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Operating Manual

qTOWER³ auto / qTOWER³ 84 auto
Real-Time PCR Thermal Cycler

Manufacturer

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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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Technical Documentation Analytik Jena GmbH+Co. KG

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1 Notes on this operating manual

This operating manual describes the following thermocycler models:

- qTOWER³ auto
- qTOWER³ 84 auto

In the text below, these devices are collectively called qTOWER³ auto, 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.

In addition, these instructions include the description of the Power Modul qTOWER³ auto power module, which supplies the thermocycler with power.

The operating manual describes the design and function of the device, and 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).
- 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.

WARNING

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

CAUTION

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

NOTICE

Provides information on potential material or environmental damage.

2 Intended use

NOTICE

The device is intended for **general laboratory use**.

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.

Thanks to a modular design that has been specially adapted to meet the requirements of automation technology, the device can be used for all relevant real-time PCR applications,for example for the detection of pathogens, gene expression analysis, SNP genotyping or mutation detection, as well as for experimental studies with increased sample throughput.

The integrated detector allows measurement of the sample flourescence 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.

In addition to the optical components for the detection of real-time signals, the amplification of the target sequences plays a central role. With Peltier technology and the use of high-quality block materials, the device boasts superb thermal homogeneity, maximum speed and accuracy.

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 auto 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
  - ΔΔCt 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.

References to potential hazards do not replace the work protection regulations which must be observed.

The device meets all EMC requirements for commercial and industrial use and for use in small businesses!

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+Co. KG warrants that these substances will not be released from the device within the next 25 years provided the device is employed as intended.

Further symbols can be found on the type plate (→ "Type plate" 🖹 19).

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 drawer has become contaminated with hazardous substances. Suitable disinfection agents and procedures are described in "Disinfecting the device" (→ "Disinfecting the device" 28).

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.
- Risk of crushing when moving the drawer.
- The thermal block, the samples, and the heated lid reach high temperatures. There is a risk of burns during contact.
- 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 boasts a modular design concept, comprising a block cycler unit with fluorescence spectrometer and a power module unit (controller). Depending on the block system used, 96 or 384 samples may be processed per run. The device is suitable for use in a robotic system, where up to 4 devices can be integrated and controlled simultaneously using a PC. A CyBio Composer or .dll can be used to integrate the devices.

The patented high-performance optics, comprising a fiber-optic shuttle system and unique light source, guarantee a superb homogeneous excitation and illumination of all individual samples. The light source comprises 4 high-performance LEDs with a broad spectrum reaching deep into the red. In combination with specially optimized filter modules comprising one emission and one excitation filter, a broad spectrum of fluorophores can be specifically excited and detected. Depending on the application, up to 6 filter modules may be mounted in one device, whereby the simultaneous analysis of up to 6 target sequences may take place in a well.

A recalibration of the system after replacing the filter modules is not necessary here.

Fig. 1 Devices

1 qTOWER³ auto
2 qTOWER³ 84 auto
3 Power Modul qTOWER³ auto

qTOWER³ auto

The device combines a PCR thermocycler with a patented fluorescence photometer.

The status LED on the front of the device informs the operator about the current device status (active/inactive).

Fig. 2 Front view

1 Upper part with fluorescence photometer
2 Status LED (indicates whether the device is switched on or off)
3 Drawer
4 Block cycler unit

The movable drawer which can be moved in and out depending on the operating state of the device provides maximum flexibility for system integrators. With easy access to the extended drawer, the sample carrier (micro titer plate) can be easily positioned on the drawer without any problems.

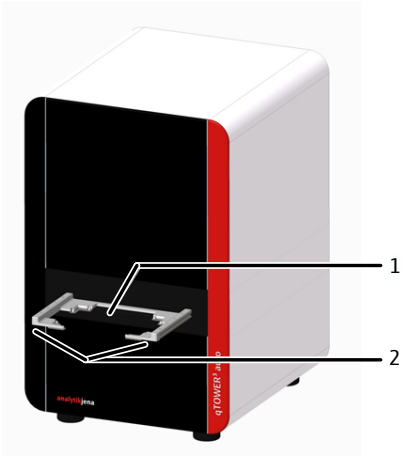


Fig. 3 Device with extended drawer

1 Drawer
2 Guide tracks of the drawer

Once a sample carrier has been positioned on the drawer and moved into the device, this is positioned above the thermal block and the front flap closes and locks automatically.

NOTICE

Never attempt to pull the drawer out or push it in manually! All movements of the drawer (moving in/out) are exclusively controlled by the software commands in the software or using an external communication software.

The electrical connections, the fans and the interface for PC connection are located on the rear of the device.

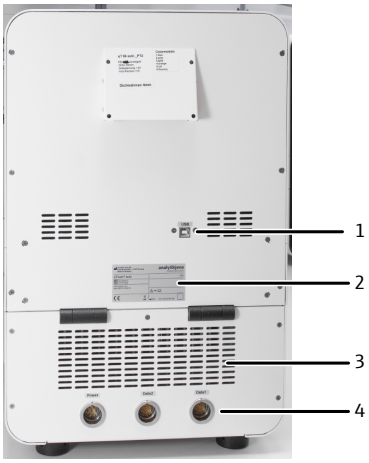


Fig. 4 Rear view

1 Interface for the connection cable to the connected PC
2 Type plate
3 Fan grille
4 Electrical connections:
- DATA 1 connection (lid heating – communication lines)
- DATA 2 connection (thermoblock sensor connection)
- Mains power connection (Power)

Power Modul qTOWER³ auto

The power module supplies power to the device. The external solution allows for flexibility with regards to installation or integration in automation systems.

The operating state (active/inactive) is indicated by the status LED on the front side of the power module. The connections for Data 1, Data 2 and Power are also located here.

Fig. 5 Power module front view

1 Status LED (indicates whether the device is switched on or off)
2 DATA 2 connection (thermoblock sensor connection)
3 DATA 1 connection (lid heating – communication lines)
4 Mains power connection (Power)

A service connection, a mains connection socket, the fuse compartment and the power switch are located on the rear of the device.

Fig. 6 Power module rear view

1 Service connection
2 Network interface (LAN)
3 Type plate
4 Mains connection socket
5 Fuse compartment
6 Warning note
7 On/Off switch

Accessories

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

- Power cable
- USB cable
- Ethernet cable
- Data cables (for the DATA 1 and DATA 2 connections)
- Power cable
- CD or USB stick with qPCRsoft auto software, with manual for software and device
- Operating instructions and software manual
- Packaging and packaging instructions

Fig. 7 Power and USB cables, Ethernet 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 detector unit for a thermal block with 384 wells is a patented 16-channel epi-fluorescence photometer with fiber multiplexer and a mechanical scanning device.

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

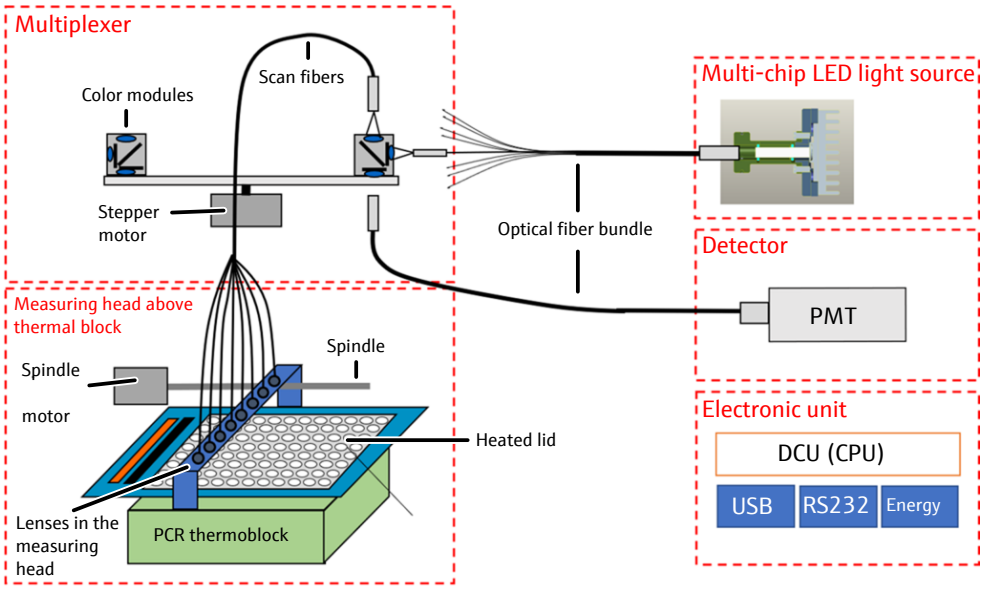


Fig. 8 Schematic representation of the fluorescence spectrometer

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.

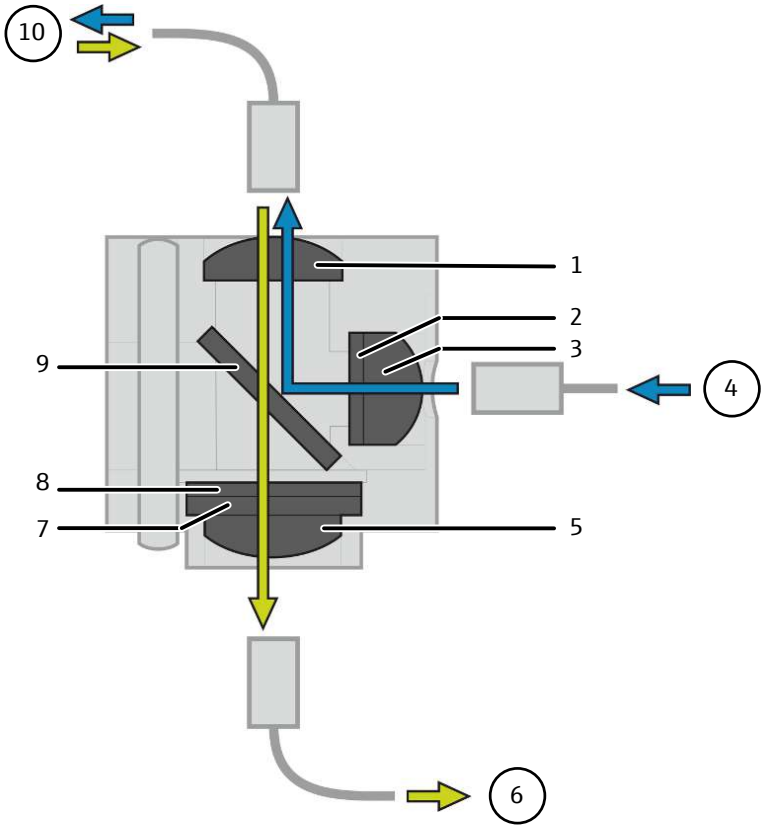


Fig. 9 Schematic representation of the light beam path through a filter color module

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.

Retrofit or replacement of the installed modules may be carried out by the Analytik Jena service team at any time.

NOTICE

If you intend to extend the application spectrum of the device with regard to using filter modules, always contact the service department because extensions – to be performed by the operator himself – are **not** intended by the manufacturer.

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 5.5 °C/s.

The thermal block with 384 wells is made of aluminum that conducts heat very well. This achieves a high temperature homogeneity and uniformity in combination with heating rates of up to 4 °C/s and cooling rates of up to 2 °C/s .
This powerful thermal block is suitable for high-throughput applications in particular.

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

NOTICE

The device is only intended for use with micro titer plates and sealing foils made of special plastic materials that are verified for automation processes.

Microtiter plates verified for automated PCR and qPCR applications have gripper positions and a full skirt. Furthermore, they should also be stackable.

For the operation of the device with a 96-well sample block in an automated environment, the following listed labware is recommended:

Manufacturer	Product	Order number
Sarstedt	Multiply® PCR plate, white, full-skirted	72.1980.232
Eppendorf	Twin.tec® 96 real-time PCR plate, skirted, white wells, blue frame	0030132505
Eppendorf	Twin.tec® 96 real-time PCR plate, skirted, white wells, white frame	0030132513
Biozym	Classic: 96 well micro plate, fully skirted, white	710873
4titude	Framestar: 96 well microplate, fully skirted, white wells, black frame	4ti-0961

Manufacturer	Product	Order number
BRAND	96 well PCR plates, white, low profile	781364 781365
Labcon	96 well PCR plates, white, skirted	3968-520-000

For the operation of the device with a 384-well sample block in an automated environment, the following listed labware is recommended:

Manufacturer	Product	Order number
4titude	Framestar: 384 well microplate white wells, black frame; 50 plates	4ti-0385
Eppendorf	Twin.tec® 384 real-time-PCR plate skirted, white Wells, white frame	0030132734
BioRad Hardshell	Hard-Shell® 384-Well PCR Plates, thin wall, skirted, black/white	HSP3865

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. It provides the following information shown in the figure:

- Manufacturer and address
- Protection class of the housing
- Safety symbols (Caution: Observe the accompanying documents!
- Device number
- Year of manufacture
- Disposal instructions (Do not dispose of as domestic waste!)
- Conformity and test sign
- Electrical connection data
- Serial number
- Order number
- 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" 36). 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

The opened device has a spatial requirement of 47.9 cm x 31 cm x 47.7 cm (H x W x D). In addition, keep a safety distance of at least 10 cm to other equipment or walls.

Also, set up the device at a minimum distance of 15 cm between the rear of the device and the wall or other objects.

The power module has a spatial requirement of 18.6 cm x 29 cm x 33.5 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 commissioning, please make sure that the operating voltage is the same as the mains voltage.

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	50/60 Hz
Power consumption	950 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.

NEVER connect or disconnect the power cable from the socket when the green status LED is lit on the power module and the device.

NOTICE

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

NOTICE

Severe damage to the box and/or the packaging material may indicate damage to the device or the power module, and must be immediately reported to Analytik Jena.

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

- Connecting the device to the mains and the PC
- Connecting the power module to the mains network
- Installing software on the PC

▶ Remove the device, the power module, the connection cables and the operating manual with the installation CD or USB stick from the transport packaging.

▶ Place the device and the power module on a stable, even surface in a secure, dry place. Wait until the device has reached room temperature for commissioning (acclimatization time approx. 2 hrs).

▶ Check the delivery for completeness (and ensure that it matches the order). Check the device and accessories for transport damage.

If the delivery is incomplete or the device is damaged, please immediately contact Analytik Jena or the dealer responsible.

Keep the original packaging for a possible return. If you have a complaint, the device must be returned in its original packaging. Transport damage caused by poor packaging is excluded from the warranty. Further information can be found in "Transport and storage" (→ "Transport and storage" 30).

Components	Quantities
qTOWER³ auto	1
Power module	1
Power cable	1
USB connection cable	1
Data cable (for data 1 and data 2 connections)	2
Power cable	1
qTOWER3 auto operating manual (EN)	1
Software incl. operating instructions	1
Ethernet cable	1

- Set the power switch on the rear of the power module to OFF.
- Connect the power cable to a grounded socket (100 V to 230 V). Observe the voltage rating on the type plate beside the power cable on the rear of the power module for this.

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.

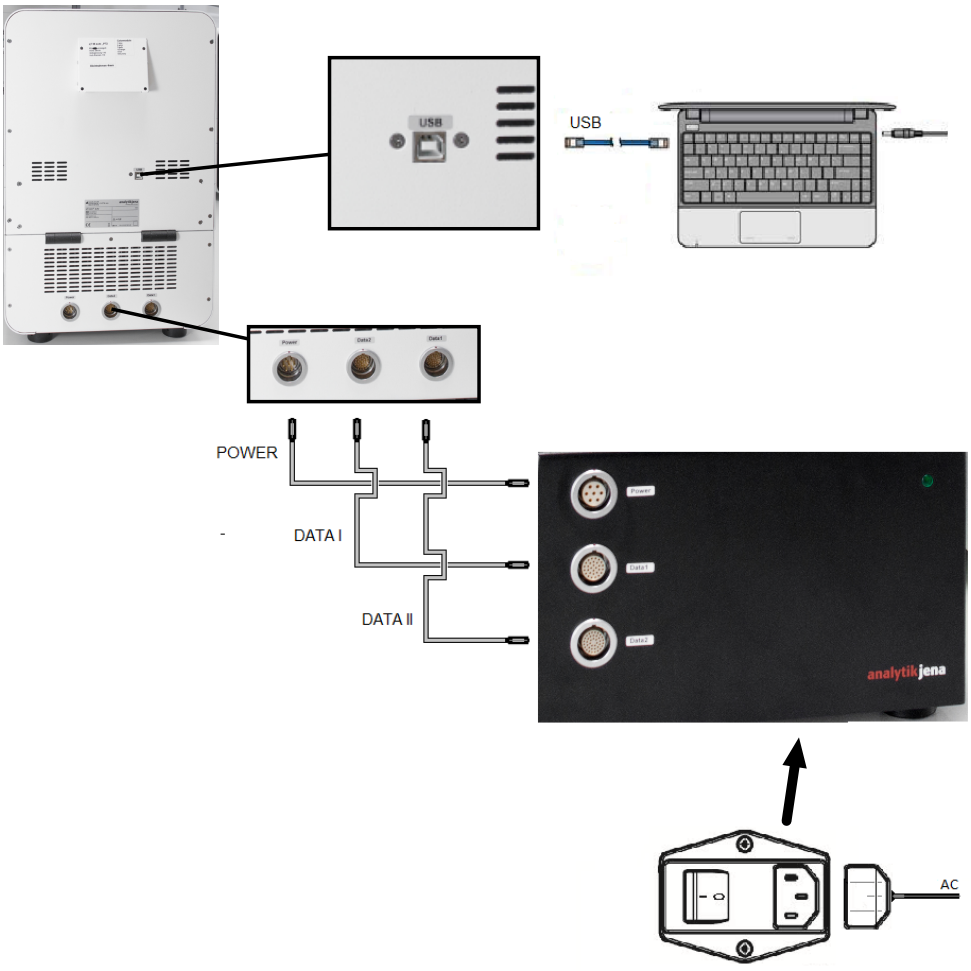


Fig. 10 Device connections

- Connect the USB cable to the USB port of the device and connect it to the PC. Alternatively, the device can be controlled via Ethernet. Connect the LAN to the power module for this.

Fig. 11 Connection on the rear of the device

- Connect the power cable and the two data connection cables to both the device and the power module. The connection cables are correctly connected as soon as the push-pull locking mechanism engages in the locked position. Before release, first push back the outer sleeve.
- Remove the transport lock and put it aside for later transports.
- Switch on the PC. Install the software on the PC. Observe the information in the software manual for this.

  ✓ The device is ready for commissioning.

6 Operation

6.1 Switching the device on and off

Switching on the device

NOTICE

Remove the transport lock before commissioning. Keep this for subsequent transports.

- Switch on the device via the power switch of the power module. The status LED on the power module flashes green and the device begins automatic initialization, checking the control electronics and all motorized components.
  - ✓ After initialization, the status LED is lit continuously in green. The device is operational.
- 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.

CAUTION

Hot surfaces

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

NOTICE

The device is only intended for use with micro titer plates and sealing foils made of special plastic materials that are verified for automation processes.

Micro titer plates verified for automated PCR and qPCR applications have gripper positions and a full skirt. Furthermore, they should also be stackable.

These and other consumables can be ordered from Analytik Jena.

The recommended plastic products from other manufacturers are listed in the corresponding section of this operating manual.

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, floures-cence measurement and sample layout of the PCR plate.
- Allow the drawer to extend and place the sample carrier on the drawer. Ensure that well A1 is on the left-hand side.

NOTICE

Never attempt to pull the drawer out or push it in manually. This may damage the device.

- Start the PCR run. The drawer with the sample carrier is automatically inserted into the device and the PCR program is processed step-by-step.

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 ≤ -100	Device error in the optical unit of the fluorescence photometer
-99 ≤ x ≤ -10	■ Software error (e.g., in the settings) ■ Data communication error
-9 ≤ x ≤ -2	General device error
-1	Does not indicate an error condition
x ≥ 0	PCR thermocycler: Device error

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!

Information on errors or malfunctions

Error/malfunction	Possible cause(s)	Suggested solution
Power supply interrupted		Check all connecting cables incl. connectors. Note: Power supply via the power module is ensured if the LED is permanently lit green.
Power failure	No device-specific causes; failure caused by lack of power supply	The device is restarted when power has been re-established.
Fuse failure		Replace the fuse.
Repeated fuse failure	Permanent electronics error	Contact customer service.
Status LED is lit in red	Indicates a device error	Check the error message in the software. Contact customer service.
Sample carrier jammed	Position error	If the sample carrier is already in the device, contact customer service!
Drawer does not move	Mechanical or electrical failure	Contact customer service.
Drawer makes strange noises when moving		Contact customer service.

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.

We recommend regularly performing the following maintenance and care tasks at the specified intervals, taking the following information into account:

Maintenance and repair work	Monthly	Every six months
Checking the drawer of the device	X	
Checking the electrical components and cables, protective conductor test (Trained electricians only!)		X

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.

- Contamination and natural wear of assemblies leads to higher stress on the device and thus to a higher probability of device failure.
- All motor-operated or manually operated parts in the device are subject to natural wear. Pay attention to signs of wear on mechanically stressed assemblies and have them replaced if necessary.

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 devices become contaminated during daily use, cleaning with a damp cloth is sufficient.

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

8.2 Checking the drawer

The guide tracks of the drawer of the device must be regularly checked for dents, burrs or deformations. If the device exhibits any defects, please contact Analytik Jena customer service immediately.

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.

Device part	Recommended disinfectants	Provider
Housing	Descosept Spezial	Dr. Schuhmacher GmbH

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

- If disinfection agents with different ingredients or concentrations than the recommended disinfection agents are used, no liability can be accepted for any damage to the device or the effectiveness of the decontamination.
- Disinfectants other than those listed may only be used after consultation with Analytik Jena.
- If the device must be sent back to Analytik Jena for servicing, first perform decontamination and document this (→ "Return" 31).

8.4 Replacing fuses

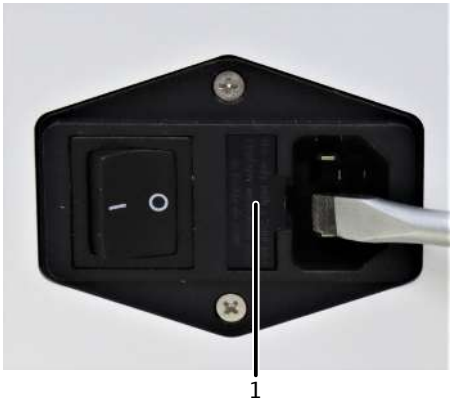
WARNING

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.

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 drawer must be installed.

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

Installation is software-controlled:

- In the software, select menu item **Extras** | **Transport lock** and follow the instructions on the screen.
- Position the transport lock in the drawer according to the instructions.

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" 36).

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

	qTOWER³ auto	qTOWER³ 84 auto
Dimensions (height x width x depth)	47.9 cm x 31 cm x 36.5 cm 47.9 cm x 31 cm x 47.7 cm with drawer extended	
Mass	27 kg	
Noise emissions	< 45 dB	
Supported plastic products	Verified for automated processes, with full skirt	
Traveling distance of the drawer	11.2 cm	
Position tolerance of the sample carrier when the drawer is moved out	± 0.15 mm	
Safety circuits	■ Sample chamber is monitored by sensors ■ Overtemperature protection in the heated lid ■ Interlock switch (front flap)	
Interface	USB (device) Ethernet (Power module)	

Thermal block/heated lid

	qTOWER³ auto	qTOWER³ 84 auto
Sample block	Silver (gold-plated)	Aluminum (special alloy)
Sample capacity	96	384
Sample volume	5 to 100 µl	2 to 30 µl (5 to 20 µl recommended)
Heating	Max. 8 °C/s	Max. 4 °C/s
Refrigeration	Max. 5.5 °C/s	Max. 2 °C/s
Temperature setting range	4 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 300 N, automated	

qPCR application

	qTOWER³ auto	qTOWER³ 84 auto
Sensitivity	1 nmol/l FAM at 30 µl sample volume	1 nmol/l FAM at 10 µl sample volume
Measuring time	Approx. 6 s for 96 / 384 wells for a single measurement, 6 colors	
Measurement range	± 130 000 (± 17 bit)	
Dynamic range	10 log stages	

Fluorescence spectrometer

	qTOWER³ auto	qTOWER³ 84 auto
Measuring principle	Fiber-optic shuttle system with 8-fold scanner and color modules for the excitation and emission filters	Fiber-optic shuttle system with 16-fold scanner and color modules for the excitation and emission filters
Light source	4 long-life, high-performance LEDs (RGBW)	
Color modules	■ 12 color-, FRET and protein modules ■ 6 positions in the device	
Detector	Highly sensitive PMT (photomultiplier tube) Optimum signal/noise characteristics due to efficient noise suppression	

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

Power module

Dimensions (height x width x depth)	18.6 cm x 29 cm x 33.5 cm
Mass	12 kg
Internal protection standard	IP 20
Protection class	I
Output ports	3 (Power, Data 1, Data 2)
Safety features	■ Overload detection ■ Ground fault ■ Overheating detection ■ Sheathed connectors and sockets

Electrical connection requirements

Operating voltage	100 / 115 / 230 V (AC)
Line frequency	50/60 Hz
Power consumption	950 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 or Ethernet for device connection

Software

qPCRsoft auto	Control and analysis program
Analysis methods	■ Absolute quantification ■ Relative quantification ■ ΔΔCt method ■ Allelic discrimination ■ Efficiency calculation ■ DNA melting curves ■ POS/NEG analysis in the end point
Export functions	Excel, CSV, LIMS, GenEx, qBase+, GeneIO

11.2 Ambient conditions

	Operation	Transport, storage
Temperature range	+15 °C to +35 °C	-10 °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 ■ EN 61010-1 ■ UL 61010-1 ■ CAN/CSA-C22.2 61010-1-12
EMC compatibility	The device has been tested for radio interference suppression and immunity and fulfills the requirements stipulated by ■ EN 61326-1, interference immunity ■ EN 61326-1, interference emission (class A)
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. In addition to the safety instructions in this operating manual and the local safety regulations that apply to the operation of the device, the general applicable regulations regarding accident prevention, occupational health and safety and environmental protection must be observed and complied with. References to potential hazards do not replace the work protection regulations which must be observed.

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