

Testing High Power Semiconductor Devices from Inception to Market

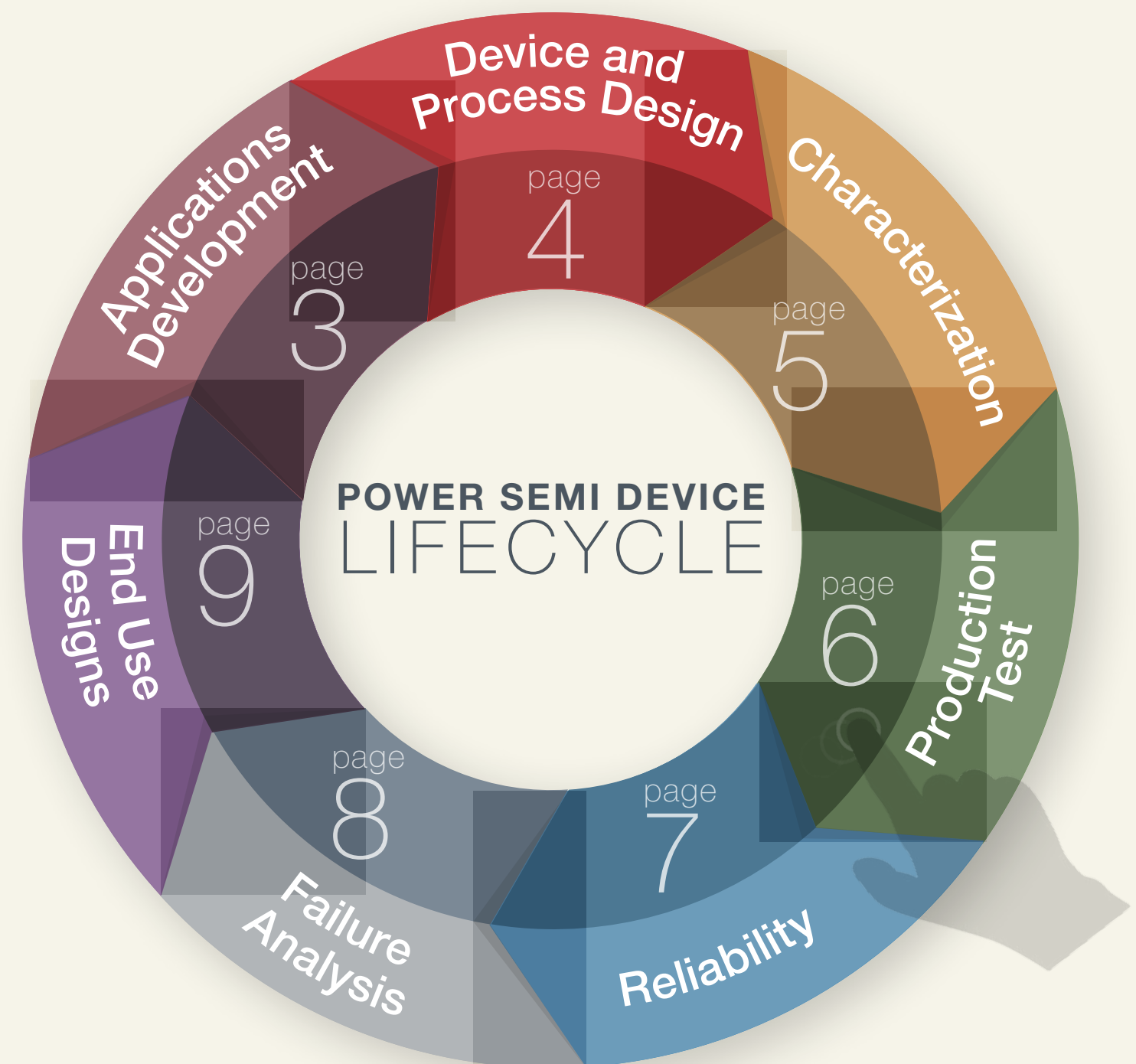
Methods for Efficient, Flexible Test and Characterization throughout the Life Cycle of a Power Semi Device

Methods for Efficient, Flexible Test and Characterization throughout the Entire Life Cycle of a Power Semi Device

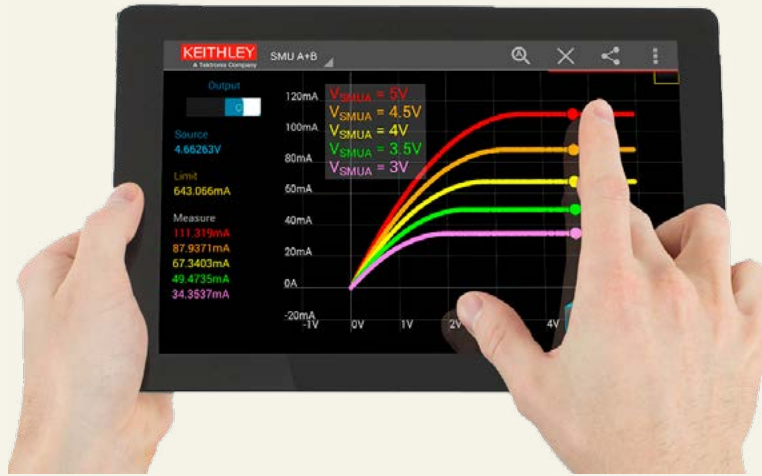
Introduction

This e-guide examines the life cycle of a power semiconductor device and the tremendous variety of test and characterization activities and measurement challenges faced by the engineers involved in each stage throughout the cycle. From the early stages of designing a new power device to the point where it's ready for market. Keithley's flexible set of high power characterization tools are ideal for testing across the entire life cycle of a power device.

- For basic curve tracing measurements, perhaps a single source measure unit (SMU) instrument with Android-based curve tracer app is sufficient.
- When more meticulous curve tracing is required, a SMU instrument with semiconductor I-V characterization software may be the solution.
- For detailed on-state, off-state, or capacitance-voltage characterization, a full parametric curve tracer (PCT) allows both easy data acquisition and detailed parameter extraction.
- The flexible instrumentation used for curve tracing can also be configured in a racked system for simple functional test, process monitoring, or other higher volume characterization.



Evaluating Existing Devices and Designs for New Application Requirements



The IVy Android App works with Series 2600B SourceMeter® SMU Instruments to perform I-V characterization. Pinch and zoom for deeper insight into device performance.

trend monitoring, and enables interactive analysis and insight into your device without programming! Or, use the Model 2450 Interactive SourceMeter SMU Instruments with KickStart I-V Characterization Software to perform current versus voltage (I-V) testing on a variety of materials, two terminal and multi-terminal semiconductor devices, solar cells, embedded systems, and much more.

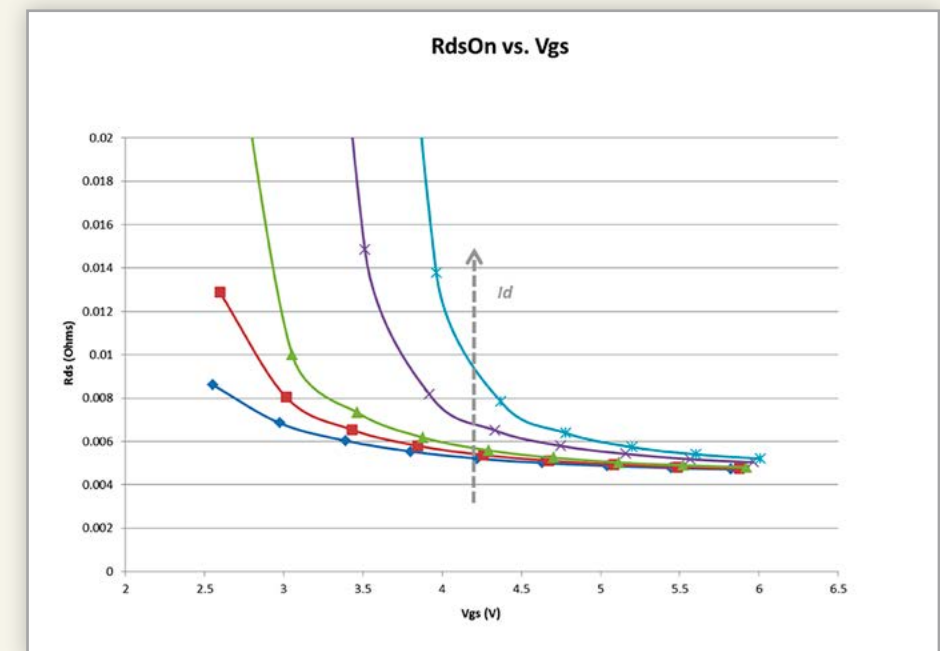
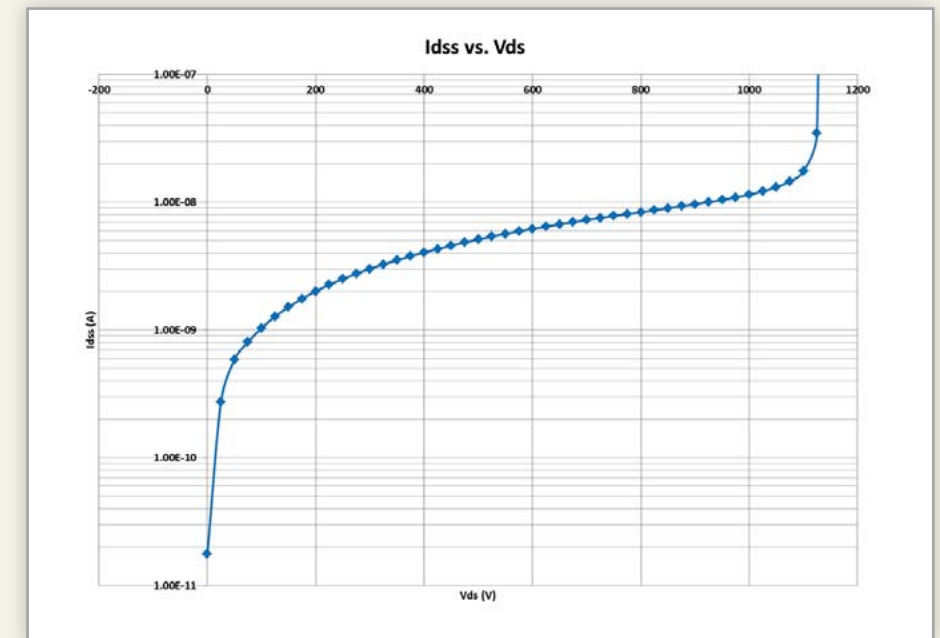
Source Measurement Unit Instruments
Simplify Characterizing a Linear Voltage
Regulator's DC Performance

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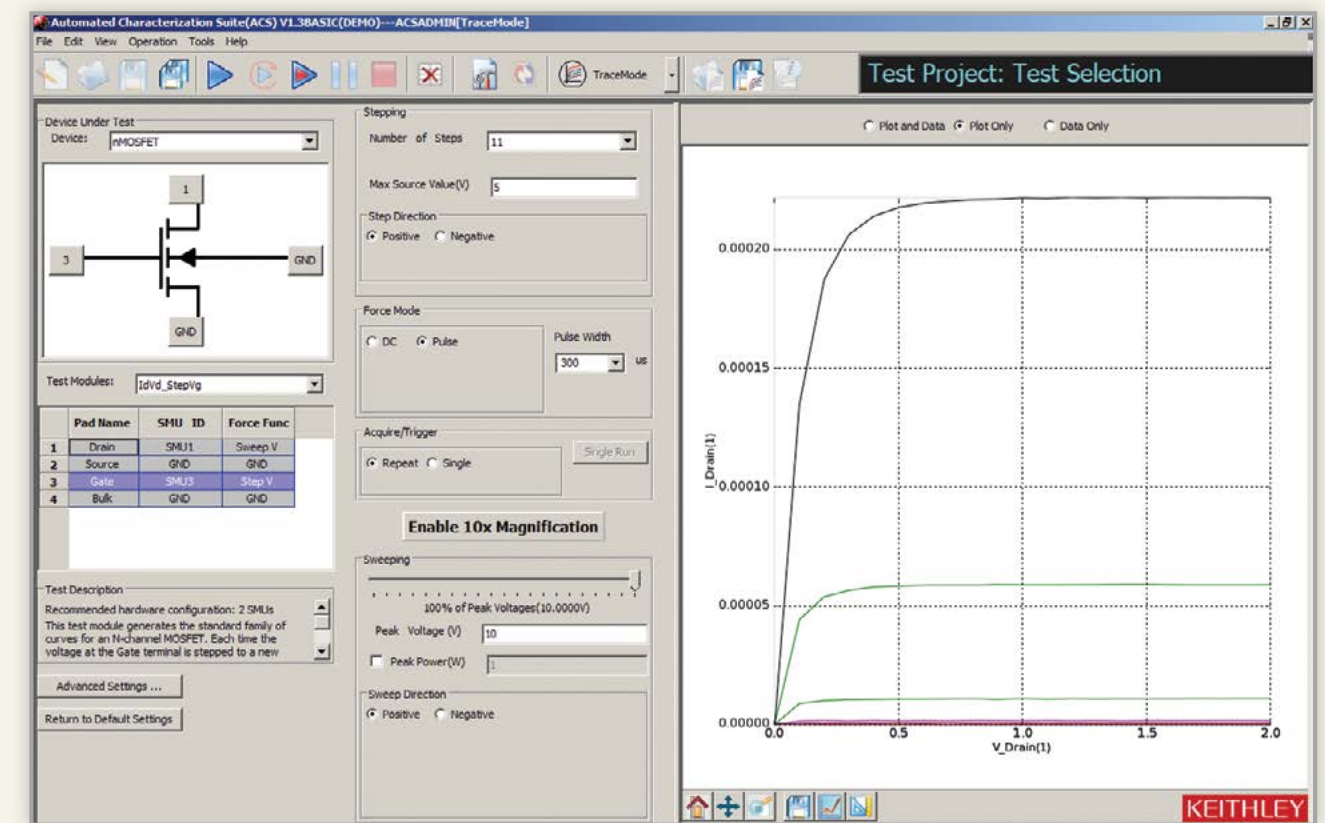
7 Keys to Detecting Potential
DUT Issues: Minimize Troubleshooting
Time and Boost Productivity



Designing New Devices to Meet Evolving Needs

To effectively on design devices to meet their customer's latest requirements, power device design engineers and process engineers must understand how to tweak the process to produce the desired device performance. There must be confidence that the device models are fairly accurate, and changing a particular process step must produce the necessary change in the device measurement parameter. Therefore, the device engineer must perform preliminary verification of key device parameters.

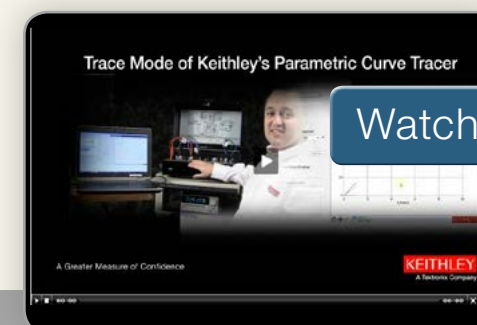
With its trace mode, ACS Basic Edition Software allows quick verification of key device parameters, including family of curves, bias voltage, etc. In addition to being intuitive, it's designed from the device perspective and includes scores of device libraries and a built-in formulator to quickly relate measurement to device parameters. Parametric Curve Tracer (PCT) Configurations and the Model 8020 Probe Station Interface simplify a wide range of tests that must be performed on-wafer for DC, CV, and pulsed test.



Trace Mode supports interactive testing of a device.



Testing Modern Power Semiconductor Devices Requires a Modern Curve Tracer

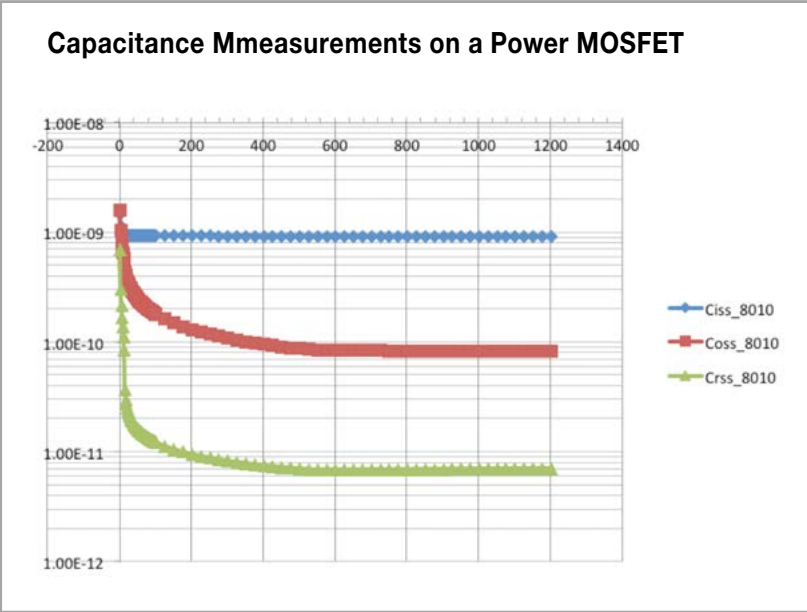


Watch the On-line Demo

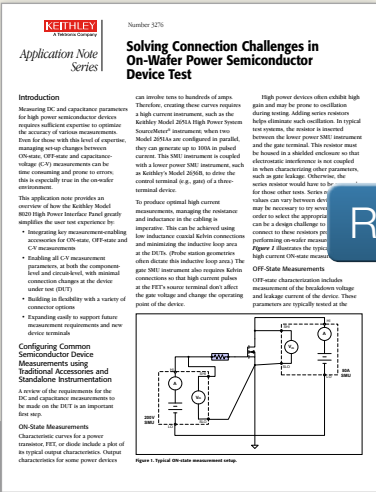
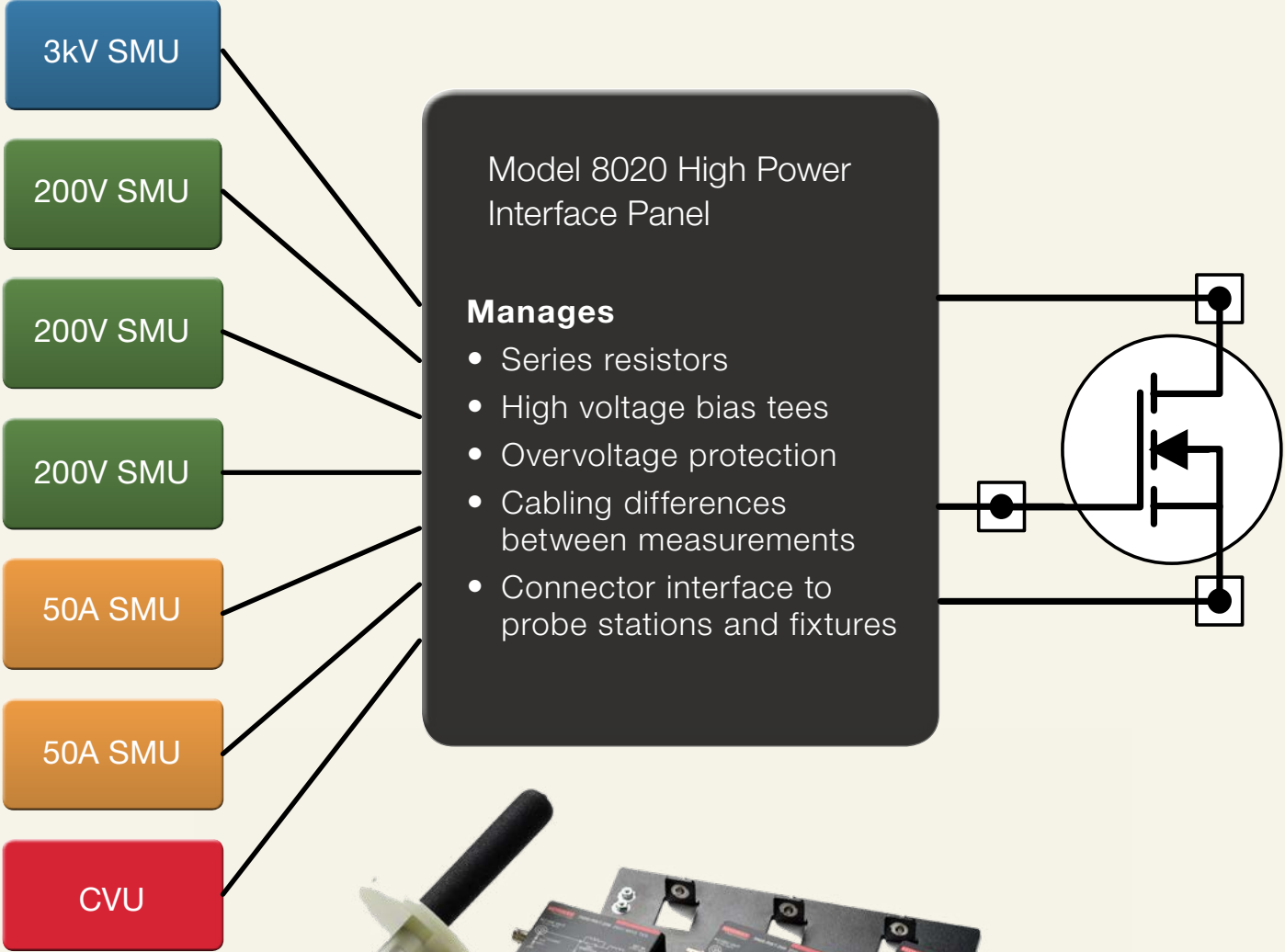
PCT Configuration in Trace Mode

Characterizing Full Performance of New Device Design

A characterization engineer provides the necessary measurement expertise and understanding of how measurement anomalies can impact non-targeted areas of device performance. It's imperative to get results fast to enable multiple iterations with device or process engineers and quickly convert measurements to device parameters.



For on-wafer characterization, the Model 8020 High Power Interface Panel minimizes connection changes between major measurement types. I-V and C-V measurements can be made through bias tees without connection changes. ACS Basic Edition Software allows users to quickly calculate desired parameters.



Read the Application Note

Solving Connection Challenges in On-Wafer Power Semiconductor Device Test

Meeting Reliability Standards for Commercial Use

To conclude that a device meets reliability standards for commercial use, reliability test engineers have several responsibilities:

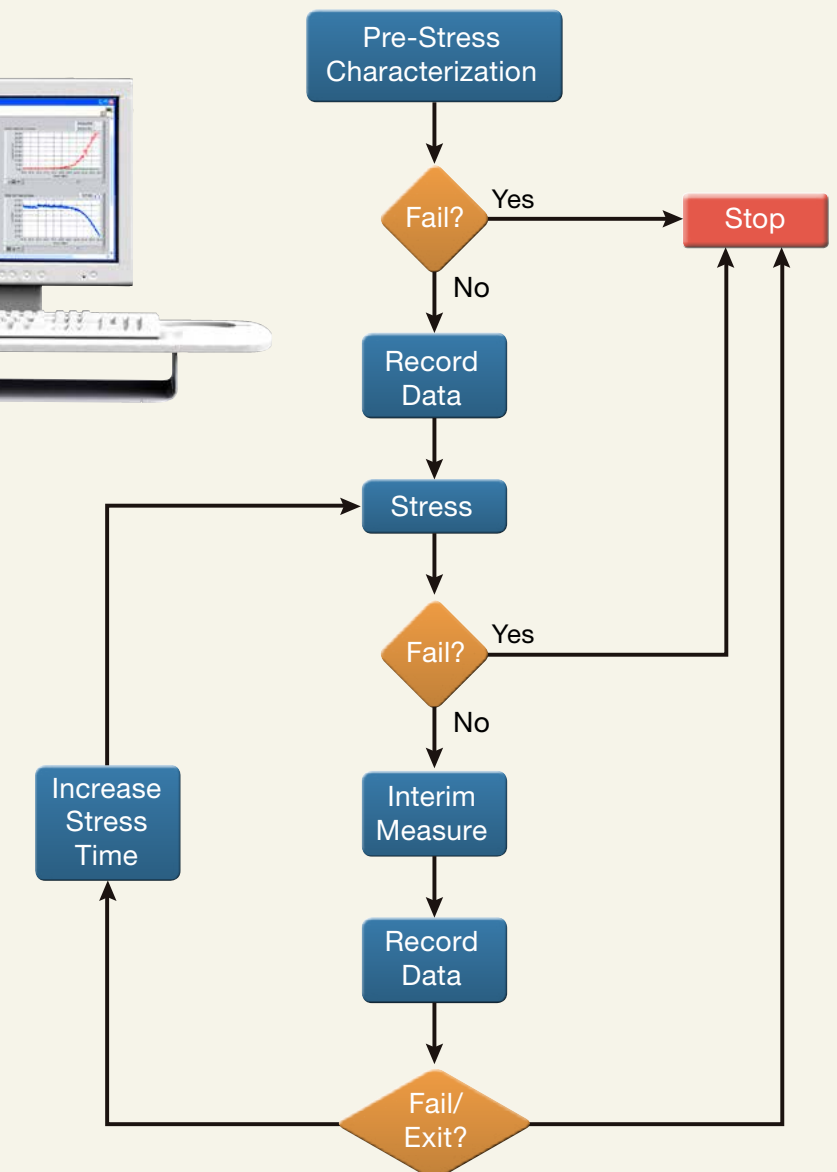
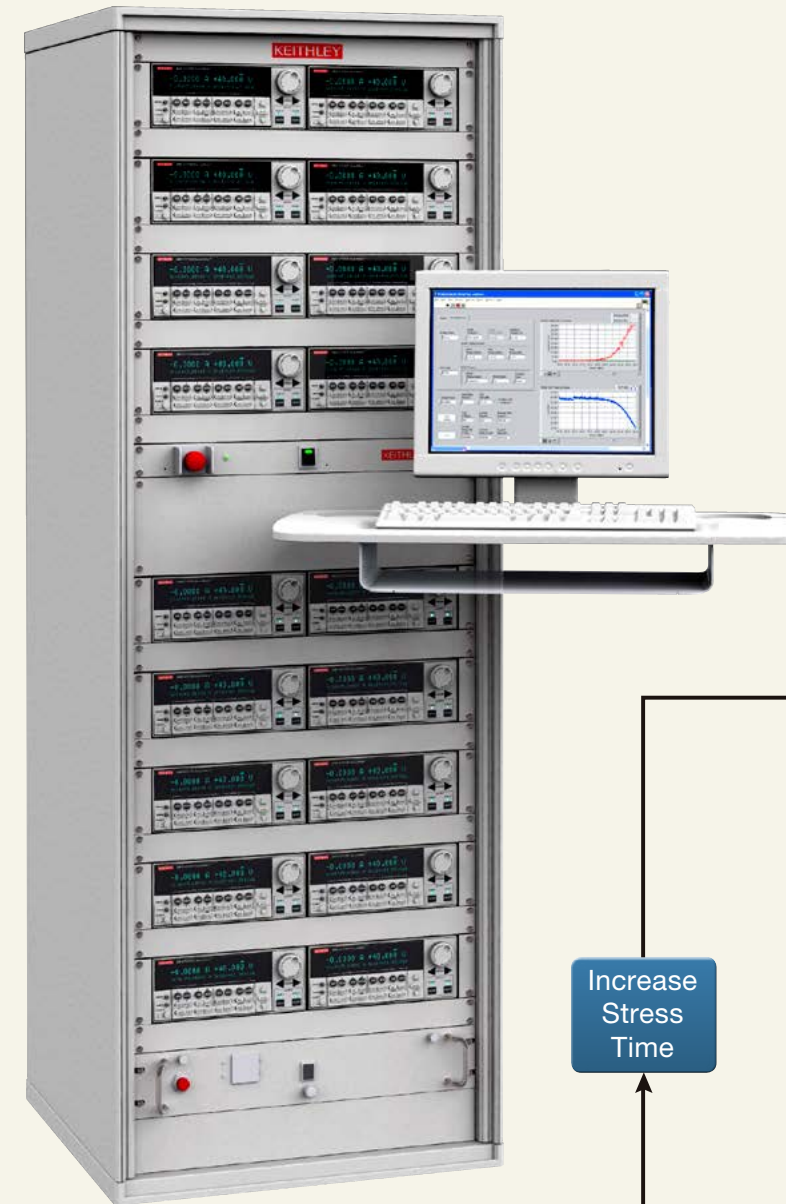
- Determining if a device will survive environmental stresses and continue to meet specifications
- Answering customer questions about device lifetime (MTBF, MTTF)
- Providing key insight into device fit for certain high reliability applications (mil/aero, automotive, etc.)

Creating statistically relevant results requires sufficient sample sizes of the test devices. The nature of stress-measure cycling over many devices necessitates multi-channel parallel test with automated data evaluation.

S500 Integrated Test Systems are reliability test systems that can be custom built to accommodate from small to large number of devices. ACS features stress measure loop cycling with integrated decision making. Keithley also provides a wide range of power supply and SMU instrument solutions to permit simultaneous power and testing of any number of devices.

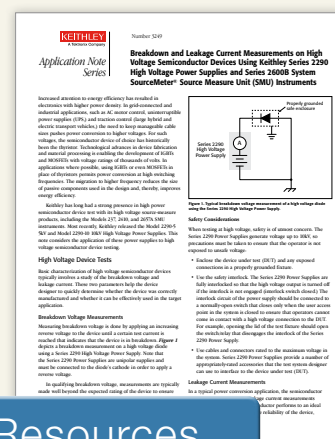
Optimizing Reliability Testing of Power Semiconductor Devices and Modules with Keithley SMU Instruments and Switch Systems

V_{DS} Ramp and HTRB Reliability Testing of High Power Semiconductor Devices with Automated Characterization Suite (ACS) Software



Breakdown and Leakage Current Measurements on High Voltage Semiconductor Devices

Process flow for HCI/NBTI/constant current EM tests.

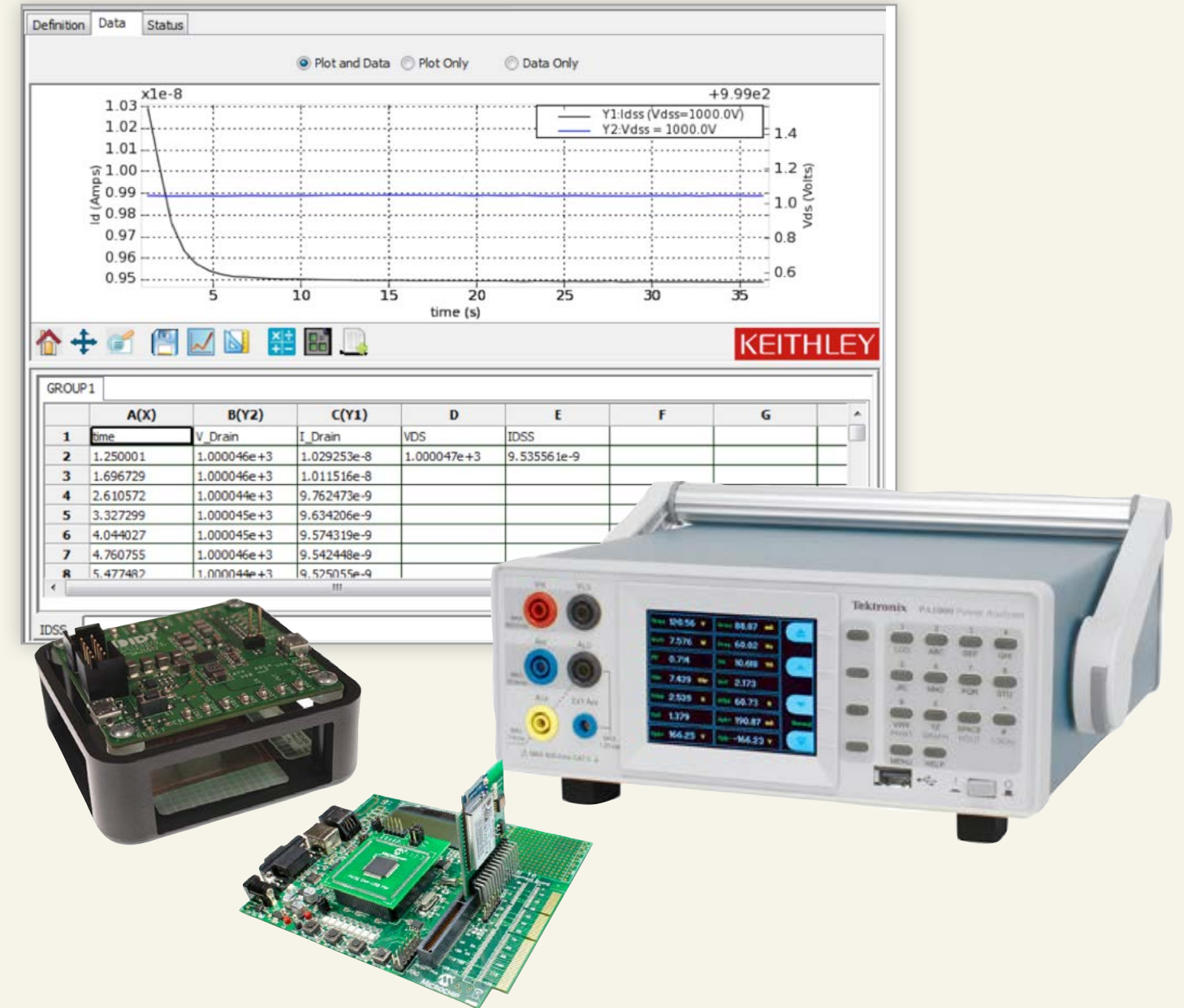


Learn More from these Application Resources

Implementing the Device in Actual Designs

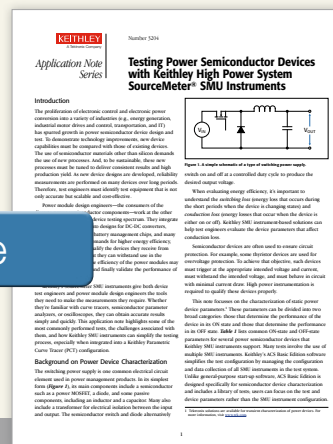
Once a device is validated, it's ready for commercial use. Those who purchase devices must verify that the device is within tolerance for a particular application to ensure that the expected power efficiency gains will be achieved in the end product. As the device matures and becomes available from multiple suppliers, power device consumers want to quickly inspect incoming devices in order to identify and eliminate counterfeit devices to avoid potential failures in the end product.

Tektronix and Keithley offer a wide variety of power supply solutions to power basic circuit boards. Additionally, Tektronix's power analyzers can quickly and accurately assess overall end product performance. Keithley's Parametric Curve Tracer (PCT) Configurations and ACS Basic Edition Software include a large library of power device tests so individual device performance can be quickly verify. Oscilloscopes with optional power analysis modules enable quick and accurate analysis of switching loss, harmonics, and safe operating area. Choose from a wide variety of high voltage, current, and differential probes to partner with an oscilloscope.



Testing Power Semiconductor Devices with Keithley High Power System SourceMeter® SMU Instruments

Learn More



Get the Application Notes

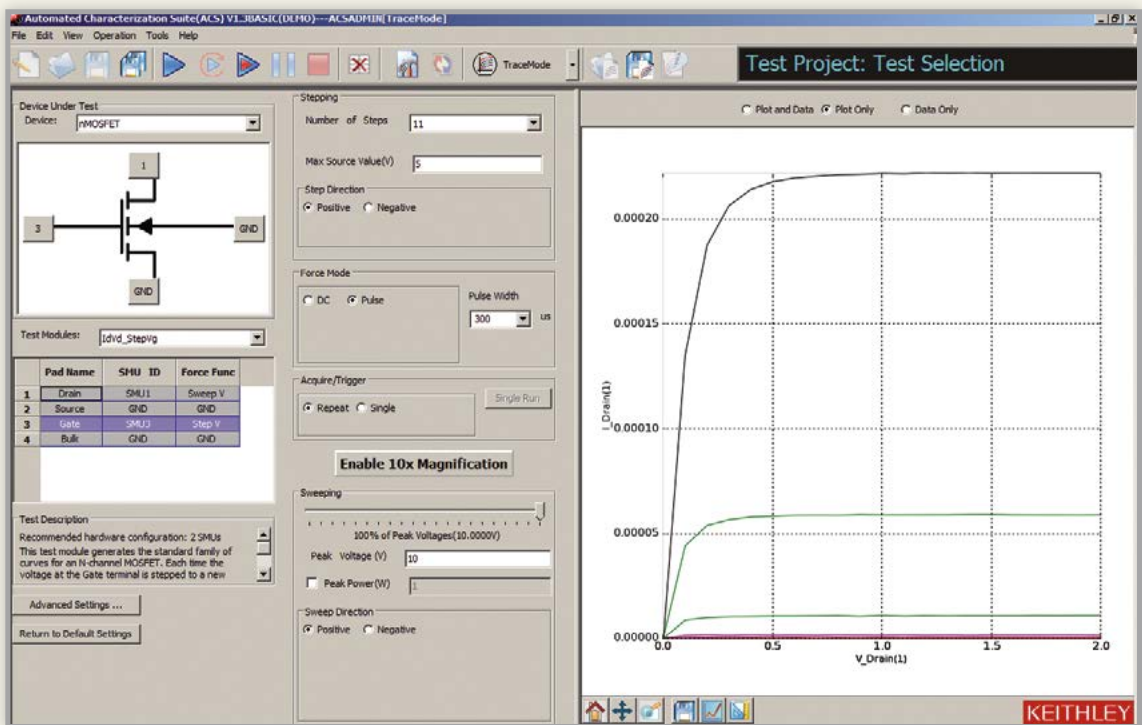
Using the Arbitrary Waveform Capabilities of the Series 2600B and Series 2650A System SourceMeter® SMU Instruments to Perform Ford EMC-CS-2009.1 CI 230 Power Cycling Testing

Diagnosing Device Failures

Failure analysis engineers must determine whether a failure has been caused by end-product use or by a design flaw that was previously overlooked. Once this determination has been made, design and process engineering must be made aware of the cause of the failure, so that either process or design changes can be implemented to prevent future failures.

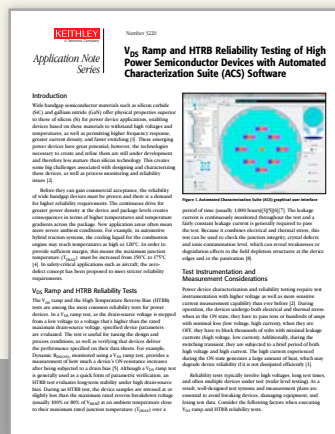
It's important that basic device specifications, both static and dynamic, can be measured quickly. The end use application is mimicked in an effort to reproduce the failure.

Parametric Curve Tracer Configurations feature trace mode, which provides quick device analysis. Additionally, Keithley's Automated Characterization Suite (ACS) has several built-in stress-measure tests that can be used until a device reaches the desired level of degradation.

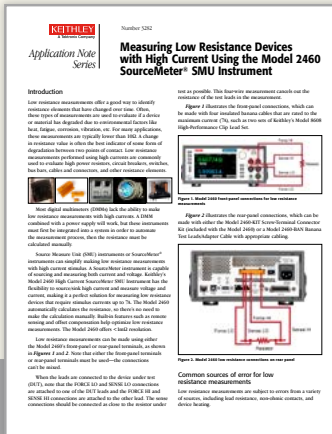


Learn More from our Experts | Download these Applications Resources

V_{DS} Ramp and HTRB Reliability Testing of High Power Semiconductor Devices with Automated Characterization Suite (ACS) Software



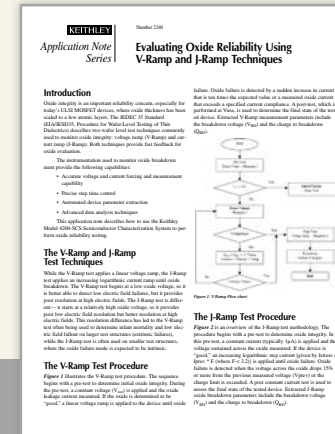
Measuring Low Resistance Devices with High Current Using the Model 2460



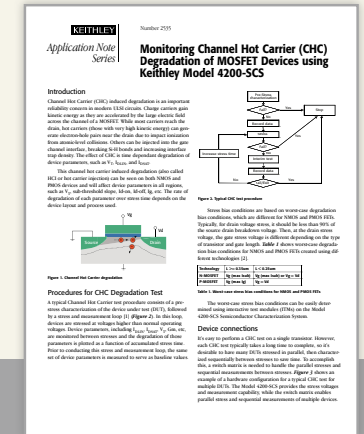
Watch the On-line Demo

PCT Configuration in Trace Mode

Evaluating Oxide Reliability Using V-Ramp and J-Ramp Techniques



Monitoring Channel Hot Carrier (CHC) Degradation of MOSFET Devices using Keithley Model 4200-SCS



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