TECHMIZE by TONGHUI

OM

OPERATION MANUAL

TH2523/A Series

Battery Internal-Resistance Tester — TH2523 / TH2523A. Covers front-panel operation, measurement/bin/trace/statistics setup, system configuration and file management; see Chapter 7 for the remote-control interfaces and Chapter 8 for the HANDLER interface.

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

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TH2523/A Series Operation Manual

Battery Internal-Resistance Tester — TH2523 / TH2523A

This manual describes the operation of the TH2523/A Series battery internal-resistance testers. Both models use a 1 kHz AC constant-current measurement method with 4-terminal (Kelvin) connection, for fast, repeatable internal-resistance and voltage testing of cells, battery packs and modules. **TH2523A** differs from **TH2523** only in its DC voltage measurement range and maximum input voltage, for higher-voltage packs — see §6.8.

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The full SCPI command reference is issued as a separate companion document, TH2523/A Series SCPI Command Reference, in line with Techmize's standard practice for command sets of this size (the source chapter lists roughly 68 commands across 11 subsystems, over 27 pages). Chapter 7 of this manual covers the remote interfaces and command-subsystem structure only.

CHAPTER 1

Safety & Compliance

1.1 About this manual

This is the original-language (English) edition of the operation manual for the Techmize TH2523 series battery internal-resistance tester, covering models **TH2523** and **TH2523A**. Where this manual and the instrument itself appear to disagree, or where a described function is not present on your particular model or configuration, contact Techmize or your authorized distributor using the details in §1.9 before relying on the instrument for measurement or sorting decisions.

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

> **WARNING — TEST-TERMINAL LOW SIDE IS CHASSIS-REFERENCED**
>
> On the TH2523/TH2523A, the low (LCUR/LPOT) side of the test terminals is internally connected to the instrument's chassis/earth ground. If you measure a device other than a battery — or send the instrument for calibration — take this into account and apply appropriate precautions, since the device under test's low side will be at ground potential.

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 next to the instrument's rear-panel ground terminal.

1.3 General safety requirements

Protective earthing of the chassis, via the three-wire AC 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 or with a two-wire (ungrounded) adapter. The power cord's protective grounding conductor must be connected to ground; disconnect the power cord before replacing the fuse.

Power	
Supply voltage	220 V AC ±10%
Supply frequency	50 Hz or 60 Hz
Power consumption	≤ 30 VA
Fuse	T1AL 250 V (factory-fitted; replace only with the same rating and type)

The AC power-inlet line L, neutral N and earth E conductors must match the instrument's power-inlet wiring. The instrument has been carefully designed to minimize noise picked up from the AC supply, but it should still be used in as low-noise an environment as practical; fit a power-line filter ahead of the instrument if this cannot be avoided.

> **WARNING — TEST TERMINALS**
>
> The front-panel four-terminal test port (LCUR, LPOT, HPOT, HCUR, marked UNKNOWN, CAT I) sources test current into the device under test. Always use the test cable or fixture supplied or specified by Techmize/Tonghui, matching the plug colour and connector to the panel socket. Disconnect the device under test before changing wiring. The maximum rated input is **±60 VDC** as marked on the panel; see §6.2/§6.8 for the actual rated maximum input voltage per model (65 V for TH2523, 350 V for TH2523A).

Test fixtures and cables. Use only the test fixture or cable supplied by Techmize/Tonghui; a user-made or third-party fixture or cable can produce incorrect measurement results. Keep the fixture, cable and the device-under-test leads clean to ensure good contact.

Environment

Item	Requirement
Operating temperature	0–40 °C
Operating humidity	≤ 75% RH
Storage temperature	5–40 °C
Storage humidity	≤ 85% RH, non-condensing

Do not use the instrument in a dusty, vibrating, direct-sunlight or corrosive-gas environment. Keep the left-side ventilation opening clear to maintain accuracy, and keep the test leads connected to the device under test away from strong electromagnetic fields. If the instrument will not be used for an extended period, store it in its original packaging, or a similar box, in a well-ventilated room within the storage conditions above.

> **CAUTION — WARM-UP AND POWER CYCLING**
>
> Allow at least **30 minutes** of warm-up after switch-on before relying on the rated accuracy given in Chapter 6. Do not power-cycle the instrument frequently, as this may cause internal data confusion.

1.4 Electrical safety test data

Dielectric-withstand, insulation-resistance and leakage-current test figures are not published in the operation manual for this series. Contact Techmize/Tonghui engineering if a formal electrical safety test report is required.

1.5 CE marking

The TH2523/A series carries the CE mark, as shown on the instrument's rear-panel nameplate.

1.6 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.

1.7 RoHS compliance

The TH2523/A series is covered by Techmize's own RoHS (Directive 2011/65/EU, as amended) self-declaration. No independent third-party RoHS certificate is currently available for this series.

1.8 Warranty

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. A warranty card is required to claim warranty service.

This warranty does not cover damage from misuse, accident, unauthorized modification or repair, consumable/wear items such as the fuse, or damage from operation outside the environmental limits given in §1.3. Repair must be carried out by qualified technical personnel; do not replace internal components without authorization. After any repair, the instrument must be recalibrated before further use, since a user-performed repair that damages a component is not covered by the warranty.

1.9 Manufacturer & EU contact

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Registration

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Register Court: Amtsgericht München
HRB 312530 · VAT ID DE463170824

CHAPTER 2

Out of the Box

2.1 Unpacking

Inspect the shipping container for damage after unpacking. It is not recommended to power on the instrument if the container shows signs of damage — contact your carrier and your Techmize distributor before proceeding. Check the contents against your order; if anything does not conform, notify Techmize or your distributor promptly.

Item	Qty
TH2523 or TH2523A instrument (model as ordered)	1
4-terminal Kelvin test clip lead	1
EU power cable (Schuko, CEE 7/7)	1
This operation manual	1
Certificate of conformity	1
Warranty card	1

Keep the original packaging — it is the recommended way to store or return the instrument. Store the instrument in a dry, well-ventilated room at 5–40 °C and ≤85% RH when not in use for an extended period, away from corrosive gases.

2.2 Connecting the power supply

Item	TH2523 / TH2523A
Supply	220 V AC ±10%, 50/60 Hz
Power consumption	≤ 30 VA
Power switch	Front-panel POWER switch, bottom-left of the front panel

Match the L (line), N (neutral) and E (earth) conductors of the supply cable to the instrument's rear-panel power inlet, and confirm reliable grounding before switching on. If mains conditions are noisy, fitting a power-line filter ahead of the instrument is recommended.

> **WARNING**
>
> Make sure the protective-earth conductor is reliably grounded before connecting the power cable, to prevent electric shock from leakage current. Disconnect the power cable before replacing the fuse.

2.3 Connecting the device under test

Connect the 4-terminal Kelvin test cable (or an equivalent Techmize-specified fixture) to the front-panel test port, matching plug colour to the panel socket: **HCUR/LCUR** (red/black) source the 1 kHz AC test current, and **HPOT/LPOT** (white/blue) sense the voltage drop across the device under test, eliminating lead and contact-resistance error from the reading. This true 4-terminal connection is what makes the instrument's reading independent of test-lead impedance.

> **CAUTION**
> A user-made or third-party test fixture or cable can produce incorrect measurement results. Keep the fixture/cable and the device-under-test leads clean for good contact, and keep test leads away from strong electromagnetic fields.

> **WARNING — LOW SIDE IS CHASSIS-REFERENCED**
> LCUR/LPOT are internally connected to the instrument's chassis/earth ground (§1.1). When measuring a device other than a battery, keep this in mind to avoid an unintended ground path.

2.4 Short-circuit zeroing (REL)

Before precision measurement, short the test leads correctly — red HCUR to black LCUR, white HPOT to blue LPOT — as shown below, then execute the short-circuit zero function (<Measurement Display> → Tools → Short, §4.1) to remove residual lead/contact resistance from subsequent readings.



Correct short-circuit connection for REL / zero-clear

2.5 Starting the instrument for the first time

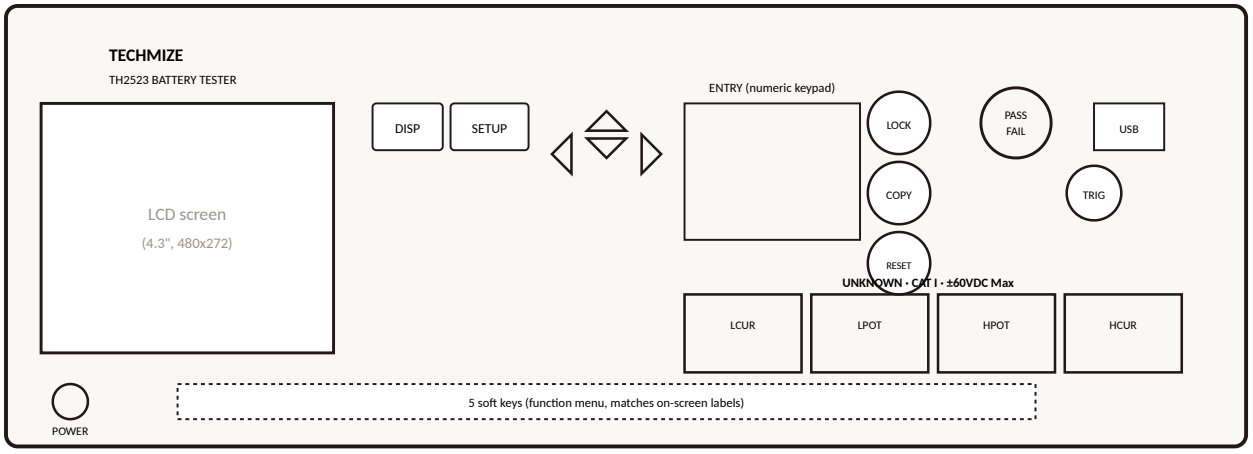
1. Connect the EU power cable to the rear-panel inlet, confirming reliable earth-ground connection.
2. Press the front-panel **POWER** switch (bottom-left of the front panel).
3. The instrument displays a startup screen showing the Tonghui trademark, model and firmware version.
4. If password protection is enabled, the instrument prompts for the startup password before continuing (factory default: `2523`).
5. The display opens on the default <Measurement Display> page.

Allow at least 30 minutes of warm-up before relying on the rated accuracy (§1.3). For an overview of the front panel, rear panel and screen layout, continue to Chapter 3.

CHAPTER 3

Getting to Know the Instrument

3.1 Front panel



Simplified front-panel layout (schematic, not to scale) — see the legend below for the full item list

1 **LCD display** — 4.3" 24-bit colour TFT screen, 480×272 resolution.

2 **DISP** — opens the <Measurement Display> main page (§3.4).

3 **SETUP** — opens the <Measurement Setup> main page (§3.4).

4 **Arrow keys** — up/down/left/right, for field navigation and selection.

5 **Numeric keypad (ENTRY)** — digits 0–9, decimal point, +/−, for direct numeric entry.

6 **LOCK** — press once to lock the screen; press again to unlock.

7 **COPY** — captures the current screen to a connected USB drive.

8 **RESET** — system reset key.

9 **PASS / FAIL indicator** — shows the comparator result on the <Bin Display> page.

10 **USB** — Host port, for USB flash-drive storage.

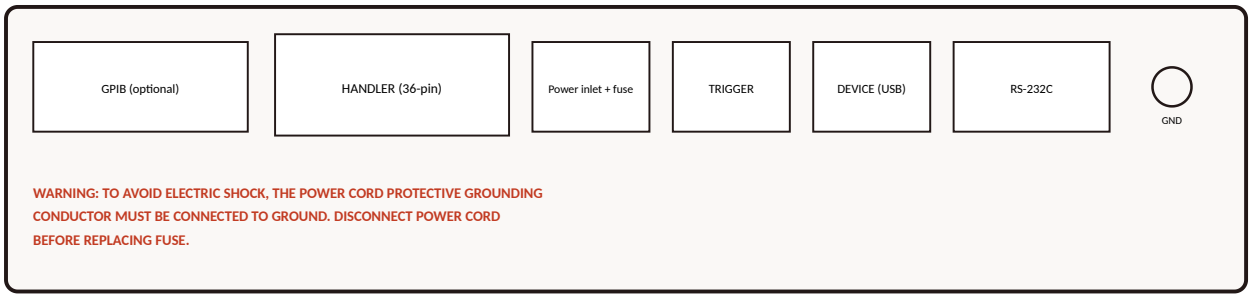
11 **TRIG** — in MAN trigger mode, press once to start one triggered measurement.

12 **4-terminal test port (UNKNOWN)** — LCUR, LPOT, HPOT, HCUR; CAT I, ±60 VDC max panel rating (§2.3).

13 **Soft-key area** — five keys matched to the on-screen menu beside the display.

14 **POWER switch** — bottom-left.

3.2 Rear panel



Simplified rear-panel layout (schematic, not to scale) — see the legend below for the full item list

1 **GPIB interface (optional)** — for GPIB/IEEE-488 parallel communication test systems (§7.2); requires the factory-fitted GPIB option.

2 **HANDLER port** — 36-pin connector; outputs the comparator/bin-sort result and interlock signals, and accepts an external "start" trigger, for automatic test-system integration (Chapter 8).

3 **Power inlet, fuse & ground** — AC power inlet and fuse holder (§1.3, §2.2); separate chassis ground terminal.

4 **TRIGGER (BNC)** — external trigger input; with Trigger mode = EXT, a connected foot switch (optional) triggers one measurement.

5 **DEVICE (USB)** — rear-panel USB port for PC control over USBTMC or USBCDC (§7.3, §7.4).

6 **RS-232C port** — serial communication with a host PC (§7.1).

7 **Nameplate** (not shown) — manufacturer, model, serial number and CE mark.

3.3 Screen display regions

The <Measurement Display> page (and the other main pages) divides the 480×272 colour screen into five regions:

Region	Description
Main-menu area	Shows the name of the current page (e.g. <Measurement Display>) and the File/Tools menu entries
Function area	Used to modify the test parameters (parameter, range, speed, etc.)
Measurement-result area	Displays the primary and secondary parameter results, in large digits
Message area	Shows status and prompt messages during testing
Soft-key area	Shows the function menu matched to the cursor's current field

3.4 Main pages

Key	Opens (soft keys across the top)
DISP	<Measurement Display> · <Bin Display> · <Trace Display> · <Statistics Display> (Chapter 4)
SETUP	<Measurement Setup> · <Bin Setup> · <Trace Setup> · <System Setup> (Chapter 4, Chapter 5)

3.5 Basic operation

1. Use the DISP / SETUP menu keys and the soft-key area to reach the page you want.
2. Use the arrow keys to move the cursor to a field (the selected field is highlighted in colour); the corresponding function menu appears in the soft-key area.
3. Press the soft key beside the display to apply the setting, or use the numeric keypad to type a value directly and confirm it with the matching soft key.

3.6 Starting the instrument

Confirm reliable earth-ground connection, then press POWER (§2.5). The instrument shows a startup screen (trademark, model, firmware version), then opens on the default <Measurement Display> page. If password protection is enabled, enter the startup password when prompted (factory default: `2523`; see §5.1). Allow at least 30 minutes of warm-up before relying on rated accuracy (§1.3, Chapter 6).

CHAPTER 4

Basic Operation

This chapter covers the <Measurement Display>, <Bin Display>, <Trace Display> and <Statistics Display> pages and their matching setup pages. The instrument measures with a 1 kHz AC constant-current source, through the front-panel 4-terminal test port.

4.1 <Measurement Display> page

Opened with DISP. Shows the live measured value(s) from the front-panel test port.

Field	Options / range
Parameter	R · V · R-V · R-Q · L-Q · L-R · R-X · C-D · Z-θd · Z-θr — 10 combinations
Range V	AUTO · HOLD · 6 V/60 V (TH2523) or 30 V/300 V (TH2523A)
Speed	FAST · MED · SLOW
Range R	AUTO · HOLD · ↑ / ↓ (6 ranges, §6.3)

Main and secondary parameters are shown as two lines of large digits, the primary parameter above the secondary. With Monitor V and Monitor I on (§4.4), the actual test voltage Vm and current Im applied to the device under test are also shown beneath the main reading.

4.1.1 Measurement parameters

Primary	Meaning	Secondary	Meaning
Z	Impedance magnitude	Q	Quality factor
R	Resistance	R	Equivalent series resistance (ESR)
L	Inductance	X	Reactance
V	DC voltage	r	Phase angle, radians
C	Capacitance	θ	Phase angle, degrees
		D	Dissipation factor

4.1.2 Tools

The Tools area on <Measurement Display> provides: **REL OFF/REL ON** (deviation-subtraction toggle, §4.4); **Short OFF/Short ON** (enables the short-circuit zero function) and **Short** (executes short-circuit zeroing — short the test leads correctly per §2.4 first); **Display OFF/Display ON** (turns the result display off/on); and **Save ON/Save OFF** (when ON, writes the current measurement continuously to a USB drive — the USB drive must already be connected, or data is not saved).

> NOTE
> At SLOW or MED speed, the measurement result is shown with 5-digit resolution; at FAST speed, 4-digit resolution. Once Save is switched ON, always switch it back OFF explicitly to close out the data file — otherwise data can be lost.

4.2 <Bin Display> page (comparator)

Opened with DISP → Bin Display. Shows the live comparator (go/no-go sorting) result together with the measured value(s).

Field	Options / range
Sorting mode	Bin sort (per-bin sorting, 9 bins) · Single bin (simple good/bad judgement)
Beep bin	NG (beep on fail) · GD (beep on pass) · OFF
Compare	ON · OFF — master enable for the comparator function
Load bin	BIN1–9 — selects which bin's limits apply in Single-bin mode only

In Bin-sort mode the display shows `BIN: n` (n = 1–9, or NG if outside all bins); in Single-bin mode it shows `COMP: HI`, `COMP: LO` or `COMP: IN` against the loaded bin's limits. The PASS/FAIL front-panel indicator and the HANDLER interface (Chapter 8) reflect the same result. The parameter/range/speed fields from <Measurement Display> (§4.1) also apply on this page.

4.3 <Bin Setup> page (comparator limits)

Reached with SETUP → Bin Setup. Configures up to 9 bins (BIN1–BIN9), each with independent primary (A) and secondary (B) parameter limits.

Field	Options / range
Mode	% (percentage-deviation limits) · ABS (absolute limits)
Compare A / Compare B	ON · OFF — enables primary/secondary-parameter comparison independently
Nominal A / Nominal B	User-entered nominal value; used only in % mode
Upper/lower limit, BIN1–9	% mode: −100 to 100 · ABS mode: −10000 to 10000, entered per bin for both A and B

In % mode, each bin's limits are computed from the nominal value: upper = nominal×(1+upper%), lower = nominal×(1+lower%). HANDLER provides one comparator-result signal set per bin (Chapter 8).

4.4 REL (deviation) and reference values

On <Measurement Setup> (§5.1), **Deviation A** and **Deviation B** independently control how the primary/secondary result is displayed, against a stored reference value (**Reference A** / **Reference B**):

Deviation mode	Displayed value
OFF	Measured value, unmodified
ABS	Measured value − reference
%	(Measured value − reference) / reference × 100, in %

The reference value is set with the increase (++/+) and decrease (−/−−) soft keys, direct numeric entry, or the **Measure** soft key, which fills the reference with the device under test's current measured value.

4.5 <Trace Display> and <Trace Setup> pages

These pages support unattended monitoring of a battery's discharge curve: the instrument scans the primary and/or secondary parameter at a set interval over a set total time, and plots the readings as a curve, with automatic stop conditions.

4.5.1 <Trace Setup> page

Reached with SETUP → Trace Setup.

Field	Description
Total time	Total duration of the trace scan
Time interval	Interval between successive measurements during the scan
A Max / A Min	Y-axis plotting range (maximum/minimum coordinate) for the primary-parameter curve
B Max / B Min	Y-axis plotting range for the secondary-parameter curve
A Stop1 / A Stop2	Auto-stop high/low limits for the primary parameter: the scan stops automatically once the primary reading exceeds Stop1 (high) or falls below Stop2 (low), after re-confirming with 2 extra measurements for reliability
B Stop1 / B Stop2	Auto-stop high/low limits for the secondary parameter, same behaviour as A Stop1/A Stop2

4.5.2 <Trace Display> page

Reached with DISP → Trace Display. The Tools area provides:

Control	Function
Scan Start / Scan Stop	Starts or stops the trace scan
Curve A+B	Cycles between plotting the primary curve (A), the secondary curve (B), or both together (A+B)
Cursor	Shows the measured value at the cursor position on the plotted curve; move the cursor with the left/right arrow keys
Max/Min value ON/OFF	When ON, the maximum and minimum value of the primary and secondary curves (with timestamp) are shown once the scan completes

This feature makes it possible to run a complete, unattended discharge-curve test and have the instrument stop automatically once the battery reaches the configured end-of-discharge condition.

4.6 <Statistics Display> page

Opened with DISP → Statistics Display. Runs a statistical analysis — mean, pass rate and process-capability indices — across a batch of up to 30,000 measurements.

Field	Options / range
Mode	ABS (absolute upper/lower limits) · % (nominal-value percentage limits)
Nominal A / Nominal B	Numeric entry, confirmed via the soft-key area
Count	Number of readings to include, up to 30,000
Statistics (A/B)	A — compares each reading's primary parameter against the limits; B — compares the secondary parameter
Upper limit / Lower limit	In % mode: upper = nominal×(1+upper%), lower = nominal×(1−lower%); in ABS mode, entered directly

The Tools area provides Statistics Start/Stop and a Trigger soft key. While running, each new measurement is compared against the limits and folded into the running statistics shown on screen (counted as HI, LO, or IN).

4.6.1 Statistical quantities

Quantity	Meaning
MEAN	Arithmetic mean of all readings: $\bar{X} = \Sigma x / n$
STDEV (σ)	Population standard deviation
SASTDEV (s)	Sample standard deviation
Cp	Process-capability index (dispersion): $Cp = \lvert Hi-Lo \rvert / 6s$
CpK	Process-capability index (centring): $CpK = (\lvert Hi-Lo \rvert - \lvert Hi+Lo-2\bar{x} \rvert) / 6s$
HI(NUM) / LO(NUM) / IN(NUM)	Count of readings above the upper limit / below the lower limit / within limits
MAX / MAXINDEX	Largest reading in the batch, and its sequence number
MIN / MININDEX	Smallest reading in the batch, and its sequence number

Cp, CpK > 1.33: process capability is good. 1.00 ≤ Cp, CpK ≤ 1.33: process capability is acceptable. Cp, CpK < 1.00: process capability is insufficient.

4.7 <Measurement Setup> page

Reached with SETUP → Measurement Setup. Collects all measurement-condition fields in one page, several of which are also reachable from <Measurement Display>.

Field	Options / range
Parameter / Range V / Speed / Range R	As §4.1
Trigger	INT (continuous internal trigger) · MAN (front-panel TRIG key) · EXT (HANDLER or rear-panel TRIGGER/foot-switch input) · BUS (remote command)
Average	1–255, programmable; a higher value improves accuracy at the cost of measurement time
Trigger delay	0–60,000 ms, 1 ms resolution (time from trigger to the start of measurement)
Power-line frequency	50 Hz · 60 Hz — match to the local mains frequency to reduce supply-frequency interference
Monitor V / Monitor I	ON · OFF — shows the actual Vm/Im applied to the device under test on <Measurement Display>
Deviation A / Deviation B	OFF · ABS · % (§4.4)
Reference A / Reference B	Numeric reference value for the deviation calculation (§4.4)

In Internal (INT) trigger mode the instrument measures continuously; in Manual (MAN) mode, each press of the front-panel TRIG key or rear-panel foot switch triggers one measurement; in External (EXT) mode, each HANDLER trigger pulse triggers one measurement; in Bus (BUS) mode, a remote command triggers each measurement.

CHAPTER 5

System Setup & File Management

5.1 <System Setup> page

Reached with SETUP → System Setup.

Field	Options / range
Beep	ON · OFF — key-press tone
Language	ENGLISH · CHINESE (operator-interface language)
Password	OFF · ON · Modify (factory default startup password: `2523`)
Bus mode	RS232C · GPIB (requires the optional GPIB card) · USBTMC · USBCDC
Baud rate	9600 · 19200 · 28800 · 38400 · 57600 · 115200
Bus address	1–31 — the GPIB bus address of the instrument
Date / time	Format YY-MM-DD HH:MM:SS, adjusted with the increase/decrease soft keys or direct numeric entry

> NOTE
>
> The startup password is factory-set to `2523`. Record any password you change it to — a lost password requires Techmize/Tonghui support to clear. The Language field above lets the operator switch the on-screen interface between English and Chinese; units shipped for the European market are configured to English at the factory, and Techmize does not market or describe the TH2523/A series as a bilingual-UI product.

5.2 File management

Reached by selecting the File entry from the top of any main page, then External File or Internal File. Configuration settings can be saved to and recalled from a file, so a complete instrument setup does not need to be re-entered manually. **I:** denotes Internal (the instrument's internal flash); **E:** denotes External (a connected USB drive).

5.2.1 Storage types

Type	Format	Recallable	Where
Configuration save	*.STA	Yes	Internal flash or USB drive
Measurement data save	*.CSV	No	USB drive only
Screen snapshot	*.GIF	No	USB drive only (front-panel COPY key)

5.2.2 USB folder structure

Folder	Max files	Contents
STA	Up to 102	Instrument configuration *.STA files, named sequentially e.g. `2523001.STA`
CSV	Up to 102	Measurement-result *.CSV files, e.g. `2523001.CSV`
PIC	Up to 102	Screen-snapshot *.GIF files, e.g. `2523001.GIF`

The STA and CSV folders are created automatically when a USB drive is connected. Use a USB2.0 drive formatted as FAT16 or FAT32 (FAT32 recommended above 512 MB), and avoid storing an excessive number of files on it for best save/load performance. Back up data on the USB drive before connecting it to the instrument — Techmize/Tonghui is not responsible for USB-drive data loss.

5.2.3 File operations

The internal-file and external-file pages each list 6 files per screen, with name and save date/time. With the cursor on a non-empty file entry, the soft-key area shows:

Operation	Effect
Load	Recalls the selected file's saved settings into the active configuration (confirm with Yes/No)
Copy to E:	Copies the selected internal file to a connected USB drive
Delete	Deletes the selected file (confirm with Yes/No)

With the cursor on an empty entry, the soft key shows **Save**: confirm with Yes/No, then enter a file name on the on-screen keyboard and confirm again to save the current configuration to that file.

To save measurement results continuously: on <Measurement Display>, open the Tools area and toggle **Save** to ON (a USB drive must already be connected); toggle it back to OFF to close the file — always stop logging explicitly, or the last block of data can be lost. To capture a screenshot to USB, use the front-panel [COPY] key.

CHAPTER 6

Performance & Specifications

6.1 Measurement function

Item	Specification
Measurement parameters	Primary: Z, R, L, V, C · Secondary: Q, R (ESR), X, r, θ, D
Parameter combinations	10: R, V, R-V, R-Q, L-Q, L-R, R-X, C-D, Z-θd, Z-θr
Math functions	Absolute deviation (ΔABS) and percentage deviation (Δ%) against a user-programmable reference (§4.4)
Range	Resistance and DC voltage, each with 2 ranges; AUTO or manual (HOLD, step ↑/↓)
Trigger	Internal (continuous) · Manual (TRIG key) · External (HANDLER/TRIGGER input) · Bus (remote command)
Test-terminal configuration	4-terminal: LCUR, LPOT, HPOT, HCUR (front panel)
Average	1–255, programmable
Displayed digits	SLOW/MED: 5 digits, max. reading 35000 (R) / 31000 (V) · FAST: 4 digits, max. reading 3500 (R) / 3100 (V)

6.2 Test signal

Item	Specification
Test signal	1 kHz ±0.2 Hz, sine wave
Max. input voltage — TH2523	65 V
Max. input voltage — TH2523A	350 V

6.3 Resistance ranges and test current

Range	Max. displayed value	Resolution	Test current
30 mΩ	33.000 mΩ	1 μΩ	100 mA (±10%)
300 mΩ	330.00 mΩ	10 μΩ	100 mA (±10%)
3 Ω	3.3000 Ω	100 μΩ	10 mA (±10%)
30 Ω	33.000 Ω	1 mΩ	1 mA (±10%)
300 Ω	330.00 Ω	10 mΩ	100 μA (±10%)
3 kΩ	3.5000 kΩ	100 mΩ	10 μA (±10%)

Both TH2523 and TH2523A share the same 6 resistance ranges, selectable AUTO/HOLD or stepped with ↑/↓.

6.4 Measurement display range

Parameter	Display range
L	0.2000 nH – 1 H
C	0.0001 pF – 9.9999 F
R, X, Z	0.001 mΩ – 3.5000 kΩ
Q, D	0.001 – 9999.9
θ	Deg: −179.99° – 179.99° · Rad: −3.1416 – 3.1416

V	0.0001 V – 350.000 V (TH2523A); 0.0001 V – 65.000 V on TH2523's own ranges

6.5 Measurement accuracy — general conditions

The figures in §6.6 and §6.7 apply at 20 °C ±5 °C, after ≥30 minutes warm-up, with the test leads correctly short-circuited and REL/short-circuit zeroing performed (§2.4). Outside this temperature band (but within the 0–40 °C operating range of §1.3), apply the stated temperature coefficient. Rdg = reading, Fs = full scale.

6.6 Resistance accuracy

6.6.1 SLOW / MED speed (5-digit display), temperature coefficient ±0.05%/°C

Range	30 mΩ	300 mΩ	3 Ω	30 Ω	300 Ω	3 kΩ
6-month accuracy	±(0.3%Rdg+0.01%Fs)	±(0.1%Rdg+0.01%Fs)				
1-year accuracy	±(0.6%Rdg+0.01%Fs)	±(0.3%Rdg+0.01%Fs)				

6.6.2 FAST speed (4-digit display), temperature coefficient ±0.05%/°C

Range	30 mΩ	300 mΩ	3 Ω	30 Ω	300 Ω	3 kΩ
6-month accuracy	±(0.5%Rdg+0.01%Fs)	±(0.3%Rdg+0.01%Fs)				
1-year accuracy	±(0.7%Rdg+0.01%Fs)	±(0.5%Rdg+0.01%Fs)				

Both tables apply identically to TH2523 and TH2523A, since the two models share the same resistance ranges and front-end.

6.6.3 Accuracy of L, C, X, Q, θ (derived from |Z| and D)

L, C and X accuracy uses the same basic figure as |Z| (§6.6.1/§6.6.2) when Dx (the measured D value) ≤ 0.1; above that, multiply the |Z| accuracy by $\sqrt{(1+D_x^2)}$. R's accuracy relative to |Z| uses the same rule with Qx (measured Q) in place of Dx. Q accuracy: $Q_e = \pm Q_x^2 \times D_e / (1 - Q_x \times D_e)$, valid for Qx×De < 1, where De = ±(|Z| accuracy)/100 for Dx≤0.1 (multiply De by (1+Dx) above that). θ accuracy: $\theta_e = (180/\pi) \times (|Z| \text{ accuracy})/100$, in degrees.

6.7 DC voltage accuracy

6.7.1 TH2523 — temperature coefficient ±0.005%/°C

Speed	Range	Resolution	6-month accuracy	1-year accuracy
SLOW/MED (5-digit)	6 V	100 µV	±(0.05%Rdg+0.01%Fs)	±(0.06%Rdg+0.01%Fs)
	60 V	1 mV		
FAST (4-digit)	6 V	1 mV	±(0.1%Rdg+0.01%Fs)	±(0.15%Rdg+0.01%Fs)
	60 V	10 mV		

6.7.2 TH2523A — temperature coefficient ±0.005%/°C

Speed	Range	Resolution	6-month accuracy	1-year accuracy
SLOW/MED (4-digit)	30 V	1 mV	±(0.05%Rdg+0.01%Fs)	±(0.1%Rdg+0.01%Fs)
	300 V	10 mV		
FAST (3-digit)	30 V	1 mV	±(0.1%Rdg+0.01%Fs)	±(0.15%Rdg+0.01%Fs)
	300 V	10 mV		

6.8 Model quick-reference

Model	DC voltage range	Max. input voltage	Resistance ranges
TH2523	6 V / 60 V	65 V	30 mΩ – 3 kΩ (6 ranges, shared)
TH2523A	30 V / 300 V	350 V	30 mΩ – 3 kΩ (6 ranges, shared)

TH2523A's only functional difference from TH2523 is its wider DC voltage range and higher maximum input voltage, for use with higher-voltage battery packs and modules; the resistance measurement ranges, test method, comparator, statistics and interfaces are identical between the two models.

6.9 General specifications

Item	Specification
Display	4.3" colour TFT, 480×272
Dimensions (bench, incl. rubber jacket)	235 mm (W) × 105 mm (H) × 360 mm (D)
Weight	≈ 3.6 kg
Power	220 V AC ±10%, 50/60 Hz, ≤30 VA

PART II

Remote Control & Handler

Covers the RS232C, GPIB, USBTMC and USBCDC remote interfaces and the HANDLER interface for automated test integration. The full SCPI command tables are issued separately as the *TH2523/A Series SCPI Command Reference*.

CHAPTER 7

Remote Control

The TH2523/A series can be controlled remotely over RS232C, GPIB (optional), USBTMC or USBCDC, using the SCPI command set. For the complete command syntax and parameter ranges, see the companion *TH2523/A Series SCPI Command Reference*.

7.1 RS232C

Item	Specification
Pin assignment (9-pin)	TXD = pin 2, RXD = pin 3, GND = pin 5
Baud rate	9600 / 19200 / 28800 / 38400 / 57600 / 115200 (§5.1)
Data format	No parity, 8 data bits, 1 stop bit
Command termination	LF (0x0A)
Max. command length	2 KB per command string

Note that the instrument's RS232C implementation provides only a minimal subset of the full RS-232 standard (TXD, RXD, GND), rather than the complete 9-pin signal set — this is a deliberate simplification common to this class of instrument, since a 3-wire interface is cheaper to operate than a full handshaking link.

7.2 GPIB (optional)

IEEE 488.2-compliant GPIB interface, factory-fitted as an option. Up to 15 instruments can share one GPIB bus; keep cable runs to ≤2 m between any two instruments on the bus and ≤20 m total bus length.

Interface function	Code	Description
Source handshake	SH1	Full source-handshake capability
Acceptor handshake	AH1	Full acceptor-handshake capability
Talker	T5	Sends instrument data; basic talker, serial poll, talk-only
Listener	L4	Receives instrument data; basic listener
Service request	SR1	Full service-request capability
Remote/local	RL1	Full remote/local capability
Device clear	DC1	Full device-clear capability
Device trigger	DT1	Full device-trigger capability
Controller	C0	No controller capability

GPIB bus address is set on <System Setup> (§5.1), in the range 1–31.

7.3 USBTMC

USBTMC-USB488 and USB2.0 compliant, over the rear-panel DEVICE (USB) port. Requires a VISA/USBTMC driver on the host PC; once installed, the instrument appears in the host OS's device manager as a USB test-and-measurement device, addressable with LabVIEW or any USBTMC-capable client.

7.4 USBCDC

Presents a virtual COM port over the rear-panel DEVICE (USB) connector, selected via Bus Mode = USBCDC (§5.1). Requires the Tonghui USB-CDC driver for the TH2523 (available from the Tonghui website, Support & Downloads); once installed, the instrument appears as a "usb VCom port" in the host OS's device manager and can be addressed as an ordinary serial port — useful when the host PC has no physical serial port.

7.5 Command-set overview

The instrument uses the SCPI command set over all four interfaces. Commands are organized into subsystems — display (`DISPlay`), function/range (`FUNCtion`), aperture/speed (`APERture`), trigger (`TRIGger`), fetch (`FETCh?`), comparator (`COMParator`), bin setup (`BINSETup`), statistics (`STATIstics`), trace (`TRACe`), system (`SYSTem`) and mass memory (`Mass MEMory`) — plus the IEEE 488.2 common commands (`*RST` , `*TRG` , `*CLS` , `*IDN?` , `*TST?` , `*ESE` , `*SRE` , `*ESR?` , `*STB?` , `*OPC`).

Command keywords use mixed-case notation in the source documentation: the capitalized portion of a keyword is mandatory, the lower-case portion is optional (e.g. `DISPlay:PAGE` can be sent in full or abbreviated to `DISP:PAGE`); the instrument itself does not distinguish upper and lower case on received commands. SCPI numeric formats NR1 (integer), NR2 (fixed point) and NR3 (floating point) are used as appropriate per command; NL (newline, decimal 10) terminates each command line.

For the full command syntax, parameter ranges and worked examples for every subsystem listed above, see the *TH2523/A Series SCPI Command Reference*.

CHAPTER 8

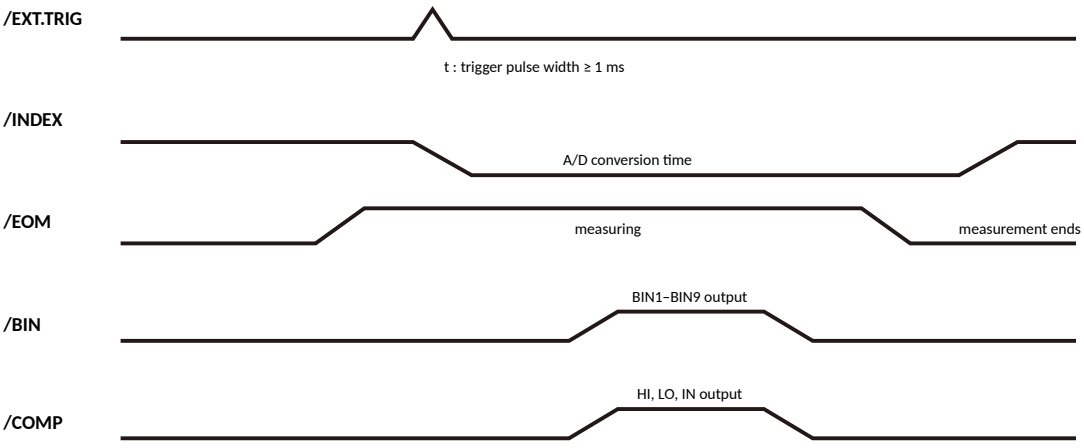
Handler Interface

The rear-panel 36-pin HANDLER interface lets the TH2523/A series integrate into an automatic component-sorting test system: it accepts an external trigger and outputs the per-bin sort result and the primary/secondary comparator result, together with status and interlock signals.

8.1 HANDLER connector pin assignment

Pin	Signal	Description
1–9	/BIN1–/BIN9	Bin-sort-mode bin-number output, active-low
10	/OUT	In bin-sort or single-bin mode: active-low whenever the result is not within any configured bin (fail); otherwise high
11	NC	Not connected
12, 13	/EXT.TRIG	External trigger input (active when Trigger mode = EXT), active-low
14, 15	EXTV2	External power 2, +5–30 V; EXTV1 and EXTV2 are both needed if using external power — do not connect only one
16–18	VCC	Internal +5 V power output
19	/PHI	Primary-parameter HIGH comparator result, active-low
20	/PLO	Primary-parameter LOW comparator result, active-low
21	/PIN	Primary-parameter IN (pass) comparator result, active-low
22	/SHI	Secondary-parameter HIGH comparator result, active-low
23	/SIN	Secondary-parameter IN (pass) comparator result, active-low
24	/SLO	Secondary-parameter LOW comparator result, active-low
25	/KEYLOCK	Front-panel key-lock input, active-low
26	NC	Not connected
27, 28	EXTV1	External power 1, +5–30 V; see pin 14/15 note
29	NC	Not connected
30	/INDEX	Active while the A/D conversion is in progress, active-low
31	/EOM	Active (goes low) when the measurement completes
32, 33	COM2	Return/ground for external power EXTV2
34–36	COM1	Return/ground for external power EXTV1

8.2 HANDLER timing



HANDLER timing diagram (schematic, not to scale) — /EXT.TRIG starts a measurement; /INDEX is active during A/D conversion; /EOM marks the end of measurement; /BIN and /COMP carry the bin-sort and comparator result

8.3 Using the HANDLER interface

1. Set Trigger mode to EXT on <Measurement Setup> (§4.7) so the instrument waits for a HANDLER trigger before each measurement.
2. Configure the comparator/bin limits on <Bin Setup> (§4.3) and enable Compare A/B as needed.
3. Apply a trigger pulse (≥1 ms) to /EXT.TRIG (pins 12/13) from the external handler/sorter.
4. /INDEX goes active while the A/D conversion runs; /EOM goes active once the measurement completes.
5. Read the bin result from /BIN1–/BIN9 (pins 1–9) or the pass/fail result from /PHI, /PLO, /PIN, /SHI, /SIN, /SLO (pins 19–24), all active-low.

> **NOTE — EXTERNAL POWER**
>
> If the connected handler system needs to drive the HANDLER interface from its own supply rather than the instrument's internal +5 V, connect both EXTV1 (pins 27/28) and EXTV2 (pins 14/15) together, with COM1 (pins 34–36) and COM2 (pins 32/33) as the corresponding return — connecting only one of the two external-power pin pairs is not supported.

APPENDIX

Packing, Warranty & Firmware

A.1 Standard accessories

See §2.1 for the standard packing contents (instrument, 4-terminal Kelvin test clip lead, EU power cable, documentation).

A.2 Transport & storage

Store the instrument in its original packaging, in a dry, well-ventilated location at 5–40 °C and ≤85% RH, away from corrosive gases, for any extended period of non-use. During transport, protect the instrument from shock, vibration and moisture.

A.3 Nameplate & markings

Each instrument's front panel or nameplate carries: the manufacturer's name/trademark; product name and model; serial number and date of manufacture; and the test-terminal markings.

A.4 Firmware upgrade

Firmware is upgraded from a FAT32 USB drive using the model-specific upgrade file `TH2523.sec`: copy the file to the root of a USB drive, insert it into the instrument's USB port, then select Tools → Upgrade on <System Setup> (§5.1).

> **CAUTION**
>
> Do not interrupt power during a firmware upgrade. If the instrument reports a file-load failure, reformat the USB drive as FAT32 (default allocation-unit size, quick format) and keep only the correct model's upgrade file on it.

A.5 Related documents

- TH2523/A Series Datasheet (Techmize)
- TH2523/A Series SCPI Command Reference (Techmize, companion to this manual)

A.6 Contacting Techmize

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

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