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SCPI & MODBUS COMMAND REFERENCE

TH342X Series

Companion document to the TH342X Series Operation Manual — TH3421 / TH3422 4-channel digital power meters. Full remote-control command set: SCPI commands by subsystem, plus the MODBUS protocol frame format and register map.

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TH342X Series SCPI Command Reference

4-Channel Digital Power Meter — TH3421 / TH3422

This document lists the full remote-control command set for the TH342X series (TH3421, TH3422). It is the companion reference named in Chapter 10 of the *TH342X Series Operation Manual*, which covers the physical remote interfaces (RS232C, RS485, USBTMC, wired LAN) and command-syntax conventions only. **TH3411 (3-channel model) is discontinued and not covered by the TH342X Operation Manual**, but some commands below note 3-channel-only or 4-channel-only behaviour because the command set is shared across the whole TH34XX family; where a command's parameter range differs between 3- and 4-channel models, both are given.

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Commands conform to the SCPI standard on all interfaces (RS232C, RS485, USBTMC, wired LAN); MODBUS is an alternative protocol available on RS232C/RS485 only. See §10.5 of the Operation Manual for general SCPI syntax conventions (short/long form, optional nodes, parameter brackets).

SECTION 1

Conventions & Reference Tables

1.1 Syntax conventions

- Commands are ASCII, hierarchical (tree-structured); related commands share a root, forming a subsystem (e.g. all `FUNC:...` commands).
- Most commands may be sent in short (capitalised) or long form; this reference mostly uses the short form.
- `{ }` — parameter options; not sent with the command. `|` — separates alternative parameter values. `< >` — a value you must supply. `[ ]` — an optional, omissible node or parameter (defaults apply if omitted).
- A query form ends in `?` and returns the current value; the same root without `?`, followed by a parameter, sets the value.
- Commands must be terminated with LF (0x0A) on RS232C/RS485/USBTMC. Maximum command-string length: 128 bytes per transfer.

1.2 Basic parameter name reference

Referenced throughout this document as "the basic parameter enum" (29 values, index 0–28 in the MODBUS register map, §11):

Value	Meaning
`URMS, UAC, UDC, UPK+, UPK-, UPP, UCF`	Voltage: RMS, AC component, DC component, positive/negative peak, peak-to-peak, crest factor
`IRMS, IAC, IDC, IPK+, IPK-, IPP, ICF`	Current: RMS, AC component, DC component, positive/negative peak, peak-to-peak, crest factor
`P, S-VA, Q-VAR, PF, PHASE, FREQ`	Active power, apparent power, reactive power, power factor, phase, frequency
`WP+, WP-, WP, WS, WQ, q, PAVG`	Positive/negative/net active-power integral, apparent/reactive-power integral, current integral (Ah), average power

Wire-system combination parameter set (12 values, used by `COMPare` CHS and `FETCh:CHS` commands): `URMS, UAC, UDC, IRMS, IAC, IDC, P, S-VA, Q-VAR, PF, WP, EFFiciency`.

1.3 Channel & wiring reference

`CH1–CH4` address individual channels (TH3421/TH3422 are both fixed 4-channel instruments). `CHS` / `CHS1` / `CHS2` address wire-system combination results; see §4.1.1 of the Operation Manual for the wiring-combination options (1P2W, 1P3W, 3P3W, 3P4W, 3V3A, and the paired combinations 1P3W_1P3W / 1P3W_3P3W / 3P3W_3P3W available on 4-channel models).

SECTION 2

IEEE488.2 Common Commands & DISPlay Subsystem

2.1 IEEE488.2 common commands

The TH342X series implements three of the standard IEEE488.2 common commands.

Command	Details
`*IDN?`	Query instrument identification. Returns 3 comma-separated fields: model (TH3421/TH3422), serial number, firmware version. Example: `*IDN?` → `TH3421,Ver 1.0.0,1234567890`.
`*TRG`	Bus trigger — when trigger source = BUS (§8), performs one measurement; the instrument returns the result in the same format as `:FETCh?` (§9.1).
`*RST`	Reset the instrument to factory-default settings (including all parameter values); the instrument restarts automatically after the reset completes.

2.2 DISPlay subsystem

Controls display-page switching, the measurement page's main display channel, and the live-update (HOLD) behaviour.

Command	Details
`:DISP:PAGE?` `:DISP:PAGE <PageName>`	Query/switch the active display page. PageName: `MEAS` (measurement), `COMP` (compare), `HARM` (harmonic), `WAVE` (waveform), `VECTOR` (vector diagram), `MEASSET` (measurement setup), `COMPSET` (compare setup), `SYSTEM` (system setup), `FILE` (file management). Example: `:DISP:PAGE MEASSET`.
`:DISP:PAGE:MEAS?` `:DISP:PAGE:MEAS <CH1|CH2|CH3|CH4|CHS>`	Query/toggle the enlarge-or-reduce state of the given channel (or the Σ/wire-system channel) on the Measurement page. Example: `:DISP:PAGE:MEAS CH1`.
`:DISP:SWIT?` `:DISP:SWIT <ON|OFF>`	Live measurement-data update display on/off. `OFF` stops refreshing the displayed reading after the current test — equivalent to the front-panel Hold key. Example: `:DISP:SWIT OFF`.

SECTION 3

FUNCtion Subsystem

Querying and setting the parameters on the Measurement Display and Measurement Setup pages: wiring, filtering, averaging, synchronization, energy integration, and voltage/current range.

3.1 Wiring & efficiency formula

Command	Details
`:FUNC:WIRING?` `:FUNC:WIRING <para_list>`	Query/set the wire-system combination. 3-channel: `1P2W`, `1P3W`, `3P3W`, `3P4W`, `3V3A`. 4-channel adds: `1P3W_1P3W`, `1P3W_3P3W`, `3P3W_3P3W`. Example: `:FUNC:WIRING 3P3W`.
`:FUNC:WIRING:EFFI?` `:FUNC:WIRING:EFFI {<group_num>,<up_para>,<down_para>}`	Query/set the wire-system efficiency formula. `group_num`: 1 (3-channel only has 1; 4-channel has 1 or 2). `up_para`/`down_para` (numerator/denominator): `P1–P4` (channel active power), `PS`/`PS1` (combination-1 active power, same meaning), `PS2` (combination-2 active power, 4-channel only). Example: `:FUNC:WIRING:EFFI 1,P1,PS` sets η1 = P1/PΣ ×100%.

3.2 Filter, averaging, synchronization

Command	Details
`:FUNC:linefilt?` `:FUNC:linefilt {ON|OFF}`	Test-line 5 kHz filter on/off. Example: `:FUNC:linefilt ON`.
`:FUNC:AVG?` `:FUNC:AVG {NUM}`	Average number of measurements, `NUM` = 1–32. Example: `:FUNC:AVG 8`.

`:FUNC:SYNC?`
`:FUNC:SYNC:CH<1|2|3|4>?`
`:FUNC:SYNC:CH<1|2|3|4>`
`{U1|I1|U2|I2|U3|I3|U4|I4|LINE}`
	Query all channels' sync source, or query/set a given channel's synchronization source: a specific channel's voltage/current signal, or `LINE` (mains-frequency signal, 50/60 Hz). Example: `:FUNC:SYNC:CH1 U1`. Restricted by the current wire-system combination — some settings may not take effect.

3.3 Energy integration

Command	Details
`:FUNC:ECMODE?` `:FUNC:ECMODE {MAN|CONT}`	Energy-integral control mode: manual or continuous. Example: `:FUNC:ECMODE CONT`.
`:FUNC:ETIME?` `:FUNC:ETIME {<ehour,emin,esec>}`	Energy-integral time limit. `ehour` 0–9999, `emin`/`esec` 0–59. Example: `:FUNC:ETIME 1,22,33` (1h 22m 33s).
`:FUNC:ENERGY?` `:FUNC:ENERGY {RUN|STOP|RESET}`	Control energy-integration run state: start, stop, or reset (clears accumulated result and elapsed time). Example: `:FUNC:ENERGY RUN`.

3.4 Voltage range

Range index values: `0`=75V, `1`=150V, `2`=300V, `3`=600V.

Command	Details
`:FUNC:VOLT:RANG?` `:FUNC:VOLT:RANG {0|1|2|3}`	Query/set the voltage range of all channels at once. Example: `:FUNC:VOLT:RANG 2` (300 V).
`:FUNC:VOLT:RANG:CH<1|2|3|4>?` `:FUNC:VOLT:RANG:CH<1|2|3|4> {0|1|2|3}`	Query/set the voltage range of the specified channel individually. Example: `:FUNC:VOLT:RANG:CH1 1` (150 V).
`:FUNC:VOLT:RANG:AUTO?` `:FUNC:VOLT:RANG:AUTO {ON|OFF}`	Query/set voltage auto-range for all channels at once. Example: `:FUNC:VOLT:RANG:AUTO ON`.
`:FUNC:VOLT:RANG:CH<1|2|3|4>:AUTO?` `:FUNC:VOLT:RANG:CH<1|2|3|4>:AUTO {ON|OFF}`	Query/set voltage auto-range for the specified channel individually. Example: `:FUNC:VOLT:RANG:CH1:AUTO ON`.

3.5 Current range

Range index values depend on the fitted current-input shunt (2A / 20A); see Operation Manual §4.1.6 / §9 for the exact A-value at each index:

Index	2A shunt	20A shunt
0	1mA	10mA
1	3mA	30mA
2	10mA	100mA
3	40mA	400mA
4	150mA	1.5A
5	500mA	5A
6	2A	20A

Command	Details
`:FUNC:CURR:RANG?` `:FUNC:CURR:RANG {0|1|2|3|4|5|6}`	Query/set the current range of all channels at once. Example: `:FUNC:CURR:RANG 6`.
`:FUNC:CURR:RANG:CH<1|2|3|4>?` `:FUNC:CURR:RANG:CH<1|2|3|4> {0-6}`	Query/set the current range of the specified channel individually. Example: `:FUNC:CURR:RANG:CH1 2`.
`:FUNC:CURR:RANG:AUTO?` `:FUNC:CURR:RANG:AUTO {ON|OFF}`	Query/set current auto-range for all channels at once. Example: `:FUNC:CURR:RANG:AUTO ON`.
`:FUNC:CURR:RANG:CH<1|2|3|4>:AUTO?` `:FUNC:CURR:RANG:CH<1|2|3|4>:AUTO {ON|OFF}`	Query/set current auto-range for the specified channel individually. Example: `:FUNC:CURR:RANG:CH1:AUTO OFF`.

3.6 Basic measurement parameters

Command	Details
`:FUNC:PARA:CH<1|2|3|4>?` `:FUNC:PARA:CH<1|2|3|4> {<S1>,<S2>,<S3>,<S4>}`	Query/set the 4 basic display parameters for the specified channel's measurement page. S1–S4: any 4 values from the basic parameter enum (§1.2). Example: `:FUNC:PARA:CH1 URMS,IRMS,P,PF`.

> **NOTE**
>
> Section 3 covers the FUNCtion subsystem commands. Commands for the Correct Measurement / Wiring page controls and System Setup are covered under SYSTem (§7) and the Operation Manual Chapters 4/6/8 for front-panel equivalents.

SECTION 4

COMPare Subsystem

Query and set the 8 comparison channels' parameter, limits and output function — the settings that drive the HANDLER interface comparator outputs (see Operation Manual Chapter 11).

Command	Details

`:COMP:COMP<1–8>:PARA?`
`:COMP:COMP<1–8>:PARA {CH<1,2,3,4>,STR}`
`:COMP:COMP<1–8>:PARA {CHS<1,2>,STR2}`
	Query/set the comparison parameter for comparison item 1–8. `CH<n>` selects a channel with `STR` from the basic parameter enum (§1.2); `CHS<1,2>` selects a wire-system combination with `STR2` from the wire-system combination parameter set (§1.2). Example: `:COMP:COMP1:PARA CH1,URMS`.

`:COMP:COMP<1–8>:LOW?` `:COMP:COMP<1–8>:LOW {float}`	Query/set the comparison lower limit for the given comparison item. Example: `:COMP:COMP1:LOW 200.2`.
`:COMP:COMP<1–8>:HIGH?` `:COMP:COMP<1–8>:HIGH {float}`	Query/set the comparison upper limit for the given comparison item. Example: `:COMP:COMP1:HIGH 200.2`.
`:COMP:COMP<1–8>:FUNC?` `:COMP:COMP<1–8>:FUNC {STR}`	Query/set the output function for the given comparison item. `STR`: `OFF` (comparison disabled), `FAILCOUNT` (conduction output on fail), `PASSCOUNT` (conduction output on pass), `FAILPULSE` (pulse output on fail), `PASSPULSE` (pulse output on pass). Example: `:COMP:COMP1:FUNC PASSCOUNT`.

SECTION 5

HARMonic Subsystem

Controls the harmonic-analysis calculation standard, result display form, data mode, and which channels' harmonic analysis is active.

Command	Details
`:HARM:calstd?` `:HARM:calstd {IEC|CSA}`	Harmonic-analysis calculation standard: IEC (International Electrotechnical Commission) or CSA (Canadian Standards Association). Example: `:HARM:calstd IEC`.
`:HARM:form?` `:HARM:form {LIST|BAR}`	Harmonic-result display form: list or bar graph (histogram). Example: `:HARM:form BAR`.
`:HARM:DATAmode?` `:HARM:DATAmode {ABS|PER}`	Harmonic data mode: absolute value or percentage. Example: `:HARM:DATAmode PER`.
`:HARM:ITEM?` `:HARM:ITEM {ON|OFF}`	Query/set harmonic calculation for all channels at once. Query returns the enumerated active channels (e.g. `U1,I1,U2,I2,U3,I3`), or none/`null` if all are off. Example: `:HARM:ITEM ON`.
`:HARM:ITEM:<STR>?` `:HARM:ITEM:<STR> {ON|OFF}`	Query/set harmonic calculation for a specific signal. `STR`: `U1, I1, U2, I2, U3, I3, U4, I4` (voltage/current per channel). Example: `:HARM:ITEM:U1 ON`.

SECTION 6

WAVE Subsystem

Controls the waveform-display page's waveform type and which channels' voltage/current/power waveforms are shown.

Command	Details
`:WAVE:TYPE?` `:WAVE:TYPE {UI|POWER}`	Waveform type: `UI` (voltage and current waveform) or `POWER` (power waveform). Example: `:WAVE:TYPE UI`.
`:WAVE:ITEM:<STR>?` `:WAVE:ITEM:<STR> {ON|OFF}`	Query/set display of a specific waveform item. `STR`: `U1, I1, U2, I2, U3, I3, U4, I4` (per-channel voltage/current) or `P1, P2, P3, P4` (per-channel power). Example: `:WAVE:ITEM:P1 ON`.

SECTION 7

SYSTem Subsystem

System-level settings: beepers, display, touch-screen calibration, date/time, and the RS232C/RS485/LAN/USB interface configuration.

7.1 Beeper & display

Command	Details
`:SYSTEM:BEEP?` `:SYSTEM:BEEP {ON|OFF}`	Key-press beeper on/off. Example: `:SYSTEM:BEEP OFF`.
`:SYSTEM:BEEP:COMP?` `:SYSTEM:BEEP:COMP {PASS|FAIL|OFF}`	Comparison-result beeper: beep on PASS, beep on FAIL, or off. Example: `:SYSTEM:BEEP:COMP FAIL`.
`:SYSTEM:LIGHT?` `:SYSTEM:LIGHT {20|40|60|80|100}`	LCD backlight brightness, percentage. Example: `:SYSTEM:LIGHT 80`.
`:SYSTEM:TOUCH`	Starts touch-screen calibration (the calibration screen appears on the instrument). Manually restart the instrument after calibrating.

7.2 Date & time

Command	Details
`:SYSTEM:DATETIME?` `:SYSTEM:DATETIME {year,month,date,hour,minute,sec}`	Query/set the full date and time in one command. Example: `:SYSTEM:DATETIME 2019,12,18,8,30,20` → 2019-12-18 08:30:20.
`:SYSTEM:YEAR? {2018–2999}` · `:SYSTEM:MONTH? {1–12}` · `:SYSTEM:DATE? {1–31}` · `:SYSTEM:HOUR? {0–23}` · `:SYSTEM:MINUTE? {0–59}` · `:SYSTEM:SEC? {0–59}`	Query/set each date/time field independently. Example: `:SYSTEM:MONTH 1` sets the month to January.

7.3 Serial communication

Command	Details
`:SYSTEM:RS232:BAUD?` `:SYSTEM:RS232:BAUD {4800|9600|38400|115200}`	Serial (RS232C/RS485) baud rate. Other serial parameters are fixed: 8 data bits, 1 stop bit, no parity, no flow control.
`:SYSTEM:RS232:ADDR?` `:SYSTEM:RS232:ADDR {NUM}`	Serial bus address of this instrument, `NUM` = 1–32 (used for RS485 multi-drop addressing).
`:SYSTEM:RS232:CMDMODE?` `:SYSTEM:RS232:CMDMODE {SCPI|MODBUS}`	Command-parsing protocol for RS232C/RS485: SCPI or MODBUS (§10–11). Not applicable to USBTMC/LAN, which are SCPI-only.

7.4 LAN & USB

Command	Details
`:SYSTEM:LAN:IPAD?` `:SYSTEM:LAN:IPAD {X.X.X.X}`	LAN IP address. Example: `:SYSTEM:LAN:IPAD 192.168.1.242`.
`:SYSTEM:LAN:PORT?` `:SYSTEM:LAN:PORT {NUM}`	LAN port number, 0–65535; factory default **45454**. Avoid well-known ports (0–1023); if communication fails after changing it, confirm the new port is not already in use on the network.
`:SYSTEM:LAN:SMASk?` `:SYSTEM:LAN:SMASk {X.X.X.X}`	LAN subnet mask. Example: `:SYSTEM:LAN:SMASk 255.255.255.0`.
`:SYSTEM:LAN:GATeway?` `:SYSTEM:LAN:GATeway {X.X.X.X}`	LAN gateway address.
`:SYSTEM:LAN:HOSTname?` `:SYSTEM:LAN:HOSTname {name}`	LAN host name.
`:SYSTEM:LAN:MAC?`	Query-only: returns the instrument's LAN MAC address.
`:SYSTEM:USB:ID?`	Query-only: returns the USBTMC device ID.

> **NOTE — WIRELESS LAN**
>
> WLAN is not offered for the TH342X series; only the wired LAN interface is available (see Operation Manual §6.2).

SECTION 8

TRIGger Subsystem

Controls the measurement trigger source and timing — including the bus-trigger command used with `*TRG` (§2.1) and the external-trigger delay also referenced by the HANDLER interface (Operation Manual Chapter 11).

Command	Details
`:TRIG`	Perform a bus trigger test (equivalent to `*TRG` when trigger source = BUS).
`:TRIG:SOUR?` `:TRIG:SOUR {INT|EXT|BUS|MAN}`	Trigger source: internal, external (HANDLER `/EXT.TRIG` pin), bus, or manual. Example: `:TRIG:SOUR EXT`.
`:TRIG:DELAY?` `:TRIG:DELAY {NUM}`	Trigger delay time, `NUM` = 0.000–60.00 seconds. Example: `:TRIG:DELAY 0.001` (1 ms).

SECTION 9

FETCh Subsystem

Reads back measurement results: per-channel, per-wire-system-combination, harmonic, waveform, comparison and vector-diagram data.

9.1 Channel measurement results

Command	Details
`:FETCH?`	Returns the 4 basic display parameters (per §3.6 `FUNC:PARA`) for all 4 channels — 16 values total, 4 per channel in channel order.
`:FETCH <para>`	Returns the named parameter's value for all channels, comma-separated. `para`: any value from the basic parameter enum (§1.2). Example: `:FETCH URMS`.
`:FETCH:auto?` `:FETCH:auto {ON|OFF}`	Automatic result push: when `ON`, the instrument sends the `:FETCH?`-format data to the host automatically after every test, without being polled.
`:FETCH:CH<1|2|3|4> <para>`	Returns the named parameter's value for the specified channel. Example: `:FETCH:CH1 URMS`.
`:FETCH:CH<1|2|3|4> ALL`	Returns all 29 basic parameters for the specified channel, in this fixed order: `FREQ, URMS, UAC, UDC, UPK+, UPK-, UPP, UCF, IRMS, IAC, IDC, IPK+, IPK-, IPP, ICF, P, S, Q, PF, PHASE, WP+, WP-, WP, PAVG, q+, q-, q, WS, WQ`.

9.2 Wire-system, harmonic, waveform & comparison results

Command	Details
`:FETCH:CHS[1|2] <para>` `:FETCH:CHS[1|2] ALL`	Returns the named parameter (or all 12, in order `URMS, UAC, UDC, IRMS, IAC, IDC, P, S, Q, PF, WP, η`) for the given wire-system combination. 3-channel instruments use `CHS`; 4-channel use `CHS1`/`CHS2` (`CHS` = `CHS1`). `para`: wire-system combination parameter set (§1.2). Example: `:FETCH:CHS2 PF`.
`:FETCH:HARM:<para>:RANGE {low,high}`	Returns harmonic data for orders `low`–`high` (2–50, low≤high) of the named signal. `para`: `U1, I1, U2, I2, U3, I3, U4, I4`. Example: `:FETCH:HARM:U1:RANGE 2,50`.
`:FETCH:HARM:THD` `{U1|I1|U2|I2|U3|I3|U4|I4}`	Returns the total harmonic distortion of the named signal. Example: `:FETCH:HARM:THD I2`.
`:FETCH:wave {U1|I1|U2|I2|U3|I3|U4|I4}`	Returns 128 points of waveform data for the named signal (even-numbered sample points across one cycle).
`:FETCH:COMP?`	Returns the 8 comparison results, comma-separated: `PASS`, `FAIL`, or `NULL` (not compared) per comparison item.
`:FETCH:VECTOR:DEG?`	Returns 6 comma-separated angle results for the vector-diagram page: I1 relative to U1 (reference, 0°), then U2, I2, U3, I3 each relative to U1.

SECTION 10

MODBUS Protocol

MODBUS is an alternative to SCPI, available on **RS232C/RS485 only** (not USBTMC or LAN). Select it with `:SYSTEM:RS232:CMDMODE MODBUS` (§7.3) before using the frames below. All register addresses are in the map in §11.

10.1 Writing command (function code 0x10)

Writes one or more registers.

Instrument address	Function code	Address (hi+lo)	Registers (hi+lo)	Byte count	Data byte 1…n	CRC (lo+hi)
1 byte	0x10	2 bytes	2 bytes	1 byte	n bytes	2 bytes

Return format: instrument address, function code, address (hi+lo), registers (hi+lo), CRC (lo+hi) — no data bytes echoed.

Example — set the voltage range of all channels to range 2 (300 V); register address 0x3000, instrument bus address 8:

```
Send:   08 10 30 00 00 01 01 02 D5 CD
Return: 08 10 30 00 00 01 CF 90
```

10.2 Reading command (function code 0x03)

Instrument address	Function code	Address (hi+lo)	Registers (hi+lo)	CRC (lo+hi)
1 byte	0x03	2 bytes	2 bytes	2 bytes

Return format: instrument address, function code, byte count, data byte 1…n, CRC (lo+hi).

Example — read the current-mode voltage test value; register address 0x3000, instrument address 8:

```
Send:   08 03 30 00 00 01 4A 53
Return: 08 03 04 02 02 02 02 43 EA
```

10.3 CRC16 calculation (look-up table method)

A standard CRC16 (Modbus) implementation using two 256-byte look-up tables:

```
// CRC high byte table
const BYTE chCRCHTable[] = {
0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
0x00,0xC1,0x81,0x40 };

// CRC low byte table
const BYTE chCRCLTable[] = {
0x00,0xC0,0xC1,0x01,0xC3,0x03,0x02,0xC2,0xC6,0x06,0x07,0xC7,0x05,0xC5,0xC4,0x04,
0xCC,0x0C,0x0D,0xCD,0x0F,0xCF,0xCE,0x0E,0x0A,0xCA,0xCB,0x0B,0xC9,0x09,0x08,0xC8,
0xD8,0x18,0x19,0xD9,0x1B,0xDB,0xDA,0x1A,0x1E,0xDE,0xDF,0x1F,0xDD,0x1D,0x1C,0xDC,
0x14,0xD4,0xD5,0x15,0xD7,0x17,0x16,0xD6,0xD2,0x12,0x13,0xD3,0x11,0xD1,0xD0,0x10,
0xF0,0x30,0x31,0xF1,0x33,0xF3,0xF2,0x32,0x36,0xF6,0xF7,0x37,0xF5,0x35,0x34,0xF4,
0x3C,0xFC,0xFD,0x3D,0xFF,0x3F,0x3E,0xFE,0xFA,0x3A,0x3B,0xFB,0x39,0xF9,0xF8,0x38,
0x28,0xE8,0xE9,0x29,0xEB,0x2B,0x2A,0xEA,0xEE,0x2E,0x2F,0xEF,0x2D,0xED,0xEC,0x2C,
0xE4,0x24,0x25,0xE5,0x27,0xE7,0xE6,0x26,0x22,0xE2,0xE3,0x23,0xE1,0x21,0x20,0xE0,
0xA0,0x60,0x61,0xA1,0x63,0xA3,0xA2,0x62,0x66,0xA6,0xA7,0x67,0xA5,0x65,0x64,0xA4,
0x6C,0xAC,0xAD,0x6D,0xAF,0x6F,0x6E,0xAE,0xAA,0x6A,0x6B,0xAB,0x69,0xA9,0xA8,0x68,
0x78,0xB8,0xB9,0x79,0xBB,0x7B,0x7A,0xBA,0xBE,0x7E,0x7F,0xBF,0x7D,0xBD,0xBC,0x7C,
0xB4,0x74,0x75,0xB5,0x77,0xB7,0xB6,0x76,0x72,0xB2,0xB3,0x73,0xB1,0x71,0x70,0xB0,
0x50,0x90,0x91,0x51,0x93,0x53,0x52,0x92,0x96,0x56,0x57,0x97,0x55,0x95,0x94,0x54,
0x9C,0x5C,0x5D,0x9D,0x5F,0x9F,0x9E,0x5E,0x5A,0x9A,0x9B,0x5B,0x99,0x59,0x58,0x98,
0x88,0x48,0x49,0x89,0x4B,0x8B,0x8A,0x4A,0x4E,0x8E,0x8F,0x4F,0x8D,0x4D,0x4C,0x8C,
0x44,0x84,0x85,0x45,0x87,0x47,0x46,0x86,0x82,0x42,0x43,0x83,0x41,0x81,0x80,0x40 };

WORD CRC16(BYTE* pchMsg, WORD wDataLen) {
  BYTE chCRCHi = 0xFF, chCRCLo = 0xFF;   // initialize
  WORD wIndex;
  while (wDataLen--) {
    wIndex  = chCRCLo ^ *pchMsg++;
    chCRCLo = chCRCHi ^ chCRCHTable[wIndex];
    chCRCHi = chCRCLTable[wIndex];
  }
  return (chCRCHi << 8) | chCRCLo;
}
```

NOTE

This is the standard CRC16 (Modbus) algorithm, provided here as a C implementation. The two 256-byte tables and the accumulation routine are identical in structure to the well-known Modbus CRC16 reference implementation; if integrating in a language without a C-style byte array, any standard Modbus CRC16 library should produce the same result.

SECTION 11

MODBUS Register Map

Register addresses, access and meaning. Most registers map directly to a SCPI command in §2–9 — cross-references are given where useful.

Register	R/W	Description
`0x0000`	R	Query instrument IDN (model, serial number, firmware version) — cf. `*IDN?` §2.1.
`0x1000`	R/W	Display page select, value 0x00–0x08: Measurement / Compare / Harmonic / Waveform / Vector diagram / Measurement setup / Compare setup / System setup / File management — cf. `:DISP:PAGE` §2.2.
`0x1001`	R/W	Display data refresh (HOLD): 0x00 = refresh off (HOLD on), 0x01 = refresh on (HOLD off) — cf. `:DISP:SWIT` §2.2.
`0x1002`	R/W	Channel highlight select: 0x00–0x03 = CH1–CH4, 0x04 = line (Σ) — cf. `:DISP:PAGE:MEAS` §2.2.
`0x2000`	R/W	Wire-system setting. 3-channel: 0x00–0x04 = 1P2W/1P3W/3P3W/3P4W/3V3A. 4-channel: 0x00–0x07 = 1P2W/1P3W/1P3W_1P3W/1P3W_3P3W/3P3W/3P3W_3P3W/3P4W/3V3A — cf. `:FUNC:WIRING` §3.1.
`0x2001`	R/W	Wire-system efficiency formula (2 bytes: up, down). 0x00–0x03 = P1–P4; 0x04/0x05 = PΣ(Σ1)/PΣ2 — cf. `:FUNC:WIRING:EFFI` §3.1.
`0x2002`	R/W	Line 5 kHz filter: 0x00 on, 0x01 off — cf. `:FUNC:linefilt` §3.2.
`0x2003`	R/W	Average number of tests, 0x01–0x20 (1–32) — cf. `:FUNC:AVG` §3.2.
`0x2004–0x2007`	R/W	Test-synchronization source, channel 1–4 respectively: 0x00–0x07 = U1/I1/U2/I2/U3/I3/U4/I4, 0x08 = Line — cf. `:FUNC:SYNC:CHn` §3.2.
`0x2008`	R/W	Energy-integral control mode: 0x00 manual, 0x01 continuous — cf. `:FUNC:ECMODE` §3.3.
`0x2009`	R/W	Energy-integral time limit (3 bytes: hour[int], minute[char], second[char]) — cf. `:FUNC:ETIME` §3.3.
`0x200A`	R/W	Energy-integral run control: 0x00 run, 0x01 stop, 0x02 reset — cf. `:FUNC:ENERGY` §3.3.

Register	R/W	Description
0x200B–0x200E	R/W	4 basic display parameters, channel 1–4 respectively (4 bytes: a,b,c,d; each 0–28, basic parameter enum §1.2) — cf. :FUNC:PARA:CHn §3.6.
0x3000	R/W	Voltage range, all channels: 0x00=75V, 0x01=150V, 0x02=300V, 0x03=600V — cf. :FUNC:VOLT:RANG §3.4.
0x3001–0x3004	R/W	Voltage range, channel 1–4 individually (same value encoding) — cf. :FUNC:VOLT:RANG:CHn §3.4.
0x3005–0x3008	R/W	Voltage auto-range, channel 1–4: 0x00 off, 0x01 on — cf. :FUNC:VOLT:RANG:CHn:AUTO §3.4.
0x4000	R/W	Current range, all channels: 0x00–0x06 (7 ranges, §3.5) — cf. :FUNC:CURR:RANG §3.5.
0x4001–0x4004	R/W	Current range, channel 1–4 individually — cf. :FUNC:CURR:RANG:CHn §3.5.
0x4005–0x4008	R/W	Current auto-range, channel 1–4: 0x00 off, 0x01 on — cf. :FUNC:CURR:RANG:CHn:AUTO §3.5.
0x5000	W	Perform a bus trigger test (write 0x00) — cf. :TRIG §8.
0x5001	R/W	Trigger source: 0x00 internal, 0x01 external, 0x02 manual, 0x03 bus — cf. :TRIG:SOUR §8.
0x5002	R/W	Trigger delay time (float, 0–60.00 s, 4 bytes) — cf. :TRIG:DELAY §8.
0x8000	R/W	Key beeper: 0x00 off, 0x01 on — cf. :SYSTEM:BEEP §7.1.
0x8001	R/W	Compare beeper: 0x00 off, 0x01 PASS beeper, 0x02 FAIL beeper — cf. :SYSTEM:BEEP:COMP §7.1.

Register	R/W	Description
0x8003	R/W	LCD backlight brightness: 0x14/0x28/0x3C/0x50/0x64 = 20/40/60/80/100% — cf. :SYSTEM:LIGHT §7.1.
0xC000	R/W	Harmonic calculation standard: 0x00 IEC, 0x01 CSA — cf. :HARM:calstd §5.
0xC001	R/W	Harmonic display form: 0x00 list, 0x01 bar graph — cf. :HARM:form §5.
0xC002	R/W	Harmonic data format: 0x00 percentage, 0x01 absolute value — cf. :HARM:DATAmode §5.
0xC003	R/W	Harmonic-analysis item on/off (2 bytes: P,S). P 0–7 = U1/I1/U2/I2/U3/I3/U4/I4; S 0/1 = OFF/ON — cf. :HARM:ITEM §5.
0xD000	R/W	Waveform type: 0x00 UI waveform, 0x01 power waveform — cf. :WAVE:TYPE §6.
0xD001	R/W	UI-waveform item on/off (2 bytes: P,S), same P/S encoding as 0xC003 — cf. :WAVE:ITEM §6.
0xEx00	R/W	Comparison-channel parameter (x = comparison item 0–7; 2 bytes: Ch,para). Ch 0–3 = CH1–CH4; para 0–28, basic parameter enum §1.2 — cf. :COMP:COMPn:PARA §4.
0xEx01	R/W	Comparison-channel upper limit (float, 4 bytes) — cf. :COMP:COMPn:HIGH §4.
0xEx02	R/W	Comparison-channel lower limit (float, 4 bytes) — cf. :COMP:COMPn:LOW §4.
0xEx03	R/W	Comparison-channel function: 0x00 OFF, 0x01 PASS-conduction, 0x02 FAIL-conduction, 0x03 PASS-pulse, 0x04 FAIL-pulse — cf. :COMP:COMPn:FUNC §4.

Read-only result registers:

Register	R/W	Description
`0xF000–0xF01C`	R	Channel-1 parameter results (29-value basic parameter enum, §1.2, address low byte 0–28) — cf. `:FETCH:CH1 ALL` §9.1.
`0xF100–0xF11C`	R	Channel-2 parameter results, same addressing — cf. `:FETCH:CH2 ALL` §9.1.
`0xF200–0xF21C`	R	Channel-3 parameter results, same addressing — cf. `:FETCH:CH3 ALL` §9.1.
`0xF300–0xF31C`	R	Channel-4 parameter results, same addressing — cf. `:FETCH:CH4 ALL` §9.1.
`0xF020–0xF02C`	R	All-channel combined parameter results; returned data length is 12 or 16 registers depending on the parameter — cf. `:FETCH?` §9.1.
`0xF400–0xF40B`	R	Wire-system combination 1 results (12 values: URMS, UAC, UDC, IRMS, IAC, IDC, P, S, Q, PF, WP, η) — cf. `:FETCH:CHS1 ALL` §9.2.
`0xF500–0xF50B`	R	Wire-system combination 2 results, same 12-value set — cf. `:FETCH:CHS2 ALL` §9.2.
`0xFx01`	R	Total harmonic distortion (THD); x (address bits 8–11) = 6–13 for U1,I1,U2,I2,U3,I3,U4,I4 — cf. `:FETCH:HARM:THD` §9.2.
`0xFx02–0xFx32`	R	Individual harmonic-order result; x as above, order 2–50 (address bits 0–7) — cf. `:FETCH:HARM:<para>:RANGE` §9.2.
`0xFE00–0xFE07`	R	128-point waveform data for U1/I1/U2/I2/U3/I3/U4/I4 — cf. `:FETCH:wave` §9.2.
`0xFF00`	R	All 8 comparator results (8 bytes): 0 = PASS, 1 = FAIL, 2 = not compared — cf. `:FETCH:COMP?` §9.2.

Contact, support & related documents

This command reference is the companion to the *TH342X Series Operation Manual* (front-panel operation, remote-interface wiring, HANDLER interface) and the *TH342X Series Datasheet* (specifications). 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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