TECHMIZE by TONGHUI

OM

OPERATION MANUAL

TH269X Series

Femtoammeters / Picoammeters / Electrometers / High-Resistance Meters — TH2690, TH2690A, TH2690H, TH2691, TH2691A, TH2691H, TH2695, TH2695A. Covers front-panel operation, measurement setup and system configuration for all eight models; see the companion *TH269X Series SCPI & MODBUS Command Reference* for the full remote-command set.

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TH269X Series Operation Manual

Femtoammeters / Picoammeters / Electrometers / High-Resistance Meters

This manual is the English-language Operation Manual for all eight TH269X series models: **TH2690, TH2690A, TH2690H, TH2691, TH2691A, TH2691H, TH2695, TH2695A**. It applies to instruments of these eight models with the current firmware and hardware. Remote-control commands (SCPI and MODBUS) are documented separately in the companion *TH269X Series SCPI & MODBUS Command Reference*.

Where this manual refers to "the instrument" or "TH269X" without naming a specific model, the statement applies to all eight models. Differences between models are called out explicitly, most often as a resolution figure (0.1 fA / 1 fA / 0.01 fA), a function group (R/V/I/Q vs. I only), or a voltage-source/voltage-measurement tier (±1000 V vs. ±3000 V vs. ±1500 V). See §1.3 for the full model comparison table.

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CHAPTER 1

Overview

1.1 About this manual

The TH269X series is a family of eight 6½-digit bench instruments built around a common femtoamp-class measurement platform: femtoammeters/picoammeters, electrometers (charge meters) and high-resistance meters, each also offering a built-in high-voltage source and voltmeter where the model supports it. This manual covers front-panel operation for all eight models; the full SCPI and MODBUS remote-command set is documented in the companion *TH269X Series SCPI & MODBUS Command Reference*.

Where a function, terminal or menu item applies to only some of the eight models, this is stated next to it — usually as "for TH2690/TH2690A/TH2690H" or similar. Where nothing is said, the description applies to all eight models.

1.2 Inspecting the shipment

This instrument has been thoroughly tested and inspected to meet published specifications before shipment. On receipt, inspect the unit for any obvious shipping damage, and verify that the delivery matches your order (model, accessories, options). If anything appears to be missing or damaged, contact Techmize or your authorized distributor before using the instrument (see Chapter 8).

1.3 The eight models compared

All eight models share a 5.0" capacitive-touch colour LCD, 6½-digit measurement resolution and live graph/histogram waveform views. They differ in the function set fitted (high-resistance meter / voltmeter / ammeter / electrometer, or ammeter only), the minimum current range and resolution, and — for the models with a built-in voltage source — its maximum output and the paired voltmeter's maximum input. The values below are the same as in Chapter 7.

Model	TH2690	TH2690A	TH2690H	TH2691	TH2691A	TH2691H	TH2695	TH2695A
Functions	R/V/I/Q	R/V/I	R/V/I/Q	I	I	I	R/V/I/Q	R/V/I/Q
Current range	20 pA–20 mA	2 nA–20 mA	2 pA–20 mA	20 pA–20 mA	2 nA–20 mA	2 pA–20 mA	2 pA–20 mA	2 pA–20 mA
Current resolution	0.1 fA	1 fA	0.01 fA	0.1 fA	1 fA	0.01 fA	0.01 fA	0.01 fA
Max. resistance	100 PΩ	1 PΩ	1000 PΩ	—	—	—	3000 PΩ	1500 PΩ
Voltage source	±1000 V	±1000 V	±1000 V	—	—	—	±3000 V	±1500 V
Voltage measurement	2 V / 20 V	2 V / 20 V	2 V / 20 V	—	—	—	300 V / 3000 V	150 V / 1500 V
Charge measurement	2 nC–2 µC	—	2 nC–2 µC	—	—	—	2 nC–2 µC	2 nC–2 µC
Temp./humidity input	✓	✓	✓	—	—	—	✓	✓

R = high-resistance meter · V = voltmeter · I = ammeter · Q = electrometer (charge). A dash (—) means the function is not fitted. **TH2691/A/H** are ammeter-only models and do not fit a voltage source, voltmeter, electrometer or temperature/humidity input. **TH2690H** and **TH2691H** extend the minimum current range to 2 pA with 0.01 fA resolution; **TH2690A** and **TH2691A** have a 2 nA minimum range with 1 fA resolution. **TH2695/TH2695A** have the same four functions as TH2690/TH2690H at a higher voltage-source and voltage-measurement tier (±3000 V / ±1500 V).

"Max. resistance" is the maximum measurable resistance of the model; the highest selectable resistance range is listed in §7.1. A dedicated TH2690_THS temperature & humidity probe is a standard accessory on every model except TH2691/A/H.

1.4 Operating conditions

Item	Rating
Power supply	AC 90–264 V, 50/60 Hz, or DC 127–370 V · ≤60 VA
Normal operating environment	0–45 °C, 30–80% RH, no condensation
Accuracy-rated (reference) environment	23 °C ± 5 °C, 30–80% RH

Storage environment	−20–60 °C, 10–90% RH, no condensation
Warm-up	≥60 minutes before relying on rated accuracy
Calibration cycle	1 year

1.5 Checking operation

After unpacking and connecting the power cable, press the front-panel power switch. The switch lights green and a splash screen shows the model and firmware version while the instrument loads, then the display opens on the measurement Home screen (§4.1). Confirm that the model name shown matches the unit you ordered, and that no error indicator is active.

The instrument supports an auto-startup function that can recover its prior state after an unexpected power loss and reconnection.

1.6 Checking for errors

If the instrument reports an error during self-test or operation, open Set → Tool → Error (§4.12) to read the active error code, and see the error code table there for its meaning. Clear an outstanding error before relying on a measurement, and contact Techmize or your authorized distributor if an error recurs (Chapter 8).

> **NOTE**
>
> Techmize continually improves the performance, features and construction of its instruments; content, specifications and accessories described here are subject to change without notice.

CHAPTER 2

Points for Notice

This chapter applies to all eight TH269X models. Several precautions concern the built-in voltage source and are therefore most relevant to TH2690/A/H and TH2695/A; where a precaution does not apply to the ammeter-only TH2691/A/H, this is stated.

2.1 Safety symbols used in this manual

Symbol / word	Meaning
WARNING	A hazard that, if not avoided, could result in personal injury or death.
CAUTION	A hazard that, if not avoided, could damage the instrument or the device under test, or invalidate a measurement.
NOTE	Supplementary information that helps with correct or efficient use.

2.2 Power supply and measurement safety

WARNING — ELECTRIC SHOCK

The instrument is a Protection Class I device: protective earthing of the chassis, via the power cord or the rear-panel ground terminal, is essential to safety and must not be defeated. Always use a supply outlet with a protective earth contact, and never operate the instrument with the protective ground disconnected.

Before switching on, confirm the AC supply matches the rating in §1.4 (90–264 V AC, 50/60 Hz) or connect the DC supply option (127–370 V DC) as applicable. Keep the side and rear ventilation openings clear. Do not operate the instrument in an explosive atmosphere or in the presence of flammable gases or fumes.

WARNING — HIGH-VOLTAGE OUTPUT (TH2690/A/H, TH2695/A)

On the models fitted with a voltage source, the High and Low terminals of the Voltage Source can present a hazardous potential — up to ±1000 V on TH2690/TH2690A/TH2690H, up to ±3000 V on TH2695, and up to ±1500 V on TH2695A — whenever the voltage source is enabled and the interlock circuit is closed. Discharge any charged or capacitive device under test before connecting it to the input terminals. Never touch the measurement circuit while a floating measurement or a high-voltage source output is in progress. TH2691/A/H do not fit a voltage source and are not subject to this warning.

2.3 Protection limits

Test	Requirement
Insulation resistance	≥ 50 MΩ under normal reference conditions; ≥ 2 MΩ under high-humidity transport conditions
Dielectric strength	Withstands 2.1 kV DC for 1 minute, with no breakdown or flashover
Leakage current	≤ 3.5 mA

2.4 Voltage source terminals and the Common terminal (TH2690/A/H, TH2695/A)

The front-panel Voltage Source High and Low terminals can output a DC voltage up to the model's rated maximum (§1.3), under control of the front-panel **Source** key. The Low terminal can be set to connect to circuit Common or to float (§5.3.5), and the Common terminal is internally shared between the Ammeter, Voltmeter and Analog Out.

WARNING

If the Common terminal is not connected to chassis ground (for a floating measurement), a voltage of up to ±500 V can be present on the Common terminal. To prevent electrical shock, do not touch any part of the measurement circuit while a floating measurement is in progress, and use only accessories that comply with IEC safety requirements. All terminals and extended conductors must be isolated with insulation caps or sleeves.

CAUTION

Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal — doing so will damage the instrument. Do not apply current to the chassis ground or earth terminal; doing so will also damage the instrument.

2.5 High-voltage shock hazard and the interlock circuit

TH2690/A/H cannot output more than ±21 V while the rear-panel Interlock terminal is open; TH2695/A are subject to the equivalent interlock requirement at their own voltage tier. To apply a higher source voltage, the interlock terminal must be connected to an interlock circuit installed in the test environment (e.g. a shielding box with an access-door switch) — see §5.7 for how to install one. The interlock circuit is a basic protective measure against electric shock when a user could otherwise touch the output terminals while high voltage is present, and is not a substitute for the general precautions in §2.2.

2.6 Electromagnetic compatibility

TH2690, TH2690A, TH2691, TH2691A, TH2690H and TH2691H are certified to the EMC Directive 2014/30/EU per **EN IEC 61326-1:2021** (*Electrical equipment for measurement, control and laboratory use — EMC requirements*) — Certificate No. MTZS24073897, Test Report No. MTEB23020048/1, issued 2024-07-03 by Shenzhen Most Technology Service Co., Ltd.

2.7 CE marking & Low Voltage compliance

TH2690, TH2690A, TH2691, TH2691A, TH2690H and TH2691H are certified to the Low Voltage Directive (LVD) 2014/35/EU per **EN 61010-1:2010+A1:2019** — Certificate No. MTZS24073946, Test Report No. MTAB23020013/1, issued 2024-07-05 by Shenzhen Most Technology Service Co., Ltd.

Where fitted, the CE mark on the rear-panel nameplate indicates conformity with the applicable EU directives. A full EU Declaration of Conformity is available from Techmize on request (Chapter 8).

CHAPTER 3

Introduction to Panels

This chapter gives a general description of the front and rear panel controls and connectors common to the TH269X series. Detailed operating instructions for each item are in Chapter 4. Several items are fitted only on the models with a voltage source, voltmeter, electrometer or temperature/humidity input (TH2690/A/H, TH2695/A) and are marked accordingly; they are not fitted on the ammeter-only TH2691/A/H.

3.1 Front panel

LCD touch screen — 5.0" capacitive-touch colour TFT. All operation is through the touch screen: pop-up selection boxes, input boxes, and scroll-bar dragging. Shows setup, measurement result and status information.

Power switch — connects/disconnects the instrument. The switch lights green once boot completes correctly. Press and hold to power off. Supports auto-startup recovery after an unexpected power loss.

USB-A connector — for a USB flash drive (file save/recall, CSV export, screenshots). Wait 10 seconds after removing a drive before reconnecting it or a new one.

Run/Stop — starts or stops measurement; results display on the Meter, Histogram or Roll view.

Source 2690/A/H · 2695/A — enables/disables the voltage source output. Lights green when the High terminal is connected to the source; red once the output exceeds ±20 V.

Ammeter — enables/disables the ammeter input. When on (green), the ammeter triaxial connector's centre conductor is connected to the ammeter; when off, it is tied to circuit common. Must be on for current, charge and resistance measurement; voltage measurement is unaffected by this key.

Func 2690/A/H · 2695/A — switches between measurement functions on the Home screen.

Zero — enables/disables zero correction (range-locked internal-offset correction) or Null/offset-cancel, depending on context (§5.13).

Voltage Source High/Low terminals 2690/A/H · 2695/A — banana-type terminals for the DC voltage output, up to the model's rated maximum (§1.3). Controlled by the **Source** key; the Low terminal connects to circuit Common or floats (§5.3.5).

Ammeter input connector — triaxial connector for current measurement, switched by the **Ammeter** key.

Voltmeter input connector 2690/A/H · 2695/A — triaxial connector (high-voltage BNC on TH2695/TH2695A) for voltage measurement; its inner shield connects to Guard or Common (§5.2.4).

Common terminal — banana terminal shared by the Ammeter, Voltmeter and Analog Out. For a grounded measurement, connect it to earth with the furnished Banana-to-Lug cable.

Earth (ground) terminal — connected to earth through the power cord and to the instrument chassis. Do not apply current to this terminal.

> **WARNING**
>
> If the Common terminal is not connected to earth (for floating measurement), a voltage of up to ±500 V may be present on it. Do not touch the measurement circuit while a floating measurement is in progress; use only accessories from Techmize/Tonghui.

3.2 Rear panel

Analog Output connector (Analog Out) — 3-pin connector; pin 1 analog-signal earth (Common), pin 3 analog-signal output, proportional to the current measurement result, maximum ±2 V (e.g. 2 V at full-scale, 0.2 V at 10% of full-scale).

Trigger In/Out connector — 3-pin connector; pin 1 GND, pin 2 trigger output, pin 3 trigger input, for synchronizing operation with external equipment (§5.10).

HANDLER connector — D-sub 9-pin female connector for automatic sorting equipment (§5.9).

LAN interface connector — 10/100 Base-T; left LED indicates activity, right LED indicates link integrity.

USB-B connector — USB device interface for remote control (USBTMC/USBCDC).

AC input connector — IEC inlet for the AC power cord.

Serial number label — attached to the underside of the instrument.

Interlock connector 2690/A/H · 2695/A — MPC300-250 (4-pin) or equivalent, for the interlock circuit (§5.7, §2.5). Output is limited to ±21 V while this terminal is open.

Temperature & humidity sensor connector 2690/A/H · 2695/A — MPC300-250 (3-pin) or equivalent, for the optional TH2690_THS probe (ASAIR AM2105A sensor or equivalent).

> **WARNING**
>
> Hazardous voltage up to the model's rated maximum (§1.3) may be present between the Voltage Source High and Low terminals when the interlock circuit is closed.

CHAPTER 4

Operation Instructions

4.1 Home screen introduction

The Home screen shows the current measurement range and speed, the voltage-source output value (or waveform-output indicator, when source waveform output is active), a menu for each function's detailed settings, the primary and secondary measurement values, temperature and humidity readings when a sensor is connected, and an optional bar chart or line chart. A sorting/limit-test result (PASS/FAIL or BIN number) is shown when the comparator is active (§4.5, §5.8).

A row of status indicators along the bottom of the screen shows, as applicable: zero-correction active, zero (Null/offset-cancel) active, an outstanding error, filter active, the voltmeter's guard-protection state, a high-voltage-output warning, a USB drive connected, a MATH function active, and the power-floating-ground state.

4.2 Measurement settings — Set → MeasSet

4.2.1 Ammeter settings

Field	Options / range
I Range	Auto, or a locked range from 20 mA down to the model's lowest range (see §7.2). Auto selects the best-fit range automatically.
Measurement speed	FAST (1 PLC, 20 ms, quick) · MID (10 PLC, 200 ms) · SLOW (100 PLC, 2000 ms, stable)
Sorting switch	ON/OFF — displays a pass/fail sorting result on the measurement screen
Upper / Lower	Sorting upper/lower limit

4.2.2 Voltmeter settings 2690/A/H · 2695/A

Field	Options / range
V Range	Auto, or a locked range (2 models: 2 V / 20 V on TH2690/A/H; 150/1500 V and 300/3000 V respectively on TH2695A/TH2695 — see §7.1)
Measurement speed	FAST / MID / SLOW, as §4.2.1
Sorting switch, Upper, Lower	As §4.2.1
Voltage Protection	Inner-shield connection of the voltmeter's triaxial input: **GUARD** — connected to Guard, for guarded (protected, more accurate) measurement, indicator lit; **CCOM** — connected to Common, for unguarded measurement, indicator off. See §5.2.4–§5.2.5.

4.2.3 High resistance meter 2690/A/H · 2695/A

Field	Options / range
R Range	Auto, a locked range from 1 MΩ up to 100 TΩ (ten steps; range availability depends on model, §7.1), or Manual (uses an internal or external voltage source with the measurement range chosen on the measurement screen)
Measurement speed	FAST / MID / SLOW
Sorting switch, Upper, Lower	As §4.2.1
Compute	**Vm/Im** — resistance = voltmeter reading ÷ ammeter reading; **Vs/Im** — resistance = internal voltage-source value ÷ ammeter reading. Only Vs/Im is available when R Range is not Manual.

4.2.4 Electrometer settings 2690 · 2690H · 2695 · 2695A

Not fitted on TH2690A, TH2691/A/H (§1.3).

Field	Options / range
Charge Range	2–20 nC auto, 0.2–2 µC auto, or a locked range (2 nC / 20 nC / 200 nC / 2 µC)
Measurement speed	FAST / MID / SLOW
Sorting switch, Upper, Lower	As §4.2.1
Discharge (auto-discharge)	ON/OFF — when on, the coulomb meter automatically resets the accumulated charge once it reaches the discharge level, preventing range overflow (§5.4.4)
Discharge Level	2 nC / 20 nC / 200 nC / 2000 nC

4.2.5 Voltage source settings 2690/A/H · 2695/A

Field	Options / range
Source Range (S Range)	Model-dependent output range tiers; on TH2690/A/H: −20–20 V, 0–1000 V, or −1000–0 V. See §7.1 for the TH2695/TH2695A tiers.
Voltage Source	Sets the output value within the selected range
Off State	**High Z** — high-impedance state, ammeter output switch off, source setting retained, applies only within the ±20 V sub-range; **Normal** — output goes to 0 V, ammeter output switch off; **Zero** — output goes to 0 V
GND	**CCOM** — Low terminal connected to circuit common, Float indicator off; **FLOAT** — Low terminal disconnected from circuit common, Float indicator on (§5.3.5)
Current Limiting Resistance (LimitRes)	**0 Ω** — no current-limiting resistance in series; **20 MΩ** — 20 MΩ in series with the source output

4.3 Configuration settings — Set → ConfSet

4.3.1 Filter

Three filter modes smooth the displayed measurement result:

Mode	Behaviour
Average	Averages a fixed group of N samples, e.g. for N=5 and samples A…E, the result is (A+B+C+D+E)/5.
Median	Reports the middle value of an odd-sized sliding group (sample size an odd number <12); e.g. with size 3 and readings 1, 2, 100, 5, 6…, the output is 2, 5, 6…
Slide	A moving average over a sliding window of 1–100 samples; e.g. with size 3 and readings 2, 4, 6, 8, 10, 12, 14…, the output is 4, 6, 8, 10, 12…

4.3.2 MATH

Applies one mathematical function to the measurement result:

Function	Formula
Scale Offset	k·data + b (k, b user-defined)
Reciprocal Scale Offset	k/data + b (k, b user-defined)
Ratio	data / std (std user-defined)
Percent	(data / std) × 100%
Deviation	(data − std) / std
Percent Deviation	[(data − std) / std] × 100%
Log	log(data)
Polynomial	a2·data² + a1·data + a0 (a2, a1, a0 user-defined)
Sheet Resistivity	(ep/gl) × data (ep, gl user-defined)

Volume Resistivity	(ea/st) × data / 10 (ea, st user-defined)

4.4 Waveform settings — Set → WaveSet

4.4.1 Graph

Field	Options
W Disp	ON/OFF — shows or hides the waveform on the measurement screen
W Type	Graph (line/time-base plot) or Histogram
X Para	t(s), MATH, I(A), U(V), R(Ω), SRC (voltage-source value) or Q(C)
Y Para	MATH, I(A), U(V), R(Ω) or Q(C)
Xmax / Xmin, Ymax / Ymin	Axis range limits
R Auto	ON — Y-axis range adjusts automatically; OFF — fixed at Ymax/Ymin

4.4.2 Histogram

X Para selects the histogram's parameter: MATH, I(A), U(V), R(Ω) or Q(C).

4.5 BIN settings — Set → BINSet

Configures the limit (bin-sorting) comparator used for pass/fail classification (see §5.8 for worked examples).

Field	Options
L Test (Limit Test)	ON/OFF
L Mode (Limit Mode)	**Grading** — hierarchical mode, typically used to grade unqualified products; **Sorting** — classification mode, typically used to screen qualified products
F Data (Feed Data)	I(A), U(V), R(Ω) or Q(C) — the data type the limit test compares
BIN# Select	Selects which of 7 bins is being configured
B Test (Bin Test Select)	ON/OFF for the selected bin
Fail On	**IN** — fails inside the upper/lower limit; **OUT** — fails outside the upper/lower limit
P Patt / F Patt (Pass/Fail Pattern)	HANDLER output bit pattern for the pass/fail state (sorting mode)
Sorting Upper / Lower	Upper/lower limit for the selected bin

4.6 Source setting 2690/A/H · 2695/A — Set → SrcSet

4.6.1 / 4.6.2 Linear Single / Linear Double sweep

Field	Description
Start / Stop	Starting / stopping voltage for the sweep
Step	Voltage step size
Trigger Mode	**Trigger** — outputs the next sweep point each time it is triggered; **Timer** — outputs the next point once the set period elapses
Period	Time between steps, when Trigger Mode = Timer

Linear Double mirrors a single staircase sweep into a symmetrical double staircase (up then down, or vice versa).

4.6.3 Square Waveform Output (ARB Squ)

Field	Description
Start	Starting voltage
Delay	Duration the starting voltage is held

Peak	Peak voltage
P Delay	Duration the peak voltage is held
E Time (Ending Time)	Duration of the ending segment
Count	Number of repeats

Pulse output (minimum pulse width 10 ms, 1 ms resolution) is available in this mode.

4.6.4 List

Begin / End select the first/last list-step number used; Count sets the number of repeats; each step's Assign Voltage and Assign Timer set its output level and hold time.

4.7 Environment system — Syst → EnviSys

Field	Options
Language	English
Beep	ON/OFF
Date / Time	Sets the instrument's real-time clock
T Disp (temperature display)	°C or °F
D Save (Data Save)	ON/OFF — logs measurement data as a timestamped .CSV file to a USB flash drive (columns: Volt, Curr, Res, Coul, Math, Src, Temp, Hum)
Digit	3½ / 4½ / 5½ / 6½ — number of digits shown in the measurement result

4.8 BUS system — Syst → BusSys

4.8.1 RS232

Field	Options
Address (Addr)	Instrument address used for the MODBUS protocol
Baud Rate	9600 / 38400 / 57600 / 115200
Protocol (Prtcl)	SCPI or MODBUS

4.8.2 LAN

Port, IP Address, Gateway and Net Mask configure the LAN interface.

4.8.3 USB

Mode: CDC (virtual serial port) or TMC. The instrument must be restarted after changing the USB mode for the change to take effect.

4.9 SetSys

Field	Options
Testing Mode (Test)	**Cont** — continuous measurement while running; **Single** — one measurement per **Run/Stop** press
Ranging Speed	**Stand** — standard; **Quick** — reduced range-switching wait time
Analog	**IM** — current/charge on the rear-panel analog output; **VM** — voltage
T Spc (test space)	Interval between consecutive tests in continuous mode
T Dly (test delay)	Measurement start delay
S Dly (source delay)	Delay before the voltage source starts
Interlock	ON — the interlock circuit must be closed before the instrument allows output above ±20 V; OFF — not required (§2.5, §5.7)

4.10 Handler — Syst → HandlerSet

Field	Options
Input (slots 1–3, IN1–IN3)	Start, Stop, Reset, ScrOn (source on), ScrOff (source off), ScrTri (trigger voltage-source waveform output)
Output (slots 4–7, OUT4–OUT7)	Level (level output) or Pulse (10 ms pulse output)

4.11 File

Save and recall instrument setups (.sta) or system parameters (.prf); delete and copy files between internal memory and a USB drive.

4.12 Tool

Item	Function
Reset	Restores factory settings, resets all parameters, and restarts the instrument
Cali	Self-calibrates the voltage board and test board
Update	Updates the instrument firmware
Version	Displays instrument/firmware version information
Error	Shows the active error code; see the error-code table below

Code	Description
0	No error
1	Error sending command data
2	CRC check error
3 / 4	V-board self-check 1 V error
5	V-board self-check high-voltage error
6	V-board HV_V alert — check for potential overloading
7	V-board LV_I alert — check for potential overloading
8	V-board OPA_TEMP alert — check for potential overheating
9	V-board HV_I alert — check for potential overloading
10	Main-board self-check AD error
11	Main-board U606-Pro — check whether the ammeter input is too large
12 / 13	Main-board U6-Pro / U7-Pro ammeter error
14	Main-board U607-Pro — check whether the ammeter input is too large
20	Error returning data

CHAPTER 5

Instrument Measurements and Instructions

5.1 Current measurement

All eight models support current measurement via the Ammeter. Table 5-1 gives the measurement value and display resolution for the ranges 20 mA to 20 pA. The lowest range available depends on the model (TH2690A/TH2691A: 2 nA; TH2690/TH2691: 20 pA; TH2690H/TH2691H/TH2695/TH2695A: 2 pA); the 2 pA range and the accuracy of every range are given in §7.2.

Range	Measurement value	Display resolution
20 mA	0 ~ ±21 mA	10 nA
2 mA	0 ~ ±2.1 mA	1 nA
200 µA	0 ~ ±210 µA	100 pA
20 µA	0 ~ ±21 µA	10 pA
2 µA	0 ~ ±2.1 µA	1 pA
200 nA	0 ~ ±210 nA	100 fA
20 nA	0 ~ ±21 nA	10 fA
2 nA	0 ~ ±2.1 nA	1 fA
200 pA	0 ~ ±210 pA	0.1 fA
20 pA	0 ~ ±21 pA	0.1 fA

5.1.1 Requirements

Before switching on, connect the cable, test leads and test fixture used for the measurement. Suitable accessories: a 200 V, 1.5 m triaxial cable (with a triaxial bulkhead connector if needed, or a triaxial-to-alligator-clip cable of the same rating as a substitute), and a Φ4 banana-plug cable for connecting Common to chassis ground. Leave the end of the measurement path open while switching on.

> NOTE
> For a floating ammeter, do not connect any cable between Common and chassis ground — see §5.1.4, Common Terminal Connection.

5.1.2 Procedure

1. On TH2690/TH2690A/TH2690H (and TH2695/TH2695A), press **Func** to select current-measurement mode.
2. Set the measurement range on the display screen (§4.2.1).
3. Set the measurement speed.
4. Open the Filter dialog (Set → ConfSet) and set the measurement filter if required (§4.3.1).
5. Connect the device under test — see §5.1.4 for a grounded or floating connection.
6. Press **Ammeter** to enable the ammeter (switch lights green).
7. Press **Run/Stop** to start the measurement (continuous or single).
8. Press **Ammeter** again to disable the ammeter when finished.

For more precise measurement, use zero correction or offset cancel (§5.13).

5.1.3 Setup parameters

See §4.2.1 (Ammeter Settings) for the full parameter reference.

5.1.4 Common terminal connection

The Common terminal is internally shared between the Ammeter, Analog Out and Voltmeter, and serves as their reference terminal.

For a device under test that has a non-ground potential, connect Common to chassis ground with the furnished Banana-to-Lug cable (or equivalent); the current/voltage measurement is then referenced to ground. For a device that has a ground potential, leave Common disconnected from chassis ground, so the Ammeter/Voltmeter float — this avoids a potential difference between the ammeter input and earth that would otherwise cause leakage current and measurement error in weak-current work.

Where a dielectric exists between the ammeter input and another potential, leakage current flows according to the potential difference and the dielectric's resistance. **Guarding** covers the wire from the ammeter input with a conductor (Guard) held at the same potential as the input, cancelling the potential difference across the surrounding dielectric and reducing the leakage current. Because Common and the ammeter input are at almost the same potential, the guard is connected to Common; without guarding, the leakage current causes measurement error, while with guarding it does not flow through the ammeter.

> **WARNING**
>
> If the Common terminal is not connected to chassis ground, a voltage of up to ±500 V can be present on it. To prevent electrical shock, do not touch any part of the measurement circuit while a floating measurement is in progress, and use accessories that comply with IEC requirements. All terminals and extended conductors must be isolated with insulation caps or sleeves.

> **CAUTION**
>
> Do not apply current to the chassis ground — doing so will damage the instrument.

5.2 Voltage measurement 2690/A/H · 2695/A

TH2690/A/H measure voltage over the ranges in Table 5-2; TH2695/TH2695A measure voltage at their own higher tier (300 V/3000 V and 150 V/1500 V respectively — see §7.1).

Range	Measurement value	Display resolution
20 V	0 ~ ±21 V	10 µV
2 V	0 ~ ±2.1 V	1 µV

5.2.1 Requirements

Connect the cable, test leads and test fixture before switching on: a 200 V, 1.5 m triaxial cable (or triaxial-to-alligator-clip equivalent), a banana-to-alligator-clip cable for connecting Common to the low side of the voltage under test, and a banana-to-lug cable for connecting Common to chassis ground. Leave the measurement path open while switching on.

> **NOTE**
>
> The voltmeter connector's inner shield is internally connected to Guard or Common (§5.2.4). It must be set to Guard for guarded measurement and to Common for unguarded measurement — an incorrect setting causes measurement error.

5.2.2 Procedure

1. Press **Func** to select voltage-measurement mode.
2. Set the measurement range and speed on the display screen.
3. Connect the device under test — guarded or unguarded (§5.2.4).
4. Press **Run/Stop** to start the measurement (continuous/single).

> **NOTE**
>
> The instrument may show a voltage around 4 V, or OVERFLOW, immediately after power-on or whenever the voltmeter input is open. This is a normal effect of the internal circuit, not a fault.

5.2.3 Setup parameters

See §4.2.2 (Voltmeter Settings).

5.2.4 Guarded and unguarded connections

The voltmeter input is a triaxial connector: the centre conductor and outer shield connect to the voltmeter input and chassis ground respectively, while the inner shield must be set to Guard (guarded measurement) or Common (unguarded measurement) at Set → MeasSet → Voltmeter → Voltage Measure Inner Shield.

Setting	Behaviour
GUARD	Inner shield connected to Guard — the protected connection method, giving more accurate measured values. The guarded-voltmeter indicator turns on.
CCOM	Inner shield connected to Common — the unguarded connection method, easier to use. The guarded-voltmeter indicator turns off.

5.2.5 Guarding

Guarding is effective when the voltage source under test has a high output resistance. Without a guard, the triaxial cable's inner shield sits at Common potential while the same voltage as the measured signal appears between the centre and inner conductors; because cable insulation resistance is finite, the voltage actually measured is divided by the ratio of the source's output resistance to the cable's insulation resistance, and the electrostatic capacitance between inner shield and centre conductor sets a settling time proportional to that resistance — for a source with high output resistance, settling can take a long time.

With a guard, the buffer amplifier holds the inner shield at the same potential as the centre conductor, so no voltage is applied across the cable's insulation resistance or capacitance and their effect can be ignored — allowing precise, fast measurement even of a source with large output resistance.

> **CAUTION**
> Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal — doing so will damage the instrument.

5.3 Resistance measurement 2690/A/H · 2695/A

The highest range and the maximum measurable resistance depend on the model (TH2690: 100 TΩ range / 100 PΩ; TH2690A: 1 TΩ range / 1 PΩ; TH2690H: 100 TΩ range / 1000 PΩ; TH2695: 100 TΩ range / 3000 PΩ; TH2695A: 100 TΩ range / 1500 PΩ) — see §7.1. Table 5-3 shows the range/current/voltage relationship used by the auto-ranging algorithm.

Range	Current range used	Voltage source level	Measurement value	Resolution
1 MΩ	200 µA	20 V	≥100 kΩ	1 Ω
10 MΩ	20 µA		≥1 MΩ	10 Ω
100 MΩ	2 µA		≥10 MΩ	100 Ω
1 GΩ	200 nA		≥100 MΩ	1 kΩ
10 GΩ	20 nA		≥1 GΩ	10 kΩ
100 GΩ	2 nA		≥10 GΩ	100 kΩ
1 TΩ	2 nA	200 V	≥100 GΩ	1 MΩ
10 TΩ	200 pA		≥1 TΩ	10 MΩ
100 TΩ	20 pA	200 V	≥10 TΩ	100 MΩ
Manual	Auto or locked range, manual compute mode (§4.2.3)			

5.3.1 Requirements

Suitable accessories: a 200 V, 1.5 m triaxial cable (or triaxial-to-alligator-clip equivalent); a high-voltage test lead, 1000 V, 1.5 m, for the High terminal; a banana-to-lug cable for connecting Common to chassis ground; a banana-to-banana cable for connecting Voltage Source High to Common; and a high-resistance-measurement universal adapter. Leave the measurement path open while switching on.

> **NOTE**
> To apply a voltage over ±21 V, the interlock terminal must be connected to an interlock circuit (§5.7). The Voltage Source Low terminal's connection to circuit common (CCOM/FLOAT) affects both a floating-device and a grounded-device measurement — see §5.3.5.

> **WARNING**
> For a grounded-device connection that applies the source voltage to the Common terminal, a voltage of up to ±500 V can be present on Common.

5.3.2 Procedure

1. Set the resistance calculation mode, Vs/Im or Vm/Im (§4.2.3).
2. Press **Func** to select resistance-measurement mode.
3. Set the current measurement range and output voltage (or the resistance range, if not Manual) on the display screen.
4. Set the desired measurement speed.
5. Connect the resistor under test (floating or grounded, per §5.3.1).
6. Press **Ammeter** to enable the ammeter (switch turns green).
7. Press **Source** to enable the voltage output (switch turns green; the source starts output).
8. Press **Run/Stop** to start a repeating measurement (minimum interval 10 ms).
9. Press **Source**, then **Ammeter**, to disable the output and the ammeter when finished.

To use voltage-source waveform output during a resistance measurement, see the settings under Set → SrcSet (§4.6) and §5.11.

5.3.3 Resistance calculation mode

Resistance is computed as R = Vs/Im or R = Vm/Im, where Vm is the measured voltage, Im the measured current, and Vs the source output voltage. The mode is set at Set → MeasSet → High Res; when the range is not Manual, only Vs/Im is available.

5.3.4 Choosing range for the high resistance meter

In **Auto** mode, the instrument automatically selects the best-fit range (a locked range can also be set to save measurement time). In **Manual** mode, an external power supply can be used to measure the voltage and current of the unit under test; the calculation mode is fixed to Vm/Im, and both the voltage and current measurement ranges must be configured.

5.3.5 Low terminal state

The Voltage Source Low terminal is internally connected to, or disconnected from, circuit common, set at Set → MeasSet → V source → GND.

Setting	Behaviour
CCOM	Low terminal internally connected to circuit common; Floating indicator off.
FLOAT	Low terminal internally disconnected from circuit common; Floating indicator on. Used when applying voltage to the Common terminal.

CAUTION

Even with the Low terminal set to FLOATING, the High and Low potentials must each stay within the model's rated maximum relative to chassis ground (§1.3); the output voltage is limited to that maximum even if the Voltage Source is cascaded with an external source.

NOTE

When both the Low and Common terminals are floating, the Common potential must lie between the Low and High potentials, and must not exceed ±500 V relative to chassis ground.

5.4 Charge measurement

2690 · 2690H · 2695 · 2695A

Not fitted on TH2690A, TH2691/A/H (§1.3). The coulomb meter uses the Ammeter terminal as its input.

Range	Measurement value	Display resolution
2 nC	0 ~ ±2.1 nC	1 fC
20 nC	0 ~ ±21 nC	10 fC
200 nC	0 ~ ±210 nC	100 fC
2 µC	0 ~ ±2.1 µC	1 pC

5.4.1 Requirements

A 200 V, 1.5 m triaxial cable (or triaxial-to-alligator-clip equivalent) and a banana-to-lug cable for connecting Common to chassis ground. Leave the measurement path open while switching on.

NOTE

For a floating coulomb meter, do not connect any cable between Common and chassis ground (§5.1.4).

5.4.2 Procedure

1. Set the automatic discharge function (§4.2.4).
2. Press **Func** to select charge-measurement mode.
3. Set the charge measurement range and speed.
4. Open the Filter dialog (Set → ConfSet) and set the filter.
5. Connect the measurement charge (DUT) to the Ammeter input connector.
6. Press **Ammeter** to enable the coulomb meter (switch turns green).
7. Press **Run/Stop** to start measuring (minimum interval 10 ms).
8. Press **Ammeter** again to disable the coulomb meter.

For more precise measurement, use zero correction or offset cancel (§5.13).

5.4.3 About charge measurement

The coulomb meter measures charge across a wide span, from the minimum range 2 nC (resolution 1 fC) to the maximum range 2 µC (resolution 1 pC). Its input amplifier integrates the input current across a known, accurate feedback capacitor, so the output voltage is proportional to the integral of the input current (charge Q = C·V).

5.4.4 Automatic discharge

Prevents the coulomb meter from overflowing its range: when enabled, the instrument resets the accumulated charge once it reaches the specified discharge level, then resumes measuring. Enabled/disabled at Set → MeasSet → Electrometer.

5.4.5 Discharge level

When Automatic Discharge is enabled, the discharge level can be set to 2 nC, 20 nC, 200 nC or 2 µC at Set → MeasSet → Electrometer.

5.5 Voltage source 2690/A/H · 2695/A

Table 5-5 shows the output range, value, resolution and maximum current for TH2690/A/H; see §7.1 for the TH2695/TH2695A tiers.

Range	Measurement value	Display resolution	Maximum current
20 V	−20 ≤ V ≤ 20	1 mV	±20 mA
1000 V	0 ≤ V ≤ 1000	1 mV	±1 mA
−1000 V	−1000 ≤ V ≤ 0	1 mV	±1 mA

5.5.1 Procedure — DC output

1. Set the output type under Set → SrcSet (§4.6).
2. With VS Func off, the source outputs DC at the set value.
3. Set the voltage source range under Set → MeasSet → V source.
4. Set the voltage source output value.
5. Press [Source] to turn VS Func on (switch turns green or red); the source starts output.
6. Press [Source] again to turn VS Func off; the source stops output.

Procedure — waveform output

1. Set the output type under Set → SrcSet, and configure its parameters (§4.6).
2. Press [Source] to turn VS Func on (switch turns green); the instrument selects the output range automatically and stands by.
3. Under Syst → HandlerSet, define an input pin as the source trigger (ScrTri); when that pin goes low, the instrument starts the sweep output (with Trigger mode, one sweep runs per trigger).
4. Press [Source] to turn the voltage source off when finished.

5.6 Temperature and humidity measurement 2690/A/H · 2695/A

With the factory default setting, the instrument measures and records temperature and humidity every 10 seconds, once a sensor is connected, and displays both on the Home screen.

Measurement	Range
Humidity	0% to 100%
Temperature	−40 °C to 80 °C

Accuracy: −40 to −10 °C, ±1 °C; 10 to 55 °C, ±0.5 °C; 55 to 80 °C, ±1 °C.

5.6.1 Requirements

A temperature and humidity sensor (ASAIR AM2105A or equivalent) and a connector head (MPC300-250-3P or equivalent).

5.6.2 Preparing the humidity sensor connection

Connect the sensor cable to the connector head by inserting each wire into its matching hole; if a wire slips out due to a worn tip, trim the pin and strip the insulation before retrying. A wrong connection can be released by pressing the associated orange button while pulling the wire.

5.7 Installing the interlock circuit 2690/A/H · 2695/A

The interlock circuit is a simple electrical circuit that opens when an access door (e.g. of a shielding box) is opened, and closes when the door is closed. The instrument cannot output more than ±21 V while the interlock terminal is open; to apply a higher voltage, the interlock terminal must be connected to an interlock circuit installed in the measurement environment. This circuit is an important safety measure against electric shock when a user could otherwise touch the output terminal.

> **WARNING**
> Potentially hazardous voltage up to the model's rated maximum (§1.3) may be present between the High and Low terminals of the Voltage Source when the interlock circuit is closed. Do not expose the connecting wire.

5.7.1 Requirements

- 1× LED (high-voltage indicator)
- 2× mechanical switch
- 1× interlock connector head, 4-pin plug, MPC300-250 (4-pin) or equivalent (furnished)
- Connection wire, of sufficient length from the shielding box to the rear-panel interlock connector

5.7.2 Procedure

1. Mount the two mechanical switches on the shielding box so they close when the access door is closed and open when it is opened.
2. Mount the LED on the shielding box; it lights whenever the instrument is in the high-voltage output state (over ±20 V).
3. Connect the two switches in series between pins 3 and 4 of the interlock connector head.
4. Connect the LED between pins 1 and 2 of the interlock connector head.
5. Connect the interlock connector head to the rear-panel Interlock connector.

5.8 BIN limit test

The instrument supports limit sorting: it classifies a measurement or MATH result by comparing it against up to seven predefined test limits (bins), and the result can be output via HANDLER (§5.9). See Set → BINSet (§4.5) for the full settings.

5.8.1.1 Grading mode

A hierarchical mode: up to 7 test limits are evaluated in order, and the test stops at the first failure, showing the failed BIN number.

> EXAMPLE
>
> With Limit Test on, Fail Interval = outside interval, and BIN1…BIN7 limits of ±150M, ±15M, ±1.5M, ±150k, ±15k, ±1.5k, ±150 (in that order): a reading of 10M passes BIN2 but fails BIN3 — the instrument displays BIN3 in red (fail) and HANDLER outputs the BIN3 fail pattern. A reading of 1k passes BIN6 but fails BIN7 — displayed BIN7 in red. A reading of 100 passes all seven intervals — displayed BIN7 in green (pass).

5.8.1.2 Sorting mode

A classification mode: up to 7 tests are evaluated in order, and the test stops at the first pass, showing the passed BIN number.

> EXAMPLE
>
> With BIN1…BIN7 limits of ±1.5k, ±15k, ±150k, ±1.5M, ±15M, ±150M, ±1.5G: a reading of 1k passes BIN1 (displayed BIN1, green). A reading of 10M passes BIN5 (displayed BIN5, green). A reading of 100G fails all seven intervals (displayed BIN7, red).

5.9 HANDLER output

The instrument's HANDLER function uses a DB-9P connector, configurable per pin: 3 pins for input, 4 for output. Pins 5, 4, 3 correspond to inputs IN1, IN2, IN3; pins 2, 9, 8, 7 correspond to outputs OUT4, OUT5, OUT6, OUT7.

5.9.1 Set input

Each input pin can be assigned: start measurement, stop measurement, reset, source off, source on, or source trigger (for voltage-source waveform sweep) — see §4.10.

5.9.2 Set output

Output pins report the HANDLER limit-test result, as a level or a pulse. Example: a pass pattern of 0010 drives pin2(OUT4) low, pin9(OUT5) low, pin8(OUT6) high, pin7(OUT7) low.

5.10 Use of TRIG IN/OUT

The rear-panel TRIG connectors perform operations synchronized with external devices, and are simpler to wire than the HANDLER connector.

Pin	Name	Colour	Description
1	TRIG IN	Black	Receives TRIG signals (falling edge)
2	TRIG OUT	Yellow	Sends TRIG signals (low pulse)
3	GND	Red	Ground

A falling edge on TRIG IN is equivalent to pressing the front-panel **Run/Stop** key (starts or stops measurement, single/continuous). After receiving a TRIG IN signal, TRIG OUT outputs a 20 ms low pulse.

5.11 Voltage source waveform output 2690/A/H · 2695/A

The voltage source can output DC, single or double staircase sweep, square waveform, or list sweep (Set → SrcSet, §4.6). With waveform output off, the source outputs the preset voltage directly and the front-panel **Source** key starts it. With a waveform mode selected, configure its parameters first, then turn Source on and select SrcTrg under Handler input to trigger the output.

Single Staircase Sweep example: start 1 V, period 2 s, step 1 V every 2 s, stopping and holding at 5 V. Double Staircase Sweep mirrors a single staircase sweep into a symmetrical up-then-down output. Square Waveform Output continuously outputs a square wave per the parameters in §4.6.3. List Sweep Output outputs any sequence of user-defined voltage/period pairs (§4.6.4).

5.12 Synchronous sweep 2690/A/H · 2695/A

The instrument can synchronously output the sweep voltage and the test current, plotting the resulting I–V trace live on screen. In Set → WaveSet, turn on the waveform display and set the waveform type to Graph; in Set → SrcSet, select one of the waveform output types (LinearS, LinearD, ARB Squ or List) and configure its parameters; turn on the synchronization function; then press **Source**, **Ammeter** and **Run/Stop** in sequence to start the synchronous sweep-voltage/test-current output.

5.12.1 Requirements

Connect the device under test the same way as for resistance measurement (§5.3.1).

5.12.2 Procedure

1. Press **Func** to select current-measurement mode.
2. Set the current measurement range to be used (synchronous sweep does not support auto-ranging).
3. Set the required measurement speed.
4. Open the measurement filter dialog and set the filter.
5. Open the source settings and turn on the synchronization function.
6. Turn on waveform output and select/configure the waveform (§4.6).
7. Connect the device under test as in §5.12.1.
8. Press **Source** to enable the source function (switch turns green/red).
9. Press **Ammeter** to enable the ammeter (switch turns green).
10. Press **Run/Stop** to start the measurement — continuous/single mode is not available in synchronous sweep.
11. Press **Run/Stop** again to stop, or let it stop automatically once the source output ends.
12. Press **Ammeter**, then **Source**, to disable the ammeter and the source function.

For more precise measurements, use zero correction or offset cancellation (§5.13).

5.13 Offset cancel and zero correction

5.13.1 Zero correction

The Zero key serves both zero correction (this section) and Null (§5.13.2); the two are told apart by their indicators — **ZC** for zero correction and **Zero** for Null. Zero correction clears the deviation of the instrument's internal circuit. Press Zero while the electrometer or ammeter is selected to enable zero correction (the range is locked); the instrument automatically measures and records the deviation across the current measurement range, and the ZC indicator turns white while active. After changing range, the ZC indicator turns grey (inactive) until zero correction is re-run.

5.13.2 Null (offset cancel)

Null stores the currently measured value as an offset, and the displayed value becomes (actual measurement − offset); the **Zero** indicator turns on (this is separate from the **ZC** zero-correction indicator in §5.13.1). Pressing Zero again disables Null and the indicator turns off. Remotely, Null is switched with the `FUNC:ZERO` command (see the Command Reference).

> EXAMPLE
>
> Measurement value is 0.2. Press Zero to store 0.2 as the offset. If the measured value is now 0.5, the display shows 0.3 (0.5 − 0.2). Pressing Zero again disables Null; if the measured value is 0.5, the display shows 0.5.

5.14 Screenshot

The instrument has a screenshot function, captured either of two ways:

- **Method 1:** double-tap the blank area of the status bar, then complete the capture as prompted.
- **Method 2:** press and hold Func for 2 seconds or more to complete the capture.

5.15 Measurement considerations

Weak-current and high-resistance measurement is sensitive to several real-world effects. Attend to each of the following to obtain reliable results:

Effect	Guidance
Insulating material	Use high-resistance insulation in all connection parts (cables, adapters); poor insulation increases leakage current.
Leakage current at connections	Moisture or ionic contamination degrades insulation and can create a battery-like offset current; keep insulating surfaces clean.
Humidity and temperature	Maintain stable, low humidity to limit electrochemical effects; temperature swings cause condensation that degrades insulation — control both appropriately.
Offset	Real instruments always show some offset current with nothing connected; the offset-cancel function (§5.13.2) reduces it.
Cable noise	Triboelectric (friction) and piezoelectric (mechanical stress) effects in cable insulation generate noise current; use low-noise coaxial cable, fix the cable in place, and avoid excessive bending or stress.
External noise	Power-line noise, often capacitively coupled, is a major source of error even through low-capacitance paths; shielding is the main countermeasure.
Dielectric absorption	A changing electric field across an insulator causes a leakage current with a long settling time; use low-absorption insulation, apply guarding to reduce the field change, and allow enough time for the current to converge.
Capacitive coupling	$I = C\cdot(dV/dt) + V\cdot(dC/dt)$ — a changing voltage or a changing coupling capacitance both generate noise current; shield against voltage fluctuation and prevent vibration that changes the coupling capacitance.
Light	In some devices (diodes, transistors), light-generated electron-hole pairs create slow, unstable currents; shield against light and prevent internal reflection.

CHAPTER 7

Technical Parameter Specifications

7.1 Main technical specifications

R = high-resistance meter · V = voltmeter · I = ammeter · Q = electrometer (charge). A dash (—) means the function is not fitted. The same per-model values are used in §1.3 and in the accuracy tables that follow.

Item	TH2690	TH2690A	TH2690H	TH2691	TH2691A	TH2691H	TH2695	TH2695A
Functions	R / V / I / Q	R / V / I	R / V / I / Q	I	I	I	R / V / I / Q	R / V / I / Q
Current measurement range	20 pA – 20 mA	2 nA – 20 mA	2 pA – 20 mA	20 pA – 20 mA	2 nA – 20 mA	2 pA – 20 mA	2 pA – 20 mA	2 pA – 20 mA
Current resolution (min.)	0.1 fA	1 fA	0.01 fA	0.1 fA	1 fA	0.01 fA	0.01 fA	0.01 fA
Resistance — highest range	100 TΩ	1 TΩ	100 TΩ	—	—	—	100 TΩ	100 TΩ
Resistance — max. measurable	100 PΩ	1 PΩ	1000 PΩ	—	—	—	3000 PΩ	1500 PΩ
Voltage measurement	2 V / 20 V	2 V / 20 V	2 V / 20 V	—	—	—	300 V / 3000 V	150 V / 1500 V
Charge measurement	2 nC – 2 µC	—	2 nC – 2 µC	—	—	—	2 nC – 2 µC	2 nC – 2 µC
Voltage source	±1000 V	±1000 V	±1000 V	—	—	—	±3000 V	±1500 V
Voltage source ranges	20 V / 1000 V	20 V / 1000 V	20 V / 1000 V	—	—	—	40 V / 400 V / 3000 V	20 V / 200 V / 1500 V
Temperature / humidity input	✓	✓	✓	—	—	—	✓	✓

7.1.1 General specifications (all models)

Item	Specification
Display	5.0" capacitive colour touchscreen LCD, 6½-digit measurement resolution
Interfaces	RS232, USB Host, USB Device, LAN, HANDLER, INTERLOCK, TRIG IN/OUT, Analog Out. GPIB, fitted on earlier hardware revisions, is not available on current TH269X hardware.
Communication protocols	SCPI, MODBUS (standard across the series)
Power supply	AC 90–264 V, 50/60 Hz, or DC 127–370 V
Operating environment	0–45 °C, 30–80% RH, no condensation
Storage environment	–20–60 °C, 10–90% RH, no condensation
Accuracy-rated environment	23 °C ± 5 °C, 30–80% RH; 1 hour warm-up; calibration cycle 1 year
Dimensions & weight — TH2690/A/H, TH2691/A/H	Rack mount 215(W) × 88(H) × 335(D) mm · Bench 235(W) × 111(H) × 440(D) mm · 3.5 kg
Dimensions & weight — TH2695	Rack mount 215(W) × 88(H) × 480(D) mm · Bench 235(W) × 111(H) × 590(D) mm · 5.5 kg
Dimensions & weight — TH2695A	Rack mount 215(W) × 88(H) × 335(D) mm · Bench 235(W) × 111(H) × 440(D) mm · 4 kg

7.2 Current measurement accuracy

Range	Accuracy (±% of reading + offset)	Display resolution	Applicable models
2 pA	±(1% + 3 fA)	0.01 fA	TH2695 / TH2695A / TH2690H / TH2691H
20 pA	±(0.5% + 3 fA)	0.1 fA	TH2695 / TH2695A / TH2690 / TH2690H / TH2691 / TH2691H
200 pA	±(0.5% + 5 fA)	0.1 fA	TH2695 / TH2695A / TH2690 / TH2690H / TH2691 / TH2691H
2 nA	±(0.2% + 50 fA)	1 fA	All models
20 nA	±(0.2% + 3 pA)	10 fA	All models
200 nA	±(0.2% + 5 pA)	100 fA	All models
2 µA	±(0.1% + 50 pA)	1 pA	All models
20 µA	±(0.05% + 500 pA)	10 pA	All models
200 µA	±(0.05% + 5 nA)	100 pA	All models
2 mA	±(0.05% + 50 nA)	1 nA	All models
20 mA	±(0.05% + 500 nA)	10 nA	All models

TH2690A and TH2691A do not have the 20 pA and 200 pA ranges (minimum range 2 nA); TH2690 and TH2691 have a minimum range of 20 pA; TH2690H, TH2691H, TH2695 and TH2695A have a minimum range of 2 pA.

7.3 Resistance measurement accuracy 2690 · 2690A · 2690H · 2695 · 2695A

Range	Display resolution	Voltage source	Current range used	Accuracy (±% + deviation)	Applicable models
1 MΩ	1 Ω	20 V	200 µA	0.135% + 1 Ω	TH2690 / TH2690A / TH2690H / TH2695 / TH2695A
10 MΩ	10 Ω	20 V	20 µA	0.135% + 10 Ω	TH2690 / TH2690A / TH2690H / TH2695 / TH2695A
100 MΩ	100 Ω	20 V	2 µA	0.185% + 100 Ω	TH2690 / TH2690A / TH2690H / TH2695 / TH2695A
1 GΩ	1 kΩ	20 V	200 nA	0.285% + 1 kΩ	TH2690 / TH2690A / TH2690H / TH2695 / TH2695A
10 GΩ	10 kΩ	20 V	20 nA	0.41% + 10 kΩ	TH2690 / TH2690A / TH2690H / TH2695 / TH2695A
100 GΩ	100 kΩ	20 V	2 nA	0.41% + 100 kΩ	TH2690 / TH2690A / TH2690H / TH2695 / TH2695A
1 TΩ	1 MΩ	200 V	2 nA	0.45% + 1 MΩ	TH2690 / TH2690A / TH2690H / TH2695 / TH2695A
10 TΩ	10 MΩ	200 V	200 pA	0.75% + 10 MΩ	TH2690 / TH2690H / TH2695 / TH2695A
100 TΩ	100 MΩ	200 V	20 pA	2.6% + 100 MΩ	TH2690 / TH2690H / TH2695 / TH2695A

These specifications apply in auto measurement-range mode only. TH2691, TH2691A and TH2691H do not support resistance measurement. The highest range and the maximum measurable resistance of each model are listed in §7.1.

7.4 Voltage measurement accuracy

2690 · 2690A · 2690H · 2695 · 2695A

Model(s)	Range	Display resolution	Accuracy (±% + deviation)
TH2690 / TH2690A / TH2690H	2 V	1 µV	0.05% + 40 µV
TH2690 / TH2690A / TH2690H	20 V	10 µV	0.05% + 400 µV
TH2695	300 V	100 µV	0.05% + 600 µV
TH2695	3000 V	1 mV	0.05% + 6 mV
TH2695A	150 V	100 µV	0.05% + 300 µV
TH2695A	1500 V	1 mV	0.05% + 300 µV

TH2691, TH2691A and TH2691H do not have a voltage measurement function.

7.5 Charge measurement accuracy

2690 · 2690H · 2695 · 2695A

Range	Display resolution	Accuracy (±% + deviation)
2 nC	1 fC	0.5% + 50 fC
20 nC	10 fC	0.5% + 500 fC
200 nC	100 fC	0.5% + 5 pC
2 µC	1 pC	0.5% + 50 pC

Specifications are valid within 1 s. TH2690A, TH2691, TH2691A and TH2691H do not have a charge measurement function.

7.6 Voltage source accuracy

2690 · 2690A · 2690H · 2695 · 2695A

Model(s)	Range	Display resolution	Accuracy (±% + deviation)	Max. output current
TH2690 / TH2690A / TH2690H	20 V	1 mV	0.05% + 2 mV	±20 mA
TH2690 / TH2690A / TH2690H	1000 V	1 mV	0.05% + 100 mV	±1 mA
TH2695	40 V	1 mV	0.05% + 4 mV	±20 mA
TH2695	400 V	1 mV	0.05% + 40 mV	±10 mA
TH2695	3000 V	1 mV	0.05% + 300 mV	±10 mA
TH2695A	20 V	1 mV	0.05% + 2 mV	±20 mA
TH2695A	200 V	1 mV	0.05% + 20 mV	±10 mA
TH2695A	1500 V	1 mV	0.05% + 150 mV	±10 mA

TH2691, TH2691A and TH2691H do not have a voltage source.

CHAPTER 8

Warranty

8.1 Warranty period

Techmize Electronic GmbH warrants this instrument against defects in materials and workmanship for a period of **two (2) years** from the date of original shipment, provided it is used under normal operating conditions as described in this manual.

8.2 Warranty terms

Within the warranty period, Techmize will repair or replace, at its discretion, any instrument found to be defective, free of charge, provided that:

- the instrument has been operated and stored in accordance with the conditions specified in this manual (§1.4);
- the defect is not the result of misuse, unauthorized modification, improper installation, accident, or operation outside the rated specifications;
- the instrument has not been disassembled or repaired by personnel other than Techmize or its authorized service partners;
- the original serial-number label (rear panel, §3.2) has not been removed, altered or defaced.

8.3 Exclusions

This warranty does not cover consumable items, damage from transport after delivery to the customer, damage from power-supply conditions outside the rated input (§7.1), or damage from connection to equipment or signals outside this manual's specifications. Calibration drift outside the stated accuracy, where caused by normal ageing rather than a material or workmanship defect, is addressed through Techmize's calibration services rather than warranty replacement.

8.4 Obtaining service

To obtain warranty service, contact Techmize Electronic GmbH directly or your authorized Techmize distributor, quoting the instrument's model number and serial number (rear panel, §3.2) and a description of the fault. Techmize or the distributor will advise on return procedure, in-region repair options, or on-site service as applicable.

> **NOTE**
>
> This warranty statement summarizes the standard Techmize warranty terms. Contractual warranty terms agreed with a specific distributor or customer take precedence where they differ.

Techmize Electronic GmbH
Ismaning, Germany

An international brand of Changzhou Tonghui Electronic Co., Ltd.

For sales and technical support, contact Techmize Electronic GmbH or your authorized Techmize distributor.

TH269X Series Operation Manual — covering TH2690, TH2690A, TH2690H, TH2691, TH2691A, TH2691H, TH2695, TH2695A.
Specifications subject to change without notice.