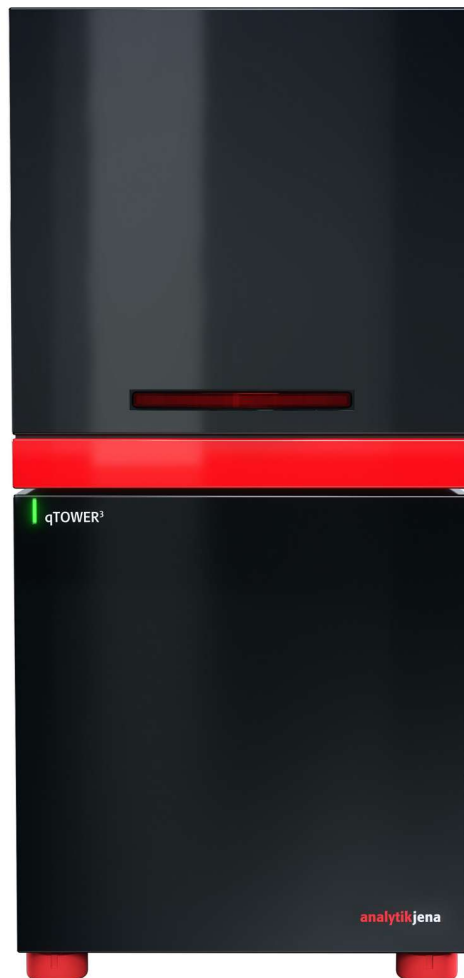


# Operating Manual

qTOWER<sup>3</sup> / qTOWER<sup>3</sup> G  
Real-Time PCR Thermal Cycler



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For a proper and safe use of this product follow the instructions. Keep the operating manual for future reference.

General Information

<http://www.analytik-jena.com>

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Analytik Jena GmbH

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# 1 Notes on this operating manual

This operating manual describes the following thermocycler models:

- qTOWER<sup>3</sup>
- qTOWER<sup>3</sup> G

In the text below, these devices are collectively called qTOWER<sup>3</sup>, or simply 'device'. Differences between the models are explained in the corresponding section.

The device is intended for operation by qualified specialist personnel observing this user manual.

The operating manual describes the design and function of the device, and provides personnel familiar with PCR technology with the necessary know-how for the safe handling of the equipment. Furthermore, this operating manual provides information on system maintenance and care, and on sources of potential faults or malfunctions and how to remedy them.

## Conventions

Instructions for actions occurring in chronological order are numbered and combined into action units.

Warnings are indicated by a warning triangle and a signal word. The type, source and consequences of the hazard are stated together with notes on preventing the hazard.

Elements of the control and analysis program are indicated as follows:

- Program terms are in bold (e.g., the **System** menu).
- Buttons are indicated by square brackets (e.g., [OK]).
- Menu items are separated by vertical lines (e.g., **System** | **Device**).

## Symbols and signal words used in this manual

The user manual uses the following symbols and signal words to indicate hazards or instructions. These warnings are always placed before an action.



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### WARNING

Indicates a potentially hazardous situation which can cause death or very serious (possibly permanent) injury.

---



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### CAUTION

Indicates a potentially hazardous situation which can cause slight or minor injuries.

---



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### NOTICE

Provides information on potential material or environmental damage.

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## 2 Intended use



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### NOTICE

The device is intended for **general laboratory use**. Its use is limited to applications outside of in-vitro diagnostics (research use only).

The device may only be used for the applications described in these operating instructions.

The manufacturer does not accept liability for any other use.

---

The device is a thermocycler which is licensed for real-time PCR experiments that amplify DNA via polymerase chain reaction (PCR) while using fluorescence spectroscopy for the highly sensitive detection of target sequences. The signal from the fluorescent dyes excited by a light source correlates quantitatively with the amount of PCR product and may be shown in real-time.

The integrated detector allows measurement of the sample fluorescence in up to six spectral channels during PCR, providing verification of multiple target sequences in a single PCR reaction. The filters used on the color or FRET modules are precisely tuned to the properties of the fluorescent dye most often used, allowing sensitive and selective detection of fluorescent PCR products.

Analytik Jena offers a series of color or FRET modules, with up to six being able to be simultaneously installed in the device.

The replacement and retrofit of color or FRET modules is easy.

The device is an open platform for real-time PCR and supports both intercalating dyes as well as individual sensors and kits from various manufacturers. The device can be used in various applications, such as expression analyses, genotyping and the detection of pathogens.

The device is fully controlled from the PC using the qPCRsoft software. The software provides the following functions:

- Device control and monitoring
- Context-sensitive help functions
- Design of real-time PCR experiments and their evaluation
- Storage of methods (templates) and measuring results (projects)
- User management
- Planning and evaluation of
  - Absolute quantifications
  - Relative quantifications
  - $\Delta\Delta C_t$  analyses
  - DNA melting curves
  - Genotyping
  - End point analyses
- Results export to MS EXCEL or as CSV file
- Results printout
- Results export to extended programs for the analysis of real-time PCR data (e.g. GenEx, qBASE)

A detailed description of the software can be found in the software manual.

We recommend the following scientific publication for an intensive introduction into the real-time PCR analysis techniques and applications:

LOGAN, Julie; EDWARDS, Kristin; SAUNDERS, Nick (ed.): Real-Time PCR – Current Technology and Application. Norfolk UK: Caister Academic Press, 2009

## 3 Safety instructions

For your own safety and to ensure error-free and safe operation of the device, please read this chapter carefully before commissioning.





Observe all safety instructions listed in this user manual and all messages and displayed by the control and analysis software on the monitor.

### 3.1 Safety markings

Warning and mandatory action labels have been attached to the device and must always be observed.

Damaged or missing warning and mandatory action labels can cause incorrect actions leading to personal injury or material damage. The labels must not be removed. Damaged warning and mandatory action labels must be replaced immediately!

The following warning and mandatory action labels have been attached to the device:

Warning/mandatory sign	Meaning
	Disconnect the power supply before opening the device cover.
	The device contains controlled substances. Analytik Jena GmbH warrants that these substances will not be released from the device within the next 25 years provided the device is employed as intended.
	General warning sign
	Warning about hot surface

Further symbols can be found on the type plate (→ "Type plate"  17).


### 3.2 Requirements for the operating personnel

The device must only be operated by qualified specialist personnel instructed in the use of the device. The instruction also includes imparting the contents of this operating manual.

In addition to the safety at work instructions in this operating manual the generally applicable safety and accident prevention regulations of the respective country of operation must be observed and adhered to. The operator must ensure the latest version of these regulations.

- The operating manual has to be accessible to the operating and maintenance personnel at all times!
- Only authorized personnel may work with the device. The operating personnel must be familiar with the dangers arising from samples and excipients. Use appropriate personal protection.



- When using the device, observe the appropriate laboratory diligence and cleanliness to prevent contamination of the device. This reduces the risk of the user being contaminated with potentially infectious material and the risk of cross-contamination of the samples. Use protective gloves and use other protective measures if skin contact with infectious materials can occur during use of the device.
- Decontaminate the device if the housing or the sample block has become contaminated with hazardous substances. Suitable disinfection agents and procedures are described in "Disinfecting the device" (→ "Disinfecting the device"  26).



## NOTICE

Other disinfection agents than those listed may only be used after consultation with Analytik Jena.

### 3.3 Safety instructions – transport and installation

The device may only be transported with the transport locks in place and in its original packaging. Always ensure that the device is empty and no sample vessels are in the sample block. More information can be found in the corresponding chapter of this operating manual.

The device can be installed by Analytik Jena customer service or trained specialist personnel authorized by Analytik Jena.

Observe the guide values and adhere to the legally mandated limits for lifting and carrying without auxiliary means!

- For safety reasons, 2 persons are required to transport the device.
- Since the device does not have handles, grip the device firmly with both hands at the bottom and lift it at the same time.
- The installation location and the space required must be in accordance with specifications.

### 3.4 Safety instructions – operation

#### 3.4.1 General safety instructions for operation

The operator must make sure that the device and its safety equipment is in sound condition each time before starting up the device. The technical condition must always comply with the legal requirements and regulations.

- Ensure easy access to the main power switch on the rear of the device housing during operation.
- The ventilation fittings at the rear and the bottom of the device must be free and operational. Covered ventilation grilles or slots etc. may cause the device to break down or may cause damage to it.
- Ensure that the lid is securely closed before starting the program! Do not touch the heated lid!
- Be careful to avoid crushing or pinching injuries when closing the device.
- The thermal block, the samples, and the heated lid reach high temperatures. There is a risk of burns during contact.

- Do not use any oil between the samples and the sample block! The use of oil during device operation can result in the formation of health-hazardous vapors. Using oil to ensure better heat exchange is not necessary due to the excellent heat conductance of the installed sample block.
- Wear safety goggles during operation!  
The rapid heating of the thermal block can cause liquids to evaporate explosively.
- Only use plates, tubes, foils and caps suitable for high temperatures (up to 110 °C)!
- Do not touch hot sample tubes or plates and do not open them or boiling liquid may escape!

### 3.4.2 Safety instructions – protection against explosion and fire

- The device must not be operated with flammable, explosive or volatile substances.
- The device may not be operated in an explosion-hazard environment.

### 3.4.3 Safety instructions – electrical equipment

The device is in accordance with the interference emission and interference immunity requirements of the corresponding standards.

- The device may only be connected to power sources whose nominal voltage is the same as that on the rating plate of the device.
- The electrical components must be checked regularly by a qualified electrician. Any defects, such as loose connections or faulty/damaged cables must be repaired immediately by specialist personnel.
- In case of malfunctions of the electrical components, switch off the device at the main switch immediately and disconnect the mains plug from the grid.
- Before opening, the device must be isolated from all circuits!
- Work on the electrical components of the device may only be performed by Analytik Jena customer service employees and specially authorized technicians in accordance with valid electrotechnical regulations. Life-threatening voltages may be applied within the device! There is a risk of electric shock if contact is made with live components, which may lead to serious injury or death.
- Any work on the interior of the device, except for that described in this operating manual, may only be carried out by Analytik Jena customer service and specially authorized technicians.
- Make sure the correct fuses are used and replace these if necessary. To do this, separate the device from the mains supply.
- The device may only be used with the supplied power cable or a power cable with the same specification (1.5 m length, shielded, with grounding conductor). Extension of the power cable used is not permitted. The use of different power cables is not permitted, and can result in increased electromagnetic interference emission or decreased electromagnetic interference immunity of the device and incorrect device operation.
- Wipe spilled samples or reagents immediately with an absorbent cloth or piece of paper. Do not allow any liquid to enter the device.
- Do not use the device in environments with extreme humidity (>95%), or in locations in which condensation may occur.

### 3.4.4 Handling of auxiliary and operating materials and samples

The operator is responsible for the selection of substances used in the process, as well as for their safe handling. This applies in particular for radioactive, pathogenic, infectious, poisonous, corrosive, flammable, explosive or otherwise hazardous materials. For details, contact the safety officer responsible for your location.

- In general, always wear safety goggles when handling reagents.
- For your own safety, please observe the potential infectious qualities of the examined biological material.
- Observe all notices on the cleaning and decontamination of the device. The use of other cleaning or decontamination procedures is only permitted following prior consultation with Analytik Jena.

## 3.5 Safety instructions – maintenance and repair

Maintenance of the device is always carried out by the Analytik Jena customer service department or specialist personnel trained and authorized by Analytik Jena. Unauthorized maintenance can damage the device.

The operator may only carry out the tasks listed in the chapter "Maintenance and care".

- The exterior of the device may only be cleaned with a damp, not dripping, cloth after the device has been switched off.
- Do not use alcohol (e.g., methanol or ethanol), organic solvents or abrasives to clean the device.
- Generally, all service and repair work on the device must be carried out in switched-off condition (unless stated otherwise).
- Use only original spare parts, wear parts and consumables. They have been tested and ensure safe operation.

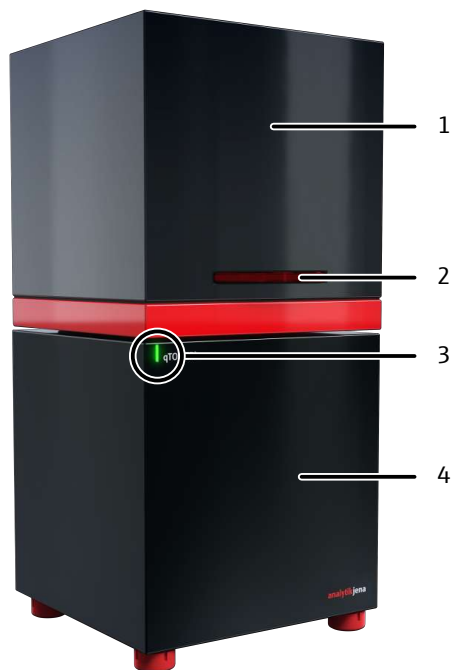
## 3.6 Behavior during emergencies

If there is no immediate risk of injury, switch off the device and the connected system components immediately in hazardous situations or in the event of an accident and/or disconnect the power plugs from the power outlets.

## 4 Design and function

### 4.1 Design, connections and control elements

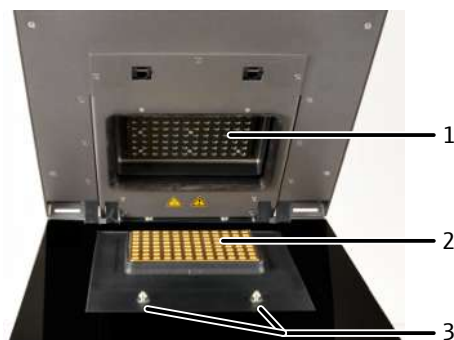
The device combines a PCR thermocycler with a patented fluorescence photometer. The lock with handle and the LED for status display are located on the front side of the device.



**Figure 1 Front view**

- |   |                                |
|---|--------------------------------|
| 1 Upper part with fluorescence spectrometer | 2 Lock with handle             |
| 3 LED for status display                    | 4 Lower part with thermocycler |

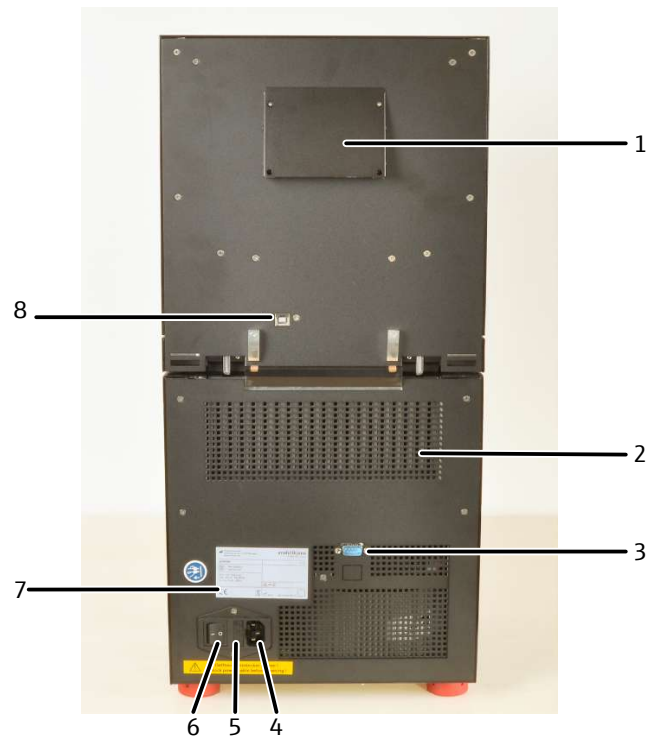
The device is opened by folding back the upper part and the cover for the sample block and fluorescence photometer it contains. To this end press the handle in until the lock disengages with a click and the upper part gently snaps open. The upper part can then be folded back from the handle.



**Figure 2 Open device**

- |                |                |
|----------------|----------------|
| 1 Heated lid   | 2 Sample block |
| 3 Locking pins |                |

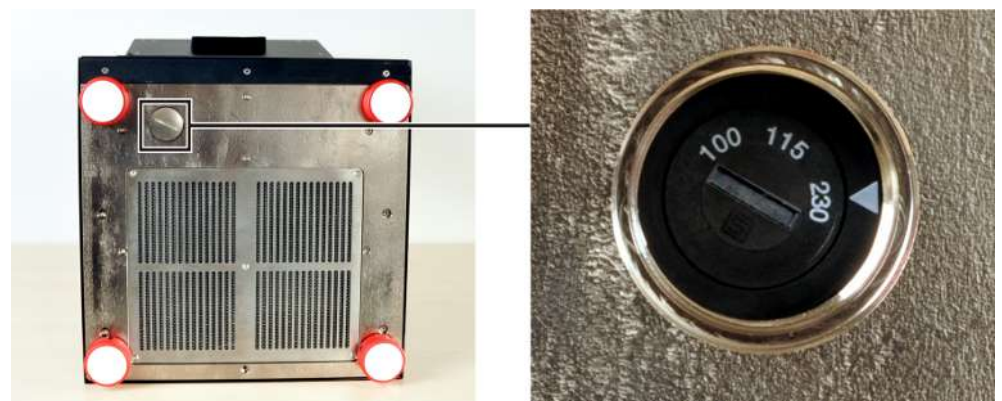
The mains connection and the power switch are located on the device rear.  
The interface for connection to the PC is also located on the device rear.



**Figure 3 Back**

- |   |  |
|---|--|
| 1 Ventilation for fluorescence spectrometer | 2 Ventilation grille on the thermal cycler               |
| 3 Service connection                        | 4 Power connection                                       |
| 5 Fuse holder for device fuses              | 6 Mains switch   |
| 7 Type plate                                | 8 Interface for the connection cable to the connected PC |

The voltage selector switch is located on the bottom of the device, behind a cover. It can be used to adjust the operating voltage to the mains voltage.



**Figure 4 Voltage selection switch on the bottom of the device**

The following accessories are included in the delivery scope of the device:

- Power cable
- Connection cable for connecting to the PC
- CD or USB stick with qPCRsoft software, with manual for software and device
- Operating manual and software manual (print version)
- Packaging and packaging instructions



**Figure 5 Mains and connection cable**

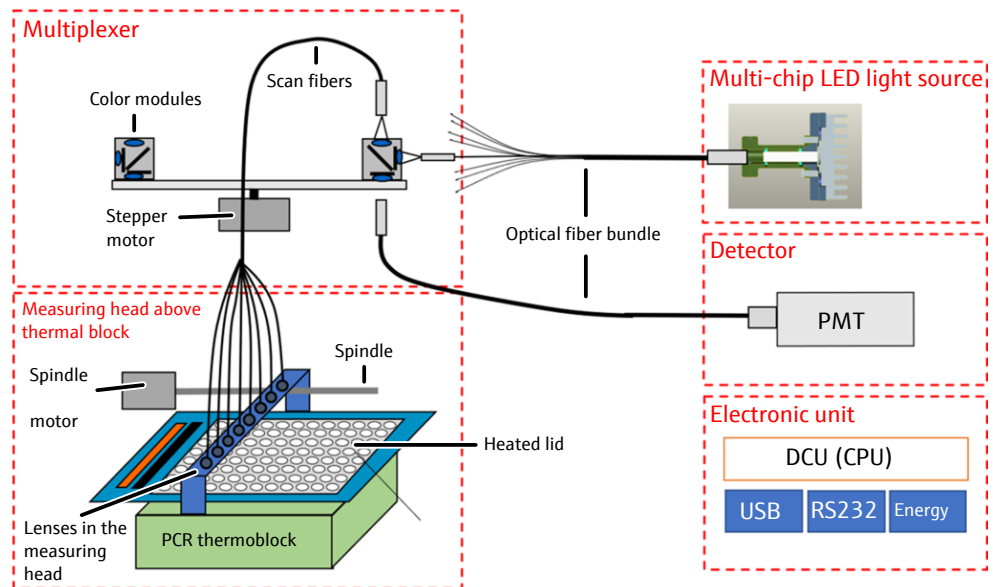
Only use the mains cable supplied or a mains cable with the same specifications.

## 4.2 Function

### 4.2.1 Fluorescence spectrometer

The detector unit for a thermal block with 96 wells is a patented 8-channel epi-fluorescence photometer with fiber multiplexer and a mechanical scanning device.

The following schematic illustration shows the components of the fluorescence spectrometer:



**Figure 6 Schematic representation of the fluorescence spectrometer**

Light source

A long-life, sturdy four-color LED (blue, green, white and red) in the device is used as an excitation light source for the emission of fluorescent dyes. The LEDs allow for sensitive excitation of various dyes across a very broad wavelength spectrum that goes deep into red, with the light source not requiring any warm-up period.

Multiplexer

The light is passed through optic fibers to collimator lenses, bundled and then transferred to the excitation filter of the color modules fitted to a rotating filter wheel. The light is deflected via a beam divider and passed through additional optical fibers to a lens array in a shuttle system scanning the sample block in columns.

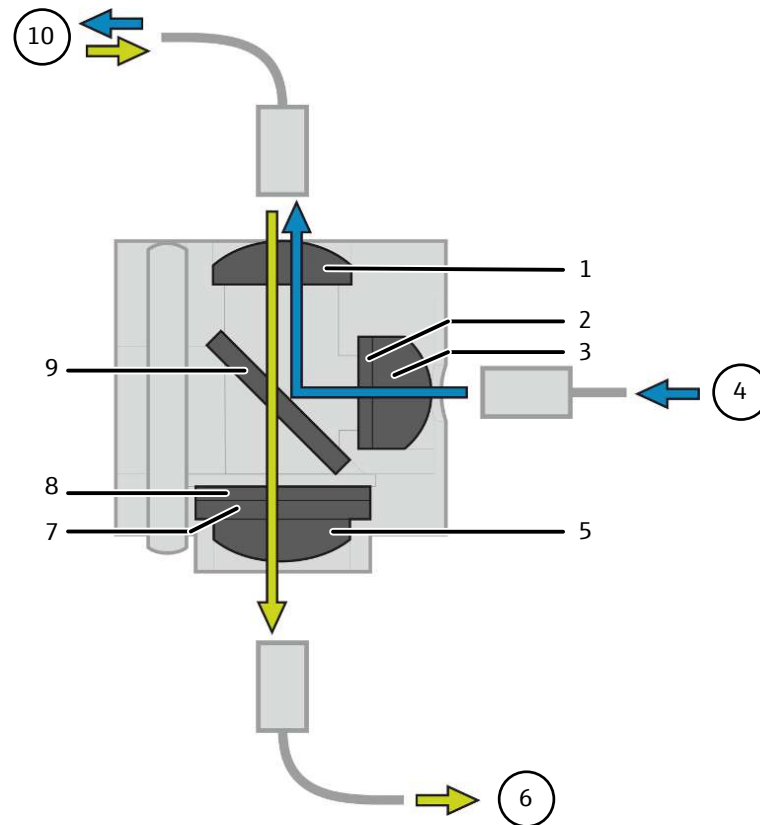
Measuring head

The fluorescent dyes are specifically excited in the reaction mix thanks to the light and emit light of a longer wavelength. Using the lenses in the shuttle system, the emitted light is bundled and passed back to the color modules via the optical fibers.

Photomultiplier (PMT)

In the color modules, the light passes the beam divider followed by two emission filters and is then transferred to the photomultiplier (CPM) for detection.

The following illustration schematically displays the beam path of the light starting at the light source via the blue and green arrows.



**Figure 7 Schematic representation of the light beam path through a filter color module**

- |                           |                                  |
|---------------------------|----------------------------------|
| 1 Aspherical lens         | 2 Excitation filter              |
| 3 Collimator lens         | 4 Light source                   |
| 5 Aspherical lens         | 6 Detector                       |
| 7 Emission filter (glass) | 8 Emission filter (interference) |
| 9 Beam splitter           | 10 Sample                        |

The filter wheel of the photometer can be populated freely with a choice of filter modules. The product portfolio of Analytik Jena comprises a total of 12 different filter modules (6 color modules for the most frequently used fluorescent dyes, from the blue to the red excitation range; 5 filter modules specially optimized for FRET applications and 1 protein module for melting curve analysis).

In addition, filter modules can be retrofitted at any time, extending the application spectrum of the device.

## 4.2.2 PCR thermocycler

The thermal block with 96 wells is made of silver for the best possible performance and thermal conductivity. The silver is coated with gold for corrosion protection. Due to its excellent heat conductivity, silver equilibrates extremely quickly, providing maximum speed and uniform temperature distribution.

This achieves a high temperature homogeneity and uniformity in combination with heating rates of up to 8 °C/s and cooling rates of up to 6 °C/s.

The G model variant is additionally equipped with a gradient function, and is particularly suited for establishing new primary pairs.

The thermal blocks are perfectly sealed to prevent condensed water from penetrating the Peltier elements underneath the sample block and other parts of the electronics. This protects the Peltier elements and prolongs the service life of the device.

## 4.2.3 Heated lid

The device comes equipped with an automated heated lid. This can be set to 30 to 110 °C and prevents condensation forming in the area of the reaction tubes above the block surface level. Furthermore, the heated lid guarantees – regardless of the consumables used – a reliable contact between the reaction tubes and the thermal block during the entire real-time PCR run thanks to a constant contact pressure. This significantly improves temperature uniformity.

## 4.2.4 Plastic

Sample blocks in 96-well SBS format are suitable for use with 0.2 mL individual tubes, 8-well strips and 96-well micro titer plates.

These and other consumables can be ordered from Analytik Jena.

For real-time PCR applications, it is important that the sample carriers in plate format are sealed with optically transparent foil (sealing foil) before the PCR run. 0.2 mL individual tubes and 8-well strips must be sealed with the corresponding suitable optical lids.

**NOTICE!** The optical transparency of the foils affects the fluorescence signal directly. For this reason, only use clear adhesive foil such as that provided for real-time PCR.

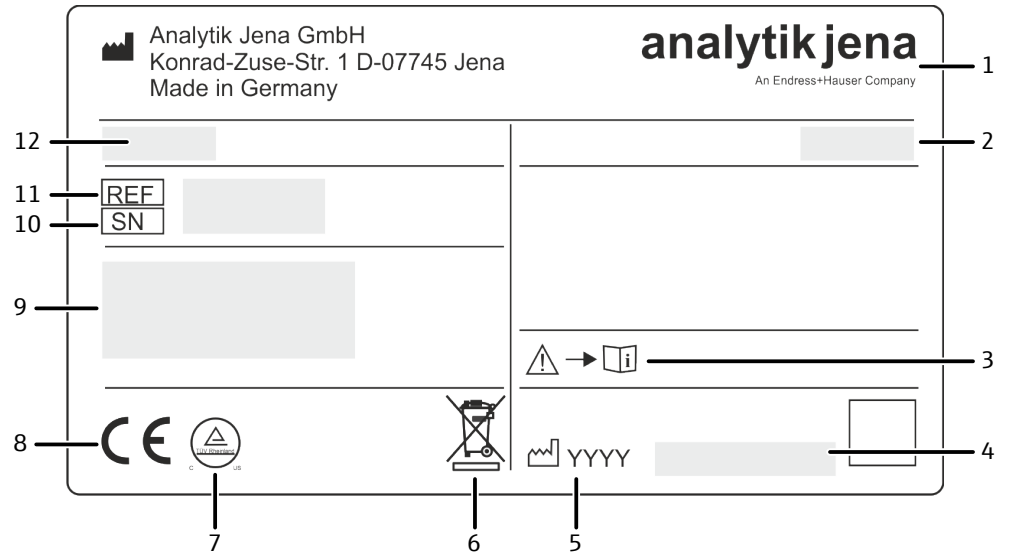
Regardless of the sealing method used, thanks to the lid technology, the same pressure is always applied to the consumables for absolutely reproducible conditions.

The device is not limited to specific detection reagents or the plastic products of a specific manufacturer.



## 4.3 Type plate

The type plate is located on the rear of the device. You can find the following information displayed in the image there:



**Figure 8 Type plate**

- |    |  |    |  |
|----|--|----|--|
| 1  | Manufacturer and address   | 2  | Protection class of the housing                              |
| 3  | Safety symbol (Attention! Observe the accompanying documentation!)                       | 4  | Device number  |
| 5  | Year of manufacture  | 6  | Disposal instructions (Do not dispose of as domestic waste!) |
| 7  | TÜV (German technical inspection association) Rheinland marking on NRTL certification    | 8  | CE marking   |
| 9  | Electrical connection data: Voltage, max. power consumptions, frequency and device fuses | 10 | Serial number  |
| 11 | Order number   | 12 | Device type and model  |

# 5 Installation

## 5.1 Installation location requirements

Ambient conditions

The climate conditions for the installation location are listed in the technical specifications (→ "Ambient conditions" 38). If required, ensure that the room is temperature-controlled.

Installation location requirements

- This laboratory device is designed for indoor use.
- Do not use the device in wet and damp environments. Keep the device surface clean and dry.
- Avoid direct sunlight and radiation from heaters onto the device. If necessary, provide air conditioning.
- Place the device on a heat-resistant and acid-resistant surface.
- Do not locate the device near sources of electromagnetic interference.
- Avoid mechanical shocks and vibrations.
- Do not use the device in explosion-hazard environments.
- Place the device on a stable surface.
- The installation site must be free of drafts, dust and caustic fumes.
- Keep the ventilation slits free and do not obstruct them with other devices.

### 5.1.1 Spatial requirements




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#### NOTICE

##### Type and source of the hazard

When opening the device, the upper device hood tilts back. Provide adequate space for this.

---

The opened device has a spatial requirement of 70 cm x 27.5 cm x 50 cm (H x W x D). In addition, keep a safety distance of at least 10 cm to other equipment or walls.

Additional space is required next to the device for the PC, monitor and possibly a printer. The PC, monitor and printer may also be placed on a separate table.

### 5.1.2 Power supply




---

#### WARNING

##### Risk of electric shock!

The device may only be connected to a properly earthed power outlet in accordance with the voltage specifications on the type plate.

---

The device operates on single-phase alternating current. Prior to making the connection check that the voltage selection switch of the device is set to the correct value.

The device may only be used with the supplied power cable or a power cable with the same specification (1.5 m length, shielded, with grounding conductor).

Electrical connection requirements

Operating voltage	100 / 115 / 230 V (AC)
Line frequency	50 to 60 Hz
Power consumption	≤ 850 W
Device fuse	2 x 10 AT / 250 V

## 5.2 Installation



### WARNING

#### Risk of electric shock!

Check that the mains connection conditions match those indicated on the type plate on the rear of the device.

Before connecting the device to the mains network set the correct operating voltage at the voltage switch on the underside of the device.



### NOTICE

Unsuitable packaging material may cause damage to the device! Keep the original packaging and transport lock for subsequent transports.

The following steps are required during the installation of the device:

- Installing the color module (if not already installed)
- Checking the set operating voltage and correcting it if it does not match the voltage supplied at the site
- Connecting the device to the mains and the PC
- Installing software on the PC
- ▶ Remove the device, the connection cables and the operating manual with the installation CD or USB stick from the transport packaging. Wait until the device has reached room temperature for commissioning.
- ▶ Verify that the delivery is complete. Check the device and accessories for transport damage.  
In the event of an incomplete delivery or transport damage, please contact Analytik Jena.
- ▶ Install the color modules if these are not already installed (→ "Installing color modules" ☰ 27).
- ▶ Set the operating voltage:
  - Place the device on its side. Remove the cover from the voltage selection switch on the bottom.
  - Adjust the switch using a screwdriver or a coin so that the arrow points in the direction of the mains voltage available on site.
  - Replace the cover on the selection switch and put the device back on its feet.



**Figure 9 Voltage selection switch on the bottom of the device**

- ▶ Open the lid of the device. To do so, press in the red handle on the front until the lock clicks open. Fold back the upper part of the device.
- ▶ Remove the transport lock and put it aside for later transports.
- ▶ Connect the connection cable to the device interface and to the PC.
- ▶ Connect the power cable to the device. Plug the plug into the mains socket.

**NOTICE!** Ensure that the power switch and the power cable can be easily accessed. This is important in the event that the device needs to be disconnected from the supply voltage.

- ▶ Switch on the PC. Install the software on the PC. Observe the information in the software manual for this.
- ▶ Switch on the device via the power switch.  
When first switched on, the device is detected as a connected device. After the drivers install automatically, the device is ready for operation. If the drivers are not installed automatically, you can complete the installation via the Windows routine. The drivers can be found on the installation CD or USB stick.
- ▶ Start the software.

**NOTICE!** The device is only supported by software version 3.2 and higher.

- ▶ If color modules have been installed, specify these in the software.
  - ✓ The device is operational.

Operation is controlled via the software program. The settings for the measuring or temperature program can be found in the software manual.

## 6 Operation

### 6.1 Switching the device on and off

#### Switching on the device

- ▶ Switch on the device via the mains switch on the rear of the device.
  - ✓ The device is initialized. During this time, the status LED on the front side of the device flashes. The device is ready for operation when the status LED is lit continuously in green.
- ▶ Start the software.
  - ✓ The device is automatically recognized by the control software and the connection to the device is shown in the status bar.

**NOTICE!** If you already started the software before switching on the device, for example, to prepare a real-time PCR project first, the software normally detects the device automatically when it is switched on.

- ▶ Carry out manual device identification if this has not already occurred. To do this, select menu item **Extras | Device identification** in the software.

#### Status LED

The status LED is located on the front of the device next to the device name. It displays the operating state of the device:

- During the device initialization the LED flashes red/green.
- As soon as the device is ready for operation, the LED switches to solid green.
- During a measurement, the LED flashes red/green.
- In case of a device error, the LED will turn red.

#### Switching off the device



---

### NOTICE

Do not switch off the device during a PCR run!

Keep the device closed even if switched off to prevent the sample block from becoming contaminated. Dust or other contamination can affect the fluorescence measurements.

---

Once the PCR run is finished, the software can be exited and the device switched off by pressing the power switch.

## 6.2 Starting a real-time PCR analysis



### WARNING

#### Biological hazard!

Exercise caution when working with potentially infectious materials. Wear suitable protective equipment, e.g. protective gloves.



### WARNING

#### Risk of eye injury!

The rapid heating of the thermal block can result in the explosive vaporization of liquids when the thermal block is opened during the PCR run. Always wear safety goggles during operation.



### CAUTION

#### Hot surfaces

The thermal block, the samples, and the heated lid reach high temperatures. There is a risk of burns during contact.

Sample blocks in 96-well SBS format are suitable for use with 0.2 mL individual tubes, 8-well strips and 96-well micro titer plates.

These and other consumables can be ordered from Analytik Jena.

**NOTICE!** The force of the lid contact pressure was designed for a fully populated block. If only a few samples are used in the block, ensure that the lid contact pressure is distributed symmetrically. Otherwise the sample vessels or the heated lid may become damaged from excess contact pressure.

When inserting only a few sample, proceed as follows:

- When using few individual tubes, also insert additional (empty) tubes of the same height in the four corner positions of the block.

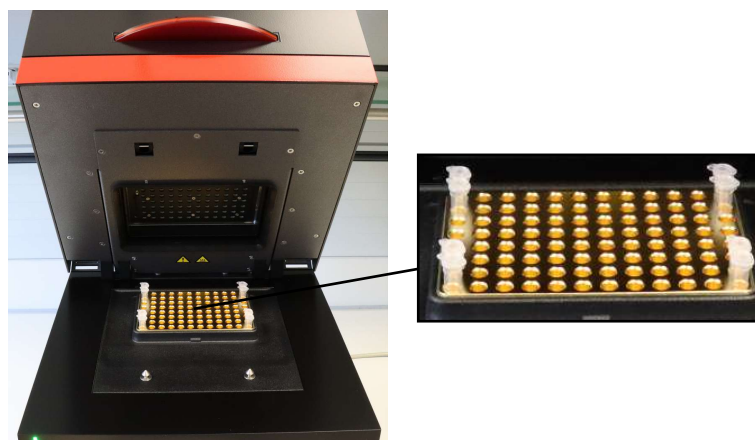


Figure 10 Positions for additional individual tubes when measuring with few samples

- When using few well strips, place one strip on each side of the sample block.



**Figure 11** Positions of additional 8-well strips when measuring with few samples

Start a real-time PCR analysis as follows:

- ▶ Pipette the PCR samples into the sample vessels. Close the sample vessels.

**NOTICE!** Micro titer plates must be sealed with optically transparent adhesive foil (sealing foil). The optical transparency of the foils affects the fluorescence signal directly. For this reason, only use clear adhesive foil such as that provided for real-time PCR. 0.2 mL individual tubes and 8-well strips must be sealed with suitable corresponding optical lids.

- ▶ Prepare a real-time PCR project with complete information on the PCR run, fluorescence measurement and sample layout of the PCR plate.



**Figure 12** Position A1 on the sample block

- ▶ Open the lid. To do so, press in the red handle on the front until the lock clicks open. Fold back the upper part of the device.
- ▶ Place the samples. Observe the information on placing samples when measuring few samples when doing this. When using PCR plates, place these on the thermal block so that well A1 is on the left-hand side (arrow in the illustration below). This position corresponds to the well allocation in the software.
- ▶ Close the lid. To do this, fold the lid forward and press it down with the handle until the lock engages with a click.
- ▶ Start the PCR run in the software.

✓ The PCR run begins and analysis starts.

## 7 Error messages

The following chapter describes possible errors of the device. The error correction measures that can be performed by the customer are limited to those listed in the following section.



### NOTICE

If you cannot eliminate errors yourself, please contact customer service.

If an error occurs, the software outputs error codes assigned to the following errors:

Error code	Cause
$x \leq -100$	Device error in the optical unit of the fluorescence photometer
$-99 \leq x \leq -10$	Software error (e.g., in the settings)
$-9 \leq x \leq -2$	General device error, e.g., lid open
-1	Does not indicate an error condition
$x \geq 0$	PCR thermocycler: Device error

For the following errors, check these options for elimination:

Error code	Cause	Remedy
	Device cannot be switched on.	Check the power supply. Replace the fuses. Replace the power cable.
	Sample cups are damaged during measurements.	Check the suitability of sample cups. Insert the sample properly.
$x = -8$	Lid not closed.	Check that the sample are inserted correctly. Close the lid, ensuring that it engages correctly.
$-99 \leq x \leq -10$	Software or data communication error	Check the settings in the software.
$x = 80$	USB not available	Replace USB cable Switch to a different USB port on the PC

**NOTICE!** The error code overview (incl. the examples) documents the status at the time of printing; more current information may be available – please contact the manufacturer/service for more information!

If these measures do not eliminate the error, or if further errors occur, inform Analytik Jena customer service.



## 8 Maintenance and care



### WARNING

#### Risk of electric shock! Do not touch!

Prior to commencing any maintenance or cleaning work, switch off the device and unplug the power plug.

The following maintenance and care tasks can be performed by the customer:

- Cleaning and disinfection of the housing and sample block
- Replacing the fuses
- Installation or replacement of color modules

All maintenance work and repairs beyond that listed in this chapter may only be performed by Analytik Jena customer service or persons trained and authorized by Analytik Jena. Any unauthorized intervention limits warranty entitlements. If the device exhibits any faults or defects, please contact Analytik Jena customer service immediately.

### 8.1 Cleaning the housing



### WARNING

#### Risk of short circuit!

Switch off the device before all maintenance and cleaning work and remove the power plug from the socket.

Do not use any dripping wet cloths for cleaning. No liquids are permitted to enter the device interior.

Only put the device back into operation after cleaning when it has completely dried.



### NOTICE

Do not use concentrated alcohol, organic solvent or abrasives for cleaning. These can cause damage to the device housing.

If the device becomes contaminated during daily use, cleaning with a damp cloth is sufficient.

Only wipe the device housing with a soft, clean cloth which can be wetted with a commercially available neutral cleaning agent, if necessary.

### 8.2 Cleaning the sample block



### WARNING

#### Risk of eye injury!

Wear safety goggles when blasting the sample block with compressed air.

Dust or reagent residue in the sample block can cause an increase in the background signal.

- Use compressed air to blow out the recesses in the sample block.
- To remove reagent residue, fill the affected wells with max. 20 µL of distilled water or ethanol. Let the liquid act for approx. 1 min before sucking it out again. Repeat the process until the background signal is in the normal range.

### 8.3 Disinfecting the device



#### WARNING

##### Biohazard

Clean the device with particular care after analysis of potentially infectious material. Wear suitable protective equipment, e.g., protective gloves.



#### NOTICE


The only suitable cleaning method for the housing is wipe disinfection.

If using spray disinfectants there is a risk that the liquid may enter the sensitive electronic system through the ventilation slots. If the disinfectant has a spray nozzle, apply disinfectant to a suitable cloth before using it on the device.

- Avoid contamination by handling samples carefully.
- Wipe spilled samples or reagents immediately with an absorbent cloth or piece of paper.
- If the device is used for the analysis of infectious material, great care must be taken, as the device cannot be decontaminated as one unit.
- Remove visible contamination immediately with suitable means. Do not allow solvents to enter the device.
- The sample block is also suitable for wipe and spray disinfection. The only suitable cleaning method for the housing is wipe disinfection.

Device part	Recommended disinfectants	Provider
Housing	Decosept Spezial	Dr. Schuhmacher GmbH
Sample chamber	Decosept AF	Dr. Schuhmacher GmbH
	Meliseptol HBV (tissues)	B. Braun

Observe the efficacy spectrum of the listed disinfectants with regard to the customer-specific decontamination requirements!

- Only disinfection agents containing ethanol or isopropanol are approved. The use of disinfection agents with ingredients or concentrations that differ from the recommended disinfection agents invalidates all warranty claims regarding damage to the device or non-effectiveness.
- If the device must be sent back to Analytik Jena for servicing, first perform decontamination and document this (→ "Return"  33).

## 8.4 Replacing fuses



### WARNING

#### Risk of electric shock! Do not touch!

Before exchanging fuses, switch off the power switch and disconnect the device from the mains network.

Only use the specified fuses. If the wrong fuses are used, there is a risk of fire, injuries and device damage.

Mains voltage	Device fuse
100 / 115 / 230 V (AC)	2 x 10 AT / 250 V



1 Fuse compartment

- ▶ Switch off the device via the device switch and disconnect the power plug from the socket.
- ▶ Open the fuse compartment on the rear of the device with a small flat screwdriver. To do this, insert the screwdriver into the slot and carefully twist it.
- ▶ Remove the fuse holder from the compartment.
- ▶ Remove the old fuses and replace them with identical types.
- ▶ Reinsert the fuse holder into the compartment and close the lid.

**NOTICE!** The fuse compartment cannot be opened if a power cable is connected to the power connection.

If the fuses repeatedly fail, the device must be checked by Analytik Jena customer service, or by personnel trained and authorized by Analytik Jena.

## 8.5 Installing color modules

Depending on the delivery state of the device, or when purchasing additional color modules, it may be necessary to install the color modules in the device. The top device hood must be removed for this purpose.



### NOTICE

The lens of the fluorescence spectrometer is very sensitive, and can become damaged due to improper installation.

Follow the instructions precisely to install the color modules.

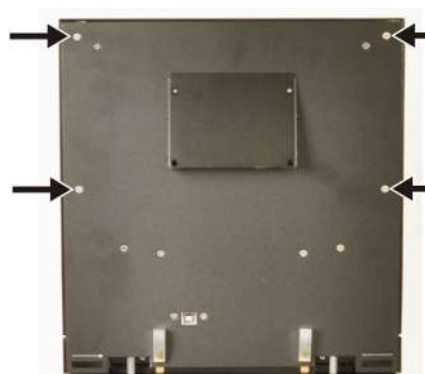
Do not remove the inner device hood protecting the lens.

Installing color modules

The proper installation of the color modules is as follows:



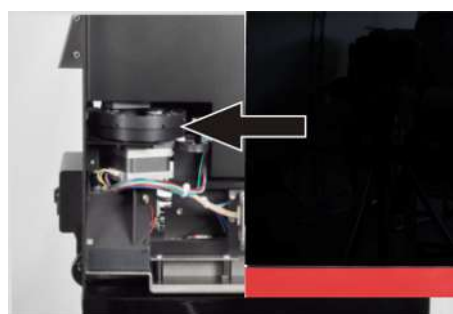
- ▶ Switch off the device.
- ▶ Open the lid. Remove the four external screws on the inside of the lid.
- ▶ Close the lid.



- ▶ Remove the four outer screws on the rear of the device on the upper part the hood is fastened with.

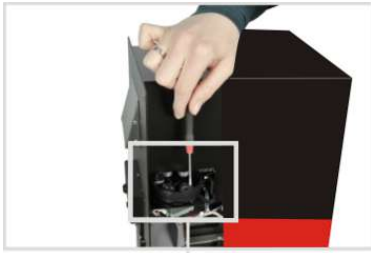


- ▶ Pull the hood forward slightly.



- ▶ Pull the hood forward for enough to access the rotating filter wheel for the color modules.
- ▶ Secure the hood in this position to prevent it from falling.

**NOTICE!** The hood can also be completely removed and set down in a safe place.



- ▶ Note the code on the color module and the position in which the color module is to be installed. Remove the old color module or dummy element (dummy module). To do this, unscrew the two M2 screws and pull the color module out. Keep the color module or dummy element.
- ▶ Place the new color module in the free position with the pin pointing down. The silver pin points to the motor axis and must engage in the centering hole next to the large hole for the pin of the color module.

**NOTICE!** The correct position of the color module can be found more quickly if you rotate the color module slightly around its own axis during insertion.

- ▶ Press the color module down until it rests flat on the filter wheel.
- ▶ Screw on the color module with the M2 screws supplied.
- ▶ Repeat this procedure for all color modules.
- ▶ Close the remaining openings of the filter wheel with the color module dummy elements supplied to protect them from light.



- ▶ Rotate the filter wheel with the installed color modules and check whether the color modules grind against the upper lid. If this is the case, loosen the screw connection of the color module. Check its position again and retighten the screws.

**NOTICE!** Do not attempt to force a jammed color module into the correct position simply by tightening it further. The sensitive optics may become damaged.

- ▶ Push the hood back in its initial position.



- ▶ First fasten the four external screws on the upper part on the rear of the device.



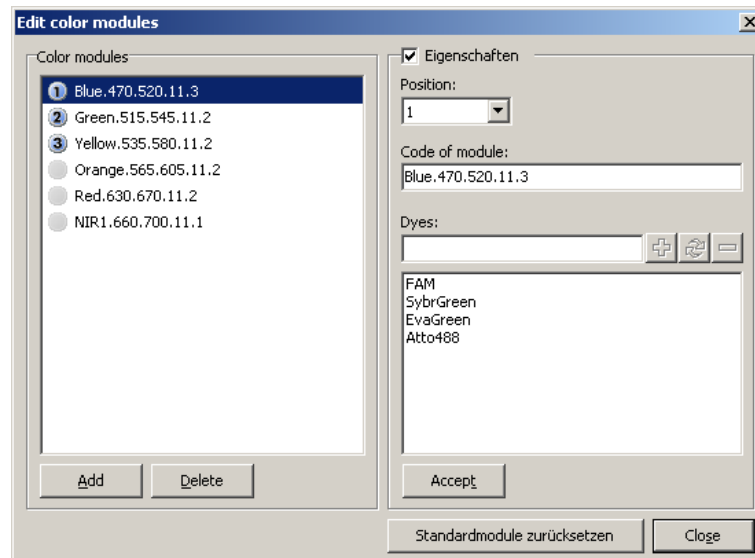
- ▶ Open the lid and fasten the four outer screws on the inside of the lid.
- ▶ Close the lid again.
  - ✓ The color modules are installed.

Registering color modules in the software

To use the color modules correctly in the software, these must be registered in the software.

- ▶ Switch on the device. Start the software.
- ▶ Select menu item **Extras | Color modules**.

The **Edit color modules** window opens. The available color modules are listed on the left-hand side of the window.



**Figure 13** Selection window for color modules. Note: With software version 4.1 and higher, only the color module names are displayed in the "color modules" list, and not the complete module code.

- ▶ Select the module installed in the device from the **Color modules** list.
- ▶ Activate the **Properties** checkbox and select the position the module has been installed in the device at. Add further dye names if these are not included in the list. Click on **[Accept]**.
- ▶ Follow the above instructions for every installed color module.
- ▶ Close the window with **[Close]**.
  - ✓ The inserted color modules are ready for measurements.

Adding a new color module to the list

If you cannot find a color module in the list, it must be created new:

- ▶ On the left side of the **Edit color modules** window, click on **[Add]**. A new color module with the name COLOR.000.000.00.0 is created.
- ▶ Activate the **Properties** checkbox. Enter the position, the module code and the dyes in the right side of the window.
  - ✓ The color module is available in the software.

Removing a color module

A color module that is not required can be removed from the software.

- ▶ Mark the color module in the **Color modules** list and click on **[Delete]**.
  - ✓ The color module has been removed from the software.

Changing color module properties

The properties of a color module can be changed or re-specified.

- ▶ Mark the color module in the list.
- ▶ Activate the **Properties** checkbox.
- ▶ In the **Position** list, select the position of the color module on the carrier in the fluorescence measuring head.
- ▶ In the **Code of module** entry field, enter the code of the color module.
- ▶ In the **Dyes** input field, enter the dye detected with the color module. Click on **[+]**.
  - ✓ The dye is added to the list.
- ▶ To delete a dye, mark it in the list and click on **[-]**.
- ▶ Assign the properties to the marked color module with **[Accept]**.
  - ✓ The color module has been assigned the new properties.

## 9 Transport and storage

### 9.1 Transport



#### NOTICE

Use suitable packaging material and transport locks!

Unsuitable packaging material may cause damage to the device! Only transport the device in its original packaging and with the transport lock in place! Information on proper packaging is included with the device.

Please observe the information regarding device transport (→ "Safety instructions – transport and installation" 9). Avoid the following during transport:

- Impact and vibration  
Risk of damage due to shock, impact or vibration!
- Large temperature fluctuations  
Risk of condensation!

#### 9.1.1 Inserting the transport lock

Before packing the device, the transport lock for the upper part that contains the fluorescence photometer must be installed. If the transport lock is no longer available, you can place an empty PCR plate in the sample block.

To insert and fasten this, the device must be connected to the PC and the software must have been started.



Installation is software-controlled:

- ▶ Place the transport lock on the sample block and close the lid.
- ▶ In the software, select menu item **Extras | Transport lock** and follow the instructions on the screen.



### 9.1.2 Return



#### WARNING

##### Risk of damage to health due to improper decontamination!

Perform a professional and documented decontamination of the device before returning it to Analytik Jena. The decontamination report is available from the customer service department when registering the return. Analytik Jena must refuse acceptance of contaminated devices. The sender may be liable for any damage caused by inadequate decontamination of the device.

- ▶ Clean all device components of biologically hazardous, chemical and radioactive contamination.
- ▶ The decontamination report is available from the customer service department when registering the return. Complete the form and attach the signed decontamination declaration to the outside of the return shipment.
- ▶ Only use the original packaging for the shipment and insert the transport lock. If the original packaging is no longer available, please contact Analytik Jena or your local distributor.
- ▶ Apply the following warning sign to the packaging:  
**"CAUTION! SENSITIVE ELECTRONIC DEVICE!"**
- ▶ Include a sheet with the following information:
  - Name and address of the sender
  - Name and telephone number of a contact for inquiries
  - A detailed description of the fault, the precise conditions and situations under which the fault occurs

### 9.1.3 Moving the device in the laboratory



#### CAUTION

##### Risk of injury during transport

Dropping the device poses a risk of injury and damage to the device.

- Proceed carefully when moving and transporting the device. Two persons are required to lift and carry the device.
- Grip the device firmly at the bottom with both hands and lift it simultaneously.

Observe the following when moving the device within the laboratory: 2 persons are required to lift and carry the device. They should position themselves on both sides of the equipment.

Since the device does not have handles, grip the device firmly with both hands at the lower end, lifting it simultaneously.

- ▶ Disconnect the power and the PC from the device.
- ▶ Position one person each at the two opposing device sides. Grip the device firmly at the bottom with both hands and lift it simultaneously.
- ▶ Observe the information for setting up the device at a new location.

## 9.2 Storage



---

### NOTICE


Environmental influences and condensate formation can destroy individual components of the device!

The device must only be stored in air-conditioned rooms. The atmosphere must be low in dust and free from aggressive vapors.

---

If the device is not installed immediately after delivery or not required for prolonged periods, it should be stored in its original packaging. A suitable desiccant should be added to the equipment to prevent damage from moisture.

Ambient conditions

Refer to the technical specifications for the ambient climate requirements of the device's storage location (→ "Ambient conditions"  38).

## 10 Disposal

The operator of the device must dispose the waste materials that occur during measurements (sample materials) in accordance with the statutory and local regulations. At the end of its service life, the device and all its electronic components must be disposed of as electronic waste in accordance with applicable regulations.

# 11 Specifications

## 11.1 Technical data

### General data

Dimensions (height x width x depth)	59 cm x 27.5 cm x 27.5 cm, 70 cm x 27.5 cm x 50 cm when opened
Mass	30 kg
Noise level	45 dB
Safety circuits	<ul style="list-style-type: none"> <li>■ Sensor-based monitoring of the closing and locking of the sample chamber</li> <li>■ Overtemperature protection in the heated lid</li> </ul>
Supported plastic products	96 -well micro titer plates with optical sealing foil 8-well strips 0.2 ml with optical lids 0.2 ml individual vessels with optical lids
Interface	USB

### Thermal block/heated lid

Sample block	Silver (gold-plated)
Block capacity	96-well micro titer plate
Sample volume	5 to 100 µl
Heating	Max. 8 °C/s
Refrigeration	Max. 6 °C/s
Temperature setting range	3 to 99 °C
Heating rate adjustment	Min. 0.1 °C/s
Temperature uniformity after 15 s	± 0.15 °C at 55 °C ± 0.25 °C at 72 °C ± 0.50 °C at 95 °C
Temperature control precision	± 0.1 °C
Temperature increments	Min. 0.1 °C/cycle
Time increments	Min. 1 s/cycle
Lid temperature	30 to 110 °C
Contact pressure	Corresponds to 30 kg, automated

### Gradient function for the qTOWER<sup>3</sup> G

Gradient	12 columns: 3 to 99 °C, linear gradient tool
Max./min. gradient	40 °C / 0.1 °C

### qPCR application

Sensitivity	1 nmol/l FAM at 30 µl sample volume
Measuring time	Approx. 6 s for 96 wells for a single measurement, 6 colors
Measurement range	± 130 000 (± 17 bit)
Dynamic range	10 log stages

Fluorescence spectrometer	Measuring principle	Fiber-optic shuttle system with 8-fold scanner and color modules for the excitation and emission filters
	Light source	4 long-life, high-performance LEDs (RGBW)
	Color modules	<ul style="list-style-type: none"> <li>▪ 12 color-, FRET and protein modules</li> <li>▪ 6 positions in the device</li> </ul>
	Detector	Highly sensitive PMT (photomultiplier tube)

Color modules	Description	Order number	Dyes (examples)
	Color module 1	844-00520-0	FAM, SYBR Green, Alexa488
	Color module 2	844-00521-0	JOE, HEX, VIC, YakimaYellow
	Color module 3	844-00522-0	TAMRA, DFO, Alexa546, NED
	Color module 4	844-00523-0	ROX, TexasRed, Cy3.5
	Color module 5	844-00524-0	Cy5, Alexa633, Quasar670
	Color module 6	844-00525-0	Cy5.5, LightCycler Red
	FRET module 1	844-00526-0	FAM (donor) / TAMRA (acceptor)
	FRET module 2	844-00527-0	FAM (donor) / Cy5 (acceptor)
	FRET module 3	844-00528-0	FAM (donor) / Cy5.5 (acceptor)
	FRET module 4	844-00529-0	JOE (donor) / Cy5 (acceptor)
	FRET module 5	844-00531-0	FAM (donor) / ROX (acceptor)
	Color module Protein 1	844-00530-0	SYPRO Orange

Electrical connection requirements	Operating voltage	100 / 115 / 230 V (AC)
	Line frequency	50 to 60 Hz
	Power consumption	≤ 850 W
	Device fuses	2 x 10 AT / 250 V

Minimum PC requirements	Processor	Intel Core 2 Duo
	Working memory	2048 MB RAM
	Display resolution	Min. 1280 x 1024 pixels
	Operating system	Windows 7 or higher
	Interface	USB 2.0 for device connection

Software	qPCRsoft	Control and analysis program
	Analysis methods	<ul style="list-style-type: none"> <li>▪ Absolute quantification</li> <li>▪ Relative quantification</li> <li>▪ <math>\Delta\Delta C_t</math> method</li> <li>▪ Allelic discrimination</li> <li>▪ Efficiency calculation</li> <li>▪ DNA melting curves</li> <li>▪ POS/NEG analysis in the end point</li> </ul>
	Export functions	Excel, CSV, LIMS, GenEx, qBase+, GeneIO

## 11.2 Ambient conditions

	Operation	Transport, storage
Temperature range	+15 °C to +35 °C	+5 °C to +55 °C
Max. humidity	70 %	10 % to 30 % Use desiccant!
Max. permissible height	2000 m	
Air pressure	0.7 to 1.06 bar	
Work environment	Only suitable for operation in rooms	

## 11.3 Standards and directives

Protection class and protection type	The device is protection class I. The housing is protection type IP 20.
Device safety	The device complies with the following safety standards <ul style="list-style-type: none"> <li>▪ EN 61010-1</li> <li>▪ UL 61010-1</li> <li>▪ CAN/CSA-C22.2 61010-1-12</li> </ul>
EMC	The device has been tested for radio interference suppression and immunity and fulfills the requirements stipulated by <ul style="list-style-type: none"> <li>▪ EN 61326-1, interference immunity</li> <li>▪ EN 61326-1, interference emission (class A)</li> </ul>
US regulations	The device meets the requirements of Part 15 of the FCC regulations (Federal Communications Commission Advisory). The following two requirements pertain to operation: (1) The device does not cause interference, and (2) the device is resistant to interference, including such interference as is liable to cause malfunctions. The device meets the requirements of Part 18 of the FCC regulations.
Canada regulations	The device meets the requirements of Canadian industry standard ICES-001 (Interference-Causing Equipment Standard).
Guidelines for China	The device contains substances subject to regulation (according to the directive GB/T 26572-2011). Analytik Jena guarantees that, if the device is used as intended, these substances will not leak within the next 25 years and therefore will not pose a threat to the environment or health within this time period.
EU directives	The device meets the requirements of the directive 2011/65/EU.  The device is designed and tested in accordance with standards meeting the requirements of EU directives 2014/35/EU and 2014/30/EU. The device leaves the factory in a sound condition with regard to technical safety. To maintain this condition and to ensure safe operation, the user must strictly observe the safety and operating instructions contained in this operating manual. For accessories delivered with the device and system components from other manufacturers, the information provided in their respective operating manuals has priority.

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