User Manual

Tektronix

571
Curve Tracer

070-7723-01

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

First Printing July 1992

INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument.Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, U.S.A.
J300000	Sony / Tektronix, Japan
H700000	Tektronix Holland, N.V., Heerenveen, The Netherlands
HK00000	Tektronix, Inc., Hong Kong

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two digit alpha code to identify the country of manufacture (e.g., J3 for Japan, HK for Hong Kong, IL for Israel, etc.).

Tektronix, Inc. , P.O. Box 500, Beaverton, OR 97077.

Printed and produced in The Netherlands.

Welcome

This manual contains the following sections:

- *Overview* describes the 571 Curve Tracer and provides Safety information and Start-up information.
- Tutorial: *Initial Setup* provides information and instructions to get you started making measurements.
- *Measurement Examples*
- *At A Glance* describes the locations and purposes of the various functions on the front panel and the rear panel of the instrument.
- *In Detail* provides further detail on aspects of the 571, building on the information contained in *At A Glance*. The topics of this chapter are:
  - General
  - Menu Screen
  - Test Screen
  - Sockets
  - Making Hardcopies
  - Messages
  - Maintenance and Repair
  - EEROM Protection Utility
  - Power Requirements
- Appendix A: *Options & Accessories* describe the standard and optional accessories available for the 571 and the Options for the 571.
- Appendix B: *Specifications* provides warranted specifications for the 571 Curve Tracer.

- Appendix C: *Performance Verification* describes the procedures to verify that the 571 is performing according to specifications.
- *Appendix I: Index* . The *Index* helps you locate information quickly.

Related Documentation

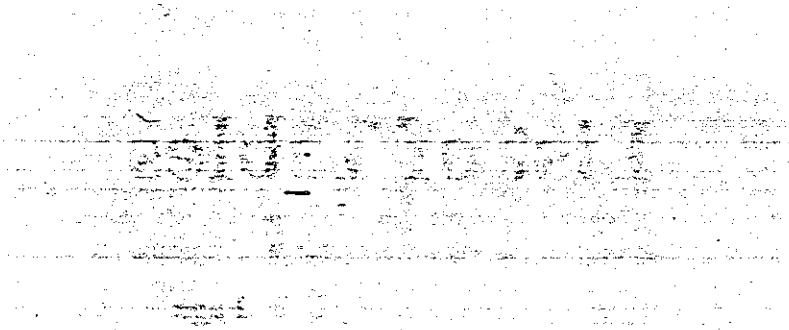
Other documentation for the 571 Curve Tracer include:

- The 571 Service Manual (Tektronix Part Number 070-7722-00) that provides information to maintain and service the 571.

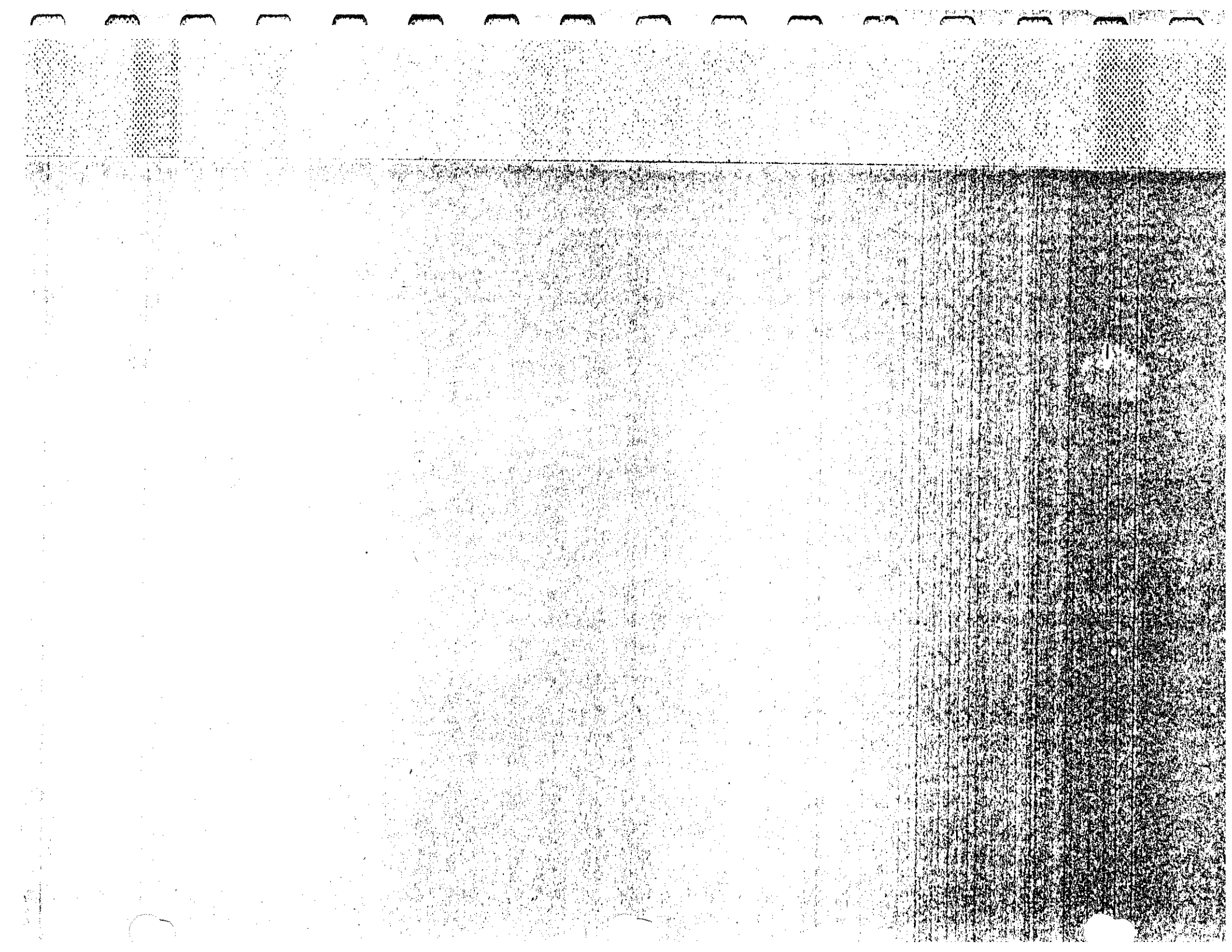
Contents

List of Illustrations

List of Tables



Overview



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.

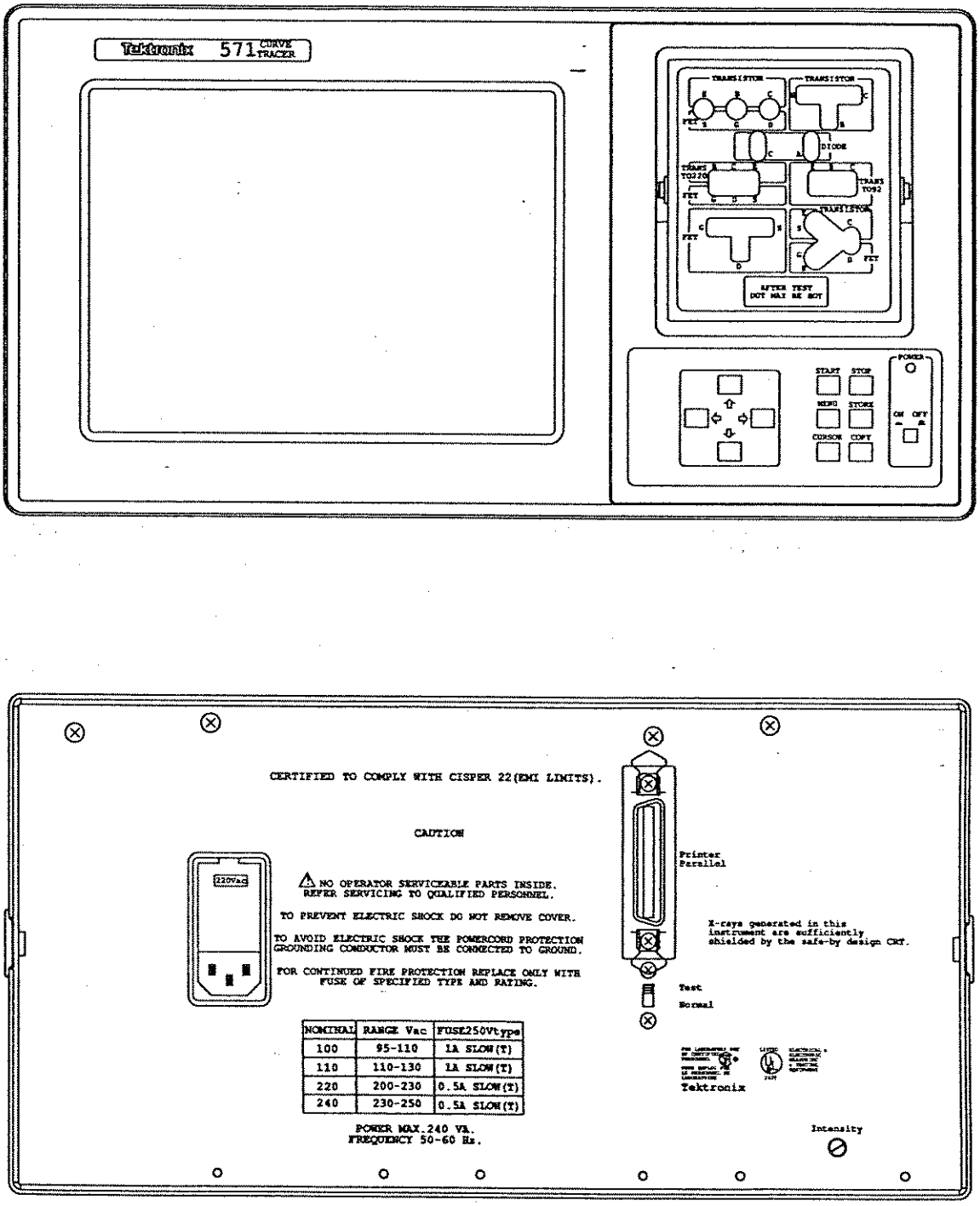
Front / Rear Panel Controls

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.



NOMINAL	RANGE Vac	FUSE250Vtype
100	95-110	1A SLOW(T)
110	110-130	1A SLOW(T)
220	200-230	0.5A SLOW(T)
240	230-250	0.5A SLOW(T)

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

Safety

Before you begin using your Tektronix 571, please take a moment to review these safety precautions. We provide them for your protection and to prevent damage to the 571 Curve Tracer. The general safety information is for both operating and servicing personnel.

Symbols and Terms

These two terms appear in manuals:

- CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.
- WARNING statements identify conditions or practices that could result in personal injury or loss of live.

These two terms appear on equipment:

- *CAUTION* indicates a personal- injury hazard not immedi ately accessible as one reads the markings, or a hazard to property including the instrument itself.
- *DANGER* indicates a personal-injury hazard immediately as one reads the markings.

This symbol appears in manuals:

Static-Sensitive Devices

These symbols appear on equipment:

DANGER
High Voltage

Protective
ground(earth)
terminal

ATTENTION
Refer to
manual

Specific Precautions

Observe all these precautions to ensure your personal safety and to prevent damage to the 571 or to the equipment connected to it.

Power Source – Use the proper power source. This product is intended to operate from a power source that does not apply more than 250 V rms between the supply conductor or between either supply conductor and ground. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

Grounding the Product – This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before making any connections to the product input or output terminals. A protective ground connection by way of the ground conductor in the power cord, is essential for safe operation.

Danger Arising from Loss of Ground – Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulated) can render an electrical shock.

Use the Proper Power Cord – Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

Use the Proper Fuse – To avoid fire hazard, use only a fuse of the correct type, voltage rating and current rating specified on the back of your instrument.

Do Not Operate in an Explosive Atmosphere – To avoid explosion, do not operate this instrument in an explosive atmosphere.

Do Not Remove Covers or Panels – To avoid personal injury, do not remove the instrument covers or panels. Do not operate the instrument without covers and panels properly installed.

Heating of the Device Under Test (DUT) – Testing at high power settings may cause the device under test (DUT) to get hot enough to cause injury. Avoid touching the DUT until cooled.

Consignes de Securité

Ce rappel des consignes générales de secureté s'addresse à la fois aux utilisateurs et au personnel de maintenenance. Avertissements et précautions à respecter sont annotés au long de ce manuel à chaque fois que l'utilisation du 571 l'exige. Il est à noter que ceux-qui peuvent ne pas figurer dans cette rubrique de rappel.

Symboles et Termes dans ce manuel

- Les paragrahpes intitulés CAUTION (ATTENTION) identificient les circonstaces ou opérations pouvant entraîner la détérioration de l'appareil ou de tout autre équipment.
- Les paragraphes intitulés WARNING (AVERTISSEMENT) indiquent les circonstances dangereuses pour l'utilisateur (danger de mort ou risque de blessure).
-  Static-Sensitive Devices (Composants sensible à statique)

Termes reperères gravés sur l'appareil

- *CAUTION* (ATTENTION) : ce mot identifie les zones de risque non immédiatement perceptibles ou un risque éventuel de détérioration de l'appareil.
- *DANGER* (DANGER) : ce mot indique les zones de risque immédiat pouvant entraîner blessures ou mort.

Symboles gravés sur l'appareil

DANGER
Haute tension

Borne de masse
de protection (terre)

ATTENTION
se reporter au manuel

Source d'alimentation – L'appareil est conçu pour fonctionner à partir d'une source d'alimentation maximale de 250 V efficace entre les conducteurs d'alimentation ou entre chaque conducteur et la terre. Pour utiliser l'appareil en toute sécurité, une connexion à la masse, realisée au moyen d'un conducteur prévu dans le cordon d'alimentation, est indispensable.

Mise à la masse de l'appareil – Une fois installé dans le châssis d'alimentation, l'appareil est relié à la masse à l'aide d'un conducteur du cordon d'alimentation. Pour eviter tout choc électrique, insérer la prise du cordon d'alimentation dans une prise de distribution correspondante, avant de connecter l'entrée ou les sorties de l'appareil. Pour utiliser l'appareil en tout sécurité, une connexion à la masse, réalisée au moyen d'un conducteur prévu dans le cordon d'alimentation, est indispensable.

Danger provoqué par la coupure de connection de masse – En cas de coupure de la connexion de masse, tous les élements conducteurs accessible (y compris boutons et commandes apparissant isolants) peuvent provoquer un choc électrique.

Utuliser le cordon d'alimentation approprié – N'utiliser que le cordon d'alimentation et la prise recommandés pour votre appareil. Utiliser un cordon d'alimentationen parfait état.

Seul, un personnel qualifié peut procéder à un changement de cordon et prises.

Utiliser le fusible approprié – Pour éviter tout risque d'accident (incendie...) n'utiliser que le fusible recommandée pour votre apppareil. Le fusible remplacement doit toujours correspondre au fusible remplacée: même type, même tension et même courant. Un remplacement de fusible ne doit être effetué que par personnel qualifié.

Ne pas utiliser l'appareil en atmosphères explosives – Pour éviter toute explosion, ne pas utiliser cet appareil dans un atmosphère de gaz explosifs.

Ne pas demonter les capots ou les panneaux – Pour éviter toute blessure, ne pas ôter les capots ou les panneaux. N'utiliser l'appareil que si ceux-ci ont été correctivement remis en place.

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.

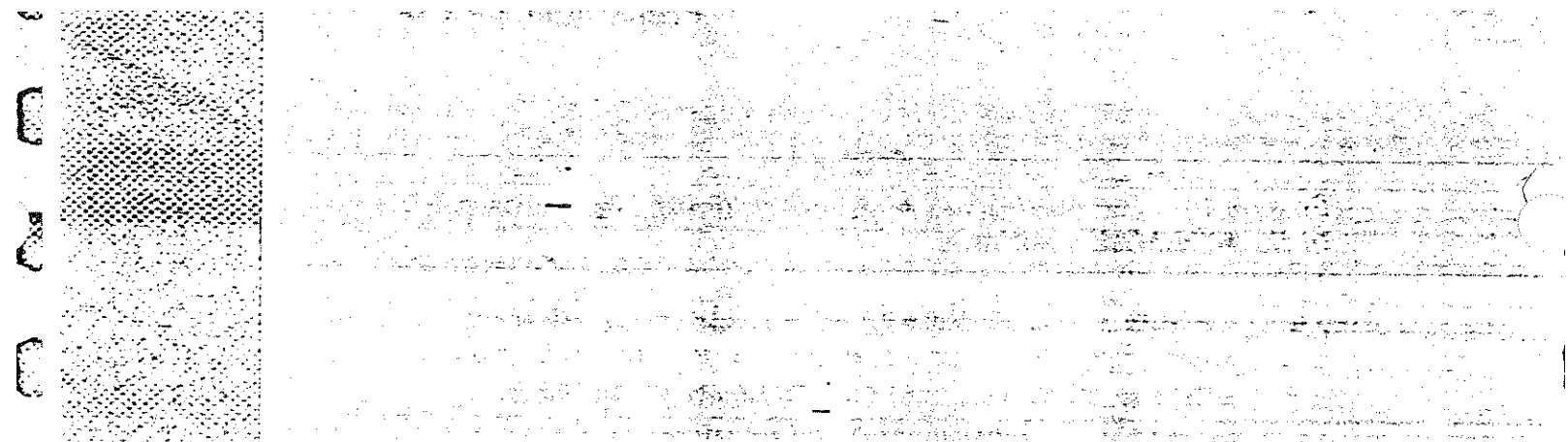
NOTE

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

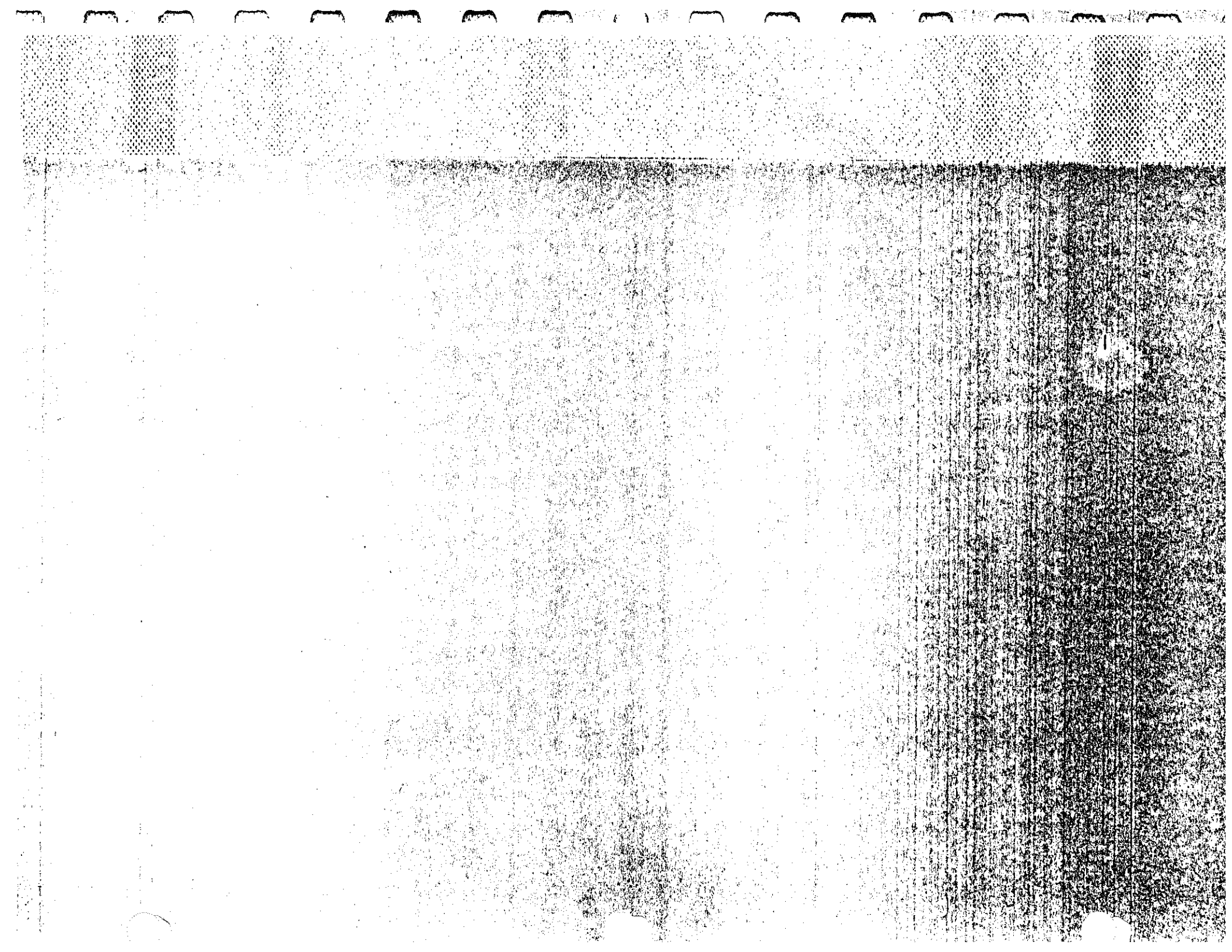
Step 4: Be sure you have the appropriate operating environment. Specifications for temperature, relative humidity, altitude, vibrations and emissions are included in Appendix B: *Warranted Specifications.*

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.



Tutorial



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.

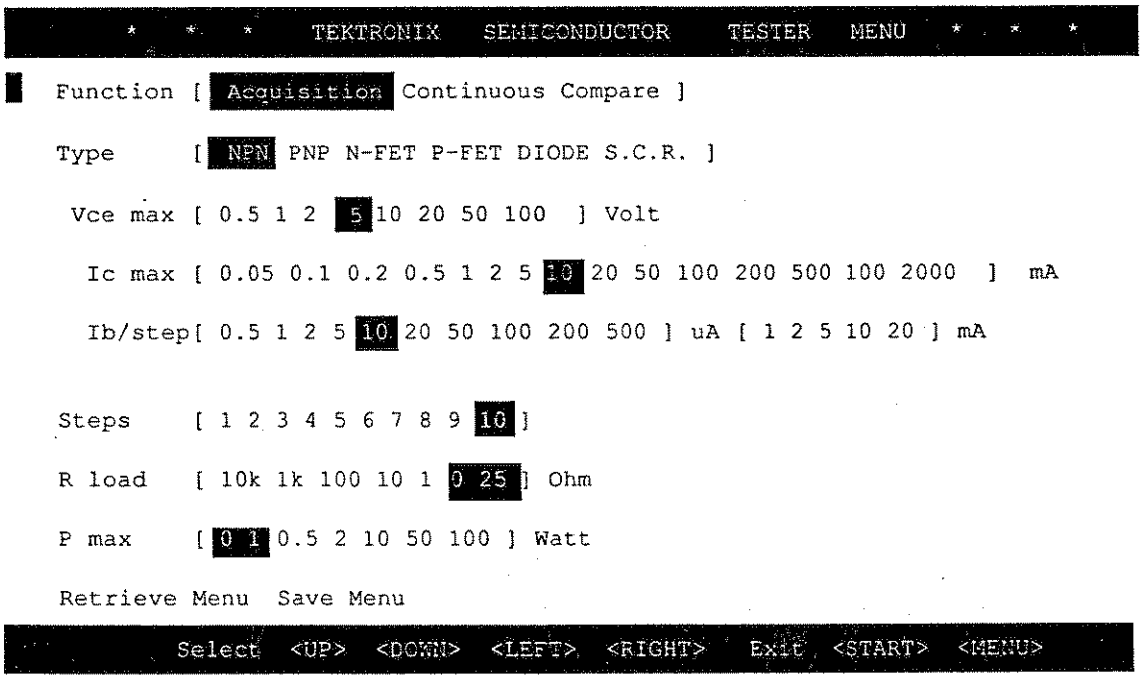
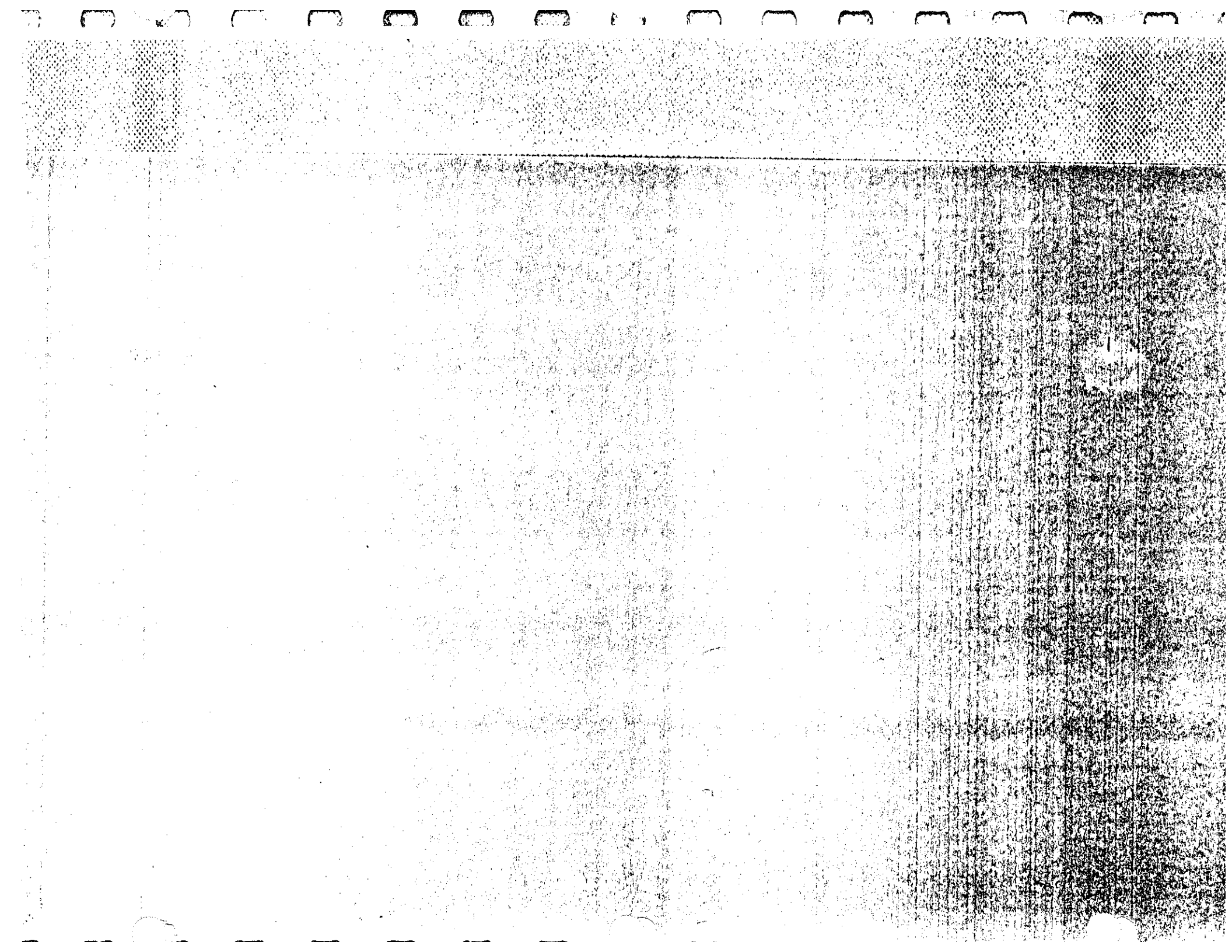


Figure 2-1: Menu Screen at Default

Measurement Examples



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).

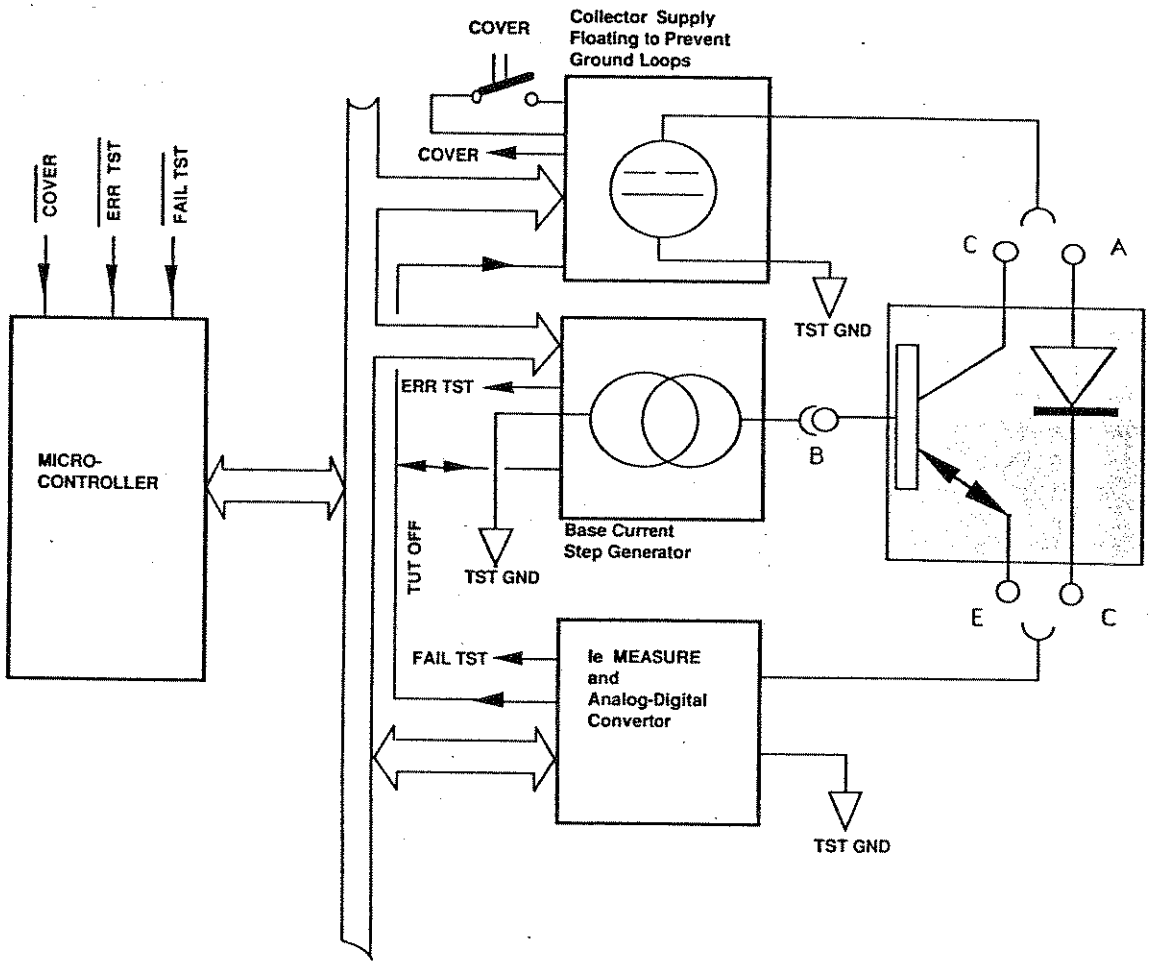


Figure 3-1: Block Diagram of the 571 Curve Tracer

Transistor Measurements

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

Step1. 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.

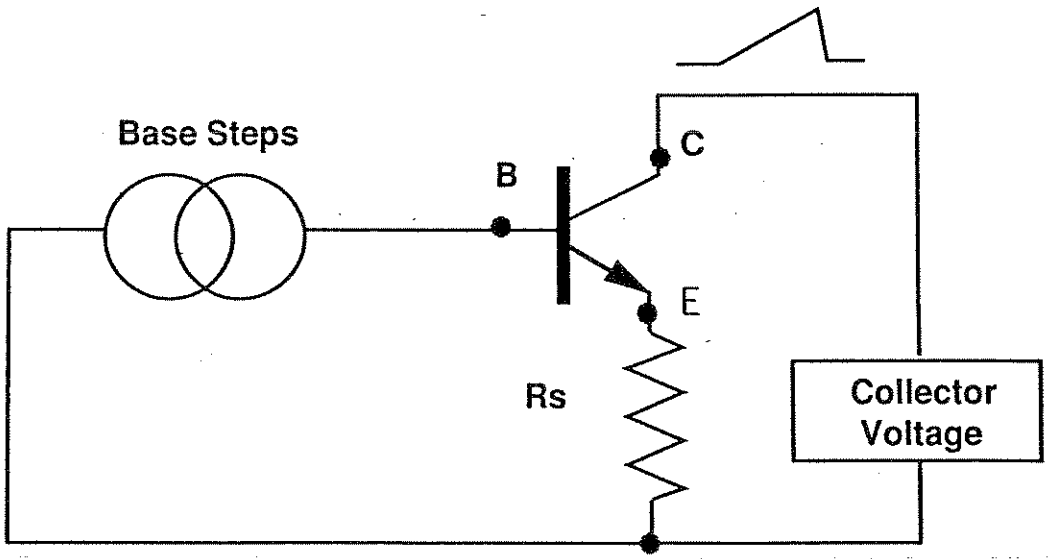


Figure 3-2: Transistor Connection Diagram

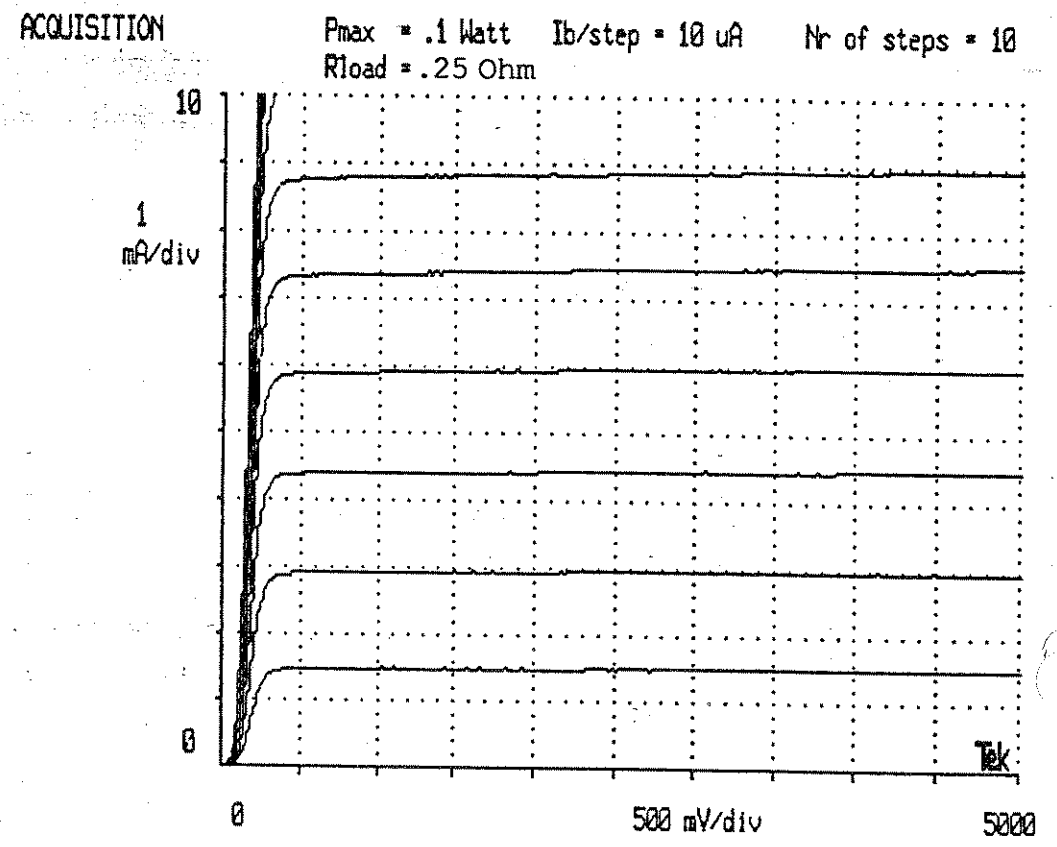


Figure 3-3: Vce - Ic curves (NPN transistor)

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.

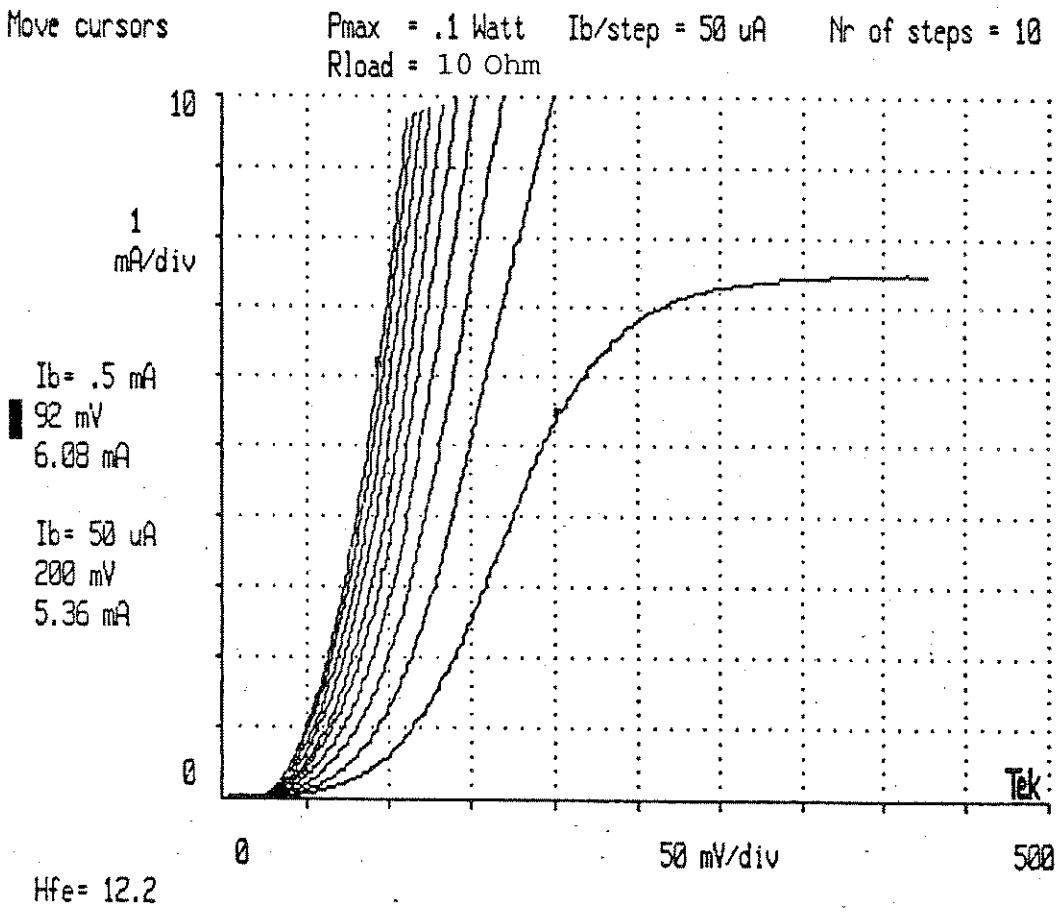


Figure 3-4: Transistor Saturation Area

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.

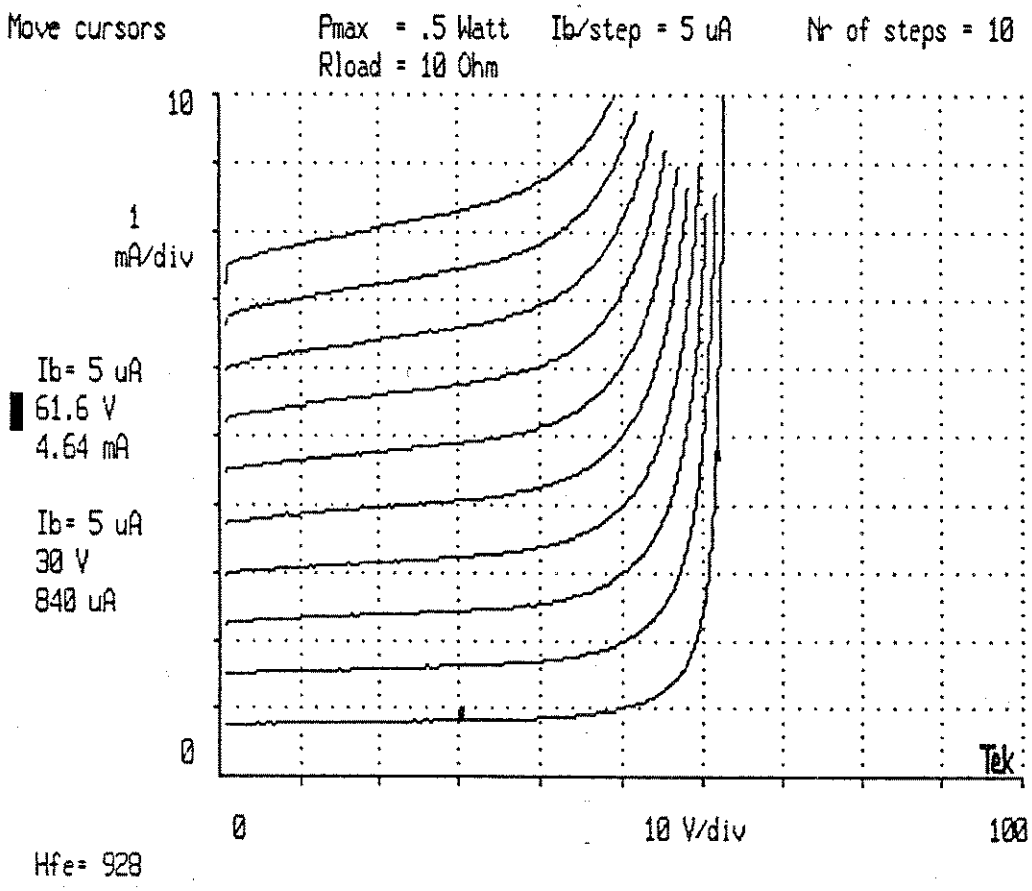


Figure 3-5: Collector-base Breakdown Voltage Curves

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.

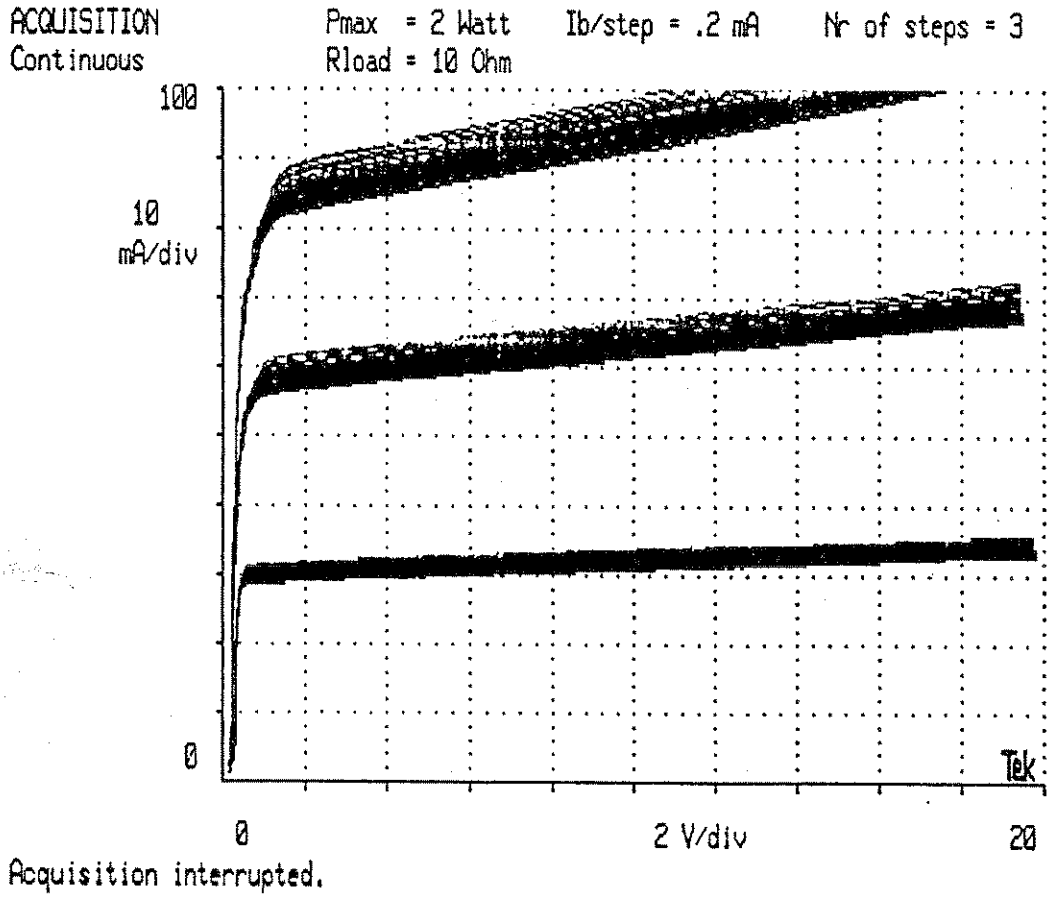


Figure 3-6: Temperature Drift Curves

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
Rload .....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)

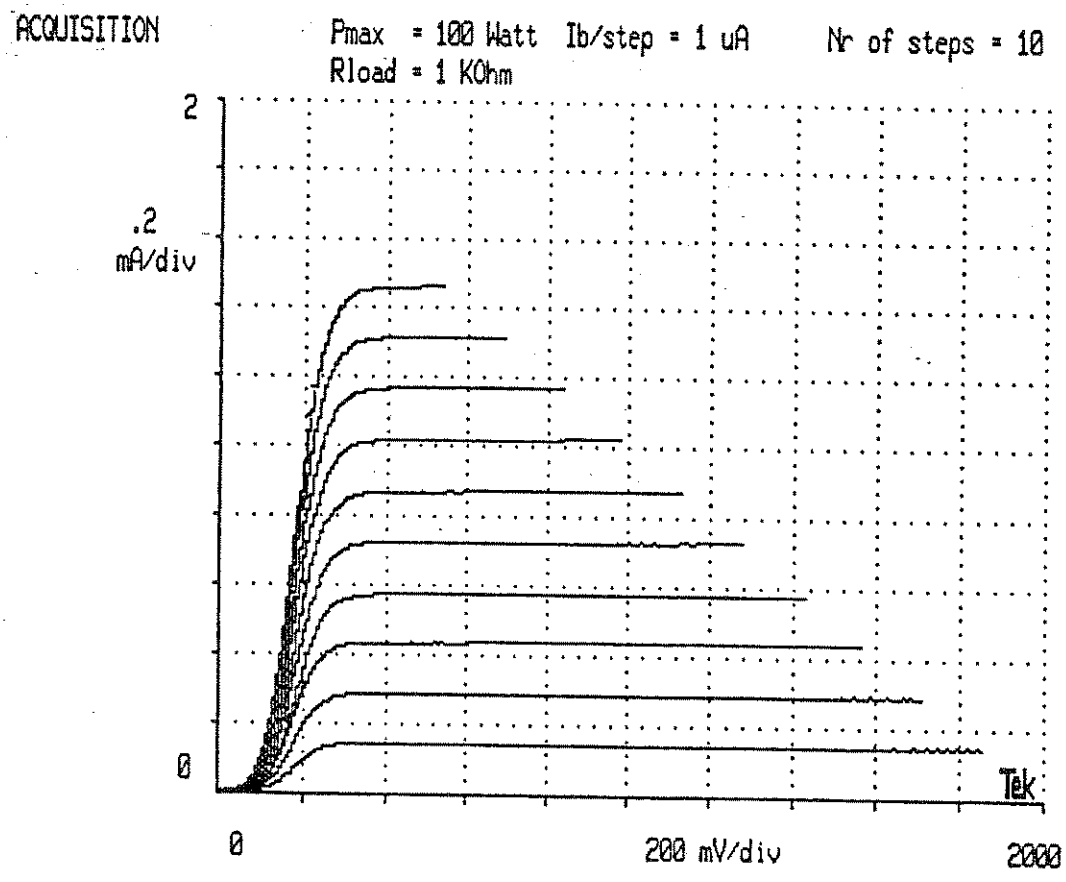


Figure 3-7: Loadline Curve

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
Rload .....0.25 Ω
Pmax .....0.1 Watt

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

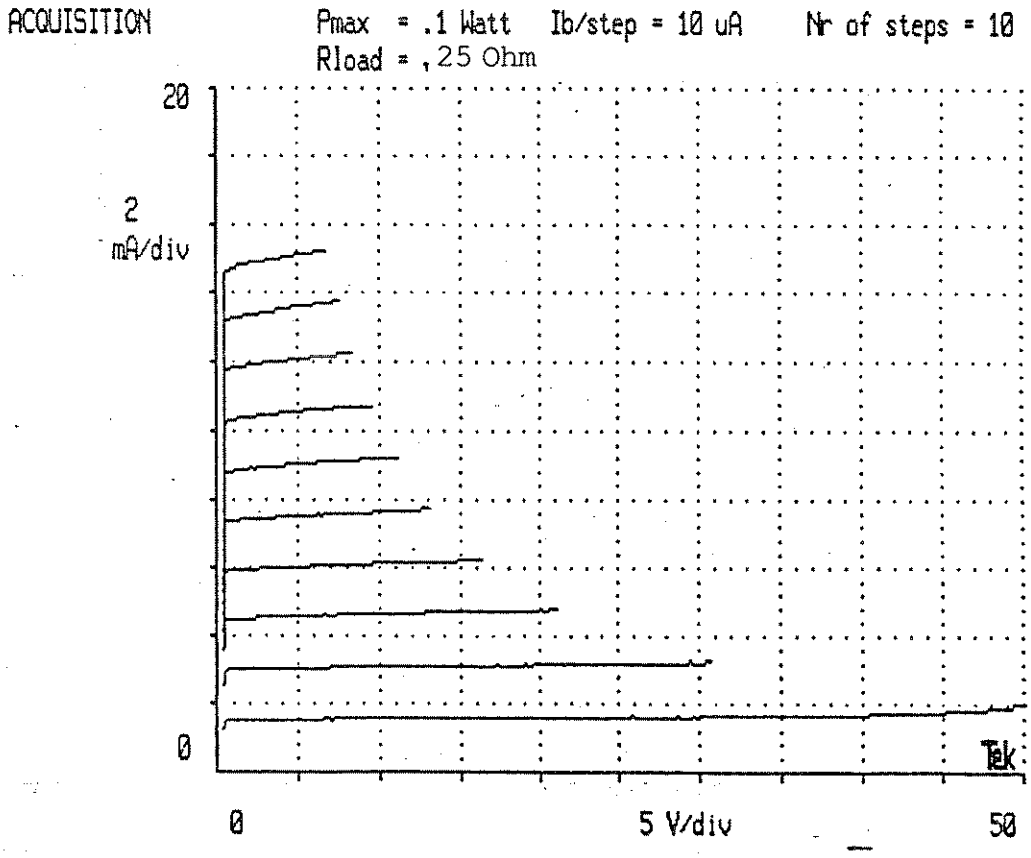


Figure 3-8: Power curve

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 ΔIb 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 ΔVce gives the hoe under these specified conditions of collector current and collector voltage.

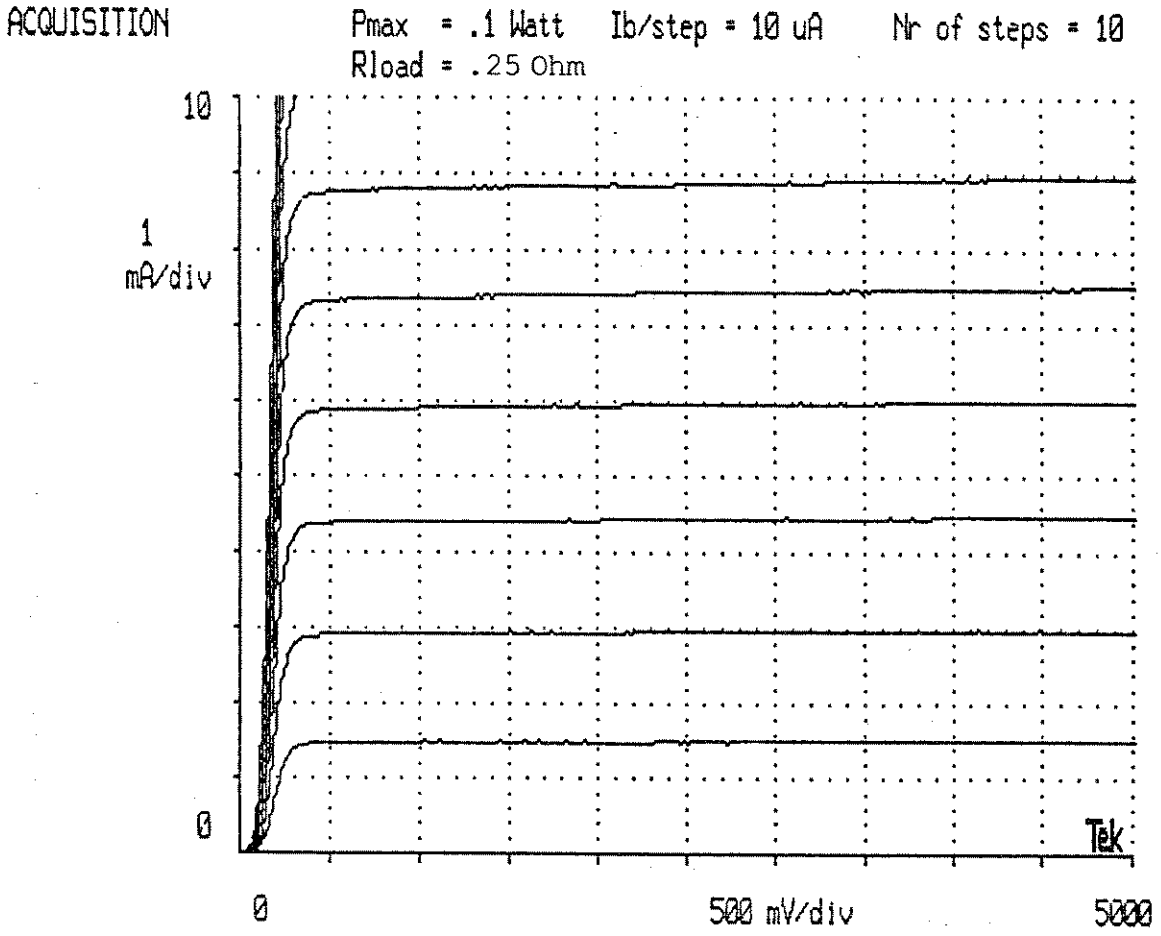


Figure 3-8a: Vce-Ic Curves

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.

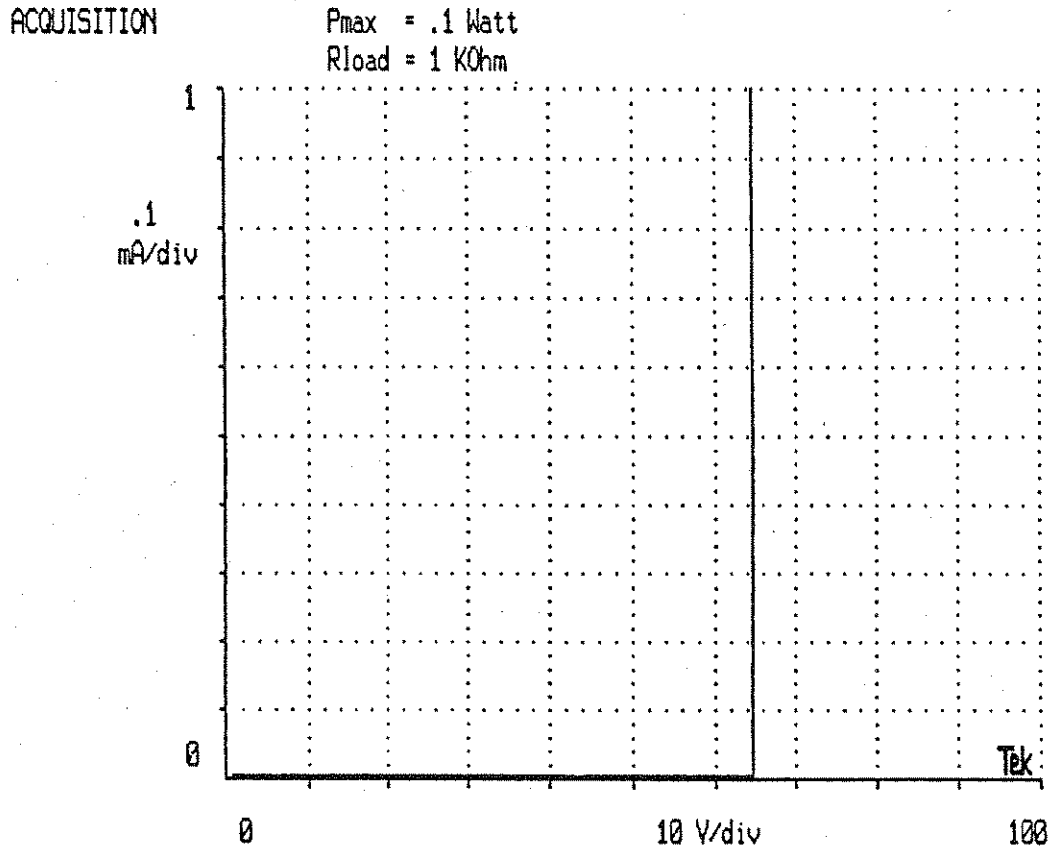


Figure 3-9: Vceo Curve Curve

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.

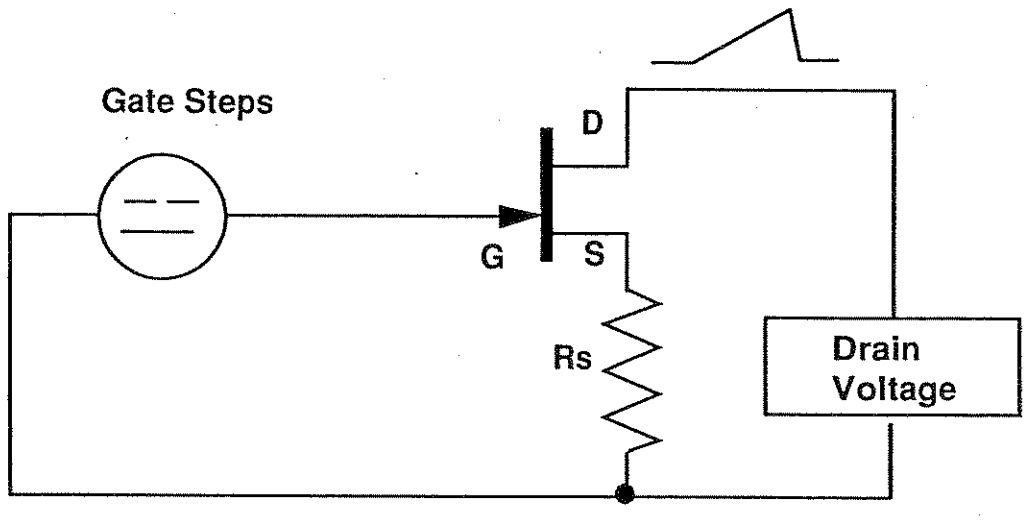


Figure 3-10: FET Connection Diagram

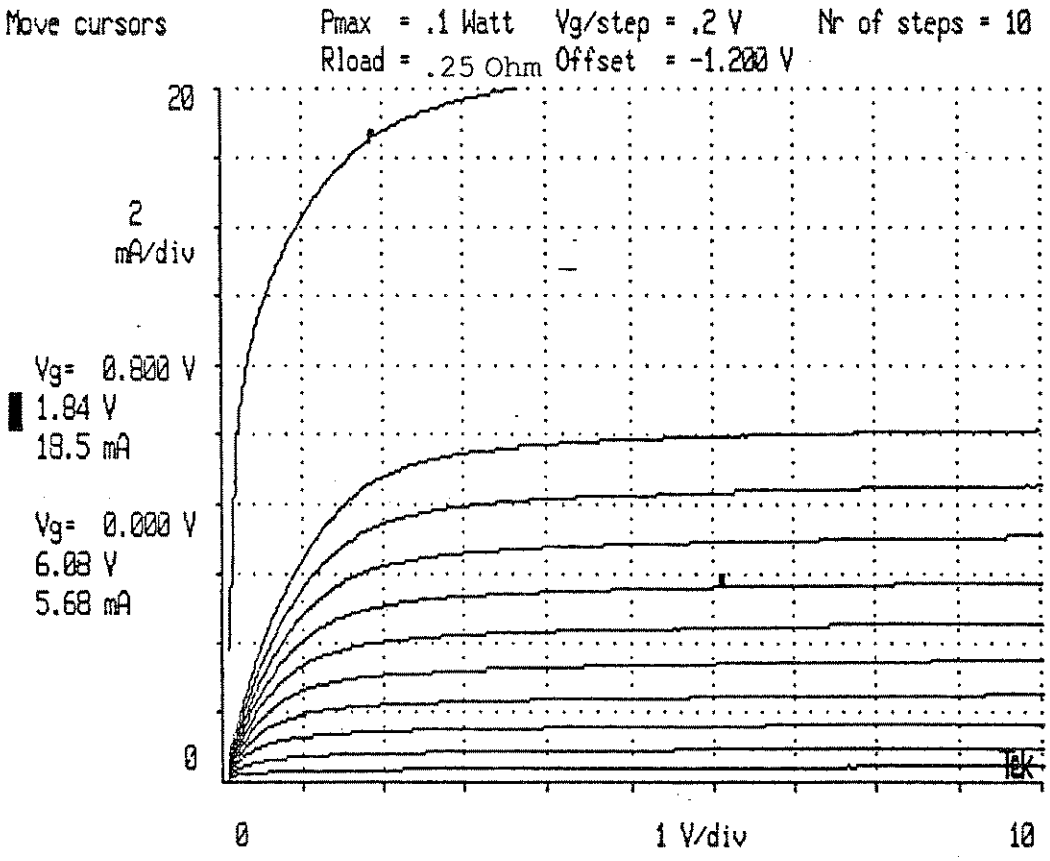


Figure 3-11: JFET Curves in Depletion and Enhancement Mode

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.

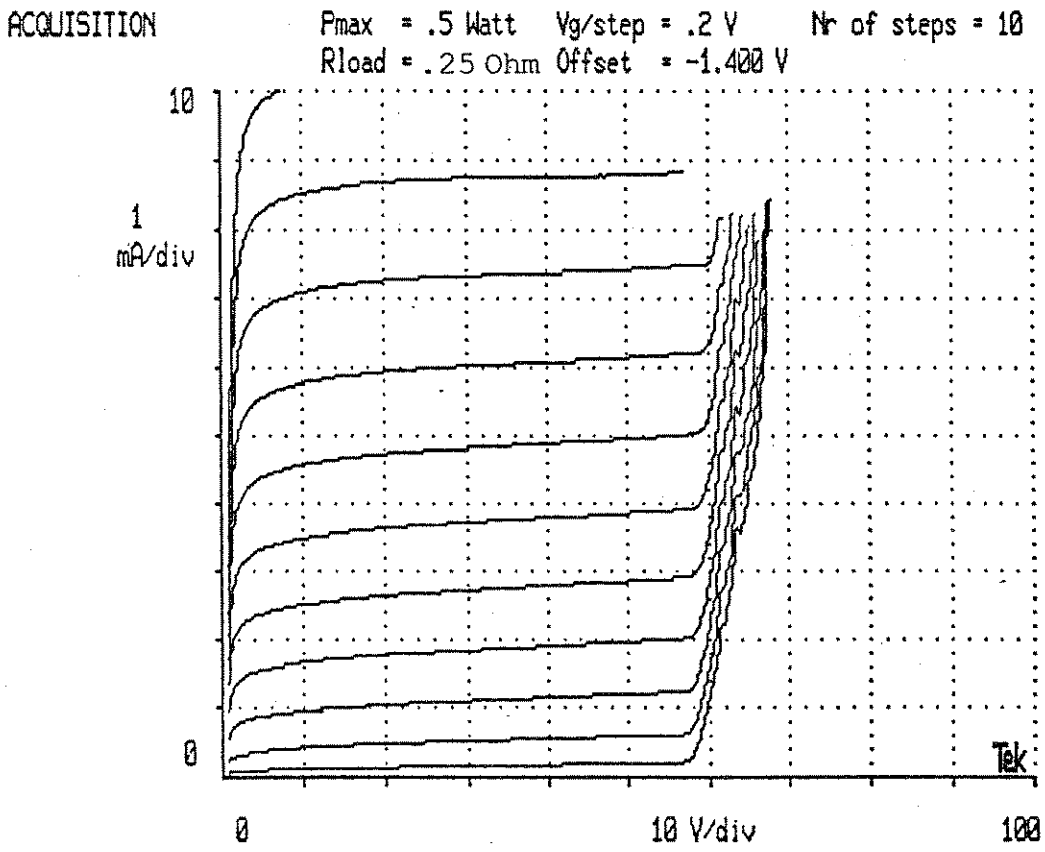


Figure 3-12: Drain Breakdown Voltage Curves

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.

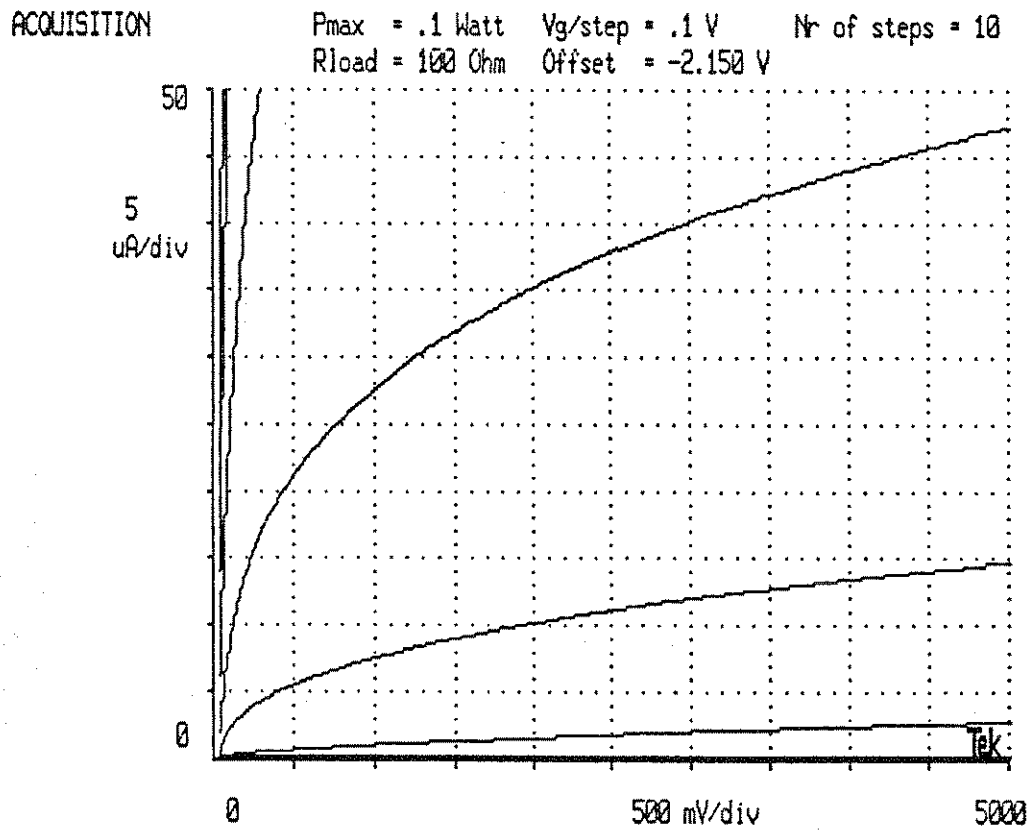


Figure 3-13: Pinchoff Voltage Curves

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.

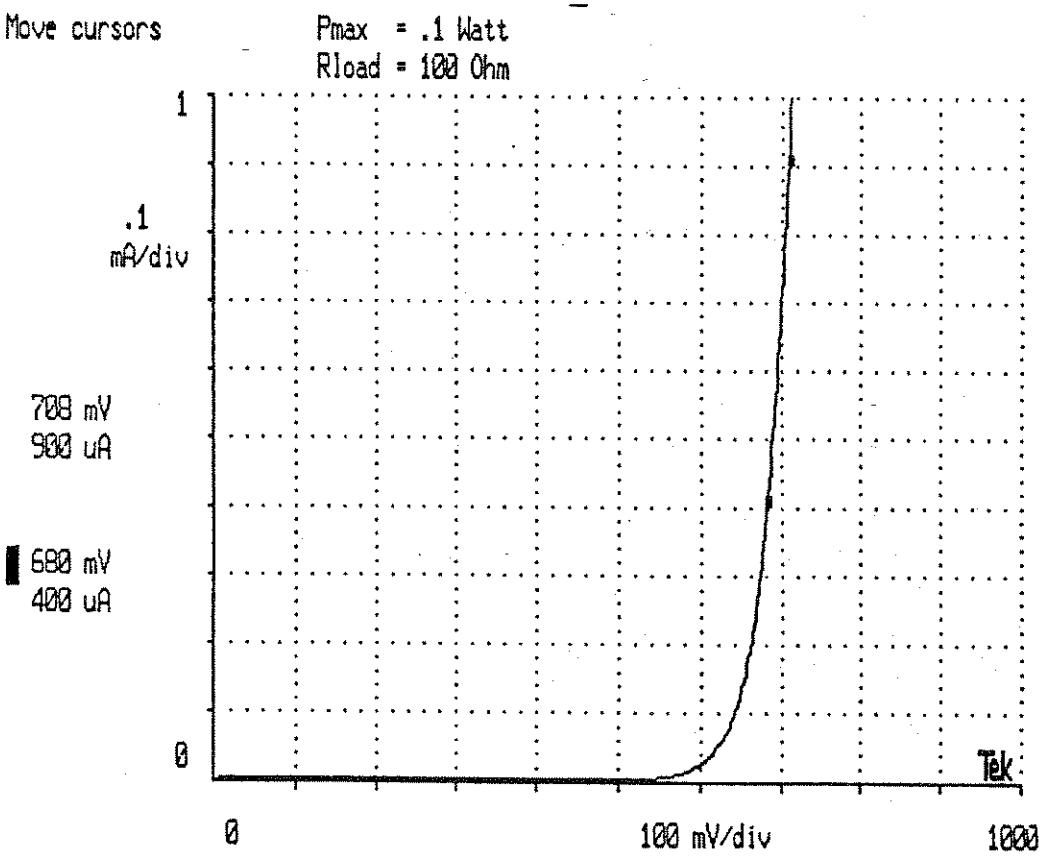


Figure 3-14: Diode Curve in Forward Direction

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).

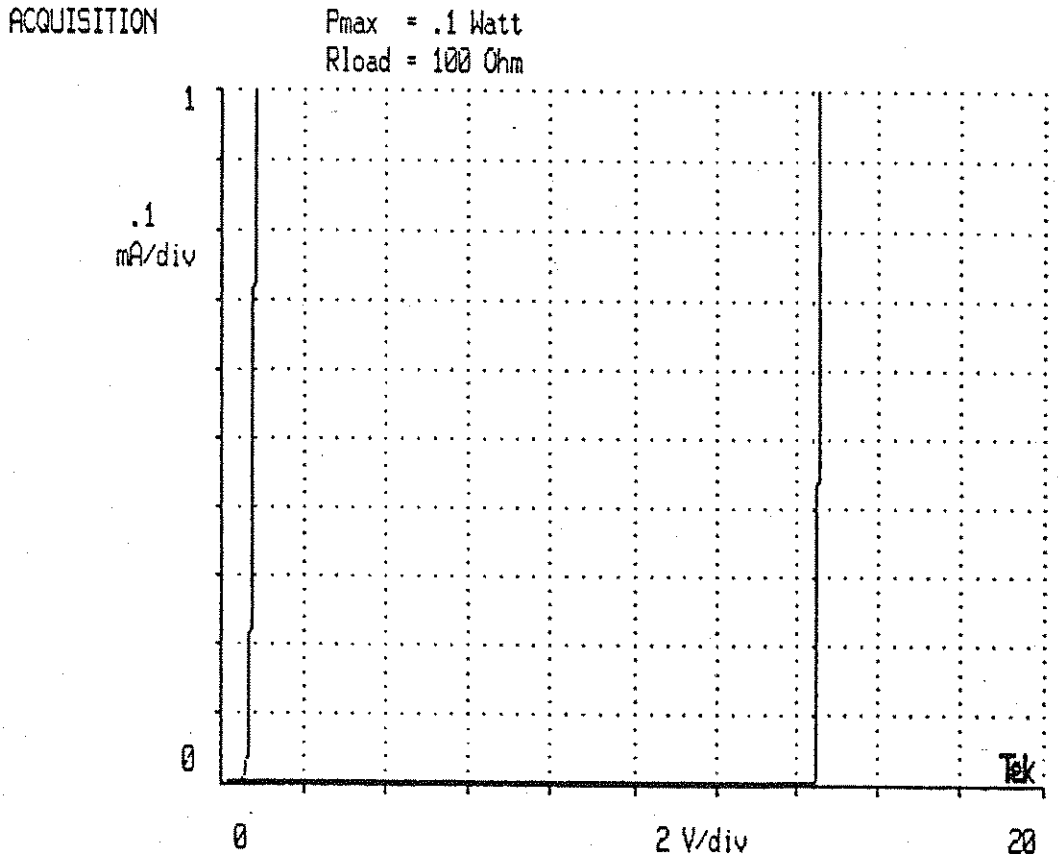


Figure 3-15: Zener Diode Curve in Forward and Reversed Direction

Thyristor Measurements

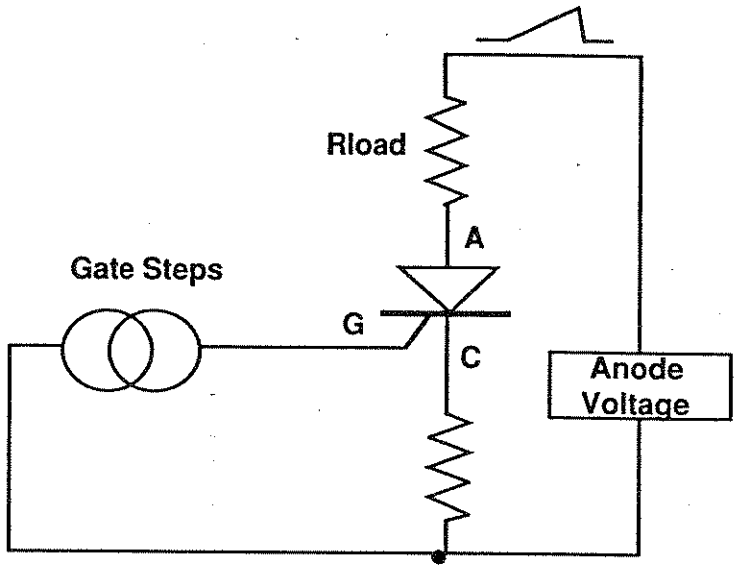


Figure 3-16: Thyristor Connection Diagram

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.

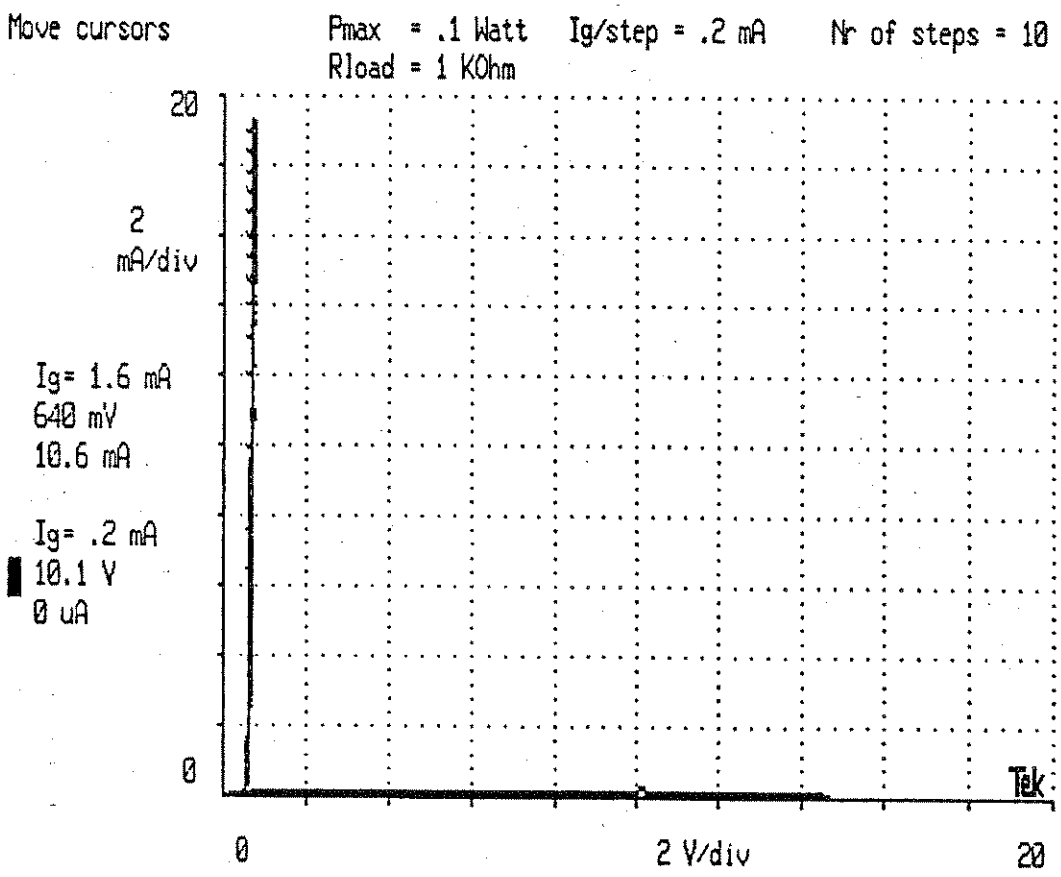


Figure 3-17: Thyristor Curves

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 !

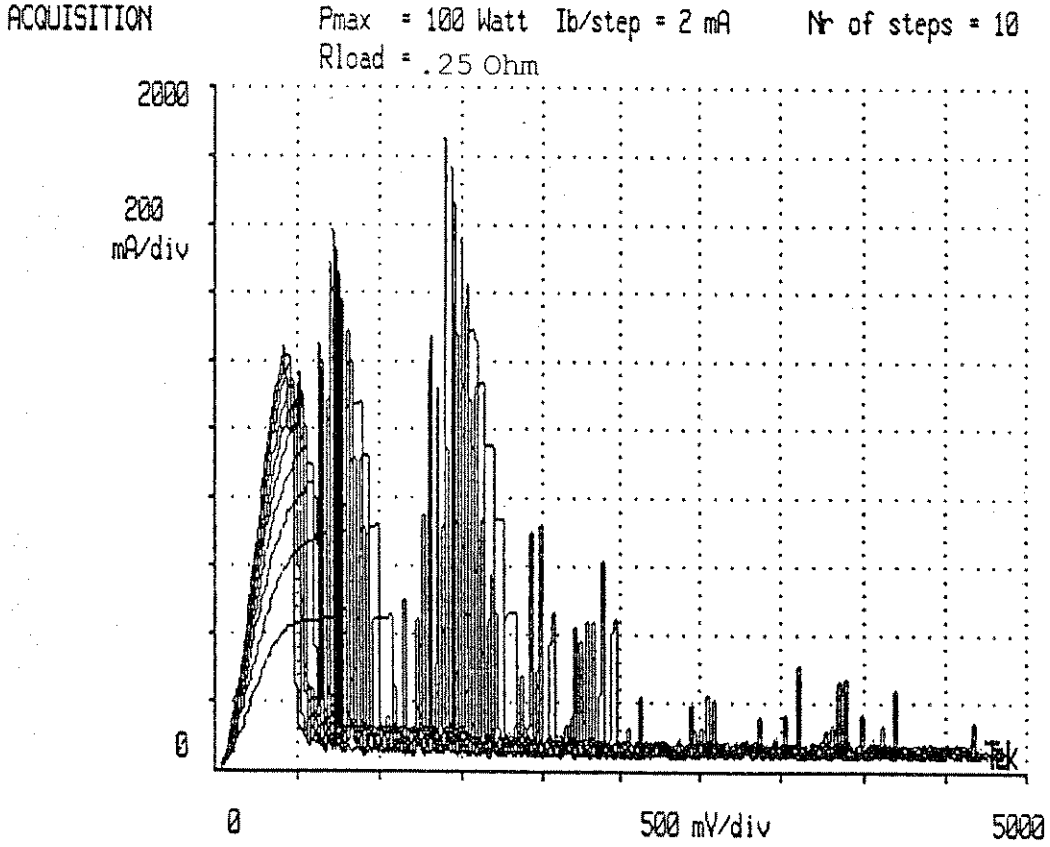


Figure 3-18: Thermal Protection Curve

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.

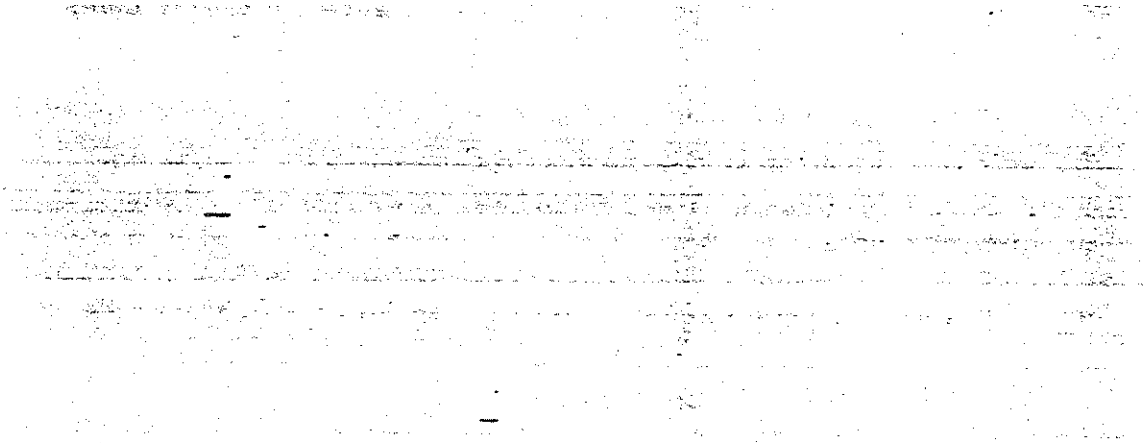
Step 6. Now hook up a PNP transistor and press the <UP> or <DOWN> button.

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

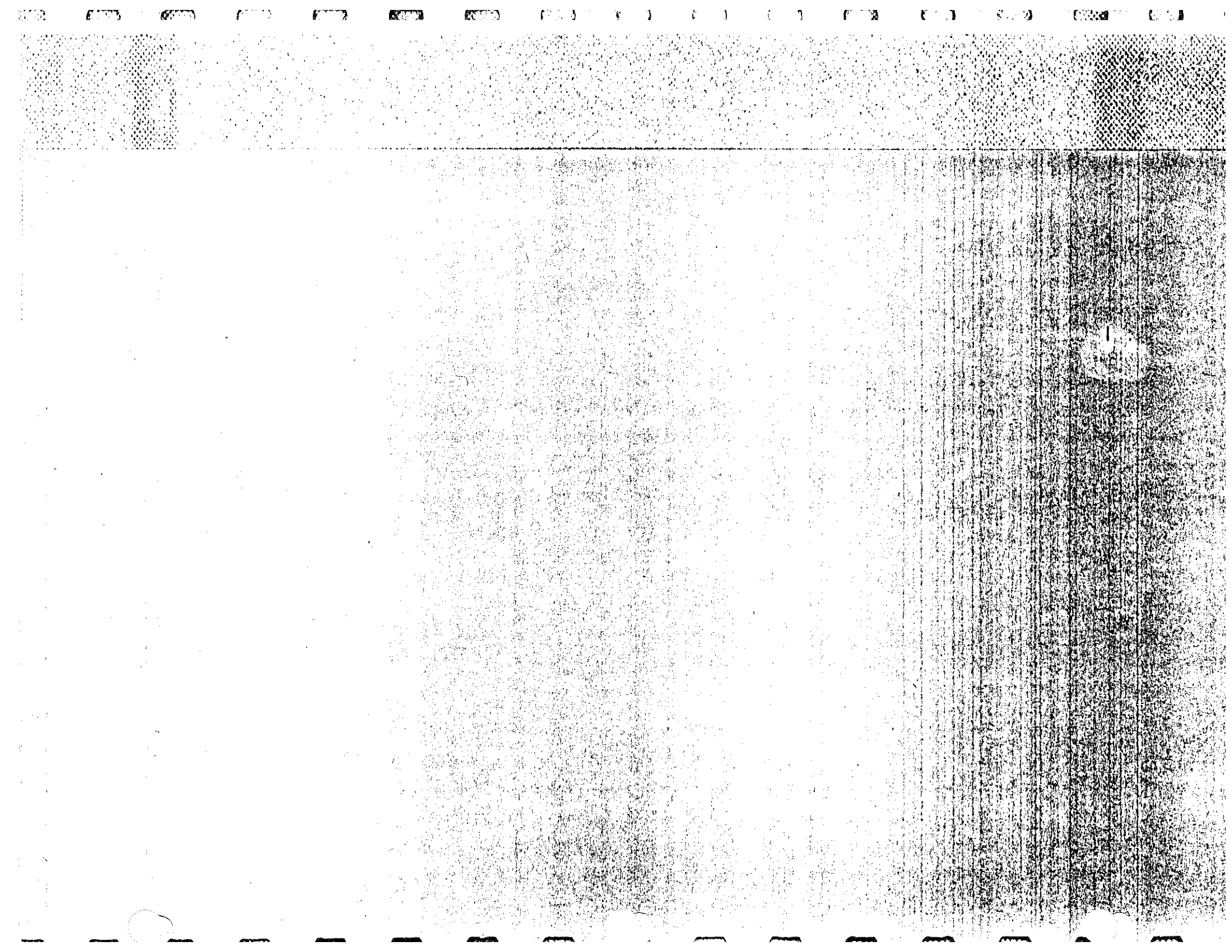
The reference device type is displayed below the word 'COMPARE' upper left on the screen, and the type of the device under test is displayed inverse in the top line on the screen.

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.



At a Glance



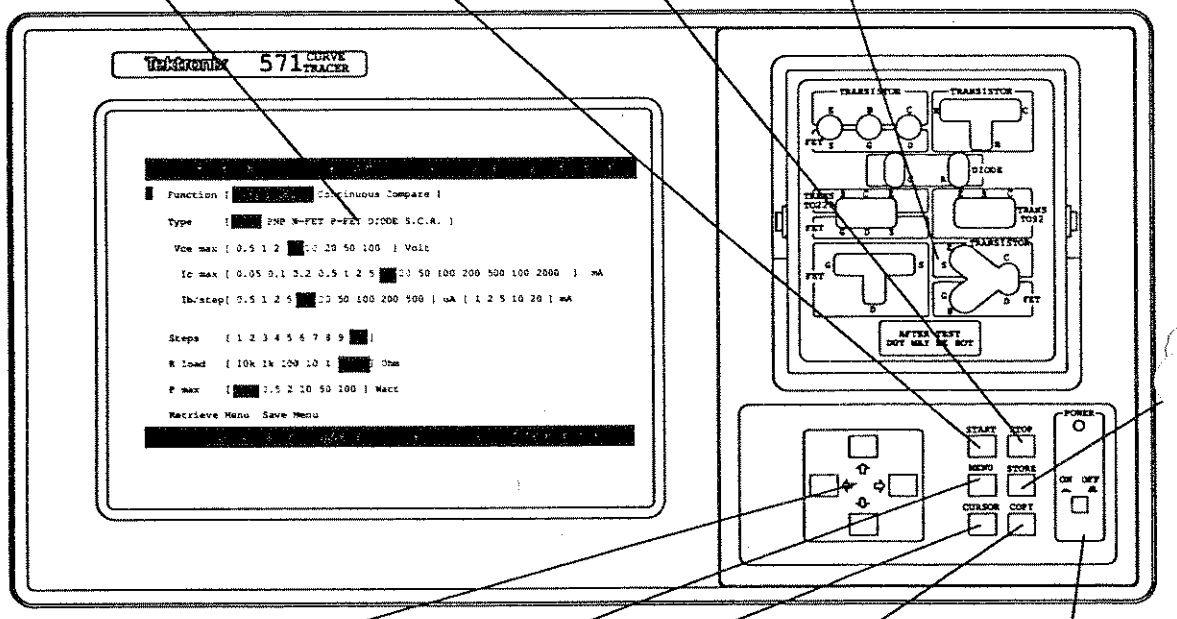
At a Glance

The *At a Glance* section contains maps of the front panel and rear panel. These maps should help you navigate the 571 Curve Tracer.

- The *Front Panel* map of shows the parts, the locations and purposes of the connectors and buttons of the 571 Curve Tracer.

- The *Rear Panel* map shows the locations and purposes of the various parts on the rear panel of your 571 Curve Tracer.

Front Panel Map



Display of Curves or MENU Lines page 5-3, 5-9

START Acquisition Switch page 5-9

STOP Acquisition Switch page 5-10

Sockets page 5-13

STORE Curves Switch page 5-11

Change Scale Switches page 5-11

Show MENU Switch page 5-3

CURSOR Mode Switch page 5-12

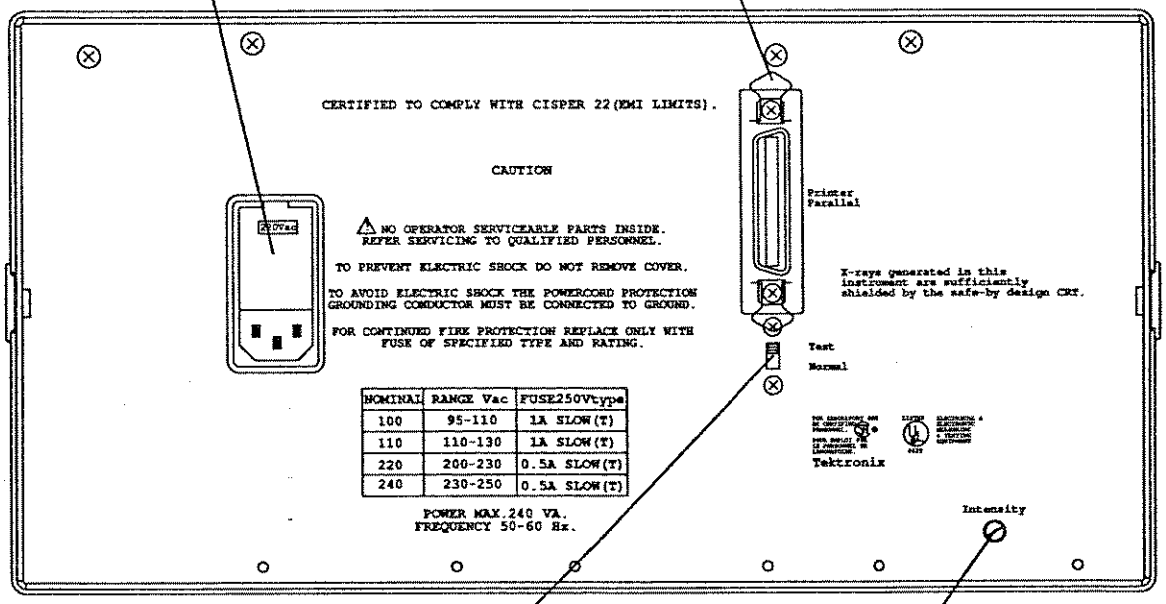
Make a Hardcopy Switch page 5-14

POWER ON/OFF Switch page 5-22

Rear Panel Map

Power Connector/ Fuse Holder/ Voltage Range Selector page 1-4, 5-22

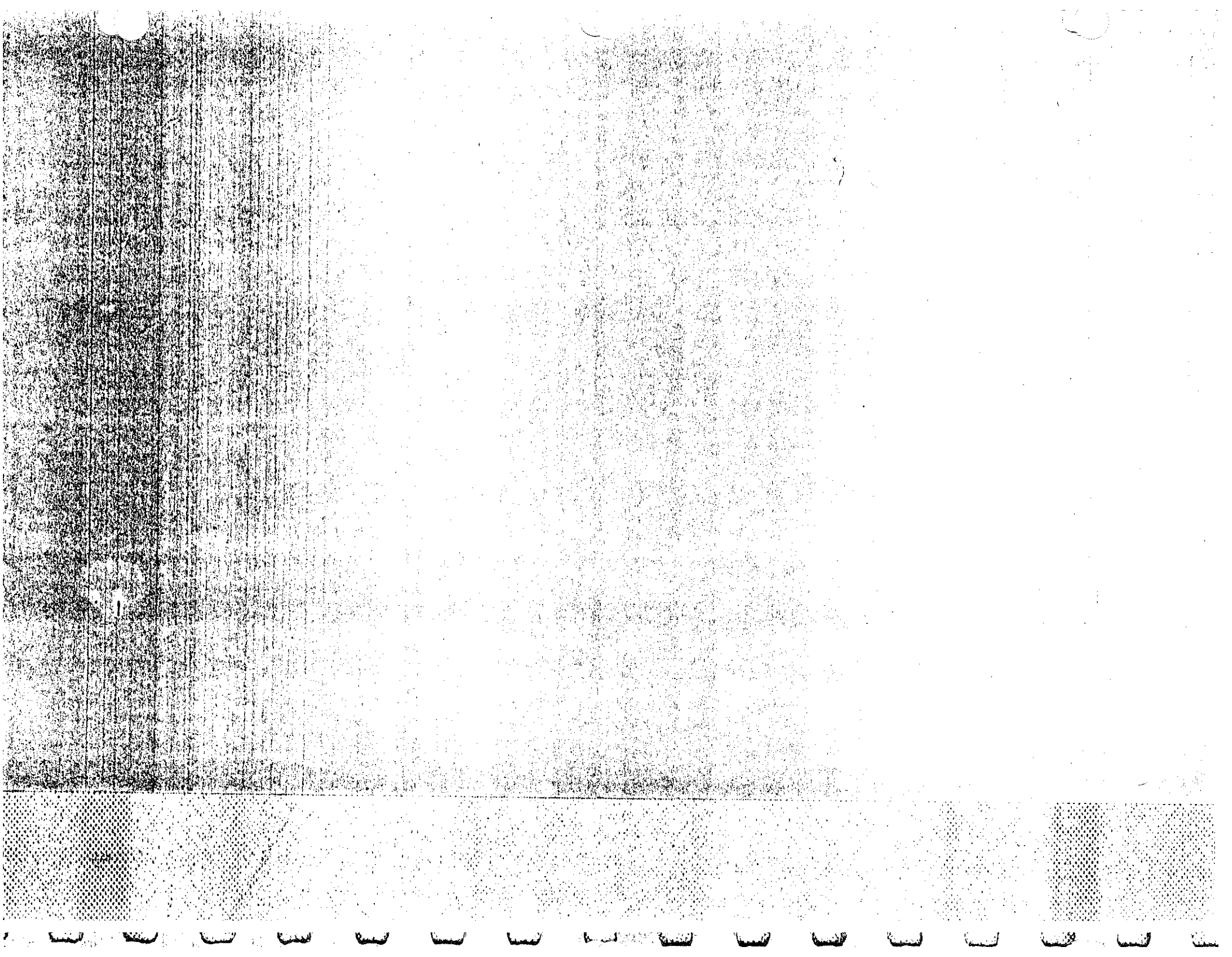
Parallel Printer Output (Centronics compatible) Connector page 1-4, 5-14



Normal/Test Switch page 1-4, C-2

Intensity Control page 1-4

In Detail



General

The *In Detail* section contains a description of the 571 functions and locations of the 571 controls, connectors, and indicators on the front and rear panel. It is intended to provide you more detailed information about the locations and purposes of the various functions of the 571 Curve Tracer.

The *In Detail* section is split up in the following subsections:

- Menu Screen
- Test Screen
- Front & Rear Panel Controls
- Sockets
- Making Hardcopies
- Messages
- Maintenance and Repair
- EEROM Protection Utility
- Power

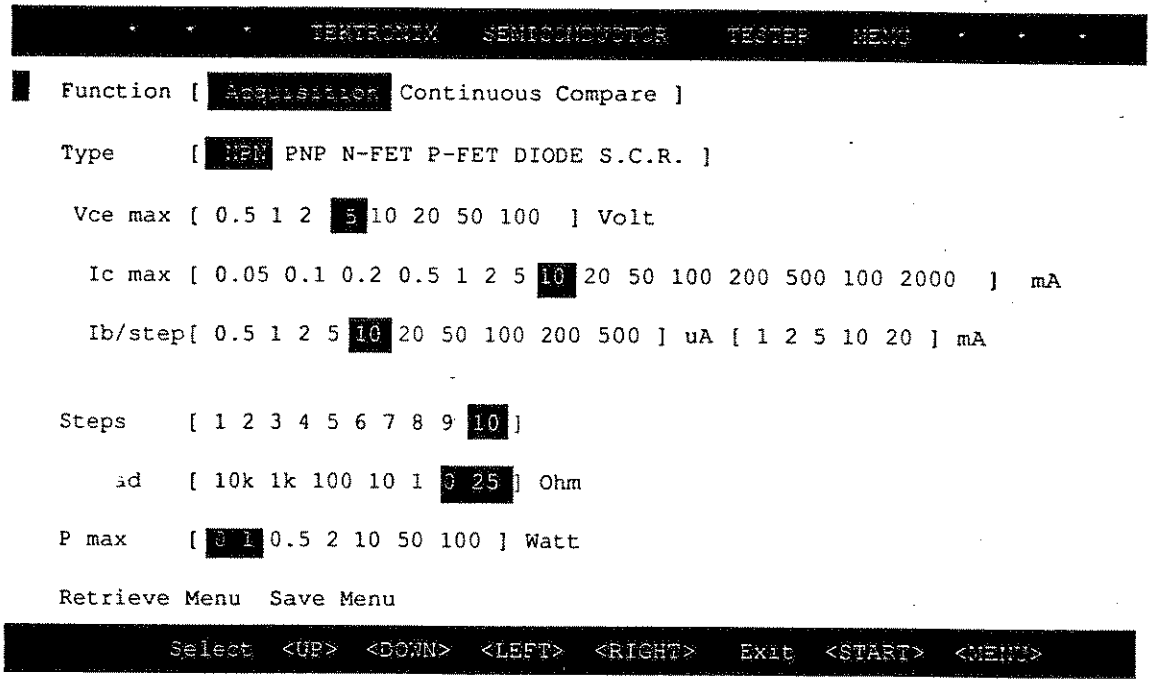


Figure 5-1: Menu Screen

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 "Retrieve Menu" or "Save Menu" 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. Function
(Recall **Acquisition** Continuous Compare)

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

- Recall

  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.

- Acquisition

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 .

- Acquisition Continuous

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.

- Compare

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. Type [**NPN** PNP N-FET P-FET DIODE S.C.R.]

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. `Vce max [0.5 1 2 5 10 20 50 100] Volt`

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. `Ix max [0.05 0.1 0.2 0.5 1 2 5 10 20 50 100 200 500 1000 2000] mA`

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. `Ib/step`
`[0.5 1 2 5 10 20 50 100 200 500] uA`
`[ 1 2 5 10 20] mA`

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. `Offset [ -1.250 ] Volt`

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. `Steps [ 1 2 3 4 5 6 7 8 9 10 ]`

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. `R load [ 10k 1k 100 10 0.25 ] Ohm`

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. `P max [ 0.1 0.5 2 10 50 100 ] Watt`

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. **Retrieve Menu** Save Menu

When this line is selected with the cursor, Retrieve Menu is displayed inverse. The right and left arrow keys toggle between Retrieve Menu and Save Menu.
Pressing the start or menu key, with Retrieve Menu inverse, activates the sub-screen RETRIEVE MENU FROM EEROM. 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 Save Menu inverse, activates the sub-screen SAVE MENU IN EEROM.
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 " SAVE MENU " to " RETRIEVE MENU ".
Pressing the stop key will erase the selected EEROM location, regardless of whether " SAVE MENU " or " RETRIEVE MENU " 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).

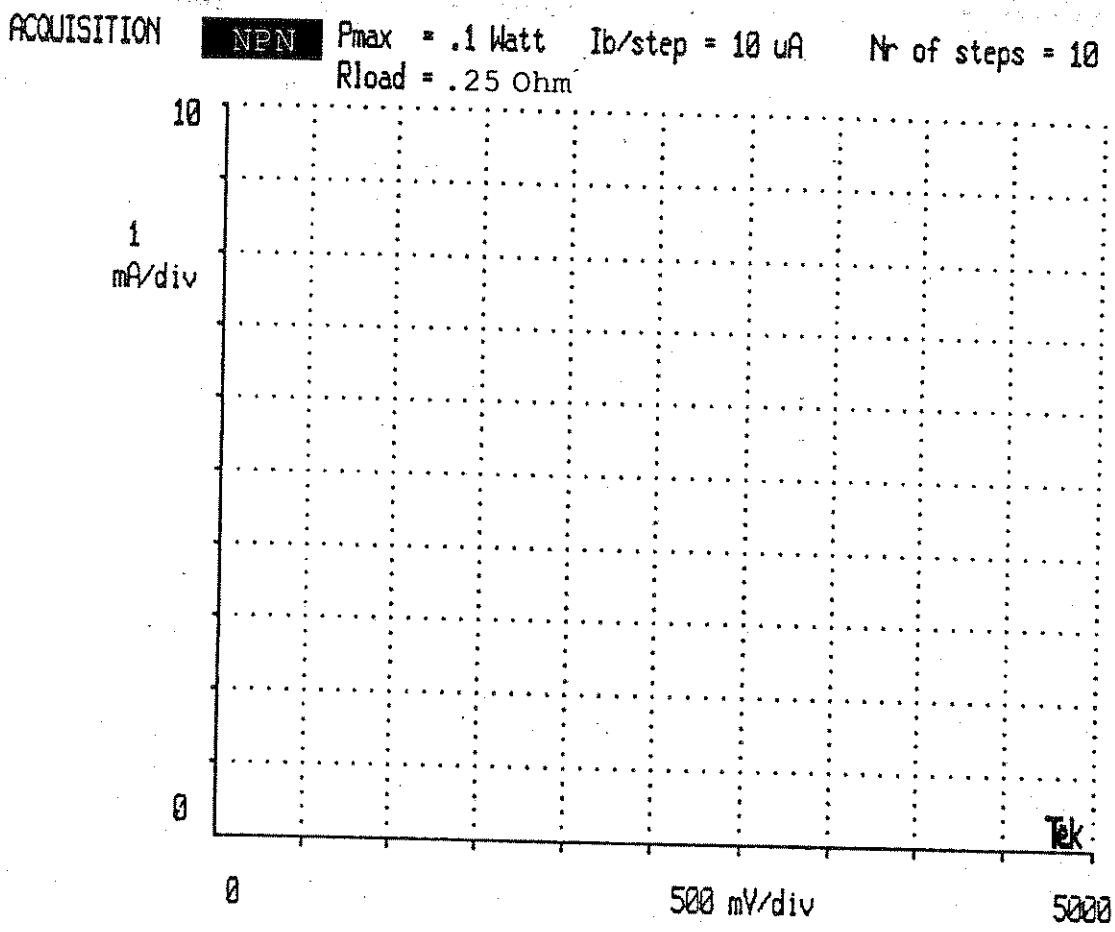


Figure 5-2: Test Screen Default Settings

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:

   ```
   " Acquisition aborted :overcurrent! "
   ```

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:

   ```
   "Acquisition aborted: base/gate drive out of-range!"
   ```

3. Cover opened during acquisition.

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

   " Acquisition aborted : cover open! "

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:

   " Acquisition interrupted "

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. " Rload modified "

   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. " Current scale factor modified "

   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. " Ib/step reduced "

   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:

" Store display in RAM ".

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.:

" Do acquisition first!! "

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: " Do acquisition first!! " *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 " `Printer not ready!` " appears at the prompt line for about two seconds and the 571 resumes its normal operation.
If it says " `Printer not ready!` " 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 " `Printing...` " 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:

- " Acquisition Interrupted. "

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

- " Close cover "

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

- " Acquisition aborted: cover open! "

  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.

- " Acquisition aborted: base/gate drive out of range! "

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

- " Acquisition aborted: Overcurrent! "

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

- " Do acquisition first!! "

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

- " Store display in RAM "

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

– " Ib/step reduced "

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

– " Current scalefactor modified "

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

NOTE

This message can be displayed together with " Ib/step reduced ".

– " Rload adapted "

Rload is increased in order to get a usable display.

NOTE

This message can be displayed together with " Ib/step reduced ".

Maintenance and Repair

The 571 Curve Tracer is covered by a standard Tektronix three-year warranty. If the 571 fails during the warranty period, return it to Tektronix for free servicing (subject to the conditions of the warranty statement).

To arrange for warranty service or get an estimate for out-of-warranty repairs within the United States, call the following toll-free customer service number between 8.00 AM and 4.30 PM Pacific Time:

1-800-937-6007

Outside the U.S., call your local Tektronix Sales Office or Service Center. They are fully equipped to service your instrument.

To help diagnose the problem, have the instrument serial number available. The serial number is located at the rear panel.

WARNING

To avoid fire hazard, use only the fuse of correct type, voltage rating, and current rating as specified on the instrument and in fuse replacing instructions.

If your instrument must be returned for servicing, package it as described on page 5-20.

Cleaning Instructions

This instrument should be cleaned as often as operation conditions require. Accumulation of dirt on components may act as an insulating blanket and prevents efficient heat dissipation that can cause overheating and component breakdown.

Use a non-residue type of cleaner; preferable isopropyl alcohol or denatured ethyl alcohol.

Before using any other type of cleaner consult your Tektronix Service Center or representative.

Exterior : Loose dust accumulated on the front can be removed by a soft cloth or a small brush. Dirt that remains on the front can be removed with a soft cloth dampened with a mild detergent and water solution.

CAUTION

Do not use abrasive cleaners !!

Interior : It is recommended that in cleaning the interior, the accumulated dust be first blown off with dry low pressure air, then use a soft brush to remove any remaining dust.

CAUTION

This instrument contains electrical components that are susceptible to damage from static discharge. Discharge the static voltage from your body by wearing an approved wrist strap and pad connection while cleaning the interior of the instrument !!

Repackaging for Shipment

We recommend that you save the original carton and packing material, in case you must return your instrument for repair or service. If the original packaging is unfit for use or is not available, then repackage the instrument in the following manner:

Step 1. Use a corrugated cardboard shipping carton having inside dimensions at least 15 cm (6 in) taller, wider and deeper than the instrument. The carton must be constructed of cardboard with a test strength of at least 375 pounds.

Step 2. If the instrument is being shipped to a Tektronix Service Center for repair or calibration, attach a tag to the instrument showing:

- The owner of the instrument and address.
- The name and phone number of a person to be contacted if additional information is needed.
- Instrument type and serial number.
- The reason for returning the instrument.
- A complete description of the service required.

Step 3. Wrap the instrument with polyethylene sheeting or equivalent material to protect the outside finish of the instrument.

Step 4. Cushion the instrument in the shipping carton by tightly packing dunnage or urethane foam on all sides between the carton and the instrument. Allow for 7.5 cm (3 in) of padding on all sides (including top and bottom).

Step 5. Seal the carton with strapping tape or with an industrial stapler.

Step 6. Mark the address of the Tektronix Service Center and your return address on the carton in one or more prominent locations.

EEROM Protection Utility

The application of the EEROM was explained as part of the menu screen in this chapter.
The write protect utility was not discussed there because it may be wise to restrict this information to just a few people who are authorized to make changes in the protected programs of the EEROM.

To activate the write protection, use the following procedure:

- Save all the menu settings you wish to have saved in the EEROM as described in the Menu Screen section of this chapter.
- Switch-off the 571 (Don't worry, the EEROM is non volatile, so all settings are save).
- Press both the UP and DOWN arrow keys at the same time.
- Keep the keys pressed, while switching-on the 571 until the menu appears on the screen.

During power up initialization the write protect attribute will be stored in the EEROM. It will remain there until it is removed, (after de-activating the write protection) no matter how often the 571 is switched on and off.

To de-activate the write protection, use the following procedure:

- Switch-off the 571.
- Press both the LEFT and RIGHT arrow keys at the same time.
- Keep the arrow keys pressed while switching-on the 571, until the menu appears on the screen.

During power up initialization the 571 removes the write protect attribute from the EEROM.

Power Requirements

The instrument can be operated from an external power source of 100 VAC, 120 VAC, 220 VAC or 240 VAC.
The requirements for the power source are as follows:

– Power transformer primary:

Nominal Voltage	High Line Voltage	Low Line Voltage	Fuse 250 V type Slow Blow
100 V	110V	95 V	1 A
120 V	130 V	110 V	1 A
220 V	230 V	200 V	0.5 A
240 V	250 V	230 V	0.5 A

– Line frequency : 50 to 60 Hz ± 5%.

– Power input insulation : 1500 V RMS at 50 Hz for 3 seconds minimum duration.

– Power input ground continuity : Less than 0.1 Ω between safety ground and instrument.

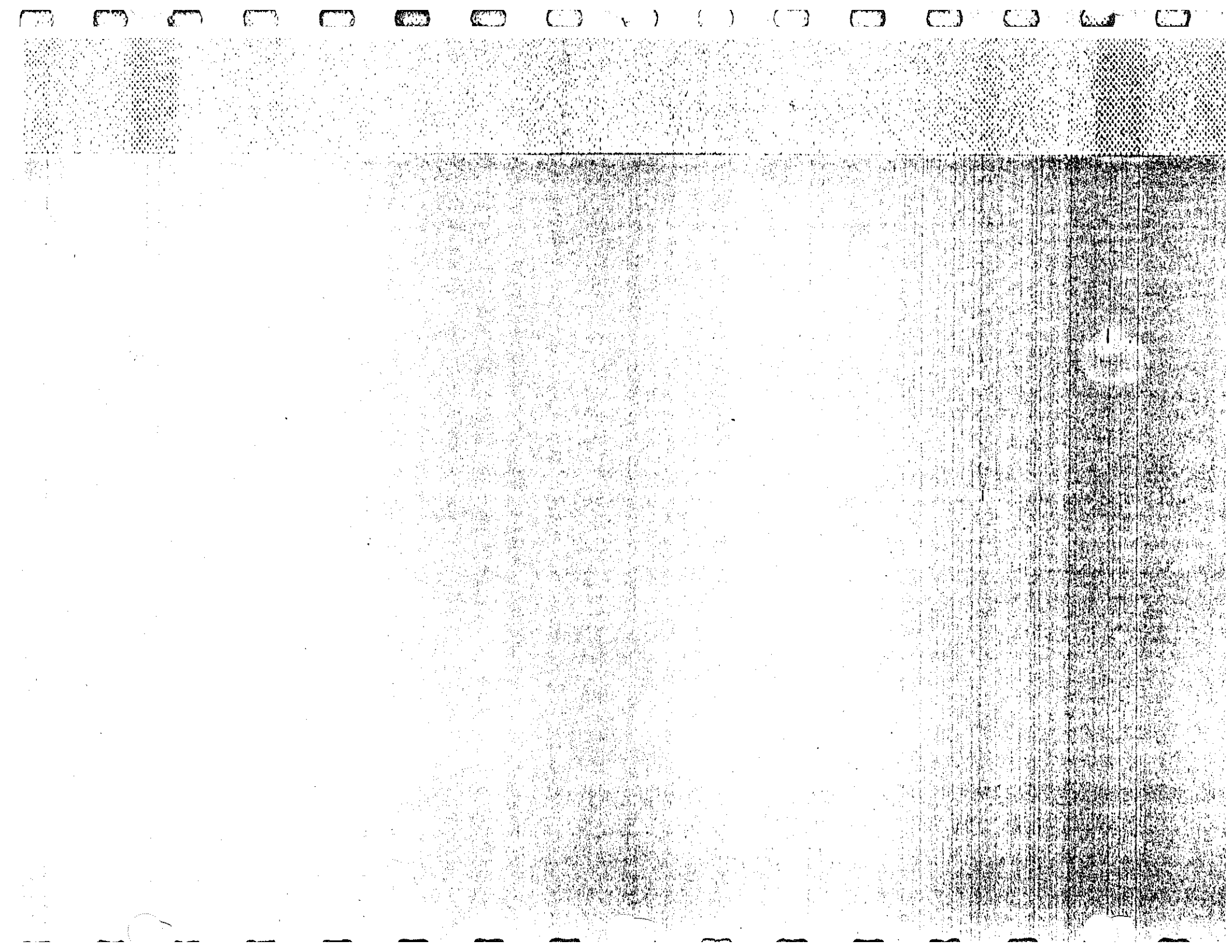
Changing the Line Voltage

The procedure to change the line voltage is as follows:

– Remove the power cord.
– Open the cover of the lineselector.
– Pull-out the actuator.
– Reinstall the actuator in the desired position.

- Pull-out the fuseholde.
- Install a correct rated fuse.
- Reinstall the fuseholder.
- Close the cover. The desired line voltage is readable now on the voltage selector.
- Reinstall the power cord.

Appendices



Options & Accessories

This section presents you a general description of the 571 options and accessories.

- Standard Accessories
- Optional Accessories
- Options

You can obtain additional information about instrument options, option availability, and other accessories by consulting the current Tektronix Product Catalog, or by contacting your local Tektronix Field Office or representative.

Standard Accessories

The following standard accessories are provided with each 571:

1	Users Manual	070-7723-01
1	Test Socket Board	671-1577-00

Optional Accessories

Optional Accessories include :

Service Manual	070-7722-00
Printer Cable	012-0555-00

Options

Options A1 – A5 International Power Cords

Instruments are shipped with a detachable power-cord configuration ordered by the customer. Table A-1 identifies the Tektronix part numbers for the available power cords and fuses.

Table A-1: Power Cord Options

Option	Description	Tektronix Part Number
Standard		
(North American)	120 V, 60 Hz, 74 in.	161-0230-01
Fuse	1.0 A, 250 V, Slow	159-0019-00
Option A1		
(Universal Euro)	220 V, 50 Hz, 2.5 m	161-0104-06
Fuse	0.5 A, 250 V, Slow	159-0032-00
Option A2		
(United Kingdom)	240 V, 50 Hz, 2.5 m	161-0104-07
Fuse	0.5 A, 250 V, Slow	159-0032-00
Option A3		
(Australian)	240 V, 50 Hz, 2.5 m	161-0104-05
Fuse	0.5 A, 250 V, Slow	159-0032-00
Option A4		
(North American)	220 V, 50 Hz, 2.5 m	161-0104-08
Fuse	0.5 A, 250 V, Slow	159-0032-00
Option A5		
(Switzerland)	220 V, 50 Hz, 2.5 m	161-0167-00
Fuse	0.5 A, 250 V, Slow	159-0032-00

Warranted Characteristics

This section lists the various *warranted characteristics* that describe the 571 Curve Tracer. Included are electrical and environmental characteristics.

Warranted characteristics are described in terms of quantifiable performance limits in Table B-1 thru Table B-10, which are warranted.

Environmental characteristics are given in Table B-10. This instrument meets the requirements of MIL-T-28800D for Type lll, Class 5 equipment, except where noted otherwise.

Performance Conditions

The characteristics in Table B-1 thru Table B-10 are valid under the following conditions:

- The instrument must have been calibrated at an ambient temperature between +22 °C and +24 °C.
- The instrument must be in a non-condensing environment whose limits are described under Environmental.
- Allow 30 minutes warm-up time for operation to the specified accuracy, and two hours after exposure to or storage in high humidity (condensing) environment.
- Specifications are valid only with those connections to the instrument that are required to verify each specification.

Items listed in the Description Column of the following tables (Table B-1 thru Table B-9) are verified by completing the Performance Check in the Service Manual.

Table B-1: Warranted Characteristics – Power Transformer Primary

Name	Description			
Nominal	100 V	120 V	220 V	240 V
High line	110 V	130 V	230 V	250 V
Low line	95 V	110 V	200 V	230 V
Fuse	1 A slow blow	1 A slow blow	0.5 A slow blow	0.5 A slow blow
Maximum power consumption	240 VA			
Line frequency	50 to 60 Hz, ±5%.			
Power input insulation	1500 V RMS, at 50Hz for 3 seconds minimum duration.			
Power input ground continuity	≤ 0.1 Ω between safety ground and instrument.			

Table B-2: Warranted Characteristics – Vce Supply

Name	Description
Voltage Range	0.5 Volt - 100 Volt both positive and negative Selectable in 8 ranges (1-2-5 sequence)
Resolution	1/250 of the selected end value.
Accuracy (18 °C to 28 °C)	Better than 2% over the entire range.
Max. current	2 A in the 0.5V through 50V ranges. 1 A in the 100V range.
Load resistor	Selectable at : 0.25Ω ±6%, 10 Ω ±1%, 100 Ω ±1% 1 kΩ ±1% 10 kΩ ±1%

NOTE

Maximum power dissipation in D.U.T. can be programmed independent of the selected load resistor.

Table B-3: Warranted Characteristics – Vce Display

Name	Description
Accuracy (18 °C to 28 °C)	± (2.5 % of FS + 30 mV) In 2A scale of Ic ± (2.5 % of FS + 15 mV) In 1A scale of Ic ± (2.5 % of FS + 7.5 mV) In .5A scale of Ic ± (2.5 % of FS) In all other scales of Ic

Table B-4: Warranted Characteristics – Basedrive (Ib)

Name	Description
Step Generator	0.5 µA / step - 20 mA / step (20 mA/step excluded in the 100 V range) (Source and sink, selectable in 15 ranges) (1-2-5 sequence)
Number of steps	1 to 10 (Selectable)
Resolution	1/100 of the selected end value.
Accuracy (18 °C to 28 °C)	± 2% over entire range

Table B-5: Warranted Characteristics – Gate drive (Vg)

Name	Description					
Step Generator	0.1V/step - 1 V/step positive and negative. (Selectable in 4 ranges)(1-2-5 sequence)					
Offset	–	Vg/Step	0.1V	0.2V	0.5V	1V
	P-FET	Offset min.	–3.75V	–7.5V	–5V	–5V
		max.	+2.5V	+5V	+10V	+10V
	N-FET	Offset min.	–2.5V	–5V	–10V	–10V
		max.	+3.75V	+7.5V	+5V	+5V
Offset Increment	25 mV, 50 mV, 100 mV (Depends on Vg/step)					
Output Resistance	±50 Ω					
Output accuracy (18 °C to 28 °C)	2% over the entire range					

Table B-6: Warranted Characteristics – Ic measure (Ic)

Name	Description
Sensitivity	5 µA - 200 mA per division (Selectable in 15 ranges) (1-2-5 sequence)
Resolution	8 bits.
Accuracy	Better than 2% over the entire range.
Overcurrent Protection	±150 % of full scale
Power limits	0.1- 100 W Selectable in six ranges

Table B-7: Warranted Characteristics – Cursors

Name	Description
Total Accuracy (18 °C to 28 °C)	≤ ± 2.5% of full scale
hfe accuracy (18 °C to 28 °C)	≤ ± 4% at center of the scale

Table B-8: Warranted Characteristics – Monitor

Name	Description
Video Area	640 x 336 pixels
Line Rate	17.8 kHz
Frame Rate	50.6 Hz non interlaced.
Video Bandwidth	≥15 MHz

Table B-9: Warranted Characteristics – Miscellaneous

Name	Description
Net Weight	19.8 Lbs (9 kg)
Size	14.6 in.(37 cm) W x 13.8 in.(35 cm) D x 8.1 in. (20.5 cm) H
Shipping Carton	
Gross Weight	25 Lbs (11 kg)
Dimensions	18.5 in. (47 cm) W x 17.7 in. (45 cm) D x 14.2 in. (36 cm) H

Table B-10: Environmental Characteristics

Name	Description
Temperature	
Non-Operating	–55 °C to +75 °C
Operating	0 °C to +50 °C
Humidity	
Operating /Non Operating	90% to 95% relative humidity (For 5 days and derated above 25 °C)
Altitude	
Operating	to 15,000 feet (4.5 Km)
Non-operating	to 50,000 feet (15 Km)
Vibration	.38 mm(0.015 inch) P-P at resonance , Freq. 5 -55 Hz during 10 min. at 3 axis. 2G at 55 Hz (Mil T28800 D class 5, or better).
Shock	30 G, Half sine,11 ms duration,18 shocks (Mil T28800 D class 5, orMil T28800 D class 5, or better).
Bench handling	45 degrees or 4 " drop, or equilibrium, whichever occurs first. (Mil T28800 D class 5, or better).
Packaged product vibration and shock	Excursion of 1 " (25.4 mm) p.p. at 4.63 Hz (1.1 G) for 30 min..
Packaged drop	91 cm (3 ft), 10 Drops
Electrostatic immunity	Will withstand a discharge through 1 KΩ resistor of a 500 pF capacitor charged to 10 KV or less. (Charge applied to each protruding area of the frontpanel, except the input test sockets).
Electromagnetic compatibility	VDE 0871 class "B" CISPR 22
Product conformance to safety standards	IEC 348 Class 1 UL 1244 CSA C22.2 no. 231

Verification Test

This section of the manual provides information on verification and recalibration of the 571 Curve Tracer.

To assure proper operation, execute the verification procedure of the instrument every 6 months or after 1000 hours of use, whichever occurs first.

Adjustments of internal circuits to specified accuracy, and / or calibration check should only be performed at the factory or a Tektronix Service Center by a qualified service technician. Before returning the instrument for any servicing, please contact your nearest Tektronix Service Center.

WARNING

To avoid fire hazard, use only the fuse of correct type, voltage rating, and current rating as specified on the instrument and in fuse replacing instructions.

Verification Procedure

The 571 has a build in verification program, that is accessible to the user. The test provides:

- test patterns for the monitor,
- checks on the performance of the frontpanel keys, the hardware protection circuitry and the overall accuracy of the 571 analog hardware.

To test the accuracy of the hardware, a digital multimeter (for example a Tektronix DM 504 or DM 511) is required to do some external checks on the build in reference sources. This ensures the traceability of the references.

The 571 verification program offers these references on the testsockets during the verification test.
To start the verification test use the following procedure:

- Switch off the 571.
- Set the slide switch NORM/TEST on the rear panel to "TEST".
- Switch on the 571.
- The 571 starts testing successively:
  - the video part
  - the front panel keys
  - the EEROM and the references
- Examine the patterns and follow the instructions on the screen..

NOTE

If the slide switch on the rear is used by switching from "NORM" to "TEST" or "TEST" to "NORM", while the 571 is on, the software gets confused. An error message " `Contact your local Tek service office` *" is being displayed. Reset the 571 by switching the power off and on again.*

Video Test

The 571 displays a test pattern for checking CRT deflection linearity.

Step 1. After evaluation of the deflection system, press any key to get the next test pattern.

This allows checking the video attributes and the focus of the monitor.

Step 2. Again, press any key to get the next test pattern.

Front Panel Key Test

Any time a key is pressed, the corresponding word on the screen changes to inverse video.
The sequence of pressing a key is not essential. The keys may be pressed more than once.
As soon as all the keys, including the protect cover switch, have been activated at least once, the 571 goes on to the next test.

EEROM (Electrical Erasable Read Only Memory) Test.

The 571 checks the EEROM function.
Press any key to continue.

References Test

In this test the next two reference values are checked:

1. The 571 prompts for the collector voltage.
   Check the collector voltage according to the message on the screen with a DMM (connected to the banana jacks marked "E" and "C" on the front). "E" is the low output, "C" is the high output.

2. The 571 generates a current of 10 mA.
   When the 571 asks for it, connect the DMM in current mode between the banana jacks "E" and "B" on the frontpanel. "E" sinks the current, "B" sources the current.

Verification Test

After the last instructions on the screen have been executed, the 571 indicates a complete selftest, using the two values you just verified, as its references.
The 571 displays the progress of the test procedure on the screen. As soon as a test fails the 571 displays on the screen for instance:

```
TEST # 2 . 7 positive . XX FAILED;
READ YY EXPECTED ZZ +/- Z
```

The first number (the '2') indicates which part of the analog hardware was under test (also printed at top of the screen).
The second number (the '7') indicates which range of that part was under test.

XX is the sub test number. (Usually the stimulus that was written at the base drive or the collector supply digital to analog convertor (DAC)).

YY is the value that was read by the analog to digital convertor (ADC).

ZZ is the value that was expected.

Z is the tolerance in counts (1 count out of 250 full scale means 0.4%).

When the 571 detects an error it stops execution of the subsequent checks. If no errors are detected, the 571 displays:

```
" *** UNIT  OK ! *** ".
```

After completing the verification test, switch off the 571, set the slide switch back to NORMAL, switch the 571 on again and resume the normal operation.
If any of the tests fails, please contact your nearest local Tektronix Service Center for repair and/or calibration.

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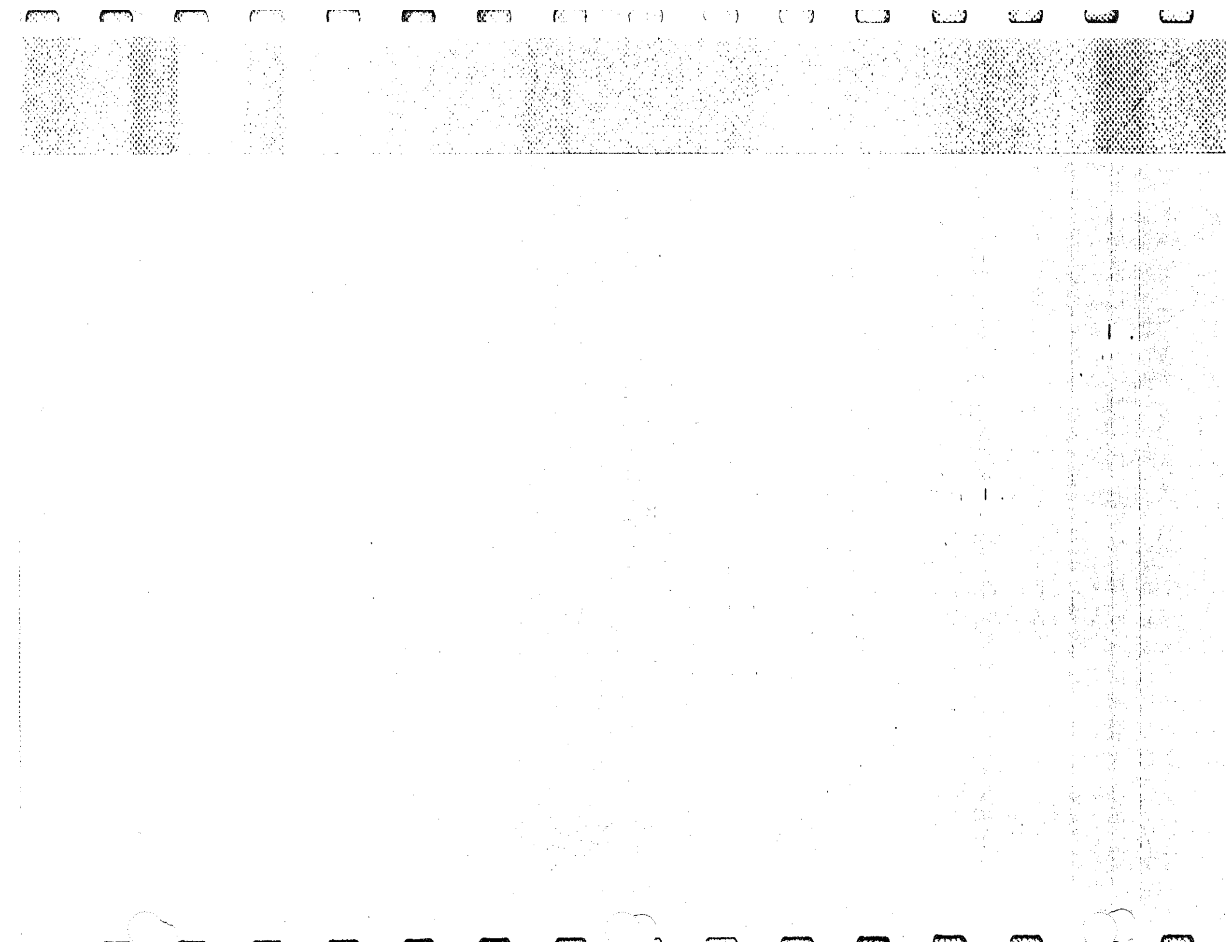

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with the latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on the following pages.

A single change may effect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.