

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139
1-888-KEITHLEY
www.keithley.com

Portable Device Battery/Charger Simulator

OUTPUT #1 (BATTERY):

DC VOLTAGE OUTPUT (1 Year, 23°C ± 5°C)

OUTPUT VOLTAGE: 0 to +15VDC

OUTPUT ACCURACY: ± (0.05% + 3mV)

PROGRAMMING RESOLUTION: 1mV

READBACK ACCURACY¹: ± (0.05% + 3mV)

READBACK RESOLUTION: 1mV

OUTPUT VOLTAGE SETTling TIME: 5ms to within stated accuracy

LOAD REGULATION: 0.01% + 2mV

LINE REGULATION: 0.5mV

STABILITY²: 0.01% + 0.5mV

MEASUREMENT TIME CHOICES: 0.002 to 10 PLC³, in 0.002PLC steps

AVERAGE READINGS: 1 to 10

VOLTAGE STEP TIME^{1, 4}: 6ms, typical

TRANSIENT RESPONSE:

Transient Recovery Time⁵

High Bandwidth

<35µs⁶

Low Bandwidth

<50µs⁶

Transient Voltage Drop

<90mV⁶

<180mV⁶

REMOTE SENSE: 1V max. drop in each lead. Add 2mV to the voltage load regulation specification for each 1V change in the negative output lead due to load current change. Remote sense required. Integrity of connection continually monitored. If compromised, output will turn off automatically once settable window (±0 to ±8 volts) around normal voltage exceeded.

Variable Output Impedance:

RANGE: 0 to 1.00 in 0.01 steps. Value can be changed with output on

DC CURRENT (1 Years 23°C ± 5°C)

CONTINUOUS AVERAGE OUTPUT CURRENT:

Channel #2 (Charger) OFF:

$$I = 50W / (V_{\text{set}} \text{ channel 1} + 6V); 5A \text{ max.}^7$$

¹ PLC = 1.00 Power Line Cycle

² Following 15 minute warm-up, the change in output over 8 hours under ambient temperature, constant load, and line operating conditions

³ PLC = Power Line Cycle. 1PLC = 16.7ms for 60Hz operation, 20ms for 50Hz operation

⁴ Display off, Message Exchange Protocol MEP off, auto zero off

⁵ Recovery to within 20mV of previous level

⁶ Remote sense, at terminals 2 and 5, with 4.5m (15 feet) 16 AWG (1.31mm²) twisted pair, with 1.5A load change, (0.15A to 1.65A) resistive load only, typical.

⁷ Peak current can be a max. of 5A provided the average current is within the stated limits and using terminals 1 and 6 on channel 1.

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Portable Device Battery/Charger Simulator**Channel #2 (Charger) ON:**

$$I = (50W - \text{Power consumed by channel \#2}) / (V_{\text{set channel 1}} + 6V); 5A \text{ max.}^7$$

The power consumed by channel #2 is calculated as:

Channel #2 sourcing current:

$$\text{Power consumed} = (V_{\text{set channel 2}} + 6V) \times (\text{current supplied})$$

Channel #2 sinking current:

$$\text{Power consumed} = 5 \times (\text{sink current})$$

Peak currents can be a max. of 5A provided the average current is within the above limits.

CONTINUOUS AVERAGE SINK CURRENT:**Channel #2 (Charger) OFF:**

0–5V: 3A max.⁸

5–15V: Derate 0.2A per volt above 5V. Compliance setting controls sinking

Channel #2 (Charger) ON:

Available current = $(50W - \text{Power consumed by channel \#2}) / 5$; 3A max. (0–5V)⁸

Derate 0.2A per volt above 5V

SOURCE COMPLIANCE ACCURACY: $\pm (0.16\% + 5\text{mA})^9$

PROGRAMMED SOURCE COMPLIANCE RESOLUTION: 1.25mA

READBACK ACCURACY¹:

5A Range:	$\pm (0.2\% + 200\mu\text{A})$
500mA Range:	$\pm (0.2\% + 100\mu\text{A})$
50mA Range:	$\pm (0.2\% + 5\mu\text{A})$
5mA Range:	$\pm (0.2\% + 2\mu\text{A})$

READBACK RESOLUTION:

5A Range:	100 μA
500mA Range:	10 μA
50mA Range:	1 μA
5mA Range:	0.1 μA

LOAD REGULATION: 0.01% + 1mA

LINE REGULATION: 0.5mA

STABILITY: 0.01% + 50 μA

MEASUREMENT TIME CHOICES: 0.002 to 10 PLC³, in 0.002PLC steps

AVERAGE READINGS: 1 to 10

READING TIME^{1, 4, 10}: 22ms, typical

RANGE CHANGE AND READ TIME^{1, 4, 10}: 27ms, typical

⁸ Based on settled signal: 100 μs pulse trigger delay

⁹ Minimum current in constant current mode is 6mA

¹⁰ Speed includes measurement and binary data transfer out of GPIB

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PULSE CURRENT MEASUREMENT OPERATION:

TRIGGER LEVEL: **5A Range:** 0A to 5A, in 5mA steps.
500mA Range: 0mA to 500mA, in 0.5mA or 500 μ A steps
50mA Range: 0mA to 50mA, in 0.05mA or 50 μ A steps
5mA Range: 0mA to 5mA, in 0.005mA or 5 μ A steps

TRIGGER DELAY: 0 to 100ms, in 10 μ s steps.

INTERNAL TRIGGER DELAY: 10 μ s.

HIGH/LOW/AVERAGE MODE:

Measurement Aperture Settings: 33.3 μ s to 833ms, in 33.3 μ s steps

Average Readings: 1 to 100

PULSE CURRENT MEASUREMENT ACCURACY¹¹ (1 Year, 23°C \pm 5°C):

APERTURE	ACCURACY \pm (% reading + offset) 5A Range	ACCURACY \pm (% reading + offset) 500mA Range	ACCURACY \pm (% reading + offset) 50mA Range	ACCURACY \pm (% reading + offset) 5mA Range
<100 μ s	0.3% + 2mA	0.3% + 1mA	0.3% + 700 μ A	0.3% + 200 μ A
100 μ s – 200 μ s	0.3% + 2mA	0.3% + 1mA	0.3% + 700 μ A	0.3% + 100 μ A
200 μ s – 500 μ s	0.3% + 2mA	0.3% + 1mA	0.3% + 700 μ A	0.3% + 100 μ A
500 μ s – <1 PLC	0.3% + 900 μ A	0.3% + 900 μ A	0.3% + 500 μ A	0.3% + 90 μ A
1 PLC ¹²	0.3% + 900 μ A	0.3% + 900 μ A	0.3% + 200 μ A	0.3% + 90 μ A
>1 PLC	0.3% + 900 μ A	0.3% + 900 μ A	0.3% + 200 μ A	0.3% + 90 μ A

BURST MODE CURRENT MEASUREMENT:

MEASUREMENT APERTURE: 33.3 μ s to 833ms, in 33.3 μ s steps

CONVERSION RATE: 4100/second, typical¹³

INTERNAL TRIGGER DELAY: 10 μ s

NUMBER OF SAMPLES: 1 to 5000

TRANSFER SAMPLES ACROSS IEEE BUS IN BINARY MODE⁴: 4400 readings/s, typical (4 bytes per reading)

¹¹ Based on settled signal: 100 μ s pulse trigger delay

¹² Also applies to other apertures that are integer multiples of 1PLC

¹³ At 33.3 μ s aperture

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MEASUREMENT TIME¹⁴: 850ms (840ms) to 60 seconds in 1ms steps

ANALOG OUTPUT

5A/500mA output: 1 V/A \pm 25mA (typical)

50mA/5mA output: 1 V/10mA \pm 0.25mA (typical)

Internal Impedance: 1000 Ω (nominal)

¹⁴ 60Hz (50Hz)

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Portable Device Battery/Charger Simulator**OUTPUT #2 (CHARGER):****DC VOLTAGE OUTPUT (1 YEAR, 23°C ± 5°C)****OUTPUT VOLTAGE:** 0 to +15VDC**OUTPUT ACCURACY:** ± (0.05% + 10mV)**PROGRAMMING RESOLUTION:** 10mV**READBACK ACCURACY¹:** ± (0.05% + 3mV)**READBACK RESOLUTION:** 1mV**OUTPUT VOLTAGE SETTLING TIME:** 5ms to within stated accuracy**LOAD REGULATION:** 0.01% + 2mV**LINE REGULATION:** 0.5mV**STABILITY²:** 0.01% + 0.5mV**MEASUREMENT TIME CHOICES:** 0.002 to 10 PLC³, in 0.002 PLC steps**AVERAGE READINGS:** 1 to 10**VOLTAGE STEP TIME^{1, 4}:** 7ms, typical**TRANSIENT RESPONSE:****Transient Recovery Time⁵****High Bandwidth**<50µs¹⁵**Low Bandwidth**<60µs¹⁵**Transient Voltage Drop**<180mV¹⁵<500mV¹⁵

REMOTE SENSE: 1V max. drop in each lead. Add 2mV to the voltage load regulation specification for each 1V change in the negative output lead due to load current change. Remote sense required. Integrity of connection continually monitored. If compromised, output will turn off automatically once settable window (±0 to ±8 volts) around normal voltage exceeded.

¹⁵ Remote sense, with 4.5m (15 feet) of 16 AWG (1.31mm²) wire, 1.5A load change (0.15A to 1.65A), resistive load only.

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Portable Device Battery/Charger Simulator**DC CURRENT (1 Year, 23°C ± 5°C)****CONTINUOUS AVERAGE OUTPUT CURRENT:****Channel #1 (Battery) OFF:**

$$I = 50W / (V_{\text{set channel 2}} + 6V); 5A \text{ max.}^7$$

Channel #1 (Battery) ON:

$$I = (50W - \text{Power consumed by channel \#1}) / (V_{\text{set channel 2}} + 6V); 5A \text{ max.}^7$$

The power consumed by channel #1 is calculated as:

Channel #1 sourcing current:

$$\text{Power consumed} = (V_{\text{set channel 1}} + 6V) \times (\text{current supplied})$$

Channel #1 sinking current:

$$\text{Power consumed} = 5 \times (\text{sink current})$$

Peak currents can be a max. of 5A provided the average current is within the above limits.

CONTINUOUS AVERAGE SINK CURRENT:**Channel #1 (Battery) OFF:**

0–5V: 3A max.

5–15V: Derate 0.2A per volt above 5V. Compliance setting controls sinking

Channel #1 (Battery) ON:

Available current = $(50W - \text{Power consumed by channel \#1}) / 5$; 3A max. (0–5V)

Derate 0.2A per volt above 5V

SOURCE COMPLIANCE ACCURACY: $\pm(0.16\% + 5\text{mA})^9$

PROGRAMMED SOURCE COMPLIANCE RESOLUTION: 1.25mA

READBACK ACCURACY¹: **5A Range:** $\pm (0.2\% + 200\mu\text{A})$

5mA Range: $\pm (0.2\% + 2\mu\text{A})$

READBACK RESOLUTION: **5A Range:** 100 μA

5mA Range: 0.1 μA

LOAD REGULATION: 0.01% + 1mA

LINE REGULATION: 0.5mA

STABILITY: 0.01% + 50 μA

MEASUREMENT TIME CHOICES: 0.002 to 10 PLC³, in 0.002PLC steps.

AVERAGE READINGS: 1 to 10

READING TIME^{1, 4, 10}: 22ms, typical

PULSE CURRENT MEASUREMENT OPERATION

TRIGGER LEVEL: 5A Range: 5mA to 5A, in 5mA steps

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Portable Device Battery/Charger Simulator**TRIGGER DELAY:** 0 to 100ms, in 10 μ s steps**INTERNAL TRIGGER DELAY:** 10 μ s**HIGH/LOW/AVERAGE MODE:****Measurement Aperture Settings:** 33.3 μ s to 833ms, in 33.3 μ s steps**Average Readings:** 1 to 100**PULSE CURRENT MEASUREMENT ACCURACY¹¹:** (1 Year, 23°C \pm 5°C):

APERTURE	ACCURACY \pm (% reading + offset) 5A Range
<100 μ s	0.3% + 2mA
100 μ s – 200 μ s	0.3% + 2mA
200 μ s – 500 μ s	0.3% + 2mA
500 μ s – <1 PLC	0.3% + 900 μ A
1 PLC ¹²	0.3% + 900 μ A
>1 PLC	0.3% + 900 μ A

BURST MODE CURRENT MEASUREMENT**MEASUREMENT APERTURE:** 33.3 μ s to 833ms, in 33.3 μ s steps**CONVERSION RATE:** 3200/second, typical¹³**INTERNAL TRIGGER DELAY:** 10 μ s**NUMBER OF SAMPLES:** 1 to 5000**TRANSFER SAMPLES ACROSS IEEE BUS IN BINARY MODE⁴:** 4400 readings/s, typical (4 bytes per reading).**LONG INTEGRATION MODE CURRENT MEASUREMENT****MEASUREMENT TIME¹⁴:** 850ms (840ms) to 60 seconds in 1ms steps**DIGITAL VOLTMETER INPUT (1 Year, 23°C \pm 5°C)****INPUT VOLTAGE RANGE:** –5 to +30VDC**INPUT IMPEDANCE:** 2M Ω typical**MAX. VOLTAGE (either input terminal) WITH RESPECT TO OUTPUT LOW:** –5V, +30V**READING ACCURACY¹:** \pm (0.05% + 3mV)**READING RESOLUTION:** 1mV**CONNECTOR:** HI and LO input pair part of Output #2's terminal block**MEASUREMENT TIME CHOICES:** 0.002 to 10 PLC³, in 0.002PLC steps**AVERAGE READINGS:** 1 to 10**READING TIME^{1, 4, 10}:** 22ms, typical

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Portable Device Battery/Charger Simulator**GENERAL**

ISOLATION (LOW-EARTH): 22VDC max. Do not exceed 60VDC between any two terminals of either connector.

PROGRAMMING: IEEE-488.2 (SCPI)

USER-DEFINABLE POWER-UP STATES: 4.

REAR PANEL CONNECTORS: Two 8-position quick disconnect terminal blocks

TEMPERATURE COEFFICIENT (outside 23°C ±5°C): Derate accuracy specification by (0.1 x specification)/°C.

OPERATING TEMPERATURE: 0° to 50°C (Derate to 70%). 0° to 35°C (Full power)

STORAGE TEMPERATURE: -20° to 70°C

HUMIDITY: <80% @ 35°C non-condensing

DISPLAY TYPE: 2-line x 16 character VFD

REMOTE DISPLAY/KEYPAD OPTION: Disables standard front panel

DIMENSIONS: 89mm high x 213mm wide x 411mm deep (3 1/2 in x 8 3/8 in x 16 3/16 in)

NET WEIGHT: 3.2kg (7.1 lbs)

SHIPPING WEIGHT: 5.4kg (12 lbs)

INPUT POWER: 100–120VAC/220–240VAC, 50 or 60Hz (auto detected at power-up)

POWER CONSUMPTION: 150VA max.

WARRANTY: One year parts and labor on materials and workmanship

EMC: Conforms with European Union Directive, directive 2004/108/EC

SAFETY: Conforms with European Union Directive 2006/95/EC, EN 61010-1

AC LINE LEAKAGE CURRENT: 450µA @ 110VAC, typ.; 600µA @ 220V, typ.

RELAY CONTROL PORT: 4-channel, each capable of 100mA sink, 24V max. Total port sink capacity (all 4 combined) is 250mA max. Accepts DB-9 male plug. A source of +5 VDC referenced to output common is also provided on the port to power external 5V relays.

ACCESSORIES SUPPLIED: CD with documentation, output connectors mating terminal (part no. CS-846)

ACCESSORIES AVAILABLE:

Model 2306-DISP: Remote LCD Display/Keypad (4.6 in x 2.7 in x 1.5 in). Includes 2.7m (9 ft) cable and rack mount kit.

SC-182: Low Inductance Coaxial Cable