TECHMIZE by TONGHUI

OM

OPERATION MANUAL

TH9110 Series

AC/DC Withstand Voltage & Insulation Resistance Tester — TH9110, TH9110A, TH9111, TH9111A and TH9112A. Covers safety, installation, front-panel operation, test setup for ACW, DCW, IR, OSC and breakdown-voltage testing, file storage, and the remote-control and HANDLER interfaces.

Techmize Electronic GmbH · Ismaning, Germany · an international subsidiary of Changzhou Tonghui Electronic Co., Ltd.

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TH9110 Series Operation Manual

AC/DC Withstand Voltage & Insulation Resistance Tester

This manual applies to the five models of the TH9110 series. **TH9110** and **TH9110A** output up to 500 VA, **TH9111** and **TH9111A** up to 200 VA, and **TH9112A** is the high-current model with CK pin/contact detection. Each model performs AC withstand-voltage (ACW), DC withstand-voltage (DCW), insulation-resistance (IR), open/short (OSC) and breakdown-voltage testing. Where a function or setting differs by model, the models concerned are named.

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The complete SCPI command syntax is issued as a separate companion document, TH9110 Series SCPI Command Reference. Chapter 6 of this manual covers the interfaces, their settings and the command-subsystem structure.

CHAPTER 1

Safety & Compliance

1.1 About this manual

This manual describes the operation of the Techmize TH9110 series AC/DC withstand-voltage and insulation-resistance testers: **TH9110**, **TH9110A**, **TH9111**, **TH9111A** and **TH9112A**. If anything described here differs from the instrument you received, contact Techmize or your authorized distributor (§1.8) before relying on the instrument for production decisions. Techmize continually improves its products; content, specifications and accessories may change without notice.

> **WARNING — HIGH TEST VOLTAGE**
>
> The instrument outputs up to **5 kV AC** or **6 kV DC**. Incorrect operation can cause serious injury or death. Read this chapter completely before operating the instrument.

1.2 Safe operation

1. **Insulating gloves.** Wear insulating gloves when operating the instrument, but never intentionally touch live conductors during a high-voltage test.
2. **Grounding.** Connect the rear-panel protective-ground terminal to protective earth with a suitable tool. Without a reliable ground, the chassis can carry high voltage if the supply circuit or any connected device shorts to ground.
3. **Connecting test leads.** Press STOP and confirm the DANGER lamp is off before connecting. Connect the HV2 or RTN/LOW lead to the device under test (DUT) first, then the HV1 lead. A loose or dropped RTN/LOW lead can bring the entire DUT to high voltage. After inserting a high-voltage plug into HV1 or HV2, turn it 90° clockwise to lock it, and check all leads before every test.
4. **Pausing a test.** To change test conditions, press STOP once and confirm the DANGER lamp is off. Switch the power off when leaving the workplace to prevent accidental starts.
5. **Remote control.** When the instrument is controlled remotely, the operator cannot tell its real state from the screen. Wire the STOP control reliably, press it before changing the DUT, and fit a high-voltage indicator lamp and an INTERLOCK switch on the remote controls. Nobody may touch the DUT, test leads, probes or output terminals while voltage is present.
6. **Before touching the DUT.** Confirm the power is off or the instrument is not in test state, the DANGER lamp is off, and the DUT has fully discharged.

7. **Discharge.** The instrument discharges the DUT automatically after the test (fixed discharge time 0.2 s). The time for a DUT to discharge to a safe 30 V is `t = −ln(30/U) × R × C`, with U the test voltage, R the discharge impedance (about 2 kΩ) and C the DUT capacitance. For a DUT equivalent to 0.01 µF in parallel with 100 MΩ that is disconnected before discharge ends, about 5 s is needed from 5000 V and about 3.5 s from 1000 V. Do not remove the DUT during the test or before discharge has finished.
8. **Power switch.** After switching off, wait several seconds before switching on again. Never cycle the power repeatedly, and never switch off while high voltage is present except in an emergency. Keep the output terminals unconnected when switching the instrument on or off.
9. **Do not touch high-voltage areas.** While the instrument is in test state, the output terminals, leads, probes, DUT and their exposed conductors can carry dangerous voltage.

> **WARNING — CROCODILE CLIPS**
>
> Never touch the crocodile clips on the test leads while the instrument is in test state. Their rubber insulation is not sufficient protection.

10. **Do not short outputs to ground.** Do not short the high-voltage output or return lead to the ground of other equipment or to the AC supply. If HV1 is to be shorted to HV2 or RTN/LOW, first make sure the instrument chassis is reliably grounded.
11. **No external voltage.** Never connect any external voltage to the output terminals.

1.3 Emergency and fault handling

- **Emergency** (electric shock, burning DUT) while high voltage is still output: switch the power switch off *and* pull the power cord from the inlet. Do both.
- **Fault state.** If the DANGER lamp stays on after [STOP] is pressed, or the DANGER lamp is on while the voltmeter shows no voltage, high voltage may still be present at the outputs. Switch off, unplug, and move away from the instrument. Have a qualified technician check the test circuit, or leave the instrument for at least one hour and confirm there is no output voltage before removing the connections. Contact your distributor or Techmize for repair.
- **DANGER lamp failure.** If voltage is displayed after [START] but the DANGER lamp does not light, switch off immediately and return the instrument for repair.
- **Long high-current use.** When the current upper limit is set to 100 mA or more for ACW tests, watch the ambient temperature. Pause use above 40 °C until the instrument has cooled.
- **Fuse.** Switch the power off and unplug the cord before inspecting or replacing the fuse. Use a fuse of the same shape, rating and characteristic only (see §1.4).

> **WARNING — INTERNAL VOLTAGE**
>
> After a fault, do not dismantle the test circuit immediately. The instrument can retain high voltage internally; only qualified personnel may service it.

1.4 Operating conditions

Item	Requirement
Supply voltage	100–240 V AC, 47–63 Hz
Power	No load <100 W · rated 1000 W
Fuse (slow-blow)	10 A for 100–120 V AC · 5 A for 200–240 V AC
Operating environment	0–45 °C, 20–90% RH
Calibration reference	18–28 °C, 30–70% RH
Storage	−10–55 °C, <80% RH
Warm-up	≥20 minutes (TH9110, TH9110A, TH9111, TH9111A)
Dimensions / weight	430 (W) × 132 (H) × 500 (D) mm · 21 kg (TH9110, TH9110A, TH9112A) · 20 kg (TH9111, TH9111A)

Check that the supply voltage and fuse match the rating shown on the rear panel before switching on; a wrong fuse can damage the instrument. A very unstable supply can cause erratic operation — use a voltage stabilizer if necessary. If the DUT draws high current, inrush of several tens of amperes for several tens of milliseconds can occur before the fail decision and output cut-off, so use a mains supply and cord of sufficient capacity and do not share the circuit with other equipment.

Installation precautions

- Do not use the instrument in dusty, vibrating, sunlit, corrosive or flammable-gas environments, or near strong magnetic or electric fields. Store it dry and ventilated, in its original packing, when not in use for long periods.
- Keep the fan (rear) and the ventilation openings (sides) clear.
- Use a mains filter where the supply is noisy. Keep the instrument away from sensitive equipment: above 3 kV the field between the test leads ionizes air and radiates RF interference, so keep the leads well apart and away from conductive surfaces, especially sharp metal ends.
- Keep high-voltage leads and the DUT at least 30 cm from the front panel to avoid interference with the display.
- When connecting to automation equipment, join the instrument and system grounds; fit ferrite rings (at least one turn) to the HV and RTN/LOW leads at both ends; and route them separately from control cables and away from the instrument and panel.
- Use the INTERLOCK function whenever possible: build a box around small DUTs, or place a fence around large ones, and open the INTERLOCK loop when the guard is opened.

CAUTION — ELECTRIC-SHOCK PROTECTION

The instrument can output up to 500 VA / 100 mA (TH9110, TH9110A, TH9112A) or 200 VA / 40 mA (TH9111, TH9111A) in ACW mode; a shock at this level can cause unconsciousness or death. Where the product allows, keep the shock-protection function switched on, or use a model with high-voltage floating output (TH9110, TH9111) — see §4.2.5.

1.5 Compliance

CE marking

The TH9110 series carries the CE mark. Conformity is supported by the following Certificates of Compliance issued by Shenzhen BCTC Testing Co., Ltd.:

Directive	Standard	Certificate
Low Voltage Directive 2014/35/EU	EN 61010-1:2010	BCTC-FY190301582C, approved Apr. 18, 2019 (test report BCTC-FY190301582S)
EMC Directive 2014/30/EU	EN 61326-1:2013	BCTC-FY181206899C, approved Feb. 27, 2019 (test report BCTC-FY181206899E)

Certificates are for the exclusive use of Techmize / Tonghui and its distributors. Contact Techmize for a copy.

RoHS

The TH9110 series complies with Directive 2011/65/EU (RoHS); supporting documentation is available from Techmize on request.

WEEE — disposal of electrical and electronic equipment

The instrument must not be disposed of as unsorted municipal waste. Within the European Union, return it to Techmize, your distributor, or a designated collection point in accordance with the WEEE Directive (2012/19/EU) and its national transposition.

1.6 Warranty

Techmize warrants this instrument to be free from defects in material and workmanship for **two (2) years** from the date of dispatch. A warranty card is required to claim warranty service. Repair costs for damage caused by improper operation during the warranty period are borne by the user. Techmize provides lifetime repair service.

Repairs must be carried out by qualified technical personnel; do not replace internal components without authorization. After any repair the instrument must be recalibrated. Damage caused by unauthorized repair or component replacement is not covered by the warranty. Protect the instrument from sun and moisture and use it within the conditions of §1.4. For long periods of non-use, store it in its original packing.

1.7 Safety test data

Under reference conditions the insulation resistance between the power terminals and the enclosure is not less than 50 MΩ (not less than 2 MΩ after humid-heat transport). The enclosure withstands 1.5 kV / 50 Hz AC for 1 minute between the power terminals and the enclosure without breakdown or flashover. Leakage current is not greater than 3.5 mA.

1.8 Manufacturer & EU contact

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CHAPTER 2

Out of the Box

2.1 Unpacking

Inspect the shipping container for damage after unpacking. If it is damaged, do not power on the instrument; contact your carrier and your Techmize distributor. Check the contents against your order and notify Techmize or your distributor promptly if anything does not conform. Keep the original packing for storage or return.

Standard accessories	Qty
TH9110 series instrument (model as ordered)	1
EU power cable (Schuko, CEE 7/7)	1
TH90018 withstand-voltage test lead (TH9110, TH9111 only)	1 set
TH90015 withstand-voltage test lead (TH9110A, TH9111A, TH9112A only)	1 set
TH90003R/B withstand-voltage test lead (TH9112A only)	1 set

Optional accessories: TH90015 test cable, TH90003R/B test cable with clips, GPIB interface (factory-fitted when ordered). Ask Techmize or your authorized distributor for fixtures. The operation manual is supplied as a PDF.

2.2 Connecting the power supply

Match the line, neutral and earth conductors of the power cable to the rear-panel inlet and confirm reliable earth before switching on. Supply: 100–240 V AC, 47–63 Hz; fuse as in §1.4.

> **WARNING**
>
> Make sure the protective-earth conductor is reliably grounded before connecting the power cable. Disconnect the power cable before replacing the fuse.

2.3 Connecting the device under test

1. Confirm the instrument has no voltage output and the DANGER lamp is neither lit nor flashing.
2. Insert the low-potential lead into RTN/LOW (or HV2) and the high-voltage lead into HV1; confirm there is no output. Lock the plugs by a 90° clockwise turn.
3. Connect the low-potential (RTN/LOW or HV2) lead to the DUT first, then the HV1 lead.

> **CAUTION**
>
> A user-made or third-party fixture or cable can give incorrect results or compromise safety. Keep leads and contacts clean and away from strong electromagnetic fields. Stray capacitance of long leads and fixtures adds a base current; compensate it with the OFFSET function (§4.5.1).

2.4 First start-up

1. Connect the EU power cable and confirm reliable earth connection.
2. Check that the INTERLOCK terminals on the rear panel are shorted (high voltage is only allowed with the interlock closed).
3. Press the front-panel POWER switch (pressed in = on). The instrument starts and opens the TEST interface.
4. Warm up for at least 20 minutes before precision measurements (TH9110, TH9110A, TH9111, TH9111A).

2.5 Quick-start: AC withstand-voltage test

Example: test a Class I appliance at 1.5 kV AC for 1 minute with a 5 mA current limit.

1. Press [SETUP]. Select test mode **AC**.
2. Set the test voltage to 1.500 kV, frequency 50 Hz, current upper limit 5.000 mA and test time 60 s. Leave current lower limit and arc limit off unless the application requires them; set rise and fall time to suit the DUT capacitance.
3. Press [F4] (Save) to store the test file (§4.8).
4. Connect the DUT as described in §2.3 and close the INTERLOCK loop.
5. Press [TEST], then [STOP] to ready the instrument, then [START]. The DANGER lamp flashes while voltage is output.
6. On PASS the instrument cuts the output, lights the green PASS lamp and sounds a short tone. On FAIL it cuts the output immediately, lights the red FAIL lamp and sounds a continuous tone until [STOP] is pressed.

> **NOTE**
>
> Press STOP at any time to end the test and cut the output immediately. Before a precision current test, perform the OFFSET operation with no DUT connected (§4.5.1).

CHAPTER 3

Getting to Know the Instrument

3.1 Front panel



1 **POWER** — pressed in: power on; released: power off.

2 **START** (green) starts the test; the DANGER lamp lights. **STOP** (red) ends the test and cancels PASS/FAIL indications.

3 **USB port** — connects an external USB memory (files, screen capture).

4 **PrtScn** — saves the current screen to the USB memory (insert it beforehand).

5 **F1–F6** — soft keys whose function depends on the page; blank or grey labels are inactive.

6 **FILE** — shortcut to internal and external files.

7 **FUNCTION** keys **TEST** **SETUP** **SYSTEM** — lit key shows the active interface.

8 **Direction keys / knob** — move the cursor (selected field is shown on a blue background).

9 **Numeric keypad** — numbers and, where needed, characters (file names).

10 **PASS / FAIL / DANGER** lamps — PASS: test passed; FAIL: a limit was exceeded; DANGER: test running and high voltage present.

11 **HV1** — high-voltage output (high-potential end). Do not touch while the DANGER lamp is on.

12 **HV2** — floating return output, present on TH9110 and TH9111 only (shock-protection setting FLOAT).

13 **RTN/LOW** — high-voltage test reference (low-potential end).

14 **Display** — 7-inch 800×480 TFT-LCD showing test information.

Photograph: TH9110. Model name and, on models without floating output, the HV2 terminal differ.

3.2 Rear panel



1 **HV1 / HV2 / RTN/LOW** — rear high-voltage outputs for automated production-line testing (HV2 on TH9110 and TH9111 only). Do not touch while the DANGER lamp is on.

2 **INTERLOCK** — the two terminals must be shorted to allow high-voltage output.

3 **HANDLER** — start/stop control and test-result output (§6.6).

4 **RS-232C** — serial interface to a computer (§6.1).

5 **LAN** and **USB** (device) — communication interfaces to a computer (§6.2, §6.3).

6 **GPIB** (optional) — general-purpose parallel interface (§6.4).

7 **Protective-ground terminal** — connect reliably to earth.

8 **Power inlet and fuse holder** — three-wire inlet with fuse. Cooling fan and side ventilation openings must stay clear.

3.3 Main interfaces

Interface	Purpose
TEST	Starts the high-voltage test and shows live results. Parameters cannot be edited here.
SETUP	Edits the current test file: steps and test mode (AC, DC, IR, Pause, OSC) with their parameters.
SYSTEM	Test, Environment and Communication settings.
FILE	Saves, loads, copies and deletes internal and USB test files.

Each interface has three levels: the function key opens the interface; the initial page shows its parameters (for example, SETUP opens at step 01/01, AC mode); and selecting a mode or tab on that page switches the parameter set (changing AC to DC replaces the AC parameters with the DC parameters).

CHAPTER 4

Operation & Configuration

This chapter covers the SYSTEM, SETUP, TEST and FILE interfaces, the test procedures and the breakdown-voltage test. Settings are saved when you leave the interface; after changing data in SETUP or SYSTEM, switch to another interface before powering off.

4.1 SYSTEM — test settings

Press [SYSTEM], then [F1] (Test), [F2] (Environment) or [F3] (Communication). Move the cursor with [▲] [▼]; change values with F1–F6 or the keypad ([ENTER] confirms, [ESC] re-enters, [BAS] deletes).

Item	Range	Default	Description
Trigger mode	Manual / External / Bus	Manual	Source of the start signal; only the selected source is accepted, and only on the TEST interface. Manual: START key. External: a low level >10 ms on the HANDLER interface. Bus: command over RS-232C or GPIB (settable by bus command only).
Trigger delay	0.0–99.9 s	0.0 s	Delay from receiving the trigger to the start of the measurement.
Test mode	Normal / Repeat / Continuous	Normal	Normal: one run of the file. Repeat: run the set number of times. Continuous: uninterrupted loop.
Repeat count	0–999	0	Number of runs in Repeat mode.
Test interval	0.0–99.9 s	0.0 s	Time between runs in Repeat and Continuous modes.
After fail	Continue / Restart / Stop	Continue	Behaviour after FAIL (see below).
Pass tone time	0.2–99.9 s	0.5 s	Buzzer duration on PASS.
Step hold	0.1–99.9 s / Key	0.2 s	Interval between steps; Key = press START after each step.
Hardware compensation	Off / On	On	Automatic gain compensation of the source (below).
Software compensation	Off / On	On	Slower compensation without voltage impact on the DUT.
Auto range	Off / On	Off	Automatic current-range switching for withstand tests (below).
Shock protection	Off / On / Float	On	Electric-shock protection (§4.2.5). Float is available on TH9110 and TH9111 only.

After fail. *Continue*: if any step fails the DUT, the remaining steps are still tested. *Restart*: press START to restart the test. *Stop*: press STOP before START can restart.

4.2 Compensation, auto range and shock protection

4.2.1 Hardware / software compensation

The source output impedance causes the output voltage Vo to fall below the set voltage Vs under load ($Vo/Vs = R_L/(R_s+R_L)$). Hardware compensation restores Vo to Vs within 0.1 s. Software compensation is slower, so it does not subject the DUT to a voltage surge; because IR load impedance is normally far above the source impedance, Vo ≈ Vs.

Range	Hardware compensation	Software compensation
ACV 50 V–5 kV	Always on	Default on; can be switched off
DCV 50–499 V	Default on; can be switched off	Default on; can be switched off
DCV 500 V–6 kV	Always on	Default on; can be switched off
IR 50–499 V	Default on; can be switched off	Default on; can be switched off
IR 500 V–5 kV	Always on	Default on; can be switched off

4.2.2 Auto range

With auto range on, 0.6 s before the end of the test the instrument switches to a lower current range if the measured current fits it, improving the displayed resolution (for example, a 100 mA range showing 0.4 mA changes to a low range showing 94.8 µA).

4.2.3 Environment settings

Item	Range	Default
Key sound	Off / On	Off
Sound volume	Off / Low / Medium / High	High
Key lock	Manual / Bus	Manual
Pass sound	Off / On	On
Fail sound	Off / On	On
Screen brightness	1–10	5
Date / time	Year, month, day; 24-hour time	—

4.2.4 Key lock

On any page other than TEST (SYSTEM or SETUP), press [STOP] to open the key-lock and password page, then press [F6] to lock the keys; press [F6] again to unlock. An icon and text at the lower left show the lock state.

4.2.5 Shock protection

On: the instrument compares the current at both output terminals; if a person touches the high-voltage output, the current through the body (i3 = i2 − i1) is detected and the output is cut off when it exceeds the limit (0.5 mA ± 0.25 mA). **Off:** function disabled. **Float** (TH9110 and TH9111 only): HV1 and HV2 are isolated from earth through very high insulation resistance, so the current through a person touching either output stays below 3 mA (leakage <3.5 mA).

> **CAUTION**
> Where the product allows, keep shock protection on or use Float. Floating output applies to ACW, DCW and IR tests.

4.2.6 Communication settings

Press [F3] in SYSTEM, move the cursor to the port-type field and select RS-232C, GPIB (optional), USB or LAN with F1–F4; then set that interface's parameters (Chapter 6).

4.3 SETUP — test steps and modes

Press SETUP. The step indicator shows *current step / total steps*. Use the keys below to edit the file, then move the cursor right to the mode field and select AC, DC, IR, Pause or OSC with F1–F5. Edit the parameters of the selected mode with the direction keys, F1–F6 and the keypad.

Key	Function	Description
F1	Insert	Adds a new step after the current one
F2	Delete	Deletes the current step
F3	New	Creates a new test file (save it after editing)
F4	Save	Saves the current file
F5 / F6	Previous / Next	Moves to the previous / next step

4.3.1 AC withstand voltage (ACW)

Item	Range	Default	Description
Test voltage	0.050–5.000 kV (0 = off)	Off	AC test voltage
Frequency	50 / 60 Hz	50 Hz	Test frequency
Current upper limit	TH9110, TH9110A, TH9112A: 0.001–120.0 mA (≤4 kV), up to 100 mA (>4 kV) · TH9111, TH9111A: 0.001–40.0 mA	500.0 µA	Upper leakage-current limit
Current lower limit	0.001 mA to upper limit (0 = off)	Off	Must not exceed the upper limit
Arc limit	1–20 mA (0 = off)	Off	Off = no arc requirement
Rise time	0.1–999.9 s (0 = off)	Off	Off: voltage rises within the first cycle
Test time	0.3–999 s (0 = continuous)	3.0 s	0 = test until STOP is pressed
Fall time	0.1–999.9 s (0 = off)	Off	Off: output is cut at the end of the test; the DUT may remain charged

4.3.2 DC withstand voltage (DCW)

Item	Range	Default	Description
Test voltage	0.050–6.000 kV (0 = off)	Off	DC test voltage
Current upper limit	TH9110, TH9110A: 0.0001–25 mA (≥1.5 kV), 20 mA (<1.5 kV) · TH9111, TH9111A: 0.0001–20 mA · TH9112A: 0.0001–100 mA (≤5 kV), 90 mA (5–5.5 kV), 80 mA (>5.5 kV)	500.0 µA	Upper leakage-current limit
Current lower limit	0.0001 mA to upper limit (0 = off)	Off	Must not exceed the upper limit
Arc limit	1–10 mA (0 = off)	Off	Off = no arc requirement
Ramp arc	1–10 mA (0 = off)	Off	Arc limit during voltage rise
Ramp judgement	Off / On	Off	On: the current is compared with the upper limit during the rise time. Switch off for DUTs with large distributed capacitance
Rise time	0.1–999.9 s (0 = off)	Off	As ACW
Wait time	0.1–999 s (0 = off)	Off	Current limits are not judged while waiting, but the selected current range upper limit still applies
Test time / fall time	as ACW	3.0 s / Off	As ACW

4.3.3 Insulation resistance (IR)

Item	Range	Default	Description
Test voltage	0.050–5.000 kV (0 = off); TH9112A up to 6.000 kV	Off	IR test voltage
Resistance lower limit	0.1 MΩ to 50 GΩ (TH9112A: 100 GΩ)	1.000 MΩ	Lower limit
Resistance upper limit	Lower limit to 50 GΩ (TH9112A: 100 GΩ); 0 = off	Off	Must exceed the lower limit
Rise time / test time / fall time	as ACW	Off / 3.0 s / Off	As ACW
Auto range	Auto, 10 mA, 3 mA, 300 µA, 30 µA, 3 µA, 300 nA	Auto	Auto switches range with the measured value; a fixed range stays selected

To pick a fixed range, calculate the current I = U/R from the test voltage and expected DUT resistance. Resistance measurement range by current range (TH9110, TH9110A, TH9111, TH9111A):

Current range	50–499 V	500 V–5 kV
10 mA (3–10 mA)	0.1–1 MΩ	0.1–4.5 MΩ
3 mA (0.3–3 mA)	0.5–4.5 MΩ	3.0–15.0 MΩ
300 µA (30–300 µA)	3.0–15.0 MΩ	10.0–45 MΩ
30 µA (3–30 µA)	10.0–45 MΩ	35.0–450 MΩ
3 µA (0.3–3 µA)	45 MΩ–0.45 GΩ	0.40–4.5 GΩ
300 nA (20–300 nA)	0.40–4.9 GΩ	4.0–50.0 GΩ

4.3.4 Pause mode

Pause mode holds the sequence between steps. **Message**: up to 16 characters (letters, digits, `.` and `-`). **Pause time**: *Continue* — waits until START is pressed on the front panel or a START signal arrives externally; or 0.3–999 s — ends when the time has elapsed.

4.3.5 Open/short detection (OSC)

OSC checks that the DUT is reliably connected before the high-voltage test, by comparing the measured capacitance with a sampled standard value.

Item	Range	Default	Description
Open judgement	10–100% (step 1%)	50%	Open when the measured value is below this percentage of the standard
Short judgement	100–500% (step 10%); 0 = off	300%	Short when the measured value exceeds this percentage of the standard
Standard capacitance	0.001–40 nF	10.0 nF	Enter a value or sample it (F1)

Sampling. Place the cursor on the standard-capacitance field and press F1. The instrument outputs a 100 V, 600 Hz AC signal for 1 s and measures the current through the DUT. Voltage is present during sampling — observe the safety rules. The displayed value is not the true capacitance but the sampled current converted through impedance; it approximates the capacitance actually installed between the test terminals.

4.3.6 CK pin detection (TH9112A)

TH9112A additionally provides pin/contact detection in addition to OSC, to confirm a reliable connection between the DUT and the test leads. Settings: test voltage 0.1–0.5 kV; current lower limit 0.001–5 mA.

4.4 TEST interface

Press TEST to open the measurement interface. Parameters cannot be changed here. The centre of the screen shows three large values: the output voltage (kV); the measured value — current (mA, µA) for withstand tests, resistance (MΩ, GΩ) for IR, capacitance (nF) for OSC; and time (s) covering rise, wait (DCW only), test, fall and step interval, with the information bar naming the active timer. With test time 0 the elapsed time is shown, restarting from zero after 65535 s; the test then ends only with STOP or a FAIL. After a test, the last result remains on screen until STOP is pressed.

F1 performs OFFSET (zero), F3 / F4 show the main parameters of other steps, and F6 switches between step display and list display. The **step display** shows step, mode and the set voltage and current limit before the test; after START it shows the live voltage, current and time and the result at the lower right. The **list display** shows, for all steps, the mode, the set value, the limit and the result; during a test the set-value column shows the live voltage and the limit column the live current or resistance.

4.4.1 OFFSET (zero) — test cable / fixture

1. Remove the DUT from the leads or fixture and set the test conditions in SETUP.
2. On TEST press F1. The instrument measures the leakage current of the leads and stores it as zero. The DANGER lamp flashes; voltage is output for 5 s (or the test time, if shorter).
3. When the DANGER lamp stops flashing, the zero has been stored.

Repeat the zero operation whenever the leads or fixture change, and before OSC standard sampling.

4.5 Running a test

4.5.1 ACW / DCW / IR

1. Connect the DUT (§2.3) and press TEST. The prepared steps are displayed.
2. Press STOP to ready the instrument, then START. High voltage is output and the DANGER lamp flashes.
3. **PASS:** when all steps finish and the result shows PASS, the instrument cuts the output, gives the PASS signal on the HANDLER interface and sounds the buzzer.
4. **FAIL:** if a value is abnormal the output is cut immediately, the FAIL signal is given and the buzzer sounds until STOP is pressed.

Result	Meaning
Over limit (HI)	Measured value is above the upper limit
Below limit (LOW)	Measured value is below the lower limit
ARC FAIL	Arc current exceeds the limit
GFI FAIL	Shock-protection / ground fault interruption
SHORT FAIL	Output current exceeds the fixed internal current limit, which cannot be changed

4.5.2 OSC

1. Before the first OSC test, or when the DUT type changes, sample the standard capacitance (§4.3.5) after performing OFFSET. Use a known-good sample as the DUT for sampling.
2. Connect the DUT, press [STOP], then [START]. The screen shows voltage, capacitance and time.
3. PASS and FAIL are signalled as for ACW/DCW. **OPEN**: measured value below the open percentage of the standard. **SHORT**: measured value above the short percentage.

Example (three-terminal coil): capacitance between 1–2 about 300 pF, 1–3 about 200 pF, 2–3 possibly shorted. Sample with no DUT: 100 pF (open value). Repeated samples of good DUTs: 350–450 pF, so the standard Cs = 400 pF. With 2–3 shorted: 550–650 pF. Open threshold: 100/400 = 25% to 350/400 = 88%, so about 60% is suitable. Short threshold: 450/400 = 112% to 550/400 = 138%, so about 125% is suitable.

4.6 Breakdown-voltage test

The breakdown-voltage test raises the voltage in steps to find the voltage at which the DUT fails. It is a destructive test for analysing the limit of the DUT's insulation. All five models support it. The voltage at which the DUT fails is stored; if the end voltage is reached without breakdown, set a higher end voltage and repeat.

1. On the SYSTEM or SETUP interface (not TEST), press [STOP] to open the key-lock page.
2. Press [F1] to select breakdown mode, then press [TEST] to open the breakdown test page.
3. Press [F3] or [F4] to select **normal step** or **voltage step**; set the parameters below with the direction keys, knob, F1–F6 and keypad.
4. Start the test.

Item	Range	Default	Description
Step mode	Normal step / Voltage step	Normal	Step by number of steps or by voltage increment
Number of steps	2–999	2	Normal step only
Step voltage	0.005–0.5 kV	0.005 kV	Voltage-step mode only
Test mode	AC / DC	AC	Withstand mode
Start voltage	0.05 kV to end voltage	0.05 kV	Starting voltage
End voltage	0.05–5 kV	0.05 kV	Stop voltage
Rise time	0–999 s (0 = off)	Off	Per step
Test time	0.3–999 s	3.0 s	Per step
Current upper limit	TH9110, TH9110A: AC 0–100 mA, DC 0–20 mA · TH9111, TH9111A: AC 0–40 mA, DC 0–20 mA	0.500 mA	Leakage-current upper limit
Current lower limit	AC / DC: 0 to upper limit (0 = off)	Off	Leakage-current lower limit
Arc limit	AC 0–20 mA, DC 0–10 mA (0 = off)	Off	Arc upper limit
Continuous test	On / Off	Off	Continue testing after all steps have finished

4.7 File storage

Press FILE to open file management. Up to **100 files** can be stored internally, each with up to **50 steps**. F1 and F2 switch between internal files and external files on a USB memory. Move the cursor with ▲ ▼.

Key	Function	Description
F1	New	Creates a new file
F2	Save	Saves the currently loaded file
F3	Load	Loads the selected file as the current file
F4	Copy all	Copies all files (batch processing)
F5	Copy	Internal file: copy to the USB memory. USB file: copy to internal memory
F6	Delete	Deletes the selected file

The front-panel PrtScn key saves the current screen as a picture on the USB memory. Insert the USB memory in the front-panel port beforehand.

4.8 Typical test sequence

Each step runs through: start → trigger delay → voltage rise → (DCW: wait time) → test → voltage fall → discharge (DCW and IR) → result judgement. If any limit is exceeded, the output is cut immediately and the failure procedure starts; in a multi-step file one failing step fails the file. STOP ends the test immediately without a result.

- **Current upper limit (HI)** and **lower limit (LOW)** are judged on timed samples. A LOW fail often means that no DUT is connected.
- **SHORT** is a fast hardware protection that acts when the current exceeds the fixed internal limit; fall time is bypassed.
- **ARC** detects high-speed current pulses from local discharge in the test loop. It is a qualitative indicator and is sensitive to the DUT, fixture and lead layout.
- **Shock protection (GFI)** cuts the output and displays GFI FAIL (§4.2.5).

CHAPTER 5

Performance & Specifications

5.1 Withstand-voltage test (ACW / DCW)

Parameter	TH9110 / TH9110A	TH9111 / TH9111A	TH9112A
AC output voltage	0.05–5.00 kV, 50/60 Hz ±0.1% sine wave		
Output power	500 VA	200 VA	500 VA
DC output voltage	0.05–6.00 kV		
DC output ripple	—		–2% / +3% of average (5 kV / 100 mA resistive load)
Load variance	±(1% setting + 0.2% F.S.), at rated power		
Voltage resolution / accuracy	2 V / ±(1% setting + 0.1% F.S.)		
AC current range	0.001–120 mA (≤4 kV) 0.001–100 mA (>4 kV)	0.001–40 mA	0.001–120 mA (≤4 kV) 0.001–100 mA (>4 kV)
AC resolution / accuracy	1 µA / ±(1% reading + 0.5% F.S.)		
DC current range	0.0001–25 mA (≥1.5 kV) 0.0001–20 mA (<1.5 kV)	0.0001–20 mA (<1.5 kV)	0.0001–100 mA (≤5 kV) 0.0001–90 mA (5–5.5 kV) 0.0001–80 mA (>5.5 kV)
DC resolution / accuracy	0.1 µA / ±(1% reading + 0.5% F.S.)		
Max. short-circuit current	200 mA (AC test only)	80 mA (AC test only)	200 mA
Discharge	Automatic after the test (DCW)		

5.2 Insulation resistance (IR)

Parameter	TH9110, TH9110A, TH9111, TH9111A	TH9112A
Output voltage	DC 0.05–5.00 kV, resolution 2 V, accuracy ±(1% reading + 0.1% F.S.)	DC 0.05–6.00 kV, resolution 2 V, accuracy ±(1% reading + 0.1% F.S.)
Resistance range	0.1 MΩ–50.0 GΩ, resolution 0.1 MΩ	0.1 MΩ–100.0 GΩ, resolution 0.1 MΩ
Accuracy ≥1 kV	1–1000 MΩ: ±(3% rdg + 0.1% F.S.); 1–10 GΩ: ±(7% rdg + 2% F.S.); 10–50 GΩ: ±(10% rdg + 1% F.S.)	1–1000 MΩ: ±(3% rdg + 1 MΩ); 1–10 GΩ: ±(7% rdg + 0.2 GΩ); 10–100 GΩ: ±(10% rdg + 0.5 GΩ)
Accuracy 500 V–1 kV	0.1–1000 MΩ: ±(3% rdg + 0.1% F.S.); 1–10 GΩ: ±(7% rdg + 2% F.S.); 10–50 GΩ: ±(10% rdg + 1% F.S.)	0.1–1000 MΩ: ±(3% rdg + 1 MΩ); 1–10 GΩ: ±(7% rdg + 0.2 GΩ); 10–100 GΩ: ±(10% rdg + 0.5 GΩ)
Accuracy <500 V	0.1–1000 MΩ: ±(5% rdg + 2% F.S.)	0.1–1000 MΩ: ±(5% rdg + 100 V/Vs × 10 MΩ); Vs = test voltage
Discharge	Automatic after the test	

5.3 ARC, OSC, CK pin and breakdown test

Function	Specification
ARC detection	AC 1.0–20.0 mA / DC 1.0–10.0 mA
OSC standard capacitance	0.001–40 nF
OSC open / short judgement	Open 10–100% / Short 100–500%; sampling signal 600 Hz, 1 s
CK pin / contact detection (TH9112A)	Test voltage 0.1–0.5 kV, current lower limit 0.001–5 mA
Breakdown-voltage test	AC / DC; start 0.05 kV to end 5 kV; normal step (2–999 steps) or voltage step (5–500 V); 0.3–999 s per step

5.4 Timing

Item	Specification
Test time (ACW / DCW / IR)	0.3–999 s (0 = continuous)
Voltage rise / fall time	0.1–999.9 s (0 = off)
Wait time (DCW only)	0.1–999 s (0 = off)
Time accuracy	±(1% + 0.1 s)

5.5 Safety and protection

Item	Specification
High-voltage floating output (TH9110, TH9111)	ACW, DCW, IR; leakage <3.5 mA
Electric-shock protection	0.5 mA ± 0.25 mA; On / Off
Start protection	INTERLOCK pins must be shorted to allow high-voltage output
Panel protection	Key lock, password
Alarm indication	PASS: short tone, green lamp FAIL: long tone, red lamp

5.6 Storage, interfaces and general

Item	Specification
Internal memory	100 files, up to 50 steps per file
Standard interfaces	RS-232C, USB device, USB host, LAN, HANDLER
Optional interface	GPIB
Display	7-inch, 800×480 TFT-LCD
Operating environment	0–45 °C, 20–90% RH
Calibration reference	18–28 °C, 30–70% RH
Storage environment	−10–55 °C, <80% RH
Power supply / power	100–240 V AC, 47–63 Hz; no load <100 W, rated 1000 W
Dimensions (W×H×D)	430 × 132 × 500 mm
Weight	TH9110, TH9110A, TH9112A: 21 kg · TH9111, TH9111A: 20 kg

CHAPTER 6

Interfaces & Remote Control

The TH9110 series can be controlled remotely over RS-232C, USB, LAN or the optional GPIB interface using the SCPI command set; nearly all front-panel functions are available. RS-232C and GPIB use the same commands but different hardware and protocols and cannot be used at the same time. Select the interface under SYSTEM → Communication (§4.2.6). Command syntax is given in the *TH9110 Series SCPI Command Reference*.

6.1 RS-232C

The 9-pin male DB connector provides a minimum subset of RS-232C: TXD (pin 3), RXD (pin 2) and GND (pin 5). Connect to a computer with a standard DB9 cross-over (null-modem) cable, or a self-made three-wire shielded cable shorter than 1.5 m; on the computer connector short pins 4–6 and pins 7–8. Switch the instrument off before connecting or disconnecting.

Item	Setting
Transmission	Full-duplex asynchronous, with start and stop bits
Baud rate	9600 / 19200 / 38400 / 115200 bps
Data bits	8 or 7
Stop bits	1 or 2
Parity	None / odd / even
Terminator	NL (line feed, ASCII 10)
Handshake	Software (character echo)
Connector	DB9

Software protocol

- Commands are sent as ASCII, terminated by NL; the instrument executes the string on receiving NL.
- The instrument echoes each received character; the host should wait for the echo before sending the next. If no echo returns, check the cable, check that the RS-232C function is enabled, or note that the instrument is busy executing a command — in this case the character was ignored and must be resent.
- The instrument sends data only when echoing characters or answering a query. A query result is sent immediately and ends with NL. Use one query per command string, and read each result completely (up to NL) before sending more.
- For long commands such as OFFSET, wait for completion before sending the next command.

6.2 USB

The rear-panel USB device port connects to a computer, which controls the instrument with the command set. The front-panel USB port connects a USB memory for files and screen capture (§4.7). Select USB under SYSTEM → Communication.

6.3 LAN

The rear-panel LAN port is a standard communication interface. Select LAN under SYSTEM → Communication.

6.4 GPIB (optional)

GPIB is factory-fitted when ordered. The instrument uses single-address addressing without secondary address; the address can be 0–30 (factory default 1) and is stored in non-volatile memory. Set it under SYSTEM → Communication → GPIB → address number. Switch the instrument off before connecting or disconnecting GPIB cables.

6.5 Command-set overview

Commands are grouped in subsystems: `DISPlay` (display page), `FUNCtion` (start/stop, file editing, per-mode test parameters and results), `SYSTem` (system, test and environment settings), `MMEM` (internal file store/load), `USB` and `FETCh` (result query), plus common and other control commands. Several commands can be sent in one line. Keywords are not case-sensitive.

> **NOTE**
>
> In remote-control mode the instrument state is not visible to the operator. Follow §1.2 item 5: STOP and INTERLOCK controls must be reliably connected.

6.6 HANDLER interface

The HANDLER interface connects the instrument to automatic test systems: it provides handshake signals and test-result outputs. Internal signal outputs: DC 24 V, 20–40 mA. External signal inputs: DC 3–26 V (HIGH), 10 mA ± 4 mA. Output signals are active low.

Pin	Signal	I/O	Description
1	/PA	Out	LOW when the test starts; changes state at each pause step
2	/OPEN	Out	OSC open result, combined with /PASS and /FAIL
3	/SHORT	Out	OSC short result, combined with /PASS and /FAIL
4	/FAIL	Out	LOW on FAIL; then /HIGH, /LOW, /ARC_FAIL, /GFI_FAIL, /SHORT_FAIL give the cause
5	/PASS	Out	LOW on PASS; the cause signals stay HIGH
6	/HIGH	Out	LOW on HIGH FAIL
7	/LOW	Out	LOW on LOW FAIL
8	/EXT_STOP	In	External STOP, active LOW
9	/EXT_START	In	External START, active LOW
10, 11	EXT_DCV	In	External DC supply, +3 to +26 V
12, 13	+24V	Out	Internal DC supply
14	/SYSTEM ERROR	Out	LOW on internal system error
15, 18	NC	—	Reserved
16	/EOT	Out	HIGH while the test program runs; LOW when finished or idle
17	/EOS	Out	HIGH while a step is running; LOW when the step or all steps have ended
19	/SHORT_FAIL	Out	LOW on SHORT FAIL
20	/ARC_FAIL	Out	LOW on ARC FAIL
21	/GFI_FAIL	Out	LOW on GFI FAIL
22, 23	COM	—	Common of input/output signals
24, 25	GND	—	Ground of the internal supply

6.7 Using the HANDLER interface

1. Close the INTERLOCK loop (safety guard in place); the instrument cannot output high voltage otherwise.
2. Configure the test file in SETUP and the trigger mode in SYSTEM (set trigger mode to External for /EXT_START).
3. Start the test with /EXT_START (low level longer than 10 ms) or the front-panel START key.
4. Read /PASS, /FAIL and the cause signals from the external system when the test ends; /EOT and /EOS show the program and step status.
5. /EXT_STOP can abort the test at any time, equivalent to the front-panel STOP key.

The interface can be powered from the internal +24 V supply or from an external supply connected to EXT_DCV with COM as the return; the two connection variants differ in the supply and common pins used. Keep control cables separate from the high-voltage leads, and join the instrument and system grounds (§1.4).

> **WARNING**
> When the instrument is started remotely, the DANGER lamp may light without operator action. Do not touch the DUT, leads or fixture unless the INTERLOCK is open and the DANGER lamp is off.

APPENDIX

Related Documents & Contact

A.1 Model overview

Model	Output power	HV floating output	IR to 100 GΩ	Contact check	Weight
TH9110	500 VA	Yes	—	OSC	21 kg
TH9110A	500 VA	—	—	OSC	21 kg
TH9111	200 VA	Yes	—	OSC	20 kg
TH9111A	200 VA	—	—	OSC	20 kg
TH9112A	500 VA	—	Yes	OSC, CK pin	21 kg

All models provide ACW, DCW, IR, ARC detection, breakdown-voltage testing and SCPI remote control.

A.2 Related documents

- TH9110 Series Datasheet (Techmize)
- TH9110 Series SCPI Command Reference (Techmize, companion to this manual)

A.3 Contacting Techmize

For technical support, accessories, calibration or service, contact Techmize directly or through your authorized Techmize distributor.

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