

# 2600-PCT-xB Parametric Curve Tracer Configurations



2600-PCT-4B with 8010 Test Fixture

**KEITHLEY**  
A Tektronix Company

## High Power Device Characterization

Developing and using MOSFETS, IGBTs, diodes and other high power devices requires comprehensive device-level characterization such as breakdown voltage, on-state current and capacitance measurements. Keithley's line of high power Parametric Curve Trace configurations supports the full spectrum of device types and test parameters. Keithley's Parametric Curve Trace configurations include all necessary hardware for the characterization engineer to develop a complete test system quickly. Ordered separately, ACS Basic Edition software provides complete device characterization, including both real-time trace mode for quickly checking fundamental device parameters like breakdown voltage and full parametric mode for extracting precise device parameters. ACS Basic Edition goes beyond traditional curve tracer interfaces by offering a broad array of sample libraries. More important, users have complete control of all test resources, allowing the creation of more advanced tests than previously possible on a curve tracer.

## Key Features

- Complete solutions engineered for optimum price and performance
- Field upgradable and reconfigurable – convert your PCT to a reliability or wafer sort tester
- Configurable power levels:
  - From 200 V to 3 kV
  - From 1 A to 100 A
- Wide dynamic range:
  - From  $\mu\text{V}$  to kV
  - From fA to 100 A
- Full range of capacitance-voltage (C-V) capability :
  - From fF to  $\mu\text{F}$
  - Supports 2, 3, and 4 terminal devices
  - Up to 3 kV DC bias
- High performance test fixture supports a range of package types
- Probe station interface supports most probe types including HV triax, SHV coax, standard triax, and others

## Applications

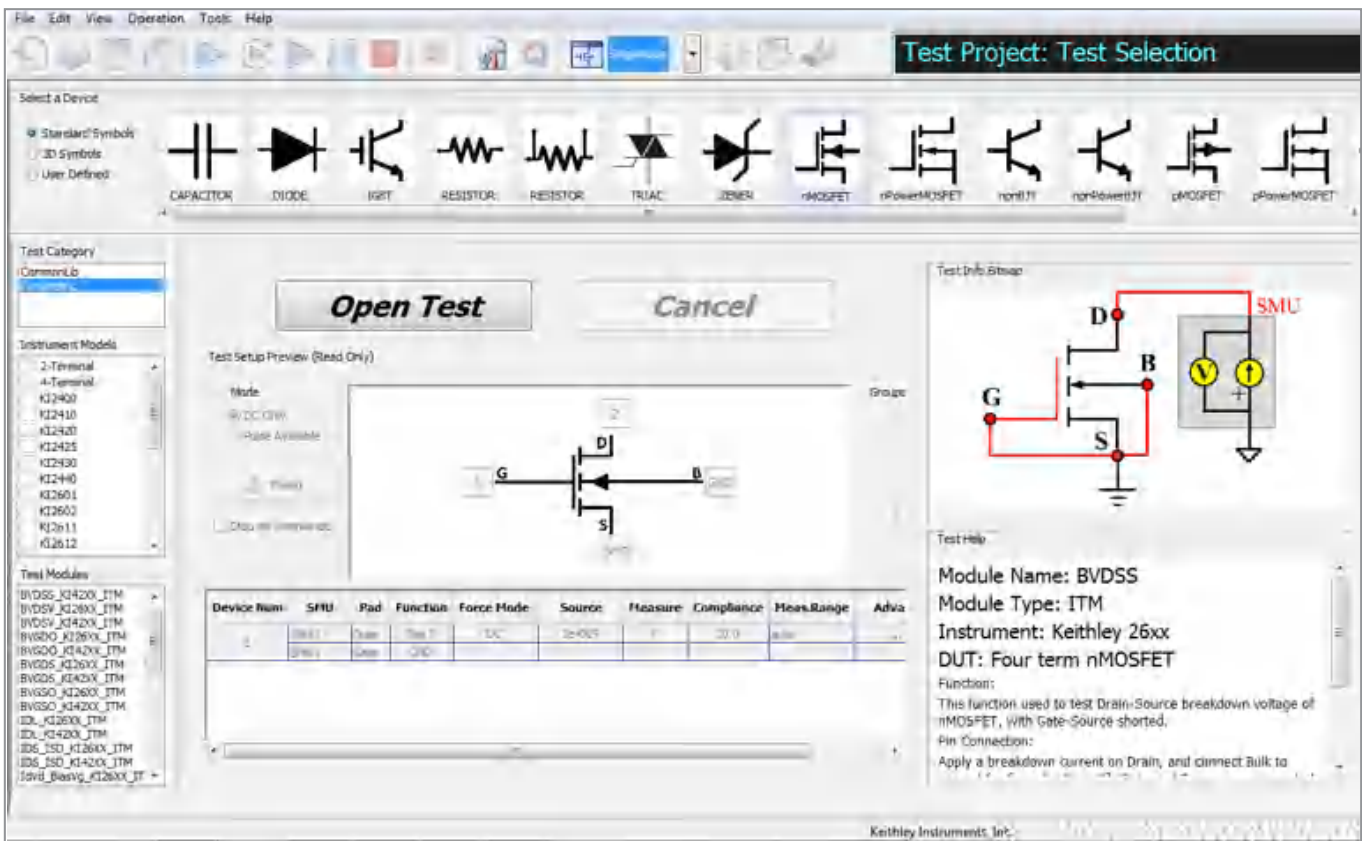
- Power semiconductor device characterization and testing
- Characterization of GaN and SiC, LDMOS and other devices
- Reliability studies on power devices
- Incoming inspection and device qualification

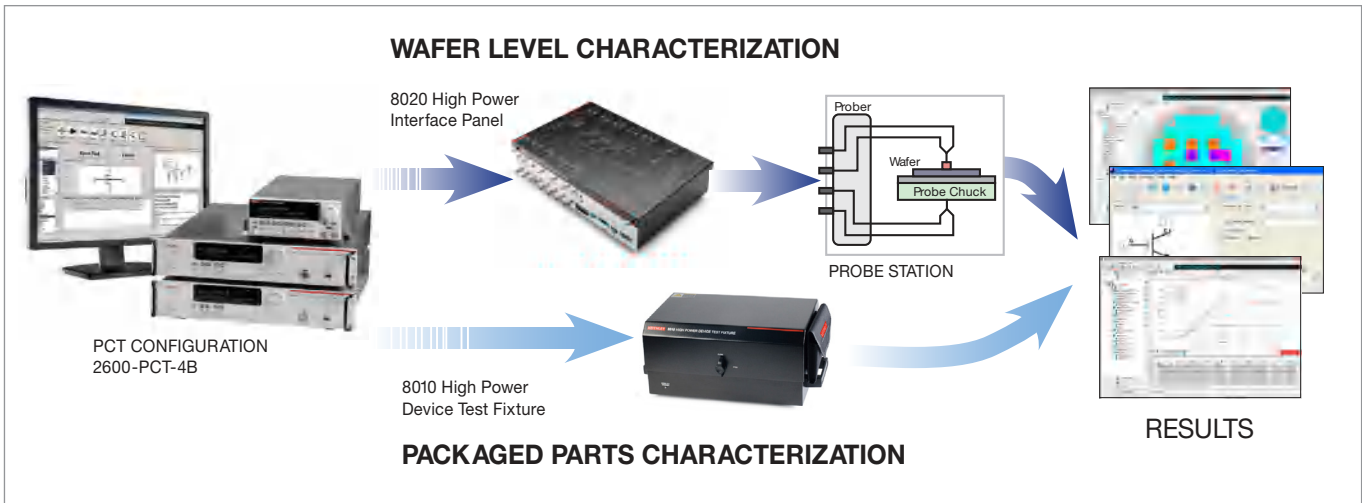
Electrical characterization of a variety of power device types, including:

- MOSFET
- BJT
- IGBT
- Diode
- Triac
- Capacitor
- Resistor
- And many more...

Measurements of key parameters, such as:

- Breakdown Voltage ( $Bvd_{ss}$ ,  $Bv_{ceo}$ )
- On-State Current ( $V_{dson}$ ,  $V_{cesat}$ ,  $V_f$ )
- Drain/Collector Leakage ( $I_{dss}$ ,  $I_r/I_{cbo}$ ,  $I_{ceo}$ )
- Gate/Base Leakage ( $I_{gss}$ ,  $I_b$ )
- Threshold or Cutoff voltage ( $V_{th}$ ,  $V_f$ ,  $V_{beon}$ )
- Forward Transfer ( $y_{fs}$ ,  $G_{fs}$ ,  $H_{fe}$ , gain)
- Capacitance ( $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$ )
- And many more...





Keithley's Parametric Curve Trace configurations support both package part and wafer level testing.

Keithley's Parametric Curve Trace configurations are complete characterization tools that include the key elements necessary for power device characterization. The measurement channels consist of Keithley SourceMeter® Source Measure Unit (SMU) Instruments and an optional Multi-frequency capacitance-voltage (C-V) meter. The dynamic range and accuracy of these instruments is orders of magnitude beyond what a traditional curve tracer could offer.

### Complete System Accessories

To achieve this performance, Keithley has developed a complete set of precision cables to connect the instrumentation to either Keithley's 8010 High Power Device Test Fixture for package part testing, or the 8020 High Power Interface Panel for wafer level testing. For the high voltage channel, custom triax cables provide a guarded pathway that enables fast settling and very

low currents, even at the full 3 kV. For the high current channel, special low inductance cables provide fast rise time pulses to minimize self heating effects.

### High Voltage Capacitance-Voltage (C-V)

Testing device capacitance versus DC voltage is becoming more and more important. Keithley offers the PCT-CVU Multi-frequency capacitance-voltage meter. When combined with the optional 200 V or 3 kV bias tees, capacitance vs. voltage can be measured on two, three or four terminal devices. Capacitances from fF to 100 nF can be measured, with test frequencies from 10 kHz to 2 MHz. ACS Basic Edition software provides over 60 canned tests for C-V including MOSFET Ciss, Coss, Crss, Cgd, Cgs, Cds, and a full suite of other devices such as BJTs and diodes. As always, users have complete control to develop their own test algorithms in ACS Basic Edition.

### Configuration Selector Guide

Model <sup>1</sup>		Collector/ Drain Supply <sup>2</sup>		Step Generator Base/Gate Supply	Auxiliary Supply
		High Voltage Mode	High Current Mode		
Low Power	2600-PCT-1B	200 V/10 A	200 V/10 A	200 V/10 A	N/A
High Current	2600-PCT-2B	200 V/10 A	40 V/50 A	200 V/10 A	200 V/10 A
High Voltage	2600-PCT-3B	3 kV/120 mA	200 V/10 A	200 V/10 A	200 V/10 A
High Current and High Voltage	2600-PCT-4B	3 kV/120 mA	40 V/50 A	200 V/10 A	200 V/10 A

1. Contact your Keithley field applications engineer for custom configurations.  
 2. Add a Model 2651A to increase high current mode to 50A or 100A.  
 3. PCT-CVU Multi-Frequency capacitance meter can be added to any configuration.

### Typical Power Transistor Parameters

Parameter	Symbol	Test Method <sup>1</sup>	Maximum Range	Typical Best Resolution	Typical Accuracy
Breakdown Voltage	Bvdss, Bvceo	Id-Vd or Id (pulse)	±3000 V <sup>2</sup>	100 μV, 10 fA	0.05% rdg + 0.05% rng
On-State Current (DC)	Vdson, Vcesat, Vf	Id-Vd	±20 A <sup>4</sup> , Optional: ±40 A <sup>4</sup>	100 nA, 1 μV	0.05% rdg + 0.05% rng
On-State Current (Pulse)	Vdson, Vcesat, Vf	Id-Vd	±50 A <sup>4</sup> , Optional: ±100 A <sup>4</sup>	100 μA, 1 μV	0.05% rdg + 0.05% rng
Drain/Collector Leakage Current	Idss, Ir/Icbo, Iceo	Id-Vd	±20 mA @ 3000 <sup>2,5</sup>	10 fA, 1 μV	0.2% rdg + 1% rng
Gate/Base Leakage Current	Igss, Ib	Ig-Vg	±1 A or, ±10 A Pulsed <sup>3</sup>	10 fA, 1 μV	0.2% rdg + 1% rng
On-State Threshold Voltage or Cutoff Voltage	Vth, Vf, Vbeon, Vcesat	Id-Vg	±200 V <sup>3</sup>	10 fA, 1 μV	0.2% rdg + 0.5% rng
Forward Transfer Admittance or Forward Transconductance	yfs  Gfs, Hfe, gain	Vd-Id @ Vds	1 ms ~ 1000 s <sup>6</sup>	1 pA, 1 μV	1%
On-State Resistance	RDS(on), Vcesat	Vd-Vg @ Id	<100 μΩ <sup>7</sup>	10 μΩ, 1 μV	1%
Input Capacitance	Ciss	C-V 100 kHz	100 nF <sup>8</sup> ±3 kV	10 fF, 100 μV	Typical 5%+2pF
Output Capacitance	Coss	C-V 100 kHz	100 nF <sup>8</sup> ±3 kV	10 fF, 100 μV	Typical 5%+2pF
Reverse Transfer Capacitance	Crss	C-V 100 kHz	100 nF <sup>8</sup> ±3 kV	10 fF, 100 μV	Typical 5%+2pF

1. Test method used for extracting the parameter. Only typical MOSFET listed, but similar method for other devices.
2. 2657A High Power System SourceMeter® SMU Instrument.
3. 2636B SourceMeter SMU Instrument.
4. 2651A High Power System SourceMeter SMU Instrument or optional dual 2651A High Power System SourceMeter SMU Instruments.
5. Maximum 20 mA at 3000 V, 120 mA at 1500 V.
6. Typical extracted capability (Example: 1 mA/1 V ~ 1 A/1 mV).
7. Typical extracted capability (Example: 1 mV/10 A).
8. Max. ±200 VDC (or ±3kV) bias with PCT-CVU and CVU-3K-KIT.



8010 High Power Device Test Fixture



8020 High Power Interface Panel



High current, low inductance cables



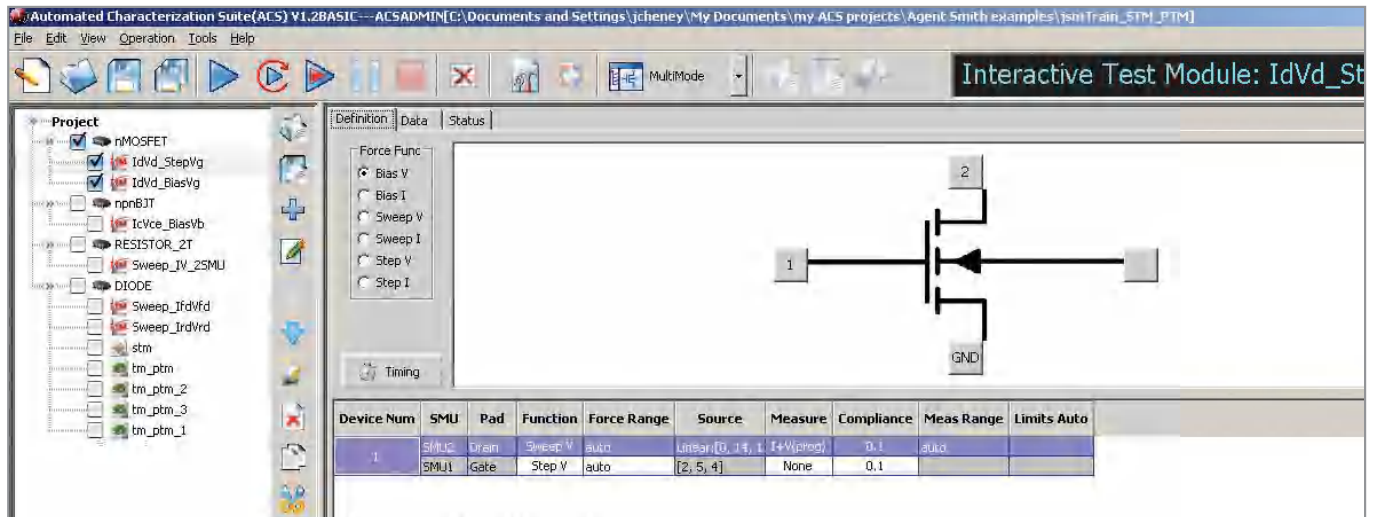
High voltage, low noise triaxial cables



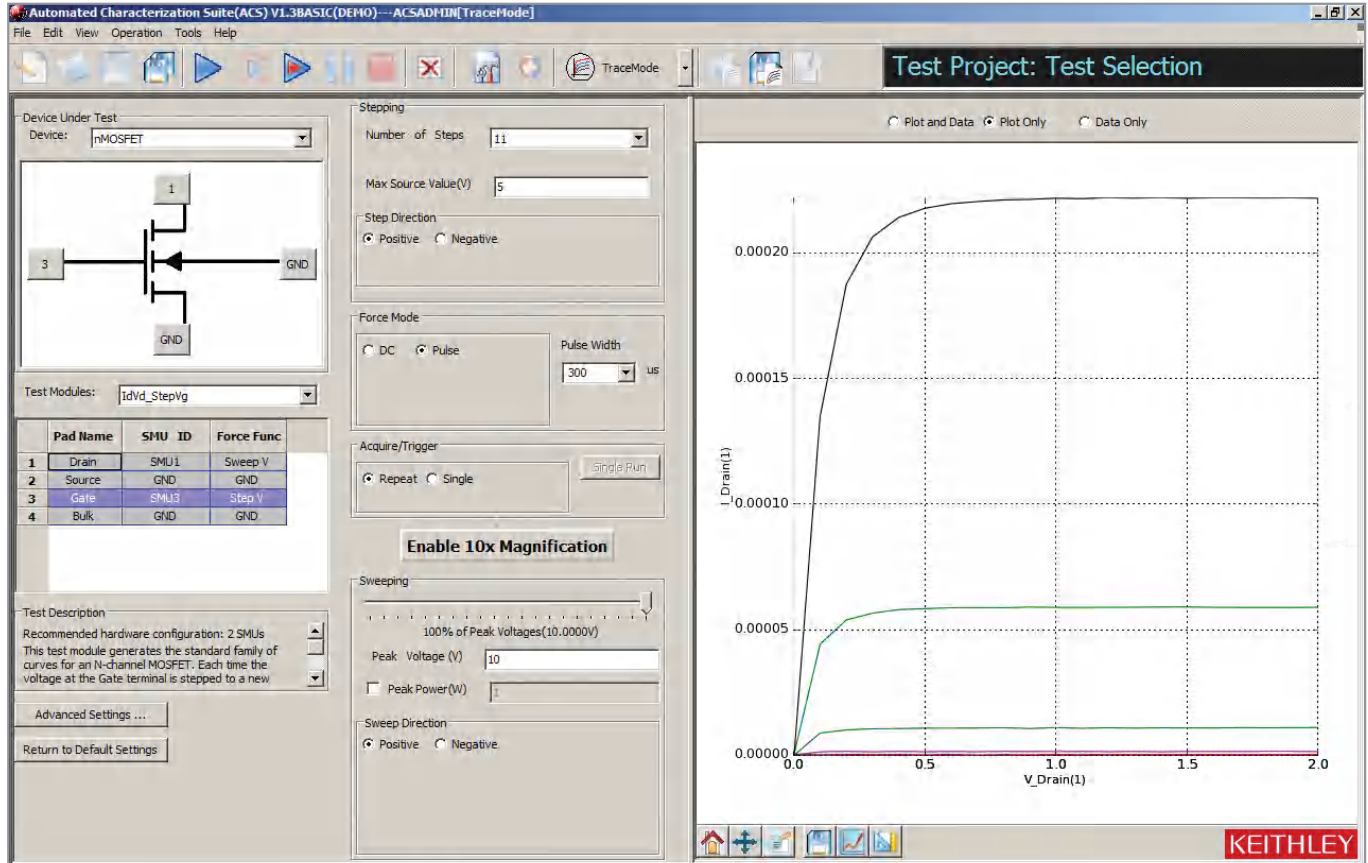
2600-PCT-4B with Model 8010 Test Fixture

## Semiconductor Parametric Test Software for Component and Discrete Devices

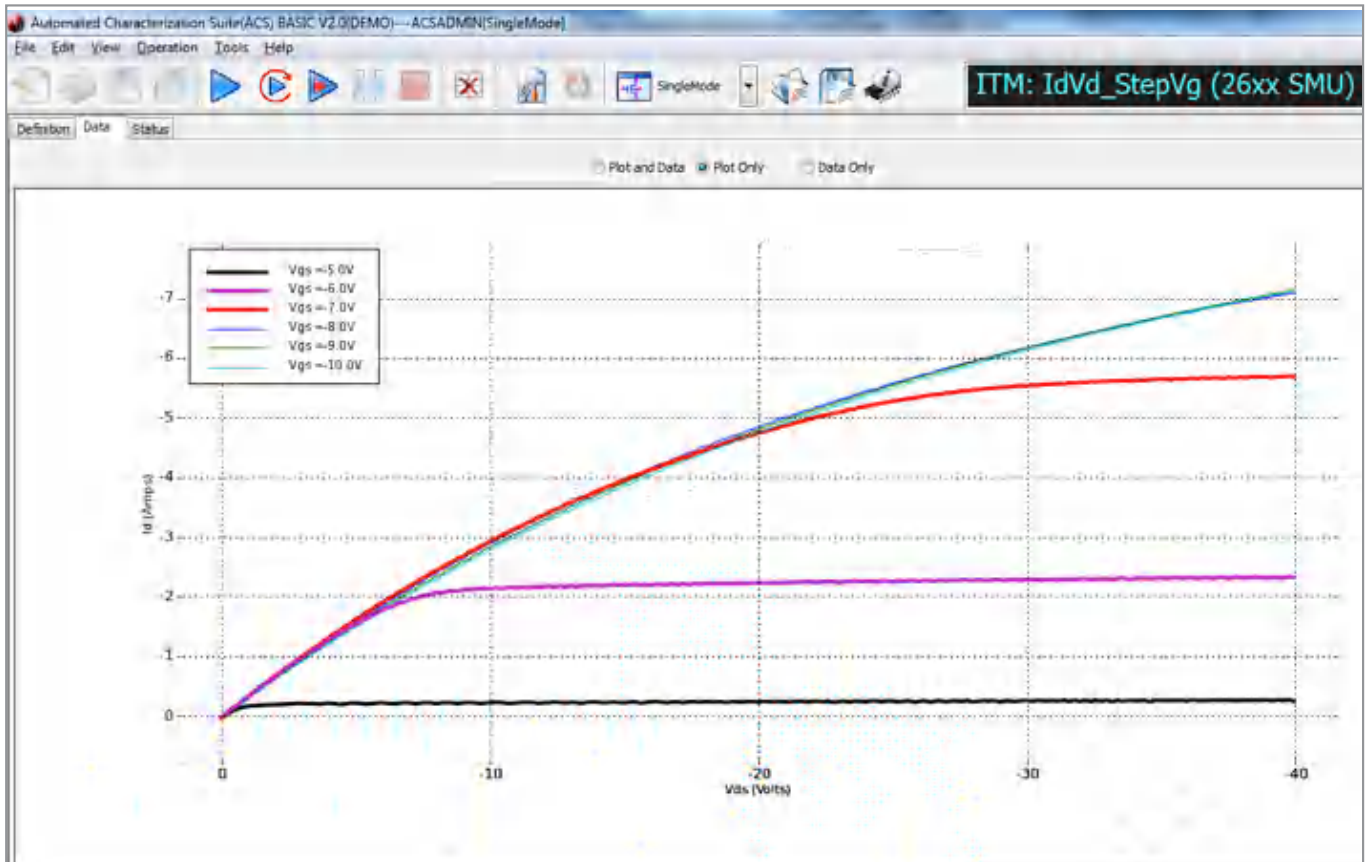
ACS Basic Edition software is specifically tuned to take advantage of the high performance capabilities of the Keithley instrumentation and includes several sample libraries for performing common high power device tests. Unlike other systems, the software allows the user almost unlimited flexibility in configuring all of the measurement channels to create tests far beyond what a traditional curve tracer could achieve.



Multi test mode allows multiple tests to be performed on a device.



Trace mode supports interactive testing of a device.



Compared to a traditional curve tracer, PCT graphics offer high resolution, on-screen data analysis, complete graph customization, and easy export to any word processor or reporting software.

### Summary of Typical Tests

Device	Leakage	Breakdown	Gain	On-State
Bipolar Junction Transistor	IEBO, IECO, IEVEB, ICVCB	BVCBO, BVCEI, BVCEO, BVCEV, BVEBO, BVECO	HFE	IBCO, IBEO, IBICVBE, IBVBE, ICBO, ICEV, ICVCE_BiasIB, ICVCE_BiasVB, ICVCE_StepIB, ICVCE_StepVB, VBCO, VCE
MOSFET	IDL, IDS_ISD, IGL, ISL	BVDSS, BVDSV, BVGDO, BVGDS, BVGSO	GM	IDVD_BiasVG, IDVD_StepVG, IDVG_BiasVD, IDVG_StepVD, IDVG_StepVSub, IGVG, VTCI, VTEXT, VTEXT_IISQ
Diode	IRDVRD	VBRIRD	NA	DYNAMICZ, IFDVFD, VDFDIFD, VRDIRD
Resistor	NA	NA	NA	IV
Capacitor	IV	Ciss, Coss, Crss, Cgd, Cds, Cgs	NA	Independent bias on up to 4 terminals.

#### Formulator Function Summary

Type	
Math	ABS, AVG, DELTA, DIFF, EXP, LN, LOG, LOG10, SQRT
Parametric Extractions	GMMAX, RES, RES_4WIRE, RES_AVG, SS, SSVTCI, TTF_DID_LGT, TTF_LGDID_T, TTF_DID_T, TTF_LGDID_LGT, VTCI, VTLINGM, VTSATGM
Fitting	EXPFIT, EXPFITA, EXPFITB, LINFIT, LINFITSLP, LINFITXINT, LINFITYINT, REGFIT, REGFITSLP, REGFITXINT, REGFITYINT, REGFIT_LGX_LGY, REGFIT_LGX_Y, REGFIT_X_LGY, TANFIT, TANFITSLP, TANFITXINT, TANFITYINT
Manipulation	AT, FINDD, FINDLIN, FINDU, FIRSTPOS, JOIN, LASTPOS, MAX, MAXPOS, MIN, MINPOX, POW, SMOOTH

## Ordering Information

2600-PCT-1B	Low Power
2600-PCT-2B	High Current
2600-PCT-3B	High Voltage
2600-PCT-4B	High Voltage and High Current

## Accessories Supplied

KUSB-488B	USB to GPIB Adapter
All cables and adapters for connecting to the 8010 Test Fixture or 8020 High Power Interface Panel	
<b>Note:</b> PC and monitor not included; user must supply a Windows XP/7 PC with a USB port.	

## Accessories Available

2651A	High Power System SourceMeter (adds 50 A to any system, max 100 A)
2657A	High Power System SourceMeter (adds 3 kV to any system, max of one unit per system)
PCT-CVU	Multi-frequency Capacitance-Voltage (C-V) Meter
8020	High Power Interface Panel: Ideal for connecting to probe stations
8010	High Power Device Test Fixture

### 8010 Options

CVU-3K-KIT	Bias Tee kit for up to 3 kV C-V
CVU-200-KIT	Bias Tee kit for up to 400 V C-V

## Required Software

ACS-BASICFL	Characterization Software
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Rev. 02.2022



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