User Manual

Tektronix

571
Curve Tracer

070-7723-01

Please check for CHANGE INFORMATION
at the rear of this manual.

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Product Description

The 571 CurveTracer is a semiconductor tester with a set of attractive specifications.
It is a menu-driven, digital, microprocessor controlled instrument, designed to easily make DC- measurements on several types of semiconductors.
The 571 has the capability of testing the following types of semiconductors:

- Bipolar Transistors NPN and PNP
- Diodes
- F.E.T.'s
- Thyristors and Triac's

To assure that all functions work properly, use the *Performance Verification* check (Appendix C).

Product Description

The 571 consists of one unit. At the front panel there are :

–	1	9" C.R.T. screen monochrome green
–	10	Keys
–	7	Array test sockets with a protection cover
–	1	L.E.D. for power on indication
–	1	Power on switch

The C.R.T. is used for the presentation of the menu's and the test results.
The 10 keys are used for selecting the desired function and parameters from the menu. The functions of the keys are:

UP **START** **CURSOR** **STORE** **MENU** **COPY**
DOWN **STOP**
LEFT
RIGHT

In section 5, *In Detail*, functions of the keys are explained in detail.

The device under test (DUT) is placed in the test socket during acquisition.
At test voltages that exceed 20 Volts, the protection cover must be in the closed position.
At the rear panel there are :

Power inlet with EMI filter / Fuseholder / Line Selector Switch.
- Norm/Test switch
- Printer output for an IBM® / EPSON® (compatible) printer.
- Intensity Control

Functional Description

The 571 Curve Tracer consists of the following functional modules:

1. Vce power supply (stimulus for DUT)
2. Compensation amplifier/A.D. Converter
3. Basedrive/Gatedrive (stimulus for DUT)
4. DUT test socket's and keypad
5. Micro controller
6. Video controller
7. Power supply
8. Video monitor

The units 2, 3, 5, 6 and 7 are located on the mainboard.
Unit 4 is located at the frontpanel.
Unit 1 is located on a separate board (electrical floating).
Unit 8 is a complete monitor.

Features

The 571 Curve Tracer offers a number of features, such as :

1. Acquisition of:
   - NPN and PNP transistors
   - Diodes
   - JFET's, MOSFET's, both N-channel and P-channel Thyristors (and Triacs)
2. A Store mode that is capable of :
   - Storing 1 picture of a tested device in the volatile memory (RAM).
3. An EEROM utility that is capable of :
   - Storing 12 different menu setup's in the non-volatile memory. (EEROM)
4. The intensity can be set by the intensity control on the rear panel.
5. A print-out of the screen can be made by connecting the Centronics parallel output at the rear to an IBM®/EPSON® (compatible) printer.
6. A cursor mode, where two cursors can be moved along the displayed curves. The x and y value of the cursor will be displayed on the left side of the screen.
   This feature offers you the possibility of making accurate measurements (within 2.5%) in a set of displayed curves.
7. The possibility of making a verification test.
   Diagnostic firmware is available in the standard ROM.
   The function NORM or TEST is selectable by a switch on the rear panel.

If you need more information about your 571 Curve Tracer or other Tektronix products, please contact your nearest Tektronix sales office or distributor, consult the Tektronix product catalog, or, in the U.S., call the Tektronix National Marketing Center toll-free at 1-800-426-2200.

Front / Rear Panel Controls

The front-panel of the 571 (see Figure 1-1) has 10 keys that enable the operator to select functions and ranges of the 571 curve tracer.

- 4 arrow keys, to select ranges, modes and control cursor position.
- Start key, to start execution of the menu setting.
- Menu key, to pass control to the selected menublock.
- Stop key, to interrupt or stop a measurement.
- Store key, to store a set of test results.
- Cursor key, to activate the cursors.
- Copy key, to start passing information to a printer.

The following controls and connectors are located on the 571 rear panel (see Figure1-1):

- Intensity Control, to set the intensity of the display.
- Printer-output connector. Connect an IBM® /EPSON® (compatible) printer to the Centronics ® output connector to make a hardcopy of the screen .
- Normal/Test switch. Selects between the normal mode and the test mode.
- Power connector /voltage range selector/fuse.

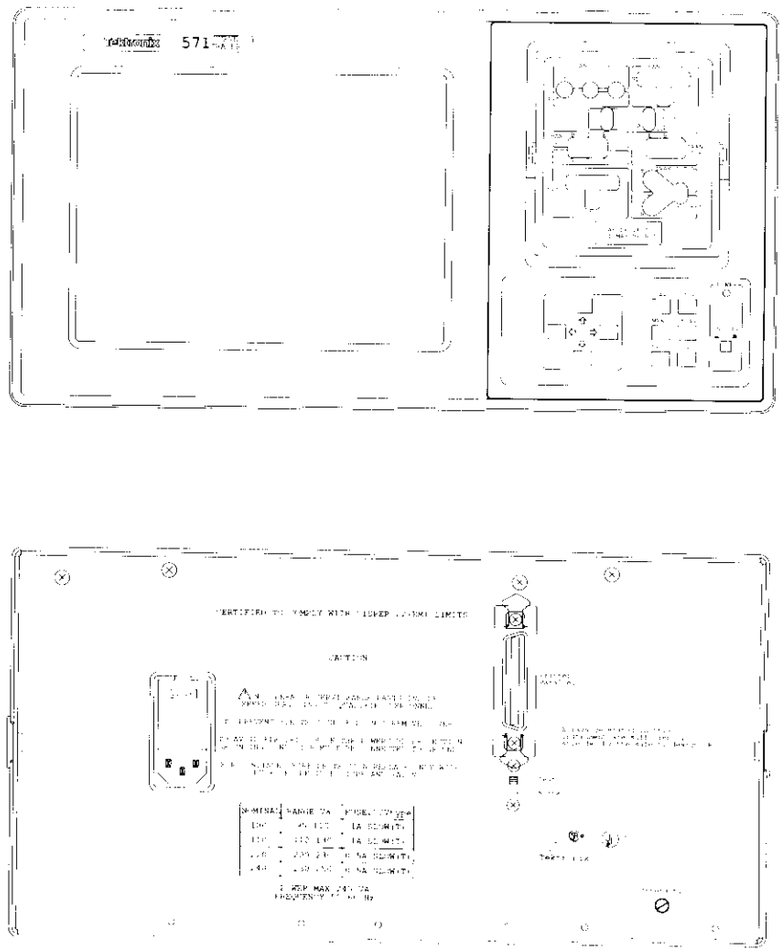


Figure 1-1: Front and Rear Panel 571 Curve Tracer

Preparation for Use

Before you use the 571 Curve Tracer, refer to the Safety part of this chapter for power source, grounding, and other safety considerations pertaining to the use of the instrument.

The 571 is calibrated and ready for use when received. It should be free of mars and scratches and meets all electrical specifications. If there is damage or deficiency, contact your local Tektronix Field Office or representative.

The instrument is menu-driven to select the required function and parameters. This is a kind of pop up menu and only relevant information is displayed on the screen.
There are 10 keys on the front panel to step through the menu for selecting functions and ranges.
The analog circuits are completely microprocessor controlled.

Installation

Step 1: Check that you have the proper electrical connections. The 571 Curve Tracer operates from a nominal ac-power line between 95 V and 110 V rms,110 Vand 130 V, 200 V and 230 V or 230 V to 250 V rms, depending on the power range setting, with any frequency from 50 Hz to 60 Hz.

Step 2: Connect the proper power cord from the rear-panel power connector to the power system.

Step 3: Check the fuse (located in the power connector/voltage range selector, on the rear panel), to be sure it is of the proper type and rating.

CAUTION

This instrument can be damaged if the wrong line fuse is installed.

NOTE
Be sure that the NORMAL/TEST switch on the rear panel is in the NORMAL position.

Step 4: Be sure you have the appropriate operating environment. Specifications for temperature, relative humidity, altitude, vibrations and emissions are included in Appendix B: *Warranted Specifications.*

Step 5: Leave space around the instrument for cooling. Maintain adequate airflow to prevent instrument damage from internally generated heat. Before turning on the power, verify that the spaces around the air-intake holes on the bottom, sides, top, and rear cabinet are free of any obstruction to airflow.

Step 6: Turn on your 571 Curve Tracer by pressing in the POWER button. Observe that the POWER-ON indicator, located above the button, comes on. After a few seconds the menu page appears on the CRT screen, and the instrument is ready to make measurements.

Initial Setup

This tutorial get you started making measurements, using the capabilities of the 571 Curve Tracer. The following will be discussed:

- Initial Setup
- Screens

Initial Setup

The following procedure will allow you to set up and operate the instrument to obtain the most commonly used displays.

Step 1. Verify that the POWER switch is OFF (switch is in the OUT position).

Step 2. Plug the power cord into the ac power outlet.

Step 3. Press in the POWER switch (ON) and let the instrument warm up (30 minutes is recommended for best accuracy).

Step 4. Observe the MENU screen being displayed on the screen.

Screens

The 571 has two main screens, the TEST screen and the MENU screen. Within the menu screen there are two sub-screens, the RETRIEVE MENU and the SAVE MENU.

In each screen the inverse top line shows which screen is currently selected.

The inverse bottom line (the prompt line) shows which keys are valid and how the 571 is going to test. Pressing a key that is not mentioned in the prompt line or pressing two keys at the same time are considered invalid commands. That kind of commands are neglected.
One exception is the copy key to print the screen data onto a printer. Pressing the copy key is always answered, unless otherwise stated in the prompt bar. In some cases no prompt bar is displayed. During that time no keys can be answered.

The line located above the prompt line is the message line. Messages are displayed here.

The main screens are:

- **Test screen**

  This screen displays an axis with scale parameters and all other selected parameters. After the test (acquisition) of a device the screen displays the characteristic curves.

- **Menu screen**

  This screen shows all the items that can be selected to test a device. After power up the 571 comes up with this screen and shows the default settings.
  The first (not inverse) line is for selecting the function.
  The second line is for selecting the DUT (Device Under Test) type.
  Each subsequent line represents one test parameter, and for each parameter, a value can be selected.
  The last line gives access to the sub-screens .

The menu sub-screens are:

- **Retrieve Menu**
- **Save Menu**

Both screens show 12 locations of non-volatile memory which are marked " Used " or " EMPTY ".
Each location can store the settings of a menu screen.

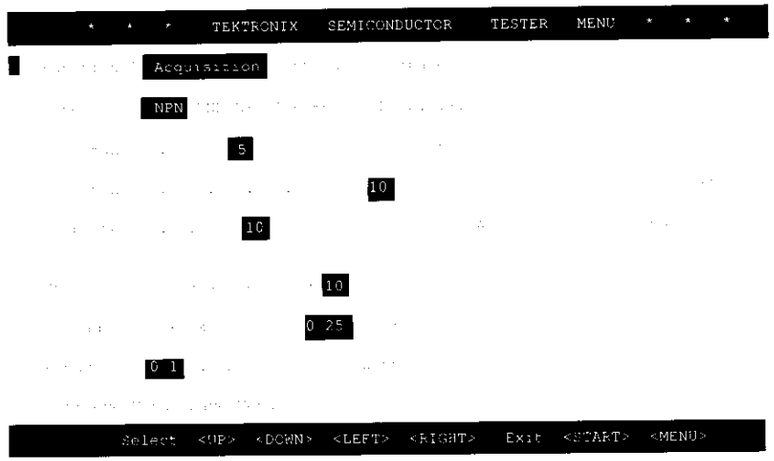


Figure 2-1: Menu Screen at Default

Basic Measurements

The following measurement examples will enable you to perform basic measurements and to become familiar with the 571 Curve Tracer capabilities. Some applications and exceptions are also indicated.

NOTE

The tests on the following pages are merely examples. Select the parameters in all the tests carefully for your specific device. Exceeding the limit values, as indicated in the component data sheet, may be destructive to the device. Especially the various breakdown voltage tests can be destructive.

- Transistor Measurements
  - Saturation Voltage Measurement
  - Collector-Base Breakdown Voltage Measurement
  - Temperature Drift Measurement
  - Loadline Measurement
  - Power Limit Measurement

  H-Parameter Measurement

  Vceo Measurement
- Field Effect Transistor Measurements
  - Drain Breakdown Voltage Measurement
  - Pinch-Off Voltage Measurement

  Diode Measurements

  Forward Voltage Measurement

  Reversed Voltage Measurement

  Thyristor Measurement

  Remarks for all Measurements
- Compare Mode

Block Diagram

Figure 3-1 shows the basic measurement block diagram of the 571 Curve Tracer. For more details see the 571 Service Manual (Tektronix Part Number 070-7722-00).

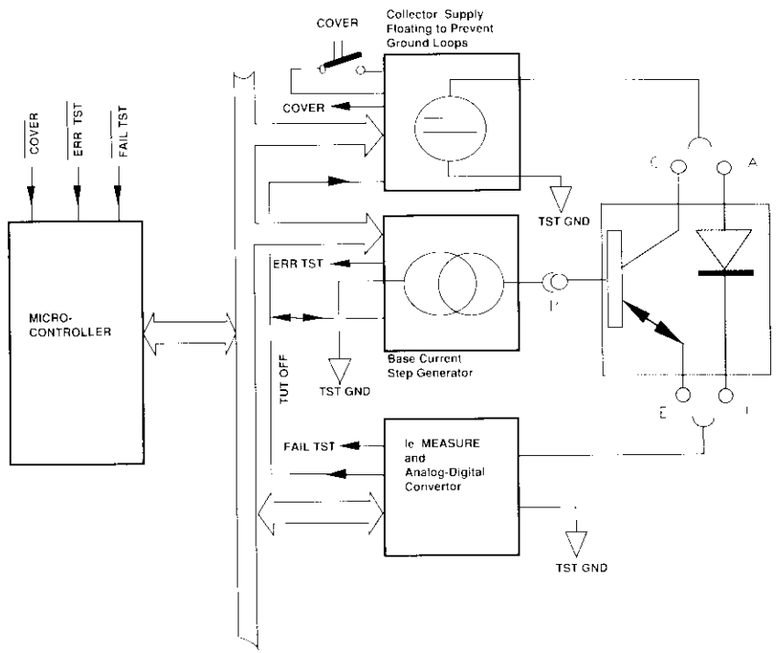


Figure 3-1: Block Diagram of the 571 Curve Tracer

Transistor Measurements

A NPN transistor, type 2N2219, is used in the following examples. (A type 2N3904 provides similar results.)

Step 1. Put the transistor in the appropriate socket with the leads in the correct contact, as indicated on the front panel (see Figure 3-2).

Step 2. Press MENU

Step 3. Select the appropriate type and parameters on the menu page. In this example an NPN type is used, but a PNP (2N3906) provides similar results.

Step 4. Pressing START will result in a set of Vce - Ic curves (see Figure 3-3) that gives a general indication of the transistor's performance.

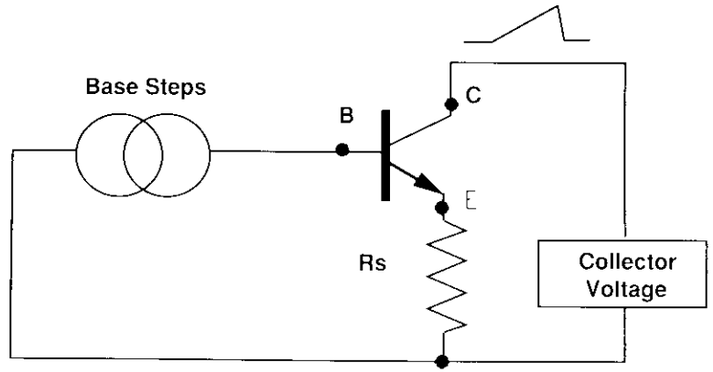


Figure 3-2: Transistor Connection Diagram

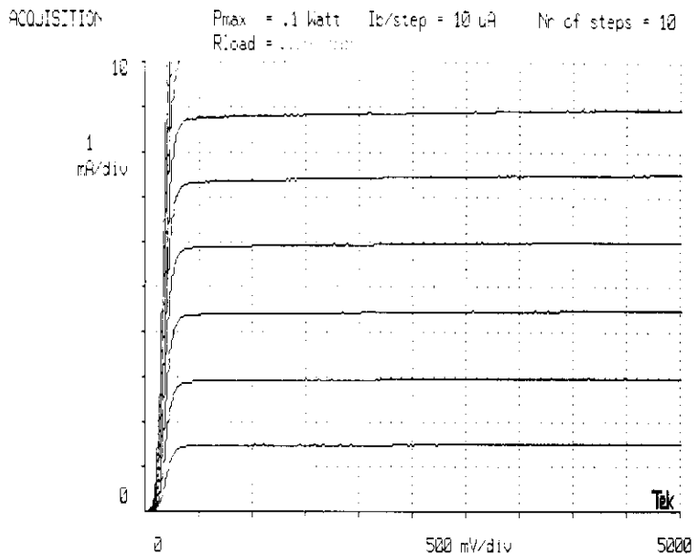


Figure 3-3: Vce - Ic curves (NPN transistor)

Saturation Voltage [Vce (sat)] Measurement

Step 1. Press MENU to return to the menu page.

Step 2. Change Vce max. to 0.5 V, Ib/step to 50 µA/step, and select Rload 10 Ohm using the arrow keys.

Step 3. Pressing START results in a set of curves in the saturation region of the transistor. Saturation voltages at a given current can be examined. (Figure 3-4)

For closer readout of the saturation voltage press CURSOR and direct the active cursor to the required position. The position of the cursor is shown at the left of the graticule.

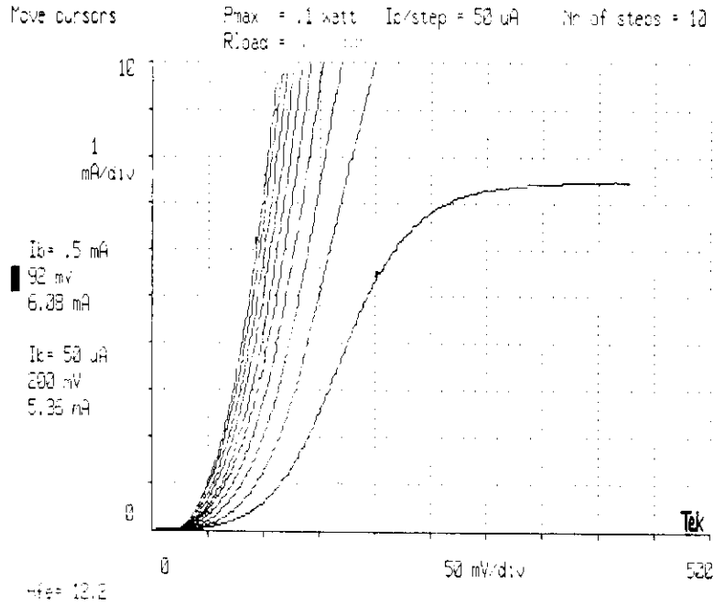


Figure 3-4: Transistor Saturation Area

Transistor Breakdown Voltages

Generally, a breakdown of a reverse biased PN junction is the transition from a state of high dynamic resistance to a state of lower dynamic resistance for increasing magnitude of reverse current. The following types breakdown voltages are commonly used:

VCEO - Collector-to-emitter breakdown voltage, with base open.
VCES - Collector-to-emitter breakdown voltage, with base short circuited to emitter.
VCBO - Collector-to-base breakdown voltage, with emitter open.
VEBO - Emitter-to-base breakdown voltage, with collector open.

As an example of a transistor breakdown voltage, a set of curves on the 571 shows the Collector-Emittor break down voltages as a function of Ib in Figure 3-5.

Step 1. Press MENU to return to the menu page.

Step 2. Select by using the arrow keys.:

Vce max ..... 100 V
Ic max ..... 10 mA
Ib/step ..... 5 mA
Pmax ..... 0.5 Watt

Step 3. Press START.
Notice that the collector-base breakdown voltage is at about 60 Volt at a given current (Figure 3-5).

NOTE:
Select the parameters carefully!! If not, this test can be destructive to the device. Refer to the component data sheet for more information.

Step 4. Press the STOP button as soon as the current rises and the breakdown starts, to prevent damage to the device.

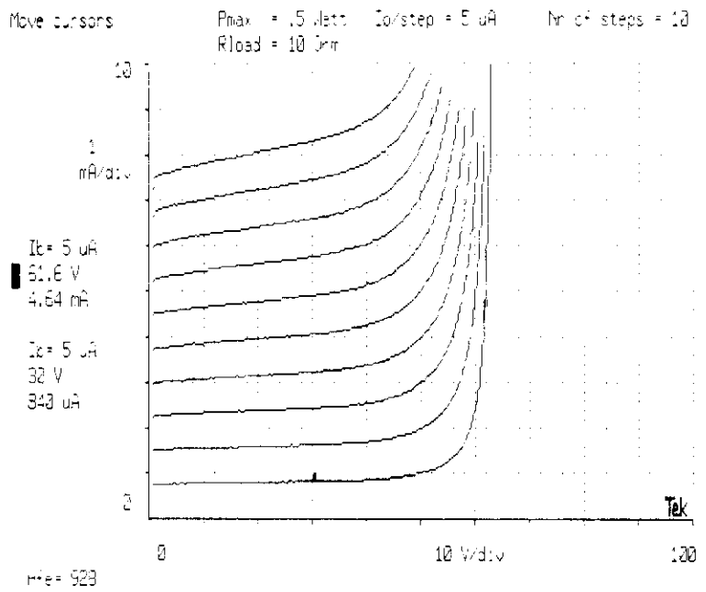


Figure 3-5: Collector-base Breakdown Voltage Curves

Temperature Drift Measurement

Step 1. Press MENU to return to the menu page.

Step 2. Select by using the arrow keys:

Function .....acquisition continuous.
Vce max.....20 V
Ic max .....100 mA
Ib/step .....200 µA
Steps 3
Pmax .....2 Watt

Step 3. Press START and watch the curves grow until they look like in Figure 3-6.

Step 4. Press STOP to interrupt the acquisition.

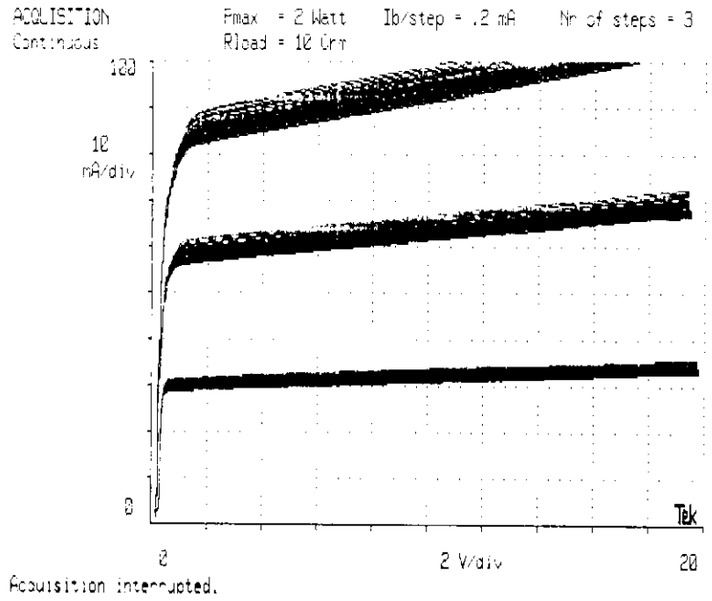


Figure 3-6: Temperature Drift Curves

Loadline Measurement

Step 1. Press MENU to return to the menu page.

Step 2. Select by using the arrow keys:

Function ..... acquisition
Vce max ..... 2 V
Ic max ..... 2 mA
Ib/step ..... 1 mA
Steps 10
RIoad ..... 1 kΩ
Pmax ..... 100 W

Step 3. Press START. The curves will end along the loadline representing a load of 1 kΩ. (Figure 3-7)

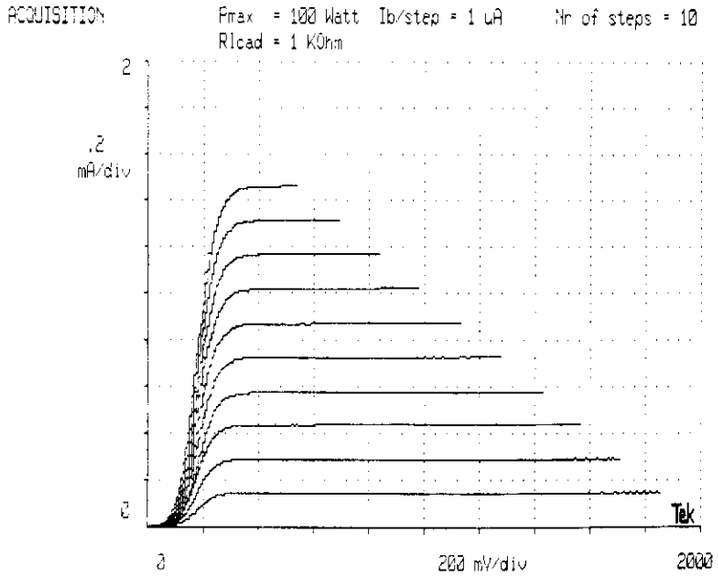


Figure 3-7: Loadline Curve

Power Limit Measurement

Step 1. Press MENU to return to the menu page.

Step 2. Select by using the arrow keys:

Function ..... acquisition
Vce max ..... 50 V (remember the cover!)
Ic max ..... 20 mA
Ib/step ..... 10 mA
Steps 10
RIoad ..... 0.25 Ω
Pmax ..... 0.1 Watt

Step 3. Press START and notice the curves end along a hyperbola. (Figure 3-8)

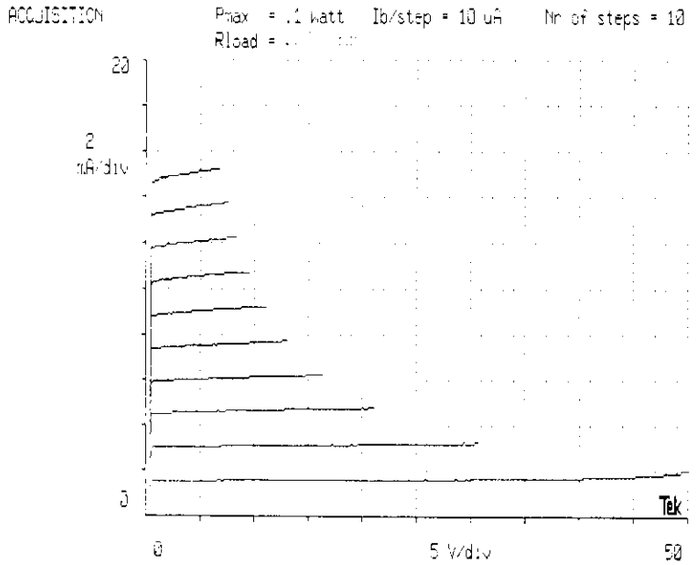


Figure 3-8: Power curve

H - Parameter Measurements [hFE, hfe, hoe]

Static h-parameter measurement (hFE)

hFE - Measurement

Step1. Create the curves according to the default settings, as indicated at the Vce - Ic test. (See Figure 8a).

Step 2. Press CURSOR and notice the cursors appear in the middle of the lowest curve.

The hFE at the position of the blinking cursor is printed in the lower left corner of the display.
The cursor can be moved by the horizontal arrow keys along the curve. After the arrow key is released, the hFE is updated for the new cursor location.

Small signal h-parameter measurements (hfe , hoe)

hfe - Measurement

Step 1. Move one cursor to a specific position, for instance the highest curve at 4 V.

Step 2. Press CURSOR to swap the activity and move the other cursor to the same voltage, one curve below.

ΔIc divided by Alb gives the hfe under these specified conditions of collector current and collector voltage.

hoe - Measurement

Step 1. Move both cursors to the same curve (with the vertical arrow keys). One for instance at 2 V , the other at 4 V.

Δ Ic divided by AVce gives the hoe under these specified conditions of collector current and collector voltage.

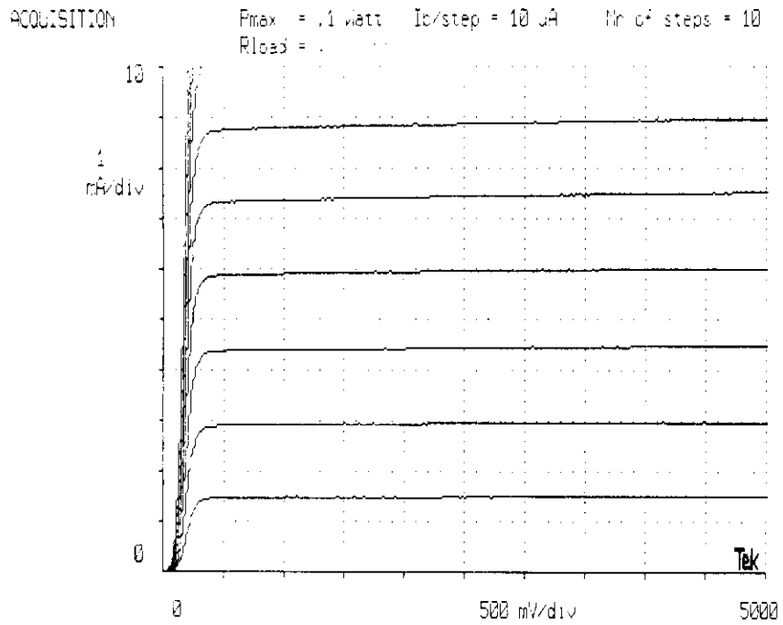


Figure 3-8a: Vce-Ic Curves

Collector-Emitter Breakdown Voltage Measurement [V ceo(br)]

Step 1. Remove the base lead of the DUT from the socket. (For a PNP device, interchange the emitter and collector leads also)

Step 2. Press MENU to return to the menu page.

Step 3. Select by using the arrow keys:

Type.....DIODE
Va max . .....100 V
Ia max .....1 mA
Rload .....1 kΩ
Pmax .....0.1 Watt

Step 4 Press START and observe a curve as in Figure 3-9.

NOTE:
Your picture may not look as clean as this example, try another Rload or other Ia max for better results.

Testing Vces has the same procedure, only the base lead of the DUT must be connected to the same contact as the emitter. For most devices Vces is above 100 V which is beyond the range of the 571.

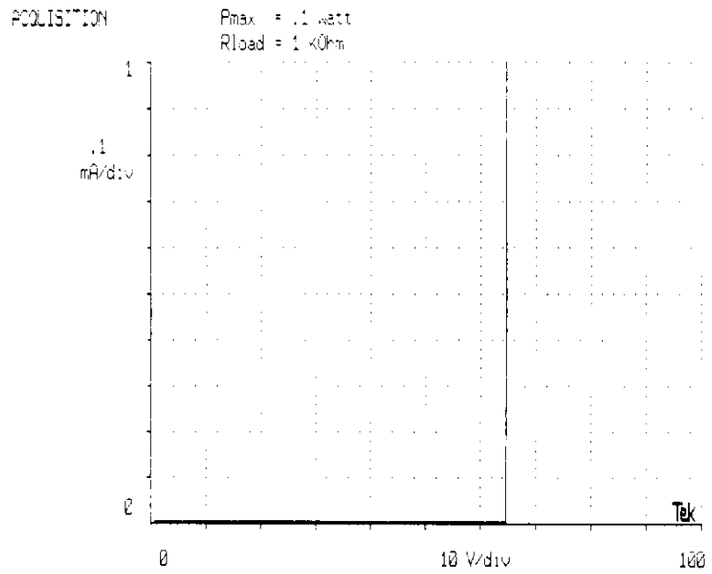


Figure 3-9: Vceo Curve Curve

Field Effect Transistor Measurements

For this example a JFET type 2N4416 is used (See Figure 3-10 for proper connections).

Step 1. Connect the DUT in the appropriate socket on the front panel.

Step 2. Go to the menu page and select:

Function ..... acquisition
Type ..... N-FET
Vds max. ..... 10 V
Id max . ..... 20 mA
Vg/step ..... 200 mV
Offset ..... −1.200 V
Steps 10
Rload ..... 0.25 Ω
Pmax ..... 0.1 W

Step 3. Press START and observe a set of curves as in Figure 3-11.

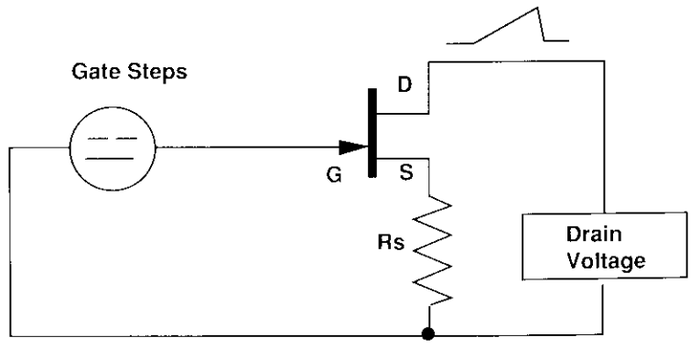


Figure 3-10: FET Connection Diagram

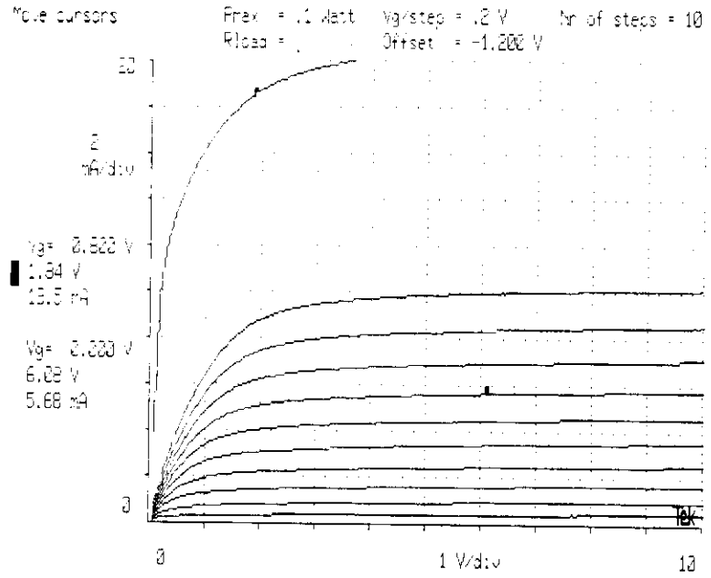


Figure 3-11: JFET Curves in Depletion and Enhancement Mode

The curves above the curve Vg = 0 V in Figure 3-11 represent the enhancement mode, the curves below Vg = 0 V represent the depletion mode.

Notice the highest curve at Vg = 800 mV. At that drive voltage, the FET has the electrical properties of a good conductor.
In addition, at a drive voltage above about 600 mV the gate-channel diode opens so the gate current is changing from substantial zero to a few mA (The driving source is a voltage source!).
This effect only happens with J fet's. Usually, J fet's are driven in depletion mode.

MOS-FET's can be driven as well in enhancement mode as in depletion mode, depending of the type and purpose.

Drain Breakdown Voltage

Step 1. Press MENU to return to the menu page.

Step 2. Select by using the arrow keys:

Vds ..... 100 V
Id max. ..... 10 mA
Vg/step ..... 0.2 V
Offset ..... −1.400 V

Step 3. Press START and notice the Drain breakdown at about 60 V (See Figure 3-12).

There is another breakdown voltage: The gate-source breakdown. This is a destructive test so we will not discuss it here.

NOTE

Select your parameters carefully!! If not, ***this test may be destructive to the device****. Refer to your component data sheet.*
Press STOP as soon as the current rises, and the break down starts, to prevent damage to the device.

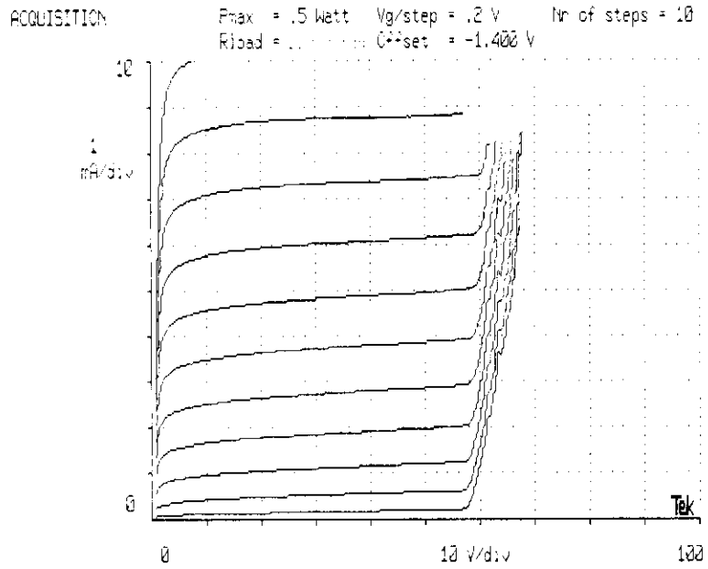


Figure 3-12: Drain Breakdown Voltage Curves

Pinchoff Voltage

Step 1. Press MENU and select by using the arrow keys:

Vds max. ..... 5 V
Id max . ..... 0.05 mA
Vg/step ..... 0.1 V
Offset ..... – 2.150 V
Rload ..... 100 Ω

Step 2. Press START. This will result in a picture of the pinch off region of the DUT (Figure 3-13).

Using the cursors, you can determine exactly at which curve the DUT starts to conduct. By changing the offset voltage, the pinch off voltage can be measured within 25 mV.

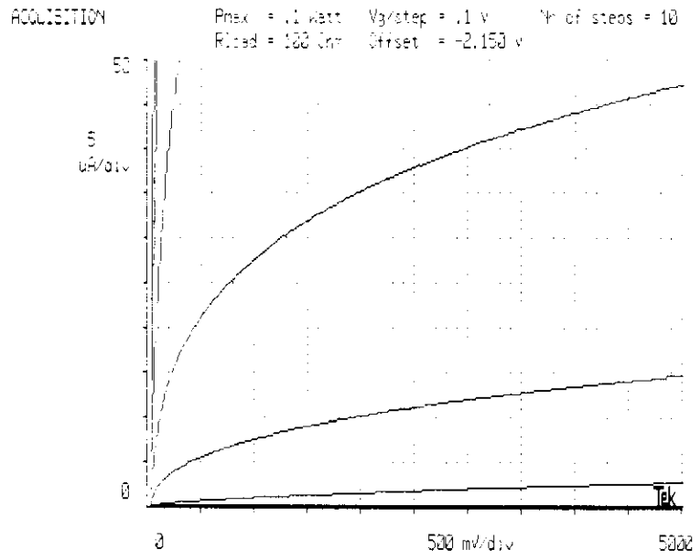


Figure 3-13: Pinchoff Voltage Curves

Diode Measurements

Forward Voltage Measurement

Step 1. Connect a diode in the diode socket on the front panel in forward direction.

Step 2. Press MENU and select by using the arrow keys:

Type.....diode
Va max. .....1 V
Ia max. .....1 mA
Rload .....100 Ω

Step 3. Press START. This results in a curve as in Figure 3-14.

To calculate Ri: Press CURSOR and direct the 2 cursors to any position you like. Ri = ΔVa divided by ΔIa.

Step 4. Press STOP to leave the cursor utility.

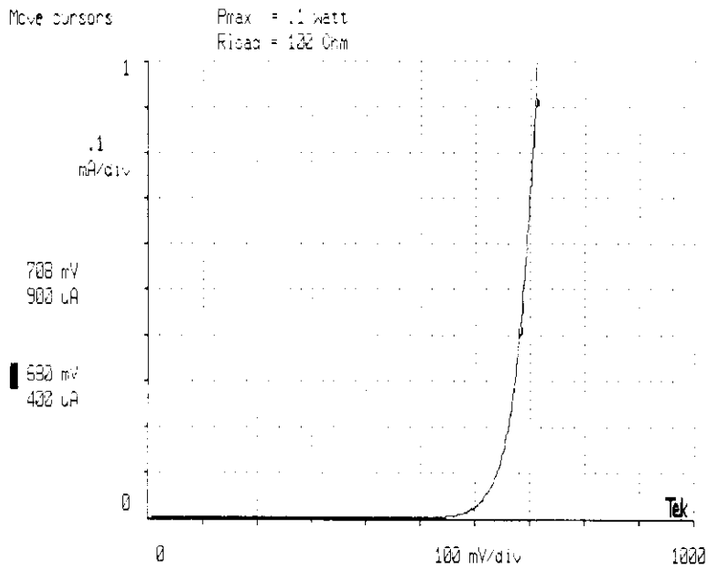


Figure 3-14: Diode Curve in Forward Direction

Reversed Voltage

Step 1. Connect a zener diode in the diode socket in reversed direction.

Step 2. Change Va max. with the right arrow key to the appropriate value for the zener diode.

Step 3. Press START.

Step 4. After acquisition press STORE.

To measure the forward characteristic of the zener diode, connect the zener in forward direction.

Step 5. Press START.

On one picture, the forward characteristic as well as the zener characteristic are presented (Figure 3-15).

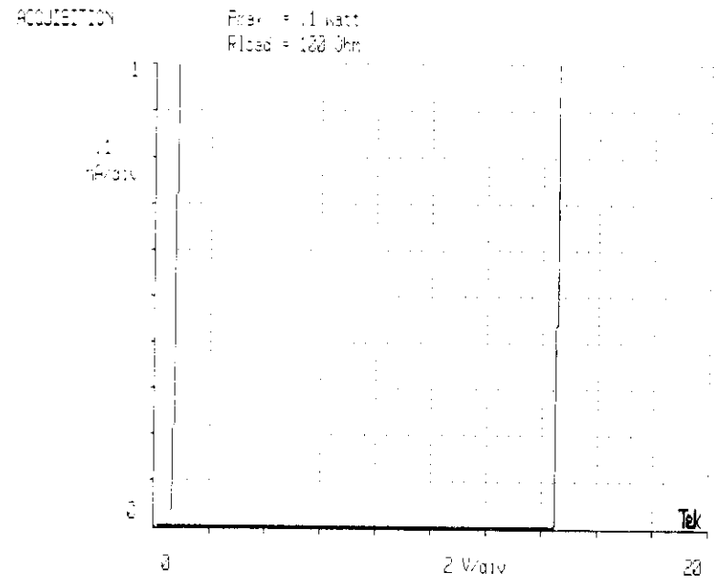


Figure 3-15: Zener Diode Curve in Forward and Reversed Direction

Thyristor Measurements

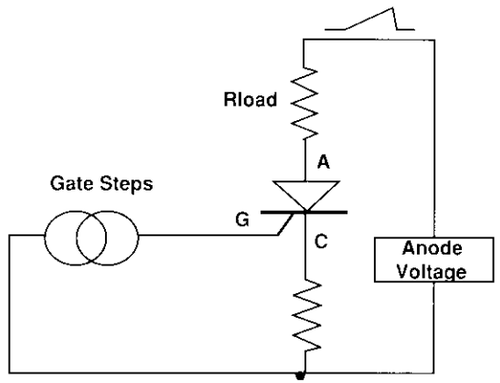


Figure 3-16: Thyristor Connection Diagram

Thyristors are tested the same way as NPN transistors, but a minimum R-load of 100 Ohm is required (See Figure 3-16).
The 571 is performing this Rload selection automatically if an S.C.R. is selected. This measurement is executed with a BT151 type. The 571 does not show vectors with negative ΔVxx.
Use the cursor utility to determine the range of the curve.

Step 1. Select by using the arrow keys:

Type.....SCR
Va max. .....20 V
Ia max. .....20 mA
Ig/step.....0.2 mA
Steps 10
Rload .....1 kΩ
Pmax. .....0.1 W

Step 2. Press START and notice a curve as in Figure 3-17.

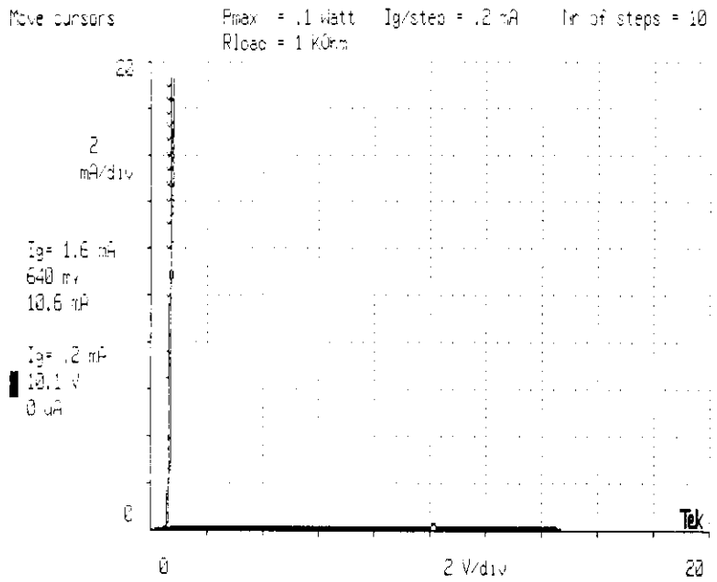


Figure 3-17: Thyristor Curves

Remark for all Measurements

Precautions have been taken inside the 571 to prevent oscillations inside the DUT.
Nevertheless it may happen that some special high frequency devices still have a tendency to oscillate. This can be noticed by a noisy display or the hfe decreasing very suddenly in the curves.
Adding a small capacitor (15 pF) between emitter and base, or a 1000 pF capacitor between collector and base of the DUT, in the same socket, will eliminate the oscillations.
Figures as shown may differ depending on types used.
The 571 has a hardware overcurrent protection and a thermal protection. Trying to test a shortcircuit according to the parameters in Figure 3-18, causes the internal thermal protection circuit to activate after a few seconds, resulting in the meaningless picture like Figure 3-18 is.

Terminate the test quickly !

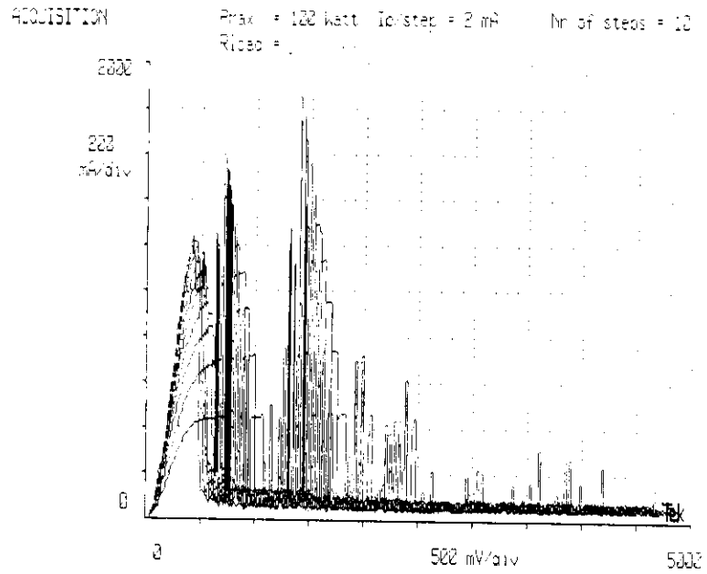


Figure 3-18: Thermal Protection Curve

Compare Mode

The 571 compare mode feature is intended to compare devices to a reference device. During a compare session two sets of curves will be displayed on the screen. The high lighted curve is the reference: it will be retrieved from the memory each time an acquisition in compare mode is initiated.

The second set of curves is in normal intensity. This is the set of curves of the device under test. The compare mode allows the comparison of :

1. Diodes to diodes.
2. S.C.R.'s to S.C.R.'s.
3. Bipolar transistors of the same type (NPN or PNP).
4. Bipolar transistors of the complementary type (NPN to PNP and PNP to NPN).
5. FET's of the same type (P-FET's or N-FET's).
6. FET's of the complementary type (P-FET's to N-FET's and N-FET's to P-FET's).

For example :

Step 1. Select : COMPARE mode.
NPN
The desired test parameters.

Step 2. Hook up a NPN transistor in the appropriate socket

Step 3. press <START>.

After the acquisition the curves are stored as the reference.

Step 4. Hook up another NPN transistor

Step 5. Press <START>.

Two sets of curves reflecting the two transistors are displayed.

Step 6. Now hook up a PNP transistor and press the <UP> or <DOWN> button.

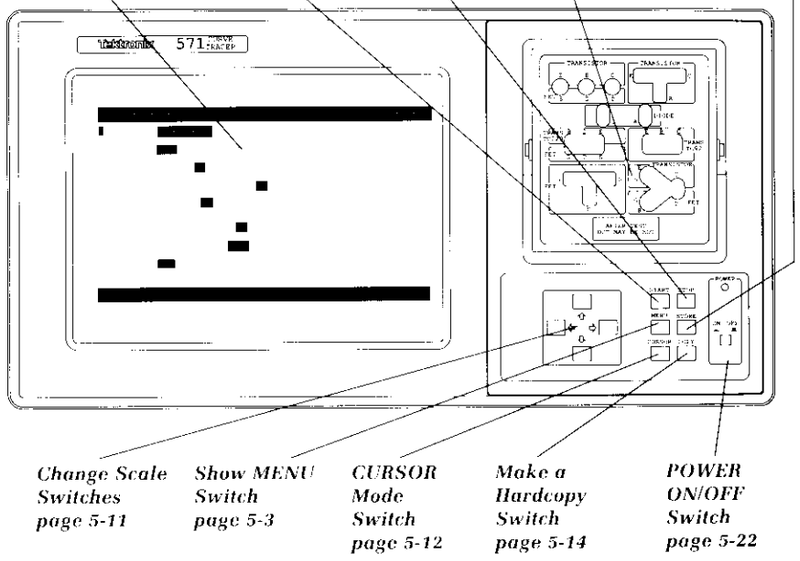
Before the acquisition starts, the absolute values of the test parameters are not altered, but ALL the polarities are inverted and the acquisition starts.

The reference device type is displayed below the word 'COMPARE' upper left on the screen, and the type of the device under test is displayed inverse in the top line on the screen.

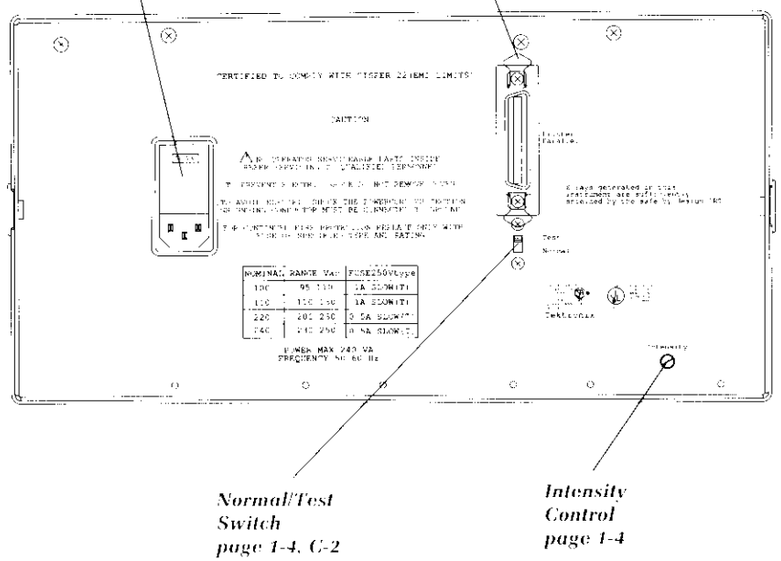
During a compare session it is not possible to change scale factors. The scale factors used to sample the reference are also used to sample the devices under test.

The prompt bar at the bottom of the screen indicates the keys that are valid and how they affect the 571.

Front Panel Map



Rear Panel Map



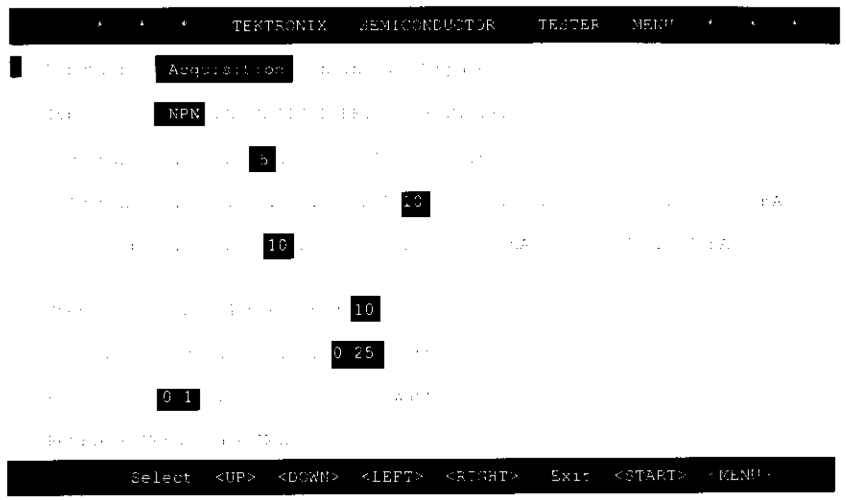


Figure 5-1: Menu Screen

Menu Screen

The Menu screen shows all the items that can be selected to test a device.
The menu key will set the 571 to the menu screen, waiting for the next command (See Figure 5-1).
Pressing the start key will perform the same function but also starts an acquisition immediately.
However, when " " or " " is selected, the menu or start key will show one of the sub-screens Save Menu or Retrieve Menu.

Menu Lines

The 10 menu lines are described next.
The **bold / underlined** printed item per line is the default setting after power up.

Line 1.

Acquisition

The folowing types of measurement can be selected from the function line:

The 571 has the ability to store a set of curves in a RAM memory (volatile). If a set of curves is stored, the recall function becomes part of the menu. With the recall function, a set of curves can be retrieved from the memory, and displayed highlighted on the test screen.
Also all test parameters along with these curves become active.

NOTE

At power up, there is no RECALL function on the menu screen.

One acquisition (2500 samples max.) of the DUT's curves can be executed. After the acquisition the curves can be examined, even when the DUT is removed from the test socket .

With this function acquisitions of the DUT can be executed continuously. After each acquisition the 571 waits for 2.5 seconds and starts a new acquisition without erasing the previous measurement. This is continuing until the stop key is pressed.
This measurement results in a picture in "envelope" mode permitting thermal drift or noise to be examined.

NOTE
Only the latest acquisition can be used for RAM storage or cursor measurements.

The 571 executes one acquisition, stores the test curves in the RAM memory and displays the curves high lighted. This set of curves is considered to be a reference. Each subsequent acquisition will be displayed together with this reference. Pressing the store key will make the latest acquisition the new reference.

Line 2. **NPN**

The type of DUT (device under test) can be selected on this line. The 571 automatically updates the menu to the type of semiconductor that is selected.

NOTE
The 571 doesn't recognize what type of device is inserted in its sockets. Inserting a different type of device or a defective component will give meaningless curves or at least an error message.

Line 3. 5

The Vce max. determines the maximum test voltage (collector to emitter) across the DUT. The voltage is incremented from 0 to the selected maximum value during acquisition.
For PNP transistors the sign of Vce (collector to emitter) is changed to minus. For FETs Vce is changed to Vds (drain to source) and DIODE and S.C.R. displays Va (anode).

Line 4. 10

The Ix max. determines the current limit through the DUT. If the limit is reached, that curve will be terminated. If the current exceeds the limit too much, or too fast, then the hardware protection circuit activates and generates "overcurrent" and the acquisition is terminated.
With NPN and PNP transistors Ix is Ic (collector).
With N-FET and P-FET Ix is Id (drain) and for DIODE and S.C.R. it is Ia (anode).
With PNP and P-FET a minus sign appears before Ix.

NOTE :
Vmax = 100 V and Imax = 2 A are mutually exclusive. Vmax voltages above 20 V require the protection cover.

Line 5. 10

The Ib/step function determines the drive to the DUT. When NPN or PNP or SCR is selected, the drive is a current source.
When FET's are selected, Ib (base current) is replaced by Vg (gate voltage) and the drive is a voltage source with a Ri = 50 Ω. The menu line for FET's looks like:
Vg/step ±0.1 0.2 0.5 1 | Volt

Polarities are automatically adapted to N- or P- devices.
For a S.C.R. it is Ig/step (gate current).
For DIODE this menu line is blanked.

Line 6.

When type N-FET or P-FET is selected, an offset voltage can be selected with the left and right arrow keys. The amount of offset is linked to the Vg/step menu line.(For more information see Table 1-2 in Chapter 1 at Gate Drive.) The polarity is automatically changed when a P-FET is selected.

Line 7.

The number of base/gate steps is set here.
For FET's, the offset voltage is implemented and the curve at the offset voltage is also displayed.
For type DIODE this line is blanked.

Line 8.

The load resistor in series with the DUT is selected on this line, causing the curves to end along a load line. If type S.C.R. is selected , three load resistors (10 kΩ, 1 kΩ and 100 Ω) are available.

NOTE
Selecting S.C.R. sets the R load to at least 100Ω.

Line 9.

The maximum allowed dissipation in the DUT can be programmed. A curve that reaches the programmed maximum power will be terminated, resulting in curves that end along a hyperbola.

Line 10.

When this line is selected with the cursor, is displayed inverse. The right and left arrow keys toggle between and .
Pressing the start or menu key, with Retrieve Menu inverse, activates the sub-screen . In this menu one of the twelve locations in the non-volatile memory can be selected with the up and down keys.
Pressing the start key retrieves the data from the selected EEROM location.
The Main menu will be displayed with the function, type of DUT and test parameters retrieved from the EEROM location.

NOTE
EEROM stands for Electrical Erasable Read Only Memory. This device is also writable as a Programmable ROM. After power off no information is lost.

Pressing the start or menu key with inverse, activates the sub-screen .
Pressing the start key again causes all the selections from the main menu to be saved in the selected EEROM location.
The 571 will stay in the EEROM menu, but the function will change from " " to " ".
Pressing the stop key will erase the selected EEROM location, regardless of whether " " or " " has been selected.
Pressing the menu key within the save or retrieve menu function, causes the 571 to return to the main menu screen without changes.

NOTE
The EEROM has a write protect utility. If write protect was enabled, save and erase commands will be denied (For more information, see Section 5, EEROM Protection Utility).

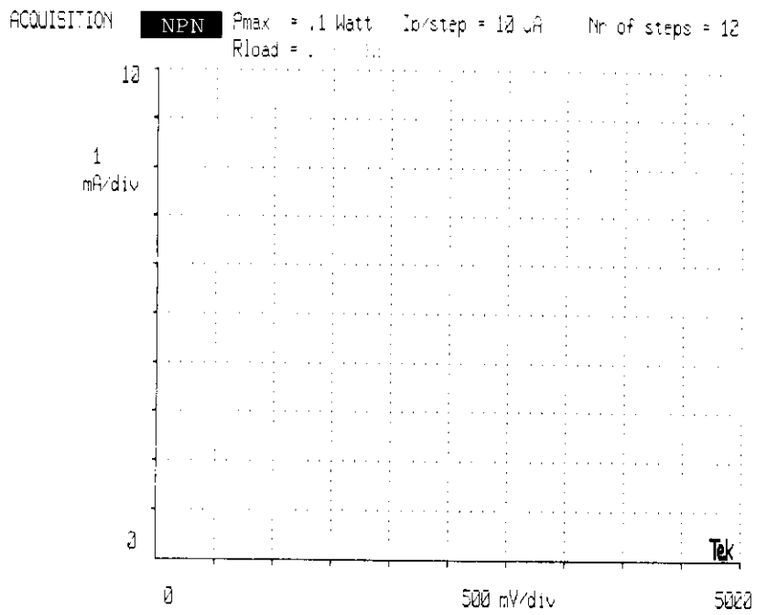


Figure 5-2: Test Screen Default Settings

Test Screen

The test screen consists of a graticule with the scale factors and a list of selected test parameters (see Fig. 5-2). Each dot represents a minor division, which is 0.2 division.
If an acquisition is performed, the graticule is filled with curves, representing the measured test data.

Acquisition

Press the start key to initiate an acquisition of the DUT. The 571 prepares itself according to the selected parameters and starts taking samples. The resulting curves are displayed immediately on the test screen.
If there were curves displayed from a previous acquisition, the display will be cleared first.
If the displayed curves were retrieved from the RAM memory, the display will not be cleared so that both sets of curves will be displayed.

Once the acquisition is started, it may be interrupted under the following conditions:

1. Overcurrent occurs.

   Remedy: Change test parameters and retry.
   Check your DUT, it may be defective!
   Message line displays:

   "

2. Base/gate drive out of range.

   Check your DUT, it may be defective!
   Check if the DUT was inserted in the test socket correctly!
   The DUT may not be the type selected in the menu.
   Message line:

   "

3. Cover opened during acquisition.

   Vce max. is set to > 20 V. Remedy: Close cover and press start key. Message line:

   "[illegible]"

4. Pressing the stop key.

   Press the start key to resume or press the stop key to terminate. Any other valid key terminates the acquisition function and activates the related function. Message line:

   "[illegible]"

Display Curves

After the acquisition has been executed the display is filled with curves.
The DUT may be removed unless Acquisition Continuous was selected.
The curves can be examined, referring to the graticule.

Automatic Adaption of Parameters

The 571 checks before the start of the acquisition, to determine if conflicting parameters are selected.
If so, the 571 adapts one or more parameters, prints a message on the screen and starts the acquisition.
There are three types of messages:

1. "[illegible]"

   At very low voltages and very low currents a transistor may not function as a transistor, but as two conducting diodes. One connected to the emitter circuit and one to the collector supply.
   The base current is shared between emitter and collector randomly resulting in a noisy image. To prevent this a minimum R load is selected. The resulting load line is still very steep so the final result is very close to the parameters originally selected.

2. "[illegible]"

   If the selected current scale Ix is greater than Vxx divided by Rload , only a small part of the Ix scale will be used. In this case the Ix scale is reduced, and the full Ix scale will be used.

3. "[illegible]"

   The 571 tests the emitter current and calculates the collector current, as: Ic = Ie - Ib.
   The maximum selected base current must fit within the selected Ic scale.
   If : Ib/step x (number of steps) exceeds the Ic scale, then the Ib/step is reduced.
   If the maximum Ib is about the same value as Ic, then the test is not very meaningful.

Change Scale Parameters

In the test screen the Ix max. and Vxx max. can be changed without returning to the menu.
Changing these parameters affects the 571 the same as in the main menu:

– Press the left key to reduce the maximum test voltage, press the right key to increase the maximum test voltage.

  Press the down key to reduce the maximum test current, and the up key to increase the maximum test current.

Store

Press the store key to store a set of curves in the RAM memory.
After an acquisition has been executed, the set of curves may be stored in a RAM memory for later investigation or comparison with other devices.
The message line displays:

"[illegible]".

The curves are displayed highlighted in this situation.

If the number of samples is too small , the command will be denied and the following message is printed on the screen.:

" [illegible] "

Cursors

If a set of displayed curves must be examined more closely than the graticule allows, the cursor mode is used.

Step 1. Press the cursor key to evoke the cursor utility.
Two cursors will appear on the screen in the middle of the lowest curve. To the left of the graticule information will be printed on the screen, concerning:

The base or gate drive

- The voltage and the current of the cursor positions.
- If the DUT is a NPN or PNP transistor, the Hfe at the location of the active (blinking) cursor is also printed.

The parameters of the blinking cursor are indicated with a pointer (the same as the cursor in the menu screen). This is the active cursor.

Step 2. To move the active cursor along the curve press the left or right arrow key.

Step 3. Press the up or down arrow key to jump to other curves.

Step 4. To swap the cursor activity, press the cursor key .
To disable the cursor activity , press the stop key.
Pressing any other valid key disables the cursor activity and evokes the related function.

NOTE
When there are insufficient samples, the cursor command will be denied. A message:" [illegible] " is displayed.

Sockets

Socket Description

There are several types of sockets on the front panel.
All the pins of the sockets are connected in parallel to the electronic circuitry of the 571. Therefore, do not attempt to install more than one device at a time!
Each socket has its own legend. Select the right socket for the device!
See the manufacturers component data sheets for more information.

Auxiliary Socket Board

The auxiliar socket board delivered with the instrument, fits into the three banana plug sockets on the front panel of the 571.
Small devices are easy to insert on the socket board.
Sometimes a device must be connected to the banana sockets by test leads.
The maximum voltage (Vc, Vd or Va) that can be applied is 20 Volts (The protective cover must be closed if the maximum voltage is more than 20V).

Making a Hardcopy

Connecting a Printer

The 571 printer output connector at the rear is a Centronics® type. To connect a printer use a Centronics® cable (Tektronix part number 012-0555-00).
An Epson® or IBM® printer, or at least a printer that is Epson®- and/or IBM®-compatible, is required.

NOTE
The automatic linefeed option of the connected printer should be switched off.
For most printers this is the default position. Refer to your printer manual !

Making the Hardcopy

To make a hard-copy of the display use the following procedure:

Step 1. Switch on the printer and the 571.

Step 2. Push the copy key. A message appears in the lower left edge of the display.

The 571 first check if a printer is connected and on-line (ready).
If not, a message "[illegible]" appears at the prompt line for about two seconds and the 571 resumes its normal operation.
If it says "[illegible]" check if your printer is functioning correctly. (Printer power- on, enough paper, on-line).

When the printer is connected and on-line, the 571 starts passing data to the printer to reproduce a hard copy of the screen data.

A message "[illegible]" appears at the prompt bar and a small marker shows the progress of printing.
Once the activity of passing output data to the printer has been started, the 571 must complete the process.

If an error situation occurs, such as paper empty, the 571 waits until the printer responds and asks for more data. In that situation the hardcopy activity will not be interrupted. After finishing the hardcopy, the 571 resumes its normal operation.

NOTE
The prompt line is not sent to the printer.

NOTE
The automatic line feed option of the connected printer must be OFF. For most printers this is the default situation. Refer to your printer manual.

Messages

At the message line the following messages are possible:

– "[illegible]"

Reason: During an acquisition the stop key has been pressed. Pressing the start key resumes the acquisition.

– "[illegible]"

If the voltage to the DUT is set to > 20 Volts, and the cover is not closed, the 571 prints "[illegible]" on the screen. The acquisition will stop until the cover is closed.

– "[illegible]"

The 571 stops acquisition unconditionally, regardles of the voltage. There is no opportunity to resume.
Closing the cover and pressing the start key will start a new acquisition.

– "[illegible]"

No component inserted in a socket or a defective device is inserted.

– "[illegible]"

The current through the DUT exceeds the maximum current.
Remedy: Decrease drive current, or increase Ixx max or increase Rload.

"[illegible]"

Pressing the store or the cursor key without the minimun required number of samples to form a curve, will activate this message.

– "[illegible]"

Pressing the store key displays this message until the curves are stored.

"[illegible]"

The current into the base is too high to generate a usable display, so it is automatically reduced.

– "[illegible]"

The Ixx is too high to generate a usable display, so the Ixx is automatically modified.

NOTE
This message can be displayed together with "[illegible]".

– "[illegible]"

Rload is increased in order to get a usable display.

NOTE
This message can be displayed together with "[illegible]".