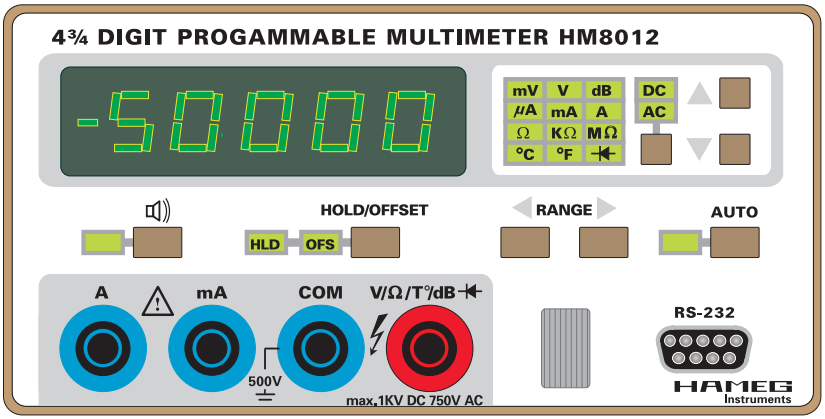
DEUTSCH ENGLISH FRANÇAIS

HAMEG®
Instruments

4¾ Digit Programmable Multimeter HM 8012



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HAMEG® Instruments

Name und Adresse des Herstellers **Manufacturer´s name and address** **Nom et adresse du fabricant**	**HAMEG GmbH** **Kelsterbacherstraße 15-19** **D - 60528 Frankfurt** **HAMEG S.a.r.l.** **5, av de la République** **F - 94800 Villejuif**

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:	**Digital-Multimeter/Digital Multimeter/Multimètre numérique**
Typ / Type / Type:	**HM8012**
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

EN 50081-1: 1992 / EN 55011: 1991 / CISPR11: 1991 / VDE0875 T11: 1992

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

Datum /Date /Date
03.03.2001

Unterschrift / Signature /Signatur

M. BOUTAN
Directeur Général

HM8012 autoranging digital multimeter

- 50,000 measurement points, 4 ¾ digit
- 42 measurement ranges
- Between 3 and 6 measurements/second
- Measurement of AC or AC + DC true rms values
- Basic accuracy 0.05%
- Max. resolution 10µV, 0.001dBm, 10nA and 10mΩ
- Input resistance > 1GΩ (0.5V and 5V ranges)
- Communication by serial link on front panel

HM8012 is a high integration digital multimeter with 42 measurement ranges. Its 4 ¾ figure display will represent a measured value of up to 50,000 counts. The absolute resolution obtained in this way depends on the measurement mode and the range, offering **10µV**, 1**0nA** or **10mΩ**. Input resistance exceeds **1GΩ** for the two lowest ratings of the VDC. AC measurements are made in **true rms** values up to **100kHz**. The equipment is capable of making **temperature** and **diode junction** measurements. Analyses of audio and communication circuits are easy thanks to direct reading in dB. Resolution is **0.01dB** above 9mV.

The display indicates the measurement unit. Disengageable autoranging provides best resolution. Calibration factors are backed up to EEPROM for each range. The absence of potentiometers provides **reliable calibrations**. Some protection circuits ensure safe operation of HM8012, protecting the equipment at the limit values as indicated against any damage resulting from manipulation errors**. The connection terminals are protected** (safe terminals). The **HM8012** digital multimeter is an appropriate measurement instrument whenever the value obtained has to be highly accurate, very stable in the long term and easy to use.

Technical characteristics (18°C-28°C)
Reference temperature: 23°C ± 1°C

DC voltages:
Measurement ranges:
500mV, 5V, 50V, 500V, 1000V
Resolution:
10µV, 100µV, 1mV, 10mV, 100mV
Accuracy:
5V, 500V, 1000V: ±(0.05%rdg[1] + 0.002%fs[2]
500mV, 50V: ± (0.05%rdg + 0.004%fs)
Max. input voltage:
1000Vc for the 50V, 500V and 1000V ranges; 300Vrms for the 500mV and 5V ranges.
Input impedance:
10MΩ//90pF for the 50V, 500V and 1000V ranges
> 1GΩ//90pF for the 500mV, 5V ranges
Input current: 20pA max. (23°C)
TRMC[3] ≥ 100dB (50/60Hz ± 0.5%)
TRMS[4] ≥ 60dB (50/60Hz ± 5%)
dB Mode
Precision: ±(0.02dB+2digits) (display>-38.7dBm)
Resolution: .001dB above 18% of rating.

DC current:
Measurement ranges:
500µA, 5mA, 50mA, 500mA, 10A
Resolution:
10nA, 100nA, 1µA, 10µA, 1mA
Accuracy:
0.5-500mA: ± (0.2%rdg + 0.004%fs)
10A: ±(0.3%rdg + 0.004%fs)

AC voltages:
Measurement ranges:
500mV, 5V, 50V, 500V, 750V
Resolution:
10µV, 100mV, 1mV, 10mV, 100mV
Accuracy: 0.5-50V:
at 40Hz-10Hz: ± (0.4%rdg + 0.07%fs)
at 20Hz-20kHz: ± (1%rdg + 0.07%fs)
500V and 750V:
at 40Hz-1kHz: ± (0.4%rdg + 0.07%fs)
at 20Hz-1kHz: ± (1%rdg + 0.07%fs)
Max. input voltage:
1000Vc for the 50V, 500V and 1000V ranges; 300Vrms for the 500mV and 5V ranges.
Input impedance:
AC mode: 1MΩ // 90pF
AC + DC mode: 10MΩ // 90pF
Bandwidth at - 3dB: 80kHz typical
dB Mode: (20Hz-20kHz)
Accuracy: -23.8dBm to 59.8dBm; ± 0.2 dBm
TRMC: ≥ 60dB (50/60Hz ± 0.5%)
Peak factor: 7 max.

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[1] rdg = reading;
[2] fs = full scale
[3] common mode rejection factor
[4] serial mode rejection factor

Technical characteristics: (continued)

AC current:
Measurement ranges:
500µA, 5mA, 50mA, 500mA, 10A
Resolution:
10nA, 100nA, 1µA, 10µA, 1mA
Accuracy: (40Hz-100Hz)
0.5-500mA: ± (0.7%rdg + 0.07%fs)
10A: ± (1%rdg + 0.07%fs)

AC + DC measurements
Same as AC + 25 digits

Resistances:
Measurement range:
500Ω, 5kΩ, 50kΩ, 500kΩ, 5MΩ, 50MΩ
Resolution:
10mΩ, 100mΩ, 1Ω, 10Ω, 100Ω, 1kΩ
Accuracy:
± (0.05%rdg + 0.004%fs + 50mΩ)
ranges 5MΩ and 50MΩ: ± 0.3%rdg+0.004%fs)
Input protected to max. 300 Vrms

Temperatures:
2-wires resistance measurement with linearization for Pt 100 sensors as per standard EN60751
Range: - 200°C to + 500°C
Resolution: 0.1°C
Measurement current: approximately 1 mA
Display: in °C, °F
Accuracy:
± 0.1°C from - 200°C to + 200°C
± 0.2°C from 200°C to 500°C (except for sensor tolerance)

Temperature coefficient: (10-18°C and 28-40°C)

V =	500mV, 50V	30ppm/°C
	1000V range	80ppm/°C
	other ranges	20ppm/°C
V ~	750V range	80ppm/°C
	other ranges	50ppm/°C
mA	all ranges	200ppm/°C
mA-	all ranges	300ppm/°C
Ω	5 MΩ, 50 MΩ ranges	200ppm/°C
	other ranges	50ppm/°C

Measurement current for resistance measurement:

500Ω/5kΩ range	1mA
50kΩ range	100µA
500kΩ range	10µA
5/50MΩ range	100nA

Measurement voltage for resistance measurement:
10V typical for open inputs; depending on value of resistance to be measured. Negative polarity of measurement voltage is across common terminal.
Voltage drop for current measurements:

10A range	0.3V max.
500mA range	2.5V max.
Other ranges	0.7V max.

Operating conditions:
+ 10°C to + 40°C max. relative humidity 80%.
Power supply: (HM8001 or HM8003).

+ 5V	300mA
+ 16V	75mA
- 16 V	20mA (Σ = 3 W)

Case size: (without flat 22-pole connector)
L 135, H 68, D 228 mm
Weight: approx. 500g

General information

The operator should not neglect to carefully read the following instructions and those of the mainframe HM8001, to avoid any operating errors and to be fully acquainted with the module when later in use.

After unpacking the module, check for any mechanical damage or loose parts inside. Should there be any transportation damage, inform the supplier immediately and do not put the module into operation.

This plug-in module is primarily intented for use in conjunction with the Mainframe HM8001. When incorporating it into other systems, the module should only be operated with the specified supply voltages.

Safety

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.*** It corresponds as well to the CENELEC regulations EN 61010-1. All case and chassis parts are connected to the safety earth conductor. Corresponding to Safety Class 1 regulations (three-conductor AC power cable). Without an isolating transformer, the instruments power cable must be plugged into an approved three-contact electrical outlet, which meets International Electrotechnical Commission (IEC) safety standards.

Warning!

Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

The instrument must be disconnected and secured against unintentional operation if there is any suggestion that safe operation is not possible. This may occur:

- if the instrument has visible damage,
- if the instrument has loose parts.
- if the instrument does not function,
- after long storage under unfavourable circumstances (e.g. outdoors or in moist environments),

Symbols as Marked on Equipment


ATTENTION refer to manual.


DANGER High voltage.


Protective ground (earth) terminal.

Operating conditions

The ambient temperature range during operation should be between +10°C and +40°C and should not exceed -40°C or +70°C during transport or storage. The operational position is optional, however, the ventilation holes on the HM8001 and on the plug-in modules must not be obstructed.

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.

Maintenance

Various important properties of the module 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.

When removing the case detach mains/line cord and any other connected cables from case of the mainframe HM8001. Remove both screws on rear panel and, holding case firmly in place, pull chassis forward out of case. When later replacing the case, care should be taken to ensure that it properly fits under the edges of the front and rear frames.

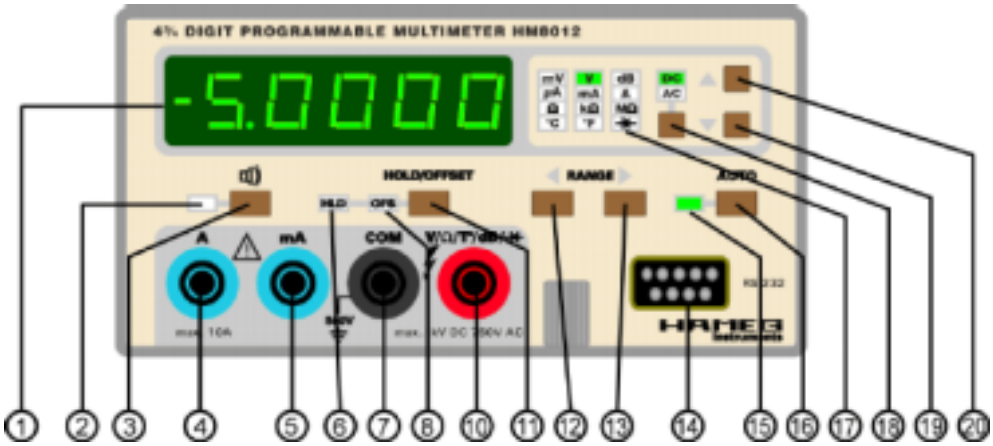
After removal of the two screws at the rear of the module, both chassis covers can be lifted. When reclosing the module, care should be taken that

the guides engage correctly with the front chassis.

Operation of the module

Provided that all hints given in the operating instructions of the HM8001 Mainframe were followed, especially for the selection of the correct mains voltage, start of operation consists practically of inserting the module into the right or left opening of the mainframe. The following precautions should be observed:

Before exchanging the module, the mainframe must be switched off. A small circle (o) is now revealed on the red power button in the front centre of the mainframe. If the BNC sockets at the rear panel of the HM8001 unit were in use before, the BNC cables should be disconnected from the basic unit for safety reasons. Slide in the new module until the end position is reached. Before being locked in place, the cabinet of the instrument is not connected to the protective earth terminal (banana plug above the mainframe multipoint connector). In this case, no test signal must be applied to the input terminals of the module.



HM8012 FRONT PANEL COMMANDS

(1) DISPLAY (7-segment LED + LED)

The digital display shows the measurement value with 4 3/4 digit resolution, in which the largest figure is used up to "5". It will also display various warning messages. The measurement value will be displayed with decimal points and polarity sign. For DC measurement, a minus sign will appear in front of the figures when the positive polarity of the measured value is connected to the COM input (7).

(2) 🔊 (LED)

Indicator denoting validation of the audible continuity test signal. When used as an Ohmmeter, the audible signal triggers when the measured resistance value is less than 0.1% of the range or 50 counts.

(3) BEEP 🔊 (pushbutton)

Pushbutton for activating the audible signal.

(4) A (10A) (safety terminal for 4 mm banana plugs)

Connection (high potential) for DC and AC current measurements in the 10 A range in conjunction with the COM input (7) (low potential). The input is not fuse-protected. **Current in excess of 10 A (max. 20 A) must not be applied for a period exceeding 30 s, otherwise the internal measurement resistor thermal device will blow.**

(5) mA/µA (safety terminal for 4 mm banana plugs)

Connection (high potential) for DC and AC current measurements up to 500 mA in conjunction with COM (7) input (low potential). The input is fuse-protected. This input is opened when functions other than mA/µA are being used.

(6) HOLD (LED)

Indicator denoting that the displayed value has been frozen. The function can be activated

using key (11). Deactivation is by pressing the HOLD/OFFSET key.

(7) COM (safety terminal for 4 mm bana plugs)
The COM terminal (low potential) is the common connector for all the measurement functions to which the potential close to the ground of the measured quantity will be applied.
CAUTION! For safety reasons, the voltage across this terminal compared to the case (guard wire, ground) shall be 500 V at most.

(8) OFFSET (LED)
Indicator denoting that the displayed value is a relative measurement. The displayed value corresponds to the input value less the value present on the display during initial action on the HOLD/OFFSET key (11). Activate this function by means of a second press on the HOLD/OFFSET key.

(10) V/Ω/T°/dB/ ⊣◄ (safety terminal for 4 mm banana plugs)
Connection (high potential) for measurements of voltages, resistances, temperatures and diode junctions in conjunction with the COM input (7) (safety terminal).
CAUTION! For safety reasons, the voltage across this terminal compared to the case (guard wire, ground) shall be 1,000 V at most.

(11) HOLD/OFFSET (pushbutton)
Pushbutton for validating the HOLD or OFFSET functions. Pressing the key the first time will freeze the front panel display. The HOLD indicator (6) then comes on. The AUTO, AC-DC, BEEP, ◄ and ► keys are inoperative.
A second press gives access to the relative mode. The value memorized by the HOLD function is then subtracted from each measurement before being displayed. The OFFSET indicator (8) comes on.
A third press will freeze the relative value. The HOLD (6) and OFFSET (8) indicators come on.
A fourth press will delete the HOLD and OFFSET mode.
NOTE: When the HOLD/OFFSET mode is engaged, pressing the ▲ or ▼ key will provoke return to the normal mode. Further, the manual mode is set on for HOLD and OFFSET functions.

(12) ◄ (pushbutton)
Pushbutton for changing to lower range. On each press, the new range is displayed fleetingly on the display in code form (L1 for lowest range, L2 for second range, etc.).

(13) ►(pushbutton)
Pushbutton for changing to higher range. Each time pressed, the new range will be displayed fleetingly on the display in code form (L1 for lowest range, L2 for second range, etc.).

(14) RS232 (DB9)
Female DB9 connector intended for serial communication.

(15) AUTO (LED)
Indicator signaling that the multimeter is in AUTOMATIC mode. In this mode, action on keys (12) and (13) is inoperative and transmits an audible beep.

(16) AUTO (pushbutton)
Pushbutton for switching the AUTO range selection to the MANUAL range selection and vice versa.
In AUTO mode, the choice of range is determined automatically by the unit. This is the default mode when the unit function is changed (V, mA, Ω, dB).
In MANUAL mode, the choice of range is left to user initiative using the keys (12) and (13).

(17) Unit display zone (LED)
This zone contains a display of the measurement units. It also identifies the function selected by pressing the ▲ (20) or ▼ (19) key.

(18) AC-DC (pushbutton)
This key is used for selecting the measurement mode (DC, rms AC or rms AC + DC).
Indicators below indicate the measurement mode :
DC : measurement of DC voltages
AC : measurement of RMS AC voltages
DC and AC : measurement of RMS AC+DC voltages.

(19) ▼ (pushbutton)
Pushbutton for selecting the next function.

(20) ▲ (pushbutton)
Pushbutton for selecting the previous function. On startup, the unit switches automatically to the DC voltmeter, AUTO mode function.

Choice of multimeter function

The ▲ and ▼ keys can through all the multimeter functions one by one, i.e., in order:

- DC or AC voltages. Input on the V/Ω/T°/dB and COM connectors.
- The measurement of DC or AC voltages in decibels (reference 1mW/600Ω). Input to V/Ω/T°/dB and COM connectors.

- DC or AC current up to 500 mA. Inputs on mA/µA and COM connectors.
- DC or AC current, 10 A range. Inputs on the A and COM connectors.
- Resistors. Inputs V/Ω/T°/dB and COM connectors.
- Temperature in degrees Celsius. Connection of probe to V/Ω/T°/dB and COM connectors.
- Temperature in degrees Fahrenheit. Connection of probe to V/Ω/T°/dB and COM connectors.
- Diode test. Inputs on V/Ω/T°/dB and COM connectors.

On each press, the new function is indicated by an LED corresponding to the unit of the quantity to be measured. It is possible to move from one function directly to any other function by a successive series of pressings.

Mode selection

For current and voltage modes, the AC-DC key is used for choosing between DC voltage measurement, AC or AC + DC true rms voltage measurement.

Choice of range

In manual mode, the ◄ and ► keys are used for switching between the various measurement ranges. The measurement ranges are split into decades. After each range change, a code appears indicating the new range being used. This code is in LX form, where X is a value that may vary from 1 to 6 depending on the range and function and L1 is the lowest range.
During measurements of unknown voltages or currents, first choose the highest measurement range, then switch to the range giving the most favorable display.
In automatic mode, the unit itself decides on the range selection. Ranges are changed with some hysteresis to avoid repetitive switchover during transitions between two ranges. Change to the higher range is obtained when the caliber value exceeds 51,000 counts. Change to the lower range is obtained when the value drops below 4,900 counts. It is possible to know which range has been selected by the unit by temporarily deactivating the AUTO mode so that the range indication code appears fleetingly.

Measurement value display

Measurement values are represented by 7 segment LED's display associated with one LED for the negative sign. The maximum value of the 1st digit is 5: this corresponds to a 4 3/4 digit display with a 51,000 counts measurement capacity. A minus sign appears in front of the figures when, during DC measurements, the positive polarity of the measured value is on the COM terminal. With the inputs short-circuited, the display indicates (depending on the measurement range) value zero ± 2 digit. When the range is overrun, the display shows "OFL" and an audible beep is emitted repeatedly. For the resistance measurement function, the exceeding of the capacity (> 50MΩ) generates the "OPEN" message.
If the multimeter is not connected to a circuit, the display indicates random values due to the very high input impedance for ranges of 500mV and 5V.

Measurement inputs

HM8012 has four safety terminals with which, when using appropriate measurement cables (e.g. HZ15), fortuitous contacts with the measurement quantity are totally ruled out. As a safety measure the measurement cables should be checked periodically for insulation faults and, when necessary, be replaced. The "COM" terminal (black) is common to all the measurement ranges. The potential close to ground of all the measurement quantities should be applied to this terminal. This is where the analog zero potential and the guard tracks are located. The input mA/µA (blue) and A (blue) is intended only for current measurements, whereas the input V/Ω/T°/dB is designed for all other measurements. Each terminal is appropriate to receive 4 mm banana plugs.

Voltage measurements

The maximum input voltage of HM8012 is 1000V DC when the COM terminal is to ground potential, i.e. by connecting HM8012 to the object to be measured, the sum of the measurement voltage and that of the COM terminal with respect to ground shall not exceed 1000V DC. In this case, the maximum voltage value between the COM terminal and ground is 500V DC.
For AC voltages, the true rms value of the input voltage will be measured, and the DC component eliminated in AC mode. If possible, the COM terminal shall be connected directly to ground or to the point of the measurement circuit having the lowest potential. The 0.5 V and 5 V voltage measurement ranges are protected from input voltages to 300 V rms; all the other ranges are protected to 1000 V DC.
During measurements on circuits using inductive components, inadmissible high voltages may appear when the circuit is

opened. In such cases, take steps to prevent the destruction of HM8012 by inductive voltages.

Input impedance in the V_{DC} range

To make the most of the excellent linearity of the measurement system, the input impedance for voltage measurements is very high for some ranges. For instance, this makes possible to perform accurate measurements on ranges of up to ± 5V, even when the internal impedance of the source to be measured is high. For instance, for the 500mV range, an internal 5MΩ source resistance will induce a maximum error of 150µV.
During measurement with high source resistors, continuous swinging between the 5V and 50V ranges may occur if the instrument is in automatic mode. Indeed, switching to the 50V range will cause the input voltage to drop because of the input impedance of 10 MΩ which can cause the multimeter to switch to the lower range and so on. After some swings, the instrument goes into MANUAL mode.

Current measurement

For current measurements, the connection of the object to be measured is made across the mA/µA terminal or to the A terminal for currents of up to 10 A. The HM8012 should be connected to the circuit whose potential with respect to ground is lowest. For safety reasons, the COM terminal must not exceed 500Vp with respect to ground. Current ranges are protected by a fuse against overloads of up to 500mA. If the fuse blows, the cause of the overload must first be eliminated and then the fuse can be replaced. See "**Protection from overloads**" paragraph for more details about fuse replacement.
The **10A** current measurement function **is not fuse protected**. Current in excess of 10A (max. 20A) must therefore not circulate through HM8012 continuously. The maximum current measurement time > 10A (max. 20A) is 30 sec. For this function, the AUTO mode is inhibited because there is only one range.

AC voltage measurement

The instrument measures the true rms value of the input voltage with or without its DC component. To measure low voltages, or in the event of high noise, it is possible to use a shielded cable.
Take into account the input impedance of the multimeter. It is 1MΩ in the AC mode and 10MΩ in the AC + DC mode. In addition, there is a slight measurement difference between these two modes due to the input circuits. If AC measurements without a DC component are to be made, it is preferable to use the straight AC mode.
When the multimeter is used in AUTOMATIC mode, there can be continuous swinging between two ranges for frequencies above 30kHz or so, because of the frequency response difference of the two ranges. After some swings, the instrument goes into MANUAL mode.

Resistance measurements

For resistance measurements, connect the object to be measured between the COM terminal and the V/Ω/T°/dB terminal. There is a DC voltage across the connection terminals. Accordingly, only voltage-free objects need to be measured because the voltages in the measurement circuit will distort the result. In the case of low resistance measurements, the OFFSET key can be used to compensate, where applicable, for measurement cord resistance.
For high resistance measurements, it is advisable to place the resistance to be measured as close as possible to the measurement terminal or to use a shielded measurement cable connected to ground.
On startup, simultaneously pressing MODE and OFFSET will eliminate the correction of the HZ15 measurement cord resistance.

Protection against overloads

All the HM8012 measurement ranges are protected against various forms of overload. Precise indications are given in the technical characteristics.
In general: during the measurement of unknown quantities, always begin with the highest measurement range and, from then on, switch ranges using optimum display. If HM8012 malfunctions, first eradicate the cause before going on to make the following measurement.
If these safety limit values are exceeded, i.e. 1000 V_{DC} or 750 V_{RMS}, the OFL message will be displayed and the associated audible signal will sound. For an overrun exceeding 5% of the range, a fast audible signal will be heard and the input relay will open to prevent any damage to the equipment. The OFF message will be displayed. Resetting is by pressing the ▲ or ▼ key.

Changing fuse: to repair HM8012 after an overload in a current range, the fuse needs to be replaced. To do this, open the unit because the fuse can only be reached from the inside. In any case, only a fuse of the indicated type may be used; otherwise HM8012 could sustain

damage and the technical characteristics of the current measurement ranges would no longer be maintained.

Characteristics of fuse: 500 mA fast-blow, 250 V.

Crest factor

To evaluate complex or deformed signals, the determination of a true rms value is necessary. The HM8012 digital multimeter will allow the measurement of AC quantities with a display of the true AC or AC + DC value. The crest factor is important data for interpreting measurement values and for evaluating its accuracy. It is defined as the ratio between the peak voltage and the rms value of the signal.

$$\text{Crest factor} = CF = U_p/U_{eff}$$

It is a measurement of the dynamic input voltage range of the AC converter and expresses the capability of processing measurement signals with a high peak value, without the converter entering into saturation. The HM8012 crest factor ranges from 1 to 7 (for additional measurement error of < 1%) and depends on the magnitude of the rms value of the signal to be measured. Figure 1 gives an additional error depending on the crest factor for a pulse type signal. To avoid saturation of the HM8012 input stages, make sure that the input signal peak value does not exceed 3 times the value of the range, or 1000 V. At the middle of the measurement range, the maximum crest factor is 6. The accuracy of the displayed value depends, among other things, on the rms value converter bandwidth. Complex signal measurements will barely be influenced when there are no harmonic components in the measurement signal placed outside the 100 kHz (- 3 dB) bandwidth of the converter.

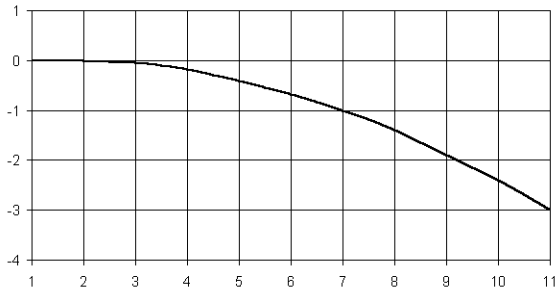


Figure 1: Additional error due to crest factor

Another factor influencing the measurement precision is the duty cycle of the measurement signal. The crest factor in this relation becomes:

$$CF = \sqrt{T/t}$$

T = period duration
t = pulse duration
U = pulse voltage.

Accordingly, a rectangular signal having a duty cycle of 1% has a crest factor of 10. The minimum pulse duration should be approximately 10 µs.
While ensuring that this maximum pulse amplitude does not exceed 3 times the maximum value of the rating, the overall on the measurement result of such a signal will be ± (1% rdg ± 0.07% fs) ± 2.5% rdg, i.e. ± 3.5% rdg ± 0.07% fs.

Diode test

Choose the diode test function (⊣◀) using ▲ or ▼ key. It is preferable to remove, if necessary, any components connected to the semiconductor for precise results. It is possible to measure voltages up to 5 V. The maximum voltage that the equipment will supply is 10 V in an open circuit. Take care when making measurements on sensitive circuits. The current supplied by HM8012 is 1 mA constant for this function. All keys except ▲, ▼ and HOLD/OFFSET are inactive for this function.

Temperature measurements

Choose the temperature measurement function (°C or °F) using ▲ or ▼ key. The temperature probe is connected between the COM terminal and the V/Ω/T°/dB terminal.
Temperature measurement requires a temperature probe type Pt100 as per standard EN60751. The instrument is designed for the HZ812 probe. The use of another probe is possible but can generate additional errors due to a different link cable resistance. All keys except ▲, ▼ and HOLD/OFFSET are inactive for this function.
On starting, simultaneously pressing BEEP and OFFSET will eliminate probe cable resistance compensation (zero value). In all cases, compensation can be carried out by setting the probe to a temperature of 0°C and using the OFFSET function.

Decibel measurements

HM8012 is used for DC or AC voltage measurements in decibels. The 0dB reference is defined for 1mW power in a 600Ω load, i.e. a voltage of approximately 0.7746V. The scale extends from - 78dBm to 59.8dBm.

Equipment remote control

HM8012 includes a front panel connector for controlling the equipment by means of a point-to-point serial link. There are three wires used : RxD (Receive Data), TxD (Transmit data), SGnd (Signal Ground). The signal voltage levels must comply with the following levels (+/- 15 V max., +/- 3 V min.).
The links is of the bi-directional asynchronous type with a fixed configuration: 4800 Baud, 8 bits, no parity, one stop bit. The synchronization protocol is XON/XOFF (half duplex) and is also fixed.
Each control must have two ASCII code characters followed by character 13 (symbolized as <CR> in ASCII) or two characters 13 and 10 (symbolized as <CR> <LF> in ASCII), while the <LF> character is ignored during reception.
The instrument internal buffer includes only three characters, and there is no way of sending more than one command at a time. On reception of terminator <CR>, the equipment sends the character 19 (<DC3> ASCII) to indicate that the dialogue is suspended. As soon as it is possible to resume dialogue, the instrument sends character 17 (<DC1> ASCII).
The commands are divided into six groups.

- **Function commands**

These commands are used for choosing another magnitude to be measured and corresponding to the choice of FUNCTION key on the front panel.

VO<CR> voltage measurement (VOLT)
AM<CR> current measurement (A)
MA<CR> current measurement (mA)
OH<CR> resistance measurement
DI<CR> diode test
TC<CR> temperature measurement in °C
TF<CR> temperature measurement in °F
DB<CR> measurement in dB.

For these commands, there is no error recovery provided for because it is normally possible to put the instrument in one of these states at any time.

- **Mode commands**

Mode commands correspond to the "MODE" key on the front panel.

DC<CR> switches the instrument to the DC measuring mode.
AC<CR> switches the instrument to the AC measuring mode.
AD<CR> switches the instrument to the AC + DC measuring mode.
BY<CR> enables the beeper function.
DN<CR> disables the beeper function.

If the requested mode is not compatible with the current function (e.g.: sending the AC command while the instrument is measuring resistances), the instrument will indicate this by a beep in the same way as for the front panel control. In addition, the control error indicator is set (see command E7).

- **Range modification commands**

These correspond to the "RANGE" keys on the front panel.

AY<CR> switches to automatic range change
AN<CR> switches to manual range change
R+ <CR> switches to the next higher range
R- <CR> switches to the next lower range.

If it is impossible to activate or deactivate the autoranging the current function (e.g. following the AM command to switch to current measurement the AY command cannot be executed since the measurement is made in a single range for this function) or if it is impossible to change ranges, the instrument will send a beep. In addition, the command error indicator is then set (see command E?).

- **Display type commands**

These correspond to the choice of the HOLD OFFSET key on the front panel.

HD<CR> switches the instrument to HOLD
01 <CR> switches the instrument to OFFSET (Single)
00<CR> switches the instrument to NORMAL
L0<CR> locks the front panel. In this case, pressing a front panel key will cause the “rtEOn” message to appear.
L1<CR> is a way of unlocking the front panel.

The NORMAL type corresponds to a display without a reference (OFFSET) and without maintaining (HOLD) the front panel state. In the same way as for the manual control, it is impossible to switch to the OFFSET mode without first going to the HOLD mode. Indeed, the maintained measurement is used as a reference.

The possible steps are therefore:
NORMAL (HD) → HOLD (01) → OFFSET (HD) → OFFSET + HOLD (00) → NORMAL

Unlike the manual command, it is possible to return directly to the NORMAL mode at any time during command 00.

- **Status commands**

The status commands are used for recovering the status of the instrument. The returned information consists of ASCII character strings, each terminating in a <CR>.

I? <CR>
Request for equipment identification which returns:

HAMEG, HM8012,,V1.08<CR>

I.e.: manufacturer, instrument reference, void and software version (Firmware).

F? <CR>
Requests current measurement function. The instrument returns one of the following strings:

VOLT<CR>
AMP<CR>
MAMP<CR>
OHM<CR>
DIODE<CR>
TDGC<CR>
TDGF<CR>
DB<CR>

M? <CR>
Requests current measurement mode. The instrument returns one of the six following strings:

AC BEEP-OFF<CR> or AC BEEP-ON<CR>
DC BEEP-OFF<CR> or DC BEEP-ON<CR>
AC+DC BEEP-OFF or AC+DC BEEP-ON<CR>
BEEP ON<CR>
BEEP OFF<CR>
The two last responses are only obtained during resistance measurement, diode junction measurement and temperature measurement.

D? <CR>
Request for current display option. The instrument sends back one of the strings:

HOLD<CR>
REF<CR>
HOLD+REF<CR>
NORMAL<CR>

The REF string corresponds to the front panel OFFSET mode. The NORMAL string indicates that the display is neither on HOLD nor on REF.

R? <CR>
Requests for current measurement range. The instrument returns one of the following strings:

NUM<CR>
NUM AUTO<CR>
The first NUM field represents a digital character indicating the current range number. Where applicable, a second field is displayed indicating that the automatic range change mode is active.
Note that the range numbers correspond respectively to:

(1 - > 0.5 V, 0.5kΩ, 500 µA, T°C, T°F)
(2 - > 5 V, 5 kΩ, 5 mA, Diode)
(3 - > 50 V, 50 kΩ, 50 mA)
(4 - > 500 V, 500 kΩ, 500 mA)
(5 - > 1000 V, 5 MΩ)
(6 - > 50 MΩ, 10 A)

P? <CR>
This command alone is used for recovering complete parameter settings of the equipment. The instrument returns:

string_F, string_M, string_R, string_D <CR>
. string_F is one of the responses returned by command F?
. string_M is one of the responses returned by command M?
. string_R is one of the responses returned by command R?
. string_D is one of the responses returned by command D?

S? <CR>
Request to send current measurement. The instrument returns a string in the shape:

NUM UNIT <CR>

NUM represents the digital value field in IEEE NR2 format (in our case, 5 significant digits at most with the presence of a decimal point). The significant digits are those of the front panel display.
UNIT is the field giving, as suggested by the name, the unit or a sub-multiple thereof. The possible values are identical to that of the front panel.

E? <CR>
Request for status of command error indicator. The instrument returns:

O<CR> if the command or commands received previously have not generated an error,
1<CR> if one of the commands received previously has generated an error.

The use of this command resets the error indicator to 0. Indeed, in the event of an error, as long as the user has not requested the status of the indicator through this command, the latter will remain set even if other commands go through without errors.

- **Calibration commands**

Commands - N, + N, M!, A! and F! are commands for calibrating the equipment and must not be used.

Function Test

General

This test should help verify, at certain intervals, the functions of HM8012 without any great expenditure in measurement instruments. To achieve thermal balance, the module and the basic instrument, in its case, must be energized for at least 60 minutes before the test begins.

Measurement equipment used

Fluke 5101B / Fluke 5700A / Rotek 600 AC/DC calibrator
Resistors of 5 kΩ, 50 kΩ, 500 kΩ 0.01% for instance model S102 J by Vishay
Resistors 500 kΩ, 5 MΩ 0.02%, for instance models CNS020 by Vishay.

If one of the indicated calibrators is available or if precision calibrators are appropriate, all the HM8012 measurements ranges can be checked using the following tables which indicate the limit values. Recalibration, however, should only be performed if the appropriate precision calibrator is available.
Before any change of ranges, ensure that the signal at HM8012 does not represent an unacceptable load of the object under examination.

For the link between the calibrator and HM8012, shielded cables must be used to prevent any unwanted influence caused by the measurement signal.

a) DC voltage ranges

No.	Range	Reference (+23°C)	Display limits
1	500mV	250.00mV	249.85-250.15
2	5V	2.5000V	2.4986-2.5014
3	50V	25.000V	24.985-25.015
4	500V	250.00V	249.86-250.14
5	1000V	900.0V	899.5-900.5

b) AC voltage ranges

No.	Range	Reference (+23°C)	Display limits
1	500mV	250.00mV	(1) 248.65-251.35 (2) 247.15-252.85
2	5V	2.5000V	(1) 2.4865-2.5135 (2) 2.4715-2.5285
3	50V	25.000V	(1) 24.865-25.135 (2) 24.715-25.285
4	500V	250.00V	(3) 248.65-251.35 (4) 247.15-252.85
5	750V	700.0V	(3) 692.4-707.5 (4) 692.4-707.5

(1) = 50 Hz to 10 kHz
(2) = 20 Hz to 20 kHz
(3) = 50 Hz to 1 kHz
(4) = 20 Hz to 1 kHz.

c) DC ranges

No.	Range	Reference (+23°C)	Display limits
1	500µA	250.00µA	249.48-250.52
2	5mA	2.5000mA	2.4948-2.5052
3	50mA	25.000mA	24.948-25.052
4	500A	250.00mA	249.48-250.52
5	10 A	1.800A	1.794-1.806

d) AC ranges (f = 400 Hz)

No.	Range	Reference (+23°C)	Display limits
1	500µA	250.00µA	247.9-252.1
2	5mA	2.5000mA	2.479-2.521
3	50mA	25.000mA	24.79-25.21
4	500mA	250.00mA	247.9-252.1
5	10 A	1.800A	1.775-1.825

e) Resistor ranges

No.	Range	Reference (+23°C)	Display limits
1	500Ω	200.00Ω	199.88-200.12
2	5kΩ	2.0000kΩ	1.9989-2.0011
3	50kΩ	20.000kΩ	19.989-20.011
4	500kΩ	200.00kΩ	199.89-200.11
5	5MΩ	2.0000MΩ	1.9939-2.0061
6	50MΩ	20.000MΩ	19.939-20.061

Calibration sequence

HM8012 is calibrated for the greater part by software. Access to the adjustment mode is obtained by turning on HM8012 and simultaneously pressing the AUTO (16) and BEEP(3) keys.

Wait for the CAL message to appear on the display. Release the keys. The instrument indicates a calibration step. The first character indicates the measured magnitude, followed by the standard value to be applied to the input. In this mode, the keys play a particular function as detailed below.

Key	**Action**
AUTO (16)	Correction of the current range if indicator (2) is on, otherwise display of input value with former calibration.
BEEP (3)	Display of non-calibrated value. Indicator light (2) comes on to permit calibration by key (16). Pressing the MODE key a second time is a way of returning to the indication of the step.
►(13)	Change to next calibration.
◄(12)	Change to previous calibration.
AC-DC (18)	Storing of calibrations.

Adjustment procedure

1) Inject at the input of HM8012 the value indicated for each step.
2) Press the **BEEP** (3) key. A value is then displayed corresponding to the value without a correction. Indicator (2) must light up.
3) Press the **AUTO** (16) key to calibrate. The displayed value must be correct.
4) Press the ►key (13) to move to the next step (pressing **AUTO** is a way of not changing steps but of redisplaying the current step indication.

NOTES:

- On each calibration step, it is possible to check whether calibration is needed. To do this, simply press the **AUTO** key without first pressing the **BEEP** key. The value corrected during the latest calibration is then displayed. It is possible to do without the calibration if the value is correct. Press the **AUTO** key a second time to return to the menu or press the ◄ or ► key to change step.

- Although it is possible to perform some of the steps separately, it is highly advisable to carry out complete calibration of the equipment.

- When calibrating the resistor ranges, connect the standard resistor as close as possible to the input terminals.

List of calibration steps

Step	Indication	Input
1	U 0.5 V	500.00 mV
2	U 5 V	5.0000 V
3	U -5 V	-5.0000V
4	U 500 V	500.0 V
5	U 1E3 V	1000.0 V
6	U- 1E3 V	-1000.0 V
7(*)	u0 0.0 V	0V (short-circuit)
8(*)	u1 0.0 V	0V (short-circuit)
9(*)	u 0.25 V	0.25 V rms/500 Hz
10	o 5 kΩ	5 kΩ
11	o 50 kΩ	50 kΩ
12	o 500 kΩ	500 kΩ
13	o 5MΩ	5 MΩ
14	o oFS Ω	0 Ω (with cords)

(*) Wait for complete stabilization of the display.

Frequency compensation adjustment

This adjustment means opening up the unit. Turn to the 50 V DC range. Apply 25 V DC / 15 kHz. Adjust adjustable capacitor CV1 to obtain a display of 25,000 ± 5 counts.