# 2600-PCT-xB

# Parametric Curve Tracer Configurations



**Model 2600-PCT-4B with Model 8010 Test Fixture**

## 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 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 deivce 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.

- **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 200V to 3kV**
  - **From 1A to 100A**
- **Wide dynamic range:**
  - **From µV to kV**
  - **From fA to 100A**
- **Full range of capacitance-voltage (C-V) capability :**
  - **From fF to µF**
  - **Supports 2, 3, and 4 terminal devices**
  - **Up to 3kV 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**
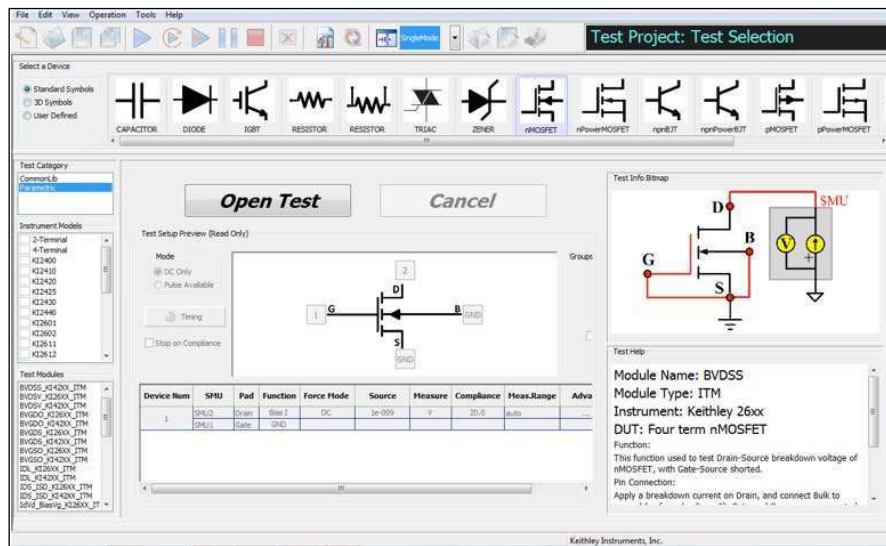
### Electrical characterization of a variety of power device types, including:

| | |
|---|---|
| MOSFET | BJT |
| IGBT | Diode |
| Triac | Capacitor |
| Resistor | And many more… |

### Measurements of key parameters, such as:

| | |
|---|---|
| Breakdown Voltage (Bvdss, Bvceo) | On-State Current (Vdson, Vcesat, Vf) |
| Drain/Collector Leakage (Idss, Ir/Icbo,Iceo) | Gate/Base Leakage (Igss, Ib) |
| Threshold or Cutoff voltage (Vth, Vf, Vbeon) | Forward Transfer (yfs, Gfs, Hfe, gain) |
| Capacitance (Ciss, Coss, Crss) | And many more… |

Parametric curve tracer configurations

SEMICONDUCTOR

# 2600-PCT-xB

# Parametric Curve Tracer Configurations

## 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

**ACS Basic Component Test Software**

**KUSB-488B USB to GPIB Adapter**

**All cables and adapters for connecting to the 8010 Test Fixture or 8020 High Power Interface Panel**

**Note: PC and monitor not included; user must supply a Windows XP/7 PC with a USB port.**
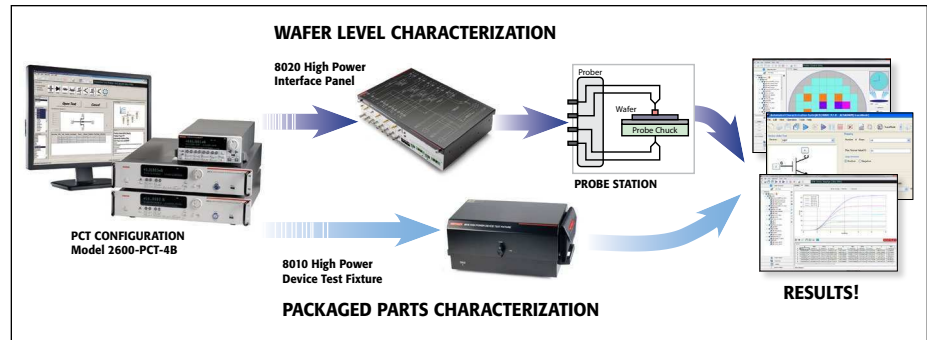
### ACCESSORIES AVAILABLE

| | |
|---|---|
| 2651A | High Power System SourceMeter (adds 50A to any system, max 100A) |
| 2657A | High Power System SourceMeter (adds 3kV to any system, max of one unit per system) |
| K420 | Workbench Cart Mobile cart for smaller PCT configurations |
| K475 | Workstation Tower Mobile cart for all PCT configurations |
| PCT-CVU | Multi-frequency Capacitance-voltage (C-V) Meter |
| 70161-MSA | Keyboard/Monitor Arm for K420 and K475 Carts |
| 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 3kV C-V |
| CVU-200-KIT | Bias Tee kit for up to 400V C-V |
| 8010-CTB | Customizable Test Board |
| 8010-DTB | Device Test Board with TO-247 socket |
| 8010-DTB-220 | Device Test Board with TO-220 socket |
| 8010-DTB-CT | Device Test Board compatible with Tek curve tracer sockets |



WAFER LEVEL CHARACTERIZATION

8020 High Power Interface Panel

Prober

Wafer

Probe Chuck

PROBE STATION

PCT CONFIGURATION
Model 2600-PCT-4B

8010 High Power Device Test Fixture

PACKAGED PARTS CHARACTERIZATION

RESULTS!

**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 Model 8010 High Power Device Test Fixture for package part testing, or the Model 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 3kV. 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 Model PCT-CVU Multi-frequency capacitance-voltage meter. When combined with the optional 200V or 3kV bias tees, capacitance vs. voltage can be measured on two, three or four terminal devices. Capacitances from pF to 100nF can be measured, with test frequencies from 10kHz to 2MHz. 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 [1] | | Collector/ Drain Supply [2] | | 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.

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# 2600-PCT-xB

# Parametric Curve Tracer Configurations

## Typical Power Transistor Parameters

| Parameter | Symbol | Test Method [1] | Maximum Range | Typical Best Resolution | Typical Accuracy |
|---|---|---|---|---|---|
| Breakdown Voltage | Bvdss, Bvceo | Id–Vd or Id (pulse) | $\pm$3000 V [2] | 100 $\mu$V, 10 fA | 0.05% rdg + 0.05% rng |
| On-State Current (DC) | Vdson, Vcesat, Vf | Id–Vd | $\pm$20 A [4], Optional: $\pm$40 A [4] | 100 nA, 1 $\mu$V | 0.05% rdg + 0.05% rng |
| On-State Current (Pulse) | Vdson, Vcesat, Vf | Id–Vd | $\pm$50 A [4], Optional: $\pm$100 A [4] | 100 $\mu$A, 1 $\mu$V | 0.05% rdg + 0.05% rng |
| Drain/Collector Leakage Current | Idss, Ir/Icbo, Iceo | Id–Vd | $\pm$20 mA @ 3000 [2,5] | 10 fA, 1 $\mu$V | 0.2% rdg + 1% rng |
| Gate/Base Leakage Current | Igss, Ib | Ig–Vg | $\pm$1 A or, $\pm$10 A Pulsed [3] | 10 fA, 1 $\mu$V | 0.2% rdg + 1% rng |
| On-State Threshold Voltage or Cutoff Voltage | Vth, Vf, Vbeon, Vcesat | Id–Vg | $\pm$200 V [3] | 10 fA, 1 $\mu$V | 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 $\mu$V | 1% |
| On-State Resistance | RDS(on), Vcesat | Vd–Vg @ Id | <100 $\mu\Omega$ [7] | 10 $\mu\Omega$, 1 $\mu$V | 1% |
| Input Capacitance | Ciss | C–V 100 kHz | 100 nF [8] $\pm$3 kV | 10 fF, 100 $\mu$V | Typical 5%+2pF |
| Output Capacitance | Coss | C–V 100 kHz | 100 nF [8] $\pm$3 kV | 10 fF, 100 $\mu$V | Typical 5%+2pF |
| Reverse Transfer Capacitance | Crss | C–V 100 kHz | 100 nF [8] $\pm$3 kV | 10 fF, 100 $\mu$V | Typical 5%+2pF |

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 2636B SourceMeter SMU Instrument.
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. $\pm$200VDC (or $\pm$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**



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## 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.
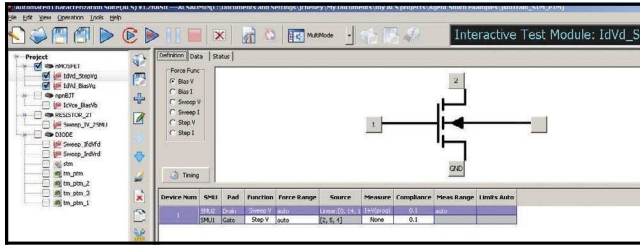


**Multi test mode allows multiple tests to be performed on a device.**
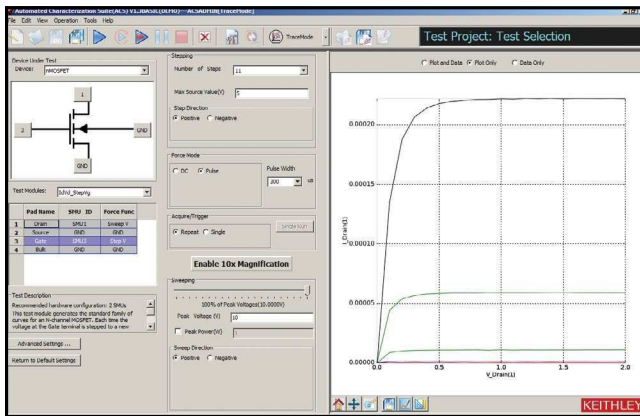


**Trace mode supports interactive testing of a device.**
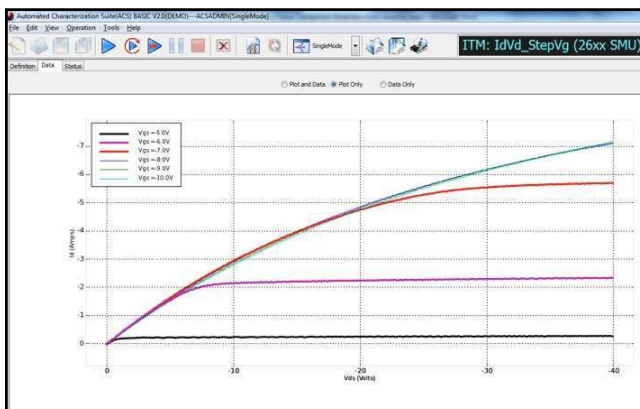


**Compared to a traditional curve tracer, PCT graphics offer high resolution, on-screen data analysis, complete graph customization, and easy export to any word processor or reporting software.**

## 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, VFDIFD, 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 |

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