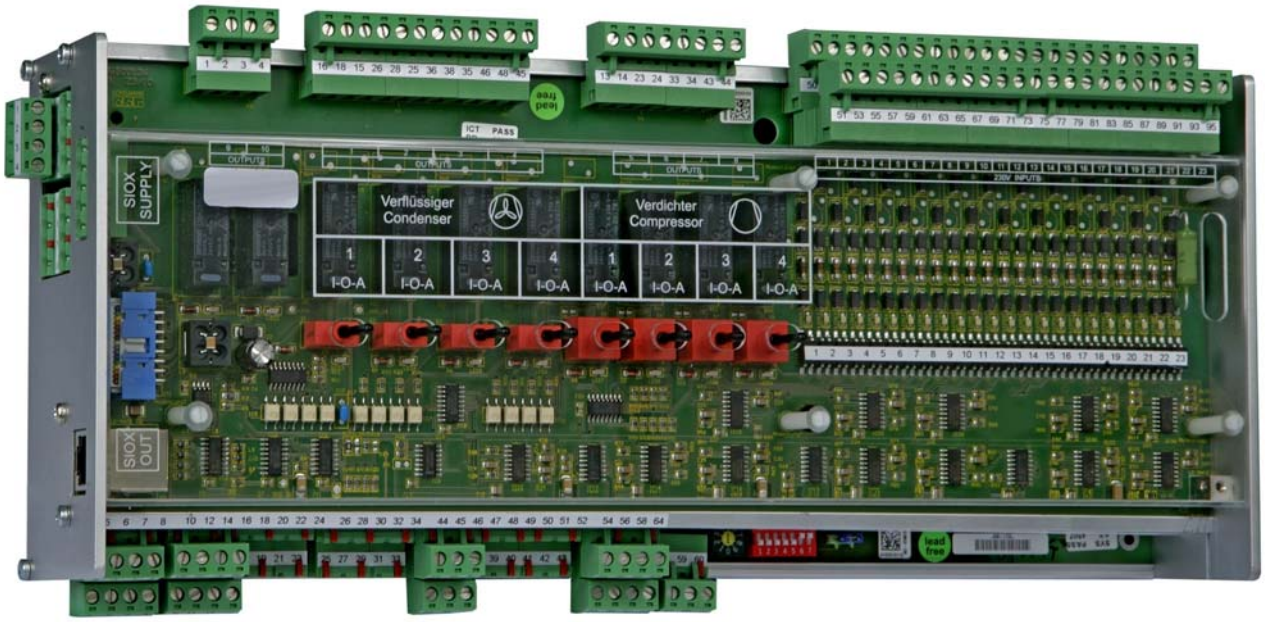
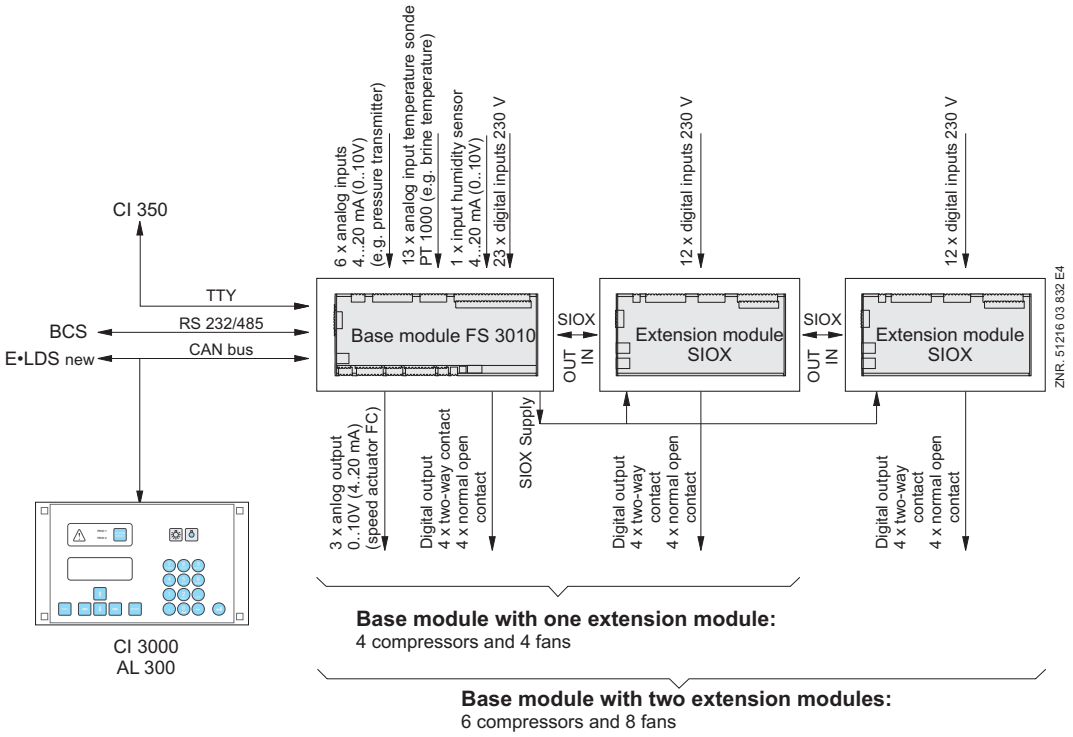
FS 3010 Pack Controller
V4.00



1 Design of FS 3010

1.1 Introduction

The FS 3010 consists of the base module with analog and digital inputs and outputs and a minimum of one SIOX extension module. The controller is of modular design and can be used with additional extension modules as required for more extensive systems. A CI 3000 Store Computer or AL 300 Operator Terminal is required for set-up and operation of the controller.



These notes describe the control and monitoring functions of the new FS 3010 pack controller.

Device and pin assignments of the FS 3010 pack controller are shown in section Pin and Terminal Assignments.

Basic version:

Digital inputs/outputs

23 inputs 230 V	(FS 3010)	- Electrically isolated, for alarm inputs, etc.
12 inputs 230 V	(SIOX)	- Electrically isolated, for alarm inputs, etc.
10 outputs 230 V	(FS 3010)	- Relay outputs for compressor/fan control
8 outputs 230 V	(SIOX)	- Relay outputs for compressor/fan control

Analog inputs/outputs

13 inputs Pt1000 (two-wire)	- Connection for Pt1000 temperature sensors
2 inputs Pt1000 (four-wire)	- Connection for Pt1000 temperature sensors (room and outdoor temp.)
6 inputs / 4-20 mA (0-10 V)	- e.g. connection for pressure transducers
1 input / 4-20 mA (0-10 V)	- Connection for humidity sensor
3 outputs / 0-10 V (0-20 mA)	- e.g. connection for continous fan control speed adjuster
SIOX supply	- Power supply for extension modules (SIOX)

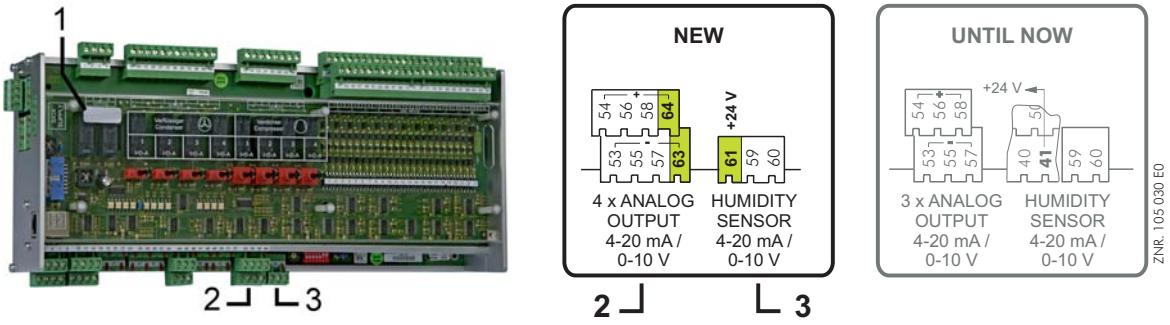
Interfaces:

CAN bus	: Communication in new LDS System
TTY	: Communication in earlier LDS System
RS232	: Communication between LDS System and building control system with firmware update capability
RS485	: Connection for control system
SIOX OUT	: Connection for data transfer to extension modules (SIOX)

From Version 4.00

- Adjustment of the manual to the new FS 3010 hardware

The pack controllers of the FS 3010 series can, without problem, be replaced by the pack controllers of the FS 3010 series. The controller ID and the corresponding firmware ID are located on the cover (1). In the course of technical developments, the pack controller hardware has been extended with the addition of an analog output (2) and a humidity sensor at the 24 V terminal (3):



2 Aufgaben FS 3010

The FS 3010 incorporates all required control and regulating functions for compressor pack and condenser or dry cooler. Fault reporting and fault archiving are also included. The specific functions implemented are as follows:

Compressor control for single- and dual-circuit systems

Step controller with up to
4 compressors each with two capacity stages or
2 compressors each with three capacity stages or
6 stand-alone compressors without capacity control

With following functions:
Low-pressure control (single circuit only) or
control of brine outlet temperature or
control of brine inlet temperature
Base load rotation
Compressor monitoring for
- reciprocating compressors
- screw compressors
Pumpdown
Load shedding

Liquid level monitoring

Dry cooler/fan control for single- and dual-circuit systems

Step controller for maximum 8 fan capacity stages
Continuous control (0-10 V)
High-pressure control or
control of coolant temperature
Heat recovery
Fan monitoring
Motor overload protection

Brine pumps

Control of two pumps in one brine loop
Base load rotation
Motor overload cutout monitoring

Coolant pumps

Control of two pumps in one coolant loop
Base load rotation
Motor overload cutout monitoring

Monitoring of brine and coolant loop

Antifreeze protection (brine)
Pressure (brine and coolant)
Flow (brine and coolant)

Data archiving

Messages/alarms
Starts
On times
Activity/utilization

Communication with operator terminal

Entering, changing and deleting parameters
isplaying actual values
Managing messages and alarms
Displaying archived data

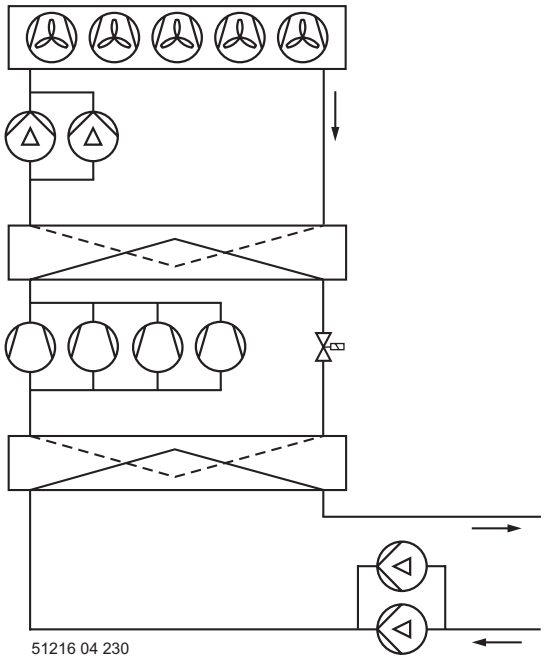
2.1 Application

Application			**Required settings and parameters**		
Control of	*Refrigeration via*	*Condensing via*	*DIP switch 4 setting*	*Parameter setting for dry cooler in menu list 3.1.d*	*Parameter setting for sensor in selection menu 3.2.1.1.a*
Single-circuit system	Brine	Brine	ON	Single-circuit	Brine_OFF (Brine_OUT) or Brine_ON (Brine_In)
Single-circuit system	Direct evaporation	Brine	ON	Single-circuit	Pressure
Single-circuit system	Brine	Direct condensation	ON	None	Brine_OFF (Brine_OUT) or Brine_ON (Brine_In)
Dual-circuit system	Brine	Brine	OFF	Single-circuit	Brine_OFF (Brine_OUT) or Brine_ON (Brine_In)
Dual-circuit system	Brine	Direct condensation	OFF	None	Brine_OFF (Brine_OUT) or Brine_ON (Brine_In)

See Section 4 - Installation and Startup for more details.

The following diagrams show the scope of application for the FS 3010:

Control of single-circuit system. Refrigeration and condensing via brine



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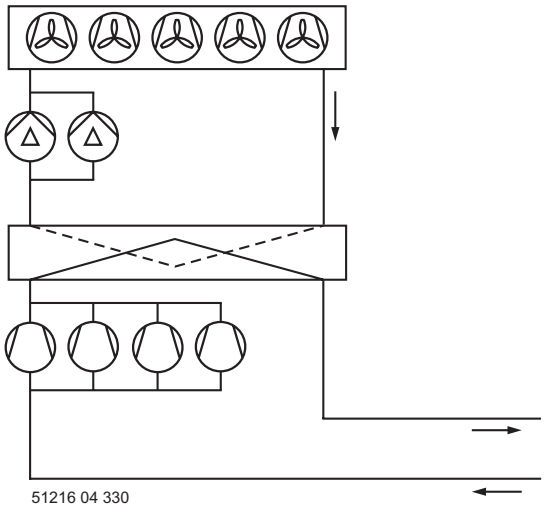
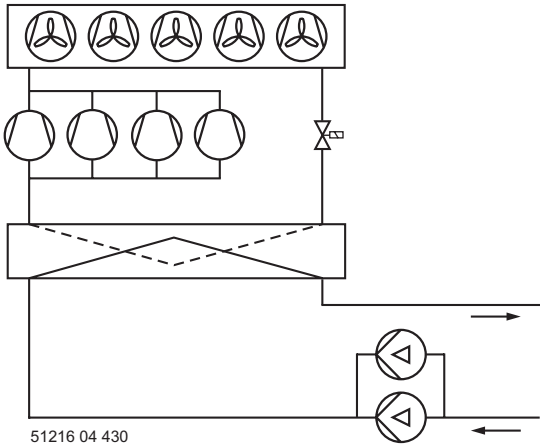
Control of single-circuit system. Refrigeration by direct evaporation, condensing via brine

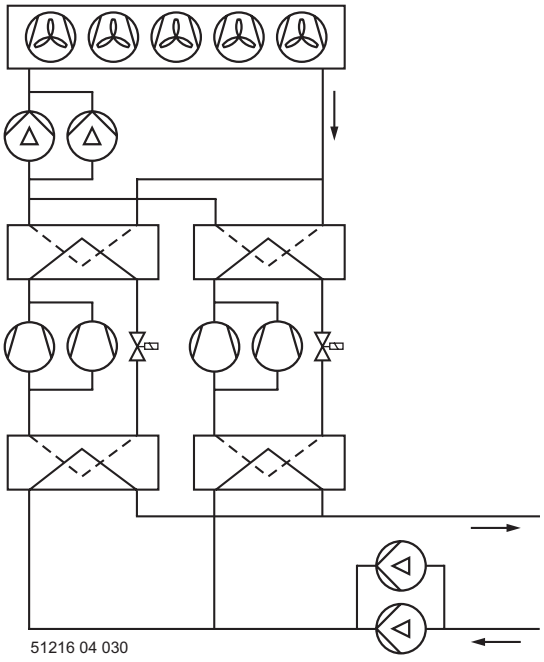


51216 04 330

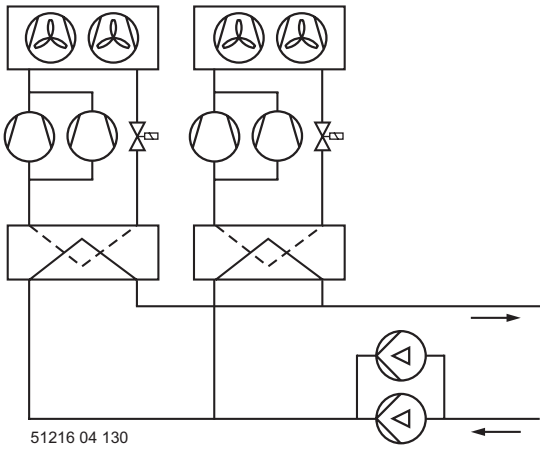
Control of single-circuit system. Refrigeration via brine, direct condensation



Control of dual-circuit system. Refrigeration and condensing via brine



Control of dual-circuit system with direct condensation, refrigeration via brine



3 Function of FS 3010

3.1 Compressor control

Compressor control largely covers the following control and regulating functions:

- Low-pressure control for single-circuit systems or
- Brine outlet temperature control for single– and dual–circuit systems or
- Brine inlet temperature control for single- and dual-circuit systems
- Base load rotation
- Compressor monitoring

3.2 Control type

With the FS 3010, the cold side can be controlled by low pressure or brine outlet or inlet temperature.

3.2.1 Low-pressure control

Low-pressure control is used to maintain suction side pressure at a defined setpoint. This is accomplished by loading or unloading compressor stages or compressor capacity stages. The setpoint can be defined as a function of room temperature.

The actual value is measured by a pressure transducer with continuous current output (4-20 mA). Low-pressure control is usable only on single-circuit systems.

3.2.2 Brine outlet or inlet temperature control

With brine temperature control, the brine outlet or inlet temperature is controlled at a defined setpoint. This is accomplished by loading and unloading compressor stages or compressor capacity stages. The setpoint can be defined as a function of room temperature. The actual value is measured by a PT 1000 temperature sensor.

3.3 Neutral zone

No compressor actuation takes place as long as the control error is within a programmable neutral zone (deadband).

3.4 Control algorithm

The controller is designed to operate as a digital step controller. The controller cycle time is 1 second. The actual value (suction pressure or brine outlet temperature) measured by an A/D converter is compared with the setpoint.

Control error = Actual value - Setpoint

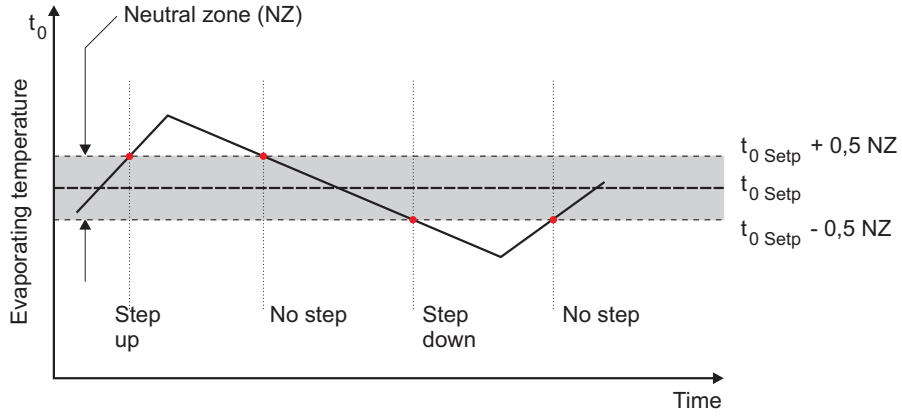
When the error is positive, the step-by-step switch advances one step at a time. This results in enabling of the compressor or compressor capacity stage that has then logged the shortest running time, which is performed subject to the definable basic and variable load times.

When the control error is negative, the step-by-step switch reverses one step at a time. This results in disabling of the compressor or compressor capacity stage that has then logged the longest running time, which is performed subject to the definable basic and variable unload times. As long as the control error remains within a programmable neutral zone, no compressor loading or unloading takes place.

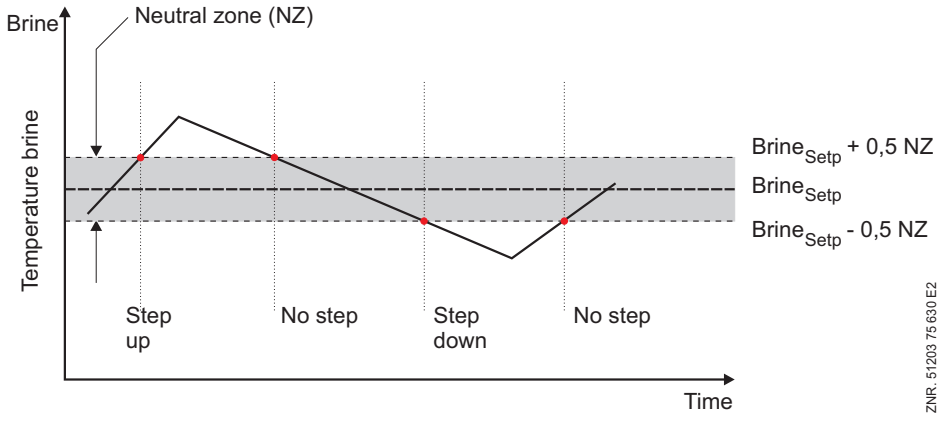
In the wet vapor range the temperature is clearly a function of refrigerant and pressure: t = f (p, refrigerant). With pressure control the FS 3010 computes temperatures from the measured pressures according to the specified refrigerant.

Exclusively temperature values are used for control. Temperatures (t_0 and t_c) therefore represent pressures (p_0 and p_c) in the system documentation.

Controlling evaporating temperature



Controlling brine temperature



3.5 Compressor control times

Compressor actuation takes place only when a certain time has elapsed for loading or unloading and the control error has exceeded a defined level (neutral zone). The time delay is dependent on the actual control error. With a large error, actuation takes place quicker than with a smaller error.

The control time is calculated as the sum of basic time t_b and variable time t_v. Differentiation is made between up and down stepping of the step controller. The variable time is inversely proportional to the control error. At maximum error the variable time is $t_v = 0$. As the error decreases, time t_v automatically increases up to a defined maximum. Basic time and maximum variable time for loading (stepping up) and unloading (stepping down) can be programmed as parameters for each capacity stage.

Relationships for determining control times are as follows:

$$t = t_b + t_v$$

t_b = *Basic time*

The basic time can be programmed for each compressor capacity stage.

For t_v: $t_v = t_{v\_max} - (t_{v\_max} * d_t) / d_{t\_max}$

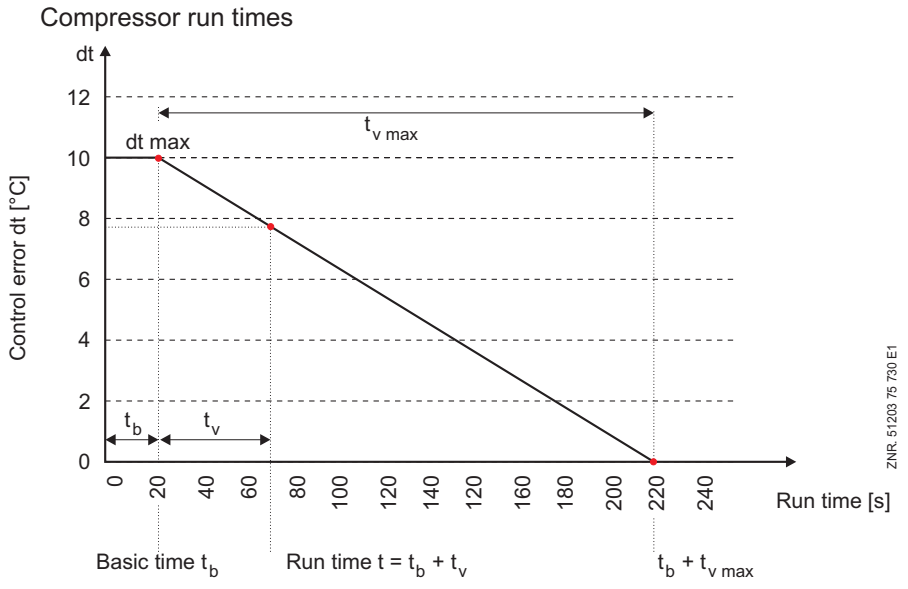
The following applies for $d_t > d_{t\_max}$: $d_t = d_{t\_max}$

t_v	= Variable control time
t_{v_max}	= Maximum variable control time (definable for each capacity stage)
d_t	= Control error
d_{t_max}	= Maximum control error (definable)

The start time delay commences on loading a compressor capacity stage. The stop time delay commences on unloading a compressor capacity stage. The control time is calculated for every controller run.

For this purpose the variable time is recalculated and the time elapsed since the last control time is compared with the calculated time. If the calculated control time is less than or equal to the expired time, compressor actuation takes place when the control error is larger than the specified neutral zone.

Calculation of control time is represented in the following graph:



3.6 Determination of setpoint

3.6.1 Setpoint determination with low-pressure control

The t_0 setpoint can be determined as a function of room temperature (setpoint shift).

$$t_0 = (t_{0\_max} - t_{0\_min}) * (t_r - t_{r\_max})/(t_{r\_min} - t_{r\_max}) + t_{0\_min}$$

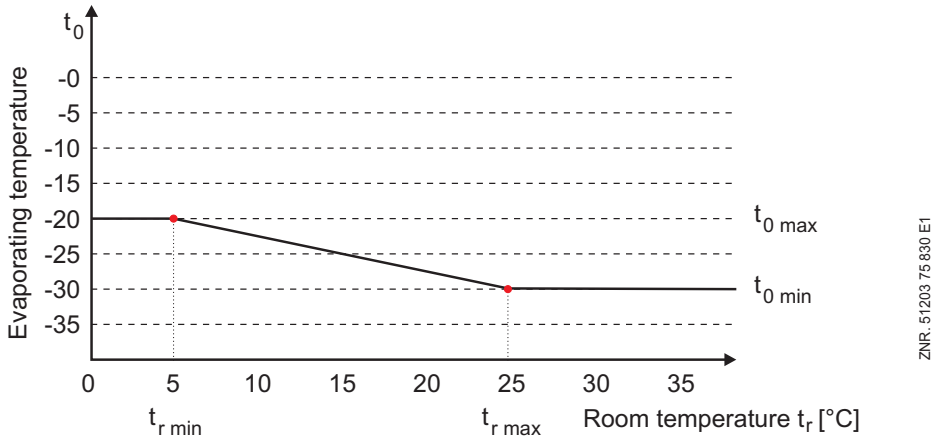
t_0	= t_0 setpoint
t_{0_max}	= Maximum t_0 setpoint
t_{0_min}	= Minimum t_0 setpoint
t_r	= Current room temperature
t_{r_max}	= Maximum room temperature for setpoint shift
t_{r_min}	= Minimum room temperature for setpoint shift

The setpoint t_0 is defined as a constant for room temperature greater than t_{r_max} or less than t_{r_min}.

For $t_r < t_{r\_min}$: $t_0 = t_{0\_max}$

for $t_r > t_{r\_max}$: $t_0 = t_{0\_min}$

Setpoint calculation of evaporating temperature



Temperatures t_{0_max}, t_{0_min}, t_{r_min} and t_{r_max} can be set as parameters. The pressure setpoint for actual control is determined from a conversion table stored in the program.

At the present time, conversion of t_0 to the corresponding pressure value can be made for the following refrigerants: R22, R502, R134a, R402a, R404A, R717, R1270, R407c.

3.6.2 Setpoint determination with brine outlet temperature control

The brine outlet temperature setpoint can be determined as a function of room temperature (setpoint shift).

$$Brine_{Out} = (Brine_{Out\_max} - Brine_{Out\_min}) * (t_r - t_{r\_max})/(t_{r\_min} - t_{r\_max}) + Brine_{Out\_min}$$

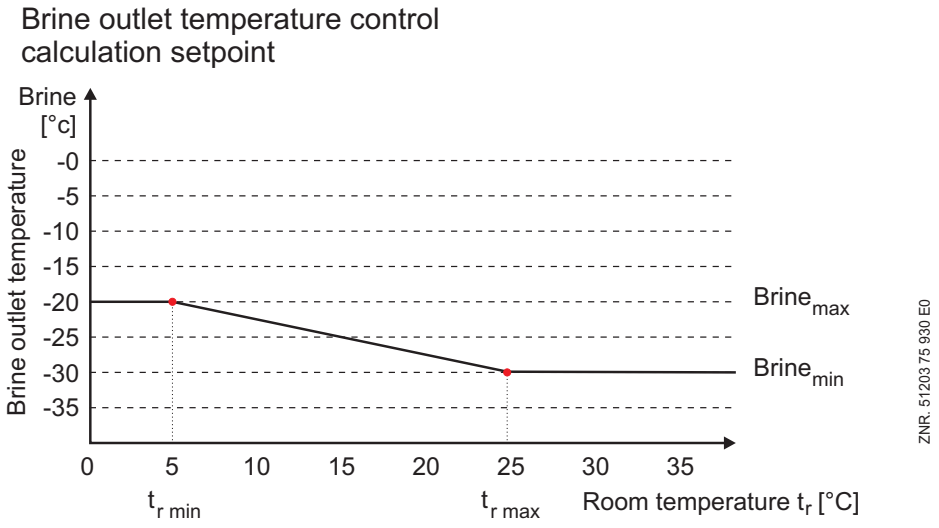
$Brine_{Out}$	= Brine outlet temperature setpoint
$Brine_{Out\_max}$	= Maximum brine outlet temperature
$Brine_{Out\_min}$	= Minimum brine outlet temperature
t_r	= Current room temperature
t_{r_max}	= Maximum room temperature for setpoint shift
t_{r_min}	= Minimum room temperature for setpoint shift

The setpoint $Brine_{Out}$ is defined as a constant for room temperature greater than t_{r_max} or less than t_{r_min}.

For $t_r < t_{r\_min}$: $Brine_{Out} = Brine_{Out\_max}$

for $t_r > t_{r\_max}$: $Brine_{Out} = Brine_{Out\_min}$

Temperatures $Brine_{Out\_max}$, $Brine_{Out\_min}$, t_{r_min} and t_{r_max} can be set as parameters.



3.6.3 Setpoint determination with brine inlet temperature control

The coolant outlet temperature setpoint can be determined as a function of room temperature (setpoint shift).

$$Brine_{In} = (Brine_{In\_max} - Brine_{In\_min}) * (t_r - t_{r\_max})/(t_{r\_min} - t_{r\_max}) + Brine_{In\_min}$$

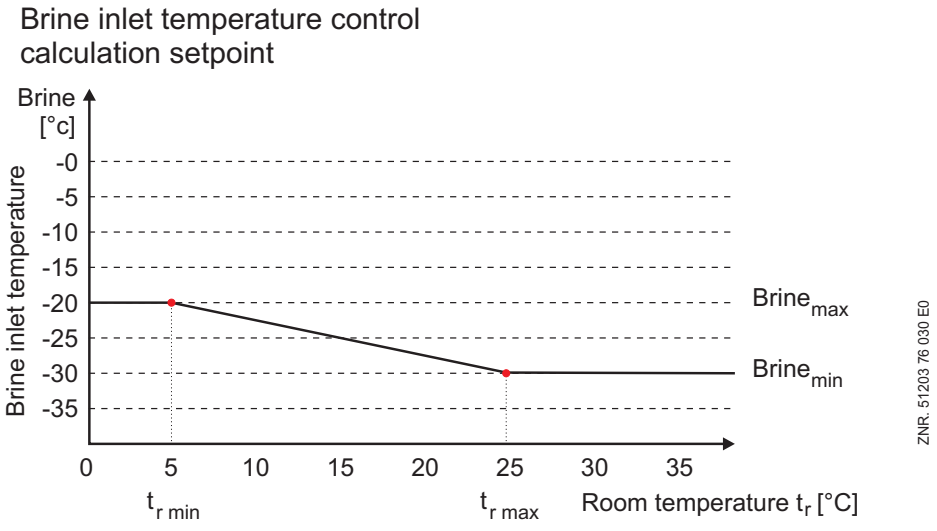
$Brine_{In}$	= Brine inlet temperature setpoint
$Brine_{In\_max}$	= Maximum brine inlet temperature
$Brine_{In\_min}$	= Minimum brine inlet temperature
t_r	= Current room temperature
t_{r_max}	= Maximum room temperature for setpoint shift
t_{r_min}	= Minimum room temperature for setpoint shift

The setpoint $Brine_{In}$ is defined as a constant for room temperature greater than t_{r_max} or less than t_{r_min}.

For $t_r < t_{r\_min}$: $Brine_{In} = Brine_{In\_max}$

For $t_r > t_{r\_max}$: $Brine_{In} = Brine_{In\_min}$

Temperatures $Brine_{In\_max}$, $Brine_{In\_min}$, $t_{r\text{-}min}$ and t_{r_max} can be set as parameters.



3.7 Capacity-controlled compressors

The FS 3010 can be used to control capacity-controlled compressors having up to three capacity stages (base load plus two capacity stages. The number of capacity stages can be set as a parameter. Capacity-controlled compressors do not have any effect on the control algorithm of the FS 3010. When the compressors are actuated, the base load of an available compressor is first switched on.

The capacity stages of the same compressor are then loaded as refrigeration is demanded before the base load of the next compressor can be switched on. Capacity stages are unloaded in the reverse order. The number of capacity stages actuated for one compressor is taken into account for compressor running base load rotation (also see Section 3.13 Base Load Rotation).

The base load stage of a compressor can be controlled by the integral manual switches. When the base load stage is shut down, the controller also shuts down the associate capacity stages. When the base load stage of a compressor is switched on, the capacity stages of this compressor are first loaded as refrigeration is demanded by the system.

3.7.1 Capacity-controlled compressors with dual-circuit systems

With dual-circuit systems, two compressor stages are loaded and unloaded alternately in Circuit 1 and 2 when refrigeration is demanded. With V1.35 and later, the control sequence of the capacity-controlled compressor can be changed by the parameter *sequence* (menü 3-2-1-1-b).

With earlier versions, compressor stages were loaded and unloaded alternately in both circuits. From Version 1.35 on, the Control Type parameter enables setting higher priority so that a capacity-controlled compressor is operated at full capacity where possible (bypass valve closed) before loading the base load stage of an additional compressor.

The following options are therefore selectable by the parameter *sequence*:

BBVV:

Priority at the nearly same number of compressor stages in Circuit 1 and 2. Loading in the sequence *base load circuit 1 - base load circuit 2 - valve circuit 1 - valve circuit 2.*

BVBV:

Priority for the operation of the capacity-controlled compressor at maximum level. Loading in the sequence *base load circuit 1 - valve circuit 1 - base load circuit 2 - valve circuit 2.*

The effect that control type has is shown for the example of a dual-circuit system equipped with four two-stage compressors.

Loading compressors with BBVV control type:

B1...B4: Base load stage 1 to 4

V1...V4: Valve 1 to 4

S1...S8: Relay outputs for compressor stages 1 to 8 FS 3010

BBVV	Circuit 1				Circuit 2			
	S1	S2	S3	S4	S5	S6	S7	S8
	B1	V2	B3	V4	B5	V6	B7	V8
1	**X**							
2	X				X			
3	X	X			X			
4	X	X			X	X		
5	X	X	X		X	X		
6	X	X	X		X	X	X	
7	X	X	X	X	X	X	X	
8	X	X	X	X	X	X	X	X

Unloading compressors with BBVV control type:

BBVV	Circuit 1				Circuit 2			
	S1	S2	S3	S4	S5	S6	S7	S8
	B1	V2	B3	V4	B5	V6	B7	V8
1	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	
3	X	X	X		X	X	X	
4	X	X	X		X	X		
5	X	X			X	X		
6	X	X			X			
7	X				X			
8	X							

Loading compressors with BVBV control type:

B1...B4: Base load stage 1 to 4

V1...V4: Valve 1 to 4

S1...S8: Relay outputs for compressor stages 1 to 8 FS 3010

BVBV	Circuit 1				Circuit 2			
	S1	S2	S3	S4	S5	S6	S7	S8
	B1	V2	B3	V4	B5	V6	B7	V8
1	X							
2	X	X						
3	X	X			X			
4	X	X			X	X		
5	X	X	X		X	X		
6	X	X	X	X	X	X		
7	X	X	X	X	X	X	X	
8	X	X	X	X	X	X	X	X

Unloading compressors with BVBV control type:

BVBV	Circuit 1				Circuit 2			
	S1	S2	S3	S4	S5	S6	S7	S8
	B1	V2	B3	V4	B5	V6	B7	V8
1	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	
3	X	X	X	X	X	X		
4	X	X	X		X	X		
5	X	X			X	X		
6	X	X			X			
7	X	X						
8	X							

3.8 Setpoint increase / decrease

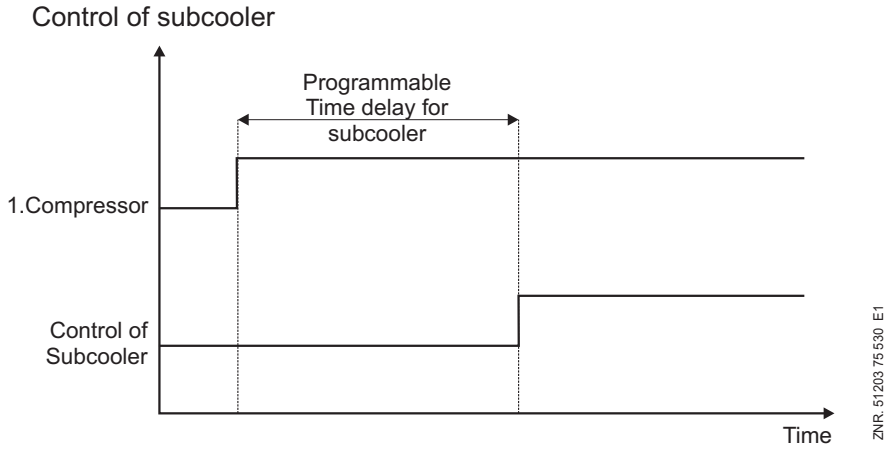
With cold side control it is possible to program a second characteristic (see 11.3.5. Setpoint Determination) that can be activated via a digital input on the controller. Setpoint increase/decrease is intended to allow better matching to nighttime and weekend operation.

3.9 Control of fluid valves/subcooler FS 3010

Fluid valves or a subcooler can be controlled through output 9 and 10, on terminals 1, 2 and 3, 4. The type of control is governed by that on the low-pressure side. The outputs control fluid valves when brine control is provided on the low-pressure. Output 9 controls a subcooler when pressure is controlled on the low-pressure side (only available with single-circuit systems).

Subcooler control

On loading a compressor capacity stage, output 9 is activated with a programmable delay. The delay can be defined in Menu 3-2-1-1 by the parameter Del.SubcoolerON xxxs. This parameter is only shown when suction-side pressure control is provided and the setting range is 0 to 255 sec (factory setting 120 sec). Output 10 has no function with pressure control (single-circuit system).



3.10 Pumpdown

In any extended shutdown the system can be pumped down for protection of the compressors. Pumpdown is influenced by the following parameters:

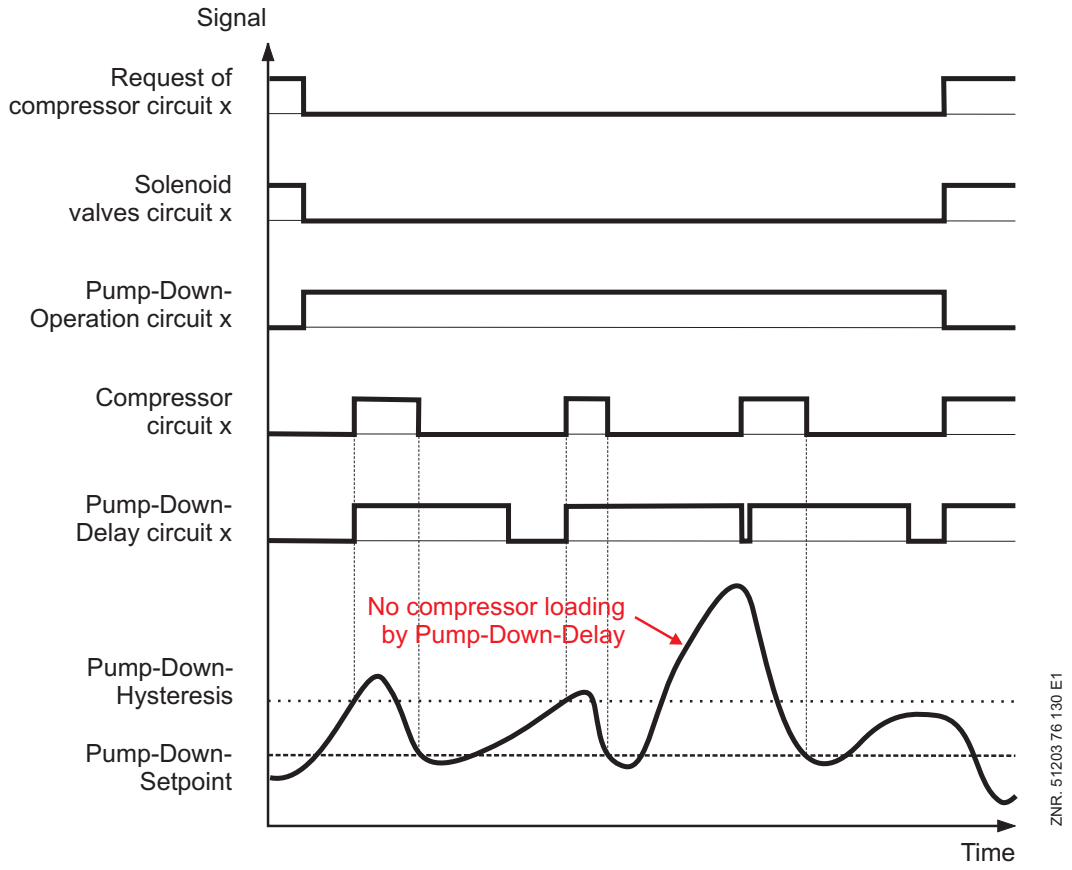
Line	Display		LT Specification		NT Specification		Min.	Max.
			Single-circuit system	*Dual-circuit system*	*Single-circuit system*	*Dual-circuit system*		
13	PD op.	X	N	J	N	J	N	J
14	PD temp.	XX °C	-40 °C	-40 °C	-15 °C	-15 °C	-50 °C	+5 °C
15	PD delay	XX m	6 Min.	6 Min.	6 Min.	6 Min.	1 Min.	20 Min.
16	PD hyst.	XX K	5 K	5 K	5 K	5 K	1 K	10 K

The parameter in Line 13 allows of activating or deactivating pumpdown. In the default setting, operation is activated for dual-circuit systems and deactivated for single-circuit systems. With dual-circuit systems the operating mode is independent for each circuit. The parameter in Line 14 controls the evaporating temperature that must be obtained before a pumpdown compressor is again stopped.

So as to avoid short-circuiting, the parameter in Line 15 defines a time delay that must elapse before a compressor can be restarted. This delay is also initiated in cooling mode when a compressor starts so that compressor loading is delayed when switching to pumpdown operation.

The parameter in Line 16 controls a positive temperature differential to the pumpdown setpoint. A compressor cannot be restarted before the evaporating temperature has increased to a value greater than *PD temp.* plus *PD hyst.* **and** the time set for *PD delay* has expired.

The solenoid valves remain closed during pumpdown. This mode is deactivated when refrigeration is demanded. The pumpdown sequence is represented in the following graph:



3.11 Ambient data

The quantities used for setpoint shift, namely

- room temperature (shift of t_0)
- outdoor temperature (shift of t_c)
- humidity (shift of t_0)

can either be supplied by sensors connected to the pack controller or received from another pack controller via the CAN bus.

Action of the controller is then controlled by the following parameters in *menu 3-1 System Configuration:*

- *Room temp.*
- *Outdoor temp.*
- *Humidity*

The parameters *Room temp., Outdoor temp.* and *Humidity* can be used to set whether sensors directly connected to the controller are present. If one of these parameters is set to **N**, the controller will attempt to receive the respective value from another VS 3000 or FS 3010 via the CAN bus.

It is important to note that the sensors for room temperature, outdoor temperature and humidity may only be connected and activated for one pack controller in the system. The other pack controllers in the system will then receive this data via the CAN bus.

3.12 Load shedding

In order to prevent excessive use of electrical energy in the store, it may be necessary to provide forced shut-down of compressor capacity stages. A controller for four compressors has one digital input and a controller for six compressors has two digital inputs for load shedding. Compressors are shut down directly. Action of the digital inputs is shown in the following table:

Load shedding Input 1	Load shedding Input 2	No. of disabled compressors
OFF	OFF	0
OFF	ON	1
ON	OFF	1
ON	ON	2

Regardless of load shedding signals, a minimum refrigeration capacity must be assured, requiring a minimum number of compressors to be enabled. The minimum number of enabled compressors varies with the number of compressors in the system.

The following relationships apply:

Compressor stages	Number of active load shedding stages	Minimum number of enabled compressor stages
1	0	1
2	1	1
3	2	1
4	2	2
5	2	3
6	2	4
7	2	5
8	2	6

3.13 Compressor base load rotation

Base load rotation is only active under the following conditions:

- When all defined compressors are enabled, base load rotation takes place only within the neutral zone.
- Outside the neutral zone, base load rotation takes place only when compressors have been disabled by load shedding or high-pressure fault.

Base load rotation can be set in Menu 3-4 *Base Load*:

with the following parameters:

Cycle time: xxx

Range: 5 – 720 minutes or “---”

Default NT: 30

Default LT: 30

Particularly when working with screw compressors fitted with an oil return system that does not require base load rotation, the parameter can be set to --- to deactivate base load rotation. The base load rotation function differs for single- and dual-circuit systems.

3.13.1 Base load rotation for single-circuit systems

At the end of the set cycle time, the compressor then having the longest running time will be disabled and that having the shortest running time will be enabled. With capacity-controlled compressors, base load rotation only takes place when the base load stage of a compressor is available.

When base load rotation is activated, all capacity stages of the compressor having the longest running time are disabled and the base load stage of the compressor having the shortest running time is loaded. Loading of the associate capacity stages can take place by demand for refrigeration.

3.13.2 Base load rotation with dual-circuit systems

Base load rotation takes place at the end of the set cycle time. If only one compressor is on, it will be disabled. The compressor having the shortest running time in the other circuit is enabled. If a minimum of one compressor is on in each circuit and one compressor is available in each circuit, base load rotation takes place within each circuit.

The compressor having the longest running time in a circuit is disabled and that having the shortest running time in the same circuit is enabled. If no compressor is available in a circuit, the compressor having the longest running time in that circuit is shut down and the compressor having the shortest running time in the other circuit is loaded.

The procedure is the same for capacity-controlled compressors. Base load rotation takes place only when the base load stage of a compressor is available. Only the base load stage of the compressor having the shortest running time is loaded. Loading of the associate capacity stages can take place by demand for refrigeration.

3.14 Monitoring functions

In addition to the control and regulating functions, monitoring functions are integrated in the controller. The following functions are continuously monitored:

- Safty loop
- Low oil pressure cutout
- Low oil flow cutout
- Motor overload cutout/phase monitor
- Compressor cylinder head temperature
- Low pressure
- High pressure

3.14.1 Safety loop

For reasons of monitoring system redundancy, the monitoring functions of the FS 3010 are supplemented by provision to disable all or individual compressors of a pack in critical operating situations. The switching contacts used for this purpose are prioritized in descending order according to the system wiring as follows:

Reciprocating compressors:

- Disabling of all compressors
1. Safety high-pressure cutout
2. High-pressure cutout
3. Low-pressure cutout

- Disabling of compressors affected
4. Compressor high-pressure cutout
5. Compressor low oil pressure cutout (see note below)
6. Compressor motor overload cutout

Screw compressors:

- Disabling of all compressors
1. Safety high-pressure cutout
2. High-pressure cutout
3. Low-pressure cutout

- Disabling of compressors affected
4. Compressor high-pressure cutout
5. Compressor motor overload cutout + phase monitor
6. Compressor low oil flow cutout (see note below)

Due to this set-up, actuation of a high-priority safety contact (e.g. high-pressure cutout) causes all lower-priority alarm contacts to be de-energized and thus activated. So as to prevent the pack controller from transmitting all sequential alarms in this instance, transmission of lower-priority alarms is blocked in the simultaneous occurrence of a higher-priority alarm event.

3.14.2 Monitoring of low oil pressure cutout (reciprocating compressors only)

The low oil pressure cutout is monitored only in systems equipped with reciprocating compressors. Oil pressure is monitored by the *low oil pressure cutout* with floating contact. In the alarm state the contact is open. If the low oil pressure cutout is actuated while the compressor is running, the compressor will be stopped after a time delay and disabled for subsequent control actions.

When refrigeration is demanded, one compressor stage is loaded. If the low oil pressure cutout does not reset to the OK state within the time delay, the compressor stage is disabled again. Time delays can be adjusted using the AL 300 Operator Terminal, CI 3000 Store Computer or a PC by the following parameters:

- *Del.OilPr.On:* Delay on starting compressor
- *Del.OilPr.Op.:* Delay during operation of compressor

In view of the time delays, the low oil pressure cutout should not be connected in the safety loop. The input is connected direct to the FS 3010. If the pressure switch is in series with the safety loop (oil pressure switch with integral time element), the time delays on the FS 3010 must be set to the smallest possible value.

When a compressor is started by manual switch, the compressor output will not be actuated if the oil pressure switch is defective. Oil pressure switches that do not have an integral time delay must be bypassed when the compressor is at standstill.

3.14.3 Monitoring of low oil flow cutout (screw compressors only)

Monitoring of the low oil flow cutout is limited to systems equipped with screw compressors. Oil flow rate is monitored by the *oil flow cutout* with floating contact. In the alarm state the contact is open. If the low oil flow cutout is actuated while the compressor is running, the compressor will be stopped after a time delay and disabled. The compressor must be re-enabled manually for control actions to again take effect.

When refrigeration is demanded, one compressor stage is loaded. If the low oil flow cutout does not reset to the *OK state* within the time delay, the compressor stage is again shut down and disabled. The compressor must then be re-enabled manually.

Time delays can be adjusted using the AL 300 Operator Terminal, CI 3000 Store Computer or a PC by the following parameters:

Del.Flow.On: Delay on starting compressor
Del.Flow.Op.: Delay during operation of compressor

In view of the time delays, the low oil flow cutout should not be connected in the safety loop. The input is connected direct to the FS 3010. If the flow cutout is in series with the safety loop (oil flow switch with integral time element), the time delays on the FS 3010 must be set to the smallest possible value.

When a compressor is started by manual switch, the compressor output will not be actuated if the oil flow switch is defective. Oil flow switches that do not have an integral time delay must be bypassed when the compressor is at standstill.

3.14.4 Monitoring of motor overload cutout/phase monitor

The compressor motor is monitored by the motor overload cutout/phase monitor. In the alarm state the auxiliary contact is open. If the motor overload cutout is actuated, the compressor is directly shut down and disabled for subsequent control actions. The compressor is re-enabled when the overload cutout/phase monitor is reset.

Monitoring concerns different protective devices. Reciprocating compressors are monitored by a motor overload cutout, screw compressors by a motor overload cutout **and** phase monitor connected in series.

3.14.5 Monitoring of cylinder head temperature

Compressor cylinder head temperature is monitored to keep it from exceeding a defined maximum so as to prevent damage to the compressor. The maximum cylinder head temperature at which a compressor is disabled and also the compressor enabling temperature can be programmed.

If temperature exceeds the set maximum, the compressor is directly shut down and disabled for subsequent control actions. The compressor remains disabled until the temperature drops to the enabling level. If this action occurs several times in a single day (5 shutdowns), the compressor will be disabled and must then be re-enabled manually.

3.14.6 Monitoring of low pressure

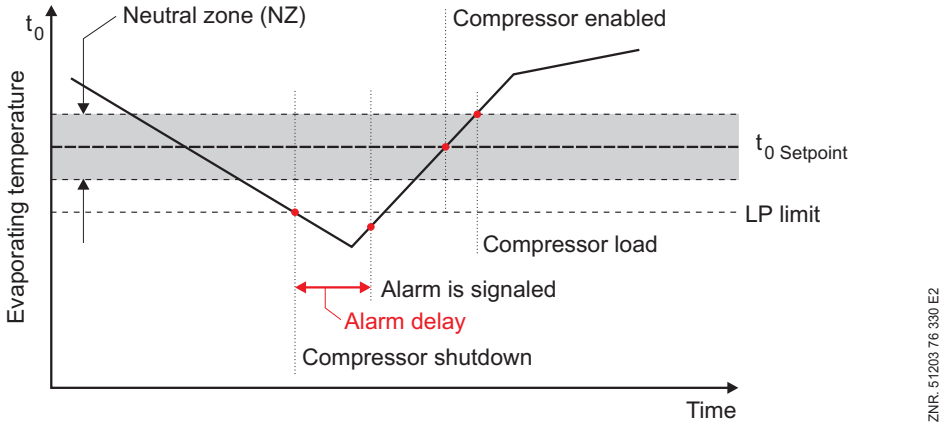
Low pressure is measured in the low pressure line of both refrigerant circuits by a continuous transmitter delivering a current output (0-10 bar abs). Low pressure monitoring is contingent on the cold side control type.

3.14.6.1 Monitoring of low pressure with suction pressure control

If low pressure drops below a definable limit, all compressors will be shut down and disabled. The compressors are enabled when low pressure rises to the pressure value proportional to $t_{0\text{-}Setp.}$. Suction pressure control is available only for single-circuit systems.

Alarm is generated at the end of a delay interval. Delay time and priority of the alarm can be defined. The pressure limit is set in °C. From this value the controller computes an absolute proportional pressure value.

Monitoring evaporating temperature



Additionally, the low-pressure cutout is evaluated. Forced shutdown of al compressors is initiated if pressure drops below the limit set on the low-pressure cutout.

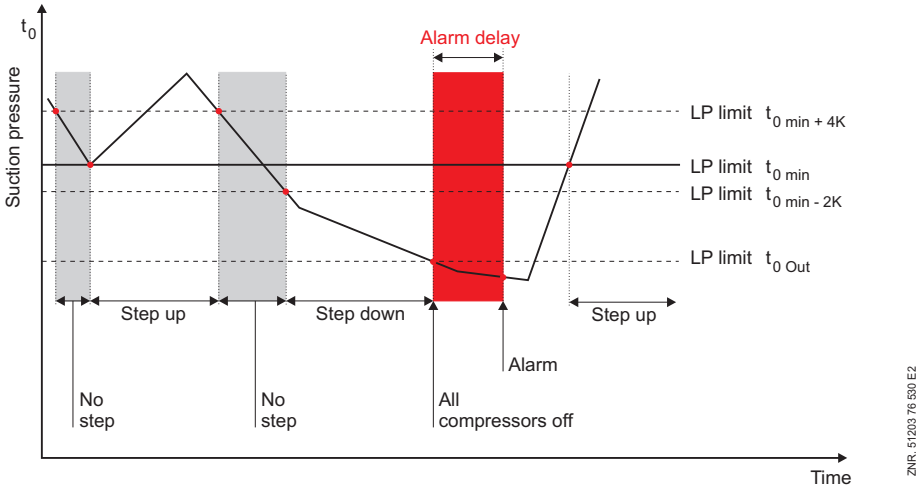
3.14.6.2 Monitoring of low pressure with brine control

If low pressure in one circuit drops below a definable limit of $t_{0\text{-}min}$ plus 4 K and pressure continues to drop, no further compressor capacity stages are loaded. Compressor stages can be loaded when pressure increases and the actual value of t_0 is greater than $t_{0\text{-}min}$.

If the pressure in one circuit drops to a value smaller than $t_{0\text{-}min}$ minus 2 K, compressor stages of this circuit are shut down according to their running time and with a time delay. Compressor stages are again loaded when pressure increases and the actual value of t_0 is greater than $t_{0\text{-}min}$.

If low pressure in one circuit drops below a definable limit of $t_{0\text{-}Off}$, all compressors will be shut down. Compressor stages are again loaded when pressure increases to a value greater than $t_{0\text{-}min}$. Alarm is generated at the end of a delay interval. Delay time and priority of the alarm can be set as a parameter. The pressure limit is set in °C. From this value the controller computes an absolute proportional pressure value.

Monitoring evaporating temperature



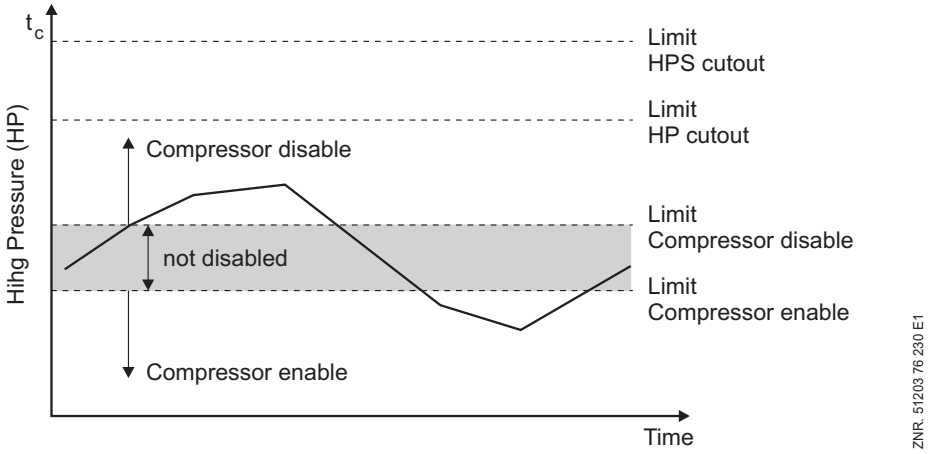
Additionally, each circuit contains a low-pressure cutout. Forced shutdown of all compressors in the circuit affected is initiated if pressure drops below the limit set on the low-pressure cutout.

3.14.7 Monitoring of high pressure

High pressure is measured in the high-pressure line of each circuit by a continuous transmitter delivering a current output (1-26 bar abs). Pressure is also monitored in each circuit by the high-pressure cutout. These devices deliver a digital signal when the set pressure level is exceeded.

If high pressure rises to a definable limit and all compressor stages of the circuit are loaded, one compressor capacity stage of this circuit will be disabled immediately. The compressor capacity stage is re-enabled when pressure drops to a definable enabling level. Heat recovery mode is an exception in that compressor unloading does not take place in this mode.

Control algorithm HP monitoring



If pressure exceeds the limit set on the safety high-pressure cutout or high-pressure cutout, positive shutdown of all compressors is initiated. The compressors are loaded again stagewise after mechanically resetting the pressure switches.

If the limit set for *Comp. Disable* is exceeded, a *High HP* alarm is generated. Priority of this alarm can be set as a parameter. No alarm is generated in heat recovery mode. Additional compressor capacity stages will not be loaded as long as the high HP fault state persists.

3.15 Dry cooler control/fan control

Cooling of the refrigerant or coolant takes place in a dry cooler. Dry cooler control can be operated in three modes:

- Control by enabling or disabling fan stages (step controller).
- Control by means of speed adjuster (continuous control); control is made by an analog signal that inputs the required speed to the speed adjuster.
- Combination of step controller and continuous control; control is made by enabling or disabling fan stages and by means of speed adjuster (currently not implemented).

The control type (step controller, continuous control or combined control) can be programmed using the AL 300 Operator Terminal, CI 3000 Store Computer or by a PC. When using the AL 300 Operator Terminal or CI 3000 Store Computer, the control type is programmed in the Controller menu item (Menu 3-2-2-1-b).

The control type can be set from the following selection list:

Display	Setting	Control type
Step controller	√	Stagewise loading or unloading of several condenser stages
Speed controller		Continous HP control by means of speed adjuster (FC or phase control)
Combi controller		Currently not implemented

The control functions covered by dry cooler control are:

- Control of high pressure or
- Control of coolant temperature
- High pressure monitoring

3.16 Control type

With the FS 3010 the hot side can be controlled through the high pressure or coolant temperature. Using the parameter *Dry cooler* (menu 3-1) it is possible to select an existing dry cooler or to condense directly. If an existing dry cooler is employed, the parameter *Sensor* under menu 3-2-2-1 can be used to select whether regulation is carried out via the coolant temperature or the high pressure.

3.16.1 High pressure control

High pressure control has the purpose of maintaining high-side pressure at a defined setpoint. This is accomplished by loading and unloading of fan stages. The setpoint can be defined as a function of outdoor temperature. The actual value is measured by a pressure transmitter (or two in dual-circuit systems) delivering a continuous current output (4-20 mA).

3.16.2 Control of coolant temperature

In coolant temperature control, temperature of the coolant is controlled to a defined setpoint. This is accomplished by loading and unloading of fan stages. The setpoint can be defined as a function of outdoor temperature. The actual value is measured by a Pt1000 temperature sensor.

3.17 Neutral zone

No condenser fan actuation takes place as long as the control error remains within a programmable *neutral zone* (NZ).

3.18 Control algorithm

3.18.1 Control algorithm with step controller

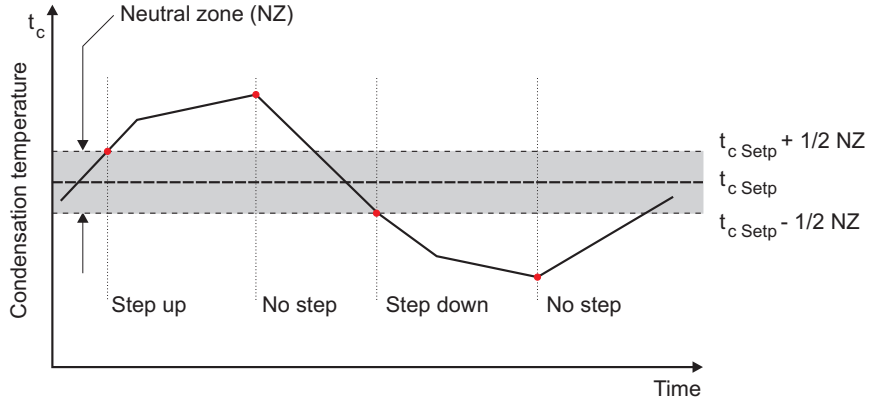
The actual value (high pressure or coolant temperature) measured by an A/D converter is compared with the setpoint. The following relationship applies:

Control error = Actual value - Setpoint

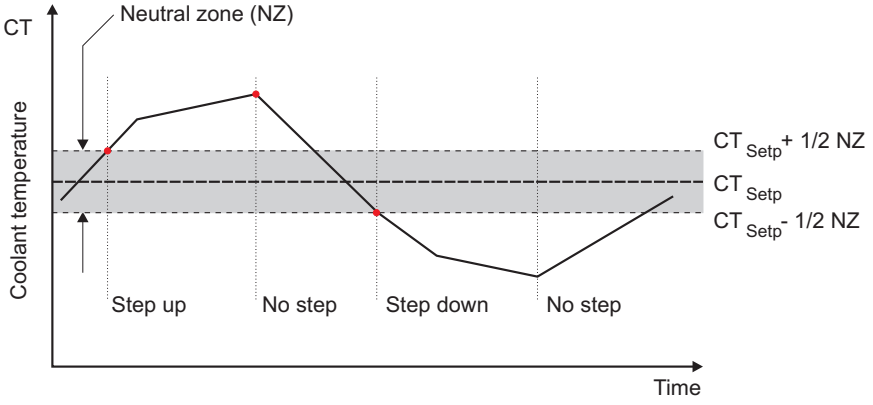
When the error is positive, greater than half of the neutral zone and pressure/temperature is rising, the step-by-step switch advances one step at a time. This means that condenser capacity stages are enabled in sequence, subject to the definable basic and variable load times.

When the error is negative, greater than half of the neutral zone and pressure/temperature is falling, the step-by-step switch reverses one step at a time. This means that condenser capacity stages are disabled in sequence, subject to the definable basic and variable load times.

Controlling of condensation temperature



Controlling of coolant temperature



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The fan stage switching sequence is defined as follows:

- With all single-circuit systems and with dual-circuit systems equipped with a dry cooler (single-loop hot brine circuit but dual-loop refrigerant circuit), fans are loaded in sequence beginning with Stage 1 and unloaded in sequence beginning with the last fan stage defined.
- With dual-circuit systems not equipped with a dry cooler (no hot brine circuit, direct condensation) fan loading begins with fan Stage 1 for the first circuit and with the fan stage assigned to 2 in the first circuit for the second circuit:

$L_{Start\ Circuit\ 2}$ = *No. of condenser fans / 2*

Unloading commences with the fan stage assigned to the respective circuit. No compressor actuation takes place as long as the control error remains within a programmable *neutral zone*.

3.18.2 Control algorithm with continuous control

The actual value (high pressure or coolant temperature) measured by an A/D converter is compared with the setpoint. The following relationship applies:

Control error = Actual value - Setpoint

When the error is positive, the speed adjuster is enabled through the first capacity stage of the FS 3010. Depending on the error, a speed setpoint is computed by a PI control algorithm and supplied to the speed adjuster via an analog output (0-10 V). The speed adjuster controls the fan speed to the defined setpoint.

When the error is negative, the speed adjuster is disabled through the first capacity stage of the FS 3010 when speed has dropped to the minimum speed level. Control can be influenced by three parameters.

The following parameters can be programmed with the AL 300 Operator Terminal or CI 3000 Store Computer in Menu 3-2-2-1:

Line	Display	Setting	Min.	Max.
1	Sensor →	-	-	-
2	Controller →	-	-	-
3	Base ld. rot.. X	N	N	Y
4	Adjusting diff. XX	0	-15	+15
5	Min. speed XX %	0 %	0 %	50 %
6	t_{c_max} XX °C Brinemax with BrineCtrl.	40 °C	25 °C	56 °C
7	Fan off by al.. X	Y	N	Y

Parameters in Lines 4 to 6 are only displayed when speed controller or combination controller has been activated as the control type (see 3.15 Dry Cooler Control/Fan Control). The parameter in Line 4 can be used to influence controller speed. Set a higher value if the controller is too slow or set a lower value if the controller hunts.

The parameter in Line 5 can be used to define minimum speed of the speed adjuster. Enter a value in percent of the 0-10 V analog output of the FS 3010. If the limit displayed in Line 6 is exceeded, the second capacity stage of the controller is activated. With the second capacity stage, a bypass can be activated to connect the speed-controlled fans to the fixed-speed power supply. The controller returns to control mode when the defined setpoint is attained.

With dual-circuit systems not equipped with a dry cooler, two HP transducers are used to measure p_c/t_c and two analog outputs are actuated for control of two speed adjusters. The speed adjuster for Circuit 2 is enabled through the fan stage:

$L_{Start\ Circuit\ 2}$ = *Number of condenser fans / 2*

Bypassing of the speed adjuster for Circuit 2 takes place through the fan stage:

$L_{Start\ Circuit\ 2}$ = *Number of condenser fans/2 + 1*

A bypass must be connected to the bypass-stage at a system with speed control, because the dry cooler control disables the speed adjuster at rising temperatures.

3.18.3 Temperature hold

The purpose of this function is to hold temperature of the coolant (i.e. heat transfer fluid) at a defined setpoint during the winter season and in heat recovery mode, including at part-load conditions. Flow of the coolant in the dry coolers is controlled by a three-way valve.

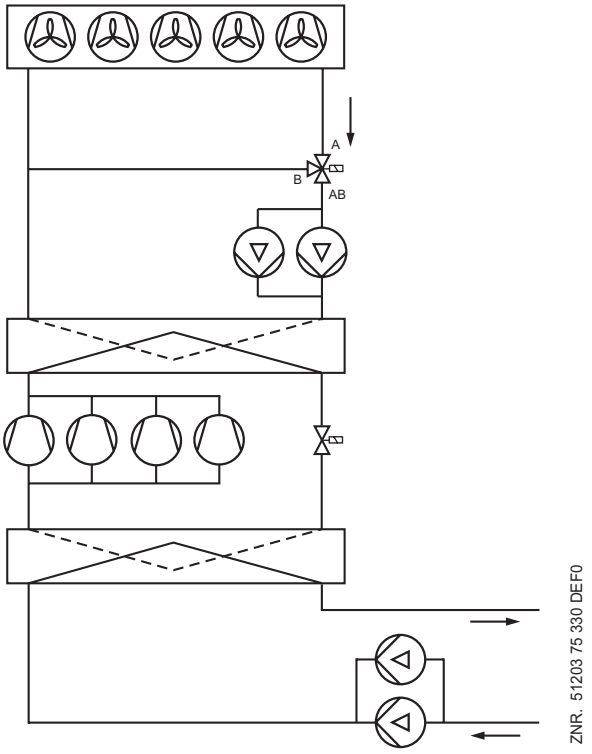
The three-way valve is operated by a 0 - 10 V signal at terminals 55/56. Due to this connection also being used for control of variable-speed fans in dual-circuit systems, temperature hold is not available in every application. The following table shows were the function is usable.

	Fan control	
	Step controller	**Speed controller**
No dry cooler (direct condensing)	NO	NO
Single-circuit dry cooler Single-circuit condensing	YES	YES
Single-circuit dry cooler Dual-circuit condensing	YES	YES
Two-circuit dry cooler Dual-circuit condensing	YES	NO

This function can only be used properly when coolant outlet temperature is measured by the coolant temperature sensor (controlled variable). Control can be changed to the inlet temperature in heat recovery mode. To activate temperature hold, the *Temp.Hold* parameter must be set to *Y* in Menu 3-2-2-2. Fan control works independently of temperature hold and vice versa.

The following relationship however exists between fan control and temperature hold:

- Fan control is only enabled when the three-way valve is fully open in A-AB direction (0 V at the FS 3010 output).
- The three-way valve is only actuated (signal greater than 0 V at FS 3010 output) when all fan stages are off.



3.18.3.1 Control of three-way valve

The following relationship applies to computing the control signal for the three-way valve:

U_{Setp} = $P_{Action} + I_{Action}$

U_{Setp} = Three-way valve actuating signal (0 - 10 V)

P_{Action} = Controller proportional action

I_{Action} = Controller integral action

P_{Action} = $(Coolant_{Setp} - Coolant_{Act}) * Vp$

$Coolant_{Act}$ = Current coolant temperature

$Coolant_{Setp}$ = Coolant temperature setpoint

V_p = P-action gain

The P-action of the controller responds direct to control errors. The I-action avoids persistent control errors.

I_{Action} = $I_{Action} + (Coolant_{Setp} - Coolant_{Act}) * V_I$

V_I = I-action gain

The I-action is formed by summation at every controller cycle (1 sec). Gain V_P and V_I can be programmed. Both parameters are only shown when temperature hold is activated.

The analog output is set to 0 V when the *System OFF* input is active and all fans and compressors are off. In failure of the sensor to detect coolant temperature, the analog output is set to 0 V. With variable-speed fans, speed is set to 80% maximum.

When all compressors are off, the fan capacity stages are stopped stagewise on elapse of the basic unload time with a step controller. When compressors are loaded, the fan capacity stages are again loaded stagewise on elapse of the basic load time. The actuating signal for the three-way valve (0 - 10 V) can be inverted by setting the *10V-0V Signal* parameter to Y.

3.18.4 Control algorithm in heat recovery mode

Heat recovery mode can be activated via a digital input of the controller (terminals 70/71 of SIOX 1). In this mode, control is made to a higher setpoint level (condensing pressure or coolant temperature).

This setpoint can be shifted within programmable limits by an external voltage signal (0 -10 V, terminals 51/52) when HR mode is activated via the digital input. Setpoint shift is enabled by a separate parameter. Heat recovery mode of the FS 3010 is implemented with four parameters. The *Setp.Shift = Y/N* parameter is used to disable or enable setpoint shift via an external voltage signal.

According to the control type, the Max. *HR = xxx* parameter specifies the maximum condensing temperature or maximum coolant temperature allowed in HR mode.

Range: 30 C - 50 C
Default NT: 46 C
Default LT: 46 C

The Min. HR = xxx parameter is only shown when setpoint shift is enabled via the external control signal. It specifies the minimum condensing temperature or minimum coolant temperature allowed in HR mode.

Range: 25 C - 40 C
Default NT: 30 C
Default LT: 30 C

For control of condensing temperature the temperature setpoint is converted to pressure of the selected refrigerant. The parameter Dif. HR = xx defines a temperature difference.

Range: 2K - 8K
Default NT: 5K
Default LT: 5K

If the actual value drops to a level less than HR_Setpoint - Dif. HR, fan stages are unloaded allowing for the basic and variable unload time.

Determining the setpoint:

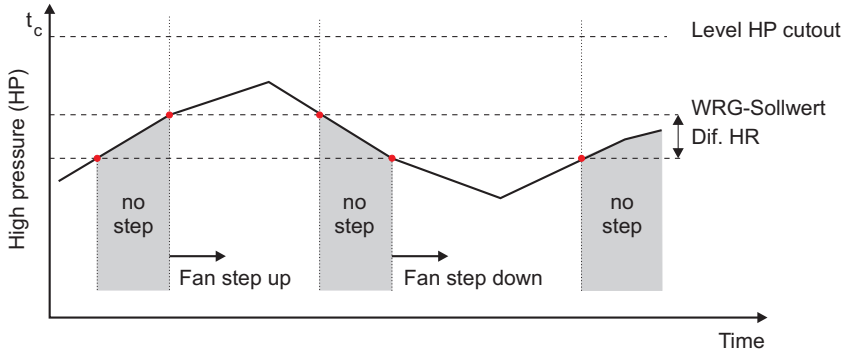
When setpoint shift is not active, the Max. HR parameter is taken as HR setpoint. When setpoint shift is activated, the setpoint is calculated according to the following function:

$$HR_{Setp} = HR_{Min} + \frac{(HR_{Max} - HR_{Min})}{10V} * U_E$$

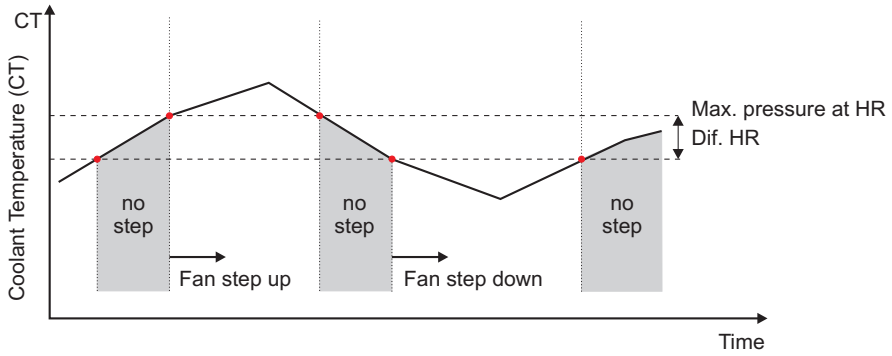
HR_{Setp}: Calculated HR setpoint
HR_{Max}: Programmed maximum HR temperature
HR_{Min}: Programmed minimum HR temperature
U_E: Input voltage (0 - 10 V) for setpoint shift

If temperature rises to a level greater than HR Setpoint, the first fan stage is loaded immediately (disregarding programmed control times). Each additional fan stage is loaded at the end of the basic load time (disregarding the variable control time). When temperature hold is activated, fan control is not enabled until the constant pressure valve control signal drops to 0 V.

Control algorithm heat recovery mode (HR mode)



Control algorithm coolant in HR mode



High actual value does not initiate any fault report or compressor shutdown in heat recovery mode. With single-circuit systems and also with dual-circuit systems operating one a single circuit brineside, control can take place with one temperature sensor each at the coolant inlet and coolant outlet.

The input for Circuit 2 coolant temperature (terminals 29, 30 on the FS 3010 basic module) is then used with heat recovery mode activated. If this input is not connected, the Circuit 1 coolant temperature input (terminal 27,28 on the FS 3010 basic module) will be used in both normal mode and heat recovery mode. Priority of the system fault message *17 M.err.coolt-out* must then be set to -- (Menu 3-5).

3.19 Setpoint determination

3.19.1 Setpoint determination with high pressure control by step controller

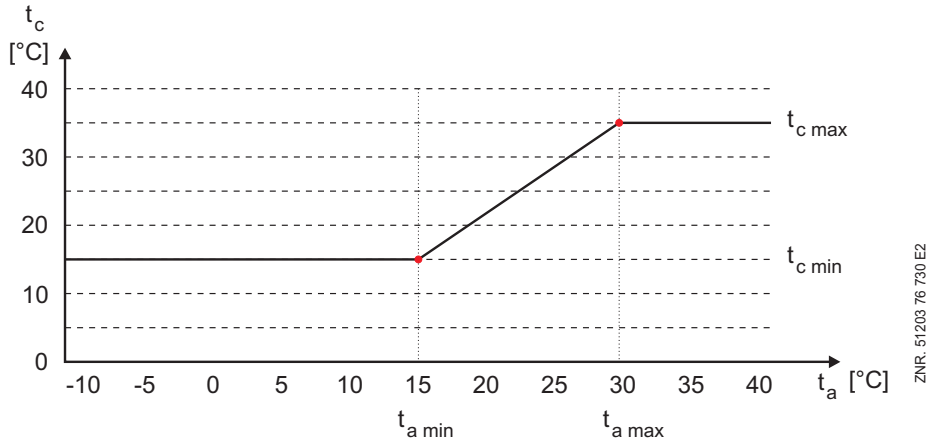
Determination of the setpoint for t_c can be made as a function of outdoor temperature according to a programmable characteristic.

$$t_c = (t_{c\_max} - t_{c\_min}) * (t_a - t_{a\_min})/(t_{a\_max} - t_{a\_min}) + t_{c\_min}$$

t_c	= t_c setpoint
t_{c_max}	= Maximum t_c setpoint
t_{c_min}	= Minimum t_c setpoint
t_a	= Current outdoor temperature
t_{a_max}	= Maximum outdoor temperature for setpoint shift
t_{a_min}	= Minimum outdoor temperature for setpoint shift

The setpoint is defined as a constant for outdoor temperature greater than t_{a_max} or less than t_{a_min}.

Setpoint calculation of condensation temperature



3.19.2 Setpoint calculation for high pressure control

The pressure setpoint for actual control is determined from a conversion table stored in the program. Conversion of t_c to the corresponding pressure value is made for all currently used refrigerants.

3.19.3 Setpoint determination with coolant control by step controller

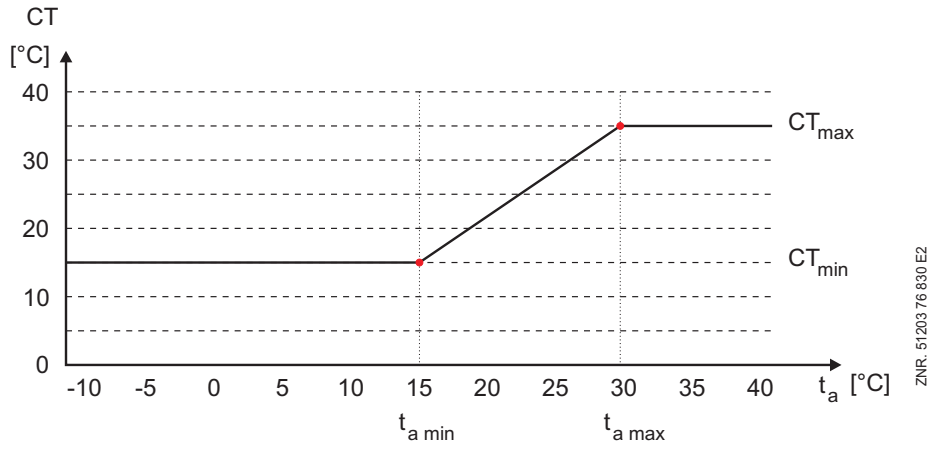
Determination of the coolant setpoint can be made as a function of outdoor temperature according to a programmable characteristic.

$$t_{Coolant} = (t_{Coolant\_max} - t_{Coolant\_min}) * (t_a - t_{a\_min})/(t_{a\_max} - t_{a\_min}) + t_{Coolant\_min}$$

$t_{Coolant}$ = Coolant setpoint
$t_{Coolant\_max}$ = Maximum coolant temperature
$t_{Coolant\_min}$ = Minimum coolant temperature
t_a = Current outdoor temperature
t_{a_max} = Maximum outdoor temperature for setpoint shift
t_{a_min} = Minimum outdoor temperature for setpoint shift

The setpoint is defined as a constant for outdoor temperature greater than t_{a_max} or less than t_{a_min}.

Setpoint calculation coolant



3.19.4 Setpoint determination with continuous control

The setpoint is calculated as described in chapter 3.19.1 Setpoint Determination With High Pressure Control By Step Controller or chapter 3.19.3 Setpoint Determination With Coolant Control By Step Controller. Additionally, a speed setpoint is determined. The following relationship applies:

$$U_{Setpoint} = P_{Part} + I_{Part}$$

$U_{Setpoint}$ = Speed adjuster setpoint (0-10 V)
P_{Part} = Proportional part of controller action
I_{Part} = Integral part of controller action

$$P_{Part} = t_{Actual} - t_{Setpoint}$$

t_{Actual} = Current temperature value (t_c or coolant)
$t_{Setpoint}$ = Temperature setpoint ($t_{c\text{-}Setp.}$ or coolant setpoint)

The P part of the controller responds directly to control errors. The I part avoids sustained control errors.

$$I_{Partl} = I_{Part} + [(t_{Actual} - t_{Setpointl})/4 + Adjustdif]$$

Adjust dif. = Definable controller speed

3.20 Dry cooler control times with step controller

Rise or fall of temperature (t_c or coolant temp.) to a value outside the neutral zone causes the first condenser capacity stage to be loaded or unloaded immediately. Subsequent actuations take place only when a defined time for loading or unloading has expired and control error has exceeded a defined level (neutral zone).

Time is dependent on the actual error, actuation taking place in a shorter time when the error is at its maximum than when it is smaller. Control time is calculated from the sum of a basic time t_b and a variable time t_v. Differentiation is made between advance and reverse stepping of the step controller.

The variable time is inversely proportional to the control error. Variable time is $t_v = 0$ when the error is at its maximum and automatically increases up to a defined maximum time as the error decreases. Basic time and maximum variable time for advance and reverse stepping are programmable as parameters for each dry cooler stage. The following relationships apply for determination of control times:

$$t = t_b + t_v$$

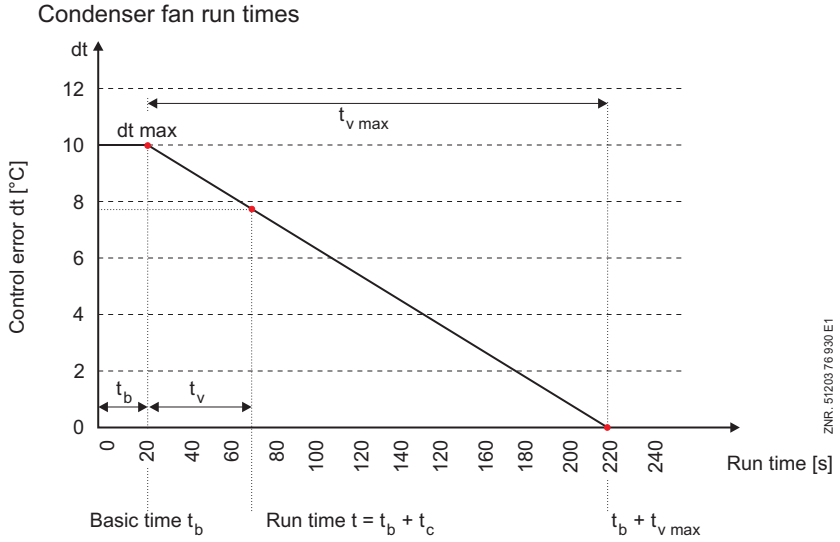
t_b = Definable parameter

For t_v: $t_v = t_{v\_max} - (t_{v\_max} * d_t)/d_{t\_max}$

For $d_t > d_{t\_max}$: $d_t = d_{t\_max}$

t_v = Variable control time
t_{v_max} = Maximum variable control time (definable parameter for each stage)
d_t = Control error
d_{t_max} = Maximum control error (definable parameter)

Control time is calculated at every controller run. For this purpose the variable time is recalculated and the time elapsed since the last control time is compared with the calculated time. If the calculated control time is less than or equal to the expired time, fan actuation takes place when the control error is larger than the defined neutral zone. Heat recovery mode is an exception. In this mode, capacity stages are loaded when the basic time t_b elapses. Calculation of control time is represented in the following graph:



3.21 Monitoring condenser fan motors

Step control:

Digital inputs are provided for monitoring of condenser fan motors. When the floating contact of the motor overload cutout opens, the corresponding fan output is reset and a fault report is entered in fault memory. Transmission of the report takes place according to the preselected priority. When the contact is closed, the fan is enabled for control. Some types of system require the fan output to remain activated after actuation of the motor overload cutout. Resetting of the fan output can therefore be deactivated by parameter setting.

Speed control:

Digital inputs are provided for monitoring of condenser fan motors. When the floating contact of the motor overload cutout opens, a fault report is entered in fault memory for the fan motor concerned. Transmission of the report takes place according to the preselected priority. The number of fans to be monitored is defined by the parameter *No. Cond.Stages* (Menu 3-1) for variable-speed fans. Two stages are alowasy used for control.

3.22 Pump control

Coolant and brine pumps installed in the system can be controlled with the FS 3010. The number of pumps is programmed in Menu 3-1:

Parameter	Display AL 300/CI 3000	Default	Min.	Max.
No. of brine pumps	No. Brine Pumps	2	0	2
No. of coolant pumps	No. Coolant Pumps	2	1	2

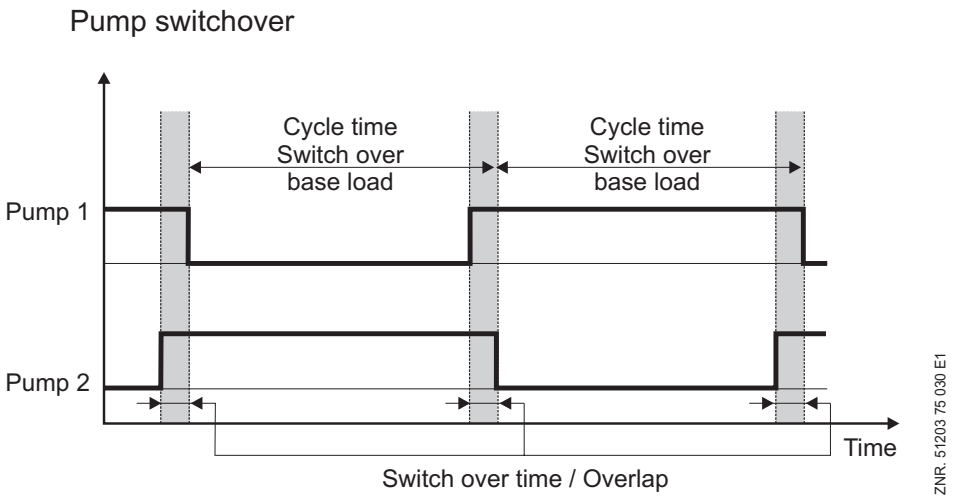
3.22.1 Pump monitoring

The pump motor overload cutouts are similarly monitored by the controller. In failure of a pump, a Brine Pump x or Coolant Pump x alarm (x indicating the pump number) is generated. Only one pump is in operation for the brine and coolant.

Direct switchover to the second pump can be made in actuation of a pump motor overload cutout. The system cannot continue operating in failure of the full number of brine or coolant pumps programmed. The compressor and fan outputs are reset stagewise.

3.22.2 Pump base load rotation

To ensure even utilization of the pumps, their running sequence is rotated at definable intervals. This requires two brine or coolant pumps to be programmed. The motor overload cutout of the second pump must not have actuated. The stationary pump can be started for a definable time prior to rotation as a means of avoiding pressure surges.



3.22.3 Pump parameter setting

The parameters listed in the table can be set in the Menu 3-6:

Line	Parameter	Display AL 300/CI 3000	Default	Min.	Max.
1	Delay coolant pump ON	Del. coolant ON	20 s	0 s	60 s
2	Delay coolant pump OFF	Del. coolant OFF	180 s	0 s	250 s / ---
3	Time overlap when rotating coolant pumps (both pumps ON)	Overlap coolant	0 s	0 s	30 s
4	Base load rotation coolant pump	Cycle coolant	12 h	1 h	48 h
5	Stop brine pump with ”External OFF” input	Brine OFF w.ext.	J	N	J
6	Stop brine pump with last compressor	Brine OFF w.comp.	N	N	J
7	Time overlap when rotating brine pumps (both pumps ON)	Overlap brine	0 s	0 s	30 s
8	Base load rotation brine pump	Cycle coolant	12 h	1 h	48 h

The parameter in Line 1 determines the delay for the coolant pump to be started after starting the first compressor. The parameter in Line 2 determines the delay for the coolant pump to be stopped after the last compressor is stopped. No shutdown will take place if ”---” is entered as the parameter.

The parameter in Line 3 determines whether the brine pump is to be stopped when the ”External OFF“ digital input is actuated or to continue running. The parameter in Line 4 determines whether the brine pump is to be stopped when the last compressor is stopped or to continue running. When central defrosting is active, the pump will be restarted.

3.23 Flow monitor

Flow of brine and coolant must be monitored for proper operation of the system. The monitoring function is identical for both circuits. Monitoring is dependent on the number of pumps. If only one pump has been programmed or if one pump has failed, the monitoring function will be as follows:

- The pump will be stopped if the flow monitor is not detected within a programmable time delay after being started.
- The compressor and fan outputs are reset stagewise when the pump is stopped.

Shutdown of the pump generates the message *Brine flow mon.* or *Coolant flow mon.* When two pumps have been programmed and both are available (motor overload cutout not actuated), the monitoring function is as follows:

- Rotation is made to the second pump if the flow monitor is not detected within a programmable time delay after being started. Switchover generates the message *Brine Pump Rotate* or *Coolant Pump Rotate*.

The pump will be stopped if the flow monitor is not detected within 30 seconds of switchover. The compressor and fan outputs are reset stagewise when the pump is stopped. Shutdown of the pump generates the message *Brine flow mon.* or *Coolant flow mon*.

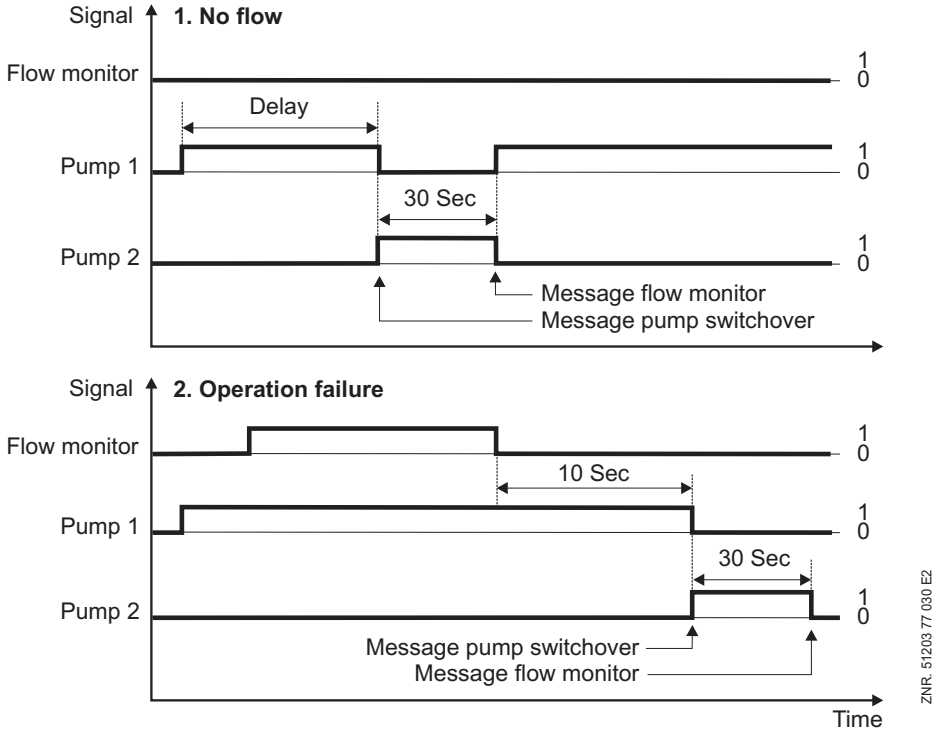
Delay for the flow monitor can be programmed in menu 3-3-3:

Del. flow mon.	xxs
Default NT/LT:	20 seconds
Range:	10-250 seconds

The two parameters *SysOFF Flow Br* and *SysOFF Flow Ct* in Menu 3-3-3 are used to define whether the system is to be shut down in occurrence of *Flow Monitor Brine* or *Flow Monitor Coolant* alarm. This also enables preliminary alarm to be registered. Only a message is generated and the system is not shut down when *SysOFF Flow Br* or *SysOFF Flow Ct* is set to NO. The system will be shut down on elapse of a delay when the parameter is set to YES.

Pump rotation is represented in the following graph:

Flow monitor



3.24 Controller start

There are two different start conditions for the controller:

- First start
- Restart

3.24.1 First start

First start takes place when internal check ascertains that parameter setting is not correct, e.g. when first starting the system (the controller loads default parameters on first start) or after updating the firmware or after changing the operating mode (NT - LT, screw/reciprocating compressors, single- or dual-circuit systems, 1, 2 or 3 external SIOX).

The set of parameters depends on the refrigeration system - low-temperature (LT) or normal-temperature (NT) - and is selected with DIP switch S1 on the circuit board of the FS 3010 (see Section 4 - Basic Parameter Settings / Startup).

All variables, except the parameters, are set to zero on fist start. Owing to the large number of parameters, the basic settings can also be loaded using the AL 300 Operator Terminal or CI 3000 Store Computer (menu 7). Date should be backed up in the LDSWin software prior to first start.

3.24.2 Restart

Restart takes place following return of power after an outage when the parameter settings have been preserved. All variables, except the parameters, the fault memory and the archived data, are deleted.

3.25 Central defrosting

Central defrosting can be carried out with the FS 3010. Defrosting is activated by the controller's internal defrost timer (Menu 3-7-a). Setpoints for defrosting can be checked and adjusted with the AL 300 Operator Terminal or CI 3000 Store Computer or by PC.

A total of 14 defrost times can be defined. Defrost time can be allocated to a single weekday, the weekdays Mo-Su, Mo-Fr, Mo-Sa or Sa-Su. Entering ----- for a weekday suppresses defrosting for that day. All compressor stages are unloaded at one-second intervals (fast unload) on initiation of defrosting. Defrosting actually commences when the last stage is stopped. Central defrosting does not affect fan control. The coolant pump is started during defrosting.

The Defrost Temp. parameter defines the brine temperature that must be obtained with the compressor stages off. Cooling is resumed when this temperature is obtained. When ---- is entered for the defrost termination temperature, defrosting is terminated by the safe defrost time and no Defrost Termination By Time message is logged.

The Safe Defrost Time parameter defines the maximum duration of defrosting. Defrosting will be terminated if the set defrost termination temperature is not obtained within this time. The FS 3010 then transmits the Defrost Termination By Time alarm. Priority of the alarm can be programmed, the default setting being Prio. 0.

Defrost Menu 3-7 is only shown when brine temperature control is activated. Central defrosting cannot be carried out when suction pressure is controlled on the cold side.

During defrosting, a "D" is placed before the setpoint being controlled (Brine ON or Brine OFF) on the display of the AL 300 / CI 3000, indicating that defrosting is in progress.

The Brine Off With Comp. parameter (Menu 3-6 Pumps) is used to determine whether the brine pump is to be stopped when the compressors are off in normal cooling mode. Regardless of the setting entered for this parameter, the brine pump is always started during defrosting.

Defrost and cooling commands are transmitted simultaneously to the case/coldroom controller via the CAN for defrosting. With Version 2.47 and earlier software (case controller) controllers of type UR141TK and UA131DD perform defrosting. All other controller types switch to cooling mode. So as to ensure that defrosting is carried out, the outputs for the solenoid valve and defrosting must be connected in parallel on the case controllers. With software Version 2.47 and later, both outputs (cooling and defrosting) are switched simultaneously. The LDS System displays Defrosting status.

	Step		Defrosting	Cooling	
1	Unload all compressors				Fast unload at one-second intervals
2	Disable all compressors				
3	Brine pump ON				Required when pump is set to stop with compressors
4	Defrost and cooling command to refrigeration points via CAN bus				Defrost termination by temperature or time
5	Cooling mode: Load compressors				

3.26 Monitoring

3.26.1 Refrigerant monitoring

A liquid level switch (digital input 23, active when de-energized) signals to the controller when liquid level in the receiver falls below the low-level setpoint. Low refrigerant level does not affect control and regulating functions. Alarm is generated after a definable time (Menu 3-3-2 Refrigerant).

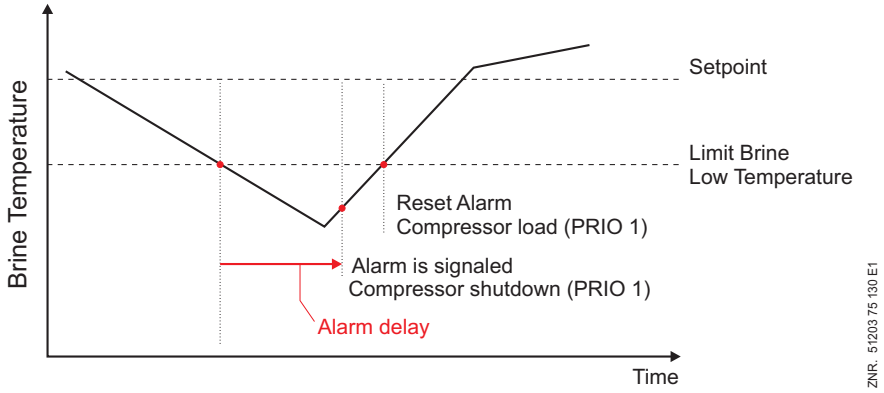
3.26.2 Brine and coolant temperature monitoring

Temperature of the brine and coolant can be monitored with the FS 3010. A fault report is generated after a definable delay if temperature rises above or falls below a set limit. Priority of the alarm can also be programmed. Parameters for brine/coolant monitoring can be set in Menu 3-3-3 Brine-Coolant.

The *Brine Low Temp.* parameter defines the minimum brine temperature. The message *Low Brine Temp.* is generated if temperature falls below this level for the time defined under *Del.LowBrineTemp.*. Priority of the alarm can also be programmed. When Prio. 1 is set, all compressors are stopped at the time of the alarm.

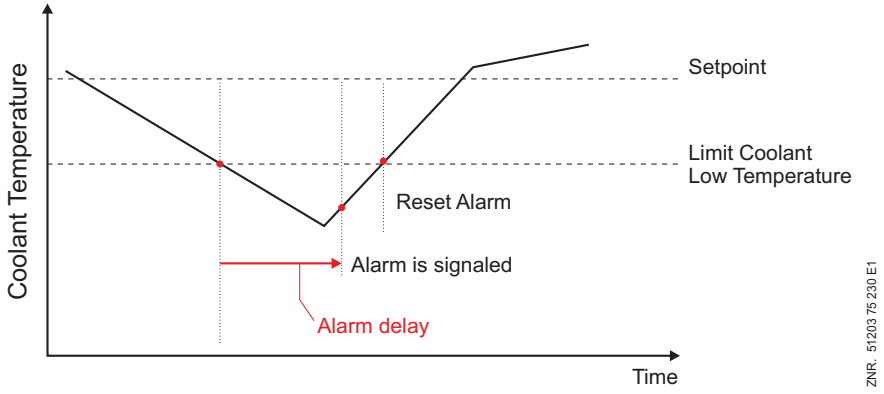
Brine outlet temperature is also monitored when the brine outlet temperature is controlled. Brine inlet temperature is monitored when the brine inlet temperature is controlled.

Monitoring Brine Temperature



The *Low Coolant Temp.* parameter defines the minimum coolant temperature. The message *Low Coolant* Temp is generated if temperature falls below this level for the time set under *Del.LowBrineTemp.* Priority of the alarm can also be programmed. The alarm has no effect on control and regulating functions.

Monitoring Coolant Temperature



3.26.3 Monitoring brine or coolant circuit pressure

A pressure transducer installed in the brine or coolant circuit can be monitored by means of a digital input on the FS 3010. The parameter *SysOFF Flow Br/ Ct* in menu 3-3-3 is used to define whether the system is to be shut down in occurrence of a *PressureSwitch Brine/Coolant* alarm.

This also enables preliminary alarm to be registered. Only a message is generated and the system is not shut down when *SysOFF Flow Br/ Ct* is set to NO. The system will be shut down when the parameter is set to YES.

3.26.4 Monitoring of the fast unload / external off

The pack controller can be turned off via the digital input 20 (terminals 88/89). When the input is activated the following occurs:

- Fans and compressors are switched off in quick succession (2 seconds unload time).
- Pumps are switched off as a function of the parameter *Coolt P ext.OF* (menu 3-6).
- The consumer enable of the corresponding case controller UA 300 is revoked, unless the low pressure is too low.
- The fault report *Comp./fan OFF* is sent.
- The pack controller is shown in grey in the store view of the PC software LDSWin.

3.26.5 Monitoring of external alarm

An external alarm can be transmitted via a digital input of the controller. When the input is de-energized, the alarm is transmitted after a definable time delay according to the preselected priority.

The input has no effect on control functions of the controller and is available for free use to transmit user-defined fault messages. The message text can be entered using the AL 300 Operator Terminal or the CI 3000 Store Computer (menu 3-3-4 External Alarm). The default text on first start is **External Alarm.**

3.27 Disabling of refrigeration points

In the occurrence of a fault on the refrigeration system the pack controller can transmit a *Disable Refrigeration Points* signal to all associate refrigeration points. The associate refrigeration points are case controllers on which the node address of the pack controller has been programmed in the controller configuration.

The *Disable Refrigeration Points* signal is sent to all associate refrigeration points when no compressor is available. Possible causes of failure are:

Safety loop faults

- Tripping of high-pressure cutout
- Tripping of all motor overload cutouts (reciprocating compressors)
- Tripping of all low oil pressure cutouts (reciprocating compressors)
- Tripping of all low oil flow cutouts (screw compressors)
- Tripping of all motor overload cutouts/phase monitors (screw compressors)

Other causes of disabling refrigeration points

- Emergency stop input activated
- System Off input activated and all compressors stopped
- Brine or cooling pump fault (flow monitor, motor overload cutout)

Additionally, an *Enable Refrigeration Points* signal is supplied through a digital output to enable external controllers to be incorporated. Refrigerant point enabling can be set or cancelled manually by the associate manual switch.

3.28 Archiving of operating data

3.28.1 Compressor/fan operating hours

Total operating time of the compressors/fans is scanned at 30-second intervals and saved to fail-safe memory. Readings are shown in hours. Recorded operating hours can be adjusted after replacing compressors/fans or the controller.

3.28.2 Daily run times and starts

In addition to total operating hours, the daily run times, compressor starts and activity (utilization) of the compressor pack are recorded and saved to memory with the respective date. The recording cycle commences at midnight. The current status can be displayed in hours and minutes. This data is additionally archived on the pack controller over a period of 32 days.

3.28.3 Pack activity/utilization

Activity is calculated by the following formula:

$$Activity = \frac{L}{[n \cdot (T_1 - T_0)]}$$

Activity	: Activity of compressor pack
L	: Sum of all compressor run times
n	: Number of compressors installed
T_1	: Current time
T_0	: End of day

The current status is displayed as a percentage.

Notice:

4 Installation and Startup of FS 3010

The operator terminal AL 300, the store computer CI 3000 or the PC-Software LDSWin are used to set parameters on the controller at startup and for subsequent changes.

The controller should only be used with compatible versions of the PC software LDSWin, otherwise the range of functions could be restricted.
Tip: The latest version of LDSWin should be used at all times.

It is also used to read out actual values and archived long-term data. Before commissioning the FS 3010 Pack Controller, basic settings of parameters must be made on the hardware and in the software.

4.1 Connection and safety notes

- This manual is an integral part of the equipment. It should be kept close to the equipment for ready reference whenever needed.
- For safety reasons, the equipment must not be used for any application other than described in the manual i.e. only for the intended purpose.
- Before using the equipment, always check that its limits are suitable for the intended application.
- Check that the electric power supply is correct for the equipment before connecting it to power.
- If required, a reverse voltage protection must be installed by the customer, e.g. by means of a coding of the plug.
- Specified ambient conditions (e.g. humidity and temperature limits) must be observed and complied with in order to avoid malfunctioning (see Section 10 - Specifications).
- Check correct wiring of the connections before switching on power to the equipment.
- Never operate the equipment without its casing. Before opening the casing the equipment must be switched to zero potential.

Beware of external voltage at the digital inputs and outputs!

- Contact the supplier in any malfunction or in case of doubt.
- Note and observe maximum load on relay contacts (see Section 10 - Specifications).
- Note that all leads running to and from the equipment (except 230 V power supply and signal leads) must be shielded! This applies in particular to analog inputs (sensor leads) and CAN bus wiring. The leads must also be installed sufficiently clear of other leads carrying live power. Doing so will avoid faulty measurements and will protect the equipment from external interference via the analog inputs.

All leads running to and from the FS 3010 (except the 230 V power supply and signal leads) must be shielded! This applies especially to analog inputs (sensor leads) and CAN bus wiring. The leads must also be installed sufficiently clear of other leads carrying live power. Doing so will avoid faulty measurements and will protect the equipment from external interference via the analog inputs.

For further details please refer to the manual titled Introduction, General Safety and Connection Notes.

Experience shows that transmission of alarms is often not operational (telephone line not yet installed, etc.) at the time of commisioning the system. In such instances it is urgently recommended to monitor the controller with a CI 3000 Store Computer or AL 300 Operator Terminal via the CAN bus and allow transmission of alarms via a mobile telephone system using a GSM modem for example.

4.2 DIN rail mounting

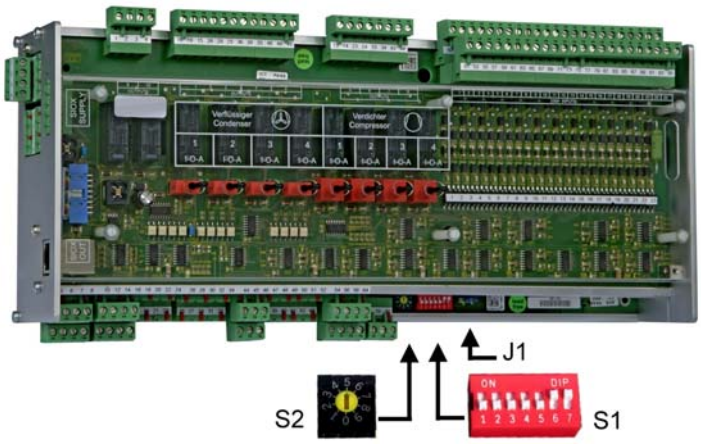
The FS 3010 Pack Controller is designed for cap rail mounting. It fastens on the cap rail by snapping on with two clips (on the underside). Power loss of the controller is 24 VA and allowance must be made for this in installation. The pack controller is ready for operation after completing mechanical and electrical installation.

All leads running to and from the FS 3010 (except the 230 V power supply and signal leads) must be shielded! This applies especially to analog inputs (sensor leads) and CAN bus wiring (see manual Introduction, General Safety and Connection Instructions). As a general rule, care should be taken to ensure that signal leads and leads carrying a supply voltage are routed through separate cable channels.

See Section 10 - Specifications of FS 3010 for electrical enclosures and measurements.

4.3 Basic parameter settings on hardware

Basic parameter settings for the pack controller are configured with DIP Switch S1, Decade switch S2 and Jumper J1. These switches S1, S2 and J1 are located beside the cover on the circuit board of the pack controller (see illustration).



Use the setting switches S1 and S2 to configure the following basic settings:

- **S1 - DIP switch for setting of**
  - Refrigeration type NT / LT — Coding switch 1
  - Max. number of extension modules — Coding switch 2
  - Compressor type — Coding switch 3
  - System type — Coding switch 4
  - Service mode — Coding switch 5
  - Firmware update mode — Coding switch 6 and 7
- **S2 – Decade switch for**
  - Setting Node No. (Nd.nnn) or CAN bus address — Position 1-9 / Address 101-109
  - Deactivation as CAN bus station — Position 0 / NO address

J1 - jumper for the activation of the interfaces

- TTY (terminals 9..12) factory setting, for communication within the old LDS system
- RS485 (terminals 13..16) currently no use, in future for the connection of BMS control technology

As a rule the jumper J1 doesn't need to be changed.
For further information on jumper settings see the drawing in chapter 4.3.5.

4.3.1 SIOX Extension Modules - for DIN rail mounting

A maximum of 2 SIOX (Serial IO-Extension) extension modules can be connected to the FS 3010 Pack Controller.

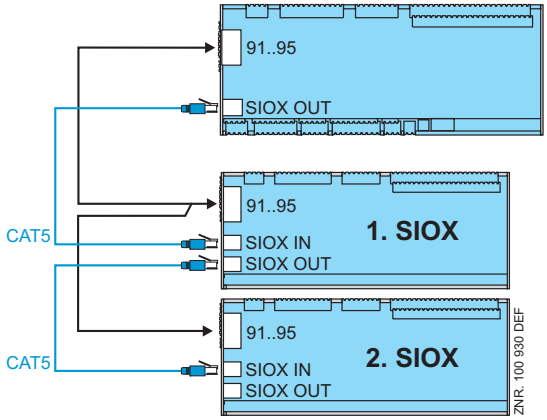
Each SIOX module extends the pack controller by an additional 12 digital inputs, i.e. 8 digital outputs. The number of connected SIOX modules must be parameterised (see chapter 4.3.3) .

The modules are connected to the pack controller via SIOX power supply cables, i.e. SIOX data cables (see capter 4.3.2).

4.3.2 Connecting the SIOX modules to the Pack Controller

The individual SIOX extension modules are supplied with power from the pack controller via the terminals 91-95 (SIOX-SUPPLY), i.e. connected to one another in series via the SIOX data cables (SIOX OUT / SIOX IN).

Example of a pack controller configuration with two SIOX extension modules:



SIOX Extension Modules may **only** be connected or disconnected to the pack controller while disconnected from power.

SIOX Extension Modules power supply leads

- For the power supply (terminals 91 - 95), shielded cables with a cross-section > 0.5 mm^2 must be used. Recommended cables include e.g. **LiYCY 4x0,75** mm^2 with 25 Ohm/km.
- Max. permitted cable length is 50 m.
- The pack controller power supply is configured for the connection of a maximum of 3 extension modules.

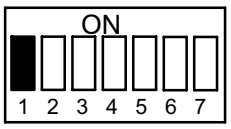
SIOX Extension Modules data lines

- The data cables (SIOX IN / SIOX OUT) should **not** be routed in the immediate proximity of high voltage or high frequency cables.
- When routing the cables care must be taken to ensure that the minimum bend radius is complied with and that the cables are not routed **parallel to cables** which have the potential to generate strong **interference coupling**.
- Max. permitted cable length is 50 m.
- CAT5 cable or better must be used.

4.3.3 Basic settings with S1

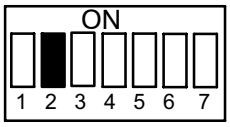
Setting refrigeration type

Coding switch 1 of DIP switch S1 defines the type of refrigeration for which the compressor pack is used, either NT (normal-temperature) or LT (low-temperature):

DIP switch S1 Coding switch 1	Switch position	Refrigeration type
	**ON**	NT (Normal-temperature)
	OFF	LT (Low-temperature)

Setting number of expansion modules (number of capacity stages)

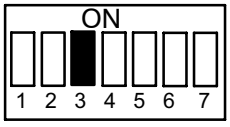
Coding Switch 2 of DIP Switch S1 defines the maximum number of compressor and fan capacity stages. One extension module (SIOX) is used in the basic version of the FS 3010 (4 compressor capacity stages) to provide the necessary inputs and outputs. An additional extension module (SIOX) is required for 8 compressor capacity stages.

DIP switch S1 Coding switch 2	Switch position	Number of SIOX modules
	**ON**	**1 external SIOX module** - max. 6 compressors respect. 8 **compressor stages** - max. 8 fans
	OFF	**No SIOX module** - max. 4 **compressor stages** - max. 4 fans

A maximum of 6 compressors can be controlled by the FS 3010 and maximum 8 compressor capacity stages with capacity-controlled compressors.

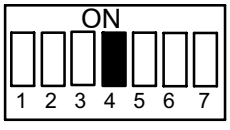
Setting compressor type

Coding switch 3 of DIP switch S1 defines the compressor type:

DIP switch S1 Coding switch 3	Switch position	Compressor type
	**ON**	Screw compressor
	OFF	Reciprocating compressor

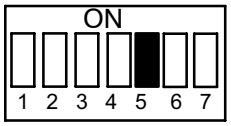
Setting system type (single- or dual-circuit system)

Coding switch 4 of DIP switch S1 defines the system type:

DIP switch S1 Coding switch 4	Switch position	System type
	**ON**	Single-circuit system
	OFF	Dual-circuit system

Setting service mode

Coding switch 5 of DIP switch S1 defines service mode:

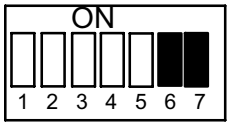
DIP switch S1 Coding switch 5	Switch position	Service mode
	**ON**	Service mode
	OFF	Normal operating mode

Following electric power failure, the system starts in service mode using default parameters for service purposes. Changes to parameters are not permanently saved (power failure). Coding switch 5 of DIP switch S1 may be set ON **only** for service mode purposes.

Normal operation of the system **always requires service mode to be deactivated.** (Coding switch 5 of DIP switch S1 **must** be set OFF)!

Setting firmware update mode

Coding switches 6 and 7 of DIP switch S1 define firmware update mode:

DIP switch S1 Coding switches 6 and 7	Switch position	Firmware update mode
	**ON**	Normal operating mode
	OFF	Firmware update mode

Coding switches 6 and 7 of DIP switch S1 may **only** be set OFF for downloading firmware.
At this setting the controller awaits firmware update from a connected Service PC.
Firmware update mode must **always be deactivated** for normal system operation
(Coding switches 6 and 7 of DIP switch S1 **must** be set ON)!

If a switch position is changed after startup, the basic parameters for the set temperature range will be loaded the next time the controlled is started (power failure) and the controller will perform first start. In view of the large number of parameters, the basic parameters can also be loaded with the operating terminal (see Section 8 - Menu Structure).

After changing switch positions on S1 or S2, the FS 3010 **must** be turned off briefly for the new settings to take effect!

4.3.4 Setting the CAN bus address with S2

Setting Node No. / Deactivating CAN bus communication

Decade switch S2 defines the Node No. (Nd.nnn) or CAN bus address. Setting will normally be made by the control system manufacturer.

Decade switch S2	Switch position	Node No. (Nd.nnn) CAN bus address	Function
	**0**	NONE	CAN bus communication of pack controller disabled
	1..9	101..109	Node No. nnn allocated to pack controller

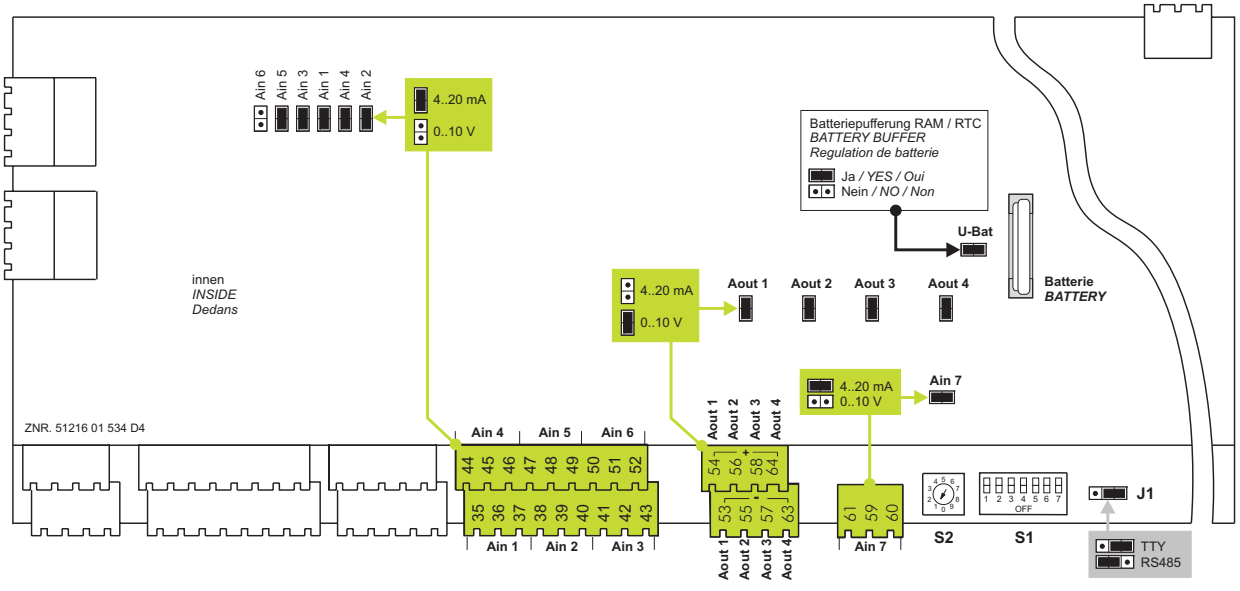
After changing the switch positions of both S1 and S2, power to the FS 3010 **must** be cut off briefly so that the new settings can be applied!

4.3.5 Configuration of the analogue inputs and outputs

A reconfiguration of the analogue inputs and outputs is **only** necessary if settings other than those in the delivery condition are required, e.g. when the pressure transmitter in the installation is to be used with 0..10 V signals.
A reconfiguration, i.e. opening of the controller is only to be carried out by trained staff or factory-side by the manufacturer. Incorrect handling can lead to damage and an impairment of the control functions! For important safety instructions and information on disassembly see chapter 4.5.

The analogue inputs and outputs can only be configured via the jumpers on the pack controller's **bottom** circuit board which are configured factory-side as follows:

Analogue inputs	1-5 and 7:	4 .. 20 mA
Analogue input	6	0 .. 10 V
Analogue outputs		0 .. 10 V



4.4 Basic parameter settings in software

On the CI 3000 Store Computer or AL 300 Alarm Terminal, the FS 3010 Pack Controller must be selected in the screen that opens when choosing *Menu 5 Remote Operation*. The parameters shown below must be set in the corresponding FS 3010 operating screens.

On the Operator Terminal, the following parameters must be entered in *Menu 3 Setpoints - 1 System Configuration* (or using the LDSWin software):

System Configuration parameters (Menu 3-1)

- *Refrigerant* — Use the Up and Down cursor keys (↑) (↓) to select the appropriate refrigerant
- *No.compressors* — Enter the number of compressors
- *No.stg. per comp.* — Enter the number of capacity stages per compressor (bypass valves, etc.)
  Enabl.comp.stages — Enable compressor stages as required
- *No.cond.stages* — Enter the number of fans
  Enabl.cond.stages — Enable fan stages as required
- *No.BrinePumps* — Enter the number of brine pumps
- *No.CoolantPumps*. — Enter the number of coolant pumps
- *DryCooler* — Direct condensing or hot brine

Brine/LP Control parameters (Menu 3-2-1-1)

- *Sensor* — Direct expansion of chilled brine
- *Control Type* — Dual-circuit systems ONLY: Choose BBGVV / BVBV
  (see Section Capacity-Controlled Compressors with Dual-Circuit Systems)

Coolant/HP Control parameters (Menu 3-2-2-1)

- *Sensor* — Condensing pressure controlor hot brine control
- *Controller* — Step controller or speed control

Incorrect parameter setting can result in severe impairment of controller function.

4.5 Commissioning of speed controlled condenser fans / compressors

For the activation of speed controlled condenser fans a frequency converter, i.e. speed actuator is required in addition to the FS 3010. When wiring an installation with FCs/speed actuators a range of further measures are required, in particular for interference suppression:

1. All low voltage signal inputs and outputs of the FS 3010 must be contacted using shielded cable. With installations deploying FCs/speed actuators, the correct execution of the shielding is of special importance. In the event of inadequate shielding, the high level of interference radiation generated by the FCs/speed actuators can lead to a significant impairment of the measured values.

2. With the temperature inputs (Pt1000 inputs) special care must be taken to avoid a connection between the sensor leads and the signal ground or the shielding.

3. Analog inputs and outputs are sensitive to interference supply and reverse polarity! It is **essential** to check that the polarity is correct when connecting the FS 3010 to the control input of the FC/ speed actuator. Furthermore, FCs/speed actuators are frequently equipped with a supply for sensors or potentio meters which can be used to set the speed default.

Under no circumstances is this supply to be connected to the analog output of the FS 3010. In the event of a faulty connection between the FS 3010 and the FU/speed actuator subassemblies within the FS 3010 can be permanently damaged.

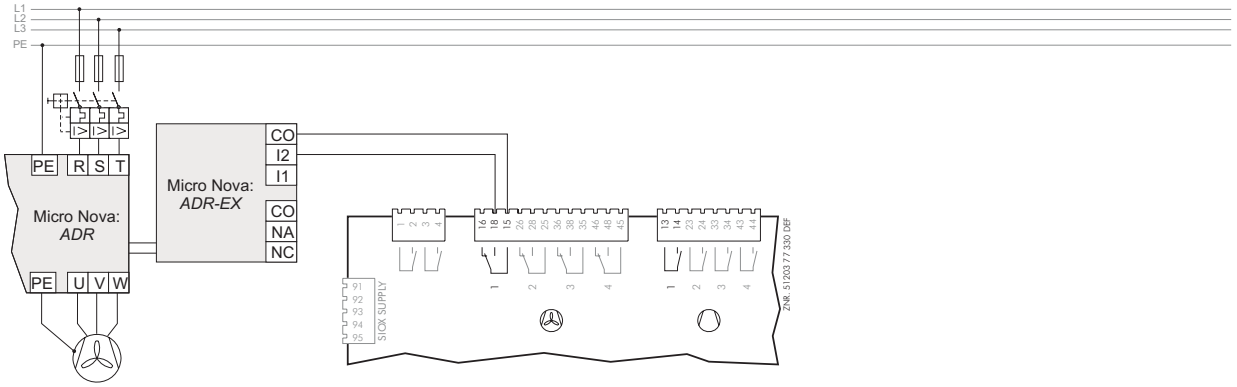
4.5.1 Procedure for commissioning an installation

The following circuit diagrams are simplified diagrams of the connections between the FS 3010 and the FC (using the example of the *smd* series from *Lenze*), i.e. speed actuator (using the example of the *ADR* series from *Micro Nova*). Detailed safety measures (e.g. lock-down) are not illustrated in the simplified diagrams and must be taken into account during assembly.

For the correct activation of the FCs/speed actuators the following signals are provided by the pack controller:

1. Enable FC/speed actuator:

With speed controlled condenser fans the enable command for the FC/speed actuator is transmitted via the digital output for fan 1 (terminals 15/18). In normal operation the enable command is withdrawn if the condenser pressure is too low. The following picture shows an installation **without** power supply bridging.

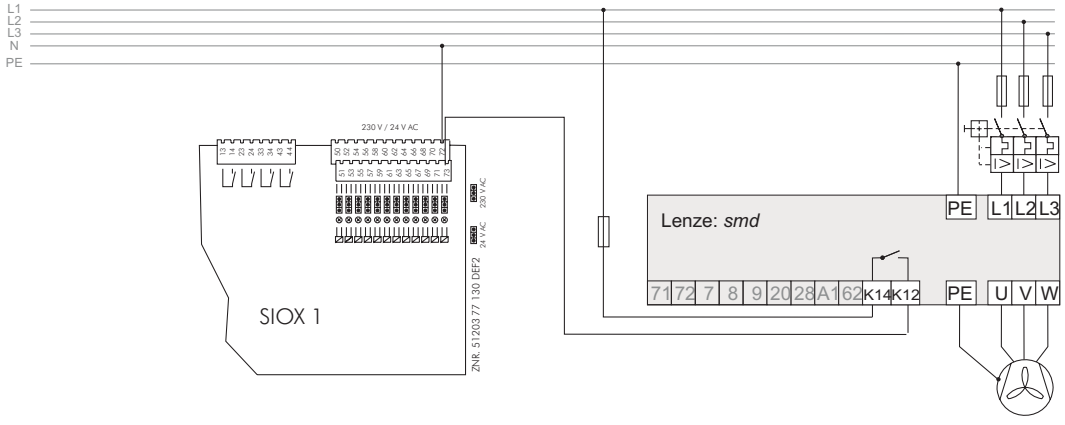


The FC/speed actuator must be parameterised so that the enable command is issued when the contact is closed, i.e. a voltage is applied.

2. Fault indication input speed actuator / external alarm:

A. Speed controlled condenser control:

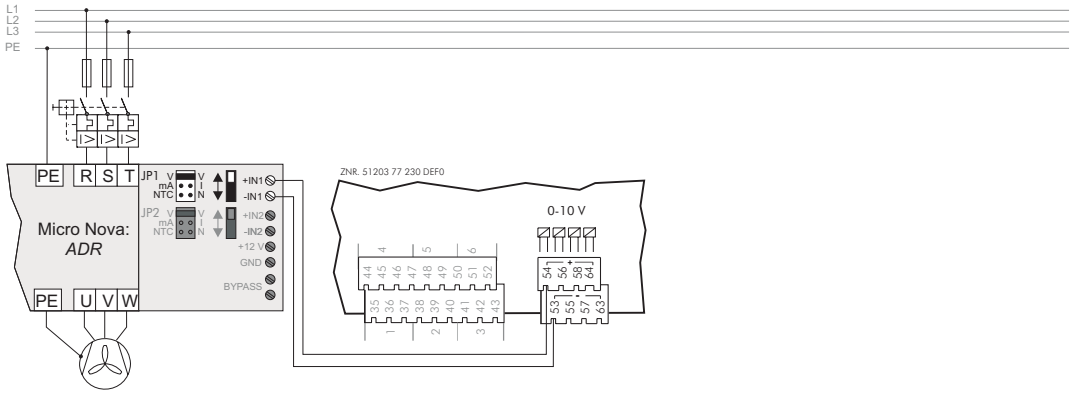
The error message output of the FC/speed actuator is monitored via digital input 12 (terminals 72/73) of the SIOX module during fan speed control. The indicator text for the input *External alarm* parameterised for continual control should be set to *Speed contr.*



This fault indication is active when there is no voltage at the input of the FC/speed actuator, i.e. the FC/speed actuator must be parameterised, i.e. connected so that 230 V AC is present at input 12 under normal conditions.

3. Analog actuating variable for the fan speed:

Via the analog output 1 (terminals 53/54) a 0-10 V signal for the condenser fan is emitted.



When connecting these outputs special precautions need to be taken (see instructions in chapter 4.5).

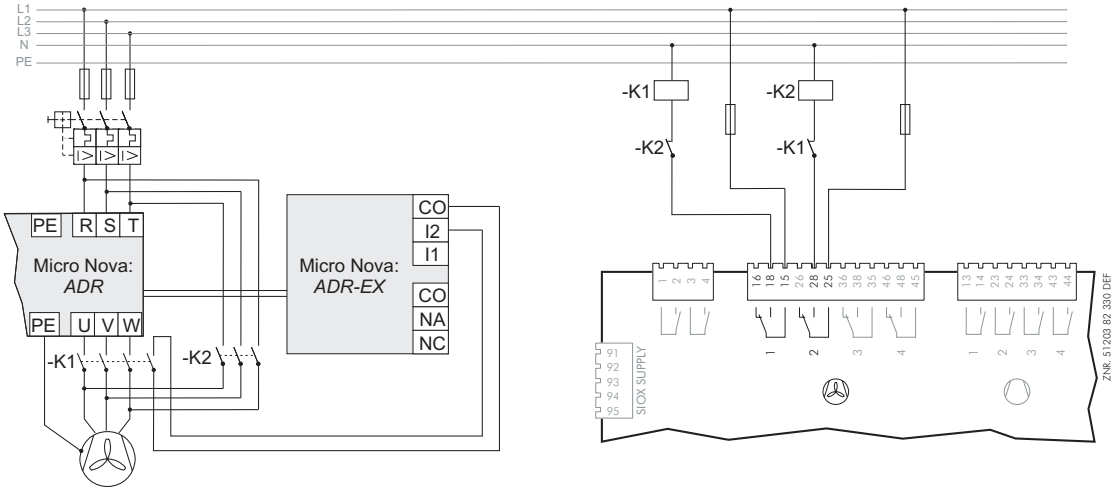
In addition to the adjustment of the frequency converter input for the receipt of a 0-10 V signal, the operating point of the FC/speed actuator needs to be set. A request from the pack controller for 0 V at the analog output means minimum speed, a request for 10 V means maximum speed. The FU/speed actuator must be operated in the speed control mode for this purpose, i.e. the speed of the fan is directly proportional to the voltage emitted by the pack controller.

4. Digital output for power supply bridging

It is essential to ensure that the power supply bridging is also realised in the switch cabinet, otherwise when t_c is too high ($t_c > t_c$ max.) no condenser capacity is available!

A. With speed controlled condenser fans

The digital output for fan 2 (terminals 28/25) serves to bridge the FC/speed actuator for the speed controlled fan. If the parameterisable temperature tc-Max. (menu 3-2-2-1) is exceeded, then the speed actuator enable is withdrawn (terminals 15/18, fan output 1 switches off) and instead, fan output 2 is set (trminal 25/28, power supply bridging).



4.6 Wartung Batteriewechsel

In der Verbundsteuerung befindet sich eine Pufferbatterie vom Typ CR 2450 N, 3 V Lithium. Für das Wechseln der Batterie ist es erforderlich, dass die Verbundsteuerung aus der Anlage entfernt wird. In diesem Fall wird der Verbund nicht mehr geregelt und überwacht.

Im Fall, dass der Regler über den CAN-Bus an eine übergeordnete Steuerung angeschlossen ist, ist die Verbundsteuerung nicht mehr am CAN-Bus vorhanden. Daher sind außer den Vorsichtmaßnahmen, die die Verbundsteuerung direkt betreffen, auch Konsequenzen in den übergeordneten Steuerungen am CAN-Bus zu beachten.

Beim Batteriewechsel sind die Sicherheitsbestimmungen im **Handbuch Einführung, allgemeine Sicherheits- und Anschlusshinweise** zu beachten. Ein Batteriewechsel ist **nur** durch geschultes Personal oder werkseitig vom Hersteller durchzuführen. Alle Steckanschlüsse dürfen nur im spannungslosen Zustand gesteckt und gezogen werden. Leiterkarten dürfen nur im spannungslosen Zustand getauscht werden. Leiterkarten immer am Rand anfassen.

ESD-Vorschriften (Electrostatic Discharge) beachten (siehe Handbuch Einführung, allgemeine Sicherheits- und Anschlusshinweise)!

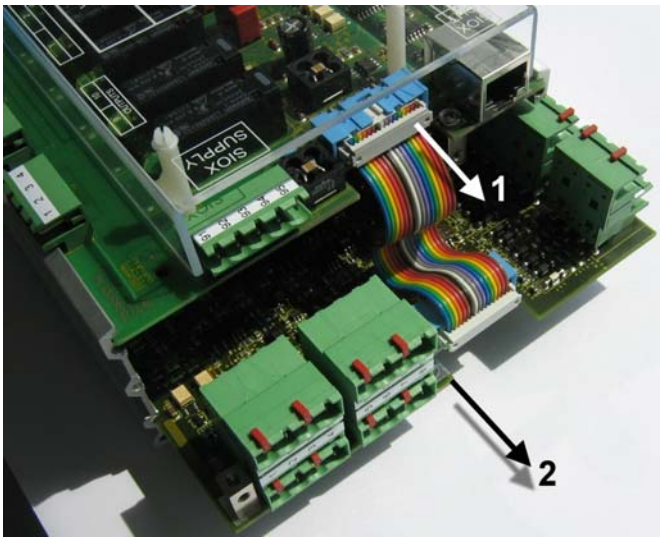
Im Fall des Anschlusses über den CAN-Bus: Die Wegnahme der Verbundsteuerung vom CAN-Bus wird in der überlagerten Steuerung (Marktrechner) zu einer Fehlermeldung führen. Es ist darauf zu achten, dass der Service-Mode am Marktrechner CI 3000 aktiviert bzw. die Servicezentrale vorher entsprechend informiert wird.

1. Verbundsteuerung spannungslos schalten. Alarm am Marktrechner quittieren.
2. Alle aufgesteckten Stecker abziehen, Gerät evtl. von der Halterung abnehmen.

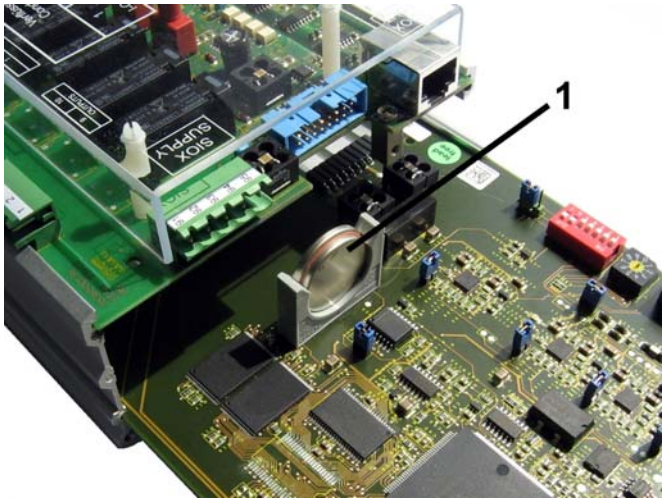
Auf einigen Steckern kann ein Potential von 230 V AC liegen. Stecker evtl. vor Abziehen kennzeichnen.

3. Sechs Schrauben der Seitenplatte lösen.

4. Stecker (1) herausziehen und untere Leiterkarte (2) herausziehen.



5. Batterie (1) nach oben aus der Batteriehalterung herausziehen und fachgerecht entsorgen.



Die neue Batterie nicht mit einer Metallzange anfassen, da diese durch den entstehenden Kurzschluss zerstört werden kann.
- Mit einem sauberen, trockenen Tuch abreiben.
- Nicht an den Randkontaktflächen anfassen.

7. Die neue Batterie mit einem Tuch anfassen und in die Batteriehalterung hineindrücken.
8. Der Zusammenbau geschieht in umgekehrter Reihenfolge. Alle Stecker wieder aufstecken.
9. Verbundsteuerung wieder mit Spannung versorgen.
10. Die Verbundsteuerung wird bei unveränderter Konfiguration des Marktrechners CI 3000 über den CAN-Bus automatisch wieder erkannt. Datum, Uhrzeit und automatische Umschaltung Sommer-/Winterzeit erfolgt automatisch über die zentrale Uhrzeitsynchronisation.

Beim Wiederanlauf der Verbundsteuerung werden (Fehler-)Meldungen ausgegeben. Diese sind im Marktrechner CI 3000 oder Bedienterminal AL 300 zu kontrollieren!

Es empfiehlt sich, nach dem Batteriewechsel einen Erstanlauf durchzuführen!

4.7 Firmware-Update

Die Verbundsteuerung wird mit der aktuellen Firmware betriebsbereit ausgeliefert. Zukünftige Softwarestände können bei Bedarf mittels eines Firmware-Updates in die Verbundsteuerung geladen und somit aktualisiert werden.

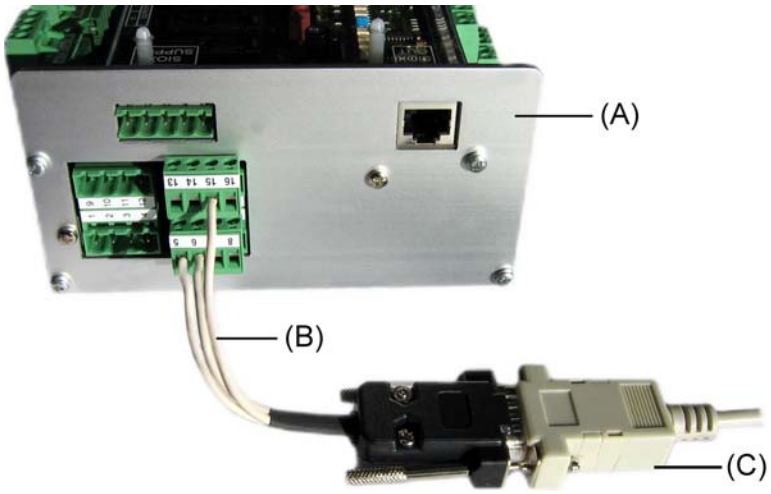
Nach einem Firmware-Update wird ein Erstanlauf durchgeführt. Dabei werden alle Parameter mit den Grundeinstellungen geladen sowie alle Archive (Meldungen und Betriebsdaten z. B. Betriebszeiten, Schalthäufigkeit, Quoten) gelöscht!

Der Parametersatz (Konfiguration der Verbundsteuerung) kann **vor** dem Firmware-Update mit Hilfe der PC-Software LDSWin über die Sollwertmaske (dort die Funktion *Parametersätze*) abgespeichert werden. **Nach** dem Firmware-Update kann dann der zuvor gespeicherte Parametersatz wieder zurück in die Steuerung geladen werden. Nähere Details hierzu sind im Handbuch der PC-Software LDSWin beschrieben.

4.7.1 Vorraussetzungen für ein Firmware-Update

Folgende Vorraussetzungen sind für ein Firmware-Update notwendig:

1. (A) Verbundsteuerung
2. (B) Flash-Kabel, Artikel-Nr. KABLINDAD1
3. (C) Nullmodemkabel, 2 Buchsen female 9-polig Sub-D, Artikel-Nr. PCZKABSER2
4. Updatedatei *progvs.zip*



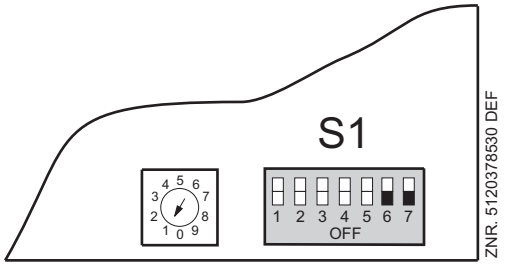
Verbundsteuerung (A), Flash-Kabel (B), Nullmodemkabel (C)

Das Firmware-Update für die Vorgängergeräte der FS 3000-Reihe unterscheidet sich von der hier beschriebenen Vorgehensweise! Es ist **unbedingt** darauf zu achten, dass die zur Verbundsteuerung passende Firmware-Update-Version verwendet wird!

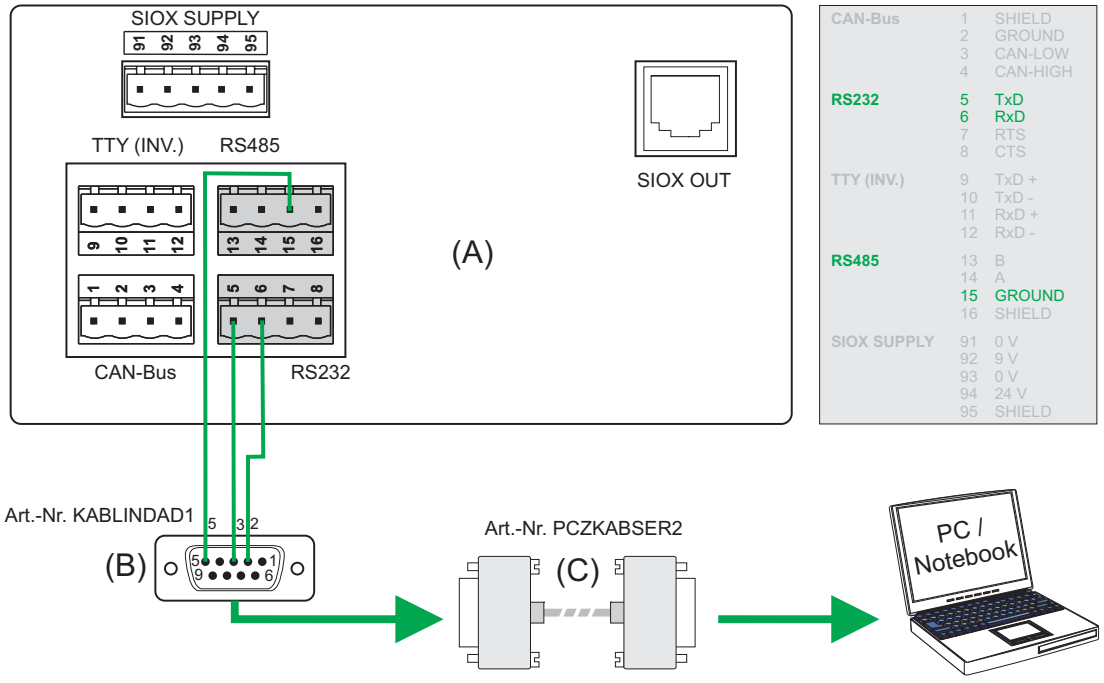
4.7.2 Update der aktuellen Firmware

Das Firmware-Update erfolgt mit Hilfe eines PC oder Notebooks, die über die COM-Schnittstelle mit der Verbundsteuerung verbunden sind. Folgende Schritte müssen dazu **unbedingt** durchgeführt und beachtet werden:

1. Verbundsteuerung unbedingt vom Netz trennen (**muss** spannungsfrei sein)
2. DIP-Schalter S1-Kodierschalter 6 und 7 auf OFF stellen (siehe hierzu auch Kapitel 4.4.3):

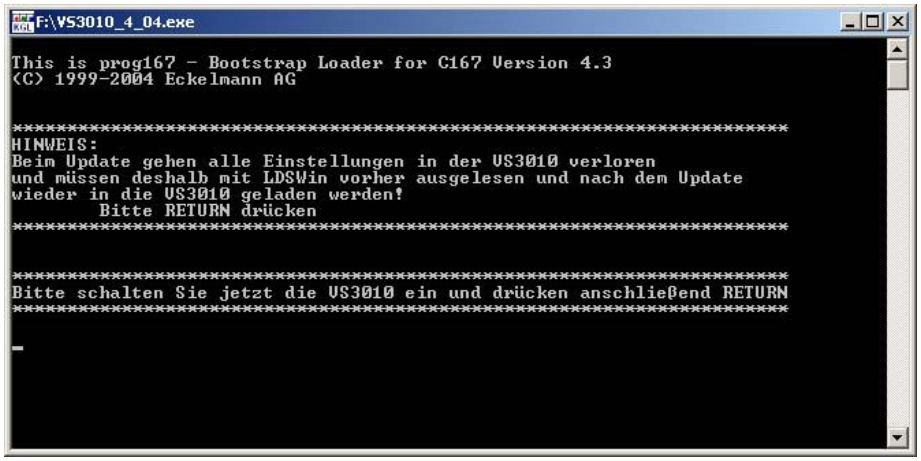


3. Verbundsteuerung (A) mit Flash-Kabel (B) verbinden
   (die beiden 4-poligen Steckverbinder an die Klemmen 5..8 und 13..16).
4. Flash-Kabel (B) mit Nullmodemkabel (C) verbinden.
5. Nullmodemkabel mit COM 1 des PCs verbinden.



6. Im Windows-Explorer die Datei *VS3010Vx.xx.exe* / *VS3010BSVx.xx.exe / FS3010Vx.xx.exe* (je nach Steuerung) durch Doppelklicken starten (ggf. ZIP-Archiv vorher entpacken).
Folgende Maske öffnet sich:

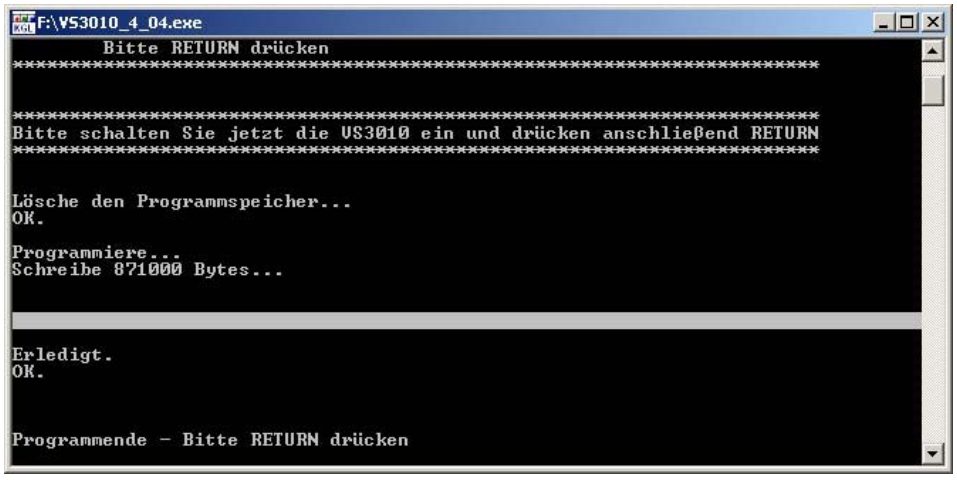
7. Enter-Taste (Return) drücken. Folgende Maske öffnet sich:



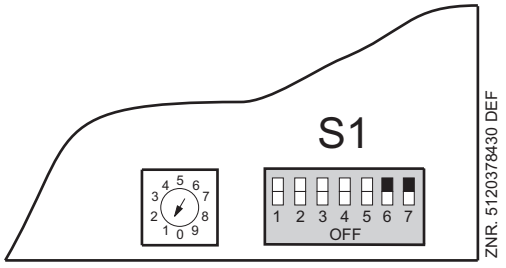
8. Verbundsteuerung nun wieder einschalten.
Durch Drücken der Enter-Taste (Return) dann den Download starten:

Der Balken unten zeigt den Fortschritt des Downloads an.

9. Nach abgeschlossenem Download die Enter-Taste (Return) drücken:



10. Nach der Aktualisierung des Firmware-Update die Maske durch Drücken der Return-Taste schließen.
11. DIP-Schalter S1-Kodierschalter 6 und 7 wieder auf ON stellen (siehe hierzu auch Kapitel 4.4.3).



12. Nach dem Firmmware-Update muss die Steuerung kurzzeitig vom Netz getrennt werden.

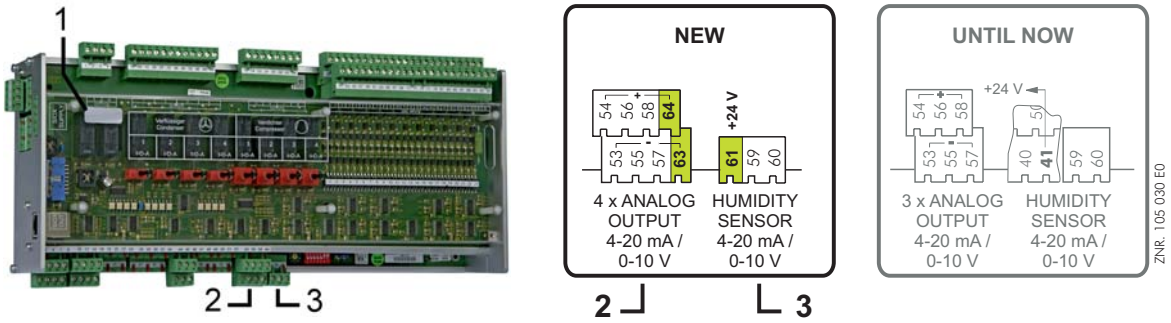
Im Normalbetrieb stehen vom DIP-Schalter S1 die Kodierschalter 6 und 7 immer auf ON!
Nach Veränderung der Schalterpositionen von S1 als auch S2 muss die FS 3010 kurzzeitig spannungslos gemacht werden, damit die neuen Einstellungen übernommen werden!

Notice:

5 Pin and Terminal Assignments of FS 3010

The following figures and tables show the terminal assignments of the FS 3010 Pack Controller inputs and outputs required for maximum 8 compressor and 8 fan stages.

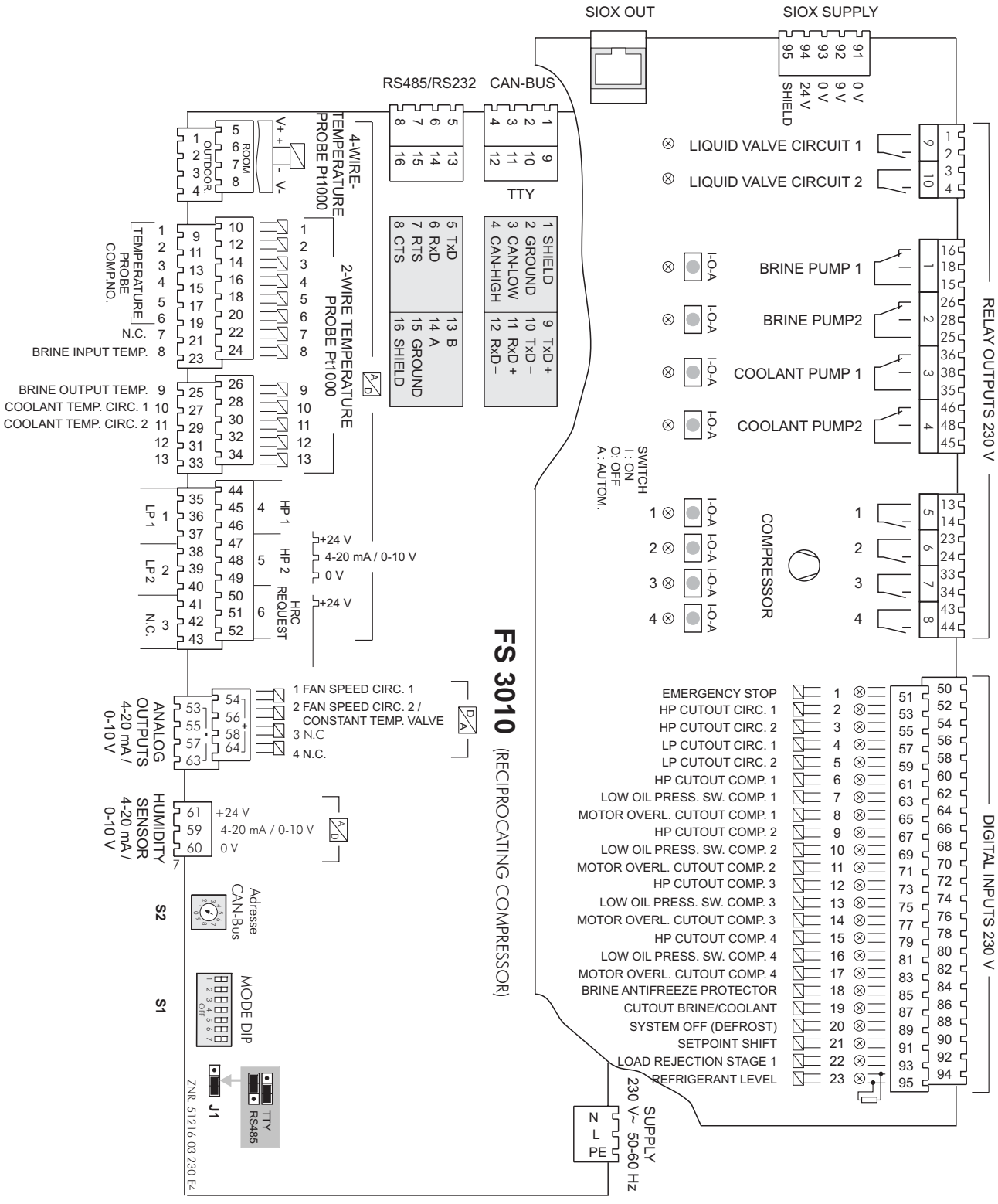
The pack controllers of the FS 3000 series can, without problem, be replaced by the pack controllers of the FS 3010 series. The controller ID and the corresponding firmware ID are located on the cover (1). In the course of technical developments, the pack controller hardware has been extended with the addition of an analog output (2) and a humidity sensor at the 24 V terminal (3):



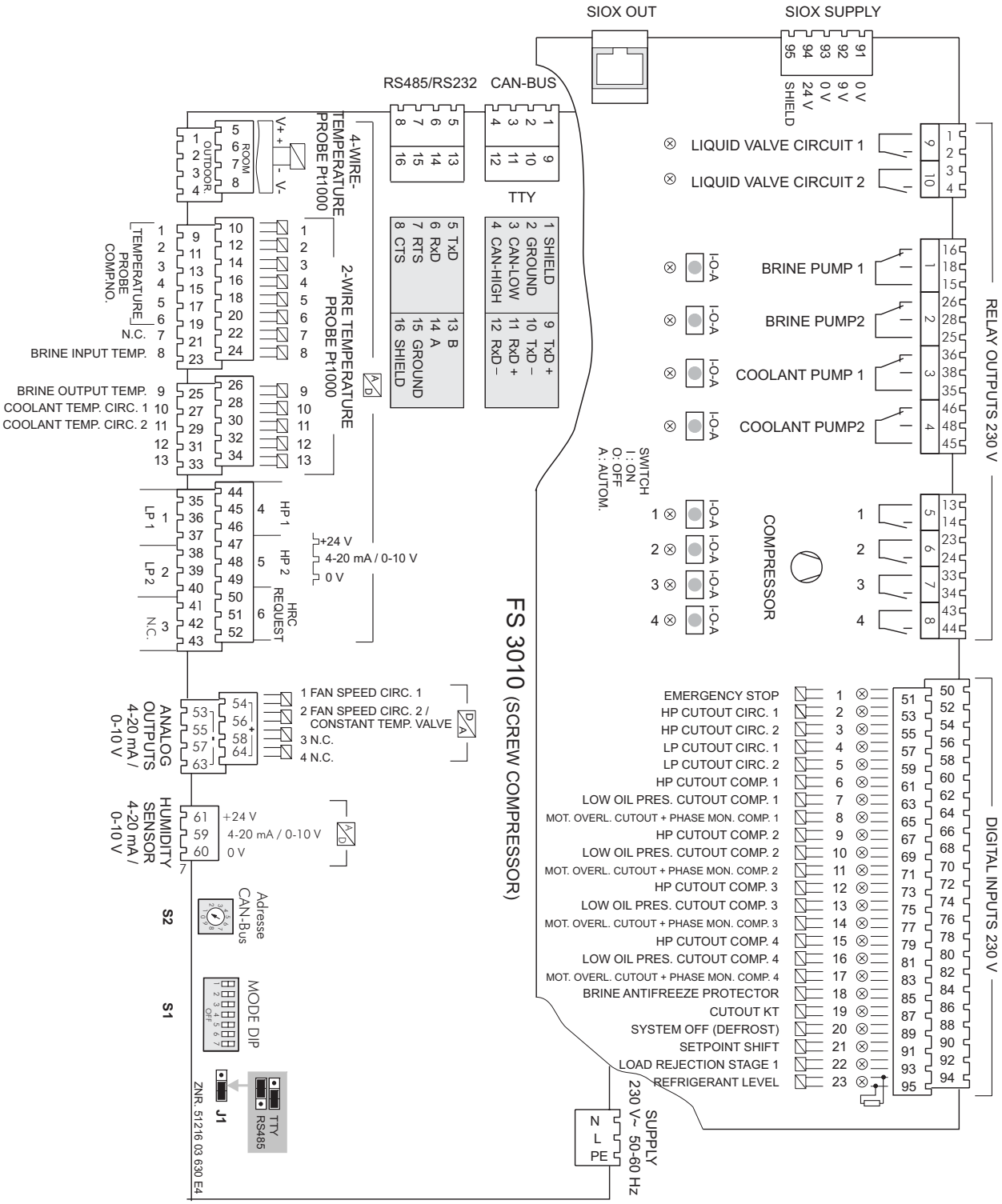
The following items MUST be observed and complied with when connecting wiring:

- All connecting leads from and to the FS 3010 - except digital inputs and relay outputs - must be shielded in order to prevent malfunction, e.g. faulty measurements.
- Make sure that polarity is correct on inputs and outputs carrying current and voltage signals (0 to 10 V or 4 to 20 mA). Short circuiting or incorrect signal feed can result in impairment of function or even destruction of internal components of the FS 3010. Also make sure that the inputs and outputs are correctly configured (for current or voltage signals) by the jumpers provided.
- Always disconnect the system from power before disconnecting or connecting connectors on the FS 3010.

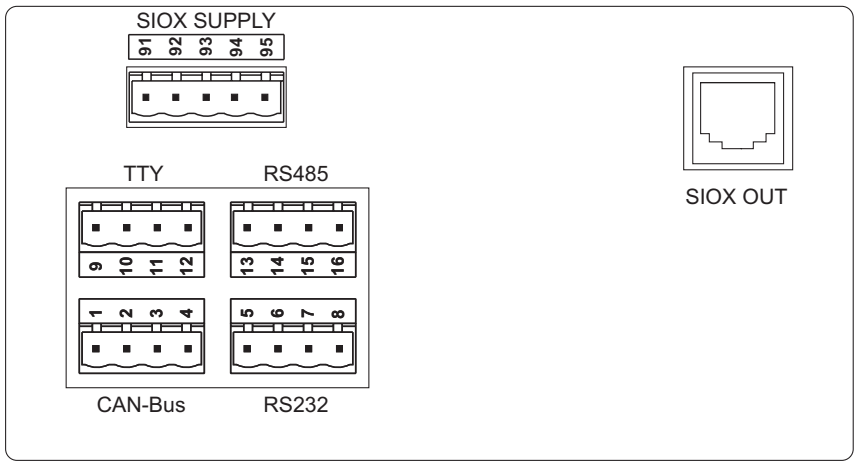
5.1 Pin assignments



Terminal assignments, FS 3010 basic module for reciprocating compressors



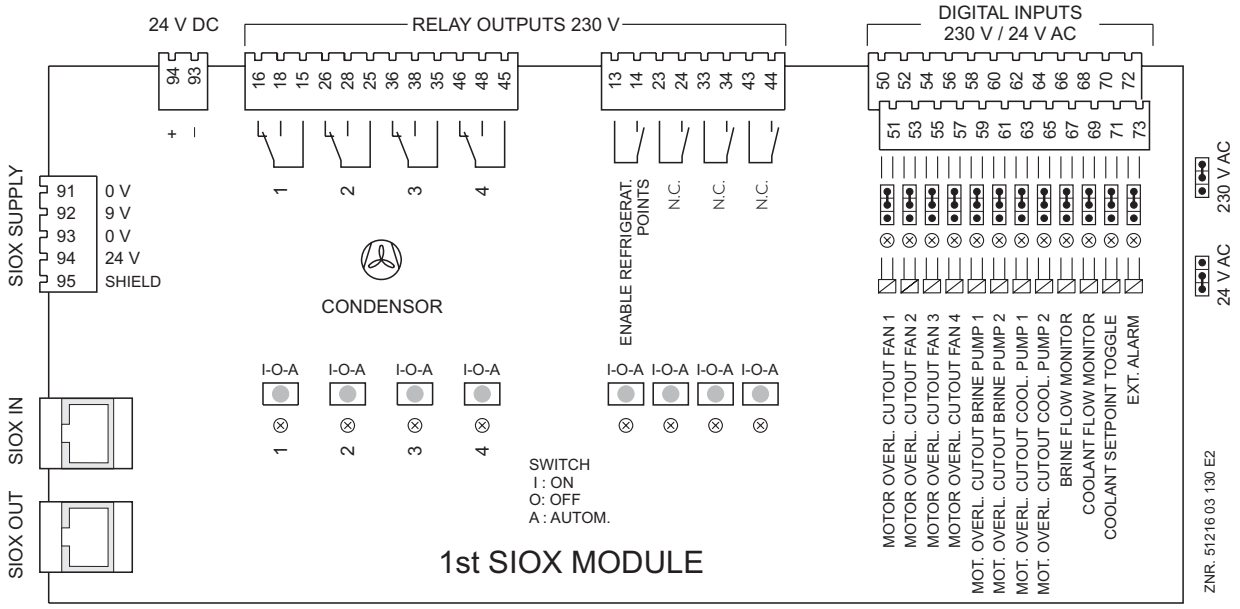
Terminal assignments, FS 3010 basic module for srew compressors



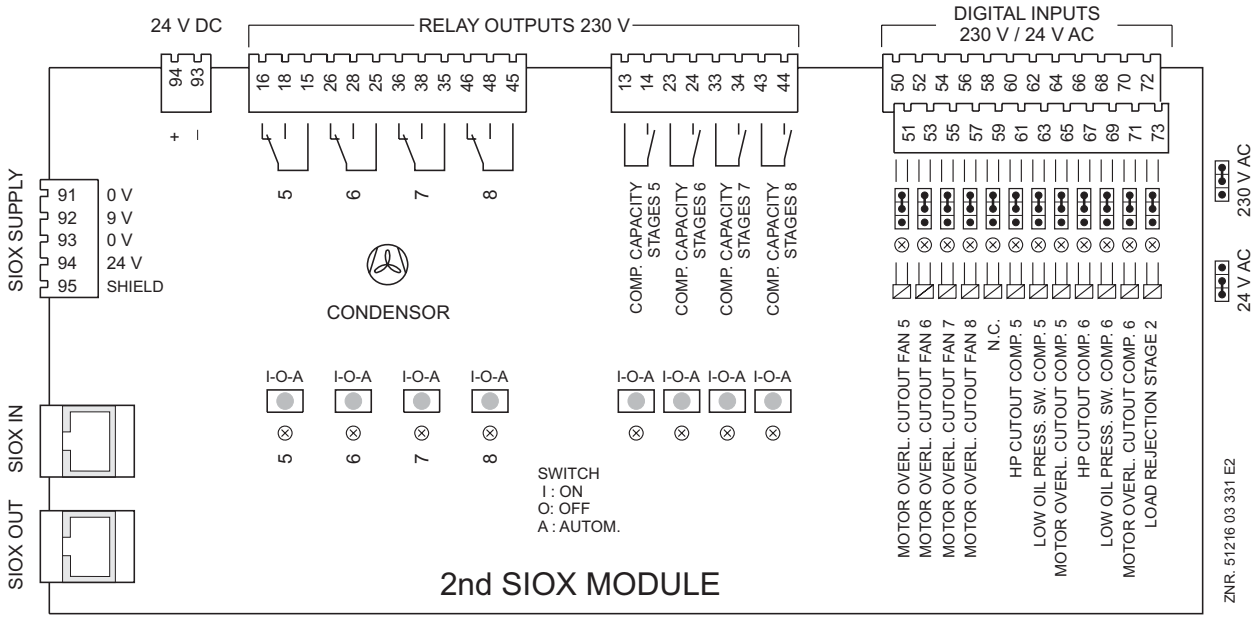
CAN-Bus	1	SHIELD
	2	GROUND
	3	CAN-LOW
	4	CAN-HIGH
RS232	5	TxD
	6	RxD
	7	RTS
	8	CTS
TTY	9	TxD +
	10	TxD -
	11	RxD +
	12	RxD -
RS485	13	B
	14	A
	15	GROUND
	16	SHIELD
SIOX SUPPLY	91	0 V
	92	9 V
	93	0 V
	94	24 V
	95	SHIELD

ZNR. 51203 55 830 D0

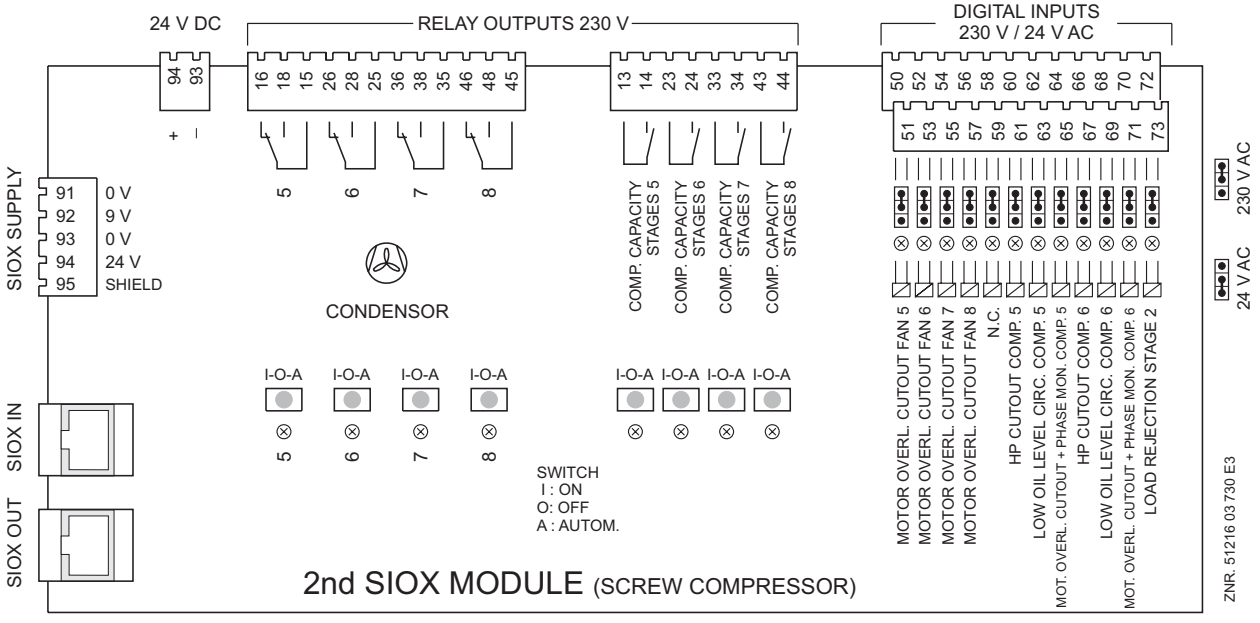
Terminal assignments, FS 3010 basic module - side connections



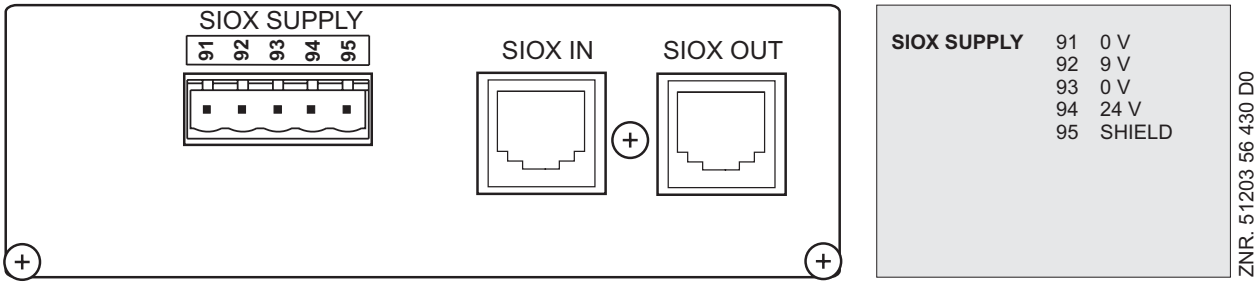
Terminal assignments, 1st SIOX module: FS 3010 basic configuration



Terminal assignments, 2nd SIOX module: I/O extension module for screw compressors



Terminal assignments, 2nd SIOX module: I/O extension module for reciprocating compressors



Terminal assignments, SIOX extension module - side connections

5.2 Inputs/outputs for basic version: 4 compressor capacity stages, 4 fan stages

Digital Inputs			
Function	***Internal Input***	***External SIOX 1 Input***	***-***
EMERGENCY STOP	50, 51	-	-
High-pressure cutout Circuit 1	52, 53	-	-
High-pressure cutout Circuit 2	54, 55	-	-
Low-pressure cutout Circuit 1	56, 57	-	-
Low-pressure cutout Circuit 2	58, 59	-	-
High-pressure cutout Compressor 1	60, 61	-	-
Low oil pressure cutout Compressor 1	62, 63	-	-
Low oil flow cutout Compressor 1 (screw compressors)			
Motor overload cutout Compressor 1 (reciprocating compressors)	64, 65	-	-
Mot. overl. cutout + phase mon. Compr. 1 (screw compressors)			
High-pressure cutout Compressor 2	66, 67	-	-
Low oil pressure cutout Compressor 2 (reciprocating compressors)	68, 69	-	-
Low oil flow cutout Compressor 2 (screw comressors)			
Motor overload cutout Compressor 2 (reciprocating compressors)	70, 71	-	-
Mot. overl. cutout + phase mon. Compr. 2 (screw compressors)			
High-pressure cutout Compressor 3	72, 73	-	-
Low oil pressure cutout Compressor 3 (reciprocating compressors)	74, 75	-	-
Low oil flow cutout Compressor 3 (screw compressors)			
Motor overload cutout Compressor 3 (reciprocating compressors)	76, 77	-	-
Mot. overl. cutout + phase mon. Compr. 3 (screw compressors)			
High-pressure cutout Compressor 4	78, 79	-	-
Low oil pressure cutout Compressor 4 (reciprocating compressors)	80, 81	-	-
Low oil flow cutout Compressor 4 (screw compressors)			

Digital Inputs			
Function	***Internal Input***	***External SIOX 1 Input***	**-**
Motor overload cutout Compressor 4 (reciprocating compressors)	82, 83	-	-
Mot. overl. cutout + phase mon. Compr. 4 (screw compressors)			
Motor overload cutout Fan 1	-	50, 51	-
Motor overload cutout Fan 2	-	52, 53	-
Motor overload cutout Fan 3	-	54, 55	-
Motor overload cutout Fan 4	-	56, 57	-
Motor overload cutout Brine Pump 1	-	58, 59	-
Motor overload cutout Brine Pump 2	-	60, 61	-
Motor overload cutout Coolant Pump 1	-	62, 63	-
Motor overload cutout Coolant Pump 2	-	64, 65	-
Brine flow monitor	-	66, 67	-
Coolant flow monitor	-	68, 69	-
Brine antifreeze protector	84, 85	-	-
Brine/coolant pressure limiter	86, 87	-	-
System OFF	88, 89	-	-
Brine setpoint toggle	90, 91	-	-
Condenser setpoint toggle	-	70, 71	-
Load shedding 1	92, 93	-	-
Load shedding 2	-	-	72, 73
Low liquid level	94, 95	-	-
External alarm	-	72, 73	-

Digital Outputs			
Function	***Internal Output***	***External SIOX 1 Output***	***-***
Compressor capacity stage 1	13, 14	-	-
Compressor capacity stage 2	23, 24	-	-
Compressor capacity stage 3	33, 34	-	-
Compressor capacity stage 4	43, 44	-	-
Control Fan 1	-	15-18	-
Control Fan 2	-	25-28	-
Control Fan 3	-	35-38	-
Control Fan 4	-	45-48	-
Liquid valve Circuit 1	1, 2	-	-
Liquid valve Circuit 2	3, 4	-	-
Brine Pump 1	15-18	-	-
Brine Pump 2	25-28	-	-
Coolant Pump 1	35-38	-	-
Coolant Pump 2	45-48	-	-
Enable refrigeration points	-	13, 14	-

Analog Inputs			
Function		***Standard module***	***External SIOX 1***
Outdoor temperature	+ Sensor + Pt1000 - Pt1000 - Sensor	1 2 3 4	- - - -
Room temperature	+ Sensor + Pt1000 - Pt1000 - Sensor	5 6 7 8	- - - -
Cylinder head temperature Compressor 1	+ Pt1000 - Pt1000	9 10	- -
Cylinder head temperature Compressor 2		11, 12	-
Cylinder head temperature Compressor 3		13, 14	-
Cylinder head temperature Compressor 4		15, 16	-
Brine inlet temperature		23, 24	-
Brine outlet temperature		25, 26	-
Coolant temperature Circuit 1		27, 28	
Coolant temperature Circuit 2		29, 30	
Low pressure transducer Circuit 1	+ 24 V DC 4..20 mA GND	35 36 37	- - -
Low pressure transducer Circuit 2	+ 24 V DC 4..20 mA GND	38 39 40	- - -
High pressure transducer Circuit 1	+ 24 V DC 4..20 mA GND	44 45 46	- - -
High pressure transducer Circuit 2	+ 24 V DC 4..20 mA GND	47 48 49	- - -
HR setpoint shift	+ 24 V DC 4..20 mA GND	51 52 53	- - -
Humidity sensor (optional)	+ 24 V DC GND 4..20 mA	61 60 59	- - -

Analog Outputs			
Function		***Standard Module***	***External SIOX 1***
Variable-speed fan control Circuit 1	 0-10 V DC GND	 54 53	-
Single-circuit system: Constant temperature valve control **Dual-circuit system:** Variable-speed fan control Circuit 2	 0-10 V DC GND	 56 55	-

All leads running to and from the FS 3010 (except the 230 V power supply and signal leads) must be shielded! This applies especially to analog inputs (sensor leads) and CAN bus wiring (see manual Introduction, General Safety and Connection Instructions). As a general rule, care should be taken to ensure that signal leads and leads carrying a supply voltage are routed through separate cable channels.

Interfaces			
Function		***Standard Module***	***External SIOX 1***
CAN bus connection	 Shield Ground CAN-L CAN-H	CAN 1 2 3 4	- - - - -
RS232		5, 6, 7, 8	-
TTY		9, 10, 11, 12	-
RS485		13, 14, 15, 16	-
External SIOX connection output		SIOX OUT	SIOX OUT
External SIOX connection input		-	SIOX IN

Power Supply			
Function		***Standard Module***	***External SIOX 1***
230 V AC		N, L	-
Grounding conductor		PE	-
SIOX power supply	 - 0 V - 9 V - 0 V - 24 V - Shield	 91 92 93 94 95	 91 92 93 94 95

5.3 Inputs/outputs for upgrades version: 6 compressors, 8 compressor capacity stages, 8 fan stages

Digital Inputs				
Function	***Internal Input***	***External SIOX 1 Input***	***External SIOX 2 Input***	***-***
EMERGENCY STOP	50, 51	-	-	-
High-pressure cutout Circuit 1	52, 53	-	-	-
High-pressure cutout Circuit 2	54, 55	-	-	-
Low-pressure cutout Circuit 1	56, 57	-	-	-
Low-pressure cutout Circuit 2	58, 59	-	-	-
High-pressure cutout Compressor 1	60, 61	-	-	-
Low oil pressure cutout Compressor 1 (reciprocating compressors)	62, 63	-	-	-
Low oil flow cutout Compressor 1 (screw compressors)				
Motor overload cutout Compressor 1 (reciprocating compressors)	64, 65	-	-	-
Mot. overl. cutout + phase mon. Compr. 1 (screw compressors)				
High-pressure cutout Compressor 2	66, 67	-	-	-
Low oil pressure cutout Compressor 2 (reciprocating compressors)	68, 69	-	-	-
Low oil flow cutout Compressor 2 (screw compressors)				
Motor overload cutout Compressor 2 (reciprocating compressors)	70, 71	-	-	-
Mot. overl. cutout + phase mon. Compr. 2 (screw compressors)				
High-pressure cutout Compressor 3	72, 73	-	-	-
Low oil pressure cutout Compressor 3 (reciprocating compressors)	74, 75	-	-	-
Low oil flow cutout Compressor 3 (screw compressors)				
Motor overload cutout Compressor 3 (reciprocating compressors)	76, 77	-	-	-
Mot. overl. cutout + phase mon. Compr. 3 (screw compressors)				
High-pressure cutout Compressor 4	78, 79	-	-	-
Low oil pressure cutout Compressor 4 (reciprocating compressors)	80, 81	-	-	-
Low oil flow cutout Compressor 4 (screw compressors)				
Motor overload cutout Compressor 4 (reciprocating compressors)	82, 83	-	-	-
Mot. overl. cutout + phase mon. Compr. 4 (screw compressors)				

Digital Inputs				
Function	***Internal Input***	***External SIOX 1 Input***	***External SIOX 2 Input***	***-***
High-pressure cutout Compressor 5	-	-	60, 61	-
Low oil pressure cutout Compressor 5 (reciprocating compressors)	-	-	62, 63	-
Low oil flow cutout Compressor 5 (screw compressors)				
Motor overload cutout Compressor 5 (reciprocating compressors)	-	-	64, 65	-
Mot. overl. cutout + phase mon. Compr. 5 (screw compressors)				
High-pressure cutout Compressor 6	-	-	66, 67	-
Low oil pressure cutout Compressor 6 (reciprocating compressors)	-	-	68, 69	-
Low oil flow cutout Compressor 6 (screw compressors)				
Motor overload cutout Compressor 6 (reciprocating compressors)	-	-	70, 71	-
Mot. overl. cutout + phase mon. Compr. 6 (screw compressors)				
Motor overload cutout Fan 1	-	50, 51	-	-
Motor overload cutout Fan 2	-	52, 53	-	-
Motor overload cutout Fan 3	-	54, 55	-	-
Motor overload cutout Fan 4	-	56, 57	-	-
Motor overload cutout Fan 5	-	-	50, 51	-
Motor overload cutout Fan 6	-	-	52, 53	-
Motor overload cutout Fan 7	-	-	54, 55	-
Motor overload cutout Fan 8	-	-	56, 57	-
Motor overload cutout Brine Pump 1	-	58, 59	-	-
Motor overload cutout Brine Pump 2	-	60, 61	-	-
Mot. overl. cutout Coolant Pump 1	-	62, 63	-	-
Mot. overl. cutout Coolant Pump 2	-	64, 65	-	-
Brine flow monitor	-	66, 67	-	-
Coolant flow monitor	-	68, 69	-	-
Brine antifreeze protector	84, 85	-	-	-
Brine/coolant pressure limiter	86, 87	-	-	-
System OFF (defrost)	88, 89	-	-	-
Brine setpoint toggle	90, 91	-	-	-
Coolant setpoint toggle	-	70, 71	-	-
Load shedding 1	92, 93	-	-	-
Load shedding 2	-	-	72, 73	-

Digital Inputs				
Function	***Internal Input***	***External SIOX 1 Input***	***External SIOX 2 Input***	***-***
Low refrigerant	94, 95	-	-	-
External alarm / Refrigerated unit pump	-	72, 73	-	-

Digital Outputs				
Function	***Internal Output***	***External SIOX 1 Output***	***External SIOX 2 Output***	***-***
Compressor capacity stage 1	13, 14	-	-	-
Compressor capacity stage 2	23, 24	-	-	-
Compressor capacity stage 3	33, 34	-	-	-
Compressor capacity stage 4	43, 44	-	-	-
Compressor capacity stage 5	-	-	13, 14	-
Compressor capacity stage 6	-	-	23, 24	-
Compressor capacity stage 7	-	-	33, 34	-
Compressor capacity stage 8	-	-	43, 44	-
Control Fan 1	-	15-18	-	-
Control Fan 2	-	25-28	-	-
Control Fan 3	-	35-38	-	-
Control Fan 4	-	45-48	-	-
Control Fan 5	-	-	15-18	-
Control Fan 6	-	-	25-28	-
Control Fan 7	-	-	35-38	-
Control Fan 8	-	-	45-48	-
Liquid valve Circuit 1	1, 2	-	-	-
Liquid valve Circuit 2	3, 4	-	-	-
Brine Pump 1	15-18	-	-	-
Brine Pump 2	25-28	-	-	-
Coolant Pump 1	35-38	-	-	-
Coolant Pump 2	45-48	-	-	-
Enable refrigeration points	-	13, 14	-	-

Analog Inputs			
Function		***Standard Module***	***External SIOX 1***
Outdoor temperature	+ Sensor + Pt1000 - Pt1000 - Sensor	1 2 3 4	- - - -
Room temperature	+ Sensor + Pt1000 - Pt1000 - Sensor	5 6 7 8	- - - -
Cylinder head temperature Compressor 1	+ Pt1000 - Pt1000	9 10	- -
Cylinder head temperature Compressor 2		11, 12	-
Cylinder head temperature Compressor 3		13, 14	-
Cylinder head temperature Compressor 4		15, 16	-
Cylinder head temperature Compressor 5		17, 18	-
Cylinder head temperature Compressor 6		19, 20	-
Brine inlet temperature		23, 24	-
Brine outlet temperature		25, 26	-
Coolant temperature Circuit 1		27, 28	
Coolant temperature Circuit 2		29, 30	
Low pressure transducer Circuit 1	+ 24 V DC 4..20 mA GND	35 36 37	- - -
Low pressure transducer Circuit 2	+ 24 V DC 4..20 mA GND	38 39 40	- - -
High pressure transducer Circuit 1	+ 24 V DC 4..20 mA GND	44 45 46	- - -
High pressure transdurcer Circuit 2	+ 24 V DC 4..20 mA GND	47 48 49	- - -
Brine pump pressure differential	+ 24 V DC 4..20 mA GND	41 42 43	- - -
Humidity sensor (optional)	+ 24 V DC GND 4..20 mA	61 60 59	- - -

Analog Outputs			
Function		***Standard Module***	***External SIOX 1***
Variable-speed fan control Circuit 1	 0-10 V DC GND	 54 53	-
Single-circuit system: Constant temperature valve control **Dual-circuit system:** Variable-speed fan control Circuit 2	 0-10 V DC GND	 56 55	-

All leads running to and from the FS 3010 (except the 230 V power supply and signal leads) must be shielded! This applies especially to analog inputs (sensor leads) and CAN bus wiring (see manual Introduction, General Safety and Connection Instructions). As a general rule, care should be taken to ensure that signal leads and leads carrying a supply voltage are routed through separate cable channels.

Interfaces			
Function		***Standard Module***	***External SIOX 1***
CAN bus connection	 Shield Ground CAN-L CAN-H	CAN 1 2 3 4	- - - - -
RS232		5, 6, 7, 8	-
TTY		9, 10, 11, 12	-
RS485		13, 14, 15, 16	-
External SIOX connection output		SIOX OUT	SIOX OUT
External SIOX connection input		-	SIOX IN

Power Supply			
Function		***Standard Module***	***External SIOX 1 +***
230 V AC		N, L	-
Ground Conductor		PE	-
SIOX power supply	 - 0 V - 9 V - 0 V - 24 V - Shield	 91 92 93 94 95	 91 92 93 94 95

Notice:

6 Operating Modes of FS 3010

6.1 Emergency manual-automatic mode selection

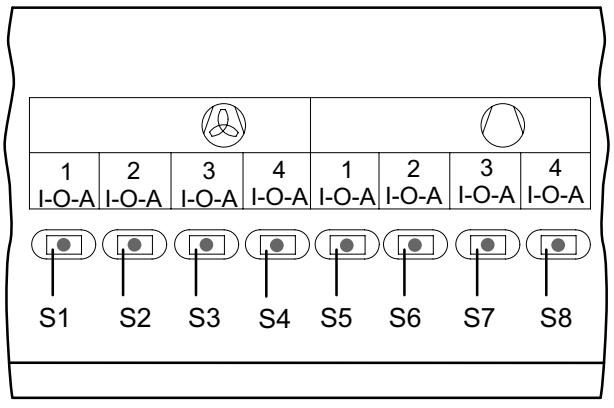
The system can be controlled manually using the manual switches. In this mode, compressor stages can be loaded and unloaded. The manual switches transmit a control request to the controller that is translated by the controller's internal sequential control. Mode is selected for each compressor and condenser by switches S1 - S8 on the circuit board (see Figure).

Manual control is only available when the controller is in normal operating mode. Relays are not controlled directly by the switches. Manual-automatic mode selection is equally available on the expansion module (SIOX).

The switch positions provided are "A - O - I":

- **A:**	Automatic ON	Compressor stage is switched on and off by controller
- **O**:	Manual OFF	Manual mode: Compressor stage if OFF
- **I**:	Manual ON	Manual mode: Compressor stage if ON

When all switches are set to the A position, the controller registers the logic state of AUTOMATIC ON. If a minimum of one switch is set to the I or O position, a message (*Manual OFF/ON CapStg x*) is entered in the log memory. The message is transmitted according to the preselected priority.



6.2 Service-Mode

When choosing *Service Mode* of (Menu 8) the FS 3010 Pack Controller, all compressor and condenser outputs are reset stagewise. All controller functions are subsequently inactivated, enabling each digital and analog output to be actuated manually. The controller registers Service Mode by entering a message in the log memory. The message is transmitted according to the preselected priority. In Service Mode the controller's digital and analog inputs (motor overload cutouts, low oil pressure cutouts, pressure transducers) are disregarded. Switching commands or output of an analog voltage signal are carried out directly.

6.3 Displaying operating status

Supplementary characters are placed before the measurement in some display lines to indicate operating states of the system. The following supplementary characters are used:

System Pos: XXXXX	
Brine OFF +/-/= -20 °C	Shows current brine outlet temperature t_0

- **Suction pressure trend:**

  Shows whether compressor capacity stages are to be loaded, unloaded or not actuated on expiration of the delay times.

  Example:

$t_{0\text{-Act.}}$	X	-20°C
$p_{0\text{-Act.}}$	X	2.34b
	↓	
	+	Compressor capacity stages are loaded: $t_{o-Act.} > t_{o-Setp.} + \frac{NZ}{2}$
	=	Compressor capacity stages are not actuated: $t_{o\text{-Act.}}$ in neutral zone.
	-	Compressor capacity stages are unloaded: $t_{o-Act.} < t_{o-Setp.} - \frac{NZ}{2}$

- **Condensing pressure trend:**

  Shows whether fan capacity stages are to be loaded, unloaded or not actuated on expiration of the delay times.

  Example:

$t_{c\text{-Act.}}$	X	30°C
$p_{c\text{-Act.}}$	X	15.45b
	↓	
	+	Fan capacity stages are loaded: $t_{c-Act.} > t_{c-Setp.} + \frac{NZ}{2}$
	=	Fan capacity stages are not actuated: $t_{c\text{-Act.}}$ in neutral zone.
	-	Fan capacity stages are unloaded: $t_{c-Act.} < t_{c-Setp.} - \frac{NZ}{2}$

- **Setpoint characteristic:**

  Example:

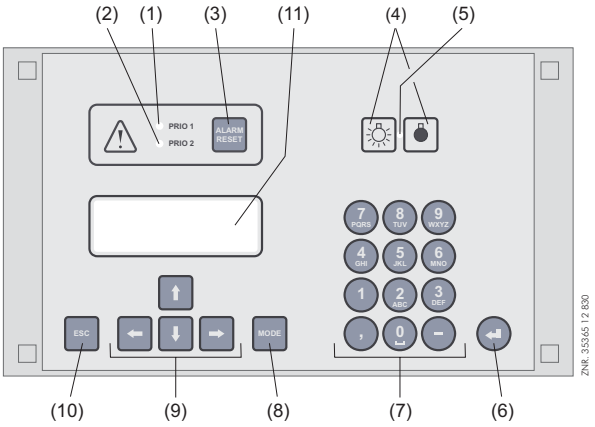
$t_{0\text{-Setp.}}$	X	-20°C
$p_{0\text{-Setp.}}$	X	2.34b
$t_{c\text{-Setp.}}$	X	30°C
$p_{c\text{-Setp.}}$	X	15.45b
	↓	
	D	Controller works with parameters for daytime operation.
	N	Controller works with parameters for nighttime operation.
	HR	Controller works with parameters for heat recovery operation.

7 Operation of FS 3010

The FS 3010 Pack Controller can be operated via the CAN bus interface with an AL 300 Operator Terminal or CI 3000 Store Computer. No provision is made for operation on the FS 3010 Pack Controller itself except for manual-automatic mode selection (see Section 6 Operating Modes).

7.1 Operation with CI 3000 Store Computer or AL 300 Operator Terminal

Operation is the same whether using the CI 3000 Store Computer or the AL 300 Operator Terminal. The operator interface and the functions are the same on both devices.



(1) Priority 1 alarm indicator light

(2) Priority 2 alarm indicator light

(3) Buzzer and horn stop key and alarm reset key

(4) External lighting on/off switch (general lighting)

(5) Lighting on/off switch indicator light

(6) **ENTER** key

(7) Alphanumeric keypad

(8) **MODE** key; CAPS SHIFT function for text entry

(9) Cursor keys

(10) **ESC** key

(11) Display (4 lines of 20 characters)

7.2 Menus and screens

Differentiation is made between menus and screens for operation of the controller.

Numbering of menus and screens:

Each menu in the menu tree can be opened by entering a specific number and each operating screen in a menu can be opened by selecting it in the menu. This is achieved by distinct marking by numbers and letters in the menu tree. Numbers 1, 2, etc. identify the menu and the letters a, b, etc. identify the order of the screens in the menu.

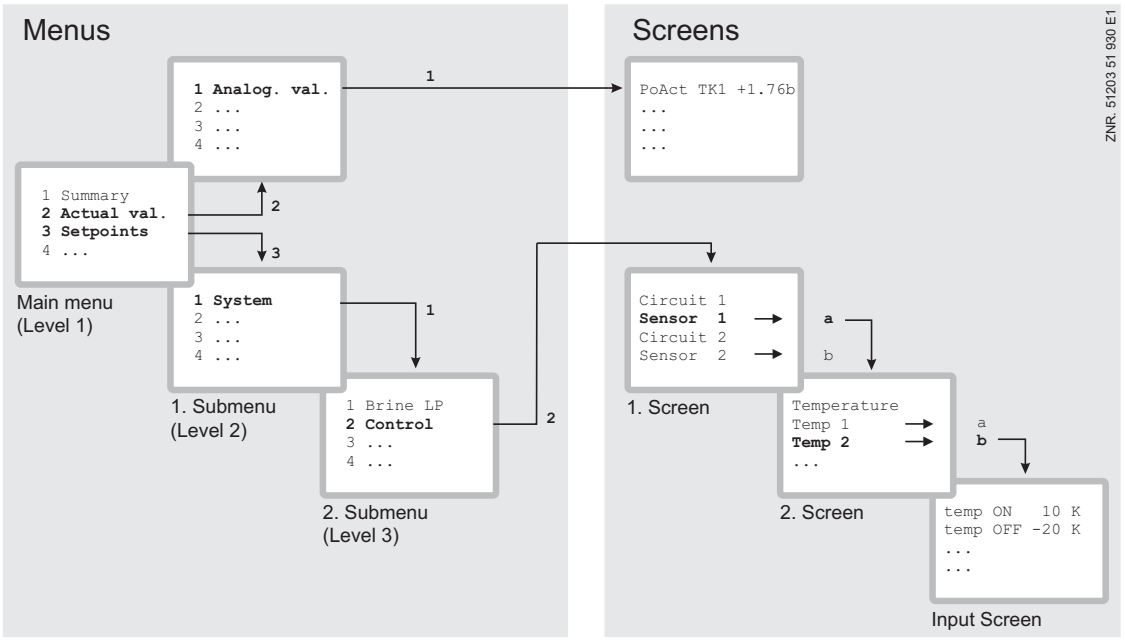
Example of screen numbering:

2 - 1 means that the screen can be opened from the menu tree by entering the numbers 2 - 1. This may be a display screen or operating screen.

Example of operating screen numbering:

3 - 1 - 2 - a - b means that the higher-level screen can be opened from the menu tree by entering the numbers 3 - 1 - 2. The letter or letters following indicate that one or more additional operating screens or selection lists can be opened in the screen by selecting them (?). The letters show their order in the screen.

Each operating screen of the FS 3010 can be opened by entering its respective number.



Menus

A menu contains a list of up to nine items for selection. Each item selected may contain separate submenus or operating screens.

Selecting menu items

Each line of the selection list displayed contains a number from 1 to 9 and 0 and the name of the corresponding item. The separate items can be selected directly by pressing the appropriate numeric key 1 to 9, or 0 for item 10. If the menu lists more than three items, the cursor keys can be used to scroll through the menu and view the remaining items.

A menu item can be selected by pressing the respective numeric key regardless of whether the item itself is visible on the display.

Operating screens

An operating screen shows values for output and/or input. There may be more values for output and/or input than fit into the display at one time. The cursor keys can be used to scroll through these additional values. The screen may also contain more than one page, in which case the pages can be viewed one at a time.

Arrows appear on the right of the display to indicate whether you can scroll or page through a menu or screen.

Scrolling

Use the up and down cursor keys (↑) and (↓) to:

- Scroll line by line, for example when selecting a variable in a line from a list of predefined variables.
- Scroll block by block to view values that extend beyond the capacity of the display.

Paging

The left and right cursor keys (←) and (→) can be used to page through screens containing more than one page. If a menu contains more than three submenus, the remaining items can be viewed by scrolling with the up and down cursor keys (↑) and (↓).

Cancelling entry block

Before any values can be entered, the entry block must be deactivated as follows:

- In the Main Menu choose item 9 Parameter Setting.
- Then choose item 3 Block.
- Press ENTER (↵) to set the check mark (√). When the check mark is set, entry block is deactivated, allowing settings to be entered.
- Press ESC to exit the screen.

Blocking is activated automatically if no key is pressed for 10 minutes and when the operator terminal is switched on.

Superuser mode (granting Superuser rights)

Superuser mode is reserved exclusively for use by service personnel!

- In the Main Menu choose item 9 Parameter Setting.
- In this menu choose item 3 Block.
- Enter the current date in reverse order (not shown on display).
- Press the ENTER key (↵) to confirm, causing ”S” to be shown on the screen.
- Press the ESC key to exit the screen.

Example:

The current date is April 17, 2035, which in order of day-month-year is 17.04.35. In this instance the entry required to grant Superuser rights is 534071.

Unblocking from the main menu cancels entry block for all components of the CAN bus system. If you have moved to the operator interface of a CAN bus station but have omitted to cancel entry block, simultaneously press the **MODE and decimal** (**.**) keys to cancel entry block for the particular controller. Entry block is reactivated on exiting the operator interface for the controller.

Activating service mode

Service mode is reserved exclusively for use by service personnel!

Service mode enables the service technician to suppress the remote alarm function of the CI 3000 Store Computer for a limited time while carrying out maintenance of repair work.

- In the Main Menu, choose 9 Parameter Setting..
- From this menu item choose 3 Block.
- - Simultaneously press the **MODE and ENTER** (↵) keys to open the screen for suppressing remote alarm and enter the time required for service work (1 to 255 min.).
- - This activates service mode for the specified time.

Any alarms (Priority 1 and 2) still active when the set service mode time expires cause the audible signalling devices and alarm relays to be actuated and are forwarded by automatic fault report transmission.

Service mode can be reset/cancelled by entering a time of 0 min.

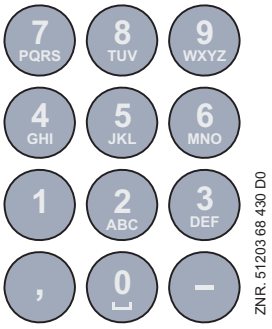
Entering values and text

Use the up and down cursor keys (↑) and (↓) to select the line wanted and press the ENTER key (↵). The cursor jumps to the entry field. The cursor keys (↑) and (↓) or numeric keys can then be used to enter or change values. Keep the cursor key (↑) or (↓) depressed to change values in fast mode.

Entering text

In fields that allow text entry, text can also be entered by the alphanumeric keypad. Repeatedly press the numeric keys to generate letters. Press the ENTER key (↵) to confirm the entered value or text.

Key	Letter/Character
0	äöüß0 Space
1	1
2	abc2
3	def3
4	ghi4
5	jkl5
6	mno6
7	pqrs7
8	tuv8
9	wxyz9
-	. _ -
,	Insert space



Alphanumeric key assignments

Press the **MODE** key to shift between upper and lower case letters.

Deleting text entry

Simultaneously press the **MODE and minus** (**-**) keys to delete a complete line of text.
Press the **MODE and decimal** (**.**) keys to delete one character.

Cancelling an entry

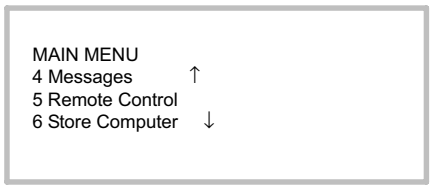
Press the ESC key to cancel an entry at any time. The entry will not be applied.

Exiting menus and screens

Press the ESC key to exit the menu or screen you are in at any time. This returns you to the next higher menu. All menus and screens are closed automatically if no key is pressed for 10 minutes. The display then jumps to the Main Menu or to the Alarm menu if any fault report is currently active.

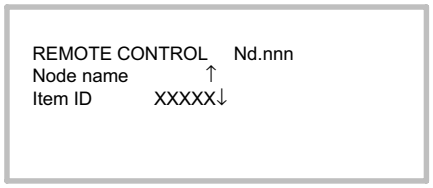
7.3 Operation / Parameter setting of FS 3010 Pack Controller

The LCD display contains 4 lines of 20 characters. If a menu or screen consists of more than 4 lines, the cursor keys can be used to scroll through the remaining lines.

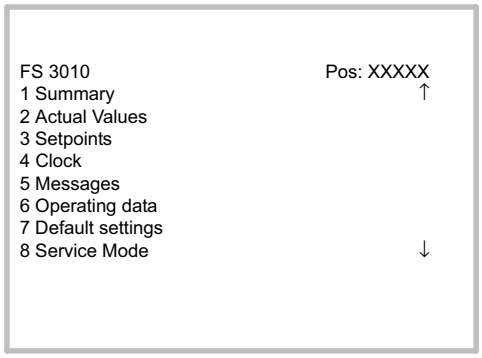


Entry block must be deactivated before parameters can be set (see chapter 8 Menu Structure).

In the Main Menu of the AL 300 Operator Terminal or CI 3000 Store Computer, open submenu *5 Remote Operation*. This displays the following screen:



Select the FS 3010 Pack Controller wanted with the cursor keys (↑) (↓) or by entering its Node No. *nnn* with the numeric keys. Press the ENTER key to open the case controller. This displays the following main menu for the FS 3010 Pack Controller:



Notice:

8 Menu Structure of FS 3010

The FS 3010 Pack Controller must be connected to a setup unit to allow setting of parameters. Parameter setting is made via the CAN bus interface communicating with the FS 3010. The setup unit for operation of the FS 3010 may be either an AL 300 Operator Terminal or a CI 3000 Store Computer (see also Section 1 - System Design).

Working with menus and screens

See Section 7 for details.

Numbering of menus and screens

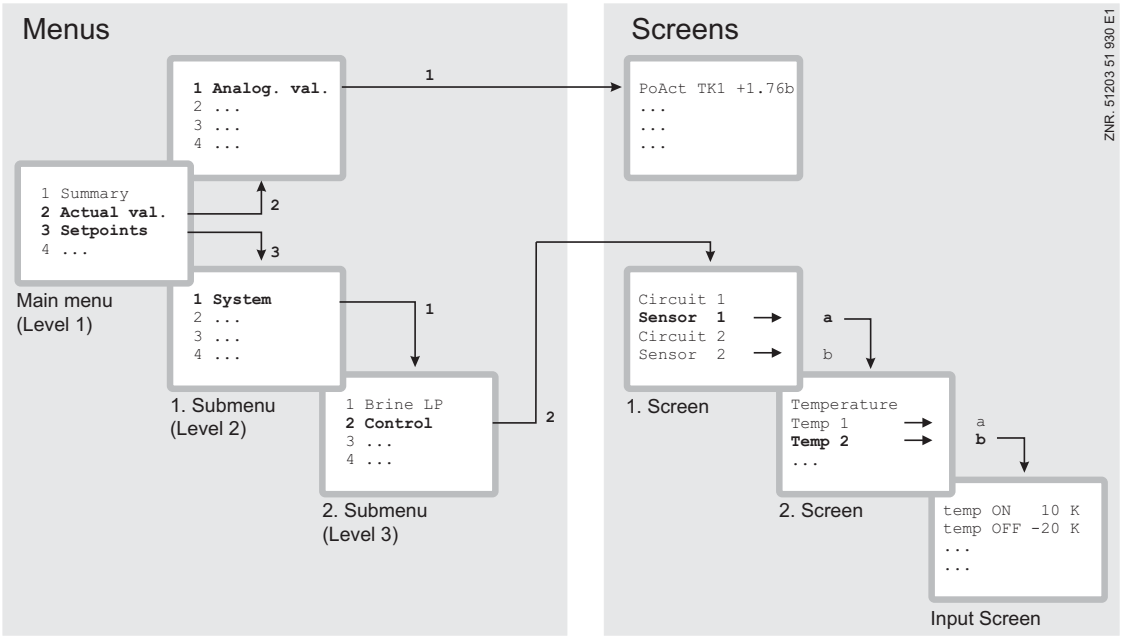
Each menu can be opened by entering a specific number and each operating screen in a menu can be opened by selecting it from the menu. This is achieved by distinct marking by numbers and letters in the menu tree. Numbers 1, 2, etc. identify the menu and the letters a, b, etc. identify the order of the screens in the menu.

Example of screen numbering:

2-1 means that the screen can be opened from the menu tree by entering the numbers 2 - 1. This may be a display screen or operating screen.

Example of operating screen numbering:

3-1-2-a-b means that the higher-level screen can be opened from the menu tree by entering the numbers 3 - 1 - 2. The letter or letters following indicate that one or more additional operating screens or selection lists can be opened in the screen by selecting them (→). The letters show their order in the screen.



8.1 Menu tree

Level 1	Level 2	Level 3	Level 4	Level 5	Menu No.	Menu Name
Main Menu					0	FS 3010
Summary					1	Summary
	Circuit 1				1-1	
	Circuit 2				1-2	
	Brine & Coolant				1-3	
Actual values					2	Actual values
	Analog values				2-1	ANALOG VAL
		Circuit 1			2-1-1	CIRCUIT 1
		Circuit 2			2-1-2	CIRCUIT 2
		System			2-1-3	SYSTEM
			Cylindre temperature		2-1-3-a	ANALOG VAL
	Compressor				2-2	COMPRESSOR
	Condenser fan				2-3	FAN
	System equipment				2-4	SYSTEM
Setpoints					3	SETPOINT
	System configuration				3-1	CONFIG
		Refrigerant			3-1-a	REFRIGERT.
		P0 transmitter			3-1-b	Po-TRANSM
		Enable compressor stages			3-1-c	ENABL.COMP
		Dry cooler			3-1-d	DRY COOLER
		Enable condenser stages			3-1-e	ENABL.COND
		Offset			3-1-f	Offset
	Control				3-2	Control
		Brine/LP control			3-2-1	Brine/LP ctr
			Control		3-2-1-1	Control
				Sensor	3-2-1-1-a	Sensor
				Switching sequence	3-2-1-1-b	SEQUENCE
			Brine/LP control day		3-2-1-2	BR CRTL D

Certain menus may be hidden depending on the system type (single- or dual-circuit).

Level 1	Level 2	Level 3	Level 4	Level 5	Menu No.	Menu Name
Setpoints	Control	Brine/LP control	Brine/LP control day	Base load time compressor	3-2-1-2-a	BAS LOAD T
				Variable load time compressor	3-2-1-2-b	VAR LOAD T
				Base unload time compressor	3-2-1-2-c	BAS UNLO T
				Variable unload time compressor	3-2-1-2-d	VAR UNLO T
			Brine/LP control night		3-2-1-3	BR CRTL D
				Base load time compressor	3-2-1-3-a	BAS LOAD T
				Variable load time compressor	3-2-1-3-b	VAR LOAD T
				Base unload time compressor	3-2-1-3-c	BAS UNLO T
				Variable unload time compressor	3-2-1-3-d	VAR UNLO T
		Coolant/HP control			3-2-2	Coolant/HP C
			Control		3-2-2-1	Control
				Sensor	3-2-2-1-a	Sensor
				Controller	3-2-2-1-b	Controller
			Setpoints		3-2-2-2	Setpoints
				Base load time fan	3-2-2-2-a	BAS LOAD T
				Variable load time fan	3-2-2-2-b	VAR LOAD T
				Base unload time fan	3-2-2-2-c	BAS UNLO T
				Variable unload time fan	3-2-2-2-d	VAR UNLO T
	Monitoring (Compressor)				3-3	COMP MON
	Base load				3-4	BASE LOAD
	Messages				3-5	MESSAGE
	Pumps				3-6	Pumps
	Defrost				3-7	Defrost
Clock					4	CLOCK

Certain menus may be hidden depending on the system type (single- or dual -circuit).

Level 1	Level 2	Level 3	Level 4	Level 5	Menu No.	Menu Name
Messages					5	MESSAGE
	Display				5-1	MESSAGE
	Delete				5-2	MESSAGE
Operating data					6	OP DATA
	Compressor operating hours				6-1	OP DATA
	Fan operating hours				6-2	OP DATA
	History				6-3	HISTORY
		Run times			6-3-1	HISTORY
			Run times		6-3-1-a	Run time
		Starts			6-3-2	HISTORY
			Starts		6-3-2-a	Starts
		Activity			6-3-3	HISTORY
Default settings					7	FS 3010 G
Service Mode					8	SERVICE
	Analog values				8-1	SERVICE
	Compressor				8-2	SERVICE
	Condenser fan				8-3	SERVICE
	System equipment				8-4	SERVICE

Certain menus may be hidden depending on the system type (single- or dual -circuit).

8.1.1 Menu 0 Main Menu

FS 3010 XX POS: XXXXX	XX = LT or NT (depending on system typ setting DIP switch 1, Coding switch 1)
1 Summary	Continue to Menu 1
2 Actual values	Continue to Menu 2
3 Setpoints	Continue to Menu 3
4 Clock	Continue to Menu 4
5 Messages	Continue to Menu 5
6 Operating data	Continue to Menu 6
7 Default settings	Continue to Menu 7
8 Service Mode	Continue to Menu 8

8.1.2 Menu 1 Summary

Summary POS: XXXXX	
1 Circuit 1	Continue to Menu 1-1
2 Circuit 2	Continue to Menu 1-2 (Displayed **only** for dual-circuit systems)
3 Brine & coolant	Continue to Menu 1-3

- Menu 1-1 Circuit 1

Act. to 1	XXX °C	Shows current evaporating temperature
Setp.to 1	XXX °C	Shows evaporating pressure setpoint for comparison Shown only with cold side pressure control (Menu 3-2-1-1-a)
Act. tc 1	XXX °C	Shows current condensing temperature
Setp.tc 1	XXX °C	Shows condensing temperature setpoint for comparison Shown only with hot side pressure control (Menu 3-2-2-1-a) or for systems that do not have dry cooler (Menu 3-1-d)

- Menu 1-2 Circuit 2 *)

Act. to 2	XXX °C	Shows current evaporating temperature
Setp.to 2	XXX °C	Shows evaporating pressure setpoint for comparison Shown only with cold side pressure control (Menu 3-2-1-1-a)
Act. tc 2	XXX °C	Shows current condensing temperature
Setp.tc 2	XXX °C	Shows condensing temperatures setpoint for the comparison Shown only with hot side pressure control (Menu 3-2-2-1-a) or for systems that do not have dry cooler (Menu 3-1-d)

*) Shown only for dual-circuit systems

- Menu 1-3 Brine and coolant

Brine OFF act. or Brine OUT act. XXX °C	Shows current brine outlet temperature *)
Brine ON act. or Brine IN act. XXX °C	Shows current brine inlet temperature *)
Brine OFF setp or Brine OUT setp XXX °C	Shows brine outlet temperature setpoint for comparison *)
Brine ON setp or Brine IN setp XXX °C	Shows brine inlet temperature setpoint for comparison *)
CoolantAct. or Coolt Act XXX °C	Shows current coolant temperature *)
CoolantSetp. or Coolt Setp XXX °C	Shows coolant temperature setpoint for comparison *)

*) Brine entries are displayed only for systems with brine circuit (Menu 3-2-1-1-a).
Coolant entries are displayed only for systems with coolant circuit (Menu 3-2-2-1-a and 3-1-d).
Brine IN entries are displayed only with brine inlet control (Menu 3-2-1-1-a).
Brine OUT entries are displayed only with brine outlet control (Menu 3-2-1-1-a).

8.1.3 Menu 2 Actual values

ACT.VALUES POS: XXXXX	
1 Analog values	Continue to Menu 2-1
2 Compressor	Continue to Menu 2-2
3 Condenser fan	Continue to Menu 2-3
4 System equipment	Continue to Menu 2-4

- Menu 2-1 Analog values

ANALOG VAL POS: XXXXX	
1 Circuit 1	Continue to Menu 2-1-1
2 Circuit 2	Continue to Menu 2-1-2 *)
3 System	Continue to Menu 2-1-3

*) Shown only for dual-circuit systems

- Menu 2-1-1 Circuit 1

CIRCUIT 1 POS: XXXXX		
Act. LP 1	XXX b	Shows current evaporating pressure
Setp.LP 1	XX.XX b	Shows evaporating pressure setpoint for comparison Shown **only** with cold side pressure control (Menu 3-2-1-1-a)
Act. t0 1	XXX °C	Shows current evaporating temperature
Setp.t0 1	XX °C	Shows setpoint for comparison Shown **only** with cold side pressure control (Menu 3-2-1-1-a)
Act. HP 1	XXX b	Shows current condensing pressure
Setp.HP 1	XX.XX b	Shows setpoint for comparison **Not** shown for systems with dry cooler (Menu 3-1-d) and control by coolant temperature (Menu 3-2-2-1-a)
Act. tc 1	XXX °C	Shows current condensing temperature
Setp.tc 1	XX °C	Shows setpoint for comparison **Not** shown for systems with dry cooler (Menu 3-1-d) and control by coolant temperature (Menu 3-2-2-1-a)
Coolt. ON 1	XXX °C	Shows current coolant temperature **Not** shown for systems without dry cooler and with hot side pressure control (Menu 3-2-2-1-a)
CoolantSetp. or Coolt.Setp. 1	XXX °C	Shows setpoint for comparison **Not** shown for systems without dry cooler (Menu 3-1-d) and with hot side pressure control (Menu 3-2-2-1-a)
SollDrehz WS1 or SpeedSetp.HS1	XX %	Shows fan speed setpoint **Not** shown with hot side step control (Menu 3-2-2-1-b)

- Menu 2-1-2 Circuit 2

CIRCUIT 2 POS: XXXXX		
Act. LP 2	XXX b	Shows current evaporating pressure
Setp.LP 2	XX.XX b	Shows evaporating pressure setpoint for comparison Shown only with cold side pressure control (Menu 3-2-1-1-a)
Act. t0 2	XXX °C	Shows current evaporating temperature
Setp.t0 2	XX °C	Shows setpoint for comparison Shown **only** with cold side pressure control (Menu 3-2-1-1-a)
Act. HP 2	XXX b	Shows current condensing pressure
Setp.HP 2	XX.XX b	Shows setpoint for comparison **Not** shown for systems with dry cooler (Menu 3-1-d) and control by coolant temperature (Menu 3-2-2-1-a)
Act. tc 2	XXX °C	Shows current condensing temperature
Setp.tc 2	XX °C	Shows setpoint for comparison **Not** shown for systems with dry cooler (Menu 3-1-d) and control by coolant temperature (Menu 3-2-2-1-a)
SollDrehz WS2 or SpeedSetp.HS2	XX %	Shows fan speed setpoint **Not** shown with hot side step control (Menu 3-2-2-1-b) and for systems with single-circuit dry cooler (Menu 3-1-d)

- Menu 2-1-3 System

SYSTEM	POS: XXXXX	
room temp.	XXX °C	Shows current room temperature
Outdoor temp.	XXX °C	Shows current outdoor temperature
Brine OFF or Brine OUT +/-/=	XXX °C	Shows current brine outlet temperature **Not** shown with cold side pressure control (Menu 3-2-1-1-a) *)
Brine ON or Brine IN +/-/=	XXX °C	Shows current brine inlet temperature Not shown with cold side pressure control (Menu 3-2-1-1-a) *)
Br.OUT setp	XXX °C	Shows brine outlet temperature setpoint Not shown with cold side pressure control (Menu 3-2-1-1-a)
Br.IN setp	XXX °C	Shows brine inlet temperature setpoint Not shown with cold side pressure control (Menu 3-2-1-1-a)
Coolt. ON 1	XXX °C	Shows current coolant temperature 1
Coolt. ON 2	XXX °C	Shows current coolant temperature 2
Coolt.Setp.	XXX °C	Shows current coolant temperature setpoint
Air humidity	XXX %	Shows current air humidity
Cyl. temp.	→	Continue to Menu 2-1-3-a Cylinder head temperature
HR-setpoint	XXX %	HR signal for setpoint shift (0 to 10 V)
3-Way Valve	XXX %	Actuating signal for three-way valve (0 to 10 V)

*) Trend +/-/= is displayed only with control of brine temperature (Menu 3-2-1-1-a).

- Masque 2-1-3-a Cylindre temperature

ANALOG VAL	POS: XXXXX	
Cyl.temp. C 1	XXX °C	Shows current cylinder head temperature Compressor 1
...		
Cyl.temp. C 6	XXX °C	

- Menu 2-2 Compressor

Only existing compressor stages are displayed.

COMPRESSOR POS: XXXXX		
HP cutout 1	XXX	Shows current OFF/ON state at input *HP Cutout Circuit 1*
Strömungsw. 1 or Low oil flow 1	XXX	Shows current OFF/ON stat at input *Low Oil Flow Cutout Comp. 1* Not displayed for reciprocating compressors (DIP switch 3 = OFF)
Low oil pr. 1	XXX	Shows current OFF/ON state at input Low Oil Pressure Cutout Comp. *1* Not displayed for screw compressors (DIP switch 3 = ON)
Mot.S+Phase 1	XXX	Shows current ONN/ON state at input *Motor Overload Cutout Compressor 1* **Not** displayed for reciprocating compressors (DIP switch 3 = OFF)
Mot. cutout C 1	XXX	Shows current OFF/ON state at input *Motor Overload Cutout Compressor 1* **Not** displayed for screw compressors (DIP switch 3 = ON)
Man. switch 1	XXX	Shows current OFF/ON/AUTO state of manual switch for Compressor 1
Cap. stage 1	XXX	Shows current OFF/ON stat at output *Compressor 1*
...		....
HP cutout 6	XXX	As for Compressor 1
Strömungsw. 6 or Low oil flow 6	XXX	
Low oil pr. 6	XXX	
Mot.S+Phase 6	XXX	
Mot. cutout C 6	XXX	
Man. switch 6	XXX	
Cap. stage 6	XXX	

- Menu 2-3 Condenser fan

Only existing fans are displayed.

FAN POS: XXXXX		
Mot. cutout F 1	XXX	Shows current OFF/ON state at input *Motor Overload Cutout Fan 1*
Fan F 1	XXX	Shows current OFF/ON state at output *Condenser stage 1*
...		
Mot. cutout F 8	XXX	As for Fan 1
Fan F 8	XXX	

- Menu 2-4 System equipment

SYSTEM POS: XXXXX		
Cooling CT 1	XXX	Shows current OFF/ON state at output *Liquid Valve Circuit 1*
Subcooler	XXX	Shows current OFF/ON state at output *Liquid Valve Circuit 2*
Cooling CT 2	XXX	Shows current OFF/ON state at output *Liquid Valve Circuit 2*
Emergency OFF	XXX	Shows current OFF/ON state at input *Emergency Stop*
HP cutout CT 1	XXX	Shows current OFF/ON state at input *HP Cutout Circuit 1*
HP cutout CT 2	XXX	Shows current OFF/ON state at input *HP Cutout Circuit 2* **Not** shown for single-circuit systems (DIP switch 4 = ON)
LP switch CT 1	XXX	Shows current OFF/ON state at input *LP Cutout Circuit 1*
LP switch CT 2	XXX	Shows current OFF/ON state at input *LP Cutout Circuit 2* **Not** shown or single-circuit systems (DIP switch 4 = ON)
Liquid level	XXX	Shows current OFF/ON state at input Low *Refrigerant Level* **Not** shown for screw compressors (DIP switch 3 = ON)
Low oil lev CT1	XXX	Shows current OFF/ON state at input *Low Refrigerant Level* **Not** shown for reciprocating compressors (DIP switch 3 = OFF)
External alarm	XXX	Shows current OFF/ON state at input External Alarm/Refrigeration Point Pump
Setpoint toggle	XXX	Shows current OFF/ON state at input *Setpoint Toggle (Day/Night)*
Heat recovery	XXX	Shows current OFF/ON state at input *Setpoint Toggle Condenser*
Compr./Fan	XXX	Shows current OFF/ON state at input *System Off (Defrost)*
Load shed 1	XXX	Shows current OFF/ON state at input *Load shed 1*
Load shed 2	XXX	Shows current OFF/ON state at input *Load shed 2*
Consumer	XXX	Shows current OFF/ON state of manual switch for input *Enable Refrigeration Points*
Enable case	XXX	Shows current OFF/ON state at output *Enable Refrigeration Points*
Brine flow mon.	XXX	Shows current OFF/ON state at input *Flow Monitor Brine*
Mot.cut.BrP 1	XXX	Shows current OFF/ON state at input *Motor Overload Cutout Brine Pump 1*
Brine pump CT 1	XXX	Shows current OFF/ON state at output *Brine Pump 1*
Mot.cut.BrP 2	XXX	Shows current OFF/ON state at input *Motor Overload Cutout Brine Pump 2*
Brine pump CT 2	XXX	Shows current OFF/ON state at output *Brine Pump 2*
Coolt flow mon.	XXX	Shows current OFF/ON state at input *Flow Monitor Coolant*
Mot.cut.CltP 1	XXX	Shows current OFF/ON state at input *Motor Overload Cutout Coolant Pump 1*
Coolant pump CT 1	XXX	Shows current OFF/ON state at output *Coolant Pump 1*
Mot.cut.CltP 2	XXX	Shows current OFF/ON state at input *Motor Overload Cutout Coolant Pump 2*
Coolant pump CT 2	XXX	Shows current OFF/ON state at output *Coolant Pump 2*
Br/coolt pr.cut	XXX	Shows current OFF/ON state at input *Pressure Limiter Brine*
Antifreeze prot	XXX	Shows current OFF/ON state at input *Antifreeze Protector Brine*

8.1.4 Menu 3 Setpoints

SETPOINTS POS: XXXXX	
1 System config.	Continue to Menu 3-1 System configuration
2 Control	Continue to Menu 3-2 LP control list of parameters
3 Monitoring	Continue to Menu 3.3 Monitoring list of parameters
4 Base load	Continue to Menu 3.4 Base load rotation list of parameters
5 Messages	Continue to Menu 3.5 Alarm priorities list of parameters
6 Pumps	Continue to Menu 3.6 Pumps list of parameters
7 Defrosting	Continue to Menu 3.7 Defrosting list of parameters

- Menu 3-1 System configuration

CONFIG POS: XXXXX			Entry	Default NT	Default LT
Refrigerant	XXXXX →	Continue to Menu 3-1-a Refrigerant	→, ↵		
po-Transm.	XXXXXX →	Continue to Menu 3-1-b Pressure transducers	→, ↵		
No. of compr.	XX	Enter number of compressors	1 ... 6	4	4
No. stgs. comp	X	Enter number of capacity stages	1 ... 2	1	1
Mot.cutout C	X	Enable motor overload cutout YES/NO	↑, ↓, (Y/N)	N	N
Oil pr. cutout	X	Enable disabling of motor overload cutout YES/NO (only shown when Motor Overload Cutout Comp. set to Y)	↑, ↓, (Y/N)	Y	Y
Enabl.compr.stgs.	→	Continue to Menu 3-1-c Show of compressor stages	→, ↵		
Dry cooler	→	Continue to selection list 3-1-d Design of dry cooler	→, ↵		
No. fan	X	Number of condenser stages	1 ... 8	8	8
Enabl.evap.stgs.	→	Continue to Menu 3-1-e Enable condenser stages			
No.brine pumps	X	Number of brine pumps	0 ... 2	2	2
No.coolt.pumps	X	Number of coolant pumps Not displayed for systems without dry cooler (Menu 3-1-d)	1 ... 2	2	2
Oil supply	X	Oil supply control	↑, ↓, (N/Y)	Y	Y
Room temp.	XXX	Enable room temperature sensor	↑, ↓, (OFF/ON)	ON	ON
Outdoor temp.	XXX	Enable outdoor temperature sensor	↑, ↓, (OFF/ON)	ON	ON
Air humidity	XXX	Enable humidity sensor	↑, ↓, (OFF/ON)	OFF	OFF
Offset	→	Continue to Menu 3-1-f Offset temperature	→, ↵		

- Selection List 3-1-a Refrigerant

REFRIGERT. POS: XXXXX		Entry	Default NT	Default LT
R22		↵		
R502		↵		
R134a		↵		
R404A √		↵	√	√
R402A		↵		
R717		↵		
R1270		↵		
R407C		↵		

- Selection List 3-1-b Selection po-Transmitter

Po-TRANSM POS: XXXXX		Entry	Default NT	Default LT
0..10b √		↵	√	√
1..26b		↵		

- Selection List 3-1-c Enable compressor stages

Only existing compressor stages are displayed.

ENABL.COMP POS: XXXXX		Entry	Default NT	Default LT
Compr.stg. 1 XXX	Enable Compressor Stage 1	↑, ↓, (OFF/ON)	ON	ON
...				
Compr.stg. 6 XXX		↑, ↓, (OFF/ON)	ON	ON

- Selection List 3-1-d Rückkühler or Dry cooler

Select between values according to input. Checkmark shows current setting.

R-KÜHL or DRY COOLER POS: XXXXX		Entry	Default NT	Default LT
None √		↵		
Single circuit		↵	√	√

- Selection List 3-1-e Enable condenser stages

Only existing capacity stages are displayed.

ENABL.COND POS: XXXXX			Entry	Default NT	Default LT
Evap. stg. 1	XXX	Enable Condenser Stage 1	↑, ↓, (OFF/ON)	ON	ON
...					
Evap. stg. 8	XXX		↑, ↓, (OFF/ON)	ON	ON

- Masque 3-1-f Offset (Sensor matching)

OFFSET POS: XXXXX			Entry	Default NT	Default LT
Brine OFF or Brine OUT	X K	Match brine outlet temperature sensor	-12 K ... 5 K	0 K	0 K

- Menu 3-2 Control

CONTROL POS: XXXXX	
1 Brine/LP ctrl.	Continue to Menu 3-2-1 Brine/LP control
2 Coolant/HP ctrl.	Continue to Menu 3-2-1 Coolant/HP control

- Menu 3-2-1 Brine/LP control

BRINE/LP ctr POS: XXXXX	
1 Control	Continue to Menu 3.2.1.1 LP control
2 Brine/LP ctrl. D	Continue to Menu 3.2.1.2 List of parameters day control
3 Brine/LP ctrl. N	Continue to Menu 3.2.1.3 List of parameters night control

- Menu 3-2-1-1 Control

REGELUNG POS: XXXXX			Entry	Default NT	Default LT
Sensor	→	Continue to selection list 3-2-1-1-a Sensor	→, ↵		
Switching Seq	→	Continue to selection list 3-2-1-1-b Switching sequence	→, ↵		
Delay Subc. ON	xxxs	Subcooler start delay; parameter only shown with suction-side pressure control	0..255	120	120

- Selection list 3-2-1-1-a Sensor

Select between values according to input. Checkmark shows current setting.

SENSOR POS: XXXXX		Entry	Default NT	Default LT
Brine OFF Brine OUT √	Control by brine outlet temperature	↵	√	√
Brine ON Brine IN	Control by brine inlet temperature	↵		
Pressure	Control by t_0	↵		

- Selection list 3-2-1-1-b Switching sequence

Select between values according to input. Checkmark shows current setting.

SEQUENCE POS: XXXXX		Entry	Default NT	Default LT
BBVV √	Base load Circuit 1, Base load Circuit 2, Valve Circuit 1, Valve Circuit 2	↵	√	√
BVBV	Base load Circuit 1, Valve Circuit 1, Base load Circuit 2, Valve Circuit 2	↵		

- Menu 3-2-1-2 Brine/LP control day

BR CTRL D POS: XXXXX		Entry	Default NT	Default LT
to - max. XXX °C	Max. t_0 setpoint for setpoint shift. Displayed **only** with cold side pressure control (Menu 3-2-1-1-a) and for single-circuit systems (DIP switch 4 = ON)	-40 ... 20	-12 °C	-36 °C
Brine temp max. XXX °C	Max. brine temperature setpoint for setpoint shift. Displayed **only** with brine control (Menu 3-2-1-1-a)	-40 ... 20	-12 °C	-36 °C
tr-max. XXX °C	Max. room temperature for setpoint shift	-18 ... 35	25 °C	25 °C
to - min. XXX °C	Min. t_0 setpoint for setpoint shift. Displayed **only** with cold side pressure control (Menu 3-2-1-1-a) and for single-circuit systems (DIP switch 4 = ON)	-40 ... 20	-16 °C	-40 °C
Brine temp min. XXX °C	Min. brine temperature setpoint for setpoint shift. Displayed **only** with brine control (Menu 3-2-1-1-a)	-40 ... 20	-16 °C	-40 °C
tr-min. XXX °C	Min. room temperature for setpoint shift	-25 ... 15	15 °C	15 °C
Bas. load time C →	Menu 3-2-1-2-a Basic load times	→, ↵		
Var. load time C →	Menu 3-2-1-2-b Variable load times	→, ↵		
Bas. unlo time C →	Menu 3-2-1-2-c Basic unload times	→, ↵		
Var. unlo time C →	Menu 3-2-1-2-d Variable unload times	→, ↵		
Dead band X K	Deadband	1 ... 5	3 K	3 K
Control const. XX K	Max. control error for variable control times	1 ... 10	5 K	5 K

- Masque 3-2-1-2-a Base load time compressors

Only existing compressors are displayed.

BAS LOADT T POS: XXXXX			Entry	Default NT	Default LT
B. load t. C 1	XXX s	Basic load time Compressor Stage 1	5 ... 250	20 sec	20 sec
...					
B. load t. C 8	XXX s		5 ... 250	20 sec	20 sec

- Masque 3-2-1-2-b Variable load time compressors

Only existing compressors are displayed.

VAR LOAD T POS: XXXXX			Entry	Default NT	Default LT
V. load t. C 1	XXX s	Variable load time Compressor Stage 1	5 ... 250	100 sec	100 sec
...					
V. load t. C 8	XXX s		5 ... 250	100 sec	100 sec

- Masque 3-2-1-2-c Base unload time compressors

Only existing compressors are displayed.

BAS UNLO T POS: XXXXX			Entry	Default NT	Default LT
B. unlo t. C 1	XXX s	Basic unload time Compressor Stage 1	3... 250	5 sec	5 sec
...					
B. unlo t. C 8	XXX s		3... 250	5 sec	5 sec

- Masque 3-2-1-2-d Variable unload time compressors

Only existing compressors are displayed.

VAR UNLO T POS: XXXXX			Entry	Default NT	Default LT
V. unlo t. C 1	XXX s	Variable unload time Compressor Stage 1	5 ... 250	10 sec	10 sec
...					
V. unlo t. C 6	XXX s		5 ... 250	10 sec	10 sec

- Menu 3-2-1-3 Brine/LP control night

BR CTRL N POS: XXXXX			Entry	Default NT	Default LT
to - max.	XXX °C	Max. t_0 setpoint for setpoint shift. Displayed **only** with cold side pressure control (Masque 3-2-1-1-a) and for single-circuit systems (DIP switch 4 = ON)	-40 ... 20	-10 °C	-34 °C
Brine temp max.	XXX °C	Max. brine temperature setpoint for setpoint shift. Displayed **only** with brine control (Masque 3-2-1-1-a)	-40 ... 20	-10 °C	-34 °C
tr-max.	XXX °C	Max. room temperature for setpoint shift	-18 ... 35	25 °C	25 °C
to - min.	XXX °C	Min. t_0 setpoint for setpoint shift. Displayed **only** with cold side pressure control (Masque 3-2-1-1-a) and for single-circuit systems (DIP switch 4 = ON)	-40 ... 20	-14 °C	-38 °C
Brine temp min.	XXX °C	Min. brine temperature setpoint for setpoint shift. Displayed **only** with brine control (Masque 3-2-1-1-a)	-40 ... 20	-14 °C	-38 °C
tr-min.	XXX °C	Min. room temperature for setpoint shift	-25 ... 15	15 °C	15 °C
Bas. load time C	→	Masque 3-2-1-3-a Basic load times	→, ↵		
Var. load time C	→	Masque 3-2-1-3-b Variable load times	→, ↵		
Bas. unlo time C	→	Masque 3-2-1-3-c Basic unload times	→, ↵		
Var. unlo time C	→	Masque 3-2-1-3-d Variable unload times	→, ↵		
Dead band	X K	Deadband	1 ... 5	3 K	3 K
Control const.	XX K	Max. control error for variable control times	1 ... 10	5 K	5 K

- Masque 3-2-1-3-a Base load time compressors

Only existing compressors are displayed.

BAS LOAD T POS: XXXXX			Entry	Default NT	Default LT
B. load t. C 1	XXX s	Basic load time Compressor Stage 1	5 ... 250	20 sec	20 sec
...					
B. load t. C 6	XXX s		5 ... 250	20 sec	20 sec

- Masque 3-2-1-3-b Variable load time compressors

Only existing compressors are displayed.

VAR LOAD T POS: XXXXX			Entry	Default NT	Default LT
V. load t. C 1	XXX s	Variable load time Compressor Stage 1	5 ... 250	100 sec	100 sec
...					
V. load t. 6	XXX s		5 ... 250	100 sec	100 sec

- Masque 3-2-1-3-c Base unload time compressors

Only existing compressors are displayed.

BAS UNLO T POS: XXXXX		Entry	Default NT NK-Betrieb	Vorgabe Default LT
B. unlo t. C 1 XXX s	Basic unload time Compressor Stage 1	5 ... 250	5 sec	5 sec
...				
B. unlo t. C 6 XXX s		5 ... 250	5 sec	5 sec

- Masque 3-2-1-3-d Variable unload time compressors

Only existing compressors are displayed.

VAR UNLO T POS: XXXXX		Entry	Default NT	Default LT
V. unlo t. C 1 XXX s	Variable unload time Compressor Stage 1	5 ... 250	10 sec	10 sec
...				
V. unlo t. C 6 XXX s		5 ... 250	10 sec	10 sec

- Menu 3-2-2 Coolant/HP control

COOLANT/HP C POS: XXXXX	
1 Control	Continue to Menu 3-2-2-1 Control parameters
2 Setpoints	Continue to Menu 3-2-2-2 Setpoint parameters

- Menu 3-2-2-1 Control

CONTROL POS: XXXXX			Entry	Default NT	Default LT
Sensor	→	Continue to selection list 3-2-2-1-a Sensors. Not displayed for systems without dry cooler (Masque 3-1-d) and for dual-circuit systems (DIP switch 4 = OFF)	→, ↵	Screen 3-2-2-1-a	
Controller	→	Continue to selection list 3-2-2-1-b Controller	→, ↵	Screen 3-2-2-1-b	
Base ld. rot.	X	Running sequence control	↑, ↓ (N/Y)	N	N
Adjust diff.	XX	Adjustment difference **Not** displayed with hot side step control (Masque 3-2-2-1-b)	-15 ... 15	0	0
Min. speed	XX	Input in % of voltage 0 ... 10 V of analog outputs *Fan Speed Circuit 1* and *Fan Speed Circuit 2*. **Not** displayed with hot side step control (Masque 3-2-2-1-b)	0 ... 50	0 %	0 %
Switch mode	→	Actuation type fan control/star-delta mode (only shown when control type selected as Step Controller - Screen 3-2-2-1-b)	→, ↵	Screen 3-2-2-1-c	
Fast speed N	XX	High speed (delta mode) also with night setpoint allowed Y/N (only shown when control type selected as Speed Controller (Screen 3-2-2-1-a) and actuation type selected as SSFF or SSSF (Screen 3-2-2-1-c)	↑, ↓, (Y/N)	Y	Y
Del. slow speed.	XX s	Delay for loading fan stage in star mode after being unloaded in delta mode(only shown when control type selected as Speed Controller (Screen 3-2-2-1-a) and actuation type selected as SSFF or SSSF (Screen 3-2-2-1-b)	0..30	5 sec	5 sec
tc - max.	XX °C	Max. t_c setpoint for setpoint shift. **Not** displayed with hot side step control (Masque 3-2-2-1-b) and for systems with dry cooler (Masque 3-1-d) or for control by coolant temperature (Masque3-2-2-1-a)	25 ... 50	40 °C	40 °C
Coolant max.	XX °C	Max. coolant setpoint for setpoint shift. **Not** displayed with hot side step control (Masque 3-2-2-1-b). Displayed **only** for systems with dry cooler (Masque 3-1-d) and control by coolant temperature (Masque 3-2-2-1-a)	25 ... 50	40 °C	40 °C
Fan off by al.	X	Fan OFF in occurrence of fault	↑, ↓ (N/Y)	Y	Y

- Masque 3-2-2-1-a Sensor

Select between values according to input. Checkmark shows current setting.

SENSOR POS: XXXXX			Entry	Default NT	Default LT
Coolant	√	Control by coolant temperature	↵	√	√
Pressure		Control by t_c (pressure control)	↵		

- Masque 3-2-2-1-b Controller

Select between values according to input. Checkmark shows current setting.

CONTROLLER POS: XXXXX		Entry	Default NT	Default LT
Step controller √	Step control	↵	√	√
Speed controller	Speed control	↵		
Combi controller	Combined control (not yet implemented)	↵		

- Masque 3-2-2-1-c HP Actuation Type - Star/Delta Operating Mode

Switch mode POS: XXXXX		Entry	Default NT	Default LT
Direct √	Load and unload fan stages in sequence - standard operating mode. Star-delta mode deactivated.	√	√	√
SSFF	Star-delta operating mode: Fans start successively at low speed (S) and then successively switch to high speed (F)	√		
SSSF	Star-delta operating mode: Fans start successively at low speed (S) and then switch simultaneously to high speed (F).	√		

- Menu 3-2-2-2 Setpoints

SETPOINTS POS: XXXXX			Entry	Default NT	Default LT
tc - max.	XXX °C	Max. t_c setpoint for setpoint shift. **Not** displayed for systems with dry cooler (Masque 3-1-d) and control by coolant temprature (Masque 3-2-2-1-a)	15 ... 35	30 °C	30 °C
Coolant on max Coolant in max	XXX °C	Max. coolant temperature setpoint for setpoint shift. Displayed **only** for systems with dry cooler (Masque 3-1-d) and control by coolant temperature (Masque 3-2-2-1-a)	15 ... 40	25 °C	25 °C
ta - Max.	XXX °C	Max. outdoor temperature for setpoint shift	16 ... 35	30 °C	30 °C
tc - min.	XXX °C	Min. t_c setpoint for setpoint shift. **Not** displayed for systems with dry cooler (Masque 3-1-d) and control by coolant temperature (Masque 3-2-2-1-a)	10 ... 15	15 °C	15 °C
Coolant on min Coolant in min	XXX °C	Min. coolant temperature setpoint for setpoint shift. Displayed **only** for systems with dry cooler (Masque 3-1-d) and control by coolant temperature (Masque 3-2-2-1-a)	10 ... 35	25 °C	25 °C
ta - Min.	XXX °C	Min. outdoor temperature for setpoint shift	0 ... 15	0 °C	0 °C
Setp.shift.	x	Enable setpoint shift for HR	Y/N	N	N
Max.ht.rec.	xx°C	Max. tc/coolant in HR mode	30..50	46 °C	46 °C
Min.ht.rec.	xx°C	Min. tc/coolant in HR mode Shown only when HR setpoint shift is activated.	25..40	30 °C	30 °C
Dif.ht.rec.	xK	Fan unload temperature in HR mode	2...8	5 K	5 K
Bas. load time F	→	Masque 3-2-2-2-a Basic load times	→, ↵	Screen 3-2-2-2-a	
Var. load time F	→	Masque 3-2-2-2-b Variable load times	→, ↵	Screen 3-2-2-2-b	
Bas. unlo time F	→	Masque 3-2-2-2-c Basic unload times	→, ↵	Screen 3-2-2-2-c	
Var. unlo time F	→	Masque 3-2-2-2-d Variable unload times	→, ↵	Screen 3-2-2-2-d	
Dead band	XX °C	Max. control error step controller /2	2 ... 10	5 °C	5 °C
Control const.	XX K	Max. control error for variable control times	2 ... 10	7 K	7 K
Const. Temp.	x	Temperature hold with three-way valve	Y/N	N	N
P-factor	x.x	Temperature hold P action; shown when temperature hold is enabled	0.0 ... 2.0	0.0	0.0
I-factor	x.x	Temperature hold I action; shown when temperature hold is enabled	0.0 ... 1.0	0.1	0.1
I-factor/s	x.x V	Limit for I-factor in V/s	0.1 ... 1.0	0.4	0.4
10V-0V-signal	x	Inverts signal for temperature hold	Y/N	N	N

- Masque 3-2-2-2-a Base load time fan

Only existing fans are displayed.

BAS LOAD T POS: XXXXX			Entry	Default NT	Default LT
B. load t. F 1	XXX s	Basic load time Fan 1	5 ... 250	20 sec	20 sec
...					
B. load t. F 8	XXX s		5 ... 250	20 sec	20 sec

- Masque 3-2-2-2-b Variable load time fan

Only existing fans are displayed.

VAR LOAD T POS: XXXXX			Entry	Default NT	Default LT
V. load t. F 1	XXX s	Variable load time Fan 1	5 ... 250	20 sec	20 sec
...					
V. load t. F 8	XXX s		5 ... 250	20 sec	20 sec

- Masque 3-2-2-2-c Base unload time fan

Only existing fans are displayed.

BAS UNLO T POS: XXXXX			Entry	Default NT	Default LT
B. unlo t. F 1	XXX s	Basic unload time Fan 1	5 ... 250	30 sec	30 sec
...					
B. unlo t. F 8	XXX s		5 ... 250	30 sec	30 sec

- Masque 3-2-2-2-d Variable unload time fan

Only existing fans are displayed.

VAR UNLO T POS: XXXXX			Entry	Default NT	Default LT
V. unlo t. F 1	XXX s	Variable unload time Fan 1	5 ... 250	100 sec	100 sec
...					
V. unlo t. F 8	XXX s		5 ... 250	100 sec	100 sec

- Menu 3-3 Monitoring

Monitoring POS: XXXXX	
1 Compressor	Continue to Menu 3-3-1 Compressor monitoring
2 Refrigerant	Continue to Menu 3-3-2 Liquid level monitoring
3 Brine-Coolant	Continue to Menu 3-3-3 Brine/coolant monitoring
4 Ext. alarm	Continue to Menu 3-3-4 External alarm monitoring

- Menu 3-3-1 Compressor monitoring

COMP MON POS: XXXXX			Entry	Default NT	Default LT
Comp. OFF temp	XXX °C	Cylinder head temperature at which compressor is shut down	100 ... 150	145 °C	145 °C
Comp. ON temp	XXX °C	Cylinder head temperature at which compressor is started after shutdown (deadband)	50 ... 100	100 °C	100 °C
tc Comp OFF	XX °C	t_c, limit above which no compressors are loaded	40 ... 56	52 °C	52 °C
tc Comp ON	XX °C	t_c, limit below which compressors are again loaded after being disabled due to high t_c (deadband)	35 ... 50	42 °C	42 °C
to min	XX °C	Safety limit of t_0 for brine control; below which compressor stages are unloaded with time delay	-48 ... 0	-18 °C	-41 °C
to Comp OFF	XX °C	Limit of t_0 for compressor shutdown	-50 ... -5	-22 °C	-46 °C
Del. to OFF	XX m	Delay for compressor shutdown alarm due to temperature below t_0 Comp OFF	0 ... 30	10 min	10 min
Del. LP cutout	XXX s	Delay for LP cutout actuation alarm	0 ... 600	0 sec	0 sec
Del. oil pr on	XXX s	Delay for low oil pressure cutout actuation alarm on starting. **Not** displayed for screw compressors (DIP switch 3 = ON)	2 ... 120	2 sec	2 sec
Del. oil pr op	XXX s	Delay for oil pressure cutout actuation alarm in operation. **Not** displayed for screw compressors (DIP switch 3 = ON)	2 ... 120	2 sec	2 sec
Del. flow on	XXX s	Delay for low oil flow cutout actuation alarm on starting. Not displayed for reciprocating compressors (DIP switch 3 = OFF)	2 ... 30	20 sec	20 sec
Del. flow op	XXX s	Delay for low oil flow cutout actuation alarm in operation. **Not** displayed for reciprocating compressors (DIP switch 3 = OFF)	2 ... 30	3 sec	3 sec
Min. Off Time.	X s	Minimum idle time	0 ... 900	0 s	0 s
PD-operation	X	Activate pumpdown	↑, ↓, (N/Y)	Y	Y
PD-temperature	X °C	Pumpdown stop temperature. Displayed **only** with pumpdown activated	-50 ... 5	-15 °C	-40 °C
PD-delay	XX m	Pumpdown delay. Displayed **only** with pumpdwon activated	1 ... 20	6 min	6 min
PD-difference	XX K	Pumpdown deadband. Displayed **only** with pumpdown activated	1 ... 10	5 K	5 K

- Menu 3-3-2 Refrigerant (Liquid level monitoring)

REFRIGT M POS: XXXXX			Entry	Default NT	Default LT
Del.low level	XXX m	Delay for low refrigerant level alarm. No alarm when input is --	10 ... 120 or --	60 min	60 min

- Menu 3-3-3 Brine-Coolant

Br/Co Mon. POS: XXXXX			Entry	Default NT	Default LT
Del. flow mon	XXX s	Delay for flow monitor actuated alarm	10 ... 250	20 sec	20 sec
SysOFF Flow Br	X	System OFF by flow monitor BRINE	N/ O	O	O
SysOFF Flow Ct	X	System OFF by flow monitor COOLANT	N/ O	O	O
SysOFF Pr Br/Ct	X	System OFF by pressure switch BRINE/ COOLANT	N/ O	O	O
Brine min	XXX °C	Limit for brine low temperature alarm; shown only when pressure control is not activated on cold side. (Masque 3-2-1-1-a)	-45 ... 10	-19	-43°C
Del.Brine min	XXX m	Delay for brine low temperature alarm; shown only when pressure control is not activated on cold side. (Masque 3-2-1-1-a)	1 ... 30	10 min	10 min
Coolt. min	XXX °C	Limit for coolant low temperature alarm; shown only with brine control and single-circuit dry cooler design (Masque 3-1-d)	5 ... 45	9°C	9°C
Del.Coolt.min	XXX m	Delay for coolant low temperature alarm; shown only with brine control and single-circuit dry cooler design (Masque 3-1-d)	1 ... 60	15min	15 min

- Menu 3-3-4 External alarm

EXT. ALARM POS: XXXXX			Entry	Default NT NK-Betrieb	Vorgabe Default LT
Time delay	XX s	Delay in seconds for alarming external alarm	3 ... 60	5 sec	5 sec
Alarm message: XXXXXXXXXXXX.XXX.XXX.X		User-defined message text to be displayed in occurrence of external alarms	0 ... 19 characters	External alarm	External alarm

- Menu 3-4 Base load

BASE LOAD POS: XXXXX			Entry	Default NT NK-Betrieb	Vorgabe Default LT
Cycle time	XXX m	Cycle time for compressor running sequence control. No running sequence control when input is --	5 ... 720 or --	30 min	30 min

- Menu 3-5 Messages

Meaning of input options:

-	=	Event ignored
0	=	Reported (only entry in alarm list)
1	=	Alarmed with Priority 1
2	=	Alarmed with Priority 2

MESSAGE	POS: XXXXX		Entry	Default NT	Default LT
Motor coutout C	X	Compressor motor overload cutout actuated	-, 0 ... 2	2	2
High cyl. temp.	X	High cylinder head temperature exceeded	-, 0 ... 2	2	2
HP cutout C	X	Compressor high-pressure cutout actuated	-, 0 ... 2	2	2
Flow monitor C	X	Compressor low oil flow cutout actuated (for screw compressors only)	-, 0 ... 2	2	2
Motor c+phase C	X	Compressor motor overload cutout/phase monitor actuated (for screw compressors only)	-, 0 ... 2	2	2
Low oil pr. C	X	Compressor low oil pressure cutout actuated (for reciprocating compressors only)	-, 0 ... 2	2	2
High tc	X	High t_c exceeded	-, 0 ... 2	2	2
Max. speed F	X	High fan speed exceeded	-, 0 ... 2	0	0
HP cutout CT	X	High-pressure cutout actuated Circuit X	-, 0 ... 2	1	1
Low to	X	Low t_0 exceeded	-, 0 ... 2	2	2
LP cutout CT	X	Low-pressure cutout actuated Circuit X	-, 0 ... 2	2	2
Motor cutout F	X	Fan motor overload cutout actuated	-, 0 ... 2	2	2
Low liquid level	X	Low refrigerant level switch actuated	-, 0 ... 2	2	2
Low oil level	X	*(Currently not used)*	-, 0 ... 2	2	2
High oil level	X	*(Currently not used)*	-, 0 ... 2	2	2
Comp. Manual OFF	X	Compressor manual switch set OFF	-, 0 ... 2	0	0
Comp. Manual ON	X	Compressor manual switch set ON	-, 0 ... 2	0	0
Service Mode	X	Service mode activated	-, 0 ... 2	0	0
Comp./fan OFF	X	Input *System Off* actuated	-, 0 ... 2	2	2
Emergency OFF	X	Input *Emergency Stop* actuated	-, 0 ... 2	1	1
Load shed	X	Input *Load Shed* X actuated	-, 0 ... 2	0	0
External alarm	X	Input *External Alarm* actuated	-, 0 ... 2	2	2
Power failure	X	Start following power failure	-, 0 ... 2	0	0
First start	X	First startup of controller (default values loaded)	-, 0 ... 2	2	2
Setpoint changed	X	Message generated when setpoint has been changed	-, 0 ... 2	0	0
Brine flow mon.	X	Input *Flow Monitor Brine* actuated	-, 0 ... 2	1	1
Brine pump toggl	X	Message generated when brine pump has been toggled	-, 0 ... 2	2	2

MESSAGE	POS: XXXXX		Entry	Default NT	Default LT
Coolant flow mon	X	Input *Flow Monitor Coolant* actuated	-, 0 ... 2	1	1
Coolt pump toggl	X	Message generated when coolant pump has been toggled	-, 0 ... 2	2	2
Oil filter CT	X	*(Currently not used)*	-, 0 ... 2	2	2
Startg. oil pump	X	*(Currently not used)*	-, 0 ... 2	2	2
Antifreeze	X	Input *Antifreeze Protector Brine* actuated	-, 0 ... 2	1	1
Br/coolt pr cut.	X	Input *Pressure Limiter Brine* actuated	-, 0 ... 2	1	1
Brine pump CT	X	Input *Motor Overload Cutout Brine Pump X* actuated	-, 0 ... 2	2	2
Coolant pump CT	X	Input *Motor Overload Cutout Coolant Pump X* actuated	-, 0 ... 2	2	2
Meas.err.cyl.hd	X	Error in cylinder head temperature measuring loop	-, 0 ... 2	2	2
meas.err.HP	X	Error in high pressure measuring loop	-, 0 ... 2	2	2
Meas.err.LP	X	Error in low pressure measuring loop	-, 0 ... 2	2	2
M.err. outd.tp.	X	Error in outdoor temperature measuring loop	-, 0 ... 2	2	2
M.err. rm.tmp.	X	Error in room temperature measuring loop	-, 0 ... 2	2	2
Error brine ON Error brine IN	X	Error in brine inlet temperature measuring loop	-, 0 ... 2	2	2
Error brine OFF Error brine OUT	X	Error in brine outlet temperature measuring loop	-, 0 ... 2	2	2
Error coolant or Error coolt. IN	X	Error in coolant inlet temperature measuring loop	-, 0 ... 2	2	2
M. err. humidity	X	Error in humidity sensor measuring loop	-, 0 ... 2	2	2
Error oil sep.	X	*(Currently not used)*	-, 0 ... 2	2	2
RTC error	X	Error in real-time clock	-, 0 ... 2	2	2
EEPROM error	X	EEPROM (parameter memory) defective	-, 0 ... 2	2	2
RAM error	X	Internal data memory defective	-, 0 ... 2	1	1
I/O module error	X	SIOX module defective or missing	-, 0 ... 2	1	1
Battery power	X	Low battery voltage	-, 0 ... 2	2	2
Messkreis WT-Aus Error coolt. OUT	X	Error in coolant outlet temperature measuring loop	-, 0 ... 2	-	-
Defr.time exceed		Defrost termination by time	-, 0 ... 2	0	0
Fault defrost		Defrost fault	-, 0 ... 2	-	-
Low Temp. Brine		UntertemperaturKälteträger	-, 0 ... 2	-	-
Low Temp. Coolt		Coolant low temperature	-, 0 ... 2	-	-

- Menu 3-6 Pumps

PUMPS POS: XXXXX			Entry	Default NT	Default LT
Del.Coolt P ON	XXX s	Coolant pump start delay. **Not** displayed for systems without dry cooler (Masque 3-1-d)	0 ... 60	20 sec	20 sec
Del.Coolt P OF	XXX s	Coolant pump stop delay. **Not** displayed for systems without dry cooler (Masque 3-1-d) Coolant pump not stopped when input is --	0 ... 250 or --	180 sec	180 sec
Delay Coolt.P	XXX s	Time overlap coolant pump	0 ... 30	0 sec	0 sec
Cycle Coolt.P	XXh	Cycle time coolant pump	1 ... 48	12 h	12 h
Coolt P ext.OF	XXX s	Brine pump stopped when *System Off* input active. **Not** displayed with cold side pressure control (Masque 3-2-1-1-a). **Not** displayed when number of brine pumps is 0 (Menu 3-1).	↑, ↓(N/Y)	Y	Y
BR-P.Off w. C.	XXX s	Brine pump stopped when compressors stationary. **Not** displayed with cold side pressure control (Masque 3-2-1-1-a). **Not** displayed when number of brine pumps is 0 (Menu 3-1).	↑, ↓(N/Y)	Y	Y
Delay Brine.P	XXX s	Time overlap brine pump	0 ... 30	0 sec	0 sec
Cycle Brine.P	XXh	Cycle time brine pump	1 ... 48	12 h	12 h

- Menu 3-7 Defrost

Defrost POS: XXXXX			Eingabe	Vorgabe NK-Betrieb	Vorgabe TK-Betrieb
Defr.timer		Continue to Masque 3-7-a			
Defr.Temp.	xx°C	Defrost termination temperature	---, 5 ... 15	6°C	6°C
Max Defr.Time	xx min	Safe defrost time	30 ... 90	45 min	45 min

- Masque 3-7-a Defrost timer

Defr.timer POS: XXXXX		Eingabe	Vorgabe NK-Betrieb	Vorgabe TK-Betrieb
Defr. 1	Defrost timer 1	Mo, Tu, We, Th, Fr, Sa, Su, Mo-Su, Mo-Fr, Mo-Sa, Sa-Su,---	---	---
...				
Defr. 14	As above	As above	---	---

8.1.5 Menu 4 Clock

Time is defined by the time master (CI 3000 Store Computer, AL 300 Operator Terminal).

CLOCK POS: XXXXX	
Date: XX dd.mm.yy	Shows current day, date
Time: hh.mm	Shows current time
Auto daylt. savg X	Automatic clock adjustment for daylight saving time (Y/N)

8.1.6 Menu 5 Messages

MESSAGE POS: XXXXX	
1 Display	Continue to menu 5-1 Display fault memory
2 Delete	Continue to menu 5-2 Delete fault memory (with prompt)

- Menu 5-1 Display

MESSAGE POS: XXXXX	
Fault text 1:	Fault message Fault 1
dd.mm.yy hh:mm EIN	Beginning of Fault 1
dd.mm.yy hh:mm AUS	End of Fault 1 (only when Fault 1 is terminated)
...	
Fault text n:	Fault message Fault n
dd.mm.yy hh:mm EIN	Beginning of Fault n
dd.mm.yy hh:mm AUS	End of Fault n (only when Fault n is terminated)

- Menu 5-2 Delete

MESSAGE POS: XXXXX		Entry
Delete ! Are you sure ? No: ESC Yes: ↵	Prompt to confirm deletion of fault memory	↵, ESC

8.1.7 Menu 6 Operating data

OP DATA POS: XXXXX	
1 Compr.op.hours	Menu 6-1
2 Fan op.hours	Menu 6-2
3 History	Menu 6-3

- Menu 6-1 Compressor operating hours

Only the actual number of fans is displayed.

OP DATA POS: XXXXX		
On t. stg 1	X h	Shows operating hours Compressor 1 (since startup)
...		
On t. stg 6	X h	

- Menu 6-2 Fan operating hours

Only the actual number of fans is displayed.

OP DATA POS: XXXXX		
On t. fan 1	X h	Shows operating hours Fan 1 (since startup)
...		
On t. fan 8	X h	

- Menu 6-3 History

HISTORY POS: XXXXX	
1 Run times	Menu 6-3-1 Show compressor run times
2 Starts	Menu 6-3-2 Show compressor starts
3 Activity	Menu 6-3-3 Show compressor activity

- Menu 6-3-1 Run times

HISTORY POS: XXXXX		
Date:	dd.mm.yy	Select date within max. 31 days past
Run times	→	Continue to Masque 6-3-1-a Run times for selected date

- Masque 6-3-1-a Run times

RUN TIME POS: XXXXX		
Compr.stg. 1	hh.mm	Daily run time Compressor 1
...		
Compr.stg. 6	hh.mm	

- Menu 6-3-2 Starts

HISTORY POS: XXXXX		
Date:	dd.mm.yy	Select date within max. 31 days past
Starts	→	Continue to Masque 6-3-2-a Compressor starts for selected date

- Masque 6-3-2-a Run times

Run time POS: XXXXX		
Compr.stg. 1	hh.mm	Daily starts Compressor 1
...		
Compr.stg. 6	hh.mm	

- Menu 6-3-3 Activity

HISTORY POS: XXXXX			Entry
Date:	dd.mm.yy	Select date within max. 31 days past	↑, ↓
Activity	XXX %	Activity (pack utilization 0 to 100%) for selected date	

8.1.8 Menu 7 Default settings

FS3000G POS: XXXXX			Entry
Load default Are you sure ? No: ESC	Yes: ↵	Prompt to confirm loading of default settings *)	↑, ↓

*)Completely overwrites current settings with factory default settings!

8.1.9 Menu 8 Service Mode

SERVICE POS: XXXXX	
1 Analog values	Continue to Menu 8-1 Input voltage at analog outputs
2 Compressor	Continue to Menu 8-2 On/off state of compressors
3 Condenser fan	Continue to Menu 8-3 On/off state of fans
4 System equipment	Continue to Menu 8-4 On/off state of system equipment

- Menu 8-1 Analog values

SERVICE POS: XXXXX			Entry
AnalogOut 1	XX.X V	Voltage at analog output *(terminals 53, 54)*	XX.X
AnalogOut 2	XX.X V	Voltage at analog output *(terminals 55, 56)*	XX.X
AnalogOut 3	XX.X V	Voltage at analog output (terminals 57, 58)	XX.X
AnalogOut 3	XX.X V	Voltage at analog output (terminals 63, 64)	XX.X

- Menu 8-2 Compressor

Only existing number of compressor stages is displayed.

SERVICE POS: XXXXX		Entry
Compr.stg. 1	XXX	ON/OFF state of Compressor (Stage) 1	↑, ↓
...			↑, ↓
Compr.stg. 6	XXX		↑, ↓

- Menu 8-3 Condenser fan

Only existing number of fans is displayed.

SERVICE POS: XXXXX		Entry
Evap. stg. 1	XXX	ON/OFF state of Fan 1	↑, ↓
...			↑, ↓
Evap. stg. 8	XXX		↑, ↓

- Menu 8-4 System equipment

SERVICE POS: XXXXX			Entry
Liq.Valve CT 1	XXX	Output *Liquid Valve Circuit 1* ON/OFF	↑, ↓
Liq.Valve CT 2	XXX	Output *Liquid Valve Circuit 2* ON/OFF	↑, ↓
Brine pump CT 1	XXX	Output *Brine Pump 1* ON/OFF	↑, ↓
Brine pump CT 2	XXX	Output *Brine Pump 2* ON/OFF	↑, ↓
CoolantPump 1	XXX	Output *Coolant Pump 1* ON/OFF	↑, ↓
CoolantPump 2	XXX	Output *Coolant Pump 2* ON/OFF	↑, ↓
Enable case	XXX	Output *Enable Refrigeration Points* ON/OFF	↑, ↓
SV.OilRet CT1	XXX	Output *Oil Return Solenoid Valve Circuit 1* ON/OFF	↑, ↓
SV.OilRet CT2	XXX	Output *Oil Return Solenoid Valve Circuit 2* ON/OFF	↑, ↓

Notice:

9 Alarms and Messages of FS 3010

9.1 Reporting system

A number of messages/alarms are recognized by the system and logged in internal memory with date, time and priority. Incoming and outgoing messages/alarms are entered in memory. Time resolution is 1 second. The memory is battery-backed, meaning that its contents are preserved in the event of an electric power failure.

Messages/alarms are entered in memory in their order of occurrence. Capacity of the memory is sufficient to store 200 entries. When the memory is full, the next message/alarm received overwrites the oldest entry (ring buffer).

Messages/alarms can be retrieved with an operator terminal. The most recent message/alarm is displayed first in the list. Contents of the memory can be deleted with the operator terminal. Messages/alarms are also transmitted via the CAN bus, enabling the current message to be displayed on the operator terminal and a central fault memory to be compiled with the CI 3000 Store Computer for the complete refrigeration system.

9.2 Structure of messages/alarms

Messages/alarms are made up of the date and time of event, priority and specific message text in real language. They are presented on the display of the operator panel in three lines of 20 characters. One line is used to identify the active controller.

Line	Example	Meaning
1	Alarms Pos: XXXXX	Active controller
2	Motor overload cutout C1	Message
3	20.5.98 10:20 IN	Date and time of message
4	20.5.98 10:25 OUT	Fault corrected

9.3 Types of message/alarm

The controller records the following alarm types:

- Process fault alarms
- System fault alarms

9.3.1 Process fault alarms

No.	Message	Process fault reported
1	Motor cutout Cx	Motor overload cutout acutated on Compressor Cx (reciprocating compressors only)
2	High cyl. temp. Cx	High cylinder head temperature exceeded on Compressor Cx
3	HP cutout Cx	High-pressure cutout actuated on Compressor Cx
4	Flow monitor Cx	Low oil flow cutout actuated on Compressor Cx (screw compressors only)
5	Mot. cut+phase Cx	Phase monitor or motor overload cutout actuated on Compressor Cx (screw compressors only)
6	Low oil press Cx	Low oil pressure cutout actuated on Compressor Cx (reciprocating compressors only)
7	High tc x	High limit of t_c exceeded in Circuit x
8	Max. speed	High threshold for speed adjuster exceeded
9	HP cutout CTx	High-pressure cutout actuated in Circuit x
10	Low to x	Low limit of t_0 exceeded in Circuit x
11	LP cutout CTx	Low-pressure cutout actuated in Circuit x
12	Motor cutout Fx	Motor overload cutout actuated on condenser fan Fx
13	Low liquid level	Low refrigerant level switch actuated (reciprocating compressors only)
14	-	
15	-	
16	Comp. stage OFF Sx	Compressor capacity stage stopped by manual switch
17	Comp. stage ON Sx	Compressor capacity stage started by manual switch
18	Service Mode ON	Service mod activated (not yet implemented)
19	Comp./fan OFF	Compressors and fans shut down
20	EMERGENCY OFF	Digital input for emergency stop actuated
21	External alarm	Digital input for external alarm actuated
22	Load shed x	Compressor disabled by Load Shed Input x
23	Power failure	Controller start following power failure *)
24	First start	Controller start for first startup
25	Setpoint changed	Setpoint has been adjusted
26	Brine flow monitor	Digital input for brine low flow cutout actuated
27	Brine pump toggled	Brine pumps toggled by low flow cutout
28	Coolant flow monitr	Digital input for coolant low flow cutout actuated
29	Coolant pump toggle	Coolant pumps toggled by low flow cutout
30	-	
31	Antifreeze	Digital input for antifreeze protector actuated
32	Br/coolt pr. cutout	Digital input for brine or coolant pressure limiter actuated
33	Brine pump x	Digital input for motor overload cutout actuated on Brine Pump x
34	coolant pump x	Digital input for motor overl. cutout actuated on Coolant Pump x

No.	Message	Process fault reported
35	-	
36	Defr.time exceeded	Defrost terminated by time. Correction: Wait longer (e.g. increase defrost duration) or correct technical problems related to system.
37	Fault defrost	Compressors could not be completed shut down during defrosting. Correction: Check if compressors might be set to manual control mode.
38	Low Temp. Brine	Correct technical problems related to system.
39	Low Temp. Coolt	Correct technical problems related to system.

*) Message *23 Power Failure* is not transmitted via CAN bus. Restart is recognized by AL 300 Operator Terminal and CI 3000 Store Computer. Alarm not entered in memory following *First Start*.

9.4 System fault alarms

No.	Message	System fault reported
1	Meas.err.cyl.hd. Vx	Fault in measuring loop to detect cylinder head temperature
2	Meas. err. HP x	Fault in measuring loop to detect high pressure Circuit x
3	Meas. err. LP x	Fault in measuring loop to detect low pressure Circuit x
4	M.err. rm.tmp.	Fault in measuring loop to detect room temperature
5	Meas. error tod	Fault in measuring loop to detect outdoor temperature
6	Error brine OFF or Error brine OUT	Fault in measuring loop to detect brine outlet temperature
7	Error brine ON or Error brine IN	Fault in measuring loop to detect brine inlet temperature
8	Error coolant x or Error coolant IN x	Fault in measuring loop to detect coolant inlet temperature Circuit x
9	-	
10	-	
11	M. err. humidity	Fault in measuring loop to detect air humidity
12	RTC Error	Fault in controller real-time clock
13	EEPROM Error	Internal EEPROM (parameter memory) defective
14	RAM Error	Internal data memory defective
15	I/O module Mx	Failure of I/O module (SIOX)
16	Battery power	Internal battery defective
17	M.err.coolt-out	Fault in measuring loop to detect coolant outlet temperature
18	Error coolant OUT	Fault in measuring loop to detect coolant outlet temperature Circuit x

When a *HP Measuring Loop Fault* is signalled, condenser capacity stages are shut down in the refrigeration circuit affected when compressors are at standstill and condenser capacity stages are loaded when compressors are running. Capacity stages are also loaded when compressors of a refrigeration circuit have been started manually. Actuation takes place on expiration of the basic time. Variable times are disregarded.

When a *LP Measuring Loop Fault* is signalled, compressor capacity stages are loaded in the refrigeration circuit affected. Suction pressure is monitored by the low-pressure cutout, which shuts down all compressors of the circuit that are running. The compressors are restarted after resetting the low-pressure cutout so as to ensure emergency operation. Actuation takes place on expiration of the basic time. Variable times are disregarded.

When a *Brine Measuring Loop Fault* is signalled, a minimum of 50% of the compressors are loaded. In occurrence of all other *measuring loop faults*, calculation continues with the most recent valid value for the duration of the fault. This value is indicated as --- on the AL 300 Operator Terminal and CI 3000 Store Computer.

A RAM fault is a fatal error and results in the controller going to *HOLD* state, as the program can then not be expected to run correctly. All output signals are reset.

9.5 Alarm priorities

Four alarm priorities are provided:

Priority	Reporting level
-	Alarm is not entered in alarm list
0	Alarm is entered in alarm list but not transmitted to higher-order system components
1	Alarm is entered in alarm list and transmitted to higher-order system components with Prio. 1
2	Alarm is entered in alarm list and transmitted to higher-order system components with Prio. 2

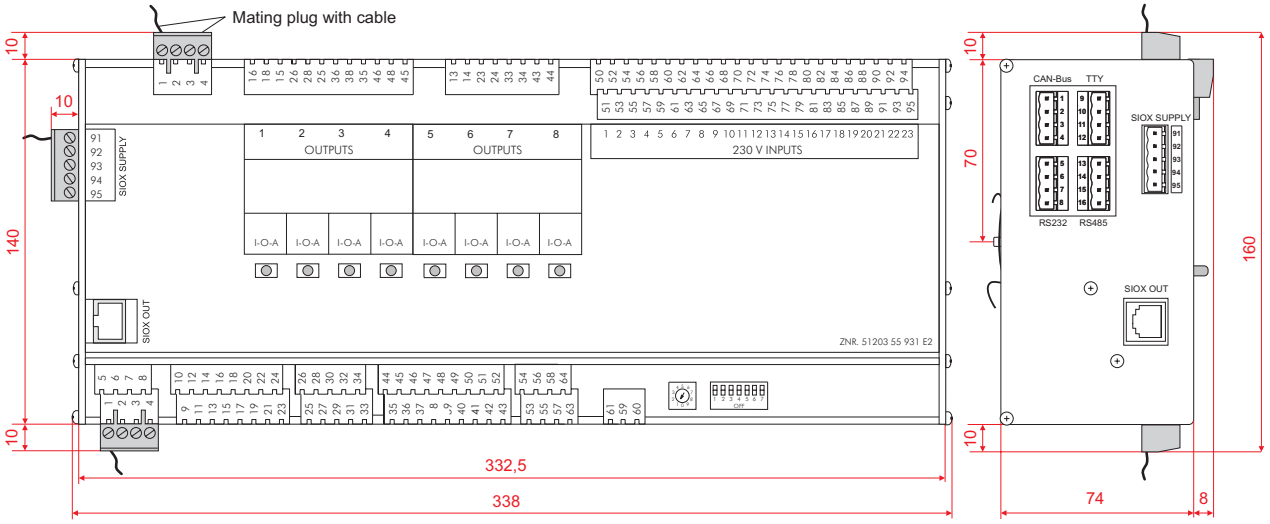
In occurrence of a compressor fault, an alarm is automatically upgraded to Priority 1 when 50% of the compressors fail.

10 Specifications of FS 3010

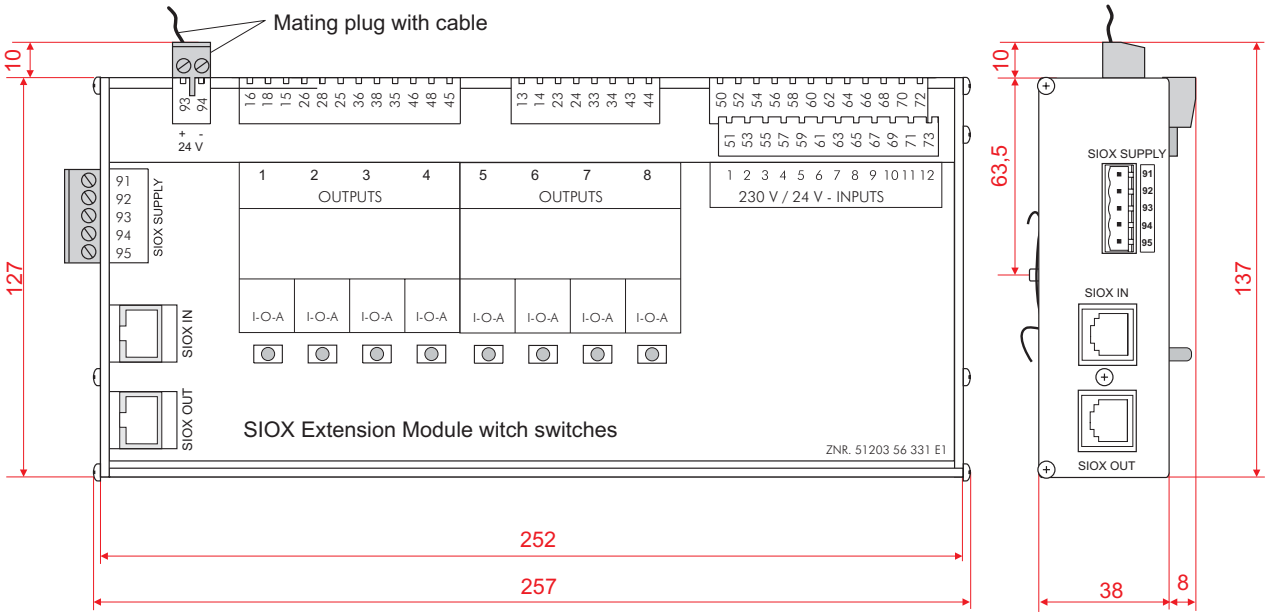
10.1 Electrical Data

	FS 3010
Power supply	U_{Nom} = 230 V AC, 200 V AC - 265 V AC, 50/60 Hz
Rated power	24 VA
Leakage current over PE	max. 1 mA
Relay outputs	10 x 250 V AC, max. 6 A / min. 10 mA (6 N.O., 4 changeover), floating Transverse voltage between outputs max. 400 V AC
Digital inputs	23 x 230 V AC floating Transverse voltage between inputs max. 400 V AC
Analog inputs	13 x PT1000 temperature sensors, 2-wire type 2 x PT1000 temperature sensors, 4-wire type 6 x pressure sensors 4..20 mA and 1 x humidity sensor 4..20 mA All inputs internally convertible by jumper (Leads running to analog inputs must be shielded)
Analog outputs	1 x 0-10 V / 4-20 mA (internally convertible by jumper) 0-10 V (min. load 1 k)/4-20 mA (max. load 800Ω) (Leads running to analog inputs must be shielded)
Fieldbus port	CAN bus, floating
Data ports	Serial RS232 / RS485 Data port for SIOX TTY (passive)
Other ports	Power supply for external SIOX extension modules
Archive memory	Compressor run times, starts, activity, fault reports
Monitoring function	Watchdog
Real-time clock	Battery-backed, Lithium cell (Typ CRC 2450 N / 3V Lithium, (10 years shelf life), typically 12 min/yr at 25 °C
Temperature range	Transport: -20 °C ... +80 °C Operation: 0 °C ... +50 °C
Temperature change	Transport: max. 20 K/h Operation: max. 10 K/h
Relative humidity (non-condensing)	Transport: 8 % ... 80 % Operation: 20 % ... 80 %
Shock to DIN EN 60068-2-27	Transport and operation: 30 g
Vibration 10-150 Hz to DIN EN 60068-2-6	Transport and operation: 2 g
Atmospheric pressure	Transport: 660 hPa ... 1060 hPa Operation: 860 hPa ... 1060 hPa
Weight	FS 3010: ca. 1600 g SIOX: ca. 800 g
Enclosure	IP20
CE conformity	Conforming to EC Directives 73/23/EEC (Low-Voltage Directive) 89/336/EEC (EMC Directive)

10.2 Mechanical data of FS 3010



10.3 Mechanical data of SIOX extension module



11 Order No.’s and accessories of FS 3010

11.1 FS 3010 Pack Controller / SIOX Extension Module

Type	Description	Order number
FS 3010	FS 3010 Pack Controller (brine controller)	LIVS301014
SIOX	SIOX Extension Module	LISIOX0014

11.2 Components for FS 3010

Component	Description	Order number
NP-pressure transmitter	LP-pressure transmitter 0..10 bar	KGLZDRUCK3
HP-pressure transmitter	HP-pressure transmitter 1..26 bar	KGLZDRUCK4
Cylinder head sensor	Cylinder head sensor (Pt1000 in 2-wires technology), brass	KGLZPTZYLM
Humidity and temperature sensor	Combined humidity (4..20 mA) and temperature sensor (Pt1000 in 4-wires technology) for wall mounting	KGLZPTHYGR
Out / room sensor	Temperature sensor (Pt1000 in 4-wires technology) for outside and room temperature, for wall mounting	KGLZPT1000
Brine temperature sensor	Brine temperature sensor (Pt1000 in 2-wires technology)	KGLZPT1KTH
Connector set	Connector set for FS 3010	STVSETVS12
Connector set extension for speed control	Connector set extension for speed control of FS 3010	STVSETVS03
Flash cable	For firmware updates of the VS 3010 family	KABLINDAD1
Null modem cable	Connects the flash cable with the serial interface of the PC / notebook, lenght: 3,0 m	PCZKABSER2
Null modem cable extension	Extension for null modem cable, Lenght: 1,8 m	PCZKABSER3
SIOX Supply cable	Supply cable for SIOX Lenght: 2 m	KABLIND006
SIOX Data cable	Data cable from FS 3010/SIOX to SIOX, lenght: 0,4 m 0,7 m 2,0 m 5,0 m	 KABLIND001 KABLIND002 KABLIND003 KABLIND007

Notice: