ONMEAS®

Rev.A

AT69210

Multi-Channel Insulation Resistance Tester



User's Guide

Scan QR code for operation video

ICON DESCRIPTION

	High Voltage Hazard – Indicates a risk of severe personal injury.
	Prohibited Action – May result in personal injury or irreversible equipment damage.
	Warning & Caution – Highlights potential hazards to safety or equipment integrity.
	Important Notice.
	Refer to Details.

Safety Instructions

If any of the following abnormalities occur, stop operation immediately, disconnect the power cord, and contact Applent Instruments for service. Continuing operation may result in fire hazards or electric shock risks:

- Abnormal instrument operation.
- Unusual noise, odor, smoke, or flashing light emitted from the instrument.
- Excessive heat or electric shock during operation.
- Damaged power cord, power switch, or power socket.
- Presence of foreign objects or liquids inside the instrument.

Disclaimer

Prior to using the instrument, users must carefully read the following safety instructions. Applent Instruments will not be liable for any personal injury or property damage resulting from non-compliance with these guidelines.

To prevent the risk of electric shock, make sure the power ground connection is properly established.

Do not operate the instrument in environments with flammable or explosive gases, vapors, or excessive dust. Using any electronic equipment in such conditions presents a significant safety hazard.

Non-qualified personnel should not attempt to open the instrument casing for repairs. Even after being powered off, the instrument may retain residual electrical charge for some time, posing a potential electric shock hazard.

If the instrument is damaged, the potential risks are unpredictable. Disconnect the power cord immediately, cease use, and refrain from attempting any repairs yourself.

If the instrument is malfunctioning, its risks are unpredictable. Disconnect the power cord immediately, discontinue use, and do not attempt to repair it yourself.

Using the instrument in a manner not outlined in this manual will invalidate the protection features provided by the instrument.

After the instrument starts the Measurement, high voltage will be present at the Measurement terminals, which can cause harm. Do not touch the exposed metal parts of the Measurement leads with your body.

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1. OVERVIEW



Thank you for choosing our product! Please read this chapter carefully before use to ensure optimal performance. This Chapter covers the following topics:

- Main Functions and Packing List
- Power Requirements
- Operating Environment
- Cleaning Instructions

1.1 Packing List

Before operating the instrument, please:
1. Check the product for any visible damage, such as cracks or scratches;
2. Verify that all accesspries are included by comparing them with the packing list.
If you notice any damage or missing items, contact Applent's sales department or your distributor immediately.

1.2 Power Requirements

AT69210 can only be operated under the following power conditions:
Voltage: 100~240VAC(1±10%)
Frequency: 50Hz/60Hz(1±10%)



Warning:
Risk of electric shock. Please ensure the power ground wire is properly connected.
If replacing the power cord, make sure its ground connection is secure.

1.3 Operating Environment

AT69210 must be operated under the following conditions:
Temperature: 0°C～55°C，
Humidity: Below 70%RH at 23°C

1.4 Cleaning

To prevent the risk of electric shock, disconnect the power cord before cleaning.
Wipe the casing and panel with a clean cloth slightly dampened with water.
Do not clean the interior of the instrument.



Warning:
Do not use solvents (such as alcohol or gasoline to clean the instrument.

2. OVERVIEW

This chapter covers the following:

- Preface
- Main Functions

2.1 Preface

Thank you for choosing AT69210 Multi-Channel Insulation Resistance Measurementer!

AT69210 is a compact benchtop instrument designed for fully automated real-time detection, powered by a high-performance ARM microprocessor. It features a full-color LCD display and a fully digital keypad, integrated with the Applent Instrument operating system, ensuring clearer display and more convenient operation.

The instrument includes a built-in programmable voltage source with 1V resolution, ranging from 10V to 1000V.

It offers 2% insulation resistance accuracy, with a maximum measurement range of up to 20GΩ. The device can display up to 9999 counts and achieve a measurement speed of up to 30 readings per second.

The instrument can store up to 10 setting groups internally and an additional 10 groups on an external USB drive, allowing for easy retrieval of different configurations.

A built-in comparator function is also provided.

Standard communication interfaces include USB-232 and RS-232, supporting SCPI (Standard Commands for Programmable Instruments) and Modbus RTU protocols. These features enable seamless communication with computers, PLCs, or WINCE devices for efficient remote control and data acquisition.

Furthermore, the instrument is equipped with an RS-485 interface, supporting the Modbus RTU protocol, which facilitates easy integration with PLC systems.

For reference, please refer to the Specifications chapter for technical details.

2.2 Main Functions

2.2.1 Measurement Range

Supports four measurement ranges with selectable automatic, manual, and nominal range modes.
Nominal Range (Newly Defined by Applent): The instrument automatically determines the optimal range based on the nominal value.

2.2.2 Measurement Speed

The instrument operates at three speed modes: Slow, Medium, and Fast.

Manual Mode:
With Contact Check Disabled:
Slow: 4 readings/sec
Medium: 8 readings/sec
Fast: 30 readings/sec
With Contact Check Enabled:
Slow: 4 readings/sec
Medium: 7 readings/sec

Fast: 19 readings/sec

Automatic Mode:
With Contact Check Disabled:
Slow: 3 readings/sec
Medium: 7 readings/sec
Fast: 19 readings/sec
With Contact Check Enabled:
Slow: 4 readings/sec
Medium: 6 readings/sec
Fast: 13 readings/sec

2.2.3 Trigger Mode

Manual Trigger: Press the START button to trigger a single scan measurement. The process stops and discharges upon completion.
Remote Trigger: Use a remote command to trigger a single scan measurement. The process stops and discharges upon completion.

2.2.4 Basic Accuracy

Voltage Source Accuracy: 1% * Set Value ±2V
Monitoring Voltage Accuracy: 2% ±1V (@ Output Current <1.8mA)
Slow Mode: 2%
Medium Mode: 2%
Fast Mode: 5%



Reference: For detailed accuracy specifications, please refer to the Technical Specifications chapter.

2.2.5 Comparator Function (Sorting Function)

AT69210 is equipped with a sorting function.
Measurement results include NG-HI, NG-LO, and OK.

2.2.6 System Settings

Keyboard Lock Function
Usage: Click the [Key Lock] button in the bottom menu bar to enable or disable the keyboard lock.
Administrator and User Accounts
The administrator can set a password for account protection.

2.2.7 Screenshot Function

AT69210 features a screenshot function for user convenience.

Operation Steps:
1. Insert a USB flash drive.
2. Use the SCPI command PrtScn to capture a screenshot.

2.2.8 Interfaces

RS-232 Interface:
Supports a maximum baud rate of 115200bps and is compatible with both SCPI and Modbus RTU protocols.
USB-232 Interface:
Emulates a virtual serial port on a computer, supporting SCPI and Modbus RTU protocols.
RS-485 Interface:
Supports up to 115200bps baud rate and communicates via the Modbus RTU protocol.
LAN Interface:
Enables network connectivity and supports the SCPI protocol.

3. OVERVIEW

This chapter covers the following topics:

- Front Panel Overview – Introduction to buttons and Measurement terminals.
- Rear Panel – Information on power and interface connections.
- Power-On Process – Including self-Measurement procedures, default settings, and warm-up time.

3.1 Understanding the Front Panel

3.1.1 Front Panel Description

Figure 3-1 Front Panel

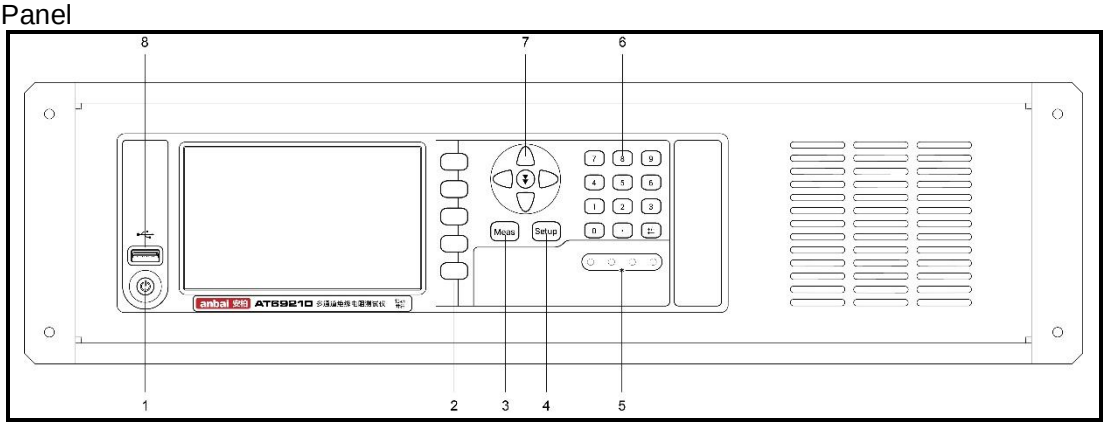
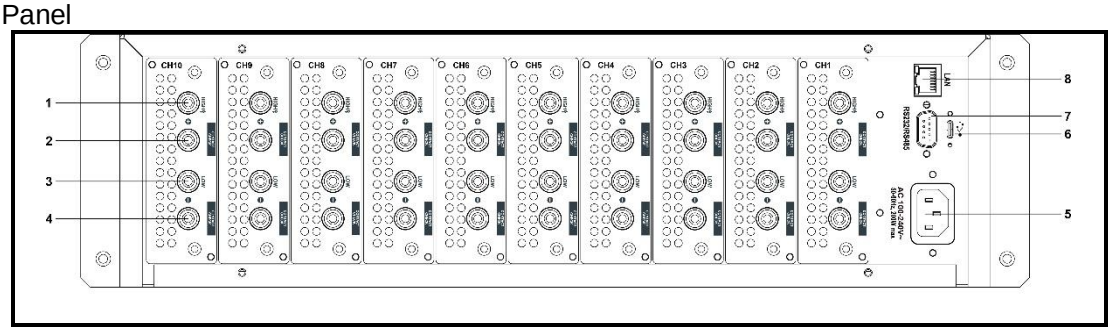


Table 3-1Front Panel Function Description

No.	Function
1	Power Switch: The blue indicator light is on when the device is powered on.
2	Side Function Keys
3	Main Function Keys: Meas
4	Main Function Keys: Setup
5	Measurement Indicator & Keyboard Lock Indicator
6	Numeric Keypad
7	Cursor Keys
8	USB Interface: for connecting USB flash drive

3.2 Understanding the Rear Panel

Figure 3-2 Rear Panel



1. HIGH terminal: Used for primary Measurementing and short circuit detection.
2. HIGH terminal: Used for open circuit detection.
3. LOW terminal: Used for primary Measurementing and short circuit detection.
4. LOW termial: Used for open circuit detection.
5. Votage socket: AC 100V-240V~, 50/60Hz，20VA MAX
6. USB communication interface

7. RS-232/RS-485 interface
8. LAN interface

> **!** Warning:
> The instrument provides a positive voltage output. The + terminal has a voltage output. Please do not touch it to avoid the risk of electric shock.

3.3 Powering On

3.3.1 Power On

The button marked "⏻" on the lower left of the panel is the power switch.
Blue indicator light: Power on status.

3.3.2 Warm-Up

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

4. <SINGLE CHANNEL> PAGE

In this chapter, you will learn about the following:

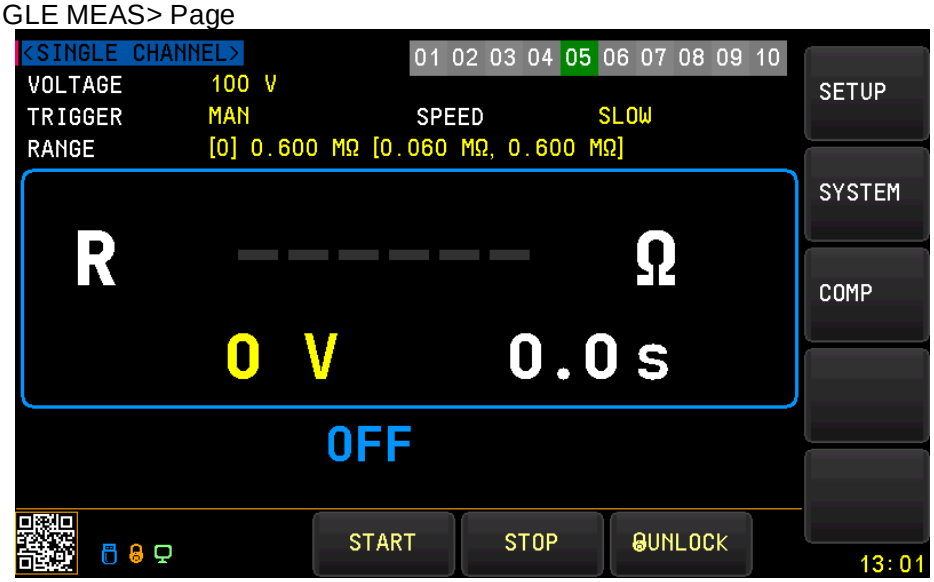
- Explanation on Measurement Page
- Start/Stop function
- Measurement result explanation

4.1 <SINGLE CHANNEL> Page

Press the [MEAS] button or select [MEAS] from the sidebar to enter the [SINGLE CHANNEL] or [MULTI MEAS] page (automatically selected based on the number of enabled channels).
On the Single Channel page, the main measurement result is prominently displayed, along with the current sorting result.
This page allows configuration of four commonly used functions:

- VOLTAGE – Preset output voltage
- SPEED – Measurement speed setting
- TRIGGER – Trigger mode setting
- RANGE – Measurement range setting

Figure 4-1 <SINGLE MEAS> Page



4.1.1 Channel Settings

■ Steps to set Channels:

1. Enter the <SINGLE CHANNEL> Page.
2. Use the arrow keys to select[01]-[10]field.
3. Use the function keys to select the desired channel.

Function Key	Function
ON/OFF	Enable or disable the selected channel
SINGLE	Enable only the selected channel
ALL ON	Enable all channels of the instrument
BATCH SET	Set the voltage and range of all enabled channels to match those of the selected channel.

4.1.2 Voltage Settings

The instrument has a built-in voltage source ranging from 10V to 1000V.
Voltage Source Accuracy: ±1% of the set value ±2V (@10V~1000V)(@10V~1000V)
Voltmeter Accuracy: ±2% of the set value ±1V (@ output current <1.8mA)

Note: The voltage source output below 10V is for reference only; the voltmeter's measurement accuracy below 10V is not calibrated.

■ Steps to Set the Voltage:

1 Enter the <SINGLE CHANNEL> or <SETUP> page;

2 Use the arrow keys to select the [VOLTAGE] field.

3 Either use the function keys to select a preset voltage or enter the desired voltage value directly using the numeric keypad.

Function Key	Function
10V	
25V	
50V	
100V	
200V	
400V	
500V	
1000V	

4.1.3 Measurement [SPEED]

Manual Range:
Contact Check Disabled:
SLOW: 4 readings/sec
MED: 8 readings/sec
FAST: 30 readings/sec
Contact Check Enabled:
SLOW: 4 readings/sec
MED: 7 readings/sec
FAST: 19 readings/sec

AUTO Range:
Contact Check Disabled:
SLOW: 3 readings/sec
MED: 7 readings/sec
FAST: 19 readings/sec
Contact Check Enabled:
SLOW: 4 readings/sec
MED: 6 readings/sec
FAST: 13 readings/sec

■ Steps to Set the Measurement Speed:

1 Enter the <SINGLE CHANNEL> page or <SETUP> page.

2 Use the cursor keys to select the [SPEED] field.

3 Use the function keys to select the desired speed.

Function Key	Function
SLOW	
MED	
FAST	

4.1.4 [Trigger] Mode

The instrument supports 2 trigger modes:

Trigger Mode	Description
Manual	Manual: Pressing the START button initiates a single measurement cycle, after which the instrument returns to standby mode.
Remote	Remote: The instrument is triggered via a command from the host computer. Upon receiving the trigger command, it completes one measurement cycle before returning to standby mode.

Note:
When the Measurement time is set to OFF:
Manual Trigger: Each time the START button is pressed, a single measurement is performed.
Remote Trigger: The instrument performs a single measurement when it receives the trig or TRG command.
When the Measurement time is set:
Any Trigger: The measurement starts and continues until the Measurement time elapses, at which point the instrument discharges and stops.

■ Steps to Set the Trigger Mode:

1. While in the discharge state, press the [Meas] button to enter the main measurement page, or press the [Setup] button to enter the main settings page.
2. Use the arrow keys to select the [Trigger] field.
3. Use the function keys to select the desired trigger mode.

Function Key	Function
Manual	Manual Trigger
Remote	Remote Trigger

4.1.5 Measurement [RANGE]

AT69210 features highly precise range segmentation with a total of four measurement ranges. The applicable range varies depending on the selected voltage.
There are three ranges available:

Table 4-1 Measurement Range Description

Range Mode	Description	Advantages	Limitations
Auto	The instrument automatically selects the optimal Measurement range based on the impedance value. The range number in the range field will update automatically.	No user input required.	Pre-measurement is required
Manual	The instrument always uses the user-specified range for Measurementing.	Maximum measurement speed	Requires user to manually select the appropriate range
Nominal	In Nominal Range mode, the instrument selects the optimal range based on the comparator's lower limit.	Ideal for sorting Measurements; offers the fasMeasurement speed	Only suitable for sorting applications.

■ Steps to Set the Range

1. Press the [Meas] button to enter the measurement page, or the [Setup] button to enter the settings page.
2. Use the arrow keys to select the [Range] field.
3. Use the function keys to choose between Auto, Manual, or select a specific range.

Function Key	Function
Auto	The instrument automatically selects the appropriate range.
Manual	The instrument is locked to the current range.
Nominal	The instrument selects the optimal range based on the nominal value.
Increase+	Increases the range number and switches to manual mode.
Decrease-	Decreases the range number and switches to manual mode.

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Note:
When set to Auto Range, the instrument performs range estimation during each measurement cycle, which results in slightly slower measurement speeds—especially noticeable in Medium and Fast modes. Additionally, frequent range switching in Auto mode may lead to slower response times.
For sorting applications, Auto Range is generally not recommended.
Users performing sorting measurements are advised to use Nominal Range mode.

4.2 Start/ Stop

- Manual Trigger:
  Press the [Start] button to begin the measurement.
- Remote Trigger:
  Measurement begins upon receiving the communication command [STAT: STAR]

4.3 Measurement Result Display

4.3.1 Measurement Result Area Desciption

Table 4-2 Measurement Result Area

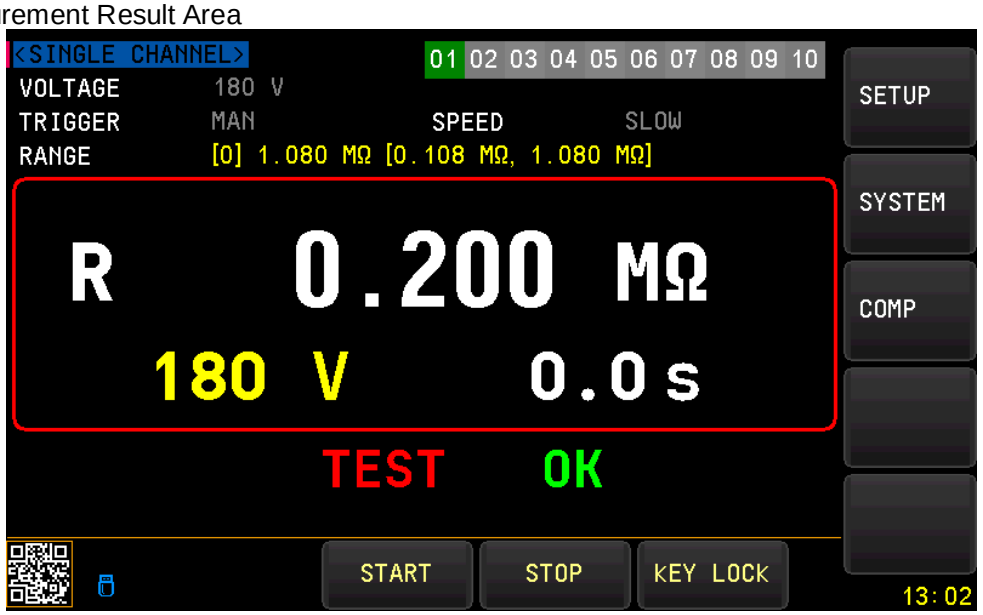
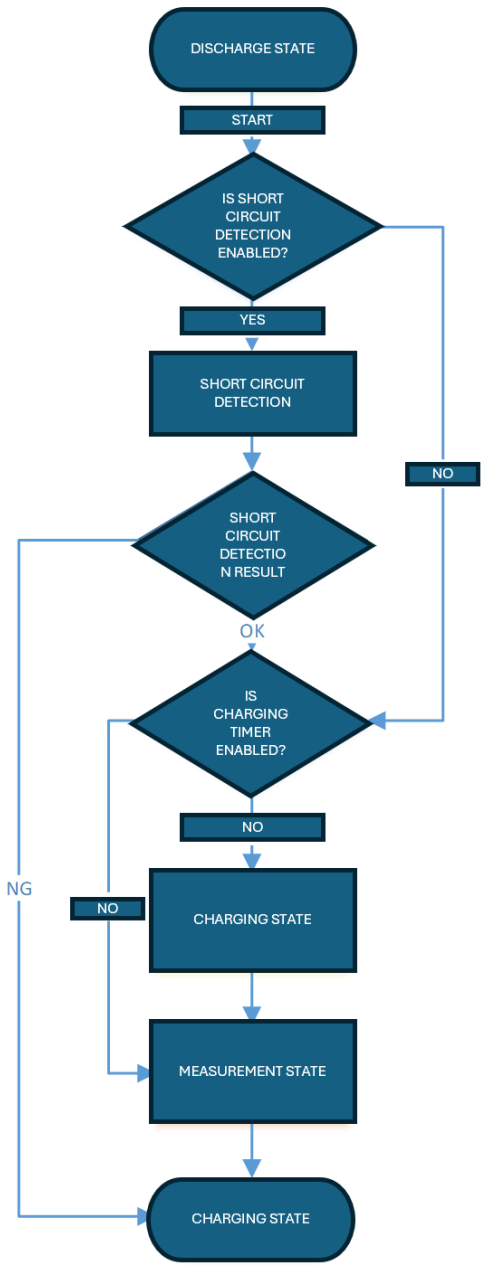


Table 4-2 Measurement Result Area Description

No.	Description
1	Short Circuit Check Indicator – Only visible and active when short circuit check is enabled in the [SETUP] page.
2	Insulation Resistance Display – Shown in white during measurement, and gray during discharge. Error messages may include: SHORT (short circuit) or CC (contact check failure).
3	Voltmeter Display – Continuously monitors the voltage across the Measurement terminals.
4	Status Display The instrument has three measurement states: OFF (Discharge), CHAR (Charge), MEASUREMENT (Measurement).
5	Start Button – When pressed, the HIGH (+) terminal outputs voltage, and the instrument enters charging or measurement mode.
6	Stop Button – When pressed, the HIGH (+) terminal stops outputting voltage, and the instrument returns to standby.
7	Charge/Measurement Timer Display – Shows countdown during timed operations.
8	Comparator Status Display (active only when comparator is enabled): OK: Pass HI: Fail (above upper limit) LO: Fail (below lower limit)

4.3.2 Working Status

Figure 4-3 Single-Channel Measurement Mode Switching



- Discharge State:
  In this state, the discharge circuit is continuously connected to the Measurement terminals. Any charge stored in the connected device will be discharged internally by the instrument until the voltage drops to 0V.
- Charge State:
  Indicated by CHAR on the status display, with the Measurement indicator light illuminated. The HIGH (+) terminal will output voltage.
  When the [Charge Timer] is set on the Settings page and the Start button is pressed, the instrument enters the charge state.
  During charging, the device under Measurement is rapidly charged using a constant current of 1.8mA. Once the voltage reaches the preset value, the instrument switches to constant voltage mode.
  After the charge timer completes, the instrument automatically enters the measurement state.

i	For larger battery packs, increasing the charge time appropriately can facilitate faster measurements, which is especially beneficial for rapid sorting in automated Measurementing systems.

- Measurement State:

Indicated by MEASUREMENT on the status display, with the Measurement indicator light illuminated. The HIGH (+) terminal outputs voltage during this state.

- If [Timer] is set to Off on the Settings page, the instrument will remain in the Measurement state continuously until the Stop button is pressed.
  If a measurement duration is preset in the [Timer], the instrument will remain in the Measurement state for the specified time, then automatically return to the discharge state.

5. <MULTI MEAS> PAGE

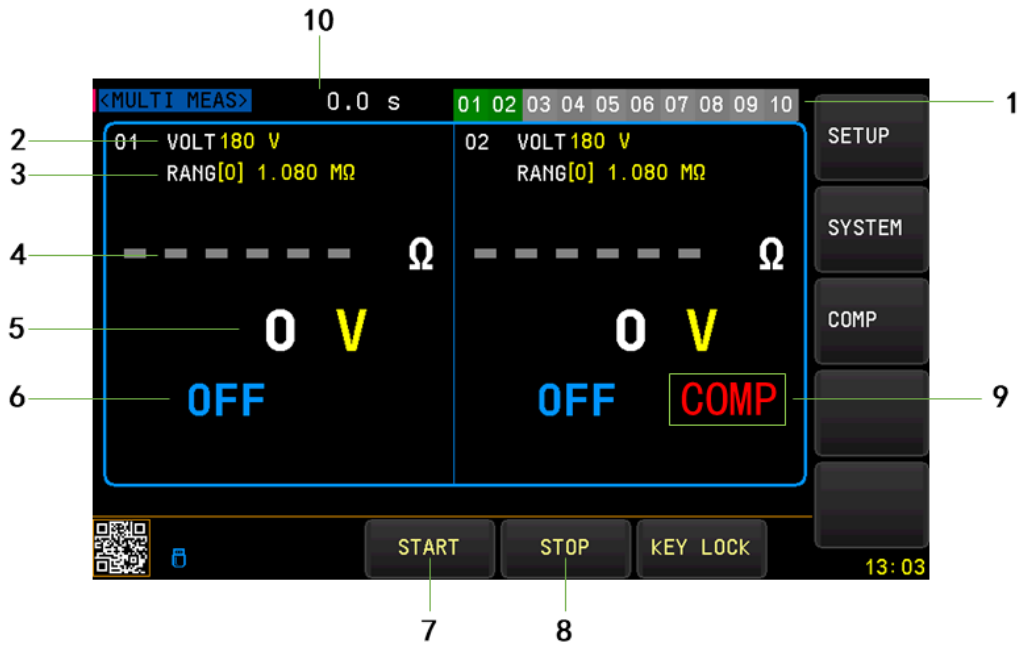
This chapter covers the following topics:

- Multi-Channel Measurement Display Overview
- Parallel Operating Mode
- Channel Configuration
- Additional Multi-Channel Measurement Page Descriptions

5.1 <MULTI MEAS> Page

Press the [Meas] button to enter the Multi Meas page when more than one channel is enabled. The interface will automatically adapt based on the number of active channels.
On the Multi Meas page, both voltage and range settings can be configured.

Figure 5-1 <MULTI MEAS> Page Description



1	Channel Configuration Settings can only be adjusted when the instrument is in the Stop state.
2	Voltage Setting for the Selected Channel
3	Range Setting for the Selected Channel
4	Measurement Result If short circuit detection is enabled and a short is detected, the result will display SHORT. If contact check is enabled and an open circuit is detected, the result will display CC.HL.
5	Preset Voltage Display
6	Status Display: CHAR: Charging MEASUREMENT: Measuring DICH: Discharging OFF: Stopped
7	Start Measurement
8	Stop Measurement
9	Comparator Display (when enabled): OK: Pass

	HI: Above upper limit LO: Below lower limit
10	Timer Display Shows the timer duration corresponding to each operating state.

5.2 Parallel Working Status

AT69210 operates in full parallel mode, meaning all channels begin measurement simultaneously. Each channel can be individually configured with its own Measurement voltage and range to meet the specific requirements of different Measurement objects. Other parameters, such as measurement speed and Measurement duration, are set globally for all channels.

Features:

1. High Efficiency: The parallel measurement mode significantly boosts Measurementing throughput, making it ideal for applications involving simultaneous Measurementing of large quantities of DUTs (Devices Under Measurement).
2. Synchronized Start: All channels begin Measurementing simultaneously via a unified trigger signal, improving overall efficiency.
3. Independent Configuration: Each channel's Measurement voltage and range can be individually set according to the requirements of the DUT, supporting diverse Measurementing needs.
4. Independent Evaluation: Each channel independently determines its Measurement result. If an error is detected on a specific channel (e.g., short circuit, poor insulation), that channel will automatically stop and enter a safe state, while the others continue Measurementing unaffected.

Workflow:

1. Parameter Setup: Configure the Measurement voltage and range for each channel based on DUT requirements and set shared parameters globally.
2. Start Measurement: Initiate Measurementing via button press or remote control; all channels start simultaneously.
3. Measurementing Process: Each channel performs Measurementing according to its settings, with real-time status monitoring.
4. Error Handling: If any channel detects an abnormal condition (e.g., short or open circuit), it will stop Measurementing, enter a safe state, and display an error message. Other channels continue Measurementing normally.
5. Measurement Completion: Upon completion, each channel displays its individual Measurement result.

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Note:

- Safe Operation: Before Measurementing, ensure all connections are properly made to avoid Measurement failure or safety hazards caused by poor contact or incorrect wiring.
- Parameter Configuration: Set appropriate Measurement voltage and range for each channel based on the characteristics of the DUT. Configure other parameters uniformly to ensure measurement accuracy.
- Error Handling: If an error occurs on any channel during Measurementing, promptly check the error message, identify the cause, and take corrective action to ensure smooth continuation of subsequent Measurements.

5.3 Channel Settings

The instrument includes 10 channels. You can enable or disable individual channels using the function keys. The interface will automatically adjust based on the number of channels enabled.

Steps to Configure Channels:

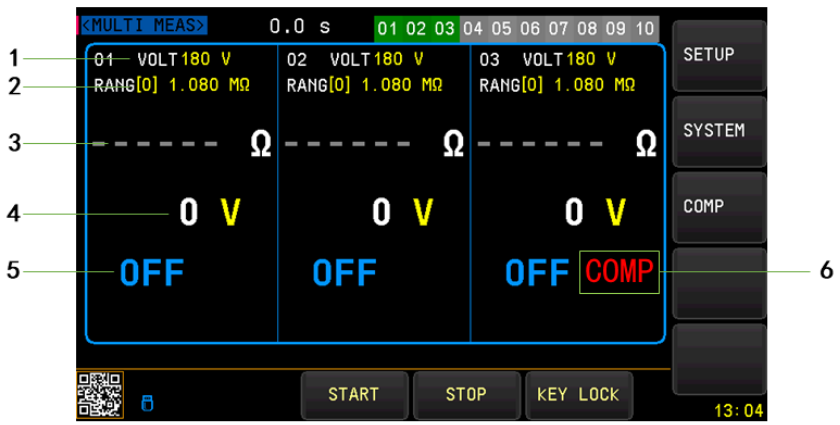
- Enter the <Scan Measurement> page.
- Use the arrow keys to select fields [01]– [10].
- Use the function keys to select the desired channels.

Function Key	Description
ON/OFF	Enable or disable the selected channel.
SINGLE	Enable only the currently selected channel.
ALL ON	Enable all channels on the instrument.
BATCH SET	Apply the voltage and range settings of the selected channel to all enabled channels.

5.4 Additional <MULTI MEAS> Pages

5.4.1 Three Channels

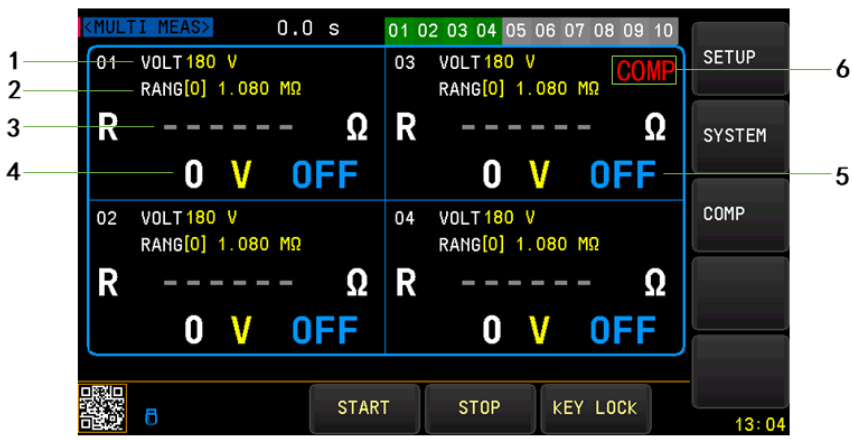
Figure 5-2 Three-channel Measurement Page



1	Voltage Setting for the Channel
2	Range Setting for the Channel
3	Measurement Result If short circuit detection is enabled and a short is detected, the result will display SHORT. If contact check is enabled and an open circuit is detected, the result will display CC.HL.
4	Preset Voltage Display
5	Status Display: CHAR: Charging MEASUREMENT: Measuring DICH: Discharging OFF: Stopped
6	Preset Comparator Display (visible when comparator is enabled): OK: Pass HI: Fail – Above upper limit LO: Fail – Below lower limit

5.4.2 Four Channels

Figure 5-3 Four-channel Measurement Page

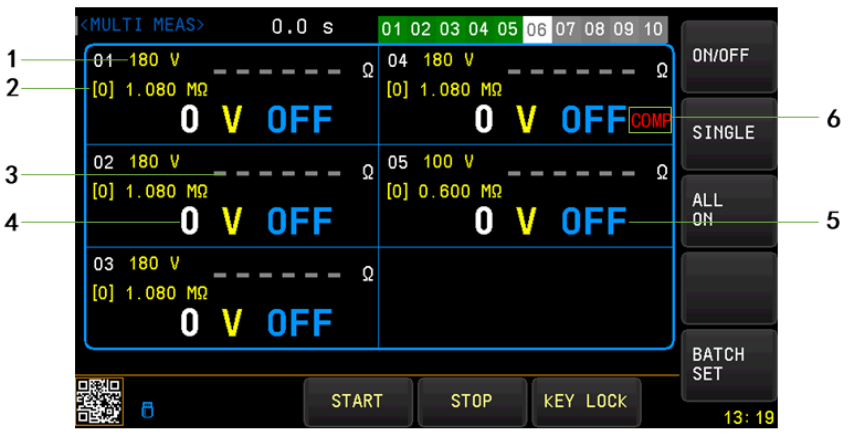


1	Voltage Setting for the Channel
2	Range Setting for the Channel
3	Measurement Result If short circuit detection is enabled and a short circuit is detected, the result will display SHORT. If contact check is enabled and an open circuit is detected, the result will display CC.HL.
4	Preset Voltage Display

5	Status Display: CHAR: Charging MEASUREMENT: Measurementing DICH: Discharging OFF: Stopped
6	Preset Comparator Status (displayed only when the comparator is enabled): OK: Pass HI: Fail — Above upper limit LO: Fail — Below lower limit

5.4.3 Five/Six Channels

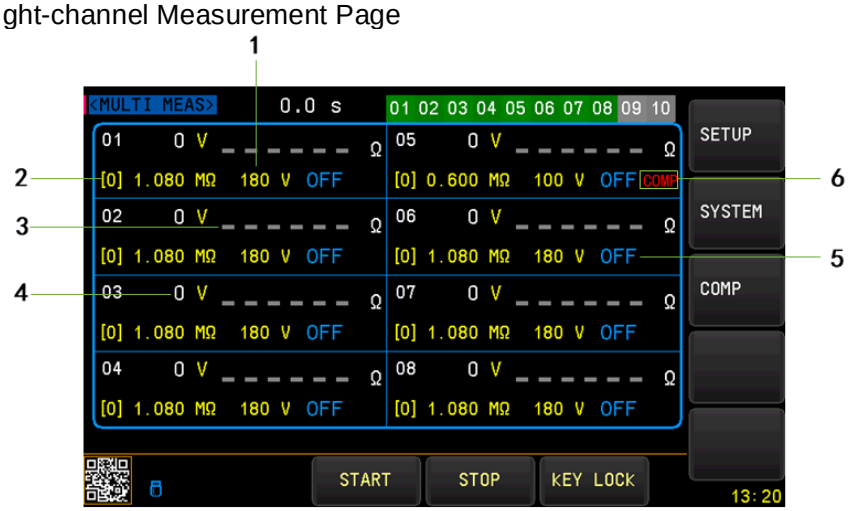
Five/Six-channel Measurement Page



1	Channel Voltage Setting
2	Channel Range Setting
3	Measurement Result If short circuit detection is enabled and a short is detected, the result will display SHORT. If contact check is enabled and an open circuit is detected, the result will display CC.HL.
4	Preset Voltage Display
5	Status Indicator: CHAR – Charging MEASUREMENT – Measurementing DICH – Discharging OFF – Stopped
6	Comparator Result Display (visible when the comparator is enabled): OK – Passed HI – Failed (Above upper limit) LO – Failed (Below lower limit)

5.4.4 Seven/Eight Channels

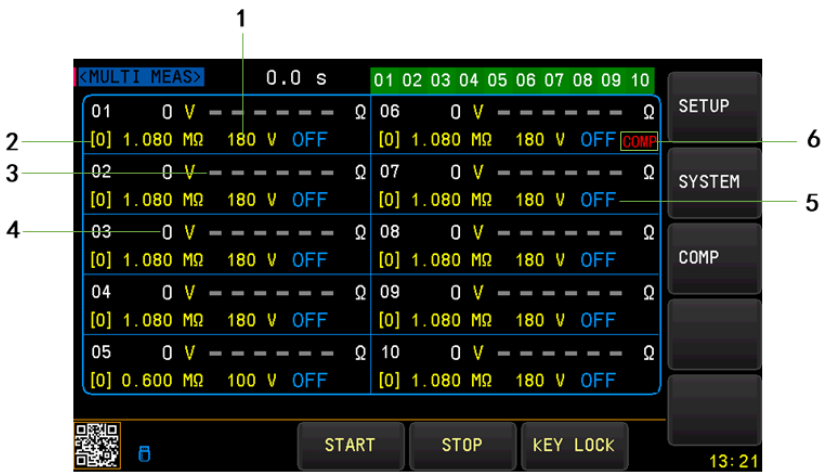
Figure 5-4 Seven/ Eight-channel Measurement Page



1	Voltage Setting for the Channel
2	Range Setting for the Channel
3	Measurement Result If short circuit detection is enabled and a short is detected, the result will display SHORT. If contact check is enabled and an open circuit is detected, the result will display CC.HL.
4	Preset Voltage Display
5	Status Display: CHAR: Charging MEASUREMENT: Measurementing DICH: Discharging OFF: Stopped
6	Comparator Status Display (visible when the comparator is enabled): OK: Pass HI: Fail — Above upper limit LO: Fail — Below lower limit

5.4.5 Nine/ Ten Channels

Figure 5-5 Nine/ Ten-channel Measurement Page



1	Channel Voltage Setting
2	Channel Range Setting
3	Measurement Result If short-circuit detection is enabled and a short circuit is detected, the result will display SHORT. If contact check is enabled and an open circuit is detected, the result will display CC.HL.
4	Preset Voltage Display
5	Status Display CHAR: Charging MEASUREMENT: Measurementing DICH: Discharging OFF: Stopped
6	Preset Comparator Display (visible when the comparator is enabled): OK: Pass HI: Fail — Above upper limit LO: Fail — Below lower limit

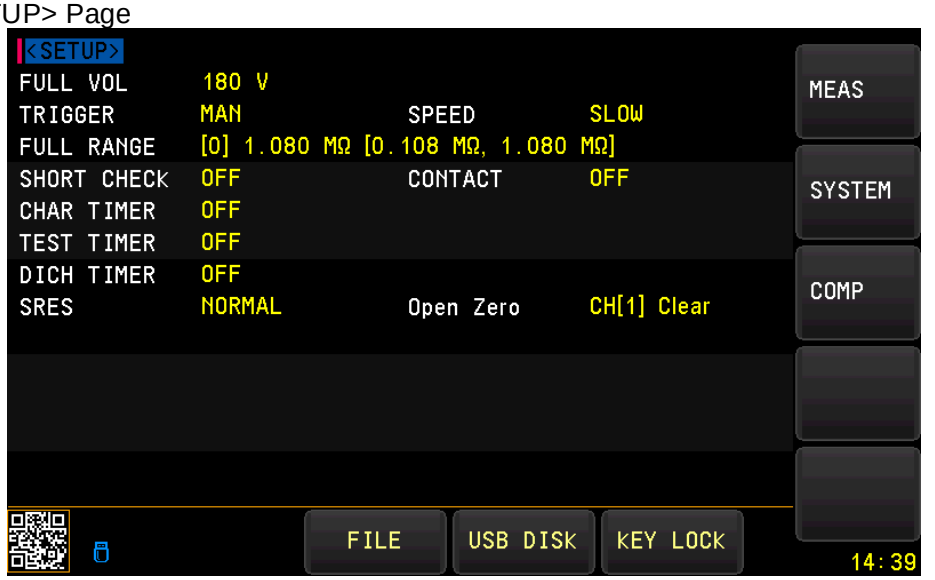
6. <SETUP> Page

In this chapter, you will learn about the following topics:
- Contact Check
- Short Circuit Detection
- Source Impedance
- Charge Timer, Measurement Timer, and Discharge Timer

6.1 Measurement Settings

On the <SETUP> page, the instrument does not perform any measurements.

Figure 6-1 <SETUP> Page



For voltage, speed, trigger, and range settings, please refer to the relevant sections of the Measurement Display Page chapter. <SINGLE CHANNEL> PAGE

In this chapter, you will learn about the following:
- Explanation on Measurement Page
- Start/Stop function
- Measurement result explanation

<SINGLE CHANNEL>

6.1.1 [CONTACT]

In some cases, the measured insulation resistance may exceed the instrument's maximum measurement range, causing an overflow reading. This overflow could result either from the DUT (Device Under Measurement) having a very high insulation resistance, or from a poor connection — making it difficult to determine the actual cause and potentially leading to misjudgment.
To address this issue, the instrument uses two additional terminals to independently check for poor contact on both the HIGH and LOW sides.
During both the charging and measurement phases, the instrument performs contact checks. These checks are conducted twice during each measurement cycle — once at the beginning and once at the end. If a poor connection is detected at either point, the current measurement is terminated immediately, and the instrument returns to the discharge state.
The instrument performs a contact check before every measurement to ensure reliable results.

When the contact check function is enabled, the measurement time will be extended.
Please refer to the Measurement Speed section for details.

■ Enabling Contact Check:

1 While in the discharge state, press the [SETUP] key to enter the settings page.

2 Use the arrow keys to select the [Contact Check] field.

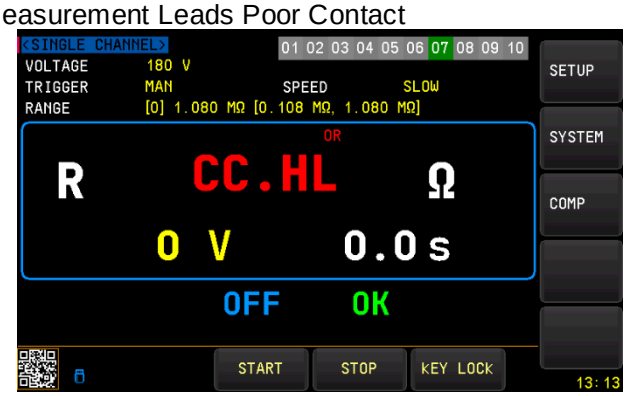
3 Use the function keys to select:

Function Key	Description
OFF	
ON	

When contact check is enabled, the instrument will first check for poor contact in the Measurement leads during measurement.
If either end is disconnected, the system will display an open-circuit warning and immediately return to the discharge state.

1. If both HIGH and Low terminals are disconnected, the display will show CC.HL.

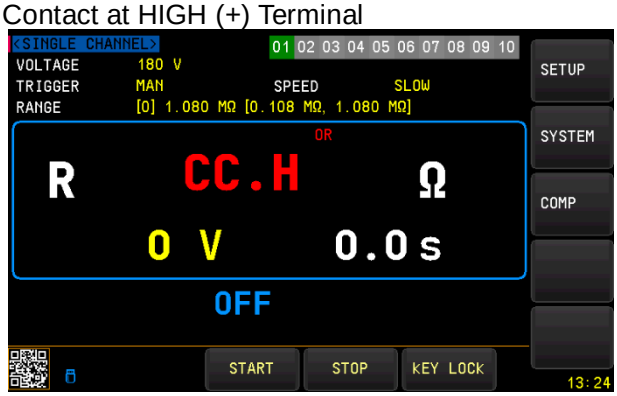
Figure 6-2 All Measurement Leads Poor Contact



At this point, you should check the Measurement leads connected to the HIGH (+) and LOW (–) terminals.

2. If the HIGH (+) terminal is open, the display will show CC.H.

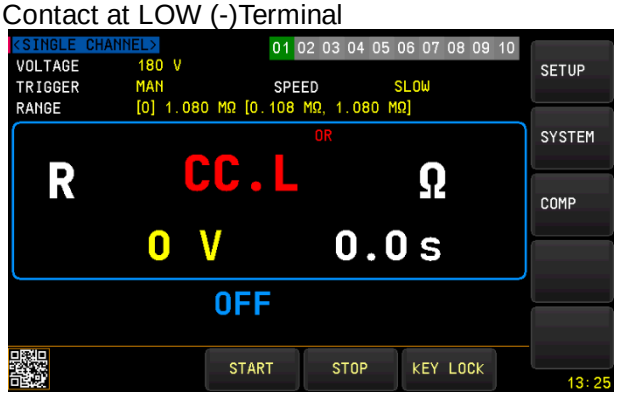
Figure 6-3 Poor Contact at HIGH (+) Terminal



At this point, you should check the HIGH(+) Measurement lead.

3. If the LOW (-) terminal is open, the display will show CC.L

Figure 6-4 Poor Contact at LOW (-)Terminal



At this point, you should check the LOW (-) Measurement lead.

6.1.2 [CHAR TIMER]

The instrument includes a charging function that allows the DUT (Device Under Measurement) to be charged with a constant current of 1.8 mA until the preset voltage is reached. This is particularly helpful for capacitive loads, as it speeds up the charging process and improves response time.
If excessive under-limit misjudgments occur during automated Measurementing, increasing the charge time appropriately can help improve measurement reliability.

The charge timer can be set within a range of **0.1 seconds to 60.0 seconds**.

■ Setting the Charge Timer:

1 While in the discharge state, press the [SETUP] key to enter the settings page.

2 Use the arrow keys to select the [Charge Timer] field.

3 You can either:

Directly enter the desired charge time using the numeric keypad (maximum: 60.0 seconds), or Use the function keys to select a preset value.

Function Key	Description
OFF	Charge Timer Offas
200 ms	
500 ms	
1s	
2s	

6.1.3 [TEST TIMER]

If the measurement timer is set, the instrument will automatically stop the measurement and return to the discharge state once the countdown reaches 0 seconds.
If the measurement timer is turned off, the instrument will remain in the measurement state continuously until either the Stop key is pressed or a stop command is received via communication.
When the timer is off, the timer display on the <Measurement Display> page will count upward, and will stop updating once it reaches 999.9 seconds.

The measurement timer can be set within a range of **0.1 seconds to 999.9 seconds**.

■ Setting the Measurement Timer:

1 While in the discharge state, press the [SETUP] key to enter the settings page.

2 Use the arrow keys to select the [Measurement Timer] field.

3 You can either:

- Enter the desired measurement time directly using the numeric keypad (maximum: 999.9 seconds), or
- Use the function keys to select a preset value.

	Function
OFF	Continuous Measurement
200 ms	
500 ms	
1s	
2s	

6.1.4 [DICH TIMER]

The discharge timer can be set within a range of 0.1 seconds to 60.0 seconds.

■ Setting the Discharge Timer:

1 While in the discharge state, press the [Setup] key to enter the settings page.

2 Use the arrow keys to select the [Discharge Timer] field.

3 You can either:

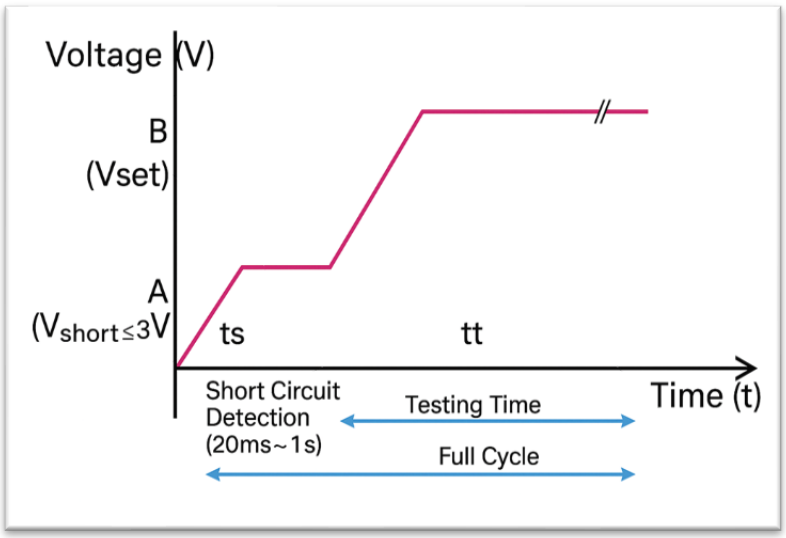
- Enter the desired discharge time directly using the numeric keypad (maximum: 60.0 seconds), or
- Use the function keys to select a preset value.

Function Key	Function
OFF	Continuous Measurement
200 ms	
500 ms	
1s	
2s	

6.1.5 [SHORT CHECK]

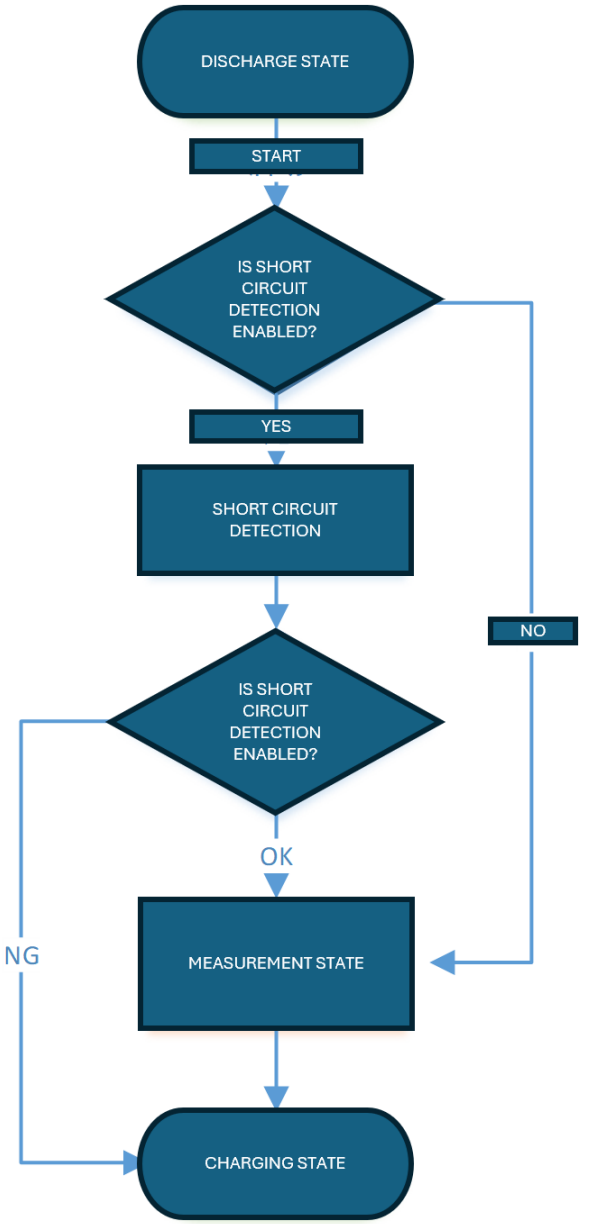
Due to manufacturing limitations, some DUTs (Devices Under Measurement) may contain filament-like contaminants. These impurities might be burned by the high output voltage and remain in the product, potentially leading to a false judgment of insulation pass.
To avoid such misjudgment, the instrument provides a Short Circuit Detection function. Before applying the full Measurement voltage, it performs a pre-check using a lower voltage (approximately 3V) to ensure that the DUT is not short-circuited. Only after confirming the DUT is safe does the instrument proceed with the normal high-voltage insulation Measurement.

Figure 6-5 Short Circuit Detection Timing Diagram



On the diagram:
Point A: Short circuit detection output voltage, fluctuating around 3V (range: approx. 2V–4V)
Point B: Set Measurement voltage
ts: Short circuit detection time
tt: Measurement time (includes both short circuit detection time and Measurement time)
tst: Total cycle time (tst = ts + tt)

Figure 6-6 Short Circuit Detection Flowchart



- Short Circuit Detection Time Set to [AUTO]

  If the required detection time is uncertain, it is recommended to set the short circuit detection time to [AUTO]. The default auto detection time is 0.5 seconds.

  In this mode:

  The instrument uses up to 0.5 seconds to check for a short circuit.

  If no short circuit is detected during this time, the instrument will display the actual detection time used and immediately proceed to the Measurement phase.

  If a short circuit is continuously detected within the full 0.5 seconds, the instrument will terminate the current measurement and return to the discharge state.

> When using the instrument in automated Measurementing systems, it is not recommended to set the short circuit detection time to [AUTO].

- Manual Input of Short Circuit Detection Time

  For DUTs from the same production batch, the required short circuit detection time is typically consistent.

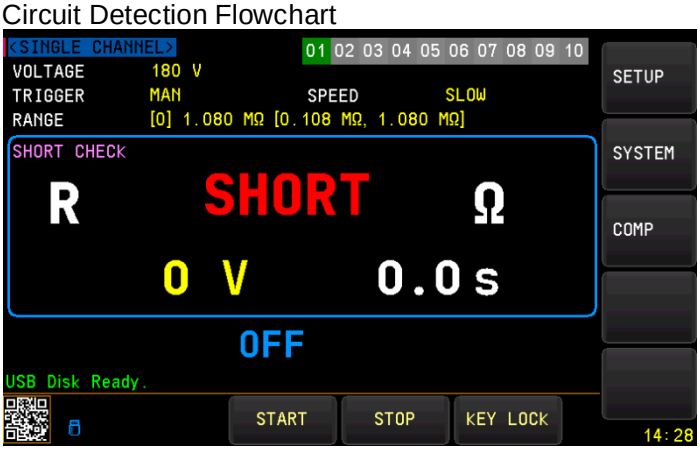
  In such cases, you can manually set a fixed detection time to achieve the shorMeasurement possible Measurementing duration.

> The short circuit detection timer can be set within a range of 10 milliseconds (10 ms) to 1 second (1 s).

Typically, the exact short circuit detection time is not known in advance. However, it can be easily determined using the following method:

1. Set the Short Circuit Detection Timer to [Auto].
2. Set the Trigger Mode to [Internal].
3. While in the Discharge state, connect the DUT properly.
4. Press Start to begin the Measurement.

Figure 6-7 Short Circuit Detection Flowchart



5. After short circuit detection is complete, if no short circuit is found, the instrument will display the detection time (this is shown only on the *Single Measurement* page).
   If a short circuit is detected, only the SHORT status will be displayed—see example above.

■ To set the short-circuit detection timer:

1. In the discharge state, press the [Setup] key to enter the setup page.
2. Use the arrow keys to select the [Short-Circuit Detection] field.
3. You can either use the numeric keypad to input the desired detection time directly (maximum 1 second, unit: seconds), or select using the function keys.

Function Key	Function
OFF	Short Circuit Detection Function: OFF
AUTO	The detection will be performed for a maximum duration of **500 ms**.
100 ms	
200 ms	
500 ms	

6.1.6 [SRES] Selection

The instrument is equipped with two internal current-limiting resistance modes: Normal and Limited. In Normal Mode, the voltage source delivers sufficient current for charging and measurement, effectively improving Measurementing efficiency. For DUTs sensitive to charging current - such as crystal oscillators or clock circuits—to prevent damage from high voltage, the Limited Mode should be selected. For power battery Measurementing, Limited Mode is also typically recommended. The source resistance in Limited Mode is 50 kΩ.

■ Steps to Select Current-Limiting Resistance:

1 Press the [SETUP] key to enter the Settings page.

2 Use the arrow keys to navigate to the [Source Impedance] field.

3 Use the function keys to select one of the following options:

Function Key	Function
NORMAL	
LIMIT	For current-sensitive devices, it is necessary to enable Limited Mode to prevent potential damage during high-voltage Measurementing.

7. COMPARATOR SETTINGS

In this chapter, you will learn about the following:

- Comparator Settings
- How the Comparator Works

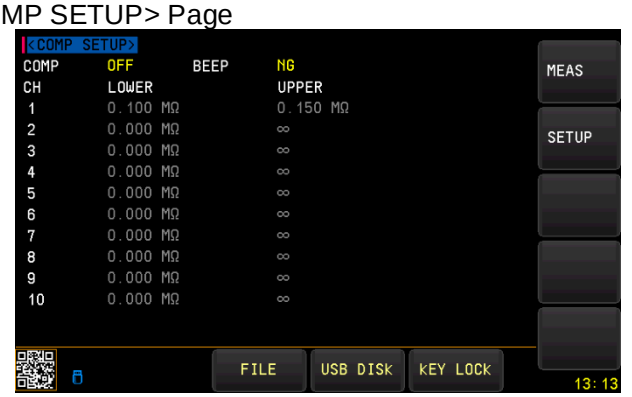
7.1 Comparator Settings

The instrument is equipped with a built-in comparator function. While in the discharge state, press the [MEAS] or [SETUP] key, then press the [COMP SETUP] function key on the right to enter the <COMP SETUP > page.
With a few simple steps, users can configure the instrument to sort Measurement results into Pass or Fail categories and associate them with corresponding beep alerts. Once the comparator is enabled, if any channel meets the alert criteria during Measurementing, a buzzer will sound.

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

- Comparator On/Off – Enable or disable the comparator function
- Beep Settings – Choose to beep on OK, NG, or disable beep entirely
- Beep Volume – Adjust the beep volume level
- Upper and Lower Limits – Set the pass/fail threshold values

Figure 7-1 <COMP SETUP> Page



7.1.1 [COMP] Switch

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

■ Steps to enable or disable the comparator:

1. Press the [MEAS] or [SETUP] key to enter the respective page.
2. Press the [COMP SETUP] key to access the < COMP SETUP > page.
3. Use the arrow keys to select the [COMP] field.
4. Use the function keys to choose

FUNCTION KEY	FUNCTION
OFF	Disables the comparator
ON	Enables the comparator (*displayed only on AT517L*)

7.1.2 [BEEP] Settings

Communication Command: COMParator: BEEP {OFF, OK, NG}
The instrument allows the buzzer to alert on either pass or fail results.

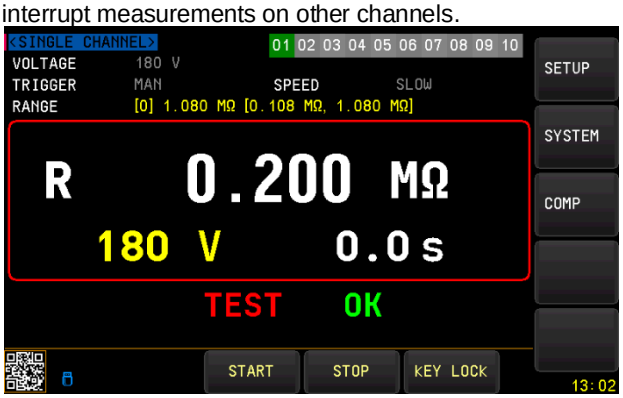
■ Beep Setting:

1 Enter the <COMP SETUP> page.
2 Use the arrow keys to select the [BEEP] field.
3 Use the function keys to choose from the following options:

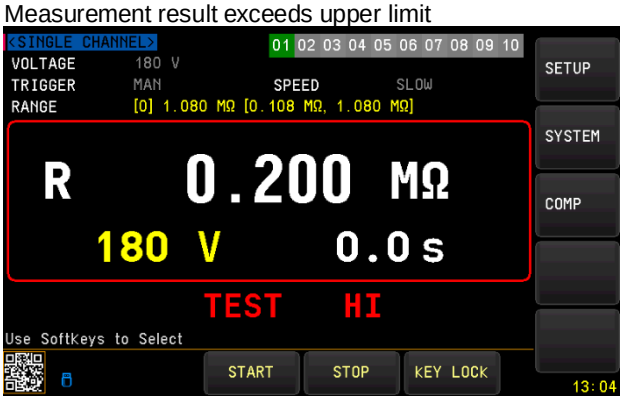
FUNCTION KEY	FUNCTION
OFF	Disable Beep
PASS	Beep on Pass
FAIL	Beep on Fail

■ Beep Operation Process

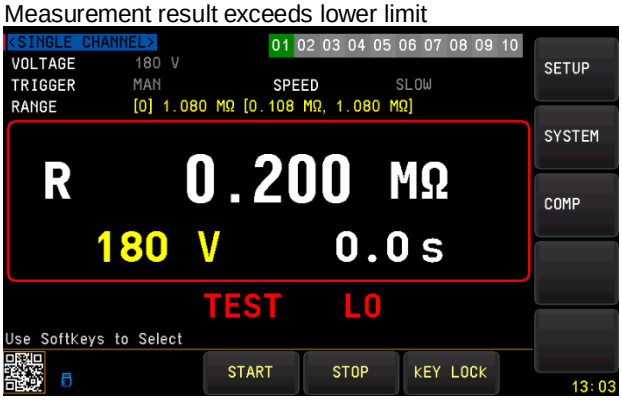
1.Enable the Comparator – Once activated, the instrument begins sorting Measurement results based on predefined criteria.
2.Set the Beep Mode – Choose whether the buzzer should sound for pass, fail, or not at all.
3.Switch to the Measurement Page – After configuration, return to the measurement interface and start Measurementing.
If any enabled channel meets the buzzer condition (pass or fail, as set), the buzzer will sound immediately.
If multiple channels meet the condition simultaneously, the buzzer will only trigger once and will not interrupt measurements on other channels.



Measurement result exceeds upper limit



Measurement result exceeds lower limit



The beep mode should be selected according to actual requirements.

7.1.3 [LOWER] Settings

SCPI command: COMParator: LOWer <float>

- To enter the lower limit value:

1. Navigate to the <COMP> page.
2. Use the arrow keys to select the [Lower Limit] field.
3. Enter the desired value and use the sidebar function keys to select the unit (e.g., 10 MΩ).

7.1.4 [UPPER] Settings

SCPI command: COMParator:UPper <float>

The upper limit of the comparator can be set to infinity (∞), in which case it will be excluded from evaluation and comparison.

- To set and input the upper limit:

1. Enter the <COMP> page.
2. Use the arrow keys to select the [UPPER] field.

3a. Enter a numeric value and use the sidebar function keys to select the unit (e.g., 1 GΩ).

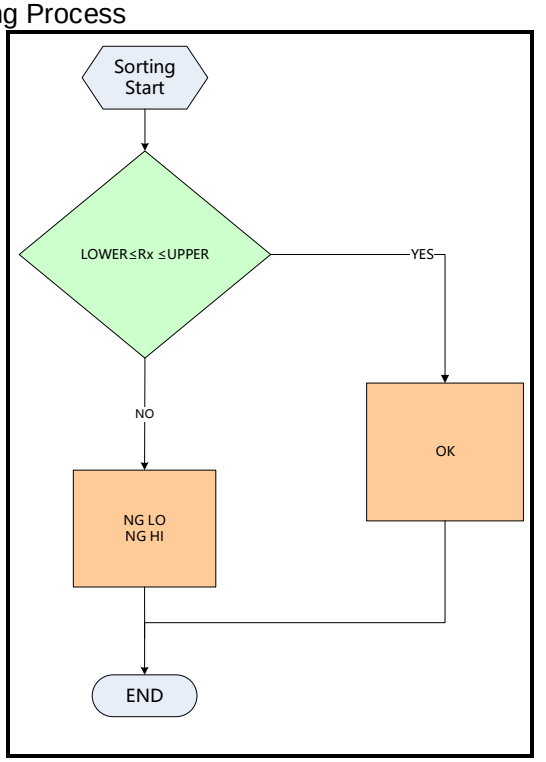
3b. Alternatively, use the sidebar function key to select ∞ (infinity) to disable the upper limit.

Once the comparator upper limit is set to ∞ (infinity), the instrument will evaluate only the lower limit. Measurements above the lower limit will be displayed as OK, while measurements below the lower limit will be displayed as NG LO.

7.2 How the Comparator Works

7.2.1 Sorting Process

Figure 7-2 Sorting Process



8. SYSTEM CONFIGURATION

In this chapter, you will learn about the following:

- System Configuration Page
- System Information Page

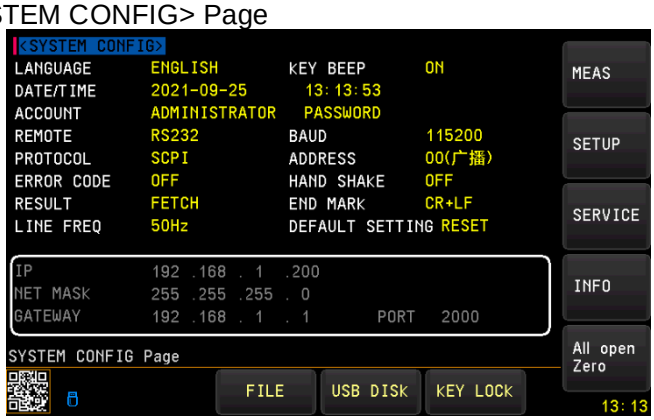
8.1 System Configuration Page

Press the [SYSTEM] sidebar key to enter the page.
The system configuration page includes the following settings:

- LANGUAGE – Choose between Chinese and English
- [KEY BEEP] Setting – Enable/disable keypress sounds
- [DATE/TIME] Setting
- [ACCOUNT] Setting – Set administrator/user account passwords
- [REMOTE] Setting – Supports RS232 / RS485 / USB interfaces
- [BAUD] Setting
- [PROTOCOL] Selection – Select between SCPI or MODBUS
- [ADDRESS] Setting – Set station number for multi-device communication
- Command [HAND SHAKE] Switch – Enable SCPI command handshake
- [RESULT] Mode – Set to Auto or Manual result transmission
- SCPI [END MARK] Setting – Configure SCPI command terminator
- LINE FREQ – 50Hz/60Hz filter selection
- DEFAULT SETTINGS – Reset instrument and system configuration to factory defaults

All settings on the System Configuration page are automatically saved and will be loaded the next time the instrument is powered on.

Figure 8-1 <SYSTEM CONFIG> Page



8.1.1 Change System Language [LANGUAGE]

SCPI command: SYSTem: LANGuage {ENGLISH, CHINESE, EN, CN}
The instrument supports both Chinese and English languages.

■ Steps to Change the Language:

1. Enter the <SYSTEM CONFIG > page.
2. Use the arrow keys to select [LANGUAGE].
3. Use the function keys to choose a language:

Function Key	Language
中文[CHS]	Simplified Chinese
ENGLISH	English

8.1.2 [KEY BEEP] Settings

The instrument's keypress sound can be turned off if desired.

■ Set the Key Beep

Step 1: Enter the <SYSTEM CONFIG> page.

Step 2: Use the arrow keys to select the [Key Beep] field.
Step 3: Use the function keys to choose the desired setting.

Function Key	Function
OFF	
ON	

8.1.3 Modify Date and Time

SCPI command: SYSTem: dt <YYYYMMDDHHmmss>

The instrument uses a 24-hour clock format.

■ To Change the Date:

1. Enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to select the [DATE] field.
3. Use the function keys to adjust the date:

Function Key	Funtion
MONTH INCR+	+1 Month
MONTH DECR-	-1 Month
DAY INCR+	+1 Day
DAY DECR-	-1 Day
YEAR INCR+	+1 Year
YEAR DECR-	-1 Year

■ To Change the Time

1. Enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to select the [CLOCK] field.
3. Use the function keys to adjust the time:

Function Key	Funtion
HOUR INCR+	+1 hour
HOUR DECR-	-1 hour
MINUTE INCR+	+1 Minute
MINUTE DECR-	-1 Minute
SECOND INCR+	+1 Sec
SECOND DECR-	-1 Sec

8.1.4 Account Settings

The instrument provides two user modes to choose from:

1. Administrator – All functions are accessible to the administrator, except for the [SERVICE] page. The parameters set by the administrator are saved in the system memory after a 5-second delay, making it easier to load them the next time the instrument is powered on.
2. User – The user can access all functions except for the [SERVICE] and [FILE] pages. Any data modified by the user will revert to the administrator's settings the next time the instrument is powered on.

■ Change the Account Mode:

1. Enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to select the [ACCOUNT] field.
3. Use the function keys to change the account mode:

Function Key	Function
ADMIN	All functions are accessible, except for the [SERVICE] page. If you forget the password, please contact our sales department.
USER	The user can operate all functions except for the [SERVICE] and [FILE] pages. Data changes are not saved.

■ Administrator Password Settings:

1. Enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to select the [ACCOUNT] field.
3. Use the function keys to select:

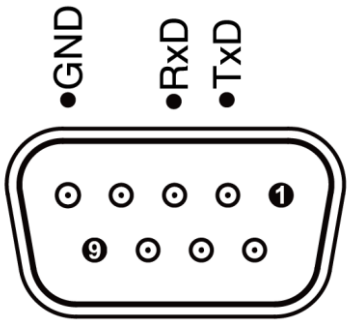
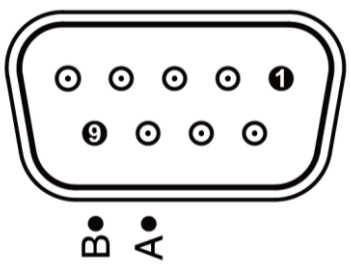
Function Key	Function
CHANGE PWD.	Enter a password consisting of up to 9 digits, which can include numbers and symbols.
DELETE PWD.	Remove the password protection for the administrator.

8.1.5 [REMOTE] Settings

The instrument supports three types of remote-control interfaces: RS232, RS485, and LAN interfaces.

All three interfaces support SCPI and Modbus (RTU) protocols.

To Select the Remote-Control Interface
1. Enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to select the [REMOTE] field.
3. Use the function keys to select the desired interface.

FUNCTION KEY	FUNCTION
RS232	RS232 communication uses the DB9 interface on the rear panel, utilizing 3 of its pins. P2: TxD P3: RxD P5: GND 
RS485	RS485 communication also uses the DB9 interface on the rear panel, utilizing 2 of its pins. P8: A (+) P9: B (-) 
LAN	

8.1.6 [PROTOCOL]Selection

The instrument supports two communication protocols: SCPI and Modbus (RTU) protocols. SCPI is more convenient for communication with computers, while Modbus protocol is easier for communication with industrial control devices such as PLCs, and it supports multi-device communication.

■ Selecting the Communication Protocol:
1. Enter the System Configuration page.
2. Use the cursor keys to select the Communication Protocol field.
3. Use the function keys to select the desired protocol.

Function Key	Function
SCPI	
Modbus	

8.1.7 [ADDRESS] Selection

For multi-device communication, a station number must be set.
If using the Modbus (RTU) protocol, ensure the station number address for the device is set properly. This station number can also be used for multi-device communication with the SCPI communication protocol.

Using the extended SCPI communication protocol from Applent Instruments, multi-device communication is also possible.
To select a slave device, add addr #;: at the beginning of each command line. For example: addr 02;:fetch? would represent fetching data from the slave device with station number 2.

■ Select RS485 Station Number:
1. Enter the <SYSTEM CONFIG> page.
2. Use the cursor keys to select the [Station Number] field.
3. Use the function keys to select the station number.

Function Key	Function
00 (BC)	The instrument will only receive commands and will not return any data.

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

Under the Modbus protocol, to facilitate the simultaneous operation of multiple identical instruments, the instrument allows the use of station number 00 for broadcast communication. When communicating with station number 00, the instrument will only receive instructions and will not return a response code.

8.1.8 [BAUD] Settings

The instrument is equipped with an RS-232 interface. Once the instrument receives a correct command via the RS-232 interface, it will immediately communicate with the host at the set baud rate, and the keyboard will be locked.
To ensure proper communication, please verify that the baud rate settings are correct. If the baud rates between the host and the instrument differ, communication will not occur properly.
The RS-232/RS-485/USB configuration of the instrument is as follows:

- Data Bits: 8 bits
- Stop Bits: 1 bit
- Parity: None
- Baud Rate: Configurable

Setting the Baud Rate:
1. Enter the <System Configuration> page.
2. Use the cursor keys to select the **Baud Rate** field.
3. Use the function keys to choose the desired baud rate.

Function Key	Function
9600	
19200	For Modbus communication with the host, it is recommended to use this baud rate.
38400	
57600	
115200	For SCPI communication with the host computer, it is recommended to use this high-speed baud rate.

8.1.9 SCPI [HANDSHAKE] Switch

This feature is only effective for SCPI protocol.
The instrument supports SCPI command handshake.
SCPI Command: SYSTem: SHAKhand {ON, OFF, 0, 1}
SCPI Query Command: SYSTem: SHAKhand?

When the command handshake is enabled, all commands sent from the host to the instrument will be returned to the host as they were sent before any data is returned.
When the command handshake is disabled, commands sent from the host to the instrument will be processed immediately.

■ Steps to Set Command Handshake:
1. Enter the <System Configuration> page.
2. Use the cursor keys to select the [Command Handshake] field.
3. Use the function keys to select the desired option.

Function Key	Function
OFF	Do not use command handshake. Unless specifically required, set the command handshake to Off.
ON	

8.1.10 SCPI Measurement [RESULT] Mode

This feature is only valid for the SCPI protocol.
The instrument supports automatic data transmission to the host. After each Measurement is completed, the data is automatically sent to the host, without the need for the host to send a FETCH? command.
After each Measurement, the instrument sends the Measurement results and comparator results to the host in the following format:
+1.000E+09, □100, TEST, OK□□□
Where:

- Parameter 1: Resistance measurement result (where +1.000e+20 indicates an overflow above the limit, and -1.000e+20 indicates an overflow below the limit)
- Parameter 2: Voltage output result (always takes up four digits, and spaces are padded on the left for shorter values)
- Parameter 3: Measurement status (there are five possible states: SHT, CHAR, MEASUREMENT, DICH, OFF)
- Parameter 4: Abnormal status and comparator results (two types of abnormal status: SHORT, OPEN, where the open circuit states are: CC_HL, CC_H, CC_L; comparator results include OK, LO, HI)
  1. OK indicates a pass
  2. LO indicates fail (below limit)
  3. HI indicates fail (above limit)

If the result transmission is set to AUTO, the measurement data will be returned based on the status of the Measurement Timer:

- When the measurement timer is set to OFF, the instrument will return data after each measurement.
- When the measurement timer is set to a specific duration, data will only be returned once after the measurement ends.

■ Steps to Set [RESULT]:

1. Enter the <SYSTEM CONFIG> page.
2. Use the cursor keys to select the [RESULT] field.
3. Use the function keys to select:
   FETCH: Only uses the FETCH? command to retrieve all measurement data.
   Auto: Automatically sends the measurement results to the host after each Measurement completion.

Function Key	Function
FETCH	FETCH: Only uses the FETCH? command to retrieve all measurement data.
AUTO	Automatically sends the measurement results to the host after each Measurement completion.

8.1.11 SCPI Measurement [END MARK] Switch

This function is only valid for the SCPI protocol.
The instrument supports SCPI command terminator settings.
When the host sends a command, it can either include or omit the terminator; the instrument can receive and parse both.
When the instrument sends a response to the host, it will always append the configured terminator at the end.
Terminators: A terminator is required in the communication commands between the instrument and the host to mark the end of a command.
The instrument supports three types of terminators:

END MARK	ASCII Name	ASCII Hex	Byte Count	Description
LF(0x0A)	Line Feed	0x0A	1 byte	Default for the instrument
CR(0x0D)	Carriage Return	0x0D	1 byte	
CR+LF	Carriage Return+ Line Feed	0x0D 0x0A	2 bytes	
NUL(0x00)	Null Character	0x00	1 byte	

■ Steps to Set the End Mark:

1. Enter the <System Configuration> page.
2. Use the cursor keys to select the [Terminator] field.
3. Use the function keys to select the terminator.

Function Key	Function
LF(0x0A)	LF: Line Feed, ASCII Code: 0x0A

CR(0x0D)	CR: Carriage Return, ASCII Code: 0x0D
CR+LF	
NUL(0x00)	NUL: Null Character, ASCII Code: 0x00

8.1.12 SCPI [ERROR CODE] Display

This function is only valid for SCPI protocol.
SCPI Command: SYSTem:CODE {ON,OFF,0,1}
SCPI Query Command: SYSTem:CODE?
When the error code feature is enabled, the instrument will return an error code after receiving a command.
For query commands, an error code will only be returned if there is an error in the command itself.
When the error code feature is disabled, the host can query the error code of the last executed command by sending the ERR? command.

■ Steps to Set Error Code:

1. Enter the <System Configuration> page.
2. Use the cursor keys to select the Error Code field.
3. Use the function key to select:

Function Key	Function
OFF	Error code will not be returned automatically.
ON	Error code will be returned after executing each command.

8.1.13 [LINE FREQ] Settings

The measurement stability of the instrument is highly dependent on the power frequency. Please select the power frequency according to the country's standard. The power frequency in China is 50Hz, and in Taiwan, it is 60Hz.

■ Select Power Frequency Filter:

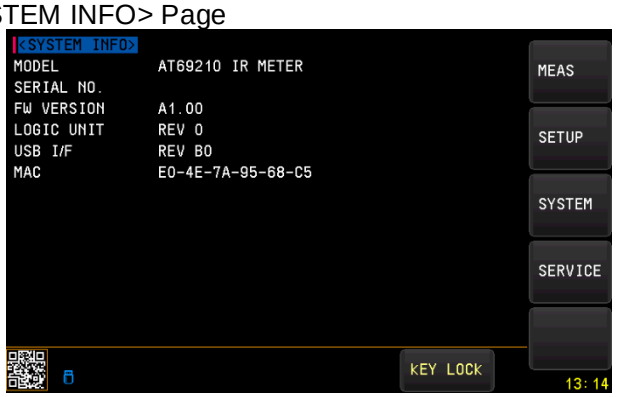
1. Enter the <System Configuration> page.
2. Use the cursor keys to select the Power Frequency field.
3. Use the function key to select:

Function Key	Function
50Hz	Set to 50Hz power frequency (standard in China).
60Hz	Set to 60Hz power frequency (standard in Taiwan).

8.2 <SYSTEM INFO> Page

Press the System key in the side taskbar to enter the [SYSTEM CONFIG] page, and then press the function key to select [SYSTEM INFO].
The System Information page does not have any user-configurable options.

Figure 8-2 <SYSTEM INFO> Page



9. File Management

This chapter covers the following topics:

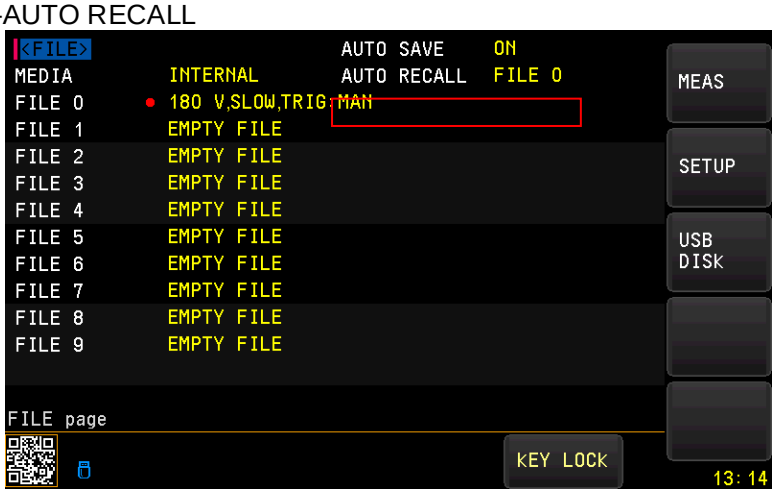
- [Startup File] - Specifies the file to be called upon startup.
- [Auto Save] - Allows the parameters to be modified and automatically saved in the current file.
- [File] - Specifies saving, reading, or deleting files.

Press the [FILE]function key at the bottom to enter the <FILE> page.
File Management allows users to save settings to 10 different files, making it easy to load files during startup or when changing specifications.

9.1 [AUTO RECALL]

The AUTO RECALL option allows you to specify which file will be loaded upon startup.

Figure 9-1 File—AUTO RECALL



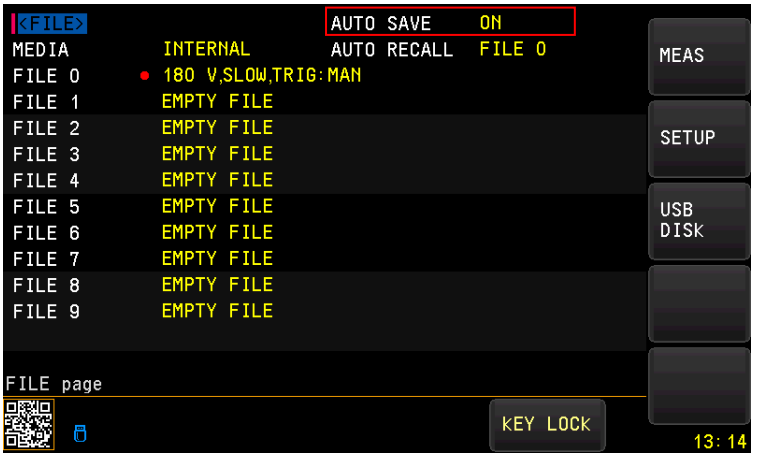
- Steps to Set the Startup File:
  1. Enter the <File Management> page.
  2. Use the cursor keys to select the [Startup File] field.
  3. Use the function key to select:

Function Key	Function
FILE 0	Load the settings from file 0 upon startup.
CURRENT FILE	Load the settings from the current file number upon startup.

9.2 [AUTO SAVE]

The Auto Save option allows user-defined parameters to be automatically saved to the current file.

Figure 9-2 File—Auto Save



- Steps to Enable Auto Save:

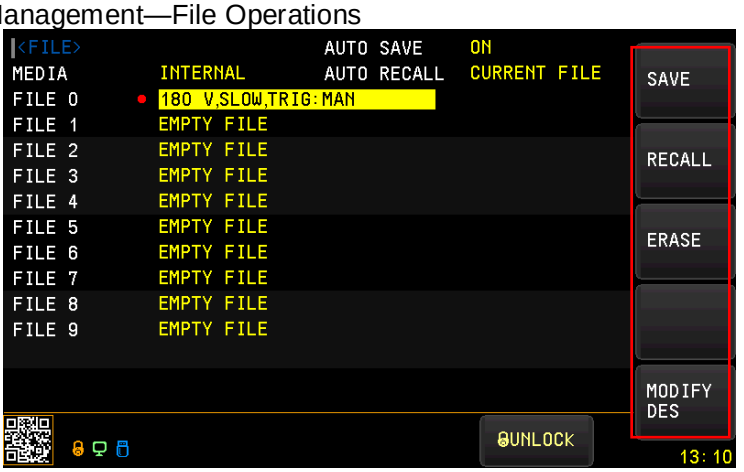
1. Enter the File Management page.
2. Use the arrow keys to select the [AUTO SAVE] field.
3. Use the function keys to choose an option:

Function Key	Function
ON	User-defined parameters will be automatically saved to the current file.
OFF	Parameters must be manually saved; otherwise, changes will be lost after power-off.

9.3 [FILE 0]~[FILE 9]

Users can specify 10 files (0~9) for saving, loading, and deleting.

Figure 9-3 File Management—File Operations



■ Steps for setting the file:

1. Enter the <File Management> page.
2. Use the cursor keys to select the [File 0] ~ [File 9] field.
3. Use the function key to select:

Function Key	Function
SAVE	Save all settings to the current file.
RECALL	Load the parameters from the selected file into the system.
ERASE	Delete the data from the selected file.

10. USBDISK DATA LOGGER

This chapter covers the following topics:

- Timed Saving – When the measurement timer is disabled, data is automatically saved to a file at predefined intervals.
- Auto Enable – Upon inserting a USB flash drive, the instrument automatically opens the designated file and begins data logging.
- File Management – Allows users to create new files for organized data storage.
- USB Storage Mechanism – Describes how data is written and managed on a USB flash drive.

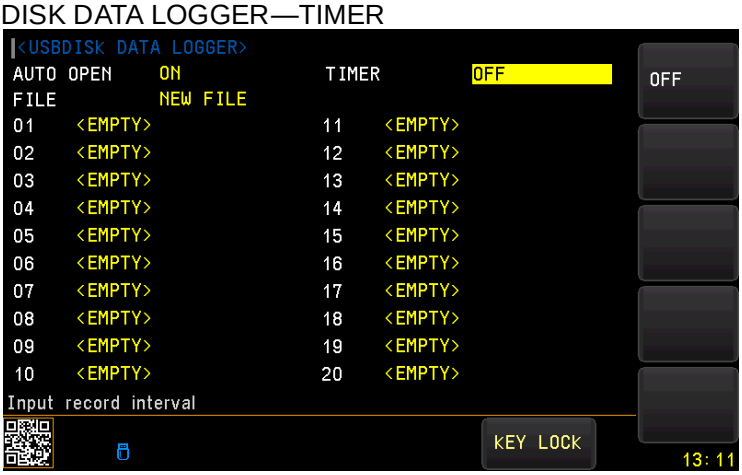
10.1.1 [TIMER]

The Timed Saving function can only be enabled when the following conditions are met:

1. In the <SETUP> page, [TIMER] must be set to Off.
2. A valid time interval must be configured for [TIMER] (i.e., not set to "Off").

If either of the above conditions is not met, the Timed Saving function will remain inactive even if a save interval has been set.

Figure 10-1 USBDISK DATA LOGGER—TIMER



■ Steps to Configure [Timed Saving]

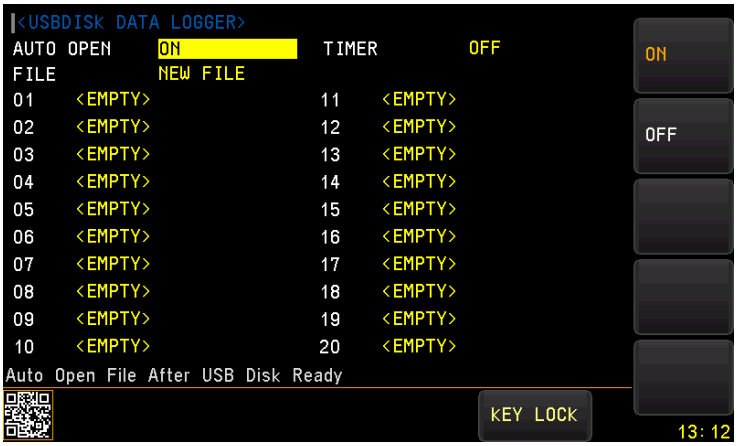
1. Navigate to the <USBDISK DATA LOGGER> page.
2. Use the arrow keys to select the [TIMER] field.
3. Use the function keys to select [OFF], or enter a custom time interval directly using the numeric keypad. The minimum interval for timed saving is 1 second.

Function Key	Function
OFF	

10.1.2 [AUTO OPEN]

When the [AUTO OPEN] option is turned on, the instrument will automatically detect whether a recently used file exists on the USB drive upon insertion. If such a file is found, it will be automatically opened and used for data recording.

Figure 10-2 USBDISK DATA LOGGER—AUTO OPEN



■ Steps to Configure [Auto Enable]:

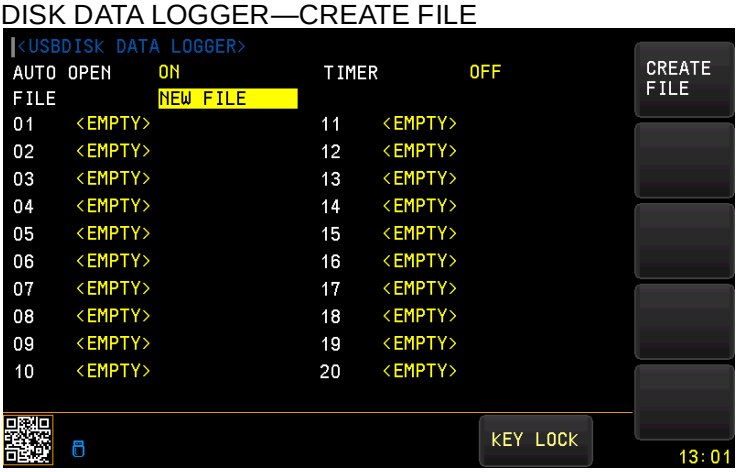
1. Go to the <USB Storage> page.
2. Use the arrow keys to select the [Auto Enable] field.
3. Use the function keys to make your selection.

Function Key	Function
ON	
OFF	

10.1.3 Create [NEW FILE]

The [CREATE FILE] field is used to create a new file on the USB flash drive. The file name can be customized by the user.
The file format is fixed as CSV.

Figure 10-3 USBDISK DATA LOGGER—CREATE FILE



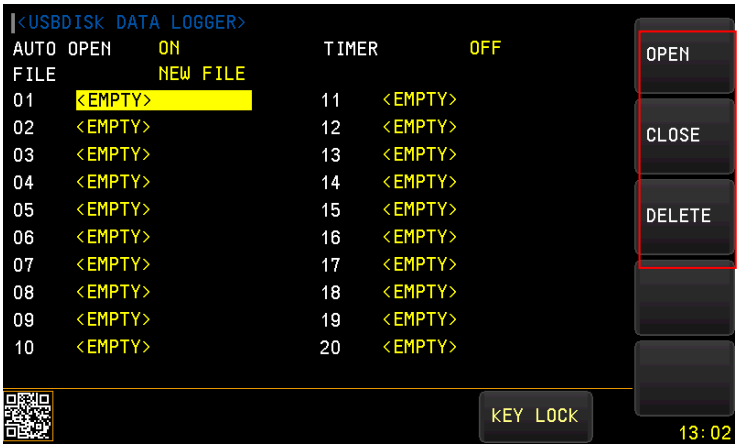
■ Steps to Create a [NEW FILE]:

1. Navigate to the <USB Storage> page.
2. Use the arrow keys to select the [File] field.
3. Use the function keys to select the operation.

Function Key	Function
CREATE FILE	A character keyboard will pop up, allowing you to enter a custom file name. Once the input is complete, press the function key [OK] to create a new file. The newly created file name will then appear in the list.

10.1.4 [FILE] Selection

Figure 10-4 File Selection



1. Enter the page.
2. Use the [Next Page] or [Previous Page] function keys to navigate between the File 0–9 and File 10–19 pages.
3. Use the arrow keys to select the desired File 0–19 field.
4. Use the function keys to choose an action.

Function Key	Function
OPEN	Opens the file and uses it for data storage.
CLOSE	Closes the file.
DELETE	Deletes the file along with all stored data. Once deleted, the file cannot be recovered.

10.1.5 USB Storage Mechanism

The data storage method differs between internal and external trigger modes.

Internal Trigger Recording:

1. When the Measurement Timer is set to OFF, the measurement data will be saved at intervals defined by the Timed Saving setting.
2. When the Measurement Timer is set to a specific duration, the data will be saved once at the end of the measurement cycle.

External Trigger Recording:

1. When the Measurement Timer is set to OFF, data is saved once for each trigger event.
2. When the Measurement Timer is set to a specific duration, the data is saved once at the end of the measurement cycle.

11. PREPARATION FOR MEASUREMENT

To help you get started quickly, this chapter provides a simple walkthrough on how to perform a basic measurement and verify that the voltage output is functioning properly.
Before beginning the measurement, please make sure you have reviewed the previous setup sections.

11.1 Connection of Measurement Terminals

When connecting the Measurement leads:
Insert the red banana plug into the HIGH + terminal.
Insert the black banana plug into the LOW – terminal.

Danger:
During charging and measurement states (when the front panel's MEASUREMENT high voltage indicator is illuminated), the HIGH + terminal will output high voltage. If the HIGH terminal is connected to ground, the LOW – terminal may carry a negative voltage. Do not touch any exposed metal parts of the Measurement terminals or leads to avoid the risk of electric shock.

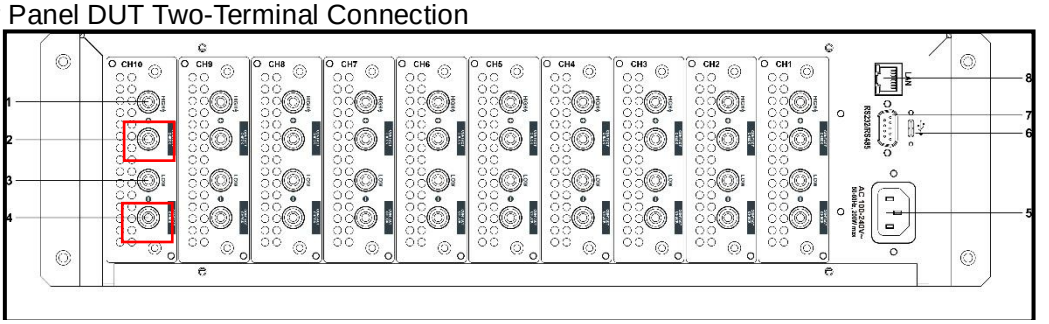
Note:
Use the Measurement leads provided by our company. The standard leads are rated with high insulation levels, ensuring both safety and measurement accuracy.

Do not measure the insulation resistance of powered devices, as this may damage the instrument. For capacitive loads, ensure complete discharge before measurement.

Caution:
The front and rear Measurement terminals are internally connected in parallel. Use only one set of terminals for measurement at a time.

11.1.1 Rear Panel Measurement Terminal Connection Method

Figure 11-1 Rear Panel DUT Two-Terminal Connection



Connect the positive Measurement leads to Terminal 1, and the negative Measurement leads to Terminal 3.

11.1.2 Rear Panel Contact Check Connection Method

If the Contact Check function is enabled, two additional Measurement leads are required. Connect them to the CONTACT CHECK terminals on the rear panel to enable four-terminal measurement.

For detailed configuration, please refer to the Contact Check section on the <SETUP> page.

11.2 Start Measurement

Warning:
- When the MEASUREMENT indicator on the Measurement terminal is illuminated, do not touch the exposed metal parts of the Measurement terminals or Measurement clips on the front or rear panel to avoid electric shock.
- After the Measurement is completed, please enter the discharge state to safely discharge the DUT (Device Under Measurement).

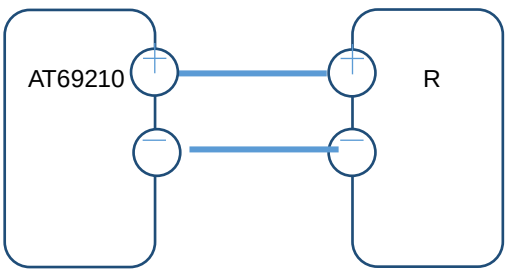
To demonstrate the measurement process clearly, we use the input impedance of a digital multimeter (DMM) as the DUT in this example. This also allows you to verify whether AT69210 is outputting the correct voltage.
If you have a handheld or benchtop multimeter, please connect it as follows.

11.2.1 Digital Multimeter Setting

Set the multimeter to DC voltage mode.
Insert the multimeter's red probe into the HIGH + terminal (red) of AT69210.
Insert the black probe into the LOW – terminal (black) of AT69210.
(You can also use the standard red and black Measurement clips provided with AT69210 to attach to the DMM probes. However, be careful not to touch the exposed metal parts to prevent electric shock.)

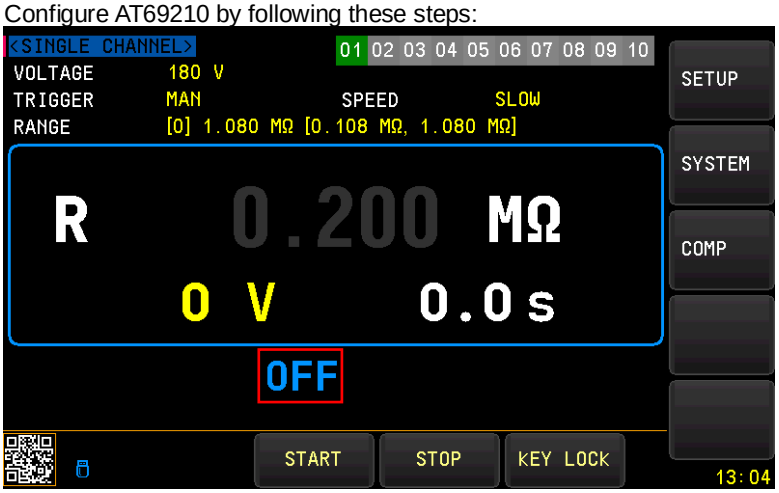
11.2.2 Connect Device Under Measurement)

Connect the positive terminal of AT69210 to the positive terminal of the DUT, and the negative terminal of the AT69210 to the negative terminal of the DUT.



11.2.3 Set Instrument Parameters

Configure AT69210 by following these steps:

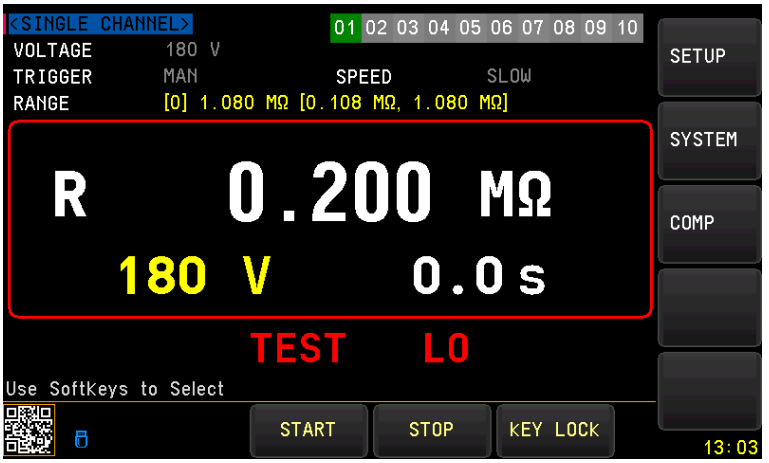


Ensure the instrument is in the discharge state. The status should display OFF, and the MEASUREMENT indicator should be off.
Press the [MEAS] key to enter the measurement page.
On this page, set the Measurement voltage and measurement range.
In the [SETUP] page, configure additional options such as short-circuit detection.
Once all settings are complete, proceed to start the Measurement.

11.2.4 [START] Measurement

While in the discharge state, press the [START] key. The instrument will begin the measurement. The measurement results will then be displayed on screen.

Figure 11-2 Measurement Results



In the figure

R 9.99MΩ: Indicates the internal resistance of the multimeter is approximately 10MΩ.

U 36 V: Indicates the output voltage is approximately 36V.

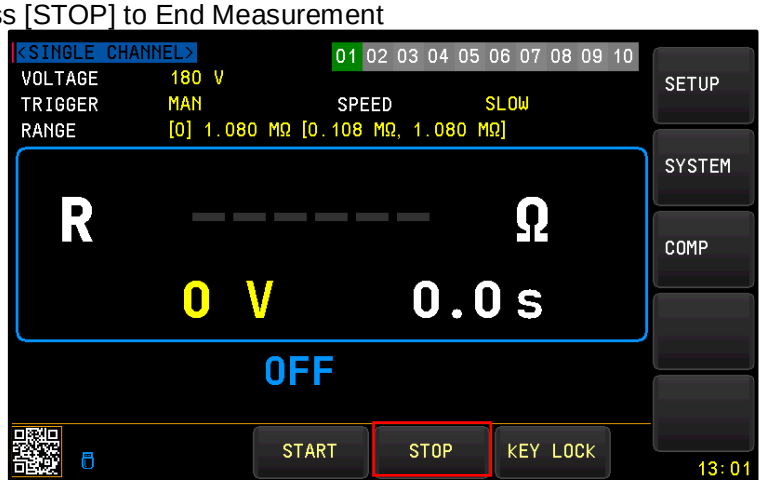
11.2.5 Verify Voltage

When measuring the DC voltage range resistance of the multimeter with AT69210, the multimeter also simultaneously verifies the instrument's output voltage value.

11.2.6 Stop Measurement

While in the Measurement state, press the [STOP] key to terminate the measurement and return the instrument to the discharge state.

Figure 11-3 Press [STOP] to End Measurement



Note: After pressing the [STOP] key, the display retains the previous measurement result. Pressing the [STOP] key again will reset the display to the initial state, as shown in Figure 11-3.

12. Remote Communication

In This Chapter, You Will Learn About the Following:

- Introduction to the RS-232 Interface
- RS-232 Connection
- Baud Rate Selection
- Software Protocol

The instrument uses the RS-232 interface (standard configuration) to communicate with a computer, enabling full control over all instrument functions.
By using standard SCPI commands, users can also easily develop customized data acquisition systems tailored to their specific requirements.

12.1 RS-232C

RS-232 is a widely adopted serial communication standard, also referred to as the asynchronous serial communication standard, commonly used for data exchange between computers and peripheral devices.
"RS" stands for Recommended Standard, and 232 is the standard number. It was officially released by the Electronic Industries Association (EIA) in 1969. RS-232 defines data transmission over a single wire, one bit at a time.
Although the original RS-232 specification used a 25-pin connector, most modern computers now use a 9-pin connector. The most commonly used RS-232 signals are listed below:

Table 12-1 Common RS-232 Signal

Signal	Symbol	25-Pin Connector	9-Pin Connector
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

Most modern instruments, including this one, use a minimal RS-232 subset, which includes only the essential three-wire configuration.

Table 12-2 Minimum Subset of RS-232 Standard

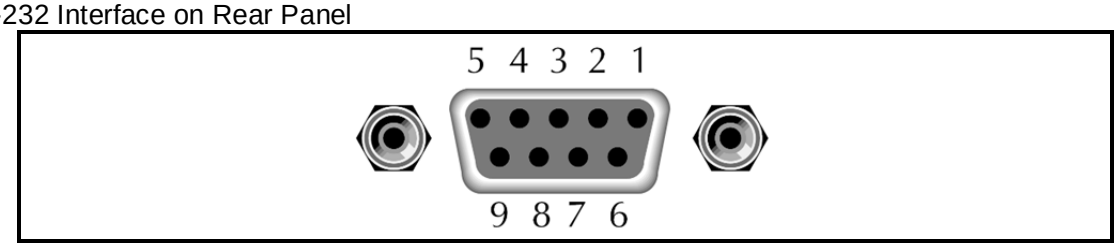
Signal	Symbol	9-Pin Connector
Transmit Data	TXD	2
Receive Data	RXD	3
Ground	GND	5

12.1.1 RS232C Connection

The RS-232 serial interface can be connected to a controller (such as a PC or industrial computer) via a straight-through DB-9 cable.

Note: The instrument does not support null modem cables.
You may either use a factory-made 9-pin straight-through cable provided by Applent Instruments, or build your own cable as per the specifications.
For custom 3-wire cables, please note:
When using the PC's built-in DB-9 port, it may be necessary to short pins 4 and 6, and pins 7 and 8 on the PC's DB-9 connector.

Figure 12-1 RS-232 Interface on Rear Panel



! To prevent electrical shock, please turn off the instrument power before plugging in or unplugging any connectors.

■ Default Communication Settings

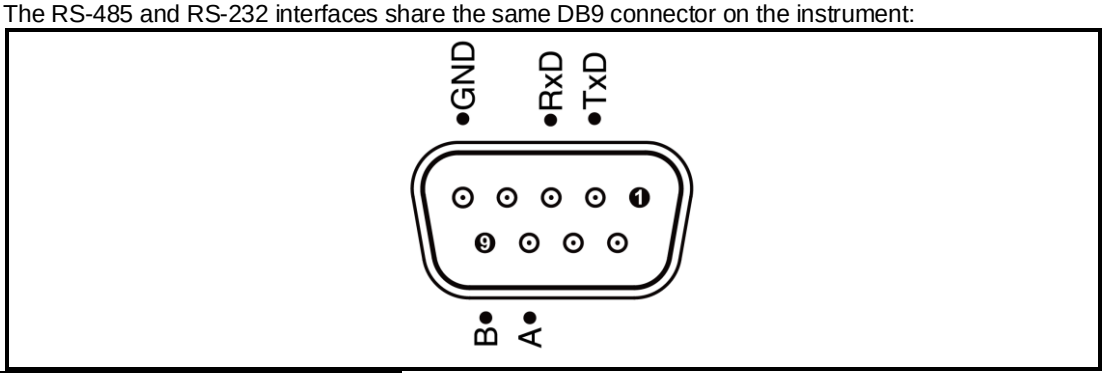
Transmission Mode: Full-duplex asynchronous communication (with start and stop bits)
Data Bits: 8 bits
Stop Bits: 1 bit
Parity Bit: None

12.2 RS485 Connection

The instrument comes with a standard RS-485 interface and supports Modbus RTU protocol.
RS-485 is a communication interface that supports multi-device communication, allowing one host to connect with multiple slave devices simultaneously.

For detailed specifications of RS-485, please refer to:
https://en.wikipedia.org/wiki/RS-485

The RS-485 and RS-232 interfaces share the same DB9 connector on the instrument:



Pin	Function
8	A
9	B

12.3 Handshake Protocol

Since the instrument uses the minimal subset of the RS-232 standard and does not use hardware handshake signals, it offers software handshake support to minimize communication errors or data loss. Software engineers must follow the protocol below when developing communication programs:

- The instrument only accepts ASCII-formatted commands, and its responses are also returned in ASCII.
- The host must send command strings ending with a newline character (NL or \n). The instrument begins processing the command only after receiving this end character.
- If software handshake is enabled, the instrument echoes back each character it receives. The host must wait for this echoed character before sending the next one.

! If the host does not receive data from the instrument, try the following steps:

1. Software Handshake Disabled
   – Go to the System Settings page on the instrument and enable it.
2. Serial Port Connection Failure
   – Check all cable connections.
3. Incorrect Host Communication Format
   – Verify that the port number, communication format, and baud rate match the instrument's settings.
4. Command Parsing Delay
   – If the instrument is still processing a previous command, the host may not receive a response. Please wait and try again.

12.4 SCPI Language

SCPI — *Standard Commands for Programmable Instruments* — is a general-purpose command set

adopted by Applent Instruments for controlling Measurement equipment. Also known as TMSL (Measurement and Measurement System Language), SCPI was developed by Agilent Technologies based on the IEEE488.2 standard and has since become widely adopted by Measurement equipment manufacturers.

The instrument has a built-in command parser responsible for interpreting various command formats issued by the user. Although the parser is based on the SCPI protocol, it is not fully SCPI-compliant. Please read the "SCPI Command Reference" chapter carefully before starting operation.

12.5 LAN

To facilitate remote control of the instrument, a LAN function is provided. LAN (Local Area Network) allows your computer and the instrument to connect to the same network, enabling remote operation. To access this feature, go to the page, use the function keys or navigation keys to select [LAN], and press to switch to the <Remote Service - LAN> interface.

Figure 12-2 LAN



Parameter	Description
MAC Adress	Physical address used to uniquely identify the device.
IP Adress	Logical address used for locating and communicating within the network.
Port	Connection point between the hipot Measurementer and network devices.
Subnet Mask	Used to divide the network address and host address within an IP address.
Gateway	Connect devices from different networks to forward data.

With the LAN remote communication function, you can connect the hipot Measurementer to a local area network (LAN) via the LAN port, enabling remote communication and data exchange with other devices. The steps are as follows:

1. Ensure the LAN port of the hipot Measurementer is properly connected to a switch or router within the LAN.
2. In the interface of the Measurementer, configure the correct IP address, subnet mask, and gateway to ensure the device is on the same network segment as other devices.
3. Open the network connection assistant, set the protocol type, IP address, and port number, then click “Connect” to begin communication.

13. SCPI COMMAND REFERENCE



In this chapter, you will learn about the following:

- Command Parser – Understand the basic rules of the command interpreter.
- Command Syntax – Writing rules for SCPI command lines.
- Query Syntax – Format and structure of query commands.
- Query Responses – Format of data returned from the instrument.
- Command Reference – A complete list of SCPI commands supported by the instrument.

This chapter provides all SCPI commands used by the instrument. These commands allow full control over the instrument's functions via remote communication.

13.1 Command String Parsing

The host can send a series of commands to the instrument. The command parser will start interpreting the commands once it receives a termination character or after 20 ms of inactivity.

For Example: A valid command string:

AAA:BBB CCC;DDD EEE;:FFF

The command parser is responsible for interpreting and executing all received instructions. Before writing your program, it's important to understand the parsing rules.

13.1.1 Command Parsing Rules

1. The command parser only recognizes and processes ASCII characters.
2. Parsing begins upon receipt of the termination character (which can be configured in the <System Configuration> menu).
3. If no termination character is received, the parser will begin processing the command after 20 ms of inactivity.
4. If handshake mode is enabled, the parser will echo each character back to the host as it is received. The host must wait for this echo before sending the next character.
5. If a command error is detected, parsing is immediately terminated, and the current command is discarded.
6. When a query command is detected, the parser stops parsing the rest of the string. Everything after the query is ignored.
7. The parser is case-insensitive.
8. Commands can be entered using their abbreviated forms, as defined in the following sections.

13.1.2 Symbol Conventions and Definitions

The following symbols are used throughout this chapter for clarity. These are not part of the command tree but are used to help understand command formats.

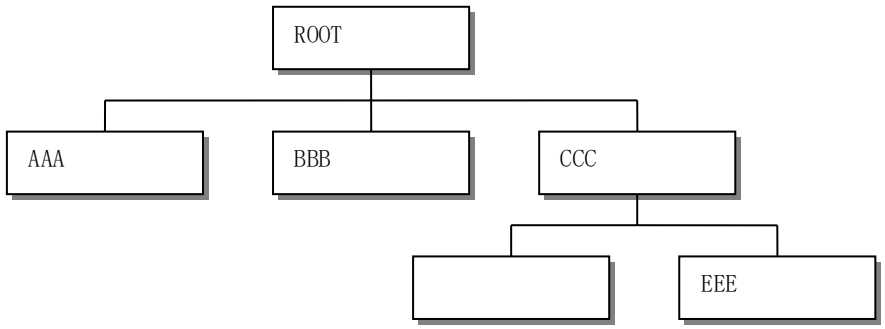
Symbol	Description
<…..>	Angle brackets enclose required parameters. Examples: <float> (floating point number), <integer> (integer number)
[……]	Square brackets enclose optional elements. Example: COMP[:STAT] ON is equivalent to COMP ON
{……}	Curly braces indicate a list of mutually exclusive options. Example: FUNC:RATE {SLOW, MED, FAST} means only one of these can be chosen
UPPERCASE	Indicates command abbreviation
□	indicates a space character, used only for readability

13.1.3 Command Tree Structure

SCPI commands follow a tree structure, typically three levels deep (although this instrument supports deeper nesting). The top-level node is known as the subsystem command, and sub-commands are only valid after their parent subsystem command is invoked.

Use a colon : to separate commands across different levels in the tree structure.

Figure 13-1 Command Tree Structure



For Example

ROOT:CCC:DDD ppp
ROOT Subsystem command
CCC Second level
DDD Third level
ppp Parameter

13.2 Commands and Parameters

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

For Example

AAA:BBB□1.234
Command [Parameter]

13.2.1 Commands

Command keywords can be written in long form or abbreviated form.

- Long form is easier to understand and read, especially for engineers.
- Abbreviated form is shorter and more convenient for coding.

13.2.2 Parameters

1. Some commands are simple and contain no parameters.
   Example: AAA:BBB
2. Parameters can be in string format, following the same abbreviation rules as commands.
   Example: AAA:BBB□1.23
3. Parameters can be in numeric format, which may include:

<integer>	Integer values 123，+123， -123
<float>	Any floating-point value: Fixed-point notation: 1.23，-1.23 Scientific notation: 1.23E+4，-1.23e-4 Multiplier notation: 1.23k，1.23MA，1.23G，1.23u
<SciFloat>	Scientific notation only 1.2345E+04 indicates 1.2345×10^4

Table 13-1 Multiplier Abbreviations

Multiplier	Prefix
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

SCPI is **case-insensitive**, which means it does not differentiate between uppercase and lowercase letters. Therefore, the notation for multipliers differs from standard SI unit conventions.

- "1M" in SCPI indicates **1 milli** (1E−3), *not* 1 mega (1E+6)
- "1MA" should be used to represent **1 mega** (1E+6)

13.2.3 Separators

The instrument's command parser only accepts valid separators. Any unrecognized separator will trigger an "Invalid separator" error. The following separators are recognized:

; Semicolon – Used to separate multiple commands in a command string.
Example: AAA:BBB 100.0;CCC:DDD

: Colon – Used to separate hierarchical levels in a command tree, or to restart the command tree.
Example: AAA:BBB:CCC 123.4;:DDD:EEE 567.8

? Question Mark – Indicates a query command.
Example: AAA?

□ Space (ASCII 20h) – Used to separate the command from its parameter(s).
Example: AAA:BBB□1.234

13.2.4 Error Codes

The following error codes may be returned by the instrument's SCPI command parser:

Error Code	Description	Explanation
*E00	No error	No error occurred
*E01	Bad command	Invalid or unrecognized command
*E02	Parameter error	Incorrect parameter provided
*E03	Missing parameter	Required parameter is missing
*E04	buffer overrun	Input buffer overflow
*E05	Syntax error	Command format is incorrect
*E06	Invalid separator	Unsupported or illegal delimiter
*E07	Invalid multiplier	Unrecognized unit prefix
*E08	Numeric data error	Number format is invalid
*E09	Value too long	Provided value exceeds length limit
*E10	Invalid command	The command is not valid
*E11	Unknow error	An undefined or unexpected error

13.3 Command Reference

All commands are organized and explained according to their subsystem categories. The following subsystems are available:

- DISPlay — Display Subsystem
- FUNCtion — Function Subsystem
- CORRection — Correction Subsystem
- COMParator — Comparator subsystem
- SYSTem — System settings subsystem
- TRIGger — Trigger subsystem
- FETCh? — Data acquisition subsystem
- ERRor — Error information subsystem

Common Commands:

- IDN? — Instrument identification query
- TRG — Trigger and acquire data
- PrtScn — Screenshot

13.4 DISPlay Subsystem

The DISPlay subsystem allows you to switch between different instrument display pages or display a string of text in the message area.

Figure 13-2 DISPlay Subsystem Tree

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

13.4.1 DISPlay: PAGE

The DISP:PAGE command is used to switch to a specific screen page.

Command Syntax	DISPlay:PAGE <Page Name>
Parameters	<Page Name>:

	MEAS Measurement display page SETUP(MSET) Setup page COMParator(comp) Comparator page SYSTem System configuration page SYSTEMINFO(SINF) System information page CATalog File management page USBDisk(USB) USB storage page
Example	Send > disp:page setup // Switches to the Setup page.
Query Syntax	DISP:PAGE?
Query Response	Abbreviation of <Page Name> meas Measurement display page mset Setup page comp Comparator page syst System configuration page sinf System information page cat File management page usb USB storage page
Example	Send > disp:page? Response > sngl

13.4.2 DISP: LINE

The DISP:LINE command is used to display a string of text in the message bar at the bottom of the screen. The text can contain up to 30 characters.

Command Syntax	DISPlay:LINE <*string*>AA
Parameter	<string> A text string with a maximum length of 30 characters.
Example	Send > DISP:LINE “This is a Comment.”
Query Syntax	DISPlay:LINE?
Example	Send >DISP:LINE? Response >NULL \/NULL, indicates a blank or empty line.

13.5 FUNCtion Subsystem

> **Note:**
> Parameters set through the FUNCtion subsystem are not automatically saved to a file.
> After configuring the parameters, you must explicitly save them using either the FILE subsystem or the SAV common command to store them into the internal memory file.

Figure 13-3 FUNCtion Subsystem Tree

FUNCtion	:RANGe	{range, max, min}	Sets the measurement range.
		:MODE {AUTO,HOLD,NOMinal}	Sets the range mode
	:SPEED(RATE)	{SLOW,MED,FAST }	Sets the measurement speed.
	:CONTCHECK(CC)	{ON,OFF,0,1}	Enables or disables contact check.

Parameters configured through the FUNCtion subsystem are not retained after shutdown.

13.5.1 FUNCtion: RANGe Range

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

Command Syntax	FUNCtion:RANGe {(ch),<integer(0~3)>}
Parameters	<integer> indicates the range number: 0 to 3. The maximum range value depends on the selected output voltage.
Example	Send > FUNC:RANG 1,3 // Set channel 1 to range 3
Query Syntax	FUNC:RANG?
Query Response	Range 0~3
Example	Send > FUNC:RANGE? Response > 3

13.5.2 FUNCtion: RANGe: MODE - Range Mode

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

Command Syntax	FUNCtion:RANGe:MODE {AUTO,HOLD,NOMinal(NOM)}
Example	Send > FUNC:RANG:MODE NOM<NL> // Switch to Nominal Range Mode
Query Syntax	FUNC:RANG:MODE?
Query Response	{AUTO,HOLD,NOM}

13.5.3 FUNCtion: RATE - Measurement Speed

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

Command Syntax	FUNCtion:RATE {SLOW,MED,FAST} FUNCtion:SPEED {SLOW,MED,FAST}
Example	Send > FUNC:RATE MED // Set to medium speed measurement.
Query Syntax	FUNCtion:RATE? FUNCtion:SPEED?
Query Response	{SLOW,MED,FAST}

13.5.4 FUNCtion: CONTCHECK(CC) - Contact Check

FUNC:CONTCHECK or FUNC:CC is used to configure the contact check switch.

Command Syntax	FUNCtion:CONTCHECK {OFF,ON,0,1} FUNCtion:CC {OFF,ON,0,1}
Example	Send > FUNC:CC ON
Query Syntax	FUNCtion:CONTCHECK? FUNCtion:CC?
Query Response	{on,off} //The return value is lowercase: on or off.

13.5.5 FUNCtion: SRES - Source Resistance

。FUNC: SRES is used to set the internal source resistance. For current-sensitive precision devices or power batteries, it is recommended to use the LIMIT mode.

Command Syntax	FUNCtion:SRES {NORMAL,LIMIT}
Example	Send > FUNC:SRES LIMIT // Set to current-limiting mode
Query Syntax	FUNCtion:SRES?
Query Reponse	{NORMAL,LIMIT} // The return value is uppercase.

13.5.6 FUNCtion: CHENABLE(CHEN) - Range

FUNC: RANG his command is used to enable or disable specific channels in multi-channel measurement mode.

Command Syntax	FUNCtion: chenable(chen) {(ch),<ON,FF,0,1>}
Parameters	Parameter 1: Channel number Parameter 2: ON/OFF
Example	Send > FUNC: chenable 1,ON // Enable Channel 1
Command Syntax	FUNCtion: chenableOnly(chenOnly) {(ch)}
Parameters	Parameter: Channel Number
Example	Send > FUNC: chenOnly 1 // Enable Channel 1 only
Command Syntax	FUNCtion: chenableAll(chenAll) {<on,1>}
Parameter	Parameter: only on or 1
Example	Send > FUNC: chenAll ON // Enable all the Channels
Query Syntax	FUNC:chen? 1
Query Response	ON,OFF
Example	Send > FUNC:CHEN? Response > ON

13.6 VOLTage Subsystem

The VOLTage subsystem is used to configure the Measurement voltage.

Figure 13-4 VOLTage Subsystem Tree

VOLTage	<integer(10~1000)>

Command Syntax	VOLTage <10~1000>
Example	Send >VOLT 100 //Set the voltage to 100V
Query Syntax	VOLT?

Query Response	<A 4-digit positive integer between 10 and 1000. >
Example	Send >VOLT? Response >□100,□100,□100,□100,□100,□100,□100,□100,□100,□100 //A 4-digit positive integer between 10 and 1000. If the value has fewer than four digits, leading spaces are used to pad the output.

Note:
1. The set voltage affects the maximum available measurement range. Be sure to check the updated range after voltage is configured.
2. Return values are 4-digit integers, left-padded with spaces if needed.
3. Voltage settings via this subsystem are not automatically saved. Use the FILE subsystem or the SAV common command to save settings to memory.
4. Voltage can only be configured while the instrument is in the discharge (OFF) state.

13.7 TIMEr Subsystem

The TIMEr subsystem is used to configure timing-related parameters, including charging timer, Measurement timer, short-circuit timer, and trigger delay.

Figure 13-5 shows the TIMEr Subsystem Tree

TIMEr	:CHARge	<float>	Charging timer, 0 = off
	:SAMPle	<float>	Measurement timer, 0 = off
	:SHORt	<float>	Short-circuit timer, 0 = off, 9 = auto
	:TRIGdelay	<float>	Trigger delay, 0 = off

13.7.1 TIMER: CHARGE - Charging Timer

TIMEr:CHARge: This command sets the charging time duration.

Value Range: 0.1 to 60 seconds
- 0 disables the charging timer
- Values outside range return error code *E02 (Parameter error)

Command Syntax	TIMER: CHARge <float>
Example	Send >TIME:CHAR 0.5 //Charging timer = 0.5s Send >TIME:CHAR 0 //Disable charging timer
Query Syntax	TIMEr:CHARge?
Query Response	<FixFloat>
Example	Send >TIME:CHAR? Response >□□0.0 //Charging timer is off

13.7.2 TIMER: TEST - Measurement Timer

TIMEr:MEASUREMENT: This command sets the measurement duration.

Value Range: 0.05 to 999 seconds
- 0 disables the measurement timer
- Values outside range return error code *E02 (Parameter error)

Command Syntax	TIMEr:MEASUREMENT <float>
Example	Send >TIME:MEASUREMENT 0.2 //Measurement timer = 0.2s Send >TIME:MEASUREMENT 0 //Disable Measurement timer
Query Syntax	TIMEr:MEASUREMENT?
Query Response	<FixFloat>
Example	Send >TIME:MEASUREMENT? Response >□□0.2 // Disable charge timer

13.7.3 TIMEr: SHORt - Short Circuit Detection Timer

TIMEr:SHORt command sets the short-circuit detection time.

Minimum value: 0.01 s.
Maximum value: 1 s.
A value of 0 disables the timer.
A value of 9 enables automatic mode.
If the value is out of range, the instrument will return error code *E02 (Parameter error).

Command Syntax	TIMEr:SHORt <float>
Example	Send >TIME:SHOR 0.1 // Short-circuit detection timer is set to 0.1 seconds.

	Send >TIME:SHOR 0 // Short-circuit detection timer is turned off. Send >TIME:SHOR 9 // Short-circuit detection timer is set to automatic mode.
Query Syntax	TIMEr:SHORt?
Query Response	<FixFloat>
Example	Send >TIME:SHOR? Send >0.10 Send >TIME:SHOR? Response >9.00 // Short-circuit detection timer: Automatic mode

13.7.4 TIMER: DISCHARGE(DICH) - Discharge Timer

TIMEr:Discharge is used to set the discharge timer.

> Minimum discharge timer: 100 ms
> Maximum value: 60 seconds
> A value of 0 disables the timer.
> If the time set exceeds the allowed range, the system will return error code *E02 (Parameter error).

Command Syntax	TIMEr: Discharge <float>
Example	Send >TIME: Dich 0.1 //Set the discharge timer to 100ms Send >TIME: Dich 0 // Disable the discharge timer.
Query Syntax	TIMEr: Dich?
Query Response	<FixFloat>
Example	Send >TIME: Dich? Response >0.0 //Indicates the timer is off Send >TIME: Dich? Response >0.

13.8 COMParator Subsystem

The COMP subsystem is used to configure comparator parameters.

> Note:
> The settings in the COMParator subsystem are **not** stored automatically. To retain the settings, use the FILE subsystem to save them or use the common command SAV to store them in internal memory.

Figure 13-6 COMParator Subsystem Tree

COMParator	[:STATe]	{OFF,ON}	Comparator Status
	:BEEP	{OFF,OK,FAIL}	Beep Setting
	:TONE	{LOUD,WEAK}	Beep Volume
	:LOWer	<float>	Lower Limit
	:UPper	<float>	Upper Limit
	:LIMIT(LMT)	<float>,<float>	Lower and Upper Limits

13.8.1 COMParator[:STATe] - Comparator Status

COMP[:STATe] is used to enable or disable the comparator.

Command Syntax	COMParator[:STATe] {OFF,ON,0,1}
Example	Send >COMP:STAT ON // Enable comparator Send >COMP OFF // Disable comparator
Query Syntax	COMP[:STAT]?
Query Response	{off,on}

13.8.2 COMParator: BEEP Comparator Beep

COMP: BEEP is used to enable beeping sound for results.

Command Syntax	COMParator: BEEP {OFF,OK,NG}
Example	Send > COMP:BEEP OK // Beep for "PASS" results
Query Syntax	COMP: BEEP?
Query Response	{OFF, OK, NG}

13.8.3 COMParator:LOWer Comparator Lower Limit

COMP:LOWer sets the comparator's lower limit. The value can be any valid floating-point number.

Command Syntax	COMParator: LOWer <float>

Example	Send > COMP:LOW 1MA // sSet lower limit to 1MΩ Send > COMP:LOW 1G // Set lower limit to 1GΩ Send > COMP:LOW 10E6 // Set lower limit to 10MΩ
Query Syntax	COMP:LOW?
Query Response	<Scifloat Scientific Notation>
Example	Send > COMP:LOW? Response > 1.000E+06 //=1MΩ

13.8.4 COMParator:Upper Comparator Upper Limit

COMP:UPper sets the comparator's upper limit. The value can be any valid floating-point number.

Maximum allowed value for upper limit: 20 GΩ
If the value exceeds this range, error code 90 is returned.
Setting the value to 1E20 disables the upper limit comparison.

Command Syntax	COMParator:UPper {<float upper limit>，OFF}
Example	Send > COMP:UP 10G // Set upper limit to 10GΩ Send > COMP:UP 10E9 // Set upper limit to 10GΩ Send > COMP:UP 10E6 // Set lower limit to 10MΩ Send > COMP:UP 1E20 // Disable lower limit Send > COMP:UP OFF // Disable lower limit
Query Syntax	COMP:UP?
Query Response	<Scifloat Scientific Notation>
Example	Send > COMP:UP? Response > 1.000E+10 //=10GΩ Response > 1.000E+20 //1E20 indicates lower limit disabled

13.8.5 COMParator:LIMIT(LMT)Comparator Limits

COMP:LIMIT is used to set both lower and upper limits of the comparator.

Command Syntax	COMParator:LIMIT <float lower limit>,<float upper limit>
Example	Send > COMP:LMT 10MA,100MA //lower limit=10MΩ, upper limit=100MΩ Send > COMP:LMT 1G,1E20 //lower limit=1GΩ, upper limit=disable
Query Syntax	COMP:LMT?
Query Response	<scifloat>,<scifloat>
Example	Send > COMP:LMT? Response > 1.000E+09,+1.000E+20 //Lower=1GΩ, upper=disable

13.9 SYSTem Subsystem

The SYSTem subsystem is used to configure system-related parameters. Most commands correspond to settings found in the instrument's <System Config> page.

Note:
Parameters configured under the SYSTem subsystem are **automatically saved** to internal memory — no additional SAV command is required.

Figure 13-7 SYSTem Subsystem Tree

SYSTem	:LANGuage	{ENGLISH,CHINESE,EN,CN}	Set system language
	:THEMe	{CLASSIC,MORDEN}	Set theme style
	:TIME	<YEAR>,<MONTH>,<DAY>,<HOUR>,<MINUTE>,<SECOND>	Set internal system time
	:KEYLock(keyl)	{ON(1),OFF(0)}	Keyboard lock setting
	:KEYBeep	{ON(1),OFF(0)}	Key beep setting
	:SHAKEHAND(SHAK)	{ON(1),OFF(0)}	SCPI handshake setting
	:CODE	{ON(1),OFF(0)}	SCPI error code display
	:TERM?	{LF,CR,CR+LF,NUL}	Query terminator symbol
	:RESult	{FETCh,AUTO}	Result sending mode
	:FILTler	{50Hz,60Hz,AUTO}	Power frequency filter setting

13.9.1 SYSTem:LANGuage System Language

Used to set the system display language.

Command Syntax	SYSTem:LANGuage {ENGLISH,CHINESE,EN,CN}
Example	Send > SYST:LANG EN // Set language to English
Query Syntax	SYST:LANG?
Query Response	{ENGLISH,CHINESE}

13.9.2 SYSTem:SYTLe Theme Style Settings

The instrument provides two built-in themes: CLASSIC and MORDEN.

Command Syntax	SYSTem:STYLe { CLASSIC,MORDEN}
Example	Send > SYST:STYLe MORDEN // Switch to modern style
Query Syntax	SYST:STYL?
Query Response	{CLASSIC,MORDEN }

13.9.3 SYSTem:TIME System Time Setting

Command Syntax	SYSTem:TIME <YEAR>,<MONTH>,<DAY>,<HOUR>,<MINUTE>,<SECOND>
Example	Send > SYST:TIME 2020,2,1,11,18,31 //2020-2-1 11:18:31
Query Syntax	SYSTem:TIME?
Query Response	<YEAR>-<MONTH>-<DAY> <HOUR>:<MINUTE>:<SECOND>
Example	Send > SYST:TIME? Receive > 2016-12-30 11:18:31

13.9.4 SYSTem: KEYLock or SYSTem: KLOCk Keyboard Lock Settings

Command Syntax	SYSTem:KEYLock {ON,OFF,0,1} SYSTem:KLOCk {ON,OFF,0,1}
Example	Send > SYST:KEYL OFF // Unlock the keyboard
Query Syntax	SYSTem:KEYLock? SYSTem:KLOCk?
Query Response	{on,off}

13.9.5 SYSTem: KEYBeep Sound Setting

Enable or disable key press beeping.

Command Syntax	SYSTem:KEYBeep(KEYB) {OFF,ON,0,1}
Parameter	{OFF,ON,0,1}
Example	Send > SYST: KEYB OFF
Query Syntax	SYSTem: KEYB?
Query Response	{on,off}

13.9.6 SYSTem: SHAKhand Communication Handshake (Data Header Return)

When the communication handshake is enabled, the instrument will echo the received command back to the host before returning data.

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

Syntax	
Example	Send > SYST:SHAK ON
Query Syntax	SYSTem:SHAKhand?
Query Response	{on,off}

13.9.7 SYSTem: CODE Error Code Return Setting

When enabled, the instrument returns an error code after each command is received.
List of Error Codes:

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

If the error code function is disabled, the host can still retrieve the last error code by sending the ERR? command.

Command Syntax	SYSTem:CODE {ON,OFF,0,1}
Example	Send > SYST:CODE ON
Query Syntax	SYSTem:CODE?
Query Response	{on,off}

13.9.8 SYSTem: TERM? Query End Symbol (Query Only)

Used to check which terminator symbol is configured on the instrument.

Query Syntax	SYSTem:TERM?
Example	Send > SYST:TERM? Response > CR+LF

13.9.9 SYSTem: RESult Measurement Result Transmission

Used to configure how Measurement results are sent: either automatically or via the FETCH command.

If set to AUTO, the instrument sends results automatically based on the measurement timer status:
If the measurement timer is off, results are sent after every measurement.
If the timer is set, results are sent once at the end of the measurement.

Command Syntax	SYSTem:RESult {FETCH,AUTO}
Parameters	FETCH: Data is returned only when the FETCH? command is sent (passive mode). AUTO: Data is sent automatically upon Measurement completion (active mode).
Example	Send > SYST:RES AUTO // Set to auto-send results
Query Syntax	SYST:RES?
Query Response	{FETCH,AUTO}

13.9.10 SYSTem: FILTer Power Line Frequency Setting

Sets the local AC power frequency. The power line frequency affects the stability of measurements and must be set correctly.

- China Mainland: 50Hz
- Taiwan: 60Hz

Command Syntax	SYSTem:FILTer {50Hz,60Hz}
Example	Send > SYST:FILT 50Hz
Query Syntax	SYSTem:FILTer?
Query Response	{50Hz，60Hz}

13.10 TRIGger Subsystem

Figure 13-8 TRIGger Subsystem Tree

TRIGger	[:IMMediate]		Trigger once
	:SOURce	{INT,MAN,BUS,EXT}	Select trigger source
TRG			Trigger once and return data after measurement

The TRIGger subsystem is used to set the trigger source and initiate a single trigger.

13.10.1 TRIGger[:IMMediate]

TRIG[:IMM] is used to generate a trigger when the trigger source is set to BUS.

i If Result Sending in the <System Configuration> page is set to AUTO, each trigger will return measurement data.
If Result Sending is set to FETCH, data will not be returned automatically.
To ensure data is returned, use the TRG command instead.
If the instrument is in discharge state, it will automatically enter charge/Measurement state and perform one measurement.

Command Syntax	TRIGger[IMMediate]
Example	Send > TRIG // The instrument performs one Measurement and then stops

13.10.2 TRIGger: SOURce

TRIG:SOUR sets the trigger source.

Command Syntax	TRIGger:SOURce {INT,MAN,BUS,EXT}
Example	Send > TRIG:SOUR BUS // Set to bus trigger mode
Query Syntax	TRIG:SOUR?
Query Response	{INT,MAN,BUS,EXT>

13.10.3 TRG

TRG performs a single trigger and returns measurement data when the trigger source is set to BUS.

i Every TRG command will return measurement data regardless of the Result Sending setting.
If the instrument is in discharge state, it will automatically switch to charge/Measurement state, perform one measurement, and return results.
To ensure consistent data length, trailing spaces will be added as padding.
If charge or measurement time is long, adjust host-side communication timeout settings.
This command is only valid on the Measurement Display page.
Remote triggering must be set to Remote.

Returned Data Format:

+1.008e+09,□100,OFF□□
+1.008e+09,□100,NG HI
+1.008e+09,□100,NG HI
+1.006e+09,□100,OK□□□

+1.006e+09,□100,OK□□□		
+1.006e+09	□100	OK□□□
Insulation resistance value	Voltage value	Comparator result

Command Syntax	TRG
Example	Send > TRG // Instrument performs a Measurement and returns the result Response > +1.007e+09,□100,OFF□□

13.11 FETCh (READing) Subsystem

The FETCh (or READing) subsystem is used to retrieve measurement data.

Figure 13-9 FETCh? Subsystem Tree

FETCh READing	FETCh?	FETCh? is used to obtain measurement data compatible with AT682/683 models.
	READing?	Retrieve full measurement data (use this command for new applications)

13.11.1 READing?/ Fetch? Retrieve Measurement Data

In the <Measurement Display> page, sending READing? will return the current measurement data.

i	To use this command, the [Result Send] field under the <System Configuration> page must be set to [FETCH]. To ensure consistent response length, trailing spaces are added as padding. This command is only valid in the <Measurement Display> page. In Discharge state, the last measurement result will always be returned.

Query Syntax	READing?/Fetch?
Query Response	{+1.000E+09,□100,MEASUREMENT,OK□□□} Parameter 1: Measured resistance value (+1.000e+20 indicates overflow; -1.000e+20 indicates underflow) Parameter 2: Output voltage (fixed width of 4 characters; padded with leading spaces if necessary) Parameter 3: Measurement status (five states: SHT, CHAR, MEASUREMENT, DICH, OFF) Parameter 4: Error status and comparator result (Error types include: SHORT, OPEN, with open subtypes CC_HL, CC_H, CC_L; Comparator results: OK, LO, HI)
Example	Send > READing? Response >+1.000E+09,□100,MEASUREMENT,OK□□□

13.12 FILE(MMEM) Subsystem

The FILE (MMEM) subsystem is used to manage files. It allows saving user-defined parameters to internal flash memory or loading files into the system.

Figure 13-10 FILE(MMEM) Subsystem Tree

FILE MMEM	:SAVE	<no parameter> or <File No. 0 – 9>	Save current or specified file
	:LOAD	<no parameter> or <File No. 0 – 9>	Load current or specified file
	:DELete	<File No. 0 – 9>	Delete file

13.12.1 FILE: SAVE Save File

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

Command Syntax1	FILE:SAVE
Example	Send > FILE:SAVE // Save to the current file
Command Syntax2	FILE:SAVE <File No. 0-9>
Example	Send > FILE:SAVE 1 // Save to file 1

13.12.2 FILE: LOAD Load File

FILE:LOAD loads the saved file data into the system.

Command Syntax1	FILE:LOAD
Example	Send > FILE:LOAD // Load current file data into the system
Command Syntax1	FILE:LOAD <File No. 0-9>
Example	Send > FILE:LOAD 1 // Load data from file 1 into the system

13.12.3 FILE: DELete Delete File

FILE:DELete deletes the data of a specified file.

Command Syntax	FILE:DELete <File No. 0-9>
Example	Send > FILE:DEL 1 // Delete file 1
Note	Deleting the current file does not affect the system's current parameters.

13.12.4 SAV

SAV is a shortcut command equivalent to FILE:SAVE. It saves current settings to the current file.

Command Syntax	SAV = FILE:SAVE
Example	Send > SAV // Save to the current file

13.12.5 RCL

RCL is used to load data from the current file into the system.

Command Syntax	RCL = FILE:LOAD

Example	Send > FILE:LOAD // Load current file data into the system

13.13 IDN? Subsystem

Figure 13-11 IDN? Subsystem Tree

IDN?	Query system information

IThe IDN? subsystem is used to query the instrument's version information.

Query Syntax	IDN?
Query Response	<MODEL>,<Revision>,<SN>,< Manufacturer>
Example	Send > IDN? Response > AT69210,REV E0.90,0000000,APPLENT INSTRUMENTS LTD.

13.14 PrtScn Subsystem

Figure 13-12 PrtScn Subsystem Tree

PrtScn	Screenshot

The PrtScn subsystem is used to capture the current screen.

Query Syntax	PrtScn
Query Response	
Example	Send > PrtScn

13.15 ERRor Subsystem

The ERRor subsystem is used to retrieve the laMeasurement error message.

Query Syntax:	ERRor?
Query Response:	Error string
Example:	Send > ERR?<NL> Response > no error.<NL>

Error Code Table:

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

14. MODBUS (RTU) COMMUNICATION PROTOCOL

In this chapter, you will learn:

- Data Format – Understand the Modbus communication structure
- Functions
- Variable Area
- Function Codes

14.1 Data Format

This instrument adheres to the Modbus (RTU) communication protocol. The instrument responds to commands from the host and returns standard response frames.

Refer to

You can contact our sales department to obtain the Applent Instrument Communication Measurement Tool, which includes Modbus communication debugging methods, a CRC-16 calculator, and floating-point to Modbus format converter.

14.1.1 Instruction Frame

Figure 14-1 Modbus Command Frame

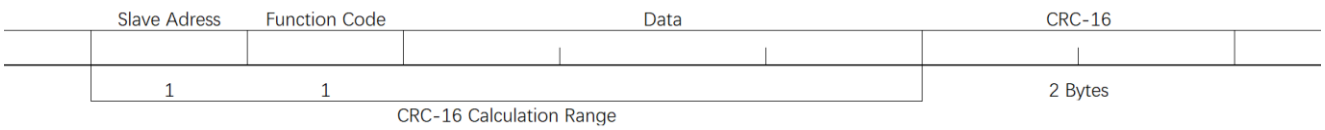


Table 14-1 Description of Command Frame Fields

	At least 3.5 character times of silence before and after the frame
Station Address	1 byte. Modbus supports Station Addresses from 00 to 0x63 (99). Broadcast address is 00. Default Station Address is 0x01 if RS485 option is not configured.
Function Code	1 byte: 0x03: Read multiple registers 0x04: Same as 0x03 (not used) 0x06: Write single register (can be replaced by 0x10) 0x08: Loopback Measurement (for debugging only) 0x10: Write multiple registers
Data	Register address, quantity, and values
CRC-16	2 bytes (low byte first). CRC is computed from Station Address to data end

14.1.2 CRC-16 Calculation Method

1. Initialize the CRC-16 register with the value 0xFFFF.
2. XOR the first byte of the message with the CRC register.
3. Shift the CRC register right by 1 bit, padding with 0 on the left.
4. If the LSB (Least Significant Bit) was 0, repeat step 3.
5. If the LSB was 1, XOR the CRC register with 0xA001.
6. Repeat steps 3 and 4 for 8 shifts.
7. If more bytes remain in the message, XOR the next byte and repeat from step 3.

CRC16 Calculation Function in VB Language

```
FUNCTION CRC16(DATA() AS BYTE) AS BYTE()
  DIM CRC16LO AS BYTE, CRC16HI AS BYTE   ' CRC REGISTER
  DIM CL AS BYTE, CH AS BYTE             ' POLYNOMIAL CODE &HA001
  DIM SAVEHI AS BYTE, SAVELO AS BYTE
```

```
  DIM I AS INTEGER
  DIM FLAG AS INTEGER

  CRC16LO = &HFF
  CRC16HI = &HFF
  CL = &H01
  CH = &HA0

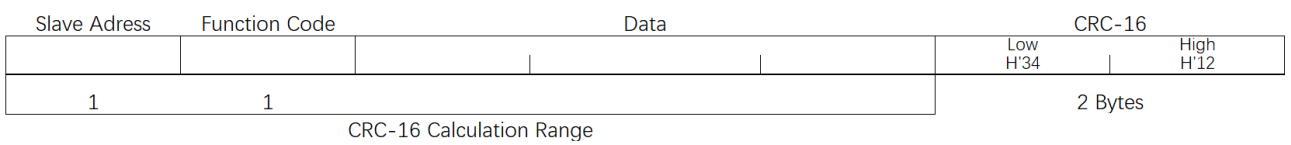
  FOR I = 0 TO UBOUND(DATA)
    CRC16LO = CRC16LO XOR DATA(I)     ' XOR EACH DATA BYTE WITH THE CRC REGISTER
    FOR FLAG = 0 TO 7
      SAVEHI = CRC16HI
      SAVELO = CRC16LO
      CRC16HI = CRC16HI \ 2        ' SHIFT HIGH BYTE RIGHT BY ONE
      CRC16LO = CRC16LO \ 2        ' SHIFT LOW BYTE RIGHT BY ONE
      IF ((SAVEHI AND &H1) = &H1) THEN   ' IF THE LAST BIT OF HIGH BYTE IS 1
        CRC16LO = CRC16LO OR &H80     ' ADD 1 AT FRONT AFTER SHIFT
      END IF
      IF ((SAVELO AND &H1) = &H1) THEN   ' IF LSB IS 1, XOR WITH POLYNOMIAL
        CRC16HI = CRC16HI XOR CH
        CRC16LO = CRC16LO XOR CL
      END IF
    NEXT FLAG
  NEXT I

  DIM RETURNDATA(1) AS BYTE
  RETURNDATA(0) = CRC16HI     ' HIGH BYTE OF CRC
  RETURNDATA(1) = CRC16LO     ' LOW BYTE OF CRC
  CRC16 = RETURNDATA
END FUNCTION
```

Our "Applent Instrument Communication Measurementing Tool" includes debugging methods for Modbus communication and features a built-in CRC-16 calculator.

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

Figure 14-2 Modbus Appended CRC-16 Value.



14.1.3 Response Frame

Except for instructions with Station Address 00H (broadcast), all other Station Addresses will cause the instrument to return a response frame.

Figure 14-3 Normal Response Frame

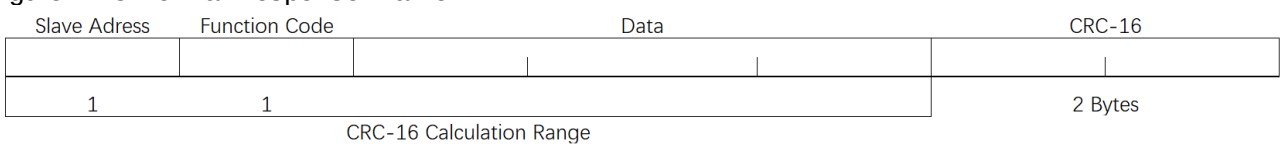


Figure 14-4 Exception Response Frame

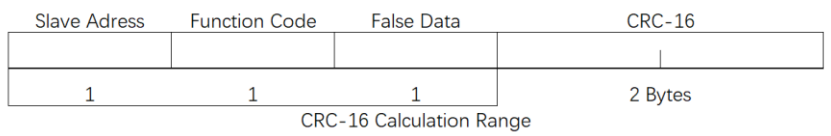


Table 14-2 Exception Response Frame Description

Station Address	1 byte Returned as-is from the instruction frame
Function Code	1 byte Original function code OR'ed with BIT7 (0x80) Example: 0x03 OR 0x80 = 0x83

Error Code	Exception code: 0x01 Function code error (unsupported) 0x02 Register error (nonexistent register) 0x03 Data error 0x04 Execution error
CRC-16	2 bytes Cyclic Redundancy Check Low byte first. CRC-16 is calculated from the Station Address to the end of the data

14.1.4 No Response

In the following scenarios, the instrument will neither process the instruction nor respond, resulting in a communication timeout:

1. Incorrect Station Address
2. Transmission error
3. CRC-16 check failed
4. Incorrect byte count
   Example: Function code 0x03 requires exactly 8 bytes; receiving more or fewer will result in no response
5. Station Address is 0x00 (broadcast), which the instrument does not respond to.

14.1.5 Error Codes

Table 14-3 Error Code Definitions:

Error Code	Name	Description	Priority
0x01	Function Code Error	Function code not supported	1
0x02	Register Error	Register does not exist	2
0x03	Data Error	Incorrect register count or byte count	3
0x04	Execution Error	Illegal data or data out of valid range	4

14.2 Function Codes

The instrument only supports the following function codes. Any unsupported function codes will return an error frame.

Table 14-4 Supported Function Codes

Function Code	Name	Description
0x03	Read Multiple Registers	Reads multiple continuous register values
0x04	Same as 0x03	Please use 0x03 instead
0x08	Loopback Measurement	Echoes back received data (for debugging)
0x10	Write Multiple Registers	Writes multiple continuous register values

14.3 Registers

The instrument uses a 2-byte register format, meaning each write operation must write exactly 2 bytes. Example: To write the measurement speed to register 0x3002, the data length must be 2 bytes, such as: 0x0001

Data:
The Instrument Supports the Following Data Formats:

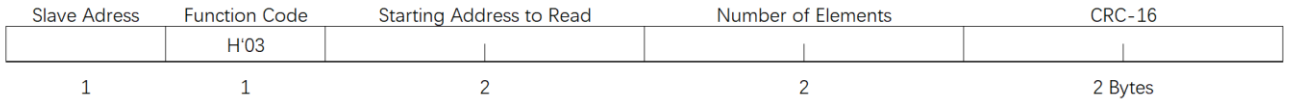
1. 1 Register – 2 Bytes (16-bit Integer) Example: 0x64 → 00 64
2. 2 Registers – 4 Bytes (32-bit Integer) Example: 0x12345678 → 12 34 56 78
3. 2 Registers – 4 Bytes (32-bit Float) Example: 3.14 → 40 48 F5 C3



Our proprietary tool, “Applent Communication Measurement Tool,” includes Modbus communication debugging functions, such as a floating-point number converter.

14.4 Read Multiple Registers

Figure 14-5 Reading Multiple Registers (Function Code 0x03)

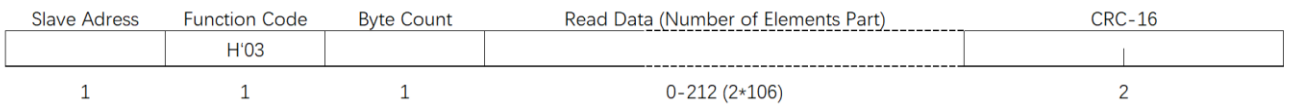


Function code 0x03 is used to read multiple registers.

Table 14-5 Reading Multiple Registers:

	Name	Description
	Station Address	Default is 01 if no specific RS485 address is assigned
0x03	Function Code	
	Start Address	Register starting address. Refer to the Modbus register map.
	Register Count 0001~006A(106)	Number of consecutive registers to read. Range: 0001~006A (max 106). Ensure that all specified addresses exist, or an error frame will be returned.
CRC-16	Cyclic Redundancy Check	

Figure 14-6 Response Frame for Reading Multiple Registers (Function Code 0x03)



	Name	Description
	Station Address	Echoed back from request
0x03 or 0x83	Function Code	0x03 if successful 0x83 if an error occurred
	Byte Count	Equal to the number of registers × 2 *Example: 1 register returns 02 bytes*
	Data	The actual register values
CRC-16	CRC checksum	

14.5 Write Multiple Registers

Figure 14-7 Writing Multiple Registers (Function Code 0x10)

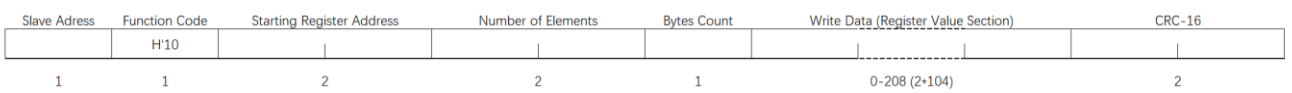
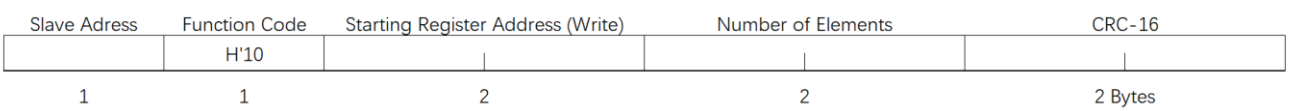


Table 14-6 Writing Multiple Registers

	Name	Description
	Station Address	If no RS485 address is specified, the default is 01.
0x10	Function Code	
	Starting Address	Starting register address; please refer to the Modbus register map
	Number of Registers to Write 0001~0068(104)	。0001~0068 (up to 104 registers). Ensure all specified register addresses exist, otherwise an error response will be returned
	Byte Count	=number of registers x 2
CRC-16	Checksum	

Figure 14-8 Response Frame for Writing Multiple Registers (0x10)



	Name	Description
	Station Address	Returned as is
0x10 Or 0x90	Function Code	0x10 if successful 0x90 if an error occurred
	Starting Address	

	Number of Registers	
	CRC-16Checksum	

14.6 Echo Measurement

Function code 0x08 is used for debugging Modbus communication.

Figure 14-9 Echo Measurement (0x08)

Command Frame

Slave Adress	Function Code	Fixed Value		Data	CRC-16
	H'08	H'00	H'00		
1	1	2		2	2 Bytes

Response Frame

Slave Adress	Function Code	Fixed Value		Data	CRC-16
	H'08	H'00	H'00		
1	1	2		2	2 Bytes

	Name	Description
	Station Address	Echoed from the Request
0x08	Function Code	
	Fixed Value	00 00
	Measurement Data	Any Value: Example 12 34
	CRC-16Checksum	

Example:
Assuming the Measurement data is 0x1234

COMMAND:	01	08	00 00	12 34	ED 7C(CRC–16)
RESPONSE:	01	08	00 00	12 34	ED 7C(CRC–16)

15. Modbus (RTU) Instruction Set

In this chapter, you will learn the following:

- Register addresses
- Execution of specific commands

Our "Applent Instrument Communication Measurementing Tool" includes debugging methods for Modbus communication and a floating-point converter.

Unless otherwise specified, all values in the following instructions and response frames are hexadecimal.

15.1 Register Overview

Unless otherwise specified, all values in the following instructions and response frames are hexadecimal.

Table 15-1 Register Overview

Register		Byte Count	Description	Data Type	Notes
Address	Qty.				
0000	1	2	Read instrument version number	4-bite integer	Read-only, occupies 2 registers
2000	2	4	Read Channel 1 measurement result	4-bite float Bite order AABBCCDD	Read-only
2002	2	4	Read Channel 2 measurement result	4-bite float	Read-only
2004	2	4	Read Channel 3 measurement result	4-bite float	Read-only
2006	2	4	Read Channel 4 measurement result	4-bite float	Read-only
2008	2	4	Read Channel 5 measurement result	4-bite float	Read-only
200A	2	4	Read Channel 6 measurement result	4-bite float	Read-only
200C	2	4	Read Channel 7 measurement result	4-bite float	Read-only
200E	2	4	Read Channel 8 measurement result	4-bite float	Read-only
2010	2	4	Read Channel 9 measurement result	4-bite float	Read-only
2012	2	4	Read Channel 10 measurement result	4-bite float	Read-only
2100	1	2	Read Channel 1 measurement voltage	2-bite integer	Read-only
2101	1	2	Read Channel 2 measurement voltage	2-bite integer	Read-only
2102	1	2	Read Channel 3 measurement voltage	2-bite integer	Read-only
2103	1	2	Read Channel 4 measurement voltage	2-bite integer	Read-only
2104	1	2	Read Channel 5 measurement voltage	2-bite integer	Read-only
2105	1	2	Read Channel 6 measurement voltage	2-bite integer	Read-only
2106	1	2	Read Channel 7	2-bite integer	Read-only

			measurement voltage		
2107	1	2	Read Channel 8 measurement voltage	2-bite integer	Read-only
2108	1	2	Read Channel 9 measurement voltage	2-bite integer	Read-only
2109	1	2	Read Channel 10 measurement voltage	2-bite integer	Read-only
2200	1	2	Read Channel 1 Measurement Status	Measurement Status: 0000:OFF 0001:OK 0002:LO 0003:HI 0004:SHORT 0005:OPEN	Read-only
2201	1	2	Read Channel 2 Measurement status	Same as above	Read-only
2202	1	2	Read Channel 3 Measurement status	same as above	Read-only
2203	1	2	Read Channel 4 Measurement status	same as above	Read-only
2204	1	2	Read Channel 5 Measurement status	same as above	Read-only
2205	1	2	Read Channel 6 Measurement status	same as above	Read-only
2206	1	2	Read Channel 7 Measurement status	same as above	Read-only
2207	1	2	Read Channel 8 Measurement status	same as above	Read-only
2208	1	2	Read Channel 9 Measurement status	same as above	Read-only
2209	1	2	Read Channel 10 Measurement status	same as above	Read-only
2300	2	4	Read Channel measurement result	4-bite float Byte order CCDDAABB	Read-only
2302	2	4	Read Channel measurement result	4-bite float	Read-only
2304	2	4	Read Channel measurement result	4-bite float	Read-only
2306	2	4	Read Channel measurement result	4-bite float	Read-only
2308	2	4	Read Channel measurement result	4-bite float	Read-only
230A	2	4	Read Channel measurement result	4-bite float	Read-only
230C	2	4	Read Channel measurement result	4-bite float	Read-only
230E	2	4	Read Channel measurement result	4-bite float	Read-only
2310	2	4	Read Channel measurement result	4-bite float	Read-only
2312	2	4	Read Channel measurement result	4-bite float	Read-only

3000	1	2	Channel 1 Measurement Voltage	0001~03E8	Read/Write register, 2-bite integer
3001	1	2	Channel 2 Measurement Voltage	0001~03E8	Read/Write register,2-bite integer
3002	1	2	Channel 3 Measurement Voltage	0001~03E8	Read/Write register,2-bite integer
3003	1	2	Channel 4 Measurement Voltage	0001~03E8	Read/Write register,2-bite integer
3004	1	2	Channel 5 Measurement Voltage	0001~03E8	Read/Write register,2-bite integer
3005	1	2	Channel 6 Measurement Voltage	0001~03E8	Read/Write register,2-bite integer
3006	1	2	Channel 7 Measurement	0001~03E8	Read/Write register,2-bite

			Voltage		integer
3007	1	2	Channel 8 Measurement Voltage	0001~03E8	Read/Write register,2-bite integer
3008	1	2	Channel 9 Measurement Voltage	0001~03E8	Read/Write register,2-bite integer
3009	1	2	Channel 10 Measurement Voltage	0001~03E8	Read/Write register,2-bite integer
3100	1	2	Channel 1 Range Mode	0000: Auto Range 0001: Manual Range 0002: Nominal Range	Read/Write register,2-bite integer
3101	1	2	Channel 2 Range Mode	same as above	Read/Write register,2-bite integer
3102	1	2	Channel 3 Range Mode	same as above	Read/Write register,2-bite integer
3103	1	2	Channel 4 Range Mode	same as above	Read/Write register,2-bite integer
3104	1	2	Channel 5 Range Mode	same as above	Read/Write register,2-bite integer
3105	1	2	Channel 6 Range Mode	same as above	Read/Write register,2-bite integer
3106	1	2	Channel 7 Range Mode	same as above	Read/Write register,2-bite integer
3107	1	2	Channel 8 Range Mode	same as above	Read/Write register,2-bite integer
3108	1	2	Channel 9 Range Mode	same as above	Read/Write register,2-bite integer
3109	1	2	Channel 10 Range Mode	same as above	Read/Write register,2-bite integer
3200	1	2	Channel 1 Range	0001~0004	Read/Write register,2-bite integer
3201	1	2	Channel 2 Range	0001~0004	Read/Write register,2-bite integer
3202	1	2	Channel 3 Range	0001~0004	Read/Write register,2-bite integer
3203	1	2	Channel 4 Range	0001~0004	Read/Write register,2-bite integer
3204	1	2	Channel 5 Range	0001~0004	Read/Write register,2-bite integer
3205	1	2	Channel 6 Range	0001~0004	Read/Write register,2-bite integer
3206	1	2	Channel 7 Range	0001~0004	Read/Write register,2-bite integer
3207	1	2	Channel 8 Range	0001~0004	Read/Write register,2-bite integer
3208	1	2	Channel 9 Range	0001~0004	Read/Write register,2-bite integer
3209	1	2	Channel 10 Range	0001~0004	Read/Write register,2-bite integer
3300	1	2	Measurementing Speed	0000: Slow 0001: Medium 0002: Fast	Read/Write register,2-bite integer
3301	1	2	Trigger Mode	0000: Internal Trigger 0001: Manual Trigger 0002: Remote Trigger 0003: External Trigger	Read/Write register,2-bite integer
3302	1	2	Contact Check	0000: OFF 0001: ON	Read/Write register,2-bite integer
3303	1	2	Source Internal Resistance	0000: Normal 0001: Limit	Read/Write register,2-bite integer
3304	2	4	Charging Time	4-bite float	Read/Write register
3308	2	4	Measurement Time	4-bite float	Read/Write register
331C	2	4	Short-Circuit Time	4-bite float	Read/Write register
3320	2	4	Discharge Time	4-bite float	Read/Write register
3400	1	2	Comparator Status	0000: OFF 0001: ON	Read/Write register,2-bite integer
3401	1	2	Comparator Beep	0000: OFF	Read/Write register,2-bite

				0001: OK 0002: NG	integer
3410	2	4	Channel 1 Comparator Lower Limit	4-bite float	Read/Write register
3412	2	4	Channel 1 Comparator Lower Limit	4-bite float	Read/Write register
3414	2	4	Channel 2 Comparator Lower Limit	4-bite float	Read/Write register
3416	2	4	Channel 2 Comparator Lower Limit	4-bite float	Read/Write register
3418	2	4	Channel 3 Comparator Lower Limit	4-bite float	Read/Write register
341A	2	4	Channel 3 Comparator Lower Limit	4-bite float	Read/Write register
341C	2	4	Channel 4 Comparator Lower Limit	4-bite float	Read/Write register
341E	2	4	Channel 4 Comparator Lower Limit	4-bite float	Read/Write register
3420	2	4	Channel 5 Comparator Lower Limit	4-bite float	Read/Write register
3422	2	4	Channel 5 Comparator Lower Limit	4-bite float	Read/Write register
3424	2	4	Channel 6 Comparator Lower Limit	4-bite float	Read/Write register
3426	2	4	Channel 6 Comparator Lower Limit	4-bite float	Read/Write register
3428	2	4	Channel 7 Comparator Lower Limit	4-bite float	Read/Write register
342A	2	4	Channel 7 Comparator Lower Limit	4-bite float	Read/Write register
342C	2	4	Channel 8 Comparator Lower Limit	4-bite float	Read/Write register
342E	2	4	Channel 8 Comparator Lower Limit	4-bite float	Read/Write register
3430	2	4	Channel 9 Comparator Lower Limit	4-bite float	Read/Write register
3432	2	4	Channel 9 Comparator Lower Limit	4-bite float	Read/Write register
3434	2	4	Channel 10 Comparator Lower Limit	4-bite float	Read/Write register
3436	2	4	Channel 10 Comparator Lower Limit	4-bite float	Read/Write register

4000	1	2	Save settings to the current file	Fixed Value: 0001	Write-only register, 2-byte data
4001	1	2	Read Channel Current File Data	Fixed Value: 0001	Write-only register, 2-byte data
4002	1	2	Save settings to the designated file	0000~0009	Write-only register, 2-byte data
4003	1	2	Read Channel Designated File Data	0000~0009	Write-only register, 2-byte data
4004	1	2	Boot File Load	0000: File 0 0001: Current File	Read/Write register,2-bite integer
4005	1	2	Auto Save	0000: Forbiden 0001: Permit	Read/Write register,2-bite integer
4010	1	2	System Language	0000: English 0001: Simplified Chinese	Read/Write register,2-bite integer
4011	1	2	Power Frequency	0000: 50Hz 0001: 60Hz	Read/Write register,2-bite integer
5000	1	2	Status Control	0000: Stop 0001: Start	Write-only register, 2-byte data
5001	1	2	Trigger Once	Fixed Value: 0001	Write-only register, 2-byte data
5002	1	2	Key Lock	0000 Unlock 0001: Lock	Write-only register, 2-byte data

15.2 Retrieving Measurement Data

15.2.1 Retrieving Resistance Measurement Result [2000] [2012]

Registers 2000–2012 are used to retrieve resistance values from the instrument.
Command Frame:

1	2	3	4	5	6	7	8
01	03	2000		0002		CFCB	
Slave	Read	Register		Qty.		Checksum	

Response Frame:

1	2	3	4	5	6	7	8	9
01	03	04	**4B**	**18**	**E5**	**26**	A6	9A
01	03	Bytes	Float Value				CRC-16	

- Retrieving Measurement Result:
  Bytes B4–B7 represent a 4-byte IEEE 754 single-precision float in the order AA BB CC DD.
  For example, 0x4B18E526 = 1.0020134E7 (decimal).

To retrieve the measurement result for n (1–10) channels simultaneously, set the Register Quantity to 2 × n.
For IEEE754 float converter, please refer to: https://www.anbai.cn/Support/IEEE754.aspx

15.2.2 Retrieving Voltage Measurement Result [2100] [2109]

Registers 2100–2109 are used to retrieve the output voltage.
Command

1	2	3	4	5	6	7	8
01	03	2100		0001		8E36	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7
01	03	02	**00**	**64**	**B9**	**AF**
Slave	Read	Bitys	Interger		CRC-16	

Bytes B4~B5 represent integer: 0x0064 = 100 (decimal)

To retrieve the voltage of n (1–10) channels at once, set Register Quantity = 2 × n.

15.2.3 Retrieving Comparator Result [2200] [2209]

Registers 2200–2209 are used to retrieve comparator results.
The returned 2-byte integer corresponds to:
0000: OFF
0001: OK
0002: LO
0003: HI
0004: SHORT
0005: CC_HL
0006: CC_H
0007: CC_L

■ Read

1	2	3	4	5	6	7	8
01	03	22	00	00	01	8E	72
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7
01	03	02	**00**	**03**	**F8**	**45**
Slave	Read	Bytes	Integer		CRC-16	

If you want to retrieve the measurement results for n (1–10) channels simultaneously, you can set the Register Quantity to 2 × n.

15.2.4 Retrieving Measurement Result (CCDD AABB) [2300] [2312]

Register 2300~2312 are used to obtain instrument resistance values.
Command

1	2	3	4	5	6	7	8
01	03	2300		0002		CF8F	

Response

1	2	3	4	5	6	7	8	9
01	03	04	**C2**	**97**	**4B**	**18**	40	9D
01	03	Bytes	Single-precision float				CRC-16	

Data B4–B6: C2 97 4B 18 indicates a single-precision float, high byte first, byte order: CC DD AA BB. After byte swap, 4B18C297 is converted to decimal: 1.0011287E7

To retrieve measurement results for n (1–10) channels simultaneously, set the register count to 2n.

15.3 Parameter Settings

15.3.1 Measurement Voltage [3000] [3009]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	3000		0001		02	0064		97B8	
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Voltage 0xA~0x3E8 (Decimal 10~1000)

Write Response:

1	2	3	4	5	6	7	8
01	10	30	00	00	01	0E	C9
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3000		0001		8B0A	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7
01	03	02	**00**	**64**	**B9**	**AF**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: Voltage 0064 = 100 (Decimal)

To set or retrieve the Measurement voltage of n channels (1–10) simultaneously, you can set the Register Count to 2n.

15.3.2 Range Mode [3100] [3109]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	31	00	00	01	02	00	00	86	93
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Range Mode
0000: Auto
0001: Manual
0002: Nominal

Write Response

1	2	3	4	5	6	7	8
01	10	31	00	00	01	0F	35
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3100		0001		8AF6	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7
01	03	02	**00**	**02**	**39**	**85**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: 0002 = Nominal

15.3.3 Measurement Range[3200][3209]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	32	00	00	01	02	00	01	74	53
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Range 号 1~4

Write Response

1	2	3	4	5	6	7	8
01	10	32	00	00	01	0F	71
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3200		0001		8AB2	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7
01	03	02	**00**	**03**	**F8**	**45**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: 0003 Range3。

15.3.4 Speed [3300]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	33	00	00	01	02	00	01	64	93
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Speed
0000: Slow
0001: Medium
0002: Fast

Write Response

1	2	3	4	5	6	7	8
01	10	33	00	00	01	0E	8D
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3300		0001		8B4E	
Slave	Read	Register		Register Qty.		Checksum	

响应:

1	2	3	4	5	6	7
01	03	02	**00**	**01**	**79**	**84**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: 0001 Medium Speed

15.3.5 Trigger Mode [3301]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	3301		0001		02	0001		6542	
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Trigger Mode
0000: Manual Mode
0001: External Trigger

Write Response:

1	2	3	4	5	6	7	8
01	10	33	01	00	01	5F	4D
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3301		0001		DA8E	
Slave	Read	Register		Register Qty.		Checksum	

Response:

1	2	3	4	5	6	7
01	03	02	**00**	**01**	**79**	**84**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: 0001 = External Trigger

15.3.6 Contact Check Switch [3302]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	3302		0001		02	0001		6571	
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Contact Check Switch
0000: OFF
0001: ON
Write Response

1	2	3	4	5	6	7	8
01	10	33	02	00	01	AF	4D
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel:

1	2	3	4	5	6	7	8
01	03	3302		0001		2A8E	
Slave	Read	Register		Register Qty.		Checksum	

Reponse

1	2	3	4	5	6	7
01	03	02	**00**	**00**	**B8**	**44**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: 0000 = OFF

15.3.7 Source Resistance [3303]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	3303		0001		02	0001		64A0	
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Source Internal Resistance
0000: Normal
0001: Limit
Write Response

1	2	3	4	5	6	7	8
01	10	33	03	00	01	FE	8D
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3303		0001		7B4E	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7
01	03	02	**00**	**00**	**B8**	**44**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: 0000 = OFF

15.3.8 Charging Time [3304]

> **i** The minimum value for the charging timer is 0.1 seconds, and the maximum is 60 seconds.
> Setting it to 0 disables the timer.
> If the time value exceeds this range, the instrument will return Error Code 90.

■ Write

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	3304		0002		04	3F 80 00 00				BF51	
Station Address	Write	Register		Register Qty.		Bytes	Float Point				CRC16	

B8-B11: Charging Time, in Float Point Format
3F 80 00 00 = 1 (Decimal)
Write Response

1	2	3	4	5	6	7	8

01	10	33	04	00	02	0F	4D
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel:

1	2	3	4	5	6	7	8
01	03	3304		0002		8A8E	
Slave	Read	Register		Register Qty.		Checksum	

Response:

1	2	3	4	5	6	7	8	9
01	03	04	**3F**	**80**	**00**	**00**	**F7**	**CF**
Slave	Read	Bytes	Float Point				CRC-16	

B4-B7:3F 80 00 00 = 1 (Decimal)

15.3.9 Measurement Time [3308]

> Minimum: 0.1s, Maximum: 999.9s, 0 to disable.
> Exceeding range returns Error Code 90.

■ Write

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	3308		0002		04	3F 00 00 00				BEEC	
Station Address	Write	Register		Register Qty.		Bytes	Float Point				CRC16	

B8-B11: Measurement Time, in Floating Point Format
00 00 00 00: indicates OFF
3F 00 00 00 = 0.5 (Decimal)
Write Response

1	2	3	4	5	6	7	8
01	10	33	08	00	02	CF	4E
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel

1	2	3	4	5	6	7	8
01	03	3308		0002		4A8D	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7	8	9
01	03	04	**3F**	**00**	**00**	**00**	**F6**	**27**
Slave	Read	Bytes	Floating Point				CRC-16	

B4-B7:3F 00 00 00 = 0.5 (Decimal)

15.3.10 Short Circuit Detection [331C]

> Minimum: 10ms, Maximum: 1s, 0 to disable.
> Values outside range will return Error Code 90.

■ Write

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	331C		0002		04	41 10 00 00				A7FE	
Station Address	Write	Register		Register Qty.		Bytes	Floating Point				CRC16	

B8-B11: Short circuit detection time, in float point format.
00 00 00 00: (Decimal 0) indicates OFF
41 10 00 00: (Decimal 9) indicates AUTO
Write Response

1	2	3	4	5	6	7	8
01	10	33	1C	00	02	8F	4A
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	331C		0002		0A89	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7	8	9
01	03	04	**41**	**10**	**00**	**00**	**EF**	**0A**
Slave	Read	Bytes	Floating Point				CRC-16	

B4-B7: 41 10 00 00 (Decimal 9) indicates AUTO.

15.3.11 Discharge Time [3320]

> Discharge Time: The minimum discharge timer value is 0.1 seconds, and the maximum is 60.0 seconds. Setting the value to 0 disables the timer.
> If the set value exceeds this range, the instrument will return Error Code 90.

■ Write

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	3320		0002		04	3D CC CC CD				E840	
Station Address	Write	Register		Register Qty.		Bytes	Floating Point				CRC16	

B8-B11: Trigger Delay Setting, in Floating-Point Format
00 00 00 00: (Decimal 0) indicates the delay is disabled
3D CC CC CD = (Decimal) 0.1
Write Response

1	2	3	4	5	6	7	8
01	10	33	20	00	02	4F	46
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3320		0002		CA85	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7	8	9
01	03	04	**3D**	**CC**	**CC**	**CD**	**A3**	**35**
Slave	Read	Bytes	Floating Point				CRC-16	

B4-B7: 3D CC CC CD = (Decimal) 0.1。

15.4 Comparator Setting

The register addresses for Comparator Parameter Settings start from 3100.

15.4.1 Comparator Status [3400]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	34	00	00	01	02	00	01	12	53
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Comparator Status
0000: OFF
0001: ON
Write Response

1	2	3	4	5	6	7	8
01	10	34	00	00	01	0F	F9
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3400		0001		8A3A	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7
01	03	02	**00**	**01**	**79**	**84**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: 0001 Enabled

15.4.2 Comparator Beep [3401]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	3401		0001		02	0001		1382	
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: Beep Status
0000: OFF
0001: OK Beep
0002: NG (Not Good) Beep

Write Response

1	2	3	4	5	6	7	8
01	10	3401		0001		5E39	
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel:

1	2	3	4	5	6	7	8
01	03	3401		0001		DBFA	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7
01	03	02	**00**	**01**	**79**	**84**
Slave	Read	Bytes	Integer		CRC-16	

B4-B5: 0001 OK Beep

15.4.3 Comparator Limit Value [3410-3436]

The Comparator Lower Limit values use two registers from [3410] to [3434], stored as 4-byte float values.
The Comparator Upper Limit values use two registers from [3412] to [3436], also stored as 4-byte float values.

> The maximum value for comparator limits is 20GΩ. Values exceeding this limit will return Error Code 90.

Lower and upper limits can be set independently or together.

a） Setting the Lower Limit

■ Write

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	3410		0002		04	4B 18 96 80				6D81	
Station Address	Write	Register		Register Qty.		Bytes	Floating Point				CRC16	

B8-B11: Lower Limit, Floating Point Fomat
4B 18 96 80 = 1E7 (Decimal 10M)
Write Response

1	2	3	4	5	6	7	8
01	10	34	10	00	02	4E	3D
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel:

1	2	3	4	5	6	7	8
01	03	3410		0002		CBFE	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4	5	6	7	8	9
01	03	04	**4B**	**18**	**96**	**80**	**F7**	**CF**
Slave	Read	Bytes	Floating Point				CRC-16	

B4-B7: 4B 18 96 80 = 1E7 (Decimal 10M)

b） Setting the Upper Limit

■ Write

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	3412		0002		04	4B 98 96 80				EDB0	
Station Address	Write	Register		Register Qty.		Bytes	Floating Point				CRC16	

B8-B11: Upper Limit Value, in Floating Point Format
4B 18 96 80 = 2E7 (Decimal 20M)
Write Response

1	2	3	4	5	6	7	8
01	10	34	12	00	02	EF	FD
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel:

1	2	3	4	5	6	7	8
01	03	3412		0002		6A3E	
Slave	Read	Register		Register Qty.		Checksum	

Response:

1	2	3	4	5	6	7	8	9
01	03	04	4B	98	96	80	**02**	**38**
Slave	Read	Bytes	Floating Point				CRC-16	

B4-B7: 4B 98 96 80 = 1E8 (Decimal 20M)

c） Setting Both Upper and Lower Limits Simultaneously:

■ Write (10M~20G)

1	2	3	4	5	6	7	8~15	16	17
01	10	3410		0004		08	4B 18 96 80 4B 98 96 80	0190	
Station Address	Write	Register		Register Qty.		Bytes	Lower Limit and Upper Limit	CRC16	

B8-B11: 4B 18 96 80 Lower Limit 10MΩ,
B12-B15: 4B 98 96 80 Upper Limit 20MΩ.

Write Response

1	2	3	4	5	6	7	8
01	10	34	10	00	04	CE	3F
Slave	Write	Register		Register Qty.		CRC16	

■ Read Channel :

1	2	3	4	5	6	7	8
01	03	3410		0004		4BFC	
Slave	Read	Register		Register Qty.		Checksum	

Response

1	2	3	4~7	8~11	12	13
01	03	04	4B 18 96 80	4B 98 96 80	F9	B6
Slave	Read	Bytes	Lower Limit	Upper Limit	CRC-16	

B4~B7: 4B 18 96 80 Lower Limit 10MΩ
B8~B11: 4B 98 96 80 Upper Limit 20MΩ

15.5 File Operations

Since instrument settings are stored in files, if the [Auto Save] field in the <File> page is not enabled, all Modbus command settings will not be saved in real time to internal Flash ROM. This means that upon the next power-on, the register data will revert to the values of the original file.
Users can utilize file operation registers to store all current settings into the current or a specified file. Likewise, users can load settings from a specific file back into the registers.

> You can enable the [Auto Save] option in the <File> page so that each parameter adjustment is saved automatically. In that case, file instructions are no longer necessary.

15.5.1 Save to Current File [4000]

To save all current settings into the current file, send the value 0001 to register 4000.
This register is write-only and 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
Slave	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9 Data Value:
0001: Fixed value, any other value will return Error Code 90
Reponse

1	2	3	4	5	6	7	8
01	10	40	00	00	01	14	09
Slave	Write	Register		Register Qty.		CRC16	

15.5.2 Reload Current File [4001]

Send the fixed value 0001 to Register 4001 to load the current file's settings into the system.
This register is write-only and 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
Slave	Write	Register		Register Qty.		Bytes	Data		CRC	

B8-B9 Data Value
0001: Fixed Value (any other value returns error code 90)
Response

1	2	3	4	5	6	7	8
01	10	40	01	00	01	45	C9
Slave	Write	Register		Register Qty.		CRC16	

15.5.3 Save to Specified File [4002]

Send the desired file number to Register 4002. The instrument will save the current settings to the specified file and set it as the current system file.
This register is write-only.

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	40	02	00	01	02	00	01	27	85
Slave	Write	Register		Register Qty.		Bytes	Data		CRC	

Data Value
B8~B9: File Numbers 0000~0009
Response:

1	2	3	4	5	6	7	8
01	10	40	02	00	01	45	C9
Slave	Write	Register		Register Qty.		CRC16	

15.5.4 Load Specified File [4003]

Send a file number to Register 4003 to load the corresponding file into the system and set it as the current file.
This register is write-only.

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	40	03	00	01	02	00	00	27	85
Slave	Write	Register		Register Qty.		Bytes	Data		CRC	

Data Value
B8~B9: File number 0000~0009
Response

1	2	3	4	5	6	7	8
01	10	40	03	00	01	E4	09
Slave	Write	Register		Register Qty.		CRC16	

15.5.5 Set File to Load at Startup [4004]

Send a file number to Register 4004 to automatically load a specified file at power-on and set it as the current file.

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	40	04	00	01	02	00	00	E6	10
Slave	Write	Register		Register Qty.		Bytes	Data		CRC	

Data Value
B8~B9: File number 0000~0009
Response

1	2	3	4	5	6	7	8
01	10	40	04	00	01	55	C8
Slave	Write	Register		Register Qty.		CRC16	

15.5.6 Shutdown Save [4005]

Send a file number to Register **4005** to enable the instrument to automatically save current settings upon shutdown.

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	40	05	00	01	02	00	00	E7	C1
Slave	Write	Register		Register Qty.		Bytes	Data		CRC	

Data Value
B8~B9: File Number 0000~0009
Response

1	2	3	4	5	6	7	8
01	10	40	05	00	01	04	08
Slave	Write	Register		Register Qty.		CRC16	

15.6 System Functions

15.6.1 Start/ Stop Measurement [5000]

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	5000		0001		02	0002		7794	
Station Address	Write	Register		Register Qty.		Bites	Data		CRC16	

B8-B9:
0000: Stop
0001: Start
Write Response

1	2	3	4	5	6	7	8
01	10	50	00	00	01	10	C9
Slave	Write	Register		Register Qty.		CRC16	

15.6.2 Trigger [5001]

Write-only Register. Valid only under the <Measurement Display> page and when the trigger mode is set to remote.

■ Write

1	2	3	4	5	6	7	8	9	10	11
01	10	5001		0001		02	0001		48F1	
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9: 0001 Fixed Value
Write Response

1	2	3	4	5	6	7	8
01	10	50	01	00	01	41	09
Slave	Write	Register		Register Qty.		CRC16	

15.6.3 Key Lock [5002]

Write-only Register.

1	2	3	4	5	6	7	8	9	10	11
01	10	5002		0001		02	0000		F7B7	
Station Address	Write	Register		Register Qty.		Bytes	Data		CRC16	

B8-B9:
0000: Unlock
0001: Lock
Write Response:

1	2	3	4	5	6	7	8
01	10	50	02	00	01	B1	09
Slave	Write	Register		Register Qty.		CRC16	

16. Specifications

In this chapter, you will learn:

- Technical Specifications
- General Specifications
- Physical Dimensions

16.1 Technical Specifications

The following data were obtained under the following conditions:

- Temperature: 23°C ± 5°C
- Humidity: ≤ 65% R.H. (non-condensing)
- Warm-up Time: > 30 minutes
- Calibration Interval: 12 months

16.1.1 Voltage Accuracy

Table 16-1 Voltage Accuracy

Voltage Output Range	Arbitrary settings from 10V to 1000V
Voltage Source Accuracy	1%±2V
Voltage Measurement Accuracy	2%±1V(CV, <1.8mA)
Max Charging Current	≈1.8mA
Short-Circuit Current	<2mA

16.1.2 Resistance Measurement Accuracy

Table 16-2 Resistance Measurement Accuracy

Rated Voltage Range	Range	Display Range	Accuracy
10V≤Vx＜100V	0	6k-600k	2%±5 counts
	1	40k-4M	2%±5 counts
	2	200k-40M	2%±5 counts
	3	6k-600k	5%±5 counts
		400M-2G	25%±10 counts
100V≤Vx＜500V	0	60k-3M	2%±5 counts
	1	400k-20M	2%±5 counts
	2	2M-200M	2%±5 counts
	3	20M-2G	5%±5 counts
		2G-10G	25%±10 counts
500V≤Vx＜1000V	0	300k-6M	2%±5 counts
	1	2M-40M	2%±5 counts
	2	10M-400M	2%±5 counts
	3	100M-4G	5%±5 counts
		4G-999G	25%±10 counts

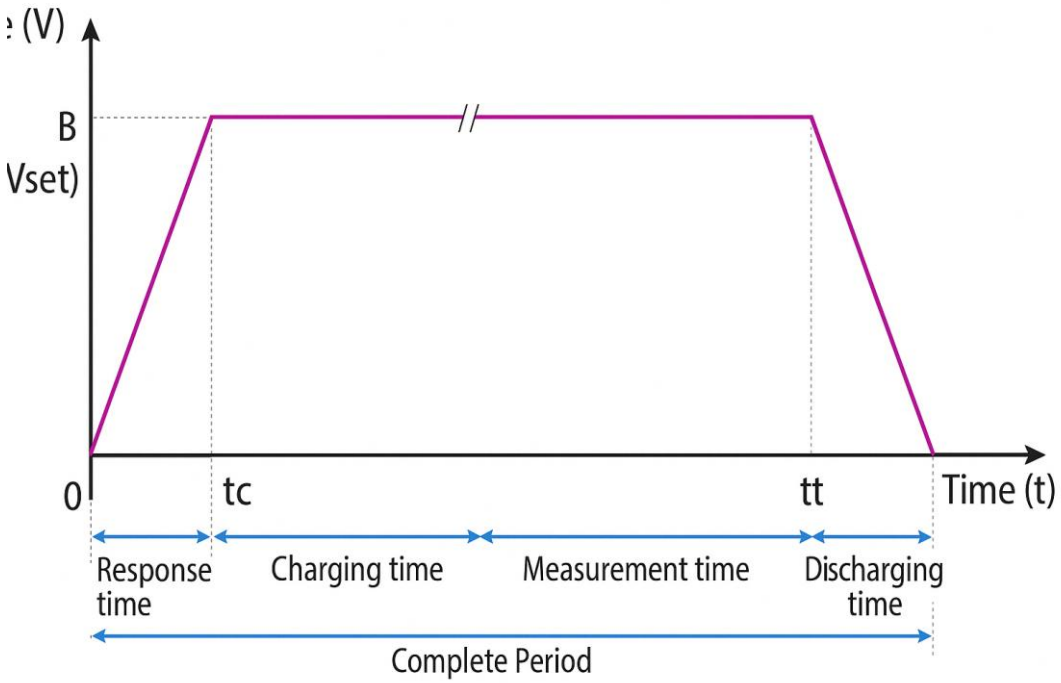
* Measurement range depends on the set voltage. The actual upper and lower limits of the range will vary with different voltage settings.

Table 16-3 Resistance Measurement Resolution

Display Range	Resolution
0-5M	0.001M
50M-500M	0.01M
500M-5G	0.1M
5G-999G	1M

16.1.3 Measurement Cycle

Figure 16-1 Complete Measurement Cycle



When the charging time is disabled:
Total Measurement Cycle = Response Time + Measurement Time + Discharge Time
When the charging time is enabled:
Total Measurement Cycle = Response Time + Charging Time + Measurement Time + Discharge Time

16.1.4 Charging Time

Charging Time Range	0.1s~60.0s (can be disabled)
Display	Countdown, measurement starts when the timer reaches 0.0s
Resolution	100ms

16.1.5 Measurement Time

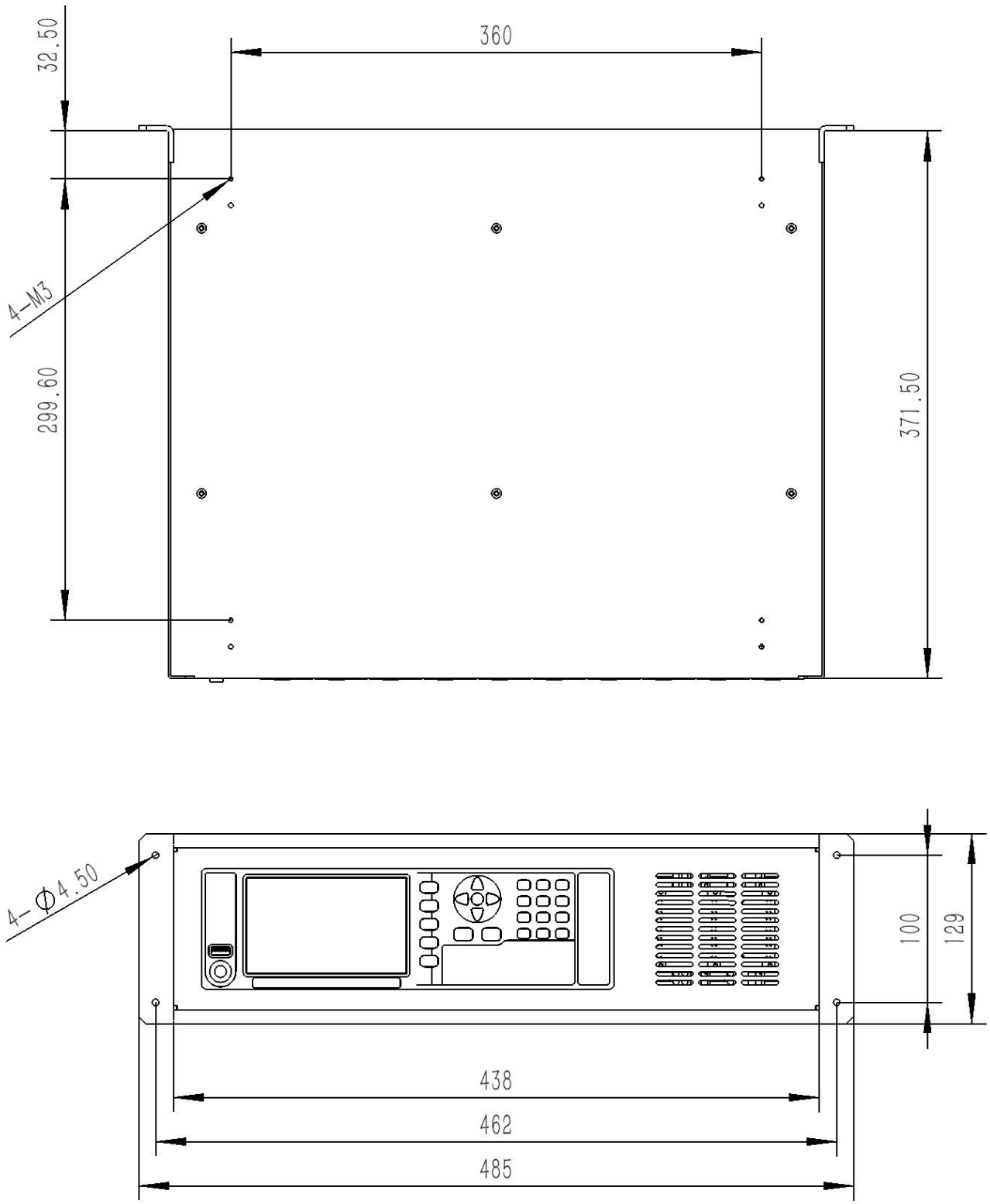
Time Range	0.1s~999.9s (Continuous measurement when disabled)
Display	When time is disabled: Counts up, stops counting at 999.9s
	When time is enabled: Counts down, ends measurement at 0.00s and enters discharge state
Resolution	100ms

16.2 General Specifications

Display	5-inch TFT-LCD full-color screen		
Measurement Range	0.000M ~ 20.00GΩ		
Measurementing Speed	■ Auto Range Mode *(Contact Check OFF)*: Slow: 3 times/sec Medium: 7 times/sec Fast: 19 times/sec ■ Manual Range Mode *(Contact Check OFF)*: Slow: 4 times/sec Medium: 8 times/sec Fast: 30 times/sec ■ Auto Range Mode *(Contact Check OFF)*: Slow: 1.9 times/sec Medium: 11 times/sec Fast: 15 times/sec ■ Manual Range Mode *(Contact Check ON)*: Slow: 4 times/sec Medium: 6 times/sec Fast: 13 times/sec		
Range Mode	Auto, Manual, and Nominal Range		
Short Circuit Detection	Mode	OFF / AUTO / Preset Time	
	Preset Time	10ms~1.00s	
	Auto Detection	Max 500ms	
	Short Circuit Output Voltage	≈3V	
	Action	If short circuit is detected within the set time: End measurement If not detected: Enter normal measurement cycle	
Contact Check	Method	4-wire method	
	Display Indicators	CC.HL: Both HIGH and LOW contacts are faulty CC.H: HIGH contact faulty CC.L: LOW contact faulty	
Comparator	Setting Range	0~20GΩ	
	Result	OK: Pass LO: Below lower Limit HI: Above Upper Limit	
	Beep Setting	OK/NG/OFF	
Trigger Method	Manual or Remote Trigger		
File Storage	Parameters can be saved automatically or manually to memory: • 10 internal memory files • 10 USB files		
USB Storage	Data can be saved by time interval or upon trigger Supports up to 20 files on USB		
Interfaces	RS232 LAN RS485		
Communication Protocols	SCPI/ModBus (RTU)		
Environmental Requirements	Specification	Temperature: 18°C ~ 28°C Humidity: <65% RH, non-condensing	
	Operation	Temperature: 10°C ~ 40°C Humidity: 10% ~ 80% RH	
	Storage	Temperature: 0°C ~ 50°C Humidity: 10% ~ 90% RH	
Power Requirements	Voltage	100V~240VAC	
	Fuse	250V / 4A slow-blow (installed inside the instrument)	
	Power Consumption	Max 20VA	
	Weight	≈5kg	

16.3 Dimensions

(Diagram)



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