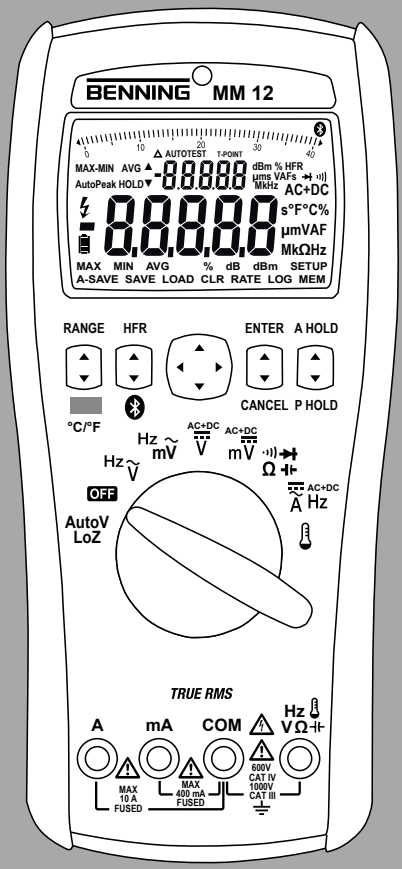
BENNING

(D) **Bedienungsanleitung**
(GB) **Operating manual**
(PL) **Instrukcji obsługi**



BENNING MM 12

Operating manual
BENNING MM 12

TRUE RMS digital multimeter for
- Direct/ alternating voltage measurement
- Direct/ alternating current measurement
- Resistance measurement
- Diode/ continuity testing
- Capacity measurement
- Frequency measurement
- Temperature measurement

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1. Operating instructions

This operating manual is intended for

- skilled electricians and
- trained electronics personnel.

The BENNING MM 12 is designed for measurements in dry surroundings. It must not be used in electrical circuits with rated voltages higher than 1000 V AC/ DC (For more details, see in section 6 “Ambient conditions”). The following symbols are used in the operating manual and on the BENNING MM 12 itself:

Attention! Magnets might affect the correct functioning of cardiac pacemakers and implanted defibrillators. As a user of such medical devices, keep a sufficient distance to the magnet.

Warning of electrical danger!
Indicates instructions which must be followed to avoid danger to persons.

Important, comply with the documentation!
The symbol indicates that the information provided in the operating manual must be complied with in order to avoid risks.

This symbol on the BENNING MM 12 indicates that the unit is protection insulated (safety class II).

This symbol on the BENNING MM 12 indicates the fuses which it contains.

This symbol on the BENNING MM 12 means that the BENNING MM 12 complies with the EU directives.

This symbol appears on the display for a discharged battery.

This symbol indicates the “diode testing” application.

This symbol indicates the „continuity testing” application. The buzzer provides an audible signal.

This symbol marks the range „capacity testing”.

(DC) voltage or current.

(AC) voltage or current.

Earth (voltage to earth).

2. Safety notes

The instrument is built and tested in accordance with
DIN VDE 0411 part 1/ EN 61010-1
DIN VDE 0411 part 2-033/ EN 61010-2-033
DIN VDE 0411 part 031/ EN 61010-031
and has left the factory in perfectly safe technical condition.
To maintain this condition and to ensure safe operation of the multimeter, the user must observe the notes and warnings given in these instructions at all times. Improper handling and non-observance of the warnings might involve severe **injuries** or **danger to life**.

WARNING! Be extremely careful when working with bare conductors or main line carrier! Contact with live conductors will cause an electric shock!

Attention! Magnets might affect the correct functioning of cardiac pacemakers and implanted defibrillators. As a user of such medical devices, keep a sufficient distance to the magnet.

The unit may be used only in electrical circuits of overvoltage category III with a maximum voltage of 1000 V to earth, or of overvoltage category IV with a maximum voltage of 600 V to earth.
Only use suitable measuring leads for this. With measurements within measurement category III, the projecting conductive part of a contact tip of the measuring leads must not be longer than 4 mm.
Prior to carrying out measurements within measurement category III, the push-on caps provided with the set and marked with CAT III and CAT IV must be pushed onto the contact tips. The purpose of this measure is user protection.
Remember that work on electrical components of all kinds is dangerous. Even low voltages of 30 V AC and 60 V DC may be dangerous to human life.

In order to prevent any danger, always measure a present voltage first without low-pass filter (without high-frequency suppression) to detect a dangerous voltage.

Before starting the multimeter, always check it as well as all measuring leads and wires for signs of damage.

Should it appear that safe operation of the multimeter is no longer possible, it should be shut down immediately and secured to prevent that it is switched on accidentally.

It may be assumed that safe operation is no longer possible:
- if the instrument or the measuring leads show visible signs of damage, or
- if the multimeter no longer works, or
- after long periods of storage under unfavourable conditions, or
- after being subjected to rough transport, or
- if the device or the measuring leads are exposed to moisture.

In order to avoid danger,
- **do not touch the bare probe tips of the measuring leads,**
- **insert the measurement leads in the appropriately designated measuring sockets on the multimeter**

Cleaning:
Regularly wipe the housing by means of a dry cloth and cleaning agent. Do not use any polishing agents or solvents!

3. Scope of delivery

The scope of delivery for the BENNING MM 12 comprises:

3.1 One BENNING MM 12
3.2 One software BENNING PC-Win MM 12
3.3 One serial data cable with USB 2.0 compatible connection
3.4 One safety measuring lead, red (L = 1.4 m)
3.5 One safety measuring lead, black (L=1.4 m)
3.6 One wire temperature sensor type K
3.7 One protective rubber holster
3.8 One magnetic holder with adapter and strap
3.9 One compact protection carrying case
3.10 Four 1.5 V mignon batteries (IEC LR6/ type AA) and two different fuses (integrated into the device)
3.11 One operating manual

Note on optional accessory:
- Temperature probe (K-type) made of V4A tube (part no. 044121)

application: insertion probe for soft-plastic materials, liquids, gas and air
measuring range: - 196 °C up to 800 °C
dimensions: length = 210 mm, tube length = 120 mm, tube diameter = 3 mm, V4A

Note on replaceable parts:
- The BENNING MM 12 contains fuses for overload protection:
  One fuse rated current 11 A fast-acting (1000 V), 20 kA, D = 10.3 mm, L = 38.1 mm (part no. 10016656) and one fuse rated current 440 mA fast-acting (1000 V), 10 kA, D = 10 mm, L = 34.9 mm (part no. 10016655).
- The BENNING MM 12 is supplied by means of four integrated 1.5 V mignon batteries (IEC LR6/ type AA).
- The above mentioned safety measuring leads (tested accessories) are approved in accordance with CAT III 1000 V/ CAT IV 600 V and are approved for a current of 10 A.

4. Description of unit

See figure 1: Front panel

The display and operating elements shown in Fig. 1 are as follows:

❶ **Digital display**, for the measurement value, bar graph and display for overrange indication
❷ **Sub-display**
❸ **Polarity indication**
❹ **Battery condition indicator**
❺ **RANGE respectively function key**
RANGE (up/ ▲), switchover between automatic and manual measuring range
Function (down/ ▼), selects the secondary, third or fourth function
❻ **HFR respectively Bluetooth® key**
HFR (up/ ▲), high-frequency suppression (low-pass filter)
Bluetooth® (down/ ▼), activation of the Bluetooth® interface
❼ **Cursor key**, menu control (up/ ▲, down/ ▼, right/ ►, left/ ◄)
❽ **ENTER respectively CANCEL key**
ENTER (up/ ▲), confirms the function
CANCEL (down/ ▼), terminates the function
❾ **A HOLD respectively P HOLD key**
A HOLD (up/ ▲), Auto HOLD, automatic measured value storage
P HOLD (down/ ▼), Peak HOLD, peak value storage
❿ **Rotating switch**, for selecting measurement function
⓫ **Socket** (positive[1]), for V, Ω, ⊣⊢, Hz,
⓬ **COM socket**, common socket for current, voltage, resistance, frequency, temperature, capacity measurement, continuity and diode testing
⓭ **Socket** (positive[1]), for mA range, for currents up to 400 mA
⓮ **Socket** (positive[1]), for 10 A range, for currents up to 10 A
⓯ **Protective rubber holster**
⓰ **Optical interface**, for accommodating the adapter located on the data cable
⓱ **Light sensor for LC display illumination**

[1]) The automatic polarity display for DC current and voltage refers to this.

5. Multimeter functions

5.1 General data

5.1.1 The digital display ❶ is designed as a 3¾ or 4¾ digit liquid crystal indicator with 15 mm digit height and decimal point. The highest value displayed is 4.000/ 40.000.

5.1.2 The bar graph display consists of 40 segments.

5.1.3 The polarity indication ❸ functions automatically. Only a polarity contrary to the socket definition is indicated as "-".

5.1.4 The range overload will be displayed with "OL" or "- OL" and sometimes with an acoustic signal.
Attention: No indication and prior warning in the event of an overload condition! A exceeding of dangerous contact voltage (> 60 V DC/ 30 V AC rms) is indicated by an additional flashing symbol „⚡".

5.1.5 The BENNING MM 12 confirms each button press with a signal sound. Invalid button presses are confirmed by a double signal sound. In the event of an incorrect circuit of the jack for the mA ⓭/ A range ⓮ BENNING MM 12 warns with a signal sound and the indication of ProbE in the display ❶
The acoustic signal and the indication ProbE in the display ❶ extinguish if a safety measuring lead is plugged into the jack for the mA ⓭/ A range ⓮ and the corresponding current measurement range was selected by means of the rotary switch ❿.
In case of a defective fuse, the BENNING MM 12 emits an acoustic warning signal and "FUSE" is shown on the display ❶.

5.1.6 The nominal measurement rate of the BENNING MM 12 is 10 measurements per second (sec) for the digital display.

5.1.7 The BENNING MM 12 is switched on and off by the rotating switch ❿. Switch-off position "OFF".

5.1.8 The BENNING MM 12 switches off automatically after approx. 10 minutes (**APO**, **A**uto-**P**ower-**Off**). It will switch on again as soon as a key is pressed or the rotating switch is operated. The switch-off can be adjusted individually in the setup menu (see section 5.3.5).

5.1.9 Temperature coefficient of measurement value: 0.1 x (stated measurement accuracy)/ °C < 18 °C or > 28 °C, relative to the value at the reference temperature of 23° C.

5.1.10 The BENNING MM 12 is powered by four 1.5 V mignon batteries (IEC LR6/ type AA).
5.1.11 The battery indication ❹ continuously shows the remaining battery capacity via a maximum of three segments.

> ⚠ **As soon as all segments of the battery symbol have disappeared and the battery symbol is flashing, the batteries must be replaced by new ones immediately in order to prevent danger for persons due to incorrect measurements.**

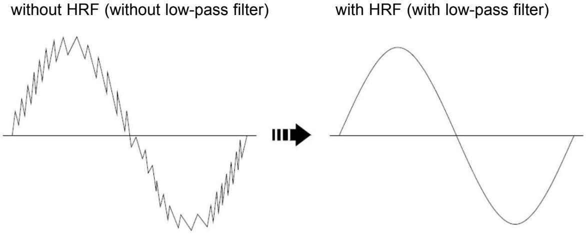
5.1.12 The life span of a battery is approx. 50 hours (alkali battery).
5.1.13 Appliance dimensions:
(L x W x H) = 200 x 87 x 40 mm without protective rubber holster
(L x W x H) = 206 x 94 x 54 mm with protective rubber holster
Appliance weight:
480 g without protective rubber holster
640 g with protective rubber holster
5.1.14 The safety measuring leads supplied are expressly suited for the rated voltage and the rated current of the BENNING MM 12.
5.1.15 The BENNING MM 12 is protected against mechanical damage by a protective rubber holster ⓯. The protective rubber holster ⓯ makes it possible to suspend the BENNING MM 12 during the measuring process or to stand it upright.
5.1.16 The BENNING MM 12 has an optical interface ⓰ on the top side. This is used for the galvanic isolation of the measuring signal to a PC/ laptop. The enclosed data cable is used for the transmission of measuring data and is equipped with a USB 2.0 compatible connection.
5.1.17 The BENNING MM 12 supports wireless data transmission via the Bluetooth® 4.0 standard to an Android or IOS device (smartphone/tablet).

5.2 Key functions

The operating keys ❺, ❻, ❽ and ❾ are provided with a double function and can be pressed upwards/ ▲ and downwards/ ▼.
5.2.1 The **RANGE** key ❺ (up/ ▲) can be used to change over to the manual measuring ranges and to hide “AUTO” on the display at the same time. Press the key for approx. 2 seconds to activate the automatic range selection (“AUTO” on the display).
5.2.2 Press the **Function** key ❺ (down/ ▼) to select the secondary, third or fourth function of the rotary switch position:

Rotary switch position:	Secondary function:	Third / fourth function:
V AC	Hz	
mV AC	Hz	
V DC	V AC + DC	
mV DC	mV AC + DC	
Ω	)))	▶| / ⊣(
A AC	A DC	A AC + DC/ Hz

5.2.3 The **HFR** key ❻ (up/ ▲) is intended for connecting a **low-pass filter (high-frequency suppression)** in the V AC and A AC functions in order to filter out high-frequency pulses e. g. at pulsed motor drives. “HRF” symbol on the LC display ❶. The limiting frequency (- 3 dB) of the filter is fg = 800 Hz. When reaching the limiting frequency fg, the displayed value is lower by a factor of 0.707 than the actual value without filter.



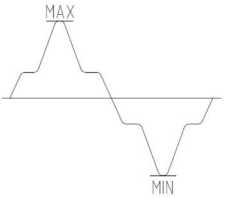
> ⚠ **In order to prevent any danger, always measure a present voltage first without low-pass filter (high-frequency suppression) to detect a dangerous voltage.**

5.2.4 Press the **Bluetooth**® key ❻ (down/ ▼) to activate the **Bluetooth® interface** with the Bluetooth symbol shown on the LC display ❶ at the same time.
5.2.5 Press the **Cursor** key ❼ (up/ ▲, down/ ▼, right/ ►, left/ ◄) to select the menu function on the LC display ❶.
5.2.6 Press the **ENTER** key ❽ (up/ ▲) to confirm the selected function.

5.2.7 Press the **CANCEL** key ❽ down/ ▼) to terminate a selected function.

5.2.8 Press the **A-HOLD** key ❾ (up/ ▲) (automatic storage of measured values) to store the displayed values on the secondary display ❷. The “Auto HOLD” symbol simultaneously appears on the display ❶. As soon as a new stable measured value with a deviation of > 5 digits (resolution of 3¾ digits) is detected, the secondary display ❷ will be updated automatically with the new value. Press the key again to switch the device back to measuring mode.
The automatic storage of measured values can be deactivated in the setup menu.

5.2.9 Press the **P-HOLD** key ❾ (down/ ▲) (peak value storage) to detect and store the “Peak Max”/“Peak MIN” value (function: V, mV and A) with “PeakHOLD” being shown on the display ❶ at the same time. Each time a new “Peak MAX”/“Peak MIN” value is stored, this is confirmed by an acoustic signal. The “Peak MAX” / “Peak MIN” value is called via the **P-HOLD** key ❾ (down/ ▼) and is shown on the secondary display ❷. Pressing the **P-HOLD** key ❾ (down/ ▼) for approx. 2 seconds switches the instrument back to normal operating mode. The P-HOLD function has a response time of 10 µs.



5.3 Menu functions

Press the **Cursor** key ❼ to select the functions shown on the LC display ❶. The selected function is indicated by a flashing symbol. To start a function, press the **ENTER** key ❽ (up/ ▲) and the symbol will be shown with an underscore. To exit a function, press the **CANCEL** key ❽ (down/ ▼).

5.3.1 **“MAX”, “MIN”, “AVG” (average value) functions**
Use the **Cursor** key ❼ to select the “**MAX**”, “**MIN**” or “**AVG**” function and start the measurement by pressing the **ENTER** key ❽ (up/ ▲). The function automatically records and stores the highest measured value (MAX), the lowest measured value (MIN) and the average value (AVG) of a series of measurements and shows the respective value in the secondary display ❷. Pressing the **CANCEL** key ❽ (down/ ▼) switches the instrument back to normal operating mode.

5.3.2 **Relative value function Δ**
Use the **Cursor** key ❼ to select the relative value function “Δ” and start the measurement by pressing the **ENTER** key ❽ (up/ ▲). The relative value function “Δ” stores the currently displayed value on the secondary display ❷ and shows the difference (offset) between the stored measured value and the following measured values on the display ❶.
Example:
Stored reference value: 235 V (secondary display ❷), currently measured value: 230 V, this results in a difference (offset) of 5 V (main display ❶). Pressing the **CANCEL** key ❽ (down/ ▼) switches the instrument back to normal operating mode.

5.3.3 **Relative value function %**
Use the **Cursor** key ❼ to select the relative value function “%” and start the measurement by pressing the **ENTER** key ❽ (up/ ▲). The relative value function “%” stores the currently displayed value on the secondary display ❷ and shows the relative percentage between the stored measured value and the following measured values on the display ❶.
Relative value % = [(measured value - reference value) / reference value] x 100 %
Example:
Stored reference value: 235 V (secondary display ❷), currently measured value: 230 V, this results in a relative percentage of -2.13 % V (main display ❶). Pressing the **CANCEL** key ❽ (down/ ▼) switches the instrument back to normal operating mode.

5.3.4 **Level measurement in dB/ dBm**
The level measurement in decibels is the logarithmic ratio of two powers P1 to P2. LP = 10 x log (P1/P2).
If the BENNINGF MM 12 is in the AC voltage (V AC) measuring mode, use the **Cursor** key ❼ to select the menu function “**dB**” or “**dBm**” and start the measurement by pressing the **ENTER** key ❽ (up/ ▲). The secondary display ❷ shows the voltage level in dB with a reference value of 1 V or the power level in dBm (reference value: 1 mW at 600 Ω). Voltage level and power level can be calculated as follows:

Voltage level in dB:	Reference value: 1 V	$L_U = 20 \times \log \frac{U}{1\,V}$ [dB]	
Performance level in dBm:	Reference value: 1 mW an 600 Ω	$L_P = 10 \times \log \frac{P}{1\,mW}$ [dBm]	$L_P = 10 \times \log \frac{U^2}{\frac{600\,\Omega}{1\,mW}}$ [dBm]

Pressing the **CANCEL** key ❽ (down/ ▼) switches the instrument back to normal operating mode.

5.3.5 **SETUP menu**

The BENNING MM 12 offers individual setting possibilities. To change a setting, use the **Cursor** key ❼ to select the "**SETUP**" menu. Press the **ENTER** key ❽ (up/ ▲) to open the „**SETUP**" menu. Use the **Cursor** key ❼ to choose between the following settings:

APO	Automatic switch-off:	1 minute to 30 minutes or OFF
bL it	LC display illumination:	Auto (automatic), ON or OFF
bEEP	Acoustic signal:	ON or OFF
A.Hold	Automatic storage of measured values:	ON or OFF
Cnt in	Limiting value of continuity test:	10 Ω to 50 Ω
diGit	number of digits of the LC display:	Lo (low) or Hi (high)
TEMP	Unit of temperature	°C or °F
RESET	Factory settings:	YES, confirm with **ENTER** ❽ (up/ ▲)

Pressing the **CANCEL** key ❽ (down/ ▼) switches the instrument back to normal operating mode.

5.4 Data logger function "LOG"

The **data logger function "LOG"** allows the automatic storage of series of measurements with a predefined measuring interval and up to 40,000 measured values. The measuring interval can be set from 1 s to 600 s. For further processing, the measured values can be read out later by means of the display ❶, the optical interface ⓰ or via Bluetooth®.

Use the **Cursor** key ❼ to select the "**LOG**" function and press the **ENTER** key ❽ (up/ ▲) to open the "**LOG**" menu.

Use the **Cursor** key ❼ to select the following submenus:

SAVE	Press the **ENTER** key ❽ (up/ ▲) to start the data logger function "**LOG**". Pressing the **ENTER** key ❽ (up/ ▲) again interrupts the measurement. Press it again to continue measuring. Press the **CANCEL** key ❽ (down/ ▼) to cancel the function. Note: Any restart will delete all measured values stored in the data logger (LOG).
LOAD	Press the **ENTER** key ❽ (up/ ▲) to open the measured values stored in the data logger. Use the **Cursor** key ❼ (up/ ▲, down/ ▼) to call the stored measured values including their storage location number on the display ❶. Press the **CANCEL** key ❽ (down/ ▼) to cancel the function.
CLR	Press the **ENTER** key ❽ (up/ ▲) to delete all measured values stored in the data logger (LOG).
RATE	Press the **ENTER** key ❽ (up/ ▲) to set the sampling rate defining the time interval between two measuring points. Use the **Cursor** key ❼ to adjust the sampling from 1 s to 600 s. The deviation of the timer is less than 3 s per hour.
MAX	Press the **ENTER** key ❽ (up/ ▲) to open the maximum value of a series of measurements stored in the data logger.
MIN	Press the **ENTER** key ❽ (up/ ▲) to open the minimum value of a series of measurements stored in the data logger.

The measured values stored in the data logger can be read out and stored as MS Excel® file by means of the enclosed PC software BENNING PC-Win MM 12.

5.5 Memory function "MEM"

The **memory function "MEM"** allows the automatic and manual storage of series of measurements with up to 1,000 measured values. For further processing, the measured values can be read out later by means of the display ❶, the optical interface ⓰ or via Bluetooth®.

Use the **Cursor** key ❼ to select the "**MEM**" function and press the **ENTER** key ❽ (up/ ▲) to open the "**MEM**" menu.

Use the **Cursor** key ❼ to select the following submenus:

A-SAVE	Press the **ENTER** key ❽ (up/ ▲) to start the automatic storage of measured values "**A-SAVE**" for voltage and resistance measurement. As soon as a stable measured value is detected by the measuring probes of the safety measuring leads, an acoustic signal will be emitted and the measured value will be stored in the memory automatically. Connect the safety measuring leads to the next measuring point in order to store another measured to the memory. Press the **CANCEL** key ❽ (down/ ▼) to cancel the function. Measured values below 5 % of the final measuring range value will not be recorded. Note: Any restart will delete all measured values stored in the memory (MEM).
SAVE	Each time the **ENTER** key ❽ (up/ ▲) is pressed, a measured value will be stored in the memory. Press the **CANCEL** key ❽ (down/ ▼) to cancel the function.
LOAD	Press the **ENTER** key ❽ (up/ ▲) to open the measured values stored in the memory. Use the **Cursor** key ❼ (up/ ▲, down/ ▼) to call the stored measured values including their storage location number on the display ❶.
CLR	Press the **ENTER** key ❽ (up/ ▲) to delete all measured values stored in the memory (MEM).
MAX	Press the **ENTER** key ❽ (up/ ▲) to open the maximum value of a series of measurements stored by means of the automatic storage of measured values "**A-SAVE**".
MIN	Press the **ENTER** key ❽ (up/ ▲) to open the minimum value of a series of measurements stored by means of the automatic storage of measured values "**A-SAVE**".

5.6 Data transmission to PC and smartphone/ tablet

5.6.1 Data transmission to the PC

To transmit measured values, please install the PC software BENNING PC-Win MM 12 and the hardware driver from the CD-ROM. Then, connect the multimeter to the PC using a serial data cable with USB connector. For an operating manual of the PC software, please refer to the "Help" function in the menu bar.

The PC software BENNING PC-Win MM 12 offers the following functions:

- Graphical representation of the measured values recorded in real time by the multimeter and storage of these values as MS Excel® file. The maximum number of measured values is limited to 100,000 measured values. The sampling rate can be adjusted from 1 s to 600 s.
- Download of the measured values stored in the data logger "LOG" (up to 40,000 measured values) and in the memory "MEM" (up to 1,000 measured values) of the digital multimeter and storage of these measured values as an MS Excel® file.

5.6.2 Data transmission to the smartphone/ tablet

The BENNING MM 12 is provided with a Bluetooth® Low Energy 4.0 interface for real-time wireless transmission of measured values to an Android or IOS device.

The "BENNING MM-CM Link" app required for this is available in the Google Play Store and in the Apple App Store.

6. Ambient conditions

- The BENNING MM 12 is designed only for measuring in dry surroundings,
- Maximum barometric height during measurement: 2222 m.
- Overvoltage category / setting category: IEC 60664/ IEC 61010-1 → 600 V category IV; 1000 V category III.
- Degree of contamination: 2
- Protection class: IP 30 (DIN VDE 0470-1 IEC/ EN 60529).
  IP 30 means: Protection against access to dangerous parts and protection against solid impurities of a diameter > 2.5 mm, (3 - first index). No protection against water, (0 - second index).
- Operating temperature and relative humidity:
  At operating temperatures of 0 °C to 30 °C: relative humidity under 80 %.
  At operating temperatures of 31 °C to 40 °C: relative humidity under 75 %.
  At operating temperatures of 41 °C to 50 °C: relative humidity under 45 %.
- Storage temperature: The BENNING MM 12 can be stored at temperatures from - 20 °C to + 60 °C (humidity 0 up to 80 %). The batteries must be removed from the unit.

7. Electrical data

Note: The measurement accuracy is stated as the sum of

- a relative proportion of the measurement value and
- a number of digits (i.e. numerical steps of the last place).

This measurement accuracy applies for a temperature of 18 °C to 28 °C and a maximum relative humidity of max. 80 %.

For the indicating range of 40,000 digits (4¾ digit mode), the specified digit deviation must be multiplied by 10.

7.1 Voltage ranges

Overload protection: 1000 $V_{AC/DC}$

Function	Measuring range	Resolution	Measurement accuracy
AC	40.00 mV [1]	0.01 mV	Sine curve: ± (0.5 % of measured value + 3 digits), 40 Hz - 70 Hz [3] ± (1.5 % of measured value + 5 digits), 70 Hz - 1 kHz [3] ± (3.0 % of measured value + 5 digits), 1 kHz - 5 kHz [3] ± (5.0 % of measured value + 25 digits), 5 kHz - 100 kHz [4], [5]
	400.0 mV [1]	0.1 mV	
	4.000 V	1 mV	
	40.00 V	10 mV	
	400.0 V [1]	0.1 V	
	1000 V [2]	1 V	
DC	40.00 mV	0.01 mV	± (0.03 % of measured value + 4 digits)
	400.0 mV	0.1 mV	± (0.03 % of measured value + 2 digit)
	4.000 V	1 mV	
	40.00 V	10 mV	
	400.0 V	0.1 V	
	1000 V	1 V	
AUTOV LoZ	400.0 V	0.1 V	± (2.0 % of measured value + 5 digits), VAC 40 Hz - 1 kHz and VDC
	1000 V	1 V	

[1] Frequency range: 40 Hz - 5 kHz
[2] Frequency range: 40 Hz - 1 kHz
[3] Below 10 % of the final measuring range value plus 2 digits
[4] Below 10 % of the final measuring range value plus 10 digits, < 50 kHz
[5] Below 10 % of the final measuring range value plus 20 digits, > 50 kHz

Input resistance: 10 MΩ, < 100 pF
LoZ input resistance: 3 kΩ
Frequency range AC: 40 Hz - 100 kHz

Additional specifications:

The measured value is obtained and displayed as a true effective value (TRUE RMS). Selectable coupling type: AC or AC+DC. For the coupling AC+DC an additional error of 1 % must be taken into account. In the case of non-sinus-shaped curves the display value becomes less precise. Thus an additional error results for the following crest factors:

Crest factor from 1.4 to 2.0 additional errors + 1.0 %
Crest factor from 2.0 to 2.5 additional errors + 2.5 %
Crest factor from 2.5 to 3.0 additional errors + 4.0 %

HFR high-frequency suppression (low-pass filter):
AC accuracy plus 1 % of the measured value, 40 Hz to 400 Hz
Limiting frequency (- 3 dB): 800 Hz
Attenuation: approx. - 24 dB

Peak-Hold: ± 3 % of the measured value + 200 digits, 40 Hz to 1 kHz, sinusoidal

7.2 Current ranges

Overload protection:
- 440 mA (1000 V) fuse, 10 kA, rapid on mA input
- 11 A (1000 V) fuse, 20 kA, rapid on A input

Function	Measuring range	Resolution	Measurement accuracy
AC	40.00 mA	0.01 mA	Sine curve: ± (0.8 % of measured value + 3 digits), 40 Hz - 70 Hz [2] ± (2.0 % of measured value + 5 digits), 70 Hz - 1 kHz [2] ± (2.0 % of measured value + 5 digits), 1 kHz - 10 kHz [3]
	400.0 mA	0.1 mA	
	4.000 A [1]	1 mA	
	10.00 A [1]	10 mA	
DC	40.00 mA	0.01 mA	± (0.2 % of measured value + 2 digit)
	400.0 mA	0.1 mA	
	4.000 A	1 mA	
	10.00 A	10 mA	± (0.2 % of measured value + 3 digits)

[1] Frequency range: 40 Hz - 1 kHz
[2] Below 10 % of the final measuring range value plus 2 digits
[3] Below 10 % of the final measuring range value plus 10 digits

Input resistance: < 2 Ω on mA input, < 0,1 Ω on A input
Frequency range: 40 Hz - 10 kHz
Max. measuring time:
- 1 minute on A input (pause > 20 minutes)
- 10 minutes on mA input (pause > 20 minutes)

Additional specifications:
The measured value is obtained and displayed as a true effective value (TRUE RMS). Selectable coupling type: AC or AC+DC. For the coupling AC+DC an additional error of 1 % must be taken into account. In the case of non-sinus-shaped curves the display value becomes less precise. Thus an additional error results for the following crest factors:

Crest factor from 1.4 to 2.0 additional errors + 1.0 %
Crest factor from 2.0 to 2.5 additional errors + 2.5 %
Crest factor from 2.5 to 3.0 additional errors + 4.0 %

HFR high-frequency suppression (low-pass filter):

AC accuracy plus 1 % of the measured value, 40 Hz to 400 Hz
Limiting frequency (- 3 dB): 800 Hz
Attenuation: approx. - 24 dB

Peak-Hold: ± 3 % of the measured value + 200 digits, 40 Hz to 1 kHz, sinusoidal

7.3 Resistance measuring ranges

Overload protection: 1000 $V_{AC/DC}$

Measuring range	Resolution	Measurement accuracy
400.0 Ω	0.1 Ω	± (0.2 % of measured value + 3 digits)
4.000 kΩ	1 Ω	± (0.2 % of measured value + 2 digit)
40.00 kΩ	10 Ω	
400.0 kΩ	100 Ω	
4.000 MΩ	1 kΩ	± (1.0 % of measured value + 2 digit)
40.00 MΩ	10 kΩ	± (2.0 % of measured value + 25 digits)

Max. no-load voltage: approx. 2.5 V
Max. short-circuit current: approx. 0.1 mA

7.4 Diode testing

Overload protection: 1000 $V_{AC/DC}$

Measuring range	Resolution	Measurement accuracy
2.000 V	1 mV	± (1.5 % of measured value + 3 digits)

Max. no-load voltage: approx. 2.5 V
Max. short-circuit current: approx. 0.1 mA

7.5 Continuity testing

Overload protection: 1000 $V_{AC/DC}$

Measuring range	Resolution	Measurement accuracy
400.0 Ω	0.1 Ω	± (0.2 % of measured value + 3 digits)

Max. no-load voltage: approx. 2.5 V
Max. short-circuit current: approx. 0.1 mA
The integrated buzzer sounds at a resistance R lower than 30 Ω (preset). The resistance value can be set within a range from 10 Ω to 50 Ω.

7.6 Capacity ranges

Overload protection: 1000 $V_{AC/DC}$
Conditions: Capacitors discharged and connected in accordance with the polarity stated.

Measuring range	Resolution	Measuring time	Measurement accuracy
40.00 nF	0.01 nF	1 s	± (1.0 % of measured value + 20 digits)
400.0 nF	0.1 nF	1 s	± (1.0 % of measured value + 10 digits)
4.000 µF	1 nF	1 s	± (1.0 % of measured value + 2 digits)
40.00 µF	10 nF	1 s	
400.0 µF	100 nF	1 s	
4.000 mF	1 µF	4 s	± (1.0 % of measured value + 10 digits)
40.00 mF	10 µF	8 s	± (1.0 % of measured value + 20 digits)

7.7 Frequency ranges

Measuring range	Resolution	Measurement accuracy
400.0 Hz	0.1 Hz	± 3 digit for a 3¾-digit display ± 10 digit for a 4¾-digit display
4.000 kHz	1 Hz	
40.00 kHz	10 Hz	
100.0 kHz	100 Hz	

Minimum sensitivity of the frequency ranges

Function	Measuring range	Minimum sensitivity (peak-peak)	
		5 Hz - 10 kHz	10 kHz - 100 kHz
mV	40.00 mV	10 mV	10 mV
	400.0 mV	40 mV	100 mV
V	4.000 V	0.4 V	1 V
	40.00 V	4 V	10 V
	400.0 V	40 V	not specified
	1000 V	400 V	
mA	40.00 mA	10 mA	not specified
	400.0 mA	40 mA	
A	4.000 A	1 A	
	10.00 A	4 A	

7.8 Temperature ranges °C/ °F

Overload protection: 1000 $V_{AC/DC}$

Measuring range	Resolution	Measurement accuracy*
- 200 °C ~ + 1200 °C	0.1 °C	± (1.0 % of measured value + 30 digits)
- 328 °F ~ + 2192 °F	0.1 °F	± (1.0 % of measured value + 54 digits)

* The measuring accuracy of the K-type temperature sensor has to be added to the specified measuring accuracy.
Wire temperature sensor (type K): Measuring range: - 60 °C up to 200 °C
Measuring accuracy: ± 2 °C
The measuring accuracy applies to stable ambient temperatures < ± 1 °C. After a change of the ambient temperature of ± 2 °C, the measuring accuracy data will apply after 1 hour.

8. Measuring with the BENNING MM 12

8.1 Preparation for measuring

Store and use the BENNING MM 12 only under the correct temperature conditions stated. Always avoid longer exposure to sunlight.

- Check the rated voltage and rated current stated on the safety measuring leads. The safety measuring leads supplied with the unit are suitable for the rated voltage and current of the BENNING MM 12.
- Check the insulation of the safety measuring leads. If the insulation is damaged in any way, do not use the leads.
- Check the continuity of the safety measuring leads. If the conductor in the safety measuring lead is interrupted, do not use the leads.
- Before selecting another function with the rotating switch ❿, always disconnect the safety measuring leads from the measuring point.
- Sources of strong current in the vicinity of the BENNING MM 12 may cause unstable or incorrect readings.

8.2 Voltage and current measurement

Always observe the maximum voltage to earth potential!
Electrical hazard!

The maximum voltage which may be applied to the sockets,
- COM socket ⓬
- socket for V, Ω, ⊣⊢, Hz, 🌡 ⓫
- socket for mA range ⓭ and the
- socket for 10 A range ⓮

of the BENNING MM 12 to earth is 600 V CAT IV/ 1000 V CAT III.

8.2.1 Voltage measurement

- Use the rotating switch ❿ to select the required function (V AC, mV AC, V DC, mV DC) on the BENNING MM 12.
- In the direct voltage (DC) range, press the **Function** key ❺ (down/ ▼) of the BENNING MM 12 to select the voltage type to be measured: (DC) or (AC+DC).
- Connect the black safety measuring lead to the COM socket ⓬ on the BENNING MM 12.
- Connect the red safety measuring lead to the socket ⓫ on the BENNING MM 12.
- Connect the safety measuring leads to the measuring points. Read the measurement value displayed in the digital display ❶ of the BENNING MM 12.

See figure 2: Direct voltage measurement
See figure 3: Alternating voltage measurement

8.2.2 Current measurement

- Use the rotating switch ⑩ to select the required range and function (A AC, A DC, A AC/ DC) on the BENNING MM 12.
- Press the **Function** key ❺ (down/ ▼) of the BENNING MM 12 to select the current type to be measured: alternating current (AC), direct current (DC) or (AC+DC).
- Connect the black safety measuring lead to the COM socket ⑫ on the BENNING MM 12.
- Connect the red safety measuring lead to the socket for the mA range ⑬ for currents up to 400 mA or to the socket for 10 A range ⑭ for currents greater 400 mA to 10 A on the BENNING MM 12.
- Connect the safety measuring leads to the measuring points. Read the measurement value displayed in the digital display ❶ of the BENNING MM 12.

See figure 4: Direct current measurement
See figure 5: Alternating current measurement

8.3 Resistance measurement

- Use the rotating switch ⑩ to select the required function (Ω,))), ▶|, ⊣(–) on the BENNING MM 12.
- Connect the black safety measuring lead to the COM socket ⑫ on the BENNING MM 12.
- Connect the red safety measuring lead to the socket ⑪ on the BENNING MM 12.
- Connect the safety measuring leads to the measuring points. Read the measurement value displayed in the digital display ❶ of the BENNING MM 12.

See figure 6: Resistance measurement

8.4 Diode testing

- Use the rotating switch ⑩ to select the required function (Ω,))), ▶|, ⊣(–) on the BENNING MM 12.
- Press the **Function** key ❺ (down/ ▼) of the BENNING MM 12 to switch over (press twice) to the diode test (▶|).
- Connect the black safety measuring lead to the COM socket ⑫ on the BENNING MM 12.
- Connect the red safety measuring lead to the socket ⑪ on the BENNING MM 12.
- Contact the diode connections with the safety measuring leads. Read the measurement value displayed in the digital display ❶ of the BENNING MM 12.
- For a normal silicone diode located in flow direction, the flow voltage between 0.4 V and 0.8 V is displayed. “OL” indicates a short-circuit or an interruption inside the diode.
- For a diode applied in reverse direction, a negative forward voltage between -0.400 V and -0.900 V is indicated.

See figure 7: Diode testing

8.5 Continuity testing with buzzer

- Use the rotating switch ⑩ to select the required function (Ω,))), ▶|, ⊣(–) on the BENNING MM 12.
- Press the **Function** key ❺ (down/ ▼) of the BENNING MM 12 to switch over (press once) to the continuity test))).
- Connect the black safety measuring lead to the COM socket ⑫ on the BENNING MM 12.
- Connect the red safety measuring lead to the socket ⑪ on the BENNING MM 12.
  Connect the safety measuring leads to the measuring points. If the line resistance between the COM jack ⑫ and the jack ⑪ falls below the adjustable limiting value (10 Ω to 50 Ω), the integrated buzzer of the BENNING MM 12 sounds.

See figure 8: Continuity testing with buzzer

8.6 Capacity measurement

Discharge capacitors fully before measurement! Never apply voltage to the sockets for capacitance measurement as this may cause irreparable damage to the unit. A damaged unit may represent an electrical hazard!

- Use the rotating switch ⑩ to select the required function (Ω,))), ▶|, ⊣(–) on the BENNING MM 12.
- Press the **Function** key ❺ (down/ ▼) of the BENNING MM 12 to switch over (press three times) to the capacity measurement function (⊣(–).
- Determine the polarity of the capacitor and discharge capacitor completely.
- Connect the black safety measuring lead to the COM socket ⑫ on the BENNING MM 12.
- Connect the red safety measuring lead to the socket ⑪ on the BENNING MM 12.
- Contact the discharged capacitor with the safety measuring leads observing correct polarity. Read the measurement value on the digital display ❶ of the BENNING MM 12.

See figure 9: Capacity measurement

8.7 Frequency measurement

- Use the rotating switch ⑩ to select the required function (V AC, mV AC, A AC) on the BENNING MM 12.
- Press the **Function** key ❺ (down/ ▼) of the BENNING MM 12 to switch over to the frequency measurement function (Hz).
- Connect the black safety measuring lead to the COM socket ⑫ on the BENNING MM 12.
- Connect the red safety measuring lead to the socket ⑪ on the BENNING MM 12. Remember the minimum sensitivity for frequency measurements using the BENNING MM 12!
- Connect the safety measuring leads to the measuring points. Read the measurement value displayed in the digital display ❶ of the BENNING MM 12.

See figure 10: Frequency measurement

8.8 Temperature measurement

- Use the rotating switch ⑩ to select the required function (🌡) on the BENNING MM 12.
- Press the **Function** key ❺ (down/ ▼) of the BENNING MM 12 to switch over to °C or °F.
- Connect the temperature sensor (type K) to the COM jack ⑫ and to the jack ⑪ observing correct polarity.
- Place the contact point (end of the sensor lead) on the point to be measured. Read the measurement value on the digital display ❶ of the BENNING MM 12.

See figure 11: Temperature measurement

9. Maintenance

Before opening the BENNING MM 12, ensure that it is not connected to a source of voltage! Electrical danger!

Any work required on the BENNING MM 12 when it is under voltage **must be done only by a qualified electrician. Special steps must be taken to prevent accidents**.
Before opening the BENNING MM 12, remove it from all sources of voltage as follows

- First remove the both safety measuring leads from the measurement points.
- Remove both safety measuring leads from the BENNING MM 12.
- Turn the rotating switch ⑩ to ”OFF”.

9.1 Securing the unit

Under certain circumstances, the safety of the BENNING MM 12 can no longer be guaranteed. This may be the case if:

- there are visible signs of damage on the unit,
- errors occur in measurements,
- the unit has been stored for a long period of time under the wrong conditions, and
- if the unit has been subjected to rough handling during transport.

In these cases, the BENNING MM 12 must be switched off immediately, removed from the measuring points and secured to prevent it from being used again.

9.2 Cleaning

Clean the outside of the unit with a clean dry cloth. (Exception: any type of special cleaning cloth). Never use solvents or abrasives to clean the testing unit. Ensure that the battery compartment and the battery contacts have not been contaminated by electrolyte leakage.
If any electrolyte or white deposits are seen near to the battery or in the battery compartment, remove them with a dry cloth, too.

9.3 Battery replacement

Before opening the BENNING MM 12, ensure that it is not connected to a source of voltage! Electrical danger!

The BENNING MM 12 is powered by four 1.5 V mignon batteries (IEC LR6/ type AA). Battery replacement (see figure 12) is required as soon as all segments of the battery symbol ❹ have disappeared and the battery symbol is flashing.
Proceed as follows to replace the batteries:

- First remove the safety measuring leads from the measurement circuit.
- Remove the safety measuring leads from the BENNING MM 12.
- Turn the rotating switch ⑩ to “OFF”.
- Remove the protective rubber holster ⑮ from the BENNING MM 12.
- Put the BENNING MM 12 face down and unscrew the lower screw of the battery compartment cover.
- Lift the battery compartment cover off the bottom part.
- Remove the discharged batteries from the battery compartment.
- Insert the new batteries into the battery compartment at the provided places (please observe correct polarity of the batteries).
- Lock the battery compartment cover into place on the bottom part and tighten the screw.
- Place the BENNING MM 12 into the rubber protection frame ⑮.

See figure 12: Battery replacement

Remember the environment! Do not dispose of used batteries with domestic waste. Dispose of them at a battery-collection point or as toxic waste. Your local authority will give you the information you need.

9.4 Fuse replacement

Before opening the BENNING MM 12, ensure that it is not connected to a source of voltage! Electrical danger!

The BENNING MM 12 is protected against overload by means of an integrated fuse (G melt insert) 440 mA fast-acting and an integrated fuse (G melt insert) 11 A fast-acting (see figure 14). Proceed as follows to replace the fuses:

- First remove the safety measuring leads from the measurement circuit.
- Remove the safety measuring leads from the BENNING MM 12.
- Turn the rotating switch ❿ to “OFF”.
- Remove the protective rubber holster ⓯ from the BENNING MM 12.
- Put the BENNING MM 12 face down and unscrew the lower screw of the battery compartment cover.
- Lift the battery compartment cover off the bottom part.
- Lift one end of the defective fuse from the fuse holder.
- Push the defective fuse out of the fuse holder completely.
- Replace the defective fuse with another of the same rated power, same triggering characteristics and same dimensions.
- Push the new fuse into the centre of the holder.
- Lock the battery compartment cover into place on the bottom part and tighten the screw.
- Place the BENNING MM 12 into the rubber protection frame ⓯.

See figure 13: Fuse replacement

9.5 Calibration

Benning guarantees compliance with the technical and accuracy specifications stated in the operating manual for the first 12 months after the delivery date.
To maintain the specified accuracy of the measurement results, the instrument must be recalibrated at regular intervals by our factory service. We recommend a recalibration interval of one year. Send the multimeter to the following address:

Benning Elektrotechnik & Elektronik GmbH & CO. KG
Service Centre
Robert-Bosch-Str. 20
D - 46397 Bocholt

9.6 Spare parts

Fuse F 440 mA, 1000 V, 10 kA, D = 10 mm, L = 34.9 mm,	P.no. 10016655
Fuse F 11 A, 1000 V, 20 kA, D = 10.3 mm, L = 38.1 mm,	P.no. 10016656

10. How to use the protective rubber holster

- The safety measuring leads can be stored by coiling them round the protective rubber holster ⓯ and clipping the probe into the holster ⓯ so that they are sufficiently protected (see fig. 14).
- You can clip one lead onto the protective rubber holster ⓯ in such a way that the measuring probe projects. This allows you to bring the measuring probe and the BENNING MM 12 up to the measuring point together.
- The support at the back of the holster ⓯ can be used to prop the BENNING MM 12 up in a diagonal position (to make reading easier) or to suspend it (see fig. 15).
- The protective rubber holster ⓯ has an eyelet for suspending the unit in a convenient position.

See figure 14: Winding up the safety measuring leads
See figure 15: Standing up the BENNING MM 12

11. Technical data of the measuring accessories

- Standard: EN 61010-031,
- Maximum rated voltage to earth (⏚) and measuring category:
  With push-on caps: 1000 V CAT III, 600 V CAT IV,
  Without push-on caps: 1000 V CAT II,
- Maximum rated current: 10 A,
- Protective class II (⧈), continuous double or reinforced insulation,
- Contamination class: 2,
- Length: 1.4 m, AWG 18,
- Environmental conditions:
  Maximum barometric elevation for making measurements: 2000 m,
  Temperatures: 0 °C to + 50 °C, humidity 50 % to 80 %
- Only use the measuring leads if in perfect and clean condition as well as according to this manual, since the protection provided could otherwise be impaired.
- Throw the measuring lead out if the insulation is damaged or if there is a break in the lead/plug.
- Do not touch the bare contact tips of the measuring lead. Only grab the area appropriate for hands!
- Insert the angled terminals in the testing or measuring device.

12. Environmental notice

	At the end of the product’s useful life, please dispose of it at appropriate collection points provided in your country.