

KEITHLEY

2401

The Keithley 2401 is a low-voltage SourceMeter (SMU) instrument designed for high-precision voltage and current sourcing and measurement. Part of the industry-standard Keithley 2400 series, it is optimized for low-voltage applications such as testing photovoltaic cells, semiconductor devices, and other components requiring precise 4-quadrant operation up to 20V and 1A.

SPECIFICATIONS

General

Interfaces	GPIB (IEEE-488), RS-232, Digital I/O, Trigger Link
Display	5×7 dot matrix vacuum fluorescent display (VFD)

Physical

Power Supply	100 V to 240 V AC (±10%), 50 Hz or 60 Hz, 190 VA maximum
Operating Temperature	0 °C to 50 °C °C
Dimensions (W×H×D)	213 mm × 89 mm × 370 mm mm
Weight	3.21 kg kg

Voltage Source

Maximum Output Voltage	21.0000 V
Voltage Ranges	200 mV, 2 V, 20 V
Programming Resolution (200mV range)	5 μV
Programming Resolution (2V range)	50 μV
Programming Resolution (20V range)	500 μV
Programming Accuracy (200mV range)	±(0.02% + 600 μV)
Programming Accuracy (2V range)	±(0.02% + 600 μV)
Programming Accuracy (20V range)	±(0.02% + 2.4 mV)
Temperature Coefficient (Voltage Source)	±(0.15 × accuracy specification) / °C (0°C–18°C & 28°C–50°C)
Noise (0.1Hz to 10Hz)	30 μV p-p (typical on 20V range)
Line Regulation (Voltage)	0.01% of range
Load Regulation (Voltage)	0.01% of range + 100 μV

Current Limit and Source

Maximum Output Current	1.05 A
Current Ranges	1 μ A, 10 μ A, 100 μ A, 1 mA, 10 mA, 100 mA, 1 A
Programming Resolution (1 μ A range)	50 pA
Programming Resolution (10 μ A range)	500 pA
Programming Resolution (100 μ A range)	5 nA
Programming Resolution (1mA range)	50 nA
Programming Resolution (10mA range)	500 nA
Programming Resolution (100mA range)	5 μ A
Programming Accuracy (1 μ A range)	$\pm(0.035\% + 600 \text{ pA})$
Programming Accuracy (10 μ A range)	$\pm(0.033\% + 2 \text{ nA})$
Programming Accuracy (100 μ A range)	$\pm(0.031\% + 20 \text{ nA})$
Programming Accuracy (1mA range)	$\pm(0.034\% + 200 \text{ nA})$
Programming Accuracy (10mA range)	$\pm(0.034\% + 2 \text{ } \mu\text{A})$
Programming Accuracy (100mA range)	$\pm(0.034\% + 20 \text{ } \mu\text{A})$
Temperature Coefficient (Current Limit)	$\pm(0.15 \times \text{accuracy specification}) / ^\circ\text{C}$ (0 $^\circ\text{C}$ –18 $^\circ\text{C}$ & 28 $^\circ\text{C}$ –50 $^\circ\text{C}$)
Line Regulation (Current)	0.01% of range
Load Regulation (Current)	0.01% of range + 100 pA

Measurement

Voltage Measurement Ranges	200 mV, 2 V, 20 V
Voltage Measurement Resolution (200mV range)	100 nV
Voltage Measurement Resolution (2V range)	1 μ V
Voltage Measurement Resolution (20V range)	10 μ V
Voltage Measurement Accuracy (200mV range)	$\pm(0.012\% + 300 \mu\text{V})$
Voltage Measurement Accuracy (2V range)	$\pm(0.012\% + 300 \mu\text{V})$
Voltage Measurement Accuracy (20V range)	$\pm(0.015\% + 1.5 \text{ mV})$
Voltage Measurement Input Impedance	> 10 G Ω
Current Measurement Ranges	1 μ A, 10 μ A, 100 μ A, 1 mA, 10 mA, 100 mA, 1 A
Current Measurement Resolution (1 μ A range)	10 pA
Current Measurement Resolution (10 μ A range)	100 pA
Current Measurement Resolution (100 μ A range)	1 nA
Current Measurement Resolution (1mA range)	10 nA
Current Measurement Resolution (10mA range)	100 nA
Current Measurement Resolution (100mA range)	1 μ A
Current Measurement Accuracy (1 μ A range)	$\pm(0.029\% + 300 \text{ pA})$
Current Measurement Accuracy (10 μ A range)	$\pm(0.027\% + 700 \text{ pA})$
Current Measurement Accuracy (100 μ A range)	$\pm(0.025\% + 6 \text{ nA})$
Current Measurement Accuracy (1mA range)	$\pm(0.027\% + 60 \text{ nA})$
Current Measurement Accuracy (10mA range)	$\pm(0.035\% + 600 \text{ nA})$
Current Measurement Accuracy (100mA range)	$\pm(0.055\% + 6 \mu\text{A})$
Temperature Coefficient (Measurement)	$\pm(0.15 \times \text{accuracy specification}) / ^\circ\text{C}$ (0 $^\circ\text{C}$ –18 $^\circ\text{C}$ & 28 $^\circ\text{C}$ –50 $^\circ\text{C}$)
Integration Time Range	0.01 PLC to 10 PLC

Output and Connection Characteristics

Output Connector Type	Front panel banana jacks, rear panel screw terminal block
Remote Sensing (4-Wire Sense)	Supported (up to 1V drop per lead)
Maximum Sense Lead Resistance	1 M Ω for rated accuracy
Maximum Common Mode Voltage	40 V DC

System, Control and Connectivity

Command Language	SCPI (Standard Commands for Programmable Instruments)
Data Buffer/Memory Capacity	5000 readings
Maximum Reading Rate (to memory)	2081 readings/s (at 0.01 NPLC)
Maximum Reading Rate (to GPIB)	1750 readings/s (at 0.01 NPLC)
Digital I/O Port	4-bit I/O port, DB-9 connector

Power Requirements

Input Frequency Range	47 Hz to 63 Hz (automatic sensing)
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Physical and Environmental Specifications

Storage Temperature Range	-25 °C to 65 °C
Operating Humidity Range	Maximum 70% RH at up to 35 °C (non-condensing)
Warm-up Time	1 hour to rated specifications
Cooling Method	Forced air cooling (internal fan)

Output Characteristics

Maximum Output Power	20 W
Overvoltage Protection (OVP) Range	2 V to 21 V

Resistance Measurement

Resistance Measurement Ranges	2.00000 Ω to 200.000 M Ω
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System Performance

Common Mode Rejection Ratio (CMRR)	> 120 dB (DC, 50 Hz, 60 Hz)
Normal Mode Rejection Ratio (NMRR)	> 60 dB (50 Hz, 60 Hz) at 1 PLC or greater
Source Delay Range	0 s to 9999.999 s

Power and Safety

Maximum Power Consumption	190 VA
Safety Compliance	Conforms to European Union Directive 73/23/EEC, EN 61010-1

Inputs & Outputs

Trigger Link Connector	8-pin micro DIN
Active Guard Terminal	Yes, available on rear panel

Guard

Guard Offset Voltage	< 150 μ V
Guard Output Impedance	< 0.1 Ω
Maximum Guard Current	50 mA

Source Specifications

Voltage Source Settling Time	< 250 μ s to 0.1% of final value
Current Source Settling Time	< 250 μ s to 0.1% of final value
Voltage Source Overshoot	< 0.1% typical (full scale step, resistive load)
Current Source Overshoot	< 0.1% typical (full scale step, resistive load)
Sweep Type	Linear, Log, Custom

Memory

Source Memory	100-point
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Display

Display Resolution	5.5 digits
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Environmental

Maximum Operating Altitude	2000 m
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TECHNOLOGY

Source Measure Unit (SMU)

APPLICATIONS

Precision DC sourcing and measurement of low-voltage semiconductor and electronic components

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