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COMMAND REFERENCE

TH521 Series

Power Device Analyzer — TH521-35 model line

Companion document to the TH521 Series Operation Manual. Full remote-control command set over RS-232C, LAN, GPIB and USB Device, covering module output control, DC and pulsed source/measure, sweep, triggering, oscilloscope-mode sampling and MFCMU capacitance (C/V) measurement.

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TH521 Series Command Reference

TH521-35 model line (3500 V-tier, 8 models)

This document lists the full remote-control command set for the TH521 series power device analyzer. It is the companion reference to the *TH521 Series Operation Manual*. The command set is available over RS-232C, LAN, GPIB and USB Device, and uses the same flat, mnemonic command language on every interface.

> **NOTE — SCOPE OF THIS EDITION**
>
> Only the 3500 V-tier (TH521-35-xx) models are currently in production; this edition covers that model line. Commands apply uniformly across the 8 TH521-35 models — availability of a given module's commands (HVMCU, MFCMU) depends on which modules are fitted, not on the command set itself.

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Commands only describe the characters sent or received; all characters are ASCII. Every command string must be terminated with `\n` (line feed) on every interface. This document presents the same 57 commands as Chapter 7 of the Operation Manual, grouped by function and expanded with parameter detail and the module/slot context needed to use them.

SECTION 1

Conventions

1.1 Syntax rules

- Commands are flat, mnemonic keywords (for example `DV`, `POW`, `FETCH?`) — not hierarchical SCPI colon-notation.
- Every command string must end with the terminator `\n` (line feed) — on every interface (RS-232C, LAN, GPIB, USB Device).
- A query command ends in `?` and returns an ASCII-encoded result, also terminated with `\n`.
- `[…]` marks an optional parameter; `{a|b|c}` marks a set of alternatives, of which exactly one is chosen.
- Physical-quantity parameters (voltage, current, time) are sent as plain numbers, in the unit noted per command (V, A or s) — the unit itself is never written in the command string.

1.2 Module slot addressing (`chnum`)

Most commands address a specific module by its slot number, `chnum` — one of `{1,3,4,5,6,7,8,9,10,11}`. This follows the rear-panel slot layout (Operation Manual §3.2):

chnum	Module	Role
1	GNDU	Measurement reference ground
2	MPSMU	Gate/base bias source
3	MFCMU	C/V and Qg measurement (C-models)
4, 5, 6, 7	MCSMU	Gate/base step generator (×4)
9	HVSMU	Drain/collector supply, ±3500 V
10	HCSMU	Drain/collector supply, 20 A-tier models
11	UHCU	Drain/collector supply, 200/600/1800 A-tier models (extender unit)

The valid `chnum` values are as listed above. A command sent to a slot with no module fitted returns an error.

SECTION 2

Output Control & Compliance

Command	Details
`POW chnum,state`	Enable/disable a module's output. `state`: `0` = off, `1` = on. No query form. Example: `POW 10,1` turns on the HCSMU (slot 10) output.
`CL [chnum[,chnum…]]`	De-energize the specified module(s); with no argument, de-energizes all modules. No query form.
`DZ [chnum[,chnum…]]`	Zero the DC voltage output of the specified module(s) (or all modules, with no argument) and clamp the current limit/range to ≤100 µA. No query form.
`*RST`	Stop output on all modules and reset SMU state to the power-on default. No query form.
`RSTEXPAND`	Set all extender-unit (UHCU, slot 11) channels to open-circuit. No query form.
`LIM chnum,mode,value`	Set a module's compliance (protection) limit. `mode`: `1` = voltage compliance, `2` = current compliance. `value`: the limit, in V or A.
`LIM? chnum,mode`	Query a module's voltage or current compliance limit (same `mode` coding as `LIM`).
`LIMP chnum,state[,value]`	Enable/disable (`state`: `0`/`1`) and, when enabling, set a module's power-compliance limit (`value`, W).
`RI chnum,range`	Set a module's current measurement range. `range` = `0` selects auto-ranging.
`RV chnum,range`	Set an SMU's voltage measurement range. `range` = `0` selects auto-ranging.

Each source-measure module (GNDU excepted) is addressed independently for compliance and ranging — a sweep or pulse on one module does not change another module's compliance settings.

SECTION 3

DC Source & Measurement Mode

Command	Details
`CMM chnum,mode`	Set a module's source mode. `mode`: `1` = current source, `2` = voltage source. Must be set before issuing `DI`/`DV` or the corresponding pulse/sweep commands on that module.
`DV chnum,vrange,voltage[,Icomp[,irange]]`	Apply a DC voltage output. The module must first be set to voltage-source mode (`CMM`). `vrange`: voltage range (`0` = auto); `voltage`: output value, V; optional `Icomp`/`irange`: current compliance and its range.
`DI chnum,irange,current[,Vcomp[,vrange]]`	Apply a DC current output. The module must first be set to current-source mode (`CMM`). `irange`: current range (`0` = auto); `current`: output value, A; optional `Vcomp`/`vrange`: voltage compliance and its range.
`MM chnum,mode`	Set an SMU's measurement mode. `mode`: `1` = DC single-point, `2` = DC sweep, `3` = pulse single-point, `4` = pulse sweep.

Typical sequence — DC voltage source, single-point measurement

```
CMM 9,2
MM 9,1
DV 9,0,100,0.005,0
XE 9
FETCH? 9
```

Sets the HVSMU (slot 9) to voltage-source mode and DC single-point measurement mode, applies 100 V with a 5 mA current compliance (both on auto-range — 100 V falls on the HVSMU's 200 V range, whose maximum current is 8 mA per the Operation Manual §5.3 spec table; the compliance value here is kept safely under that limit), triggers the module, then reads back the result.

SECTION 4

Pulsed Source — Single Point & Timing

4.1 Single-point pulse source

Command	Details
`PV chnum,base,pulse`	Set an SMU's single-point pulse voltage source. The module must first be set to voltage-source mode (`CMM`). `base`/`pulse`: base and peak voltage levels, V.
`PI chnum,base,pulse`	Set an SMU's single-point pulse current source. The module must first be set to current-source mode (`CMM`). `base`/`pulse`: base and peak current levels, A.
`MCPNX chnum,base,pulse`	Set a module's single-shot pulse source levels (base/peak), as an alternative to `PV`/`PI` for the single-shot pulse path.

4.2 Pulse timing

Command	Details
`MCPNT chnum,width,delay`	Set a module's single-shot pulse width and delay, s.
`PTDCV chnum,holdtime,width[,period[,Tdelay[,Mdelay]]]`	Set a module's pulse-source timing in full: hold time, pulse width, period, source delay and measurement delay, all in s.
`MCPT chnum,holdtime[,period[,Mdelay]]`	Set a module's pulse-source timing: hold time, period and measurement delay, s.

`MCPNT` / `MCPNX` and `PTDCV` / `MCPT` both configure pulse source and timing but address slightly different module families — use the pair matching the module's documented command set (Operation Manual §7.2).

Typical sequence — single-shot pulse

```
CMM 10,2
MM 10,3
PV 10,0,20
MCPNT 10,0.0001,0
XE 10
FETCH? 10
```

Sets the HCSMU (slot 10) to voltage-source mode and pulse single-point measurement mode, configures a 0–20 V pulse, sets a 100 µs pulse width with no delay, triggers the module, then reads back the result.

> **NOTE — PULSE TIMING LIMITS**
>
> Each module's minimum/maximum pulse width and duty-cycle limit are given in the Operation Manual's module specification tables (§5.3–5.5) — for example the UHCU (slot 11) is limited to ≤0.4% duty cycle on its 600 A range and ≤0.1% on its 1800 A range. The command set does not itself enforce a module's timing limits in this summary; consult the Operation Manual before programming a pulse width or period near a module's rated limit.

SECTION 5

Pulsed & Swept Source

5.1 Non-pulsed (DC) sweep

Command	Details
`WV` `chnum,mode,start,stop,count`	Set an SMU's non-pulsed voltage-source sweep. `mode`: `1` = LinearSingle, `2` = LogSingle, `3` = LinearDouble, `4` = LogDouble; `start`/`stop`: sweep endpoints, V; `count`: number of sweep steps.
`WI` `chnum,mode,start,stop,count`	Set an SMU's non-pulsed current-source sweep (same parameter coding as `WV`, current in A).

5.2 Pulsed sweep

Command	Details
`PWV` `chnum,mode,base,start,stop,count`	Set an SMU's voltage-source pulse-sweep. Same `mode` coding as `WV`; `base`: pulse base level, V; `start`/`stop`: pulse peak sweep endpoints, V.
`PWI` `chnum,mode,base,start,stop,count`	Set an SMU's current-source pulse-sweep (same parameter coding as `PWV`, current in A).
`MCPWS chnum,mode,count`	Set a module's pulse-sweep mode and point count (same `mode` coding as `WV`).
`MCPWNX chnum,base,start,stop`	Set a module's pulse-sweep source levels: base, start and stop.

Sweep-mode parameter (used by `WV`, `WI`, `PWV`, `PWI`, `MCPWS`): `1` = LinearSingle, `2` = LogSingle, `3` = LinearDouble, `4` = LogDouble.

Typical sequence — DC voltage sweep (I-V curve)

```
CMM 10,2
MM 10,2
WV 10,1,0,20,41
XE 10
FETCH? 10
```

Sets the HCSMU (slot 10) to voltage-source mode and DC sweep measurement mode, then sweeps linearly from 0 V to 20 V in 41 steps — the basic pattern behind the front-panel I/V curve-tracer (Operation Manual §4.3).

Typical sequence — pulsed voltage sweep

```
CMM 10,2
MM 10,4
PWV 10,1,0,0,20,41
MCPT 10,0.0001,0.01,0
XE 10
FETCH? 10
```

As above, but pulsed: pulse base 0 V, peak swept 0–20 V in 41 steps, 100 µs hold time and a 10 ms period between pulses.

SECTION 6

Triggering & Data Retrieval

6.1 Source and measurement trigger timing

Command	Details
`STC chnum,num`	Set an SMU's source trigger count.
`STD chnum,value`	Set an SMU's source trigger delay, s.
`STP chnum,value`	Set an SMU's source trigger period, s.
`MTC chnum,num`	Set an SMU's measurement trigger count.
`MTD chnum,value`	Set an SMU's measurement trigger delay, s.
`MTP chnum,value`	Set an SMU's measurement trigger period, s.

6.2 Execution & status

Command	Details
`XE chnum[,chnum…]`	Trigger the specified module(s) — SMUs and UHCU only, not MFCMU (use `TC?` for an MFCMU measurement, §8).
`AB`	Stop the current measurement. Does not change any module's output state. No query form.
`*OPC?`	Query whether the current measurement has completed. Returns `0` = not complete, `1` = complete.

6.3 Reading measurement data

Command	Details
`FETCH? chnum`	Read a module's voltage/current measurement data. Requires a prior `XE` trigger on that module. Returns: `voltagevalue1,currentvalue1,voltagevalue2,currentvalue2,…,voltagevalueN,currentvalueN` (comma-separated, one voltage/current pair per measured point).
`BC`	Clear all modules' data buffers. No query form.

6.4 Oscilloscope-mode sampling

Captures a time-domain voltage/current waveform on a module, independent of the normal single-point/sweep measurement path — the data source behind the Operation Manual's oscilloscope (time-domain) view (§4.3).

Command	Details
`DSMPLSETUP chnum,count,interval[,index]`	Enable and configure a module's oscilloscope-mode sampling. `count`: number of samples, up to 2000; `interval`: sample interval, s, minimum 200 ns; optional `index`: starting sample index.
`DSMPLFLUSH chnum`	Read back the sample data captured by a prior `DSMPLSETUP` on the module. Returns: `voltagevalue1,currentvalue1,voltagevalue2,currentvalue2,…,voltagevalueN,currentvalueN` (comma-separated, one voltage/current pair per captured sample).

SECTION 7

HVSMU Range & IV-Linked C/V Setup

7.1 HVSMU voltage range

Command	Details
`HVSMUOP {0|1|2|3|4}`	Set the HVSMU's (slot 9) voltage range. `0` = auto, `1` = 200 V, `2` = 500 V, `3` = 1500 V, `4` = 3500 V (matching the HVSMU voltage ranges of Operation Manual §5.3).
`HVSMUOP?`	Query the HVSMU's voltage range (same coding as above).

7.2 IV-measurement terminal routing (ERPF…)

These commands configure which module is connected to each of the I/V measurement's logical terminals (DS, GD, GS) and whether Qg measurement is enabled — the remote-control equivalent of the front-panel I/V and Qg interfaces' internal module routing (Operation Manual §4.3, §4.5). *IV measurement only.*

Command	Details
`ERPFDS unit[,res]`	Set the module (and, optionally, a series resistance) connected to the DS (drain-source) terminal.
`ERPFGD unit`	Set the module connected to the GD (gate-drain) terminal.
`ERPFGS unit[,res]`	Set the module (and, optionally, a series resistance) connected to the GS (gate-source) terminal.

Command	Details
`ERPFQG {0|1}`	Enable/disable Qg measurement — whether the Aux terminal is connected to the MCSMU for a gate-charge test. `C-models only.`
`ERPFQG?`	Query whether Qg measurement is enabled.
`CVMEAS mode`	Set the C/V measurement mode for an IV-measurement-linked capacitance test. `mode` accepts the device-specific pairs `CIES`/`COES`/`CRES` (IGBT) or `CISS`/`COSS`/`CRSS` (MOSFET), plus `CGS`/`CDS`/`CGD`, `Rg`, `Cox`, and the sweep-terminal selectors `V23`/`V13`. `C-models only.`

NOTE

`ERPFDS` / `ERPFGD` / `ERPFGS` / `ERPFQG` / `CVMEAS` configure the I/V interface's internal terminal routing and are intended for use together with the front-panel I/V and Qg test modes, rather than as a standalone capacitance-measurement path — for a direct MFCMU capacitance measurement, use the commands in §8 instead.

SECTION 8

MFCMU — Capacitance (C/V) Measurement

Configures and triggers a direct MFCMU (slot 3) capacitance measurement. *C-models only.* Matches the module specifications of Operation Manual §5.5.

Command	Details
`FC value`	Set the MFCMU's test frequency, 1 kHz–10 MHz.
`ACV value`	Set the MFCMU's AC voltage (test signal) level, 0–1 V.
`DCV value`	Set the MFCMU's DC bias voltage, −25–25 V.
`ACT value`	Set the MFCMU's integration time, in PLC (power-line cycles).
`ADJ {0|1}`	Set the MFCMU's phase-compensation mode. `0` = Auto, `1` = Adaptive.
`ADJ?`	Query the MFCMU's phase-compensation mode.
`IMP mode`	Set the MFCMU's measurement parameter pair (see table below).
`TC?`	Trigger an immediate MFCMU measurement and return the result, in the parameter pair set by `IMP`.

8.1 `IMP` measurement-parameter pairs

Mode	Pair	Mode	Pair
1	R-X	103	Cp-Rp
2	G-B	200	Cs-Rs
10	|Z|-θ(rad)	201	Cs-D
11	|Z|-θ(deg)	300	Lp-G
20	|Y|-θ(rad)	302	Lp-Q
21	|Y|-θ(deg)	303	Lp-Rp
100	Cp-G	400	Ls-Rs
101	Cp-D	401	Ls-D
102	Cp-Q	402	Ls-Q

Typical sequence — single capacitance reading

```
FC 1000000
ACV 0.05
DCV 0
ACT 1
IMP 100
TC?
```

Sets a 1 MHz, 50 mV_{rms} test signal with no DC bias, 1 PLC integration time, selects the Cp-G parameter pair, then triggers and reads a single measurement.

SECTION 9

System & Identification

Command	Details
`*IDN?`	Query the instrument identification string (manufacturer, model and firmware version).
`APE chnum,value`	Set a module's aperture (integration) time, s.

> **NOTE — COMMAND LIST**
> This document presents all 57 commands of the TH521 command set (Operation Manual §7.2), grouped by function. For the complete flat alphabetical listing, see Operation Manual Chapter 7.

Contact, support & related documents

This command reference is the companion to the *TH521 Series Operation Manual* (front-panel operation, module architecture, performance specifications) and the *TH521 Series Datasheet* (full 16-model TH521-02/TH521-35 platform overview). For questions about any command's exact behaviour, or to report a discrepancy against your instrument's firmware, contact Techmize using the details below.

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