

HAMILTON Heater Shaker

User Manual



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HAMILTON 
the measure of excellence

DOMINIQUE DUTSCHER SAS

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1 General Information

You should read through the entire manual before beginning to operate your HAMILTON Heater Shaker (HHS). This first chapter should be read with particular attention. It contains important information about the use of HHS. For further information on your ML STAR instrument, we recommend to read the documentation shipped with your MICROLAB® STAR Line instrument.

1.1 About this Manual

This manual is to help users to operate the HAMILTON Heater Shaker correctly and safely.

Warnings and **notes** are included in this manual to emphasize important and critical instructions. They are printed in italics, begin with the word 'Attention' accompanied by the  symbol, or the word 'Note' accompanied by the  symbol, as appropriate.

[...] Push buttons and their corresponding description.

“...” Description for all kinds of entry fields, control fields, check boxes, lists, etc.

___ References to Manuals, figures, sections, etc.

HAMILTON's MICROLAB® STAR, STARPlus and STAR^{let} are in the following summarized as ML STAR Line.

1.2 Intended Use of the HAMILTON Heater Shaker

The HHS is a compact module designed for operation on the ML STAR Line robotic pipetting workstation. It is not suitable as stand alone product. The HHS is used for heating and shaking of standard microtiter plates in SBS format (Society for Biomolecular Sciences). In order to get efficient and evenly distributed heating of plates, specific adapters are required.



NOTE

The HHS is only intended to be used in combination with the ML STAR Line. A stand alone operation of the HHS is not foreseen.

1.3 Operation

For operation of the HHS, a specific library is required ([see chapter “HHS Library”](#)).

**NOTE**

The maximum shaking speed of the HHS depends on the Orbit and the type of labware used ([see chapter “Technical Specifications”](#)).

**NOTE**

An efficient heating of the liquid is only achieved if the appropriate adapter for the labware is used. The heating time and the maximum temperature, which can be reached for the liquid inside the plate, is dependent on the amount of liquid, the size / weight of the used labware, the size / weight of the used adapter and the connection between the plate and the adapter.

1.4 Safety Precautions and Hazards

The following section describes the main safety considerations, electrical and biological, in operating this product, and the main hazards involved.

**ATTENTION**

Read the following safety notices carefully before using the HHS.

1.4.1 General Precautions

1.4.1.1 Instrument

Installation and Verification of the HHS have to be performed by trained service engineers.

For repair or shipment, the HHS must be decontaminated if it was in a laboratory environment with infected or hazardous materials. The HHS must be repacked in the original packaging.

Only original HHS-specific parts and tools may be used with the HHS, e.g. adapters. Commercially available liquid containers, such as microtiter plates and tubes, may of course be used.

1.4.1.2 Operating the HAMILTON Heater Shaker

When using the HHS, Good Laboratory Practices (GLP) must be observed. Suitable protective clothing, safety glasses and protective gloves must be worn, particularly when dealing with a malfunction of the instrument where the risk of contamination from spilled liquids exists.

1.4.1.3 Method Programming

Perform test runs first with water and then with the final liquids, prior to routine use. The method has to be validated by the programmer.



ATTENTION

When working with samples, which will be used in particularly sensitive tests, take into account the evaporation that may occur while the HHS is running. Be aware that heating of liquids will affect the pipetting process, as well as shaking the labware can influence the precision of pipetting.



ATTENTION

When shaking labware, the speed has to be adjusted to the type of labware and the volume within the labware to prevent cross-contamination due to spillages.

Further information on the maximum shaking speed for MTP and DWP can be found in the chapter "[Technical Specifications](#)".

1.4.1.4 Loading of Labware

The appropriate labware can either be loaded manually by Hand or automatically by using the iSwap or the CO-RE Grip from the ML STAR Line instrument. Or, by other robotic handling devices, which can reach the labware on the HHS device.

1.4.1.5 Work Routine



ATTENTION

Do not touch the HHS during run time and also not shortly after finishing a run, as it might be hot. Wait until the HHS has cooled down to room temperature, which can take up to 1 hour.

1.4.2 Chemical Precautions

If the HHS is used for toxic or irritant chemicals, the user is responsible to take appropriate actions for protections. This is especially important when toxic chemicals can evaporate during the heating process. Flammable liquids must not be heated on the HHS as they might cause a fire.

Evaporation of hazardous liquids can cause corrosion of the ML STAR Line. Use a lid to cover the labware or an extractor hood to protect the user and the instrument.

If the HHS becomes contaminated with biohazardous or chemical material, it should be cleaned and decontaminated. Wear gloves when handling with a contaminated HHS. Any surfaces on which liquid is spilled must be decontaminated.

Do not use disinfecting materials, which contain hypochlorite (Javel water, Chlorox) or bleaching fluids.

1.4.3 Electrical Safety Precautions



ATTENTION

Before connecting or disconnecting the HHS either from or to a ML STAR instrument or Heater Shaker Box (HSB) make sure that the ML STAR or HSB is switched off. Only when the ML STAR or the HSB is switched off it is safe to connect or disconnect HHS devices. Not obeying this may result in damage of the HHS.

1.4.4 Hazards

Explanation of warning and attention labels:



On the HHS device the following Labels are available



Hot Surface

Avoid contact of HHS. Surfaces are hot and may cause personal injury if touched.



Biohazard Warning

HHS device may be contaminated, Good Laboratory Practices (GLP) must be observed.



PC / USB Connection

Use only the appropriate shielded cables. Signals can be interfered if using a total cable length of more than 5m.

On the HSB device the following Labels are available



Power connection

Connect only to earth-grounded outlet



Biohazard Warning

HSB device may be contaminated, Good Laboratory Practices (GLP) must be observed.

1.4.5 Disposal

At the end of the instruments life cycle, please contact your local Hamilton representative regarding disposal of the instrument.

The European Community requires from manufacturers to organize the disposal and waste of electrical and electronic equipment (WEEE). For this reason, HAMILTON Bonaduz AG took part to organize the disposal of STAR Line products through a European disposal network. Please contact your local HAMILTON representative for further information about the recycling procedure.

Otherwise local disposal regulations are to be observed.

1.4.6 Contacting Hamilton

Europe, Africa and Asia:

HAMILTON Bonaduz AG
CH-7402 Bonaduz / Switzerland

Phone +41 81 660 60 60

Americas, Far East and Pacific Rim:

HAMILTON Company
P.O. Box 10030
Reno, NV 89520-0012 USA

Toll Free +1 (800) 648-5950
Phone +1 (775) 858-3000

HAMILTON Company URL

www.hamiltonrobotics.com
www.hamiltoncompany.com

2 Description of the HAMILTON Heater Shaker

2.1 General description of the HAMILTON Heater Shaker

The HHS is designed to heat and / or shake standard microtiter plates in SBS format.

The maximum shaking speed depends on the labware used. For details, see chapter "[HHS Library](#)". Shaking can be performed clockwise or counter-clockwise.

Before heating or shaking is started, the plates are locked and positioned in the centre of the HHS. When heating or shaking has finished the plates are unlocked and can then easily be removed from the HHS.

The HHS can be heated to temperatures up to 105°C. The temperature is constantly measured by two sensors, one located in the middle and one at the edge of the adapter plate.

2.2 Installation

Generally; the HHS will be installed by trained service engineers.

Up to 8 HHS modules can be integrated into one ML STAR Line instrument. When integrating more than 2 heater shakers, the additional Heater Shaker Box is required for control.

Up to 4 HHS have to be mounted onto one carrier baseplate for heater-shakers. Where HHS for deepwell (archive) plates shall be positioned directly onto the carrier baseplate and HHS for standard plates can be positioned raised up by using the HHS support block.



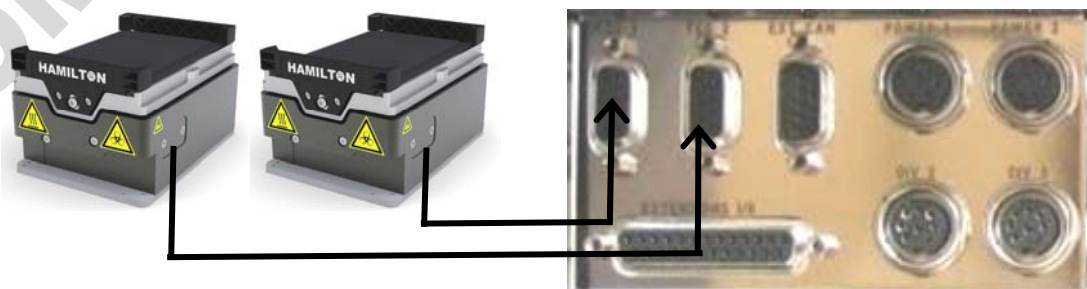
Note

Carrier base plate and support block have to be ordered separately.

For Ordering information see chapter "[Appendix A](#)".

2.2.1 Up to two HHS via TCC

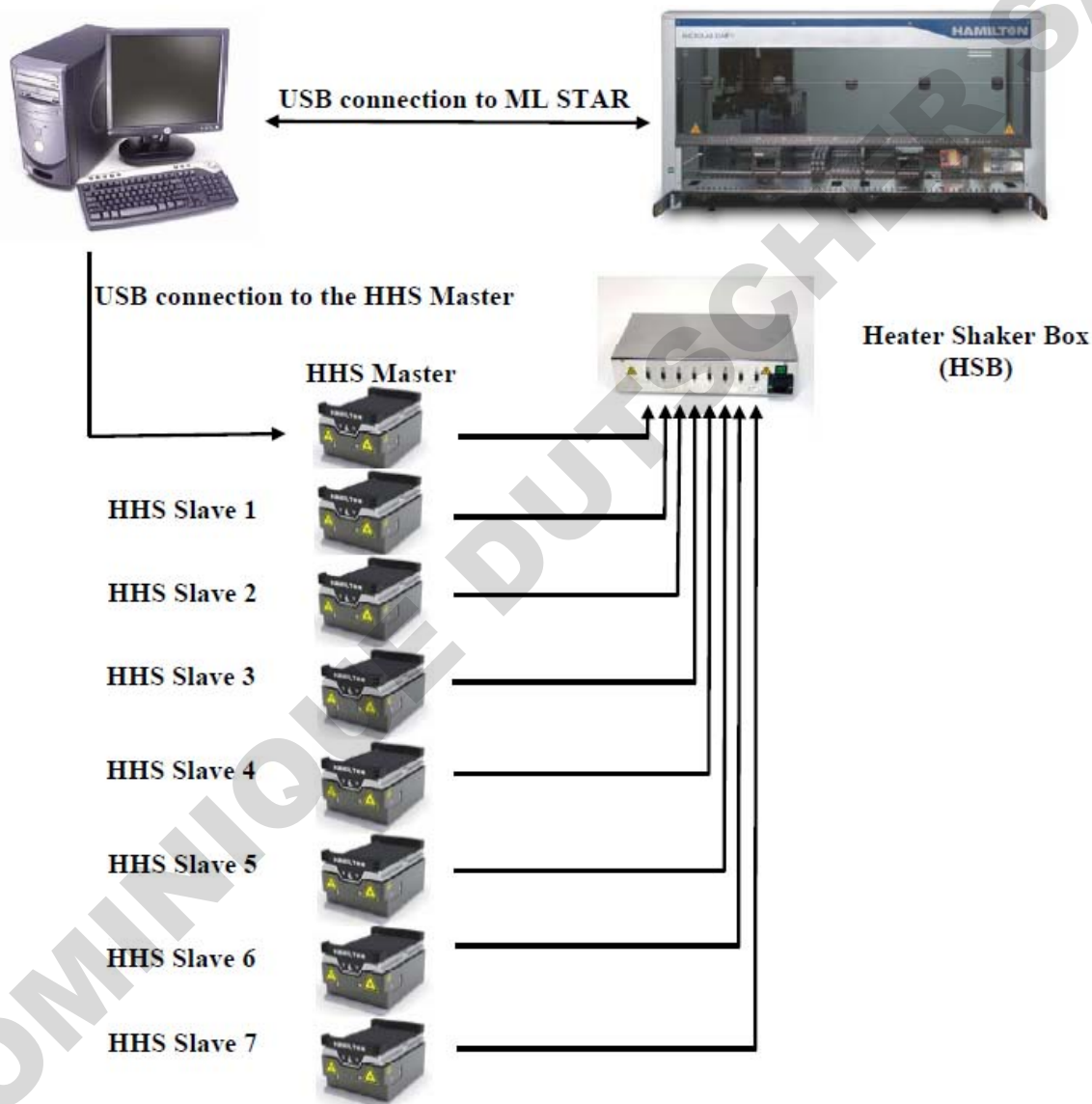
It is possible to integrate one or two HHS directly into a ML STAR instrument (via TCC connector, see [picture below](#)).



Up to two HHS connected to the TCC connector of the Periphery Connector Board of the ML STAR instrument

2.2.2 Up to eight HHS via HSB and USB port

If more than two HHS are required, the Heater Shaker Box (HSB) is needed. One HHS (HHS master) is connected to the USB port of the PC and to the HSB and serves as master module. In addition to the master HHS, up to seven additional HHS (HHS slave 1.....7) can be connected to the HSB. The HSB serves a power supply and as a signal distributor for all the HHS slaves.



Up to eight HHS connected to the Heater Shaker Box and to the PC which is controlling the ML STAR instrument

2.3 Computer Requirements

The PC controlling the ML STAR Line instrument will be used to control HHS devices installed on the ML STAR Line instrument.

2.4 Software Requirements

The HHS specific library “ **HslHamHeaterShakerLib.hsl**” will provide a set of commands to control the HHS device.

The HHS library can be run with any of the following ML STAR Line Software Versions:

- MICROLAB® STAR IVD V3.2.3
- MICROLAB® STAR IVD V4.2.x
- MICROLAB® STAR IVD V4.3.x
- MICROLAB® STAR Venus one 4.2.x
- MICROLAB® STAR Venus two 4.3.x

These Versions are referred as ML STAR Line Software in the following chapters. For further information please consult the appropriate “Operators Manual” available with your ML STARLine instrument.

3 HHS Library

The HHS library provides several functions to control the HHS, such as shaking and heating settings. The functions can be integrated into standard methods of the ML STAR Line instrument.

To install the library execute the file “**InstallHHSLibrary_Vx.x.exe**”. If needed, obtain the library, from your local HAMILTON representative.

Confirm the question that you want to install this addition. The heater shaker library will be installed automatically.



NOTE

The library requires the following Microsoft Package, which will be installed automatically during the setup procedure.

Microsoft Visual C++ 2005 Redistributable Package (x86)

In order to use the library, it has to be selected in the Method Editor. Go to “**Method**” → “**Libraries...**” → “**Add libraries**” and select the file “**HslHamHeaterShakerLib.hsl**”.













3.1 The HAMILTON Heater Shaker commands











The table below gives an overview of commands included in the HHS library:

Command	Icon	Action performed
Create Star Device		Creates the device number which must be used as input parameter for each function of this library.
Create USB Device		Creates the device number which must be used as input parameter for each function of this library.
Terminate		The connection to the ML Star Line instrument and/or USB device is terminated. Note that this function does not stop the heating or shaking process of the heater shaker.
Start Shaker		This function starts the shaking process. If necessary, the heater shaker will be initialized. Before the shaking process is started, the plate is locked. Shaking has to be stopped by the "Stop Shaker" command. Terminating the connection will not stop shaking. However, shaking is stopped upon method abort.
Start All Shaker		Start shaking on all initialized shakers. Shakers that have not been initialized are not addressed. The plates are locked before the shaking process.
Start Shaker Timed		Start shaking for an indicated time. If necessary, the heater shaker will be initialized. Before the shaking process is started, the plate is locked. After shaking, the plate lock has to be opened with the "SetPlateLock" function.
Start All Shaker Timed		Start shaking on all initialized heater shakers for an indicated time. The plates are locked before the shaking process. After shaking, the plate lock has to be opened with the "SetPlateLock" function.
Wait For Shaker		Wait for the heater shaker to finish. The plate is unlocked after shaking has been stopped. This command is only used in combination with "Start Shaker Timed" or "Star All Shaker Timed".

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Stop Shaker		Stop shaking and unlock plate.
Stop All Shaker		Stop shaking on all heater shakers. The plates will be unlocked subsequently.
Set shaker parameter		Set shaking parameters, such as shaking direction, shaking speed and acceleration.
Get Shaker Parameter		Get shaking parameters, such as shaking direction, shaking speed and acceleration.
Start Temp Control		Start temperature control on the heater shaker (must be greater than ambient temperature plus 5°C). Temperature control has to be stopped by the “Stop Temp Control” function or will be constantly on. Terminating the connection will not stop heating. However, heating is stopped upon method abort.
Wait for Temp Control		Wait until the heater shaker has reached the set temperature. This function will wait until the defined temperature is reached and is stable for 180 seconds. Only then, the method will continue.
Stop Temp Control		Stop temperature control of the heater shaker.
Get Temperature		Receive the current temperature of the heater shaker.
Set Temperature Parameter		Set parameters for temperature control. In most cases, the default settings can be used and this function is not needed.
Get Temperature Parameter		Receive the parameters for temperature control.
Get Temperature State		Get the status of the temperature control. The temperature should be within a defined temperature range.
Send Firmware Command		Send a firmware command to the heater shaker.

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Set Plate Lock		Open or close the plate lock. The plate is always locked automatically before shaking is started, but this command is useful to position and fix the plate in the center of the flat bottom adapter before pipetting, or when using the commands "Start Shaker Timed" or "Start All Shaker Timed" as these commands do not open the plate lock after shaking.
Set Simulation		Set run mode to simulation for all functions in this library. In simulation mode, no signals are sent to the HHS.
Set USB Trace		Turn on/off tracing of communication to and from USB port.
Begin Monitoring		Start to monitor the performance of the HHS. This function monitors the temperature and speed in the background. The tolerated range of the temperature can be set with the function "SetTempParameter". The tolerated range of speed is defined in this function. The status of the temperature can be requested in a defined interval and is then written to the trace file.
End Monitoring		Finish monitoring the performance of a HHS.
Get Shaker Speed		Get the shaking speed of a HHS.
Get Serial Number		Get the serial number a HHS.
Get Firmware Version		Get the firmware version of a HHS.

4 Programming the HAMILTON Heater Shaker

The following two examples demonstrate the use of the HHS.

Before using the HHS, a connection and device number has to be generated. After the connection has been established, the heater shaker will be initialized.

The library offers two commands for this task, depending on the kind of connection determined by the hardware. For connections made via TCC, use the command **“CreateStarDevice”** (used for connecting 1 or 2 heater shakers); otherwise use the command **“CreateUSBDevice”**. In both cases, a device number is generated that can be stored in a variable. This variable must be used in all other commands of the library to control the heater shaker.

Number of HHS	Library function
1-2	 Create Star Device (Establish a connection to 1 or 2 shakers connected via TCC)
1-8	 Create USB Device (Establish a connection to up to 8 heater shakers using the heater shaker box)




NOTE

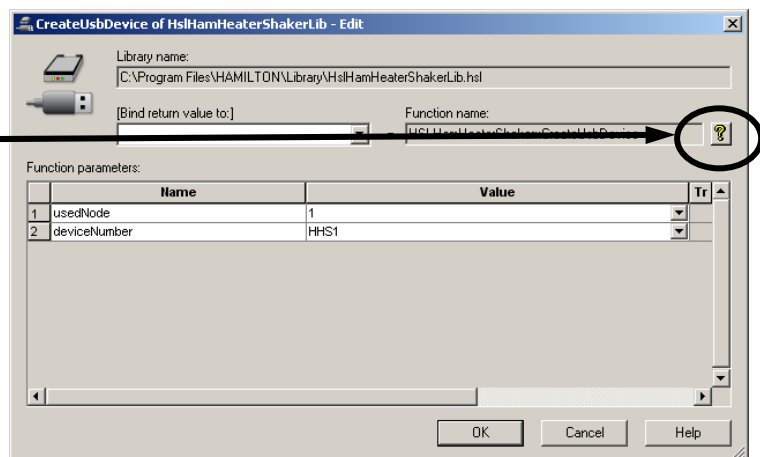
It is required to establish a connection to all heater shakers that will be used in the method. If for example, only two out of four shakers have been initialized then only these two shakers can be started with the **“StartAllShaker”** function.



NOTE







The help function contains a description of all functions of the heater shaker library with a description of parameters passed to the functions or obtained by them. You can access the help documentation by clicking on the yellow question

mark  within the dialog windows.



4.1 Example 1: Controlling only one HAMILTON Heater Shaker

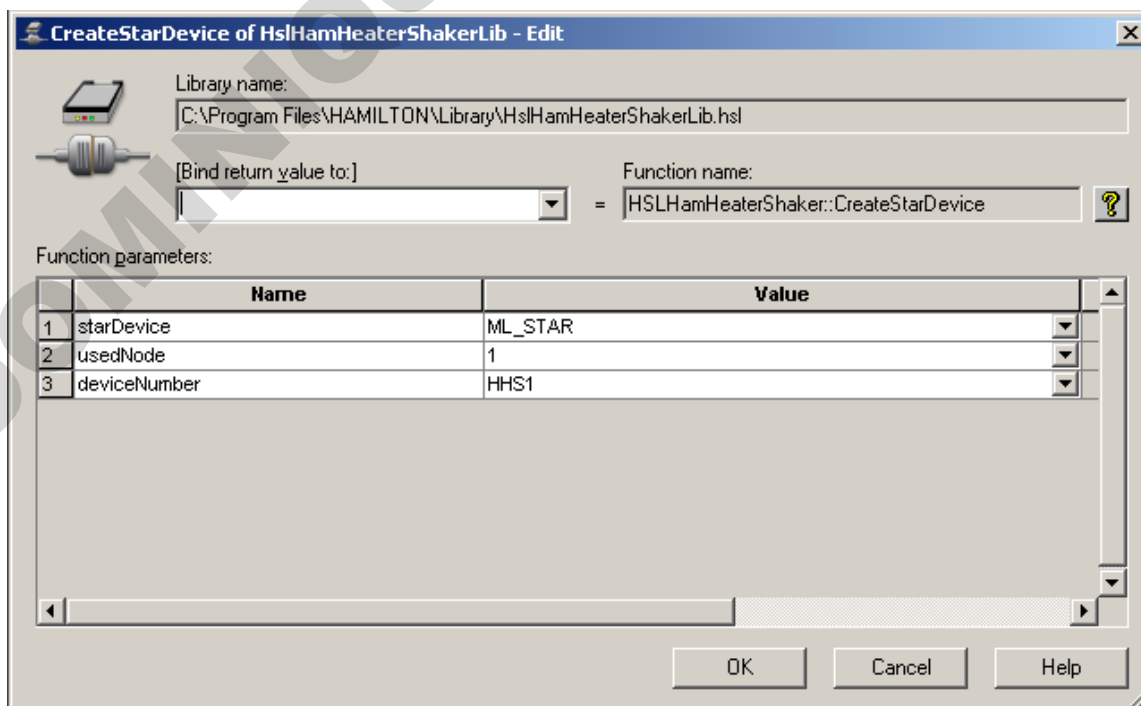
In this first example, a single heater shaker is connected via the ML STAR Line instrument TCC connector. The heater shaker is heated to 65°C followed by shaking for 10 min at 200 rpm. A detailed description of all steps can be found in the following section.

Method	OnAbort	Method
1		 CreateStarDevice of HslHamHeaterShakerLib HSLHamHeaterShaker::CreateStarDevice(ML_STAR, 1, HHS1)
2		 StartTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StartTempCtrl(HHS1, 65, 1)
3		 StartShakerTimed of HslHamHeaterShakerLib HSLHamHeaterShaker::StartShakerTimed(HHS1, 200, 600)
4		 WaitForShaker of HslHamHeaterShakerLib HSLHamHeaterShaker::WaitForShaker(HHS1)
5		 StopTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StopTempCtrl(HHS1)
6		 Terminate of HslHamHeaterShakerLib HSLHamHeaterShaker::Terminate()

Overview of a method to run the heater shaker at 200 rpm for 10 minutes at 65°C.

4.1.1 Step by Step Analysis of Example 1

Step 1: Create a connection to the shaker with the command “**CreateStarDevice**”. The node can be “1” or “2” if the heater shaker is connected via TCC. You can assign the device number, which is generated by this command, to any variable of your choice. This variable has to be used for all subsequent commands regarding the control of the heater shaker.





NOTE

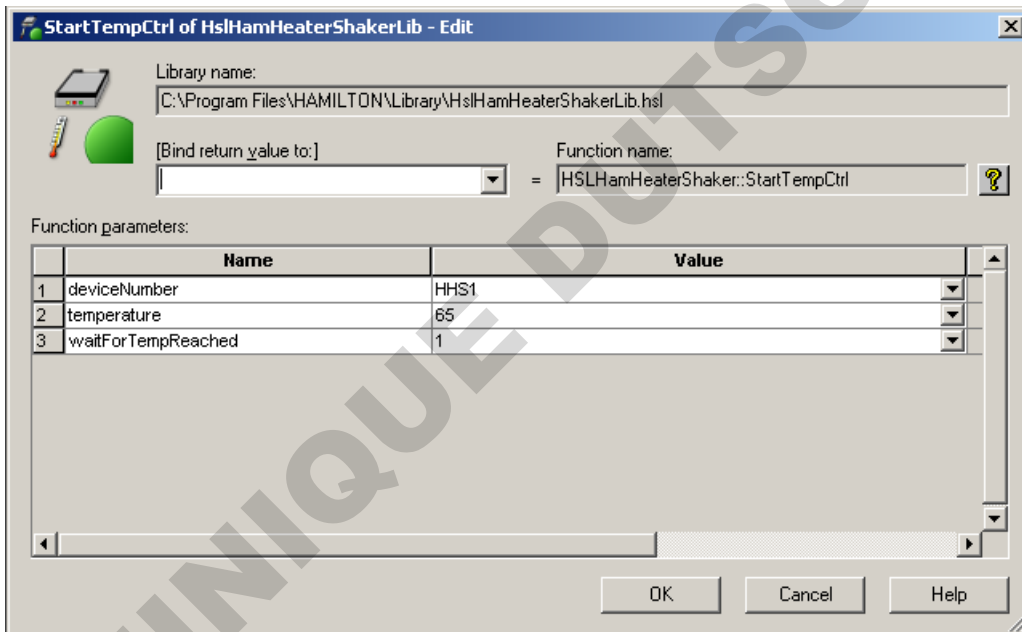
If you insert a step in the method, the first time, on the frame the add-on New is trailed.



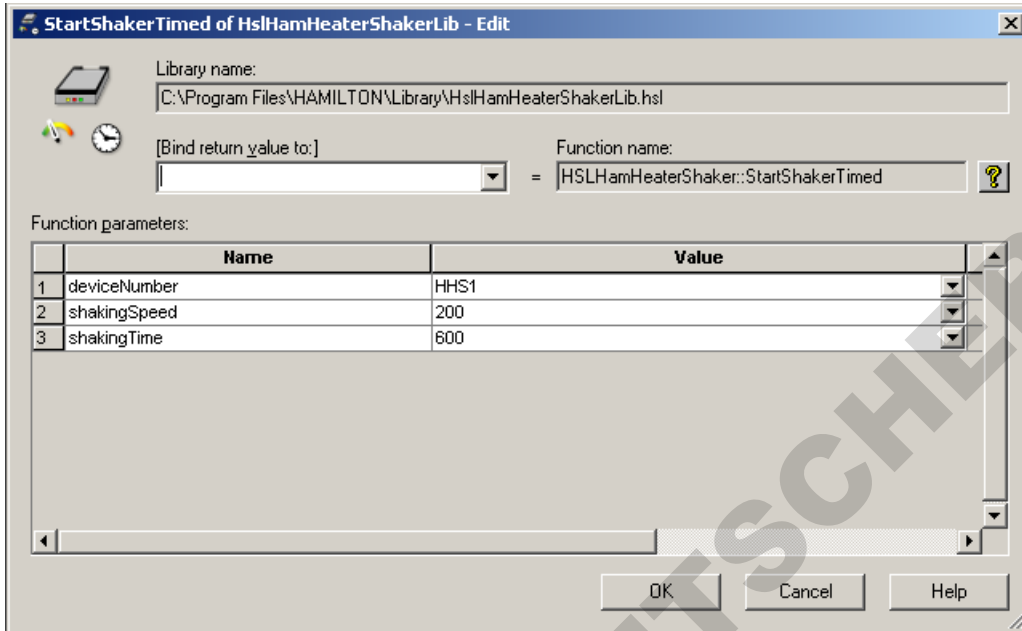
If you have a method inserted and you want to edit it, the add-on Edit is inserted.



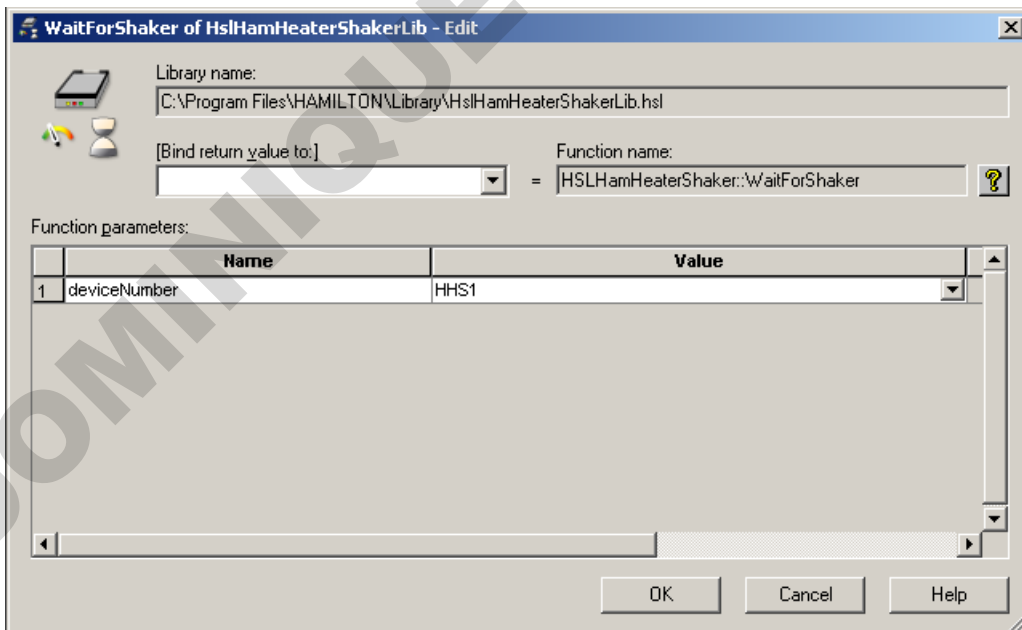
Step 2: Use the variable containing the device number to access the correct heater shaker. Set the temperature to 65°C. If you choose the **“waitForTempReached”** option with the setting “1”, the method will halt at this step until the defined temperature has been reached and is stable for 180 seconds. Only then the method will continue with the next step. If you do not want to pause your method, but carry out other tasks in parallel to the heating process, you should set **“waitForTempReached”** to “0”. At a later time, you can check for the temperature, and if necessary wait for the heating process to finish using the **“WaitForTempCtrl”** command.



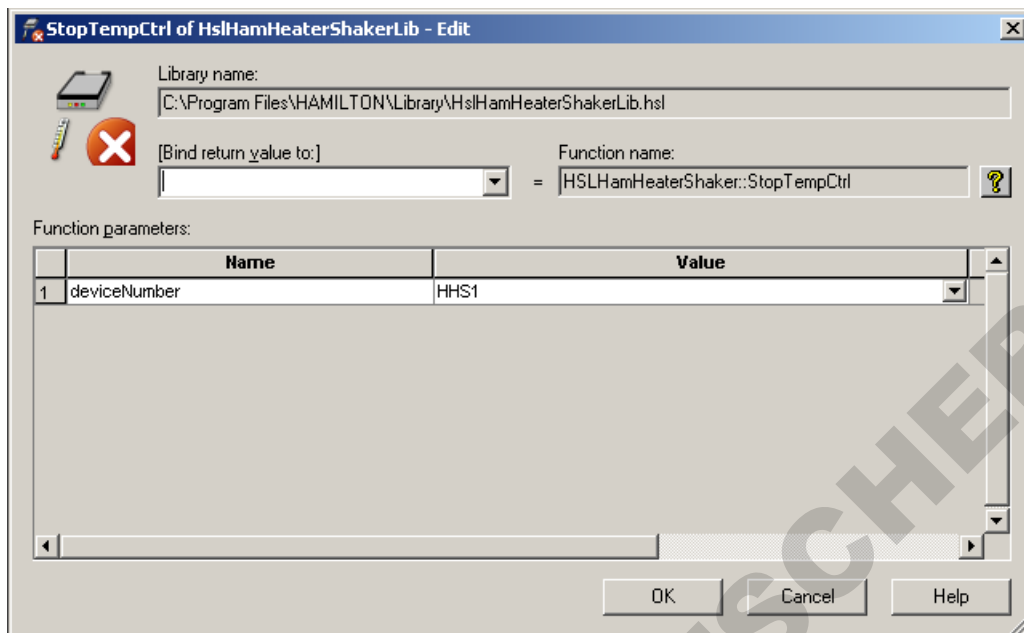
Step 3: Here, the shaking parameters, shaking speed and duration of shaking can be set. The speed is defined in rpm and the time in seconds. The shaking speed ranges from 30 rpm to 2500 rpm. The maximum speed depends on the orbit and adapter of the shaker and must not exceed the maximum given in the “Technical Specifications”. Any function to start shaking will also close the plate lock automatically.



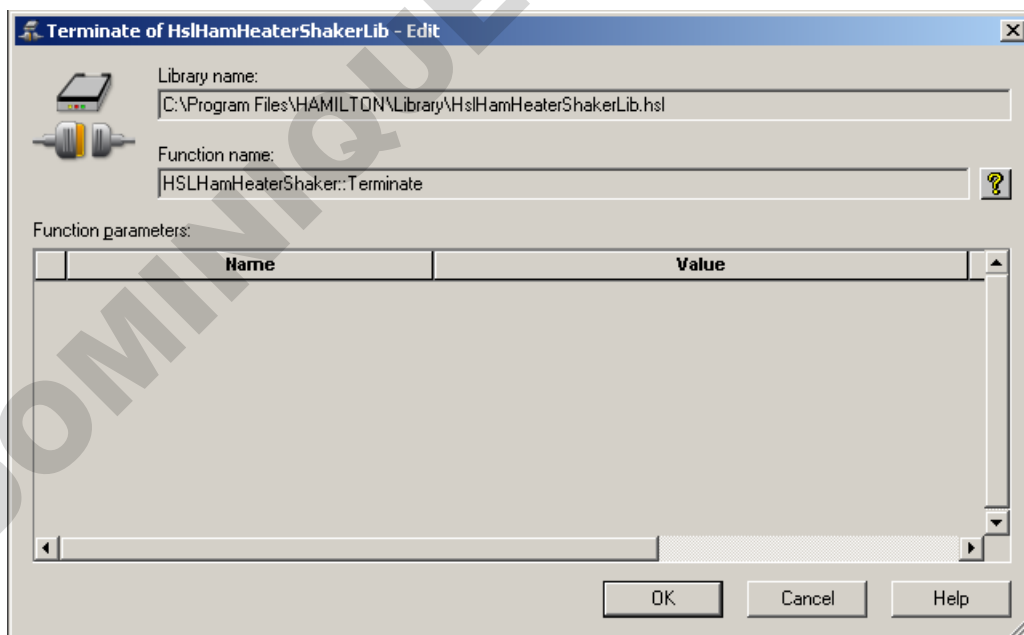
Step 4: This command will wait until the shaker defined by the device number has finished the timed shaking process. If the shaker is already finished before this function is called, the method will immediately proceed with the next step. This function will also open the plate lock.

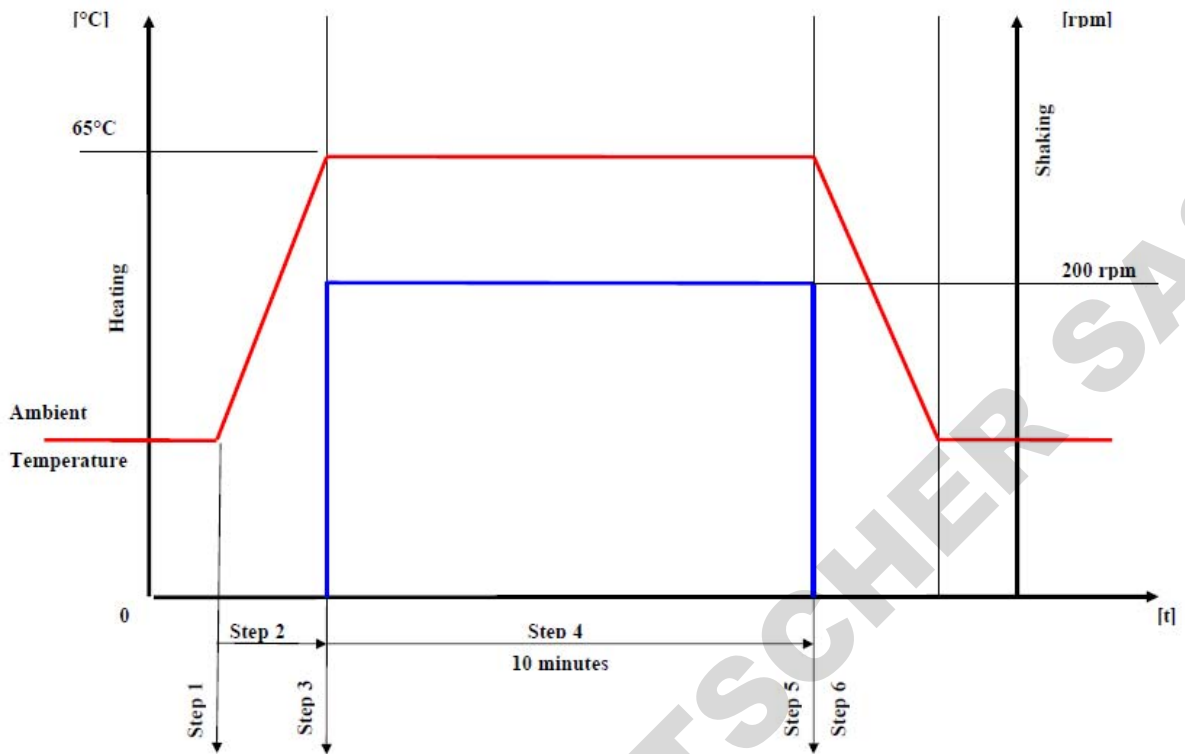


Step 5: As heating is controlled independently from shaking, the heating process has to be terminated explicitly. Otherwise, the heater shaker will continue heating even if it is not used anymore.



Step 6: If the heater shaker will not be used any longer, the connection can be terminated. At the end of a method or upon abort, the connection is automatically terminated and will stop heating as well as shaking. Finally the plate lock will open.

























The figure above shows a schematic view of the heating and shaking process as in example 1.

4.2 Safety measures upon method abort

If the method is aborted, the heater shaker will automatically be stopped. This implies that the heating and shaking process is stopped, the plate lock is opened and finally, the connection to the heater shaker is terminated. No further precautions within the submethod **“OnAbort”** are required.

4.3 Example 2: Controlling multiple HAMILTON Heater Shakers

This second example shows the usage of multiple heater shakers via USB and the heater shaker box. The connection via USB and HSB is needed in order to control more than two heater shakers. The Method is using three heater shakers with different temperature settings.

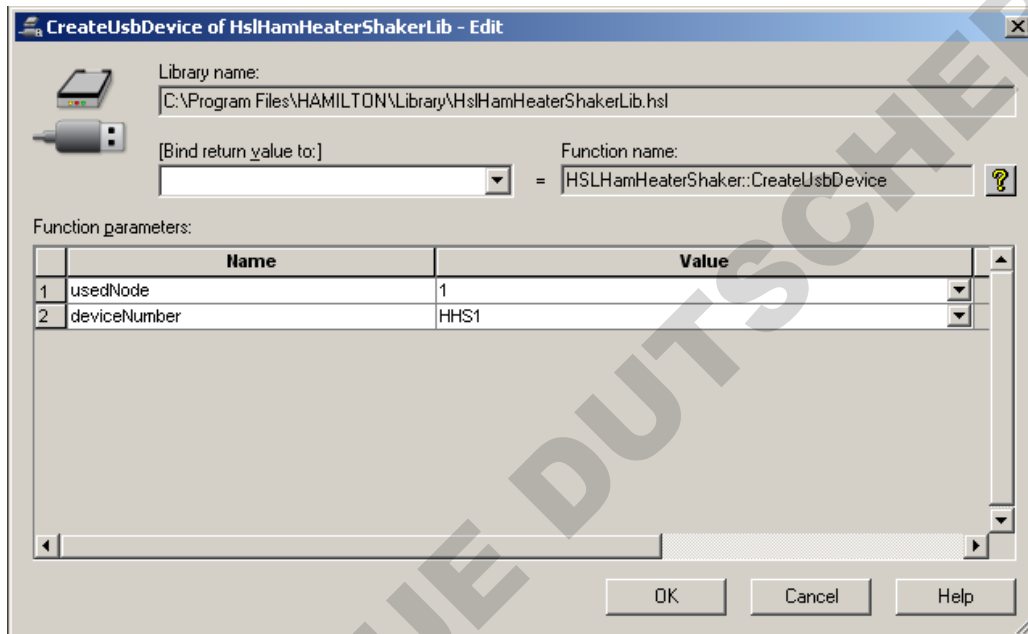
Method	OnAbort	Method
1		CreateUsbDevice of HslHamHeaterShakerLib HSLHamHeaterShaker::CreateUsbDevice(1, HHS1)
2		CreateUsbDevice of HslHamHeaterShakerLib HSLHamHeaterShaker::CreateUsbDevice(2, HHS2)
3		CreateUsbDevice of HslHamHeaterShakerLib HSLHamHeaterShaker::CreateUsbDevice(3, HHS3)
4		StartTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StartTempCtrl(HHS1, 50, 0)
5		StartTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StartTempCtrl(HHS2, 60, 0)
6		StartTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StartTempCtrl(HHS3, 70, 0)
7		WaitForTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::WaitForTempCtrl(HHS1)
8		WaitForTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::WaitForTempCtrl(HHS2)
9		WaitForTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::WaitForTempCtrl(HHS3)
10		SetShakerParameter of HslHamHeaterShakerLib HSLHamHeaterShaker::SetShakerParameter(HHS1, 1, 630)
11		SetShakerParameter of HslHamHeaterShakerLib HSLHamHeaterShaker::SetShakerParameter(HHS2, 1, 630)
12		SetShakerParameter of HslHamHeaterShakerLib HSLHamHeaterShaker::SetShakerParameter(HHS3, 1, 630)
13		StartAllShaker of HslHamHeaterShakerLib HSLHamHeaterShaker::StartAllShaker(2000)
14		Timer: Start Start timer 'timer1', set to relative time: '60' [s]
15		Timer: Wait for Wait for timer 'timer1', show timer display, not stoppable timer.
16		StopAllShaker of HslHamHeaterShakerLib HSLHamHeaterShaker::StopAllShaker()
17		StopTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StopTempCtrl(HHS1)
18		StopTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StopTempCtrl(HHS2)
19		StopTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StopTempCtrl(HHS3)
20		Terminate of HslHamHeaterShakerLib HSLHamHeaterShaker::Terminate()

4.3.1 Step by Step analysis of example 2

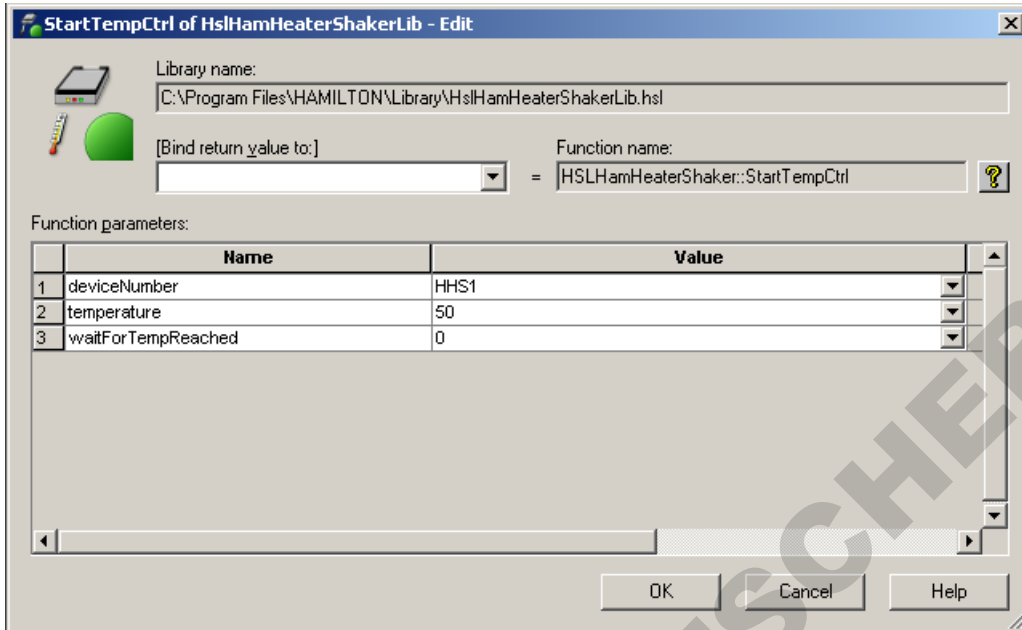
Step 1-3: Create a connection to all heater shakers you want to use in this method using the function “**CreateUSBDevice**”. It is required to initialize each shaker individually in order to create a device number and to control the heater shaker throughout the method. Heater shakers that are not initialized cannot be started with the “**StartAllShaker**” function.

The usedNode can range from 1 to 8, depending on the number of heater shakers in use. Node 1 corresponds to the master heater shaker.

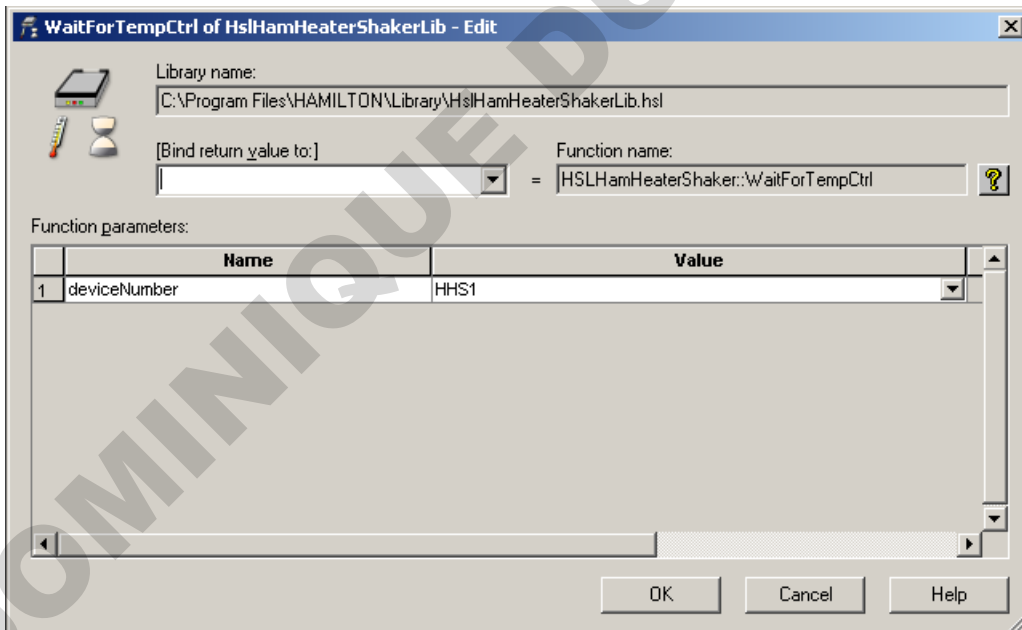
The deviceNumber is stored in a variable, which is needed to control the heater shaker in all following functions.



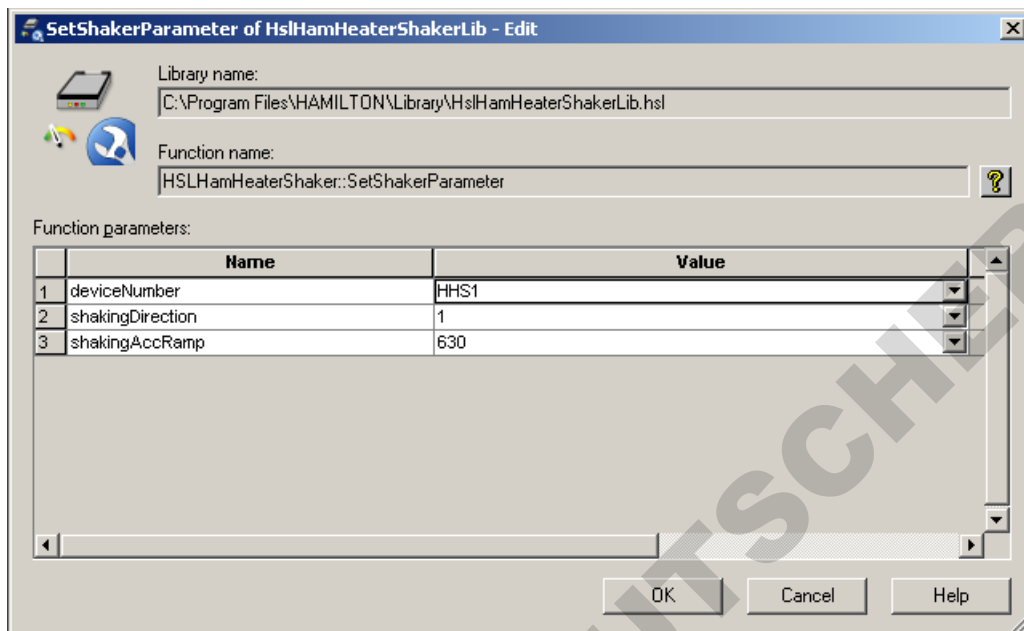
Step 4-6: Set the temperatures for each individual heater shaker, for example to 50°, 60° und 70°C as shown below. If working with several heater shakers, the option “waitForTempReached” has to be set to “0”, so that all shakers are heated in parallel.



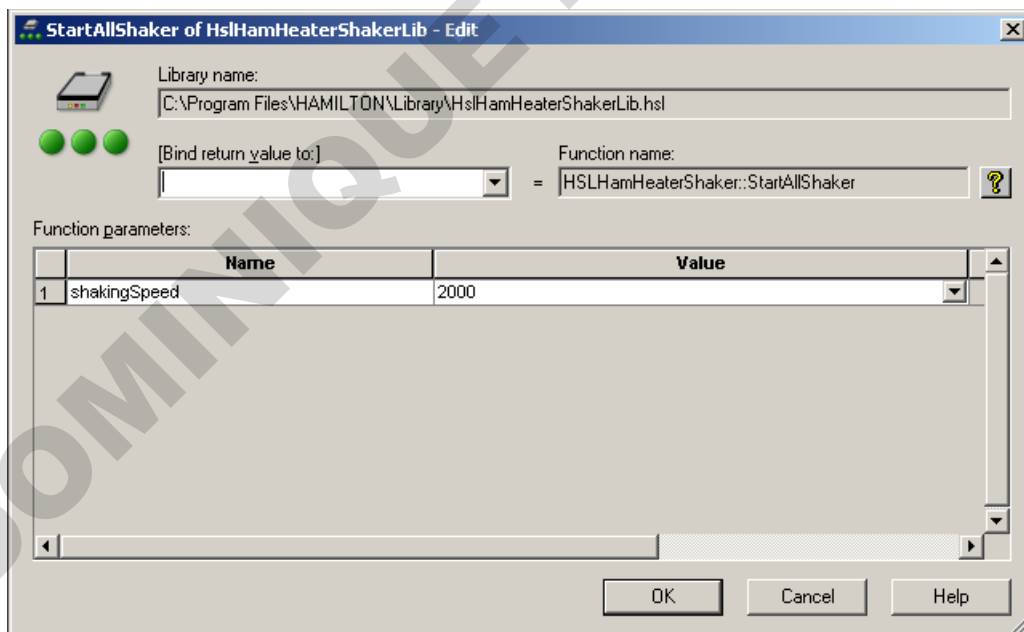
Step 7-9: Wait until all heater shakers have reached the set temperature before proceeding with the method.



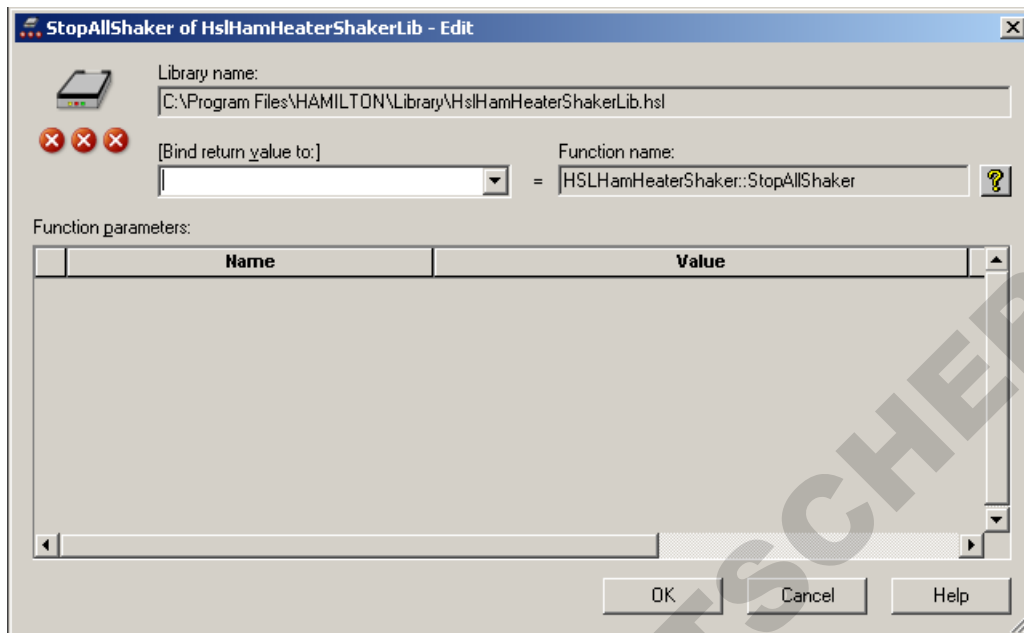
Step 10-12: The “**SetShakerParameter**” function can be used to change the shaking direction or acceleration of the heater shaker. Usually, the default settings can be used. The default settings are clockwise shaking and an acceleration of 1250. The shaking direction can be changed by entering “1” for counter-clockwise shaking. The value for the acceleration (shakingAccRamp) ranges from 630 to 125000. The default setting of 1250 corresponds to acceleration from 0 to the maximum speed of 2500 rpm within two seconds.



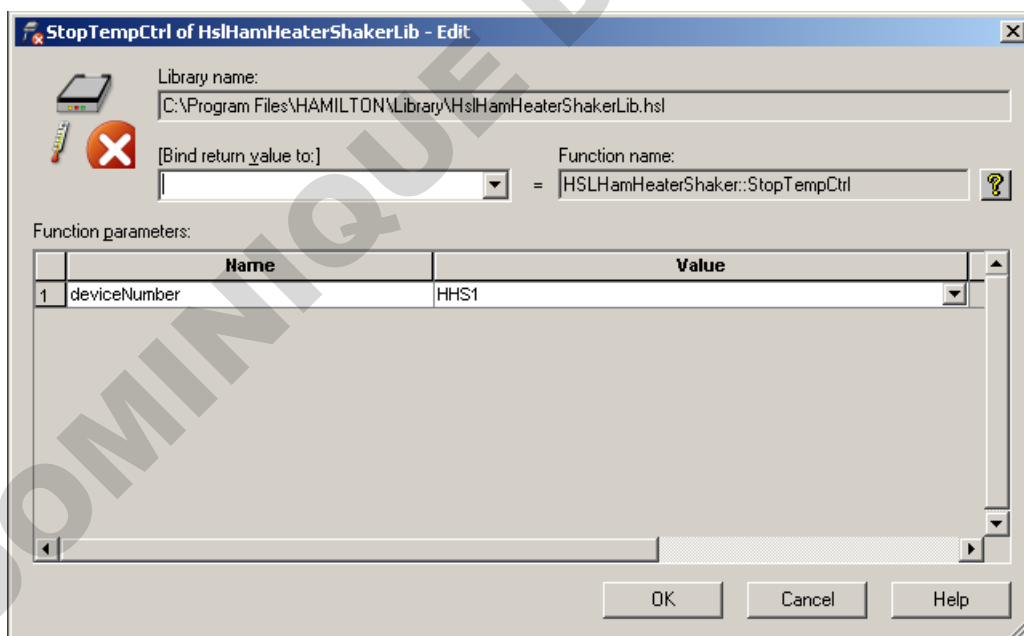
Step 13: All shakers can be started in parallel. The shaking speed is set to 2000 rpm. This function will automatically close the plate lock on all shakers.



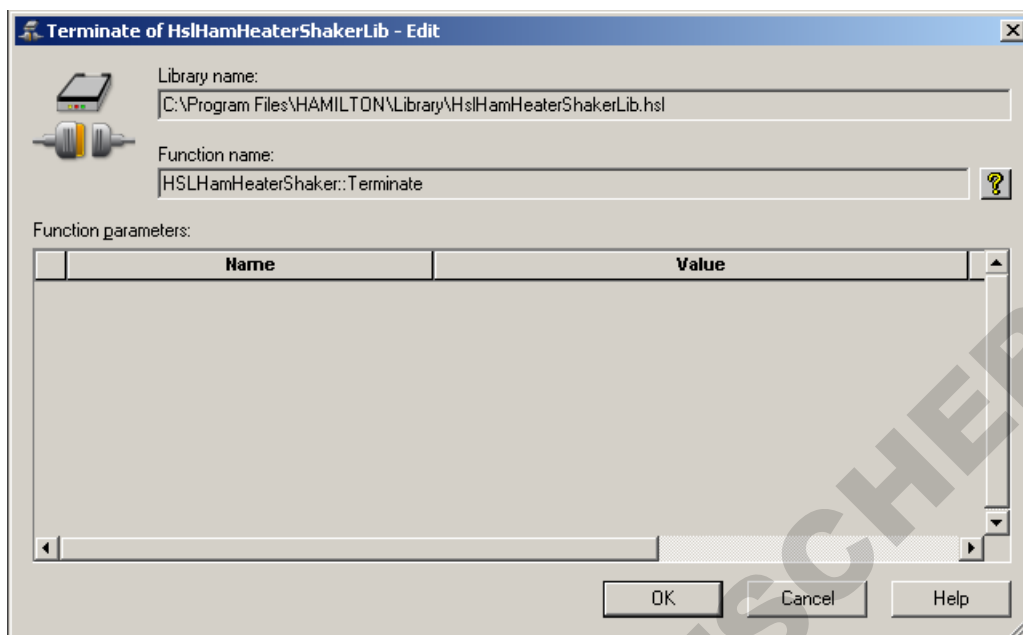
Step 16: To finish shaking of all shakers at the same time use the “**StopAllShaker**” function. This function does not require any device numbers but will stop all initialized shakers and will automatically open the plate lock.



Step 17-19: The temperature control of the heater shaker can be terminated after its usage. If the temperature control is not stopped, heating will continue even after terminating the shaking process.



Step 20: The connections to the heater shakers are terminated. This step can be omitted at the end of a method, as the connections to all heater shakers are automatically terminated at the end of a method or upon abort of a method.



4.4 Monitoring the performance of the HAMILTON Heater Shaker

For some applications, it might be desirable to monitor the performance of the heater shaker. The library offers the possibility to monitor the shaking speed and temperature during an application. The status of the heater shaker is continuously written to the trace file. The settings for the monitoring can be adjusted within the functions "**BeginMonitoring**" and "**SetTempParameter**".

Within the function "**BeginMonitoring**" you can define the intervals, how often the performance of the heater shaker will be checked, and the deviation from the set shaking speed that will be tolerated. You can also decide which action will be taken if monitoring reports an out of range measurement.

All settings regarding the temperature control have to be made within the function "**SetTempParameter**". However, the default settings are usually sufficient.

After monitoring you can examine the return value from the function "**EndMonitoring**". The function reports whether heating or shaking or both were out of range.













ATTENTION

Placing a cold plate on the hot heater shaker will cool down the heater shaker so that the temperature might fall below the defined tolerated temperature range. In this case, the “**BeginMonitoring**” function will return an error although heating is working correctly.

To avoid this kind of error, the function “**StartTempCtrl**” has to be used immediately before the transport step. This results in heating the heater shaker again until the temperature is stable for 3 min. Monitoring is paused during “**StartTempCtrl**” step.

Example of the monitoring function:

Method	OnAbort	Method
1		 CreateUsbDevice of HslHamHeaterShakerLib HSLHamHeaterShaker::CreateUsbDevice(1, HHS1)
2		 StartTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StartTempCtrl(HHS1, 42, 1)
3		 StartShaker of HslHamHeaterShakerLib HSLHamHeaterShaker::StartShaker(HHS1, 1000)
4		 BeginMonitoring of HslHamHeaterShakerLib HSLHamHeaterShaker::BeginMonitoring(1, 10, 10, 0)
5		 Timer: Start Start timer 'timer1', set to relative time: '40' [s]
6		 Timer: Wait for Wait for timer 'timer1', show timer display, not stoppable timer.
7		 EndMonitoring of HslHamHeaterShakerLib HSLHamHeaterShaker::EndMonitoring(HHS1, HHSMonitorResult)
8		 StopShaker of HslHamHeaterShakerLib HSLHamHeaterShaker::StopShaker(HHS1)
9		 StopTempCtrl of HslHamHeaterShakerLib HSLHamHeaterShaker::StopTempCtrl(HHS1)
10		 Terminate of HslHamHeaterShakerLib HSLHamHeaterShaker::Terminate()

5 Verification

It is recommended that HHS devices are verified twice a year, preferably in combination with Preventive Maintenance of the ML STAR instrument.

If the HHS is used for IVD applications, it must be verified twice a year.

Refer to the ML STAR Line Operator's Manual for further information or contact your local Hamilton representative.

6 Maintenance

Hamilton recommends cleaning the HHS regularly to prolong its life-span. In case of contamination or spillages clean the HHS immediately. The HHS must be turned off and cooled down for the maintenance procedure. Follow the maintenance procedure described in the ML STAR Line Operator's Manual. There are no further actions required.



ATTENTION

Do not clean the HHS when it is still hot!

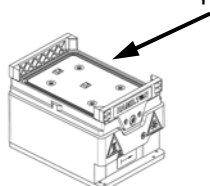
Wait until the HHS has cooled down to room temperature before starting the cleaning procedure.

7 Technical Specifications

7.1 HAMILTON Heater Shaker

Instrument Dimensions	Width (X)	Height (Z)	Depth (Y)	
	150 mm	90 mm	105 mm	
Weight	2500 g			
Labware	Standard microtiter plates with adapter Standard deep well plates with adapter Maximum weight (incl. adapter): 500 g			
Temperature Specifications*	Temperature	Ramp from 25°C	Deviation compared to target temp	Tolerance Band for measurement and control: Deviation on plate (middle to edge position)
	37°C	in 3 min	36.0°-38.0°C	35.0°-39.0°C
	60°C	in 10 min	58.5°-61.5°C	57.0°-63.0°C
	90°C	in 20 min	88.0°-92.0°C	86.0°-94.0°C
	100°C	in 30 min	97.5°-102.5°C	95.0°-105.0°C
	105°C	In 35 min	102.5°-107.5°C	100°-110°C
Features of the Heater Shaker	Temperature control		From 5°C above ambient temperature to 105°C	
	Shaking directions		Controlled by two sensors (located in the middle and at the edge of the adapter plate)	
	Acceleration		clockwise and counter-clockwise	
	Deceleration		2.0 s (from 0 to max rpm)	
	Shaking orbits: (peak to peak)		2.0 s (from max rpm to 0)	
			1.5 mm	
			2.0 mm	
			3.0 mm	

*Measured on top of the MTP flat bottom plate



HAMILTON Heater Shaker

Features of the Heater Shaker (cont.) ¹	Recommended shaking speed in rpm depending on labware and shaking orbit				
	Orbit	MTP	DWP	Sarstedt	customized
	1.5 mm	Not available	2000	1800	Not available
	2.0 mm	2500	2000	Not available	2000
	3.0 mm	2400	1800	Not available	1800
Operating Data	Power consumption		41 V / 140 W (max.) supplied by ML STAR Line instrument or HSB		
	Installation category		II		
	Pollution Degree		2		
	Temperature range		15°C - 35°C		
	Relative humidity		15% - 85%		
	Noise level		<65 dBA with max. speed		
	Altitude		Max. 2000 m above sea level		
	Life time		6 years		
	Indoor use only				
Storage and Transportation	Temperature range		-25°C - +70°C		
	Relative humidity		10% - 90% (non-condensing)		
Communication	CAN via TCC connector or via USB				




¹ The Heater Shaker can always be adjusted from 100 to 2500 rpm not depending the version.

7.2 HAMILTON Heater Shaker Box (HSB)



Instrument Dimensions	Width (X)	Height (Z)	Depth (Y)
	270 mm	90 mm	210 mm
Weight	6000 g		
Operating Data	Voltage	100-240 VAC	
	Frequency	47-63 Hz	
	Power consumption	1000 VA (max.)	
	Delayed action fuse	250V 10 AT F	
	Installation category	II	
	Pollution Degree	2	
	Temperature range	15°C - 35°C	
	Relative humidity	15% - 85%	
	Noise level	<65 dBA	
	Altitude	Max. 2000 m above sea level	
	Life time	6 years	
	Indoor use only		
Storage and Transportation	Temperature range	-25°C - +70°C	
	Relative humidity	10% - 90% (non-condensating)	
HHS connectors	8		


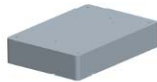

8 Appendix

A Ordering Information

Heater Shaker		
Part number	Description	
199037	<p>HEATER SHAKER 1.5MM NUNC DWP 96 2ML</p> <p>Heater Shaker with 1.5mm shaking orbit and fitted adapter for plates (Shaking speed: 100 -2000 rpm, Temperature control: RT+5°C - 105°C, max. loading: 300g)</p>	
199027	<p>HEATER SHAKER 1.5MM SARSTEDT 48 X 1.5ML</p> <p>Heater Shaker with 1.5mm shaking orbit and fitted adapter for plates (Shaking speed: 100 -1800 rpm, Temperature control: RT+5°C - 105°C, max. loading: 300g)</p> <p>Sarstedt Tubes 1.5ml:</p>	
199033	<p>HEATER SHAKER 2.0MM MTP FLAT BOTTOM</p> <p>Heater Shaker with 2.0mm shaking orbit and flat bottom adapter (Shaking speed: 100 -2500 rpm, Temperature control: RT+5°C - 105°C, max. loading: 300g)</p>	
199038	<p>HEATER SHAKER 2.0MM NUNC DWP 96 2ML</p> <p>Heater Shaker with 2.0mm shaking orbit and fitted adapter for plates (Shaking speed: 100 -2000 rpm, Temperature control: RT+5°C - 105°C, max. loading: 300g)</p>	
199034	<p>HEATER SHAKER 3.0MM FLAT BOTTOM</p> <p>Heater Shaker with 3.0mm shaking orbit and flat bottom adapter (Shaking speed: 100 -2400 rpm, Temperature control: RT+5°C - 105°C, max. loading: 300g)</p>	
199039	<p>HEATER SHAKER 3.0MM NUNC DWP 96 2ML</p> <p>Heater Shaker with 3.0mm shaking orbit and fitted adapter for plates (Shaking speed: 100 -1800 rpm, Temperature control: RT+5°C - 105°C, max. loading: 300g)</p>	

HAMILTON Heater Shaker

Heater Shaker		
Part number	Description	
188318	<p>HEATER SHAKER 2.0MM MTP FLAT BOTTOM APE</p> <p>Heater Shaker with 2.0mm shaking orbit and the option to be equipped with a customized adapter. The labware has to be sent to Hamilton Bonaduz. (Shaking speed depends on used adapter, Temperature control: RT+5°C - 105°C, max. loading: 300g)</p>	
188319	<p>HEATER SHAKER 3.0MM MTP FLAT BOTTOM APE</p> <p>Heater Shaker with 3.0mm shaking orbit and the option to be equipped with a customized adapter. The labware has to be sent to Hamilton Bonaduz. (Shaking speed depends on used adapter, Temperature control: RT+5°C - 105°C, max. loading: 300g)</p>	

Heater Shaker Accesories		
Part number	Description	
190755	<p>HEATER SHAKER BOX</p> <p>Needed if more than two HAMILTON Heater Shakers are integrated (or the connectors "TCC1", "TCC2" on the STAR are occupied by other devices). One heater shaker module is connected to a USB port of the PC and serves as master module for up to seven additional HHS's. The modules are connected to the external heater shaker box (HSB), which serves as power supply and as signal distributor.</p>	
199013	<p>HAMILTON HEATER SHAKER SUPPORT BLOCK FOR MTP</p> <p>Hamilton Heater Shaker support block for MTP. Used to raise the heater shaker on the carrier base if MTP's are processed.</p>	
187001	<p>PLT_CAR_L4_Shaker</p> <p>Template carrier with 4 positions for Hamilton Heater Shaker (7T).</p>	
610766	VENUS two – Operator's Manual	
624043	VENUS two - Programmer's Manual	
624294	<p>MANUALS STAR/LET IVD 4.3:</p> <p>IVD Operator's Manual</p> <p>IVD Programmer's Manual</p>	

B Glossary

HHS	HAMILTON Heater Shaker
HSB	Heater Shaker Box
MTP	Microtiter plate in standard SBS format
DWP	Deep well plate in standard SBS format
TCC	Temperature controlled carrier
SBS	Standard format of the Society for Biomolecular Screening
Labware	Refer to movable items to be placed on the instruments, such as carriers, containers, plates or racks.
Orbit / Amplitude	<p>The Orbit (Rotation Distance) is defined as peak to peak distance in one direction, e.g. distance between extreme positions in the Y-Direction of the Plate measured in millimeters [mm].</p> <p>The Amplitude is defined as the distance from the center of the shaking movement and it is 50% of the peak to peak distance.</p>

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