TECHMIZE by TONGHUI

OM

OPERATION MANUAL

TH2848 Series

Precision Impedance Analyzer — TH2848-02L / TH2848-02 / TH2848-05 / TH2848-10. Covers touchscreen operation, measurement setup and system configuration; the full SCPI/MODBUS command set is documented in the companion TH2848 Series SCPI & MODBUS Command Reference.

Techmize Electronic GmbH · Ismaning, Germany

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TH2848 Series Operation Manual

Precision Impedance Analyzer — TH2848-02L / TH2848-02 / TH2848-05 / TH2848-10

This manual consists of a self-contained Part I for day-to-day touchscreen operation and a condensed Part II giving an overview of remote control. The standalone TH2848 Series SCPI & MODBUS Command Reference provides the full remote-control detail.

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Full SCPI and MODBUS command syntax: see the companion TH2848 Series SCPI & MODBUS Command Reference.

CHAPTER 1

Safety & Compliance

1.1 About this manual

This is the operation manual for the Techmize TH2848 series of precision impedance analyzers, covering models **TH2848-02L**, **TH2848-02**, **TH2848-05** and **TH2848-10**. Where this manual and the instrument itself appear to disagree, or where a described function is not present on your particular model, contact Techmize or your authorized distributor using the details in §1.10 before relying on the instrument for measurement decisions.

Techmize continually improves the performance, features and construction of its instruments; content, specifications and accessories described here are subject to change without notice. This manual does not necessarily describe every optional accessory or every firmware revision.

1.2 Safety symbols used in this manual

The following symbols and signal words appear in this manual and on the instrument itself:

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, but is not itself a hazard.

Protective ground — this terminal must be connected to protective earth. Also printed on the instrument chassis ground terminal.

1.3 General safety requirements

The TH2848 series is a **Protection Class I** instrument: protective earthing of the chassis, via the power cord, is essential to safety and must not be defeated.

> **WARNING — ELECTRIC SHOCK**
> Always use a supply outlet with a protective earth contact. Never connect the AC supply, or operate the instrument, with the protective ground disconnected. Disconnect the power supply before replacing the fuse or opening the case.

Before switching on, confirm the fuse fitted on the rear panel matches your local supply. This European edition ships configured for **220–240 VAC, 47–63 Hz**; the rear-panel rating label shows the matching fuse.

Supply range	Rated power	Fuse
220–240 V / 50 Hz	100 VA	T2AL 250V

> **CAUTION**
> Use only the fuse rating shown on the rear-panel label; use of an incorrect fuse can damage the instrument or defeat its fire protection. The instrument's fuse holder can also be configured for other supply voltages — if exporting this unit outside Europe, contact Techmize first to confirm the correct configuration for the destination market.

1.4 Electrical safety test data

Test	Requirement
Insulation resistance	≥ 50 MΩ between mains and chassis under reference operating conditions; ≥ 2 MΩ under transport humid-heat conditions
Dielectric strength	Withstands 1.5 kV AC, 50 Hz, for 1 minute between mains and chassis, with no breakdown or flashover
Leakage current	≤ 3.5 mA AC (rms)

1.5 Low Voltage & EMC compliance

The TH2848 series is designed and tested to meet the essential requirements of the following EU directives:

Directive	Harmonised standard(s)
Low Voltage Directive 2014/35/EU	EN 61010-1:2010+A1:2019
EMC Directive 2014/30/EU	EN 61326-1:2021; CISPR 11:2015+A1:2016+A2:2019 (Group 1, Class A); EN 61000-4-2:2009, EN 61000-4-3:2020, EN 61000-4-4:2012, EN 61000-4-5:2014+A1:2017, EN 61000-4-6:2014, EN 61000-4-11:2020; EN 61000-3-2:2019+A1:2021, EN 61000-3-3:2013+A1:2019+A2:2021

> **NOTE**
> As a Class A / Group 1 ISM-adjacent instrument, the TH2848 series is intended for industrial/laboratory environments; it may not provide adequate protection against radio interference in a residential setting.

The CE mark on the rear-panel nameplate indicates conformity with the directives above. A full EU Declaration of Conformity is available from Techmize on request (see §1.10).

1.6 Environment & handling

- Operate indoors, away from dust, strong vibration, direct sunlight and corrosive gases; ambient **0–40 °C**, relative humidity **≤75%**.
- Keep the side and rear ventilation openings clear — the rear panel carries the instrument's heat-dissipation vents.
- For storage, keep the instrument in its original packaging at 5–40 °C, relative humidity ≤85%, away from corrosive contaminants and direct sunlight.
- Keep the instrument and its test leads away from strong electromagnetic fields, which can affect both safety and measurement accuracy.

1.7 WEEE — disposal of electrical and electronic equipment



This symbol indicates that the instrument must not be disposed of as unsorted municipal waste at the end of its service life. Within the European Union, return the instrument to Techmize, your distributor, or a designated collection point for electrical and electronic equipment, in accordance with the WEEE Directive (2012/19/EU) and its national transposition in your country. Correct disposal helps prevent potential harm to the environment and human health from uncontrolled waste handling.

1.8 RoHS compliance

The TH2848 series is designed to comply with Directive 2011/65/EU (RoHS), as amended, restricting the use of certain hazardous substances in electrical and electronic equipment. Supporting documentation is available from Techmize on request.

1.9 Warranty & limitation of liability

Techmize warrants this instrument to be free from defects in material and workmanship for a period of **two (2) years** from the date of delivery to the original purchaser. During the warranty period, Techmize will repair or replace, at its discretion, a product that proves defective, provided it has been used within the specified operating conditions and re-calibrated by qualified personnel after any repair.

This warranty does not cover: damage from misuse, accident, unauthorized modification or repair; consumable/wear items such as fuses and connectors; or damage from operation outside the environmental limits given in §1.6. Standard test fixtures and cables are covered by their own applicable warranty terms. Except as expressly stated here, Techmize makes no other warranty, express or implied, regarding this instrument or its documentation, and is not liable for indirect, incidental or consequential damages arising from its use, to the extent permitted by applicable law.

1.10 Manufacturer & EU contact

Techmize Electronic GmbH

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Carl-Zeiss-Ring 15a, 85737 Ismaning,
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An international subsidiary of Changzhou
Tonghui Electronic Co., Ltd. (China)

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Registration

Managing Director: Haohua Zhao
Register Court: Amtsgericht München
HRB 312530 · VAT ID DE463170824

CHAPTER 2

Out of the Box

2.1 Unpacking

Thank you for purchasing a Techmize instrument. After unpacking, check the instrument for shipping damage before applying power — do not power on a unit with visible external damage. Then confirm the contents against the packing list in the Appendix; contact Techmize or your distributor promptly if anything is missing or damaged.

1× TH2848-series precision impedance analyzer (model as ordered) · 1× 3-wire power cable · standard test fixture/cable (see the datasheet for the model supplied) · 1× this operation manual · 1× test report · 1× warranty certificate.

The table below summarizes how the four models differ — useful when confirming you received the correct unit:

Model	Max. frequency	Max. AC level	Max. DC bias	Analysis functions
TH2848-02L	4 Hz – 2 MHz	0–2 Vrms / 0–20 mArms	0–±10 V / 0–±100 mA	None
TH2848-02	4 Hz – 2 MHz	0–20 Vrms / 0–100 mArms	0–±40 V / 0–±100 mA	Piezoelectric admittance circle
TH2848-05	4 Hz – 5 MHz	0–20 Vrms / 0–100 mArms	0–±40 V / 0–±100 mA	Piezoelectric admittance circle, dielectric constant
TH2848-10	4 Hz – 10 MHz	0–20 Vrms / 0–100 mArms	0–±40 V / 0–±100 mA	Piezoelectric admittance circle, dielectric constant

TH2848-05 and TH2848-10 carry both the piezoelectric admittance-circle and dielectric-constant options; TH2848-02 carries the admittance-circle function only; TH2848-02L carries neither.

2.2 Connecting the power supply

1. Supply voltage: **220–240 VAC** (this European edition's factory configuration).
2. Supply frequency: **47–63 Hz**.
3. Power consumption: **≤130 VA**.
4. Match the phase (L), neutral (N) and protective-earth (E) leads of the supply cable to the instrument's power inlet.
5. The instrument is designed to minimize noise coupled in from the AC supply, but should still be used in a low-noise environment where possible; fit a power-line filter if this cannot be avoided.

> **WARNING**
> To prevent electric shock, the user must ensure the supply's protective-earth conductor is reliably connected to ground.

2.3 Connecting a test fixture

Use only a test fixture or test cable supplied or approved by Techmize/Tonghui for this instrument; a third-party or user-made fixture can produce incorrect measurement results. Connect the fixture or cable to the four front-panel terminals — **Hcur, Hpot, Lpot, Lcur** — and keep both the fixture contacts and the DUT's leads clean to ensure good electrical contact. If the DUT has a shielding shell, connect the shield to the instrument's ground terminal.

> **NOTE**
> With no test fixture or cable connected, the instrument will display an unstable reading — this is expected and not a fault.

2.4 Warm-up

- Allow at least **15 minutes** of warm-up before relying on the instrument for measurement; the formal accuracy-verification condition used in Chapter 7 is **≥30 minutes**.
- Avoid frequent power-cycling, which can leave internal calibration data in an inconsistent state.

2.5 Starting the instrument for the first time

1. Connect the power cable at the rear panel, having confirmed the fuse fitted matches your local supply (§1.3).
2. Press the **POWER** switch at the front-left of the instrument. The instrument uses a soft power switch: after the mains cable is connected, front-panel indicators flash briefly, then the POWER key settles to red (standby).
3. Press POWER again to switch on; the key turns green and a splash screen shows the company logo, instrument model and firmware version while the instrument loads, then the touchscreen opens on the <Meas Display> page.

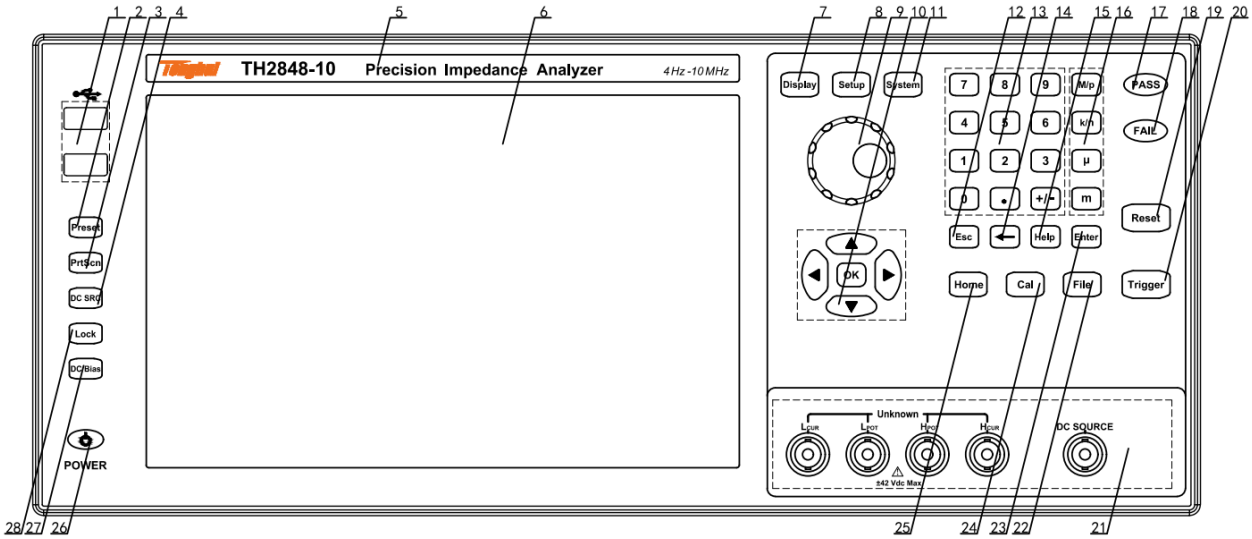
To power off, press and hold the POWER key; the key returns to red (standby). If the instrument will not be used for an extended period, disconnect the power cable and store it per §1.6.

> **NOTE**
> The factory-set system password is **2848**. It can be changed from the <System Setup> page (§5.1) once the unit is in service.

CHAPTER 3

Getting to Know the Instrument

3.1 Front panel



1 **USB HOST** — two ports for a USB flash drive (save/recall files) or mouse/keyboard/barcode scanner; only one flash drive can be used at a time.

2 **Preset** — restores the instrument to its factory default settings.

3 **PrtScn** — screenshot key; saves the current screen image to a connected USB drive.

4 **DC SRC** — enables/disables the independent DC voltage-source output, with an LED status indicator.

5 **Trademark & model** — instrument brand and model designation.

6 **Touchscreen** — 10.1", 1280×800 colour capacitive touchscreen; shows measurement results, test conditions and status.

7 **Display** — opens the measurement display pages (§3.4).

8 **Setup** — opens the measurement setup pages (§3.4).

9 **Rotary knob with OK** — moves the cursor and selects/adjusts parameter values; pressing the centre ends and confirms an entry.

10 **Cursor keys & OK** — ▲ ▼ ◄ ► move the cursor between fields on screen; the active field is highlighted. Centre **OK** works like Enter.

11 **System** — opens the system setup page (§3.4).

12 **Esc** — exits the current entry or dialog.

13 **Numeric keypad** — digits 0–9, decimal point and **+/-** for data entry.

14 **←** — Backspace; deletes the last digit entered.

15 **Help** — lights and shows context-sensitive help for the field under the cursor; press again to dismiss.

16 **Magnitude keys** (M/p, k/n, µ, m) — apply an SI magnitude/unit to the value being entered.

17 **PASS** indicator — lights on a qualified (PASS) comparator result.

18 **FAIL** indicator — lights on an unqualified (FAIL) comparator result.

19 **Reset** — pauses/resumes a running trigger sequence (e.g. a list or trace sweep).

20 **Trigger** — manually triggers a reading when the trigger mode is set to Single.

21 **UNKNOWN terminals** — four-terminal-pair test port: **Hcur** (current-source high), **Hpot** (voltage-sense high), **Lpot** (voltage-sense low), **Lcur** (current-source low); plus the independent **DC SOURCE** output.

22 **File** — quick access to the <File> management page.

23 **Enter** — ends data entry and confirms/saves the value shown.

24 **Cal** — quick access to the <User Corr> page.

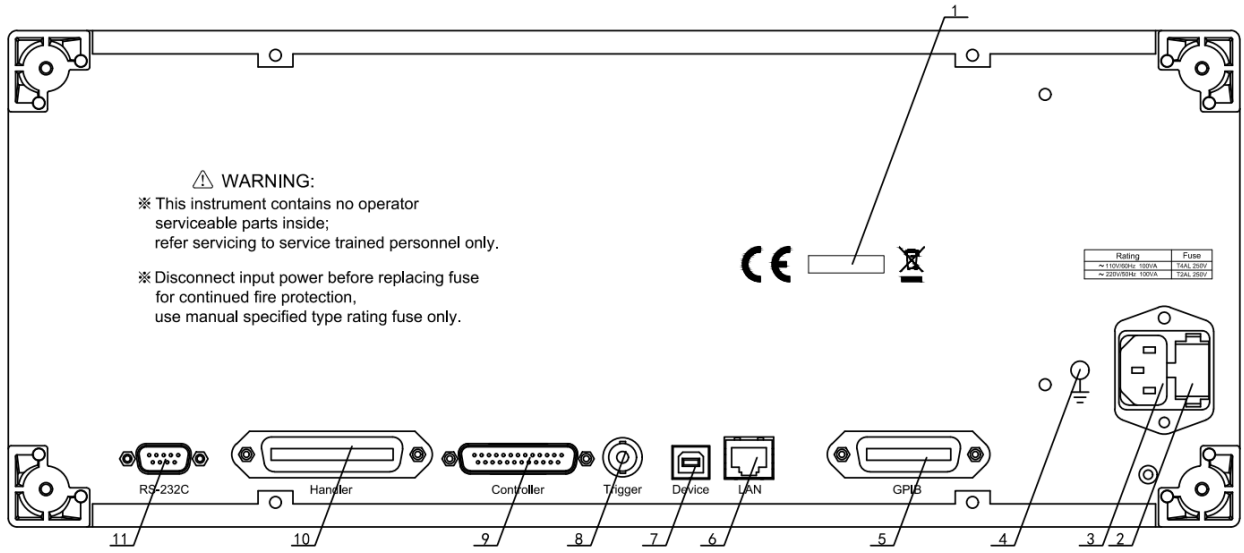
25 **Home** — switches quickly between frequently used function pages.

26 **POWER switch** — red in standby, green when on; press and hold to power off.

27 **Lock** — locks/unlocks the front-panel keys; also lights when the instrument is under remote (RS232/USB/LAN) control.

28 **DC Bias** — enables/disables the DC bias output; lit when bias output is enabled. Has no effect on pages where DC bias cannot be applied.

3.2 Rear panel



1 **Rating label** — production date, serial number and manufacturer information; also carries the CE mark and the fuse/rating table (§1.3).

2 **Fuse holder** — houses the power fuse for the 220–240 V European configuration (§1.3); Techmize can configure it for other supply voltages on request.

3 **Power inlet** — IEC AC mains input.

4 **Ground terminal** — connected to the instrument chassis; for protective or shield grounding.

5 **GPIB** — IEEE-488 interface, standard.

6 **LAN** — network interface for remote control/communication.

7 **USB Device** — USB communication interface to a PC.

8 **TRIGGER** — for a foot switch or other external trigger source.

9 **Controller** — reserved interface.

10 **HANDLER** — sorted bin/comparator result output for automatic handling equipment (Chapter 9).

11 **RS-232C / RS-485** — shares one 9-pin connector: pins 2, 3, 5 carry RS-232C; pins 1, 4 carry the RS-485 differential A/B pair.

3.3 Display zones

The 10.1" capacitive touchscreen is divided into the following zones on every measurement page:

Zone	Contents
Title zone	The name of the current page, shown as a bar across the top of the screen, with a Home icon at the far right.
Measurement-condition zone	The active test conditions — frequency, level, speed, DC bias, DC source, AC monitor, range — shown as touchable fields.
Four-parameter result zone	Up to four simultaneous measurement results in large digits, with deviation/reference and bin-limit status alongside each.
Bin-result zone	The comparator's per-bin count/status strip along the bottom of the measurement area.
Menu zone	The touch-menu column on the right; its contents change with the page and with the selected field.
Status bar	Cable-length setting, remote-interface icon and date/time, along the very bottom of the screen.

3.4 Main menu keys and pages

Key	Opens (touch the corresponding menu item to select)
Display	<Meas Display> · <List Display> · <Trace Display> · <Save>
Setup	<Meas Setup> · <Limit Setup> · <List Setup> · <Trace Setup> · <User Corr> · <Handler>
System	<System Info> · <Message> · <System Check> · <License>

3.5 Basic operation

1. Use the menu keys (Display, Setup, System) and the touchscreen to reach the page you want.
2. Use the cursor keys, the rotary knob, or tap the screen directly to move the cursor to the field you want to set; the active field is highlighted.
3. The menu zone shows the soft-key options for the current field. Select the option you need; numeric keys, ←, the magnitude keys and Enter are used for direct data entry. After a numeric key, press a magnitude key or Enter to complete the entry.

3.6 Power on / power off

Connect the 3-wire power cable, confirming the supply voltage, frequency and phase/neutral/ground wiring match the instrument's requirements (§1.3, §2.2). The TH2848 series uses a soft power switch: after connecting mains power, some front-panel indicators flash briefly, then the POWER key settles to red.

Power on: press the POWER key at the front-panel bottom-left; the instrument boots, showing a splash screen with the company logo, model and firmware version (e.g. Ver 1.0.0), then opens on <Meas Display>. The POWER key turns green.

Power off: press and hold the POWER key; the key returns to red (standby power only). For extended storage, disconnect the power cable entirely and store the unit per §1.6.

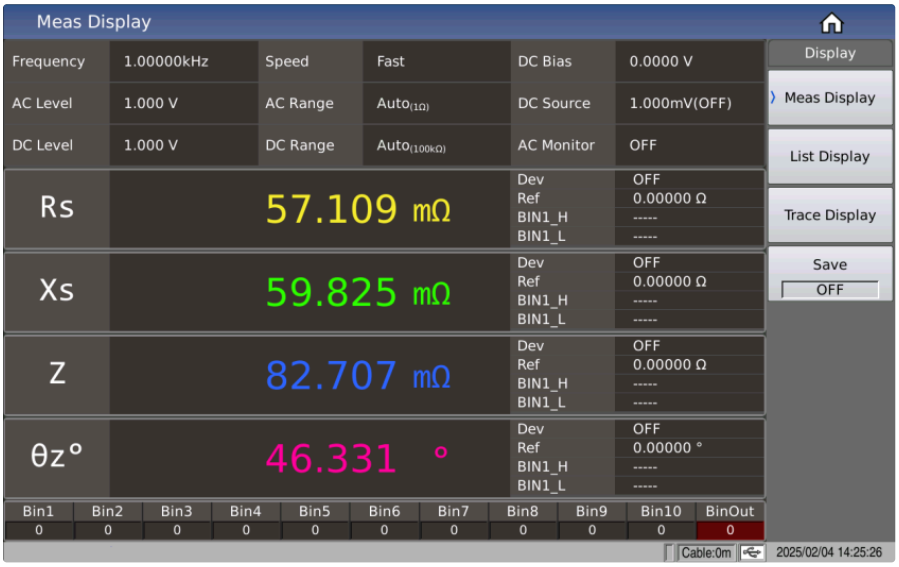
CHAPTER 4

Touchscreen Function Modules

This chapter documents every page reached from the front-panel **Display** and **Setup** keys. System-level setup and file management are covered separately in Chapter 5; the Handler comparator hardware is covered in Chapter 9.

4.1 <Meas Display>

Reached by pressing **Display**. Shows up to four simultaneous measurement results together with the active test conditions and bin/comparator status.



<Meas Display> page

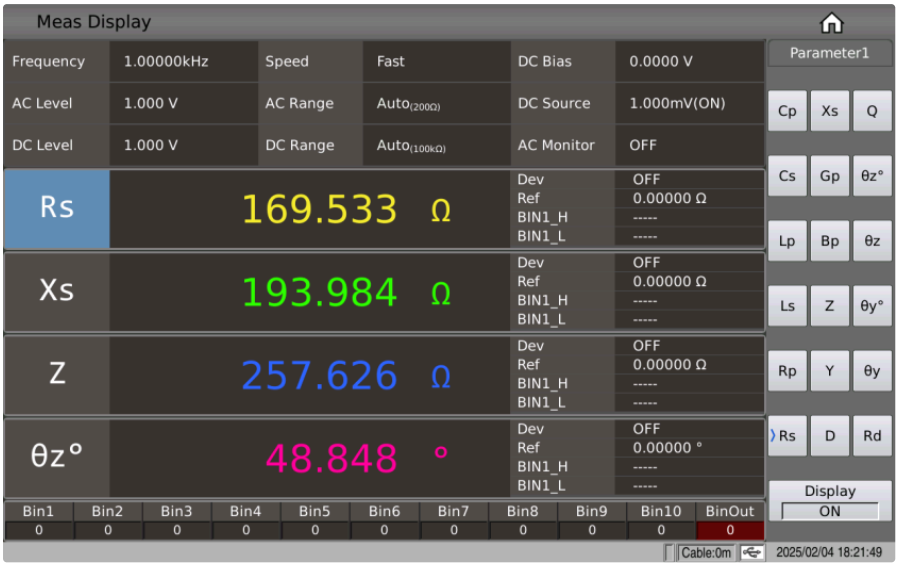
4.1.1 Common measurement conditions

Nine touchable fields appear in the measurement-condition zone; each is detailed fully in §4.4 <Meas Setup>:

Frequency	Speed	DC Bias
AC Level	AC Range	DC Source
DC Level	DC Range	AC Monitor

4.1.2 Test function selection

Tap a parameter name in the result zone to open the matching function menu in the touch-menu column, then tap the parameter you want:



Parameter function selection menu

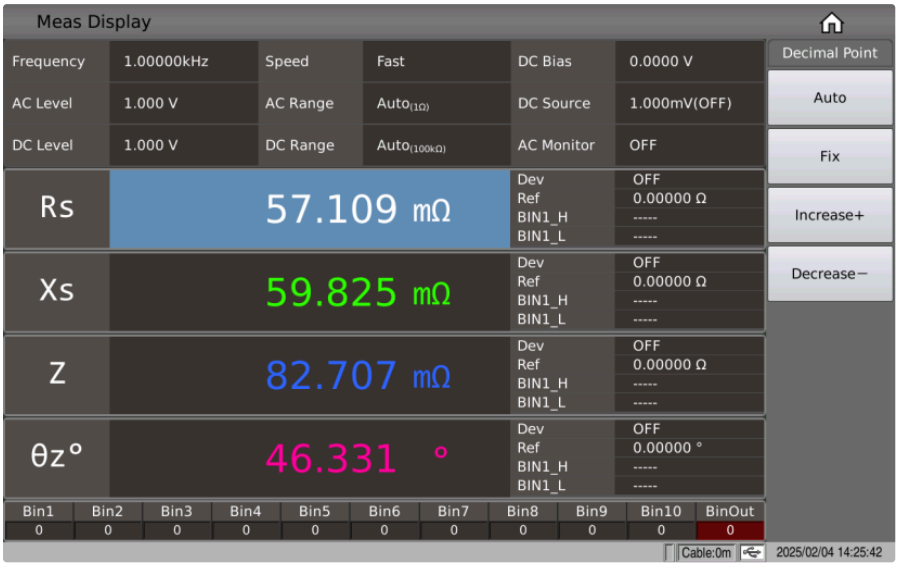
All four parameters can be measured simultaneously in a single measurement cycle, and any combination is allowed — there is no primary/secondary restriction:

Cp	Parallel capacitance	Cs	Series capacitance
Lp	Parallel inductance	Ls	Series inductance
Rp	Parallel resistance (EPR)	Rs	Series resistance (ESR)
Gp	Conductance	Bp	Susceptance
Z	Impedance magnitude	Y	Admittance magnitude
D	Dissipation factor	Q	Quality factor
θz°/θz	Impedance angle (deg/rad)	θy°/θy	Admittance angle (deg/rad)
X	Reactance	Rd	DC resistance

Each of the four result panels has its own display on/off switch (set from <Meas Display>); when off, the panel shows `OFF` in place of a reading.

4.1.3 Decimal point position

Controls the resolution at which a reading is displayed, and gives a visual sense of reading stability. Position moves left/right while keeping the number of significant digits fixed.



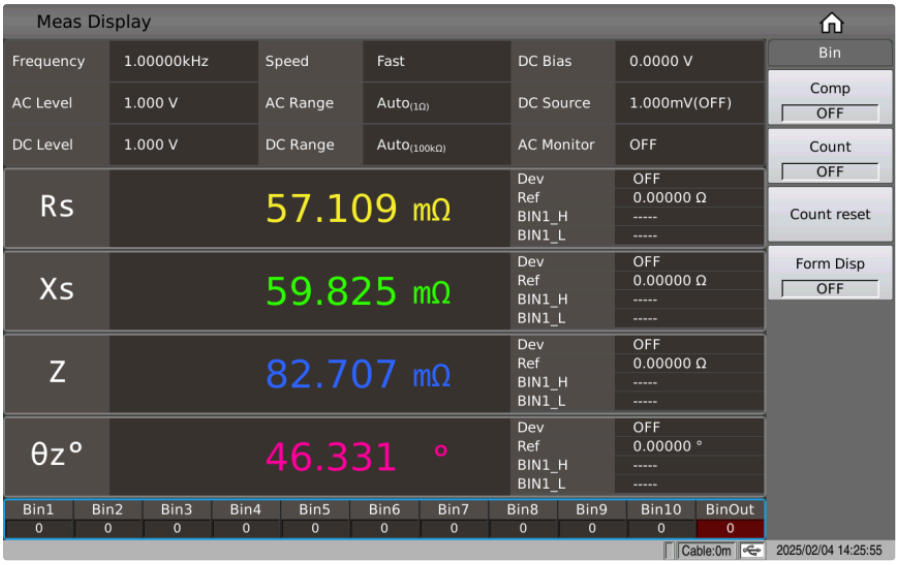
Decimal-point menu

Option	Function
Auto	Default — the decimal point floats automatically
Fix	Locks the decimal point at its current position
Increase+	Moves the locked decimal point left
Decrease−	Moves the locked decimal point right

> **NOTE**
> A locked decimal point automatically reverts to floating (Auto) whenever the test function or deviation mode changes.

4.1.4 Bin/comparator quick settings

Tapping the bin-result strip opens quick controls for the comparator:



Bin/comparator quick-settings menu

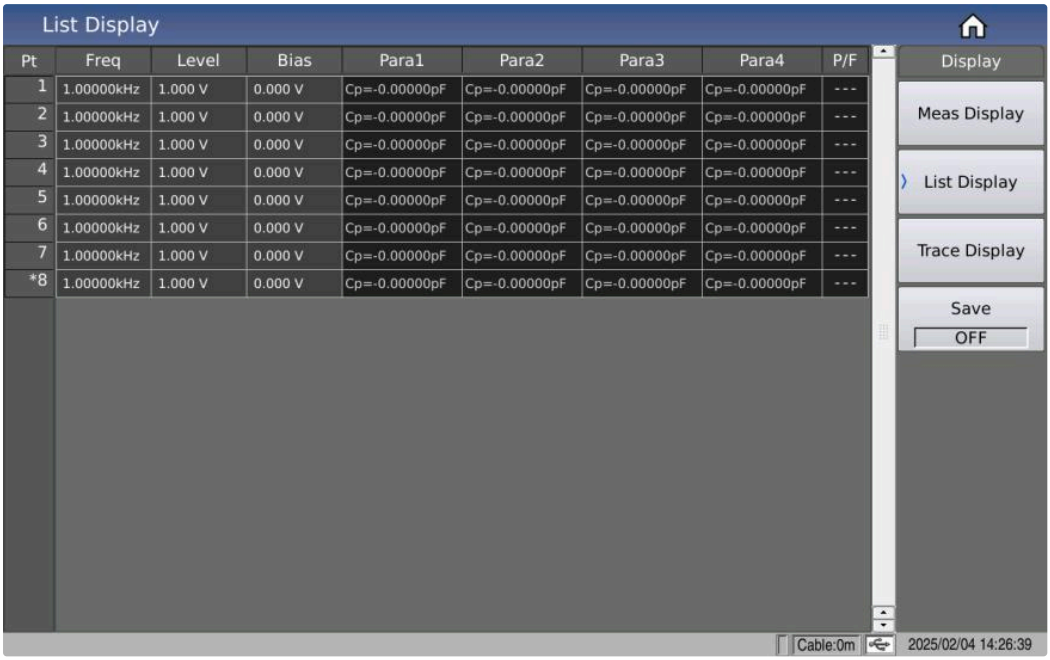
Field	Function
Comp	Comparator on/off (default OFF). Sorts the DUT into up to 11 bins (BIN1–BIN10 and BIN OUT) using the limits set on <Limit Setup> (§4.5); results can be streamed to automated handling equipment via the HANDLER interface (Chapter 9).
Count	Bin-count accumulation on/off (default OFF).
Count reset	Zeroes the accumulated bin counts and restarts counting.
Form Disp	Toggles the per-bin count display format.

4.1.5 Saving results to USB

<Meas Display> can log every reading to a connected USB drive in the format `Time,P1,P2,P3,P4,BIN` (test time, the four parameter results, and the bin result). Files are written under `usb/CSV/`, named `rx-<serial>-<date>.csv`.

4.2 <List Display>

Up to 201 points of test frequency, level, DC bias, delay and per-point limits are entered on <List Setup> (§4.6); <List Display> runs the sweep and shows each point's result against its limit. An asterisk (*) at the left marks the point currently being tested.

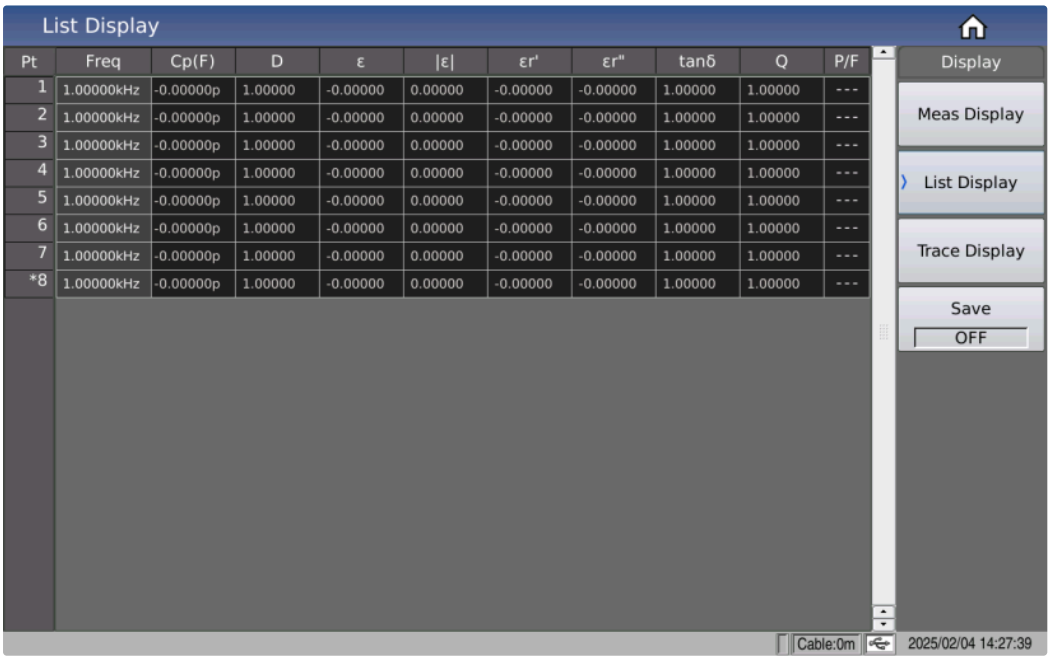


<List Display> — standard four-impedance-parameter view

The rightmost **P/F** column shows each point's comparison result: `---` (not yet compared), **PASS** (green) or **FAIL** (red).

4.2.1 Dielectric-constant list view

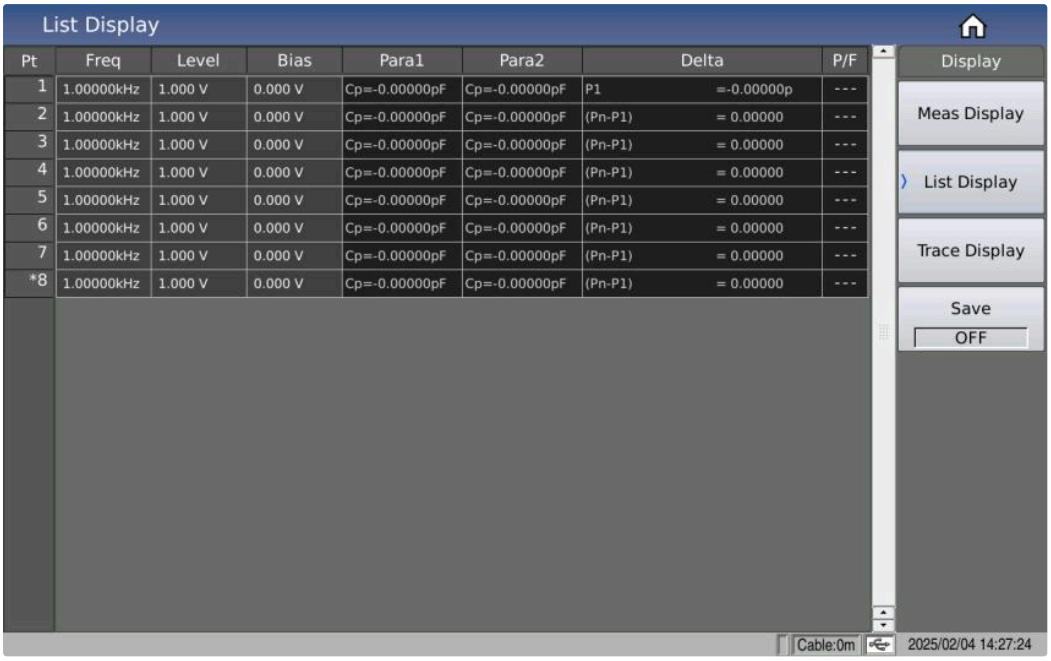
On models with the dielectric-constant option (TH2848-05/-10; see §2.1), turning on the Dielectric switch on <List Setup> replaces the four-parameter columns with the dielectric result set:



<List Display> — dielectric-constant view (Cp, D, ε, |ε|, εr′, εr″, tanδ, Q)

4.2.2 Delta (difference) mode

When Delta Mode is enabled on <List Setup>, Parameter 1 of each point is compared against the Parameter 1 reading at sweep point 1 or point 2; Parameter 2's raw result is hidden and a Delta column is shown instead:



<List Display> — Delta mode

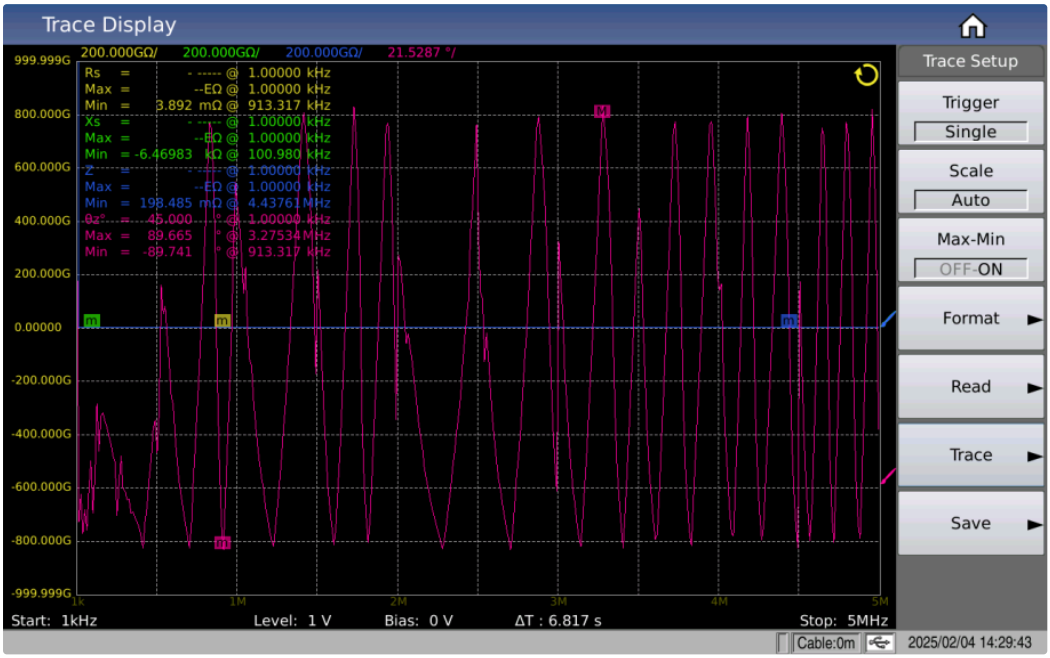
> **NOTE**
> Delta mode and the dielectric-constant switch cannot both be active — enabling one automatically turns the other off.

4.2.3 Saving results to USB

Format: `Time,pt,para1-4,P1,P2,P3,P4,COMP` (test time, point index, the four active parameters, the four results, comparator result). Files are written under `usb/CSV/`, named `list-<serial>-<date>.csv`.

4.3 <Trace Display>

Sweeps the DUT across a user-defined range of frequency, AC level or DC bias — 51, 101, 201, 401 or 801 points, linear or logarithmic — and plots up to four parameters' response live on screen. Any point in the sweep can be read back with the cursor, and each trace's extreme (max/min) values are shown alongside it.

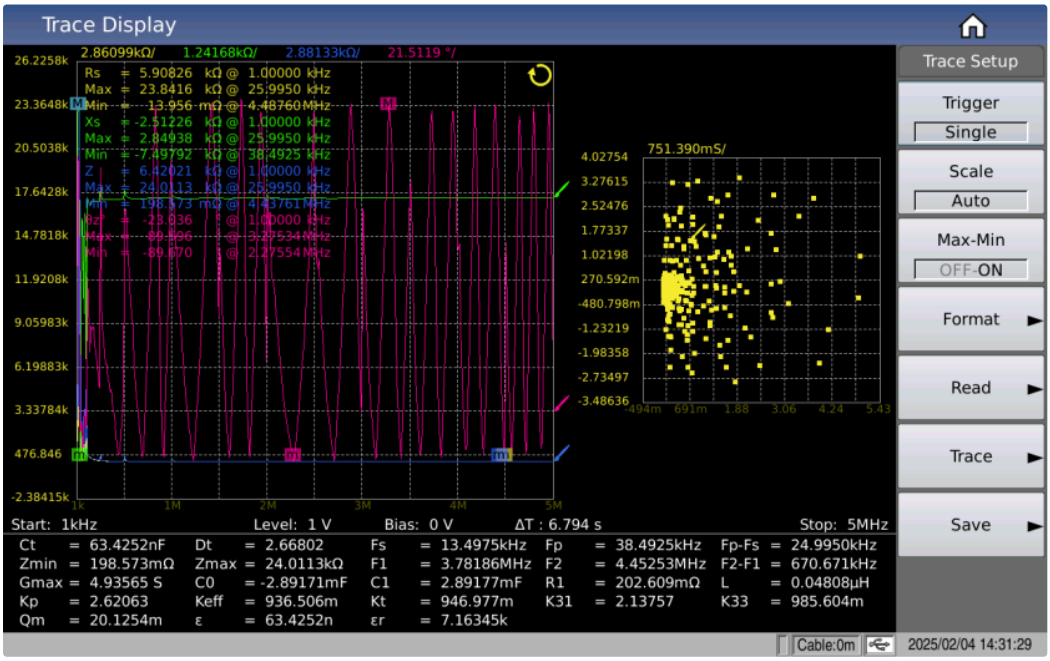


<Trace Display> page

> **NOTE**
> After configuring the sweep conditions, press the front-panel **Trigger** key to start the sweep. **Reset** pauses a running sweep; pressing it again restarts from the first point.

4.3.1 Piezoelectric admittance-circle testing

On models with the piezoelectric option (TH2848-02/-05/-10; see §2.1), <Trace Display> integrates a piezoelectric-ceramic test solution built on the same sweep engine, including an admittance-circle plot:

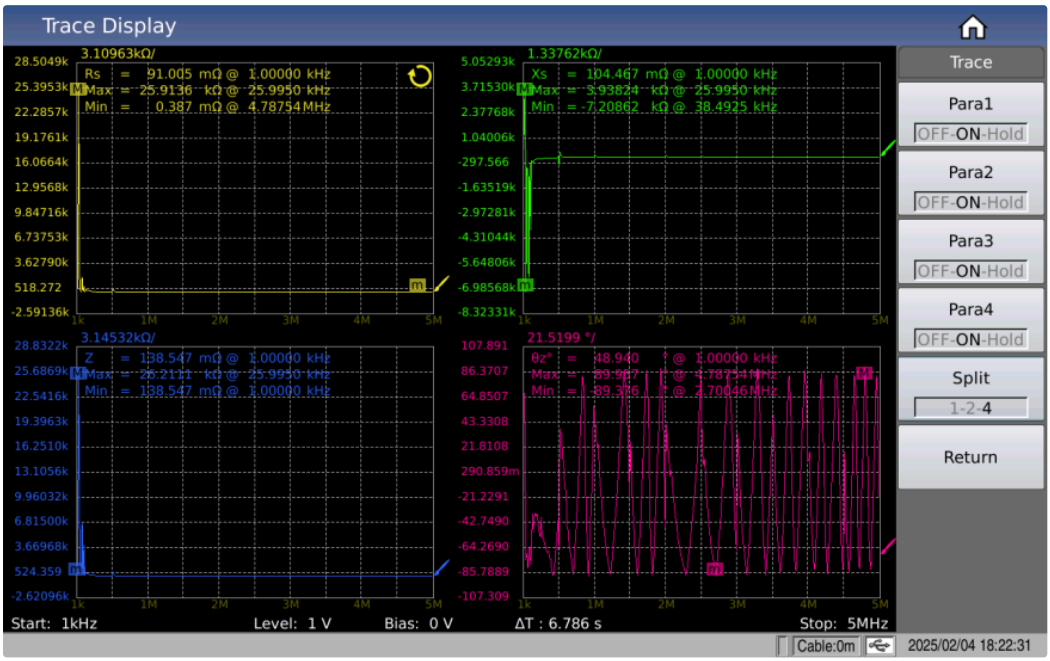


<Trace Display> — piezoelectric admittance-circle test

Condition setup (formulas for Kp, Qm, Kt, K31, K33) is reached from <Trace Setup> (§4.7.4).

4.3.2 Split-screen views

Option	Effect
1-split	All active traces share one plot window
2-split	The four parameters are grouped in pairs, each pair in its own window
4-split	Each of the four parameters gets its own independent window



4-split trace view

4.3.3 Cursor readout

A red cursor line, moved with the rotary knob or the ◄ ► keys, reads out every active trace's value at the same sweep condition:

Read mode	Function
OFF	Cursor hidden
Manual	Cursor position set manually (knob or ◄ ►)
Para1–4 Min / Max	Cursor automatically tracks the minimum or maximum of the selected parameter

4.3.4 Ultrasonic/resonator result parameters

When the sweep parameter is frequency and impedance-family results are shown, the instrument also derives a standard set of resonator parameters automatically:

Ct	Static (1 kHz) capacitance	Dt	Static (1 kHz) dissipation
Zmin @ fs	Minimum impedance and its frequency (cursor **m**)	Zmax @ fp	Maximum impedance and its frequency (cursor **M**)

ΔF = fp − fs, with the coupling coefficient and mechanical Q factor derived as:

$$k_p \approx 2.51\cdot\sqrt{(\Delta F / fs)} \qquad Q_m = f_p^{\,2} / [2\cdot f_s\cdot Z_{min}\cdot C_T\cdot(f_p^{\,2} - f_s^{\,2})]$$

4.3.5 Saving results to USB

Format: `Time,pt,x,P1,P2,P3,P4,COMP` (test time, point index, x-axis value, the four results). Continuous save writes `trace-<serial>-<date>.csv`; a single (triggered) save writes `trace-trg-<serial>-<date>.csv`. Files are written under `usb/CSV/`.

4.4 <Meas Setup>

Reached via Setup → Meas Setup. Shares FUNC/FREQ/LEVEL/RANGE/BIAS with <Meas Display> and exposes every measurement condition on one screen.



<Meas Setup> page

4.4.1 Frequency

Overall range 4 Hz – 10 MHz, split by model as in §2.1. Resolution narrows as frequency rises:

Frequency range	Resolution
4 – 99.999 Hz	0.0001 Hz
100 – 999.9 Hz	0.001 Hz
1 – 9.999 kHz	0.01 Hz
10 – 99.99 kHz	0.1 Hz
100 – 999.9 kHz	1 Hz
1 – 10 MHz	10 Hz

Enter a value with the numeric keypad, or step with the coarse (**++**, jumps to the next decade point: 4, 20, 100 Hz…1, 2, 5, 10 MHz) and fine (**+**, next standard point) soft keys.

4.4.2 AC level

Sets the RMS test-signal level, as voltage or current, at the internally generated sine-wave test frequency. Range depends on both model and frequency band:

Model	Frequency band	AC voltage range	AC current range
TH2848-02	[4 Hz, 1 MHz] (1 MHz, 2 MHz]	0–20 V 0–15 V	0–100 mA 0–100 mA
TH2848-02L	[4 Hz, 2 MHz]	0–2 V	0–20 mA
TH2848-05	[4 Hz, 1 MHz] (1 MHz, 2 MHz] [2 MHz, 5 MHz]	0–20 V 0–15 V 0–2 V	0–100 mA 0–100 mA 0–20 mA
TH2848-10	[4 Hz, 1 MHz] (1 MHz, 2 MHz] (2 MHz, 5 MHz] (5 MHz, 10 MHz]	0–20 V 0–15 V 0–2 V 0–1 V	0–100 mA 0–100 mA 0–20 mA 0–10 mA

Voltage and current levels are linked through the fixed 100 Ω source impedance (ACV = 100 × ACI). The set voltage is the open-circuit (Hcur) voltage; the set current is the short-circuit current.

AC voltage (Vrms)	Resolution	AC current (Arms)	Resolution
[0, 0.2)	0.1 mV	[0, 2m)	1 µA
[0.2, 0.5)	0.2 mV	[2m, 5m)	2 µA
[0.5, 1)	0.5 mV	[5m, 10m)	5 µA
[1, 20]	1 mV	[10m, 100m]	10 µA

With **Auto Level Control** (ALC, §4.4.11) enabled, the instrument continuously adjusts its internal drive so the DUT sees the set level regardless of loading; the level field then shows a trailing "*". Switching between voltage and current units requires the touch menu, not the magnitude keys alone.

4.4.3 DC level (DC-resistance test)

Sets the drive condition for the Rd (DC resistance) function, independent of the AC level above.

Quantity	Range	Resolution
Voltage (100 Ω internal resistance)	0.1 – 1 Vrms	0.1 mV
Current	0 – 10 mA	1 µA

4.4.4 Speed

Actual measurement speed depends on integration time (A/D conversion), averaging count and measurement delay. Slower speeds give a more stable, accurate reading.

Speed	Time @ 1 kHz	Time @ 1 MHz
Fast	19.8 ms	2.58 ms
Medium	110 ms	90 ms
Slow	252 ms	220 ms

Measured with a held range, AC monitor off, zero trigger/step delay, ALC off, averaging = 1.

4.4.5 Range

AC and DC ranges are set independently; both offer AUTO and HOLD (with Increase+/Decrease− step keys once held).

Range set	Steps
AC (LCRZ) — 15 ranges	0.1 Ω, 1, 10, 20, 50, 100, 200, 500 Ω, 1, 2, 5, 10, 20, 50, 100 kΩ
DC (Rd) — 13 ranges	10, 20, 50, 100, 200, 500 Ω, 1, 2, 5, 10, 20, 50, 100 kΩ
DCI (bias current)	20 µA, 200 µA, 2 mA, 20 mA, 100 mA

> **NOTE**
> Setting DC Range to HOLD automatically also sets DCI Range and AC Range to HOLD (and AUTO likewise cascades to AUTO). If DC bias is on when an Rd measurement starts, bias is switched off automatically; bias cannot be applied together with Rd and (Lp or Ls) in the same parameter set.

4.4.6 DC bias

Two internal sources plus an external option; the instrument enforces **Vosc×√2×1.15 + Vdc×1.002 < 42 V** (and the equivalent current-based forms) between AC level and DC bias at all times.

Bias source	Type	Range
Internal	Voltage	−10 V to +10 V (TH2848-02L) · −40 V to +40 V (TH2848-02/-05/-10)
	Current	−100 mA to +100 mA
External (TH1778)	Current	0–120 A, set by the external bias unit

Press the front-panel **DC Bias** key to enable bias output; the key lights while bias is applied.

4.4.7 DC source

An independent DC voltage-source output, separate from the bias circuit, for quick bench use. Range **−10 V to +10 V**, 1 mV resolution. Set the value here, then toggle the output with the front-panel **DC SRC** key, which lights while the output is active.

4.4.8 AC monitor

When ON, <Meas Display> shows the actual AC voltage and/or current present at the DUT (rather than only the programmed level) in the AC Level / AC Range fields. Values change when open/short/load correction is switched on or off, since correction affects the true level at the test port.

4.4.9 Trigger

Mode	Behaviour
Continuous	The instrument re-triggers and re-measures continuously
Single	One measurement per front-panel **Trigger** press, HANDLER positive-edge pulse, or remote trigger command

A trigger received while a measurement is in progress is ignored. **Trigger delay** (0–60 s, 1 ms resolution) is the wait from the trigger event to the start of measurement — useful for letting a HANDLER fixture seat the DUT. **Step delay** (0–60 s, 1 ms resolution) is the wait between applying the test signal and starting the measurement; Rd measurements apply it twice (once per polarity), so the effective delay is doubled.

4.4.10 Average

Averages 1–255 readings (resolution 1). Independently of this, a fixed 8-reading moving average can be enabled for continuous measurement on <Meas Display>, for maximum stability on a settled DUT.

4.4.11 Auto Level Control (ALC)

Adjusts the internal drive so the real voltage across, or current through, the DUT tracks the set AC level as closely as possible — useful when DUT loading would otherwise pull the level away from its programmed value. If the set level falls outside the range ALC can maintain, ALC is switched off automatically and the setting is treated as an open-loop level.

4.4.12 Output impedance

The signal-source output impedance is fixed at **100 Ω**.

4.4.13 DCI isolation

Prevents DC bias current from disturbing the AC measurement path. With DCI isolation **ON**, up to 100 mA of bias current can flow through the DUT on any range. With it **OFF**, the maximum bias current is range-dependent:

Range	10 Ω	30 Ω	100 Ω	300 Ω	1 kΩ	3 kΩ	10 kΩ	30 kΩ	100 kΩ
Max. bias current	2 mA		1 mA		300 µA	100 µA	30 µA	10 µA	

> NOTE
> DCI isolation ON affects measurement accuracy — turn it OFF when testing high-impedance components at low frequency with small bias current.

4.4.14 Bias polarity

An AUTO polarity mode is provided for varactor-diode testing: the instrument applies a small internal sense voltage (~1 V) to detect how the diode is connected, then automatically applies the programmed bias in the correct (reverse-bias) direction — removing the need to check polarity by hand before connecting. AUTO shows a trailing "*" after the bias-voltage reading. If the diode is connected in reverse, the applied bias is inverted relative to the programmed value so the diode always sees reverse bias.

> NOTE
> Auto bias-polarity control has no effect while DC bias itself is off.

4.4.15 Deviation & reference

Displays a deviation from a reference instead of the raw reading — useful for tracking a parameter against temperature, frequency or bias.

Mode	Formula
Δ (absolute)	Δ = X − Y
Δ% (percentage)	Δ% = (X − Y) / Y × 100%; result shows `Inf` if Y = 0

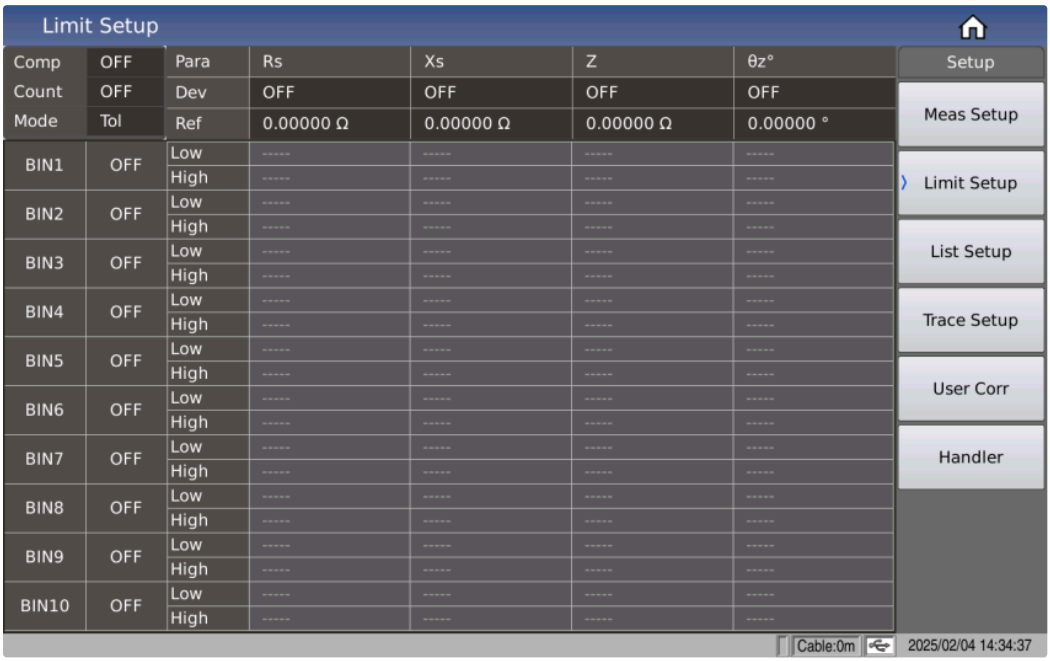
X is the current reading, Y the reference value — entered directly, or auto-captured by running one measurement against a known-good reference component.

4.4.16 Cylinder control

Controls an external pneumatic test-head cylinder: an on/off switch plus independently programmable open-delay and close-delay times (0–60 s).

4.5 <Limit Setup>

Configures the comparator used by the Comp switch on <Meas Display> (§4.1.4). Up to 10 bin limits (BIN1–BIN10) can be set; a DUT is sorted into the first bin whose limits it satisfies, or BIN OUT if none match.



<Limit Setup> page

Field	Function
Comp	Comparator on/off
Count	Bin-count accumulation on/off
Mode	Limit-entry mode — Tolerance or Sequential (see below)
Para	The measured parameter each bin's limits apply to — follows the four parameters set for measurement
Dev / Ref	Deviation display mode and reference/nominal value (§4.4.15)
BIN1–BIN10	Per-bin enable switch and Low/High limit, for each of the four parameters

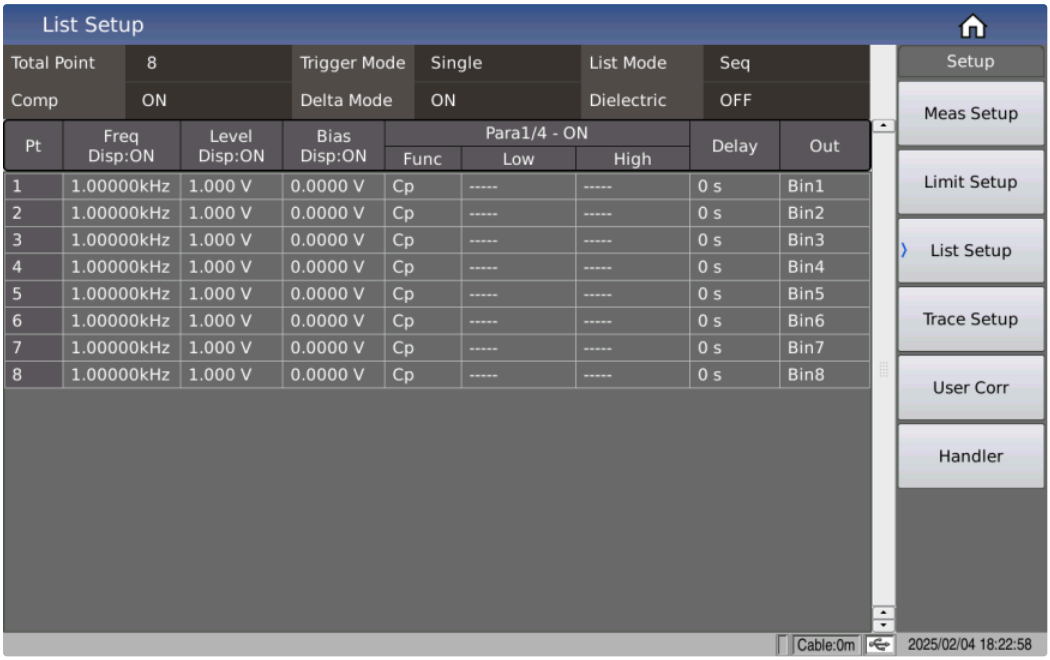
4.5.1 Limit modes

Mode	Basis
Tolerance	Each bin's limits are a deviation (absolute or %) from the nominal value set in the Ref field
Sequential	Each bin's limits are the raw test-value range itself, entered from smallest to largest

> **NOTE**
> In Tolerance mode, enter bin ranges from smallest to largest across BIN1→BIN10, or a DUT may be caught by the first (widest) bin that fits it rather than the intended one. In Tolerance mode a bin's low limit need not be below nominal, nor its high limit above it, and bin ranges may be non-contiguous or overlap; in Sequential mode, ranges must run low→high in sequence. A limit left blank on one side only produces a single-sided comparison for that bin.

4.6 <List Setup>

Configures the up-to-201-point sweep read on <List Display> (§4.2): total points, trigger/list mode, per-point frequency/level/bias/delay, per-parameter limits, and per-point output routing.



<List Setup> page

Field	Function
Total Point	Number of sweep points, 1–201
Trigger Mode	Same options as §4.4.9; with Reset, one press pauses (resume continues from the current point), two presses restarts from point 1
List Mode	**Seq** — one trigger sweeps every point in order. **Step** — one trigger advances one point. The visible difference is clearest under Single trigger mode.
Comp	List-level compare on/off — when OFF, points are still measured and logged but no PASS/FAIL judgement or HANDLER output is produced (default ON, for compatibility with earlier list-scan instruments)
Delta Mode / Dielectric	See §4.2.2/§4.2.1 — mutually exclusive

4.6.1 Dielectric-constant testing

All models except TH2848-02L support the dielectric-constant solution, built directly on the list-sweep engine — the same setup covers both single-frequency and multi-frequency dielectric testing, simply by whether the list's frequency points repeat or vary.

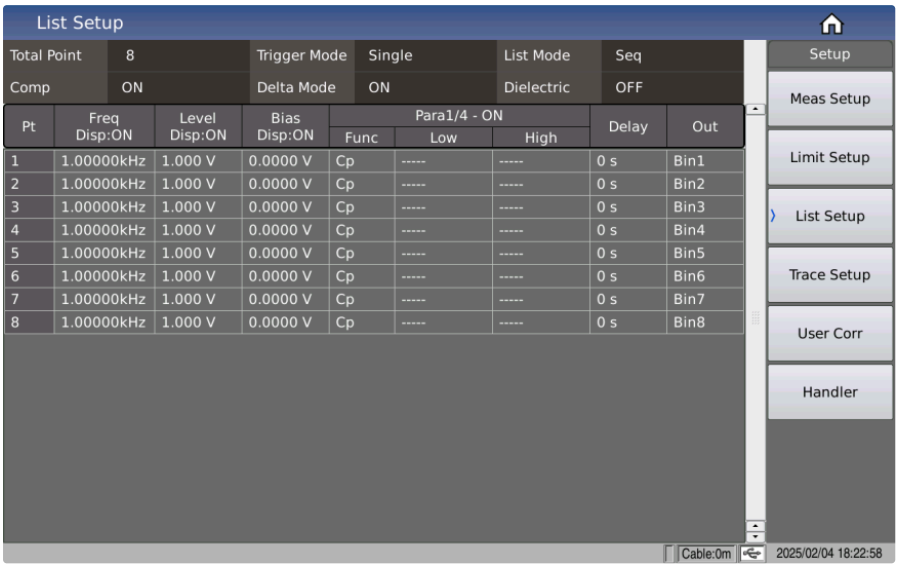


Dielectric sample-size configuration (diameter/area, thickness)

With the Dielectric switch ON, <List Display> shows the dielectric parameter set (§4.2.1) instead of the four standard parameters, and comparison uses the dielectric limits configured here rather than the Parameter 1–4 limits.

4.6.2 Scan conditions per point

Frequency, level and bias can each be set independently per point, or copied quickly across points when only one condition needs to vary. The Para Disp menu selects which of the four parameters' function and limits are currently being edited (it only changes what is shown for editing, not what is measured):



List scan-condition columns: Freq, Level, Bias, Para1–4 (Func/Low/High), Delay, Out

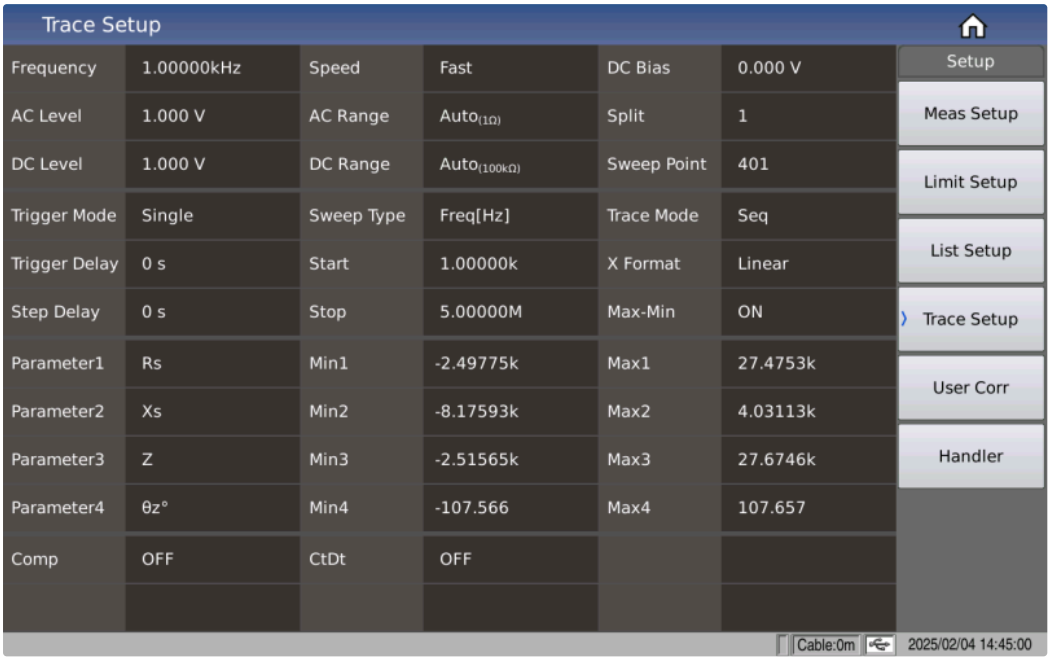
Delay is the wait after each point's measurement completes before the next point starts — mainly used to accommodate settling time on an external bias source (e.g. TH1778); it adds to the <Meas Setup> step delay rather than replacing it.

4.6.3 Bin output routing

Unlike earlier list-scan instruments, where the first 10 points map one-to-one to BIN1–BIN10, the TH2848 series lets each point's comparison result be routed to any Bin output pin — including several points sharing one pin (that pin fails if any of its mapped points fail). The default routing (point 1→Bin1 … point 10→Bin10) remains available for compatibility. The physical HANDLER output behaviour is defined on the <Handler> page (§4.9, Chapter 9).

4.7 <Trace Setup>

Configures the sweep read on <Trace Display> (§4.3): common test conditions, the four trace parameters, sweep type and range, split-screen layout, comparison limits and (where fitted) the piezoelectric test.



<Trace Setup> page

Frequency, level, speed, range, bias, trigger and delay behave exactly as on <Meas Setup> (§4.4). The four trace parameters are independent of the four parameters used elsewhere: any function can be assigned to any of the four traces except Rd, each with its own display on/off, scale and Y-axis range, but all four share one X-axis (the swept condition).

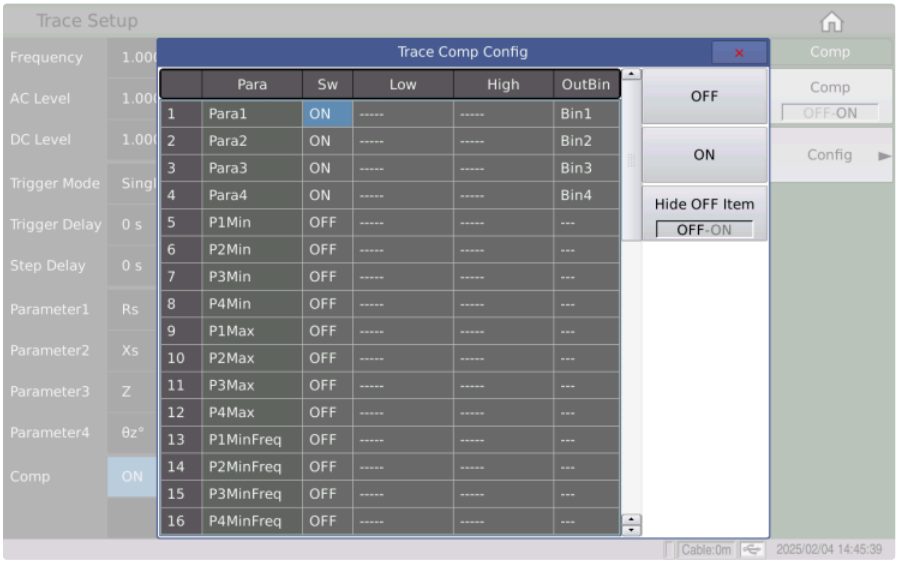
4.7.1 Sweep type & range

Sweep parameter	Linear	Logarithmic
Frequency [Hz]	✓	✓
Level [V] / [A]	✓	—
Bias [V] / [A]	✓	—

Set the start and stop values of the swept condition; log-scale X is only available when sweeping frequency.

4.7.2 Trace mode & split screen

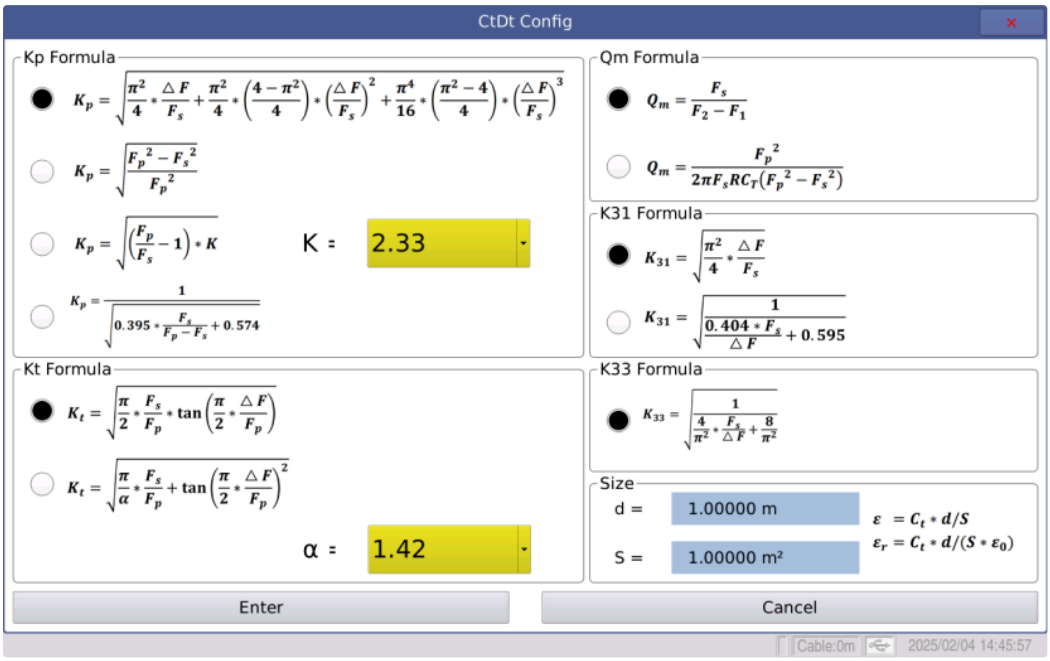
Trace Mode offers the same Seq/Step choice as List Mode (§4.6); split-screen options are 1/2/4-split as described in §4.3.2. Max-Min toggles the extreme-value readout; Comp opens the trace comparator (range checks on whole traces, on a trace's extreme value, on the extreme value's X-position, and — where fitted — on piezoelectric parameters):



Trace comparator configuration — Para1–4, per-parameter Min/Max and MinFreq/MaxFreq checks, each independently switchable

4.7.3 CtDt piezoelectric-ceramic testing

All models except TH2848-02L carry the piezoceramic test solution, covering Kp, Qm, Kt, K31, K33 and the CtDt parameter set, with a dedicated admittance-circle plot, a full-screen parameter readout and programmable comparison on every parameter. The underlying formula for each derived coefficient is selectable:

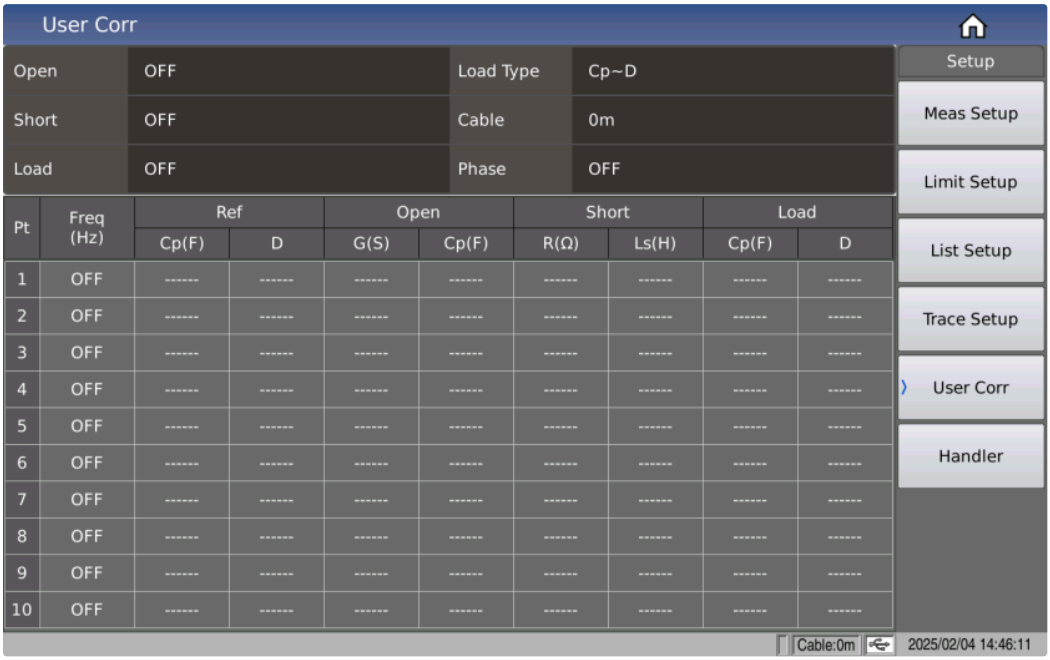


CtDt formula configuration — Kp, Qm, Kt, K31, K33 and sample size (thickness d, electrode area S)

Symbol	Meaning	Symbol	Meaning
Ct	Free capacitance (Cs @ 1 kHz)	C0	Static capacitance of the resonator (C0 = Ct − C1)
Dt	Free dissipation (D @ 1 kHz)	C1	Dynamic capacitance at resonance
Fs	Series resonant frequency	R1	Dynamic resistance (reciprocal of the conductance excess at the impedance-minimum point)
Fp	Parallel resonant frequency	L1	Dynamic inductance
Fp−Fs	Difference between the two resonant frequencies	Kp	Planar coupling coefficient (thin-disc ceramic, thickness-polarized, radial mode)
Zmin / Zmax	Minimum / maximum impedance (anti-resonance)	Keff	Effective electromechanical coupling coefficient
F1, F2	Half-power points of the resonator	Kt	Thickness coupling coefficient (thin-plate ceramic, thickness mode)
F2−F1	Half-power bandwidth	K31 / K33	Transverse / longitudinal coupling coefficient (slender-rod ceramic)
Gmax	Maximum conductance	Qm	Mechanical quality factor
d / S	Dielectric sample thickness / electrode area	ε / εr	Dielectric constant / relative dielectric constant

4.8 <User Corr>

Ten user correction spots let you remove stray admittance, series parasitic impedance and other systematic error from the test fixture and leads, via open, short and load correction.



<User Corr> page

Method	Description
Full-range correction	Interpolated open/short correction across the whole frequency range, from a fixed set of calibrated points (§4.8.1)
Point-frequency correction	Open, short and load correction at one specific, user-set frequency (§4.8.1, up to 10 spots)

> NOTE
> If both full-range and point-frequency correction are active at the measurement frequency, point-frequency data takes priority.

4.8.1 Open correction

Removes the error from stray admittance (G, B) in parallel with the DUT. With the fixture left open (no DUT), running full-range open correction measures open admittance at a set of fixed calibration frequencies (the count and range scale with each model's maximum frequency); other frequencies use interpolation between them. Full-range open correction takes roughly 75 seconds.

4.8.2 Short correction

Removes the error from series parasitic impedance (R, X) in the DUT path. With the fixture shorted (short plate TH26010 or equivalent), running full-range short correction measures short-circuit impedance at the same fixed calibration frequencies, again taking roughly 75 seconds.

4.8.3 Load correction

Computes a transfer coefficient between the actual measured value and a known standard-component reference value at one set frequency, removing residual error beyond what open/short correction alone can reach. Enter the reference values first, then run open, short and finally load correction at that frequency. Load correction is valid only for components of the specification used to derive it — redo it if the specification changes. Three load types are supported: **Ls-Rs**, **Ls-Q**, **Cp-D**.

4.8.4 Cable length & phase correction

Selectable cable length: **0 m, 1 m** standard (factory-calibrated); 2 m and 4 m are available as a custom-order calibration. Default is 0 m. Phase correction, when needed for an unusual test setup, provides a manual override of the system's built-in phase-correction data for the selected cable length; leave it OFF to use the built-in data, which is correct for normal use.

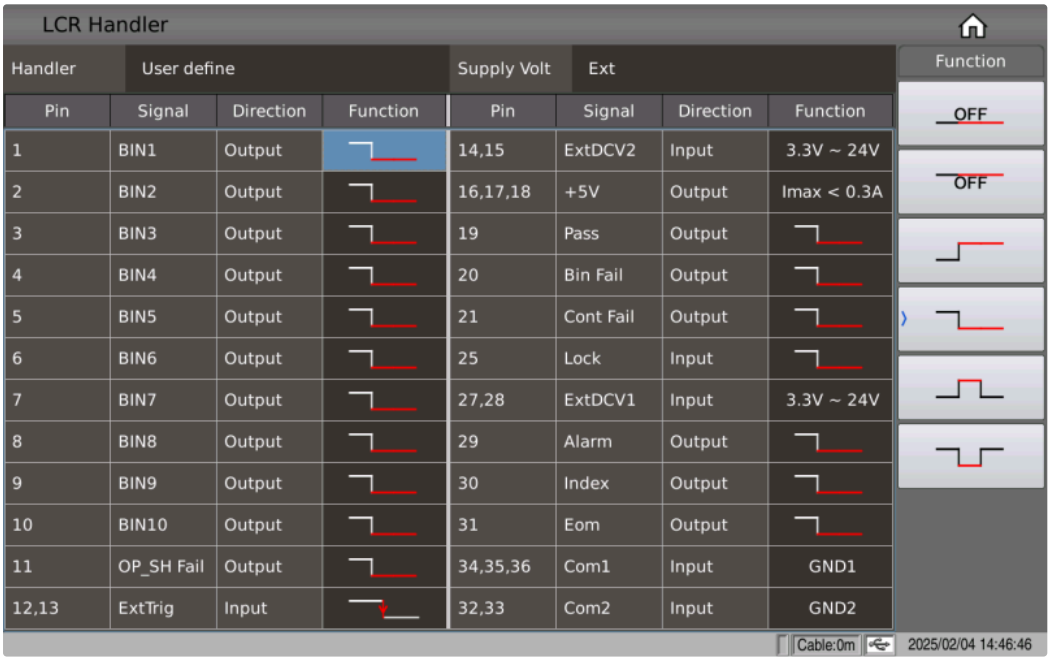
4.8.5 Point-frequency correction procedure

1. Move the cursor to the frequency field for the spot you want to use, and enter the correction frequency.
2. With the fixture open, run **open correction** for that spot.
3. With the fixture shorted, run **short correction** for that spot.
4. Set the Load Type to match your reference component's parameter, connect the reference component, and run **load correction**.

> **CAUTION**
> Only one spot's correction status is visible at a time, so it is easy to lose track across up to 10 point-frequency spots. Clear all point-frequency correction data before starting a new set if you are not certain of the existing state.

4.9 <Handler>

Configures the electrical behaviour of the rear-panel HANDLER interface — active-high/active-low polarity per signal and the internal/external interface-voltage source. Full pin definitions, electrical characteristics and timing are given in Chapter 9.



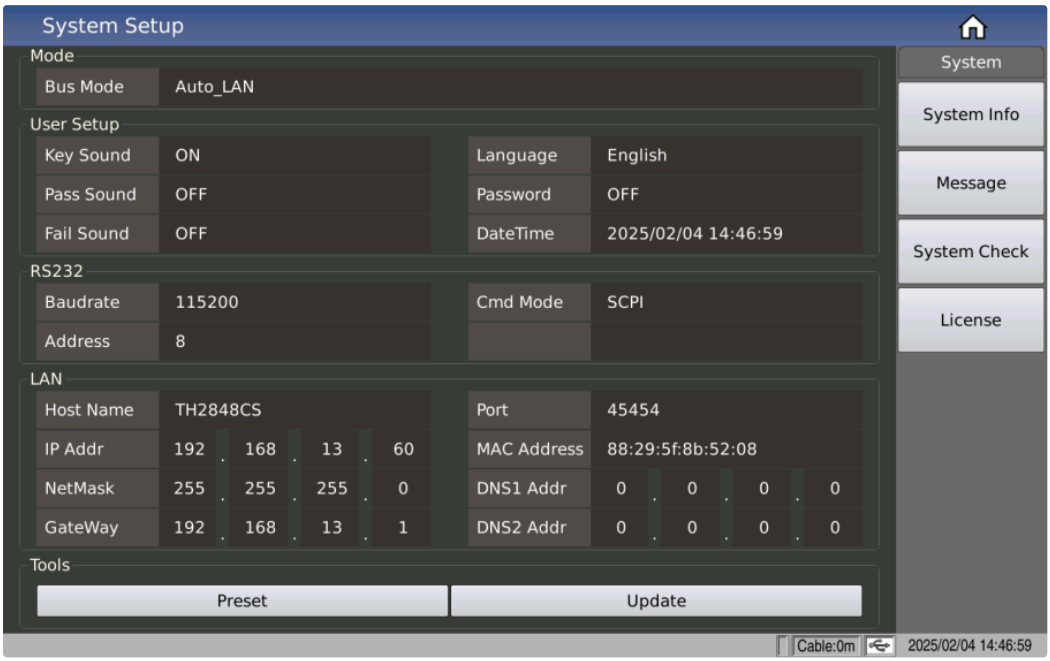
<Handler> page — per-pin signal, direction and active-edge configuration

CHAPTER 5

System Setup & File Management

5.1 <System Setup>

Reached by pressing **System**. Covers communication mode, user preferences, RS232, LAN, and firmware/maintenance tools.



<System Setup> page

5.1.1 Bus mode

Option	Description
Auto	Selects RS232/LAN/USB automatically from external signal input
RS-232 / RS-485 / GPIB	Switched via internal relays — in Auto mode the instrument can only fall back to whichever of these three was last active
LAN	10M/100M auto-sensing
USB Device	USBCDC or USBTMC

When RS-485 or GPIB is used, the bus address set under RS232 (§5.1.3) is used as this unit's address.

5.1.2 User setup

Field	Options
Key Sound	ON / OFF
Pass Sound / Fail Sound	OFF, Two-Short, Low-Long, High-Short, High-Long — independently for a qualified and an unqualified comparator result
Password	OFF · Lock System (startup + files) · Lock File (files only) · Lock Setting (limits touch-panel setting changes) · Modify (change password). Factory default: `2848`
DateTime	Sets the instrument's real-time clock

5.1.3 RS232 serial setup

Fixed frame: 8 data bits, 1 stop bit, no parity.

Field	Options
Baud rate	4800, 9600, 19200, 38400, 57600, 115200
Address	1–32 (also used for RS-485, GPIB and MODBUS)
Cmd Mode	SCPI (ASCII string protocol) or MODBUS

Full SCPI and MODBUS command syntax is documented in the companion TH2848 Series SCPI & MODBUS Command Reference; see Chapter 8 of this manual for an overview.

5.1.4 LAN

Configure network parameters to match your LAN before connecting the rear-panel network cable. Double-tap an address field to open the numeric keypad and edit it directly, or use the on-screen Auto button to request an address by DHCP (allow a few seconds; do not operate the instrument during negotiation). If DHCP fails, the instrument may fall back to the loopback address 127.0.0.1 — use the Default button to restore the factory network configuration and adjust from there, or consult your network administrator.

Port (default)	45454
Factory default IP	192.168.22.209
Factory default gateway	192.168.22.1

5.1.5 Tools — Preset

Gives every instrument a known, consistent starting state:

Menu	Resets	Command
Clear Setting	Front-panel and SCPI-set parameters, to factory defaults	`*RST`
Clear Set & Corr	As above, plus power-on-state memory and all user correction data	`:SYST:PRES`
Factory Default	As above, plus power-on-state memory, user correction data, and all user-saved files	`:SYS:DEFT`

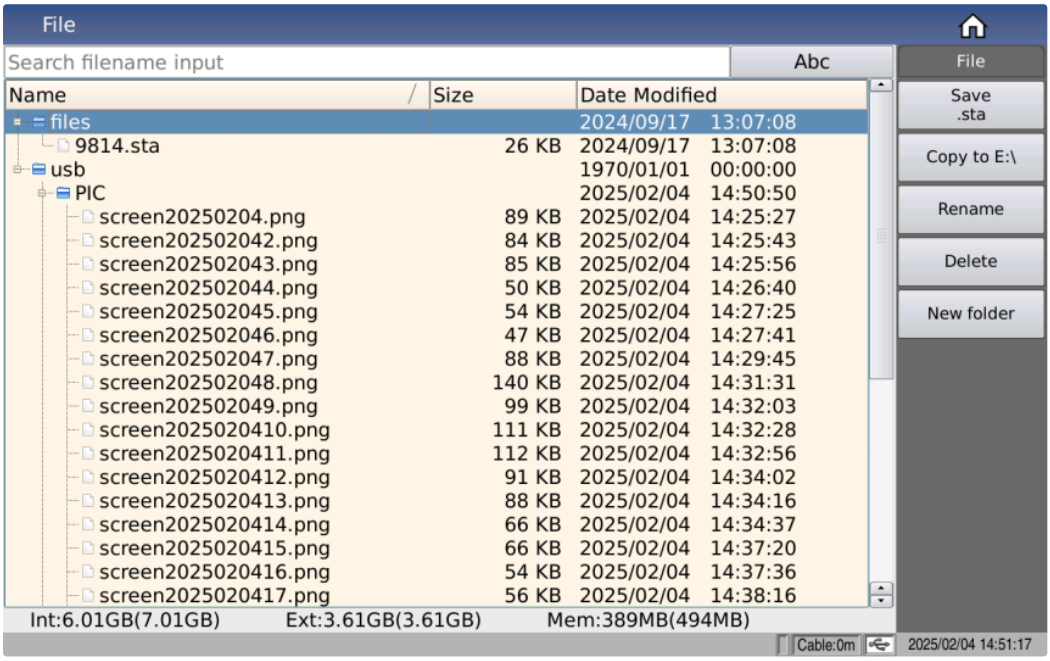
None of the three Preset options clears factory calibration data or the real-time clock.

5.1.6 Firmware update

The instrument carries multiple internal CPUs; a one-key update lets a single action bring all of them up to date. After starting an update, wait roughly 30 seconds without operating the instrument — it restarts automatically once complete, and the System Setup page can then confirm the new firmware version. Three update paths are supported: selecting a specific file from the file-management list; the default path (place `update2848.sec` in the root of a USB drive and trigger one-key update); or Techmize's PC-side update utility pointed at a specific file.

5.2 <File Management>

Reached via File or Setup → File. Instrument setups can be saved as files, either in internal storage or on a USB drive, and reloaded later instead of re-entering every setting by hand.



<File> management page

5.2.1 USB drive requirements

USB 2.0 mass-storage device, formatted FAT16 or FAT32 (format on Windows if the drive is not recognized).

5.2.2 File types

Type	Extension	Reloadable?	Purpose
LCR setup file	`.sta`	Yes	Saves the instrument's complete LCR test configuration
Screenshot	`.png`	No	Saves a screen capture (USB drive only)
Test data	`.csv`	No	Logged measurement data (USB drive only)

`files` refers to internal storage; `usb` refers to an external USB drive. Setup files can be stored either internally or externally; screenshots and logged test data can only be written to a USB drive.

5.2.3 Basic file operations

Move the cursor with the up/down keys or the rotary knob; use left/right to expand or collapse a folder. Select a file or folder to see its available actions in the menu column: **Save .sta** (save the current setup under a new name in the current folder), **Load** (apply the selected setup file), **Copy to E:** / **Copy to I:** (copy between the USB drive and internal storage — an existing file of the same name on the destination is overwritten; an existing same-named folder causes the copy to fail), **Rename**, **Delete**, **New folder**. The provided root folders cannot be renamed.

CHAPTER 6

LCR Measurement Examples

6.1 Zero-correction procedures

Perform an open/short correction before relying on a measurement, to remove the effect of stray impedance. Press the front-panel **Cal** key to jump straight to <User Corr>.

6.1.1 Full-range (sweep) zero

1. Move the cursor to Open. With the fixture left open, select **Full-range Open Zero** and wait for the status message confirming completion; then set Open to **ON**.
2. Fit the short plate (TH26010) to the fixture. Move the cursor to Short, select **Full-range Short Zero** and wait for completion; then set Short to **ON**.
3. Move the cursor to Load and set it to **OFF** (unless load correction is also being used).
4. Move the cursor to Freq (point-frequency correction) and set it to **OFF** — full-range and point-frequency correction should not both be active at the same measurement frequency.

6.1.2 Point-frequency zero (best for single-frequency testing)

Example: testing at 5.5 kHz.

1. Move the cursor to Freq, set it to **ON**, and enter **5.5k** — the field shows 5.5000 kHz.
2. With the fixture open, run **Open Zero** for this frequency.
3. Fit the short plate and run **Short Zero** for this frequency.

6.2 Correct connection of the DUT

The instrument provides four independent test terminals — **Hcur** (current-source high), **Lcur** (current-source low), **Hpot** (voltage-sense high), **Lpot** (voltage-sense low) — each with its own shield return, to reduce stray ground capacitance and EM interference.

For accurate four-terminal measurement, connect Hc/Hp and Lc/Lp as separate pairs to the DUT leads, forming a true 4-terminal (Kelvin) connection that keeps lead and contact impedance out of the result — this matters most for loss measurements and low-impedance DUTs, where Hp/Lp should sense the voltage actually present at the DUT rather than adding lead impedance to the reading. Avoid tying Hc+Hp and Lc+Lp together ahead of the DUT unless the lead resistance R_{lead} is negligible against the DUT impedance Zx (rule of thumb: $R_{lead} < Zx/1000$, for <0.1% added error).

The supplied Kelvin test leads give good results up to about 10 kHz; above that, lead position starts to affect stray inductance/capacitance and a rigid test fixture should be used instead (or, if leads must be used, their position must be kept identical between correction and measurement). Whichever fixture is used — Kelvin leads, a standard fixture, or a user-made one — it needs low distributed impedance, low contact resistance, and a reliable open/short state for correction.

> **WARNING — DISCHARGE THE DUT**
> Discharge polarized or capacitive components before connecting them to the test terminals. Connect a polarized component's positive/high terminal to Hc/Hp, and its negative/low terminal to Lc/Lp.

6.3 Eliminating the influence of stray impedance

For high-impedance DUTs (e.g. small capacitance), stray capacitance between the test leads and any nearby ground plane can add a significant parallel error path. Fitting a grounded shield conductor between the high and low terminals, and connecting it to any conductive surface under the DUT, removes most of this stray coupling — the same "guarded" connection principle used by Techmize's standard test fixtures.

For low-impedance DUTs (e.g. small inductance, large capacitance), the current flowing through Hc/Lc is larger, so beyond contact-resistance effects, electromagnetic coupling between the measurement leads becomes the dominant error source — as a rule of thumb, contact resistance affects the resistive part of the measured impedance, while lead coupling affects the reactive part. A four-terminal-pair connection, where the current in Hc/Lc and their shields is equal and opposite, cancels the resulting magnetic fields and removes most of this mutual-inductance error.

6.4 Example 1 — testing inductance

Function	Ls-Q
Frequency	5.5 kHz
Level	1.5 Vrms
Output impedance	100 Ω

1. Power on the instrument (§3.6).
2. On <Meas Display>, set the parameter to **Ls** and the secondary to **Q**; set frequency to 5.5 kHz and level to 1.5 V.
3. On <Meas Setup>, confirm output impedance is **100 Ω**.
4. Fit test fixture TH26005 to the test terminals.
5. Perform a point-frequency zero at 5.5 kHz (§6.1.2).
6. Insert the inductor under test into the fixture and read the result on <Meas Display>.

If the reading looks wrong: check the inductor's contact with the fixture, check the fixture's contact with the instrument terminals, and redo the open/short correction. If a full-range (swept) correction is in use, remember to keep point-frequency correction OFF (§6.1.1).

6.5 Example 2 — capacitance by multi-frequency list sweep

Frequency	Compare parameter	Low limit	High limit
1 kHz	Cp	325.0 nF	333.0 nF
10 kHz	D	0.0001	0.0003
100 kHz	D	0.0060	0.0100

Function Cp-D, level 1 Vrms, Fail Sound = High-Long.

1. Power on the instrument.
2. On <Meas Display>, confirm the parameters are **Cp** and **D**, level 1.000 V.
3. Open <List Setup> and enter the three frequency points above, each with its own compare parameter and limits (§4.6.2).
4. On <System Setup>, set Fail Sound to **High-Long**.
5. Fit test fixture TH26005, run a full-range zero correction (§6.1.1), then insert the capacitor under test.
6. Open <List Display> — the instrument sweeps continuously, showing each point's result and PASS/FAIL flag, and sounds an alarm on any out-of-limit point.

If the reading looks wrong: check the DUT's contact with the fixture, check the fixture's contact with the instrument terminals, and redo the open/short correction (keeping point-frequency correction OFF if using a full-range zero).

6.6 Example 3 — load correction

Reference component: Cp = 11 nF, D = 0.0005 at 100 kHz.

1. Press **Cal** to open <User Corr>. Set **Load** to ON, and Load Type to **Cp-D**.
2. Move to the frequency field, set it to **ON**, and enter **100k**.
3. Enter the reference values: Ref A = **11.0000 nF**, Ref B = **0.00050**.
4. With the fixture open (keep hands and other interference sources away), run **Open Zero**.
5. Fit the short plate (TH26010) so it makes reliable contact with the fixture, and run **Short Zero**.
6. Insert the reference (standard) capacitor so its leads make reliable contact with the fixture, and run **Load Correction**.

Load correction is valid only for components of the same specification as the standard used to derive it — redo it if the specification changes. Firmware differences between units may present the on-screen soft-key labels or status text slightly differently from this manual, without affecting the underlying procedure.

CHAPTER 7

Performance & Specifications

Ratings apply after at least **30 minutes** of warm-up, with correction (§4.8) performed after warm-up, DC bias off, and range set to AUTO unless stated otherwise. For the four models' headline specifications (frequency range, AC level range, DC bias range), see the TH2848 Series Datasheet; this chapter gives the underlying measurement-function detail.

7.1 Measurement function

Measurement combination	Four parameters, arbitrarily selectable — no primary/secondary restriction
Mathematical operation	Absolute deviation Δ_{ABS} and percentage deviation Δ% from a programmable nominal value
Equivalent circuit	Series, Parallel
Range	AUTO or manual (Hold, Increase+, Decrease−)
Trigger	Continuous or Single (front-panel key, HANDLER external trigger, foot switch, or bus trigger command)
Delay	Trigger delay and step delay, each 0–60 s, programmable in 1 ms steps
Test-terminal connection	Four-terminal pair (Hcur, Lcur, Hpot, Lpot)
Average	1–255 readings, programmable; independent moving-average switch for continuous measurement
Display	6 digits, maximum reading 999999

7.1.1 Measurement speed (frequency ≥10 kHz)

Speed	Rate
Fast	≈130 readings/s (2.56 ms/reading)
Medium	≈11 readings/s (90 ms/reading)
Slow	≈4 readings/s (220 ms/reading)

Medium and Fast speeds slow down below 10 kHz.

7.2 Test signal

Waveform	Sine wave
Frequency accuracy	0.01%
Frequency range	4 Hz – 2 MHz (TH2848-02L/-02) · 4 Hz – 5 MHz (TH2848-05) · 4 Hz – 10 MHz (TH2848-10)
Output impedance	100 Ω, ±1% @ 1 kHz

7.2.1 Signal mode

Mode	Behaviour
Normal	The set level is the open-terminal (no-load) value; the level actually at the DUT can be lower under load
Constant level (ALC)	The internal level auto-adjusts so the voltage/current actually at the DUT matches the set value

7.2.2 Test signal level accuracy

	Mode	Range	Accuracy	Step
Voltage	Normal	5 mVrms – 20 Vrms	±(10%×setting + 2 mV)	100 µV
	Constant level	10 mVrms – 1 Vrms	±(6%×setting + 2 mV)	
Current	Normal	50 µArms – 20 mArms	±(10%×setting + 10 µArms)	1 µA
	Constant level	100 µArms – 10 mArms	±(6%×setting + 10 µArms)	

7.2.3 Signal-level monitor accuracy

	Range	Frequency	Accuracy
Voltage	5 mVrms – 2 Vrms	≤1 MHz	±(3%×reading + 0.5 mVrms)
		>1 MHz	±(6%×reading + 0.1 mV)
Current	50 µArms – 20 mArms	≤1 MHz	±(3%×reading + 5 µA)
		>1 MHz	±(6%×reading + 1 µA)

7.2.4 Maximum display range

Parameter	Range
L	0.00001 µH – 99.9999 kH
C	0.00001 pF – 9.99999 F
Z, R, X, DCR	0.00001 Ω – 99.9999 MΩ
Y, B, G	0.00001 µS – 99.9999 S
D	0.00001 – 9.99999
Q	0.00001 – 99999.9
θ	−179.999° – 179.999° (−3.14159 – 3.14159 rad)

7.2.5 DC bias source

Voltage range	0 – ±10 V (TH2848-02L) · 0 – ±40 V (TH2848-02/-05/-10)
Voltage resolution	0.1 mV (0 – ±5 V) · 1 mV (±5 V – ±40 V)
Voltage accuracy	1%×setting + 5 mV (AC level ≤2 V) · 2%×setting + 8 mV (AC level >2 V)
Current range	0 – ±100 mA
Current resolution	1 µA (0 – 50 mA) · 10 µA (50 – 100 mA)

7.3 Measurement accuracy

Measurement accuracy includes measurement stability, temperature coefficient, linearity, repeatability and calibration-interpolation error. Basic accuracy is **0.05%** for |Z|, |Y|, L, C, R, X, G, B; checks are performed after ≥30 minutes warm-up, correct open/short zeroing, DC bias off, and AUTO range.

Full accuracy for |Z|, |Y|, L, C, R, X, G, B is given by:

$$A_e = \pm[A + (K_a + K_{aa} + K_b \times K_{bb} + K_c) \times 100 + K_d] \times K_e \quad [\%]$$

A	Basic accuracy at the set test level — see the basic-accuracy charts (by test level, frequency and DUT impedance/capacitance/inductance)
K_a, K_b	Low- and high-impedance proportional factors (piecewise functions of frequency, level and |Zm|)
K_{aa}, K_{bb}, K_d	Cable-length factors for 1/2/4 m cable
K_c	Calibration-interpolation factor — 0 exactly at a directly-calibrated frequency, 0.0003 elsewhere
K_e	Temperature de-rating factor outside roughly 18–28 °C

Valid for Dx (measured D) ≤0.1 (L, C, X, B) or Qx (measured Q) ≤0.1 (R, G); above that, multiply Ae by (1+Dx) or (1+Qx) respectively. G accuracy applies only to the Cp-G and Lp-G measurement combinations.

7.3.1 Derived-parameter accuracy

D, Q, θ, G, Rp and Rs accuracy are derived from the impedance accuracy A_e above:

$D_e = A_e / 100$	valid for Dx ≤0.1; above that multiply by (1+Dx)
$Q_e = Qx^2 \cdot D_e / (1 - Qx \cdot D_e)$	valid while $Qx \cdot D_e < 1$
$\theta_e = (180/\pi) \cdot (A_e/100)$ [deg] or $A_e/100$ [rad]	—
$G_e = Bx + D_e$ [S], where $Bx = 2\pi fCx = 1/(2\pi fLx)$	Cp-G and Lp-G combinations only, Dx ≤0.1
$Rp_e = Rpx \cdot D_e / (Dx + D_e)$ [Ω]	Dx ≤0.1
$Rs_e = Xx \cdot D_e$ [Ω], where $Xx = 2\pi fLx = 1/(2\pi fCx)$	Dx ≤0.1

7.3.2 DC resistance (DCR) accuracy

$$A_e = A \cdot (1 + Rx/5\ M\Omega + 16\ m\Omega/Rx)\ [\%] \pm 0.2\ m\Omega$$

where Rx is the measured resistance and **A = 0.25** at Medium/Slow speed, **A = 0.5** at Fast speed.

7.4 Dimensions & weight

Dimensions (W×H×D)	430 × 177 × 265 mm
Weight	≈11 kg

For the complete accuracy charts referenced by A above (basic accuracy by test level/frequency/impedance, and the full Ka/Kb piecewise tables), contact Techmize or your authorized distributor.

CHAPTER 8 · PART II — REMOTE CONTROL & HANDLER

Remote Control Overview

This chapter gives a working overview of remote control — available interfaces, command protocols, and the handful of commands most users need for basic automation. It is intentionally condensed: full SCPI and MODBUS command syntax, parameters and examples for every subsystem are documented in the companion **TH2848 Series SCPI & MODBUS Command Reference**, which should be treated as the authoritative reference for programming work.

8.1 Remote interfaces

Interface	Notes
RS-232C	Standard, 9-pin (shared connector with RS-485). Baud rate set at §5.1.3.
RS-485	Standard, shares the RS-232C connector (pins 1, 4). Uses the address set at §5.1.3.
USB Device	Standard — USBTMC or USBCDC.
LAN	Standard — 10M/100M auto-sensing; configured at §5.1.4.
GPIB	Standard — IEEE-488.

Select the active bus with Bus Mode (§5.1.1). All five interfaces are standard across all four TH2848 models.

8.2 Command protocols

Cmd Mode (§5.1.3) selects between two supported protocols:

Protocol	Description
SCPI	Standard Commands for Programmable Instruments — an ASCII, hierarchical ("tree") command language. Most commands (and some parameters) mix upper- and lower-case; the upper-case letters are the shortest legal abbreviation, e.g. `DISPlay` can be sent as `DISP`. A query form appends `?`.
MODBUS	Register-based read/write protocol, addressed by the bus address set at §5.1.3, with CRC16 frame checking. See the Command Reference for the full register map.

SCPI syntax conventions used throughout the Command Reference: `{ }` encloses a parameter choice, `|` separates alternatives, `<>` marks a required value, `[ ]` marks an optional node or parameter. Numeric data: **NR1** integer (`123`), **NR2** fixed-point (`12.3`), **NR3** floating-point (`12.3E+5`); **Bool** is `1`/`0` or `ON`/`OFF`; `NL` (newline, ASCII 10) ends a string.

8.3 Common commands

Task	Command
Identify the instrument	`*IDN?` → `<model>,<firmware>,<sn>` (e.g. `TH2848-10,V1.0.0,sn12345678`)
Reset to power-on state	`*RST`
Trigger and read a result	`*TRG` — triggers a measurement and returns the result directly (format below)
Switch display page	`:DISPlay:PAGE <PageName>` / `:DISPlay:PAGE?`
Self-test	`*TST?` → sum of outstanding error codes (NR1), 0 if none
Status registers	`*ESE`/`*ESE?`, `*ESR?`, `*SRE`/`*SRE?`, `*STB?`, `*CLS`, `*OPC`/`*OPC?` — standard IEEE-488.2 behaviour

8.3.1 *TRG / FETCh data format

The data format returned depends on which display page is active:

Page	Format
Meas Display	`<P1>,<P2>,<P3>,<P4>,<bin>` — bin: 0 = out of tolerance, 1–10 = BIN1–BIN10 (present only when the comparator is ON)
List Display — Step mode	`<point>,<P1>,<P2>,<P3>,<P4>,<compare>` — compare: 0 = not compared, 1 = pass, other = fail
List Display — Seq mode	All points' data, in the same per-point format, returned together after the full sweep completes
Trace Display	`<point>,<P1>,<P2>,<P3>,<P4>` per point (Step), or all points together after the sweep (Seq)

Example Meas Display response: `1.12345E2,1.23456E-2,1.11023E2,-1.12345E2,1`

8.4 Full command reference

The SCPI subsystems (DISPlay, FREQuency, VOLTage/CURRent, APERture, OUTPut, BIAS, TRIGger, AMPLitude, FUNCtion, COMParator, LIST, TRACe, Handler, FETCh, CORRection, MassMEMory, SYSTem) and the full MODBUS register map — several hundred commands and registers in total — are documented in the companion **TH2848 Series SCPI & MODBUS Command Reference**. Contact Techmize or your authorized distributor for a copy.

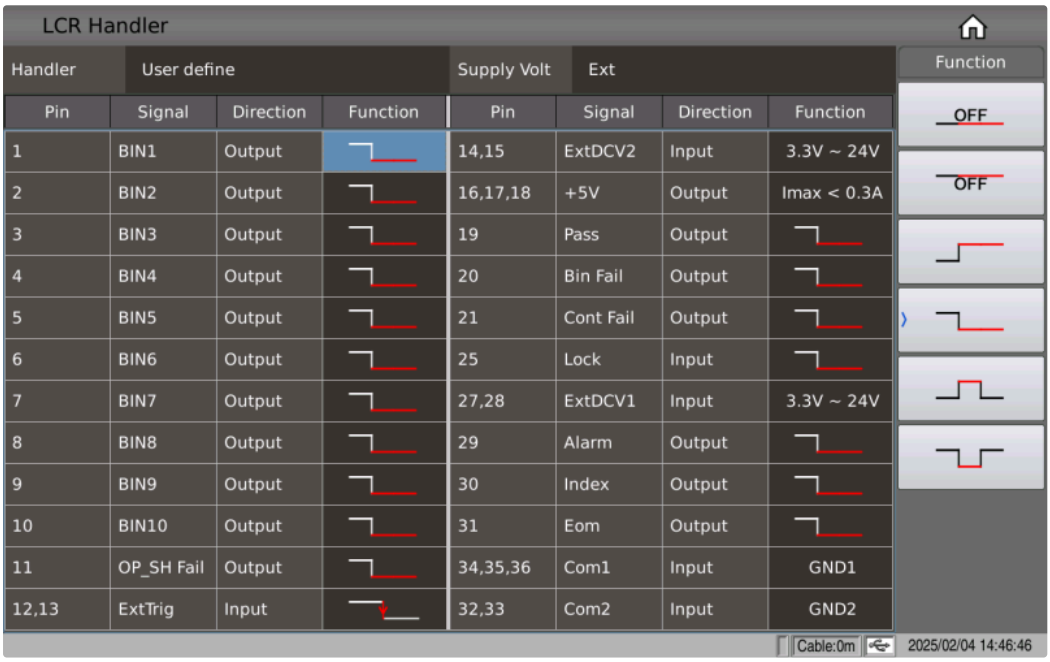
CHAPTER 9

Handler Interface

The HANDLER interface outputs the instrument's bin/comparator result to automated handling equipment, providing both the sort result and the handshake signals needed to run the instrument in an automatic component-sorting system. Signal behaviour is fully configurable — see <Handler> (§4.9) for the on-screen setup, and this chapter for the underlying pinout, electrical characteristics and timing.

9.1 Technical summary

Outputs	Active-low, open-collector, opto-isolated. Bin-comparator mode: qualified bin number, out-of-tolerance and fail state. List-sweep-comparator mode: per-point IN/OUT plus overall sweep pass/fail.
INDEX	Asserted when the analog measurement (A/D conversion) completes
EOM	Asserted when one measurement-and-comparison cycle is complete
ALARM	Asserted on momentary power-loss detection
Inputs	Opto-isolated. Keylock (front-panel lockout); External Trigger (pulse width ≥1 µs)



<Handler> page — pin/signal/direction/active-edge summary

9.2 Connector pinout — comparator (bin) mode

Used when the standard 10-bin comparator (§4.5) is active. The signals below share the same physical 36-pin connector in both operating modes; §9.3 lists how pins 1–11 and 19–21 are redefined in list-sweep-comparator mode.

Pin(s)	Signal	Description
1–9	/BIN1–/BIN9	Bin-sorted result outputs (open-collector)
10	/OUT	Out-of-tolerance / reject output
11	/AUX	Auxiliary-bin output
12, 13	/EXT.TRIG	External trigger input — a rising-edge pulse triggers a measurement when Trigger Mode = External
14, 15	EXT.DCV2	External DC supply for the opto-coupled control signals (/EXT.TRIG, /Keylock, /ALARM, /INDEX, /EOM)
16–18	+5V	Instrument's internal +5 V supply. Use of the internal supply is discouraged; if used, keep load <0.3 A and keep the wiring away from noise sources.
19	/PHI	Primary-parameter result above the BIN1–BIN9 high limit
20	/PLO	Primary-parameter result below the BIN1–BIN9 low limit
21	/SREJ	Secondary-parameter result outside its limit range
22–24	NC	Not connected
25	/KEY LOCK	While asserted, all front-panel keys are locked
27, 28	EXT.DCV1	External pull-up supply for the comparator outputs (/BIN1–/BIN9, /AUX, /OUT, /PHI, /PLO, /SREJ)
29	/ALARM	Asserted on a power-loss event
30	/INDEX	Asserted once the analog measurement completes and the DUT can be swapped — the comparison result itself is not yet valid until /EOM
31	/EOM	End of Measurement — asserted once the reading and comparison result are both valid
32, 33	COM2	Reference ground for the EXT.DCV2 supply
34–36	COM1	Reference ground for the EXT.DCV1 supply

9.3 List-sweep-comparator mode

When list-sweep comparison (§4.6) is active instead of the bin comparator, pins 1–11 and 19–21 change meaning:

Pin(s)	Signal	Description
1–10	/BIN1–/OUT	Per-point IN/OUT (pass/exceeds-limit) result for sweep points 1–10
11	/AUX	Asserted if one or more points in the sweep failed (overall pass/fail)
30	/INDEX	**Seq mode:** asserted once the analog measurement of the last point completes. **Step mode:** asserted after each point's analog measurement.
31	/EOM	**Seq mode:** asserted once the whole sweep and all comparisons are complete. **Step mode:** asserted after each point's measurement and comparison; the point's own compare result is valid only once /EOM for the final point has fired.

All other pins keep the definitions in §9.2.

9.4 Electrical characteristics

Both operating modes share the same electrical characteristics. Every DC output (pins 1–16 area) is isolated through an open-collector opto-coupler; its output-high level is set by a pull-up resistor on the HANDLER interface board, connected either to the instrument's internal +5 V supply or, via a jumper, to an externally supplied voltage (EXTV).

Signal group	Output LOW	Output HIGH	Max. current	Reference ground
Comparator signals (/BIN1–/BIN9, /AUX, /OUT, /PHI, /PLO, /SREJ)	≤0.5 V	+5 to +24 V	6 mA	Internal pull-up: instrument ground. External (EXTV1): COM1
Control signals (/INDEX, /EOM, /ALARM)	≤0.5 V	+5 to +24 V	5 mA	Internal pull-up: instrument ground. External (EXTV2): COM2

9.5 Timing

Per test cycle: external trigger → measurement (T2 delay from trigger to measurement start, then the measurement itself) → /INDEX asserts the instant the analog measurement finishes (the DUT can be swapped, but the compare result is not yet valid) → comparison and display processing (typically ≈1 ms compare time, plus a page-dependent display time) → /EOM asserts once the compare result is valid and stable → the handler reads the bin/pass-fail state → the instrument waits (T3) before accepting the next trigger.

Interval	Minimum	Maximum
T1 — trigger pulse width	1 µs	—
T2 — trigger to measurement start	200 µs	display time + 200 µs
T3 — wait after /EOM before next trigger	0 µs	—

Typical per-page display time: Meas Display ≈8 ms · Bin No. Display ≈5 ms · Bin Count Display ≈0.5 ms.

9.6 Setting up bin sorting via HANDLER

1. Open <Limit Setup> (§4.5); enter the nominal value and bin limits.
2. Move the cursor to Comp and select **ON**.
3. Open <Meas Display> and run production testing; the bin/count fields there provide DUT and auxiliary-bin counts as testing proceeds.

For list-sweep comparison instead: configure sweep mode, points and limits on <List Setup> (§4.6), then run from <List Display> (§4.2).

For fastest cycle time in a sorting application: lock the range to the expected value instead of AUTO (§4.4.5), turn off the AC Monitor (§4.4.8), and run testing from the fastest suitable display page.

APPENDIX

Terms, Symbols & Quick Reference

A.1 Terms and symbols

Symbol	Meaning	Symbol	Meaning
C	Capacitance	D	Dissipation factor
L	Inductance	Q	Quality factor
R	Resistance	θ	Phase angle
Z	Impedance	DCR / Rd	DC resistance
Y	Admittance	X	Reactance
G	Conductance	B	Susceptance
Hcur / Hpot	Current-source high / voltage-sense high test terminal	Lcur / Lpot	Current-source low / voltage-sense low test terminal
Cp / Cs	Capacitance, parallel / series equivalent circuit	Lp / Ls	Inductance, parallel / series equivalent circuit
ε / εr	Dielectric constant / relative dielectric constant	Kp / Kt / K31 / K33	Piezoelectric coupling coefficients (§4.7.3)
Qm	Mechanical quality factor	fs / fp	Series / parallel resonant frequency

A.2 Front-panel key quick reference

Key	Function
Display	Opens <Meas Display> / <List Display> / <Trace Display> / <Save> (§4)
Setup	Opens <Meas Setup> / <Limit Setup> / <List Setup> / <Trace Setup> / <User Corr> / <Handler> (§4)
System	Opens <System Info> / <Message> / <System Check> / <License> (Chapter 5)
Trigger	Manual trigger (trigger mode = Single, §4.4.9)
DC Bias	Enables/disables DC bias output (§4.4.6)
DC SRC	Enables/disables the independent DC voltage-source output (§4.4.7)
Lock	Locks/unlocks the front panel
Cal	Quick access to <User Corr> (§4.8)
File	Quick access to <File> management (§5.2)
Home	Switches between frequently used pages
Reset	Pauses/resumes a running list or trace sweep
PrtScn	Saves a screenshot to USB

A.3 Accessories quick reference

Standard and optional test fixtures for the TH2848 series (TH26011BS, TH26005D, TH26010, and the optional fixtures TH26007A, TH26008A, TH26009B, TH26047/48B/62A/63/108C, TH26077) are listed in the TH2848 Series Datasheet. Use only fixtures and cables supplied or approved by Techmize/Tonghui (§2.3).

A.4 Warranty & document history

Warranty terms: see §1.9. Content, specifications and accessories are subject to change without notice — contact Techmize for the latest revision.

A.5 Contact, service & support

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