ONMEAS®

Rev.B

AT517

Ultra Low DC Resistance Meter



User's Guide

Scan QR code for operation video

Safety Notice

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

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

Security Information

To avoid possible electric shock and personal safety, follow these guidelines .

Disclaimer	Before starting to use the instrument, please read the following safety information carefully. Applent Instrument will not be responsible for any personal safety and property damage caused by the user's failure to comply with the following terms.
Instrument ground	To prevent the danger of electric shock, please connect the power ground wire.
Do not use the instrument in explosive gas environment.	Do not use the instrument in a flammable and explosive gas, vapor or dusty environment. Using any electronic device in such an environment is a risk to personal safety.
Do not open the instrument housing.	Non-professional maintenance personnel should not open the instrument case in an attempt to repair the instrument. The instrument may still have undischarged charges for a period of time after it is turned off, which may cause an electric shock hazard to persons.
Do not use damaged instruments.	If the instrument has been damaged, the danger will be unpredictable. Please disconnect the power cord, do not use it again, and do not attempt to repair it yourself.
Don't use abnormal instruments.	If the instrument is not working properly and its danger is unpredictable, disconnect the power cord, do not use it, and do not attempt to repair it yourself.
Do not use the instrument beyond the way specified in this manual.	Beyond the range, the protection provided by the instrument will be invalid.

LIMITED WARRANTY AND LIMITATION OF LIABILITY

Changzhou Applent Instrument Co., Ltd. (hereinafter referred to as Applent) guarantees that every AT517 you buy is fully qualified in quality and measurement. This warranty does not cover fuses and damage caused by negligence, misuse, contamination, accidental or abnormal use. THIS WARRANTY APPLYS ONLY TO THE ORIGINAL PURCHASER AND IS NOT TRANSFERABLE.

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

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

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People's Republic of China
Jiangsu Province
Changzhou Applent Instrument Co., Ltd.
October 2009
Rev.A3

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1. Installation and Setup Wizard

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

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

1.1 Packing List

Before using the instrument, please:

1. Check the appearance of the product for damage, scratches and other undesirable phenomena;
2. Check for missing instrument accessories against the instrument packing list .

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

1.2 Power requirements

The AT517/AT517L can only be used under the following power conditions:

Voltage: 220 VAC (1±10%)

Frequency: 50Hz /60Hz (1±10%)

! Warning: To prevent the danger of electric shock, please connect the power ground wire
If the user replaces the power cord, please make sure that the ground of the power cord is securely connected.

1.3 Operating environment

AT517/AT517L must be used under the following environmental conditions:

Temperature: 0℃～ 55℃,

Humidity: less than 23℃ and 70 %RH

1.4 cleaning

To prevent electric shock hazard, unplug the power cord before cleaning.
Please use a clean cloth dipped in a little water to clean the case and panel.
Do not clean the inside of the instrument.

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

1.5 Instrument handle

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

picture 1 - 1 Instrument handle (schematic diagram, panel graphics do not match the actual)



Position 1 【Hold both sides of the handle with both hands at the same time, gently pull to both sides until it can rotate freely, and then switch to visual position 2】

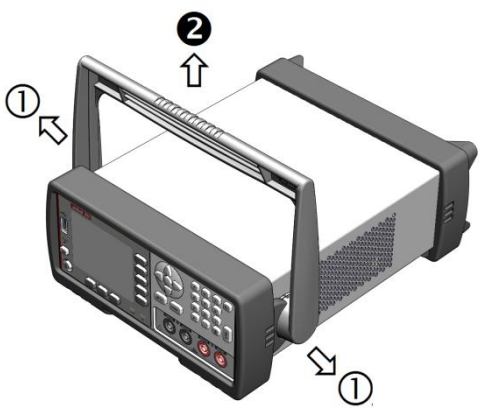
fi



Portable position



Position 2 【Hold both sides of the handle with both hands at the same time, gently pull to both sides until it can rotate freely, and then switch to the hand-held position】



Remove handle position. (Pull to the sides ① and upward ② to remove the handle.)

2. Overview

In this chapter you will learn about:

- introduction
- The main function

2.1 introduction

Thank you for purchasing the AT517/AT517L Resistance Tester .

AT517 series resistance tester is a miniature desktop instrument controlled by high-performance ARM microprocessor with automatic real-time detection . The instrument has an accuracy of 0.05% and a measurement range of 1μΩ~2MΩ. The resistance value is displayed in 6 digits, with 200,000 readings, and the measurement speed can reach 60 times /second .

The instrument has a built-in temperature compensation interface to compensate for errors caused by room temperature.

The instrument has built-in 10 -level comparator output, 6 qualified levels can be set, and the results of all levels of comparators can be output through the Handler interface.

The instrument comes standard with RS-232 interface, uses SCPI (Standard Command for Programmable Instrument Standard Command Set) and Modbus RTU protocol to communicate with computer, PLC or WINCE equipment , and efficiently completes remote control and data acquisition functions.

The instrument is equipped with a USB interface as standard , which can simplify the communication between the computer and the instrument .

The instrument comes standard with RS-485 interface, supports Modbus RTU protocol , and communicates with PLC very conveniently .



See the Specifications chapter for complete technical specifications.

2.2 The main function

2.2.1 range

AT517 uses 9 ranges to test,
AT517L uses 7 ranges to test
Range auto , manual and nominal .
Range nominal (Applent new term definition): The instrument will automatically select the best range according to the nominal value.

2.2.2 Test speed

The instrument has three speeds: slow , medium and fast .

Manual range mode:
Slow: 3 times/sec
Medium speed: 18 times /sec
Fast: 60 times/sec (AT517 only)

2.2.3 Trigger method

Internal trigger
External trigger

2.2.4 basic accuracy

Slow: <AT517> 0.05% <AT517L> 0.1%
Medium speed: <AT517> 0.1% <AT517L> 0.2%
Fast: <AT517> 0.5%

2.2.5 Calibration function

Clear "0" for full-scale short circuit: Eliminate the influence of lead resistance.

2.2.6 Bias compensation function (remove thermal electromotive force)

It can effectively remove the thermal electromotive force generated by the contact surface of different metals.

2.2.7 Comparator function (sort function)

AT517 has 6-level sorting function, AT517L has 1 set of comparator function
Compare by:
Absolute value tolerance ± TOL sorting: The absolute deviation of the measured value and the nominal value is compared with the limit of each grade.
Percentage tolerance ± TOL sorting: The percentage deviation of the measured value from the nominal value is compared with the limit of each grade.
Sorting by sequential comparison: the measured value is directly compared with the upper and lower limits

2.2.8 System settings

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

2.2.9 Interface

RS-232 interface:
Support maximum baud rate of 115200bps, compatible with SCPI protocol and Modbus RTU protocol .
USB interface :
A serial port is virtualized on the computer, which is compatible with SCPI protocol and Modbus RTU protocol .
RS-485 interface:
Supports a maximum baud rate of 115200 bps , using the Modbus RTU communication protocol.
Handler interface
Full light-coupled isolation, built-in pull-up resistor input and output ports.
Supports internal 5V and 24V external power supplies.
Input: Trigger signal
Output: qualified file (BIN1~BIN6), HI/LO, OK/NG output; measurement synchronization signal (EOC).

3. Start

In this chapter you will learn about:

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

3.1 Getting to know the front panel

3.1.1 Front Panel Description

Figure 3 - 1 Front Panel

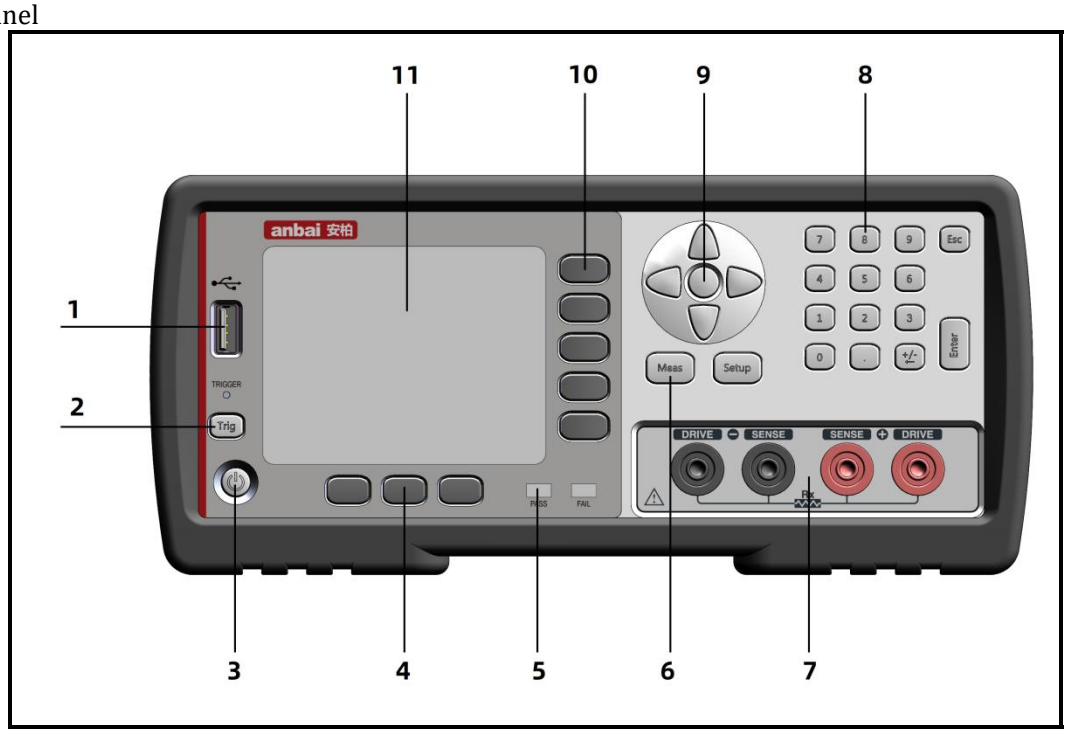
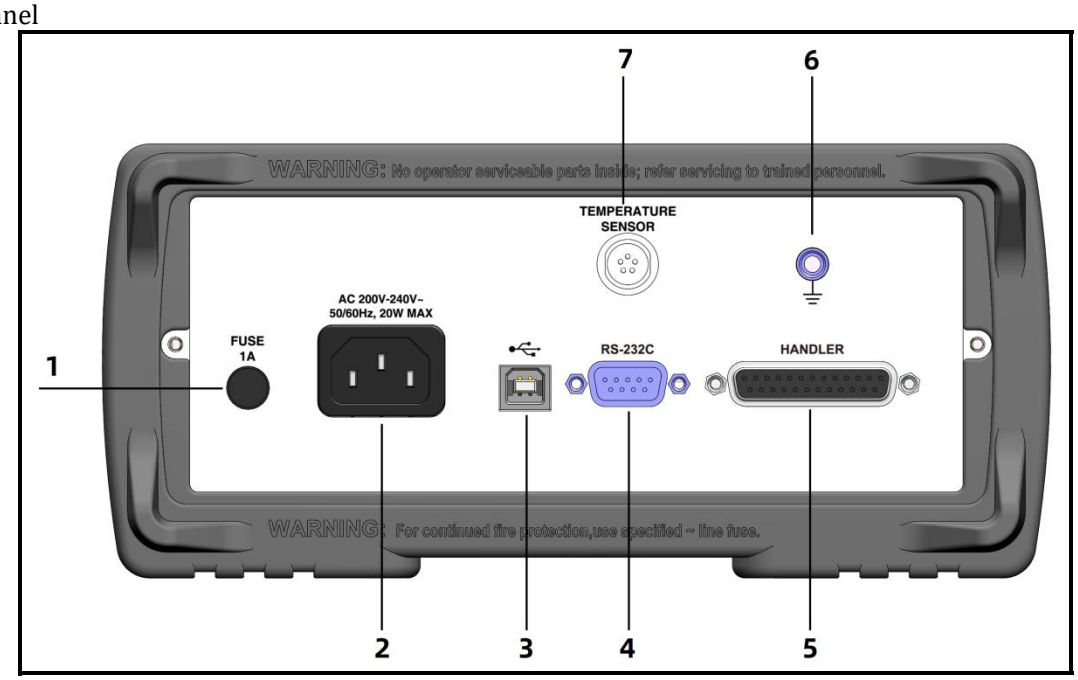


Table 3 - 1 Front panel function description

serial number	Features
1	USB disk interface
2	Manual trigger key, and manual or remote trigger indicator
3	Power switch , the orange indicator light represents the off state, and the green indicator light represents the power on
4	System function keys, including system, keyboard lock, etc.
5	function keys
6	Main function keys: measure and set
7	test end
8	Numeric keypad
9	Cursor keys
10	Function select keys
11	LCD display

3.1.2 know the rear panel

Figure 3 - 2 Rear Panel



1. Fuse 1A slow blow .
2. Voltage socket AC200V - 240V~ 50/60Hz , 20W MAX .
3. USB communication interface .
4. RS-232/RS-485 interface .
5. HANDLER interface .
6. Ground Post (GND).
7. Temperature compensation interface.

3.2 Power on

3.2.1 boot

+" at the bottom left of the panel is the power switch.
Orange light: off state
Green light : power-on status

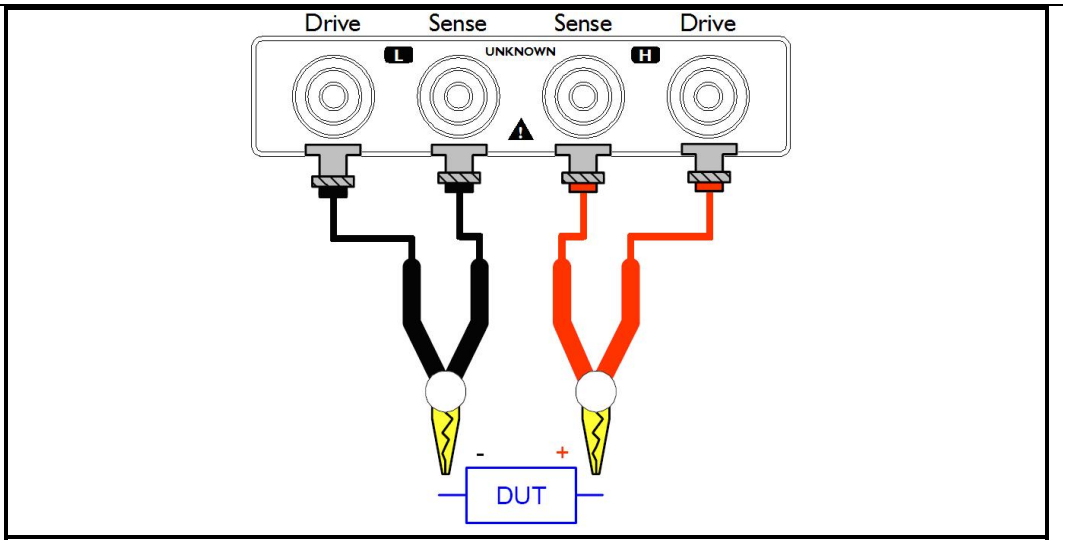
3.2.2 warm up

Warm-up time: To achieve the specified accuracy, the instrument needs to warm up for at least 15 minutes.

3.3 Test side connection

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

Insert the test cable marked in *red* into the + end, pay attention to the one-to-one correspondence between the Drive and Sense logos;
Insert the *black* mark into the - end, pay attention to the one-to-one correspondence between the Drive and Sense marks.
The red cable is the **high** end of the test end.
The black cable is the **low** end of the test end.



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

4. [Meas] Measurement main page

4.1 < Measurement display > page

Press【 Meas 】key to enter【Measurement Display】page.

The <measurement display> page mainly highlights the measurement results, and displays the current sorting results in small characters.

Six common functions can be set on this page, they include:

- Trigger - how to trigger
- Comparator - turn the comparator on or off
- Range - test range
- speed - test speed

Figure 4 - 1 <Measurement display> page



4.1.1 【Trigger】Method

Communication command: Triger:Source {INT,EXT}

The instrument has 2 trigger modes:

Internal trigger and external trigger.

Trigger method	describe
Internal	Also known as continuous test, the trigger signal is continuously tested by the instrument according to the inherent cycle.
External	External trigger includes 3 trigger modes: When a rising edge pulse is received from the Handler interface on the rear panel, the instrument performs a measurement cycle. At other times the instrument is in a waiting state. Please refer to the Handler interface. Each time the [Trig] key on the front panel is pressed, the instrument will perform a measurement cycle, and the instrument will be in a waiting state at other times. After receiving the RS232 trigger command, the instrument executes a measurement cycle, and waits for other times.

■ Steps to set the trigger method:

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

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

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

function keys	Features
internal	Internal trigger method
external	External trigger method

4.1.2 【Range】

Communication command:

FUNCtion : RANGe {<range number>,min,max}

FUNCtion : RANGe:MODE {AUTO,HOLD,NOMinal}

AT51 7 has 9 ranges, and the variation range of each range is as follows:

Table 4 - 1 Range of Variation

Range number	range	Measuring range	Rise range	drop range
0	10mΩ	0.0000mΩ ~ 22.000mΩ	↓ 20mΩ	↑ 19mΩ
1	100mΩ	20.000mΩ ~ 22 0.00mΩ	↓ 200mΩ	↑ 190mΩ
2	1Ω	20 0.00mΩ ~ 2.2 000Ω	↓ 2Ω	↑ 1.9 Ω
3	10Ω	2.0000Ω ~ 22.000Ω	↓ 2 0Ω	↑ 19Ω
4	100Ω	20.000Ω ~ 22 0.00Ω	↓ 2 00Ω	↑ 190Ω
5	1kΩ	20 0.00Ω ~ 2.2 000kΩ	↓ 2kΩ	↑ 1.9kΩ
6	10kΩ	2.0 000kΩ ~ 22.000kΩ	↓ 20kΩ	↑ 19kΩ
7	100kΩ	20.000kΩ ~ 22 0.00kΩ	↓ 200kΩ	↑ 190kΩ
8	1MΩ	20 0.00kΩ ~ 2.2 000MΩ	↓ 2MΩ	↑ 1.9MΩ

AT517L has 7 ranges, and the variation range of each range is as follows:

Table 4 - 2 Range Variation

Range number	range	Measuring range	Rise range	drop range
0	10mΩ	0.0000mΩ ~ 22.000mΩ	↓ 20mΩ	↑ 19mΩ
1	100mΩ	20.000mΩ ~2 2 0.00mΩ	↓ 200mΩ	↑ 190mΩ
2	1Ω	20 0.00mΩ ~ 2.2 000Ω	↓ 2Ω	↑ 1.9Ω
3	10Ω	2.0000Ω ~ 22.000Ω	↓ 20Ω	↑ 19Ω
4	100Ω	2 0.000Ω ~ 22 0.00Ω	↓ 200Ω	↑ 190Ω
5	1kΩ	2 0 0.00Ω ~ 2.2 000kΩ	↓ 2kΩ	↑ 1.9kΩ

There are 3 range modes:

Table 4 - 3 Test range description

Range method	describe	advantage	shortcoming
automatic	The instrument automatically selects the best test range according to the impedance value, and the range number in the range field will be automatically set.	Users do not need any involvement	Auto-ranging requires a predictive range, and the test speed will be lower than the manual-ranging method.
manual	The instrument will always use the user-specified range for testing	The test speed is the fastest.	The user needs to participate in the selection of the range
Nominal	Nominal range mode , there are 2 modes to select range: 1. During SEQ comparison , the instrument will select the best range according to the **upper limit and maximum value** of all enabled comparators . 2. When comparing Δ and Δ % , the instrument will automatically select the best range for testing according to the **nominal value .**	The best mode to sort test. The fastest speed.	Only suitable for sorting tests.

■ Steps to set the range:

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

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

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

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

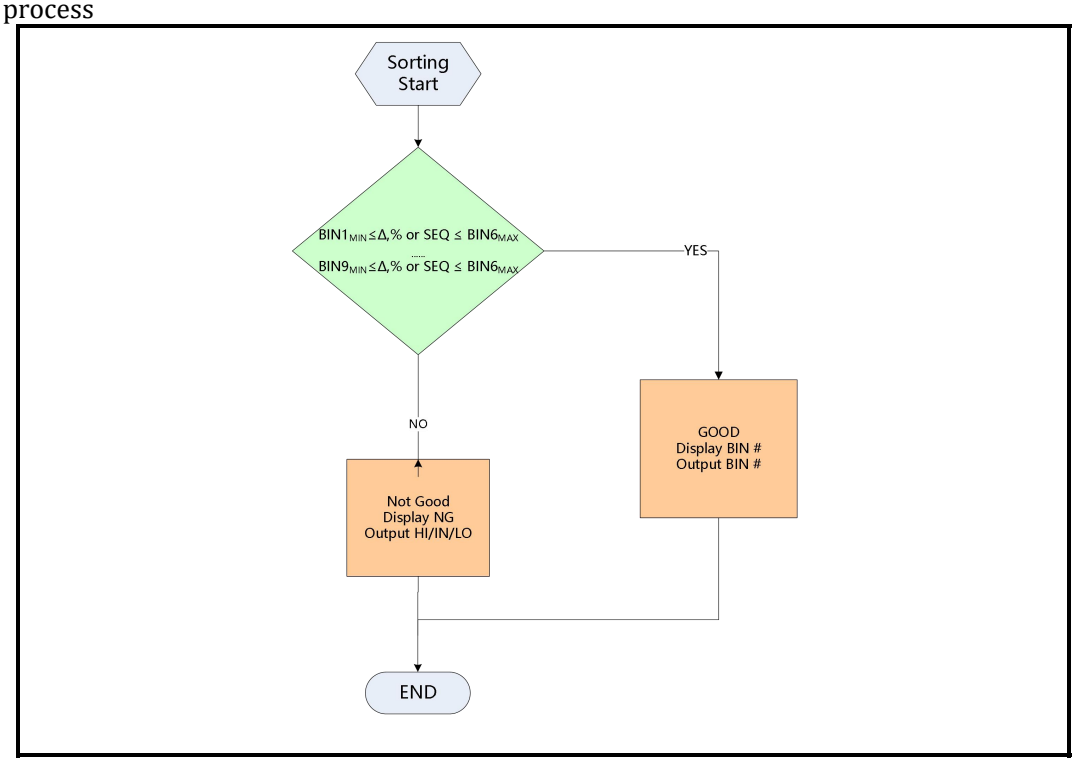
i When the range is automatic, the instrument will predict the range in each measurement cycle, so the test speed will be slightly slower than the locked range. Moreover, during automatic measurement, frequent changing of the range will cause the response to slow down. Usually, when the instrument is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

4.1.3 【Comparator】Switch

Communication command: COMParator[: STATe] {OFF, #-BIN }

The comparator function can be turned on or off through the [Comparator] switch. After the comparator is turned off, the instrument will not display the comparator result and the Handler function will be disabled.

Figure 4 - 2 Sorting process



■ To turn the comparator on or off:

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

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

Step 3 Use the function keys to select

function keys	Features
closure	The comparator is turned off and the comparator function is invalid.
Open	The comparator is turned on and the comparator function is enabled.

4.1.4 test [speed]

Communication command: FUNCtion : RATE {SLOW,MED,FAST}

The instrument provides three ways to test speed (slow, medium, fast). The slower of the speed, the more accurate and stable of the test results are. The sampling time in manual range mode is as follows:

Slow: 3 times/sec

Medium speed: 18 times/sec

Fast: 60 times/sec (AT517 only)

■ To set the test speed:

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

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

Step 3 Use the function keys to select

function keys	Features
slow	
medium speed	
fast	(AT517 only)

5. [Setup] Set the main page

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

- Measurement settings
- Temperature Compensation Settings
- Short circuit clear operation
- Comparator settings

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

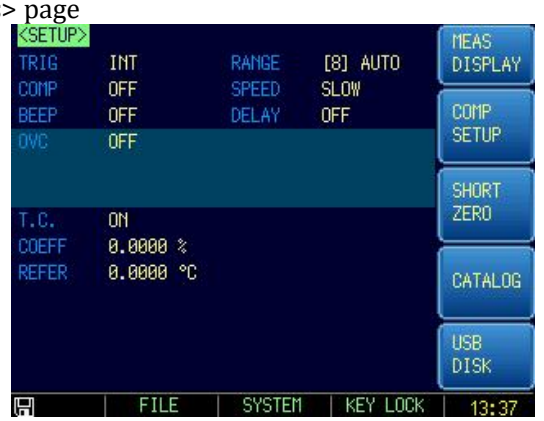
5.1 Measurement settings

All measurement-related settings are operated on the <Settings> page.
In the <Settings> page, the instrument does not perform tests.
These settings include the following parameters:

- Trigger - how to trigger
- Comparator - turn the comparator on, off
- Beeper settings
- Range - test range
- speed - test speed
- delay - Set a delay for the trigger
- Temperature Compensation - Turn temperature compensation on and off
- Temperature Coefficient - Enter the temperature coefficient
- Reference Temperature - Input Compensation Temperature

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

Figure 5 - 1 <Settings> page



5.1.1 Trigger 【Delay】

In the external trigger mode , in order to synchronize with the external device, it is sometimes necessary to set the trigger delay to ensure reliable measurement .
Trigger delay refers to the time between when the instrument receives the trigger signal and starts measuring.
The trigger delay time can be set to a maximum of 9s.

■ Enter the trigger steps:

step 1 Press【Setup】to enter the setting page;

Step 2 Use the cursor keys to select the [Delay] field;
Step 3 Use the numeric keyboard to input the desired delay time in ms and s .
For example: input 1.00 ms , after the instrument receives the trigger signal, it will start measuring after a delay of 1ms.

5.1.2 【 OVC】Bias compensation function

OVC(Offset Voltage Compensation) : Bias voltage compensation function . When dissimilar metals come into contact, a thermoelectric is formed on the contact surface, and the thermoelectric increases as the ambient temperature increases . Enabling the OVC function can effectively remove the thermoelectric force formed on the contact surface.
function is not enabled on ranges of 20Ω and above because the thermal EMF is insignificant at high ranges, and since OVC increases the measurement time .

■ Open OVC steps:

step 1 Press【Setup】to enter the setting page;
Step 2 Use the cursor keys to select the [OVC] field;
Step 3 Use the function keys to select

function keys	Features
closure	
turn on	OVC function is on

> OVC function is only available for the 20 mΩ , 200mΩ and 2Ω ranges.
> OVC function is enabled, the measurement speed will be slower in the 20 mΩ , 200mΩ and 2Ω ranges .
> OVC function is enabled, the 20 mΩ , 200mΩ and 2Ω ranges will not use the zero calibration function .

5.1.3 【Temperature Compensation】Switch

valid for AT517)

Communication command: FUNCtion : TC {ON,OFF,1,0}

The instrument has a built-in temperature compensation circuit, which can compensate for the deviation of the measured value caused by temperature.
The instrument compensation formula is as follows:

$$F2 = \frac{100 + \alpha \times (T - To)}{100} \times F1$$

To - reference temperature
T - current measured temperature
α - temperature coefficient at reference temperature (%)
F1 - Uncompensated value
F2 - value after temperature compensation

■ To turn on temperature compensation:

step 1 Press【Setup】to enter the setting page;
Step 2 Use the cursor keys to select the [Temperature Compensation] field;
Step 3 Use the function keys to select

function keys	Features
closure	
turn on	The measurement result is the value when compensated to the reference temperature

5.1.4 【Temperature coefficient】 α

Communication command: FUNCtion : TC:COEFficient <float>

Temperature compensation requires setting the temperature coefficient of the material.

■ To enter the temperature coefficient:

step 1 Press【Setup】to enter the setting page;

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

Step 3 Use the numeric keyboard to input the desired temperature coefficient, the unit of temperature coefficient is percentage.

For example: the temperature coefficient of copper is 0.393%, so enter 0.393 here.

5.1.5 【Reference temperature】T0

Communication command: FUNCtion : TC:REFEr <float>

Reference temperature for temperature compensation. The measurement results reflect the value at that temperature.

■ To enter a reference temperature:

step 1 Press【Setup】to enter the setting page;

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

Step 3 Use the numeric keypad to enter the temperature to be compensated for.

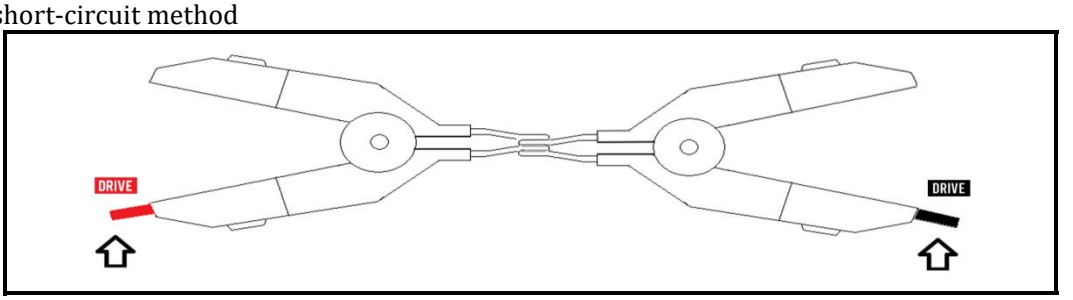
5.2 Short circuit clear

Communication command: CORRect:SHORt

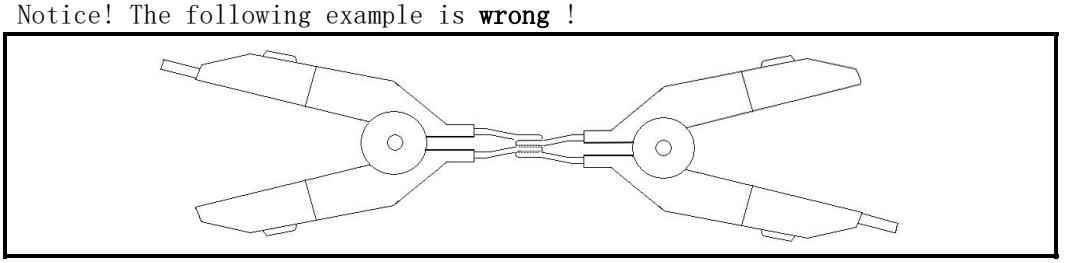
In order to achieve high precision measurement, zero calibration is necessary. Short-circuit clearing can effectively offset the stray resistance of the test leads.

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

Figure 5 - 2 Correct short-circuit method



Notice! The following example is **wrong** !



■ The method of short circuit clearing

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

Step 2 Short test clip

Step 3 Use the function keys to select the [short circuit clear] key

Step 4 After pressing [OK], the instrument starts to clear

Step 5 Return to the setting page after clearing

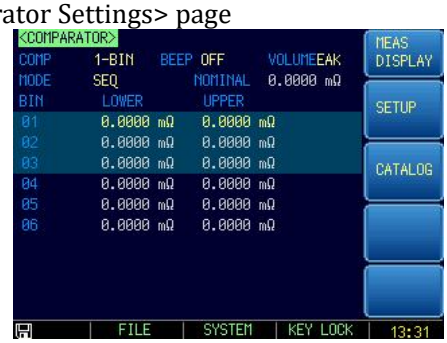
5.3 Comparator settings

Press【 Setup 】key, then press【Comparator Setup】function key to open the <Comparator Setup> page.
AT517 has comparator with 6 gears, AT517L has comparator with 1 gear.

In order to make full use of the comparator, AT51 7 also has a built-in Handler interface, which is used to output the comparison results of these files to PLC or industrial computer.
On the <Comparator> page, you can set the following:

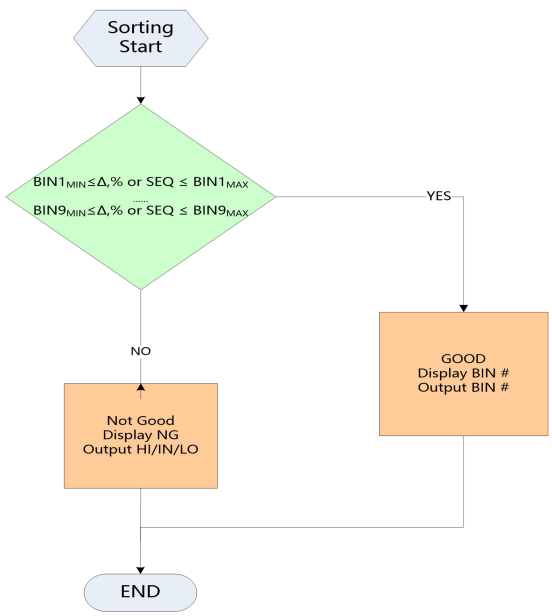
- 【Comparator】Switch
- 【Comparison】Method setting
- 【Nominal value】setting
- Enter the [upper limit] and [lower limit] data of each file

Figure 5 - 3 <Comparator Settings> page



5.3.1 Sorting process

Figure5 - 4 Sorting process



5.3.2 【Comparator】Switch

Communication command: COMParator[: STATe] {OFF,#-BIN}

■ To turn the comparator on or off:

step 1 Press【Meas】or【Setup】key to enter the corresponding page;
Step 2 Press【Comparator Setting】key to enter the <Comparator Setting> page;
Step 3 Use the cursor keys to select the 【Comparator】field;

Step 4 Use the function keys to select

function keys	Features
closure	Turn off the comparator
Open	Turn on the comparator (only AT517L display)
1 gear in total	(Only AT517 display)
2 gears in total	(Only AT517 display)
3 gears in total	(Only AT517 display)
4 gears in total	(Only AT517 display)
5 gears in total	(Only AT517 display)
6 gears in total	(Only AT517 display)

5.3.3 Compare [method]

Communication command: COMParator:MODE {ABS,PER,SEQ}

The built-in comparator of the instrument has three comparison methods:

- absolute valueΔ
- Relative value Δ%
- Direct reading value SEQ

absolute valueΔ = measured value - nominal value

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

The direct reading value SEQ comparison uses the direct reading measurement value to compare with the upper and lower limit ranges of the gear, so the nominal value does not need to be involved in the calculation.

■ To set the comparison method:

step 1 Enter the <Comparator Settings> page

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

Step 3 Use the function keys to select

function keys	Features
absolute valueΔ	Switch the comparator to absolute value comparison mode
Relative value Δ%	Switch the comparator to relative value comparison mode
Direct reading value SEQ	Switch the comparator to direct reading value comparison mode

5.3.4 【Nominal value】input

Communication command: COMParator:NOMinal <float>

The absolute value and relative value comparison method must enter the nominal value. The nominal value of the direct reading value comparison method does not participate in the operation.

In the [nominal] range mode, in the absolute value comparison and relative value comparison modes, the nominal value will participate in the range selection, so in the [nominal] range, you need to input the correct nominal

value.

■ Enter the nominal value:

step 1 Enter the <Comparator Settings> page

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

Step 3 Use the numeric keys to input data, and use the function keys to select the unit.

5.3.5 【Beep】setting

Communication command: COMParator:BEEP {OFF, PASS(OK) , FAIL(NG) }

The instrument can set a qualified beep or a non-qualified beep .

■ Beeper settings:

step 1 Enter the <Comparator Settings> page

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

Step 3 Use the function keys to select

function keys	Features
closure	Beeper off
qualified	Qualified beeper
Failed	Ineligible options

i When the instrument exceeds the limit or open circuit , the beeper will not work .

5.3.6 【Lower Limit】and 【Upper Limit】settings

Command format: COMParator:BIN <file number 1~ 6 >,<float lower limit>,<float upper limit> (AT517)

Command format: COMParator: BIN <float lower limit>,<float upper limit> (AT517L)

Each comparison mode has independent upper and lower limit values, which do not interfere with each other.

Please Δenter the absolute value of the main parameter for the "absolute value" comparison method, the unit is ohm (Ω).

Please Δenter the relative value of the main parameter for the "relative value %" comparison method, the unit is %.

Please input the direct reading value of the main parameter for the comparison method of "direct reading value SEQ", the unit is ohm (Ω).

■ Enter limit value

step 1 Go to the <Comparator> page

Step 2 Use the cursor keys to select the 【1】【Lower Limit】field;

Step 3 Input data

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

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

Step 4 Use the cursor keys to select the [1] [Upper Limit] field;

Step 5 Input data

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

The instrument has prepared independent storage space for the three comparison modes, so the comparator data in each comparison mode are independent of each other.

5.4 Temperature compensation

Press the function key 【 Temperature Compensation 】 to enter the < Temperature Compensation > page.

Figure 5-5 <Comparator setting> Page



5.4.1 【 Temperature compensation 】 switch

Communication instruction: FUNCtion:TC {ON,OFF,0,1}

The instrument has a built-in temperature compensation circuit, which can compensate the deviation of the measured value caused by temperature.

The instrument compensation formula is as follows:

$$R0 = R1 \cdot [1 + \alpha \cdot (T0 - T1)]$$

T0 — Reference temperature

T1 —Current measured room temperature

α —Temperature coefficient at reference temperature T0

R1 — Uncompensated value (measured value)

R0 — Value after temperature compensation (display value)

Example:

It is known that the measured value R1=104 Ω at 30℃ and the temperature coefficient α=3930ppm, then the resistance is at 20℃.:

$$R0 = R1 \cdot [1 + \alpha \cdot (T0 - T1)] = 104 \cdot [1 + 3930 \cdot 1e^{-6} \cdot (20 - 30)] = 99.9128\Omega$$

■ To turn on temperature compensation:

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

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

Step 3 Use function keys to select

Function key	Function
close	
Open	The measurement result is the value when compensated to the reference temperature.

5.4.2 【Temperature coefficient】 α

Communication instruction: FUNCtion:TC:COEFficient <float>

Temperature compensation needs to set the temperature coefficient of the material.

■ To input the temperature coefficient:

Step 1 Press the [Setup] key, and then press the function key [Temperature Compensation] to enter the < Temperature Compensation > page.

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

Step 3 Use the numeric keypad to enter the required temperature coefficient in ppm.。For example, the temperature coefficient of copper is 3930ppm, just enter 3930 here.

5.4.3 Reference temperature【T0】

Communication instruction: FUNCtion:TC:REFEr <float>

Reference temperature for temperature compensation. The measurement result reflects the value at this temperature.

■ To enter a reference temperature:

Step 1 Press the [Setup] key, and then press the function key [Temperature Compensation] to enter the < Temperature Compensation > page.

Step 2 Use the cursor keys to select the [T0] field.

Step 3 Use the numeric keypad to enter the temperature to be compensated.

5.4.4 【Temperature conversion】 switch

Temperature conversion (Δ t) function, according to the temperature coefficient of metal materials, calculate the corresponding temperature value under the current resistance.

$$\Delta t = \frac{R2}{R1}(k + T1) - (k + T2)$$

R2 —Current measured value
R1 —Initial resistance value
k — Reciprocal of the temperature coefficient of the measured part（0℃）
T1 — Initial temperature
T2 —Current measured room temperature

For Example:

It is known that the initial temperature is T1=20℃, the initial resistance R1=10Ω, the measured value R2=11Ω, and the room temperature T2=30℃ and 0℃. k=234.5, Then:

$$\Delta t = \frac{R2}{R1}(k + T1) - (k + T2) = \frac{11}{10}(234.5 + 20) - (234.5 + 30) = 15.45\ ℃$$

$$T = (\Delta t + T2) = 15.45 + 30 = 45.45\ ℃$$

■ To turn on temperature conversion:

Step 1 Press the [Setup] key, and then press the function key [Temperature Compensation] to enter the < Temperature Compensation > page.;

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

Step 3 Use function keys to select.

functional key	function
Close	
Open	

5.4.5 【T1】Initial temperature

Communication instruction: FUNCtion:DT:T1 <float>

Set the initial temperatureT1。

■ To input the temperature coefficient:

Step 1 Press the [Setup] key, and then press the function key [Temperature Compensation] to enter the < Temperature Compensation > page.

Step 2 Use the cursor keys to select the initial temperature [T1] field.

Step 3 Use the numeric keypad to enter the required temperature, usually 20℃.

5.4.6 【k】Reciprocal of temperature coefficient

Communication instruction: FUNCtion:DT:k <float>

Set the reciprocal of the temperature coefficient.。

$$k = \frac{1}{\alpha} - T0$$

For example, the temperature coefficient of copper at 20℃ is 3930, then At 0℃:

$$k = \frac{1}{\alpha} - T0 = \frac{1}{3930 \cdot 10^{-6}} - 20 \approx 234.5$$

■ To input the temperature coefficient:

Step 1 Press the [Setup] key and then press the function key [Temperature Compensation] to enter the < Temperature Compensation > page;

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

Step 3 Use the numeric keypad to enter the required k value, for example, k=234.5 for copper.

5.4.7 【R1】Initial resistance

Communication instruction: FUNCtion:DT:R1 <float>

Set the corresponding initial resistance at T1 temperatureR1。

■ Step of inputting initial resistance R1:

Step 1 Press the [Setup] key, and then press the function key [Temperature Compensation] to enter the < Temperature Compensation > page.;

Step 2 Use the cursor keys to select the initial resistance [R1] field.;

Step 3 Use the numeric keypad to enter.

5.4.8 Table of Temperature Coefficients of Metal Materials

Figure 5- 1Table of temperature coefficient of metallic materials

metal material	Content of related metals (%)	Material density(x10^3) [kg/m^3]	conductivity	Temperature coefficient(20℃) [ppm]
Annealed copper	Copper>99.9	8.89	1.00 ~ 1.02	3810 ~ 3970
Hard drawn copper	Copper>99.9	8.89	0.96 ~ 0.98	3370 ~ 3850
cadmium copper	cadmium: 0.7 至1.2	8.94	0.85 ~ 0.88	3340 ~ 3460
Silver copper	Silver: 0.03 至0.1	8.89	0.96 ~ 0.98	3930
Chromium copper	Chromium: 0.4 至 0.8	8.89	0.40 ~ 0.50 0.80 ~ 0.85	20 30
Corrosion resistant alloy	nickel: 2.5 to 4.0 silicon: 0.5 to 1.0		0.25 ~ 0.45	980 ~ 1770
Soft aluminum	aluminium>99.5	2.7	0.63 ~ 0.64	42

Hard drawn aluminum	aluminium>99.5	2.7	0.60 ~ 0.62	40
aluminium alloy	silicon: 0.4 ~ 0.6 magnesium: 0.4 ~ 0.5 aluminium: 99.2 ~98.9		0.50 ~ 0.55	36

5.4.9 Relationship between conductivity and temperature coefficient of copper wire

Table 5- 2 Table of Conductivity and Temperature Coefficient of Copper Wire

diameter[mm]	Conductivity of annealed copper	Conductivity of tinned annealed copper	Hard drawn copper conductivity
0.01 to 0.26	0.98	0.93	---
0.26 to 0.50	0.993	0.94	0.96
0.50 to 2.00	1.00	0.96	0.96
2.00 to 8.00	1.00	0.97	0.97

The temperature coefficient α varies with the temperature and the conductivity of the material.

For example, the temperature coefficient of a material at 20℃ is α20, and the conductivity of the material at t℃ =c, then the α of the temperature coefficient at t℃

The calculation formula is as follows:

$$\alpha = \frac{1}{\frac{1}{\alpha_{20} \cdot c} + (t - 20)}$$

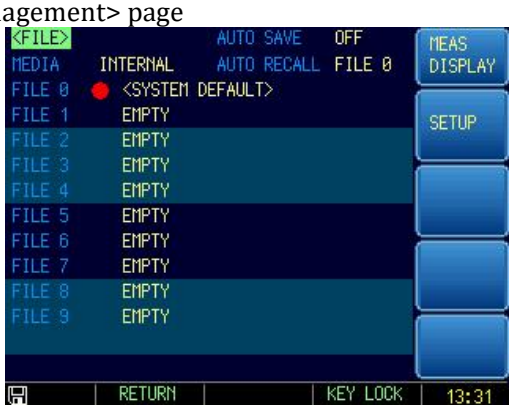
5.5 File management

Press the bottom function key [File] to enter the <File Management> page. File management allows users to save settings into 10 files for easy access at startup or when changing specifications.

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

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

Figure 5 - 6 <File Management> page



5.5.1 【Start-up call 】

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

■ Steps to set up power-on invocation:

step 1 Enter the <File Management> page
Step 2 Use the cursor keys to select the [Power-On Call] field;
Step 3 Use the function keys to select

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

5.5.2 【Auto save 】

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

■ Steps to set up auto save:

step 1 Enter the <File Management> page
Step 2 Use the cursor keys to select the [Auto Save] field;
Step 3 Use the function keys to select

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

5.5.3 【File 0】~【File 9】

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

■ Steps to set up the file:

step 1 Enter the <File Management> page
Step 2 Use the cursor keys to select the [File 0]~[File 9] fields;
Step 3 Use the function keys to select

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

5.6 U disk storage

Press【 Setup 】key, then press【U Disk Storage】function key to enter the < U Disk Storage > page.
instrument

- 【Auto-enable】-When inserting the U disk , the file is automatically opened and stored
- 【File】-Create a new file
- 【Unit of Resistance】- Units of measurement data stored in the file

Figure 5 - 7 < USB Storage > page



5.6.1 【Automatically enable】

[Auto-Enable] field is turned on , every time the U disk is inserted, it will detect whether there is a recently used file in the U disk file, if there is, it will automatically open the file and use it for recording.

■ Steps for file [Auto-enable]:

step 1 Enter the < U Disk Storage > page

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

Step 3 Use the function keys to select

function keys	Features
Open	
closure	

5.6.2 Create [new file]

Create [New File] field , used to create a new file in the U disk, the file name is user-defined.

The file format is fixed to CSV format.

■ Steps to create a [new file]:

step 1 Enter the < U Disk Storage > page

Step 2 Use the cursor keys to select the [File] field

Step 3 Use the function keys to select

function keys	Features
Create a file	A character keyboard will pop up , enter a custom file name . After the input is completed , pressing the function key [OK] will create a new file and the file name will be displayed in the list.

5.6.3 【Resistance Unit】Select

Due to the large span of measurement value units , in order to facilitate the user to post-organize the data , the stored data unit can be preset .

■ Steps to set [Resistance Unit]:

step 1 Enter the < U Disk Storage > page

Step 2 Use the cursor keys to select the [Resistance Unit] field

Step 3 Use the function keys to select

function keys	Features
automatic	The unit of measurement data is the same as the measurement result on the measurement page.
mΩ	The unit of measurement data is fixed to mΩ
Ω	The unit of measurement data is fixed to Ω

kΩ	The unit of measurement data is fixed to kΩ
MΩ	The unit of measurement data is fixed to MΩ
Scientific notation	The measurement data format is scientific notation, in the form of decimal + exponent, and the unit is Ω

5.6.4 【File】Select

step 1 Enter the < U Disk Storage > page

Step 2 Use [Next Page] or [Previous Page] Use the function keys to select the pages of 【File 0】~【File 9】
Or【File 10 】~【File 19 】page

Step 3 Use the cursor keys to select the [File 0]~[File19] fields;

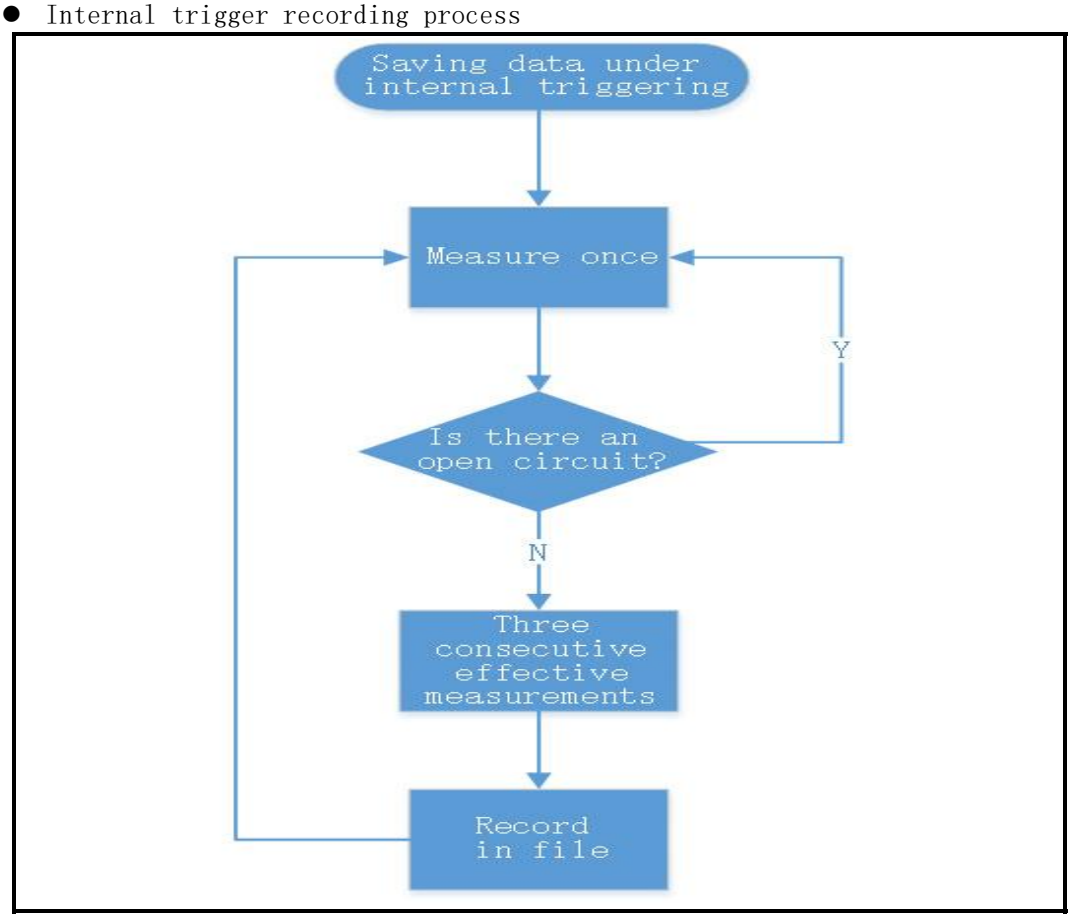
Step 4 Use the function keys to select

function keys	Features
Open	Open this file for data storage
closure	close this file
delete	Delete this file, the stored data will be cleared, and the file will not be recovered after deletion.

5.6.5 U disk data storage mechanism

Internal triggering and external triggering differ in how files store data.

- Internal trigger recording process



- External trigger recording

Under external triggering , the circuit status will not be distinguished . When a trigger signal or trigger command is received , the data will be stored in a file .

6. System Configuration

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

- System Configuration Page
- system information page
- System service page

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

6.1 System Configuration Page

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

The System Configuration page includes the following settings:

- LANGUAGE
- Date/Time Settings
- Account Settings
- Key tone setting
- 【Communication Protocol】Select
- 【Baud rate】setting
- RS485 station number selection
- Communication [command handshake] switch
- Communication [result sending] method
- S CPI 【Terminator】setting

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

Figure 6 - 1 <System Configuration> page



6.1.1 theme style

Instruments are available in 2 styles: classic and modern.

Classic style : dominated by a blue background .

Modern style : dominated by a black background .

■ To choose a theme style

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select [Theme Style] .

Step 3 Use the function keys to select:

function keys	Features
classic	
modern	

6.1.2 Change the system language [LANGUAGE]

Communication command: SYSTem:LANGuage {ENGLISH,CHINESE,EN,CN}

The instrument supports both Chinese and English languages.

■ Steps to change the language

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to select the language:

function keys	Features
Chinese [CHN]	
ENGLISH	English

6.1.3 Modified date and time

The instrument uses a 24-hour clock.

■ Change date:

step 1 Go to the <System Configuration> page

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

Step 3 To set the date using the function keys:

function keys	Features
Year+	+1 year
year-	-1 year
month+	+1 month
moon-	- January
day+	+1 day
day-	-1 day

■ Change the clock:

step 1 Go to the <System Configuration> page

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

Step 3 To set the clock using the function keys:

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

6.1.4 Account Settings

The instrument has two user modes to choose from:

- Administrator - Except the [System Services] page, other functions are open to the administrator, and the parameters set by the administrator are saved in the system memory after a delay of 5 seconds, which is convenient for

loading after the next boot.

- User - Except the [System Services] and [File] pages, users can operate other functions. The data modified by the user will be restored to the value set by the administrator after the next boot.

■ Change account:

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to change:

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

■ Administrator password settings:

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to select:

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

6.1.5 【Key tone】setting

The key tone of the instrument can be turned off.

■ Set key tone

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to select

function keys	Features
closure	
Open	

6.1.6 【Communication Protocol】Select

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

Select communication protocol:

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to select

function keys	Features
SCPI _	
Modbus _	

6.1.7 RS 485 [Station No.] selection

If the Modbus (RTU) protocol is used, be sure to set the station number address of the machine .
This station number can also be used for SCPI communication protocol for multi-machine communication.

> Tip: Using the SCPI communication protocol extended by Applent Instruments, it is also possible to carry out multi-machine communication. At the beginning of each line of instructions, add addr #; : The subsystem can select the slave .
> For example : addr 02 ; :fetch? ΔRepresents fetching data from the slave of station number 2.

Select RS 485 station number:

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to select

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

Under the Modbus protocol , in order to facilitate the simultaneous operation of multiple identical instruments , the instrument is allowed to use station number 00 for broadcast communication, and station number 00 for communication, the instrument only receives commands and does not return response codes.

6.1.8 【Baud rate】setting

The instrument has a built-in RS-232 interface. After the instrument senses that the RS-232 interface has signal conversion, it immediately communicates with the host at the set baud rate, and the keyboard is locked at the same time.
In order to communicate correctly, please confirm that the baud rate is set correctly. If the baud rate of the host computer and the instrument is different, the correct communication will not be possible.
The instrument RS-232 /USB/RS-485 configuration is as follows:

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

Set the baud rate:

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to select

function keys	Features
9600	
19200	Modbus communicates with the host, it is recommended to use this baud rate
38400	
57600	
115200	SCPI communicates with the computer host, it is recommended that you use this high-speed baud rate.

6.1.9 Communication [command handshake] switch

This function is only valid for SCPI protocol .

The instrument supports SCPI command handshake.

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

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

Steps to set up the command handshake:

step 1 Go to the <System Configuration> page

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

Step 3 Use the function keys to select

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

6.1.10 [Upload] method of measurement results

Communication command: SYSTem: UPLOAD {FETCH,AUTO}

This function is only valid for SCPI protocol .

The instrument supports the function of automatically sending data to the host. Data will be automatically sent to the host after each test, without the need for the host to send a FETCH? instruction.

The instrument sends the test results and comparator results to the host after each test, the format is as follows:

+9.9651e+01, BIN1

+ 1.0000 e +20 , BIN0

Where +1.0000e+20 means overflow or open circuit

BIN0 means fail or comparator off.

Steps to set [Result Send]:

step 1 Go to the <System Configuration> page

Step 2 Use the cursor keys to select the 【Result Send】field;
Step 3 Use the function keys to select

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

6.1.11 S CPI [terminator] switch

This function is only valid for SCPI protocol .
The instrument supports SCPI command terminator setting.
It can be used when the host computer sends the command, or it can be used without the terminator, and the instrument can receive and parse it.
When the instrument sends the response result to the upper computer , the set terminator will always be sent at the end .

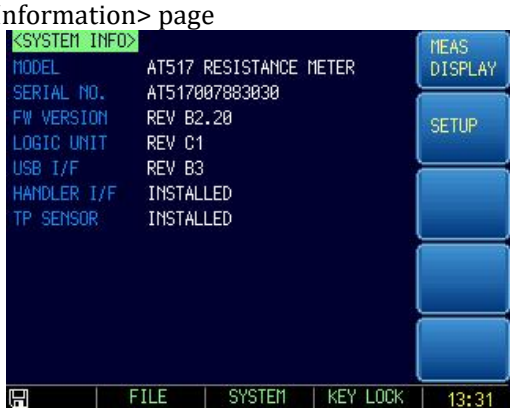
Steps to set the terminator:
step 1 Go to the <System Configuration> page
Step 2 Use the cursor keys to select the [Terminator] field;
Step 3 Use the function keys to select

function keys	Features
LF(0x0A)	L F: Line feed , ASCII code : 0x 0A
CR (0x0D)	CR: carriage return , ASCII code : 0x 0D
CR+ LF	
NUL (0x00)	N UL: Null character , ASCII code : 0x 00

6.2 System information page

Press [Meas] or [Setup] to enter the main page, press the [System] key in the bottom task bar to enter the <System Configuration> page, and press the function key to select [System Information].
The system information page has no user-configurable options.

Figure 6 - 2 <System Information> page



7. Handler interface <AT517 >

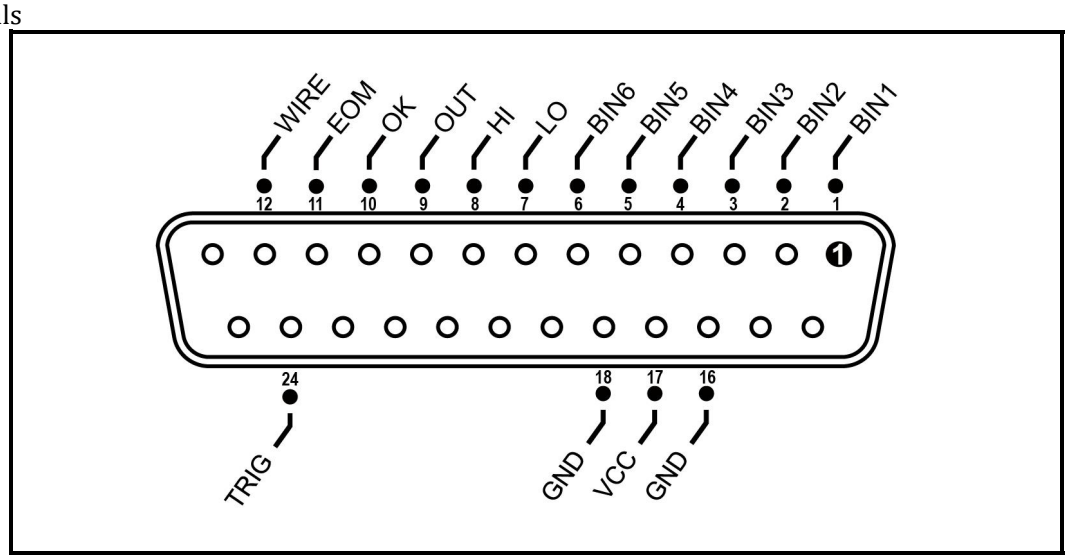
You will learn the following:

- Terminals
- How to connect and interface the schematic

The processor interface is only available for AT517 .
The instrument provides users with a fully functional processor interface, which includes 6 levels of qualified sorting output, 10 levels of output such as HI/LO, P ASS /FAIL, E OM test completion signal output and TRIG (external trigger start) Input and other signals. Through this interface, the instrument can easily complete the automatic control function with the user's system control components.

7.1 Terminals and Signals

Figure 7 - 1 Terminals



■ Output (all signals are active low)

Table 7 - 1 Output pin definition

pin	name	illustrate
1	BIN1	0: OK
2	BIN 2	0: OK
3	BIN3	0: OK
4	BIN4	0: OK
5	BIN5	0: OK
6	BIN6	0: OK
7	LO	0: LOW
8	HI	0: HIGH
11	OUT	0: NG
12	OK	0: OK

13	EOM	0: READY 1: MEAS

■ input

surface 7 - 2 input pin definition

pin	name	illustrate
twenty four	trigger input	Trigger input, built-in 0.25W, 499 Ω current limiting resistor. rising edge.

■ power supply

Table 7 - 3 power supply pin definition

pin	name	illustrate
16,18	GND	common ground
17	Internal VCC	Positive terminal of internal VCC power supply, internal isolated power supply power: 5V, 0.5A , 2.5WMAX If you don't need to use the internal power supply , please leave this terminal floating .

7.2 Connection method

■ Use an external power supply (recommended)

Please connect the external power GND to the following pins:

GND: 16 or 18 pins

Internal Power 17 : Floating.

■ Use internal power



In the case of unknown or uncertain power, the internal power supply **cannot be** used, otherwise the meter will not work properly.

In known low-power applications, you can use the internal power supply to work, but may make the instrument less immune to interference.

Internal power supply: 5V 0.5 A max.

Using the internal power supply, connect the following pins at the same time:

VCC (5V): 17 feet

GND: 16 or 1 8 pins

■ Electrical parameters

Output signal: Collector output with built-in pull-up resistor. optocoupler isolation. Active low.

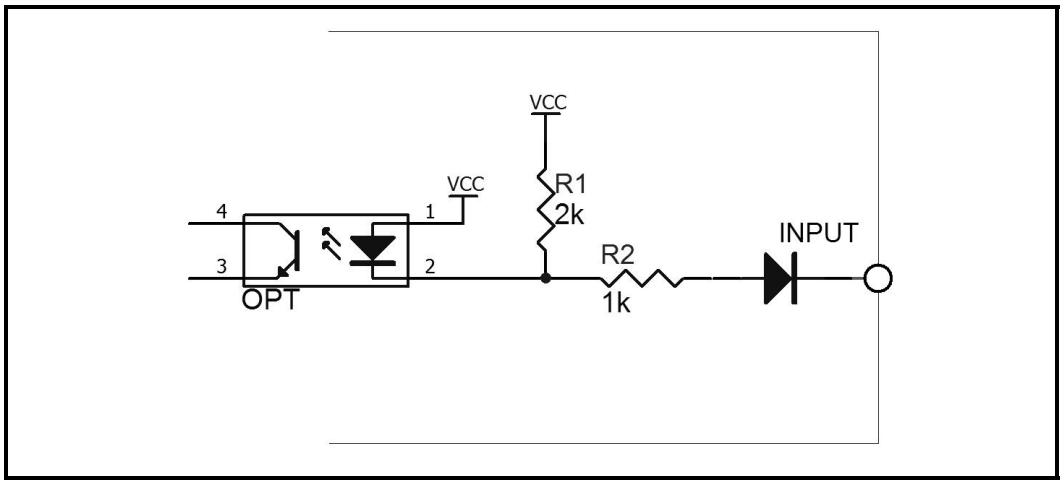
Maximum voltage: External supply voltage.

Input signal: optocoupler isolation. Active low.

Maximum current: 50mA

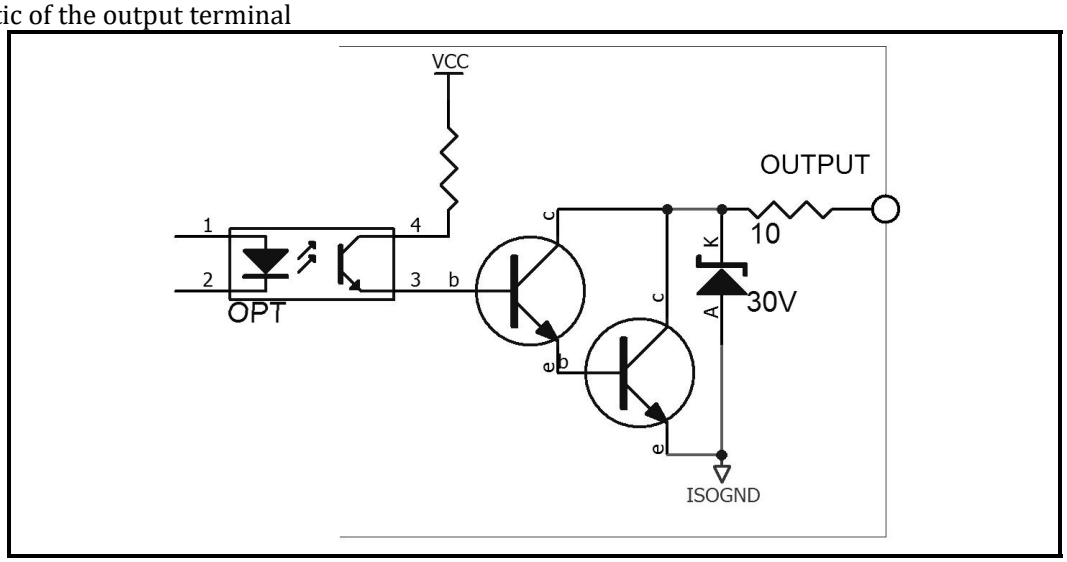
7.2.1 Input Schematic

Figure 7 - 2 Input schematic diagram (Trig)



7.2.2 Schematic of the output terminal

Figure 7 - 3 Schematic of the output terminal



7.2.3 Input circuit connection method

Figure 7 - 4 connection to switch

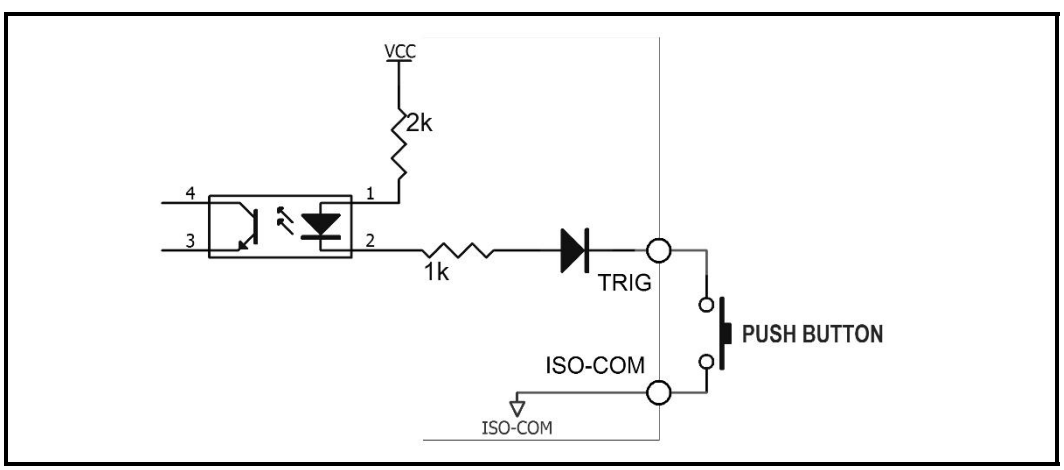


Figure 7 - 5 Use relay control

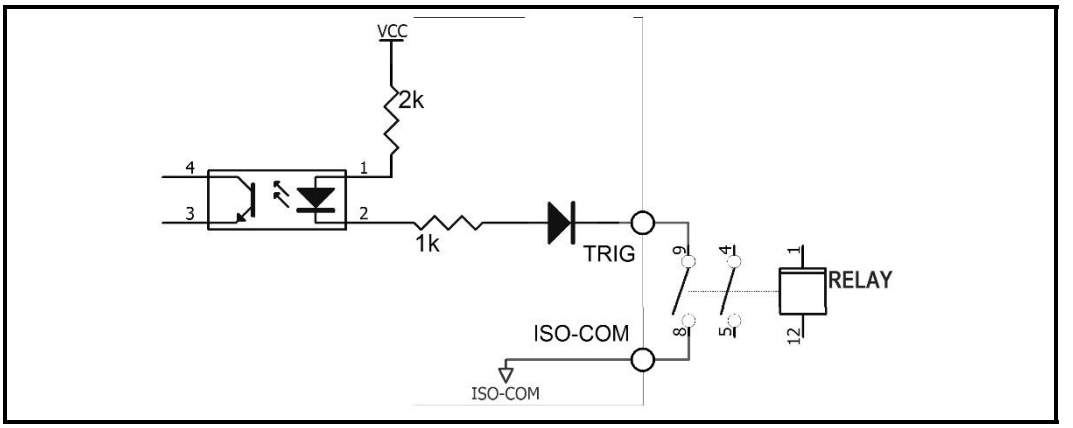


Figure 7 - 6 Use PLC negative common terminal to control

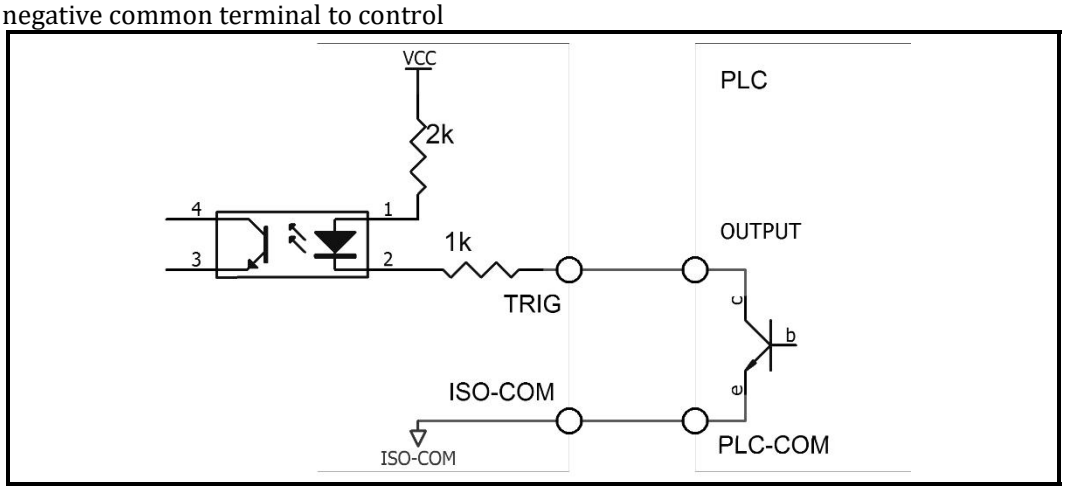
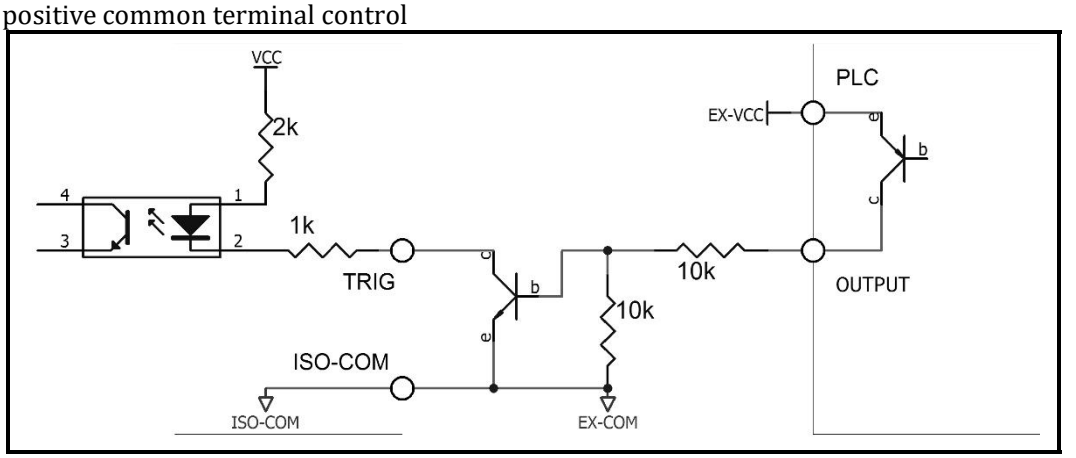


Figure 7 - 7 Use PLC positive common terminal control



7.2.4 Output circuit connection

Figure 7 - 8 control relay

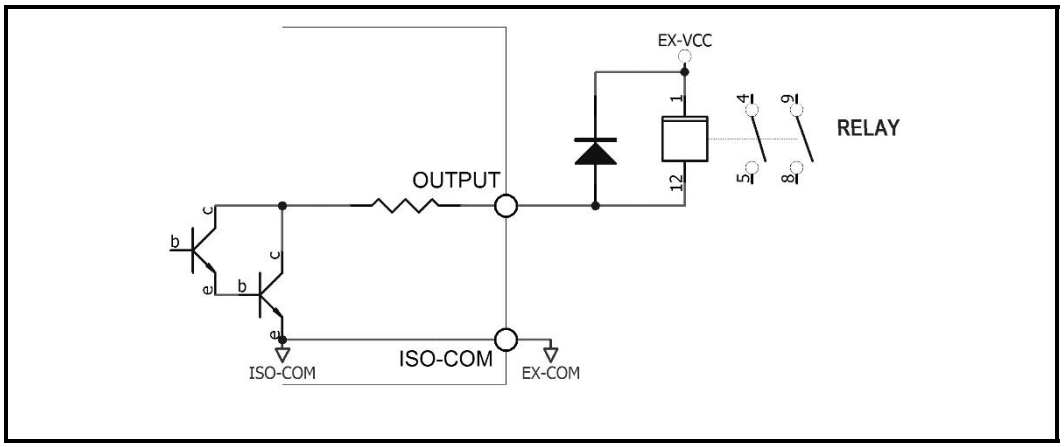


Figure 7 - 9 Control LEDs or optocouplers

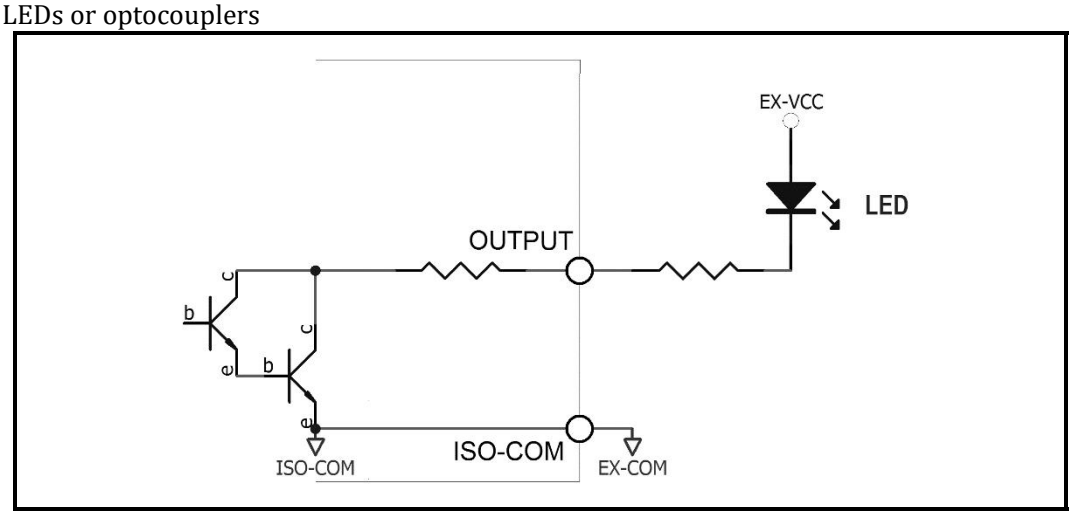


Figure 7 - 10 Negative logic output

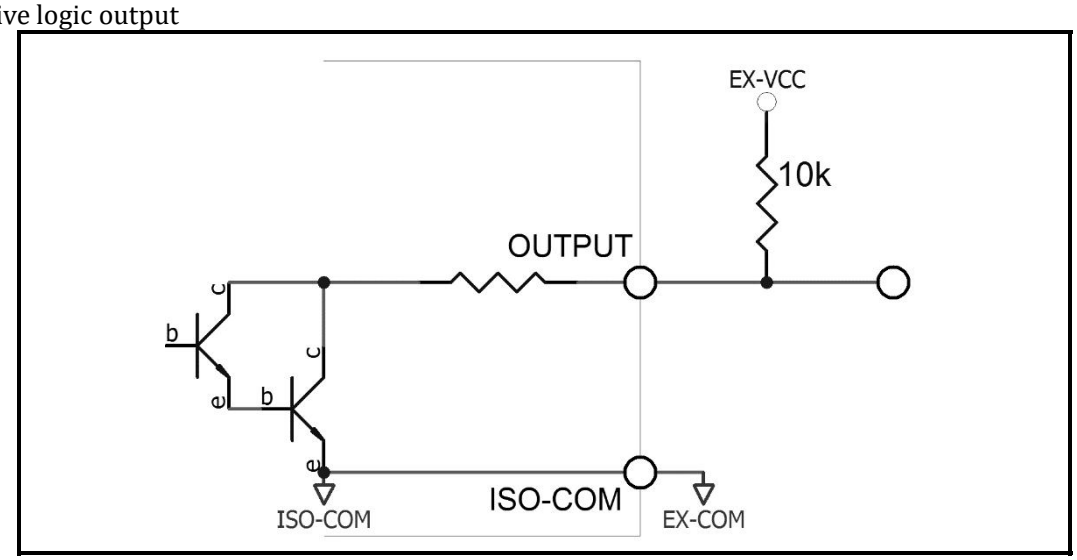


Figure 7 - 11 Dual-port outputs form a logical OR circuit

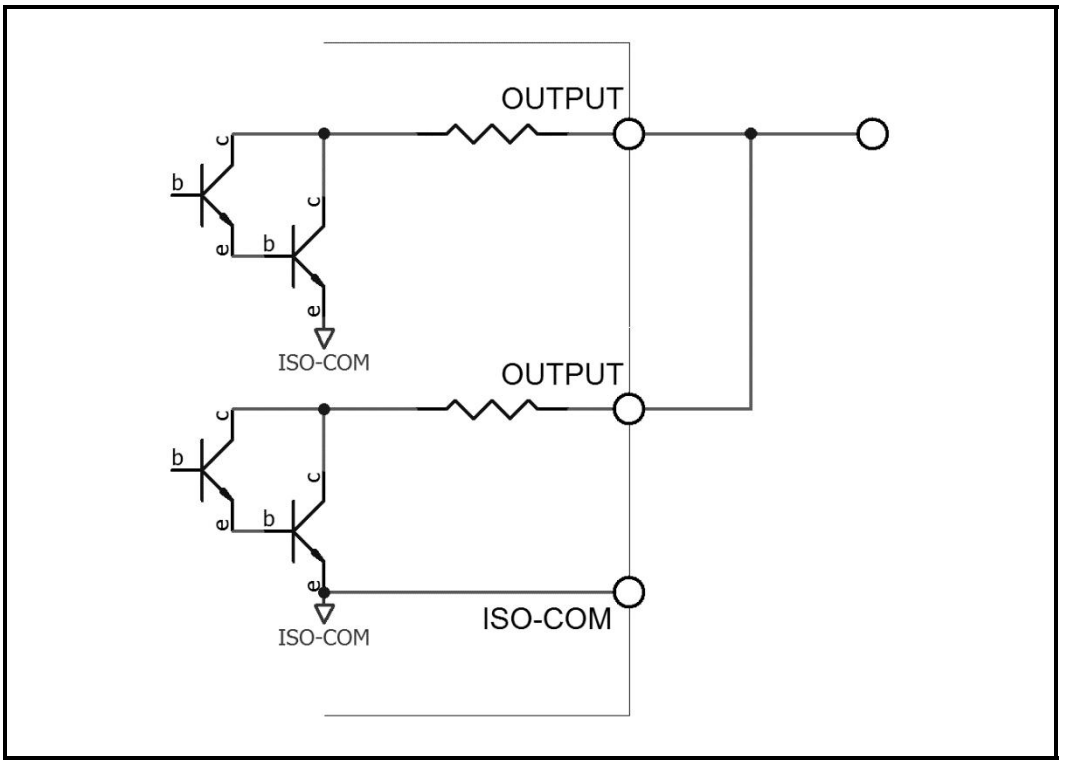


Figure 7 - 12 Output to PLC negative common terminal

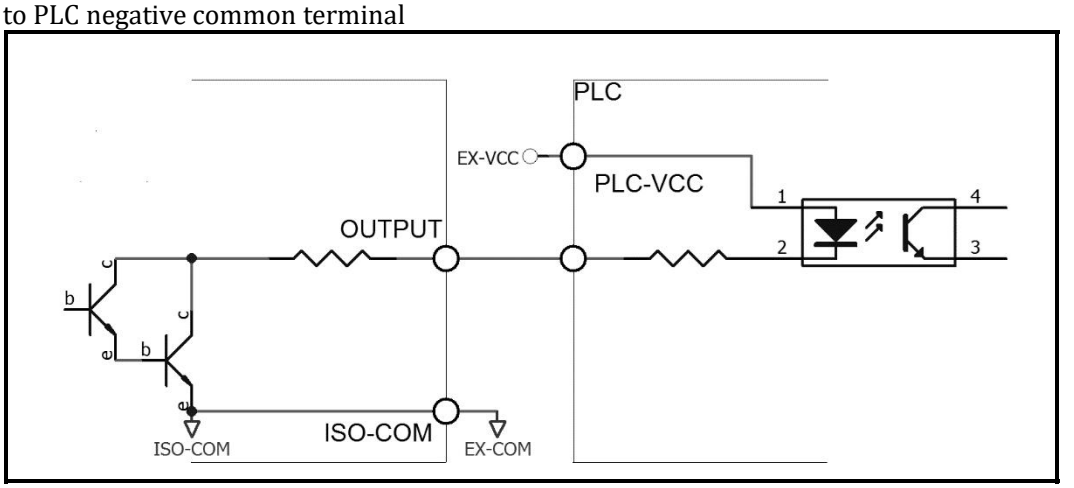
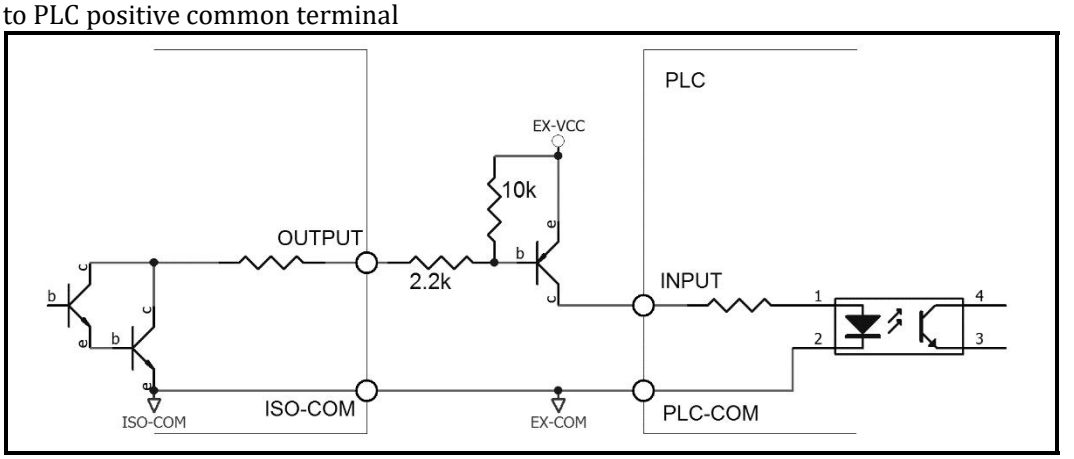


Figure 7 - 13 Output to PLC positive common terminal



7.3 Periodic Table

Figure 7 - 14 Periodic Table

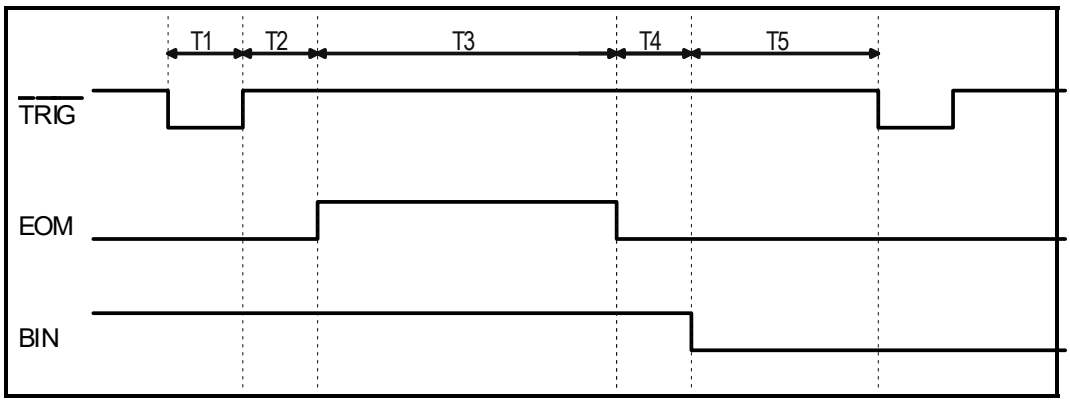


Table 7 - 4 schedule

describe			minimum
T1	Trigger pulse width		1ms
T2	Measurement period	Trigger delay	< 10 μs
T3		measure time	Related to settings
T4		BIN output delay	200 μs
T5	wait time after trigger		0 s

8. Remote Communication

You will learn the following:

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

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

8.1 RS-232C

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

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

Table 8 - 1 Commonly used RS-232 signals

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

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

Table 8 - 2 Smallest subset of RS-232 standard

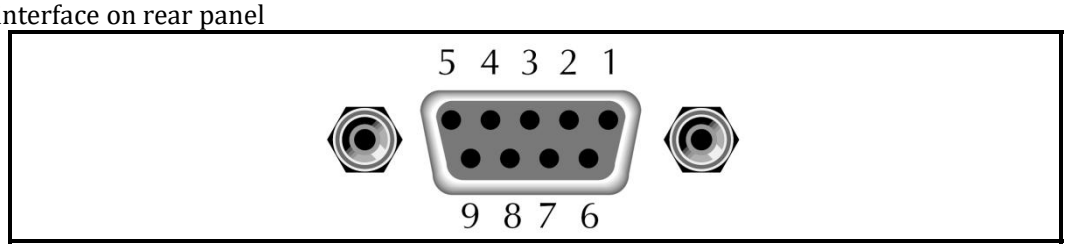
Signal	symbol	9-pin connector pin number
send data	TXD	2
Receive data	RXD	3
ground	GND	5

8.1.1 RS 232Cconnection

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

NOTE: The instrument cannot use a null modem cable.
You can make or purchase a 9-conductor straight- through cable from Applent Instrument Format.
User-made 3-wire cables should pay attention to:
• Use the DB9 port that comes with the PC, it may be necessary to short-circuit the 4-6, 7-8 of the DB-9 connector (pin) on the computer side

Figure 8 - 1 RS-232 interface on rear panel



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

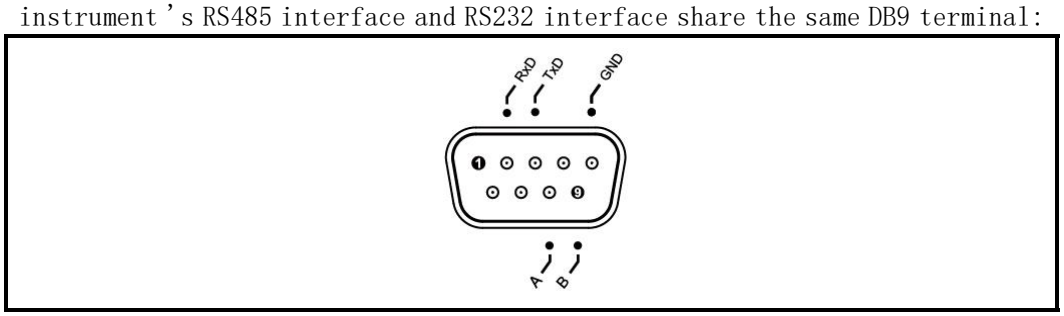
■ Instrument default communication settings:
Transmission mode: full-duplex asynchronous communication with start bit and stop bit
Data bits: 8 bits
Stop bit: 1 bit
Check Digit: None

8.2 RS 485 connection

Since the instrument version D7.30 , the instrument comes standard with RS485 interface and supports ModBus RTU protocol at the same time .

RS 485 is a communication interface that supports multi-machine communication, which can be connected in parallel with multiple slave machines through one host .
detailed RS485 specification is not the focus of this user manual, please refer to
https://en.wikipedia.org/wiki/RS-485

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



pin	Features
8	A
9	B

8.3 handshake protocol

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

- The instrument command parser only accepts ASCII format, and the command response also returns ASCII code.
- The command string sent by the host must end with NL (’ \n ’), and the instrument command parser will start executing the command string after receiving the terminator.
- The instrument can set the command handshake: after receiving a character, the instrument immediately sends the character back to the host, and the host can only send the next character after receiving the echo character.

If the host cannot receive the data returned by the instrument, you can try to solve it by using the following methods:

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

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

8.4 SCPI language

SCPI-Standard Commands for Programmable Instruments (Programmable Instrument Standard Commands) is a general command set used by Applent Instruments for testing instruments. SCPI, also known as TMSL-Test and Measurement System Language (Test System Language), was developed by Agilent Technologies based on IEEE488.2 extensions and has been widely adopted by test equipment manufacturers.

The built-in command parser of the instrument is responsible for parsing various command formats of the user. Since the command parser is based on the SCPI protocol, but is not fully SCPI compliant, please read the "SCPI Command Reference" chapter carefully before starting work.

9. S CPI Command Reference

This chapter covers the following areas :

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

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

9.1 command string parsing

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

E.g: Valid command strings:

AAA:BBB CCC;DDD EEE;:FFF

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

9.1.1 Command Parsing Rules

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

9.1.2 Notational Conventions and Definitions

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

<> The text in angle brackets indicates the parameters of the command

[ ] Text in square brackets indicates optional commands

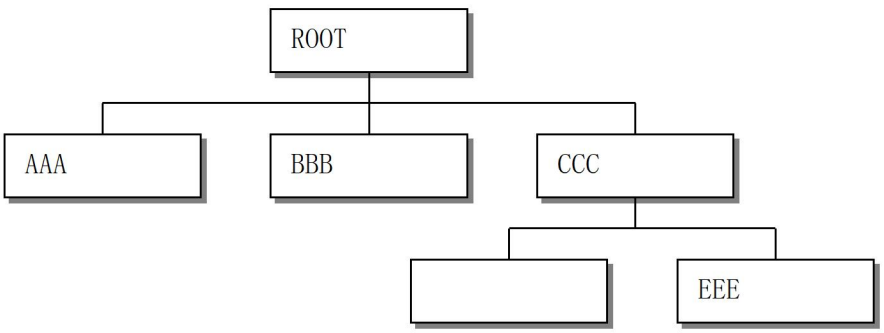
{} When braces contain several parameter items, it means that only one item can be selected.

( ) The abbreviated form of the parameter is enclosed in parentheses. Abbreviated form of uppercase command.

9.1.3 command tree structure

The tree structure for SCPI commands can go down to three levels (note: the command parser of this instrument can parse down to any level) , where the highest level is called subsystem command. Subordinate commands are valid only if a subsystem command is selected . SCPI uses a colon (:) to separate high-level and low -level commands.

Figure 9 - 1 Command tree structure



for example

ROOT:CCC:DDD ppp

ROOT subsystem command

CCC Level 2

DDD Level 3

ppp parameter

9.2 Commands and Parameters

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

For example

AAA:BBB 1.234

command [parameters]

9.2.1 Order

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

9.2.2 parameter

1. Single command word command, no parameters.

   For example: AAA:BBB

2. Arguments can be strings, and their abbreviation rules still follow the "Command Abbreviation Rules" in the previous section.

   Such as: AAA:BBB 1.23

3. Arguments can be in numeric form

   < *integer* > integer 123, +123, -123

< float > float

<fixfloat>: Fixed-point float: 1.23, -1.23

<Sciload>: Scientific floating point number: 1.23E+4, +1.23e-4

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

Table 9 - 1 magnification abbreviation

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

The magnification is not case-sensitive and is written differently from the standard name.

9.2.3 delimiter

Instrument command parsers only accept allowed delimiters, other delimiter command parsers will generate an "Invalid separator" error. These delimiters include:

; semicolon, used to separate two commands.

For example: AAA:BBB 100.0 ; CCC:DDD

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

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

? Question mark, used for query.

For example: AAA ?

□ Space, used to separate parameters.

For example: AAA:BBB□1.234

9.2.4 error code

The corresponding error codes are as follows:

error code	illustrate	
*E00	No error	no errors
*E01	Bad command	command error
*E02	Parameter error	Parameter error
*E03	Missing parameter	Missing parameters
*E04	buffer overrun	buffer overflow
*E05	Syntax error	Grammatical errors
*E06	Invalid separator	illegal delimiter
*E07	Invalid multiplier	Illegal Multiplier Unit

*E08	Numeric data error	Numerical error
*E09	Value too long	number is too long
*E10	Invalid command	invalid instruction
*E11	Unknown error	unknown mistake

9.3 Command Reference

All commands are explained in subsystem command order, all subsystems are listed below

- DISPlay display subsystem
- FUNCtion functional subsystem
- CORR ection correction subsystem
- COMP arator comparator subsystem
- SYSTem system subsystem
- TRIG ger trigger subsystem
- FETC h? Get Results Subsystem
- ERRor error message subsystem

public command:

- IDN? Instrument Information Query Subsystem
- TRG trigger and get data

9.4 DISPlay display subsystem

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

Figure 9 - 2 DISPlay subsystem tree

DISPlay	:PAGE	{TEST,SETUP(MSET),COMParator,CORRECTION(CSET),FILE,SYSTem,SYSTEMINFO(SINF)}
	:LINE	<string>

9.4.1 DISPlay:PAGE

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

Command syntax: DISPlay : PAGE <page name>

parameter: < page name > includes:

TEST	measurement display page
SETUP (MSET)	setup page
COMParator	comparator page
CO RRection	calibration page
FILE	file management page
SYSTem	system configuration page
SYSTEMINFO (SINF)	system information page

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

Query syntax: DISP:PAGE?

Query response: <page name> abbreviation

test

mset

comp

cset

	file syst sinf
E. g:	send > disp:page? <NL> return > test <NL>

9.4.2 DISP:LINE

DISP:LINE is used to display a string of text in the tooltip at the bottom of the page. Text can display up to 30 characters.

Command syntax:	DISPlay : LINE < *string* >
parameter:	<string> up to 30 characters
E. g:	Send > DISP:LINE “ This is a Comment. ” <NL>

9.5 FUNCtion subsystem

Figure 9 - 3 FUNCtion subsystem tree

FUNCtion	:RANGe	{range number, max, min}	
		:MODE	{AUTO, HOLD, NOMinal}
	:RATE	{SLOW, MED, FAST }	
	:TC	: COEFficient	<float>
		:REFEr	<float>

Using the parameters set by the FUNCtion subsystem, the instrument will not be saved in the system, and needs to be reset the next time it is powered on.

9.5.1 FUNCtion:RANGe

FUNC:RANG is used to set the range mode and range number

Command syntax:	FUNCtion : RANGe {<range number>, min, max}
Parameter:	Where, < range number > 0~9 (AT517) 0~5 (AT517L) **min** minimum range **max** range
E. g:	Send > **FUNC:RANG 5** <NL> // Switch to 5 range (1k Ω)
Query syntax:	FUNC: RANG?
Query response:	Range number 0~9 (AT517)
E. g:	Send > FUNC:RANGE? <NL> return > 5 <NL>

9.5.2 FUNCtion:RANGe:MODE

FUNC:RANG:MODE is used to switch the range mode

Command syntax:	FUNCtion : RANGe:MODE {AUTO, HOLD(MANual) , NOMinal}
E. g:	Send> FUNC:RANG:MODE NOM <NL> // Switch to the nominal range mode
Query syntax:	FUNC:RANG:MODE?
Query response:	{AUTO, HOLD, NOM}

9.5.3 FUNCtion:RATE

FUNC:RATE or FUNC:SPEED is used to set the test speed.

Command syntax:	FUNCtion : RATE {SLOW, MED, FAST}
E. g:	Send > FUNC:RATE MED <NL> // Set as medium speed test
Query syntax:	FUNC:RATE?

Query response:	{SLOW, MED, FAST}

9.5.4 FUNCtion:TC

FUNC:TC is used to turn temperature compensation on or off.

Command syntax:	FUNCtion : TC {ON, OFF, 1, 0}
E. g:	Send> FUNC:TC ON <NL> // Enable temperature compensation function
Query syntax:	FUNC:TC?
Query response:	{ON, OFF}

9.5.5 FUNCtion:TC: COEFficient

FUNC:TC: COEFficient is used to set the temperature coefficient.

Command syntax:	FUNCtion : TC: COEFficient <float>
E. g:	Send> FUNC:Tc:COEF 0.394 <NL> // Set the temperature coefficient to 0.394%
Query syntax:	FUNC:TC:COEF?
Query response:	<fixfloat>
E. g:	Send > FUNC:Tc:COEF? <NL> Response > +0.39400 <NL>

9.5.6 FUNCtion:TC:REFErence

FUNC:TC:REFE is used to set the reference temperature

Command syntax:	FUNCtion : TC:REFErence <float>
E. g:	Send> FUNC:Tc:REFE 25 <NL> // Set the reference temperature to 25 degrees
Query syntax:	FUNC:TC:REFE?
Query response:	<fixfloat>
E. g:	Send > FUNC:Tc:REFE? <NL> Response > +25.00 <NL>

9.5.7 FUNCtion:DT

FUNC:DC used to turn the temperature conversion function on or off.

Command syntax:	FUNCtion:DT {ON, OFF, 1, 0}
E. g:	Send > FUNC:DC ON <NL> //Turn on the temperature conversion function
Query syntax:	FUNC:DT?
Query response:	{ON, OFF}
Points for attention:	The temperature conversion function is only effective after the temperature sensor is connected to the instrument.

9.5.8 FUNCtion:DT:T1

FUNC:DT:T1 Used to set the initial temperature.

Command syntax:	FUNCtion:DT:T1 <float>
E. g:	Send> FUNC:DT:T1 20<NL> //Set the reference temperature to25℃
Query syntax:	FUNC:DT:T1?
Query response:	<fixfloat>
E. g:	Send> FUNC:DT:T1?<NL> Response> +20.00<NL>
Points for attention:	1. The initial temperature T1 corresponds to the temperature at which the initial resistance R1 occur. 2. The unit of temperature is℃

9.5.9 FUNCtion:DT:R1

FUNC:DT:R1 Used to set the resistance value at the initial temperature.

Command syntax:	FUNCtion:DT:R1 <float>
E.g:	Send> FUNC:DT:R1 100<NL> //Set the initial resistance to 100Ω
Query syntax:	FUNC:DT:R1?
Query response:	<Scifloat>
E.g:	Send> FUNC:DT:R1?<NL> Response> 1.00000e+02<NL>
Points for attention:	1. Corresponding initial resistance at initial temperatureR1 2. The unit is Ω

9.5.10 FUNCtion:DT:K

FUNC:DT:Kis used to set the reciprocal of the temperature coefficient of the measured part at 0℃ (1/α)

Command syntax:	FUNCtion:DT:K <float> FUNCtion:DT:K <float> Note: The unit is Ω
E.g:	Send> FUNC:DT:K 234.5<NL>
Query syntax:	FUNC:DT:K?
Query response:	<fixfloat>
E.g:	Send> FUNC:DT:K?<NL> Response> +234.5<NL>
Points for Attention:	K is the reciprocal of the temperature coefficient (reference is 0℃).

COMParator subsystem

COMP subsystem is used to set comparator parameters.

Figure 9-4 COMParator Subsystem tree

COMParator	[:STATe]	{OFF,#-BIN} (AT517) {OFF,ON} (AT517L)
	:BEEP	{OFF,PASS(OK),FAIL(NG)}
	:MODE	{ABS,PER,SEQ}
	:NOMinal	<float>
	:BIN	<File number1~10>, <float lower limit>,<float upper limit>

9.5.11 COMParator[:STATe]

COMP[:STATe] is used to turn off the comparator or set the gear number.。

Command syntax:	COMParator[:STATe] {OFF,#-BIN} (AT517) COMParator[:STATe] {OFF,ON} (AT517L)
parameter:	Among them, <#-BIN> Including: 1-BIN ~ 6-BIN
E.g:	Send> COMP:STAT 6-BIN<NL> //Open the comparator and set it to 6 gears sorting. Send> COMP:STAT OFF<NL> //Turn off the comparator
Query syntax:	COMP[:STAT]?
Query response:	{OFF,#-BIN}

9.5.12 COMParator:BEEP

COMP:BEEP is used to enable ringing.。

Command syntax:	COMParator:BEEP {OFF,OK,NG}
E.g:	Send> COMP:BEEP OK<NL> //Qualified Beeper
Query syntax:	COMP:BEEP?
Query response:	{OFF,OK,NG}

9.5.13 COMParator:MODE

COMP:MODE is used to set the comparator mode

Command syntax:	COMParator:MODE {ABS,PER,SEQ}
E.g:	Send> **COMP:MODE SEQ** //Switch to sequential comparison mode
Query syntax:	COMP:MODE?
Query response:	{ABS,PER,SEQ}

9.5.14 COMParator:NOMinal

COMP:NOM is used to set the nominal value.

Command syntax:	COMParator:NOMinal <float>
E.g:	Send> COMP:NOM 1.0000k //The nominal value is set to 1k.
	Send> **COMP:NOM 1E3** //The nominal value is set to 1k.
	Send> **COMP:NOM 1000** //The nominal value is set to 1k.
Query syntax:	COMP:NOM?
Query response:	<scifloat>
E.g:	Send> COMP:NOM?<NL>
	Return> 1.0000E+03<NL> //The nominal value is set to 1k.

9.5.15 COMParator:BIN

COMP:BIN is used to set the nominal value.

Command syntax:	COMParator:BIN <File number1~6>,<float lower limit>,<float upper limit> (*AT517) COMParator:BIN <float lower limit>,<float upper limit> (*AT517L)
E.g:	Send> **COMP:BIN 1,-10,+10** //If in the percentage sorting mode: BIN1 the lower limit is -10% and the upper limit is 10%.
Query syntax:	COMP:BIN? <1~6>
Query response:	<scifloat>,<scifloat>
E.g:	Send> COMP:BIN? 1<NL>
	Return> -10.000E+00,+10.000E+00<NL> //-10,+10

9.6 TRIGger Subsystem

Figure 9 - 5 TRIGger Subsystem Tree

TRIGger	[:IMMediate]	
	:SOURce	{INT,EXT}
	:DELAy	< float >
TRG		

TRIGger is used to set the trigger source and generate a trigger.

9.6.1 TRIGger[:IMMediate]

TRIG[:IMM] will generate a trigger when the trigger source is set to EXT , but will not return the data that triggers the test. If you want to return

data, you need to use the TRG instruction.

Command syntax:	TRIGger[IMMediate]
E.g:	send > **TRIG** <NL> // the instrument stops after one test

9.6.2 TRIGger:SOURce

TRIG:SOUR is used to set the trigger source.

Command syntax:	TRIGger:SOURce{INT,EXT}
E.g:	Send > TRIG:SOUR BUS <NL> // Set as bus trigger mode.
Query syntax:	TRIG: SOUR?
Query response:	<INT,EXT>

9.6.3 TRIGger: DELAy

TRIG: DELAy is used to set the trigger delay.

Command syntax:	TRIGger: DELAy {0, <float> } Parameter 0: will turn off the trigger delay. parameter< float>: 0.001~9.0
E.g:	Send > TRIG: DELA 0.1 <NL> // set trigger delay 0 .1s Send > TRIG: DELA 10m <NL> // set trigger delay to 10 ms
Query syntax:	TRIG: DELA?
Query response:	0.1

9.6.4 TRG

When the trigger source is set to EXT, TRG generates a trigger and returns the data that triggers the test.

Command syntax:	TRG
E.g:	send > **TRG** <NL> // instrument test once and return test data Return > +9.9651e+01, BIN00 <NL>

9.7 FETCh? Subsystem

FETCh? is used to acquire test data. Before using this command, you need to set the [Result Send] field under the <System Configuration> page to [FETCH]. FETCh? The instruction will return test data.

Figure 9- 6 FETCh? Subsystem Tree

FETCh?	<NONE>
	:RT?
	:T2?

9.7.1 FETCh? Obtain measurement results

Query syntax:	FETCh?
Query response:	<scifloat>,{BIN0~BIN6 } Where BIN0 stands for unqualified.
E.g:	send> FETC? <NL> Return>+9.9651e+01,BIN0<NL>

9.7.2 FETCh:RT? Get the current room temperature

Query syntax:	FETCh:RT?
Query response:	<Fixfloat>
E.g:	send> FETC:RT? <NL> Return>+27.94<NL>

Attention:
1. If the sensor is not plugged in, or the temperature compensation and temperature conversion functions are not turned on, it will return to +999.99.
2. The unit is ℃

9.7.3 FETCh:T2? Get the current room temperature

Query syntax: FETCh:T2?
Query response: <Fixfloat>
E.g: send> FETC:T2?<NL>
Return>+19.91<NL>

Attention:
1. If the sensor is not plugged in or the temperature conversion function is not turned on, it will return to +999.99.
2. The unit is ℃

9.8 SYSTem subsystem

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

Figure 9 - 7 SYSTem subsystem tree

SYStem	:LANGuage	{ENGLISH, CHINESE, EN, CN}
	:TIME	<YEAR>, <MONTH>, <DAY>, <HOUR>, <MINUTE> , <SECOND>
	:KEYLock (KLOC)	{ON(1), OFF(0)}
	: BEEP	{ON(1), OFF(0)}
	: SHAKEHAND(SHAK)	{ON(1), OFF(0)}
	: UPLOAD(UPLD)	{FETCh, AUTO}

9.8.1 SYSTem:LANGuage system language

Instrument language setting.

Command syntax: SYSTem:LANGuage {ENGLISH, CHINESE, EN, CN}
E.g: send > SYST:LANG EN // set to English display
Query syntax: SYST:LANG?
Query response: {ENGLISH, CHINESE}

9.8.2 SYSTem: TIME system time setting

Command syntax: SYSTem:TIME <YEAR>, <MONTH>, <DAY>, <HOUR>, <MINUTE> , <SECOND>
E.g: Send > SYST: TIME 2016, 12, 30, 11, 18, 31 //2016-12-30 11:18:31
Query syntax: SYSTem:TIME?
Query response: <YEAR> - <MONTH> - <DAY> <HOUR> : <MINUTE> :<SECOND>
E.g: send > SYST: TIME?
receive> 2016-12-30 11:18:31

9.8.3 SYSTem: KEYLock or SYSTem : KLOCk Keypad lock settings

Command syntax: SYSTem: KEYLock { ON, OFF, 0, 1}
SYSTem: KLOCk { ON, OFF, 0, 1}
E.g: send > SYST: KEYL OFF // Keyboard unlock
Query syntax: SYSTem: KEYLock?
SYSTem: KLOCk?
Query response: { on, off }

9.8.4 SYSTem: BEEPer key tone

This command **does not** affect the comparator beep.

Command syntax:	SYSTem: BEEPer { OFF,ON,0 ,1}
parameter:	{OFF,ON,0,1} OFF/0: key tone off ON/1: key tone off
E.g:	Send > SYST: BEEP OFF
Query syntax:	SYST em : BEEPer ?
Query response:	{ OFF, ON }

9.8.5 SYSTem: SHAKhand communication handshake command (data header return)

communication handshake is turned on , the instrument will return the received command to the host as it is, and then return the data.

Command syntax:	SYSTem: SHAKhand { ON,OFF,0,1} SYSTem:HEADer { ON,OFF,0,1}
E.g:	Send > SYST: SHAK ON send > SYST: HEAD ON
Query syntax:	SYSTem: SHAKhand? SYSTem:HEADer?
Query response:	{ on, off }

9.8.6 SYSTem: UPLOAD (UPLD) test result sending

SYST em : UPLOAD (UPLD) can set the data sending method: automatic or FETCH command.

Command syntax:	SYSTem: UPLOAD {FETCH,AUTO}
parameter:	{FETC H,AUTO} FETCH: The data needs to be returned to the host through the command fetch?, and the instrument sends it passively. AUTO: After each test is completed, the test results are automatically sent to the host, and the instrument actively sends them.
E.g:	Send > SYST: UPLD AUTO // set to send automatically
Query syntax:	SYST: UPLD ?
Query response:	{FETCH,AUTO}

9.9 CORRect subsystem

The CORR subsystem is used to perform a short-circuit calibration.

Figure 9 - 8 CORRect Subsystem Tree

CORRect	: STATe	{ ON,OFF,0,1}
	:SHORt	

9.9.1 C ORRect:STATe

Command syntax:	SYSTem: STATe { OFF,ON,0 ,1}
parameter:	{OFF,ON,0,1} OFF/0: Short circuit clear value is off ON/1: Short-circuit clearing value is valid
E.g:	send > SYST: STAT OFF
Query syntax:	SYSTem : STAT ?

Query response: { OFF, ON }

9.9.2 CORRect:SHORt

CORR:SHOR completes a short-circuit calibration, the test terminal must be short-circuited before sending the command.

Command syntax: CORRect:SHORt

E.g: Send > CORRect:SHORt <NL>
Return > Short Clear Zero Start. <NL> // Prompt to clear zero start
Return > **PASS** <NL> // Prompt: Clear pass, (fail: FAIL)

9.10 FILE(MMEM) subsystem

The FILE(MMEM) subsystem is used to manage files and can be used to save user parameters to the internal flash memory , or to read flash files into the system.

Figure 9 - 9 FILE(MMEM) subsystem tree

FILE MMEM	: SAVE _	< no parameter > or <file number 0-9 >
	: LOAD	< no parameter > or <file number 0-9 >
	:DELete	<file number 0-9 >

9.10.1 FILE:SAVE save file

FILE:SAVE can save the current settings to the current file or the specified file.

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

E.g: send > **FILE:SAVE** // save to the current file
send> **FILE:SAVE 1** // save to file 1

9.10.2 FILE:LOAD read file

FILE:LOAD can read file data into the system.

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

E.g: send > **FILE:LOAD** // Read the current file data into the system
send > **FILE:LOAD 1** // Read the data of file 1 into the system

9.10.3 FILE:DELete deletes the specified file

FILE: DELete can delete the data of the specified file.

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

E.g: send > **FILE:DEL 1** // Delete the specified file

Note : Deleting the current file will not affect the parameters of the system

9.10.4 SAV

SAV can save the current settings to the current file.

Command syntax: SAV = FILE : SAVE

E.g: send > **SAV** // save to the current file

9.10.5 R CL

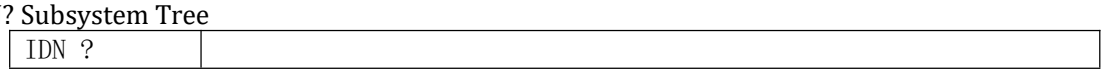
RCL can read the current file data into the system.

Command syntax: RCL = FILE:LOAD

E.g: send > **FILE:LOAD** // Read the current file data into the system

9.11 IDN? Subsystem

Figure 9 - 10 IDN? Subsystem Tree



The IDN? subsystem is used to return the version number of the instrument.

Query syntax:	IDN?
Query response:	<MODEL>,<Revision>,<SN>,< Manufacturer >
E. g:	send > IDN? <NL> Return> AT517, REV A1.0, 0000000, Applent Instruments <NL>

9.12 ERRor subsystem

The error subsystem is used to obtain information about the last error that occurred

Query syntax:	ERRor?
Query response:	Error string
E. g:	send > ERR? <NL> return > no error. <NL>

The corresponding error codes are as follows:

error code	illustrate
*E00	No error
*E01	Bad command
*E02	Parameter error
*E03	Missing parameter
*E04	buffer overrun
*E05	Syntax error
*E06	Invalid separator
*E07	Invalid multiplier
*E08	Numeric data error
*E09	Value too long
*E10	Invalid command
*E11	Unknown error

10. Modbus (RTU) communication protocol

This chapter covers the following areas :

- Data Format - Learn about the Modbus communication format .
- Features
- Variable area
- Function code

10.1 Data Format

We follow the Modbus (RTU) communication protocol, the instrument will respond to the command of the upper computer and return a standard response frame.

See also :

You can contact the sales department of our company to obtain the communication test tool of Applent Instrument, which includes the Modbus communication debugging method. Contains CRC - 16 calculator and floating point conversion to Modbus floating point format.

10.1.1 command frame

Figure 10 - 1 Modbus command frame

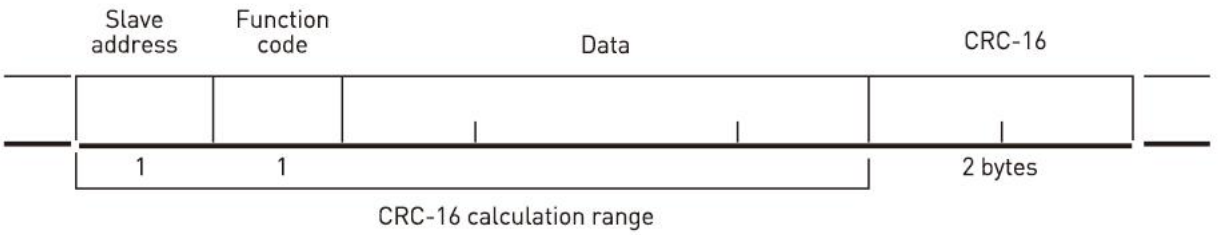


Table 10 - 1 Instruction frame description

	A squelch interval of at least 3.5 character time is required
Slave address	1 byte Modbus Can support 00~ 0 x 63 slaves Specify 00 for unified broadcast In instruments without the RS 485 option, the default slave address is 0x01
function code	1 byte 0 x 03 : read multiple registers 0 x 04 := 03 H, not used 0 x 06 : write a single register, can be replaced with 10H 0x08 : _ _ Echo test (for debugging only) 0 x 10 : write to multiple registers
data	Specify register address, quantity and content
CRC- 16	2 bytes, LSB first Cyclic Redun dancy Check Calculate all data from the station address to the end of the data to get the CRC 16 check code
	A squelch interval of at least 3.5 character time is required

10.1.2 CRC-16 calculation method

1. Set the initial value of the CRC-16 register to 0x FFFF .
2. XOR the CRC-16 register and the first byte of information , and return the result to the CRC register.
3. Fill the MSB with 0 , while right-shifting the CRC register by 1 bit.
4. If the bit shifted from the LSB is ″ 0 ″, repeat step (3) (processing the next shift) . If the bit shifted from the LSB is ’ 1 ’, XOR the CRC register with 0x A001 and return the result to the CRC register.
5. Repeat steps (3) and (4) until you move 8 bits.
6. If the information processing has not ended, XOR operation is performed on the CRC register and the next byte of the information, and the CRC register is returned, and the execution is repeated from step (3) .
7. the result of the calculation (the value of the CRC register) to the message from the lower byte.

The following is a CRC calculation function in VB language:

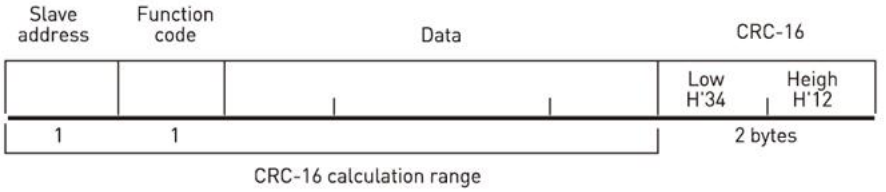
```
Function CRC16(data() As Byte) As Byte()
im CRC16Lo As Byte, CRC16Hi As Byte 'CRC register
im CL As Byte, CH As Byte ' Polynomial code &HA001
im SaveHi As Byte, SaveLo As Byte
im i As Integer
im flag As Integer
RC16Lo = &HFF
RC16Hi = &HFF
L = &H1
H = &HA0
or i = 0 To UBound(data)
CRC16Lo = CRC16Lo Xor data(i) ' Each data is XORed with the CRC register
For flag = 0 To 7
SaveHi = CRC16Hi
SaveLo = CRC16Lo
CRC16Hi = CRC16Hi \ 2 'The high bit is shifted to the right by one
CRC16Lo = CRC16Lo \ 2 'The low bit is shifted to the right by one
If ((SaveHi And &H1) = &H1) Then ' If the last bit of the high-order byte is 1
CRC16Lo = CRC16Lo Or &H80 ' The lower byte is shifted to the right and the front is filled
with 1
End If ' Otherwise add 0 automatically
If ((SaveLo And &H1) = &H1) Then ' If LSB is 1 , XOR with polynomial code
CRC16Hi = CRC16Hi Xor CH
CRC16Lo = CRC16Lo Xor CL
End If
Next flag
ext i
im ReturnData(1) As Byte
eturnData(0) = CRC16Hi 'CRC high bit
eturnData(1) = CRC16Lo 'CRC low bit
RC16 = ReturnData
End Function
```



Our company's "Applent Instrument Communication Test Tool" contains Modbus communication debugging method. It includes CRC- 16 calculator.

Calculated CRC - 16 data needs to be appended to the end of the command frame, for example: 1 234H :

Figure 10 - 2 Modbus Append CRC - 16 value



10.1.3 response frame

Unless it is a 0 0 H slave address broadcast command, other slave address devices will return response frames.

Figure 10 - 3 normal response frame

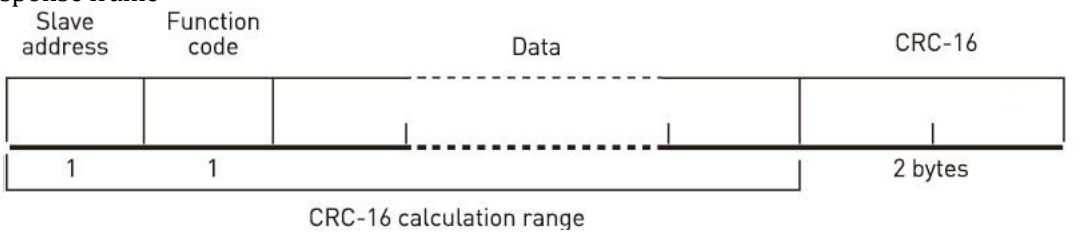


Figure 10 - 4 exception response frame

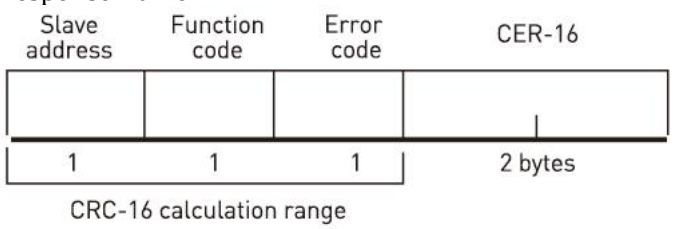


Table 10 - 2 Exception response frame description

Slave address	1 byte The slave address is returned as it is
function code	1 byte The function code of the instruction frame is logically ORed (OR) on BIT 7 (0x8 0), for example: 0x 03 OR 0 x 80 = 0 x83
error code	Exception code: 0x 01 Function code error (function code not supported) 0 x 02 register error (register does not exist) 0 x 03 Data error 0 x 04 Execution error
CRC-16	2 bytes, LSB first Cyclic Redun dancy Check Calculate all data from the station address to the end of the data to get the CRC 16 check code

10.1.4 No response

In the following cases, the instrument will not perform any processing and will not respond, resulting in a communication timeout.

1. Slave address error
2. transmission error
3. CRC-16 error
4. The number of digits is wrong, for example: the total digits of function code 0x03 must be 8, and the received digits are less than 8 or more than 8 bytes.
5. When the slave address is 0x 00 , it represents the broadcast address and the instrument does not respond.

10.1.5 error code

Table 10 - 3 Error code description

error code	Name	Illustrate	Priority
0x01	Function code error	Function code does not exist	1
0x02	register error	register does not exist	2
0x03	data error	wrong number of registers or number of bytes	3
0x04	execution error	The data is illegal, the written data is not within the allowed range	4

10.2 function code

The instrument only supports the following function codes, other function codes will respond to error frames.

Table 10 - 4 function code

Function code	Name	Illustrate
0x03	read multiple registers	Read multiple consecutive register data
0x04	same as 0x 03	replace with 0x03
0x08	echo test	The received data is returned as it is
0x10	write to multiple registers	Write to multiple consecutive registers

10.3 register

The number of registers of the instrument is in 2-byte mode, that is, 2 bytes must be written each time, for example: the speed register is 0x 3002 , the data is 2 bytes, and the value must be written 0x0001

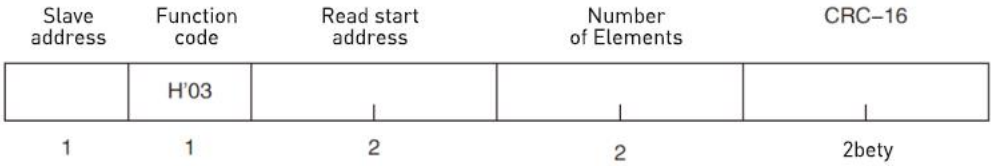
Data:
The instrument supports the following values:

1. 1 register, double-byte (1 6 -bit) integer, for example: 0x6 4 → 00 64
2. 2 registers, four-byte (32 -bit) integers, eg: 0 x 12345678 → 12 34 56 78
3. 2 registers, four-byte (3 2 -bit) single-precision floating-point numbers, 3. 14 → 40 48 F5 C3

Our company's "Applent Instrument Communication Test Tool" contains Modbus communication debugging methods. It includes floating point converters.

10.4 read multiple registers

Figure 10 - 5 Read multiple registers (0x0 3)

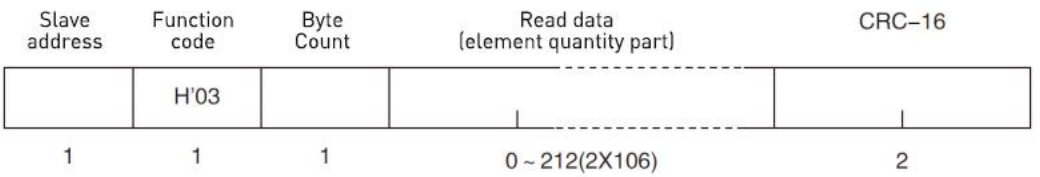


The function code for reading multiple registers is 0 x 03 .

Table 10 - 5 read multiple registers

Name	Name	Illustrate
	Slave address	No RS485 address is specified, the system default is 0 1
0x03	Function code	
	Starting address	Register start address, please refer to Modbus Instruction Set
	Number of read registers 000 1~ 006 A (1 06)	Number of registers to read consecutively. Please refer to Modbus instruction set to ensure that these register addresses are present, otherwise an error frame will be returned.
CRC-16	check code	

Figure 10 - 6 Read multiple registers (0x03) response frame



Name	Name	Illustrate
	Slave address	Return as it is
0x03 or 0x 83	Function code	No exception: 0x 03 Error code : 0x83
	Number of bytes	= number of registers x 2 For example: 1 register returns 02
	Data	read data
CRC-16	Check code	

10.5 write to multiple registers

Figure 10 - 7 Write to multiple registers (0x 10)

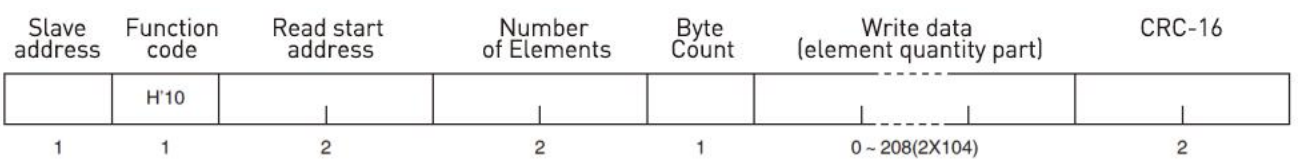
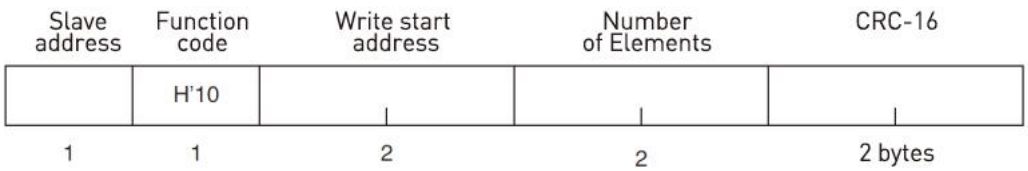


Table 10 - 6 write to multiple registers

Name	Name	Illustrate
	Slave address	No RS485 address is specified, the default is 01
0x10	Function code	
	Starting address	Register start address, please refer to Modbus Instruction Set

	Number of write registers 000 1~ 0068 (1 04)	Number of registers to read consecutively. Please refer to Modbus instruction set to ensure that these register addresses are present, otherwise an error frame will be returned.
	number of bytes	= number of registers x 2
CRC-16	check code	

Figure 10 - 8 Write multiple registers (0x0 3) response frame

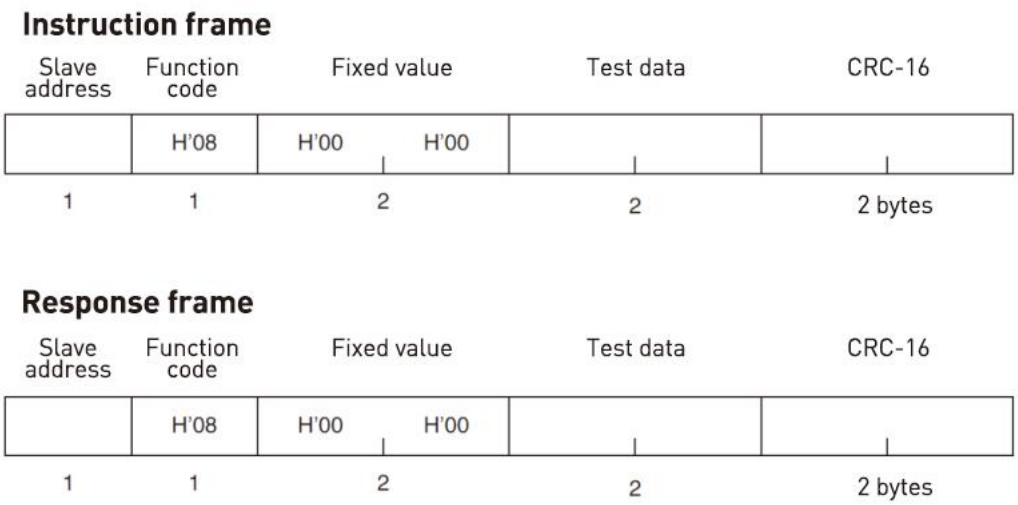


Name	Name	Illustrate
	Slave address	return as is
0x10 or 0x 90	Function code	No exception: 0x 10 Error code : 0x90
	Starting address	
	Number of registers	
	CRC-16 check code	

10.6 echo test

Echo test function code 0x 08 , used to debug Modbus.

Figure 10 - 9 echo test (0x0 8)



Name	Name	Illustrate
	Slave address	Return as it is
0x08	Function code	
	Fixed value	00 00
	Test Data	Any number: e.g. 12 34
	CRC-16 check code	

E.g:

Assuming the test data is 0 x 1234 :

Instructions	01	08	00 00	12 34	ED 7C(CRC-16)
Response	01	08	00 00	12 34	ED 7C(CRC-16)

11. Modbus (RTU) instruction set

This chapter covers the following areas :

- register address

Our company's "Applent Instrument Communication Test Tool" contains Modbus communication debugging methods. It includes floating point converters.

Unless otherwise specified, the values of the command and response frames in the following description are all hexadecimal data.

11.1 Register overview

by the instrument are listed below, any address not in the table will return error code 0x02 .

Table 11 - 1 Register overview

Register address	Name	Numerical value	Illustrate
2000	Read measurement results	4-byte floating point number	Read only, data occupies 2 registers, 4 bytes Byte order ABCD, LSB first
2100	Read the comparator result of the channel	4 byte integer	Read only, data occupies 2 registers
2200	Read measurement results	4-byte floating point number	Read only, data occupies 2 registers, 4 bytes byte order CDAB
2300	Trigger once and read the measurement AABB CCDD	4-byte single-precision floating point number Character Order : Least Significant AABB CCDD	Read only, data occupies 2 registers, 4 bytes After receiving the command, it will automatically turn to the measurement page, and the trigger mode will be switched to remote trigger.
2400	Trigger once and read the measurement CCDD AABB	4-byte single-precision floating point number Character order : high order first CCDD AABB	Read only, data occupies 2 registers, 4 bytes After receiving the command, it will automatically turn to the measurement page, and the trigger mode will be switched to remote trigger.
0000	Read instrument version number	4 byte integer	Read only, data occupies 2 registers
3000	Range number	0000 ~ 0009	Read and write registers,

			2-byte integers
3001	Automatic range	0000 : Auto range 0001 : Manual range 0002 : Nominal range	Read and write registers, 2-byte integers
300 2	Test speed	0000: slow 0001 : medium speed 0002 : fast	Read and write registers, 2-byte integers
3003	File boot call	0000: file 0 0001 : current file	Read and write registers, 2-byte integers
3004	Auto save	0000: Forbidden 0001 : Allowed	Read and write registers, 2-byte integers
3005	System language	0000 : English 0001 : Simplified Chinese	Read and write registers, 2-byte integers
3006	Beep	0000: close 0001 : Qualified beeper 0002 : Unqualified beep	Read and write registers, 2-byte integers
3008	Trigger settings	0000: Internal trigger 0003 : External trigger	Read and write registers, 2-byte integers
3009	Trigger delay	0: Trigger delay off 4-byte floating point number range (0.1 ~9.0s)	Read and write registers, 2-byte integers
3100	Comparator gear number	0000 : Comparator off 0001 : 1- BIN 0002 : 2- BIN 0003 : 3- BIN 0004	Read and write registers, 2-byte integers
3101	Comparator mode	0000: ABS 0001 : PER 0002 : SEQ	Read and write registers, 2-byte integers
3102	Nominal value	4-byte floating point number	Read and write registers, data occupies 2 registers
3110	BIN1 lower limit value	4-byte floating point number	Read and write registers, data occupies 2 registers
3112	BIN1 upper limit value	4-byte floating point number	Read and write registers, data occupies 2 registers
3114	BIN2 lower limit	4-byte floating point number	Read and write registers, data occupies 2 registers
3116	BIN2 upper limit value	4-byte floating point number	Read and write registers, data occupies 2 registers

3118	BIN3 lower limit	4-byte floating point number	Read and write registers, data occupies 2 registers
311A	BIN3 upper limit value	4-byte floating point number	Read and write registers, data occupies 2 registers
311C	BIN4 lower limit	4-byte floating point number	Read and write registers, data occupies 2 registers
311E	BIN4 upper limit value	4-byte floating point number	Read and write registers, data occupies 2 registers
31 2 0	BIN5 lower limit	4-byte floating point number	Read and write registers, data occupies 2 registers
3122	BIN5 upper limit value	4-byte floating point number	Read and write registers, data occupies 2 registers
3124	BIN6 lower limit	4-byte floating point number	Read and write registers, data occupies 2 registers
3126	BIN6 upper limit	4-byte floating point number	Read and write registers, data occupies 2 registers
4000	Save settings to current file	Fixed value: 0001	Write-only register, data 2 bytes
4001	Read current file data	Fixed value: 0001	Write-only register, data 2 bytes
4002	Save settings to specified file	000 0 ~ 0009	Write-only register, data 2 bytes
4003	Read the specified file data	0000~ 0009	Write-only register, data 2 bytes
5000	Execute clear register read clear status	Read: 0001 clearing 0000 Cleared successfully	Read-only register, data occupies 1 register
5001	Key lock	0000: Unlock 0 001 : Locked	write-only register , 2 bytes
5002	Trigger once = Handler Trig pin	Fixed value : 0001	write-only register, 2 bytes

11.2 Get measurement data

11.2.1 Get measurement results

Registers 2000~ 2003 are used to obtain instrument measurement data.

Example: Get measurement data

Instruction:

1	2	3	4	5	6	7	8
01	03	2000		0002		CRC-16	
Slaves	Read	Register		Number of registers		Check code	

Response

1	2	3	4	5	6	7	8	9
01	03	Byte	Single precision floating point number				CRC-16	

- Get measurement data:

send:

1	2	3	4	5	6	7	8
01	03	20	00	00	02	CF	CB

response:

1	2	3	4	5	6	7	8	9
01	03	04	60	AD	78	EC	56	5F

Among them, B4~B6 are measurement data: 60 AD78EC represents single-precision floating -point numbers , with the low order first .
byte order AA BB CC DD converted to decimal is 1E 20

11.2.2 Get comparator result [2100]

The returned 4-byte integer represents the comparator result:
0 0 : Failed
0 1 : Qualified file 1
0 2 : Qualified file 2
0 3 : Qualified file 3
0 4 : Qualified file 4
0 5 ; qualified file 5
0 6 : Qualified file 6

send:

1	2	3	4	5	6	7	8
01	03	twenty one	00	00	02	CE	37

response:

1	2	3	4	5	6	7	8	9
01	03	04	00	00	00	00		

11.2.3 Get Measurement Results (CCDD AABB) [2200]

Registers 2200~ 2203 are used to obtain instrument measurement data.
Example: Get measurement data
instruction:

1	2	3	4	5	6	7	8
01	03	2 2 00		0002		CRC-16	
Slaves	read	register		Number of registers		check code	

response

1	2	3	4	5	6	7	8	9
01	03	byte	single precision floating point number				CRC-16	

- Get measurement data:

send:

1	2	3	4	5	6	7	8
01	03	twenty two	00	00	02	CE	73

response:

1	2	3	4	5	6	7	8	9
01	03	04	43	8D	3F	80	6F	CC

Among them, B4~B6 are measurement data: 43 8D 3F 80 represent single-precision

floating -point numbers , high -order word first , byte order CCDDAABB . The swap word order is AABBCCDD : 3 F 80 8D 43 converted to decimal is 1.002061 *4862442017*

11.2.4 Trigger once and return measurement result (AABB CCDD) [2300]

Register 2300~ 2303 are used to obtain instrument measurement data.
Example: Get measurement data
instruction:

1	2	3	4	5	6	7	8
01	03	2 3 00		0002		CRC-16	
Slaves	read	register		Number of registers		check code	

response

1	2	3	4	5	6	7	8	9
01	03	byte	single precision floating point number				CRC-16	

- Get measurement data:

send:

1	2	3	4	5	6	7	8
01	03	twenty three	00	00	02	CF	8F

response:

1	2	3	4	5	6	7	8	9
01	03	04	3F	80	44	98	C5	65

Among them, B4~B6 are measurement data: 3F80 4498 represent single-precision floating -point numbers , with the low order first .
byte order AA BB CC DD converted to decimal is 1.002093 *3151245117*

> This command will automatically switch the page back to the measurement page and change the trigger mode to remote trigger .

11.2.5 Trigger once and return measurement result (CCDD AABB) [2400]

Registers 2400~ 2403 are used to obtain instrument measurement data.
Example: Get measurement data
instruction:

1	2	3	4	5	6	7	8
01	03	2 4 00		0002		CRC-16	
Slaves	Read	Register		Number of registers		Check code	

response

1	2	3	4	5	6	7	8	9
01	03	Byte	Single precision floating point number				CRC-16	

- Get measurement data:

send:

1	2	3	4	5	6	7	8
01	03	2 4	00	00	02	CF	CB

response:

1	2	3	4	5	6	7	8	9
01	03	04	44	CE	3F	80	9F	6C

Among them, B4~B6 are measurement data: 44CE 3F80 represents single-precision floating -point numbers , with the high order first .
adjust byte order CCDD AABB is AABBCCDD , that is, 3 F8044CE converted to decimal number is 1.002099 *7524261475*

11.3 parameter settings

11.3.1 Speed【3002】

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	30	02	00	01	02	00	01	56	71
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	10	30	02	00	01	AF	09
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	03	30	02	00	0 1	2A	CA
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7
01	03	02	00	00	B8	44
		byte	data		CRC	

in
0000 slow
0001 medium speed
0002 fast
0003 high speed

11.4 Comparator settings

Comparator parameter register addresses start at 3100.

11.4.1 Nominal value【3102 - 3103】

The nominal value uses 2 registers, 3102 and 3103. Notice! 3103 cannot be read alone.

- write

100E-3 (single precision floating point number: 0x 3DCCCCCD)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	31	02	00	02	04	3D	CC	CC	CD	72	E1
	Write	register		Number of registers		byte	data				CRC	

response:

1	2	3	4	5	6	7	8
01	10	31	02	00	02	EE	F4
		register		Number of registers		CRC	

- read

1	2	3	4	5	6	7	8
01	03	31	02	00	02	6B	37
	read	register		Number of registers		CRC	

response:

1	2	3	4	5	6	7	8	9
01	03	04	3D	CC	CC	CD	A3	35
		byte	Data 100E-3				CRC	

11.4.2 Limit value【3110-3126 】

6 -level comparator starts from 3110 and ends at 3126. Each comparator level uses 2 registers for the lower limit and 2 registers for the upper limit, for a total of 4 registers.

The lower limit and upper limit can be set separately or at the same time.

- write

Lower limit: 1E-3, Upper limit: 2E3

Send: 01 10 3110 0004 08 3A83126F 3B03126F 6384

Response: 01 10 3110 0004 CEF3

- read

Send: 01 03 3110 0004 4B30

Response: 01 03 08 3 A83126F 3B03126F C2A7

11.5 file operations

The [Auto Save] field in the <File> page is not turned on , after all the Modbus commands are set, the data cannot be stored in the internal FlashRom in real time, which will result in the register data before the next power-on. Restore the value to the original file.

The user can operate the register with the file to store all the setting values in the current or specified file. At the same time, the specified file data can also be called into the setting register.

> You can open the [Auto Save] field in the <File> page , and the parameters set each time will be automatically saved , and the file command can be ignored .

11.5.1 Save to the current file [4000]

Send the value 0001 to 4000 register, the instrument will perform the file

write operation, and all settings will be saved to the current file.
This register cannot be read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	40	00	00	01	02	00	01	26	54
	Write	register		Number of registers		byte	data		CRC	

response:

1	2	3	4	5	6	7	8
01	10	40	00	00	01	14	09
		register		Number of registers		CRC	

where the data values are:

data	Features	illustrate
0001	allow operation	Fixed value

11.5.2 Reload the current file [4001]

Send the fixed value 0001 to 4001 register, the instrument loads the current file data into the system.
This register cannot be read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	40	01	00	01	02	00	01	27	85
	Write	register		Number of registers		byte	data		CRC	

where the data values are:

data	Features	illustrate
0001	Fixed value	

11.5.3 Save to the specified file [4002]

Send the file number to the 4002 register, the instrument will execute the file write operation, all settings will be saved to the specified file, and the specified file will be used as the current file of the system.
This register cannot be read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	40	02	00	01	02	00	01	27	85
	Write	register		Number of registers		byte	data		CRC	

where the data values are:

data	Features	illustrate
0000~0009	file 0~9	

11.5.4 Load the specified file [40 03]

Send the file number to the 40 03 register, the instrument will load the settings of the specified file into the system, and the specified file will be used as the current file of the system.
This register cannot be read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	40	03	00	01	02	00	0 1	26	67

	Write	register	Number of registers	byte	data	CRC

where the data values are:

data	Features	illustrate
0000~0009	file 0~9	

11.6 System function

11.6.1 Clear【5000】

Read register 5000, the instrument will start to perform short circuit clearing operation.
Before performing the reset, be sure to short the test leads, otherwise the reset will fail.

Because the zeroing process takes a few seconds.

During clearing execution or after clearing is complete, it returns to the cleared state:
0000 reset successfully
Failed to clear FFFF

- read

During the execution of clearing, you can determine whether the clearing is complete by reading the register data
Send: 01 03 5000 0001 950A
Response: 01 03 02 0000 ####

11.6.2 Key lock【5001】

Write unlock command 5001, data 0000 :
01 10 50 01 00 01 02 00 00 F7 84

11.6.3 Trigger 【 5002 】

Write trigger command 5002, data 0001 :
01 10 50 02 00 01 02 00 01 36 77



This command returns an error code only when triggered internally .

12. Specification

You will learn the following:
technical indicators.
General Specifications .
Dimensions .

12.1 Technical indicators

The following data were measured under the following conditions:
Temperature condition: 23° C ± 5° C
Humidity Conditions: ≤65% RH
Zero adjustment: short circuit clear before test
Warm-up time: >60 minutes
Calibration time: 12 months

Test current accuracy: 10 %
AT517 :

measuring range		slow, medium maximum display value	Resolution	high speed /fast	medium speed	Slow speed	Test current	Test terminal open circuit voltage
0	20mΩ	22.000mΩ	1 μΩ	0. 8 % ± 5 characters	0. 2 % ± 5 characters	0.1%± 3 characters	1A	< 1 V
1	200mΩ	220.00mΩ	10Ω _μ	0. 5 % ± 5 characters	0. 1 % ± 3 characters	0.05%± 2 characters	1 A	< 1 V
2	2Ω	2.2000Ω	100Ω μ_	0. 5 % ± 5 characters	0. 1 % ± 3 characters	0.05%± 2 characters	100mA	< 1 V
3	20Ω	22.000Ω	1mΩ	0. 5 % ± 5 characters	0. 1 % ± 3 characters	0.05%± 2 characters	10mA	< 1 V
4	200Ω	220.00Ω	10mΩ	0. 5 % ± 5 characters	0. 1 % ± 3 characters	0.05%± 2 characters	1mA	< 5 V
5	2kΩ	2.200kΩ	100mΩ	0. 5 % ± 5 characters	0. 1 % ± 3 characters	0.05%± 2 characters	1mA	< 5 V
6	20kΩ	22.000kΩ	1Ω	0. 5 % ± 5 characters	0. 1 % ± 3 characters	0.05%± 2 characters	100μA	< 5 V
7	200kΩ	220.00kΩ	10Ω	0. 5 % ± 5 characters	0. 1 % ± 3 characters	0.05%± 2 characters	10μA	< 5 V
8	2MΩ	2. 2000MΩ	100Ω	0.8% ± 5 characters	0. 2 % ± 5 characters	0. 1 % ± 5 characters	1μA	<3V

AT517L :

measuring range	Slow/ medium maximum display value	Resolution	medium speed	slow	Test current	Test terminal open circuit voltage

0	20mΩ	22.000mΩ	1 μΩ	0.2%±5 characters	0.1%± 3 characters	1A	< 1 V
1	200mΩ	220.00mΩ	10 μΩ	0.1%±3 characters	0.1%± 2 characters	1 A	< 1 V
2	2Ω	2.2000Ω	100μΩ	0.1%±3 characters	0.1%± 2 characters	100mA	< 1 V
3	20Ω	22.000Ω	1mΩ	0.1%±3 characters	0.1%± 2 characters	10mA	< 1 V
4	200Ω	220.00Ω	10mΩ	0.1%±3 characters	0.1%± 2 characters	1mA	< 5 V
5	2kΩ	2.200kΩ	100mΩ	0.1%±3 characters	0.1%± 2 characters	1mA	< 5 V
6	20kΩ	22.000kΩ	1Ω	0.1%±3 characters	0.05%± 2 characters	100μA	< 5 V

12.2 General Specifications

Screen: TFT-LCD true color display, screen size 3.5 inches.
Test range: 0.001mΩ~ 2.20 00MΩ (AT517)
0.001mΩ~ 2.20 00kΩ (AT517L)

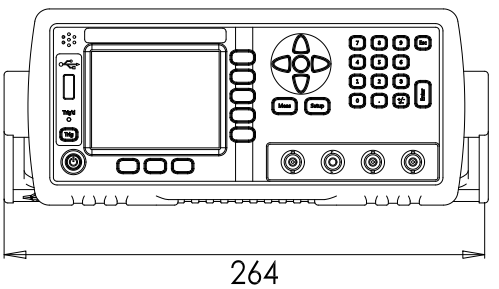
Test speed: manual range mode:
Slow: 3 times/sec
Medium speed: 12 times/sec
Fast: 60 times/sec
Maximum reading: 220000
Range mode: automatic manual and nominal
Calibration: Short circuit full scale clear
File: Parameters are automatically saved
Beep: Off, Pass, Fail.
Trigger: Internal/ external trigger.
Interface: Handler interface
RS232 interface
USB interface
RS485 interface
Temperature Compensation Interface
Programming language: SCPI
Accessibility: Keypad lock

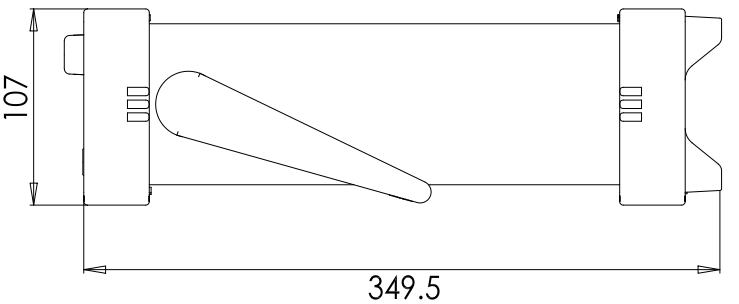
Environment: Indicator: Temperature 18℃~28℃ Humidity ≤65%RH
Operation: Temperature 10℃~40℃ Humidity 10~80% RH
Storage: Temperature 0℃~50℃ Humidity 10~90% RH

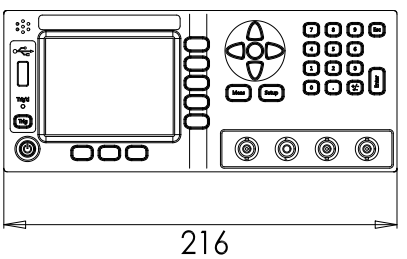
Power supply: 220VAC (1±10%)
Fuse: 250V 1 A slow blow
Power: Max 20VA
Weight: about 5 kg.

12.3 Dimensions

(schematic)









Applent Instruments
-AT517/AT517L Instruction Manual-
Simplified Chinese version
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