

DEN-600 Photometer



If you have any feedback on our products or services, we would like to hear from you.
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1. About this edition of user instructions

1.1 The current edition of the user instructions applies to the following models:

Model	Version
DEN-600, photometer	V.2AW

1.2 Edition 2.01 – June of 2022.

2. Safety precautions

2.1 Symbols used in these instructions.



Caution! Make sure you have fully read and understood the present user instructions before using the equipment. Please pay special attention to sections marked by this symbol.

2.2 Symbols and icons used on the unit and packaging.

	CE marking, manufacturer affirms conformity with European health, safety, and environmental protection standards, see 11.1
	WEEE directive marking, see 11.1
	Polarity of the power connector
	Equipment uses direct current

2.3 General safety.

- The protection provided can be ineffective if the operation of the appliance does not comply with the manufacturer's requirements.
- Save the unit from shocks and falling.
- Store and transport the unit as described in section **Storage and transportation**.
- Use only original parts and accessories, provided by manufacturer for this product.
- Before using any cleaning or decontamination methods except those recommended by the manufacturer, check with the manufacturer that the proposed method will not damage the equipment.
- Do not make modifications in design of the unit.

2.4 Electrical safety

- Connect only to the mains with voltage corresponding to that on the serial number label.
- Use only the external power supply provided with this product.
- Ensure that the power plug is easily accessible during use.
- Disconnect the unit from the mains before moving.
- If liquid penetrates into the unit, disconnect it from the mains and have it checked by a repair and maintenance technician.
- Do not operate the unit in premises where condensation can form. Operating conditions of the unit are defined in the **Specifications** section.



Caution! Do not fully discharge the battery. Connect the unit to the mains when on low battery, see **4.3**.

2.5 During operation

- Do not operate the unit in environments with aggressive or explosive chemical mixtures. Please contact manufacturer for possible operation of the unit in specific atmospheres.
- Do not operate the unit if it is faulty or has been installed incorrectly.
- Do not use outside laboratory rooms.

2.6 Biological safety

- The user is responsible to carry out appropriate decontamination if hazardous material spills on or penetrates into the equipment.

3. General information

DEN-600 is a compact, portable, rechargeable battery powered photometer. It comprises of 600 nm wavelength optical system, which enables to apply - 1) OD600 method that estimated total number of cells, 2) McFarland (McF) turbidity measurement method, 3) Bradford protein assay method for protein concentration measurement, 4) other methods that can be adjusted or optimized using 600 nm wavelength.

The device serves as an inexpensive alternative to a spectrophotometer, which is commonly used for these applications. Because DEN-600 is battery powered and compact, it can be comfortably located in a biosafety cabinet, anaerobic chamber or quickly moved to another lab room. Additionally, the vessel holding mechanism allows accommodating round bottom, conical vials or falcon tubes, therefore enabling to measure the absorbance (Abs) and turbidity in Abs, OD and McFarland units.

USB connectivity and DEN software allow for data transfer, data processing and calculation, software calibration for Bradford protein assay method or a custom calibration for a specifically applicable vessel.

Common applications:

- Cell concentration measurement
- Cell growth data estimation
- Log phase estimation for microbial cells induction
- Competent cell preparation
- Bradford protein assay method
- Antibiotic susceptibility testing
- Inhibitory tests

4. Getting started

4.1 **Unpacking.** Remove packing materials carefully and retain them for future shipment or storage of the unit. Examine the unit carefully for any damage incurred during transit. The warranty does not cover in-transit damage. Warranty covers only the units transported in the original package.

4.2 **Complete set.** Package contents:

4.2.1 Standard set:

- **DEN-600** photometer 1 pce.
- External power supply 1 pce.
- USB cable for connection to PC 1 pce.
- PC software and instructions, on USB disk drive 1 pce.
- User instructions, declaration of conformity 1 copy

4.2.2 Optional accessories

- Abs verification set on request
- **CKG16** McF calibration kit for Ø 16 mm glass tubes on request
- McF calibration kit for Ø 12 mm glass tubes..... on request
- Glass sample tubes, set of 78 pcs on request

4.3 **Setup.**

- Make sure that no direct overhead light enters the socket.
- Connect the external power supply unit into the socket at the rear side of the unit and position the unit for an easy access to the external power supply and the power switch.
- Remove the protective film from the display.



Note. Connecting external power supply is optional when running from the built-in battery.



Caution! Do not fully discharge the battery. Connect the unit to the mains when on low battery.

4.4 **Factory calibration.** The device is pre-calibrated for McF parameter at the factory for operation with the glass tubes 16 mm in external diameter at temperature range from +15°C to +25°C and saves calibration data when being switched off. For Abs parameter, no additional calibration is required (only verification depending on laboratory internal guidelines).



Caution! Recalibrate the unit before using the tubes that are different from factory calibrated (e.g., with different outer diameter, bottom shape or different material, e.g., plastic, glass thickness). See **5.6**.

5. Operation

Recommendations during operation

- Remove the tube with the solution from the socket before switching the unit on or off.
- Keep the unit switched on for 15 minutes before starting the operation in order to stabilize it in the working mode.
- If required, agitate the reaction vessel by pipette or vortexing the reaction vessel by, e.g. **Biosan pipettes** or **Biosan V-1 plus** respectively.

5.1 Connect the external power supply to electric circuit. Switch on the unit using the green **Power** key (fig. 1/4) on the control panel.



Note. Connecting external power supply is optional when running from the built-in battery or when connected to PC.



Caution! Do not fully discharge the battery. Connect the unit to the mains when on low battery.

5.2 The following indication may be shown on the display (fig. 1/1):

- Battery indicator, top left corner. Animated when charging.
- USB data transfer, bottom right corner. Appears only when connected to PC and during data transfer.
- Two measurement modes for operation are available – McFarland (McF) and Abs (Absorbance) see Figure 2 and **5.3**.
- Request for baseline calibration, see **5.4**.
- Current operation mode, see **5.5**.

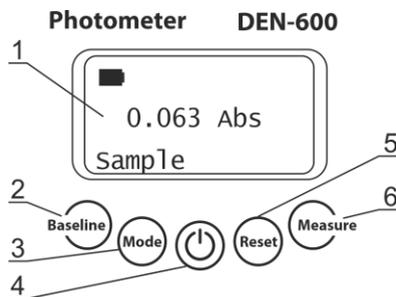


Figure 1. Control panel

5.3 **Measurement mode selection (Figure 2).** Select measurement units by pressing **Reset** key for McF (fig. 1/5) and **Mode** key for Abs (fig. 1/3).

5.4 **Baseline calibration.** Unit requires initial baseline (only in Abs mode), e.g., depending on the reaction vessel or suspension colour. Insert the reaction vessel with or without suspension into the unit and press the **Baseline** key (fig. 1/2).

- 5.5 **Choosing mode of operation.** Press the **Mode** key (fig. 1/3) to circle through available operation modes, **Sample**, **Save** and **Read**.
- 5.5.1 **Sample** mode - measurement without saving the results. Place the sample in the unit and press the **Measure** key (fig. 1/6). Display shows the measurement result.
- 5.5.2 **Save** mode – measurement and saving of measurement results. An indication **S#** appears in the top right corner, where # is a number from 0 to 999. Place the sample in the unit and press the **Measure** key. Display shows the measurement result and saves it to internal memory that can be uploaded to dedicated PC software (see the software manual).
- 5.5.3 **Read** mode – view the saved measurements. An indication **R0** appears in the top right corner, and the corresponding value – in the middle of the display. Press the **Measure** key to see the next saved measurement value. Press the **Reset** key to move back to the previously saved value (**R0**).

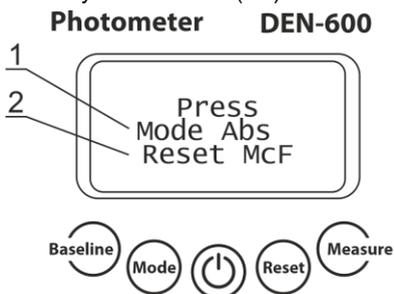


Figure 2. Measurement mode selection.

5.6 **Creating McF user calibration (figure 3).**

- 5.6.1 The device is pre-calibrated at the factory for operation with the glass tubes 16 mm (or other if separately requested) in external diameter at temperature range from +15°C to +25°C and saves calibration data when being switched off. To use different types of tubes, recalibrate the unit as shown below.



Note. Before using the standards, prepare them by following the instructions from the manufacturer.

- 5.6.2 During calibration, unit requests measurements of standards with known turbidity value. The performed measurement is then assigned to corresponding calibration point in unit's memory. After a successful procedure, unit measures with the user-made calibration.
- 5.6.3 Calibration points must be measured from low to high values. Available calibration points are 0.00 McF, 0,50 McF and 1.00–16.00 McF with 1.00 McF step.



Note. Calibrate the unit using as many points as possible to obtain precise results. Minimum requirement are 2 points closest to the working range limits (e.g. 0.00 and 6.00 for operation in 0.00–6.00 McF range).

- 5.6.4 If the standard for 0.00 value is not available, fill the sample tube with distilled water and use that as the 0.00 value standard.

- 5.6.5 Press **Baseline** key 5 times in McF mode to enter user calibration regime (figure 3).
- 5.6.6 Display shows the value of necessary standard (fig. 3/1).
- Insert the standard tube into the socket and press Meas (fig. 3/3, **Measure** key). Unit measures turbidity, display sequentially shows indications “Wait...” and the McF value in the lower line. After the measurement, next calibration point appears on display. Remove the standard tube and repeat.
 - If the displayed standard is not available, press Next (fig. 3/2, **Baseline** key) to skip to the next standard.
- 5.6.7 After measuring or skipping the last calibration point (16.00 McF), unit prompts the user to save or discard the new user calibration.
- Press No (**Baseline** key) to discard new user calibration.
 - Press Yes (**Measure** key) to save new user calibration.
 - If the calibration was successful, display shows “OK!” before returning to default screen (figure 1).
 - If the calibration was not successful, display shows “Data Error” before restarting the calibration procedure (figure 3).
- 5.6.8 Press the **Reset** key at any time to exit the calibration mode without saving.

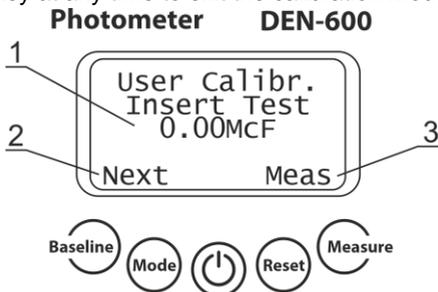


Figure 3. Creating user calibration.

- 5.7 **Saved user calibration data observation (figure 4).** Press **Mode** key in user calibration regime, then press Next (**Baseline** key) to observe calibrated points and Abs result equivalent to McF in user calibration.

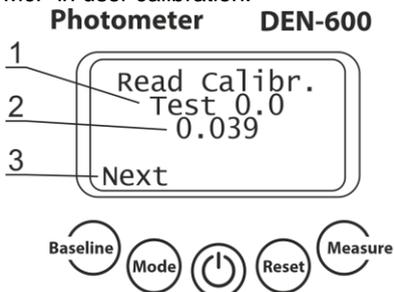


Figure 4. Saved user calibration data.

- 5.7.1 **Restoring to McF factory calibration settings (figure 5).** Enter user calibration regime by pressing **Baseline** key 5 times in **McF** measurement mode, press **Mode** key 2 times, then select between User and Factory calibration settings, by pressing Sel (**Baseline** key, fig. 5/2), to exit the menu press **Reset** key.
- 5.8 **Resetting the memory.** In the **Save** mode, press the **Reset** key twice to delete all saved values from the memory.
- 5.9 To control the unit from a PC, please see the software manual.

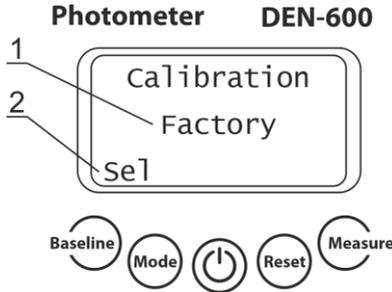


Figure 5. User and factory calibration selection.

- 5.10 **Abs correction coefficient (Figure 6).**
- 5.10.1 OD600 value can vary when results of different photometers are compared since every instrument can have a different optical set up that affects turbidity measurement results. Abs correction coefficient is used to proportionally adjust Abs measurement data. When Abs correction is active, the calculations are as follows:

$$Abs_{LCD} = Abs_{meas} \cdot k_{corr.coef.}$$
- 5.10.2 Enter Abs correction regime by pressing and holding **Mode** and **Reset** keys for 5 seconds simultaneously. Press **Baseline** key to select the digit position, use **Mode** key to increment the number. Press **Measure** key twice to save the correction coefficient. To reset the coefficient, return the value to 1.000.
- 5.11 After finishing the operation, switch off the unit using the green **Power** key. If the external power supply is used, disconnect it from electric circuit.



Caution! Do not fully discharge the battery. Connect the unit to the mains when on low battery.

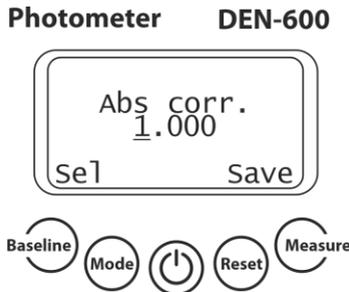


Figure 6. Abs correction coefficient setting window.

6. Specifications

6.1 Manufacturer is committed to a continuous programme of improvement and reserves the right to alter design and specifications of the equipment without additional notice.

6.2 Measurement specifications

Light source	LED	
Wavelength (λ), nm	600 \pm 10	
Photodetector	Silicon photodiode	
Vessel types	Cuvettes, round bottom tubes, falcon tubes	
Measurement mode	Absorbance, Abs	McFarland, McF
Measurement range	0 – 3.000	0.00 – 16.00
Resolution	0.001	0.01
Accuracy	\pm 0.006 @ 1 Abs	\pm 0.1 @ 0-8 McF
Repeatability	\pm 0.003 @ 1 Abs	\pm 0.05 @ 0-8 McF

6.3 General specifications

Battery type	lithium-ion polymer battery (LiPo)	
Display	LCD	
PC system requirements	Intel/AMD Processor, 1 GB RAM, Windows Vista/7/8, USB	
Weight, accurate within \pm 10%	0.5 kg	
Dimensions (WxDxH)	120 x 145 x 65 mm	
Operating voltage	12 V=	
Power consumption	2.5 W	
External power supply	input 100–240 V~, 50/60 Hz, output 12 V=	

6.4 Workroom specifications

Workroom description	Cold rooms and closed laboratory rooms, incubators (except CO ₂ incubators)
Temperature range	+4 °C ... +40 °C
Humidity requirements	Maximum of 80% RH at 31 °C, decreasing linearly to 50% RH at 40 °C. Non-condensing atmosphere.
Operating height, maximum	2000 m ASL

6.4.1 **Optimum performance workroom specifications.** For optimum performance, photometer DEN-600 should be sited in a clean, dry, dust free atmosphere. When in use, ambient temperature, relative humidity and light levels should remain as constant as possible. In order to perform a measurement under the most stable condition and to conform to measurement specification, the instrument must be used in an air-conditioned room at 20–25°C and non-condensing atmosphere of 30–70% humidity.

7. Ordering information

7.1 Models and versions available:

Model	Version	Plug	Catalogue number
Photometer DEN-600	V.1AW	Europlug (Type C/E/F/K)	BS-050109-AAA
		Multiplug (Type A/C/E/F/G/I/K)	BS-050109-AAK

7.2 To inquire about or order the optional accessories, contact Biosan or your local Biosan representative.

7.2.1 Optional accessories:

Description	Catalogue number
Verification set for Abs. Certified reference material, neutral density glass filter set of 4 Abs reference points - 0.3532, 1,0512, 2,0425, 2,927 (the values may vary slightly from batch to batch)	BS-050109-AK
CKG16 , calibration kit for glass tubes 16 mm in diameter. Latex particles. Set of 0.5, 1.0, 2.0, 3.0, 4.0 McF turbidity standards	BS-050102-BK
Calibration kit for glass tubes 12 mm in diameter. Polymer particles. Set of 0.0, 0.5, 2.0, 3.0 McF turbidity standards	On request
Glass sample tubes, set of 78 pcs. Outer diameter 16 mm, height 100 mm, wall thickness 0.8 mm	BS-050102-LK

8. Care and maintenance

8.1 Service.

8.1.1 If the unit is disabled (e.g., LED not working, no reaction on key and switch presses, etc.) or requires maintenance, follow the guide in table below. If the problem persists or is not listed, disconnect the unit from the mains and contact Biosan or your local Biosan representative.

8.1.2 Troubleshooting errors.

Problem	Cause	Solution
Device not working	No mains/power connection or failure	Check the mains/power connection
	External power supply cables are not fully connected	Check the external power supply's cables
	Low battery	Check battery charge
Measurement result is not as expected	Influence of direct ambient light on the measurement chamber	Eliminate influence of direct ambient light, remeasure baseline
	Sedimentation	Mix sample thoroughly before measurement
	The cuvette is not positioned correctly	Cuvette's optical window must be on the optical axis of the unit

Problem	Cause	Solution
McF measurement results of the same sample significantly vary	Non-repetitive positioning of the tube	Tube positioning in the chamber must be as close as possible to the previous (add a mark on the tube for better alignment)
	Scratches on the tube	Switch to unscratched samples
	Sedimentation	Mix the sample thoroughly before measurement
	Reagent is past its shelf life	Ensure that the reagent is still within its shelf life
OD600 results of cell suspensions do not compare to another instrument	Scattered light measurement variability due to difference in optical configuration of instruments in comparison	Calculate a conversion factor or create a standard curve to correlate to other device's OD600 relationship to specific culture
Unit does not connect to PC using provided USB cable	No USB drivers installed	Install USB drivers provided on the flash drive
	Old USB port	USB 2.0 or higher is required

- 8.1.3 All maintenance and repair operations (except listed here) must be performed only by qualified and specially trained personnel.
- 8.1.4 Operating integrity check. If the unit follow the procedure described in section **Operation**, then no additional checks are required.
- 8.2 **Cleaning and disinfection.**
- 8.2.1 Use mild soap and water with a soft cloth or sponge for cleaning the unit. Rinse remaining washing solution with distilled water. Wipe dry the excess water with clean, soft cloth or sponge.
- 8.2.2 To disinfect the unit, use a DNA/RNA removing solution (e.g., Biosan PDS-250). After disinfecting, wipe the surfaces dry.
- 8.2.3 Do not use liquids to clean optical parts. Use air from a rubber siphon to blow away any particles.
- 8.2.4 The unit and its accessories are not autoclavable.

9. Storage and transportation

- 9.1 Store and transport the unit in a horizontal position (see package label) at ambient temperatures between -20°C and +60°C and maximum relative humidity of 80%.
- 9.2 After transportation or storage and before connecting it to the electric circuit, keep the unit under room temperature for 2-3 hrs.
- 9.3 For extended storage, connect the unit to the mains at least every 3 months to keep the battery in good condition.

10. Warranty. Production date

- 10.1 The Manufacturer guarantees the compliance of the unit with the requirements of Specifications, provided the Customer follows the operation, storage and transportation instructions.
- 10.2 The warranted service life of the unit from the date of its delivery to the Customer is 24 months. For extended warranty, see **10.5**.
- 10.3 Warranty covers only the units transported in the original package.
- 10.4 If any manufacturing defects are discovered by the Customer, an unsatisfactory equipment report shall be compiled, certified and sent to the local distributor address. To obtain the claim form, visit **Technical support** page on our website at link below.
- 10.5 Extended warranty. For **DEN-600**, the *Smart* class model, extended warranty is a paid service. Contact your local Biosan representative or our service department through the **Technical support** section on our website at the link below.
- 10.6 Description of the classes of our products is available in the **Product class description** section on our website at the link below.

Technical support



biosan.lv/en/support

Product class description



biosan.lv/classes-en

- 10.7 The following information will be required in the event that warranty or post-warranty service comes necessary. Complete the table below and retain for your records.

Model	Serial number	Date of sale
DEN-600 , photometer		

- 10.8 **Production date.** Production date is placed in the serial number, on the label of the unit. Serial number consists of 14 digits styled XXXXXXYYMMZZZZ, where XXXXXX is model code, YY and MM – year and month of production, ZZZZ – unit number.

11. EU Declaration of conformity

11.1 Photometer **DEN-600** is in conformity with the following relevant Union legislations:

LVD 2014/35/EU	LVS EN 61010-1:2011 Safety requirements for electrical equipment for measurement, control, and laboratory use. General requirements.
EMC 2014/30/EU	LVS EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements.
RoHS3 2015/863/EU	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
WEEE 2012/19/EU	Directive on waste electrical and electronic equipment.

11.2 Declaration of Conformity is available for download on the page for the relevant model on our website by links below, in the **Downloads** section:



DEN-600

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