

**FROM DESIGN TO DELIVERY**  
Semiconductor test solutions

**KEITHLEY**

A GREATER MEASURE OF CONFIDENCE



**FROM THE LAB TO THE FAB,**



**MATERIALS RESEARCH**



**DEVICE CHARACTERIZATION**



**RELIABILITY TESTING**

# Keithley helps you test faster, more efficiently, and with greater confidence.

From materials research to production test and monitoring, Keithley is the leader in semiconductor test solutions you can trust. In the development lab, Keithley semiconductor characterization systems provide unmatched sensitivity and flexibility for investigating material properties, describing device attributes, and qualifying new designs. Keithley is also at the leading edge of automated parametric test technology for production process monitoring, and has pioneered many innovations that shorten test cycles and lower the cost of test.

- **Applications insight**

We create flexible solutions that address tomorrow's application requirements as well as today's.

- **Long-term customer relationships**

Our success depends on helping our customers do their jobs better, so they can become heroes within their own organizations.

- **Global sales and support**

Keithley has built a worldwide network of more than 100 sales and service offices to support customers who have global manufacturing facilities.

- **Test and measurement expertise**

Keithley instrumentation is backed by more than 55 years of institutional knowledge of precision and low-level measurements. Our applications and design engineering staffs include some of the most knowledgeable and experienced people in the industry.

- **Superior measurement integrity**

Our measurement instrumentation is so accurate that national metrology labs around the world use our equipment to calibrate their own systems.

- **Flexible, modular architecture**

Flexible architecture makes it easy and inexpensive to add new functions to adapt to new testing requirements.

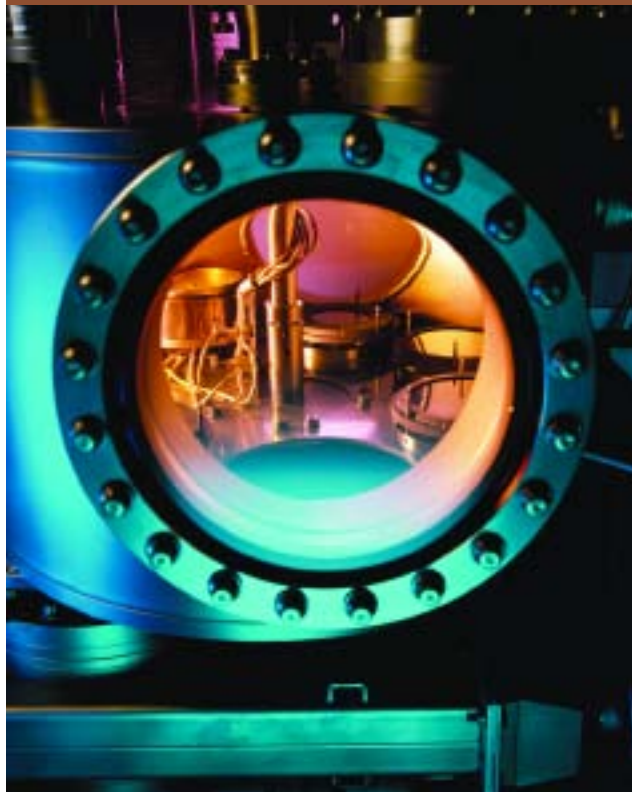


PROCESS MONITORING



FUNCTIONAL TEST

# MATERIALS research



Helping researchers measure ultra-low levels of DC voltage, current, and resistance with unmatched sensitivity and accuracy

Innovative instruments and systems from Keithley are helping researchers commercialize technologies like high  $\kappa$  gate materials, copper traces, low  $\kappa$  insulation, III-V compounds, and carbon nanotubes. Modular design allows greater integration flexibility and simplifies expanding and repurposing systems to address new test needs cost-effectively.



## Model 4200-SCS Semiconductor Characterization System

- Fully integrated characterization system provides turnkey productivity
- Sub-femtoamp measurement resolution allows characterizing both standard and exotic devices
- Windows<sup>®</sup> interface reduces system training requirements



## Model 6517A Electrometer

- Wide measurement ranges enhance test flexibility
- High input impedance supports the lowest possible circuit loading
- Built-in, time-stamped temperature and humidity measurements allow evaluating environmental influences on test results
- NIST-traceable calibration ensures greater measurement confidence



| Material                                     | Application Needs   | Keithley's Solution  |
|--|---|--|
| <b>Conductor/<br/>interconnect materials</b> | Low resistance and capacitance measurements   | <b>Model 2182 Nanovoltmeter</b><br><b>Model 2010 DMM</b><br><b>Model 2750 Multimeter/<br/>Switch System</b><br><b>Model 4200-SCS</b><br><b>Series 2400/6430 SourceMeter</b><br><b>Model 590 C-V Analyzer/<br/>Model 3330 LCZ Meter</b> |
|  | Low current measurements  | <b>Model 6485 Picoammeter</b><br><b>Model 4200-SCS</b><br><b>Model 6430 Sub-Femtoamp<br/>Remote SourceMeter</b>  |
| <b>Superconductors</b>                       | Fast, low noise measurements of low voltages  | <b>Model 2182 Nanovoltmeter</b><br><b>Model 1801 Preamp</b><br><b>Series 2000 DMMs</b><br><b>Model 2510 TEC SourceMeter</b>  |
|  | Fast, low noise measurements of low resistances   |  |
| <b>Insulators/dielectrics</b>                | High resistance measurements  | <b>Model 6517A Electrometer</b><br><b>Model 6430 Sub-Femtoamp<br/>Remote SourceMeter</b><br><b>Model 6485 Picoammeter</b>  |
| <b>Semiconductors</b>                        | Stress test for reliability<br>Capacitance (charge storage)<br>Resistivity measurements | <b>Model 4200-SCS</b><br><b>Model 6430 Sub-Femtoamp<br/>Remote SourceMeter</b><br><b>Model 590 C-V Analyzer</b><br><b>707A/7174A Switch System</b><br><b>Series 2000 DMMs</b><br><b>System 82 WIN C-V</b>                              |



### Model 2182 Nanovoltmeter

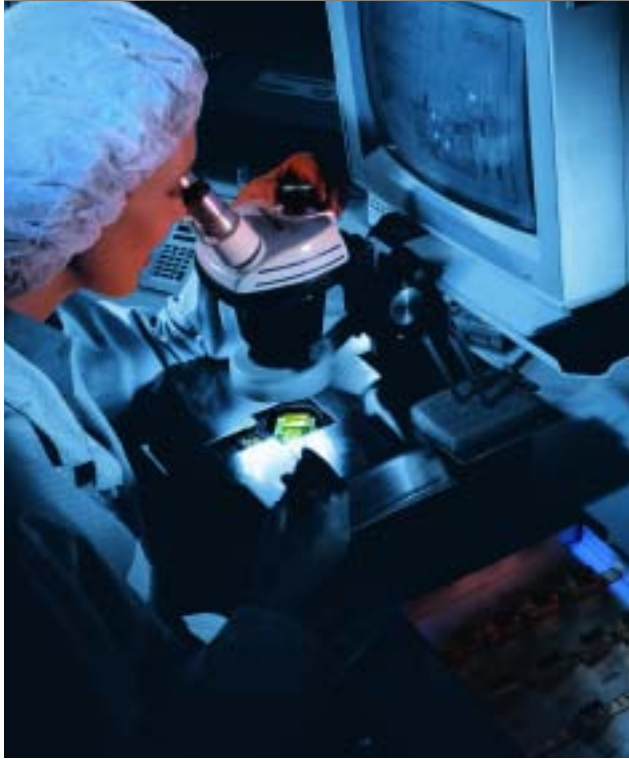
- Low-level resistance and voltage sensitivity for measuring advanced materials
- Can be used with Model 2400 for delta mode measurements to cancel thermal offsets and drift
- 6½-digit precision
- Low noise performance at high speeds
- Built-in thermocouple linearization and cold reference junction



### SourceMeter® Instruments

- Tightly coupled source/measure engine minimizes test station development, set-up, and maintenance time
- Complete, single-channel DC parametric testers
- Choice of ranges and measurement functions: Model 2400 (general-purpose), Model 2410 (high voltage), Model 2420 (3A), Model 2425 (100W), Model 2430 (pulse mode), Model 2440 (5A), Model 6430 (sub-femtoamp resolution)
- Widely used as laser drivers in LIV testing.

# DEVICE characterization solutions



Superior precision and accuracy with exceptional speed and ease of use

Semiconductor manufacturers rely on Keithley instruments and systems to help them get to market faster, hit targeted yields quicker, and achieve the highest device reliability in the shortest possible time. Systems are designed specifically for critical tests that semiconductor fabs and researchers need most.



## Model 4200-SCS Semiconductor Characterization System

- Fully integrated characterization system provides turnkey productivity
- Windows interface reduces system training requirements
- Project Navigator organizes tests and automates test sequencing, eliminating the need to write code
- Sub-femtoamp measurement resolution allows characterizing both standard and exotic devices



## SourceMeter® Instruments

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| Device Under Test             | Application Needs   |   |
|-------------------------------|---|---|
| <b>Transistors</b>            | I-V, C-V measurements   | <b>Model 4200-SCS</b><br><b>Model 590 C-V Analyzer</b><br><b>Series 2400 SourceMeter Instruments</b>  |
| <b>Device Modeling</b>        | Data acquisition and parameter extraction   | <b>Model 4200-SCS</b><br><b>Model 590 C-V Analyzer</b>  |
| <b>Capacitors</b>             | Capacitance, charge, low current, breakdown voltage   | <b>Model 4200-SCS</b><br><b>Model 2410 SourceMeter</b><br><b>Model 590 C-V Analyzer</b><br><b>Model 6517A Electrometer</b>  |
| <b>Nanoelectronic Devices</b> | C-V characterization<br>Low resistance measurements<br>Nanoelectronic and molecular electronic I-V curves | <b>Model 4200-SCS</b><br><b>Model 6517A Electrometer</b><br><b>Model 2182 Nanovoltmeter</b><br><b>Model 590 C-V Analyzer</b><br><b>Model 6430 Sub-Femtoamp Remote SourceMeter</b> |
| <b>Diodes</b>                 | High breakdown voltage, I-V curves  | <b>Model 4200-SCS</b><br><b>Model 2400/2410 SourceMeter</b>   |
| <b>Resistors</b>              | Wide dynamic range, high testing accuracy, fast measurements  | <b>Model 4200-SCS</b><br><b>Series 2400 SourceMeter Instruments</b><br><b>Model 6517A Electrometer</b><br><b>Series 2000 DMMs</b>   |



### Series 2000 Digital Multimeters

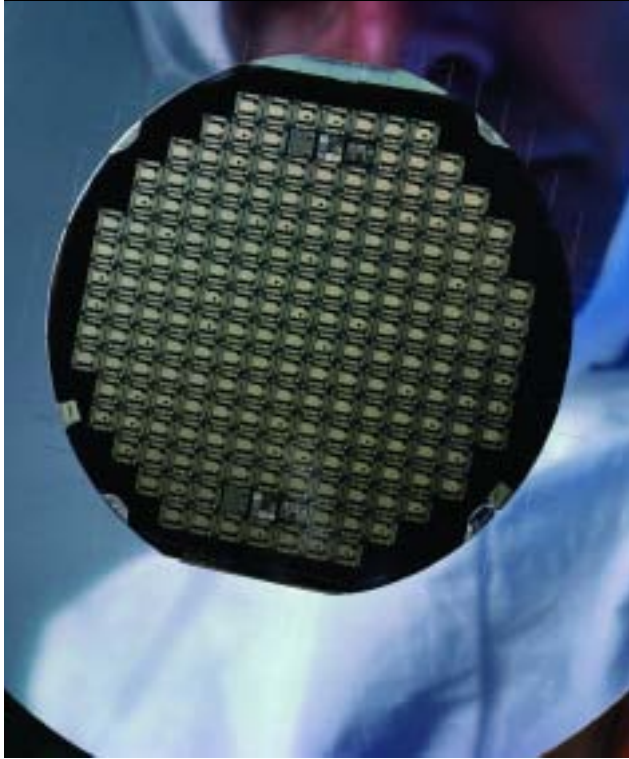
- Wide dynamic range and high measurement accuracy to characterize low resistance devices and nanoelectronic components
- Built-in measurement functions, such as  $2W\Omega$ ,  $4W\Omega$ , continuity and diode testing, speed and simplify basic device characterization
- The low power ohms measurement mode and dry circuit test function in the Model 2010 prevent self-heating damage to nanoelectronics and other fragile devices

### System 82-WIN C-V and Model 590 C-V Analyzer

- System 82 provides quasistatic and high frequency C-V measurements in a single voltage sweep, improving measurement accuracy
- Accurate C-V and C-t data for determining important device characteristics like threshold voltage, oxide characteristics, mobile ion density, interface trap density, and minority carrier lifetime

**Request a copy of our full-line test and measurement catalog  
at [www.keithley.com/catalog](http://www.keithley.com/catalog).**

# RELIABILITY test solutions



## Exceptional throughput with superior measurement integrity

Keithley supplies integrated solutions for reliability testing that help manufacturers control yields, reduce field failures, and increase customer satisfaction. From wafer level devices to packaged parts testing, these systems come with superior measurement algorithms for exceptional throughput.



### Integra Series DMM/Acquisition/Switch Systems

- Combined DMM, switch, and datalogger for easy sourcing, monitoring, and measuring
- Model 2701's Ethernet connectivity makes networking and data transfer simple



### Integra Series Modules

- Plug-in modules for a variety of reliability test solutions including:
  - Wide bandwidth (3.5GHz)
  - High speed switching (0.5ms solid state relay switching speed)
  - High voltage (300V)
  - High current (2A)



| Test  | Application Needs  | Keithley's Solution   |
|---|--|---|
| <b>Accelerated Stress Testing (AST)</b>             | Source power, monitor temperature, measure multiple DUTs               | <b>Model 2400 SourceMeter<br/>Integra Series Systems</b>  |
| <b>Wafer level hot carrier degradation</b>          | Stress multiple transistors in parallel and measure small degradations | <b>Model 4200-SCS<br/>Model 4200HCI-4.3 Advanced HCI Application Package</b>  |
| <b>Quality Assurance Testing (QAT)</b>              | Modular building blocks for custom-built solutions and drivers         | <b>Model 2400 SourceMeter<br/>Model 6430 Sub-Femtoamp Remote SourceMeter<br/>Integra Series Systems<br/>Series 700 Switch Systems<br/>Series 2000 DMMs<br/>LabVIEW VI Drivers,<br/>VISA Drivers</b> |
| <b>Monitor and log lab environmental parameters</b> | Temperature and humidity measurement, distributed/remote communication | <b>Integra Series Systems</b>   |



**Model 6430** Sub-Femtoamp Remote SourceMeter

- Lowest current sensitivity in its class for earliest detection of degradation
- Tightly coupled source/measure engine for ease of test development and setup



**Model 4200-SCS** Semiconductor Characterization System

- Flexible architecture for a variety of reliability test types
- Model 4200 HCI-4.3 Advanced HCI application package for turnkey standard HCI testing
- Intuitive interface for easy operation and increased productivity

**Contact an applications engineer to determine the most cost-effective solution at 1-888-KEITHLEY (534-8453).**

# PROCESS monitoring solutions



## Control parametric test costs more efficiently

Keithley helps fabs control their parametric test costs without compromising throughput or accuracy. A variety of system features make this possible, including ultra-low leakage signal paths, parallel (single insertion) DC and RF measurements, adaptive testing with flexible sampling, and Recipe Manager software that speeds generation of valid test plans.



### S630 DC/RF Parametric Test System

- Stable fA and fF measurements for process control of wireless mobile ICs
- Single-insertion RF s-parameter measurements to 40GHz
- Superior measurements of sub-12Å gate dielectrics
- SEMI-compliant, single-wire, 300mm SECS/GEM automation



### S400 DC/RF Parametric Test System

- Lowest cost per pin for sub-pA measurements
- High voltage option for process control of power ICs
- Automated process diagnostics via site-level, real-time AdapTest
- Same flexible Keithley Test Environment and test execution engine as the S630

| Process                             | Application Needs  | Keithley's Solution  |
|-------------------------------------|--|--|
| <b>New technologies</b>             | RF/DC, SOC, FeRAMs, MRAMs, LCD-TEGs                              | <b>S400/S630 Parametric Test Systems<br/>Model 4200-SCS</b>                            |
| <b>Gate/poly</b>                    | MOSCAP GOI, ECD, $V_t$   | <b>Model 4200-SCS<br/>S400/S630 Parametric Test Systems<br/>Model 2400 SourceMeter</b> |
| <b>Metal-2</b>                      | Contact check, electromigration, EWR                             | <b>S400/S630 Parametric Test Systems<br/>Model 4200-SCS</b>                            |
| <b>Equipment qualification</b>      | Defect density   | <b>S400/S630 Parametric Test Systems</b>   |
| <b>End-of-line wafer acceptance</b> | Transistors ( $V_t$ ), diodes, capacitors, resistors, gate delay | <b>S400/S630 Parametric Test Systems<br/>Model 4200-SCS</b>                            |



### **Model 4200-SCS** Semiconductor Characterization System

- Fully integrated characterization system provides turnkey productivity
- Sub-femtoamp measurement resolution to measure ultra-low-level phenomena
- Flexible and configurable to grow with expanding test needs
- Easy control of external instruments to extend test capabilities
- Powerful on-board or post-test data analysis to streamline monitoring



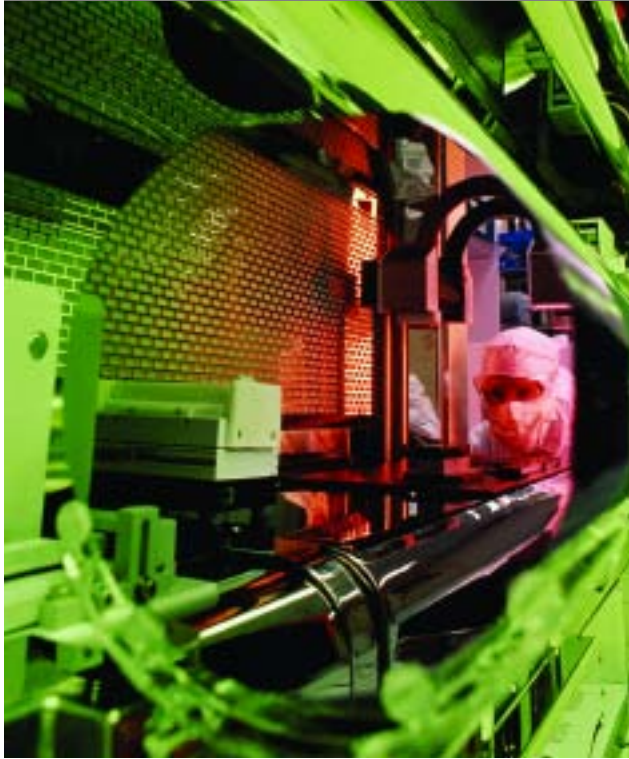
### **Series 2400 SourceMeter®** Instruments

- Tightly coupled source/measure engine minimizes test station development, setup, and maintenance time
- Complete, single-channel DC parametric testers
- Built-in comparator for fast pass/fail testing
- Fast measurement speed for high throughput
- Built-in test sequencer reduces communications overhead

**Call 1-888-KEITHLEY (534-8453) to request a FREE consultation before purchasing your next system.**



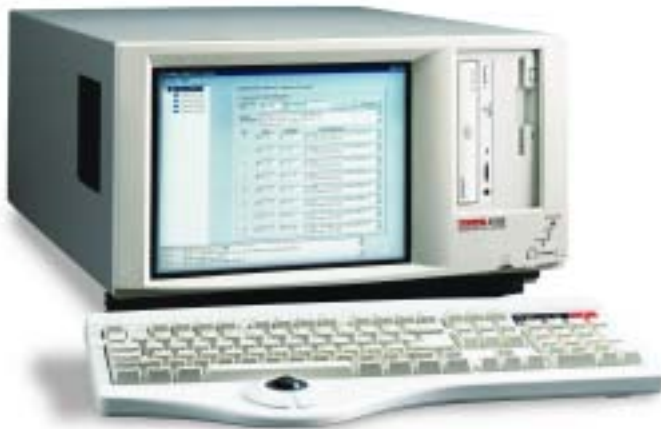
# FUNCTIONAL test solutions



## Flexible, low cost components for custom functional test

Economical, high speed functional testing is available from Keithley, even for low volume applications. Highly repeatable pass/fail testing of packaged devices, like RFICs, optical ICs, and other short-run or specialty components helps reduce manufacturers' total Cost of Test.

Expertise in system integration allows Keithley to incorporate parts handling and high speed switching for a variety of applications



### Model 4500-MTS Modular Test System

- Test multiple devices in parallel with up to 36 individually programmable source/measure channels. Tight channel coordination and on-card embedded controllers simplify executing multiple operations.
- Reduce system complexity. An integral PC and a PCI bus simplify operation and allow combining Series 4500 cards with standard PCI cards.
- Measure from 1nA to 1A or 10 $\mu$ V to 6V on a single channel. Four-wire measurements and 5 $\frac{1}{2}$ -digit resolution ensure high measurement integrity.



### Model 2800 RF Power Analyzer

- Simplified, low cost RFIC power amplifier testing
- Pre-set cellular measurement bands
- Simultaneous measurements of channel power and adjacent/alternate channel bandwidth power
- 6ms channel power measurements

| Process  | Application Needs                                       | Keithley's Solution  |
|--|---|--|
| <b>I<sub>DDQ</sub> (SOC and other highly integrated devices)</b> | Source V, measure low I                                 | <b>Model 2400, 2420 SourceMeter Series 7000 Switch Mainframes Series 7000 Switch Cards Model 4500-MTS</b>  |
| <b>Optical ICs and transceivers</b>                              | Source V, measure I; Source I, measure V                | <b>Model 2425 100W SourceMeter Model 2520 Pulsed Laser Diode Test System Series 7000 Switch Mainframes Series 7000 Switch Cards Model 4500-MTS</b>                 |
| <b>Customized flexible low volume functional test</b>            | Test sequence list, fast pass/fail, binning/sorting, RF | <b>Series 2400 SourceMeter Instruments Model 707A/708A Switch Mainframes Series 7000 Switch Cards System 40 RF/Microwave Signal Routing Systems Model 4500-MTS</b> |
| <b>Specialized testing</b>                                       | Multi-channel I-V testing RFIC power amplifier testing  | <b>Model 4500-MTS Model 2800 RF Power Analyzer</b>   |



### Series 2400 SourceMeter® Instruments

- Tightly coupled source/measure engine minimizes test station development, set-up, and maintenance time
- Complete, single-channel DC parametric testers
- Built-in comparator for fast pass/fail testing
- Digital I/O for binning and handler control



### Model 2520 Pulsed Laser Diode Test System

- Combines high speed, precision pulsing and measurement to prevent destructive device self-heating when testing opto devices at the wafer, bar or chip level
- Remote test head minimizes cable effects and maximizes the signal-to-noise ratio for greater pulse measurement accuracy
- Optional Model 2520INT Integrating Sphere allows making direct measurements of a device's optical power

Visit [www.keithley.com](http://www.keithley.com) to access our library of application notes and white papers.

# THE KEITHLEY DIFFERENCE is Keithley support

As you can see, we offer solutions for virtually every phase of semiconductor materials research, device design, process development, and fabrication. But we believe the quality of the customer service we provide is just as important as the quality of our products.

## Global offices, global support

Half of all Keithley sales come from countries other than the U.S. Our success comes from our ability to build working relationships with customers that last long after the purchase order is issued, no matter where they're located. To meet the needs of customers around the world, we're continuing to expand our global network of sales and support centers. For example, our newest semiconductor sales office in Singapore provides applications and service support for all Keithley semiconductor products sold in Southeast Asia.

### **Our service network can provide a complete range of support from on-line to on-site to meet customers' evolving needs.**

Our sales engineers all have technical degrees, as well as in-depth industry knowledge and product-specific training to help you choose the best solution for a specific application. They're available to meet with you personally to demonstrate products, show you how to build your solution, or point you to an integration partner who can build it for you. They'll also keep you updated on product availability and price/delivery information to your location.



Our sales and support centers serve Keithley customers in dozens of countries, providing the native language support services our

customers have told us they want. Our growing network also assures you that, no matter where you are, someone from Keithley is nearby and ready to help you solve your test and measurement problems. Visit

**[www.keithley.com](http://www.keithley.com)** for current contact information on your nearest sales and support center.





## Applications insight

Selecting and configuring a test system can be complicated and confusing, but it doesn't have to be. Just call one of the test experts on Keithley's Applications Engineering team. Their only job is to help you solve your toughest test challenges quickly, efficiently, and cost-effectively, before and after the sale.

## The support you need, when you need it

For fastest applications assistance, call our toll-free hotline at **1-888-KEITHLEY** (534-8453) from 8:00 am to 5:00 pm ET (U.S. only). For assistance at other times, send our Applications Engineering Department a facsimile (440-248-6168) or an e-mail message ([product\\_info@keithley.com](mailto:product_info@keithley.com)) and we'll respond as soon as possible. You can also get help through **www.keithley.com**, with online forms that make it simple to explain your problem to an Applications Engineer.

## Repair and calibration support

Keithley maintains a complete repair and calibration service, as well as standards laboratories in Cleveland, Ohio and Munich, Germany. The calibration and repair service can provide technical assistance, oversee calibration of all units, and handle parts or upgrade requirements. Service is also available at regional authorized calibration/repair facilities.

## FREE Keithley handbooks

Want a fast refresher on test and measurement techniques? Request your **FREE** copies of Keithley's handbooks on low level measurements, switching, and data acquisition and control by calling your local sales engineer or visiting our website at [www.keithley.com](http://www.keithley.com).



## Check something out of our library

Visit [www.keithley.com](http://www.keithley.com) to download materials from our growing library of **FREE** technical literature on semiconductor testing, including articles, application notes, online demonstrations, and white papers.

## Ready to step up to Keithley test performance?

With more than a half-century of expertise in making demanding low-level measurements, Keithley offers you a greater measure of testing confidence in your materials research and device characterization labs, reliability test facilities, fabs, and functional test environments. To learn how Keithley test solutions can help you keep pace with changing semiconductor technologies, **call your local Keithley sales engineer or visit our website.**

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**KEITHLEY**

A G R E A T E R M E A S U R E O F C O N F I D E N C E

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