

2600-PCT-x 4200-PCT-x



Model 4200-PCT-4 on K420 Cart



Model 2600-PCT-4

High Power Device Characterization

Characterizing and testing today's high power semiconductor devices and components is placing a high demand on test equipment. Device design engineers need equipment that can support them throughout the complete lifecycle of a power device. Today, high power characterization systems are available in two main forms — complete turnkey systems and building blocks that must be configured by the user

and completed with good software. Turnkey systems can be set up and running quickly, but they can be quite expensive and limited in the breadth of testing that can be performed.

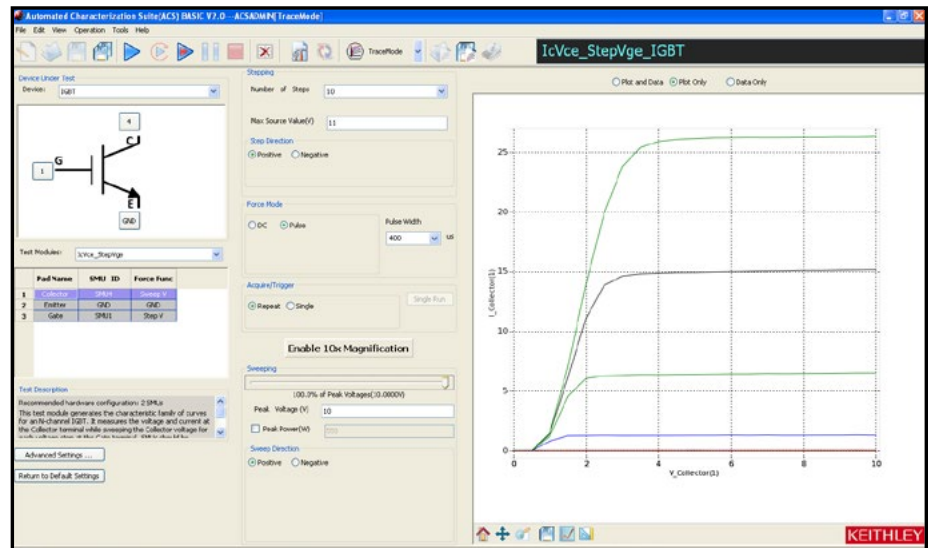
Keithley's Parametric Curve Tracer configurations are complete solutions configured with a variety of high quality instruments, cables, test fixturing, and software. This building block approach offers the advantages of easy upgrading or modification to meet changing test needs. For example, a low cost 200V/10A system can be purchased initially, and 50A or 100A capability can be easily added later. Additionally, these instruments and accessories can be used across different test system platforms, such as for reliability or device qualification testing.

Keithley's Parametric Curve Trace configurations include everything necessary for the characterization engineer to develop a complete test system quickly. 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 device libraries. More important, users have complete control of all test resources, allowing them to create more advanced tests than previously possible on a curve tracer.

- **Configurable power levels**
 - From 200V to 3kV
 - From 1A to 100A
- **Wide dynamic range**
 - From μ V to 3kV
 - From fA to 100A
- **Capacitance-voltage methods**
 - ± 400 V multi-frequency C-V
 - 200V ramp rate C-V
 - 20V very low frequency (VLF) C-V
- **DC or pulsed I-V to 50 μ s**
- **High voltage and high current channels have both 24-bit precision A/D converters and 18-bit high speed (1 μ s) digitizers**
- **Test management software includes both trace mode for real-time control and Parametric mode for parameter extraction**

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**



ACS Basic Edition Software quickly captures output characteristics of an IGBT device.

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2600-PCT-x 4200-PCT-x

Ordering Information

- 2600-PCT-1 Low Power**
- 2600-PCT-2 High Current**
- 2600-PCT-3 High Voltage**
- 2600-PCT-4 High Voltage and Current**
- 4200-PCT-2 High Current + C-V**
- 4200-PCT-3 High Voltage + C-V**
- 4200-PCT-4 High Voltage and Current + C-V**

Accessories Supplied

ACS-BASIC Component Test Software

8010 High Power Device Test Fixture (includes 8010-CTB, 8010-DTB, and 8010-DTB-220)

KUSB-488B USB to GPIB Adapter (Series 2600B configurations only)

All cables and adapters

Sample parts

4200-CVU-PWR (4200-SCS configurations only)

Note: Computer and monitor not included with 2600-PCT-x configurations

ACCESSORIES AVAILABLE

2651A	High Power System SourceMeter (adds 50A to any system, max 100A)
2657A	High Power System SourceMeter (adds 3kV to any system, max of one unit per system)
8010-CTB	Customizable Test Board
8010-DTB	Device Test Board with TO-247 socket
8010-DTB-220	Device Test Board with TO-220 socket
70161-MSA	Keyboard/Monitor Arm for K420 and K475 Carts
HV-CA-554-1	HV Triax Cables (three required for 2657A)
K475 Workstation Tower	Mobile cart for all PCT configurations
K420 Workbench Cart	Mobile cart for smaller PCT configurations

Parametric Curve Tracer Configurations

The Keithley Parametric Curve Trace configurations are complete characterization tools that include all of the key elements necessary for power device characterization.

The measurement channels consist of high quality Keithley SourceMeter (trademark) and/or Semiconductor Characterization instruments. The dynamic range and accuracy of these instruments is orders of magnitude beyond what a traditional curve tracer could offer.

To achieve this performance, Keithley has developed a set of precision cables to connect the instruments to the test fixture. For the high voltage channel, custom triax cables provide a guarded pathway that enables fast settling and very low currents, even at the full 3kV. For the high current channel, special low inductance cables provide fast rise time pulses to minimize device self heating effects.

Equally critical is a safe, efficient test fixture. The 8010 provides an interlocked, shielded environment that allows for both low current, high voltage testing and high current, low voltage testing. Included with the test fixture are the same high performance connectors that mate with the precision cables. Also included are protection circuits to prevent the high voltage channel from destroying the base/gate channel in the event of a device fault.

Configuration Selector Guide

Model ¹		Collector/ Drain Supply ²		Step Generator Base/Gate Supply	Auxiliary Supply
		High Voltage Mode	High Current Mode		
Low Power	2600-PCT-1	200 V/10 A	200 V/10 A	200 V/10 A	N/A
	2600-PCT-2	200 V/10 A	40 V/50 A	200 V/10 A	200 V/10 A
High Current	4200-PCT-2 plus C-V	200 V/1 A	40 V/50 A	200 V/1 A	200 V/1 A
	2600-PCT-3	3 kV/120 mA	200 V/10 A	200 V/10 A	200 V/10 A
High Voltage	4200-PCT-3 plus C-V	3 kV/120 mA	200 V/1 A	200 V/1 A	200 V/1 A
	2600-PCT-4	3 kV/120 mA	40 V/50 A	200 V/10 A	200 V/10 A
High Current and High Voltage	4200-PCT-4 plus C-V	3 kV/120 mA	40 V/50 A	200 V/1 A	200 V/1 A

1. Contact your Keithley field applications engineer for custom configurations
2. Add a Model 2651A to increase High Current Mode to either 50A or 100A.



Model 2600-PCT-4



Model 4200-SCS

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Parametric Curve Tracer Configurations

Typical Power Transistor Parameters

Parameter	Symbol	Test Method ¹	Maximum Range	Typical Best Resolution	Typical Accuracy
Breakdown Voltage	Bvds, Bvceo	Id-Vd or Id (pulse)	±3000 V ²	100 μV, 10 fA	0.05% rdg + 0.05% rng
On-State Current (DC)	Vdson, Vcesat, Vf	Id-Vd	±20 A ⁴ , Optional: ±40 A ⁴	100 nA, 1 μV	0.05% rdg + 0.05% rng
On-State Current (Pulse)	Vdson, Vcesat, Vf	Id-Vd	±50 A ⁴ , Optional: ±100 A ⁴	100 μA, 1 μV	0.05% rdg + 0.05% rng
Drain/Collector Leakage Current	Idss, Ir/Icbo, Iceo	Id-Vd	±20 mA @ 3000 ^{2,5}	10 fA, 1 μV	0.2% rdg + 1% rng
Gate/Base Leakage Current	Igss, Ib	Ig-Vg	±1 A or, ±10 A Pulsed ³	10 fA, 1 μV	0.2% rdg + 1% rng
On-State Threshold Voltage or Cutoff Voltage	Vth, Vf, Vbeon, Vcesat	Id-Vg	±200 V ³	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 ⁶	1 pA, 1 μV	1%
On-State Resistance	RDS(on), Vcesat	Vd-Vg @ Id	<100 μΩ ⁷	10 μΩ, 1 μV	1%
Input Capacitance	Ciss	C-V 100 kHz	10 nF ⁸ ±200 V	10 fF, 10 μV	Better than 1% at C<10 nF
Output Capacitance	Coss	C-V 100 kHz	10 nF ⁸ ±200 V	10 fF, 10 μV	Better than 1% at C<10 nF
Reverse Transfer Capacitance	Crss	C-V 100 kHz	10 nF ⁸ ±200 V	10 fF, 10 μV	Better than 1% at C<10 nF

1. Test method used for extracting the parameter. Only typical MOSFET listed, but similar method for other devices.
2. Model 2657A High Power System SourceMeter® SMU Instrument.
3. Model 2636A SourceMeter SMU Instrument or Model 4210-SMU.
4. Model 2651A High Power System SourceMeter SMU Instrument or optional dual Model 2651A High Power System SourceMeter SMU Instruments.
5. Maximum 20mA at 3000V, 120mA at 1500V.
6. Typical extracted capability (Example: 1mA/1V ~ 1A/1mV).
7. Typical extracted capability (Example: 1mV/10A).
8. Max. ±200VDC (±400VDC differential) bias with 4210-CVU and 4200-CVU-PWR.

Flexible, safe test fixture for 3kV and 100A



8010 Test Fixture



High current, low inductance cables



High voltage, low noise triaxial cables

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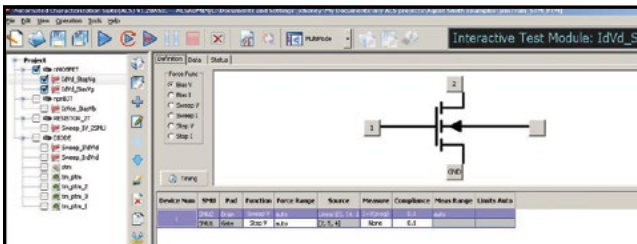
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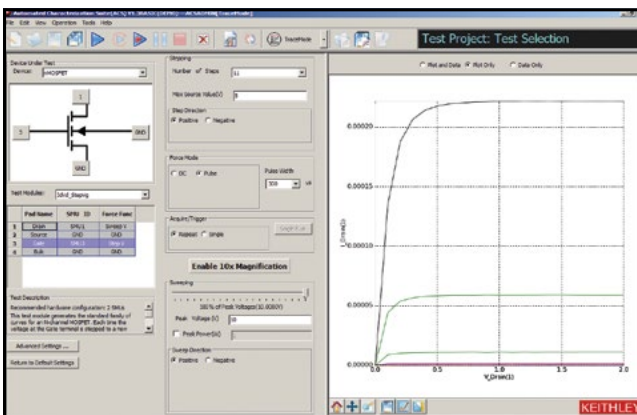
Parametric Curve Tracer Configurations

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.

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, IFDVF, VFDIFD, VRDIRD
Resistor	NA	NA	NA	IV
Capacitor	IV		NA	

FORMULATOR FUNCTION SUMMARY

Type	Functions
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_LGDDID_LGT, VTCI, VTILINGM, VTSATGM
Fitting	EXPFIT, EXPFITA, EXPFITB, LINFIT, LINFITSLP, LINFITXINT, LINFITYINT, REGFIT, REGFITSLP, REGFITXINT, REGFITXINT, REGFIT_LGX_LGY, REGFIT_LGX_X, REGFIT_X_LGY, TANFIT, TANFITSLP, TANFITXINT, TANFITYINT
Manipulation	AT, FINDD, FINDLIN, FINDU, FIRSTPOS, JOIN, LASTPOS, MAX, MAXPOS, MIN, MINPOS, POW, SMOOTH

Parametric curve tracer configurations

SEMICONDUCTOR

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