

Curve Tracers

▶ 370B • 371B



370B and 371B Programmable Curve Tracers

Tektronix curve tracers offer power and versatility to test the DC characteristics of semiconductor devices. The 370B and 371B curve tracers combine a simple-to-use front panel, digital acquisition and display, and programmability to serve a variety of application needs.

In the R&D lab, Tektronix curve tracers are used for characterization of new designs, extraction of SPICE parameters, failure analysis and data sheet generation. In manufacturing test, Tektronix curve tracers are used to verify device quality and process monitoring. They are also used for incoming inspection to verify device performance, perform failure analysis and match components.

▶ Features & Benefits

High-resolution DC Parametric Measurements With the 370B (Resolution Down to 1 pA or 2 μ V)

High Voltage and Current Sourcing With the 371B (Up to 3,000 V or 400 A)

Built-in Cursor Measurements – Dot, Window and Function Line

Kelvin Sense Measurements

Sweep Measurement Mode

Waveform Comparison and Averaging

Fully Programmable

1.44 MB Floppy Drive Stores Setup and Bitmap of Curves

Direct Hardcopy with Third-party Printer

▶ Applications

Parametric Characterization of Semiconductors

Failure Analysis

Data Sheet Generation

Manufacturing Test

Process Monitoring and Quality Control

Incoming Inspection

Component Matching

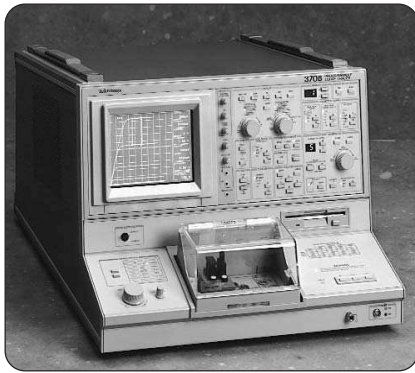
COMPUTING

COMMUNICATIONS

VIDEO

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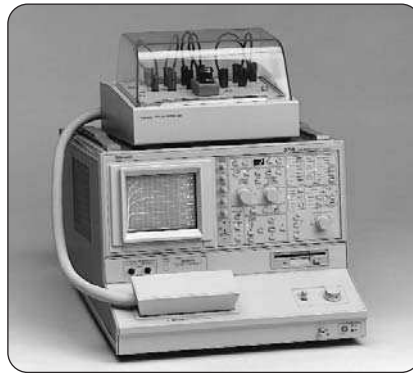
▶ 370B.

The World Standard for High-resolution Curve Tracers

The 370B, the world standard for high-resolution curve tracers, provides up to 20 A/2,000 V sourcing capability combined with 1 pA and 50 μ V measurement resolution. The 370B performs DC parametric characterization of integrated circuits, transistors, thyristors, diodes, SCRs, MOSFETs, electro-optic components, solar cells, solid-state relays and other semiconductor devices. It has push button source and measurement configuration so it's easy to change from one test to the next.

The Industry Leader in High-power Curve Tracers

The 371B, the industry leader in high-power curve tracers, 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 3,000 volts. The pulsed high-current collector mode provides output current pulses greater than 400 amps peak to test On-



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characteristics and permits high-power testing up to 3,000 watts. In the sweep measurement mode, the 371B 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 370B and 371B measurements is accomplished from the full-featured front panel or over the GPIB. Every operating parameter can be controlled using the GPIB controller. 370B and 371B Series LabView drivers are available at the Tektronix.com web site. These drivers have many of the building blocks to create a custom measurement solution.

Store and Recall Setups and Digitized Curves

Up to 80 digitized characteristic curves can be stored on a diskette or in internal non-volatile memory 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 370B and 371B system memory, the built-in 1.44 MB floppy drive, or sent externally via the GPIB controller.

Automated Cursor

The 370B and 371B provide 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 is a standard accessory that provides safe device enclosure to ensure operator protection during measurements. The test fixture accommodates standard adapters with Kelvin sensing.

Sweep Measurement Mode

In the sweep measurement mode, the curve tracer automatically constructs a family of curves. The 371B achieves this with low duty-cycle pulses. With this capability, power curves can be displayed without excessive heating of the device.

Direct Hardcopy Printouts

Curve output data can be sent directly from the 370B and 371B to a Citizen iDP-3240 thermal printer. Printing can continue while the 370B and 371B perform the next tasks.

► Characteristics

► 370B Curve Tracer Characteristics

Collector Supply Peak Voltage (Range)	16 V	80 V	400 V	2,000 V
Polarity Modes	AC, ± DC, ± Leakage, ± Rectified Sine			
Available Current				
Peak Current	10 A	2 A	0.4 A	0.05 A
Peak Current (PULSE mode)	20 A	4 A	0.8 A	0.1 A
Available Resistance				
Minimum Series Resistance	0.26 Ω	6.4 Ω	160 Ω	20 kΩ
Maximum Series Resistance	800 Ω	20 kΩ	500 kΩ	12.5 MΩ

Available Peak Power

16, 80 and 400 V Range –

0.08, 0.4, 2, 10, 50, 220 W.

2,000 V Range – 0.08, 0.4, 2, 10, 50 W.

Variable Collector Supply Settings As a % of Maximum Peak Voltage –

0 to 100% in 0.1% increments.

Looping Compensation (typical) Range – at least 100 pF.

Step Generator

Accuracy

Incremental – 1.5%.

Absolute –

Less than 1.5% of total output + 3% x STEP AMPLITUDE setting + 1 mV or 1 nA.

Offset Control Range –

Variable from –10 to +10 times STEP AMPLITUDE.

Resolution – STEP AMPLITUDE setting x 1%.

Current Mode

Amplitude Range –

50 nA to 200 mA in a 1-2-5 sequence of 21 steps.

Maximum Current –

20x STEP AMPLITUDE setting, 10x STEP AMPLITUDE setting when control is set to 200 mA.

Maximum Voltage – At least 10 V.

Maximum Opposing Offset Current –

10x STEP AMPLITUDE.

Maximum Opposing Volts – Less than 15 V.

Ripple Plus Noise –

Less than 0.5% x STEP AMPLITUDE + 10 nA.

Voltage Mode

Amplitude Switch Range –

50 mV to 2 V, in a 1-2-5 sequence of six steps.

Maximum Voltage – 20x STEP AMPLITUDE.

Maximum Current –

At least 500 mA at 10 V or less, at least

200 mA at 15 V, at least 10 mA at 40 V.

Short Circuit Current Limiting –

500 mA, +50%, –20%.

Maximum Opposing Offset Current –

10x STEP AMPLITUDE.

Maximum Opposing Current –

Less than 20 mA.

Ripple Plus Noise –

Less than 0.5% x STEP AMPLITUDE + 10 mV.

Step Rates –

2x line frequency (1x line frequency in AC collector supply mode). Steps occur at 0 collector voltage.

Pulsed Steps – 80 μs or 300 μs wide, ±10%.

Steps and Offset Polarity –

Corresponds to Collector Supply Polarity when STEP GENERATOR POLARITY INVERT is disabled. Opposite to Collector Supply Polarity when STEP GENERATOR POLARITY INVERT is selected or CONFIGURATION switch is set to BASE COMMON. BASE COMMON configuration disables STEP GENERATOR POLARITY INVERT.

Number of Steps – Ranges from 0 to 10.

AUX Supply

Range – From –40 to +40 volts, with 20 mV step resolution.

Accuracy (typical) –

Within 50 mV + 1.5% of total output.

Output Current –

At least 100 nA at ±20 V.

At least 10 mA at ±40 V.

Ripple Plus Noise – Less than 50 mV_{p-p}.

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Max. Volts Range	16 V	80 V	400 V	2000 V
Noise or Ripple	1 nA _{p-p}	1 nA _{p-p}	2 nA _{p-p}	5 nA _{p-p}

Non-store Vertical Deflection System

Collector/Base Current

Range –

1 μ A/div to 2 A/div in a 1-2-5 sequence.
X10 MAG extends maximum sensitivity to 100 nA/div (1 nA resolution).

Accuracy (typical) –

Within 2% of WINDOW cursor readout
+ 0.1 x VERT/DIV setting.

Emitter Current

Range –

1 nA/div to 2 mA/div in a 1-2-5 sequence
X10 MAG extends maximum sensitivity to 100 pA/div.

Accuracy (typical) –

Within 2% of WINDOW cursor readout
+ 0.1 x VERT/DIV settings + 1 nA.

Maximum Displayed Noise or Ripple –

Depending on setting of MAX PEAK VOLTS.

Step Generator Display

Range –

1 step/division.
1 step/10 divisions with X10 MAG.
10 steps/division with STEP MULTI .1x.

Accuracy – Within 0.3 division.

Display Offset (typical)

Range – ± 10 divisions with 0.1 div resolution.

Accuracy –

Within 1.5% of offset + 0.1 x VERT/DIV setting.

Display X10 MAG (typical)

Accuracy –

Within 1.5% of window cursor readout
+ 0.3 x VERT/DIV setting.

Display Invert (typical)

Accuracy – Within 0.1 x VERT/DIV setting.

Digital Storage Vertical Acquisition

A/D Converter

Resolution –

10-Bits for 10.24 divisions, 100 counts
per division.

Max. Data Points – 1024.

Max. Sampling Rate – Line frequency x 1024.

Min. Sampling Rate – Line frequency x 2.

Collector/Base Current

Range –

1 μ A/div to 2 A/div in a 1-2-5 sequence.
X10 MAG extends maximum sensitivity to 100 nA/div (1 nA resolution).

Accuracy –

Within 1.5% of DOT cursor readout
+0.05 x VERT/DIV setting.

Emitter Current

Range –

1 nA/div to 2 mA/div in a 1-2-5 sequence.
X10 MAG extends max sensitivity to 100 pA/div
(1 pA resolution).

Accuracy –

Within 1.5% of DOT cursor readout +0.05 x
VERT/DIV setting + 1 nA.

Step Generator Display

Range –

1 step/division, 1 step/10 divisions with
X10 MAG, 10 steps/division with
STEP MULTI .1x.

Accuracy – Within 0.3 division.

Display Offset (typical)

Range – ± 10 divisions with 0.1 div resolution.

Accuracy –

Within 1.5% of offset + 0.06
x VERT/DIV setting.

Display X10 MAG (typical)

Accuracy –

Within 1.5% of window cursor readout + 0.3 x
VERT/DIV setting.

Display Invert (typical)

Accuracy – Within 0.04 x VERT/DIV setting.

Non-store Horizontal Deflection System**Collector Volts****Range –**

50 nV/div to 500 V/div in a 1-2-5 sequence.
X10 MAG extends maximum sensitivity to
5 mV/div (50 μ V resolution).

Accuracy (typical) –

Within 2% of WINDOW cursor readout
+ 0.1 x HORIZ/DIV setting.

Base/Emitter Volts**Range –**

50 mV to 5 V/div in a 1-2-5 sequence.
X10 MAG extends maximum sensitivity to
5 mV/div (50 μ V resolution).

Accuracy (typical) –

Within 2% of WINDOW cursor readout
+ 0.1 x HORIZ/DIV setting.

Step Generator Display**Range –**

1 step/division, 1 step/division with X10 MAG,
10 steps/division with STEP MULTI .1x.

Accuracy – Within 0.3 division.

Display Offset**Range –**

\pm 10 divisions in 0.1 division steps.

Accuracy –

Within 1.5% of offset + 0.1 x HORIZ/DIV setting.

Display X10 MAG**Accuracy –**

Within 1.5% of window cursor readout + 0.3 x
HORIZ/DIV setting.

Display Invert

Accuracy – Within 0.1 x HORIZ/DIV setting.

Digital Storage Horizontal Acquisition**A/D Converter****Resolution –**

10 bits for 10.24 divisions, 100 counts
per division.

Max. Data Points – 1024.

Max. Sampling Rate – Line frequency x 1024..

Min. Sampling Rate – Line frequency x 2.

Collector Volts**Range –**

50 mV/div to 500 V/div in a 1-2-5 sequence.
X10 MAG extends maximum sensitivity to
5 mV/div (50 μ V resolution).

Accuracy –

Within 1.5% of DOT cursor readout
+ 0.05 x HORIZ/DIV setting.

Acquisition Modes

Normal, Envelope, and Average.

Envelope is Vertical or Horizontal.

Average is moving average with weight of 1/16.

Safety**Standards Met –**

UL3111-1, CAN/CSA C22.2 NO. 1010.1,
EN 61010-1 with second amendment.

Collector Supply**Modes (positive and negative polarities for both modes) –**

High current: 250 μ s pulses with maximum peak
of 30 V.

High voltage: Full rectified sine wave with maximum
peak of 3,000 V.

Polarity Modes –

NPN +.

PNP –.

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▶ 371B Curve Tracer Characteristics

Peak Power Watts (range)	High Voltage Mode				High Current (pulsed) Mode	High Current (pulsed) Mode
	30 mW	300 mW	3 W	30 W	300 W	3 kW
Collector Peak Current	0.4 mA ±20%	4 mA ±20%	4 mA ±20%	40 mA ±20%	40 A	400 A
Maximum Peak Voltage	300 V + 15% – 0%	300 V + 15% – 0%	3 kV + 10% – 0%	3 kV + 10% – 0%	30 V + 10% – 5%	30 V + 10% – 5%

Variable Collector Supply Range –

Continuously variable from 0% to 100% in 0.1% increments.

Looping Compensation (high voltage mode) –

Stray capacitance between collector terminal and ground is compensated for up to a maximum of 100 pF.

Pulsed Collector Supply Repetition Rate –

3 kW: 1/4 (0.25 x) line frequency.
300 W: 1/2 (0.5 x) line frequency.

Pulse Width (half amplitude) –

250 μs ±10% (more than 30% of collector supply).

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.

Step Generator

Offset Control Range –

Variable 0 to 10 times STEP/OFFSET AMPLITUDE setting. However, 0 to 5 times when STEP/OFFSET AMPLITUDE is 5 V or 2 A.

Number of Steps –

0 to 10. However, 0 to 5 when STEP/OFFSET.

Step Polarity – Positive, Negative.

Step Rate –

Pulse:

3 kW: 1/4 (0.25x) the line frequency,
300 W: 1/2 (.5X) the line frequency.

Stairstep:

300 W, 3 W, 300 mW, 30 mW: 2x the line frequency.

Current Mode

Amplitude Range

Normal Step –

1 μA to 2 mA in 1-2-5 sequence. COLLECTOR SUPPLY HIGH VOLTAGE MODE (30 W/3 W and 300 mW/30 mW).

Pulsed Step –

1 mA to 2 A in 1-2-5 sequence. COLLECTOR SUPPLY HIGH CURRENT MODE (3 kW/300 W).

Maximum Current –

20 x step amplitude, except 10 times STEP/OFFSET AMPLITUDE when control is set to 2 A per step.

Maximum Voltage –

12 V ±30%.

Accuracy: At least 5 V.

Ripple Plus Noise –

Within 1% of STEP AMPLITUDE + 10 nA.

Voltage Mode

Step Amplitude Range –

200 mV to 5 V in 1-2-5 sequence.

Short Circuit Current Limiting –

100 mA +50%, –20%.

Maximum Voltage –

10 x STEP AMPLITUDE, with 5 V setting.

20 x STEP AMPLITUDE, except 5 V setting.

Ripple Plus Noise –

Within 1% of STEP AMPLITUDE + 10 mV.

Vertical Deflection System

Collector Current (Ic) Range

3 kW Peak Power – 1 A/DIV to 50 A/DIV.

300 W Peak Power – 500 mA/DIV to 5 A/DIV.

30 W Peak Power – 100 μA/DIV to 5 mA/DIV.

3 W Peak Power – 10 μA/DIV to 500 μA/DIV.

0.3 W Peak Power – 10 μA/DIV to 500 μA/DIV.

0.03 W Peak Power – 1 μA/DIV to 50 μA/DIV.

Collector Current (Ic) Accuracy –

Within 0.1 DIV to the Vertical graticule lines.

Collector Current (Ic) Cursor Accuracy –

Within 1.5% of readout +0.1 DIV of the CURRENT/DIV setting.

Horizontal Deflection System

Collector Supply Volts (Vce) Range

3 kW, 300 W Peak Power –

100 mV/DIV to 5 V/DIV in a 1-2-5 sequence.

30 W, 3 W Peak Power –

50 V/DIV to 500 V/DIV in a 1-2-5 sequence.

300 mW, 30 mW Peak Power –

5 V/DIV to 50 V/DIV in a 1-2-5 sequence.

Step Generator Volts (Vbe) Range –

100 mV/DIV to 5 V/DIV in a 1-2-5 sequence.

Step Generator Volts (Vbe) Accuracy –

Within 0.1 DIV of Horizontal graticules.

Digital Storage Acquisition

A/D Converter

Resolution –

10 bits for 1024 division, 100 points per one division.

Tolerance – Within ±2 counts.

Max. Data Point – 1024.

Max. Sample Rate – 1024 x line frequency.

Min. Sample Rate – 1/8 x line frequency.

Safety

Standards Met –

UL3111-1, CAN/CSA C22.2 NO. 1010.1, EN 61010-1 with second amendment.

▶ Ordering Information

370B

High-Resolution Programmable Curve Tracer.

370B Standard Accessories

A1001– Blank adapter for mounting custom sockets.

A1002– In-line transistor adapter.

A1005– Axial diode lead adapter.

User Manual– Order 070-A838-00 (English).

Protective Cover– Order 337-3344-02.

Power Cord– Order 161-0066-00.

Fuses–

Order 159-0260-00 (125 V, 4 A).

Order 159-0259-00 (250 V, 2 A).

Utility Software– Order 063-3341-02.

370B Recommended Accessories

Service Manual– Order 071-A842-00.

K4000– Instrument cart.

Rackmount kit– Order 016-0930-00 (Opt. 1R).

371B

High-Power Programmable Curve Tracer.

371B Standard Accessories

A1002– In-line transistor adapter.

Test Fixture– Order 016-A328-00.

User Manual– Order 070-A840-00 (English).

Power Cord– Order 161-0066-00.

Wire Set– Order 012-1371-00.

Fuses–

Order 159-0291-00 (250 V, 1 A).

Order 159-0238-00 (250 V, 4 A).

Utility Software– Order 063-3341-02.

371B Recommended Accessories

A1001– Blank adapter for mounting custom sockets.

A1005– Axial lead adapter.

Service Manual– Order 070-A843-00.

K4000– Instrument cart.

Rackmount Kit– Order 016-0930-00 (Opt. 1R).

Power Plug Options

Opt. A1– Euro Plug, 220V, 50 Hz.

Opt. A2– UK Plug, 240V, 50 Hz.

Opt. A3– Australian Plug, 240V, 50 Hz.

Opt. A5– Swiss Plug, 220V, 50 Hz.

Opt. AC– China Plug, 50 Hz.

Opt. A9– No power cord, set to 220/240 V.

Service

Opt. C3– Calibration Service 3 Years.

Opt. C5– Calibration Service 5 Years.

Opt. D1– Calibration Data Report.

Opt. D3– Calibration Data Report 3 Years (with Option C3).

Opt. D5– Calibration Data Report 5 Years (with Option C5).

Opt. R3– Repair Service 3 Years.

Opt. R5– Repair Service 5 Years.