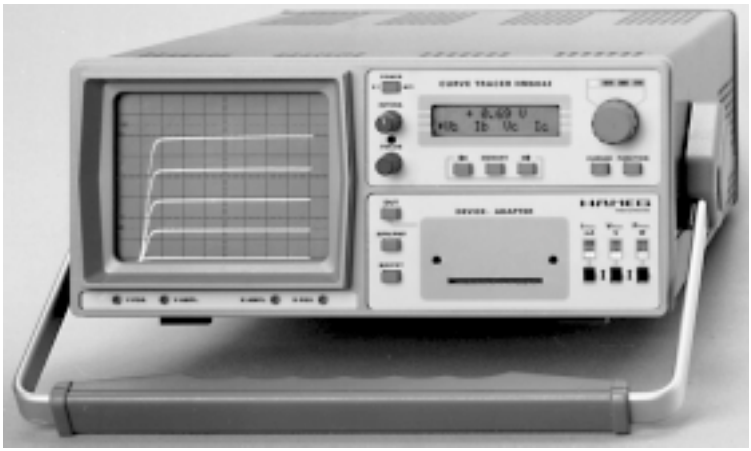
ENGLISH

HAMEG®
Instruments

MANUAL

Curve Tracer
HM6042



MANUAL•HANDBUCH•MANUEL

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KONFORMITÄTSERKLÄRUNG
DECLARATION OF CONFORMITY
DECLARATION DE CONFORMITE

CE

HAMEG® Instruments

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Die HAMEG GmbH / HAMEG S.a.r.l bescheinigt die Konformität für das Produkt
The HAMEG GmbH / HAMEG S.a.r.l herewith declares conformity of the product
HAMEG GmbH / HAMEG S.a.r.l déclare la conformite du produit

Bezeichnung / Product name / Designation: Kennlinienschreiber / Curve Tracer

Typ / Type / Type: **HM6042**

mit / with / avec: **-**

Optionen / Options / Options: **-**

mit den folgenden Bestimmungen / with applicable regulations / avec les directives suivantes

EMV Richtlinie 89/336/EWG ergänzt durch 91/263/EWG, 92/31/EWG
EMC Directive 89/336/EEC amended by 91/263/EWG, 92/31/EEC
Directive EMC 89/336/CEE amendée par 91/263/EWG, 92/31/CEE

Niederspannungsrichtlinie 73/23/EWG ergänzt durch 93/68/EWG
Low-Voltage Equipment Directive 73/23/EEC amended by 93/68/EEC
Directive des equipements basse tension 73/23/CEE amendée par 93/68/CEE

Angewendete harmonisierte Normen / Harmonized standards applied / Normes harmonisées utilisées

Sicherheit / Safety / Sécurité

EN 61010-1: 1993 / IEC (CEI) 1010-1: 1990 A 1: 1992 / VDE 0411: 1994
Überspannungskategorie / Overvoltage category / Catégorie de surtension: II
Verschmutzungsgrad / Degree of pollution / Degré de pollution: 2

Elektromagnetische Verträglichkeit / Electromagnetic compatibility / Compatibilité électromagnétique

EN 50082-2: 1995 / VDE 0839 T82-2
ENV 50140: 1993 / IEC (CEI) 1004-4-3: 1995 / VDE 0847 T3
ENV 50141: 1993 / IEC (CEI) 1000-4-6 / VDE 0843 / 6
EN 61000-4-2: 1995 / IEC (CEI) 1000-4-2: 1995 / VDE 0847 T4-2: Prüfschärfe / Level / Niveau = 2

EN 61000-4-4: 1995 / IEC (CEI) 1000-4-4: 1995 / VDE 0847 T4-4: Prüfschärfe / Level / Niveau = 3

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Gruppe / group / groupe = 1, Klasse / Class / Classe = B

Datum /Date /Date
14.12.1995

Unterschrift / Signature /Signatur

E. Baumgartner
Technical Manager
Directeur Technique

General information regarding the CE marking

HAMEG instruments fulfill the regulations of the EMC directive. The conformity test made by HAMEG is based on the actual generic- and product standards. In cases where different limit values are applicable, HAMEG applies the severer standard. For emission the limits for residential, commercial and light industry are applied. Regarding the immunity (susceptibility) the limits for industrial environment have been used.

The measuring- and data lines of the instrument have much influence on emmission and immunity and therefore on meeting the acceptance limits. For different applications the lines and/or cables used may be different. For measurement operation the following hints and conditions regarding emission and immunity should be observed:

1. Data cables

For the connection between instruments resp. their interfaces and external devices, (computer, printer etc.) sufficiently screened cables must be used. Without a special instruction in the manual for a reduced cable length, the maximum cable length of a dataline must be less than 3 meters long. If an interface has several connectors only one connector must have a connection to a cable.

Basically interconnections must have a double screening. For IEEE-bus purposes the double screened cables HZ72S and HZ72L from HAMEG are suitable.

2. Signal cables

Basically test leads for signal interconnection between test point and instrument should be as short as possible. Without instruction in the manual for a shorter length, signal lines must be less than 3 meters long.

Signal lines must screened (coaxial cable - RG58/U). A proper ground connection is required. In combination with signal generators double screened cables (RG223/U, RG214/U) must be used.

3. Influence on measuring instruments.

Under the presence of strong high frequency electric or magnetic fields, even with careful setup of the measuring equipment an influence of such signals is unavoidable.
This will not cause damage or put the instrument out of operation. Small deviations of the measuring value (reading) exceeding the instruments specifications may result from such conditions in individual cases.

December 1995
HAMEG GmbH

Curve Tracer HM6042

- **Ease of Operation**
- **Characterisation and Test of Semiconductor Devices**
- **Accurate Cursor Measurements**
- **Quick and easy Comparison of Semiconductors**
- **Reference Data Memory**
- **On-Screen Display of 5 Curves**
- **Low Power Consumption**

The **HM6042 Curve Tracer** is used to accurately display the characteristics of two and three terminal semiconductor devices. The instrument combines ease of operation and versatile features at an affordable price. Unlike its counterpart, the HM8042 plug-in unit, it uses a built-in **CRT** and an **LCD** to display the characteristics of the device under test.

The **HM6042** displays a set of 5 curves at a time. All numeric values and parametric data can be read out on a 2x16 digit **LCD**. Device type and all relevant parameters are selected and modified by a simple front-panel keypad entry. Collector voltage and current parameters are easily changed. A 3-step power limiter avoids damage of the **D**evice **U**nder **T**est by excessive power.

One set of parameters can be stored in memory for comparison of one device to another or a reference device. This feature gives substantial enhancements in productivity when matching semiconductors. Two cursors can be moved along the displayed curves. X and Y position of the cursor will be displayed on the screen. Basic accuracy is 2% of the measurement value. Measured parameters are: base voltage, base current, collector current, collector voltage and Beta. The dynamic parameters h11, h21, and h22 are **calculated** by the **internal processor**.

A device adapter socket with side-by-side terminals for two devices for the comparison of two semiconductors is supplied with the instrument.

The **HM6042** is remarkably easy to operate. This makes the instrument also ideally suited for educational use.

Specifications
(Reference Temperature 23°C ± 1°C)

Measurement Ranges
3 Voltage Ranges:
Collector/Drain Voltages ≤ 2V, 10V, 40V ±5%
3 Current ranges:
Collector/Drain Currents ≤ 2mA, 20mA, 200mA ±5%
3 Power Ranges:
Output Power ≤ 0.04W, 0.4W, 4W ±10%

Base-/Gate-Voltages and Currents:
I_b 1µA to 10mA V_b to 2V ±5% V_g to 10V ±5%

Accuracy
Accuracy of Static Values:
$V_{c/d}$ ± (2% o.v.[1] + 3 Dig.) $I_{c/d}$ ± (2% o.v. + 3 Dig.)
I_b ± (2% o.v. + 3 Dig.) V_b ± (2% o.v. + 3 Dig.)
V_g ± (3% o.v. + 3 Dig.)
β to 1000: ± (5 % o.v. + 3 Dig.)
to 100000: ± [(6 + 0.001 x β) % o.v. + 3 Dig.]

Accuracy of Dynamic Values:
h11 ≤ 1000Ω ± (12% o.v. + 3 Dig.)
≥ 1000Ω
± [(12 + 0.001 meas. value) % o.v.+ 3 Dig.]
h21 ≤ 1000 ± (12% o.v. + 3 Dig.)
≥ 1000
± [(12 + 0.001 meas. value) % o.v.+ 3 Dig.]
y21 ≤ 1000mS ± (12% o.v.. + 3 Dig.)
h/y22 ≤ 1000mS ± (12% o.v.. + 3 Dig.)

Miscellaneous
Reference measurement values can be stored for component selection.

Cursor Measurements:
Single mode: The Cursor marks the position from which the measurement value is calculated.

Tracking mode: Two Cursors mark the positions, from hich the h/y-Parameter measurement values are calculated.

Evaluation of curves from
Diodes, Zener Diodes, NPN/PNP-Transistors, FET/MOS-FET (N/P-Channel), Thyristors

Display: 2x16-Digit, LCD
Presentation of measurement values from a set of 5 curves on CRT.

General Information
CRT: D14-364GY/123 or ER151-GH/-, 6" rectangular screen (8x10cm) internal graticule
Acceleration voltage: approx. 2000V
Trace rotation: adjustable on front panel
Line voltage: 100-240V AC ±10%, 50/60Hz
Power consumption: approx. 36 Watt at 50Hz.
Min./Max. ambient temperature: 0°C...+40°C
Protective system: Safety class I (IEC 1010-1)
Weight: approx. 5.6kg, color: techno-brown
Cabinet: **W** 285, **H** 125, **D** 380 mm
1) o.v. = of value

1. General Information

The Curve Tracer **HM6042** is easy to operate. The logical arrangement of the controls allows anyone to quickly become familiar with the operation of the instrument. However, experienced users are also advised to read through these instructions so that all functions are understood. Immediately after unpacking, the instrument should be checked for mechanical damage and loose parts in the interior. If there is transport damage, the supplier must be informed immediately. The instrument must then not be put into operation.

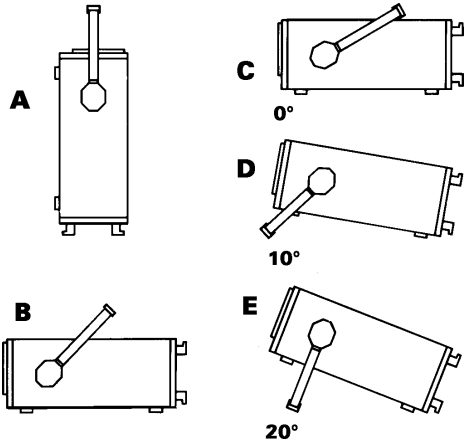
1. 1. Symbols used for the instrument

ATTENTION - refer to manual

Danger - High voltage

Protective ground (earth) terminal

1. 2. Tilt handle



To view the CRT screen from the best angle, there are three different positions (C, D, and E) for setting up the instrument. If the instrument is set down on the floor after being carried, the handle automatically remains in the upright carrying position (A). In order to place the instrument onto a horizontal surface, the handle should be turned to the upper side of the Curve Tracer (C). For the D position (10° inclination), the handle should be turned to the opposite direction of the carrying position until it locks in place automatically underneath the instrument. For the E position (20° inclination), the handle should be pulled to release it from the D position and swing backwards until it locks once more. The handle may also be set to a position for horizontal carrying by turning it to the upper side to lock in the B position. At the same time, the instrument must be lifted, because otherwise the handle will jump back.

1. 3. Safety hints

This instrument has been designed and tested in accordance with IEC Publication 1010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use. The CENELEC regulations EN

61010-1 correspond to this standard. It has left the factory in a safe condition. This operating manual contains important information and warnings that have to be followed by the user to ensure safe operation and to retain the Curve Tracer in a safe condition. The case, chassis and all measuring terminals are connected to the protective earth contact of the appliance inlet. The instrument operates according to **Safety Class I** (three-conductor power cord with protective ground conductor and a plug with ground contact). The mains/line plug shall only be inserted in a socket outlet provided with a protective ground contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

The grounded accessible metal parts (case, sockets, and jacks) and the mains/line supply contacts (line/live, neutral) of the instrument have been tested against insulation breakdown with 2200V DC. Under certain conditions, 50Hz or 60Hz hum voltages can occur in the measuring circuit due to the interconnection with other mains/line-powered equipment or instruments. This can be avoided by using an isolation transformer (Safety Class II) between the mains/line outlet and the power plug of the device being investigated.

Cathode-ray tubes normally emit X-rays. However, the dose equivalent rate falls far below the maximum permissible value of 36 pA/kg (0.5mR/h). Whenever it is likely that protection has been impaired, the instrument shall be made inoperative and be secured against any unintended operation. The protection is likely to be impaired if, for example, the instrument

- shows visible damage,
- fails to perform the intended measurements,
- has been subjected to prolonged storage under unfavorable conditions (e.g. in the open or in moist environments),
- has been subject to severe transport stress (e.g. in poor packaging).

1. 4. Operating Conditions

The instrument has been designed for indoor use. The permissible ambient temperature range during operation is +10°C (+50°F) ... +40°C (+104°F). It may occasionally be subjected to temperatures between +10°C (+50°F) and -10°C (+14°F) without degrading its safety. The permissible ambient temperature range for storage or transportation is -40°C (+14°F) ... +70°C (+158°F).

The maximum operating altitude is up to 2200 m; the maximum relative humidity is up to 80%. If condensed water exists in the instrument it should be acclimatized before switching on. In some cases (e.g. instrument extremely cold) two hours should be allowed before the instrument is put into operation. The instrument should be kept in a clean and dry room and must not be operated in explosive, corrosive, dusty, or moist environments. The Curve Tracer can be operated in any position, but the convection cooling must not be impaired. For continuous operation the instrument should be used in the horizontal position, preferably tilted upwards, resting on the tilt handle.

The specifications stating tolerances are only valid if the instrument has warmed up for 60 minutes at an ambient temperature between +15°C (+59°F) and +30°C (+86°F). Values without tolerances are typical for an average instrument.

1. 5. Warranty

HAMEG warrants to its customers that the products it manufactures and sells will be free from defects in materials and workmanship for a period of two years. This warranty shall not apply to any defect, failure or damage caused by improper use or inadequate maintenance and care. **HAMEG** shall not be obliged to provide service under this warranty to repair damage resulting from attempts by personnel other than **HAMEG** representatives to install, repair, service, or modify these products.

In order to obtain service under this warranty, customers have to contact and notify their distributor.

Each instrument is subjected to a quality test with ten-hour burn-in before leaving the factory. Practically all early failures are detected by this method. In the case of shipments by post, rail, or carrier it is recommended to preserve the original packing carefully. Transport damages and damage due to gross negligence is not covered by warranty.

In the case of a complaint, a label should be attached to the housing of the instrument that describes briefly the faults observed. If at the same time the name and telephone number (dialing code and telephone or direct number or department designation) is stated for possible queries, this helps towards speeding up the processing of warranty claims.

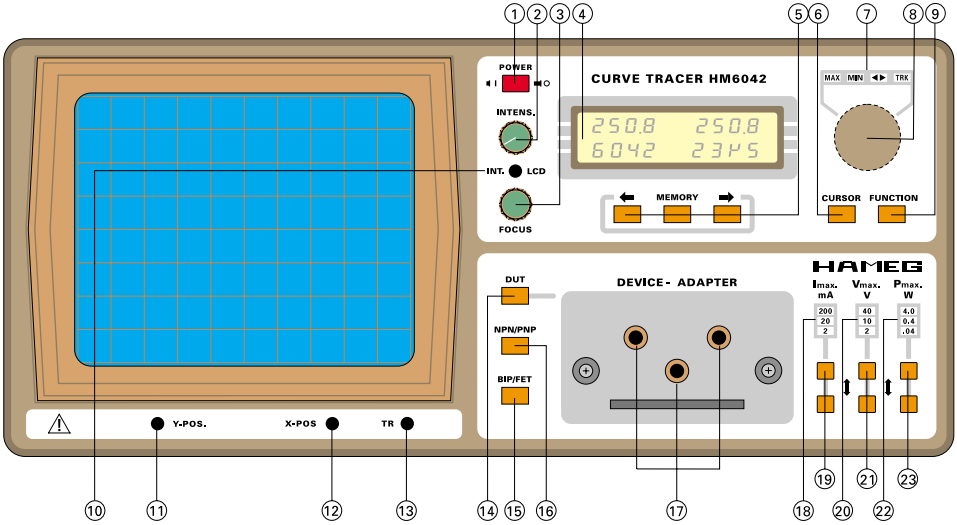
1. 6. Maintenance

Various important properties of the instrument should be checked carefully in certain intervals to ensure that all signals and measurement results are displayed with the accuracy on which the technical data are based.

The exterior of the instrument should be cleaned regularly with a dusting brush. Dirt that is difficult to remove on the casing and handle, the plastic and alloy parts, can be removed with a moistened cloth (99% water +1% mild detergent). Spirit or washing benzene (petroleum ether) can be used to remove greasy dirt.

The screen may be cleaned with water or washing benzene (but not with spirit (alcohol) or solvents), it must then be wiped with a dry clean lint-free cloth. Under no circumstances may the cleaning fluid get into the instrument. The use of other cleaning agents can attack the plastic and paint surfaces.

Front panel / Control elements HM6042



(1) POWER
Power switch (mains).

(2) INTENS
Adjust the beam intensity.

(3) FOCUS
Adjust the beam sharpness.

(4) DISPLAY (LCD)
Indicates measurement results and parameters.

(5) ← → (push buttons)
Select the parameters to be measured

(5) MEMORY (push button)
Store measured values and enable compare function

(6) CURSOR (push button)
Move cursor from curve to curve.

(7) TRK/ ◀▶ /MIN/MAX (LED bar)
Indicates the selected cursor function.

(8) Tune test voltages and currents.

(9) ↕ FUNCTION (push button)
Select one of the cursor functions.

(10) INT. LCD
Adjust the contrast of the LCD.

(11/12) Y-POS X-POS
Adjust the trace in vertical and horizontal position.

(13) TR
Adjust the trace rotation.

(14) DUT (push button)
Start/stop test, connect/disconnect the Device Under Test

(15) BIP/FET (switch)
Select between bipolar and field effect transistor/diode.

(16) NPN/PNP (switch)
Select between NPN and PNP transistors.

(17) E/S; C/D; B/G (jacks)
Mechanical and electrical connection for the DEVICE ADAPTER.

(18) 200mA, 20A, 2 mA (LED bar)
Indicates selected max. test current

(19) Imax. (push buttons)
Select max. test current.

(20) 40V, 10V, 2V (LED bar)
Indicates selected max. test voltage

(21) Vmax. (push buttons)
Select max. test voltage.

(22) 4W, 0.4W, 0.04W (LED bar)
Indicates selected max. test power.

(23) Pmax. (push buttons)
Select max. test power.

2. Set-up of the instrument

2. 1. Safety advice

Due to its measuring technique voltages up to 50 V are present at the 4 mm banana jacks, marked as E/S, C/D, and B/G. Therefore, it is assumed that the **HM6042** will only be operated by qualified personnel which is acquainted with the danger involved.

2. 2. General

The **HM6042** provides DC parameter characterization of 2- and 3-lead semiconductor devices like transistors, diodes and MOSFETs. Five characteristic curves displayed on the CRT's screen and digitized to be used for the calculation and indication of ten different parameters. Depending on the parameter to be measured one or two cursors enable the user to precisely select the point of measurement on one of the curves. The microprocessor-operated instrument is extremely versatile, yet remarkably easy to operate. Most of the instrument set-ups are done automatically by the instrument according to the selected measuring function.

To use the **HM6042** no special expertise is required. The instrument is easy to set-up and operation is straightforward. Nevertheless, a few basic guidelines should be followed in order to ensure problem-free operation of the curve tracer.

2. 3. Selecting the line voltage

The instrument is able to operate with mains/line voltages of 115V AC and 230V AC. The voltage selection switch is located on the rear side of the instrument and indicates the voltage as set. The desired voltage can be selected using a small screwdriver.

Remove the power cable from the wall outlet prior to making any changes to the voltage setting. Fuses have to be replaced by fuses with an appropriate value (see table below) prior to connecting the power cable. Both fuses are accessible by removing the fuse cover located above the 3-pole power connector. The fuse holder can be released by pressing its plastic retainers with the aid of a small screwdriver. The retainers are located on the right and left side of the holder and must be pressed towards the center. The fuse(s) then can be replaced by pressing it/them in until locked on both sides. The use of patched fuses or a short-circuited fuse holder is not permissible; **HAMEG** assumes no liability for any damage caused as a result of incorrect fuse usage; all warranty claims become null and void.

Fuse type:
Size 5 x 20 mm; 250 V AC;
Must meet IEC specification 127,
Sheet III (or DIN 41 662 or DIN 41 571, sheet 3).
Time characteristic: time lag
Line voltage 115 V~ ±10 %: Fuse rating: T 315 mA
Line voltage 230 V~ ±10 %: Fuse rating: T 160 mA

2. 4. Screen settings

2. 4. 1. Adjusting the trace rotation

Due to influences of the magnetic earth field it may be necessary to compensate an angular misalignment of the trace. To adjust the trace into its horizontal position (in parallel to the bottom grid line) turn the TR potentiometer **(13)** located below the CRT screen with a small screwdriver. The DUT function may not be activated during this procedure.

2. 4. 2. Adjusting Y-POS./X-POS.

Normally the readjustment of the X and Y position of the trace is not necessary. However, if the left end of the trace is not aligned to the lower left corner of the grid you should adjust it to start at this point. To perform this procedure use the Y-POS. and the X-POS. screws, which are located below the CRT screen at the front panel of the instrument.

3. Performing device tests

As soon as the **HM6042** is switched on, a baseline is visible at the CTR screen as long as no DUT (Device Under Test) is inserted. A bright spot on the line indicates the current cursor position.

The standard device adapter, as supplied with each **HM6042**, is to be mounted to the instrument using the banana jack combination **(17)** at the front panel of the instrument. The terminals are designated as E/S (Emitter/Source), C/D (Collector/Drain), and B/G (Base/Gate).

This adapter is able to carry two DUTs; with the help of the instrument's memory function (see chapter 4. 3) and the device adapter's toggle switch device selections and component matching tests can be performed easily.

On request other device adapters are available from **HAMEG** to be used on the **HM6042** instrument.

If the standard device adapter is not suitable for special test purposes a DUT can be connected to the terminals using ordinary test cables. Their maximum length is limited to 25 cm each. The measurement accuracy of the instrument however can be degraded due to hum and noise on the cables. The use of shielded cables is not recommended because of their relatively high stray capacitance.

When using single wire connections extreme care has to be taken for safety purposes.

For testing diodes please use terminal E and C **(17)** and set the BIP/FET switch **(15)** to position FET (locked).

To start a test the push button DUT **(14)** has to be pressed. Immediately, the value of the selected parameter appears on the LCD.

The instrument can be toggled from its active to its inactive state by pressing the DUT key repeatedly; simultaneously the DUT will be disconnected from the internal test circuitry. The inactive state is indicated on the LCD by the message -off-.

3. 1. Choosing the DUT type

The **HM6042** has to be set-up according to the type of DUT (Device Under Test) to be proved.

To test NPN bipolar transistors switch BIP/FET **(15)** and switch NPN/PNP **(16)** has to be in released position. When working with PNP transistors switch NPN/PNP **(16)** has to be set into the locked position. As usual, the measurement is performed using the common-emitter circuit.

To test FETs set switch BIP/FET **(15)** into the locked position.

Diodes are tested with the same set-up as FETs using terminals E and C.

3. 2. Setting the test ranges

Through its range settings the instrument is enabled to limit the test voltage (U_{CE}, U_{DS}) and the test current (IC, ID) to predefined values. The ranges for current, voltage, and power can be selected by use of the push buttons for:

Imax **(19)**	200 mA	20 mA	2 mA
Vmax **(21)**	40 V	10 V	2 V
Pmax **(23)**	4.0 W	0.4 W	.04 W

The corresponding LEDs **(18)**, **(20)**, and **(22)** indicate the maximum value of the range as set. In test mode BIP the rotary knob enables the user to adjust the base current in incremental steps according to the selected range as defined below:

Range	Current (I_B)	No. of steps	Current / step
1	0.3 µA ... 100 µA	127	0.8 µA ± 10 %
2	3 µA ... 1 mA	127	8 µA ± 10 %
3	30 µA ... 10 mA	127	80 µA ± 10 %

The base current at the indicated cursor position is displayed on the LCD with IB/IG selected by the push buttons (← →, 5).

When FETs are under test the rotary knob **(8)** allows adjusting the gate voltage U_G between -10V to +10V in 256 incremental steps. This means 80mV/ step approximately.

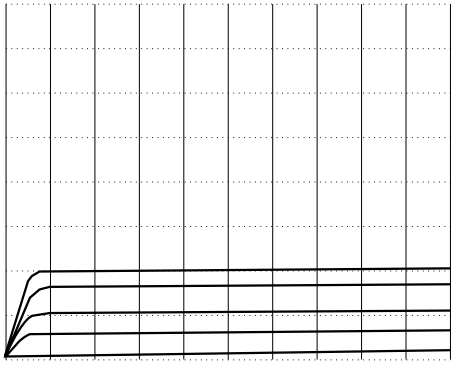


Figure 1

Five curves ($I_C = f(U_{CE})$, $ID = f(U_G)$) normally are displayed on the screen to represent the characteristic behavior of a transistor under test. After selecting the **MIN** or **MAX** setting with the push button called **FUNCTION (9)** the rotary knob can be used to modify the minimum/maximum base current/gate voltage in a sense that the five curves fit for the operating range to be evaluated. Please consider not exceeding the current and voltage settings beyond the DUTs power dissipation limits.

3. 3. Displaying curves

The Imax and Vmax settings determine the operating range for the test and define how the curves are going to be displaying on the CRT screen.

As shown in Figure 1, the upper edge of the grid represents the maximum value of the test current (I_C, I_D) according to the selected range (Imax = 200mA/ 20mA/ 2mA).

The right edge of the 8 x 10 screen grid represents the maximum value of the selected voltage range (Vmax = 40V/ 10V/ 2V).

The display is linear along both axes.

For example, if Vmax is set to 40V and Imax is set to 20mA the horizontal resolution will be 4V/DIV and a vertical resolution will be 2.5mA / DIV.

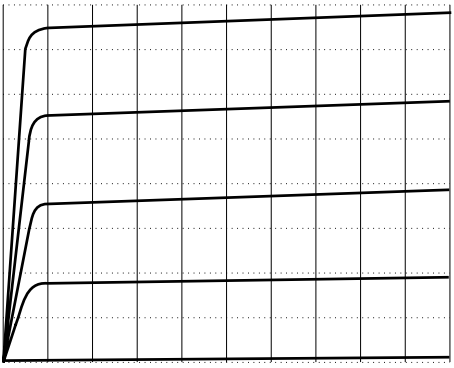


Figure 2

Using the **MIN** or **MAX** function **(9)** and then turning the rotary knob **(8)** allows you to position five characteristic curves on the screen and get the desired diagnostic results. Care has to be taken not to supersede the safe operating area of the device. Use the Vmax setup **(22)** to automatically limit the power applied to the device.

Please ensure that the DUT function has been activated for enabling the measurement.

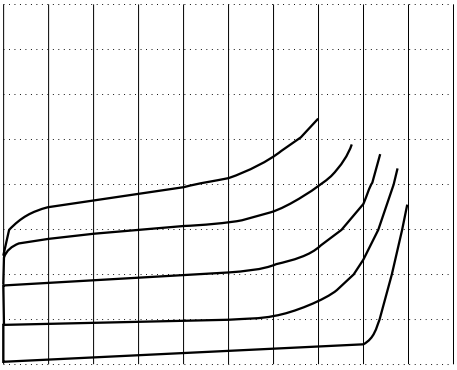


Figure 3

3. 4. Measuring device parameters

Generally, the behavior of transistors is determined by their static and dynamic parameters. To display the different parameter values on the display press one of the two bush buttons ← → **(5)** which are located below the LCD.

The screen cursor (highlighted dot) indicates exactly the point on the curve where the actual measurement happens to be done.

Please ensure that the DUT function has been activated to perform the measurement.

The following parameters can be measured and displayed by the instrument:

Static Parameters

V_B/V_G	Base/Gate Voltage
I_B/I_G	Base/Gate Current
I_C/I_D	Collector/Drain Current
V_C/V_D	Collector/Drain Voltage
β	Current Gain

Dynamic Parameters

h11	Short-circuit input impedance
h21	Short-circuit forward-current transfer ratio
h22	Open-circuit output conductance
y21	Short-circuit forward admittance
y22	Short-circuit output admittance

3. 5. Using the cursor functions

The cursor (highlighted dot) indicates the point on a characteristic curve where the actual value is going to be digitized by the instrument. After the **HM6042** has been powered on, the cursor will appear on the third of the five characteristic curves.
The cursor can be repositioned by using the **CURSOR** switch **(6)** or the rotary knob **(8)**. With the **CURSOR** key **(6)** the cursor can be moved from one curve to the next. To move the cursor horizontally along a curve please select ◄ ►on the LED function bar **(FUNCTION 9, 7)** and turn the rotary knob **(8)** to reposition it in the desired direction.

The numerical value for the selected static parameter **(5)** will be displayed on the LCD in accordance to the actual cursor position.

When choosing the option to display one of the dynamic parameters h11, h21, or y21, a second cursor appears on the curve below. Turning the rotary knob, now moves both cursors horizontally along their respective curves. The **HM6042** digitizes the values as required at the highlighted positions and displays the calculated result on the LCD.

If you selected to test one of the dynamic parameters h22 or y22, the second cursor appears on the same curve beside the original cursor. Turning

the rotary knob **(8)** while function ◄ ►is activated **(9, 7)** will change the position of the second cursor.
After selecting function **TRK (9, 7)** and turning the rotary knob, now both cursors will be moved along the curve in their tracking mode. The **HM6042** digitizes the values at the highlighted positions and displays the calculated result for h22 or y22 on the LCD as requested.

The second cursor is only visible in the measuring mode for the dynamic parameters and will be switched on and off by the instrument automatically.

3. 6. Memory function, component matching

To support the easy selection of transistors (component matching), the **HM6042** provides a very helpful memory function. When pressing the **MEMORY** push button **(5)** the instrument stores the measured parameter internally and allows comparing the parameters of a second transistor with the value stored in memory. The second device under test should be mounted on the second test socket of the adapter. So, the selection of devices related to a reference component can be simply achieved by switching between the left and right socket of the adapter.

Thus the selection of components with respect to the displayed parameter (i.e. I_C/I_D, β, h11, h22, y21, or y22) is a rather easy and time saving task.

To quit the memory function or to use another transistor as reference component press the memory button **(5)** repeatedly.

4. Application examples

4. 1. Characteristic curves of a bipolar transistor

1. Connect the device to be tested to the appropriate input.
2. Ensure the BIP/FET switch **(15)** is set to the BIP position.
3. Select NPN or PNP as appropriate with the NPN/PNP switch **(16)**.
4. Select the appropriate range for the maximum current **(Imax) (19)**, maximum voltage **(Vmax) (21)**, and maximum power **Pmax (23)**.
5. Press the DUT switch **(14)**. Five curves (see Figure 1 or 2) now will be visible on the screen.

   Components under test can have higher temperatures. Please be careful when handling components having been connected to the test instrument.

6. The vertical position of the curves $I_C = f(U_{CE})$ is determined by the base current IB as parameter and can be adjusted stepwise by turning the rotary knob **(8)** while **FUNCTION (9, 7)** is set to **MAX** or **MIN**. With **MAX** selected base current for the top curve will be set, with **MIN** selected that for the bottom curve. The three curves between these two are going to be displayed in equal distances.

   After the **HM6042** is powered on, the base current is set to its minimum value.

7. Use the cursor functions **(FUNCTION (9), CURSOR (8))** and choose the parameter to be calculated by the instrument and displayed on the **LCD (← →, 5)** by pressing the appropriate keys.

4. 2. Characteristic curves of a field effect transistor

Testing a FET is similar to that for a bipolar transistor with respect of the following exceptions:

The BIP/FET switch has to be set to the FET position.

The vertical position of the curves $I_D = f(V_{DS})$ is determined by the gate voltage (U_G) parameter and can be adjusted stepwise by turning the rotary knob **(8)** with **FUNCTION (9)** set to **MAX** or **MIN**. With **MAX** selected the gate voltage for the top curve will be set, with **MIN** selected that for the bottom curve. The three curves between these two are displayed in equal distances.Choose the parameter to be calculated and displayed **(← →, 5)** on the LCD by pressing the appropriate key until you get the expected result.

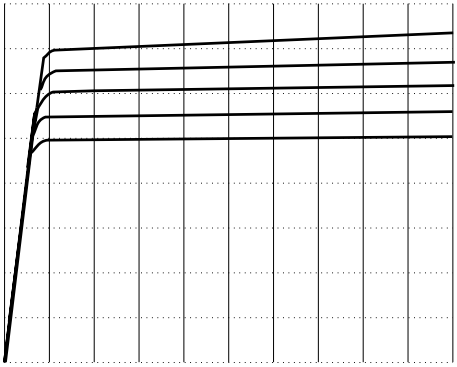


Figure 4

Security hint

Voltages up to 50V DC can be present at the device under test when using the following max. test voltages: V_D = 40V and V_G = -10V. Anyone using the test equipment needs to be advised of the possible danger and the proper precautions to be taken when working with voltages of this level.

4. 3. Component matching

1. Measure the desired parameter of the reference transistor (← →, 5), the DUT key **(14)** is activated.
2. Press the MEMORY push button **(5)** to store the parameters of the reference transistor and to enable the compare function. The character ? appears on the LCD, and - 0 - is displayed as the value.
3. Press the DUT push button once more and insert the transistor to be tested into the second socket of the adapter. Now toggle the adapter's switch to connect the second component to the instrument.
4. Press the DUT button again. Now, the numerical difference between the reference and the actually measured value of the selected parameter will be displayed on the LCD.
   Repeat steps 3. and 4. to test other components for matching.
5. Press the MEMORY push button again to return the test set to normal operation.

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