

Process Description O8352-EN

for variothermal control with Vario-5

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1 Purpose

The process description for variothermal temperature control with Vario-5 serves as a guide for start-up and use of the Vario-5 system in process operation. It serves as a supplement to the Operating Instructions for the Thermo-5 units and the Vario-5 switching unit.



2 Procedure

The procedure describes in short steps the tasks to be carried out in the individual phases.

Detailed descriptions and safety notes can be found in the referenced chapters.

2.1 Installation

Step	Task	Comment	Chapter
1. Install	Place Thermo-5 and Vario-5 at the installation site	<ul style="list-style-type: none"> Observe requirements for the installation location 	3.1 3.1.1
2. Make connections	Connect Thermo-5 to cooling water supply and, if required, to system water supply	<ul style="list-style-type: none"> Depending on the water quality, use a separate system water connection with conditioned water 	3.1.2 3.1.3
	Connect supply and return of temperature control units with the switching unit <ul style="list-style-type: none"> OUT (hot) to IN H IN (hot) to OUT H OUT (cold) to IN C IN (cold) to OUT C 	<ul style="list-style-type: none"> Adapt hose specification to maximum temperature of hot unit Observe the connections 	
	Connect the switching unit with the mould <ul style="list-style-type: none"> OUT M to mould IN M from mould 	<ul style="list-style-type: none"> Adapt hose specification to maximum temperature of hot unit Keep hose lengths as short as possible Keep the weight of possible manifolds or fittings as small as possible Observe the connections 	
	Connect Thermo-5 and Vario-5 as well as Panel-5, if present, to the mains power	<ul style="list-style-type: none"> Observe the specifications of the power supply for Vario-5 and Panel-5 (see rating plate) 	
3. Connect interfaces	Interconnect Thermo-5 and Vario-5 as well as Panel-5, if present, via control cable	<ul style="list-style-type: none"> Note arrangement of other dependent items to be connected Make sure to use the correct cable 	3.1.4
	Connect the system with the machine control	<ul style="list-style-type: none"> Switch-over signal or timing signal from machine with two contacts or one contact Optional communication interface between temperature control units and machine 	
	Connect any mould sensors	<ul style="list-style-type: none"> The temperature sensor must be installed in the variothermal area 	3.1.5
	Connect functional earth	<ul style="list-style-type: none"> If there are strong EMC noise fields in the vicinity of the Vario-5 switching unit 	3.1.6
4. Switch on	Switch on the main switch and configure the system (units)	<ul style="list-style-type: none"> The initialisation window appears automatically (change in Display \ Variothermal systems) VCn as well as THn and TCn must appear in the module bar Set type of sensor, if present (Setting \ Miscellaneous) 	3.1.7



Fig. 1. Example of an installed Vario-5 system (demonstration set-up with test mould and machine simulator)

2.2 Commissioning

Step	Task	Comment	Chapter
1	Set the nominal values	<ul style="list-style-type: none"> For the first test: TH 80 °C and TC 40 °C (Nominal values) 	3.2.1
2	Switch on the system	<ul style="list-style-type: none"> Select module no. (VCn) and switch on Check tightness of connections 	3.2.2
3	Switch system to manual mode and test switching function	<ul style="list-style-type: none"> Check temperature changes at hoses or mould sensor 	3.2.3
4 optionally	Switch system to test mode and observe the behaviour	<ul style="list-style-type: none"> Check temperature changes at hoses or mould sensor Change set temperatures and switching times (Setting \ Vario \ Test mode) An IR sensor can be used instead of a mould sensor (Setting \ Miscellaneous) 	3.2.4 3.2.5

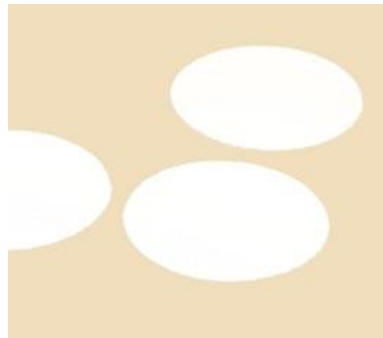


Fig. 2: Infra-red sensor with magnetic base and reflective tape for temperature measurement on shining surfaces



NOTICE!

Use reflective tape for surfaces with metallic lustre.

2.3 Parameter determination (Assistants)

Step	Task	Comment	Chapter
1	Define a suitable assistant	<ul style="list-style-type: none"> The selection depends on the existing basic conditions 	3.3.1
2	Start teaching	<ul style="list-style-type: none"> Select Teaching function 	3.3.2
3	Select assistant type and enter required parameters	<ul style="list-style-type: none"> Values that have to be entered are highlighted 	
4	Start assistant.	<ul style="list-style-type: none"> Select “Start assistant” and launch process by pressing OK. 	
5	During teaching, follow the instructions on the screen.	<ul style="list-style-type: none"> For types 3, 4 and 5, the moulding machine must be ready for production. 	
6	Close the assistant	<ul style="list-style-type: none"> At the end of the assistant, select “Apply values” if you wish to continue working with these values. Note the values you have determined, if required. 	

2.4 Process operation

Step	Task	Comment	Chapter
1	Set the temperature nominal values	<ul style="list-style-type: none"> From parameters previously determined or from past processes 	3.4
2	Enter actuation type	<ul style="list-style-type: none"> Select Machine actuation (Setting \ Vario) 	
3	Set actuation times (only when setting the time on the system)	<ul style="list-style-type: none"> Duration, breaks and delays (Setting \ Vario) 	
4	Switch on process operation and start the production	<ul style="list-style-type: none"> Observe and corroborate the switching characteristic 	
5	Check the monitoring	<ul style="list-style-type: none"> It is recommended to switch on the monitoring to verify the variothermal temperature control (Monitoring) 	3.4.1

2.5 Optimising the process

If positive effects show following an initial sampling with variothermal temperature control, then check if the quality can be further improved and if the energy requirement can be reduced using other temperatures and different time responses. Also check if a reduction of the cyclic time is possible.

The settings must be optimised similar to an initial sampling, even if the workpiece quality is acceptable. This is true, in particular, for energy-efficient operation.

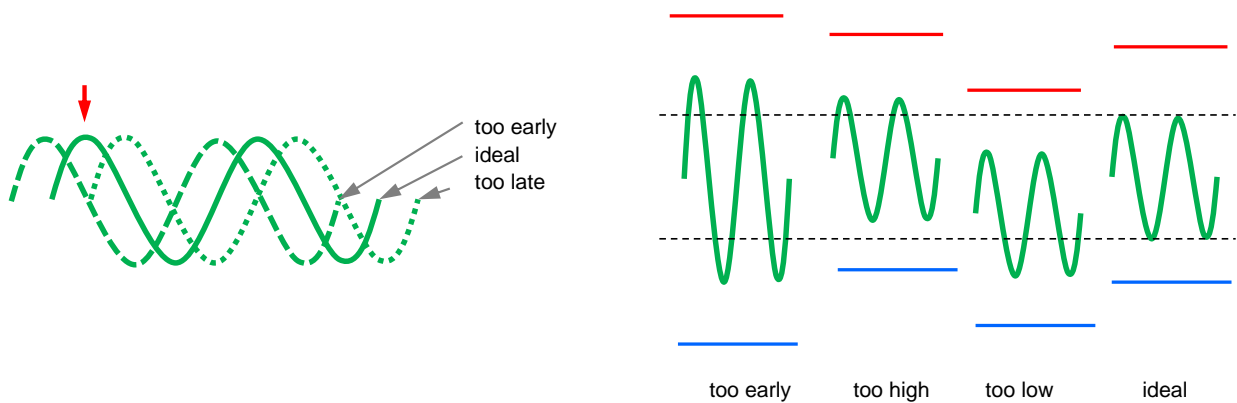


Fig. 3: Optimisation of settings (left: time of the maximum, right: temperatures)

2.6 Decommissioning

Step	Task	Comment	Chapter
1	Switch off the system	<ul style="list-style-type: none"> Select module no. (VCn) and switch off System will only switch off, if the temperature of both units is lower than the safety shut-off temperature. 	3.5
2 alternatively	Switch off the system after it has cooled down and/or after mould evacuation	<ul style="list-style-type: none"> Switch-off and/or mould evacuation are carried out simultaneously on both units 	3.5.1 3.5.2

2.7 Recording

For long-term recordings with a higher level of detail, the actual values can be saved to a USB data carrier.

Step	Task	Comment	Chapter
1	Select actual values for recordings	<ul style="list-style-type: none"> The more values you select, the larger the recording file 	3.6
2	Set the recording interval	<ul style="list-style-type: none"> 10 seconds are sufficient for long-term recordings Use 1 second for recording data for fault finding 	
3	Insert USB data carrier		
4	Start USB recording	<ul style="list-style-type: none"> The active recording is indicated with the symbol ● on the basic display. 	

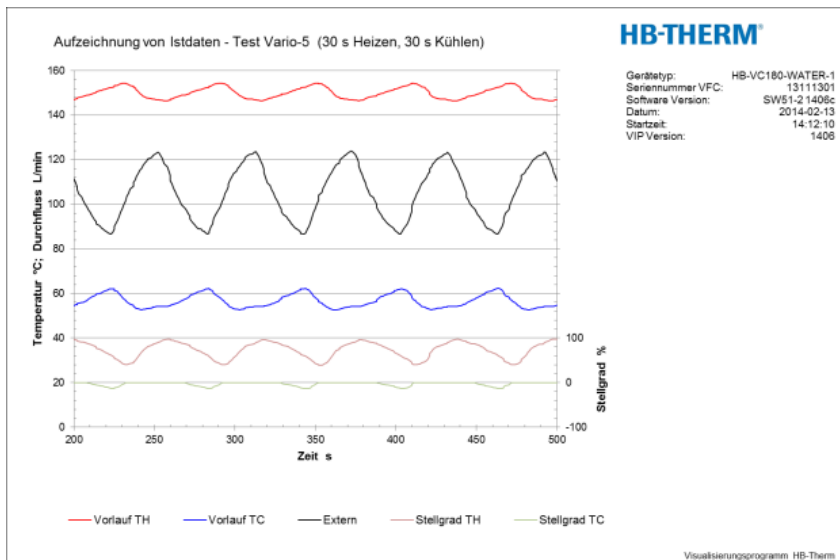


Fig. 4: Example of an evaluated recording

3 Detailed description

3.1 Installation

Personnel

- The installation and commissioning must only be carried out by qualified personnel.
- Work on the electrical system must only be carried out by certified electricians.
- Work on the hydraulic system must only be carried out by qualified hydraulics technicians.

Special dangers

The following dangers exist:

- Danger of fatal injury by electric current.
- Risk of burns due to hot materials.
- Risk of burns due to hot surfaces.
- Danger of crushing due to rolling away or tipping.

Improper installation and initial commissioning



WARNING!

Risk of injury due to improper installation and initial commissioning!

Improper installation and initial commissioning can lead to severe personal injury or material damage.

Therefore:

- Before starting work, ensure that there is sufficient space for assembly.
- Open components with sharp edges should be handled carefully.



WARNING!
Improper installation can cause risk of injury and fire!

Improper installation can lead to severe personal injury or material damage.

Therefore:

- Observe and comply with the requirements at the installation site

Install the temperature control unit under the following conditions:

- on a level, load-bearing surface
- secured against rolling away and tipping
- Access to main switch guaranteed at all times
- Connecting cables to and from the unit must not touch any pipelines that have surface temperatures greater than 50 °C
- Protect the unit with a suitable back-up fuse and, if necessary, a residual current circuit breaker (max. back-up fuse and recommended residual current circuit breaker → Instruction Manual Thermo-5)

3.1.1 Lock castors

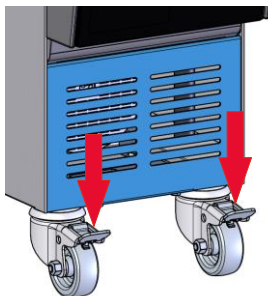


Fig. 5: Lock castors

The castors must be locked in order to secure the unit from rolling away unintentionally.

1. Place the unit in the appropriate location.
2. Press the two brake arms on the castors downwards.

3.1.2 Set the separate connection for system water

The common connection for cooling and system water can be changed over to separate connections.

Necessary equipment

- Torx screwdriver
- Slotted screwdriver

Separate connection cooling and system water inlet

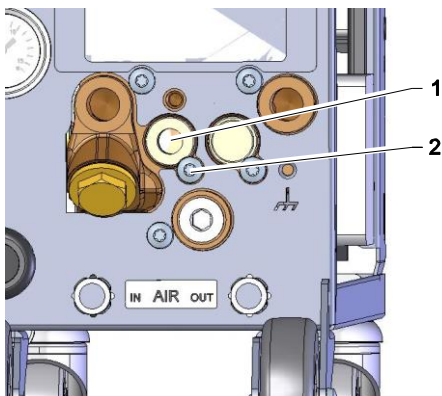


Fig. 6: Separate connection cooling and system water inlet

Proceed as follows in order to change to separate connection for cooling and system water inlet:

1. Remove the Torx screws (2) with the Torx screwdriver.
2. Insert the flat-blade screwdriver into the groove of the trunnion (1) and press it out.
3. Refit the trunnion (1) the other way round with the screw connection visible outwards.
4. Retighten the Torx screws (2) with the Torx screwdriver (pay attention to the notch in the trunnion).

Separate connection cooling and system water outlet

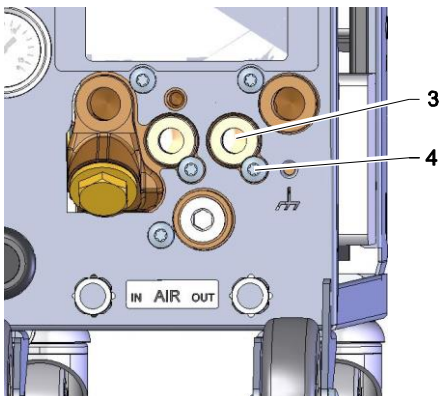


Fig. 7: Separate connection cooling and system water outlet

Proceed as follows in order to change to separate connection for cooling and system water outlet:

1. Remove the Torx screws (4) with the Torx screwdriver.
2. Insert the flat-blade screwdriver into the groove of the trunnion (3) and press it out.
3. Refit the trunnion (3) the other way round with the screw connection visible outwards.
4. Retighten the Torx screws (4) with the Torx screwdriver (pay attention to the notch in the trunnion).

3.1.3 Setting up system connections



WARNING!
Danger from hydraulic energy!

When using unsuitable pressure lines and connectors, the danger exists that liquids under high pressure can escape and cause severe or fatal injuries.

Therefore:

- Use only temperature-resistant pressure lines.



NOTICE!

Specific to the product, system connections are screwed or plugged in. If the recommended size of hose cannot be connected to the consumer, a reduction in bore at the consumer and not at the unit must be achieved to keep the pressure drop to a minimum.



ATTENTION!

Bolted assemblies, especially combinations of stainless-steel/stainless-steel tend to strongly adhere after a longer period of operation at high temperatures. This results in difficulties in dismantling.

Therefore:

- *It is recommended to use the appropriate lubricants when installing dangerous bolting.*

Connect cooling water inlet and outlet



NOTE!

In order to optimally utilize the cooling capacity of the temperature control unit, keep the cooling water outlet as short and free of back-pressure as possible.

1. Connect cooling water inlet and outlet to cooling water system.
2. Optionally connect system water inlet and outlet to system water system.
3. Connect main line (OUT) of "hot" Thermo-5 to hot water circuit input (IN H).
4. Connect return line (IN) of "hot" Thermo-5 with to water circuit output (OUT H).
5. Connect main line (Out) of "cold" Thermo-5 to cold water circuit input (IN C).
6. Connect return line (IH) of "cold" Thermo-5 to cold water circuit output (OUT C).
7. Connect mould circuit (OUT M) and (IN M) to consumer.
8. Have electrical connections made under the following conditions:
 - First make the hydraulic connections, then make the electrical connections.
 - Ensure that mains voltage and frequency are observed and correspond to the specification on the nameplate and in the technical data.

Secure hose connections



WARNING!

Risk of burns at hot hose connections!

During operation, the hose connections between the temperature control unit, the switching unit and the external consumer can become very hot. Where hose connections are covered insufficiently, there is the danger of contact which can cause severe burns.

Therefore:

- Secure all hose connections adequately against the possibility of direct contact.

3.1.4 Connect data interfaces

HB interface

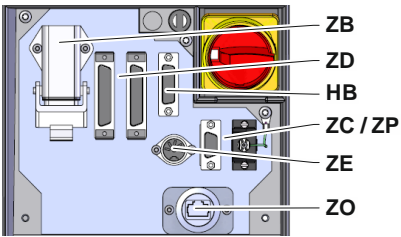


Fig. 8: Interfaces individual unit

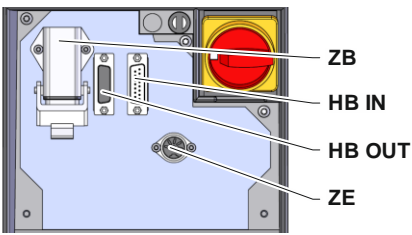


Fig. 9: Interfaces modular unit

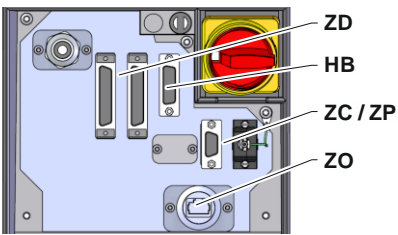


Fig. 10: Interfaces Panel-5

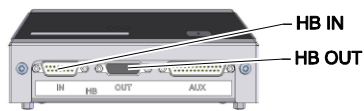


Fig. 11: Interfaces Flow-5
Modul: Unit attached/ stand-alone

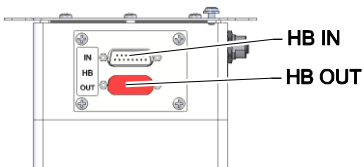


Fig. 12: Interfaces Flow-5
Modul: Autonom.

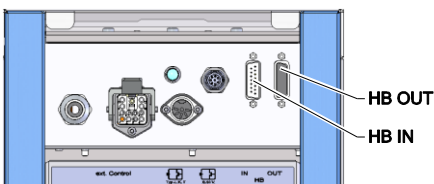
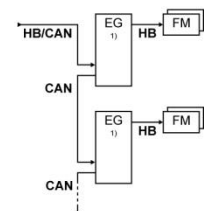
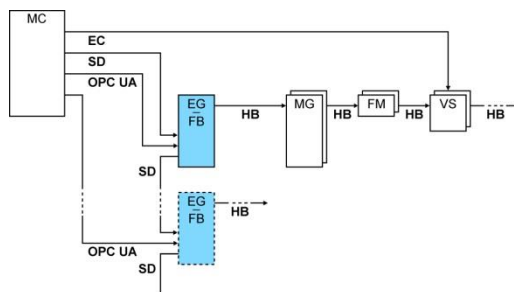


Fig. 13: Interfaces Vario-5

To operate or monitor a modular unit Thermo-5 Ext. Flow meter Flow-5 or a switching unit Vario-5, a control cable must be connected to the device:

1. Loop the control cable between the front and the service cover at Thermo-5 resp. Panel-5.
2. Plug the control cable into socket HB IN.
3. Attach the other side of the control cable to the HB-Therm Thermo-5, Flow-5 or Vario-5 through the HB IN plug.
4. Attach additional HB-Therm products through the socket HB OUT.
5. Close the service lid.

Legend	Designation	Comment
MC	Machine controller	max. 1
FB	Operating module Panel-5	max. 1
EG	Temperature thermostat Thermo-5 singular unit	max. 16 (per operation)
MG	Temperature thermostat Thermo-5 modular unit	
FM	Flow meter Flow-5	max. 32 (with 4 circuits)
VS	Switching unit Vario-5	max. 8
SD	Communication via serial data interfaces DIGITAL (ZD), CAN (ZC), PROFIBUS-DP (ZP)	Maximum number of sim. modules, operating volume and transfer of flow rate values depend on the machine controller or protocol
OPC UA	Communication OPC UA via Ethernet (ZO)	
HB	Communication Interface HB	Order of connection not relevant
HB/CAN	Communication Interface HB/CAN	For remote control of singular units
CAN	Communication Interface CAN (ZC)	
EC	External control (ext.) Control	Configuration depends on machine controller



Ext. Control

For actuation through the machine, either an active 24V DC signal or an isolated contact can be used. If the actuation through the machine is not possible, the synchronisation of the control can be achieved through a proximity switch.

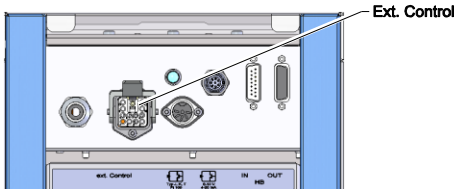


Fig. 14: Interfaces Vario-5

To actuate the switching unit through signals by means of a control cable of the machine control, proceed as follows:

1. Pull the control cable of the machine control between the front and the service cover.
2. Connect the control cable to the socket Ext. Control.
3. Close the service lid.
4. For schematical terminal assignment (→ Instruction Manual Vario-5).

3.1.5 Connect external sensor

Connecting an external temperature sensor

You can connect an external temperature sensor to the switching unit to display the consumer temperature.

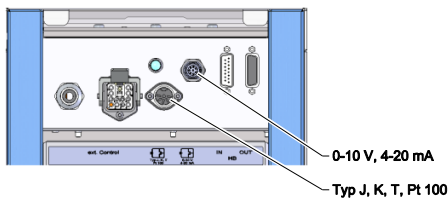


Fig. 15: Interfaces Vario-5

1. Loop the cable of the external temperature sensor between the front and the service flap.
2. For type J, K, T or Pt 100, plug the external temperature sensor into socket type J, K, T or Pt 100.
3. For type 0–10 V or 4–20 mA, plug the external temperature sensor into socket type 0–10 V or 4–20 mA.
4. Close the service lid.
5. Setting of sensor type (→ page 23).

Table: Sensor type designation

Type	Code	Casing	Core
J (Fe-CuNi)	IEC	black	black (+) / white (-)
	DIN	blue	red (+) / blue (-)
K (NiCr-Ni)	IEC	green	green (+) / white (-)
	DIN	green	red (+) / green (-)
T (Cu-CuNi)	IEC	brown	brown (+) / white (-)
	DIN	brown	red (+) / brown (-)

3.1.6 Connecting the functional grounding

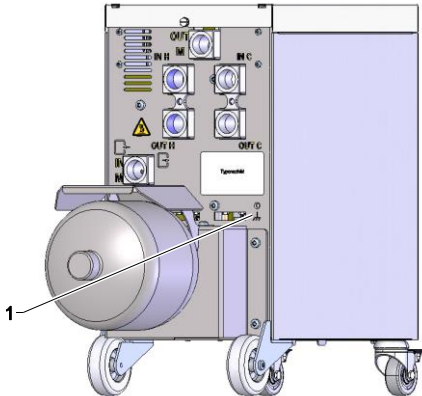


Fig. 16: Functional grounding

Large emitters of electromagnetic disturbance near the switching unit can influence its operation. In this case, the switching unit casing must be earthed with an grounding strap (for functional grounding connecting point, refer to (1) Fig. 16).

3.1.7 Switching on

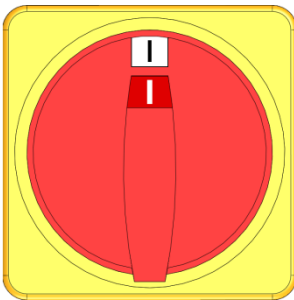


Fig. 17: Main switch

Switch on the system as follows:

1. Insert the mains cable from the Vario-5 switching unit.
 2. Turn all main switches of the associated Thermo-5 and Panel-5 to position "I".
- The device initializations are terminated.

3.1.8 Initialisation

Initialisation window

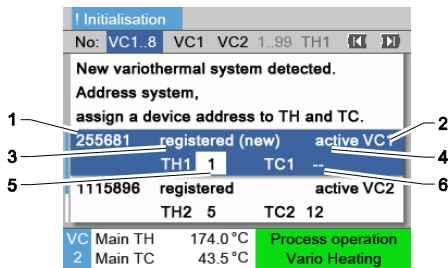


Fig. 18: Initialisation

If a new switching unit is detected, the initialisation window appears at the singular unit or operating module.

Pos. no.	Display
1	Module ID
2	VC module address
3	Registration status of switching unit
4	Active/inactive status of switching unit
5	Assignment TH (Thermo-5 cold water circuit)
6	Assignment TC (Thermo-5 cold water circuit)

Address allocation and assignment

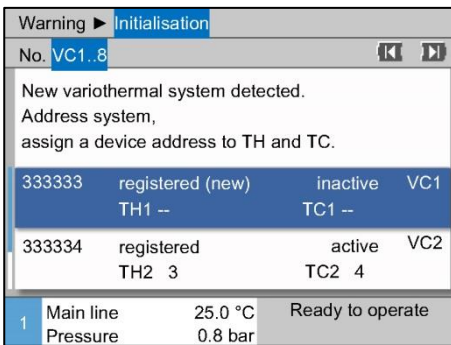


Fig. 19: New system detected.

The switching unit must be assigned an address (VC1 to VC8), status ("active" or "inactive") and a respective unit address for TH and TC. Proceed as follows:



NOTICE!

To completely define the assignment of the switching unit, the hydraulically connected Thermo-5 units need to be switched on and already registered at the control.

1. Select the Module ID with the or key.
2. Press the key and adjust the address of the VC module (→ Fig. 20 Ex. VC1)



NOTICE!

A set address (VC module) may only exist once in a network. The menu page can not be exited as long as the address is repeatedly assigned.

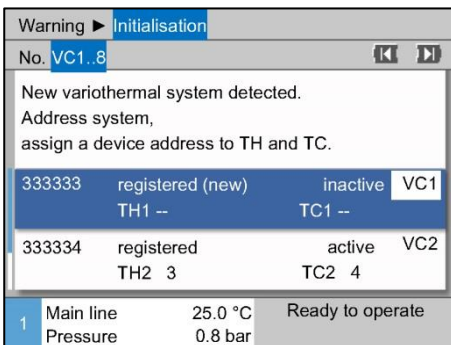


Fig. 20: Assign Module ID

3. Jump to the TH address with the key and assign the registered address. (→ Fig. 21 Ex. assign address 1 to TH1)

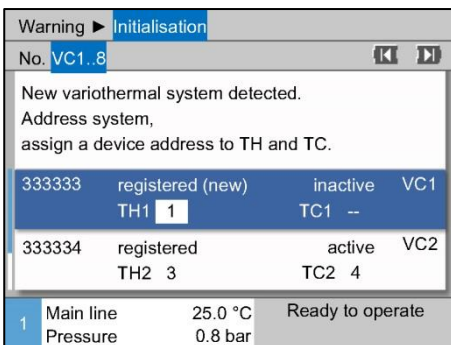



Fig. 21: Assign TH address

Warning ► Initialisation			
No. VC1..8			
New variothermal system detected. Address system, assign a device address to TH and TC.			
333333	registered (new)	inactive	VC1
	TH1 1	TC1 2	
333334	registered	active	VC2
	TH2 3	TC2 4	
1	Main line	25.0 °C	Ready to operate
	Pressure	0.8 bar	

Fig. 22: Assign TH address

- Jump to the TC address with the  key and assign the registered address.
(→ Fig. 22 Ex. assign address 2 to TC1)






NOTICE!

A VC switching unit must be assigned a registered address of a Thermo-5 and the parameter TH and TC. Otherwise the variothermal system cannot be operated.





Warning ► Initialisation			
No. VC1..8			
New variothermal system detected. Address system, assign a device address to TH and TC.			
333333	registered (new)	active	VC1
	TH1 1	TC1 2	
333334	registered	active	VC2
	TH2 3	TC2 4	
1	Main line	25.0 °C	Ready to operate
	Pressure	0.8 bar	

Fig. 23: Setting of the status

- Jump to Status with the  key and set to "active".
- Confirm assignment with the  key and then leave the initialisation window with the  key.




Change the address resp. assignment

Proceed as follows in order to subsequently change the address assignment:

- Open the [Display \ Variothermal systems](#) menu page.
- Choose VC module address and confirm with the  key.
- Set the VC module address.
- Press the  key and assign a registered TH address.
- Press the  key and assign a registered TC address.
- Acknowledge assignment with the  key.

Activate and deactivate

Switching units can be activated and deactivated. To activate resp. deactivate a switching unit, proceed as follows:

- Open the [Display \ Variothermal systems](#) menu page.
- Choose VC module address and confirm with the  key.
- Jump to Status with the  key and set status to "active".resp. "inactive"
- Confirm with the  key.

3.2 Commissioning

3.2.1 Nominal values

Setting nominal values

Set nominal values as follows:



NOTICE!

The nominal values can only be set with Modul VCn and not with THn or TCn.

1. Select model No. "VCn" with or .
2. Display menu page **Nominal values**.
3. Set parameter **Nominal Value TH** and **Nominal value TC** to the desired value.

Limit of the nominal value

A nominal value can be adjusted maximum to the value of the **Temperature limiting** minus 5 K .

Manual temperature limiting

Nominal values			
Nominal value 1		40.0 °C	
Nominal value 2		0.0 °C	
Ramp heating		OFF	
Ramp cooling		OFF	
Temperature limiting		165 °C	
Safety cut-off temperature		70 °C	
1	Main line	25.0 °C	Ready to operate
	Pressure	0.5 bar	

Fig. 24: Temperature limiting

Proceed as follows in order to manually set the **Temperature limiting** :

1. Open the **Nominal values** menu page.
2. Set parameter **Temperature limiting** to the desired value.

automatic temperature limiting

The **Temperature limiting** is being automatically reduced when using different types of devices in variothermal systems. The reduction depends on the built-in safety valves.

The reduction is as follows:

Type of unit	Safety valve	Temperature limiting
HB-100/140/160Z	10 bar *)	165 °C
HB-180Z	17 bar	185 °C

*) a special edition with a safety valve 17 bar instead of 10 bar (→ nameplate below additional, inscription „XA“, means special edition with appendix) for devices up to 160 °C (housing size 2 and 3).

3.2.2 Ready to operate

Switching on the system



Fig. 25: Basic screen VC1

Switch on the system as follows:

1. To select the module no., press the or key.



NOTICE!

You can switch on the systems using module no. VCn, THn or TCn.

2. Press the key.
 - The system starts in the set operating mode. If necessary, the units TH and TC are automatically filled and vented.
 - When the nominal values are reached, the set operating mode is displayed.

Setting "Nominal value ready for operation"

When the consumer is switched on, it is conditioned to the temperature set in **Nom. value ready for operation**. By default, **Nom. value ready for operation** is set to "auto". With the "auto" setting, the consumer is conditioned to the mean value of **Nominal value TH** and **Nominal value TC**. If a different starting temperature is desired, you can adjust your setting as follows:

1. Open the **Nominal values** menu page.
2. Set the **Nom. value ready for operation** parameter to the desired value.



NOTICE!

Nom. value ready for operation must never be larger than **Nominal value TH**.

3.2.3 Manual mode

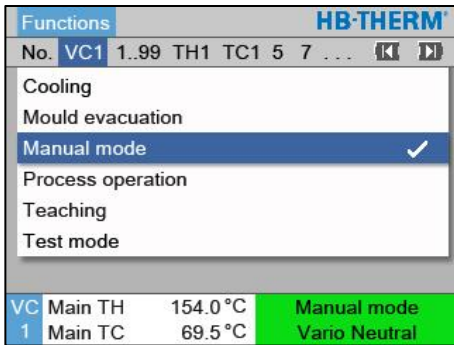


Fig. 26: Menu functions



Fig. 27: Basic screen for manual mode

Switch on the manual mode as follows:

1. To select module no. "VCn", press the key or the key.
 2. Open the **Functions** menu page.
 3. Select **Manual mode** and press the key to activate it. The symbol indicates the activated function.
- The operating mode "Manual mode" flashes, until the system is ready for operation.
- Use the key to activate "Vario Heating", use the key to activate "Vario Cooling", and use the key to activate "Vario Neutral".



NOTICE!

"Vario Heating", "Vario Cooling" and "Vario Neutral" cannot be active simultaneously.



NOTICE!

The manual mode can only be active at a single variothermal system.

3.2.4 Test mode

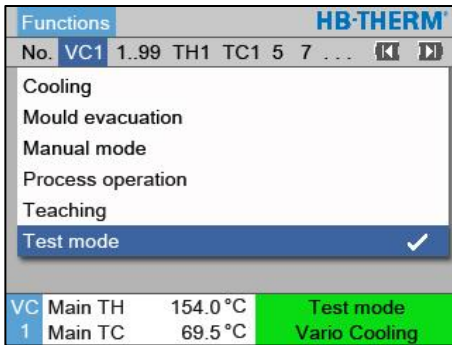


Fig. 28: Menu functions

Switch on the test mode as follows:

1. To select module no. "VCn", press the **⏪** key or the **⏩** key.
 2. Open the **Functions** menu page.
 3. Select **Test mode** and press the **OK** key to activate it. The **✓** symbol indicates the activated function.
- The operating mode "Test mode" flashes, until the system is ready for operation.



NOTICE!

In test mode, a variothermal process can be run without machine signals and using the set durations.

Test mode settings

For the test mode, separate settings for the nominal values and durations apply. To define the parameter, proceed as follows:

1. To select module no. "VCn", press the **⏪** key or the **⏩** key.
2. Open the **Setting \ Vario \ Test mode** menu page.
3. Set the **Nominal value TH test** and **Nominal value TC test** parameters to the desired values.
4. Set the **Heating test duration**, **Cooling test duration**, **Heating-cooling test pause** and **Cooling-heating test pause** parameters to the desired values.

3.2.5 External sensor

Pre-selection of external sensor type

The external sensor type is set as follows:

1. Open the **Settings \ Miscellaneous** menu page.
2. Set the **Sensor type external sensor** parameter to the connected sensor type.



NOTICE!

On variothermal systems, the external sensor is used for temperature indication only.

3.3 Parameter determination (Assistants)

In order to reach the requested temperature profile at a specific location of the mould cavity surface, the temperatures of both temperature control units and the switching times of the switching units must be known. Because these parameters depend on the mould geometry and the application as such, they can only be determined empirically by trials. This is supported on the Vario-5 system by assistants.

The parameter determination process requires running the expected cycle with the open tool by driving the system initially with a freely selected setting. During this process, the characteristic attenuations and time delays are determined based on the temperature profile measured at a requested location of the mould cavity surface. From these values, in turn the desired setting values are calculated.

For better understanding, the typical temperature profile and the variothermal actuation is shown below.

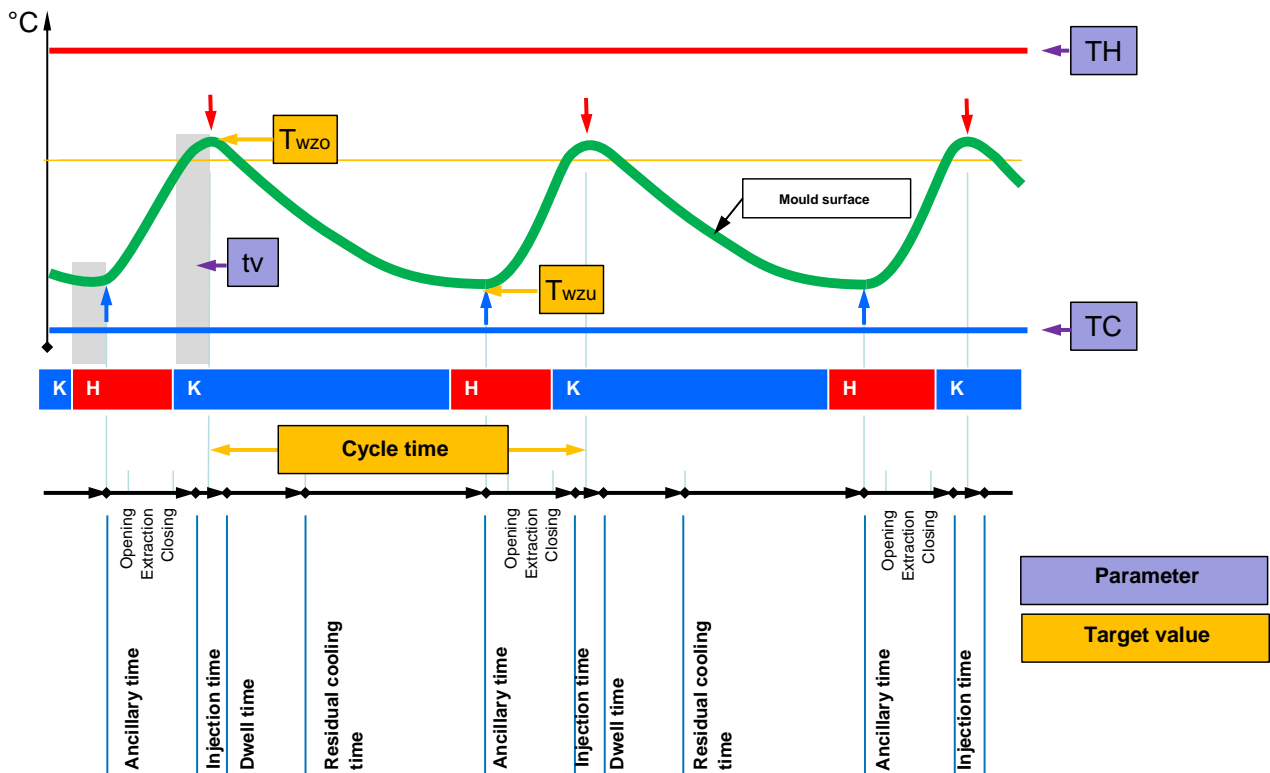


Fig. 29: Typical temperature profile with desired target values (yellow) and parameters (lilac) required to reach these values.



NOTICE!

The times that must be set for actuation result from the desired times for the maximum and the minimum based on the delay time and the selected machine cycle.

If no suitable mould sensor is present, you can measure the surface temperature of the mould cavity at the open mould using a hand-held thermometer or an IR sensor (infrared sensor or pyrometer).

3.3.1 Assistants

Types of assistants

Five types of assistants are available. However, types 4 and 5 are combinations of types 1, 2 and 3. The selection depends on the existing basic requirements of the application involved.

Type	Designation	Short description	Necessary input	calculated parameter
1	Only dry running condition, without external sensor connected	Decision on the delay time at the open mould, if there is only a hand thermometer available.	Nominal value TH Nominal value TC Cycle time	Delay time
2	Only dry running condition, with external sensor connected	Decision on the typical values at the open mould.	Nominal value mould up Nominal value mould down Cycle time	Delay time Nominal value TH Nominal value TC
3	Set/adjust only time lapse	Determination of the switching times depending on the machine cycle during production.	Nominal value TH Nominal value TC Nominal value isothermal Delay time	Cycle delay Heating duration Cooling duration Heating-cooling pause Cooling-heating pause Machine actuation
4	Dry running operation and setting of time lapse without a connected external sensor.	Combination type 1 and 3	Nominal value TH Nominal value TC Cycle time Nominal value isothermal	Delay time Cycle delay Heating duration Cooling duration Heating-cooling pause Cooling-heating pause Machine actuation
5	Dry running operation and setting of time lapse with a connected external sensor.	Combination type 2 and 3	Nominal value mould up Nominal value mould down Cycle time Nominal value isothermal	Delay time Nominal value TH Nominal value TC Cycle delay Heating duration Cooling duration Heating-cooling pause Cooling-heating pause Machine actuation



NOTICE!

The assistants 3, 4 and 5 are only applicable, if you use the Vario-5 system for time setting and if there is only a timing signal from the machine available.

Reference values for the temperature of the mould cavity surface

The most important variables for variothermal temperature control are the temperatures to be reached at the mould cavity surface. They depend primarily on the materials processed but also depend on the component configuration and the moulding parameters. The following values can be used as reference values for the surface temperatures of the mould cavity (mould wall temperature) at the time of injection:

Material	Surface temperatures
ABS	110 °C
PMMA	120 °C
PC + ABS	125 °C
PC	140 °C
amorphous PA	160 °C

Process diagram for type 1 assistant

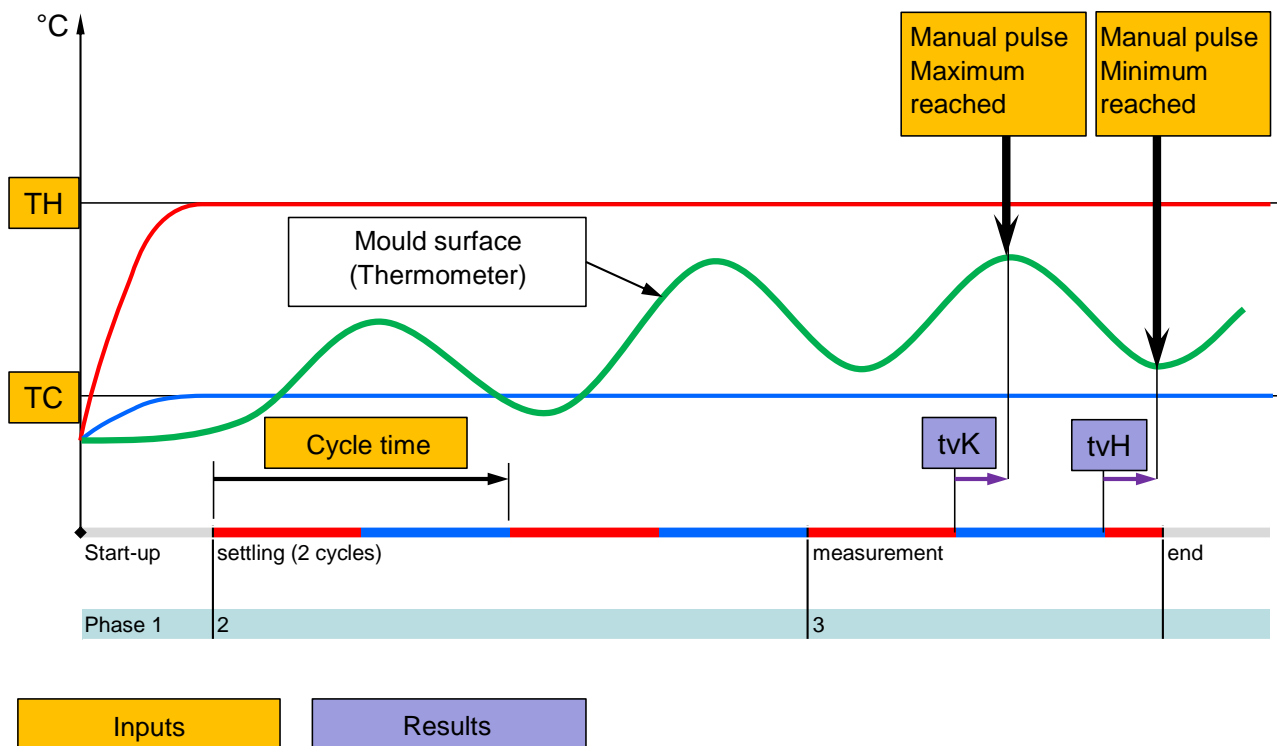


Fig. 30: Process for type 1 assistant, determination of the delay time at the open mould, if there is only a hand-held thermometer available.

Process diagram for type 2 assistant

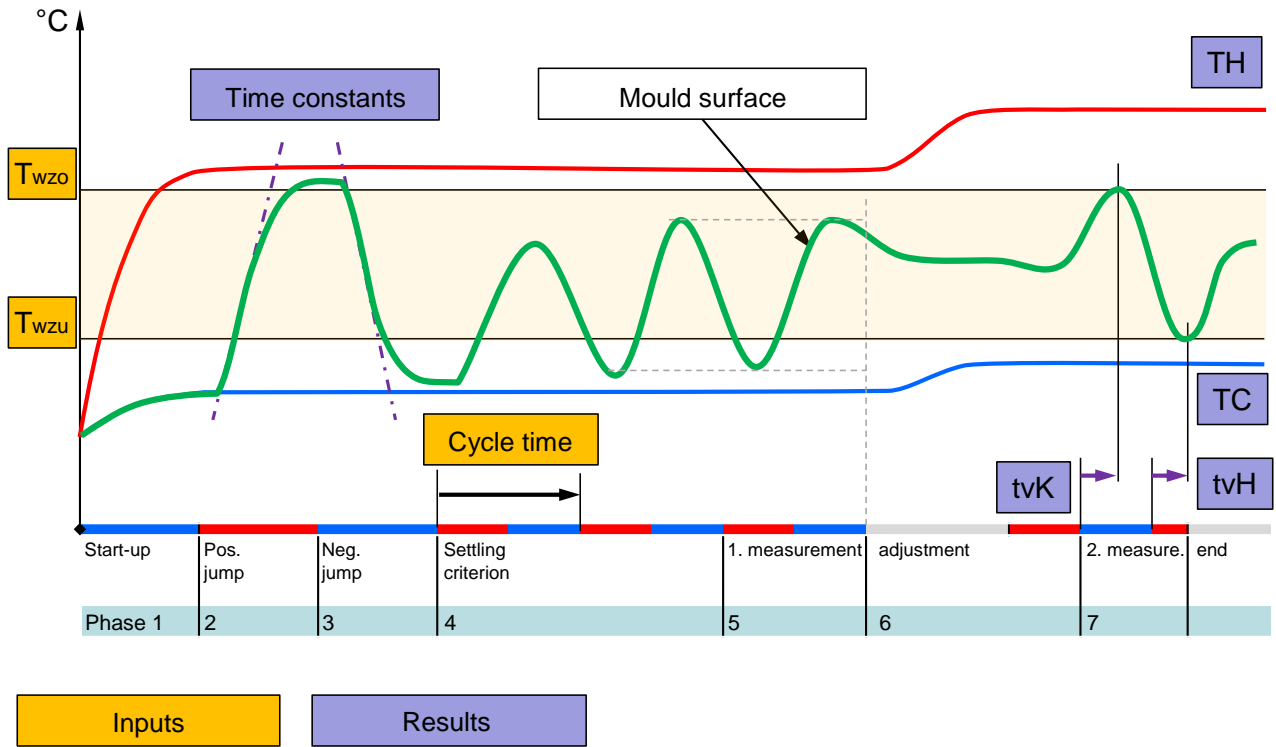


Fig. 31: Process for type 2 assistant, determination of the characteristic values at the open mould

Process diagram for type 3 assistant

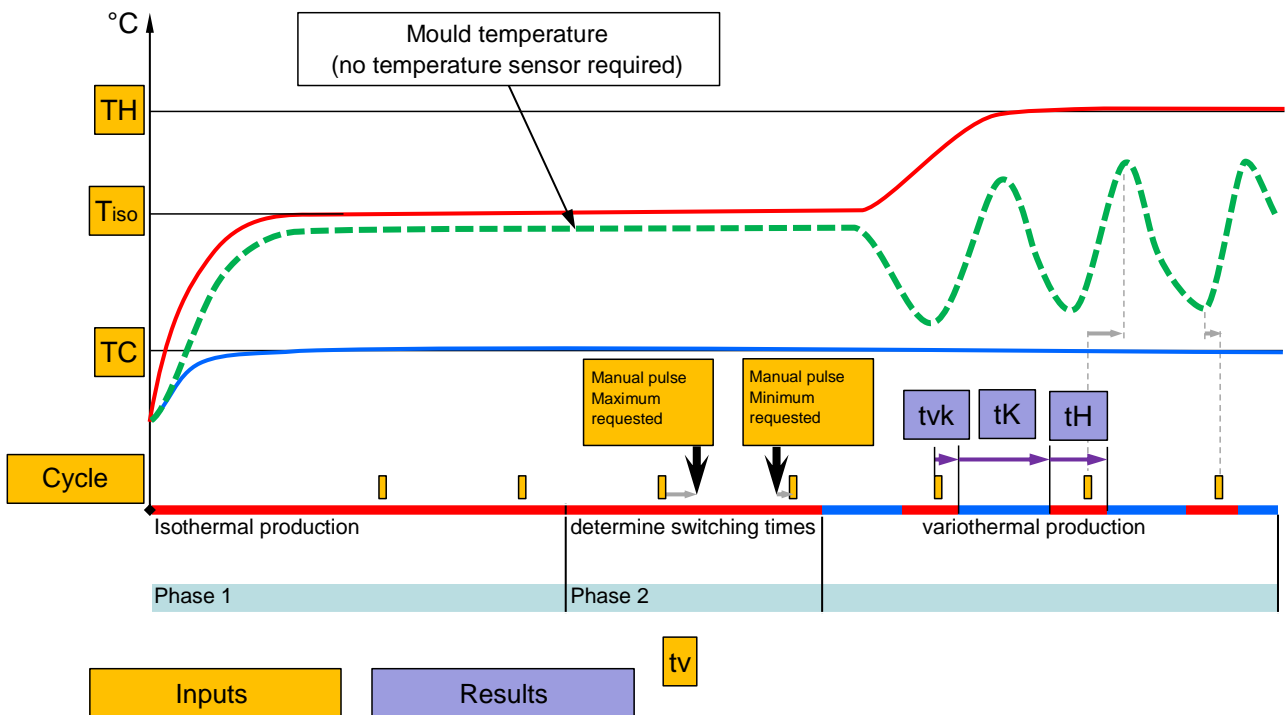


Fig. 32: Process for type 3 assistant, determination of the switching times depending on the machine cycle during production.

3.3.2 Teaching

With the function **Teaching**, using different assistants, specific variotherm parameters can be automatically determined.

Start function Teaching

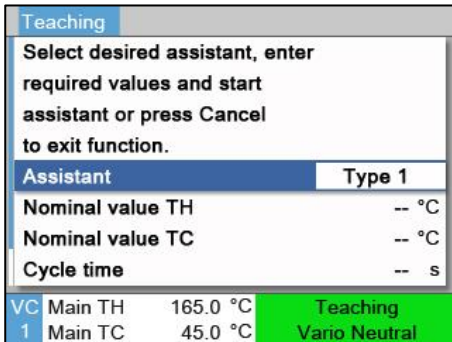


Fig. 33: Choose assistant

Proceed as follows in order to activate the function Teaching:

1. Select model No. "VCn" with **⏪** or **⏩**.
2. Display menu page **Functions**.
3. Select the parameter **Teaching** and activate with the **OK** key. The activated function is indicated with the **✓** symbol.
→ For as long as the system is not ready, the operating mode "Teaching" flashes.
4. Select the desired **Assistant** in the input field and confirm with the **OK** key.
5. Choose all parameters shown in black with the **OK** key and set to the desired value. Confirm with the **OK** key.



NOTICE!

Depending in the chosen assistant the input may differ.

6. Choose **Start assistant** and confirm with the **OK** key. Use **Cancel** to stop the function Teaching.
→ Teaching starts. Follow indications on screen.

3.4 Process operation

During process operation, the variothermal system reacts to machine signals. Depending on the application and the possibilities of the machine control, there are two possible types of control: Time setting on the machine or time setting on the variothermal system.

Type	Time setting	Description	Number of contacts	Actuation settings
1	Machine	The machine sends the signals for heating and cooling, the switching unit carries out the commands directly and immediately.	2 (1)	Contact HC Cycle HC (Contact H)
2	Vario-5 system	The machine sends a clock pulse signal at a specific moment during the injection cycle. The variothermal system controls the valves in relation to this signal, depending on the selected times.	1	Cycle H Cycle C

Process operation switching ON/OFF

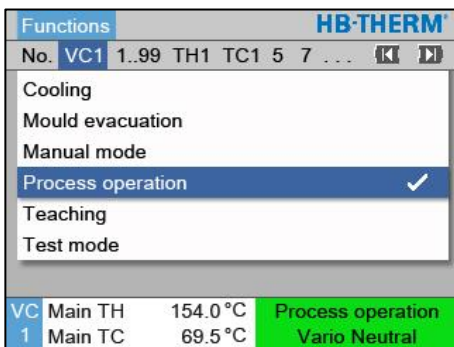


Fig. 34: Menu Functions

Switch on the process operation as follows:

1. Select model No. "VCn" with **←** or **→**.
 2. Display menu page **Functions**.
 3. Select the parameter **Process operation** and activate with the **OK** key.
The activated function is indicated with the **✓** symbol.
- For as long as the system is not ready, the operating mode "Process Operation" flashes.
- As soon as the machine signals are available, switching between "Vario Heating", „Vario Neutral“ and „Vario Cooling“ is enabled.



NOTICE!



For the pin assignment of the machine signals (→ Instruction Manual Vario-5).

Process interruption

Process interruption is being activated automatically in case of missing machine signals. As soon as the machine signals are available again, the operating mode changes automatically to process operation.

Settings machine actuation

Set the machine signal actuation as follows:

1. Select model No. "VCn" with  or .
2. Display the menu page [Setting \ Vario](#).
3. Set parameter [Machine actuation](#) to the desired value according the table.

Actuation	Description
Contact HC	Direct actuation with 2 contacts for "Vario Heating" and "Vario Cooling".
Contact H	Direct actuation with 1 contact for "Vario Heating". If the "Vario Heating" contact is open, then switching on "Vario Cooling" is enabled.
Cycle HC	Cycle actuation with 2 contacts for "Vario Heating" and "Vario Cooling".
Cycle H	Cycle actuation with 1 contact for Start "Vario Heating". The times for each phase must be set manually.
Cycle C	Cycle actuation with 1 contact for Start "Vario Cooling". The times for each phase must be set manually.

Settings for times of actuation machine cycle H and cycle K

If settings of [Machine actuation](#) are „Cycle H“ or „Cycle K“ times for [Heating duration](#), [Cooling duration](#), [Heating-cooling pause](#) and [Cooling-heating pause](#) must be set. Set times as follows:

1. Display the menu page [Setting \ Vario](#).
2. Set parameter [Heating duration](#) and [Cooling duration](#) to the desired value.
3. Set the parameter [Heating-cooling pause](#) for „cycle H“ resp. [Cooling-heating pause](#) for „cycle K“ to the desired value.





NOTICE!

The sum of times set for [Heating duration](#), [Cooling duration](#) and [Heating-cooling pause](#) resp. [Cooling-heating pause](#) should correspond to the cycle time (time between 2 pulse). If the sum of the set times is larger than the time between 2 pulse, the actual cycle is aborted and the new cycle starts.

Settings for cycle delay (only for machine actuation cycle H and cycle K)

The delay time between the cycle signal and Start „Vario Heating“ resp. „Vario Cooling“ can be defined by means of [Cycle delay](#). Set the cycle delay as follows:

1. Select model No. "VCn" with  or .
2. Display the menu page [Setting \ Vario](#).
3. Set parameter [Cycle delay](#) to the desired value.



Setting nominal values

Set nominal values as follows:



NOTICE!

The nominal values can only be set with Modul VCn and not with THn or TCn.

1. Select model No. "VCn" with  or .
2. Display menu page **Nominal values**.
3. Set parameter **Nominal Value TH** and **Nominal value TC** to the desired value.

3.4.1 Process monitoring

3.4.2 Limit value monitoring

Function

After each unit start-up, the limit values for process monitoring are automatically determined and set in the standard settings according to the set monitoring level.



NOTICE!

If the limit values have not been set, the operating mode indicator flashes green.

Cancelling monitoring

Monitoring			
No:	All	1	2
Temperature		▶	
Flow rate		▶	
Tool data		▶	
Level		▶	
Monitoring	autom.		
Monitoring level	rough		
Reset monitoring	no		
1	Main line	39.5 °C	Ready to operate
	Pressure	0.4 bar	

If automatic limit value calculation is not desired, make the following setting:

1. Open menu page **Monitoring**.
2. Set parameter **Monitoring** to "manual" or "OFF".



NOTICE!

If monitoring is set to "OFF", the process will not be monitored. This can lead to unnecessary connections.

Fig. 35: Monitoring

Reset monitoring

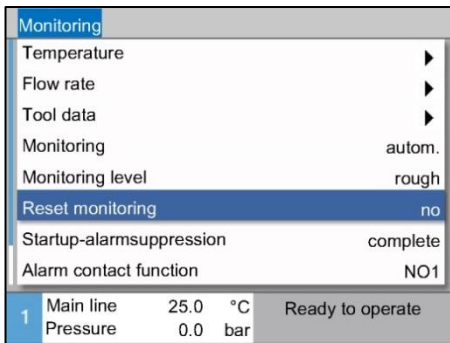


Fig. 36: Reset monitoring

Proceed as follows in order to automatically adjust the limit values during operation:

1. Open menu page **Monitoring**.
2. Set parameter **Reset monitoring** to "yes".
3. Press the key **OK**.



NOTICE!

Limit values that are set to "OFF" will not be adjusted.

Set monitoring level

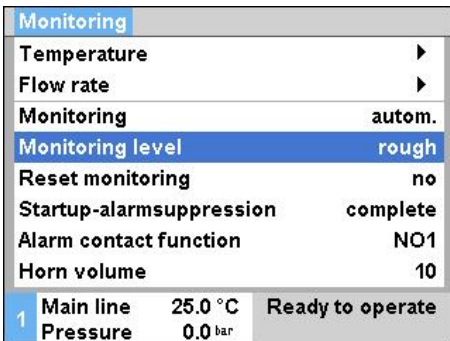


Fig. 37: Monitoring level

The tolerance range is determined with the parameter **Monitoring level** and can be adapted as follows:

1. Display menu page **Monitoring**.
2. Set parameter **Monitoring level** to "fine", "middle" or "rough".

The limit values for temperature and flow rate are calculated according to the following table:

Designation	Monitoring level						Basis
	fine		middle		rough		
	Factor	min	Factor	min	Factor	min	
Upper dev. nominal/actual	1.5	5 K	2	10 K	2.5	20 K	max. deviation during "Vario Cooling"
Lower dev. nominal/actual	1.5	5 K	2	10 K	2.5	20 K	max. deviation during "Vario Heating"
Flow rate internal max.	1.2	-	1.4	-	1.7	-	max. flow rate during "Vario Heating" resp. "Vario Cooling"
Flow rate internal min.	0.8	0.5 L/min	0.6	0.5 L/min	0.3	0.5 L/min	min. flow rate during "Vario Heating" resp. "Vario Cooling"

3.5 Decommissioning



Fig. 38: Basic screen VC1

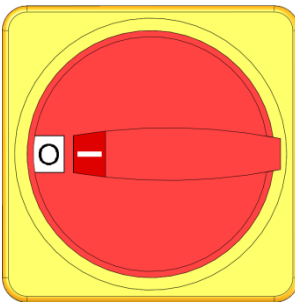


Fig. 39: Main switch

After use, switch the unit off as follows:

1. Select the Module No. with the **[Left Arrow]** or **[Right Arrow]** key.



NOTICE!

The system can be installed under module no. VC_n , TH_n , and TC_n , respectively.

2. Press the **[Power]** key.
 - Cool the associated Thermo-5 units until the flow and return - temperature is less than the set **safety cut-off temperature**.
 - Afterwards, a pressure release is carried out.
 - The associated Thermo-5 devices then switch off. In the operating mode display "OFF" is indicated.
3. Turn all main switches of the associated Thermo-5 and Panel-5 to position "0".
4. Connect the mains plug of the changeover unit to the variothermal temperature control.

3.5.1 Cooling down and switching off

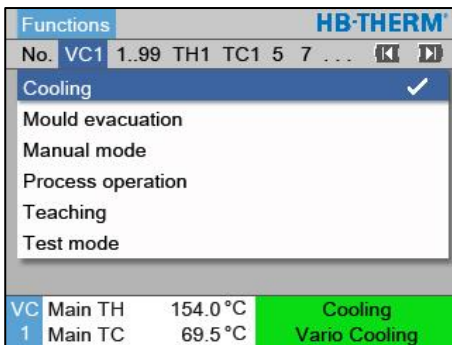


Fig. 40: Switch on cooling

Switch on cooling as follows:

1. To select module no. "VCn", press the **[Left Arrow]** key or the **[Right Arrow]** key.
2. Open the **Functions** menu page.
3. Select the **Cooling** parameter and press the **[OK]** key to activate it.

The activated function is indicated with the **✓** symbol.

 - The switching unit switches to "Vario Cooling" and the associated Thermo-5 units cool down to the set **Cooling temperature**. Then a pressure release is carried out.



NOTICE!

If the **Mould evacuation** function is activated after activating the **Cooling** function, the system carries out a mould evacuation before the system is switched off.

3.5.2 Mould evacuation

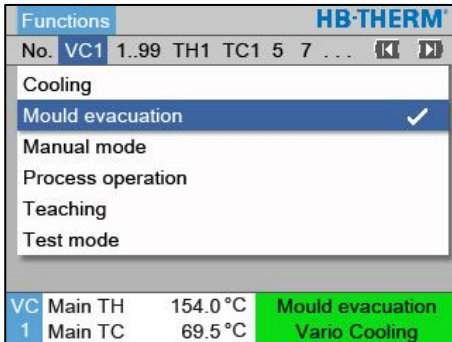


Fig. 41: Switch on mould evacuation

Switch on mould evacuation as follows:

1. To select module no. "VCn", press the key or the key.
2. Open the **Functions** menu page.
3. Select the **Mould evacuation** parameter and press the key.

The ✓ symbol indicates the activated function.

- Before mould evacuation is started, the associated Thermo-5 units are cooled down to 70°C.
- The switching unit switches to "Vario Cooling" and the consumer and feed lines are evacuated by suction and depressurised.
- Finally the system switches off.



NOTICE!

Check pressure for 0 bar before opening connections between switching unit and consumer.

3.6 Recording

Variothermal temperature control is a dynamic process where temperatures change together with the injection moulding process. Recording the temperature over a specific time period helps in assessing the temperature profile. If a temperature sensor is installed on the mould, then the temperature can be visualised for analysis and monitoring purposes.

(on the screen for short-term and on a USB data carrier for long-term)

3.6.1 Recording actual data

Function

When the **Record USB** function is activated, the values selected in **Setting \ Recording USB** are written to the USB data carrier.- A new recording file is created each day. If saving to the USB data carrier is not possible, a corresponding warning is displayed.-

Start recording

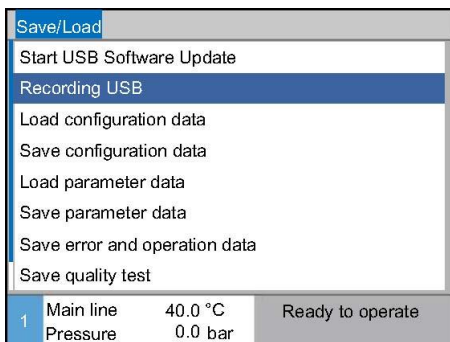


Fig. 42: Recording USB

Proceed as follows to start recording actual data to a USB data carrier:

1. Display menu page **Save/Load**.
2. Connect USB data carrier to front connector.
3. Select the **Recording USB** function and confirm with the **OK** key.

The function activated is indicated with the symbol.

→ The data is saved to the USB data carrier.

→ The active Recording USB is indicated with the symbol on the basic display.

Stop recording

Proceed as follows to stop an active recording:

1. Display menu page **Save/Load**.
 2. Select the **Recording USB** function and confirm with the **OK** key.
- The USB data carrier can be removed.

Set recording interval

Proceed as follows to set the recording interval:

1. Display the menu page **Settings \ Recording USB**
2. Set parameter **Cycle serial recording** to the desired value.



NOTICE!

If the desired recording interval is not possible, recording will be made at the fastest possible interval.

Select values

Proceed as follows to choose the values to be recorded:

1. Display the menu page **Settings \ Recording USB**
2. Select the desired value and confirm with the **OK** key.
The active value is indicated with the **✓** symbol.



NOTICE!

You may choose as many values as you like.

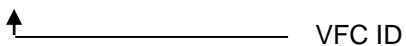


NOTICE!

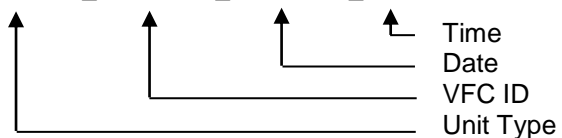
When the **Recording USB** function is activated and/or deactivated at module no. **VCn**, recording for **THn** and **TCn** is also activated and/or deactivated.

File name

For each unit, a separate directory is created on the USB storage medium into which the recording files are written.

Exa. **HB_Data_00001234**


The unit automatically creates file names on the USB storage medium according to the following examples:

Exa. **HBVC180_00001234_20100215_165327.csv**




NOTICE!

For VFC-ID, refer to **Display \ Variothermal system**.

Visualize the data recorded

To visualize and prepare the actual data recorded, the VIP (Visualisation programme – Recording of actual values) software can be downloaded from www.hb-therm.ch.