TECHMIZE by TONGHUI

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OPERATION MANUAL

TH2851 Series

Complete installation, operation and remote-control reference for the TH2851 series ultra-high-frequency precision impedance analyzer — models TH2851-015, -030, -050, -080 and -130.

Techmize Electronic GmbH · Ismaning, Germany

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TH2851 Series Operation Manual

Ultra-High-Frequency Precision Impedance Analyzer — TH2851-015 / -030 / -050 / -080 / -130

This manual describes the operation, specifications and remote control of the TH2851 Series ultra-high-frequency precision impedance analyzers. It covers installation and safety, the touch-screen menus and measurement modes, system setup, measurement examples, the remote command summary and the Handler interface.

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CHAPTER 1

Safety & Compliance

1.1 About this manual

This is the operation manual for the Techmize TH2851 series of ultra-high-frequency precision impedance analyzers, covering models **TH2851-015**, **TH2851-030**, **TH2851-050**, **TH2851-080** and **TH2851-130**. The five models share one measurement platform and differ only in maximum test frequency (10Hz–15/30/50/80/130MHz respectively); every procedure in this manual applies to all five unless a specific model is named. Where this manual and the instrument itself appear to disagree, or where a described function is not present on your particular unit's firmware revision, 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 (see Chapter 7 and the TH2851 Series datasheet for the dielectric-constant and magnetic-permeability option packages) 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.

i **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 TH2851 series is a **Protection Class I** instrument: protective earthing of the chassis, via the power cord or the rear-panel ground terminal, 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 or with a two-wire (ungrounded) adapter. 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. The rear-panel rating label shows two settings: **~110V/60Hz 100VA, T4AL 250V** and **~220V/50Hz 100VA, T2AL 250V** — the instrument accepts 100–120VAC or 198–242VAC, 47–63Hz, selected by the fuse/voltage-selector position on the rear panel.

> **CAUTION**
>
> Use only the fuse rating shown for the selected supply voltage (T4AL 250V at 110V, T2AL 250V at 220V); do not bend or distort the fuse-holder contacts.

Environment. Operate the instrument indoors, at 5–40°C and ≤75% relative humidity, away from strong vibration, dust, direct sunlight and corrosive gases, and keep the side and rear ventilation openings clear. For storage, keep the instrument in its original packaging at −20 to 60°C and <85% relative humidity. Keep the instrument and its test leads away from strong electromagnetic fields, which can affect both safety and measurement accuracy.

Test fixtures and cables. Use only test fixtures and cables supplied or approved by Techmize/Tonghui for this instrument (see the datasheet's accessories list). Unapproved cables can produce misleading measurement results and, in some configurations, compromise safety. Connect the fixture or cable to the four **Hcur / Hpot / Lpot / Lcur** test terminals on the front panel; for a DUT with a shielded enclosure, also connect the shield/ground terminal.

> **WARNING — DISCHARGE THE DUT**
>
> Discharge polarised or capacitive devices under test before connecting them to the UNKNOWN terminals. Connecting a charged component can damage the instrument and may present a shock hazard. The front-panel UNKNOWN terminal block is rated **CAT I** and carries a printed **±42V peak maximum output** warning — do not exceed this at the test port, including any external bias contribution.

Warm-up. Allow the instrument to warm up for 60 minutes after power-on before relying on rated accuracy. Frequent, unnecessary power-cycling should be avoided, as it also affects measurement stability.

Touch screen. Do not use sharp objects (toothpicks, pen tips, screwdrivers, etc.) to press on the touch-screen surface — this may damage the screen or create dead spots. Operate on-screen buttons with a finger or a stylus intended for capacitive touch screens.

Software environment. The TH2851 runs a Windows-based platform. Installing additional software on the instrument is not recommended, as it may affect measurement performance; if the instrument is connected to a network with internet access, install appropriate antivirus protection.

1.4 Electrical safety test data

For insulation-resistance, dielectric-withstand and leakage-current test data, contact Techmize or your authorized distributor (§1.10).

1.5 Low Voltage & EMC compliance

The TH2851 series carries the **CE** mark, visible on the rear-panel label (Fig. 3-2 in Chapter 3). Techmize declares the TH2851 series compliant with the applicable EU Low Voltage Directive and EMC Directive requirements for this class of bench-top test instrument. Full Declaration of Conformity documentation is available from Techmize on request (§1.10).

1.6 WEEE — disposal of electrical and electronic equipment

This product must not be disposed of as unsorted municipal waste. At end of life, return it to Techmize, an authorized distributor, or a designated WEEE collection point for proper recycling, in accordance with EU Directive 2012/19/EU and its national implementations.

1.7 RoHS compliance

Techmize provides a RoHS self-declaration (EU Directive 2011/65/EU) for the TH2851 series. To obtain it, contact Techmize or your authorized distributor (§1.10).

1.8 Warranty

Techmize warrants TH2851 series instruments against defects in materials and workmanship for a period from delivery; contact Techmize or your authorized distributor for the warranty term and registration process applicable to your unit (see §1.10). The warranty does not cover damage from misuse, unauthorized modification, operation outside the environmental limits in §1.3, or use of test fixtures/cables not approved for this instrument.

1.9 Limitation of liability

Techmize is not liable for indirect, incidental or consequential damages arising from use of this instrument, including loss of data or production downtime, except where liability cannot be excluded under applicable law. This instrument is a measurement tool; the person operating it is responsible for verifying that its results are suitable for the intended purpose, and for following the safety requirements in this chapter.

1.10 Manufacturer & EU contact

Techmize Electronic GmbH

Office 125–126, Regus
Carl-Zeiss-Ring 15a, 85737 Ismaning,
Germany
An international subsidiary of Changzhou
Tonghui Electronic Co., Ltd. (China)

Contact

Mobile: +49 171 4981898
Email: dx.han@tonghui.com.cn
Web: en.tonghui.com.cn
Or contact your authorized distributor

Registration

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

CHAPTER 2

Out of the Box

2.1 Unpacking

Inspect the shipping container for damage before unpacking. If the container is damaged, do not power on the instrument until it has been inspected; contact Techmize or your distributor. Check the contents against the packing list — a TH2851 ships with:

Item	Description
TH2851 main unit	The selected model (TH2851-015/030/050/080/130)
—	EU power cable (Schuko, CEE 7/7)
TH26047A	Four-terminal-pair test fixture
TH26005D	Four-terminal-pair test fixture
TH26082A	100Ω standard component (calibration reference)
TH26010	Gold-plated short-circuit board
TH26061D_P1	Calibration kit
AR05TTS1000N	Chip resistor (calibration reference)

If any item is missing or does not match the packing list, notify Techmize or your dealer before use. Optional fixtures (SMD, magnetic-ring, dielectric-constant, magnetic-permeability, etc.) are ordered separately — see the TH2851 Series datasheet for the full optional-accessories list.

2.2 Connecting the power supply

- Supply voltage: 100–120VAC or 198–242VAC, selected by the rear-panel fuse/voltage position — see §1.3.
- Supply frequency: 47–63Hz.
- Power consumption: max 150VA.
- Confirm the phase (L), neutral (N) and earth (E) conductors match the instrument's power plug.

> **WARNING**
> To prevent injury from a leakage fault, the protective earth conductor of the supply must be reliably grounded before connecting the power cable.

The instrument is designed to reduce conducted mains noise, but should still be used in a low-noise electrical environment; fit a power-line filter if this cannot be arranged.

2.3 Connecting a test fixture

1. Align the four test ends of the fixture (e.g. TH26005D) with the four **Hcur / Hpot / Lpot / Lcur** UNKNOWN terminals on the front panel and insert gently.
2. Turn the fixture's rotating locking lever clockwise until secure.
3. To remove the fixture, reverse the above steps.

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

2.4 Starting the instrument for the first time

1. Press the front-panel **POWER** button. The button illuminates and the instrument boots its Windows-based platform, then loads the measurement interface.
2. Allow the instrument to warm up before relying on rated accuracy (60 minutes — see §1.3).
3. To restore factory default settings at any time, press **Preset** and confirm — see §5.4.
4. Before measuring, perform user calibration (open/short, and load or phase calibration if required for your fixture and accuracy target) — see §4.7.

> **CAUTION**
> Use the front-panel power button to switch the instrument on and off. Do not unplug the power cord or otherwise remove power before the instrument has fully shut down — doing so can damage the instrument and shorten its service life.

Once running, the instrument opens directly into one of the three main measurement interfaces — point measurement, list sweep, or trace (graphic) sweep — according to the **Start Form Setup** configured in the System menu (§5.3). Chapter 3 introduces the front panel, rear panel and on-screen layout; Chapter 4 covers every touch-screen menu in detail.

CHAPTER 3

Getting to Know the Instrument

3.1 Front panel



Fig. 3-1 — TH2851-130 front panel, shown in point-measurement mode

The front panel groups its keys by function, around a central 10.1" capacitive touch screen. The ten functional groups are:

Group	Keys & function
CHANNEL/TRACE	**Sweep** switches to the trace-sweep interface; **Channel Prev/Next** and **Trace Prev/Next** activate the previous/next channel or trace (only an activated channel/trace can be edited); **Channel Max** / **Trace Max** toggle full-window display of the active channel or trace.
STIMULUS	**Sweep Setup**, **Sweep Type**, **Start**, **Stop**, **Center**, **Span** — open the sweep-source and sweep-range menus in trace-sweep mode.
MKR/ANALYSIS	**Marker**, **Marker Search**, **Marker Function**, **Analysis** — marker placement/search, sweep-range-from-marker functions, and curve sorting / equivalent-circuit / OSC analysis.
RESPONSE	**Meas**, **Format**, **Scale**, **Display**, **Avg**, **Cal** — measurement parameters, Y-axis format/scale, display layout, averaging, and user calibration, all for trace-sweep mode.
LCR METER	**LCR** switches to point-measurement mode; **Meas** opens measurement setup; **Display** sets displayed parameters; **Point/List** toggles point ↔ list-sweep view; **Cal** opens user calibration; **DC Bias** toggles the bias output.
ENTRY	Numeric keys **0**–**9**, **+/-**; magnitude keys **T/p** **G/n** **M/µ** **k/m** **x1** (each applies whichever of its two prefixes fits the entered value; **x1** enters no unit); **Esc** cancels an entry or a running calibration; **BS** ◄ backspaces; **Help** opens help and also unlocks a locked screen/panel.
INSTR STATE	**Save/Recall** opens the save/load menu (contents differ between point/list and sweep modes — §5.4); **System** opens system setup (§5.1–§5.3); **Preset** restores the instrument to its initial state after confirmation.
TRIGGER	**Trigger Mode** opens the trigger-mode menu; **Hold** freezes the current measurement mode; **Trigger** issues a manual trigger.
JUDGEMENT	**Pass** / **Fail** indicator lights (not buttons) — show the comparator sorting result.

Two further groups complete the front panel:

Group	Function
Direction keys & dial	Move the entry cursor and adjust values during numeric input: the scroll wheel steps by a small increment, the up/down keys by a larger increment, and left/right move the cursor within the entry field.
UNKNOWN terminals	Four BNC connectors — **Lcur, Lpot, Hpot, Hcur** — forming the four-terminal-pair test port. Rated **CAT I**, **±42V peak maximum output**; discharge the DUT before connecting (§1.3).

The touch screen itself displays numerical values, sweep traces, division values, setup values, on-screen buttons and other measurement information; on-screen buttons are operated by touch. See §3.3 for the layout of each display type.

3.2 Rear panel



Fig. 3-2 — Rear panel, TH2851-130 shown; layout is identical across all five models

Serial label — production date, manufacturer and instrument serial number.

Handler — sorting-result output and control I/O for automated handling equipment (Chapter 9).

USB Device — USB communication port for PC control.

Ground terminal — chassis protective/shield ground.

RS-232 — serial communication port.

Power socket & fuse holder — AC input; fuse rating switches between the printed 110V/220V settings (§1.3).

GPIB — IEEE-488 interface for automated test systems.

Main-board interface group — USB 3.0 ×2, HDMI, VGA, USB 2.0 ×2, LAN, headphone and microphone jacks: the PC-platform I/O that lets the screen be mirrored, networked, or used with a mouse/keyboard.

3.3 Display zones

The TH2851 has a family of measurement-interface and setup-interface screens. The main measurement interfaces are:

Display	Shows
Point measurement	The measured point's parameters and results
List sweep	All measured points and their results, in a table
Trace (graphic) sweep	The curve drawn from measured points, on a set of axes
User calibration	All calibration-point settings and calibration values, in a table

Setup screens (point/list comparator setup, list setup, list quick-edit, list/sweep comparator setup, sweep segment setup) are covered alongside the corresponding measurement mode in Chapter 4.

3.3.1 Point measurement display



Point measurement display: 8-channel selector, measurement conditions, AC/DC monitor, Point Root menu, up to 4 parameters

Zone	Content
Channel number	Up to 8 channels; the highlighted number is active. Each channel can hold its own frequency, level, bias and measurement parameters — tap a channel number to switch.
Measurement conditions	Frequency, Meas Time, OSC Level, AC Range, DC Bias and Avg Count for the active channel; tapping any value opens **Meas Setup** pre-navigated to that field (§4.1).
AC/DC monitor	Live AC/DC current and voltage monitor readings; tap to open Meas Setup.
Menu name / menu	The name and contents of the currently open menu. A right-facing arrow opens a sub-menu; a filled square marks the currently selected option.
Device status row	Status indicators — see table below.
Parameters & results	Up to 4 measurement parameters at once, each with its own Math (relative) and Ref (reference) value; tap to change parameters or result display settings.

Status indicator	Meaning
Open / Short / Load / Phase (blue)	The corresponding user calibration is turned on
Acce (blue)	User accessory (fixture) calibration is turned on
Bias (red)	DC bias output is on
Lock (red)	Front panel and screen operation is locked
Pass (green) / Fail (red)	Comparator sorting result
Meas / Manual / External / Bus (blue)	Current trigger mode: internal (continuous) / manual / external / bus

3.3.2 List sweep display

Shows the active channel (up to 8, as in point measurement), the measured-point serial number, the measurement conditions for that point (frequency, average count, OSC level, AC range, DC bias — editable from the list setup page, §4.2), and the measured parameters/results for each point in sequence.

3.3.3 Trace (graphic) sweep display



Trace sweep display: channel window, moving-average state, ordinate axis, marker, Sweep Root menu

Zone	Content
Moving-average state	Shown only when moving average is on, as n/m (m = set count, n = current count); configured in the Response — Avg menu (§4.3.2).
Channel number	The channel shown in the current window; switch with **Channel Prev** / **Channel Next** or by tapping the window.
DC monitor	Current measured DC level and monitor value, when DC monitoring is on.
Equivalent-circuit result	The selected model and its fitted R/L/C values, shown when equivalent-circuit display is on (§4.5.2).
Ordinate label	Y-axis tick distribution for the active trace; the highlighted reference value can be changed in Scale, or set from a marker in Marker Function.
Marker(s)	Up to 10 per trace; the active marker's shape differs from inactive ones and can be dragged directly on the touch screen (§4.4).

CHAPTER 4

Touch-Screen Menus & Measurement Modes

This chapter covers every touch-screen menu, organized by the five measurement modes introduced in the TH2851 Series Technical & Applications Guide: point measurement, list sweep, trace (graphic) sweep, equivalent-circuit analysis and crystal-oscillator (OSC) analysis, plus marker analysis and user calibration, which apply across modes. Press [Preset] first to restore factory settings if you want to follow the examples from a known starting point.

4.1 Point measurement

Press [LCR] to open the point-measurement interface (§3.3.1).

4.1.1 Channel

The point-measurement interface shows 8 channels; each can hold different measurement conditions and parameters. Tap a channel button on the left edge of the screen to switch to it.

4.1.2 Frequency

1. Tap **Frequency** directly on screen, or tap [Meas] to open **Meas Setup** then tap **Frequency**.
2. Enter the value — e.g. for 1kHz, press [1] then [k/m] on the front panel.
3. The value can also be adjusted with the up/down arrows and scroll wheel.

4.1.3 Meas Time

Tap **Meas Time** on screen, or **Meas Setup** → **Meas Time**, and select a speed level. In general, a slower measurement rate gives a more accurate reading — see the five-level speed/accuracy table in §7.3.

4.1.4 Avg Count

Tap **Avg Count** on screen, or **Meas Setup** → **Avg Count**, and enter the number of measurements to average (e.g. press [1] then [x1] for a count of 1). The value can also be adjusted with the up/down arrows and scroll wheel.

4.1.5 OSC Level

1. Tap **OSC Level** on screen, or **Meas Setup** → **OSC Level**.
2. Set the source mode (**OSC Unit**) to Voltage or Current; the corresponding level is applied automatically and shown on the Point Root screen.
3. Enter the level using the numeric keys, or the direction keys and dial.

> **NOTE**
> With 100Ω internal resistance, Voltage Level ranges 5mV–2V and Current Level 50µA–20mA. Levels above 1V / 10mA are only available when Frequency ≤1MHz; above 1MHz the source level is capped automatically to the maximum allowed value.

Automatic Level Control (ALC): open **ALC** on the OSC menu, toggle **ALC Control**, and set **Max Iteration** (2–10) and **Target %** (0.05–10) to control how the drive signal is corrected to hold the level actually seen at the DUT — see the "why it matters" explanation in the Technical & Applications Guide §2.

4.1.6 DC Bias

1. Tap **DC Bias** on screen, or **Meas Setup** → **DC Bias**, or press the front-panel [DC Bias] key to toggle the state directly.
2. In the DC Bias menu: **Meas Range** selects the bias range; **DC Bias Mode** switches Voltage/Current (the corresponding **Voltage Level** or **Current Level** field becomes editable); **Constant Mode** toggles constant-voltage behaviour; **Max/Min Limit Voltage** sets bounds.

> NOTE
>
> Meas Range and the bias level only apply to the measurement while DC Bias State is on. With bias off, the range defaults to 1mA and the bias level to 0.

4.1.7 AC Range

Tap **ACRange** on screen, or **Meas Setup** → **ACRange**. In Auto, the instrument judges the range during measurement and displays the resulting true range; otherwise select a fixed range value.

4.1.8 Trigger

Trigger source	Behaviour
Internal	Continuous — a trigger follows immediately after each measurement completes
External	Uses the Handler's external-trigger input (Chapter 9)
Manual	Press [Trigger] to fire one measurement
Bus	Triggered remotely via GPIB/LAN/USB (Chapter 8)

Set the mode from [Trigger Mode] on the front panel, or **Meas Setup** → **Trigger Mode**. **Trigger Delay** (Meas Setup → Trigger Delay) sets the time between trigger and the start of measurement; adjust it with the numeric keys or the direction keys and dial.

4.1.9 Result parameters

Point measurement displays up to 4 parameters simultaneously. Tap a parameter name on screen to open the parameter-selection menu; each parameter carries its own **Math** (relative) and **Ref** (reference) value, independently of the other three, plus display-format options (significant digits, etc.).

> DEVIATION TESTING
>
> Two deviation channels (DEV A / DEV B) are available for comparing a measured parameter against a nominal value as a percentage or absolute deviation — configure them alongside the parameter selection.

4.2 List sweep

Press [Point/List] to switch to the list-sweep interface. List sweep steps the instrument through up to **1,601 independently defined points**; unlike a simple log/linear sweep, every point can carry its own frequency, AC level, DC bias and averaging count, and every point sorts independently.

Menu	Function
List setup	Enter or edit every point's frequency, level, bias and averaging in a table, one row per point.
List quick edit	Fast entry for evenly spaced or patterned lists (e.g. a run of frequencies) without editing each row individually.
List comparator setup	Pass/fail limits per point — see §4.6.

Run the list from the List Sweep Display interface (§3.3.2); each point's parameters and results are shown in sequence, with pass/fail status if the comparator is on.

> TYPICAL USE
>
> List sweep is the right tool whenever a customer specification calls out a fixed set of test frequencies rather than a continuous sweep — e.g. "measure Cp and D at 120Hz, 1kHz and 10kHz" — since it avoids sweeping (and reporting) results at every frequency in between. For a continuous view of behaviour across a range, use trace sweep (§4.3) instead.

4.3 Trace (graphic) sweep

Press [Sweep] to switch to trace-sweep mode. The instrument plots up to **4 channels × 4 curves** (16 curves total) against a swept frequency, level or DC-bias stimulus, across **14 split-screen layouts**.

4.3.1 Stimulus — sweep setup, type & range

Key / menu item	Function
[Sweep Setup]	Signal-source parameters, sweep time and number of trace points, for the active channel.
[Sweep Type]	Switches the active channel's sweep mode — logarithmic, linear, or segmented (§4.3.4).
[Start] / [Stop]	Sets the sweep-range start/end value.
[Center] / [Span]	Sets the sweep range as a center value and span instead of start/stop.

4.3.2 Response — measurement, format, scale, display, averaging, calibration

Key	Function
Meas	Sets the measurement parameter for each trace, and toggles offset-monitor display.
Format	Changes the ordinate (Y-axis) type per trace.
Scale	Sets Y-axis distribution and scaling — reference position, division value, etc. — per trace.
Display	Channel/trace display mode, number of traces, value memory (Chapter 6's curve-trajectory-comparison workflow uses this).
Avg	Sweep speed, moving-average count and on/off state.
Cal	Opens user calibration (§4.7) from within trace-sweep mode. On screen this appears as **Cal Compen**.

4.3.3 Split-screen layouts

14 layouts are available for arranging the 4 channels and their traces — from a single full-screen curve to all 4 channels shown simultaneously, each able to display up to 4 traces. Configure the layout from the **Display** menu.

4.3.4 Segmented scanning

Segmented sweep type lets you define several frequency segments within one sweep cycle, each with its own level and offset, skipping the ranges between them. This is the standard way to characterize a crystal resonator's nominal resonance, anti-resonance and spurious responses without sweeping — or displaying — the irrelevant frequencies in between; pair it with OSC analysis (§4.5.3) for a complete crystal characterization workflow (§6.4).

> **TIP**
>
> Choosing a split-screen layout is mostly a question of what you're comparing: a single full-screen curve suits detailed inspection of one trace's shape (e.g. reading a resonance dip precisely with markers); a 2×2 four-channel layout suits comparing four different DUTs or four different stimulus conditions side by side. **Display → Value Memory** freezes a copy of the current trace on screen for visual comparison against the next live sweep, without needing the full Trace Trails workflow (§4.5.4).

4.4 Marker analysis

Every trace can carry up to **10 markers**, including one reference marker, each with an excitation value (X-axis) and response value (Y-axis). Markers read exact values, locate points automatically, and drive statistics — without leaving the graphic display.

4.4.1 Marker

Press [Marker] to open the marker menu: toggle individual markers on/off, and set a marker's position by entering its stimulus (X-axis) value directly, or by dragging it on the touch screen.

4.4.2 Marker Search

Search mode	Moves the marker to
Max / Min	The highest / lowest value on the trace
Peak / Target	The nearest peak (or target value) to the current marker position
Multi Peak / Multi Target	Cycles through all peaks, or all points matching the target value, on the trace

Additional Marker Search settings: **Tracking** (repeat the search automatically after every sweep — used to keep a marker locked to, e.g., a resonance minimum as conditions drift), **Search Range** and **Bandwidth** (constrain where on the trace the search operates).

4.4.3 Marker Function

Press [Marker Function] for functions driven by marker position: **Marker→Start / →Stop / →Center / →Reference** set the sweep range or Y-axis reference directly from the active marker's position; **Marker Zoom** and **Zooming Aperture** narrow the sweep around a marker; **Discrete** and **Couple** control marker-to-trace-point snapping and multi-trace marker linking; **Statistics** computes mean/std-dev etc. over the trace region a marker defines.

> **TYPICAL USE**
>
> Search for the |Z| minimum with **Marker Search → Min**, then use **Marker Zoom** to narrow the sweep range around that point for a closer look at a resonance dip, or **Marker→Center** to re-center a follow-up sweep there. Turning **Tracking** on keeps the marker locked to the minimum automatically as temperature or DUT-to-DUT variation shifts the resonance from sweep to sweep — useful when characterizing a batch of similar crystal resonators (§6.4).

4.5 Analysis

Press Analysis in trace-sweep mode to reach curve sorting, equivalent-circuit analysis, OSC (crystal oscillator) analysis, trace trails and marker limit.

4.5.1 Limit test (curve sorting)

Applies pass/fail judgement to some or all of a scanned curve's region — the standard way to screen resonance curves, e.g. filtering piezoelectric elements by resonance-frequency shape rather than a single-point reading. Configure begin/end stimulus and upper/lower limit per segment in the Limit Line table; toggle **Limit Test** on to sort live.

4.5.2 Equivalent circuit

Fits the measured impedance curve to one of **7 standard models** — 4 three-element (A–D) and 3 four-element (E–G) — describing a component's parasitic behaviour with a small set of physical values instead of a raw curve. See the Technical & Applications Guide §6 for the full model table and topology diagrams.

Menu item	Function
Select Circuit	Choose model A–G
Calculate	Runs the fit against the currently measured curve
R1 / C1 / L1 / C0 / R0	Fitted (or user-entered starting) component values, depending on the selected model
Stimulate	Toggles simulation of the fitted circuit's impedance curve for on-screen comparison against the measured curve
Display	Toggles the equivalent-circuit result readout on the channel window (§3.3.3)

The fitted model can be exported as a plain TXT file for use outside the instrument.

Model	Elements	Typical fitting object
A	Three-element — L1 & C1 in parallel, R1 in series with the pair	High-leakage-inductance components
B	Three-element — C1 in parallel with (L1 series R1)	Inductive resistors
C	Three-element — L1 in parallel with (C1 series R1)	High-resistance-value resistors
D	Three-element — L1, C1, R1 all in series	Capacitors
E	Four-element — C0 in parallel with (L1, C1, R1 in series)	Resonators
F	Four-element — R0 in series with (L1 parallel C1 parallel R1)	Inductance equivalent series resistance
G	Four-element — R0, L1 in series, with C1 & R1 in parallel across the output	Capacitors

4.5.3 OSC analysis (crystal oscillator / piezoelectric analysis)

Measures and calculates key parameters for quartz crystals and other piezoelectric devices (ceramic filters, notch filters, discriminators, transformers, high-power ultrasonic generators, transducers/vibrators, surface-acoustic-wave and electro-acoustic devices).

Menu item	Meaning
State	Turns OSC analysis on/off
C1 / D1	Static capacitance and loss (dissipation)
Fs / Fp	Resonant frequency (Fs) and anti-resonant frequency (Fp)
Zmin / Zmax	Minimum and maximum impedance across the scanned range
Kt	Mechanical (electromechanical) coupling coefficient
F1	Additional characteristic frequency reported for the device under test

> NOTE
> OSC analysis and equivalent-circuit analysis describe the same physical device from two angles: a quartz crystal's electrical behaviour is exactly what the four-element **Model E** resonator topology (C0 parallel to L1-C1-R1, §4.5.2) represents — the Fs/Fp/Kt values reported here can be cross-checked against, or used to seed, a Model E curve fit for the same device.

4.5.4 Trace trails (curve-trajectory comparison)

Overlays multiple measurement runs in the same coordinate system — either different DUTs under different conditions, or repeated measurements of the same DUT to check repeatability — with the value at any chosen frequency point calculated for every curve at once.

Menu item	Function
Measure Once / Cancel Once	Captures (or discards) one trace into the comparison set
Parameter 1 / Parameter 2	Selects which two parameters are compared across captured traces
Start Frequency / Stop Frequency	Range over which comparison values are calculated
Get Screen	Captures the current trace-comparison table as a screen image

4.5.5 Marker limit

Applies pass/fail judgement to values read at specific marker positions, as an alternative to region-based limit testing (§4.5.1) when only a handful of discrete frequency points matter.

4.6 Comparator (sorting)

The comparator applies pass/fail (and multi-bin) sorting to measurement results, in point, list and trace-sweep modes alike.

Mode	Sorting behaviour
Point measurement	Up to 10-bin LCR sorting against nominal value and high/low limits, on each selected parameter
List sweep	Each of the up to 1,601 points sorts independently against its own limits
Trace sweep	Curve sorting (§4.5.1) judges pass/fail across a defined stimulus region of each curve

1. Open **Limit Table Setup** (point/list) or **Limit Line** (sweep); enter the nominal value and bin high/low limits.
2. Set the comparator to **ON**.
3. Run measurement; the [Pass] / [Fail] indicator lights and the on-screen bin/count display report the result.

Comparator tables can be exported/imported as `.pbi` files, and list data as `.csv` — see §5.2.

> **DEVIATION-BASED SORTING**
> Beyond simple high/low limits, a comparator condition's **Mode** can sort on absolute deviation, percent deviation, or percent-of-nominal from a set nominal value (the same DEV A/DEV B deviation channels available in point measurement, §4.1.9) — useful when the acceptance criteria are expressed as "±5% of nominal" rather than as absolute limits.

4.7 User calibration

Press [Cal] to open the user calibration interface. User calibration removes measurement errors introduced by fixtures and cabling; it should be performed before precision measurement, and after changing fixtures. The TH2851 provides **20 calibration points**, each independently switchable, with its own frequency and reference; the left-hand list shows all 20 points, the right-hand menu performs all-frequency calibration and its on/off controls.

4.7.1 Choose a measuring accessory

Tap **Accessory** in the calibration menu and select the fixture in use (default: 0m offset). If using a custom or unlisted fixture, set Accessory to 0m and perform accessory calibration (§4.7.5) instead.

4.7.2 Open calibration

1. Tap **Open** to enter the open-circuit calibration menu; toggle **ON**/**OFF** to set whether open calibration is applied.
2. Install the standard open (unterminated) reference on the fixture and tap **All frequency clear** to run a full-frequency open-circuit calibration; the new data overwrites the previous open-calibration data and open calibration switches on automatically once complete.

> **CAUTION**
> A full-frequency clear overwrites the existing calibration data for that type. Back up any calibration data you may need to restore later before re-running it.

4.7.3 Short calibration

Tap **Short**, install the standard short reference on the fixture, and tap **All frequency clear** — the same pattern as open calibration.

4.7.4 Phase calibration

Tap **Phase Cal**, install the standard open reference, and tap **Start Phase Cal**. Once complete, user phase calibration switches on; tap **Return** to exit.

4.7.5 Accessory calibration

1. Tap **Accessory Cal** to enter the accessory calibration menu.
2. Select the file location to save the calibration to (if a fixture-specific file already exists, it can be reused).
3. Tap **Start Accessory Cal** and follow the on-screen prompts to complete calibration.
4. Once complete, user accessory calibration switches on; tap **Return** to exit.

4.7.6 Per-point calibration settings

Each of the 20 calibration points in the left-hand list can independently: toggle on/off, set its own frequency, set a load reference value, and run open/short/load calibration at that single frequency — useful for touching up calibration at one specific test frequency without repeating a full-frequency sweep.

CHAPTER 5

System Setup & File Management

5.1 System menu

Press **System** to open the System menu.

Menu item	Function
System Cal	Factory calibration — password-protected; not for general user access (affects measurement accuracy directly).
Test	Front Panel Test and Handler Test — see §5.2.
Preset	Restores factory (or user-saved, per Preset Setup) settings, after confirmation.
Info	System information — product name, frequency range, manufacturer, software version, serial number, MAC/IP address — and software-update entry point.
Misc Setup	GPIB, network, serial-port, preset, startup and start-form settings, key lock, Handler supply voltage, beeper — see §5.3.
Dump Screen Image	Saves the current screen as an image file — also reachable from Save/Recall (§5.4).

5.2 System test

Front Panel Test — displays the front panel graphically; press each physical key and confirm a green tick appears on its on-screen graphic. Panel keys with backlighting will also cycle their backlight during the test.

Handler Test — each Handler line is shown as a grey/green indicator; tap an indicator to toggle that line's output between high and low, or tap **Start Test** to cycle automatically through every Handler line in sequence. Use this to verify wiring to automated handling equipment before production use (Chapter 9).

5.3 Misc Setup

Setting	Function
GPIB Setup	Set the instrument's GPIB address — enter the new address and press [x1] to confirm.
Network Setup	Enable/disable the network interface and configure its IP address; changes take effect after a software restart (see §8.1 for the LAN remote-control workflow, including port 5025).
Serial Port Setup	Baud rate for the RS-232 port.
Preset Setup	What [Preset] restores to (factory or user-saved settings — user settings only if a user file exists) and whether a confirmation prompt is required.
Startup Setup	What loads automatically at power-on: factory / user / auto (last-saved) settings. If the corresponding file doesn't exist, the instrument falls back to factory settings.
Start Form Setup	Which interface the instrument opens into at startup — point measurement, list sweep, or trace sweep.
Key Lock	Temporarily locks the front panel and/or touch screen, e.g. to prevent accidental input during remote operation. Press [Help] to unlock.
Handler Setup → Supply Voltage	Selects the pull-up supply used by the Handler interface's photocoupled outputs (internal +5V or external EXT.DCV — Chapter 9).
Beeper	Toggles the key-press beep on the front panel and on-screen menu.

5.4 Save/Recall

Press Save/Recall; the menu contents differ between point/list mode and trace-sweep mode.

5.4.1 Point & list measurement

Key	Saves to
State 01–08	One of 8 numbered setting-state slots
Autorec	The auto-save file (SaveData\PointAutorec.sta), refreshed periodically when Start From Setup is Auto (§5.3), and reloaded automatically at startup if present.
UserPres	The user-preset file used for Preset/startup loading (§5.3)
File	A custom filename and location

Recall works the same way in reverse — tap the corresponding key, or **Recall State** to browse for any file on disk. **Dump Screen Image** saves a screenshot of the current interface to a chosen location. **Export List Data** saves the current list-sweep table as a `.csv` file.

5.4.2 Comparator tables

From the Comparator Table interface, **All Tables → Export All** saves every comparator table as a `.pbi` file; **All Tables → Import All** loads one back.

5.4.3 Trace sweep

Save Type is **State Only** (settings) or **State & Trace** (settings + measurement data); Channel/Trace scope is **Display Only** or **All**. **Save Channel**/**Recall Channel** save/load a single activated channel's settings to one of four temporary slots (A–D) — convenient for copying setup between channels, but lost on power-off since it is held in memory, not on disk. **Save Trace Data** exports trace data with scope Single / Channel / Displayed.

CHAPTER 6

Measurement Examples

6.1 Correct connection of the DUT

Connect the fixture to the four **Hcur / Hpot / Lpot / Lcur** UNKNOWN terminals as described in §2.3. Keep test leads short and away from strong electromagnetic fields (§1.3); for a shielded DUT, also connect the shield to ground. Discharge polarised or capacitive DUTs before connection (§1.3).

6.2 Eliminating the influence of stray impedance

Run open and short user calibration (§4.7.2–§4.7.3) with the actual fixture installed, at the frequency and level you intend to measure at. Open calibration removes stray parallel admittance (capacitance/conductance) introduced by the fixture; short calibration removes stray series impedance (resistance/inductance). For the tightest accuracy on a specific fixture, also run accessory calibration (§4.7.5) once with that fixture installed.

6.3 Example 1 — Point measurement of an inductor

1. Press [Preset], confirm, then connect a four-terminal-pair fixture (e.g. TH26005D) and run open/short calibration (§6.2).
2. Press [Meas] to open **Meas Setup**; set **Frequency** to 1MHz (press [1] then [M/μ]).
3. Set **Avg Count** to 5 (press [5] then [x1]).
4. Open **OSC Level**, set the desired AC voltage or current level.
5. Press the front-panel [DC Bias] key if a bias voltage is required for this inductor's operating point.
6. Press [LCR] to return to the point-measurement display.
7. Tap a parameter name on screen (e.g. the first parameter slot) and select **Ls** (series inductance) and **Q** (quality factor) as the two parameters to display.
8. Connect the inductor to the fixture and read Ls and Q directly on screen.

6.4 Example 2 — Capacitance by multi-frequency list sweep

Characterizing a capacitor's Cp and D at several specific frequencies called out in a customer specification, without sweeping the frequencies in between:

1. Press **Point/List** to open list-sweep mode, then open **List Setup**.
2. Enter each required test frequency as its own row (e.g. 1kHz, 10kHz, 100kHz, 1MHz) — see §4.2.
3. In the parameters menu, select **Cp** and **D** as the measured parameters for each point.
4. Optionally open the list comparator and enter a nominal Cp value with tolerance limits per point (§4.6), so out-of-tolerance points are flagged automatically.
5. Connect the capacitor and run the list — results for every frequency appear together in the List Sweep Display table (§3.3.2).

6.5 Example 3 — Crystal resonator via segmented sweep & OSC analysis

1. Press **Sweep** to open trace-sweep mode; press **Meas** and set the parameter to **|Z|**.
2. Press **Sweep Type** and select **Segmented**; define one narrow segment around the crystal's nominal resonant frequency and, if relevant, further segments around known spurious frequencies — see §4.3.4.
3. Press **Analysis** → **OSC Analysis**, set **State** to ON.
4. Connect the crystal and trigger a sweep; Fs, Fp, C1, D1, Kt and F1 are calculated and displayed (§4.5.3).
5. Optionally cross-check by fitting the same curve to equivalent-circuit **Model E** (§4.5.2) and comparing the fitted L1/C1/R1/C0 values against the OSC analysis result.

6.6 Example 4 — Comparator setup for production sorting

1. Set up the measurement (frequency, level, parameters) for the component type being sorted, as in Example 1 or 2.
2. Open **Limit Table Setup** (point/list) or **Limit Line** (sweep); enter the nominal value and the high/low limits for each bin (§4.6).
3. Set the comparator to **ON**.
4. For fastest cycle time: lock the AC range to the expected value instead of Auto (§4.1.7), and run from the sorting count display rather than the full parameter display.
5. For automated handling equipment, wire the Handler interface (Chapter 9) so /BIN1–/BIN9 and /EOM drive the sorting mechanism directly.

CHAPTER 7

Performance & Specifications

7.1 Definitions

Specification / guaranteed performance — valid at 23°C (±5°C) unless otherwise noted, after the instrument's specified warm-up time, and includes guard bands for expected statistical performance distribution, measurement uncertainty, and environmental variation. **Typical value** — expected performance of a typical unit, excluding guard bands; not covered by warranty. **General feature** — a descriptive term implying no specific performance level.

7.2 Basic measurement capability

Impedance parameters	|Z|, θz, |Y|, θy, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, R, X, G, B, DCR
Level monitoring	Vac, Iac, Vdc, Idc
Test terminal configuration	Four-terminal pair, four BNC (female) connectors

7.3 Full technical specifications

Parameter	TH2851-015	TH2851-030	TH2851-050	TH2851-080	TH2851-130
Display	10.1" TFT LCD, 1280×800, capacitive touch screen, Windows-based UI				
Reading resolution	6 digits				
Test frequency range	10Hz–15MHz	10Hz–30MHz	10Hz–50MHz	10Hz–80MHz	10Hz–130MHz
Frequency resolution	1mHz				
Frequency tolerance	±0.0005% (typical, 5–40°C)				
AC voltage	5mV – 2Vrms (1mV resolution, output resistance 100Ω, ≤1MHz); 5mV–1Vrms at 25Ω				
AC current	50μA – 20mArms (10μA resolution)				
DC bias voltage	0 – ±40V (1mV resolution)				
DC bias current	0 – ±100mA (40μA resolution)				
Test terminal configuration	Four-terminal pair				
Output impedance	25Ω / 100Ω (typical)				
Impedance range	25mΩ – 40MΩ (±10% accuracy)				
Test speed (5 levels)	1: 2.5ms · 2: 10ms · 3: 40ms · 4: 80ms · 5: 400ms				
Peak accuracy	0.08% typical (≤ ±0.045%) at 1kHz–1MHz · 0.5% at 2MHz · 1% at 10MHz · 5.0% at 130MHz				

Parameter	All models
List sweep	Up to 1,601 points, independently averaged and sorted per point — frequency, AC voltage/current, DC bias voltage/current
Graphic sweep	4 channels × 4 curves (16 curves total), 14 split-screen layouts; logarithmic, linear or segmented sweep, 2–1,601 points
Equivalent circuit analysis	7 models — 4× three-element, 3× four-element; exportable as TXT
Crystal oscillator (OSC) analysis	Resonant/anti-resonant frequency, quality factor, static capacitance and loss (piezoelectric devices)
Cursor / marker analysis	Up to 10 markers per curve incl. reference marker; max/min, peak/valley and target search
Sorting	10-bin LCR sorting; each scan-mode curve sorted independently
Interface	RS232C, USB Host, USB Device, LAN, GPIB, HANDLER, VGA, HDMI
Power-on warm-up	60 minutes
Input voltage	100–120VAC / 198–242VAC selectable, 47–63Hz
Power consumption	Max 150VA
Dimensions (W×H×D)	428 × 220 × 325mm
Weight	14.5kg

7.4 DC bias function

Parameter	Value
DC voltage bias range	0 to ±40V
DC voltage bias accuracy	± [0.1% + (5 + 30×|Imon|) mV], typical; ± [0.2% + (10 + 30×|Imon|) mV] above 23±5°C
DC current bias range	0 to ±100mA
DC current bias accuracy	± [2% + (0.2 + |Vmon|/20) mA], typical; ± [4% + (0.4 + |Vmon|/20) mA] above 23±5°C
DC bias output impedance	25Ω / 100Ω (nominal)

Vmon / Imon: DC voltage/current offset monitor reading.

7.5 Optional analysis packages

Dielectric-constant analysis (TH26077 fixture, DC–30MHz, parallel-plate method) and magnetic-permeability analysis (TH26086 adapter + TH26088 fixture, DC–130MHz / 1kHz–1GHz) are optional packages requiring separate fixtures and software, not included in the specifications above. See the TH2851 Series Technical & Applications Guide §9–§10 for full principles, formulas and configuration tables, and §8.10/§8.11 of this manual for their SCPI subsystems (`PERMittivity`, `TROIdalcore`).

PART II — REMOTE CONTROL & HANDLER

CHAPTER 8

Remote Command Reference

This chapter summarizes remote control of the TH2851 series; it is not an exhaustive command dictionary. For the complete command list — all 296 documented commands with full syntax, parameter ranges and defaults — see the companion **TH2851 Series SCPI Command Reference**. Starting remote control locks the front panel and screen; press Help to unlock.

8.1 Remote interfaces

Interface	Notes
GPIB	IEEE 488.1/488.2, IEC-625, JIS-C1901 compliant; connects an external controller directly.
LAN	SCPI over SICL-LAN. Enable in **System → Misc Setup → Network Setup**, set the IP address, restart the software when prompted, then connect on the same subnet at **port 5025**.
USB	Presented as a virtual serial port to the controller.
RS-232	Serial connection; set the baud rate in **System → Misc Setup → Serial Port Setup** to match the controller.

8.2 About the SCPI commands

Two command groups are available:

- **TH2851 commands** — instrument-specific measurement and general-purpose functions, arranged as a hierarchical command tree: mnemonics separated by colons, e.g. `:BIAS:VOLTage <number>`.
- **IEEE common commands** — generic IEEE 488.2 commands, all beginning with an asterisk, not part of the hierarchical tree (e.g. `*IDN?`, `*RST`).

Each mnemonic has a long form and a short form (shown here as capitalized letters within the long form, e.g. `FREQuency` / `FREQ`); either may be used. A trailing `?` queries the current value instead of setting it.

8.3 Command subsystem summary

Commands are organized into the following subsystems (alphabetical, as implemented):

Subsystem	Covers
ABORt	Aborts a measurement/sweep in progress
AMPLitude	ALC control (§4.1.5)
APERture	Measurement time / aperture (Meas Time, §4.1.3)
AVERage	Averaging count and moving-average control (§4.1.4, §4.3.2)
BIAS	DC bias mode, level, range, state (§4.1.6)
CALCulate	Marker, marker search/function, equivalent-circuit and OSC analysis results (§4.4, §4.5)
COMParator	Bin limits, conditions, nominal value, sorting state (§4.6)
CORRection	Open/short/load/phase user calibration, per-point and all-frequency (§4.7)
CURRent	AC current level (alias grouping with VOLTage/AMPLitude)
DISPlay	Screen/trace display control, clear
FETCh	Reads back the most recent measurement result
FREQuency	Test frequency, sweep range (§4.1.2, §4.3.1)
FUNCtion	Selects the measurement parameter/function (Z, Cp, Ls, etc.)
INITiate	Starts (arms) a measurement
LIST	List-sweep point definitions (§4.2)
MMEMory	Save/load setup state and data files (§5.4)
PERMittivity	Dielectric-constant option — see Technical & Applications Guide §9
SENSe	Measurement-side configuration (range, impedance format)
SERVice	Service-level functions (factory/Techmize use)
SOURce	Source-side configuration (level, output resistance)
SYSTem	Key/mouse lock, power-off, preset, user-reset, system state (§5.1–§5.3)
TRIGger	Trigger source and delay (§4.1.8)
TROIdalcore	Magnetic-permeability option — see Technical & Applications Guide §10
VOLTage	AC voltage level

8.4 BIAS subsystem — example commands

Command	Function
`:BIAS:STATe {ON|OFF|1|0}` / `:BIAS:STATe?`	Set/query DC bias on/off
`:BIAS:MODE {VOLTage|CURRent}` / `?`	Set/query bias mode
`:BIAS:VOLTage <number>` / `?`	Set/query bias voltage level
`:BIAS:CURRent <number>` / `?`	Set/query bias current level
`:BIAS:RANGe {M1|M10|M100}` / `?`	Set/query bias range

Example: `:BIAS:MODE VOLT` then `:BIAS:VOLT 1` then `:BIAS:STAT ON` sets constant-voltage bias to 1V and enables it.

8.5 CORRection subsystem — example commands

Command	Function
`:CORRection:OPEN[:STATe] {ON|OFF|1|0}` / `?`	Set/query open-calibration on/off
`:CORRection:SHORt[:STATe] {ON|OFF|1|0}` / `?`	Set/query short-calibration on/off
`:CORRection:LOAD[:STATe] {ON|OFF|1|0}` / `?`	Set/query load-calibration on/off
`:CORRection:LOAD:TYPE {CPD|...}` / `?`	Set/query the equivalent-circuit type used for the load standard
`:CORRection:SPOT<n>:FREQuency <value>` / `?`	Set/query the frequency of calibration point *n* (1–20)
`:CORRection:SPOT<n>:LOAD:STANdard <num1>, <num2>` / `?`	Set/query the load reference values at point *n*
`:CORRection:CLEar`	Clears calibration data

8.6 COMParator subsystem — example commands

Command	Function
`:COMParator:BIN<n>[:STATe] {ON|OFF|1|0}` / `?`	Enable/query bin *n* (1–9)
`:COMParator:BIN<n>:CONDition<c>:LIMit <lo>,<hi>` / `?`	Set/query bin *n* condition *c* (1–4) limits
`:COMParator:BIN<n>:CONDition<c>:LTYPe {IN|OUT|ALL}` / `?`	Set/query the limit type for that condition
`:COMParator:CONDition<c>:MODE {OFF|DEV|PCNT|PDEV}` / `?`	Set/query deviation-mode for condition *c*
`:COMParator:CONDition<c>:NOMinal <number>` / `?`	Set/query the nominal value for condition *c*
`:COMParator:CONDition<c>:PARameter {Z|Y|...}` / `?`	Set/query which parameter condition *c* sorts on

Example: `:COMP:COND1:NOM 1E3` then `:COMP:COND1:LIM 1E3,2E3` then `:COMP:BIN1 ON` sets a nominal value of 1kΩ, a bin-1 limit band, and enables bin 1.

8.7 FREQuency, VOLTage/CURRent/AMPLitude and SOURce

Frequency, level and source-related settings follow the same set/query pattern, e.g. `:FREQuency <value>` for the test frequency (or sweep start/stop/center/span in trace-sweep mode via the `SENSe` / `SOURce` tree), `:VOLTage <value>` / `:CURRent <value>` for OSC level, and `:AMPLitude:ALC {ON|OFF}` for ALC control (§4.1.5).

8.8 LIST subsystem

Defines and queries list-sweep point data — frequency, level, bias and averaging per point (§4.2) — and reads back per-point results, mirroring the on-screen List Setup table.

8.9 APERture, TRIGger and FETCh

Command	Function
`:APERture <speed>,<avg>` / `?`	Set/query measurement time (speed level) and averaging count
`:TRIGger:SOURce {INTernal|EXTernal|MANual|BUS}` / `?`	Set/query trigger source (§4.1.8)
`:TRIGger` or `*TRG`	Issues a bus trigger when source is BUS
`:FETCh?`	Reads back the most recent measurement result over the remote interface

On RS-232, `:FETCh?` results can also be configured to return automatically after each measurement, without needing to be polled explicitly — see the companion TH2851 Series SCPI Command Reference for the configuration command.

8.10 MMEMory subsystem

Mirrors the on-screen Save/Recall functions (§5.4): `MMEMory:STORe:STATe` / `MMEMory:LOAD:STATe` save/load a setup state file; further `MMEMory` commands cover list-data export and comparator-table import/export.

8.11 PERMittivity and TROIdalcore subsystems (option packages)

When the corresponding option is installed and licensed, `PERMittivity` commands configure and read back dielectric-constant measurements (electrode type, C/D/εr'/εr'' results — Technical & Applications Guide §9), and `TROIdalcore` commands configure and read back magnetic-permeability measurements (sample geometry, μ'/μ'' results — Technical & Applications Guide §10). Both subsystems are inactive, and their commands return an error, on a unit without the corresponding fixture and software installed.

8.12 IEEE-488.2 common commands

The TH2851 implements the following IEEE-488.2 common commands:

Command	Function
`*IDN?`	Returns manufacturer, model, serial number, firmware revision
`*RST`	Resets to the power-on default state
`*TRG`	Bus trigger (equivalent to `:TRIGger` with source BUS)
`*OPC` / `*OPC?`	Operation-complete flag / query — used to synchronize a controller with a slow operation such as a full-frequency calibration sweep

8.13 Common remote tasks — quick table

Task	Command
Identify the instrument	`*IDN?`
Reset to power-on state	`*RST`
Set the measured parameter	`FUNCtion <fn>` (e.g. `CPD` for Cp+D)
Set frequency / level	`FREQuency <value>` · `VOLTage <value>`
Enable DC bias	`BIAS:MODE VOLT` · `BIAS:VOLT <value>` · `BIAS:STAT ON`
Trigger and read a result	`TRIGger:SOURce BUS` then `*TRG` and `FETCh?`
Run open/short correction	`CORRection:OPEN ON` · `CORRection:SHORt ON`
Set up a comparator bin	`COMParator:COND1:NOM <value>` · `:LIMit <lo>,<hi>` · `BIN1 ON`
Save/load a setup file	`MMEMory:STORe:STATe` · `MMEMory:LOAD:STATe`

> **NOTE**
>
> This chapter covers the subsystems and command patterns needed to automate the common workflows in Chapter 4 and Chapter 6. It intentionally omits full parameter enumerations (e.g. every valid `FUNCtion` value, every `CORRection:LOAD:TYPE` option) — query the instrument directly (append `?` to the relevant command) or see the companion TH2851 Series SCPI Command Reference for exhaustive lists.

CHAPTER 9

Handler Interface

The Handler interface outputs sorting results for automated component-handling systems and accepts external trigger/control input. Signal definitions differ by measurement mode (§9.2); electrical characteristics are consistent across all modes (§9.3).

9.1 Connector pin definitions

Pin	Signal	Description
1–9	/BIN1 – /BIN9	Sorting result output
10	/OUT	Sorting result output
11	/AUX	List-sweep sorting result output
12–13	/EXT.TRIG	External trigger: a rising-edge pulse on this pin triggers a measurement when trigger source is EXTernal
14–15	EXT.DCV2	External DC supply for photocoupled control signals (/EXT.TRIG, /ALARM, /INDEX, /EOM, /Keylock)
16–18	+5V	Instrument-internal +5V — not recommended for general use; if used, keep current <0.3A and keep the line away from interference sources
19–20	/PHI / /PLO	List-sweep sorting result output
21	/SREJ	List-sweep sorting result output
22	/SHI	List-sweep sorting result output
23	/SIN	List-sweep sorting result output
24	/SLO	Sorting measurement result invalid (out of range)
25	/KEYLOCK	Spare input
26	NC	No connection
27–28	EXT.DCV1	Pull-up DC supply for photocoupled outputs (/BIN1–/BIN9, /AUX, /OUT, /PHI, /PLO, /SREJ)
29	/ALARM	Asserted on a power-down event
30	/INDEX	Asserted when the analog measurement completes — safe to connect the next DUT, but bin outputs are not yet valid
31	/EOM	Asserted once measurement data and comparison result are valid
32–33	COM2	Ground reference for EXT.DCV2
34–36	COM1	Ground reference for EXT.DCV1

9.2 Signal definitions by measurement mode

9.2.1 Point measurement

Sorting output: /BIN1–/BIN9, /OUT, /SLO (invalid result). **Control output:** /INDEX, /EOM, /ALARM. **Control input:** /EXT.TRIG, /Keylock.

Timing	Min.	Max.
T1 — trigger pulse width	1µs	—
T2 — measurement start delay	200µs	display time + 200µs
T3 — trigger wait after /EOM	0µs	—

Typical comparison time ≈1ms. Typical display time: component measurement page ≈8ms, sorting display page ≈5ms, sorting count page ≈0.5ms.

9.2.2 List sweep

Sorting output: /BIN1–/BIN9, /AUX (BIN10), /OUT, /PHI (BIN11), /PLO (BIN12), /SREJ (BIN13), /SHI (BIN14), /SIN (BIN15), /SLO — asserted once the entire list-sweep measurement completes. **Control output:** /INDEX is asserted when the last sweep point's analog measurement completes; /EOM is asserted once all sorting results for the full list are valid. **Control input:** /EXT.TRIG, /Keylock. T1–T3 as in point measurement.

9.2.3 Trace (graphic) sweep

Sorting output: /BIN1–/BIN4 = curves 1–4 pass, on the current scan channel; /BIN5–/BIN8 = curves 1–4 fail. **Control output/input:** as in list sweep — /INDEX on completion of the last sweep point, /EOM once results are valid.

9.3 Electrical characteristics

Electrical characteristics are the same across all measurement modes. Each DC output (pins 1–16 group) is an isolated open-collector optocoupler output; its output voltage is set by a pull-up resistor connected either to the instrument's internal +5V or to an external EXTV supply via a jumper on the Handler interface board.

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

Pull-up voltage is selected by jumpers JP1–JP6 on the Handler interface board — internal +5V or an external EXT.DCV1/EXT.DCV2 supply. The /EXT.TRIG and /Keylock input stage is opto-isolated.

9.4 Operation sequence

Per test cycle: trigger → delay (T2, configurable, §4.1.8) → analog measurement → **/INDEX** asserts the instant analog measurement finishes (safe to remove/insert the next DUT, but bin outputs are not yet valid) → comparison and display processing (≈1ms compare time, plus page-dependent display time, §9.2.1) → **/EOM** asserts once bin outputs are valid and stable → the handler reads the bin state → the instrument waits up to T3 before accepting the next trigger.

In list-sweep and trace-sweep modes, /INDEX and /EOM assert once per complete sweep, not once per point (§9.2.2–9.2.3).

9.5 Setting up bin sorting

1. Open **Limit Table Setup** (point/list, §4.6) or **Limit Line** (sweep, §4.5.1); enter the nominal value and bin high/low limits.
2. Set the comparator to **ON**.
3. Wire the Handler connector per §9.1, using the signal set that matches your measurement mode (§9.2).
4. Run **Handler Test** (§5.2) to verify each line switches correctly before connecting production equipment.
5. Run production testing; bin/DUT counts are shown on the sorting count display, and the handler reads bin state from /BIN1–/BIN9 (or /AUX, /PHI, /PLO, /SREJ, /SHI, /SIN for list sweep) once /EOM asserts.

> **FOR FASTEST CYCLE TIME IN A SORTING APPLICATION**
>
> Lock the AC range to the expected value instead of Auto (§4.1.7), turn off unneeded signal monitors, and run from the sorting count display rather than the full parameter display.

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	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
Fs / Fp	Resonant / anti-resonant frequency (OSC analysis)	Kt	Mechanical coupling coefficient
εr', εr''	Dielectric constant, real / imaginary part	μ', μ''	Complex permeability, real / imaginary part

A.2 Front-panel key quick reference

Key	Function
LCR	Opens point-measurement mode (§4.1)
Sweep	Opens trace-sweep mode (§4.3)
Point/List	Toggles point ↔ list-sweep view (§4.2)
Meas	Opens measurement setup for the active mode
Cal	Opens user calibration (§4.7)
DC Bias	Toggles DC bias output (§4.1.6)
Trigger Mode / **Trigger** / **Hold**	Trigger source select / manual trigger / hold current mode (§4.1.8)
Save/Recall	Opens save/load menu (§5.4)
System	Opens System menu (§5.1)
Preset	Restores factory/user default state, after confirmation
Help	Opens help; also unlocks a locked screen/panel (§5.3)

A.3 Common remote commands

Task	Command
Identify the instrument	`*IDN?`
Reset to power-on state	`*RST`
Set the measured parameter	`FUNCtion <fn>` (§8.7)
Set frequency / level	`FREQuency <value>` · `VOLTage <value>`
Trigger and read a result	`TRIGger:SOURce BUS` then `*TRG` and `FETCh?`
Run open/short correction	`CORRection:OPEN ON` · `CORRection:SHORt ON`
Save/load a setup file	`MMEMory:STORe:STATe` · `MMEMory:LOAD:STATe`

See Chapter 8 for the fuller (still non-exhaustive) command reference.

A.4 Contact, warranty and support

Warranty terms: see §1.8. For service, calibration, accessories, electrical safety test data (§1.4) or compliance documentation (§1.5–§1.7), contact Techmize or your authorized distributor using the details below.

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