

OPERATION MANUAL

TH1952

5¹/₂ Digit Multimeter

Changzhou Tonghui Electronic Co., Ltd.

www.tonghui.com.cn

Manual Printing History

The manual printing data and part number indicate its current edition. The printing date changes when a new edition is printed. The manual part number changes when extensive technical changes are incorporated.

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Announcement

The description of the manual may not cover all contents of the instrument, and our company is subject to change and to improve the performance, function, inner structure, appearance, accessory and package of the instrument without notice. If there is puzzle caused by inconsistency of manual and instrument, then you can contact with our company by the address on the cover.

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Chapter 1 General Information

Thanks very much for choosing and using our product. If you have any questions after reviewing this manual, please contact your local representative or call directly to our application engineers for further consultation.

1.1 Feature Overview

TH1952 is a 5½ digital multimeter with high accuracy, stability and speed. The digital multimeter provides a maximum measurement speed of 200 readings/sec. TH1952 has a 0.012% DC voltage basic accuracy, 0.05% basic resistance accuracy and other high performance.

TH1952 has broad measurement ranges:

- 5½ reading with dual-display
- DC voltage from 1μV to 1000V
- AC voltage from 1μV to 750V
- AC/DC voltage from 1μV to 750V (RMS)
- DC current from 10nA to 12A
- AC current from 10nA to 12A
- AC/DC current from 10nA to 12A (RMS)
- Resistance measurement from 1mΩ to 100MΩ
- Frequency from 1Hz to 1MHz

Some additional capabilities of Model TH1952:

- Full range of functions: In addition to those listed above, TH1952 functions include period, dB, dBm, continuity, diode testing, max, min and percent.
- Programming languages and remote control interfaces: TH1952 provides the SCPI programming language and the remote control interface port RS-232C, USB interface and Handler interface.
- Closed-cover calibration: The multimeter can be calibrated either from the front panel or through the remote control interface. Manual Calibration function is added for your convenience.

1.2 Operating Environment

Power supply: 110V/220V ±10%

Line frequency: 50Hz / 60Hz ±5%

Power consumption: ≤10VA

Operating temperature: 0°C to 45°C


Humidity: ≤ 90%RH


1.3 Dimensions and Weight

Dimensions (W×H×D): 277mm×115mm×354mm

Net weight: Around 2.5Kg

1.4 Safety symbols and Precautions

The  symbol on the instrument indicates that user should refer to the operating instructions located in the manual before performing.

The  symbol on the instrument shows that high voltage may be present on the terminal(s). Be careful to avoid personal contact with these voltages.

The symbol  on the instruments means earth grounding.

The **WARNING** heading used in the manual explains high voltage danger that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the manual reminds user that hazards could damage the instruments if not according to operating instructions. Such damage may invalidate the warranty.

1.5 Incoming Inspection

The TH1952 was carefully inspected mechanically and electrically before shipment. After unpacking all items from the shipping carton, please check for any obvious signs of physical damage that may have occurred during transportation. Report any damage to the shipping agent immediately. Save the original packing carton for possible future reshipment. The following items are included with every Model TH1952 order:

- Model TH1952 5¹/₂ Digital Multimeter
- Test leads (Model TH26036)
- Power cord
- Two 0.5A fuses
- Two 1A fuses
- Operation Manual
- Quality and warranty certificate
- Test report
- Other optional accessories if ordered

Verify that you have received all the items above when you get multimeter. If anything is missing, please contact our representative or our sales office.

1.6 Warranty

Tonghui warrants this product to be free from defects in material and workmanship for a period of 2 years from the date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

1.7 Limitation of Warranty

This warranty does not apply to defects resulting from product modification without our express written consent, or misuse of any product or part. This warranty also does not apply to fuses, software, or problems arising from normal wear or failure to follow instructions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES.

NEITHER TONGHUI ELECTRONICS NOR ANY OF ITS EMPLOYEES SHALL BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF ITS INSTRUMENTS AND SOFTWARE EVEN IF TONGHUI ELECTRONICS HAS BEEN ADVISED IN ADVANCE OF THE POSSIBILITY OF SUCH DAMAGES. SUCH EXCLUDED DAMAGES SHALL INCLUDE, BUT ARE NOT LIMITED TO: COSTS OF REMOVAL AND INSTALLATION, LOSSES SUSTAINED AS THE RESULT OF INJURY TO ANY PERSON, OR DAMAGE TO PROPERTY.

Chapter 2 TH1952 Overview

2.1 Brief introduction

TH1952 5 1/2 Digital Multimeter is a multi-functional voltage/current/resistance meter with fast speed and high accuracy. TH1952 provides high brightness VFD dual-display, which brings you great convenience for display of multiple function combinations. The inherent test platform and system performance make TH1952 an all-purpose measurement solution.

Convenient test platform features:

- High brightness VFD dual-display
- Built-in arithmetical operation function
- Short and diode test function
- Manual setup of reading hold function
- Portable shape design

Flexible system performance:

- RS-232 interface
- Handler interface
- USB interface
- Standard programming language SCPI
- Max. ADC sampling rate can be 200/sec
- Limit test with HI/LO signal can help you select good products

2.2 Front Panel Summary

The front panel of the TH1952 is shown in Figure 2-1. This figure includes some important abbreviated information that should be reviewed before operating the instrument.

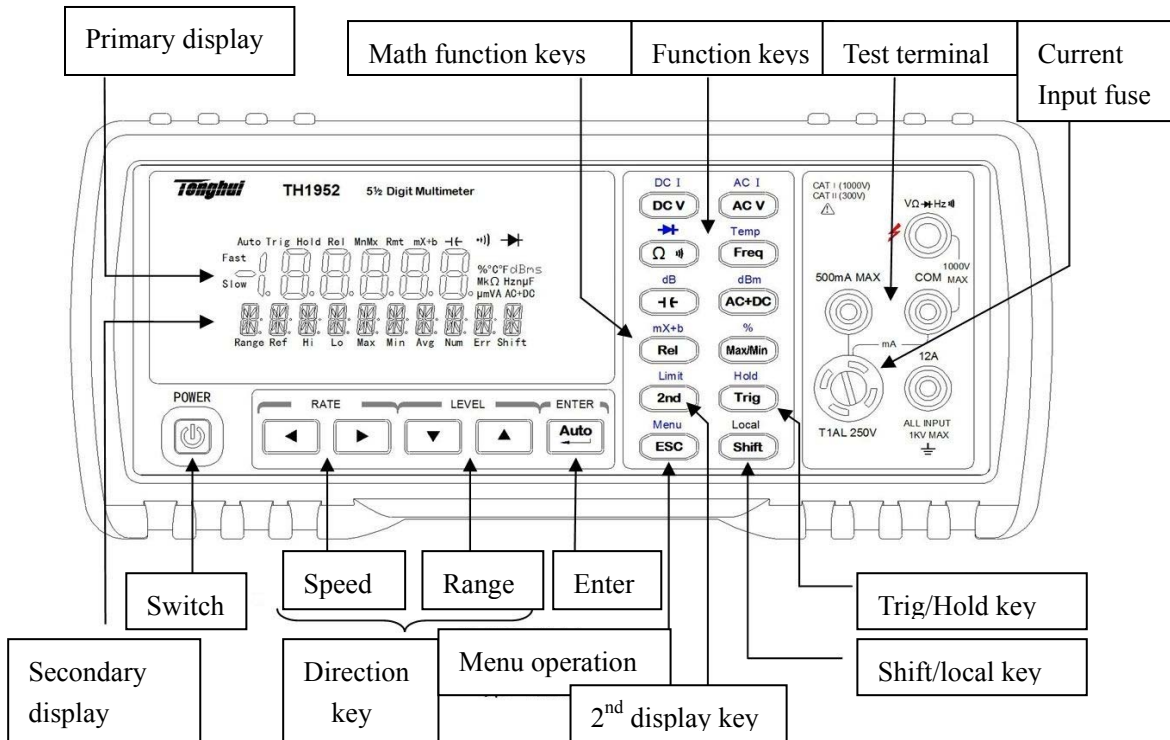


Figure 2-1 TH1952 Front Panel

1. Function keys

Select measurement function: DC voltage (DCV) / DC current (DCI), AC voltage (ACV) / AC current (ACI), resistance (Ω) / continuity (\rightarrow) / diode (\rightarrow), temperature (Temp) / frequency (Freq), capacitance / dB, AC+DC / dBm.

2. Math function keys

Select the math function: Rel / mX+b, Max / Min / %.

3. Trig / Hold Key

Trig Trigger a measurement from the front panel.

Shift → **Trig** Hold a stable reading on the display when selected numbers of samples are within the selected tolerance.

4. Shift / Local keys

Shift Used to access shifted keys.

Shift (LOCAL) Cancel RS232C remote control mode and back to the LOCAL mode.

5. 2nd Display key

2nd Control the secondary parameter display.

Shift → **2nd** Turn on the Limit function.

Auto Use this key to select and save settings in SETUP page; to switch between auto and manual ranging in MEAS page.

7. Range keys

▲ Select a higher range.

▼ Select a lower range.

8. Speed key

◀ Select slow speed.

▶ Select fast speed.

Shift + Select 4 1/2 display.
Shift + Select 5 1/2 display.

9. Menu operation keys

Shift → **Esc** Open/Close menu
 Move through selections within menu level, command level or parameter level
 Move through selections within menu level, command level or parameter level.
 Move up a level.
 Move down a level.
Auto (Enter) Save the change made on “parameter” level.
Esc Quit the menu.

2.2.1 Annunciators on Screen

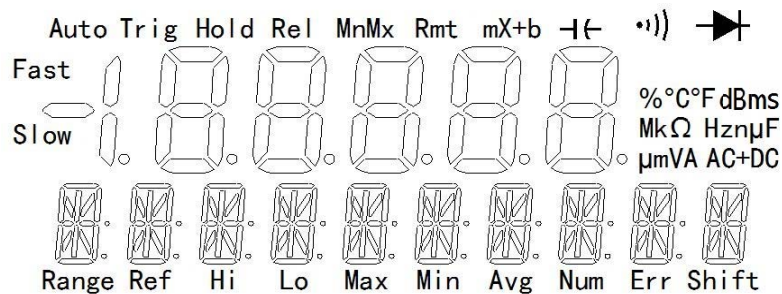


Figure 2-2 Display Annunciators

AUTO	Auto ranging state indication
TRIG	Indicates external trigger (front panel, bus) selected.
HOLD	Reading HOLD function is enabled.
REL	Relative reading displayed.
MnMx	Data statistics function is enabled.
Rmt	Remote operation is in progress.
mX+b	Coefficient adjustment mX+b function is enabled.
←←	Capacitance measurement function is enabled.
••))	Continuity measurement function is enabled.
→	Diode measurement function is enabled.
Range	Secondary parameter display
Ref	Zero ref under dB/dBm
Hi	Limit indicates the upper limit testing results
Lo	Limit indicates the lower limit testing results
Max	Maximum value of data statistics
Min	Minimum value of data statistics
Avg	Average value of data statistics
Num	Number of data statistics
ERR	Hardware or remote control error detected
SHIFT	Accessing shifted keys

2.2.2 Front Panel Menu Reference

A: MATH MENU

— 1: HI LIMIT	Set the high limit for limit testing
— 2: LO LIMIT	Set the low limit for limit testing
— 3: PERC REF	Set the reference value for PERCENT function
— 4: dB REF	Set the dB reference voltage value
— 5: dBm REF	Set the dBm reference impedance value.
— 6: MxB MSET	Set the M parameter for Mxb
— 7: MxB BSET	Set the b parameter for Mxb
— 8: CONTFLAG	Set the link reference for continuity function






B: TRIGger MENU

— 1: TRIG MOD	Set the trigger mode
— 2: HOLD WIN	Set the reading hold sensitivity band
— 3: HOLD CNT	COUNT of readings for reading hold
— 4: RDGS STOR	Data storage function is enabled
— 5: RDGS COUN	Set the data storage number
— 6: SCAN RDGS	Scan the saved data

C: SYStem MENU

— 1: BAUD RATE	Set the baud rate
— 2: BEEP START	Enable or disable the beep function
— 3: KEY SONG	Enable or disable the key sound
— 4: REVISION	Version number
— 5: ZERO CAL	Zero clearing calibration
— 6: TEMP TNST	Switch between degree centigrade °C and Fahrenheit degree °F
— 7: PLACE 4/5	Function selection between 4 1/2 and 5 1/2
— 8: HANDLER:IO	Set the HANDLER interface and select the internal or external power
— 9: SCALALLOW	Enable or disable the manual calibration function

2.2.3 Front Panel Menu Overview

The menu is organized in a top-down tree structure with three levels (menus, commands and parameters) as shown in Figure 2-3. You can use down () or up () to move menu tree from one level to another. Each of the three levels has several horizontal choices which you can view by using left () or right (). Press  to confirm.

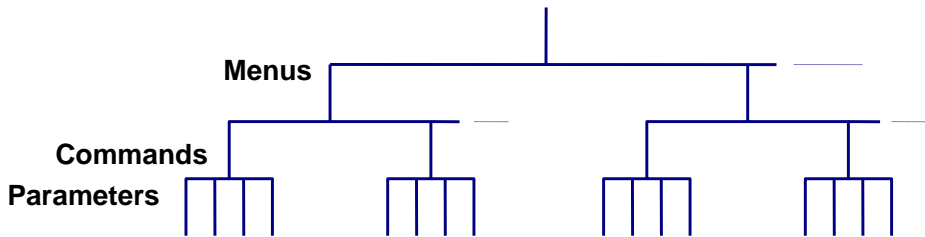
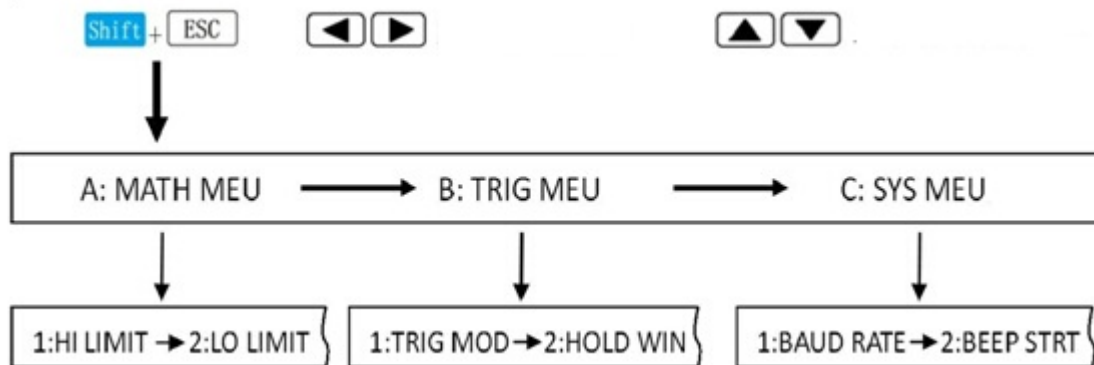


Figure 2-3 Menu Tree



2.3 Rear Panel Summary

The rear panel of TH1952 is shown in Figure 2-4. This section includes important information that should be reviewed before operating the instrument.

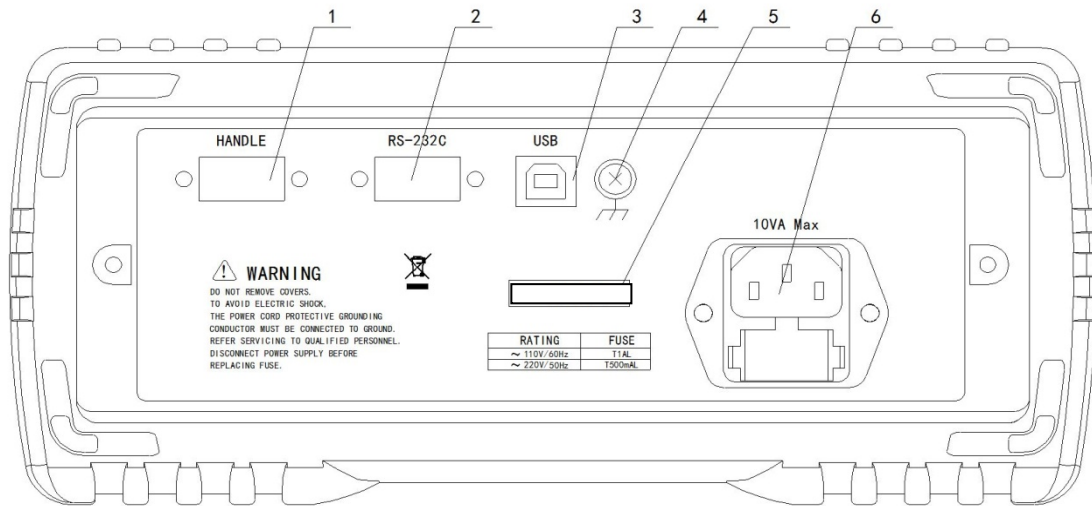


Figure 2-4 TH1952 Rear Panel

1. HANDLER interface
Use a standard DB-9 hole-type connector. Use external signal to trigger test
2. RS-232C Connector
Use a standard DB-9 needle-type connector for RS-232 operation.
3. USB interface
Use a USB-B square connector. Use USB wire to make remote operation.
4. Grounding
Chassis Grounding terminal
5. Label
Serial number for this instrument
6. Power-Line Fuse-Holder Assembly
TH1952 can be configured for line voltage of 110/220V \pm 10% AC at line frequency of 50/60Hz \pm 5%. Power-line fuse is used for instrument protection. (220V/500mA or 110V/1A)
Note: Please use the same-type fuse or contact your nearest Tonghui sales and service office.
To verify and replace the fuse, remove the power cable and pull out the fuse holder.

2.4 Power up

2.4.1 Power Line Connection

Follow the procedure below to connect the TH1952 to line power and turn on the instrument.

1. Check to make sure that the line voltage is in the range of 110V/220V \pm 10% and line frequency is in the range of 50Hz/ 60Hz \pm 5%) before connecting the power cord.

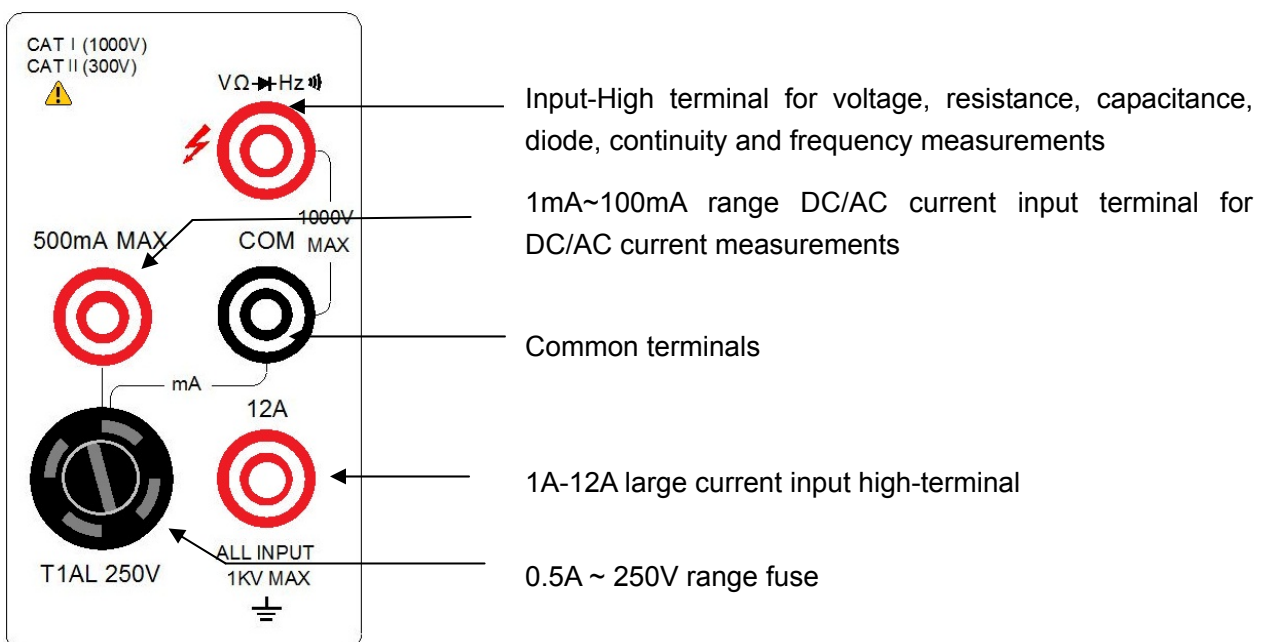
CAUTION: Operating the instrument on an incorrect voltage may cause damage to the instrument, possibly voiding the warranty.

2. Before plugging in the power cord, make sure that the front panel power switch is in the off position.
3. Connect the female end of the supplied power cord to the AC receptacle on the rear panel. Connect the other end of the power cord to a grounded AC outlet.

WARNING: The power cord supplied with the Model TH1952 contains a separate ground wire for use with grounded outlets. When proper connections are made, instrument chassis is connected to power line ground through the ground wire in the power cord. Failure to use a grounded outlet may result in personal injury or death due to electric shock.

4. Turn on the instrument by pressing the front panel power switch and get ready for measuring.

2.4.2 Input Terminals



Function	Input Terminals	Maximum Allowable Input
DCV	V Ω \rightarrow Hz \rightarrow to COM	1010V DCV
ACV, FREQ	V Ω \rightarrow Hz \rightarrow to COM	760V ACV
100mA current	500mA to COM	120mA DC or 120mA AC
10A current	12A to COM	12A DC or 12A AC
Resistance, diode, continuity	V Ω \rightarrow Hz \rightarrow to COM	200V DC or 200V AC RMS
All functions	Any terminals to earth	1000V DC 1000V AC Peak
Capacitance	V Ω \rightarrow Hz \rightarrow to COM	1.2mF
Temperature	V Ω \rightarrow Hz \rightarrow to COM	-200—650 °C

2.4.3 High Energy Circuit Safety Precautions

To optimize safety when measuring voltage in high energy distribution circuits, read and use the directions in the following warning.

When making measurements in high energy circuits, use test leads and accessories that meet the following requirements:

- Test leads and accessories must be fully insulated.
- Only use test leads that can be connected to the circuit (e.g., alligator clips, spade lugs, etc.) for hands-off measurements.
- Do not use test leads or accessories that decrease voltage spacing. This diminishes arc protection and creates a hazardous condition.

Use the following sequence when measuring high energy circuits:

1. De-energize the circuit using the regular installed connect-disconnect device, such as a circuit breaker, main switch, etc.
2. Attach the test leads to the circuit under test. Use appropriate safety rated test leads for this application.
3. Set the multimeter to the proper measurement function and range.
4. Energize the circuit using the installed connect-disconnect device and make measurements without disconnecting the multimeter.
5. De-energize the circuit using the installed connect-disconnect device.
6. Disconnect the test leads from the circuit under test.

WARNING: *The maximum common-mode voltage (voltage between COM and the chassis ground) is 500V peak. Exceeding this value may cause a breakdown in insulation, creating a shock hazard.*

2.4.4 Power-on Defaults

Model TH1952 uses the factory default settings for the power-on settings.

Since the basic measurement procedures in this manual assume the factory defaults, reset the

instrument to the factory settings when following step-by-step procedures. Table below lists the factory default settings.

Setting	Factory Default
Function	DCV
Rang	Auto Range
Rate	FAST
Remote/Local	Local
Bit	5 $\frac{1}{2}$
Trigger Mode	Immediate
Relative Mode	OFF
Compare Mode	OFF
Hi Limit	+1
Lo Limit	-1
Percent Mode	OFF
Reference	1
Max/Min Mode	OFF
Reading Hold	OFF
Secondary Display Mode	Display Rang
Cal Mode	OFF

Chapter 3 Basic Measurements

3.1 Preparation

One of the first things you would like to do with your multimeter is to become acquainted with its front panel. We have provided some exercises in foregoing chapters about preparations for use and operations of front panel.

The front panel has six rows of keys to select various functions and operations. Most keys have a shifted function printed in blue above the key. To perform a shifted function, press **Shift** (the **Shift** annunciator will turn on). Then, press the key that has the desired label above it. For example, to select the AC current function, press **Shift** then press **ACV** (ACI).

If you accidentally press **Shift**, just press it again to turn off the **Shift** annunciator.

3.2 Measuring Voltage

Voltage ranges: 100 mV, 1V, 10V, 100 V, 1000 V, 1000 V (750 VAC)

Maximum resolution: 1 μ V (on 100mV range)

AC technique: true RMS, ac-coupled, 1000V Peak AC

1. Select the desired measurement function.

DCV	select	DCV
ACV	select	ACV
ACV+DCV	select	AC+DC

NOTE: **AC+DC** is effective when the current measurement function is voltage measurement.

2. Connection manner

Connect test leads to the sources as shown in Figure 3-1.

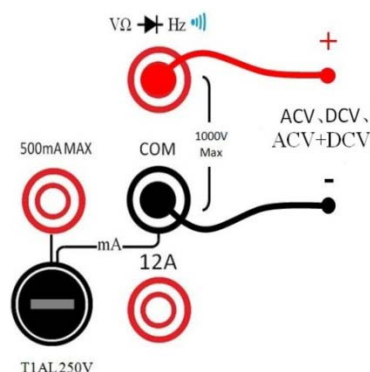




Figure 3-1 Voltage Measurement Connections



3. Range selection and switch

Press **Auto** toggles auto ranging. Notice that the **AUTO** annunciator is displayed with auto ranging.

If you want manual ranging, use the RANGE  and  keys to select a measurement range consistent with expected voltage.

CAUTION: Do not apply more than 1000V peak to the input or instrument damages may occur.

4. How to acquire a more accurate measuring result

If the “.OL” message is displayed in the primary display, press the up  key to select a higher range until a normal reading is displayed (or press  key for auto ranging). Use the lowest possible range for the best resolution.

5. Internal resistance of voltage measurement

DCV input impedance=10 MΩ 1000V~10V range
 > 10GΩ 1V~100mV range

CAUTION: Maximum Input voltage=1010VDC

ACV Input Impedance = 1MΩ and 100pF

CAUTION: Maximum Input voltage= 750V RMS or 1000V peak

6. Crest factor

AC voltage and current accuracies are affected by the crest factor of the waveform, the ratio of the peak value to the RMS value.

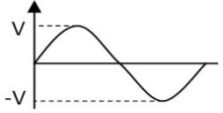
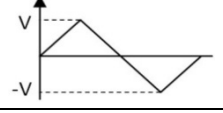
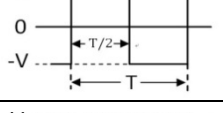
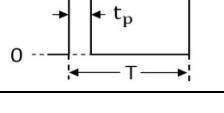
Waveform	Crest factor CF	AC RMS	AC+DC RMS
	$\sqrt{2}$	$\frac{V}{\sqrt{2}}$	$\frac{V}{\sqrt{2}}$
	$\sqrt{3}$	$\frac{V}{\sqrt{3}}$	$\frac{V}{\sqrt{3}}$
	1	v	v
	$\sqrt{\frac{T}{t_p}}$	$\frac{V}{CF} \times \sqrt{1 - \frac{1}{CF^2}}$	$\frac{V}{CF}$

Table 3-1 Crest factor of some AC signal waveform

3.3 Measuring Current

Model TH1952 current measurement range: 1mA, 10mA, 100mA, 1A, 10A

Maximum resolution: 10nA (on 1mA range)

1. Select the desired measurement function.

- DCI select **Shift** **DC V**
- ACI select **Shift** **AC V**
- ACI+DCI select **AC+DC**

NOTE: **AC+DC** is effective when the current measurement function is current measurement.

2. Connection manner

If the current is less than 120mA, connect test leads to the sources as shown in Figure 3-2.

If the current is larger than 120mA, connect test leads to the sources as shown in Figure 3-3.

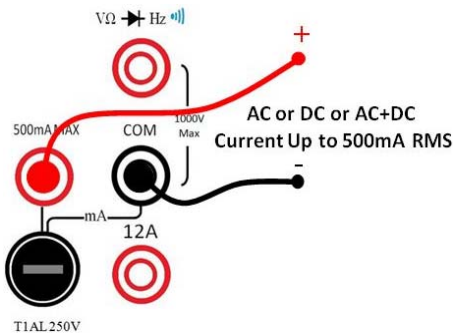


Figure 3-2 Small Current Measurement Connections

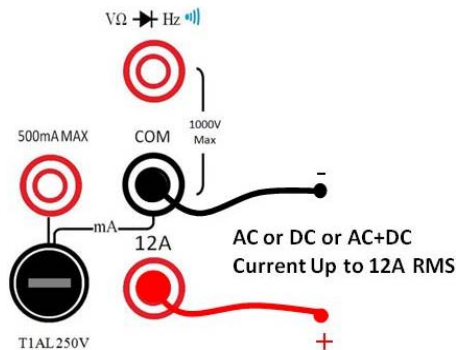


Figure 3-3 Large Current Measurement Connections

3. Range selection and switch

Press **Auto** toggles auto ranging. Notice the **AUTO** annunciator is displayed with auto ranging. If you want manual ranging, use the **RANGE** **▲** and **▼** keys to select a measurement range consistent with expected current.

4. How to acquire more accurate measurement result

If the “.OL” message is displayed, press up **▲** key to select a higher range until a normal reading is displayed (or press **Auto** key for auto ranging). Use the lowest possible range for the best resolution.

5. Sampling resistance of current resistance

For the sampling resistance of current measurement, select different resistance value according to the range.

Range	Sampling resistance
1.00000 mA	100Ω
10.0000 mA	10Ω
100.000 mA	1Ω
1.00000 A	0.01Ω
10.0000 A	0.01Ω

Table 3-2 Sampling resistance of current measurement range


6. Crest factor

Refer to the crest factor of voltage.

3.4 Measuring Resistance

Model TH1952 Resistance measurement range: 100Ω, 1kΩ, 10kΩ, 100kΩ, 1MΩ, 10MΩ, 100MΩ;
Maximum resolution: 1mΩ (on 100Ω range)




1. Select the desired measurement function.

DCR select 



2. Connection manner

Connect test leads to the sources as shown in Figure 3-1 voltage measurement connections.

3. Range selection

Press  toggles auto ranging. Notice the **AUTO** annunciator is displayed with auto ranging. If you want manual ranging, use the RANGE  and  keys to select a measurement range consistent with expected resistance.

4. How to acquire more accurate measurement results

If the “OVL.D” message is displayed, press up  key to select a higher range until a normal reading is displayed (or press  key for auto ranging). Use the lowest possible range for the best resolution.

5. Test current of DCR

Range	Test current
100.000Ω	1.25mA
1.00000kΩ	1.25mA
10.0000kΩ	125μA
100.000kΩ	12.5μA
1.00000MΩ	1.125μA
10.0000MΩ	204.5nA
100.000MΩ	204.5nA 10MΩ

Table 3-3 Test current of resistance measurement range

3.5 Measuring Continuity

- **Connection manner**

Connect test leads to the sources the same as resistance measurement connections.

- **Entering to the measurement function**

If the current test function is DCR measurement, press $\Omega \rightarrow$.

If the current test function is not DCR measurement, press $\Omega \rightarrow$ two times.

- **Beeper under conducting state**

Under continuity test, the multimeter alerts you with a beep when a reading is below a threshold resistance level of 10Ω .

- **Test current**

The test current is 1.25mA.

3.6 Measuring Diode

- **Connection manner**

Connect test leads to the sources the same as resistance measurement connections.

- **Entering to the measurement function**

Shift + $\Omega \rightarrow$

- **Beeper under conducting state**

The multimeter alerts you with a long-time beep when the test voltage is less than 0.1V and this indicates the diode is damaged. In general, the continuity voltage of the diode is larger than 0.1V. The multimeter alerts you with one beep when the test voltage is between 0.1V~1V.

- **Test current**

The test current is 1.25mA.

3.7 Measuring temperature

- **Connection manner**

Connect test leads to the sources the same as resistance measurement connections.

- **Entering to the measurement function**

Shift + Freq

- **Test current**

The test current is 0.125mA

3.8 Measuring Frequency

- **Connection manner**

When testing the frequency of voltage signal, connect test leads to the sources the same as AC voltage measurement connections; when testing the frequency of current signal, select the current measurement connections according to the value of current.

- **Entering to the frequency test**

Press **Freq** to enter into the frequency test. The measurement is on the basis of the AC voltage range. If you want to view the frequency of the current signal, you can observe the AC current signal in the secondary display in AC current measurement.

3.9 Measuring capacitance

The capacitance measurement ranges from 1nF to 10000μF with the maximum resolution ratio up to 1pF. TH1952 adopts DC constant current charge test. The capacitance is calculated by measuring the voltage change (ΔV) in a extremely short time (Δt). The measurement period includes two sections: charging stage and discharging stage.

- **Basic operation**

Connect the test leads to the sources the same as voltage measurement. Press **←** key to enter into the capacitance measurement function. In order to acquire more accurate results, please make open Rel measurement to the probe before connecting the capacitor to be measured with the probe.

3.10 Math Functions

3.10.1 dB Calculation

Expressing DC and AC voltage in dB makes it possible to compress a large range of measurements into a much smaller scope. The relationship between dB and voltage is defined by the following equation:

$$dB = 20 \log_{10} \frac{V_{IN}}{V_{REF}}$$

Where: V_{IN} is the DC or AC input signal.

V_{REF} is the specified voltage reference level.

The instrument will read 0dB when the reference voltage level is applied to the input.

Application method:

Method 1:

1. Press **Shift** + **←** for dB math operation and the present dB value is displayed in the primary display and the current measurement result is displayed in the secondary display.
2. Press **2nd** key and the initial value of V_{REF} is displayed: +1.00000 V.
3. Press **Auto** key to enter into the edit interface of V_{REF} .

- Use \uparrow \downarrow \leftarrow and \rightarrow keys to enter the data. Use Auto key to save the data and press ESC key to cancel the current data.

Method 2:

- Press Shift and ESC to enter into the menu setup interface.
- Use \leftarrow \rightarrow keys to select the menu A:MATH MEU.
- Use \downarrow or Auto key to enter into the next level menu and then use \leftarrow \rightarrow to select 4:dB REF.
- Use \downarrow or Auto key to enter into the parameter setup interface. Factory setting: +1.00000 V.
- Use \uparrow \downarrow \leftarrow \rightarrow keys to enter the data. Use Auto key to save the data and press ESC key to cancel the current data.
- Press Shift + $\text{+} \leftarrow$ for dB math operation and the present dB value is displayed in the primary display and the current measurement result is displayed in the secondary display.

Notes:

- The setup value will be lost after shut down in method 1; the last setup value will be saved after restart in method 2.
- The default unit of the set value is V, with the suffix m, the unit is mV. +1.00000 means 1V, 100.000m means 100mV.
- The dB calculation takes the absolute value of the ratio V_{IN}/V_{REF} .
- The largest negative value of dB is -160dB.

3.10.2 dBm Calculation

dBm is defined as decibels above or below a 1mW reference. With user-programmable reference impedance, Model TH1952 reads 0dBm when the voltage needed to dissipate 1mW through the reference impedance is applied. The relationship between dBm, reference impedance, and the voltage is defined by the following equation:

$$\text{dBm} = 10 \log_{10} \frac{V_{in}^2 / Z_{Ref}}{1\text{mW}}$$

Where: V_{in} is the DC or AC input signal.

Z_{REF} is the specified reference impedance.

Application method:

To set the reference impedance, perform the following steps:

Method 1:

- Press Shift + AC+DC key for dBm math operation and the present dBm value is displayed in the primary display and the current measurement result is displayed in the secondary display.
- Press 2nd key, the Z_{Ref} initial value is displayed: 75 Ω .
- Press Auto key to enter into the edit interface of Z_{Ref} .
- Use \uparrow \downarrow \leftarrow \rightarrow keys to enter the data. Use Auto key to save the data and press ESC key to cancel the current data.

Method 2:

- 1) Press **Shift** and **ESC** to enter into the menu setup interface.
- 2) Use **◀ ▶** keys to select the menu A:MATH MEU.
- 3) Use **▼** or **Auto** key to enter into the next level menu and then use **◀ ▶** to select 5:dBm REF.
- 4) Use **▼** or **Auto** key to enter into the parameter setup interface. Factory setting: 75Ω.
- 5) Use **▲ ▼ ◀ ▶** keys to enter the data. Use **Auto** key to save the data and press **ESC** key to cancel the current data.
- 6) Press **Shift** + **AC+DC** for dBm math operation and the present dBm value is displayed in the primary display and the current measurement results is displayed in the secondary display.

Notes:

1. The setup value will be lost after shut down in method 1; the last setup value will be saved after restart in method 2.
2. The default unit of the set value is Ω, the maximum value is 9999Ω.
3. dBm is valid for both positive and negative DC voltage.
4. The largest negative value of dBm is -140.

3.10.3 Percent

If the percent calculation is selected, a reference value must be specified. The displayed reading will be expressed as percent deviation from the reference value. The percentage calculation is performed as follows:

$$\text{Percent} = \frac{\text{Input} - \text{Reference}}{\text{Reference}} \times 100\%$$

Where: Input is the normal display reading
 Reference is the user-entered constant
 Percent is the displayed result

Application method:

To set the reference impedance, perform the following steps:

Method 1:

1. Press **Shift** + **Max/Min** key to enter into the percent math function. The percent value is displayed in the primary display and the current measurement result is displayed in the secondary display.
2. Press **2nd** key, the Reference value is displayed: +1.00000.
3. Press **Auto** key to enter into the edit interface.
4. Use **▲ ▼ ◀ ▶** keys to enter the data. Use **Auto** key to save the data and press **ESC** key to cancel the current data.

Method 2:

1. Press **Shift** and **ESC** to enter into the menu setup interface.
2. Use **◀ ▶** keys to select the menu A:MATH MEU.
3. Use **▼** or **Auto** key to enter into the next level menu and then use **◀ ▶** to select 3:PERC REF.
4. Use **▼** or **Auto** key to enter into the parameter setup interface. Factory setting: +1.00000.

- Use \blacktriangle \blacktriangledown \blacktriangleleft \blacktriangleright keys to enter the data. Use Auto key to save the data and press ESC key to cancel the current data.
- Press Shift + Max/Min for percent math operation and the present percent value is displayed in the primary display and the current measurement result is displayed in the secondary display.

Notes:

- The setup value will be lost after shut down in method 1; the last setup value will be saved after restart in method 2.
- The default unit of the voltage is V, the resistance is Ω .

3.10.4 $mX+b$

The calculation of reading X on screen is performed as follows:

$$Y = mX + b$$

Where,

- X is the normal display reading on screen
- m and b is the user-entered value
- Y is the displayed result

Application method:

To set the reference impedance, perform the following steps:

Method 1:

- Press Shift + 2nd key to enter into the $mX+b$ math function. The Y value is displayed in the primary display and the X value is displayed in the secondary display.
- Press 2nd key at the first time, the m value is displayed; press 2nd key again, the b value is displayed.
- Press Auto key to enter into the edit interface when displaying the m value and b value.
- Use \blacktriangle \blacktriangledown \blacktriangleleft \blacktriangleright keys to enter the data. Use Auto key to save the data and press ESC key to cancel the current data.

3.10.5 Max/Min data statistics

The math operation of Max/Min (Maximum/Minimum) is used for storing the maximum value, minimum value, average value and reading numbers during measurement.

When enabling this function, the Min/Max operation will enable the MnMx annunciator and start to collect all kinds of statistical figures for readings being displayed. When storing a new minimum value or maximum value, the instrument will beeps (if beeper function is enabled) one time and open the corresponding Max or Min annunciator. The multimeter calculates the average values of all readings and records the measured reading numbers since the Min/Max operation is enabled.

Collected statistical figures including:

- Max—the maximum reading since Min/Max operation is enabled
- Min—the minimum reading since Min/Max operation is enabled
- Avg—the average value of all readings since Min/Max operation is enabled
- Num—the measured reading numbers since Min/Max operation is enabled

When enabling Min/Max operation, press $\boxed{2nd}$ key, the Max, Min, Avg and Num value will be displayed in the secondary display. The count value is displayed as integer before the maximum display is reaching 120000. Otherwise, the scientific notation format is displayed.

Application method:

1. Press $\boxed{Max/Min}$ key to enter into the Max/Min math function. The measurement result is displayed in the primary display and the Max value is displayed in the secondary display.
2. Press $\boxed{2nd}$ key to switch the display value in the secondary display. The Max, Min, Avg and Num values can be displayed or disable the secondary display.

Chapter 4 Measurement Options

This chapter provides more in-depth description of features of TH1952. This chapter is organized as follows:

- **Measurement Configuration** – Describes Range, Relative readings, Digits of Resolution and Measurement rate
- **Triggering operations** – Explains trigger sources
- **MAX and MIN operations** – Records the minimum and the maximum input signals
- **Limit operations** – Defines how to set reading limits
- **System Operations** – Provides details on save and return of instrument setup

4.1 Measurement configuration

The following paragraphs discuss configuring multimeter for making measurement.

4.1.1 Range

You can let the multimeter automatically select the range using auto ranging or you can select a fixed range using manual ranging. Auto ranging is convenient because the multimeter automatically selects the appropriate range for each measurement. However, you can use manual ranging for faster measurements since the multimeter doesn't have to determine which ranging to use for each measurement. The multimeter returns back to auto ranging when power has been off or after a remote interface reset.

Maximum readings


The full scale readings for every range on each function are 20% over range except for the 1000VDC, 750VAC and diode test ranges.

Manual ranging





To select a range, simply press  or  key or  key.


If the instrument displays the "OVL.D" message on a particular range, select a higher range until an on-range reading is displayed. Use the lowest range possible without causing an overflow to ensure best accuracy and resolution.

Auto ranging

To enable auto ranging, press  key. The **AUTO** annunciator turns on when auto ranging is selected. While auto ranging is selected, the instrument automatically chooses the best range to measure the applied signal. However, auto ranging should not be used when optimum speed is required.

Note that up-ranging occurs at 20% of normal range and down-ranging occurs at 20% of normal range.

To cancel auto ranging, press  or  or  key. Pressing  to cancel auto ranging leaves the instrument on the present range.

The  key has no effect on the continuity and diode test functions.

4.1.2 Relative operation

The relative operation could be used to null offsets or subtract a baseline reading from present and future readings. When relative function is enabled, Model TH1952 uses the present reading as a relative value. Subsequent readings will be the difference between the actual input value and the relative value.

You can define a relative value for each function. Once a relative value is set for a measurement function, the value is the same for all ranges. For example, if 2V is set as a relative value on the 20V range, the relative is also 2V on the 1000V, 200V, 2V or 200mV ranges.

Additionally, when you perform a zero correction for DCV, Ω measurements by enabling REL, the displayed offset becomes the reference value. Subtracting the offset from the actual input zeroes the display, as follows:

$$\text{Displayed reading} = \text{Actual Input} - \text{Reference}$$

Note: Select a range that cannot accommodate the relative value does not cause an overflow condition, but it also does not increase the maximum allowable input for that range. For example: on the 1V range, Model TH1952 still overflows for a 1.2V input.



4.1.3 Digits and Rate



4 1/2 and 5 1/2 digits can be selected in this instrument. You can make choice in rate and accuracy.

The RATE operation sets the integration time of the A/D converter. In general, the fastest integration time (FAST set from the front panel or remote interface) results in increased reading noise and fewer usable digits, while the slowest integration time provides the best common-mode and normal-mode rejection. In-between settings are a compromise between speed and noise.

Digit selection

Method 1:

 +  Select 4 $\frac{1}{2}$ (largest display: 11999)

 +  Select 5 $\frac{1}{2}$ (largest display: 119999)

Method 2:

Except the above method, it can also select digits through the menu options:

1.  +  key to enter into the menu option.

2. Use ◀ ▶ keys to select C:SYS MEU.
3. Use ▼ key or [Auto] key to enter into the next menu.
4. Use ◀ ▶ keys to select 7: $5\frac{1}{2}/4\frac{1}{2}$.
5. Use ▼ key or [Auto] key to enter into the parameter setting.
6. Use ◀ ▶ keys to select PLACE: $4\frac{1}{2}$ or PLACE: $5\frac{1}{2}$.
7. Use [Auto] key to save the setup parameter.

NOTE:

The setup will be lost after shut down in method 1; the setup will be saved after restart in method 2.

The default setup is $5\frac{1}{2}$.

Rate selection:

Use ◀ key to select Slow, use ▶ key to select Fast.

The default setup is Slow.

The RATE parameters are explained as follows:

Digit	Fast	Slow
$5\frac{1}{2}$	15	4
$4\frac{1}{2}$	100	15

Note: *The integration time can be set for any measurement function except frequency, period, continuity (FAST) and diode test (Medium). For frequency and period, this value is little excess a gate time.*

4.2 Trigger Operations

The multimeter’s triggering system allows you to generate triggers either manually or automatically or externally and take multiple readings per trigger. The following paragraphs discuss front panel triggering, and the reading hold feature.

4.2.1 Trigger procedure

Wait for Trigger



The control source holds up operation until the programmable event occurs and is detected. See description below for trigger sources:

- Immediate














With this trigger source, event detection is immediately satisfied allowing operation to continue.

- External

Event detection is satisfied for both kinds of triggers as below:

1. A bus trigger (*TRG) command is received.
2. The front panel  key is pressed (TH1952 must be taken out of remote before it will respond to  key).
- 3.

Take steps below for trigger settings:

1. Press  →  to enter the menu on the menu level.
2. Use  or  key to move across to the TRIG MEU on the menu level, “**B: TRIG MEU**” will be displayed. Press  or  key to move down to the next level within the TRIG MEU.
3. Use  or  key to select “**1: TRIG MOD**” and use  or  key to enter into the parameter setting SOURCE: “Parameter”.
4. Using  or  to select IMM, MAN, BUS or EXT trigger source and press  to save the setup.

4.2.2 Measurement Sample



















The primary measurement sample action is a measurement. However, the measurement sample action block could include the following additional actions:

Hold — with hold enabled, the first processed reading becomes the “Seed” reading and operation loops back within the measurement sample block. After the next reading is processed, it is checked to see if it is within the selected window (0.01%, 0.1%, 1% and 10%) of the “seed” reading. If the reading is within the window, operation again loops back within the measurement sample block. This looping continues until the specified number (2 – 100) consecutive readings are within the window. If one of the readings is not within the window, the instrument acquires a new “seed” reading and the hold process continues.

4.2.3 Reading Hold

When a hold reading is acquired as described in “Measurement Sample”, an audible beep is sounded (if enabled) and the reading is considered a “true measurement”. The reading is held on the display until an “out of window” reading occurs to restart the hold process. The reading hold feature allows you to capture and hold a stable reading on the display.

Take steps below to enable and set reading hold function.

1. Press  +  to enable reading hold function
2. Press  →  to enter the menu on the menu level.
3. Use  or  key to select “**B: TRIG MEU**” and press  or  key to move down to the next level within the TRIG MEU.
4. Use  or  to select “**2: HOLD WIN**” and use  or  key to enter into the parameter setting HOLD: “Parameter”.
5. Use  or  key to select a window percentage (0.01%, 0.1%, 1%, 10%).
6. Use  or  to select “**2: HOLD CNT**” and use  or  key to enter into the parameter setting RDGS: “Parameter”

7. Use     keys to setup the parameters and press  to save the setup.

4.2.4 External trigger

BUS trigger: use RS232C or USB bus control to trigger the instrument.

EXT trigger: use START signal pin in HANDLER interface to trigger the instrument.

4.3 Limit Operations

Limit operations set and control the values that determine the HI / IN / LO status of subsequent measurements. Limits can be applied to all measurement functions except continuity. The limit test is performed after percent math operations. Unit prefixes are applied before the limit test, for example:











Low Limit = -1.0, High Limit = 1.0
A 150mV reading equals 0.15V (IN).

Low Limit = -1.0, High Limit = 1.0
A 0.6k Ω reading equals 600 Ω (HI)


















You can configure the multimeter to beep or not when readings are outside of the limit range.

Application method

Method 1:

1. Press  +  key to enter the Limit measurement function.
2. Press  key and the Hi value is displayed in the secondary display. The initial value is +1.00000; press  key again, the Lo value is displayed in the secondary display. The initial value is -1.00000.
3. Press  key to enter into the edit interface of Hi or Lo.
4. Use     keys to setup the parameters and press  to save the setup.

Method 2:

1. Press  \rightarrow  to enter the menu on the menu level.
2. Use  or  key to select **A: MATH MEU**.
3. Use  or  key to move down to the next level and use  or  key to select 1:HI LIMIT or 2: LO LIMIT.
4. Use  or  key to enter into the parameter setting interface. The default value is HI: +1.00000; LO: -1.00000.
5. Use     keys to setup the parameters and press  to save the setup.
6. Press  +  key to enter into the Limit measurement function. The current measurement value is displayed in the primary display and the current measurement state is displayed in the secondary display.

4.4 System Operations

This section describes some other operations of Model TH1952.

4.4.1 Beeper Control

Normally, the multimeter will emit a tone whenever certain conditions are met. For example: the multimeter will beep when a stable reading is captured in reading hold. You may want to disable the beeper for certain applications.

- When you disable the beeper, the multimeter will not emit a tone when:
 1. A limit is exceeded in a limit test
 2. A stable reading is captured in reading hold.
- Disabling the beeper has no effect on the tone generated when:
 1. An internal error is generated.
 2. The continuity threshold is exceeded.
 3. A front panel key is pressed.

Use the following steps to change the beeper's state:

1. Press **Shift** → **Esc** to enter the menu on the menu level and use **◀** or **▶** key to select **"C: SYS MEU"**.
2. Press **▼** or **Auto** key to enter into the BEEP command and use **◀** or **▶** key to select **"2: BEEP STAT"**.
3. Use **▼** or **Auto** key to enter into the parameter setting interface.
4. Use **◀** or **▶** key to select ON or OFF and press **Auto** to save the setup.

4.4.2 Key Sound

To avoid mis-operation, Model TH1952 has key sound function and you can enable or disable it. Factory default setting is enabled. The key sound state is stored in non-volatile memory and does not change when power has been off of after a reset.

Use following steps for key sound setting:

1. Press **Shift** → **Esc** to enter the menu on the menu level and use **◀** or **▶** key to select **"C: SYS MEU"**.
2. Press **▼** or **Auto** key to enter into the BEEP command and use **◀** or **▶** key to select **"3: KEY SONG"**.
3. Use **▼** or **Auto** key to enter into the parameter setting interface.
4. Use **◀** or **▶** key to select ON or OFF and press **Auto** to save the setup.

4.4.3 Display

When the instrument is in remote control state, the front display can be set to OFF for quick measurement speed.

When the display is OFF, the readings will not be sent to the front display. The auxiliary display information is still displayed.

The display is enabled when power has been off or after a remote interface reset.

4.4.4 Calibration

To make sure the instrument could achieve the designed performance, re-calibration and verification is required at least once a year. Instrument calibration could be performed either via the calibration menu from the front panel or through a remote control interface.

The calibration criterion is FLUKE5520A.

The CAL MENU can be used to view the calibration date, to view the number of times calibration has been performed and to perform calibration. Some of the items are password-protected to prevent accidental or unauthorized calibration of the digital multimeter

Note: *To prevent destroying the calibration data stored in non-volatile memory, only the authorized service center or qualified individual can do the instrument calibration with desired equipment.*

Chapter 5 Remote Operation

Besides the front panel control, TH1952 supports RS-232 serial interface or USB interface for remote control. Standard Commands for Programmable Instruments (SCPI) is fully supported to communicate with computer via both interfaces, with a certain communication protocols.

You can connect RS-232 interface with a computer. Some considerations will draw your attention:

- You can only select an interface
- You must define the baud rate
- You must use the SCPI programming language

5.1 RS-232 remote interface

5.1.1 RS-232 Interface Instruction

RS232C standard now is widely used as the serial communication standard. RS232 stands for Recommend Standard number 232 and C is the latest revision of the standard.

The common RS232 signals are listed in Table 5-1:

Table 5-1 Signal Definition

Signal	Code	25 Pin Connector Pin number	9 Pin Connector Pin number
Request To Send	RTS	4	7
Clear To Send	CTS	5	8
Data Set Ready	DSR	6	6
Data Carrier Detect	DCD	8	1
Data Terminal Ready	DTR	20	4
Transmitted the data	TXD	2	3
Receive the data	RXD	3	2
Grounding	GND	7	5

TH1952's serial port uses the transmit (TXD), receive (RXD), and signal ground (GND) lines of the RS232 standard. It does not use the hardware handshaking lines CTS and RTS. TH1952 only uses the smallest subset of the RS232C standard, the signal are listed in Table 5-2.

Table 5-2 Signal Definition

Function	Code	9 Pin Connector Pin Number
Transmitted Data	TXD	3
Received Data	RXD	2
Signal Ground Common	GND	5

Figure 5-1 shows the rear panel connector for the RS232 interface of TH1952.



Figure 5-1 Rear Panel RS232 Interface

5.1.2 RS-232 Interface Operation

A. Connection

Connection between TH1952 and a computer shown as Figure 5-2:

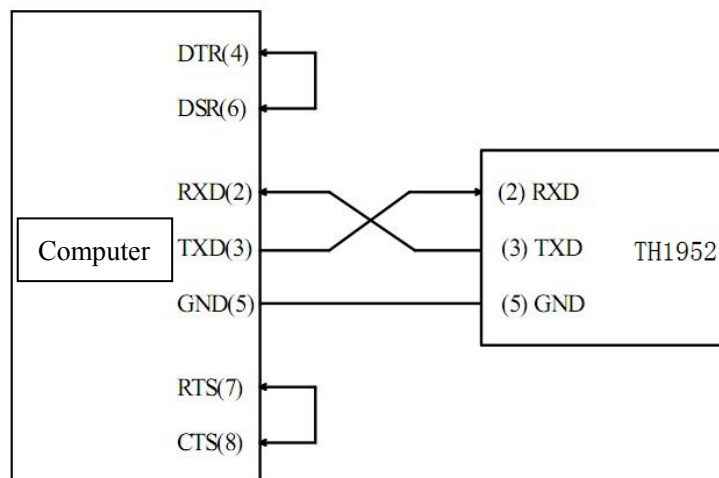


Figure 5-2 RS-232 Connection Sketch

There may be some difference between TH1952 RS232 interface and a standard RS232C interface. You can make the connection cable by yourself according to the diagram or order one from our company.

Note: Pin 4 and 6, pin 7 and 8 are shorted respectively at the end of controller.

B. Sending and receiving data

Model TH1952 transfers data using 8 data bits, 1 stop bit, and no parity. Each program message that is transmitted to the controller is terminated with <LF>.

C. Selecting Baud Rate

The baud rate is the rate at which Model TH1952 multimeter and the computer communicate. Choose one of these available rates:

- 115.2k
- 28.8k
- 19.2k
- 9600

Note: Factory default baud rate is 9600.

Before you choose a baud rate, make sure the programming terminal that you are connecting to the TH1952 can support the baud rate you selected. Both the multimeter and the other device must be configured for the same baud rate.

Perform the following steps to select a baud rate:

1. Press **Shift** → **Esc** to enter the menu on the menu level and use **◀** or **▶** key to move across to “C: SYS MEU”. Press **Auto** key to enter into the Baud command and use **▼** or **▲** key to select “2:BAUD RAT” and press **Auto** key to enter into the baud parameter setting, “BAUD: <rate>” is displayed.
2. Use **▼** or **▲** key to select a baud rate and then press **Auto** to confirm the selection.
3. Press **Shift** + **Esc** key to exit from the menu and return to the measurement status.

D. Software Protocol

Since the hardware handshaking lines CTS and RTS are not used by TH1952, the multimeter uses the character return method to decrease the data losses and errors during communication. Please refer to the content below before programming communication software.

1. For command syntax and format, refer to Chapter 6 Command Reference.
2. The controller transmits the command using the ASCII code with <LF> as the terminal character. TH1952 executes the command after the terminal character is received.
3. The character received by TH1952 will be sent back to the controller again. The controller will not send the next character until the last returned character is received correctly from TH1952. If the controller fails to receive the character sent back from TH1952, the possible reasons are listed as follows:
 - The serial interface is not connected correctly.
 - Check if the same baud rate is selected for both TH1952 and the controller.
 - When TH1952 is busy with executing a bus command, TH1952 will not accept any character from the serial interface at the same time. So the character sent by controller will be ignored. In order to make sure the whole command is sent and received correctly, the character without a return character should be sent again by the controller.
4. TH1952 only sends information under following two conditions. The first is when a character is received normally; TH1952 will send the character back as a handshake. The second is when a query command is received; TH1952 will send the query response information.
5. Once a query command is received, TH1952 will send the query response information immediately even if the rest commands have not been finished. So if the command includes two queries, the controller should read the query responses twice. One query is recommended to be included in a single command.
6. A query response is sent out in ASCII codes with the preset terminal character.
7. Several query responses will be sent continuously with 1ms interval. The controller should be ready to receive the responses; otherwise the response information will be lost.
8. The controller should receive the query response terminal character. Otherwise you will confuse a terminal character with a returned character. At the same time the controller should receive the last returned character before receiving a query response.
9. For some commands that will take a long time to execute, for example reset command, the controller should keep waiting to avoid the next command being lost when TH1952 is executing the

former command.

5.2 USB Interface

5.2.1 USB introduction

USB is short for universal serial bus. As one kind of the external bus standard, USB is used for the communication between PC and external devices. In general, there are four pieces of circuits:

Signal	Code	Color	Pin
Power	VCC	Red	1
Data low-terminal	Data-	White	2
Data high-terminal	Data+	Green	3
Grounding	GND	Black	4

This instrument uses square type socket and the pin sequence is as follows:



This instrument uses USB-B type interface.

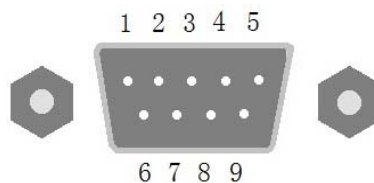
5.2.2 USB Communication

The instrument is communicating through USB simulated Virtual Serial Port. Before using it, please install the driver in PC.

Also, the baud rate is needed to be set.

5.3 Handler Interface

For convenience of industrial manufacture, TH1952 is provided with Handler interface. The interface definition is as follows:



Signal	Code	Pin
External trigger signal	START	5
Sorting signal 1	HI	9
Sorting signal 2	IN	4
Sorting signal 3	LO	8
Fail signal	FALL	3
Measurement end signal	EOC	7
Internal voltage	IN_VCC	2
External ground	EXT_GND	6
External power	EXT_VCC	1

Handler is mainly used under Limit function. Each signal is described as follows:

Signal	Description
START	Starting signal. Pulse signal falling edge trigger.
HI	When the measurement result is larger than HI, this signal is low level, or high level is output.
IN	When the measurement result is between HI and LO, this signal is low level, or high level is output.
LO	When the measurement result is lower than LO and larger than HI, this signal is low level, or high level is output.
FALL	When the measurement result is lower than LO, this signal is low level, or high level is output.
EOC	Measurement end signal. The low output signal will be valid.
IN_VCC	Internal power output signal. +5V
EXT_VCC	External input power
EXT_GND	External input power ground

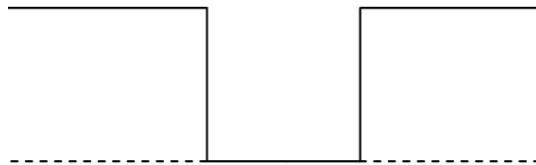
NOTE: the maximum input of external power should not be larger than 24V and its signal low level is valid.

The instrument provides external power supply. When using external power supply, the setup in menu is as follows:

1. Press **Shift** → **Esc** to enter the menu on the menu level and use **◀** or **▶** key to move across to "C: SYS MEU". Press **Auto** key to enter into the command option and use **▼** or **▲** key to select "8:HANDLE PW" and press **Auto** key to enter into the power setting of the handler, "POWER: <parameter>" (IN/EXT) is displayed.
2. Use **◀** or **▶** key to select the power and then press **Auto** to confirm the selection.
3. Press **Shift** + **Esc** key to exit from the menu and return to the measurement status.

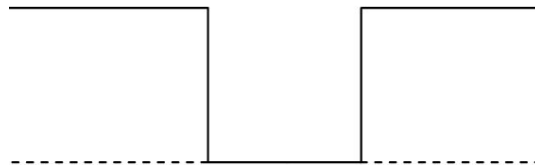
START signal:

Low level valid pulse signal can trigger the multimeter. If using this signal to trigger, the trigger mode must be set as EXT. The time width of low level should not be less than $2\mu\text{s}$.



EOC signal:

Low level valid pulse signal. When one measurement is ended, EOC outputs a low level pulse signal. The time width of this signal should be larger than $1\mu\text{s}$.



Chapter 6 SCPI Command Reference

6.1 Command structure

TH1952 command system adopts SCPI commands. The SCPI commands are tree structured three levels deep. (The highest level commands are called the subsystem commands in this manual.) So the lower level commands are legal only when the subsystem commands have been selected. A colon (:) is used to separate the higher level commands and the lower level commands. See Figure 6-1 for a sample.

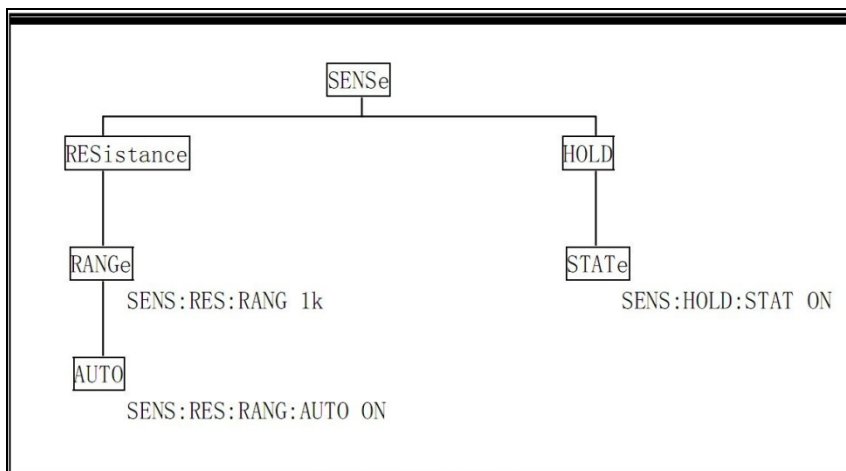


Figure 6-1 Command Tree Example

6.2 Command Syntax

The information in this section covers the syntax for both common commands and SCPI commands.

6.2.1 Commands and command parameters

Common commands and SCPI commands may or may not use a parameter. The following are some examples:

*RST	No parameter used
:FORMat <name>	Parameter<name> required
:IMMediate	No parameter used

Put at least one space between the command word and the parameter.

- Brackets []: Some command words are enclosed in brackets. These brackets are used to denote an optional command word that does not need to be included in the program message. For example:
:RANGe[:UPPer] <n>

These brackets indicate that :UPPer is optional and does not have to be used. Thus, the above command can be sent in one of the two ways below:

:RANGe <n>
or :RANGe:UPPer <n>

NOTICE: When using optional command words in your program, do not include the brackets.

- Angel brackets <>: Angle brackets are used to denote a parameter type. Do not include the brackets in the program message. For example:

:HOLD:STATe

The indicates that a Boolean-type parameter is required. Thus, to enable the HOLD feature, you must send the command with ON or 1 parameter as below:

:HOLD:STATe ON
or :HOLD:STATe 1

- Parameter types: The following are some of the more common parameter types:
 Boolean: Used to enable or disable an instrument operation. 0 or OFF disables the operation and 1 or ON enables the operation. Example:

:CURRent:AC:RANGe:AUTO ON Enable auto ranging

<name> Name parameter: Select a parameter name from a listed group. Example:

<name> = MOVing
REPeat

:RESistance:AVERage:TCONtrol MOVing

<NRf> Numeric Representation format: This parameter is a number that can be expressed as an integer (e.g., 6), a real number (e.g., 25.3) or an exponent (e.g., 5.6E2). Example:

:MMFactor 5

<n> Numeric value: A numeric value parameter can consist of a NRf number or one of the following name parameters: DEFault, MINimum, MAXimum. When DEFault parameter is used, the instrument is programmed to the *RST default value. When the MINimum parameter is used, the instrument is programmed to the lowest allowable value. When the MAXimum parameter is used, the instrument is programmed to the largest allowable value. Examples:

```

:CURRent[:DC]:NPLCycles 1
:CURRent[:DC]:NPLCycles DEFault
:CURRent[:DC]:NPLCycles MINimum
:CURRent[:DC]:NPLCycles MAXimum
:CURRent[:DC]:NPLCycles PLAC4
:CURRent[:DC]:NPLCycles PLAC5

```

6.2.2 Short-form Rules

Use the following rules to determine the short-form version of any SCPI command:

- If the length of the command word is four letters or less, no short form version exists. Example:
:AUTO =:AUTO
- These rules apply to command words that exceed four letters:
- If the fourth letter of the command word is a vowel, delete it and all the letters after it. Example:
:immediate =:imm
- Rule exception – The short form version of the following command uses only the first two letters of the word.
:TCouple = :tc
- If the fourth letter of the command word is a consonant, retain it but drop all the letters after it. Example:
:format = :form
- If the command contains a question mark (?; query) or a non-optional number included in the command word, you must include it in the short-form version. Example:
:delay? = :del?
- Command words or characters that are enclosed in brackets ([]) are optional and need not be included in the program message.

6.2.3 Basic Rules of Command Structure

- Letter case (upper and low) is ignored.
For example:
FUNC:VOLT:DC = func:volt:dc = Func:Volt:Dc
- Spaces (␣ is used to indicate a space) must not be placed before and/or after the colon (:).
For example:
(wrong) FUNC␣:␣VOLT:DC
(right) FUNC: VOLT:DC
- The command can be completely spelled out or in abbreviated type. (In the following description, short form will be printed in upper case.)
For example:
FUNCTION: VOLTAGE:DC = FUNC:VOLT:DC
- The command header should be followed by a question mark (?) to generate a query for that command.
For example:
FUNC?

6.2.4 Multiple Command Rules

The semicolon (;) can be used as a separator to execute multiple commands on a single line. The multiple command rules are as follows.

- Commands at the same level and in the same subsystem command group can be separated by a semicolon (;) on a multiple command line.

For example:

```
:RESistance:NPLCycle <n>;NPLCycles ?
```

- To restart commands from the highest level, a semicolon (;) must be used as the separator, and then a leading colon (:), which shows that the restarted command is a command at the top of the command tree, must follow.

For example:

```
:RESistance:NPLCycle <n>; :RESistance:NPLCycles ?
```

- The common commands can restart only after a semicolon on a multiple command line.

For example,

```
:RESistance:NPLCycles<n>;*IDN?
```

6.2.5 Command Path Rules

- Each new program message must begin with the root command, unless it is optional (e.g., FUNCTION). If the root is optional, simply treat a command word on the next level as the root.
- The colon at the beginning of a program message is optional and need not be used. Example:
:DISPlay:ENABLE = DISPlay:ENABLE
- When the path pointer detects a colon(;), it moves down to the next command level.
- When the path pointer detects a colon (:) after a semicolon (;), it resets back to the root level.
- The path pointer can only move down. It cannot be moved up a level. Executing a command at a higher level requires that you start over at the root command.

6.3 Command Reference

Model TH1952 provides following subsystem commands:

- DISPlay •FUNCTION •VOLTage •CURRent •RESistance
- FREQuency •PERiod •HOLD •TRIGer •FETCh
- CAPacitance •SPEED •RETURN

Model TH1952 supports following common commands:

- ◆ *RST ◆ *TRG ◆ *IDN

6.3.1 DISPlay subsystem

The DISPlay subsystem commands are mainly used to control the display of the TH1952. and are summarized in Table 6-1.

Table 6-1 DISPlay Subsystem Commands Summary

Command	Function Description
:DISPlay	Display control command
:ENABLE 	Enable or disable front panel display
:ENABLE?	Query state of the display

:DISPlay

:ENABLE

Command syntax:

:DISPlay:ENABLE

Command Parameter:

 = 0 or OFF Disable front panel display
 1 or ON Enable front panel display

Query:

:ENABLE? Query state of the display

Description:

This command is used to enable or disable front panel display circuitry. When disabled, the instrument operates at a higher speed. While disabled, the display is frozen. All front panel controls except LOCAL are disabled. Normal display operation can be resumed by using:ENABLE command or pressing LOCAL key to enable the display.

6.3.2 FUNCTION subsystem

The commands in this subsystem are used to configure the measurement function subsystems and are summarized in Table 6-2.

Table 6-2 FUNCTION Subsystem Commands Summary

Command	Command Description
:FUNCTION <name>	Select measurement function : 'VOLTage:AC', 'VOLTage:DC', 'RESistance', 'FRESistance', 'CURRent:AC', 'CURRent:DC', 'FREQuency', 'PERiod', 'DIODE', 'CONTInuity', 'CAPacitance', 'TEMPerature'.
:FUNCTION?	Query function.

:FUNCTION Command

:FUNCTION <name>

Command syntax:

:FUNCTION <name>

Command Parameter:

<name> =	'VOLTage:AC'	Select AC Voltage
	'VOLTage:DC'	Select DC Voltage
	'CURRent:AC'	Select AC Current
	'CURRent:DC'	Select DC Current
	'RESistance'	Select 2-wire Resistance
	'FRESistance'	Select 4-wire Resistance
	'FREQuency'	Select Frequency
	'PERiod'	Select Period
	'DIODE'	Select Diode Testing
	'CONTInuity'	Select Continuity Testing
	'CAPacitance'	Selecting Capacitance testing
	'TEMPerature'	Select Temperature testing

Query:

:FUNCTION? Query currently programmed function

Description:

This command is used to select the measurement function of the instrument. Note that the parameter names are enclosed in single quotes ('). However, double quotes (") can instead be used. For example:

```
:FUNC 'VOLT'= :FUNC "VOLT"
```

Each measurement function "remembers" its own unique setup configuration, such as range, speed, filter and rel. This eliminates the need to re-program setup conditions every time you switch from one function to another.

6.3.3 FUNCTION2 subsystem

The commands in this subsystem are used to configure the second measurement function subsystems and are summarized in Table 6-3.

Table 6-3 FUNCTION 2 Subsystem Commands Summary

Command	Command Description
:FUNCTION2 <name>	Select measurement function : 'VOLTage:AC', 'VOLTage:DC', 'CURRent:AC', 'CURRent:DC', 'FREQuency'
:FUNCTION2?	Query the second function.

:FUNCTION2 Command

:FUNCTION2 <name>

Command syntax:

:FUNCTION2 <name>

Command Parameter:

<name> =	'VOLTage:AC'	Select AC Voltage
	'VOLTage:DC'	Select DC Voltage
	'CURRent:AC'	Select AC Current
	'CURRent:DC'	Select DC Current
	'FREQuency'	Select Frequency

Query:

:FUNCTION2? Query currently second programmed function

Description:

This command is used to select the second measurement function of the instrument.

6.3.4 UNIT subsystem

The UNIT subsystem is used to configure and control the measurement units for ACV, and DCV, and is summarized in Table 6-4.

Table 6-4 UNIT Subsystem Commands Summary

Command	Command Description	Default parameters
:UNIT <name>	Select measurement units: 'V', 'dB', 'dBm'	'V'
:UNIT?	Query the measurement units	

UNIT command

: UNIT <name>

command syntax: : UNIT <name>

Command parameter:

<name> = V Set the measurement units as V
 dB Set the measurement units as dB
 dBm Set the measurement units as dBm

Query:

:UNIT? Query the current measurement units

NOTE: this command is only valid when in DCV, ACV, AC+DC, V function measurement.

6.3.5 CALCulate subsystem

The commands in this subsystem are used to configure and control the calculate subsystems and are summarized in Table 6-5.

Table 6-5 CALCulate Command Summary

Command	Function Description	Default Parameter
:CALCulate[1]	Subsystem to control CALC1:	
:FORMat <name>	Select math format (NONE, MXB, PERCent)	PERCent
:FORMat?	Query math format.	
:KMATH	Path to configure math calculations:	
:MMFactor <NRf>	Set "m" factor for mx+b (-100e6 to 100e6)	1
:MMFactor?	Query "m" factor	
:MBFactor <NRf>	Set "b" factor for mx+b (-100e6 to 100e6)	0
:MBFactor?	Query "b" factor	
:PERCent <NRf>	Set target value for PERCent calculation(-100e6 ~100e6)	1
:ACQuire	Use input signal as target value.	
:PERCent?	Query percent	
:STATe 	Enable or disable KMATH calculation	OFF
:STATe?	Query state of KMATH calculation	
:DATA?	Read result of KMATH calculation	
:CALCulate2	Subsystem to control CALC2	NONE
:FORMat <name>	Select Math format.	
:FORMat?	Query math format.	
:STATe 	Enable or disable calculation	OFF
:STATe?	Query state of math function	
:DATA?	Read math result of CALC2	
:CALCulate3	Subsystem to control CALC3 (limit test):	
:LIMit[1]	Path to control LIMIT test:	
:UPPer <n>	Set upper limit (-100e6 to 100e6).	1
:UPPer?	Query upper limit.	
:LOWer <n>	Set lower limit (-100e6 to 100e6).	-1
:LOWer?	Query lower limit	
:STATe 	Enable or disable limit test	OFF

:STATE?	Query state of limit test	
:FAIL?	Query test result (1=pass, 0=fail)	

:CALCulate[1]

Use these commands to configure and control MXB and percent math calculations.

:FORMat <name>

Command syntax:

:CALCulate[1]:FORMat <name>

Command Parameter:

<name> =	NONE	No calculations
	MXB	Polynomial math calculation
	PERCent	Percent math calculation

Query:

:FORMat? Query programmed math format

Description:

This command is used to specify the format for the CALC1 math calculations. With NONE selected, no CALC1 calculation is performed. With MXB or PERCent selected and enabled, the result of the calculation is displayed. The calculated reading is refreshed every time the instrument takes a reading.

:KMATH Commands

:MMFactor <NRf>

Command syntax:

:CALCulate[1]:KMATH:MMFactor <NRf>

Command Parameter:

<NRf> =	-100e6 to 100e6	Specify "m" factor.
---------	-----------------	---------------------

Query:

:MMFactor? Query "m" factor.

Description:

This command is used to define the "m" factor for the mx+b calculation.

:MBFactor <NRf>

Command syntax:

:CALCulate[1]:KMATH:MBFactor <NRf>

Command Parameter:

<NRf> =	-100e6 to 100e6	Specify "b" factor.
---------	-----------------	---------------------

Query:

:MBFactor? Query "b" factor

Description:

This command is used to define the "b" factor for the mx+b calculation.

:PERCent <NRf>

Command syntax:

:CALCulate[1]:KMATh:PERCent <NRf>

Command Parameter:

<NRf> = -1e6 to 1e6 Specify target value.

Query:

:PERCent? Query percent target value

Description:

This command is used to specify the target value for the percent calculation.

:ACQuire

Command syntax:

:CALCulate[1]:KMATh:PERCent:ACQuire

Description:

This action command is used to acquire the present input signal reading and use it as the target value for the PERCent calculation.

**:STATe **

Command syntax:

:CALCulate[1]:STATe

Command Parameter:

 = 0 or OFF Disable CALC1 calculation.
 1 or ON Enable CALC1 calculation.

Query:

:STATe? Query state (ON or OFF) of CALC1.

Description:

This command is used to enable or disable the CALC1 calculation. When enabled, each instrument reading will reflect the selected calculation.

:DATA?

Command syntax:

:CALCulate[1]:DATA?

Description:

This query command is used to read the result of the CALC1 calculation. If CALC1 is disabled or NONE is selected, the “raw” reading will be read.

:CALCulate2

These commands are used to configure and control the CALC2 operations on readings stored in the buffer.

:FORMat <name>

Command syntax:

:CALCulate2:FORMat <name>

Command Parameter:

<name> =	NONE	No calculation
	MEAN	Mean value of readings in buffer
	SEdViation	Standard deviation of readings in buffer
	MAXimum	Largest reading in buffer
	MINimum	Lowest reading in buffer

Query:

:FORMat? Query programmed math format.

Description:

This command is used to specify the format for the CALC2 math calculation. The calculation operations for CALC2 use data stored in the buffer.

With NONE selected, no CALC2 calculation is performed. With any of the other formats selected and CALC2 enabled, the math calculation will be performed every time the :IMMediate or :IMMediate? Command is executed.

**:STATe **

Command syntax:

:CALCulate2:STATe

Command Parameter:

 =	0 or OFF	Disable CALC2 calculation
	1 or ON	Enable CALC2 calculation

Query:

:STATe? Query state (ON or OFF) of CALC2

Description:

This command is used to enable or disable the CALC2 calculation. When enabled, the selected CALC2 format will be calculated when the :IMMediate or :IMMediate? Command is executed.

:DATA?

Command syntax:

:CALCulate2:DATA?

Description:

This query command is used to read the result of the CALC2 calculation. If CALC2 is disabled or NONE is selected, the “raw” reading will be read.

:CALCulate3

These commands are used to configure and control the CALC3 limit test.

:LIMit[1]:UPPer <n> Specify upper limit

:LIMit[1]:LOWer <n> Specify lower limit

Command syntax:

:CALCulate3:LIMit[1]:UPPer <n>

:CALCulate3:LIMit[1]:LOWer <n>

Command Parameter:

<n> =	-100e6 to 100e6	Specify limit value
	DEFault	Specify upper limit to 1
		Specify lower limit to -1
	MINimum	Specify limit to -100e6
	MAXimum	Specify limit to +100e6

Query:

:UPPer? Query upper limit

:LOWer? Query lower limit

Description:

This command is used to specify the upper and lower limit for LIMIT1. The actual limit depends on which measurement function is currently selected. For example, a limit value of 1 is 1V for the volts functions (DCV or ACV), 1A for the current function (DCI or ACI), 1Ω on the ohms functions (2 or 4). A limit value is not range sensitive. A limit of 1 for DCV is 1V on all measurement ranges.

**:STATe **

Command syntax:

:CALCulate3:LIMit[1]:STATe

Command Parameter:

 =	0 or OFF	Disable limit test
	1 or ON	Enable limit test

Query:

:STATe? Query state (on or off) of limit test

Description:

This command is used to enable or disable the LIMIT test. When enabled, the limit test will be performed.

:FAIL?

Command syntax:

:CALCulate3:LIMit[1]:FAIL?

Description:

This command is used to read the results of the LIMIT1 test

0 = Limit test failed

1 = Limit test passed

The response message (0 or 1) only tells you if a limit test has passed or failed. It does not tell you which limit (upper or lower) has failed.

6.3.6 VOLTage subsystem

The commands in this subsystem are used to configure and control voltage measurement function and are summarized in Table 6-6.

Table 6-6 VOLTage Subsystem Commands Summary

Command	Function Description	Default
:VOLTage:DC	Path to configure DC voltage	
:NPLCycles <n>	Set the test speed and display digits	SLOW
:NPLCycles?	Query line cycle integration rate	
:RANGe	Path to configure measurement range	
[:UPPer] <n>	Select range (0 to 1010)	1000
[:UPPer]?	Query range	
:AUTO 	Enable or disable auto range	ON
:AUTO?	Query auto range	
:REFerence <n>	Specify reference (-1010 to 1010)	0
:STATe 	Enable or disable reference	OFF
:STATe?	Query state of reference (0,1)	
:ACQuire	Use input signal as reference.	
:REFerence?	Query reference value	

:VOLTage:AC	Path to configure AC voltage	
:NPLCycles <n>	Set the test speed and display digits	SLOW
:NPLCycles?	Query line cycle integration rate	
:RANGe	Path to set measurement range	
[:UPPer] <n>	Select range (0 to 757.5)	757.5
[:UPPer]?	Query range	
:AUTO 	Enable or disable auto range	ON
:AUTO?	Query auto range	
:REFerence <n>	specify reference (-757.5 to 757.5)	0
:STATe 	Enable or disable reference	OFF
:STATe?	Query state of reference	
:ACQuire	Use input signal as reference	
:REFerence?	Query reference value	

Speed Commands

: NPLCycles <n>

Command Syntax:

```
:VOLTage:AC:NPLCycles <n>          Set NPLC for ACV
:VOLTage:DC:NPLCycles <n>          Set NPLC for DCV
```

Command Parameter:

```
<n> =  SLOW,FAST,PLAC4,PLAC5      Set the test speed and digit display
        DEFault                    SLOW
        SLOW                        Set the test speed as SLOW
        FAST                        Set the test speed as FAST
        PLAC4                       Set the display digits as 4 1/2
        PLAC5                       Set the display digits as 5 1/2
```

Query:

```
:NPLCycles?                        Query the current test speed
```

Description:

The command is used for the basic measurement functions (except Frequency and Period) and test speed (display digits).

:RANGe Commands

:[UPPer] <n>

Command syntax:

```
:VOLTage:AC:RANGe[:UPPer] <n>      Set measurement range for ACV
:VOLTage:DC:RANGe[:UPPer] <n>      Set measurement range for DCV
```

Command Parameter:

<n> =	(0.1,1,10,100,750) V	ACV
	(0.1,1,10,100,1000)V	DCV
DEFault		0.1(ACV)
		0.1 (DCV)
MINimum		0.1
MAXimum		750(ACV) 1000(DCV)

Query:

:RANGe[:UPPER]? Query measurement range of the current function.

Description:

This command is used to manually select the measurement range for the specified measurement function. The range is selected by specifying the expected reading as an absolute value. The instrument will then go to the most sensitive range that will accommodate that expected reading. For example, if you expect a reading of approximately 20mV, simply let the parameter (<n>) =0.02 (or 20e-3) in order to select the 200mV range.

**:AUTO **

Command syntax:

:VOLTage:AC:RANGe:AUTO Set auto range for ACV
:VOLTage:DC:RANGe:AUTO Set auto range for DCV

Command parameter:

 = 1 or ON Enable auto range
 0 or OFF Disable auto range

Query:

:AUTO? Query auto range (ON or OFF)

Description:

These command are used to control auto ranging. With auto ranging enabled, the instrument automatically goes to the most sensitive range to perform the measurement.

The auto range command (:RANGe:AUTO) is coupled to the command that manually selects the measurement range (:RANGe <n>). When auto range is enabled, the parameter value for :RANGe <n> changes to the automatically selected range value. Thus, when auto range is disabled, the instrument remains at the automatically selected range. When a valid :RANGe <n> command is sent, auto ranging disables.

:REFerence <n> Commands

:REFerence <n>

Command syntax:

:VOLTage:AC:REFerence <n> Specify reference for ACV
:VOLTage:DC:REFerence <n> Specify reference for DCV

Command parameter:

<n> =	-757.5 to 757.5	Reference for ACV
	-1010 to 1010	Reference for DCV
	DEFault	0 (All measurement functions)
	MINimum	Minimum value for specified function
	MAXimum	Maximum value for specified function

Query:

:REFerence?	Query reference for relative function
-------------	---------------------------------------

Descripton:

These commands are used to establish a reference value for the specified function. When reference is enabled (:REFerence:STATe), the result will be the algebraic difference between the input signal and the reference value:

Reading = Input signal – Reference

From the front panel, reference is called relative (REL).

The:REFerence <n> command is coupled to the :ACQuire command. The last command sent (:REFerence <n> or :ACQuire) eestablishes the reference. When a reference is set using the:REFerence <n> command, the REFerence? Query command returns the programmed value. Conversely, when a reference is set using the:ACQuiry command, the:REFerence? Query command returns the acquired reference value.

**:STATe **

Command syntax:

:VOLTage:AC:REFerence:STATe 	Control reference for ACV
:VOLTage:DC:REFerence:STATe 	Control reference for DCV

Command parameter:

 =	1 or ON	Enable reference
	0 or OFF	Disable reference

Query:

:STATe?	Query state of reference.
---------	---------------------------

Description:

These commands are used to enable or disable Reference for the specified function. When enabled, the displayed reading will include the programmed reference value. When disabled, the displayed reading will not include the reference value.

:ACQuire

Command syntax:

:VOLTage:AC:REFerence:ACQuire	Acquire reference for ACV
-------------------------------	---------------------------

:VOLTage:DC:REFerence:ACQuire

Acquire reference for DCV

Description:

When one of these commands is sent, the measurement input signal is acquired and established as the reference value. This command is typically used to zero the display. For example, if the instrument is displaying a 1 μ V offset, sending this command and enabling Reference zeroes the display.

This command is functional only if the instrument is on the specified measurement function. Sending this command while in any other function causes an error. Also, if the latest reading is overflowed or a reading has not been triggered, an error occurs when this command is sent.

6.3.7 CURRent subsystem

The commands in this subsystem are used to configure and control current measurement function and are summarized in Table 6-7.

Table 6-7 CURRent Subsystem Commands Summary

Command	Function Description	Default
:CURRent:DC	Path to configure DC current	
:NPLCycles <n>	Set the test speed and display digits	SLOW, PLAC5
:NPLCycles?	Query line cycle integration rate	
:RANGe	Path to configure measurement range	
[:UPPer] <n>	Select range (0 to 20)	20
[:UPPer]?	Query range	
:AUTO 	Enable or disable auto range	ON
:AUTO?	Query auto range	
:REFerence <n>	Specify reference (-20 to 20)	0
:STATe 	Enable or disable reference	OFF
:STATe?	Query state of reference	
:ACQuire	Use input signal as reference	
:REFerence?	Query reference value	
:CURRent:AC	Path to configure AC voltage	
:NPLCycles <n>	Set the test speed and display digits	SLOW, PLAC5
:NPLCycles?	Query line cycle integration rate	
:RANGe	Path to set measurement range	
[:UPPer] <n>	Select range (1m,10m,100m,1,10)	20
[:UPPer]?	Query range	
:AUTO 	Enable or disable auto range	ON
:AUTO?	Query auto range	
:REFerence <n>	specify reference (-20 to 20)	0
:STATe 	Enable or disable reference	OFF
:STATe?	Query state of reference	
:ACQuire	Use input signal as reference	
:REFerence?	Query reference value	

Speed Commands

: NPLCycles <n>

Command Syntax:

- : CURRent:AC:NPLCycles <n> Set NPLC for ACI
- : CURRent:DC:NPLCycles <n> Set NPLC for DCI

Command Parameter:

- <n> = SLOW,FAST,PLAC4,PLAC5 Set the test speed and display digits

DEFault	SLOW
SLOW	Set the test speed as SLOW
FAST	Set the test speed as FAST
PLAC4	Set the display digits as 4 1/2
PLAC5	Set the display digits as 5 1/2

Query:
:NPLeCycles? Query the current test speed

Description:
The command is used for the basic measurement functions (except Frequency and Period) and test speed (display digits).

:RANGe Commands

:[UPPer] <n>

Command syntax:

: CURRent:AC:RANGe:[UPPer] <n>	Set measurement range for ACI
: CURRent:DC:RANGe:[UPPer] <n>	Set measurement range for DCI

Command Parameter:

<n> =	(1m,10m,100m01,10)	A	ACI
	(1m,10m,100m01,10)	A	DCI
DEFault		1mA (ACI, DCI)	
MINimum		1mA (All functions)	
MAXimum		10A	

Query:
:RANGe:[UPPer]? Query measurement range of the current functon.

Description:

This command is used to manually select the measurement range for the specified measurement function.

**:AUTO **

Command syntax:

: CURRent:AC:RANGe:AUTO 	Set auto range for ACI
: CURRent:DC:RANGe:AUTO 	Set auto range for DCI

Command parameter:

 =	1 or ON	Enable auto range
	0 or OFF	Disable auto range

Query:
:AUTO? Query auto range (ON or OFF)

Description:

These command are used to control auto ranging. With auto ranging enabled, the instrument automatically goes to the most sensitive range to perform the measurement.

The auto range command (:RANGe:AUTO) is coupled to the command that manually selects the measurement range (:RANGe <n>). When auto range is enabled, the parameter value for:RANGe <n> changes to the automatically selected range value. Thus, when auto range is disabled, the instrument remains at the automatically selected range. When a valid:RANGe <n> command is sent, auto ranging disables.

:REFerence <n> Commands

:REFerence <n>

Command syntax:

- : CURRent:AC:REFerence <n> Specify reference for ACI
- : CURRent:DC:REFerence <n> Specify reference for DCI

Command parameter:

- <n> = -20 to 20 Reference for DCI
- 0 to 20 Reference for ACI
- DEFault 0 (All measurement functions)
- MINimum Minimum value for specified function
- MAXimum Maximum value for specified function

Query:

- :REFerence? Query reference for relative function

Descripton:

These commands are used to establish a reference value for the specified function. When reference is enabled (:REFerence:STATe), the result will be the algebraic difference between the input signal and the reference value:

Reading = Input signal – Reference

From the front panel, reference is called relative (REL).

The:REFerence <n> command is coupled to the :ACQuire command. The last command sent (:REFerence <n> or :ACQuire) eestablishes the reference. When a reference is set using the:REFerence <n> command, the REFerence? Query command returns the programmed value. Conversely, when a reference is set using the:ACQuiry command, the :REFerence? Query command returns the acquired reference value.

**:STATe **

Command syntax:

- : CURRent:AC:REFerence:STATe Control reference for ACI

: CURRent:DC:REFeRence:STATe

Control reference for DCI

Command parameter:

 =	1 or ON	Enable reference
	0 or OFF	Disable reference

Query:

:STATe? Query state of reference.

Description:

These commands are used to enable or disable Reference for the specified function.

:ACQuire

Command syntax:

: CURRent:AC:REFeRence:ACQuire	Acquire reference for ACI
: CURRent:DC:REFeRence:ACQuire	Acquire reference for DCI

Description:

When one of these commands is sent, the measurement input signal is acquired and established as the reference value. This command is typically used to zero the display. For example, if the instrument is displaying a 10 μ A offset, sending this command and enabling Reference zeroes the display.

This command is functional only if the instrument is on the specified measurement function. Sending this command while in any other function causes an error. Also, if the latest reading is overflowed or a reading has not been triggered, an error occurs when this command is sent.

6.3.8 RESlister subsystem

The commands in this subsystem are used to configure and control resistance measurement function and are summarized in Table 6-8.

Table 6-8 RESlister Subsystem Commands Summary

Command	Function Description	Default
:RESistance	Path to configure resistance	
:NPLCycles <n>	Set the test speed and display digits	SLOW, PLAC5
:NPLCycles?	Query line cycle integration rate	
:RANGe	Path to configure measurement range	
[:UPPer] <n>	Select range (100,1k,10k,100k,1M,10M,100M)	100
[:UPPer]?	Query range	
:AUTO 	Enable or disable auto range	ON
:AUTO?	Query auto range	
:REFerence <n>	Specify reference (0 to 20e6)	0
:STATe 	Enable or disable reference	OFF
:STATe?	Query state of reference	
:ACQuire	Use input signal as reference	
:REFerence?	Query reference value	

: NPLCycles <n>

Command Syntac:

:RESistance:NPLCycles <n> Set the test speed and display digits for Ω

<n> =	SLOW,FAST,PLAC4,PLAC5	Set the test speed and display digits
	DEFault	SLOW
	SLOW	Set the test speed as SLOW
	FAST	Set the test speed as FAST
	PLAC4	Set the display digits as 4 1/2
	PLAC5	Set the display digits as 5 1/2

Query:

:NPLCycles? Query the current test speed

Description:

The command is used for the basic measurement functions (except Frequency and Period) and test speed (display digits).

:RANGe Commands

:[UPPer] <n>

Command syntax:

:RESistance:RANGe[:UPPer] <n> Set measurement range for Ω

Command Parameter:

<n> =	(100,1k,10k,100k,1M,10M,100M) Ω	Expected reading is ohms
DEFault	100 (Ω)	
MINimum	100	
MAXimum	100M	

Query:

:RANGe[:UPPer]? Query measurement range of the current function.

Description:

This command is used to manually select the measurement range for the specified measurement function.

**:AUTO **

Command syntax:

:RESistance:RANGe:AUTO Set auto range for Ω

Command parameter:

 =	1 or ON	Enable auto range
	0 or OFF	Disable auto range

Query:

:AUTO? Query auto range (ON or OFF)

Description:

These commands are used to control auto ranging. With auto ranging enabled, the instrument automatically goes to the most sensitive range to perform the measurement.

The auto range command (:RANGe:AUTO) is coupled to the command that manually selects the measurement range (:RANGe <n>). When auto range is enabled, the parameter value for:RANGe <n> changes to the automatically selected range value. Thus, when auto range is disabled, the instrument remains at the automatically selected range. When a valid:RANGe <n> command is sent, auto ranging disables.

:REFerence <n> Commands

:REFerence <n>

Command syntax:

:RESistance:REFerence <n>

Specify reference for Ω

Command parameter:

<n> =	0~10e6	Reference for Ω
	DEFault	0
	MINimum	Minimum value for specified function
	MAXimum	Maximum value for specified function

Query:

:REFerence? Query reference for relative function

Description:

These commands are used to establish a reference value for the specified function. When reference is enabled (**:REFerence:STATe**), the result will be the algebraic difference between the input signal and the reference value:

Reading = Input signal – Reference

From the front panel, reference is called relative (REL).

The **:REFerence <n>** command is coupled to the **:ACQuire** command. The last command sent (**:REFerence <n>** or **:ACQuire**) establishes the reference. When a reference is set using the **:REFerence <n>** command, the **REFerence?** Query command returns the programmed value. Conversely, when a reference is set using the **:ACQuiry** command, the **:REFerence?** Query command returns the acquired reference value.

**:STATe **

Command syntax:

**:RESistance:REFerence:STATe ** Control reference for Ω

Command parameter:

 =	1 or ON	Enable reference
	0 or OFF	Disable reference

Query:

:STATe? Query state of reference.

Description:

These commands are used to enable or disable Reference for the specified function.

:ACQuire

Command syntax:

:RESistance:REFerence:ACQuire Acquire reference for Ω

Description:

When one of these commands is sent, the measurement input signal is acquired and established as

the reference value. This command is typically used to zero the display. For example, if the instrument is displaying a 0.1Ω offset, sending this command and enabling Reference zeroes the display.

This command is functional only if the instrument is on the specified measurement function. Sending this command while in any other function causes an error. Also, if the latest reading is overflowed or a reading has not been triggered, an error occurs when this command is sent.

6.3.9 FREQuency and PERiod subsystem

The commands in this subsystem are used to configure and control frequency as well as period measurement function and are summarized in Table 6-9.

Table 6-9 FREQuency and PERiod Subsystem Commands Summary

Command	Function Description	Default
:FREQuency	Path to configure frequency	
:THReshold	Path to select the threshold voltage range:	
:VOLTagE	Set the measurement range of voltage	1
:RANGe <n>	Select threshold range (0.1,1,10,100,750)	
:RANGe?	Query threshold range	0
:REFerence <n>	Specify reference (0 to 1.0e6)	OFF
:STATe 	Enable or disable reference	
:STATe?	Query state of reference	
:ACQuire	Use input signal as reference	
:REFerence?	Query reference value	

:THReshold command

This command is used to set the range of frequency measurement.

:RANGe <n>

Command syntax:

- :FREQuency:THReshold:VOLTagE:RANGe <n> Set voltage threshold range.
- :PERiod:THReshold:VOLTagE:RANGe <n> Set voltage threshold range.

Command parameter:

- <n> = 0.1,1,10,100,750 Specify signal levels in volts (voltage threshold)

Query:

- :RANGe? Query maximum signal level.

Description:

These commands are used to specify the expected input level.

:REFeRence <n> Commands

:REFeRence <n>

Command syntax:

:FREQUency:REFeRence <n> Specify reference for FREQ

Command parameter:

<n> =	
0 to 1.0e6	Reference for FREQ
DEFault	0 (All measurement functions)
MINimum	Minimum value for specified function
MAXimum	Maximum value for specified function

Query:

:REFeRence? Query reference for relative function

Description:

These commands are used to establish a reference value for the specified function. When reference is enabled (:REFeRence:STATe), the result will be the algebraic difference between the input signal and the reference value:

Reading = Input signal – Reference

From the front panel, reference is called relative (REL).

The:REFeRence <n> command is coupled to the :ACQUire command. The last command sent (:REFeRence <n> or :ACQUire) establishes the reference. When a reference is set using the:REFeRence <n> command, the REFeRence? Query command returns the programmed value. Conversely, when a reference is set using the:ACQUire command, the :REFeRence? Query command returns the acquired reference value.

**:STATe **

Command syntax:

:FREQUency:REFeRence:STATe Control reference for FREQ

Command parameter:

 =	1 or ON	Enable reference
	0 or OFF	Disable reference

Query:

:STATe? Query state of reference.

Description:

These commands are used to enable or disable Reference for the specified function.

:ACQuire

Command syntax:

:FREQuency:REFerence:ACQuire

Acquire reference for FREQ

Description:

When one of these commands is sent, the measurement input signal is acquired and established as the reference value. This command is typically used to zero the display. For example, if the instrument is displaying a 10Hz offset, sending this command and enabling Reference zeroes the display.

This command is functional only if the instrument is on the specified measurement function. Sending this command while in any other function causes an error. Also, if the latest reading is overflowed or a reading has not been triggered, an error occurs when this command is sent.

6.3.10 CAPacitance subsystem

Command	Function Description	Default
:CAPacitance	Path to configure capacitance	
:RANGe	Path to configure measurement range	
[:UPPer] <n>	Range (1n,10n,100n,1u,10u,100u,1000u,10000u)	1n
[:UPPer]?	Query range	
:AUTO 	Enable or disable auto range	ON
:AUTO?	Query auto range	
:REFerence <n>	Specify reference (0~10000uF)	0
:STATe 	Enable or disable reference	OFF
:STATe?	Query state of reference	
:ACQuire	Use input signal as reference	
:REFerence?	Query reference value	

:RANGe Commands

:[UPPer] <n>

Command syntax:

:CAPacitance:RANGe[:UPPer] <n> Set measurement range for capacitance

Command Parameter:

<n> =	1n,10n,100n,1u,10u,100u,1000u,10000u)	Expected reading is F
	DEFault	1nF
	MINimum	1nF
	MAXimum	10000uF

Query:

:RANGe[:UPPer]? Query measurement range of the current function.

Description:

This command is used to manually select the measurement range for the specified measurement function.

**:AUTO **

Command syntax:

:CAPacitance:RANGe:AUTO Set auto range for capacitance

Command parameter:

 =	1 or ON	Enable auto range
	0 or OFF	Disable auto range

Query:

:AUTO? Query auto range (ON or OFF)

Description:

These commands are used to control auto ranging. With auto ranging enabled, the instrument automatically goes to the most sensitive range to perform the measurement.

The auto range command (:RANGe:AUTO) is coupled to the command that manually selects the measurement range (:RANGe <n>). When auto range is enabled, the parameter value for :RANGe <n> changes to the automatically selected range value. Thus, when auto range is disabled, the instrument remains at the automatically selected range. When a valid :RANGe <n> command is sent, auto ranging disables.

:REFerence <n> Commands

:REFerence <n>

Command syntax:

:CAPacitance:REFerence <n> Specify reference for capacitance

Command parameter:

<n> =	0~10000uF	Reference for capacitance
	DEFault	0
	MINimum	Minimum value for specified function
	MAXimum	Maximum value for specified function

Query:

:REFerence? Query reference for relative function

Description:

These commands are used to establish a reference value for the specified function. When reference is enabled (**:REFerence:STATe**), the result will be the algebraic difference between the input signal and the reference value:

Reading = Input signal – Reference

From the front panel, reference is called relative (REL).

The **:REFerence <n>** command is coupled to the **:ACQuire** command. The last command sent (**:REFerence <n>** or **:ACQuire**) establishes the reference. When a reference is set using the **:REFerence <n>** command, the **REFerence?** Query command returns the programmed value. Conversely, when a reference is set using the **:ACQuiry** command, the **:REFerence?** Query command returns the acquired reference value.

**:STATe **

Command syntax:

**:CAPacitance:REFerence:STATe ** Control reference for Ω

Command parameter:

 =	1 or ON	Enable reference
	0 or OFF	Disable reference

Query:

:STATe? Query state of reference.

Description:

These commands are used to enable or disable Reference for the specified function.

:ACQuire

Command syntax:

:CAPacitance:REFerence:ACQuire Acquire reference for capacitance

Description:

When one of these commands is sent, the measurement input signal is acquired and established as

the reference value. This command is typically used to zero the display. For example, if the instrument is displaying a 0.1Ω offset, sending this command and enabling Reference zeroes the display.

This command is functional only if the instrument is on the specified measurement function. Sending this command while in any other function causes an error. Also, if the latest reading is overflowed or a reading has not been triggered, an error occurs when this command is sent

6.3.11 HOLD subsystem

The commands in this subsystem are used to configure and control hold measurement function and are summarized in Table 6-11.

Table 6-11 HOLD Subsystem Commands Summary

Command	Function Description	Default
:HOLD	Path to control Hold feature:	
:WINDow <NRf>	Set Hold window(%); 0.01 to 10	1
:WINDow?	Query Hold window	
:COUNT <NRf>	Set Hold count; 2 to 100	10
:COUNT?	Query HOLD count	
:STATe <NRf>	Enable or disable HOLD	OFF
:STATe?	Query state of HOLD	

:HOLD Command

The following commands are used to configure and control the HOLD feature.

:WINDow <NRf>

Command syntax:

:HOLD:WINDow <NRf>

Command Parameter:

<NRf> = 0.01 to 10 Set window (percent)

Query:

:WINDow? Query Hold window

Description:

This command is used to set the window for HOLD. This window is expressed as a percent of the “seed” reading for the Hold process.

:COUNT <NRf>

Command syntax:

:HOLD:COUNT <NRf>

Command Parameter:

<NRf> = 2 to 100 Specify HOLD count

Query:
 :COUNT? Query HOLD count.

Descripton:
 This command is used to specify the count for HOLD. COUNT is the number of readings that are compared to the “seed” reading during the HOLD process.

**:STATe **
 Command syntax:
 :HOLD:STATe

Command Parameter:
 = 0 or OFF Disable HOLD
 1 or ON Enable HOLD

Query:
 :STATe? Query state of HOLD

Description:
 This command is used to enable or disable HOLD.

6.3.12 TRIGger subsystem

These commands in this subsystem are used to configure and control trigger measurement function and are summarized in Table 6-12.

Table 6-12 TRIGger Subsystem Commands Summary

Command	Function Description	Default
:TRIGger		
:SOURce <name>	Select control source	IMMEDIATE
:SOURce?	Query control source	0

:TRIGger

TRIGger subsystem commands are used for the instrument settings of trigger mode, trigger delay and trigger a measurement.

:SOURce <name>
 Command Syntax:
 TRIGger:SOURce <name>

Command parameter:
 <name> = IMMEDIATE instrument default setting is internal trigger
 BUS Triggered via RS232 interface
 MANual Press **Trig** in the front panel for Trigger

EXT

Triggered by Handler inetreface

Query:

:SOURce?

Query control source

Description:

These are used to select the event control source.

6.3.13 FETCh Subsystem

FETCh? Command

Command syntax:

:FETCh?

Description:

This query command is used to obtain the latest post-processed reading. This command does not affect the configuration of the instrument.

This command does not trigger a measurement. The command simply requests the last available reading. This command continues to return the same old reading, until there is a new reading.

This command will be automatically asserted when :READ? or :MEASure? command is sent.

6.3.14 SPEED Subsystem

:SPEED < >

ON: set the speed as FAST

OFF: Set the speed as SLOW

PLAC4: set the digit display as $4\frac{1}{2}$

PLAC5: set the digit display as $5\frac{1}{2}$

This query command is used to query the current speed. The result is:

1: FAST

0: SLOW

Function: set the measurement speed.

Instruction: the measurement speed is set as:

$4\frac{1}{2}$ +FAST = FAST

$4\frac{1}{2}$ +SLOW= $5\frac{1}{2}$ +FAST = Medium

$5\frac{1}{2}$ +SLOW = SLOW

6.3.15 RETURN Subsystem

:RETURN < >

ON set the return function as ON

OFF set the return function as OFF

Function: Set the bus command response function as ON/OFF.

Instruction: when verifying the return function, only sending one command without return data can confirm whether the function is ON.

6.3.16 Common Commands

Common commands can be used to all equipments. We provide some common commands as below:

***RST**

Command Syntax:

*RST

Description:

Reset the instrument

***TRG**

Command Syntax:

*TRG

Description:

Trigger the instrument for measurement

***IDN?**

Query Syntax:

*IDN?

Query return:

<product>,<version><LF^END>

Here:

<product> TH1952 Digital Multimeter

<version> Ver1.0

Description:

Query information returned to instrument.

