INVITATION TO SUBMIT BIDS

to small-scale public contract for supplies

1. Identification of the Contracting Authority:

Name:	Fyzikální ústav AV ČR, v. v. i. (Institute of Physics – "IoP")
Seat:	Na Slovance 1999/2, 182 21 Praha 8
Identification No.:	68378271
Tax ID:	CZ68378271
Authorized representative:	RNDr. Michael Prouza, Ph.D. – Director

[redacted]

2. Name and description of the public contract

2.1. Name of the public contract:

Set of instruments for electrical characterization of semiconductor devices

2.2. Name of the project under Operational Programme Research, Development and Education:

"Investments for Data processing and Detector Testing for the CERN-CZ RI (CERN-CD)",
Reg. No. CZ.02.1.01/0.0/0.0/18_046/0016013

2.3. Description of the subject of the public contract:

The subject of this public contract is the purchase of four measuring instruments, namely:

A) High Resistance Meter (2 pieces)

1) Required measurement ranges
- Current measurement from 10 aA to 20 mA
- Voltage measurement from 1 uV to 100 V
- Resistance measurement from 1 Ω to 10^{18} Ω
- Electric charge measurement from 1 fC to 1 uC

2) Built-in voltage source
- Range of the built-in voltage source from -1000 V to +1000 V

3) Required voltage measurement resolution and accuracy

Range	Resolution	Accuracy ±(% + offset)
2 V	2 uV	0.025 + 50 uV
20 V	20 uV	0.025 + 500 uV
200 V	200 uV	0.1 + 5 mV

4) Required current measurement resolution and accuracy

Range	Resolution	Accuracy ±(% + offset)
20 pA	10 aA	1 + 5 fA
2 nA	2 fA	0.2 + 500 fA
2 uA	2 pA	0.2 + 500 pA
2 mA	2 nA	0.2 + 500 nA

5) Required resistivity measurement resolution and accuracy

Range	Resolution	Accuracy ±(% + offset)
2 MΩ	2 Ω	0.125 + 20 Ω
200 MΩ	200 Ω	0.15 + 2 kΩ
2 GΩ	2 kΩ	0.225 + 20 kΩ
200 GΩ	200 kΩ	0.35 + 2 MΩ
2 TΩ	2 MΩ	0.35 + 20 MΩ
200 TΩ	200 MΩ	1.15 + 2 GΩ

6) Required electrical charge measurement resolution and accuracy

Range	Resolution	Accuracy ±(% + offset)
2 nC	2 fC	0.5 + 100 fC
20 nC	20 fC	0.5 + 1 pC
200 nC	200 fC	0.5 + 10 pC
2 uC	2 pC	0.5 + 100 pC

7) Required voltage source resolution, accuracy and maximum output current

Range	Resolution	Accuracy ±(% + offset)	Max. current
100 V	10 mV	0.2 + 10 mV	±10 mA
1000 V	100 mV	0.2 + 100 mV	±1 mA

8) High input impedance of the voltage circuit
The voltage circuit input impedance is equal or greater than 100 TΩ

EUROPEAN UNION
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Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION,
YOUTH AND SPORTS

9) Available PC communication interfaces
- GPIB
- RS-232

B) High Power SourceMeter Unit (1 piece)

1) Required total power of the SourceMeter unit
The total power of the system will be 180 W or greater

2) Required voltage source range between -3000 V and +3000 V

3) Required current source range between -120 mA and +120 mA

4) Required voltage/current ranges
- (0,±1500 V) with current up to ±120 mA
- (±1500 V, ±3000 V) with current up to ±20 mA

5) Required voltage source programming resolution and accuracy, as well as voltage measurement display resolution and accuracy

Range	Prog. resolution	Source accuracy ±(% rdg + offset)	Displ. resolution	Measurement accuracy[1] ±(% rdg + offset)
200 V	5 mV	0.03 + 50 mV	100 uV	0.025 + 50 mV
500 V	10 mV	0.03 + 150 mV	100 uV	0.025 + 150 mV
1500 V	40 mV	0.03 + 500 mV	1 mV	0.025 + 500 mV
3000 V	80 mV	0.03 + 1 V	1 mV	0.025 + 1 V

[1]The best achievable measurement accuracy.

6) Required current source programming resolution and accuracy, as well as current measurement display resolution and accuracy

Range	Prog. resolution	Source accuracy ±(% rdg + offset)	Displ. resolution	Measurement accuracy[1] ±(% rdg + offset)
1 nA	50 fA	$0.1 + 2E^{-12} + VoE^{-15}$	1 fA	$0.1 + 6E^{-13} + VoE^{-15}$
100 nA	5 pA	$0.1 + 6E^{-11} + VoE^{-13}$	100 fA	$0.1 + 6E^{-11} + VoE^{-13}$
1 uA	50 pA	0.03 + 1 nA	1 pA	0.025 + 500 pA
100 uA	5 nA	0.03 + 100 nA	100 pA	0.02 + 50 nA
1 mA	50 nA	0.03 + 500 nA	1 nA	0.02 + 500 nA
20 mA	1 uA	0.03 + 15 uA	10 nA	0.02 + 10 uA
120 mA	5 uA	0.03 + 40 uA	100 nA	0.02 + 30 uA

[1]The best achievable measurement accuracy.

7) Available PC communication interfaces
- IEEE-488 GPIB
- RS-232
- Ethernet connection

C) SourceMeter Unit (1 piece)

1) Required total power of the SourceMeter unit
The total power of the system will be 20 W or greater

2) Required voltage source range between -1100 V and +1100 V

3) Required current source range between -1 A and +1 A

4) Required voltage/current ranges
- (0,±20 V) with current up to ±1 A
- (±20 V, ±1100 V) with current up to ±20 mA

5) Required voltage source programming resolution and accuracy, as well as voltage measurement resolution and accuracy

Range	Prog. resolution	Source accuracy ±(% rdg + offset)	Meas. resolution	Measurement accuracy[1] ±(% rdg + offset)
200 mV	5 uV	0.02 + 600 uV	1 uV	0.012 + 500 uV
2 V	50 uV	0.02 + 1 mV	10 uV	0.012 + 500 uV
20 V	500 uV	0.02 + 5 mV	100 uV	0.015 + 5 mV
1000 V	50 mV	0.02 + 200 mV	10 mV	0.015 + 100 mV

[1]The best achievable measurement accuracy.

6) Required current source programming resolution and accuracy, as well as current measurement resolution and accuracy

Range	Prog. resolution	Source accuracy ±(% rdg + offset)	Meas. resolution	Measurement accuracy[1] ±(% rdg + offset)
1 uA	100 pA	0.035 + 600 pA	10 pA	0.030 + 300 pA
10 uA	1 nA	0.035 + 5 nA	100 pA	0.030 + 700 pA
100 uA	10 nA	0.035 + 50 nA	1 nA	0.030 + 10 nA
1 mA	100 nA	0.035 + 500 nA	10 nA	0.030 + 100 nA
20 mA	1 uA	0.045 + 5 uA	100 nA	0.035 + 5 uA
100 mA	10 uA	0.070 + 50 uA	1 uA	0.055 + 10 uA
1 A	100 uA	0.3 + 1 mA	10 uA	0.25 + 1 mA

[1]The best achievable measurement accuracy.

7) Available PC communication interfaces

- IEEE-488 GPIB

- RS-232

3. Deadline for submission of bids

The deadline for submission of bids is **October 16, 2020** at **11:00 a.m.**

4. Term and Place

Time of Performance:	within 4 weeks of delivery of the order
Place of Performance:	Fyzikální ústav AV ČR, v. v. i. (Institute of Physics), Na Slovance 1999/2, 182 21 Praha 8, Czech Republic

5. Structure of the Bid price

Bidders are obliged to specify the total Bid price for the subject of performance according to the required specifications. The Bid price must include the entire subject matter and shall represent a fixed, binding amount as the maximum amount and maximum admissible price, including all fees and other costs that may be associated with the performance provided hereunder, such as insurance costs etc. The bid price may be exceeded exclusively in connection with the change of tax legislation related to mandatory VAT, by an amount corresponding to this legislative amendment only.

The Bid price is to be quoted in **EUR excl. VAT**. Bidders shall indicate the Bid price to Cover sheet (**Annex No. 1** hereto).

6. Conditions and requirements for bid preparation and place for submitting bids

Bids may be submitted either in **electronic or paper form**. Bids submitted **electronically** must be submitted through the certified electronic tool **E-ZAKAZKY** available at http://www.e-zakazky.cz (hereinafter referred to as **"E-ZAKAZKY"**), where also detailed instructions for its use are available (link "Manual for the supplier" in the footer - https://e-zakazky.cz/Content/files/ManualSupplier.pdf) as well as user support contacts. Bids submitted in **paper form** must be delivered in a properly sealed envelope marked **"Do not open"** and bear the name of the public contract **"Set of instruments for electrical characterization of semiconductor devices"** to the address of the Contracting Authority (Fyzikální ústav AV ČR, v. v. i., Na Slovance 1999/2, 182 21 Prague 8, Czech Republic), to the filing room on the ground floor next to the main entrance (the main entrance is in the Pod Vodárenskou věží Street at No. 1). Bids in paper form can be delivered by any suitable means, i.e. by post, courier, personally, etc. **The filing room's office hours are 8:00 am – 3:00 pm**

on business days, and on the last day of the deadline 8:00 am to 11:00 am. The envelope must also bear the name and address of the bidder. Submissions in other forms will not be considered.

In case of submission of the bid in paper form, the bidder shall deliver the **paper original** of the offer in a properly sealed envelope, and at the same time submit the offer also in electronic copy on CD or other suitable data medium in PDF or MS Office or compatible format.

In order to submit a bid in electronic form, the bidder must be registered as a supplier in the electronic tool **E-ZAKAZKY** (link "supplier registration" on the website https://e-zakazky.cz/registrace-dodavatel) and the bidder's user must have the appropriate user authorization. Registration takes up to 3 working days after submission of all required documents and registration is free of charge. The bidder must have a personal computer with normal performance for office use, an Internet connection and an Internet browser installed (e.g. Microsoft Internet Explorer, Mozilla Firefox, Google Chrome, etc.).

The individual file that is included in the electronic bid must not exceed 100 MB. The bid must be processed using acceptable file formats, i.e. Microsoft Office (Word, Excel), Open Office, PDF, JPEG, GIF, or PNG. The Bid price will also be submitted by the bidder in the form of an inscription into the tender form, which will be displayed when the bid is submitted electronically. This is without prejudice to the obligation to submit other documents containing the Bid price.

The bid must be processed in Czech or English language.

The bid must include **identification data of the bidder**, i.e. primarily: business name, registered office, identification number, legal form, persons authorized to act on behalf of / represent the bidder, contact details for correspondence.

The offer must include:

a) **Cover sheet** (**Annex 1** to this Invitation can be used),

b) **Technical description** of the performance offered, which will demonstrate the fulfilment of the required specification,

c) **Draft contract or business conditions** containing the reserved business conditions of the Contracting Authority (business conditions reserved by the Contracting Authority are specified in point 8. of this invitation).

7. Evaluation criteria

First, the Contracting Authority will check the technical specifications of the offered equipment based on information provided by the bidders. If one of the mandatory technical requirements (specified in annex 1 of the Draft contract) is not fulfilled, the bidder will be excluded from further participation in the proceedings.

The bids will then be evaluated **on the basis of the lowest Bid price**. The Contracting Authority will evaluate the total Bid price in EUR excl. VAT.

8. Business conditions

A draft contract containing business and payment conditions (or separate business and payment conditions) shall be submitted by the bidder in his bid.

The contracting authority reserves the following business conditions, without the possibility of their restriction:

- Part of the performance is the transport of the equipment to the place of delivery, delivery of instructions and manuals for operation and maintenance in Czech or English in electronic or printed form and warranty service,
- warranty period shall be at least 12 months,
- delivery of the equipment no later than 4 weeks from the date of delivery of the order with the possibility of withdrawal from the contract in the event of a delay of more than 14 days,
- the supplier is entitled to invoice the purchase price after acceptance of the equipment by the Contracting Authority; the Contracting Authority undertakes to perform the verification whether the equipment is functional and meets the technical requirements within 5 working days of the delivery of the equipment,
- the due date of invoices is thirty (30) days from the date of their delivery,
- invoices issued by the supplier must contain all the requisites stipulated by law and the name and registration number of the project: "Investments for Data processing and Detector Testing for the CERN-CZ RI (CERN-CD), Reg. No. CZ.02.1.01/0.0/0.0/18_046/0016013"
- the place of delivery is the Fyzikální ústav AV ČR, v. v. i. (Institute of Physics), Na Slovance 1999/2, 182 21 Praha 8, Czech Republic,
- the Contracting Authority is not obliged to accept equipment, which would show defects that would otherwise not form a barrier, on their own or in connection with other defects, to using the Equipment,
- the Contracting Authority is entitled to withdraw from the contract without any sanctions on its part, if the delivered equipment does not meet the technical parameters or conditions according to the required technical specification and according to the valid technical standards,

- the supplier is obliged to rectify the claimed defects within 15 working days from the date of receipt of the notification; in the event of a delay, the Contracting Authority is entitled to have the defects removed by a third party at the supplier's expense, without prejudice to the validity of the warranty,
- the supplier agrees that the contract (or business conditions) as a whole, including all attachments and data on the parties, subject-matter of the contract, the purchase price and the date of the contract conclusion, will be published in accordance with Act No. 340/2015 Coll. on special conditions for the effectiveness of some contracts, publication of these contracts and Contract Register, as amended; the supplier grants permission for the use and disclosure of all information contained in the contract and its annexes without setting any additional conditions.

9. Explanation of the tender conditions

Bidders are entitled to require the Contracting Authority in writing to provide explanation of the tender conditions. The request has to be received by the Contracting Authority no later than 4 working days before the deadline for submission of bids.

The Contracting Authority shall send an explanation of the tender conditions, or any related documents, no later than 2 working days after receipt of the request under the previous paragraph.

The Contracting Authority may also provide an explanation of the tender conditions without prior request.

The Contracting Authority may amend or supplement the tender conditions before the deadline for submitting bids. The Contracting Authority shall extend the time limit for the submission of bids, provided that the nature of the addition or change of the tender conditions so requires. In the event of such an amendment or addition to the tender conditions, which may extend the range of potential bidders, the Contracting Authority shall extend the time limit to at least its original length.

10. Additional conditions

The Contracting Authority has the right to:

a. require further explanations to the bid in the case of confusion,
b. verify the data declared by the bidder,
c. specify or modify the Draft contract (maintaining the substantial parameters),
d. cancel the small-scale public contract at any time in the course of the procurement procedure, up until conclusion of the contract,

e. specify the subject of the public contract,

f. enter into a contract with the bidder, whose bid has been evaluated as the most suitable; if the selected bidder refused to enter into a contract, the Contracting Authority has the right to enter into a contract with the bidder, whose bid has been evaluated as the second most suitable etc.

g. publish the decision on the selection of the economic operator and possibly also notice of exclusion of a bidder on the Contracting Authority profile at: http://www.e-zakazky.cz/Profil-Zadavatele/74e987e1-b4a1-4571-b8b6-2cd93fe6f932 and on IoP websites at: http://www.fzu.cz/verejne-zakazky. In such a case, the decision on the selection of the economic operator and the notice of exclusion of a bidder shall be considered to be delivered to all bidders concerned at the point of time of publication on the Contracting Authority profile.

11. Conclusion

This small-scale public contract is not awarded pursuant to Act No. 134/2016 Coll., on Public Procurement, as amended.

The information and data contained in this Invitation (including Annexes) define mandatory requirements of the Contracting Authority on the subject of the public contract. The bidder has to respect and accept these requirements fully and unconditionally when processing the bid. Non-acceptance of the requirements specified in this Invitation (including Annexes) will be considered a breach of the terms.

If this Invitation (including Annexes) mentioned trade names of some products or supplies, or other signs pertaining to a particular supplier, it is only a definition of quality standard and the bidder is entitled to propose a different, qualitatively and technically comparable solutions.

In Prague

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RNDr. Michael Prouza, Ph.D., Director

Annexes:

1. Cover sheet

Testwall
Test & Measurement

QUOTATION NO
0017559
DATE
12 OCT 2020
CUSTOMER
THE CZECH ACADEMY OF SCIENCES - INSTITUTE OF PHYSICS
NAME
[redacted]

Testwall Ltd
Unit 1E Three Rock Road Sandyford
Industrial Estate Dublin D18 W3Y4
Ireland

PRODUCT NAME	PRODUCT DESCRIPTION	RATE	QTY	PRICE
Keithley 6517B	Electrometer/High Resistance Meter	[redacted]	2	[redacted]
Keithley 2657A	High Power System SourceMete	[redacted]	1	[redacted]
Keithley 2410	Source Meter	[redacted]	1	[redacted]
	Calibration cost			[redacted]
	Discount			[redacted]
	Shipping			[redacted]
			TOTAL	€35640.00

WARRANTY	PAYMENT TERMS	LEAD TIME	EQUIPMENT TYPE	SHIPPING METHOD
12 Months	See Below	9-12 days	Refurbished	DHL

For specific options or further information, please email **info@testwall.com**

THE PRICE INCLUDES

- Full electrical, mechanical and safety refurbishment in our in-house Calibration Lab.
- Manuals and accessories required for normal operation.
- Ongoing support from our Test & Measurement engineers

BUSINESS CONDITIONS

Government, University and Educational Institutions bodies have 30 days net payment terms

Existing customers have 30 days net payment terms

The place of delivery is the Fyzikální ústav AV ČR, v. v. i. (Institute of Physics), Na Slovance 1999/2, 182 21 Praha 8, Czech Republic
Prices exclude vat. intra-Community transactions: Under the EU VAT Directive, B2B sales of goods across EU VAT
borders is VAT zero-rated

Testwall is entitled to invoice the purchase price after acceptance of the equipment by the Contracting Authority;
the Contracting Authority undertakes to perform the verification whether the equipment is functional and meets the technical requirements within 5 working days of the delivery of the equipment

Testwall accepts all business and payment conditions for purpose of the bid listed in point 8. in "Invitation to submit bids" document

Testwall
Test & Measurement

QUOTATION NO
0017559
DATE
12 OCT 2020
CUSTOMER
THE CZECH ACADEMY OF SCIENCES - INSTITUTE OF PHYSICS
NAME
[redacted]

Testwall Ltd
Unit 1E Three Rock Road Sandyford
Industrial Estate Dublin D18 W3Y4
Ireland

ORDER OPTIONS	
OPTION 1	All major Credit Cards accepted. Please call the number above. We also accept PayPal (PayPal ID info@testwall.com)
OPTION 2	**Fax / Email Orders** - simply print or scan this quotation and return it with your contact details
OPTION 3	**Issue Purchase Order** - Simply, send us this quotation reference number along with an official purchase order. Purchase orders can be sent via fax, email or postal mail.
OPTION 4	**Wire/Bank Transfer** – Testwall Ltd accepts bank transfer payments from all international organizations and business entities.

If you require additional payment options, or if you would like to contact a sales representative you can contact us at:
Email info@testwall.com
Phone +353 (0)1 4050003

NOTES.

1. Terms are ex-works Testwall, payment in advance unless stated otherwise above.
2. This quotation is valid for 5 days
3. Testwall Standard terms and conditions of sale apply, details available on request.

High power SourceMeter SMU instrument

SMU INSTRUMENTS

2657A

High Power System SourceMeter® SMU Instrument

- **Source or sink up to 180W of DC or pulsed power (±3000V@20mA, ±1500V@120mA)**
- **1fA low current resolution**
- **Dual 22-bit precision ADCs and dual 18-bit 1µs per point digitizers for high accuracy and high speed transient capture**
- **Fully TSP® compliant for easy system integration with Series 2600B System SourceMeter models**
- **Combines a precision power supply, current source, DMM, arbitrary waveform generator, V or I pulse generator, electronic 18-bit load, and trigger controller – all in one instrument**
- **Includes TSP® Express characterization software, LabVIEW® driver, and Keithley's Test Script Builder software development environment**

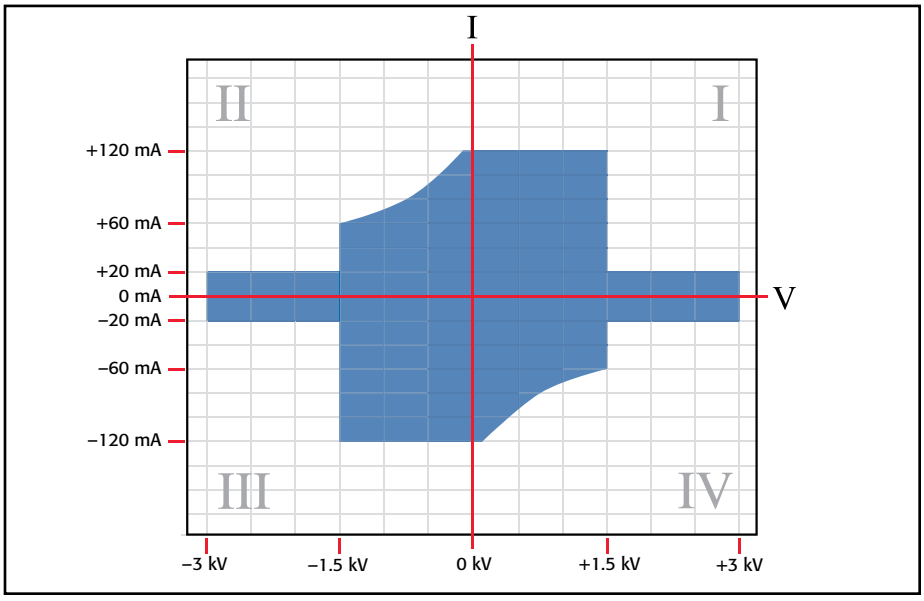
TYPICAL APPLICATIONS

- **Power semiconductor device characterization and testing**
- **Characterization of GaN, SiC, and other compound materials and devices**
- **Breakdown and leakage testing to 3kV**
- **Characterization of sub-millisecond transients**

The Model 2657A is a high voltage, high power, low current source measure unit (SMU) instrument that delivers unprecedented power, precision, speed, flexibility, and ease of use to improve productivity in R&D, production test, and reliability environments. The Model 2657A is designed specifically for characterizing and testing high voltage electronics and power semiconductors, such as diodes, FETs, and IGBTs, as well as other components and materials in which high voltage, fast response, and precise measurements of voltage and current are required. The Model 2657A offers the highest power and best low current performance in the industry. It is supported by the industry's most powerful parametric characterization software platforms to grow with you as your applications evolve.

The Model 2657A offers highly flexible, four-quadrant voltage and current source/load coupled with precision voltage and current meters. It can be used as a:

- Semiconductor characterization instrument
- V or I waveform generator
- V or I pulse generator
- 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



The Model 2657A can source or sink up to 3000V @ 20mA or 1500V @ 120mA.

1.888.KEITHLEY (U.S. only)
www.keithley.com

KEITHLEY
A Tektronix Company

2657A

High Power System SourceMeter SMU Instrument

Ordering Information

2657A High Power System SourceMeter SMU Instrument
Cables must be purchased separately. Please contact your local sales office for configuration assistance.

8010 High Power Device Test Fixture

Accessories Supplied

7709-308A Digital I/O and Interlock Connector
CA-180-3A TSP-Link/Ethernet Cable
Documentation CD
Software tools and drivers CD

ACCESSORIES AVAILABLE

2657A-LIM-3	Low Interconnect Module
2657A-PM-200	200V Protection Module
4299-6	Fixed Rack Mount Kit
SHV-CA-553-x*	High Voltage Triax to SHV Cable (1, 2, 3m)
HV-CA-554-x*	High Voltage Triax to Triax Cable (0.5, 1, 2, 3m)
HV-CA-571-3*	High Voltage Triax to Unterminated Cable
HV-CS-1613	High Voltage Triax Feedthrough Connector

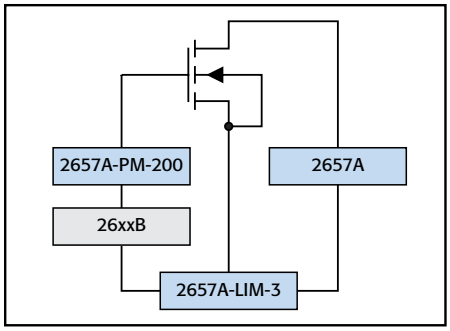
* **Cables must be purchased separately. Please contact your local sales office for configuration assistance.**

ACCESSORIES SUPPLIED WITH THE 8010

CA-558-2	25-pin D-sub Interlock Cable for 26xxA
CA-560-x	4mm Black and Red Banana Cables, 8 in.
CA-562-x	6mm Black and Red Banana Cables, 10 in.
CA-563	BNC to Banana Cable, 9.5 in.
CA-568-120	Safety Earth Ground Cable
8010-DTB	Device Test Board with TO-247 Socket

ACCESSORIES AVAILABLE FOR THE 8010

8010-CTB	Customizable Test Board
8010-DTB-220	Device Test Board with TO-220 Socket (1.5kV)

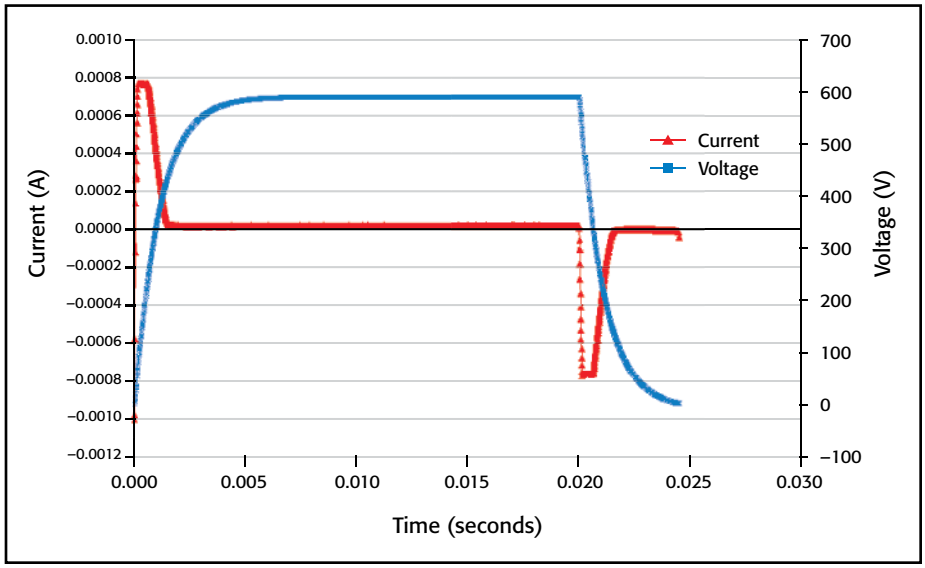


The Model 2657A can be combined with Series 2600B and Model 4200-SCS SMU instruments to support multi-terminal test capability. The Models 2657A-PM-200 Protection Module and 2657A-LIM-3 Low Interconnect Module make it easier to connect multiple instruments to a probe station safely (not required for connecting to the Model 8010 High Power Device Test Fixture).

Two Measurement Modes: Digitizing or Integrating

Precisely characterize transient and steady-state behavior, including rapidly changing thermal effects, with the two measurement modes in the Model 2657A. Each mode is defined by its independent analog-to-digital (A/D) converters.

The digitizing measurement mode provides speeds up to 1μs per sample. The dual 18-bit digitizers allow you to capture voltage and current transients simultaneously. In the integrating measurement mode, the dual 22-bit integrating analog to digital converters allow more precise measurement of voltage and current. Two A/D converters are used with each measurement mode, one for current and the other for voltage, that run simultaneously for accurate source readback that does not sacrifice test throughput.



The dual high speed A/D converters sample as fast as 1µs per point, enabling full simultaneous characterization of both voltage and current.

Expansion Capabilities

Through TSP-Link Technology technology, the Model 2657A can be linked with Series 2600B SMU instruments to form a larger integrated system with up to 32 nodes. Precision timing and tight channel synchronization are guaranteed with built-in 500ns trigger controllers. The fully isolated, independent channels of the SourceMeter SMU instruments make true SMU-per-pin testing possible.

High Power Device Test Fixture

The Model 8010 High Power Device Test Fixture provides safe and easy connections for testing packaged high power devices at up to 3000V or 100A. The Model 8010 provides connections for a high voltage SourceMeter SMU instrument (Model 2657A), one or two high current SourceMeter SMU instruments (Model 2651A), and three low power SourceMeter SMU instruments (Series 2600B or Model 4200-SCS SMU instruments). This allows devices with two terminals (diodes) or three terminals (transistors) or even four or five terminals to be characterized safely and accurately. The Model 8010 has full interlock capability for up to six SourceMeter SMU instruments. The Model 8010 has integrated protection circuits that protect the low voltage SourceMeter SMU instruments from high voltages the Model 2657A can output should a device fault occur. The Model 8010 includes both a high current (100A) and a high voltage (3000V) test socket. Various replacement test socket modules are available, including TO-247, TO-220, axial lead, and a blank socket module that allows building a custom socket. In addition to standard banana jumpers, the Model 8010 has rear-panel scope and thermal probe ports to simplify system integration.

2657A

High Power System SourceMeter SMU Instrument

Standard Capabilities of Series 2600B SMU instruments

Each Model 2657A includes all the features and capabilities provided in Series 2600B SourceMeter SMU instruments:

- Flexibility for use as either a bench-top I-V characterization tool or as a building block component of multiple channel I-V test systems.
- TSP Express software to perform common I-V tests quickly and easily without programming or installing software.
- ACS Basic Edition software for semiconductor component characterization (optional). ACS Basic Edition now features a "Trace" mode for generating a suite of characteristic curves.
- Keithley's Test Script Processor (TSP) technology supports creating and running custom user test scripts for high speed test automation, as well as creating programming sequences that allow the instrument to operate asynchronously without direct PC control.
- Parallel test execution and precision timing when multiple Series 2600B SMU instruments are connected together in a system.
- LXI Class C compliance.
- 14 digital I/O lines for direct connection to a probe station, component handler, or other automation tools.
- USB port for extra data and test program storage via USB memory device.

Model 2657A Condensed Specifications

VOLTAGE ACCURACY SPECIFICATIONS [1]

	SOURCE		MEASURE		
Range	Programming Resolution	Accuracy ±(% rdg + volts)	Display Resolution	Integrating ADC Accuracy [2] ±(% rdg + volts)	High Speed ADC Accuracy [3] ±(% rdg + volts)
200 V	5 mV	0.03% + 50 mV	100 µV	0.025% + 50 mV	0.05% + 100 mV
500 V	10 mV	0.03% + 125 mV	100 µV	0.025% + 100 mV	0.05% + 200 mV
1500 V	40 mV	0.03% + 375 mV	1 mV	0.025% + 300 mV	0.05% + 600 mV
3000 V	80 mV	0.03% + 750 mV	1 mV	0.025% + 600 mV	0.05% + 1.2 V

CURRENT ACCURACY SPECIFICATIONS [4]

	SOURCE		MEASURE		
Range	Programming Resolution	Accuracy ±(% rdg + amps)	Display Resolution	Integrating ADC Accuracy [2] ±(% rdg + amps)	High Speed ADC Accuracy [3] ±(% rdg + amps)
1 nA	30 fA	0.1% + $2E^{-12}$ + VoE^{-15}	1 fA	0.1% + $6E^{-13}$ + VoE^{-15}	0.2% + $6E^{-13}$ + VoE^{-15}
10 nA	300 fA	0.1% + $5E^{-12}$ + VoE^{-15}	10 fA	0.1% + $5E^{-12}$ + VoE^{-15}	0.2% + $5E^{-12}$ + VoE^{-15}
100 nA	3 pA	0.1% + $6E^{-11}$ + VoE^{-13}	100 fA	0.1% + $6E^{-11}$ + VoE^{-13}	0.2% + $6E^{-11}$ + VoE^{-13}
1 µA	30 pA	0.03% + 700 pA	1 pA	0.025% + 400 pA	0.08% + 800 nA
10 µA	300 pA	0.03% + 5 nA	10 pA	0.025% + 1.5 nA	0.08% + 3 nA
100 µA	3 nA	0.03% + 60 nA	100 pA	0.02 % + 25 nA	0.05% + 50 nA
1 mA	30 nA	0.03% + 300 nA	1 nA	0.02 % + 200 nA	0.05% + 400 nA
2 mA	60 nA	0.03% + 1.2 µA	1 nA	0.02 % + 500 nA	0.05% + 1 µA
20 mA	600 nA	0.03% + 12 µA	10 nA	0.02 % + 5 µA	0.05% + 10 µA
120 mA	3 µA	0.03% + 36 µA	100 nA	0.02 % + 24 µA	0.05% + 50 µA

1. For temperatures 0° to 18°C and 28° to 50°C, accuracy is degraded by ±(0.15 × accuracy specification)/°C.
2. Derate accuracy specification for NPLC setting <1 by increasing error term. Add appropriate typical percent of range term for resistive loads using the table below.

NPLC Setting	200 V and 500 V Ranges	1500 V and 3000 V Ranges	100 nA Range	1 µA to 120 mA Ranges
0.1	0.01%	0.01%	0.01%	0.01%
0.01	0.08%	0.07%	0.1 %	0.05%
0.001	0.8 %	0.6 %	1 %	0.5 %

3. 18-bit ADC. Average of 1000 samples taken at 1µs intervals.
4. For temperatures 0° to 18°C and 28° to 50°C, accuracy is degraded by ±(0.35 × accuracy specification)/°C.

SUPPLEMENTAL CHARACTERISTICS

TYPICAL VOLTAGE SOURCE NOISE: 0.005% of range.

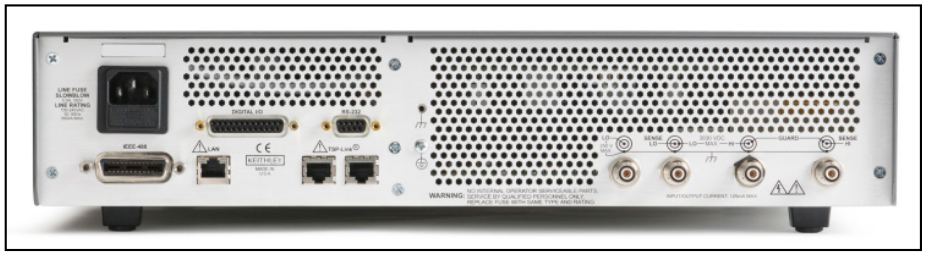
TYPICAL CURRENT SOURCE NOISE: 0.08% of range.

TYPICAL VOLTAGE SOURCE SETTLING: <1ms to 200V, <7ms to 3000V.

TYPICAL CURRENT SOURCE SETTLING: <5ms to 120mA, <200ms to 1µA.

Specifications are subject to change without notice.

Model 8010 High Power Device Test Fixture



Model 2657A rear panel

2657A

High Power System SourceMeter SMU Instrument

TRIGGERING AND SYNCHRONIZATION SPECIFICATIONS

TRIGGERING: Trigger In to Trigger Out: 0.5µs, typical.

SYNCHRONIZATION: Single- or multi-node synchronized source change: <0.5µs, typical.

PROGRAMMING

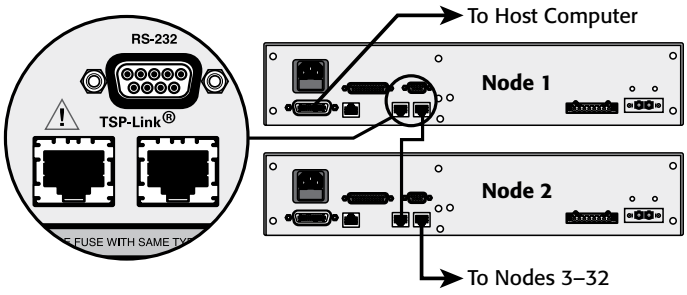
TEST SCRIPT BUILDER: Integrated development environment for building, running, and managing TSP scripts.

TSP EXPRESS (Embedded): Tool that allows users to perform common I-V tests quickly and easily without programming or installing software.

SOFTWARE INTERFACE: TSP Express (Embedded), Direct GPIB/VISA, Read/Write with VB, VC/C++, VC#, LabVIEW™, TestPoint™, LabWindows™/CVI, etc.

SYSTEM EXPANSION

The TSP-Link expansion interface allows TSP-enabled instruments to trigger and communicate with each other. See figure below:



GENERAL

USB: USB 2.1 Host Controller, supports external data storage.

CONTACT CHECK: ±50Ω.

PC INTERFACE: IEEE-488.1 and .2; LXI Ethernet; RS-232.

DIGITAL I/O INTERFACE: Input/Output Pins: 14 open drain I/O bits. 5.25V max.

POWER SUPPLY: 100V to 250VAC, 50Hz–60Hz (auto sensing), 550VA max.

COOLING: Forced air. Side and top intake and rear exhaust.

EMC: Conforms to European Union EMC Directive.

SAFETY: ETL listed (PENDING). Conforms to European Union Low Voltage Directive.

WARRANTY: 1 year.

DIMENSIONS: 89mm high × 435mm wide × 549mm deep (3.5 in × 17.1 in × 21.6 in). Bench Configuration (with handle and feet): 104mm high × 483mm wide × 620mm deep (4.1 in × 19 in × 24.4 in).

WEIGHT: 9.98kg (22 lbs).

ENVIRONMENT: For indoor use only.

CALIBRATION PERIOD: One year.

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Referenced in 1000's of research papers

6517B Electrometer/High Resistance Meter

Datasheet

The Keithley 6517B Electrometer/High Resistance Meter is the worldwide research laboratory standard for sensitive measurements. With over 60 years of low level measurement expertise, Keithley electrometers provide reliable measurements of current levels down to 10 aA (10×10^{-18} A), charge levels down to 1 fC, and the highest resistance measurements available up to 10^{18} Ω. The 6517B is also capable of measuring the largest voltage range—up to 200 V—with an input impedance exceeding 200 TΩ. All this performance is built into an instrument that operates as simply as a digital multimeter.

Exceptional Performance Specifications

The 6517B has incorporated Keithley's decades of expertise in low level measurement technology into an innovative, low current input amplifier with an input bias current of <3 fA, just 0.75 fA p-p noise, and <20 µV burden voltage on the lowest current ranges. The voltage circuit input impedance is greater than 200 TΩ for near-ideal circuit loading. These specifications ensure the accuracy and sensitivity needed for accurate low current and high impedance voltage, resistance, and charge measurements in areas of research such as physics, optics, nanotechnology, and materials science. A built-in ±1 kV voltage source with sweep capability simplifies performing leakage, breakdown, and resistance testing, as well as volume (Ω-cm) and surface resistivity (Ω/square) measurements on insulating materials.

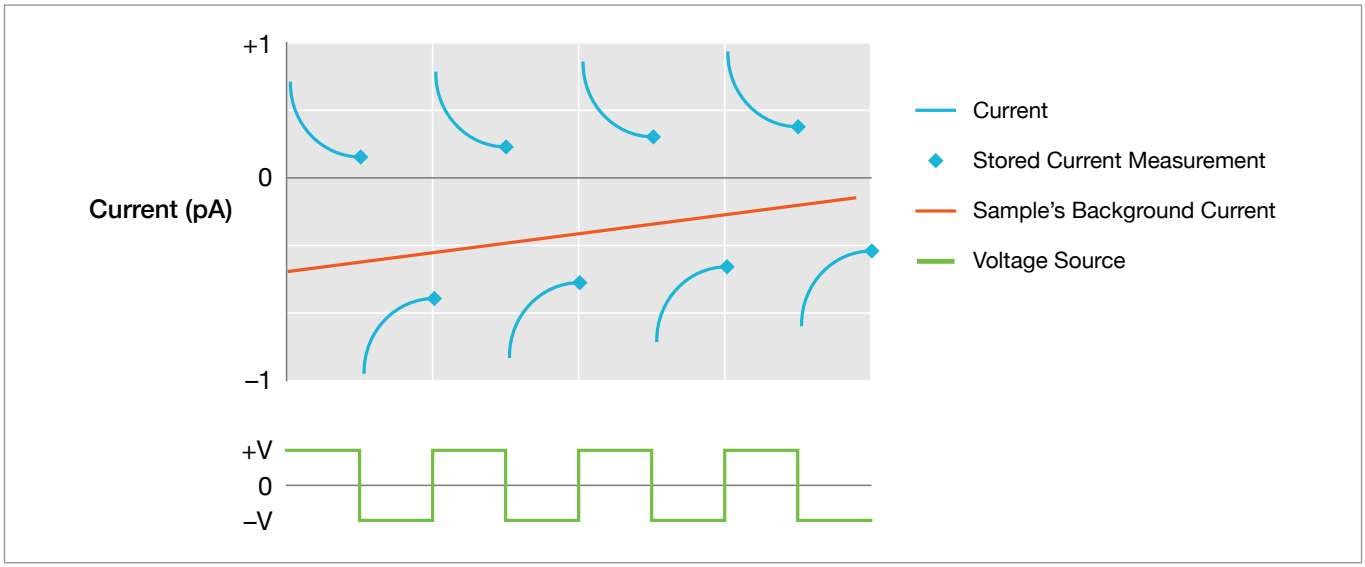
Key Features

- Measures resistances up to 10^{18} Ω
- 10 aA (10×10^{-18} A) current measurement resolution
- Complete hardware-software solution for ASTM D257 high resistivity measurements with the 6517B, 8009 Resistivity Test Fixture, and the KickStart High Resistivity Measurement Application
- <3 fA input bias current
- 6½-digit high accuracy measurement mode
- <20 µV burden voltage on the lowest current ranges
- Voltage measurements up to 200 V with >200 Ω input impedance
- Built-in ±1000 V voltage source
- Unique alternating polarity voltage sourcing and measurement method for high resistance measurements
- Built-in test sequences for four different device characterization tests, surface and volume resistivity, surface insulation resistance, and voltage sweeping
- Optional plug-in scanner cards for testing up to ten devices or material samples with one test setup
- GPIB and RS-232 interfaces

Wide Measurement Ranges

The 6517B offers autoranging over the full span of ranges on current, resistance, voltage, and charge measurements. The 6517B combines the following measurement capabilities:

- Ultra-sensitive ammeter with current measurement from 10 aA to 20 mA
- Highest impedance voltmeter with voltage measurement from 1 µV to 200 V
- Ultra-high range ohmmeter with resistance measurement from 1 Ω to 10^{18} Ω
- Sensitive coulombmeter with charge measurement from 1 fC to 2 µC



The alternating voltage source polarity method eliminates the effects of background currents in materials for making repeatable, accurate high resistance and resistivity measurements.

Improved High Resistivity Measurements

Many test applications require measuring high levels of resistivity (surface or volume) of materials. The conventional method of making these measurements is to apply a sufficiently large voltage to a sample, measure the current that flows through the sample, then calculate the resistance using Ohm's Law (R=V/I). While high resistance materials and devices produce very small currents that are difficult to measure accurately, Keithley electrometers and picoammeters are used successfully for such measurements.

Even with high quality instrumentation, inherent background currents in the material can make these measurements difficult to perform accurately. Insulating materials, polymers, and plastics typically exhibit background currents due to piezoelectric effects, capacitive elements charged by static electricity, and polarization effects. These background currents are often equal to or greater than the current stimulated by the applied voltage. In these cases, the result is often unstable, providing inaccurate resistance or resistivity readings or even erroneous negative values. Keithley's 6517B is designed to solve these problems and provides consistent, repeatable, and accurate measurements for a wide variety of materials and components, especially when used in combination with the 8009 Resistivity Test Fixture.

Alternating Polarity Method for High Resistivity Measurements

The 6517B uses the Alternating Polarity Method, which virtually eliminates the effect of any background currents in the sample. First and second order drifts of the background currents are also canceled out. The Alternating Polarity Method applies a voltage of positive polarity, then the current is measured after a specified delay (Measure Time). Next, the polarity is reversed and the current measured again, using the same delay. This process is repeated continuously, and the resistance is calculated based on a weighted average of the four most recent current measurements. This method typically produces a highly repeatable, accurate measurement of resistance (or resistivity) by the seventh reversal on most materials (i.e., by discarding the first three readings). For example, a 1mm-thick sample of 10^{14} Ω-cm material can be measured with 0.3% repeatability in the 8009 Resistivity Test Fixture, provided the background current changes less than 200 fA over a 15-second period.

Built-In Source Enhances Accuracy of High Resistance Measurements

The 6517B offers a number of features and capabilities that help ensure the accuracy of high resistance measurement applications. For example, the built-in voltage source simplifies determining the relationship between an insulator's resistivity and the level of source voltage used. It is well-suited for capacitor leakage and insulation resistance measurements, tests of the surface insulation resistance of printed circuit boards, voltage coefficient testing of resistors, and diode leakage characterization.

Complete High Resistivity Measurement Solution

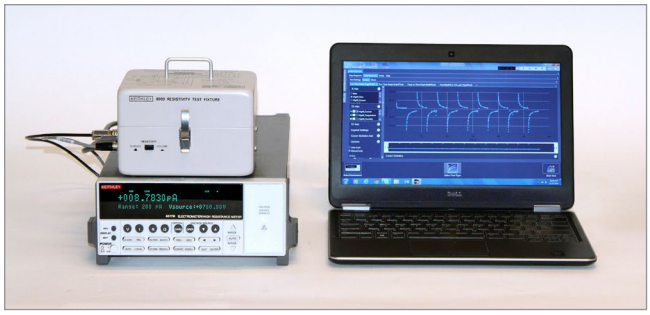
Perform high resistivity measurements using test methods defined by the standard, ASTM D-257, "DC Resistance or Conductance of Insulating Materials", with the following package:

- KICKSTARTFL-HRMA High Resistivity Measurement Application for the KickStart Instrument Software Control environment
- 6517B Electrometer
- 8009 Resistivity Test Fixture

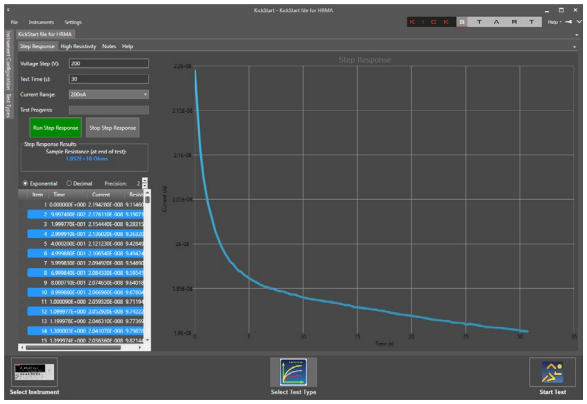
The KickStart High Resistivity Measurement Application controls the electrometer and the test fixture to perform all the measurements needed to make ASTM- D-257 standard resistivity measurements. Test materials at voltages up to 1000V. Determine resistivity up to 10^{18} Ω-cm. Analyze step response plots of current vs time to determine how long to wait for a measurement to settle on the material-under-test. Analyze a plot of multiple readings to ensure that settled and consistent measurements are being taken. The KickStart High Resistance Measurement Application uses the alternating polarity technique to eliminate inherent background currents for the most accurate resistivity measurements. Also use the application to observe resistivity dependency on temperature and relative humidity using the optional thermocouple and relative humidity probes.

Temperature and Humidity Stamping

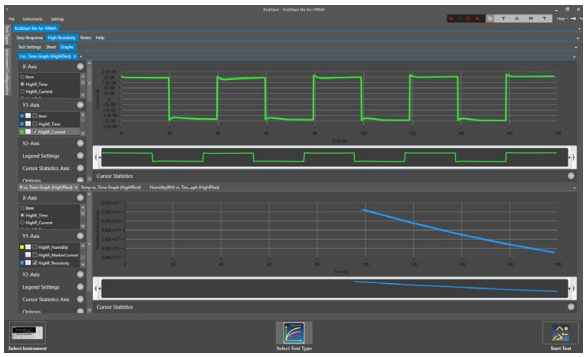
Humidity and temperature can influence the resistivity values of materials significantly. To help you make accurate comparisons of readings acquired under varying conditions, the 6517B offers a built-in type K thermocouple and an optional 6517-RH Relative Humidity Probe. A built-in 50,000 reading data storage buffer allows recording and recalling measurements stamped with the time of the measurement, the temperature, and the relative humidity.



ASTM-D257-compliant High Resistivity Test System with the 6517B Electrometer, 8009 Resistivity Test Fixture, and the KickStart High Resistivity Measurement Application.



KickStart High Resistivity Measurement step response plot



KickStart High Resistivity Measurement resistivity plot

Internal Test Sequences Expand and Simplify Applications

The 6517B has a number of internal test sequences that assists in easily setting up and performing a number of tests. Device characterization sequences include diode leakage current measurement, capacitor leakage current measurement, cable insulation resistance measurement, and resistor voltage coefficient measurement. Resistivity and resistance tests include volume resistivity, surface resistivity, and surface insulation resistance testing. Parameters can be characterized as a function of voltage with the square wave and staircase test sequences.

In addition to its built-in tests, the 6517B excels in low current, high impedance voltage, resistance, and charge measurements in areas of research such as physics, optics, and materials science. The electrometer's extremely low voltage burden makes it particularly valuable for use in solar cell characterization applications and its built-in voltage source and low current sensitivity make it an excellent solution for high resistance measurements of nanomaterials such as polymer-based nanowires, other nanomaterials, ceramics, dielectric films, and biomaterials.

With its highly responsive measurements and DMM-like operation, the 6517B performs well in quality control, design engineering, and production test applications involving leakage current, breakdown, and resistance testing. Volume and surface resistivity measurements on non-conductive materials are particularly enhanced by the 6517B's voltage reversal method. The 6517B is also excellent for electrochemistry applications such as high impedance, ion-selective electrodes and pH measurements, conductivity cells, and potentiometry.

Typical Applications

- Nanomaterial characterization
- Polymer electrical characterization
- Beam measurements
- Dosimetry
- Device leakage current measurements
- Insulation resistance measurements
- Optoelectronic detector characterization
- Volume and surface resistivity

Accessories Extend Measurement Capabilities

A variety of optional accessories can be used to extend the 6517B applications and enhance its performance.

The 8009 Resistivity Test Fixture is a guarded test fixture for measuring volume and surface resistivities of sample materials. It has stainless-steel electrodes built to ASTM D257 standards. The fixture's electrode dimensions are pre-programmed into the 6517B, so there's no need to calculate those values then enter them manually. This accessory is designed to protect you from contact with potentially hazardous voltages —opening the lid of the test fixture automatically turns off the 6517B's voltage source.

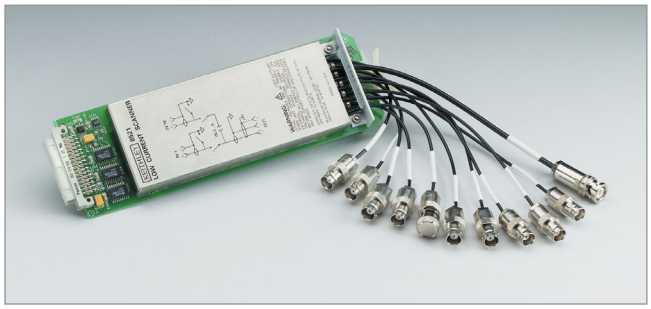
8009 Resistivity Test Fixture is compliant with American Society for Testing and Materials (ASTM) Standard D257 Standard Test Methods for DC Resistance or Conductance of Insulating Materials. The 8009 combined with the 6517B provides a complete system for making high quality, safe resistivity measurements. The 8009 comes with the 6517B-ILC-3 Safety Interlock Cable, the 7078-TRX-3 Triax-Triax Cable, and the 8607 1 kV Source Voltage Banana Jack Cable Set.

6521 and 6522 Low Current, 10-Channel Scanner Cards

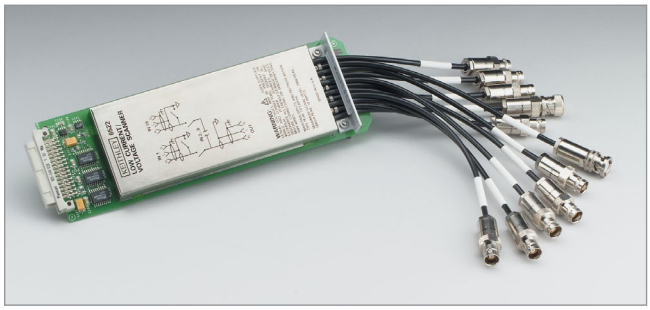
Two optional 10-channel plug-in scanner cards are available to extend the measurement performance of the 6517B Electrometer/High Resistance Meter. The cards install directly into the option slot in the back panel of the 6517B. The cards are also compatible with the 6517A and 6517.

The **6521 Low Current Scanner Card** is a 10-channel multiplexer, designed for switching low currents in multipoint testing applications or when the test configuration must be changed. Offset current on each channel is <1 pA and high isolation is maintained between each channel (>10^{15} Ω). The 6521 maintains the current path even when the channel is deselected, making it a true current switch. BNC input connectors help provide shielding for sensitive measurements and make the card compatible with low noise coaxial cables. The 6521 is well suited for automating reverse leakage tests on semiconductor junctions or gate leakage tests on FETs.

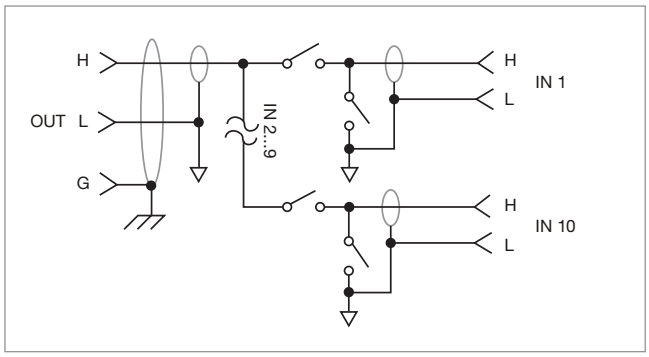
The **6522 Voltage/Low Current Scanner Card** can provide up to ten channels of low-level current, high impedance voltage, high resistance, or charge switching. Although it's similar to the 6521 in many ways, the 6522's input connectors are 3-lug triax. The card can be software configured for high impedance voltage switching of up to 200 V. Triaxial connectors make it possible to float the card 500 V above ground and drive guard to 200 V.



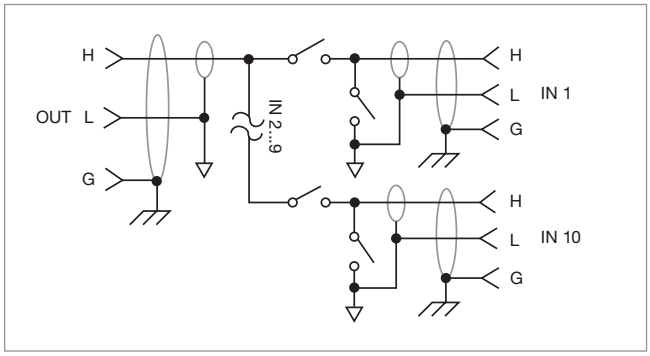
6521 Low Current Scanner Card.



6522 Voltage/Low Current Scanner Card.



6521 schematic.



6522 schematic.

6521 and 6522 Specifications

Channels Per Card	10.
Functions	**6521:** Amps. **6522:** Volts, Amps.
Contact Configuration	Single pole, "break-before-make" for signal HI input. Signal LO is common for all 10 channels and output. When a channel is off, signal HI is connected to signal LO. **6522:** 6517B can also configure channels as voltage switches.
Connector Type	**6521:** Inputs: BNC. Outputs: Triaxial. **6522:** Inputs: Triaxial. Outputs: Triaxial.
Signal Level	**6521:** 30 V, 500 mA, 10 VA (resistive load). **6522:** 200 V, 500 mA, 10 VA (resistive load).
Contact Life	>10^6 closures at maximum signal level; >10^7 closures at low signal levels.
Contact Resistance	<1 Ω.
Contact Potential	<200 µV.
Offset Current	<1 pA (<30 fA typical at 23°C, <60% RH).
Actuation Time	2 ms.
Common Mode Voltage	**6521:** <30 V peak. **6522:** <300 V peak.
Channel Isolation (6522)	>10^{13} Ω, <0.3 pF.
Input Isolation (6522)	>10^{10} Ω, <125 pF (Input HI to Input LO).
Environment	**Operating:** 0°C to 50°C up to 35°C at 70% R.H. **Storage:** –25°C to 65°C.

Specifications

Volts

Range	6½-Digit Resolution	Accuracy (1 Year)[1] 18°–28°C ±(% + offset)	Temperature Coefficient 0°–18°C & 28°–50°C ±(% + offset)/°C
2 V	1 µV	0.025 + 40 µV	0.003 + 20 µV
20 V	10 µV	0.025 + 300 µV	0.002 + 100 µV
200 V	100 µV	0.06 + 3 mV	0.002 + 1 mV

NMRR 2 V and 20 V ranges: >60 dB. 200 V range: >55 dB. 50 Hz or 60 Hz[2].

CMRR >120 dB at DC, 50 Hz or 60 Hz.

Input Impedance >200 TΩ in parallel with 20 pF, <2 pF guarded (1 MΩ with zero check on).

Small Signal Bandwidth at Preamp Output
Typically 100 kHz (–3 dB).

Notes
1. When properly zeroed, 6½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.
2. Line sync on.

Amps

Range	6½-Digit Resolution	Accuracy (1 Year)[1] 18°–28°C ±(% + offset)	Temperature Coefficient 0°–18°C & 28°–50°C ±(% + offset)/°C
20 pA	10 aA[2]	1 + 3 fA	0.1 + 500 aA
200 pA	100 aA[2]	1 + 5 fA	0.1 + 1 fA
2 nA	1 fA	0.2 + 300 fA	0.1 + 20 fA
20 nA	10 fA	0.2 + 500 fA	0.03 + 100 fA
200 nA	100 fA	0.2 + 5 pA	0.03 + 1 pA
2 µA	1 pA	0.1 + 100 pA	0.005 + 20 pA
20 µA	10 pA	0.1 + 500 pA	0.005 + 100 pA
200 µA	100 pA	0.1 + 5 nA	0.005 + 1 nA
2 mA	1 nA	0.1 + 100 nA	0.008 + 20 nA
20 mA	10 nA	0.1 + 500 nA	0.008 + 100 nA

Input Bias Current <3 fA at T_{cal}. Temperature coefficient = 0.5 fA/°C, 20 pA range.

Input Bias Current Noise <750 aA p-p (capped input), 0.1 Hz to 10 Hz bandwidth, damping on. Digital filter = 40 readings, 20 pA range.

Input Voltage Burden at T_{cal} ±1°C <20 µV on 20 pA, 2 nA, 20 nA, 2 µA, and 20 µA ranges.
<100 µV on 200 pA, 200 nA, and 200 µA ranges.
<2 mV on 2 mA range. <5 mV on 20 mA range.

Temperature Coefficient of Input Voltage Burden
<10µV/°C on pA, nA, and µA ranges.

Preamp Settling TimE (to 10% of final value), Typical
0.5 sec (damping off) 2.0 sec (damping on) on pA ranges. 15 msec on nA ranges damping off, 1 msec on µA ranges damping off. 500 µsec on mA ranges damping off.

NMRR >60 dB on all ranges at 50 Hz or 60 Hz[3].

Notes
1. When properly zeroed, 6½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.
2. aA = 10^{-18} A, fA = 10^{-15} A.
3. Line sync on.

Ohms (Normal Method)

Range	6½-Digit Resolution	Accuracy (1 Year) [1] (10–100% Range) 18°–28°C ±(% + offset)	Temperature Coefficient (10–100% Range) 0°–18°C & 28°–50°C ±(% + offset)	Auto V Source	Amps Range
2 MΩ	1 Ω	0.125 + 10 Ω	0.01 + 10 Ω	40 V	200 µA
20 MΩ	10 Ω	0.125 + 100 Ω	0.01 + 100 Ω	40 V	20 µA
200 MΩ	100 Ω	0.15 + 1 kΩ	0.015 + 1 kΩ	40 V	2 µA
2 GΩ	1 kΩ	0.225 + 10 kΩ	0.035 + 10 kΩ	40 V	200 nA
20 GΩ	10 kΩ	0.225 + 100 kΩ	0.035 + 100 kΩ	40 V	20 nA
200 GΩ	100 kΩ	0.35 + 1 MΩ	0.110 + 1 MΩ	40 V	2 nA
2 TΩ	1 MΩ	0.35 + 10 MΩ	0.110 + 10 MΩ	400 V	2 nA
20 TΩ	10 MΩ	1.025 + 100 MΩ	0.105 + 100 MΩ	400 V	200 pA
200 TΩ	100 MΩ	1.15 + 1 GΩ	0.125 + 1 GΩ	400 V	20 pA

Notes

1. Specifications are for auto V-source ohms, when properly zeroed, 6½-digit, 1 PLC, median filter on, digital filter = 10 readings. If user selectable voltage is required, use manual mode. Manual mode displays resistance (up to 10^{18} Ω) calculated from measured current. Accuracy is equal to accuracy of V-source plus accuracy of selected Amps range.

Preamp Settling Time

Add voltage source settling time to preamp settling time in Amps specification. Ranges over 20 GΩ require additional settling based on the characteristics of the load.

Ohms (Alternating Polarity Method)

The alternating polarity sequence compensates for the background (offset) currents of the material or device under test. Maximum tolerable offset up to full scale of the current range used.

Using Keithley 8009 fixture

Repeatability

$\Delta I_{BG} \times R/V_{ALT}$ + 0.1% (1σ) (instrument temperature constant ±1°C).

Accuracy

$(V_{SRC}Err + I_{MEAS}Err \times R)/V_{ALT}$

where: ΔI_{BG} is a measured, typical background current noise from the sample and fixture.

V_{ALT} is the alternating polarity voltage used.

$V_{SRC}Err$ is the accuracy (in volts) of the voltage source using V_{ALT} as the setting.

$I_{MEAS}Err$ is the accuracy (in amps) of the ammeter using V_{ALT}/R as the reading.

Voltage Source

Range	5½-Digit Resolution	Accuracy (1 Year) 18°–28°C ±(% setting + offset)	Temperature Coefficient 0°–18°C & 28°–50°C ±(% setting+offset)/°C
100 V	5 mV	0.15 + 10 mV	0.005 + 1 mV
1000 V	50 mV	0.15 + 100 mV	0.005 + 10 mV

Maximum Output Current

100 V Range: ±10 mA, hardware short circuit protection at <14 mA.
1000 V Range: ±1 mA, hardware short circuit protection at <1.4 mA.

Settling Time

100 V Range: <8 ms to rated accuracy.
1000 V Range: <50 ms to rated accuracy.

Noise (typical)

100V Range: <2.6 mV rms.
1000V Range: <2.9 mV rms.

Coulombs

Range	6½-Digit Resolution	Accuracy (1 Year) [1, 2] 18°–28°C, ±(% + offset)	Temperature Coefficient 0°–18°C & 28°–50°C ±(% + offset)/°C
2 nC	1 fC	0.4 + 50 fC	0.04 + 30 fC
20 nC	10 fC	0.4 + 500 fC	0.04 + 100 fC
200 nC	100 fC	0.4 + 5 pC	0.04 + 1 pC
2 µC	1 pC	0.4 + 50 pC	0.04 + 10 pC

Notes

1. Specifications apply immediately after charge acquisition. Add
   $(4\ \text{fA} + \frac{|Q_{AV}|}{RC})\ T_A$
   where T_A = period of time in seconds between the coulombs zero and measurement and Q_{AV} = average charge measured over T_A and RC = 300,000 typical.
2. When properly zeroed, 6½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.

Input Bias Current <4 fA at T_{cal}. Temperature coefficient = 0.5 fA/°C, 2 nC range.

Temperature (Thermocouple)

Thermocouple Type	Range	Accuracy (1 Year) [1], 18°–28°C ±(% rdg + °C)
K	–25°C to 150°C	±(0.3% + 1.5°C)

Humidity

Range	Accuracy (1 Year) [2] 18°–28°C, ±(% rdg + % RH)
0–100%	±(0.3% +0.5)

Notes

1. Excluding probe errors, T_{cal} ± 5°C, 1 PLC integration time.
2. Humidity probe accuracy must be added. This is ±3% RH for 6517-RH, up to 65°C probe environment, not to exceed 85°C.

IEEE-488 Bus Implementation

Implementation	SCPI (IEEE-488.2, SCPI-1999.0).
Trigger to Reading Done	150 ms typical, with external trigger.
RS-232 Implementation	**Supports:** SCPI 1991.0. **Baud Rates:** 300, 600, 1200, 2400, 4800, 9600, 19.2k, 38.4k, 57.6k, and 115.2k.
Flow Control	None, Xon/Xoff.
Connector	DB-9 TXD/RXD/GND.

General Characteristics

Overrange Indication	Display reads “OVERFLOW” for readings >105% of range. The display reads “OUT OF LIMIT” for excesive overrange conditions.
Ranging	Automatic or manual.
Conversion Time	Selectable 0.01 PLC to 10 PLC.
Maximum Input	250 V peak, DC to 60 Hz sine wave; 10 sec. per minute maximum on mA ranges.
Maximum Common Mode Voltage (DC to 60 Hz sine wave)	Electrometer, 500 V peak; V Source, 750 V peak.
Isolation (Meter COMMON to chassis)	$>10^{10}$ Ω, <500 pF.
Input Connector	Three lug triaxial on rear panel.
2 V Analog Output	2 V for full range input. Non-inverting in Volts mode, inverting when measuring Amps, Ohms, or Coulombs. Output impedance 10 kΩ.
Preamp Output	Provides a guard output for Volts measurements. Can be used as an inverting output or with external feedback in Amps and Coulombs modes.
External Trigger	TTL compatible External Trigger and Electrometer Complete.
Guard	Switchable voltage guard available.
Digital I/O and Trigger Line	Available, see manual for usage.
EMC	Conforms to European Union Directive 89/336/EEC, EN 61326-1.
Safety	Conforms to European Union Directive 73/23/EEC, EN 61010-1.
Reading Storage	50,000.
Reading Rates	**To Internal Buffer:** 425 readings/second [1]. **To IEEE-488 Bus:** 400 readings/second [1, 2]. **Bus Transfer:** 3300 readings/second [2]. 1. 0.01PLC, digital filters off, front panel off, temperature + RH off, Line Sync off. 2. Binary transfer mode.
Digital Filter	Median and averaging.
Environment	Operating: 0°–50°C; relative humidity 70% non-condensing, up to 35°C. Storage: –25° to +65°C.
Altitude	Maximum 2000 meters above sea level per EN 61010-1.
Warm-Up	1 hour to rated accuracy (see manual for recommended procedure).
Power	User selectable 100, 120, 220, 240 VAC ±10%; 50/60 Hz, 100 VA max.
Physical	**Case Dimensions:** 90 mm high × 214 mm wide × 369 mm deep (3½ in. × 8½ in. × 14½ in.). **Working Dimensions:** From front of case to rear including power cord and IEEE-488 connector: 394 mm (15.5 inches). **Net Weight:** 5.4 kg (11.8 lbs.). **Shipping Weight:** 6.9 kg (15.11 lbs.).

Ordering Information

6517B	Electrometer/High Resistance Meter

Supplied Accessories

237-ALG-2	Low Noise Triax Cable, 3-slot Triax to Alligator Clips, 2 m (6.6 ft)
8607	Safety High Voltage Dual Test Leads
6517-TP	Thermocouple Bead Probe
CS-1305	Interlock Connector

Available Software

KickStartFL-HRMA	High Resistivity Measurement Application Floating License for the KickStart Instrument Software Control Environment (Requires KickStart Instrument Control Software version 1.9 or later). Free 30 day trial available on tek.com/keithley-kickstart.

Available Accessories

Test Fixture	
8009	Resistivity Test Fixture
Scanner Cards	
6521	Low Current Scanner Card
6522	Voltage/Low Current Scanner Card
Cables	
6517B-ILC-3	Interlock Cable
7007-1	Shielded IEEE-488 Cable, 1 m (3.2 ft)
7007-2	Shielded IEEE-488 Cable, 2 m (6.5 ft)
7009-5	RS-232 Cable
7078-TRX-x	Low Noise Triax Cable, 3-Slot Triax Connectors, x=3: 0.9 m (3 ft), x=10: 3 m (10 ft), x=20: 6 m (20 ft)
8501-1	Trigger Link Cable, 1 m (3.3 ft)
8501-2	Trigger Link Cable, 2 m (6.6 ft)
8503	Trigger Link Cable to 2 male BNCs, 1 m (3.3 ft)
8607	1 kV Source Banana Cables
Probes	
6517-RH	Humidity Probe with Extension Cable
6517-TP	Temperature Bead Probe (included with 6517B)
Other	
CS-1305	Interlock Connector
Adapters	
237-BNC-TRX	Male BNC to 3-Lug Female Triax Adapter
237-TRX-NG	Triax Male-Female Adapter with Guard Disconnected
237-TRX-T	3-Slot Male Triax to Dual 3-Lug Female Triax Tee Adapter
237-TRX-TBC	3-Lug Female Triax Bulkhead Connector (1.1 kV rated)
7078-TRX-BNC	3-Slot Male Triax to BNC Adapter
7078-TRX-GND	3-Slot Male Triax to BNC Adapter, guard removed
7078-TRX-TBC	3-Lug Female Triax Bulkhead Connector with Cap

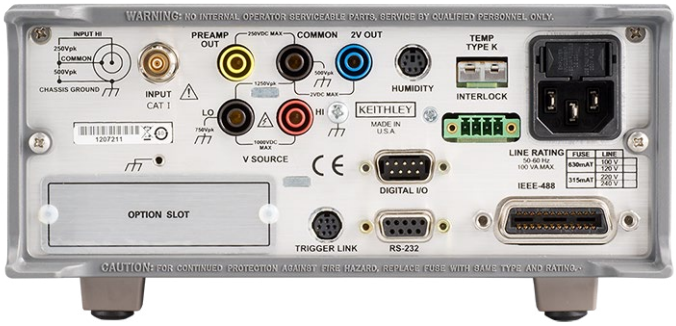
Rack Mount Kits	
4288-1	Single Fixed Rack Mounting Kit
4288-2	Dual Fixed Rack Mounting Kit
4288-4	Shelf Rack Mount kit, for 3U and 2U high instruments
4288-5	Shelf Mount Rack Kit, for two 2U high instruments
4299-7	Universal Shelf Mount Rack Kit
GPIB Interfaces	
KPCI-488LPA	IEEE-488 Interface/Controller for the PCI Bus
KUSB-488B	IEEE-488 USB-to-GPIB Interface Adapter

Service Options

6517B-EW	1 Year KeithleyCare Gold Extended Warranty Plan
6517B-3Y-EW-STD	3 Year KeithleyCare Gold Extended Warranty Plan
6517B-5Y-EW-STD	5 Year KeithleyCare Gold Extended Warranty Plan
C/6517B-3Y-STD	KeithleyCare 3-Calibration, 3-Year Standard Calibration Plan
C/6517B-3Y-DATA	KeithleyCare 3-Calibration, 3-Year Calibration Plan with Data
C/6517B-3Y-17025	KeithleyCare 3-Calibration, 3-Year ISO 17025 Calibration Plan
C/6517B-5Y-STD	KeithleyCare 5-Calibration, 5-Year Standard Calibration Plan
C/6517B-5Y-DATA	KeithleyCare 5-Calibration, 5-Year Calibration Plan with Data
C/6517B-5Y-17025	KeithleyCare 5-Calibration, 5-Year ISO 17025 Calibration Plan

Warranty Information

Warranty Summary	This section summarizes the warranties of the 6517B. For complete warranty information, refer to the 6517B Reference Manual. Any portion of the product that is not manufactured by Keithley is not covered by this warranty and Keithley will have no duty to enforce any other manufacturer's warranties.
Hardware Warranty	Keithley Instruments, Inc. warrants the Keithley manufactured portion of the hardware for a period of one year from defects in materials or workmanship; provided that such defect has not been caused by use of the Keithley hardware which is not in accordance with the hardware instructions. The warranty does not apply upon any modification of Keithley hardware made by the customer or operation of the hardware outside the environmental specifications.
Software Warranty	Keithley warrants for the Keithley produced portion of the software or firmware will conform in all material respects with the published specifications for a period of ninety (90) days; provided the software is used on the product for which it is intended in accordance with the software instructions. Keithley does not warrant that operation of the software will be uninterrupted or error-free, or that the software will be adequate for the customer's intended application. The warranty does not apply upon any modification of the software made by the customer.



6517B rear panel.

Contact Information:

Australia* 1 800 709 465
Austria 00800 2255 4835
Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Belgium* 00800 2255 4835
Brazil +55 (11) 3759 7627
Canada 1 800 833 9200
Central East Europe / Baltics +41 52 675 3777
Central Europe / Greece +41 52 675 3777
Denmark +45 80 88 1401
Finland +41 52 675 3777
France* 00800 2255 4835
Germany* 00800 2255 4835
Hong Kong 400 820 5835
India 000 800 650 1835
Indonesia 007 803 601 5249
Italy 00800 2255 4835
Japan 81 (3) 6714 3010
Luxembourg +41 52 675 3777
Malaysia 1 800 22 55835
Mexico, Central/South America and Caribbean 52 (55) 56 04 50 90
Middle East, Asia, and North Africa +41 52 675 3777
The Netherlands* 00800 2255 4835
New Zealand 0800 800 238
Norway 800 16098
People's Republic of China 400 820 5835
Philippines 1 800 1601 0077
Poland +41 52 675 3777
Portugal 80 08 12370
Republic of Korea +82 2 6917 5000
Russia / CIS +7 (495) 6647564
Singapore 800 6011 473
South Africa +41 52 675 3777
Spain* 00800 2255 4835
Sweden* 00800 2255 4835
Switzerland* 00800 2255 4835
Taiwan 886 (2) 2656 6688
Thailand 1 800 011 931
United Kingdom / Ireland* 00800 2255 4835
USA 1 800 833 9200
Vietnam 12060128

*** European toll-free number. If not accessible, call:** +41 52 675 3777

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112316.sbg 1KW-60280-1

Tightly coupled precision sourcing and measurement

SMU INSTRUMENTS

Series 2400

SourceMeter® SMU Instruments

- **Five instruments in one (IV Source, IVR Measure)**
- **Seven models: 20–100W DC, 1000W pulsed, 1100V to 1µV, 10A to 10pA**
- **Source and sink (4-quadrant) operation**
- **0.012% basic measure accuracy with 6½-digit resolution**
- **2-, 4-, and 6-wire remote V-source and measure sensing**
- **1700 readings/second at 4½ digits via GPIB**
- **Pass/Fail comparator for fast sorting/binning**
- **Available high speed sense lead contact check function**
- **Programmable DIO port for automation/handler/prober control (except Model 2401)**
- **Standard SCPI GPIB, RS-232 and Keithley Trigger Link interfaces**
- **Keithley LabTracer 2.0 I-V curve tracing application software (download)**

Keithley's Series 2400 Source Measure Unit (SMU) Instruments are designed specifically for test applications that demand tightly coupled sourcing and measurement. All SourceMeter models provide precision voltage and current sourcing as well as measurement capabilities. Each SourceMeter SMU instrument is both a highly stable DC power source and a true instrument-grade 6½-digit multimeter. The power source characteristics include low noise, precision, and readback. The multimeter capabilities include high repeatability and low noise. The result is a compact, single-channel, DC parametric tester. In operation, these instruments can act as a voltage source, a current source, a voltage meter, a current meter, and an ohmmeter. Manufacturers of components and modules for the communications, semiconductor, computer, automotive, and medical industries will find the SourceMeter SMU instruments invaluable for a wide range of characterization and production test applications.

Advantages of a Tightly Integrated Instrument

By linking source and measurement circuitry in a single unit, these instruments offer a variety of advantages over systems configured with separate source and measurement instruments. For example, they minimize the time required for test station development, setup, and maintenance, while lowering the overall cost of system ownership. They simplify the test process itself by eliminating many of the complex synchronization and connection issues associated with using multiple instruments. And, their compact half-rack size conserves precious "real estate" in the test rack or bench.

Power of Five Instruments in One (IV Source, IVR Measure)

The tightly coupled nature of a SourceMeter SMU instrument provides many advantages over solutions configured from separate instruments, such as a precision power supply and a digital multimeter. For example, it provides faster test times by reducing GPIB traffic and simplifies the remote programming interface. It also protects the device under test from damage due to accidental overloads, thermal runaway, etc. Both the current and voltage source are programmable with readback to help maximize device measurement integrity. If the readback reaches a programmed compliance limit, then the source is clamped at the limit, providing fault protection.

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
5808	Low Cost Single-pin Kelvin Probe Set
5809	Low Cost Kelvin Clip Lead Set
8607	2-Wire, 1000V Banana Cables, 1m (3.3 ft)
CA-18-1	Shielded Dual Banana Cable, 1.2m (4 ft)

SWITCHING HARDWARE

7001	Two-Slot Switch System
7002	Ten-Slot Switch System
7019-C	6-Wire Ohms Switch Card
7053	High-Current Switch Card

CABLES/ADAPTERS

7007-1	Shielded GPIB Cable, 1m (3.3 ft)
7007-2	Shielded GPIB Cable, 2m (6.6 ft)
7009-5	RS-232 Cable
8620	Shorting Plug

COMMUNICATION INTERFACE

KPCI-488LPA	IEEE-488 Interface/Controller for the PCI Bus
KUSB-488B	IEEE-488 USB-to-GPIB Interface Adapter

TRIGGERING AND CONTROL

2499-DIGIO	Digital I/O Expander Assembly (not for Model 2401)
8501-1	Trigger Link Cable, DIN-to-DIN, 1m (3.3 ft)
8501-2	Trigger Link Cable, DIN-to-DIN, 2m (6.6 ft)
8502	Trigger Link to BNC Breakout Box
8503	Trigger Link Cable, DIN-to-Dual BNC, 1m (3.3 ft)
8505	Male to 2-Female Y-DIN Cable for Trigger Link

RACK MOUNT KITS

4288-1	Single Fixed Rack Mount Kit
4288-2	Dual Fixed Rack Mount Kit
4288-4	Dual Fixed Rack Mount Kit
4288-5	Shelf Type Side by Side Rack Mounting Kit
4288-9	Dual Fixed Rack Mounting Kit

SOFTWARE

LabTracer 2.0	Curve Tracing Software (downloadable)

Series 2400

SourceMeter® SMU Instruments

Ordering Information

2400 200V, 1A, 20W SourceMeter SMU Instrument

2400-C 200V, 1A, 20W SourceMeter SMU Instrument with Contact Check

2401 20V, 1A, 20W SourceMeter SMU Instrument

2410 1100V, 1A, 20W SourceMeter SMU Instrument

2410-C 1100V, 1A, 20W SourceMeter SMU Instrument with Contact Check

2420 60V, 3A, 60W SourceMeter SMU Instrument

2420-C 60V, 3A, 60W SourceMeter SMU Instrument with Contact Check

2425 100V, 3A, 100W SourceMeter SMU Instrument

2425-C 100V, 3A, 100W SourceMeter SMU Instrument with Contact Check

2430 100V, 10A, 1000W Pulse Mode SourceMeter SMU Instrument

2430-C 100V, 10A, 1000W Pulse Mode SourceMeter SMU Instrument with Contact Check

2440 40V, 5A, 50W SourceMeter SMU Instrument

2440-C 40V, 5A, 50W SourceMeter SMU Instrument with Contact Check

Accessories Supplied

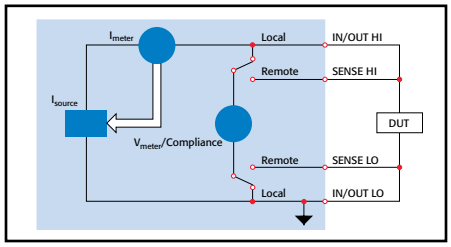
Model 8605 Test Leads

LabVIEW Software Driver (downloadable)

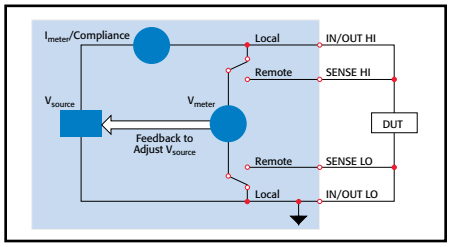
LabTracer Software (downloadable)

I-V Characteristics

All SourceMeter SMU instruments provide four-quadrant operation. In the first and third quadrants they operate as a source, delivering power to a load. In the second and fourth quadrants they operate as a sink, dissipating power internally. Voltage, current, and resistance can be measured during source or sink operation.

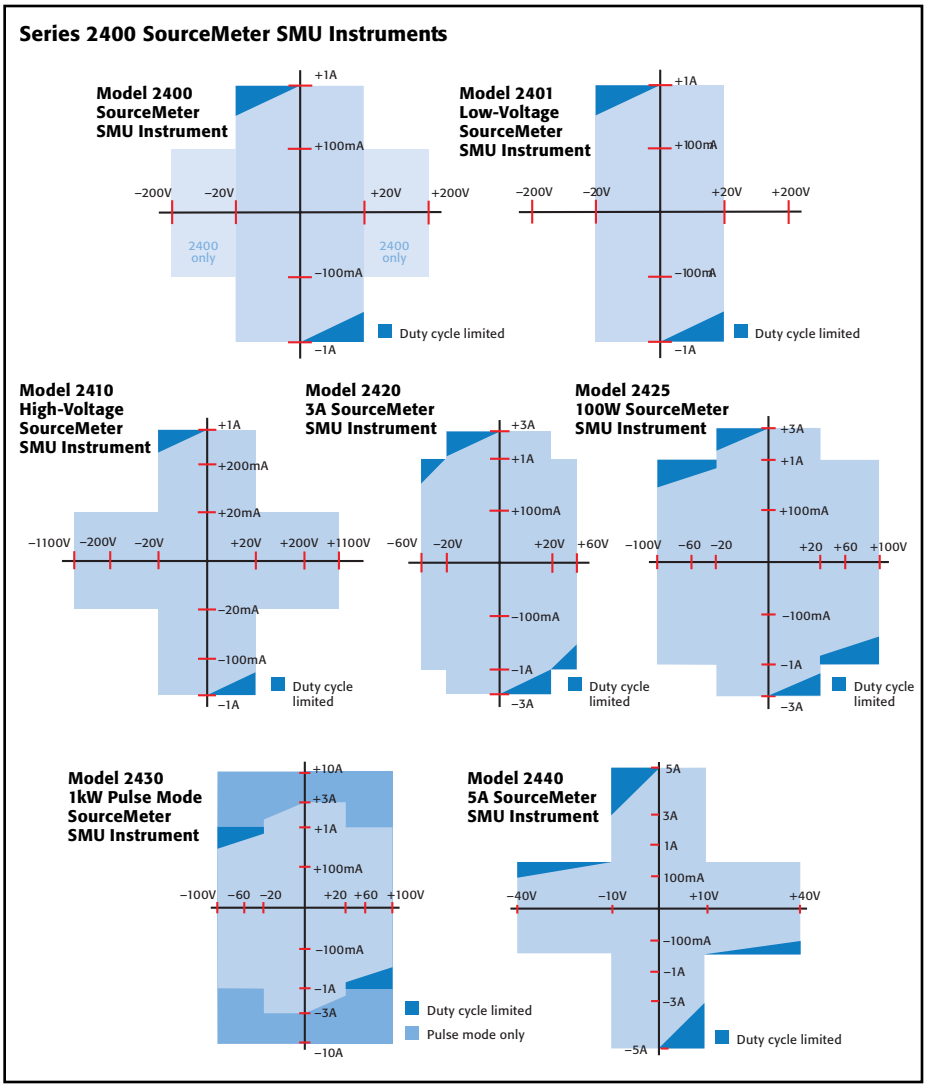


Source I–Measure V, I, or Ω configuration



Source V–Measure I, V, or Ω configuration

Series 2400 SourceMeter SMU Instruments



Tightly coupled precision sourcing and measurement

SMU INSTRUMENTS

Series 2400 SourceMeter® SMU Instruments

Tightly coupled precision sourcing and measurement

SMU INSTRUMENTS

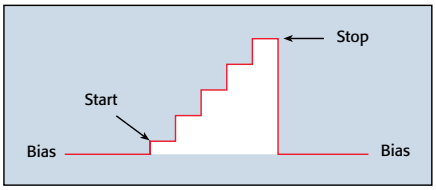
Automation for Speed

A SourceMeter SMU instrument streamlines production testing. It sources voltage or current while making measurements without needing to change connections. It is designed for reliable operation in non-stop production environments. To provide the throughput demanded by production applications, the SourceMeter SMU instrument offers many built-in features that allow it to run complex test sequences without computer control or GPIB communications slowing things down.

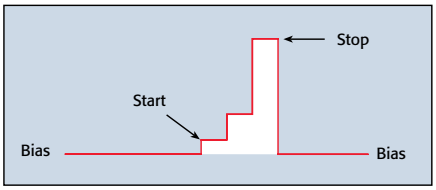
Standard and Custom Sweeps

Sweep solutions greatly accelerate testing with automation hooks. Three basic sweep waveforms are provided that can be programmed for single-event or continuous operation. They are ideal for I/V, I/R, V/I, and V/R characterization.

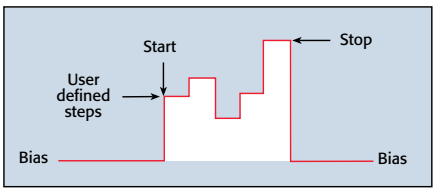
- Linear Staircase Sweep: Moves from the start level to the stop level in equal linear steps
- Logarithmic Staircase Sweep: Done on a log scale with a specified number of steps per decade
- Custom Sweep: Allows construction of special sweeps by specifying the number of measurement points and the source level at each point
- Up to 1700 readings/second at 4½ digits to the GPIB bus
- 5000 readings can be stored in the non-volatile buffer memory



Linear staircase sweep



Logarithmic staircase sweep



Custom sweep

Built-In Test Sequencer (Source Memory List)

The Source Memory list provides faster and easier testing by allowing you to setup and execute up to 100 different tests that run without PC intervention.

- Stores up to 100 instrument configurations, each containing source settings, measurement settings, pass/fail criteria, etc.
- Pass/fail limit test as fast as 500µs per point
- Onboard comparator eliminates the delay caused when sending data to the computer for analysis
- Built-in, user definable math functions to calculate derived parameters

TYPICAL APPLICATIONS

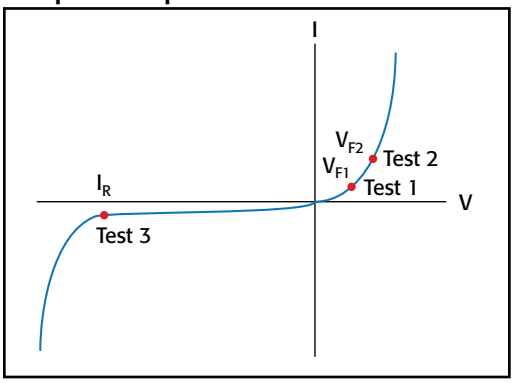
Devices:

- **Discrete semiconductor devices**
- **Passive devices**
- **Transient suppression devices**
- **ICs, RFICs, MMICs**
- **Laser diodes, laser diode modules, LEDs, photodetectors**
- **Circuit protection devices: TVS, MOV, Fuses, etc.**
- **Airbags**
- **Connectors, switches, relays**
- **High brightness LEDs (DC and pulse)**

Tests:

- **Leakage**
- **Low voltage/resistances**
- **LIV**
- **IDDQ**
- **I-V characterization**
- **Isolation and trace resistance**
- **Temperature coefficient**
- **Forward voltage, reverse breakdown, leakage current**
- **DC parametric test**
- **DC power source**
- **HIPOT**
- **Photovoltaic cell efficiency (source and sink)**
- **Dielectric withstanding**

Example Test Sequence



Test	Pass/Fail Test	If Passes Test	If Fails Test
Test 1	Check V_{F1} at 100mA against pass/fail limits	Go to Test 2	1. Bin part to bad bin 2. Transmit data to computer while handler is placing new part 3. Return to Test 1
Test 2	Check V_{F2} at 1A against pass/fail limits	Go to Test 3	
Test 3	Check leakage current at –500V and test against pass/fail limits	1. Bin part to good bin 2. Transmit readings to computer while handler is placing new part 3. Return to Test 1	

Digital I/O Interface

The digital I/O interface can link a SourceMeter SMU instrument to many popular component handlers, including Aetrium, Aeco, and Robotronics. Other capabilities of the interface include:

- Tight systems integration for applications such as binning and sorting
- Built-in component handler interface
- Start of test and end of test signals
- 5V, 300mA power supply
- Optional expander accessory (Model 2499-DIGIO) adds 16 digital I/O lines

The digital I/O interface is available on all Series 2400 SoourceMeter instruments except the Model 2401.

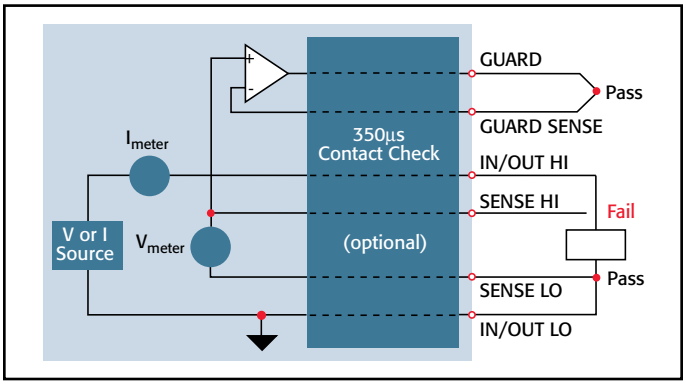
Trigger Link Interface

All SourceMeter SMU instruments include Keithley's unique Trigger Link interface which provides high-speed, seamless communications with many of Keithley's other instruments. For example, use the Trigger Link interface to connect a SourceMeter SMU instrument with a Series 7000 Switching System for a complete multi-point test solution. With Trigger Link, the Series 7000 Switching Systems can be controlled by a SourceMeter SMU instrument during a high-speed test sequence independent of a computer and GPIB.

Optional Contact Check Function

The Contact Check function makes it simple to verify good connections quickly and easily before an automated test sequence begins. This eliminates measurement errors and false product failures associated with contact fatigue, breakage, contamination, loose or broken connection, relay failures, etc. Some capabilities of this function are:

- 350μs verification and notification process time
- The output of the SourceMeter SMU instrument is automatically shut off after a fault and is not re-activated until good contact is verified, protecting the device under test from damage and the operator from potential safety hazards.
- 3 pass/fail threshold values: 2Ω, 15Ω, and 50Ω
- No energy passes through the device under test during the operation.
- Enabled either from the front panel or remotely over the GPIB
- 3 fault notification methods

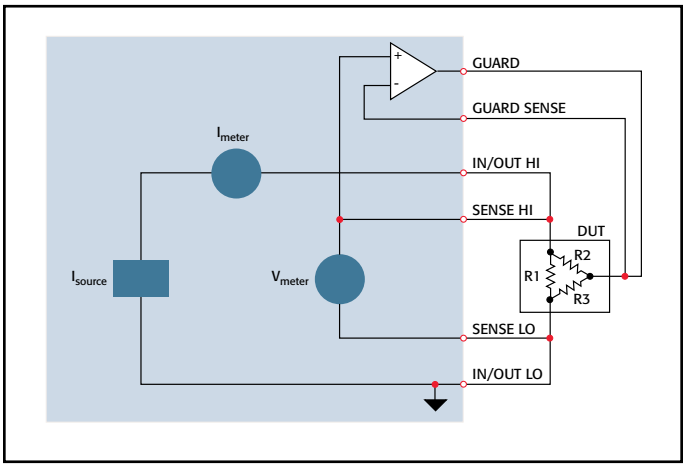


Contact check option for 4-wire or 6-wire applications

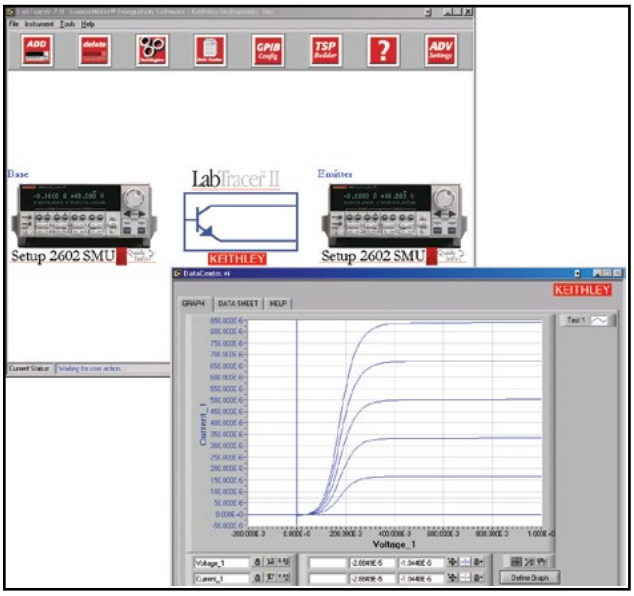
Unique 6-Wire Ohms Technique

SourceMeter SMU instruments can make standard 4-wire, split Kelvin, and 6-wire, guarded ohms measurements and can be configured for either the constant current or constant voltage method. The 6-wire ohms technique:

- Uses guard and guard sense leads in addition to the 4-wire sense and source leads.
- Locks out parallel current paths when measuring resistor networks or hybrid circuits to isolate the component under test.
- Allows users to configure and plot data easily from Series 2400 SourceMeter SMU instruments, making characterization of two, three, and four terminal devices a snap.



6-Wire Ohms Circuit. All test current flows through R1 because the high current guard drives the voltage across R2 to 0V.



Free LabTracer 2.0 device characterization software (downloadable)

Series 2400 SourceMeter® SMU Instruments

Voltage Accuracy (Local or Remote Sense)

Model	Range	Programming Resolution	Source[1] Accuracy (1 Year) 23°C ±5°C ±(% rdg. + volts)	Default Measurement Resolution	Measurement[2, 3, 4] Accuracy (1 Year) 23°C ±5°C ±(% rdg. + volts)	Output Slew Rate (±30%)	Source/Sink Limit
2400, 2400-C, 2401	200.000 mV	5 µV	0.02% + 600 µV	1 µV	0.012% + 300 µV		±21 V @ ±1.05 A ±210 V @ ±105 mA*
	2.00000 V	50 µV	0.02% + 600 µV	10 µV	0.012% + 300 µV		
	20.0000 V	500 µV	0.02% + 2.4 mV	100 µV	0.015% + 1.5 mV	0.08 V/µs	
	200.000 V*	5 mV	0.02% + 24 mV	1 mV	0.015% + 10 mV	0.5 V/µs	
2410, 2410-C	200.000 mV	5 µV	0.02% + 600 µV	1 µV	0.012% + 300 µV		±21 V @ ±1.05 A ±1100 V @ ±21 mA
	2.00000 V	50 µV	0.02% + 600 µV	10 µV	0.012% + 300 µV		
	20.0000 V	500 µV	0.02% + 2.4 mV	100 µV	0.015% + 1 mV	0.15 V/µs	
	1000.00 V	50 mV	0.02% + 100 mV	10 mV	0.015% + 50 mV	0.5 V/µs	
2420, 2420-C	200.000 mV	5 µV	0.02% + 600 µV	1 µV	0.012% + 300 µV		±21 V @ ±3.15 A ±63 V @ ±1.05 A
	2.00000 V	50 µV	0.02% + 600 µV	10 µV	0.012% + 300 µV		
	20.0000 V	500 µV	0.02% + 2.4 mV	100 µV	0.015% + 1 mV	0.08 V/µs	
	60.0000 V	1.5 mV	0.02% + 7.2 mV	1 mV	0.015% + 3 mV	0.14 V/µs	
2425, 2425-C	200.000 mV	5 µV	0.02% + 600 µV	1 µV	0.012% + 300 µV		±21 V @ ±3.15 A ±105 V @ ±1.05 A
	2.00000 V	50 µV	0.02% + 600 µV	10 µV	0.012% + 300 µV		
	20.0000 V	500 µV	0.02% + 2.4 mV	100 µV	0.015% + 1 mV	0.08 V/µs	
	100.0000 V	2.5 mV	0.02% + 12 mV	1 mV	0.015% + 5 mV	0.25 V/µs	
2430, 2430-C	200.000 mV	5 µV	0.02% + 600 µV	1 µV	0.012% + 300 µV		±105 V @ ±1.05 A ±105 V @ ±10.5 A (pulse mode only)
	2.00000 V	50 µV	0.02% + 600 µV	10 µV	0.012% + 300 µV		
	20.0000 V	500 µV	0.02% + 2.4 mV	100 µV	0.015% + 1 mV	0.08 V/µs	
	100.0000 V	2.5 mV	0.02% + 12 mV	1 mV	0.015% + 5 mV	0.25 V/µs	
2440, 2440-C	200.000 mV	5 µV	0.02% + 600 µV	1 µV	0.012% + 300 µV		±10.5 V @ ±5.25 A ±42 V @ ±1.05 A
	2.00000 V	50 µV	0.02% + 600 µV	10 µV	0.012% + 300 µV		
	10.0000 V	500 µV	0.02% + 1.2 mV	100 µV	0.015% + 750 µV	0.08 V/µs	
	40.0000 V	5 mV	0.02% + 4.8 mV	1 mV	0.015% + 3 mV	0.25 V/µs	

***Not available on Model 2401.**

TEMPERATURE COEFFICIENT (0°–18°C and 28°–50°C): ±(0.15 × accuracy specification)/°C.
VOLTAGE REGULATION: Line: 0.01% of range. **Load:** 0.01% of range + 100µV.
OVER VOLTAGE PROTECTION: User selectable values, 5% tolerance. Factory default = none.
CURRENT LIMIT: Bipolar current limit (compliance) set with single value. Min. 0.1% of range.
OVERSHOOT: <0.1% typical (full scale step, resistive load, 10mA range).

ADDITIONAL SOURCE SPECIFICATIONS (All Models)

TRANSIENT RESPONSE TIME: 30µs minimum for the output to recover to its spec. following a step change in load.

COMMAND PROCESSING TIME: Maximum time required for the output to begin to change following the receipt of :SOURce:VOLTage|CURRent <nrf> command. **Autorange On:** 10ms. **Autorange Off:** 7ms.

OUTPUT SETTLING TIME: Time required to reach 0.1% of final value after command is processed. 100µs typical. Resistive load. 10µA to 100mA range.

DC FLOATING VOLTAGE: Output can be floated up to ±250VDC (Model 2440 ±40VDC) from chassis ground.

REMOTE SENSE: Up to 1V drop per load lead.

COMPLIANCE ACCURACY: Add 0.3% of range and ±0.02% of reading to base specification.

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

RANGE CHANGE OVERSHOOT: Overshoot into a fully resistive 100kΩ load, 10Hz to 1MHz BW, adjacent ranges: 100mV typical, except 20V/200V (20V/60V on Model 2420), 20V/100V on Model 2425 and 2430, range boundary, and Model 2440.

MINIMUM COMPLIANCE VALUE: 0.1% of range.

ADDITIONAL PULSE MODE SOURCE SPECIFICATIONS (2430 and 2430-C only)

MAXIMUM DUTY CYCLE: 8%, hardware limited, 10A range only. All other ranges 100%.

MAXIMUM PULSE WIDTH: 5ms from 90% rising to 90% falling edge, 2.5ms 10A range.

MINIMUM PULSE WIDTH: 150µs.

MINIMUM PULSE RESOLUTION: 50µs typical, 70µs max., limited by system jitter.

SOURCE ACCURACY: Determined by settling time and source range specifications.

OUTPUT SETTLING TIME 0.1%:
800µs typ., source I = 10A into 10Ω, limited by voltage slew rate.
500µs typ., source I = 10A into 1Ω, limited by voltage slew rate.

OUTPUT SLEW RATE:
Voltage (10Ω load): 0.25V/µs ±30% on 100V range. 0.08V/µs ±30% on 20V range, 10A range.
Current (0Ω load): 0.25A/µs ±30% on 100V range. 0.08A/µs ±30% on 20V range, 10A range.

NOTES

1. **2400, 2401, 2410 Only:** Specifications valid for continuous output currents below 105mA. For operation above 105mA continuous for >1 minute, derate accuracy 10%/35mA above 105mA.
2. Speed = Normal (1 PLC). For 0.1 PLC, add 0.005% of range to offset specifications, except 200mV, 1A, 10A ranges, add 0.05%. For 0.01 PLC, add 0.05% of range to offset specifications, except 200mV, 1A, 10A ranges, add 0.5%.
3. Accuracies apply to 2- or 4-wire mode when properly zeroed.
4. In pulse mode, limited to 0.1 PLC measurement.

Current Accuracy (Local or Remote Sense)

Model	Range	Programming Resolution	Source [1, 3] Accuracy (1 Year) 23°C ±5°C ±(% rdg. + amps)	Default Measurement Resolution	Measurement [5, 6, 7] Accuracy (1 Year) 23°C ±5°C ±(% rdg. + amps)	Source/Sink Limit
2400, 2400-C, 2401	1.00000 µA	50 pA	0.035% + 600 pA	10 pA	0.029% + 300 pA	±1.05A @ ±21 V ±105 mA @ ±210 V[8]
	10.0000 µA	500 pA	0.033% + 2 nA	100 pA	0.027% + 700 pA	
	100.000 µA	5 nA	0.031% + 20 nA	1 nA	0.025% + 6 nA	
	1.00000 mA	50 nA	0.034% + 200 nA	10 nA	0.027% + 60 nA	
	10.0000 mA	500 nA	0.045% + 2 µA	100 nA	0.035% + 600 nA	
	100.000 mA	5 µA	0.066% + 20 µA	1 µA	0.055% + 6 µA	
	1.00000 A[2]	50 µA	0.27 % + 900 µA	10 µA	0.22 % + 570 µA	
2410, 2410-C	1.00000 µA	50 pA	0.035% + 600 pA	10 pA	0.029% + 300 pA	±1.05A @ ±21 V ±21 mA @ ±1100 V
	10.0000 µA	500 pA	0.033% + 2 nA	100 pA	0.027% + 700 pA	
	100.000 µA	5 nA	0.031% + 20 nA	1 nA	0.025% + 6 nA	
	1.00000 mA	50 nA	0.034% + 200 nA	10 nA	0.027% + 60 nA	
	20.0000 mA	500 nA	0.045% + 4 µA	100 nA	0.035% + 1.2 µA	
	100.000 mA	5 µA	0.066% + 20 µA	1 µA	0.055% + 6 µA	
	1.00000 A[2]	50 µA	0.27 % + 900 µA	10 µA	0.22 % + 570 µA	
2420, 2420-C	10.0000 µA	500 pA	0.033% + 2 nA	100 pA	0.027% + 700 pA	±3.15A @ ±21 V ±1.05 A @ ±63 V
	100.000 µA	5 nA	0.031% + 20 nA	1 nA	0.025% + 6 nA	
	1.00000 mA	50 nA	0.034% + 200 nA	10 nA	0.027% + 60 nA	
	10.0000 mA	500 nA	0.045% + 2 µA	100 nA	0.035% + 600 nA	
	100.000 mA	5 µA	0.066% + 20 µA	1 µA	0.055% + 6 µA	
	1.00000 A[2]	50 µA	0.067% + 900 µA	10 µA	0.066% + 570 µA	
	3.00000 A[2]	50 µA	0.059% + 2.7 mA	10 µA	0.052% + 1.71 mA	
2425, 2425-C	10.0000 µA	500 pA	0.033% + 2 nA	100 pA	0.027% + 700 pA	±3.15A @ ±21 V ±1.05 A @ ±105 V
	100.000 µA	5 nA	0.031% + 20 nA	1 nA	0.025% + 6 nA	
	1.00000 mA	50 nA	0.034% + 200 nA	10 nA	0.027% + 60 nA	
	10.0000 mA	500 nA	0.045% + 2 µA	100 nA	0.035% + 600 nA	
	100.000 mA	5 µA	0.066% + 20 µA	1 µA	0.055% + 6 µA	
	1.00000 A[2]	50 µA	0.067% + 900 µA	10 µA	0.060% + 570 µA	
	3.00000 A[2]	50 µA	0.059% + 2.8 mA	10 µA	0.052% + 1.71 mA	
2430, 2430-C	10.0000 µA	500 pA	0.033% + 2 nA	100 pA	0.027% + 700 pA	±1.05A @ ±105 V ±10.5 A @ ±105 V (pulse mode only)
	100.000 µA	5 nA	0.031% + 20 nA	1 nA	0.025% + 6 nA	
	1.00000 mA	50 nA	0.034% + 200 nA	10 nA	0.027% + 60 nA	
	10.0000 mA	500 nA	0.045% + 2 µA	100 nA	0.035% + 600 nA	
	100.000 mA	5 µA	0.066% + 20 µA	1 µA	0.055% + 6 µA	
	1.00000 A	50 µA	0.067% + 900 µA	10 µA	0.060% + 570 µA	
	3.00000 A[2]	500 µA	0.059% + 2.8 mA	10 µA	0.052% + 1.71 mA	
	10.00000 A[4]	500 µA	0.089% + 5.9 mA	10 µA	0.082% + 1.71 mA	
2440, 2440-C	10.0000 µA	500 pA	0.033% + 2 nA	100 pA	0.027% + 700 pA	±5.25A @ ±10.5 V ±1.05 A @ ±42 V
	100.000 µA	5 nA	0.031% + 20 nA	1 nA	0.025% + 6 nA	
	1.00000 mA	50 nA	0.034% + 200 nA	10 nA	0.027% + 60 nA	
	10.0000 mA	500 nA	0.045% + 2 µA	100 nA	0.035% + 600 nA	
	100.000 mA	5 µA	0.066% + 20 µA	1 µA	0.055% + 6 µA	
	1.00000 A	50 µA	0.067% + 900 µA	10 µA	0.060% + 570 µA	
	5.00000 A	50 µA	0.10 % + 5.4 mA	10 µA	0.10 % + 3.42 mA	

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

CURRENT REGULATION: Line: 0.01% of range. **Load:** 0.01% of range (except Model 2440 5A range 0.05%) + 100pA.

VOLTAGE LIMIT: Bipolar voltage limit (compliance) set with single value. Min. 0.1% of range.

OVERSHOOT: <0.1% typical (1mA step, RL = 10kΩ, 20V range for Model 2400, 2401, 2410, 2420, 2425, 2430), (10V range for Model 2440).

CONTACT CHECK SPECIFICATIONS (requires -C version)

(Not available for Model 2401)

SPEED: 350µs for verification and notification.

CONTACT CHECK:	2 Ω	15 Ω	50 Ω
No contact check failure	<1.00 Ω	<13.5 Ω	<47.5 Ω
Always contact check failure	>3.00 Ω	>16.5 Ω	>52.5 Ω

NOTES

1. **2400, 2401, 2410 Only:** Specifications valid for continuous output currents below 105mA. For operation above 105mA continuous for >1 minute, derate accuracy 10%/35mA above 105mA.
2. Full operation (1A) regardless of load to 30°C (50°C for Model 2420 and 2440). Above 30°C (50°C for Model 2420 and 2440) ambient, derate 35mA/°C and prorate 35mA/Ω load. 4-wire mode. For current sink operation on 1A, 3A, or 5A ranges, maximum continuous power is limited to approximately 1/2 rated power or less, depending on current, up to 30°C ambient. See power equations in the User's Manual to calculate allowable duty cycle for specific conditions.
3. For sink mode, 1µA to 100mA range, accuracy is:
   Model 2400, 2401: ±(0.15% + offset*4). **Models 2410, 2420, 2425, 2430, 2440:** ±(0.5% + offset*3).
   For 1A range, accuracy is:
   Model 2400, 2401: ±(1.5% + offset*8). **Models 2410, 2420, 2425, 2430, 2440:** ±(1.5% + offset*3).
4. 10A range only in pulse mode. Limited to 2.5ms pulse width maximum. 10% duty cycle maximum.
5. Speed = Normal (1 PLC). For 0.1 PLC, add 0.005% of range to offset specifications, except 200mV, 1A, 10A ranges, add 0.05%. For 0.01 PLC, add 0.05% of range to offset specifications, except 200mV, 1A, 10A ranges, add 0.5%.
6. Accuracies apply to 2- or 4-wire mode when properly zeroed.
7. In pulse mode, limited to 0.1 PLC measurement.
8. Model 2400 and 2400-C only.

Resistance Measurement Accuracy (Local or Remote Sense)[1, 2, 5]

Range	Default Resolution	Default Test Current 2400, 2401, 2410	Default Test Current 2420, 2425, 2430, 2440	Normal Accuracy (23°C ±5°C) 1 Year, ±(% rdg. + ohms) 2400, 2401	2410	2420, 2425, 2430, 2440	Enhanced Accuracy (23°C ±5°C)[4] 1 Year, ±(% rdg. + ohms) 2400, 2401
<0.20000 Ω[3]	–	–	–	Source I_{ACC} + Meas. V_{ACC}	Source I_{ACC} + Meas. V_{ACC}	Source I_{ACC} + Meas. V_{ACC}	Source I_{ACC} + Meas. V_{ACC}
2.00000 Ω[3]	10 μΩ	–	1 A	Source I_{ACC} + Meas V_{ACC}	Source I_{ACC} + Meas. V_{ACC}	0.17% + 0.0003 Ω	Source I_{ACC} + Meas. V_{ACC}
20.0000 Ω	100 μΩ	100 mA	100 mA	0.10% + 0.003 Ω	0.11% + 0.006 Ω	0.10% + 0.003 Ω	0.07% + 0.001 Ω
200.000 Ω	1 mΩ	10 mA	10 mA	0.08% + 0.03 Ω	0.09% + 0.1 Ω	0.08% + 0.03 Ω	0.05% + 0.01 Ω
2.00000 kΩ	10 mΩ	1 mA	1 mA	0.07% + 0.3 Ω	0.08% + 0.6 Ω	0.07% + 0.3 Ω	0.05% + 0.1 Ω
20.0000 kΩ	100 mΩ	100 μA	100 μA	0.06% + 3 Ω	0.07% + 6 Ω	0.06% + 3 Ω	0.04% + 1 Ω
200.000 kΩ	1 Ω	10 μA	10 μA	0.07% + 30 Ω	0.07% + 60 Ω	0.07% + 30 Ω	0.05% + 10 Ω
2.00000 MΩ[6]	10 Ω	1 μA	1 μA	0.11% + 300 Ω	0.12% + 600 Ω	0.11% + 300 Ω	0.05% + 100 Ω
20.0000 MΩ[7]	100 Ω	1 μA	1 μA	0.11% + 1 kΩ	0.12% + 2.4 kΩ	0.11% + 1 kΩ	0.05% + 500 Ω
200.000 MΩ[3]	1 kΩ	100 nA	–	0.66% + 10 kΩ	0.66% + 24 kΩ	Source I_{ACC} + Meas. V_{ACC}	0.35% + 5 kΩ
>200.000 MΩ[3]	–	–	–	Source I_{ACC} + Meas. V_{ACC}	Source I_{ACC} + Meas. V_{ACC}	Source I_{ACC} + Meas. V_{ACC}	Source I_{ACC} + Meas. V_{ACC}

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

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

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

6-WIRE OHMS MODE: Available using active ohms guard and guard sense. Max. Guard Output Current: 50mA (except 1A range). Accuracy is load dependent. Refer to White Paper no. 2033 for calculation formula.

GUARD OUTPUT IMPEDANCE: <0.1Ω in ohms mode.

NOTES

1. Speed = Normal (1 PLC). For 0.1 PLC, add 0.005% of range to offset specifications, except 200mV, 1A, 10A ranges, add 0.05%. For 0.01 PLC, add 0.05% of range to offset specifications, except 200mV, 1A, 10A ranges, add 0.5%.
2. Accuracies apply to 2- or 4-wire mode when properly zeroed.
3. Manual ohms only – except 2420, 2425, 2430, 2440 for 2Ω range and 2400, 2401, or 2410 for 200MΩ range.
4. Source readback enabled, offset compensation ON. Also available on 2410, 2420, 2425, 2430, and 2440 with similar accuracy enhancement.
5. In pulse mode, limited to 0.1 PLC measurement.
6. Except 2440; default test current is 5μA.
7. Except 2440; default test current is 0.5μA.

SERVICES AVAILABLE

2400-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2400-C-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2401-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2410-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2410-C-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2420-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2420-C-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2425-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2425-C-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2430-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2430-C-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2440-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2440-C-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
C/2400-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2400, 2400-C, 2400-LV*
C/2401-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Model 2401*
C/2410-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2410, 2410-C*
C/2420-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2420, 2420-C*
C/2425-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2425, 2425-C*
C/2430-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2430, 2430-C*
C/2440-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2440, 2440-C*
TRN-2400-1-C	Course: Unleashing the Power of Your SourceMeter SMU Instrument

*Not available in all countries

System Speeds

MEASUREMENT[1]

MAXIMUM RANGE CHANGE RATE: 75/second.

MAXIMUM MEASURE AUTORANGE TIME: 40ms (fixed source).[2]

Sweep Operation[3] Reading Rates (rdg./second) for 60Hz (50Hz):

Speed	NPLC/Trigger Origin	Measure To Mem.	Measure To GPIB	Source-Measure To Mem.	Source-Measure To GPIB	Source-Measure Pass/Fail Test[4, 5] To Mem.	Source-Measure Pass/Fail Test[4, 5] To GPIB	Source-Memory[4] To Mem.	Source-Memory[4] To GPIB
Fast	0.01 / internal	2081 (2030)	1754	1551 (1515)	1369	902 (900)	981	165 (162)	165
IEEE-488.1 Mode	0.01 / external	1239 (1200)	1254	1018 (990)	1035	830 (830)	886	163 (160)	163
Fast	0.01 / internal	2081 (2030)	1198 (1210)	1551 (1515)	1000 (900)	902 (900)	809 (840)	165 (162)	164 (162)
IEEE-488.2 Mode	0.01 / external	1239 (1200)	1079 (1050)	1018 (990)	916 (835)	830 (830)	756 (780)	163 (160)	162 (160)
Medium	0.10 / internal	510 (433)	509 (433)	470 (405)	470 (410)	389 (343)	388 (343)	133 (126)	132 (126)
IEEE-488.2 Mode	0.10 / external	438 (380)	438 (380)	409 (360)	409 (365)	374 (333)	374 (333)	131 (125)	131 (125)
Normal	1.00 / internal	59 (49)	59 (49)	58 (48)	58 (48)	56 (47)	56 (47)	44 (38)	44 (38)
IEEE-488.2 Mode	1.00 / external	57 (48)	57 (48)	57 (48)	57 (47)	56 (47)	56 (47)	44 (38)	44 (38)

Single Reading Operation Reading Rates (rdg./second) for 60Hz (50Hz):

Speed	NPLC/Trigger Origin	Measure To GPIB	Source-Measure[5] To GPIB	Source-Measure Pass/Fail Test[4,5] To GPIB
Fast (488.1)	0.01 / internal	537	140	135
Fast (488.2)	0.01 / internal	256 (256)	79 (83)	79 (83)
Medium (488.2)	0.10 / internal	167 (166)	72 (70)	69 (70)
Normal (488.2)	1.00 / internal	49 (42)	34 (31)	35 (30)

Component for 60Hz (50Hz):[4, 6]

Speed	NPLC/Trigger Origin	Measure To GPIB	Source Pass/Fail Test	Source-Measure Pass/Fail Test[5, 7] To GPIB
Fast	0.01 / external	1.04 ms (1.08 ms)	0.5 ms (0.5 ms)	4.82 ms (5.3 ms)
Medium	0.10 / external	2.55 ms (2.9 ms)	0.5 ms (0.5 ms)	6.27 ms (7.1 ms)
Normal	1.00 / external	17.53 ms (20.9 ms)	0.5 ms (0.5 ms)	21.31 ms (25.0 ms)

NOTES

[1] Reading rates applicable for voltage or current measurements. Auto zero off, autorange off, filter off, display off, trigger delay = 0, and binary reading format.

[2] Purely resistive lead. 1μA and 10μA ranges <65ms.

[3] 1000 point sweep was characterized with the source on a fixed range.

[4] Pass/Fail test performed using one high limit and one low math limit.

[5] Includes time to re-program source to a new level before making measurement.

[6] Time from falling edge of START OF TEST signal to falling edge of END OF TEST signal.

[7] Command processing time of :SOURce:VOLTage|CURRent:TRIGgered <nrf> command not included.

GENERAL

Noise Rejection:

	NPLC	NMRR	CMRR
Fast	0.01	—	80 dB
Medium	0.1	—	80 dB
Slow	1	60 dB	100 dB[1]

[1] Except lowest 2 current ranges = 90dB.

LOAD IMPEDANCE: Stable into 20,000pF typical.

COMMON MODE VOLTAGE: 250V DC (40V DC for Model 2440).

COMMON MODE ISOLATION: >10^9Ω, <1000pF.

OVERRANGE: 105% of range, source and measure.

MAX. VOLTAGE DROP BETWEEN INPUT/OUTPUT AND SENSE TERMINALS: 5V.

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

SENSE INPUT IMPEDANCE: >10^{10}Ω.

GUARD OFFSET VOLTAGE: <150μV, typical (300μV for Models 2430, 2440).

SOURCE OUTPUT MODES:
Pulse (Model 2430 only)
Fixed DC level
Memory List (mixed function)
Stair (linear and log)

MEMORY BUFFER: 5,000 readings @ 5 digits (two 2,500 point buffers). Includes selected measured value(s) and time stamp. Lithium battery backup (3 yr+ battery life).

SOURCE MEMORY LIST: 100 points max.

PROGRAMMABILITY: IEEE-488 (SCPI-1995.0), RS-232, 5 user-definable power-up states plus factory default and *RST.

DIGITAL INTERFACE:
Interlock: Active low input.
Handler Interface: Start of test, end of test, 3 category bits. +5V@ 300mA supply. Not available on Model 2401.
Digital I/O: 1 trigger input, 4 TTL/Relay Drive outputs (33V @ 500mA, diode clamped). Not available on Model 2401.

POWER SUPPLY: 100V to 240V rms, 50–60Hz (automatically detected at power up). **Model 2400, 2401:** 190VA. **Model 2410:** 210VA. **Model 2420:** 220VA. **Model 2425, 2430:** 250VA. **Model 2440:** 240VA.

COOLING: Model 2401: Convection. **Model 2410, 2420, 2425, 2430, 2440:** Forced air, variable speed.

EMC: Conforms to European Union Directive 89/336/EEC, EN 61326-1.

SAFETY: UL listed to UL 61010B-1:2003: Conforms to European Union Low Voltage Directive.

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

WARM-UP: 1 hour to rated accuracies.

DIMENSIONS: 89mm high × 213mm wide × 370mm deep (3½ in × 8⅜ in × 14⅝ in). **Bench Configuration (with handle and feet):**104mm high × 238mm wide × 370mm deep (4⅛ in × 9⅜ in × 14⅝ in).

WEIGHT: 3.21kg (7.08 lbs) (Model 2425, 2430, 2440: 4.1kg, 9.0 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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2410-C 2430-C 2400 2420-C 2401 2440-C 2440 2430 2425-C 2400-C 2425 2410 2420