



# 370A and 371A Digital Storage Curve Tracers



The 370A High-Resolution Programmable Curve Tracer (left) and the 371A High-Power Programmable Curve Tracer (right).

Fully Programmable Digital Curve Tracers with Cursors and Hardcopy

High-resolution DC Parametric Measurements with the 370A

High Voltage and Current Sourcing with the 371A

Metrics Software and LabView Drivers Available to Enhance Operation

CE Certified

## Introduction

Nothing compares to a curve tracer when power, versatility, and ease of use are needed to test the DC characteristics of semiconductor devices. The Sony/Tektronix 370A and 371A curve tracers combine a simple-to-use front panel, digital acquisition and display, and programmability to serve many application needs. The 370-series digital curve tracers offer several advantages over analog curve tracers:

- Higher voltage and current sourcing capability (up to 3000 V and 400 A)
- Higher resolution voltage and current measurements (down to 1 pA and 50  $\mu$ V)
- View a family of curves without flicker
- Display a reference curve to measure variations due to temperature, etc.
- Voltage, current, DC beta, and slope measurement with built-in cursor measurements
- Store curves and setups for consistent tests and measurements based on reference curves
- Full-color printouts using an HPGL plotter instead of expensive Polaroids
- Automate tests with computer and software (e.g., Metrics, LabView, etc.)

## 370A High-Resolution Programmable Curve Tracer

The 370A high-resolution curve tracer performs DC parametric characterization of transistors, thyristors, diodes, SCRs, MOSFETs, opto-electronic components, solar cells, solid-state displays, and other semiconductor devices. The 370A is a versatile workhorse in many labs and production stations with up to 20 A/2000 V sourcing capability combined with 1 pA and 50 V measurement resolution. It has pushbutton source and measurement configuration so it's easy to change from one test to the next.

### 371A High-Power Programmable Curve Tracer

The 371A high-power curve tracer performs DC parametric characterization on a wide variety of power semiconductors including thyristors, SCRs, IGBTs, and power MOSFETs. The high-voltage collector mode permits testing the Off-Characteristics of a device up to 3000 volts. The pulsed high-current collector mode provides output current pulses greater than 400 amps peak for testing On-Characteristics. It also permits high-power testing up to 3,000 watts. In the sweep measurement mode, the 371A automatically constructs a family of curves while stimulating the device with low-duty-cycle pulses. With this capability, power curves can be displayed without excessive heating of the device.

### Interactive, Programmable Control

Interactive control of all 370A/371A measurements is accomplished from the full featured front panel or over the GPIB. Every operating parameter can be controlled using a GPIB controller. For interactive control, Metrics software provides complete control and analysis without

having to program the instrument. 370/371-series Lab-View drivers are available from the Tektronix BBS. These drivers have many of the building blocks for creating a custom measurement solution.

### Store and Recall Setups and Digitized Curves

Up to 64 digitized characteristic curves can be stored on a diskette and recalled at the touch of a button. A live curve can then be compared with a previously stored curve to assess temperature drift or other changes in operating parameters. To help identify the data, up to 24 characters of text may be used to label or annotate the curve data.

Operating parameters can be adjusted, stored, and recalled using several storage methods including the 370A/371A non-volatile memory, the built-in DOS compatible floppy disk, or to an external GPIB controller.

### Built-in Cursor Measurements

The 370A/371A provides three cursor-measurement modes. The Dot cursor provides direct screen readout of voltage, current, gm, or DC beta at any point. The Window cursor can be positioned

between two curves to measure small-signal beta or gm, and can also be used for visual go/no-go tests. The Function Line cursor provides screen readout of a slope or intercept value.

### Test Fixturing

A test fixture which provides safe device enclosure to ensure operator protection during measurements is provided as a standard accessory. The test fixture accommodates standard A1001 through A1005 adapters with Kelvin sensing, 3-pin adapters without Kelvin sensing, and the A1023 and A1024 surface-mount adapters.

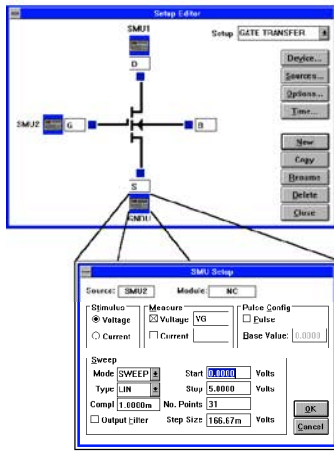
### Direct Hardcopy

Plotter output data can be sent directly from the 370A/371A without the need for an external controller. Plotting can continue while the 370A/371A performs the next tasks.

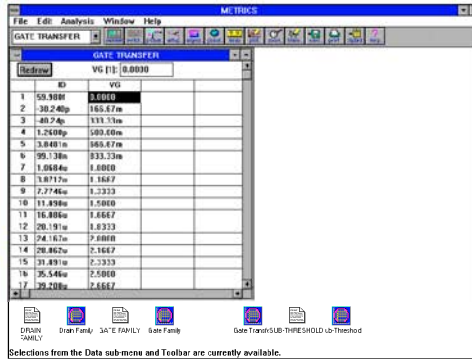
### Test and Measurement Software

Metrics ICS Interactive Characterization Software (Tektronix PN 063-1649-00) combined with the 370/371 driver (Tektronix PN 063-1650-00) offers computer-controlled DC parameter characterization and analysis of numerous semicon-

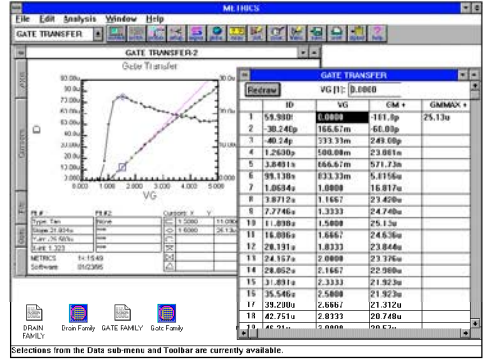
# 1 Define Test Setup



# 2 Press the Measure Button to Capture Data



# 3 Plot the Data and Make Measurements



Setup, capture, and measurement with Metrics ICS software.

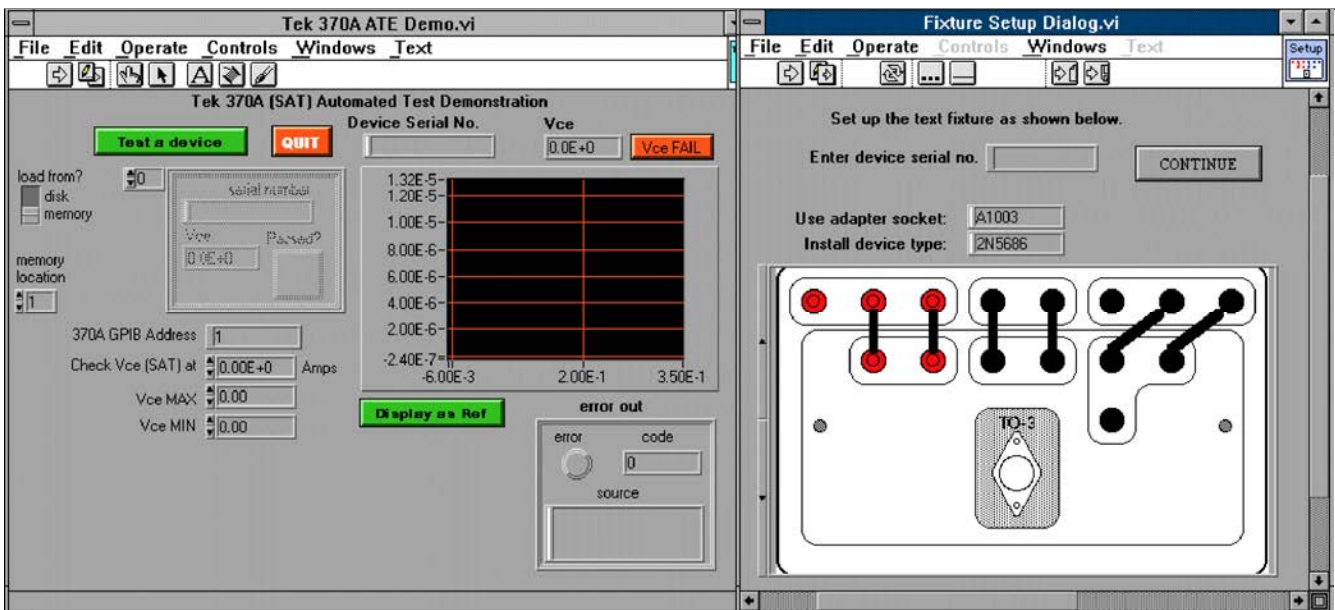
ductor devices. Every aspect of instrument control and data analysis is available through a set of interactive dialog boxes that are configured in a graphics-oriented Microsoft Windows environment. Metrics ICS can make measurements that are not available on a manually operated instrument, including the ability to sweep any supply. Extensive data management capabilities include project files, data export,

DDE links, and search capabilities. Metrics ICS built-in automation capabilities include conditional pass/fail testing and result logging.

### Labview™ Driver

370A and 371A drivers for National Instruments LabView software is available from the Tektronix Bulletin Board Service. These drivers allow setting most controls in the instrument, saving data to disk, and displaying

the data on the computer screen. Since LabView is a graphical programming language, the drivers can be modified to suit a particular measurement requirement. To download either driver, set your modem for N,8,1, 19,200 baud and dial 503-627-5658. Once logged in, select the download option and type TEK370.ZIP to download the 370 driver or TEK371.ZIP to download the 371 driver.



Labview ATEdemo incorporates many of the 370/371 control VIs.

## 370A Characteristics

### Collector Supply

Polarity Modes – AC, DC, Leakage, Rectified Sine.  
Range – 16 V, 80 V, 400 V, 2000 V.  
Max Peak Current – 10 A, 2 A, 0.4 A, 0.05 A.  
Peak Current Pulsed – 20 A, 4 A, 0.8 A, 0.1 A.  
Minimum Series Resistance – 0.26  $\Omega$ , 6.4  $\Omega$ , 160  $\Omega$ , 20 k  $\Omega$ .  
Maximum Series Resistance – 800  $\Omega$ , 20 k  $\Omega$ , 500 k  $\Omega$ , 12.5 M  $\Omega$ .  
Peak Power Wattage – 0.08W, 0.4W, 2W, 10W, 50W, 220W.

### Step Generator

**Current Mode –**  
Amplitude range: 50 nA to 200 mA in 1-2-5 sequence in 21 steps.  
Maximum current: 20X STEP AMPLITUDE, except for 2 A with switch set to 200 mA.  
Maximum voltage: At least 10 V.  
Maximum opposing offset current: 10X STEP AMPLITUDE.  
Maximum opposing volts: Less than 7 V.  
Ripple plus noise: Less than 0.5% X STEP AMPLITUDE + 1 nA.  
**Voltage Mode –**  
Amplitude switch range: 50 mV to 2 V, in 1-2-5 sequence.  
Maximum voltage: 20 X STEP AMPLITUDE.  
Max current: At least 500 mA at 10 V or less, or 10 mA at 40 V.  
**Accuracy** (current or voltage steps including offset) –  
Incremental: 2%.  
Absolute: Less than 2% X total output +3% X AMPLITUDE setting.  
**Offset Control Range –** Variable from –10 to +10 X STEP AMPLITUDE, with 0.1% resolution.  
**Short Circuit Current Limiting –** 500 mA.

### Maximum Opposing Offset

**Volts –** 10X STEP AMPLITUDE.  
**Maximum Opposing Current –** Less than 20mA.  
**Step Rates –** 2X line frequency (1X line frequency in AC collector supply). Steps occur at 0 collector voltage.  
**Pulsed Steps –** 80  $\mu$ s or 300  $\mu$ s wide  $\pm$ 10%.  
**Steps and Offset Polarity –** Same as collector supply polarity when STEP GENERATOR POLARITY INVERT is disabled. Opposite to collector supply polarity when STEP GENERATOR POLARITY INVERT is selected or CONFIGURATION is set to BASE GROUNDED, STEP GENERATOR POLARITY INVERT is disabled.

**Number of Steps –** Selectable from 0 to 10.

### Auxiliary Supply –

Range: From –40 to +40 V with 20 mV resolution.  
Accuracy: Greater than 50 mV +2% of total output.  
Output current:  $\pm$ 20 V, at least 100 mA;  $\pm$ 40V, at least 10 mA.

**Nonstore Mode Collector Current Range –** 1 A/div to 2A/div in 1-2-5 sequence of 20 steps. X10 MAG extends maximum sensitivity to 100 nA/div. Both unmagnified and magnified accuracy are within 3%

**Step Generator Display Range –** 1 to 10 steps/division, or 1 step/10 divisions. Unmagnified and magnified accuracy are within 3%.

**Display Offset –** Vertical offset of display centerline value up to 10 divisions in 21 half-division steps.

### Digital Storage Vertical Acquisitions

#### A/D Converter –

Resolution: 10 bits for 10.24 divisions, 100 counts per division. Maximum data points are 1024.

Maximum sampling rate: Line frequency X 1024.

Minimum sampling rate: Line frequency X 2.

**Collector Current Range –** 1 A/div to 2A/div in 1-2-5 sequence of 20 steps. X10 MAG extends maximum sensitivity to 100nA/div (1 nA resolution). Unmagnified accuracy is within 1.5% of readout +0.05 div of setting with DOT cursor.

**Emitter Current Range –** 1 nA/div to 2mA/div in 1-2-5 sequence of 20 steps. X10 MAG extends maximum sensitivity to 100 pA/div (1 pA resolution). Unmagnified accuracy is within 1.5% of readout +0.05div of setting + 1 nA with DOT cursor.

### Nonstore Horizontal Deflection System

**Collector Volts Range –** 50 mV/div to 500V/div in 1-2-5 sequence of 13 steps. X10 MAG extends maximum sensitivity to 5mV/div (50  $\mu$ V resolution). Unmagnified and magnified accuracy (NONSTORE) are within 3%.

**Base/Emitter Volts Range –** 50 mV/div to 5V/div in 1-2-5 sequence of 6 steps. X10 MAG extends maximum sensitivity to 5mV/div (50  $\mu$ V resolution). Unmagnified and magnified accuracy (NONSTORE) are within 3%.

**Step Generator Display Range –** 1 or 10 steps/division, or 1 step/10 divisions. Unmagnified and magnified accuracy (NONSTORE) are within 3%.

**Display Offset –** Horizontal offset of display center-line value up to 10 divisions in 21 half-division steps.

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## Digital Storage Horizontal Acquisition

**A/D Converter Acquisition** –  
Resolution: 10 bits for 10.24 divisions, 100 counts per division.  
Sampling rate: 2X line frequency.

**Collector Volts Range** – 50 mV/div to 500V/div in 1-2-5 sequence of 21 steps. X10 MAG extends maximum sensitivity to 5mV/div (50  $\mu$ V resolution). Unmagnified accuracy is within 1.5% of readout +0.03div of setting with DOT cursor.

**Acquisition Modes** – Normal, Envelope, and Average. Envelope is Vertical or Horizontal. Average is moving average with weight of 1/16.

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## CRT and Readout

**CRT** – 7-inch diagonal (173 mm), electrostatic deflection, P31 phosphor.

**Readout** – Automatic on-screen display. Over-range is shown by a flashing display. 100 pA to 2 A per vertical division; 5 mV to 500V per horizontal division; 5 nA to 200mA and 5 mV to 2 V per step.

**BETA or Gm** –

BETA: 500 nano to 400 Mega.

Gm: 50 ns to 400 s.

Cursor: 4-digit horizontal and vertical values without X10 MAG: 5-digit with MAG. Offset: 4-digit value.

Auxiliary supply: –40 V to +40 V.

## 371A Characteristics

### Collector Supply

Modes (positive and negative polarities for both modes) –  
High Current: 250 s pulses with maximum peak of 30 V.  
High Voltage: Full rectified sine with maximum peak of 3000 V (positive and negative polarities for both modes).

**Output –**  
High-Current (pulsed) Mode:

Peak Voltage	Peak Current	Maximum m Power
30 V +10%, -5%	400 A	3 kW
30 V +10%, -5%	40 A	300 W

High-Voltage Mode:

Peak Voltage	Peak Current	Maximum m Power
3 kV +10, -0%	40 mA ±20%	30 W
3 kV +10, -0%	4 mA ±20%	3 W
300 V +15%, -0%	4 mA ±20%	300 mW
300 V +15%, -0%	0.4 mA ±20%	30 mW

**Polarities –**  
NPN+: Positive.  
NPN-: Negative.

**Variable Collector Supply Range –** Continuously variable from 0% to 100% in 0.1% resolution.

**Pulsed Collector Supply Pulse Width –** 250 µs 10%.

**Pulsed Collector Repetition Rate –**  
3 kW: 0.25 times line frequency.  
300 W: 0.5 times line frequency.

**Loop Compensation (High Voltage mode) –** Stray capacitance between collector terminal and ground is compensated for up to a maximum of 100pF.

**Circuit Breakers –** Both the high-voltage and the high-current supplies have breakers which operate independently. The high-current output breaker opens automatically in an over-current condition. Both breakers can be operated manually.

### Vertical Display System Collector Current Measurement

**Vertical Range (in 1-2-5 increments) –**  
3 kW maximum: 1 A/div to 50 A/div.  
300 W maximum: 500 µA/div to 5 A/div.  
30 W maximum: 100 µA/div to 500 µA/div.  
3 W, 300 mW maximum: 10 A/div to 500A/div.  
30 mW maximum: 1 µA/div to 50 µA/div.

**Accuracy –** Within 0.1 vertical division.

**Cursor Accuracy (nonstore mode, window cursor) –** Readout X 2% plus 0.2 div of vertical setting.

### Horizontal Display System Collector Voltage Measurement

**Vertical Range (in 1-2-5 increments) –**  
3 kW, 300 W maximum: 100 mV/div to 5V/div.  
30 W, 3 W maximum: 50 V/div to 500V/div.  
300 mW, 30 mW maximum: 5 V/div to 50V/div

**Step Generator Voltage Range (VBE) –** 100 mV/div to 5 V/div (in increments of 1-2-5).

**Accuracy –** Within 0.1 horizontal division.

**Cursor Accuracy (nonstore mode, window cursor) –** Readout times 2% plus 0.2 div of the horizontal setting.

### Step Generator

**Current Mode –**  
High-Current (pulsed) Mode:

Step Range and Waveform	Maximum Current	Maximum m Voltage
1 mA/step to 2 mA/step pulsed	Step/offset amplitude setting X 20, maximum 20 A at 2A/step	10 V ±20%

High-Voltage Mode:

Step Range and Waveform	Maximum Current	Maximum m Voltage
1 µA/step to 2 mA/step stairstep	Step/offset amplitude setting X 20, maximum 20 A at 2A/step	10 V ±20%

**Ripple, Noise –** Step/offset amplitude setting X 1% plus 10 nA.

**Pulse Width (collector supply high-current mode, 1 mA/step step/offset amplitude setting) –** 500 s ±10%.

**Voltage Mode –**  
High-Current (pulsed) and High-Voltage Mode:

Step Range and Waveform	Maximum Current	Maximum m Voltage
200 mV/step to 5 V/step stairstep	100 mA +50%, -20%	Step/offset amplitude setting X 20, maximum 50 V.

**Ripple, Noise –** Step/offset amplitude setting X 1% plus 10 mV,

**Number of Steps –** 0 to 10 except 0 to 5 for the 5 V/step and 2A/step ranges.

**Step Polarity –** Same as collector supply polarity. Reverse with STEP-INVERT button.

**Step Rate –**  
Pulse: 0.25 X the line frequency at 3kW, 0.5 X the line frequency at 300W.  
Stairstep: 2 X the line frequency.

**Offset –** 0 to 10 X the step/offset amplitude setting with 1% resolution except 0 to 5 X at 5V/step and 2A/step settings. Polarity is same as the step signal.

### Test Fixture

**Test Fixture –** Designed to allow easy connection to a variety of devices. Includes an integral safety enclosure to assure operator protection. Special patch cords are provided for connecting large devices.

### Metrics Software

**Recommended Computer Configuration –**  
Minimum processor: 386DX/33 MHz IBM compatible computer.  
Free memory: 8 Mb minimum.  
Disk space: At least 14 Mb.  
Floppy drive: 1.44 Mb 3.5-inch.  
Operating system: Microsoft Windows 3.  
Interface cards: National Instruments GPIB card.

## Ordering Information

### 370A High Resolution Curve Tracer

Includes: Operations Manual, A1001 Blank Adapter, A1005 Axial Lead Diode Adapter, A1009 Four- and Six-lead Dual-width Transistor FET Adapter, 3.5-inch Floppy Disk, Power Cord, 125 V/4 A Fuse, 250 V/2 A Fuse.

#### 370A Options

- Option 1R – Rackmount kit.
- Option 95 – Provide test report.
- Option 96 – Provide Inspection Passed certificate.
- Option C5 – Five-year calibration Service Assurance Plan.
- Option R2 – Two additional years repair Service Assurance Plan.

#### International Power Plug Options

- Option A1 – Universal Euro 220 V, 50 Hz.
- Option A2 – UK 240 V, 50 Hz.
- Option A3 – Australian 240 V, 50 Hz.
- Option A4 – North American 240 V, 60 Hz.
- Option A5 – Switzerland 220 V, 50 Hz.

### 371A High Power Curve Tracer

Includes: Operations Manual, Wiring Kit, A1002 In-line Adapter, A1003 TO-3/TO-66 Adapter, 3.5-inch Floppy Disk, Power Cord, 250 V/1 A Fuse, 250 V/2 A Fuse, 250 V/4 A Fuse.

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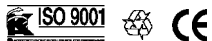
### 370A/371A Optional Accessories

- Metrics Software (core program – requires 063-1650-00 drivers to operate 37x curve tracers) – 063-1649-00.
- 370/371 Drivers for Metrics Software – 063-1650-00.
- LabView for Windows – LVWIN.
- K475 Instrument Cart.
- HC100 Plotter for Low-cost, Four-color Plotting.
- A1001 – Blank adapter.
- A1002 – TO220 Kelvin sense adapter.
- A1003 – TO3/TO066 Kelvin sense adapter.
- A1004 – Offset-lead Kelvin sense adapter.
- A1005 – Axial diode lead Kelvin sense adapter.
- A1006 – Long-lead, dual-width transistor adapter.
- A1007 – Bipolar and MOSFET transistor adapter.
- A1008 – Long-lead, dual-width, FET adapter.
- A1009 – 4- and 6-lead, dual-width FET adapter.
- A1010 – 16-pin IC, zero-insertion adapter.
- A1023 – SOT 23 for surface-mount devices.
- A1024 – TO252/SMT D-pack surface-mount devices adapter.

**For further information, contact Tektronix:**

World Wide Web: <http://www.tek.com>; ASEAN Countries (65) 356-3900; Australia & New Zealand 61 (2) 888-7066; Austria 43 (1) 7 0177-261; Belgium 32 (2) 725-96-10; Brazil and South America 55 (11) 3741 8360; Canada 1 (800) 661-5625; Denmark 45 (44) 850700; Finland 358 (9) 4783 400; France & North Africa 33 (1) 69 86 81 81; Germany, Eastern Europe, & Middle East 49 (221) 94 77-0; Hong Kong (852) 2585-6688; India 91 (80) 2275577; Italy 39 (2) 250861; Japan (Sony/Tektronix Corporation) 81 (3) 3448-4611; Mexico, Central America, & Caribbean 52 (5) 666-6333; The Netherlands 3 12 35 6 95555; Norway 47 (22)070700; People's Republic of China (86) 10-62351230; Republic of Korea 82 (2) 528-5299; Spain & Portugal 34 (1) 372 6000; Sweden 46 (8) 629 6500; Switzerland 41 (42) 219192; Taiwan 886 (2) 765-6362; United Kingdom & Eire 44 (1628) 403300; USA 1 (800)426-2200

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