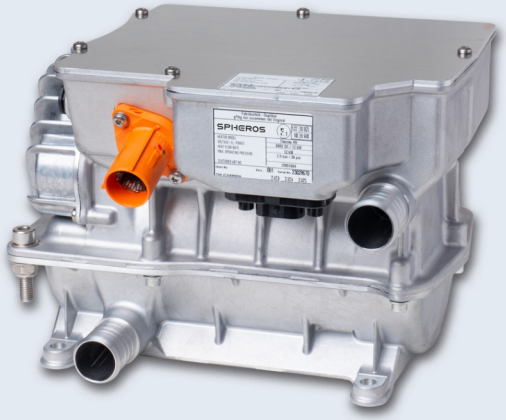


HEATING SYSTEMS

THERMO HV

Installation, operating and maintenance instructions

Rev. 12/2024
Id.No. 11145926B

SPHEROS

Table of contents

1 Introduction

1.1. Content and purpose

These installation instructions are used to install the following water heaters, hereinafter referred to as heaters:

– Thermo HV

1.2. Target audience

Work on the heater may only be carried out by Spheros trained and / or instructed personnel.

You can find the current training courses at www.Spheros.com/Service/Downloads.

1.3. Validity of the document

In the case of a multilingual version, German is binding. We reserve the right to make changes.

The current versions of this document and other special documentation can be found in the download center under www.spheros.com.

1.4. Definition of warning notices

In this document, certain contents are emphasized by special writing and layout styles. The following examples show the implementation in the document.

Warning!	**Danger to life and health!**

Points to a dangerous situation which, if not avoided, can result in death or serious injuries.

Caution!	**Health hazard!**

Points to a dangerous situation which, if not avoided, can lead to minor or moderate injuries.

ATTENTION:
Points to actions that can lead to property damage.

NOTE: Indicates something special.

1.5. Definition of symbols

Tightening torque

Identifies parts (e.g. screws) that must be fitted with a torque wrench. The torque values can be found on the symbol and are binding.

2 The fully electric heater Thermo HV

2.1. Description and function

Figure 1, on the right, gives an overview of the heater, its connections to the cooling and electrical systems of the vehicle.

Figure 2 shows the most important dimensions.

Water enters the heater via the water inlet connection, flows around an electrical heating coil and then leaves the heater via the water outlet connection and is warmed up.

The power electronics are housed in the upper part of the heater. It regulates the electrical high voltage fed in according to the heat demand and makes it available to the heating coil.

The heater is controlled via a CAN bus interface.

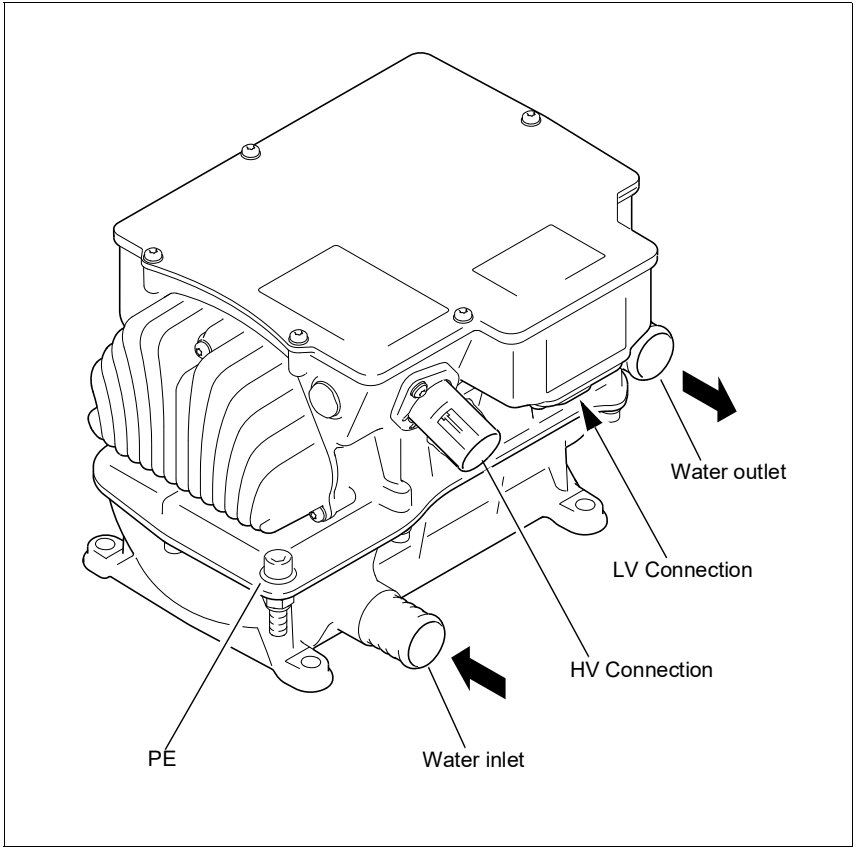


Bild 1: Heater overview

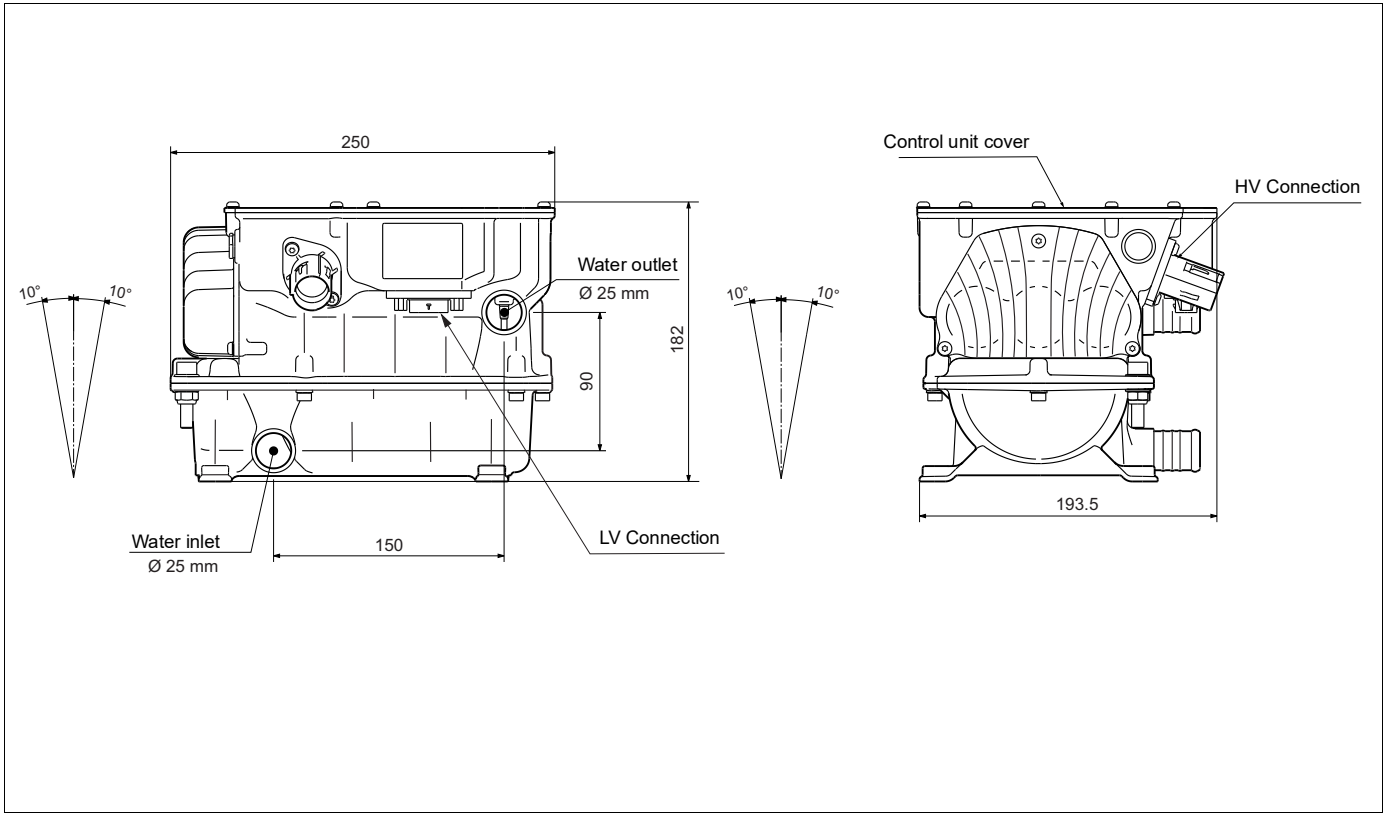


Bild 2: Heater dimensions

2.2. Technical data

Heater		Thermo HV		
Ident. no.		11139431	11148275	11149288
Kind of construction		Fully electric heater		
Ambient temperature during operation	°C	-40 … +100		
Storage temperature	°C	-40 … +100		
Operating overpressure	bar	max. 2.5		
Capacity of the heat exchanger	l	approx. 1.8		
Minimum water flow	l/h	> 1000		
Antifreeze ratio in the cooling system	%	30 thru 60		
Max. operation altitude	m	3000		
Heater dimensions (tolerance +-3 mm)	mm	Length: 249 Width: 183 Height: ca. 170		
Water outlet / inlet outer diameter	mm	25		
Weight	kg	<5		

Unless limit values are given, the technical data is understood to be subject to the usual tolerances for heating appliances of +/-10% at an ambient temperature of +20 °C and at nominal voltage.

NOTE:
The allocation of the circulation pumps to the heating appliances must be carried out according to the upstream resistances and the minimum flow rate.

Heater (electrical system)		Thermo HV		
Ident. no.		11139431	11148275	11149288
Nominal heating power (heating flow)	kW	12		
Nominal voltage	VDC	600		
Nominal power consumption	kW	12		
Max. current RMS	A	20		
Operating voltage range HV acc. ISO 21498	VDC	450 - 850		
Max. ripple DDT (per device)	%	<5		
Min. cross section HV supply cable	mm²	4		
Insulation resistance at 1000V	MΩ	100		
IP rating	-	67 / 6k9k		
LV protection (24V network)	A	max. 5		
CAN baud rate	kbaud	250		500
Rated HVIL current	mA	15	15* / --**	500
max. HVIL current	mA	100	100* / 650**	100
max. HVIL short-circuit current	mA	100	100* / 1300 for 1 s**	100
max. HVIL loop resistance	mΩ	--	--* / 200**	--

* for 11148275 with index A ** for 11148275 with index B or higher

ATTENTION:
An HV fuse must be integrated in accordance with the HV vehicle electrical system. The fuse value is to be determined depending on the highest operating current and the temperature derating of the fuse.

2.3. Usage

The heater can be used in electric driven vehicles or hybrid vehicles where a 600 VDC power supply is provided, in association with the vehicle‘s own heating system:

– to heat the passenger cabin, and
– for pre-heating.

The heater may only be installed and operated in vehicles of the class **M2, M3, N2, N3, O3, O4.**

Any use beyond is not permitted.

The heaters operate independently of the vehicle engine and are connected to the vehicle’s cooling and electrical systems.

 **Warning!**	**Danger to life and health!**

The heater is not approved for use in vehicles carrying dangerous goods according to Annex 9 of the UN/ECE Regulation R122.

3 Safety instructions and regulations

The general accident pevention provisions and the valid industrial safety directions must be adhered to.

"General Safety Regulations" and "Statutory regulations for installation" which exceed the frame-work of these provisions are listed below.

3.1. General safety instructions

3.1.1. Installation and maintenance

Warning!	**High voltage! Danger to life!**

Electrical work may only be performed by a qualified electrician for HV systems in motor vehicles, craftsman, activity with repetitive character. Training acc. to DGUV-I 209-093.

NOTE:
The provisions of these Regulations are binding within the territory governed by DGUV Regulations and should similarly be observed in countries without specific regulations.
Country specific rules / standards are to be considered additionally.

Installation, maintenance and repairs may only be carried out when the vehicle's engine is not running and the high voltage supply is switched off.

Before starting the work at the heater, it is to make voltageless acc. to DIN VDE 0105-100 and this state must be ensured for the duration of the work.

The following safety precautions must be observed:

- **switch off the power supply to the heater**
- **ensure it cannot be switched on again**
- **verify, system is voltage-free, all poles**
- **ground and short circuit (the de-energized circuit)**
- **cover or block neighbouring parts under voltage**

Electrical cables and operating elements of the heater must be arranged in the vehicle in such a way that their functioning is faultless under normal operating conditions and cannot be hampered.

Work at electrical equipment may only be started if protective measures against electric shock, short circuits and arcing faults have been carried out.

3.1.2. Operation

See 5.

3.2. Statutory regulations governing installation

For the heater exists a type approval according to the ECE Regulations
R10 (EMC)No. 06 9480 and
R122 (Heater)No. 00 0625.

Installation is governed above all by the provisions in Annex 7 of the ECE Regulation R122. In addition, the electrical safety requirements of ECE Regulation R100 are to be observed.

NOTE: The provisions of these Regulations are binding within the territory governed by ECE Regulations and should similarly be observed in countries without specific regulations!

Extract from ECE Regulation R122, Annex 7:

4 The heater must have a manufacturer's label showing the manufacturer's name, the model number and type together with its rated output in kilowatts. The operating voltage and the electric power must also be stated.

7.1 A clearly visible tell-tale in the operator's field of view shall inform when the heater is switched on or off.

Extract from ECE Regulation R122, Part I:

5.3 Installation Requirements for Combustion Heaters and Electrical Heaters into Vehicles

5.3.1 Scope

5.3.1.1 Subject to paragraph 5.3.1.2., heaters shall be installed according to the requirements of paragraph 5.3.

5.3.2 Positioning of combustion heater

5.3.2.1 Body sections and any other components in the vicinity of the heater must be protected from excessive heat and the possibility of fuel or oil contamination.

5.3.2.2 The heater shall not constitute a risk of fire, even in the case of overheating. This requirement shall be deemed to be met if the installation ensures an adequate distance to all parts and suitable ventilation, by the use of fire resistant materials or by the use of heat shields.

5.3.2.3 In the case of M2 and M3 vehicles, the heater must not be positioned in the passenger compartment. However, an installation in an effectively sealed envelope which also complies with the conditions in paragraph 5.3.2.2 may be used.

5.3.2.4 The label referred to in Annex 7, paragraph 4 or a duplicate, must be positioned so that it can be easily read when the heater is installed in the vehicle.

5.3.2.5 Every reasonable precaution should be taken in positioning the heater to minimize the risk of injury and damage to personal property.

5.3.6 Heating air inlet

not applicable

5.3.7 Heating air outlet

not applicable

Applicable local regulations, laws and standards for electrical installations, in particular the provisions of ECE Regulation R100 are to be observed by the vehicle manufacturer and should be appropriately implemented.

ATTENTION:
Failure to follow the installation instructions and the notes contained therein will lead to all liability being refused by Spheros.

3.3. Model plate

The model plate must be protected from damage and must be clearly legible when the heater is installed (otherwise a duplicate model plate must be used).

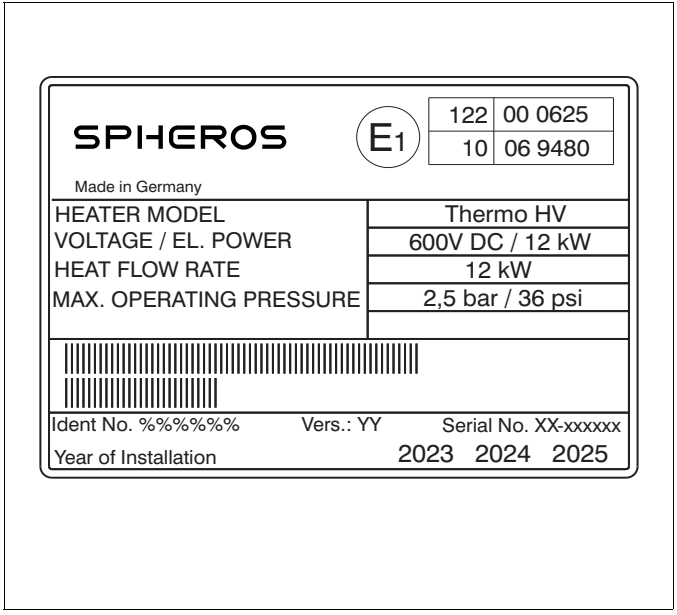


Bild 3: Model plate (example)

NOTE: The year of the initial operation must be durably marked by removing the year numbers that are not applicable.

4 Heater Installation

4.1. Installation in the vehicle

ATTENTION:

- **The statutory regulations governing the installation must be adhered.**
- **Heaters and circulating pumps shall be always installed in such a way that a negative impact by road dirt, splashing water, exhaust gases or other harmful influences is excluded.**

Caution!	**Risk of scalds and burns!**

The cooling water and the components of the cooling water circuit achieve high temperatures.

- **Coolant carrying parts are to be routed and fastened in such a manner that no temperature risk to humans, animals or material sensitive to temperature due to radiation / contact occurs.**
- **Before working on the cooling water circuit, switch off the heater and wait until all parts are cooled down, if necessary wear protective gloves.**

Installation location

Attention should be paid to the particular location conditions of the specific vehicle type.
The heater and the circulation pump are integrated into the cooling system (or into a separate heating circuit). Both should be installed below the minimum water level of the cooling circuit so that bleeding of the heater and the circulation pump is automatically assured. This is particularly important since the circulation pump is not self-priming.
If the heating appliance and the circulation pump can not be accommodated in the engine room of the vehicle, they can be installed in a sealed housing. This housing must be adequately ventilated from the outside, so that a maximum temperature of +100 °C inside is not exceeded.

NOTE:
Due to the resulting temperatures on the surface of the heater, it is recommended to keep a distance of 10 cm to other components.

Installation position

NOTE:
The heater is approved for horizontal installation only.

The dimensions of the heater and the permitted installation positions, can be found in figure 2.

Heater attachment

The heater is screwed at a suitable point onto the structure of the vehicle with 4 M8 bolts and suitable washers (hole pattern see figure 4).

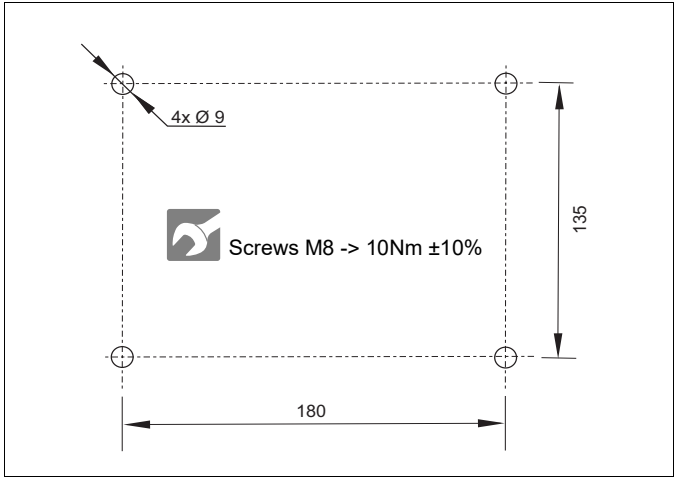


Bild 4: Hole pattern

4.2. Connection to the vehicle cooling system

The heater is to be connected to the vehicle cooling system in accordance with Figures 1 and 2. The heater must be installed below the minimum water level of the cooling circuit.

In the vehicle cooling system, or in a separate heating circuit, only pressure control valves with an opening pressure of min. 0.4 bar and max. 2.5 bar may be used.

The heater may only be put into operation bleeded and with a sufficient volume flow. If this is not adhered, this can lead to a pre-existing defect and to a reduction of the service life of the heater.

The amount of coolant in the circuit must be designed in such a way that the heat provided can be removed. Minimum flow see Cha. 2.2.Technical data.

NOTE:
Coolant is made up of water and antifreeze. The portion of anti-freeze must be at least 30%. Heaters may only be operated with an anti-freeze agent approved by Spheros.
You can find the antifreeze agents approved by Spheros at www.Spheros.com/Service/Technical-Updates-TI/Heating-Systems.

4.2.1. Coolant hoses

Basically the water hoses supplied by Spheros should be used. Hoses from a third party manufacturer must at least comply with DIN 73411.

To ensure proper ventilation of the heater, lay the hoses so that they are free of kinks and rise.

Hose connections must be secured against slipping off by means of hose clamps.

NOTE:
The tightening torques of the hose clamps used must be observed. After 2 hrs. heater operation / 100 km distance traveled, the hose clamps schould be retightened.

4.2.2. Bleeding of the cooling system

ATTENTION:
If air bubbles are present, they could cause destruction of the cartridge heaters!
Bleed the cooling system without usage of the circulating pump.

- **Before commissioning the heater**
- **After renewing the coolant**

Proper bleeding action can be recognised by the nearly silent operation of the circulating pump. Insufficient bleeding during heater operation can result to tripping of the temperature limiter.

4.3. Installation of the circulating pump

Install the circulation pump in such a way that its function is not impaired by external influences. External influences are e.g. road dirt, splash water and exhaust gases.

NOTE:
Spheros heaters and circulation pumps are designed to work optimal together. Approval by Spheros is required when using circulation pumps from third parties.

4.3.1. Versions

The following circulating pumps 24V are available:

- Aquavent 5000 (U4814)
- Aquavent 5000S (U4854)
- Aquavent 6000C (U4855)
- Aquavent 6000SC (U4856)
- SPump

4.3.2. Documentation to be used

For information on the correct installation, operation and maintenance of the circulation pump, use the following documents:

- Installation Instructions Aquavent Pumps
- Installation Instructions SPump S120
- Installation Instructions SPump 260 and 500

The current versions of these documents can be found at www.Spheros.com/Service/Downloads/Pumps.

Information about these pumps and their installation you find in the download center under www.Spheros.com.

4.3.3. Installation location

The circulation pump is connected to the cooling system and the electrical system of the vehicle.
The circulation pump is installed as deep as possible so that an automatic ventilation is guaranteed.

NOTE:
Spheros circulation pumps do not self prime coolant.

4.3.4. Installation position

For installation, note the installation positions according to the information in the above mentioned documentation.

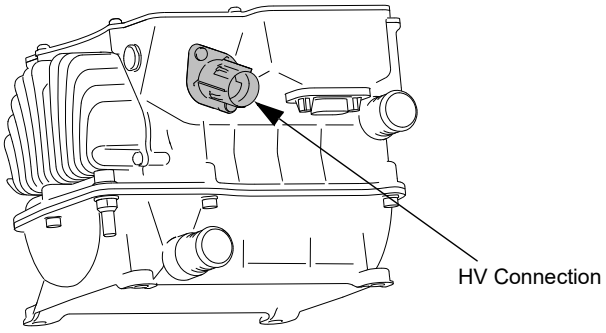
NOTE:
Pump ports and lines from the water inlet and outlet must run in a straight line. Ensure tension-free installation.

ATTENTION:
If the pump is not controlled by the heater, its operation is to be ensured by all means during whole heater operation (initial cycle, heating operation and purge cycle). At least turn on the Thermo HV and pump at the same time, but ensure the operation of the pump by an appropriate control circuit at least 30 s after switching-off the heater.

4.4. Electrical hook-up

The heater is connected via a high-voltage connector and a low-voltage connector. Additional potential equalization is required.

High-voltage connection



HV Connector

Bild 5:

HV Connector Mating connector customer	
Connector	HPS40-2 HCT4 2+2 coding A
Connection heater	**Pin**
1	HV +
2	HV -
3*	HVIL +
4*	HVIL -

Cable cross-section minimum 4 mm², maximum 6 mm²

NOTE:
For detailed information on the connector, see processing specification HIRSCMANN PowerStar 40-2 HCT4.

The HIRSCMANN HPS40-2 connector operating instructions contain information on operating the connector (plugging and unplugging).

*** NOTE:**
Pins 3 and 4 of the vehicle connector must be directly short-circuited. Continuing the HVIL circuit is not permitted and strictly prohibited.

Low-Voltage connection

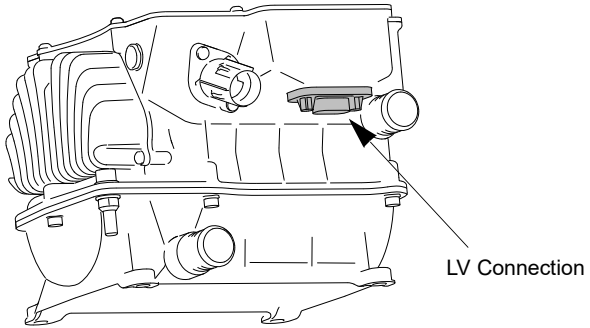


Bild 6:

LV Connector Mating connector customer	
Connector	805-031-551 with CPA (double locked) 805-031-541 w/o CPA (simply locked)
Contact	967067-1 (for cross-section 0.5 - 0.75 mm²)
Connection heater	**Pin**
1	CAN ADDR2
2	CAN ADDR1
3	HVIL IN
4	HVIL OUT
5	T. 30
6	T. 31
7	CAN H
8	CAN L

Heater start and addressing

Sequence for every heater start:

1. Apply LV power
2. Wakeup via CAN
3. Apply HV power

CAN adressing:

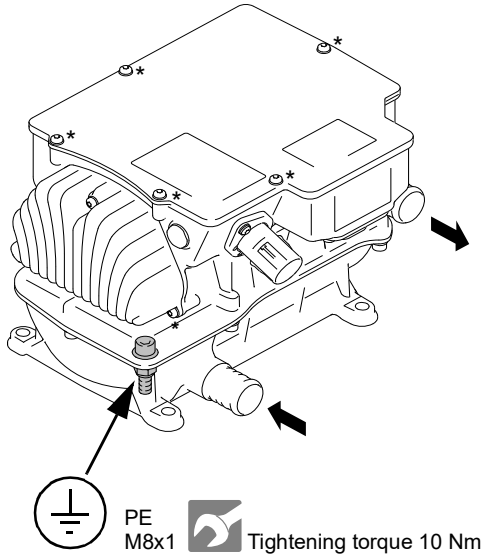
Heater No.	CAN ADDR2 Connection 1 signal status	CAN ADDR1 Connection 2 signal status
1	open	open
2	open	GND
3	GND	open
4	GND	GND

Terminal 31 can also be used to ground the addressing pin.

CAN integration according to: "External CAN Interface - Customer"

Potential equalization (PE)

A grounding cable with the dimensions of the HV cable, at least 1x4 mm² Cu, is to be connected to the marked and approved position on the housing. For that a ring cable lug and a M8x1 potential equalization screw are to be used.



* PE connection: do not remove!

Bild 7:

Overcurrent protection / insulation monitoring device

ATTENTION:
The power supply circuit is to be protected through an all pole overcurrent protection device.

If the overcurrent device has been triggered, the heater is to be switched off. It is essential that the cause is identified and the error rectified by a qualified electrician in a specialised workshop. Only then the heating appliance can be reconnected to the mains.

The use of overcurrent protection devices with another as specified load ability is not permitted and will result in loss of the operating approval!

ATTENTION:
Pre-charging of DC-link capacitors (C_x = 6 uF):
The heater is not equipped with an internal pre-charging circuit for the DC-link capacitors.
When applying high-voltage to the heater, the inrush current must be limited by using a sufficient pre-charging circuit on the vehicle side in order to avoid damage to the heater or blow the protective fuses.

Warning!	**High voltage! Danger to life!**

The heater must be protected on the vehicle side with all poles by an insulation monitoring device (tripping resistance 0.5 MΩ) against fault currents.
If the Thermo HV is monitored as a subcomponent of the BUS system, the value can be adapted according to the applicable statutory requirements.

The connecting schematic of the insulation monitoring device is shown in figure 8 (for example if monitoring the stand alone device).
The specified for the fasteners torque value must be met.

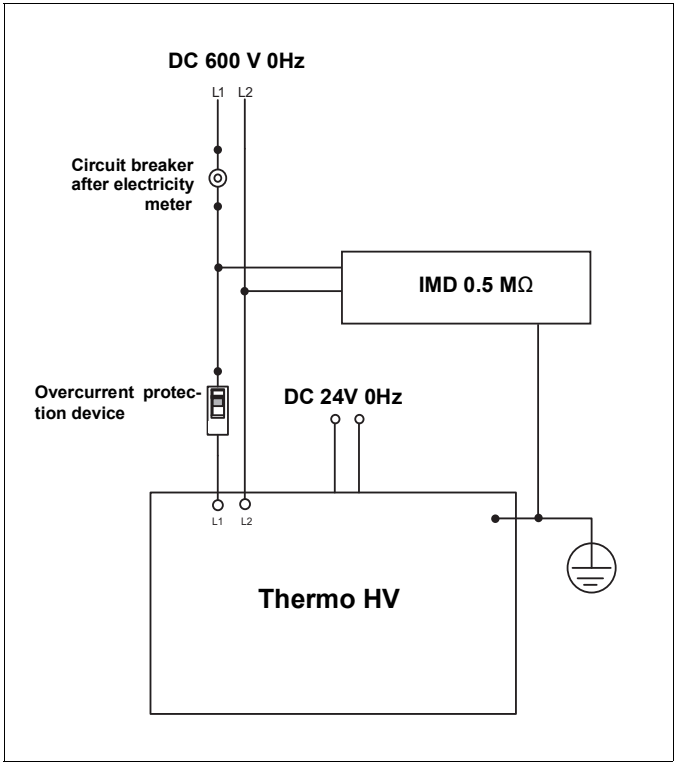


Figure 8:Hook-up schematic

5 Operation

5.1. Safety hints for operation

ATTENTION:

- **The heater is only to be used in accordance with 2.3. Any other use of the heater or any use going beyond that is to be assessed as not intended use. The manufacturer / supplier is not responsible for damage resulting from not intended use. The user then bears the risk himself.**
- **The heater is only to be used in closed heating systems of vehicles to heat up the coolant.**
- **The heater must not be operated at temperatures above +100 °C.**
- **It must not be operated unattended for a longer period in the depot. The circulation pump, the cooling water circuit and its temperature must be monitored. In the event of any malfunction, the heater must be switched off immediately.**

The content of anti-freeze in the cooling circuit can be found in the technical data.

5.2. Operation / control

The heater is controlled as part of the vehicle's own climate control system using appropriate CAN bus commands.

The required CAN commands are described in the SG1592HV_Device_Specification.

The circulation pump must also be included in this control.

6 Maintenance

6.1. General maintenance information

TBD

6.2. Maintenance schedule

In order to guarantee the safety and operation of the heater at all times, the heater is subject to periodic maintenance.

The maintenance schedule can be found in the download center under www.spheros.com.

 **Warning!**	**High voltage!** **Danger to life!**

The safety instructions preceding the maintenance schedule must be observed.

6.3. Spare parts and accessories

ATTENTION:

1. **A replacement of components in the Thermo HV is not permitted (This may only be carried out by appropriately trained Spheros employees).**
2. **The error memory must be read out during commissioning/ recommissioning.**

Available spare parts and accessories for the Thermo HV heater are included in a list in the appendix A.

Annex / Anhang

Spare parts list / Ersatzteilliste

Item Pos.	Quantity Stück	Part no. Bestell-Nr.	Designation	Benennung	Remarks Bemerkungen
Heater / Heizgerät					
1	1	11139431A	**Thermo HV 120.001**	Thermo HV 120.001	
2	1	11120074A	**warning placard HV**	Warnschild HV	
3	1	11116438B	**placard “grounding“**	Hinweisschild „Erdung“	
4	x	11116557A	**cylinder head screw M8x35**	Zylinderschraube M8x35	for PE connection für PE-Anschluss
5	x	11120897A	**toothed washer**	Zahnscheibe	
6	x	11143884A	**nut M8**	Mutter M8	

x - quantity as required / Anzahl wie erforderlich

memos

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