

T Robot
Thermocycler

Instruction Manual
Ver. 09/10

Model	Order No.
TRobot 96	050-991
TRobot 384	050-992



!! Warning !!

Please read these instructions carefully before using this apparatus!



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This document describes the state at the time of publishing. It needs not necessarily agree with future versions.

Subject to change!

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1 Introduction

1.1 Field of Applications

The Biometra TRobot is a Thermocycler that is licensed for PCR applications (research use only) and intended to be used for performing polymerase chain reactions. For integration in automated environments a Thermocycler has to meet very different needs than a bench-top instrument. Since space under the robotic arm is limited, a Thermocycler needs a small footprint. To ensure automated workflow, the instrument must have a motorized lid that allows the robotic arm to access the block easily and that is strong enough to reliably seal microplates. All features of the Thermocycler have to be controlled via user-friendly software. After cycling, plates need to be easily removed for downstream processing. These specifications were the starting point for the development of the new TRobot Thermocycler.

1.2 Special Features

- Designed specifically for robotic systems
- Integrated cycler with external controller
- Proven peltier technology
- Unique: motorized plate lifter!
- Motorized heated lid
- Lid opening angle 110°
- Adjustable lid pressure
- Small footprint
- Available with 96 well (silver) or 384 well (aluminium) block
- Low power consumption
- Communication with PC via serial RS232 protocol
- Instrument provides extensive status report

1.2.1 Motorized heated lid

The TRobot lid is powered by a two step electric motor. First, the lid closes quickly, then the second mechanism carefully interlocks the lid at the front. This ensures that a defined, reproducible pressure is applied. When the lid is closed the electric motor is uncoupled for a long life. The amount of pressure exerted by the lid can be precisely set to one of 15 different positions.

1.2.2 Reliable uniform cycling

The TRobot Thermocycler is available in two different block formats. Taking advantage of the high thermal conductance of silver the TRobot 96 achieves high ramping rates as well as excellent temperature uniformity. The silver block is coated with gold to ensure lasting performance. The TRobot 384 block is made of aluminium and achieves perfect fit for 384 well microplates (050-231). The 384 well block is coated with a special alloy, which supports easy removal of plates by the motorized lifter.

1.2.3 Small footprint

To produce a compact instrument, the TRobot block module has been separated from the controller unit. Thus the controller can be placed outside the workstation. By switching the Thermocycler chassis, the airflow direction can be inverted (front to back or vice versa). This minimizes contamination due to air flowing towards a liquid handler or other components.

1.2.4 Motorized plate lifter

Removing plates from the block has been one of the major obstacles to Thermocycler automation. Due to the tight fit, air between the block and the plate is displaced during cycling

causing microplates to stick. This makes it difficult for the plates to be removed by a robotic arm. To solve this problem the TRobot is equipped with four levers that lift the plate from the block as the lid opens. Once lifted, the plate can be easily removed by a robotic arm. The levers then return to their initial position allowing a new plate to be positioned.

1.2.5 Communication with the TRobot

All features of the TRobot are controlled via its serial port. A detailed communication protocol is available (see chapter 6). Integration in existing software environments (of individual robotic stations) is very easy. In addition to controlling standard features, the TRobot can provide extensive status messages that allow monitoring of all instrument parameters. A software tool for directly operating the TRobot from a Personal Computer is also available.

1.2.6 Internal memory

The TRobot provides an internal memory organized in 10 subdirectories. Programs can be started either by downloading the protocol prior to starting this program. Alternatively, an existing program can be started from the internal memory of the TRobot.

1.3 Technical specifications

	TRobot 96	TRobot 384
Thermocycler	Remote Thermocycler with motorized heated lid	Remote Thermocycler with motorized heated lid
Capacity	96 well microplate	384 well microplate
Block	96 well gold plated silver block	384 well aluminium block, special coating
Max. heating	3,5 °C/sec	1,0°C/sec
Max. cooling	2,5 °C/sec	1,0 °C/sec
Temperature range	-3,0 – 99,9°C	-3,0 – 99,9°C
Temperature uniformity	+ 0,5°C	+ 0,5°C
Control accuracy	+ 0,1°C	+ 0,1°C

Heated Lid		
Temperature range	30 – 99°C	30 – 99°C
Pressure range	0 – 10 kg/plate, adjustable in 15 increments	0 – 10 kg/plate, adjustable in 15 increments
Max. opening angle	110°	110°
Two step electric motor	Yes	Yes
Front locking mechanism	Yes	Yes
Motorized plate lifter	Yes	Yes

Thermocycler dimensions		
Footprint (W x L)	168 x 226mm	168 x 226 mm
Height (lid closed)	195mm	195mm
Height (lid opened)	306mm	306mm
Weight	7 kg	7 kg
Interface	37 pin (controller), 10 pin (power)	37 pin (controller), 10 pin (power)

Controller		
Input voltage	100, 115, 230 Volt	100, 115, 230 Volt
Maximum power consumption	350 Watt	350 Watt
Interface	37 pin (controller), 10 pin (power) serial RS232	37 pin (controller), 10 pin (power) serial RS 232
Dimensions (W x L x H)	190 x 440 x 125 mm	190 x 440 x 125 mm
Weight	5,9 kg	5,9 kg

1.4 Legal Notes

1.4.1 PCR License – Legal Disclaimer

Purchase of a Biometra Thermocycler conveys a limited non-transferable immunity from suit for the purchaser's own internal research and development and applied fields other than human in vitro diagnostics under one or more of US Patents Nos. 5,038,852, 5,656,493, 5,333,675, 5,475,610, and 6,703,236, or corresponding claims in their non-US counterparts, owned by Applera Corporation.

No right is conveyed expressly, by implication or by estoppel under any patent claim, reagents, kits, or methods such as 5' nuclease methods, or under any other apparatus or system claim, including but not limited to US Patent No. 6,814,934 and its non-US counterparts, which describe and claim thermal cyclers capable of real-time detection.

Further information on purchasing licenses may be obtained by contacting the Director of Licensing, Applied Biosystems, 850 Lincoln Centre Drive, Foster City, California 94404, USA.

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1.4.2 Copyright

All rights reserved. It is not allowed to copy and publish the manual or parts of it in any form as copies, micro film or other methods without a written authorisation from Biometra. Biometra is pointing out that applied company and brand names are usually protected trade marks.

1.4.3 Liability





Biometra is not liable for damages and injuries caused by use not considering these operating instructions in parts or completely.

1.4.4 Meaning of the Instructions

Biometra recommends that you first read these instructions carefully. This operation instruction is part of the product and should be kept over the full life-time of the instrument. It should also be forwarded to subsequent owners and users. Make sure that additions and updates are inserted into the operation instructions.

2 Safety and Warning Notices

2.1 Definition of Symbols

<u>Symbol</u>	<u>Definition</u>
	Caution! Refer to instruction manual! <i>Achtung! Beachten Sie die Hinweise im Handbuch</i>
	Danger! High voltage! <i>Gefahr! Hochspannung!</i>
	Fragile! <i>Zerbrechlich!</i>
	Danger! Hot surface! <i>Gefahr, Heisse Oberfläche!</i>

Please read this manual carefully before starting operation of the TRobot Thermocycler. The TRobot Thermocycler is intended for sample incubation at varying temperatures.

- General safety precautions for laboratory work must be observed when working with the TRobot Thermocycler.
- The TRobot does not produce a sound power level that could be hazardous for the user.

The thermoblock and the heated lid will reach high temperatures during operation. Both thermoblock and heated lid can burn you.

Das schnelle Heizen des Thermoblocks kann dazu führen, dass Flüssigkeiten explosionsartig verkochen. Verwenden Sie daher immer eine Schutzbrille während des Betriebs! Schliessen Sie vor dem Start eines Programms den Deckel des Gerätes!



Rapid heating of the thermoblock can cause liquids to boil explosively. Always wear safety goggles and gloves during operation. Close the lid before starting a program.

Das schnelle Erhitzen von Flüssigkeiten kann zu plötzlichem Überkochen führen. Tragen Sie daher immer Schutzbrille und Handschuhe während des Betriebs. Schliessen Sie den Deckel bevor Sie ein Programm starten.

Do not heat samples without having the lid locked securely.



Stellen Sie vor Programmstart sicher, dass der Deckel sicher geschlossen ist!

Be aware that samples are reaching high temperatures. Do not touch or open hot tubes or microplates, because hot liquid may quickly spill out.



Die Proben können hohe Temperaturen erreichen. Fassen Sie heiße Probengefäße oder -platten nicht an und öffnen Sie diese nicht, andernfalls kann kochende Flüssigkeit herausspritzen!

Do not touch the heated lid.



Fassen Sie nicht an den Heizdeckel!

Use only suited plastic ware in the TRobot thermocycler. Tubes and plates must show good fit when placed in the thermoblock. Only use tubes that are suited for high temperatures (tight lids).



Benutzen Sie nur Platten und Gefäße, die für hohe Temperaturen (bis 100°C) geeignet sind, die gut in den Thermoblock passen (kein Wackeln) und deren Deckel dicht schliessen!

The TRobot Thermocycler contains no user serviceable parts. Do not open the housing instrument. Service and repair may only be carried out by the Biometra Service department or otherwise qualified technical personal.



Der TRobot Thermocycler beinhaltet keine Teile, die vom Anwender gewartet oder repariert werden können. Öffnen Sie nicht das Gehäuse des Thermocyclers! Lassen Sie Service und Reparaturen von der Biometra Service Zentrale oder von qualifiziertem Fachpersonal durchführen.

Do not use the instrument when damages of the housing, block, cable or other parts are visible.



Benutzen Sie den TRobot Thermocycler nicht, wenn Beschädigungen am Block, Gehäuse, Kabel oder an anderen Teilen erkennbar sind.

Prior to connecting the unit to the power source please ensure that the voltage selector at the backside of the controller is set to the required voltage and make sure that the appropriate fuses are inserted in the fuse holder (see chapter 3.3).



Stellen Sie vor dem Anschalten sicher, dass die Einstellung des Spannungswahlschalters auf der Rückseite des Controllers mit der Netzspannung übereinstimmt und die passenden Sicherungen im Sicherungshalter eingesetzt sind (siehe Abschnitt 3.3).

Make sure that the main supply voltage is in accordance with the label above the power connection.



Die Netzspannung muß mit dem Wert auf dem Typenschild über dem Netzanschluss übereinstimmen.

Unplug the power cable before you open the TRobot Thermocycler.
Danger of electric shock!



Vor dem Öffnen des Gehäuses unbedingt den Netzstecker ziehen. Gefahr eines elektrischen Schlages!

Make sure that the appliance connector and the plug of the supply cord are accessible, so you can separate the instrument from the mains.



Stellen Sie sicher, dass der Netzschalter und das Netzkabel gut zugänglich sind, so dass das Gerät im Bedarfsfall von der Netzspannung getrennt werden kann.

Connect the TRobot Thermocycler to a grounded socket.



Schliessen Sie den TRobot Thermocycler an eine geerdete Steckdose an.

When only few samples are put in the block place additional tubes in the four corner positions. This is to evenly distribute the lid pressure and prevents single tubes from excessive pressure. Use of few tubes may result in damage of the tubes by excessive pressure.



Sofern nur wenige Proben behandelt werden, bitte zusätzlich jeweils ein (leeres) Gefäß gleicher Höhe in die Eckpositionen des Blocks setzen. Bei einer zu geringen Probenzahl im Block besteht die Gefahr, dass Gefäße beschädigt werden.

Appropriate safety regulations must be observed when working with infectious, pathogenic or radioactive material. Ask the responsible local safety inspector for details.



Wenn pathogene, radioaktive oder infektiöse Proben behandelt werden, müssen die einschlägigen Sicherheitsbestimmungen berücksichtigt werden. Fragen Sie den für Ihren Standort zuständigen Sicherheitsbeauftragten für Details.

The TRobot Thermocycler must not be used with explosive, flammable or volatile liquids.



Der TRobot Thermocycler darf nicht mit brennbaren, explosiven oder flüchtigen Substanzen betrieben werden.

Do not place fingers between lid and housing when opening or closing the lid.



Beim Öffnen und Schliessen des Deckels keine Finger zwischen Block und Deckel bringen. Gefahr von Quetschungen!

It is not necessary to apply oil into the opening of the block in order to improve the heat transfer between the block and the sample tubes.

If you still decide to use oil, **do not** use silicon oil. Mineral oil may be used.



Die Verwendung von Öl zwischen Proben und Block für einen besseren Wärmeübergang ist nicht erforderlich. Sofern Sie dennoch Öl einsetzen wollen, auf keinen Fall Silikonöl, sondern Mineralöl verwenden.

Ensure that both the rear and bottom ventilation slits not clogged by dust or other material. Danger of overheating!



Stellen Sie sicher, dass die Lüftungsschlitze an der Unter- und Rückseite frei zugänglich und nicht durch Staub oder andere Materialien verstopft sind. Gefahr der Überhitzung!

Let equilibrate the TRobot Thermocycler to room temperature before starting operation.



Insofern der TRobot transportiert wurde, das Gerät bitte vor dem ersten Anschalten auf Raumtemperatur equilibrieren lassen (1 bis 6 Stunden).

There must be sufficient distance between the ventilation slots on the front and rear side of the Thermocycler and a wall or another instrument (min 10 cm). Danger of overheating!



Das Gerät sollte mit einem Mindestabstand von 10 cm zwischen der Geräterückseite und einer Wand oder anderen Gegenständen aufgestellt werden. Gefahr der Überhitzung!

This instrument is designed and certified to meet EN 61010-1 safety standards. It should not be modified or altered in any way. Alteration of this instrument will void the warranty, void the EN61010-1 certification, and create a potential safety hazard.



Das Gerät ist gebaut und zertifiziert nach dem Sicherheitsstandard EN 61010-1. Es darf in keiner Weise modifiziert werden. Jegliche Veränderung des Gerätes führt zum Verlust der Garantie, der EN 61010-1 Zertifizierung und ist eine potentielle Gefahrenquelle.

Place the TRobot Thermocycler on a stable, non flammable surface in a dry, safe environment.



Stellen Sie den TRobot Thermocycler auf eine stabile, nicht entflammbare Unterlage in einer sicheren und trockenen Umgebung.

The TRobot is designed for operation in robotic workstations. Access during operation should be restricted. The instrument is equipped with a motorized lid that opens and closes automatically. Never put your hands inside the instrument during the motorized lid is in action! The closing lid exerts significant pressure and can cause bruises when operated improperly.



Der TRobot ist für die Integration in automatisierte Anlagen konzipiert. Während des Betriebs sollte für Anwender kein Zugang zum Gerät möglich sein. Das Gerät ist mit einem motorisierten Heizdeckel ausgerüstet, der beim Schließen erhebliche Kraft ausübt. Beim Schließen des Deckels niemals die Hände in den Thermocycler halten! Durch die Kraft des Deckels besteht bei unsachgemäßer Handhabung die Gefahr von Quetschungen.

Do not use alcohol (e.g. methanol, ethanol), organic solvents or abrasives to clean the instrument.



Verwenden Sie keine Alkohole (Methanol, Ethanol), organische Lösungsmittel oder Scheuermittel zur Reinigung des Instruments. For transports always use the original Biometra box.



Verwenden Sie zum Transport des Gerätes ausschliesslich die Biometra-Originalverpackung.

3 Installation

3.1 Content of delivery

- 1) TRobot Thermocycler
- 2) Controller, TRobot
- 3) Manual
- 4) Thermocycler Manager Software

Please keep the original packaging material for return shipment in case of servicing. The TRobot shipping box provides a specially developed system for contact-free transport of this electronic device.

3.2 Unpack and Check

Unpack and carefully examine the instrument. Report any damage to Biometra. Do not attempt to operate this device if physical damage is present.

Please keep the original packing material for return shipment in case of service issues



!! Attention !!



Please fill out and send back the warranty registration card. This is important for you to claim full warranty.

3.3 Operation Voltage

The TRobot Thermocycler can operate at 100, 115 or 230 Volt.

Important: Prior to connecting the controller to the mains, make sure that the setting of the Voltage selector at the backside of the controller is in accordance with your mains Voltage and that it is equipped with the correct fuses.

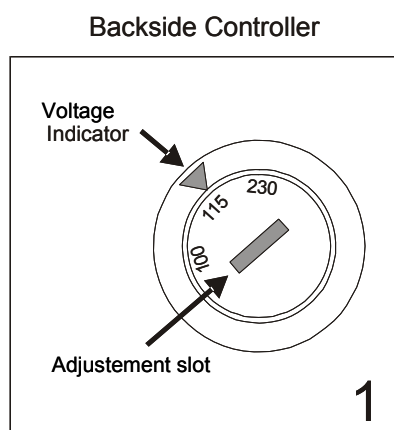


Figure 1: Voltage adjustment slot

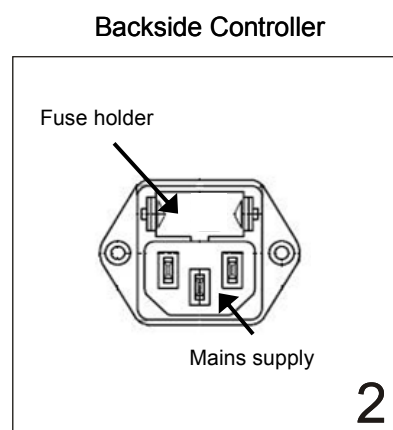


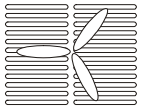
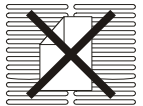
Figure 2: Fuse holder

1. To change the operation Voltage settings switch off the instrument and disconnect the mains plug.

2. Use a coin or another round shape item to turn the adjustment slot of the Voltage selector at the backside of the controller (see figure 1) to the new Voltage setting.
3. Pull out the fuse holder at the backside of the controller (see figure 2). Load the fuse holder with two fuses corresponding to the designated operation Voltage. At an operation Voltage of 230V use two slow-blow fuses of 2 Ampere (2x 2ATT), at an operation Voltage of 100 or 115 Volt use two slow-blow fuses of 4 Ampere (2x 4ATT).
4. Reinsert the fuse holder.
5. Before switching on the instrument make sure that the instrument is fully assembled (see chapter 3.4).

3.4 Installation Conditions

- Place the TRobot Thermocycler on a stable surface in a dry environment.
- Let equilibrate the TRobot Thermocycler to room temperature before starting operation (1 to 6h).
- Make sure that the appliance connector and the plug of the supply cord are accessible, so you can separate the controller from the mains.
- Make sure that the ventilation slots at the front and the rear of the TRobot are not obstructed. Make sure that there is no object in front of the Thermocycler that may block the ventilation slots at the front (e.g. a piece of paper etc.)
- There must be sufficient distance between the ventilation slots on the rear side of the Thermocycler and a wall or another instrument (min 10 cm).

 	<p>Ensure that the ventilation slots at the front and back of the instrument are unobstructed.</p> <p><i>Die Lüftungsschlitze an der Vorder- und Rückseite müssen freigehalten werden.</i></p> <p>Insufficient ventilation can cause overheating of the instrument.</p> <p><i>Eine unzureichende Belüftung kann zu einer Überhitzung des Gerätes führen.</i></p>
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- Make sure that the main supply voltage is in accordance with the label above the power connection (see section 3.3).
- Connect the TRobot Thermocycler and controller to a grounded socket.
- For installation of the TRobot connect controller and Thermocycler. Both units are connected with a power cable (9 pin) and a controller cable (37 pin). Cables and plugs are shown in Figure 3. Both cables have a length of 3m.



power cable
9 pin

controller cable
37 pin

Figure 3: Cable and plugs for connection of TRobot Thermocycler and controller unit

- Connections on the back of the Thermocycler module are shown in figure 5 (see chapter 4.2).
- The plugs fit only the correct ports. Incorrect connection is avoided.

	<p>Before connecting the unit to the power source, please ensure that the voltage selector at the back side of the controller is set to the correct voltage.</p>
	<p>Danger of electric shock! Unplug the controller mains cable and the TRobot power and controller cable (see Figures 3 and 5) before you open the Thermocycler or controller.</p>
	<p><i>Gefahr eines elektrischen Schlages! Vor dem Öffnen des TRobot oder Controllergehäuses unbedingt den Netzstecker vom Controller und das Controllerkabel und Netzkabel vom TRobot abziehen.</i></p>

4 Operating elements

4.1 The TRobot front view

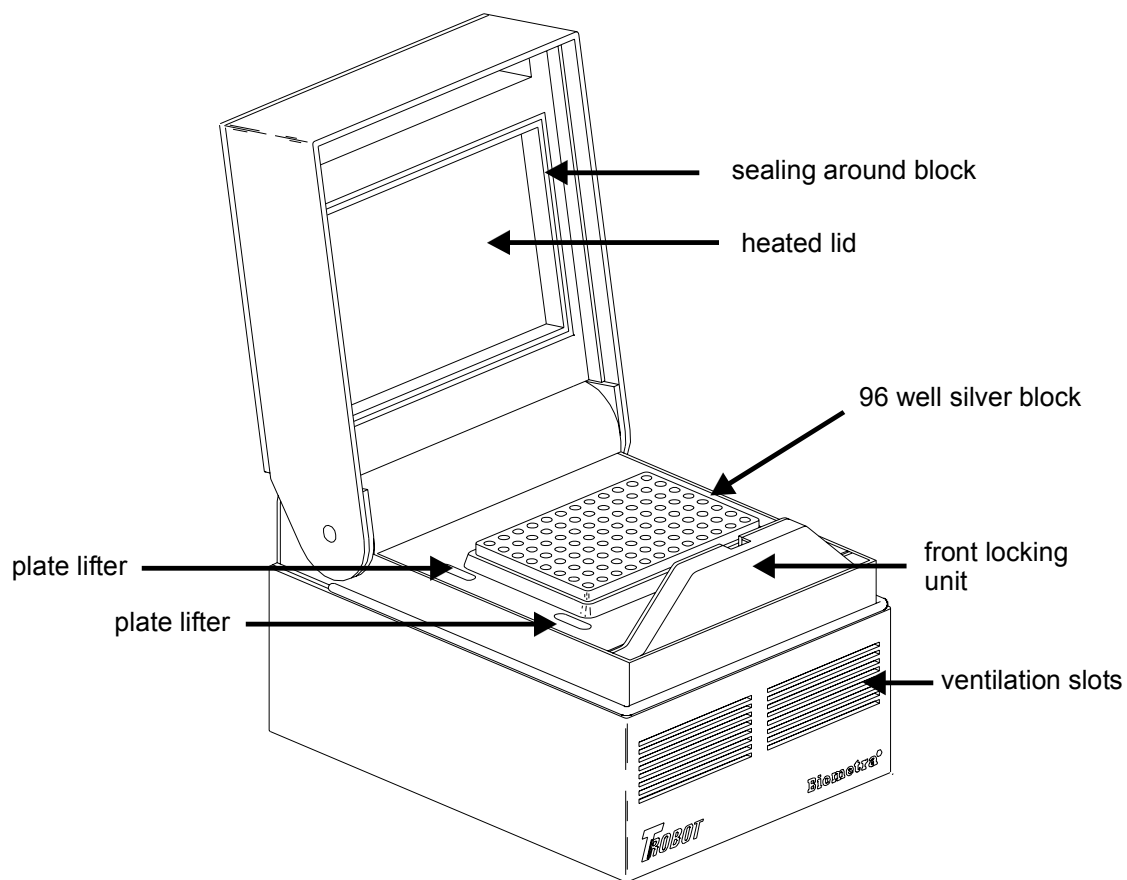


Figure 4: TRobot front view.

4.2 The TRobot rear view

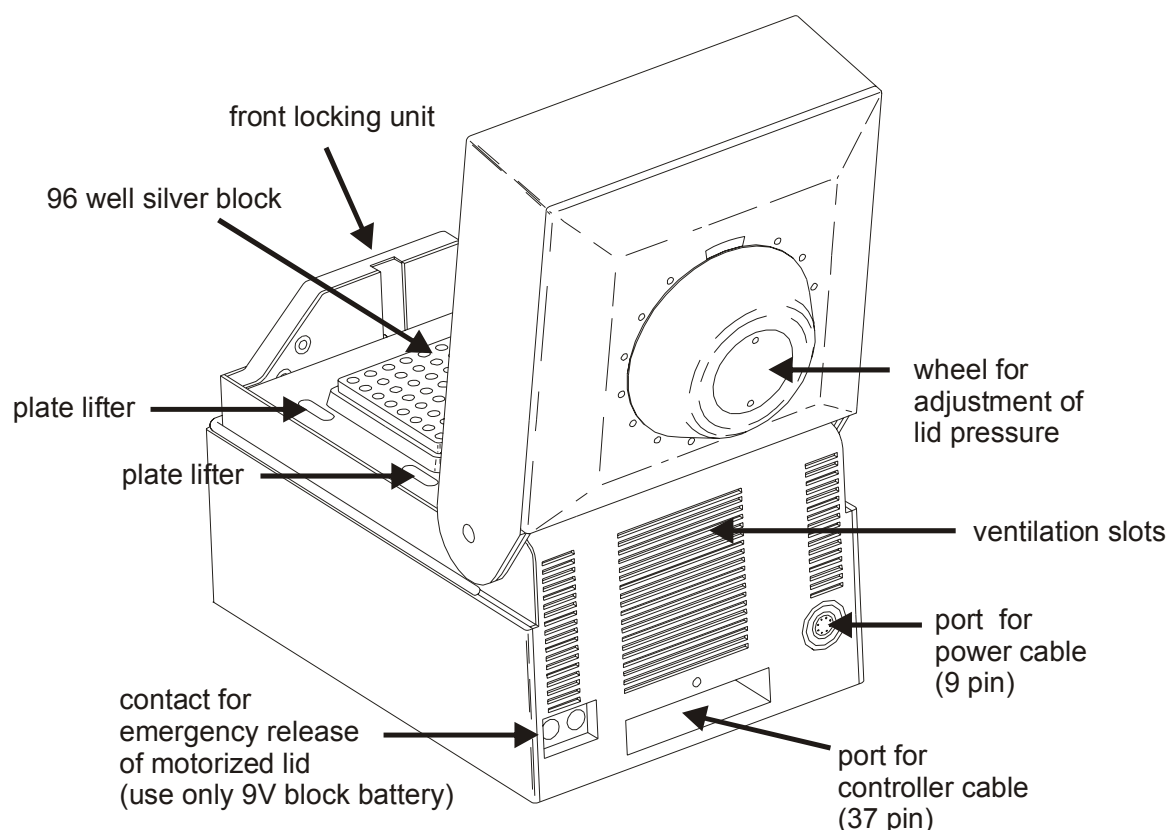





Figure 5: TRobot rear view.

	English	Deutsch
	Only use a 9V block battery to open the TRobot lid manually	Verwenden Sie ausschließlich eine 9V Blockbatterie, um den TRobot Deckel manuell zu öffnen.

4.3 Initializing motorized lid pressure

The TRobot lid pressure can be set in 15 increments. The maximum pressure on the whole block is 10kg. Before using the motorized pressure lid, it has to be adjusted to the type of plasticware. Because the plate dimensions of different suppliers significantly vary, the lid has to be adjusted to the ZERO position (no pressure, turn knob to "0").

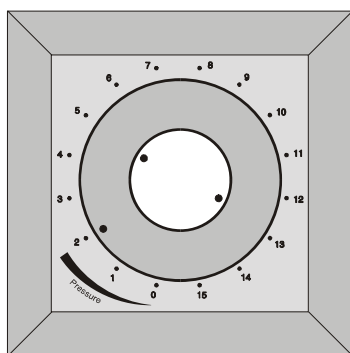
	Always unplug the power cable before you adjust the lid pressure of the TRobot!
	<i>Vor dem Justieren des TRobot Heizdeckels immer den Netzstecker ziehen!</i>

	<p>Never put your hands inside the instrument during the motorized lid is in action! The closing lid exerts significant pressure and can cause bruises when operated improperly. Biometra strongly recommends to use a 9V battery to open and close the lid (see chapter 7.4).</p> <p><i>Beim Schließen des Deckels niemals die Hände in den Thermocycler halten! Durch die Kraft des Deckels besteht bei unsachgemäßer Handhabung die Gefahr von Quetschungen. Biometra empfiehlt den Heizdeckel mittels einer 9V Batterie zu öffnen und zu schließen (siehe Abschnitt 7.4)</i></p>
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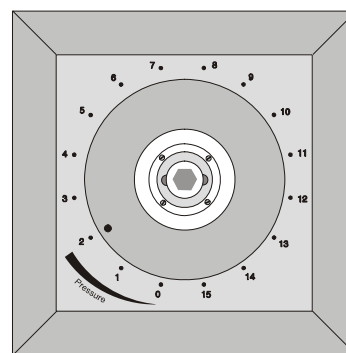
4.4 Adjust TRobot lid to zero position

The TRobot lid has to be initially adjusted to the specific type of microplates that will be used. The reason is that plates from different suppliers differ in height, which has a strong impact on the lid pressure.

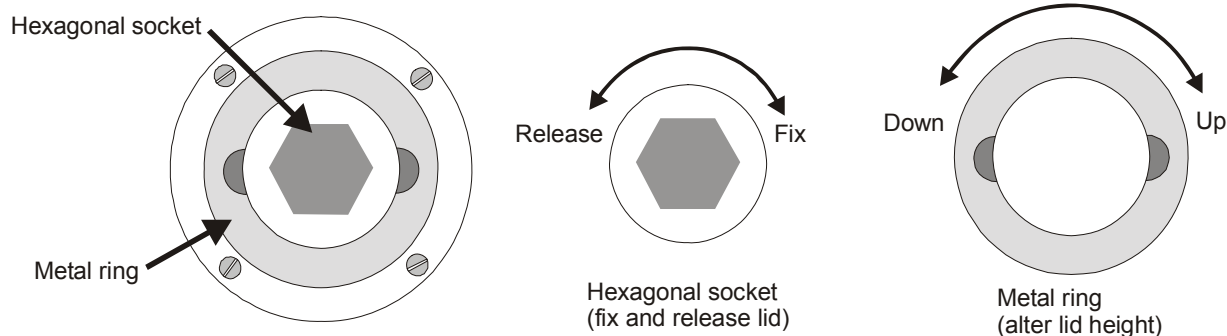
- 1) Turn the knob on the TRobot lid to "0"



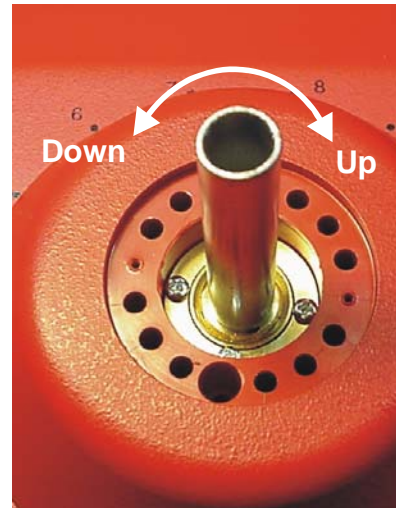
- 2) Remove the white cap on top of the knob (unscrew two screws)



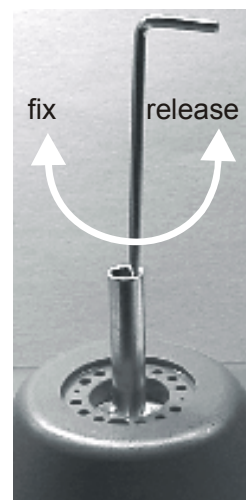
- 3) Open the TRobot lid (either by using a battery (see chapter 7.4), or with the Thermocycler Manager software)
- 4) Put the desired microplate on the TRobot block (complete with sealing!)
- 5) Close the TRobot lid (either by using a battery, or with the Thermocycler Manager software)
- 6) Release the internal heated lid by screwing the hexagon socket counter clockwise



- 7) Turn the metal ring to alter the height of the internal lid.
A special tool is included. Turn the ring three times clockwise to raise the lid
- 8) Turn the metal ring counter clockwise to lower the internal lid until you can feel that the lid has just come in contact with the plate on the thermoblock. This is the defined zero position: direct contact between plate and lid but no pressure.



- 9) Hold the metal ring tight (eventually use a pliers) to fix lid height and screw hexagonal screw clockwise to fix the position of the inner lid.



4.5 Setting lid pressure

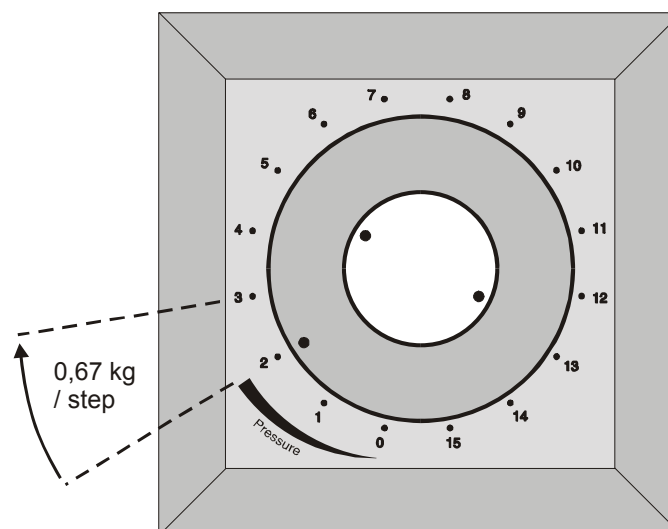


Figure 6: Setting lid pressure

If evaporation occurs despite elevated pressure, please choose different brand of plastic ware. Since microplate dimensions vary between manufactures, not every plate may be compatible with the instrument. Perfect fit between block and plate is essential for trouble free operation.

Biometra recommends 96 well plates (050-232) and 384 well plates (050-231).



Never dose liquid to the PCR microplate inside the TRobot! Dose liquids outside of the instrument and always use already sealed PCR microplates.

Keine Flüssigkeiten innerhalb des TRobots in die PCR Mikrotiterplatte dosieren! Dosieren Sie die Flüssigkeiten außerhalb des Gerätes und verwenden Sie immer bereits versiegelte Mikrotiterplatten!

5 Thermocycler Manager Software

5.1 Introduction

The Thermocycler Manager V4.11 is a PC-Software designed to address the following Biometra Thermocycler models: T1 plus, TRobot, T3000 und TPersonal. Up to 16 Thermocyclers can be connected and controlled in a network. The software allows to create, modify and store programs that can be exchanged between different Thermocyclers.

Since the TRobot is designed for integration in workstations, the cycler will normally be controlled by the software of the robotic station. For this purpose the cycler has to be integrated in the workstation software. Integration will be done by the manufacturer of the workstation. For a detailed description of all commands see section 6.9.

5.2 Installing the Thermocycler Manager Software

To install the Thermocycler Manager Software execute the file SetupThermocyclerManager.exe and follow the instructions of the installation Wizard. All software drivers will be automatically installed.

5.3 The Thermocycler Manager Software main screen

After the Software is started, the Thermocycler Manager main screen is displayed that allows access to all functions:

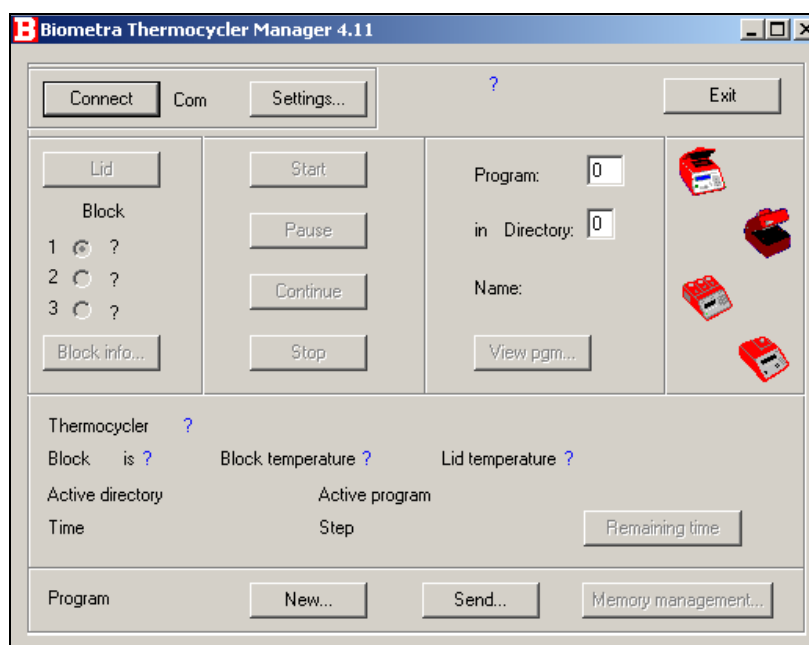


Figure 7: Thermocycler Manager Software main screen

Since it is not yet a Thermocycler connected to the software, the status messages contain blue question marks and most of the buttons appear greyed out.

5.3.1 Network settings

Click on button , to open the menu for network settings:

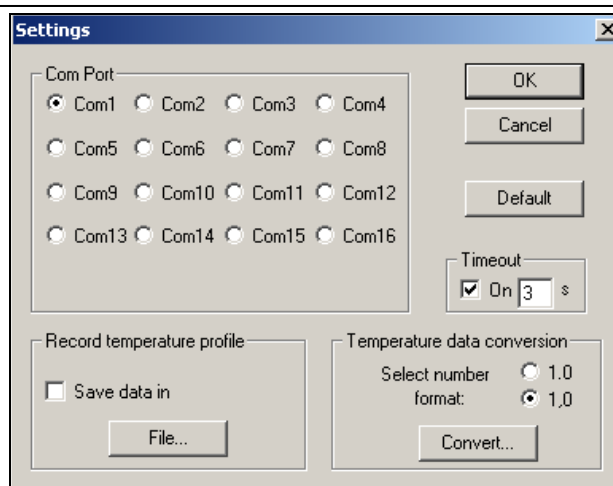
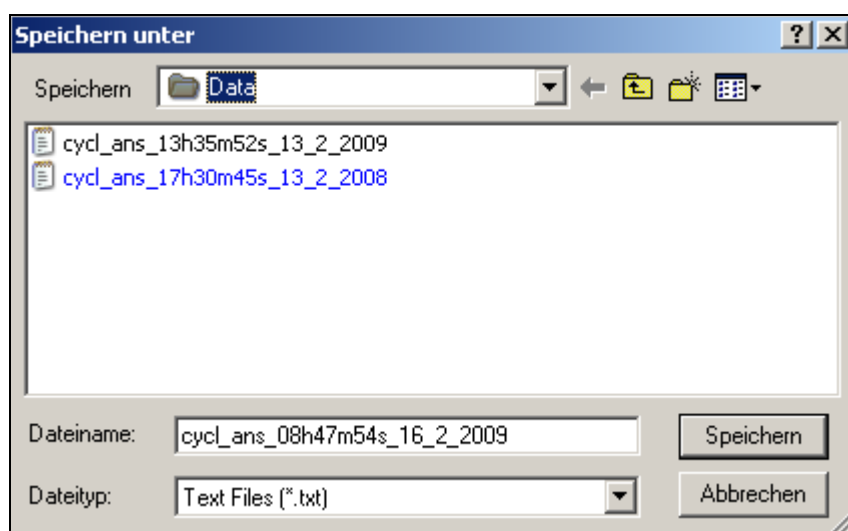


Figure 8: Network settings screen

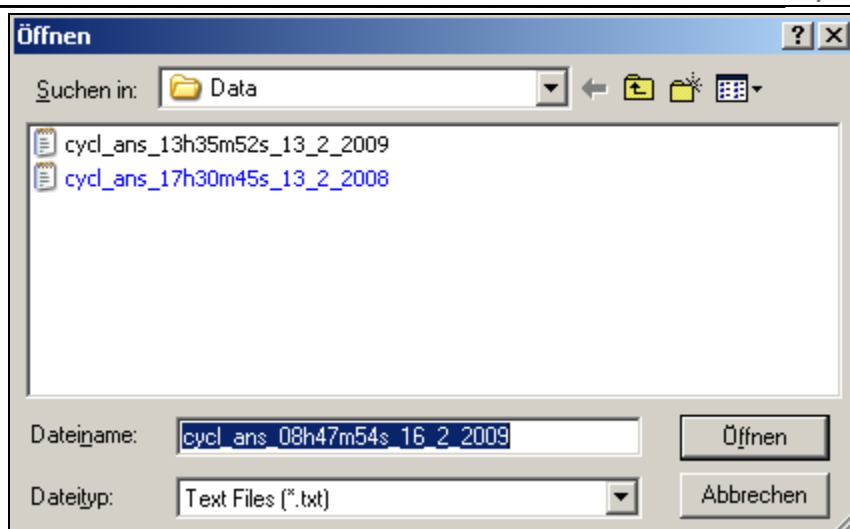
Activate the radio button for the serial port (Com Port), the Thermocycler that you would like to address is connected to.

5.3.2 Record temperature profile

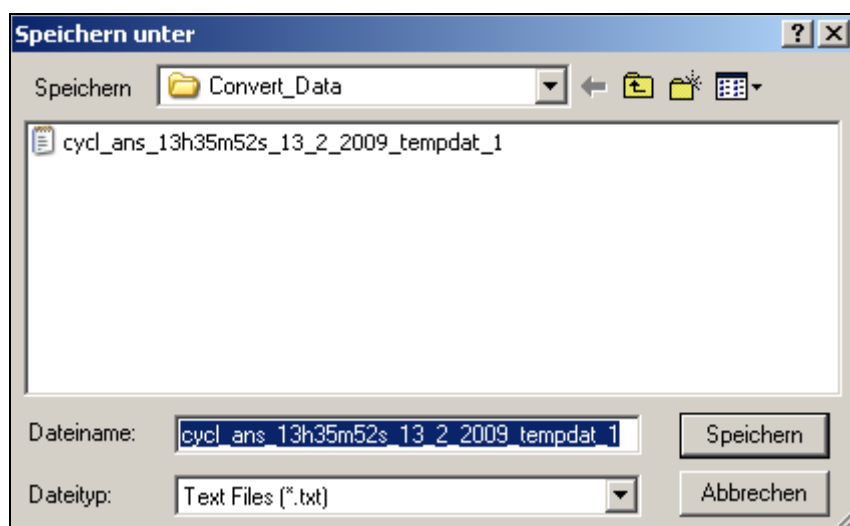
The Thermocycler Manger Software can save a temperature profile for each run. Each second the set and the actual temperature of the block and the actual temperature of the lid are recorded. The data later can be analysed with a Microsoft Excel™ file specially configured by Biometra (Temperature_profile_ThermocyclerManager.xls). To record temperature data activate the check box Save data in (see figure 8, chapter 5.3.1). The software either saves the files in a preset folder or you may also set another path. Click on the button . A new window opens where the name and location of the files can be defined:



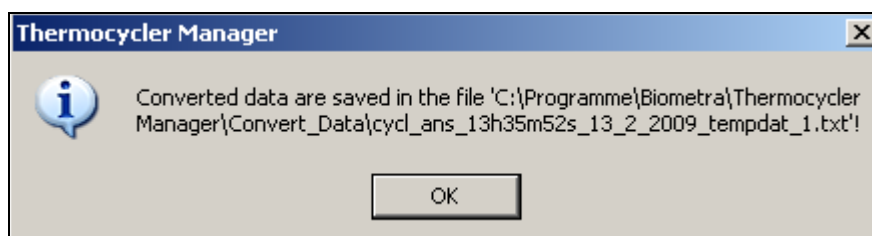
The data format of the stored files can subsequently be changed. Choose under "Temperature data conversion" the appropriate format by activating the corresponding radio button (see figure 8 chapter 5.3.1). The temperature data can either be displayed separated by a point or a comma. Then click the button and in the new window that opens select the file to convert:



Click on **Open** to confirm your selection. A new window opens where the name and location of the converted file can be defined:



Click on <save> to complete the process. After the file is converted a message window with the location and name of the file is displayed:

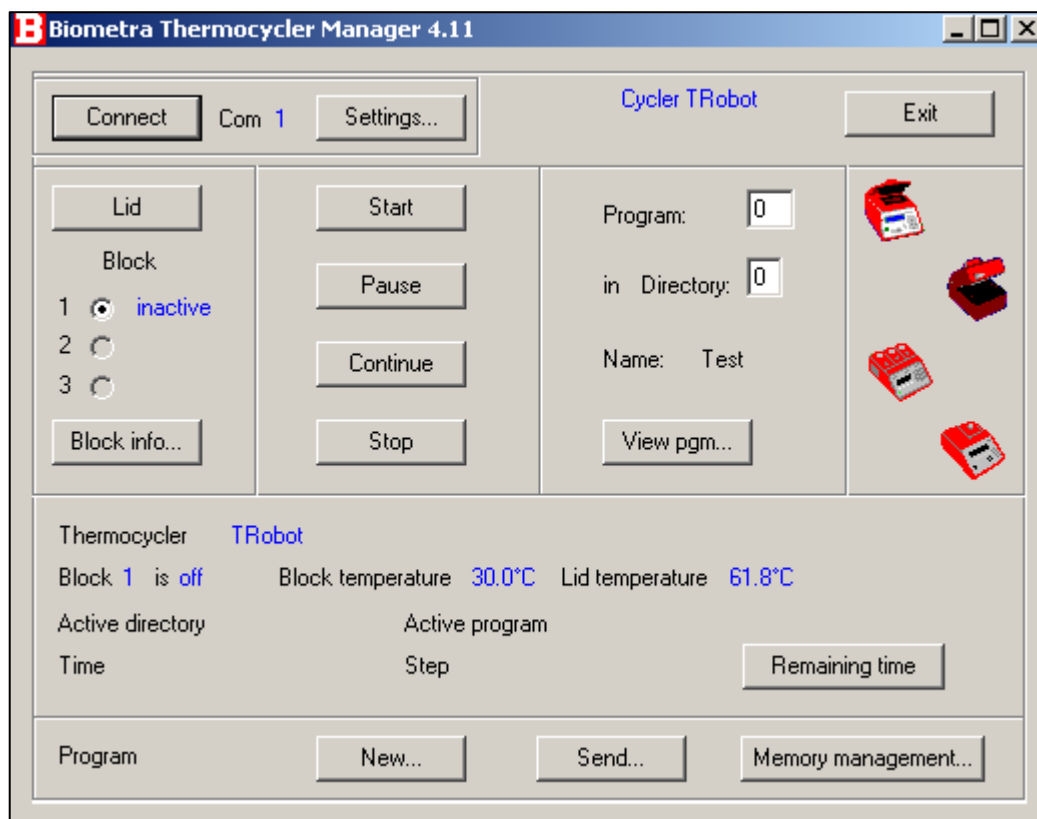


Note: For analysis of temperature data the file Temperature_profile_ThermocyclerManager.xls (see chapter 5) can be used.

5.3.3 Connect Thermocycler to the Thermocycler Manager Software

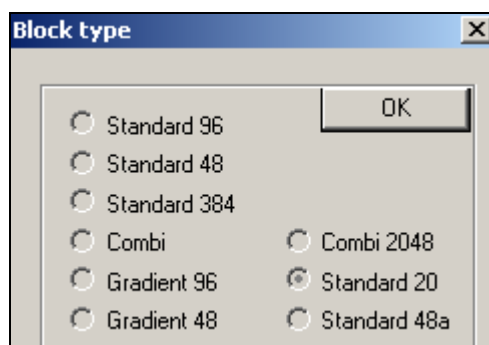
After the network setup is completed, Thermocyclers can be addressed by the Thermocycler Manager Software. Press the button **Connect** in the Thermocycler Manager Software main screen (see chapter 5.3). After a connection is established the type of Thermocycler that is

controlled and the status of various parameters are displayed in blue by the Thermocycler Manager Software. Moreover, different buttons that previously were grayed out and therefore inactive (see figure chapter 5.3), now have become active and can be used:



5.3.4 Block Info

Press button **Block info...** to receive information on the block type of the Thermocycler that is currently addressed by the software:

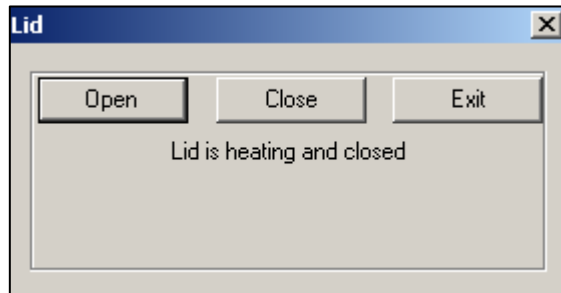


Additionally, in the main screen an information is displayed which blocks are currently active. This feature is especially interesting for multi-block systems like the T3000 Thermocycler that may also be controlled by the Thermocycler Manager Software. Since the TRobot is not a multi-block system, while in use, always block 1 is set active:



5.3.5 Lid

By activating the button **Lid**, a new window opens providing the functions for controlling the automatic lid:




Press **Open** to open the TRobot lid.

Press **Close** to close the TRobot lid.

Press **Exit** to close the window.

Moreover a status line is displayed below the buttons giving information on the lid status.

Note: See chapter 7.4 how to open and close the lid off-line.

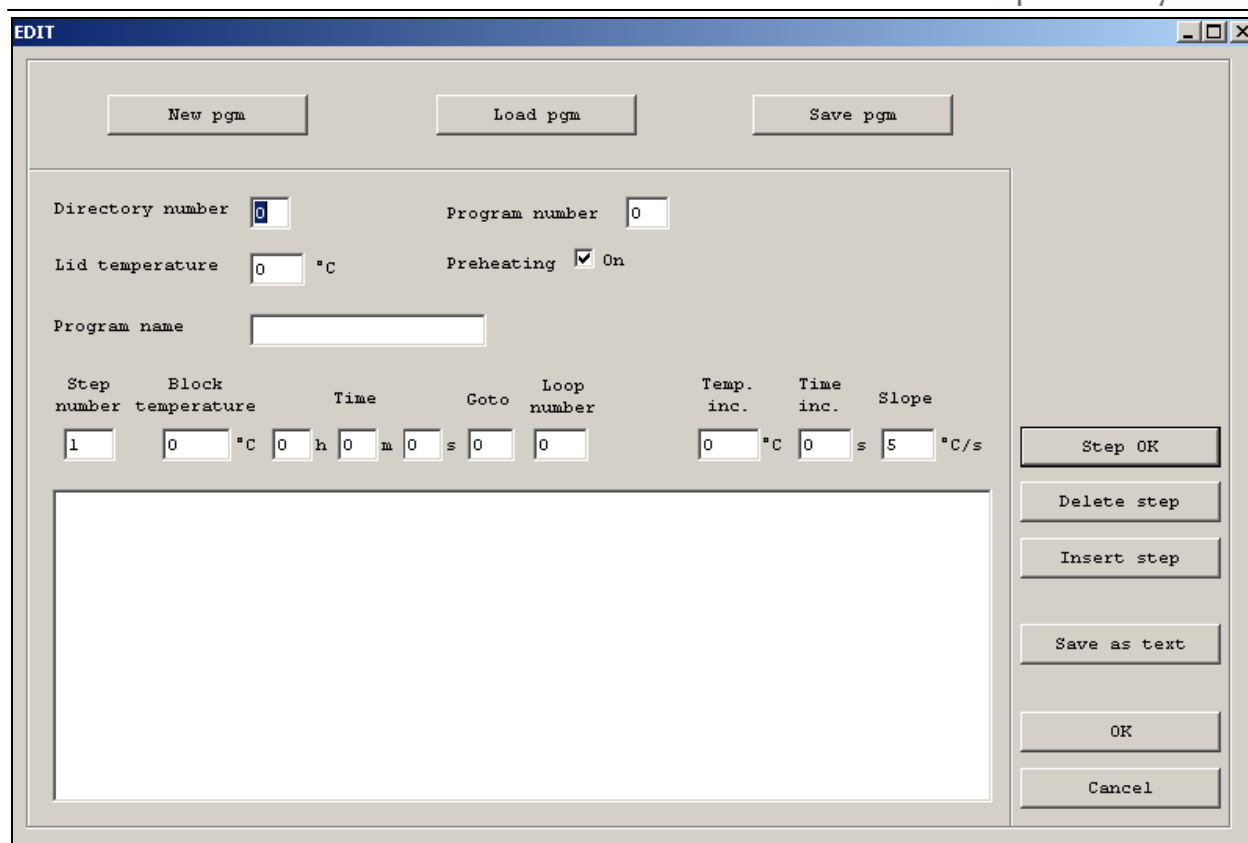
	English	Deutsch
	Never put your hands inside the instrument during the motorized lid is in action! The closing lid exerts significant pressure and can cause bruises when operated improperly	Beim Schließen des Deckels niemals die Hände in den Thermocycler halten! Durch die Kraft des Deckels besteht bei unsachgemäßer Handhabung die Gefahr von Quetschungen.

5.4 Programming screen

5.4.1 Create program

To create a new a program press button **New...** in the Thermocycler Manager Software main screen (see chapter 5.3.3).

The programming screen opens:



There are a number of input fields for various parameters available. First define the directory number, program number, lid temperature, lid preheating and assign a program name. Then enter parameters for the first program step.

- Goto: This parameter specifies the starting point of a loop
- Loop number: This specifies how many times a cycle is run (total cycle number = number backloops +1)
- Temp. inc.: Temperature increment. This option allows increasing /decreasing temperature within a cycle
- Time inc.: Temperature increment. This option allows increasing /decreasing dwell time within a cycle
- Slope: This parameter specifies the maximum ramping rate (value 5 means maximum heating and cooling)

Confirm your entries by pressing the button **Step OK**. The parameters of the first step will be displayed in a spreadsheet and the next program step can be entered:

Step number	Block temperature	Time	Goto	Loop number	Temp. inc.	Time inc.	Slope
2	0 °C	0 h 0 m 0 s	0	0	0 °C	0 s	5 °C/s
1	95.0	0 5 0	0	0	0.00	0	5.00

5.4.2 Edit program

To open a program stored on TRobot Thermocycler, enter program number and directory number and press button **View pgm...** in the Thermocycler Manager Software main screen (see chapter 5.3):

Program:

in Directory:

Name: AAA

The programming screen opens (see chapter 5.4.1). By the functions and new program steps can be inserted or existing program steps deleted. To modify a step, activate it in the programming screen and then change desired parameter in the input form:

Step number	Block temperature	Time	Goto	Loop number	Temp. inc.	Time inc.	Slope
	°C	h m s			°C	s	°C/s
<input type="text" value="3"/>	<input type="text" value="65"/>	<input type="text" value="0"/> h <input type="text" value="1"/> m <input type="text" value="0"/> s	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="5"/>
1	95.0	0 5 0	0	0	0.00	0	5.00
2	95.0	0 1 0	0	0	0.00	0	5.00
3	55.0	0 1 0	0	0	0.00	0	5.00
4	72.0	0 1 0	2	24	0.00	0	5.00
5	72.0	0 5 0	0	0	0.00	0	5.00

5.4.3 Load program

To load a program stored on the computer press button . The program will be opened in the programming screen and can be edited as described in chapter 5.4.2.

5.4.4 Save program

Enter the parameters for all the required steps of the PCR program, and then either click on the button or the button to save the program on the computer. Define the name and location of the program and then click on <save>:

Speichern unter

Speichern:

Dateiname:

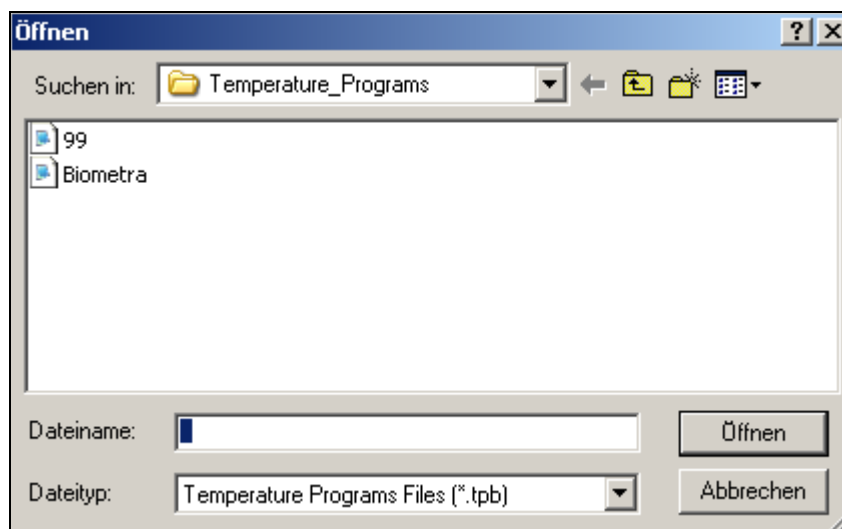
Dateityp:

Press the button to export protocols as text files. These may be opened and printed out with the Windows™ Editor.

Note: In each case the program is saved to the computer harddisk. See chapter 5.4.5 how to send a file to the Thermocycler.

5.4.5 Send program to Thermocycler

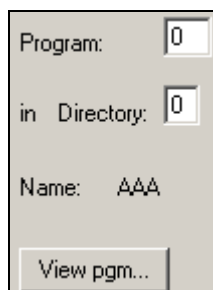
To send a saved program to the Thermocycler, press button **Send...** in the Thermocycler Manager Software main screen (see chapter 5.3). Choose the program to be transferred and press **Open** :



Note: The program store (directory and program number) is pre-defined in its parameter list (see chapter 5.4) and can not be selected before transmission. If you would like to save the program to a certain store number, first specify the desired location in the parameter list and save the program prior to transmission.

5.4.6 Start program

To start a program, first enter the program and directory number in the Thermocycler Manager Software main screen:



Note: The name of the program will be displayed automatically. To check the program prior to start press button **View pgm...**

Press button **Start** in the Thermocycler Manager Software main screen (see chapter 5.3) to start the program.

5.4.7 Pause program

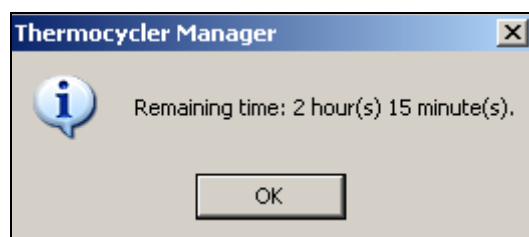
To pause a program press button **Pause** in the Thermocycler Manager Software main screen (see chapter 5.3). Press **Continue** to resume the started program.

5.4.8 Stop program

Press button **Stop** in the Thermocycler Manager Software main screen (see chapter 5.3) to stop the program.

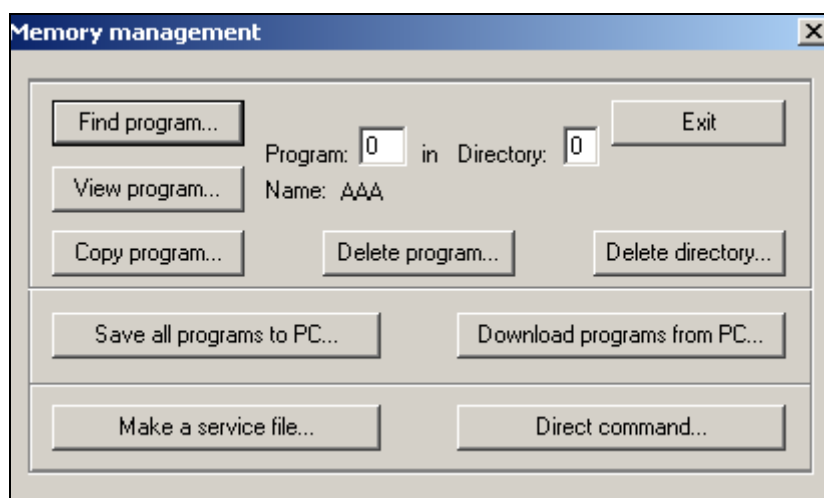
5.4.9 Show remaining time

Press button **Remaining time** in the Thermocycler Manager Software main screen (see chapter 5.3) to let the software display the remaining time of started programs. A new window opens that shows the remaining time:



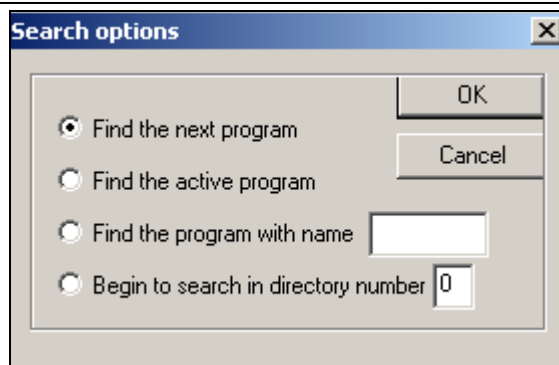
5.5 Memory management

The Thermocycler Manager Software provides various functions for the management of programs and directories on the computer or on Thermocyclers. The button **Memory management...** will take you to an extra window for the memory management:



5.5.1 Find program

The Thermocycler Manager Software offers several options to search for a program. After pressing the button **Find program...** (see chapter 5.3), a new window opens where the parameters for the search can be set:



a) Find next program

Searches for the program which is, based on the currently viewed program, deposited at the next higher memory location of the Thermocycler. If the currently viewed program is stored at the highest memory location, the software starts to search at the beginning of the memory and the program at the first used memory location will be displayed.

b) Find active program

Search for the currently used program.

c) Find the program with name

Search for a program by name.

d) Begin to search in directory number

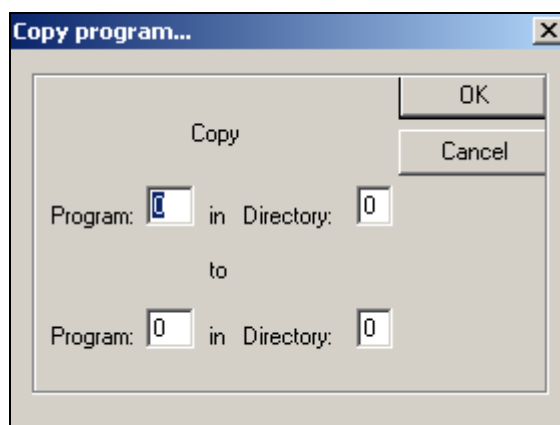
Finds the program that is stored at the first used memory location in the specified directory.

5.5.2 View program

Press button **View program...** in the memory management window (see chapter 5.5) to enter the programming screen (see chapter 5.4). In the programming screen programs can be viewed and edited.

5.5.3 Copy program

The function **Copy program...** allows to copy programs. After activation the following windows opens:



In the window you can specify which program where to be copied. Press **OK** to confirm your selection. The program then will automatically be copied to the chosen memory location.

Note: Existing programs will be overwritten.

5.5.4 Delete program

In the window for memory management (see chapter 5.5) enter the location of the program that you would like to delete:

Program: in Directory:

Press button **Delete program...** and in the next window confirm your selection with <yes>:



When the program is deleted a new window opens showing the following message:

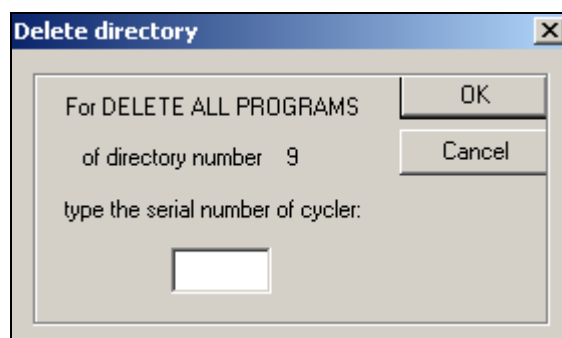


5.5.5 Delete directory

In the window for memory management (see chapter 5.5) enter the number of the directory that you would like to delete:

Directory:

Press button **Delete directory...** and in the next window enter the serial number of the Thermocycler:

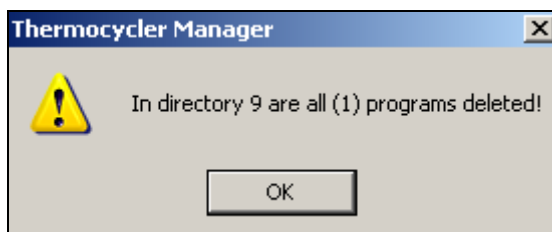


Note: The serial number of the instrument is written on the type label.

Press button **OK**. In the next window press <yes> to confirm the deletion of the directory:

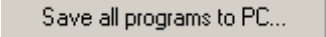


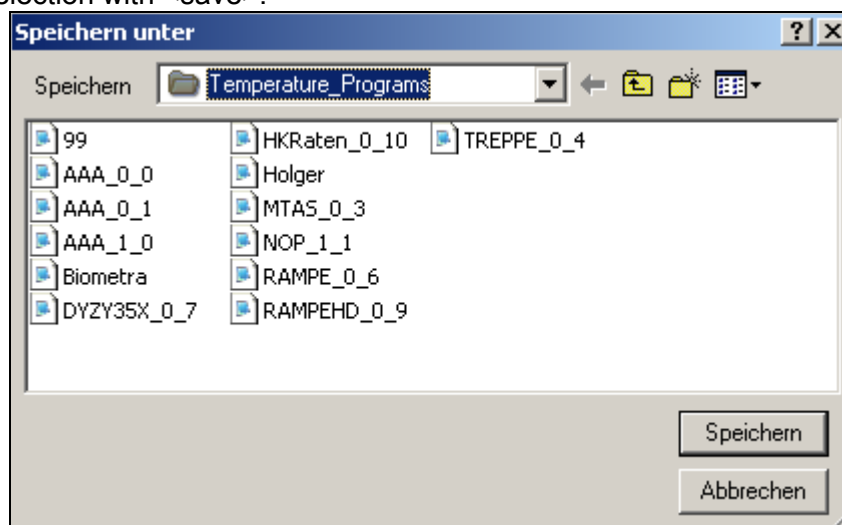
When the directory is deleted a new window opens showing the following message:



5.5.6 Save all programsto PC

The Thermocycler Manager Software offers the function to save all programs located in the memory of a Thermocycler to PC.

Press button  in the window for memory management (see chapter 5.5). In the next window define the path where to programs are going to be saved to and confirm your selection with <save>.

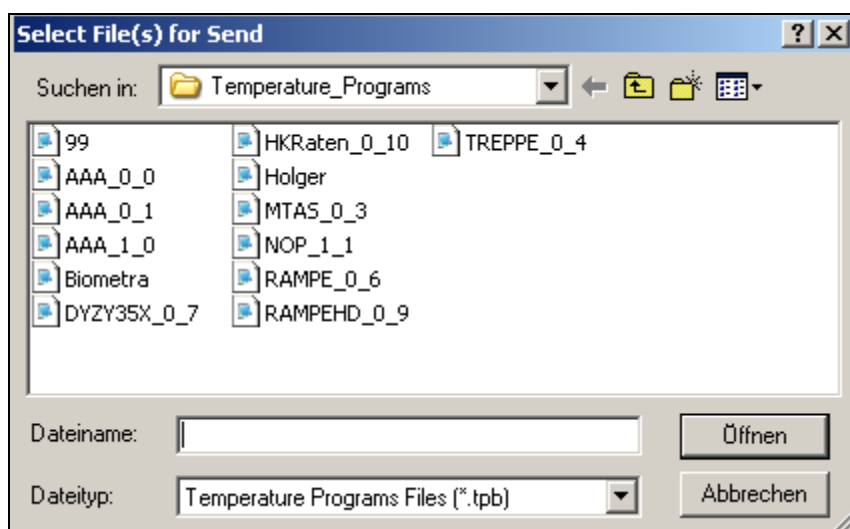


After copying, you receive a message, how many programs have been copied to the selected folder:



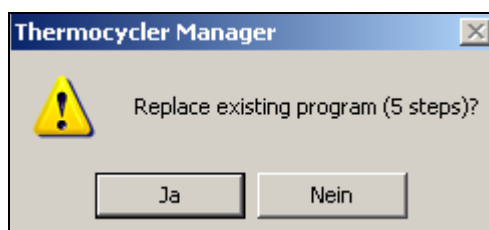
5.5.7 Transfer programs from PC to Thermocycler

Press button **Download programs from PC...** in the window for memory management (see chapter 5.5). In the next window specify which programs to be transferred to the Thermocycler.

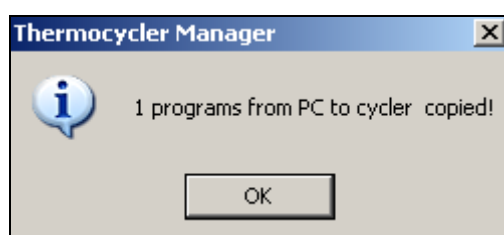


Note: If you would like to select multiple programs at one time, hold down the Ctrl key during the selection process.

Press **Open** to confirm your selection. If a memory location is already in use, you will receive a message. If the existing program shall be overwritten, confirm with <yes>, otherwise press <no>:



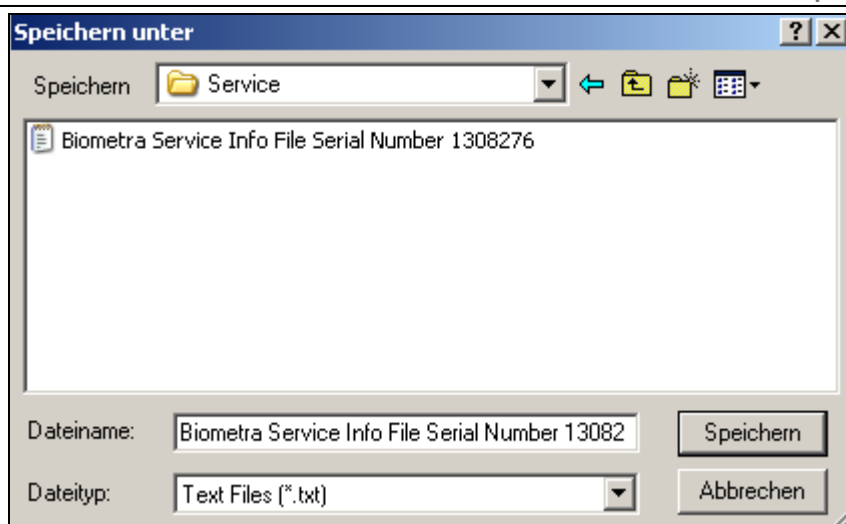
Finally, you receive a message, how many programs during the process have been copied:



5.5.8 Create Service Info File

This function creates an information file that can be sent to the Biometra service by email. This allows to some degree an advanced remote diagnosis in case of problems.

To create a Service Info File press **Make a service file...**. Assign a file name and then select the location to save the file on your computer:



Send the file by email to: service@biometra.com.

5.5.9 Direct command

Biometra Thermocyclers can be directly controlled by serial commands. Press button **Direct command...** to activate the Thermocycler Manager Software command line. Enter a command and press button **Send command**. Chapter 6 gives a comprehensive overview over all serial commands.

5.5.10 Exit memory management window

Press **Exit** to leave the window for memory management.

5.6 Exit Thermocycler Manager Software

Press button **Exit** in the Thermocycler Manager Software main screen (see chapter 5.3) to leave the software.

5.7 Analysis of temperature data

For Microsoft™ Excel based analysis of temperature data, the file "Temperature_profile_ThermocyclerManager.xls" has to be installed on the computer. The file allows the reading and the graphic representation of temperature data.

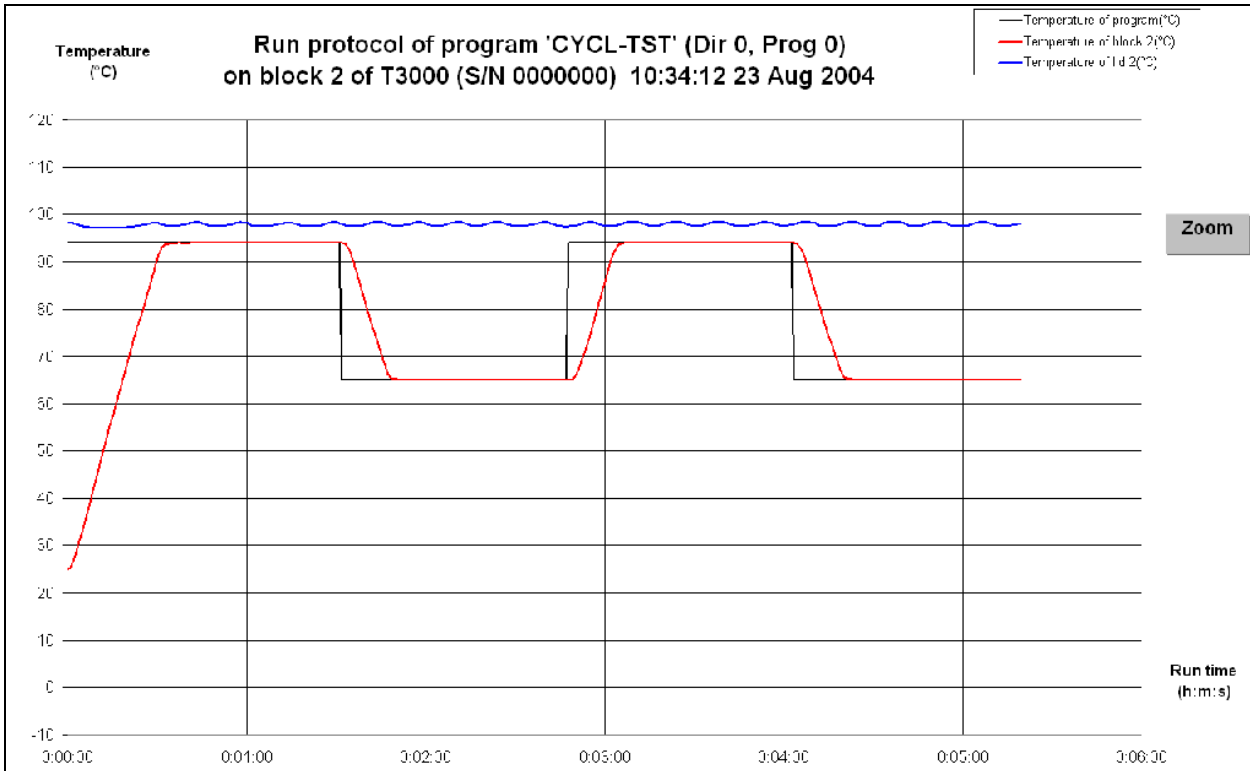
Open the Excel file „Temperature_profile_ThermocyclerManager.xls“.

	A	B	C	D	E	F	G	H	I
1	Run protocol of program 'CYCL-TST' (Dir 0, Prog 0)								
2	on block 2 of T3000 (S/N 0000000) 10:34:12 23 Aug 2004								
3	Time counter	Temperature	Temperature	Temperature					
4	(Min:Sek)	of program(°C	of block 2(°C)	of lid 2(°C)					
5	00:00,0	94	24,8	98,2					
6	00:01,0	94	25,2	98,2					
7	00:02,0	94	26,6	98,1					
8	00:03,0	94	28,6	97,9					
9	00:04,1	94	30,9	97,7					
10	00:05,1	94	33,3	97,5					
11	00:06,1	94	35,8	97,4					
12	00:07,1	94	38,2	97,3					
13	00:08,2	94	40,6	97,2					
14	00:09,2	94	43,1	97,2					

To open a file containing temperature data, click button "Open new source file" and select the file to open.

The Excel file is divided into two sheets:

- a) Log-Data
 - b) Log-Curve
- a) The sheet „Log-Data“ in lines 1-4 shows run data like the protocol name, used type of Thermocycler and date. From line 5, the data for the programmed target temperature, the measured block temperature and lid temperature listed.
- b) In the sheet „Log-Curve“ the temperature data is displayed graphically:



The function “Zoom” allows the customized the display of temperature curves. Click on button “Zoom”. A new window opens where you can change the corresponding parameters to optimize the display:

Zoom [X]

Min Temperature (°C)	<input type="text" value="-10"/>	<input type="button" value="Default"/>
Max Temperature (°C)	<input type="text" value="120"/>	
Major Unit(°C)	<input type="text" value="10"/>	<input checked="" type="checkbox"/> Show Lines
Minor Unit(°C)	<input type="text" value="5"/>	<input type="checkbox"/> Show Lines
<input checked="" type="checkbox"/> Automatically Set Time Scale		
Min Time (h:m:s)	<input type="text" value="0:0:0"/>	
Max Time (h:m:s)	<input type="text" value="0:6:0"/>	
Major Unit (h:m:s)	<input type="text" value="0:1:0"/>	<input checked="" type="checkbox"/> Show Lines
Minor Unit (h:m:s)	<input type="text" value="0:1:0"/>	<input type="checkbox"/> Show Lines
<input type="button" value="Cancel"/>		<input type="button" value="OK"/>

6 Serial Communication Protocol

The following chapters describe all commands for serial communication with the TRobot.

This serial documentation protocol is the basis for integrating the TRobot in automatized workstations. Since workstations from different manufacturers have different software systems, the TRobot has to be integrated individually. For integration, please contact the manufacturer of your workstation.

6.1 General Information

The definition describes the communication between a Biometra TRobot and a controlling device, the master. You have to distinguish between “asynchronous communication” and “synchronous data”. With the “asynchronous communication” the master transfers single commands to control the cyler. The “synchronous data” is used for the control of the thermoblock-activity. If this mode is online the cyler transfers in periodic cycles data about the operating conditions of the thermoblock.

6.2 Asynchronous Communication

6.2.1 General

Commands and replies:

The controlling device transfers one or more commands to the cyler in one block. The command interpreter works through the commands in chronological order. The cyler sends conformation to the master on completion of each task. Each data block terminates with <CR> (ASCII Carriage Return).

Each Command Induces a Reply.

Exceptions:

If the cyler notices an error during the processing of a command all following commands in the same data block will be ignored and the master receives no reply from the cyler.

In general the cyler gives only a status signal after the request of the master.

Exceptions:

a. Spontaneous message of the cyler: If the cyler detects an error by the use of its security system (e.g. overheating), the cyler sends a spontaneous error message to the master if the connection to the master is still online (see chapter 6.2.4).

b. Synchronous data: see chapter 6.3

Next data block: Before a new data block can be transferred to the cyler the reply relating to the last data must be received by the master or else the cyler sends an error message.

6.2.2 Command Structure

General output format: *command block1[;command block2[;command block3[;...]]][CRC16]<CR>*

<i>command block</i>	= command code and parameter
<i>CRC16</i>	= CRC16-Check value (optional)
<CR>	= ASCII “Carriage Return” (OD)

The elements in angular brackets are optional.

A transmission block may be constructed of multiple command blocks which are separated by “;”. Each command block terminates with <CR>. If the “check process” is activated, a check value will be sent in front of each termination signal. (see chapter 6.6.1).

Each command block has the following format:

command code[*_parameter1*[,*parameter2*[,....]]]

<i>command code</i>	= command code
–	= blank
<i>Parameter</i>	= parameter according to the list of instructions

If parameters were sent in combination with a command, a blank follows the command code and one or more parameters. Several parameters are separated by a “;”. An optional parameter between two other parameters could be left out, by setting a separator. Optional parameter at the end may be left out totally.

For an example a command block with multiple commands see chapter 6.2.5.

Command Codes: Basically you have to distinguish between long and short commands. The current version implements only short commands. The following description also shows the long commands. The list of all command codes is given in chapter 6.9.2.

Short Commands: The command code of short commands is defined by a single letter. The command letter may be used for different commands in different submenus but each command may be used once within the same submenu. (see chapter 6.9.2).

Note: When short commands are used the parameters are also transferred in a compact format (see chapter 6.10).

Long Commands: (yet to be implemented): The command codes of long commands are constructed of four letters. The letter combination is used in such a way that it draws conclusions from the commands. Each letter combination exists only once. (see chapter 6.9.2).

Note: When using of long commands the parameters are transferred in a simple readable format (see chapter 6.10).

Shifting between Short and Long Commands: (yet to be implemented): After the Initialisation the communication works with short commands. If the cycler receives from the master a long command, the interpretation switches to long commands. As a result error messages will be sent also in the long format (see chapter 6.11). The use of any short command switches the communication back into the short format.

6.2.3 Command Reply

6.2.3.1 Standard Reply

A command reply starts with the short command code with a capital letter, without distinguishing between the short and long format. The format of the parameters depends on the form of the last command which was sent. With each transferred data block only one reply is sent.

reply code[*_parameter1*[,*parameter2*[,....]]][*CRC16*]<CR>

<i>reply code</i>	= command code with a capital letter
–	= blank

<i>parameter</i>	=	parameter according to the list of instructions
[CRC16]	=	check code (optional)
<CR>	=	ASCII "Carriage Return" (OD)

If a reply is sent with parameters after the reply code there will follow a blank and then one or more parameters (see chapter 2.2 "Description of Commands").

Example:

```
command:      a<CR>      HEAD (menu EDIT) reads the program head data
reply:A_ 63,1,'TEST1'<CR>      heated lid 99°C, heated lid preheating on, program name
                                'TEST1'
```

6.2.3.2 Error Message

Error identifier: error messages always have the sign "!" as error identifier detection and a following three figure error code in HEX. short commands are replied from the cyclor by error messages in the short format, long commands are replied by error messages in the long format. (see chapter 6.11).

Command codes with errors:

short form: ! *error code_ command block*[CRC16]<CR>

long form: ! *error code_ error text_ command block*[CRC16]<CR>

<i>! error code</i>	=	error identifier (see error list)
_	=	blank
<i>command block</i>	=	invalid command block
<i>error text</i>	=	plain text-error message (English)
[CRC16]	=	check code (optional)
<CR>	=	ASCII "Carriage Return" (OD)

A command with an error results in a reply with an error identifier, a blank, followed by the error text with a terminating blank using the long format and the invalid command block. Optionally the checksum may be transferred in front of the terminating sign.

Example:

```
!501_k 78_<CR>      short form
!501_invalid command!_k 78<CR>      long form
```

Parameter:

short form: *reply code_! error code_ parameter*[CRC16]<CR>

long form: *reply code_! error code_ error text_ parameter*[CRC16]<CR>

reply code = command code in capital letter

_	= blank
! <i>error code</i>	= error identifier (see error list)
<i>parameter</i>	= invalid parameter
<i>error text</i>	= plain text-error message (English)
[CRC16]	= check code (optional)
<CR>	= ASCII "Carriage Return" (OD)

A long command with an incorrect parameter receives a reply in the long format, otherwise in the short form. The reply code is identical in both forms. The error message consists of the reply code (command code with a capital letter), a blank, an error identifier, a blank, in the long form the error text with a following blank, and the erroneous parameter.

Example:

E_!112_FE<CR>	short form
E_!112_max = 5!_FE <CR>	long form

Other errors

short form: *reply code*_! *error code*[CRC16]<CR>

long form: *reply code*_! *error code*_ *error text*[CRC16]<CR>

<i>Reply code</i>	= command code in capital letter
_	= blank
! <i>error code</i>	= error identifier (see error list)
<i>error text</i>	= plain text-error message (English)
[CRC16]	= check code (optional)
<CR>	= ASCII "Carriage Return" (OD)

After a long command the error message returns in the long form, otherwise in the short form. The reply code is identical in both forms. The error message consists the reply code (command code with a capital letter), blank, error identifier as well as in the long form the error text separated by a blank.

Example:

E_!108<CR>	short form
E_!108_ RAM full! <CR>	long form

6.2.4 Spontaneous Error Messages

Spontaneous error messages are not connected with a precursory command of the master. They are not a reply to a command.

short form: !*error code*[btip][CRC16]<CR>

long form: ! *error code_error text*[*btip*] [CRC16]<CR>

! <i>error code</i>	= error identifier (see error list)
_	= blank
<i>error text</i>	= plant text-error message (English)
[<i>btip</i>]	= only in error group 2xx (see chapter 6.11.3)
[CRC16]	= check code (optional)
<CR>	= ASCII "Carriage Return" (OD)

After a long command the error message returns in the long form, otherwise in the short form. The reply code is identical in both forms. The error message consists the reply code (command code with a capital letter), blank, error identifier as well as in the long form the error text separated by a blank.

If the last command was sent in the long form the error message is in the long form. Otherwise it is in the short form. The error message consists of the error identifier as well as in the long form the error text separated by a blank from the error identifier. In Error group 2xx (see chapter 6.11.3) the parameter *btip* (block number *b*, temperature *t*, current *i* and pulse *p*) will be transferred.

Example:

!004<CR>	short form
!004 cooler too hot!<CR>	long form

6.2.5 Menu Structure

All commands are sorted in a menu structure with a main menu and several submenus (see chapter 6.9.1. Within a menu only the commands of this menu are available. The command codes in the short form are termed alphabetically "a", "b", "c",..... The short command code "b" has different meanings in different submenus. After the power up the command interpreter is in the main menu. To move from one menu to a submenu a command has to be sent. All commands are explained in the command list. (see chapter 6.9.2).

Example of a command sequence in the short form: (editing of a programme)

c;a_3,2;a_63,,'TEST1';b_1,251C,1E;c_1388,1E;g<CR>

explanation:

c;	LIBR (main menu)	goes to menu LIBR
a_3,2;	EDIT (menu LIBR)	goes to menu EDIT, editing of programme 2 directory 3
a_63,,'TEST1';	HEAD (menu EDIT)	editing of the header: heated lid 99°C, preheating of the lid on (default), name 'Test'
b_1,251C,1E;	STEP (menu EDIT)	editing of programme step 1:

		temperature 95.00°C, hold time 30 s
c_1388,1E;	NSTP (menu EDIT)	editing of the next step: temperature 50.00°C, hold time 30s
g	EEND (menu Edit)	terminating of editing and return to menu LIBR
<CR>		terminating sign of the command block

Return to the main menu: If the command interpreter should return to the main menu the command has to start with ":". The colon has always to combine with a command code.

Example: request of the system status: :a<CR>

6.3 Synchronous transferred data

Synchronous data are used for the control of the activity of a block. They can be sent serially in an adjustable gap of 1 to 15 seconds. The start and stop of the synchronous data transfer can be controlled with the command INTV in the menu BSET. During the initialisation the release is deactivated. After the activation of the synchronous data transfer the cycler sends periodically every second data beginning with a "#" or only the "#" if there is no data for transfer to the master.

6.3.1 Data format of synchronously transferred data

Separator: After the identifier "#" follows a blank. The data is separated by a comma

ASCII-presentation

	internal format	value +	separator =	buffer
Format:	Bytes	Bytes	Bytes	Bytes
identifier "#"	1	1	1	2
block NR,	1	to 2	1	to 3
block status,	2	to 4	1	to 5
actual time*,	4	to 8	1	to 9
hold time**,	4	to 8	1	to 9
step NR,	1	to 2	1	to 3
loop counter *****	1	to 2	1	to 3
0,	2	to 4	1	to 5

heated lid-temperature,	2	to 4	1	to 5
heat sink-temperature,	2	to 4	1	to 5
format identifier ***	1	1	1	2

temperature data depends on the format identifier

*actual time: counter, which is incremented each 64ms.

**hold time: Increment every second. Shows the hold time from the beginning of a temperature-plateau or during a break the time of this break.

*** format identifier of temperature data:

'A' : middle temperature 2 to 4 Bytes

***** counter of the innermost loop

The termination of synchronous data is marked by <CR> and – if tuned in – in front of each terminating sign the CRC16-check value.

The format of the data is flexible. Leading zeros are not transferred.

Example:

“#_1,23,84C7F3,54,B,3, 0,230A,10A4,A,1B58“

Explanation:

#_1, 0023, 8701939 * 64ms, 84s, 11, 3, 0, 89.70°C, 42,60°C, A, 70.0°C

6.3.2 Sending only One-Time

Synchronous transferable data can be sent from the cycler after the demand by the master only one-time (see SDAT-command in menu BLCK). In this case the reply begins with “E” in place of “#”.

6.4 Setting of the Transfer Protocol

interface configuration:	9600 Baud, 8 Bit, no parity, 1 Stop bit
data format:	US-ASCII-sign
handshake:	RTS/CTS switchable at the cycler
echo mode:	Quasi-Echo switchable at the cycler
buffer size:	124 signs for each buffer (sending - and receiving buffer)
check process:	CRC16 according to ISO 3309, switchable

6.5 Communication Start and Stop

The cycler only sends data if the master is ready and signals this by sending a sign to the cycler.

6.5.1 Power up of the cycler / Connection start

During the power up of the TRobot the cycler stores one or more messages for the master. After the cycler receives the first sign from the master (connection start) the saved messages of the cycler are transferred to the master before the cycler evaluates and replies the message to the master. Check process (CRC16) and long commands are deactivated after the initialisation of the cycler which results in a switch on message without a check value in the short format. The first message which is stored by the cycler is always the message of the protocol version:

```
!000_protocol version<CR>_           = blank
protocol version                       = version number of the communication protocols
```

Example: !000_0.0.1.0<CR>

During the power up the cycler checks its own memory content. If an error is found during the check a further message block with the corresponding error message will be added to the initialisation message.

Example: During the save test an uncompleted program is found because the cycler has been switch off during the editing of this program. The uncompleted program is removed from the memory and the following message is shown:

```
!403<CR>    program empty
```

If the cycler-software comes across an error in the software the following error message is shown a new power up and the initialisation message:

```
!002_Error_code1_code2_code3_code4_code5_code6_code7<CR>
_                               = blank
code                             = HEX-code 4 digit
```

This special message is the same in the long and short format. The analysis of the code will be done by Biometra.

Spontaneous messages which are generated between the power up of the cycler and the first communication with the master (see chapter 6.2.4) are also temporarily stored.

6.5.2 Activation of the Remote Control

Sending “:” and a command activates the remote control of the Cycler.

6.5.3 Re-Initialisation of the Communication

The command

```
<ESC><ESC> (2 * ASCII 1B)
```

without any other sign re-transfers the communication to its starting point. All sending – and receiving buffers are reset, all settings of the communication are re-transferred to the setting of the start and the command interpreter is in the main menu. The cycler replies with a message of the protocol version.

6.5.4 Re-Initialisation of the Cyclers-Software

The command

```
^^      (2 * ASCII 5E)
```

without any other sign re-starts the software and the cyclers itself. (see chapter 6.5.1). The modus "remote control" is deactivated.

6.5.5 Auto-Restart

A cycler with an active block which is switched off or terminates as a result of a power failure checks the aborted temperature program and if it is without an error the program starts again from the point of the deactivation of the block. The communication is the same as above. The auto-restart-status can be controlled with the command BSTT in the menu BLCK.

6.6 Setting of the Communication

The following attributes of the communication are deactivated after the initialisation and have to be switch on with the corresponding commands.

6.6.1 Check Process CRC16

The check process CRC16 according to ISO 3309 is for transmission reliability. The check value will be sent in 4 ASCII-signs at the end of a transmission block in front of <CR> without a separator. The check process is applied during the asynchronous as well as during the synchronous data transfer by activating the CHCK-command in menu PROT.

6.6.2 Handshake

Hardware handshake makes sure that no data are sent as long as the receiving device is busy. At using hardware handshake, both CTS and RTS-line of the communication cable must be wired, a null modem cable is not suitable. Handshake must be enabled at the Cyclers (with command HWHS in menu PROT) and the controlling device.

6.6.3 Quasi-Echo Operation

To check the quality of a connection, the quasi echo operation can be used. During the quasi echo operation the cycler repeats the transferred command string of the master. During the active check the cycler attaches its check value to the received command. The ECHO-command can be activated in menu PROT.

6.6.4 Transfer of Synchronous Data

See chapter 6.3. Activating with the INTV-command in menu BSET.

6.6.5 Time-out of the Receiving Buffer

The serial communication can be controlled by the measurement of the receiving time. Whenever the first sign arrives at the cycler the time-out counter starts and stops when the <CR> reaches the cycler. If the adjusted time has elapsed an error will be reported and the received data will be deleted. The Time-out time can be set in 64ms steps with the ITOR-command in menu PROT.

6.7 Complications during the Communication

6.7.1 Communicational Collisions

The Master did not wait for all replies and sends new commands before the last message arrives from the cycler. In this case it receives the error message “!601”, the cycler works out the previous commands and the last commands of the master become lost.

6.7.2 Receiving Buffer overflow from the Cycler

If the master sends more signs in one transmission block than the receiving buffer can store, the cycler reacts with an error message. As soon as the cycler receives a <CR> (Carriage Return) the receiving buffer will delete and the sent data will be lost.

6.7.3 Checksum Error

If the cycler recognises a checksum error a repeat transmission will be demanded from the master with an “!?”. The same occurs for a checksum error recognised by the master. It also demands a repeat of the last transmission from the cycler with an “!?”. If this does not occur in the space of a reaction time especially after the faulty receiving of a new command, the master has no access to the transmission. The reaction time can be set in PROT/WATM in 64ms steps.

Note: If a fault message has been received, it must be checked if the message begins with “!000”. Then it is a reboot of a cycler and the check process is deactivated.

6.7.4 Software-Error

If there is an error in the cycler-software the safety programme “SetError” will be started. After the registration of a software-error the block stops, an error message will be sent to the master and the cycler is inactivated. After this the cycler must be started by switching off the cycler or the command “^^” (see chapter 6.5.4). The analyses of the error is checked by Biometra.

6.7.5 Restart of the communication

See chapter 6.5.3 and chapter 6.5.4.

6.8 Special Commands

6.8.1 Commands to operate the Automated Lid

The lid can be opened and closed only if the block is inactive or paused. Use the commands OPEN and CLOS in menu BLCK. After the cycler receives one of the two commands the cycler sends the reply to the command and moves the lid. The successful opening and closing of the automated lid will not be communicated to the master. The status of the lid can be checked with the command HSTT in menu BLCK.

If the lid is already in the position of the received command the reply is a corresponding error message to the master.

If the command STRT in menu BLCK(program start) follows the CLOS-command the start of the program is delayed until the lid is closed.

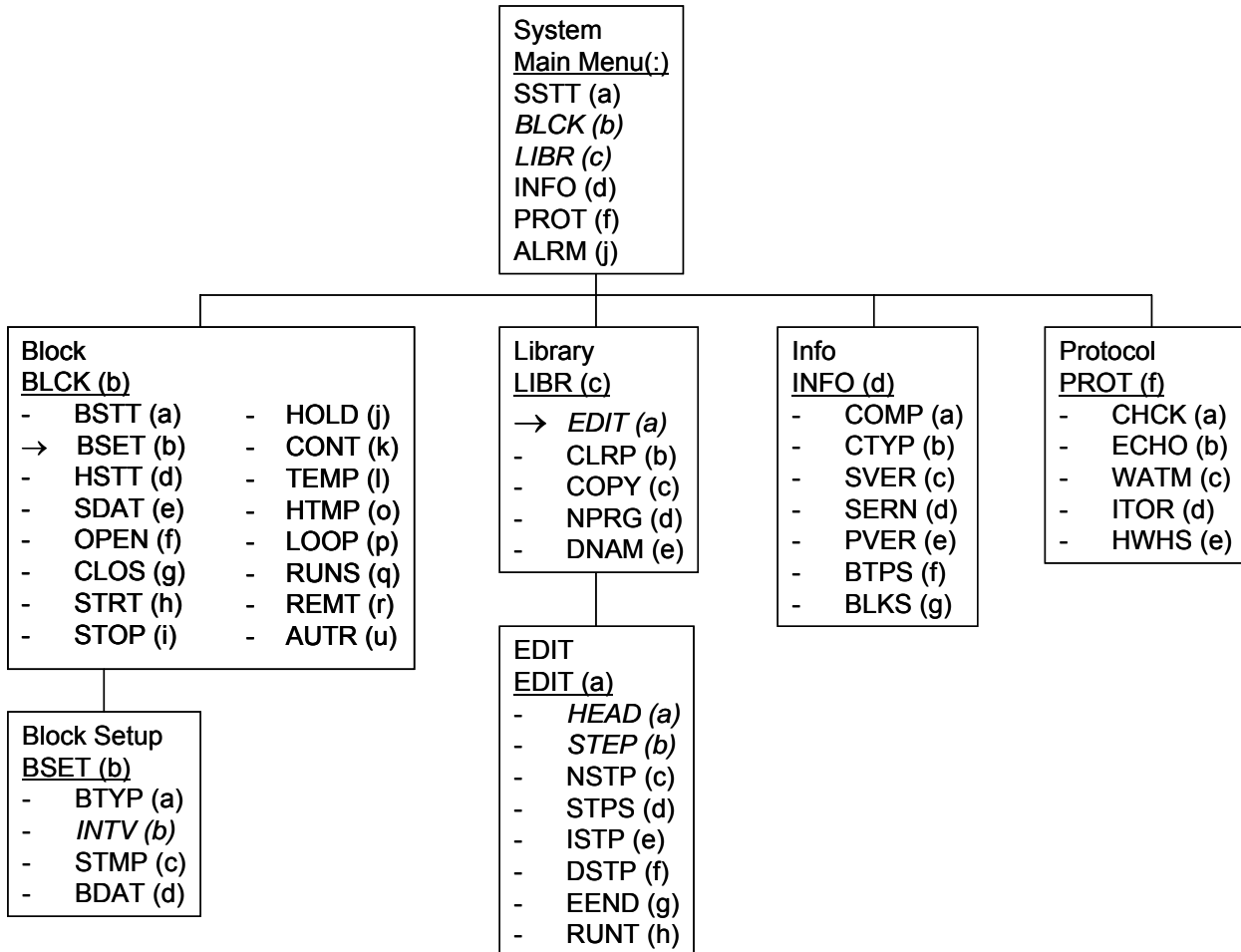
The following errors result in a spontaneous error message by the cycler:

- Release of the safety switch.
- A defined time after the action the lid has not moved from his start position
- After a period of waiting the lid did not reach his target position
- Both end switches are released.

- Emergency switch off of the control logic.

6.9 Structure of Menus and Description of Commands

6.9.1 Overview of the Structure of Menus



6.9.2 Description of Commands

- SM = Change to submenu
- UM = Return into the upper menu
- [] = Parameter is optional

6.9.3 Main Menu

com	mnemonic	parameter	description		reply
a	SSTT	[0]	status?, alarm off	Sends system status and switches off the present acoustic signal. With 0 all error flags of sysstatus apart the block error flag are cleared. The block error flag is automatically cleared by starting the next program or restarting the cyler software.	systatus
b	BLCK	[blocknr]	block number	→ SM BLCK Current block number, is saved up to the next change	blocknr
c	LIBR		library	→ SM LIBR	

d	INFO		information	→ SM INFO	
f	PROT		protocol	→ SM PROT	
j	ALRM	[<i>alarmfl</i>]	set/clear alarm flag	0 = without acoustic signal, 1 = with acoustic signal	<i>alarmfl</i>

6.9.4 Menu Block (BLCK)

com	mnemonic	parameter	description		reply parameter
a	BSTT		block status?	Sends block status. Controller error flag and autorestart flag are automatically cleared by starting the next program or restarting the cycler software without running block. Lid error flag is cleared with clearing the heated lid status (lidstatus), reset cooler error flag .	<i>blstatus</i>
b	<i>BSET</i>		block setup	→ SM BSET	
d	HSTT	[0]	heated lid status?	Sends status of heated lid. With 0 following error flags are cleared: emergency off of automated lid, safety switch released, motor time-out. The flags 'lid too hot' and 'lid too often on' are automatically cleared with starting the next program or reset of the cycler software.	<i>lidstatus</i>
e	SDAT		synchronous data once	Sends once data in the same format as the synchronous data.	<i>syncdata</i> (once)
f	<i>OPEN</i>		lid open	Opens lid, doesn't send any success message. The lid position can be questioned in lidstatus (see HSST). If the lid is already open, then error	
g	<i>CLOS</i>		lid close	Closes lid, doesn't send any success message. The lid position can be questioned in lidstatus (see HSST). If the lid is already closed, then error	
h	<i>STRT</i>	[<i>dirnr, progrnr</i>]	start block	With parameter: starts program progrnr of directory dirnr. Without parameter: starts the last used program. Error message if this program isn't edited completely.	<i>dirnr, progrnr</i>
i	<i>STOP</i>		stop block	Only active block, otherwise error message.	
j	<i>HOLD</i>		pause	Only active block, otherwise error message.	
k	<i>CONT</i>		continue	Continues the paused program, switches off the present acoustic signal. Only at pause, otherwise error message..	
l	<i>TEMP</i>		temp?	Sends current block temperature	<i>bltempa</i>
o	<i>HTMP</i>		heated lid temp?	Sends current heated lid temperature	<i>lidtempa</i>
p	<i>LOOP</i>		cycle counter?	Sends current counters of all open loops of the current step, starting with the innermost. Without reply parameter: no loop.	[<i>cyclcount</i> #, <i>cyclcount</i> #, <i>cyclcount</i> #,...]]]
q	<i>RUNS</i>		running step?	Sends directory, program, step number and all set values of the current step. If direct mode active sends invalid value (FFhex) of directory and program numbers. Nothing if the block is off.	[<i>dirnr,progrnr,pr</i> <i>ogname,lidtem</i> <i>p,preheating,</i> <i>stepnr,bltemp,h</i> <i>time,loop,#loop</i> <i>s,0,tempinc,tim</i> <i>ein c, slope</i>]
r	<i>REMT</i>		remaining time?	Sends remaining time of active program, if the direct mode is active then 0.	<i>remtime</i>

u	AUTR		autorestart data?	Sends step number and all cycle counter of program run at the moment of the last restart. Counters of all open loops, starting with the innermost. If the direct mode is active, then sends step number 0. Without reply parameter: Block was off during restart or data were cleared, when block was started once more.	[<i>aurestepnr</i>], [<i>cy</i>], [<i>clcount</i>], [<i>cyclcount</i>], [<i>clcount</i>], [<i>cyclcount</i>], ...]
---	------	--	-------------------	--	--

6.9.5 Menu Block Setup (BLCK / BSET)

co	mnemon	paramete	description		reply
a	BTYP	[<i>blocktype</i>]	block type[?]	Sets block type. Without parameter: sends block type	<i>blocktype</i>
b	INTV	[<i>interval</i>]	interval sync. data	{ <i>interval/seconds</i> } Sets measuring interval of synchronous data and starts output of data. <i>interval</i> = 0: Sends "sign of life" without data each second. <i>interval</i> ≠ 0: Sends data and if necessary "sign of life" each second in which no data are sent. Without parameter: Stops output of	<i>syncdata</i> (repeated every interval seconds)
c	STMP	[<i>tempform</i>]	tmp.-format for synchro	Sets or sends temperature format of synchronous data: 'A': middle temperature Without parameter: query	<i>tempform</i>
d	BDAT		block characteristics?	Sends block characteristics: Number of sensors, lines, spreading factor, conversion factor "0" if gradient not possible.	# <i>sensors</i> , # <i>lines</i> , <i>spreadfac</i> , <i>ltempfac</i> or

6.9.6 Menu Info (INFO)

co	mnemon	paramete	description		reply
a	COMP		company		<i>company</i>
b	CTYP		cyclertype?		<i>cyclertype</i>
c	SVER		software version?		<i>sversion</i>
d	SERN		serial number?	Software serial number	<i>ssernr</i>
e	PVER		protocol version?		<i>protver</i>
f	BTPS		block types?	string of possible block types	<i>blocktypes</i>
g	BLKS		number of blocks?		# <i>blocks</i>

6.9.7 Menu Library (LIBR)

co	mnemo	paramet	description		reply
a	EDIT	[<i>dirnr</i> , <i>progrnr</i>]	edit program	→ SM EDIT Without parameters: last used program With parameters: edit program <i>progrnr</i> of directory <i>dirnr</i> .	<i>dirnr</i> , <i>progrnr</i>
b	CLRP	<i>dirnr</i> , <i>progrnr</i>	clear program	Error if program is active.	<i>dirnr</i> , <i>progrnr</i>
c	COPY	<i>dirnr</i> , <i>progrnr</i> (source), <i>dirnr</i> , <i>progrnr</i>	copy program	Error, if destination is active.	

d	NPRG	[<i>dirnr</i>]	next existing program[?]	Sends directory and program number of next existing program in order of the numbers. If no number was saved before yet (e.g. by editing), the search starts with directory 0, program 0. With <i>dirnr</i> the start directory can be determined. The search ends with the last program in the last directory, e.g. directory 9 prg. 99. Without reply parameter: no program is found.	[<i>dirnr,prognr</i>]
e	DNAM	<i>dirnr</i> [, <i>dirname</i>]	directory name[?]	Without directory name: sends directory name With directory name: sets directory name	[<i>dirname</i>]

6.9.8 Menu Edit (LIBR / EDIT)

co	mnemo	parameter	description		reply parameter
a	HEAD	[<i>lidtemp</i> [, <i>preheating</i> [, <i>progrname</i>]]]	program head[?]	Without parameters: sends program header data. With parameters: sets all program header. default: <i>lidtemp</i> = 0 (without lid heating), <i>preheating</i> = 1	[<i>lidtemp,preheating,progrname</i>]
b	STEP	<i>stepnr</i> [, <i>bltemp</i> , <i>htime</i> [, <i>loop</i> , # <i>loops</i> [, 0	edit / read step,	Without any optional parameter: sends step data. With parameter 1-3: sets all step data. "0" = 30 hex. defaults: <i>loop</i> = 0, # <i>loops</i> = 0 (no back cycle), <i>tempinc</i> = 0, <i>timeinc</i> = 0, <i>slope</i> = maximum slope	[<i>bltemp,htime,loop,#loops,timeinc,slope</i>]
c	NSTP	[<i>bltemp</i> , <i>htime</i> [, <i>loop</i> , # <i>loops</i> [, 0 [, <i>tempinc</i> [, <i>timeinc</i> [, <i>slope</i>]]]]]]	next step[?]	Without any optional parameter: sends step data. With parameter 1 and 2: sets all step data. "0" = 30 hex. defaults: <i>loop</i> = 0, # <i>loops</i> = 0 (no back cycle), <i>tempinc</i> = 0, <i>timeinc</i> = 0, <i>slope</i> = maximum slope	[<i>stepnr, bltemp, htime, loop,#loops,0,tempinc,timeinc,slope</i>]
d	STPS		number of steps?	Sends number of steps of edited program.	#steps
e	ISTP	<i>stepnr</i> [, <i>bltemp</i> , <i>htime</i> [, <i>loop</i> , # <i>loops</i> [, 0 [, <i>tempinc</i> [, <i>timeinc</i> [, <i>slope</i>]]]]]]	insert step	<i>stepnr</i> must not be more than the previous step number +1. "0" = 30 hex. defaults: <i>bltemp</i> = 50.00°C, <i>htime</i> = 30 s, <i>loop</i> = 0, # <i>loops</i> = 0 (no back cycle), <i>tempinc</i> = 0, <i>timeinc</i> = 0, <i>slope</i> = maximum slope;	
f	DSTP	<i>stepnr</i>	delete step	<i>stepnr</i> must not be more than the previous step number.	
g	EEND		edit end	→ UM LIBR Ends editing and returns to LIBR.	
h	RUNT		runtime?	Sends runtime of edited program	runtime

6.9.9 Menu Protocol (PROT)

co	mnemo	parameter	description		reply parameter
a	CHCK	[<i>checktype</i>]	check type (?)	Data transfer check 0 - without CRC16 check value 1 - with CRC16 check value without parameter: sends check type	<i>checktype</i>
b	ECHO	[<i>echoflag</i>]	echo type (?)	0 - without echo 1 - quasi echo without parameter: sends echo type	<i>echoflag</i>
c	WATM	[<i>waittime</i>]	waiting time(?)	Waiting time for the repetition function of CRC (without syncdata). It is active only for once command, and for more commands with ';' inactive. Values between 0 and 254 (* 64ms) .	<i>waittime</i>

d	ITOR	[<i>timeoutlen</i>]	timeout length(?)	0: disables time-out of the receiving buffer. > 0: enables time-out of the receiving buffer. Parameter is the initialisation value of the time-out counter, values between 1 and 255 (* 64ms). Without parameter: sends time-out length	<i>timeoutlen</i>
e	HWHS	[<i>handsflag</i>]	handshake type(?)	0 - without handshake (default) 1 - hardware handshake without parameter: sends handshake type	<i>handsflag</i>

6.10 Formats of the parameters

D =	decimal
B =	bit
C =	character
± =	sign (nothing = +)
HHHH =	flexible format, max. 2 bytes converted in 1,2,3 or 4 ASCII- hex characters ("0"
..	"9", "A" .. "F", "a", .. "f");
HHHHHH =	the same, but max. 3 bytes possible
* =	value * 100d . The real value is multiplied by 100 before converted to hex.
** =	special time format: if (value < 9 hour) then seconds convert to hex else then minutes converted to hex and add up 8000h
u =	unsigned
s =	signed, highest bit determines the sign, 0 = plus, 1 = minus

Parameter	long format	short format	description	range
<i>#blocks</i>	D	HHHHu	number of blocks	1 .. 3
<i>#lines</i>	DD	HHHHu	number of lines	1 .. 12
<i>#loops</i>	DD	HHHHu	number of back cycles	1 .. 99 0 = no loop
<i>#sensors</i>	D	HHHHu	number of sensors	1 .. 3
<i>#steps</i>	DD	HHHHu	steps	0 .. 99
<i>alarmfl</i>	B	B	acoustic signal	0 = no alarm, 1 = alarm
<i>acttime</i>	HHHHu	HHHHu	cyclical time counter / 64 ms	0 .. FFFF
<i>aurestepnr</i>	DD	HHu	step number of auto restart, if 0 then direkt mode was active	0 .. 99
<i>blocknr</i>	D	HHHHu	block number	1
<i>blocktype</i>	D	HHHHu	block type	0 = 96, 2 = 384
<i>blocktypes</i>	'C:CC,C:CCC,'	'C:CC,C:CCC,.... ...'	list of block types	'0:96,2:384'

<i>blstatus</i>	BBBBBBBB BBBBBBBB	HHHHu	block status low byte: bit 0 - block is running bit 1 - controller or cooler error bit 2 - plateau bit 3 - ramp bit 4 - autorestart bit 5 - cooling = 1 /heating = 0 bit 6 - lid preheating bit 7 - pause high byte: bit 0 - headed lid error bit 1 - cooler error	0 .. FFFF
<i>bltemp</i>	±DD.D	HHHHS *	set block temperature	-3.00 .. 99.90
<i>bltempa</i>	±DDD.D	HHHHS *	actual block temperature	-7.0 .. 101.7
<i>checktype</i>	B	B	protocol check	0 = no check, 1 = check
<i>company</i>	'CCCCCCCC'	'CCCCCCCC'	name of company	'Biometra'
<i>cooltempa</i>	DD.D	HHHHS *	actual cooler temperature	2.30 .. 70.00
<i>ctrlnr</i>	D	HHHHu	controller number	1-3
<i>cyclcount</i>	DD	HHHHu	cycle counter	1 .. 100
<i>cyclertype</i>	'CCCCCCCC'	'CCCCCCCC'	cycler type	'TRobot'
<i>dirname</i>	'CCCCCCCC'	'CCCCCCCC'	directory name	A .. Z, - () # / , < > & + . % !
<i>dirnr</i>	D	HHHHu	directory number	0 .. 9, FF – if direct mode is active
<i>echoflag</i>	B	B	echo on/off	0 = off, 1 = on
<i>gradient</i>	±DD.D	HHHHS *	set temperature gradient	0 .. 40.0, if gradient possible; 0, if gradient not possible
<i>handsflag</i>	B	B	hardware handshake on/off	0 = off, 1 = on
<i>htime</i>	DD.DD.DD	HHHHu **	set holding time / s or / m (short format) hh.mm.ss (long format)	00h00m01s .. 08h59m59s 09h00m .. 99h59m 0 = pause
<i>htimea</i>	DD.DD.DD	HHHHu **	holding time / s or / m up till now	00h00m01s .. 08h59m59s 09h00m .. 99h59m
<i>interval</i>	DD	HHHHu	synchronous data interval / s	1 .. 15 0 = "life sign" no parameter -> stop
<i>lidtemp</i>	DDD	HHHHu	set lid temperature	30 - 99, 0 = no heating

<i>lidstatus</i>	BBBBBBBB BBBBBBBB	HHHHu	heated lid status low byte: bit 0 - lid is heated bit 1 - lid too hot bit 2 - lid too often on bit 3 - lid is fast heated high byte: bit 0 - lid is open bit 1 - lid is closed bit 2 - HW error 1 bit 3 - HW error 2 bit 4 - time-out of engine bit 5 - safety switches on	0 ... FFFF
<i>lidtempa</i>	DDD	HHHHu *	actual lid temperature	10.00 .. 139.00
<i>lintempfac</i>	±DDDDD ±DDDDD ...	HHHHS, HHHHS, ...	up to 12 factors for calculation of line temperatures, separated by commas	-16000 ... 16000
<i>loop</i>	DD	HHHHu	back cycle step number	1 .. actual step number 0 = no loop
<i>preheating</i>	B	B	set preheating lid	0 = no preheating, 1 = preheating
<i>programe</i>	'CCCCCCCC'	'CCCCCCCC'	program name	A .. Z, - () # / , < > & + . %
<i>progrnr</i>	DD	HHHHu	program number	0 .. 99, FF – if direct mode is active
<i>protver</i>	'DD.DD.DD.DD'	'DD.DD.DD.DD'	protocol version	'00.00.00.00' .. '99.99.99.99'
<i>remtime</i>	DDDDD	HHHHu	remaining time of active	0 .. 59940 minutes
<i>runtime</i>	DDDDD	HHHHu	complete runtime	0 .. 59940 minutes
<i>scbltemp</i>	±DDD.DD	HHHHS *	temperature at block error	-7.00 .. 101.70
<i>scpeltcur</i>	±DD.DD	HHHHS *	peltier current at block error	0 .. ±99.99
<i>scpuls</i>	HHHH	HHHHu	pulse width at block error	0 .. FFFF
<i>slope</i>	D.DD	HHHHu *	set slope	0.01 .. 1.99 2.0 .. 5.0
<i>spreadfac</i>	DDDDD	HHHH	spreadfactor for gradients	0 .. FFFF
<i>ssernr</i>	'CCCCCCCC'	'CCCCCCCC'	serial number	0000000 ... 9999999
<i>stepnr</i>	DD	HHHHu	step number	1 .. 99
<i>sversion</i>	'DD.DDCC'	'DD.DDCC'	software version	'00.01tr' .. '99.99tr'
<i>syncdata</i>	see short format of single parameters	see short format of single parameters	synchronous data are used for the control of the activity of a block. Contents: <i>blocknr</i> , <i>blstatus</i> , <i>acttime</i> , <i>htimea</i> , <i>stepnr</i> , <i>cyclcount</i> , <i>0</i> , <i>lidtempa</i> , <i>cooltempa</i> , <i>tempform</i> , <i>bltempa</i> (see chapter 6.3.1).	see range of single parameters

<i>systatus</i>	BBBBBBBB	HHHHu	system status bit 0 - low voltage bit 1 - block error (controller,lid,cooler) bit 2 - bit 3 - bit 4 - remote control error bit 5 - memory error bit 6 - software error	0 ... FF
<i>tempform</i>	C	HHHHu	temperature format of	'A'
<i>tempinc</i>	±DD.DD	HHHHs *	set temp. increment/C	0 .. ±20.00
<i>timeinc</i>	DDD	HHHHu	set time increment /s	0 .. 240
<i>timeoutlen</i>	DDD	HHHHu	length of timeout	0 .. 255 (*64ms)
<i>waittime</i>	DDD	HHHHu	waiting time of repeat function if crc16-check is selected	0 .. 254 (*64ms)

6.10.1 Examples

Query of block temperature

:b 1;l 6 Bytes

in mnemonics

:BLCK 1;TEMP 12 Bytes

6.11 Error codes

Error codes consist of three decimal numbers. The first sign determines the error group. Variable numerical values of several formats in this description are represented by format signs, beginning with "%".

Examples:

%4x ; hexadecimal, 4 digit

%2d ; integer, 2 digit

%5f1 ; decimal value, signed, 5 digit altogether, consisting of 3 integer digits, decimal point and 1 post-decimal digit.

All error texts end with "!".

See also chapter 6.2.3.2.

Special error code:

!? checksum error

6.11.1 Error Group 0xx: System Errors

001	remote control off!	; remote control not activated
002	Error %4x %4x %4x %4x %4x %4x %4x	; software error, system halted
003	wait: too cold!	; cooler too cold
004	cooler too hot!	; cooler too hot
005	no printer!	; no printer available
006	no heated lid!	; heated lid not connected

007	printer active!	; printer is already active
008	1..%2d only!	; paper feed 1,2 or 3
009	1..%2d only!	; display contrast
010	handshake not possible!	; communication cable not ; suitable

6.11.2 Error Group 1xx: Edit Errors

101	max %1d!	; max. directory number
102	max %2d!	; max. program-number
103	edit not possible!	; program is active
104	pgm full: %2d steps!	; max. number of steps reached
105	pgm is empty!	; program is empty
106	pgm is active!	; program cannot be changed
107	pgm is edited!	; Editing of this program isn't finished
108	RAM full!	, memory full
109	only %3d programs possible!	; max. number of programs exceeded
110	max %2d!	; step number larger than progr.length+1
111	min = 1!	; step number too small
112	max = %2d!	; step number larger than progr. length
113	min %4f1 max %5f1!	; heated lid temperature out of range
114	min %5f1C, max %5f1C!	; block temperature out of range
115	max %2h%2m%2s!	; max. time exceeded
116	max %2d!	; max. number of back cycles exceeded
117	too many nested cycles!	; too many nested cycles
118	back cycles only: max = %2d!	; destination step is larger than start step
119	cycle into cycle!	; cycle into cycle
120	cycle out of cycle!	; cycle out of cycle
121	gradient out of temperature range!	; temp. out of range because of gradient
122	%5f1C - %5f1C!	; gradient out of range
123	max +-%2d C!	; temperature increment too large
124	max. %3d s!	; time increment too large
125	value?!	; step incomplete (temperature, time!)
126	cycle value?!	; back cycle destination or number of ; back cycles missing

6.11.3 Error Group 2xx: Block Errors

In the long format after the error text or in the short format after the error code follows the block number (*blocknr*) b (%1d), controller number (*ctrlnr*) c (%1d), temperature (*scbltemp*) t (%5f1C), current (*scpeltemp*) i (%4f1A) and pulse (*scpuls*) p (%4x). (See chapter 6.2.4).

200	no block error! bctip	; no error
201	unidentified error! bctip	; unidentified block error
202	emergency off! bctip	; error detected by hardware
203	peltier contact??! bctip	; missing peltier contact
204	temp fault! bctip	; block temperature out of range
205	cooling current low! bctip	; set temperature cannot be reached
206	heating current low! bctip	; set temperature cannot be reached

207	lid too hot! bctip	; heated lid temperature out of range
208	cooler fault! bctip	; cooler temperature out of range
209	opening not possible! bctip	; lid cannot be opened automatically
210	closing not possible! bctip	; lid cannot be closed
211	motor disconnected??! bctip	; both endposition switches are active

6.11.4 Error Group 3xx: Block Using Errors

300	pgm finished or paused!	; regular program end or pause, no error
301	start not possible!	; block is already active
302	block off!	; block is (already) off
303	blocks 1 .. %1d!	; wrong block number
304	lid is open!	; lid is already open
305	lid is closed!	; lid is already close
306	lid is not in endposition!	; lid not ready, start not possible
307	block is active!	; not possible, block is active
308	wrong block type!	; wrong block type
309	no in tube sensor!	; no intube sensor connected
310	pgm not paused!	; program isn't paused

6.11.5 Error Group 4xx: Memory Error

401	name deleted!	; Error in directory name
402	pg %1d/%2d and the following empty!	; Error in program memory
403	%3d pgm's empty!	; Error in program memory
404	no steps!	; program without any step
405	data error: block %1d stopped!	; error in active program after ;autorestart
406	checksum error!	; checksum error of software

6.11.6 Error Group 5xx: Input Syntax Error

501	invalid command!	; command not available in this menu
502	missing command!	; command expected
503	missing separator!	; separator expected
504	separator error!	; wrong use of separator
505	missing apostrophe!	; apostrophe expected
506	convert error!	; conversion error in parameter
507	missing parameter!	; parameter expected
508	wrong parameter!	; wrong parameter

6.11.7 Error Group 6xx: Buffer Error

601	rx write denied!	; writing into the receiving buffer not possible
602	rx read denied!	; reading from the receiving buffer not possible
603	overflow rx!	; overflow of the receiving buffer
604	rx time-out	; time-out of the receiving buffer
611	tx write denied!	; writing into transmit buffer 0 not possible
612	tx read denied!	; reading from transmit buffer 0 not possible
613	overflow tx!	; overflow of the transmit buffer 0
621	sy0 write denied!	; writing into transmitting buffer 1 not possible
622	sy0 read denied!	; reading from transmitting buffer 1 not possible

623	overflow sy0!	; overflow of the transmitting buffer 0
631	sy1 write denied!	; writing into transmitting buffer 2 not possible
632	sy1 read denied!	; reading from transmitting buffer 2 not possible
633	overflow sy1!	; overflow of the transmitting buffer 0
641	sync data fault!	; writing into transmitting buffer 1 and 2 not ; possible

7 Trouble shooting

7.1 Slow heating and cooling

See chapter 0

7.2 Autorestart

Running programs will be continued from the same step where the power failure has happened as soon as the power is supplied again. In the Thermocycler Manager Software main screen (see chapter 5.3) a message is displayed showing that the TRobot has been restarted:

Block 1 is restarted.

7.3 Autorestart due to unrecognised power failure

High voltage fluctuation can lead to an automatic restart of the TRobot Thermocycler. In this case the cycler restarts at the step where there power failure has occurred. A message is displayed showing that the TRobot has been restarted (see chapter 7.2). To avoid voltage fluctuation, do not connect the cycler to a socket shared by a strong power consumer like a refrigerator or a centrifuge.

7.4 Opening and closing heated lid off-line

The motorized lid can be operated with a 9V block battery. This option can be used in case of power failure to remove the samples. For operating the lid a battery is contacted to the socket on the rear side of the Thermocycler (see chapter 4.2)



	English	Deutsch
	Only use a 9V block battery to open the TRobot lid manually	Verwenden Sie ausschließlich eine 9V Blockbatterie, um den TRobot Deckel manuell zu öffnen.

7.5 Recommendations for the use of 384 well Thermocyclers

a) Use the recommended 384 well plates and sealing materials

To prevent sample evaporation by insufficient sealing please use 384 well plates and sealings tested and recommended by Biometra. A list of plates and sealing is available at www.biometra.com -> thermocyclers -> plasticware

b) Reduce the temperature of the heated lid

Due to the fact that the heated lid is very close to the reaction volume with a 384 well plate compared to 0.2 ml vessels the lid temperature can have a significant impact on the effective incubation temperature. For reaction volumes less than 10 μl the lid temperature is recommended to be set at 95 °C. When using a reaction volume of 10 μl or more, set lid temperature at 85 °C. Even at these lowered lid temperatures possible condensation will not occur as problem due to a mixture of physical factors like dew point, salt concentration, temperature difference, air pressure within the tube and reaction volume. It is strongly recommend to reduce the lid temperature according to the reaction volume. Otherwise, at conventional lid temperature settings, sample volumes or amplification yields might be reduced.

8 Maintenance and repair

8.1 Cleaning and Maintenance

The TRobot was built to operate for a long time without the need for periodical maintenance. Nevertheless, occasionally cleaning of the air inlet may be necessary to maintain the efficiency of the Thermocycler. Insufficient airflow may lead to reduced heating and cooling rates. The inlet for the airflow is located at the front side of the instrument (see chapter 4). Be sure that the inlet is not clogged by dust or other material (e.g. a sheet of paper placed under the cyclor can be attached to the inlet as the fan is in operation). Dust can be removed easily from the inlet with a conventional vacuum cleaner. Additionally, the Thermocycler housing may be cleaned from time to time with a smooth cotton cloth. Do not use strong detergents or organic solvents for cleaning. Never treat the block with abrasive agents.

Important: Appropriate safety regulations must be observed when working with infectious or pathogenic material.

8.2 Service and repair

The TRobot Thermocycler contains no user serviceable parts. Do not open the housing instrument. Service and repair may only be carried out by the Biometra Service department or otherwise qualified technical personal.

The Service department offers Thermocycler maintenances and temperature verifications. Biometra recommends an annual maintenance and a biannual temperature check for all Thermocyclers. Please call the following phone number for detailed information: +49 551-50881-10/12.

8.3 Firmware update

For instruction for firmware upgrade, please contact the Biometra Service Department or your local distributor/sales representative.

8.4 Replacement of Spare Parts

Only original spare parts mentioned in these operating instructions are allowed.

9 Accessories

9.1 Plasticware

Biometra offers a broad range of plasticware for the use in PCR. The following table provides an overview for the product portfolio:

Cat. no.	Description	Quantity
Single tubes		
050-310	0.2 ml tubes with caps	1000 pcs.
050-320	0.5 ml tubes with caps	1000 pcs.
Tube strips		
050-254	Strips 8 tubes and flat caps	125 pcs.
050-255	Strips 8 tubes and domed caps	125 pcs.
48 well plates		
050-225	48 well microplate	50 pcs.
96 well plates		
050-232	96 well skirted	25 pcs.
050-213	96 well non-skirted (low profile)	25 pcs.
050-253	96 well non-skirted	25 pcs.
384 well plates		
050-231	HSQ 384 well skirted	50 pcs.
050-240	384 well microplate	50 pcs.
Miscellaneous		
050-237	Silicone mat	50 pcs.
050-256	Adhesive film	100 pcs.
050-257	Heat Sealing Film	100 pcs.
050-236	Heat Sealing Film Aluminium	10 pcs.
050-194	96 well aluminium plate	1 pcs.
050-694	384 well aluminium plate	1 pcs.
050-251	Nop mat 96 well	20 pcs.
050-252	Nop mat 384 well	20 pcs.

10 Service

Should you have any problems with this unit, please contact our service department or your local Biometra dealer:

Biometra GmbH

Service Department

Rudolf-Wissell-Straße 14 - 16

D-37079 Göttingen

Phone: ++49 (0)5 51 50 68 6 - 10 or 12

Fax: ++49 (0)5 51 50 68 6 -11

e-mail: Service@biometra.com



If you would like to send the unit back to us, please read the following return instructions in chapter 10.1

10.1 Instructions for return shipment

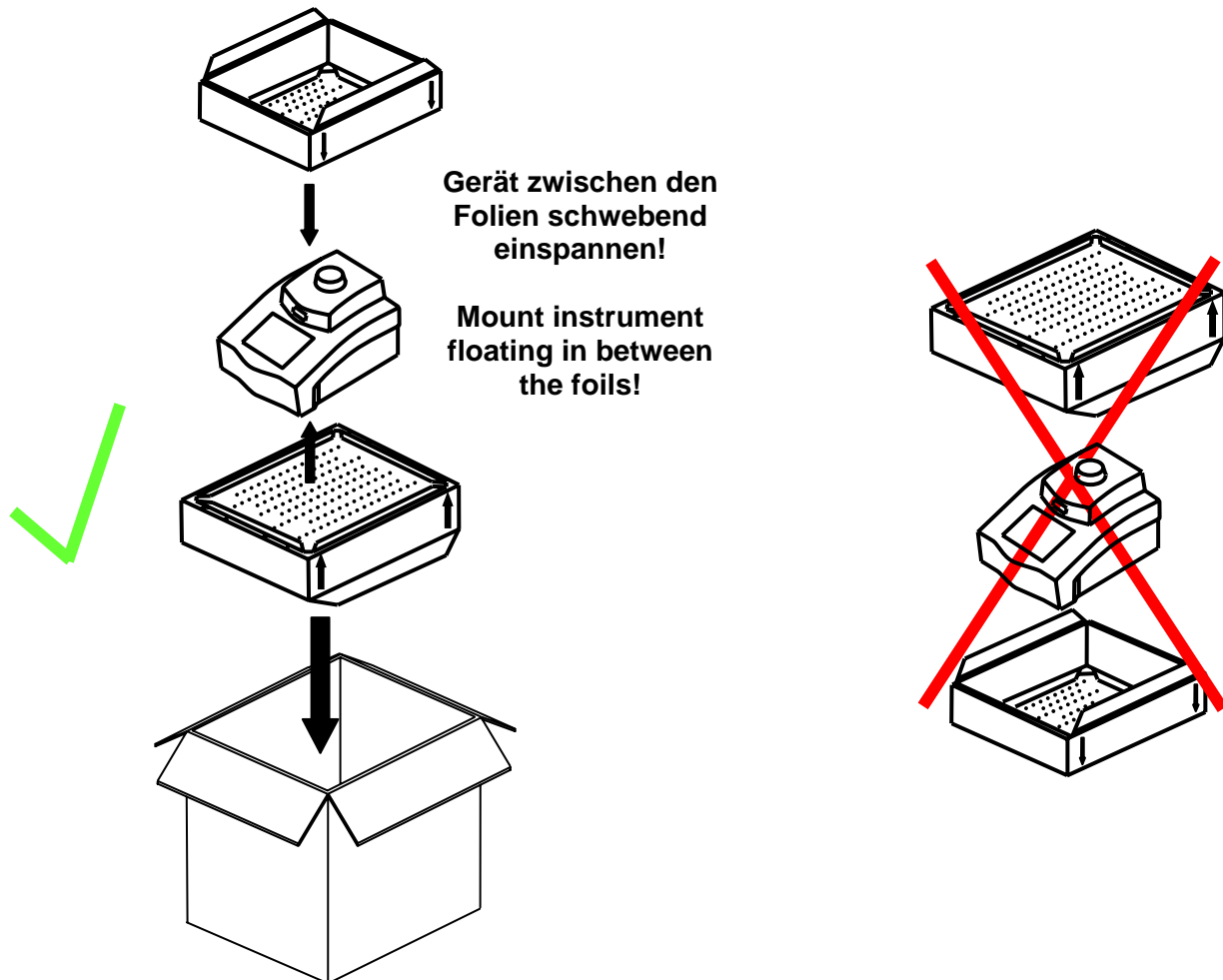
In case of an instrument failure that cannot be fixed by the procedures described in section 7 please proceed as follows:

- Return only defective devices. For technical problems which are not definitively recognisable as device faults please contact the Technical Service Department at Biometra (Tel.: +49 551-50881-10/12, Fax: +49 551-50881-11, e-mail: service@biometra.com).
- Please contact our service department for providing a **return authorization number (RAN)**. This number has to be applied clearly visible to the outer box. **Returns without the RAN will be not be accepted!**
- Important: Carefully clean all parts of the instrument of biologically dangerous, chemical or radioactive contaminants. If an instrument is contaminated, Biometra will be forced to refuse to accept the device. The sender of the repair order will be held liable for possible losses resulting from insufficient decontamination of the device.
- Please prepare written confirmation that the device is free from biologically dangerous and radioactive contaminants. The declaration of decontamination (see section 11) must be attached to the outside of the packaging.
- Use the original packing material. If not available, contact Biometra or your local distributor.
- Label the outside of the box with "CAUTION! SENSITIVE ELECTRONIC INSTRUMENT!"
- Please enclose a note which contains the following:
 - a) Sender's name and address,
 - b) Name of a contact person for further inquiries with telephone number,
 - c) Description of the fault, which also reveals during which procedures the fault occurred, if possible

10.2 Packing of the TRobot Thermocycler

Biometra uses an extra designed packaging system where the instrument is mounted in between two tearproof foils. The TRobot Thermocycler and controller are put onto the lower inlet and is fixed in between the foils by pressing the upper inlet down.

Note: The instruments are only protected from transport damage if the packing instructions are followed and if they are mounted in between the foils. Biometra will not be responsible for transport damage by improper packing. Always use two separate boxes for the shipment of the controller and the TRobot instrument to prevent damages!



11 Equipment Decontamination Certificate

To enable us to comply with German law (i.e. §71 StrlSchV, §17 GefStoffV and §19 ChemG) and to avoid exposure to hazardous materials during handling or repair, please complete this form, prior to the equipment leaving your laboratory.

COMPANY / INSTITUTE _____

ADDRESS _____

PHONE NO _____ FAX NO _____

E-MAIL _____

EQUIPMENT	Model	Serial No
	_____	_____
	_____	_____
	_____	_____
	_____	_____

If on loan / evaluation Start Date: _____ Finish Date _____

Hazardous materials used with this equipment:

Method of cleaning / decontamination:

The equipment has been cleaned and decontaminated:

NAME _____ POSITION _____
(HEAD OF DIV./ DEP./ INSTITUTE / COMPANY)

SIGNED _____ DATE _____

PLEASE RETURN THIS FORM TO BIOMETRA GMBH OR YOUR LOCAL BIOMETRA DISTRIBUTOR TOGETHER WITH THE EQUIPMENT.
PLEASE ATTACH THIS CERTIFICATE OUTSIDE THE PACKAGING. INSTRUMENTS WITHOUT THIS CERTIFICATE ATTACHED WILL BE RETURNED TO SENDER.

General Information for Decontamination:

Please contact your responsible health & safety officer for details.

Use of radioactive substances:

Please contact your responsible person for details.

Use of genetically change organism or parts of those:

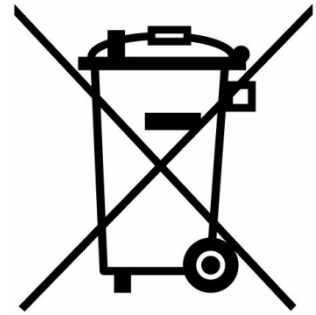
Please contact your responsible person for details.

12 Note for the disposal of electric / electronic waste.

Note for disposal of electric / electronic waste

Hinweis für die Entsorgung von Elektroaltgeräten

Renseignement du traitement des déchets des appareils électrique / électronique



This symbol (the crossed-out wheeled bin) means, that this product should be brought to the return and / or separate systems available to end-users according to your country regulations, when this product has reached the end of its lifetime.

For details, please contact your local distributor!

This symbol applies only to the countries within the EEA*.

EEA = European Economic Area, comprising all EU-members plus Norway, Iceland and Liechtenstein.

Dieses Symbol (die durchgestrichene Abfalltonne) bedeutet, dass dieses Produkt von der Firma Biometra für eine kostenlose Entsorgung zurückgenommen wird. Dies gilt nur für Geräte, die innerhalb Deutschlands gekauft worden sind.

Kontaktieren Sie für die Entsorgung bitte die Biometra Service-Abteilung!
Außerhalb Deutschlands wenden Sie sich bitte an den lokalen Händler.

Dieses Symbol gilt nur in Staaten des EWR*.

*EWR = Europäischer Wirtschaftsraum, umfasst die EU-Mitgliedsstaaten sowie Norwegen, Island und Liechtenstein.

Cet symbol (conteneur à déchets barré d'une croix) signifie que le produit, en fin de vie, doit être retourné à un des systèmes de collecte mis à la disposition des utilisateurs finaux en conséquence des réglementations par la loi de votre pays.

Pour des information additionel nous Vous demandons de contacter votre distributeur!

Cet symbole s'applique uniquement aux pays de l'EEE*.

EEE = Espace économique européen, qui regroupe les États membres de l'UE et la Norvège, Islande et le Liechtenstein.

13 Declaration of Conformity

EU – Konformitätserklärung
EC - Declaration of Conformity

Göttingen, August 2004

im Sinne der EG-Richtlinie über elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen 73/23/EWG
following the EC directive about electrical equipment for use within certain limits of voltage 73/23/EEC

und / *and*

im Sinne der EG-Richtlinie für die elektromagnetische Verträglichkeit 89/336/EWG.
following the EC directive about the electromagnetic compatibility 89/336/EEC .

Hiermit erklären wir, dass folgende **Thermocycler**:
*Herewith we declare that the following **Thermocyclers**:*

Typen / *types*: TRobot Thermocycler 96, TRobot Thermocycler 384
Best.-Nr. / *Order No.:* 050-991, 050-992

den grundlegenden Anforderungen der
corresponds to the basic requirements of

EG-Niederspannungsrichtlinie 73/23/EWG und der
EC low voltage directive 73/23/EEC and the

EG-Richtlinie über die elektromagnetische Verträglichkeit 89/336/EWG entsprechen.
EC directive about the electromagnetic compatibility 89/336/EEC .

Dr. Jürgen Otte
Quality Manager

14 Warranty

This Biometra instrument has been carefully build, inspected and quality controlled before dispatch. Hereby Biometra warrants that this instrument conforms to the specifications given in this manual. This warranty covers defects in materials or workmanship for 24 months as described under the following conditions:

This warranty is valid for 24 month from date of shipment to the customer from Biometra or an authorised distributor. This warranty will not be extended to a third party without a written agreement of Biometra.

This warranty covers only the instrument and all original accessories delivered with the instrument. This warranty is valid only if the instrument is operated as described in the manual.

Biometra will repair or replace each part which is returned and found to be defective. This warranty does not apply to wear from normal use, failure to follow operating instructions, negligence or to parts altered or abused.

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