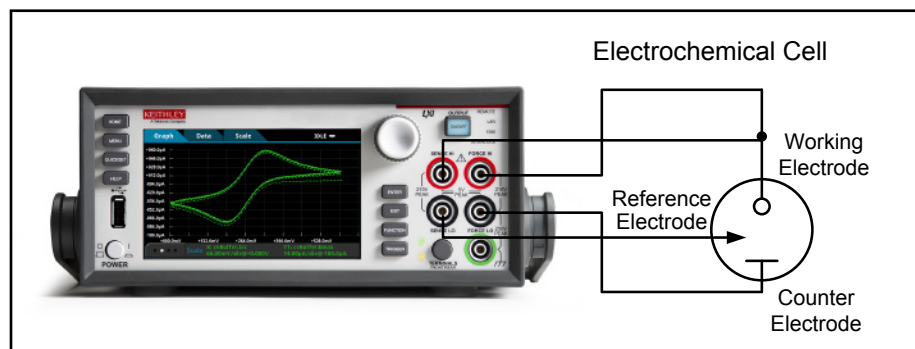# 2450-EC

Electrochemistry Lab System

The 2450-EC Electrochemistry Lab System is Keithley's low cost alternative to traditional electrochemistry potentiostats. The 2450-EC brings speed, flexibility, and simplicity right to your fingertips. Its innovative graphical user interface (GUI) and advanced, capacitive touchscreen technology allow intuitive usage and minimize the learning curve to enable researchers, scientists, and students to learn faster, work smarter, and invent easier. The 2450-EC is a versatile instrument, particularly well-suited for research and development in fundamental electrochemical lab research, characterizing the next generation of materials and electrolytes, new energy storage devices, and faster, smaller sensors.

- Lower cost alternative to potentiostats
- Perform Cyclic, Squarewave, or Galvanic Voltammetry, Chronoamperometry, and Chronopotentiometry
- Simplified user interface for faster test setup and analysis of results
- Real-time plotting of voltammograms on the front panel
- Analytical graph cursors for immediate analysis of results without the need for a PC
- Create libraries of reusable, customizable experimental software with built-in open source scripting
- Screen capture function allows copying test results from the display to reports
- 10nV and 10fA measurement sensitivity
- Front panel input banana jacks; rear panel input triaxial connections
- Context-sensitive help function minimizes learning
- Front-panel USB 2.0 memory I/O port for transferring data, test scripts, or test configurations

**The Keithley 2450-EC Electrochemistry Lab System:
A Low Cost Alternative to the Potentiostat**

While potentiostats are excellent instruments for electrochemistry applications, they typically lack any front panel display and control knobs, often are 2-quadrant systems only, and must be completely controlled by a computer with software that is not always open for users to customize tests beyond what the software can do.

Keithley's 2450-EC is a smart alternative as a DC/low frequency potentiostat. The 2450-EC has features that, in many cases, can perform as well as a potentiostat at lower cost including a wide range of voltages and currents for sourcing or measuring, nV / fA sensitivities, and high impedance sense leads with a typical input resistance of 50G ohms and only 1pA of input bias current, typically acceptable with a wide variety of reference electrodes. The 2450-EC can run internal application test scripts so electrochemistry meaurements can be run without the use of an external computer. Results (graphs) are immediately displayed right on the instrument front panel touchscreen. Connecting the 2450-EC to a 2-, 3-, or 4-electrode cell to perform the same tests as a potentiostat is simple with the included translation cable.

The 2450-EC can be easily connected to a 3-electrode cell.

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2450-EC

Electrochemistry Lab System

Ordering Information

2450-EC	Electrochemistry Lab System, 200V, 1A, 20W Instrument

Accessories Supplied

Electrochemistry Translation Cable Accessory Kit

8608	High Performance Test Leads
USB-B-1	USB Cable, Type A to Type B, 1m (3.3 ft)
CS-1616-3	Safety Interlock Mating Connector
CA-180-3A	TSP-Link/Ethernet Cable

Documentation CD

Application Test Scripts and Documentation

Test Script Builder Software (available at www.tektronix.com)

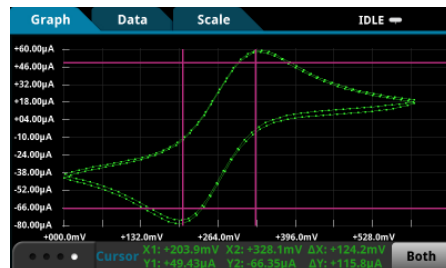KickStart Startup Software (available at www.tektronix.com)

LabVIEW and IVI Drivers (available at www.tektronix.com)

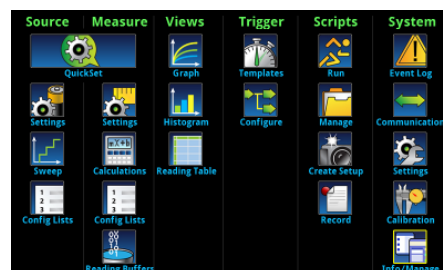## Learn Faster; Work Smarter; Invent Easier

Unlike traditional potentiostats that lack a user-interface front panel to interact with, the 2450-EC features a five-inch, full-color, high resolution touchscreen that facilitates ease of use, and optimizes overall speed and productivity. Built-in, context-sensitive help enables intuitive operation and minimizes the need to review a separate manual. These capabilities combined with its application versatility make the 2450-EC inherently easy to use for basic and advanced measurement applications, regardless of your experience level with electrochemistry instruments.
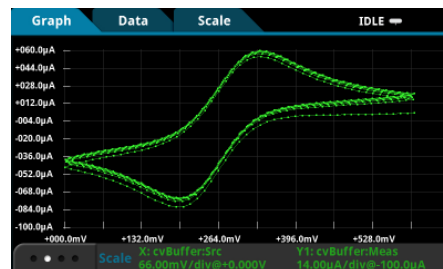
Convert Raw Data into Information

A full graphical plotting window converts raw data and displays it immediately as useful information, such as cyclic voltammograms. The touch screen interface makes it easy to observe, interact with, and explore measurements with "zoom and pinch" simplicity. By using the built-in graphing cursors, you can immediately analyze your data without a computer. All graphic screens can be saved to a USB thumb drive for incorporation into reports and journals. Using the graphical sheet view, test data can also be displayed in tabular form. The instrument supports exporting data to a spreadsheet for further analysis, dramatically improving productivity for research and development. This combination of high performance and high ease of use offers unparalleled insight into your test results.

2450-EC main home screen.

View of 2450-EC menu.

Graph view of results.

Built-in real-time graphing, charting, scope-like cursors, and data display spreadsheet for export simplifies converting test results into useful information.

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2450-EC Electrochemistry Lab System

Test Applications

The 2450-EC's built-in open source scripting enables electro-chemists, chemists, and materials scientists to create libraries of reusable, customizable experimental software for running tests including cyclic voltammetry, chronoamperometry, chronopotentiometry, and more. The following electrochemistry test scripts are loaded in the internal memory of the 2450-EC.

- **Cyclic Voltammetry:** Potential is swept at a user programmable scan rate between two to four defined vertices while current is measured.

- **Linear Sweep Voltammetry:** Potential is swept at a user programmable scan rate between two defined points while current is measured.

- **Open Circuit Potential:** Measures the cell potential difference between two electrodes with high input impedance as a function of time.

- **Potential Pulse and Square Wave with Current Measure:** The 2450-EC sources potential at programmable peak and base levels while current is recorded at a user-defined position on the pulse peak level.

- **Current Pulse and Square Wave with Voltage Measure:** The 2450-EC sources current at programmable peak and base levels while potential is recorded at a user-defined position on the pulse peak level.

- **Chronoamperometry:** The potential is stepped to a programmed value while the resulting current is measured as a function of time.

- **Chronopotentiometry:** The current is stepped to a programmed value while the resulting potential is measured as a function of time.

In addition to pre-loaded test scripts, the built-in open source scripting language enables the user to create their own library of electrochemistry test scripts that can be modified as the test and measurements evolve.

All-in-One Instrument

The 2450-EC offers a highly flexible, four-quadrant voltage and current source/load coupled with precision voltage and current meters. When not used in potentiostat type applications, this all-in one instrument can be repurposed as a general lab instrument, including use as a:

- Precision power supply with V and I readback

- True current source

- Digital multimeter (DCV, DCI, ohms, and power with 6½-digit resolution)

- Precision electronic load

- Trigger controller

TYPICAL APPLICATIONS

Ideal for electrochemical research and development in a wide variety of applications studies, including:

- Basic Analytical Research
  - Electrochemical cells
  - Electrode studies
  - Solid electrolytes

- Materials Research
  - Electrode compositions
  - Electrolyte solutions
  - Ceramics, polymers, ferro/ piezoelectrics
  - Organic semiconductors
  - Low-κ dielectrics
  - Biomaterials
  - Nanomaterials
  - Electrodesposition

- Energy Systems and Storage
  - Dye-sensitized solar cells
  - Batteries
  - Fuel cells, flow batteries
  - Supercapacitors

- Sensors
  - Environmental monitoring
  - Industrial process control
  - Healthcare/medical

2450-EC power envelope.

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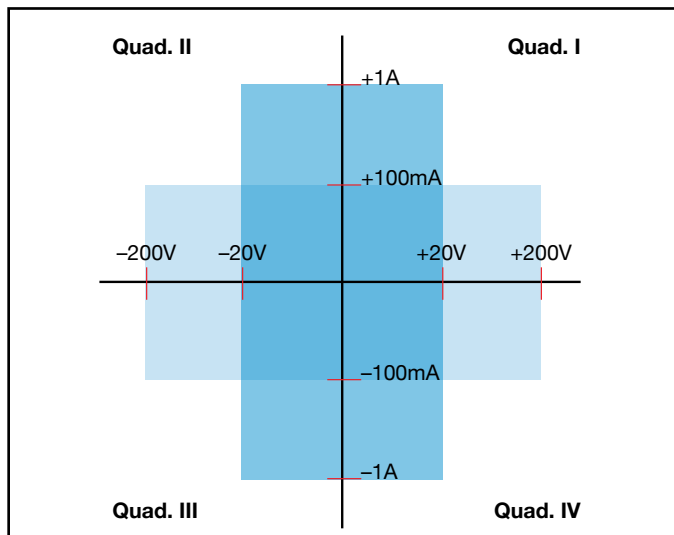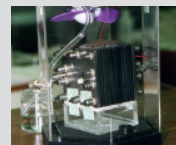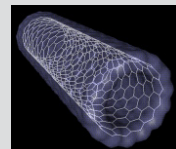
2450-EC

Electrochemistry Lab System

Ease of Use Beyond the Touchscreen

In addition to its five-inch, color touchscreen, the 2450-EC front panel has many features that supplement its speed, user-friendliness, and learnability, including a USB 2.0 memory I/O port, a HELP key, a rotary navigation/control knob, a front/rear input selector button, and banana jacks for basic bench applications. The USB 2.0 memory port supports easy data storing, saving instrument configurations, loading test scripts, and system upgrades. Plus, all front panel buttons are backlit to enhance visibility in low-light environments.

5″ color graphical touchscreen display

Online HELP key

USB 2.0 memory I/O

Rotary navigation/control knob

Front/rear input selector

Model 2450-EC front panel with high resolution, capacitive touchscreen.

Comprehensive Built-in Connectivity

Rear panel access to rear-input triax connectors, remote control interfaces (GPIB, USB 2.0, and LXI/Ethernet), D-sub 9-pin digital I/O port (for internal/external trigger signals and handler control), instrument interlock control, and TSP-Link® jacks enables easy configuration of multiple instrument test solutions and eliminates the need to invest in additional adapter accessories.

Triax inputs

Interlock

Ethernet

USB   Digital I/O   TSP-Link   GPIB

Rear panel connections are optimized for signal integrity.
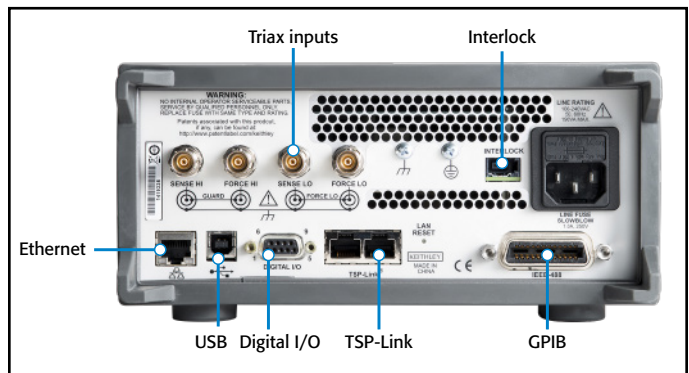
Free Instrument Control Start-up Software

The 2450-EC can be repurposed for applications beyond electrochemistry as a general purpose lab tool, e.g. I-V testing, leakage testing, battery charge/discharge profiling, etc. KickStart, Keithley's instrument control non-programming start-up software, lets users start taking measurements in minutes for typical current versus voltage applications. In most cases, users merely need to make quick measurements, graph the data, and store the data to disk to perform analysis in software environments such as Excel.

KickStart offers the following functionality:

- Instrument configuration control to perform I-V characterization
- Native X-Y graphing, panning, and zooming
- Spreadsheet/tabular viewing of data
- Saving and exporting data for further analysis
- Saving of test setups
- Screenshot capturing of graph
- Annotation of tests
- Command line dialog for sending and receiving data
- HTML help
- GPIB, USB 2.0, Ethernet compliant

With KickStart start-up software, users are ready to take measurements in minutes.

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2450-EC

Electrochemistry Lab System

Simplified Programming with Ready-to-Use Instrument Drivers

For those who prefer to create their own customized application software, native National Instruments LabVIEW® drivers, as well as IVI-C and IVI-COM drivers are available at www.tektronix.com.

Test Script Specifications

CYCLIC VOLTAMMETRY

Potential Range: ±5V

Voltage Step Size During Ramping:
100µV (0.1mV/s ≤ scan rate < 35mV/s)
1mV (35mV/s ≤ scan rate < 350mV/s)
10mV (350mV/s ≤ scan rate ≤ 3500mV/s)

Scan Rate: 0.1mV/s to 3500mV/s

Current Measurement Range (full scale): 100µA, 1mA, 10mA, 100mA, 1A

Number of Cycles: 1 to 100

User Selectable Sampling Interval Units: Points/ Test, Points/Cycle, Seconds/Point, Points/Second, mV/Point, Points/mV, mA/Point, Points/mA

Maximum number of readings: up to 100,000

OPEN CIRCUIT POTENTIAL

Vrange: 0.02 V,0.2 V,2 V,20 V

Number of Samples: $1 \leq n \leq 100,000$

Measure Interval: 0.75s ≤ measurement interval ≤ 100s

POTENTIAL PULSE AND SQUARE WAVE

Peak Potential: $V_{peak} \leq \pm 20$ V

Base Potential: $V_{base} \leq \pm 20$ V

Current Ranges: 1 µA, 10 µA, 100 µA, 1 mA, 10 mA, 100 mA, 1A

Pulse Period and Width:
I_{range} = 1 µA
200 ms ≤ period ≤ 3600 s
100 ms≤ pulse width ≤ (0.99 × period)s
I_{range} = 10 µA, 100 µA, 1 mA, 10 mA, 100 mA, 1 A
4 ms ≤ period ≤ 3600 s
2 ms ≤ pulse width ≤ (0.99 × period)s

Number of Cycles: $1 \leq n \leq 100,000$

Program Time:
10 ms ≤ program time ≤ (100,000 × period)s

Sample Time: 0.01 PLC ≤ sample time ≤ 10 PLC & sample time ≤ (pulse width – 0.001)s

CURRENT PULSE AND SQUARE WAVE

Peak and Base Current: $I_{peak} \leq \pm 1A$, $I_{base} \leq \pm 1A$

Potential Ranges: 0.02 V, 0.2 V, 2 V, 20 V

Pulse Period and Width:
$I_{peak} \leq 1.05$ µA
200 ms ≤ period ≤ 3600 s
100 ms ≤ pulse width ≤ (0.99 × period)s
1.05 µA < $I_{peak} \leq 1A$
4 ms ≤ period ≤ 3600 s
2 ms ≤ pulse width ≤ (0.99 × period)s

Number of Cycles: $1 \leq n \leq 100,000$

Program Time:
10 ms ≤ program time ≤ (100,000 × period)s

Sample Time: 0.01 PLC ≤ sample time ≤ 10 PLC & sample time ≤ (pulse width - 0.001)s

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CHRONOAMPEROMETRY

Step Potential: $V_{step} \leq \pm 20$ V

Current Ranges: 10 nA, 100 nA, 1 µA, 10 µA, 100 µA, 1 mA, 10 mA, 100 mA, 1A

Step Duration: 10 ms ≤ t ≤ 99,999 s

Measurement Interval:
10 ms ≤ measurement interval ≤ 100 s

Sample Period: 0.01 PLC ≤ sample period ≤ 10 PLC & sample period ≤ (measurement interval – 0.005)s & sample period ≤ (t – 0.005)s

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CHRONOPOTENTIOMETRY

Step Current: $I_{step} \leq \pm 1.05$ A

Potential Ranges: 0.02 V, 0.2 V, 2 V, 20 V

Step Duration: 10 ms ≤ t ≤ 99,999s

Measurement Interval:
10 ms ≤ measurement interval ≤ 100s

Sample Period: 0.01 PLC ≤ sample period ≤ 10 PLC & sample period ≤ (measurement interval – 0.005)s & sample period ≤ (t – 0.005)s

ACCESSORIES AVAILABLE

TEST LEADS AND PROBES

1754	2-wire Universal 10-Piece Test Lead Kit
5804	Kelvin (4-Wire) Universal 10-Piece Test Lead Kit
5805	Kelvin (4-Wire) Spring-Loaded Probes
5806	Kelvin Clip Lead Set
5808	Low Cost Single-pin Kelvin Probe Set
5809	Low Cost Kelvin Clip Lead Set
8605	High Performance Modular Test Leads
8606	High Performance Modular Probe Kit
8608	High Performance Clip Lead Set

CABLES, CONNECTORS, ADAPTERS

237-ALG-2	3-slot Male Triax Connector to 3 Alligator Clips
237-BAN-3A	Triax to Banana Plug
2450-TRX-BAN	Triax to Banana Adapter. Converts the 4 Triax adapters on the rear panel to 5 banana jacks
7078-TRX-*	3-slot, Low Noise Triax Cable
7078-TRX-GND	3-slot Male Triax To BNC Adapter (guard removed)
8607	2-wire, 1000V Banana Cables, 1m (3.3 ft)
CA-18-1	Shielded Dual Banana Cable, 1.2m (4 ft)
CAP-31	Protective Shield/Cap for 3-lug Triax Connectors
CS-1546	Triax 3-lug Special Shorting Plug. Shorts cente pin to outer shield
CS-1616-3	Safety Interlock Mating Connector

COMMUNICATION INTERFACES & CABLES

KPCI-488LPA	IEEE-488 Interface for PCI Bus
KUSB-488B	IEEE-488 USB-to-GPIB Interface Adapter
7007-1	Shielded GPIB Cable, 1m (3.3 ft)
7007-2	Shielded GPIB Cable, 1m (6.6 ft)
CA-180-3A	CAT5 Crossover Cable for TSP-Link/Ethernet
USB-B-1	USB Cable, Type A to Type B, 1m (3.3 ft)

TRIGGERING AND CONTROL

2450-TLINK	DB-9 to Trigger Link Connector Adapter.
8501-1	Trigger Link Cable, DIN-to-DIN, 1m (3.3 ft)
8501-2	Trigger Link Cable, DIN-to-DIN, 2m (6.6 ft)

RACK MOUNT KITS

4299-8	Single Fixed Rack Mount Kit
4299-9	Dual Fixed Rack Mount Kit
4299-10	Dual Fixed Rack Mount Kit. Mount one 2450 and one Series 26xxB
4299-11	Dual Fixed Rack Mount Kit. Mount one 2450 and one Series 2400, Series 2000, etc.
2450-BenchKit	Ears and Handle for 2450-NFP-RACK and 2450-RACK models

SERVICES AVAILABLE

2450-EC-3Y-EW	1 Year Factory Warranty extended to 3 years from date of shipment
2450-EC-5Y-EW	1 Year Factory Warranty extended to 5 years from date of shipment
C/2450-3Y-17025	KeithleyCare® 3 Year ISO 17025 Calibration Plan
C/2450-3Y-DATA	KeithleyCare 3 Year Calibration w/Data Plan
C/2450-3Y-STD	KeithleyCare 3 Year Std. Calibration Plan
C/2450-5Y-17025	KeithleyCare 5 Year ISO 17025 Calibration Plan
C/2450-5Y-DATA	KeithleyCare 5 Year Calibration w/Data Plan
C/2450-5Y-STD	KeithleyCare 5 Year Std. Calibration Plan
C/New Data	Calibration Data for New Units
C/New Data ISO	ISO-17025 Calibration Data for New Units

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Voltage Specifications[1,7]

| | | Source | | | Measure[2] | |
Range	Resolution	Accuracy (23° ±5°C) 1 Year ± (% setting + volts)	Noise (RMS) (<10Hz)	Resolution	Input Resistance	Accuracy (23° ±5°C) 1 Year ± (% rdg. + volts)
20.00000 mV	500 nV	0.100% + 200 µV	1 µV	10 nV	>10 GΩ	0.100% + 150 µV
200.0000 mV	5 µV	0.015% + 200 µV	1 µV	100 nV	>10 GΩ	0.012% + 200 µV
2.000000 V	50 µV	0.020% + 300 µV	10 µV	1 µV	>10 GΩ	0.012% + 300 µV
20.00000 V	500 µV	0.015% + 2.4 mV	100 µV	10 µV	>10 GΩ	0.015% + 1 mV
200.0000 V	5 mV	0.015% + 24 mV	1 mV	100 µV	>10 GΩ	0.015% + 10 mV

Current Specifications[1,7]

| | | Source | | | Measure[2] | |
Range	Resolution	Accuracy (23° ±5°C)[3] 1 Year ± (% setting + amps)	Noise (RMS) (<10Hz)	Resolution	Voltage Burden	Accuracy (23° ±5°C) 1 Year ± (% rdg. + amps)
10.00000 nA[4]	500 fA	0.100% + 100 pA	500 fA	10 fA	<100 µV	0.10% + 50 pA
100.0000 nA[4]	5 pA	0.060% + 150 pA	500 fA	100 fA	<100 µV	0.060% + 100 pA
1.000000 µA	50 pA	0.025% + 400 pA	5 pA	1 pA	<100 µV	0.025% + 300 pA
10.00000 µA	500 pA	0.025% + 1.5 nA	40 pA	10 pA	<100 µV	0.025% + 700 pA
100.0000 µA	5 nA	0.020% + 15 nA	400 pA	100 pA	<100 µV	0.02% + 6 nA
1.000000 mA	50 nA	0.020% + 150 nA	5 nA	1 nA	<100 µV	0.02% + 60 nA
10.00000 mA	500 nA	0.020% + 1.5 µA	40 nA	10 nA	<100 µV	0.02% + 600 nA
100.0000 mA	5 µA	0.025% + 15 µA	100 nA	100 nA	<100 µV	0.025% + 6 µA
1.000000 A	50 µA	0.067% + 900 µA	3 µA	1 µA	<100 µV	0.03% + 500 µA

TEMPERATURE COEFFICIENT (0°–18°C and 28°–50°C): ±(0.15 × accuracy specification)/°C.

1. Speed = 1 PLC.
2. Accuracies apply to 2- and 4-wire mode when properly zeroed.
3. For sink mode, 1µA to 100mA range accuracy is ±(0.15% + offset*4). For 1A range, accuracy is ±(1.5% + offset*8).
4. Rear panel triax connections only.

Resistance Measurement Accuracy (Local or Remote Sense)[7]

Range	Default Resolution	Default Test Current	Normal Accuracy (23°C ±5°C) 1 Year, ±(% rdg. + ohms)	Enhanced Accuracy[6] (23°C ±5°C) 1 Year, ±(% rdg. + ohms)
< 2.000000 Ω [5]	1 µΩ	—	Source I$_{ACC}$ + Meas. V$_{ACC}$	Meas. I$_{ACC}$ + Meas. V$_{ACC}$
20.00000 Ω	10 µΩ	100 mA	0.098% + 0.003 Ω	0.073% + 0.001 Ω
200.0000 Ω	100 µΩ	10 mA	0.077% + 0.03 Ω	0.053% + 0.01 Ω
2.000000 kΩ	1 mΩ	1 mA	0.066% + 0.3 Ω	0.045% + 0.1 Ω
20.00000 kΩ	10 mΩ	100 µA	0.063% + 3 Ω	0.043% + 1 Ω
200.0000 kΩ	100 mΩ	10 µA	0.065% + 30 Ω	0.046% + 10 Ω
2.000000 MΩ	1 Ω	1 µA	0.11% + 300 Ω	0.049% + 100 Ω
20.00000 MΩ	10 Ω	1 µA	0.11% + 1000 Ω	0.052% + 500 Ω
200.0000 MΩ	100 Ω	100 nA	0.655% + 10 kΩ	0.349% + 5000 Ω
>200.0000 MΩ [5]	—	—	Source I$_{ACC}$ + Meas. V$_{ACC}$	Meas. I$_{ACC}$ + Meas. V$_{ACC}$

TEMPERATURE COEFFICIENT (0°–18°C and 28°–50°C): ±(0.15 × accuracy specification)/°C.

SOURCE CURRENT, MEASURE RESISTANCE MODE:
Total uncertainty = I source accuracy + V measure accuracy (4-wire remote sense).

SOURCE VOLTAGE, MEASURE RESISTANCE MODE:
Total uncertainty = V source accuracy + I measure accuracy (4-wire remote sense).

GUARD OUTPUT IMPEDANCE: 0.5Ω (DC) in ohms mode.

5. Source Current, Measure Resistance or Source Voltage, Measure Resistance only.
6. Source readback enabled. Offset compensation ON.
7. All specifications are guaranteed with output ON.

OPERATING CHARACTERISTICS

MAX. OUTPUT POWER: 20W, four-quadrant source or sink operation.

SOURCE/SINK LIMITS:
Vsource: ±20V @ ±1.00A, ±200V @ ±100mA.
Isource: ±1.00A @ ±20V, ±100mA @±200V.

REGULATION:s
Voltage: Line: 0.01% of range. Load: 0.01% of range + 100µV.
Current: Line: 0.01% of range. Load: 0.01% of range + 100pA.

SOURCE LIMITS:
Voltage Source Current Limit: Bipolar current limit set with single value. Min. 10% of range.
Current Source Voltage Limit: Bipolar voltage limit set with single value. Min. 10% of range.

OVERSHOOT:
Voltage Source: <0.1% typical (full scale step, resistive load, 20V range, 10mA I-Limit.
Current Source:
<0.1% typical (1mA step, R$_{Load}$ = 10kΩ, 20V range).

VOLTAGE SOURCE:
Noise 10Hz–1MHz (RMS): 2mV typical into a resistive load.

OVER VOLTAGE PROTECTION: User selectable values, 5% tolerance. Factory default = none.

OUTPUT SETTLING TIME: Time required to reach 0.1% of final value, 20V range, 100mA I-Limit: <200µs typical.

MAXIMUM SLEW RATE: 0.2V/µs.

V/I-LIMIT ACCURACY: Add 0.3% of setting and ±0.02% of reading to base specification.

RANGE CHANGE OVERSHOOT: Overshoot into a fully resistive 100kΩ load, 10Hz to 1MHz BW, adjacent ranges: 100mV typical.

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System Measurement Speeds [8]

Reading rates (readings per second) typical for 60Hz (50Hz), (TSP®) programmed[9]

NPLC	Trigger Origin	Measure to Memory	Measure to GPIB/USB/LAN	Source Measure to Memory	Source Measure to GPIB/USB/LAN
0.01 NPLC	Internal	3050 (2800)	2800 (2500)	1700 (1600)	1650 (1550)
0.01 NPLC	External	2300 (2100)	2150 (2000)	1650 (1550)	1600 (1450)
0.1 NPLC	Internal	540 (460)	530 (450)	470 (410)	470 (400)
0.1 NPLC	External	500 (420)	500 (420)	460 (390)	450 (350)
1 NPLC	Internal	59 (49)	59 (49)	58 (48)	58 (48)
1 NPLC	External	58 (48)	58 (48)	57 (48)	57 (46)

Reading rates (readings per second) typical for 60Hz (50Hz), SCPI programmed[9]

NPLC	Trigger Origin	Measure to Memory	Measure to GPIB/USB/LAN	Source Measure to Memory	Source Measure to GPIB/USB/LAN
0.01 NPLC	Internal	3000 (2800)	3000 (2790)	1700 (1600)	1550 (1500)
0.01 NPLC	External	2330 (2150)	2330 (2150)	1650 (1550)	1500 (1450)
0.1 NPLC	Internal	540 (460)	540 (460)	470 (410)	460 (400)
0.1 NPLC	External	510 (430)	510 (430)	470 (400)	460 (390)
1 NPLC	Internal	59 (49)	59 (49)	58 (48)	58 (48)
1 NPLC	External	58 (49)	58 (49)	58 (48)	58 (48)

8. Reading rates applicable for voltage or current measurements, autozero off, autorange off, filter off, binary reading format, and source readback off.
9. 2450 SCPI programming mode. Speeds do not apply to 2400 SCPI mode.

GENERAL CHARACTERISTICS (default mode unless specified)

FACTORY DEFAULT STANDARD POWER-UP: 2450 SCPI Mode.

NOISE REJECTION (typical):

NPLC	NMRR	CMRR
0.01	—	60 dB
0.1	—	60 dB
1	60 dB	100 dB[1]

1. Except lowest two current ranges ~90dB.

LOAD IMPEDANCE: Stable into 50µF typical (High-C mode). 20nF typical (standard). High-C mode not valid for 20mV range. High-C mode not valid in 2400 SCPI mode.

COMMON MODE VOLTAGE: 250V DC.

COMMON MODE ISOLATION: >1GΩ, <1000pF.

OVERRANGE: 105% of range, source and measure.

MAX. VOLTAGE DROP BETWEEN force AND SENSE TERMINALS: 5V.

MAX. SENSE LEAD RESISTANCE: 1MΩ for rated accuracy.

SENSE INPUT IMPEDANCE: >10GΩ.

GUARD OFFSET VOLTAGE: <300µV, typical

SOURCE OUTPUT MODES: Fixed DC Level, Memory/Configuration List (mixed function), Stair (linear and log).

SOURCE MEMORY LIST: 100 points max. (2400 SCPI Mode only).

MEMORY BUFFER: >250,000 readings. Includes selected measured value(s) and time stamp. NVRAM: Lithium battery backup (3 yr. + battery life).

REAL-TIME CLOCK: Lithium battery backup (3 yr. + battery life).

REMOTE INTERFACES:
  GPIB: IEEE-488.1 compliant. Supports IEEE-488.2 common commands and status model topology.
  USB Device (rear panel, type B): 2.0 Full Speed USBTMC.
  USB Device (front panel, type A): USB 2.0, support for thumb drives.
  Ethernet: RJ-45 (10/100BT)

IP CONFIGURATION: Static or DHCP

EXPANSION INTERFACE: The TSP-Link expansion interface allows TSP enabled instruments to trigger and communicate with each other.

LXI COMPLIANCE: 1.4 LXI Core 2011.

PROGRAMMABILITY: SCPI or TSP language modes.

TSP Mode: Embedded Test Script Processor (TSP) accessible from any host interface.

INPUT SIGNAL CONNECTIONS: Front: Banana. Rear: Triaxial (3-Lug)

DIGITAL I/O INTERFACE:
  Lines: 6 Input/Output user defined for digital I/O or triggering
  Connector: 9-pin female D
  Input Signal Levels: 0.7 V (maximum logic low), 3.7 V (minimum logic high)
  Input Voltage Limits: -0.25 V (Abs. minimum), +5.25 V (Abs. maximum)
  Maximum Source Current: +2.0 mA @ >2.7 V (per pin)
  Maximum Sink Current: -50 mA @ 0.7 V (per pin, solid-state fuse protected)
  5 V Power Supply Pin: Limited to 500 mA @ >4V (solid-state fuse protected)
  Handler: User definable Start of Test, End of Test, 4 category bits

COOLING: Forced air, variable speed.

OVER TEMPERATURE PROTECTION: Internally sensed temperature overload puts unit in standby mode.

POWER SUPPLY: 100V to 240V RMS, 50–60Hz (automatically detected at power up).

VA RATING: 190 volt-amps max.

ALTITUDE: Maximum 2000 meters above sea level.

EMC: Conforms to European Union EMC Directive.

SAFETY: NRTL listed to UL61010-1 and UL61010-2-30. Conforms with European Union Low Voltage Directive.

VIBRATION: MIL-PRF-28800F Class 3 Random.

WARM-UP: 1 hour to rated accuracies.

DIMENSIONS: (With handle and bumpers): 106mm high × 255mm wide × 425mm deep (4.18 in × 10.05 in × 16.75 in). (Without handle and bumpers): 88mm high × 213mm wide × 403mm deep (3.47 in × 8.42 in × 15.9 in).

WEIGHT: With bumpers & handle: 4.04 kg (8.9 lbs.). Without bumpers & handle 3.58 kg (7.9 lbs.).

ENVIRONMENT:
  Operating: 0°–50°C, 70% R.H. up to 35°C. Derate 3% R.H./°C, 35°–50°C.
  Storage: –25°C to 65°C.

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