Operating and Service Manual
Star Cool Refrigeration Unit

Model SCI-20/40/CA and SCU-20/40

Version 810900E June 2019

STAR COOL MAERSK CONTAINER INDUSTRY

1. Preface

This version of the manual is dated June 2019, edited by Maersk Container Industry AS.

This user's manual is valid for software version 0356 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	SCI - 20/40/CA and SCU - 20/40
Software version	0356

2. Warnings

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 R134a or R513A and ester oil BSE 55. Do not use any other refrigerant or oil. Do not use contaminated refrigerant or oil. Never release any refrigerant into the atmosphere. Use recovery equipment according to present legislation.

During maintenance, please observe 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.

Please note that some unit models do not have Schräder valves installed for Psuc and Pdis 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.

Do not enter the container, including opening the service hatches, when the oxygen level is below 20.9%. Ventilation is necessary before entering, either for repairing the unit or unloading. Stay away from doors while venting.

Human response to low oxygen atmosphere:

Oxygen content of air	Symptoms of a person exposed
20.9%	Level in ambient air - no effect.
15% - 19%	May impair coordination and induce early symptoms in persons who have coronary, pulmonary, or circulatory problems.
12% - 15%	Respiration and pulse increase, impaired coordination, poor perception and judgement.
10% - 12%	Respiration increases further in rate and depth, poor judgement, and bluish lips.
8% - 10%	Mental failure, fainting, unconsciousness, an ash-coloured face, blue lips, nausea, and vomiting.
6% - 8%	8 minutes - 100% fatal, 4-5 minutes - recovery with treatment.
4% - 6%	Coma within 40 seconds, convulsions, respiration ceases, death.

3. Contents

4. Legend

Short name	Name
AAS	Alarm Action System
Act	Actual
ACT	Automatic Cold Treatment
AirEx	Air exchange
AKS	Danfoss pressure transmitter
AL	Alarm
Atm	Atmosphere
AV	Automatic Ventilation
CA	Controlled Atmosphere
CalUs1	Calibration USDA sensor 1
CalUs2	Calibration USDA sensor 2
CalUs3	Calibration USDA sensor 3
CapReq	Requested capacity
Com	Communication
Cond	Condenser
Cpr	Compressor
CT	Cold treatment
Cur	Current
Err	Error
Evap	Evaporator
F	Frequency
Fact	Compressor actual frequency
FC	Frequency converter
Fcpr	Compressor frequency
FcprAct	Compressor frequency actual
FcprReq	Compressor frequency requested
Fpower	Power supply frequency converter
FT	Function test
FW	Firmware
H	Heater
Hevap	Evaporator heater
HP	High pressure
HPS	High pressure switch
Hpump	Vacuum pump motor heating element
I	Current
I1	Current phase 1
I2	Current phase 2
I3	Current phase 3
Ifc	Current in AC compressor motor
Init	Initialization
ITI	Intelligent Trip Inspection
LED	Light emitting diode
LP	Low pressure
M	Motor
Mcond	Condenser motor
Mcpr	Compressor motor

Short name	Name
Mevap	Evaporator motor
Mevap1	Evaporator motor 1
Mevap2	Evaporator motor 2
MOP	Maximum operating pressure
Mpump	Vacuum pump motor
MTS	Multi Temperature Setpoints program
NSK/DST	Saigonomya/DST P100 pressure transmitter
OH	Overheat
P	Pressure
PCB	Printed circuit board
Pdis	Discharge pressure
Pmem	Pressure membrane
Psuc	Suction pressure
PTI	Pre Trip Inspection
PTI Short	Pre Trip Inspection Short
Ptot	Power total
PWM	Pulse Width Modulation
Pwr	Power
Req	Requested
RH	Relative humidity
RHset	Relative humidity setpoint
RMM	Remote Monitoring Modem
S	Switch contact key
SC	Star Cool
Set	Setpoint
SH	Superheat
Shp	High pressure switch
Sup	Supply
T	Temperature
Tact	Actual temperature
Tamb	Ambient temperature
TC	Calculated condenser temperature
Tcargo	Cargo temperature
TCmin	Temperature condensor minimum
Tevap	Evaporator temperature
Tfc	Frequency converter temperature
Tint	Tinternal (controller board)
T0	Calculated suction temperature
Tret	Return air temperature
Tset	Temperature setpoint
Tsuc	Suction temperature
Tsup	Supply air temperature average
Tsup1	Supply air temperature 1
Tsup2	Supply air temperature 2
Tusda1	USDA 1 temperature

Short name	Name
Tusda2	USDA 2 temperature
Tusda3	USDA 3 temperature
Ubat	Battery voltage
Udc	DC voltage in frequency converter
U/f	Voltage/frequency ratio
V	Valve
Veco	Economizer valve
Vexp	Expansion valve
Vhg	Hot gas valve

5. General description

The ❄ STAR COOL units, models SCU-40 and SCI-40 are electric powered picture frames, cooling and heating units operating on refrigerant R134a or R513A.
The unit is designed to maintain cargo temperatures in a range from -30°C (-22°F) to +30°C (+86°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 aluminium, 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
- Condenser/compressor module
- Evaporator module
- Evaporator fan module

The cooling system of the unit is equipped with a two–stage compressor, electrically driven through a frequency converter.

The cooling system is also equipped with an economizer, which performs the task of sub-cooling the liquid from receiver to evaporator, thereby increasing the cooling capacity of the cooling unit. The evaporator and economizer are controlled by electronic expansion valves.

The equipment is designed to operate on a nominal 410/450 V AC, 3 phase, 50/60 Hz, primary power source, according to ISO 1496-2. An integrated dual winding transformer supplies the control circuit voltage. One winding for 24 V AC (for RMM modem supply) and another for 26 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.

An optional water-cooled condenser is mounted in series with the air-cooled condenser. This water-cooled condenser allows operation of unit below deck, where no air ventilation is possible, provided that water connections are present.

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 a dehumidification function controlled by the electronic controller of the unit. The humidity setpoint can be set in the range from 95 – 65% RH (or 50 % with closed ventilation). The unit can control to the lowest level. The dehumidification function is active as long as the temperature control is in setpoint range. The unit is equipped with heating elements, mounted under the evaporator coil, for the dehumidification. The dehumidification system is also active in Economy mode.

The unit is equipped with a dual system for defrosting. The refrigeration system has a hot gas valve installed, for hot gas defrosting of the evaporator coil. Furthermore, the heating elements mounted under the evaporator coil, are energized during defrost. This dual system for defrosting ensures a fast defrost sequence and thereby only a very small input of heat to the container. The dual system for defrost also ensures an even distribution of heat to the evaporator coil. The result of this is that there is no build up of ice in corners or other places of the evaporator coil. The two defrost systems, hot gas and heating elements, are independent. This ensures a defrost sequence to be carried out at any time. A demand defrost system is integrated in the software ensuring that the evaporator coil will not ice up.

The unit is controlled by an electronic controller manufactured by Lodam Electronics, controlling the supply temperature probe in Chilled mode (temperature setting above or equal to -5°C (+23°F) and the return temperature in Frozen mode (temperature setting below -5°C (+23°F). Controller accuracy is ±0.25°C (±0.45°F). The unit can operate the evaporator fans in low speed and high speed.

From the controller display, Normal or Economy mode can be selected under the Operation menu. In Economy mode the fans always run on low speed. In Normal mode the fan speed can run in high or low speed depending on running conditions.

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. The logging of the USDA sensors (3 pieces) and the cargo sensor is done with an interval of one hour according to USDA requirements. With a logging interval of one hour, there is storage capacity for 365 days of temperature loggings. Datalogger accuracy is ±0.25°C (±0.45°F). The datalog can be retrieved with a PC–system Starview and Psion Logman, 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. For CIM 6, the battery is rechargeable. For CIM 5, the battery is not rechargeable.

The controller is optimized for communication with Remote Monitoring Equipment, according to ISO standard 10368. Events, alarms, and datalogs can be retrieved by various download tools such as Refcon, Logman, StarView etc.

6. Function description

6.1 Start-up procedure

The start-up procedure has 5 modes:

1. Initialize: Self check controller.
2. Stabilize: The evaporator fan operates at high speed to ensure that temperature sensors are at current temperature.
3. Crank case heating: If Tamb is lower than 2°C (36°F) heat is applied until Tfc is above 12°C (54°F).
4. Ramp up.
5. Terminate: Switching to normal temperature and valve regulation.

6.2 Temperature control

This function incorporates the container temperature controller.

The function has 2 modes:

1. Chill
   If Tset more than -5°C (+23°F) Chill mode is activated.
   If Standard Tact = Tsup if cooling need, and Tact = Tret if heating is needed.
2. Frozen
   If Tset is less than or equal to -5°C (+23°F) Frozen mode is activated and Tact = Tret.

The value of the Tset limit is dependent on the software version.

The temperature control is set to Cool Down or Heat Up mode depending on Tact being above or below Tset. As long as the temperature is not within Tset ± ranges, the function remains in Cool Down or Heat Up mode. If the temperature is within range, the green IN-RANGE indicator light starts flashing. When the temperature has been within Tset ± 1,5°C ranges for 30 min. 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 start flashing. After 4 hours in out-of-range condition, an in-range alarm is set. On the basis of Tact and Tset the function calculates the requested capacity (CapReq) value by means of a Micro controller. CapReq is the desired chilling/heating capacity. CapReq value can range from –100% to +100%. –100% being maximum cooling and +100% being maximum heating.

Chill mode

Defect sensor(s)	Substitution sensor/Action	Alarm
Tsup1 (2)	Tact = Tsup2 (1)	
Tsup1 and Tsup2	Tact = Tret + constant	611, Too many sensor err
Tsup1, Tsup2, and Tret	Tact = Tevap + constant	
Tsup1, Tsup2, Tret, and Tevap	**	600, No control sensor

Frozen mode

Defective sensor(s)	Substitution sensor/Action	Alarm
Tret	Tact = Tevap + constant	
Tret and Tevap	Tact = Tsup1 + constant	611, Too many sensor err
Tret, Tevap, and Tsup1	Tact = Tsup2 + constant	
Tret, Tevap, Tsup1, and Tsup2	**	600, No control sensor

** = No more available sensors for substitution.

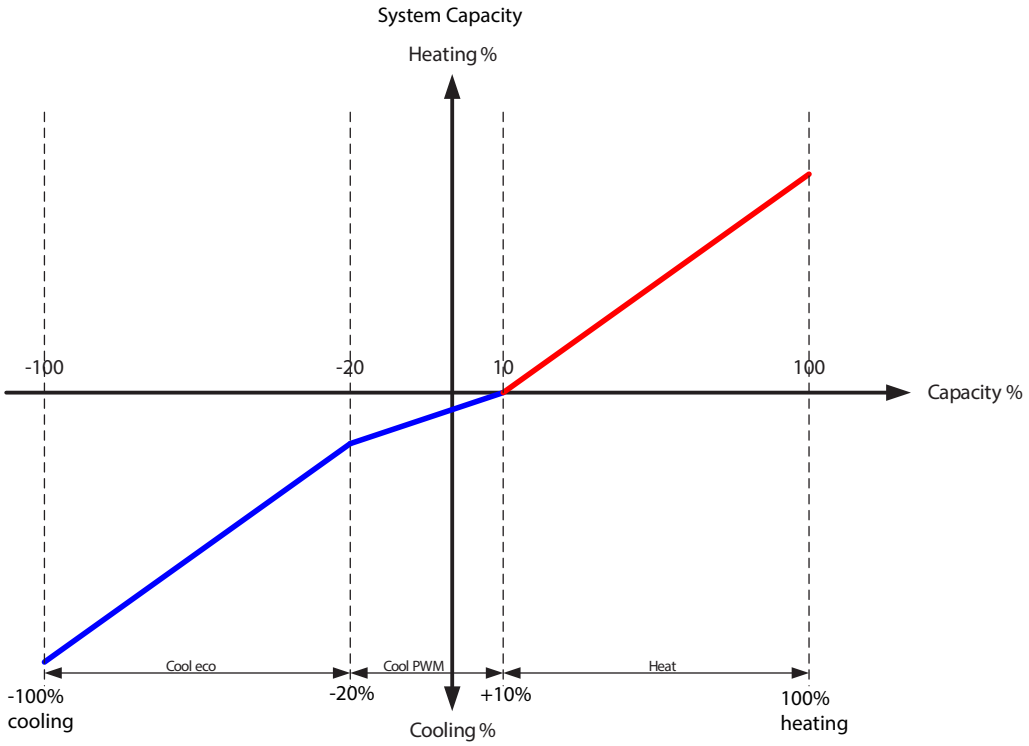
6.3 Capacity control and limiter

On the basis of requested capacity, this function determines operation mode and actions of the individual system components (compressor, valves, heating elements) and ensures that compressor minimum off time is observed. This function has 5 gears (modes). On the basis of requested capacity, the gear is determined. Compressor frequency is directly dependent upon current mode. Evaporator heater, on the other hand, is gear independent. There is overlap over the modes to maintain slow mode shifting.

Gear	Function
Off	Everything is turned off.
Start up	If cooling is required, the FC is starting at default frequency before shifting to correct cooling mode.
PWM	On/Off regulation of compressor.
CoolEco	Maximum cooling capacity with use of economizer.
Heat	Only the heaters are used.
Defrost	Heaters are always used and hot gas valve is used if ambient temperature is above 5°C (41°F).

The capacity of the unit is controlled between maximum cooling capacity (-100% capacity) and maximum heating capacity (+100% capacity). This is done by regulation of the compressor speed by means of the FC or on/off regulation. In maximum capacity (+100% capacity) the unit uses the heating elements, by means of Pulse Width Modulation, to control the capacity.

The below figure indicates the ranges for the capacity and compressor speed (frequency).



If there is a limiter active on the unit then the compressor speed will be slower and the unit will operate with reduced capacity. 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 ⓘ, line I40 (I40).

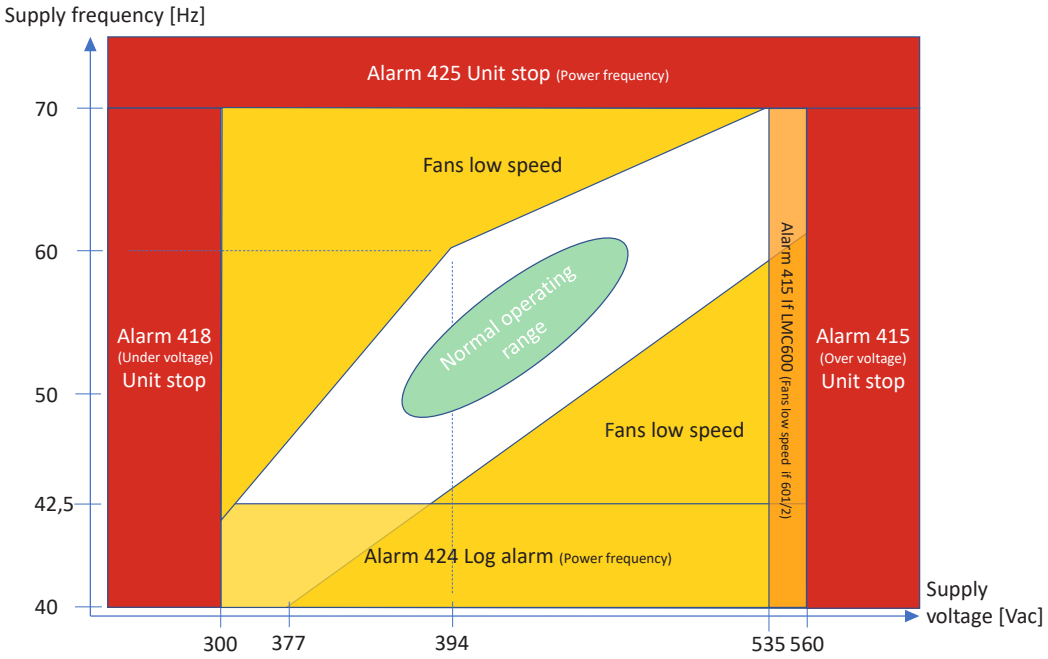
Limiter types:

- **TC**, limits the maximum condenser pressure (and temperature) and is typically active during pull down. If the unit is lacking capacity compared to other Star Cool units, clean the condenser coil, check Pdis, and check CFM 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 Cool units, see AL 511 for trouble shooting and check the 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 Cool units, see AL 517 for trouble shooting.
- **T0**, ensures a minimum evaporator pressure and is rarely active. If this limiter is active for more than 2 minutes, check the refrigerant level (undercharged), check Psuc and Tsuc, check Vexp and LP valve plate.

There can be multiple limiters activate simultaneously. The most critical limiter will be shown. The largest of the factors is used as the active limiter. If the limiter factor is higher than the requested capacity change, the capacity is actually reduced instead of increased. If, for example, the ambient temperature is very high, the requested capacity may increase the FC temperature over its limits and so the limiter will reduce the capacity until a safe and stable operation condition for the FC has been reached.

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 valve

This function ensures optimum evaporator superheat (SH) and calculates the percentage of opening (SHVod) and controls the valve. This function is active during compressor operation. The valve is closed during compressor turn off. The expansion valve function includes the following three sub-functions:

1. MSS (Minimum Stable Superheat search)
   This function searches for minimum stable superheat within the ranges SHmin and SHmax.
   SHact: = Tsuc - T0 (Psuc)
2. Superheating
   Function output is the expansion valve opening rate (Vexp). At start-up the opening rate is 0%. The electronic expansion valve is an on/off valve controlled on the basis of opening rate with a constant cycle time.
3. MOP (Maximum Operating Pressure)
   The MOP function prevents the suction pressure from getting too high.

Defective sensor(s)	Substitution sensor/Action	Alarm
Psuc	Emergency injection	611, Too many sensor err
Tsuc	Emergency injection	611, Too many sensor err

6.6 Economizer valve

This function ensures optimum sub cooling of liquid to the evaporator and cooling of the FC. In addition, the cooling capacity is increased and compressed gas temperature is reduced. Function output is the economizer valve opening rate (Veco).

The economizer control has two modes:

1. Superheat control
   Valve opening rate control is based on calculations.
2. FC cooling
   This function is active during compressor operation.

6.7 Dehumidification

The dehumidification function dehumidifies air in the container by means of a heater. This function can only be activated if the temperature control function is active. Dehumidification is achieved by decreasing evaporator surface temperature. This is done through activation of the heater and letting the temperature control increase cooling capacity resulting in an evaporator temperature descending.

This function has 3 modes:

1. Off
   The dehumidification function is in the OFF position.
2. Active
   The heater (Hevap) is activated when RH is more than RHSet and deactivated when RH is less than RHSet – 3 [%]. The humidity setpoint can be set in the range 50% to 95% relative humidity. The range 50% to 64% is only possible with no fresh air/evaporator ventilation in low speed. The range 65% - 95% is possible to run with fresh air/evaporator ventilation in high speed.
3. Override
   Accessing override mode if:
   - Cooling demand exceeds 80% capacity
   - Large demand for heating
   - PTI
   - A fatal alarm is active
   - When operating without FC
   - Manual operation is active
   - Defrosting

Dehumidification function	
	Off
	Enabled
	Active

Other comments
The dehumidification icon is shown in the display even if override is active.
The heat icon follows the current state of the heater.

If dehumidification is active:

Defective sensor(s)	Substitution sensor/Action	Alarm
RH	Stop dehumidification	614, Humidity deactivated

6.8 Condenser fan

Condenser fan control will reduce condenser pressure through condenser ventilation. The condenser pressure control also monitors the compressor outlet pressure in case of water-cooling. This function is activated when control is being in the automatic mode.

Condenser pressure control has two primary modes:

1. Air-cooled
   In Air-cooled mode ventilation takes place in the following way:
   Depending on the compressor outlet pressure, the fan is Off or runs in 2 different speeds: High and Low.
   The fan runs in 4 modes: Off, Low-speed, High-speed and a cycle shifting between high and low-speed in two minutes intervals.
   If Tamb is more than 48°C (118°F) or the compressor outlet pressure remains constantly high, the condenser fan constantly runs at high speed.
2. Water-cooled
   If the condenser fan is constantly on for more than 1 hour, an alarm will be given.
   The fan runs in 4 modes: Off, Low-speed, High-speed and a cycles shifting between high and low-speed in two minutes intervals.

Defective sensor(s)	Substitution sensor/Action	Alarm
Pdis	Start up: Condenser fan speed = slow Chill/Frozen mode: Condenser fan speed depends on ambient temperature.	203, Pdis invalid
Tamb	Tamb = Tinternal	129, Tamb invalid
Tret, Tevap and Tsup1	Tact = Tsup2 + constant	102/123/105, Tret/Tevap/Tsup 1 invalid
Tamb and Tinternal	Tc min	129, Tamb invalid

6.9 Evaporator fan

The evaporator fan function ensures correct fan speed (high or low). The function is active in the automatic mode.

This function has 2 modes:

1. Normal
   Low speed in Frozen mode or if the following three conditions are set:
   - Tset is more than or equal to 0°C (32°F)
   - No fresh air exchange
   - Dehumidification is turned off or humidity setpoint below 65%
   Otherwise high speed.

2. Economy
   The fans run at a constant low speed. Exception: Tret > Tsup + 8°C (14°F) then high speed, until Tret > Tsup + 3°C (5°F) is reached.
   Economy mode is switched on by the operator.

6.10 Defrost function

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

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 minimum time between defrosts is always 2½ hours, but it is adjusted to the actual set-point.

The actual defrost execution is carried out using combinations of air defrost, hot gas, and electrical heaters and uses 4 modes:

1. Wait
   In Wait mode the time is refreshed for the next defrost provided that the following conditions are satisfied:
   - Compressor is running
   - T0 is less than 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. Initialize
   Wait until the condenser temperature is above 50°C (122°F), however no more than 300 sec.

3. Execute
   In this mode the actual evaporator defrosting takes place. A defrost start event is made in the trip log. Cooling system termination results in compressor initiation, only ramp up mode is executed. Evaporator fan is stopped. Evaporator heating elements are turned on. Compressor runs at a constant frequency at 83% of full speed. Expansion valve control is deactivated. Hot gas valve is used to heat the evaporator from the inside with the hot gas from the compressor. Evaporator defrosting terminates when evaporator temperature (Tevap), is above defrost termination temperature for 2 min. 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 two parts:
   - Evaporator re-freezing preventing remaining water drops on evaporator from blowing into the container upon evaporator fan initiation.
   - Termination ensuring low evaporator fan speed to prevent shock boiling and to ensure that 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.

General information
If the Tevap sensor is not OK, adaptive defrosting uses a reduced defrost interval compared to normal calculated defrost intervals. Setpoint alteration leads to a new calculated defrost interval, and defrost starts when the defrost criteria is reached. With manual defrost initiation the current defrost interval is set to default defrost interval.

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

Regarding user interface
Defrost icon is displayed during defrost function execution.

Other comments
If service mode or PTI mode is selected during a defrost, the defrost mode is terminated and the time for the next defrosting is set to the preset value as if a normal defrost end had occurred.

If the unit is shut off for some reason during a defrost and the power disappears for less than 12 hours, the unit will start and try to finish the defrost again when the power returns. If the unit is shut off for more than 12 hours, the active defrost is terminated and the defrost function enters the wait state.

6.11 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 and a constant so that the unit can maintain its functionality with reduced precision.

6.12 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 program RefCon and the RMM modem and the power line.
- Retrieved via a program, LogMan, on a PSION pda using the retriever socket.
- 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 and Psion Logman software:

File Download Info			
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	Supply air temperature [°C]	Short Log
D11	Tret	Return air temperature [°C]	
D12	Tusda1	USDA 1 temperature [°C]	
D13	Tusda2	USDA 2 temperature [°C]	
D14	Tusda3	USDA 3 temperature [°C]	
D15	Tcargo	Cargo temperature [°C]	
D16	Tset	Temperature setpoint [°C]	
D17	Humidity	Relative humidity [%]	
D18	AirEx	Air exchange [m^3/h]	
D19	Psuc	Suction pressure [BarE]	Extended Log Type 1
D20	Pdis	Discharge pressure [BarE]	
D21	Fpower	Net frequency [Hz]	
D22	Upower	Highest power voltage of U1, U2, U3	
D23	I1	Current, Ph. 1 [A]	
D24	I2	Current, Ph. 2 [A]	
D25	I3	Current, Ph. 3 [A]	
D26	Ifc	FC current [A]	
D27	Fcpr	Compressor frequency [Hz]	
D28	Heater	Heating element [%]	
D29	Mevap	Evaporator motor status	
D30	Mcond	Condenser motor status	
D31	Tfc	Frequency module temperature [°C]	
D32	Tamb	Ambient temperature [°C]	
D33	Extended Log Type 2		Extended Log Type 2
D34			
D35			
D36			
D37			
D38			
D39			
D40			
D41			
D42			
D43			
D44	CA datalog		CA datalog
D45			
D46			
D47			
D48			
D49			

D50	Extended Log Type 3	Extended Log Type 3
D51		
D52		
D53		
D54		
D55		
D56		
D57	Extended Log Type 4	Extended Log Type 4
D58		
D59		
D60		
D61		
D62		
D63		
D64		
D65		

Header can be retrieved by Refcon, Logman, StarView and can be viewed in Refcon, LogView and StarView. Extended Log Type 1 can only be retrieved by Logman and StarView and shown in LogView and StarView. Extended Log Type 2 can only be retrieved by StarView and viewed in StarView. StarView is the unique program designed for communication with a Star cool unit through a serial connection to a PC.

7. Tests

The unit has 5 test functions:

1. Fuction test
2. Full PTI (Pre-Trip Inspection) test
3. Short PTI (Pre-Trip Inspection) test
4. ITI (Intelligent Trip Inspection)
5. CA PTI (Pre-Trip Inspection) test

ITI (Intelligent Trip Inspection) is a test function doing self-test during transport of cargo. The purpose is to eliminate the need for PTI test once the journey is finalized and the cargo unloaded.

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, please see event list.

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: If there is too much liquid in the compressor house before compressor test (part of the function test), the compressor test will fail because of high intermediate pressure. This liquid needs to be evaporized. Let the unit run under normal conditions for 10 min. and activate PTI or function test as usual after this.

Function test includes the following items:

1. PTI - init
2. Controller test
3. Power check
4. Evaporator fan (Mevap)
5. Condenser fan (Mcond)
6. Heating element (Hevap)
7. Compressor/FC/valve test (Vexp, Vhg and Veco)
8. Test completion status

For a Star Cool CA unit the following tests are added to the function test:

9. STD function test
10. CO_2 sensor test
11. O_2 sensor test
12. AirEx motor test
13. Heater in the vacuum pump
14. Test completion/status

Compressor/valve test (Vexp, Vhg, Veco)		
No	Test description (steps)	Passing conditions
80	**Compressor** High pressure switch test Pump down test	Max. duration 5 min Reached within max. 5 min. 20 Bar < Pdis < 24 Bar If error: AL 250 Reached within max. 5 min. Tc - T0 > 20°C If error: AL 845
81	**Valve leak** All valves, reed valves included	Max. duration 5 min T0diff < |25|°C If error: AL 840
83	**Vexp** Testing capacity	Max. duration 5 min When Pdis ≥ 5 Bar: Max. change in Pdis ± 0.75 When Pdis < 5 Bar: Max. change in Pdis ± 0.3 When Tret ≥ -15°C: Min. change in T0 + 20 °K When Tret < -15°C: Min. change in T0 + 10 °K If error: AL 842
84	**Vhg (hot gas valve)** Testing capacity	Max. duration 5 min When Pdis ≥ 5 Bar: Max. change in Pdis ± 0.75 When Pdis < 5 Bar: Max. change in Pdis ± 0.3 When Tret ≥ -15°C: Min. change in T0 + 20 °K When Tret < -15°C: Min. change in T0 + 10 °K If error: AL 844

NOTE: At ambient temperature above +40°C (+104°F) and below -20°C (-4°F), the unit has to be running in normal operating mode at setpoint of 0°C (32°F) for of 10 minutes with compressor running before executing a function test or PTI test. The reason for this is to ensure correct function of unit during PTI test or function test.

7.2 Full PTI

Full PTI includes the following test items:
1. Function test (see "7.1 Function test" p. 18)
2. 5°C (41°F) test + 5°C (41°F) hold test 45 min. O_2/CO_2 sensor calibration if installed
3. 0°C (32°F) run test
4. -18°C (-0.4°F) run test
5. Defrosting
6. Test completion/status

7.3 Short PTI

Short PTI includes the following test items:
1. Function test (see "7.1 Function test" p. 18)
2. 5°C (41°F) test + 5°C (41°F) hold test 45 min. O_2/CO_2 sensor calibration if installed
3. 0°C (32°F) run test
4. Defrosting
5. Test completion/status

7.4 CA PTI

CA PTI includes the following test items:
1. Function test (see "7.1 Function test" p. 18)
2. 13°C (55°F) run test
3. 5°C (41°F) run test + 5°C (41°F) hold test 45 min. O_2/CO_2 sensor calibration if installed
4. 0°C (32°F) run test
5. Defrosting
6. Test completion/status

Ensure a manual inspection and function test is performed before taking the Star Cool CA unit into operation. The progress of the Pre Trip Inspection can be followed in the display T04 in steps.

8. Refrigeration system data

8.1 Refrigerant charge

4.5 kg R134a or R513A, with water cooled and non-water cooled condenser.

8.2 General specification

Total unit weight	Range from 400 kg to 460 kg depending on model		
Dimensions	Height: 2235 mm	Width: 2025 mm	
Noise level	Less than 75 dB(A) in 250 Hz band. Measured 1.5 m in front of unit and 1.2 m above the ground, with the unit operating at 50 Hz.		

8.3 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
Nominal power	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	58 kg

8.4 Frequency converter (FC)

Type	FC 1.0, FC 1.1, and FC 2.0
Frequency range	20 - 110 Hz (450 - 3300 rpm)
Converter housing	Sea water resistant aluminium, unpainted
Tightness	IP 56 mounted on compressor (IP 54 stand-alone/unmounted)

8.5 Evaporator coil

Tube material	Copper, inner grooved
Fin material	Aluminium, hydrophilic treated
Fin spacing	3.4 mm
Attitude	45° from horizontal

8.6 Evaporator coil heaters

Type	ø8,5 mm in stainless steel AISI 304
Number	6
Rating	750 W each @ 400 V (750 W ± 10 W)

8.7 Evaporator fan

Material	Polypropylene, glass fibre reinforced
Type	Axial
Number of fans/blades	2 pcs/7 pcs
Pitch	25°
Diameter	ø315 mm
Drive	Direct on motor shaft

8.8 Evaporator fan motor

Manufacturer	Grundfos dahlander motor		ABB dahlander motor	
Type	Enclosed, non-vented			
Frame size	071B14			
Shaft material	Stainless steel, X20CrNi172			
No. of motors	2			
Voltage	3–phases, 400/460 V AC, 50/60 Hz			
Nominal power	0.45/0.07 kW @ 460V/60 Hz		0.45/0.07 kW @ 460V/60 Hz	
Protection, electrical	Thermistors			
Speed	Dual-speed 3460/2850 rpm (60/50 Hz) 1760/1425 rpm (60/50 Hz)		Dual-speed 3430/2890 rpm (60/50 Hz) 1750/1440 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	Driven end 6203 2CS C3	Non driven end 6304 2CS C3
Bearing lubricant	Lubricant Klüberquiet BQH 72 - 102 or equivalent. Temperature range: -40°C to +140°C (-40°F to +284°F)			

8.9 Condenser coil

Tube material	Copper, inner grooved
Fin Material	Aluminium
Fin spacing	2.0 mm
Coating, tube/fin	Cataphoresis treatment, with additional acrylic resin

8.10 Condenser fan

Material	Polypropylene, glass fibre reinforced
Type	Axial
Number of fans/blades	1 pcs/4 pcs
Pitch	30°
Diameter	ø400 mm
Drive	Direct on motor shaft

8.11 Condenser fan motor

Manufacturer	Grundfos dahlander motor		Zhongda dahlander motor		ABB dahlander motor	
Type	Enclosed, non-vented					
Frame size	071B3					
Shaft material	Stainless steel, X20CrNi172					
No. of motors	1					
Voltage	3–phases, 400/460 V AC, 50/60 Hz					
Nominal power	0,25/0,07 kW at 460 V/60 Hz		0,30/0,08 kW at 460 V/60 Hz		0,30/0,08 kW at 460 V/60 Hz	
Protection, electrical	Thermistors					
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)		Dual-speed 1710/1420 rpm (60/50 Hz) 830/690 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	Driven end 6203 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)					

8.12 Water cooled condenser (optional)

Operating water pressure, max.	8 BarE (115 Psi)
Water temperature, max. cooling cap.	30°C (86°F) - minimum water temperature should be higher or equal to highest actual setpoint on the containers on board
Water flow rate	22.7 - 30.2 L/min (6 - 8 gal/m)
Pressure drop	0.9 Bar (13.05 Psi) - 1.2 Bar (17.4 Psi) at above flow rate
Connections	Inlet: Hansen B-66 or equivalent. Outlet: Hansen B8-HP36-VAA or equivalent.
Condenser tubing	Cu - Ni (90/10)
Water specification	Fresh water or salt water, without free chlorine

8.13 Fresh air exchange

Fresh air exchange	Adjustable 0 - 225 m^3/h (0 - 132 CFM) at 60 Hz adjustable by steps of 5 m^3/h. Equivalent to 0 - 170 m^3/h (0 - 100 CFM) at 50 Hz
AV+ controlled (optional)	0 - 75 m^3/h (50 Hz) controlled by the controller

8.14 Air exchange motor

Type	Gear motor
Supply	12-24 V DC

8.15 Economizer

Type	Brazed plate heat exchanger
Material	Stainless steel, AISI 316 L

8.16 Refrigeration controls

Expansion valves	2 solenoid valves, electronically controlled by the controller
Filter drier	Danfoss DML 164 with O-ring or equivalent
Hot gas valve	Solenoid valve electronically controlled by the controller
Moisture indicator	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. Top coat: Polyurethane resin Hipon - 50.

8.17 Vacuum pump, including heating element

Capacity	16 m^3/h at 50 Hz and 19 m^3/h at 60 Hz
Supply	3 phase AC 50 Hz 340-460 V and 60 Hz 400-520 V
Oil (type/amount)	ISO VG 32 - 0.35 L

8.18 Electrical data

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

8.19 Circuit breaker

Main power ampere	16 A

8.20 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

8.21 High pressure cut out switch

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)

8.22 Fusible plug, receiver

Blow temperature	100°C (212°F)

8.23 Fuses

Control circuit supply	0.4 A, tube fuse

8.24 Power plug

Type	CEE 3P+E (4 pole) 32 A 400/460 V, 50/60 Hz

8.25 Power cable

Type	4 x 2.5 mm^2, 450/750 V, PU – sheath
Length/colour	18 m/Yellow
Temperature range	-37°C to +90°C (-34.6°F to +194°F)

8.26 USDA socket requirements

Location	Rear left side
Number	3 pcs and 1 cargo sensor
Type	Deutsch HD 10, female socket. Tin plated.

8.27 O_2 sensor

Type	Ziconium oxide
Operating range	0 - 21%
Accuracy	At O_2 (3%) ± 0,5%, temperature ranges from -1°C to +15°C (+30°F to +59°F)
Supply	8 - 15 V DC
Output	RS-485

8.28 CO_2 sensor

Type	Nondispersive infrared sensor
Operating range	0 - 20%
Accuracy	CO_2 (5%) ± 0,3% CO_2 (0,5%) ± 0,1%
Supply	22 - 43 V DC
Output	RS-485

8.29 Temperature sensors, including USDA

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)

8.30 CA pressure transmitter

Type	Ratiometric
Operating range	8 - 1164 mBar
Accuracy	±10 mBar
Supply	5 V DC
Output	Ratiometric

8.31 Pressure transmitters

Manufacturer		AKS	NSK	DST
Range	High pressure side	0 to 32 BarE	0 to 30 BarE	0 to 40 BarE
	Low pressure side	-1.0 to 12.0 BarE	-0.69 to 9.8 BarE	-0.69 to 13.0 BarE
Type		Ratio metric pressure transmitter, with sealed gauge measuring principle. ¼" female flare connection with deflator.		

8.32 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.
- Fresh air exchange is measured and logged in m^3/h, definition 5 m^3/h.

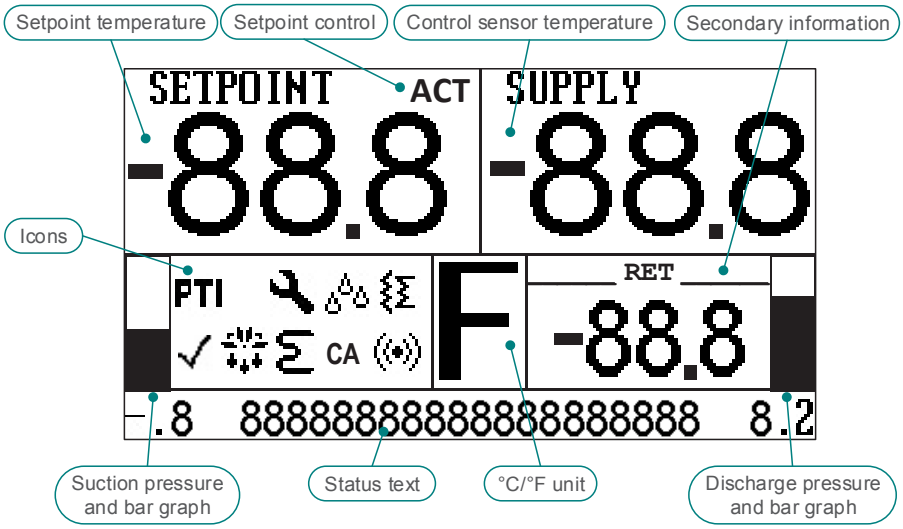
9. User interface

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

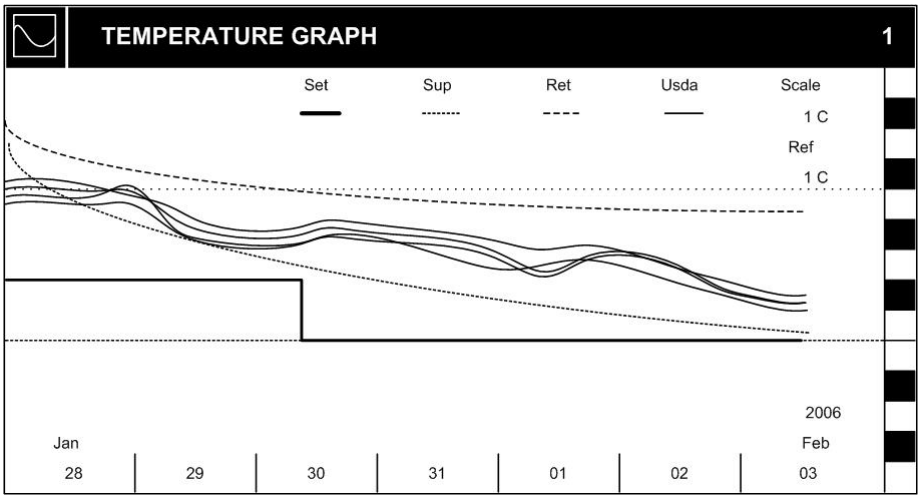
Both lights are only active when the container is connected to a power supply line. During power up, both lights are shortly illuminated to verify their function. A "Slow flash" is a short flash every 3 sec. A "Quick flash" is a flash every 1 sec. A "Normal flash" is a flash every 1½ sec.

9.2 Display

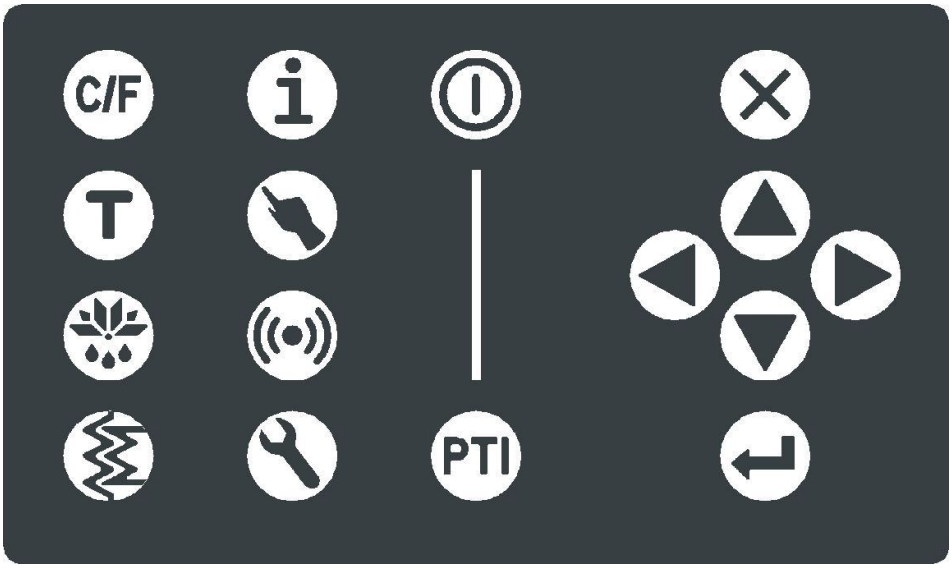


✓	Intelligent Trip Inspection passed
C / F	Temperature and pressure unit selection Celsius and Bar or Fahrenheit and Psi
PTI	Pre Trip Inspection or Function Test is running
	Unit is operated in Service mode
	Humidity control is enabled
	Humidity control is active
	Water cooled condenser is activated
	Defrosting is running
	Heater elements are switched on
	Alarms are present in the Alarm menu
ACT	Setpoint is controlled by Automatic Cold Treatment, ACT program
MTS	Setpoint is controlled by Multiple Temperature Set-points, MTS program

It is possible to obtain a datalog graph display (See “11.20 Datalog view” p. 51)



9.3 Key pad



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	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)

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	O10 manual defrost (see "11.15 Manual defrost" p. 47)
	Water cool	Press 3 sec. to activate and deactivate water cooled condenser

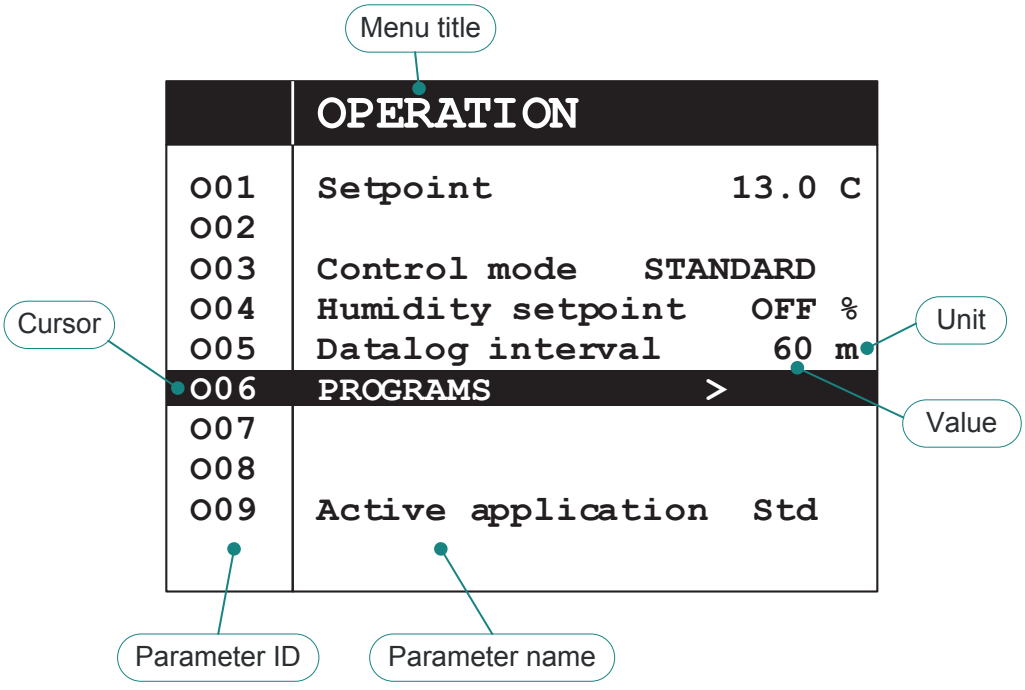
If no key is activated for a period of time, the controller will do this:

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.

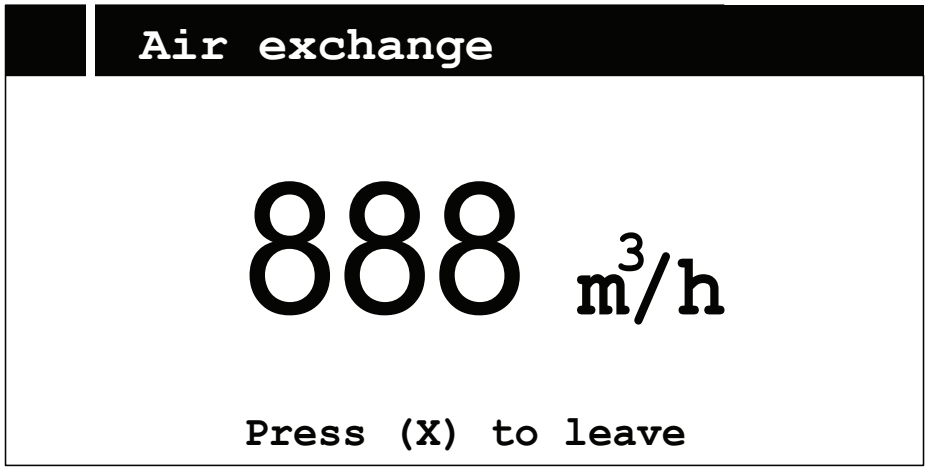
10.3 Changing a parameter value

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.

10.5 Air exchange page

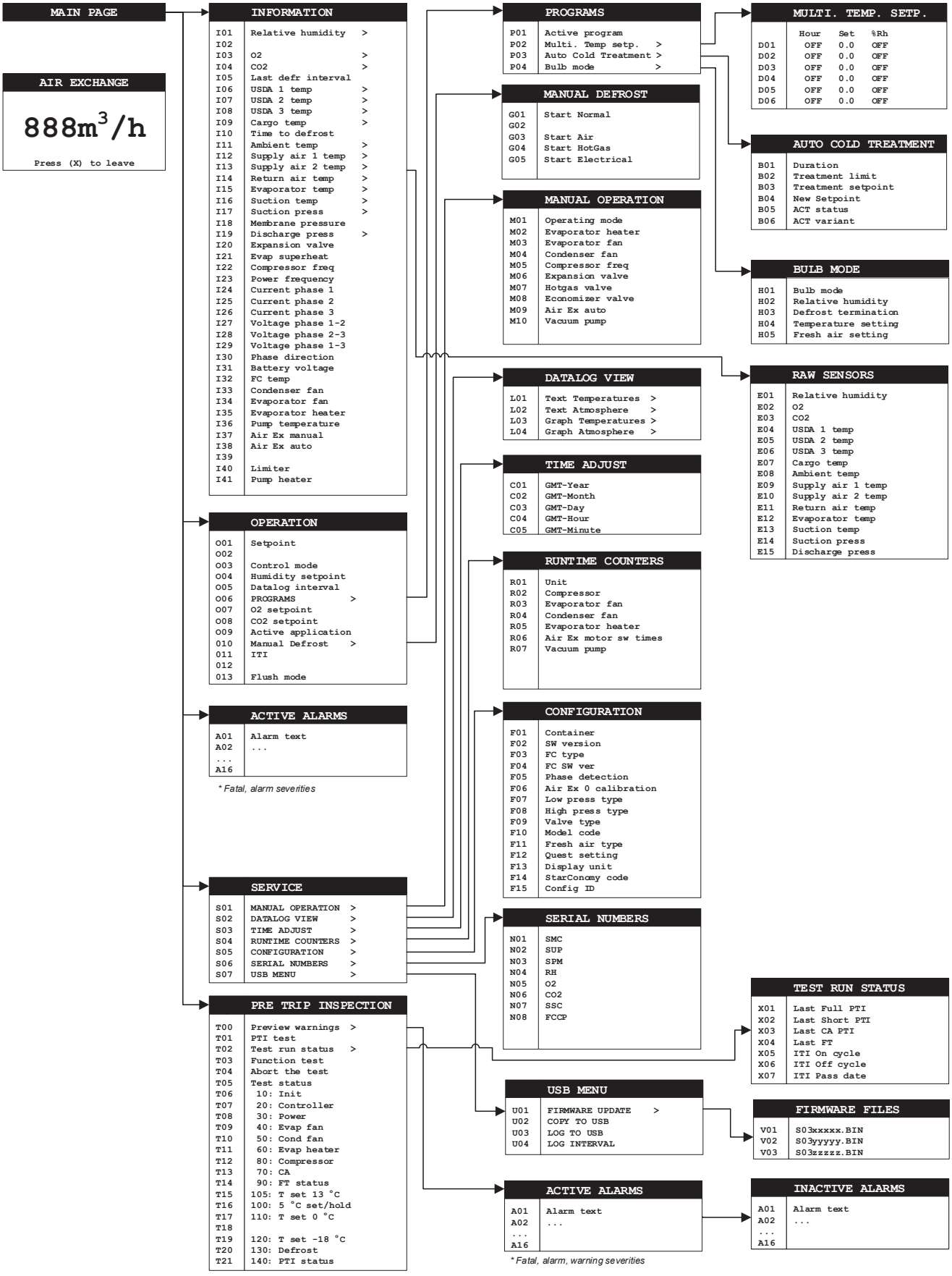


This page is automatically displayed when the user starts changing the air exchange valve position. The display returns to the main page after 10 min. or when the Cancel key ⊗ is pressed.

To view actual airflow at a different time use the Information menu ⓘ line I02.

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., 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 Cool 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 ⏻ 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 ("11.20 Datalog view" p. 51)).
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 Water-cooling activation/deactivation

The following only applies for with water cooling (WC).

Water-cooling connecting is executed as follows:

- The container must be connected to the water-cooling system.
- Press and hold it for 3 sec. The display shows the icon as an acceptance of water-cooling operation. The condenser fan is deactivated.

Water-cooling turn-off is executed as follows:

- Press and hold it for 3 sec. The display turns off the icon as an acceptance of non-operating water-cooling. The condenser fan turns on automatically.
- The container can be disconnected from the water-cooling system.

If the water supply is insufficient (the water hose is jammed, the water is not running or the water temperature is too high), the temperature in the condenser will rise and cooling capacity is decreasing and thereby threatening the cargo. If the condenser temperature rises above 58°C (136°F), the system will automatically switch to air-cooling of condenser by turning the condenser fan on. If the water flow is restored, the controller stops air-cooling of the condenser.
If the temperature stays at the high temperature for more than 1 hour, an alarm is given. The actual setting of water-cooling is remembered if the unit is switched off or there should be a power loss. Water-cooling is only turned off when the setpoint temperature is changed or when water-cooling is turned off manually.

11.9 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.

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 T12 and then performance testing in menu items T13 to T17.

A short PTI takes approx. 1.5 hours.

A function test is initiated in the same way by selecting menu T02. A function test performs menu items T04 to T12, 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)/T18(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 T18. Alarms found are logged in the datalog.

A detailed description and trouble shooting of an alarm can be found in this manual "14. Detailed alarm description" p. 61, together with a description of the specific test alarms "Test Alarms (AL 8XX)". 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 "11.17 Alarms" p. 48.

Value:

-

T01 PTI test start

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 NORMAL or SHORT via ▲ or ▼ and press ↵ which initiates the test. The PTI test is automatically terminated in case of no errors. Finally, temperature set-point 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 CA PTI

Function:

Date of last CA PTI.

Value:

YYYY-MM-DD or N/A.

X04 Last FT

Function:

Date of last FT.

Value:

YYYY-MM-DD or N/A.

X05 ITI On cycle

Function:

Display remaining on time of current test interval.

Value:

Shown as hours.

X06 ITI Off cycle

Function:

Display remaining off time of current test interval.

Value:

Shown as hours.

X07 ITI Pass date

Function:

Date of last ITI pass –> checkmark set.

Value:

YYYY-MM-DD or N/A.

T03 Function test start

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 running 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 Evaporator 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 - 813.

T10 Test result: 50 Condenser 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 Evaporator 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.

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.

T16 Test result: 100 Temperature setpoint 5°C

Function:

Shows the status of the performance test with temperature setpoint of 5°C (41°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 855.

T17 Test result: 110 Temperature setpoint 0°C

Function:

Shows the status of the performance test with temperature setpoint of 0°C (32°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 860.

T19 Test result: 120 Temperature setpoint -18°C

Function:

Shows the status of the performance test with temperature setpoint of -18°C (-0.4°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 870.

T20 Test result: 130 Testing of defrost

Function:

Shows the status of the performance test of 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.

T21 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.

11.10 Info menu

By pressing (i) the Information menu is selected. The i icon is displayed.
The info menu includes the following parameters:

I01 Relative humidity

Function:

Shows current relative humidity in the container.

Value:

Shown as a percent value.

I03 O2 level

Function:

Shows the O_2 level [%].

Value:

An actual value of the O_2 level inside the container.

I04 CO2 level

Function:

Shows the CO_2 level [%].

Value:

An actual value of the CO_2 level inside the container.

I05 Last defrost interval

Function:

Show current interval between last two defrostings.

Value:

Shown in hours.

I06 USDA 1 temperature

Function:

Shows current temperature for USDA 1 sensor.

Value:

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

I07 USDA 2 temperature

Function:

Shows current temperature for USDA 2 sensor.

Value:

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

I08 USDA 3 temperature

Function:

Shows current temperature for USDA 3 sensor.

Value:

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

I09 Cargo temperature

Function:

Shows current temperature for cargo sensor.

Value:

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

I10 Time to next defrost

Function:

Shows current time to the next defrosting.

Value:

Shown in hours and minutes.

I11 Ambient temperature

Function:

Shows current ambient temperature.

Value:

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

I12 Supply air 1 temperature

Function:

Shows current temperature for supply 1 sensor.

Value:

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

I13 Supply air 2 temperature

Function:

Shows current temperature for supply 2 sensor.

Value:

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

I14 Return air temperature

Function:

Shows current temperature for return sensor.

Value:

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

I15 Evaporator temperature

Function:

Show current temperature for evaporator.

Value:

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

I16 Suction temperature

Function:

Shows measured suction gas temperature.

Value:

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

I17 Suction pressure

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).

I18 Membrane pressure

Function:

Membrane pressure.

Value:

Actual vacuum pressure between the vacuum pump and membrane. Under normal conditions: 40 - 130mBar.

I19 Discharge pressure

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).

I20 Expansion valve opening

Function:

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

Value:

Shown as a percent value.

I21 Evaporator superheat

Function:

Shows current superheat of expansion valve. Tsuc - T0 = SH.

Value:

Shown in temperature scale °C or °F. Switch by pressing C/F. Value is only user-changeable with system in the Service mode.

I22 Compressor frequency

Function:

Shows current compressor frequency.

Value:

Shown in units of Hz.

I23 Power frequency

Function:

Shows current power (net) frequency.

Value:

Shown in units of Hz.

I24 Current consumption phase 1

Function:

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

Value:

Shown in units of ampere.

I25 Current consumption phase 2

Function:

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

Value:

Shown in units of ampere.

I26 Current consumption phase 3

Function:

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

Value:

Shown in units of ampere.

I27 Voltage between phase 1 and 2

Function:

Shows current voltage between phase 1 and 2.

Value:

Units in volt.

I28 Voltage between phase 2 and 3

Function:

Shows current voltage between phase 2 and 3.

Value:

Shown in units of volt.

I29 Voltage between phase 1 and 3

Function:

Shows current voltage between phase 1 and 3.

Value:

Shown in units of volt.

I30 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.

I31 Battery voltage

Function:

Shows current Battery voltage.

Value:

Shown as voltage.

I32 Frequency converter temperature

Function:

Shows current converter temperature.

Value:

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

I33 Condenser fan speed

Function:

Shows current speed for condenser fan.

Value:

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

I34 Evaporator fan speed

Function:

Shows current speed for evaporator fan.

Value:

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

I35 Evaporator heating

Function:

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

Value:

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

I37 Air exchange in m^3/h for manual valve

Function:

Shows current opening of manual air exchange valve.

Value:

Shown as m^3/h.

I38 Air exchange in m^3/h for automatic valve

Function:

Shows current opening of automatic air exchange valve.

Value:

Shown as m^3/h.

I40 Limiter

Function:

Shows what condition is limiting the cooling capacity.

Value:

None, T0 (suction pressure), Tc (discharge pressure), Ifc (compressor current), Tfc (frequency converter temperature), Uni (defrost limiter), Itot (total current).

I41 Pump heater

Function:

Shows current operation of vacuum pump heater.

Value:

OFF, ON.

11.11 Raw sensors

Shows the unfiltered and unsubstituted value of the sensors. When sensor is malfunctioning, the value of this sensor is substituted and marked with a ´ (e.g. 0.7' C). By pressing the Enter key ↵ in the Information menu, raw temperature sensor values are shown in the user panel.

E01 Relative humidity

Function:

Shows current relative humidity in the container.

Value:

Shown as a percent value.

E02 O2

Function:

Shows the O_2 level [%].

Value:

An actual value of the O_2 level inside the container.

E03 CO2

Function:

Shows the CO_2 level [%].

Value:

An actual value of the CO_2 level inside the container.

E04 USDA 1 temp

Function:

Shows current temperature for USDA 1 sensor.

Value:

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

E05 USDA 2 temp

Function:

Shows current temperature for USDA 2 sensor.

Value:

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

E06 USDA 3 temp

Function:

Shows current temperature for USDA 3 sensor.

Value:

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

E07 Cargo temp

Function:

Shows current temperature for cargo sensor.

Value:

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

E08 Ambient temp

Function:

Shows current ambient temperature.

Value:

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

E09 Supply air 1 temp

Function:

Shows current temperature for supply 1 sensor.

Value:

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

E10 Supply air 2 temp

Function:

Shows current temperature for supply 2 sensor.

Value:

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

E11 Return air temp

Function:

Shows current temperature for return sensor.

Value:

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

E12 Evaporator temp

Function:

Show current temperature for evaporator.

Value:

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

E13 Suction temp

Function:

Shows measured suction gas temperature.

Value:

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

E14 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).

E15 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).

11.12 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.

The Operation menu includes the following parameters:

O01 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:

-

O03 Control mode

Function:

Setting the control modes: STANDARD or STARCON mode.

If STANDARD mode is selected:

In Chill mode, the evaporator fans run at high speed unless:
a. The setpoint Tset ≥ -4.9°C (23.2°F) and

b. The air exchange is closed and

c. Dehumidification is off and

d. CA/AV+ is inactive In Frozen mode the evaporator fans run at low speed.

If STARCON mode is selected:

See "11.23.1 StarConomy" p. 54.

Value:

Function set to STANDARD, STARCON. Default is customer dependent.

O04 Reference relative humidity setting

Function:

Setting of reference relative humidity. Note that container relative humidity is only reducible.

Value:

Shown as 'Off' or a percent value. Value can be set to Off or values from 50% to 95% in 1% increments. Default = off.

O05 Datalog interval setting

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.

11.13 Programs

O06 Programs

Function:

Leads to the programs sub-menu.

Value:

Go to the programs sub menu.

P01-P04 Show/select active program

Function:

Shows active program or activates selected program.
Attention: Program setpoints have to be set before activating the program is activated.

Value:

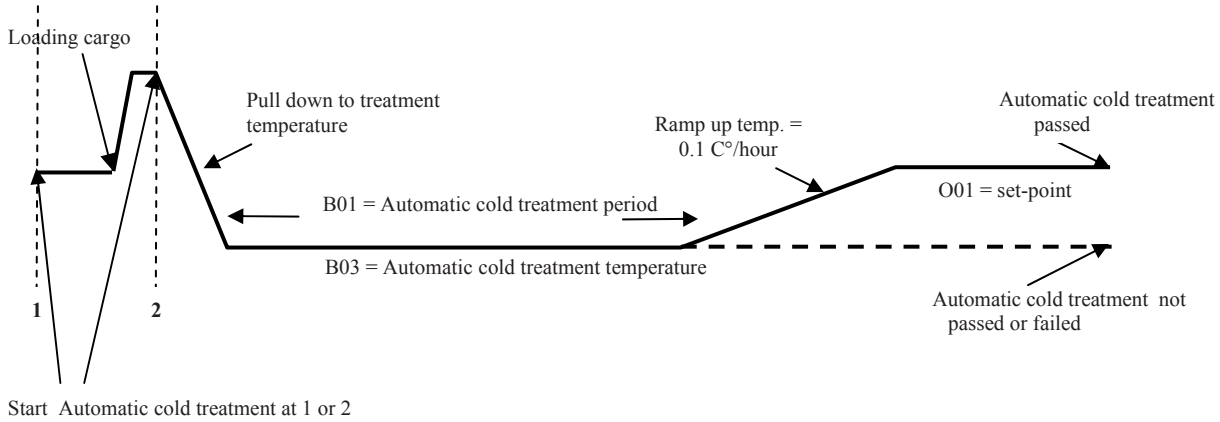
Shown as None, ACT, MTS or Bulb mode. Press ↵ for 3 seconds to activate selected program or stop an active program by selecting None.
Values: None, ACT, MTS or Bulb mode.

11.13.1 Automatic Cold Treatment program, ACT

Automatic Cold Treatment can only be started when all Tusda sensors are in function. If one or more Tusda sensors fail under the Automatic Cold Treatment period, the treatment temperature is kept as setpoint for the whole trip. When Automatic Cold Treatment is done without any sensor failure, ACT PASSED-PRG ACTI is written in the display status texts (“9.2 Display” p. 26). If the USDA sensors are out of range, ACT FAILED will be written.

The ACT-status will be displayed until:

- Program status set to none
- Initiated PTI
- Power off more than 48 hours



Termination of an active ACT can only be done by manually setting active program (P01) to none or if the unit has been powered off for more than 48 hours. Datalog interval during ACT is default 60 min. (cannot be changed). After ACT activation, the treatment setpoint is adjustable in the legal range.

B01 Duration of the treatment

Function:

Setting of duration in days of the Automatic Cold Treatment.

Value:

Values 1 - 45 days. The number of days to use depends on the cargo and the treatment temperature. The treatment time is counted from the validity of at least 3 USDA sensors all showing a temperature below the maximum USDA temperature. If one or more USDA sensors is outrange and returns to inrange again, the timer for the Automatic Cold Treatment will reset. ACT passed shows that all USDA sensors have been under maximum allowed temperature in the duration time in one period.

B02 Treatment limit

Function:

Setting of the maximum allowed temperature of the mounted USDA sensors.

Value:

-4.7°C to +30.0°C.
Shall be locked after ACT activation.

B03 Treatment setpoint

Function:

Setting of the setpoint during the treatment.

Value:

-4.9°C to [Treatment limit - 0.2K].
After ACT activation, adjustable in the legal range.

B04 New setpoint

Function:

Setting of final setpoint.

Value:

-1.5°C to +30.0°C.
Shall be locked after ACT activation.

B05 Status of the Automatic Cold Treatment program

Function:

Shows the status of the ACT program.

Value:

Not active, Active, Aborted, Pass, Done, Fail.

The Automatic Cold treatment program stops automatically if the unit has been powered off for more than 48 hours.

USDA

Function:

The bottom line shows the temperatures of USDA sensors 1 – 3 and the cargo sensor.

Value:

Actual temperature measured of the sensor. -70°C indicates that the sensor is not mounted! Check alarm list to see if there should be an USDA alarm.

11.13.2 Multiple Temperature Setpoints program, MTS

D01-D06 Settings per step

Function:

Settings for step 1 to 6 of the Multiple Temperature Setpoints program.

Value:

D01 - D06: Step number 1 - 6:

Hours: Defines how many hours the temperature setpoint is used (from 1 to 999 hours). When setpoint from "Set" is in-range, the time starts. Setting hours to Off clears all settings in this step and the succeeding steps.

Set: The setpoint temperature to use for this step. Temperature change per hour (ramp) is fixed for cooling, and change is done with maximum cooling capacity available.

%RH: Dehumidification - humidity setpoint. Values: Off, 50% – 95%. Off means the controller maintains as high humidity as possible, at all other values the controller will use the humidity setpoint to maintain dehumidification. Dehumidification is active immediately when the step starts including under temperature ramps.

If the duration (hours) is set to OFF or it is the last step, the program is terminated. After this the unit continues with the temperature set as last step in the MTS.

The Multiple Temperature Setpoints program stops automatically if the unit has been powered off for more than 48 hours, or if the user stops the program or if PTI or Automatic Cold Treatment is initiated.

11.13.3 Bulb mode

The major functionality in Bulb mode is:
1. 1. Bulb mode selection:
   a. MevapL
   b. MevapH
   c. MevapL for 1 hour then MevapH for 1 hour etc.
2. This in connection with the possibility to control dehumidification and termination temperature of defrosts.

Bulb mode is only available under normal SC operation mode. Temperature control and control of relative humidity must be as under normal operation mode conditions except from the control of the Mevap. Mevap will be controlled according to the selection of the mode as described above. Bulb mode is NOT active in Frozen mode, StarConomy and CA/AV+. If Bulb mode compromise the temperature control, standard control will be active to correct temperature deviation.

Bulb mode settings are:
1. Temperature setting. From -1°C to +30°C, only Chill mode. Default 10°C.
2. RH setting. From 50% to 95%. Default 95%.
3. Fresh air setting (ventilation). From 0 m^3/h to 225 m^3/h. Default 0 m^3/h.
4. Defrost termination. From +4°C to +25°C. Default to 15 degree Celsius.
5. Bulb mode selection:
   a. MevapL = BulbLo
   b. MevapH = BulbHi
   c. BulbAlt = MevapL for 1 hour then MevapH for 1 hour etc. (Always starting with low speed, also after defrost or power on)

Fresh air setting will be done by actually adjusting the manual air vent to the desired amount of fresh air and hereafter accept the settings in the program.

In the datalog the following will be recorded as an event:
1. Bulb mode ON
2. Bulb mode OFF

The Bulb setup parameters will be logged as parameters to the event (RHset, Ventilation, Defrost termination criteria, Type of Bulb mode (either Hi, Low or Alt)).

H01 Bulb mode evaporator fans speed regulation

Function:

Fan pattern when in Bulb mode.

Value:

Values: Lo, Hi or Alt.

H02 Bulb mode relative humidity setpoint

Function:

Relative humidity setpoint when in Bulb mode.

Value:

Values: Set from 50% to 95%.

H03 Bulb mode defrost termination temperature

Function:

Evaporator temperature must be above this limit before defrost can stop.

Value:

Values: Set from +4°C to +25°C (default 15°C).

H04 Bulb mode temperature setpoint

Function:

Temperature setpoint when in Bulb mode.

Value:

Values: Set from -1°C to +30°C (default 10°C).

H05 Bulb mode fresh air setting

Function:

When user moves the marker (using the butterfly valve) to the fresh air setting, the setting will be highlighted and prompt the user to press ↵.

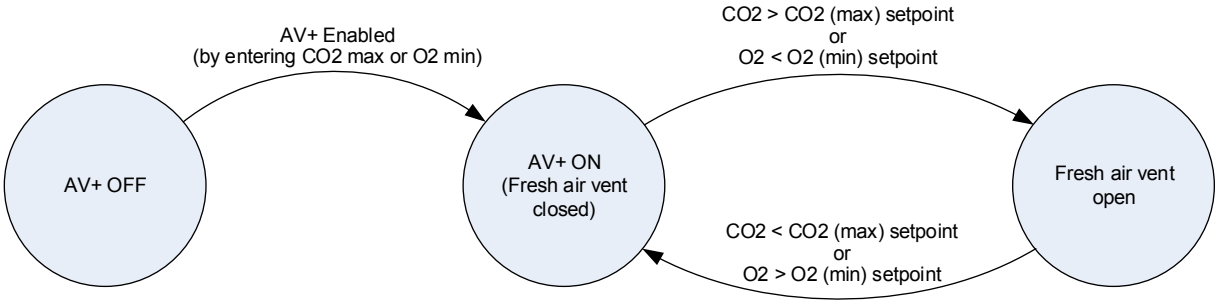
Value:

Values: Set from 0 to 225 m^3/h.

Bulb mode off after:
1. PTI pass or fail
2. Manual deactivation of program

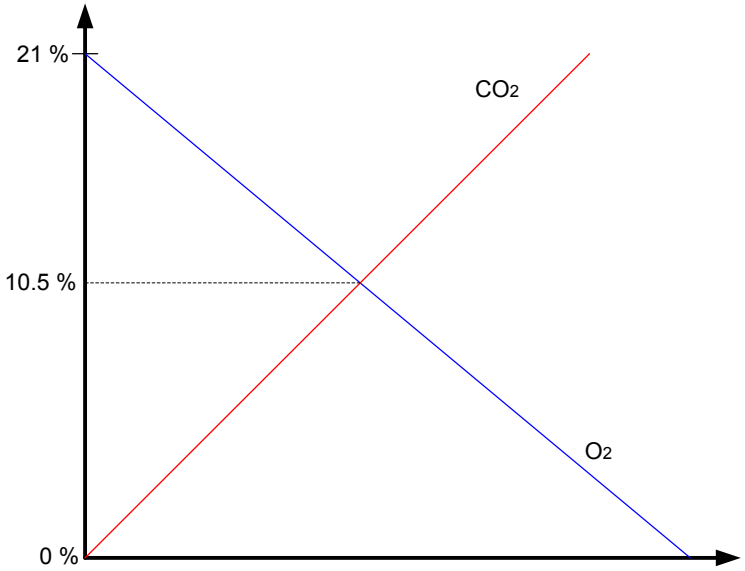
11.14 AV/AV+/CA settings

The Star Cool AV+ is a system designed to automatically regulate the internal atmosphere of the container using greatly reduced energy consumption compared to manual or other automated fresh air systems. With a respiring cargo, the container's atmosphere attains the desired gas composition based on entered setpoints for maximum CO_2, or minimum O_2 via the controller which accurately regulates the exchange of CO_2 for O_2 using ambient air.



Perishables will generate CO_2 via respiration, leading to an increase in the CO_2 and a proportional decrease in O_2 level inside the container. If the CO_2 level in the container atmosphere reaches above the pre-set CO_2 max level or the O_2 level reaches below the pre-set O_2 minimum level, the air exchange valve will open and thereby lower the CO_2 level and raise in O_2 by diluting with ambient air.

For AV+ setpoints are entered via the display: Max CO_2 level range 1-12% and minimum O_2 range 1-19% or OFF. If O_2 is set to OFF, ventilation is solely controlled by CO_2 setpoint, and if CO_2 is OFF ventilation is solely controlled by O_2 setpoint. The relation between O_2 and CO_2 in the atmosphere of the container is as illustrated:

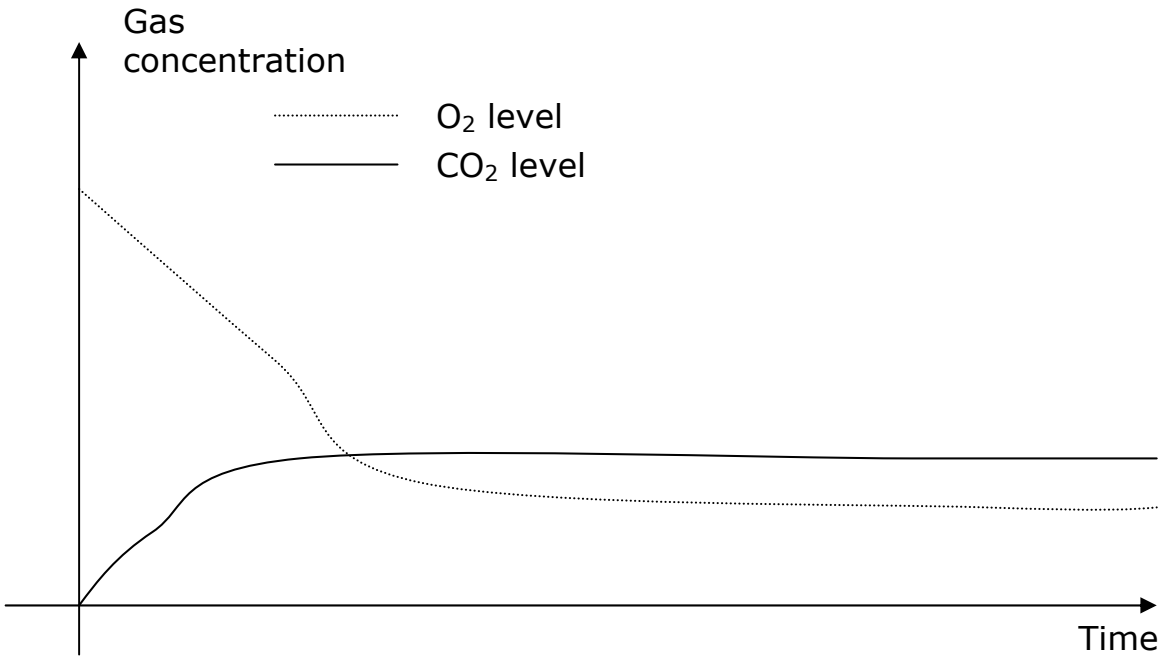


CO_2 level is set in O08 and O_2 level is set in O07 (see "11.1 Menu structure" p. 30).

The Star Cool CA is a controlled atmosphere system designed to prolong the shelf life of perishables by regulating the internal atmosphere of the container. The container's atmosphere obtains the desired gas composition based on entered setpoints for O_2 and CO_2 via the controller. The desired atmospherical composition of the gas serves to lower the respiration of the perishables, and thereby providing a prolonged shelf life.

ATTENTION! Due to regulation of the cargo atmosphere during transport, the oxygen level may be low and/or the carbon dioxide level high inside the container! Please check gas levels and flush with fresh air before entering and unloading. Exposure to low oxygen/high carbon dioxide may cause loss of consciousness and suffocation.

The basic principle is that the fruit will generate CO_2 from O_2 via respiration. This will increase the CO_2 level and decrease the O_2 level inside the container. When the CO_2 level reaches above the CO_2 set-point the vacuum pump will activate and evacuate CO_2 with the selective membrane. If the O_2 level goes below the O_2 setpoint the air exchange valve will open and let in ambient air (20,9% O_2). This described mechanism will regulate the gas concentration within the container as illustrated below:



Setpoints are entered via the operation menu. O_2 level is set in O07 and CO_2 level is set in O08 (see "11.1 Menu structure" p. 30):

O_2 range 3 - 21%
CO_2 range 4 - 12%

Level readings:

Actual O_2 and CO_2 concentrations can be viewed in the menu structure I03, I04, and in the main display window. The membrane pressure can be viewed in the menu structure I18. Actual vacuum pump oil temperature can be viewed in the menu structure I36 (pump temperature).

If the setpoints for O_2 and CO_2 are set to Off, the CA function is turned off. If the setpoint is set to Frozen mode, the CA function is turned off.

To turn on the CA function:

1. Tset to a chill setpoint
2. Set Active application to CA
3. Scroll to an O_2 setpoint
4. Scroll to a CO_2 setpoint

All of the above need to be set for the CA function to be activated. If temperature setpoint (Tset) is changed to a frozen setpoint, the CA function is deactivated.

The AirEx motor can be activated in Manual mode in the menu structure M09.

0%: Valve closed
100%: Valve open

The vacuum pump can be activated in the menu structure M10. Activating the vacuum pump should result in a pressure drop which can be viewed in the menu structure I18 when running range 30-130 mBar.

Only manually activate the vacuum pump when absolutely necessary! The vacuum pump is not pre-heated if manually activated - this can cause damage to the vacuum pump over time.

Please note that it will take 5 minutes before O_2 and CO_2 can be viewed in the display.

O07 O2 setpoint

Function:

O_2 setpoint.

Value:

Range 3 - 21%.

O08 CO2 setpoint

Function:

CO_2 setpoint.

Value:

Range 4 - 12%.

O09 Active application

Function:

Actual application.

Value:

- Std (standard)
- AV (automatic ventilation) */#
- AV+ (automatic ventilation +) *
- CA (controlled atmosphere) *

O13 Flush mode

Function:

Activating command will allow very high levels of CO_2 for 4 hours, then returning to normal control.

Value:

On, off.

11.15 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 O10 Manual defrost menu, selecting specific defrost type and holding it for 3 sec. The display shows the icon as an acceptance of defrost initiation.

O10 Manual defrost

Function:

Go to manual defrost sub menu.

Value:

None.

G01 Start normal

Function:

Defrost where defrost type is selected automatically.

Value:

Default OFF. Select ON and hold for 3 seconds to start defrosting.

G03 Start air

Function:

Defrost using evaporator fan only.

Value:

Default OFF. Select ON and hold for 3 seconds to start defrosting.

G04 Start hot gas

Function:

Defrost using hot gas only.

Value:

Default OFF. Select ON and hold for 3 seconds to start defrosting.

G05 Start electrical

Function:

Defrost using electrical heater only.

Value:

Default OFF. Select ON and hold for 3 seconds to start defrosting.

11.16 Intelligent Trip Inspection (ITI)

O11 Intelligent Trip Inspection

Function:

Turning Intelligent Trip Inspection on or off.

Value:

OFF, ON.

O12 User request of Intelligent trip inspection result log

Function:

Activating command generates result of ITI, if test sequence is completed.

Value:

NONE, LOG.

11.17 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 is not deletable from the list, but may change to inactive state by eliminating the cause of the alarm.

An inactive alarm is deletable from the list by pressing ↵ during alarm displaying.

11.18 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 - M10) Manual start/stop of motors etc.
- Datalog view (L01 - L04) View of temperature log.
- Time adjust (C01 - C05) Setting of date and time.
- Run time counters (R01 - R07) View of running hours for unit, compressor etc.
- Configuration (F01 - F11) Software version and various configurations
- Serial numbers (N01 - N08) Serial number for various parts
- USB menu (U01 - U04) USB functions for firmware update and logging

11.19 Manual operations

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 Turn the evaporator heater on/off

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 Turn the evaporator fan on/off

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, LO (low speed) or HI (high speed).

M04 Turn the condenser fan on/off

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 Setting of compressor frequency/capacity

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 100 Hz.

M06 Setting of expansion valve % opening

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 Setting of hot gas valve % opening

Function:

Manual setting of hot gas 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 Setting of economizer valve % opening

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 AirEx motor

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 Vacuum pump

Function:

Manual control of vacuum pump. Note that value is only accepted if control is in the manual mode (menu item M01 is MANUAL).

Value:

ON/OFF

11.20 Datalog view

The number under the text Ref shows the temperature at the ◂ mark, ex. 5°C.

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 Viewing log of temperatures

Function:

Viewing of logged temperatures.

Value:

The following temperatures can be viewed: Setpoint temperature, supply air temperature, return air temperature, relative humidity%, air exchange m^3/h, 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, relative humidity%, air exchange 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.

L03 Viewing log of temperatures as graph

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.

11.21 Time adjust

C01 Setting of year (GMT-Year)

Function:

Setting of year.

Value:

Set from 1999 to 2099.

C02 Setting of month (GMT-Month)

Function:

Setting of month.

Value:

Set from 1 to 12.

C03 Setting of day (GMT-Day)

Function:

Setting of day.

Value:

Set from 1 to 31.

C04 Setting of hours (GMT-Hour)

Function:

Setting of hours.

Value:

Set from 0 to 23.

C05 Setting of min. (GMT-Minute)

Function:

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

Value:

Set from 0 to 59.

11.22 Run time counters

R01 Viewing of operation hours for the Star Cool unit

Function:

Viewing of Star Cool unit operation hours.

Value:

Shown as hours.

R02 Viewing of compressor operation hours

Function:

Viewing of compressor operation hours.

Value:

Shown as hours.

R03 Viewing of evaporator fan operation hours

Function:

Viewing of evaporator fan operation hours.

Value:

Shown as hours.

R04 Viewing of condenser fan operation hours

Function:

Viewing of condenser fan operation hours.

Value:

Shown as hours.

R05 Viewing of heater operation hours

Function:

Viewing of heater operation hours.

Value:

Shown as hours.

R06 AirEx motor sw times

Function:

Total run time.

Value:

Hours.

R07 Vacuum pump

Function:

Total number of vacuum pump run time.

Value:

Hours.

11.23 Configuration

F01 Container ID viewing

Function:

Viewing of container ID.

Value:

Shown in the lower display line e.g. MCID 000 001 2.

F02 Software version viewing

Function:

Viewing of software version and revision.

Value:

-

F03 Compressor FC type setting

Function:

Setting of actual FC type.

Value:

Setting as DANFOSS for Danfoss VLT® and NONE for no FC mounted (see "22. Emergency operation" p. 92).

F04 Compressor frequency converter ID

Function:

Viewing of ID for FC for compressor.

Value:

-

F05 Setting of phase direction

Function:

Setting of phase direction.

Value:

Is only possible when AL423 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 Calibration of air exchange sensor

Function:

Zero adjust of air exchange sensor when the air inlet is closed.

Value:

Actual value of sensor is set to zero when Enter key ↵ is pressed.

F07 Type of low pressure transmitter

Function:

Set the pressure transmitter that is physically mounted for low pressure measurement. Press Enter for 3 sec. to make the selection.

Value:

Select between AKS, NSK or DST.

F08 Type of high pressure transmitter

Function:

Set the pressure transmitter that is physically mounted for high pressure measurement. Press Enter for 3 sec. to make the selection.

Value:

Select between AKS, NSK or DST.

F09 Valve type

Function:

Set the valve type to correspond to physical mounted type.

Value:

R134a only, R134a/R513A.

F10 Model code

Function:

Configure the reefer unit model Value: See table below.

Value:

Function	Water-cooled condenser	CA	AV/AV+
Limit	off/on	off/on	off/on
SCU-40	off	off	off
SCU-40-W	on	off	off
SCU-40-AV+	off	off	on
SCU-40-W-AV+	on	off	on
SCU-40-AV+02	off	off	on
SCI-20	off	off	off
SCI-20-W	on	off	off
SCI-20-AV+	off	off	on
SCI-20-W-AV+	on	off	on
SCI-40	off	off	off
SCI-40-W	on	off	off
SCI-40-AV+	off	off	on
SCI-40-W-AV+	on	off	on
SCI-40-CA	off	on	on
SCI-40-W-CA	on	on	on
SC-MCI140	off	off	off
SC-MCI140-WC	on	off	off

F11 Freshair type

Function:

Fresh air valve type selection.

Value:

35 CMH or 75 CMH.

F12 Starconomy setting

Function:

Configure if Starconomy is available as a control mode.
Configure if Starconomy is as default on or off.

Value:

No Starconomy, Default off, Default on.

F13 Display unit

Function:

Choose between temperature and pressure units.

Value:

C/bar or F/psi.

F15 Config ID

Function:

Only for internal use.

Value:

Only for internal use.

11.23.1 StarConomy

StarConomy is an energy saving function, which uses StarConomy for ventilation control and the Standard temperature control. Under certain conditions, StarConomy is suspended (e.g. temperature is not in range), where the Standard temperature and ventilation control is used instead.

11.24 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 RH
Function:
Humidity sensor.
Value:
Humidity sensor serial no.

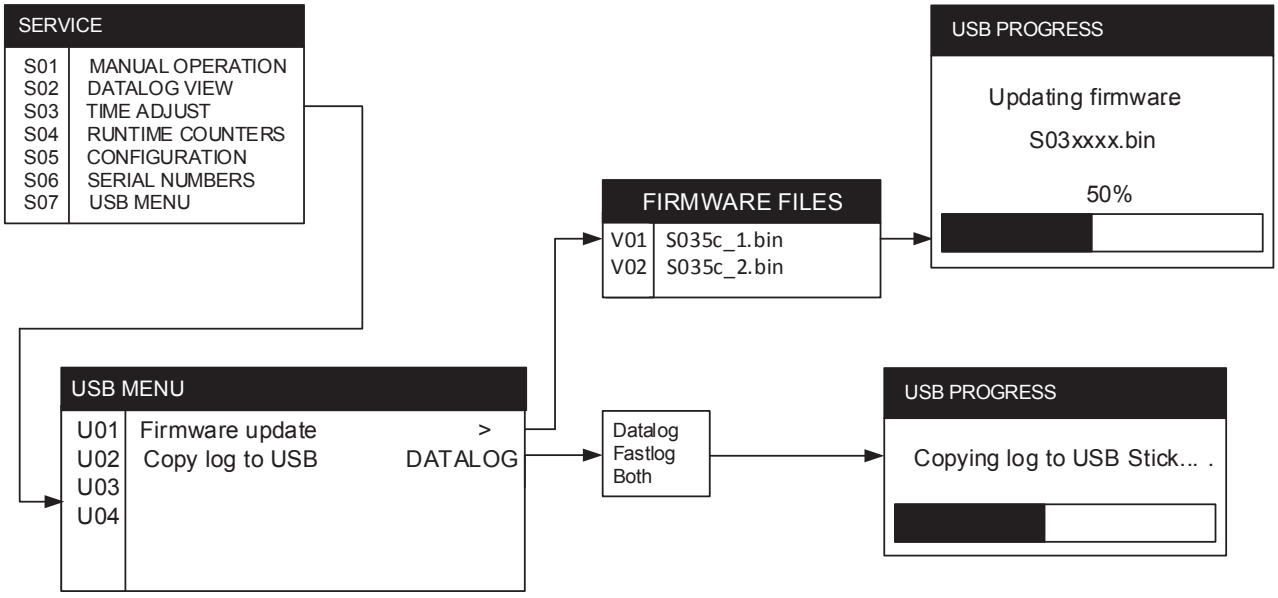
N05 O2
Function:
O_2 sensor.
Value:
O_2 sensor serial no.

N06 CO2
Function:
CO_2 sensor.
Value:
CO_2 sensor serial no.

N07 SSC
Function:
Sub controller.
Value:
Sub controller serial no.

N08 FCCP
Function:
Frequency converter.
Value:
Frequency converter serial no.

11.25 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 datalog/fastlog 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):

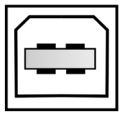
Datalog: SMCIU123.456

Fastlog: FMCIU123.456

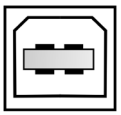
Value:

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



PC

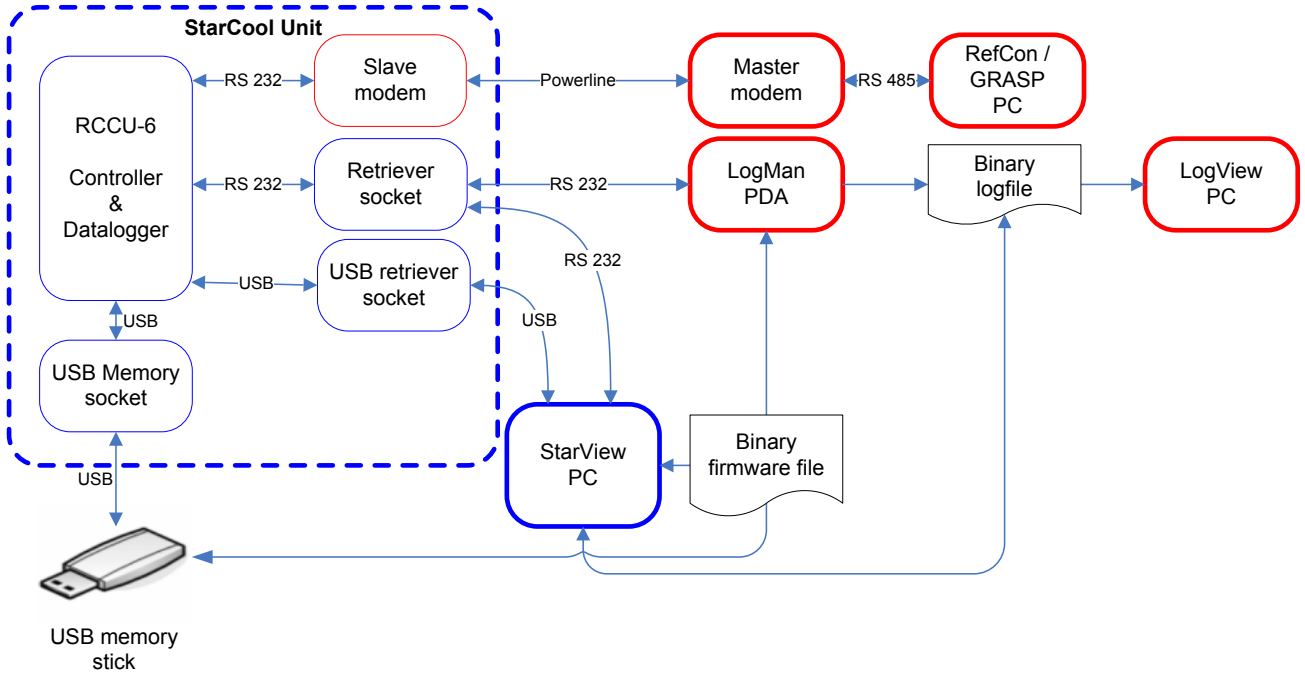


PC

Memory Stick

12. External interfaces

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



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
LogMan	Hand held datalog retriever terminals
LogView	PC software viewer for container datalog files
SCCU6	Reefer Container Controller Unit (Star Control)
RefCon	Powerline based container monitoring system and PC software
RMM	Remote Monitor Modem for power line communication
Star Cool	Reefer container unit name
StarView	PC software Star Cool unit monitor

12.3 Functions overview

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

Function	LogMan	LogView	RefCon	StarView	Controller
Display basic data[1]			x	x	x
Display alarm list			x	x	x
Display controller information			x	x	(x)
Change container ID	x		x	x	x
Change temperature setpoint			x		x
Change humidity setpoint			x		x
Change controller date and time	x		x		x
Change units from °C/Bar to °F/Psi				x	

Calibrate USDA and cargo sensors	x			x	x
Acknowledge alarms				x	x
Initiate manual defrost			x		x
Initiate Trip Start	x		x		
Initiate Function test and PTI			x	x	x
Terminate Function test and PTI			x	x	x
Display Function test and PTI results			x	x	x
Retrieve datalog from unit	x		x	x	
Save datalog file (binary)	x			x	
Save datalog file (RefCon)			x		
Save datalog file (CSV text)				x	
Display datalog file (binary)		x		x	
Display datalog file (RefCon)			x		
Display datalog file (CSV text)				x	
Update controller software via bootloader	x				
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 controllers 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 analyze the behavior of the container unit.

No.	Name	Datalog parameter				
		Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5
0	Temperature setpoint	Old setpoint	New setpoint	n/a	n/a	SW revision
1	Humidity setpoint	Old setpoint	New setpoint	n/a	n/a	n/a
2	Watercool deselect	n/a	n/a	n/a	n/a	n/a
3	Watercool select	n/a	n/a	n/a	n/a	n/a
4	FT start	PTI Test Ver	1: FT 2: CA FT	n/a	n/a	Alarms 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]	Alarms count
8	PTI start	PTI Version	1: Full PTI 2: Short PTI 3: CA PTI	n/a	n/a	Alarms count
9*	PTI step OK	PTI test ID	n/a	n/a	n/a	n/a
10	PTI abort	PTI test ID	n/a	n/a	time [sec]	Alarms 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: 1: Manuel start 2: Ice counter 3: Demand defrost 4: Restarted 5: PTI 6: Motor Overheat	DoD criteria: 0: None 1-x: One of the currently defined DoD counters in RQ's	Defrost type: 0: Air 1: Hotgas 2: El	Ice counter	Actual defrost interval [minutes]
15	Defrost Stop	Tevap at time of execute end	Tret at time of execute end	Time it took Tret to come from -1 °C to 1 °C [sec]	Time it took Tret to come from -2 °C to 2 °C [sec]	Defrost function: 0x8000: Standard 0x4000: Extended 0x2000: Long

16	Trip Start	1: Auto trip-start 0: User trip-start	SW ver. low	SW ver. high	n/a	SW rev.
17	USDA Sensor Calibrated	1: USDA 1 2: USDA 2 3: USDA 3 4: CARGO	Sensor offset (reading of uncalibrated probe in ice water)	n/a	n/a	Compatibility flag 0x8000 = version 1 format
			Old calibration offset - before calibration	New calibration offset - after calibration		Compatibility flag 0x0000 = version 0 format
18	Extended defrost active	0 = Deactivated 1 = Activated				
19	Configuration changed	Interface changing the configuration 0 = StarView, Logman (Communication interface) 1 = Modem 2 = User panel 3 = Auto detect	Par2 contains configuration bitfield 6-7 (MSB) Par3 contains configuration bitfield 4-5 Par4 contains configuration bitfield 2-3 Par5 contains configuration bitfield 0-1 Displayed as 16 characters HEX value			
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	FW version (Least Significant Byte)	FW version (Most Significant Byte)	Vbatt.	Power up count	FW revision
23	Software update	Current FW version (2 Least Significant Bytes)	Current FW version (2 Most Significant Bytes)	New FW version (2 Least Significant Bytes)	New FW version (2 Most Significant Bytes)	
24	FC Software update	Current FW version (2 Least Significant Bytes)	Current FW version (2 Most Significant Bytes)	New FW version (2 Least Significant Bytes)	New FW 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 change	1st: Old	n/a	n/a	n/a	n/a
31	Press sensor type	Old LP	New LP	Old HP	New HP	n/a
32	Parameter change	Source	Parameter id / Telegram id	Old value	New value	n/a
33	Sensor substituted	Substituted sensor	New sensor used	Temperature of substituted sensor	Temperature of new sensor	n/a
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
36	Singlestep ok	Step ID	n/a	n/a	n/a	n/a
37	Service	Bit 1 = Mpump oil changed	n/a	n/a	n/a	n/a
40	ACT initiated	Treatment limit: XX.XX	Treatment setpoint: XX.XX	Probes Used 1: USDA 1 2: USDA 2 4: USDA 3 8: CARGO	Duration: X (in days)	New setpoint: XX.XX
41	ACT started					
42	ACT passed					
43	ACT ramp up					
44	MTS step start	Step number	Step duration	Step setpoint	Step ramp °C/h	Humidity
45	MTS step stop	Step number	0: Normal stop 1: Abort	Step setpoint	Step ramp °C/h	Humidity
46	ACT ramp completed	Treatment limit: XX.XX	Treatment setpoint: XX.XX	Probes Used 1: USDA 1 2: USDA 2 4: USDA 3 8: CARGO	Duration: X (in days)	New setpoint: XX.XX
47	ACT terminated user					
48	ACT failed					
49	Bulb mode active	0 = Deactivated 1 = Activated	RHsetpoint	Fresh air (ventilation)	Defrost termination	Evap fans speed regulation mode
51	CO_2 sensor restarted	CO_2 value before	n/a	n/a	n/a	n/a
52	Software version	FW version (2 least significant bytes)	FW version (2 most significant bytes)	FW revision	n/a	Missing zero crossing (1 count per minute)

53	ACT restarted	Treatment limit: XX.XX	Treatment setpoint: XX.XX	Probes Used 1: USDA 1 2: USDA 2 4: USDA 3 8: CARGO	Duration: X (in days)	New setpoint: XX.XX
54	ACT redefined					
55	ACT terminated defaulting					
68	Power Spike Robustness	Udc value	Udc limit	n/a	n/a	n/a
69	Model code changed	Old model code	New model code	n/a	n/a	n/a
70**	Atm control start	O_2 setpoint	CO_2 Setpoint	Type: O_2 or CO_2	Pump runtime	AirEx switched on total number
71**	Atm control stop	n/a	n/a	n/a	Pump runtime	n/a
72**	Atm setpoint	Old	New	Type: O_2=0 [%], CO_2=1 [%], AirEx exchange rate=2 [m^3/h]	n/a	n/a
73	Module removed	1 = RH 2 = O_2 3 = CO_2 4 = SSC 5 = SPM 6 = SUP 8 = FC	Serial no	Serial no	Serial no	Serial no
74	Module added	1 = RH 2 = O_2 3 = CO_2 4 = SSC 5 = SPM 6 = SUP 8 = FC	Serial no	Serial no	Serial no	Serial no
75**	Calibration finished	2: O_2 3: CO_2	0: Failed, 1: Passed, 2: Failed, and retry started	New O_2 or CO_2 measurement	Old O_2 or CO_2 measurement	n/a
76**	Calibration start denied	2: O_2 3: CO_2	Sensor in session	O_2 or CO_2 measurement	Pmem	Reason for calibration deny: 1=Wrong sensor type, cal not supported 2=Measurement is good, cal not neeeded 3=Measurement is bad, change sensor 4=Pressure outside interval 5=No measure-ment possible/no sensor online
77	Controller moved	Number of changed SN's	Change bitmask	0	0	0
78	CO_2/O_2 Concentration Wrong	Sum of CO_2 and O_2 concentration	CO_2 concentration	O_2 concentration	n/a	n/a
79	GE CO_2 Sensor Debug Values	Temperature	Voltage	Zenith	Nadir	Mode
80	FDIH data	Validationscore Tsup1 (LowByte) Validationscore Tsup2 (HiByte)	Validationscore Tret (LowByte) Validationscore Tevap (HiByte)	Validationscore Tsuc (LowByte) Reliability (HiByte)	FDIH active	Mechanical conditions for reliability decrease
87	USB log recovered	1	Number of recoveries done	Number of loggings made up to recovery	n/a	n/a
88	Flushing mode	0: Deactivated 1: Activated	n/a	n/a	n/a	n/a
89	ITI step OK	Step ID	n/a	n/a	n/a	n/a

90	Debug (intern. use)	1:Alarm system info (obsolete) 2:Watchdog timer err 3:O_2 sensor cleaning 4:O_2 sensor alarm (obsolete) 5:EXV state error (obsolete) 6:O_2 internal alarm 7:CO_2 Sensor RefComp 8:Dataflash overload warning 9:USB logging 10:StarInject issue 11:Tint invalid	Task number Started (1) / Stopped (0) O_2 Alarm count CO_2 ppm diff before and after Written Bytes per second 0=Stopped 1=Started	0 = Recovered, 1 = Warning n/a O_2 Sensor Status CO_2 before value (signed ppm) Written bytes per second Limit value	Tick count n/a O_2 Errorcode CO_2 after value (signed ppm) File beeing written	Tick count n/a O_2 Errorcode CO_2 after value (signed ppm) File beeing written
92	Database updated	ErrorFlag	ErrorIndex	n/a	n/a	n/a
93	ITI BYPASSED	n/a	n/a	n/a	n/a	n/a
94	UDO channel statistics	UDO channel Bit1=K2 CCW Bit2=K3 Hevap Bit3=K4 Mcond Low Bit4==K5 Mcond High Bit5=K6 Mevap Low Bit6=K7 Mevap High Bit7=K8 CW Bit9=Veco Bit10=Vexp Bit11=Vhg Bit14=K9 Mpump Bit15=K10 Mheat	Active time [Minutes]	Active/failure time [Minutes]	Idle time [Minutes]	Idle/failure time [Minutes]
97	FC Silent Alarm	Alarm code that is treated silently	Fact (6sec)	IFC (6sec)	Psuc (6sec)	Pdis (6sec)
98	Power adjusting	0 = Inactive 1 = Active	n/a	Actual Fcpr	Udc	Power supply frequency

(*) 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 description and their causes.

- 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.

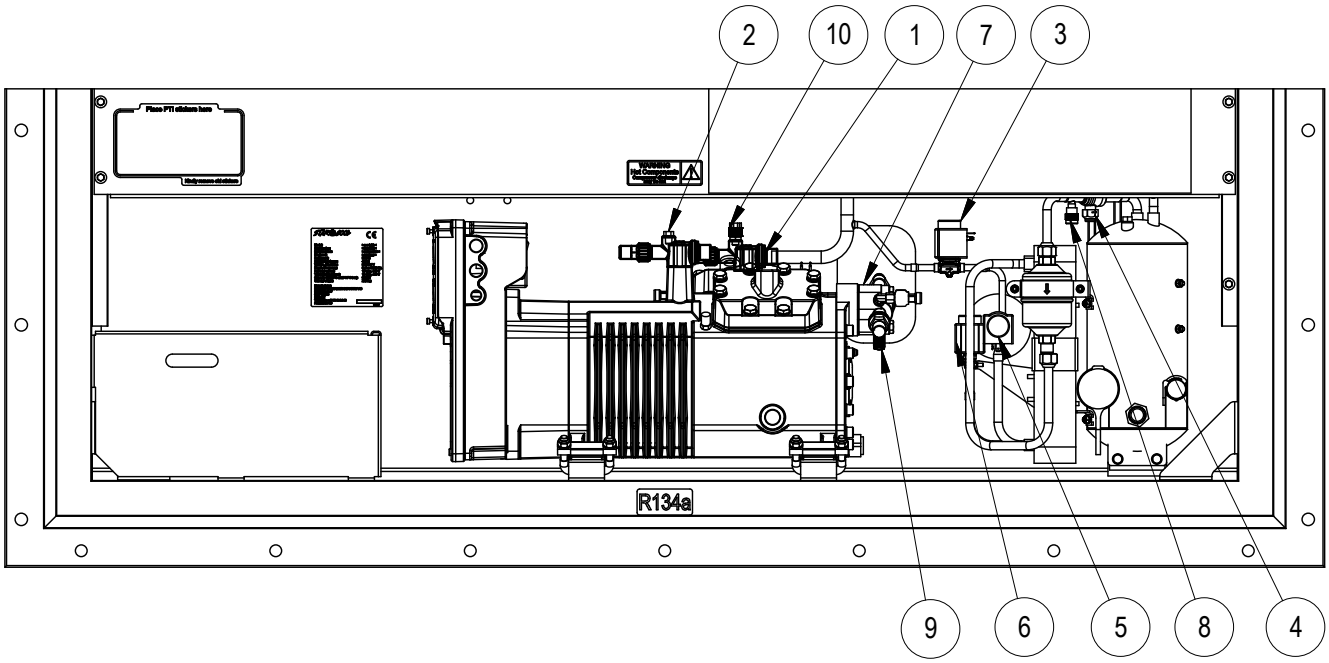
Id	Display text	Description	Alarm type
1. Temperature sensor alarms			
102	Tret invalid	Return air temperature sensor invalid	Alarm
105	Tsup 1 invalid	Supply air temperature sensor 1 invalid	Alarm
108	Tsup 2 invalid	Supply air temperature sensor 2 invalid	Alarm
111	Tusda 1 out of range	USDA 1 temperature sensor invalid	Log
114	Tusda 2 out of range	USDA 2 temperature sensor invalid	Log
117	Tusda 3 out of range	USDA 2 temperature sensor invalid	Log
120	Tcargo out of range	Cargo temperature sensor invalid	Log
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	Tpump invalid	Vacuum pump temperature sensor invalid	Alarm
146	PTI recommended	Reliability calculation signals something is wrong	Log
148	Tsup error	Supply air temperature error	Alarm
2. Pressure transmitter alarms			
203	Pdis invalid	Compressor discharge pressure transmitter invalid	Alarm
207	Psuc invalid	Compressor suction pressure transmitter invalid	Alarm
214	Pmem invalid	Also activated by alarm 977, 978 (voltage reference fault)	Alarm
250	Config Psuc/Pdis	Wrong suction pressure transmitter	Alarm
3. Other sensors			
302	RH invalid	Relative humidity sensor invalid	Alarm
303	AirEx invalid	Air exchange sensor short circuit	Alarm
306	HPS switch - K1	High pressure switch is active	Fatal alarm
310	CO_2 sensor invalid	CO_2 sensor communication missing	Alarm
313	O_2 sensor invalid	O_2 sensor communication missing	Alarm
314	Replace CO_2 sensor	Replace CO_2 sensor	Warning
315	Replace O_2 sensor	Replace O_2 sensor	Warning
4. Power alarms			
400	Mevap 1 over heat	Evaporator motor 1 overheat	Fatal alarm
401	Mevap 2 over heat	Evaporator motor 2 overheat	Fatal alarm
402	Mcond over heat	Condenser motor overheat	Fatal alarm
403	Mpump over heat	Vacuum pump motor overheat	Alarm
415	Over voltage	U1-2 and U1-3 and U2-3 overvoltage	Fatal alarm
418	Under voltage	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
5. FC alarms			
501	FC local control	FC setting in local mode	Alarm
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	P3000 only	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
601	No watercooling	Water-cooling fault	Alarm
603	In range fault	In-range fault	Fatal alarm
607	AirEx open	Air exchange valve open in conflict with settings	Alarm
608	Config AirEx Type	Air exchange type missing	Alarm
610	Defrost time exceed	Max. defrost time exceeded	Log
611	Too many sensor err	Too many (controlling) sensors have errors	Log
621	Cpr restarted	The compressor has been restarted	Log
623	Loss of cooling	Attempts to cool down but Tsup is above Tret	Fatal alarm
624	Config valve type	System identifies controller was changed	Alarm
630	Manual phase dir	Manually selected phase direction	Warning
650	O_2 low	The O_2 sensor measures low O_2 levels in container	Alarm
651	CO_2 high	The CO_2 sensor measures high CO_2 levels in container	Fatal alarm
652	Vacuum fault	Vacuum pump unable to reach the required pressure	Alarm
653	Mpump heat element	Vacuum pump operating temperature is low	Alarm
654	Mpump temp high	Motor for vacuum pump is overheated	Alarm
656	Mpump service	Vacuum pump needs an oil change	Warning
657	Mpump start failure	Vacuum pump operating in wrong direction	Fatal alarm
660	Check coil	Coil(s) acting suspicious	Warning
661	Check contactor	Contactor(s) acting suspicious	Warning
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
730	No RH sens com	RH sensor is missing	Log
740	No CO_2 sens com	CO_2 sensor is missing or communication lost	Log
750	No SSC com	CA module is missing or communication is lost	Log
760	No O_2 sens com	O_2 sensor is missing or communication lost	Log
8. Test alarms			
800	Func test failed	Function test fault	Warning
801	Controller	Controller internal voltage reference fault	Warning
802	AirEx Open	Manual air exchange is opened preventing other function tests to succeed	Warning
805	Idle current	Unit idle overcurrent fault	Warning
810	Mevap cur LO speed	Evaporator motor low speed current fault	Warning
811	Mevap cur HI speed	Evaporator motor high speed 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
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
826	Hpump current ON	Heat vacuum pump too high or too low	Warning
827	Hpump current OFF	Measured current is too high when heater is turned off	Warning
830	Mpump current error	Mpump current failure	Warning
831	Pmem sensor	Pmem above or below 1000 mBar (±60 mBar) after Mpump off for 300 sec.	Warning
832	CO_2 sensor	No reading or value above 1%	Warning
833	O_2 sensor	No reading or value out of range	Warning
836	Pmem vacuum	Unable to create vacuum	Warning
837	Pmem ambient	Not measuring Pmem pressure 1000 mBar (±60 mBar)	Warning
838	Mpump ON current	Current failure	Warning
839	Mpump OFF current	Current in off position is too high	Warning
840	Valve leaks	Valve leak fault	Warning
841	K1 contactor welded	Contactor damaged (always drawn) making FC always powered	Warning
842	Expansion valve	Expansion valve fault	Warning
844	Hot gas valve	Hot gas valve fault	Warning
846	FC check	FC internal fault	Warning
847	High press switch	High pressure switch fault	Warning
848	Temp press invalid	Temperature and pressure sensor malfunctioning	Warning
849	Valve error	Check that compressor can operate valves failed	Warning
850	PTI test failed	PTI test fault	Warning
851	Alarm is active	Active alarms turning ITI checkmark off	Warning
855	PTI Tset 5	PTI 5°C set fault	Warning
860	PTI Tset 0	PTI 0°C set fault	Warning
861	Broken valve plates	Compressor mass flow indicates valve plate has become defect	Warning
862	LowRefrig/ExvBlock	Compressor mass flow too low	Warning
863	Expansion valve leak	See alarm 840 and 842	Warning
864	ExValveLeak/ValvePlate	See alarm 840, 842, and 861	Warning
870	PTI defrost	PTI defrost fault	Warning
880	PTI Tset -18	PTI -18°C set fault	Warning
884	Psuc invalid	See alarm 207	Warning
885	Tsup1 invalid	See alarm 105	Warning
886	Tsup2 invalid	See alarm 108	Warning
887	Tevap invalid	See alarm 123	Warning
888	Tsuc invalid	See alarm 126	Warning
889	Tret invalid	See alarm 102	Warning
890	PTI Tset 13	PTI test fault	Warning
894	RH sensor	RH sensor communication missing	Warning
895	CO_2 sensor	The CO_2 sensor communication and CO_2 level are tested	Warning
896	O_2 sensor	The O_2 sensor communication and O_2 level are tested	Warning
897	Hpump broken	Vacuum pump could not be heated	Warning
899	ITI failed	ITI test fault	Log
9. Controller alarms			
900	User stop	User stop was executed from PC-program	Fatal alarm
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

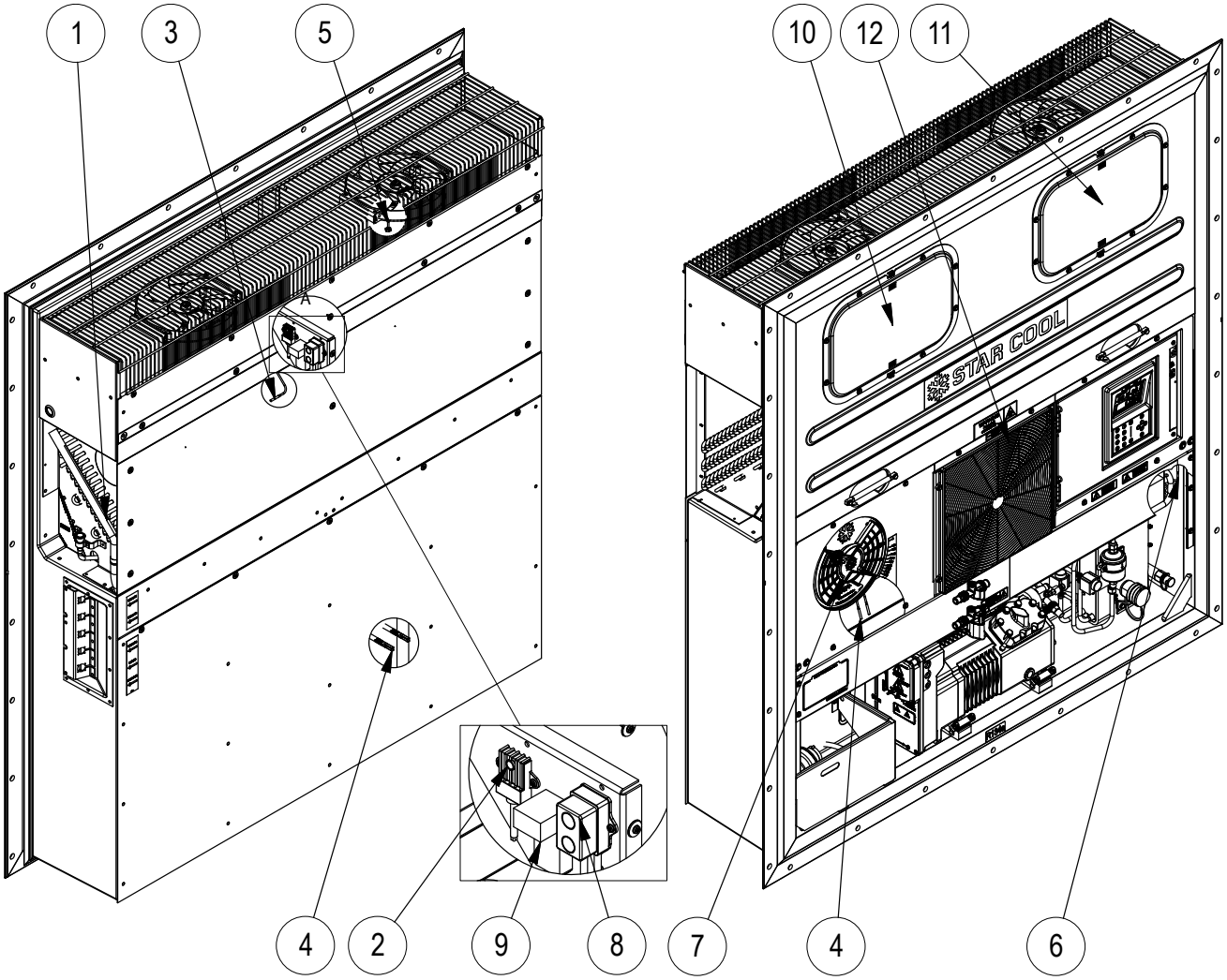
962	Pdis sens sup HI	Controller internal voltage reference fault	Log
963	Psuc sens sup LO	Controller internal voltage reference fault	Log
964	Psuc sens sup HI	Controller internal voltage reference fault	Log
965	Controller sup LO	Controller internal voltage reference fault	Log
966	Controller sup HI	Controller internal voltage reference fault	Log
967	AirExMot sup LO	Controller internal voltage reference fault	Log
968	AirExMot sup HI	Controller internal voltage reference fault	Log
969	AirEx sens sup LO	Controller internal voltage reference fault	Log
970	AirEx 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
977	Pmem sens sup LOW	Controller internal voltage reference fault	Log
978	Pmem sens sup HIGH	Controller internal voltage reference fault	Log
987	Software test ver	Controller internal voltage reference fault	Alarm
989	Software test ver	Software test version	Warning
990	Firmware update fail	Failed to activate firmware	Alarm
991	Config model mode	Model code missing	Alarm
994	Req min SW352-11	The software which has been uploaded to the controller is not compatible with the current hardware version, please use software 0352 rev. 11 or newer	Alarm
995	Contr internal error	Controller module must be replaced	Alarm
998	Could not detect CA	Unable to detect CA	Alarm
999	Keyboard failure	Indication of defective keyboard	Warning

15. Location of valves



Position	Description
1	Discharge service valve
2	Economizer service valve
3	Hot gas valve
4	Manual stop valve
5	Expansion valve, evaporator
6	Expansion valve, economizer
7	Suction service valve
8	Liquid charging valve
9	Evacuation valve
10	Evacuation valve

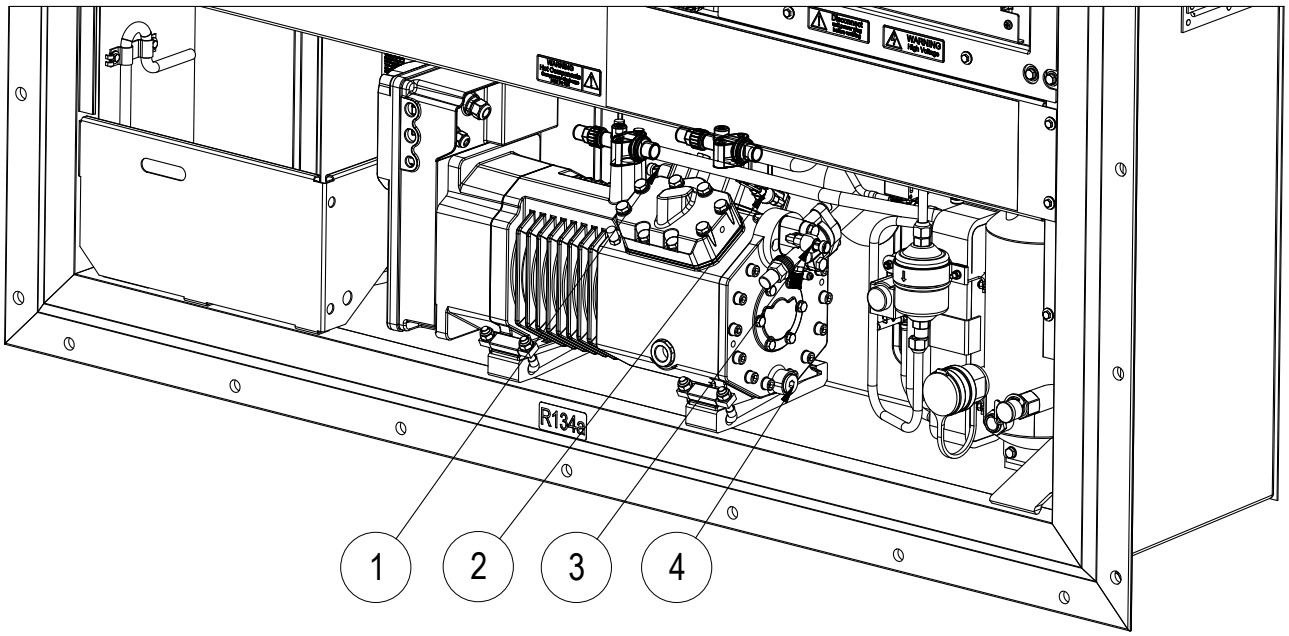
16. Location of motors, temperature sensors, humidity sensor and air exchange potentiometer



Pos	Description	Short name	Quantity	Location	Accessibility
1	Suction temperature sensor	Tsuc	1	Inside	Through inspection hatch
2	Relative humidity sensor	RH	1	Inside	Through inspection hatch
3	Evaporator temperature sensor	Tevap	1	Inside	Through inspection hatch
4	Supply temperature sensor	Tsup	2	Outside	
5	Return temperature sensor	Tret	1	Inside	Through inspection hatch
6	Ambient temperature sensor	Tamb	1	Outside	
7	Air exchange potentiometer	AirEx	1	Outside	Behind fresh air cover panel
8*	Carbon dioxide sensor	CO_2	1	Inside	Through inspection hatch
9*	Oxygen sensor	O_2	1	Inside	Through inspection hatch
10	Evaporator motor no. 1	Mevap1	1	Inside	Through inspection hatch
11	Evaporator motor no. 2	Mevap2	1	Inside	Through inspection hatch
12	Condenser motor	Mcond	1	Inside	Through fan grille

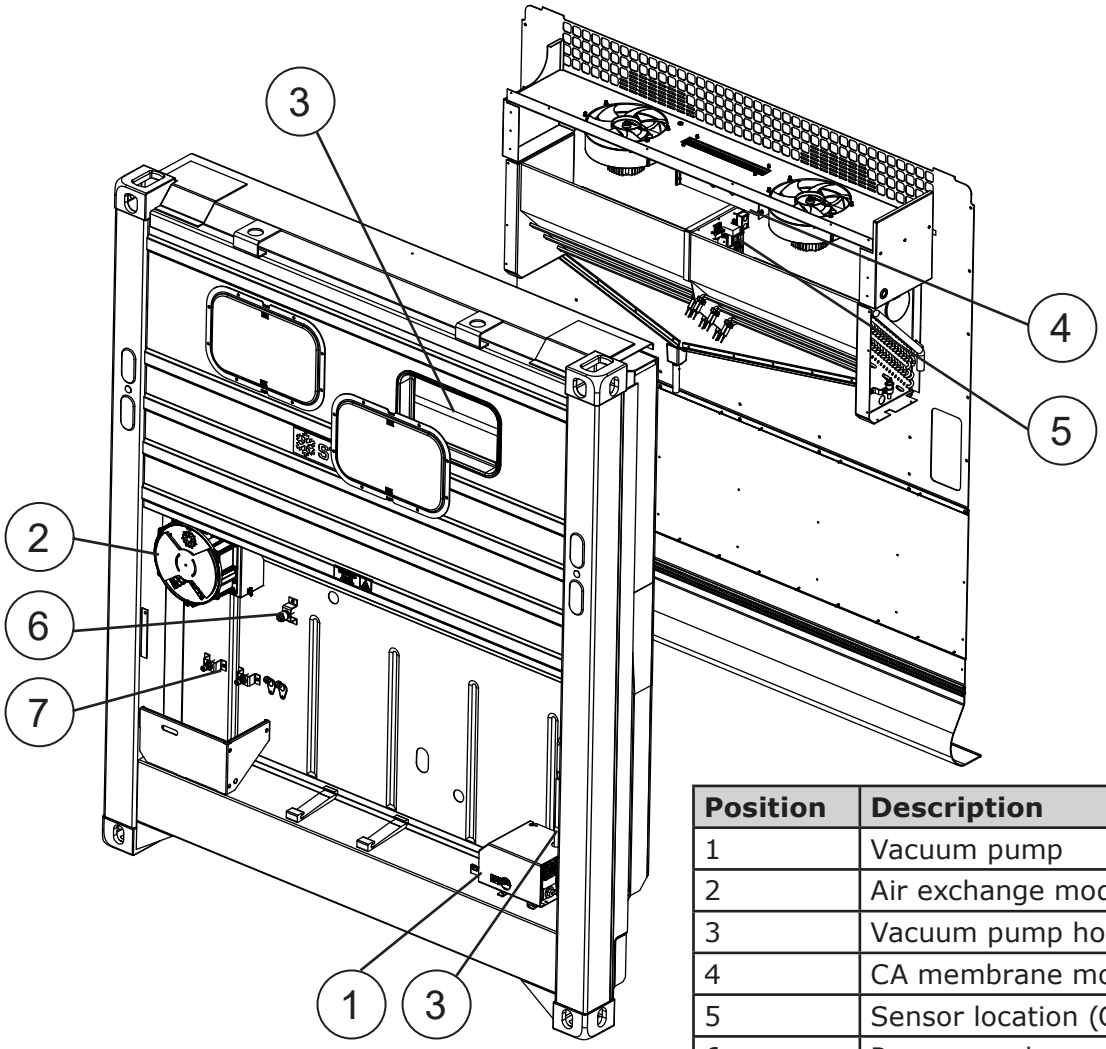
*) Optional

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



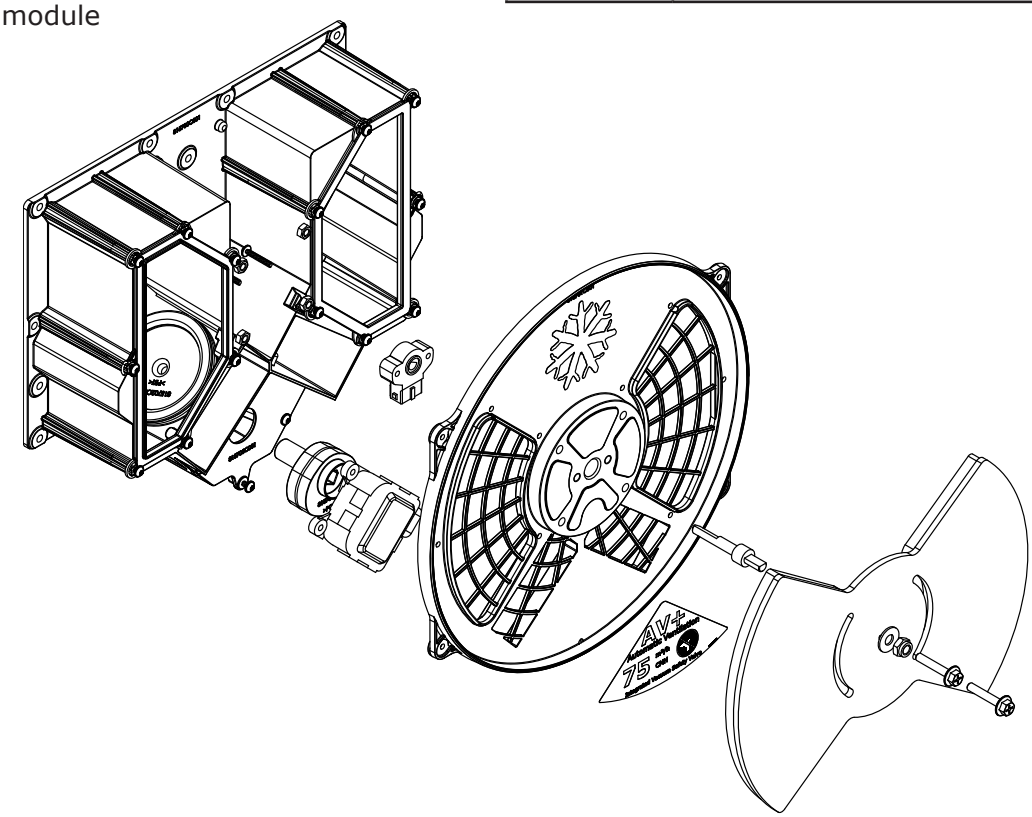
Pos	Description	Short name	Quantity	Location
1	Discharge pressure transmitter	Pdis	1	Outside
2	High pressure switch	Shp	1	Outside
3	Suction pressure transmitter	Psuc	1	Outside
4	Oil outlet port		1	Outside

18. Locations of AV and CA components



Position	Description
1	Vacuum pump
2	Air exchange module
3	Vacuum pump hose
4	CA membrane module
5	Sensor location (O_2 and CO_2)
6	Pressure release valve
7	Injection ports

Air exchange module



CA membrane module

Oil filter

Note: O-ring has to be in place

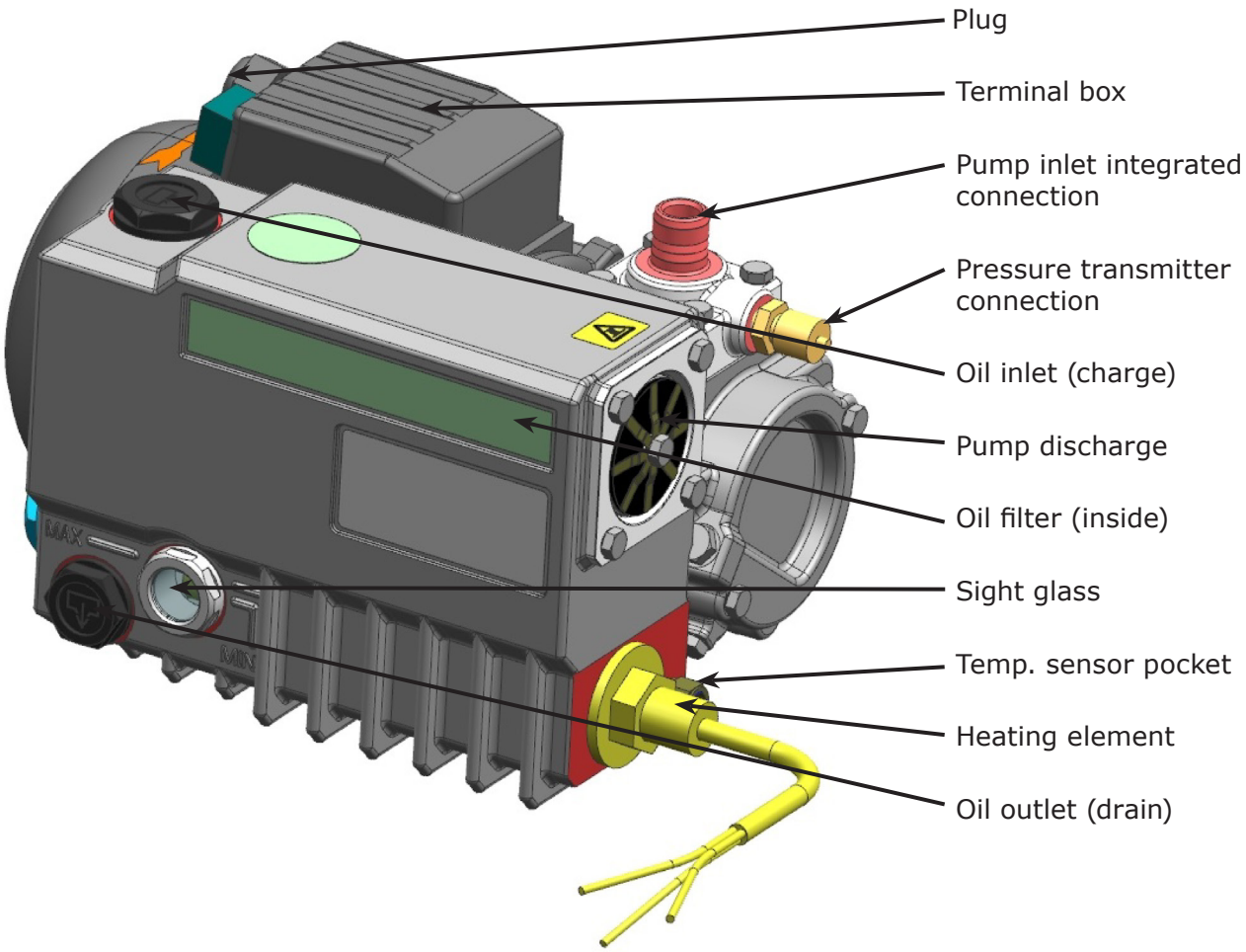
Pressure transmitter

CO_2 sensor

O_2 sensor

Displayed sensors may vary from currently used models

Vacuum pump



Tightening torques for M6 screws on vacuum pump cover shield: 6 Nm
Tightening torques for plugs and heating element: 15 Nm

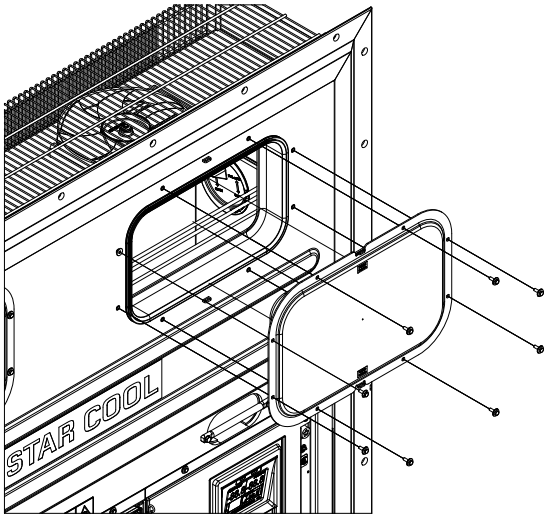
19. Replacements

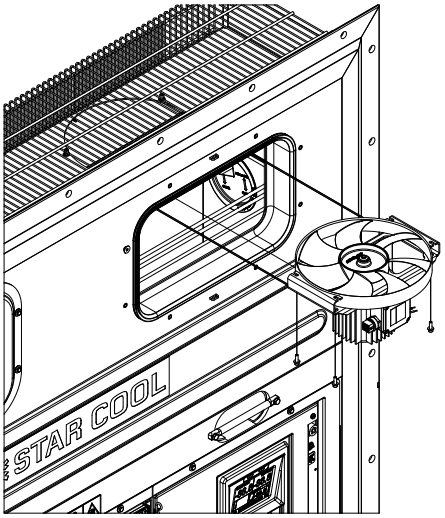
19.1 Replacement of evaporator motor and fan

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

Note: Due to high aerodynamic requirements (decreased energy consumption) beware of sharp edges is located in this area!

Disconnect the power supply to the motor by removing the motor cover and unscrew the earth wire placed directly on the motor. Do not disconnect the other cable connection which is connected directly in the motor cover. Remove the 4 x M6 bolts that hold the evaporator motor bracket, incl. motor and fan. Then the evaporator motor bracket with motor and fan can slide right through the inspection opening of the unit, by dragging it towards yourself.



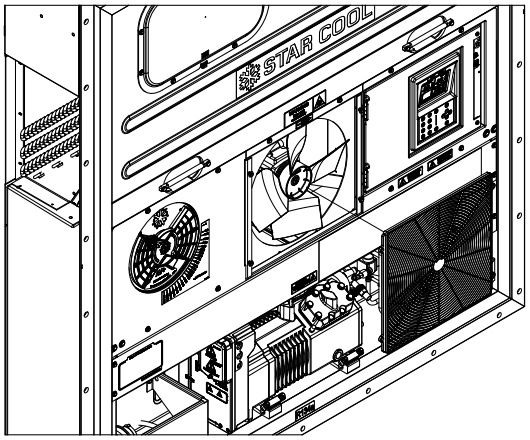


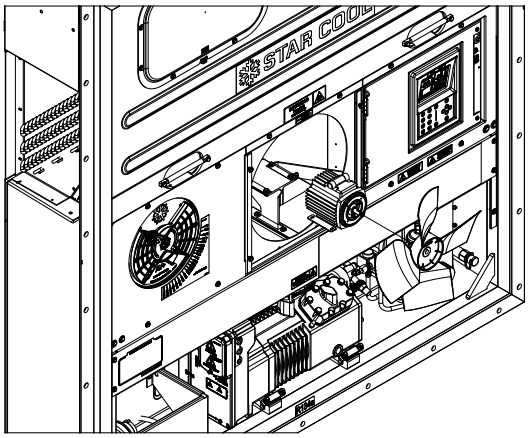
Replace the defective parts and reinstall the evaporator fan module. Prior to mounting the motor cover, check the sealing for any damages. If damaged, the sealing must be replaced.

19.2 Replacement of condensor motor and fan

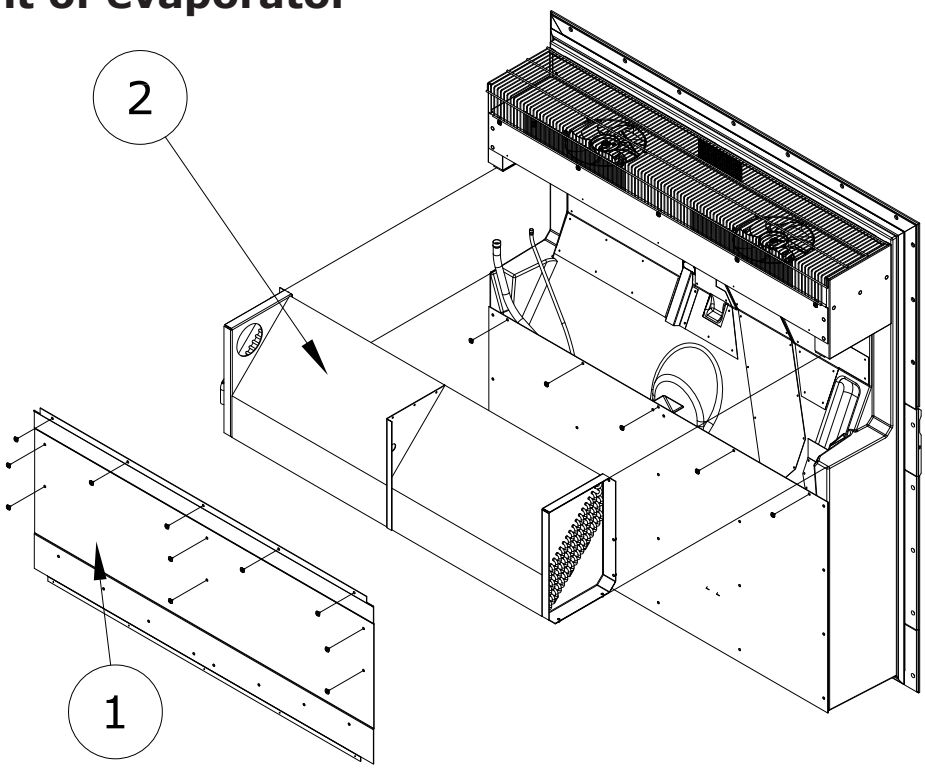
Note: Turn off main power supply for unit before replacing condenser motor and fan.

Remove the condenser grille and disconnect the power supply to the motor by removing the motor cover and unscrew the earth wire, which is placed directly on the motor. Do not disconnect the other cable connection which is connected directly in the motor cover. Replace the defective parts and reinstall the parts. Prior to mounting the motor cover, check the sealing for any damages, if damaged the sealing must be replaced.





19.3 Replacement of evaporator



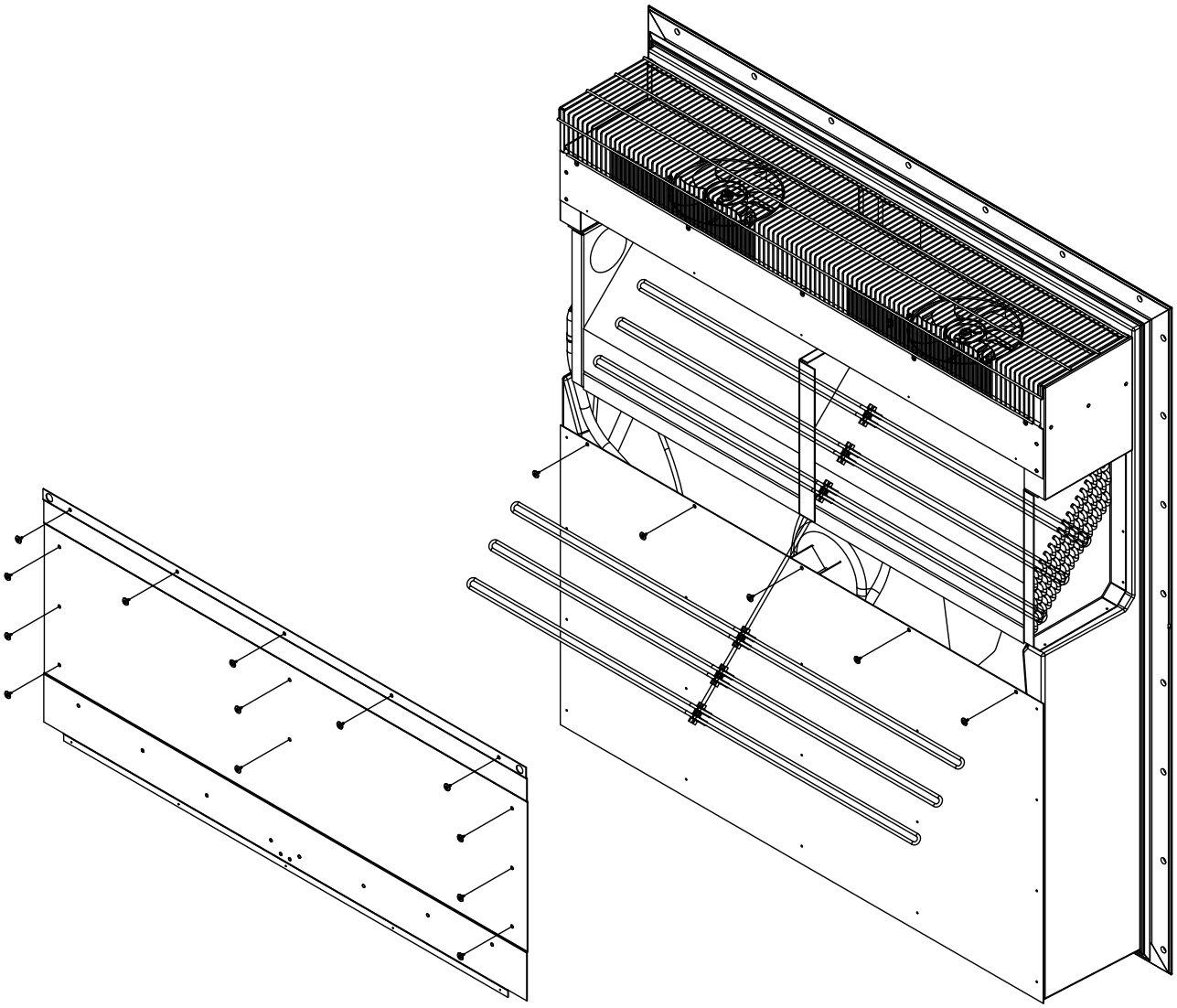
Position	Description
1	Back plate, evaporator
2	Evaporator

The replacing of evaporator is done in the following steps:

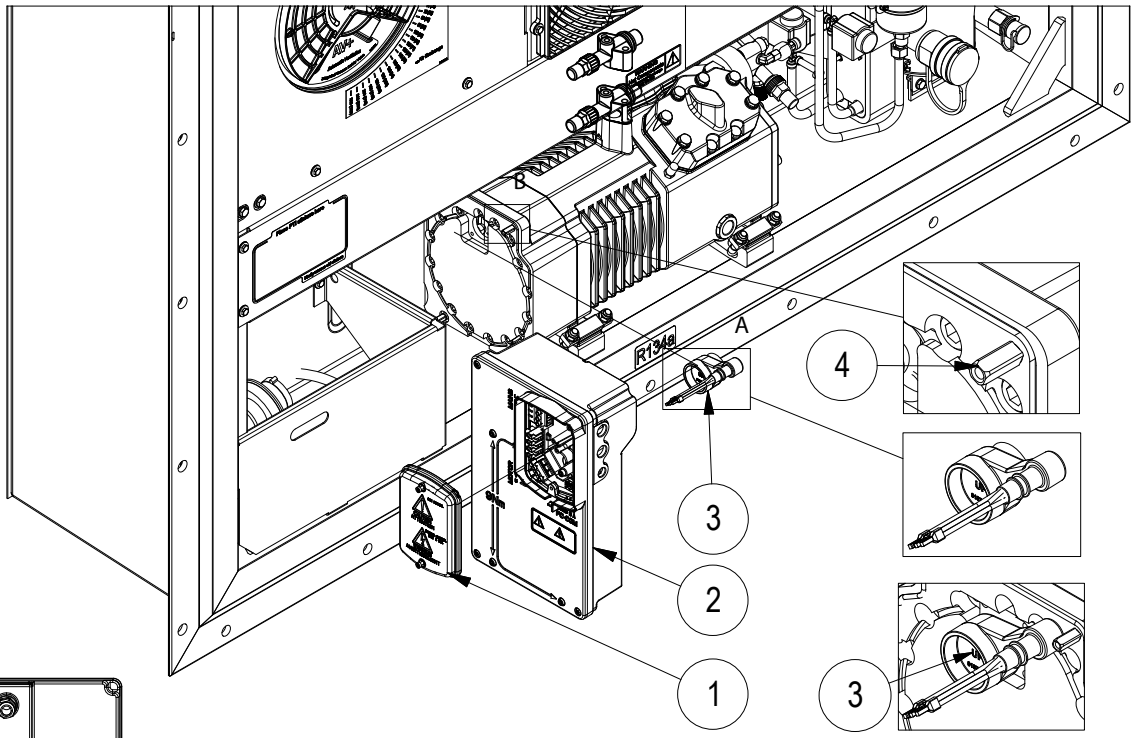
1. Evacuate refrigerant as described in this manual (see "20.1 Evacuation of refrigerant" p. 79).
2. Remove the evaporator back plate (pos. 1).
3. Remove the heating elements below the evaporator (pos. 2).
4. Remove the sensors for evaporator temperature, suction temperature, and humidity.
5. Dismount or cut the suction and liquid pipes for the evaporator (pos. 2) in the correct place.
6. Remove/drill out rivets heads and remove the evaporator (pos. 2).
7. Punch the remaining rivet pieces into the foam using a (max ø5 mm) tool.
8. Mount new evaporator on chassis with appropriate stainless steel rivets.
9. Connect the suction and liquid pipe to the new evaporator.
10. Reinstall the heating elements (see "19.4 Replacement of heating elements" p. 74).
11. Reinstall the sensors for evaporator temperature suction temperature humidity.
12. Reinstall the evaporator back plate (pos. 1).
13. Pump down the unit (see "20.4 Pump down of unit" p. 81).
14. Charge unit as described in this manual (see "20.6 Charging of refrigerant" p. 82).

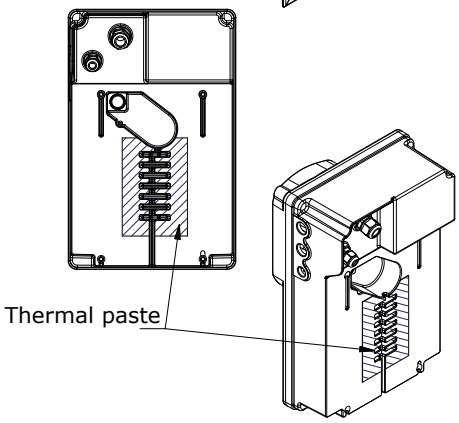
19.4 Replacement of heating elements

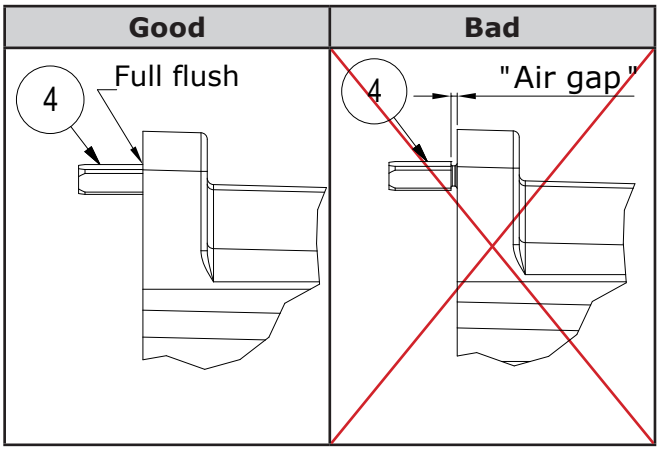
Dismount the upper back plate of the unit and replace the defective heating element. After replacing the heating element, reinstall the back plate of the unit. Please note that the illustrated model may be different from the actual model.



19.5 Replacement of FC



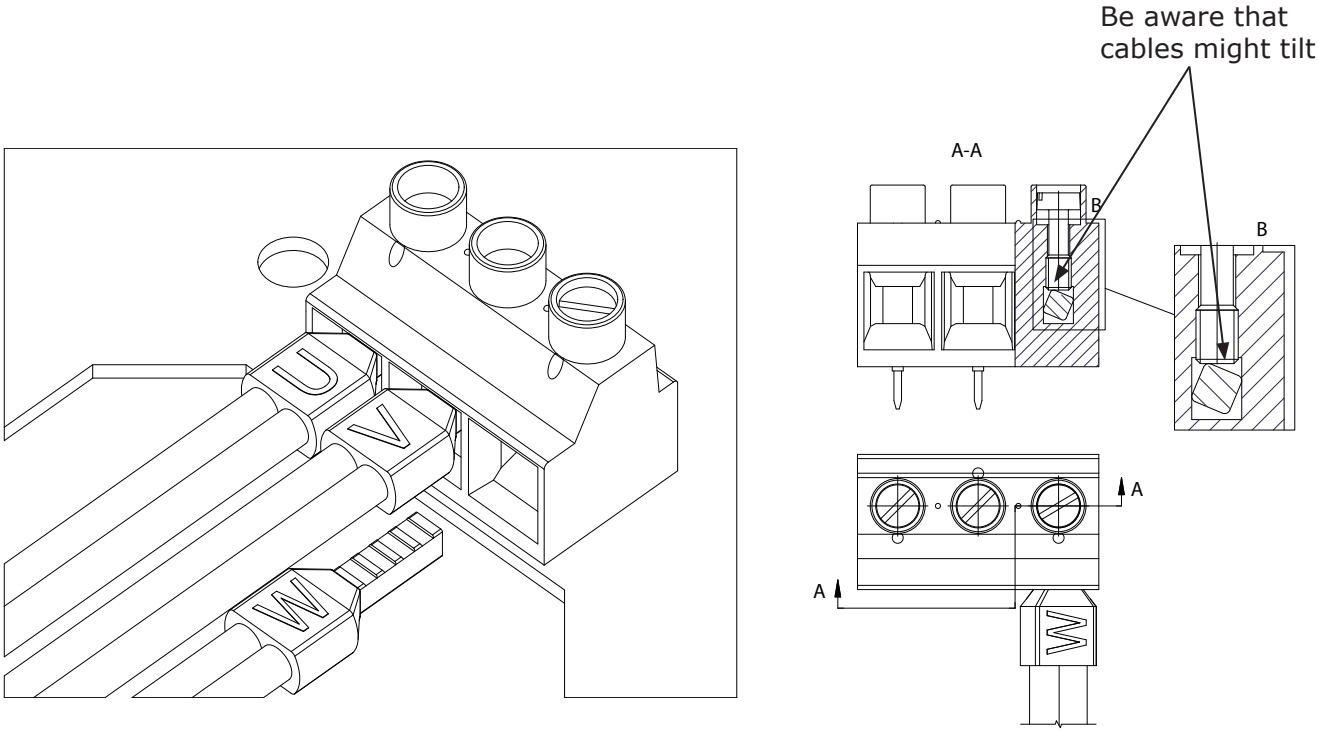




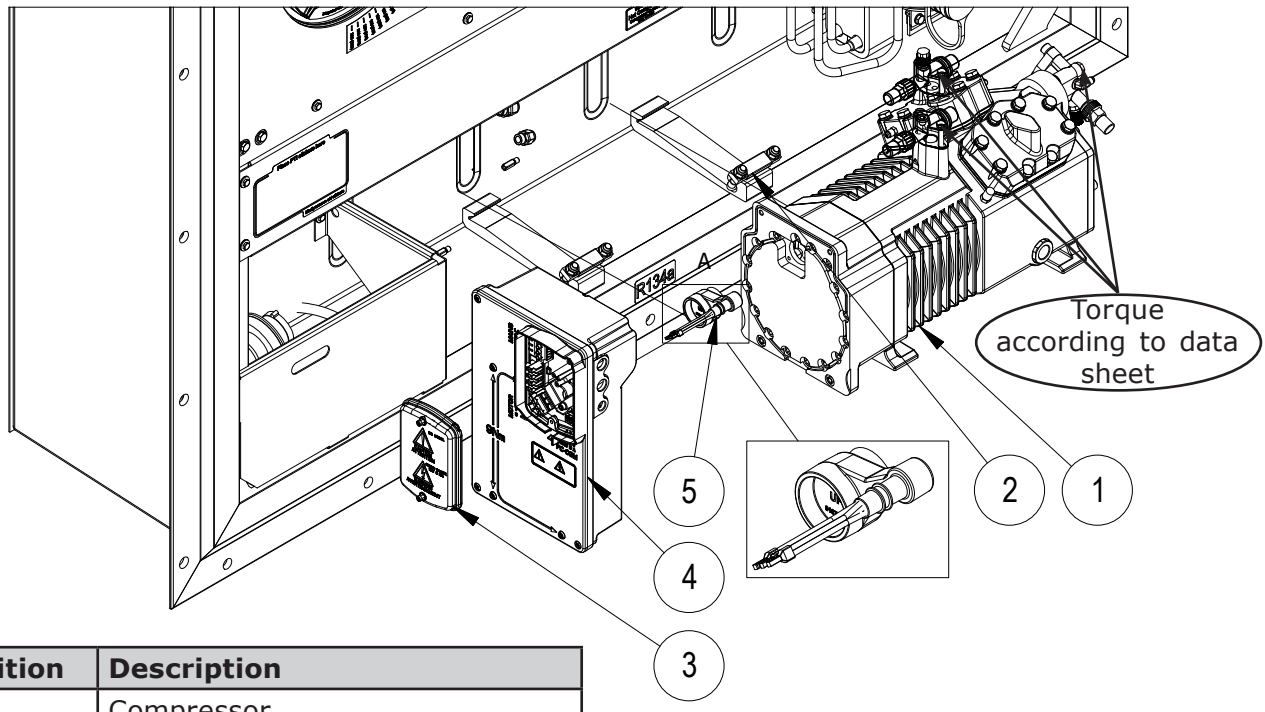
Position	Description
1	Black cover, FC 2.0
2	Frequency converter 2.0
3	Cable, FC 2.0 to compressor
4	Threaded bushing, FC mounting

The procedure for replacing the FC is as follows (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 compressor are straight and tightened correctly before mountung the FC. All 4 studs must be flush to the surface of the compressor.
3. Clean the 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 compressor before the FC is installed.
5. Mount the new FC. Observe that the cable is not squeezed between the compressor and FC. Make sure that there is absolutely no air gap between the FC and the 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.



19.6 Replacement of compressor



Position	Description
1	Compressor
2	Bracket, compressor
3	Black cover, FC 2.0
4	Frequency converter 2.0
5	Cable, FC 2.0 to compressor

The procedure for replacing the compressor is as follows. Please ensure correct tightening torque is used throughout replacement.

If the compressor is NOT running, close all 3 stop valves and evacuate refrigerant, and proceed from point 1. 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.

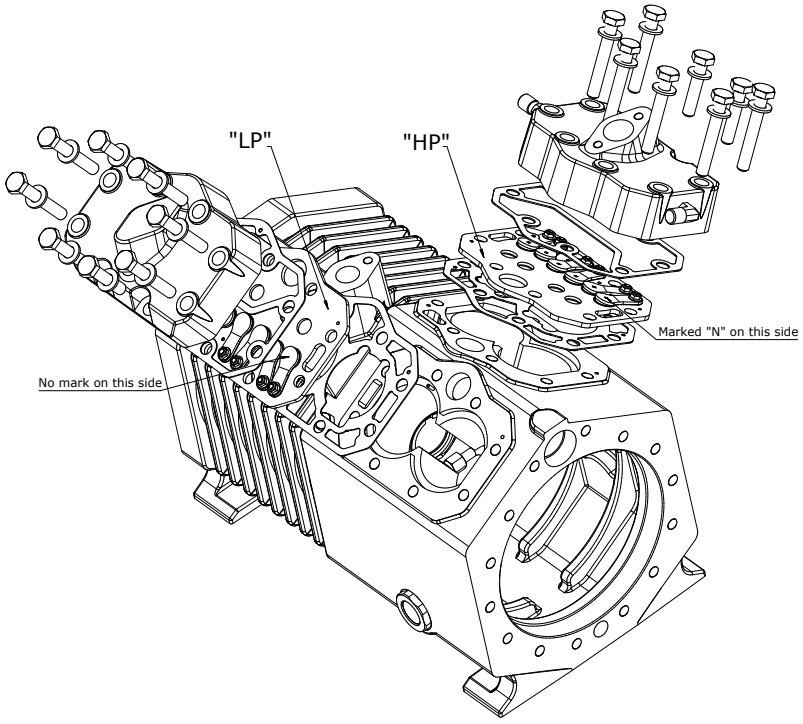
If the compressor IS running but needs replacement, complete the following before going to point 1.

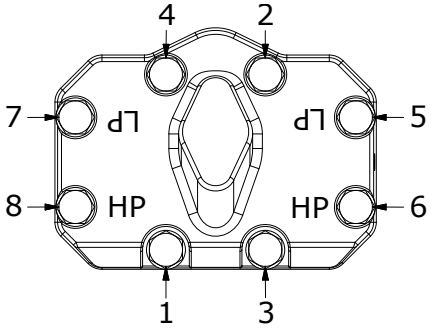
a. Close Veco and Vsuc.
b. Go to the Service menu and select Manual operation and set the compressor freq to 20 Hz.
c. Let the pressure drop to vacuum.
d. Stop the compressor by pressing Off on the controller and closing discharge stop valve.
e. Press wake up on the controller, and read pressure in the corner of the display. Ensure it is 0 Bar.

1. Remove the FC (pos. 4) and the motor cable (pos. 5).
2. Dismount all pressure transmitters and high pressure switch.
3. Loosen all bolts for compressor stop valves.
4. Loosen bracket for compressor and turn it downwards.
5. Slide compressor out.
6. Slide new compressor in place. Observe that the rear compressor foot is inserted firmly into the bracket slot.
7. Reinstall the compressor brackets (but do not tighten).
8. Reinstall all pressure transmitters and high pressure switch.
9. Fasten all bolts for all 3 compressor stop valves. Fasten the compressor brackets!
10. Mount the cable (pos. 5) on the compressor before the FC is installed.
11. Mount the new FC. Observe that the cable is not squeezed between the compressor and FC. Make sure that there is absolutely no air gap between the FC and the compressor.
12. Remove the black cover (pos. 3). 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.
13. Evacuate the compressor before starting up, as described in this manual.

19.7 Replacement of compressor valve plate/cylinder head gasket

1. Depressurize the compressor.
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.





19.8 Replacement of filter dryer

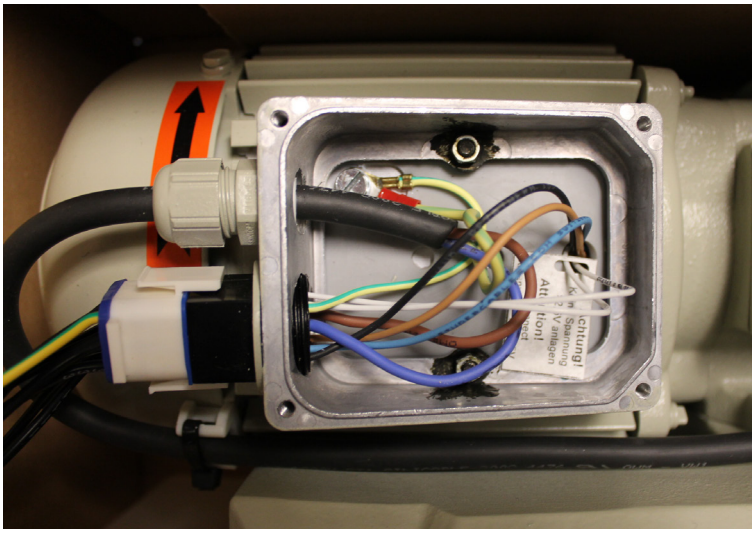
Before replacing the drying filter, the power plug to the unit has to be disconnected.

The drying filter has to be changed every time the compressor is changed or if the moisture indicators indicate too much moisture in the refrigerant circuit. To change the drying filter, please follow the procedure below:

1. Power off the unit.
2. Close the stop valve, pos. 14 (P & I diagram).
3. Start the unit in Manual operation.
4. Select compressor frequency to 40 Hz.
5. Observe the suction pressure (Psuc). When Psuc = 0 BarE, power off the unit.
6. Carefully loosen the two union nuts for the 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 “23.12 Tightening torques” p. 103).
9. Remove the electrical coils and mount permanent magnet on the two electronically expansion valves, pos. 16 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 two electronically expansion valves, pos. 16 and 18 (P & I diagram).
13. Open the stop-valve, pos. 14 (P & I diagram).
14. Power up the unit.

19.9 Replacement of vacuum pump heating element

1. Power off the unit.
2. **Be aware of hot surfaces.**
3. Remove the cover shield from the vacuum pump by the 4 bolts. Dismantle the vacuum pump from its socket. Disconnect the heating element in the terminal box.
4. Tilt the vacuum pump to avoid spilling oil when replacing the heating element.
5. Attach the cables to the terminal box on top of the vacuum pump according to the wiring diagram.
6. Reinstall the vaccum pump and turn the power on.
7. Test performance of the heating element by running a CA PTI.



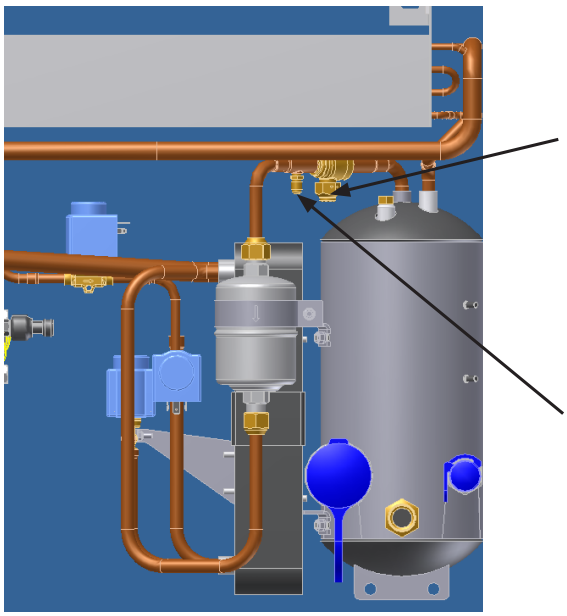
20. Service and maintenance

20.1 Evacuation of refrigerant

Evacuation of refrigerant from the unit is done by the following procedure:

1. Connect a service gauge manifold to the evacuation point, pos. 6 and 27 (P & I diagram) on the 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 compressor:
   a. Remove the electrical coils and install a permanent magnet on the 3 valves pos. 16, 18, and 32 (P & I diagram).
   b. Turn off the unit.
   c. Close and open again, the discharge service valve pos. 5 (P & I diagram) 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 compressor:
   a. Continue operation of the compressor.
   b. Close the economizer service valve, pos. 14 (P & I diagram), and run a pump down of the LP side of the compressor to approx. -0.8 BarE.
   c. Turn off the compressor.
   d. Close the suction service valve, pos. 26 (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.
   e. Check the recovery unit is set for vapour recovery.
   f. Remove the electrical coils and install a permanent magnet on the 2 valves, pos. 16 and 18 (P & I diagram).
   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 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.

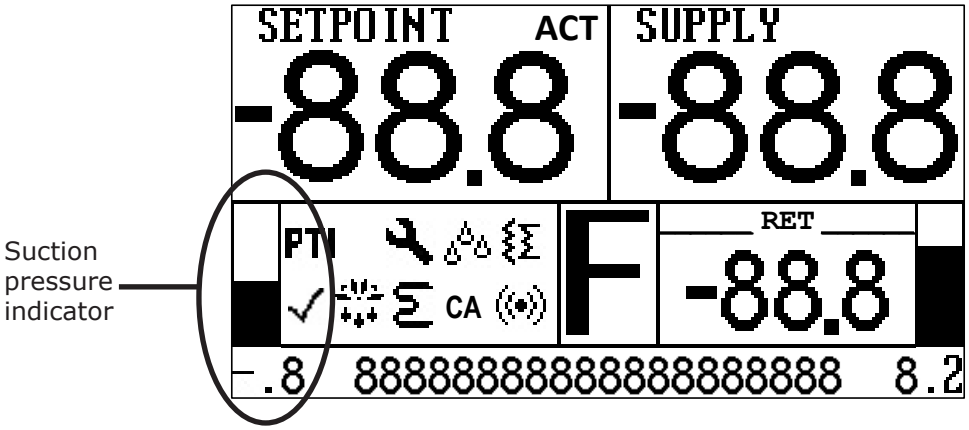
Note: Refer to operating and service manuals for the recovery equipment.



20.2 Compressor pump down and operation

Pump down of the compressor is done by the following procedure:

1. Connect a service gauge manifold to the two evacuation points, pos. 6 and 27 (P & I diagram) on the 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. Close the suction service valve and economizer suction service valve, pos. 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.
4. Close the discharge service valve, pos. 5 (P & I diagram), approx. 4 turns.
5. Run the compressor in Manual operation on 50 Hz, (see "11.19 Manual operations" p. 49).
6. Observe the LP indication until a vacuum of -0.5 Bar/E (-7.3 Psi) has been reached.



7. Turn off the compressor.
8. Close the discharge service valve pos. 5 (P & I diagram).
   a. The evacuation points, pos. 6 and 27 (P & I diagram), are open, when the service valves, pos. 5 and 26 (P & I diagram), are closed.
9. Open the HP valve on the service gauge manifold.
10. Check that the recovery unit is set for vapour recovery.
11. Start and operate the recovery unit as long as necessary to evacuate the remaining pressure.
12. Check the service gauge manifold, should be in a slight vacuum.
13. After disconnecting the evacuation unit, the compressor is now ready to be replaced.

20.3 Compressor pump down (replaced)

Pump down of a new/replaced compressor is done by the following procedure:

1. Connect a vacuum pump with a service gauge manifold to the two evacuation points, pos. 6 and 27 (P & I diagram).
2. Check that all service valves are still closed, 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.
3. Pump down the ambient pressure in the 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. 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.
9. If the vacuum is not maintained, there is a possible leak somewhere. Check all service gauge manifold hoses and connections, between the compressor and vacuum pump. If these are OK, check the compressor and valves for leaks.
10. Disconnect the service gauge manifold and operate the unit as normal.

20.4 Pump down of unit

Main power supply to unit shall be switched off during pump down of unit.

Pump down of unit is done by the following procedure:

1. Connect a service gauge manifold to the evacuation points, pos. 6 and 27 (P & I diagram) on the 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. Close (4 turns only), service valves, pos. 5 and 26 (P & I diagram). (Pos. 30 still full open). 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.
4. Replace the electrical coils with permanent magnet on pos. 16 and 18 (P & I diagram).
5. Check that the recovery unit is set for vapour recovery.
6. Open both service gauge manifold valves (LP and HP).
7. Start and operate the recovery unit as long as necessary to evacuate desired amount of refrigerant from the unit, until there is no pressure left (slight vacuum).
8. Close the service gauge manifold LP/HP valves.
9. Connect and start a vacuum pump.
10. Open the service gauge manifold LP/HP valves.
11. Continue vacuum pumping for at least 2 hours.
12. Switch off the vacuum pump and close all service gauge manifold valves,
13. Observe the vacuum level for minimum 0.5 hour.
14. If the vacuum level is maintained, then the unit can be charged as described in this manual.
15. If the vacuum level is not maintained, there is a possible leak somewhere.
    Perform leak check on vacuum pump & gauge manifold:
    a. Open all service valves complete 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.
    b. Start the vacuum pump, open all service gauge manifold valves run to max. vacuum, (there is no connection to the unit, only your tools are checked).
    c. Close only the service gauge manifold valve which connects the vacuum pump.
    d. Switch off the vacuum pump.
    e. Observe the vacuum level for minimum 0.5 hour, if the vacuum level is OK for vacuum pump and gauge manifold, then the unit has a leak!
    f. Check for leaks (see "20.5 Pressure test" p. 81).

20.5 Pressure test

After performing a major repair to the unit 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. N_2, which is let into the piping system through the two evacuation points, pos. 6 and 27 (P & I diagram). The procedure for this is as follows:

Note: Do not use oxygen (O_2) for a pressure test, but only nitrogen (N_2).

1. Install a service gauge manifold on the unit to the two evacuation points, pos. 6 and 27 (P & I diagram).
2. Close the compressor discharge stop valve and compressor suction stop valve, pos. 5 and 26 (P & I diagram), 4 turns.
3. Connect the pressurized gas bottle (e.g. N_2) to the discharge stop valve of the service gauge manifold.
4. Remove the electrical coils and mount permanent magnet on the two electronic expansion valves, pos. 16 and 18 (P & I diagram).
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 "20.7 Leakage detection" p. 83).
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 "20.7 Leakage detection" p. 83).

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. Do a pump down of unit (see "20.4 Pump down of unit" p. 81).
14. Charge the unit (see "20.6 Charging of refrigerant" p. 82).

20.6 Charging of refrigerant

Always charge refrigerant according to name plate on unit (R134a or R513A). You must NOT mix R134a and R513A, avoid it at all times.

20.6.1 Charging of 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 an empty unit is done by weight, by the following procedure:

1. Pump down unit (see "20.4 Pump down of unit" p. 81).
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, pos. 11 (P & I diagram).
5. Close economizer service valve, pos. 14 (P & I diagram).
6. With an installed service gauge manifold to the evacuation points, LP on: pos. 27 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 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). 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.
16. Remove all tools again.
17. Make sure to install all valve caps again.
18. 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.

20.6.2 Charging of unit low on charge

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:

1. Install a service gauge manifold to the unit, and connect the HP hose to the Liquid charging line, pos. 11 (P & I diagram) and the LP to the closed suction service valve - pos 27 (P & I diagram).
2. 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.
3. Close the economizer service valve, pos. 14 (P & I diagram).
4. Set the refrigerant bottle for liquid charging and open the valve.
5. Open the LP service gauge manifold valve fully, and check the refrigerant bottle pressure (suction service valve pos. 26 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.
6. Operate the unit under normal condition, it will pump down the LP.
7. Open the HP valve on the service gauge manifold to allow refrigerant to enter into the system.
8. 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).
9. Close the refrigerant bottle valve.
10. Close the service gauge manifold valves and remove them.
11. Open the economizer service valve pos. 14 (P & I diagram).
12. Run the unit 0.5 h and check the R134a/R513A level in the receiver.
13. Make sure to install all valve caps again.

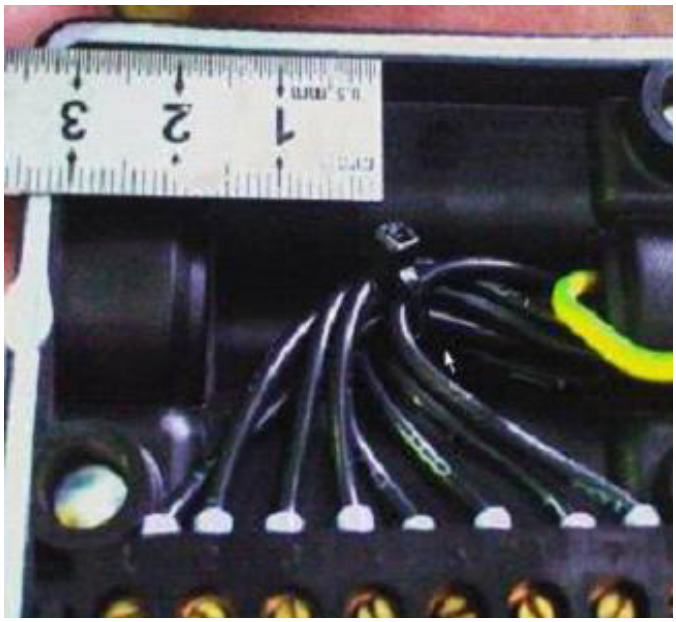
Caution: Do not overcharge the unit. Maximum charge is 4.5 kg of refrigerant. During recovery, observe receiver top sightglass as level indicator.

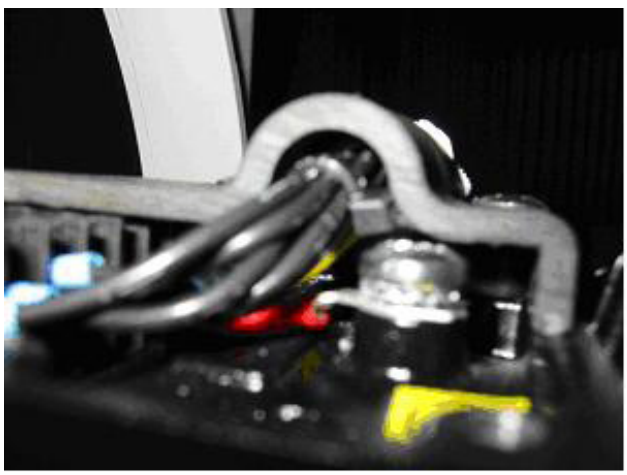
20.7 Leakage detection

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.

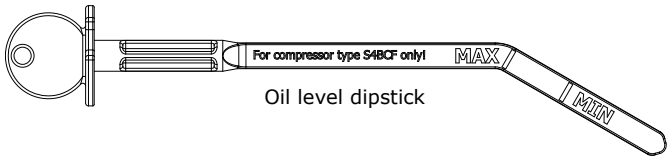
20.8 Fan motors

In order to prevent a single wire from getting caught between the ground screw and the junction box cover, a cable tie collecting all wires except the ground wire, needs to be placed in the center of the junction box. Furthermore, insulation tape must be applied on top of the ground screw. This reduces the possibility of sharp edges on the top of the ground screw damaging nearby wiring.





20.9 Compressor



Oil level dipstick

20.9.1 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 on full Cool mode for as long as possible (minimum 1 hr) before the oil level is checked. If the level is below 1/3 in the sight glass after a period of minimum 1 hour normal operation in Cool mode, additional oil shall be added as described in this manual.

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 set-point 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:
In order to check the oil level in compressors without a sight glass, the below procedure shall be followed.

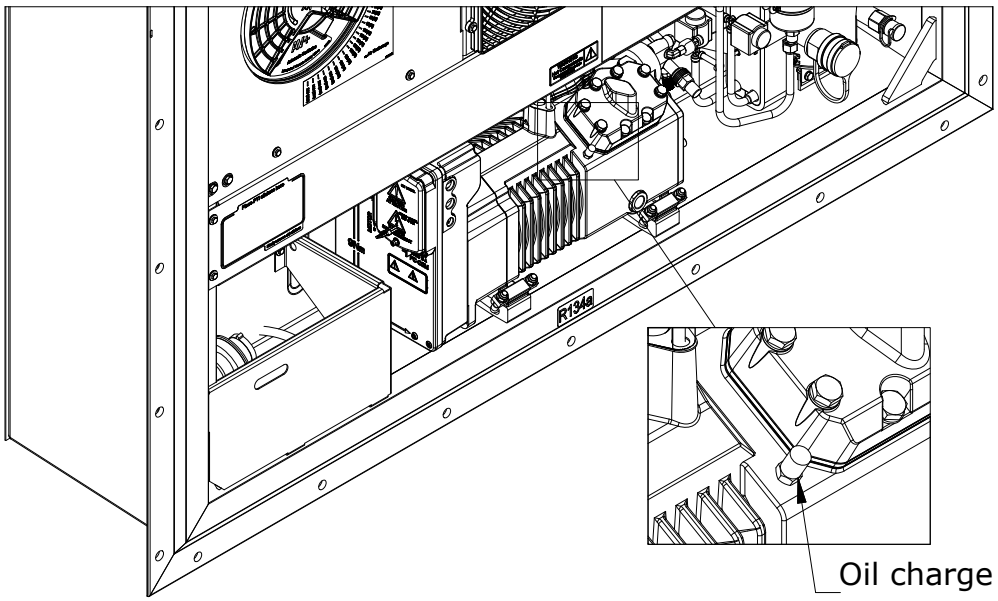
1. Run the unit on full Cool mode as long as possible (minimum 20 min) before the oil level is checked.
2. Pump down the compressor, as described in this manual on p. 90.
3. Remove the oil plug on top of the compressor (left side to the LP valve plate).
4. Use the compressor oil dipstick (Star Cool item 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.

20.9.2 Charging of oil

If during normal operation is has been observed that there is too little oil charge on the compressor, additional oil may be charged. The compressor is filled with 1,5 L Reniso Triton SEZ 55 or equivalent oil from the factory.
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 liter 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.
9. Check the oil level during start up and after 6 hours in normal stable operation.
10. If oil is still missing, repeat above.



20.9.3 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.
14. Observe the oil level when the unit is running minimum 6 hours in a stable condition.

20.10 Soldering

When soldering and desoldering components on the unit, please observe the following:

1. Use the following material for soldering:

   For 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 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.

2. Use wet cloths to protect sensitive valves and other equipment against heat input during soldering and desoldering.
3. Use nitrogen (N_2) as inert backing gas during soldering and desoldering.

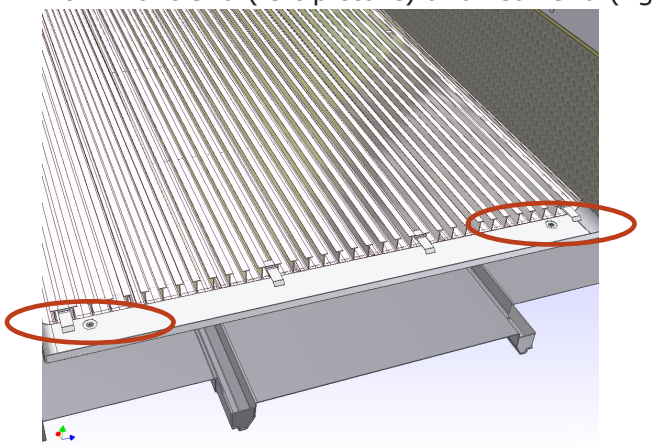
Warning:
Any soldering or de-brazing must ONLY be carried out after recovery of any excess gas/refrigerant in the system. Also make sure to expel oxygen from system to prevent flash-ignition of hot oil. Make sure to comply to local safety regulations and government environmental laws whenever soldering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

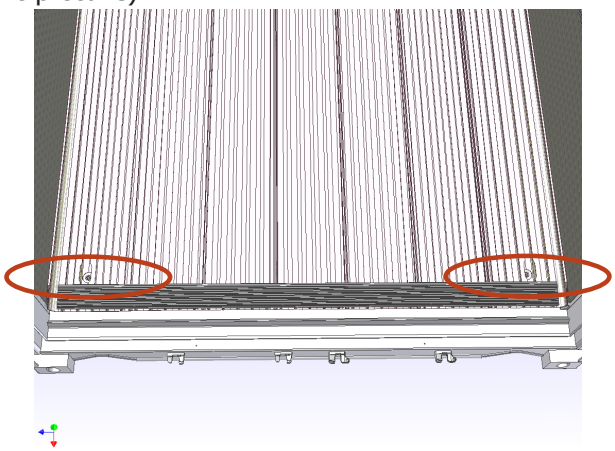
20.10.1 Welding

Do not perform welding on the unit before disconnecting the power plug. Furthermore, disconnect the power measurement module and main controller (and modem if present).

20.11 CA manual inspection

1. Check for structural damages on sides, doors, and roof of the container.
2. Secure tight plugs at each of the floor’s drain plugs, placed near the corners. Cut-out views from front end (left picture) and rear end (right picture):





3. Make sure the service hatches are in perfect condition and installed correctly.
4. Inspect the air exchange module to ensure it is in perfect condition. Make sure the butterfly is operational, kept secured in a closed position, and that the valves are intact.
5. Check the drain hose for any damage.
6. Make sure lead-ins (cables and vacuum hose) are intact.
7. Check that the oil level in the vacuum pump is at max. on the indicator.

After ensuring steps 1-7 the unit is now ready for CA PTI.

20.12 Container leak test

When using the CA system, the box must conform to leak rates in order to maintain control of the O_2 and CO_2 setpoints. The minimum box requirement is a pressure of 500Pa/2” to 250 Pa/1” for 8 minutes or more. It is recommended that it is checked prior to the stuffing. Please see point 5 and 6.

A container leak test needs to be performed:

- After replacing wiring going through the unit
- After replacing hoses and/or piping going through the unit
- After repairing structural damage on the unit and/or container
- After replacing air exchange valve and/or module
- When a container is suspected of leakage

Equipment needed:

- Star Cool test damper
- Test manometer - differential pressure gauge (for instance a Dwyer Magnehelic model 2002)
- CA curtain
- Drain plugs

Method:

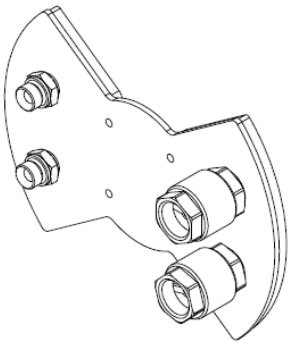
1. Install drain plugs.
2. Install CA curtain properly.
3. Install Star Cool test damper.
4. Connect test manometer.
5. Apply air pressure 500 Pa/2” water column.
6. The air pressure shall remain above 250 Pa/1” water column for minimum 8 min.
7. Close air supply, and perform leak search (with soap water) at the container front and end.

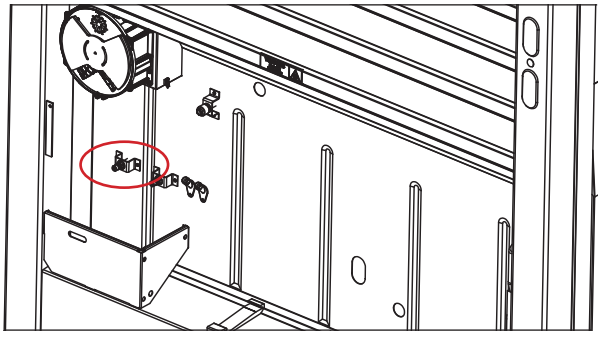
20.13 CA+ flushing

For cargo with low respiration rates, the container must be flushed with nitrogen and carbon dioxide after stuffing.

Liquid or dry nitrogen can be used for this process. However, when using liquid nitrogen, it is vital to use an evaporator between the nitrogen tanks/bottle and the container inlet in order to avoid freezing damage to the cargo.

1. Check that a CA flushing damper is available (item no. 818251B). If the damper is not available, it is possible to use the injection ports found on some unit models. Skip to step 6 if using the injection ports.





2. Press to enter the Service menu. Select line S01 Manual operation. Then change line M01 Operating mode to MANUAL.
3. Remove the original air ventilation damper from the unit.
4. Install the damper for CA flushing (item no. 818251B).
5. Return the unit to Automatic mode. Press to enter the Service menu. Select line S01 Manual operation. Then change line M01 Operating mode to AUTO.
6. Press to enter the Operation menu and change line O13 to ON. This overrides any automatic vent opening in case of out of range gas levels for 4 hours. A countdown clock will be visible in the main display. The unit will automatically go into Normal mode when the time limit is reached.

7. Check that the gas injection tanks/bottle have proper operation handles and pressure gauges in order to control the gas flow correctly.
8. Connect both the N_2 and CO_2 gas tanks/bottles to the damper or injection ports.
9. Monitor the supply temperature throughout the process. It should not be too much below the setpoint (each shipping line has an allowance during the flushing process, however generally the supply setpoint should never be undershot without approval).
10. Inject N_2 until the O_2 level has reached the O_2 setpoint plus 1%. The O_2 level will drop further during CO_2 injection. Note the sensors need some stabilization time. During injection, ensure that the pressure is not too high. The recommended pressure is 120 PSI. If water comes out the drain hose, then the gas injection pressure is too high.
11. Inject CO_2 until the CO_2 level has reached the CO_2 setpoint minus 3%. Note the sensors need some stabilization time. During injection, ensure that the pressure is not too high. The recommended pressure here is 100 PSI.
12. Once the CO_2 level has been reached, stop flushing. Wait for 8 minutes whilst monitoring the gas levels as they stabilize. This is to ensure that the gases are thoroughly mixed and that the controller readings are accurate.
13. If more CO_2 is needed, inject a little more gas.
14. Ensure that there is water in the defrost drain hose.
15. The flushing is now completed. Disconnect the N_2 and CO_2 gas tanks/bottles. If using the CA flushing damper, continue to step 16.
16. When the O_2 and CO_2 setpoints are reached, set the unit to Manual mode. Press to enter the Service menu. Select line S01 Manual operation. Then change line M01 Operating mode to MANUAL.
17. Replace the original air exchange damper so it is fully closed and secured.
18. Return the unit to Automatic mode. Press to enter the Service menu. Select line S01 Manual operation. Then change line M01 Operating mode to AUTO.

20.14 Container venting procedure

To be performed whenever entering a Star Cool CA unit/container

1. Press for Operation mode and select line O03 and set the Air flow mode to "STANDARD".
2. Open the air exchange module fully.
3. Wait for the O_2 level to reach 21% ± 2% before entering.

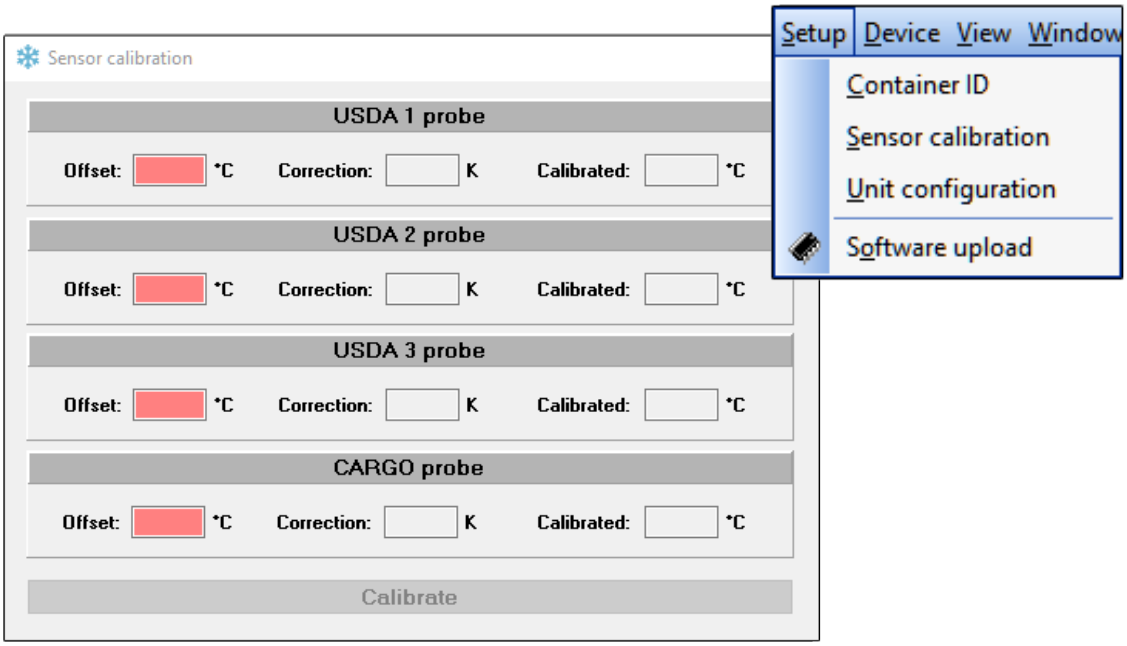
Close the air module and clear AL 607.

20.15 Calibration of air exchange sensor

Air exchange sensor calibration:

1. Close the air exchange cover plate.
2. In the Service menu S05 Configuration, line F06 Air exchange calibration, select START and press the Enter key .
3. Calibration is done.

20.16 Sensor calibration using StarView



When placing the USDA and cargo probes in ice water, they should display 0°C. If any reading deviates from this value the probe requires calibration. Calibration is simply done by looking at the reading for the USDA sensor and then double clicks in e.g. CalUs1. In the popup window enter the calibration value required in order for the sensor to reach 0°C. Then press Enter.

Do this calibration for each of the USDA and cargo sensors. Max. offset calibration is 3K. If more is required, the probe must be replaced.

21. 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, F1 and or F2 are not blown.
   Check the alarm list. Clear all alarms and the causes.
   The unit is wired for emergency operation but the parameter F03 FC type under S05 Configuration in the Service menu is not set to NONE.
   The line F03 under the Service menu is set to NONE for emergency operation but the wires have not been correctly mounted for emergency operation.
2. Unit starts but stops shortly after. Check that the condenser motor is rotating and that the air is blowing away from the unit. Check if the high pressure switch alarm is active in the alarm list. 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 cargo is very warm – it takes a long time to cool it down. 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 hot gas valve may be leaking so that the hot gas is by-passing the condenser and is pumped into the evaporator and heating it up. The 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 compressor 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 compressor through the evaporator. The temperature sensor, Tsuc is not working properly. Check that the sensor is mounted close to the pipe and is placed beneath the isolation. The pressure transmitter, Psuc is not working properly. The evaporator sensor, Tevap is not working properly.
5. Display is blank. Adjust contrast ("11.5 Contrast adjustment of the display" p. 31).

21.1 Trouble shooting for Star Cool the main controller

A method to check if the controller is performing correct readings. If there is a problem with a sensor or a transmitter, the X22, X23, X24, and X25 cable on the main controller must be disconnected to see if the defective is with the sensor/transmitter or the main controller. The procedure is:

1. Set the unit to Manual operation mode by choosing the Service menu, line S01 Manual operation and changing the parameter from AUTO to MANUAL.
2. Disconnect the X22, X23, X24 and X25 cable from the main controller.
3. After a while, enter the Information menu. In here the following values shall appear:
   a. Temperature drops to -70°C
   b. NA
   c. NA
   d. AirEx must read: 0 m^3
   e. Humidity: 0%
4. If one of these listed values does not appear, the main controller must be replaced.

21.2 Trouble shooting the vacuum system

Note: Be aware of hot surfaces when handling the vacuum pump.
The vacuum system consists of a membrane connected with a hose to a vacuum pump. Below you will find a step-by-step method to determine the root cause of a vacuum fault. Please be aware that there can be more than one problem in a vacuum system, and you might need to go through the tutorial several times to eliminate the problem.

A vacuum fault alarm can be caused by a single or a combination of the following points:

1. Insufficient amount of oil in the vacuum pump
2. Defective pressure transmitter (Pmem)
3. Defect or leakage in the vacuum pump
4. Leak in fittings or connections
5. Leak in membrane

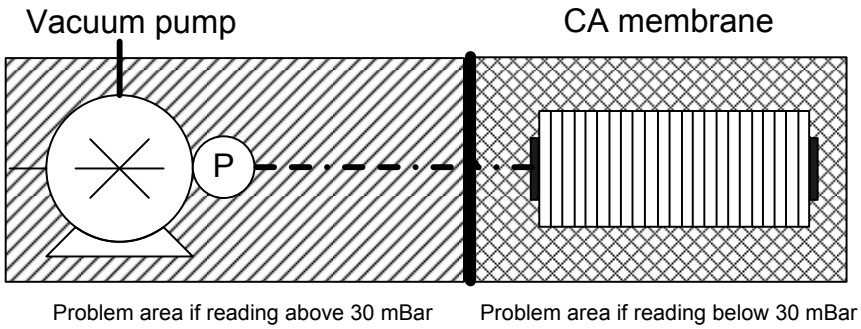
Method to determine the cause:

1. Check the oil level in the vacuum pump. Must be clean and on max. level. Refill if needed.
2. Go to menu structure M10 and turn on the vacuum pump and verify that it rotates in the right direction. If vacuum pump does not activate, see "21.5 Trouble shooting vacuum pump/controller module" p. 91. If the vacuum pump activates proceed to point 3.
3. Disconnect the vacuum hose at the vacuum pump and plug the vacuum pump inlet.
   a. If the pressure is above 30 mBar, proceed to point 4.
   b. A pressure below 30 mBar indicates the vacuum pump is OK, proceed with the following: Connect the hose to the vacuum pump again and ensure the connection is tight.
4. Install a manometer at the transmitter inlet and ensure the reading is similar to the display reading. If not, the pressure transmitter is defect. If pressure is OK, change the vacuum pump. Go to menu structure M10 and turn on the vacuum pump.

   If the vacuum fault alarm is still present, there are two further options:
   a. If the unit is in operation with cargo, do nothing. Either the membrane or the connection to the membrane is leaking. It is not possible to correct this fault during operation, due to the low oxygen level inside the container. Do not enter the container, including opening the service hatches, when the oxygen level is below 20.9%.
   b. If the container is empty, disconnect the vacuum hose at the membrane. Go to menu structure M10 and turn on the vacuum pump and seal off the hose. If readings are:

   Above 30 mBar, see "21.3 Trouble shooting the vacuum hose" p. 91.

   Below 30 mBar, see "21.4 Trouble shooting the membrane" p. 91.



21.3 Trouble shooting the vacuum hose

In case the vacuum hose is defective:

1. Check the hose for leaks. Repair or replace the hose.
2. After repair or replacement of the vacuum hose, see “20.12 Container leak test” p. 87.

21.4 Trouble shooting the membrane

1. Ensure vacuum hose is connected correctly.
2. If this does not solve the problem, replace the membrane.

Please note that this guide only resolves one leak in the system, and may need to be repeated until all potential leaks are fully terminated.

21.5 Trouble shooting the vacuum pump/controller module

1. Check the contactor coil K9.
2. Measure wiring, see wiring diagram.
3. Ensure vacuum pump is between 60°C and 90°C (140°F and 194°F) and engage contactor K9.
   If the pump starts, the controller is faulty.
   If the pump does not start, the pump or motor is faulty.
4. Pull the contactor K9 manually. If the pump starts, replace the controller module.
5. Pull the contactor K9 manually. If the pump does not start, replace the pump.

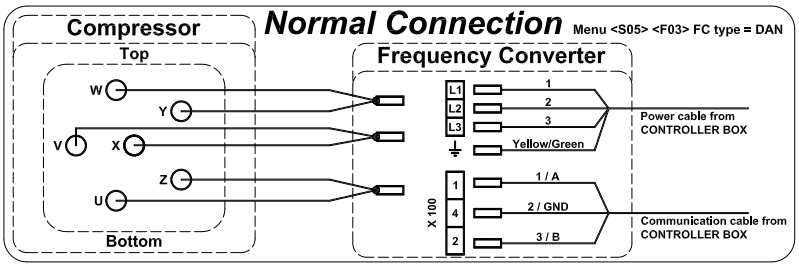
22. Emergency operation

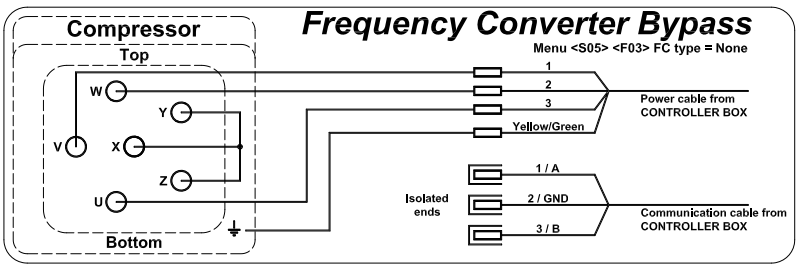
Warning: High voltage. Unit must be disconnected from power. Only to be done by trained personnel.

22.1 FC defective

If the FC is defective and no replacement part is available, the compressor may be run in On/off mode. The defective FC is dismounted and the 3 phases are directly applied to the compressor supply terminals. Also a wire-jumper has to be fitted on the remaining 3 terminals, see below figure.

In the Service menu, under S05 Configuration, select line F03 FC TYPE and set the parameter to NONE. The unit will then run in On/off mode with deteriorated temperature controlling performance. The connection for the FC is shown in the below wiring diagrams:





22.2 Controller defective

If the controller of the unit is malfunctioning or defective and no replacement is available, the unit can be run in an Emergency mode with deteriorated temperature controlling performance. This operation is only recommended for cargo being transported in Frozen mode with a setpoint below -10°C (14°F). If the cargo is transported in Chilled mode, it is recommended that the defective controller is replaced with one from a unit operating in Frozen mode.

The emergency procedure for a unit with a defective controller, running in Frozen mode, is as follows:

1. Dismount the frequency converter and connect the compressor directly to the power supply. Use the contactor in the controller as a main switch for the compressor.
2. Connect the evaporator fans in low speed and the condenser fan in high speed directly to the power supply.
3. Mount a permanent magnet on the electronic expansion valve, pos. 18 (P & I diagram).
4. Install a service gauge manifold on the unit to the two evacuation points, pos. 6 and 27 (P & I diagram).
5. Close the stop valve, pos. 14 (P & I diagram).
6. Energize the fans and the compressor.
7. Carefully open the stop valve pos. 14 (P & I diagram), observing the pressure readings on the service gauge manifold as this is done.
8. For a setpoint temperature of -20°C (-4,0°F) a suction pressure of -24°C (-11,2°F) is to be maintained. In general, the suction pressure (temperature) is to be 5°C (7°F) below the set point temperature. In general, the discharge pressure (temperature) is to be 10°C (18°F) above ambient temperature.
9. If there is ice building up on the compressor, it indicates that there is coming too much liquid back from the evaporator. Close the stop valve, pos. 14 (P & I diagram) slightly.

23. Tables

23.1 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:

No.	Name	Value	Unit
1	Tsupply temperature	Temperature from supply sensor	°C
2	Treturn temperature	Temperature from return sensor	°C
3	Tusda 1 temperature	Temperature from USDA sensor 1	°C
4	Tusda 2 temperature	Temperature from USDA sensor 2	°C
5	Tusda 3 temperature	Temperature from USDA sensor 3	°C
6	Tcargo temperature	Temperature from cargo sensor	°C
7	Tset temperature	Setpoint temperature	°C
8	Humidity %	Humidity from humidity sensor	%
9	AirEx airflow	Airflow from air exchange sensor	m^3/h

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
2	Tsup2	Supply air temperature	°C
3	Tevap	Evaporator temperature	°C
4	Tsuc	Suction temperature	°C
5	Vhg	Hot gas valve opening	%
6	Vexp	Expansion valve opening	%
7	Veco	Economizer valve opening	%
8	SHref	Superheat reference	°C
9	Tint	Internal temperature	°C

Alarms:
Alarms which may occur and a detailed explanation and trouble shooting is described previously in this manual.

23.2 Temperature sensor - resistance table

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

23.3 Temperature sensor – voltage table

Temperature sensors except for reference temperature sensor.
Vcc = 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

23.4 Air exchange sensor table voltage - m³/h for 35 CMH

There is an offset of 0.2 V due to mechanical design. The air exchange must be properly calibrated before measuring.

Voltage [V]	Air exchange [m³/h]	Voltage [V]	Air exchange [m³/h]	Voltage [V]	Air exchange [m³/h]	Voltage [V]	Air exchange [m³/h]
0.20	0	1.45	60	2.25	120	3.35	180
0.30	5	1.50	65	2.35	125	3.40	185
0.50	10	1.55	70	2.40	130	3.50	190
0.65	15	1.65	75	2.50	135	3.60	195
0.80	20	1.70	80	2.55	140	3.65	200
0.85	25	1.75	85	2.65	145	3.80	205
0.95	30	1.90	90	2.70	150	3.85	210
1.05	35	1.95	95	2.80	155	3.95	215
1.15	40	2.00	100	2.90	160	4.00	220
1.20	45	2.05	105	3.00	165		
1.30	50	2.10	110	3.10	170		
1.35	55	2.20	115	3.20	175		

23.5 Air exchange sensor table voltage - m³/h for 75 CMH

There is an offset of 0.2 V due to mechanical design. The air exchange must be properly calibrated before measuring.

Voltage [V]	Air exchange [m³/h]	Voltage [V]	Air exchange [m³/h]	Voltage [V]	Air exchange [m³/h]	Voltage [V]	Air exchange [m³/h]
0.20	10	1.45	85	2.45	145	3.40	205
0.35	20	1.50	90	2.55	150	3.50	210
0.50	30	1.60	95	2.65	155	3.55	215
0.65	35	1.70	100	2.70	160	3.65	220
0.75	40	1.80	105	2.80	165	3.70	225
0.85	45	1.90	110	2.85	170	3.75	230
1.00	50	2.00	115	2.95	175	3.80	235
1.10	60	2.10	120	3.00	180	3.90	240
1.20	65	2.25	130	3.10	185	3.95	245
1.30	75	2.35	135	3.25	195	4.00	250
1.35	80	2.40	140	3.35	200		

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

Vcc = 5 V. Pressure is relative

Voltage [V]	Pressure [BarE]	Pressure [Psi]
	-0,69	-10,01
0,3	-0,65	-9,49
0,35	-0,49	-7,12
0,4	-0,33	-4,75
0,45	-0,16	-2,38
0,5	0,00	-0,01
0,55	0,16	2,36
0,6	0,33	4,73
0,65	0,49	7,10
0,7	0,65	9,47
0,75	0,82	11,84
0,8	0,98	14,21
0,85	1,14	16,58
0,9	1,31	18,95
0,95	1,47	21,32
1	1,63	23,69
1,05	1,80	26,06
1,1	1,96	28,43
1,15	2,12	30,80
1,2	2,29	33,17
1,25	2,45	35,54
1,3	2,61	37,91
1,35	2,78	40,28
1,4	2,94	42,65
1,45	3,10	45,02
1,5	3,27	47,39
1,55	3,43	49,76
1,6	3,59	52,13
1,65	3,76	54,50

Voltage [V]	Pressure [BarE]	Pressure [Psi]
1,7	3,92	56,87
1,75	4,08	59,24
1,8	4,25	61,61
1,85	4,41	63,97
1,9	4,57	66,34
1,95	4,74	68,71
2	4,90	71,08
2,05	5,06	73,45
2,1	5,23	75,82
2,15	5,39	78,19
2,2	5,55	80,56
2,25	5,72	82,93
2,3	5,88	85,30
2,35	6,04	87,67
2,4	6,21	90,04
2,45	6,37	92,41
2,5	6,53	94,78
2,55	6,70	97,15
2,6	6,86	99,52
2,65	7,02	101,89
2,7	7,19	104,26
2,75	7,35	106,63
2,8	7,51	109,00
2,85	7,68	111,37
2,9	7,84	113,74
2,95	8,00	116,11
3	8,17	118,48
3,05	8,33	120,85
3,1	8,49	123,22

Voltage [V]	Pressure [BarE]	Pressure [Psi]
3,15	8,66	125,59
3,2	8,82	127,96
3,25	8,98	130,33
3,3	9,15	132,70
3,35	9,31	135,07
3,4	9,47	137,44
3,45	9,64	139,81
3,5	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

23.7 Voltage – pressure table, LP transmitter (AKS)

Vcc = 5 V. Pressure is relative

Voltage [V]	Pressure [BarE]	Pressure [Psi]	Voltage [V]	Pressure [BarE]	Pressure [Psi]	Voltage [V]	Pressure [BarE]	Pressure [Psi]
0.50	-1.000	-14.50	1.85	3.388	49.14	3.20	7.775	112.77
0.55	-0.838	-12.15	1.90	3.550	51.49	3.25	7.938	115.13
0.60	-0.675	-9.79	1.95	3.713	53.85	3.30	8.100	117.48
0.65	-0.513	-7.44	2.00	3.875	56.20	3.35	8.263	119.84
0.70	-0.350	-5.08	2.05	4.038	58.57	3.40	8.425	122.19
0.75	-0.188	-2.73	2.10	4.200	60.92	3.45	8.588	124.56
0.80	-0.025	-0.36	2.15	4.363	63.28	3.50	8.750	126.91
0.85	0.138	2.00	2.20	4.525	65.63	3.55	8.913	129.27
0.90	0.300	4.35	2.25	4.688	67.99	3.60	9.075	131.62
0.95	0.463	6.72	2.30	4.850	70.34	3.65	9.238	133.99
1.00	0.625	9.06	2.35	5.013	72.71	3.70	9.400	136.34
1.05	0.788	11.43	2.40	5.175	75.06	3.75	9.563	138.70
1.10	0.950	13.78	2.45	5.338	77.42	3.80	9.725	141.05
1.15	1.113	16.14	2.50	5.500	79.77	3.85	9.888	143.41
1.20	1.275	18.49	2.55	5.663	82.13	3.90	10.050	145.76
1.25	1.438	20.86	2.60	5.825	84.48	3.95	10.213	148.13
1.30	1.600	23.21	2.65	5.988	86.85	4.00	10.375	150.48
1.35	1.763	25.57	2.70	6.150	89.20	4.05	10.538	152.84
1.40	1.925	27.92	2.75	6.313	91.56	4.10	10.700	155.19
1.45	2.088	30.28	2.80	6.475	93.91	4.15	10.863	157.55
1.50	2.250	32.63	2.85	6.638	96.28	4.20	11.025	159.90
1.55	2.413	35.00	2.90	6.800	98.63	4.25	11.188	162.27
1.60	2.575	37.35	2.95	6.963	100.99	4.30	11.350	164.62
1.65	2.738	39.71	3.00	7.125	103.34	4.35	11.513	166.98
1.70	2.900	42.06	3.05	7.288	105.70	4.40	11.675	169.33
1.75	3.063	44.43	3.10	7.450	108.05	4.45	11.838	171.70
1.80	3.225	46.77	3.15	7.613	110.42	4.50	12.000	174.05

23.8 Voltage – pressure table, HP transmitter (NSK) + DST

Vcc = 5 V. Pressure is relative

Voltage [V]	Pressure [BarE]	Pressure [Psi]
0,5	0,00	0
0,55	0,50	7,254
0,6	1,00	14,508
0,65	1,50	21,762
0,7	2,00	29,016
0,75	2,50	36,27
0,8	3,00	43,524
0,85	3,50	50,778
0,9	4,00	58,032
0,95	4,50	65,286
1	5,00	72,54
1,05	5,50	79,794
1,1	6,00	87,048
1,15	6,50	94,302
1,2	7,00	101,556
1,25	7,50	108,81
1,3	8,00	116,064
1,35	8,50	123,318
1,4	9,00	130,572
1,45	9,50	137,826
1,5	10,00	145,08
1,55	10,50	152,334
1,6	11,00	159,588
1,65	11,50	166,842
1,7	12,00	174,096
1,75	12,50	181,35
1,8	13,00	188,604

Voltage [V]	Pressure [BarE]	Pressure [Psi]
1,85	13,50	195,858
1,9	14,00	203,112
1,95	14,50	210,366
2	15,00	217,62
2,05	15,50	224,874
2,1	16,00	232,128
2,15	16,50	239,382
2,2	17,00	246,636
2,25	17,50	253,89
2,3	18,00	261,144
2,35	18,50	268,398
2,4	19,00	275,652
2,45	19,50	282,906
2,5	20,00	290,16
2,55	20,50	297,414
2,6	21,00	304,668
2,65	21,50	311,922
2,7	22,00	319,176
2,75	22,50	326,43
2,8	23,00	333,684
2,85	23,50	340,938
2,9	24,00	348,192
2,95	24,50	355,446
3	25,00	362,7
3,05	25,50	369,954
3,1	26,00	377,208
3,15	26,50	384,462

Voltage [V]	Pressure [BarE]	Pressure [Psi]
3,2	27,00	391,716
3,25	27,50	398,97
3,3	28,00	406,224
3,35	28,50	413,478
3,4	29,00	420,732
3,45	29,50	427,986
3,5	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

23.9 Voltage – pressure table, HP transmitter (AKS)

Vcc = 5 V. Pressure is relative

Voltage [V]	Pressure [BarE]	Pressure [Psi]	Voltage [V]	Pressure [BarE]	Pressure [Psi]	Voltage [V]	Pressure [BarE]	Pressure [Psi]
0.50	0.00	0.00	1.85	10.80	156.64	3.20	21.60	313.28
0.55	0.40	5.80	1.90	11.20	162.44	3.25	22.00	319.08
0.60	0.80	11.60	1.95	11.60	168.24	3.30	22.40	324.88
0.65	1.20	17.40	2.00	12.00	174.05	3.35	22.80	330.69
0.70	1.60	23.21	2.05	12.40	179.85	3.40	23.20	336.49
0.75	2.00	29.01	2.10	12.80	185.65	3.45	23.60	342.29
0.80	2.40	34.81	2.15	13.20	191.45	3.50	24.00	348.09
0.85	2.80	40.61	2.20	13.60	197.25	3.55	24.40	353.89
0.90	3.20	46.41	2.25	14.00	203.05	3.60	24.80	359.69
0.95	3.60	52.21	2.30	14.40	208.85	3.65	25.20	365.50
1.00	4.00	58.02	2.35	14.80	214.66	3.70	25.60	371.30
1.05	4.40	63.82	2.40	15.20	220.46	3.75	26.00	377.10
1.10	4.80	69.62	2.45	15.60	226.26	3.80	26.40	382.90
1.15	5.20	75.42	2.50	16.00	232.06	3.85	26.80	388.70
1.20	5.60	81.22	2.55	16.40	237.86	3.90	27.20	394.50
1.25	6.00	87.02	2.60	16.80	243.66	3.95	27.60	400.30
1.30	6.40	92.82	2.65	17.20	249.46	4.00	28.00	406.11
1.35	6.80	98.63	2.70	17.60	255.27	4.05	28.40	411.91
1.40	7.20	104.43	2.75	18.00	261.07	4.10	28.80	417.71
1.45	7.60	110.23	2.80	18.40	266.87	4.15	29.20	423.51
1.50	8.00	116.03	2.85	18.80	272.67	4.20	29.60	429.31
1.55	8.40	121.83	2.90	19.20	278.47	4.25	30.00	435.11
1.60	8.80	127.63	2.95	19.60	284.27	4.30	30.40	440.91
1.65	9.20	133.43	3.00	20.00	290.08	4.35	30.80	446.72
1.70	9.60	139.24	3.05	20.40	295.88	4.40	31.20	452.52
1.75	10.00	145.04	3.10	20.80	301.68	4.45	31.60	458.32
1.80	10.40	150.84	3.15	21.20	307.48	4.50	32.00	464.12

23.10 Pressure - temperature table for R134a

°C	°F	Bar	Psi
-40	-40	-0,5	-7.3
-38	-36	-0,45	-6.5
-36	-33	-0,38	-5.6
-34	-29	-0,32	-4.6
-32	-26	-0,25	-3.6
-30	-22	-0,17	-2.5
-28	-18	-0,09	-1.3
-26	-15	0	0
-24	-11	0,1	1.4
-22	-8	0,2	2.9
-20	-4	0,31	4.6
-18	-0,4	0,43	6.3
-16	3	0,56	8.1
-14	7	0,69	10.1
-12	10	0,84	12.2
-10	14	0,99	14.4
-8	18	1,16	16.8
-6	21	1,33	19.3
-4	25	1,51	21.9
-2	28	1,71	24.8
0	32	1,91	27.8

°C	°F	Bar	Psi
2	36	2,13	30.9
4	39	2,36	34.3
6	43	2,61	37.8
8	46	2,86	41.5
10	50	3,13	45.4
12	54	3,42	49.6
14	57	3,72	53.9
16	61	4,03	58.4
18	64	4,36	63.2
20	68	4,7	68.2
22	72	5,07	73.5
24	75	5,44	79
26	79	5,84	84.7
28	82	6,26	90.7
30	86	6,69	97
32	90	7,14	103.6
34	93	7,61	110,4
36	97	8,1	117.6
38	100	8,62	125
40	104	9,15	132.7
42	108	9,71	140,8

°C	°F	Bar	Psi
44	111	10,29	149.2
46	115	10,89	157.9
48	118	11,52	167
50	122	12,17	176.5
52	126	12,84	186.2
54	129	13,54	196.4
56	133	14,27	207
58	136	15,02	217.9
60	140	15,8	229.2
62	144	16,61	241
64	147	17,45	253.2
66	151	18,32	265.8
68	154	19,22	278.8
70	158	20,15	292.3
72	162	21,12	306.3
74	165	22,12	320,8
76	169	23,15	335.7
78	172	24,22	351.2
80	176	25,32	367.2

23.11 Pressure - temperature table for R513A

°C	°F	Bar	Psi
-40	-40	-0,40	-5.8
-38	-36	-0,33	-4.9
-36	-33	-0,27	-3.8
-34	-29	-0,19	-2.8
-32	-26	-0,11	-1.6
-30	-22	-0,02	-0.3
-28	-18	0,07	1.0
-26	-15	0,17	2.5
-24	-11	0,28	4.0
-22	-8	0,39	5.7
-20	-4	0,51	7.4
-18	0	0,64	9.3
-16	3	0,78	11.3
-14	7	0,93	13.4
-12	10	1,08	15.7
-10	14	1,25	18.1
-8	18	1,43	20.7
-6	21	1,61	23.4
-4	25	1,81	26.2
-2	28	2,02	29.2
0	32	2,24	32.4

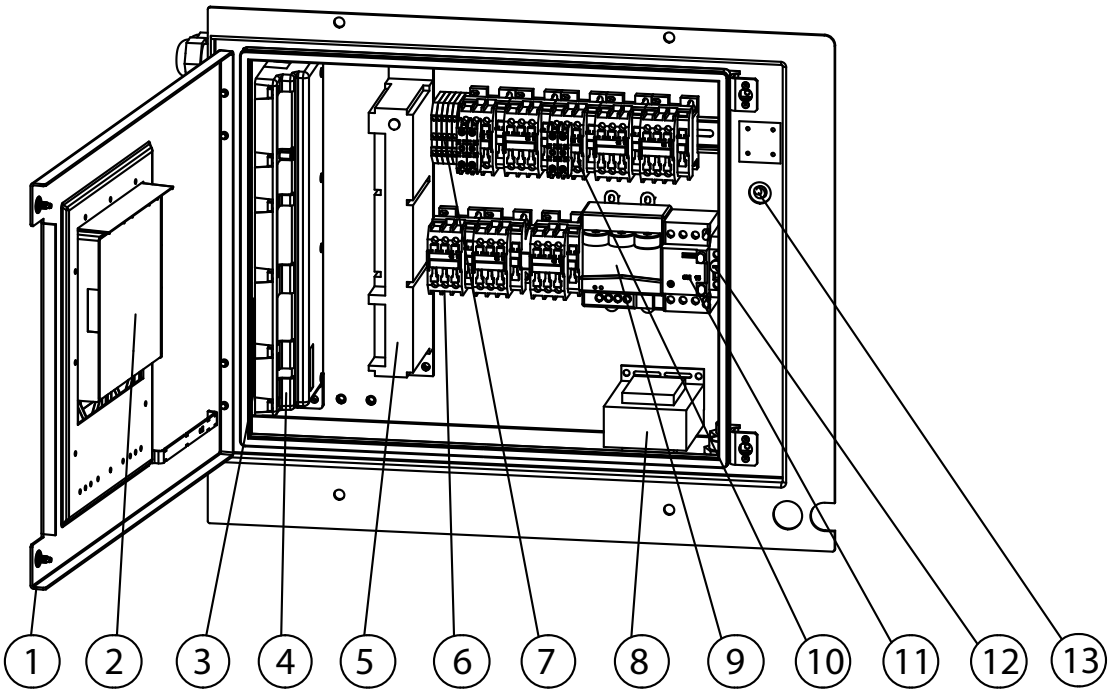
°C	°F	Bar	Psi
2	36	2,47	35.8
4	39	2,71	39.3
6	43	2,97	43.0
8	46	3,24	46.9
10	50	3,52	51.0
12	54	3,82	55.4
14	57	4,13	59.9
16	61	4,45	64.6
18	64	4,80	69.6
20	68	5,15	74.8
22	72	5,53	80.2
24	75	5,92	85.9
26	79	6,33	91.8
28	82	6,75	98.0
30	86	7,20	104.4
32	90	7,66	111.1
34	93	8,14	118.1
36	97	8,65	125.4
38	100	9,17	133.0
40	104	9,71	140.9
42	108	10,28	149.0

°C	°F	Bar	Psi
44	111	10,86	157.5
46	115	11,47	166.4
48	118	12,10	175.6
50	122	12,76	185.1
52	126	13,44	194.9
54	129	14,15	205.2
56	133	14,88	215.8
58	136	15,63	226.7
60	140	16,42	238.1
62	144	17,23	249.9
64	147	18,07	262.1
66	151	18,94	274.7
68	154	19,84	287.7
70	158	20,77	301.2
72	162	21,73	315.2
74	165	22,72	329.6
76	169	23,75	344.5
78	172	24,82	359.9
80	176	25,92	375.9

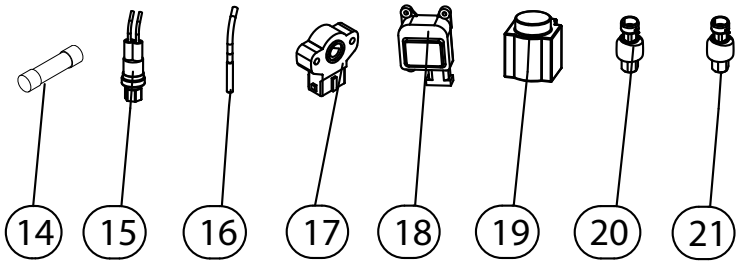
23.12 Tightening torques

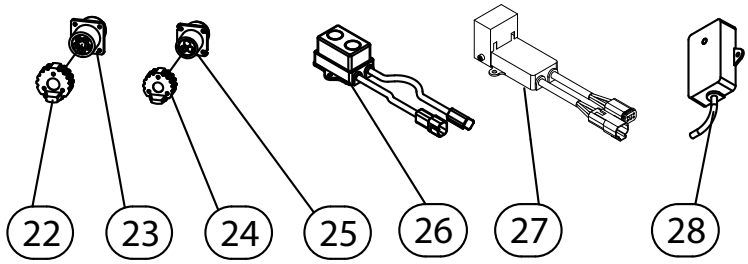
Description	Type	Torque [Nm] ± 5%
General		
Hex Head Bolt + Nut, M5		4,5
Hex Head Bolt + Nut, M6		5,5
Hex Head Bolt + Nut, M8		10
Hex Head Bolt + Nut, M10		25
Hex Socket Counters. Head Bolt, M6		5,5
Hex Socket Counters. Head Bolt, M8		10
Flare Nut ½", Brass	Hex Head	35
Schräder Valve, 1/8"	Hex Head	24
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
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	5

24. Controller unit illustration



Pos.	Description
1	Controller hatch
2	User panel (SUP6)
3	Battery pack
4	Controller module (SMC6)
5	Modem
6	Contactor
7	Duo terminal
8	Transformer, 105VA
9	Power measurement module (SPM6)
10	Auxiliary contact
11	Main circuit breaker, 16A
12	Fuseholder for 0.4A fuse
13	On/Off switch
14	Fuse, 400mA
15	High pressure switch
16	Temperature sensor, 1.8 m
17	Air exchange potentiometer
18	Motor, fresh air
19	Solenoid coil, 11W, 24VAC
20	Pressure transmitter -0.69-9.8 Bar
21	Pressure transmitter 0-30 Bar
22	Retreiver socket cap
23	Retreiver socket
24	USDA socket cap
25	USDA socket
26	Sensor, C02
27	Sensor, 02
28	Humidity sensor

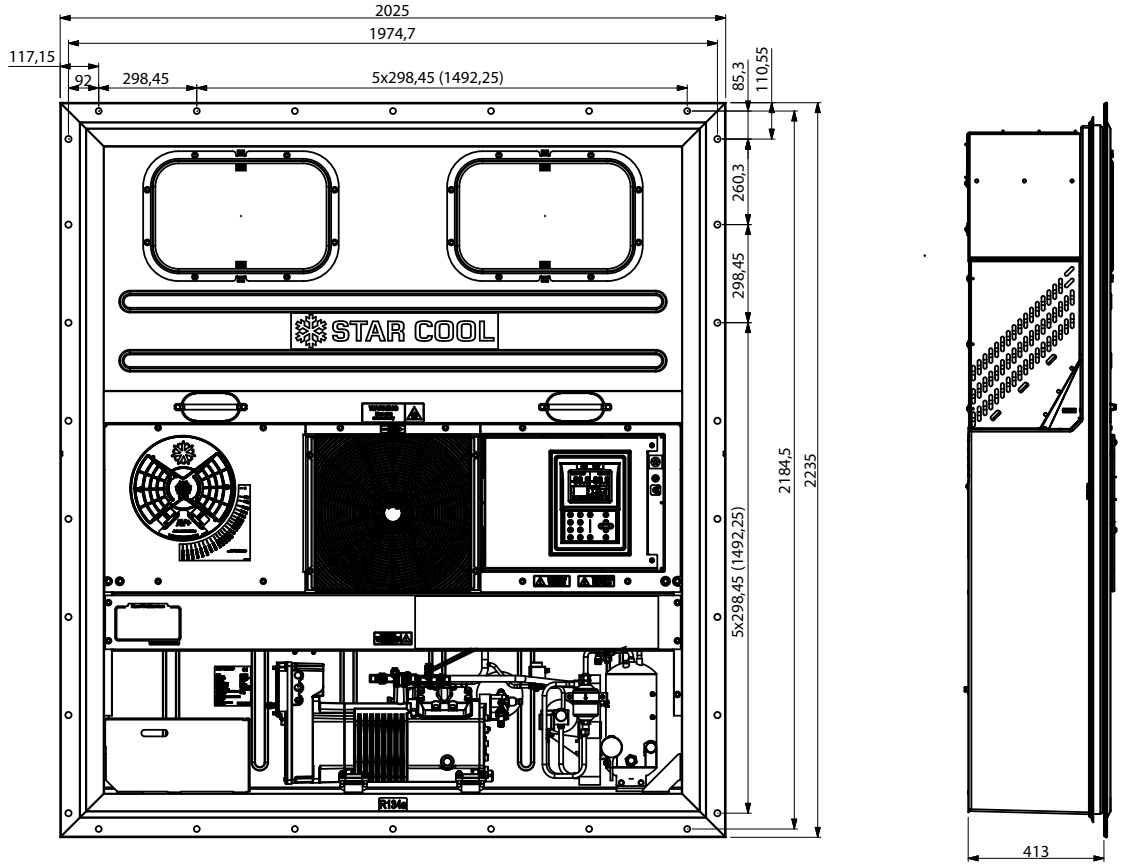




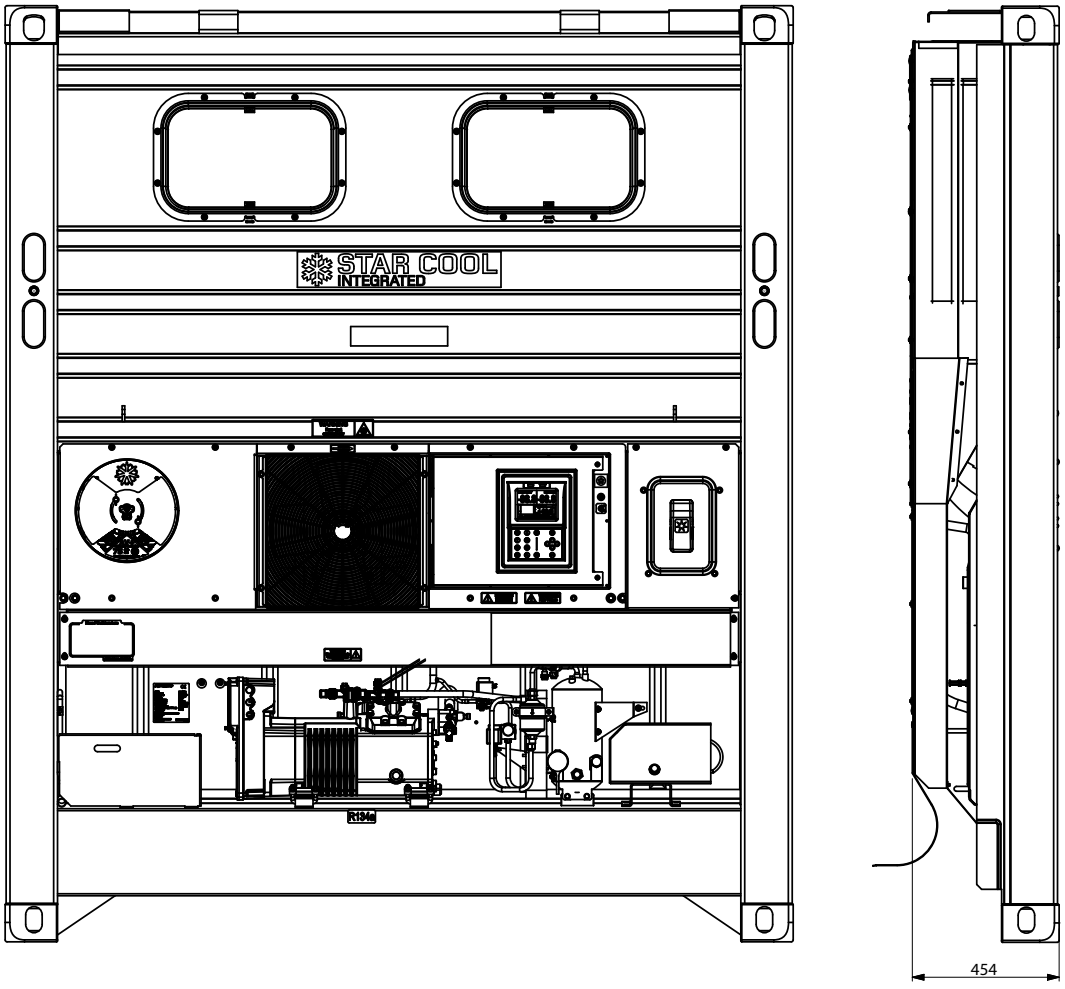
Setup may vary depending on model

25. Star Cool unit installation dimensions

Type: SCU

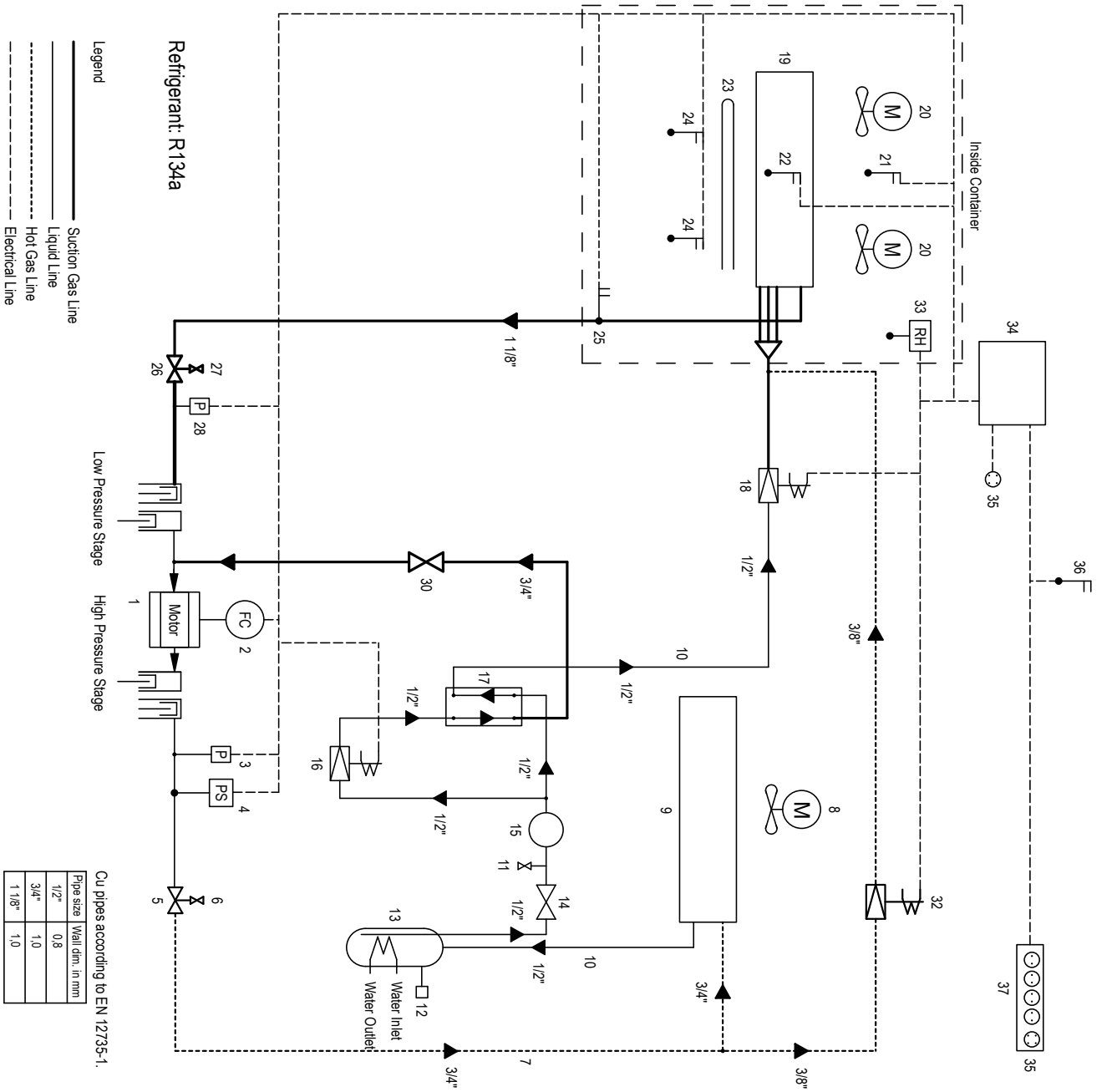


Type: SCI



26. Diagrams

26.1 P & I diagram

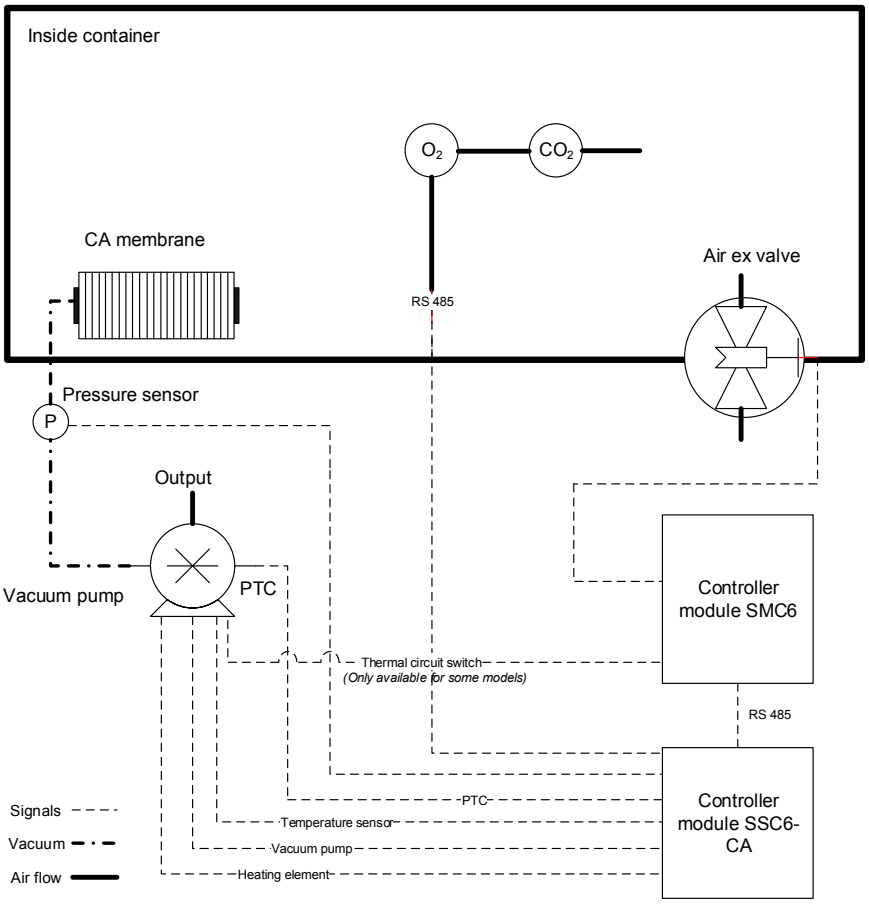


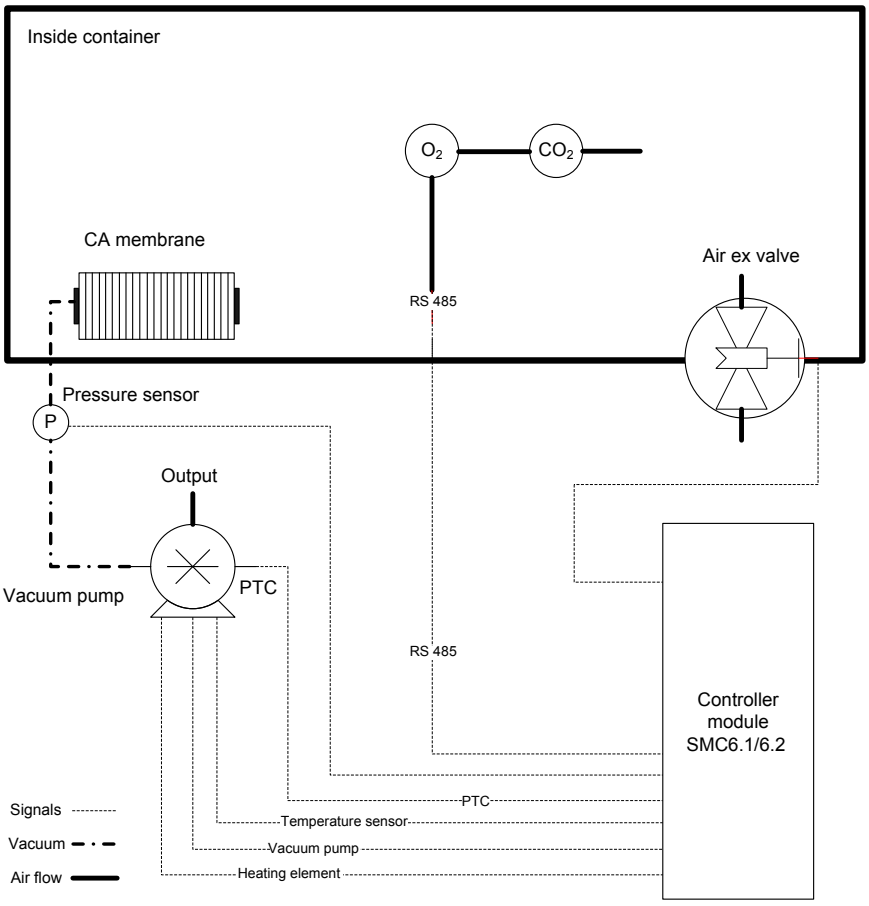
Pipe size	Wall dim. in mm
1/2"	0,8
3/4"	1,0
1 1/8"	1,0

Cu pipes according to EN 12735-1.

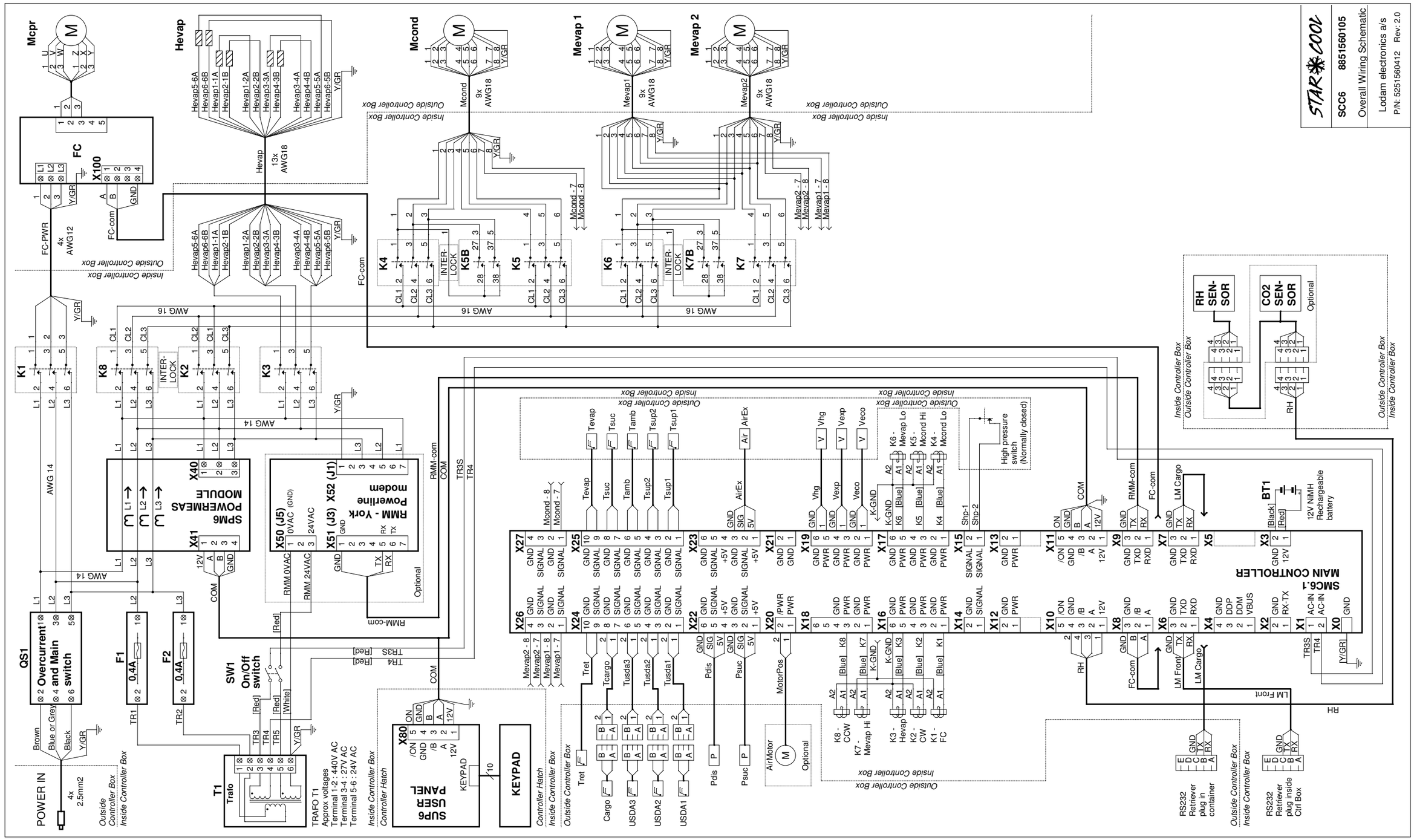
1 Compressor
2 Frequency Converter
3 Discharge Pressure Transmitter (Pdis)
4 High Pressure Cut Out PZH (P=PS)
5 Discharge Service Valve
6 Evacuation Point
7 Discharge Line
8 Condenser Fan
9 Air Cooled Condenser
10 Liquid Line
11 Liquid Charging Valve
12 High Pressure Cut Out PZHH (P=PS+2)
13 Receiver / Water Cooled Condenser
14 Manual stop valve
15 Drying Filter
16 Electronical Expansion Valve, Economizer (Veco)
17 Economizer
18 Electronical Expansion Valve, Evaporator (Vexp)
19 Evaporator
20 Evaporator Fan
21 Return Air Sensor (T ret)
22 Evaporator Temperature Sensor (T evap)
23 Heating Elements
24 Supply Air Sensors (T_{sup1}+ T_{sup2})
25 Suction Temperature Sensor (T_{suc})
26 Suction Service Valve
27 Evacuation Point
28 Suction Pressure Transmitter (P_{suc})
30 Economizer Suction Service Valve
32 Hot Gas Valve (V hg)
33 Humidity Sensor (RH)
34 Controller
35 Communication Slot
36 Ambient Temperature Sensor (T_{amb})
37 Plugs for Cargo Temperature Sensors

26.2 CA function overview - two versions

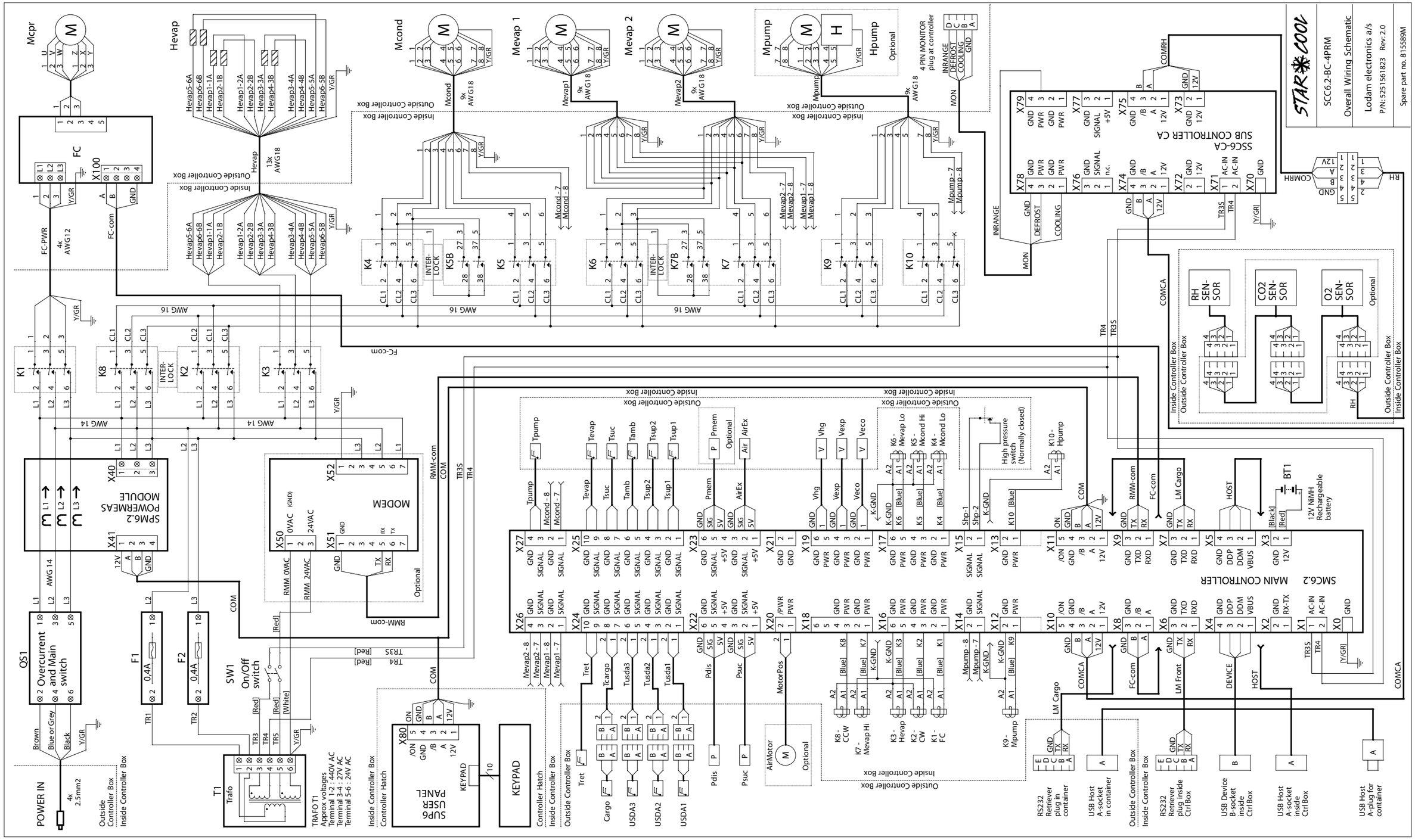


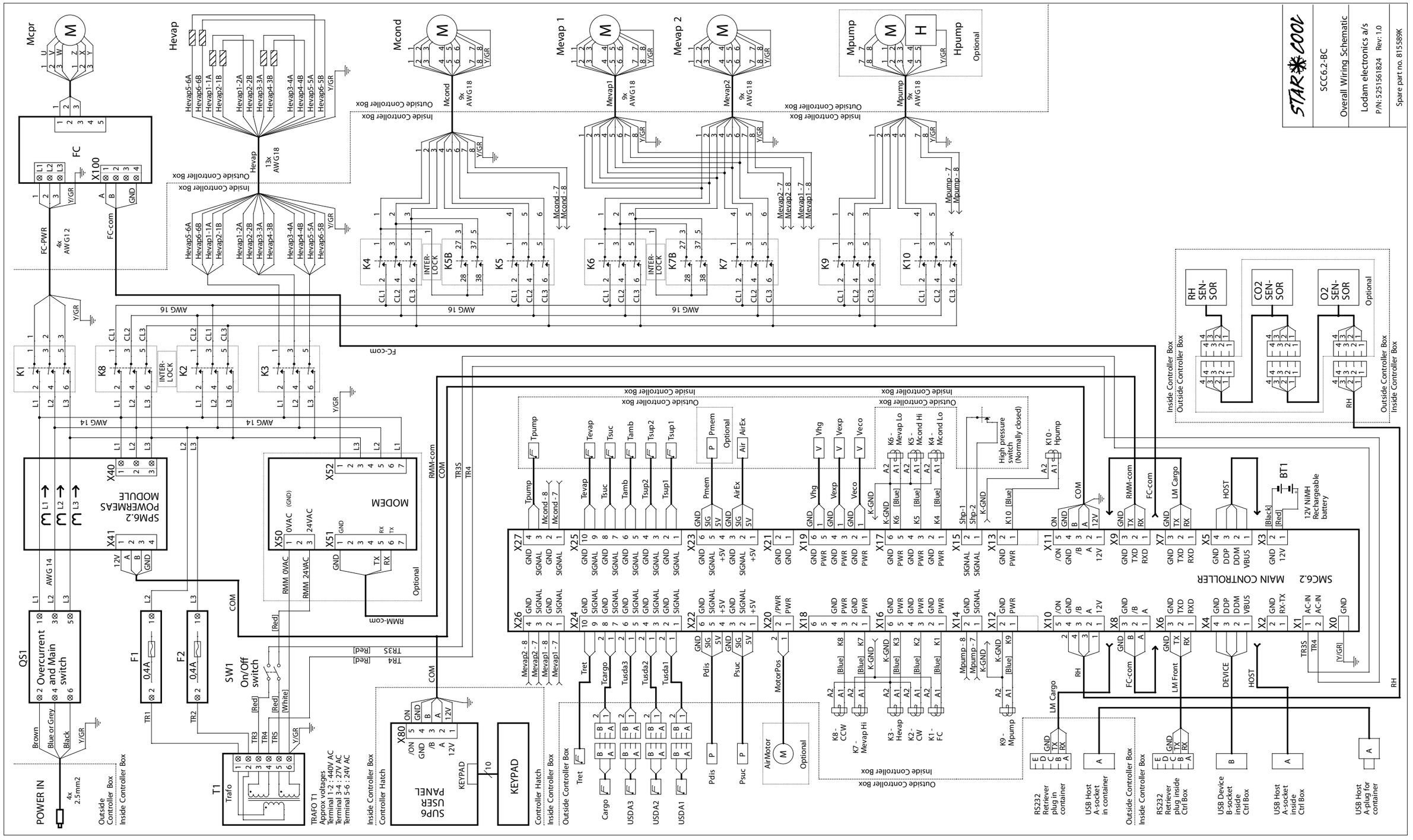


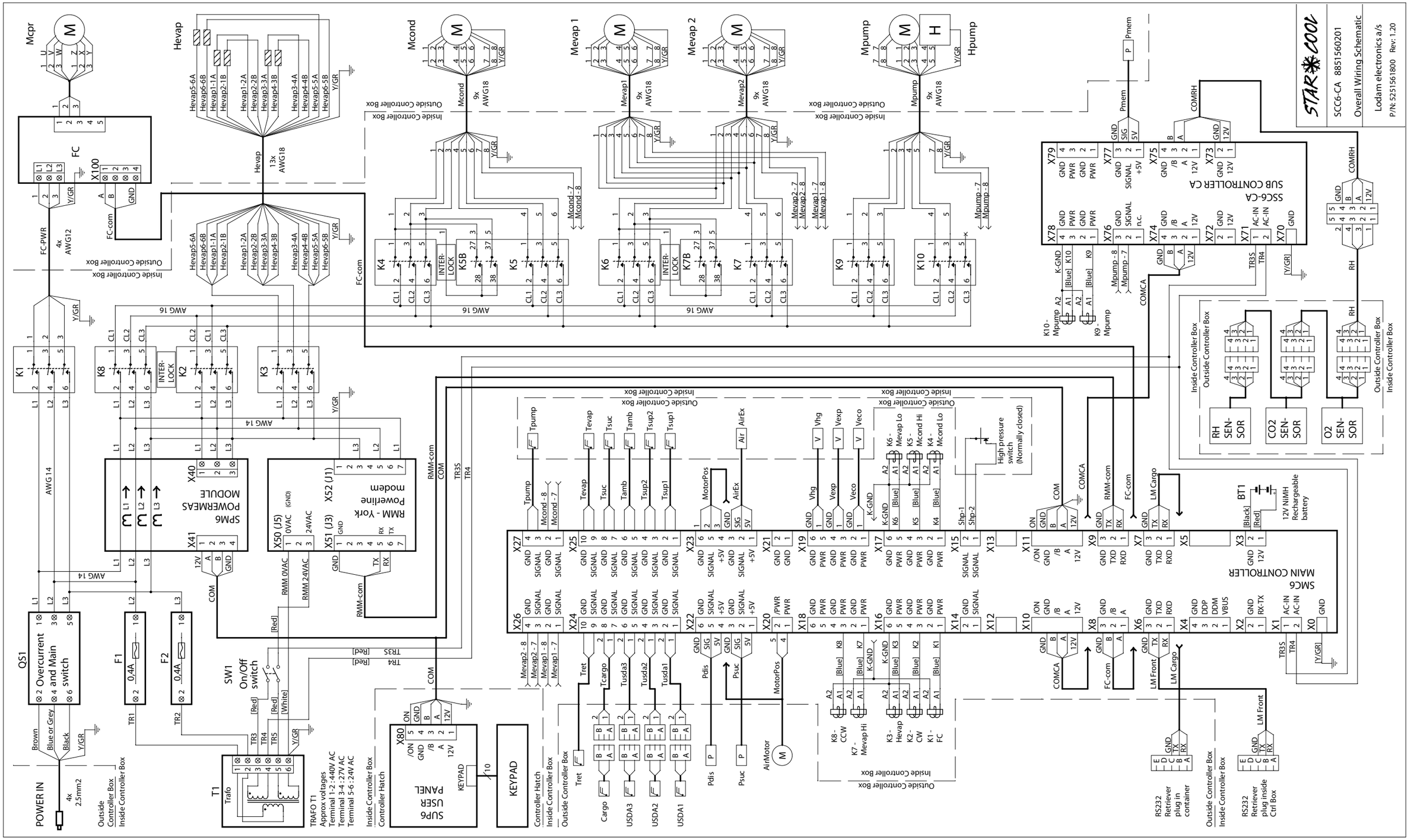
27. Overall wiring schematic



28. Overall wiring schematics (optional)




STAR COOL
SCC6.2-BC
Overall Wiring Schematic
Lodam electronics a/s
P/N:525156824 Rev: 1.0
Spare part no. 815589K
Mcpr
Hevap
Mcond
Mevap 1
Mevap 2
Mpump
Hpump
Optional
FC
X100
FC-PWR
FC-com
Outside Controller Box
Inside Controller Box
K1
K2
K3
K4
K5
K5B
K6
K7
K7B
K8
K9
K10
INTER-LOCK
AWG 16
AWG 14
QS1
2 Overcurrent and Main switch
F1
F2
0.4A
SW1
On/Off switch
T1
Trafo
TRAFO T1
Approx voltages
Terminal 1-2 : 440V AC
Terminal 3-4 : 27V AC
Terminal 5-6 : 24V AC
POWER IN
4x 2.5mm2
Brown
Blue or Grey
Black
Y/GR
SPM6.2 POWERMEAS MODULE
X40
X41
12V
GND
MODEM
X50
X51
X52
0VAC (GND)
24VAC
RMM 0VAC
RMM 24VAC
RMM-com
COM
TR3S
TR4
Optional
SUP6 USER PANEL
X80
KEYPAD
Controller Hatch
Tret
Cargo
USDA3
USDA2
USDA1
Pdis
Psuc
AirMotor
MotorPos
Tpump
Tevap
Tsuc
Tamb
Tsup2
Tsup1
Pmem
AirEx
Vhg
Vexp
Veco
High pressure switch (Normally closed)
SMC6.2 MAIN CONTROLLER
X0
X1
X2
X3
X4
X5
X6
X7
X8
X9
X10
X11
X12
X13
X14
X15
X17
X18
X19
X20
X21
X22
X23
X24
X25
X26
X27
BT1
12V NiMH Rechargeable battery
RH SEN-SOR
CO2 SEN-SOR
O2 SEN-SOR
RS232 Retriever plug in container
USB Host A-socket in container
RS232 Retriever plug inside Ctrl Box
USB Device B-socket inside Ctrl Box
USB Host A-socket inside Ctrl Box
USB Host A-plug for container
LM Cargo
LM Front
HOST
DEVICE
RMM-com
FC-com
K1 - FC
K2 - CW
K3 - Hevap
K4 - Mcond Lo
K5 - Mcond Hi
K6 - Mevap Lo
K7 - Mevap Hi
K8 - CCW
K9 - Mpump
K10 - Hpump


STAR COOL
SCC6-CA 8851560201
Overall Wiring Schematic
Lodam electronics a/s
P/N: 5251561800 Rev: 1.20
Mcpr
Hevap
Mcond
Mevap 1
Mevap 2
Mpump
Hpump
Pmem
FC
X100
FC-PWR
FC-com
4x AWG12
13x AWG18
9x AWG18
Outside Controller Box
Inside Controller Box
SSC6-CA
SUB CONTROLLER CA
COMRH
RH
K1
K2
K3
K4
K5
K5B
K6
K7
K7B
K8
K9
K10
INTER-LOCK
AWG 16
AWG 14
SPM6 POWERMEAS MODULE
X40
X41
RMM - York Powerline modem
X50 (J5)
X51 (J3)
X52 (J1)
RMM 0VAC
RMM 24VAC
RMM-com
COM
TR3S
TR4
SMC6 MAIN CONTROLLER
BT1
12V NiMH Rechargeable battery
QS1
Overcurrent and Main switch
F1
0,4A
F2
0,4A
SW1
On/Off switch
T1
Trafo
TRAFO T1
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Y/GR
SUP6 USER PANEL
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Controller Hatch
Tret
Cargo
USDA3
USDA2
USDA1
Pdis
Psuc
AirMotor
Tpump
Tevap
Tsuc
Tamb
Tsup2
Tsup1
MotorPos
AirEx
Air
Vhg
Vexp
Veco
High pressure switch (Normally closed)
K6 - Mevap Lo
K5 - Mcond Hi
K4 - Mcond Lo
K8 - CCW
K7 - Mevap Hi
K3 - Hevap
K2 - CW
K1 - FC
RS232 Retriever plug in container
RS232 Retriever plug inside Ctrl Box
LM Front
LM Cargo
LH Front
RH SEN-SOR
CO2 SEN-SOR
O2 SEN-SOR

Star Cool Service

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Phone: +45 73 64 34 00
Fax: +45 73 64 35 69
E-mail: starcool@starcool.com
www.starcool.com

24-hour hotline support

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Version 810900E June 2019