Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922) 49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Ижевск (3412)26-03-58
Иваново (4932)77-34-06
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Курган (3522)50-90-47
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Саранск (8342)22-96-24
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сыктывкар (8212)25-95-17
Сургут (3462)77-98-35
Тамбов (4752)50-40-97
Тверь (4822)63-31-35
Тольяти (8482)63-91-07
Томск (3822)98-41-53
Тула (4872)33-79-87
Тюмень (3452)66-21-18
Улан-Удэ (3012)59-97-51
Ульяновск (8422)24-23-59
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Чебоксары (8352)28-53-07
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Чита (3022)38-34-83
Якутск (4112)23-90-97
Ярославль (4852)69-52-93

Киргизия (996)312-96-26-47
Россия (495)268-04-70
Казахстан (772)734-952-31

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Портативный фотометр DEN-600

Photometer

DEN-600

Operating Manual

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1. About this edition of user manual

The current edition of the user manual applies to the following models:

Model	**Version**
DEN-600, photometer	V.1GW

2. Safety precautions

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

2.1. 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 at ambient temperatures between -20°C and +60°C and maximum relative humidity of 80%.
- After transportation or storage and before connecting it to the electric circuit, keep the unit under room temperature for 2-3 hrs.
- 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.

2.2. 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.

2.3. 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.

2.4. 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.

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 manual .....1 copy

4.2.2. Optional accessories

- Abs Calibration 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.

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

- Remove the protective film from the display.

4.4. **Factory calibration.** The device is pre-calibrated 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.

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

5.1. **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. **Grant pipettes** or **Grant PV-1** respectively.

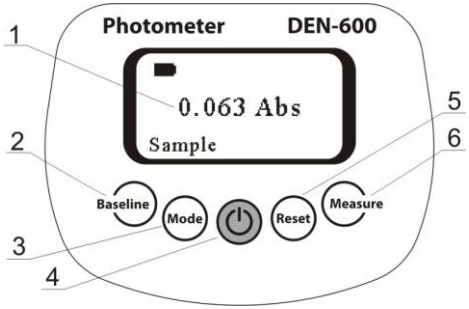

Figure 1. Control panel

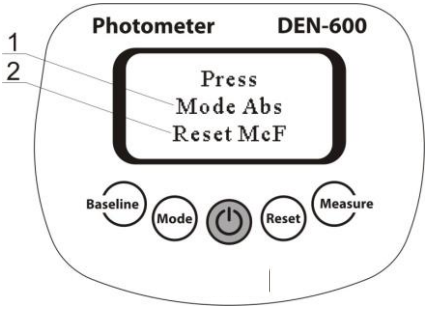

Figure 2. Measurement mode selection

5.2. 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.

5.3. 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 **5.3**.
- Current operation mode, see **5.4**.

5.4. **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).

5.5. **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).

5.6. **Choosing mode of operation**. Press the **Mode** key (fig. 1/3) to circle through available operation modes, **Sample**, **Save** and **Read**.

5.6.1. **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.

5.6.2. **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).

5.6.3. **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**).

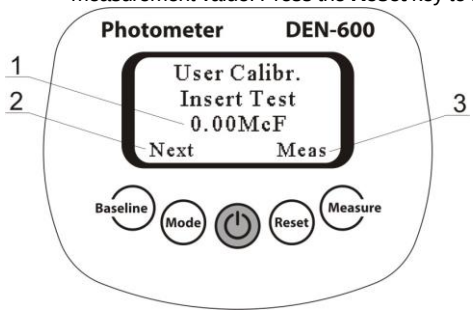

Figure 3. Creating user calibration

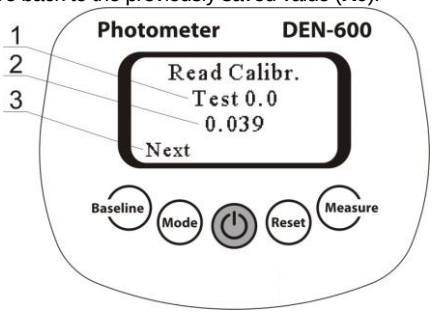

Figure 4. Saved user calibration data

5.7. **Creating McF user calibration** (Figure 3).

5.7.1. 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.

5.7.2. The standard suspensions must be sufficiently resuspended before measurement. To do this, proceed as follows:

- Mix adequately at the highest RPM setting of your vortex mixer device, i.e. **Grant V-1 plus**.
- Invert the tubes carefully before comparison. Avoid bubble formation during operation.
- Additionally, McF standards preparation/mixing before measurement can vary from different manufacturers, we advise to follow those requirements thoroughly to achieve the best results.

5.7.3. Perform calibration from lower to higher calibration value. Use at least 2 points for calibration. Different calibration points are available – 0.00, 0.50, 1.00, 2.00, 3.00, 4.00, 5.00, 6.00, 7.00, 8.00, 9.00, 10.00, 11.00, 12.00, 13.00, 14.00, 15.00, 16.00.

5.7.4. Minimum requirement is 5 points closest to the working range limits (e.g. 0.00 and 6.00 for operation in 0.00 - 6.00 McF range). The best results are obtained when maximum amount of calibration points for the required range are used.

5.7.5. If the standard for 0.00 value is not available, fill the tube (of the kind that is used for operations) with distilled water. Use the tube as the 0.00 value standard.

5.7.6. Press **Baseline** key 5 times in McF mode to enter user calibration regime (Figure 3).

5.7.7. Insert the required McF standard (fig. 3/1) into the socket and press Meas (**Measure** key). If the required standard is not available press Next (**Baseline** key) to skip to the next standard.

5.7.8. To finish calibration process press Next (**Baseline** key) skipping all the not required calibration points, when asked to save user calibration or not, press **Measure** key for Yes and **Baseline** key for No.

5.8. **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.

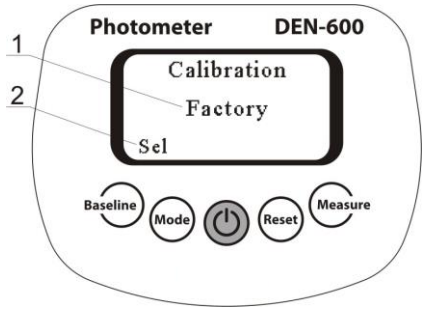

Figure 5. User and factory calibration selection

5.8.1. **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.

5.9. **Resetting the memory**. In the **Save** mode, press the **Reset** key twice to delete all saved values from the memory.

5.10. To control the unit from a PC, please see the software manual.

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.

6. Specifications

The unit is designed for operation in cold rooms, incubators (except CO_2 incubators) and closed laboratory rooms at ambient temperature from +4°C to +40°C in a non-condensing atmosphere and maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.

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.

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

6.1. **Measurement specifications**

Light source	LED, self-calibrating	
Wavelength (λ), nm	600 ± 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	± 0.006 @ 1 Abs	± 0.1 @ 0-8 McF
Repeatability	± 0.003 @ 1 Abs	± 0.05 @ 0-8 McF

6.2. **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 ±10%	0.5 kg
Dimensions (W×D×H)	120 × 145 × 65 mm
External power supply	Input AC 100–240 V 50/60 Hz, Output DC 12 V

7. Ordering information

7.1. Models and versions available:

Model	Version
DEN-600	V.1GW

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

7.2.1. Optional accessories:

Description
Calibration set for Abs. Certified reference material, neutral density glass filter set of 4 Abs calibration points – 0.3532, 1,0512, 2,0425, 2,927 (the values may vary slightly from batch to batch)
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
Calibration kit for glass tubes **12 mm** in diameter. Polymer particles. Set of 0.0, 0.5, 2.0, 3.0 McF turbidity standards
Glass sample tubes, set of 78 pcs. Outer diameter 16 mm, height 100 mm, wall thickness 0.8 mm

8. Care and maintenance

8.1. **Guarantee**. When used in laboratory conditions and according to this Operating Manual, this product is guaranteed for TWO YEARS (excluding items mentioned in tables 2 and 3) against faulty materials or workmanship.

8.2. **Service**. There are no user-serviceable parts inside the unit. For all maintenance and repairs (except as defined below) return to our service department in the UK or in other countries, our distributor.

8.3. **Cleaning and disinfection**.

8.3.1. 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.

8.3.2. To disinfect the unit, use a DNA/RNA removing solution (e.g. Grant PDS-250). After disinfecting, wipe the surfaces dry.

8.3.3. Do not use liquids to clean optical parts. Use air from a rubber siphon to blow away any particles.

8.3.4. The unit and its accessories are not autoclavable.

EU Declaration of Conformity

All the products covered by this Manual comply with the requirements of the EU harmonised legislation verified using the following standards

Low Voltage Directive (2014/35/EC) for Electrical safety.	LVS EN 61010 Part 1 LVS EN 61010 Part 2-051
EMC directive (2014/30/EC) for Electromagnetic compatibility	LVS EN 61326-1
RoHS Directive (Directive 2011/65/EC including 2015/863) for Hazardous substances	LVS EN50581

UK Declaration of Conformity

All the products covered by this Manual comply with the requirements of UK statutory requirements verified using the following standards.

Electrical Equipment (Safety) Regulations 2016	BS EN 61010 Part 1 BS EN 61010 Part 2-051
Electromagnetic Compatibility Regulations 2016	BS EN 61326-1
The Restriction of the Use of Certain Substances in Electrical and Electronic equipment Regulations 2012	BS EN50581