AIR CONDITIONING

REVO®-E
VOLVO

Workshop Manual

Rev. 08/2016
Id.No. 11123006A

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1 Introduction

1.1 Content and purpose

This workshop handbook is for repairs and maintenance purposes of the rooftop air-conditioning system REVO-E (subsequently referred to as the air-conditioning system).

Warning!	**Potential risk to health and life!**

Work on the air-conditioning system is only to be conducted by personnel who are qualified pursuant to DGUV Information 200-005 (old BGI 8686) or, outside of the German market, by personnel who are instructed/trained according to corresponding local regulations.

The required qualifications differ depending on the content and scope of the work on the air-conditioning system. See point 1.6.1 below.

1.2 Validity of the workshop handbook

This workshop handbook is valid for all of the air-conditioning systems listed on the cover page.
It may be subject to changes and addenda. The currently valid version is binding. These are found on the Spheros homepage in the Service / Technical Documents area.

1.3 Meaning of emphasis

In this handbook, the emphases of Warning!, Caution!, ATTENTION: and NOTE: mean the following:

Warning!	**Potential risk to health and life!**

This heading is used when improperly following or not following instructions or processes can lead to serious injuries or fatal accidents.

Caution!	**Hazardous to health!**

This heading is used when improperly following or not following instructions or processes can lead to minor injuries.

ATTENTION:

Indicates procedures which may lead to material damage.

NOTE:

Is used when something is to be emphasized.

1.4 Symbols

Symbol of tightening torque:
Used in graphics, indicates parts (e.g. lock nuts, screws) that must be attached with a certain tightening torque. The values of the tightening torque are found in the torque table in Attachment A and are binding.

1.5 Additional documentation to be used

The use of additional servicing literature is required. This is indicated in the workshop manual in the corresponding location.
Use the following documents when operating and servicing the air-conditioning system:

- Installation instructions for the REVO-E
- Evacuation and filling instructions for the REVO-E
- Maintenance and service plan for the REVO-E
- Spare parts list for the REVO-E
- Technical information (TI)

This servicing literature is also available for download at www.spheros.eu/Service/Downloads/Air-Conditioning.

1.6 Safety information and condition

The air-conditioning system was designed and produced according to EC directives. The system is safe to operate if properly installed and used
in accordance with the installation, operation and servicing instruction.
Nonobservance of the servicing literature listed under 1.5 and the instructions included within excludes Spheros from liability.
Always observe the general accident prevention regulations. The “general safety conditions” beyond the framework of these regulations are listed below.

1.6.1 General safety information

Required qualifications

Warning!	High voltage! Caution Mortal danger!

To work on the refrigeration section of the air-conditioning system, proof of both of the following qualifications is required:

– electrically qualified person (EQP)
  EQP: Trained in non-electrical work on/near high-voltage systems, knows the dangers, does not work independently (supervision and controls), trained according to DGUV 200-005 (old BGI 8686)
– Specialists trained in refrigeration technology with certificate of competence pursuant to Directive (EC) no. 307/2008

To work on the high-voltage section of the air-conditioning system, proof of both of the following qualifications is required:

– Electrician for HV systems in powered vehicles Vocational education, job of repeating character, training pursuant to DGUV 200-005 (old BGI 8686)
– Specialists trained in refrigeration technology with certificate of competence pursuant to Directive (EC) no. 307/2008

NOTE:

The conditions of these rules are valid within the jurisdiction of DGUV (German Social Accident Insurance) and must be followed even in countries without special provisions.

Know and follow the operating and servicing instruction for the systems, tools and aids used as well as their accompanying safety information from the manufacturer when evacuating and filling the air-conditioning system.

Working on the bus roof

Warning!	Danger of serious injury or death by falling!

When working on the bus roof or hydraulic lifts, scaffolding, etc, take suitable measures to prevent falling.

1.6.2 Working with high-voltage air-conditioning systems

Warning!	High voltage! Caution Mortal danger!

Only conduct installation, maintenance and repair work if the motor is still and the 24V DC power supply as well as the high-voltage has been switched off.

Before starting work on the air-conditioning system, ensure that the system is voltage-free and make sure it remains so for the duration of the work.

In certain cases, the following safety rules must be followed:

– **make the system voltage-free**
– **ensure that the system cannot be reactivated**
– **check whether the system is voltage-free**
– **ground and short-circuit**
– **cover or block off neighboring voltage-carrying parts**

Electrical work may only commence if protective measures against electrical shock, short-circuits and electric arcs have been taken.

1.6.3 Working with refrigerants

Caution!	Hazardous to health!

Observe EN 378 when working on cooling systems. There is an info data sheet or material sheet (available from manufacturer) for each refrigerant as well as the general information from professional organizations within the chemical industry.

Certain conditions apply, that must be maintained, for the safe and proper use of refrigerants:

– Wear protective eye wear when working with refrigerants. If a refrigerant gets into the eye, serious frostbite damage may occur. Thoroughly rinse the eyes with water immediately and seek medical attention.
– Wear protective gloves when working with refrigerants. Liquids refrigerant is not to come into contact with the skin. The hands must be protected from frostbite (leaking R 134a condenses at -26.5°C) and from erosion to the skin's protective layer (refrigerants dissolve fat)! If a refrigerant comes into contact with the skin, thoroughly rinse the point of contact with water immediately and seek medical attention.

Warning!	Potential risk to health and life!

- There is a possible risk of suffocation if the refrigerant leaks into the atmosphere. Refrigerants are heavier than air. At and beyond a concentration of approx. 12% in the air, there will not be sufficient oxygen to breathe. Loss of consciousness and increased cardiovascular problems caused by stress and lack of oxygen will result. This is a fatal hazard!
- It is forbidden to smoke when handling refrigerants. A burning cigarette can break the refrigerant down. Poisonous substances will form as a result.
- Before welding and soldering cooling systems, the cooling system must be completely evacuated and any residue removed by blowing in nitrogen. If exposed to heat, refrigerants will release products of decomposition that are not hazardous but can also cause corrosion.
- Nonflammable refrigerants also pose a fire risk via the ignition of displaced oil residue and insulating material as well as the oil mist caused by strong leakages.

1.6.4 Working with pressurized containers

Warning!	Potential risk to health and life!

- Ensure that the container does not fall over or roll away
- Do not throw the container. If struck, the containers may be so deformed that they rupture. Considerable forces are let free if the heat exchanger is suddenly struck and refrigerants leak out. The same applies if cylinder valves break. Therefore, the cylinders are only to be transported with protective cap.
- Refrigerant cylinders are not to be kept near heating units. Higher temperatures mean higher pressures, which may lead to the container exceeding its maximum allowed pressure. The rules for pressurized containers stipulate that containers are not to be warmed beyond 50 °C.
- Never warm refrigerant cylinders with an open flame. The material may become damaged from the excessive temperature, resulting in decomposition of the refrigerant.
- Close empty containers to prevent the entry of moisture.
- Never overfill refrigerant cylinders, since an increase in temperature can lead to enormous pressures.

1.6.5 Technical rules for pressurized gases (TRG)

The applicable rules for the manufacturer and workshop are listed in the Technical Rules for Pressurized Gases (TRG). Personnel who conducted maintenance and repair work on the air-conditioning system must know and follow these rules.

1.6.6 Waste and residual materials

The valid legal conditions and regulations, that concern waste disposal as well as how to process residual material, must be followed.

Disposing of refrigerant and refrigerator oil

The refrigerants to be disposed of are to be placed into the labeled recycling containers, taking into consideration the present fill level.
Used refrigerator oils from systems with halogenated hydrocarbons must be disposed of as special waste. It is forbidden to mix these with other oils or substances.
Follow country-specific guidelines for proper storage and disposal.

1.7 Suggestions for improvement and change

Please refer any complaints, suggestions for improvement or change for this manual to:

service@spheros.de

1.8 Abbreviations

Abbreviations	DE	EN	Explanation
HVAC	Heizen/ Lüften/ Klima	Heating/ Ventilation/ Air-Conditioning	
BEA (el.)		Body Electrical Architecture	electronic regulations of the passenger compartment
PTC	positiver Temperaturkoeffizient	Positive Temperature Coefficient	
HVIL		High Voltage Interlock Loop	safety loop for high-voltage systems
GH		Global Hybrid	chassis application
EU6	Euro 6	Euro 6	
n.i.O. / NOK	nich in Ordnung	not in working order	
i.O. / OK	in Ordnung	in working order	
V DC	Gleichspannung	Volts Direct Current	
V AC	Wechselspannung	Volts Alternating Current	
PE		Protection Earth	safety earthing

2 Technical specifications

The technical specifications, provided that there are no limit values given, comply with the standard tolerances for air-conditioning systems of ±10% for an ambient temperature of +20° C and nominal voltage.

Table 201 Technical specifications

REVO-E		Solo	Articulated bus [1)]
Refrigerating capacity (T_{CL1}=35°C, T_{UL1}=40°C)(kW)		25	31
Air flow volume (m^3/h)		6,960	13,920
Heating capacity (kW)		40	80
Power consumption (24V DC)	maximum (all 100%)	85A	140A
	nominal (condenser 80%, heat exchanger 70%)	55A	90A
	regulated (the temperature in the passenger compartment is at the set point)	11A	17A
Power consumption (600V DC)	maximum (compressor speed at 50Hz)	22A	
	regulated (the temperature in the passenger compartment is at the set point of 25°C - external temperature 35°C)	9A	11A
Weight (kg)		258	258 + 118
Dimensions LxWxH (mm)		2,800 x 2,091 x 406	Master system: 2,800 x 2,091 x 406 Slave system: 2,600 x 2,077 x 210
Refrigerant		R134A	
Fill level without front box (kg)		4.5	7
Fill level with front box (kg)		5.5	-

[1)] For articulated buses, REVO-E of rear section/ REVO heat exchanger unit of front section

3 Description of assemblies and components

This chapter provides an overview of the design and function of the air-conditioning system and its individual assemblies / components.

- Overview of REVO-E versions on the Volvo Hybrid Bus
- Full overview of the design and components of the REVO-E
- Design / task and function of the assemblies

3.1 REVO-E versions on the Volvo Hybrid Bus

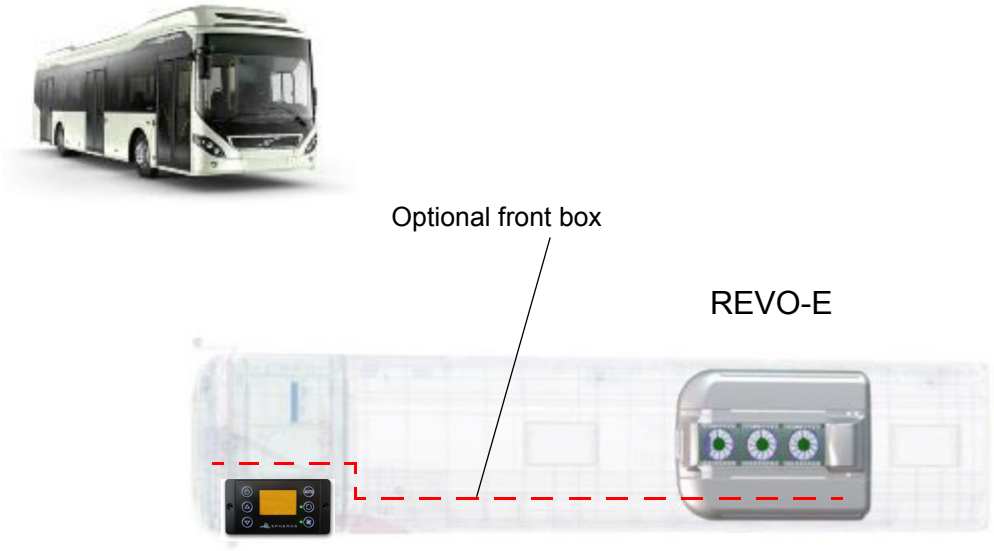


Fig. 1 Single bus systems

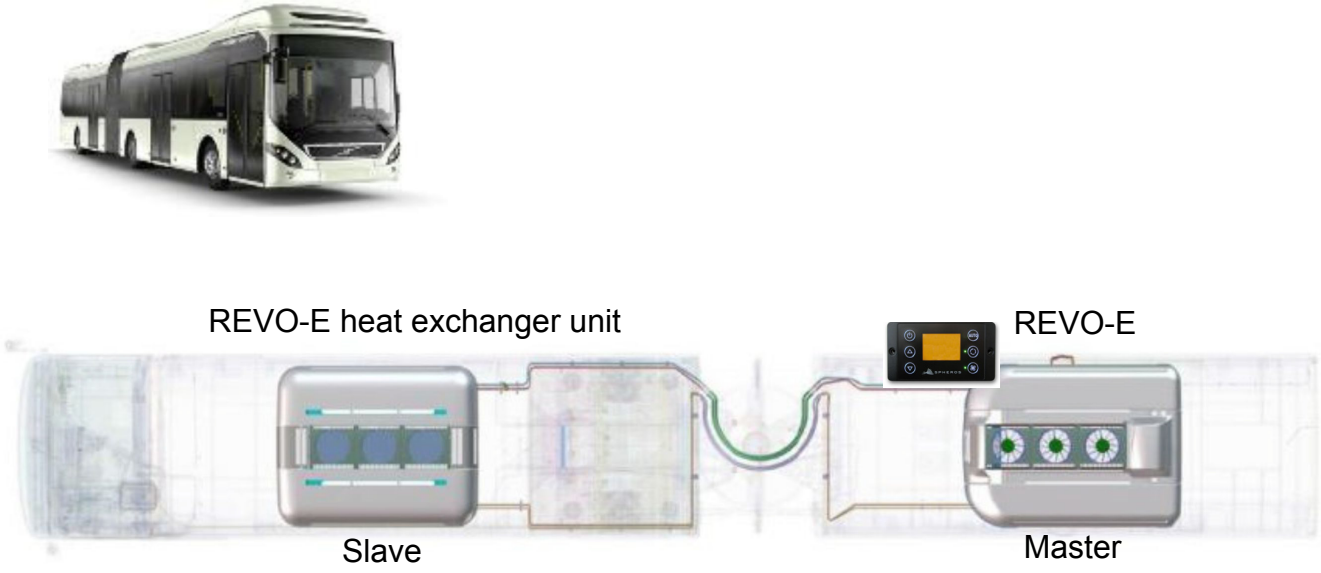


Fig. 2 Articulated bus systems

3.2 Total overview of the design and components of the REVO-E

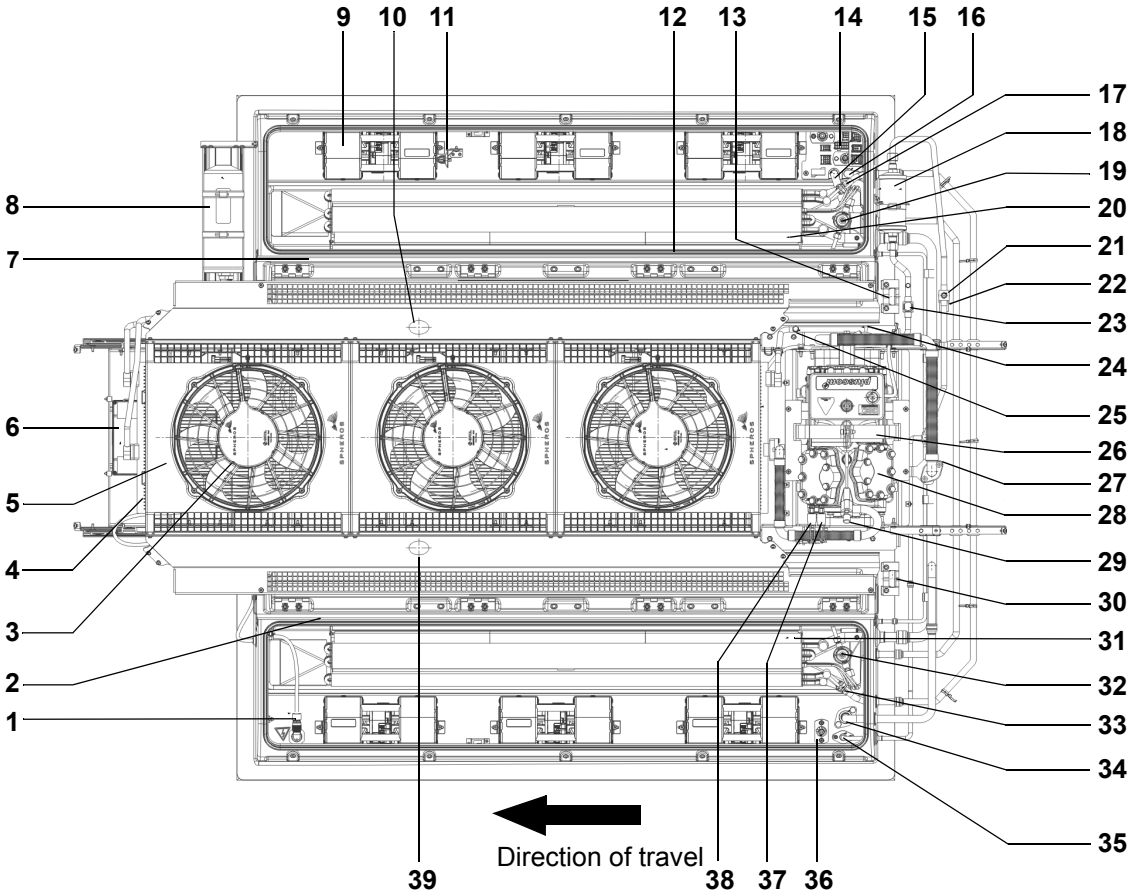
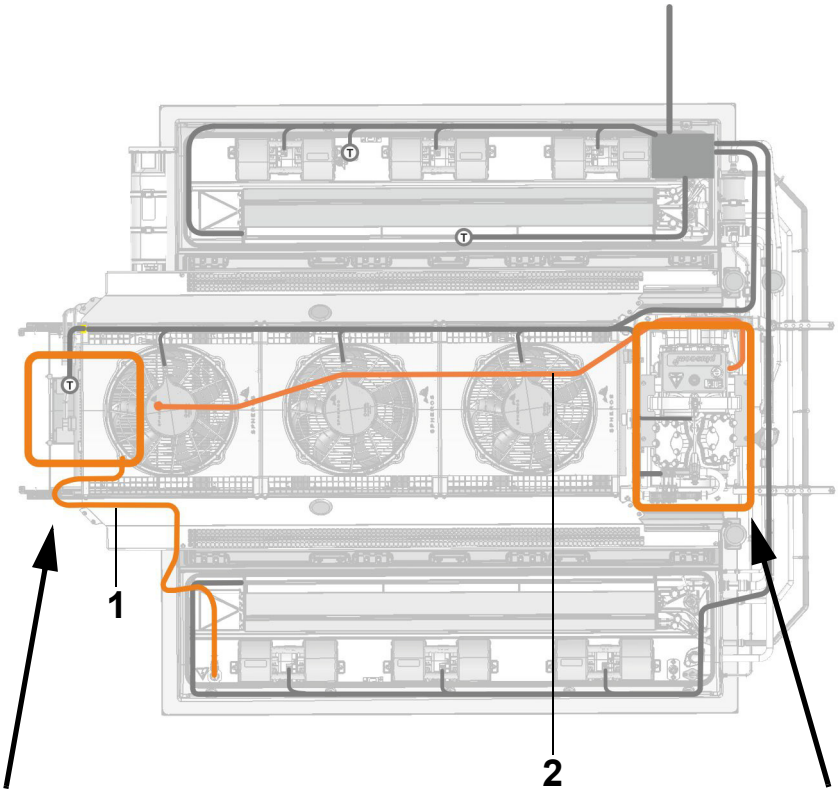
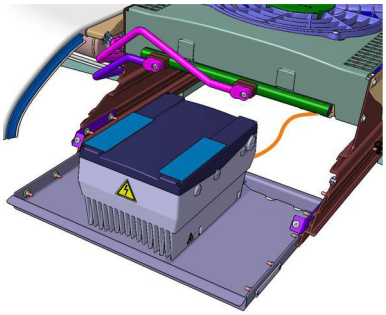


Fig. 3 REVO-E Total overview

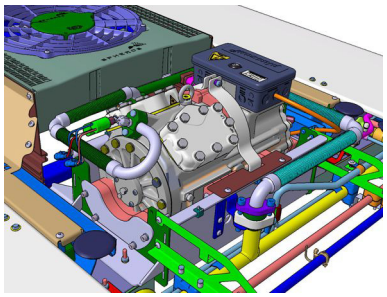
1 Electrical interface 600V
2 Flap actuator (covered)
3 Axial fans
4 Condenser
5 Blower module
6 Frequency converter
7 Flap actuator (covered)
8 Refrigerant receiver
9 Double radial blower
10 Safety lifting point of system, front right
11 Temperature sensor (exhaust temperature)
12 Temperature sensor of passenger compartment (covered)
13 Safety lifting point of system, rear right
14 Electrical interface 24V
15 Water flow NW20
16 Water return NW20
17 Bleeding port of heating section NW6
18 Dryer
19 Expansion valves
20 Air filter
21 Sight glass
22 Solenoid valve
23 Shut-off valve
24 Refrigerant charging valve, suction side
25 Safety valve 30 bar
26 Mount, refrigerant compressor
27 Suction pressure sensor (covered)
28 Refrigerant compressor
29 Refrigerant charging valve, pressure side
30 Safety lifting point of system rear left
31 Air filter
32 Expansion valve
33 Bleeding port of heating section NW6
34 Refrigerant connection, suction side, slave system
35 Refrigerant connection, pressure side, slave system
36 Ground (GND), high-voltage components
37 Low pressure switch
38 High pressure switch
39 Safety lifting point of system, front left

3.3 Overview of high-voltage cable harnesses / components (400V AC / 600V DC)





Frequency converter
600V DC -> 3x400V AC

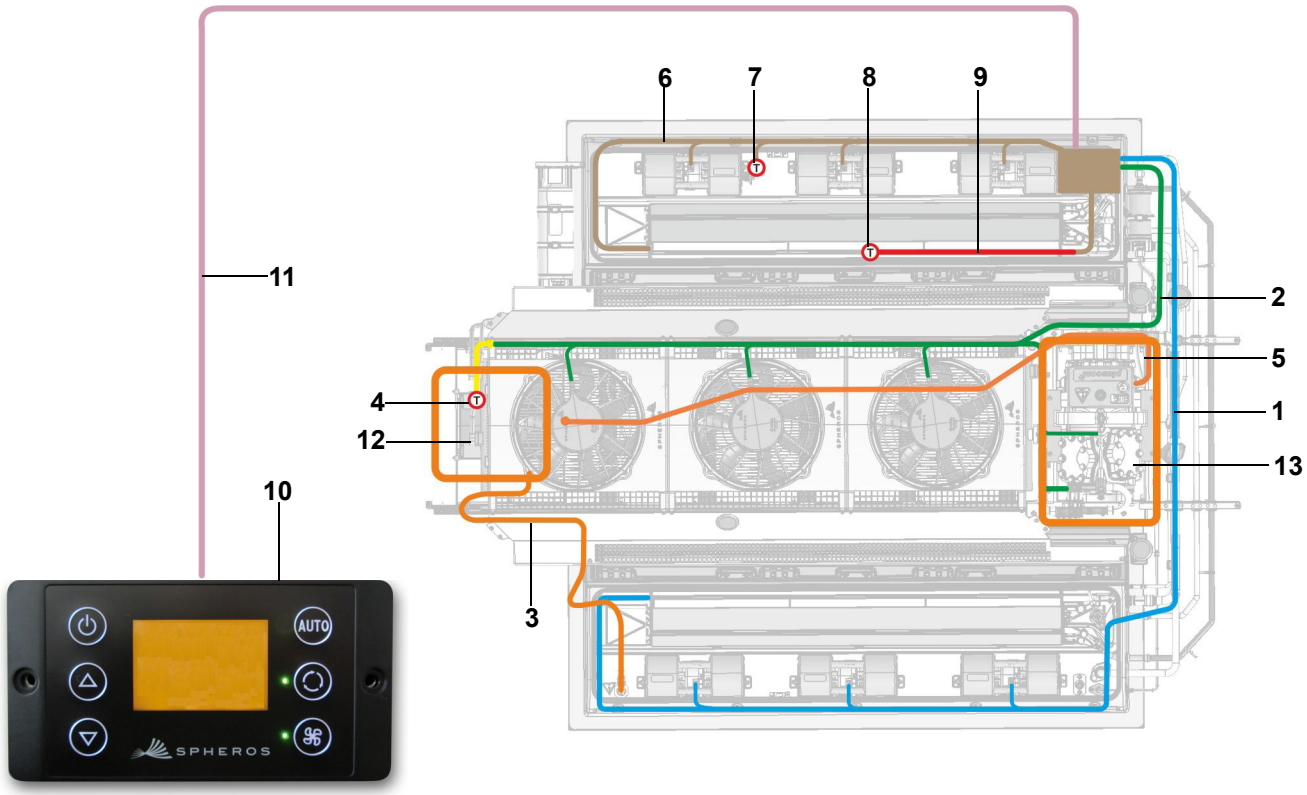


Compressor with 3x 400V AC e-motor

1 - High-voltage power supply of the frequency converter 600V DC
2 - High-voltage power supply of the compressor 3x 400V AC

Fig. 4 Overview of high-voltage cable harnesses / components (400V AC / 600V DC)

3.4 Overview of all cable harnesses (high-voltage / low-voltage) in the REVO-E system



1 - Cable harness, double radial blower, left
2 - Cable harness, axial fans
3 - Cable harness, 600V DC
4 - Temperature sensor, condenser outlet
5 - Cable harness, 400V AC
6 - Cable harness of double radial blower, right, incl. connection plate
7 - Temperature sensor, blow-out temperature
8 - Temperature sensor, passenger compartment
9 - Cable harness of temperature sensor, passenger compartment
10 - SC600 control unit
11 - Cable harness, SC600 to REVO-E
12 - Frequency converter 600V DC -> 3x400V AC
13 - Compressor

The articulated bus version further comes with the connection cable harness between Master and Slave system (no image).

Fig. 5 Overview of all cable harnesses (high-voltage / low-voltage) in the REVO-E system

3.5 Design / task and function of the assemblies

Condenser
The condenser consists of aluminum flat tubes and aluminum fins that are jointly connected to a large heat exchanger.
It cools the hot refrigerant gas in order to liquefy it and super cool it, and it also transfers the condensation heat over its fins and out with the exhaust air.

Heat exchanger
The heat exchanger is tasked with picking up heat from its environment and transferring this to the refrigerant. To do so, the condenser temperature must be lower than the environmental temperature. The desired condenser temperature can be achieved by simultaneously evacuating the refrigerant compressor and narrowing the expansion device.
The temperature difference of the warm current flowing between the heat exchanger and its environment results in refrigerant fluid from the expansion device overheating (overheating zone) and evaporating in the heat exchanger (evaporation zone).

Compressor (HGX34P/315-2 A)
This semi-hermetic, 4 cyl. reciprocating compressor is driven by a 2 pole, asynchronous motor integrated into the housing. It is flushed / cooled by R134a, a gaseous refrigerant, and an integrated PTC element monitors the temperature level. Signals are evaluated by the frequency converter. The frequency converter also provides power and controls the speed.
The duty of the compressor is to condense vaporous refrigerant from low pressure to a higher pressure. To do so, it must ensure the necessary discharge (refrigerant flow) required for cooling.

The compressor is integrated into the air-conditioning system. The compressor with patented vibration decoupling design is created using a special absorption foam. The compressor is embedded and fixed in this foam.

Receiver
The receiver is a compensating /storage tank the balances out changes in the refrigerant circuit.

Dryer
The interior of the dryer contains a granulate that removes small amounts of water from the refrigerant and chemically binds to it.
The dryer also filters contaminates from the refrigerant that might lead to malfunctions.

Thermostatic expansion valve
The thermostatic expansion valve with external pressure equalization regulates the refrigerant flow to the compressor, depending on the refrigerant needs or the condenser temperature. The thermostatic expansion valve is the control element between the high and low pressure sections of the refrigerant circuit.

Pressure switch
The high and low pressure switches are installed on the compressor and are a key component of the safety chain of the air-conditioning system.
High pressure switch
– Monitors the pressure level in the high-pressure area of the refrigerant circuit
– Deactivates the air-conditioning system if pressure is too high (e.g. too much refrigerant)
Low pressure switch
– Monitors the pressure level in the low-pressure area of the refrigerant circuit
– Deactivates the air-conditioning system if pressure is too low (e.g. too little refrigerant)

Switch point

Switch point	High pressure switch	Low pressure switch
On	19 ± 1.5 bar (relative)	1.8 ± 0.3 bar (relative)
Off	24 ± 1.0 bar (relative)	0.3 ± 0.3 bar (relative)

Axial fans
The three axial fans are driven by brushless EC motors. If Cooling Mode is activated, the fans are continuously controlled depending on the load (refrigerant pressure) via the PWM, and provide the condenser with sufficient fresh air.

Double radial blowers
The six double radial blowers are driven by brushless EC motors. The blowers move recirculated / fresh air through the evaporator / heat exchanger and blow it at the right temperature (depending on the mode) into the air ducts of the vehicle.
Speed controls are continuous (PWM); e.g. speed is reduced when the desired vehicle temperature has been reached. This reduces energy needs and helps to stabilize the passenger cabin temperature.

Frequency converter
This component is supplied via the 600V DC electrical system of the vehicle and provides 400V AC for the three-phase AC motor of the compressor. Depending on system requirements, the compressor speed is set between 10Hz-50Hz.
The frequency converter is placed onto an adapter plate (Fig. 803), which makes it easy to remove / install.

Sensors

Suction pressure
The suction pressure sensor determines the pressure level in the low-pressure range. The system attempts to manage the suction pressure between 3.0 bar and 3.7 bar (absolute).
Central parameters for:
– Climate control
– Recognizing icing

Condenser temperature
The temperature sensor is located on the pipe of the condenser exhaust (Fig. 908) and delivers the signal to indirectly determine the condenser pressure. It is therefore very important to fill this system properly.

Passenger compartment temperature
This sensor measures the air temperature of the passenger cabin around the intake area of the recirculating air (Fig. 906).

Air duct temperature (blow-out temperature)
This sensor measures the air intake temperature of the air-conditioning system at the first double radial blower, front right (Fig. 906).

Monitoring the temperature of the e-motor of the compressor
A PTC element monitors the temperature of the compressor e-motor. The frequency converter evaluates the signal without directly influencing the air-conditioning control.
R25 ≤ 300 Ω

Air valves
Regulate the intake of fresh air or use of recirculated air from the passenger cabin. The BEA body sends the positional signals “open / closed” via CAN to the SC600 in all operating modes (except for Gas Charging mode). If both signals are active, the valves will move to the Recirculating position. Intermediate positions (air mixing) are not provided in this vehicle.

SC600
This control unit is used as the control device in the Volvo Hybrid Bus system (display / keyboard **inactive**).
HVAC demands are only managed by the BEA body, which the SC600 uses as a “slave system”.
Two LEDs become active when the system is turned on (permanent & blinking).

4 Function and functional schematics of the REVO-E

4.1 General function of the REVO-E

The fully electric rooftop air-conditioning system (referred to as the air-conditioning system) REVO-E for hybrid, electric and trolley buses is a proven system, especially with its intelligent energy management, meaning cooling is provided as needed depending on existing power, and with the special way its compressor has been installed. The electric compressor is located on the roof in an exceptionally compact manner, and not on the rear of the vehicle as in previous versions. This has, in the purest sense of the word, obvious advantages and makes the system closed by integrating all of the components carrying refrigerant, an efficient, tight and almost maintenance free design (solo design without front box connection).

General
The refrigerant circuit and the cooling functions of the REVO-E correspond to those of a conventional air-conditioning system.
The difference:
– Electrically driven high-voltage compressor
– Frequency converter to provide power to and control the speed of the compressor

The intelligent controller logic of the SC600 controls the entire system. It communicates with the vehicle via CAN bus.

Independent HVAC control (stand alone) is also possible with this system.

Functionality of the REVO-E in the vehicle line of the Volvo Hybrid EU6
The HVAC control system of the vehicle is responsible for regulating the Heating, Ventilation and Cooling modes in the Volvo 7900 Euro 6 Bus. The REVO-E system is operated only as a “slave” system and only follows the vehicles requirements.

If the air-conditioning system is activated by switching on the vehicles electrical network. all of the system’s sensor values are automatically verified for plausibility and the system will be set to “Standby Mode”. Various sensor values are used as the basis for calculating the bus-side requirements, including those from the passenger cabin sensors of the air-conditioning system.

These requirements are sent via CAN bus over the Dbus to the SC600 as needed.
The SC600 implements these requirements in the REVO-E (mode / blower speed, etc.).

The REVO-E will turn off if there are any limitations in the temperature / high-voltage supply, etc.

4.2 Functional schematic of the REVO-E

Tasks of the SC600
- Implementing climatic requirements
- Turning off high-voltage components in case of error (HVIL)
- Component protection of the climate unit if overloaded

Required to start the system:
- Power supply clamp 30 (battery of main switch)
- Ignition on (clamp 15)
- CAN communication between vehicle and SC600 activated - approval for system start shared
- 600V DC to the frequency converter
- Approval (D_AuxiliaryPowerEnable) and supply

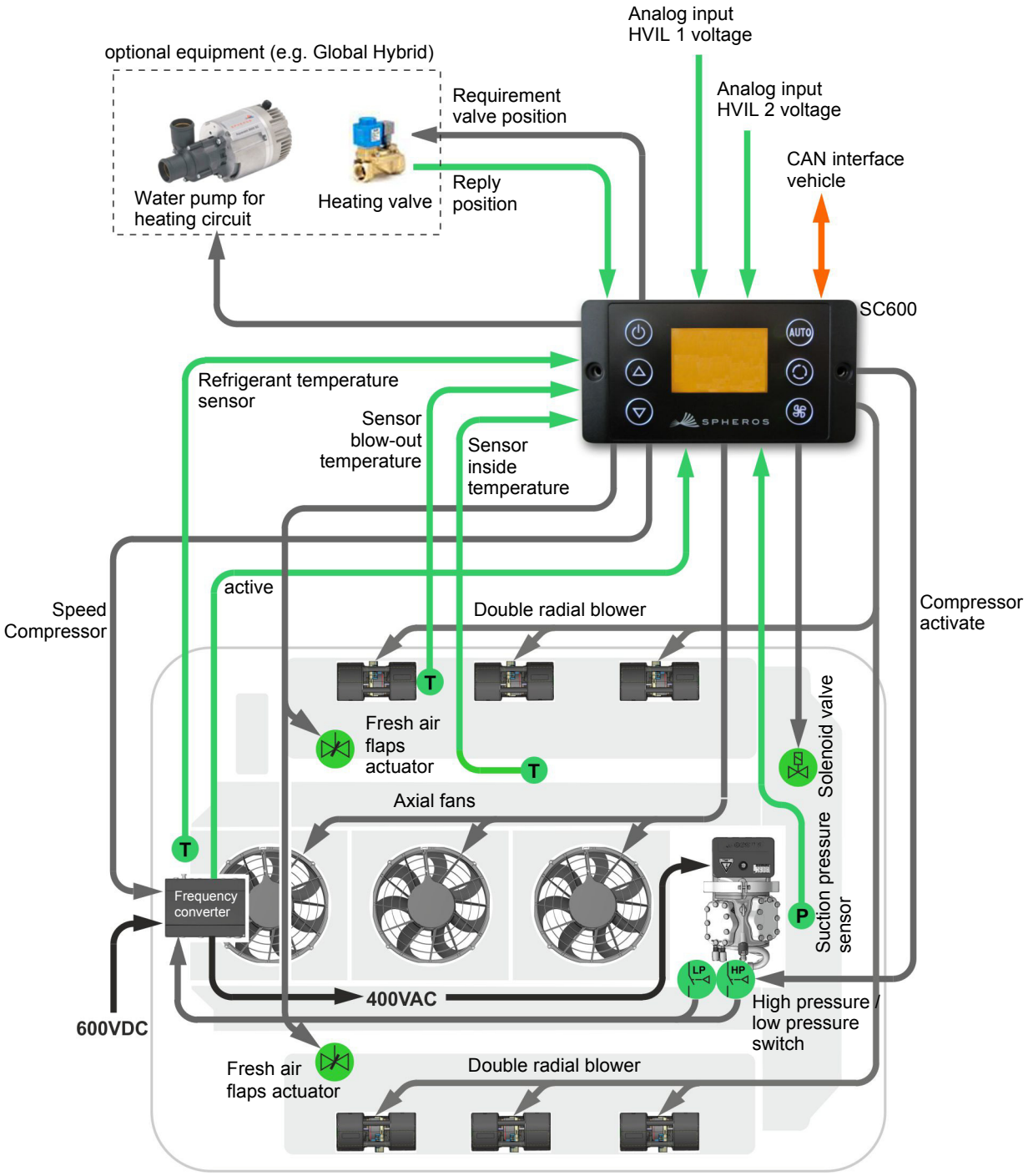


Fig. 401 Functional schematic of the REVO-E

4.3 Functional schematic of the REVO-E Volvo Hybrid EU6

On single buses, the REVO-E and SC600 are connected to one another using a Spheros cable harness.
On articulated buses, the master and slave systems are also connected to one another electrically as well as in terms of refrigeration equipment.
The HVAC control system of the BEA body system is responsible for regulating the Heating, Ventilation and Cooling modes in the Volvo 7900 Euro 6 Bus.

The REVO-E system therefore behaves only as a “slave” system and implements the particular requirements.
In Heating / Ventilation or Reheat Mode, the vehicle controller gives the speed of the double radial blowers.
In Cooling, Waste Energy or Gas Charging Mode, the double radial blowers are controlled by the SC600.
The two temperature sensors of the “slave” unit are connected to the I/O-A modules of the BEA Body system.

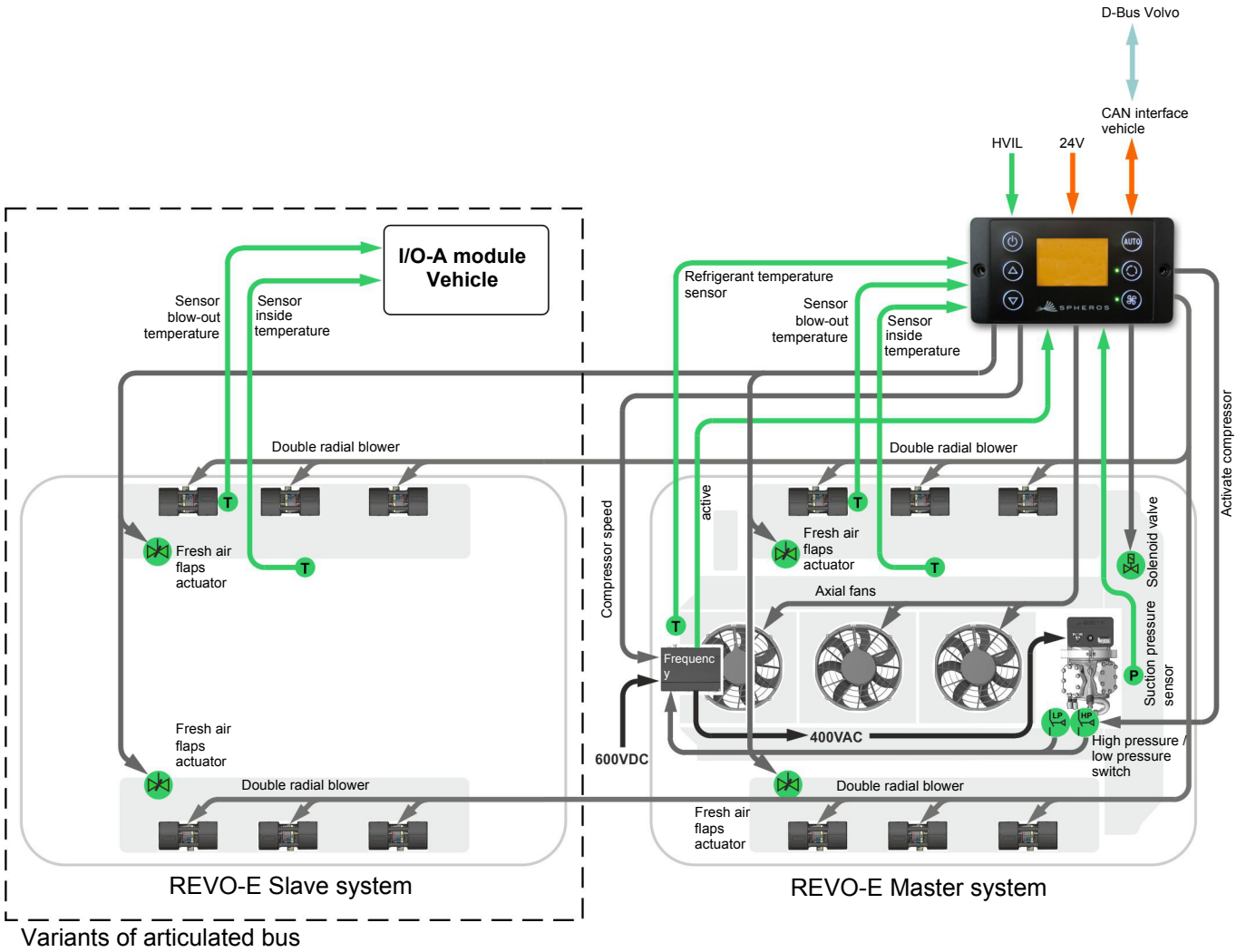


Fig. 402 Functional schematic of the REVO-E, internal

4.4 Work modes of the REVO-E in the Volvo Hybrid Bus EU6

There are 6 different operating modes.
Choosing or switching between modes occurs according to defined criteria of the BEA body climate control system.

1. Heating / Ventilation Mode
2. Heating / Ventilation Mode ready for cooling
3. Cooling Mode
4. Reheat Mode
5. Waste Energy Mode
6. Gas Charging Mode

This is a list of priorities in case several modes are simultaneously required by the BEA body system. The SC600 must employ the mode with the highest priority.

Operating mode conditions:
- mode required by BEA body (e.e. Cooling Mode to reduce temperature in passenger compartment)
- general system conditions (e.g. external temperatures / status of 600V DC system)

Depending on the mode, the SC600 or BEA body system will control the actuators.

4.4.1 Heating and Ventilation Mode (HV Mode)

Requirements:
– Clamp 30 active
– HV Mode required by BEA body

Both modes are required directly by the BEA body.

CAN messages from the BEA body to SC600 for defined speed of double radial blowers and position of air flaps (fresh air / recirculating air).
Water valves are controlled by the BEA body directly.

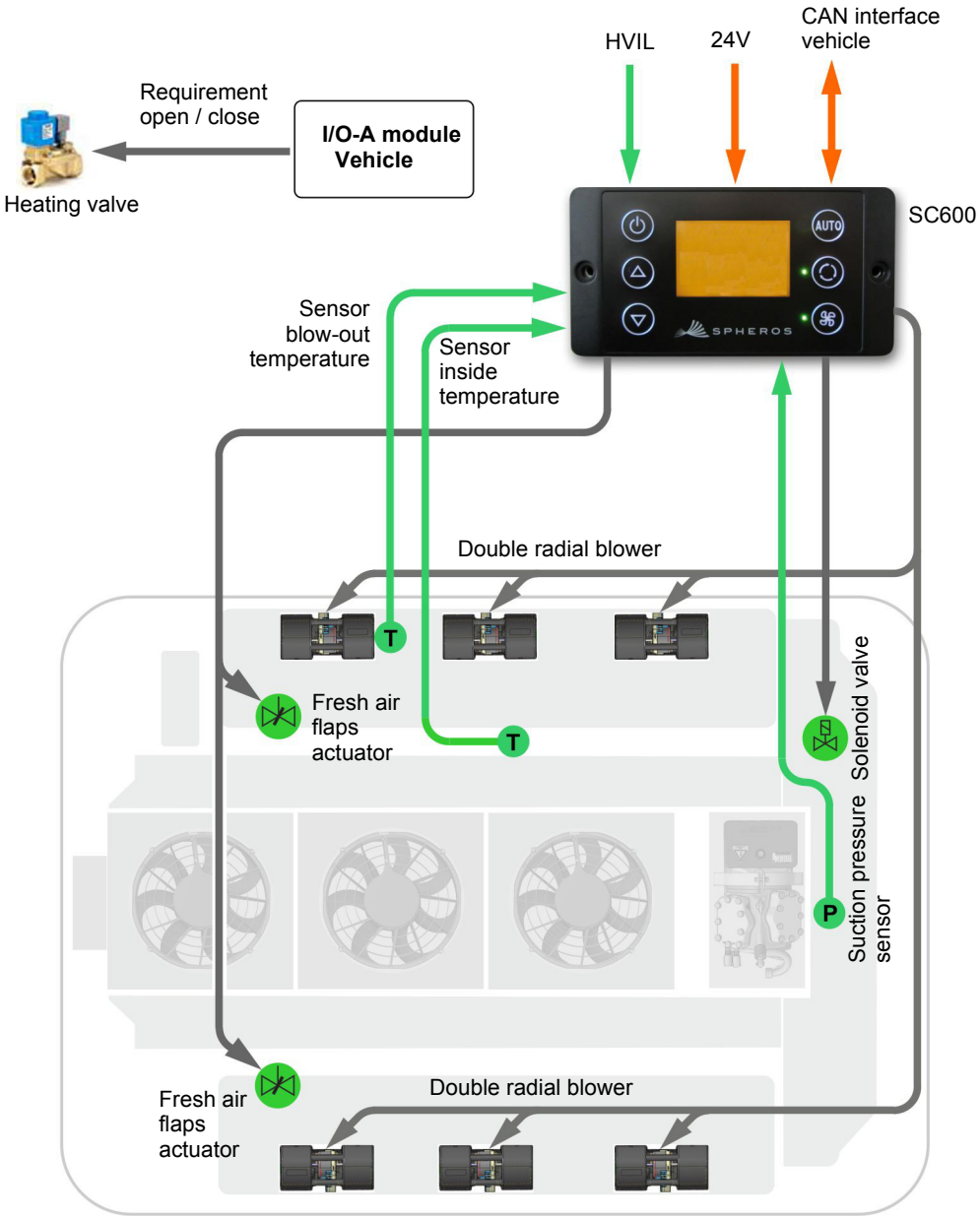


Fig. 403 Heating and Ventilation Mode (HV Mode)

4.4.2 Heating and Ventilation Mode Ready for cooling

Requirements:
– Clamp 30 / 15 active
– HV Mode required by BEA body

Preconditions for Cooling Mode filled shortly before or after this, however cool request not sent by BEA body. System works primarily in Heating / Ventilation Mode.

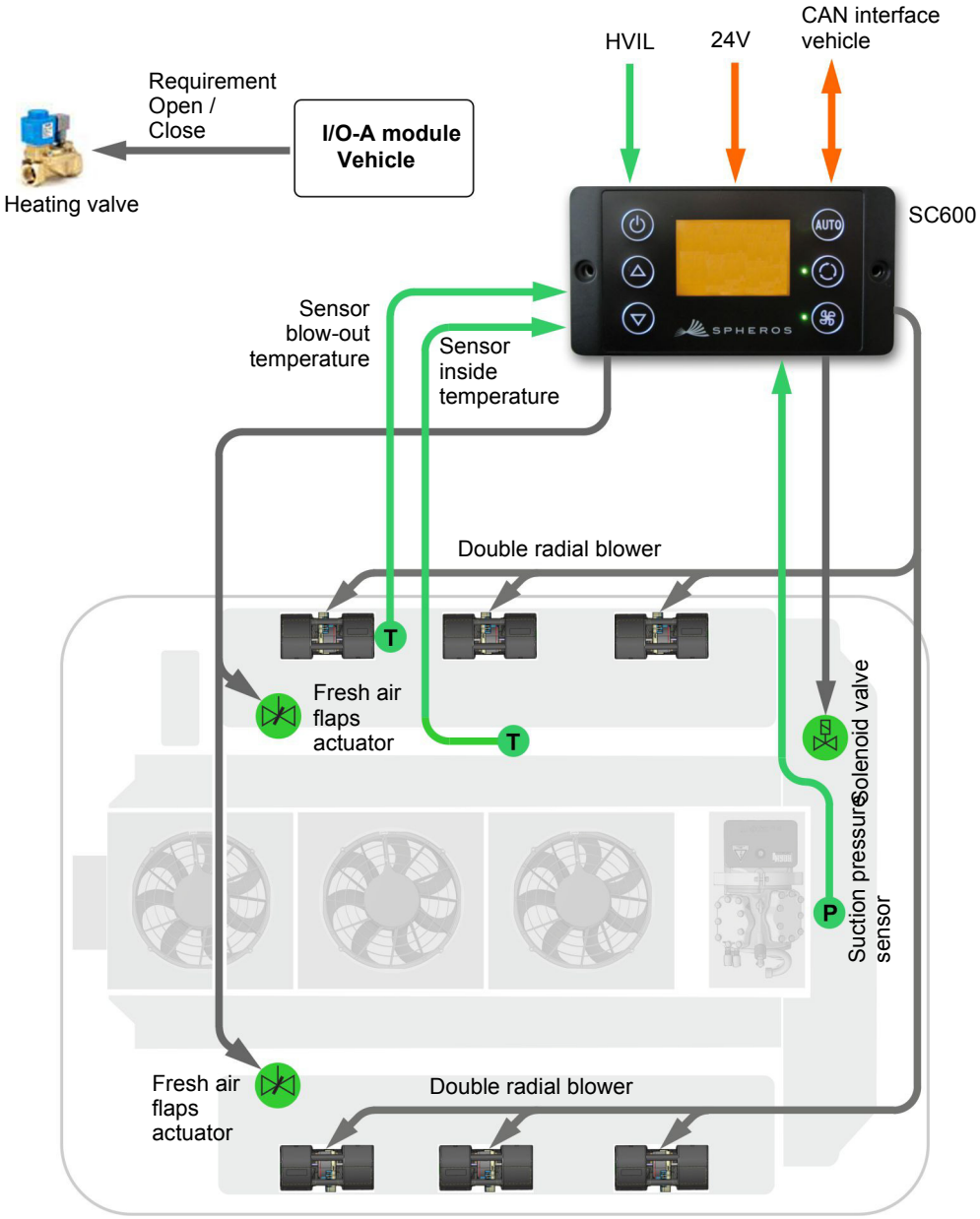


Fig. 404 Heating and Ventilation Mode Ready for cooling

4.4.3 Cooling Modus

Requirements:
– Clamp 15 active (ignition)
– “Ready for Cooling” mode active
– HVAC power consumption enabled by “D_AuxiliaryPowerEnabled” signal
– “D_CabinCoolReq” signal sent by BEA body
– Environmental temperature >5°C

Cooling Mode is requested by the BEA body system in order to cool the air in the passenger cabin. The SC600 therefore assumes internal control of the components in the system in order to cool the air in the passenger cabin to the Delta T value requested by the BEA Body.

Task of the SC600:
– Control the speed of the double radial blowers / axial fans
– Activate and give the speed of the compressor (via frequency converter)

In Cooling Mode, the BEA body is not able to influence the speed of the double radial blowers.
The value of the interior temperature to be reached is given by the difference of the external temperature and the ΔT required by the BEA body.

Example of ΔT – 7 Kelvin

$T_{passenger\ cabin}$ = [$T_{external}$ (35°C) – ΔT (7K)]
$T_{passenger\ cabin}$ = 28°C

This value is sent via CAN by the BEA body and used as an internal control signal.
The "D_ElAcMaxPowerAllowed" CAN signal (from the vehicle's power system) specifies the maximum power consumption of the compressor.
If the cooling required cannot be implemented (e.g. malfunction), the system automatically switches to Heating Mode / Ventilation Mode.

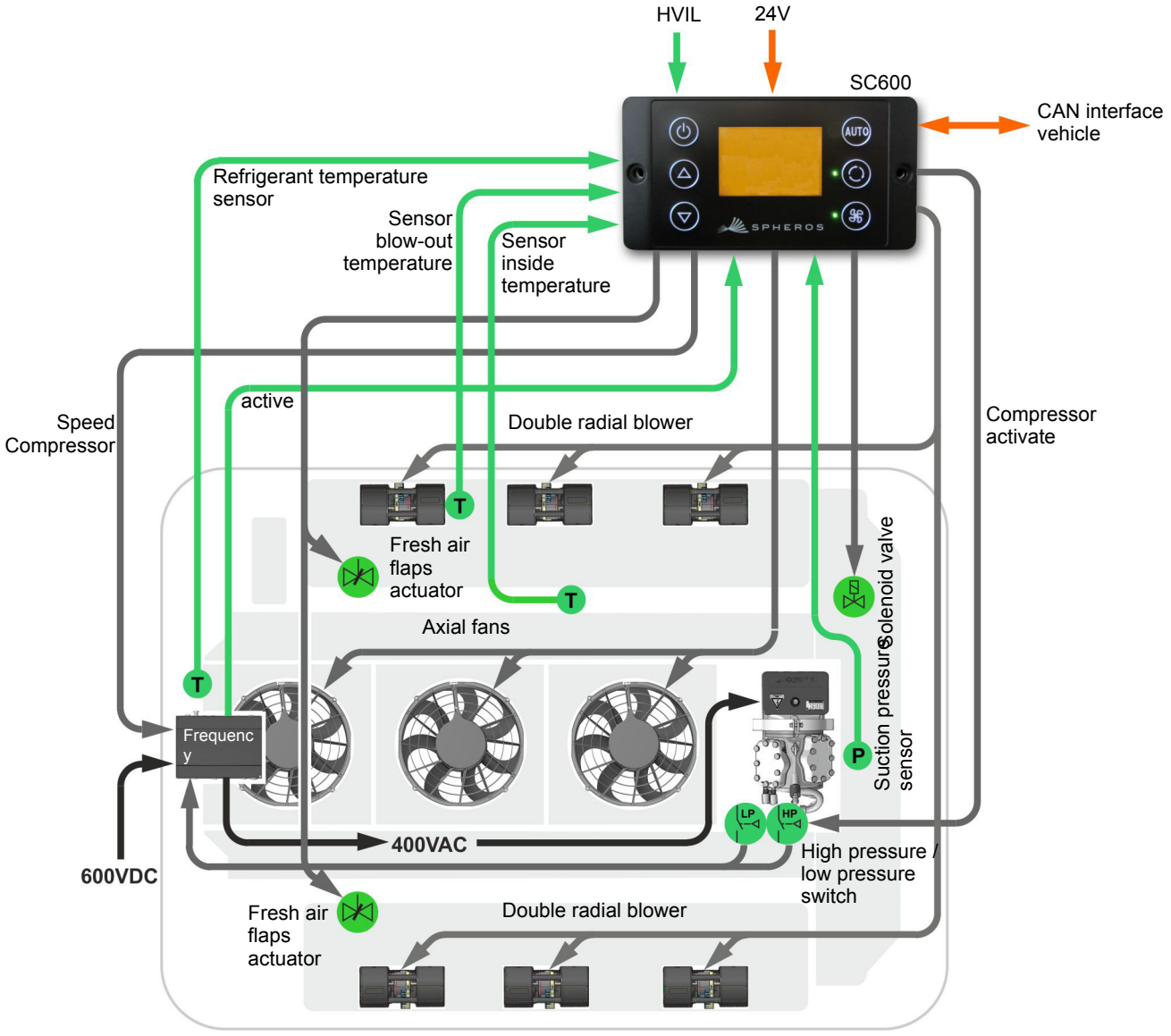


Fig. 405 Cooling Modus

4.4.4 Reheat Mode

Requirements:
– Clamp 15 active (ignition)
– The HVAC's power needs are enabled by the signal "D_AuxiliaryPowerEnabled"
– “D_CabinReheatReq” signal is requested by the BEA body
– Environmental temperature >5°C

Reheat Mode is requested by the BEA body in order to dry the air in the passenger cabin.
The SC600 activates the compressor and the axial fans for maximum cooling.
The BEA body system activates the valves of the roof-top heater simultaneously. Hot coolant is delivered to the heat exchangers of the air-conditioning system.

The maximum condenser capacity can be limited by the "D_ElAcMaxPowerAllowed" signal.

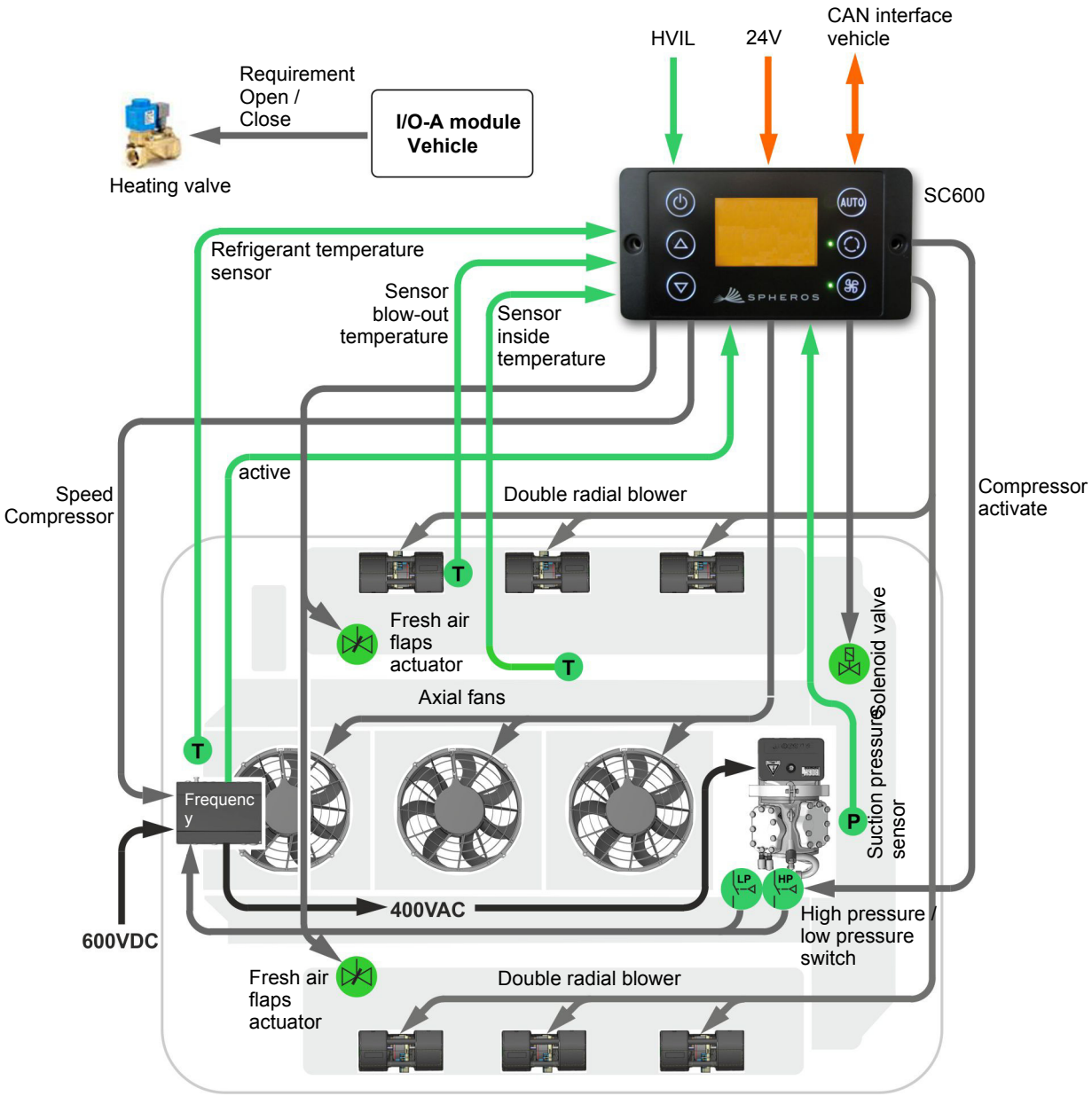


Fig. 406 Reheat Mode

4.4.5 Waste Energy Mode

Requirements:
– Clamp 15 active (ignition)
– The HVAC's power needs are enabled by the signal "D_AuxiliaryPowerEnabled"
– “D_CabAcWasteEnergyReq” signal is requested by the BEA body
– Environmental temperature >5°C

In Waste Energy Mode, the air-conditioning system attempts to dissipate additional energy from the drive battery.
This is achieved by running back the efficiency of the air-conditioning system, e.g. by reducing the speed of the axial fans.
The reduction in power must occur without any noticeable change to the conditions in the passenger cabin. This mode is only used to support the power management system.

The maximum condenser capacity can in turn be limited by the "D_ElAcMaxPowerAllowed" signal.

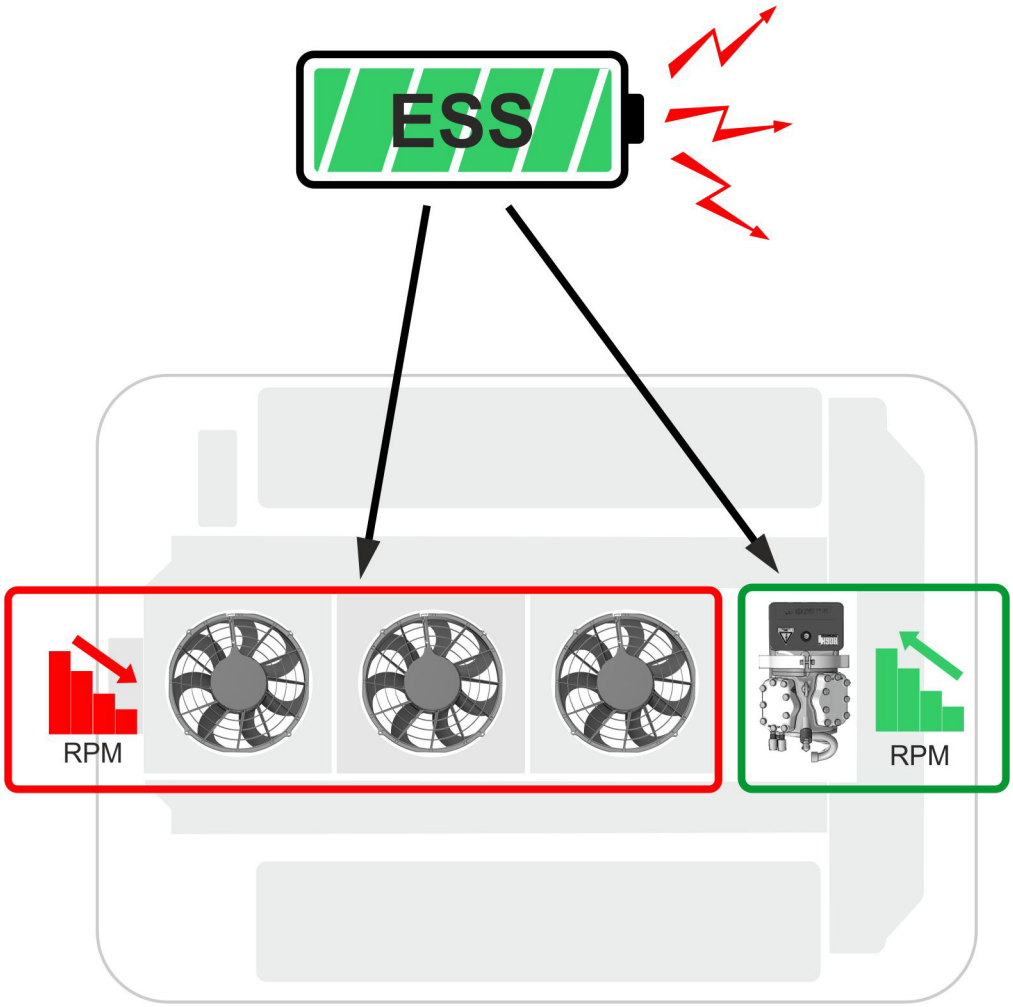


Fig. 407 Waste Energy Mode

4.4.6 Gas Charging Mode

Requirements:
- Clamp 15 active (ignition)
- The HVAC's power needs are enabled by the signal "D_AuxiliaryPowerEnabled"
- “D_CabAcGasCgeReq” signal is requested by the BEA body
- Environmental temperature >5°C

The task of Gas Charging Mode is to activate the compressor to fill the system with the refrigerant R 134a. Gas Charging Mode works independently with a small ΔT that is sent by the BEA body to the SC600.

This activates the compressor, the double radial blowers / axial fans of the REVO-E at **minimal power**.
Monitoring of the suction pressure is deactivated in Gas Charging Mode, since the system is normally not filled when this mode is started and the suction pressure sensor would therefore read a false value in the vacuum of the system. *

The mode is not part of standard operation and is only to be used by trained servicing personnel.
The maximum condenser capacity can be limited by the "D_ElAcMaxPowerAllowed" signal.

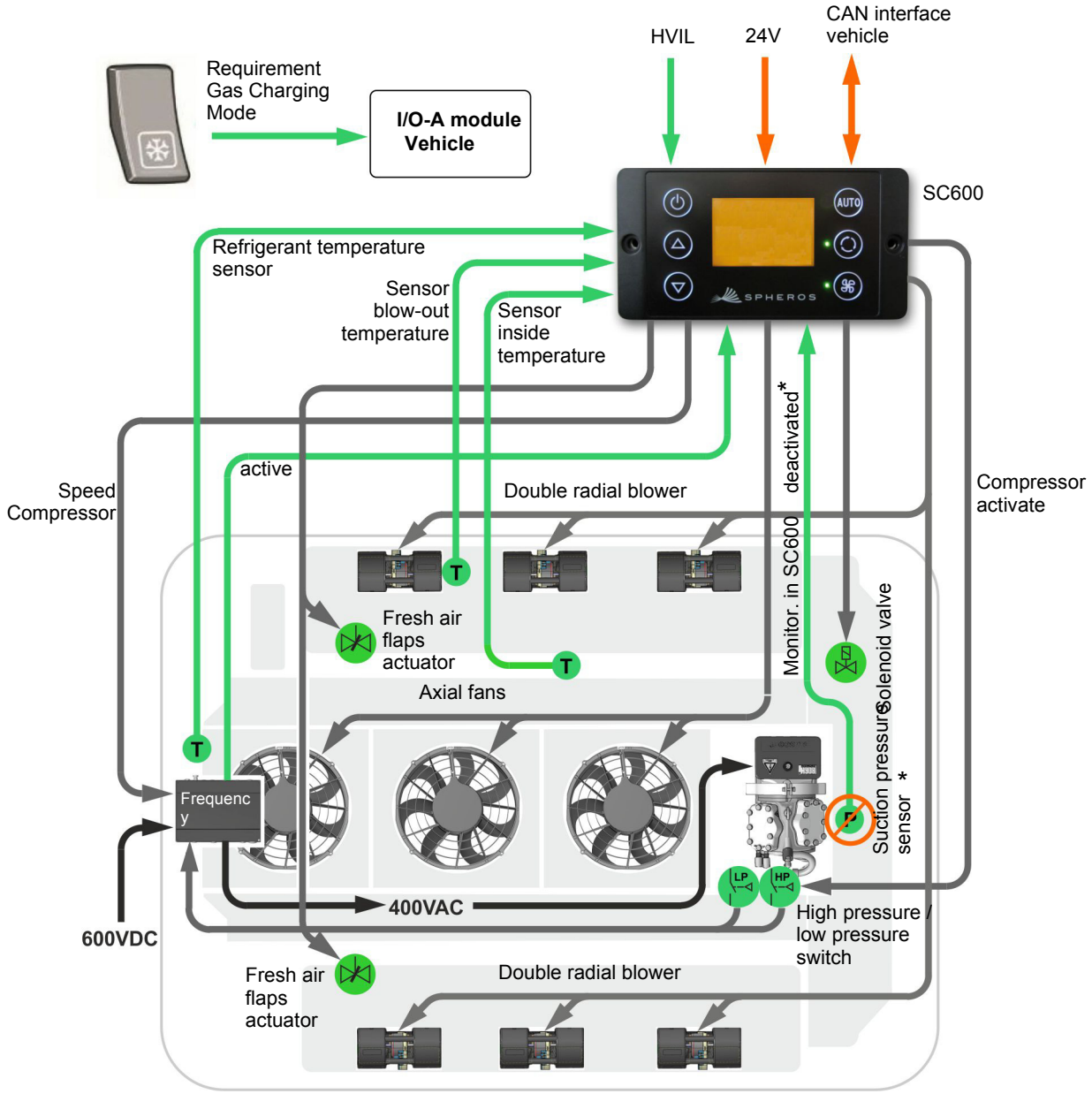


Fig. 408 Gas Charging Mode

5 Troubleshooting

5.1 General

Warning!	Potential risk to health and life!

Follow the safety information and conditions from Chapter 1 (see 1.6).

This section describes how to look for and eliminate errors in the REVO-E air-conditioning system.

In the event of doubt, Chapters 3 and 4 contain the functional relationships.

When searching for errors and how to eliminate them, a systematic procedure is required. The corresponding measures for malfunctions of a general type or for deviations from desired conditions are to be implemented as described below.
Certain malfunctions can only be determined and eliminated by specialized personnel with special tools.

5.2 Malfunctions in the air-conditioning circuit

5.2.1 Causes of malfunctions in the air-conditioning system

- defective double radial blower or axial fan
- dirty or blocked air filter, dirty condenser or compressor fins
- too little / much refrigerant in the system
- defective solenoid valve
- malfunctions in the expansion valve
- foreign gas in the system
- insufficiently evacuated refrigerant circuit (final vacuum <10 mbar)

For continuous shutoff, we recommend having the system inspected by an authorized specialist.

5.2.2 What to do for malfunctions in the refrigerant circuit

If errors in the refrigerant circuit appear, the system must be inspected by a specialist and properly serviced. Do not allow the refrigerant to release into the atmosphere under any circumstances.

5.2.3 Why the desired conditions are not reached when testing pressure

If deviations from the desired conditions are determined when testing the pressure, the following may have caused this.

Pressure is too high at the high-pressure manometer
- air flow through the condenser is too low
- too much refrigerant

Pressure is too low at the high-pressure manometer
- too little refrigerant
- compressor speed too low (system in regular operation, maximum speed can be forced with the SCT component test)
- defective compressor

Verify and localize these causes, service or replace, as needed, defective parts.

5.3 Malfunctions in the electrical system

Warning!	High voltage! Caution Mortal danger!

Only conduct installation, maintenance and repair work if the motor is still and the 24V DC power supply as well as the high-voltage has been switched off.

Before starting work on the air-conditioning system, ensure that the system is voltage free and make sure it remains so for the duration of the work.

In certain cases, the following safety rules must be followed:
- **ensure the system is voltage free**
- **ensure system will not be reactivated**
- **verify system is voltage free**
- **ground and short-circuit**
- **cover or block off neighboring voltage-carrying parts**

Electrical work may only commence if protective measures against electrical shock, short-circuits and electric arcs have been taken.

Chapter 4 contains the functional relationships when searching for errors.
Recognizing errors is normally limited to localizing the defective components. The following causes of malfunctions are not considered and should be verified and eliminated if a malfunction occurs for these reasons:

- corrosion on the plugs
- loose contact
- crimping errors on the plugs or pins
- corrosion on lines and fuses
- corrosion on the battery poles
- damage to the line insulation

ATTENTION:
Search for malfunctions before replacing a fuse. Separate the air-conditioning system from the vehicle's wiring system and replace the fuse while the system is powered down.
Install a fuse of the correct size (see Chapter 6 Wiring plan).

Inspect the system's functionality after eliminated a malfunction in the vehicle.

5.4 Table of error codes

Spheros code	Volvo ID	Error description	EU / GH
01	10911	ECU internal error	EU6 / GH
02	10912	PWM axial fan defective	EU6 / GH
03	10913	PWM double radial blower defective	EU6 / GH
04	10914	24V power supply too low	EU6 / GH
05	11554	External temperature signal not received >10s	EU6
06	11555	600V system status not received >10s	EU6 / GH
07	10917	Temperature of air duct / outlet temperature too high (T≥ 105°C)	EU6 / GH
08	10918	Temperature of air duct / outlet temperature too low (T≥ -40°C)	EU6 / GH
09	10919	Temperature of recirculated air / passenger cabin too high (T≥ 105°C)	EU6 / GH
10	10920	Temperature of recirculated air / passenger cabin too low (T≥ -40°C)	EU6 / GH
11	10921	Condenser pressure too high (measured value T ≥ 105°C)	EU6 / GH
12	11573	Condenser pressure too low (measured value T ≥ -40°C)	EU6 / GH
14	11536	Suction pressure too low	EU6 / GH
15	11542	System locked due to too many instances of high pressure	EU6 / GH
16	11569	System locked due to too many instances of low pressure	EU6 / GH
17	11543	Icing on heat exchanger (calculated via determination of suction pressure)	EU6 / GH
18	10928	Common EDS (common error in electrical drive system)	EU6 / GH
19	n/a	External temperature signal not received >10s	GH
20	11563	“Alternate charging status” signal not received	EU6 / GH
21	n/a	“Parking brake” status not received	GH
22	n/a	Door signal error	GH
23	11560	“Maxpowerallowed” signal not received	EU6 / GH
24	11548	Inverter error	EU6 / GH
31	10931	Water valve (GH)	GH
32	11325	HVIL error	EU6 / GH

For errors, we recommend using the diagnostic kit with the Spheros Control Test SCT diagnostic software (see OI REVO-E Diagnostic).
Conceptionally, inactive errors are only saved in the VOLVO BEA Body error memory and can only be read or deleted there.
When using the Spheros Control Test SCT diagnostic software, ONLY active errors in the system are emphasized in red (e.g. **F01 – ECU internal**).

Then describe the error in detail with the associated test run and possible cause.

5.5 Error codes

F01 ECU internal error

System behavior
- System not functioning & display off (GH) / LED not blinking

or
- Display shows 'boot' and 'Err code'

Necessary inspections
- Test system with SC600 and SCT diagnostic from the diagnostic kit
- Inspect the power supply of the SC600

Actions
- Replace SC600

F02 PWM axial fan defective

System behavior
- Refrigerant compressor stops during Cooling Mode
- Axial fans do not run despite Cooling Mode being activated
- System in Ventilation Mode despite cooling being required in vehicle

Necessary inspections
- Inspect axial fans with SCT component test
- Inspect cable harnesses according to wiring plan
- Force control of system via SCT test mode "Active with cooling"

Actions
- Replace SC600
- Replacing axial fans NOT necessary

F03 PWM double radial blowers defective

System behavior
- Failure of all double radial blowers in system
- Refrigerant compressor stops during Cooling Mode
- System in Ventilation Mode despite cooling being required in vehicle

Necessary inspections
- Inspect double radial blowers with SCT component test
- Inspect cable harnesses according to wiring plan
- Force control of system via SCT test mode "Active with cooling"

Actions
- Replace SC600
- Replacing double radial blowers NOT necessary

F04 24V power supply too low

System behavior
- double radial blowers not functioning
- Cooling Mode not functioning
- Power supply < 22V/ >10s

Necessary inspections
- Inspect 24V power supply (error active up to power supply >28V)

Actions
- Bus servicing necessary

F05 External temperature signal not received >10s

System behavior
- Limited cooling function
- System in Cooling Mode

Necessary inspections
- Inspect external temperature sensor of bus
- Inspect CAN bus communication

Actions
- according to Volvo documentation

F06 600V system status not received >10s

System behavior
– Limited cooling functionality
– System in Cooling Mode

Necessary inspections
– Inspect system with SCT component test
– Inspect CAN bus communication

Actions
– according to Volvo documentation

F07 Temperature of air duct / outlet temperature too high (T≥ 105°C)

System behavior
– Limited heating functionality

Necessary inspections
– Sensor values using SCT
– Sensor resistance on the sensor / to the SC600 plug (SC600 not connected) according to wiring plan
  10kOhm 12.5kOhm 15.7kOhm
  25°C 20°C 15°C
– Voltage present on sensor when SC600 and sensor plug connected
  1.36V 1.5V 1.7V
  25°C 20°C 15°C

Actions
– Measured values on sensor NOK => replace sensor
– Measured values on cable harness (SC600 side) NOK => inspects pin / replace cable harness
– Measured values on cable harness (SC600 side) OK => replace SC600

F08 Temperature of air duct / outlet temperature too low (T<= -40°C)

System behavior
– Limited heating functionality

Necessary inspections
– Sensor values using SCT
– Sensor resistance on the sensor / to the SC600 plug (SC600 not connected) according to wiring plan
  10kOhm 12.5kOhm 15.7kOhm
  25°C 20°C 15°C
– Voltage present on sensor when SC600 and sensor plug connected

  1.36V 1.5V 1.7V
  25°C 20°C 15°C

Actions
– Measured values on sensor NOK => replace sensor
– Measured values on cable harness (SC600 side) NOK => inspects pin / replace cable harness
– Measured values on cable harness (SC600 side) OK => replace SC600

F09 Temperature of recirculated air / passenger cabin too high (T≥ 105°C)

System behavior
– Limited heating functionality
– Limited cooling functionality

Necessary inspections
– Sensor values using SCT
– Sensor resistance on the sensor / to the SC600 plug (SC600 not connected) according to wiring plan
  10kOhm 12.5kOhm 15.7kOhm
  25°C 20°C 15°C
– Voltage present on sensor (SC600 / sensor plug connected)
  1.36V 1.5V 1.7V
  25°C 20°C 15°C

Actions
– Measured values on sensor NOK => replace sensor
– Measured values on SC600 plug NOK => inspects pin / replace cable harness
– Measured values on cable harness SC600 side OK => replace SC600

F10 Temperature of recirculated air / passenger cabin too low (T<= -40°C)

System behavior
– Limited cooling functionality
– System in Cooling Mode

Necessary inspections
– Sensor values using SCT
– Sensor resistance on the sensor / to the SC600 plug (SC600 not connected) according to wiring plan
  10kOhm 12.5kOhm 15.7kOhm
  25°C 20°C 15°C
– Voltage present on sensor (SC600 / sensor plug connected)
  1.36V 1.5V 1.7V
  25°C 20°C 15°C

Actions
– Measured values on sensor NOK => replace sensor
– Measured values on SC600 plug NOK => inspects pin / replace cable harness
– Measured values on cable harness SC600 side OK => replace SC600

F11 Condenser pressure too high (Measured values T >= 105°C)

System behavior
– Axial fans 100% in Cooling Mode

Necessary inspections
- Sensor values using SCT
- Sensor resistance 5.4kOhm on the sensor / to the SC600 plug (SC600 not connected) according to wiring plan when compressor has not been functioning for long period of time
- Voltage present on sensor (SC600 / sensor plug connected) when system running
  ~7.4bar ~6.4bar
  1.36V 1.5V
  When compressor has been off for awhile
  1.7V at 15°C

Actions
- Measured values on sensor NOK => replace sensor
- Measured values on SC600 plug NOK => inspects pin / replace cable harness
- Measured values on cable harness SC600 side OK => replace SC600

F12 Condenser pressure too low (Measured values T <= -40°C)

System behavior
- Axial fans 100% in Cooling Mode

Necessary inspections
- Sensor values using SCT
- Sensor resistance 5.4kOhm on the sensor / to the SC600 plug (SC600 not connected) according to wiring plan when compressor has not been functioning for long period of time
- Voltage present on sensor (SC600 / sensor plug connected) when system running
  ~7.4bar ~6.4bar
  1.36V 1.5V
  When compressor has been off for awhile
  1.7V at 15°C

Actions
- Measured values on sensor NOK => replace sensor
- Measured values on SC600 plug NOK => inspects pin / replace cable harness
- Measured values on cable harness SC600 side OK => replace SC600

F14 Suction pressure too low

System behavior
- Cooling functionality limited
- Compressor speed minimal (assuming suction pressure of 2.5 bar)

Necessary inspections
- Sensor values using SCT (operating >2 bar)
- Plug connection to sensor
- Measurements on X854 plug
  - Sensor power supply (5V)
  - Sensor voltage (feedback) when compressor deactivated
  - Sensor voltage (feedback) when compressor deactivated (2V-4V)
  Note: Compressor controllable using SCT components test.

Actions
- Replace cable harness or SC600
- Replace sensor

F15 System locked due to too many instances of high pressure

System behavior
- System locked due to too many instances of high pressure (5x)
- Error only in combination with F18

Necessary inspections
- Sensor values using SCT (after first unlocking system)
- High pressure error + axial fan speed high
  - Air flow at condenser (dirty condenser)
  - Amount of refrigerant (according to Volvo documentation)
- High pressure error + axial fan speed low
  - Proper bracing of condenser temperature sensor (see 9.11)

Actions
- To unlock the system, press the Gas Charging button (above driver) for at least 15 s. System can then be inspected.
- Clean condenser fins
- Refill according to Volvo documentation
- Sensor correctly attached / replace as needed

F16 System locked due to too many instances of low pressure

System behavior

- System locked due to too many instances of low pressure (3x)
- Error only in combination with F18

Necessary inspections
- Sensor values using SCT (after first unlocking system)
- Solenoid valve with SCT components test (acoustic)
- Voltage at the solenoid valve 0V= closed / 24V open
- Pressure level in low pressure range using manometer when compressor >2 bar - expansion valve OK
- Suction pressure sensor on X854 plug
  - Power supply of the connected sensor (5V)
  - Sensor voltage (feedback) when compressor deactivated
  - Sensor voltage (feedback) when compressor deactivated (2V-4V)

Note: Compressor controllable using SCT components test.

Actions
– To unlock the system, press the Gas Charging button (above driver) for at least 15 s. System can then be inspected.
– Replace solenoid valve
– Replace expansion valve or refill according to Volvo documentation
– Replace suction pressure sensor

F17 Icing on the heat exchanger

System behavior
– Cooling functionality temporarily limited / air-conditioning system in Ventilation Mode
– Compressor turned off until deiced (<2 bar absolute pressure for at least 15s)

Necessary inspections
– Sensor values using SCT
– Visually inspect icing on heat exchanger
– Visually inspect contamination of fresh air filter
– Expansion valve (suction pressure >2 bar)
– Refrigerant level

Actions
– Defrost heat exchanger
– Replace fresh air filter
– Replace expansion valve(s)
– Refill according to Volvo documentation

F18 Common error in EDS (Electrical Drive System)

System behavior
– Compressor does not start
– Red LED of frequency converter is blinking
Note: No common problem of the frequency converter

Necessary inspections
– Sensor values using SCT
– Only relevant in connection with other errors
– Inspect high pressure switch
– Inspect low pressure switch
– Read off from error memory of frequency converter (handheld reader / PC diagnostic)

Actions
– Eliminate error depending on other errors entered
– Eliminate error in frequency converter according to EPA description (see OI REVO-E Diagnostics)

F19 External temperature signal not received >10s

System behavior
– Defective signal of external temperature of the vehicle system
– Missing external temperature signal

Necessary inspections
– Vehicle system
– CAN bus communication

Actions
– Eliminate error according to vehicle documentation

F20 “Alternate charging status” signal not received

System behavior
– Limited cooling functionality - Ventilation Mode

Necessary inspections
– Vehicle system
– CAN bus communication

Actions
– Eliminate error according to vehicle documentation

F21 “Parking brake” status not received

System behavior
– Service and Gas Charging Mode not functioning

Necessary inspections
– Vehicle system
– CAN bus communication

Actions
– Eliminate error according to vehicle documentation

F22 Door signal error

System behavior
– Permanently recirculating
– No limitations to operation of air conditioning

Necessary inspections
– Vehicle system

Actions
– Eliminate error according to vehicle documentation

F23 “Maxpowerallowed” signal not received

System behavior
– Compressor runs without limitations, sometimes very high power usage

Necessary inspections
– Vehicle system
– CAN bus communication

Actions
– Eliminate error according to vehicle documentation

F24 Frequency converter / inverter error

System behavior
– System locked - system in Ventilation Mode
  Error entry after 10x F18 (Common EDS)
  Note: without simultaneous high or low pressure result (other FS)

Necessary inspections
– Sensor values using SCT
– Read off from error memory of frequency converter (handheld reader / PC diagnostic)
– Safety chain (high / low pressure switch / frequency converter)
  – Continuity test of X854 plug Pin3 and Pin11
  – Individual components of safety chain (pressure switch)

Actions
– Replace pressure switch
– Eliminate error in frequency converter according to EPA description (see operating instructions of diagnostics kit)

Unlock - ignition off and wait 1 min

F31 Water valve

System behavior
– Unexpected temperatures in passenger cabin
– Heating Mode
  – Temperature in passenger cabin too high (valve blocked in open position)
  – Temperature in passenger cabin too low (valve blocked in closed position)

– Cooling Mode
  – Outlet temperature higher than expected (no cooling) + high double radial blower speed

– Dehumidification (reheat)
  – Temperature in passenger cabin too high (valve blocked in open position)
  – Temperature in passenger cabin too low (valve blocked in closed position)

Necessary inspections
– Sensor values using SCT
– HVAC Mode for temperature / sensor values (e.g. Cooling Mode - low outlet temperature)
– Initialization run of servo-motor of water valve
– Cable harness according to wiring plan

Actions
– Repair cable harness
– Replace water valve
– Replace SC600

F23 HVIL error

System behavior
– Cooling Mode not available

Necessary inspections
– HVIL power using SCT (13-19 mA)
– Other high-voltage components affected in vehicle
– HVIL "loop" in the air-conditioning system according to wiring plan
– HVIL resistance in the system (~10 Ohm)
– HVIL resistance of system + cable harness (SC600 separated) ~11 Ohm
– HVIL power supply for vehicle according to vehicle documentation

Actions
– Replace cable harness
– Replace SC600
– Repair according to Volvo documentation

There are two options to select when reading out from the error memory of the frequency converter:

1. Output error messages via MMI handheld control device
   – Read out current error of the frequency converter
   – Read out error memory (inactive error) of the frequency converter
2. Expert analysis via PC (installation required)
   – Read out current error of the frequency converter
   – Read out the last 20 errors of the frequency converter (“Time elapsed” field)
   – All errors over lifetime incl. frequency (“Counter” field)
   – Read out operating hours (600V DC power supply)
   – Possible to record data

In both cases, the frequency converter must be provided with 600V DC
   – Hybrid system must be active (motor started)

5.6 Inspecting functionality of individual components

The inspection of individual components may take the form of a visual inspection or manual electric inspection. In addition, electrical components can be inspected using the SCT components test. A compilation of these can be found in Table 501.
Details can be found in “OI REVO-E Diagnostics“ Chap. 3.5 SPHEROS Control Test.

Components	Measured values	Measurement steps
Axial fans	Speed	0%/ 50%/ 80%/ 100%
Double radial blowers	Speed	0%/ 50%/ 80%/ 100%
Compressor[1)]	Speed	32%/ 50%/ 100%
Solenoid valve	Position	opened / closed
Low pressure switch[1), 2)]	Position	switched off
High pressure switch[1), 3)]	Position	switched off
Position of air valves	Position	Fresh air / recirculating air

Table 501

1) When switching off compressor, error F18 will be marked for 1 min.
2) Adjustment forces system into low pressure range until shut off.
3) Adjustment forces system into high pressure range until shut off.

5.6.1 General visual inspection

– Inspect components for damage (cracks, deformation, seal, discoloration, etc.) and replace, as needed.
– Inspect plugs and lines for corrosion, (loss of) contact, crimping errors, etc. and repair, as needed.
– Inspect plug contacts for corrosion and proper seating, repair as needed.
– Visually examine all electric lines (high and low voltage) for abrasion

5.7 Diagnosing the REVO-E using the SPHEROS Control Test – SCT diagnostic software

Information about this can be found in the operating instructions “OI REVO-E Diagnostics“, Chap. 4.

5.8 Diagnosing the frequency converter

Information about this can be found in the operating instructions “OI REVO-E Diagnostics“, Chap, 5 / Attachment EPA instructions for searching for errors.

6 Wiring diagrams

The chapter contains the wiring diagram and fuse assignment for the following systems:
- REVO-E Master
- REVO Slave (articulated bus)
- Electrical connections electrical components

NOTE:

For the wiring diagram, keep in mind:
- All lines without information on the cross-section have A=0.75mm^2
- Lines without color information = white
- Illustrations are generally without power or pressure

6.1 Electrical fuses

REVO-E Master:

Secured components	Fuse	Fuse value
Double radial blower right	F1	15
Double radial blower right	F2	15
Double radial blower right	F3	15
Double radial blower left	F4	15
Double radial blower left	F5	15
Double radial blower left	F6	15
Axial fan	F7	20
Axial fan	F8	20
Axial fan	F9	20

REVO Slave:

Secured components	Fuse	Fuse value
Double radial blower right	F1	15
Double radial blower right	F2	15
Double radial blower right	F3	15
Double radial blower left	F4	15
Double radial blower left	F5	15
Double radial blower left	F6	15

6.2 REVO-E Master wiring diagram

Fig. 601 (pages 1 - 6) includes the wiring diagram for the REVO-E Master.

6.3 REVO Slave circuit diagram

Fig. 602 (pages 1 - 3) includes the wiring diagram for the REVO Slave.

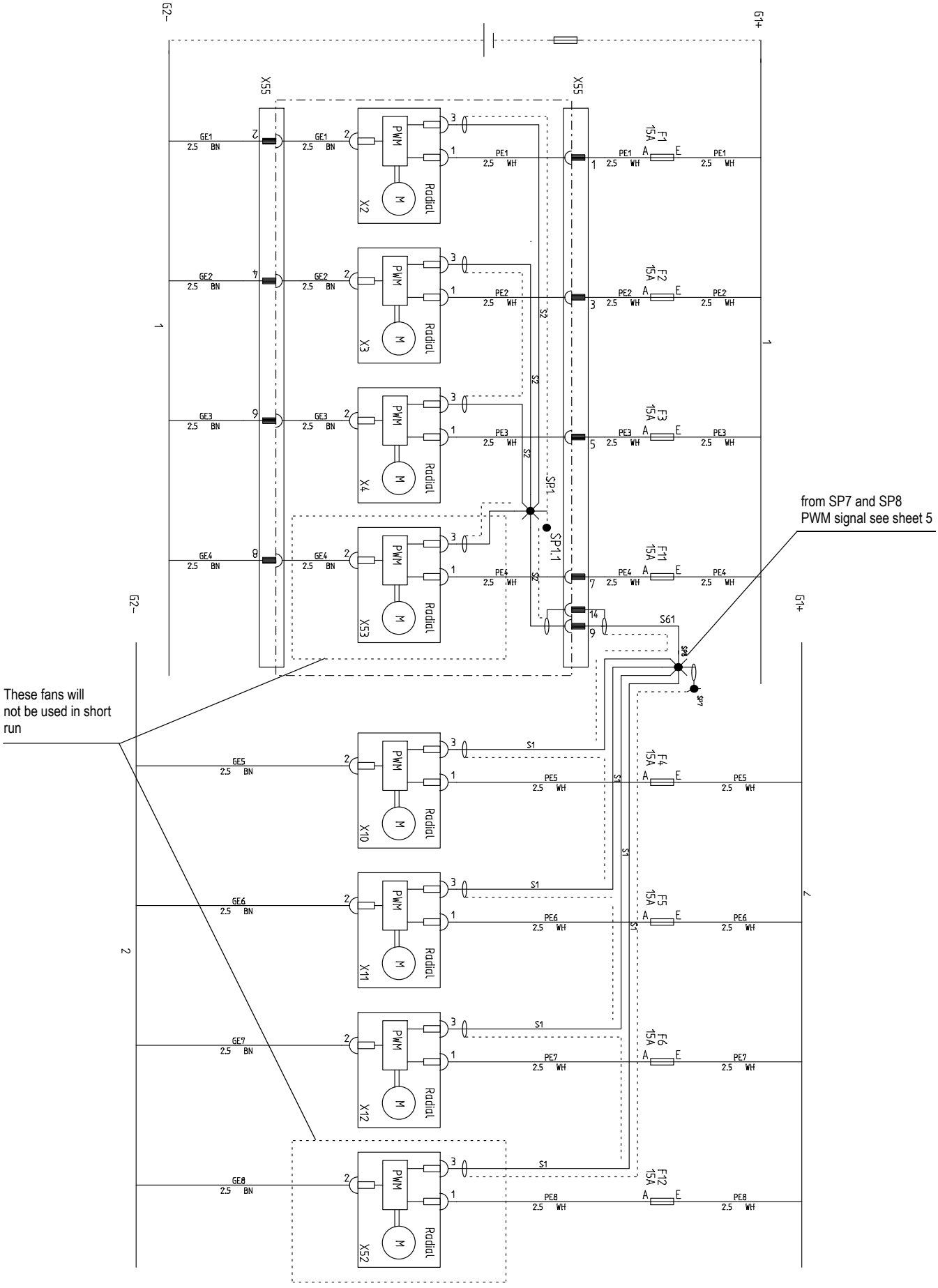


Fig. 601 Wiring diagram for REVO-E (Sheet 1)

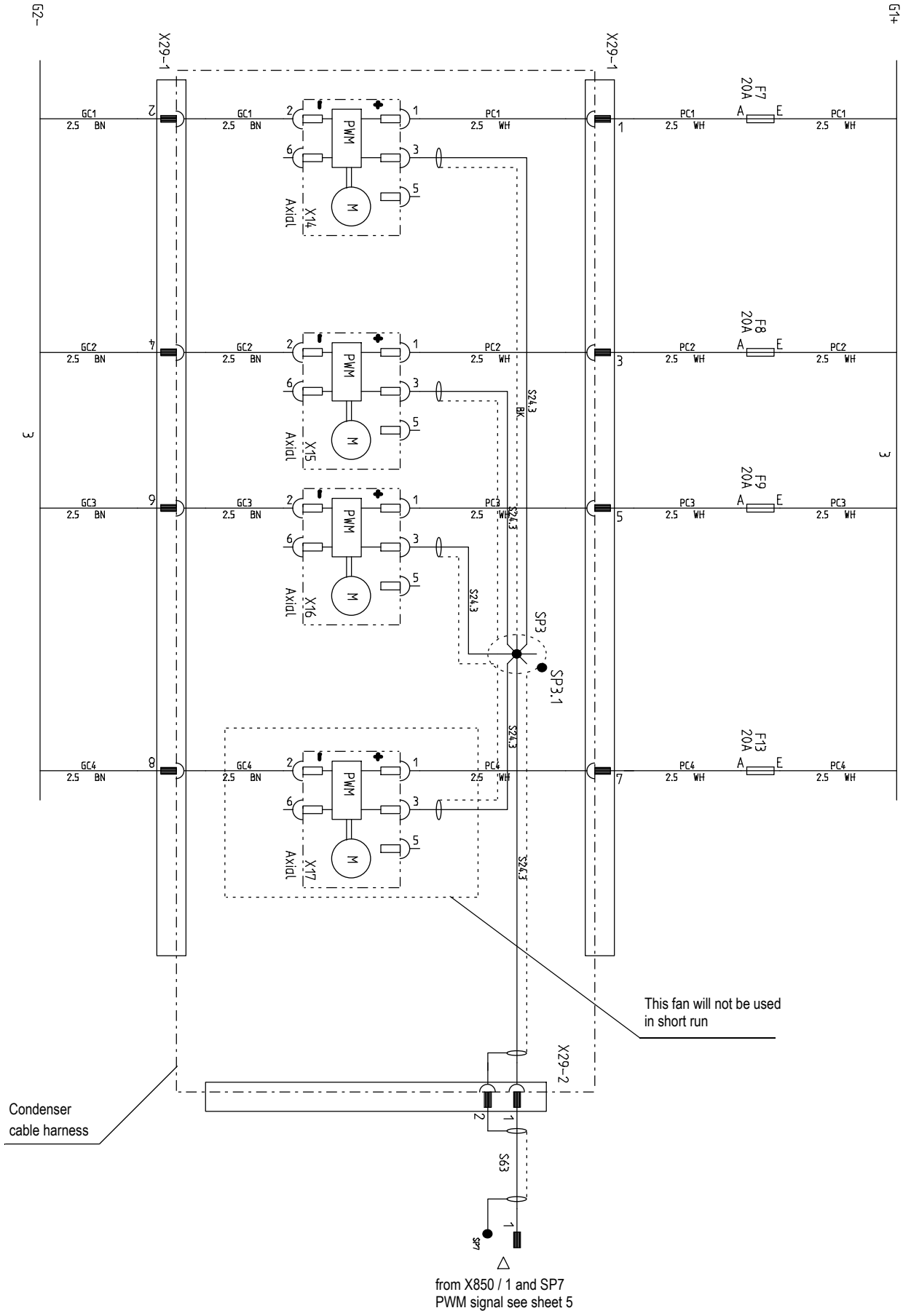


Fig. 601 Wiring diagram for REVO-E (Sheet 2)

Volvo Interface

X133:6 with =<10A Fuse

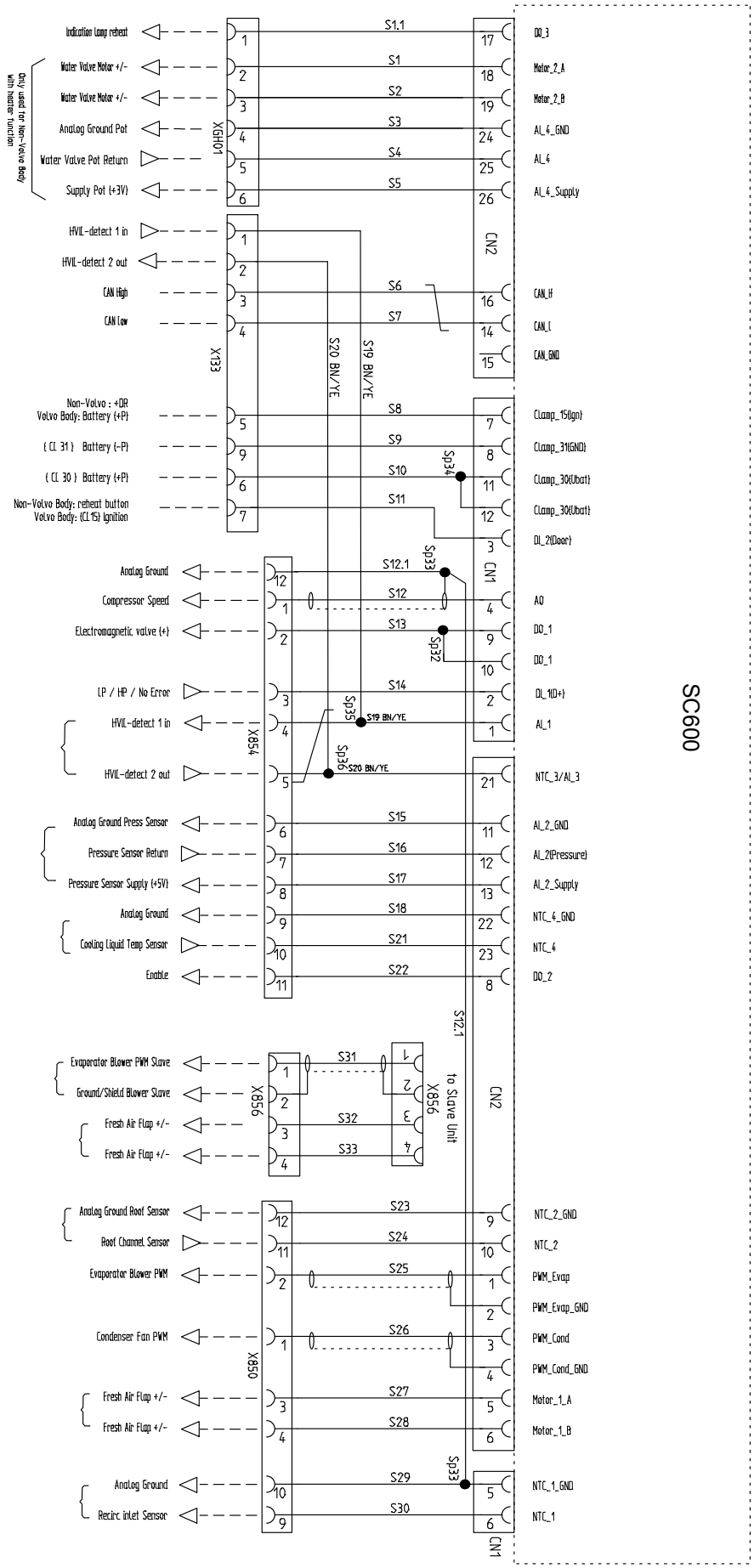


Fig. 601 Wiring diagram for REVO-E (Sheet 3)

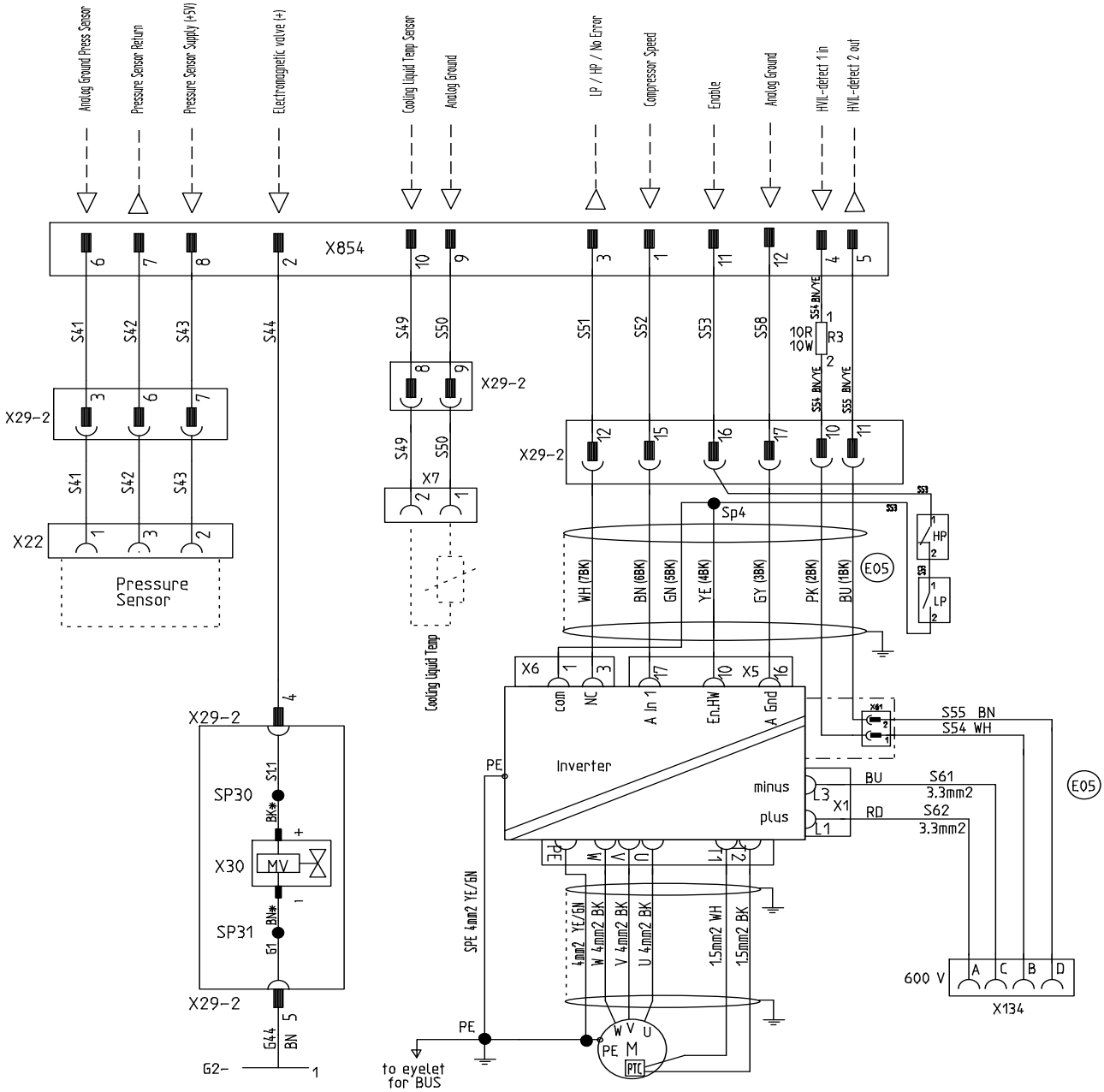


Fig. 601 Wiring diagram for REVO-E (Sheet 4)

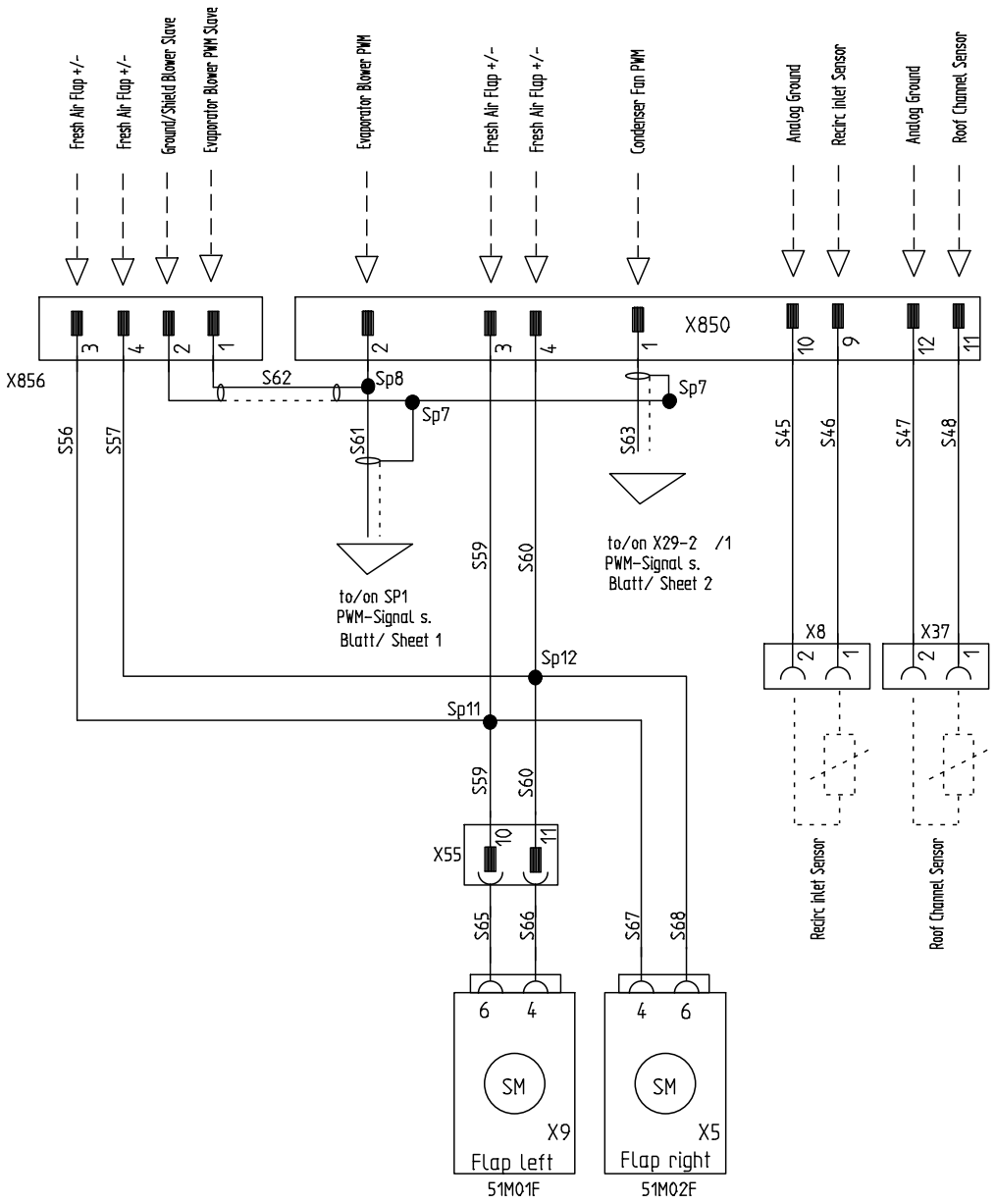


Fig. 601 Wiring diagram for REVO-E (Sheet 5)

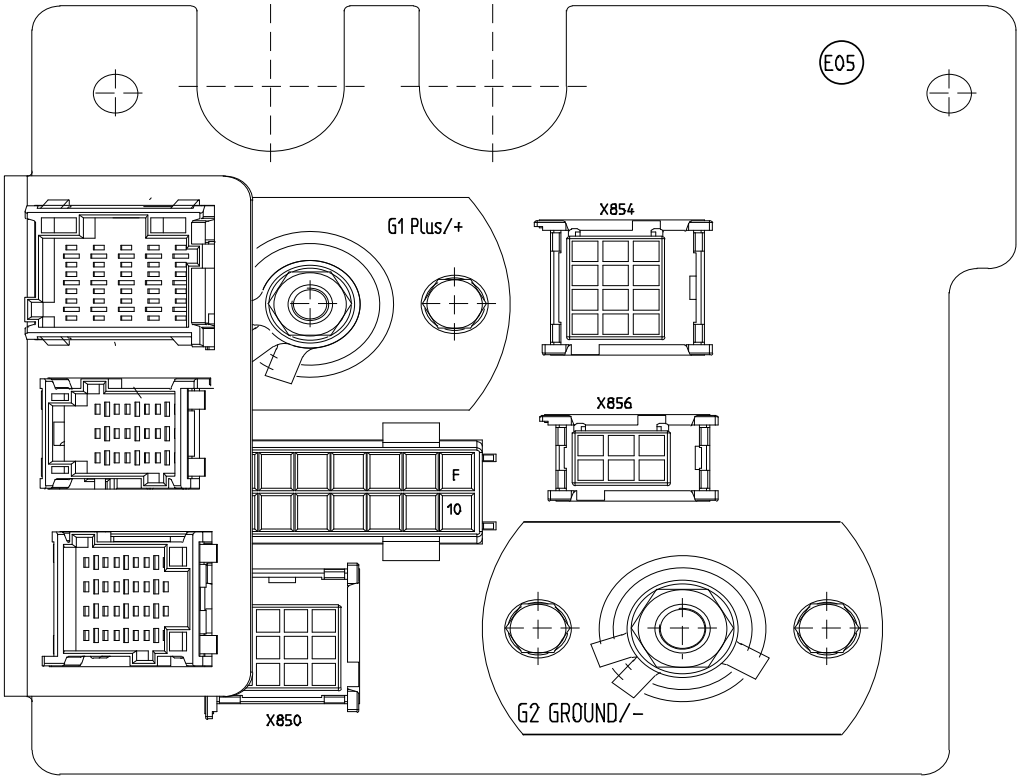


Fig. 601 Wiring diagram for REVO-E (Sheet 6)

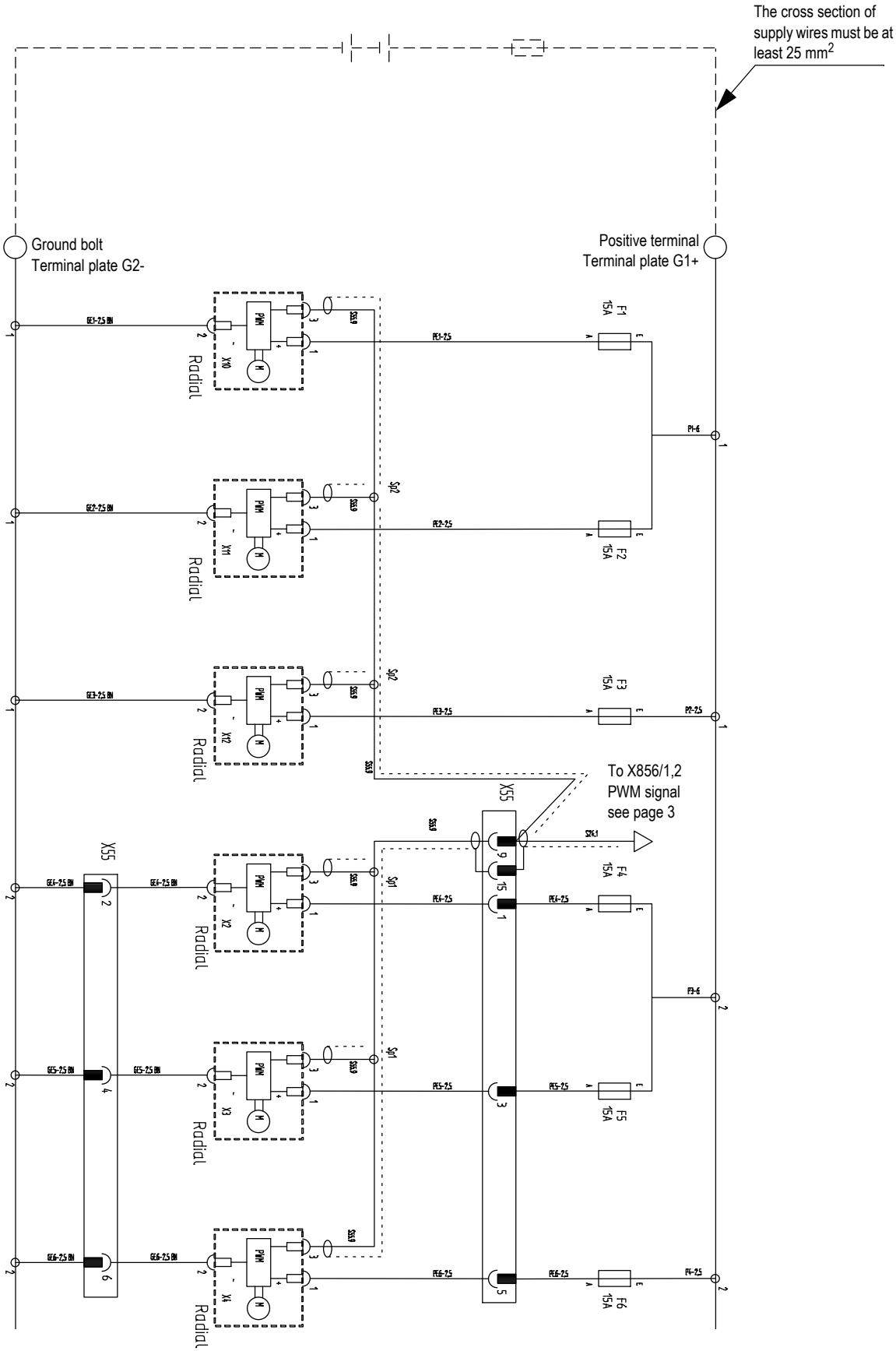


Fig. 602 Wiring diagram for REVO Slave (Sheet 1)

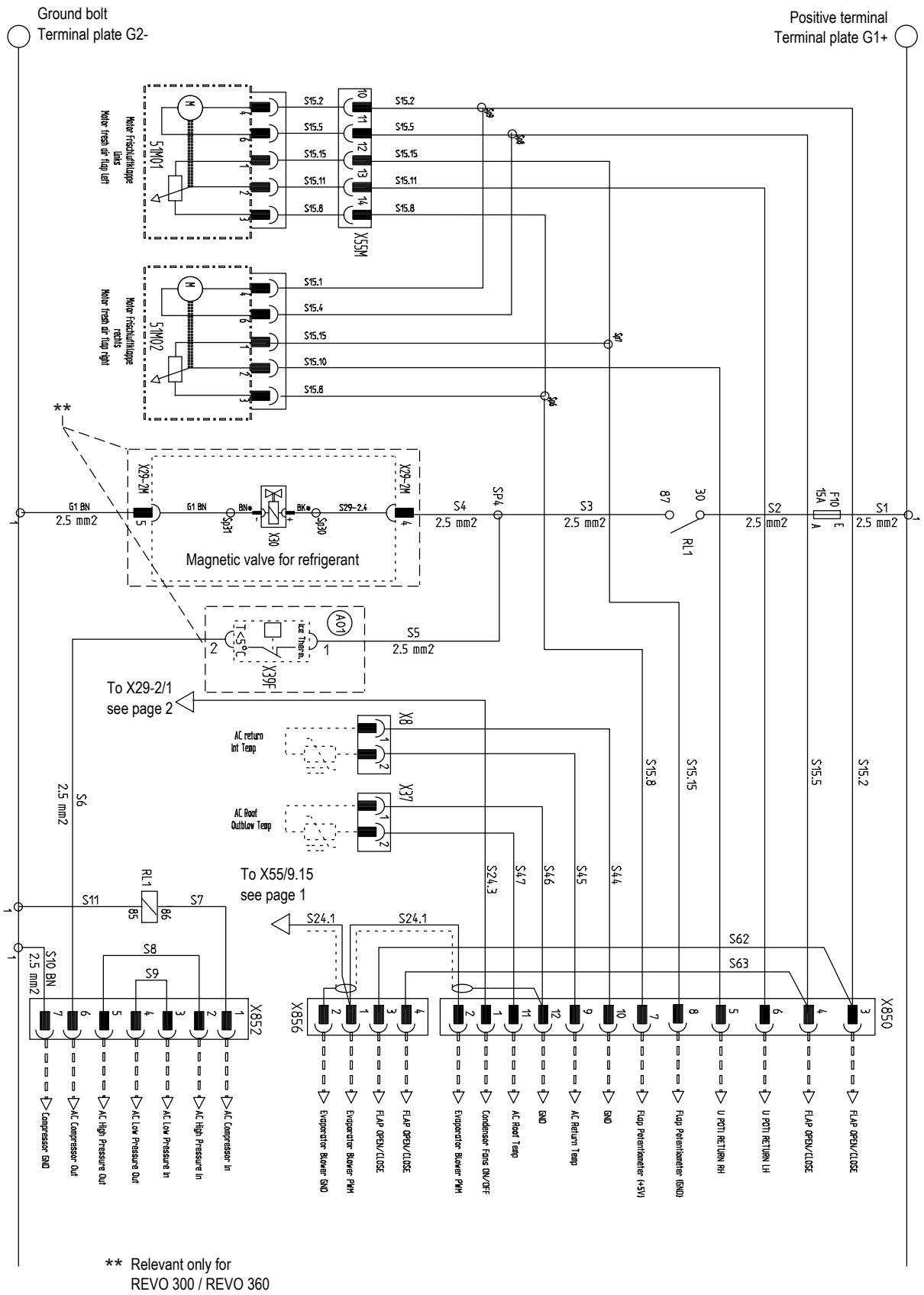


Fig. 602 Wiring diagram for REVO Slave (Sheet 2)

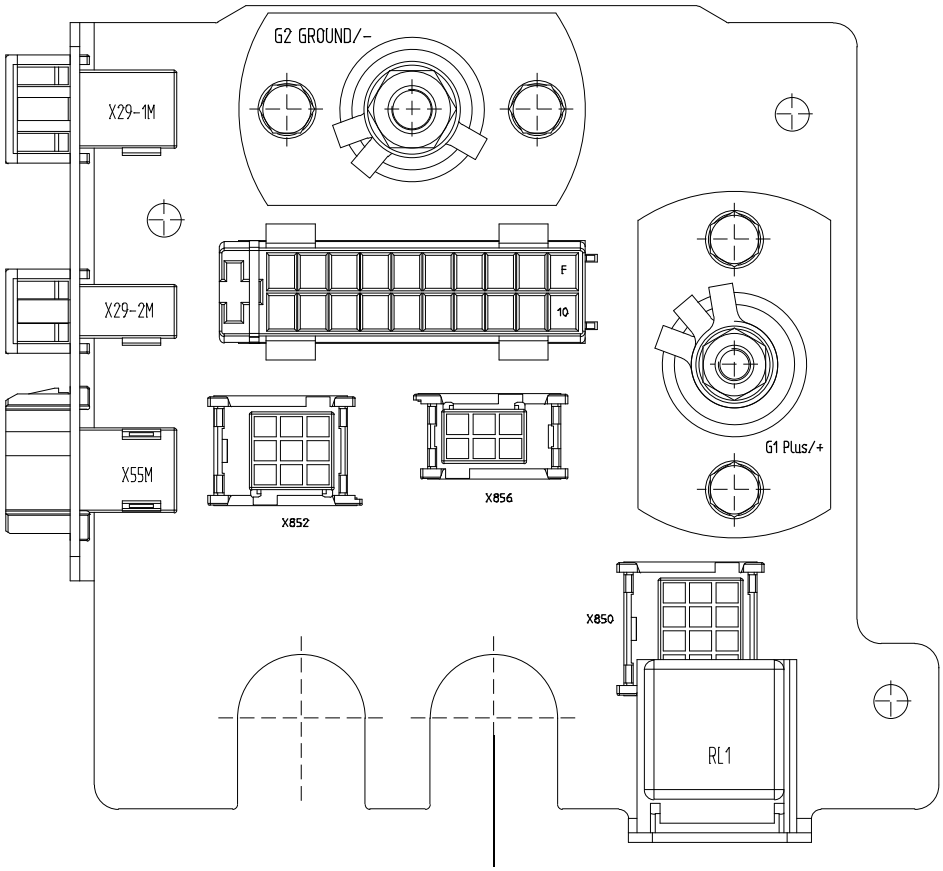


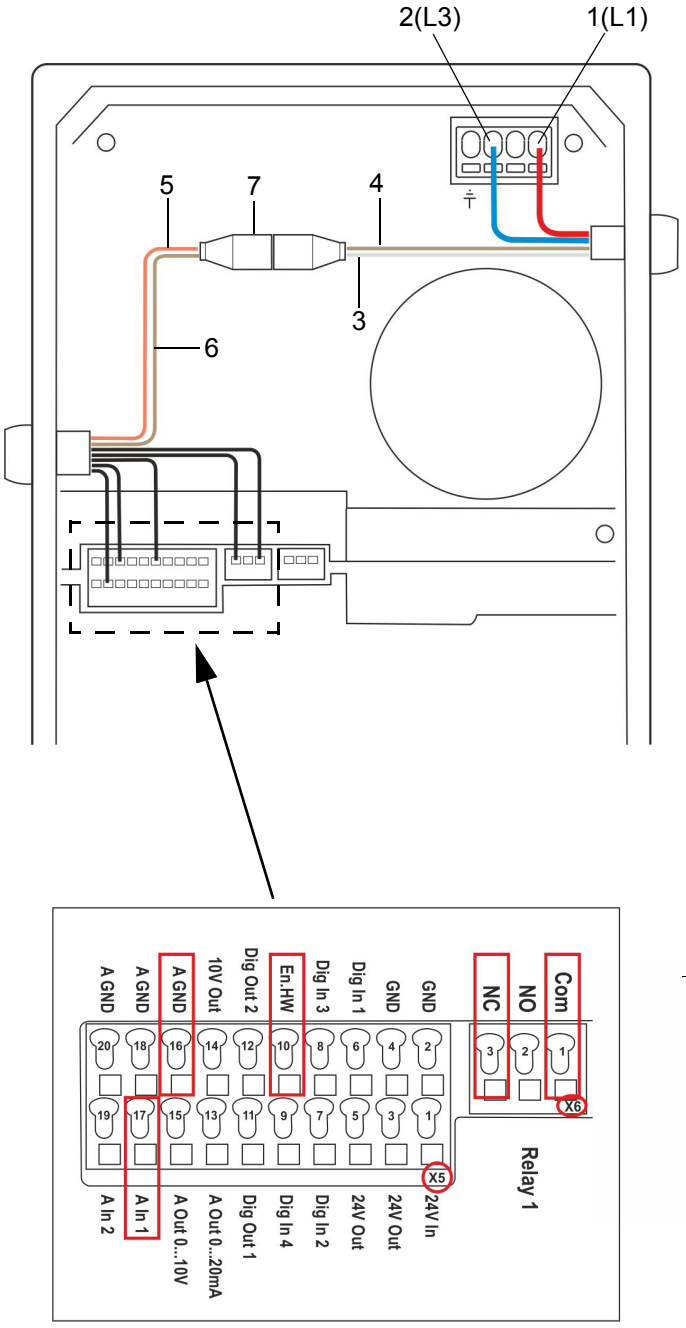
Fig. 602 Wiring diagram for REVO Slave (Sheet 3)

6.4 Frequency converter - electrical connections

6.4.1 600V DC power supply including HVIL connector

The air-conditioning system is linked to the HVIL monitoring system via the 600V DC wiring harness.

Inspect the operating voltage at the connections L1 (Pos1) and L3 (Pos2) with the designated voltage tester (CAT IV), see Fig. 603.



Application map

No.	Designation	Configuration	Cable color
1	L1	DC network (+)	Red
2	L3	DC network (-)	Blue
3	HVIL in vehicle	X61 Pin 1	White
4	HVIL out of vehicle	X61 Pin 2	Brown
5	HVIL in system	X61 Pin 1	Pink
6	HVIL out of system	X61 Pin 2	Brown

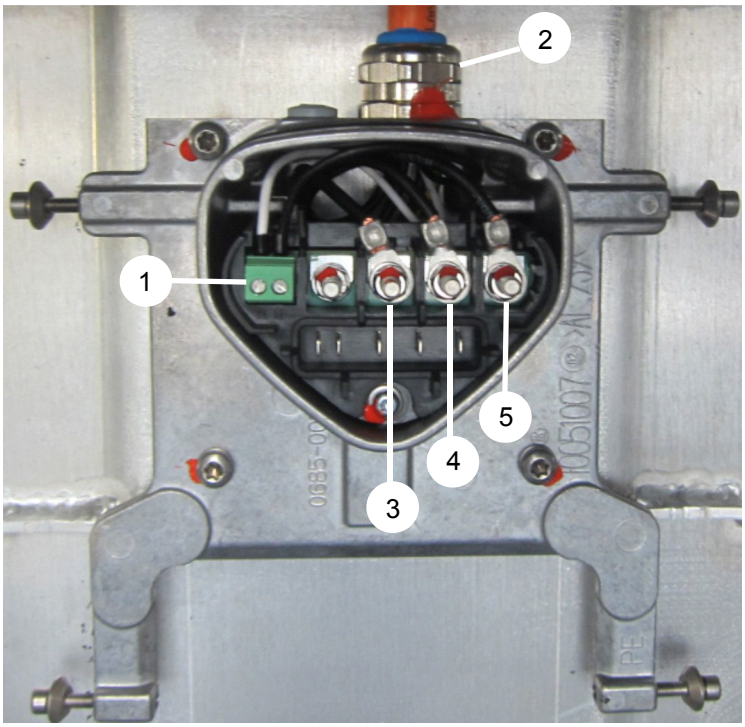
Strip	No.	Designation	Configuration	Cable color	Cable no.
X5	10	EN-HW	Approval	Yellow	4
	16	A GND (Ground 10V)	Ground	Gray	3
	17	A. In 1	Desired speed of compressor	Brown	6
X6	1	Com	Center contact of relay 1	Green	5
	3	NC	Break contact of relay 1	White	7

Cable assignment for application map

Fig. 603 Power supply 600V DC including HVIL connector

6.4.2 400V AC voltage output

The PE line as well as the lines to monitor the PTC sensor of the e-motor for the compressor are integrated into this cable in addition to the live wires.



1 Connection for PTC sensor e-motor for compressor
2 Cable connection for 400V AC cable
3 U – connection
4 V – connection
5 W – connection
6 PE (within connection plate)

Phase designations on the individual cables must correspond to the designations on the compressor (cover graphic).

U <-> U
V <-> V
W <-> W

Fig. 604 Voltage output 400V AC

6.4.3 PE connection (potential equalizing)

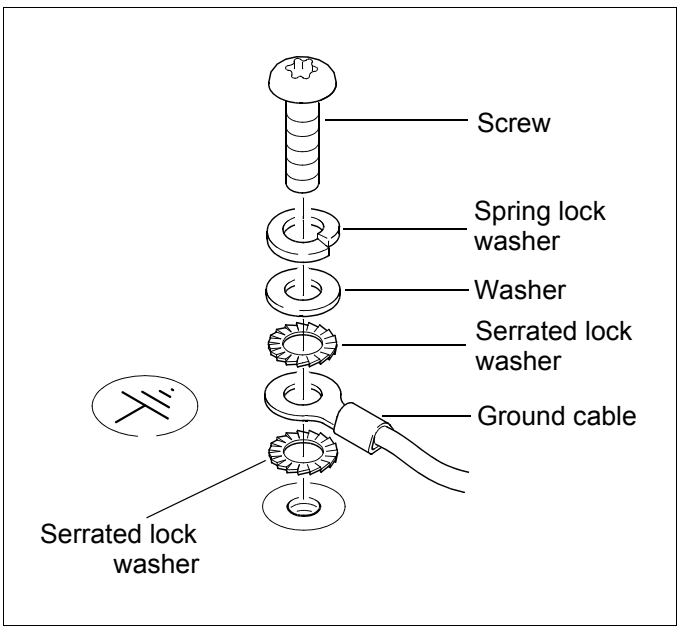
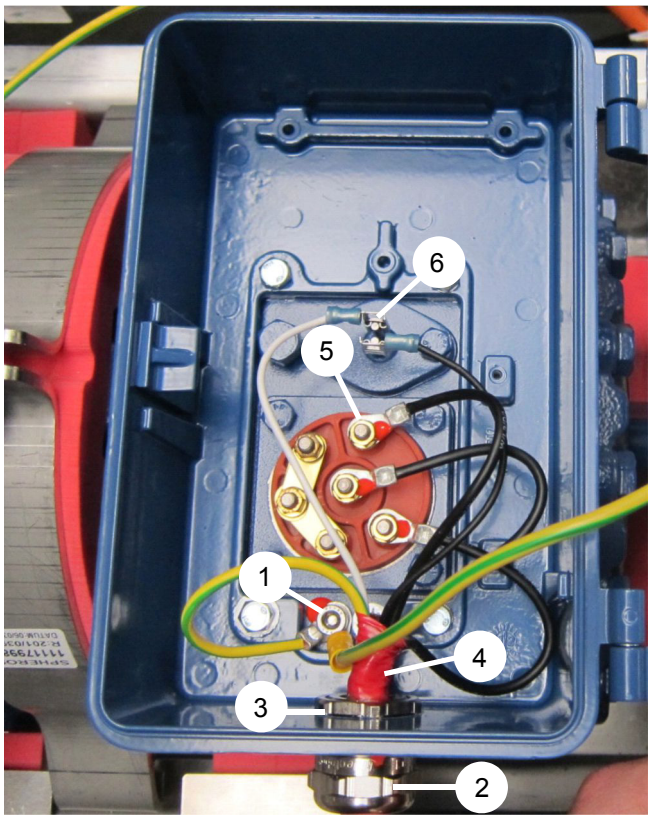


Fig. 605

In order to guarantee a secure electrical connection when connecting the PE line, the order of the individual parts must be maintained (Fig. 605).

6.5 Compressor - electrical connections

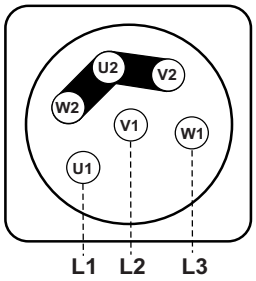
6.5.1 400V AC voltage supply



1 PE connection
2 Cable gland
3 Cable gland lock nut
4 Position marking cable
5 Phase connections for 400V AC (3)
6 Connection for PTC sensor for electrical motor

The position marking cable must be secured with lock nut during assembly.

Phase designations on the individual cables must correspond to the designations on the compressor (cover graphic).
U <-> U
V <-> V
W <-> W



PE line is connected.
Cable for PTC sensor for e-motor is plugged in.

Fig. 606 Voltage supply 400V AC

6.5.2 PE connection (potential equalizing)

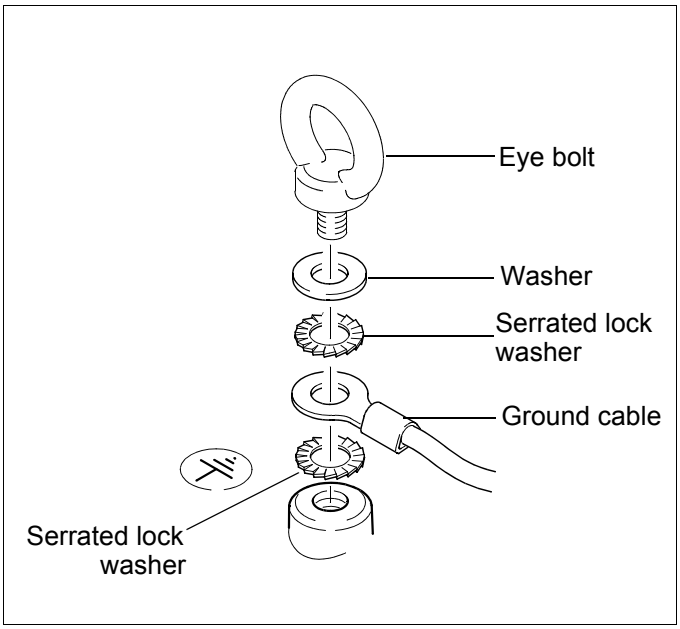


Fig. 607

In order to guarantee a secure electrical connection when connecting the PE line, the order of the individual parts must be maintained (Fig. 607).

7 Maintenance

7.1 Safety information

Warning!	Potential risk to health and life!

Follow the safety information and conditions from Chapter 1 (see 1.6).

Warning!	High voltage! Caution Mortal danger!

The work described in the following requires proof of the following qualifications:
See 1.6.1.

7.2 Maintenance and upkeep

Details can be found in the REVO-E maintenance and service plan (for the download link, see 1.5).

7.3 Inspection and maintenance

The rules in the evacuating and filling instructions for the REVO-E apply (for the download link, see 1.5).
For work from this chapter where opening the air-conditioning circuit is required, carry out the following preparation and follow-up work.

Preparation work
- Vehicle / air-conditioning system powered off (primary switch / battery disconnection switch)
- If necessary, remove protective cover for the compressor / frequency converter
- Open the side covers of the air-conditioning system and prop up with rods (attached to cover)
- Remove the coil of the solenoid valve and replace with permanent magnet
- Siphon refrigerant via high and low pressure connections on the compressor
- As soon as the system is open, always plug the openings with designated stoppers (prevents water absorption via refrigerator oil)

Follow-up work
- Exchange filter dryers
- Evacuation the air-conditioning system
- Check tightness

ATTENTION:
The maximum pressure is 17 bar, the suction pressure sensor will become damaged otherwise!

- Fill the air-conditioning system with R134a
- Remove the permanent magnet from the magnet valve and install the coil
- Mount / close the cover
- Test functionality
- Inspect oil level after 10 minutes of running system.

7.3.1 Changing the fresh air filter

- Remove filter
- Clean filter area carefully
- Inspect heat exchanger for contamination / damages
- Insert filter

ATTENTION!

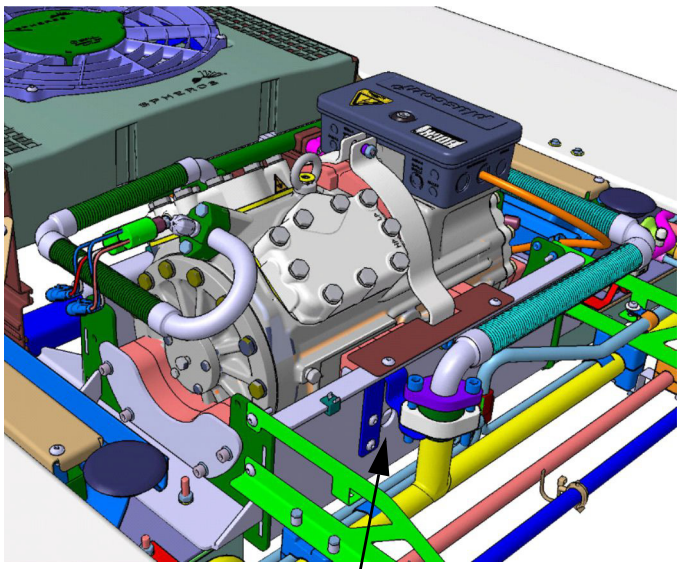
Note the position / direction of air flow exactly. Arrow marks on the upper edge of the filter in the direction of the heat exchanger.

7.3.2 Changing the filter dryer

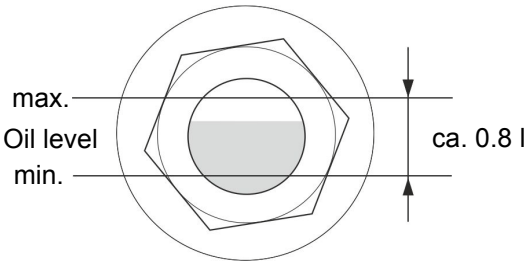
The replacement intervals for the filter dryer are found in the maintenance and service plan.
For removal and insertion, see Chapter 9.5.

7.3.3 Inspecting the oil level of the compressor

Inspect the oil level after at least 10 minutes of running the system.
Inspect the oil level by opening the rear side of the compressor pan (Fig. 701).
The correct oil level is between the minimum and maximum display Fig. 701. For deviations, see Chapter7.3.4.



Opening for sight glass



Sight glass

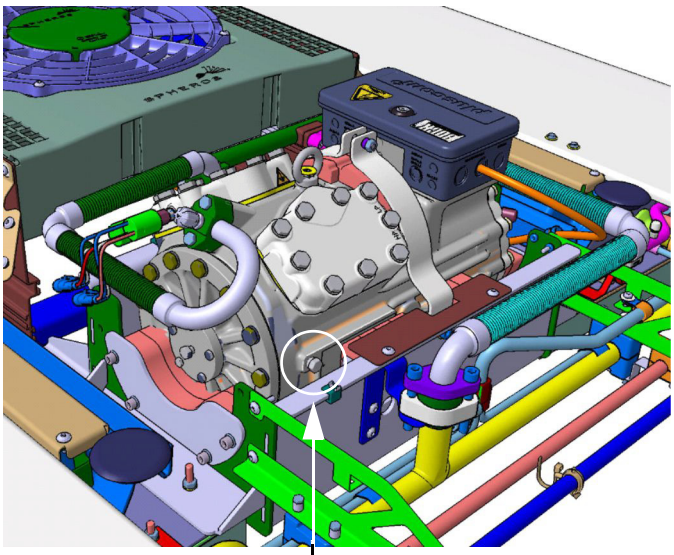
Fig. 701

7.3.4 Changing the compressor oil

NOTE:
For this procedure, follow the preparation and follow-up work described in 7.3.

Always change the compressor oil when conducting servicing or repair work on the compressor.
Open the oil filling screw (Fig. 702), siphon out the old oil and feed in the new oil.
The amount of oil to put in corresponds to the amount taken out. The oil level, however, must be verified using the sight glass after running the system for 10 min.
The following refrigerator oils are approved for use in the compressor:

– Fuchs Reniso Triton SE55
– Fuchs SEZ 32
– ICI Emkarate RL 46 S
– Mobil Arctic AL46
– Shell Clavus R 46



Filling screw
Compressor oil

Fig. 702

8 Removal and installation of components (high-voltage system)

8.1 Safety information

Warning!	**Potential risk to health and life!**

Follow the safety information and conditions from Chapter 1 (see 1.6).

Warning!	**High voltage! Caution Mortal danger!**

The work described in the following requires proof of the following qualifications:
See 1.6.1.

It is strictly forbidden to work on high-voltage components that are under voltage! MORTAL DANGER !!

8.2 Preparation/follow-up

The use of a suitable and secure lifting device is required when lifting heavy components.

Warning!	**Risk of injury from falling components of the air-conditioning system!**

Use only suitable and technically secure lifting devices (>100kg).

Do not stand under suspended loads!

8.2.1 High-voltage system

The vehicle's battery system must be separated by an authorized (by the vehicle manufacturer) and trained specialist of high-voltage systems (decommissioning). The rules provided by the vehicle manufacturer must be followed precisely.

Before beginning any work on the high-voltage system, always make sure there is no voltage present at the power supply of the frequency converter, using a voltage tester (CAT IV) suitable for HV systems (Fig. 603 Chap. 6.4)!

8.2.2 Refrigeration section

When working on the refrigerant circuit, the rules for evacuating and filling the REVO-E apply. Replace the sealing rings from the opened connections and oil them before replacing (refrigerator oil). If opening the refrigerant circuit is required, the following preparation and follow-up work must be completed.

Preparation work
- Vehicle / air-conditioning system powered off (primary switch / battery disconnection switch)
- If necessary, remove protective cover for the compressor / frequency converter
- Open the side covers of the air-conditioning system and prop up with rods (attached to cover)
- Remove the coil of the solenoid valve and replace with permanent magnet
- Siphon refrigerant via high and low pressure connections on the compressor
- Close openings of components of the refrigerant circuit with suitable plugs (presents water absorption by the refrigerant oil)

Follow-up work
- Exchange filter dryers
- Evacuation the air-conditioning system
- Check tightness

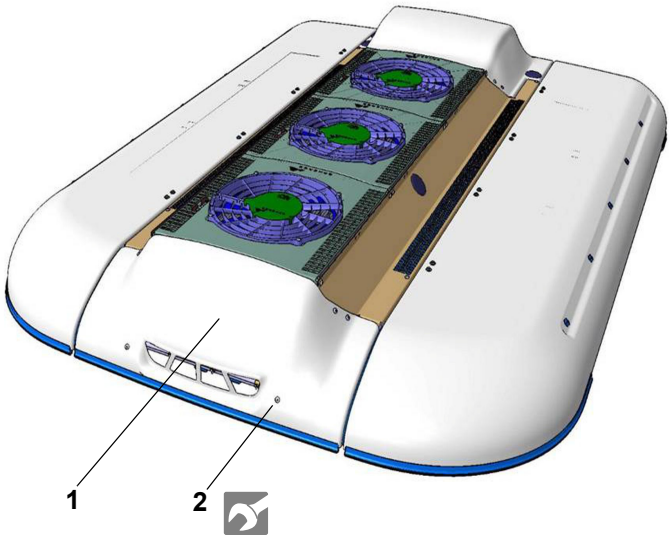
ATTENTION:
The maximum pressure is 17 bar, the suction pressure sensor will become damaged otherwise!

- Fill the air-conditioning system with R134a
- Remove the permanent magnet from the magnet valve and install the coil
- Mount / close the cover
- Test functionality

Torque table, see Attachment A.

8.3 Frequency converter removal/ installation

8.3.1 Remove the frequency converter

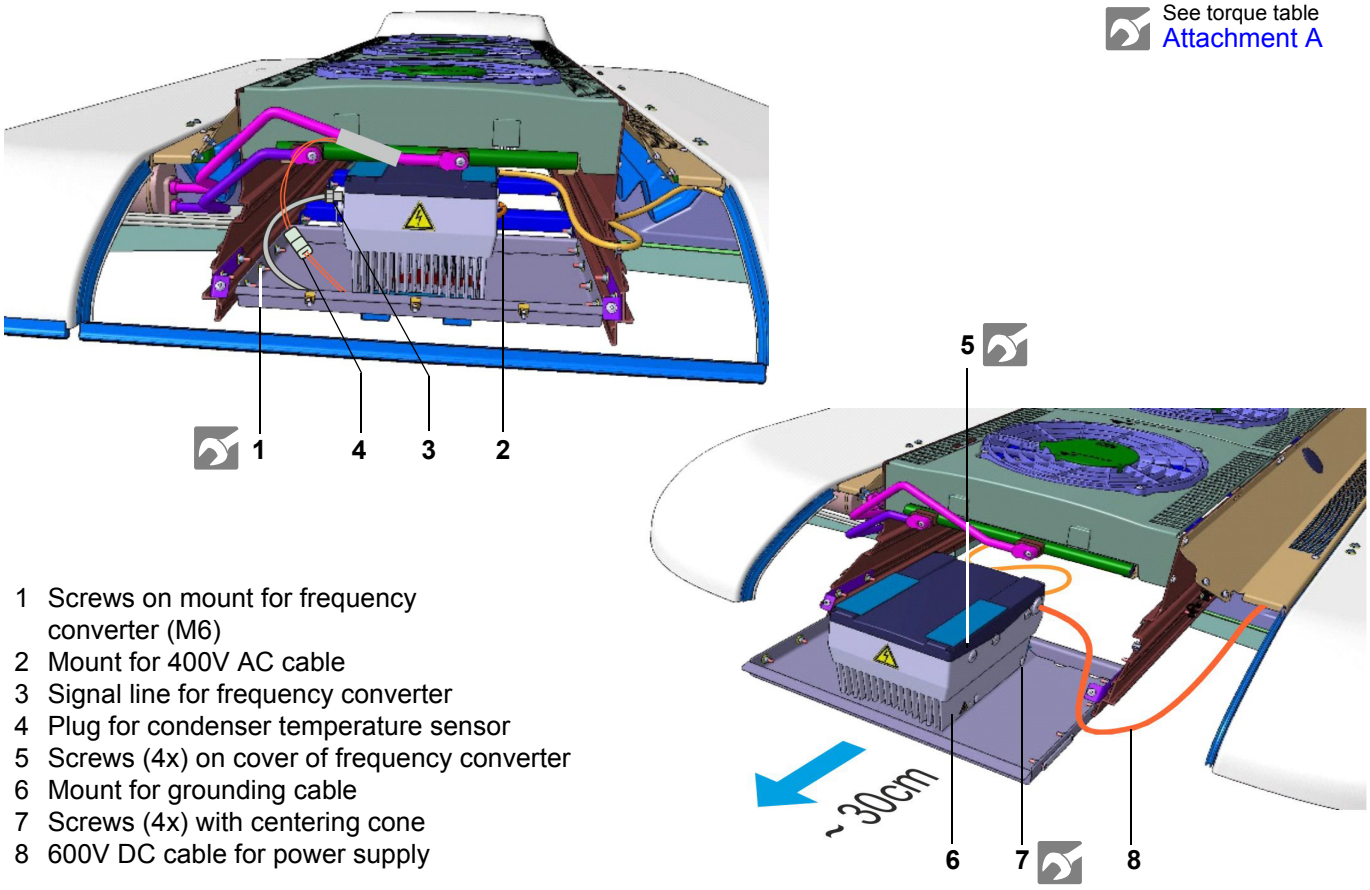


1 Cover of the frequency converter
2 Torx screws (6)

Fig. 801

1. Prepare to remove the frequency converter
   - Loosen the mount of the 400V AC cable (2) (cross-bars under condenser).
   - Open the plug for the temperature sensor (4) of the condenser.
   - Loosen the mount for the ground cable (6).
   - Loosen the eight screws (1) on the frequency converter's mount.
   - Take out the plate with frequency converter ca. 30 cm until the rear edge of the frequency converter is in front of the condenser pressure line connection.
   - Loosen the captive cover screws (5).
   - Lift the cover, remove the grounding cable.
2. Disconnect the electrical connections of the frequency converter.
   - Electrical connections, see Chap. 6.4.
   - Check voltage levels at connections L1 and L3 (Fig. 603) with suitable voltage tester (CAT IV).
   - Remove power supply from the terminal strip
   - Remove the HVIL plug.

See torque table Attachment A



1 Screws on mount for frequency converter (M6)
2 Mount for 400V AC cable
3 Signal line for frequency converter
4 Plug for condenser temperature sensor
5 Screws (4x) on cover of frequency converter
6 Mount for grounding cable
7 Screws (4x) with centering cone
8 600V DC cable for power supply

Fig. 802

- Remove cable screw for 600V DC cable (tension relief), remove from housing.
- Remove control lines from terminal strip of the application board (Fig. 603).
- Remove cable screw for signal cable (tension relief), remove from housing.
- Disconnect grounding cable from housing of frequency converter.
- Loosen cone screw Fig. 802, Pos 7.
- Remove frequency converter.

NOTE:
Inspect area and make sure there is sufficient free space (collision with condenser pressure line).

- Pull the frequency converter firmly up and off the mounting plate (Fig. 803).

8.3.2 Install the frequency converter

- Ensure that connection terminals U / V / W (Fig. 604) of the 400V AC cable for the mounting plate are securely fastened.
- Set the frequency converter on the mounting plate (Fig. 803), the collar of the plate will dip into opening in the bottom of the heat sink of the frequency converter.
- Inspect the positioning of the centering cone of the fastening screws.
- Attach the frequency converter.
- Pull the control line cable into the housing and attach cable gland.
- Connect control lines according to wiring diagram Fig. 603.
- Pull the 600V DC cable of the power supply into the housing and attach cable gland.
- Connect power supply according to wiring diagram Fig. 603.
- Connect the HVIL plug.
- Inspect the internal grounding cable to see if there is contact with the cover.
- Cover device with the cover and secure it against unauthorized access using sealing wax.
- Push the mount with frequency converter ca. 30 cm back under the condenser, tighten screws.
- Connect grounding cable to housing according to Fig. 605.
- Connect condenser temperature sensor.
- Install protective cover.
- Test functionality (using diagnostic as needed)

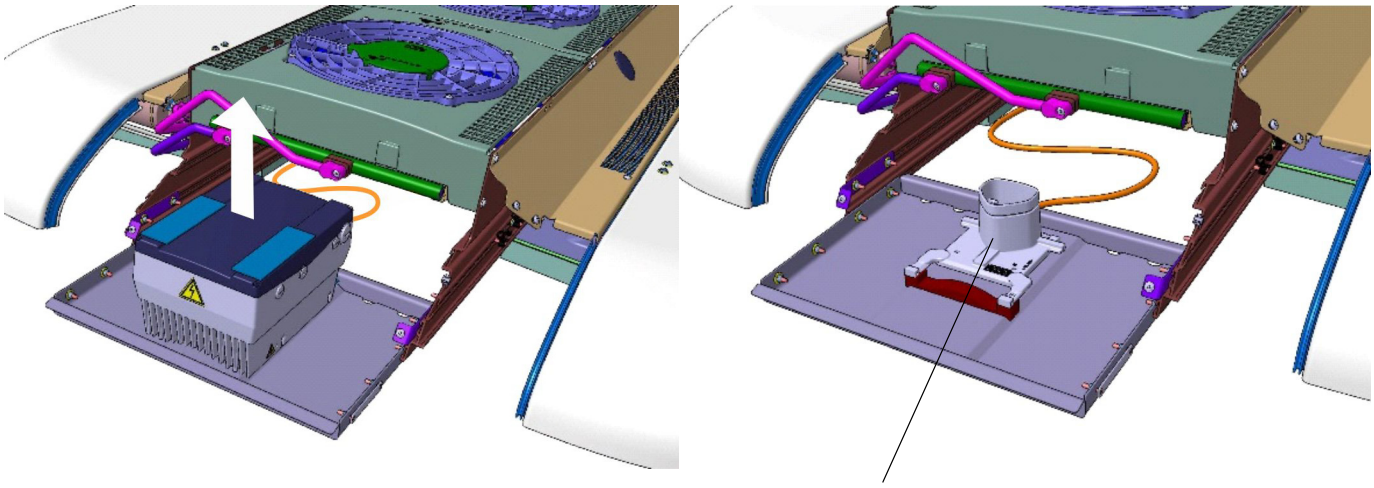
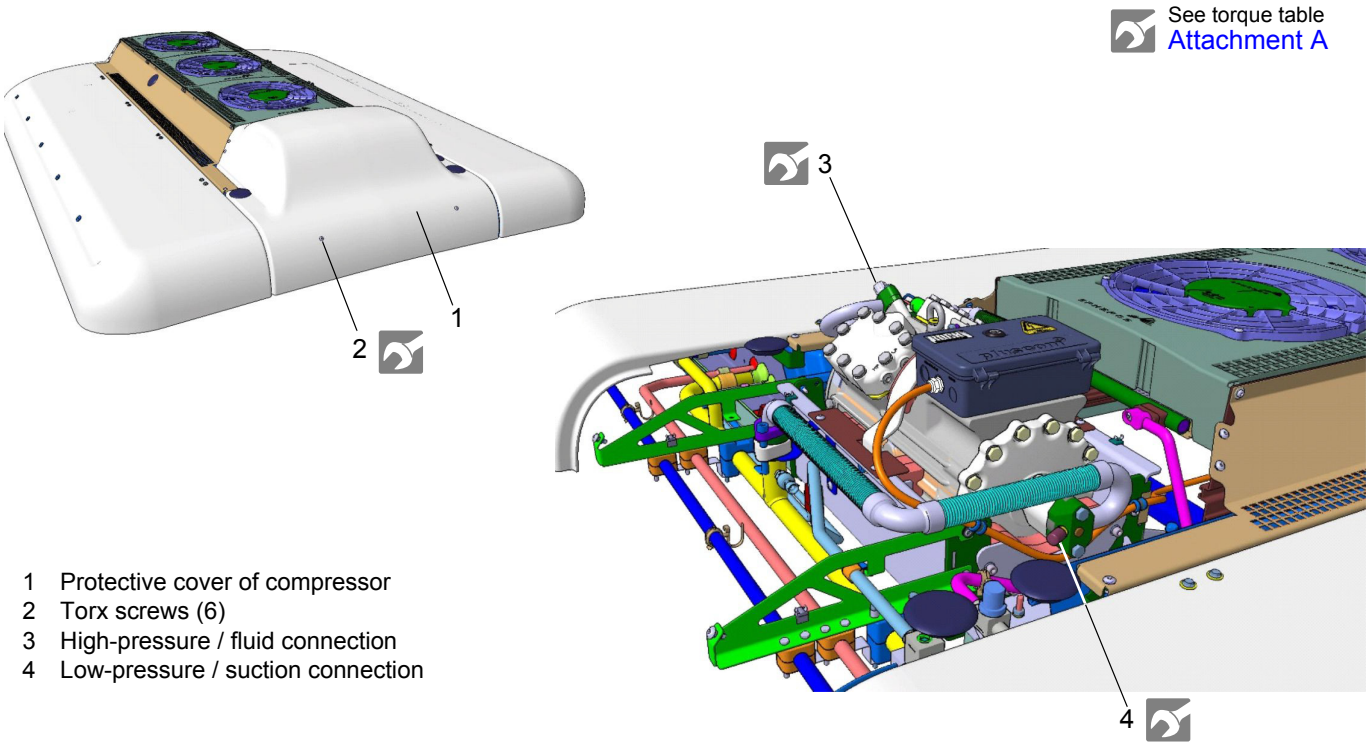


Fig. 803

8.4 Refrigerant compressor removal/ installation

8.4.1 Remove the compressor

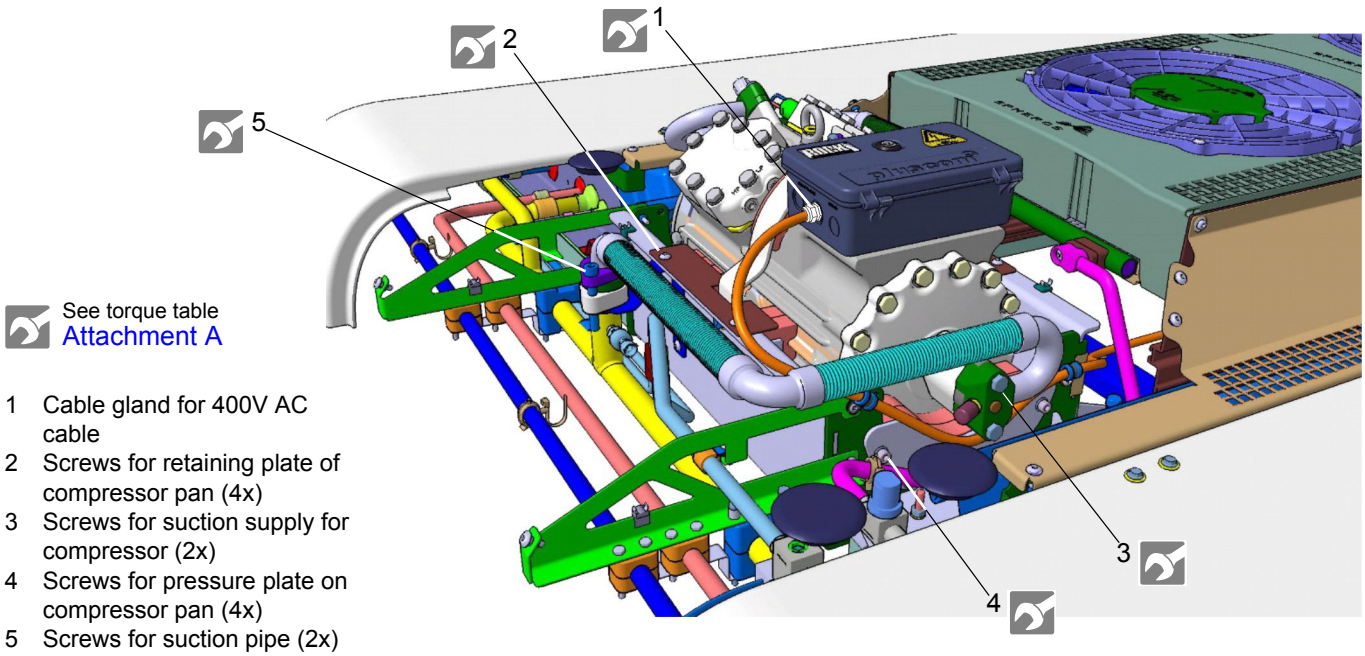
1. Preparation work, see 8.2.



1 Protective cover of compressor
2 Torx screws (6)
3 High-pressure / fluid connection
4 Low-pressure / suction connection

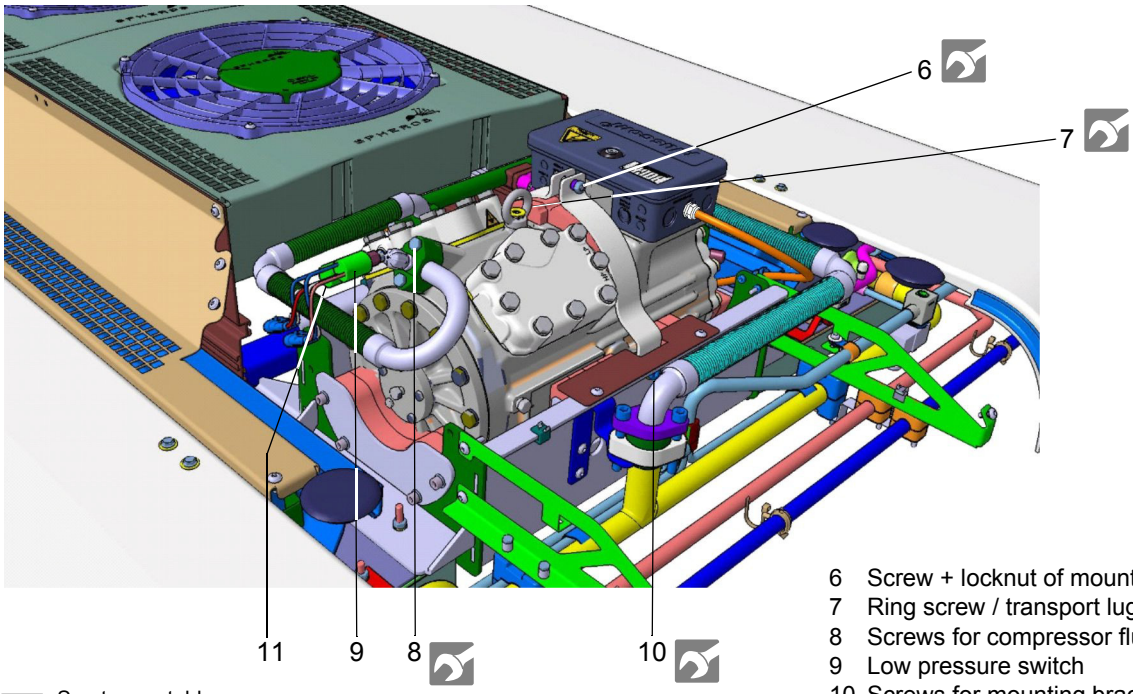
Fig. 804

2. Disconnecting the electrical lines
   - Open the terminal box of the compressor using the special key (attached to the compressor).
   - Loosen electrical connections, see Fig. 606.
   - Loosen lock nuts (3, Fig. 606) of the cable glands for the 400V AC cable and pull the cable out of the terminal box.



1 Cable gland for 400V AC cable
2 Screws for retaining plate of compressor pan (4x)
3 Screws for suction supply for compressor (2x)
4 Screws for pressure plate on compressor pan (4x)
5 Screws for suction pipe (2x)

Fig. 805



See torque table Attachment A

6 Screw + locknut of mounting bracket
7 Ring screw / transport lug / grounding
8 Screws for compressor fluid lines
9 Low pressure switch
10 Screws for mounting bracket of compressor (both sides)
11 High pressure switch

Fig. 806

3. Remove attachments / connections
   - Remove 24V cables from compressor pan (not pictured).
   - Remove screws (2) that attach the retaining clamp to the compressor pan and remove retaining clamp.
   - Suction line (see 9.13).
   - Remove screws (4) that hold the pressure plate on the compressor and remove pressure plates.
   - Fluid line (see 9.13).
   - Low / high pressure switch (see 9.12).
   - Remove screws (6 and 10) that hold the mounting bracket and remove mounting bracket.
   - Separate grounding cable by pulling out ring screws (7) from compressor housing, screw ring screws back in.

4. Removing compressor
   - Lift compressor at the ring screw (7) from compressor pan with suitable lifting device.

NOTE:
Ensure components of the compressor mounting do not fall.

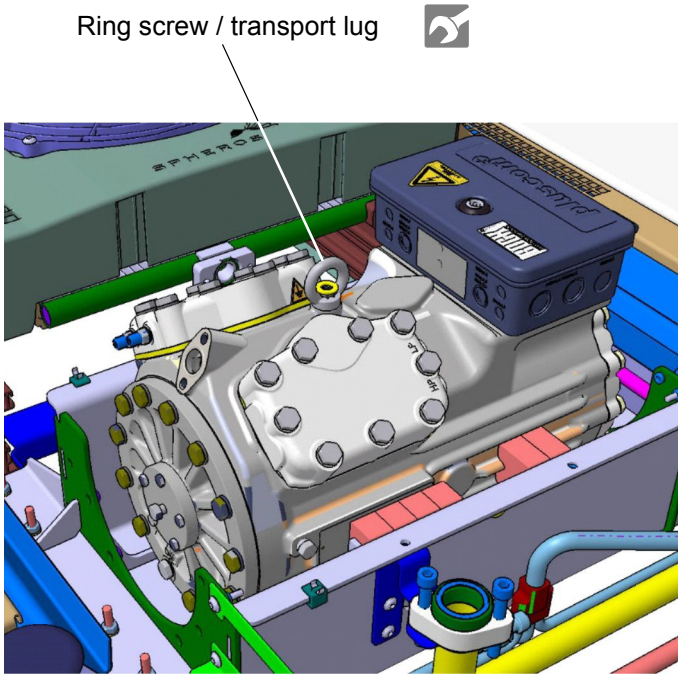


Fig. 807

8.4.2 Comparing the old/new oil level

While the air-conditioning system is being operated, some of the compressor oil will spread in the refrigerant circuit. The replacement compressor is already filled with 1.3 l of compressor oil. Before replacement, compare the oil levels of both refrigerant compressors via the sight glass and adjust the replacement compressor as needed in order to avoid overfilling the air-conditioning system (see 7.3.4). Note the minimum and maximum oil level.

Check, and adjust as needed, the oil level of the air-conditioning system after commissioning.

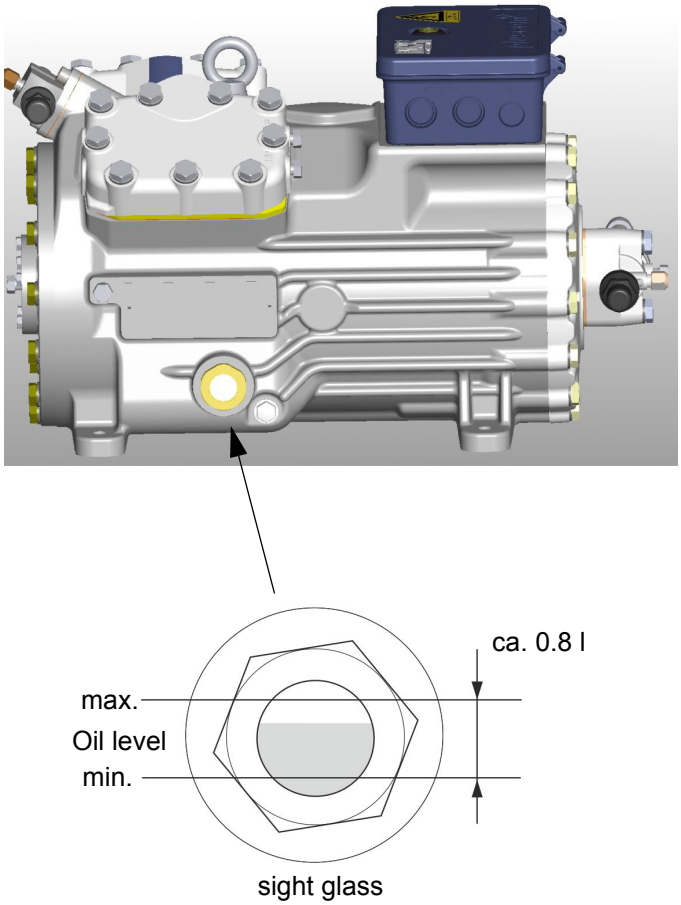
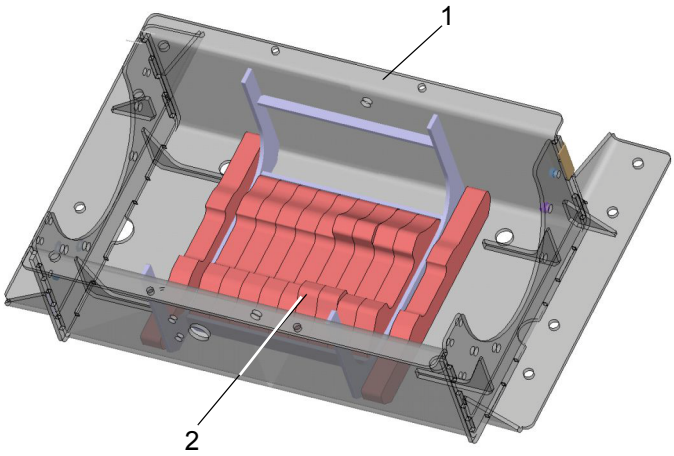


Fig. 808

8.4.3 Install the compressor

1. Set into the compressor pan
   - Inspect the positioning of the foam in the compressor pan (Fig. 809).
2. Insert and attach the compressor.



1 Compressor pan
2 Absorption foam of compressor

Fig. 809

- Lift the compressor on the ring screw with suitable lifting device and place into compressor pan with side foam (3, Fig. 810).

NOTE:
The sight glass oil level must be well visible when opening the compressor pan.

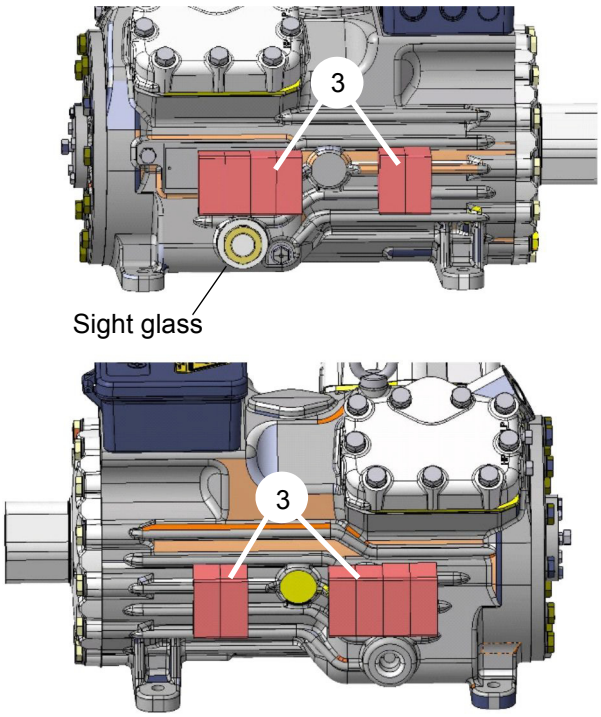


Fig. 810

- Insert foam (4, Fig. 811) on both long sides in the compressor pan and affix with compressor pressure plate.

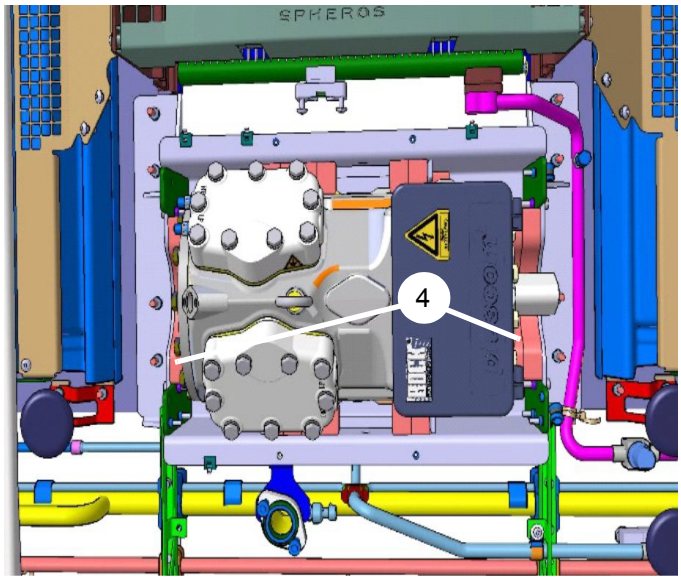


Fig. 811

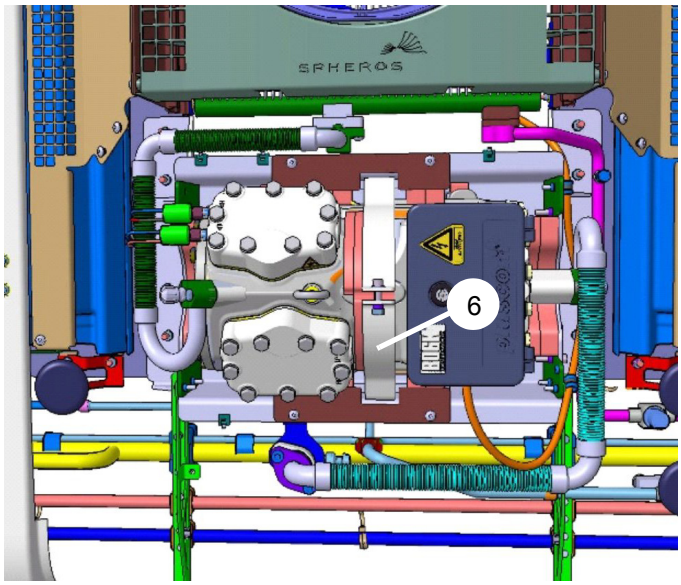


Fig. 813

- Align foam (5, Fig. 812) on the upper side of the compressor and reaffix compressor with mounting bracket (6, Fig. 813). Secure screw with sealing wax against unauthorized access.

NOTE:
Please always comply with given torque. Otherwise, the foam will lose its absorbent affect. This causes the transference of vibration to the bus roof.

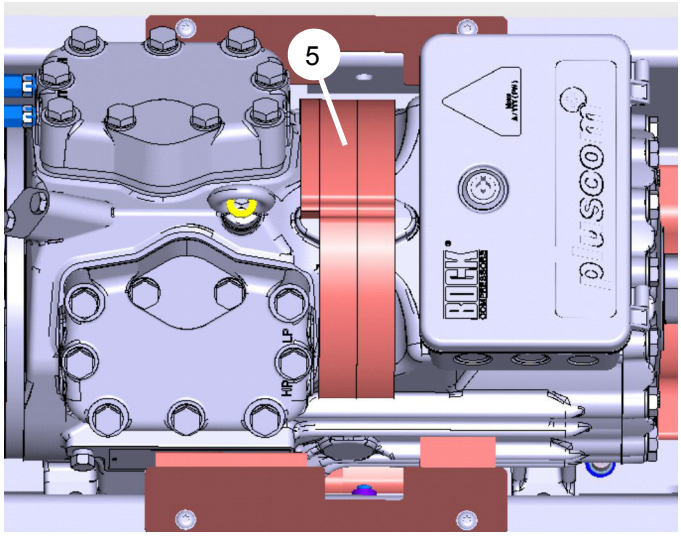


Fig. 812

- Install mounting parts of the compressor in the opposite order (Removing compressor, point 3.). Use new seals when removing the refrigerant cables.
- Lead the 400V AC cable through the opening in the terminal box of the compressor.
- Connect the compressor to the electrical system (see 6.5).
- Close the cap of the terminal box with the key. Reattach the key to the compressor.

8.5 600V DC/ 400V AC high-voltage cable removal/ installation

Warning!	High voltage! Caution Mortal danger!

Follow the safety information in 1.6.

8.5.1 Remove the 600V AC cable

The cable's path is described in 3.3, Fig. 4.

NOTE:
Do not replace individual components, for reasons of safety.

1. Preparation
   - Remove protective cover of the frequency converter, open right side cover of the air-conditioning system and prop open with bar (attached to cover).

Warning!	High voltage! Caution Mortal danger!

   - **Conduct work in accordance with 8.2.1 (high-voltage system).**
2. Removal
   - Separate vehicle connections to the REVO-E in the vehicle's interior.
   - Uncover and disconnect the 600V DC cable on the frequency converter (8.3.1 point 2.).
   - Dismount connector of plug from pan by loosening the lock nut on the lower side of the REVO-E (Fig. 814).
   - Loosen cable clamps in the compressor pan and pull out 600V DC cable.

8.5.2 Install the 600V DC cable

- Install cable in the opposite order. Connecting the clamps, see 6.4.

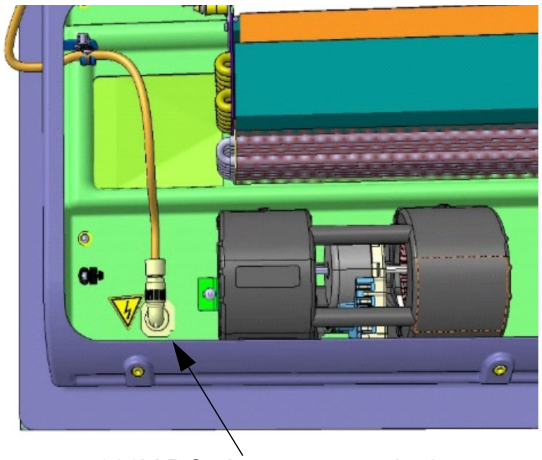
ATTENTION:

The cable must not touch any sharp edges - abrasion hazard!

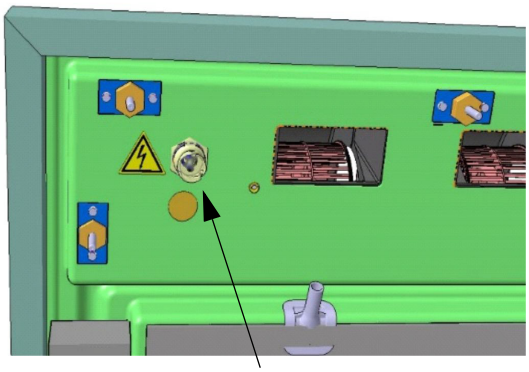
8.5.3 Remove the 400V AC cable

The cable's path is described in 3.3, Fig. 4.

NOTE:
The 400V AC cable is only preinstalled as a replacement part on the mounting plate of the frequency converter. Do not replace individual components.



600V DC plug connector in the air-conditioning system pan: View from above



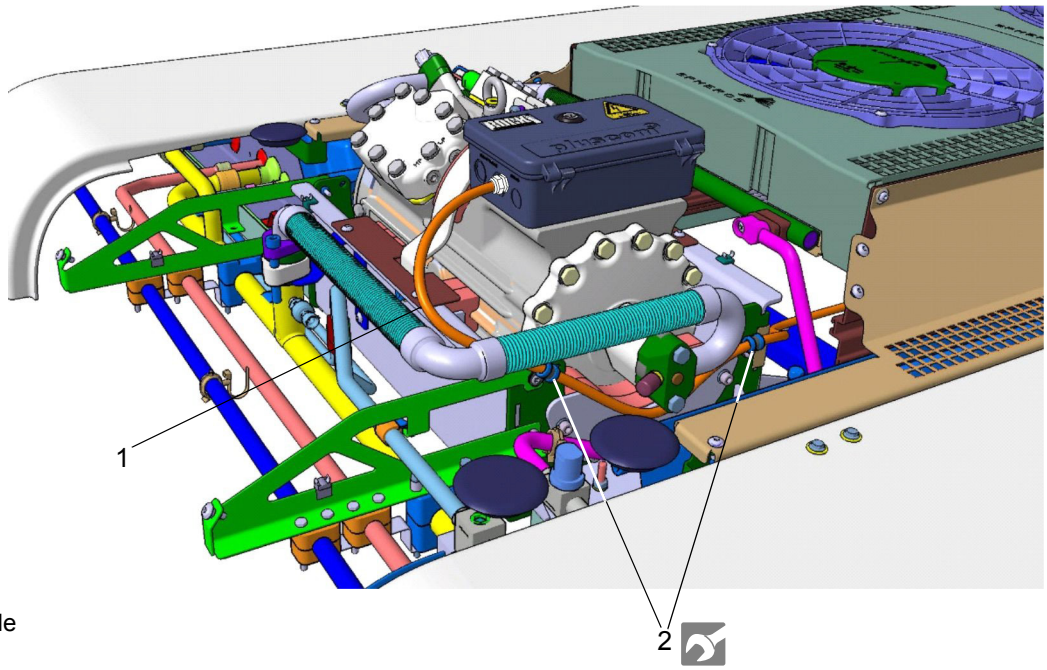
View from below (cable unplugged)

Fig. 814

1. Preparation
   - Removing the compressor (see 9.3).

Warning!	High voltage! Caution Mortal danger!

   - **Conduct work in accordance with 8.2.1 (high-voltage system).**
2. Removal
   - Disconnect the 400V AC cable from the compressor(see 8.4.1, point 2.).
   - Remove cable clamps (Fig. 815) on the compressor pan.
   - Removing the frequency converter (see 8.3.2).
   - Remove the screws of the frequency converter mounting plate.
   - Loosen the attachments of the 400V AC cable to the crossbars and remove the cable.



See torque table
Attachment A

1 400V AC cable
2 Clamps for 400V AC cable

Fig. 815

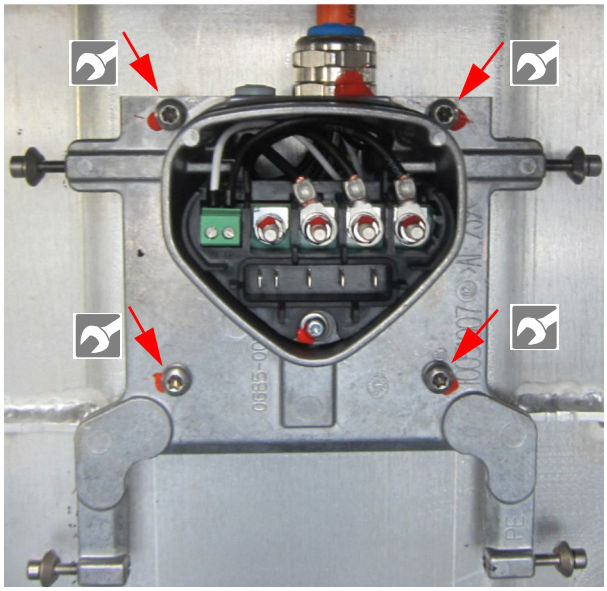


Fig. 816 Screws of the mounting plate

8.5.4 Install the 400V AC cable

- Replace the plug-in holder for the 400V AC cable to the crossbars (Fig. 817).
- Screw on the mounting plate of the frequency converter (Fig. 816).
- Lay the 400V AC cable according to Fig. 815 and Fig. 817 and attach to the traverses and compressor pan.

ATTENTION:
The cable cannot touch any sharp edges - abrasion hazard!

- Connect the 400V AC cable to the compressor (see 6.5).
- Install the condenser (see 9.3).

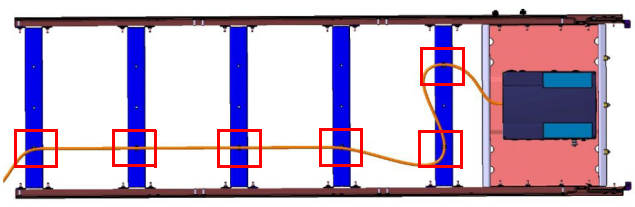


Fig. 817 Moving the 400V AC cable with fixing points

9 Removal and installation of components

9.1 Safety information

Warning!	**Potential risk to health and life!**

Follow the safety information and conditions from Chapter 1 (see 1.6).

Warning!	**High voltage! Caution Mortal danger!**

The work described in the following requires proof of the following qualifications:
See 1.6.1 under working on the refrigeration section of the air-conditioning system.

9.2 Preparation/follow-up

When working on the refrigerant circuit, the rules for evacuating and filling the REVO-E apply. Replace the sealing rings from the opened connections and oil them before replacing (refrigerator oil). If opening the conditioning circuit is required, the following preparation and follow-up work is required.

Preparation work
– Vehicle / air-conditioning system powered off (primary switch / battery disconnection switch)
– If necessary, remove protective cover for the compressor / frequency converter
– Open the side covers of the air-conditioning system and prop up with rods (attached to cover)
– Remove the coil of the solenoid valve and replace with permanent magnet
– Siphon refrigerant via high and low pressure connections on the compressor
– Close openings of components of the refrigerant circuit with suitable plugs (presents water absorption by the refrigerant oil)

Follow-up work
– Exchange filter dryers
– Evacuation the air-conditioning system
– Check tightness

ATTENTION:
The maximum pressure is 17 bar, the suction pressure sensor will become damaged otherwise!

– Fill the air-conditioning system with R134a
– Remove the permanent magnet from the magnet valve and install the coil
– Mount / close the cover
– Test functionality / SCT components test

Torque table, see Attachment A.

9.3 Condenser module removal/ installation

9.3.1 Removal of the condenser module

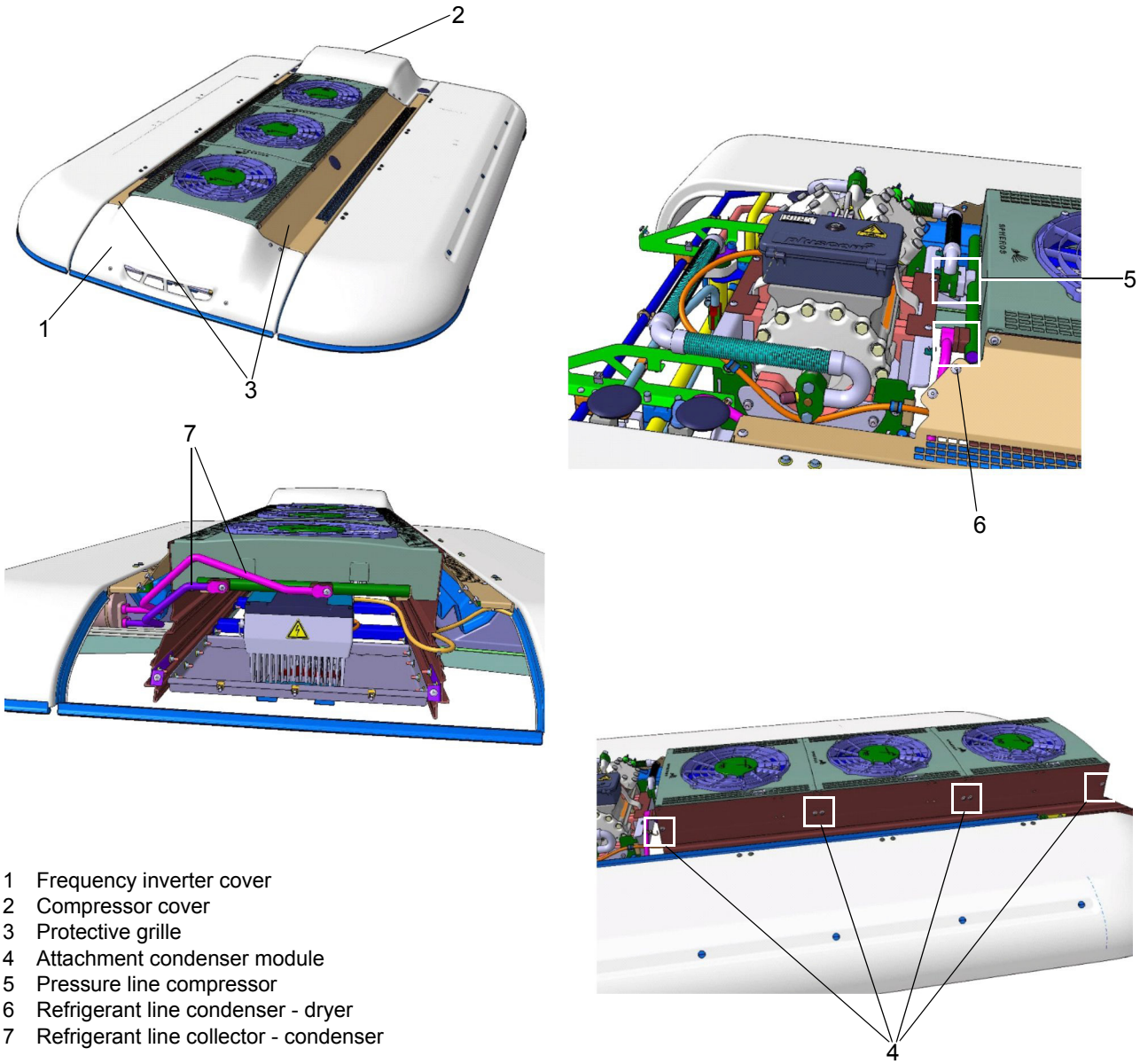
Observe the safety instructions in Cha. 8!

1. Preparation

NOTE:
The condenser module as spare part is only available as pre-assembled unit. Replacement of individual parts is not possible. Minimum of 2 persons is required.

- Do the preparation work according to 9.2.

2. Removal (Fig. 901)
   - Protective grille (3)
   - Refrigerant line collector - condenser (7)
   - Pressure line compressor (5)
   - Refrigerant line condenser - dryer (6)
   - Disconnect electrical connections X29-2 condenser wiring harness at terminal board (see Abb. 601, Blatt 6).
   - Remove wiring harness from clips.



1 Frequency inverter cover
2 Compressor cover
3 Protective grille
4 Attachment condenser module
5 Pressure line compressor
6 Refrigerant line condenser - dryer
7 Refrigerant line collector - condenser

Fig. 901

- Remove the 24V wiring harness of the frequency converter (see Cha. 8.3.1, step 1/2).
- Remove screws (4) securing the condenser module.
- Lift out the condenser module by two persons.
- Close the openings of the refrigerant circuit and the condenser module.
- Remove the axial fan (see 9.7.3).
- Remove the wiring harness from the condenser module

9.3.2 Installation of the condenser module

- The installation of the condenser module is carried out in reverse order.
  Thereby the gaskets of the refrigerant circuit are to be replaced!

Do the final work according to 9.2.

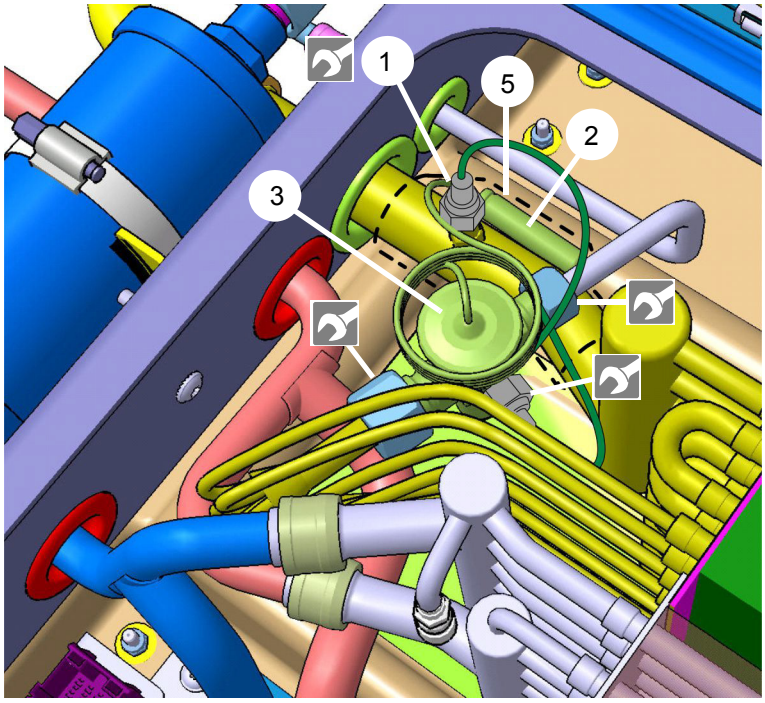
9.4 Expansion valves removal/ installation

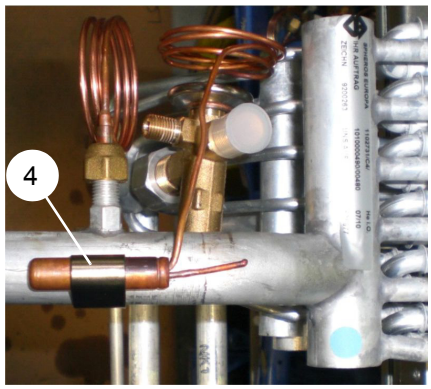
9.4.1 Remove an expansion valve

- Conduct preparation work according to 9.2.
- Remove tar binding and holding clamp (4) from thermostat sensor (2).
- Remove compensating cable between refrigerant tube and expansion valve.
- Remove cap nuts from the expansion valve and remove expansion valve.

9.4.2 Install an expansion valve

- Apply refrigerator oil to sealing rings.
- Place the expansion valve into the location of installation and attach with cap nuts.
- Attach thermostat sensor with holding clamp (4, Fig. 901) and wrap with tar binding.
- Connect compensating cable between refrigerant tube and expansion valve.
- Conduct follow-up work according to 9.2.





See torque table Attachment A

1 Connection of refrigerant tube for compensating line
2 Thermostat sensor with safety clamp
3 Expansion valve
4 Holding clamp for thermostat sensor
5 Tar binding (dashed)

Fig. 902

9.5 Filter dryer removal/ installation

9.5.1 Remove the filter dryer

- Conduct preparation work according to 9.2.
- Loosen cap nuts on filter dryer. While doing so, prevent dryer filter from twisting with suitable tool.
- Loosen retaining clamp.
- Remove filter dryer.

9.5.2 Install the filter dryer

ATTENTION:
The arrow mark on the filter dryer (Fig. 902) must be in the flow through direction of the refrigerant (right)!

- Apply refrigerator oil to sealing rings.
- Place the filter dryer into the location of installation and attach with cap nuts. While doing so, prevent dryer filter from twisting with suitable tool.

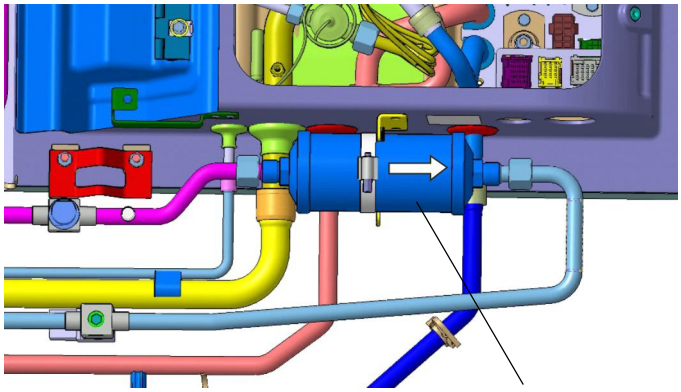


Fig. 903

- Attach retaining clamp.
- Conduct follow-up work according to 9.2.

9.6 Receiver removal/ installation

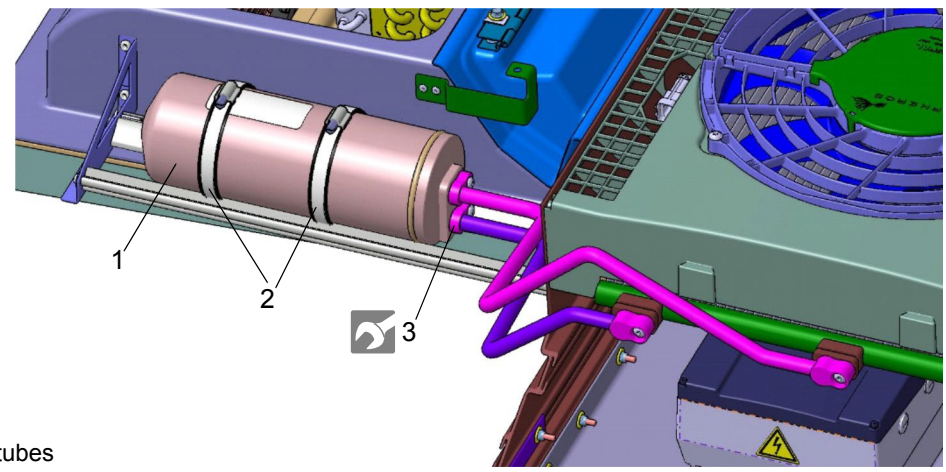
9.6.1 Remove the receiver

- Conduct preparation work according to 9.2.
- Loosen SMA connection (3, Fig. 903) of the refrigerant tube.
- Loosen retaining clamp (2).
- Remove receiver (1).

9.6.2 Install the receiver

- Replace the o-rings of the line connectors and apply refrigerator oil
- Place the new receiver into location of installation and orient around the position of the SMA connections.
- Attach SMA connections (3).
- Attach retaining clamp (2).

See torque table Attachment A



1 Receiver
2 Retaining clamps
3 SMA connection refrigerant tubes

Fig. 904

9.7 Double radial blowers / axial fans removal/ installation

9.7.1 Remove a double radial blower

- Disconnect electrical connection to the housing (1, Fig. 904)
- Loosen side holders of the housing (2).
- Remove housing.

9.7.2 Install a double radial blower

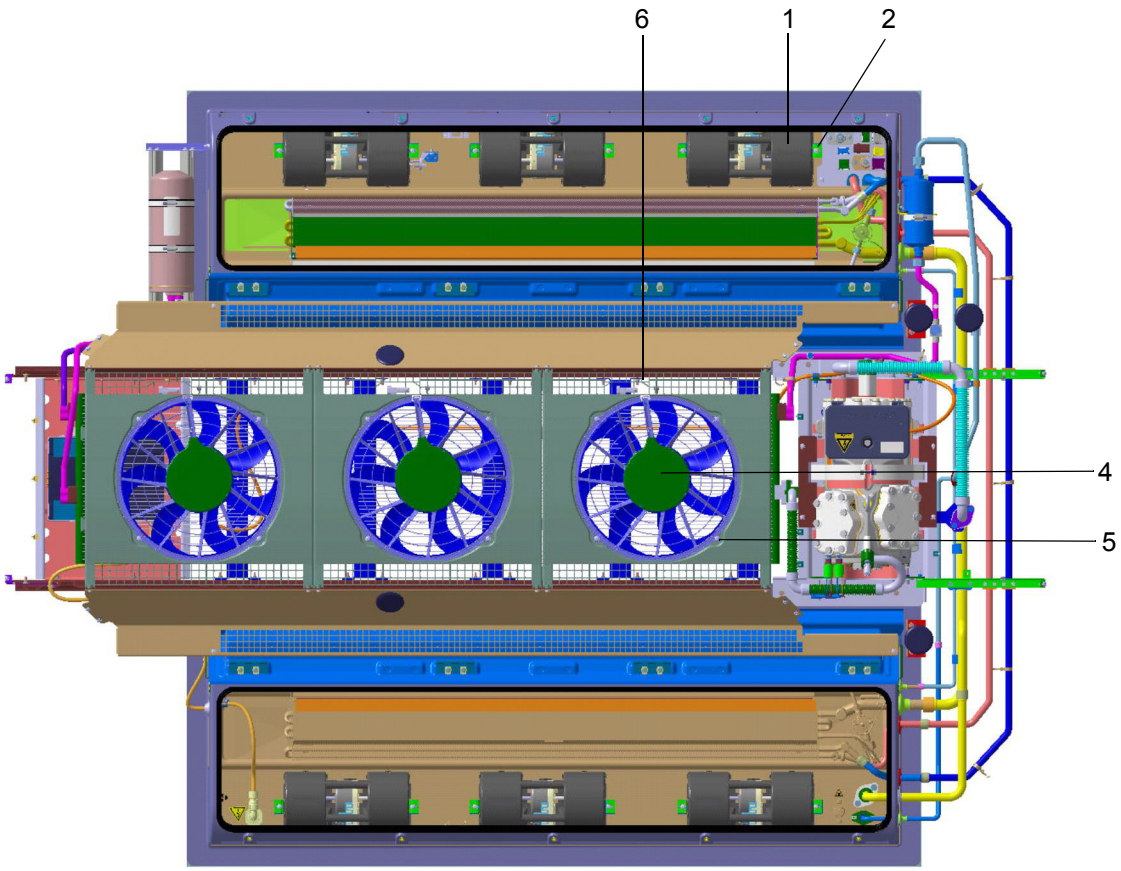
- Insert housing (1) and orient.
- Attach holder (2) with screws.
- Reattach electric connection.
- Test functionality using SCT components test

9.7.3 Remove an axial fan

- Remove the electrical connection to the housing (4) from the holder (6).
- Remove attachment screws (5).
- Remove housing (4).

9.7.4 Install an axial fan

- Insert housing (4).
- Attach housing with attachment screws (5).
- Reattach electric connection and attach in holder (6).
- Test functionality using SCT components test



1 Double radial blower of heat exchanger
2 Holder + screw for double radial blower
3 Electric connection for double radial blower (no figure)
4 Axial fan condenser
5 Attachment screws of axial fan
6 Electrical connection of the axial fan in holder

Fig. 905

9.8 Recirculating air flap actuator motor removal/ installation

9.8.1 Remove the actuator motor

- Disconnect electric connection to the motor by removing the plug.
- Remove 3 nuts that were attached to damper motor and remove damper motor (1, Fig. 905).

9.8.2 Install the actuator motor

- Place the motor into the location of installation and attach with 3 nuts (1, Fig. 905).
- Reconnect electric connection to the motor / insert plug.

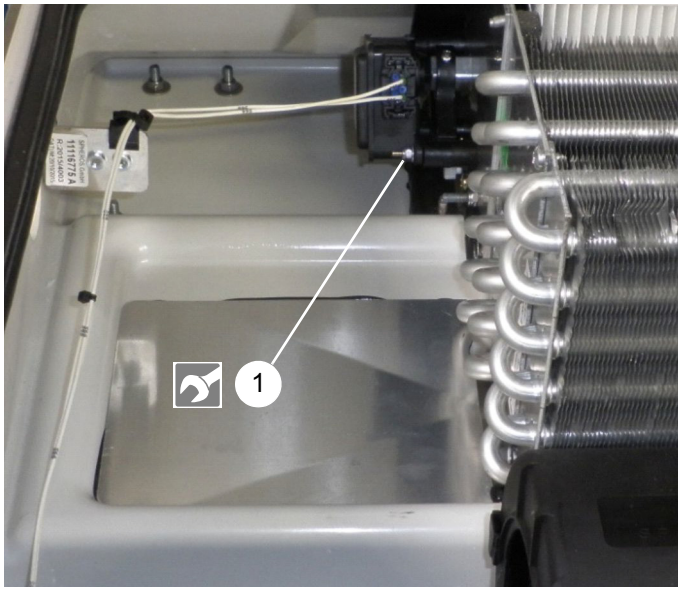


Fig. 906

9.9 Temperature sensor (duct / recirculating air suction) removal/ installation

Position: to the right side before the first double radial blower.

9.9.1 Remove the duct temperature sensor (blow-out temperature)

Position: to the right side before the first double radial blower (1, Fig. 906).
- Loosen electrical connection on the plug.
- Unscrew sensor from holder.

9.9.2 Install the duct temperature sensor (blow-out temperature)

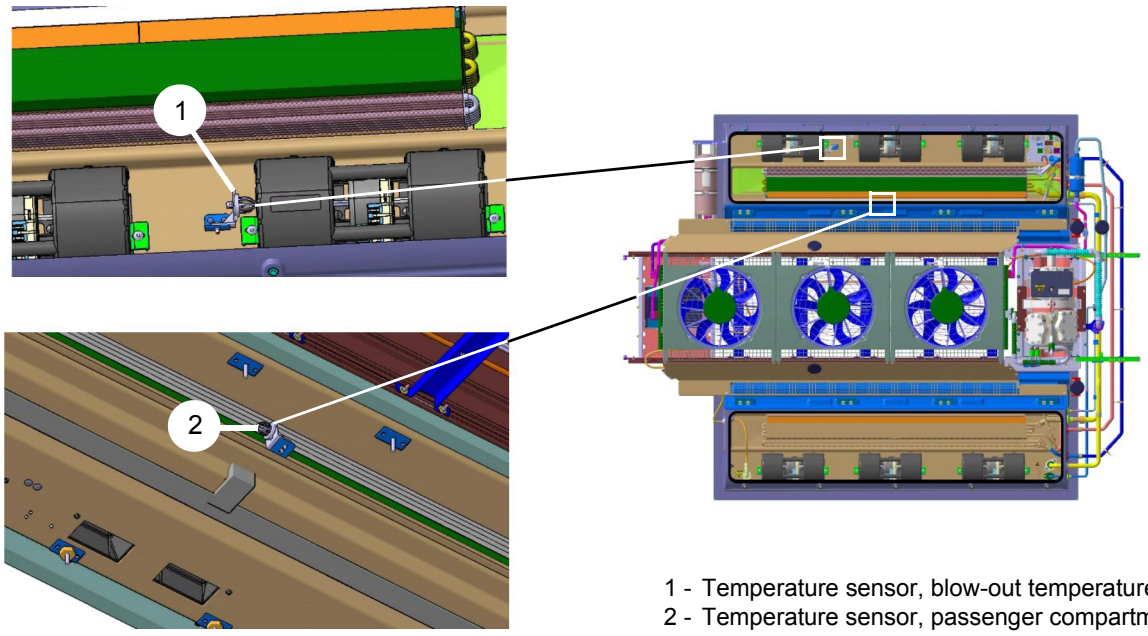
- Screw sensor to holder.
- Reconnect electrical connection on the plug.

9.9.3 Remove the recirculating air suction temperature sensor (passenger compartment)

Position: in middle, right recirculating air suction inside of air-conditioning system (2, Fig. 906).
- Remove fresh air filter, see 7.3.1.
- Loosen electrical connection on the plug.
- Unscrew sensor from holder.

9.9.4 Install the recirculating air suction temperature sensor (passenger compartment)

- Screw sensor to holder.
- Reconnect electrical connection on the plug.
- Insert fresh air filter, see 7.3.1.



1 - Temperature sensor, blow-out temperature
2 - Temperature sensor, passenger compartment

Fig. 907

9.10 Suction pressure sensor removal/ installation

There is a valve insert built into the soldering support of the suction pressure sensor (2, Fig. 907) that automatically closes when the sensor is removed from the support.

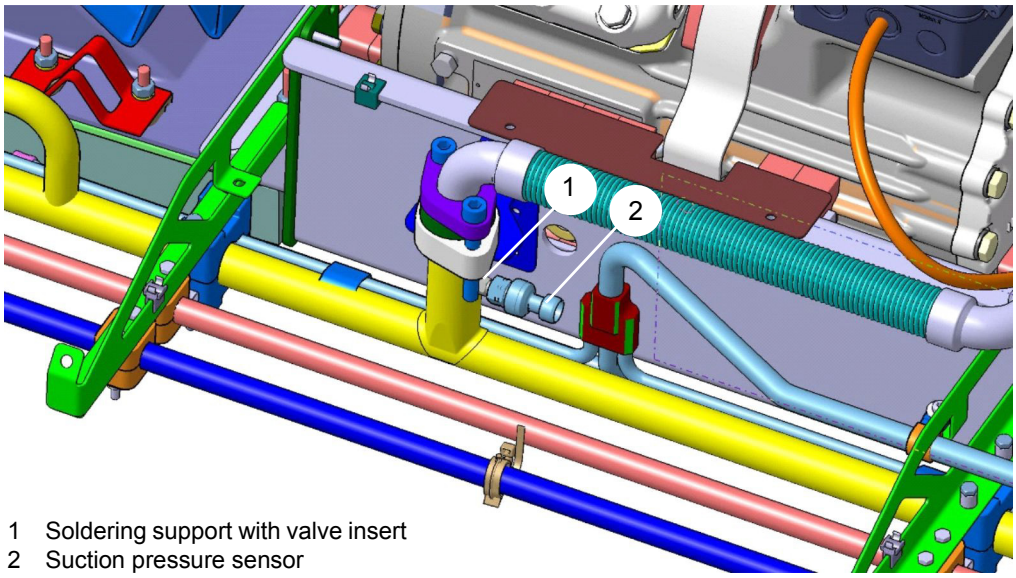
9.10.1 Remove the suction pressure sensor

- Loosen electrical connection on the plug.
- Unscrew the sensor, holding the soldering support with a suitable tool.

9.10.2 Install the suction pressure sensor

- Moisten sealing ring with refrigerator oil.
- Screw on the sensor, holding the soldering support with a suitable tool.
- Reconnect electrical connection on the plug.

ATTENTION:
The maximum pressure of the leak test is 17 bar, since otherwise the suction pressure sensor will become damaged!



1 Soldering support with valve insert
2 Suction pressure sensor

Fig. 908

9.11 Condenser temperature sensor removal/ installation

Position: on refrigerant tube of the condenser receiver (directly to the left connection, see Fig. 908).

9.11.1 Remove the temperature sensor

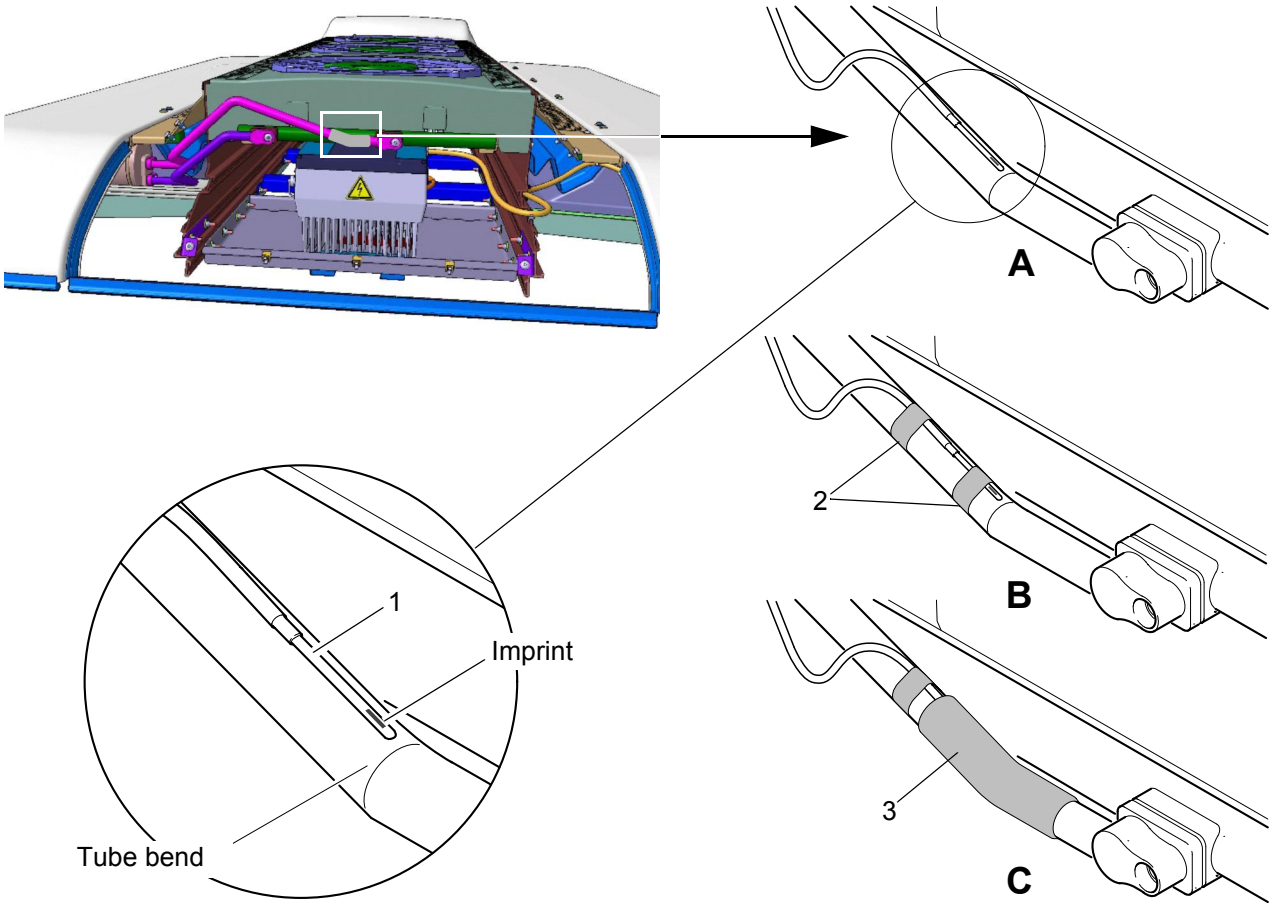
- Disconnect electric connection to the temperature sensor at the plug connector.
- Remove cork insulating tape that covers the temperature sensor.
- Loosen cable clamps that attach the temperature sensor to the tube and remove the temperature sensor.

9.11.2 Install the temperature sensor

- Position temperature sensor on the tube (A, Fig. 908) and attach with 2 cable clamps (B, Fig. 908).

NOTE:
The imprint at the top of the temperature sensor **must** be pointing upwards. The top is located at the bend in the tube, approximately, see Fig. 908.

- Attach temperature sensor with cork insulating tape (C, Fig. 908).
- Reconnect electric connection to the temperature sensor at the plug connector.



1 Temperature sensor
2 Cable clamp
3 Cork insulating tape

Fig. 909

9.12 Pressure switch removal/ installation

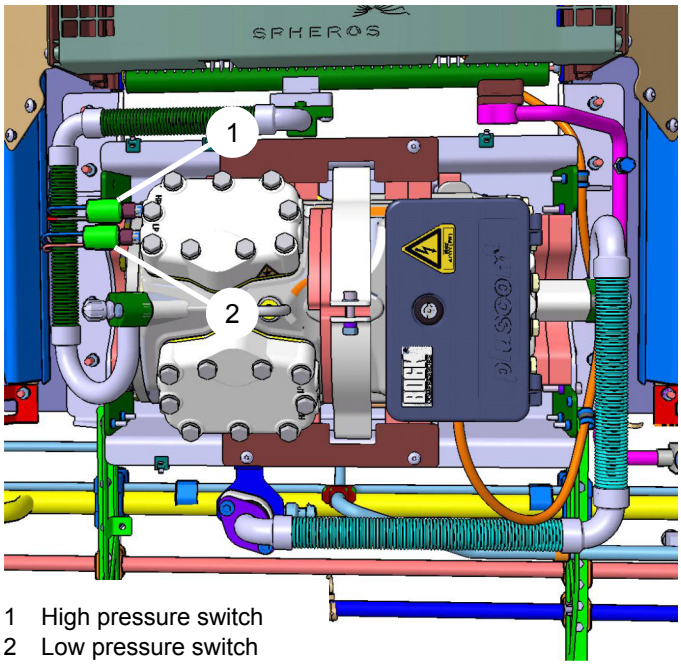
There are valve inserts built into the screw neck of the pressure switch that automatically close when the sensor is removed from the support.

9.12.1 Remove the pressure switch

- Disconnect electric connection.
- Unscrew pressure switch, holding onto the screw-in connector with suitable tool.

9.12.2 Install the pressure switch

- Screw in new pressure switch with new copper sealing ring, holding onto screw-in connector with suitable tool.
- Reattach electric connection.
- Lay cable, making sure there are no points of abrasion.



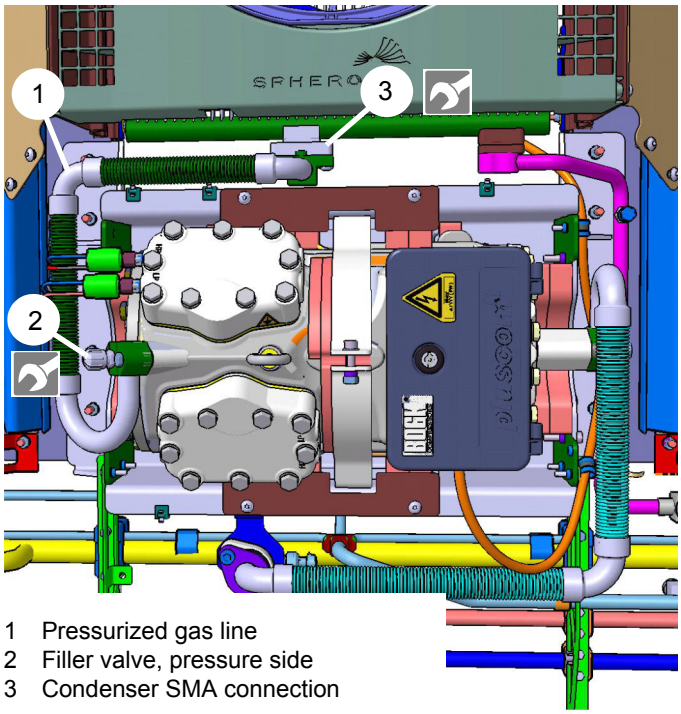
1 High pressure switch
2 Low pressure switch

Fig. 910

9.13 Compressor suction and pressure lines removal/ installation

9.13.1 Remove the pressure line

- Conduct preparation work according to 9.2.
- Unscrew filler valve (2, Fig. 910) from the pressure line.
- Separate SMA connection (3) from the pressure line on the condenser.
- Separate SMA connection from the pressure line on the compressor and remove pressure line.



1 Pressurized gas line
2 Filler valve, pressure side
3 Condenser SMA connection

Fig. 911

9.13.2 Install the pressure line

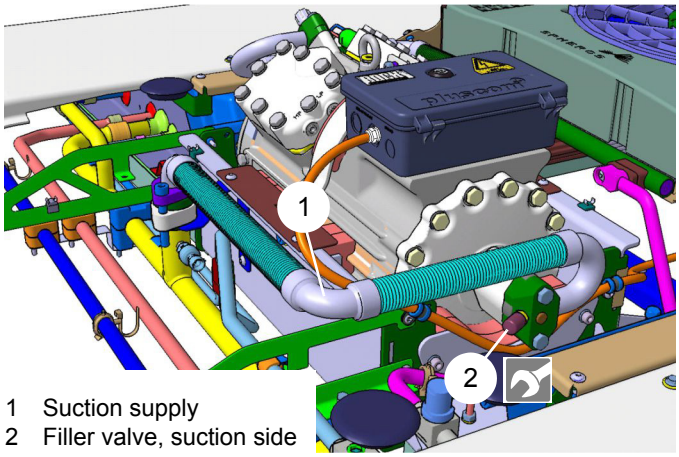
- Insert pressure line including new seals (provided with refrigerator oil) into location of installation and orient.
- Connect pressure line on the compressor with SMA connection.
- Connect pressure line on the condenser with SMA connection (3).
- Screw filler valve (2, Fig. 910) into pressure line.
- Conduct follow-up work according to 9.2.

9.13.3 Remove the suction line

- Conduct preparation work according to 9.2.
- Unscrew filler valve (2, Fig. 911) from the suction line.
- Separate connections of the suction line (1) and remove suction line.

9.13.4 Install the suction line

- Insert suction line (1) including new seals (provided with refrigerator oil) and orient.
- Connect both sides of the suction line.
- Screw filler valve (2) into the suction line.
- Conduct follow-up work according to 9.2.



1 Suction supply
2 Filler valve, suction side

Fig. 912

9.14 Solenoid valve removal/ installation

9.14.1 Remove the coil

- Unscrew knurled nuts (3, Fig. 912).
- Pull the coil (2) down.
- Pull out screw of the plug housing (4) and separate the housing from the coil.

9.14.2 Install the coil

- Plug the plug into coil (2) and attach with screw.

NOTE:
Verify seal fits correctly.

- Place coil (2) into position and secure with knurled nut (3).

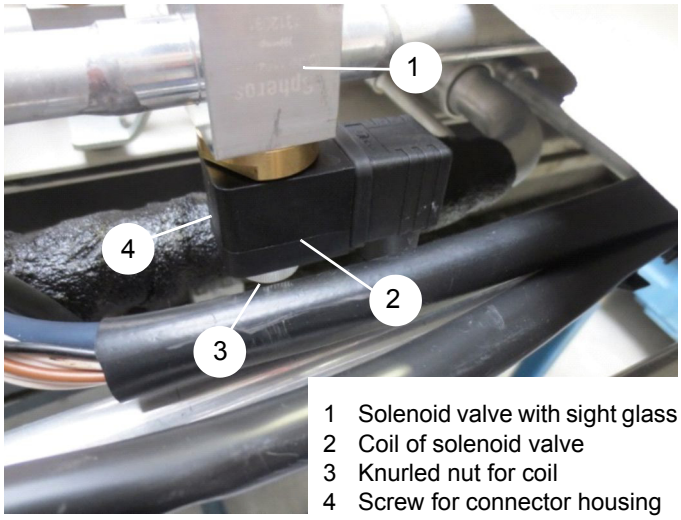
ATTENTION:
Always ensure the plug points with the cable side down in order to avoid water entry into the plug!

9.14.3 Remove the screw-in valve

- Conduct preparation work according to 9.2.
- Remove coil, see 9.14.1.
- Loosen screw-in valve, attaching the housing with suitable tool.
- Remove screw-in valve.

9.14.4 Install the screw-in valve

- Screw on screw-in valve.
- Install coil, see 9.14.2.
- Conduct follow-up work according to 9.2.



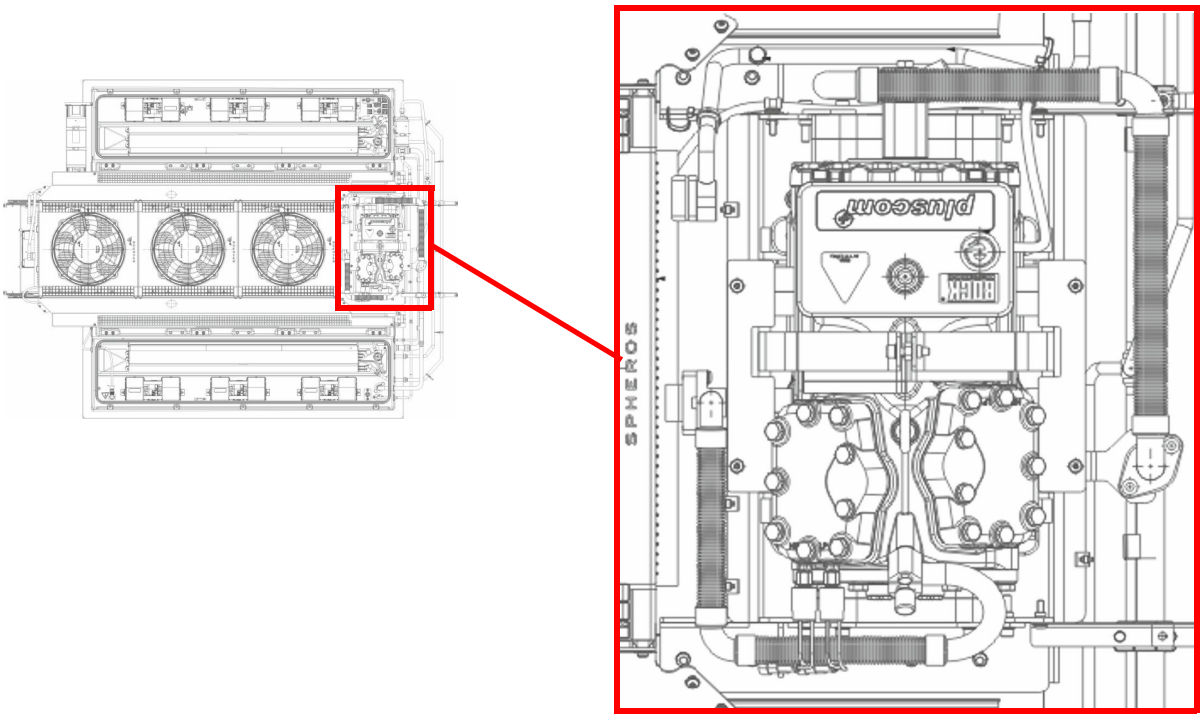
1 Solenoid valve with sight glass
2 Coil of solenoid valve
3 Knurled nut for coil
4 Screw for connector housing

Fig. 913

Attachment A

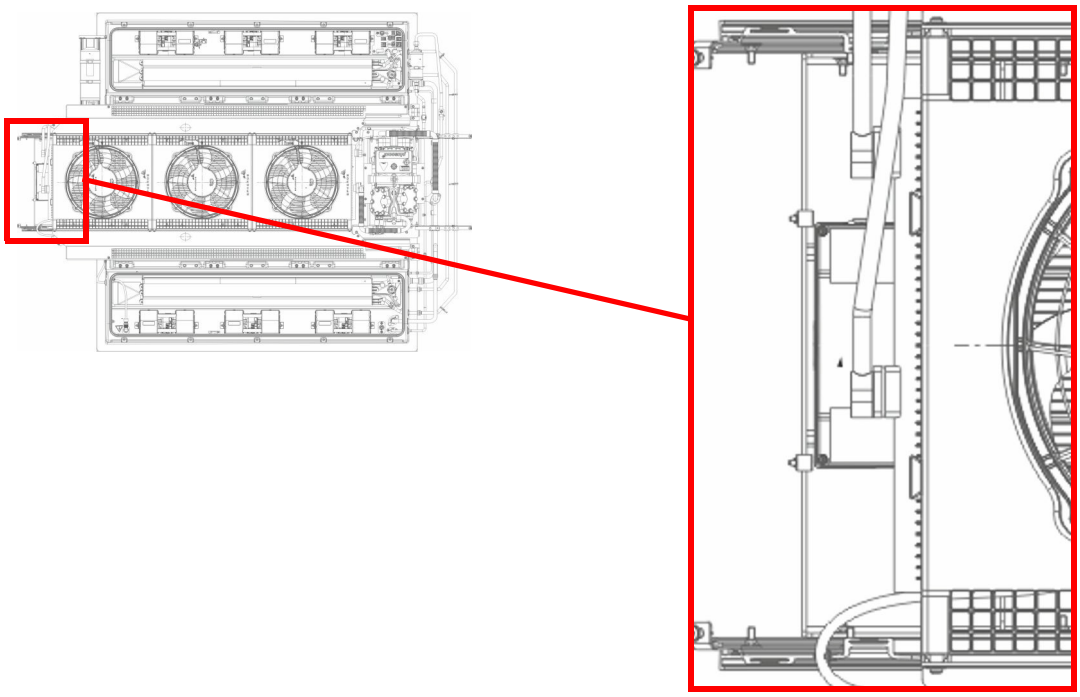
Tightening torques

Component	Designation	Torque
Compressor section		
Line to supercooler	M6x25 T30 screw	9 ± 10%
Compressor pressure line to condenser	M6x25 T30 screw	9 ± 10%
Pressure line to compressor	M8x50 screw	34 ± 10%
Service valve pressure line	Screw fitting (SW17)	13 ± 10%
Suction line to compressor	M10x110 screw	50 ± 10%
Compressor suction line to pipe	M19x70 allen screw	50 ± 10%
Suction line fixing	M10 nut	25 ± 10%
Suction pressure / low pressure	Union nut sensor	10 ± 10%
Service valve suction line	Screw fitting (SW15)	13 ± 10%
Pressure switch	Union nut	10 ± 10%
Screw-in socket pressure switch	Screw-in socket (SW12)	10 ± 10%
Pressure plates for compressor unit	M8x35 (allen)?? screw	15 ± 10%
Compressor clamping plates to the compressor mount	M10x20 (allen) screw	25 ± 10%

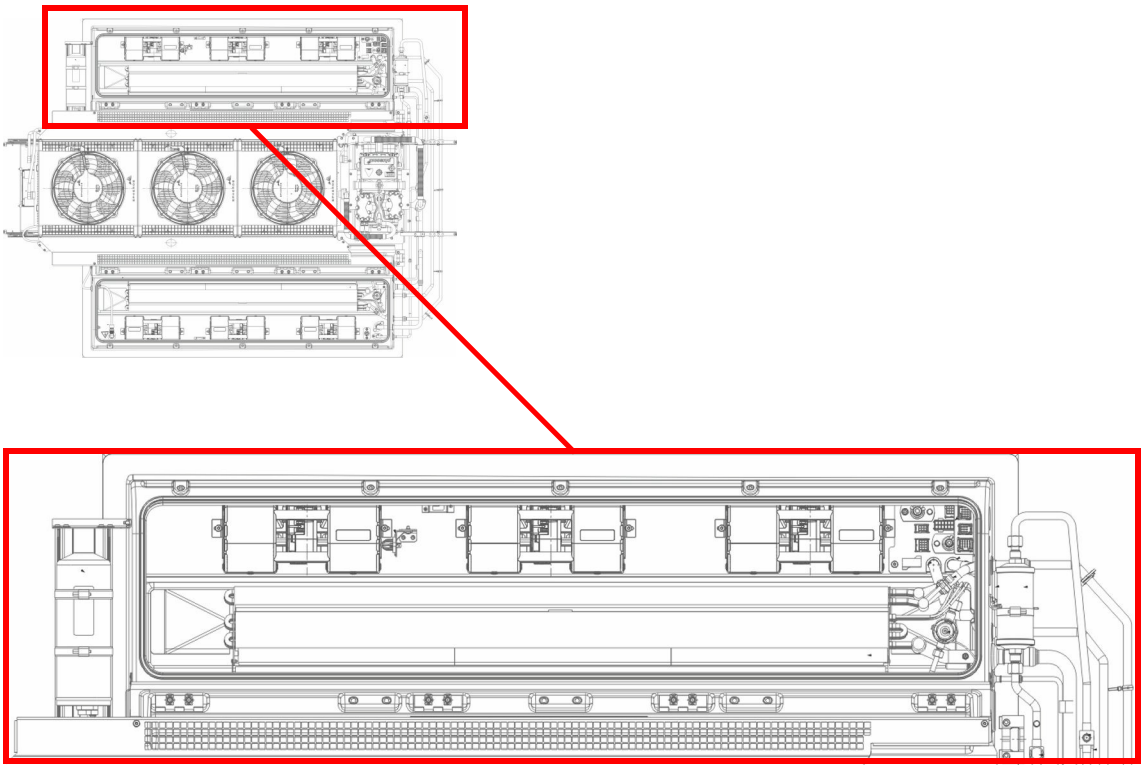


Component	Designation	Torque
Compressor clamping plates	M8x20 (allen) screw	1 ± 10%
Clamp holder 400V AC	M6x25 T30 screw	6 ± 10%
Ground cable to connection box	M6x25 (allen) screw	6 ± 10%
400V AC connection terminal	M6 nut	7 ± 10%
400V AC cable gland	Nut	15 ± 10%
400V AC cable gland lock nut terminal box	Nut	12 ± 10%
Grounding wire to compressor	Eye bolt	9 ± 10%
Retaining plates to compressor pan	M6x16 T30 screw	6 ± 10%
Compressor cover	M6x16 TX30	6 ± 10%

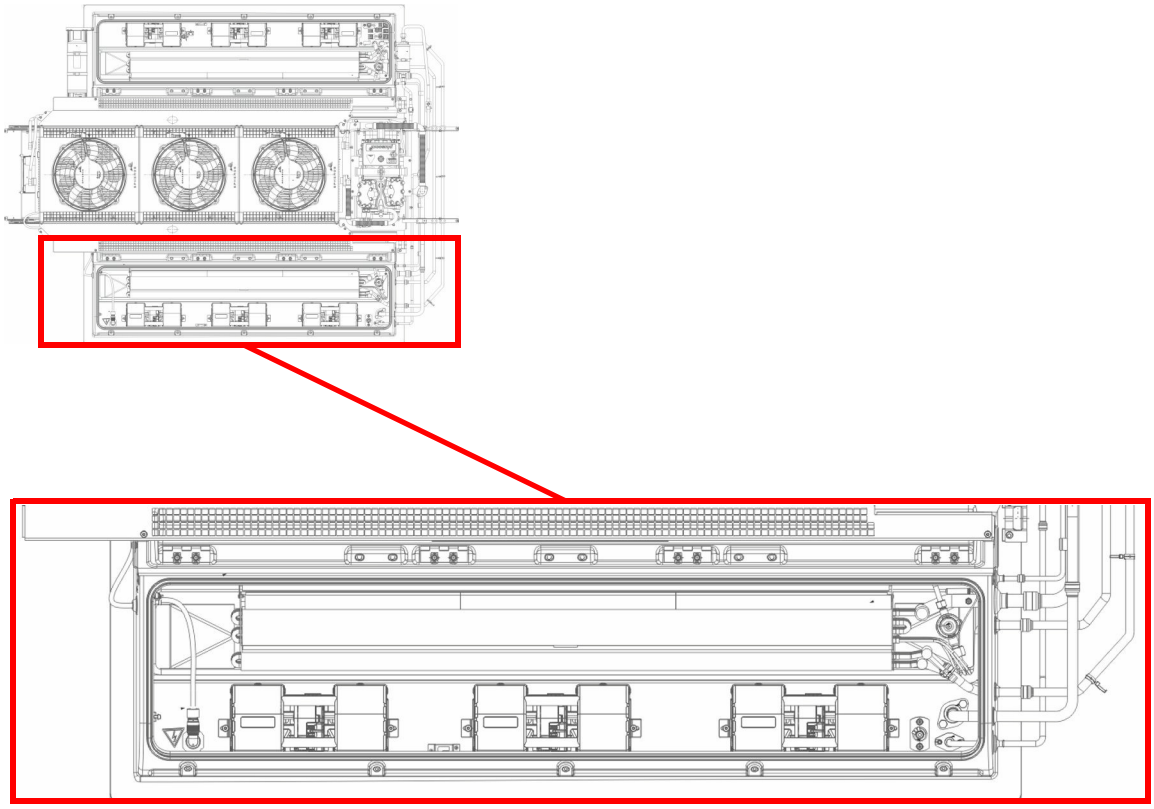
Component	Designation	Torque
Frequency converter section		
Holder for frequency converter plate	M6 nut	10 ± 10%
Cable gland 600V DC / 24V signal line into frequency converter	Nut	8 ± 10%
Cover for frequency converter	Allen screw	2 ± 10%
Grounding wire to frequency converter	M6x20 T25	6 ± 10%
Holder for frequency converter plate	M6 nut	10 ± 10%
Adapter plate for frequency converter to plate	M6x36 TX30 screw	6 ± 10%
400V AC connection terminal to adapter plate of frequency converter	M6 nut	7 ± 10%
Frequency converter to adapter plate	Screw with cone (allen)	4 ± 10%



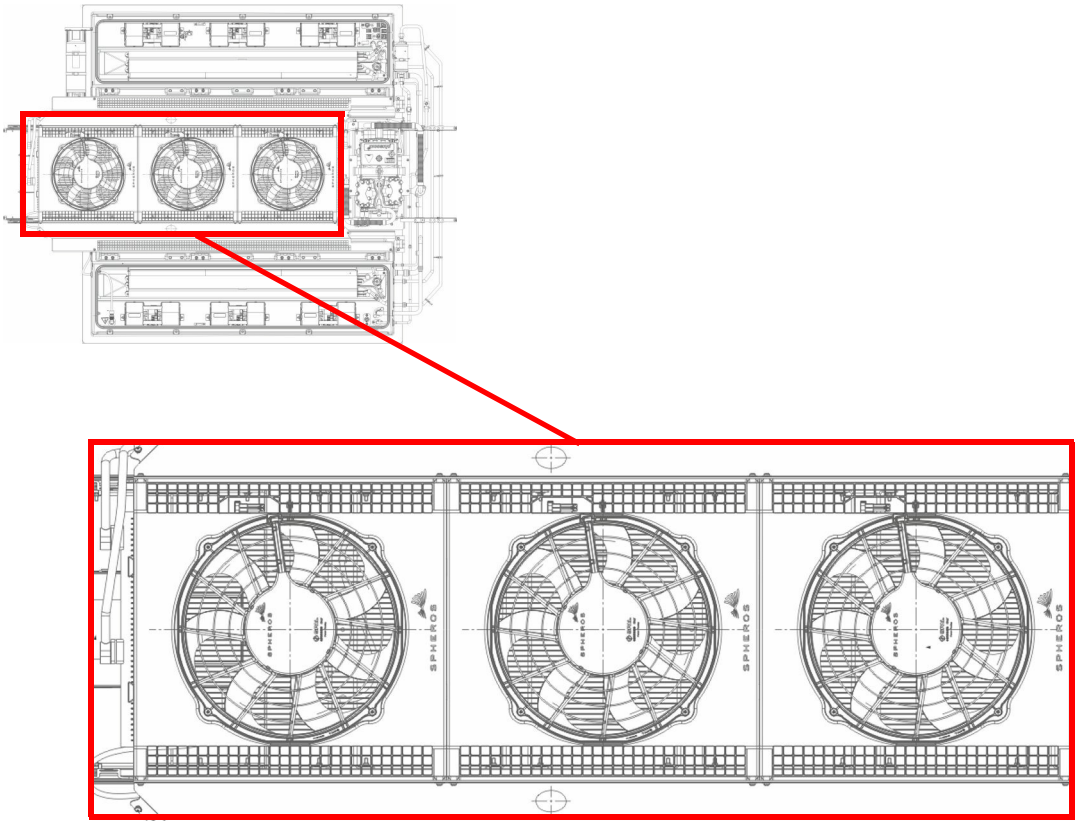
Component	Designation	Torque
Compressor pan section, right		
Side cover to hinge	M6x16 TX30	6 ± 10%
Side cover to pan	M6x20	6 ± 10%
Electric plate to pan	M6x16 TX30	6 ± 10%
Negative terminal (24V)	M8 nut	7 ± 10%
Positive terminal (24V)	M10 nut	22 ± 10%
Clamp double radial blower to pan	M6x25 TX30	6 ± 10%
Temperature sensor to clamp	M5x12 TX25 screw	4 ± 10%
Expansion valve inlet	Union nut (SW19)	17 ± 10%
Expansion valve outlet	Union nut (SW27)	25 ± 10%
Expansion valve compensation line	Union nut (SW17)	10 ± 10%
Filter dryer	Union nut (SW27)	40 ± 10%
Bracket for filter dryer	Screw (SW8)	6 ± 10%
SMA connections receiver	M6x25 T30 screw	9 ± 10%
Bracket for receiver	Screw (SW8)	6 ± 10%
Actuator motor air valve	Nut (SW7)	3 ± 10%



Component	Designation	Torque
Compressor pan section, left		
Side cover to hinge	M6x16 TX30	6 ± 10%
Side cover to pan	M6x20	6 ± 10%
Clamp double radial blower to pan	M6x25 TX30	6 ± 10%
Expansion valve inlet	Union nut (SW19)	17 ± 10%
Expansion valve outlet	Union nut (SW27)	25 ± 10%
Expansion valve compensation line	Union nut (SW17)	10 ± 10%
Seal for suction line slave system / front box	M10 nut	50 ± 10%
Fluid line slave system / front box	Union nut (SW27)	17 ± 10%
Ground terminal	M8 nut	7 ± 10%
600V DC into pan	Lock nut	20 ± 10%
Clamp holder 600V DC	M5x12 T25 screw	4 ± 10%
Actuator motor air valve	Nut (SW7)	3 ± 10%



Component	Designation	Torque
Condenser section		
Side cover to hinge	M6x16 TX30	6 ± 10%
Side cover to pan	M6x20	6 ± 10%
SMA connections condenser	M6x25 T30 screw	9 ± 10%
Blower modules at the bottom to support profile	M6x22 T30 screw	6 ± 10%
Protective grille at the top to support profile / blower module	M6x22 T30 screw	6 ± 10%
Axial fan to module	M6x25 TX30 screw	6 ± 10%
Condenser clamp to blower module	M6x22 T30 screw	6 ± 10%



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