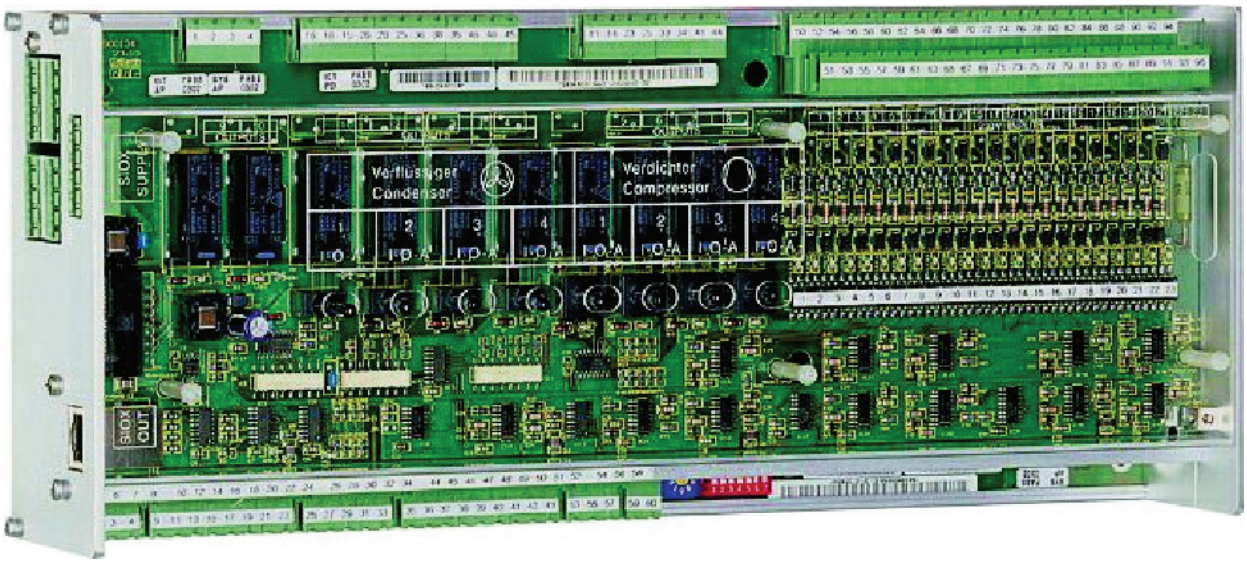
VS 3000 Pack Controller

Firmware V3.00

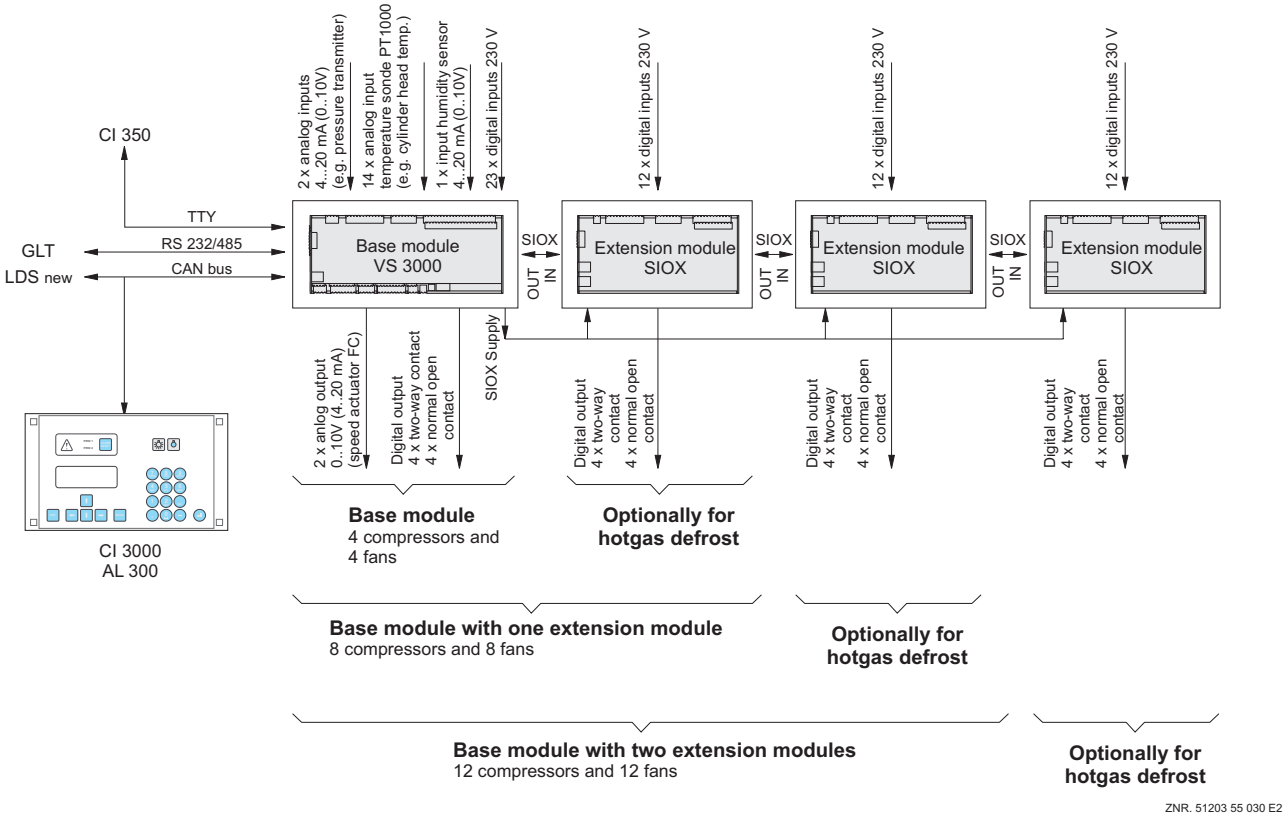


1 System Design of VS 3000

The basic construction of the VS 3000 Pack Controller consists of:

- One analog module
- One digital I/O module

The controller is of modular design and can be upgraded to a maximum of three SIOX extension modules in all (see illustration below). The following expansion stages are available:



See Section 5 Pin and Terminal Assignments for electrical connection of the VS 3000 Pack Controller.

Basic version

Digital inputs/outputs

23 inputs 230 V

10 outputs 230 V - Relay outputs

Analog inputs/outputs

14 inputs PT1000 - Connection for PT1000 temperature sensors

2 inputs / 4-20 mA (0-10 V) - Connection for pressure transducers

1 input / 4-20 mA (0-10 V) - Connection for humidity sensors

1 output / 0-10 V (0-20 mA) - Connection for speed adjuster for continuous fan control

1 output / 0-10 V (0-20 mA) - Connection for frequency changer for variable-speed compressors

SIOX Supply - Power supply for SIOX extension module

Ports:

CAN-Bus:	Communication within new E•LDS System
TTY:	Communication within earlier E•LDS System
RS232:	Communication between E•LDS System and building control system, connection for firmware update
RS485:	Connection for building control system (BCS)
SIOX OUT:	Connection for data transfer to SIOX extension modules

New features compared to earlier versions

From Version 3.00:

- High-pressure monitoring
- CO_2 cascade
- changes to single- and multi-stage compressors (Standstill Time S1) / Starts

From Version 2.98:

- High-pressure combined controller
- D2D defrost sequence

2 Application of VS 3000

Functions provided in the VS 3000 Pack Controller for refrigeration compressor packs and condensers are as follows:

- Control
- Regulation
- Fault reporting
- Fault archiving
- Monitoring
- Archiving

These functions are as follows:

Compressor control (step controller) for single-circuit systems equipped with maximum
6 compressors each with 2 capacity stages or
4 compressors each with 3 capacity stages or
12 stand-alone compressors without capacity control

Low-pressure control/compressor control:
- Step controller
- Combined controller

Base load rotation

Compressor monitoring

Load shedding

High-pressure control/fan control
- Step controller
- Combined controller

Base load rotation/Fan overload protection

Data archiving:
- Messages
- Starts
- Run times
- Activity/Utilization

Liquid level monitoring

- M- Motor overload cutout (fans)
- Motor overload cutout (compressors)
- Bursting disk
- Low oil pressure cutout
- Cylinder head temperature
- High pressure
- Low pressure
- Refrigerant level
- External alarm

Discharge gas defrosting:

- D2D two-pipe system

3 Function of VS 3000

3.1 System configuration

The VS 3000 Pack Controller contains a low-pressure control loop (LP, compressor control) and a high-pressure control loop (HP, condenser control). Two different temperature ranges are provided for compressor control (NT: normal-temperature refrigeration or LT: low-temperature refrigeration; see also Section 2 - Application).

Compressor control largely covers the following control and regulating functions:

Low-pressure control (LP, compressor control) for single-circuit systems - step or combined control

- Load shedding
- Emergency power mode
- Base load rotation
- Compressor monitoring
- Safety loop
- D2D two-pipe discharge gas defrosting

High-pressure control (HP, condenser control) for single-circuit systems - step or speed control

3.2 Low-pressure control / Compressor control

- Step controller
  - Control by loading and unloading compressor stages or compressor capacity stages
- Combined controller
  - Control by variable-speed compressor in combination with one or more fixed-speed compressors

The setpoint is defined as a function of room (ambient) temperature. Actual values are detected by a pressure transducer with continuous current output (4 to 20 mA) or voltage output (0 to 10 V).

3.2.1 Setting parameters for LP transducer characteristic

The VS 3000 Pack Controller works with linear-characteristic continuous pressure transducers. The pressure inputs can be matched to various transducers with linear characteristic. Transducers with either current output (4 to 20 mA) or voltage output (0 to 10 V) may be used.

Jumpers must be changed accordingly on the controller for voltage-output transducers!
The default configuration is for current inputs!

The following parameters (Menu 3-1-a) are used to match the controller to the transducer:

1.*LP-Transducer*
- The LP transducer must be selected for either continuous current output 4 to 20 mA or continuous voltage output 0 to 10 V.

2.LP-*Min*
- This parameter defines the pressure p_0 at which the transducer delivers a 4 mA or 0 V output signal.

3.*LP-Max*
- The parameter defines the pressure p_0 at which the transducer delivers a 20 mA or 10 V output signal.

Changing any of these parameters causes a Sensor Type Change message to be generated.

Incorrect parameter setting can result in severely impaired function.

3.2.2 Neutral zone

If low-pressure control is made by step controller, no compressor actuation takes place as long as the control error remains within a definable neutral zone. If low-pressure control is made by combined controller, the implications of the neutral zone are as follows:

If control error is within the range of 1.5 times the neutral zone, low pressure is controlled by increasing or decreasing compressor speed. Outside the range of 1.5 times the neutral zone, the variable-speed compressor runs at either maximum or minimum speed to achieve quick control correction.

3.2.3 Control algorithm

Controller cycle time is 1 second. The control algorithm depends on the type of control.

In the wet vapor range the temperature is clearly governed by the refrigerant and pressure:
t = f (p, refrigerant).The VS 3000 calculates temperatures from the pressures measured as a function of the refrigerant used. Exclusively temperature measurements are used for control.
In this manual therefore, temperatures (t_0, t_c) stand for pressure (p_0, pc).

3.2.4 Control algorithm with step controller

Low pressure as detected by an A/D converter is compared with the setpoint:

Control error = *Actual value* (t_{0_Act}) − *setpoint* (t_{0_Setp})

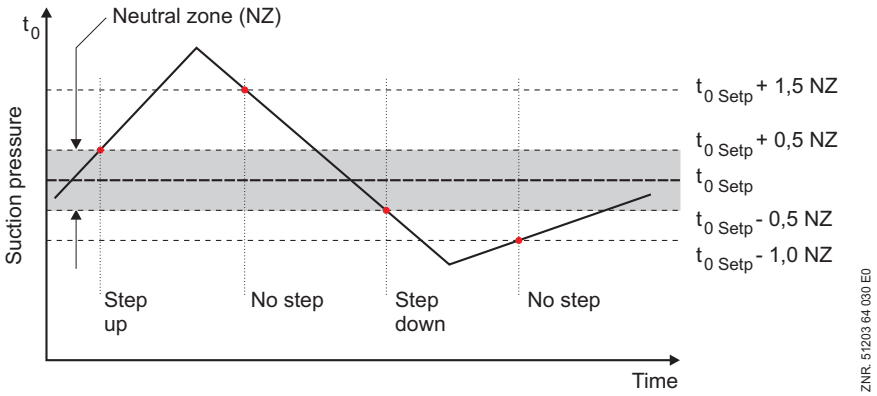
With small control errors the pressure change within the controller cycle time is also evaluated. When the control error is positive and the pressure is greater than the setpoint plus 1.5 times the neutral zone, the step switch moves one step up regardless of pressure change.

As a result the compressor having the shortest run time is enabled. If the control error is positive, pressure is falling and is less than the setpoint plus 1.5 times the neutral zone, no compressor actuation takes place in the expectation that the neutral zone will be reached shortly.

When the control error is negative and the pressure is lower than the setpoint less the neutral zone, the step switch moves one step down regardless of pressure change. As a result the compressor having the longest run time is disabled. If the control error is negative, pressure is rising and is greater than the setpoint less the neutral zone, no compressor actuation takes place.

No compressor actuation takes place when the control error is within a definable neutral zone.

VS 3000 control algorithm LP step controller



3.2.5 Control algorithm with combined controller

Low pressure detected by an A/D converter is compared with the setpoint:

$$Control\ error = Actual\ value\ (t_{0\_Act}) - setpoint\ (t_{0\_Setp})$$

Depending on the control error, a controller output is computed and used as a 0 to 10 V signal to control compressor speed. Since the controller operates as a PI controller, both P and I actions are computed.

Computation of P action:

$$P\ action = \frac{Control\ error}{4}$$

Computation of I action:

The P action acts immediately on compressor speed in response to change of pressure. The remaining control error is minimized by stepless increase or decrease of the output signal (ramping). Ramp actuating speed (I action of controller) is a function of the control error. If ramp speed is too high, it results in repeated overshoot of low pressure.

If ramp speed is too low, it results in long time delay for the low-pressure setpoint to be attained.

The controller is then too slow. Ramp speed can be adjusted by a definable adjusting difference (Menu: 3-2-1 - Adjust. Diff. to match the I action to the system.

A positive adjusting difference results in faster control correction, a negative adjusting difference results in slower control action. The I action is attenuated in order to prevent hunting of the controller at low part load.

If only the variable-speed compressor is running, the output signal (0 to 10 V) is less than 50% and the control error is smaller than the neutral zone, the compressor pack will operate at low part load.

The I action is then

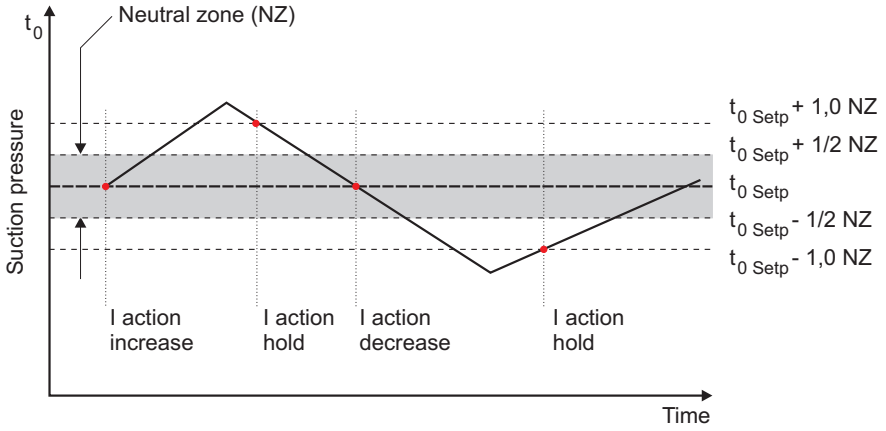
$$I\ action = \frac{Controlerror + Adjustingdifference}{8}$$

The pressure change is taken into account when the control error is small. If the control error is positive, pressure is falling and is less than the setpoint plus neutral zone in part-load operation or half the neutral zone at load, the I action will not be changed.

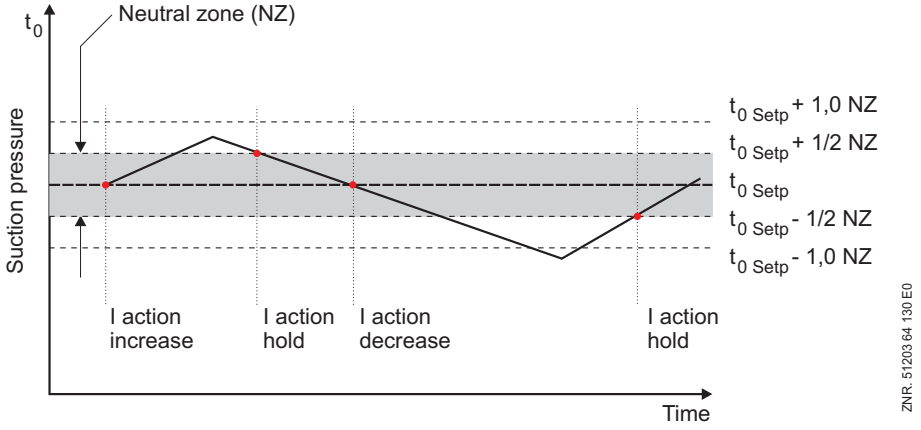
The I action is also not changed when the control error is negative, pressure is rising and is greater than the setpoint less neutral zone in part-load operation or half the neutral zone at load. So as to prevent speed increasing too quickly, the I action increase is limited to a maximum of 10% of the output signal (0 to 10 V).

With control errors greater or less than 1.5 times the neutral zone, the compressor is operated at maximum or minimum speed. So as to avoid trouble, the speed setpoint is increased at a ramp speed limited to 2 V/s. Reduction of the speed setpoint is not ramped.

VS 3000 control algorithm LP combined controller
- part-load operation -



- load operation -



The controller output for the speed adjuster is computed from the P and I actions:

Controller outout = P action + I action

If all compressor stages are off and the actual value is greater than the setpoint (positive control error), the first compressor stage (C1: Enable frequency changer) will be loaded immediately. Speed control is not activated however before a delay has expired (time = basic load time C1); see also (Menu 3-2-3-a and 3-2-4-a). While the delay times out, the compressor is operated at a definable minimum speed.

3.3 Loading and unloading fixed-speed compressors

Fixed-speed compressors can be loaded or unloaded if the required capacity cannot be supplied by changing compressor speed,. When the variable-speed compressor has attained maximum speed, the fixed-speed compressor having the shortest run time is cut in.

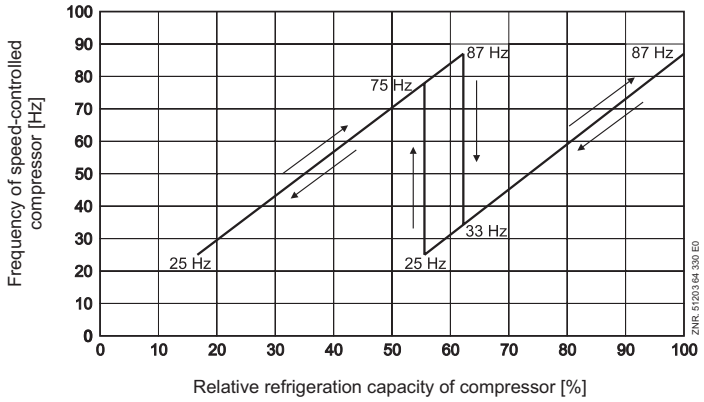
The variable-speed compressor is unloaded to a level corresponding to capacity without the addition of the fixed-speed compressor. Compressors that can be allocated to the speed adjuster by base load rotation are the last to be cut in.

When the variable-speed compressor attains minimum speed, the fixed-speed compressor having the longest rung time is cut out. The variable-speed compressor is loaded to a level corresponding to capacity with the addition of the fixed-speed compressor.

Compressors that can be allocated to the speed adjuster by base load rotation are the first to be cut out. Loading and unloading of fixed-speed compressors also depends on the compressor type. If the compressor pack is operated with capacity-controlled compressors, the load and unload points for the fixed-speed compressors will be different.

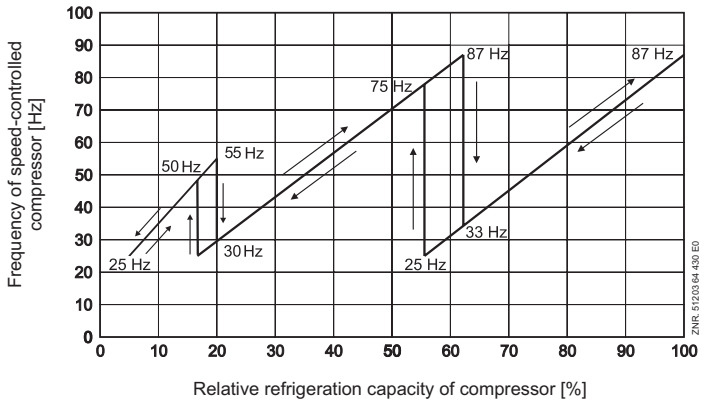
With capacity-controlled compressors the auxiliary capacity stage is used only for the variable speed compressor. The fixed-speed compressors are always operated at 100% capacity, meaning that the base and capacity stages of these compressors are always loaded and unloaded simultaneously. The graph below shows the controller action for a pack of two non-capacity-controlled compressors.

Compressor without capacity control
- Single stage compressor -



The next graph shows the controller action for a pack of two compressors equipped with two-stage capacity control.

Compressor with capacity control
- Two-stage capacity control -



This requires the characteristic of the frequency changer to be definable for an output signal of 0 V at the analog output for compressor control to correspond to a frequency of 25 Hz and an output signal of 10 V to correspond to a frequency of 87 Hz.

3.4 COP optimization

The system's coefficient of performance is a function of compressor speed. So as to prevent the system running continuously at a poor COP, the controller switches to an operating point of better energy efficiency. If compressor speed exceeds 78 Hz or 52 Hz for more than 3 minutes with capacity-controlled compressors, compressor capacity is loaded up by one stage. Compressor speed is reduced at the same time.

Speed without capacity control: Controller output = (Current controller output - 78 Hz) : 2

Speed with capacity control: Controller output = (Current controller output - 52 Hz) : 4

Controller output = 0 to 10 V signal for speed adjuster

Current controller output = Controller output prior to COP optimization.

3.5 Compressor control times

Compressor actuation with step control:

Compressor actuation takes place only outside the neutral zone, after a certain time for loading or unloading has passed and when the control error has exceeded a defined level (neutral zone).

Compressor actuation with combined control:

If low pressure is greater than the setpoint, the variable-speed compressor is cut in immediately.

Loading or unloading of additional fixed-speed compressors takes place when maximum or minimum speed of the compressor is attained and a certain time for loading or unloading has passed.

The time delay is dependent on the actual control error. With a large control error, actuation takes place in a shorter time than when the control error is smaller. 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 control error the variable time is $t_v = 0$. As the control error decreases, time t_v automatically increases up to a defined maximum. Basic time and maximum variable time for loading (starting) and unloading (stopping) can be programmed as parameters for each capacity stage.

With combined control, speed control is not enabled until the basic time of the first compressor capacity stage has expired. Until this time, the variable-speed compressor is operated at lowest speed. Relationships for determining control times are as follows:

$$t = t_b + t_v$$

t_b = Basic time. Can be programmed for each loading of a compressor capacity stage.

t_v = Variable control time

For t_v

$$t_v = t_{v\_max} - \frac{(t_{v\_max} \cdot d_t)}{d_{t\_max}}$$

The following applies:

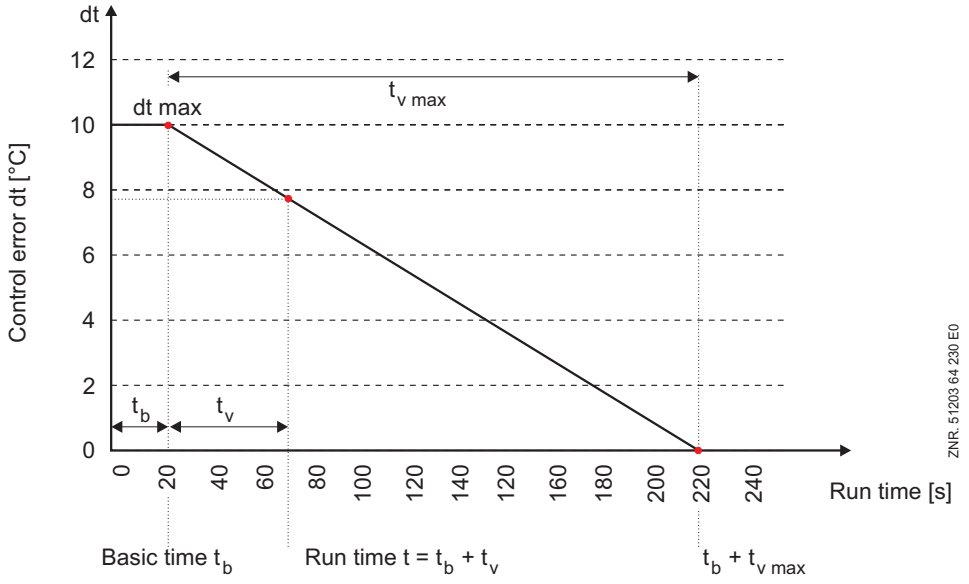
$d_t > d_{t\_max}$ is equal to $d_t = d_{t\_max}$

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/constant (definable)

The start and stop delay commences only outside the neutral zone.

Loading of a compressor stage takes place with the *No. Running Compressors* + 1 delay, unloading always commences with the first-stage delay.

VS 3000 Compressor run times



3.6 Calculating setpoint

3.6.1 Calculating setpoint by outdoor temperature

The t_0 setpoint is calculated as a function of room temperature (setpoint shift). Room (ambient) temperature is supplied either by a PT1000 sensor connected direct to a pack controller input or via the CAN bus by another pack controller in the system.

$$t_0 = t_{0\_min} + \frac{\left[\left(t_{0\_max} - t_{0\_min}\right) \cdot \left(t_r - t_{r\_max}\right)\right]}{\left[\left(t_{r\_min} - t_{r\_max}\right)\right]}$$

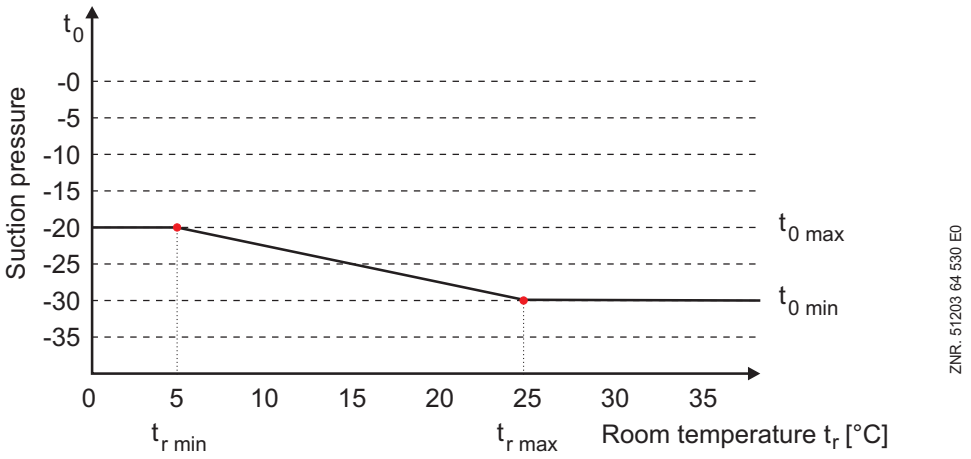
t_0	= t_0 setpoint
t_{0_max}	= Maximum t_0 setpoint
t_{0_min}	= Minimum t_0 setpoint
t_r	= Current room temperature
t_{r_max}	= Maximum room temperature for setpoint shift
t_{r_min}	= Minimum room temperature for setpoint shift

With a room temperature of $t_r > t_{r\_max}$ or $t_r < t_{r\_min}$ the setpoint t_0 is defined as a constant as follows:

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

For $t > t_{r\_max}$ $t_{0 = t0\_min}$

Low-pressure control



Temperatures t_{0_max}, t_{0_min}, t_{r_min} and t_{r_max} can be set as parameters. Additionally, allowance can be made for the air humidity via an analog input. The pressure setpoint for actual control is determined from a conversion table stored in the program. Provision is currently made for the following refrigerants when converting t_0 to the corresponding pressure:

R22, R502, R134a, R402A, R404A, R717, R1270, R507, R407c, R410a, R290 R744 (no transcritical operation)

3.6.2 Demand-dependent calculation of setpoint

This function is only available in conjunction with case/coldroom controllers that deliver load-level data (valve opening), e.g. UA 300 E.

In order to ensure optimum operation of a compressor pack and associate refrigeration points at minimum operating cost it is appropriate for the low pressure controlled by the compressor pack to be set as a function of refrigeration load at the refrigeration points.

The opening of the expansion valves at the refrigeration points lends itself as a reference input for this purpose. With a load level equal to a definable maximum at a minimum of one refrigeration point served by the compressor pack, it may be assumed that the temperature cannot be maintained reliably with the existing low pressure at this/these refrigeration point/s. In this instance low pressure is decreased so as to be able t_0 supply sufficient refrigeration capacity.

Conversely, when the load level at **all** refrigeration points served by the compressor pack is less than a definable minimum, it may be assumed that the refrigeration capacity supplied by the pack is more than sufficient. In this instance the low pressure is increased in the interests of energy-efficient operation of the plant. The t_0 setpoint should not be shifted up when superheat control is active on a transmitting case/coldroom controller. In this instance the defined t_0 setpoint is retained or shifted down by increasing the valve opening.

3.7 Processing load-level information

Each case/coldroom controller on which load-level transmission is activated transmits up to four load levels to the respectively assigned pack controller at intervals.

Decrease of low-pressure setpoint takes place on the pack controller when a single load level exceeds the definable maximum load level. Increase of low-pressure setpoint takes place on the pack controller when the load level of all case/coldroom controllers falls below the definable minimum load level. For this purpose an averaged load level (arithmetical mean of up to four separate load levels for each case/coldroom controller) is computed and saved by the VS 3000 for each case/coldroom controller (maximum 99 total).

If one of the four load levels of a refrigeration point is greater than the maximum load level, the mean load level is ignored for temperature shift. No suction pressure increase then takes place although the mean low level of all refrigeration points is below the minimum load level.

When neither of the above conditions applies, the t_0 setpoint remains at the given value. No suction pressure increase takes place as long as superheat control is active on at least one refrigeration point.

Only when superheat control is not active on any of the associated refrigeration points can low pressure be increased according to the above rules. The reason for this is that, during superheat control, the valve opening at the refrigeration point is normally small while refrigeration load continues high. In other words, this is a precaution against erroneously increasing low pressure.

Change of low-pressure setpoint takes place within definable limits at definable increments and a definable updating interval.

3.8 Response to fault conditions

Can bus fault on individual stations:

If no telegram is received from a given case/coldroom controller during a time longer than the timeout period for load level reception, the mean load level for the controller concerned will be ignored until such time as a new telegram is received.

Global bus fault:

The current t_0 setpoint is retained. At the end of a 10-minute alarm delay, a *No Load Level* fault is logged and is not reset until new load level information is received via the CAN bus.

3.9 Demand-dependent setpoint shift parameters

The range within which t_0 can be changed is defined by the parameters *t_0-max* and *t_0-min* (Menu 3-2-3).

Change to the second setpoint does not take place with demand-dependent setpoint shift.

The *Max.LoadLevel* parameter (Menu 3-2-2) defines the maximum load level (valve opening) for decrease of the t_0 setpoint.

The *Min.LoadLevel* parameter (Menu 3-2-2) defines the minimum load level (valve opening) for increase of the t_0 setpoint.

The *Increment* parameter (Menu 3-2-2) defines the increment in Kelvin by which the t_0 setpoint is increased or decreased after a definable time interval expires.

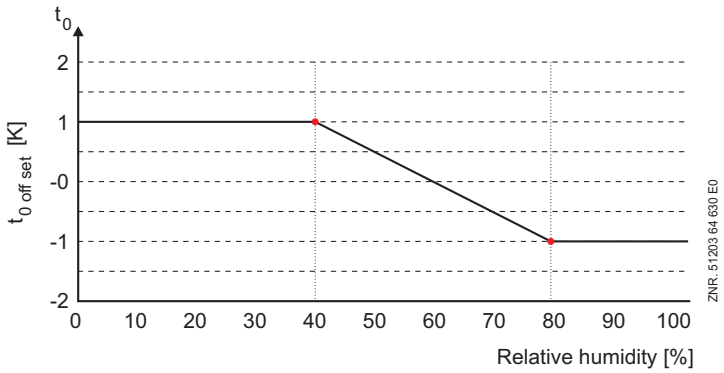
The *Interval* parameter (Menu 3-2-2) defines the interval in minutes that must expire before the t_0 setpoint is updated as required.

3.10 Humidity shift

This parameter is not active/shown when demand-dependent calculation of setpoint is selected.

The *Humidity Shift* parameter (Menu 3-2-3 and 3-2-4) can be used to define whether the t_0 setpoint is also to be matched as a function of air humidity. The air humidity signal can be supplied either by the humidity sensor or via the CAN bus by another pack controller. A temperature offset t_{0_Offset} is then formed as a function of the air humidity and added to $t_{0\ Setp}$:

Humidity shift



Allowance for air humidity can be made separately for operation at the first and second setpoints.

3.11 Ambient data

The following quantities used for setpoint shift can be supplied either via sensors connected to the pack controller or via the CAN bus from another pack controller.

- Room temperature ($t_{0\ shift}$)
- Outdoor temperature ($t_{c\ shift}$)
- Humidity ($t_{0\ shift}$)

Response of the controller is determined by the parameters *Room Temp., Outdoor Temp., Humidity* and *Node-Nr Env.dat* (Menu 3 - 1).

The parameters *Room Temp.*, *Outdoor Temp.* and *Humidity* can be used to define whether sensors are connected direct to the controller. If one of these parameters is set to N, the additional parameter *Node-Nr Env.dat* will be shown in the operating screen and can be used as required to enter the Node No. of the pack controller that supplies the required ambient data.

If no ambient data is to be received via the CAN bus, the parameter *Node-Nr Env.dat* can be set to -- so as to deactivate setpoint shift.

3.12 Second setpoint - Setpoint increase/decrease

With low-pressure control there is the option of programming a second characteristic that can be activated by the internal week timer or a digital input of the controller. Polarity of the digital input signal is definable. Setpoint increase/decrease allows better matching to night and weekend operation.

Setpoint toggle changes the following controller parameters:

- Temperature setpoints
- Neutral zone
- Control constant
- Control times
- Humidity shift

3.13 Refrigeration compressor packs with oil equalizer

Oil level in the compressors differs due to varying suction pressures. So as to achieve equalization of oil level between the separate compressors, the system is stopped for 2 minutes after one or more compressors has been operating longer than 3 hours.

At the end of the maximum operating time, fast unload takes place with compressor capacity stages being unloaded at the rate of one every 2 seconds. Refrigeration point enabling is disabled when the last capacity stage is unloaded.

The refrigeration point is re-enabled after the standstill time has expired. The compressor capacity stages are then again loaded step by step. Forced shutdown can be disabled or enabled by the parameter *Oil eq. line* (Menu 3-1).

3.14 Capacity-controlled compressors

The VS 3000 Pack Controller can be used to control capacity-controlled compressors having up to three capacity stages (base load plus two capacity stages (bypass valves)). The number of capacity stages is definable. Capacity-controlled compressors do not have any effect on the control algorithm of the VS 3000. Only the control sequence is changed.

When the compressors are actuated, the base load of an available compressor is first switched on. The capacity stages of the compressor are then loaded as refrigeration is demanded before the base load stage 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 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 loaded first as refrigeration is demanded.

If both non-capacity controlled and capacity controlled compressors have been defined by parameter, the capacity-controlled compressors are loaded first. This again takes place in the order described above (base load stage followed by associate capacity stages).

When the full number of capacity-controlled compressors are running at 100%, non-capacity-controlled compressors are loaded as additional refrigeration is demanded. So as to obtain finer staging of capacity, the capacity stages of a capacity-controlled compressor are unloaded when a non-capacity-controlled compressor is loaded. This means that only the base load stage of the capacity-controlled compressor runs until additional refrigeration is demanded, when the capacity stages are again loaded as required.

Taking an example for compressor loading and unloading, the system configuration is as follows:

- Number of base load stages: 2
- Number of capacity stages each capacity-controlled compressor: 3
- Number of capacity-controlled compressors: 1

Compressor loading:

Loading of compressors is illustrated in the following table for this example.

	VS 3000			
Relay No..	S1	S2	S3	S4
Stage	Base load stage1	Capacity stage 2	Capacity stage 3	Base load stage4
1	X			
2	X	X		
3	X	X	X	
4	X			X
5	X	X		X
6	X	X	X	X

Loading takes place by first unloading the capacity stages of a capacity-controlled compressor. Then a non-capacity-controlled compressor is loaded. At the same time the capacity stages of the capacity-controlled compressor are again loaded. Unloading of compressors is illustrated in the following table:

Compressor unloading:

	VS 3000			
Relay No	S1	S2	S3	S4
Stage	Base load stage 1	Capacity stage2	Capacity stage 3	Base load stage 4
1	X	X	X	X
2	X	X		X
3	X			X
4	X	X	X	
5	X	X		
6	X			

The number of capacity stages actuated for one compressor is taken into account for compressor base load rotation. If the system is equipped with only one multi-stage compressor or if a compressor is the variable-speed type, limiting of compressor starts is cancelled for this compressor. Compressor starts limiting remains active for the second and higher capacity stages as a means of preventing overlong standstill of the system.

If more than one capacity-controlled compressor or only one single-stage compressor is provided with a step controller, limiting of compressor starts remains active for all stages. When compressor starts limiting is cancelled for the first stage, a minimum standstill time for the first stage can be set by the *Standstill S1* xxxs parameter (Menu 3-3). This minimum standstill time is only shown when the system has no more than one capacity-controlled or variable-speed compressor.

Standstill time is always maintained after the first compressor has been shut down by the suction pressure controller or fault conditions. With a capacity-controlled compressor the first stage is only loaded again when the start delay and the minimum standstill time have both elapsed. A variable-speed compressor starts on elapse of the minimum standstill time and runs at minimum speed for the duration of the start delay.

3.15 Load shedding

Forced shutdown of compressors may be needed as a means of preventing energy consumption from rising above a specified level. Three digital inputs are provided for load shedding on the VS 3000 Pack Controller. Compressors are shut down directly. The maximum number of compressors disabled by load shedding is equal to the number of activated load shedding inputs

Regardless of the load shedding signals, a minimum refrigeration capacity must be maintained, which means that a minimum number of compressors must be enabled. At minimum, one compressor remains enabled at all times. The compressor cannot be disabled by load shedding in a system equipped with only one compressor.

3.16 Emergency power mode

Emergency power mode can be activated by the *Emerg. working* parameter (Menu 3-1). Emergency working mode is a variant of load shedding and serves to reduce power line load in electric power supply fault conditions (e.g. store power supply by emergency generator).

When emergency power mode is activated by the above parameter, the additional entry *No.emerg.stages* is shown in the operating screen (Menu 3-1). This is used to define the maximum number of compressor stages allowed to operate in emergency power mode. The parameter can be selected between the following limits:

- Minimum of one compressor stage (provision of minimum refrigeration capacity)

- Maximum of one compressor stage less than the maximum configuration

When emergency working mode is selected, it is activated through Digital Input 19 (Emerg. working / Load rejection stage 3). See Section 5 - Pin and Terminal Connections.

3.17 Compressor base load rotation

Running time of each compressor is internally monitored. So as to ensure uniform run time of all compressors, the compressor having the longest running time is disabled and that having the shortest running time is enabled at the end of a definable cycle time.

Base load rotation is only performed with capacity-controlled compressors when the base load stage of a compressor is available. With base load rotation, the compressor having the longest run time is disabled and the compressor having the shortest running time is loaded.

In base load rotation with capacity-controlled compressors the control state of the capacity stage(s) is also applied for the new compressor.

Base load rotation makes allowance for compressors disabled by load shedding. The number of compressor stages operating is not changed by compressor base load rotation. Compressor base load rotation is active only when the following conditions are satisfied:

- When all defined compressors are enabled, base load rotation takes place only at rising pressure within the neutral zone.
- If compressors have been disabled by load shedding, base load rotation only takes place at rising pressure.

Compressor base load rotation can be set with the *Cycle Time C.* parameter (Menu 3-7). Especially when the system is equipped with screw compressors, which have an oil return feature that does not necessitate base load rotation, this parameter can be set to --, thereby deactivating base load rotation.

3.17.1 Base load rotation with variable-speed compressors

In systems equipped with variable-speed compressors the first two compressors (C1 and C2) can be assigned to a speed adjuster. Additional fixed-speed compressors (C3 - Cn) can also be controlled. Base load rotation of fixed-speed compressors (C3 - Cn) takes place as described above in Section 3.17.

At the end of the cycle time, or when all compressors are shut down, compressors that can be assigned to the speed adjuster (C1 and C2) are alternately switched to the speed adjuster by a digital output of the VS 3000 according to the following sequence.

Base load rotation with two compressors running (C1 and C2)	**Base load rotation with one compressor running (C1 or C2)**
Reduce speed to minimum	
Stop fixed-speed compressor	
Reduce speed to zero	Reduce speed to zero
Stop variable-speed compressor	Stop variable speed compressor
3 seconds time delay	3 seconds time delay
Rotate base load compressor	Rotate base load compressor
3 seconds time delay	3 seconds time delay
Start fixed-speed compressor	
Start variable speed compressor	Start variable speed compressor
Increase actuating signal (0 to 10 V) by 2 V/s until speed prior to rotation is obtained	Increase actuating signal (0 to 10 V) by 2 V/s until speed prior to rotation is obtained

No compressor rotation takes place when the cycle time for base load rotation is set to --- even when all compressors are stopped. When cycle time is set to ---, the digital output signal for rotation will preserve the status at the time the data is entered even after an electric power failure.

In the event of a fault (motor overload or oil pressure cutout) on the variable-speed compressor (C1 or C2), base load rotation takes place only once to the then available fixed-speed compressor. No base load rotation will take place if the failed compressor is a fixed-speed machine.

Fault:	**Base load rotation output**	**Base load rotation performed**
Compressor 1	ON	NO
	OFF	YES
Compressor 2	ON	YES
	OFF	NO

3.18 Compressor monitoring

The controller is equipped with the following monitoring functions as well as control and regulating functions:

- Motor overload cutout
- Low oil pressure cutout
- Compressor cylinder head temperature
- High pressure
- Low pressure
- Compressor starts

3.19 Safety loop

So as to provide redundancy of the monitoring system, provisions are made in addition to the VS 3000 monitoring functions for all or individual compressors of a pack to be disabled in critical operating situations.

Due to the type of wiring in the system the control contacts used for this purpose are prioritized in descending order as follows:

Disabling of all compressors

1. Safety high-pressure cutout
2. High-pressure cutout
3. If installed: Discharge gas defrosting high-pressure cutout (Z2, Z2R and Z1)
4. LP cutout

Disabling of compressors respectively affected

5. Low oil pressure cutout
6. Motor overload cutout

As a result of their arrangement in the safety loop, actuation of a high-priority safety contact (e.g. high-pressure cutout) also de-energizes and thus activates all low-priority alarm contacts. So as to prevent the pack controller from transmitting all secondary alarms, the transmission of low-priority alarm signals is blocked in the simultaneous occurrence of a higher-priority alarm event.

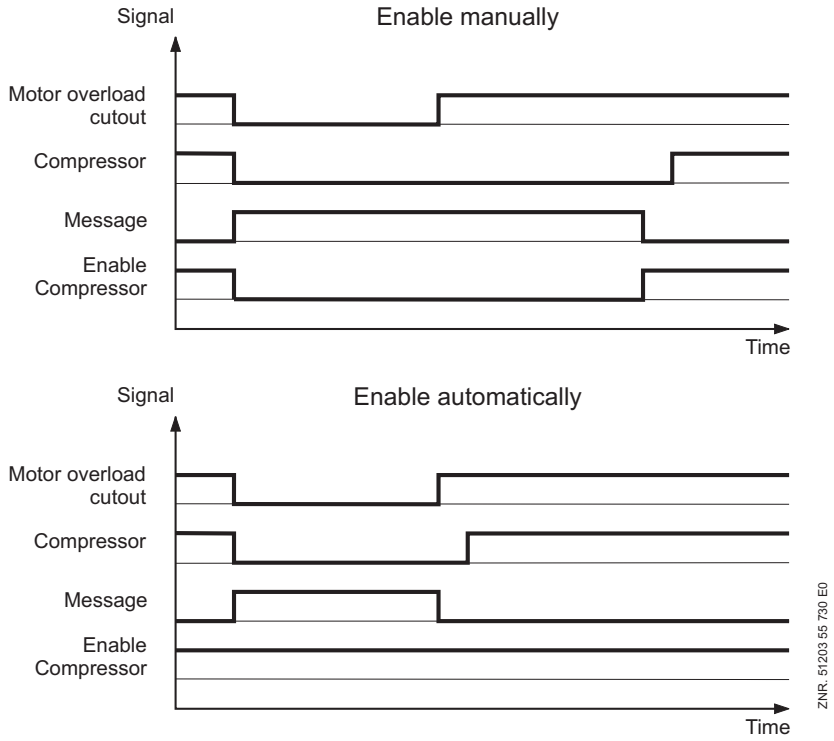
3.20 Monitoring of motor overload cutout

The compressor motor is monitored by the motor overload cutout. The auxiliary contact is open in the alarm state (no signal at controller input). The compressor is stopped directly and disabled for all further control actions when the motor overload cutout is actuated. On resetting the motor overload cutout, the compressor can be enabled either automatically or manually.

Compressor enabling mode following actuation of a motor overload cutout is defined by the *Mot.cutout C* parameter (Menu 3-1). When *Mot.cutout C* Y is entered, the compressor is stopped on actuation of the motor overload cutout and remains disabled. It then needs to be enabled manually (Menu 3-1-c *Enable comp.stages*).

The fault report generated on actuation of the motor overload cutout is not logged off until the cutout has been reset and the compressor has been enabled manually. When *Mot.cutout C* N is entered, the compressor is stopped on actuation of the motor overload cutout. After resetting the cutout, the compressor will be loaded again automatically as and when refrigeration is demanded. The default setting is *Mot.cutout C* Y.

The following diagram shows the control sequences on actuation of the motor overload cutout for manual enabling (*Mot.cutout C* Y) and automatic enabling (*Mot.cutout C* N):



With scroll compressors particularly, no motor overload cutouts are used. Monitoring of the motor overload cutout can therefore be activated or deactivated by the *Mot.cutout C* (motor overload cutout available) in Menu 3-1. If the motor overload cutout is deactivated, the *Mot.cutout C* Y/N parameter is neither shown nor evaluated.

By default the *Mot.cutout C* parameter is activated. This can result in compressor capacity stages being disabled during startup, for example, and insufficient refrigeration capacity being available in subsequent operation.

3.21 Monitoring low oil pressure cutout

Oil pressure is monitored on each compressor by the low oil pressure cutout equipped with a floating contact. The contact is open in the alarm state. The compressor is stopped directly and disabled for all further control actions when the low oil pressure cutout is actuated. On resetting the low oil pressure cutout, the compressor is re-enabled.

With scroll compressors particularly, no low oil pressure cutouts are used. Monitoring of the low oil pressure cutout can therefore be activated or deactivated via parameter.

3.22 Monitoring 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 are definable by the parameters *Comp. OFF temp* and *Comp. ON temp* (Menu 3-4). The respective compressor is stopped after a definable time delay elapses (Menu 3-4 *Comp. temp del.*) and disabled for all further control actions when temperature exceeds the set maximum.

The compressor remains disabled until temperature drops below the enabling level. If this action is repeated several times in a single day (five actuations) and if more than one compressor is still available in the pack, the compressor will be disabled permanently and must then be re-enabled manually (Menu 3-1-c *Enable comp.stages*). This causes fault report *Auto disable Cx* to be generated.

Compressor fault with combined control

Compressor fault occurs in the following conditions:

- Actuation of motor overload cutout
- Actuation of low oil pressure cutout
- Cylinder head temperature rise above maximum allowable level

In occurrence of fault conditions on one of the compressors that can be allocated to the frequency changer (Compressor 1 and 2), the compressor is stopped and fault report is generated as a function of the base load rotation output state (Digital Output 10 of VS 3000).

Compressor fault with single-stage compressors

With variable-speed compressors the frequency changer is always enabled together with the first compressor capacity stage. Either Compressor 1 or Compressor 2 can be allocated to the frequency changer by base load rotation. If base load rotation has not taken place (base load rotation output OFF), a fault on Compressor 1 causes Capacity Stage 1 to be shut down and a corresponding fault report to be generated for Compressor 1.

A fault on Compressor 2 causes Capacity Stage 2 to be shut down and a corresponding fault report to be generated for Compressor 2.

Following base load rotation (base load rotation output ON)), a fault on Compressor 1 causes Capacity Stage 2 to be shut down and a corresponding fault report to be generated for Compressor 1.

A fault on Compressor 2 causes Capacity Stage 1 to be shut down and a corresponding fault report to be generated for Compressor 2.

Fault	Base load rotation output	Capacity stage output OFF	Fault report
Compressor 1	ON	Stage 2	Compressor C1
	OFF	Stage 1	
Compressor 2	ON	Stage 1	Compressor C2
	OFF	Stage 2	

Compressor fault with capacity-controlled compressors

With multi-stage compressors operated in combined control, the frequency changer is always enabled together with the first compressor relay stage and the motor of the first compressor is actuated. The following relay stages are used to actuate the bypass valves of the first compressor.

With combined control the frequency changer can be assigned to either Compressor 1 or Compressor 2 by base load rotation. This however requires the associate compressor capacity stages to also be rotated as well as the compressor base load stage when base load rotation takes place.

If the base load is not changed (Base Load Rotation Output OFF), a fault on Compressor 1 will cause shutdown of Capacity Stage 1 (frequency changer enable and Compressor C1 motor actuation) as well as Capacity Stage

2 (compressor with two capacity stages) and - depending on the number of compressors - Capacity Stage 3 (compressor with two capacity stages).

A corresponding fault report is generated for Compressor 1. When capacity-controlled compressors are added, the relay contacts for the base load and capacity stages of the second compressor change to stage No.CS per Comp. + 1 and so on.

A fault on Compressor 2 causes shutdown of the capacity stage (No.CS per Comp. + 1 and so on) and generation of the corresponding fault report for Compressor 2. Following base load rotation (Base Load Rotation Output ON), a fault on Compressor 1 causes shutdown of the capacity stage (*No.cap.stages* + 1 and so on) and generation of the corresponding fault report for Compressor 1.

A fault on Compressor 2 causes shutdown of Capacity Stage 1 and so on and generation of the corresponding fault report for Compressor 2.

Example: Compressor with three-stage capacity control (*No.cap.stages* = 3)

Fault	Base load rotation output	Capacity stage output OFF	Fault report
Compressor	ON	Stage 4, Stage 5, Stage 6	Compressor C1
	OFF	Stage 1, Stage 2, Stage 3	
Compressor	ON	Stage 1, Stage 2, Stage 3	Compressor C2
	OFF	Stage 4, Stage 5, Stage 6	

3.23 Monitoring high pressure

High pressure is measured in the high-pressure line by a continuous transmitter delivering an output current/voltage. Pressure is also monitored by the safety high-pressure cutout and high-pressure cutout. These devices deliver a digital signal when the set pressure level is exceeded. Both of these digital signals are connected to the controller in series.

Forced shutdown of all compressors takes place if pressure exceeds the limits set for the safety high-pressure cutout and high-pressure cutout. A *HPCutout* alarm is generated. Priority of the alarm can be set by parameter. The compressors are loaded stagewise after mechanically resetting the pressure cutouts.

No further compressor capacity stages are loaded on exceeding the high limit

$$tc\ OFF\ Comp - \frac{(tc\ OFF\ Comp - tc\ ON\ Comp)}{4}$$

and a *High tc/HD* fault report is generated after a definable delay (parameter *Delay tc/HP OFF*, Menu 3-3). No message is generated in heat recovery mode.

When pressure again falls below the high limit, additional compressor stages are only loaded if the *tc OFF Comp.* limit (Menu 3-3) has not been not exceeded.

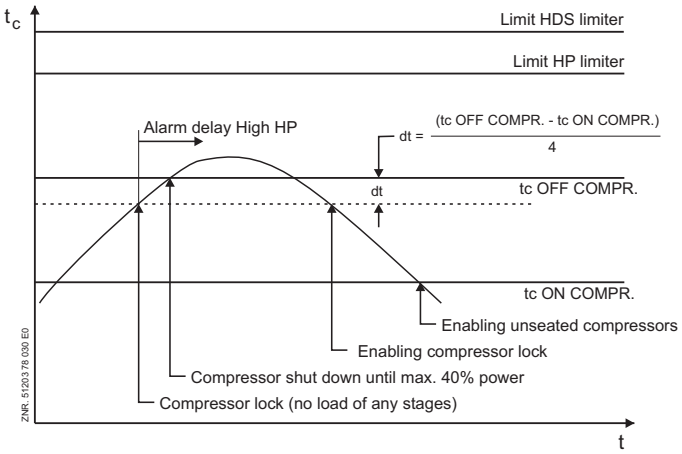
If high pressure rises to a definable limit (Menu 3-3, *tc OFF Comp*.), compressor stages are unloaded in keeping with the maximum number of compressor stages. Unloading of compressor stages continues until such time as further unloading would reduce capacity of the compressor pack to less than 40% or pressure falls below the limit (Menu 3-3, *tc OFF Comp*.). One compressor stage is shut down independent of current pack capacity. No further unloading takes place if it would cause capacity to drop below 40%.

Unloading of the first stage takes place without delay. Additional stages are unloaded on elapse of the basic unload time.

After exceeding the high limit *tc OFF Comp*. (Menu 3-3), additional compressor stages are not loaded until pressure again drops below the enabling level *tc ON Comp*. (Menu 3-3).

HP monitoring is shown diagrammatically in the following illustration:

VS 3000 HP Monitoring



3.24 CO_2 cascade

When the refrigerant of a CO2 LT pack is condensed with one or two NT systems in a plate-type heat exchanger cascade, HP fault conditions can occur on the LT pack on shutting down NT compressors. This frequently occurs during the nighttime in winter when only one NT capacity stage is required and it is disabled for example due to long start delay intervals or limiting of compressor starts.

To avoid such HP faults, the pack controller of the LT circuit needs to be able to perform forced loading of NT compressors via the CAN bus in critical cases. For this purpose the LT circuit pack controller can activate two different NT pack controllers.

The Node Nos. of the NT pack controllers can be defined by the parameters *NT Cascade 1* xxx and *NT Cascade 2* xxx (Menu 3-3). The function is deactivated when ”---” is entered for both Node Nos. Only one pack controller is activated if only one Node No. is entered. When both Node Nos. are entered, compressors can be controlled by two NT pack controllers. If the same NT pack controller is selected for both Node Nos., the second address will be ignored. These parameters are only shown for LT systems working with CO2 as the refrigerant and the function is not active for all other systems

Demand for NT compressors is made by the condensing temperature, tc. A temperature difference dt is formed from the monitoring parameters *tc OFF Comp*. (Menu 3-3) and *tc ON Comp*. (Menu 3-3) for computing the required limits:

$$d_{t=} \frac{(t_c\ OFF\ Comp - t_c\ ON\ Comp)}{4}$$

tc OFF Comp: t_c limit for compressor shutdown

tc ON Comp: t_c limit for compressor enabling

If temperature tc exceeds the defined limit *tc OFF Comp - 2*d*t, the LT pack controller immediately transmits a compressor demand signal at 1 second intervals to the NT pack controller assigned Node No. *NT Cascade 1 xxx*. If a Node No. *NT Cascade 2 xxx* has been entered and temperature tc exceeds the limit tc OFF Comp - dt, the LT pack controller immediately transmits a further compressor demand signal at 1 second intervals to the NT pack controller assigned Node No. *NT Cascade 2 xxx*.

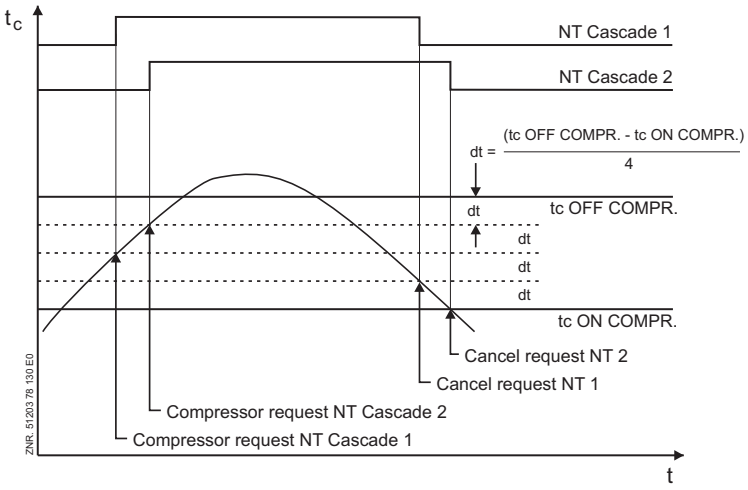
If all NT compressor stages of the pack controller addressed are shut down **and** temperature t_0 of the NT system is greater than the t_0 setpoint NT plus half neutral zone, the NT pack controller immediately loads the available compressor stage having the shortest run time. Loading takes place regardless of all capacity stages possibly being disabled by limiting of compressor starts. The LT pack controller can demand a maximum of one NT capacity stage only when the compressors are at standstill. The demand will be ignored if one NT capacity stage is already in operation.

If a NT capacity stage has been loaded or if a NT compressor is already running or if the actual value of system temperature t0 is less than the setpoint plus half neutral zone, the LT demand is acknowledged as positive. If the NT pack controller cannot load a compressor (e.g. due to HP fault of the NT circuit) or if all compressors have been shut down (e.g. due to suction pressure fault conditions), the demand is acknowledged as negative.

The LT pack controller generates fault report *NT Cascade 1 xxx* or *NT Cascade 2 xxx* at the defined Priority 2 if it receives negative acknowledgment or no acknowledgment

Compressor demand for NT pack controller *NT Cascade 1 xxx* is not cancelled until temperature tc of the LT system has dropped to a value less than limit *tc ON Comp + dt*. Compressor demand for NT pack controller *NT Cascade 2 xxx* is cancelled when temperature tc of the LT system drops to a value less than limit tc ON Comp. The pack controllers do not shut down the compressor until temperature t0 drops below the setpoint less half neutral zone and the stop delay has elapsed. This is shown diagrammatically in the following illustration:

VS 3000 CO_2 Cascade



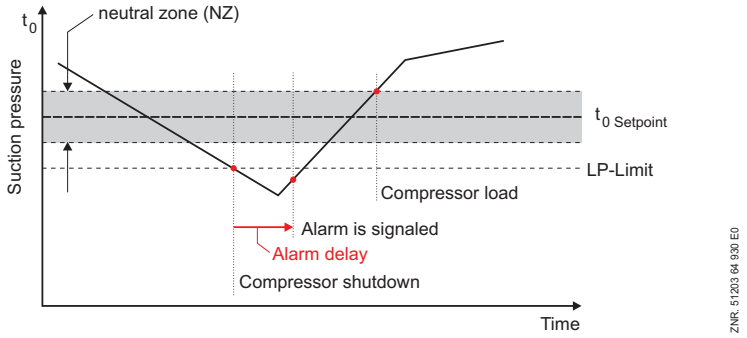
3.25 Monitoring low pressure

All compressors are shut down if low pressure drops below a definable limit (Menu 3-4 *t_0 Comp. OFF*). As previously described, the compressors are loaded stagewise when low pressure rises to the level proportional to the t_0 setpoint + NZ/2.

Alarm is signalled after a set delay. The delay (Menu 3-4 *Del. t_0 OFF*) and priority are definable. The value of the limits is entered in °C, from which the controller then calculates an absolute proportional pressure value. Additionally the LP cutout is evaluated. Forced shutdown of all compressors takes place if pressure drops below the limit set on the LP cutout.

HP monitoring is shown diagrammatically in the following illustration:

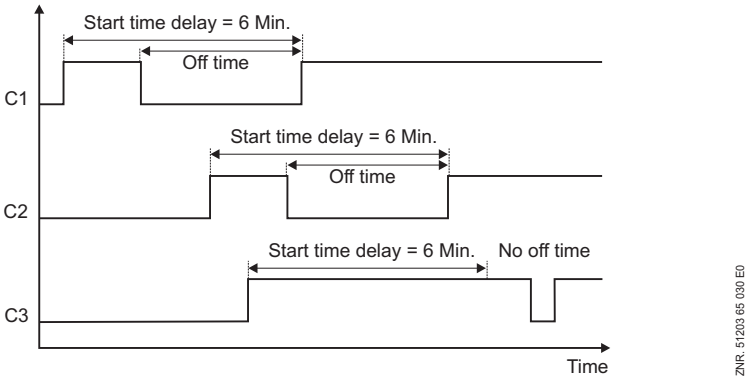
VS 3000 control algorithm LP monitoring



3.26 Monitoring compressor starts

The number of compressor starts per hour is limited as a means of preventing short cycling of compressors.

VS 3000 Starts monitoring



The Compressor *Starts/h* parameter (Menu 3-4) determines the minimum time intervals at which a compressor can be started. If, for example, the parameter is set to 10 starts per hour, the compressor cannot be started earlier than every 6 minutes.

With variable-speed compressors, limiting of compressor starts is deactivated. A *High Starts* alarm will be generated in occurrence of a system fault due to short-cycling of variable-speed compressors if the maximum number of starts set by the Compressor Starts/h parameter is exceeded.

Compressor starts limiting deactivated for variable-speed compressors will be re-activated in the event of a frequency changer fault.

3.27 High-pressure control / Condenser control

Cooling of the refrigerant takes place in the condenser by removal of heat with the condenser fans.
A physical relationship exists between high pressure and refrigerant temperature. Therefore the high pressure or condensing temperature can be controlled with the condenser fans. Four different control types are provided for high-pressure control:

- *Step controller:* Control by enabling or disabling condenser capacity stages.
- *Speed controller:* Control by speed adjuster (continuous control). High pressure is controlled by an analog signal that inputs the required speed to the speed adjuster.

- *Parallel combined controller*: Control by speed adjuster (continuous control). High-pressure control is by analog signal that supplies the required speed to the speed adjuster. The fans are all connected in parallel to the speed adjuster, but can be loaded or unloaded separately
- *Staged combined controller*: Combination of step controller and continuous control. High-pressure control is by enabling or disabling condenser capacity stages and by means of a variable-speed fan.

The control type can be programmed with the AL 300 Operator Terminal, CI 3000 Store Computer or LDSWin PC software. With the AL 300 or CI 3000 the control type is programmed in the *Control Type* selection list (Menu 3-2-2-1-a).

3.27.1 Setting parameter for HP transducer characteristic

The VS 3000 Pack Controller works with continuous pressure transducers of linear characteristic. The pressure inputs can be matched to various linear-characteristic transducers. Transducers delivering either an output current (4 to 20 mA) or an output voltage (0 to 10 V) can be used.

Jumpers must be changed accordingly for voltage-output transducers!
The default configuration is for current input!

The following sensor matching parameters (Menu: 3-1-a) are used to match the controller to the pressure transducer:

1. *HP Transducer:* Choose between transducer delivering continuous current output 4 to 20 mA or continuous voltage output 0 to 10 V.
2. *HP-Min:* Parameter specifies the pressure pc at which the HP transducer delivers an output signal of 4 mA or 0 V
3. *HP-Max:* Parameter specifies the pressure pc at which the HP transducer delivers an output signal of 20 mA or 10 V.

Changing any of these parameters causes a Changed Sensor Type message to be generated.

Faulty parameter setting can result in severe impairment of function and may lead to damage to merchandise and equipment.

3.27.2 Neutral zone

With step control, no actuation of fan stages takes place within a definable neutral zone.

3.27.3 Control algorithm

Controller cycle time is 1 second. The control algorithm depends on the type of control.

In the wet vapor range the temperature is clearly governed by the refrigerant and pressure:
t = f (p, refrigerant).
The VS 3000 Pack Controller calculates temperatures from the pressures measured as a function of the refrigerant used. Exclusively temperature measurements are used for control. In this manual therefore, temperatures (t_0, t_c) stand for pressure (p_0, p_c).

3.27.4 Control algorithm with step controller

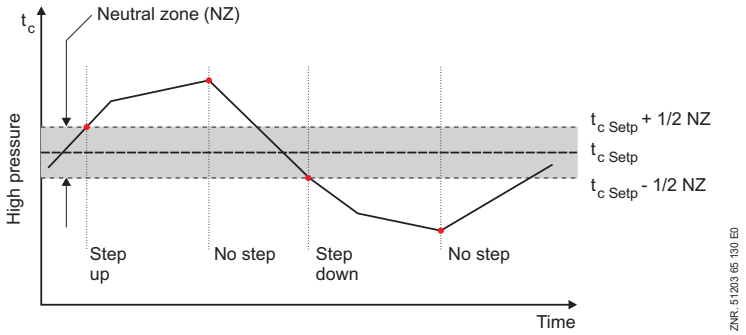
High pressure as detected by an A/D converter is compared with the setpoint. The following relationship applies:

Control error = *Actual value* (t_{0_Act}) − *setpoint* (t_{0_Setp})

When the control error is positive and pressure is rising, the step switch moves one step up, meaning that one additional condenser capacity stage is enabled. When the control error is negative and pressure is falling, the step switch moves down one stage, meaning that one condenser capacity stage is disabled.

Condenser capacity stages are also disabled when all compressors are off and disabling is activated by the parameter *Fan off w/comp* (Menu 3-3-1).

VS 3000 control algorithm HP step controller



3.27.5 Calculating setpoint with step controller

The setpoint for t_c is determined by a programmable characteristic as a function of outdoor temperature. Outdoor temperature is supplied either by a PT1000 sensor connected direct to an input of the pack controller or via the CAN bus by another pack controller in the system.

$$t_c = t_{c\_min} + \frac{\left[\left(t_{c\_max} - t_{c\_min}\right) \cdot \left(t_a - t_{a\_min}\right)\right]}{\left(t_{a\_max} - t_{a\_min}\right)}$$

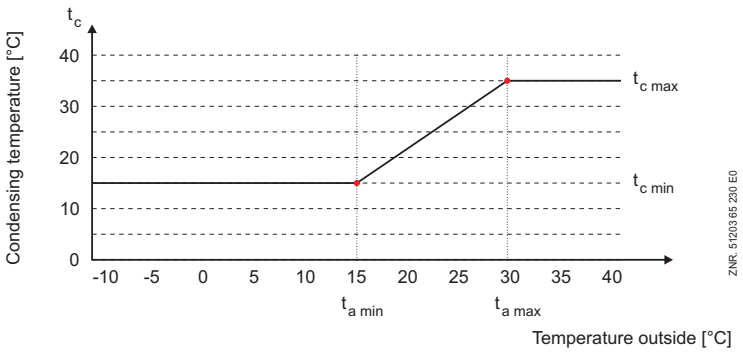
= t_c setpoint
t_{c_max} = Maximum t_c setpoint
t_{c_min} = Minimum t_c setpoint
t_a = Current outdoor temperature
t_{a_max} = Max. outdoor temperature for setpoint shift
t_{a_min} = Min. outdoor temperature for setpoint shift

Given an outdoor temperature of $t_a > t_{a\_max}$ or $t_a < t_{a\_min}$ the following applies:

For $t_a > t_{a\_max}$: $t_c = t_{c\_max}$

For $t_a < t_{a\_min}$: $t_c = t_{c\_min}$

VS 3000 HP control setpoints determination



Temperatures t_{c_min}, t_{a_min}, t_{c_max}, t_{a_max} are definable.

The pressure setpoint for actual control is determined from a conversion table stored in the program. Consideration is given to all currently used refrigerants when converting t_c to the corresponding pressure value (see Section 3.6.1).

3.27.6 Condenser fan control times with step controller

If the condensing pressure rises or falls to a value outside the neutral zone, the first condenser capacity stage is immediately loaded or unloaded. Every further actuation takes place only after a certain time has elapsed for loading or unloading and the control error has exceeded a specified value (neutral zone).

The time is dependent on the actual control error. Actuation takes place in a shorter time with a large control error than with a smaller control error. The control time is calculated as the sum of a basic time t_b and a variable time t_v. Differentiation is made between forward and back switching of the step controller.

The variable time is inversely proportional to the control error. With maximum control error the variable time t_v approaches zero. As the control error decreases, time t_v automatically increases up to the specified maximum.

Basic time and maximum variable time for switching forward (on) and back (off) are definable as parameters for each loading/unloading of a condenser stage. The following relationships apply for determining control times:

$t = t_b + t_v$ t_b = Definable

The following applies for t_v:

$$t_v = t_{v\_max} - \frac{(t_{v\_max} \cdot d_t)}{d_{t\_max}}$$

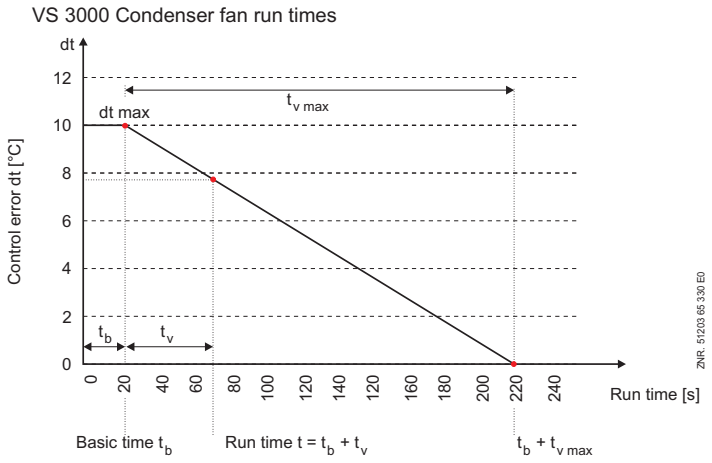
The following applies:

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

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

Control time is calculated at every controller run. The variable time is calculated anew and the time elapsed since the last control time is compared with the calculated time. If the calculated control time is smaller than or equal to the elapsed time, fan actuation takes place when the control error is greater than the specified neutral zone.

The following diagram shows calculation of the control time:



When high pressure is controlled by step controller, the number of fan stages running is output via the Fan Speed analog output according to the following equation:

$$U_{OFF} = \frac{(No\ of\ compressor\ stages\ running \cdot 10V)}{(No\ of\ compressor\ stages\ defined)}$$

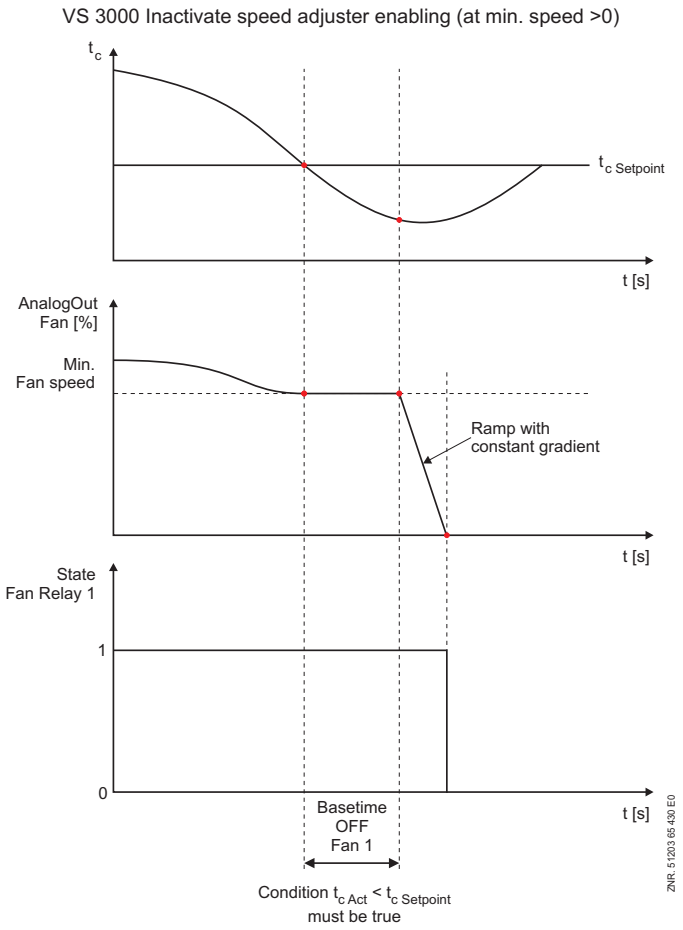
3.27.7 Control algorithm with continuous control

High pressure detected by an A/D converter is compared with the setpoint. The following relationship applies:

Control error = *Actual value* (t_{0_Act}) − *setpoint* (t_{0_Setp})

With a positive control error a speed setpoint is calculated by a PI control algorithm and is supplied to the speed adjuster via an analog output (0 to 10 V). The speed adjuster controls fan speed to the specified setpoint.

With a negative control error the speed adjuster is disabled by the first fan output L1 of the VS 3000 Pack Controller when speed has dropped to zero. If minimum speed of the speed adjuster has been entered at larger than zero by the Min. Speed parameter (Menu 3-3-1), speed is ramped down to zero after a definable time (Basic Time OFF Fan 1) and fan output L1 is deactivated.



Control is influenced by three parameters. The following parameters can be defined (Menu 3-3-1) with the AL 300 Operator Terminal or CI 3000 Store Computer.

```
3 Setpoints - 3 HP-Control - 1 Control type
1 Control type          →
2 Min. speed            XX%
3 Adjust diff.          XX
4 tc-max                XX °C
```

The parameters in Lines 2 to 4 will only be shown when speed controller has been set as the control type. The *Min. speed* parameter can be used to specify minimum speed of the speed adjuster. This is entered as a percentage and refers to the 0 to 10 V analog output of the VS 3000 Pack Controller. The *Adjust diff.* parameter can be used to influence controller speed.

If the controller is too slow, this value must be increased. If hunting of the controller occurs, the value should be decreased. If the t_c*-max* limit is exceeded, the second capacity stage of the controller is activated and the first capacity stage is disabled (enabling of speed adjuster). With the second capacity stage a bypass can be actuated to switch the variable speed fan to fixed speed.

When the setpoint is attained, the controller returns to control mode. The bypass can be deactivated by setting the t_c*-max* parameter auf ---.

3.27.8 Calculating setpoint with continuous control

Calculation of the t_c setpoint is made as described in Section 3.26.5 - Calculating Setpoint with Step Controller. Additionally, a speed setpoint is calculated. The following relationship applies:

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

U_{Setp} = Speed adjuster setpoint (0 to 10 V)
P_{Action} = Proportional action of controller
I_{Action} = Integral action of controller

$$P_{ActionI} = (t_{c\_Act} - t_{c\_Setp}) * P_{Setp}$$

t_{c_Act} = Current value of t_c
t_{c_Setp} = t_c-Setpoint

P action is the controller's direct response to control error. I action prevents persistent control error.

$$I_{Action} = I_{ActionI} + \left(t_{c\_Act} - t_{c\_Setp}\right) * I_{Setp}$$

The I-part is updated at "Interval I" (in seconds).

P_{Value}	= Definable proportional factor of PI controller	(Menu 3-2-2-1)
I_{Value}	= Definable integral factor of PI controller	(Menu 3-2-2-1)
Interval I	= Time interval for calculation of I_{Action}	(Menu 3-2-2-1)

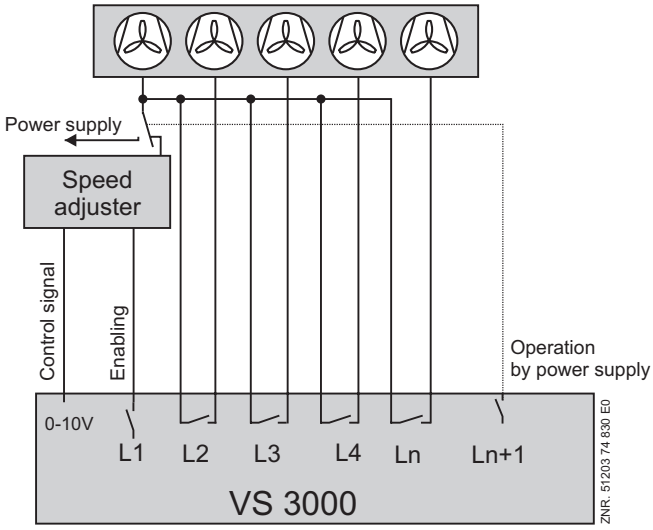
3.27.8.1 Control algorithm with parallel combined controller

High pressure detected by an A/D converter is compared with the setpoint. The following relationship applies: *Controlerror* = *Actualvalue* (t_{c_Act}) − *setpoint* (t_{c_Setp})

Using a PI control algorithm, a speed setpoint is calculated as a function of the control error and supplied to the speed adjuster via an analog output (0 - 10 V), see Section 1.27.8. The speed adjuster controls the speed of all parallel-connected fans, which can be loaded or unloaded separately. Depending on the VS 3000 expansion stage the number of fan stages that can be controlled is as follows:

- VS 3000 basic configuration: 3 fan stages
- One SIOX extension module added: 7 fan stages
- Two SIOX extension modules added: 11 fan stages

With HP combined control the available number of fans as a function of expansion stage is accordingly one less than with step control. The reason for this is that the fan output following the last definable fan output (*No.Cond.Stages XX,* Menu 3-1) is used for toggling to fixed-speed operation.



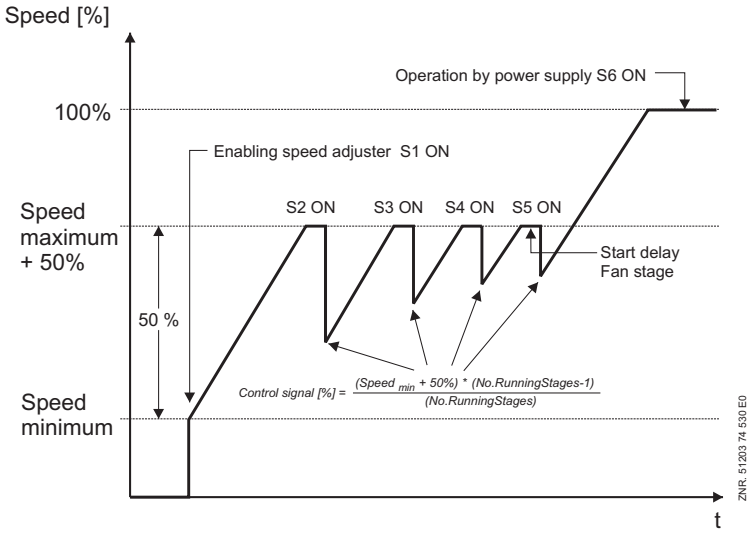
With a positive control error, the speed adjuster is enabled through the first fan capacity stage F1 of the VS 3000. A speed setpoint is calculated by a PI control algorithm as a function of the control error and supplied to the speed adjuster through an analog output (0 - 10 V). The control signal for the first to last-but-one fan stage is limited to the defined minimum speed plus 50% of the maximum control signal. When this limit is reached by a stage, the next capacity stage is loaded after a set delay. The control signal for all fans then running is calculated by the formula:

$$Controlsignal[\%] = \frac{(Speed_{min} + 50\%) \cdot (No.\ of\ running\ stages - 1)}{No.\ of\ running\ stages}$$

This results in condenser capacity approximately equal to that prior to loading the fan. The control signal can reach maximum value when the last fan stage is loaded. Fans shut down by the motor overload cutout are not considered for control.

If pressure has reached a defined HP limit (*tc-Max*. parameter, Menu 3-2-2-1), fixed-speed mode is activated with stage *No.Cond.Stage*s + 1. In fixed-speed mode the speed adjuster is disabled. All fans are then disconnected from the speed adjuster and connected to fixed-speed power supply.

The run-up speed curve for a system equipped with five fans is illustrated in the following diagram



With a negative control error, all running fans are reduced to minimum speed +20%. If pressure remains below the setpoint, fan stages are unloaded with the set time delay. Switching from fixed-speed mode back to variable-speed mode is not made until pressure drops below the tc setpoint. Finally the speed adjuster is disabled through the first fan output S1 of the VS 3000 when speed drops to 0.

If a minimum speed greater than 0 has been entered for the speed adjuster in the *Min. Speed parameter* (Menu 3-2-2-1), speed is ramped down to 0 after a definable time (*Basic Time OFF F1* parameter, Menu 3-2-2-2-c) and fan output S1 is switched off.

Enabling fan stages (Parameter ENAB.COND., Screen 3-1-e)

Enabling of fan stages is directly allocated to the fan relays. Accordingly the speed adjuster and connected fans can be disabled by disabling Fan Stage 1. When the first stage is disabled, HP control works as a step controller with stages 2 to n-1.

The maximum number of stages that can be disabled or enabled is as follows:

- VS 3000 basic configuration: 3 fan stages
- One SIOX extension module added: 7 fan stages
- Two SIOX extension modules added: 11 fan stages

The stage *No. Cond.Stages* + 1 for fixed-speed operation cannot be programmed. It is not shown on the AL 300 Operator Terminal, CI 3000 Store Computer or in the LDSWin PC software.

3.27.8.2 Control algorithm for staged combined controller

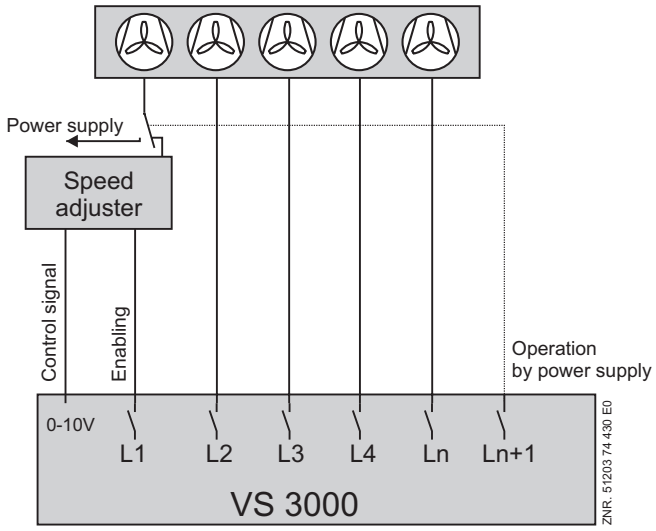
High pressure detected by an A/D converter is compared with the setpoint. The following relationship applies:
Controlerror = *Actualvalue* (t_{c_Act}) − *Setpoint* (t_{c_Setp})

Using a PI control algorithm, a speed setpoint is calculated as a function of the control error and supplied to the speed adjuster via an analog output (0 - 10 V), see Section 1.27.8. HP control takes place with one fan controlled by a speed adjuster. Additional fixed-speed stages can be loaded or unloaded separately.

Depending on the VS 3000 expansion stage the number of fan stages that can be controlled is as follows:

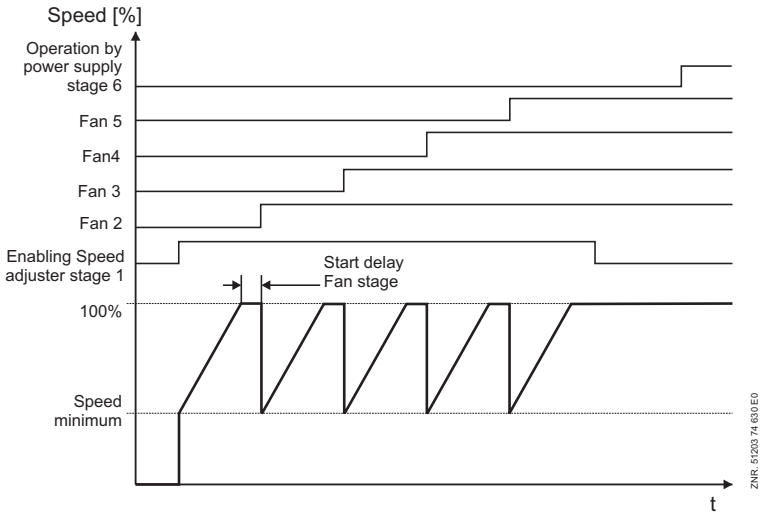
- VS 3000 basic configuration: 3 fan stages
- One SIOX extension module added: 7 fan stages
- Two SIOX extension modules added: 11 fan stages

With HP combined control the available number of fans as a function of expansion stage is accordingly one less than with step control. The reason for this is that the fan output following the last definable fan output (*No.Cond.Stages XX,* Menu 3-1) is used for toggling to fixed-speed operation.



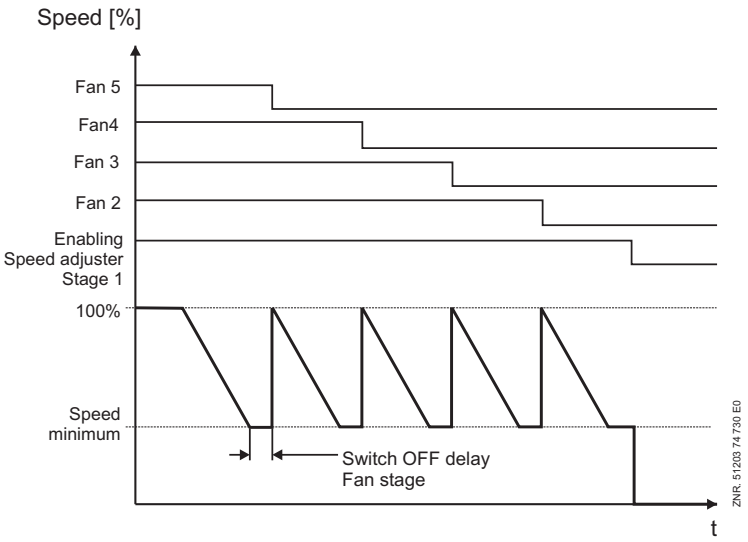
With a positive control error, the speed adjuster is enabled through the first capacity stage of the VS 3000. Depending on the control error, a speed setpoint is calculated by a PI control algorithm and supplied to the speed adjuster through an analog output (0 - 10 V). At maximum speed, the next capacity stage is loaded with a set delay.

The control signal for the first fan stage is reduced to minimum speed. Fans that have been shut down by the motor overload cutout are not considered for control. Fixed-speed mode is activated with the stage *No.Cond.Stages* + 1 when pressure reaches a defined limit. The speed adjuster is disabled in fixed-speed mode. Then the first fan is disconnected from the speed adjuster and connected to fixed-speed power supply.The run-up speed curve for a system equipped with five fans is illustrated in the following diagram:



With a negative control error, speed is reduced by the PI controller. At minimum speed one fan capacity staged in unloaded with a set delay and at the same time speed is increased to maximum. Finally the speed adjuster is disabled through the first fan output S1of the VS 3000 when speed drops to 0.

If a minimum speed greater than 0 has been entered for the speed adjuster in the Min. Speed parameter (Menu 3-2-2-1), speed is ramped down to 0 after a definable time *Basic Time OFF Fan 1*) and fan output S1 is switched off. Switching from fixed-speed mode back to variable-speed mode is not made until pressure drops below the tc setpoint. The run-down speed curve for a system equipped with five fans is illustrated in the following diagram:



Enabling fan stages (Parameter ENAB.COND., Screen 3-1-e)

Enabling of fan stages is directly allocated to the fan relays. Accordingly the speed adjuster and connected fans can be disabled by disabling Fan Stage 1. When the first stage is disabled, HP control works as a step controller with stages 2 to n-1.

The maximum number of stages that can be disabled or enabled is as follows:

- VS 3000 basic configuration: 3 fan stages
- One SIOX extension module added: 7 fan stages
- Two SIOX extension modules added: 11 fan stages

The stage *No. Cond.Stages* + 1 for fixed-speed operation cannot be programmed. It is not shown on the AL 300 Operator Terminal, CI 3000 Store Computer or in the LDSWin PC software.

3.27.9 Heat recovery mode

Heat recovery mode (HR) of the VS 3000 Pack Controller is implemented with two parameters:

- The *HR max.* parameter (Menu 3-3-2) specifies the maximum condensing temperature allowed in HR mode.

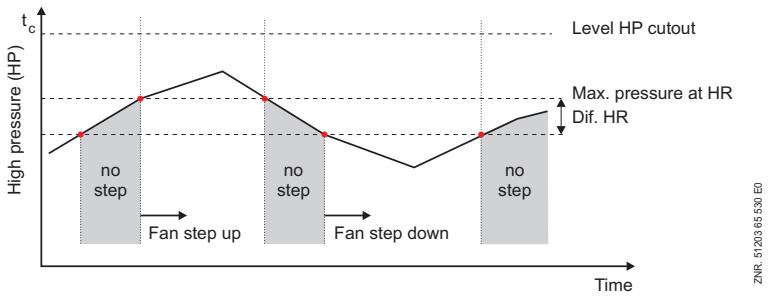
For control purposes the temperatures are converted to pressure of the selected refrigerant:

- The *HR dif.* parameter (Menu 3-3-2) defines a temperature difference.

If pressure rises to a level greater than *HR max.*, the first fan stage is loaded immediately (without regard to programmed control times). Each additional fan stage is loaded at the end of the basic start time (without regard to the variable control time).

If pressure drops to a level smaller than *HR max. - HR dif.*, fan stages are unloaded subject to the basic and variable unload time. Heat recovery mode is activated through Digital Input 21.

VS 3000 Control algorithm heat recovery mode (HR mode)



Changes to control action in HR mode:

- High-pressure fault is not signalled.
- No compressor load shedding in high-pressure fault.

HR mode is indicated on the display of the CI 3000 Store Computer or AL 300 Operator Terminal:

- HR mode active:
  $t_{c\text{-}Setp.}$ HR 45°C
  $p_{c\text{-}Setp.}$ HR 20.85b
- HR mode not active:
  $t_{c\text{-}Setp.}$ 45°C
  $p_{c\text{-}Setp\cdot}$ 20.85b

3.28 HP setpoint increase

The option is given with the VS 3000 Pack Controller of entering a temperature offset *tc Offset N* (Menu 3-3-2), which is added to the setpoint temperature t_{c_Setp} when setpoint toggle is active.

3.29 Fan protection / HP base load rotation

Additional functions for protection of the fan motors have been implemented in the VS 3000 Pack Controller. During periods of low outdoor temperatures, when only a small part of the condenser fans are needed, it is possible for fans to seize after being idle for an extended time.

This can be avoided by preventing extended standstill of fans with the *BaseLoadRot.F* parameter (Menu 3-7). When base load rotation is activated, the following additional entries appear in the operating screen:

1. *On time cond.*: One of two modes can be selected:

   - Fan protection

   When *On time cond*. is set to *N*, the fan control scheme remains unchanged. Fans are loaded in the sequence from L1 to Ln and unloaded from Ln to L2. Fans that have been off for longer than the definable *Cycle time F.* (Menu 3-7) are then started for a period of 20 seconds.

- Run time equalization

When the entry is set to Y, the fan control sequence is changed. Fans are then not loaded and unloaded in sequence but according to running time. When a fan needs to be loaded, the fan then having the shortest run time will be started. When a fan needs to be unloaded, the fan then having the longest run time will be stopped.

Fan base load rotation is also effective in this operating mode. When the HP controller remains in the neutral zone for the definable *Cycle time F.* (Menu 3-7), the fan then having the shortest run time will be started - if available - and the fan having the longest run time will be stopped.

2. *Cycle time F.*

A value can be entered to determine the time after which either fan actuation or base load rotation will take place as a function of the modes described above.

3.30 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 logged in fault memory. Alarm forwarding 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 logged in fault memory for the fan motor concerned. Alarm forwarding 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 always used for control.

Combined controller:

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 logged in fault memory.

Alarm forwarding 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.

Motorschutz Stufe 1 überwacht die am Drehzahlsteller angeschlossenen Lüfter. In der Betriebsart Kombiregelung parallel wird bei Ansprechen des Motorschutzschalters der Lüfterstufe 1 der Lüfterausgang 1 nicht zurückgesetzt, da dies alle Lüfter deaktivieren würde. Es wird lediglich eine Störmeldung ausgegeben. Maximal können folgende Anzahl Lüfterstufen überwacht werden:

- VS 3000 basic configuration: 3 fan stages
- One SIOX extension module added: 7 fan stages
- Two SIOX extension modules added: 11 fan stages

The fault output for the speed adjuster/frequency changer can be monitored through the input for the fan motor overload cutout of stage *No.Cond.Stages* + 1.

When no voltage is applied to this input (fault on speed adjuster), Fan Output 1 is reset to enable the speed adjuster and in its place the relay output for fan stage *No.Cond.Stages* + 1 is activated to allow emergency operation.

Applicable to parallel combined controller only: With condenser combined control it is essential to make sure that the output is used for power line bypass. Cooling is no longer assured in frequency changer fault conditions.

3.31 Starting characteristics

Differentiation is made between two conditions when starting the controller:

- First start
- Restart

3.31.1 First start

First start of the VS 3000 Pack Controller can be initiated in various ways:

- On first starting the system (default parameters are loaded on controller first start)
- After updating the firmware
- After changing the operating mode by the coding switches of DIP Switch S1
  (See Section 4 - Installation and Startup for details)
  - NT and LT: The set of parameters depends on the refrigeration system
    (normal-temperature - NT, or low-temperature - LT)
  - Number of external SIOX extension modules (0, 1 or 2)
  - With or without discharge gas defrosting (optional SIOX extension module)
- If parameter setting is found to be incorrect by self-check

All variables, except the parameters, are set to zero. Default parameters are loaded. Owing to the large number of parameters, the basic settings can also be loaded by using an operator terminal (menu 7).

3.31.2 Restart

Restart takes place following return of power after an outage, provided the parameter settings have been preserved.

All variables, except the parameters, the fault memory and the archived data, are deleted.

3.32 Monitoring refrigerant level

A liquid level switch (Digital Input 23) 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 actuated after a definable time.

3.33 Monitoring burst disk

The controller can monitor a bursting disk via Digital Input 22. Alarm is generated if the input is de-energized. Alarm forwarding takes place according to the preselected priority. The digital input has no effect on the control and regulating functions.

3.34 Monitoring external alarm / speed adjuster

An external alarm can be forwarded via Digital Input 15 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.

When operating the controller with HP control defined as step switch, this input is available for free use to forward user-defined alarms. The message text can be entered in Menu 3-6 *Alarm message*. The default text loaded on first start is *External Alarm*.

When operating the controller with LP control defined as combined controller, the function of this input is predefined as the input to record faults on the compressor control frequency changer. In this instance the alarm text is predefined, as *Speed Adjuster.*

3.35 Disabling refrigeration points

In the occurrence of a fault on the compressor pack, the pack controller can transmit a refrigeration point disable signal to all associate refrigeration points. The associate refrigeration points are case/coldroom controllers on which the node address of the pack controller has been programmed in the controller configuration.

The refrigeration point disable signal is sent to all associate refrigeration points when no compressor or refrigeration capacity is available. Possible causes of failure are:

- Tripping of high-pressure cutout
- Tripping of all motor overload cutouts
- Tripping of all low oil pressure cutouts
- Manual shutdown of all compressors

Refrigeration points are not disabled in the event of a low-pressure fault due to low suction pressure or tripping of the LP cutout. Additionally, a refrigeration point enable signal is supplied through Digital Output 9 to allow of incorporating external controllers.

3.36 Discharge gas defrosting

Discharge gas defrosting (D2D) is a method of passing compressed vapor from the compressor through evaporators for the purpose of defrosting them. It may be performed with either hot gas taken from the discharge line upstream of the condenser or cold gas taken from the receiver located downstream of the condenser.

Discharge gas defrosting as described herein is a two-pipe D2D system that can only be performed with hot refrigerant gas. Otherwise a risk is entailed of liquid refrigerant being drawn in by the compressors.

Two compressor packs and accordingly two VS 3000 Pack Controllers are required to perform discharge gas defrosting. They are here termed Z1 Pack and Z2 Pack. The pack controller performing defrost by D2D and controlling the defrost sequence is termed Z2-VS3000. The pack controller that does not perform D2D defrost and provides for supply of the discharge gas is termed Z1-VS3000.

Discharge gas defrosting can be carried out for an NT or LT refrigeration compressor pack, i.e. Z2 Pack working in either the NT or LT range. The pack supplying the discharge gas, i.e. Z1 Pack, always works in the NT range. Allocation of case/coldroom controllers to the Z1 or Z2 range is made exclusively by defining the CAN bus Node No. of the associate Z!-VS3000 or Z2-VS3000 pack controller on the case/coldroom controller (see description of UA 300 Case/ Coldroom Controllers).

When performing discharge gas defrosting of Z2 refrigeration points, Z2 display cases and Z2 coldrooms can be defrosted jointly or separately. Separate defrosting requires a separate suction line for the Z2 coldrooms. For discharge gas defrosting the Z2-VS3000 requires an additional digital input/output module (SIOX).

Coding Switch 4 of DIP switch S1 on the Z2 pack controller must be set ON in order to activate discharge gas defrosting and display the corresponding setpoints and actual values (see Section 4 - Installation and Startup). Defrosting can then be activated by the internal defrost timer or by digital inputs of the controller.

3.36.1 Setpoints for discharge gas defrosting

The setpoints for discharge gas defrosting can be checked and adjusted with the AL 300 Operator Terminal, the CI 3000 Store computer or a PC. When discharge gas defrosting is activated (DIP switch 4 on the VS 3000 for Z2 set ON), an additional submenu named *D2D* (Menu 3-9) is shown in the Setpoints Menu.

Discharge gas defrosting can be performed for a NT or a LT compressor pack (Z1 is always NT, Z2 can be either NT or LT). Therefore the parameters and actual values are identified as Z1/Z2 and not NT/LT. The system that does not use D2D and delivers the discharge gas is identified as Z1.

The system using D2D and controlling the defrost sequence is identified as Z2. The *Defr. Z2R* screen (Menu 3-9) opens a selection list, in which the defrost method for LT coldrooms is defined:

- *With Cases*
  Defrosting is performed simultaneously with the Z2 display cases via a common suction line.
- *Aux. Defrost*
  Joint defrosting via separate suction lines. Auxiliary defrosting can be performed on Z2 coldrooms.
- *Separate*
  Z2 coldrooms and Z2 display cases are defrosted independently via separate suction lines.
- *El. With UA 300*
  Z2 display cases and Z2 coldrooms have a common suction line. The Z2 cases are defrosted by D2D, the Z2 coldrooms by electric heater through the coldroom controller.

Choosing the *Def. timer* screen (Menu 3-9) opens a submenu that shows the defrost times for joint defrosting (Z2 cases and Z2 coldrooms). Choosing the *Def. timer* Z2R screen (Menu 3-9) opens a submenu that shows the defrost times for auxiliary defrosting or separate defrosting of the Z2 coldrooms. This line is only shown when auxiliary defrosting or defrosting for Z2 coldrooms has been defined.

The Z2 compressors must be disabled after Z2 defrost to allow oil equalization between the Z2 and Z1 compressor packs. The to *C.Suct.l.on Z2* parameter (Menu 3-9) is used to enter a value for t_0 that disables the Z2 compressors until temperature reaches the set limit.

If the system is equipped with an oil equalizer, the Z2 compressors will be enabled when temperature to of the Z2 pack reaches temperature to of the Z1 pack plus 2 K. If the system does not have an oil equalizer, the Z2 compressors are enabled when the to value of the Z2 pack equals the parameter to *Comp.ON Z2* (Menu 3-9, Compressor Enable Temperature After D2D). Compressor disabling is limited to 5 minutes maximum. Data exchange takes place between the Z2 and Z1 pack controllers for carrying out defrosting. The node address of the Z1 pack must be entered in the *Nd.No. Z1* Pack parameter (Menu 3-9).

The t_0 setpoint to be controlled by the Z1 pack controller during defrosting is only active when the defrost mode *With Cases* or *El. UA300* is selected under *Def. Z2R* (Menu 3-9-a). The *Def. Z2R* parameter (Menu 3-9) controls defrost duration of the Z2 coldrooms. This defrost time applies only to auxiliary or separate defrosting of the Z2 coldrooms. This line will only be shown when auxiliary defrosting or separate defrosting for Z2 coldrooms has been defined.

3.36.2 Actual values for discharge gas defrosting

All digital inputs and outputs required for discharge gas defrosting can be checked with the AL 300, CI 3000 or by PC. An operator terminal can be used to display the D2D actual values (Menu 2-5).

3.36.3 Manual control of D2D

The *Man. Defrost Z2* Cases digital input (D2D-SIOX) initiates joint defrosting for Z2 cases and Z2 coldrooms in systems that have only one suction line. In systems with two suction lines, the input initiates defrosting only for the Z2 cases. Coldrooms can be manually defrosted via the *Man. Defrost Z2 Rooms* input.

Defrosting can be disabled for the respective refrigeration points via the digital inputs *Disable Defrost Z2 Cases* and *Disable Defrost Z2 Rooms*.

Allocation of case/coldroom controllers or refrigeration points to the Z1 or Z2 range is made exclusively by defining the CAN bus Node No. of the associate Z!-VS3000 or Z2-VS3000 pack controller on the case/ coldroom controller (see description of UA 300 Case/Coldroom Controllers).

3.36.4 Discharge gas defrosting in fault conditions

- Defrosting is repeated if power failure occurs within the first 10 minutes of defrosting. Start delay for the drain heater is not started however.
- Defrosting is cancelled if power failure occurs after defrosting has been running for at least 10 minutes.
- Z2 defrosting is cancelled if low pressure does not drop to the t_0 limit *to Comp OFF* (Menu 3-4) within 4 minutes of closing the suction line. Fault report *Fault D2D Z2* is logged in fault memory.
- The fault report *Disab D2D Z2* or *Disab D2D Z2R* is logged in fault memory if defrosting is initiated by the internal timer and defrosting is disabled via the *Disable Defrost Z2* or *Disable Defrost Z2 Rooms* digital input.
- In occurrence of CAN bus failure, the fault report *Fault D2D Z2* or *Fault D2D Z2R* is logged in fault memory together with CAN Bus Fault.
- Defrosting is not initiated if a severe fault (safety loop) is signalled. The fault report *Fault D2D Z2* or *Fault D2D Z2R* is logged in fault memory together with the system fault.

3.36.5 Sequence of joint Z2 discharge gas defrosting

	Signal:	**Start delay-for drain heating5 to 30 min**	**Unload to one stage Speed = Minimum**	**Pumpdown to suction pressure at *LP Low***	**Defrost time 10 to 30 min**	**Defrost termination**			
1	Drain heater Z2 coldrooms	■	■	■	■				No start delay if power failure occurs during defrosting and in separate defrost
2	SV2.2/1 and SV2.2/2 close suction line			■	■	■	■		4 min monitoring time for pump-down. SV opens 10 to 100 sec after SV3.2. Z2 Low LP alarm disabled
3	SV1 common discharge line				■				SV3.2/1, SV3.2/2 discharge feed closed 5 sec later
4	SV3.2/1, SV3.2/2 discharge gas feed				■	■			Z2 coldrooms disabled with electric defrost. Defrost termination by temperature or defrost duration on NT cases
5	Defrost command to Z2 refrigeration points via bus				■				
6	Disable Z2 refrigeration points via bus					■	■		Start on defrost termination. End 30 sec after first Z2 compressor starts. Max. 5 min duration.
7	Setpoint toggle Z1 pack (no shift)			■	■	■	■		AL 300/CI 3000 displays A before t0 setpoint in overview
8	Forced cooling of all Z1 refrigeration points via bus				■				
9	Disable LP Measuring *Loop Error alarm*							■	5 min after opening suction line
10	Disable Z2 compressors 1.5 min before opening suction line when defrost duration equal to max. defrost time				Pump down or disable compressors	■	■		<u>Without oil equalizer:</u> Enable compressors when t0_Z2 < t0_Enable <u>With oil equalizer:</u> Enable compressors when t0_Z2 < (t0_Z1 + 2K) Max. disable after defrost 5 min. Min. disable 10 sec

3.36.6 Sequence of Z2 display case discharge gas defrosting

Defrost sequence is as follows when cases and coldrooms are defrosted separately.

	Signal:	**Wait max. 2 min for Z1 pack OK**	**30 sec delay**	**Defrost time 10 to 30 min.**	**Defrost termination**	
1	MV2.2/1 Saugleitung schließen	■	■	■	■	SV closes 10 - 100 sec after SV3.2/1.
2	MV1 gemeinsame Druckleitung			■		
3	SV3.2/1 discharge gas feed			■		SV3.2/1 closed 5 sec after SV1
4	Abtaubefehl an Z2-Möbel über CAN-Bus			■		
5	Disable Z2 cases via bus				■	Refrigeration points disabled until t0_Z2 < t0_Enable min. 10 sec, max. 5 min after SV2.2/1 opens
6	Setpoint toggle Z1 pack (no shift)		■	■		AL 300/CI 3000 displays A before t0 setpoint in overview
7	Forced cooling of all Z1 refrigeration points via bus			■		
8	Disable LP Measuring *Loop Error* alarm				■	5 min after opening suction line SV2.2/1.

Coldrooms can continue on cooling while cases are defrosting.

3.36.7 Sequence of Z2 discharge gas defrosting with coldroom defrost mode set to *El. With UA 300*

	Signal:	Start delayfor drain heater5 to 30 minfor oil equaliz-ation	Unload to one stage Speed = Minimum	Pumpdown to suction pressure at *LP Low*	Defrost time 10 to 30 min.	Defrost termination			
1	Drain heater Z2 coldrooms								No start delay if power failure occurs during defrosting and in separate defrost
2	SV2.2/1 close suction line								4 min monitoring time for pump-down. SV opens 10 to 100 sec after SV3.2. Z2 Low LP alarm disabled.
3	SV1 common discharge line								SV3.2/1, SV3.2/2 discharge feed closed 5 sec later
4	SV3.2/1discharge gas feed								Z2 coldrooms disabled with electric defrost. Defrost termination by temperature or defrost duration on NT cases.
5	Defrost command to Z2 cases (not to Z2 coldrooms) via bus								
6	Disable Z2 coldrooms								
7	Disable all Z2 refrigeration points via bus								Start on defrost termination. End 30 sec after first Z2 compressor starts. Max. 5 min duration
8	Setpoint toggle Z1 pack (no shift)								AL 300/CI 3000 displays A before t0 setpoint in overview
9	Forced cooling of all Z1 refrigeration points via bus								
10	Disable LP Measuring Loop Error alarm								5 min after opening suction line
11	Disable Z2 refrigeration points 1.5 min before opening suction line when defrost duration equal to max. defrost time				Absaugen oder Verd. sperre				<u>Without oil equalizer:</u> Enable compressors when t0_Z2 < t0_Enable <u>With oil equalizer:</u> Enable compressors when t0_Z2 < (t0_Z1 + 2K) Max. disable after defrost 5 min. Min. disable 10 sec

3.36.8 Sequence of Z2 coldroom discharge gas defrosting

When Z2 coldrooms are provided with auxiliary defrost or are defrosted separately, the defrost sequence for Z2 coldrooms is as follows

	Signal:	**Start delay- for drain heater5 to 30 min .**	**30 sec delay**	**Defrost time 10 to 30 min**	**Defrost termination**	
1	Drain heater Z2 coldrooms	■	■	■		No start delay if power failure occurs during defrosting
2	SV2.2/2 close suction line		■	■		SV 2.2/2 closes 10 - 100 sec after SV 3.2
3	SV1 common discharge line			■		
4	SV 3.2/2 discharge gas feed			■		SV 3.2/2 closed 5 sec after SV1
5	Defrost command to Z2 coldrooms via CAN bus			■		
6	Disable Z2 coldrooms via bus				■	Refrigeration points disabled until t0_Z2 < t0_Enable.Min. 10 sec, max. 5 min after SV 2.2/2 opens.
7	Setpoint toggle Z1 pack (no shift)		■	■		AL 300/CI 3000 displays ”A” before t0 setpoint in overview. Setpoint toggle only when enabled by parameter setting
8	Forced cooling of all Z1 refrigeration points and Z2 cases via bus			■		Forced cooling only when enabled by parameter setting.

Refrigerated display cases can continue on cooling while coldrooms are defrosting.

3.37 Archiving of operating data

3.37.1 Compressor/fan operating hours

Total running time of compressors/fans is measured at 30-second intervals and stored in memory backed up against data loss in power failure. Time is shown in hours. Operating hours can also be programmed for replacement of compressors/fans or the controller (Menu 6-1).

3.37.2 Daily run times and compressor starts

In addition to total operating hours, the daily run time, compressor starts and activity (utilization) of the compressor pack are recorded. The cycle time starts at midnight and the current status is shown in hours and minutes. This data is additionally stored in memory over a period of 32 days for use in evaluating operation of the compressor pack.

3.37.3 Compressor pack activity/utilization

Activity is calculated by the following formula:

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

Activity : Activity (utilization) of compressor pack

L : Total of all compressor run times

n : Number of compressors installed

T_1 : Current time

T_0 : Day change

The current status is shown as a percentage.

4 Installation and Startup of VS 3000

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. It is also used to read out actual values and archived long-term data. Before commissioning the VS 3000 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.
- 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.
- 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.
- 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 VS 3000 (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 Installation

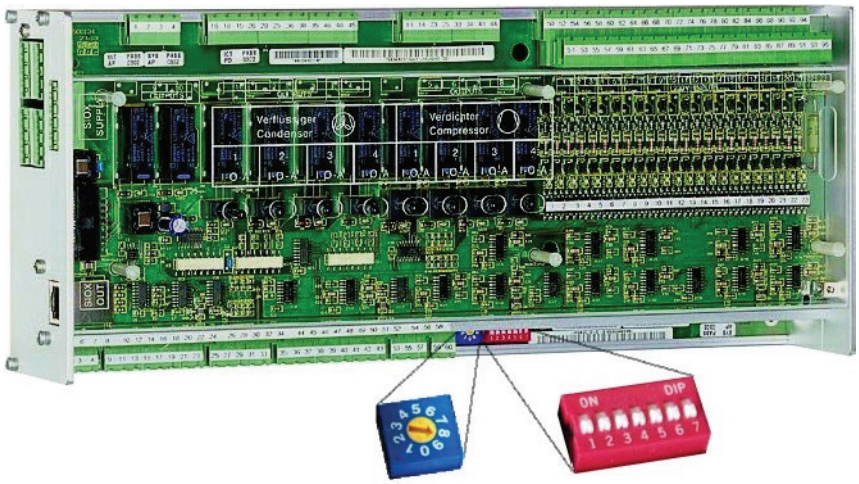
The pack controller is designed for cap rail mounting. It fastens on the cap rail by snapping on with two clips (on the underside). Power loss of the controller is 6 W and allowance must be made for this in installation.
The pack controller is ready for operation after completing mechanical and electrical installation.

All leads running to and from the VS 3000 (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.

See Section 10 - Specifications of VS 3000 for electrical enclosure and measurements.

4.3 Basic parameter settings on hardware

Basic parameter settings for the pack controller are configured with DIP Switch S1 and Decade Switch S2.
These switches 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

- Compressor pack type NT / LT	Coding Switch	1
- No. of SIOX extension modules	Coding Switch	2 and 3
- With/without discharge gas defrosting	Coding Switch	4
- Service mode	Coding Switch	5
- Firmware update mode	Coding Switch	6 and 7

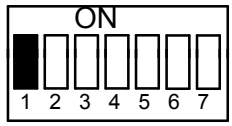
S2 - Decade Switch for

- Setting Node No. (Nd.nnn) or CAN bus address	Position 1 to 9	Address 101 to 109
- Deactivating as CAN bus station	Position 0	NO address

4.3.1 Basic settings with S1

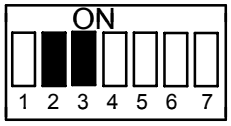
Setting compressor pack type

Coding Switch 1 of DIP Switch S1 defines the pack type NT (normal-temperature refrigeration) or LT (low- temperature refrigeration):

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

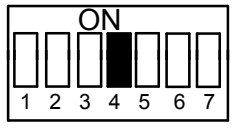
Setting the number of extension modules (number of capacity stages)

Coding Switches 2 and 3 of DIP Switch S1 define the maximum number of compressor and fan capacity stages. In the basic version the VS 3000 can control 4 compressor and 4 fan capacity stages. One additional SIOX extension module is required for maximum 8 compressor and 8 fan capacity stages. A second SIOX extension module is required for maximum 12 compressor and 12 fan capacity stages.

DIP Switch 1 Coding Switches 2 and 3	Coding Switch 2 position	Coding Switch 3 position	
	**ON**	**ON**	**2 external SIOX modules** - max. 12 compressor stages - max. 12 fans
	ON	**OFF**	**1 external SIOX module** - max. 8 compressor stages - max. 8 fans
	OFF	**OFF**	**No SIOX module** - max. 4 compressor stages - max. 4 fans

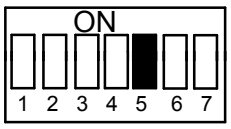
Maximum 12 compressors and 12 fans can be used (see Section 1 - System Design).

Setting discharge gas defrosting

DIP Switch S1 Coding Switch 4	Switch position	Discharge gas defrosting
	**ON**	With discharge gas defrosting
	OFF	Without discharge gas defrosting

Setting service mode

Coding Switch 5 of DIP Switch S1 5 defines service mode:

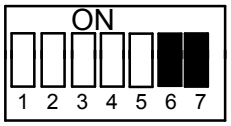
DIP Switch S1 Coding Switch 5	Switch position	Service mode
	**ON**	Service mode
	OFF	Normal operating mode

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

Service mode must always be deactivated for normal system operation (Coding Switch 5 of DIP Switch S1 **must** be set OFF)!

Setting firmware update mode

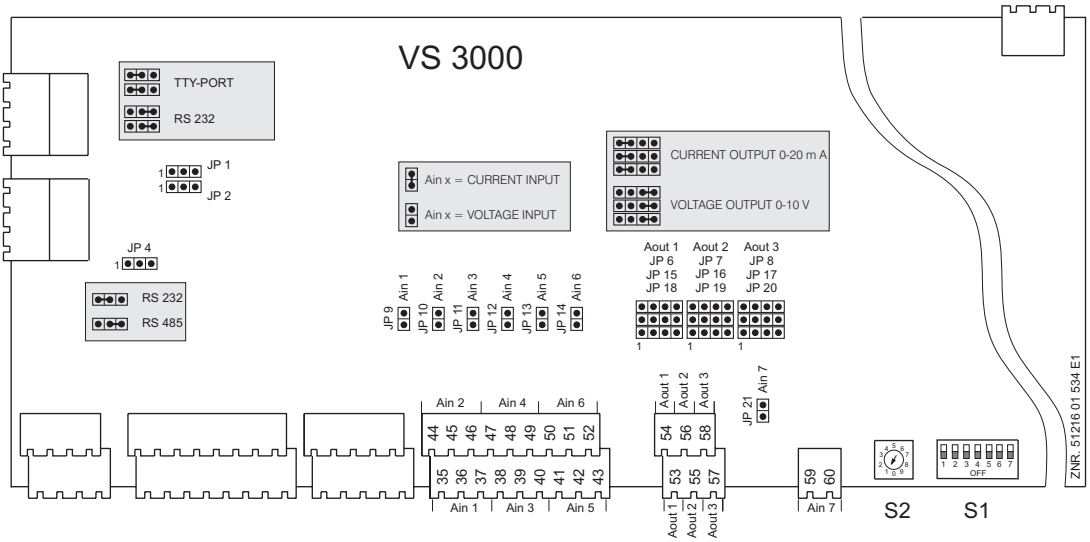
Coding Switches 6 and 7 of DIP Switch S1 define firmware update mode:

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 VS 3000 **must** be turned off briefly for the new settings to take effect!



4.3.2 Basic settings with S2

Setting the Node No. / Deactivating CAN bus communication

Decade Switch S2 defines the Node No. (Nd.nnn) or CAN bus address. This setting is normally made by the manufacturer of the switchgear.

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

After changing switch positions on S1 or S2, the VS 3000 must be turned off briefly for the new settings to take effect!

4.4 Basic parameter settings in software

On the CI 3000 Store Computer or AL 300 Operator Terminal, choose Menu 5 Remote Operation and, in the operating screen that opens, select the VS 3000 by the set Node No. (S2 - see Section 4.2.2). The parameters listed below must then be set in appropriate VS 3000 screens.

System Configuration parameter (Menu 3-1)

- *Refrigerant*
  - Scroll with the UP and DOWN cursor keys (↓) (↑) and select the appropriate refrigerant
- *Sensor match*
  The VS 3000 Pack Controller works with continuous pressure transducers of linear characteristic.
  Pressure inputs can be matched to various linear-characteristic transducers. Both transducers with current output (4 to 20 mA) and those with voltage output (0 to 10 V) can be used. The following parameters are used to match the controller to the pressure transducer:

  1. *LP Transducer and HP Transducer*
     Selects sensors for continuous current output or continuous voltage output.
  2. *LP-Min*
     Defines pressure at which LP transducer delivers 4 mA or 0 V output signal.
  3. *LP-Max*
     Defines pressure at which LP transducer delivers 20 mA or 10 V output signal
  4. *HP-Min*
     Defines pressure at which HP transducer delivers 4 mA or 0 V output signal
  5. *HP-Max*
     Defines pressure at which HP transducer delivers 20 mA or 10 V output signal.

Changing any of these parameters generates a *Changed Sensor Type* message.

Jumpers must be changed on the controller when using voltage-output transducers! The default configuration is for current inputs!

- *No. Comp.stages*
  - Number of compressor stages
- *No.cap.stages*
  - Number of capacity stages
- *No. cond.stages.*
  - *Number of condenser capacity stages*

Menu 3-4 Comp. monitor

- *t_0 Comp OFF*
  – t_0 limit for disabling compressors

The t_0 limit must be higher than the value manually set on the pressure switch.

Faulty parameter settings can result in severe impairment of function.

4.5 Replacing the battery

The pack controller contains a backup battery of type CR 2450 N, 3V lithium. The pack controller must be removed from the system when the battery needs replacing, meaning that the compressor pack is not controlled and monitored during this time.

If the pack controller is connected to a higher-order controller via the CAN bus, it will then not be present on the CAN bus. Attention is therefore required to the repercussions this has on the higher-order controllers connected to the CAN bus as well as to precautions directly affecting the pack controller.

The safety regulations contained in the **Installation, General Safety and Connection Notes Manual** must be observed and complied with when changing the battery. All connectors may only be connected or disconnected when power is off. Circuit boards may only be exchanged when power is disconnected. Always hold circuit boards at the edges.

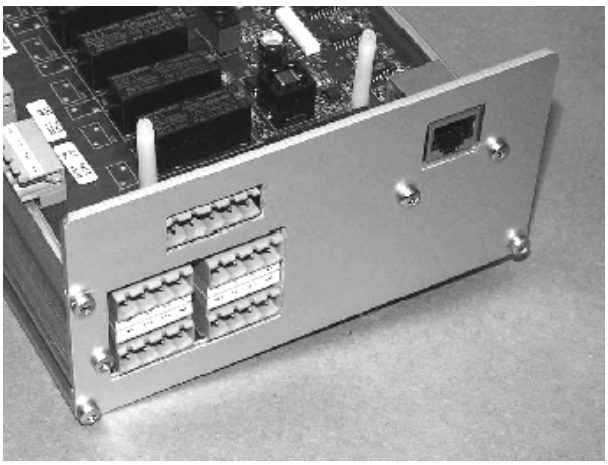
Electrostatic discharge (ESD) regulations must be observed and complied with! (See **Installation, General Safety and Connection Notes Manual**).

When the pack controller is connected to the CAN bus, removal of the controller from the CAN bus causes fault alarm on the higher-order controller (Store Computer).
Make sure that service mode is activated on the CI 3000 Store Computer or that the Service Center is notified accordingly in advance.

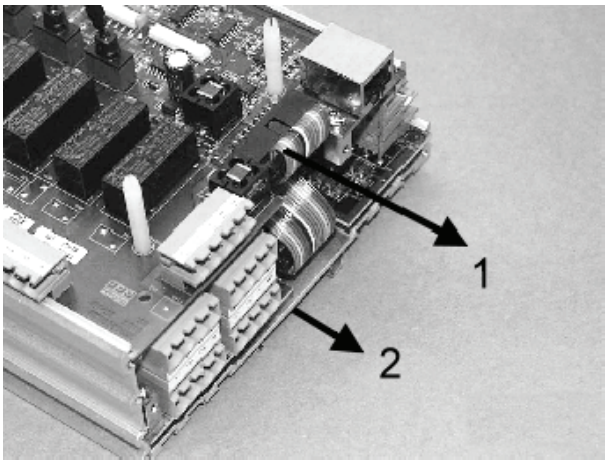
1. Disconnect the pack controller from power. Cancel alarm on Store Computer.
2. Disconnect all connectors, remove controller from support is necessary.

Some connectors carry 230 V AC power. Mark connectors as appropriate before disconnecting.

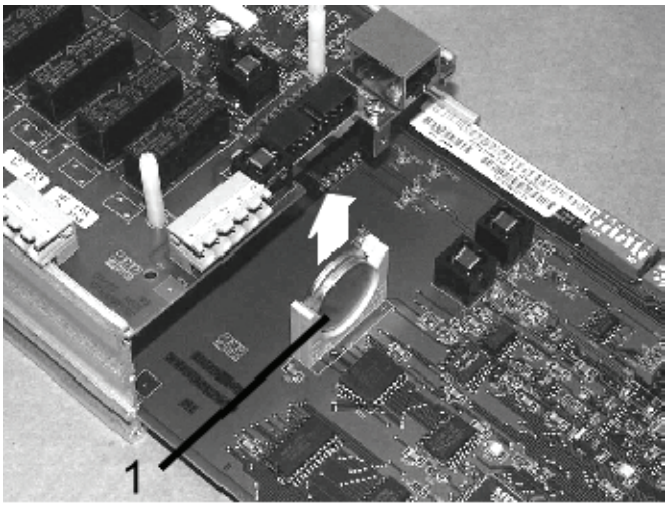
3. Undo six screws on side panel:



4. Pull connector (1) out to rear and pull out lower circuit board (2).



5. Pull battery (1) upwards out of holder and dispose of it in regulation manner:



Do not grip the new battery with metal pliers, as it might short-circuit and be destroyed.
- Wipe the new battery with a clean, dry cloth.
- Do not touch the edge contact faces.

7. Grip the new battery with a cloth and insert it in the battery holder.
8. Re-assemble in the reverse order. Reconnect all connectors.
9. Reconnect pack controller to power.
10. Provided configuration of the CI 3000 Store Computer is not changed, the pack controller will be re-detected automatically via the CAN bus. Date, time and automatic daylight saving change will be set automatically by central time synchronization.

Messages and/or alarms displayed when restarting the pack controller must be checked out on the CI 3000 Store Computer or AL 300 Operator Terminal!

First start should be performed on the pack controller after replacing the battery. All variables, except the parameters, are reset to zero. Data should be backed up with the LDSWin Software prior to performing first start.

4.6 Installing update software

As supplied, the VS 3000 pack controller is operational and contains the current firmware. Future software versions can be loaded into the VS 3000 by firmware update when required to bring them up to date.

This requires a two-step procedure:

- Install update software on the PC
- Update firmware on the VS 3000 by download

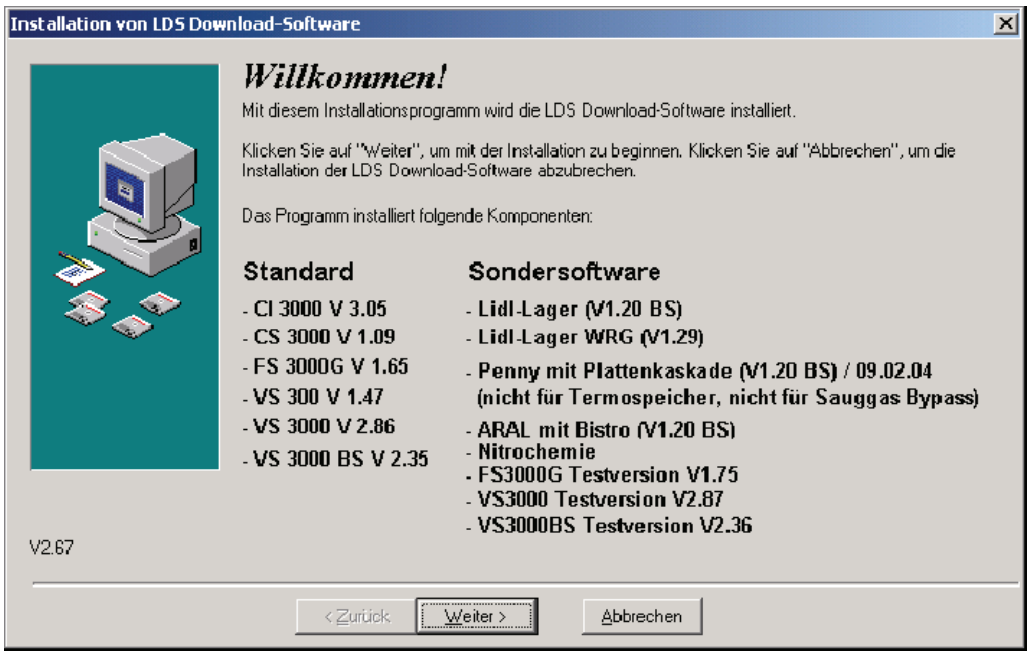
First start is performed following firmware update. This loads the default settings for all parameters and all archives (alarms/messages and operating data, e.g. starts, activity) are deleted! Your must now repeat complete startup of the system (see section 4 Startup).

4.6.1 Installing update software on the PC

The procedure for installing *LDS Download Software* under Windows 95/98 or Windows NT, 2000 and XP is as follows:

You must be authorized with Administrator rights to install software under Windows NT, 2000 and XP!

1. In *Windows Explorer*, open the drive (CD-ROM, disk or network drive) containing the *LDS Download Software*.
2. Double-click setup.exe to start installing the program.



The list and the version status of the components that can be installed may vary according to the version of the LDS download software.

3. Follow the instructions of the installer.
4. Finish installation.

To update the firmware, the *LDS Download Software* must be started by either of the following:

- Click *Start - Programs - LDS Download - Download All LDS Components*

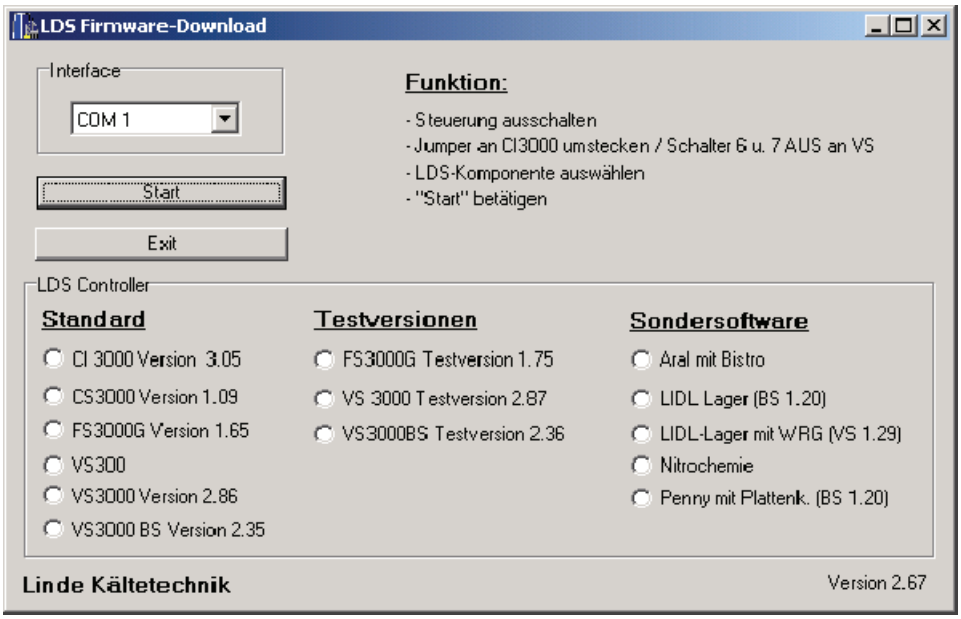
- Click *Start - Run- C:\DL\Start\dload.exe*

This will then load the current firmware update into the VS 3000 Pack Controller.

4.6.2 Updating current firmware in VS 3000

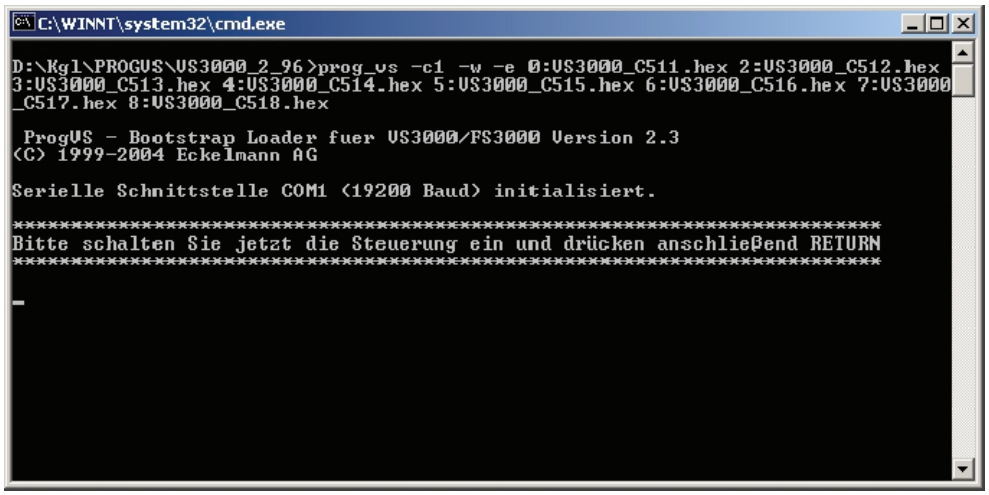
Firmware update is performed with the help of a PC or notebook computer connected to the VS 3000 pack controller via the COM port. It is **essential** to observe and carry out the steps listed below:

1. Disconnect the VS 3000 from the line power supply (the pack controller **must** be off-circuit).
2. Connect the controller to the COM port of the PC or COM adapter of the notebook.
3. Set Coding Switches 6 and 7 of DIP Switch S1 to OFF position (see chapter 4.3.1).
4. Start the *LDS Download Software* by either of the following:
   Click *Start - Programs - LDS Download - Download All LDS Components*
   Click *Start - Run- C:\DL\Start\dload.exe*
5. The following screen will open:

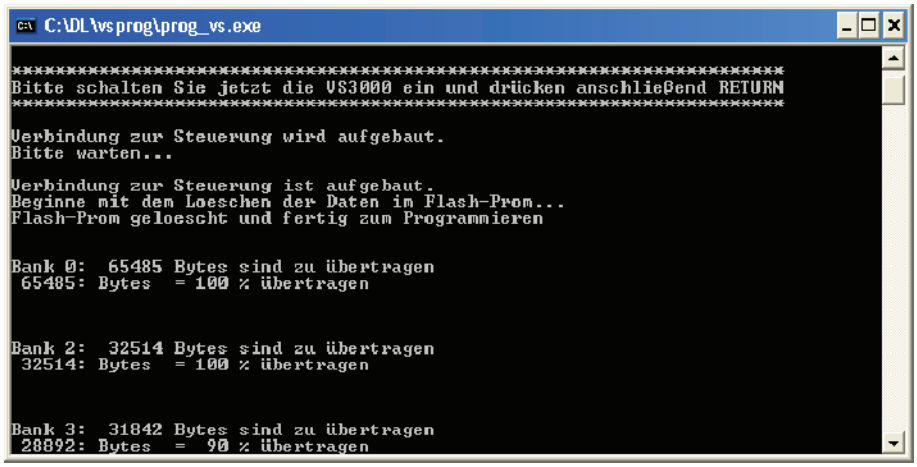


6. Select the COM port.
7. Select the LDS component.
8. Click on the *Start* button or press the *Enter* key.

9. The following screen will open:



10. Comply with the message Please switch on the controller now and then press ENTER.
    - Restart the VS 3000 pack controller
    - Then press the Enter key
11. The following screen opens while the firmware update is being loaded into the VS 3000:



12. This screen closes automatically on pressing the Enter when the firmware has been updated.
13. Close the *LDS Download Software* by clicking on the *Finish* button.
14. Set coding switches 6 and 7 of DIP Switch S1 back to ON (see chapter 4.3.1).
15. Reconnect the VS 3000 pack controller to the line power supply.

In normal operation, Coding Switches 6 and 7 of DIP switch S1 are always set ON!
After changing the switch positions of both S1 and S2, the VS 3000 must be disconnected briefly from power for the new settings to take effect!

Notizen:

5 Pin and Terminal Assignments of VS 3000

The following figures and tables show the terminal assignments of the VS 3000 Pack Controller inputs and outputs required for maximum 12 compressor and 12 fan stages.

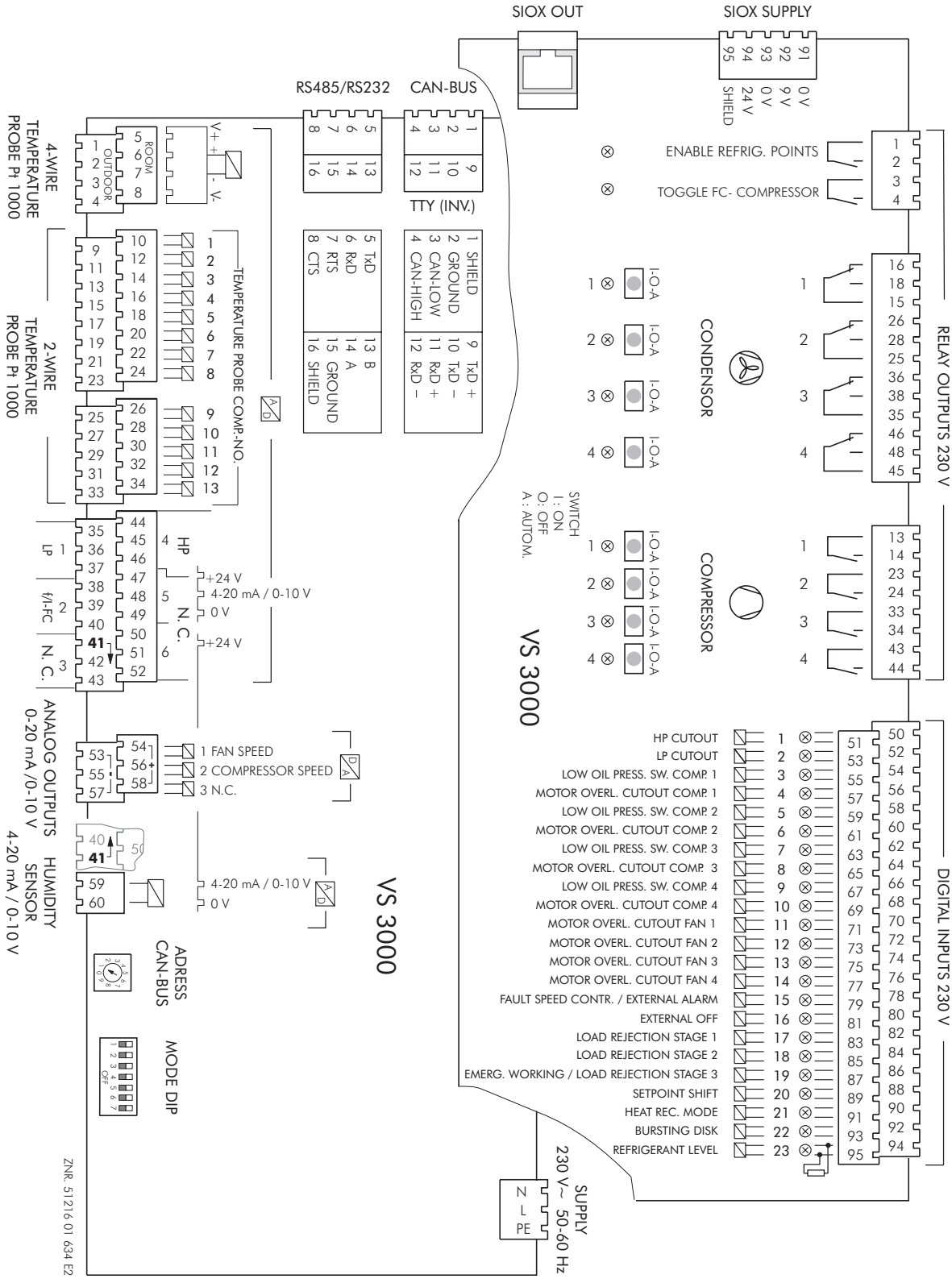
The following items MUST be observed and complied with when connecting wiring:

- All connecting leads from and to the VS 3000 - except digital inputs and relay outputs - must be shielded in order to prevent malfunction, e.g. faulty measurements.

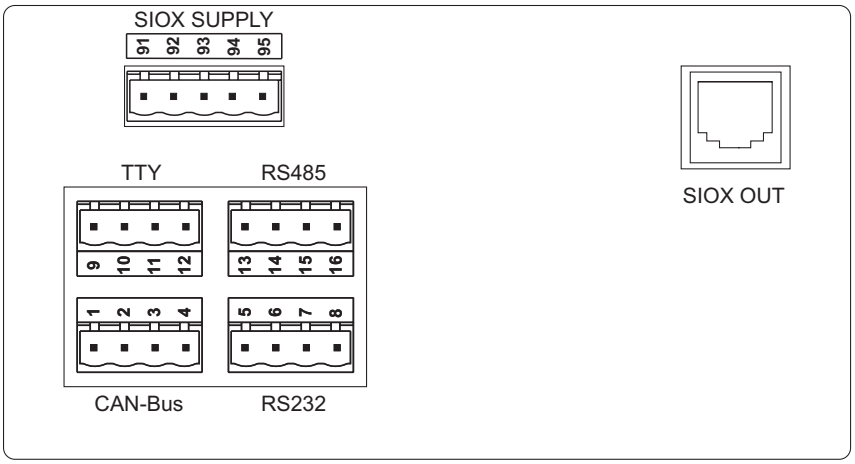
- Make sure that polarity is correct on inputs and outputs carrying current and voltage signals (0 to 10 V or 4 to 20 mA). Short circuiting or incorrect signal feed can result in impairment of function or even destruction of internal components of the VS 3000. Also make sure that the inputs and outputs 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 VS 3000

5.1 Pin assignments



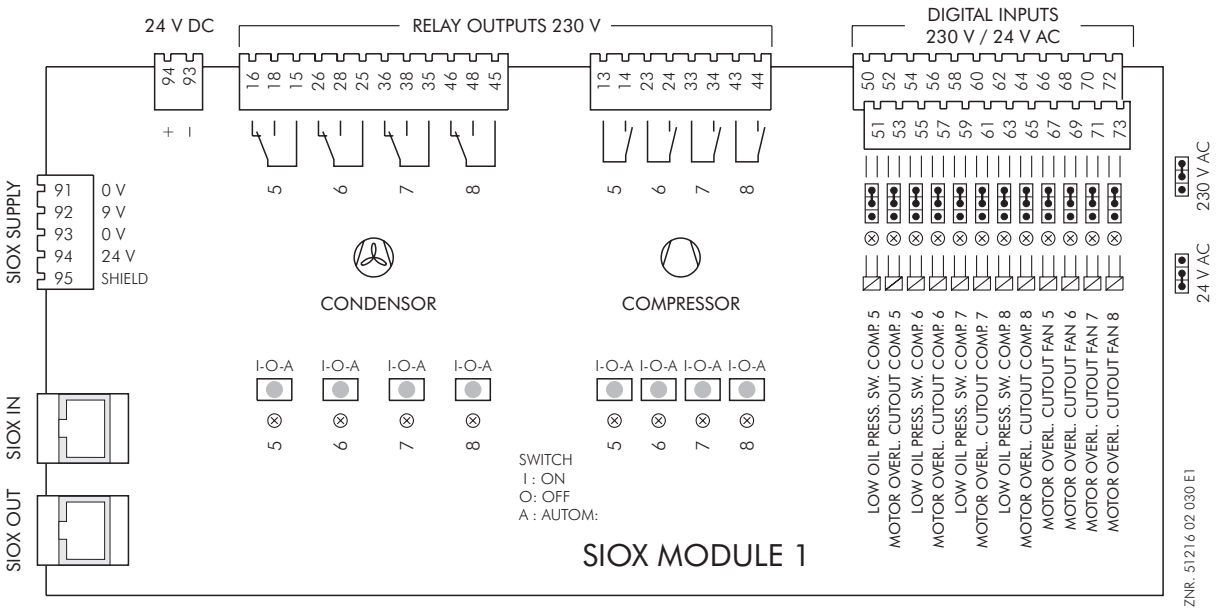
Pin assignments of VS 3000 basic module



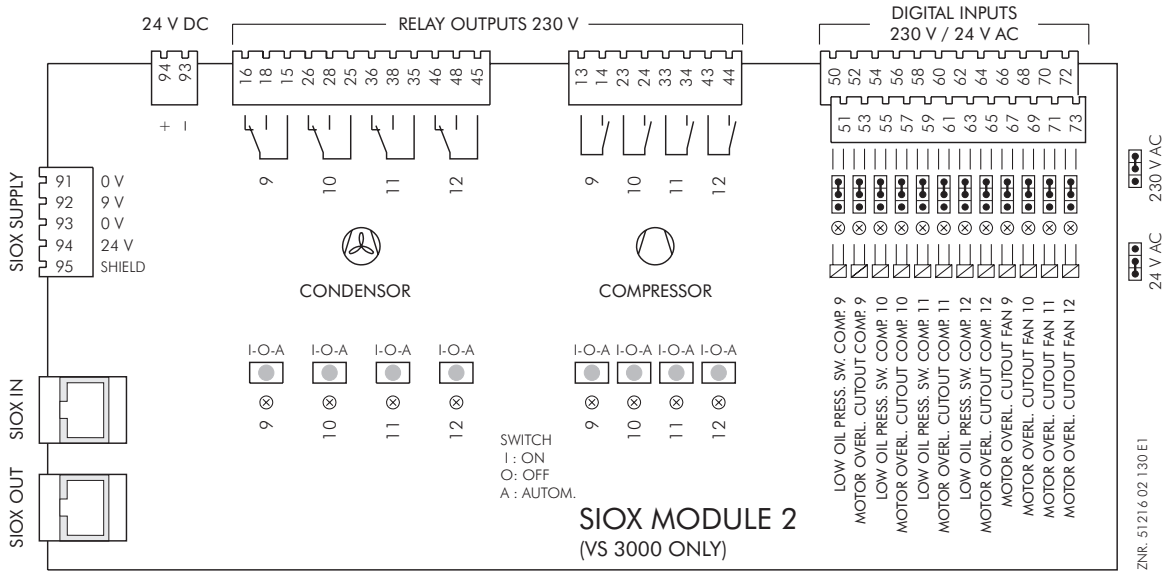
CAN-Bus	1	SHIELD
	2	GROUND
	3	CAN-LOW
	4	CAN-HIGH
RS232	5	TxD
	6	RxD
	7	RTS
	8	CTS
TTY	9	TxD +
	10	TxD -
	11	RxD +
	12	RxD -
RS485	13	B
	14	A
	15	GROUND
	16	SHIELD
SIOX SUPPLY	91	0 V
	92	9 V
	93	0 V
	94	24 V
	95	SHIELD

ZNR. 51203 55 830 D0

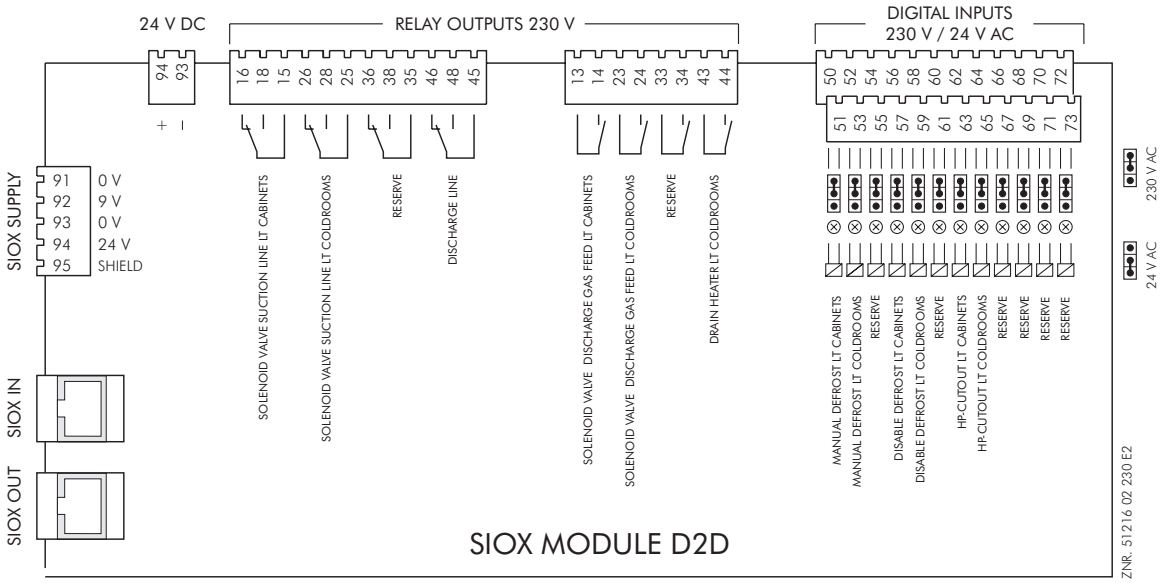
Pin assignments of VS 3000 basic module - side connections



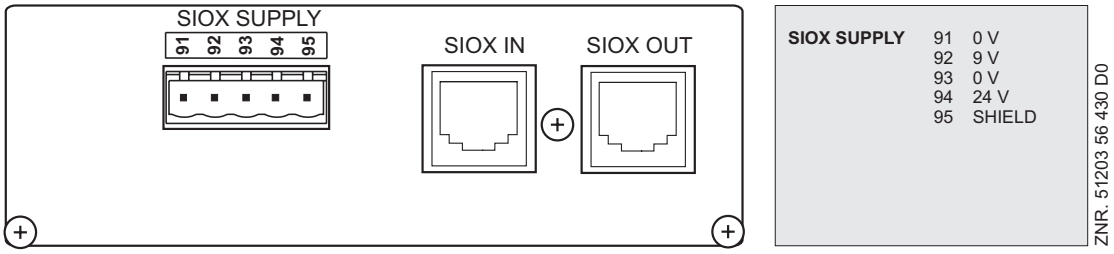
Pin assignments of first SIOX extension module



Pin assignments of second SIOX extension module



Pin assignments of SIOX D2D extension module for discharge gas defrosting



Pin assignments of SIOX extension module - side connections

5.2 Inputs/outputs for 4 compressor capacity stages / 4 fan stages

Digital Inputs	
Function	**Basic Module Terminal No.**
High-pressure cutout	50, 51
Low-pressure cutout	52, 53
Bursting disk	92, 93
Setpoint toggle (day/night operation)	88, 89
Fast unload/External OFF	80, 81
Motor overload cutout Condenser Fan 1	70, 71
Motor overload cutout Condenser Fan 2	72, 73
Motor overload cutout Condenser Fan 3	74, 75
Motor overload cutout Condenser Fan 4	76, 77
External alarm (speed adjuster fault with activated speed control)	78, 79
Low oil pressure cutout Compressor 1	54, 55
Low oil pressure cutout Compressor 2	58, 59
Low oil pressure cutout Compressor 3	62, 63
Low oil pressure cutout Compressor 4	66, 67
Motor overload cutout Compressor 1	56, 57
Motor overload cutout Compressor 2	60, 61
Motor overload cutout Compressor 3	64, 65
Motor overload cutout Compressor 4	68, 69
Heat recovery	90, 91
Load shedding Stage 1	82, 83
Load shedding Stage 2	84, 85
Emergency mode/Load shedding Stage 3	86, 87
Level monitoring/Refrigerant low liquid level	94, 95

Digital Outputs	
Function	**Basic Module Terminal No.**
Enable refrigeration points	1, 2
Toggle FC compressor	3, 4
Controller Compressor 1	13, 14
Controller Compressor 2	23, 24
Controller Compressor 3	33, 34
Controller Compressor 4	43, 44
Controller Condenser Fan 1	15, 16,18
Controller Condenser Fan 2	25, 26, 28
Controller Condenser Fan 3	35, 36, 38
Controller Condenser Fan 4	45, 46, 48

Analog Intputs		
Function		**Basic Module Terminal No.**
Outdoor temperature (optional)	+ Sensor + PT1000 - PT1000 - Sensor	1 2 3 4
Room temperature (optional)	+ Sensor + PT1000 - PT1000 - Sensor	5 6 7 8
Cylinder head temperature C1	+PT1000 - PT1000	9 10
Cylinder head temperature C2	+PT1000 - PT1000	11 12
Cylinder head temperature C3	+PT1000 - PT1000	13 14
Cylinder head temperature C4	+PT1000 - PT1000	15 16
Low-pressure transducer	+ 24 V 4..20 mA GND	35 36 37
High-pressure transducer	+ 24 V 4..20 mA GND	44 45 46
Rücklesen des FU-Ausgangs zur Ausgabe des Stroms bzw. der Frequenz	+ 24 V 4..20 mA GND	38 39 40
Humidity sensor (optional)	+24 V DC 4...20 mA	41 59

All leads running to and from the VS 3000 (except the 230 V power supply and signal leads) must be shielded! This applies especially to analog inputs (sensor leads) and CAN bus wiring.

Analog Outputs	
Function	**Basic Module Terminal No.**
Variable-speed fan control	53, 54
Variable-speed compressor control	55, 56

All leads running to and from the VS 3000 (except the 230 V power supply and signal leads) must be shielded! This applies especially to analog inputs (sensor leads) and CAN bus wiring.

Interfaces	
Function	**Basic Module Terminal No.**
CAN bus connection	CAN
Shield	1
Ground	2
CAN-L	3
CAN-H	4
External SIOX connection output	SIOX OUT
TTY	TTY
RS232	RS232
RS485	RS485

Power Supply	
Function	**Basic Module Terminal No.**
230 V AC	N, L
Grounding conductor	PE
SIOX power supply	
0 V	91
9 V	92
0 V	93
24 V	94
Shield	95

5.3 Inputs/outputs for 8 compressor capacity stages / 8 fan stages

Digital Intputs		
Function	**Basic Module Terminal No.**	**1. Extension Module SIOX**
High-pressure cutout	50, 51	-
Low-pressure cutout	52, 53	-
Bursting disk	92, 93	-
Setpoint toggle (day/night operation)	88, 89	-
Fast unload/External OFF	80, 81	-
Motor overload cutout Condenser Fan 1	70, 71	-
Motor overload cutout Condenser Fan 2	72, 73	-
Motor overload cutout Condenser Fan 3	74, 75	-
Motor overload cutout Condenser Fan 4	76, 77	-
Motor overload cutout Condenser Fan 5	-	66, 67
Motor overload cutout Condenser Fan 6	-	68, 69
Motor overload cutout Condenser Fan 7	-	70, 71
Motor overload cutout Condenser Fan 8	-	72, 73
External alarm (Speed adjuster fault with activated speed control)	78, 79	-
Low oil pressure cutout Compressor 1	54, 55	-
Low oil pressure cutout Compressor 2	58, 59	-
Low oil pressure cutout Compressor 3	62, 63	-
Low oil pressure cutout Compressor 4	66, 67	-
Low oil pressure cutout Compressor 5	-	50, 51
Low oil pressure cutout Compressor 6	-	54, 55
Low oil pressure cutout Compressor 7	-	58, 59
Low oil pressure cutout Compressor 8	-	62, 63
Motor overload cutout Compressor1	56, 57	-
Motor overload cutout Compressor2	60, 61	-
Motor overload cutout Compressor3	64, 65	-
Motor overload cutout Compressor4	68, 69	-
Motor overload cutout Compressor5	-	52, 53
Motor overload cutout Compressor6	-	56, 57
Motor overload cutout Compressor7	-	60, 61
Motor overload cutout Compressor8	-	64, 65
Heat recovery	90, 91	-
Load shedding Stage 1	82, 83	-
Load shedding Stage 2	84, 85	-
Emergency mode/Load shedding Stage 3)	86, 87	-
Level monitoring/Refrigerant low liquid level	94, 95	-

Digital Outputs		
Function	**Basic Module Terminal No.**	**1. Extension Module SIOX**
Enable refrigeration points	1, 2	-
Toggle FC compressor	3, 4	-
Controller Compressor 1	13, 14	-
Controller Compressor 2	23, 24	-
Controller Compressor 3	33, 34	-
Controller Compressor 4	43, 44	-
Controller Compressor 5	-	13, 14
Controller Compressor 6	-	23, 24
Controller Compressor 7	-	33, 34
Controller Compressor 8	-	43, 44
Controller Condenser Fan 1	15,16, 18	-
Controller Condenser Fan 2	25, 26, 28	-
Controller Condenser Fan 3	35, 36, 38	-
Controller Condenser Fan 4	45, 46, 48	-
Controller Condenser Fan 5	-	15, 16, 18
Controller Condenser Fan 6	-	25, 26, 28
Controller Condenser Fan 7	-	35, 36, 38
Controller Condenser Fan 8	-	45, 46, 48

Analog Intputs			
Function		**Basic Module Terminal No.**	**1. Extension Module SIOX**
Outdoor temperature	+ Sensor + PT1000 - PT1000 - Sensor	1 2 3 4	- - - -
Room temperature	+ Sensor + PT1000 - PT1000 - Sensor	5 6 7 8	- - - -
Cylinder head temperature C1	+PT1000 - PT1000	9 10	- -
Cylinder head temperature C2		11, 12	-
Cylinder head temperature C3		13, 14	-
Cylinder head temperature C4		15, 16	-
Cylinder head temperature C5		17, 18	-
Cylinder head temperature C6		19, 20	-
Cylinder head temperature C7		21, 22	-
Cylinder head temperature C8		23, 24	-
Low-pressure transducer	+ 24 V 4..20 mA GND	35 36 37	- - -
High-pressure transducer	+ 24 V 4..20 mA GND	44 45 46	-
Read FC output to deliver current or frequency	+ 24 V 4..20 mA GND	38 39 40	-
Humidity sensor (optional)	+ 24 V DC 4..20 mA	41 59	- -

All leads running to and from the VS 3000 (except the 230 V power supply and signal leads) must be shielded! This applies especially to analog inputs (sensor leads) and CAN bus wiring.

Analog Outputs		
Function	**Basic Module Terminal No.**	**1st SIOX Extension Module**
Variable-speed fan control	53, 54	-
Variable-speed compressor control	55, 56	-

Interfaces		
Function	**Basic Module Terminal No.**	**1st SIOX Extension Module**
CAN bus connection		-
Shield	1	
Ground	2	
CAN-L	3	
CAN-H	4	
External SIOX connection input	-	SIOX IN
External SIOX connection output	SIOX OUT	SIOX OUT
TTY	TTY	-
RS232	RS232	-
RS485	RS485	-

Power Supply		
Function	**Basic Module Terminal No.**	**1st SIOX Extension Module**
230 V AC	N, L	-
Grounding conductor	PE	-
SIOX power supply		
- 0 V	91	91
- 9 V	92	92
- 0 V	93	93
- 24 V	94	94
- Shield	95	95

5.4 Inputs/outputs for 12 compressor capacity/12 fan stages

Digital Intputs			
Function	**Basic Module Terminal No.**	**Extension Module**	
		SIOX 1	**SIOX 2**
High-pressure cutout	50, 51	-	-
Low-pressure cutout	52, 53	-	-
Bursting disk	92, 93	-	-
Setpoint toggle (day/night operation)	88, 89	-	-
Fast unload / External OFF	80, 81	-	-
Motor overload cutout Condenser Fan 1	70, 71	-	-
Motor overload cutout Condenser Fan 2	72, 73	-	-
Motor overload cutout Condenser Fan 3	74, 75	-	-
Motor overload cutout Condenser Fan 4	76, 77	-	-
Motor overload cutout Condenser Fan 5	-	66, 67	-
Motor overload cutout Condenser Fan 6	-	68, 69	-
Motor overload cutout Condenser Fan 7	-	70, 71	-
Motor overload cutout Condenser Fan 8	-	72, 73	
Motor overload cutout Condenser Fan 9	-	-	66, 67
Motor overload cutout Condenser Fan 10	-	-	68, 69
Motor overload cutout Condenser Fan 11	-	-	70, 71
Motor overload cutout Condenser Fan 12	-	-	72, 73
External alarm (Speed adjuster fault with activated speed control)	78, 79	-	
Low oil pressure cutout Compressor 1	54, 55	-	
Low oil pressure cutout Compressor 2	58, 59	-	
Low oil pressure cutout Compressor 3	62, 63	-	
Low oil pressure cutout Compressor 4	66, 67	-	
Low oil pressure cutout Compressor 5	-	50, 51	
Low oil pressure cutout Compressor 6	-	54, 55	
Low oil pressure cutout Compressor 7	-	58, 59	
Low oil pressure cutout Compressor 8	-	62, 63	
Low oil pressure cutout Compressor 9	-	-	50, 51
Low oil pressure cutout Compressor 10	-	-	54, 55
Low oil pressure cutout Compressor 11	-	-	58, 59
Low oil pressure cutout Compressor 12	-	-	62, 63
Motor overload cutout Compressor1	56, 57	-	
Motor overload cutout Compressor2	60, 61	-	
Motor overload cutout Compressor3	64, 65	-	
Motor overload cutout Compressor4	68, 69	-	
Motor overload cutout Compressor5	-	52, 53	
Motor overload cutout Compressor6	-	56, 57	
Motor overload cutout Compressor7	-	60, 61	
Motor overload cutout Compressor8	-	64, 65	

Digital Intputs			
Function	**Basic Module Terminal No.**	**Extension Module**	
		SIOX 1	**SIOX 2**
Motor overload cutout Compressor9	-	-	52, 53
Motor overload cutout Compressor10	-	-	56, 57
Motor overload cutout Compressor11	-	-	60, 61
Motor overload cutout Compressor12	-	-	64, 65
Heat recovery	90, 91	-	
Load shedding Stage 1	82, 83	-	
Load shedding Stage 2	84, 85	-	
Emergency mode / Load shedding Stage 3	86, 87	-	
Level monitoring/Refrigerant low liquid level	94, 95	-	

Digital Outputs			
Function	**Basic Module Terminal No.**	**Extension Module**	
		SIOX 1	**SIOX 2**
Enable refrigeration points	1, 2	-	-
Toggle FC compressor	3, 4	-	-
Controller Compressor 1	13, 14	-	-
Controller Compressor 2	23, 24	-	-
Controller Compressor 3	33, 34	-	-
Controller Compressor 4	43, 44	-	-
Controller Compressor 5	-	13, 14	-
Controller Compressor 6	-	23, 24	-
Controller Compressor 7	-	33, 34	-
Controller Compressor 8	-	43, 44	-
Controller Compressor 9	-	-	13, 14
Controller Compressor 10	-	-	23, 24
Controller Compressor 11	-	-	33, 34
Controller Compressor 12	-	-	43, 44
Controller Condenser Fan 1	15,16, 18	-	-
Controller Condenser Fan 2	25, 26, 28	-	-
Controller Condenser Fan 3	35, 36, 38	-	-
Controller Condenser Fan 4	45, 46, 48	-	-
Controller Condenser Fan 5	-	15,16, 18	-
Controller Condenser Fan 6	-	25, 26, 28	-
Controller Condenser Fan 7	-	35, 36, 38	-
Controller Condenser Fan 8	-	45, 46, 48	-
Controller Condenser Fan 9	-	-	15,16, 18
Controller Condenser Fan 10	-	-	25, 26, 28
Controller Condenser Fan 11	-	-	35, 36, 38
Controller Condenser Fan 12	-	-	45, 46, 48

Analog Intputs				
Function		**Basic Module Terminal No.**	**Extension Module**	
			SIOX 1	**SIOX 2**
Outdoor temperature	+ Sensor + PT1000 - PT1000 - Sensor	1 2 3 4	- - - -	- - - -
Room temperature	+ Sensor + PT1000 - PT1000 - Sensor	5 6 7 8	- - - -	- - - -
Cylinder head temperature C1	+PT1000 - PT1000	9 10	- -	-
Cylinder head temperature C2		11, 12	-	-
Cylinder head temperature C3		13, 14	-	-
Cylinder head temperature C4		15, 16	-	-
Cylinder head temperature C5		17, 18	-	-
Cylinder head temperature C6		19, 20	-	-
Cylinder head temperature C7		21, 22	-	-
Cylinder head temperature C8		23, 24	-	-
Cylinder head temperature C9		25, 26	-	-
Cylinder head temperature C10		27, 28	-	-
Cylinder head temperature C11		29, 30	-	-
Cylinder head temperature C12		31, 32	-	-
Low-pressure transducer	+ 24 V 4..20 mA GND	35 36 37	- - -	- - -
High-pressure transducer	+ 24 V 4..20 mA GND	44 45 46	-	-
Read FC output to deliver current or frequency	+ 24 V 4..20 mA GND	38 39 40	-	-
Humidity sensor (optional)	+24 V DC 4..20 mA	41 59	- -	- -

All leads running to and from the VS 3000 (except the 230 V power supply and signal leads) must be shielded! This applies especially to analog inputs (sensor leads) and CAN bus wiring.

Analog Outputs			
Function	**Basic Module Terminal No.**	**Extension Module**	
		SIOX 1	**SIOX 2**
Variable-speed fan control	53, 54	-	-
Variable-speed compressor control	53, 54	-	-

Interfaces			
Function	**Basic Module Terminal No.**	**Extension Module**	
		SIOX 1	**SIOX 2**
CAN bus connection		-	-
Shield	1		
Ground	2		
CAN-L	3		
CAN-H	4		
External SIOX connection input	-	SIOX IN	SIOX IN
External SIOX connection output	SIOX OUT	SIOX OUT	SIOX OUT
TTY	TTY	-	-
RS232	RS232	-	-
RS485	RS485	-	-

Power Supply			
Function	**Basic Module Terminal No.**	**Extension Module**	
		SIOX 1	**SIOX 2**
230 V AC	N, L	-	-
Grounding conductor	PE	-	-
SIOX power supply			
- 0 V	91	91	91
- 9 V	92	92	92
- 0 V	93	93	93
- 24 V	94	94	94
- Shield	95	95	95

5.5 Inputs/outputs of SIOX D2D extension module for discharge gas defrosting

Digital Intputs	
Function	**SIOX D2D**
Manual defrost Z2 cases	50, 51
Manual defrost Z2 coldrooms	52, 53
Disable defrost Z2 cases	56, 57
Disable defrost Z2 coldrooms	58, 59
HP cutout Z2 cases	62,63
HP cutout Z2 coldrooms	64, 65
Reserved	54, 55
Reserved	66, 67
Reserved	60, 61
Reserved	68, 69
Reserved	70, 71
Reserved	72, 73

Digital Outputs	
Function	**SIOX D2D**
Discharge gas feed solenoid valve Z2 cases	13, 14
Discharge gas feed solenoid valve Z2 coldrooms	23, 24
Reserved	33, 34
Drain heater Z2 coldrooms	43, 44
Suction line solenoid valve Z2 cases	15, 16, 18
Suction line solenoid valve Z2 coldrooms	25, 26, 28
Reserved	35, 36, 38
Discharge line solenoid valve	45, 46, 48

Interfaces	
Function	**SIOX D2D**
External SIOX connection input	SIOX IN
External SIOX connection output	SIOX OUT

Power Supply	
Function	**SIOX D2D**
SIOX power supply	
0 V	91
9 V	92
0 V	93
24 V	94
Shield	95

Notizen:

6 Operating Modes of VS 3000

6.1 Emergency manual-automatic mode selection

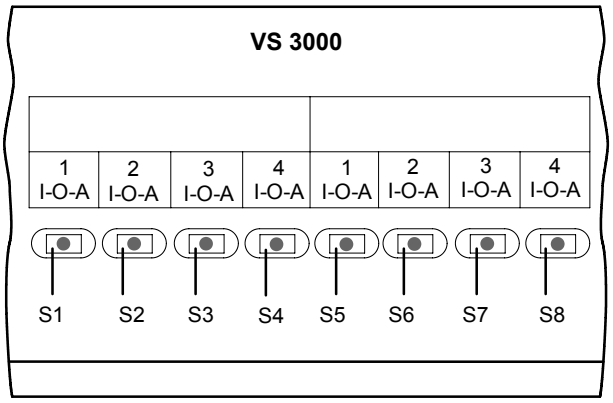
Manual-automatic mode selection makes possible emergency manual operation of the refrigeration pack in the event of pack controller failure. Manual-automatic mode selection is implemented at a relay level subordinate to the electronic controller. Mode is selected at three positions for each compressor and condenser by switches S1 to S8 installed on the printed circuit board (see illustration below).

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 extension module (SIOX).

The three switch positions 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 (*Comp.Stage OFF S#* or *Comp.Stage ON S#)* 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 VS 3000 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

In some lines of the display, additional marks are placed before the measurement to indicate system operating status. The marks used are as follows:

- Indication of suction pressure trend:

  Shows whether compressor capacity stages are to be loaded, unloaded or not actuated at the end of the time delay intervals.

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

- Indication of condensing pressure trend:

  Shows whether fan capacity stages are to be loaded, unloaded or not actuated at the end of the delay intervals.

$t_{c\text{-Act}}$	X	30°C
$p_{c\text{-Act}}$	X	15.45b
	↓	
	+	Fan capacity stages are loaded. $p_{o-Act} > p_{o-Setp} + \frac{NZ}{2}$
	=	Fan capacity stages are not actuated. $p_{0\text{-Act}}$ in neutral zone
	-	Fan capacity stages are unloaded $p_{o-Act} < p_{o-Setp} - \frac{NZ}{2}$

- Indication of setpoint characteristic:

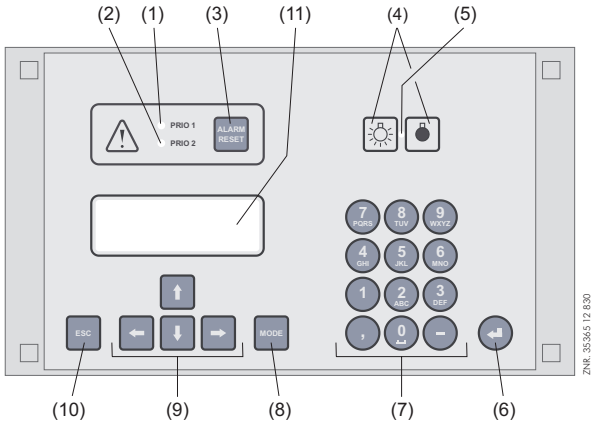
$t_{0\text{-Setp}}$	X	-20°C
$p_{0\text{-Setp}}$	X	2.34b
$t_{c\text{-Setp}}$	X	30°C
$p_{c\text{-Setp}}$	X	15.45b
	↓	
	D	Controller works with parameters for daytime operation.
	N	Controller works with parameters for nighttime operation.
	HR	Controller works with parameters for heat recovery mode.

7 Operation of VS 3000

The VS 3000 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 VS 3000 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.

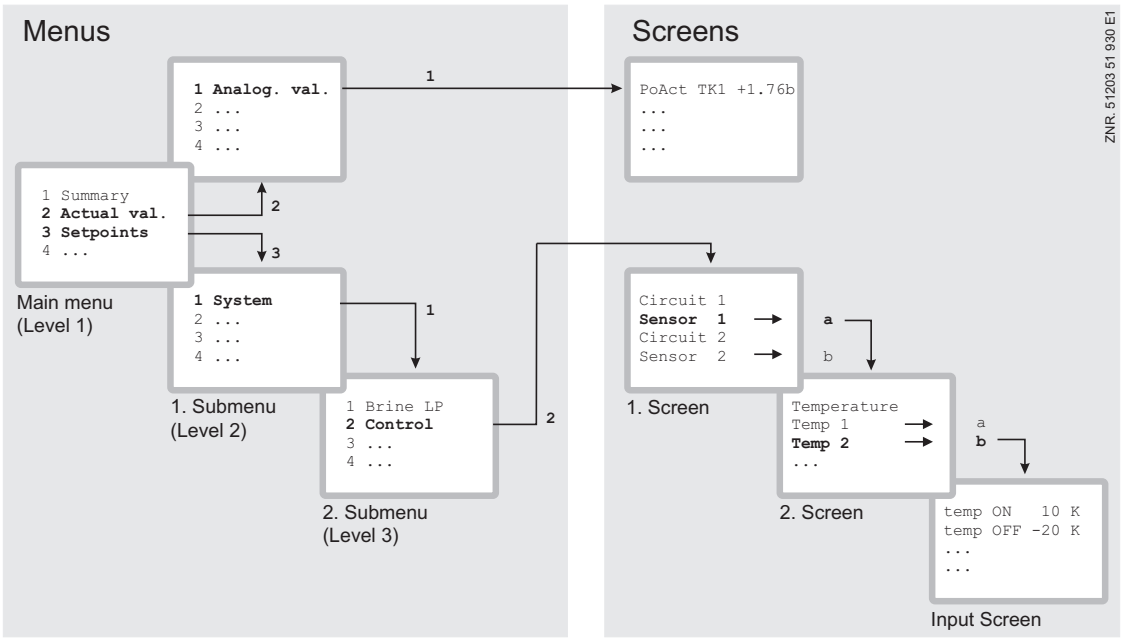
Example of screen numbering:

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 VS 3000 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** + 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.

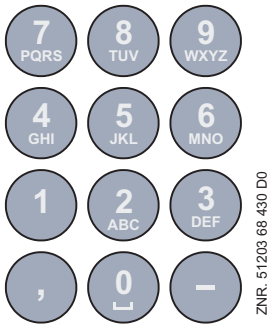
Entering values and text

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 VS 3000 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.

```
MAIN MENU
4 Messages           ↑
5 Remote Control
6 Store Computer     ↓
```

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:

```
REMOTE CONTROL     Nd.nnn
Node name                ↑
Item ID            XXXXX↓
```

Select the VS 3000 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 VS 3000 Pack Controller:

```
VS 3000              Pos: XXXXX
1 Summary                      ↑
2 Actual Values
3 Setpoints
4 Clock
5 Messages
6 Operating data
7 Default settings
8 Service Mode                 ↓
```

8 Menu Structure of VS 3000

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

Working with menus and screens

See Section 7 for details

Numbering of menus and screens

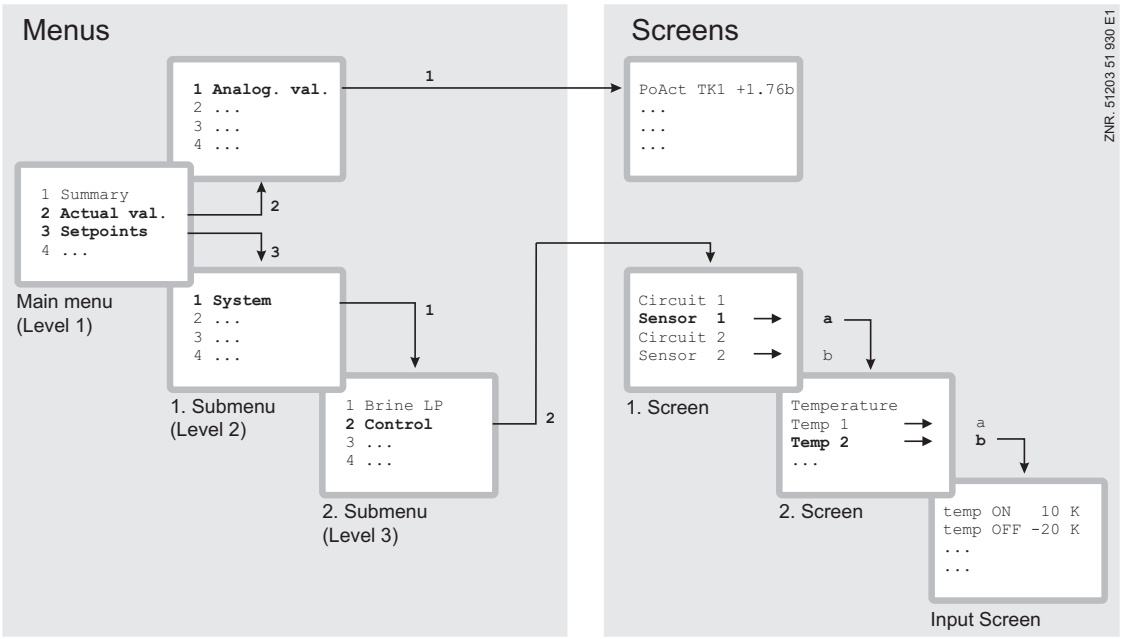
Each menu in the menu tree can be opened by entering a specific number and each operating screen in a menu can be opened by selecting it from the menu. This is achieved by distinct marking by numbers and letters in the menu tree. Numbers 1, 2, etc. identify the menu and the letters a, b, etc. identify 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 with the (→) key. The letters show their order in the screen.



8.1 Menu tree

Level 1	Level 2	Level 3	Screen No.	Screen Name
Main Menu			-	VS3000
1 Summary	Show Actual Values		1	
2 Actual Values			2	ACT.VALUES
	Analog values		2-1	ANALOG VAL
		Cyl.temp.	2-1-a	ANALOG VAL
	Compressor		2-2	COMP. IO
	Condenser fan		2-3	COND FAN
	System		2-4	SYSTEM
	D2D		2-5	D2D
3 Setpoints			3	SETPOINTS
	System config.		3-1	CONFIG
		Refrigerant	3-1-a	REFRIGT
		Sensor match	3-1-b	TRANSDUCER
		Text Oil/HP-Fault	3-1-c	Text Oil/HP-F.
		Enable comp.stages	3-1-d	ENABL.COMP
		Enable cond.stages	3-1-e	ENABL.COND
	Control		3-2	CONTROL
		LP-Control	3-2-1	LP-Control
		HP-Control	3-2-2	HP CONT
3 Setpoints	Comp. monitor		3-3	COMP MON
	Liq.level monitor		3-4	REFR. MON
	Ext. alarms		3-5	EXT. ALARM
	Base load		3-6	BASE LOAD
	Messages		3-7	Messages
	D2D		3-8	D2D
		Def. Z2R	3-8-a	DefTyp Z2R
		Def.timer	3-8-b	Def.timer
		Def.timer Z2R	3-8-c	DEF.Z2R

Level 1	Level 2	Level 3	Screen No.	Screen Name
4 Clock			4	CLOCK
	Setpoint toggle EXT/ INT		4	CLOCK
	Current time		4-a	CLOCK
	Toggle time		4-b	CLOCK
5 Messages			5	MESSAGE
	Display		5-1	MESSAGE
	Delete		5-2	MESSAGE
6 Operating data			6	OP DATA
	On time		6-1	OP DATA
		Compressor	6-1-1	OP DATA
		Condenser fan	6-1-2	OP DATA
	History		6-2	HISTORY
		Run times	6-2-1	HISTORY
		Compressor starts	6-2-2	HISTORY
		Activity	6-2-3	HISTORY
7 Default settings			7	VS3000
8 Service Mode			8	SERVICE
	Analog values		8-1	SERVICE
	Compressor		8-2	SERVICE
	Condenser fan		8-3	SERVICE
	System		8-4	SERVICE
	D2D		8-5	D2D

8.1.1 Menu 0 Main Menu

VS3000 NT/LT POS: XXX	
1 Summary	Move to Menu 1
2 Actual Values	Move to Menu 2
3 Setpoints	Move to Menu 3
4 Clock	Move to Menu 4
5 Messages	Move to Menu 5
6 Operating data	Move to Menu 6
7 Default settings	Move to Menu 7
8 Service Mode	Move to Menu 8

8.1.2 Menu 1 Summery

Act to +/-/=	XXX °C	Actual value	LP evaporating temperature
Ssetp. to N/T	XXX °C	Calculated setpoint t_0	LP evaporating temperature
Act tc +/-/=	XXX °C	Actual value	HP condensing temperature
Setp. tc WRG	XXX °C	Calculated setpoint t_c	HP condensing temperature

N = Nighttime operation D = Daytime operation HR = Heat recovery mode

8.1.3 Menu 2 Actual Values

ACT. VALUES POS:xxxxx	
1 Analog values	Move to Menu 2-1
2 Compressor	Move to Menu 2-2
3 Condenser fans	Move to Menu 2-3
4 System	Move to Menu 2-4
5 D2D	Move to Menu 2-5 (Only shown when discharge gas defrosting is activated: See Section 4 - Installation and Startup.)

- Menu 2-1 Analog values

ANALOG VAL POS: XXXXX		Display refrigeration point data archived in Store Computer	Entry
Act. ND +/-/=	X.XX b	Current evaporating pressure	
Setp. ND T/N	X.XX b	Evaporating pressure setpoint for comparison	
Act. to +/-/=	XX °C	Current evaporating temperature	
Setp. to T/N	XX °C	Evaporating temperature setpoint for comparison	
Suct.gas temp	XX °C	Current suction gas temperature	
Superheat.	XX °C	Current suction gas superheat	
Room temp.	XX °C	Current room temperature (optional)	
Act. HD -/+/=	X.XX b	Current condensing pressure	
Setp. HD WRG	X.XX b	Condensing pressure setpoint for comparison	
Act. tc -/+/=	XX °C	Current condensing temperature	
Setp. tc WRG	XX °C	Condensing temperature setpoint for comparison	
Outdoor temp.	XX °C	Current outdoor temperature (optional)	
Humidity	XXX%	Current humidity of air	
Cyl.temp.	→	Analog values cylinder head temperatures. Move to Screen 2-1-a	→
Analogausg.FU	XXX%	Frequency or current input of FC can be delivered through a programmable output of the FC. This output can be read with analog current/voltage input 2 (terminals 38-40) and displayed (Only shown when LP control type configured as combined controller in Screen 3-2-1-a)	
Soll FU	XXX%	Shows FC setpoint with compressor combined control (Only shown when LP control type configured as combined controller in Screen 3-2-1-a)	

- Menu 2-1-a Analog Values Cylinder Head Temperatures

ANALOG VAL. POS: XXXXX		
Zyl. Temp. V1	XX °C	Cylinder head temperature Compressor 1
...		Only the actual number of compressors is shown.
Zyl. Temp. V12	XX °C	Cylinder head temperature Compressor 12

VS 3000 basic module:	Cylinder head temperature Compressor 1 - max. 4
With 1st SIOX extension module:	Cylinder head temperature Compressor 1 - max. 8
With 2nd SIOX extension module:	Cylinder head temperature Compressor 1 - max. 12

- Menu 2-2 Compressor

COMP. IO POS: XXXXX		
M. cutout C 1	XXX	Digital input, motor overload cutout Compressor 1 (only shown when defined in system configuration: Menu 3-1)
Oil diff. pr. 1	XXX	Digital input, low oil pressure cutout/high-pressure cutout Compressor 1 (only shown when defined in system configuration: Menu 3-1)
Man.sw. C 1	XXX	Compressor manual switch ON-OFF-AUTO
Comp. C 1	XXX	Digital output Capacity Stage 1
...		Only the actual number of compressors is shown
M. cutout C 12	XXX	Digital input, motor overload cutout Compressor 12 (only shown when defined in system configuration: Menu 3-1)
Oil diff. pr. 12	XXX	Digital input, low oil pressure cutout/high-pressure cutout Compressor 12 (only shown when defined in system configuration: Menu 3-1)
Man.sw. C 12	XXX	Compressor manual switch ON-OFF-AUTO
Comp. C 12	XXX	Only the actual number of compressors is shown

VS 3000 basic module: Cylinder head temperature 1 - max. 4
With 1st SIOX extension module: Cylinder head temperature 1 - max. 8
With 2nd SIOX extension module: Cylinder head temperature 1 - max. 12

- Menu 2-3 Condenser fan

COND FAN POS: XXXXX		
M. cutout F 1	XXX	Digital input, motor overload cutout Fan 1
Fan 1	XXX	Digital output Fan 1
Fast speed 1	XXX	Toggle from star to delta mode for Fan Motor 1 (only shown when star-delta toggle acti-va-ted 3-2-2-1-b, actuation type SSFF or SSSF selected)
...		Only the actual number of fans is shown
M. cutout F 12	XXX	Digital input, motor overload cutout Fan 12
Fan 12	XXX	Digital output Fan 12
Fast speed 6/11*	XXX	Toggle from star to delta mode for Fan Motor 12 (only shown when star-delta toggle activa-ted 3-2-2-1-b, actuation type SSFF or SSSF selected) *

VS 3000 basic module: Fan 1 - max. 4
With 1st SIOX extension module: Fan 1 - max. 8
With 2nd SIOX extension module: Fan 1 - max. 12

* High speed available to Stage 6 only in SSFF mode and to Stage 11 in SSSF mode.

- Menu 2-4 System

SYSTEM	POS: XXXXX	
HP cutout	XXX	Digital input, HP cutout
LP cutout	XXX	Digital input, LP cutout
Burst disk	XXX	Digital input, bursting disk
Low liq. level	XXX	Digital input, low refrigerant level
Ext. alarm	XXX	Digital input, external alarm
Setp. toggle	XXX	Digital input, setpoint toggle
Heat recovery	XXX	Digital input, heat recovery
Comp/cond OFF	XXX	Digital input, external unload
Load shed 1	XXX	Digital input, Load Shedding 1
Load shed 2	XXX	Digital input, Load Shedding 2
Load shed 3	XXX	Digital input, Load Shedding 3
Cons.enab.CAN.	XXX	Enable refrigeration point via CAN bus
Cons.enab.Rel.	XXX	Enable refrigeration point via digital output (only shown when interstage feed is deacti-va-ted: Parameters Feed Temp and Feed Temp.HR (Menu 3-3) must be set to ”-”.)
Med.Press.inj.	XXX	Status of digital output for interstage feed (only shown when interstage feed is activated: Minimum of one parameter Feed Temp or Feed Temp.HR (Men 3-3) must not be set to ”-”).
toggle Comp.	XXX	Status of digital output for base load rotation of variable-speed compressors with com-pres-sor combined control (only shown when compressor combined control is activated: Control Type parameter set to Combined Controller, Menu 3-2-1-1-a).

- Menu 2-5 D2D Discharge Gas Defrosting

D2D		POS: XXXXX	
Gem.Druckltg.		XXX	Output, Solenoid Valve 1 common discharge line
Abla.Heiz.	Z2	XXX	Output, drain heater Z2 coldrooms
Abtauung	Z2	XXX	Input, manual defrost Z2/Z2 cases
Abtausper.	Z2	XXX	Input, disable defrost Z2/Z2 cases
HD-Begr.	Z2	XXX	Input, HP cutout in Z1 suction line Z2/Z2 cases
Saugltg.	Z2	XXX	Output, Solenoid Valve 2.2/1 close suction line Z2/Z2 cases
Druckgas	Z2	XXX	Output, Solenoid Valve 3.2/1 feed discharge gas Z2/Z2 cases
Abtauung	Z2R	XXX	Input, manual defrost Z2 coldrooms
Abtausper.	Z2R	XXX	Input, disable defrost Z2 coldrooms
HD-Wächter	Z2R	XXX	Input, HP cutout in Z1 suction line Z2 coldrooms
Saugltg.	Z2R	XXX	Output, Solenoid Valve 2.2/2 close suction line Z2 coldrooms
Druckgas	Z2R	XXX	Output, Solenoid Valve 3.2/2 feed discharge gas Z2 coldrooms

8.1.4 Menu 3 Setpoints

Setpoints POS: XXXXX	
1 System config.	Move to Menu 3-1
2 Control	Move to Menu 3-2
3 Comp. monitor	Move to Menu 3-3
4 Liq.level monitor	Move to Menu 3-4
5 Ext. alarms	Move to Menu 3-5
6 Base load	Move to Menu 3-6
7 Messages	Move to Menu 3-7
8 D2D	Move to Menu 3-8

- Menu 3-1 System config.

Config POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Refrigerant	XXXXX→	Select refrigerant	→	Screen 3-1-a		
Sensor match	→	Matching of pressure transducers	→	Screen 3-1-b		
Oil eq. line	X	Enable/disable oil equalization YES/NO	↑, ↓ (Y/N)	N	N	-
No. comps.	XX	Enter number of compressors	1..4/8/12	4/8/12	4/8/12	-
No.cap.stages	XX	Enter number of capacity stages	1..3	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	-
Oil/HP-F	X	Low oil pressure cutout/HP cutout YES/NO	↑, ↓ (Y/N)	N	N	-
Text Oil/HP-F	X	Select message text to be displayed on compressor oil pressure or high-pressure fault	↑, ↓ (Y/N)	Screen 3-1-c		
Enable comp.stages	→	Show capacity stages	→	Screen 3-1-d		
Emerg. working	X	Emergency operation YES/NO	↑, ↓ (Y/N)	N	N	-
No.emerg.stages	X	Number of capacity stages in emergency operation (only shown when Emergency Operation set to Y)	1..3/7/11	3/7/11	3/7/11	-
CompOFF.w.LdSh	X	One complete compressor (with capacity stages) is shut down at each load shedding stage on load shed-ding and when system configured with capacity-controlled compressors (only shown when system configured with capacity controlled compressors: No.CS Ea Comp. > 1)	↑, ↓ (Y/N)	N	N	-
No. cond.stages	X	Number of condenser stages	1..4/8/12	4/8/12	4/8/12	-
Enable cond.stages	→	Show condenser stages	→	Screen 3-1-d		
External fan	X	Enable external fan YES/NO (only required when using common condenser for two compressor packs)	↑, ↓ (Y/N)	N	N	-

OFFBAU POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Main fan	X	Enable fan master YES/NO (only shown when External Fan set to Y)	↑, ↓ (Y/N)	N	N	-
CAN-Adr. fan	--	Enter CAN bus address: Pack controller supplying external fan (only shown when External Fan set to Y)	1..9, --	--	--	-
Outdoor temp.	XXX	Enable outdoor temperature sensor ON/OFF	↑, ↓ (ON/OFF)	ON	ON	-
Room temp.	XXX	Enable room temperature sensor ON/OFF	↑, ↓ (ON/OFF)	ON	ON	-
Humidity	X	Enable humidity sensor ON/OFF	↑, ↓ (ON/OFF)	OFF	OFF	-
Node-Nr Env.dat	XX	Node No. of pack controller from which ambient data is to be used	1..9, --	--	--	-
signal setvalue	X	Setpoint toggle signal	0/1	1	1	-

- Masque 3-1-a Select Refrigerant

REFRGT POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
R22			√			
R502			√			
R134a			√			
R404a	√		√	√	√	
R402a			√			
R717			√			
R1270			√			
R507			√			
R407c			√			
R410a			√			
R290			√			
R744			√			

- Masque 3-1-b Transducer /Sensor Matching

TRANSDUCER POS: XXXXX			Entrb	Default / Dimension		
				NT	LT	Dim.
LP-Transducer	→	Select signal interface for LP pressure transducer (4 to 20 mA or 0 to 10 V)	→	Screen 3-1-a-a		
LP-Min	XXX b	Pressure at 4 mA or 0 V at LP pressure sensor output	0..2,0	0,0	0,0	bar
LP-Max	XXX b	Pressure at 20 mA or 10 V at LP pressure sensor output	8,0..60,0	10,0	10,0	bar
HP-Transmitter	→	Select signal interface for HP pressure transducer (4 to 20 mA or 0 to 10 V)	→	Screen 3-1-a-b		
HP-Min	XXX b	Pressure at 4 mA or 0 V at HP pressure sensor output	0..2,0	1,0	1,0	bar
HP-Max	XXX b	Pressure at 20 mA or 10 V at HP pressure sensor output	23,0..150,0	26,0	26,0	bar

- Masque 3-1-b-a LP-Transducer

TRANSD.LP POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
4-20 mA	√	4 to 20 mA at LP pressure sensor output	√	√	√	-
0-10 V		0 to 10 V at LP pressure sensor output	√	-	-	-

- Masque 3-1-b-b HP-Transducer

TRANSM.HD POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
4-20 mA	√	4 to 20 mA at LP pressure sensor output	√	√	√	-
0-10 V		0 to 10 V at LP pressure sensor output	√	-	-	-

- Masque 3-1-c Select Text For Oil/HP Fault

T.Oil/HP-F POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Oil diff. pr. C	√	Selected message will be displayed when Oil/HP Fault Compressor x detected through digital inputs.	√	√	√	-
HP-Fault Cx			√	-	-	-
Oil/HP-Fault Cx			√	-	-	-

- Masque 3-1-d Enable comp.stages

ENABL.COMP. POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Comp. stage 1	XXX	Condenser Stage 1	↑, ↓ (ON/OFF)	ON	ON	-
...		Only the available condenser stages (as configured) are shown				
Comp. stage 12	XXX	Condenser Stage 12	↑, ↓ (ON/OFF)	ON	ON	-

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Masque 3-1-e Enable cond.stages

ENABL.COND. POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Cond. stage 1	XXX	Condenser Stage 1	↑, ↓ (ON/OFF)	ON	ON	-
...		Only the available condenser stages (as configured) are shown				
Cond. stage 12	XXX	Condenser Stage 12	↑, ↓ (ON/OFF)	ON	ON	-

VS 3000 basic module: Fan 1 - max. 4
With 1st SIOX extension module: Fan 1 - max. 8
With 2nd SIOX extension module: Fan 1 - max. 12

- Menu 3-2 Control

Setpoints POS: XXXXX		Entry
LP-Control	√	Move to Menu 3-2-1	√
HP-Control		Move to Menu 3-2-2	√

- Menu 3-2-1 LP-Control

LP-Control POS: XXXXX	
1 Control	Move to Menu 3-2-1-1
2 to-adjustment	Move to Menu 3-2-1-2
3 LP-Control day	Move to Menu 3-2-1.3
4 LP-Control night	Move to Menu 3-2-1-4

- Menu 3-2-1-1 Compressor Control

CONTROL POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Control type	→	Move to selection list for LP control type	→	Screen 3-2-1-1-a		
minspeed	XXX%	Minimum FC compressor speed with combined control (only shown when combined controller selected as control type in Screen 3-2-1-1-a)	↑, ↓, 0..15	0	0	%
Adjust diff.	XX	Adjusting speed of speed controller (I factor) (Only shown when combined controller selected as control type in Screen 3-2-1-1-a)	↑, ↓, -20..20	0	0	-

- Masque 3-2-1-1-a Control type

CONTROL POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Step controller	√	Selection list for LP control type	√	√	√	-
Combi controller			√			

- Menu 3-2-1-2 t_0-adjustment

to-adjust POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
to-adjustment	→	Selection list for t_0 shift	→	Screen 3-2-2-a		
Max.LoadLevel	XXX%	Minimum FC compressor speed with combined control	↑, ↓, 70..100	100	100	%
minLoadLevel	XX%	Adjusting speed of speed controller (I factor)	↑, ↓, 10..60	50	50	%
Increment	XX.XK	t_0 shift increment	0,0..10,0	3,0	3,0	K
Interval	XXm	t_0 shift interval	1..20	10	10	min

- Masque 3-2-1-2-a t_0-adjustment

to-adjust POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Room temp.	√	Select t_0- shift by room temperature	√	√	√	-
Consumer		Select t_0 shift by refrigeration point	√			

- Menu 3-2-1-3 LP-Control day

LP CONT D POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
to-max.	XXX °C	Max. t_0 setpoint for setpoint shift	-50..10	-8	-34	°C
tr-min.	XXX °C	min room temperature for setpoint shift (Only shown when t0 shift by room temperature is selected in Screen 3-2-2-a)	-25..20	15	15	°C
to-min.	XXX °C	min t_0 setpoint for setpoint shift	-50..10	-12	-38	°C
tr-max.	XXX °C	Max. room temperature for setpoint shift (Only shown when t0 shift by room temperature is selected in Screen 3-2-2-a)	-18..35	25	25	°C
humid. adapt.	X	Humidity shift activated Y/N	↑, ↓, (Y/N)	N	N	-
Basic load time ON	→	Show basic times t_b ON	→	Screen 3-2-1-3-a		
Vari. load time ON	→	Show variable times t_v ON	→	Screen 3-2-1-3-b		
Basic unload time OFF	→	Show basic times t_b OFF	→	Screen 3-2-1-3-c		
Vari. unload time OFF	→	Show variable times t_v OFF	→	Screen 3-2-1-3-d		
Dead band	XX K	Switching hysteresis	1..10	4	4	K
Control const.	XX K	Max. control error for variable control times	1..15	10	7	K

- Masque 3-2-1-3-a Basic load time

B. LOAD T POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Bas Load T C 1	XXX s	Only the available capacity stages are shown	0..250	30	60	sec
Bas Load T C 2	XXX s		3..250	60	140	sec
Bas Load T C 3	XXX s		3..250	90	200	sec
Bas Load T C 4	XXX s		3..250	120	250	sec
Bas Load T C 5	XXX s		3..250	150	250	sec
Bas Load T C 6	XXX s		3..250	180	250	sec
...		Only the available capacity stages are shown				
Bas Load T C 12	XXX s		3..250	180	250	sec

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Masque 3-2-3-b Vari. load time

V. LOAD T POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Vas Laod T C 1	XXX s	Only the available capacity stages are shown	0..250	180	180	sec
Vas Laod T C 2	XXX s		3..250	200	200	sec
Vas Laod T C 3	XXX s		3..250	220	220	sec
Vas Laod T C 4	XXX s		3..250	240	240	sec
...						
Vas Laod T C 12	XXX s		3..250	240	240	sec

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Masque 3-2-1-3-c Basic unload time

B. UNLO T POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Bas. Unlo T C 1	XXX s	Only the available capacity stages are shown	3..250	5	5	sec
Bas. Unlo T C 2	XXX s		3..250	10	10	sec
Bas. Unlo T C 3	XXX s		3..250	20	20	sec
Bas. Unlo T C 4	XXX s		3..250	30	30	sec
...						
Bas. Unlo T C 12	XXX s		3..250	30	30	sec

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Masque 3-2-1-3-d Vari. unload time

V. UNLO T POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Var Unlo T C 1	XXX s	Only the available capacity stages are shown	3..250	20	20	sec
Var Unlo T C 2	XXX s		3..250	40	40	sec
Var Unlo T C 3	XXX s		3..250	60	60	sec
Var Unlo T C 4	XXX s		3..250	80	80	sec
Var Unlo T C 5	XXX s		3..250	100	100	sec
Var Unlo T C 6	XXX s		3..250	120	120	sec
...		Only the available capacity stages are shown				
Var Unlo T C 12	XXX s		3..250	120	120	sec

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Menu 3-2-1-4 LP-control night

LP CONT N POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
to-max.	XXX °C	Max. t_0- setpoint for setpoint shift	-50..10	-6	-34	°C
tr-min.	XXX °C	min room temperature for setpoint shift (Only shown when t_0 shift by room temperature is selected in Screen 3-2-1-2-a)	-25..20	15	15	°C
to-min.	XXX °C	min t_0 setpoint for setpoint shift	-50..10	-10	-38	°C
tr-max.	XXX °C	Max. room temperature for setpoint shift (Only shown when t_0 shift by room temperature is selected in Screen 3-2-1-2-a)	-18..35	25	25	°C
humid adapt.	X	Humidity shift activated YES/NO	↑, ↓, (Y/N)	N	N	-
Basic load time ON	→	Show basic times t_b ON	→	Screen 3-2-1-4-a		
Vari. load time ON	→	Show variable times t_v ON	→	Screen 3-2-1-4-b		
Basic unload time OFF	→	Show basic times t_b OFFS	→	Screen 3-2-1-4c		
Vari. unload time OFF	→	Show variable times t_v OFF	→	Screen 3-2-1-4-d		
Dead band	XX K	Switching hysteresis	1..10	4	4	K
Control const.	XX K	Max. control error for variable control times	1..15	10	8	K

- Masque 3-2-1-4-a Basic load time

B. LOAD T POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Bas Load T C 1	XXX s	Only the available capacity stages are shown	0..250	60	60	sec
Bas Load T C 2	XXX s		3..250	140	140	sec
Bas Load T C 3	XXX s		3..250	200	200	sec
Bas Load T C 4	XXX s		3..250	250	250	sec
...		Only the available capacity stages are shown				
Bas Load T C 12	XXX s		3..250	250	250	sec

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Masque 3-2-1-4-b Vari. load time

V. LOAD T POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Vas Load T C 1 XXX s	Only the available capacity stages are shown	0..250	250	250	sec
Vas Load T C 2 XXX s		3..250	250	250	sec
...					
Vas Load T C 12 XXX s		3..250	250	250	sec

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Masque 3-2-1-4-c Basic unload time

B. UNLO T POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Bas Unlo T C 1 XXX s	Only the available capacity stages are shown	3..250	5	5	sec
Bas Unlo T C 2 XXX s		3..250	10	10	sec
Bas Unlo T C 3 XXX s		3..250	15	15	sec
Bas Unlo T C 4 XXX s		3..250	20	20	sec
...					
Bas Unlo T C 12 XXX s		3..250	20	20	sec

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Masque 3-2-1-4-d Vari. unload time

V. UNLO T POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Var Unlo T C 1 XXX s	Only the available capacity stages are shown	3..250	20	20	sec
Var Unlo T C 2 XXX s		3..250	40	40	sec
Var Unlo T C 3 XXX s		3..250	60	60	sec
Var Unlo T C 4 XXX s		3..250	80	80	sec
Var Unlo T C 4 XXX s		3..250	100	100	sec
Var Unlo T C 4 XXX s		3..250	120	120	sec
...	Only the available capacity stages are shown				
Var Unlo T C 12 XXX s		3..250	120	120	sec

VS 3000 basic module: Capacity stage 1 - max. 4
With 1st SIOX extension module: Capacity stage 1 - max. 8
With 2nd SIOX extension module: Capacity stage 1 - max. 12

- Menu 3-2-2 HD-Control

HD CONT POS: XXXXX	
1 Control	Move to Menu 3-2-2-1
2 Setpoints	Move to Menu 3-2-2-2

- Menu 3-2-2-1 HD-Control

HP CONT POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Control type	→	Election list for HP control type	→	Screen 3-3-1-a		
min speed	XXX%	min fan speed (Only shown when speed controller is selected as control type in Screen 3-3-1-a)	0..50	0	0	%
p-factor	XX	P factor (amplification factor) for fan speed control signal (only shown when control type selected as Speed Controller or Combined Controller - Screen 3-2-2-1-a)	0.1 to 2.0	1.0	1.0	V/°C
i-factor	XX	I factor (integral factor) for fan speed control signal (only shown when control type selected as Speed Controller or Combined Controller - Screen 3-2-2-1-a)	0.00 to 1.00	0.20	0.20	V/ °C*s
Timeb.I-fact.	XX	Time interval for calculating I-part for fan speed con-trol signal (only shown when control type se-lected as Speed Controller or Combined Controller - Screen 3-2-2-1-a)	1 to 60	3	3	s
Switch mode	XXv	Actuation type fan control/star-delta mode (only shown when control type selected as Step Control-ler - Screen 3-2-2-1-a)	→	Screen 3-2-2-1-b		
Fast speed N	XX	High speed (delta mode) also with night setpoint allowed Y/N (only shown when control type selec-ted as Speed Controller (Screen 3-2-2-1-a) and actuation type selected as SSFF or SSSF (Screen 3-2-2-1-b)	↑, ↓, (Y/N)	Y	Y	-
Del. slow speed.	XX	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 to 30	5	→	s
tc-max.	XX°C	Maximum t_c with continuous HP control (Only shown when speed controller is selected as control type in Screen 3-3-1-a)	25..56	40	40	°C
Fan off w/comp	X	Stop fan with compressor YES/NO	↑, ↓, (Y/N)	N	N	-
Fan off by al.	X	Stop fan on actuation of motor overload cutout Y/N	↑, ↓, (Y/N)	Y	Y	-

- Masque 3-2-2-1-a Control type

CONTROL POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Step controller √	Selection list for HP control type	√	√	√	-
Speed controller		√			
Combi cont. paral		√			
Combi controller		√			

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

Switch mode POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
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 (H)	√			
SSSF	Star-delta operating mode: Fans start successively at low speed (S) and then switch simultaneously to high speed (H)	√			

- Menu 3-2-2-2 Setpoints

HP CONT POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
tc-min XX°C	min tc setpoint for setpoint shift	-10..35	25	25	°C
ta-min XX°C	min outdoor temperature for setpoint shift	0..15	15	15	°C
tc-max XX°C	Max. tc setpoint for setpoint shift	-10..45	25	25	°C
ta-max XX°C	Max. outdoor temperature for setpoint shift	16..45	30	30	°C
tc Offset N XX K	tc offset in night operation	0..15	0	0	K
Ht. rec. mode X	Activate/deactivate HR mode	↑, ↓, (Y/N)	N	N	-
Run Time HRC h	Maximum compressor run time in HR mode	0..10	--	--	h
Off Time HRC XX m	Compressor standstill time when disabled by max. run time monitoring on disabling	30..180	60	60	min
HR max. XX°C	tc-Setp in heat recovery mode	-10..50	46	46	°C
HR dif. XX K	Switching hysteresis in heat recovery mode	1..10	4	4	K
Bas. load time F ON →	Set basic times tb ON	→	Screen 3-2-2-2-a		
Var. load time F ON →	Set variable times tv ON	→	Screen 3-2-2-2-b		
Bas.unload time F OFF →	Set basic times tb OFF	→	Screen 3-2-2-2-c		
Var.unload time F OFF →	Set variable times tv OFF	→	Screen 3-2-2-2-d		
Dead band XX K	Switching hysteresis	1..20	6	6	K
Control const XX K	Max. control error for variable control times	1..10	10	10	K

- Masque 3-2-2-2-a Bas. load time F ON

B. LOAD T POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
B. load t. F 1 XXX s	Only the available capacity stages are shown	3..250	5	5	sec
B. load t. F 2 XXX s		3..250	10	10	sec
B. load t. F 3 XXX s		3..250	20	20	sec
B. load t. F 4 XXX s		3..250	60	60	sec
...	Only the available capacity stages are shown				
B. load t. F 12 XXX s		3..250	60	60	sec

VS 3000 basic module: Condenser capacity stages 1 - max. 4
With 1st SIOX extension module: Condenser capacity stages 1 - max. 8
With 2nd SIOX extension module: Condenser capacity stages 1 - max. 12

- Masque 3-2-2-2-b Var. load time F ON

V. LOAD T POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
V. load t. F 1 XXX s	Only the available capacity stages are shown	3..250	20	20	sec
V. load t. F 2 XXX s		3..250	90	90	sec
V. load t. F 3 XXX s		3..250	180	180	sec
V. load t. F 4 XXX s		3..250	250	250	sec
...	Only the available capacity stages are shown				
V. load t. F 12 XXX s		3..250	250	250	sec

VS 3000 basic module: Condenser capacity stages 1 - max. 4
With 1st SIOX extension module: Condenser capacity stages 1 - max. 8
With 2nd SIOX extension module: Condenser capacity stages 1 - max. 12

- Masque 3-2-2-2-c Bas.unload time F OFF

B. UNLO T POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
B. unlo t. F 1 XXX s	Only the available capacity stages are shown	3..250	10	10	sec
B. unlo t. F 2 XXX s		3..250	20	20	sec
B. unlo t. F 3 XXX s		3..250	30	30	sec
B. unlo t. F 4 XXX s		3..250	40	40	sec
...	Only the available capacity stages are shown				
B. unlo t. F 12 XXX s		3..250	40	40	sec

VS 3000 basic module: Condenser capacity stages 1 - max. 4
With 1st SIOX extension module: Condenser capacity stages 1 - max. 8
With 2nd SIOX extension module: Condenser capacity stages 1 - max. 12

- Masque 3-2-2-2-d Var.unload time F OFF

V. UNLO T POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
V. unlo t. F 1 XXX s	Only the available capacity stages are shown	3..250	20	20	sec
V. unlo t. F 2 XXX s		3..250	40	40	sec
V. unlo t. F 3 XXX s		3..250	60	60	sec
V. unlo t. F 4 XXX s		3..250	90	90	sec
...	Only the available capacity stages are shown				
V. unlo t. F 12 XXX s		3..250	90	90	sec

VS 3000 basic module: Condenser capacity stages 1 - max. 4
With 1st SIOX extension module: Condenser capacity stages 1 - max. 8
With 2nd SIOX extension module: Condenser capacity stages 1 - max. 12

- Menu 3-3 Comp. monitor

COMP MON POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Comp. OFF temp XXX °C	Disable one compressor at high temperature	80..180	120	120	°C
Comp. ON temp XXX °C	Enable compressor after high temperature	50..120	100	100	°C
Comp temp del. XX m	Delay for High Cylinder *Head Temperature Cx* alarm	0..5	3	3	min
Inj.Temp XXX °C	Temperature threshold to activate interstage feed	80..110	-	-	°C
Inj.Temp.HR XXX °C	Temperature threshold to activate interstage feed in HR mode	90..140	-	-	°C
Dif.Inj.Temp XXX K	THysteresis to deactivate interstage feed	5..15	10	10	K
tc Comp OFF XXX °C	t_c limit for disabling compressor capacity stages	-10..56	52	52	°C
tc Comp ON XXX °C	t_c limit for enabling compressor capacity stages after disabling	-10..50	42	42	°C
NT-Cascade 1 XXX	CAN bus Node No. NT Pack 1(LT CO2 systems)	1..9,--	--	--	-
NT-Cascade 2 XXX	CAN bus Node No. NT Pack 2(LT CO2 systems)	1..9,--	-	--	-
to Comp OFF XXX °C	t_0 limit for compressor disable	-50..2	-25	-46	°C
Del. to OFF XXX m	Delay for Low *LP alarm*	0..60	10	10	min
Del. tc/HD OFF XXX m	Delay for *High tc/HP* alarm	0..60	1	5	min
Min to diff. XXX K	Minimum allowed difference between to and tc	5..15,--	--	--	K
Starts/h XXX	Compressor starts per hour	4..16	6	6	-
Off Time S1. XXX s	Minimum allowed difference between to and tc	0..250	40	40	s
Min. Superheat XX K	Minimum allowed difference between to and tc	5..15	7	7	K
averaging toh. XX	Minimum allowed difference between to and tc	1..50	5	5	-

- Menu 3-4 Liq.level monitor

REFR. MON POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Dellow level XXX m	Delay for Low Refrigerant Level alarm	-, 1..120	60	60	min

- Menu 3-5 Ext. alarms

Ext. ALARM POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Time delay XXX s	Delay in seconds for External Alarm report	3..250	5	5	sec
Alarm message: XXXXXXXXXXXX.XXX.XXX.X	Message displayed in occurrence of external alarms. Default text: *External Alarm* or *Speed contr.*	Text			

- Menu 3-6 Base load

BASE LOAD POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Cycle time C. XXX m	Cycle time for compressor base load rotation	5..720	45	45	min
BaseLoadRot.F Y/N	Activate base load rotation for fans (Only shown when Step Controller is selected as HP control type in Screen 3-3-1-a)	↑, ↓, (Y/N)	N	N	-
On time cond. Y/N	Prompt for run time equalization (Only shown when Fan Rotation is set to Y)	↑, ↓, (Y/N)	N	N	-
Cycle time F. XXX m	Cycle time for fan base load rotation (Only shown when Fan Rotation is set to Y)	5..720	720	720	min

- Menu 3-7 Messages

Messages POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Mot. cutout C X	Compressor motor overload cutout compressor tripped	-, 0..2	2	2	-
Mot. cutout F X	Fan motor overload cutout tripped	-, 0..2	2	2	-
Oil diff.pr. X	Compressor low oil pressure cutout/HP cutout tripped	-, 0..2	2	2	-
Cyl. temp. X	Cylinder head temperature limit exceeded	-, 0..2	2	2	-
HP cutout X	High-pressure cutout tripped	-, 0..2	1	1	-
LP cutout X	Low-pressure cutout tripped	-, 0..2	2	2	-
Low LP X	Low pressure limit to exceeded	-, 0..2	2	2	-
High HP X	High pressure limit tc exceeded	-, 0..2	2	2	-
Meas.err.cyl. X	Cylinder head temperature measuring loop error	-, 0..2	2	2	-
Meas. error HP X	High-pressure measuring loop error	-, 0..2	2	2	-
Meas. error LP X	Low-pressure measuring loop error	-, 0..2	1	1	-

Messages POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Meas. error tod	X	Outdoor temperature measuring loop error	-, 0..2	2	2	-
Meas. error tr	X	Room temperature measuring loop error	-, 0..2	2	2	-
Meas.err.hunid.	X	Humidity sensor measuring loop error	-, 0..2	2	2	-
Power failure	X	Start following power failure	-, 0..2	0	0	-
First start	X	Controller start	-, 0..2	2	2	-
Burst disc	X	Bursting disk input actuated	-, 0..2	-	-	-
External alarm	X	External alarm input actuated	-, 0..2	-	2	-
I/O module error	X	SIOX I/O module failure	-, 0..2	1	1	-
Service mode	X	Service mode activated	-, 0..2	0	0	-
Comp/cond unload	X	External unload activated	-, 0..2	0	0	-
Load shed	X	Compressor disabled by load shedding	-, 0..2	0	0	-
Low liq. level	X	Low liquid level cutout tripped	-, 0..2	2	2	-
RAM error	X	Internal data memory fault	-, 0..2	1	1	-
EEPROM error	X	EEPROM (parameter memory) fault	-, 0..2	2	2	-
RTC error	X	Real-time clock fault	-, 0..2	2	2	-
Setpoint changed	X	Setpoint changed	-, 0..2	0	0	-
Max. speed F	X	Threshold value for speed adjuster exceeded.	-, 0..2	0	0	-
Battery voltage	X	Internal battery fault	-, 0..2	2	2	-
Manual OFF	X	Compressor OFF by manual switch	-, 0..2	0	0	-
Manual ON	X	Compressor ON by manual switch	-, 0..2	0	0	-
Emerg. working	X	Emergency operating mode	-, 0..2	0	0	-
HP cutout D2D Z1	X	High-pressure cutout for discharge gas defrosting Z1 cases	-, 0..2	2	2	-
HP cutout D2D Z2	X	High-pressure cutout for discharge gas defrosting Z2 cases	-, 0..2	2	2	-
HPcutout D2D Z2R	X	High-pressure cutout for discharge gas defrosting Zs coldrooms	-, 0..2	2	2	-
Disable D2D Z1	X	Disable discharge gas defrosting Z1	-, 0..2	0	0	-
Disable D2D Z2	X	Disable discharge gas defrosting Z2	-, 0..2	0	0	-
Disable D2D Z2R	X	Disable discharge gas defrosting Z2 coldrooms	-, 0..2	0	0	-
Fault D2D Z1	X	Discharge gas defrosting fault Z1	-, 0..2	2	2	-
Fault D2D Z2	X	Discharge gas defrosting fault Z2	-, 0..2	2	2	-
Fault D2D Z2R	X	Discharge gas defrosting fault Z2 coldrooms	-, 0..2	2	2	-
Sens type change	X	Sensor matching changed	-, 0..2	0	0	-
Comp auto disabl	X	Automatic compressor disable	-, 0..2	2	2	-
too many starts/h	X	Compressor short-cycling (LP combined controller)	-, 0..2	2	2	-
no load level	X	No load level received (t0 shift)	-, 0..2	2	2	-

Messages POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Speed ctrl. HP	X	HP speed adjuster fault with HP combined controller	-, 0..2	2	2	-
M.err.Suct.temp	X	Suction gas temperature sensor measuring loop error	-, 0..2	-	-	-
Low Superheat	X	Low suction gas superheat	-, 0..2	2	2	-

- Menu 3-8 D2D (Discharge Gas Defrosting)

D2D POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Def. Z2R	→	Defrost method Z2 coldrooms	→	Screen 3-9-a		
Def.timer	→	Entry screen for defrost times	→	Screen 3-9-b		
Def.timer Z2R	→	Entry screen for defrost times Z2R with separate defrosting (Only shown when *Auxiliary Defrost* or Separate is selected in Screen 3-9-a)	→	Screen 3-9-c		
tc Comp OFF	XX°C	Z1 capacity stages unloaded above specified temperatures	30..40	35	35	°C
tc comp. OFF	XX°C	No Z1 capacity stages loaded above specified temperatures	20..30	25	25	°C
Drain htr. Z2	XXm	Start delay for drain heating Z2 coldrooms	5..30	15	15	min
Defrost Z2	XXm	Defrost duration Z2 cases	10..30	12	12	min
Comp. OFF Z2	X	Disable Z2 compressors during defrosting YES/ NO	↑, ↓, (Y/N)	Y	Y	-
Del.SuctL.Z2	XXXs	Suction line open delay on termination of Z2 defros	10..100	30	30	S
C.Suct.1.on Z2	XX°C	Z2 compressors remain disabled after Z2 defrosting until temperature *C.Suct.I.on Z2* is attained	-10..5	-5	-5	°C
Node Nr. Z1	XXX	Node No. of Z1 pack controller	1..9	---	---	-
to-Setpt Z1	X°C	t_0 setpoint Z1 during discharge gas defrosting with joint defrosting Z2 and Z2R	-30..-5	-20	-20	°C
Bas.Load t. Z1	XXs	Basic load time Z1 during Z2 defrost	5..200	20	20	sec
Bas.unlo t. Z1	XXs	Basic unload time Z1 during Z2 defrost	5..100	10	10	sec
Defrost Z2R	XXm	Defrost duration Z2 coldrooms (Only shown when Auxiliary Defrost or Separate is selected in Screen 3-9-a)	10..30	10	10	min
Del.SuctL.Z2R		Suction line open delay on termination of Z2R defrost (only shown when Auxiliary Defrost or Separate se-lected under defrost method for Z2 coldrooms - Screen 3-8-a)	10..100	30	30	s
ForcedCool.Z2R		Setpoint decrease Z1 and forced cooling	(Y/N)	N	N	-

- Masque 3-8-a Def. Z2R

DefTyp Z2R POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
With cases √	Discharge gas defrosting for Z2 coldrooms jointly with Z2 cases	√	√	√	-
Aux. defrost	As above but with auxiliary defrost	√	-	-	-
Separate	Discharge gas defrosting for Z2 coldrooms independent of Z2 cases	√	-	-	-
El. UA300	Electric defrosting of Z3 coldrooms with UA 300	√	-	-	-

- Menu 3-8-b Def.timer

Def.timer POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Defr. 1	XXXXX	hh.mm	Defrost timer for Z2 cases (and Z2 coldrooms with joint and auxiliary defrosting)	↑, ↓ Mo-Su Mo-Fr Mo-Sa Sa-Su ----- Mo,Tu,We,Th, Fr,Sa, Su, number	Mo-Su 06:00	Mo-Su 06:00	-
Defr. 2	XXXXX	hh.mm	Defrost timer for Z2 cases (and Z2 coldrooms with joint and auxiliary defrosting)	↑, ↓ Mo-Su Mo-Fr Mo-Sa Sa-Su ----- Mo,Tu,We,Th, Fr,Sa, Su, number	Mo-Su 18:00	Mo-Su 18:00	-
Defr. 3	XXXXX	hh.mm	Defrost timer for Z2 cases (and Z2 coldrooms with joint and auxiliary defrosting)	↑, ↓ Mo-Su Mo-Fr Mo-Sa Sa-Su ----- Mo,Tu,We,Th, Fr,Sa, Su, number	-----	-----	-
...							
Defr. 7	XXXXX	hh.mm	Defrost timer for Z2 cases (and Z2 coldrooms with joint and auxiliary defrosting)	↑, ↓ Mo-Su Mo-Fr Mo-Sa Sa-Su ----- Mo,Tu,We,Th, Fr,Sa, Su, number	-----	-----	-

- Masque 3-8-c Def.timer Z2R

DEF.Z2R POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
Defr. 1	XXXXX hh.mm	Defrost timer for Z2 coldrooms with auxiliary and separate defrosting. (Only shown when Auxiliary Defrost or Separate is selected in Screen 3-8-a)	↑, ↓ Mo-Su Mo-Fr Mo-Sa Sa-Su ----- Mo,Tu,We,Th, Fr,Sa, Su, number	-----	-----	-
...						
Defr. 7	XXXXX hh.mm	Defrost timer for Z2 coldrooms with auxiliary and separate defrosting. (Only shown when Auxiliary Defrost or Separate is selected in Screen 3-8-a)	↑, ↓ Mo-Su Mo-Fr Mo-Sa Sa-Su ----- Mo,Tu,We,Th, Fr,Sa, Su, number	-----	-----	-

8.1.5 Menu 4 Clock

CLOCK POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Setpoint toggle XXX	Setpoint toggle external or via internal clock (INT or EXT)	↑, ↓ (INT/EXT)	EXT	EXT	-
Current time →	Show current date / time	→	Screen 4-a		
Toggle time →	Entry screen for toggle times (Only shown when setpoint toggle is set to *INT*)	→	Screen 4-b		

- Masque 4-a Current time

CLOCK POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Date: xxdd.mm.yy	Current day, date	Number	Date	Date	-
Time: hh.mm	Current time	Number	Time	Time	-
Auto daylt. savg X	Automatically adjust clock for daylight saving changes (YES/NO)	↑, ↓ (Y/N)	Y	Y	-

- Masque 4-b Toggle time

TOGGLE POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
dd hh:mm dd hh:mm	Enter up to 7 toggle times each for 2nd setpoint ON (Only shown when setpoint toggle is set to *INT)*	↑, ↓ Mo-Su Mo-Fr Mo-Sa Sa-Su ----- Mo,Tu,We,Th, Fr,Sa, Su, number	Mo 00:00 Mo 00:00	-----	-
...					
dd hh:mm dd hh:mm		As above	-----	-----	-

8.1.6 Menu 5 Messages

MESSAGE POS: XXXXX	
1 Dispaly	Move to Menu 5-1
2 Delete	Move to Menu 5-2

- Menu 5-1 Display

Messages POS: XXXXX		Entry
Message text dd.mm.yy hh:mm ON/OFF	Message text with date and time	↑, ↓
...	Additional messages	

- Menu 5-2 Delete

Messages POS: XXXXX		Entry
Delete? Are you sure? NO: ESC Yes: ↲	Prompt to confirm deletion of fault memory	↲

8.1.7 Menu 6 Operating data

OP DATA POS: XXXXX	
1 On time	Move to Menu 6-1
2 History	Move to Menu 6-2

- Menu 6-1 On time

OP DATA POS: XXXXX	
1 Compressor	Move to Menu 6-1-1
2 Condenser fan	Move to Menu 6-1-2

- Menu 6-1-1 Compressor (Stage On Time)

OP DATA POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
On time C 1 XXXX h	Show and enter compressor run times Only the available number of compressor stages is shown.	↑, ↓ 0..9999	0h	0h	H
...					
On time C 12 XXXX h		As above	0h	0h	H

VS 3000 basic module: Run time Compressor 1 - max. 4
With 1st SIOX extension module: Run time Compressor 1 - max. 8
With 2nd SIOX extension module: Run time Compressor 1 - max. 12

- Menu 6-1-2 Codenser fan (Stage On Time)

OP DATA POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
On time F 1 XXXX h	Show and enter fan run times Only the available fans are shown	↑, ↓ 0..9999	0h	0h	H
...					
On time F 12 XXXX h		As above	0h	0h	H

VS 3000 basic module: Run time Fan 1 - max. 4
With 1st SIOX extension module: Run time Fan 1 - max. 8
With 2nd SIOX extension module: Run time Fan 1 - max. 12

- Menu 6-2 History

HISTORY POS: XXXXX	
1 Run times	Move to Menu 6-2-1
2 Compressor starts	Move to Menu 6-2-2
3 Activity	Move to Menu 6-2-3

- Menu 6-2-1 Run times

HISTORY POS: XXXXX		Entry
Date: dd.mm.yy	Datum	
Run times → ↓	Press → to show run times for date shown in Line 1. Auswahl max. 31 Tage in die Vergangenheit über ↑↓	Screen 6-2-1-a

- Masque 6-2-1-a Compressor starts

RUN TIMES POS: XXXXX		Default / Dimension		
		NT	LT	Dim.
Comp. stage 1 hh:mm	Daily compressor (stage) run time. Only the actual number of compressor stages is shown.	00:00	00:00	-
...				
Comp. stage 12 hh:mm		00:00	00:00	-

VS 3000 basic module: Run time Compressor 1 - max. 4
With 1st SIOX extension module: Run time Compressor 1 - max. 8
With 2nd SIOX extension module: Run time Compressor 1 - max. 12

- Menu 6-2-2 Compressor starts

HISTORY POS: XXXXX		Entry
Date: dd.mm.yy	Datum	
Compressor starts → ↓	Press → to show run times for date shown in Line 1. Auswahl max. 31 Tage in die Vergangenheit über ↑↓	Screen 6-2-2-a

- Masque 6-2-2-a Compressor starts

STARTS POS: XXXXX		Default / Dimension		
		NT	LT	Dim.
Comp. stage 1 X	Daily compressor (stage) starts. Only the actual number of compressor stages is shown.	0	0	-
...				
Comp. stage 12 X		0	0	-

VS 3000 basic module: Starts Compressor 1 - max. 4
With 1st SIOX extension module: Starts Compressor 1 - max. 8
With 2nd SIOX extension module: Starts Compressor 1 - max. 12

- Menu 6-2-3 Activity

HISTORY POS: XXXXX		Entry
Date: dd.mm.yy	Date	
Activity XXX % ↓	Activity in % (compressor pack utilization) Press → to show run times for date shown in Line 1. Auswahl max. 31 Tage in die Vergangenheit über ↑↓	↓, ↑, ESC

8.1.8 Menu 7 Default settings

VS3000 POS: XXXXX		Entry
Load defaukt? Are you sure? NO: ESC Yes: ↲	Prompt to confirm loading of default parameters	↲, ESC

8.1.9 Menu 8 Service Mode

SERVICE POS: XXXXX	
1 Analog values	Move to Menu 8-1
2 Compressor	Move to Menu 8-2
3 Condenser fan	Move to Menu 8-3
4 System	Move to Menu 8-4
5 D2D	Move to Menu 8-5

- Menu 8-1 Default Analog Values

SERVICE POS: XXXXX			Entry	Default / Dimension		
				NT	LT	Dim.
AnalogOut1 X.X V	Voltage at Analog Output 1 (terminals 53,54)	↑, ↓ 0,0..10,0	0,0	0,0	V
AnalogOut2 X.X V	Voltage at Analog Output 2 (terminals 55,56)	↑, ↓ 0,0..10,0	0,0	0,0	V
AnalogOut3 X.XX V	Voltage at Analog Output 3 (terminals 57,58)	↑, ↓ 0,00..10,00	0,00	0,00	V

- Menu 8-2 Default Compressor ON/OFF

SERVICE POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Comp. C 1 XXX	Control status of respective compressor (stage) ON or OFF Only the actual number of compressors (stages) is shown.	↑, ↓ (ON/OFF)	OFF	OFF	-
...					
Comp. C 12 XXX		↑, ↓ (ON/OFF)	OFF	OFF	-

VS 3000 basic module: Compressor (Stage) 1 - max. 4
With 1st SIOX extension module: Compressor (Stage) 1 - max. 8
With 2nd SIOX extension module: Compressor (Stage) 1 - max. 12

- Menu 8-3 Default Condenser fan ON/OFF

SERVICE POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Fan F 1 XXX	Control status of respective fan ON or OFF Only the actual number of fans is shown.	↑, ↓ (ON/OFF)	OFF	OFF	-
...					
Fan F 12 XXX		↑, ↓ (ON/OFF)	OFF	OFF	-

VS 3000 basic module: Fan 1 - max. 4
With 1st SIOX extension module: Fan 1 - max. 8
With 2nd SIOX extension module: Fan 1 - max. 12

- Menu 8-4 Default System

SERVICE POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Consumer en. XXX	Digital output *Enable Refrigeration Points* ON or OFF	↑, ↓ (ON/OFF)	OFF	OFF	-
toggle Comp.. XXX	Digital output *Toggle Variable-Speed Compressor* ON or OFF	↑, ↓ (ON/OFF)	OFF	OFF	-

- Menu 8-5 Default D2D (Discharge Gas Defrosting)

D2D POS: XXXXX		Entry	Default / Dimension		
			NT	LT	Dim.
Com.disch.line XXX	Digital output Common Discharge Line ON or OFF	↑, ↓ (ON/OFF)	OFF	OFF	-
Drain htr. Z2 XXX	Digital output Drain Heater Z2 ON or OFF	↑, ↓ (ON/OFF)	OFF	OFF	-
Suct. line Z2 XXX	Digital output Suction Line Z2 ON or OFF	↑, ↓ (ON/OFF)	OFF	OFF	-
Discharge Z2 XXX	Digital output Discharge Gas Z2 ON or OFF	↑, ↓ (ON/OFF)	OFF	OFF	-
Suct.line Z2R XXX	Digital output Suction Line Z2R ON or OFF	↑, ↓ (ON/OFF)	OFF	OFF	-
Dischareg Z2R XXX	Digital output Discharge Gas Z2R ON or OFF	↑, ↓ (ON/OFF)	OFF	OFF	-

9 Alarms and Messages of VS 3000

9.1 Reporting system

A number of messages are recognized by the system and logged in the internal fault memory with date, time and priority. Receive/Send messages are logged in fault memory. Time resolution is 1 minute.

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

The fault memory is battery-backed, meaning that messages will not be lost in a power failure.

Alarms/messages can be retrieved with a setup unit (AL 300 Operator Terminal or CI 3000 Store Computer). The most recent message is displayed first in the list. Contents of the fault memory can be deleted with the setup unit. Messages are also transmitted via the CAN bus, enabling the current message to be displayed on the setup unit and a central fault memory to be built with the CI 3000 Store Computer for the complete refrigeration system.

9.2 Structure of alarms/messages

Messages 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 setup unit in three lines of 20 characters. One line is used to identify the active controller.

Line	Example	Data
1	Messages ID: xxxxx	Active controller
2	Motor overload cutout C1	Message
3	20.5.98 10:20 ON	Date and time of message
4	20.5.98 10:25 OFF	Fault corrected

Four alarm priorities may be used:

- – Alarm not entered in alarm log
- 0 Alarm entered in alarm log but not transmitted to higher-order system components
- 1 Alarm entered in alarm log and transmitted to higher-order system components with Prio. 1
- 2 Alarm entered in alarm log and transmitted to higher-order system components with Prio. 2

In a compressor fault condition, an alarm is automatically upgraded to Priority 1 when 50% of the compressors have failed. From Version 2.0, change of alarm priority results in automatic generation of a Priority 0 message (archived in message log only) reading as follows:

Prio M xxx: *p1 > p2*

where gilt xxx = Alarm/message number

p1: Previous alarm priority

p2: New alarm priority

9.3 Types of alarm

The following alarms are recorded by the VS 3000 Pack Controller and stored in fault memory

- Process fault alarms
- System fault alarms

9.3.1 Process fault alarms

No.	Message	Process fault reported
1	Mot. cutout Cx	Motor overload cutout tripped Compressor Cx
2	H. cyl.t. comp. Cx	Cylinder head temperature above upper limit Compressor Cx
3	Oil diff. pr. Cx	Low oil pressure cutout/HP cutout tripped Compressor Cx
4	Low LP	t_0 below lower limit
5	LP cutout	Low-pressure cutout tripped
6	Max. speed F	Speed above high threshold for speed adjuster
7	Manual OFF Sx	Compressor Stage Sx switched to Manual OFF
8	Manual ON Sx	Compressor Stage Sx switched to Manual ON
9	Mot. cutout fan x	Motor overload cutout tripped Condenser Fan x
10	High HP	t_c upper limit exceeded
11	HP cutout	High-pressure cutout tripped
12	Low liq. level	Low refrigerant level switch actuated
13	Service Mode	Service mode activated
14	Comp/cond. unload	External unload
15	Load shed x	Compressor disabled by load shedding -> Load shed input x active
16	Burst disk	Digital input for bursting disk actuated
17	Power failure	Controller restart after power failure
18	First start	First start of controller and loading of default parameters
19	Setpoint changed	Setpoint has been changed
20	External Alarm	Digital input for external alarm active
21	Speed cotr.	Digital input for speed adjuster/(external alarm) active and speed/combined control activated
22	External fan	Not currently used
23	Emerg. working	Digital input for emergency operation/(load shedding 2) is active and emergency operating mode is enabled
24	HP cutout D2D Z1	Digital input for high-pressure cutout with discharge gas defrosting of Z1 cases is active (not yet implemented)
25	HD-Begr. D2D Z2	Digital input for high-pressure cutout with discharge gas defrosting of Z2 cases is active

No.	Message	Process fault reported
26	HD-Begr. D2D Z2Z	Digital input for high-pressure cutout with discharge gas defrosting of Z2 coldrooms is active
27	Disable D2D Z1	Digital input for disabling discharge gas defrosting of Z1 cases is active (not yet implemented)
28	Disable D2D Z2	Digital input for disabling discharge gas defrosting of Z2 cases is active
29	HD-Begr. D2D Z1	Digital input for disabling discharge gas defrosting of Z2 coldrooms is active
30	Fault D2D Z1	Fault in discharge gas defrosting of Z1 cases (not yet implemented
31	HD-Begr. D2D Z2	Fault in discharge gas defrosting of Z2 cases
32	HD-Begr. D2D Z2R	Fault in discharge gas defrosting of Z2 coldrooms
33	Sens type change	Parameter for matching pressure transducers has been changed
34	Comp auto disabl	Compressor Stage x automatically disabled (high cylinder head temperature 5 times in one day)
35	too many starts/h	Compressor short cycling with compressor combined control
36	no load level	No load level information for refrigeration points received with t_0 shift
37	NT Cascade 1	NT Cascade 1 not available or fault condition
38	NT Cascade 2	NT Cascade 2 not available or fault condition

9.3.2 System fault alarms

In occurrence of a *HP Measuring Loop Error*, condenser stages are unloaded when compressors are stationary and loaded when compressors are running. Capacity stages are likewise loaded when compressors have been started manually. Actuation takes place after the basic time has elapsed. No allowance is made for variable times.

In occurrence of an *LP Measuring Loop Error*, compressor capacity stages are loaded or unloaded until about 50% of all available compressor capacity stages are working. Actuation takes place after the basic time has elapsed. No allowance is made for variable times. In occurrence of all other *Measuring Loop Errors*, computation continues with the most recent valid value for the duration of the error.

EPROM and RAM errors are fatal errors and result in the controller going on HOLD, as correct running of the program can then no longer be expected. Output signals are reset.

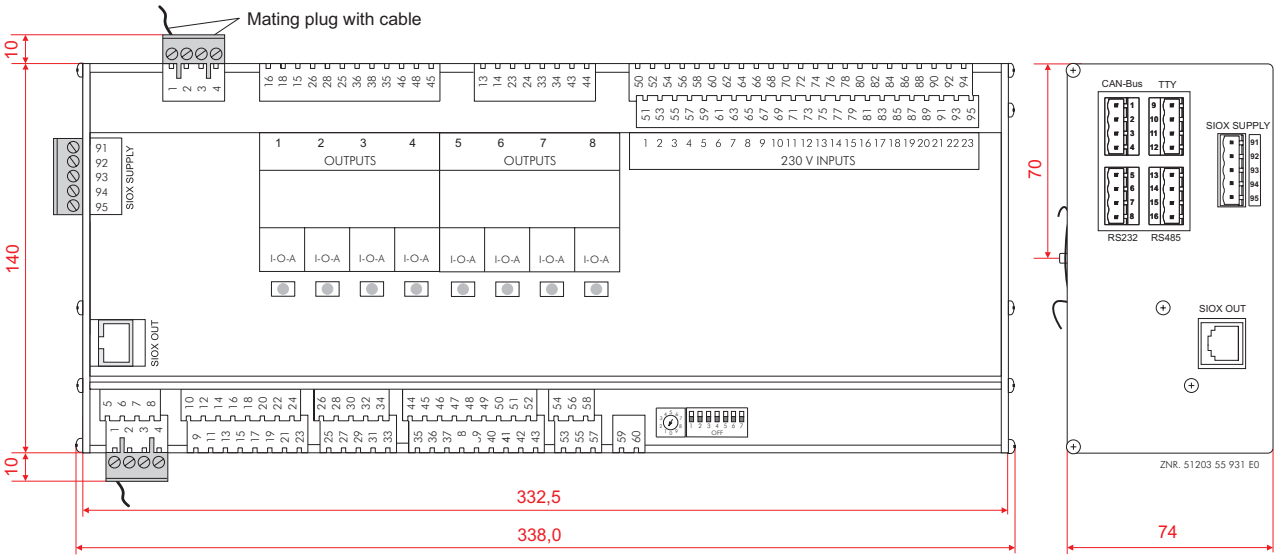
No.	Message	System fault reported
1	Meas.err.cylTemp Cx	Error in measuring loop to detect cylinder head temperature of Compressor Cx
2	Meas. error HP	Error in measuring loop to detect high pressure
3	Meas. error LP	Error in measuring loop to detect low pressure
4	Meas. error tr	Error in measuring loop to detect room temperature
5	Meas. error tod	FError in measuring loop to detect outside temperature
6	Meas.err.humid	Error in measuring loop to detect air humidity
7	RTC error	Fault in controller real-time clock
8	EEPROM error	Fault in internal EEPROM (parameter memory)
9	RAM error	Fault in internal data memory
10	SIOX error x	Failure of SIOX extension module No. x
11	Battery voltage	Internal battery fault

10 Specifications of VS 3000

10.1 Electrical Data of VS 3000

	VS 3000
Power supply	U_{Nom} = 230 V AC, 200 - 265 V AC, 50/60 Hz
Rated power	6 W
Leakage current over PE	max. 1 mA
Relay outputs	10 x 250 V AC, 6 A (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	12 x PT1000 temperature sensors, 2-wire type 2 x PT1000 temperature sensors, 4-wire type 2 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	2 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 modules
Archive memory	Compressor run times, starts, activity, fault reports
Monitoring function	Watchdog
Real-time clock	Byttery-backed Lithium cell (Typ CRC 2450 N / 3V Lithium, (10 years shelf life), typically 12 min/yr at 25°C
Temperature range	Transport: -20 .. 80°C Operation: 0 .. 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 60082-2-6	Transport and operation: 2 g
Atmospheric pressure	Transport: 660 hPa .. 1060 hPa Operation: 860 hPa .. 1060 hPa
Enclosure	IP20
CE conformity	Conforming to EC Directives 73/23/EEC (Low-Voltage Directive) 89/336/EEC (EMC Directive)

10.2 Mechanical data of VS 3000



10.3 Mechanical data of SIOX extension module