



## **USER MANUAL**

ChipGenie<sup>®</sup> edition TSO On-Chip qPCR Thermocycler



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## Important Advice

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

Caution! ChipGenie<sup>®</sup> 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<sup>®</sup> 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<sup>®</sup> edition TSO, using the contact information below.

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# 1 Safety



Caution! The ChipGenie<sup>®</sup> 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<sup>®</sup> 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  ${}^{\scriptstyle{(\![\![\![\![\!]\!]]\!]}}$  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<sup>®</sup> edition TSO.

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





**1 Safety** 

- Caution! The ChipGenie<sup>®</sup> 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<sup>®</sup> 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:



- ${\rm 1}\, ChipGenie^{{\rm \$}}\, edition\, TSO\, instrument$
- 2 External power supply 16 V 10 A DC
- 3 Power cord
- 4 USB flash drive with instrument software
- 5 Mini USB 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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#### **3 The Instrument**



The ChipGenie<sup>®</sup> 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)





- 1 Instrument lid
- 2 Instrument casing
- **3** Air slots
- 4 ON/OFF switch
- 5 Mini USB connector
- 6 Power connector 16V 10A DC
- 7 Fluorescence detector
- 8 Chip lock
- 9 PCR element





The installation of the ChipGenie<sup>®</sup> 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<sup>®</sup> edition TSO are installed.

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



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<sup>®</sup> edition TSO control software on your computer. It is not necessary to connect the ChipGenie<sup>®</sup> 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 qPCR Analyzer:

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

- 1 Open the installation folder provided with the device (E:\qPCR 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 "PCRAnalyzer.exe"
- 4 For more convenient handling it might be useful to link "PCRAnalyzer. 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<sup>®</sup> edition TSO device, follow the instructions below:

- 1 Place the ChipGenie<sup>®</sup> 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<sup>®</sup> 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<sup>®</sup> 10 will install all required drivers automatically.



1 To USB of PC via ChipGenie<sup>®</sup> edition TSO control software
2 To external power supply 16V 10A





Recommewnded system requirements for  $\mathsf{ChipGenie}^{\mathbb{B}}$  edition TSO control software:

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



## 5 Handling Procedure



#### 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: 09-0576-0793-09).





#### Insertion of loaded chip into the ChipGenie<sup>®</sup> edition TSO



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

**2** Insert the chip while pushing the chip locking lever to the left.

**3** Push the chip to the final position and release chip locking lever. Close the lid.



Following, you can find a selection of microfluidic chips provided by *microfluidic ChipShop GmbH* that are compatible with the ChipGenie<sup>®</sup> edition TSO. Chamber volumes of compatible chips vary between 2.5  $\mu$ l and 50  $\mu$ l. 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 Chamber volume [µl] Chamber depth [µm] Number of chambers	843 2.5 500 16	Perseseseseses
Fluidic number Chamber volume [µl] Chamber depth [µm] Number of chambers	750 5 500 16	EBEBEEBEBEEBE
Fluidic number Chamber volume [µl] Chamber depth [µm] Number of chambers	584 20 500 8	50000000000000000000000000000000000000

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**Rhombic chamber chips** 

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:



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





# 6 Software Application

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

- 1 Open the ChipGenie<sup>®</sup> 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

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The software "Main Menu" provides the following functions:

🔡 Chipgenie Edition T — 🔲 🗙		- 🗆 X	PCR
microfluidic Chin Shan		Shop	Starts the PCR protocol with last saved PCR profile
	Cl		Stop PCR
S	PCR	Stop PCR	Stops current PCR program (only active while PCR is running)
			PCR Settings
	PCR Settings Detection Settings		Opens the graphical PCR protocol configuration interface
			Detection Settings
	System Settings	About	Open the chip selection interface
		с	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.



#### **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  $^{\circ}C$ 

.....

#### 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

🖳 Chi	ambers	<u>-</u>	- 🗆 >	Ki (	Chip Type
Сһір Туре		S	Belect pre-configured chip profile		
chip_5	85		~		
Fluo 1	Fluo 2	FAM 1		C	Chamber 1 to 16
	$\checkmark$	FAM 2			Check box below Fluo 1 and/or Fluo 2
	$\checkmark$	FAM 3		t	o select detection channel and detection
	$\checkmark$	FAM 4		C	hamber
$\checkmark$	$\checkmark$	FAM NTC			1
$\checkmark$	$\checkmark$	Cy5 1			Load
$\square$	$\checkmark$	Cy5 2		I	mport an existing Detection protocol from
$\checkmark$	$\checkmark$	Cy5 3		y	our hard disk via "select File" dialog
$\checkmark$	$\checkmark$	Cy5 4		•	
$\square$	$\checkmark$	Cy5 NTC		I S	Save
				t	Open "Save File" dialog to save a Detec- ion protocol file to hard disk
				S	Set
				L	load PCR configuration to device
	Load	Save	Set	0	Color selection
				a b	Dpen the color selection dialog to select/ dapt 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 plateCycleDisplays the current PCR cyclePhaseDisplays the current protocol stepProgressShows progress of the protocolStop PCRStops the PCR protocol

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



6.4 PCR Menu

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.

CycleDisplays the current PCR cyclePhaseDisplays the current protocol stepProgressShows progress of the protocolStop PCRStops the PCR protocol

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

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#### **6.5 Analysis Summary**



The calculation of the Ct values from the PCR fluorescence data starts immediately after the PCR protocol is completed. Dependent 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 the drop-down menu.

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.



On the left side the calculated Ct values are displayed for each detection chamber and channel. With the drop-down menu, the results of each detection chamber and channel can be displayed. In the chart, the fluorescence measurements, smoothed curve, fitted curve, slope, baseline and Ct value are shown.

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# 6.6 Manual Mode

Attention! With the "Manual Mode", the global settings of the ChipGenie<sup>®</sup> 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"!

🛃 ManualMode	Exit Manual Mode	Closes the Manual Mode		
Exit Manual Mode	Current Temperature [°C]	Displays the current temperature of the heating plate		
Temperature Controls Current Temperature[°C]	Set Temperature	Sets the temperature of the heating plate manually; in °C		
8.97 Set Temperature	Chip Settings	Opens the chip selection interface		
8.00	Measure	Starts a manual fluorescence measu- rement; detection settings from the "Detection setting/Chambers" inter-		
Chip Settings Measurement Test		face are used; fluorescence values are shown on the chart on the left side		
Measure		of the window, upper chart displays Fluo 1, lower chart displays Fluo 2		
Save Measurements	Stop	Stops the fluorescence measurement		
Number of measurements	Save Measurement	Saves measurements as .png		
Average Runtime[s] [5.92	Number of measu- rements	Sets the number of repeated measurements		
300 Set Delay	Average Runtime [s]	Displays the average runtime of a single measurement		
Motor Controls Motor Position	Measurement Delay [ms]	Configures the integration time of the detector (Pre-set is 300 ms), It is strongly recommended not to change this setting!		
Reference Search	Set Delay	Sets the designated integration time		





Motor Position	Moves the detector to a manually designated position (between 0 and -420000) It is strongly recommended not to change this setting!
Set Position	Sets the designated motor position, the detector will move to the designated position (between 0 and -420000)
Reference Search	Starts the reference search routine of the detector motor





The PCR Analyzer is a separate tool for displaying and re-calculating Ct values of PCR experiments with the ChipGenie<sup>®</sup> edition TSO.

#### Installation of qPCR Analyzer:

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

#### **Re-calculate Ct values from existing qPCR experiments:**

- 1 Open the PCR Analyzer Software
- 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:\qPCR 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	8°C/s
Cooling rate	8°C/s

#### Detector

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

#### Fan

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

#### Miscellaneous

Mini-USB 16V 10A DC (160 Watts) Data connection Power supply

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