

TH2690 Series

fA meter / pA meter / Electrometer / High Resistance Meter Data Manual



Website



Youtube Channel

<https://en.tonghui.com.cn>

CHANGZHOU TONGHUI ELECTRONIC CO.,LTD.

TH2690 Series

fA meter / pA meter / Electrometer / High Resistance Meter

Current range: 2pA-20mA
Current resolution: 0.01fA

Built-in voltage source:
 $\pm 1000\text{V}/1500\text{V}/3000\text{V}$

Measured resistance:
 $3\text{E}\Omega$ ($10^{18}\Omega$)



- | | | | |
|--|--|---|--|
| 1
TH2690
0.1fA-20mA
100P Ω
1 μ V-20V | 2
TH2690A
10fA-20mA
1P Ω
1 μ V-20V | 3
TH2690H
0.01fA-20mA
1000P Ω
1 μ V-20V | 4
TH2691
0.1fA-20mA |
| 5
TH2691A
10fA-20mA | 6
TH2691H
0.01fA-20mA | 7
TH2695
0.01fA-20mA
3000P Ω
30mV-3000V | 8
TH2695A
0.01fA-20mA
1500P Ω
15mV-1500V |

R

$3\text{E}\Omega$ ($10^{18}\Omega$)
Measure resistance

6.5

6 1/2-digit
Measurement resolution

V

Built-in voltage sources of
 $\pm 20\text{V}$, 1500V and 3000V ,
with a voltage resolution of
1mV

I

2pA-20mA
Current range



0.01fA (10^{-17}A)
Current resolution



5.0-inch capacitive
touchscreen

Q

2nC Charge
measurement



Temperature and
humidity measurement



Supports data
logging



Shielded test box
optional

Application

| Material characteristic testing

Semiconductors, nanomaterials, polymer materials, dielectric materials, electrochemical materials, ferroelectric materials, graphene, ceramics, biological materials, rubber, thin films, metals, organic materials, etc.



Nanomaterials

Nanomaterial testing

| Leakage current and insulation resistance testing of electronic components

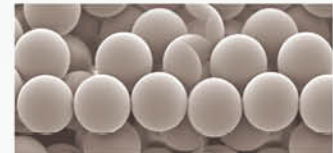
Capacitors, resistors, diodes, transistors, sensors, types such as TFT (Thin Film Transistor) and CNT (Carbon Nanotube), optoelectronic devices, nano-devices, solar cells, switches, relays, etc.



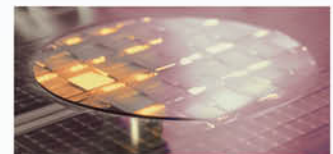
Leakage resistance testing

| Electronic/non-electronic systems

Ion beams, electron beams, sensing systems, particle measurement, embedded precision instruments, etc.



| Measurement of the I-V (current-voltage) characteristics of semiconductors and other devices



| Volume resistance/surface resistivity measurement



Surface resistance testing

Model comparison

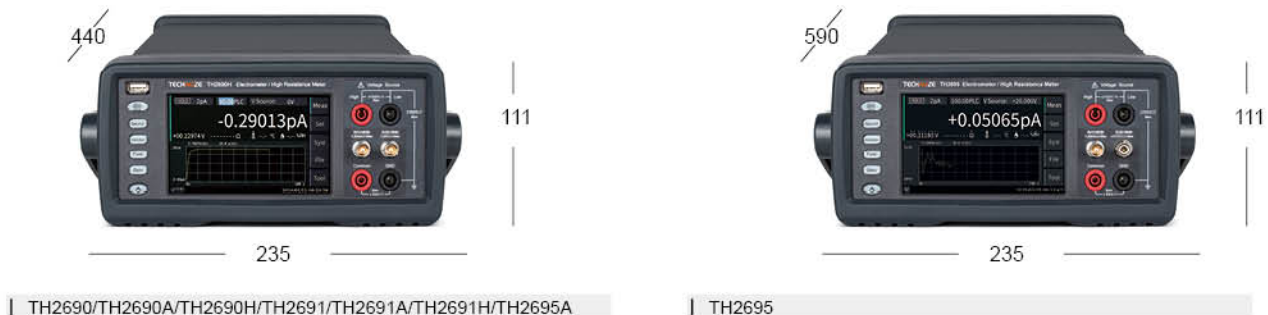
			
			
TH2690	TH2690A	TH2690H	TH2691
6 ½ -digit Measurement resolution	6 ½ -digit Measurement resolution	6 ½ -digit Measurement resolution	6 ½ -digit Measurement resolution
Current range: 0.1fA -20mA	Current range: 10fA -20mA	Current range: 0.01fA -20mA	Current range: 0.1fA -20mA
High resistance meter, voltmeter, ammeter, electrometer	High resistance meter, voltmeter, ammeter	High resistance meter, voltmeter, ammeter, electrometer	Ammeter
Resistance measurement: 100PΩ	Resistance measurement: 1PΩ	Resistance measurement: 1000PΩ	Resistance measurement: None
Voltage measurement: 1μV - 20V	Voltage measurement: 1μV - 20V	Voltage measurement: 1μV - 20V	Voltage measurement: None
Voltage source: ±1000V	Voltage source: ±1000V	Voltage source: ±1000V	Voltage source: None
Charge measurement: 1fC-2μC	Charge measurement: None	Charge measurement: 1fC-2μC	Charge measurement: None
T&H measurement	T&H measurement	T&H measurement	T&H measurement: None

			
			
TH2691A	TH2691H	TH2695	TH2695A
6 ½ -digit Measurement resolution	6 ½ -digit Measurement resolution	6 ½ -digit Measurement resolution	6 ½ -digit Measurement resolution
Current range: 10fA -20mA	Current range: 0.01fA -20mA	Current range: 0.01fA -20mA	Current range: 0.01fA -20mA
Ammeter	Ammeter	High resistance meter, voltmeter, ammeter, electrometer	High resistance meter, voltmeter, ammeter, electrometer
Resistance measurement: None	Resistance measurement: None	Resistance measurement: 3000PΩ	Resistance measurement: 1500PΩ
Voltage measurement: None	Voltage measurement: None	Voltage measurement: 30mV - 3000V	Voltage measurement: 15mV - 1500V
Voltage source: None	Voltage source: None	Voltage source: ±3000V	Voltage source: ±1500V
Charge measurement: None	Charge measurement: None	Charge measurement: 1fC-2μC	Charge measurement: 1fC-2μC
T&H measurement: None	T&H measurement: None	T&H measurement	T&H measurement

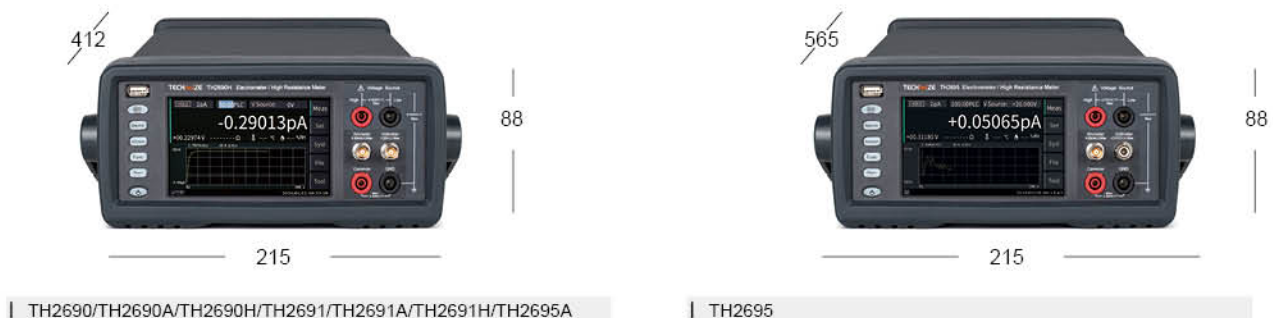
Dimensions and interfaces

01 Instrument dimensions

External shape and volume



Volume for rack-mounting



unit:mm

02 Explanation of the front and rear panels of the instrument

I. Basic Instructions for the Front Panel

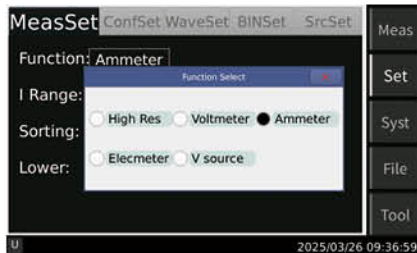


II. Basic Instructions for the Rear Panel

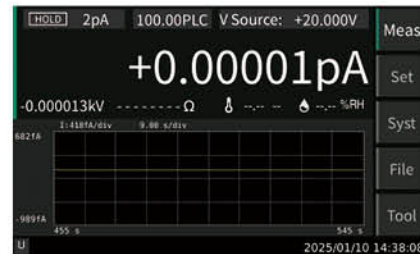


Functional features

01 Multiple function selections



02 A current measurement resolution of 0.01 fA



Multiple function selections

- 1 High Resistance Meter
- 2 Ammeter
- 3 Voltmeter
- 4 Electrostatic Meter
- 5 Voltage Source

When studying the characteristics of materials or determining the performance of devices, it is often necessary to measure extreme currents and resistances such as fA/EΩ. However, traditional digital multimeters (DMM) cannot meet these requirements. The TH2690 series femtoammeter/electrometer provides an industry-leading current measurement resolution of 0.01 fA and a resistance measurement of 3EΩ, which perfectly realizes material measurement and can meet current and future measurement needs.

03 A data reading rate of 5000 readings per second

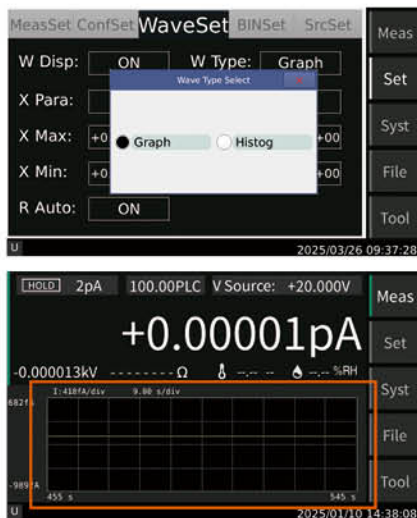
The measurement speed is generally determined by the integration period in the integration settings, and the integration period is usually an integer multiple of the power frequency period (PLC). On the premise that it can provide an adequate number of averaging times to avoid the impact of power frequency noise on the measurement, obviously, the shorter the integration period, the better.

Due to the relatively slow reading rate of traditional instruments, they are unable to capture fast transient signals. The data reading rate of the TH2690 series can reach up to 5000 readings per second. Coupled with the waveform function, it can capture the more delicate response of the device under test.

04 Waveform display of the test results

1. Curve graph (time base view) display

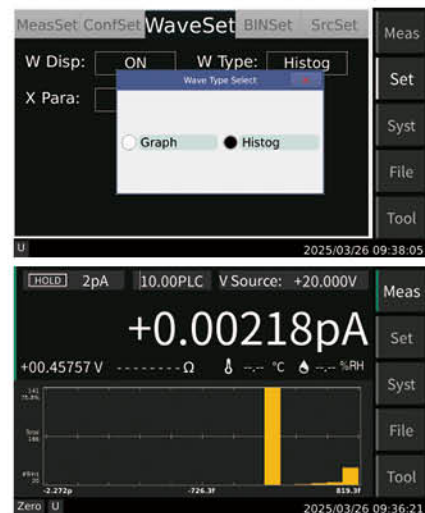
The TH2690 series can conveniently plot various curve graphs, including I-t, V-t, R-t, Q-t, and I-R graphs (specific graph display functions depend on the product model used). When conducting sensitive measurements, this powerful and comprehensive graph display capability makes it easier for you to obtain valuable data.



2. Histogram display

There are always certain noise fluctuations in any measurement environment, so low-level measurement data will inevitably carry a certain degree of statistical uncertainty. The traditional approach is to draw a histogram after the measurement is completed to evaluate the measurement data (usually on a computer). However, if you need to perform multiple measurement and test setting debugging cycles, this process can become very lengthy.

The TH2690 series features a real-time, auto-scaling histogram display function, allowing you to debug measurement settings promptly without the need for post-measurement data processing. The histogram is displayed below the measurement data, making it convenient for you to compare the accumulated data on the histogram with the real-time measurement data.



05 Waveform output of the voltage source

The TH2690 series allows you to set the output of single-step waves, double-step waves, square waves, and custom list outputs. Click the "Settings - Source Settings" tab to make the settings. The setting interfaces are as follows:



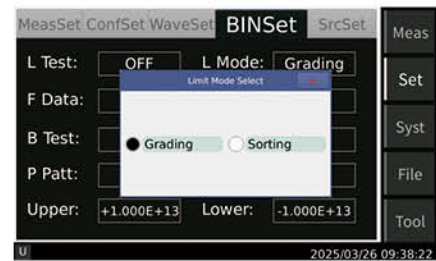
Among them, the square wave mode supports pulse output. The minimum pulse width that can be set is 10 ms, and the pulse width setting resolution is 1 ms.

06 Sorting function

The TH2690 series can judge and sort the test results. There are two modes available: Grading and Sorting, and a maximum of seven judgment conditions can be set. The setting interface is shown in the right figure:

In the Grading mode, limit judgments are carried out until a failure is encountered, and the current failed position is output. Otherwise, the next limit judgment is continued. If all are qualified, the last qualified position is output.

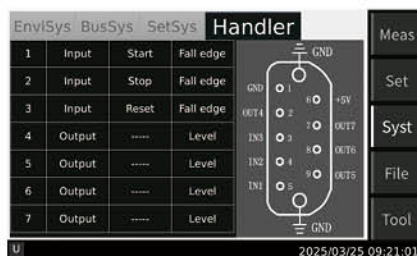
In the Sorting mode, limit judgments are carried out until a pass is encountered, and the current passed position is output. Otherwise, the next limit judgment is continued. If all fail, the last failed position is output.



07 HANDLER interface definition

Pins 1, 2, and 3 are signal input pins, corresponding to IN1, IN2, and IN3 in the above diagram. The signal definitions can be changed.

Pins 4, 5, 6, and 7 are signal output pins, corresponding to OUT4, OUT5, OUT6, and OUT7 in the above diagram. The signal output modes can be changed.



08 Error message

When there are issues such as operational errors or self-check failures in the instrument, an error message will appear in the information bar at the bottom of the instrument. Click on the "Tools - Error Information" icon. You can view the alarm information here and eliminate the error according to the prompts.



09 The dedicated temperature and humidity probe provides more reliable temperature and humidity data

Temperature and humidity are key parameters in high-value resistance measurement. The TH2690 series high-resistance meter provides an interface for temperature and humidity sensors and is equipped with a dedicated temperature and humidity probe. The digital temperature and humidity probe can be used to measure temperature and humidity, offering more accurate temperature data than thermocouples.

10 A variety of accessories are available to handle different test environments and devices under test

The TH2690 series is equipped with a variety of optional accessories to adapt to different devices under test and further enhance its testing performance. The main accessories include a resistivity test box and component test fixtures.

The resistivity test box is equipped with electrodes of various sizes, which can be used to measure the surface resistivity and volume resistivity of materials with different specifications.

The component test fixtures are equipped with a variety of test modules to handle the measurement of components with various packages, such as surface-mount devices and axial-lead devices.

Standard accessories



TH2690_THS Temperature and humidity sensor
(TH2691/TH2691A none)



TH26017
USB interface cable



TH26058C
φ4 jack short-circuit plug
(TH2695/TH2695A none)



TH26058D
Connecting cable



TH26058F
φ4 alligator clip
(one red and one black)



TH26058G
φ4 anti-electricity lantern plug cable(Double-ended cable, one red and one black)



TH26058H
Triaxial coaxial open-circuit cap



TH26058R
Connecting cable
(TH2691/TH2691A/
TH2695/TH2695A none)



TH26058S
High-voltage BNC to alligator clip RF test cable
(Only for TH2695/TH2695A)

Optional accessories



TH26090
Resistivity testing fixture



TH26058B
Triaxial coaxial to alligator clip cable (1.5m)



TH26058E
φ4 lantern test pen
(one red and one black)



TH26058J
φ4 binding post
(one red and one black)



TH26076B
Shielding box



TH26058K
BNC male to TRB female adapter (Three models E1, E2, and E3 are available for selection)



TH26058N
TRB female to TRB female adapter



TH26058P
Triaxial BNC socket



TH26058Q
Triaxial coaxial cable

11 Resistivity measurement (Optional accessory)

The TH2690 series can be optionally equipped with the TH26090 accessory for resistivity measurement.。

1) Solution configuration

Serial number	Model	Name	Mandatory Option	Remarks
1	TH2690	Picoammeter/Electrometer/High Resistance Meter Main Unit	☒	
2	TH26090	Resistivity Testing Box	☒	Option
3	Remarks	Upgrade the firmware of TH2690 to the latest version		

2) TH26090 Resistivity Testing Box



Function	Instruction
Test voltage	0-±1000V
Test electrode	Φ26mm、Φ38mm、Φ50mm (standard configuration) are available, with a total of 3 options.
Test current	0-10mA
Contact pressure	≤10kg
Measurement parameter	Surface resistance Rs, Surface resistivity ps, Volume resistance Rv, Volume resistivity pv

3) Measurement of volume resistance R_v and volume resistivity ρ_v

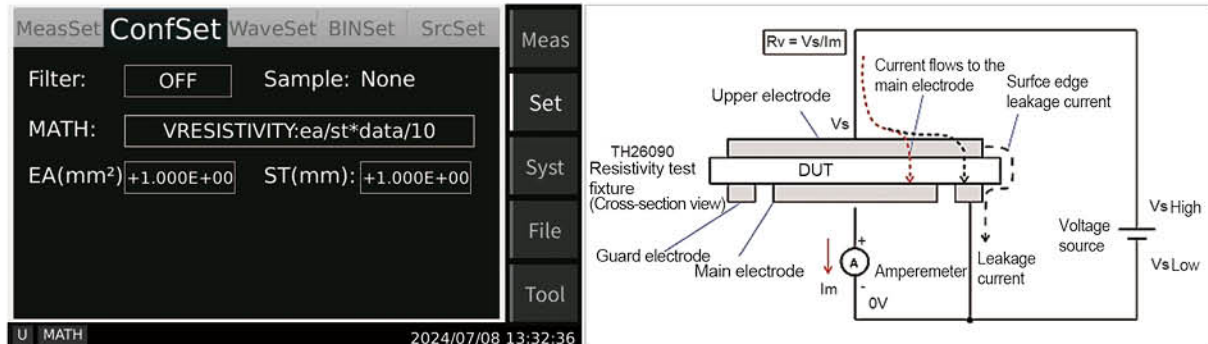
Apply the voltage source V_s to the upper electrode, and specify the large current flowing through the test sample as I_m . Subsequently, the volume resistance R_v is calculated using the formula $R_v = V_s/I_m$.

Both the large current flowing from the test sample to the guard electrode and the surface current flowing from the upper electrode to the guard electrode are leakage currents. However, these currents will all enter the low side of V_s and will not affect the magnitude of the ammeter current (I_m) used for calculating R_v .

The volume resistivity ρ_v can be calculated using the formula $\rho_v = EAR/STH \times R_v$, where:

EAR = Effective area

STH = Sample thickness.



4) Measurement of surface resistance R_s and surface resistivity ρ_s

Apply the voltage source V_s to the guard ring electrode. On the surface of the test sample, the current flows from the guard electrode to the main electrode, and the surface current is designated as I_m .

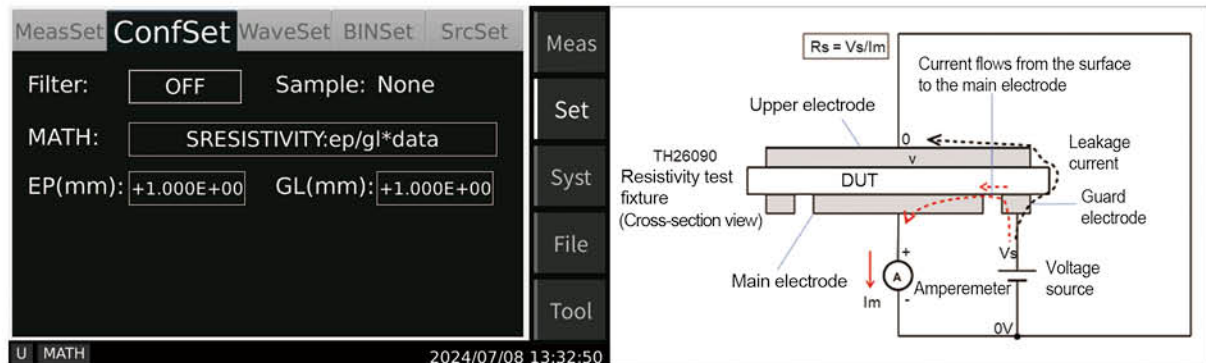
The surface resistance R_s can be calculated using the formula $R_s = V_s/I_m$.

The current flowing from the guard ring to the upper electrode is a leakage current. However, this current will flow into the low side of V_s and will not affect the magnitude of the ammeter current (I_m) used for calculating R_s .

The surface resistivity ρ_s can be calculated using the formula $\rho_s = EPER/GLEN \times R_s$, where:

EPER = Effective perimeter

GLEN = Gap length



Technical parameters

Display			
Display device	5.0-inch capacitive touch color LCD display, 6½-digit Measurement resolution		
Current measurement			
Range	Accuracy	Resolution	Remarks
2pA	±(1%+3fA)	0.01fA	It is applicable to TH2695 / TH2695A / TH2690H / TH2691H.
20pA	±(0.5%+3fA)	0.1fA	It is applicable to TH2695 / TH2695A / TH2690 / TH2690H / TH2691 / TH2691H.
200pA	±(0.5%+5fA)	0.1fA	It is applicable to TH2695 / TH2695A / TH2690 / TH2690H / TH2691 / TH2691H.
2nA	±(0.2%+50fA)	1fA	It is applicable to all models.
20nA	±(0.2%+3pA)	10fA	It is applicable to all models.
200nA	±(0.2%+5pA)	100fA	It is applicable to all models.
2μA	±(0.1%+50pA)	1pA	It is applicable to all models.
20μA	±(0.05%+500pA)	10pA	It is applicable to all models.
200μA	±(0.05%+5nA)	100pA	It is applicable to all models.
2mA	±(0.05%+50nA)	1nA	It is applicable to all models.
20mA	±(0.05%+500nA)	10nA	It is applicable to all models.
Resistance measurement			
Range	Accuracy	Resolution	Remarks
1MΩ	±(0.135%+1Ω)	1Ω	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
10MΩ	±(0.135%+10Ω)	10Ω	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
100MΩ	±(0.185%+100Ω)	100Ω	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
1GΩ	±(0.285%+1kΩ)	1kΩ	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
10GΩ	±(0.41%+10kΩ)	10kΩ	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
100GΩ	±(0.41%+100kΩ)	100kΩ	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
1TΩ	±(0.45%+1MΩ)	1MΩ	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
10TΩ	±(0.75%+10MΩ)	10MΩ	It is applicable to TH2695 / TH2695A / TH2690 / TH2690H .
100TΩ	±(2.6%+100MΩ)	100MΩ	It is applicable to TH2695 / TH2695A / TH2690 / TH2690H .
Range	Current range	Voltage source	Remarks
1MΩ	200μA	20V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
10MΩ	20μA	20V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
100MΩ	2μA	20V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
1GΩ	200nA	20V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
10GΩ	20nA	20V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
100GΩ	2nA	20V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
1TΩ	2nA	200V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
10TΩ	200pA	200V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690H .
100TΩ	20pA	200V	It is applicable to TH2695 / TH2695A / TH2690 / TH2690H .
Max.measurable resistance	3000PΩ(10 ⁻⁹)		It is applicable to TH2695.
	1500PΩ(10 ⁻⁸)		It is applicable to TH2695A.
	100PΩ		It is applicable to TH2690.
	1000TΩ		It is applicable to TH2690A.
	1000PΩ		It is applicable to TH2690H.
Voltage measurement (independent input unit)			
Range	Accuracy±(%+ error)	Resolution	Remarks
2V	±(0.05%+40μV)	1μV	It is applicable to TH2690 / TH2690A / TH2690H .
20V	±(0.05%+400μV)	10μV	It is applicable to TH2690 / TH2690A / TH2690H .
150V	±(0.05%+300μV)	100μV	It is applicable to TH2695A.
300V	±(0.05%+600μV)	100μV	It is applicable to TH2695.
1500V	±(0.05%+300μV)	1mV	It is applicable to TH2695A.
3000V	±(0.05%+6mV)	1mV	It is applicable to TH2695.
Input impedance	>200TΩ		It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
Charge measurement (The indicators are valid within 1 second)			
Range	Accuracy	Resolution	Remarks
2nC	±(0.5%+50fC)	1fC	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
20nC	±(0.5%+500fC)	10fC	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H .
200nC	±(0.5%+5pC)	100fC	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H.
2μC	±(0.5%+50pC)	1pC	It is applicable to TH2695 / TH2695A / TH2690 / TH2690A / TH2690H.

Voltage source				
Range	Accuracy±(%+ error)	Resolution	Maximum output current	Remarks
20V	±(0.05%+2mV)	1mV	±20mA	It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
40V	±(0.05%+4mV)	1mV	±20mA	It is applicable to TH2695.
200V	±(0.05%+20mV)	1mV	±10mA	It is applicable to TH2695A .
400V	±(0.05%+40mV)	1mV	±10mA	It is applicable to TH2695.
1000V	±(0.05%+100mV)	1mV	±1mA	It is applicable to TH2690 / TH2690A / TH2690H .
1500V	±(0.05%+150mV)	1mV	±10mA	It is applicable to TH2695A .
3000V	±(0.05%+300mV)	1mV	±10mA	It is applicable to TH2695
Function of the voltage source	Direct current, scanning (single scan, double scan, list scan), ARB (square wave)			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
Temperature measurement range and accuracy				
-40℃-10℃	1℃			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
10℃-55℃	0.5℃			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
55℃-80℃	1℃			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
Humidity measurement range and accuracy				
0-20%RH	4%			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
20-80%RH	3%			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
80-100%RH	4%			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
View mode	Meter view, Graph view, Histogram, Scroll view			
Test terminal				
Voltage input	Triaxial BNC (For TH2695/TH2695A, it is high-voltage BNC)			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
Current input	Triaxial BNC			It is applicable to all models.
Voltage output	√			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
COMMON	√			It is applicable to all models.
GROUND	Banana jack			It is applicable to all models.
interface				
D/A output	±2VFS			It is applicable to all models.
HANDLER	√			It is applicable to all models.
Communication interface	RS232、USB DEVICE、USB HOST、LAN			It is applicable to all models.
Sensor input	Temperature and humidity			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
Interlock input	√			It is applicable to TH2695A / TH2690 / TH2690A / TH2690H .
Ambient temperature and humidity				
Operating temperature and humidity range	0℃-45℃, 30%-80%, Without condensation			
Storage temperature and humidity range	-20℃-60℃, 10%-90%, Without condensation			
Temperature and humidity for ensuring accuracy	23℃±5℃, 30%-80%RH			
Warm-up time	1 hour			
Ambient temperature change	Less than ±3℃ after self-calibration			
Calibration period	1 year			
General specifications				
Power supply	AC: 90V-264V/50/60Hz; or DC: 127V-370V			
Power	60W			
Mounting dimensions	215(W)×88(H)×480(D)			It is applicable to TH2695.
	215(W)×88(H)×335(D)			It is applicable to all models except TH2695.
Overall dimensions	235(W)×111(H)×590(D)			It is applicable to TH2695.
	235(W)×111(H)×440(D)			It is applicable to all models except TH2695.
Weight	5.5kg			It is applicable to TH2695.
	4kg			It is applicable to TH2695A.
	3.5kg			It is applicable to all models except TH2695 and TH2695A.

Company Highlights

- Established in 1994 with a registered capital of 163 million CNY
- National High-Tech Enterprise
- National-level specialized and innovative "Little Giant" enterprise
- China's leading company in electronic component measuring instruments
- The 1st batch listed on BSE
- 300 employees, of which 28% R&D personnel. Annual R&D investment accounts for more than 18%.
- The factory at No. 1, Xinzhu Road covers an area of 30,000m² and has a construction area of 30,000m²



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Operation Video