Operating and Service Manual
Star Freeze Refrigeration Unit

Model SFI - 40

Version 810908A April 2026

STAR FREEZE

MAERSK CONTAINER INDUSTRY

Important information

Do not replace any parts on this unit before you have approval from service@starcool.com.

For full customer and technical 24/7 support, contact Star Cool Service Team:

service@starcool.com

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1. Preface

This version of the manual is dated January 2025, edited by Maersk Container Industry AS.

This user's manual is valid for software version SF 0800_02 or newer versions.
The information herein is subject to change without notice and does not represent a commitment on any part of Maersk Container Industry AS. While the information herein is assumed to be accurate, Maersk Container Industry AS assumes no responsibility for any errors or omissions that may appear in this documentation.

This manual is valid for:

Model	SFI - 40
Software version	SF 0800_84

2. Warnings

2.1 General service and maintenance

Do not operate or maintain this refrigeration unit until you have familiarized yourself completely with the equipment and operation of this unit by reading the instructions in this manual.
Do not perform any welding on the unit before disconnecting the power plug. Furthermore, disconnect the power measurement module and main controller (and modem if present).
Disconnect the main power supply to the unit before inspecting the interior of the controller box.
The unit is charged with refrigerants R473A and R134a/R513A and oils Zerol HD 46, PAG type and BSE 55, POE type. Do not use contaminated refrigerant or oil. Never release any refrigerant into the atmosphere. Use recovery equipment according to present legislation and **NEVER top up/add a partial charge of refrigerant on this equipment.**
During maintenance, please note that refrigerants operate with high and low temperatures in combination with high pressures, which may cause personal injuries if not handled properly.
During recovery and maintenance of the refrigerant, personal protection equipment must be worn.
Do not trap any liquid refrigerant inside pipes during soldering work. This may lead to an explosion of the pipes.
Any brazing or soldering work must be done with an inert gas (nitrogen) flowing inside the area being worked on to prevent carbon contamination.
Any replacement or repairs to copper tubing must include repainting with black epoxy (or similar) paint to prevent corrosion.
Please note that this unit model does not have Schräder valves installed for Psuc, Pdis, PsucLT and PdisLT pressure transmitters.
We do not recommend cleaning the inside of a reefer container with soap/chemicals with a PH value below 7. However, if this occurs, clean the evaporator coil through the inspection hatches with a soap that has a PH value between 7 and 9. This cleaning is vital to reduce the risk of copper damage in the evaporator coil.
Clean the condenser coil twice a year by backflushing it with water using medium water pressure (no more than 40 PSI) and waterflow over 2.5 GPM (9LPM). This is to avoid fin corrosion and high pressures (power consumption).

Only OEM delivered parts to be used.
Major repairs are only allowed on approved Star Freeze service locations.

2.2 Operation

Special attention to local laws and regulation is needed if the reefer is used for stationary refrigerated storage.
The use of reefers for non-operating reefer (NOR) cargo is becoming more prevalent. In some cases, the reefer containers have been transporting fertilisers, chemicals, and products that release chemicals, such as textiles and garments. If the humidity is high inside the reefer, these cargoes can develop a strong concentration of acid that will damage the copper pipes in the evaporator.
With reefers that have been used for NOR shipments, or have stood empty for a period of time, it is highly recommended to ensure fresh air ventilation by opening the container door(s), which will keep the humidity as low as possible and allow gaseous contaminants to escape.

3. Contents

4. Legend

Short name	Name
AAS	Alarm Action System
Act	Actual
AL	Alarm
CapAct	Actual capacity
CapReq	Requested capacity
Com	Communication
Cond	Condenser
Cpr	Compressor
Cur	Current
DST	DST pressure transmitter
Err	Error
Evap	Evaporator
F	Frequency
Fact	Compressor actual frequency, HT cycle
FC	Frequency converter
Fcpr	Compressor frequency, HT cycle
FcprAct	Compressor actual frequency, HT cycle
FcprReq	Compressor requested frequency, HT cycle
Fpower	Power supply frequency converter
FT	Function test
FW	Firmware
H	Heater
Hevap	Evaporator heater
HP	High pressure
HT	High-temperature cycle
I	Current
I1	Current phase 1
I2	Current phase 2
I3	Current phase 3
Ifc	Current in AC compressor motor, HT cycle
Init	Initialization
ITOT	Total current limit
LED	Light emitting diode
LP	Low pressure
LT	Low temperature cycle
M	Motor
Mcond	Condenser motor
Mcond1	Condenser motor1

Short name	Name
Mcond2	Condenser motor2
Mevap	Evaporator motor
Mevap1	Evaporator motor 1
Mevap2	Evaporator motor 2
Mevap3	Evaporator motor 3
MOP	Maximum operating pressure
NSK	NKS pressure transmitter
OH	Overheat
P	Pressure
PCB	Printed circuit board
PhDir	Phase Direction
Pdis	Discharge pressure
PdisLT (PdisR5)	Discharge pressure, LT
Psuc	Suction pressure, HT
PsucLT (PsucR5)	Suction pressure, LT
PTI	Pre-Trip Inspection
PTI Short	Pre-Trip Inspection Short
Ptot	Power total
PWM	Pulse Width Modulation
Pwr	Power
Req	Requested
S	Switch contact key
SF	Star Freeze
Set	Setpoint
SH	Superheat
Shp	High pressure switch, HT cycle
ShpLT1	High pressure switch 1 49 barg
ShpLT2	High pressure switch 2 49 barg
Sup	Supply
T	Temperature
Tact	Actual temperature
Tamb	Ambient temperature
TC	Calculated condensing temperature, HT cycle
TCLT	Calculated condensing temperature, LT cycle
Tcargo1	Cargo temperature1
Tcargo2	Cargo temperature2
TCmin	Temperature condenser minimum
Tevap	Evaporator temperature

Short name	Name
Tfc	Frequency converter temperature
Tint	Tinternal (controller board)
Tret (TretR5)	Return air temperature
Tset	Temperature setpoint
Tsuc	Suction temperature
Tsup (TsupR5)	Supply air temperature
TsuceLT (TsuceR5)	Evaporator outlet suction temperature, LT
TsuccLT (TsuccR5)	Compressor inlet suction temperature, LT
TliqLT (TliqR5)	Liquid line temperature, LT
TdisLT (TdisR5)	Compressor discharge temperature, LT
T0	Calculated boiling temperature

Short name	Name
T0LT	Calculated boiling temperature, LT
Ubat	Battery voltage
Udc	DC voltage in frequency converter
U/f	Voltage/frequency ratio
V	Valve
Veco	Expansion valve, economizer
Vexp	High temperature expansion valve
Vexp1	Expansion valve, cascade 1
Vexp2	Expansion valve, cascade 2
VexpLT (VexpR5)	Expansion valve, evaporator LT
VbpLT (VbpR5)	Expansion valve bypass, LT

5. General description

The ❄ STAR FREEZE , model SFI-40, is an electric powered cooling container operating on refrigerants R134a/R513A (high temperature cycle) and R473A (low temperature cycle). This cooling system is a cascade type cooling system in which the cooling is done by the low temperature cycle and the heat rejection is done by the high temperature cycle.
The unit is designed to maintain cargo temperatures in a range from -60°C (-22°F) to -20°C (-4°F). The unit is designed to operate in ambient temperatures from -30°C (-22°F) to +50°C (+122°F).
The outer front frame is constructed of marine grade aluminum, 5000 and 6000 series, designed to serve adequately as the container end wall. The rear bulkhead is made of food-approved material.

The unit is designed to operate under seagoing and environmental conditions as specified below:

- Salt-laden air, sea spray, and high humidity.
- Rolling: Amplitude of 30° each side, period of 13 seconds.
- Pitching: Amplitude of 6° each side, period of 8 seconds.
- Permanent list: 15° on each side.
- Shock: 2g horizontal and 5g vertical.
- Vibrations: Of the types encountered on ships, trucks, and rail.

The unit consists of the following modules:

- Frame module
- Controller module
- Condenser & gas cooler/compressor module
- Receiver module
- Evaporator coil module
- Evaporator fan module

The cooling system of the unit is equipped with 2 two–stage compressors. The R134a/R513A compressor is electrically driven through a converter and the R473A compressor is directly driven by a Dahlander (two speed) motor.

The high temperature cooling cycle is also equipped with an economizer, which performs the task of sub-cooling the liquid from the receiver to the cascade heat exchanger, thereby increasing the cooling capacity of the high temperature cycle. The cascade heat exchanger and economizer are controlled by electronic expansion valves.

The low temperature cooling cycle is also equipped with a gas cooler that is used to cool the hot trans critical R473A before entering the economizer desuperheater. This heat exchanger is part of the condenser of the high temperature cycle.

There are two micro plate heat exchangers that link the high temperature and low temperature cycles. The first is an economizer desuperheater that is used to further cool the hot R473A refrigerant coming from the gas cooler before entering the cascade heat exchanger. The second is a cascade heat exchanger that acts as the evaporator for the high temperature cycle and the condenser for the low temperature cycle. Two expansion valves are mounted on the inlet of the high temperature cascade connections to ensure optimum refrigerant flow into it.

Another plate exchanger, called a suction gas heat exchanger, is used in the low temperature cycle to both sub-cool the liquid entering the low temperature expansion valve and superheat the refrigerant going out of the evaporator before entering the low temperature compressor.

The equipment is designed to operate on a 3 phase primary power source at 50 Hz (+/- 2.5) and 360-460 V AC (max. 465 V AC) or at 60 Hz (+/- 2.5) and 400-500 V AC (max. 535 V AC), according to ISO 1496-2. An integrated dual winding transformer supplies the control circuit voltage. One winding for 18.6-32.0 V AC (for RMM modem supply) and another for 20.5-35.7 V AC converted to DC-Voltage in the controller (for controller and contactor supply). The output voltage is dependent on the supply voltage. An automatic system, power supply sensing and correction, is provided to ensure the correct direction of rotation for the fan motors. This is done regardless of the incoming phase sequence from the primary power supply, provided that all fan motors are wired correctly.

The air from the unit is delivered to the bottom of the container, with return air through the top of the evaporator coil section (bottom air delivery).

The unit is equipped with electric heaters mounted under the evaporator coil, that are energized during defrost. The number of heaters is doubled in comparison to a Star Cool unit and this ensures a fast defrost sequence even if the evaporator starting temperatures are very low. Using only electrical heaters for defrost enables the unit to be able to melt the ice independent of the ambient temperature. A demand defrost system is integrated in the software ensuring that the evaporator coil will not be blocked with ice before a defrost is be initiated. As well as the electrical on-demand defrost, an air defrost is triggered during temperature pull down. When the Tsup temperature is close to 1°C (33.8°F), the compressors are stopped and just the evaporator fans are kept running. This uses the cargo air to melt the ice on the evaporator through the forced convection.

The unit is controlled by an electronic controller manufactured by Bitzer Electronics, controlling the air return temperature. Controller accuracy is ±0.70°C (±1.25°F). The unit operates the evaporator fans in low speed only (three fans are used instead of two in Star Cool).

The unit is equipped with a datalogger incorporated into the controller. The logging interval is in predefined intervals, 15, 30, 60, 120, or 240 minutes. With a logging interval of one hour, there is storage capacity for 365 days of temperature loggings. Datalogger accuracy is ±0.7°C (±1.25°F). The datalog can be retrieved with a PC–system Starview and AM Solution via high-speed serial communication port.

The controller has a battery back-up system for the datalogger, which after power down of the unit continues logging in battery mode 120 times. The battery is rechargeable.

The controller is optimized for communication with Remote Monitoring Equipment, according to ISO standard 10368.

6. Function description

6.1 Start-up procedure

The start-up procedure has the following 5 modes:

1. Initialize: Self check controller.
2. System self-check: Before starting the compressors, only the evaporator and condenser fan motors are turned on and off sequentially, to check that they are functional in all modes (condenser low and high speed) by measuring their current draw.
3. Start high temperature cycle: The high temperature compressor, expansion valves and economizer valve are started to cool the low temperature side of the cascade and enable the low temperature compressor to start. Before running, crank case heating of the high temperature compressor is initiated if Tamb is lower than 2°C (36°F) and Tfc is lower than 10°C (54°F). The heating will continue until Tfc gets above 25°C (77°F). The high temperature compressor is also running a pump down, to evaporate any liquid refrigerant trapped inside its body and enable it to be transferred to the cascade.
4. Start low temperature cycle: The condenser motor fans, evaporator motor fans, low temperature expansion valve, low temperature cold gas valve and low temperature compressor are started. The low temperature compressor is always started in low speed to avoid high starting currents.
5. Terminate: Switching to normal temperature and valve regulation.

6.2 Temperature control

This function incorporates the container temperature controller.

In the Star Freeze unit, the only controlling temperature sensor is Tret.

The function has 2 modes:

1. Pulldown
   If Tret is above Tset plus 1.0°C (1.8°F) the system is running in pull down, meaning that it will run with its maximum cooling capacity until Tret becomes lower than Tset minus 2.0°C (3.6°F). If Tret is more than -43°C (-36.4°F), the low temperature compressor runs in low speed and when Tret is less than -43°C (-45.4°F), the low temperature compressor is switched to high speed.

2. In-range
   If Tset plus 1.0°C (1.8°F) is more than Tret, the system is running a combination of high/low and off on the low temperature compressor to keep the temperature within Tset plus 1.0°C (1.8°F) and minus 2.0°C (3.6°F).

As long as the temperature is not within the Tset plus range, the function remains in Pulldown. If the temperature is within range, the green IN-RANGE indicator light starts flashing. When the temperature has been lower than Tset plus 1.5°C (2.7°F) for 30 minuntes the green IN-RANGE indicator light is constantly on.

If the temperature is in out-of-range condition for more than 2 hours, the IN-RANGE indicator light starts flashing. After 4 hours in out-of-range condition, an in-range alarm is set.

Defective sensor(s)	Substitution sensor/Action	Alarm
Tret	Tact = Tsup + constant	102, Tret invalid
Tret and Tsup	Tact = Tevap	102, Tret invalid 105, Tsup invalid
Tret, Tsup, and Tevap	**	102, Tret invalid 105, Tsup invalid 123, Tevap invalid

** = No more available sensors for substitution. Unit runs low speed on low temperature compressor.

6.3 Capacity control and limiters

The Star Freeze unit is a cascade refrigeration system. Its cooling capacity is given by the low temperature cycle; the high temperature cycle acts as a condensing unit for the low temperature cycle.

On the basis of low temperature requested capacity (low temperature compressor speed), the capacity control function determines the operation mode and actions of the individual system components (compressors, valves) and ensures that low temperature compressor minimum off time is obtained. This function has 5 states which are determined based on the running conditions. Low temperature compressor speed is directly dependent upon the current mode.

The high temperature compressor frequency is set based on the running of the low temperature cycle (keeping a maximum condensing pressure of the low temperature cycle). In case some limiters are active on the high temperature cycle (TFC, IFC, condenser temperature), the cooling load on the whole system will be lowered through the MOP function (Maximum Operating Pressure).

The set of limiters acting on the low temperature cycle are:

States	Function
Off	Everything is turned off.
Start up	If cooling is required, the system is checked, high and low temperature cooling cycles are started. Low temperature compressor always starts in low speed.
Pull down	Maximum cooling capacity (based on running conditions and active limiters).
Cooling	High/Low/Off regulation of low temperature compressor.
Defrost	Heaters are always used.

The capacity of the unit is controlled between maximum cooling capacity (high speed on low temperature compressor), medium cooling (low speed on low temperature compressor) and off. This is done by regulation of the low temperature compressor speed (Dahlander motor) and on/off regulation. When the cooling capacity is zero, both compressors are off and the evaporator motor fans are kept on to continue measuring the correct air return temperature.

6.3.1 High temperature cycle limiters

In the Star Freeze unit there are limiters on both the high temperature and the low temperature cycles. Both sets of limiters are acting by lowering the suction pressure of the low temperature cycle therefore lowering the load on the whole system.

When a limiter is active, it will be shown in the status line on the main display window. The type of limiter can then be seen in the Information menu (i), line I34.

High temperature cycle limiter types:

- **TC**, limits the maximum high temperature condenser pressure (and temperature) of the high temperature cycle and is typically active during pull down. If the unit is lacking capacity compared to other Star Freeze units, clean the condenser coil, check Pdis, and check condensor fan motor for proper operation.
- **IFC**, limits the maximum current draw from the FC. Is typically active during pull down if the ambient temperature is over 25°C (77°F). If the unit is lacking capacity compared to other Star Freeze units, see AL 511 for trouble shooting and check the high temperature refrigerant level (overcharged).
- **TFC**, limits the maximum internal FC temperature. Is typically active during pull down if the ambient temperature is over 40°C (104°F). If the unit is lacking capacity compared to other Star Freeze units, see AL 517 for trouble shooting.

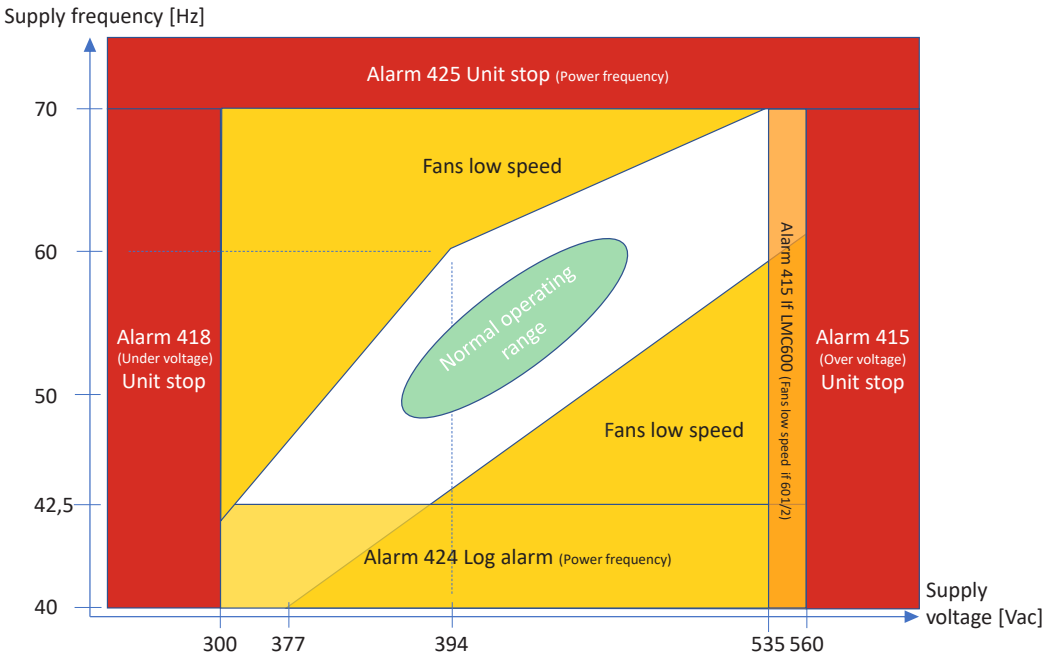
There can be multiple high temperature limiters activate simultaneously. The most critical limiter will be shown in the user panel. The largest of the factors is used as the active limiter. If the limiter factor is higher than a certain threshold, the suction pressure of the low temperature cycle will be decreased.

6.3.2 Low temperature cycle limiters

- **TC LT**, limits the condensing temperature of the low temperature cycle, in order to avoid the triggering of the low temperature high pressure switch. This limiter is typically active during pull down, in high ambient temperature conditions. It acts by lowering the target pressure in the evaporator.
- **I_LT**, limits the current draw of the total Star Freeze system (except for the frequency converter) to avoid the triggering of one of the 16A CTIs (the CTI that is connected to the power meas). This limiter can become active during pull down in high ambient conditions. It acts by lowering the target pressure in the evaporator.

6.4 Electrical control

The following graphical illustration shows the accepted volt/Hz range and the set off values for the alarms AL 415, AL 418, AL 424, and AL 425.



6.5 Expansion valves, high temperature cycle

This function ensures optimum cascade heat exchanger superheat (SH), calculates the percentage of opening degree, and controls the valves. The opening degrees of the two high temperature expansion valves are the same. This function is active when the high temperature compressor is in operation. The valves are closed during high temperature compressor turn off.

The valve is controlled as a thermostatic expansion valve (TXV), which is a refrigeration throttling device that controls the amount of refrigerant liquid injected into the evaporator based on the evaporator outlet temperature (Tsuc) and pressure (Psuc) called the superheat. The refrigerant is pumped through the system, moving through the evaporator, the compressor, the condenser, and the throttling device which injects liquid refrigerant into the evaporator before it moves into the compressor.

Defective sensor(s)	Substitution sensor/Action	Alarm
Psuc	Unit stop	206, Psuc unrealistic 207, Psuc invalid
Tsuc	Unit stop	126, Tsuc invalid

6.6 Expansion valves, low temperature cycle

This function ensures optimum filling of the evaporator based on cooling demand and active limiters, calculates the opening degree, and controls the valve. The low temperature expansion valve is active only when the low temperature compressor is in operation. The rest of the time the valve is closed.

The cascade heat exchanger acts as the condensing unit of the low temperature cycle. If it fails to reject the heat, the low temperature high pressure switch or the low temperature safety valve will be triggered and the whole system would stop. The two sensors that are used to control the valve cannot be properly substituted so in case any of them becomes invalid, the unit will be stopped.

The valve is not controlled as a standard TXV due to the high pressure of the R473A refrigerant. Several pressure (PsucLT) and temperature sensors (TliqLT, TsuccLT) are used to determine the optimal opening degree in the different running conditions. If any of those become invalid, the valve will either be used in a degraded mode or the unit will stop in case safe running cannot be ensured.

Defective sensor(s)	Substitution sensor/Action	Alarm
TliqLT	Sensor substituted with a fixed value, not used in control	117, TliqLT invalid
TsuccLT	Sensor substituted with a fixed value, not used in control	120, TsuccLT invalid
PsucLT	Stop unit	215, PsucLT invalid

6.7 Economizer valve

This function ensures optimum sub cooling of liquid going to the high temperature expansion valves and cooling of the FC. In addition, the efficiency of the whole system is increased and the temperature of the gas at the compressor outlet is reduced. Function output is the economizer valve opening degree (Veco).

The economizer control has two modes:

1. Superheat control
   Valve opening degree control is based on calculations.
2. FC cooling
   This function is active during compressor operation, if the FC temperature increases above a certain threshold.

6.8 Bypass valve (VbpLT)

The bypass valve injects cold liquid from the low temperature cycle receiver into the intermediate stage of the low temperature compressor. The valve has two functions:

1. To ensure that the gas temperature at the low temperature compressor outlet does not get above a certain threshold. This is needed to avoid the temperature degradation of the compressor oil.
2. To ensure that the temperature of the low temperature compressor motor does not get to the safety limit and thus reduce the wear of the compressor motor.

Defective sensor(s)	Substitution sensor/Action	Alarm
McprLT temp protection	Low temperature compressor stops	403, Mcpr LT over heat

6.9 Condenser fans

Controll of the condenser fans will reduce the pressure of the high temperature (HT) cycle and also cool the low temperature compressor discharge gas, through condenser and gas cooler air ventilation. The fans speed is controlled only based on the discharge pressure of the high temperature cycle; there is no input from the low temperature (LT) cycle. This function is activated when control is in automatic mode.

The condenser pressure is controlled only by ventilation air cooling that takes place in the following way: Depending on the high temperature compressor outlet pressure (saturated temperature), the fans are off or run in 2 different speeds: High and low. In total, the fans can run in 3 modes: Off, low speed and high speed.

For low ambient temperatures, the condenser fans will run in short pulses in order not to lower the HT discharge pressures too much. The control is made based on two temperature limits that determine when the condenser fans should change from off to low speed and from low speed to high speed.

Defective sensor(s)	Substitution sensor/Action	Alarm
Pdis	TC = 66°C (150.8°F), Condenser fans run in high speed	203, Pdis invalid
Tamb	Tamb is fixed TcRefMin = 10°C (50°F), For TC > 10°C (50°F), condenser fans run in high speed	129, Tamb invalid

6.10 Evaporator fans

In the Star Freeze unit, because only frozen goods are being transported, the three evaporator fans run in low speed only in automatic mode, except for during defrost and low temperature cycle start up (to lower LT compressor load) when they are turned off. The integrity of the evaporator motor fans is evaluated during start up by checking that the current draw is within limits, calculated based on the voltage and frequency of the power supply.

6.11 Defrost function

The defrost function ensures regular evaporator defrosting. The function is active in Automatic mode.

There are two types of defrost active in the Star Freeze unit:

1. Air defrost: Only triggered once during temperature pull down, when Tsup is close to 1°C (33.8°F). The compressors are stopped and only the evaporator fans are kept running to direct the warm cargo air onto the evaporator surface and melt the ice thorough forced convection.
2. Electric defrost: Thorough the use of 12 electric heaters mounted below the evaporator coil. This is triggered by a defrost demand function that detects when the evaporator is filled with ice. The following text is describing this type of defrost.

Defrost initiation

- On demand defrost, meaning defrost function will start when needed.

Defrosting interval

- The on demand defrost system is constantly monitoring the evaporator temperatures in order to prevent the evaporator blocking up with ice. If the system registers that the evaporator has become blocked up with ice, an on demand defrost will be initiated.

The actual electrical defrost execution is carried out in 4 steps:

1. Wait
   In Wait mode the time is refreshed for the next defrost provided that the following conditions are satisfied:
   - Low temperature compressor is running.
   - LT T0 is less than LT T0min.

   Wait mode termination can be due to:
   - Calculated ice amount in the evaporator is above critical level (on-demand defrost)
   - Defrosting action initiated manually (manual defrost initiation)
2. Pre-defrost
   The low temperature compressor is stopped and the evaporator fans are kept running for one minute to equalize the temperature measurements.
3. Execute
   In this mode the actual evaporator defrosting takes place. A defrost start event is made in the trip log. Both cooling circuits are stopped: compressors, motor fans and valves. Evaporator heating elements are turned on. Evaporator defrosting terminates when evaporator temperature (Tevap), is above defrost termination temperature for a certain amount of time or upon elapse of max. defrost time. A defrost stop event is made in the datalog with the current interval and Tevap temperature.
4. Terminate
   Terminate mode is dividable into three parts:
   - Water drip period: after the heaters are stopped, none of the cooling system components are started for a short period to allow the remaining water on the evaporator to drip into the drain gutter and outside the cargo space.
   - Evaporator refreezing preventing remaining water drops on evaporator from blowing into the container upon evaporator fan initiation.
   - Termination by going back to cooling, the temperature controller takes over in a controlled way.

   After termination, the unit continues normal operation again with the same setpoint temperature as before defrost start.

<u>General information</u>

If the Tevap sensor is not OK, the defrost will terminate on the maximum defrost time.

<u>Manual defrost termination</u>

Upon manual defrost termination, termination state is entered. No adaptive adjustment takes place when defrosting is manually initiated.

<u>Regarding user interface</u>

Defrost icon is displayed during defrost function execution.

6.12 Alarm Action System (AAS)

This function defines what to do if a sensor is defect. The strategy is to substitute the missing sensors reading with the value from another sensor or a constant so that the unit can maintain its functionality with reduced precision.

6.13 Datalog

The controller has a datalog to record operation of the unit. The datalog includes 4 items:
- Data
- Extended data
- Alarms
- Event data

The logged data in the datalog can be seen:
- On the display menu L01, the viewable temperatures are listed.
- On the display menu L03, the logged temperatures can be viewed graphically.
- Retrieved via the StarView program using the retriever socket.

When an alarm is activated it triggers a complete log, however max. one per 15 min. The datalogger can hold approximately 10.000 logs or more than 1 year of loggings with default logging interval of one log per hour.

The following tables show retrievables with Starview software:

File download information			
F1		Signature	Header
F2		Container ID	
F3		Controller ID	
F4		Controller software	
F5		Retriever software	
F6		Extraction date	
F7		Comments	
Datalog			
D1	DT	Date	Stamp
D2		Time	
D3		Log type [Event, Data, Log]	
D4		Event ID	Events + Alarms
D5		Param. 1	
D6		Param. 2	
D7		Param. 3	
D8		Param. 4	
D9		Param. 5	
D10	Tsup Avg	Supply air temperature, average [°C]	Short Log
D11	Tret Avg	Return air temperature, average [°C]	
D12	Tcargo1	Cargo 1 temperature [°C]	
D13	Tcargo2	Cargo 2 temperature [°C]	
D14	Tset	Temperature setpoint [°C]	
D15	Psuc	Suction pressure, HT cycle [BarE]	Extended Log Type 1
D16	Pdis	Discharge pressure, HT cycle [BarE]	
D17	Fpower	Net frequency [Hz]	
D18	Upower	Highest power voltage of U1, U2, U3	
D19	I1	Current, Ph. 1 [A]	
D20	I2	Current, Ph. 2 [A]	
D21	I3	Current, Ph. 3 [A]	
D22	Ifc	FC current [A]	
D23	Fcpr	Compressor frequency, HT cycle [Hz]	
D24	Heater	Heating element [%]	
D25	Mevap	Evaporator motor speed	
D26	Mcond	Condenser motor speed	
D27	Tfc	Frequency converter temperature [°C]	
D28	Tamb	Ambient temperature [°C]	

D29	T0	Calculated boiling temperature, HT cycle [°C]	Extended Log Type 2
D30	Tc	Calculated condensing temperature, HT cycle [°C]	
D31	Tevap	Evaporator temperature [°C]	
D32	Tsuc	Suction Temperature, HT cycle [°C]	
D33	Vexp	Expansion valve opening, HT cyle [%]	
D34	Veco	Economizer valve opening, HT cycle [%]	
D35	HT cycle	HT state machine state	
D36	SF cycle	StarFreeze state machine state	
D37	SH ref	Cascade superheat, HT cycle [K]	
D38	Tint	Internal temperature [°C]	
D39	TsuccLT	Compressor inlet temperature, LT cycle	LT datalog
D40	TsuceLT	Evaporator outlet temperature, LT cycle	
D41	TliqLT	Expansion valve inlet temperature, LT cycle	
D42	TdisLT	Discharge temperature, LT cycle [°C]	
D43	PsucLT	Suction Pressure, LT cycle [BarE]	
D44	PdisLT	Discharge Pressure, LT cycle [BarE]	
D45	Safety reason		
D46	CompLT	Compressor motor speed, LT cycle	
D47	VexpLT	Expansion valve opening, LT cycle [%]	
D48	HPS_LT	High pressure switch state, LT cycle	
D49	VbpLT	Bypass valve opening, LT cycle [%]	
D50	LT cycle	LT state machine state	
D51	Defrost cycle	Defrost state machine state	
D52	Tsup instant	Supply air temperature, instant [°C]	Extended Log Type 3
D53	Tret instant	Return air temperature, instant [°C]	
D54	Energy	Consumed energy [kWh]	
D55	T0_LT	Calculated boiling temperature, LT cycle	
D56	Tc_LT	Calculated condensing temperature, LT cycle	
D57	Mevap Avg	Evaporator motor speed, average	Extended Log Type 4
D58	Mcond Avg	Condenser motor speed, average	
D59	VexpLT Avg	Expansion valve opening, LT cycle, average [%]	
D60	Fcpr Avg	Compressor frequency, HT cycle, average [Hz]	
D61	VbpLT Av	Bypass valve opening, LT cycle, average [%]	
D62	Vexp Avg	Expansion valve opening, HT cycle, average [%]	
D63	Veco Avg	Economizer valve opening, HT cycle, average [%]	
D64	Hevap Avg	Heating element ON time, average [%]	
D65	CompLT Avg	Compressor motor speed, LT cycle, average [%]	
D66	Battery Voltage	Battery Voltage [V]	

7. Tests

The unit has 3 test functions:
1. Function test
2. Short PTI (Pre-Trip Inspection) test
3. Full PTI (Pre-Trip Inspection) test

The PTI test is a function test followed by a capacity test where the requested temperature must be reached within the time limit.

At test initiation, an event is generated in the log.

During Function and PTI test the normal alarm system remains active. If an alarm is triggered during test operation, it appears in the display and will be written in the log as it is the case during normal operation. In case of a fatal alarm during testing the test is terminated and the unit remains off.

Function or PTI sub-test failure causes an alarm "PTI FAILURE" to be generated. In case of Function or PTI sub-test pass an event, "Test status" is displayed. For more information, see "14. Events".

Clear the alarm list before starting a test. If there should be any active alarms in the alarm list when a Function or a PTI test is started, the test will always fail even if all the individual test steps PASS without failures.

PTI menu has a primary status and a status for each sub-test with own indexes. Only the primary status for a PTI test is memorized when supply voltage is removed. When PTI is initiated a trip start is set in the datalog.

7.1 Function test

Function test is a unit component test (non-destructive). The test is based on a GO/NO GO procedure. All tests must be executed without failure one by one for the function test result to be PASS. The tests can also be performed individually.

Note: Due to the risk of liquid in the compressor house before the compressor test (part of the function test), this liquid needs to be vaporized. Therefore, always let the compressor run for about 10-20 minutes under normal conditions before activating the PTI or function test.

Function test includes the following items:

1. PTI - init
2. Controller test
3. Power check
4. Evaporator fans (Mevap)
5. Condenser fans (Mcond)
6. Heating element (Hevap)
7. Compressor/FC
8. Test completion status

7.2 Short PTI

Short PTI includes the following test items:

1. Function test (see "8.1 Function test")
2. -40°C (-40°F) run test
3. Defrosting
4. Test completion/status

7.3 Full PTI

Full PTI includes the following test items:

1. Function test (see "8.1 Function test")
2. -60°C (-76°F) run test
3. Defrosting
4. Test completion/status

8. Refrigeration system data

8.1 Refrigerant charge

High temperature cycle: 3.0 kg R134a or R513A, with non-water-cooled condenser.
Low temperature cycle: 2.5 kg R473A.
NEVER top of/add a partial charge of refrigerant on this equipment.

8.2 General specification

Total unit weight	590 kg (5400 kg incl. box)		
Dimensions	Height: 2235 mm	Width: 2025 mm	
Noise level			

8.3 High temperature compressor – motor assembly

Type	Semi-hermetic two-stage reciprocating
Number of cylinders	2 low stage cylinders 2 high stage cylinders
Speed	Variable, FC controlled
Model	S4BCF-5.2Y / S4BCF-4.2Y
Nominal power	5.5 kW / 3.8 kW
Compressor oil type	Reniso Triton SEZ 55 or equivalent
Compressor oil quantity	1.5 L and 0.4 L in system
Compressor housing	Sea water resistant aluminium, unpainted
Weight	61 kg 5HP / 55 kg 4HP
Conformity	Low Voltage Directive 2006/95/EC

8.4 Low temperature compressor - motor assembly

Type	Semi-hermetic two-stage reciprocating
Number of cylinders	2 low stage cylinders 2 high stage cylinders
Speed	Dual speed 1800/900 rpm @60Hz, 1500/750 rpm @50Hz
Model	DPC-H406F
Nominal power	4.75 kW @50Hz
Compressor oil type	Shrieve Zerol HD46 (PAG type)
Compressor oil quantity	1.3 L and 0.4 L in system
Compressor housing	Casted iron, shot blast and aluminized flame spray, min. 0.25mm
Weight	98 kg
Conformity	Low Voltage Directive 2006/95/EC

8.5 Frequency converter (FC)

Type	FC 2.0, FC2.1 or newer
Frequency range	20 to 100 Hz (450 to 3300 rpm)
Converter housing	Sea water resistant aluminium, unpainted
Tightness	IP 56 mounted on compressor (IP 54 stand-alone/unmounted)
Conformity	Low Voltage Directive 2014/35/EU and EMC Directive 2014/30/EU (FC 2.0)

8.6 Evaporator coil

Tube material	Copper, inner grooved
Fin material	Aluminium, hydrophilic treated
Fin spacing	3.0 mm
Attitude	30° from horizontal
Conformity	PED 2014/68/EU and EC 2006/42/EC

8.7 Evaporator coil heaters

Type	ø8.5 mm in stainless steel AISI 304
Number	12 (+ 1 drain heater)
Rating	750 W each at 400 V (750 W ± 10 W)
Conformity	EC 2014/35/EU

8.8 Evaporator fans

Material	Polypropylene, glass fibre reinforced
Type	Axial
Number of fans/blades	3 pcs/7 pcs
Pitch	25°
Diameter	ø315 mm
Drive	Direct on motor shaft
Conformity	International Electrotechnical Commission (IEC) 62321:2008

8.9 Evaporator fan motors

Manufacturer	Nidec dahlander motor	
Type	Enclosed, non-vented	
Frame size	071B14	
Shaft material	Stainless steel, X20CrNi172	
No. of motors	3	
Voltage	3–phases, 400/460 V AC, 50/60 Hz	
Nominal power	0.45/0.07 kW @ 460V/60 Hz	
Protection, electrical	Bimetal	
Speed	Used as single-speed only. 1760/1425 rpm (60/50 Hz)	
Rotation	Counter–clockwise, when viewed from shaft end	
Bearings	Permanently lubricated, sealed	
Bearing size	Driven end 6304 2Z C3	Non driven end 6201 2Z C3
Bearing lubricant	Lubricant: Special low temperature grease, NSK MG2 (not as in Star Cool) Temperature range: -60°C to +70°C (-76°F to +158°F)	
Conformity	Low Voltage Directive 2006/95/EC	

8.10 Condenser coil

Tube material	Copper, inner grooved and smooth
Fin Material	Aluminium
Fin spacing	2.0 mm
Coating, tube/fin	Cataphoresis treatment, with additional acrylic resin
Conformity	PED 2014/68/EU and EC 2006/42/EC

8.11 Condenser fans

Material	Polypropylene, glass fibre reinforced
Type	Axial
Number of fans	2 pcs
Pitch	30°
Diameter	ø400 mm
Drive	Direct on motor shaft
Conformity	International Electrotechnical Commission (IEC) 62321:2008

8.12 Condenser fan motors

Manufacturer	Nidec dahlander motor		Zhongda dahlander motor	
Type	Enclosed, non-vented			
Frame size	071B3			
Shaft material	Stainless steel, X20CrNi172			
No. of motors	2			
Voltage	3–phases, 400/460 V AC, 50/60 Hz			
Nominal power	0,315/0,085 kW at 460 V/60 Hz		0,30/0,08 kW at 460 V/60 Hz	
Protection, electrical	Thermistors / Bimetal			
Speed	Dual-speed 1740/1460 rpm (60/50 Hz) 870/730 rpm (60/50 Hz)		Dual-speed 1688/1420 rpm (60/50 Hz) 750/650 rpm (60/50 Hz)	
Rotation	Counter–clockwise, when viewed from shaft end			
Bearings	Permanently lubricated, sealed			
Bearing size	Driven end 6204 2Z C3	Non driven end 6201 2Z C3	Driven end 6204 2Z C3	Non driven end 6202 2Z C3
Bearing lubricant	Lubricant Klüberquiet BQH 72 - 102 or equivalent. Temperature range: -40°C to +140°C (-40°F to +284°F)			
Conformity	IEC 2014/30/EU, LVD 2014/35/EU			

8.13 Economizer, cascade heat exchanger, economizer desuperheater, suction gas heat exchanger

Type	Brazed plate heat exchanger
Material	Stainless steel, AISI 316 L
Conformity	RoHS II 2011/65/EU

8.14 Refrigeration controls

Expansion valves, economizer valve and bypass valve	Solenoid valves, electronically controlled by the controller
Filter drier for high temperature Filter drier for low temperature	3Å molecular sieves with O-ring or equivalent 3Å molecular sieves with brazed connections
Moisture indicator for high temp Moisture indicator for low temp	Incorporated in receiver sight glass Material: Brass acc. to EN 12164/CW602N Incorporated in receiver sight glass Material: Brass acc. to EN 12164/CW602N
Piping	Solid copper tubes according to EN 12735-1
Pipe coating	Primer: Epoxy resin zf - a120 Topcoat: Polyurethane resin Hipon – 50

8.15 Electrical data

Input power (operational)	3 x 360 V to 460 V 50 Hz / 3 x 400 V to 500 V 60 Hz
Control circuit voltage	12 V DC
AUX voltage AC: 19 - 30 V AC	24 V AC Nominal

8.16 Circuit breaker

Main power ampere	16 A
Number of pieces	2
Conformity	Low Voltage Directive 2006/95/EC

8.17 Low temperature compressor and heaters contactor

Nominal	16 A at 40°C (104°F) and 400 V
Max	12 A at 70°C (158°F) and 520 V
Start current	6 x nominal
Conformity	Low Voltage Directive 2014/35/EU

8.18 Other contactors

Nominal	9 A at 40°C (104°F) and 400 V
Max	7 A at 70°C (158°F) and 520 V
Start current	6 x nominal
Conformity	Low Voltage Directive 2014/35/EU

8.19 High temperature high pressure cut out switch R134a/R513A

Cut out	22.5 BarE (326.3 psi) ± 0.7 Bar (10.2 Psi)
Cut in	15.9 BarE (230.6 psi) ± 0.7 Bar (10.2 Psi)
Conformity	PED 97/23/EC

8.20 Low temperature high pressure cut out switch R473A

Cut out	49.0 BarE (710.7 psi) + 0.0 Bar (0.0 Psi), - 4.0 Bar (58.0 Psi)
Cut in	39.0 BarE (565.6 psi) ± 1.0 Bar (14.5 Psi)
Conformity	PED 97/23/EC

8.21 High temperature safety valve

Body material	Brass
Spring material	AISI 304
Relief pressure	30 barg ± 1 bar

8.22 Low temperature safety valve

Body material	Brass
Spring material	AISI 304
Relief pressure	55 barg ± 2 bar

8.23 Box vacuum valve

Body material	Polypropylene
Spring material	Stainless steel AISI 302
Opening vacuum pressure	14 mbar
Number	2

8.24 High temperature receiver

Body material	Electro polished stainless steel, AISI 316L
Internal volume	1.8 litre

8.25 Low temperature receiver

Body material	Electro polished stainless steel, AISI 316L
Internal volume	1.7 litre

8.26 Spare part R473A refrigerant bottle

Body material	30CrMo (according to GB/T 18248) with marine coating
Bottle connector	CGA320 or CA660
Volume	4 liters (2,5 kg)
Maximum working pressure	200 barg
Number	1

8.27 Fuses

Control circuit supply	0.4 A, tube fuse

8.28 Power plug

Type	CEE 3P+E (4 pole) 32 A 400/460 V, 50/60 Hz
Protection degree	IP67
Conformity	International Electrotechnical Commission (IEC) 60309-1:1999 and 60309-2:1999

8.29 Power cable

Type	4 x 4 mm2, 450/750 V, PU – sheath
Length/colour	20 m/Yellow
Temperature range	-37°C to +90°C (-34.6°F to +194°F)
Conformity	EC 2014/35/EU

8.30 Cargo socket requirements

Location	Rear left side
Number	2 cargo sensor sockets
Type	Deutsch HD 10, female socket. Tin plated.

8.31 High temperature sensors

Type	NTC, 10 kOhm at 25°C (77°F) 10K3A1
Operating temperature	-40°C to +100°C (-40°F to +212°F)
Accuracy	±0.15°C, range -30°C to +100°C (±0.5°F, range -22°F to +212°F)

8.32 Low temperature sensors, including cargo

Type	NTC, 881 Ohm at 25°C (77°F) NKS8929 9.86K3A1
Operating temperature	-70°C to +100°C (-94°F to +212°F)
Accuracy	±1.0°C, range -70°C to +30°C (±1.8°F, range -94°F to +86°F)

8.33 Pressure transmitters

Manufacturer		DST
Range	HT cycle High pressure side	0 to 40 BarE
	HT cycle Low pressure side	-0.69 to 13.0 BarE
	LT cycle High pressure side	0 to 40 BarE
	LT cycle Low pressure side	0 to 40 BarE
Conformity	High pressure side	RoHS 2011/65/EU EMC 2014/30/EU
	Low pressure side	PED 2014/68/EU
Type		Ratio metric pressure transmitter, with sealed gauge measuring principle. ¼" female flare connection with deflator.

8.34 Miscellaneous

- Tin plated electrical wires
- Tin plated cables
- 2 pieces of incorporated hinges
- 2 pieces of removable evaporator hatches
- Bolts, screws and nuts in stainless steel
- Single viper peripheral seal
- Front frame is painted with polyester powder, colour RAL 9003
- 4 pieces of steel ball valves

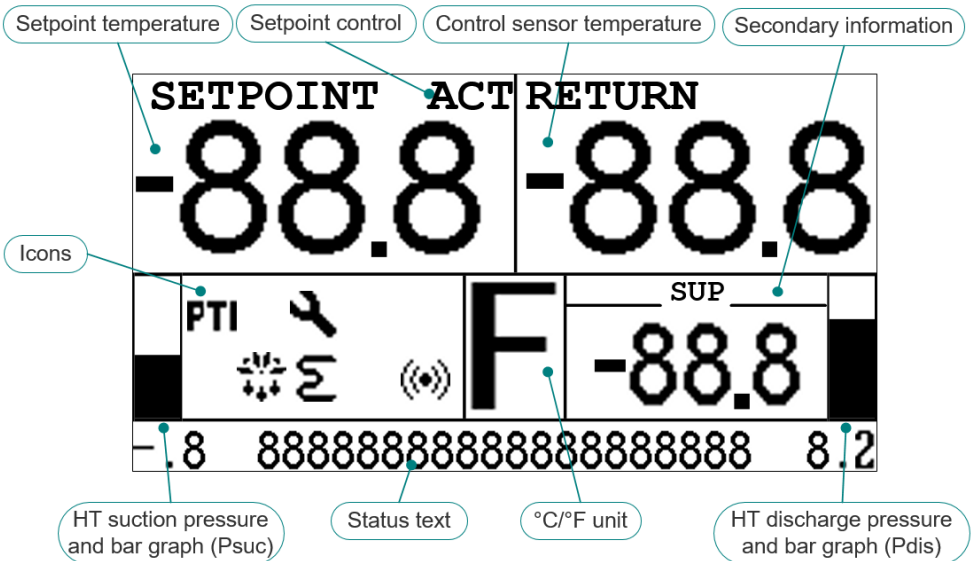
9. User interface

9.1 Indicator lights

Alarm indicator light		In-range indicator light
SLOW FLASH if there are active alarms QUICK FLASH if there are fatal alarms	 Red Green	NORMAL FLASH when controlling temperature probe is inside the acceptable range Constant ON after 30 min. in-range

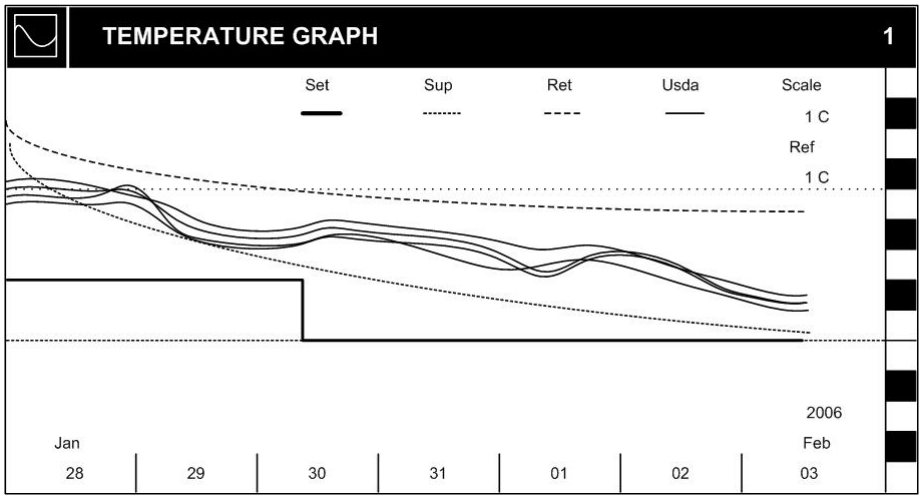
Both lights are only active when the container is connected to a power supply line. During power up, both lights are shortly illuminated to verify their function. A “Slow flash” is a short flash every 3 sec. A “Quick flash” is a flash every 1 sec. A “Normal flash” is a flash every 1½ sec.

9.2 Display

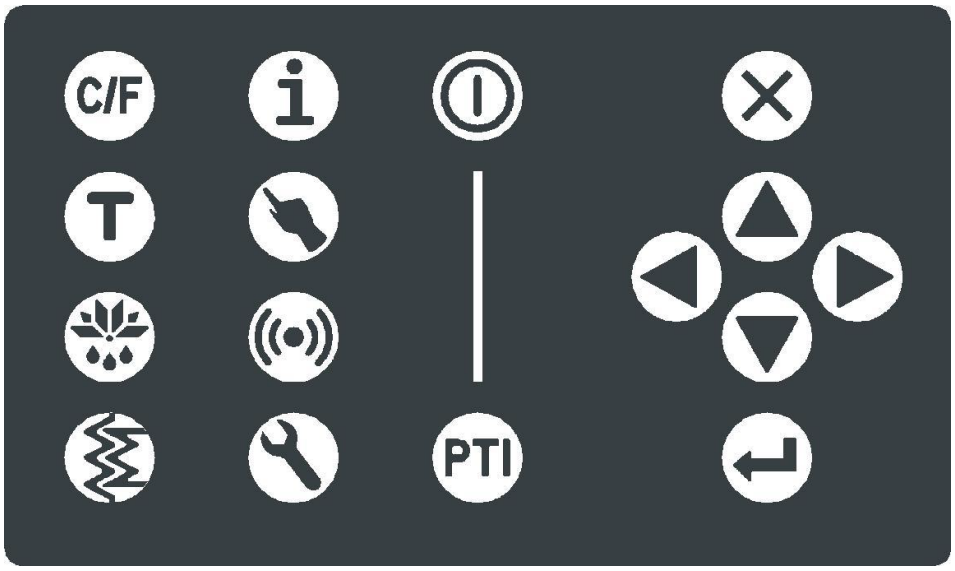


C / F	Temperature and pressure unit selection Celsius and Bar or Fahrenheit and Psi
PTI	Pre Trip Inspection or Function Test is running
	Unit is operated in Service mode
	Defrosting is running
	Heater elements are switched on
	Alarms are present in the Alarm menu

It is possible to obtain a datalog graph display (see “12.15 Datalog view”).



9.3 Keypad



Navigation keys		Use these keys to move menu display up/down and to change parameter values
⊗	Cancel	Leave active sub menu. Cancel active parameter adjustment
▲	Up	Move menu one line up Increment parameter value in menu Increment setpoint on main display page Zoom out (graphical view)
▼	Down	Move menu one line down Decrement parameter value in menu Decrement setpoint on main display page Zoom in (graphical view)
◀	Left	Move menu one line to the left. Move left (graphical view)
▶	Right	Move menu one line to the right. Move right (graphical view)
↵	Enter	Select a sub menu Activate a function (press twice) Initiate parameter adjustment Accept parameter adjustment when done

Menu keys		Press key to select menu display Press again to move menu one full page down
	Wake-up	Turn on and off battery powered display operation. No display backlight will be active
PTI	PTI	Show PRE TRIP INSPECTION menu (start/stop test and view results)
	Info	Show INFORMATION menu (actual data read out)
	Operation	Show OPERATION menu (settings)
	Alarm	Show ALARM menu (view listing of present alarms)
	Service	Show SERVICE menu (maintenance data and settings)
		Button has no function. No water cooling available
Function keys		**Direct activation and deactivation of commonly used functions**
C/F	Unit	As long as the button is pressed, °F is shown instead of °C and Psi is shown instead of Bar in the display. Otherwise °C and Bar is shown when pressed if software is set to °F/Psi default
T	Toggle	Shortcut to graphical view of logged temperatures. Toggles information on some sub menus.
	Defrost	003 manual defrost (see “12.11 Manual defrost”)

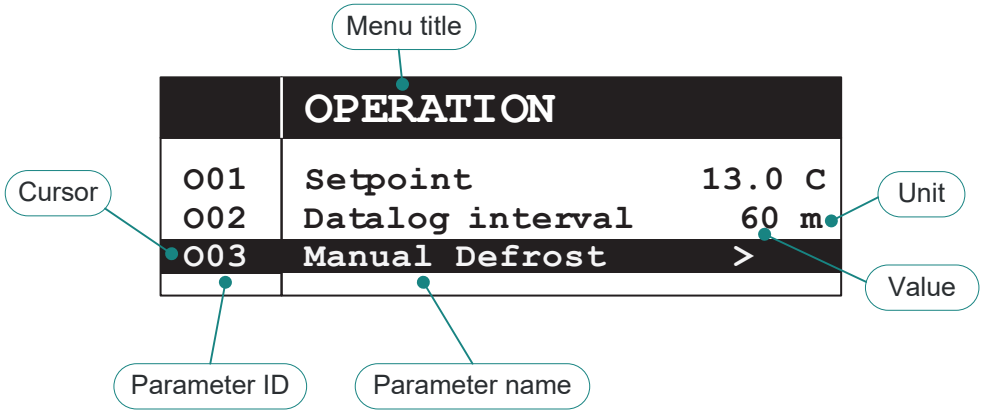
If no key is activated for a period of time, the controller will do this:

5 s.:	Cancel active parameter adjustment
30 s.:	Turn off battery powered display operation when not connected to a power supply line
5 min.:	Leave service mode operation and return to automatic mode
10 min.:	Return to main window in display

10. Menu overview

Menus are selected by pressing a menu key or by pressing the Enter key ↵ on a sub menu line shown in the display.

10.1 General page layout



10.2 Using the cursor

The parameter ID is only used for identifying each displayed line of the menu system.

Pressing the ▲ and ▼ arrow keys will move the highlighted cursor one menu line up or down. In the upper right corner of the display is shown the actual line number of the cursor together with the total number of lines in the current menu.

10.3 Changing a parameter value

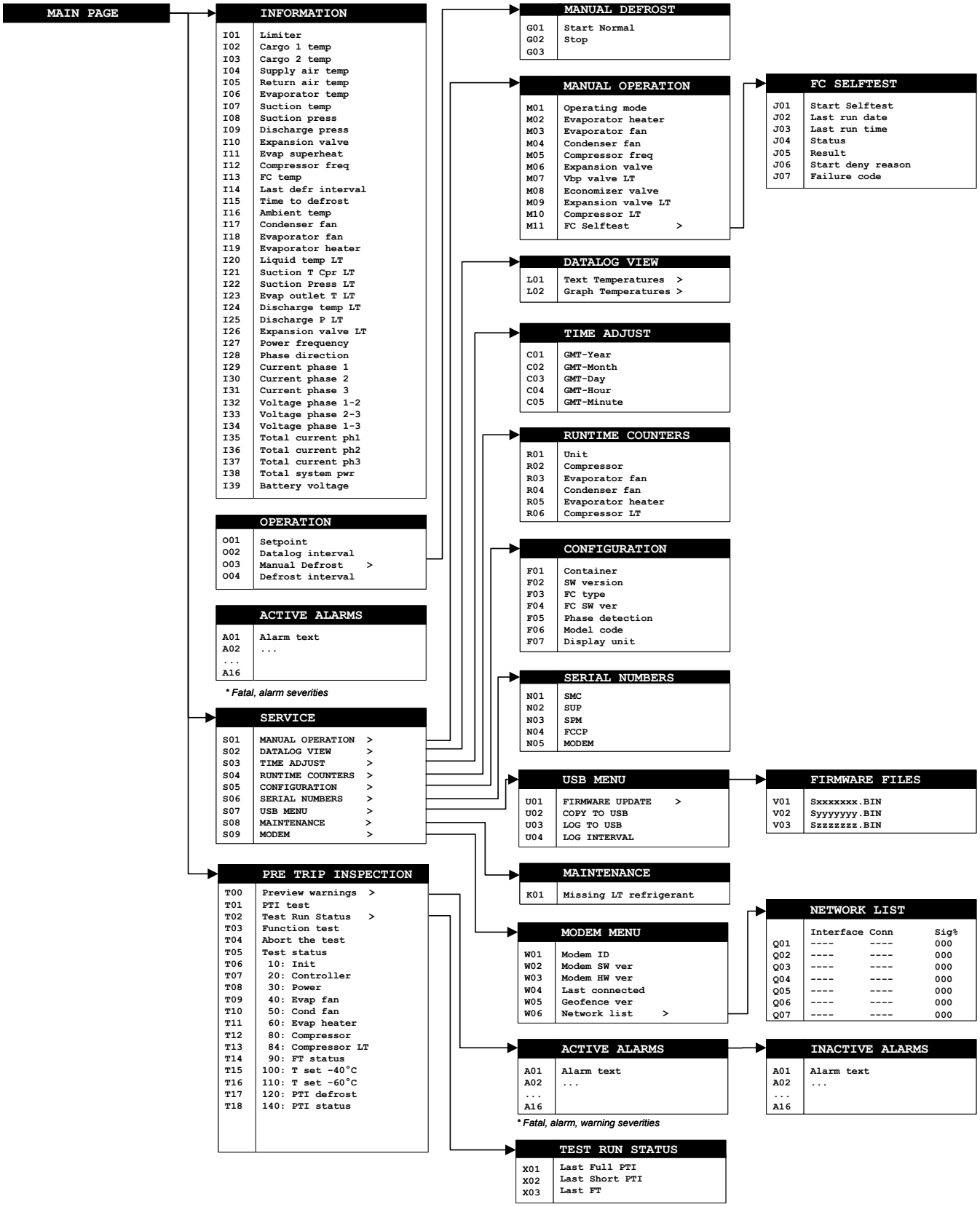
1. First move the cursor up ▲ or down ▼ to the line of the parameter to be changed.
2. Then press the Enter key ↵. The cursor will now highlight the parameter value instead of the ID.
3. Use the up ▲ or down ▼ arrow keys to increase or decrease the displayed value.
4. Accept the new parameter value by pressing and holding the Enter key ↵ for 3 sec.
5. If not pressing any key for 5 sec. or if pressing the Cancel key ✕, the value will not be changed.
6. The cursor returns to the ID column and can now be moved to other lines.

10.4 Activating a function

1. First move the cursor up ▲ or down ▼ to the line of the function to be activated.
2. Then press the Enter key ↵. The cursor will now highlight the function value instead of the ID.
3. Do the activation by pressing the Enter key ↵ once more.
4. If not pressing any key for 5 sec. or if pressing the Cancel key ✕, no function will be activated.
5. The cursor returns to the ID column and can now be moved to other lines.

11. Operation

11.1 Menu structure



11.2 General operation

The following text is a general description of operating menus and editing parameters.

By pressing a menu key the menu is selected and its icon is illuminated. The lower part of the display shows parameter number, parameter value and a short information text in English. After 30 sec. with no keyboard activities, the display returns to the main display menu.

By pressing ⊗ the display returns to the previous menu level in the menu structure. If one of the other menu keys is pressed, menu selection changes.

By pressing the ▲ and ▼ keys the individual parameters are scrollable.

For parameter change, press ↵ and the parameter is highlighted in inverse writing. By pressing ▲ and ▼ keys parameter values are changeable. When desired value is set, press ↵ to accept value and parameter is shown in normal writing again. As long as the parameter value is shown in inverse writing, the setting is erasable by pressing ⊗ and the previous parameter value is shown again.

If the keys ▲ , ▼ or ↵ are not pressed for 5 sec., the setting is cancelled and the previous parameter value is shown again.

11.3 Temperature setting

Temperature setpoint adjustment is made from the operating menu.

By pressing ▲ or ▼ the setpoint is adjusted 0.1°C (0.1°F) and the setpoint digits are highlighted in inverse writing. If the key is held, the setpoint will automatically be incremented by 0.1°C (0.1°F) until the key is no longer held. After approximately 3 sec. the setpoint will be incremented by 1°C (1°F). Upon reaching desired temperature, press ↵ and hold for 3 seconds. The setpoint will be accepted and shown in normal writing again.

During inverse writing, the new temperature setpoint is erasable by pressing ⊗ and the previous setpoint is shown again.

If the keys ▲ , ▼ or ↵ are not pressed for 5 sec., current setting will be cancelled and previous setpoint shown again.

11.4 Wake-up mode ⏻

When no main power is present the controller is switched off. The controller includes a battery for Star Freeze operation when no external voltage supply is present. For battery saving in this situation, controller will turn itself off upon disappearance of external voltage supply.

By pressing ⏻ the controller is enabled and controller operation will be possible. In case of no keyboard activities for 30 sec., controller will be turned off again.

Controller may be manually turned off in this mode by pressing ⏻ again.

11.5 Contrast adjustment of the display

Press ⊗ and hold while pressing ▲ or ▼ to adjust contrast, and ◀ or ▶ to adjust background lightning of the display. This can be done both in battery mode and when main power is applied. After adjusting the contrast, wait for a period of 25 sec before proceeding for the new setting to be saved. Make sure contrast is properly set at all times to secure readability.

11.6 °C and °F temperature scale showing C/F

While button C/F is pressed, °F is shown instead of °C and Psi is shown instead of Bar. If software is default °F/Psi, then °C and Bar is shown instead while C/F is pressed.

Permanently change to °F/Psi is available with the use of StarView. Permanently change to °C/Bar for machines initially set to °F/Psi is also possible with StarView.

Shown pressure is relative to atmosphere pressure.

11.7 Viewing graph of supply and return temperature Ⓣ

Press Ⓣ to enter graphical view (this function is a shortcut to L03 (see "12.15 Datalog view")).
To return to main page press ⊗ two times.

Press Ⓣ to toggle between stored set of temperatures: Setpoint temperature + supply air temperature, return air temperature and the other set of temperatures: USDA 1 + 2 + 3 temperatures and cargo temperature.

Press ▲ or ▼ to show newer or older stored set of values from the datalog.

11.8 PTI or function test execution (PTI)

If any active warnings or alarms exist when initiating a PTI or Function test, these active alarms/ warnings will be presented on display including an action selection window. Selecting "Run FT/PTI" here will enable running test though errors are detected. Pressing "Exit" will leave test menu to enable unit to be fixed before running test.

The test menu is opened by pressing (PTI). In the test menu, press keys ▲ or ▼ to scroll the menu. For a complete PTI test START must be highlighted by pressing ↵ at menu item T01. Pressing ↵ once more initiates the test. If ↵ is not pressed within 5 sec., the controller will cancel the operation and the cursor returns to the menu item - T01.

The unit must run for minimum 10 minutes before starting the test.

For a short PTI test START must be highlighted by pressing ↵ at menu item T01. Press keys ▲ or ▼ to scroll the menu to select SHORT. Pressing ↵ once more initiates the test.

A complete PTI test may take several hours: First a complete function test with menu items T04 to T14 and then performance testing in menu items T15 to T17.

A short PTI can take up to 10 hors if the ambient temperature is really high.

A function test is initiated in the same way by selecting menu T02. A function test performs menu items T04 to T14, without performance testing and takes about 10 – 15 min. to complete. The function test will continue through all the steps even if failures should occur. A PTI or function test can be aborted at T03.

A single item can be tested by highlighting the item, ex. T09. When START is shown in inverse writing, pressing ↵ again will start the test. Only the selected item is tested.

The PTI test is automatically terminated in case of no errors. Finally, temperature setpoint will be set to the same value as before test initiation.

If any error occurs during the test, alarms will be shown in the alarm list. Active alarms in the alarm list before start of the PTI test will lead to failure of the PTI test:

1. One alarm for PTI or function test failure. Status are also listed in the menu items T04 – T12(FT)/T17(PTI).
2. One or more alarms for a specific error during the test. Only listed in alarm list.

Failures found during the tests are listed in the alarm list and the results of the separate PTI test steps are in menu items T04 to T17. Alarms found are logged in the datalog.

A description of an alarm can be found in this manual (see "15. Detailed alarm description").
When the PTI test completes or is aborted, all alarms found during the test are set inactive in the alarm list. If the alarm list is empty, the unit is completely OK. If the controller is switched off, only the main status of a PTI test is remembered in menu item T04.

T00 Preview warnings

Function:

See “12.12 Alarms”.

Value:

-

T01 PTI test

Function:

Start Pre Trip Inspection test run to verify full functionality of the unit and performance test at different setpoint temperatures.

Value:

For starting PTI test, select either FULL or SHORT via ▲ or ▼ and press ↵ which initiates the test. The PTI test is automatically terminated in case of no errors. Finally, temperature setpoint will be set to the same value as before test initiation.

T02 Test run status

Function:

Go to test run sub menu.

Value:

None.

X01 Last Full PTI

Function:

Date of last full PTI.

Value:

YYYY-MM-DD or N/A.

X02 Last Short PTI

Function:

Date of last short PTI.

Value:

YYYY-MM-DD or N/A.

X03 Last FT

Function:

Date of last FT.

Value:

YYYY-MM-DD or N/A.

T03 Function test

Function:

Start function test runs to verify full functionality of the unit without performance tests.

Value:

For starting function test, START must be highlighted by pressing ↵. Pressing ↵ once more initiates the test.

T04 Abort the test

Function:

Stop the running PTI or function- test.

Value:

To stop the running test, STOP must be highlighted by pressing ↵. Pressing again stops the test.

T05 Test status

Function:

Shows the status of the last/running test.

Value:

The value depends on the function running. For PTI the values can be: “RUN” for running, “PASS” for test passed successfully, “ABORT” for test aborted by a user, “FAIL” for a failing PTI test – see the alarm list for specific reason.

T06 Test result: 10 Init

Function:

Shows the status of the test initialization. This test is always done.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user.

T07 Test result: 20 Controller

Function:

Shows the status of the test of the controller.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 801.

T08 Test result: 30 Power

Function:

Shows the status of the test of power consumption/connection.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 805.

T09 Test result: 40 Evap fan

Function:

Shows the status of the test of the evaporator fans.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 810 and 812.

T10 Test result: 50 Cond fan

Function:

Shows the status of the test of the condenser fan.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 815 - 817.

T11 Test result: 60 Evap heater

Function:

Shows the status of the test of the evaporator heater.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 820 - 821.

T12 Test result: 80 Compressor

Function:

Shows the status of the test of the compressor.

Value:

- : if not done yet. RUN: if still running test. PASS: if test finished successfully. FAIL: if the test failed. ABORT: if the test was aborted by the user. See specific description for AL 845 and 846.

T13 Test result: 84 Compressor LT

Function:

Shows the status of the low temperature compressor test (future).

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user.

T14 Test result: 90 FT status

Function:

Shows the status of the function test.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user.

T15 Test result: 100 T set -40°C

Function:

Shows the status of the performance test with temperature setpoint of -40°C (-40°F).

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 880.

T16 Test result: 120 T set -60°C

Function:

Shows the status of the performance test with temperature setpoint of -60°C (-76°F).

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 890.

T17 Test result: 120 PTI Defrost

Function:

Shows the status of the defrost.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 870.

T18 Test result: 140 PTI status

Function:

Shows the status of the PTI test.

Value:

"-" if not done yet. "RUN" if still running test. "PASS" if test finished successfully. "FAIL" if the test failed. "ABORT" if the test was aborted by the user. See specific description for AL 850.

11.9 Information menu ⓘ

By pressing ⓘ the Information menu is selected. The **i** icon is displayed.

I01 Limiter

Function:

Shows what condition is limiting the cooling capacity.

Value:

0: None
1: Ifc (compressor current)
2: Tfc (frequency converter temperature)
3: I_LT (low temperature cycle current)
4: TcLT (low temperature cycle discharge pressure)
5: Tc (discharge pressure)

I02 Cargo 1 temperature

Function:

Shows current temperature for Cargo 1 sensor.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I03 Cargo 2 temperature

Function:

Shows current temperature for Cargo 2 sensor.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I04 Supply air temperature

Function:

Shows current temperature for supply air sensor.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I05 Return air temp

Function:

Shows current temperature for return sensor.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I06 Evaporator temp

Function:

Show current temperature for evaporator.

Value:

Shown in hours and minutes.

I07 Suction temp

Function:

Shows measured suction gas temperature.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I08 Suction press

Function:

Shows current suction pressure for compressor.

Value:

Shown in units of Bar or Psi relative to atmosphere pressure. Switch by pressing C/F (at °C pressure is shown in BarE, at °F in Psi)..

I09 Discharge press

Function:

Shows current discharge pressure for compressor.

Value:

Shown in units of Bar or Psi relative to atmosphere pressure. Switch by pressing C/F (at °C pressure is shown in BarE, at °F in Psi).

I10 Expansion valve

Function:

Shows current percentage of expansion valve opening. Pulse Width Modulation.

Value:

Shown as a percent value.

I11 Evap superheat

Function:

Superheat of refrigerant gas at evaporator outlet.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I12 Compressor freq

Function:

Shows current compressor frequency.

Value:

Shown in units of Hz.

I13 FC temp

Function:

Shows current frequency converter temperature.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I14 Last defrost interval

Function:

Show time since last defrost.

Value:

Shown in hours.

I15 Time to defrost

Function:

Shows current time to the next defrosting. Minimum value depending on operation.

Value:

Shown in hours and minutes.

I16 Ambient temp

Function:

Shows current ambient temperature.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I17 Condenser fan

Function:

Shows current speed for condenser fan.

Value:

Shown as OFF, LO, HI or OH (overheat).

I18 Evaporator fan

Function:

Shows current speed for evaporator fan.

Value:

Shown as OFF, ON or OH (overheat).

I19 Evaporator heater

Function:

Shows current on/off-cycle of evaporator heating element. Pulse Width Modulation C/F

Value:

Shown as a percent value “on” during runtime. Cycle duration is 50 sec.

I20 Liquid temp LT (low temperature cycle)

Function:

Shows current temperature for liquid temperature sensor.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I21 Suction T Cpr LT (low temperature cycle)

Function:

Shows current suction temperature sensor value for low temperature cycle

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I22 Suction press LT (low temperature cycle)

Function:

Shows current suction pressure for compressor. (low temperature cycle).

Value:

Shown in units of Bar or Psi relative to atmosphere pressure. Switch by pressing C/F (at °C pressure is shown in BarE, at °F in Psi).

I23 Evap outlet T LT (low temperature cycle)

Function:

Evap outlet T LT (low temperature cycle)

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I24 Discharge temp LT (low temperature cycle)

Function:

Shows current discharge temperature of the low temperature cycle.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F.

I25 Discharge P LT (low temperature cycle)

Function:

Shows current discharge pressure for low temperature cycle.

Value:

Shown in units of Bar or Psi relative to atmosphere pressure. Switch by pressing (C/F) (at °C pressure is shown in BarE, at °F in Psi)..

I26 Expansion valve LT (low temperature cycle)

Function:

Shows current percentage of expansion valve opening. PWM. (low temperature cycle)

Value:

Shown as a percent value.

I27 Power frequency

Function:

Shows current power (net) frequency.

Value:

Shown in units of Hz.

I28 Phase direction

Function:

Shows current phase sequence.

Value:

Shown as CW or CCW or None. Value is not user-changeable. If AL 423 “No phase direction” go to configuration F05 for settings.

I29 Current phase 1

Function:

Shows actual current consumption on phase 1 for the unit excluding the compressor.

Value:

Shown in units of ampere.

I30 Current phase 2

Function:

Shows actual current consumption on phase 2 for the unit excluding the compressor.

Value:

Shown in units of ampere.

I31 Current phase 3

Function:

Shows actual current consumption on phase 3 for the unit excluding the compressor.

Value:

Shown in units of ampere.

I32 Voltage phase 1 - 2

Function:

Shows current voltage between phase 1 and 2.

Value:

Units in volt.

I33 Voltage phase 2 - 3

Function:

Shows current voltage between phase 2 and 3.

Value:

Shown in units of volt.

I34 Voltage phase 1 - 3

Function:

Shows current voltage between phase 1 and 3.

Value:

Shown in units of volt.

I35 Total current ph1

Function:

Shows actual current consumption on phase 1 for the unit including the HT compressor.

Value:

Shown in units of ampere.

I36 Total current ph2

Function:

Shows actual current consumption on phase 2 for the unit including the HT compressor.

Value:

Shown in units of ampere.

I37 Total current ph3

Function:

Shows actual current consumption on phase 3 for the unit including the HT compressor.

Value:

Shown in units of ampere.

I38 Total system pwr

Function:

Total power consumption of unit

Value:

Shown in units of kilo watts.

I39 Battery voltage

Function:

Shows current battery voltage.

Value:

Shown as voltage.

11.10 Operation parameter settings

By pressing the Operation menu is selected. The icon is displayed.
Use the arrow keys and to navigate and the Enter key to select.

001 Setpoint

Function:

The function is used for changing the setpoint.
Change the value to the desired value and press the Enter key for 3 seconds to acknowledge.

Value:

-

002 Datalog interval

Function:

Setting of interval between loggings in the datalog.
Setting the datalog interval to 60 min. (default value) allows logging of data for over a year.

Value:

Interval set to 15, 30, 60, 120, or 240 min. Default 60 min.

003 Manual defrost

Function:

Leads to the programs sub menu.

Value:

Go to the programs sub menu.

004 Defrost interval

Function:

Setting of interval between defrost. (The value is the shortest possible time as count down of time to defrost only is done when compressors are running).

Value:

Interval can be set in range 6 to 240 hours. Default 12 hours.

11.11 Manual defrost

A manual defrost is only accepted if Tevap less than 15°C (59°F). Defrosting is manually initiated by pressing the key or using the 003 Manual defrost menu, selecting specific defrost type and holding it for 3 sec. The display shows the icon as an acceptance of defrost initiation.

G01 Start normal
Function:
Defrost where defrost type is selected automatically.
Value:
Default OFF. Select ON and hold for 3 seconds to start defrosting.
G02 Stop
Function:
Stop active defrost.
Value:
Default OFF. Select ON and hold for 3 seconds to stop defrosting.

11.12 Alarms

The alarm list holds all active and inactive alarms. By pressing all active alarms are shown. The full list of active/inactive alarms, fatal alarms and warnings can be accessed using the T00 menu. The icon is displayed in upper left corner of the display. With any alarms in the list the icon is displayed on the main menu.

Alarm handling is to protect the unit with cargo and inform the user in case of error conditions. The main priority is to keep cargo safe.

Alarm handling is split in 2 parts:

1. Detect an abnormal situation and report it as an alarm.
2. React on the alarms and compensate for them (AAS - Active Alarm System).

An alarm can have 4 different levels.

- Log: Information for service. Only in the datalog, not on the display.
  No risk to cargo.
- Warning: Warning of an abnormal situation, but the unit continues to operate with unchanged or little change in functionality in actual running mode.
  No risk to cargo.
- Alarm: The unit operates with reduced or changed functionality.
  Risk to cargo.
- Fatal Alarm: The unit needs service now!
  Serious risk to cargo!

All errors in the 4 levels can have two states: Active or Inactive.

- Active: The alarm is active.
- Inactive: The alarm is no longer active. The alarm can be acknowledged from the alarm list.

The 4 alarm levels will be treated by the controller in the following way:

Alarm type	Datalog	Alarm list	Red LED	Cargo risk
Log	Yes	No	OFF	No risk to cargo
Warning	Yes	Yes	OFF	No risk to cargo
Alarm	Yes	Yes	SLOW FLASH 2% ON, 98 % OFF Duty time of 3 sec	Risk to cargo
Fatal Alarm	Yes	Yes	QUICK FLASH 80% ON, 20 % OFF Duty time of 1 sec	Serious risk to cargo!

Alarm handling is made to detect abnormal situations, possibly solve problems and report the problems. The alarm types indicate for the operator how severe the problem is for the safety of the cargo.

Some problems are fluctuant where the problem may be fixed if the unit restarts. Some of the alarms are only warnings but will restart the unit to try to solve the problem. There is an individual time out period for the alarms. A warning will not stop the unit permanently! If a problem with warning type continues to be active over a period, the problem seems to be of a more stable and therefore more severe character and another alarm is triggered with alarm type Alarm.

The AAS (Active Alarm System) will substitute a missing or malfunctioning sensor with one of the other sensors and thereby try to keep the cargo safe and well as long as absolutely possible. The substitution may lead to a deteriorated control precision, especially in Frozen mode, but the unit is not stopped fully until there are no further sensors to substitute with. The unit may try to restart to see if the malfunctioning is fluctuant. For example, if there is no substitution for a sensor or the substitute sensor is also faulty, alarm “611 Too many sensor err” is raised and the specific sensor(s) are listed separately in the alarm list.

The alarm list can include a maximum of 16 active/inactive alarms.

In case of an empty alarm list, √ + “No alarms” is shown.

An active alarm is shown as Acc AAnnn, where cc is the list number from 01 to 16, and nnn is the actual alarm number.

An inactive alarm is shown as Acc IAnnn, where cc is the list number from 01 to 16, and nnn is the actual alarm number.

An active alarm icannot be deleted from the list but may change to inactive state by eliminating the cause of the alarm.

An inactive alarm can be deleted from the list by pressing ↵ during alarm displaying.

11.13 Service function settings

By pressing the Service menu is selected. The icon appears in the display.

Service menu consists of various sub-menus. Use the arrow keys ▲ and ▼ to navigate and the Enter key ↵ to open a sub-menu. By pressing ⊗, the display returns to Service menu.

Service menu consists of the following sub-menus:

- Manual operation (M01 - M11) Manual start/stop of motors etc.
- Datalog view (L01 - L02) View of temperature log.
- Time adjust (C01 - C05) Setting of date and time.
- Run time counters (R01 - R06) View of running hours for unit, compressor etc.
- Configuration (F01 - F07) Software version and various configurations
- Serial numbers (N01 - N05) Serial number for various parts
- USB menu (U01 - U04) USB functions for firmware update and logging
- Modem (W01 - W06) Modem settings and status

11.14 Manual operation

M01 Operating mode

Function:

Start/stop of operating mode. If operating mode is MANUAL, controller stops, and by means of menu items M02 to M08 heaters, motors and valves may be manually operated. In menu item M05 compressor frequency is set. In case of no keyboard activities for 5 min., manual mode is automatically deactivated and unit starts automatically up.

Note that the unit should only be set to Manual mode by trained service personnel!

Value:

Set to MANUAL or AUTOMATIC. The bottom line on the menu shows the current consumption in the three phases (fan motor and heater) and for the frequency converter I1, I2, I3, FC.

M02 Evaporator heater

Function:

Manual heater on/off. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).

Value:

0 - 100 % or OFF.

M03 Evaporator fan

Function:

Manual evaporator fan on/off. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).

Value:

Set to OFF or ON.

M04 Condenser fan

Function:

Manual condenser fan on/off. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).

Value:

Set to OFF, LO (low speed) or HI (high speed).

M05 Compressor freq

Function:

Manual setting of compressor frequency. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).
MANUAL: Compressor frequency is set.

Value:

MANUAL: Set to OFF (compressor stop) or value between 20 and 50 Hz.

M06 Expansion valve

Function:

Manual setting of expansion valve % opening. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL) and compressor is not running.

Value:

Set from 0 to 100%.

M07 Vbp valve LT

Function:

Manual setting of bypass valve % opening. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).

Value:

Set from 0 to 100%.

M08 Economizer valve

Function:

Manual setting of economizer valve % opening. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).

Value:

Set from 0 to 100%.

M09 Expansion valve LT (low temperature cycle)

Function:

Manual setting of external air valve % opening. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).

Value:

0-100%.

M10 Compressor LT (low temperature cycle)

Function:

Manual control of low temperature compressor. This step will also start high temperature compressor and set valves, to enable a safe operation. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).

Value:

Set to OFF, ON.

M11 FC Selftest

Function:

Leads to the FC self-test sub menu.

Value:

Go to the FC selftest sub menu.

11.14.1 FC self test

J01 Start Self Test

Function:

Start the frequency converter built-in self-test.

Value:

Start.

J02 Last Run Date

Function:

Date of the last FC self-test.

Value:

YYYY-MM-DD.

J03 Last Run Time

Function:

Time of the last FC self-test.

Value:

HH:MM.

J04 Status

Function:

Displays the current status of the frequency converter self-test.

Value:

Not run, Try to start, Running, Start denied, Finished.

J05 Result

Function:

Displays the result of the latest frequency converter self-test.

Value:

Not run, Success, Failed.

J06 Start deny reason

Function:

Displays the reason for the frequency converter self-test not starting.

Value:

-- : Self test is not denied (self-test can run)
Wrong FC: FC 1.0 is connected
FC offline: FC is not connected
Temp high: FC is warmer than 80°C
Cpr running: Compressor is running
Trip lock: FC has a trip lock alarm active
Motorheat: FC is running motor heat
IT grid protect: FC ITI grid protection is active
FC internal: During 'Try to start' in status the FC denied starting the self-test
Timeout: During 'Try to start' in status the FC did not respond within the timeframe

J07 Failure code

Function:

Displays why the frequency converter self-test failed.

Value:

0001 pre-check alarm, 0002 pre-check op current, 0008 pre-check temp, 0016 pre-check storage, 0128 self-check alarm, 0256 self-check op current, 1024 self-check temp.

11.15 Datalog view

Press (T) to toggle between stored set of temperatures: Setpoint temperature + supply air temperature, return air temperature and the other set of temperatures: USDA 1 + 2 + 3 temperatures and cargo temperature.

Press up (▲) or down (▼) to show newer or older stored set of values from the datalog.

Press (↵) to change between the 4 zooming levels. The blank and black "bar" at the right-most edge shows a scale of 1°C per Bar.

L01 Text temperatures

Function:

Viewing of logged temperatures. Press (T) on the main menu to get directly to this menu.

Value:

The following temperatures can be viewed: Setpoint temperature, supply air temperature, return air temperature, USDA 1 + 2 + 3 temperatures and cargo temperature. When entering the menu, the newest logged temperatures are always shown.

Press (↵) to toggle between stored set of temperatures: Setpoint temperature, supply air temperature, return air temperature, and the other set of temperatures: USDA 1 + 2 + 3 temperatures and cargo temperature. To move one page up, press (▲), or down, press (▼), to list the previous or next page of stored set of values from the datalog.

L02 Graph temperatures

Function:

Viewing of logged temperatures. Press (T) on the main menu to get directly to this menu.

Value:

The following data can be viewed: Setpoint temperature, supply air temperature, return air temperature, USDA 1 + 2 + 3 temperatures and cargo temperature. When entering the menu, the newest logged temperatures are always shown.

11.16 Time adjust

C01 GMT-Year

Function:

Setting of year.

Value:

Set from 2007 to 2099.

C02 GMT-Month

Function:

Setting of month.

Value:

Set from 1 to 12.

C03 GMT-Day

Function:

Setting of day.

Value:

Set from 1 to 31.

C04 GMT-Hour

Function:

Setting of hours.

Value:

Set from 0 to 23.

C05 GMT-Minute

Function:

Setting of min. Note: when min. are set, sec. are set to 00.

Value:

Set from 0 to 59.

11.17 Run time counters

R01 Unit
Function:
Viewing of Star Freeze unit operation hours.
Value:
Shown as hours.

R02 Compressor
Function:
Viewing of HT compressor operation hours.
Value:
Shown as hours.

R03 Evaporator fan
Function:
Viewing of evaporator fan operation hours.
Value:
Shown as hours.

R04 Condenser fan
Function:
Viewing of condenser fan operation hours.
Value:
Shown as hours.

R05 Evaporator heater
Function:
Viewing of heater operation hours.
Value:
Shown as hours.

R06 Compressor LT (low temperature cycle)
Function:
Viewing of LT compressor operation hours.
Value:
Shown as hours.

11.18 Configuration

F01 Container
Function:
Viewing and setting of container ID.
Value:
Set 4 letters followed by 7 numbers e.g. MSFU 000 001 2.

F02 SW version
Function:
Viewing of controller software version and revision.
Value:
-

F03 FC type
Function:
Viewing of actual FC type.
Value:
-

F04 FC SW ver
Function:
Viewing of FC software version.
Value:
-

F05 Phase direction

Function:

Setting of phase direction.

Value:

Is only possible when AL 423 is active. Default setting is AUTO for automatic phase detection - automatically selected when the unit has been switched off for more than 30 min. before switching it on again. Can be used for manual phase setting: Setting as CW for clockwise rotation or CCW for counter-clockwise rotation. If manual phase direction is set, heat is reduced to 60% of max.

F06 Model code

Function:

View the reefer unit model value. Only a single value SFI-40

Value:

-

F07 Display unit

Function:

Choose between temperature and pressure units.

Value:

C/bar or F/psi.

11.19 Serial numbers

N01 SMC

Function:

Main controller.

Value:

Main controller serial no.

N02 SUP

Function:

User panel.

Value:

User panel serial no.

N03 SPM

Function:

Power meas.

Value:

Power meas serial no.

N04 FCCP

Function:

Frequency converter.

Value:

Frequency converter serial no.

N05 Modem

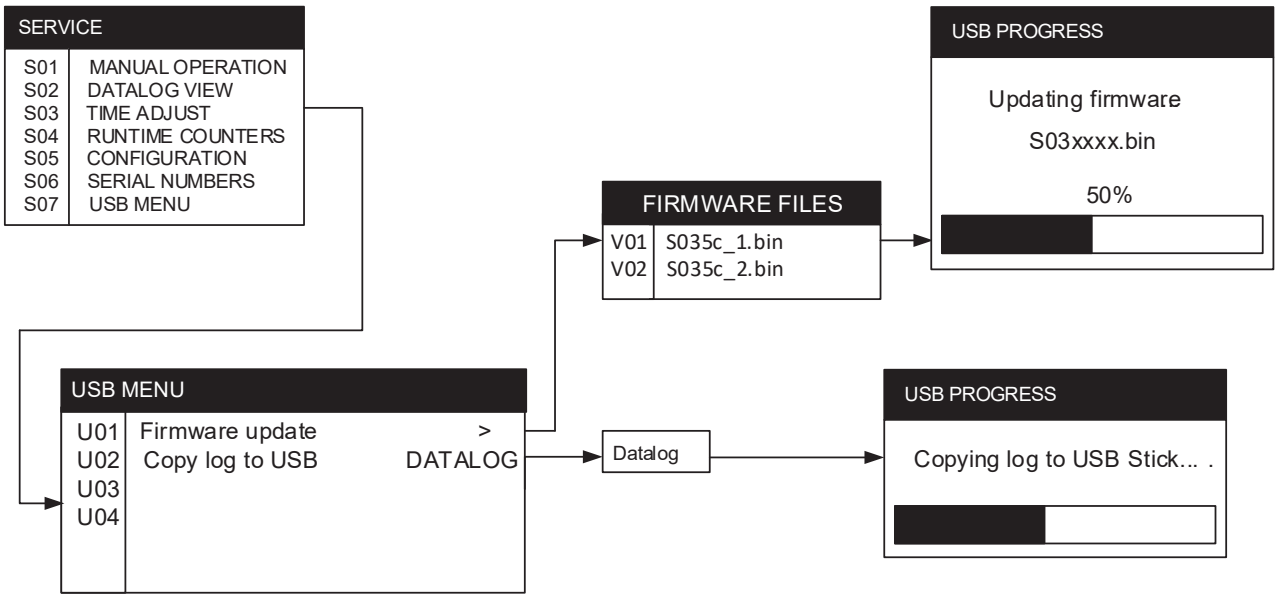
Function:

Modem.

Value:

Modem serial no.

11.20 USB menu



The use of a USB memory stick provides easy access to the unit without need of connecting any external equipment like a PC. A service technician can, using USB, upgrade container unit firmware.

U01 Firmware update

Function:

Container unit firmware can be upgraded from a USB memory stick. A firmware upgrade is started from the USB menu.

Value:

Depending on content of USB memory stick one out of following scenarios occurs:

1. If only one valid software file is placed in the root directory of the memory stick, the upgrade is started by selecting yes.
2. If more than one valid software files are placed in the root directory of the memory stick, user must select actual from valid software binaries filename list presented in display. The upgrade is started by selecting yes.

U02 Copy to USB

Function:

User selected log(s) will be stored on USB memory stick. The logs will be stored in a StarView compatible file format, enabling them to be opened here. Log file names (shown for container ID = MCIU1234567):

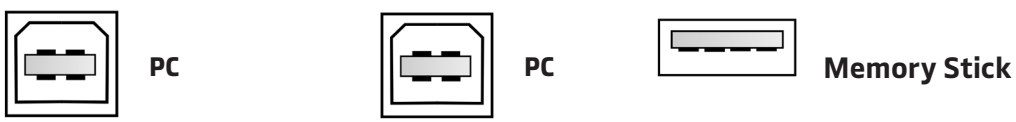
Datalog: SMCIU123.456

Fastlog: FMCIU123.456

Value:

Datalog: Saving normal datalog to USB memory stick.
Fastlog: Saving fastlog to USB memory stick.
Both: Saving both datalog and fastlog to USB memory stick.

USB type: Inside container Inside controller box



11.21 Modem

W01 Modem ID

Function:

Modem identification.

Value:

Modem serial number.

W02 Modem SW ver

Function:

Show modem software version and revision.

Value:

Software version and revision.

W03 Modem HW ver

Function:

Show modem hardware version and revision.

Value:

Hardware version and revision.

W04 Last connected

Function:

Timestamp showing last time modem was connected to backend server.

Value:

Date and time YY/MM/DD HH:MM.

W05 Geofence ver

Function:

Show version of the present geofence file.

Value:

Version of the present geofence file.

W06 Network list

Function:

Show list of active networks.

Value:

Network name - name of network type (e.g. LoRa, cellular, BLE).
Network connection - network service provider (e.g. TDC, Orange, AT&T).
Signal strength - 0-100%.

12. External interfaces

The Star Freeze controller can be accessed externally in the following ways:

Connection type	Connection method	Device
Slave modem	RS 232	Sekstant gateway
Retriever socket	RS 232	StarView
USB retriever socket	USB	StarView

12.1 General requirements

1. Serial port setup is 19200, 8, N, 1
2. Unless otherwise stated, byte order is low byte first

12.2 List of terms used for external interfaces

Term	Description
LM	Local monitor serial communication port on the container unit
RefCon	Powerline based container monitoring system and PC software
RMM	Remote monitor modem for powerline communication
SCCU6	Reefer container controller unit (Star Control)
Star Freeze	Reefer container unit name
Star Cool Connect Dongle	Bluetooth dongle used to connect to controller with the Star Cool Service App (version 3.3 or higher).
Star Cool Service App	Mobile device application for iOS or Android
StarView	PC software Star Freeze unit monitor

12.3 Functions overview

It is defined in the table below, which Star Freeze functions each device and system will support.

Function	StarView	Controller
Display basic data[1]	x	x
Display alarm list	x	x
Display controller information	x	(x)
Change container ID	x	x
Change temperature setpoint		x
Change controller date and time		x
Change units from °C/Bar to °F/Psi	x	
Acknowledge alarms	x	x
Initiate manual defrost		x
Initiate Trip Start		
Initiate Function test and PTI	x	x
Terminate Function test and PTI	x	x
Display Function test and PTI results	x	x
Retrieve datalog from unit	x	
Save datalog file (binary)	x	
Save datalog file (CSV text)	x	
Display datalog file (binary)	x	
Display datalog file (CSV text)	x	
Update controller software via bootloader		
Update controller software via protocol	x	
Operate controller in Manual mode		x

(1) Basic data: Tset, Tsup, Tret, RH, Tusda1 - 3, Tcargo, operation mode, Ubat

(x) Not all information is visible on the controller's display.

13. Events

Events, containing ID and additional run time data, are created and put into the datalog under specific occasions in order to be enable to analyse the behaviour of the container unit.

No.	Name	Datalog parameter				
		Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5
0	Temperature setpoint	Actual setpoint	New setpoint	n/a	n/a	SW revision
4	FT start	PTI test ver	1: FT	n/a	n/a	Alarm count
5*	FT step OK	Step ID	n/a	n/a	n/a	n/a
6	FT abort	Step ID	n/a	n/a	Time [sec]	Alarm count
8	PTI start	PTI version	1: Full PTI 2: Short PTI	n/a	n/a	Alarm count
9*	PTI step OK	Step ID	n/a	n/a	n/a	n/a
10	PTI abort	Step ID	n/a	n/a	Time [sec]	Alarm count
12	Manual mode select	n/a	n/a	n/a	n/a	n/a
13	Manual mode deselect	n/a	n/a	n/a	n/a	n/a
14	Defrost start	Defrost activation cause: 0: None 1: Air 2: Ice 3: Timer 4: Manual	Actual ice amount [kg]	Defrost interval [h]	Tret at time of execute start	
15	Defrost stop	Tevap at time of execute end	Tret at time of execute end			
16	Trip start	0: User trip-start 1: Auto trip-start	SW version (2 least significant bytes)	SW version (2 most significant bytes)	n/a	SW rev.
20	Power up	Unit run time [hours]	Compr. run time [hours]	Mevap run time [hours]	Mcond run time [hours]	Hevap run time [hours]
21	User wake-up	n/a	n/a	n/a	n/a	n/a
22	Power down	SW version (Least Significant Byte)	SW version (Most Significant Byte)	Vbatt.	Power up count	SW revision
23	Software update	Current SW version (2 Least Significant Bytes)	Current SW version (2 Most Significant Bytes)	New SW version (2 Least Significant Bytes)	New SW version (2 Most Significant Bytes)	Current SW revision (8 most significant bits) New SW revision (8 least significant bits)
24	FC software update	Current SW version (2 Least Significant Bytes)	Current SW version (2 Most Significant Bytes)	New SW version (2 Least Significant Bytes)	New SW version (2 Most Significant Bytes)	
25	Real time clock	Old date	Old time	New date	New time	n/a
26	FC type	Old	New	n/a	n/a	n/a
27	Datalog interval	Old	New	n/a	n/a	n/a
30	Container ID	Old	n/a	n/a	n/a	n/a
32	Parameter change	Source (0 = modem)	Config changed Prog changed PTI/FT Ctrl Tset changed, FW update	Set ID, time, humi, Logint. Reboot Std FT, Full PTI, Stop Short PTI	n/a	Failure/Success
34	Singlestep start	n/a	n/a	n/a	n/a	n/a
35	Singlestep abort	Step ID	n/a	n/a	Seconds	Alarm count
37	Service		n/a	n/a	n/a	n/a
52	Software version	SW version (2 least significant bytes)	SW version (2 most significant bytes)	SW revision	n/a	n/a
63	GPS position	Latitude part 1	Latitude part 2	Longitude part 1	Longitude part 2	n/a

65	FC self-test	Test result: 0: Not run 1: Passed 2: Failed	Test deny reason: 0: Not denied 1: Wrong FC 2: FC offline 3: Temperature high 4: Cpr running 5: Trip lock 6: Motorheat 7: IT grid protection 8: FC internal error 9: Test timed out	Self-test status word low 16 bits	Self-test status word high 16 bits	Tfc
73	Module removed	5: SPM 6: SUP 8: FC	Serial no first digit after S/A/P If Parameter 1 is MCI sensor, then: Par2 is - bit 0-6 First digit - bit 7 in parameter 2 indicates first letter: 0: P 1: A Only first byte used e.g. 137 is A9	Serial no next 4 digits	Serial no 3 digits after ID	Serial no 4 digits after W
74	Module added	5: SPM 6: SUP 8: FC	Serial no first digit after S/A/P If Parameter 1 is MCI sensor, then: Par2 is - bit 0-6 First digit - bit 7 in parameter 2 indicates first letter: 0: P 1: A Only first byte used e.g. 137 is A9	Serial no next 4 digits	Serial no 3 digits after ID	Serial no 4 digits after W
77	Controller moved	Number of changed SN's	Change bitmask	0	0	0
87	USB log recovered	1	Number of recoveries done	Number of loggings made up to recovery	n/a	n/a
92	Database updated	ErrorFlag	ErrorIndex	n/a	n/a	n/a
94	UDO channel statistics	1: K2 CCW 2: K3 Hevap 3: K4 Mcond Low 4: K5 Mcond High 5: K6 Mevap Low 7: K8 CW 9: Veco 10: Vexp	Active time [minutes]	Active/failure time [minutes]	Idle time [minutes]	Idle/failure time [minutes]
95	FT/PTI skipped	Step ID	Skip reason	n/a	n/a	n/a

(*) Every event ID has it own set of parameters
(**) Only for some models

14. Detailed alarm description

In the following, all alarms are listed with a display text and description.

- Alarm display text is the text shown in the controller display.
- An alarm can either be only logged into the datalog or both in the datalog and shown in the controller alarm list.
- The alarm light has 3 states:
  Off indicates that the alarm diodes are de-energized and there are no active alarm(s).
  Slow flash indicates that the diodes are turned on shortly every 3 sec. and that there are active alarm(s).
  Quick flash is when the diodes are turned on shortly every 1 sec. and that there are active fatal alarm(s).

When trouble shooting several alarms, it is generally advisable to start with the active alarm that has the lowest number and then go on to the active alarms with higher numbers. Remember that some alarms have a time-out of 30 sec. or more.

14.1 Alarm list

The following list includes a view of all alarms as listed on the display and a longer text. This list is subject to constant updates.
Be sure to visit **alarm.starcool.com** for latest update.

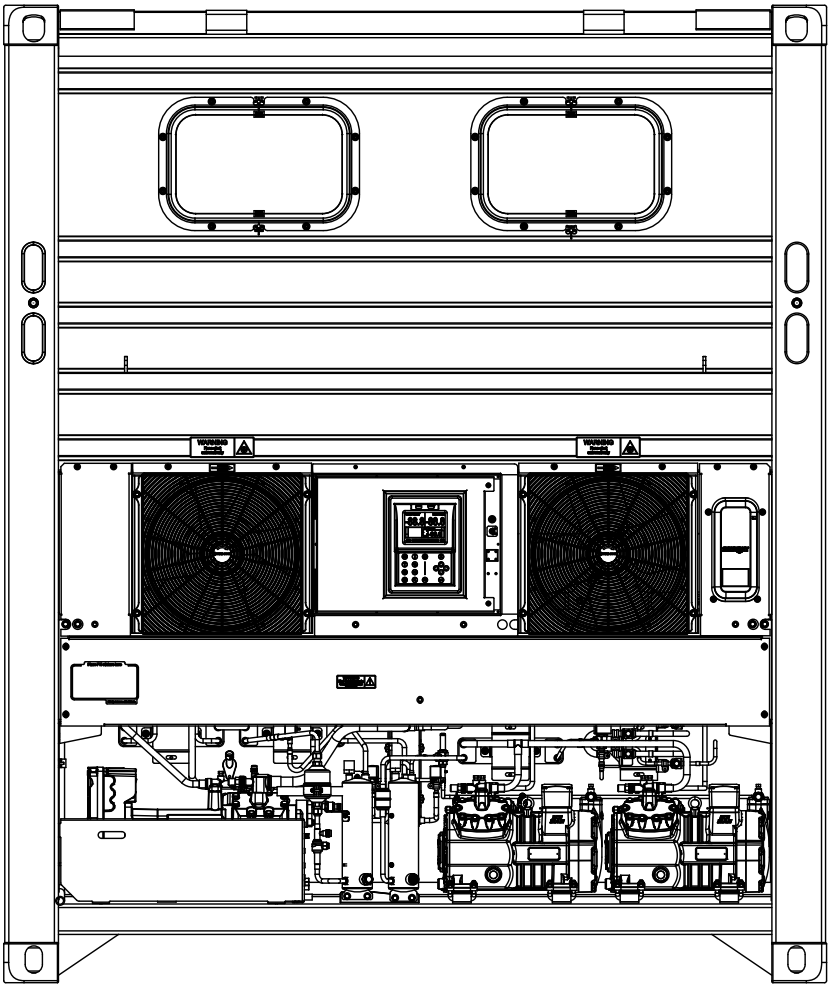
Id	Display text	Description	Alarm type
1. Temperature sensor alarms			
102	Tret invalid	Return air temperature sensor invalid	Alarm
105	Tsup 1 invalid	Supply air temperature sensor 1 invalid	Alarm
108	TsuceLT invalid	Evaporator outlet temperature sensor invalid, LT cycle	Alarm
111	Tcargo 1 out of range	Cargo 1 temperature sensor invalid	Log
114	Tcargo 2 out of range	Cargo 2 temperature sensor invalid	Log
117	TliqLT invalid	Expansion valve inlet temperature sensor invalid, LT cycle	Alarm
120	TsuccLT invalid	Compressor inlet temperature sensor invalid, LT cycle	Alarm
123	Tevap invalid	Evaporator temperature sensor invalid	Warning
126	Tsuc invalid	Suction temperature sensor invalid	Alarm
129	Tamb invalid	Ambient temperature sensor invalid	Alarm
132	TdisLT invalid	Discharge temperature sensor invalid, LT cycle	Alarm
2. Pressure transmitter alarms			
203	Pdis invalid	Compressor discharge pressure transmitter invalid	Alarm
207	Psuc invalid	Compressor suction pressure transmitter in high temperature circuit invalid	Alarm
211	PdisLT invalid	Compressor discharge pressure transmitter in low temperature circuit invalid	Alarm
215	PsucLT invalid	Compressor suction pressure transmitter in low temperature circuit invalid	Alarm
3. Other sensors			
306	SHP switch - K1	High pressure switch in high temperature circuit is active	Fatal alarm
307	SHP LT switch	High pressure switch in low temperature circuit is active	Fatal alarm
4. Power alarms			
400	Mevap over heat	Evaporator motor overheat	Fatal alarm
402	Mcond over heat	Condenser motor overheat	Fatal alarm
403	Mcpr LT over heat	Low temperature compressor motor overheat	Fatal alarm
415	Invalid power sup	U1-2 and U1-3 and U2-3 overvoltage	Fatal alarm
418	Invalid power sup	U1-2 and U1-3 and U2-3 undervoltage	Fatal alarm
421	Over current	I1-2 and I1-3 and I2-3 overcurrent	Fatal alarm
423	No phase direction	Phase direction not detectable	Fatal alarm
424	Power frequency	Phase frequency error	Log
425	Frequency too high	Power frequency too high	Fatal alarm
430	Cpr connection	Power cable from FC to compressor faulty	Alarm
431	Mcpr LT over curr	Low temperature compressor over current	Fatal alarm
5. FC alarms			
508	Compr connection	FC short circuit	Alarm
509	FC 24 V fault	FC internal 24 V supply fault	Alarm
510	Compr connection	FC earth fault	Alarm
511	Compr over current	Compressor over current	Alarm
513	Compr overload	Compressor overload	Alarm
514	Invalid power sup	FC undervoltage fault	Alarm
515	Invalid power sup	FC overvoltage fault	Alarm
516	FC supply error	Power supply error indication	Alarm
517	FC over temp	FC over temperature fault	Alarm
518	FC inrush	FC inrush fault	Alarm
519	FC internal error	Frequency converter high voltage fault warning	Alarm

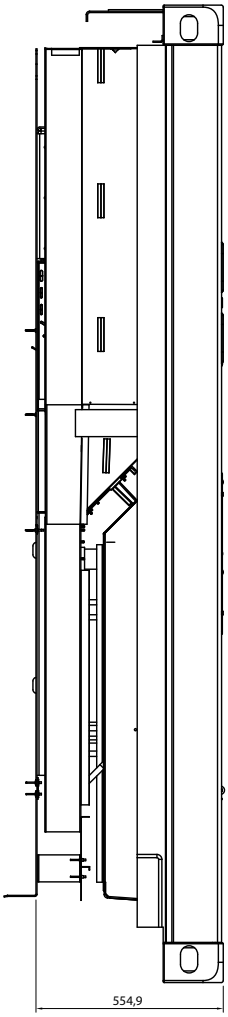
520	FC temp counter	-	Alarm
523	FC phase loss	Power supply error indication	Log
530	FC alarm undefined	Unclear error in FC	Alarm
531	PCB temperature	FC critical temperature	Alarm
532	Blocked rotor	Compressor restart fail	Alarm
533	FC comm timeout	The FC has tripped and stopped	Alarm
6. Operation alarms			
600	No control sensors	Supply air sensor 1, supply air sensor 2, return air sensor all malfunctioning	Fatal alarm
603	In range fault	In-range fault	Fatal alarm
610	Defrost time exceed	Max. defrost time exceeded	Warning
660	Check coil	Coil(s) acting suspicious	Warning
661	Check contactor	Contactor(s) acting suspicious	Warning
662	Mevap lo contactor	Mevap low contactor detected to be faulty (only in heating)	Alarm
663	Mevap hi contactor	Mevap high contactor detected to be faulty (only in heating)	Alarm
664	Mevap contactors (both)	Both Mevap contactors detected to be faulty (only in heating)	Alarm
665	Hevap contactor	Hevap contactors detected to be faulty (only in heating)	Alarm
7. Communication alarms			
700	No FC/Contr com	FC missing	Fatal alarm
710	No userpanel com	(Can only be seen in StarView)	Log
720	No SPM com	Communication to power module is missing	Alarm
8. Test alarms			
800	Func test failed	Function test fault	Warning
801	Controller	Controller internal voltage reference fault	Warning
805	Idle current	Unit idle overcurrent fault	Warning
810	Mevap cur ON	Evaporator motor current fault	Warning
812	Mevap current OFF	Evaporator motor off current fault	Warning
815	Mcond cur LO speed	Condenser motor low speed current fault	Warning
816	Mcond cur HI speed	Condenser motor high speed current fault	Warning
817	Mcond current OFF	Condenser motor off current fault	Warning
819	Contactor error	Contactor(s) acting suspicious.	Warning
820	Hevap current ON	Evaporator heater on current fault	Warning
821	Hevap current OFF	Evaporator heater off current fault	Warning
822	Hevap current error	Hevap current failure	Warning
841	K1 contactor welded	Contactor damaged (always drawn) making FC always powered	Warning
850	PTI test failed	PTI test fault	Warning
852	FC self-test	FC self-test not passed.	Warning
870	PTI defrost	PTI defrost fault	Warning
880	PTI Tset -40	PTI -40°C set fault	Warning
890	PTI Tset -60	PTI -60°C test fault	Warning
9. Controller alarms			
902	Battery malfunction	Battery malfunctioning	Alarm
904	Datalog error	SCCU6 datalog fault	Alarm
905	Database corrupt	SCCU6 database fault	Log
907	Realtime error	Real-time clock needs checking	Alarm
953	Temp ref 1 LO	Controller internal voltage reference fault	Warning
954	Temp ref 1 HI	Controller internal voltage reference fault	Warning
955	Temp ref 2 LO	Controller internal voltage reference fault	Warning
956	Temp ref 2 HI	Controller internal voltage reference fault	Warning
961	Pdis sens sup LO	Controller internal voltage reference fault	Log
962	Pdis sens sup HI	Controller internal voltage reference fault	Log
963	Psuc sens sup LO	Controller internal voltage reference fault	Log
964	Psuc sens sup HI	Controller internal voltage reference fault	Log
965	Controller sup LO	Controller internal voltage reference fault	Log
966	Controller sup HI	Controller internal voltage reference fault	Log

969	Psuc LT sens sup LO	Controller internal voltage reference fault	Log
970	Psuc LT sens sup HI	Controller internal voltage reference fault	Log
971	Sensor bus sup LO	Controller internal voltage reference fault	Log
972	Sensor bus sup HI	Controller internal voltage reference fault	Log
973	SUP6 SPM6 sup LO	Supply voltage SUP6 SPM6 low	Log
974	SUP6 SPM6 sup HI	Supply voltage SUP6 SPM6 high	Log
975	Internal sup LO	12 V supply voltage low on SMC6	Log
976	Internal sup HI	12 V supply voltage high on SMC6	Log
989	Software test ver	Test software installed	Warning
990	Firmware update fail	Failed to activate firmware	Alarm
991	Config model mode	Model code missing	Alarm
995	Contr internal error	Controller module must be replaced	Alarm
999	Keyboard failure	Indication of defective keyboard or connection	Warning

15. Star Freeze installation dimensions

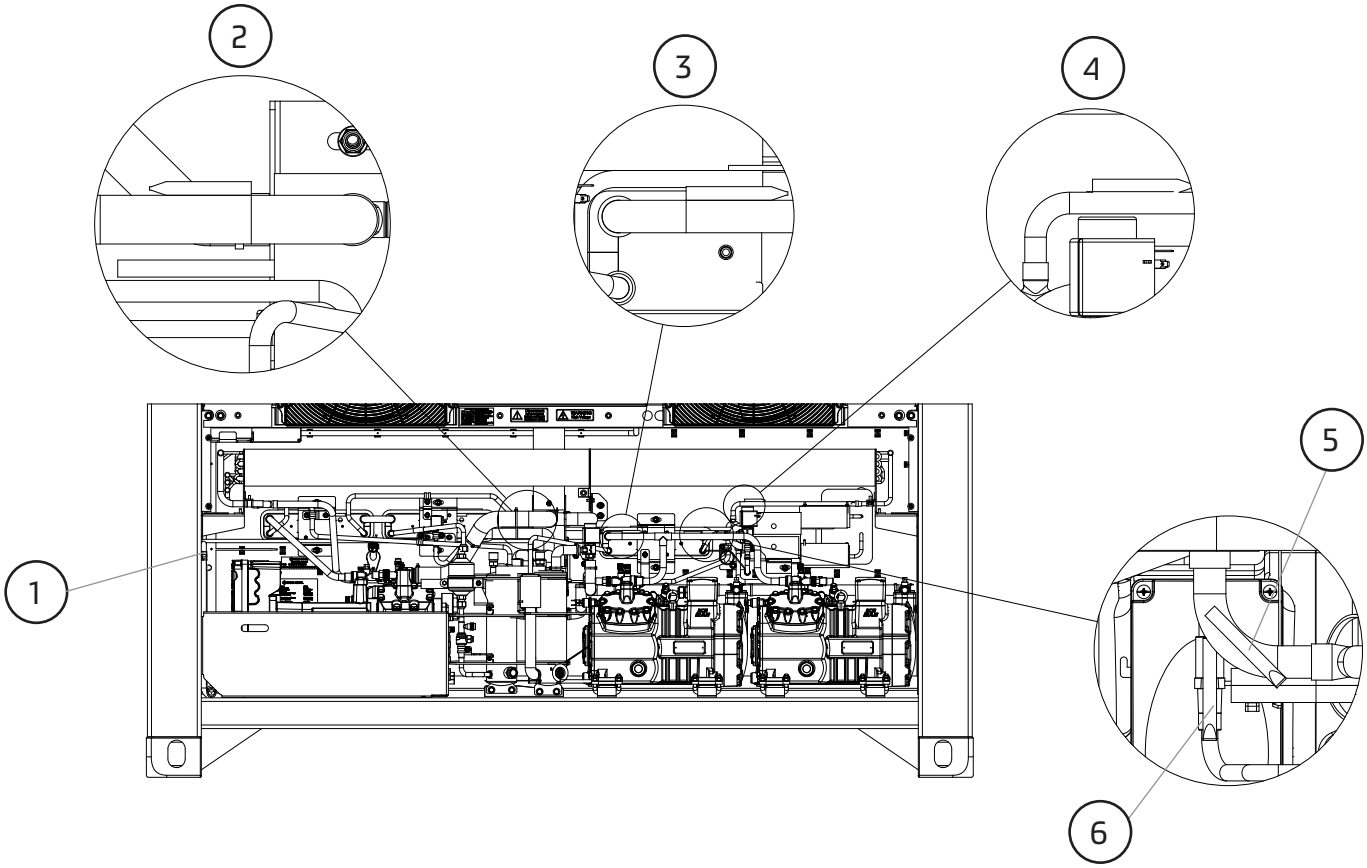
Model: SFI





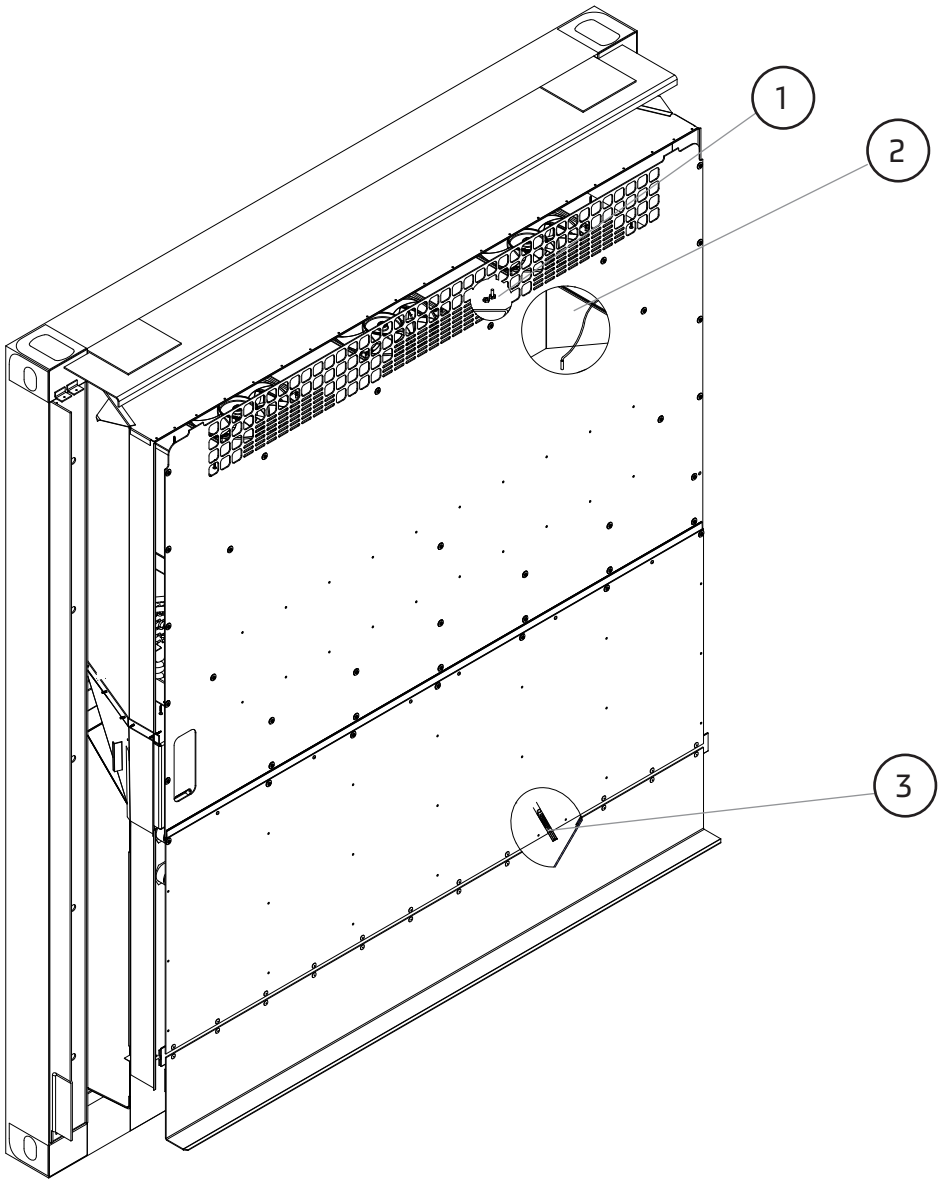
16. Location of temperature sensors

16.1 Outside



Position	Description	Short name	P & I diagram position
1	Ambient temperature sensor	Tamb	9
2	Suction temperature sensor	Tsuc	22
3	Compressor inlet suction temperature sensor	Tsucc	53
4	Discharge temperature sensor	Tdis	68
5	Evaporator outlet suction temperature sensor	Tsuce	52
6	Liquid line temperature sensor	Tliq	37

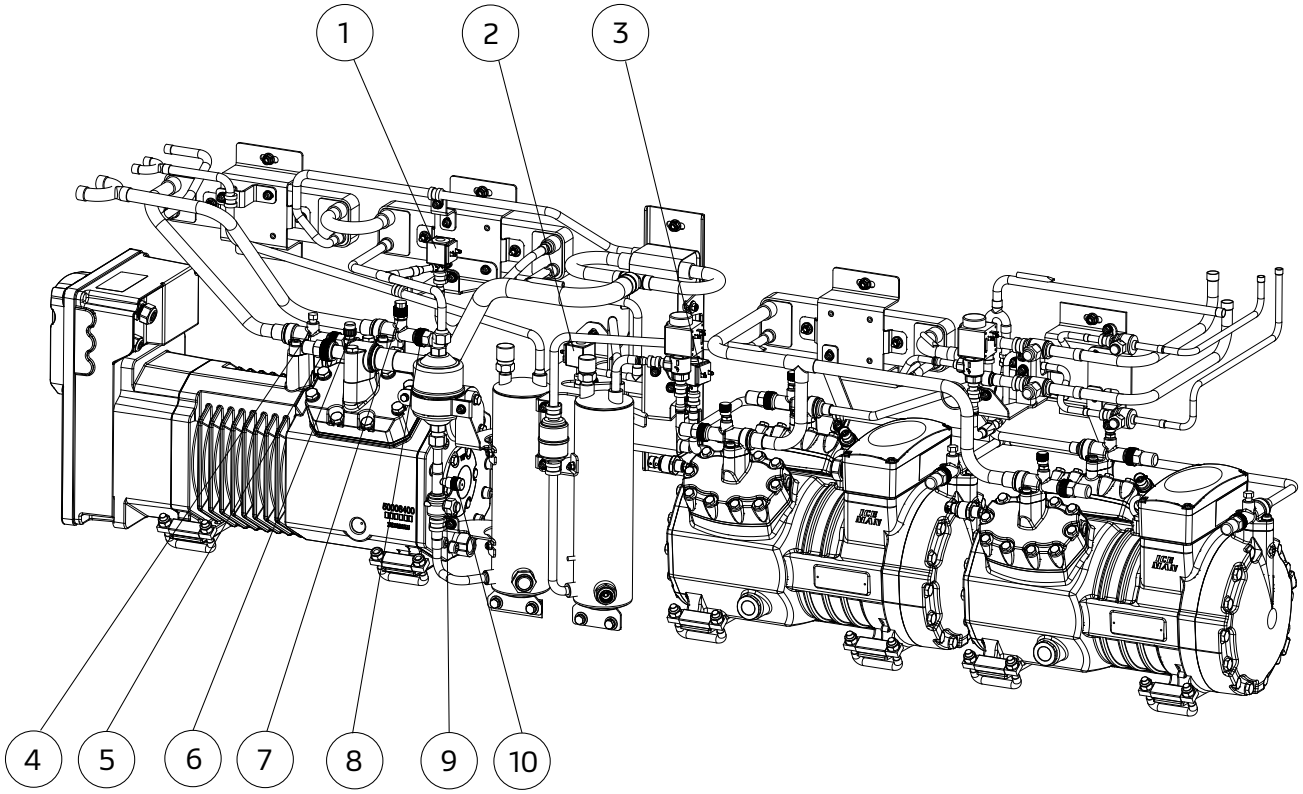
16.2 Inside



Position	Description	Short name	P & I diagram position
1	Return air temperature sensor	Tret	49
2	Evaporator temperature sensor	Tevap	47
3	Supply air temperature sensor	Tsup	43

17. Location of valves

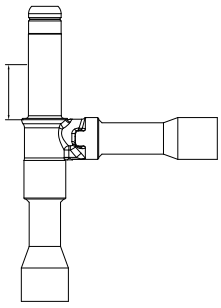
17.1 R134a



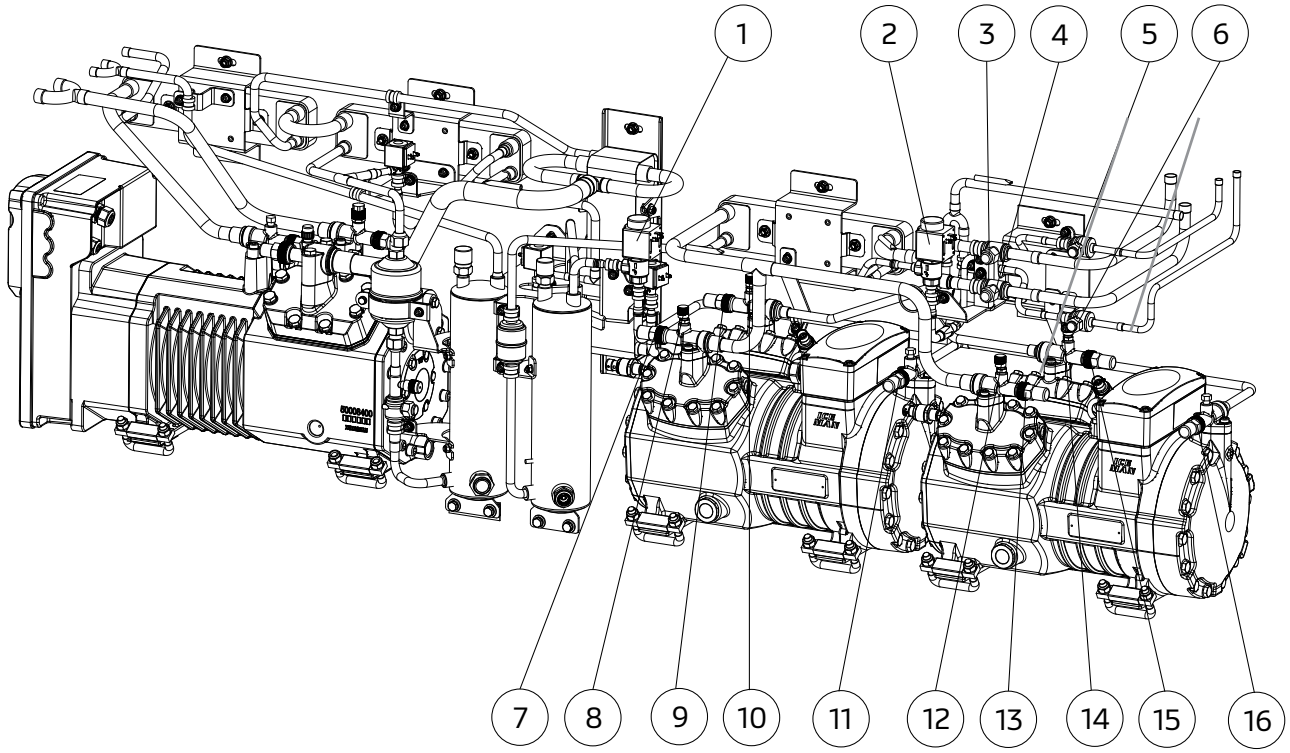
Position	Description	Short name	P & I diagram position
1	Expansion valve, economizer*	Veco	16
2	Expansion valve, cascade 1, R134a*	Vexp1	17
3	Expansion valve, cascade 2, R134a*	Vexp2	18
4	Intermediate service valve, HP		3
5	Suction service valve, LP		23
6	Evacuation point		70
7	Charging point		70
8	Discharge service valve, HP		5
9	Manual stop valve		13
10	Liquid charging valve		70

* When replacing an expansion valve, ensure that the o-ring is fitted to the valve stem and fully seated. Always use the anti-seize grease which comes with the spare part valve. Apply 20 mm to the stem, so the top area of the stem does not have any grease applied::

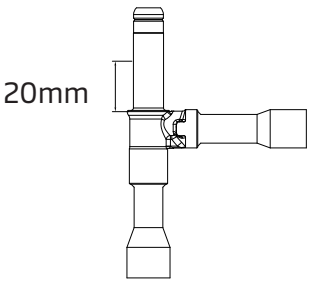
20mm



17.2 R473A



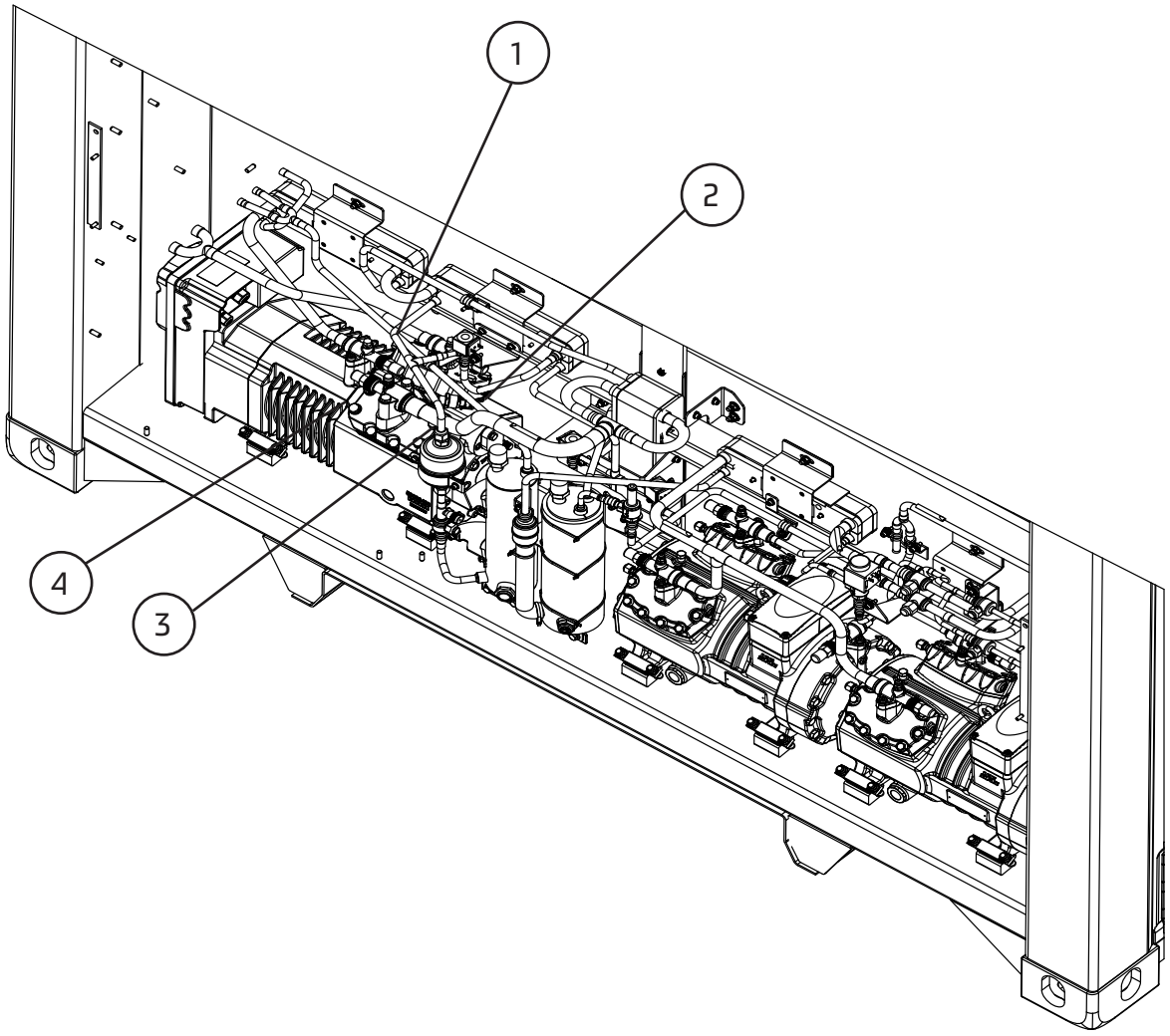
Position	Description	Short name	P & I diagram position
1	Expansion valve bypass, LT	VbpLT	34
2	Expansion valve, evaporator LT	VexpLT	38
3	Manual stop valve suction gas 1		39
4	Manual stop valve suction gas 2		40
5	Manual stop valve liquid line 1		50
6	Manual stop valve liquid line 2		51
7	Suction service valve 1, LP		55
8	Evacuation point 1		70
9	Discharge service valve 1, HP		65
10	Charging point 1		70
11	Bypass service valve 1		61
12	Evacuation point 2		70
13	Suction service valve 2, LP		54
14	Charging point 2		70
15	Discharge service valve 2, HP		64
16	Bypass service valve 2		60



*When replacing an expansion valve, ensure that the o-ring is fitted to the valve stem and fully seated. Always use the anti-seize grease which comes with the spare part valve. Apply 20 mm to the stem, so the top area of the stem does not have any grease applied:

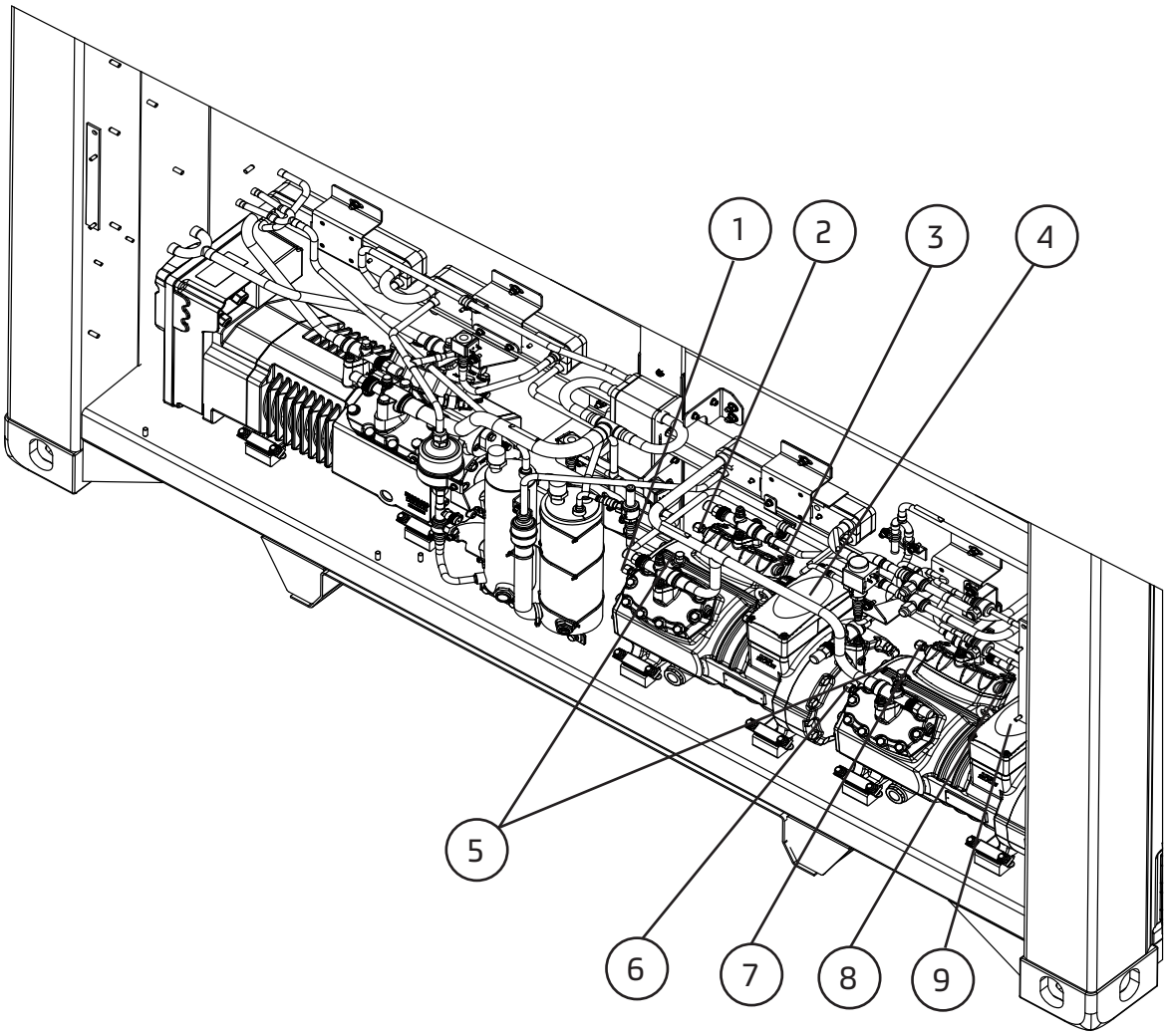
18. Location of pressure transmitters, high pressure switch and oil outlet port

18.1 R134a



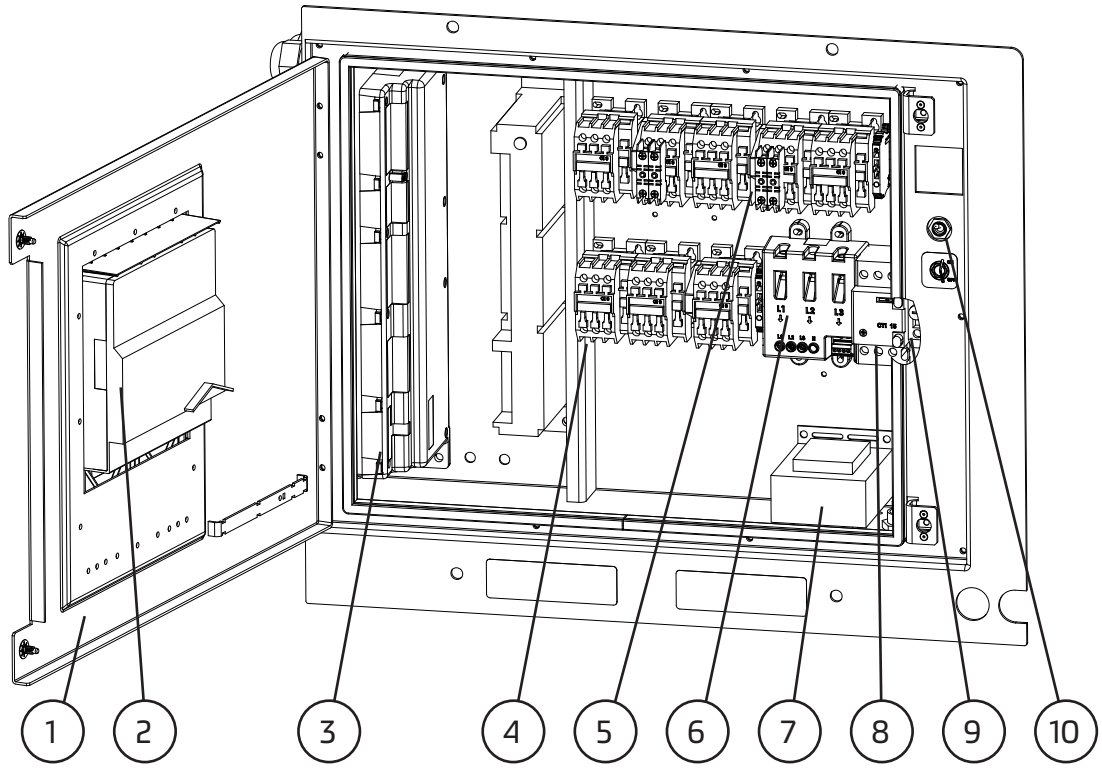
Position	Description	Short name	P & I diagram position
1	Discharge pressure transmitter	Pdis	6
2	High pressure switch 21.5 barg	Shp	4
3	Suction pressure transmitter	Psuc	21
4	Oil charging port		

18.2 R473A

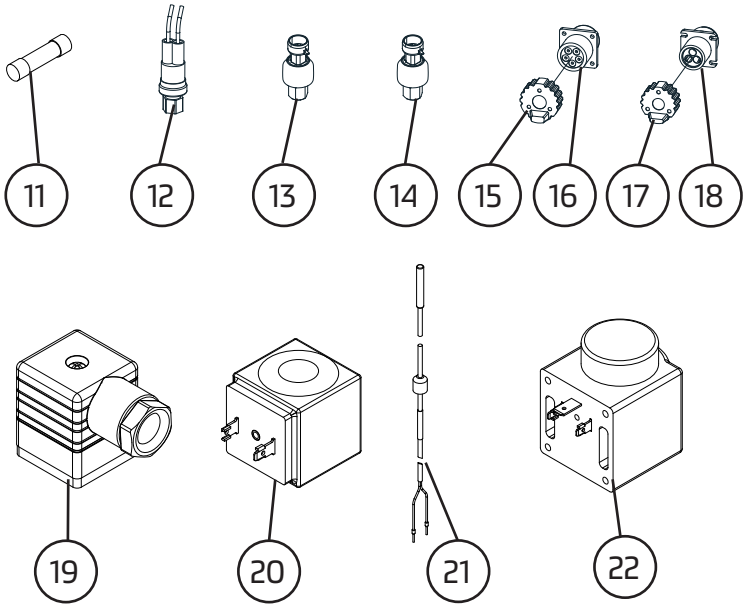


Position	Description	Short name	P & I diagram position
1	Suction pressure transmitter 1, LT	PsucLT1	57
2	Discharge pressure transmitter 1	PdisLT1	67
3	High pressure switch 1 49 barg	ShpLT1	63
4	Main LT compressor motor overheat protection	McprLTOH1	
5	Oil outlet ports		
6	Suction pressure transmitter 2, LT	PsucLT2	56
7	Discharge pressure transmitter 2	PdisLT2	66
8	High pressure switch 2 49 barg	ShpLT2	62
9	Spare LT compressor motor overheat protection (not connected to controller)	McprLTOH2	

19. Controller unit illustration



Position	Description
1	Controller door
2	User panel (SUP6)
3	Controller module (SMC6)
4	Contactor
5	Auxiliary contact
6	Power measurement module (SPM6)
7	Transformer, 105VA
8	Main circuit breaker, 16A
9	Fuse holder for 0.4A fuse
10	On/Off switch
11	Fuse, 400mA
12	High pressure switch HT and LT
13	Pressure transmitter -0.69-9.8 Bar
14	Pressure transmitter 0-40 Bar
15	Retriever socket cap
16	Retriever socket
17	Cargo socket cap
18	Cargo socket
19	Connector plug
20	Solenoid coil, 4W, 24V AC
21	Temperature sensor, HT, LT and LT compressor discharge
22	Solenoid coil, 11W 24V AC



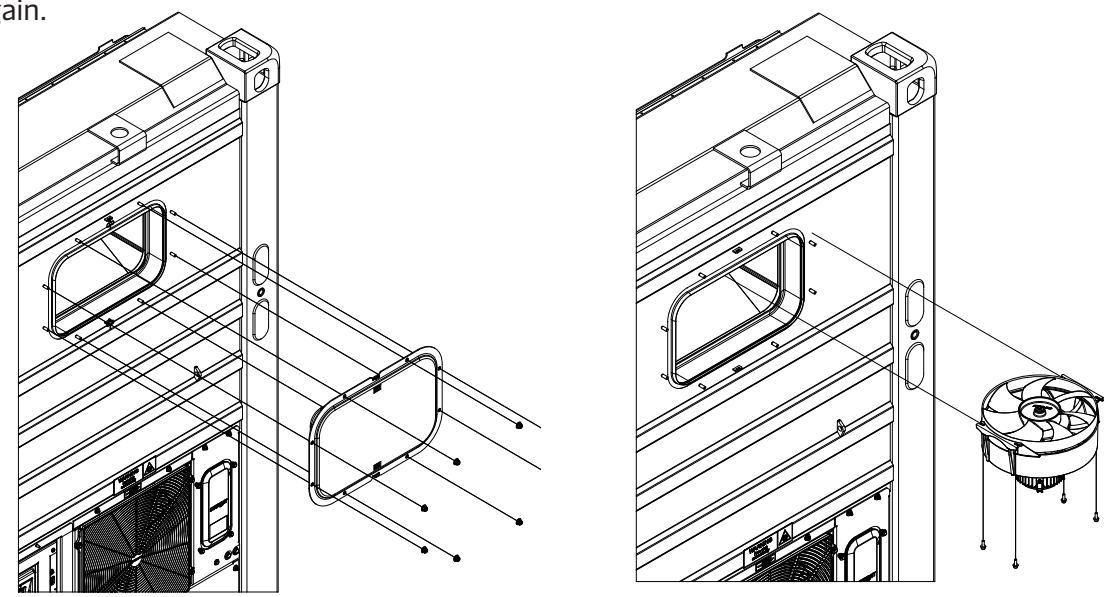
Setup may vary depending on model

20. Replacements

20.1 Replacement of evaporator motor and fan

Note: Turn off main power supply to the unit before replacing evaporator motor and fan.
Note: Beware of sharp edges located in this area!
Note: If the middle motor needs to be replaced, Mevap 1 or 3 needs to be removed first to get it out.

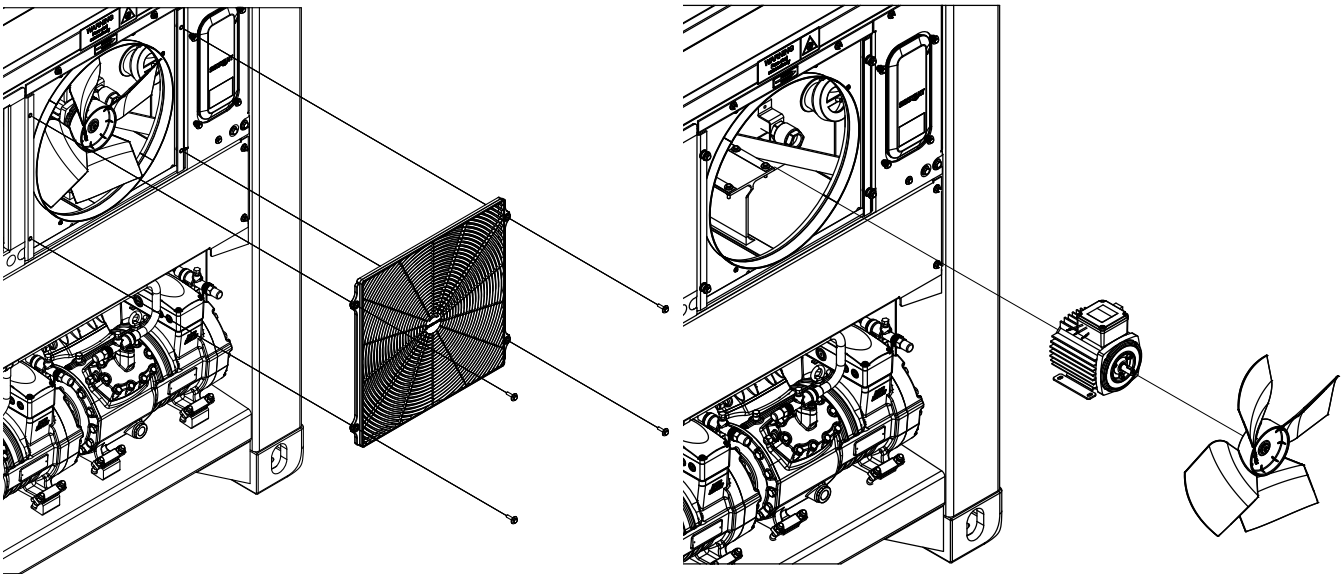
Dismount the inspection cover and disconnect the power supply to the motor by unplugging the square connector plug on the motor connection box. Do NOT open the connector box. Loosen the evaporator bracket and slide the motor and fan towards you and through the inspection cover opening. Replace the fan and/or motor and check the fan blade is aligned so it can turn freely. Mount the motor and fan back into the unit mounting plate and reconnect the power to the motor. If one or more of the bracket threads are damaged, use fan bracket repair kit (item number 818347A). Mount the inspection cover again.



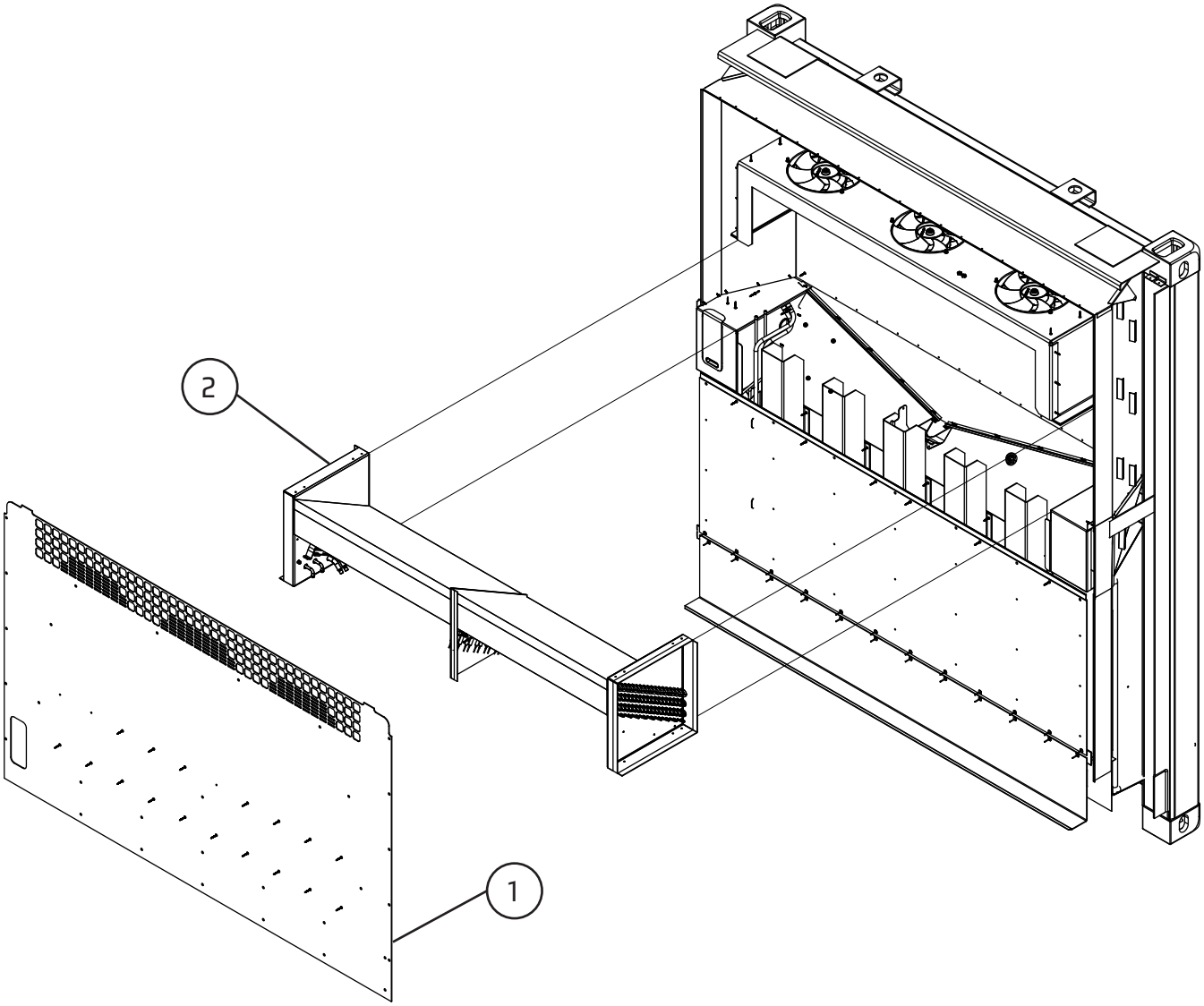
20.2 Replacement of condenser motor and fan

Note: Turn off main power supply for unit before replacing condenser motor and fan.

Remove the condenser grille and disconnect the power supply to the motor by unplugging the square connector plug on the motor connection box. Do NOT open the connection box. Replace the motor and check the fan blade is aligned so it can turn freely. Reconnect the power plug to the motor. Mount the condenser fan grille.



20.3 Replacement of evaporator

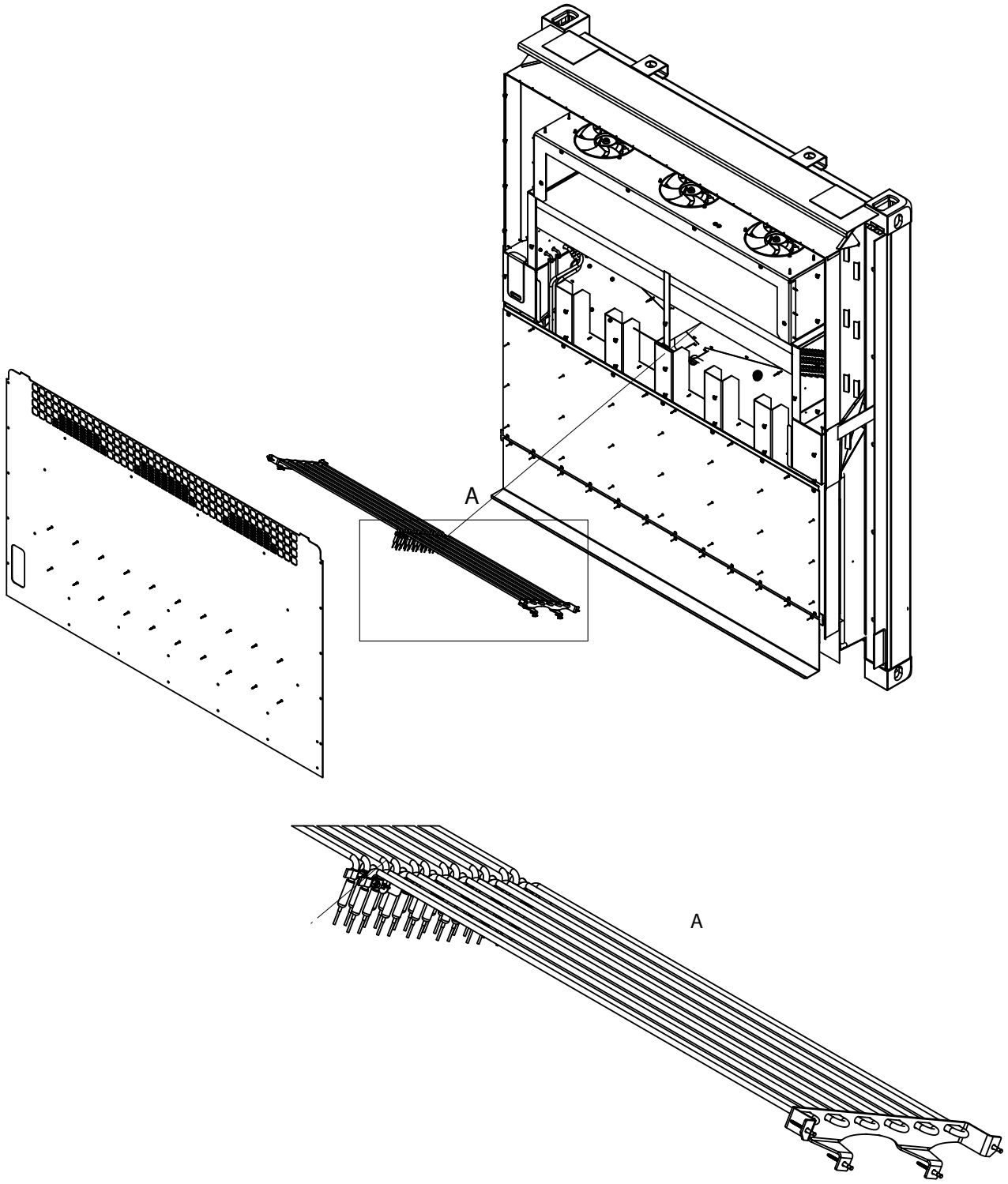


Position	Description
1	Back plate, evaporator
2	Evaporator

Replacing the evaporator is done in the following steps:

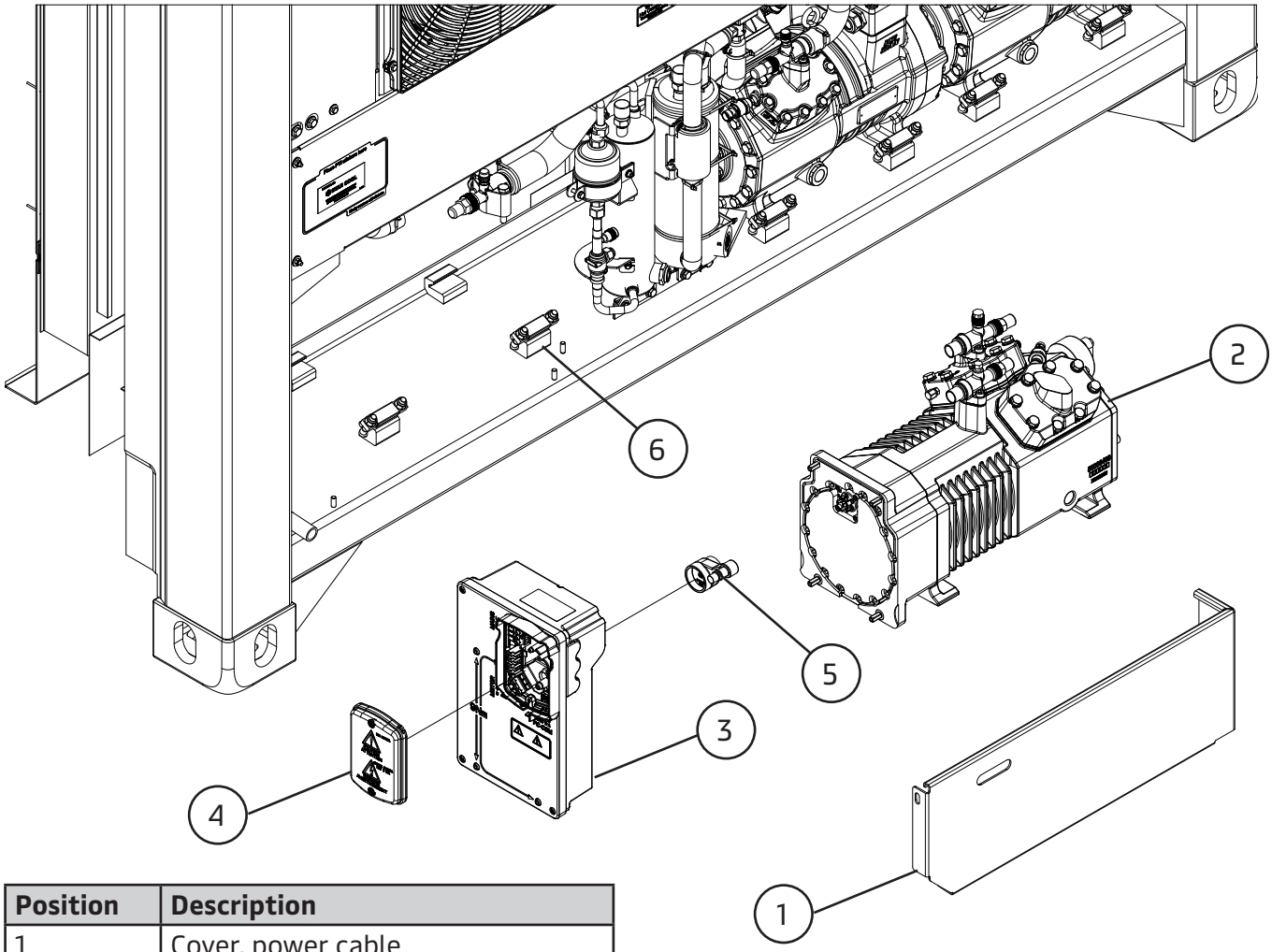
1. Evacuate the low temperature refrigerant (see “22.7 Evacuation of low temperature refrigerant”).
2. Remove the evaporator back plate (pos. 1).
3. Remove the heating elements below the evaporator (pos. 2).
4. Remove the sensor for evaporator temperature.
5. Dismount or cut the two suction pipes and the two liquid pipes for the evaporator (pos. 2) in the correct places.
6. Remove/drill out rivets heads and remove the evaporator (pos. 2).
7. Remove the middle support bracket and punch all the remaining rivet pieces into the foam using a max 5mm tool.
8. Mount new evaporator on chassis with appropriate stainless-steel rivets.
9. Cut the suction and liquid pipes to the right length and connect them to the new evaporator.
10. Reinstall the heating elements (see “21.4 Replacement of heating elements”).
11. Reinstall the sensor for evaporator temperature.
12. Reinstall the middle support bracket and mount the evaporator back panel (pos. 1).
13. Replace the LT filter drier, perform a leak test and vacuum the LT system.
14. Charge low temperature cycle (see “22.11 Charging of low temperature refrigerant on an empty unit”).

20.4 Replacement of heating elements



1. Dismount the upper back panel of the unit and dismount the defective heating element.
2. Mount the new heater onto the pin bolt and click into the bracket if installed.
3. Mount and tighten the M6 hex nut and washer.
4. Secure the heater cables with cable ties.
5. Mount the upper back panel on the unit and ensure all screws are fully secured.

20.5 Replacement of high temperature (HT) compressor



Position	Description
1	Cover, power cable
2	HT compressor
3	Frequency converter 2.1
4	Black cover, FC 2.1
5	Cable, FC 2.1 to HT compressor
6	Bracket, HT compressor

Please ensure correct tightening torque is used throughout replacement.

If the HT compressor is not running, evacuate the compressor first (see “22.2 High temperature (HT) compressor evacuation”).

If the HT compressor is running but needs replacement, pump down the compressor first (see “22.3 High temperature (HT) compressor pump down”).

1. Dismount the power cable cover (pos.1).
2. Dismount the FC (pos. 3) and the motor cable (pos. 5).
3. Dismount all pressure transmitters and the high pressure switch.
4. Loosen all bolts for HT compressor service valves.
5. Loosen the bracket (pos. 6) for HT compressor and turn it downwards.
6. Slide HT compressor (pos.2) out.
7. Slide new HT compressor in place. Observe that the rear HT compressor foot is inserted firmly into the bracket slot.
8. Reinstall the HT compressor brackets (but do not tighten).
9. Reinstall all pressure transmitters and high pressure switch.
10. Fasten all bolts for all 3 HT compressor service valves. Fasten the HT compressor brackets!
11. Mount the cable (pos. 5) on the HT compressor before the FC is installed.
12. Apply thermo paste before mounting the FC. Observe that the cable is not squeezed between the HT compressor and FC. Make sure that there is absolutely no air gap between the FC and the HT compressor.

13. Remove the black cover (pos. 2). When mounting the cables into the terminal, the cables will level into position during mounting. Be aware that cables may tilt. Fasten with the recommended torque.
14. Mount the power cable cover (pos. 1).
15. Vacuum the HT compressor before turning the unit on (see 22.4 High temperature (HT) compressor vacuum - replaced").

20.6 Replacement of low temperature (LT) compressor

Please ensure correct tightening torque is used throughout replacement.

Evacuate the system before replacing the compressor (see "22.7 Evacuation of low temperature refrigerant").

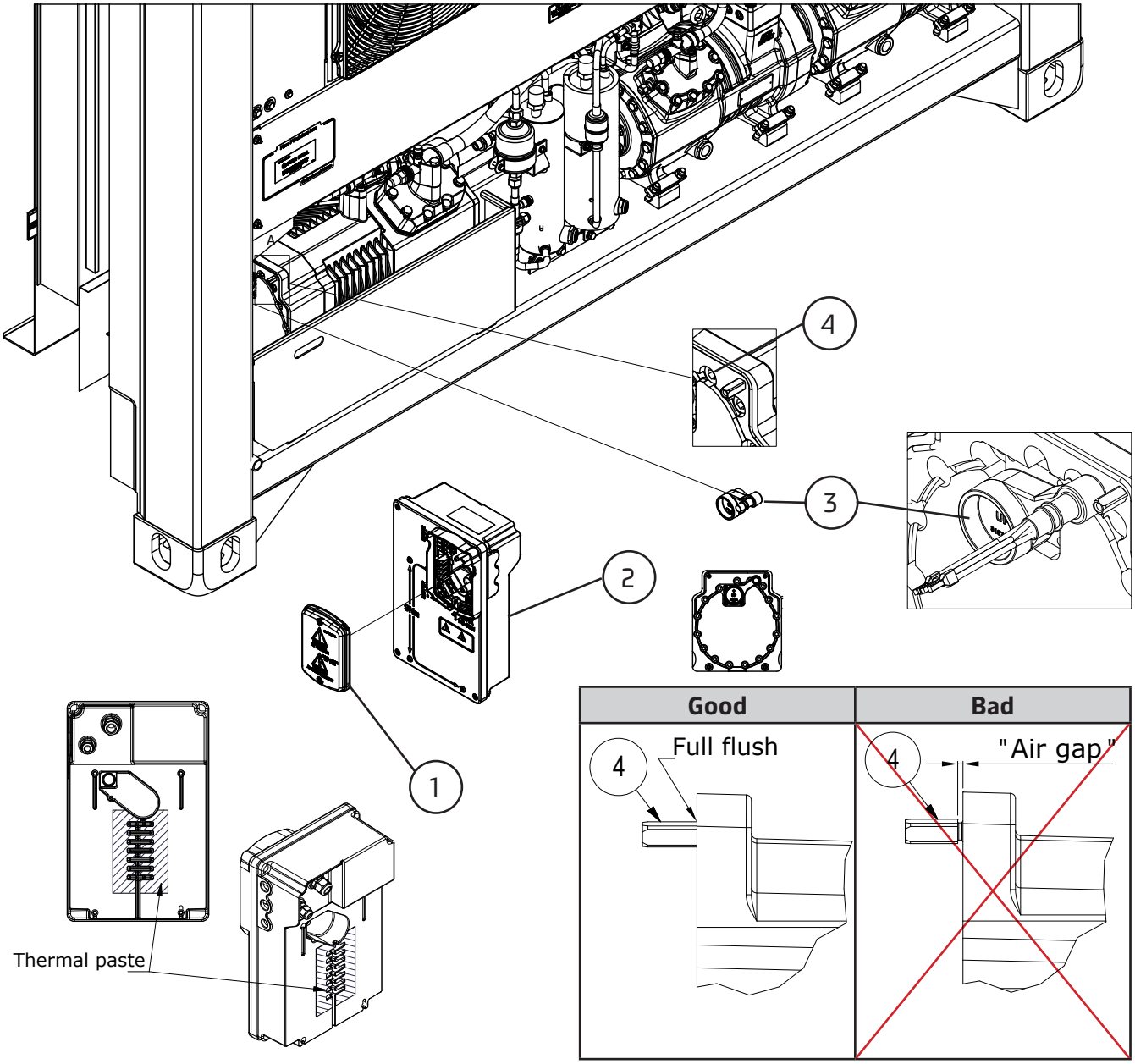
1. Remove the motor cable and motor overheat protection cable.
2. Dismount all pressure transmitters (PsucLT and PdisLT) and high pressure switch (ShpLT).
3. Loosen all bolts for LT compressor service valves.
4. Loosen bracket for LT compressor and turn it downwards.
5. Slide LT compressor out on a forklift due to its weight!
6. Using a forklift, bring the new LT compressor close to the unit and afterwards slide the new LT compressor in place. Observe that the rear LT compressor foot is inserted firmly into the bracket slot.
7. Reinstall the LT compressor brackets (but do not tighten).
8. Reinstall all pressure transmitters and high pressure switch.
9. Fasten all bolts for all 3 LT compressor service valves. Fasten the LT compressor brackets!
10. Vacuum the LT compressor before starting up (see 22.9 Low temperature (LT) compressor vacuum - replaced).

20.7 Switching from active low temperature (LT) compressor to spare LT compressor

This should be done when a mechanical or electrical fault on the LT compressor results in very high current draw, LT over current alarms or blown CTI1 (the one that powers the power meas.).

1. From the active/defect LT compressor, remove the motor cable and motor overheat protection cable.
2. Disconnect cables to pressure transmitters mounted on the active/defect LT compressor and connect them onto the pressure transmitters of the spare LT compressor.
3. Move the blind pressure transmitter plugs from the spare compressor to the defect compressor. Add grease to the pressure transmitters first!
4. Remove motor connection box of spare LT compressor and place it on the defect LT compressor.
5. Move motor connection box of the defect LT compressor (containing cable glands) onto the spare LT compressor.
6. Disconnect the motor cable (through the M20 cable gland) and motor overheat protection cable (through the M16 cable gland) from the defect LT compressor and mount them both on the spare LT compressor. The motor wires need to be connected to the 6 pins terminal plate in the following way: 1 to U, 2 to V, 3 to W, 4 to X, 5 to Y and 6 to Z. The overheat protection wires need to be connected to the two pins terminal plate. There is no rule for pin position for these overheat protection wires.
7. Before operating any of the six service valves, loosen the gland seal by ¼ turn before you move the spindle.
8. On the defect LT compressor, close Vsuc (service valve on compressor inlet) and Vdis (service valve on compressor outlet) and leave Vint (service valve on compressor intermediate stage, coming from VbpLT) open.
9. On the spare LT compressor, open Vdis and Vint service valves, and leave Vsuc service valve closed.
10. Go to the Service menu and select line S01 Manual operation and set the LT compressor to ON (low speed) until it will automatically stop after 90 seconds (the LT compressor can only run max 90 seconds in Manual mode).
11. While the spare LT compressor is running, check that the pressure (PsucLT) drops to vacuum (0 barg) and stays there.
12. When the spare LT compressor stops, close Vint service valve on defect LT compressor and open Vsuc service valve on the spare LT compressor.
13. Once finished, tighten the gland seal and put on the protective spindle cap on all six service valves on the LT compressors.

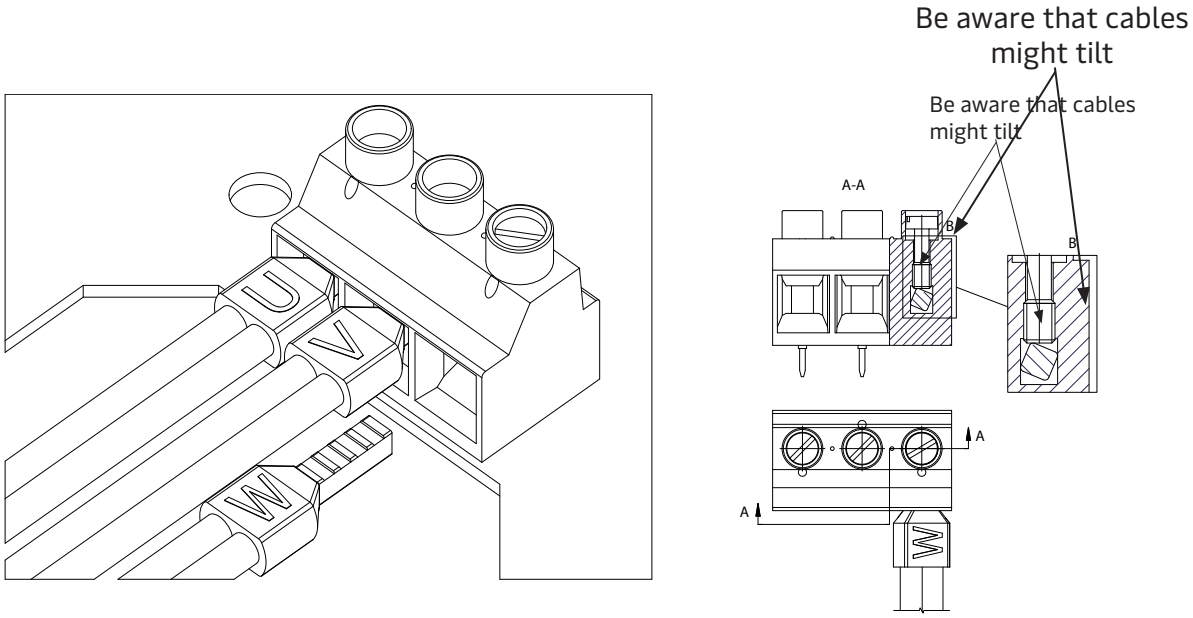
20.8 Replacement of FC



Position	Description
1	Black cover, FC 2.1
2	Frequency converter 2.1
3	Cable, FC2.1 to HT compressor
4	Threaded bushing, FC mounting

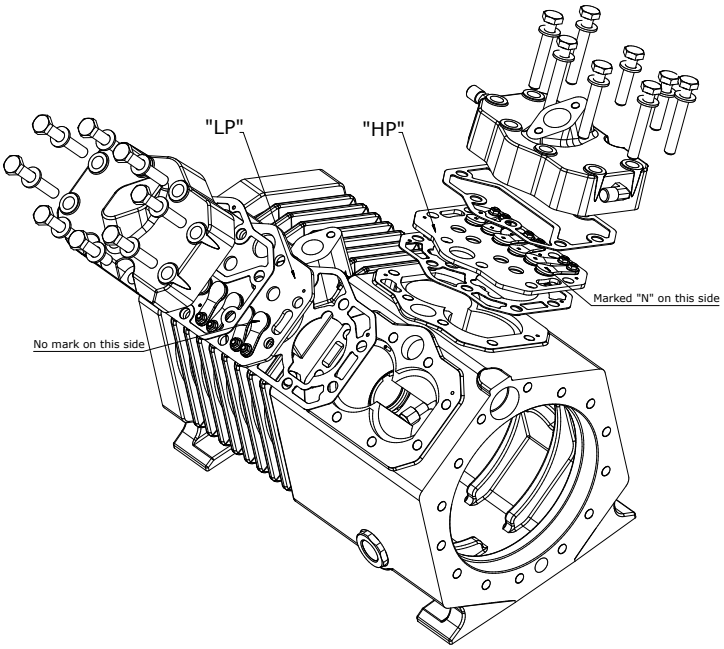
Please ensure correct tightening torque is used throughout replacement:

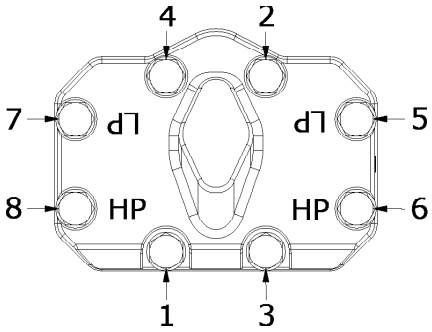
1. Remove the FC (pos. 2) and the cable (pos.3).
2. Make sure that all 4 studs (pos. 4) on the high temperature (HT) compressor are straight and tightened correctly before mounting the FC. All 4 studs must be flush to the surface of the compressor.
3. Clean the HT compressor end shield and the FC cooling surface of old thermal paste. Then apply new thermal paste on the FC cooling surface.
4. Mount the cable (pos. 3) on the HT compressor before the FC is installed.
5. Apply thermo paste before mounting the FC. Observe that the cable is not squeezed between the HT compressor and FC. Make sure that there is absolutely no air gap between the FC and the HT compressor.
6. Remove the black cover (pos. 1). When mounting the cables into the terminal, the cables will level into position during mounting. Be aware that cables may tilt. Fasten with the recommended torque.
7. Start up the unit and verify that it is running as normal.



20.9 Replacement of HT compressor valve plate/cylinder head gasket

1. Pump down the compressor (see 22.3 High temperature (HT) compressor pump down).
2. Dismount cylinder head and valve plate using a rubber mallet, if necessary. Carefully clean all sealing surfaces.
3. Check the valve plate and exchange the entire valve plate if damaged. Determine the cause and eliminate it.
4. Mount the cylinder head, valve plate and new gaskets correctly. Gaskets not made of rubber must be soaked in oil prior to mounting. If located in an inconvenient mounting position, use mounting pins.
5. Tighten the bolts in the illustrated sequence in two steps. Starting by tightening bolts no. 1 and no. 2 firmly by hand. Then tighten bolts no. 3 to no. 8 in sequence with torque 70 Nm. See the numbers of the bolts in the figure below.





20.10 Replacement of high temperature (HT) filter dryer

Before replacing the HT filter dryer, the power plug to the unit must be disconnected (see point 5).
The HT filter dryer must be changed every time the compressor is changed or if the moisture indicator in the receiver sight glass indicates too much moisture in the refrigerant circuit (yellow color).

1. Put the unit in Manual mode.
2. Close the stop valve, pos. 13 (P & I diagram).
3. Select HT compressor frequency to 40 Hz.
4. Observe the suction pressure (Psuc). When Psuc = -0.8 Barg, power off the unit. In case the maximum HT compressor ON time is reached but the Psuc is higher than -0.8 Barg, manually restart the HT compressor one more time and check that -0.8 Barg can be reached. If not, there is a leak in the system.
5. Unplug the power supply cable of the unit.
6. Carefully loosen the two union nuts for the HT drying filter. Beware of pressurized escaping refrigerant. Always wear protective goggles and gloves.
7. Replace the drying filter with a Danfoss DML 164 O-ring or equivalent. Before mounting of the filter, put some drops of compressor ester oil on the flare in order to ensure correct tightness.
8. Tighten the two union nuts for the drying filter. (see “25.11 Tightening torques”).
9. Remove the electrical coils and mount permanent magnets on the three electronically expansion valves, pos. 16, 17 and 18 (P & I diagram).
10. Carefully loosen the upper union nut for the drying filter, allowing a little amount of refrigerant gas to escape.
11. Tighten the union nut.
12. Remove the permanent magnets and reinstall the electrical coils on the three electronically expansion valves, pos. 16, 17 and 18 (P & I diagram).
13. Open the stop-valve, pos. 13 (P & I diagram).
14. Power up the unit.

20.11 Replacement of low temperature (LT) filter dryer

Before replacing the LT filter dryer, the power plug to the unit must be disconnected (see point 5).
The LT filter dryer must be changed every time the compressor is changed or if the moisture indicator in the receiver sight glass indicates too much moisture in the refrigerant circuit (yellow color).

1. Evacuate the low temperature (LT) refrigerant (see 22.7).
2. Remove the insulation and clamps.
3. De-braze the LT filter dryer (see important note 22.15).
4. Install the new filter dryer (see important note 22.15).
5. Fasten the clamps and perform a leak test (see 22.10).
6. Insulate the LT filter dryer and vacuum the system (see 22.9).
7. Charge the LT refrigerant (see 22.11).

20.12 Replacement of low temperature (LT) compressor contactor

Before replacing the contactor, make sure all necessary troubleshooting has been completed. Even though only one contactor is failing, all three contactors (K7, K9 and K10) must be replaced together using the pre-assembled “Contactor set for LT compressor, Star Freeze” (item no. 886751A) as the contactors are interconnected with clips

1. Turn the unit off and disconnect the power.
2. Remove all wires from contactors K7, K9 and K10 (can be either white or black contactors). Mark the wires with the contactor number and screw terminal so you know where to mount the wire after replacing the contactor.
3. Dismount all three contactors at the same time by pressing the contactors down on the DIN rail and releasing them by moving the lower part of the contactors upwards towards yourself.
4. Mount the new contactor set onto the DIN rail.
5. Remount the disconnected wires to the correct screw terminals. Tighten the screws to 0.25Nm.
6. onnect power to the unit and turn it on. Check that the low temperature compressor can run.

21. Service and maintenance

21.1 Evacuation of high temperature (HT) refrigerant

1. Connect a service gauge manifold to the evacuation/charging points (70) included in service valves 5 and 23 (P & I diagram) on the HT compressor.
2. Connect a recovery unit to the gauge manifold.
   a. Connect a recycling bottle to the recovery unit.
   b. Use a scale underneath the bottle, for measuring the amount of recycled refrigerant.
3. If it is NOT possible to run the HT compressor:
   a. Remove the electrical coils and install a permanent magnet on the 3 valves (pos. 16, 17, and 18).
   b. Turn off the unit.
   c. Close and open again, the discharge service valve (pos. 5) approx. 4 turns.
   d. Check that the recovery unit is set for vapour recovery.
   e. Open both service gauge manifold valves (LP/HP). Continue to 5.
4. If possible to run the HT compressor:
   a. Continue operation of the HT compressor.
   b. Close the economizer service valve (pos. 3), and run a pump down of the LP side of the HT compressor to approx. -0.8 Barg. In case the maximum HT compressor ON time is reached but the Psuc is higher than -0.8 Barg, manually restart the HT compressor one more time and check that -0.8 Barg can be reached. If not, there is a leak in the system.
   c. Turn off the HT compressor.
   d. Close the suction service valve (pos. 23). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
   e. Check the recovery unit is set for vapour recovery.
   f. Remove the electrical coils and install a permanent magnet on the 3 valves (pos. 16, 17 and 18).
   g. Open only the HP valve on the service gauge manifold.
5. Start and operate the recovery unit as long as necessary to evacuate the desired amount of refrigerant from the unit, until no pressure left.
6. Open suction service valve fully. Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the pro- tective spindle cap.
7. Check the service gauge manifold, should be in a slight vacuum.
8. Close all valves and stop the recovery unit. The evacuation is now completed.

21.2 High temperature (HT) compressor evacuation

1. Connect a service gauge manifold to the two evacuation points, pos. 5 and 23 (P & I diagram) on the HT compressor.
2. Connect a recovery unit to the gauge manifold.
3. Connect a recycling bottle to the recovery unit.
4. Use a scale underneath the bottle, for measuring the amount of recycled refrigerant.
5. Close the suction service valve and economizer suction service valve, pos. 3 and 23 (P & I diagram). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
6. Close the discharge service valve, pos. 5 (P & I diagram), approx. 4 turns.
7. Run the HT compressor in Manual operation on 40 Hz, (see “12.14 Manual operation”).
8. Observe the LP indication until a vacuum of -0.8 Barg (-7.3 Psi) has been reached.
9. Turn off the HT compressor.
10. Close the discharge service valve pos. 5 (P & I diagram).
11. The evacuation points (70) included in service valves 5 and 23 (P & I diagram), are open, when the service valves, pos. 5 and 23 (P & I diagram), are closed.
12. Open the HP valve on the service gauge manifold.
13. Check that the recovery unit is set for vapour recovery.
14. Start and operate the recovery unit as long as necessary to evacuate the remaining pressure.
15. Check the service gauge manifold, should be in a slight vacuum.
16. After disconnecting the evacuation unit, the HT compressor is now ready to be replaced.

21.3 High temperature (HT) compressor pump down

1. Close the intermediate service valve and the suction service valve (pos. 3 and 23 on the P & I diagram).
2. Go to the Service menu and select Manual operation and set the HT compressor frequecy to 20 Hz.
3. Let the pressure drop to vacuum.
4. Stop the HT compressor by pressing Off on the controller and closing discharge stop valve.
5. Press wake up on the controller and read pressure in the corner of the display. Ensure it is 0 Bar.

21.4 High temperature (HT) compressor vacuum - replaced

Vacuuming of a new/replaced HT compressor is done by the following procedure:

1. Connect a vacuum pump with a service gauge manifold to the two points (70) included in service valves 5 and 23 (P & I diagram).
2. Check that all service valves are still closed (pos. 3, 5 and 23). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
3. Pump down the ambient pressure in the HT compressor to a vacuum, indicated on the gauges of the service gauge manifold.
4. Continue vacuum – pumping for at least 2 hours (removing possible moisture in the oil).
5. Close the service gauge manifold LP/HP valves.
6. Switch off the vacuum pump. Write down the vacuum reading, from the service gauge manifold.
7. Observe the vacuum for minimum 0.5 hour.
8. If there has been no change in the vacuum, open all service valves (pos. 3, 5 and 23). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
9. If the vacuum is not maintained, there is a possible leak somewhere. Check all service gauge manifold hoses and connections, between the HT compressor and vacuum pump. If these are OK, check the HT compressor and valves for leaks.
10. Disconnect the service gauge manifold and operate the unit as normal.

21.5 Pressure test high temperature cycle

After performing a major repair to the high temperature piping system, it is recommended to perform a pressure test. A pressure test has the purpose of checking the piping system for leakages. The pressure test is done by means of a high pressurized gas, e.g. N2, which is let into the piping system through the two evacuation points, pos. points (70) included in service valves 5 and 23 (P & I diagram).

Note: Do not use oxygen (02) for a pressure test, but only nitrogen (N2).

1. Install a service gauge manifold on the unit to the two evacuation points, pos. points (70) included in service valves 5 and 23 (P & I diagram).
2. Close the compressor discharge stop valve and compressor suction stop valve (pos. 5 and 23), 4 turns.
3. Connect the pressurized gas bottle (e.g. N2) to the discharge stop valve of the service gauge manifold.
4. Remove the electrical coils and mount permanent magnet on the three electronic expansion valves (pos. 16, 17 and 18).
5. Open the discharge stop valve of the service gauge manifold.
6. Carefully open the hand valve of the pressurized gas bottle until the two gauges of the service gauge manifold show a pressure of 12 BarE (174 Psi).
7. Close the discharge stop valve of the service gauge manifold.
8. Do a leakage detection (see “22.12 Leakage detection”).
9. Leave the unit pressurized for minimum 2 hours. If the pressure gauges still show 12 BarE (174 Psi) after 2 hours, the unit has no leaks.
10. If the pressure gauges are below 12 BarE (174 Psi), perform a leakage detection (see “22.12 Leakage detection”).
11. Disconnect the pressurized gas bottle.
12. Open the discharge stop valve on the service gauge manifold to release the pressure from the unit.
13. Evacuate the unit (see “22.1 Evacuation of high temperature refrigerant”).
14. Charge the unit (see “22.6 Charging of high temperature refrigerant”).

21.6 Charging of high temperature refrigerant

Always charge high temperature refrigerant according to name plate on unit (R134a or R513A). You must NOT mix R134a and R513A, avoid it at all times.
NEVER top of/add a partial charge of refrigerant on this equipment.

21.6.1 Charging of high temperature refrigerant on an empty unit

The power to the unit must be off. Before powering off unit, it might be helpful to use/run the condenser fan motor for fast dilution of any refrigeration leak.

The charging of high-temperature refrigerant on an empty unit is done by weight, by the following procedure:

1. Evacuate the unit (see "22.1 Evacuation of high temperature refrigerant").
2. Open the discharge service valve completely, pos. 5 (P & I diagram).
3. Close the HP valve on the service gauge manifold.
4. Connect the HP service gauge manifold to the liquid charging valve (70) included in the manual stop valve pos. 13 (P & I diagram).
5. Close intermediate service valve, pos. 3 (P & I diagram).
6. With an installed service gauge manifold to the evacuation points, LP on pos 70 included in the manual stop valve pos. 13 and HP on Liquid charging valve pos. 11 (P & I diagram).
7. Connect manifold service hose to refrigerant bottle and purge as needed.
8. Place a refrigerant bottle on a scale for weighing. Record the weight of the refrigerant bottle.
9. Set refrigerant bottle for liquid charging and open refrigerant bottle hand valve.
10. Check that the service valve pos. 26 is fully open and 1 turn closed, (for service manifold gauge reading, keep the manifold gauge LP valve closed). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
11. Open the HP valve on the service gauge manifold slowly, only allowing liquid R134a or R513A to pass.
12. Observe the scale and close the hand valve located on the refrigerant bottle, when the correct amount of refrigerant has been charged. The refrigerant charge of the unit is: 4.5 kg R134a or R513A.
    a. To speed up the charging time, it is recommended to start up the unit in Manual mode, with a HT compressor speed not more than 20 Hz - until finishing charging.
13. Open the economizer service valve, pos. 14 (P & I diagram).
14. Close the valves on the service gauge manifold.
15. Open all the service valves fully, on the compressor, pos. 5, 26, and 30 (P & I diagram).
16. Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
17. Remove all tools again.
18. Make sure to install all valve caps again.
19. Operate the unit as normal.

Note: If the correct amount of refrigerant is not charged by this procedure, follow the procedure described in charging of unit low on charge in this manual.

21.6.2 Charging of unit low on charge of HT refrigerant

If during normal stable in-range operation it is observed that the setpoint temperature cannot be maintained it might be an indication of missing refrigerant. Please observe the unit for a period of at least 6 hours to ensure a stable tendency. During this observation time please observe the following:

1. The red balls in the sight glass for the receiver are constantly at bottom level.
2. Veco is more than 80% open for 0.5 hour.
3. Vexp will steadily increase to 100%.
4. Psuc (T0) is steadily going down.
   If based on the above, it is determined that the unit is too low on refrigerant charge, then perform a leakage check before additional refrigerant may be charged by following this procedure:
5. Install a service gauge manifold to the unit and connect the HP hose to the liquid charging line, pos. 13 (P & I diagram) and the LP to the closed suction service valve, pos 23 (P & I diagram).
6. Connect the service gauge manifold to the refrigerant bottle with scale. Purge as needed. Before

recharging, a complete purging is necessary including a recovery of the refrigerant or recovery for direct re-use. The refrigerant must NOT be released into the air.
7. Close the economizer service valve, pos. 3 (P & I diagram).
8. Set the refrigerant bottle for liquid charging and open the valve.
9. Open the LP service gauge manifold valve fully and check the refrigerant bottle pressure (suction service valve pos. 23 remains fully closed). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
10. Operate the unit under normal condition, it will pump down the LP.
11. Open the LP valve on the service gauge manifold to allow refrigerant to enter into the system.
12. Charge max. 0.5 kg (1 lbs) (if there is a need for more - Leak check and eventual repair MUST be done before a max. 0.5 kg recharge is performed).
13. Close the refrigerant bottle valve.
14. Close the service gauge manifold valves and remove them.
15. Open the economizer service valve pos. 3 (P & I diagram).
16. Run the unit 0.5 h and check the R134a/R513A level in the receiver.
17. Make sure to install all valve caps again.

Caution: Do not overcharge the unit. Maximum charge is 4.5 kg of refrigerant. During recovery, observe receiver top sight glass as level indicator.

21.7 Evacuation of low temperature (LT) refrigerant

Warning: Minimum 45 barg pressure rated equipment needs to be used (R410, R32 or similar equipment). Standard R134a equipment is only rated to max. 30 barg.

1. Connect a service gauge manifold to the evacuation points (70) included in the suction and discharge service valves (pos. 55 and 65 in the P & I diagram or pos. 54 and 64 for the spare LT compressor). The service connectors in the service valves are 5/16" flare connectors (as for R410, R32).
2. Connect a recovery unit to the gauge manifold.
   a. Connect a recycling bottle to the recovery unit. Check that during the refrigerant recovery the pressure in the recycling bottle does not exceed its maximum working pressure (38.5 barg). If that will be the case, stop the recovery and connect a new empty recycling bottle.
   b. Use a scale underneath the bottle to measure the amount of recycled refrigerant. The refrigerant cannot be reused as its composition can be mixed.
3. If it is NOT possible to run the LT compressor:
   a. Remove the electrical coils and install a permanent magnet on the expansion valve bypass, LT and the expansion valve, evaporator LT (pos. 34 and 38).
   b. Turn off the unit.
   c. Close and open again, the discharge service valve (pos. 65 or 64) approx. 4 turns.
   d. Check that the recovery unit is set for vapour recovery.
   e. Open both service gauge manifold valves (LP/HP). Continue to 5.
4. If possible to run the LT compressor:
   a. Continue operation of the LT compressor in low speed!
   b. Losen the bypass service valve (pos. 60 or 61) and run a pump down of the LP side of the LT compressor to 0 Barg. In case the maximum LT compressor ON time is reached but the LT Psuc is higher than 0 Barg, manually restart the LT compressor one more time and check that 0 Barg can be reached. If not, there is a leak in the system.
   c. Turn off the LT compressor.
   d. Close the suction service valve (pos. 55 or 54). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
   e. Check the recovery unit is set for vapour recovery.
   f. Remove the electrical coils and install a permanent magnet on the expansion valve bypass, LT and the expansion valve, evaporator LT (pos. 34 and 38).
   g. Open only the HP valve on the service gauge manifold.
5. Start and operate the recovery unit as long as necessary to evacuate all refrigerant from the unit, until no pressure left.
6. Open suction service valve fully. Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
7. Check the service gauge manifold, should be in a slight vacuum.
8. Close all valves and stop the recovery unit. The evacuation is now completed.

21.8 Low temperature (LT) compressor pump down

1. Close the bypass service valve and the suction service valve (pos. 61/60 and 55/54 on the P & I diagram).
2. Go to the Service menu and select S01 Manual operation and set the LT compressor to ON (maximum 90 seconds run).
3. Let the pressure (PsucLT) drop to vacuum (0 barg).
4. Stop the LT compressor by pressing Off on the controller and closing discharge service valve.
5. Press "Wake up" on the controller and read low temperature suction pressure (PsucLT) in the Information menu. Ensure PsucLT is 0 Barg.

21.9 Low temperature (LT) compressor vacuum - replaced

1. Connect a vacuum pump with a service gauge manifold to the two evacuation points (70) included in the suction and discharge service valves (pos. 55 and 65 in the P & I diagram or pos. 54 and 64 for the spare LT compressor).
2. Check that all service valves are still closed (pos. 55, 61 and 65 or 54, 60 and 64). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
3. Pump down the ambient pressure in the LT compressor to a vacuum, indicated on the gauges of the service gauge manifold.
4. Continue vacuum – pumping for at least 2 hours (removing possible moisture in the oil).
5. Close the service gauge manifold LP/HP valves.
6. Switch off the vacuum pump. Write down the vacuum reading, from the service gauge manifold.
7. Observe the vacuum for minimum 0.5 hour.
8. If there has been no change in the vacuum, open all service valves (pos. 55, 61 and 65 or 54, 60 and 64). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
9. If the vacuum is not maintained, there is a possible leak somewhere. Check all service gauge manifold hoses and connections, between the LT compressor and vacuum pump. If these are OK, check the LT compressor and valves for leaks.
10. Disconnect the service gauge manifold and operate the unit as normal.

21.10 Pressure test low temperature cycle

After performing a major repair to the low temperature piping system, it is recommended to perform a pressure test. A pressure test has the purpose of checking the piping system for leakages. The pressure test is done by means of a high pressurized gas, e.g. N2, which is let into the piping system through the two evacuation points (70) included in the suction and discharge service valves (pos. 55 and 65 in the P & I diagram or pos. 54 and 64 for the spare LT compressor).

Note: Do not use oxygen (02) for a pressure test, but only nitrogen (N2).

1. Install a service gauge manifold on the unit to the two evacuation points (70) included in the suction and discharge service valves (pos. 55 and 65 in the P & I diagram or pos. 54 and 64 for the spare LT compressor).
2. Close the suction and discharge service valves (pos. 55 and 65) 4 turns. Leave all the service valves of the spare LT compressor open.
3. Connect the pressurized gas bottle (e.g. N2) to the discharge stop valve of the service gauge manifold.
4. Remove the electrical coils and mount permanent magnet on the expansion valve bypass, LT and the expansion valve, evaporator LT (pos. 34 and 38).
5. Open the discharge stop valve of the service gauge manifold.
6. Carefully open the hand valve of the pressurized gas bottle until the two gauges of the service gauge manifold show a pressure of 40 BarE (580 Psi).
7. Close the discharge stop valve of the service gauge manifold.
8. Do a leakage detection (see "22.12 Leakage detection").
9. Leave the unit pressurized for minimum 2 hours. If the pressure gauges still show 40 BarE (580 Psi). after 2 hours, the unit has no leaks.
10. If the pressure gauges are below 40 BarE (580 Psi), perform a leakage detection (see "22.12 Leakage detection").
11. Disconnect the pressurized gas bottle.
12. Open the discharge stop valve on the service gauge manifold to release the pressure from the unit.
13. Evacuate the LT cycle (see "22.7 Evacuation of low temperature refrigerant").
14. Charge the unit (see "22.11 Charging of low temperature refrigerant on an empty unit").

21.11 Charging of low temperature refrigerant on an empty unit

NEVER top up/add a partial charge of refrigerant on this equipment.

1. Turn the unit off.
2. Remove the protective spindle caps from the discharge service valve HP (pos. 65 on the P & I diagram) and the suction service valve HP (pos. 55). Ensure both valves are closed.
3. Connect the service gauge manifold HP pipe with a 1/2" - 20 UNF connection fitting (according to SAE J513) to the charging valve (70) located on the discharge service valve HP (pos. 65).
4. Connect the service gauge manifold LP pipe with a 1/2" - 20 UNF connection fitting (according to SAE J513) to the evacuation valve (70) located on the suction service valve LP (pos. 55).
5. Open the valves on the service gauge manifold and run the vacuum pump for 1 min. to remove air from the pipes.
6. Connect manifold service hose to refrigerant bottle.
7. Open refrigerant bottle hand valve.
8. Turn the refrigerant bottle upside down and place it on the scale for weighing. Record the weight of the refrigerant bottle.
9. Halfway open the discharge service valve HP (pos 65).
10. Open the service hose on the service gauge manifold allowing refrigerant to pass.
11. Observe the weight on the scales.
12. When the weight holds steady, close the discharge service valve HP (pos 65).
13. Turn the unit on. After a couple minutes the LT compressor will start up.
14. Halfway open the suction service valve LP (pos. 55) allowing refrigerant to enter.
15. Wait until the remaining refrigerant has been charged. Check that the quantity should be 2.45 kg ± 50 g.
16. Close the suction service valve LP (pos. 55).
17. Turn the refrigerant bottle upright and close the hand valve.
18. Run the vacuum pump for 1 min. to empty the pipes.
19. Close the valves on the service gauge manifold.
20. Disconnect the service gauge manifold from the service valves and the refrigerant bottle.
21. Make sure to install all valve caps again.
22. Operate the unit as normal.

21.12 Leakage detection

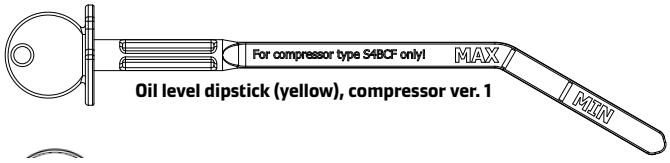
Leakage detection is done under pressure test, as described in this manual. While the unit is pressurized it is possible to check all soldered and screwed joints of the piping system. This is done with a leakage detection agent or with a solution with high foam building soap. The agent or water/soap solution is sprayed upon the joints. If there is a leakage bubbling foam will occur. This leakage detection test can also be done while the unit is running charged with refrigerant by means of a refrigerant detector or soap solution. Leakage detection is also done during pump down of unit or compressor, as described in this manual.

21.13 Leakage and isolation of the evaporator

1. Set the unit to Manual mode by choosing the Service Menu, line S01 Manual operation and changing line M01 from AUTO to MANUAL.
2. Mount a permanent magnet on the expansion valve, evaporator LT (pos 38 P & I diagram).
3. Connect service gauge manifold to the compressor charging valves (70) located on the discharge service valve HP (pos. 65) and the suction service valve LP (pos. 55).
4. Pressurize the system via the service gauge to 10 bar with N2.
5. Monitor if the pressure drops.
6. If there is a leak, the pressure will drop. Close all the manual stop valves (pos. 39, 40, 50 and 51) and pressurize the system to 10 bar again. If the pressure drops again it means that the leak is located in the pipes and equipment located in the unit front. Use soap water or a gas sniffer to locate it and fix it.
7. If the pressure does not drop it means that the leak is located in one of the evaporator circuits and the below steps should be used to locate and isolate the leaking evaporator circuit until in can be repaired. The unit can continue to be used with only one evaporator circuit.
8. Isolate the leaking part of the coil by closing the two manual stop valves (pos. 40 and 51) and leave open the other two stop valves above (pos. 39 and 50).
9. Pressurize the system again to 10 bar.

10. If 10 bar now remains, the evaporator has a leak in the circuit that has been isolated by closing the two stop valves (pos. 40 and 51).
11. If the pressure continues to drop open the two stop valves (pos. 40 and 51) and close the two stop valves above (pos. 39 and 50).
12. Pressurize the system again to 10 bar to verify that the pressure is not dropping anymore and that the evaporator circuit isolated has a leak.
13. Leave the stop valves in the positions in which the pressure does not drop anymore (evaporator leak is isolated) and continue by removing the N2 and vacuum the system for a minimum of 1 hour or until vacuum is reached.
14. Evacuate the LT cycle (see "22.7 Evacuation of low temperature refrigerant").
15. Charge the unit with the spare refrigerant bottle (see "22.11 Charging of low temperature refrigerant on an empty unit").
16. Mount the emptied refrigerant bottle back into its place on the unit and report the use of charge to service@starcool.com.

21.14 Compressor



Oil level dipstick (yellow), compressor ver. 1

21.14.1 Check of oil level

Compressor with sight glass:

The oil level can be checked on the sight glass of the compressor. During normal operation the oil level should be between 1/3 and 2/3 sight glass full. Run the unit in Chill mode for as long as possible (minimum 1 hr) before checking the oil level. If the level is below 1/3 in the sight glass after a period of minimum 20 minutes with the compressor running, additional oil shall be added as described in this manual. If the compressor is not running automatically, lower the temperature setpoint.

Due to dissolved refrigerant, the oil level shown in the compressor sight glass may be too high if the unit has not been running for a longer period of time. In that case:

1. Let the unit run for 20 minutes with a setpoint below cargo setpoint.
2. Turn off the compressor and check the sight glass.
3. If the oil level is still too high, remove oil until 1/3 to 2/3 sight glass full is obtained.
4. In case the oil level is too low in the sight glass, run the unit at a setpoint above the cargo setpoint for 20 minutes.
5. Turn off the compressor and check the sight glass.
6. If the oil level is still too low, add oil until 1/3 to 2/3 sight glass full is obtained.

Compressor without sight glass:

1. Run the unit in Chill mode for as long as possible (minimum 20 min) before checking the oil level.
2. Pump down the compressor (see "22.3 High temperature (HT) compressor pump down").
3. Remove the oil plug on top of the compressor (left side to the LP valve plate).
4. Use the compressor oil dipstick (item number 818503A) to check the oil level. It must be within the marking on the dipstick.
5. Add oil if needed and check again.
6. Reinstall the oil plug.
7. Evacuate the compressor as described in this manual.
8. Open the compressor stop valves and disconnect the vacuum pump.
9. Start up the unit and verify that everything is running as it should be, including checking for leaks at the oil plug area.

Note: Do not overfill the compressor with oil.

21.14.2 Draining of oil from compressor

If the compressor has been overcharged with oil, the procedure for drainage is as follows:

1. The two oil outlets are placed on a tee-piece located on the compressor end opposite of the FC end. Please observe that only one of the oil outlet ports is equipped with a schräder valve.
2. Connect a service gauge manifold to the outlet port with schräder valve of the oil pump.
3. Only connect the discharge hose to the outlet port of the oil pump.
   Make sure that all stop valves on the service gauge manifold are closed.
4. Open the discharge gauge stop valve on the service gauge manifold.
5. Insert the hose from the suction gauge on the service gauge manifold into a small measuring cup.

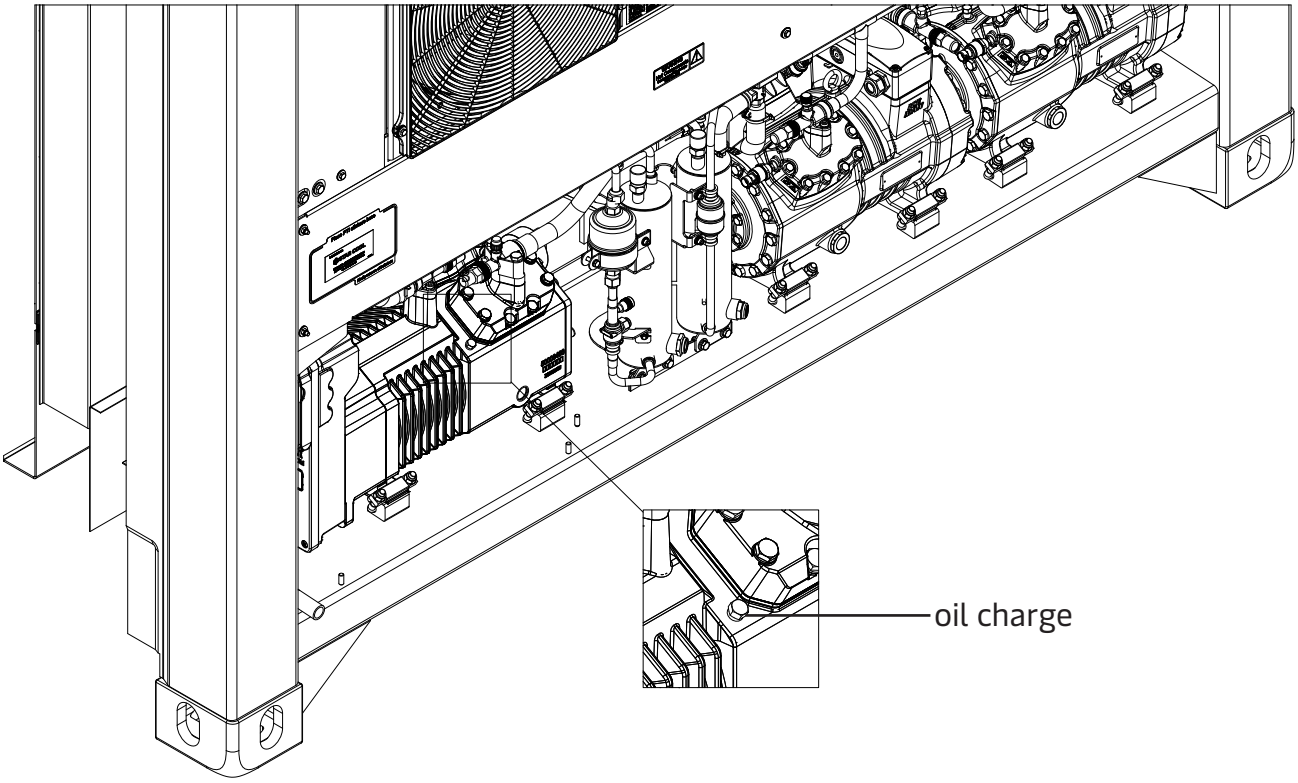
6. Run the compressor in manual operation on 25 Hz.
7. Carefully open the suction gauge stop valve on the service gauge manifold.
8. While observing the oil level in the sight glass of the compressor, carefully let out oil, until the oil level in the sight glass has reached a mid - level.
9. Close the suction gauge stop valve and discharge gauge stop valve on the service gauge manifold.
10. Disconnect the service gauge manifold.
11. Cap the oil outlet from the oil pump.
12. Set the unit to Automatic operation mode by choosing the Service menu, line S01 Manual operation and changing MANUAL to AUTO.
13. Run the unit in normal operation.

Observe the oil level when the unit is running minimum 6 hours in a stable condition.

21.14.3 Charging of oil

If during normal operation it has been observed that there is too little oil charge on the compressor, additional oil may be charged. The compressor should be filled with oil type BSE 55 (item no. 818667B). The procedure for adding oil is as follows:

1. Pump down the compressor, as described in this manual.
2. Remove the plug on top of the stop valve for the intermediate pressure.
3. Start by adding 0.25 L of compressor oil.
4. Reinstall the plug on top of the stop valve for the intermediate pressure.
5. Evacuate the compressor as described in this manual.
6. Open the compressor stop valves, pos. 5, 26, and 30 (P & I diagram). Before operating the suction service valve, loosen the gland seal by ¼ turn before you move the spindle. Once finished, tighten the gland seal and put on the protective spindle cap.
7. Disconnect the vacuum pump.
8. Start up the unit and check the oil level during start up and after 20 minutes in normal stable operation. If oil is still missing, check for oil leaks or spills both inside and outside the container. If no leaks found, repeat the above.



21.15 Soldering

Warning: Any soldering or de-brazing must ONLY be carried out after recovery of any excess gas/refrigerant in the system. Also make sure to expel oxygen from system to prevent flash-ignition of hot oil. Make sure to comply to local safety regulations and government environmental laws whenever soldering on refrigeration systems.

When soldering and de-brazing components on the unit, please observe the following. Use the following material for soldering copper - copper (all pipes):

Soldering rod:	L - Ag15P according to DIN 8513 or B - CuP5 according to AWS A 5.8.
Example for product name:	Chem - weld product 550 or Castolin RB 5283
Soldering flux:	Due to the high content of Phosphor in the soldering rod no flux is needed.

For soldering copper - stainless (connections for water cooled condenser and economizer):

Soldering rod:	L - Ag40Cd according to DIN 8513 or B - Ag 1 according to AWS A 5.8.
Example for product name:	Chem - weld product 511B or Castolin 1802 or 1802 F.
Soldering flux:	F - SH 1 according to DIN 8511 or FB 3A according to AWS A 5.31.
Example for product name:	Chem - weld product 110 or Castolin 1802 N - Atmosin.

IMPORTANT:

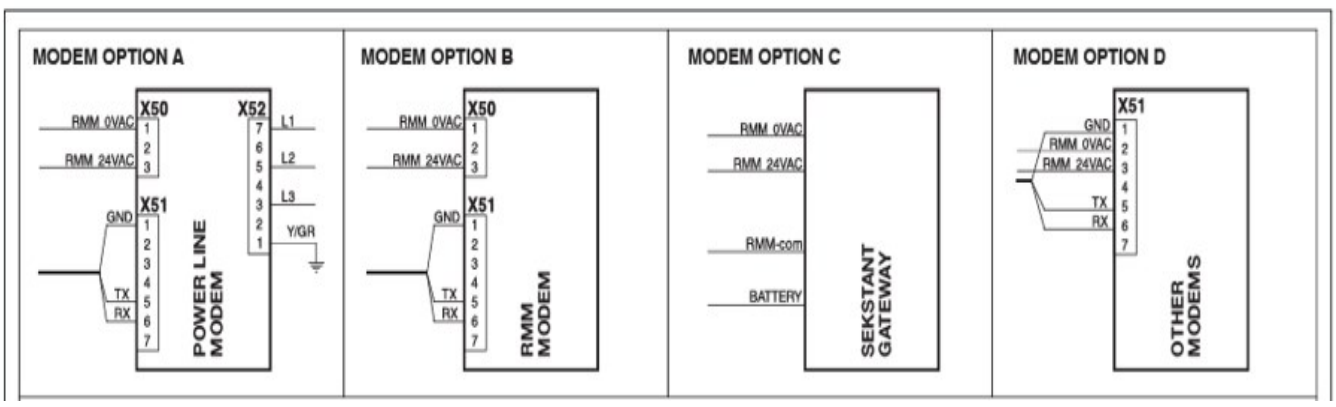
Always use wet cloths to protect sensitive valves, LT filter dryer and other equipment against heat input during soldering and de-brazing.

Always use nitrogen (N_2) as inert backing gas during soldering and de-brazing.

21.15.1 Welding

Do not perform welding on the unit before disconnecting the power plug. Furthermore, disconnect the power measurement module, the main controller (and modem if present), and the following connectors:
Controller: X0, X1, X10 and X8.
SPM Power Meas Module: X41.
User Panel: X80.
Modems:

- Option A (RMM): X50, X51 and X51
- Option B (RMM+, ML RCM, Orbcom): X50 and X51
- Option C (Sekstant): All connectors
- Option D (Other, f.x. Globe Tracker, ArrowSpot): X51



22. General trouble shooting

Hints for general trouble shooting.

1. Unit will not start up.
   Check that power is applied to the unit.
   Check that fuses at QS1, QS2, F1 and or F2 are not blown. Check the alarm list. Clear all alarms and the causes.
2. Unit starts but stops shortly after. Check that the condenser motors are rotating and that the air is blowing away from the unit. Check that the evaporator motors are rotating and there are not overheat alarms. Check if the high pressure switch alarms are active in the alarm list. Check that the high temperature compressor is working properly: motor is running without big noise. Check that the low temperature compressor is running and that its overheat alarm is not active. Temperature sensors not working properly. Check that they are placed on the pipes and are inside the isolation.
3. Unit is running but is not bringing the temperature down to temperature setpoint. The ambient temperature is very high – the condenser can only cool a little so the cooling capacity is small and the cool down process takes longer time. The low temperature expansion valve is not opening and no cooling refrigerant is pumped into the evaporator. The condenser pressure will be very high. The unit has been put in manual phase detecting mode and all motors are running the wrong way. The compressors will pump correctly but there is very little cooling capacity in the condenser and the air flow is wrong inside in the box. One of the motors (condenser or evaporator) is running in the opposite direction.
4. Liquid refrigerant is entering the compressors through the evaporator or cascade heat exchanger. The temperature sensors, Tsuc and Tsucc are not working properly. Check that the sensors are mounted close to the pipe and are placed be- neath the isolation. The pressure transmitters, Psuc and LT Psuc are not working properly.
5. Display is blank. Adjust the contrast (see “12.5 Contrast adjustment of the display”).

23. Emergency operation

Warning: High voltage. Unit must be disconnected from power. Only to be done by trained personnel.

23.1 FC bypass

Due to the type of equipment it is not posisble to bypass the FC.

23.2 Evaporator fan motor bypass

If one of the evaporator fan motors is defective and no replacement part is available, the defective motor can be bypassed.

1. Turn off the unit via the on/off switch and unplug the unit from the main power.
2. Dismount the inspection cover.
3. Unplug (or disconnect at terminal box) the faulty evaporator fan motor.
4. Using a plastic bag of a suitable size, cover the fan propeller and secure the bag around the shaft of the faulty motor. This is to prevent air short cycling by the remaining working evaporator fan motor.
5. Protect the defective evaporator fan motor loose plug from humidity and water ingresses by securing it with a smaller plastic bag.
6. Bypass the faulty motor IP connection on the microprocessor. All 3 evaporator fan motor IP’s are connected at plug X26 terminals 1 and 2 on the microprocessor.
7. Replace the IP connection with a jumper cable at X26 terminals 1 and 2. By doing this all 3 motors are working without terminal protection.
8. Mount the inspection cover, connect power to the unit and turn it on.

24. Tables

24.1 Datalog description

Explanations of datalog loggings:
Values are stored in °C/BarE and are converted to °F/Psi on retrieval or listing on the display.
The logged data in the datalog can be seen:

- On the display menu L01, the viewable temperatures are listed.
- On the display menu L03, the logged temperatures can be viewed graphically.
- Retrieved via the program RefCon and the RMM modem and the powerline.
- Retrieved via a program, LogMan, on a PSION pda using the retriever socket.
- Retrieved via the StarView program using the retriever socket.
- Retrieved via a USB stick using the USB connection port in the controller box.

Data:
See “7.13 Datalog”.

Extended data:

No.	Name	Value	Unit
1	Psuc pressure	Suction pressure (effective)	BarE
2	Pdis pressure	Discharge pressure (effective)	BarE
3	Fpower frequency	Power frequency	Hz
4	(Reserved)	--	--
5	Upower voltage	Highest power voltage of U1, U2, U3	V
No.	Name	Value	Unit
6	I1 current	Current I1	A
7	I2 current	Current I2	A
8	I3 current	Current I3	A
9	Ifc current	Current FC	A
10	Fcpr frequency	Compressor frequency	Hz
11	Heater status	Heater on-time	%
12	(Reserved)		--
13	Mevap status	Evaporator motor [OFF, LO, HI, ERR]	--
14	Mcond status	Condenser motor [OFF, LO, HI, ERR]	--
No.	Name	Value	Unit
15	Tfc temperature	Temperature of frequency controller	°C
16	Tambient temperature	Ambient temperature [-30/+96]	°C

Extended data 2 (only retrievable by StarView):

No.	Name	Value	Unit
1	Tsup1	Supply air temperature	°C
3	Tevap	Evaporator temperature	°C
4	Tsuc	Suction temperature	°C
5	Vexp	Expansion valve opening	%
6	Veco	Economizer valve opening	%
7	SHref	Superheat reference	°C
8	Tint	Internal temperature	°C

Alarms:
Alarms which may occur and a description can be found in section 14 of this manual.

24.2 Temperature sensor - resistance table (HT type)

Resistance [Ω]	Temp	
	[°C]	[°F]
3,095,611.00	-70	-94
2,851,363.00	-69	-92
2,627,981.00	-68	-90
2,423,519.00	-67	-89
2,236,398.00	-66	-87
2,064,919.00	-65	-85
1,907,728.00	-64	-83
1,763,539.00	-63	-81
1,631,173.00	-62	-80
1,509,639.00	-61	-78
1,397,935.00	-60	-76
1,295,239.00	-59	-74
1,200,732.00	-58	-72
1,113,744.00	-57	-71
1,033,619.00	-56	-69
959,789.00	-55	-67
891,689.00	-54	-65
828,865.00	-53	-63
770,880.00	-52	-62
717,310.00	-51	-60
667,828.00	-50	-58
622,055.00	-49	-56
579,718.00	-48	-54
540,530.00	-47	-53
504,230.00	-46	-51
470,609.00	-45	-49
439,445.00	-44	-47
410,532.00	-43	-45
383,712.00	-42	-44
358,806.00	-41	-42
335,671.00	-40	-40
314,179.00	-39	-38
294,193.00	-38	-36
275,605.00	-37	-35
258,307.00	-36	-33
242,195.00	-35	-31
227,196.00	-34	-29
213,219.00	-33	-27
200,184.00	-32	-26
188,026.00	-31	-24
176,683.00	-30	-22
166,091.00	-29	-20
156,199.00	-28	-18
146,959.00	-27	-17

Resistance [Ω]	Temp	
	[°C]	[°F]
138,322.00	-26	-15
130,243.00	-25	-13
122,687.00	-24	-11
115,613.00	-23	-9
108,991.00	-22	-8
102,787.00	-21	-6
96,974.00	-20	-4
91,525.00	-19	-2
86,415.00	-18	0
81,621.00	-17	1
77,121.00	-16	3
72,895.00	-15	5
68,927.00	-14	7
65,198.00	-13	9
61,693.00	-12	10
58,397.00	-11	12
55,298.00	-10	14
52,380.00	-9	16
49,663.00	-8	18
47,047.00	-7	19
44,610.00	-6	21
42,314.60	-5	23
40,149.50	-4	25
38,108.50	-3	27
36,182.80	-2	28
34,366.10	-1	30
32,650.80	0	32
31,030.40	1	34
29,500.10	2	36
28,054.20	3	37
26,687.60	4	39
25,395.50	5	41
24,172.70	6	43
23,016.00	7	45
21,921.70	8	46
20,885.20	9	48
19,903.50	10	50
18,973.60	11	52
18,092.60	12	54
17,257.40	13	55
16,465.10	14	57
15,714.00	15	59
15,001.20	16	61
14,324.60	17	63

Resistance [Ω]	Temp	
	[°C]	[°F]
13,682.60	18	64
13,052.80	19	66
12,493.70	20	68
11,943.30	21	70
11,420.00	22	72
10,922.70	23	73
10,449.90	24	75
10,000.00	25	77
9,572.00	26	79
9,164.70	27	81
8,777.00	28	82
8,407.70	29	84
8,056.00	30	86
7,720.90	31	88
7,401.70	32	90
7,097.20	33	91
6,807.00	34	93
6,530.10	35	95
6,266.10	36	97
6,014.20	37	99
5,773.70	38	100
5,544.10	39	102
5,324.90	40	104
5,115.60	41	106
4,915.50	42	108
4,724.30	43	109
4,541.60	44	111
4,366.90	45	113
4,199.90	46	115
4,040.10	47	117
3,887.20	48	118
3,741.10	49	120
3,601.00	50	122
3,466.90	51	124
3,338.60	52	126
3,215.60	53	127
3,097.90	54	129
2,985.10	55	131
2,876.90	56	133
2,773.20	57	135
2,673.90	58	136
2,578.50	59	138
2,487.10	60	140
2,399.40	61	142

Resistance [Ω]	Temp	
	[°C]	[°F]
2,315.20	62	144
2,234.70	63	145
2,156.70	64	147
2,082.30	65	149
2,010.80	66	151
1,942.10	67	153
1,876.00	68	154
1,812.60	69	156
1,751.60	70	158
1,693.00	71	160
1,636.63	72	162
1,582.41	73	163
1,530.28	74	165
1,480.12	75	167
1,431.87	76	169
1,385.37	77	171
1,340.68	78	172
1,297.64	79	174
1,256.17	80	176
1,216.23	81	178
1,177.75	82	180
1,140.71	83	181
1,104.99	84	183
1,070.58	85	185
1,037.40	86	187
1,005.40	87	189
974.56	88	190
944.81	89	192
916.11	90	194
888.41	91	196
861.70	92	198
835.93	93	199
811.03	94	201
786.99	95	203
763.79	96	205
741.38	97	207
719.74	98	208
698.82	99	210
678.63	100	212
659.10	101	214
640.23	102	216
622.00	103	217
604.36	104	219
587.31	105	221

Resistance [Ω]	Temp	
	[°C]	[°F]
570.82	106	223
554.86	107	225
539.44	108	226
524.51	109	228
510.06	110	230
496.08	111	232
482.55	112	234
469.45	113	235
456.76	114	237
444.48	115	239
432.58	116	241
421.06	117	243
409.90	118	244
399.08	119	246
388.59	120	248
378.44	121	250
368.59	122	252
359.05	123	253
349.79	124	255
340.82	125	257
332.11	126	259
323.67	127	261
315.48	128	262
307.53	129	264
299.82	130	266
292.34	131	268
285.08	132	270
278.03	133	271
271.19	134	273
264.54	135	275
258.09	136	277
251.82	137	279
245.74	138	280
239.82	139	282
234.08	140	284
228.50	141	286
223.08	142	288
217.80	143	289
212.68	144	291
207.70	145	293
202.86	146	295
198.15	147	297
193.57	148	298
189.12	149	300

24.3 Temperature sensor - voltage table (HT type)

Temperature sensors except for reference temperature sensor.
Vcc = 3.3 V

Voltage [V]	Temp [°C]	Temp [°F]
3.00	-40	-40.0
2.98	-39	-38.2
2.97	-38	-36.4
2.95	-37	-34.6
2.92	-36	-32.8
2.90	-35	-31.0
2.88	-34	-29.2
2.86	-33	-27.4
2.83	-32	-25.6
2.81	-31	-23.8
2.78	-30	-22.0
2.75	-29	-20.2
2.73	-28	-18.4
2.69	-27	-16.6
2.67	-26	-14.8
2.63	-25	-13.0
2.60	-24	-11.2
2.57	-23	-9.4
2.53	-22	-7.6
2.49	-21	-5.8
2.46	-20	-4.0
2.42	-19	-2.2
2.39	-18	-0.4
2.35	-17	1.4
2.31	-16	3.2
2.27	-15	5.0
2.23	-14	6.8
2.19	-13	8.6
2.15	-12	10.4
2.11	-11	12.2
2.07	-10	14.0
2.03	-9	15.8
1.98	-8	17.6
1.94	-7	19.4
1.89	-6	21.2
1.85	-5	23.0
1.81	-4	24.8
1.77	-3	26.6
1.73	-2	28.4
1.68	-1	30.2
1.64	0	32.0
1.60	1	33.8
1.56	2	35.6
1.52	3	37.4
1.48	4	39.2
1.43	5	41.0
1.39	6	42.8
1.35	7	44.6
1.32	8	46.4
1.28	9	48.2
1.24	10	50.0
1.21	11	51.8
1.17	12	53.6
1.14	13	55.4
1.10	14	57.2
1.06	15	59.0
1.03	16	60.8
1	17	62.6
0.97	18	64.4
0.94	19	66.2
0.90	20	68.0
0.88	21	69.8
0.85	22	71.6
0.82	23	73.4
0.79	24	75.2
0.77	25	77.0
0.74	26	78.8
0.72	27	80.6
0.69	28	82.4
0.67	29	84.2
0.65	30	86.0
0.63	31	87.8
0.61	32	89.6
0.58	33	91.4
0.57	34	93.2
0.55	35	95.0
0.53	36	96.8
0.51	37	98.6
0.49	38	100.4
0.48	39	102.2
0.46	40	104.0
0.44	41	105.8
0.43	42	107.6
0.42	43	109.4
0.40	44	111.2
0.38	45	113.0
0.37	46	114.8
0.36	47	116.6
0.35	48	118.4
0.34	49	120.2
0.32	50	122.0

24.4 Temperature sensor - resistance table (LT type)

Resistance [Ω]	Temp	
	[°C]	[°F]
127678	-70	-94
119150	-69	-92
111239	-68	-90
103897	-67	-89
97081	-66	-87
90750	-65	-85
84867	-64	-83
79399	-63	-81
74314	-62	-80
69583	-61	-78
65180	-60	-76
61081	-59	-74
57262	-58	-72
53705	-57	-71
50388	-56	-69
47295	-55	-67
44410	-54	-65
41717	-53	-63
39203	-52	-62
36855	-51	-60
34661	-50	-58
32610	-49	-56
30693	-48	-54
28899	-47	-53
27220	-46	-51
25648	-45	-49
24177	-44	-47
22798	-43	-45
21505	-42	-44
20294	-41	-42
19158	-40	-40
18091	-39	-38
17091	-38	-36
16151	-37	-35
15269	-36	-33
14439	-35	-31
13660	-34	-29
12927	-33	-27
12238	-32	-26
11589	-31	-24
10979	-30	-22
10404	-29	-20
9862	-28	-18
9352	-27	-17

Resistance [Ω]	Temp	
	[°C]	[°F]
8871	-26	-15
8418	-25	-13
7990	-24	-11
7587	-23	-9
7206	-22	-8
6847	-21	-6
6507	-20	-4
6186	-19	-2
5883	-18	0
5597	-17	1
5326	-16	3
5069	-15	5
4827	-14	7
4597	-13	9
4380	-12	10
4174	-11	12
3979	-10	14
3795	-9	16
3619	-8	18
3453	-7	19
3296	-6	21
3146	-5	23
3004	-4	25
2870	-3	27
2742	-2	28
2620	-1	30
2505	0	32
2395	1	34
2291	2	36
2192	3	37
2098	4	39
2008	5	41
1923	6	43
1841	7	45
1764	8	46
1690	9	48
1620	10	50
1553	11	52
1489	12	54
1428	13	55
1370	14	57
1315	15	59
1262	16	61
1212	17	63

Resistance [Ω]	Temp	
	[°C]	[°F]
1164	18	64
1118	19	66
1074	20	68
1032	21	70
992	22	72
953	23	73
917	24	75
882	25	77
848	26	79
816	27	81
786	28	82
756	29	84
728	30	86
701	31	88
676	32	90
651	33	91
627	34	93
605	35	95
583	36	97
562	37	99
542	38	100
523	39	102
505	40	104
487	41	106
470	42	108
454	43	109
438	44	111
423	45	113
409	46	115
395	47	117
382	48	118
369	49	120
357	50	122
345	51	124
333	52	126
322	53	127
312	54	129
302	55	131
292	56	133
283	57	135
274	58	136
265	59	138
257	60	140
248	61	142

24.5 Temperature sensor - voltage table (LT type)

Temperature sensors except for reference temperature sensor.
Vcc = 3.3 V

Voltage [V]	Temp [°C]	Temp [°F]
2.19	-60	-76
2.14	-59	-74
2.09	-58	-72
2.04	-57	-71
1.99	-56	-69
1.94	-55	-67
1.89	-54	-65
1.84	-53	-63
1.79	-52	-62
1.74	-51	-60
1.69	-50	-58
1.64	-49	-56
1.59	-48	-54
1.54	-47	-53
1.49	-46	-51
1.44	-45	-49
1.40	-44	-47
1.35	-43	-45
1.30	-42	-44
1.26	-41	-42
1.21	-40	-40.0
1.17	-39	-38.2
1.13	-38	-36.4
1.08	-37	-34.6
1.04	-36	-32.8
1.00	-35	-31.0
0.97	-34	-29.2
0.93	-33	-27.4
0.89	-32	-25.6
0.86	-31	-23.8
0.82	-30	-22.0

Voltage [V]	Temp [°C]	Temp [°F]
0.79	-29	-20.2
0.76	-28	-18.4
0.73	-27	-16.6
0.70	-26	-14.8
0.67	-25	-13.0
0.64	-24	-11.2
0.62	-23	-9.4
0.59	-22	-7.6
0.57	-21	-5.8
0.54	-20	-4.0
0.52	-19	-2.2
0.50	-18	-0.4
0.48	-17	1.4
0.46	-16	3.2
0.44	-15	5.0
0.42	-14	6.8
0.40	-13	8.6
0.39	-12	10.4
0.37	-11	12.2
0.36	-10	14.0
0.34	-9	15.8
0.33	-8	17.6
0.31	-7	19.4
0.30	-6	21.2
0.29	-5	23.0
0.28	-4	24.8
0.26	-3	26.6
0.25	-2	28.4
0.24	-1	30.2
0.23	0	32.0
0.22	1	33.8

Voltage [V]	Temp [°C]	Temp [°F]
0.21	2	35.6
0.21	3	37.4
0.20	4	39.2
0.19	5	41.0
0.18	6	42.8
0.17	7	44.6
0.17	8	46.4
0.16	9	48.2
0.15	10	50.0
0.15	11	51.8
0.14	12	53.6
0.14	13	55.4
0.13	14	57.2
0.13	15	59.0
0.12	16	60.8
0.12	17	62.6
0.11	18	64.4
0.11	19	66.2
0.10	20	68.0
0.10	21	69.8
0.10	22	71.6
0.09	23	73.4
0.09	24	75.2
0.09	25	77.0
0.08	26	78.8
0.08	27	80.6
0.08	28	82.4
0.07	29	84.2
0.07	30	86.0

24.6 Voltage – pressure table, LP transmitter (NSK) + DST (Psuc)

Vcc = 5 V. Pressure is relative

Voltage [V]	Pressure [BarE]	Pressure [Psi]
	-0.69	-10.01
0.30	-0.65	-9.49
0.35	-0.49	-7.12
0.40	-0.33	-4.75
0.45	-0.16	-2.38
0.50	0.00	-0.01
0.55	0.16	2.36
0.60	0.33	4.73
0.65	0.49	7.10
0.70	0.65	9.47
0.75	0.82	11.84
0.80	0.98	14.21
0.85	1.14	16.58
0.90	1.31	18.95
0.95	1.47	21.32
1.00	1.63	23.69
1.05	1.80	26.06
1.10	1.96	28.43
1.15	2.12	30.80
1.20	2.29	33.17
1.25	2.45	35.54
1.30	2.61	37.91
1.35	2.78	40.28
1.40	2.94	42.65
1.45	3.10	45.02
1.50	3.27	47.39
1.55	3.43	49.76
1.60	3.59	52.13
1.65	3.76	54.50

Voltage [V]	Pressure [BarE]	Pressure [Psi]
1.70	3.92	56.87
1.75	4.08	59.24
1.80	4.25	61.61
1.85	4.41	63.97
1.90	4.57	66.34
1.95	4.74	68.71
2.00	4.90	71.08
2.05	5.06	73.45
2.10	5.23	75.82
2.15	5.39	78.19
2.20	5.55	80.56
2.25	5.72	82.93
2.30	5.88	85.30
2.35	6.04	87.67
2.40	6.21	90.04
2.45	6.37	92.41
2.50	6.53	94.78
2.55	6.70	97.15
2.60	6.86	99.52
2.65	7.02	101.89
2.70	7.19	104.26
2.75	7.35	106.63
2.80	7.51	109.00
2.85	7.68	111.37
2.90	7.84	113.74
2.95	8.00	116.11
3.00	8.17	118.48
3.05	8.33	120.85
3.10	8.49	123.22

Voltage [V]	Pressure [BarE]	Pressure [Psi]
3.15	8.66	125.59
3.20	8.82	127.96
3.25	8.98	130.33
3.30	9.15	132.70
3.35	9.31	135.07
3.40	9.47	137.44
3.45	9.64	139.81
3.50	9.80	142.18
3.55**	9.97	144.66
3.60**	10.14	147.03
3.65**	10.30	149.40
3.70**	10.46	151.77
3.75**	10.63	154.14
3.80**	10.79	156.51
3.85**	10.95	158.89
3.90**	11.12	161.26
3.95**	11.28	163.63
4.00**	11.45	166.00
4.05**	11.61	168.37
4.10**	11.77	170.74
4.15**	11.94	173.11
4.20**	12.10	175.49
4.25**	12.26	177.86
4.30**	12.43	180.23
4.35**	12.59	182.60
4.40**	12.75	184.97
4.45**	12.92	187.34
4.50**	13.08	189.71

** DST P100 only

24.7 Voltage – pressure table, HP transmitter (NSK) + DST (Pdis, PsucLT, PdisLT)

Vcc = 5 V. Pressure is relative

Voltage [V]	Pressure [BarE]	Pressure [Psi]
0.50	0.00	0.00
0.55	0.50	7.25
0.60	1.00	14.51
0.65	1.50	21.76
0.70	2.00	29.02
0.75	2.50	36.27
0.80	3.00	43.52
0.85	3.50	50.78
0.90	4.00	58.03
0.95	4.50	65.29
1.00	5.00	72.54
1.05	5.50	79.79
1.10	6.00	87.05
1.15	6.50	94.30
1.20	7.00	101.56
1.25	7.50	108.81
1.30	8.00	116.06
1.35	8.50	123.32
1.40	9.00	130.57
1.45	9.50	137.83
1.50	10.00	145.08
1.55	10.50	152.33
1.60	11.00	159.59
1.65	11.50	166.84
1.70	12.00	174.10
1.75	12.50	181.35
1.80	13.00	188.60

Voltage [V]	Pressure [BarE]	Pressure [Psi]
1.85	13.50	195.86
1.90	14.00	203.11
1.95	14.50	210.37
2.00	15.00	217.62
2.05	15.50	224.87
2.10	16.00	232.13
2.15	16.50	239.38
2.20	17.00	246.64
2.25	17.50	253.89
2.30	18.00	261.14
2.35	18.50	268.40
2.40	19.00	275.65
2.45	19.50	282.91
2.50	20.00	290.16
2.55	20.50	297.41
2.60	21.00	304.67
2.65	21.50	311.92
2.70	22.00	319.18
2.75	22.50	326.43
2.80	23.00	333.68
2.85	23.50	340.94
2.90	24.00	348.19
2.95	24.50	355.45
3.00	25.00	362.70
3.05	25.50	369.95
3.10	26.00	377.21
3.15	26.50	384.46

Voltage [V]	Pressure [BarE]	Pressure [Psi]
3.20	27.00	391.72
3.25	27.50	398.97
3.30	28.00	406.22
3.35	28.50	413.48
3.40	29.00	420.73
3.45	29.50	427.99
3.50	30.00	435.24
3.55**	30.50	442.25
3.60**	31.00	449.50
3.65**	31.50	456.75
3.70**	32.00	464.00
3.75**	32.50	471.25
3.80**	33.00	478.50
3.85**	33.50	485.75
3.90**	34.00	493.00
3.95**	34.50	500.25
4.00**	35.00	507.50
4.05**	35.50	514.75
4.10**	36.00	522.00
4.15**	36.50	529.25
4.20**	37.00	536.50
4.25**	37.50	543.75
4.30**	38.00	551.00
4.35**	38.50	558.25
4.40**	39.00	565.50
4.45**	39.50	572.75
4.50**	40.00	580.00

** DST P100 only

24.8 Pressure - temperature table for R134a

Temp [°C]	Temp [°F]	Pressure [Barg]	Pressure [Psig]
-40	-40	-0.5	-7.0
-38	-36	-0.4	-6.1
-36	-33	-0.4	-5.4
-34	-29	-0.3	-4.3
-32	-26	-0.2	-3.5
-30	-22	-0.2	-2.2
-28	-18	-0.1	-0.9
-26	-15	0.0	0.2
-24	-11	0.1	1.7
-22	-8	0.2	3.0
-20	-4	0.3	4.7
-18	0	0.4	6.7
-16	3	0.6	8.2
-14	7	0.7	10.4
-12	10	0.9	12.1
-10	14	1.0	14.6
-8	18	1.2	17.2
-6	21	1.3	19.3
-4	25	1.5	22.3
-2	28	1.7	24.7
0	32	1.9	28.0
2	36	2.1	31.5
4	39	2.4	34.3
6	43	2.6	38.3
8	46	2.9	41.6
10	50	3.2	45.7
12	54	3.4	50.4
14	57	3.7	54.0
16	61	4.1	59.1
18	64	4.4	63.1
20	68	4.7	68.7
22	72	5.1	74.6
24	75	5.5	79.3
26	79	5.9	85.7
28	82	6.3	90.8
30	86	6.7	97.8
32	90	7.2	105.2
34	93	7.7	110.9
36	97	8.2	118.9
38	100	8.7	125.2
40	104	9.2	133.9
42	108	9.8	142.9
44	111	10.4	150.0
46	115	11.0	159.7
48	118	11.6	167.3
50	122	12.3	177.8
52	126	12.9	188.8
54	129	13.6	197.3
56	133	14.4	209.0
58	136	15.1	218.1
60	140	15.9	230.7
62	144	16.7	243.7
64	147	17.5	253.8
66	151	18.4	267.7
68	154	19.3	278.4
70	158	20.2	293.2
72	162	21.2	308.5
74	165	22.1	320.3
76	169	23.2	336.6
78	172	24.2	349.1
80	176	25.3	366.4

24.9 Pressure - temperature table for R513A

Temp [°C]	Temp [°F]	Pressure [Barg]	Pressure [Psig]
-40	-40	-0.4	-5.6
-38	-36	-0.3	-4.6
-36	-33	-0.3	-3.7
-34	-29	-0.2	-2.5
-32	-26	-0.1	-1.6
-30	-22	0.0	-0.2
-28	-18	0.1	1.3
-26	-15	0.2	2.5
-24	-11	0.3	4.2
-22	-8	0.4	5.5
-20	-4	0.5	7.5
-18	0	0.6	9.6
-16	3	0.8	11.2
-14	7	0.9	13.6
-12	10	1.1	15.4
-10	14	1.2	18.1
-8	18	1.4	20.9
-6	21	1.6	23.2
-4	25	1.8	26.3
-2	28	2.0	28.8
0	32	2.2	32.3
2	36	2.5	36.1
4	39	2.7	39.0
6	43	3.0	43.2
8	46	3.2	46.4
10	50	3.5	51.0
12	54	3.8	55.8
14	57	4.1	59.6
16	61	4.5	64.9
18	64	4.8	69.0
20	68	5.2	74.8
22	72	5.5	80.9
24	75	5.9	85.6
26	79	6.3	92.2
28	82	6.8	97.4
30	86	7.2	104.6
32	90	7.7	112.1
34	93	8.2	118.0
36	97	8.7	126.1
38	100	9.2	132.4
40	104	9.7	141.2
42	108	10.3	150.4
44	111	10.9	157.5
46	115	11.5	167.3
48	118	12.1	174.9
50	122	12.8	185.5
52	126	13.5	196.4
54	129	14.2	205.0
56	133	14.9	216.7
58	136	15.6	225.7
60	140	16.4	238.2
62	144	17.2	251.2
64	147	18.1	261.2
66	151	18.9	275.0
68	154	19.8	285.7
70	158	20.7	300.3
72	162	21.6	315.4
74	165	22.6	327.1
76	169	23.6	343.1
78	172	24.6	355.5
80	176	25.7	372.4

24.10 Pressure – temperature table for R473A*

Temp [°C]	Temp [°F]	Pressure (liquid)** [Barg]	Pressure (liquid)** [Psig]	Pressure (vapour)*** [Barg]	Pressure (vapour)*** [Psig]
-80	-112	0.6	8.7	0.4	6.4
-78	-108	0.8	11.7	0.6	8.8
-76	-105	1.0	14.0	0.7	10.7
-74	-101	1.2	17.5	0.9	13.4
-72	-98	1.4	20.3	1.1	15.6
-70	-94	1.7	24.3	1.3	18.8
-68	-90	1.9	28.7	1.5	22.3
-66	-87	2.2	32.2	1.7	25.1
-64	-83	2.6	37.2	2.0	29.2
-62	-80	2.9	41.3	2.3	32.5
-60	-76	3.2	47.1	2.6	37.1
-58	-72	3.6	53.3	2.9	42.2
-56	-69	4.0	58.3	3.2	46.3
-54	-65	4.5	65.4	3.6	52.1
-52	-62	4.9	71.0	4.0	56.8
-50	-58	5.4	79.0	4.4	63.5
-48	-54	6.0	87.5	4.8	70.7
-46	-51	6.5	94.3	5.3	76.4
-44	-47	7.1	103.8	5.8	84.6
-42	-44	7.8	111.4	6.3	91.2
-40	-40	8.4	122.1	6.9	100.5
-38	-36	9.1	133.4	7.5	110.5
-36	-33	9.9	142.3	8.2	118.5
-34	-29	10.6	154.8	8.9	129.8
-32	-26	11.4	164.7	9.7	138.8
-30	-22	12.3	178.5	10.4	151.5
-28	-18	13.2	193.1	11.3	165.1
-26	-15	14.2	204.5	12.2	175.9
-24	-11	15.1	220.5	13.1	191.2
-22	-8	16.2	233.0	14.1	203.3
-20	-4	17.3	241.7	15.2	220.4
-18	0	18.4	268.8	16.3	238.6
-16	3	19.6	283.1	17.5	253.1
-14	7	20.8	303.0	18.8	273.4
-12	10	22.1	318.6	20.1	289.4
-10	14	23.5	340.2	21.5	312.0
-8	18	24.8	362.7	23.0	335.9

-6	21	26.3	380.3	24.6	354.8
-4	25	27.8	404.6	26.2	381.4
-2	28	29.4	423.5	27.9	402.3
0	32	31.0	449.6	29.8	431.6
2	36	32.7	476.8	31.7	462.6
4	39	34.4	497.9	33.7	487.0
6	43	36.2	527.0	35.8	521.2
8	46	38.1	549.6	38.0	548.1
10	50	40.0	580.7	40.4	585.6
12	54	42.0	613.0	42.8	625.2
14	57	44.1	638.0	45.4	656.3
16	61	46.2	672.4	48.1	699.7
18	64	48.4	698.9	50.9	733.8
20	68	50.7	735.4	53.9	781.2
22	72	53.0	773.2	57.0	831.2
24	75	55.5	802.3	60.2	870.3
26	79	57.9	842.3	63.6	924.7
28	82	60.5	873.1	67.1	967.3

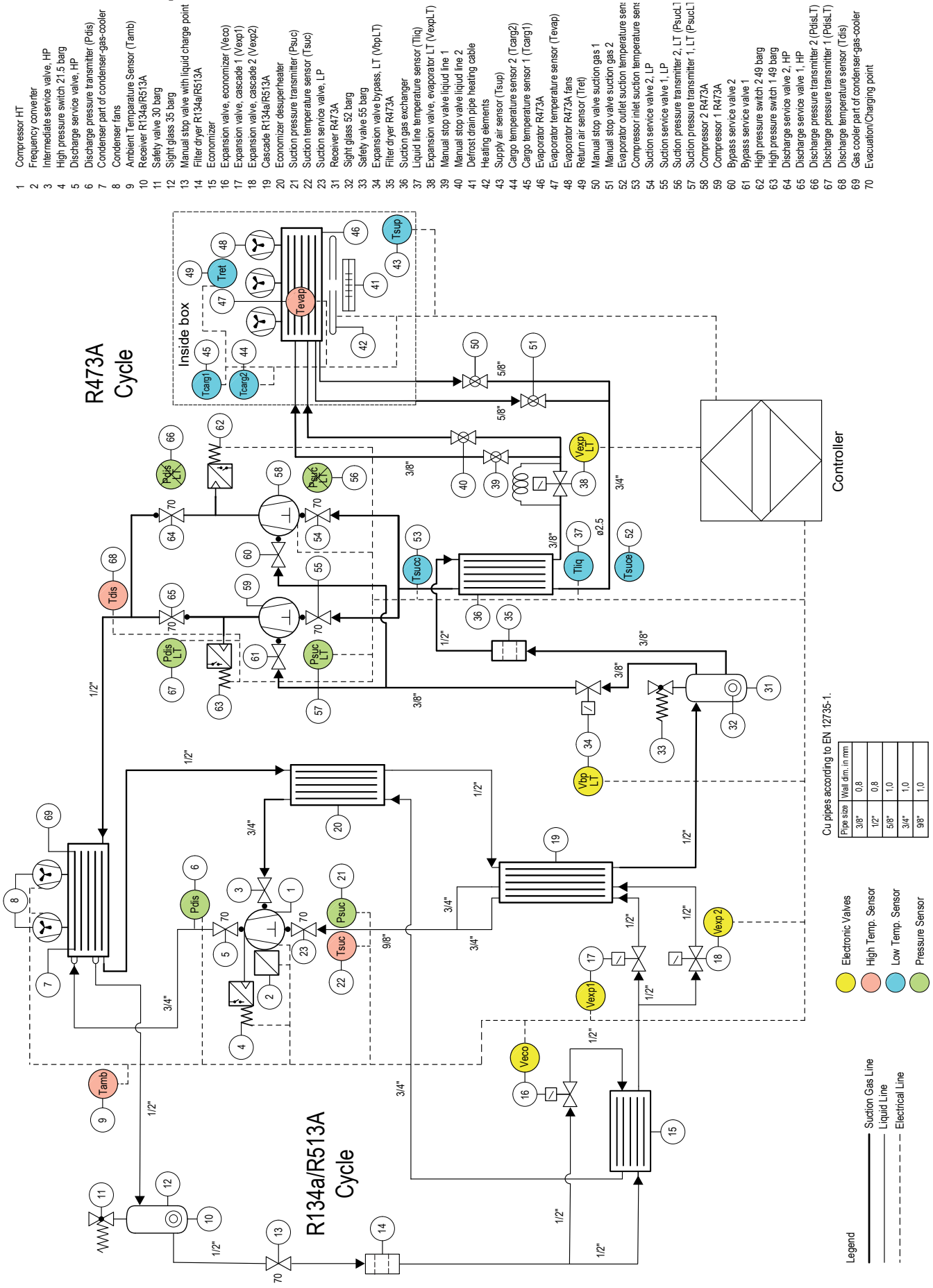
* For R473A refrigerant the critical temperature is 29.7°C (85.46°F). Above this value the refrigerant can only exist as gas and a formula to correlate the refrigerant pressure to its saturation temperature cannot be established.
** and *** The R473A refrigerant is an azeotropic refrigerant meaning that it does not have a fixed boiling/condensing temperature at a fixed pressure. The liquid and gas phases will have different pressures at a constant temperature.

24.11 Tightening torques

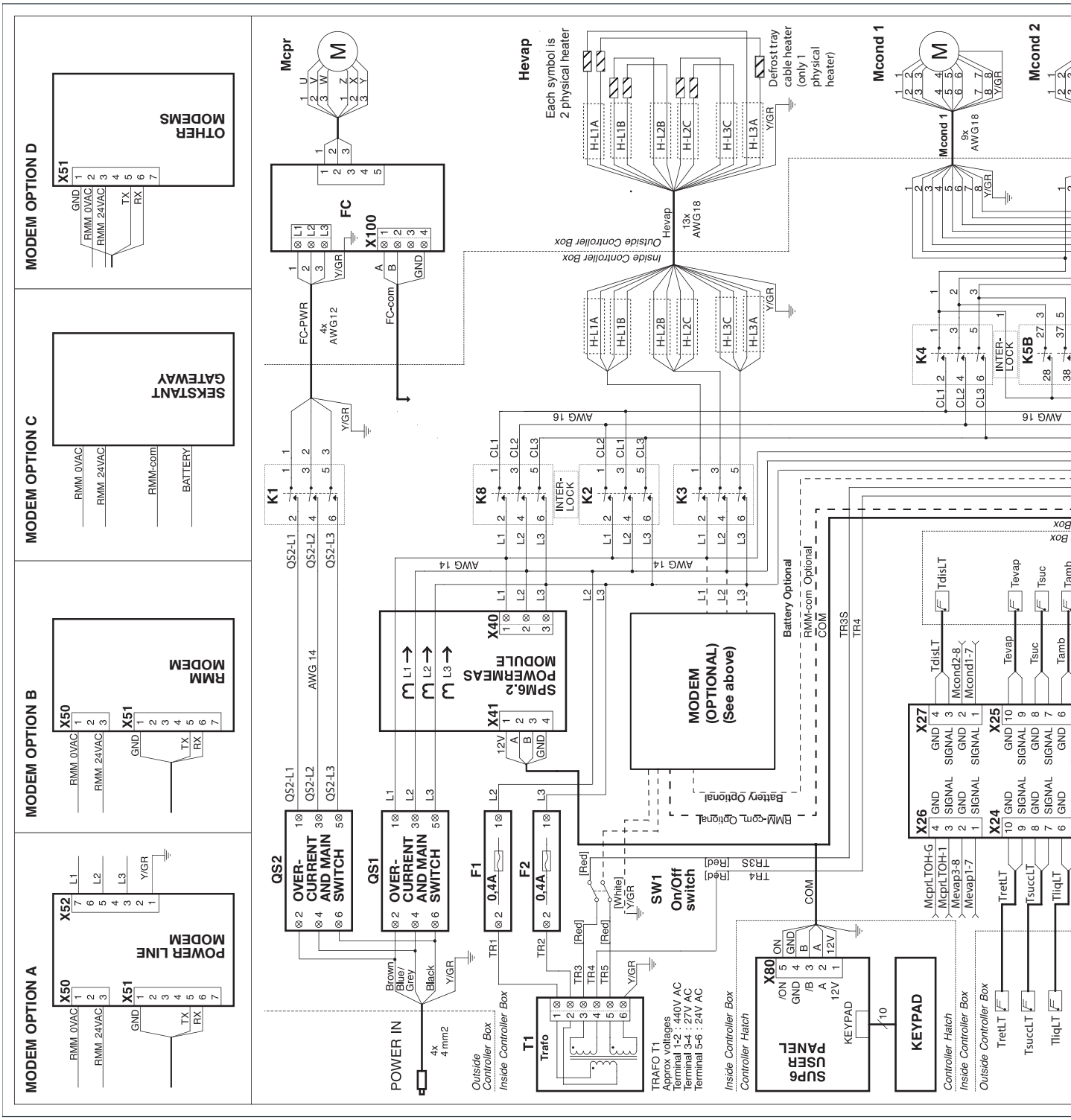
Description	Type	Torque [Nm] ± 5%
General		
Hex Head Bolt + Nut, M5		4,5
Hex Head Bolt + Nut, M6		5,5
Hex Head Bolt + Nut, M8		10
Hex Head Bolt + Nut, M10		25
Hex Socket Counters. Head Bolt, M6		5,5
Hex Socket Counters. Head Bolt, M8		10
Flare Nut ½", Brass	Hex Head	35
Schräder Valve, 1/8"	Hex Head	24
Cable Gland, M12	Lock Nut	1,5
	Cap Nut	1
Cable Gland, M16	Gland	3,5
	Cap Nut	2
Cable Gland, M20	Gland	4
	Lock Nut	4
	Cap Nut	2
Cable Gland, M25	Lock Nut	6
	Cap Nut	4
Fresh Air Module		
Air Exchange Potentiometer	Slotted Cheese Head Screw, M3	0,8
Damper for Fresh Air	Hex Head/Phillips Recess, M6	2
Insect net and AirEx motor	Screw, ø4.0x16	0,8
AirEx potentiometer	Screw, ø4.0x25	1,5
Frequency Converter (FC)		
FC Mounting	Hex Socket Counters. Head Bolt, M6	9
	Threaded bushing, sq. 8 mm	10
FC Terminal Connector 'MOTOR'/'MAINS'	Slotted Cheese Head Screw, M4	1,3
FC Earth Wire	Hex Socket Counters. Head Bolt, M4	1,8
FC Connection Box Cover	Hex Socket Counters. Head Bolt, M5	4,5
Compressor		
Cylinder Head	Hex Head, M10	70
Bearing Cover	Hex Socket Counters. Head Bolt, M10	70
Oil Pump Cover	Hex Head Bolt, M8	10
Oil Filter Plug	Hex Socket	70 (ver.1), 23.5 (ver.2)
Sight Glass	Hex Head	60
Terminal Block	Hex Socket Counters. Head Bolt, M6	14
Pressure Transmitter, AKS	Hex Head	15
Pressure Transmitter, NSK	Hex Head	15
High Pressure Switch	Hex Head	15
Receiver		
Water Outlet Coupling, Female (brass/alu)		50
Water Inlet Coupling, Male (brass/alu)	Hex Head	50
Sight Glass	Hex Head	60
Melt Fuse Valve	Hex Head	65
Valves		
Suction Gas Valve	Hex Head Bolt, M10	54
Suction Gas Valve Flange	Hex Socket Counters. Head Bolt, M10	54
Discharge- and Intermediate Valve	Hex Head Bolt, M8	30
Evacuation Valve	Hex Head	18
Unit Backside		
Evaporator Cover Panels	Hex Lobular Tapping Screw, ø4.8	5
Sensors		
Humidity Sensor, O_2 Sensor and CO_2 Sensor	Hex Lobular Tapping Screw, ø4.8	3

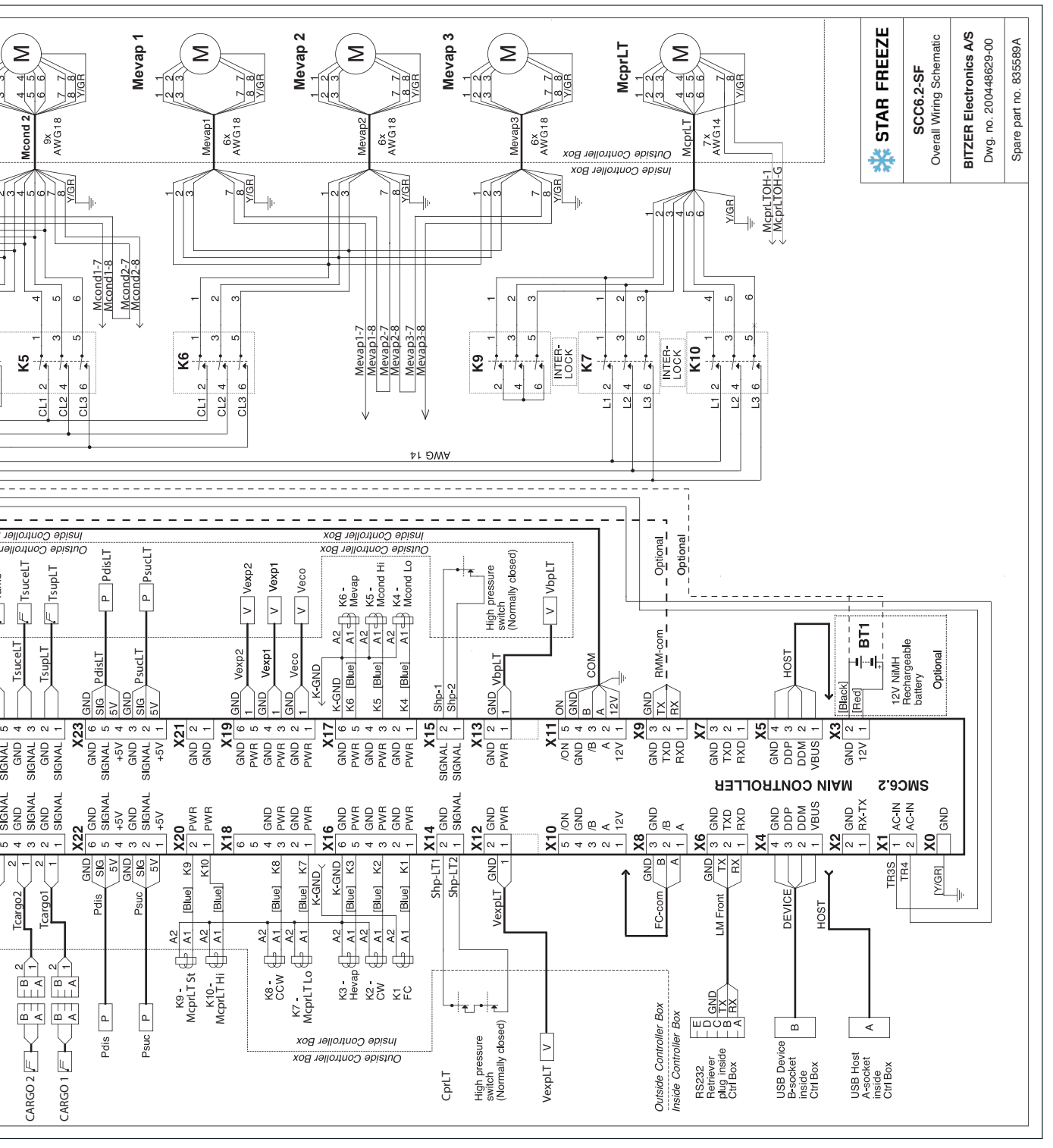
25. Diagrams

25.1 P & I diagram

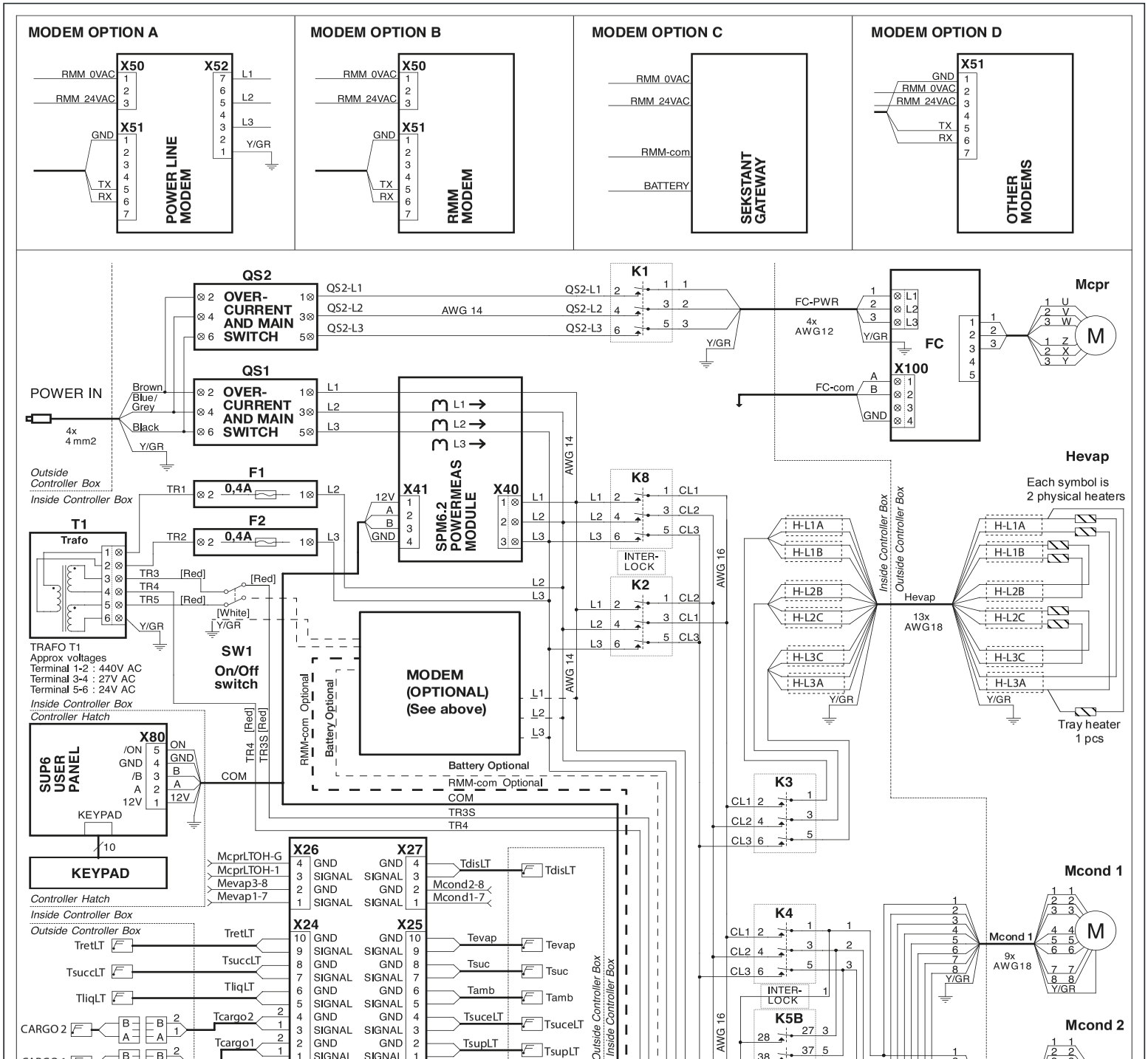


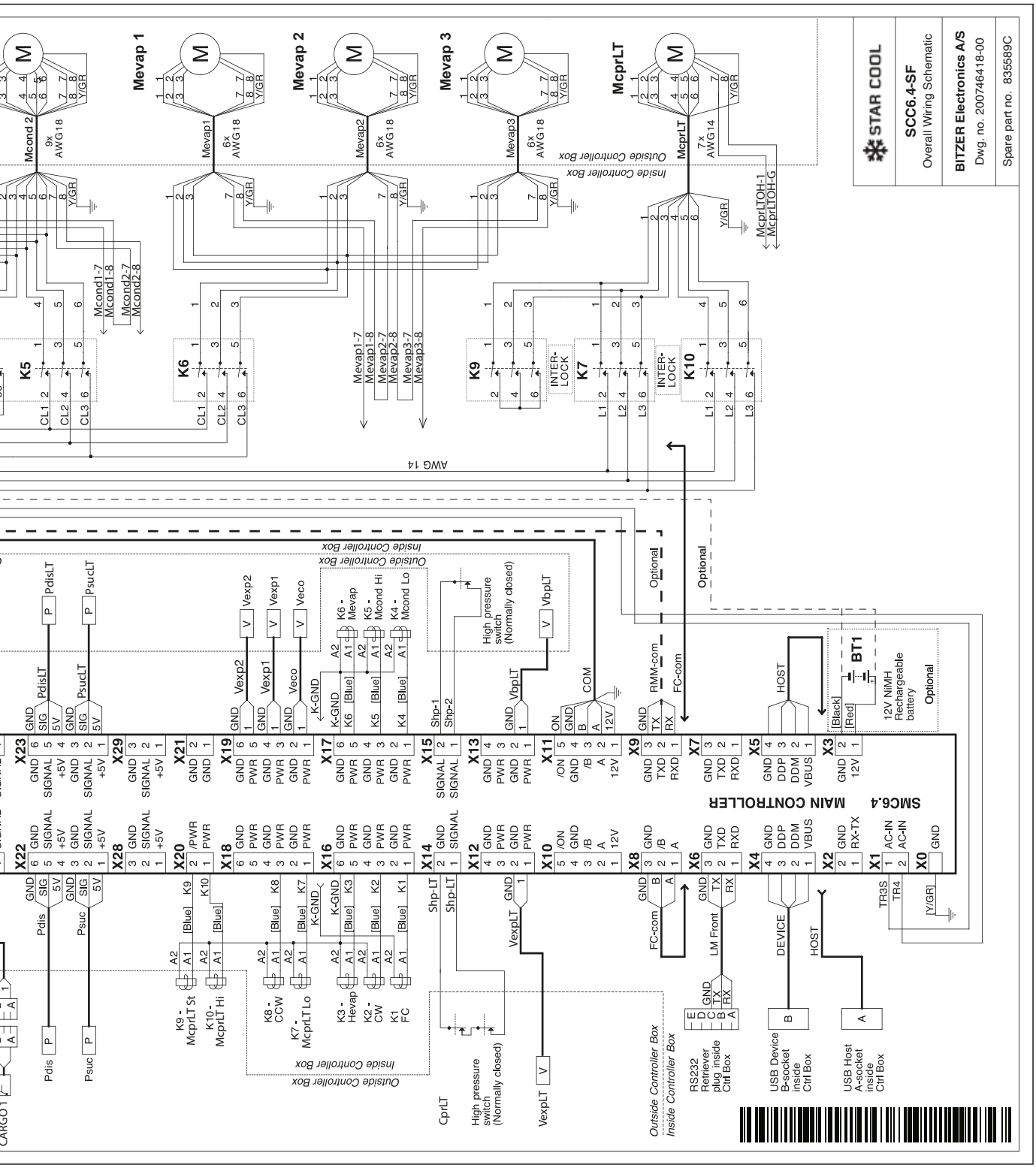
26. Overall wiring schematic - CIM 6.2-SF




STAR FREEZE
SCC6.2-SF
Overall Wiring Schematic
BITZER Electronics A/S
Dwg. no. 200448629-00
Spare part no. 835589A
SMC6.2 MAIN CONTROLLER
Mevap 1
Mevap 2
Mevap 3
McprLT
Mcond 2
Outside Controller Box
Inside Controller Box
AWG 14
K5
K6
K9
K7
K10
INTER-LOCK
CL1
CL2
CL3
L1
L2
L3
Mcond1-7
Mcond1-8
Mcond2-7
Mcond2-8
Mevap1-7
Mevap1-8
Mevap2-7
Mevap2-8
Mevap3-7
Mevap3-8
McprLTOH-1
McprLTOH-G
Y/GR
9x AWG18
6x AWG18
7x AWG14
Optional
BT1
12V NiMH Rechargeable battery
[Black]
[Red]
HOST
RMM-com
COM
ON
GND
B
A
12V
TX
RX
TXD
RXD
DDP
DDM
VBUS
RX-TX
AC-IN
TR3S
TR4
Y/GR
Tcargo2
Tcargo1
CARGO 2
CARGO 1
Pdis
Psuc
TsuceLT
TsupLT
PdisLT
PsucLT
Vexp2
Vexp1
Veco
K-GND
K9 - McprLT St
K10 - McprLT Hi
K8 - CCW
K7 - McprLT Lo
K3 - Mevap
K2 - CW
K1 FC
K6 - Mevap
K5 - Mcond Hi
K4 - Mcond Lo
Shp-1
Shp-2
Shp-LT1
Shp-LT2
High pressure switch (Normally closed)
VbpLT
VexpLT
CprLT
FC-com
LM Front
RS232 Retriever plug inside Ctrl Box
DEVICE
USB Device B-socket inside Ctrl Box
USB Host A-socket inside Ctrl Box
X0
X1
X2
X3
X4
X5
X6
X7
X8
X9
X10
X11
X12
X13
X14
X15
X16
X17
X18
X19
X20
X21
X22
X23

Overall wiring schematic - CIM 6.4-SF




STAR COOL
SCC6.4-SF
Overall Wiring Schematic
BITZER Electronics A/S
Dwg. no. 200746418-00
Spare part no. 835589C
SMC6.4 MAIN CONTROLLER
Mevap 1
Mevap 2
Mevap 3
MCprLT
Mcond 2
Inside Controller Box
Outside Controller Box
AWG 14
Optional
HOST
DEVICE
BT1
12V NiMH Rechargeable battery
USB Device B-socket inside Ctrl Box
USB Host A-socket inside Ctrl Box
RS232 Retriever plug inside Ctrl Box
LM Front
FC-com
RMM-com
CprLT
VexpLT
High pressure switch (Normally closed)
Pdis
Psuc

27. Declaration of Conformity

MAERSK
CONTAINER INDUSTRY

EC DECLARATION OF CONFORMITY

2006/42/EC Annex II A

Manufacturer and compiler of the technical file:

Name	**Maersk Container Industry AS**
Address	**Bjerndrupvej 47**
Postal code and city	**6360 Tinglev**

Declares herby that machine type:

- **Star freeze refrigeration equipment* Model SFI-40**

Is produced in accordance with the following EU directives:

- 2006/42/EC Machinery Directive
- 2014/30/EU EMC Directive
- 2014/68/EU Pressure Equipment Directive
- 2014/35/EU Low Voltage Directive

with the employment of the following harmonized standard:

- EN 378-2:2016 Refrigerating systems and heat pumps. Safety and environmental requirements. Design, construction, testing, marking and documentation

* The declaration does only cover the refrigeration system, and not the container.

Signatory	Occupation	Place	Date
M. [illegible]	General Manager	Tinglev	28-11-2024

Star Cool Service

The app

For troube shooting help, manuals, alarm codes and more, download our free Star Cool Service app by simply scanning the QR code with your smart device.

See more at **apps.starcool.com**

Training

Our expert service team offer a variety of comprehensive seminars and hands-on instruction all around the world. From basic knowledge to advanced trouble shooting, we tailor courses to meet your needs.

Also, our online e-learning portal provides interactive modules, videos, and quizzes.

Contact us at **training@starcool.com**

Spare parts

By using only genuine Star Cool spare parts and consumables, you ensure a long and reliable life time of your reefer machines.

Purchase parts quickly and reliably on our website and choose the preferred delivery option to suit you.

Ordering support at **sales@starcool.com**

Bjerndrupvej 47,
6360 Tinglev, Denmark
Phone: +45 73 64 34 00
Fax: +45 73 64 35 69
E-mail: starcool@starcool.

24-hour hotline support

Call us on +45 73 64 35 00 or send an e-mail to service@starcool.com. Our service department is available 24 hours a day, 7 days a week - providing easy access to the answers you need.

Version 810908A April 2026