

TH8400 Series | Programmable DC Electronic Load Technical Report



| TH8401/TH8402A/TH8402/TH8411/TH8412 |

| TH8403/TH8404/TH8405 |

RS232 USB HOST USB DEVICE
I-MONITOR

RS232 USB HOST I-MONITOR HANDLER
LAN Parallel interface

1 Product Introduction and Core Capabilities

The TH8400 Series is a high-performance, intelligent programmable DC electronic load designed for both rigorous laboratory characterization and high-throughput production environments. By integrating high-speed hardware with advanced measurement logic, the series eliminates the need for secondary instrumentation in many common test scenarios.

Core Technical Features

- **High-Speed Acquisition:** Features 500kHz synchronous sampling, enabling the capture of transient events and precise measurement of Voltage/Current ripple, peak (V_p+/I_p+), valley (V_p-/I_p-), and peak-to-peak (V_{pp}/I_{pp}) values.
- **Integrated Waveform Analysis:** The 4.3-inch 24-bit color TFT LCD (480x272 resolution) provides real-time voltage and current waveform displays, allowing engineers to visualize transient responses directly on the unit.
- **Extreme Resolution:** Offers a measurement resolution of 1mV and 0.1mA, ensuring high-fidelity data for low-power and high-precision applications.
- **Operational Intelligence:** Includes intelligent fan control for noise reduction, one-key screen capture, and extensive data logging to USB storage.

2 Model Lineup and Rated Parameters

The series spans eight models, categorized by voltage range and power density, with form factors designed for standardized rack integration.

Model	Max Voltage	Max Current	Max Power	Form Factor
TH8401	150V	30A	175W	2U, Half-Rack
TH8402A	150V	30A	350W	2U, Half-Rack
TH8402	150V	60A	350W	2U, Half-Rack
TH8411	500V	15A	175W	2U, Half-Rack
TH8412	500V	30A	350W	2U, Half-Rack
TH8403	150V	120A	1000W	2U, Full-Rack
TH8404	150V	180A	1500W	2U, Full-Rack
TH8405	150V	240A	2000W	2U, Full-Rack

3 Detailed Technical Specifications

Rated accuracy is guaranteed after a **minimum 20-minute warm-up period**.

Category	Parameter	Specification / Accuracy
CV Mode	Range	0-15V/150V or 0-50V/500V
	Resolution	1mV / 10mV
	Accuracy	0.05% + 0.05% FS
CC Mode	Range	Model Specific (up to 240A)
	Resolution	0.1mA / 1mA
	Accuracy	0.05% + 0.05% FS
CR Mode	Range	0.01Ω to 50kΩ (Model dependent*)
	Accuracy	1%
CP Mode	Range	Model Specific (up to 2000W)
	Resolution	10mW
	Accuracy	0.5% + 0.1% FS
Measurement	V / I Accuracy	0.08% + 0.05% FS
	Ripple BW	250kHz (0.1% accuracy)
Dynamic Mode	Frequency	0.01Hz to 25kHz
	Time Resolution	2μs
	Time Accuracy	2μs + 100ppm

*Model-specific CR minimums: TH8405 (0.01Ω); TH8404 (0.02Ω); TH8401/02/02A/03 (0.05Ω); TH8412 (0.1Ω); TH8411 (0.2Ω).

4 Static Operating Modes

- Constant Current (CC):** Maintains constant current draw. Includes programmable rising and falling slew rate control to simulate specific load profiles and prevent overshoot.
- Constant Voltage (CV):** Adjusts current to maintain a fixed voltage setpoint. Features programmable rising slew rate control for stable startup.
- Constant Resistance (CR):** Simulates a linear resistor where $I = V / R_{\text{set}}$.
- Constant Power (CP):** Maintains constant wattage consumption ($P = V \times I$) by dynamically adjusting current based on input voltage.

5 Advanced Functional Modes

Dynamic (DYN) & Frequency Sweep (SWP)

Dynamic mode supports high-speed switching between two levels (Ia/Ib) at up to 25kHz with Continuous, Pulse, or Toggle triggers. Frequency Sweep (SWP) scans a range to identify the "worst-case" DUT response, capturing Vp+, Vp-, and their corresponding frequencies.

List (LIST) & Automatic (AUTO) Test

LIST mode allows for complex sequence editing (up to 100 steps per file, 10 files) to simulate real-world profiles like EV battery discharge. AUTO mode is optimized for production, executing multi-step sequences with PASS/FAIL judging.

CR-LED Mode

Designed to eliminate oscillations in LED driver testing by simulating the non-linear V-I curve. It uses the conduction voltage (V_o), operating current (I_o), and the resistance coefficient ($R_d \text{ Coeff}$) calculated as: $R_d \text{ Coeff} = \frac{R_d}{(V_o / I_o)}$

Battery (BATT) & Time Measurement (TIME)

BATT mode supports CC, CR, and CP discharge with termination based on Voltage, Time, Capacity (Ah), or Energy (Wh). TIME mode measures intervals between trigger conditions (0s to 100,000s) with 0.1ms precision.

Load Effect Testing

Calculates the power supply's performance under varying loads (I_{min} , I_{normal} , I_{max}) using the following formulas:

- Internal Resistance: $R_s = \frac{\Delta V}{(I_{\text{max}} - I_{\text{min}})}$
- Regulation: $\text{Regulation} = \frac{\Delta V}{V_{\text{normal}}}$

Protection Testing (OCPT/OVPT/OPPT)

Automated step-ramp routines identify protection trigger points. OVPT specifically captures the peak voltage and the OVP response time (T_{ovp}) with a precision of 2μs.

6 System Features and Specialized Functions

- **Short Circuit Function:** A dedicated hardware shortcut that loads the maximum current for the selected range to test DUT safety.
- **Programmable Soft Start:** Prevents current surges and DUT instability by adjusting load rising time from 10µs to 500ms.
- **Remote Compensation (SENSE):** In high-current applications, the +S and -S terminals measure voltage directly at the DUT to eliminate errors caused by the voltage drop across test cables.

7 Hardware Interface and Connectivity

- **I-MONITOR:** Provides a 0-10V analog output representing the full-scale current of the current range, allowing for external oscilloscope monitoring.
- **HANDLER Interface:** Designed for automated system integration:
 - **ON:** Load status.
 - **TRIG:** External trigger input.
 - **VF/EXT-PROG:** Analog programming port for external voltage control of the load.
 - **PASS/FAIL:** Comparator outputs for sorting logic.
- **Standard Comms:** RS232C, LAN, and USB Host (supporting SCPI protocols and firmware updates).

8 Physical and Environmental Specifications

Dimensions and Weights

Models	Dimensions (W×H×D)	Weight
TH8401 / 8411	215 × 88 × 390 mm	3.0 kg
TH8402 / 8402A / 8412	215 × 88 × 390 mm	4.8 kg
TH8403	430 × 88 × 529 mm	13.0 kg
TH8404	430 × 88 × 529 mm	15.5 kg
TH8405	430 × 88 × 529 mm	18.0 kg

- **Power Input:** 220V (±10%), 50Hz/60Hz, <50VA consumption.
- **Operating Limits:** 0°C–40°C; Humidity <90% RH.

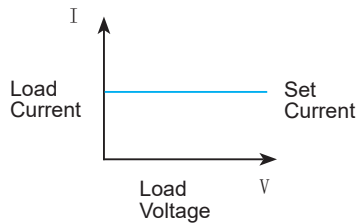
9 Features

A. Load Operating Mode

| Normal Modes (4 types)

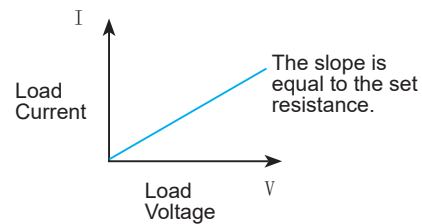
• Constant Current Mode

Regardless of voltage changes, the electronic load always draws a constant current.



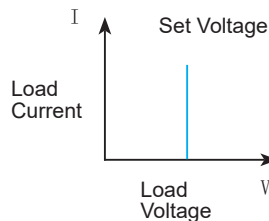
• Constant Resistance Mode

The electronic load is equivalent to a constant resistor, and the current changes linearly with the voltage.



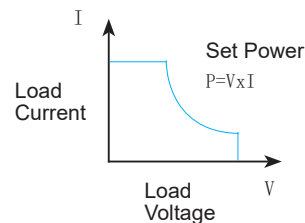
• Constant Voltage Mode

The electronic load controls the output voltage of the power supply by adjusting the drawn current according to the set voltage value.



• Constant Power Mode

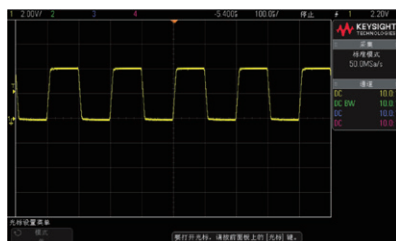
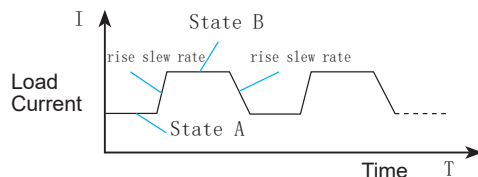
The electronic load behaves as a constant resistor; the load current varies linearly with the voltage.



| Advanced Modes (12 types)

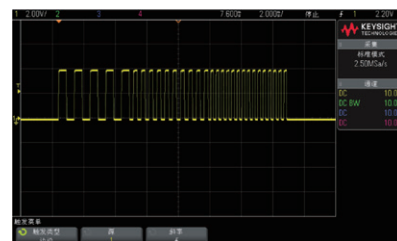
• DYN Dynamic Load Mode

Dynamic test frequency up to 25 kHz can be used to test the dynamic characteristics within the bandwidth of the power supply. Two current levels, their respective durations, rising slope, falling slope, and repetition count can be configured. This function can be applied to test the instantaneous high-current withstand capability of DC/DC converters and batteries.



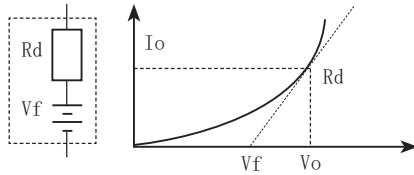
• SWP Dynamic Frequency Sweep Mode

The electronic load provides programmable dynamic frequency sweep to identify the worst-case voltage of the device under test by varying frequency. Dynamic frequency sweep requires setting two current levels, start frequency, stop frequency, step frequency, duration, rising slope and falling slope. During operation, the electronic load draws current at the set frequency within the configured duration. The maximum frequency can reach 25 kHz to capture V_{p+} , V_{p-} and corresponding F_{p+} , F_{p-} under the worst-case conditions of the power supply under test.



• CR-LED LED Simulation Test Mode

By setting the forward voltage and resistance of the LED, the actual loading characteristics of the LED can be accurately simulated. This avoids oscillation caused by unstable voltage and current in the conventional constant resistance (CR) mode, thereby testing the true loading performance of the LED power supply.



• Load Effect Test

The load operates at low-level current (Imin), high-level current (Imax), and normal operating current (Inormal), each maintained for a preset delay time. The voltage values under different loads are recorded, and the load regulation, ΔV , and internal resistance (Rs) of the power supply under test are measured and displayed.

$$V_{\max} = V_{dc}@I_{\min}$$

$$V_{\min} = V_{dc}@I_{\max}$$

$$V_{\text{normal}} = V_{dc}@I_{\text{normal}}$$

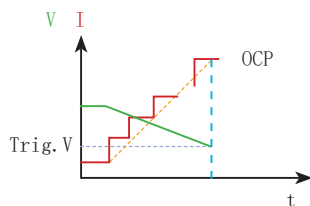
$$\Delta V = V_{\max} - V_{\min}$$

$$R_s = \frac{\Delta V}{I_{\max} - I_{\min}}$$

$$\text{Regulation} = \frac{\Delta V}{V_{\text{normal}}}$$

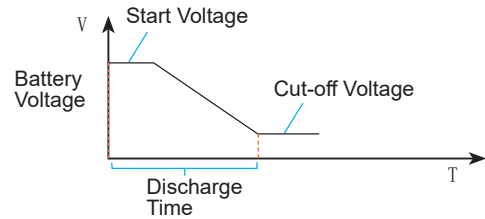
• OCPT Over Current Protection Test Mode

The electronic load draws current in ascending steps to test whether the output voltage of the power supply drops below the trigger voltage under overload conditions, thereby verifying whether the output protection function of the power supply is normal.



• BATT Battery Test Mode

The load tests battery performance. Discharge supports CC, CR, and CP modes. The electronic load stops drawing current when any of the four set conditions is reached: voltage, time, current capacity, or power capacity, preventing the battery from damage due to over-discharge.



• TIME Time Measurement Mode

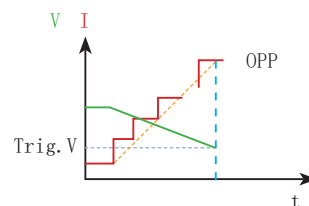
Measures the time from the start to the end of the trigger condition within the range of 0 s to 100,000 s. It can be applied to battery charge and discharge tests and other similar applications.

• OVPT Over Voltage Protection Test Mode

The load captures the input voltage peak and its falling edge, and triggers at the preset level (Vtrig) on the falling edge. This voltage peak is the OVP point of the power supply under test. The time interval between the peak and the trigger moment is the OVP response time (Tovp) of the power supply under test, with a measurement accuracy of 2 μ s.

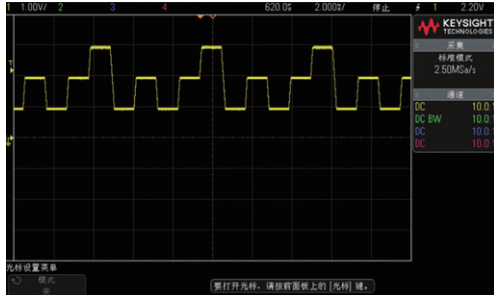
• OPPT Over Power Protection Test Mode

The electronic load draws power in ascending steps to test whether the output voltage of the power supply drops below the trigger voltage under overload conditions, thereby verifying whether the output protection function of the power supply is normal.



• LIST List Test Mode

The LIST mode can accurately and rapidly realize complex arbitrary current profiles and perform precise tests with multi-level current loading. By editing the load value, duration, slew rate and repetition count of each step, various complex sequences can be generated to meet sophisticated test requirements. It is mainly used to simulate discharge current of batteries, loading current of laptops, loading current of electric vehicles, and dynamic current with two or more current levels.



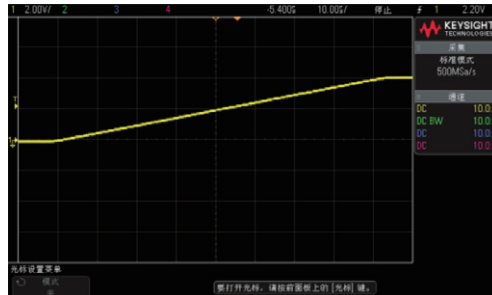
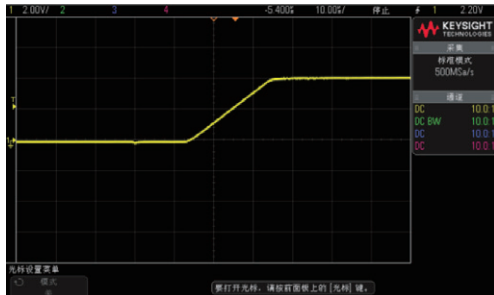
• AUTO Auto Test Mode

The AUTO mode can accurately simulate the automatic test workflow on production lines and perform multi-step precise tests, greatly helping customers reduce costs. Each step can be set to a different mode. By editing the load value, duration, rising slew rate, falling slew rate, as well as the upper and lower limits of current, voltage and power for each step, it can determine whether each step passes or fails.

B. Programmable Load Current Slew Rate

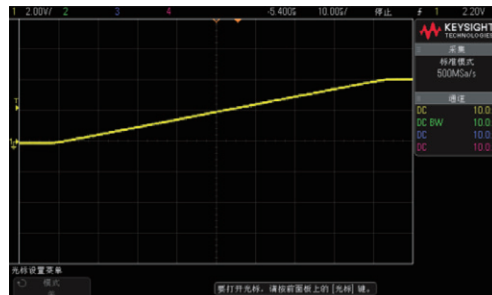
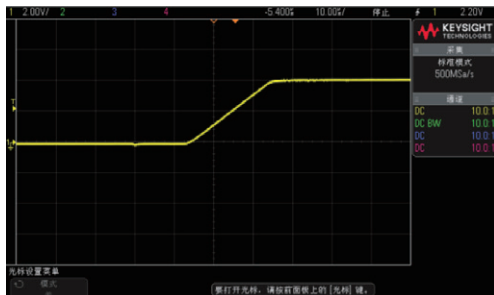
The user can set the current slew rate according to the application scenario. Once set, the slew rate will take effect under the following conditions:

- When changing the current by modifying the setting value (including all advanced functions).
- When the load current changes automatically.



C. Programmable Soft Start Function

The soft start function allows you to set the rise time of the load current. The start time is continuously adjustable from 10 μ s to 500 ms. This function can prevent output instability of the device under test caused by a rapid rise in load current, and also avoid delayed start of the power supply due to overcurrent protection.



Independent short-circuit test function, supporting short-circuit test in any operating mode and achieving seamless integration with other functions. When the instrument enters short-circuit test, it applies the maximum current of the current range.

Specifications

Model		TH8401		TH8402A		TH8402		TH8403		TH8404		TH8405		TH8411		TH8412	
Rated value	Power	175W		350W		350W		1000W		1500W		2000W		175W		350W	
	Voltage	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~50V	0~500V	0~50V	0~500V
	Current	0~3A	0~30A	0~3A	0~30A	0~6A	0~60A	0~12A	0~120A	0~18A	0~180A	0~24A	0~240A	0~1.5A	0~15A	0~3A	0~30A
	Minimum operating voltage	1.5V@30A		1.2V@30A		1.5V@60A		1.5V@120A		1.5V@180A		1.5V@240A		1.8V@15A		3V@30A	
	Minimum rise time	20μS															
CV mode	Range	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~50V	0~500V	0~50V	0~500V
	Resolution	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV
	Accuracy	0.05%+0.05%FS															
CC mode	Range	0~3A	0~30A	0~3A	0~30A	0~6A	0~60A	0~12A	0~120A	0~18A	0~180A	0~24A	0~240A	0~1.5A	0~15A	0~3A	0~30A
	Resolution	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA
	Accuracy	0.05%+0.05%FS															
CR mode	Range	0.05Ω~50kΩ		0.05Ω~50kΩ		0.05Ω~25kΩ		0.05Ω~50kΩ		0.02Ω~50kΩ		0.01Ω~25kΩ		0.2Ω~50kΩ		0.1Ω~50kΩ	
	Resolution	0.01Ω						0.01Ω						0.01Ω			
	Accuracy	1%						1%									
CP mode	Range	0~175W		0~350W		0~350W		0~1000W		0~1500w		0~2000w		0~175W		0~350w	
	Resolution	10mW		10mW		10mW		10mW		10mW		10mW		10mW		10mW	
	Accuracy	0.5%+0.1%FS															
Dynamic mode	Range	20 μs ~ 60S															
	Resolution	2 μs															
	Accuracy	2μS+100ppm															
	Rise rate	0.6A/ms~1.5A/μS		0.6A/ms~1.5A/μS		1.2A/ms~3A/μS		2.4A/ms~6A/μS		3.6A/ms~9A/μS		4.8A/ms~12A/μS		0.3A/ms~0.75A/μs		0.6A/ms~1.5A/μs	
voltage measurement	Range	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~50V	0~500V	0~50V	0~500V
	Resolution	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV
	Accuracy	0.08%+0.05%FS															
current measurement	Range	0~3A	0~30A	0~3A	0~30A	0~6A	0~60A	0~12A	0~120A	0~18A	0~180A	0~24A	0~240A	0~1.5A	0~15A	0~3A	0~30A
	Resolution	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA
	Accuracy	0.08%+0.05%FS															
ripple	Range	0~15V	0~150V	0~15V	150V	0~15V	150V	0~15V	0~150V	0~15V	0~150V	0~15V	0~150V	0~50V	0~500V	0~50V	0~500V
	Bandwidth	250kHz															
	Accuracy	0.1%															
Protection function		Over voltage protection (OVP) Over current protection (OCP) Over power protection (OPP)															
Storage		Internal: 40 groups															
Specification																	
Volume (mm) (W*H*D)		215×88×390		Shelf dimension(mm): 215×88×390 Exterior dimension(mm): 236×111×454				430mmx88mmx529mm						Shelf dimension(mm): 215×88×390 Exterior dimension(mm): 236×111×454			
Weight		3kg		4.8kg		4.8kg		13kg		15.5kg		18kg		3kg		4.8kg	
Power		Supply voltage: 220V(1±10%), Supply frequency: 50Hz/60Hz(1±5%), Power consumption: <50VA															
Temperature and humidity		0℃~40℃, humidity: < 90%RH															