setting values to the current or a specified file. At the same time, the data of a specified file can also be loaded into the setting registers.

14.5.1 Save to Current File [4000]

Send value 0001 to register 4000, and the instrument will perform a file write operation; all settings will be saved to the current file. This register is read-protected.

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**00**	**00**	**01**	**02**	**00**	**01**	**26**	**54**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**00**	**00**	**01**	**14**	**09**
		Register		No. of Registers		CRC	

where data values:

Data	Function	Description
0001	Allowed operation	Fixed value

14.5.2 Save to Specified File [4008]

Send the file number to register 4008, and the instrument will perform a file write operation; all settings will be saved to the specified file, and the specified file will be used as the current system file. This register is read-protected.

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**08**	**00**	**01**	**02**	**00**	**09**	**26**	**DA**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**00**	**00**	**01**	**95**	**CB**
		Register		No. of Registers		CRC	

where data values:

Data	Function	Description
0000~0009	File 0~9	

14.5.3 Reload Current File [4010]

Send the fixed value 0001 to register 4010, and the instrument will load the current file data into the system. This register is read-protected.

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**10**	**00**	**01**	**02**	**00**	**01**	**24**	**C4**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**10**	**00**	**01**	**15**	**CC**
		Register		No. of Registers		CRC	

where data values:

Data	Function	Description
0001	Fixed value	

14.5.4 Load Specified File [4018]

Send the file number to register 4018, and the instrument will load the settings of the specified file into the system, and the specified file will be used as the current system file. This register is read-protected.

- Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**18**	**00**	**01**	**02**	**00**	**00**	**E4**	**4C**
	Write	Register		No. of Registers		bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**18**	**00**	**01**	**94**	**0E**
		Register		No. of Registers		CRC	

Error response:

If the file is empty, the instrument will respond with error code: 04

1	2	3	4	5
01	**90**	**04**	**4D**	**C3**
		Error Codes	**CRC**	

where data values:

Data	Function	Description
0000~0009	File 0~9	

14.6 Zeroing [5000]

Write 0001 to register 5000, and the instrument will start to perform short-circuit zeroing.
Make sure the test leads are shorted before performing zeroing, otherwise zeroing will fail.

Since the zeroing process takes a few seconds, any write operation will be ignored during this period and only read operations are allowed. After zeroing is completed, write commands are allowed normally.

During or after zeroing, the zeroing status can be obtained by reading register 5000:

0000 Zeroing successful
FFFF Zeroing failed
0001 Zeroing in progress

- Write

Write the fixed value 00 01 to register 5000
Send: 01 10 5000 0001 020001 3795
Response: 01 10 5000 0001 10C9

- Load

During zeroing, you can determine whether zeroing is complete by reading the register data
Send: 01 03 5000 0001 950A
Response: 01 03 02 FFFF B9F4
A return of FFFF indicates zeroing failed

Note:

During zeroing, try not to read the zeroing status frequently; continuous interruptions may easily cause the instrument zeroing to fail. Since the zeroing time is fixed, it is recommended that after issuing the zeroing command, the host forcibly wait until the zeroing time has elapsed before reading the zeroing status.

zero result.

14.7 Trigger and Read Data [5002~5005][5102~5105]

Registers [5002-5005] are used to trigger a measurement and return the measurement results after the measurement is complete.

Registers 5002~5003 are used to obtain the instrument resistance measurement data, byte order DDCCBBAA.
Registers 5004~2005 are used to obtain the instrument voltage measurement data, byte order BBAADDCC.

Registers 5102~5103 are used to obtain the instrument resistance measurement data, byte order DDCCBBAA.
Registers 5104~5105 are used to obtain the instrument voltage measurement data, byte order BBAADDCC.

i Important:

1. Before using this command, the trigger mode must be set to external trigger mode.
2. Only reading registers 5002 and 5102 can trigger a measurement; other registers will only read the last measurement value.

15. Specifications

You will learn the following:

Technical Specifications.

General Specifications.

Dimensions.

15.1 Technical Specifications

The following data measured under these conditions:

Temperature: 23°C±5°C

Humidity: 65% R.H.

Zero adjustment: short-circuit zero before test

Warm-up time: >60 minutes

Calibration interval: 12 months

Test current accuracy: 10%

Test current frequency accuracy: 1kHz(1±20Hz),5ppm

AC resistance specifications:

Table 15-1 Resistance Specifications

RANGE No.		0	1	2	3	4	5	6
RANGE		3mΩ	30mΩ	300mΩ	3Ω	30Ω	300Ω	3kΩ
Maximum Dispalyed Values		3.3000 m	33.000m	330.00m	3.3000	33.000	330.00	3300.0
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.±1dgt.)/°C	(±0.05% rdg. ± 0.5 dgt.)/℃					

DC voltage specifications:

Table 15-2 Voltage Specifications

RANGE No.	0	1	2
Maximum Dispalyed Values	±8.08000 (±6.06000/AT2527L)	±80.8000 (±60.6000/AT2527L)	±202.000 [AT2527A] ±404.000 [AT2527] ±808.000 [AT2527B]
	±10.0100	±100.100	±1010.000 [AT2527H] ±1550.000 [AT2527K] +2050.000 [AT2527S]
Resolution	10μV	100μV	<=810V: 1mV >810V: 10mV
ACCURACY SLOW	±0.01%rdg. ±5dgt		
ACCURACY MEDIUM	±0.01%rdg. ±7dgt		
ACCURACY FAST	±0.05%rdg. ±7dgt		
ACCURACY EX.FAST	±0.1%rdg. ±10dgt		
Temperature coefficient	(±0.001%rdg.±0.5dgt.)/°C		

15.2 General Specifications

Display: TFT-LCD true-color display, capacitive touch screen, screen size 5 inch, resolution 800x480.

Test Speed: Manual range mode:

Slow: 4 times/s

Medium: 8 times/s

Fast: 20 times/s

Extra fast: 55 times/s

Range Mode: Auto, manual and nominal

Calibration: Full-scale short-circuit zero

Test Terminal: 4-terminal measurement

Comparator: ABS,PER and SEQ

Handler: Resistance HI/IN/LO, voltage HI/IN/LO, overall FAIL bin

Beeper: Off, PASS, FAIL.

Trigger: Internal, external (manual and remote) trigger.

Interface: Handler Interface

RS232 interface, RS485 interface, USB-VCOM interface and LAN interface

Programming Languages: SCPI and Modbus (RTU)

Auxiliary: Keyboard lock

15.3 Environmental Requirements

Environment: Rating: Temperature 18°C~28°C Humidity 65% RH

Operation: Temperature 10°C~40°C Humidity 10~80% RH

Storage: Temperature 0°C~50°C Humidity 10~90% RH

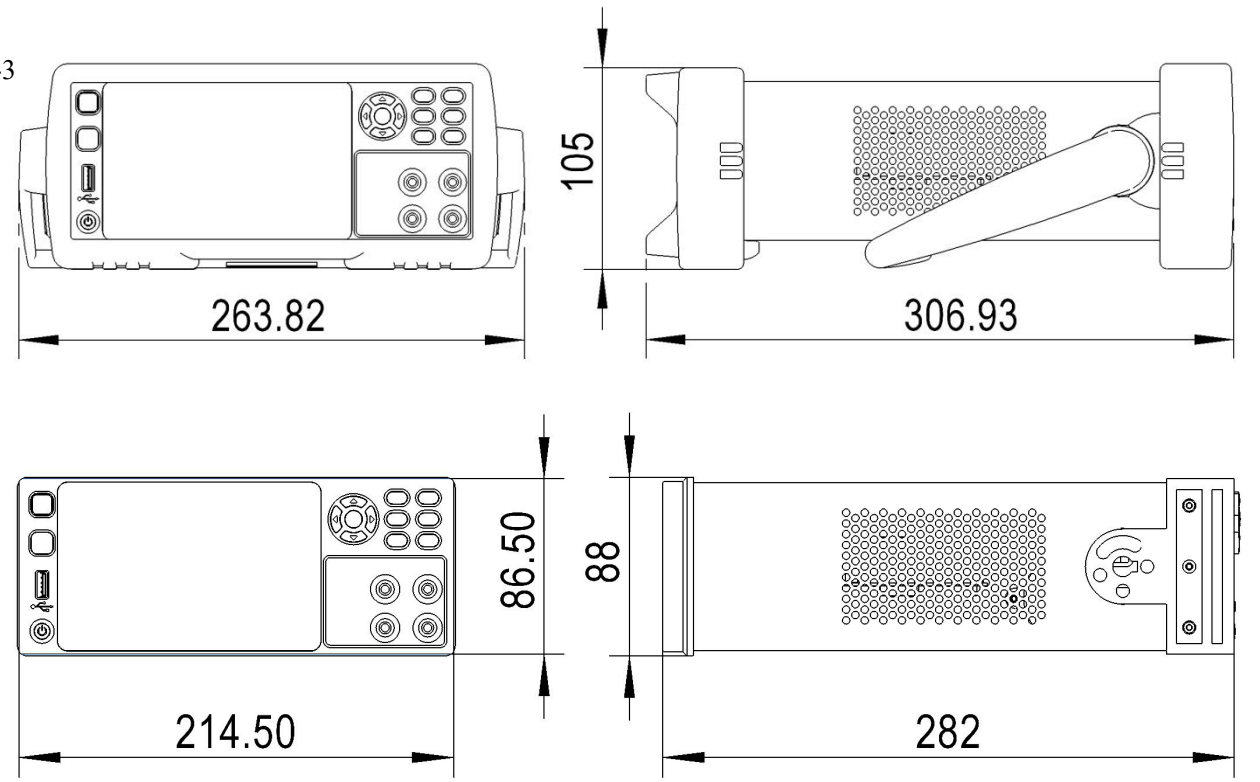
Power: 85VAC~240VAC
Fuse: 250V 1A slow-blow
Power: Max 20VA
Weight: Approx. 3.5 kg.

15.4 Dimensions

(schematic diagram)

Table Dimensions

15-3



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