Applent Instruments Ltd.

Telephone (Sales):
0086-0519-88805550
Sales Email: sales@applent.com
Tech Email: tech@applent.com
http://www.applent.com

English

Revision A2

FIRMWARE REVISIONS
This manual applies directly to instruments that have the firmware **Rev.C1.x**

Manual Print History
The print history shown below lists the printing dates of all Revisions and Addenda created for this manual. The Revision Level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between Revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new Revision is created, all Addenda associated with the previous Revision of the manual are incorporated into the new Revision of the manual. Each new Revision includes a revised copy of this print history page.
Revision A January, 2013

[AT5130 Multi-Channel Resistance Meter]

User's Guide

CERTIFICATION, LIMITED WARRANTY, & LIMITATION OF LIABILITY

Applent Instruments, Inc. （shortened form **Applent**）certifies that this product met its published specifications at the time of shipment from the factory. Applent further certifies that its calibration measurements are traceable to the People's Republic of China National Institute of Standards and Technology, to the extent allowed by the Institution's calibration facility or by the calibration facilities of other International Standards Organization members.

This Applent instrument product is warranted against defects in material and workmanship for a period corresponding to the individual warranty periods of its component products. **The warranty period is 1 year and begins on the date of shipment.** During the warranty period, Applent will, at its option, either repair or replace products that prove to be defective. This warranty extends only to the original buyer or end-user customer of a Applent authorized reseller, and does not apply to fuses, disposable batteries or to any product which, in Applent's opinion, has been misused, altered, neglected or damaged by accident or abnormal conditions of operation or handling.

For warranty service or repair, this product must be returned to a service facility designated by Applent. The buyer shall prepay shipping charges to Applent and Applent shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Applent from another country.

Applent warrants that its software and firmware designated by Applent for use with an instrument will execute its programming instruction when properly installed on that instrument. Applent does not warrant that the operation of the instrument, or software, or firmware, will be uninterrupted or error free.

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

THIS WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. APPLENT SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, WHETHER ARISING FROM BREACH OF WARRANTY OR BASED ON CONTRACT, TORT, RELIANCE OR ANY OTHER THEORY.

Applent Instruments.Ltd
Changzhou,
Jiangsu,
China,
Rev.A2 January, 2005
Rev.B0 January, 2008

Contents

Figure Contents

Table Contents

1. Unpacking and Preparation

This chapter describes how to set up and start the AT5110/AT5120 Multi-Channel Resistance Meter.

- ☐ Incoming Inspection
- ☐ Power Requirements
- ☐ Setting up the Fuse
- ☐ How to Remove the Handle
- ☐ Environmental Requirements
- ☐ Cleaning

1.1 Incoming Inspection

After you receive the instrument, carry out checks during unpacking according to the following procedure.

WARNING

If the external face of the instrument (such as the cover, front/rear panel, LCD screen, power switch, and port connectors) appears to have been damaged during transport, do not turn on the power switch. Otherwise, you may get an electrical shock.

Make sure that the packing box or shock-absorbing material used to package the instrument has not been damaged.
Referring to <Packing List> in the packing box, check that all packaged items supplied with the meter have been provided as per the specified optioned.

NOTE

If an abnormality is detected, contact the company and transport the meter to your nearest Applent Instruments sales or service office. For inspection by the transport company, save the packing box, shock-absorbing material, and packaged items as you received them.

1.2 Setting up Fuse

~Line: 110VAC/220VAC, 50Hz/60Hz
Fuse: 250V 1A Slow Blow

Please use the following fuse type.
UL/CSA type, Slow-Blow, 5×20-mm miniature fuse, 1A, 250 V

When you need a fuse, contact your nearest Applent Instruments sales or service office. To verify and replace the fuse, remove the power cable and pull out the fuse holder.

1.3 Environmental Requirements

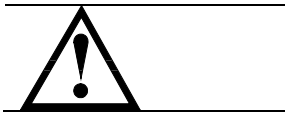
Set up the AT5130 where the following environmental requirements are satisfied.

Operating Environments
Ensure that the operating environment meets the following requirements.
Temperature: 0□C to 55□C
Temperature range at calibration: 23□C±5□C (<1□C deviation from the temperature when performing calibration)

Humidity: 15% to 85% at wet bulb temperature ≤ 40° C (non-condensation)
Altitude: 0 to 2,000m
Vibration: Max. 0.5 G, 5 Hz to 500 Hz

1.4 Cleaning

To prevent electrical shock, disconnect the AT5130 power cable from the receptacle before cleaning.
Use a dry cloth or a cloth slightly dipped in water to clean the casing.
Do not attempt to clean the AT5130 internally.

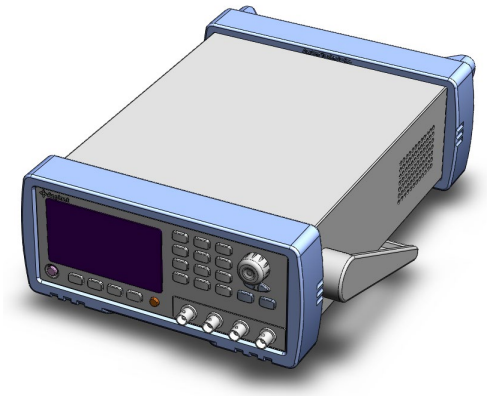


WARNING: Don't Use Organic Solvents (such as alcohol or gasoline) to clean the Instrument.

1.5 How to Remove the Handle

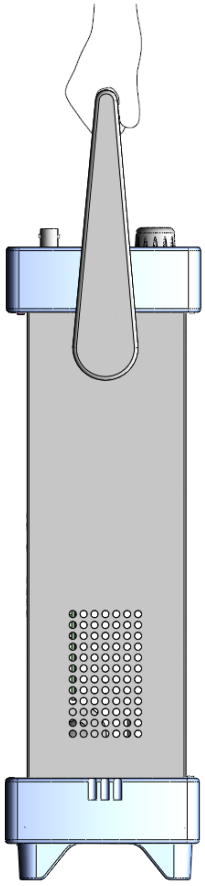
A handle kit is attached to the AT5130:

Figure 1-1 How to remove the handle

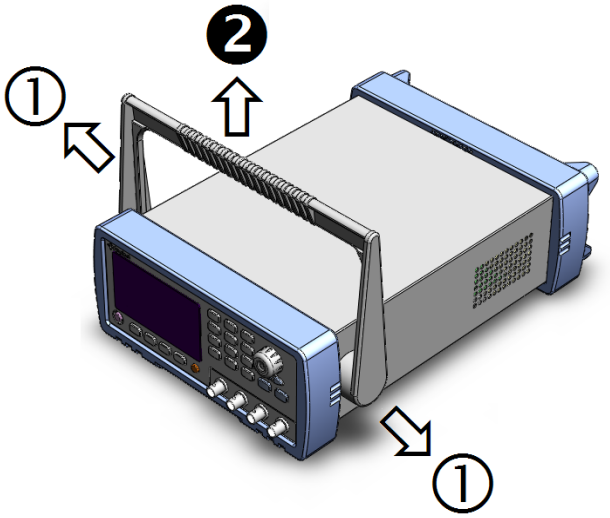


1 Retracted

2 Extended



3 Carrying Position



Remove Handle（*Lift the handle perpendicular to the unit while pulling it in the direction of 1.*）

2. Overview

This chapter contains general information about AT5130 .The information is organized as follows

- Introduction
- Main Specifications
- Feature overview

2.1 Introduction

Thank you for purchasing AT5130 Multi-Channel Resistance Meter.

AT5130 is a high-precision wide-range, high-performance ARM microprocessor-controlled multi-channel resistance meter. Its measurement range of 1μΩ～300kΩ, the maximum display number 30000.

Computer remote control commands compatible with SCPI (Standard Command for Programmable Instrument Programmable Instruments standard command set), complete and efficient remote control and data acquisition functions.

With its built-in comparator, the AT5130 can output comparison/decision results for sorting components into a maximum of ten channels. Furthermore, by using the handler interface, the AT5130 can be easily combined with a component handler, and a system controller to fully automate component testing, sorting, and quality-control data processing.

AT5130 measures of high, medium and low-value resistor; various switch contact resistance; connector contact resistance; relay line package and the contact resistance; transformers, inductors, motors, deflection coil winding resistance; wire resistance; cars, boats, aircraft riveting metal resistance; printed version of the line and pore of resistance and so on.

2.2 Main Specifications and Features

2.2.1 Ranging

Auto, Hold and Nominal range. Total 8 Ranges.
About Nominal ranges: (Applent new definition): The AT5130 will automatically select the best range according to the nominal value.

2.2.2 Measurement Speed

Slow:	3.4s/10-Channel
Medium:	830ms/10-Channel
Fast:	350ms/10-Channel
Ultra:	230ms/10-Channel

2.2.3 Trigger Mode

Include Internal, Manual, External and Bus Trigger.

2.2.4 Basic Accuracy

Slow Speed:	0.05%
Medium ：	0.2%
Fast and Ultra：	0.5%

2.2.5 Correction

Zero correction for all ranges to eliminate lead resistance's effect.

2.3 Main Functions

2.3.1 Correction Function

SHORT correction:
Eliminates measurement errors brought about by stray parasitic impedance in the test fixtures.

2.3.2 Comparator Function (Sorting)

The primary parameter can be sorted into ten NG Bin: CH1-CH20
The sequential mode or tolerance mode can be selected as the sorting mode.
Limit Setup
Absolute value, deviation value, and % deviation value can be used for setup.

2.4 Measurement Assistance Functions

2.4.1 Key Lock

The front panel keys can be locked.

2.4.2 Interface

RS-232 remote control
Support MAX 115200bps baud rate, Compatible with SCPI, ASCII transmission.
Handler Interface
Full opto-isolator、built-in pull-up resistor input and output port.
Support internal 5V and 24V external power supply.
Input：trigger signal
Output：output all sorting comparator result signal; measuring synchronizing signal （EOC）.

3. Startup

This chapter describes names and functions of the front panel, rear panel, and screen display and provides the basic procedures for operating AT5110.

- Front panel summary
- Rear panel summary
- Power On/Off
- Connect to Device under Test

3.1 Front panel

Figure 3-1 Front panel

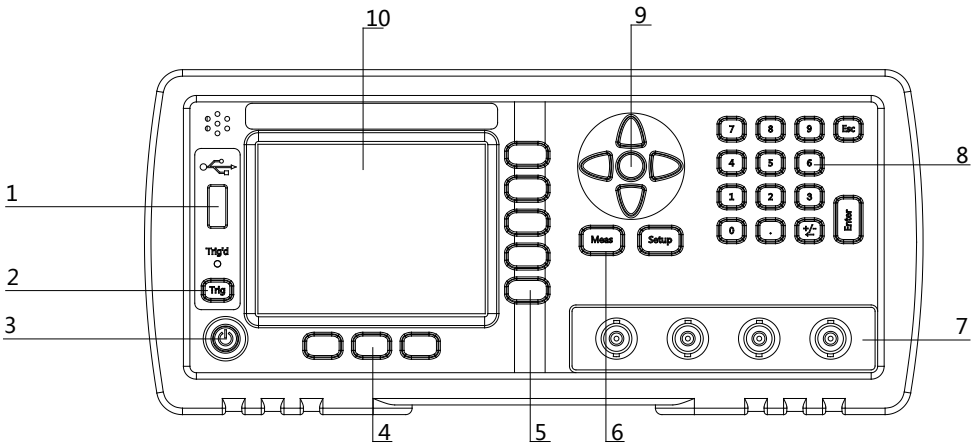


Table 3-1 Front panel description

No.	Description
1	USB Disk Port (USB-Host)
2	Trigger Key
3	Power Switch
4	System Key (Include File, System and Key Lock)
5	Soft Key
6	Menu key
7	UNKNOWN Terminal
8	Entry Key
9	Cursor Key
10	LCD Display

3.2 Rear Panel

Figure 3-2 Rear Panel

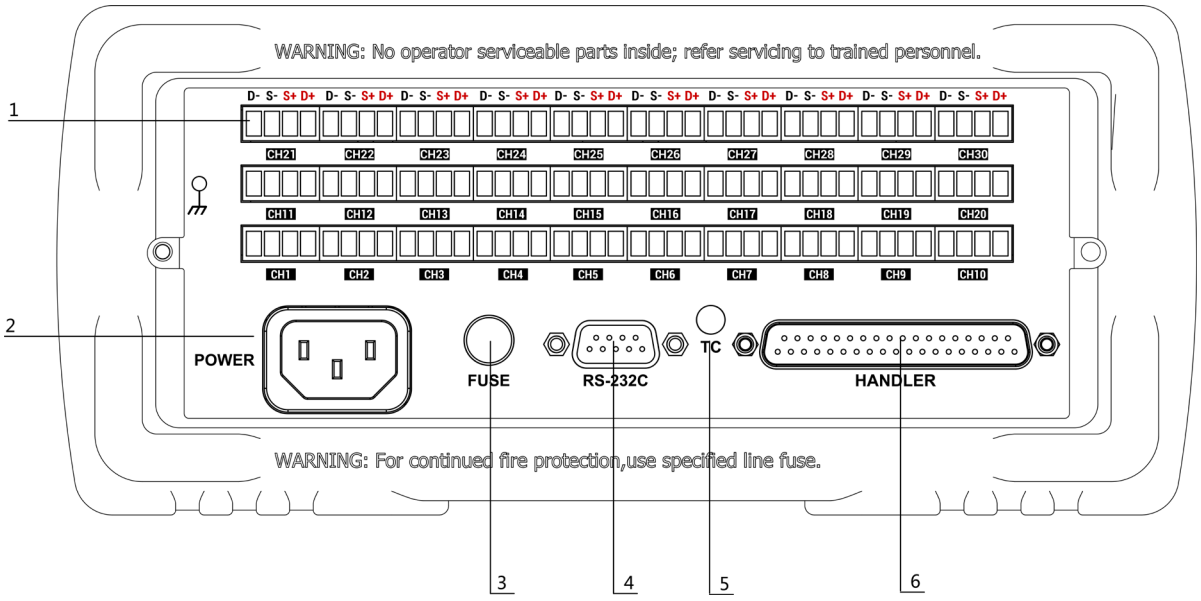


Table 3-2 Rear panel description

No.	Description
1	Test Terminal
2	AC Power Cord Receptacle
3	Fuse Holder
4	RS-232 Interface
5	Temperature Compensation Interface

3.3 Power On/Off

3.3.1 Line Power Connection

Power ON.

Power OFF.

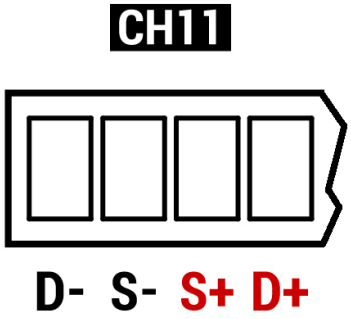
3.4 Warm-up Time

AT5130 is ready to be used as soon as the power-up sequence has completed. However, to achieve the accuracy rating, warm up the instrument for 15 minutes.

3.5 Connect to Device under Test (DUT)

The test terminals of all channels are on the rear panel.
Please insert test plug into the terminal along the rabbet direction.

Figure 3-3 Test Terminal of Each Channel



Warning:
No putting current source, voltage source directly access to test side. Energy storage device access to testing after discharging.

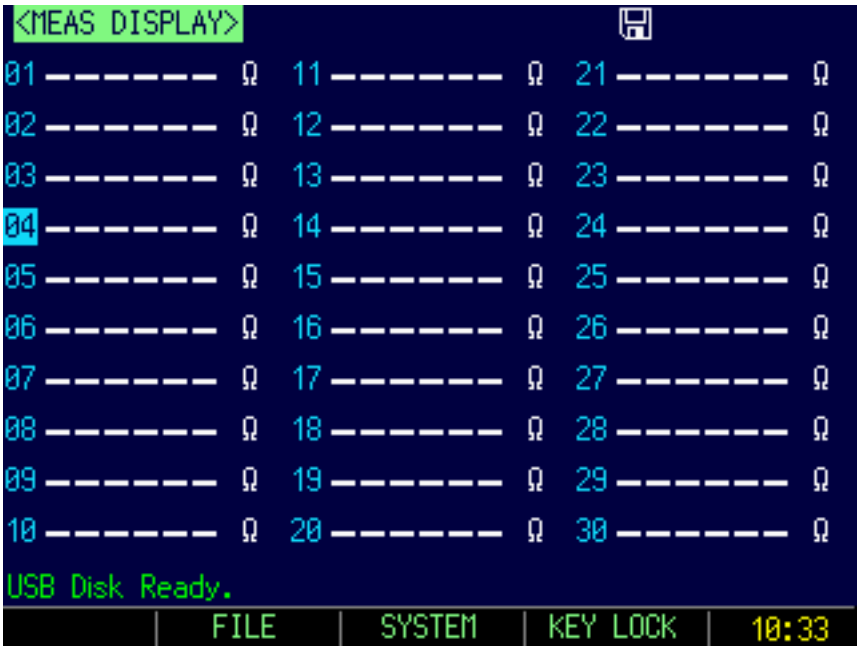
4. [Meas] Key

4.1 <MEAS DISPLAY> Page

When press the [Meas] key, the <MEAS DISPLAY> page appears.
The following measurement controls can be set.

- TRIG – Trigger Mode
- 01-30 – Set up the corresponding channel

Figure 4-1 AT5130 <MEAS DISPLAY> Page



5. [Setup] Key

This section includes the following information:

- SETUP page
- Temperature Compensation Setup
- SHORT Correction
- Comparator Setup

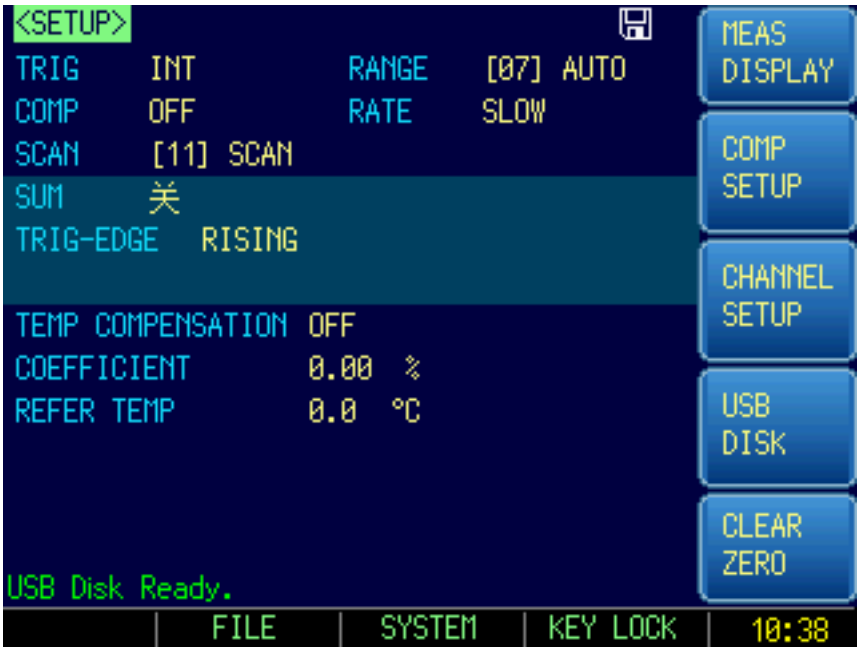
Every time or everywhere you can press the [Setup] key to open the <SETUP> page.

5.1 <SETUP> Page

NOTE

In <SETUP> page, the Instrument does not display test result and sorting result, and testing is continuing.

Figure 5-1 < SETUP> Page



5.1.1 Trigger Mode [TRIG]

SCPI Command: `TRIGger:SOURce {INT,MAN,EXT,BUS}`

AT5130 supports four trigger modes: INT (internal), EXT (external), MAN (manual) and BUS (RS-232).

Trigger Mode	Description
INT	Continuously repeats the measurement cycle.
MAN	Performs one cycle of measurement each time you press the [Trig] key.
EXT	Performs one cycle of measurement each time a rising pulse is input to the handler external trigger input pin on the rear panel.

	Please refer to the Handler section.
BUS	Performs one cycle of measurement each time it receives a trigger command sent via RS-232.

Procedure for choosing trigger mode [TRIG]

Step 1. Press the [Meas] key

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

Step 3. Use the soft keys to select desired trigger mode.

Soft key	Function
INT	Internal Trigger Mode
MAN	Manual Trigger Mode
EXT	External Trigger Mode
BUS	BUS Trigger Mode

5.1.2 Range [RANGE]

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

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

Table 5-1 Range Mode

Mode	Function overview	Advantage	Disadvantage
Auto range	Sets the optimum range automatically.	You don't need to select range.	The measurement time is longer due to the ranging time
Hold range	Measurement is performed with a fixed range	No ranging time is required	You need to select a proper range depending on the value of the DUT.
Nominal Range	Sets the optimum range depending on the nominal value.	You don't need to select range. No ranging time is required	

Table 5-2 Effective measurement range

Range No.	Range	Measurement range	Up	Down
0	10mΩ	0.0000mΩ~30.000mΩ	↓ 30mΩ	↑ 29mΩ
1	100mΩ	29.000mΩ~300.00mΩ	↓ 300mΩ	↑ 290mΩ
2	1Ω	290.00mΩ~3.0000Ω	↓ 3Ω	↑ 2.9Ω
3	10Ω	2.9000Ω~30.000Ω	↓ 30Ω	↑ 29Ω
4	100Ω	29.000Ω~300.00Ω	↓ 300Ω	↑ 290Ω
5	1kΩ	290.00Ω~3.0000kΩ	↓ 3kΩ	↑ 2.9kΩ
6	10kΩ	2.9000kΩ~30.000kΩ	↓	↑

7	100kΩ	29.000kΩ~300.00kΩ	30kΩ	29kΩ

Procedure for setting the range [RANGE]

Step 1. Press the [Setup] key

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

Step 3. Use the soft keys to select the range mode or range.

Soft key	Function
AUTO RANGE	
HOLD RANGE	
NORMINAL RANGE	
INCR +	Increments the range in the HOLD mode
DECR -	Decrements the range in the HOLD mode

Attention

When the range is automatic, the instrument will make a range prediction every measurement cycle, so the test speed will be slightly slower than the locked range. Moreover, frequent changes in the range during automatic measurement will cause a slower response. Normally, when the instrument is used as a sorting measurement, the automatic range method is not suitable.

For sorting users, please select the nominal range method.

5.1.3 Measurement Speed [RATE]

SCPI Command: `FUNCtion:RATE {SLOW,MED,FAST,ULTRA}`

SLOW, MED, FAST, ULTRA can be selected for AT5110.

SLOW mode will result in more stable and accurate measurement result.

When in Range-Hold mode:

Slow: 3.4s/10-Channel

Medium: 830ms/10-Channel

Fast: 350ms/10-Channel

Ultra: 230ms/10-Channel

Procedure for setting measurement speed mode

Step 1. Press the [Setup] key

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

Step 3. Use the soft keys to set measurement speed

Soft key	Function
SLOW	3.4s/10-Channel
MED	830ms/10-Channel
FAST	350ms/10-Channel
ULTRA	230ms/10-Channel

5.1.4 Turn the Comparator ON/OFF [COMP]

COMMREQ: `COMParator[:STATe] {ON,OFF,1,0}`

The comparator can be turned OFF or ON. After the comparator feature is turned OFF, the comparator result won't be displayed on <MEAS DISPLAY> screen and all handler functions will be turned off.

Procedure for turning ON/OFF the comparator [COMP]

Step 1. Press the [Setup] key

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

Step 3. Use the soft keys to turn ON/OFF the comparator feature.

Soft key	Function
OFF	
ON	

5.1.5 [SCAN] mode

SCPI Command: `FUNCtion:SCAN {ON,OFF,<channel number>}`

When the scan mode is set to SCAN, all channels will be measured one by one.

When the scan mode is set to SINGLE, only specified channel can be measured and displayed.

Procedure for setting scan mode

Step 1. Press the [Setup] key

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

Step 3. Use the soft keys to set scan mode

Soft key	Function
SCAN	Multi-channel loop test
SINGLE	The current channel is tested separately
INC +	Replace the channel number of the single-channel test
DEC -	Replace the channel number of the single-channel test

5.1.6 Turn Temperature Compensation ON/OFF

SCPI Command: `FUNCtion:TC {ON,OFF,1, 0}`

The AT5130 built in Temperature Compensation Interface.

The Temperature Compensation Formula is:

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

Where,

T0: Reference Temperature

T: Current Room Temperature

α : Temperature coefficient of reference temperature (%)

F1: Without compensation value

F2: Temperature compensated value

Procedure for turning the temperature compensation ON/OFF

Step 1. Press the [Setup] key

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

Step 3. Use the soft keys to turn on/off

Soft key	Function
ON	
OFF	

5.1.7 Temperature [COEFFICIENT] α

SCPI Command: `FUNCtion:TC:COEFficient <float>`

Before using the Temperature Compensation Function, you must enter the coefficient of the DUT material. Such as the coefficient of copper is 0.393%.

Procedure for inputting the coefficient:

Step 1. Press the [Setup] key
Step 2. Use the cursor key to select [COEFFICIENT] field
Step 3. Enter the coefficient value by using the entry keys and press the Enter to confirm.

5.1.8 Reference Temperature [REFER TEMP]

SCPI Command: `FUNCtion:TC:REFEr <float>`
The temperature unit is Celsius degree.

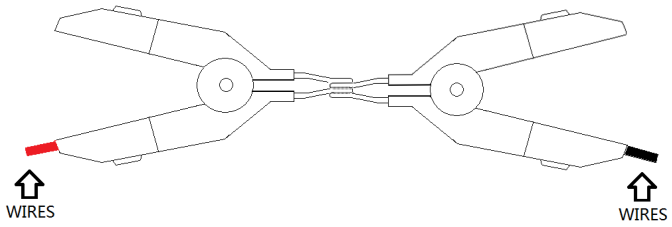
Procedure for inputting the reference temperature:

Step 1. Press the [Setup] key
Step 2. Use the cursor key to select [REFER TEMP] field
Step 3. Enter the temperature value by using the entry keys and press the Enter to confirm.

5.2 Short Correction

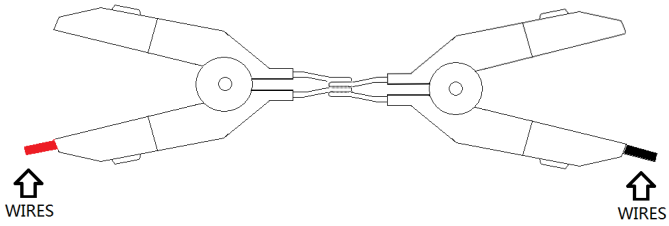
SCPI Command: `CORRect:SHORt`
The short correction feature of the AT5110/AT5120 compensates for any residual resistance that may exist within the interval from the calibration plane, which is determined by the selected cable length, to the DUT connecting points (see Figure 5-2)

Figure 5-2 Residual Resistance



To perform short correction

Step 1. Press the [Setup] key
Step 2. Short test clip
Step 3. Press the [Clear Zero] soft key.
Step 4. Press [OK] soft key, a dialog message displays “Short-circuit the test terminals”.
Please make sure the test clips short-circuit is like the following way:



Step 5. Press [OK] soft key. The AT5130 measures short resistance at the all ranges.
During the measurement, an “SHORT measurement in progress” dialog message is shown on the display.
When the measurement has finished, a message “Correction finished” will be displayed.

5.3 <Comparator> Page

Press [Setup] key and press [Comp SETUP] soft key to open <COMPARATOR> page. The comparator can be used to set the upper and lower limits of all channels. AT5130 needs to select the 11-20/21-30 channel through the 【Next】function key.

In order to make full use of the comparator, the instrument has a built-in Handler interface, which is used to output the comparison results of these files to a relay, PLC or industrial computer.

On the <Comparator> page, you can set the following:

☐[COMP] Switch and comparator input mode

☐【CODE】mode setting

☐ [NOM] Nominal value setting

☐ Enter the [upper limit] and [lower limit] data of each file

Figure 5-3 <COMPARATOR> Page

UNIFIED Setting

SEPARATED Setting

5.3.1 Turn the Comparator ON/OFF [COMP]

SCPI Command: `COMParator[:STATe] {ON,OFF,1,0}`

Procedure for turning ON/OFF the comparator [COMP]

Step 1. Press the [Meas] or [Setup] key and then press soft key [COMP SETUP]
Step 2. Use the cursor key to select [COMP] field
Step 3. Use the soft keys to turn ON/OFF the comparator feature.

Soft key	Function
OFF	
ON	

5.3.2 Comparator limit mode [MODE]

SCPI Command: `COMParator:MODE {ABS,PER,SEQ}`

The comparator built into the instrument has three comparison methods:

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

Absolute value (□) = measured value – nominal value

Deviation percentages (%) = (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 range of the file, so no nominal value is required to participate in the calculation.

To set up the comparator mode

Step 1. Press the [Meas] or [Setup] key
Step 2. Press the [COMP SETUP] soft key
Step 3. Use the cursor key to select [MODE] field
Step 4. Use the soft keys to select comparator mode

Soft key	Function
ABS	Switch the comparator to absolute value comparison mode
PER	Switch the comparator to the relative value comparison mode
SEQ	Switch the comparator to direct reading comparison method

5.3.3 Nominal value Input

`COMParator:NOMinal <float>`

The absolute value and relative value comparison method must input the nominal value. Direct reading value comparison method The nominal value does not participate in the calculation, but under the [nominal] range mode, the nominal value will participate in the range selection, so in the [nominal] range, no matter what comparison method, you need to enter the correct The nominal value of.To enter the nominal value.

Attention

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

The entered nominal value corresponds to the main parameter of the test [function]

■ **Input nominal value:**

Step 1. Press the [Meas] or [Setup] key
Step 2. Press the [COMP SETUP] soft key
Step 3. Use the cursor key to select [MODE] field
Step 4. Use the numeric keys to enter data, and the unit adopt function key to select

5.3.4 UNIFIED / SEPARATED Setup

SEPARATED SETUP: The instrument only adopt the Comparator data of CH1 to comparison.

UNIFIED SETUP: The instrument adopt all channel's comparator data to comparison.

5.3.5 Lower and upper Limits

SCPI Command: `COMParator:CH <1~20>,<float LOW>,<float upper>`

Each comparison method has independent upper and lower limits, and does not interfere with each other.

"Absolute value" comparison mode,input the absolute value of the main parameter, unit as ohm（Ω）.

"Relative value% " comparison mode,input the relative value of the main parameter, unit as %

"SEQ" comparison model, input the SEQ of main parameter, unit as ohm （Ω）

■ **Input limit value:**

Step 1. Enter into the [COMPARATOR] page

Step 2. Select [1] [LOWER] field

Step 3. Input data

The relative value% mode does not need to select the unit magnification, please enter the percentage value.

For absolute value and direct reading value SEQ mode, please adopt function key to select unit.

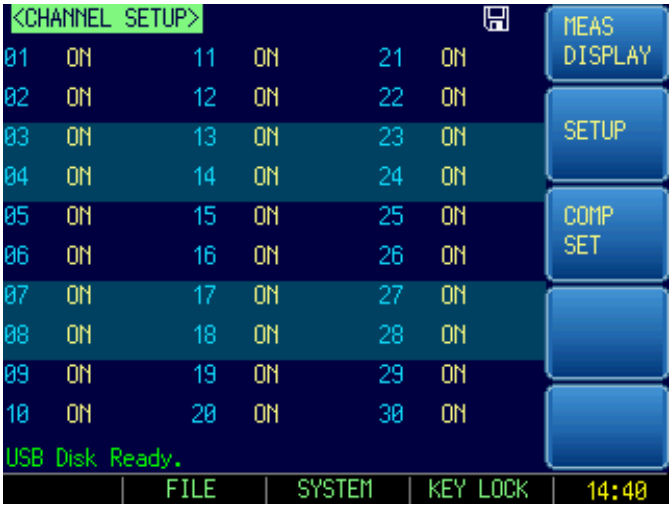
Step 4. Select [1] [UPPER] field

Step 5. Input data

Step 5. Repeat 2-5 to complete data input of others.

Attention	The instrument provides independent storage space for the three comparison methods, so the comparator data under each comparison method is independent of each other.

5.4 <CHANNEL SETUP>



Each channel can setup ON & OFF.

- **Setting method:**

Step 1. Press [SETUP] to enter into setup page, then press function key [CHANNEL SETUP] enter into <CHANNEL SETUP> page.

Step 2. Select channel no [01] ~[02]

Step 3. Adopt function key to select work methods.

6. System Configurations

This section includes the following information:
SYSTEM CONFIG page
SYSTEM INFO page
SYSTEM SERVICE page

6.1 <SYSTEM CONFIG> Page

When press the [Meas] or [Setup] key followed by [SYSTEM] bottom soft key, the <SYSTEM CONFIG> page appears.
Following information can be configured in the <SYSTEM CONFIG> page.

- LANGUAGE
- [DATE/TIME]
- Account settings [ACCOUNT]
- Beep setting [BEEP]
- RS-232 Baud rate setting [BAUD
- RS-232 Shake Hand [SHAKE HAND]
- RS-232 Result Send Mode [RESULT SEND]
- RS-232 Data Format and Handler EOC Mode [DATA/EOC]

Figure 6-1 <SYSTEM CONFIG> Page

6.1.1 To change system【LANGUAGE】

SCPI command: **SYSTem:LANGuage {ENGLISH,CHINESE,EN,CN}**

Chinese and English is available.

■ **To change language**

Step 1 Enter < SYSTEM CONFIG > page

Step 2 Use cursor key to select【LANGUAGE】

Step 3 Use soft key to select language:

Soft key	Function

[CHN]	Chinese
ENGLISH	English

6.1.2 Setting the system date and time

AT5130 features a built-in 24-hour clock.

To change the date

Step 1. Press the [Meas] or [Setup] key
Step 2. Press the [SYSTEM] bottom soft key.
Step 3. Use the cursor key to select date field
Step 4. Use the soft keys to edit date

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

To change the time

Step 1. Press the [Meas] or [Setup] key
Step 2. Press the [SYSTEM] bottom soft key.
Step 3. Use the cursor key to select time field
Step 4. Use the soft keys to edit time

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

6.1.3 Account Setting

The AT5130 has two accounts, administrator and user.

Administrator: All functions can be configured by administrator except <SYSTEM SERVICE> page.

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

To Change Account

Step 1. Press the [Meas] or [Setup] key
Step 2. Press the [SYSTEM] bottom soft key.
Step 3. Use the cursor key to select date field
Step 4. Use the soft keys to change account.

Soft key	Function
ADMIN	All functions are open except the [system services] page
USER	[system service] & [File] page can operation, but can't save the setted data.

To Change Administrator's Password

Step 1. Enter into <SYSTEM CONFIG> page

Step 2. Select [ACCOUNT]

Step 3. Adopt Function key to select:

Soft key	Function
CHANGE PASSWORD	Input password(less than 9 numbers).
DELETE PASSWORD	The password will be removed.

NOTE: If you forget your password, please send an E-Mail to tech@applent.com.

6.1.4 Beep Feature

SCPI Command: `COMParator:BEEP {OFF,GD,NG}`

To set up the beep feature

Step 1. Enter into <SYSTEM CONFIG> page

Step 2. Select [BEEP]

Step 3. Adopt function key to select

Soft key	Function
OFF	Turn off the beep feature.
GD	Beep while the comparator sorting result is GD
NG	Beep while the comparator sorting result is NG

6.1.5 RS-232 Baud Rate [BAUD]

The instrument has a build in RS-232 interface, the instrument will communicate with the host at the set baud rate, at the same time the keyboard is locked, after sensing the RS-232 interface has signal conversion.
In order to communicate correctly, please confirm that the baud rate is set up correctly, unable to communicate if the baud rate of the host and the instrument is different.
Instrument RS-232 adopt SCPI language to programming.

RS-232 configuration is as follows:
Data bits: 8-bit
Stop bits: 1-bit
Parity: none
Baud rate: Configurable

To set up the baud rate

Step 1. Enter into the <SYSTEM CONFIG> page

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

Step 3. Adopt function key to select.

Soft key	Function
1200	If you use a communication converter with optocoupler isolation, please use this baud rate.
9600	
38400	
57600	

115200	Recommend

6.1.6 RS-232 Shake Hand [SHAKE HAND]

AT5130 support RS232 “shake hand”.

AT5130 will return the whole command to host and then response the command when the [SHAKE HAND] is turned ON.

After the command shake hand is closed, the commands sent from the host to the instrument will be processed immediately

To setup the “Shake Hand”:

Step 1. Enter into <SYSTEM CONFIG>

Step 3. Use the cursor key to select [SHAKE HAND] field

Step 4. Use the soft keys to turn ON.

Soft key	Function
ON	
OFF	

NOTE: If you use Applent Software, please make sure that the [SHAKE HAND] is turned OFF.

6.1.7 RS-232 Result Send Mode [RESULT SEND]

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

When you set the [RESULT SEND] to AUTO, the test result will be sent to host every end of measurement instead of by sending “FETCH?” command.

- When the [DATA/EOC] field is set to [ALL CHANNELS], all channels’ results will return to host after end of measurement of all channels.

  The format is:

+9.9651e+01,NG,+9.9481e-01,GD,+9.9726e+00,NG,+9.9481e-01,GD,+7.6770e-04,NG,+9.9726e+00,NG,+1.0000e+20,GD,+1.0040e+04,NG,+9.9933e+02,NG,+1.1169e+04,NG <NL>

Where,“+1.0000e+20” stands for overload or open.

- When the [DATA/EOC] field is set to [ONE BY ONE], current channel’s result will return to host after end of measurement of this channel.

  The format like this:

01,+9.9651e+01,NG
02,+9.9481e-01,GD
03,+9.9726e+00,NG
04,+9.9481e-01,GD
05,+6.1717e-04,NG
06,+9.9726e+00,NG
07,+9.9331e-01,GD
08,+1.0040e+04,NG
09,+1.0008e+03,NG
10,+1.0989e+04,NG

To set up the result send mode:

Step 1. Enter into <SYSTEM CONFIG> page

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

Step 4. Use the soft keys to turn ON.

Soft key	Function
FETCH	Acquire the test result by sending “FETCH?” command only.
AUTO	return the result every EOM

6.1.8 Data format and EOC mode [DATA/EOC]

SCPI Command: `SYSTem:DATAmode {ALL,ONE}`

When the [RESULT SEND] field is set to [AUTO], The data sent after the instrument test is completed will be determined by this field, sending all channel data or the current channel data.

At the same time, this setting also affects the EOC signal of the Handler interface.

When [Data and EOC] is set to [All Channels], the EOC signal will be valid when testing all channels.

When [Data and EOC] is set to [ONE BY ONE], the EOC signal will be valid during the current channel test.

To set up the data format and EOC mode:

Step 1. Press the [Meas] or [Setup] key

Step 2. Press the [SYSTEM] bottom soft key.

Step 3. Use the cursor key to select [DATA/EOC] field

Step 4. Use the soft keys to turn ON.

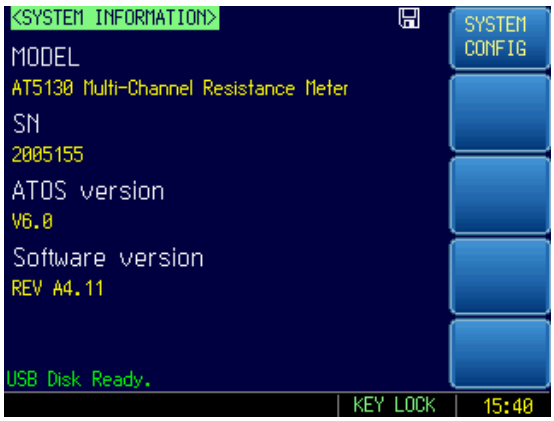
Soft key	Function
ALL CHANNELS	
ONE BY ONE	

6.2 <SYSTEM INFO> Page

When press the [Meas] or [Setup] key followed by [SYSTEM] bottom soft key, and press [SYSTEM INFO] soft key, the <SYSTEM INFO> page appears.

There are no configurable options in the <SYSTEM INFO> page.

Figure 6-2 <SYSTEM INFO> Page



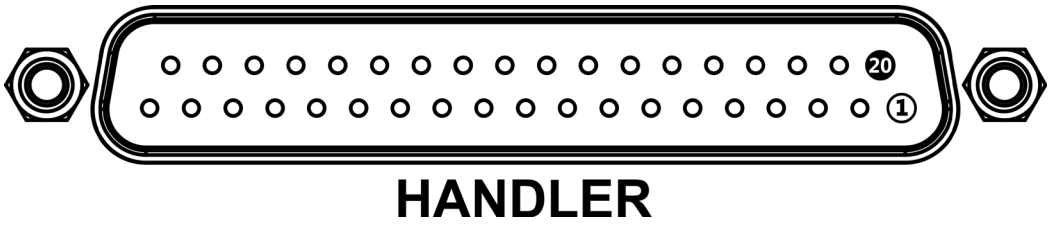
7. Handler Interface

This chapter provides information following:
Pin Assignment
Circuit Diagram
Timing Chart

The instrument provides users with a fully functional processor interface, which includes 10 channels of sorting output, EOC (test completion signal), TRIG (external trigger start) input and other signals. Through this interface, the instrument can easily complete automatic control functions with user system control components.

7.1 Pin Assignment

Figure 7-1 Pin Assignment



■ output terminal (All signals are low valid)

Table 7-1 output terminal pin description

Pin	Name	Description
1	CH1	1：OK, 0：NG
2	CH2	1：OK, 0：NG
3	CH3	1：OK, 0：NG
4	CH4	1：OK, 0：NG
5	CH5	1：OK, 0：NG
6	CH6	1：OK, 0：NG
7	CH7	1：OK, 0：NG
8	CH8	1：OK, 0：NG
9	CH9	1：OK, 0：NG
10	CH10	1：OK, 0：NG
11	CH11	1：OK, 0：NG
12	CH12	1：OK, 0：NG
13	CH13	1：OK, 0：NG
14	CH14	1：OK, 0：NG
15	CH15	1：OK, 0：NG
16	CH16	1：OK, 0：NG
17	CH17	1：OK, 0：NG

18	CH18	1 : OK, 0 : NG
19	CH19	1 : OK, 0 : NG
20	CH20	1 : OK, 0 : NG
21	CH21	1 : OK, 0 : NG
22	CH22	1 : OK, 0 : NG
23	CH23	1 : OK, 0 : NG
24	CH24	1 : OK, 0 : NG
25	CH25	1 : OK, 0 : NG
26	CH26	1 : OK, 0 : NG
27	CH27	1 : OK, 0 : NG
28	CH28	1 : OK, 0 : NG
29	CH29	1 : OK, 0 : NG
30	CH30	1 : OK, 0 : NG
31	NG	0 : NG, 1 : OK (all channels unqualified)
32	OK	0 : OK, 1 : NG (all channels are qualified)
33	EOC	0 : Under measurement , 1 : measurement completed

■ input terminal

Table 7-2 input terminal pin description

Pin	Name	Overview
37	Trigger input	Trigger input, internal build in 0.25W, 499 current limiting resistor

■ Power supply

Table 7-3 power supply terminal pin description

Pin	Name	Overview
34	GND	External power supply GND
35	External VCC	External power supply plus end

7.2 Connection

■ Use external power supply only

Please use external power supply and connect the following pins:

VCC：35

GND：34

■ Electrical Characteristics

power requirement： +3.3V~35VDC

Output Signal： Collector output of built-in pull-up resistor. Darlington drive, LOW level valid.

MAX voltage： Supply voltage

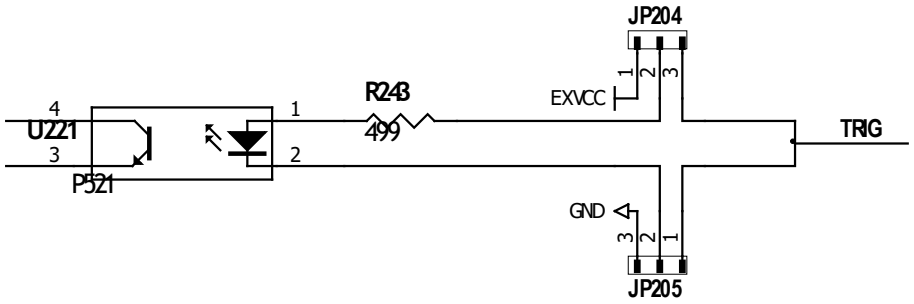
Input Signal:： Opto-isolator. LOW level valid.

MAX current： 50mA

Note：To avoid damage to interface, supply voltage cannot exceed power requirement.
To avoid damage to interface, please connect wires after power is turned off.
Output signal can control signal and small power consumption relay, but for big power consumption relay, please do not use internal power supply.

■ Typical Circuit Diagram of Handler Interface Input signals.

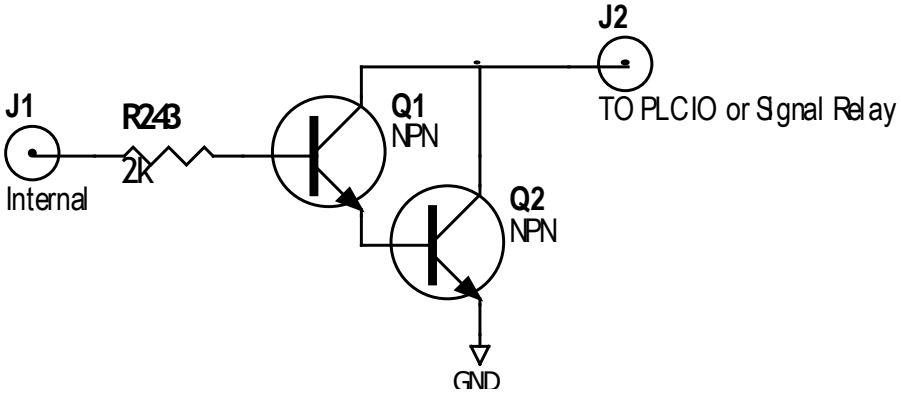
Figure 7-1 Schematic（Trig）



In figure：JP204 and JP205, factory configuration is 1-2 short circuit, trigger signal is rising edge trigger.
If trigger signal use falling edge trigger, please short circuit 2-3 for JP204 and JP205, and external VCC can be floating.

■ Typical Circuit Diagram of Handler Interface Output signals.

Figure 7-2 Schematic



8. Remote Control

This chapter provides the following information
About RS-232C
RS-232 connection
Select Baud Rate.
About SCPI

AT5130 use the RS-232 interface to communicate with the computer to complete all the instrument functions. User can compile various collection systems conveniently by standard SCPI.

8.1 About RS-232C

RS-232 is currently widely used serial communications standard, is also called asynchronous serial communications standard, it is applied to realize communication of PC and PC、 PC and peripheral. RS is the English abbreviation for "Recommended Standard" (recommended standard), 232 is standard number, this standard is officially announced by EIA in 1969.

Most configuration of serial port is not based on RS-232 standard: each port use 25-core or 9- core connector (now all PC use 9-core connector). The most common RS-232 signal is as below:

Table 8-1 Common RS-232 signal

Signal	Mark	25-core connector Pin No	9-core connector Pin No
Request To Send	RTS	4	7
Clear To Send	CTS	5	8
Data Set Ready	DSR	6	6
Data Carrier Detect	DCD	8	1
Data Terminal Ready	DTR	20	4
Transmit Data	TXD	2	3
Receive Data	RXD	3	2
Ground	GND	7	5
Request To Send	RTS	4	7

In addition, there is Min subset for RS232, instrument also adopts this connection method.

Table 8-2 RS-232 Standard minimum subset

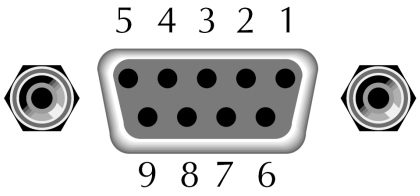
Signal	Mark	9-core connector Pin No
Transmit Data	TXD	2
Receive Data	RXD	3
Ground	GND	5

8.1.1 RS232C Connection

RS-232 serial interface can be connected to serial interface of controller (such as PC or PLC) by DB-9 cable.

Tip: instrument cannot use null modem cable.
Users can make it or buy 9-core cable from Applent Instruments.
If users make 3-core cable, should pay attention to:
• If using PC's built-in DB9 port, probably users need to short circuit 4-6、7-8 on PC port's DB-9 connector (pin).

Figure 8-1 RS-232 connector on rear panel



In order to avoid electrical shock, please disconnect power when insert and pull the connector.

TIP

■ Instrument's default communications setting:

Transmission mode: includes full duplex asynchronous communication of start bits and stop bits

Data bits: 8-bit

Stop bits: 1-bit

Parity bits: None

8.2 Handshake Protocol

Instrument adopts software handshake to reduce phenomenon of possible data loss or data error during communication.

Instrument can start using software handshake, high-level language software engineer should strictly do it according to the following handshake protocol to program communication software:

- Instrument terminator only accepts ASCII format, command response also returns ASCII code.
- **Command string that sent by host must be ended with NL ('\n') mark, instrument terminator will begin performing command string only after it receives end mark.**
- Instrument can set command handshake: instrument will return an identification code after it receives command and finishes processing.
-

Please reference following if the host can’ t receive the returned data from instrument

1. The software of handshake is turned off, please refer to the <SYSTM CONFIG> page to turn on。
2. Serial port connection failure, please check the cable connection
3. The communication format of the high-level language program on the computer is wrong. Please try to check the serial port number, the communication format is correct and the baud rate is the same as the instrument settings.
4. If the instrument is parsing the last command and the host cannot receive the response from the instrument, please try again later.

8.3 SCPI Language

SCPI-Standard Commands for Programmable Instruments is a common command that Applent adopts and it is used to test instrument. SCPI is also called TMSL-Test and Measurement System Language, which is developed by Agilent Technologies according to IEEE488.2, so far it is widely used by equipment manufacturers.

Instrument built-in terminator is responsible for parsing user’s various command formats. Because terminator is on the basis of SCPI protocol, but it is not fully consistent with SCPI, please read “SCPI command” chapter before using instrument.

9. SCPI Command Reference

This chapter includes the following content:

- **Terminator**
- **Command Syntax**
- **Query Syntax**
- **Query Response**
- **Command Reference**

This chapter provides descriptions of instrument's available SCPI commands sets, listed in functional subsystem order.

9.1 Terminator

Host can send a string of command to instrument, instrument terminator will begin parsing after it captures end mark（\n）or after input buffer overflows.

For example: Legal command string:

AAA:BBB CCC;DDD EEE;:FFF

Instrument terminator is responsible for parsing and performing all commands, before programming, users must know about parsing rules.

9.1.1 Terminator Rules

1. Terminator only parses and responds ASCII code's data.
2. **Command string must be ended with NL (' \n' ASCII 0x0A) mark, terminator will begin performing command string only after it receives end mark or after** buffer overflows.
3. If command handshake is turned on, every time terminator receives one string, it will promptly return this string to the host, only when host receives this returned string, can it continues sending the next string.
4. After terminator parses error, it will promptly stop parsing, and the current command is canceled.
5. When terminator parses the query command, it will terminate parsing this command string, the latter command string will be ignored.
6. When parsing command string, terminator is case insensitive.
7. Terminator supports command abbreviated form, please refer to the latter chapter regarding abbreviation norms.

9.1.2 Notation Conventions and Definitions

This chapter employs some marks, these marks are not a part of command tree; they are only for better understanding of command string.

< >	*the character in <> means this command's parameter*
[ ]	*the character in [] means optional command*
{}	*When there includes several parameter items in {}, means that users can only choose one item from it.*
( )	*the abbreviated form of parameter is put in ()*
Capital letter	*Abbreviated form of command.*

9.1.3 Command Structure

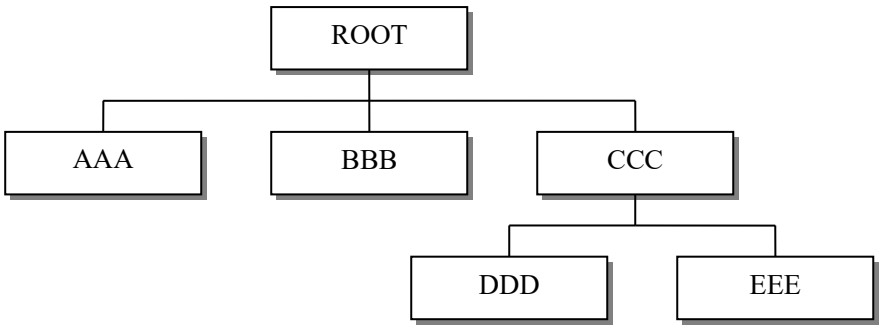
The SCPI commands are tree structured three levels deep. The highest level commands are called the subsystem commands in this manual. So the lower level commands are legal

only when the subsystem commands have been selected.

A colon (:) is used to separate the higher level commands and the lower level commands.

Semicolon (;) A semicolon does not change the current path but separates two commands in the same message.

Figure 9-1 Command Tree Example



Example

ROOT:CCC:DDD ppp
ROOT Subsystem Command
CCC Level 2
DDD Level 3
ppp Parameter

9.2 Command and Parameters

A command tree consists of header and parameters, it uses a space（ASCII: 20H）to separate in the middle.

Example

AAA:BBB 1.234
Command [Parameter]

9.2.1 Command

Command can be of the long form or the short form. The long form allows easier understanding of the program code and the short form allows more efficient use of the computer.

9.2.2 Parameter

- Single command word, no parameter.
  Example: AAA:BBB
- Parameter can be character string form, the abbreviation rules are the same as the rules for command.
  Example: AAA:BBB CCC
- Parameter can be numeric form
  - <*integer*> integer 123, +123, -123
  - <*float*> floating number
  1. <Fixfloat>：fixed point floating number：1.23, -1.23
  2. <Scifloat>：scientific notation floating number：1.23E+4, +1.23e-4
  3. <Mpfloat>: multiplier expressed by floating number: 1.23k, 1.23M,1.23G,1.23u

Table 9-1 Multiplier Mnemonics

Definition	Mnemonic
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

Multiplier is Case Insensitive, its writing style is different from standard name.

9.2.3 Separator

Instrument terminator only accepts allowed separators, terminator will occur E5 error if beyond this separator, and these separators include:

; Semicolon, used to separate two commands

Example：AAA:BBB 100.0;CCC:DDD

: colon, used for separate command tree, or restart command tree.

Example: AAA:BBB:CCC 123.4;:DDD:EEE 567.8

? question mark, used for query

Example: AAA?

□ space, used for separate parameter

Example: AAA:BBB□1.234

9.3 Command Reference

All commands in this reference are fully explained and listed in the following functional command order, the following is all subsystem

- DISPlay display SUBSYSTEM
- FUNCtion function SUBSYSTEM
- CORRection correction SUBSYSTEM
- COMParator comparator SUBSYSTEM
- SYSTem system SUBSYSTEM
- TRIGger trigger SUBSYSTEM
- FETCh? Fetch result SUBSYSTEM
- ERRor error information SUBSYSTEM

Common command：

- IDN? Information query SUBSYSTEM
- TRG trigger and acquire data

9.4 DISPlay Subsystem

The DISP Subsystem command group sets the display page.

Figure 9-1 DISP Command Tree

DISPlay	**:PAGE**	**{MEASurement, SETUp, COMParator,SYSTem, SYSTEMINFO(SINF)}**
	:LINE	**<string>**

9.4.1 DISP:PAGE

The :PAGE command sets the display page.

The :PAGE? Query returns the abbreviated page name currently displayed on the LCD

screen.

Command Syntax	**DISP:PAGE <*page name*>**
Parameter	**Where, <page name> is:** MEASurement Sets display page to MEAS DISPLAY SETUP Sets display page to SETUP COMParator Sets display page to COMPARATOR SYSTem Sets display page to SYSTEM CONFIG SYSTEMINFO [SINF] Sets display page to SYSTEM INFORMATION
Example	**SEND> DISP:PAGE setup<NL> //Set to the setup page**
Query Syntax	**DISP:PAGE?**
Query Response	**<*page name*>** **Meas** **Setu** **Syst** **Sinf** **comp**
Example	**SEND> DISP:PAGE?<NL>** **RET> meas<NL>**

9.4.2 DISP:LINE

The :LINE command enters an arbitrary comment line of up to 30 ASCII characters in the comment field.

Command Syntax	**DISP:LINE "<*string*>"**
Parameter	<string> is ASCII character string (30 ASCII characters)
Example	**SEND> DISP:LINE "This is a comment." <NL>**

9.5 FUNCtion Subsystem

The FUNCtion subsystem command group sets the measurement function, the measurement range, monitors parameter control.

Figure 9-2 FUNCtion Subsystem Tree

FUNCtion	**:RANGe**	**{Range Number, max, min}**	
		:MODE	**{AUTO,HOLD,NOMinal}**
	:RATE	**{SLOW,MED,FAST,ULTRA}**	
	:TC	: RATIO	**<float>**
		:REFEr	**<float>**
	:SCAN	**{<channel number>,on,off}**	

9.5.1 FUNCtion:RANGe

The FUNC:RANGe command sets the range.

Command Syntax	**FUNC:RANGe <RANGE NUMBER,*MIN*,*MAX*>**
Parameter	**Where, <RANGE NUMBER,MIN, MAX> is:** **0-7, The range number** **MIN, =Range 0** **MAX, =Range 7**
Example	**SEND> FUNC:RANG 5<NL> //Set range to [5] 1kΩ**
Query Syntax	**FUNC:RANGe?**
Query Response	**<*0-7*><NL>**
Example	**SEND> FUNC:RANG?<NL>** **RET> 5<NL>**

9.5.2 FUNCtion:RANGe:MODE

The FUNCtion:RANGe:MODE command sets the range mode.

Command Syntax	**FUNCtion:RANGe:MODE *{HOLD, AUTO, NOMinal}***
Example	**SEND> FUNC:RANG:MODE NOM<NL> //Sets to nominal range.**
Query Syntax	**FUNC:RANGe:MODE?**

Query Response	{HOLD,*AUTO,NOM*}

9.5.3 FUNCtion:RATE

The FUNCtion:RATE command sets the test speed.

Command Syntax	FUNCtion:RATE *{SLOW,MED,FAST,ULTRa}*
Example	SEND> FUNC:RATE FAST<NL> //Sets to FAST Speed
Query Syntax	FUNC:RATE?
Query Response	*{SLOW,MED,FAST,ULTR }*

9.5.4 FUNCtion:TC

The FUNC:TC command turns the temperature compensation function ON/OFF.

Command Syntax	FUNCtion:TC *{on,off,1,0}*
Example	SEND> FUNC:TC ON<NL>
Query Syntax	FUNC:TC?
Query Response	*{ON,OFF}*

9.5.5 FUNCtion:TC: RATIO

The FUNC:TC:RATI command sets the temperature coefficient.

Command Syntax	FUNCtion:TC:RATIo*{float}*
Example	SEND> FUNC:TC:RATI 0.394<NL> //set the temperature coefficient as 0.394%
Query Syntax	FUNC:TC:RATI?
Query Response	*{fixfloat}*
Example	*SEND> FUNC:TC:RATI <NL>* *RET> +0.3940*

9.5.6 FUNCtion:TC: REFEr

The FUNC:TC:REFE command sets the compensation reference temperature.

Command Syntax	FUNCtion:TC:REFEr *{float}*
Example	SEND> FUNC:TC:REFE 25<NL> //the unit is Celsius degree 25℃
Query Syntax	FUNC:TC:REFE?
Query Response	*{fixfloat}*
Example	*SEND> FUNC:TC:REFE? <NL>* *RET> +25.00*

9.5.7 FUNCtion:SCAN

The FUNC:SCAN command sets the scan mode.

Command Syntax	FUNCtion:SCAN *{ON,OFF,<channel number>}*
Example	SEND> FUNC:SCAN ON<NL> // SCAN ON SEND> FUNC:SCAN 5 // ONE BY ONE the 5 channel
Query Syntax	FUNC:SCAN?
Query Response	*<channel number>,{SCAN,SINGLE}*
Example	*SEND> FUNC:SCAN? <NL>* *RET> 5,SINGLE*

9.6 COMParator Subsystem

The COMParator subsystem command group sets the comparator function, including its ON/OFF setting, limit mode, and limit values.

Figure 9-3 COMParator Subsystem Command Tree

COMParator	[:STATe]	{OFF,ON,0,1}
	:BEEP	{OFF,GD,NG}
	:MODE	{ABS,PER,SEQ}
	:NOMinal	<float>
	:CH	<1~10>,<float LOW >,<float upper>

9.6.1 COMParator:STATe

The COMP:STATe command sets the comparator function to OFF or the total number of bins..

Command Syntax	`COMParator[:STATe] {ON,OFF,1,0}`
Example	`SEND> COMP:STAT ON<NL>` `SEND> COMP:STAT 0ff<NL>`
Query Syntax	`COMP:STAT?`
Query Response	`{on,off}`

9.6.2 COMParator:MODE

The :COMParator:MODE command sets the limit mode of the comparator function.

Command Syntax	`COMParator:MODE {ABS,PER,SEQ}`
Example	`SEND> COMP:MODE SEQ //Switch to sequential comparison`
Query Syntax	`COMParator:MODE?`
Query Response	`{abs,per,seq}`

9.6.3 COMParator:BEEP

COMP:BEEP sets the beep feature.

Command Syntax	`COMParator:BEEP <OFF,GD,NG>`
Example	`SEND> COMP:BEEP GD<NL>` `SEND> COMP:BEEP OFF<NL>`
Query Syntax	`COMParator:BEEP?`
Query Response	`<OFF,GD,NG>`

9.6.4 COMParator:NOMinal

The COMParator:NOMinal command sets the nominal value for the tolerance mode of the comparator function.

Command Syntax	`COMParator:NOMinal <float>`

Example	`SEND> COMP:NOM 1.0000k<NL> // Nominal value set as 1K`
	`SEND> COMP:NOM 1E3<NL> // Nominal value set as 1K`
	`SEND > COMP: NOM 1000 //Nominal value set as 1K`

Query Syntax	`COM:NOM?`
Query Response	`<scifloat>`
Example	`SEND> COMP:NOM?<NL>` `RET>COMP:NOM 1.00000E+03<NL> // Nominal value set as 1K`

9.6.5 COMParator:CH

The COMParator:CH command sets the low/high limit values of each channel

Command Syntax	`COMParator:CH <1~10>,<float low>,<float upper>`
Example	`SEND> COMP:CH 2,-10,10<NL>`
Query Syntax	`COMParator:CH? <1~10>`
Query Response	`<socifloat>,<socifloat>`
Example	`SEND> COMP:CH? 1` `RET> 1.000000e+01,+1.000000e+01<NL>`

9.7 TRIGger Subsystem

Set trigger source and generate a trigger

Figure 9-4 TRIGger Subsystem Command Tree

`TRIGger`	`[:IMMediate]`	
	`:SOURce`	`{INT,MAN,EXT,BUS}`
`TRG`		

9.7.1 TRIGger[:IMMediate]

TRIG[:IMM] when the trigger source set as BUS,a trigger is generated, but won't return the data that triggers the test. Have to adopt TRG instruction if you want to return the

data.

Command Syntax	**TRIGger[:IMMediate]**
Example	**SEND> TRIG<NL>**
Note	**This command can be ONLY used in BUS trigger mode.**

9.7.2 TRIGger:SOURce

The TRIGger:SOURce command sets the trigger mode.

Command Syntax	**TRIGger:SOURce {INT,MAN,EXT,BUS}**
Parameter	Where, {INT,MAN,EXT,BUS} is INT Internal Trigger Mode MAN Manual Trigger Mode EXT External Trigger Mode BUS BUS Trigger Mode
Example	**SEND> TRIG:SOUR BUS<NL> // Set as Bus trigger mode**
Query Syntax	**TRIGger:SOURce?**
Query Response	**{INT,MAN,EXT,BUS}**

9.7.3 TRG

The TRG command (trigger command) performs the same function as the Group Execute Trigger command but return the test result.

Command Syntax	***TRG**
Example	**SEND> TRG // The instrument tests once and returns the test data** **RET>** **+9.9651e+01,NG,+9.9481e-01,GD,+9.9575e+00,NG,+9.9481e-01,GD** **,+6.0212e-04,NG,+9.9575e+00,NG,+9.9331e-01,GD,+1.0025e+04,N** **G,+1.0008e+03,NG,+1.1139e+04,NG**
Note	This command can be used ONLY in BUS trigger mode.

9.8 FETCh Subsystem

FETCh? get test data. Before using this command, you need to set the [Result Send] field under the <System Config> page to [FETCH].

FETCh? The command will return the test data of all channels.

Figure 9-5 FETCh Subsystem Command Tree

FETCh?	

9.8.1 FETCh?

The FETCh? retrieves the latest measurement data and comparator result.

Query Syntax	**FETCh?**
Query Response	**<scifloat>,{GD,NG,xx},** **<scifloat>,{GD,NG,xx},** **<scifloat>,{GD,NG,xx},** **<scifloat>,{GD,NG,xx},** **<scifloat>,{GD,NG,xx},** **<scifloat>,{GD,NG,xx},** **<scifloat>,{GD,NG,xx},** **<scifloat>,{GD,NG,xx},** **<scifloat>,{GD,NG,xx}**
Example	**SEND> FETC?<NL>** **RET>** **+9.9651e+01,NG,+9.9481e-01,GD,+9.9575e+00,NG,+9.9481e-01,GD** **,+6.0212e-04,NG,+9.9575e+00,NG,+9.9331e-01,GD,+1.0025e+04,N** **G,+1.0008e+03,NG,+1.1139e+04,NG<NL>**

9.9 SYSTem subsystem

Figure 9-6 SYSTem

SYSTem	:SENDmode	{FETCH,AUTO}
	:DATAmode	{ALL,ONE}
	:LANGuage	{ENGLISH,CHINESE, EN,CN}

9.9.1 SYSTem:LANGuage

Instrument language setup

Command Syntax: **SYSTem:LANGuage {ENGLISH,CHINESE,EN,CN}**

Example: SEND> **SYST:LANG EN** //Set as English display

Query Syntax: **SYST:LANG?**

Query Response: **{ENGLISH,CHINESE}**

9.9.2 SYSTem:SENDmode

SYST:SEND command sets the RS-232 Result Send Mode.

Command Syntax	**SYSTem:SENDmode {FETCH,AUTO}**
Example	**SEND> SYST:SEND AUTO**<NL>
Query Syntax	**SYST:SEND?**
Query Response	**<FETCH,AUTO >**

9.9.3 SYSTem:DATAmode

SYST:DATA command sets the RS-232 Result Data Format and EOC Mode..

Command Syntax	**SYSTem:DATAmode {ALL,ONE}**
Example	**SEND> SYST:DATA ONE**<NL>
Query Syntax	**SYST:DATA?**
Query Response	**<ALL,ONE>**

9.10 CORRection Subsystem

The CORRection subsystem command group to execute the short-circuit clear zero correction function.

Figure 9-7 CORRection Subsystem Command Tree

CORRect	:SHORt	

9.10.1 CORRection:SHORt

The CORRection:SHORt command execute the short-circuit clear zero for all ranges.

Command Syntax	**CORRection:SHORt**
Example	**SEND> CORRection:SHOR**<NL> **RET> Short Clear Zero Start.** <NL> **RET> PASS**<NL>

9.11 IND? Subsystem

IDN? Subsystem tree

IND?	

IDN? Subsystem is used for return instrument's version.

Query Syntax: **IDN?**

Query Response: **<Model>**,<Version>,<Serial Number>,<Company Name>

Example: SEND> **IDN?**

RETURN> **5130,REV D1.0,0000000,Applent Instruments**

10. Modbus (RTU)

This chapter describes the following specifications
- Data Format - understand the Modbus communication format
- Function
- Variable Area
- Function Code

10.1 Data Format

We follow the Modbus (RTU) communication protocol, the Instrument will respond to the commands of host computer and return a standard response frame.

You can contact with our sales department for communication test tool, which has Modbus communication debugging method. contains CRC-16 calculator & floating-point numbers converted to Modbus floating-point format.

10.1.1 Instruction frame

Picture 10-1 Modbus instruction frame

Table 10-1 Description of Instruction frame

	At least need 3.5 character time 's squelch interval
Slave station address	1 byte Modbus can support 00~0x63 slave station Unified broadcasting specify as 00 In an instrument without RS485 option the default slave address is 0x01.
Function code	1 byte 0x03：read more registers 0x04：=03H，don' use 0x06：write to a single register, can use 10H instead 0x08: Echo Test（only used for debugging） 0x10：write to multiple registers
Data	Specify register address, number and content
CRC-16	2 byte, low bit in front Cyclic Redundancy Check Will calculate all data from the slave address to the end of the data, get CRC16 check code.
	At least need 3.5 character time's squelch interval

10.1.2 CRC-16 Calculation methods

1. Set the initial value of the CRC-16 register as 0xFFFF.
2. Perform XOR operation on the CRC-16 register and the first byte data of information, and return the calculation result to the CRC register.
3. Fill the MSB with 0, while shifting the CRC register to the right by 1 bit.
4. If the bit moved from LSB is "0" repeat steps (3)(deal with next shifting). if the bit moved from LSB is "1", will perform XOR calculation on the CRC register and 0xA001, return the results to CRC register.
5. Repeat steps of (3) & (4) until moved to 8 bit.
6. If the information processing hasn't ended, will operation XOR on CRC register and the next 1 byte of information and return to the CRC register, will repeat executive from step (3)
7. The result of the calculation (the value of the CRC register) appended from lower byte to the information.

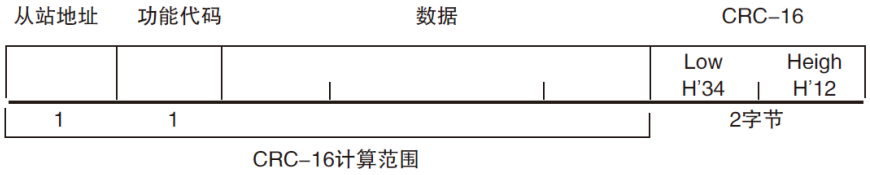
Following is a VB language of CRC calculation function:

```
  Function CRC16(data() As Byte) As Byte()
  Dim CRC16Lo As Byte, CRC16Hi As Byte   'CRC Register
      Dim CL As Byte, CH As Byte       'Polynomial code&HA001
      Dim SaveHi As Byte, SaveLo As Byte
      Dim i As Integer
      Dim flag As Integer
      CRC16Lo = &HFF
      CRC16Hi = &HFF
      CL = &H1
      CH = &HA0
      For i = 0 To UBound(data)
      CRC16Lo = CRC16Lo Xor data(i) '
          For flag = 0 To 7
              SaveHi = CRC16Hi
              SaveLo = CRC16Lo
              CRC16Hi = CRC16Hi \ 2 'High Position move right 1  bit .
              CRC16Lo = CRC16Lo \ 2  'Low  position move right 1 bit.
 If ((SaveHi And &H1) = &H1) Then 'if the last bit of high byte is
1
     CRC16Lo = CRC16Lo Or &H80   ' after the lower byte move right
  add 1 in front
      End If            ' otherwise will add 0 automatic
      If ((SaveLo And &H1) = &H1) Then 'if LSB is 1, will XOR with
  the polynomial code
                    CRC16Hi = CRC16Hi Xor CH
                CRC16Lo = CRC16Lo Xor CL
              End If
          Next flag
      Next i
      Dim ReturnData(1) As Byte
      ReturnData(0) = CRC16Hi       'CRC 高位 high bit
      ReturnData(1) = CRC16Lo       'CRC 低位 low bit
      CRC16 = ReturnData
   End Function
```

"Applent instrument communication test tool" has Modbus communication debug method. Inculding CRC-16 calculator.

Calculate CRC-16 data needs to be appended to the end of the instruction frame .Example：1234H：

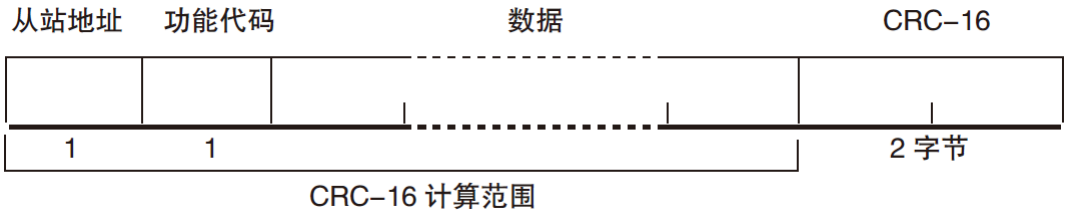
Picture 10-2 Modbus add CRC-16 value



10.1.3 Response Frame

Other slave address instruments will return a Response frame, unless 00H slave address broadcast instruct.

Picture 10-3 Normal Response Frame



Picture 10-4 Abnormal Response Frame

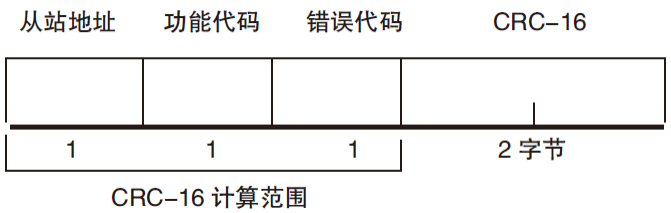


Table 10-2 Abnormal Response Frame explain

Slave station address	1byte returned from slave station address as is
Function code	1byte Function code logic of instruction frame（OR）BIT7（0x80）， Example：0x03 OR 0x80 = 0x83
Error Code	Abnormal Code： 0x01 Function Code Error（Not support Function Code) 0x02 Register Error（ Register not existed） 0x03 Data Error 0x04 Execution Error
CRC-16	2 bytes，Low Bit Ahead Cyclic Redundancy Check Calculate all the data from the slave address to the end of the data to get the CRC16 check code

10.1.4 No Response

Following situation,the instrument won't deal anything, no response result the communication overtime.

1. Slave station address Error
2. Transmission Error
3. CRC-16 Error
4. Wrong number of digits, Example: Function code 0x03 total bit should be 8, the received digits should less than 8 or more than 8 bytes.
5. When slave station address is 0x00, represent broadcast address, instrument no response.

10.1.5 Error code

Table 10-3 Explain of Error code

Error	Name	Explain	priority

code			
0x01	Function code error	function code not existed	1
0x02	Register error	Register not existed	2
0x03	Data error	Number of register or number of bytes Error	3
0x04	Execution Error	The data is illegality data, the written data is not within the allowable range	4

10.2 Function code

The instrument only supports following function codes,other function codes will response to Error frames.

Table 10-4

Function Code	Name	Explain
0x03	read more registers	read more consecutive registers data
0x04	Same as 0x03	Adopt 0x03 to instead
0x08	Echo test	The received data returned as it is
0x10	Write to several registers	write to several consecutive registers

10.3 Register

The number of Register is 2 bytes , so have to write 2 bytes each time, for example, the speed register is 0x3002, data is 2 bytes, numerical value have to write 0x0001

Data：

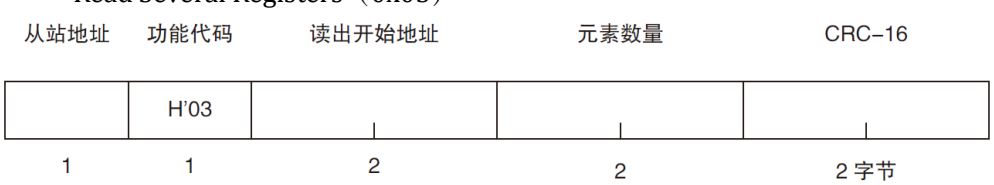
Instrument supports the following values：

1. 1 register，double byte（16 bits）integer，example：0x64 → 00 64
2. 2 registers，four bytes（32 bits）integer，example：0x12345678 → 12 34 56 78
3. 2 registers，four bytes（32 bits）float-point number with single precision，3.14 → 40 48 F5 C3

"Applent instrument communication test tool" with Modbus communication debug method. Include float-point number transverter.

10.4 Read Several Registers

Picture 10-5 Read Several Registers（0x03）



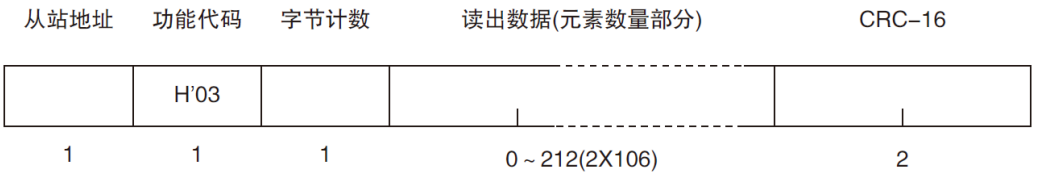
The function code of read several register is 0x03.

Table 10-5

Name	Name	Description
	Slave station address	without specified RS485 address, the default is 01
0x03	Function code	

	Start address	Please refer to Modbus Instructio set for start address of register
	Read quantity of register 0001~006A（106）	Read quantity of register continuous.please refer to Modbus instruction set, to assure the address of register existed, otherwise will return back to error frame
CRC-16	Check Code	

Picture 10-6 Read several registers（0x03）Respond frame



Name	Name	Description
	Slave station address	Return back as it is
0x03 Or 0x83	Function code	No abnormality：0x03 Error code：0x83
	Bytes	=quantity of register x 2 Example：1pcs of register turn back to 02
	Data	Read data
CRC-16	Check code	

10.5 Write Into More Registers

Picture 10-7 Write into more registers（0x10）

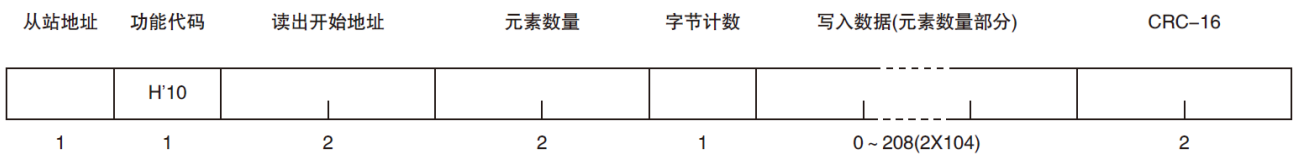
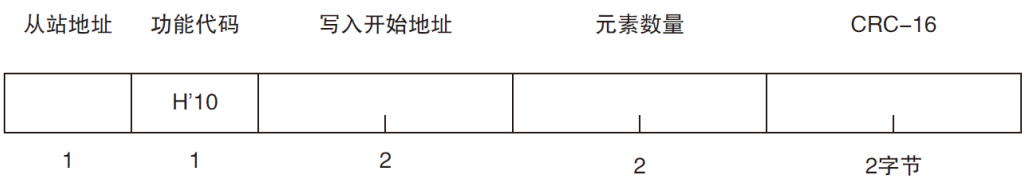


Table 10-6 Write into more registers

Name	Name	Description
	Slave station address	When no RS485 address is specified, the default is 01
0x10	Function code	
	Start address	The start address of register, please refer to Modbus instruction set
	Write into quantity of registers 0001~0068（104）	The quantity of registers read continuously. Please refer to the Modbus instruction set to ensure that these register addresses are existed, otherwise an error frame will be returned.
	Bytes	=Quantity of register x 2
CRC-16	Check code	

Picture 10-8 Write into more register（0x03）respond frame



Name	Name	Description
	Slave station	Return back as it is

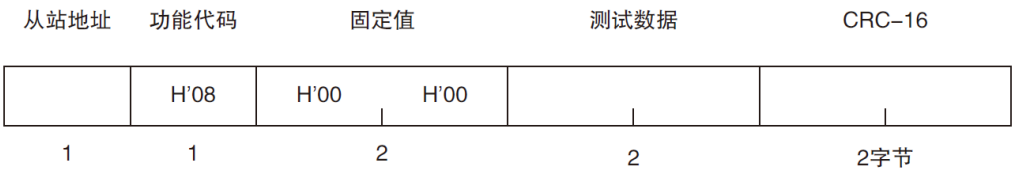
	address	
0x10 Or 0x90	Function code	No abnormality：0x10 Error code：0x90
	Start address	
	Quantity of register	
	CRC-16 check code	

10.6 ECHO TEST

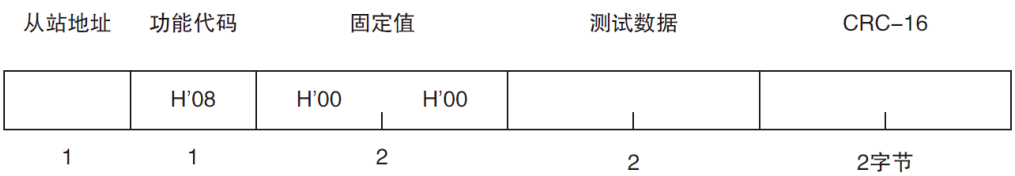
Echo Test Function Code 0x08, for debug Modbus。

Picture 10-9 Echo test（0x08）

指令帧



响应帧



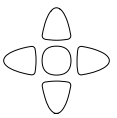
Name	Name	Description
	Slave station address 从站地址	Return back as it is
0x08	Function code 功能码	
	Fixed value 固定值	00 00
	Test data	Any values：such as 12 34
	CRC-16 check code	

Example：

Suppose the test data as 0x1234：

指令：	01	08	00 00	12 34	ED 7C(CRC-16)
响应：	01	08	00 00	12 34	ED 7C(CRC-16)

11. Modbus（RTU）



- Address of Register

"Applent Instrument Communication Test Tool" has Modbus communication debugging methods, contains CRC-16 calculator and floating-point numbers converted to Modbus floating-point format.

Unless special declare, all numeric values of command and response frames of following description are 16 hex data.

11.1 OVERVIEW OF REGISTERS

All address of registers are under following, will return to error code 0x02 for any not existed address.

Table 11-1 overview of registers

Add of Registers	Name	Numerical value	Description
2000	Read test result of Channel 1	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2002	Read test result of Channel 2	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2004	Read test result of Channel 3	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2006	Read test result of Channel 4	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2008	Read test result of Channel 5	4 byte floating point character order ABCD	Read only, data occupy 2 registers
200A	Read test result of Channel 6	4 byte floating point character order ABCD	Read only, data occupy 2 registers
200C	Read test result of Channel 7	4 byte floating point character order ABCD	Read only, data occupy 2 registers
200E	Read test result of Channel 8	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2010	Read test result of Channel 9	4 byte floating point character order ABCD	Read only, data occupy 2 registers

2012	Read test result of Channel 10	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2014	Read test result of Channel 11	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2016	Read test result of Channel 12	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2018	Read test result of Channel 13	4 byte floating point character order ABCD	Read only, data occupy 2 registers
201A	Read test result of Channel 14	4 byte floating point character order ABCD	Read only, data occupy 2 registers
201C	Read test result of Channel 15	4 byte floating point character order ABCD	Read only, data occupy 2 registers
201E	Read test result of Channel 16	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2020	Read test result of Channel 17	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2022	Read test result of Channel 18	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2024	Read test result of Channel 19	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2026	Read test result of Channel 20	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2028	Read test result of Channel 21	4 byte floating point character order ABCD	Read only, data occupy 2 registers
202A	Read test result of Channel 22	4 byte floating point character order ABCD	Read only, data occupy 2 registers
202C	Read test result of Channel 23	4 byte floating point character order ABCD	Read only, data occupy 2 registers
202E	Read test result of Channel 24	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2030	Read test result of Channel 25	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2032	Read test result of Channel 26	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2034	Read test result of Channel 27	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2036	Read test result of Channel 28	4 byte floating point character order ABCD	Read only, data occupy 2 registers

2038	Read test result of Channel 29	4 byte floating point character order ABCD	Read only, data occupy 2 registers
203A	Read test result of Channel 30	4 byte floating point character order ABCD	Read only, data occupy 2 registers
2100	Read the comparator results of channels	4 byte integer	Read only, data occupy 2 registers Each channel result occupy 1 bit
0000	Version number	4 byte integer	Read only,data occupy 2 registers
3000	Range	0000~0007	Read & write register, 2 byte integer
3001	Automatic range	0000：Auto 0001：Manual 0002：Nominal	Read & write register, 2 byte integer
3002	Test speed	0000：Slow 0001：Medium 0002：Fast 0003：High speed	Read & write register, 2 byte integer
3005	language	0000：English 0001：Chinese	Read & write register, 2 byte integer
3006	beep	0000：OFF 0001：OK-NG 0002：NG	Read & write register, 2 byte integer
3100	Comparator status	0000：OFF 0001：ON	Read & write register, 2 byte integer
3101	Comparator mode	0000：ABS 0001：PER 0002：SEQ	Read & write register, 2 byte integer
3102	Comparator setting way	0000：Unified 0001：Separated	Read & write register, 2 byte integer
310A	Norminal valve	4 byte floating number	Read & write register,data occupy 2 registers.
3110	CH1 lower limit valve	4 byte floating numbe	Read & write register,data occupy 2 registers.
3112	CH1 upper limit valve	4 byte floating numbe	Read & write register,data occupy 2 registers.
3114	CH2 lower limit valve	4 byte floating numbe	Read & write register,data occupy 2 registers.
3116	CH2 upper limit valve	4 byte floating numbe	Read & write register,data occupy 2 registers.
3118	CH3 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
311A	CH3 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
311C	CH4 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
311E	CH4 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3120	CH5 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3122	CH5 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.

3124	CH6 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3126	CH6 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3128	CH7 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
312A	CH7 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
312C	CH8 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
312E	CH8 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3130	CH9 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3132	CH9 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3134	CH10 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3136	CH10 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3138	CH11 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
313A	CH11 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
313C	CH12 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
313E	CH12 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3140	CH13 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3142	CH13 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3144	CH14 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3146	CH14 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3148	CH15 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
314A	CH15 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
314C	CH16 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
314E	CH16 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3150	CH17 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3152	CH17 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3154	CH18 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3156	CH18 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3158	CH19 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
315A	CH19 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
315C	CH20 lower limit value	4 byte floating numbe	Read & write register,data occupy

			2 registers.
315E	CH20 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3162	CH21 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3164	CH21 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3166	CH22 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
3168	CH22 upper limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
316A	CH23 lower limit value	4 byte floating numbe	Read & write register,data occupy 2 registers.
316C	CH23 upper limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
316E	CH24 lower limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3170	CH24 upper limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3172	CH25 lower limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3174	CH25 upper limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3176	CH26 lower limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3178	CH26 upper limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
317A	CH27 lower limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
317C	CH27 upper limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
317E	CH28 lower limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3180	CH28 upper limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3182	CH29 lower limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3184	CH29 upper limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3186	CH30 lower limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3188	CH30 upper limit	4 byte floating numbe	Read & write register,data occupy 2 registers.
3201	CH1 0：off，1：on	2 byte integer	Register write only, data 2 byte
3202	CH2 0：off，1：on	2 byte integer	Register write only, data 2 byte
3203	CH3 0：off，1：on	2 byte integer	Register write only, data 2 byte
3204	CH4 0：off，1：on	2 byte integer	Register write only, data 2 byte
3205	CH5 0：off，1：on	2 byte integer	Register write only, data 2 byte
3206	CH6 0：off，1：on	2 byte integer	Register write only, data 2 byte
3207	CH7 0：off，1：on	2 byte integer	Register write only, data 2 byte
3208	CH8 0：off，1：on	2 byte integer	Register write only, data 2 byte
3209	CH9 0：off，1：on	2 byte integer	Register write only, data 2 byte
320A	CH10 0：off，1：on	2 byte integer	Register write only, data 2 byte
320B	CH11 0：off，1：on	2 byte integer	Register write only, data 2 byte

320C	CH12 0：off，1：on	2 byte integer	Register write only, data 2 byte
320D	CH13 0：off，1：on	2 byte integer	Register write only, data 2 byte
320E	CH14 0：off，1：on	2 byte integer	Register write only, data 2 byte
320F	CH15 0：off，1：on	2 byte integer	Register write only, data 2 byte
3210	CH16 0：off，1：on	2 byte integer	Register write only, data 2 byte
3211	CH17 0：off，1：on	2 byte integer	Register write only, data 2 byte
3212	CH18 0：off，1：on	2 byte integer	Register write only, data 2 byte
3213	CH19 0：off，1：on	2 byte integer	Register write only, data 2 byte
3214	CH20 0：off，1：on	2 byte integer	Register write only, data 2 byte
3215	CH21 0：off，1：on	2 byte integer	Register write only, data 2 byte
3216	CH22 0：off，1：on	2 byte integer	Register write only, data 2 byte
3217	CH23 0：off，1：on	2 byte integer	Register write only, data 2 byte
3218	CH24 0：off，1：on	2 byte integer	Register write only, data 2 byte
3219	CH25 0：off，1：on	2 byte integer	Register write only, data 2 byte
321A	CH26 0：off，1：on	2 byte integer	Register write only, data 2 byte
321B	CH27 0：off，1：on	2 byte integer	Register write only, data 2 byte
321C	CH28 0：off，1：on	2 byte integer	Register write only, data 2 byte
321D	CH29 0：off，1：on	2 byte integer	Register write only, data 2 byte
321E	CH30 0：off，1：on	2 byte integer	Register write only, data 2 byte
4000	Save settings to the current file	Fixed value：0001	Register write only, data 2 byte
4001	Read current file data	Fixed value：0001	Register write only, data 2 byte
4002	Save settings to the specified file	0000~0009	Register write only, data 2 byte
4003	Read the specified file data	0000~0009	Register write only, data 2 byte
5002	Trigger once under remote mode	Write numerical value：0000	only validity under remote trigger

11.2 Obtain Measuring Data

11.2.1 Obtain Measuring Result

2000~203A registers can get Measuring data.

Example：Get the measuring data of channel 1

Command：

1	2	3	4	5	6	7	8
01	03	2000		0002		CRC-16	
Slave station	read	register		Quantity of register		Check code	

Response:

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

- **Get the Measuring Data of Channel 1：**

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

B4~B6 as measure data:60AD78EC represent 1E20 （ lower digit ahead）

Float point order ： ABCD

- **Get Measuring Data of Channel 3**

Send:

1	2	3	4	5	6	7	8
01	03	20	04	00	02	8E	0A

Response:

1	2	3	4	5	6	7	8	9
01	03	04	3D	49	9A	E9	CB	E8

B4~B6 as measure data：3D499AE9 represent 49.22E-3 （low digit ahead）

11.2.2 Get the comparator result【2100】

The register stores the OK/NG status of each channel bit by bit，0=NG, 1=OK
Example：000FFFFE
32 bit storage domain：
0011 1111 1111 1111 1111 1111 1111 1110
BIT0 = 0 mean channel 1as NG

Send:

1	2	3	4	5	6	7	8
01	03	21	00	00	02	CE	37

Response:

1	2	3	4	5	6	7	8	9
01	03	04	00	0F	E0	00	83	F0

B0~B29 corresponding CH1~CH30's comparator result

11.3 Parameter setting

Attention! After the batch parameters are set, if you want to use next time, have to write 1 to the register [4000] and save.

11.3.1 Range set【3000H】

- Write

1	2	3	4	5	6	7	8	9	10	11
01	10	30	00	00	01	02	00	01	57	93
	write	register		Qty of register		byte	Data		CRC	

Response：

1	2	3	4	5	6	7	8
01	10	30	00	00	01	0E	C9
		Register		Qty of register		CRC	

- Read

1	2	3	4	5	6	7	8
01	03	30	00	00	01	8B	0A
	read	register		Qty of register		CRC	

Response：

1	2	3	4	5	6	7
01	03	02	00	01	79	84
		byte	Data		CRC	

Range 0000~0007

11.3.2 Auto set range【3001H】

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	30	01	00	01	02	00	01	56	42
	write	register		Qty of register		byte	data		CRC	

Response：

1	2	3	4	5	6	7	8
01	10	30	00	00	01	5F	09
		register		Qty of register		CRC	

- read

1	2	3	4	5	6	7	8
01	03	30	01	00	01	DA	CA
	read	register		Qty of register		CRC	

Response：

1	2	3	4	5	6	7
01	03	02	00	01	79	84
		Byte	Data		CRC	

Range 0000~0007

11.3.3 Speed【3002H】

- 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		Qty of register		byte	data		CRC	

Response：

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

- read

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

Response ：

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

0000 slow speed
0001 medium speed
0002 fast speed
0003 high speed

11.4 Comparator set

11.4.1 Switch of comparator【3100H】

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	31	00	00	01	02	00	01	47	53
	write	register		Qty of register		byte	data		CRC	

Response：

1	2	3	4	5	6	7	8
01	10	31	00	00	01	0F	35
		register		Qty of register		CRC	

- read

1	2	3	4	5	6	7	8
01	03	31	00	00	01	8A	F6
	read	register		Qty of register		CRC	

Response：

1	2	3	4	5	6	7
01	03	02	00	01	79	84
		byte	data		CRC	

0000 Comparator off
0001 Comparator on

11.4.2 Compare mode【3101H】

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	31	01	00	01	02	00	02	06	83
	write	register		Qty of register		byte	data		CRC	

Response：

2	3	4	5	6	7	8
10	31	01	00	01	5E	F5
	register		Qty of register		CRC	

- read

1	2	3	4	5	6	7	8
01	03	31	00	00	01	DB	36
	read	register		Qty register		CRC	

Response：

1	2	3	4	5	6	7
01	03	02	00	02	39	85
		byte	data		CRC	

0000 ΔABS
0001 Δ%
0002 SEQ

11.4.3 Comparator Set Method【3102H】

- write

1	2	3	4	5	6	7	8	9	10	11
01	10	31	02	00	01	02	00	01	46	B1
	write	register		Qty of register		byte	data		CRC	

Response：

1	2	3	4	5	6	7	8
01	10	31	02	00	01	AE	F5
		register		Qty of register		CRC	

- read

1	2	3	4	5	6	7	8
01	03	31	02	00	01	2B	36
	read	register		Qty of register		CRC	

response：

1	2	3	4	5	6	7
01	03	02	00	01	79	84
		byte	Data		CRC	

0000 ΔABS
0001 Δ%
0002 SEQ

11.4.4 【310A-310B】

Nominal value use 2 registers, 310A &310B. attention！310B is unable to read alone.

- write

100E-3 (Single precision floating point number：0x3DCCCCCD)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	31	0A	00	02	04	3D	CC	CC	CD	73	47
	write	register		Qty of register		byte	data				CRC	

Response：

1	2	3	4	5	6	7	8
01	10	31	0A	00	02	6F	36
		register		Qty of register		CRC	

- read

1	2	3	4	5	6	7	8
01	03	31	0A	00	02	EA	F5
	read	register		Qty of register		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	

11.4.5 Limit value【3110】

The limit value of channel start from 3110, low limit use 2 registers, upper limit use 2 registers, total 4 registers.
Low limit & upper limit can set up separately, or set up at same time.

- write

Low limit：1E-3, upper limit：2E-3
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 3A83126F 3B03126F C2A7

11.5 Channel setup【3201H~321EH】

Each channel can be turned on or off independently through registers.

Turn off channel 1，write 0 to the register 3201
Turn on channel 1，write 1 to the register 3201

- write

Channel 1 turn off
Send：01 10 32 01 00 01 02 00 00 B4 42

Response：01 10 32 01 00 01 5E B1
Channel 2 turn on：
Send：01 10 32 01 00 01 02 00 01 75 82
Response：01 10 32 01 00 01 5E B1

11.6 File operation

Because the instrument settings are stored in the file, after all Modbus Commands are set, the data can't be stored in the internal Flashrom in real time, which will result the register data to the original file values before the next power-on.

User can store all settings to current or specified files by file operation register. At the same time, also can set the specified file data to the register.

11.6.1 Save to current file【4000】

Send number value 0001 to 4000 registers，The instrument will executable file write operation, all set will save to current files.
register can't 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		Qty of register		byte	data		CRC	

Response：

1	2	3	4	5	6	7	8
01	**10**	**40**	**00**	**00**	**01**	**14**	**09**
		Register		Qty of register		CRC	

Data value：

Data	function	explain
0001	Allow operation	Fixed value

11.6.2 Save to specified file【4008】

Send the file number to 4008 register, the instrument will execute file write operation, all settings will keeped into the pointed files, also the specified file will be use as the current file of the system . This register unable to read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**08**	**00**	**01**	**02**	**00**	**09**	**26**	**DA**
	write	register		Qty of register		byte	data		CRC	

Response：

1	2	3	4	5	6	7	8
01	**10**	**40**	**00**	**00**	**01**	**95**	**CB**
		register		Qty of register		CRC	

Data value：

Data	Function	Explain
0000~0009	File 0~9	

11.6.3 Reload Current File【4010】

Send fixed value 0001to 4010 register, instrument will load the current file data into system.
This register unable to read.

- write

1	2	3	4	5	6	7	8	9	10	11

01	10	40	10	00	01	02	00	01	24	C4
	write	register		Qty of register		byte	data		CRC	

Response：

1	2	3	4	5	6	7	8
01	**10**	**40**	**10**	**00**	**01**	**15**	**CC**
		register		Qty of register		CRC	

Data value：

Data	Function	Explain
0001	Fixed value	

11.6.4 Load the specified file【4018】

Send the file No to the 4018 register, the instrument will load the settings of the specified file to the system, and the specified file will be used as current file of system.

This register unable to read.

- write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**18**	**00**	**01**	**02**	**00**	**00**	**E4**	**4C**
	write	register		Qty of register		byte	data		CRC	

Response：

1	2	3	4	5	6	7	8
01	**10**	**40**	**18**	**00**	**01**	**94**	**0E**
		register		Qty of register		CRC	

Wrong response：

The File is empty, the instrument will response to the error code：04

1	2	3	4	5
01	**90**	**04**	**4D**	**C3**
		Error code	**CRC**	

Data value：

Data	Function	Explain
0000~0009	File 0~9	

12. Specification

This chapter describes the specifications and supplemental performance characteristics of the AT5130：

- Technical Index
- Specifications
- Dimension

Accuracy is defined as meeting all of the following conditions.
Temperature: 23℃±5℃
Humidity: □65% R.H.
Zeroing: Open and Short Correction
Warm up time is 30 min or more.
1-year calibration cycle
Test Current Accuracy: 0.01%

RANGE		Maximum Readers	Resolution	ULTRA,FAST	MEDIUM	SLOW	TEST CURRENT	OPEN VOLTAGE
0	30mΩ	30.000mΩ	1μΩ	0.5%±5	0.2%±5	0.1%±3	1A	<1V
1	300mΩ	300.00mΩ	10μΩ	0.5%±5	0.1%±3	0.05%±2	1A	<1V
2	3Ω	3.0000Ω	100μΩ	0.5%±5	0.1%±3	0.05%±2	100mA	<1V
3	30Ω	30.000Ω	1mΩ	0.5%±5	0.1%±3	0.05%±2	10mA	<1V
4	300Ω	300.00Ω	10mΩ	0.5%±5	0.1%±3	0.05%±2	1mA	<5V
5	3kΩ	3.000kΩ	100mΩ	0.5%±5	0.1%±3	0.05%±2	1mA	<5V
6	30kΩ	30.000kΩ	1Ω	0.5%±5	0.3%±5	0.1%±5	100uA	<5V
7	300kΩ	300.00kΩ	10Ω	0.8%±10	0.5%±5	0.2%±5	100uA	<5V

12.1 General Specification

Display: True color TFT-LCD, Size: 3.5”
Measurement Speed: All Channes Open,Under Range Manual Mode:
Slow: 3.4s/10-Channel
Medium: 830ms/10-Channel
Fast: 350ms/10-Channel
Ultra: 230ms/10-Channel
MAX reading： Slow and Medium：30000
Fast and Ultra：3000

Ranging: Auto, Manual and Nominal range.
Correction Function: SHORT-CIRCUIT Clear Zero
File: Parameters save automatically
Beep Feature: OFF/GD/NG
Trigger Mode: Internal, Manual, External and Remote Trigger.
Built-in Interface: Handler interface, RS232 interface, Temperature Compensation interface.
Programming language: SCPI

Environment:

Temperature and humidity range:	18℃~28℃, 65% RH or less
Storage temperature and humidity range:	0℃~50℃,10~90% RH
Power Supply:	220VAC (1±10%)
Fuse:	1A Slow-Blow
Maximum rated power:	20VA
Weight:	3.5kg, net

12.2 Dimensions

Figure 12-1 Dimensions