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## Operating instructions



Fig. 1: PHYWE Demo multimeter ADM 3, 13840-00

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## 1 SAFETY PRECAUTIONS



**Attention!**

The instrument complies with the safety requirements of DIN EN 61010-1. The instrument can be used safely and without risk if the following safety instructions are strictly adhered to.

- Read the operating instructions thoroughly and completely prior to starting the instrument. This is important for your own protection and for avoiding damage to the instrument.
- In the event of a change of ownership, these operating instructions must be handed over with the instrument.
- Use the instrument only for its intended purpose. Do not exceed the maximum values stated in section 7 „Technical data“.
- If the instrument is switched off by manual selection of the "OFF" mode or if it is switched off automatically due to standby or for deep-discharge protection, the measuring leads must be disconnected.
- The instrument is solely intended for use in dry rooms where there is no risk of explosion.
- Position the instrument on a table in an upright position for using or charging it.
- The handle is solely intended for transporting the switched-off instrument to its location of use. Do not swing the instrument around when transporting it.
- Do not open the instrument. Only PHYWE is authorised to change the batteries.
- Only use the approved accessories.

- Do not connect any devices to the instrument other than the ones that are intended for this purpose.
- Prior to opening the back panel, it is mandatory to switch the instrument off and to disconnect all of the measuring leads.
- Do not use the instrument unless its housing is closed and undamaged.
- When measuring voltages above 30 V, only use connecting leads with safety connectors (safety connecting leads with fixed insulating sleeves). For voltages above 300 V, only use high-voltage-resistant leads.
- Voltages above 300 V must only be fed in via the kV socket. These voltages must be non-hazardous (i.e. safe to touch). See the description of non-hazardous voltage in section 5.9 "Overload protection". Perform the measurement in battery mode with the power supply unplugged. Only use frequencies  $\leq 50$  Hz.
- Ensure that no liquids or objects penetrate the instrument through its slots.
- Protect the instrument against shocks, dust, moisture vapours, direct exposure to sunlight and extremely high temperatures.
- Clean the instrument only with a slightly moist, lint-free cloth. Do not use any aggressive cleaning agents or solvents.
- Do not use the instrument if you notice signs of damage to the instrument, power supply unit, mains power cable or measuring leads. Do not use the instrument if it does not work correctly.



#### Caution!

- Charge the device after the low battery warning or switch it off at the rotary switch.
- **Continuous standby (rotary switch in the ON position as a result of the low battery warning, without a connected power supply unit) will destroy the batteries.**

## 2 PURPOSE AND INTENDED USE

The PHYWE Demo multimeter ADM 3 is a modern, universal multi-range meter that has been specifically developed for teaching purposes. The integrated measuring amplifier enables voltage and current measurements over an extremely wide range. Additionally, measurements of resistance and temperature are possible.

The instrument is characterised by a high input resistance in terms of the voltage measuring ranges and a particularly small voltage drop in terms of the current measuring ranges. It has nine selectable scales, one of them with central zero and one for resistance measurements. In addition, all of the measurements can also be displayed as digital numbers.

The instrument is designed for measuring applications in test and measuring circuits that are connected to the mains power supply directly or indirectly. For test and measuring circuits, that are connected to the mains power supply directly, the instrument is designed for measurement category II 300 V (abbrev. CAT II 300 V). Allowed are measurements in circuits that are connected via a single-phase power plug to the low voltage system installation (incl. overcurrent protective element).



#### Attention!

**Do not perform measurements of the building wiring installation. (e.g. fuse box, electric meter, service box, low voltage overhead lines)!**

## 3 FUNCTIONAL AND OPERATING ELEMENTS

Fig. 2 shows the functional and operating elements at the front of the instrument and Fig. 3 those at the back.

### 3.1 Front

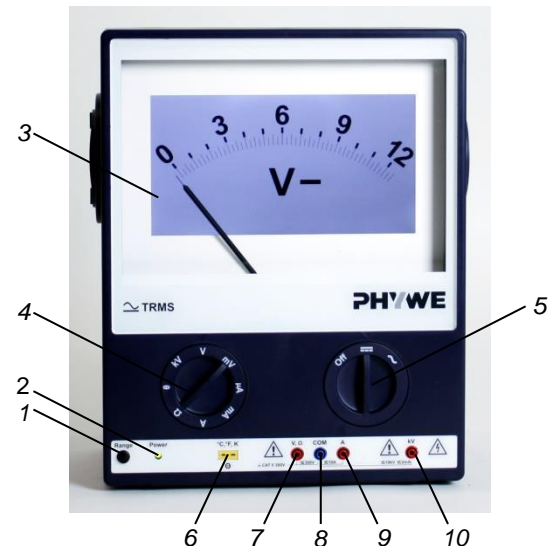
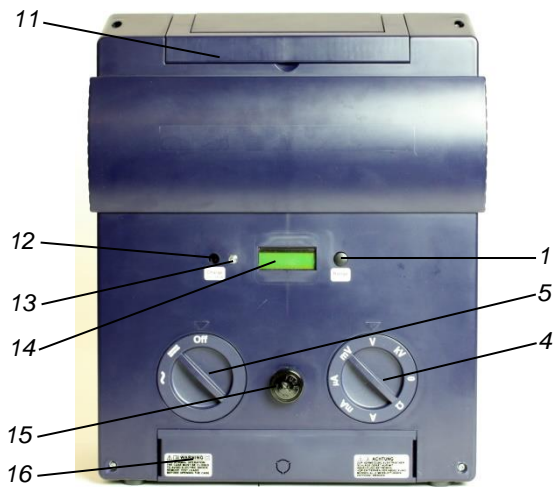


Fig. 2: Functional and operating elements, front

- 1 **"Range" scale button**  
for selecting scales, temperature unit and digital display.
- 2 **"Power" LED**  
for indicating the operating state:  
On: Ready  
Flashing: Standby  
Off: Rotary switch set to OFF or protection against deep discharge
- 3 **Display**  
for displaying the measured values in an analogue or digital form.
- 4 **Measuring range selector**  
for selecting the measuring range:  
Voltage kV / V / mV – current  $\mu$ A / mA / A – resistance  $\Omega$  – temperature  $\theta$
- 5 **Operating mode selector**  
for switching the device off (OFF) and for selecting the type of current ( $\text{---}$  (direct current DC) or  $\text{~}$  (alternating current AC)).  
In the case of AC, true root mean square (TRMS) values are measured. The input signal thereby is not limited to sinusoidal waves but measures the correct root mean square value for any given waveform. Also alternating signals with a share of direct signals are included (AC+DC measurement).
- 6 **Temperature socket**  
for connecting NiCr-Ni sensors (type K)
- 7 **4 mm safety socket V,  $\Omega$  (red)**  
for V and  $\Omega$  measurements.  
In case of DC voltage, connect the positive terminal here.
- 8 **4 mm safety socket COM (blue)**  
reference point for the measuring sockets V/ $\Omega$ , A, kV.

- 9 4 mm safety socket A (red)  
for all current measuring ranges.  
In case of DC current, connect the positive terminal here.
- 10 4 mm safety socket kV (red)  
for kV measurements. Alternating voltages only  $\leq 50$  Hz.  
In case of DC voltage, connect the positive terminal here.

### 3.2 Back



**Fig. 3:** Functional and operating elements, back

- 11 *Handle*  
can be folded out.
- 12 *Charging connector*  
for connecting the supplied charger.



**Attention!**

**Only use the charger stated in the chapter 8 "Scope of supply" for charging the integrated batteries.**

- 13 *Charge status LED*  
for indicating the charge status of the battery:  
yellow/orange: Charging  
green: Fully charged (see sec. 4.2 "Charging")
- 14 *Display*  
After a change of the unit of measurement (by way of the measuring range selector), the set scale range and the measured value together with the unit will be displayed.
- 15 *Fuse holder*  
for overload protection.



**Attention!**

**Do not use the instrument unless the fuse holder is closed!**

- 16 *Cover*



**Attention!**

**Do not use the instrument unless the cover is closed and fully intact!**

Prior to removing the cover, switch the instrument off and disconnect all of the measuring leads. (see section 6.1 "Removing the cover")



**Fig. 4:** Functional elements below the cover

- 17 *USB port*

for connecting a PC for a firmware update with the PHYWE ADM 3 Update Program. (see section 6.22 "Firmware update")

## 4 OPERATING INSTRUCTIONS

The instrument fulfils the technical requirements that are summarised in the current directives of the European Community.

The connected cables must not be longer than 2 m. Only the two sockets that are required for a particular measurement unit must be used.

### 4.1 Area of application

Near strong high-frequency transmitters, e.g. radio sets, the operating behaviour of the instrument may exceed the stated specifications.

The instrument must be used under the supervision of an expert and in an electromagnetically controlled environment at research, teaching and training facilities (schools, universities, institutes and laboratories).

This means that, in such an environment, radio transmission devices, e.g. mobile phones, should not be used in the direct vicinity of the instrument.

Electrostatic charges or similar electromagnetic phenomena (HF, bursts, indirect lightning discharge, etc.) may affect the instrument so that it will not work within the specified data range.

The following measures reduce or eliminate any potential interference:

Avoid carpets; provide equipotential bonding; perform the experiments on a conductive, earthed surface, use shields and shielded cables. Do not use radiofrequency transmitters (radio sets, mobile phones) in the direct vicinity of the instrument.

After a complete shut-down of the instrument, switch it off and then on again by way of the operating mode selector (5).

### 4.2 Charging

The instrument can be charged when it is switched on or off. During charging, the following symbol will be displayed:



To ensure trouble-free operation and a long service life of the instrument, the battery must be charged regularly. The operating time in the battery mode depends on the ambient temperature and selected measuring ranges.

During loading, interference signals are generated which superimpose the measurement signal. It is therefore recommended, especially with small measuring ranges, to measure exclusively in battery mode.

## 5 HANDLING

### 5.1 Start-up

To switch the instrument on, select the desired type of current with the aid of the operating mode selector (5). It will be ready for operation after a turn-on period of several seconds. The measuring range selector (4) and scale button (1) are used to select the measurement unit and scale and, thereby, the desired measuring range. After this step, the measuring circuit can be connected.

### 5.2 Buzzer

The buzzer is used for signalling the following operating states:

- Short beep: Overrange, >5-10 % beyond the scale range.

Display:



**Elimination of the problem:**

**The overrange state must be eliminated by changing the measuring range (scale) or by reducing the measured variable!**

- Continuous sound: overrange and deactivation of the measuring amplifier (to protect the device). The pointer returns to "0".

Display:



**Elimination of the problem:**

**The overrange state must be eliminated by reducing the measured variable!**

**After a waiting period of several minutes, the measuring amplifier can be switched on again by changing the measuring range (selector 4) or operating mode (selector 5).**

- Continuous sound of the continuity check ( $R < 50 \Omega$ )  
The active buzzer is indicated by a loudspeaker symbol on the display.

### 5.3 Continuity check

In connection with the measurement unit  $\Omega$  (can be selected by way of the measuring range selector 4), the buzzer can be activated/deactivated with the operating mode selector (5) for a continuity test.

Position „DC“: Buzzer off

Position „AC“: Buzzer on

### 5.4 Temperature measurement

The instrument can indicate the temperature measured by type K NiCr-Ni sensors. The position of the selector ("AC" or "DC") is irrelevant for the measurement.

### 5.5 Standby

To increase the service life of the battery, the instrument is equipped with an automatic shut-off system that switches the instrument off approx. 60 minutes after the last intervention by an operator. The fact that the instrument has been switched off is indicated by the inactive display and a flashing "Power" LED (2).

In order to reactivate the instrument, the scale button (1), the measuring range selector (4) or the operating mode selector (5) must be actuated.

To switch the instrument completely off, the operating mode selector must be set to "OFF".

### 5.6 Battery mode

The instrument can be operated with a connected charger or by way of the integrated battery.

When there is only approx. 1 hour of battery life left, the following symbol will be displayed:



When the battery is discharged, the appliance switches to stand-by mode. **To avoid deep discharging, which can permanently damage the battery, the device should always be switched off (OFF) using the operating switch (5).**

The device can be charged for as long as required. Once the battery is fully charged, the charge is retained.

### 5.7 Correct measurement of unsmoothed, pulsating DC voltages and currents

When measuring pulsating DC voltages and currents like the ones obtained from normal variable transformers with rectifiers, moving coil instruments are subject to a fundamental error of measurement: These instruments indicate the mean value instead of the root-mean-square (rms) value. In the case of a pulsating DC voltage obtained by way of a bridge rectifier, this mean value is almost exactly 11 % lower than the rms value.

However, the instrument still enables the exact measurement of the rms value of pulsating DC voltages and currents. Simply switch the instrument to the AC mode  $\sim$ . In the case of sinusoidal pulsating measurement signals, the instrument indicates the exact rms value. The exact rms value is also obtained in the case of distorted sinusoidal signals. (For pure DC currents, the operating mode selector (5) should always be set to  $\overline{\sim}$  since, otherwise, the measurement accuracy will be reduced.)

### 5.8 Measurement of non-sinusoidal AC voltages and currents

To measure AC voltages and currents, the voltages and currents are rectified in the ADM 3 in the  $\sim$  mode by way of a true RMS-to-DC converter. The advantage of this method is that, even in the case of signals that deviate substantially from the sinusoidal form, exact rms values will be displayed. For signals with a crest factor (this is the ratio of peak value to RMS value) of 4, hardly any influence of the waveform on the measurement result can be observed.

### 5.9 Overload protection

The instrument is equipped with numerous protective devices to protect it against damage caused nearly all conceivable types of faults.

#### Voltage overload

The "V" socket (7) is protected against mains voltage in all of the measuring ranges and protected by a surge protector against higher voltages (short-time up to 1kV). For non-hazardous voltages that are safe to touch, the protective function is effective up to 10 kV.

The "kV" socket (10) is protected up to 25 kV permanently in case of non-hazardous voltages.



A voltage is considered to be non-hazardous (i.e. safe to touch) if it complies with the following conditions (according to standard DIN EN 61010-1):

- the values are smaller than 33 V<sub>rms</sub> in the case of AC voltage or
- smaller than 70 V in the case of DC voltage or
- the current (terminated with 2 kΩ) is smaller than 2 mA in the case of direct current or
- the capacitive charge is smaller than 45 µC (valid up to U < 15 kV) or
- the stored energy value is smaller than 350 mJ (valid for U > 15 kV).

The PHYWE high voltage power supply units 13671-93 and 13673-93, for example, comply with these limits.

### Current overload

The socket „A“ (9) is protected against current overload by two protective measures: An overload cut-off (thermal cut-off) and a fuse for high currents. Due to overrange, the measuring circuit „A“ will be cut-off not later than 3 s, the measuring circuits „µA“ and „mA“ not later than 15 s. Depending on the overload of the current measuring ranges, a thermo switch may temporarily disrupt the circuit.

After a cooling period of several minutes, the current measurement function can be reactivated by selecting a new measuring range (4) or a new operating mode (5). See also section 5.2 “Buzzer”.

During an overload cut-off, a message concerning the operating instructions will be displayed:



Additionally to the overload cut-off, the instrument is protected by a fuse. A defective fuse can be recognised by the fact that no values are displayed for any of the current measuring ranges. In this case, the fuse must be replaced (see also section 10 “Replacing the overload safety device”).

### 5.10 Voltage measurement: behaviour with an open input

If the ADM 3 is used as a voltmeter, it is characterised by an extremely high input resistance. Even in the most sensitive voltage measuring range (1 mV), this resistance is as high as 10 MΩ. Since accurate voltage measurements are only possible if the source resistance is at least 10 times lower than the input resistance, the instrument opens up a multitude of new possibilities, especially when measuring low voltages with a high source resistance. For the same reason, it cannot be completely excluded that the open input becomes charged. This is why it is not unusual for the measured value not to be exactly at zero, especially in the case of the more sensitive measuring ranges, or even to fluctuate to a certain extent. To verify the zero setting, simply short-circuit the input of the device.

## 6 DISPLAY-CONNECT AND FIRMWARE UPDATE

The connector for installing a Cobra4 Display-Connect RX receiver (art. no. 12623-01) is located under the cover (16). In combination with a Cobra4 Display-Connect TX transmitter (12623-00), all of the values that are measured with a Cobra4 Mobile-Link 2 (12620-10) and any type of Cobra4 sensor can be displayed directly on the screen of the ADM 3. In this configuration, the ADM 3 is used as a large-scale display so that all of the students in the classroom can observe the measurement values provided by the external sensor.

In addition, there is also a USB port for service purposes located under the cover. This port can be used to load device updates provided by PHYWE.

### 6.1 Removing the cover



**Attention!**

**Ensure that the instrument is switched off and that no measuring leads are connected.**

Position the instrument on a level surface with its front panel facing down. There are slots on both sides between the cover and the back panel of the device. (see Fig. 5)



**Fig. 5:** Slots for removing the cover

Slide a coin into one of the slots and unlock the cover by tilting the coin outwards. Repeat this on the other side and the cover will pop out.

To do so, pry out the material still covering the cut-out with the aid of a small screwdriver. Then, press the cover against the back panel of the instrument until a clicking sound on both sides indicates that it is locked in place.



**Attention!**

**Do not use the instrument unless the cover is closed.**



**Fig. 6:** Instrument with closed cover

### 6.2 Firmware update

After the cover has been removed (see section 6.1 “Removing the cover”), the USB port (17) for the connection of a PC is accessible.

The firmware and the scales can be updated with the aid of the PHYWE ADM 3 Update Program.

Available updates can be found at:

[www.phywe.de](http://www.phywe.de) >> Downloads >> Softwaredownload

Please check whether the update is more recent than the firmware version of your instrument. Otherwise, an update is not necessary. The version number of your instrument will be displayed briefly when the instrument is switched on. To perform an update, open the program and follow the instructions on the screen of the PC.

After the firmware update, remove the USB cable and press the cover against the back panel of the instrument until a clicking sound on both sides indicates that it is locked in place.



**Attention!**

**Do not use the instrument unless the cover is closed.**

## 7 TECHNICAL DATA

### 7.1 Measuring ranges

Typical at 25°C, warm-up period of 15 min, in battery mode

Selector / unit	Measuring range	Input resistance (approx.)	Accuracy		
			--- (DC)	~ (AC)*	
kV	1	1 GΩ	±1,5 % EV**	±2 % EV	Limited to ≤50 Hz
	3			±3 % EV	
	10			±2 % EV	
V	1; 3; 10; 12; 30; 100; 300	10 MΩ	±1,5 % EV	±2 % EV	and for: 1 ... 10kHz    2% MV*** 10 ... 100kHz 30% MV
mV	1; 3; 10; 30; 100; 300	10 MΩ	±1,5 % EV	±2 % EV	
μA****	1	330 Ω	±3 % EV	±10 % EV	
	3		±10 % EV	±2 % EV	
	10; 30; 100; 300		±1,5 % EV		
mA****	1	350 mΩ	±1,5 % EV	±3 % EV	
	3; 10; 30; 100; 300			±2 % EV	
A	1; 3; 10	45 mΩ	±1,5 % EV	±2 % EV	

\* From 15% of the measuring range end value. To reduce the error, change to smaller measuring range, reference condition 50 Hz

\*\* EV – from measuring range end value

\*\*\* MV – from measuring value

\*\*\*\* Depending on the accuracy of the measuring range and the ambient temperature, the device may require a warm-up time of more than 15 min.

Selector / unit	Measuring range	Accuracy
Ω	100 Ω	±1 % EV
	1 000 Ω	
	10 kΩ	
	100 kΩ	
	1000 kΩ	
	10 MΩ	±10 % EV
Θ (°C / °F / K)	-200... 0 °C	±2 °C *
	0... +200 °C	±1 °C *
	+200... +1 200 °C	±5 °C *

\* Plus measurement error of temperature sensor

### 7.2 General

Display	TFT display
Digits height	Analogous: 15 mm Digital: 27 mm
Processor	ARM Cortex M4
Transducer	24-bit Delta-Sigma
Measuring rate	1000 measurements / s
Control unit at the back	5-digit LCD with floating decimal point and sign Digits height: 7 mm
Position of use	upright
Measuring category	CAT II, 300 V max.
Electrical safety	DIN EN 61010-1
Rectifier principle (⌚)	Root-mean-square value (true RMS-to-DC converter)
Frequency bandwidth (⌚)	2 Hz... 100 kHz (except range kV (AC) limited to ≤50Hz)
Signal shape	any
Waveshape error	
at a crest factor ≤4	≤0,5 % of the indicated value
Setting time ~	<4 s

#### Maximum load capacity of the measuring ranges

Voltage	300 V in socket „V, Ω“ and 10 kV ≤2 mA in socket „kV“
Current	10 A in socket „A“
Power supply	2x lead gel battery 6 V, 3,4 Ah
Battery life	approx. 10 hours
Supply voltage	12 V DC, 2,5 A max.
Power-on time	10 s
Dimensions (mm)	380 x 334 x 188
Weight	5,82 kg

Power supply  
Supply voltage

Input 100...240 V AC, 50...60 Hz  
Output 12 V DC, 2.5 A  
see the operating instructions  
to article 11262-99

Other data



**Attention!**

**Do not use the instrument unless the fuse holder is closed!**

Should this fuse blow when the instrument is switched on, never replace it with a more resistant fuse! A defect is indicated and the instrument must be returned to the PHYWE service department for repair.

### 7.3 Ambient conditions

Area of use Indoor  
Operating temperature 5 °C...40 °C  
Humidity max. 80 % rel. hum. up to 31 °C,  
linearly decreasing 50 % rel.  
hum. at 40 °C  
Operating altitude 2000 m msl max.

## 8 SCOPE OF SUPPLY

The ADM 3 is supplied with the following components:

- PHYWE Demo multimeter ADM 3
- Power supply 12 VDC/2.5 A 11262-99

**Only use original PHYWE spare parts.** For replacement, turn to PHYWE or an authorized dealer:

- Cover ADM 3 SP-1384000
- Overload fuse (1 piece)  
FF 10 A, 500 V SP-1384001

## 9 ACCESSORIES

The following accessories are available:

### Measuring leads

- Connecting cord, 30 kV, 1000 mm 07367-00
- Safety connecting cables, e.g. 07337-88

### Temperature probes NiCr-Ni, type K

- Thermocouple -50...1100 °C 13615-01
- Thermocouple -50...500 °C 13615-02
- Immersion probe, steel -50...400 °C 13615-03
- Surface probe -50...300 °C 13615-04
- Immersion probe, Teflon 0...300 °C 13615-05

### For measurement and display of Cobra4 sensor values

- Cobra4 Mobile-Link 2 12620-10
- Cobra4 Display-Connect TV, transmitter 12623-00
- Cobra4 Display-Connect RX, receiver 12623-01

## 10 REPLACING THE OVERLOAD SAFETY DEVICE



**Attention!**

**Ensure that the instrument is switched off and that no measuring leads are connected.**

Prior to replacing the fuse, ensure that the cause for the blown fuse is eliminated. Never bypass or repair fuses. Open the cover of the fuse holder (15) by turning it anti-clockwise with a screwdriver.

Then, the overload safety device can be replaced and the cover can be closed.

Fuse type: Type G, 10.3 mm x 38 mm  
FF 10 A, 500 V, breaking capacity: >10 kA  
Application category: gR

## 11 WARRANTY

We give a warranty of 24 months for units that we have supplied inside the EU, and a warranty of 12 months outside the EU. The following is excluded from the warranty: damage that is due to non-compliance with the operating instructions, improper use or natural wear.

The manufacturer can only be held liable for the function and safety-relevant properties of the unit if the maintenance, service and modifications of the unit are performed by the manufacturer or by an institution that is expressly authorised by the manufacturer.

## 12 DISPOSAL

The packaging mainly consists of environmentally-friendly materials that should be returned to the local recycling stations.



Do not dispose of this product with normal household waste. If this unit needs to be disposed of, please return it to the address that is stated below for proper disposal.

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Customer Service  
Robert-Bosch-Breite 10  
37079 Göttingen  
Germany

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## 13 CLEANING

Only use a soft, dry cloth for cleaning the instrument. The ingress of moisture into the openings of the instrument must be absolutely prevented.

## 14 EXPLANATION OF THE SYMBOLS



### **Attention!**

Potentially harmful situation  
(property damage)  
General hazard area  
Compliance with the operating instructions is required



Important information about the device  
Compliance with the operating instructions is required



Direct current and alternating current



Continuous double insulation

**TRMS**

True root mean square

**CAT II**

Measuring category II  
(see chapter 2)