

## USER MANUAL

**ChipGenie® edition TSO**  
**On-Chip qPCR Thermocycler**



## Contents

Important advice.....	2
1 Safety.....	3
2 Packing list .....	5
3 The instrument.....	6
4 Installation.....	7
4.1 Software installation.....	7
4.2 Hardware installation.....	8
4.3 System requirements.....	9
5 Handling procedure.....	10
5.1 Chip handling and loading.....	10
5.2 ChipGenie® edition TSO compatible microfluidic chips.....	12
6 Software application.....	15
6.1 The main menu.....	16
6.2 PCR parameter interface.....	17
6.3 Detection settings interface.....	19
6.4 PCR menu.....	20
6.5 Data storage.....	22
6.6 Manual Mode.....	23
7 TSO Analyzer.....	25
8 Technical data.....	26

## Important Advice



Before you start using ChipGenie® edition TSO, please take time to review the entire user manual and follow safety instructions at all times. Misuse of ChipGenie® edition TSO can lead to severe injuries or damage to the device and equipment.

Caution! ChipGenie® edition TSO contains heating blocks, which can reach temperatures of 120°C and above. Never touch heating blocks after heating functions has been enabled. Do not insert foreign equipment into ChipGenie® edition TSO that is not intended for use within the device.

*microfluidic ChipShop* is always happy to advise. Contact us with any questions that might arise when utilizing the ChipGenie® edition TSO, using the contact information below.

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## 1 Safety



Caution! The ChipGenie® edition TSO is an electromechanical device.

- Do not access any electrical parts or open housing while device is connected to main power supply.
- Ensure adequate power supply. Verify required voltage settings by checking the specifications on the device.
- Always disconnect the device from the main power supply before cleaning it.
- Only authorized service personnel are permitted to service and repair the device. Never attempt to access internal elements of the device.
- Do not attempt to manipulate the internal safety switches.



Caution! The ChipGenie® edition TSO contains surfaces that rapidly reach temperatures up to 120°C.

- Device lid must be closed at all times when instrument is operating.
- Never touch heating blocks after heating functions has been enabled.
- Equipment that is not resistant to high temperature above 100°C should never be inserted into the device.
- Only use microfluidic chips recommended for use with the ChipGenie® edition TSO.



Caution! Danger of explosion through sparks.

- Keep all potentially explosive or inflammable reagents and material away from the device.



Caution! Liquids are not to be handled inside ChipGenie® edition TSO.

- Always load reaction vessels or microfluidic chips outside the instrument.



Caution! The ChipGenie® edition TSO requires air ventilation.

- Always ensure airflow through ventilation slots at the side of the device.
- Never obstruct ventilation system. Never place anything in front of the ventilation slots.



Caution! ChipGenie® edition TSO is an experimental device for research use only.

- Only use the device for the intended research applications with recommended materials.
- Always wear protective goggles and gloves while handling hazardous materials
- Local regulations and laws may apply for the use of chemicals for the intended applications. Please make sure to comply with all applicable regulations.

**Warning:** If the device is not used according to the instructions, a secure handling cannot be guaranteed.



## 2 Packing List

The device is delivered with the following components:



- 1 ChipGenie® edition TSO instrument
- 2 External power supply 24 V 9.2 A DC
- 3 Power cord
- 4 USB flash drive with instrument software
- 5 USB-B cable

Please make sure that all components are included and do not show visual damages. Otherwise, contact our support using the following contact information.

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[www.microfluidic-ChipShop.com](http://www.microfluidic-ChipShop.com)

### 3 The Instrument



The ChipGenie® edition TSO device has the following characteristics:

- PCR system for stationary on-chip PCR
- Used with microfluidic chips in slide format (25 x 75 mm)
- Reaction volumes from 2.5 µl to 50 µl
  - Up to 16 chambers (dependent on chamber volume)
- Detector for two fluorescence labels
  - Emission peak 520 nm; excitation peak 470 nm
  - Emission peak 680 nm; excitation peak 625 nm
  - Compatible with all dyes that match emission and excitation windows
  - We recommend fluorescence dyes Fluorescein (6-Fam) and Indodicarbocyanine (Cy™5)

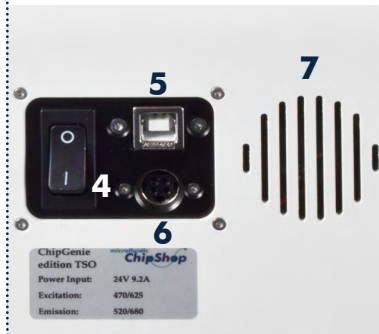
#### Instrument overview



#### Opened instrument



#### Instrument back



- 1 Instrument lid
- 2 Instrument casing
- 3 Air slots
- 4 ON/OFF switch
- 5 USB-B connector
- 6 Power connector 24V 9.2A DC
- 7 Air slots
- 8 Fluorescence detector
- 9 Chip lock
- 10 PCR element



## 4 Installation

The installation of the ChipGenie® edition TSO system requires two steps. The first step is the installation of the control software; in the second step the hardware drivers for ChipGenie® edition TSO are installed.

**Please follow the installation instructions very carefully, otherwise the system may not function properly.**



### 4.1 Software Installation

All required software and drivers can be found on the included USB flash drive. Connect the USB flash drive to your PC and follow the installation instructions below to install the ChipGenie® edition TSO control software on your computer. It is not necessary to connect the ChipGenie® edition TSO device to your PC for the software installation.

#### **Preparation of installation:**

An installation of a .net framework runtime engine is required

- 1 Open the installation device folder provided with the device (E:\.net framework)
- 2 Run the setup installation: Microsoft .NET Framework 4.8 (Web Installer) for Windows.exe
- 3 Follow the instructions of the setup installation routine (the PC has to be connected to the internet)

#### **Installation of the device software:**

Installation of ChipGenie® edition TSO device software

- 1 Open the installation folder on the USB flash drive provided with the device (E:\ChipGenie edt. TsO Software)
- 2 Copy the entire content of the folder (ChipGenie TSO.exe, DeviceSettings.xml; SerialCom.dll) into a hard drive folder of your choice.
- 3 To start the software double click on the „ChipGenie TSO.exe“
- 4 For more convenient handling it might be useful to shortcut the „ChipGenie TSO.exe“ to your desktop.





### Installation of TSO Analyzer:

The TSO Analyzer is the current analysis software for Ct value interpretation

- 1 Open the installation folder provided with the device (E:\TSO Analyzer)
- 2 Copy the content of the folder into a hard drive folder, free of choice.
- 3 To start the software double click on the „TSOAnalyzer.exe“
- 4 For more convenient handling it might be useful to link „TSOAnalyzer.exe“ to your desktop.

### Storage of experimental data:

The recorded PCR data are saved in the installation folder (on your hard disk e.g. C:\ChipGenie edt TSO). For each PCR experiment a separate folder for individual experiment tracking is created with the following string, „PCR dd-mm-yyyy–time“.

## 4.2 Hardware Installation



To install the ChipGenie® edition TSO device, follow the instructions below:

- 1 Place the ChipGenie® edition TSO instrument on a lab bench/even surface.
- 2 Connect the external power supply to the instrument.
- 3 Plug in the Mini USB cable on the back of the instrument and connect it to your PC.
- 4 Turn on ChipGenie® edition TSO using the power switch at the rear end of the device.
- 5 The operation system will detect that new hardware is connected and try to install the required drivers. Windows® 10 will install all required drivers automatically.



- 1 To USB of PC via ChipGenie® edition TSO control software
- 2 To external power supply 24V, 9.2 A DC



## 4.3 System Requirements

Recommended system requirements for ChipGenie® edition TSO control software:

Processor	: 1 GHz
RAM	: 512 MB
Operation system	: Windows 10®
.Net Framework	: version 4.8 or higher
Minimum Disk space	:
Control software	: 10 MB
.Net Framework	: 4.5 MB

## 5 Handling Procedure



The next chapter describes the general handling procedure for operating the device.

### 5.1 Chip Handling and Loading



#### Preparation of the microfluidic chip



- Place the chip on a flat laboratory benchtop.
- Load the chambers with the PCR mix using a pipette according to the volume of the respective chip. PCR mix contains PCR master mix and target nucleic acid.
- Close the chip in- and outlets with Mini Luer plugs (Product code: 10001105).



### Insertion of loaded chip into the ChipGenie® edition TSO

**1**



**1** Open the lid of the instrument by pushing it upwards.

**2**



**2** Open the chip holder by pulling the chip locking lever out to the left. Insert the chip by sliding it below the guide rails.

**3**



**3** Push the chip into the final position and close the chip locking lever by pushing it in. Close the lid.

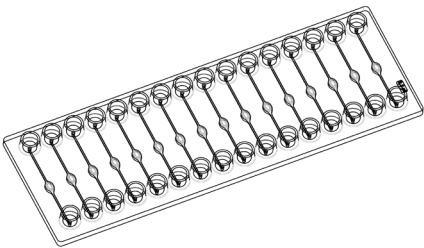


## 5.2 Compatible Microfluidic Chips

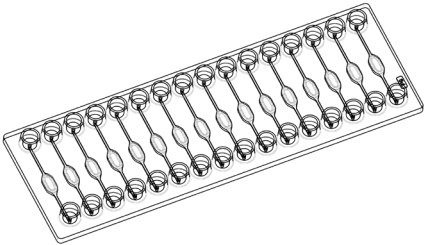
Following, you can find a selection of microfluidic chips provided by *microfluidic ChipShop GmbH* that are compatible with the ChipGenie® edition TSO. Chamber volumes of compatible chips vary between 2.5 µl and 50 µl. Dependent on the volume, up to 16 chambers can be found on one chip. For undisturbed fluorescent readouts, the reaction chamber chips feature *microfluidic ChipShop's* bubble trapping rim design, specifically developed to keep the detection area of each chamber air bubble-free.

### Reaction chamber chips

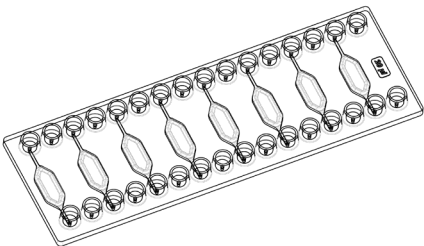
Fluidic number	843
Chamber volume [µl]	2.5
Chamber depth [µm]	500
Number of chambers	16



Fluidic number	750
Chamber volume [µl]	5
Chamber depth [µm]	500
Number of chambers	16



Fluidic number	584
Chamber volume [µl]	20
Chamber depth [µm]	500
Number of chambers	8

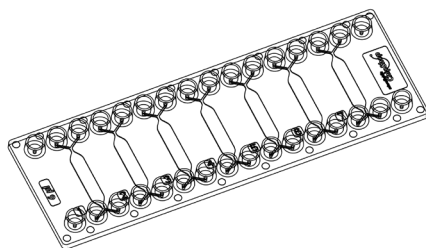




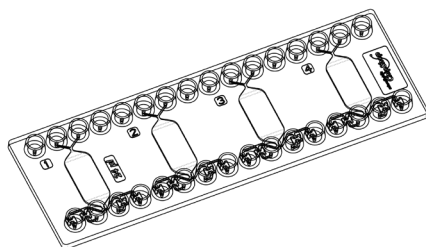
## 5.2 Compatible Chips

### Rhombic chamber chips

Fluidic number	132
Chamber volume [ $\mu\text{l}$ ]	6
Chamber depth [ $\mu\text{m}$ ]	200
Number of chambers	7



Fluidic number	133
Chamber volume [ $\mu\text{l}$ ]	24
Chamber depth [ $\mu\text{m}$ ]	400
Number of chambers	4

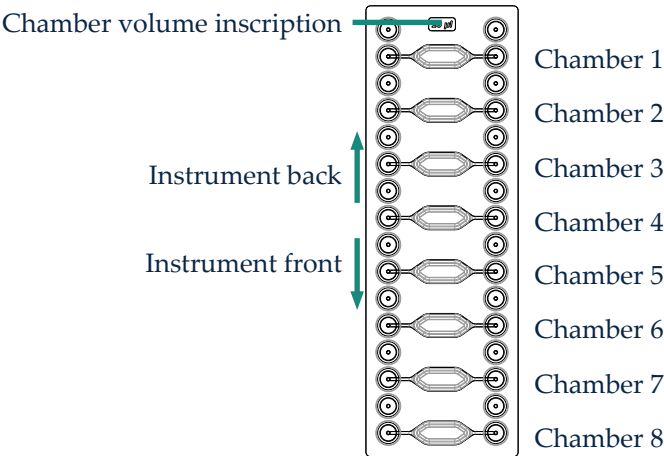


**Attention!** Due to chamber volume and geometry, some of the microfluidic chips are not symmetrical (e.g. compare Fluidic 584 and 750). Insert the chips always with the chamber volume inscription oriented towards the back of the instrument to ensure a proper detection.

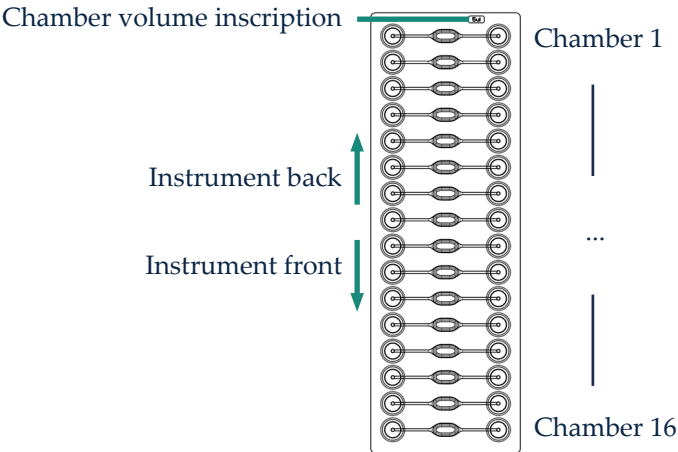


The detection positions of the instrument correspond to following positions on the chip:

**Asymmetric microfluidic chips**  
e.g. Fluidic 584



**Symmetric microfluidic chips**  
e.g. Fluidic 750





## 6 Software Application

To start a PCR protocol, please follow the steps below:

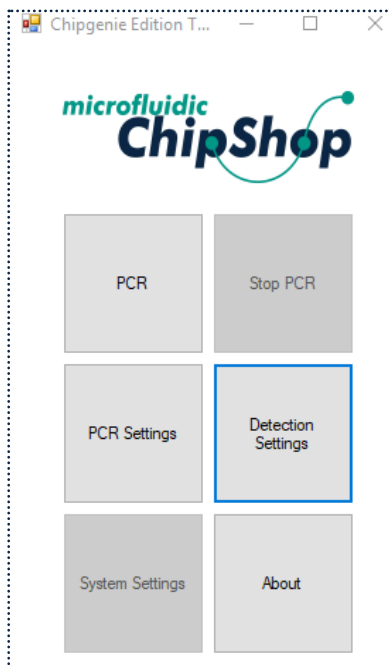
- 1 Open the ChipGenie® edition TSO Software
- 2 Select or modify the PCR profile by clicking on “PCR Settings”
  - a Load an existing profil
    - i Click the “Load” button
    - ii Navigate to the protocol folder on your computer
    - iii Click the open button to load the PCR profile
    - iv Click the “Set” button to load PCR configuration to device
  - b Configure a new Profile
    - i Configure the PCR profile according to your needs
    - ii Click the “Save” button
    - iii Navigate to your protocol folder on your computer
    - iv Click the “Save” button to save the profile on your computer
    - v Click the “Set” button to load PCR configuration to device
  - c You can close the “PCR Parameter” interface by clicking the X in the upper right corner of the window
- 3 Configure the “Detection Settings” by clicking on the respective button in the “Main Menu”
  - a Use the dropdown menu to select a chip profile
  - b Define the detection chambers and channels by selecting them in the checkboxes
    - i Fluo 1: emission peak 520 nm; excitation peak 470 nm
    - ii Fluo 2: emission peak 680 nm; excitation peak 625 nm
  - c Click the “Save” button
  - d Navigate to your protocol folder on your computer
  - e Click the “Save” button to save the profile on your computer
  - f Click the “Set” button to load detection configuration to device
  - g You can close the “Chambers” interface by clicking the X in the upper right corner of the window
- 4 Start the PCR by clicking the “PCR” button in the “Main Menu”
  - a The Temperature log window and the PCR log window will open and display the status of the PCR protocol
- 5 After the protocol has ended, calculation of Ct values starts automatically
  - a The “Analysis Summary” window displays all results of the PCR experiment



## 6.1 The Main Menu



The software “Main Menu” provides the following functions:



### PCR

Starts the PCR protocol with last saved PCR profile

### Stop PCR

Stops current PCR program (only active while PCR is running)

### PCR Settings

Opens the graphical PCR protocol configuration interface

### Detection Settings

Open the chip selection interface

### System Settings

Not active in current software Version

### About

Shows software information window

**Attention!** Clicking on the “Stop PCR” button will immediately interrupt the PCR protocol; the last set temperature will be maintained!



## 6.2 PCR Parameter Interface

To configure the PCR protocol, the “PCR Parameter” interface is used.

The screenshot shows the "PCR Parameters" window. It contains a flowchart with the following steps and fields:

- Temperature Pre-Phase [°C]**: 36
- Time Pre-Phase [sec]**: 1
- Pre-Denaturation [sec]**: 180
- Temperature Denaturation [°C]**: 95
- Time Denaturation [sec]**: 10
- Temperature Elongation [°C]**: 55
- Time Elongation [sec]**: 10
- Post cycles Elongation [sec]**: 1
- Temperature Storage [°C]**: 8
- Cycles**: 40
- Step Selection**: ☒ 2 Step, ☐ 3 Step

At the bottom, there are three buttons: **Load**, **Save**, and **Set**.

### Temperature Pre-Phase [°C]

Temperature configuration for additional incubation step prior to Pre-Denaturation; can be used for example for reverse transcriptase reaction during one-step RT-qPCR; in °C

### Time Pre-Phase [sec]

Time configuration for additional incubation step prior to Pre-Denaturation, in seconds

### Temperature Pre-Denaturation [°C]

Temperature configuration Pre-Denaturation; in °C

### Time Pre-Denaturation [sec]

Time configuration for Pre-Denaturation; in seconds

### Temperature Denaturation [°C] & Time Denaturation [sec]

Temperature configuration Denaturation; in °C & Time configuration for Denaturation; in seconds



### Temperature Annealing [°C] & Time Annealing [sec]

Temperature configuration Annealing; in °C & Time configuration for Annealing; in seconds

### Temperature Elongation [°C] & Time Elongation [sec]

Temperature configuration Elongation; in °C & Time configuration for Elongation; in seconds

### Cycles

PCR Cycle configuration

### 2 Step/3 Step

Configuration of 2 or 3 step PCR protocol; if selecting “2 Step” Annealing and Elongation are combined, configuration for Annealing not necessary

### Post-cycles Elongation [sec]

Time configuration for Post-Elongation step after last Elongation step; temperature of Elongation is used; in seconds

### Temperature Storage [°C]

Temp. configuration storage of PCR product after PCR has finished; in °C

### Load

Opens “select File...” dialog to import an existing PCR protocol file from drive

### Save

Opens “save File...” dialog to save a PCR protocol file to hard drive

### Set

Loads PCR configuration to device



## 6.3 Detection Settings Interface

Different pre-configured chip profiles can be selected in a drop-down menu. Depending on the chip selection, the number of detection chambers will change according to the selected chip design. By using the check boxes Fluo 1 and Fluo 2, the fluorescence detection channels can be configured.

The following fluorescence detection parameters are pre-defined in the device:

- Fluo 1: Emission peak 520 nm; Excitation Peak 470 nm
- Fluo 2: Emission peak 680 nm; Excitation peak 625 nm

### Chip Type

Select pre-configured chip profile

### Chamber 1 to 16

Check box below Fluo 1 and/or Fluo 2 to select detection channel and detection chamber

### Load

Import an existing Detection protocol from your hard disk via "select File..." dialog

### Save

Open "Save File..." dialog to save a Detection protocol file to hard disk

### Set

Load PCR configuration to device

### Color selection

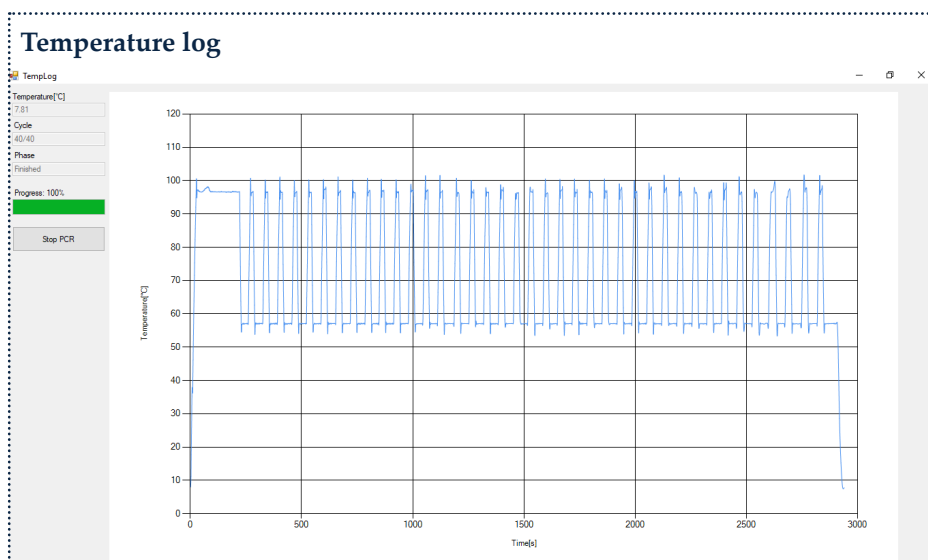
Open the color selection dialog to select/adapt colors of the displayed PCR graphs by clicking on the colored box behind each chamber

## 6.4 PCR Menu



By activating the button “PCR” in the “Main Menu”, the PCR protocol is started with the set parameters. Two windows will open that display the current protocol status in real time.

- 1 Temperature log window: Logs the PCR temperature profile
- 2 PCR log window: Logs the fluorescence detection results



Temperature [°C] : Displays the current temperature of the heating plate

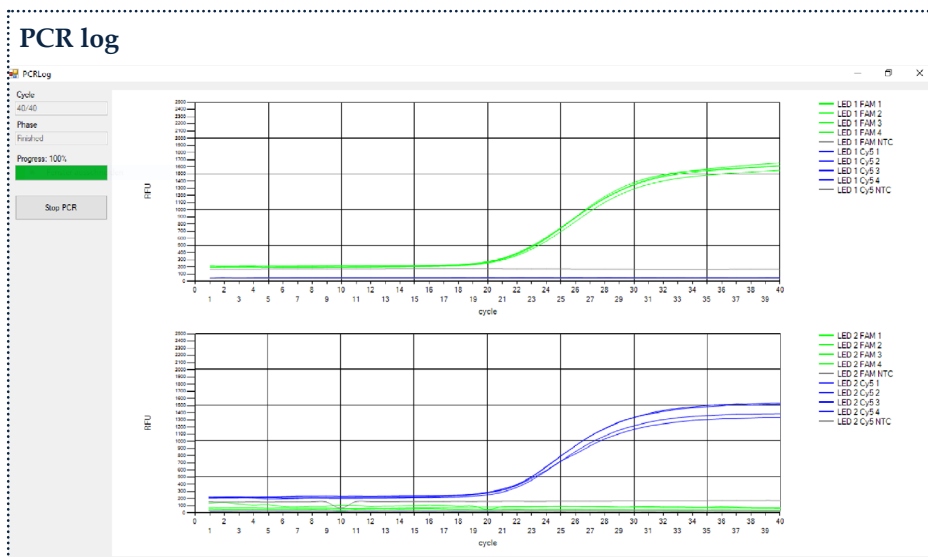
Cycle : Displays the current PCR cycle

Phase : Displays the current protocol step

Progress : Shows progress of the protocol

Stop PCR : Stops the PCR protocol

**Attention!** Clicking on the “Stop PCR” button will immediately interrupt the PCR protocol; the last set temperature will be maintained!



Two charts show the results of the fluorescence signals during the PCR. One chart displays the result for detection channel 1 (Fluo 1) the other chart displays the results for detection channel 2 (Fluo 2); all selected chambers of one detection channel are displayed in the same chart.

Cycle	Displays the current PCR cycle
Phase	Displays the current protocol step
Progress	Shows progress of the protocol
Stop PCR	Stops the PCR protocol

**Attention!** Clicking on the “Stop PCR” button will immediately interrupt the PCR protocol; the last set temperature will be maintained!

## 6.5 Data storage



The calculation of the Ct values from the PCR fluorescence can be performed after a successful experiment using the TSO Analyzer software (see Chapter 7 TSO Analyzer).

The PCR data are stored in the installation folder (on your hard disk e.g. C:\ChipGenie edt TSO). For each PCR experiment a separate folder for individual experiment tracking is created with the following string, “PCR dd-mm-yyyy—time.xml”. The data are stored in xml format. Additionally, a graph for each chamber and channel is stored as .png image.



## 6.6 Manual Mode

**Attention!** With the “Manual Mode”, the global settings of the ChipGenie® edition TSO can be changed. It is designated for system maintenance only. Changing the settings may cause serious damage to the device. It is not recommended to enter the “Manual Mode”!

The screenshot shows the 'ManualMode' window with the following sections and controls:

- Exit Manual Mode**: A button at the top.
- Temperature Controls**:
  - Current Temperature [°C]**: A text field showing 8.97.
  - Set Temperature**: A text field showing 8.00 with a dropdown arrow.
  - Set Temperature**: A button below the set temperature field.
- Chip Settings**: A button.
- Measurement Test**:
  - Measure**: A button.
  - Stop**: A button.
  - Save Measurements**: A button.
- Number of measurements**: A text field showing 100 with a dropdown arrow.
- Average Runtime [s]**: A text field showing 5.92.
- Measurement Delay [ms]**: A text field showing 300 with a dropdown arrow.
- Set Delay**: A button.
- Motor Controls**:
  - Motor Position**: A text field showing 0 with a dropdown arrow.
  - Set Position**: A button.
  - Reference Search**: A button.

Exit Manual Mode	Closes the Manual Mode
Current Temperature [°C]	Displays the current temperature of the heating plate
Set Temperature	Sets the temperature of the heating plate manually; in °C
Chip Settings	Opens the chip selection interface
Measure	Starts a manual fluorescence measurement; detection settings from the “Detection setting/Chambers” interface are used; fluorescence values are shown on the chart on the left side of the window, upper chart displays Fluo 1, lower chart displays Fluo 2
Stop	Stops the fluorescence measurement
Save Measurement	Saves measurements as .png
Number of measurements	Sets the number of repeated measurements
Average Runtime [s]	Displays the average runtime of a single measurement
Measurement Delay [ms]	Configures the integration time of the detector (Pre-set is 300 ms), <b>It is strongly recommended not to change this setting!</b>
Set Delay	Sets the designated integration time of the detector





Motor Position	Moves the detector to a manually designated position (between 0 and -220000) <b>It is strongly recommended not to change this setting!</b>
Set Position	Sets the designated motor position, the detector will move to the designated position (between 0 and -220000)
Reference Search	Starts the reference search routine of the detector motor



## 7 TSO Analyzer

The TSO Analyzer is a separate tool for displaying and calculating Ct values of PCR experiments with the ChipGenie® edition TSO.

### Installation of qPCR Analyzer:

- 1 Open the installation folder provided with the device (E:\TSO Analyzer)
- 2 Copy the content of the folder into a hard drive folder, free of choice (C:\TSO Analyzer\).
- 3 To start the software double click on the “TSOAnalyzer.exe”
- 4 For more convenient handling it could be useful to link TSOAnalyzer.exe to your desktop.

### Calculate Ct values from existing qPCR experiments:

- 1 Open the TSO Analyzer.exe
- 2 Load an existing qPCR file
  - a Navigate to the storage folder on your hard drive
  - b Select a qPCR .xml file
  - c Click open
- 3 Selecting “Yes” in the re-calculate Ct values dialog box
  - a Analysis of data starts
  - b Analysis Summary” window displays results
- 4 Selecting “No” in the re-calculate Ct values dialog box
  - a Displays previously calculated values

Depending on your hardware configuration, it may take several seconds to display the data. The data are displayed in the “Analysis Summary” window as isolated charts. Each chamber and channel can be selected using a drop-down menu.

Results are stored in the installation folder (on your hard disk e.g. C:\TSO Analyzer). For each PCR experiment, a separate folder for individual experiment tracking is created with the following string, “PCR dd-mm-yyyy—time”. The data are stored in the xml format. Additionally, a graph for each chamber and channel is stored as .png image.

## 8 Technical Data



### Instrument dimensions

Closed lid (LxWxH) [mm]	225 x 170 x 132
Opened lid (LxWxH) [mm]	225 x 221 x 132

### Heater

Dimension (LxW) [mm]	78 x 26
Heating rate	+16°C/s
Cooling rate	-9°C/s

### Detector

Excitation peak wave length 1 [nm] - Fluo 1	470
Excitation peak wave length 2 [nm] - Fluo 2	625
Detection peak wave length 1 [nm] - Fluo 1	520
Detection peak wave length 2 [nm] - Fluo 2	680

### Fan

Dimension (LxWxH) [mm]	50 x 50 x 15
Air flow rate	29 m³/h

### Miscellaneous

Data connection	USB-B
Power supply	24V 9.2A DC 221 Watts

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