Operating instructions
Güntner Motor Management GMM sincon®

for the management and speed control of AC fans.

GMM sincon® 010.1	GMM sincon® 100.1UL
GMM sincon® 010.1 UL	GMM sincon® 140.1 UL
GMM sincon® 022.1 UL	GMM sincon® 170.1 UL
GMM sincon® 041.1 UL	GMM sincon® 240.1 UL
GMM sincon® 057.1 UL	GMM sincon® 320.1 UL
GMM sincon® 078.1 UL	GMM sincon® 450.1 UL

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1 General notes

The GMM sincon is a speed controller with frequency converter and all-pole sine filter, which has been specially developed for use on heat exchangers. The GMM sincon achieves the best possible level of effectiveness for heat dissipation and consequently increases the cost-effectiveness of the refrigeration system. *The AC fans are also operated especially motor-friendly and with low noise emissions. This increases the system's service life.*

Very good radial runout of fans
The sine-form motor voltage enables excellent synchronisation of the motors. This consistent sine voltage allows the motors to build up sufficient torque in the lower speed range and very low speeds are therefore already possible from a frequency of 0.5 Hz.

Low emitted interference
Due to its sine-form output voltage, the GMM sincon also has a very low emitted interference. This means that cables without any special shielding can be used. The cable lengths can also be significantly longer than with frequency converters without sine filters. All EMC (= electromagnetic compatibility) requirements are also met without shielded cables.

The motor doesn't overheat
No additional motor overheating with non-sine form voltage parts, which increases the motor's service life.

Barrier is relieved
There are no voltage peaks, as with frequency converters without all-pole sine filters, which significantly reduces the motors' service life with flashovers in the motor winding.

Long motor cables
The extremely sine-form output voltage means that long feed cables do not have a negative EMC effect. This means that even long cables do not have to be shielded for compliance with installation regulations.

Low mains load
Smoothing coils significantly cap voltage peaks with power consumption from the mains.

Low load current peaks
Inrush current limiters, which are prescribed for larger equipment, are already standard with the GMM sincon, even with the smallest construction size. Long component service life The prevention of current and voltage peaks has a particularly good effect on the service life of all components.

Cos f always > 0.95 with public utility mains
The GMM sincon achieves Cos f > 0.9. This means hardly any idle power is generated and additional idle power compensation is not required.

Low noise emissions, high effectiveness
There are no control-related noise emissions with the GMM sincon.

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1.1 Safety instructions

In order to prevent serious physical injuries or major material damage, work on or with the unit may be performed only by authorised persons with appropriate training and qualifications who are familiar with the set-up, installation, commissioning and operation of speed controllers. These persons must read the operating instructions carefully before the installation and commissioning. In addition to the operating instructions and national accident prevention regulations, all recognised technical rules (safety and professional work under UVV, VBG, VDE etc.) must be followed.

Repairs to the device may only be made by the manufacturer or a repair centre authorised by the manufacturer.

UNAUTHORISED AND IMPROPER INTERVENTIONS WILL INVALIDATE THE WARRANTY!

The applicable national accident prevention regulations must be followed when working on control units under voltage.

1.2 Proper intended use

The unit is intended only for the purposes agreed in the order confirmation. Any other application or use for any additional purpose, is not a proper intended use. The manufacturer accepts no liability for any injury or damage arising from unintended use. Proper intended use is also contingent on compliance with the installation, operating and maintenance procedures described in these operating instructions. The technical data and the details of the connection assignments can be found on the type plate and in the instructions, and must be complied with.

Electronic equipment is not fundamentally failsafe! The user must therefore ensure that his system reverts to a safe condition in the event of failure of the equipment. The manufacturer accepts no responsibility for any damage to life and limb or to material goods and assets in the event of failure to comply with this provision and in the event of improper use.

The electrical installation must be performed in accordance with the relevant regulations (e.g. cable cross-sections, fuses, earth conductor connections, etc.). Additional information is included in the documentation. If the control unit is used in a particular area of application, the required standards and regulations must be complied with.

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1.3 Transport and storage, copyright notice

The controllers are packaged appropriately for transport and may only be transported in their original packaging. Avoid any impacts and collisions. Unless otherwise noted on the packaging, the maximum stacking height is 4 packs. When you receive the equipment, check for any damage to the packaging or the controller.

Store the equipment in its original packaging and protected from the weather, and avoid extremes of heat and cold.

Subject to technical changes in the interests of further development. Therefore no claims may be derived from information, images and drawings; errors excepted!

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Fürstenfeldbruck

1.4 Warranty and liability

The current General Terms and Conditions of Sales and Delivery of Güntner GmbH & Co. KG apply.

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1.5 Manufacturer and supplier address

Should you have a problem with any of our equipment, or any questions, suggestions or special requests, simply contact

Güntner GmbH & Co. KG
Hans-Güntner-Strasse 2-6
D-82256 Fürstenfeldbruck, Germany

Service Telephone Germany:
0800 48368637
0800 GUENTNER

Service Telephone Worldwide:
+49 (0)8141 242-4815

Fax. +49 (0)8141 242-422
service@guentner.de
http://www.guentner.de

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1.6 EMC-compliant installation

Controllers in the GMM sincon® series fulfil the requirements of EN 61000-6-2 as regards resistance to EMC interference and those of EN 61000-6-3 as regards emissions.

They also comply with standards IEC 61000-4-4/-5/-6/-11 for grid-bound interference. In order to guarantee EM compatibility, the following points must be noted:

- All measurement and signalling lines must be connected via shielded cables.
- The shielding of measuring, signal and bus lines must be earthed *at one end* only.
- Suitable shielding and routing measures must be taken to ensure that mains cables and motor cables do not give rise to any interference in signal and control lines.

The GRCF.1 controller module and any expansion modules are mounted on a top-hat rail and are attached to an earthed mounting panel in the switch cabinet. The electrical supply is connected with cable connectors.

ADVICE

If the equipment is installed in a switch cabinet, **proper attention must be given to the** temperature inside the cabinet. Güntner switch cabinets are provided with sufficient ventilation.

2 Commissioning GMM sincon®

With the GMM sincon® the AC fans are controlled via one or more frequency converters with an optional sinusoidal filter.

The GMM or frequency converters are controlled via a CAN bus.

The frequency converters must be set up in accordance with the configuration of the heat exchanger and the fans. This commissioning process determines the performance of the heat exchanger.

When switched on the GMM sincon® automatically recognizes whether commissioning has already been carried out and, if it has, continues with normal operation.

If the GRCF.1 detects that this has not yet been done, it initiates the commissioning procedure. After the procedure is completed, all the parameters are saved. All values set up by the commissioning can also be viewed and changed individually later on in the menus.

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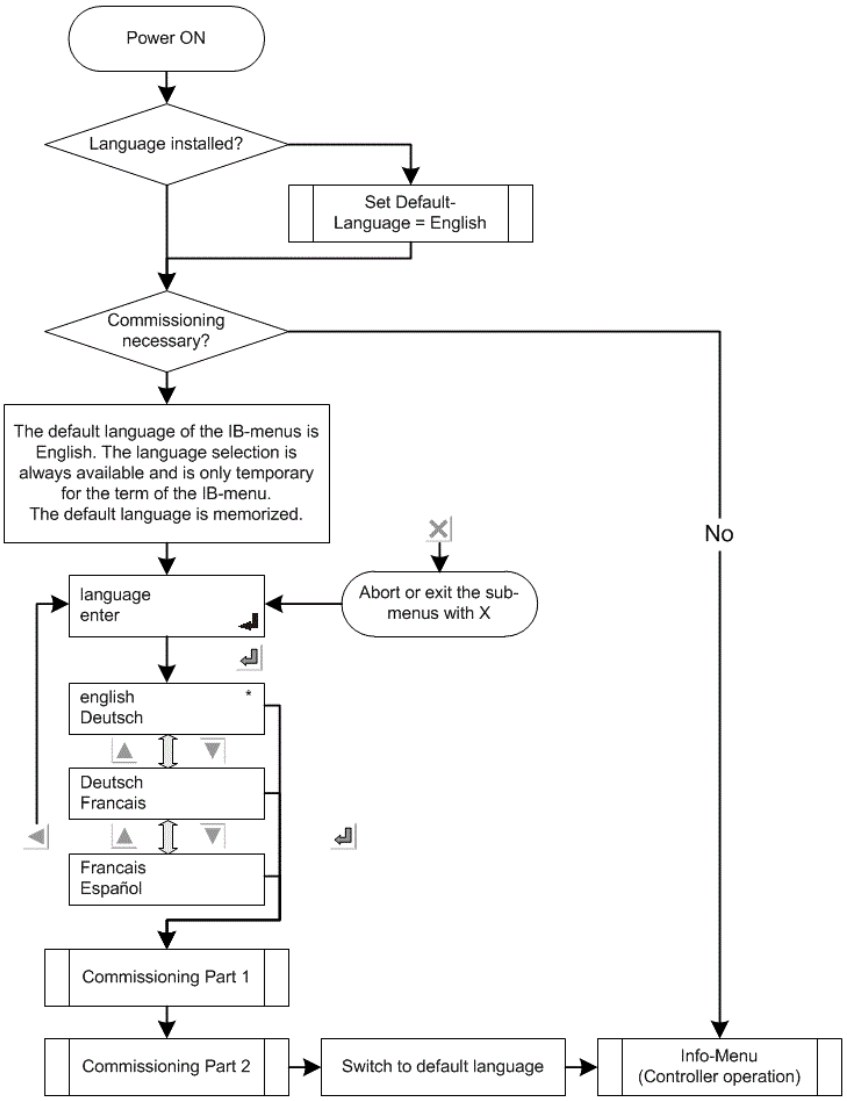
2.1 Default parameters with start-up

The parameters are set by default as indicated by the commissioning process, see also Factory setting, Page 102.

2.2 The initial commissioning procedure

If it is recognized that commissioning has not yet taken place, the following values are interrogated and set up in accordance with the following flow chart.



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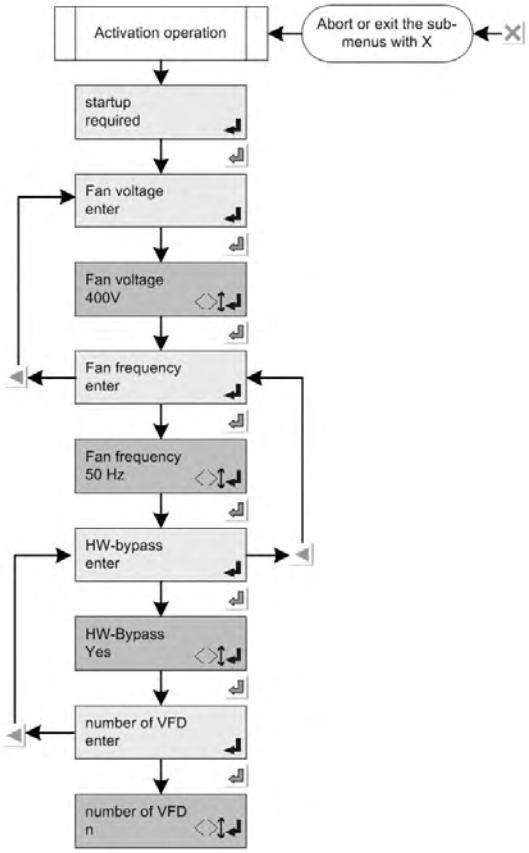
If it is recognized that commissioning is required, the commissioning menu is displayed.



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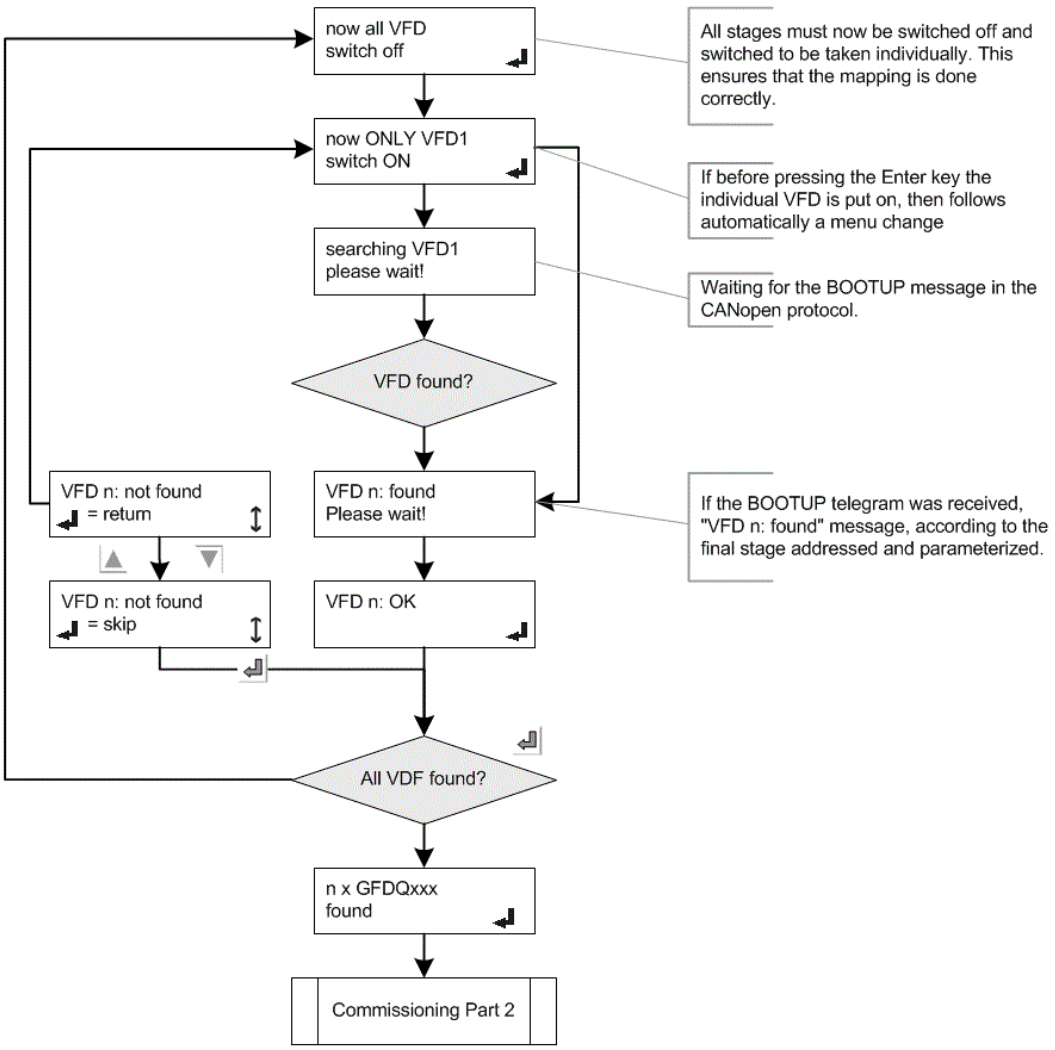
When the default parameters for all the frequency converters have been entered, the individual FCs are found and parametrised.



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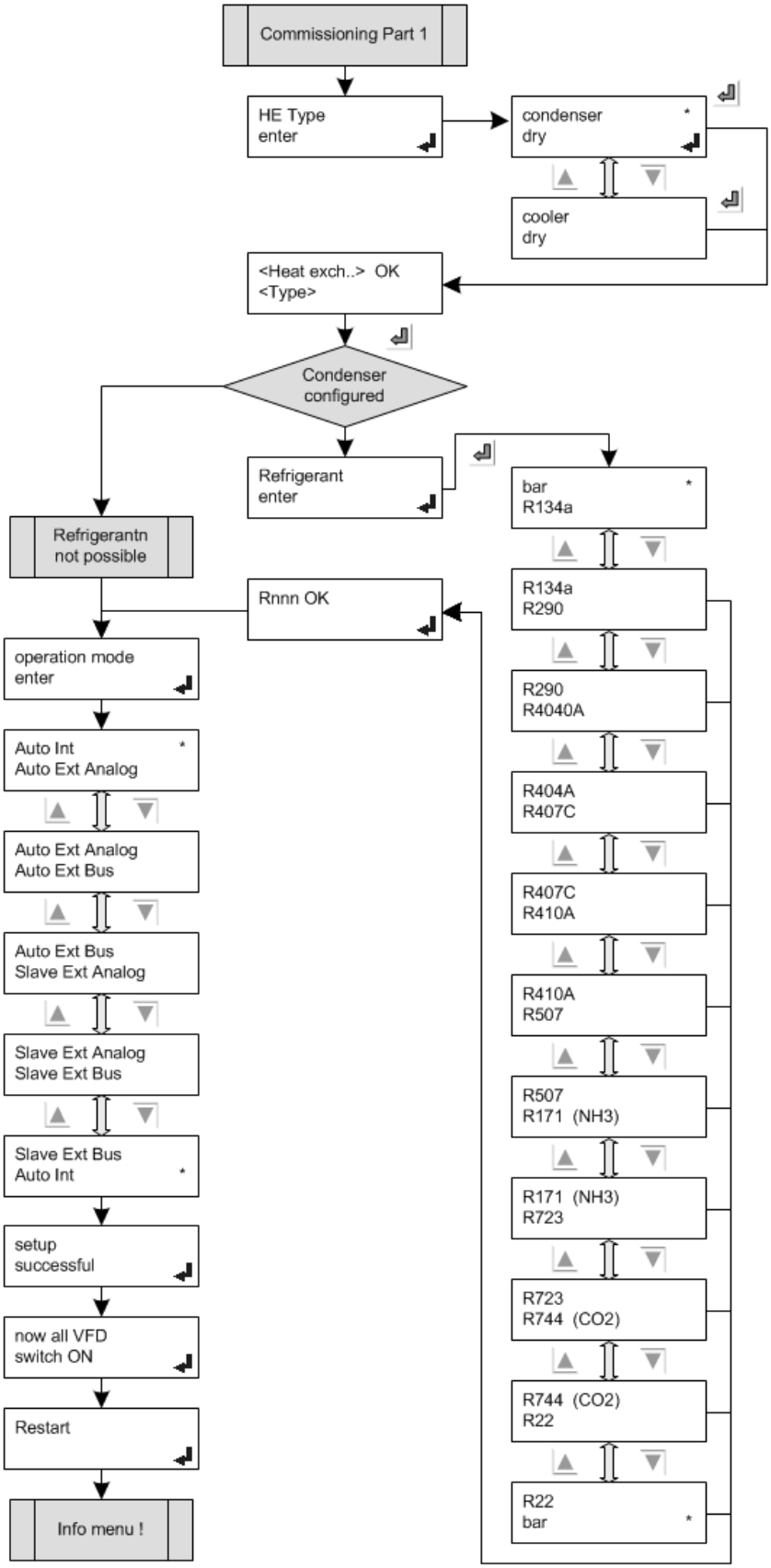
General operating parameters, such as heat exchanger type, refrigerant and operating mode, are set in the second part.



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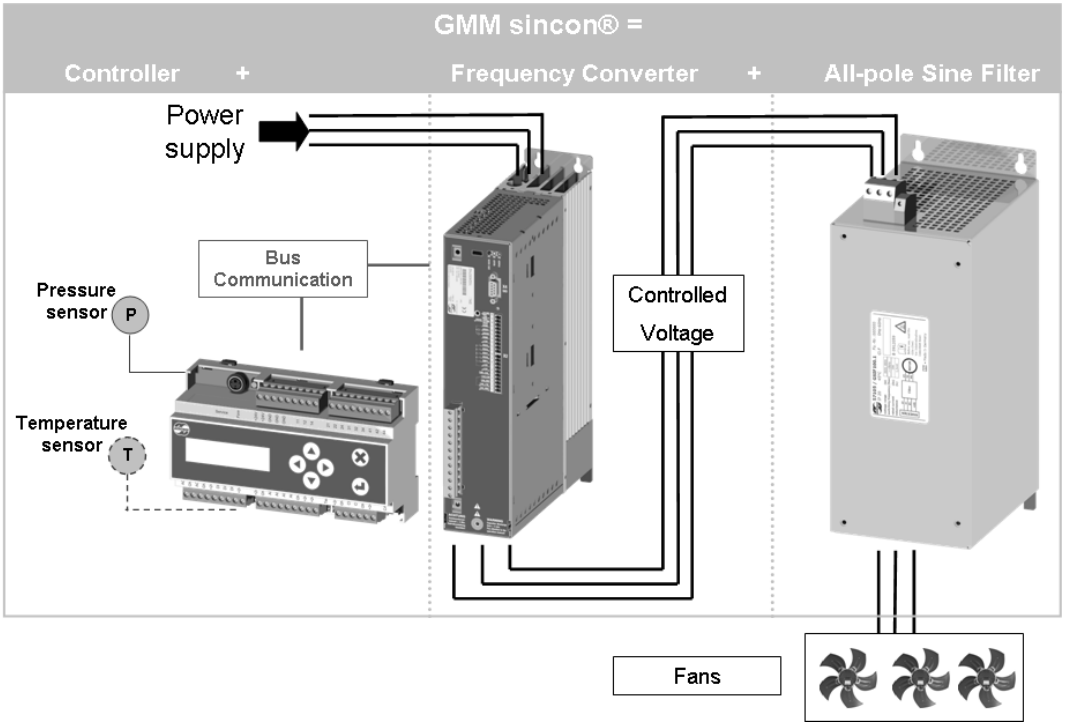
3 Construction of the GMM sincon®



Construction of the GMM sincon

The GMM sincon® consists of the following components:

1. The control unit **GRCF.1** (left)
2. The frequency converter output stage **GFQDxxx.1** (centre)
3. **The sinusoidal filter GSIFxxx.1 (optional)** (right)

GMM sincon®		Con-troller	Frequency converter	Sinusoidal filter
Description	Type	Type	Type	Type
Sine controller, 0.375 kW, 1,0 A without UL	GMM sincon® 010.1	GRCF.1	GFQD010.1	GSIF013.1
Sine controller, 0.375 kW, 1.0 A with UL	GMM sincon® 010.1 UL	GRCF.1	GFQD010.1 UL	GSIF013.1
Sine controller, 0.750 kW, 2.2 A with UL	GMM sincon® 022.1 UL	GRCF.1	GFQD022.1 UL	GSIF025.1
Sine controller, 1.5 kW, 4.1 A with UL	GMM sincon® 041.1 UL	GRCF.1	GFQD041.1 UL	GSIF040.1
Sine controller, 2.2 kW, 5.7 A with UL	GMM sincon® 057.1 UL	GRCF.1	GFQD057.1 UL	GSIF060.1
Sine controller, 3.0 kW, 7.80 A with UL	GMM sincon® 078.1 UL	GRCF.1	GFQD078.1 UL	GSIF100.1
Sine controller, 4.0 kW, 10.0 A with UL	GMM sincon® 100.1 UL	GRCF.1	GFQD100.1 UL	GSIF100.1
Sine controller, 5.5 kW, 14.0 A with UL	GMM sincon® 140.1 UL	GRCF.1	GFQD140.1 UL	GSIF165.1
Sine controller, 7.5 kW, 17.0 A with UL	GMM sincon® 170.1 UL	GRCF.1	GFQD170.1 UL	GSIF165.1

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GMM sincon®		Con-troller	Frequency converter	Sinusoidal filter
Sine controller, 11.0 kW, 24.0 A with UL	GMM sincon® 240.1 UL	GRCF.1	GFQD240.1 UL	GSIF240.1
Sine controller, 15.0 kW, 32.0 A with UL	GMM sincon® 320.1 UL	GRCF.1	GFQD320.1 UL	GSIF320.1
Sine controller, 22.0 kW, 45.0 A with UL	GMM sincon® 450.1 UL	GRCF.1	GFQD450.1 UL	GSIF500.1

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3.1 Remote controllers

3.1.1 Functional description / Suitability

Functional description of GRCF.1

The GRCF.1 is used for controlling frequency converters. Depending on the controlling algorithm, the output frequency is controlled from 0 through to the mains frequency.

In order to ensure controlled operation, the controller must have a power supply and must be enabled via digital input DI1. If it is not enabled the process will not be regulated. The unit has an internal PID controller, whose parameters (amplification factor, integral and differential time) can be configured either from the menu or via an external bus module.
The setpoint can be specified via the internal menu, an external analogue value or via an external bus module.
The actual value is determined using a pressure sensor (4-20mA), a temperature sensor (KTY, GTF210) or a 0-10V signal.

The control value is sent via a bus system to the power unit (frequency converter). At the same time this value is also provided as a 0-10V signal.

The digital inputs are designed as potential-free contacts that must be connected to +24V. As well as enable, digital inputs are also used to control the night limiter (DI2) and setpoint switchover (DI3).

ADVICE

Please note that connecting the wrong voltage (e.g. 230V) may seriously damage the controller.

The relay outputs are used for control messages. Relay 1 reports priority 1 alarms, relay 2 reports priority 2 alarms, relay 3 reports that the fans are in operation and relay 4 is used to activate hard bypass operation.

Analogue output AO1 shows the current control value from the controller (0-100%) as a voltage in the range 0-10V.

Analogue output AO2 can be used to control an additional subcooler.

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Functional description of GFQD.1

The GFQD.1 (frequency converter) is used for variable rotary field generation. Depending on the control value, the output frequency is controlled from 0 Hz through to the mains frequency. The GFQD is controlled by the Güntner controller GRCF.1 via the CAN bus.

The AC fans are connected via a sinusoidal filter to the output of this frequency converter. The fan speed matches the output frequency, from 0 rpm up to the maximum speed.

Functional description of GSIF.1

The filter should be connected as an output filter between the frequency converter and the motor. The frequency converter must fulfil the following requirements:

· Frequency converter with a DC link connection
· Frequency converter with continual PWM process.

Commissioning is permitted only

· with V/f or V/f2 characteristic control
· with a switching frequency of at least 8kHz

Make sure that automatic switching frequency is deactivated (see the documentation of your converter). The filter will overheat if the switching frequency is below 8 kHz.

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3.1.2 Installation / Operating conditions

Installation / Operating conditions GRCF.1

- The module is designed for mounting on a top-hat rail.
- All measurement and signalling lines must be connected via shielded cables.
- The shielding of measuring, signal and bus lines must be earthed at one end only.
- Suitable shielding and routing measures must be taken to ensure that mains cables and motor cables do not give rise to any interference in signal and control lines.
- Temperature:

Storage Transport:	-20°C ... +70°C
Operation:	-20°C ... +65°C

- Protection rating: IP 20
- Recommended cables: Belden 9841, Lapp 2170203, Lapp 2170803, Helukabel 81910

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Installation / Operating conditions GFQD.1

The frequency converter is mounted vertically on a galvanised mounting panel. This ensures there is sufficient air convection in the GFQD.1.

The frequency converter must be adequately earthed.

Feature		GFQD010.1 ... GFQD450.1
Climatic conditions	**In operation** as per EN 61800-2 IEC 60721-3-3 Class 3K3	+5 to +40°C (2) at relative humidity from 5 to 85% without condensation
	In storage as per EN 61800-2 IEC 60721-3-1 Class 1K3 + 1K4	-25 to +55°C (3) at relative humidity 5 to 95%
	In transit as per EN 61800-2 IEC 60721-3-2 Class 2K3	
Protection rating	Unit	IP20 (connector terminals IO00)
	Cooling concept	IP20 convection
Contact protection		BGV 3
Installation height		Up to 1000 m above sea level, above 1000 m above sea level with power reduction, max. 2000 m above sea level

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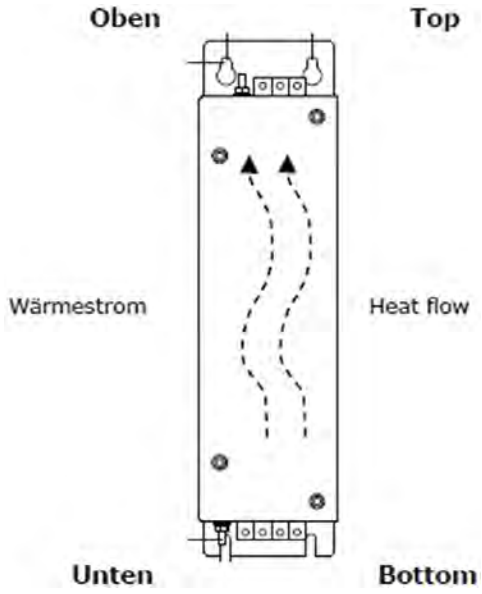
Installation / Operating conditions GSIF.1



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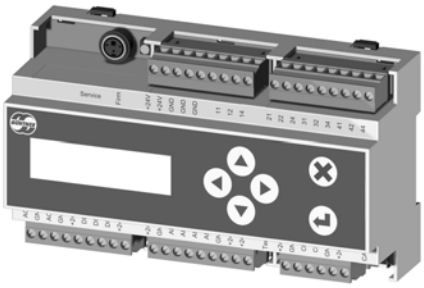
3.1.3 Controller GRCF.1



Controller GRCF.1

The GRCF.1 is used for controlling frequency converters.

Depending on the controlling algorithm, the output frequency is controlled from 0 through to the mains frequency.
The unit has an internal PID controller, whose parameters (amplification factor, integral and differential time) can be configured either from the menu or via an external bus module.
The setpoint can be defined via the internal menu, an external analogue value or via an external bus module.
The actual value is determined via a pressure sensor (4-20mA), a temperature sensor (KTY, GTF210) or a 0-10V signal.
The control value is sent via a bus system to the power unit (frequency converter). At the same time this value is also provided as a 0-10V signal.

The equipment is controlled by means of menus using a 2-line display and an input keyboard.

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3.1.4 GFQD frequency converter

GFQD frequency converter

The GFQD.1 (frequency converter) is used for variable rotary field generation. Depending on the control value, the output frequency is controlled from 0 Hz through to the mains frequency. Control is via a CAN bus from GRC.

On this frequency converter the AC fans are connected on the output side via a sine filter and rotate in acc. with the output frequency with a speed be between 0 and the maximum rpm.

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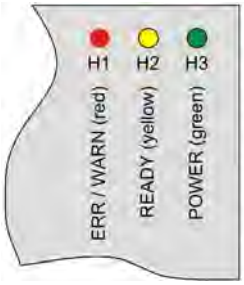
3.1.4.1 GFQDxxx.1 LEDs



device state	red LED (H1)	yellow LED (H2)	green LED (H3)
Supply voltage located	○	○	●
Operational (ENPO set)	○	●	●
Active / self-tuning active	○	✳	●
Warning	●	●	●
Error (see blinking Code)	✳	○	●

○ LED off ● LED on ✳ LED blinking

The red LED is used to signal the following fault situations

Red LED flash code	Display Display	Cause of the fault
1x	E-CPU	Collective fault message
2x	E-OFF	Undervoltage switch-off
3x	E-OC	Overcurrent switch-off
4x	E-OV	Overvoltage switch-off
5x	E-OLM	Motor overloaded
6x	E-OLI	Unit overloaded
8x	E-OTI	Cooling unit temperature too high
9x	E-PLS	Plausibility error, parameters or programme flow
10x	E-PAR	Defective parameters
11x	E-FLT	Floating point error
12x	E-PWR	Power unit unknown
13x	E-EEP	Defective EEPROM

Flash code (number of successive impulses)

These and other fault messages of the GFQDxxx.1 output stages are forwarded to the GRFC.1 controller, displayed there on the display and also saved in the alarm history.

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3.1.4.2 Inputs and outputs GFQD.1

Functions of the inputs and outputs			
	Name	**Position**	**Description**
Inputs	ENPO	FC release	Power unit released
	ISD00	Phase sequence	Phase sequence OK
	ISD01	TC error	Thermocontact error occurred
	ISD02	Motor protective cut-out	Motor protective cut-out OK
	ISD03	--	Free
Outputs	OSD00	Motor protection	Switch FC protection
	OSD01	TC reset	Reset thermocontact error
	OSD02	Threshold value	Threshold value reached

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3.1.5 GSIF sine filter

GSIF sine filter

All frequency converters generate strong electrical noise signals, which are amplified with the parallel operation of several motors on one frequency converter, which is usual with heat exchangers. These noise signals can cause damage on the external rotor motors. Bearing damage that is caused by bearing through fault current is possible here, and voltage spikes cause damage that can lead to short circuits in the coil. Both effects cause the fan to fail.

The GSIF sine filter in combination with the GFQD frequency converter reduces precisely these bearing currents and voltage spikes to guarantee a safer system operation and a long service life for the fans. The typical frequency converter noises are also reduced to a minimum to achieve very quiet system operation.

Despite the frequency converter, use of the GSFI sine filter allows all motor cables to be operated with without shielding. Significantly longer cables can also be used.

With a missing sine filter, noise signals in the axial fan destroy the bearing. In this case the warranty is null and void.

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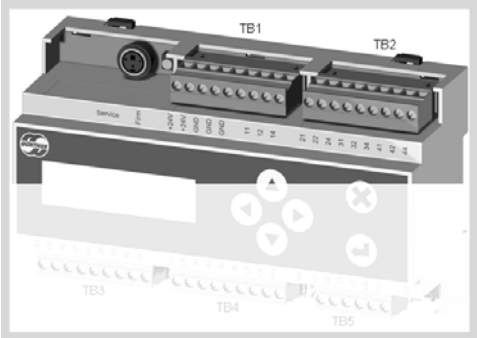
3.1.6 Connections

Connections GRCF.1



Upper row of connections			
	Name	**Description**	
	Service	Service plug only for use by service personnel	
	Firm	Pushbutton only for use by service personnel	
TB1	+24V	External feed for power supply	
	+24V		
	GND	Contact ground for external power feed	
	GND		
	GND		
		Terminal not connected	
	11		Two-way contact for priority 1 alarms
	12		
	14		
TB2	21		Two-way contact for priority 2 alarms
	22		
	24		
	31		Two-way contact for system messages
	32		
	34		
	41		Two-way contact for hard bypass operation
	42		
	44		

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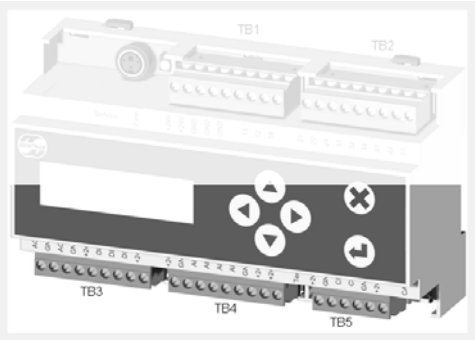

Lower row of connections		
	Name	**Description**
TB3	AO1	Analogue output 1, 0-10V
	GND	Ground
	AO2	Analogue output 2, 0-10V
	GND	Ground
	+24V	Voltage +24V
	DI1	Digital input +24V, Release
	DI2	Digital input +24V / night limiter
	DI3	Digital input +24V, setpoint changeover
	+24V	Voltage +24V
TB4	+24V	Voltage +24V
	GND	Ground
	AI1	Analogue output 4-20mA
	AI2	Analogue input 4-20mA or for temperature sensor GTF must be configured in the soft-ware
	AI3	Analogue input for temperature sensor GTF
	AI4	Analogue input 0-10V
	GND	Ground
	+24V	Voltage +24V
	+24V	
	Term	DIP switch for CAN bus termination (120Ω) / ON = termination activated
TB5	+24V	Voltage +24V
	GND	Ground
	CH	CAN high signal
	CL	CAN low signal

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Lower row of connections		
	GND	Ground
	+24V	Voltage +24V
	CAN	CAN bus plug including power supply

*TB: Terminal block

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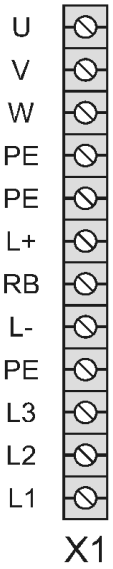
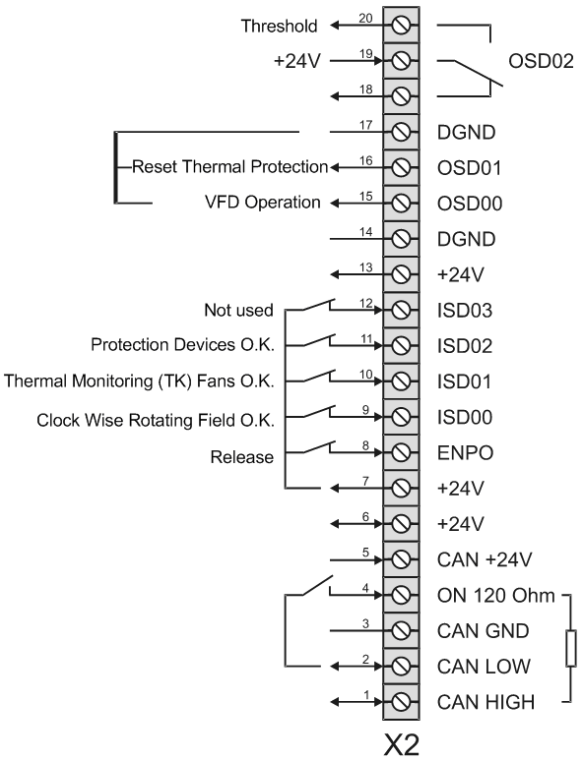
Connections to GFQD.1

The frequency converters are supplied with mains voltage. The frequency converters' wiring is defined in the switch cabinet's circuit diagram. It must be ensured that a clockwise-rotating field is connected, otherwise there may be an abrupt change of direction when you activate a bypass switch!

Power connection



Control signals



Power connection → Motor operation

The following must ALWAYS be observed when operating the frequency converter with several fans:

Individual fans can be switched off during the operation without restriction, for example by activating a thermocontact.

When switching motors on during operation, it must be ensured that the switch-on power is not higher than the frequency converter peak power. It is helpful if the frequency converter load is >40%. This 40% basic load supports the frequency converter's output voltage while switching on.

ADVICE

While being switched on the motor must not be operated in the field suppression range, as it would otherwise have to start with reduced starting torque.

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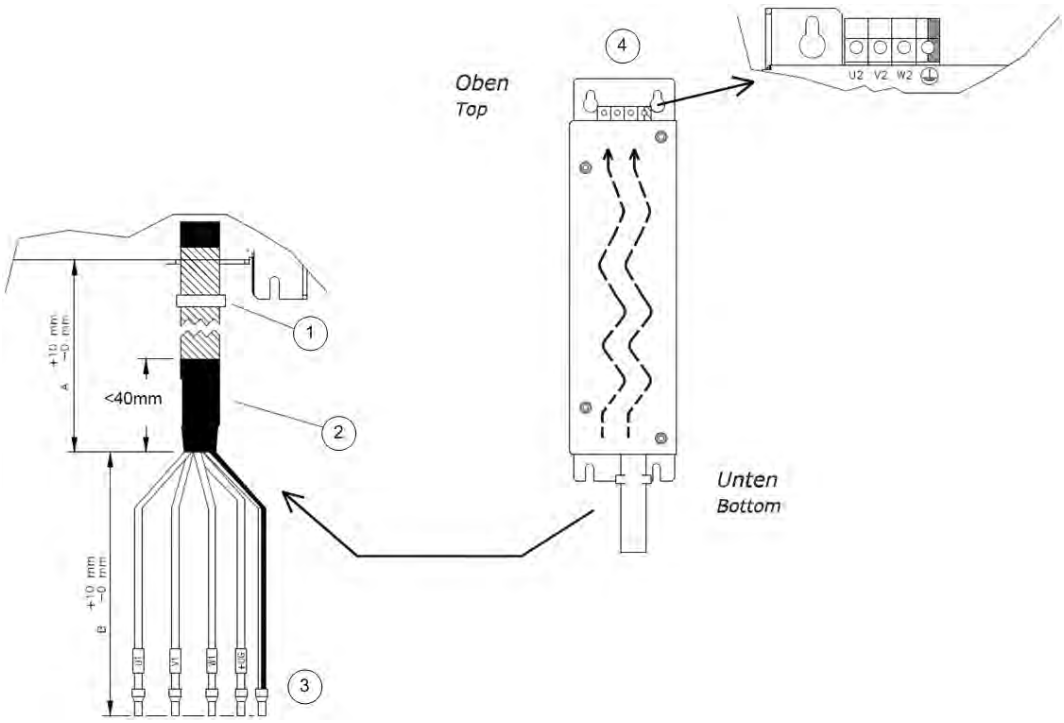
Connections to GSIF.1



1) Shield grounded to casing via cable clamp
2) Insulated against fanning out
3) Connection [X1] to converter
4) Connection [X2] to motor

Type	ERP no.	Connection [X1] strands (black / PE yellow/green) with end sleeves				Connection [X2] / screw terminal		
		Core cross-section		Length [mm]		Max. connection cross-section		Torque
		[mm²] *	AWG	A	B	[mm²] *	AWG	[Nm]
GSIF013.1	57111	1.0	14	850	100	4.0	10	0.6-0.8
GSIF025.1	57102	1.0	14	850	100	4.0	10	0.6-0.8
GSIF040.1	57103	1.5	14	900	100	4.0	10	0.6-0.8
GSIF060.1	57104	1.5	14	900	100	10	6	1.5-1.8
GSIF100.1	57105	1.5	14	950	100	10	6	1.5-1.8
GSIF165.1	57106	2.5	10	1000	100	10	6	1.5-1.8
GSIF240.1	57107	4	10	1100	100	16	6	- **
GSIF320.1	57108	6	8	1100	100	16	6	- **
GSIF400.1	57109	10	8	1200	100	16	6	- **
GSIF500.1	57112	10	6	1200	100	16	6	- **
GSIF600.1	57110	16	4	1300	100	25	4	- **

* = Cross-section with end sleeves
** = Connection type “cage clamp”

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4 Display and operation

Information are shown on a two-line display. The controller is operated via a membrane keyboard.

4.1 Info menu

Display with a dry cooler or condenser with selected refrigerant

Setpt. XX.X°C	→ Setpoint
act val XX.X°C A	→ Actual value

Display with a dry cooler without refrigerant selection

SP rel. XX.Xbar	→ Setpoint
AV rel. XX.Xbar A	→ Actual value

4.2 Status displays in the Info menu

Setpt. XX.X°C ▼ act val XX.X°C (A)	→ Status display

A	Automatic mode – internal control	Static display
H	Manual mode – control value is specified fixed via display	Static display
S	SLAVE mode – control value is specified externally	Static display
F	Priority 1 fault	Alternating with standard display
W	Priority 2 warning	Alternating with standard display

Further messages in the second line

- No release
- Night limiter (alternating with current value)
- Error messages in clear text (alternating with actual value)

See Error messages and warnings , Page 104

Setpt. XX.X°C not enabled	→ Text message

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4.3 Operation

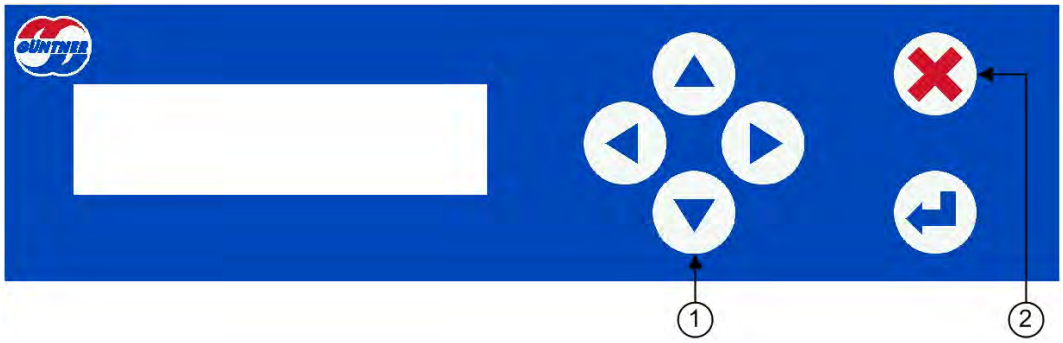
Cancel and return to INFO menu

Enter key for function selection; change to EDIT mode and value acceptance

Right arrow for moving to the next menu level.

Left arrow for moving to the previous menu level.

Up/down arrow for scrolling through the menu level.



1. Use this key to move from the **INFO** menu to the **Operating menu**.
2. Use this key to return to the **INFO** menu at any time.

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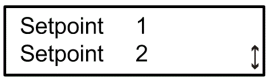
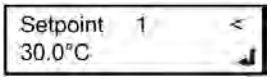
4.4 Edit mode

This mode is required to change values (setpoints, for example).

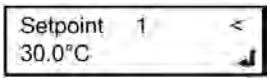
Select menu option you want (top line)

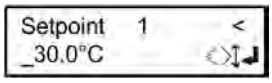


Change to menu option

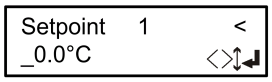


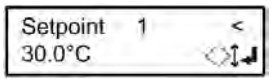
Change to writing mode (cursor flashes)



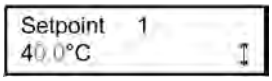


Decimal point selection (cursor flashes)

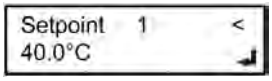




Change value



New value acceptance



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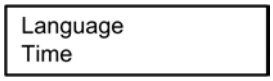
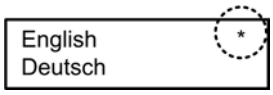
4.5 Selection mode

This mode is required to select functions (language, for example).

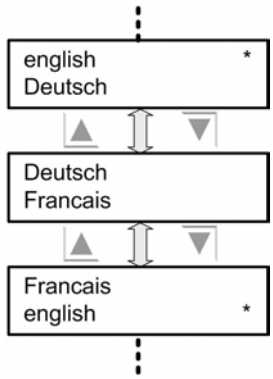
Select menu option you want ("Language", for example, top line)



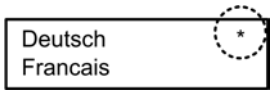
Change to the menu option
→ The function/language currently set is marked with an *asterisk*.



Set target language by scrolling to the top line
→ selected function/language in top line



Accept function/language.
→ selected language is marked with an *asterisk*.



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4.6 Configuration

The GMM sincon®is configured with an appropriate number of potential-free contacts. Their assignments will differ depending on the configuration.

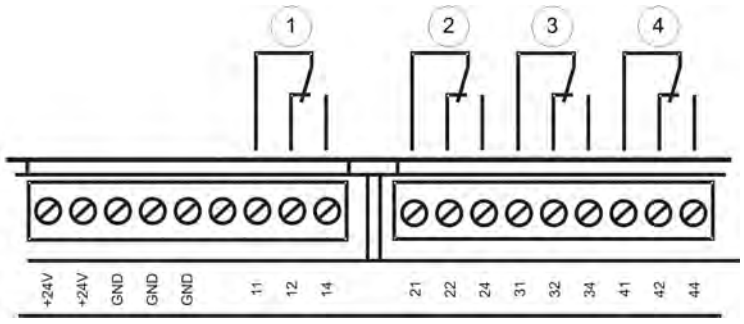
4.6.1 Configuration table

Type	BAAN no.	Power [kW]	Current [A]
GFQD010.1	5204114	0.375	1.0
GFQD010.1 UL	5204115	0.375	1.0
GFQD022.1 UL	5204116	0.75	2.20
GFQD041.1 UL	5204117	1.5	4.10
GFQD057.1 UL	5204118	2.2	5.70
GFQD078.1 UL	5204119	3	7.80
GFQD100.1 UL	5204120	4	10.00
GFQD140.1 UL	5204121	5.5	14.00
GFQD170.1 UL	5204122	7.5	17.00
GFQD240.1 UL	5204123	11	24.00
GFQD320.1 UL	5204124	15	32.00
GFQD450.1 UL	5204125	22	45.00

Configuration table

4.7 Potential-free signalling outputs

For safety reasons, the potential-free signal outputs (two-way contacts) are designed in such a way that the corresponding signal relay is deactivated when the event is triggered, i.e. the opener of the corresponding two-way contact closes. This has the effect that a malfunction is also signalled if the GMM loses power due to a fault. All signalling outputs must not exceed 250 V / 1 A.



1. Fault
2. Warning
3. System in operation
4. Hardware bypass

Potential-free signalling outputs

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4.7.1 Digital output (11/12/14) (fault)

The message on the contact 11/12/14 is a fault, which and signals complete failure and standstill of the heat exchanger.

Contact 11/12 is closed in alarm status.
Alarms, see Error messages and warnings , Page 104

4.7.2 Digital output (21/22/24) (warning)

Signals on contact 21/22/24 are warnings that do not result in the complete failure of the heat exchanger. These are warnings that the operation of the heat exchanger.

Contact 21/22 is closed when a warning is issued.

4.7.3 Digital output (31/32/34) (System in operation)

The two-way contact (31/34) is closed when a control signal is sent to the frequency converter, i.e. the fans are turning.

4.7.4 Digital output (41/42/44) (hard bypass operation)

If a bypass value is programmed as of which the frequency converter is to be bridged, this relay (contacts 41/44) is switched at this bypass value following a definable delay time.
For the precise function description, see Bypass, Page 68

4.8 Control inputs

The control inputs are designed as a **low-voltage connection** and are connected via a potential-free contact (relay, contactor contact, switch etc.). The potential-free contact must be switched between the terminals **+24V** and the **DI1** or **DI2** or **DI3** control input. The function is activated when the contact is closed.

4.8.1 Enabling of GMM sincon

Fans are enabled via terminal **DI1** (enable). Their speed then depends on the control value. If enable is not switched, the fans will be disabled (speed = 0).

*If they are not to be enabled externally, terminal **DI1** must be jumpered.*

This enabling jumper is always installed in the factory.

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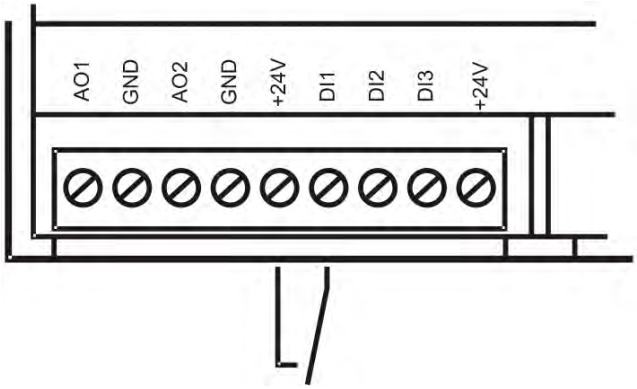
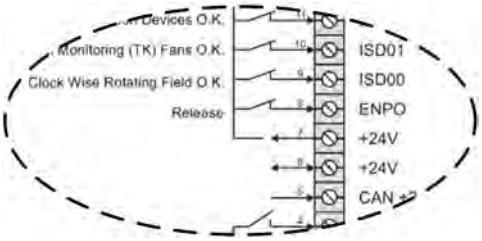


Connection of external enable contact +24V – DI1



As well as enabling the GRCF you also need to enable the power unit. The GFQD frequency converter's ENPO input has to be connected to +24V (terminals 7/8) to do so.

ADVICE

Under no circumstances may the controller be disabled by interrupting the supply voltage! Continuously switching the supply voltage can damage the controller and such damage is not covered by the warranty!

Enable is not required in "Manual" mode.
See *Manual mode, Page 60*

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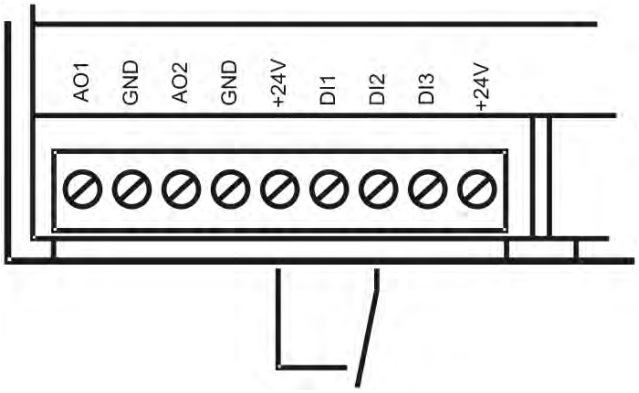
4.8.2 Speed limiter/External manual mode

Terminal **DI2** can be used to activate the (night) speed limiter and thereby limit the control signal and fan speed to their set values. This is then the maximum speed. For setting the speed limiter, see section Nightsetback, Page 54 and for general activation see section Service, Page 61.

Digital input 2 may have to be configured here accordingly (see IO configuration - Digital inputs, Page 88).

Alternatively, the input can also be used to activate manual mode. The input has to be configured accordingly for this purpose.



Activating the speed limiter externally/External manual mode

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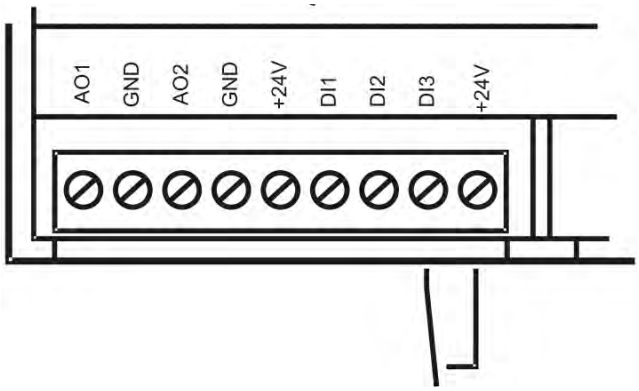
4.8.3 Switching to 2nd setpoint (or between heating and cooling mode)

Setpoint switchover:

This function enables the switchover between two setpoints, which serve as controlling input values. The switchover is made by connecting the **"DI3"** input.

If this terminal is blank, **Setpoint 1** is always active. Ex works, this connection is blank (open).

If this function is activated in the Service menu, the control mode can be switched over between heating and cooling. (Cooling and heat pump operation, for example)



Switchover from setpoint 1 to setpoint 2 or heating/cooling

The second setpoint and the second setpoint displacement are switched over with the **DI3** input.

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4.9 Analogue inputs

The GMM has four sensor inputs:

Input AI1	Current input	4-20mA
Input AI2	switchable	4-20mA or impedance sensor GTF210
Input AI3	Impedance sensor	GTF210
Input AI4	Voltage source	0-10V DC

The various ways of using inputs and how to connect them in each case are described below.

4.9.1 Connecting a pressure sensor to AI1/AI2

One or two (two-wire) sensors can be connected:

+24V = Common supply voltage (GSW4003.1: brown(1), GSW4003:brown(1))

AI1 = 4-20mA signal from sensor 1 (GSW4003.1: blue(3), GSW4003: green(2))

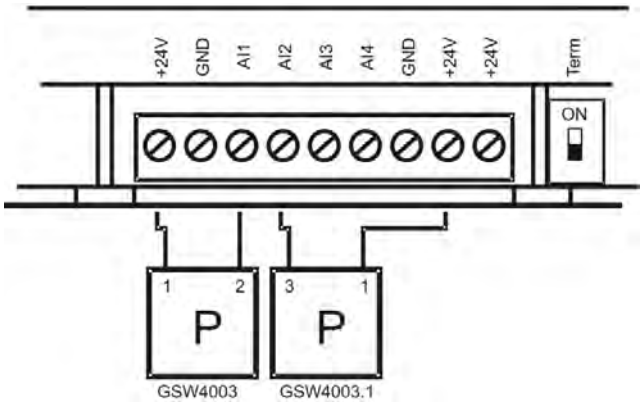
AI2 = 4-20mA signal from sensor 2 (GSW4003.1: blue(3), GSW4003: green(2))

The connected pressure sensors must be configured in the hardware configuration.
When two sensors are used the larger signal is always processed by the control unit as the actual value (max. selection)

ADVICE

Three-wire sensors with a 4-20 mA signal output can also be connected, but these then require an additional chassis potential. You can tap this from the *GND* terminal.

Important for pressure sensors: Do not install the sensor in the immediate vicinity of the compressor to protect it from large pressure impacts and vibrations. It should be installed as close to the condenser inlet as possible.



Pressure transmitter connection

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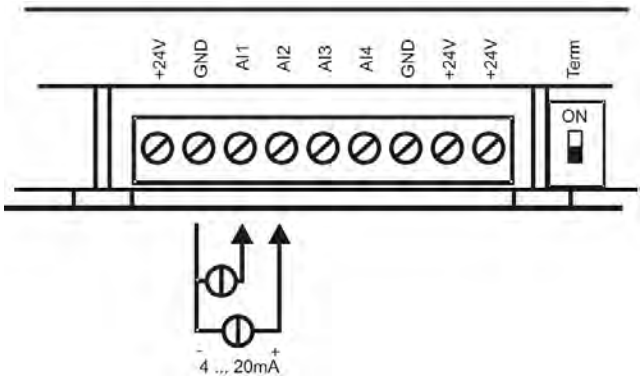
4.9.2 External power signal connection to AI1/AI2

The AI1 or AI2 inputs can also be used to control the controller in SLAVE operation.
To do this, this input must be defined as a control value slave in the I/O configuration.
The 4..20mA input signal is scaled 0-100% to a control signal and passed on to the fans.
A setpoint can also, for example, be specified externally via the AI1 or AI2 inputs.
Up to two power signals (4-20mA) can be connected to the AI1 and AI2 analogue inputs.

GND = Reference point (**–**).
AI1 = Current input (**+**) 4..20mA
AI2 = Current input (**+**) 4..20mA

ADVICE

Make sure the current source polarity is correct!



Power source connection

For current inputs, note that currents of less than **2.4mA** or greater than **22mA** will provoke a sensor fault display and corresponding message.

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4.9.3 Connecting a temperature sensor on AI3

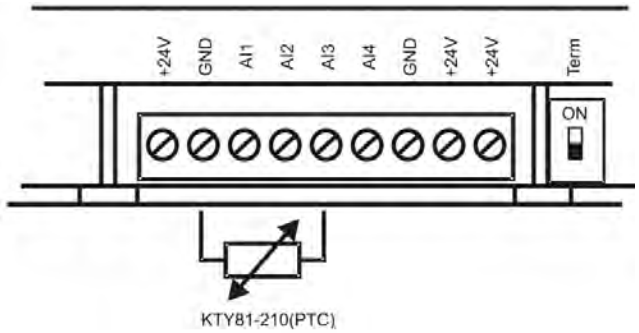
A temperature sensor is connected on the terminals

GND = Earth

AI3 = Signal input

There is no particular sequence for the cores.

The Güntner GTF210 temperature sensor is used in the range -30°C to +70°C. Please contact us for other temperature ranges.



Temperature sensor connection

To test a temperature sensor that may be defective, disconnect it from the controller and measure the impedance of the sensor (with an ohmmeter or multimeter). On the GTF210 , the impedance should be between 1.04 kΩ (-50°C) and 3.27kΩ (+100°C). You can use the table below to check whether the sensor has the correct impedance at a known temperature.

Impedance	Temperature	Impedance	Temperature
1040Ω	-50°C	2075Ω	30°C
1095Ω	-45°C	2152Ω	35°C
1150Ω	-40°C	2230Ω	40°C
1207Ω	-35°C	2309Ω	45°C
1266Ω	-30°C	2390Ω	50°C
1325Ω	-25°C	2472Ω	55°C
1387Ω	-20°C	2555Ω	60°C
1449Ω	-15°C	2640Ω	65°C
1513Ω	-10°C	2727Ω	70°C
1579Ω	-5°C	2814Ω	75°C
1645Ω	0°C	2903Ω	80°C
1713Ω	5°C	2994Ω	85°C
1783Ω	10°C	3086Ω	90°C
1854Ω	15°C	3179Ω	95°C

Temperature / Impedance

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Impedance	Temperature	Impedance	Temperature
1926Ω	20°C	3274Ω	100°C
2000Ω	25°C	3370Ω	105°C

Temperature / Impedance

4.9.4 0-10V voltage signal connection to AI4

A standard signal (0-10V) is connected on the following terminals

GND = Earth (negative)

AI4 = Signal input 0-10V DC (**max. 12V DC**).

Make sure the polarity is correct (earth to **GND**, signal to **AI4**)!

The 0-10V input is mostly used to operate the controller in SLAVE mode. To do this, this input must be defined as a slave input in the I/O configuration. The 0-10V input signal is scaled 0-100% in a control signal and passed on to the fans.

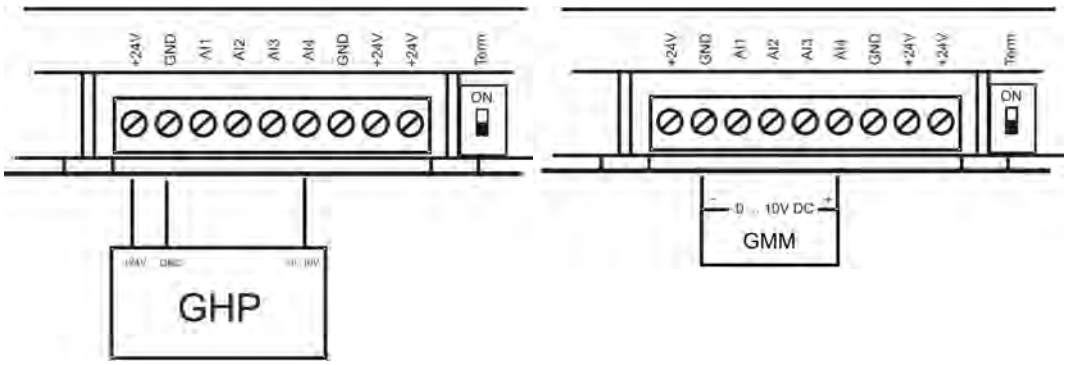
As an alternative, you can also connect a GHP manual potentiometer as a remote control. The connecting terminals on the GHP are labelled with either **1/2/3** or **x/-/Y** :

+ or **3** on **+24V**

– or **1** on **GND**

Y or **2** on **AI4**

You can then use the speed controller purely as a speed adjuster and specify the fan speed yourself manually.



0-10V standard signal connection

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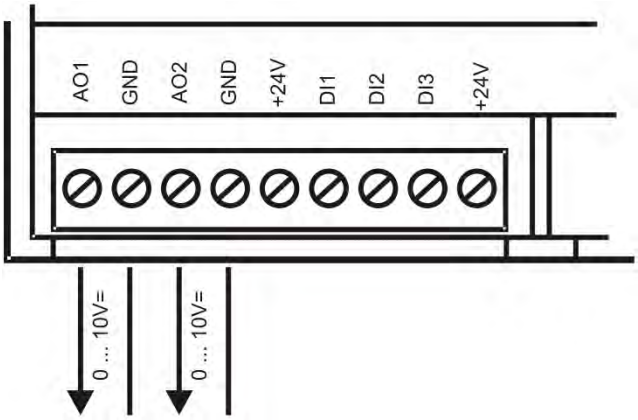
4.10 Analogue outputs

The control unit has 2 analogue outputs with 0..10V output voltage.



Analogue outputs

The **AO1** output issues the control signal (0..100%) scaled to 0..10V .

Output **AO2** issues the control signal for a subcooler, if this function is activated. 0..10V corresponds here with a control value of 0..100%.

See Subcooler function, Page 73

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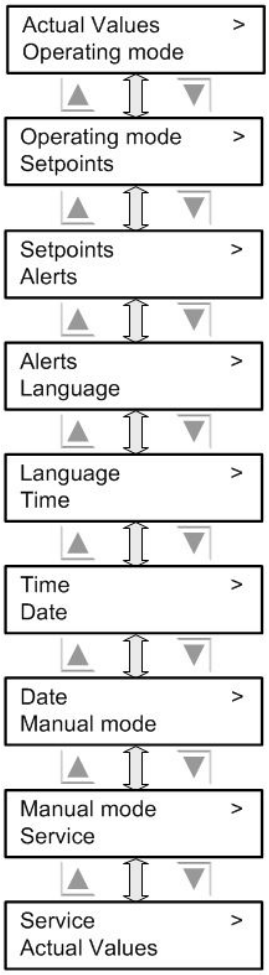
4.11 Operating menu

Structure of basic menu



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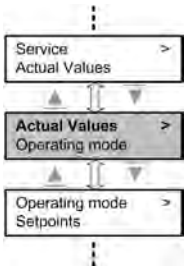
4.11.1 Actual values

The actual input signals and control values are shown here.



4.11.1.1 Input current values

Different values can be displayed when the *Current values* menu option is opened. The measured pressure, the temperature or the 0-10V control signal is displayed first. The value shown depends on the cooler type (condenser or recirculating cooler) and the operating mode (automatic or slave).

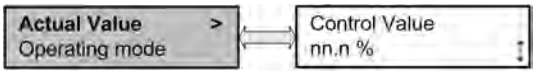
Condenser	No refrigerant	CDS press nn.n bar
Condenser	Refrigerant selected	CDS temp nn.n °C
Drycooler		Outlet temp nn.n °C
Slave	via 0..10V or 4..20mA	Control Value Master nn.n V

4.11.1.2 Ambient temperature

The current ambient temperature is shown.

4.11.1.3 Control value

The control value of the controller delivered to the fans is displayed in percent.



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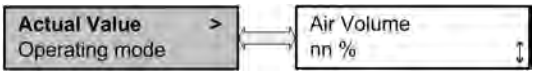
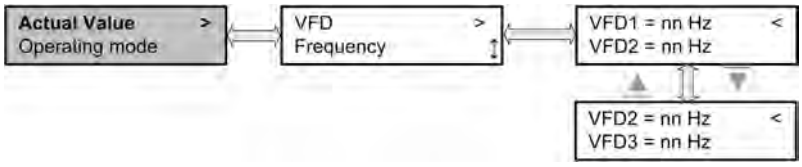
4.11.1.4 Air volume

The average control value of all fans is shown here as a percentage.



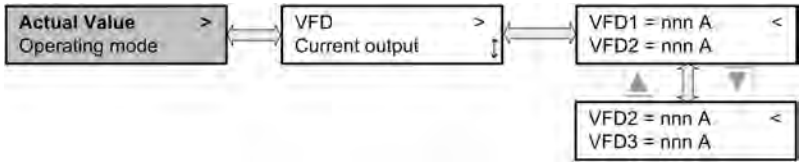
4.11.1.5 Frequency converter output frequency

The output frequency of every connected frequency converter is displayed.



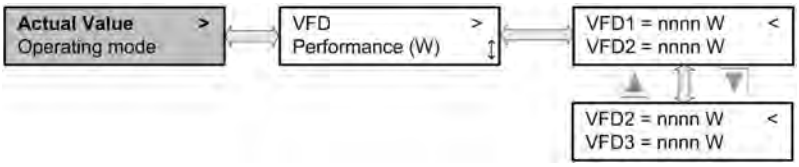
4.11.1.6 Frequency converter output power

The output power of every frequency converter is displayed. This is the power of all fans connected to this frequency converter. The active current is shown.



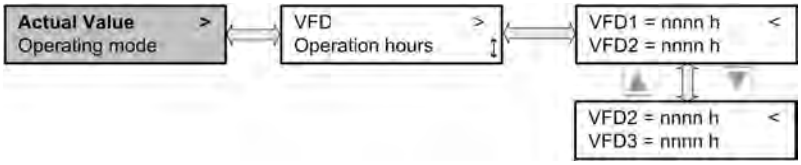
4.11.1.7 Frequency converter power

The current power of every frequency converter with its connected fans is shown here as active current.



4.11.1.8 Operating hours

The operating hours of every frequency converter are displayed.



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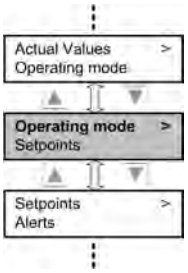
4.11.2 Status

The operating statuses and software/hardware versions are displayed here.



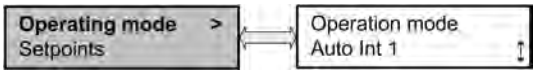
4.11.2.1 Operating mode

This shows the current operating mode.

There are:

Internal control	**Auto int. 1**	Setpoint 1 active	See Auto internal, Page 66
	Auto int. 2	Setpoint 2 active	See Auto internal, Page 66
	Auto ext. 1	Setpoint 1 active	See Auto external , Page 66
	Auto ext. 2	Setpoint 2 active	See Auto external , Page 66
	Auto ext. bus1	Setpoint 1 active	See Auto external BUS, Page 67
	Auto ext. bus 2	Setpoint 2 active	See Auto external BUS, Page 67
Slave	**Slave ext.**	Control value via 0...10V or 4-20mA	See Slave external , Page 67
	Slave ext. bus	Control value via GCM *	See Slave external BUS, Page 67
Manual mode	**Manual mode**		See Manual mode, Page 60

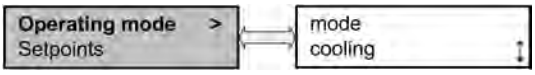
* GCM = Güntner Communication Module



For a precise description of the operating modes see section Operating mode, Page 66

4.11.2.2 Mode

Set heating or cooling mode display.



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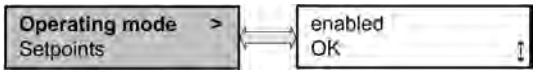
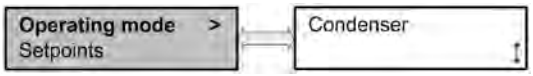
4.11.2.3 External release - Status

Controller on connection **DI1** enabled "**OK**" or not "**None**"



4.11.2.4 Heat exchanger

The heat exchanger type is displayed here.

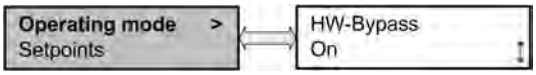


4.11.2.5 Refrigerant

If a condenser has been selected as the heat exchanger, the selected refrigerant is displayed here. If no refrigerant has been selected, “bar” is displayed.

4.11.2.6 HW bypass

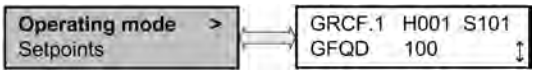
Whether the HW bypass function is switched on or off is shown here.
See Hardware bypass (HW bypass), Page 70



4.11.2.7 Hardware and software versions

This shows information about the current hardware and software versions of the GMM.

GRCF.1	→ Controller with display and keyboard
H	→ Respective hardware version
S	→ Respective software version
GFQD	→ shows that the output stage is a frequency converter
100	→ shows the type number of the frequency converter (value *0.1 = max. current)



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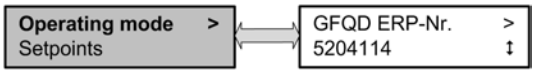
4.11.2.8 GFQD Software version

This display gives information about the current software version of the frequency converter.

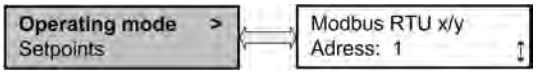
4.11.2.9 GFQD article number

The frequency converter's article number is displayed here.



4.11.2.10 Bus module

This display provides information on the module type, firmware version and the address of the GCM bus module, when it is connected.



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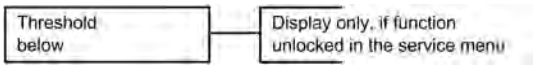
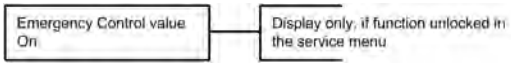
4.11.2.11 Threshold value/emergency control value

If the threshold value function is activated (see Threshold value, Page 75), a status display shows whether the value is above or below the threshold value.



If the emergency control value is issued because of the threshold value function, it is displayed here.

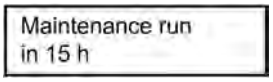


4.11.2.12 GHM Controller

If a GHM spray controller is connected, this will be shown here.

4.11.2.13 Maintenance run

If the maintenance run is activated in the Service menu, the time until the maintenance run is indicated here.



4.11.3 Setpoints

The setpoints can be set here.
The setpoint is the value (pressure, temperature or voltage) used as the reference for the control.

4.11.3.1 Setpoint 1

The current setpoint is displayed when the Setpoint 1 menu option is opened. What is displayed as the setpoint depends on the actual input value defined (voltage, temperature or pressure) and the operating mode (internal control or slave operation). As an example, setpoint 1 is displayed as the temperature.

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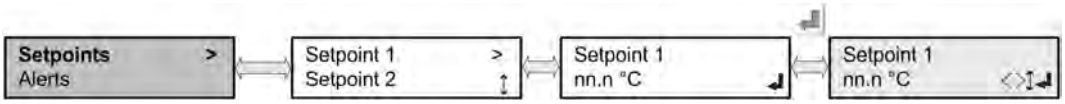


Press the enter key to enter EDIT mode.

Use the left/right arrow keys to select the write position. Use the up/down arrow keys to edit the value at the selected position.

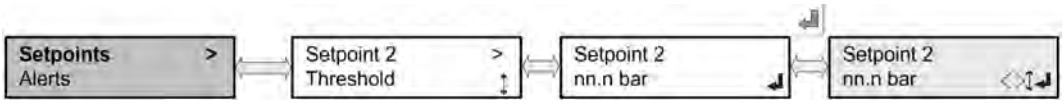
The minimum and maximum adjustment range is:

Set current value	Set operating mode	Setpoint display
Temperature	Control	-30.0 - 100.0 °C
Pressure	Control	0.0 - 50.0 bar
Volt	Control	0.0 - 10.0 V

The values are entered to one decimal place. Press the enter key to accept the set value.

4.11.3.2 Setpoint 2

If 2 setpoints are defined in the **SERVICE** menu, a second setpoint is set here. This can be activated via digital input **DI3**. Setpoint 2 is programmed the same way as **setpoint 1**.



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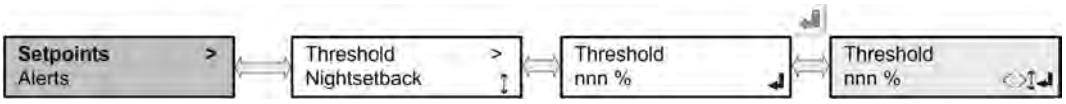
4.11.3.3 Threshold value

Here you can set the threshold values, violation of which will activate the threshold function. Appropriate threshold values for the configured system are offered in the Service menu (see Threshold value, Page 75).

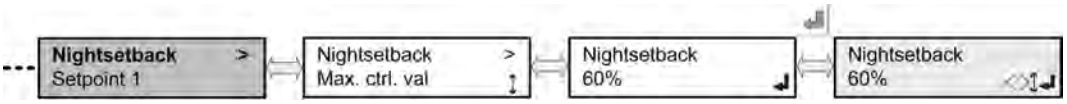
The threshold relay trips when the threshold value is exceeded (OSD02 an the GFQD frequency converter).



4.11.3.4 Nightsetback

The Nightsetback function is used to limit the control value for the fans to a maximum value and thus minimise noise emissions. The limiter can be activated via **DI2** digital input or via the built-in timer.

Defining maximum value

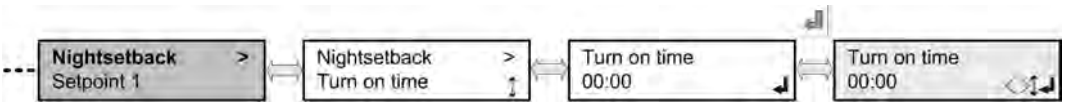


4.11.3.4.1 Night limiter activation/deactivation time

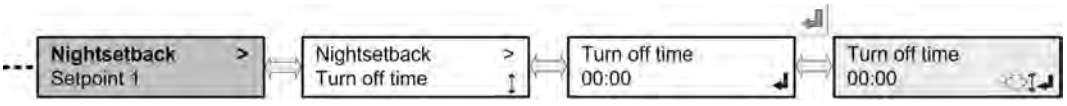
The built-in timer allows the night limiter to be activated and deactivated at specific times.

If the same value is entered for both the activation and deactivation time (e.g. 00:00), the time-controlled night limiter is deactivated.

Set start time



Set end time



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4.11.3.4.2 Night limiter functions list

Input	Night limiter with time	Night limiter
Inactive	Off	Off
Active	Off	On
Inactive	On	On
Active	On	On

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4.11.4 Alerts

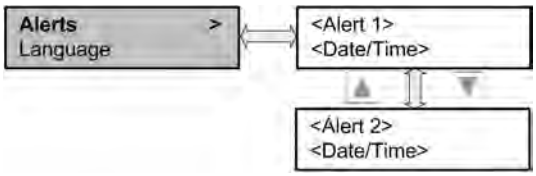
The last 85 alerts can be called up here.

4.11.4.1 Alert memory

The GMM has an alert memory that can accommodate up to 85 incident report, turn-on and reset times stored consecutively (cyclically). These incident reports consist of the fault and the time stamp, comprising the date and time when the fault occurred. For a list of error messages and warnings see Error messages and warnings , Page 104.

When the alert memory is selected, the display shows the last fault that occurred.

Use the “down” arrow key to display older faults.



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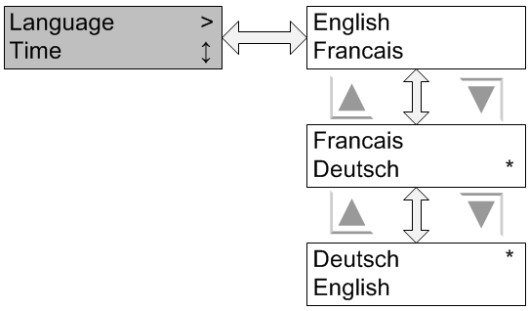
4.11.5 Language

The menu language can be selected here.

4.11.5.1 Language selection

3 languages can be selected in the Language selection menu. The selected language is marked with an *asterisk*.



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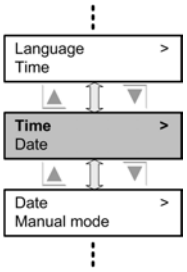
4.11.6 Time

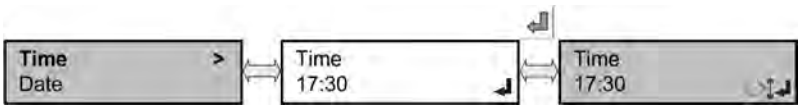
The time can be selected here.



4.11.6.1 Time setting

The set time is displayed and changed where required in the 24-hour clock.

The time is used to enter the alarm times in the alarm memory and for all timer functions (night reduction etc.).



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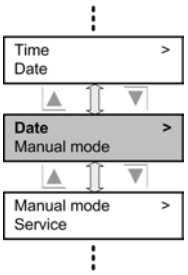
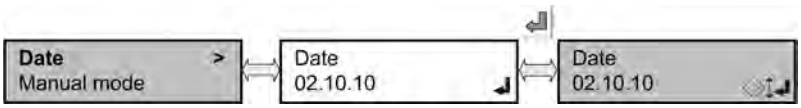
4.11.7 Date

The date can be set here.



4.11.7.1 Set date

The date is used to enter the alarm times in the alarm memory and for all timer functions. (night reduction, etc.)



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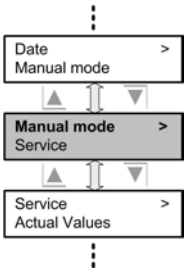
4.11.8 Manual mode

Manual mode is used to start up the heat exchanger fans by hand.
If it is activated, the fans run with the manual mode control value.
Manual mode does not depend on DI1 enabling.
Manual mode has the highest priority and switches off all other control types.
The fact that manual mode is active is recorded permanently. In other words, it will still be active after you have switched the system off and back on.



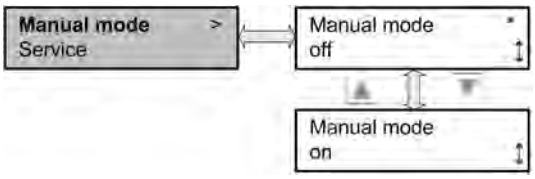
Manual mode can also be activated via digital input 2. The digital input has to be configured accordingly for this purpose in the Service menu (see Digital inputs, Page 88 or Speed limiter/External manual mode, Page 39).
If the input is configured and connected with +24 Volt, the previously defined manual mode control value is output.

4.11.8.1 Manual mode settings

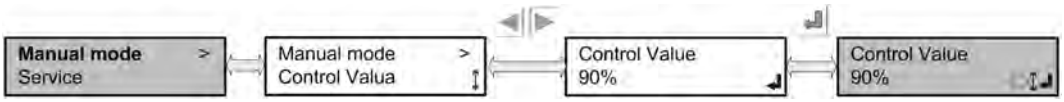
When manual mode is activated, the value in the control value menu can be changed.

The * indicates whether manual mode ON or OFF is active.

Manual mode ON / OFF



Manual mode control value



Manual mode can also be activated via digital input DI2.
The input has to be configured accordingly in the Service menu (see Digital inputs, Page 88).

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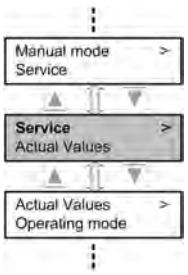
4.12 Service

The Service menu is accessible only with the correct password, which is the first thing you are asked for.

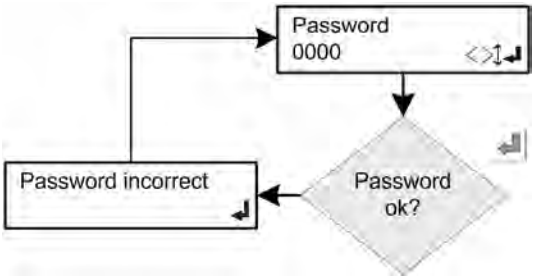
The password is **3795**.

Once the password has been accepted, the Service menu appears.

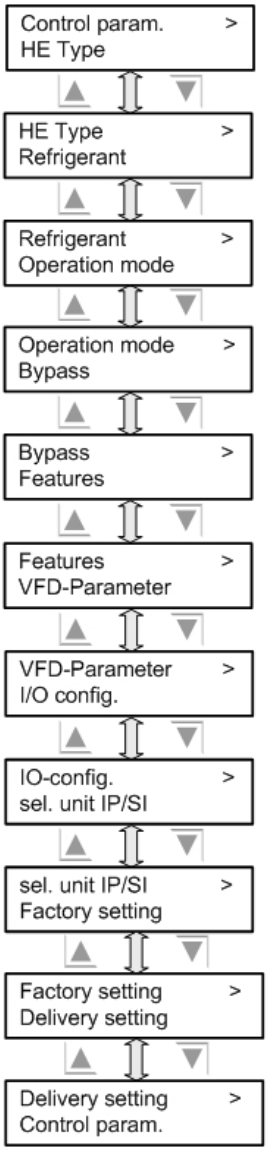
The password is valid for 15 minutes and will not be requested again during this time.



Password prompt



Service menu set-up



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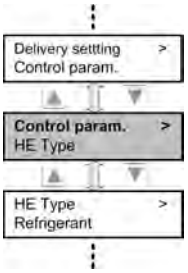
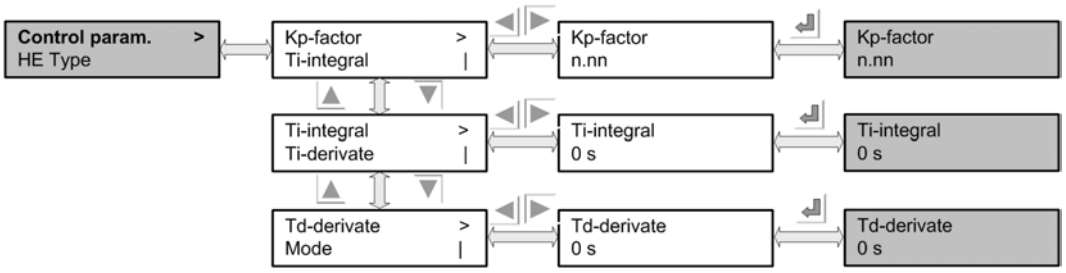
4.12.1 Control parameters

In this menu you configure the control parameters of the digital PID controller (proportional, integral, derivative controller).



4.12.1.1 Control parameters Kp, Ti and Td



The Kp factor can be entered in a range from 0.1 to 100.0 to one decimal place. The Kp factor specifies the control amplification. It is the proportion of the control path following the input signal.

The Ti reset time changes the control value in the set time by the value specified by the proportional factor.
Example: With an unchanged control deviation (X_s) of 1K and X_p = 10 the control signal in Ti = 25s is increased by 10%.

The delay time Td can be set in a range from 0 to 1000 seconds. The D part of the controller does not react to the deviation but to the speed of change.

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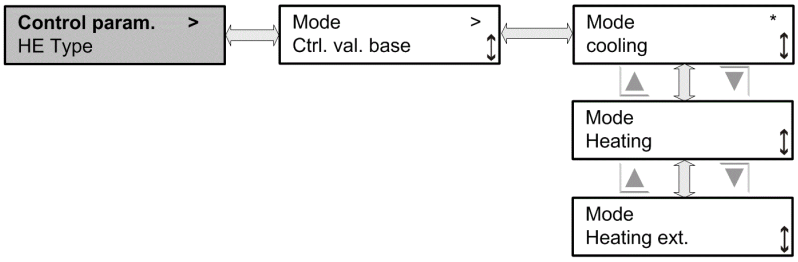
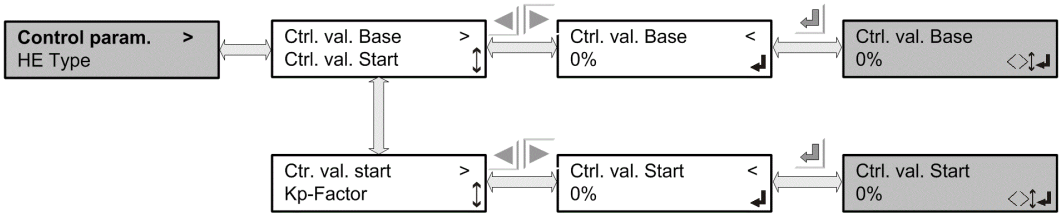
4.12.1.2 Cooling/heating control parameter mode



Normally the GMM is used to cool liquids and refrigerants. With some applications a reversal of the function is required, i.e. liquids are warmed (e.g. with heat pumps). With the “Mode” control parameter setting the control characteristics can be set to heating.

It is possible to change the mode (heating ext) via the DI3 input.

4.12.1.3 Base control value and Start control value control parameters



The **base control value** function is used to set a minimum speed.

The **start control value** function is used to define a start point for issuing the control value.

Here are some setting examples:

Base control value	Start control value	Position
0%	0%	Functions of, normal control 0%-100% with enable
10%	0%	At least 10% control value is issued, when the enable is active
10%	5%	At least 10% control value is only then issued when the control has reached 5% and the enable is due
10%	10%	The 10%-100% control value is only issued when the control reaches 10%
0%	5%	The control value is 0% when the general value is under 5%. The general value is issued from 5% control with given enable (5%-100%).

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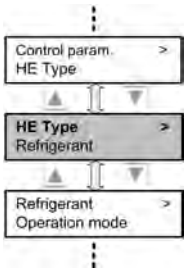
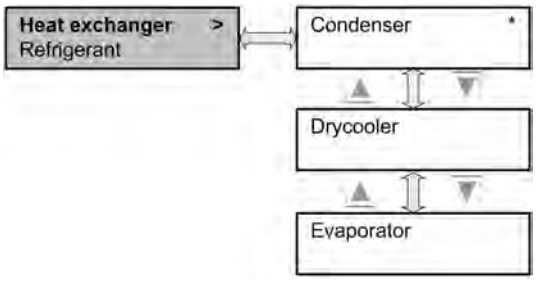
4.12.2 Heat exchanger

The heat exchanger type is selected here.



4.12.2.1 Heat exchanger type

The heat exchanger type is selected here.
The selected type is displayed with a *.



→ Select with ENTER.

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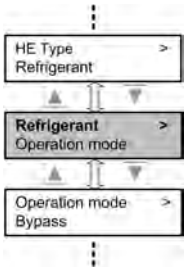
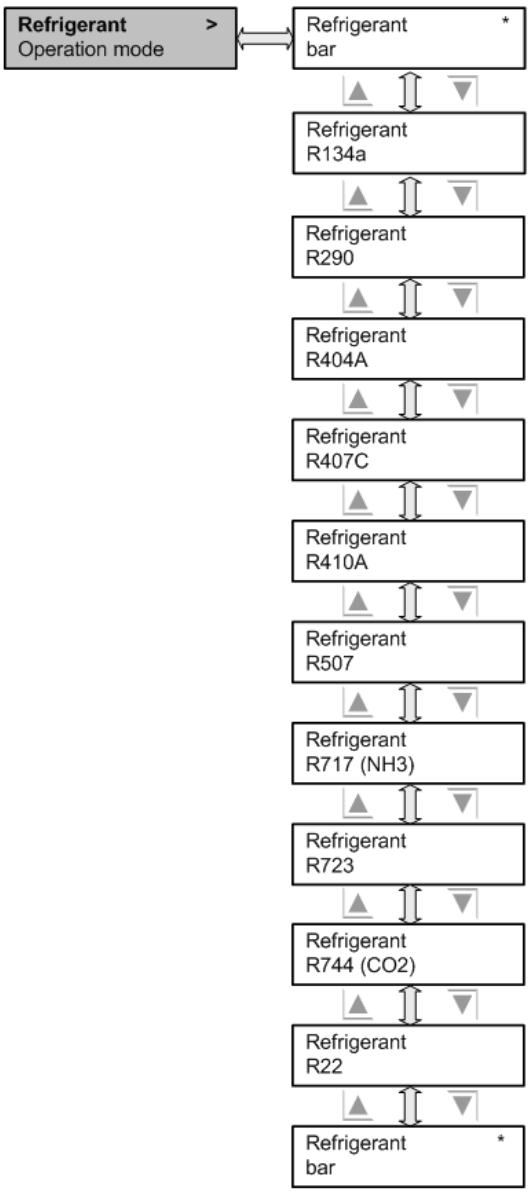
4.12.3 Refrigerant

A refrigerant is selected here.

This menu option is not offered if a drycooler is defined with the heat exchanger.



4.12.3.1 Refrigerant selection



In this menu option you can select whether a refrigerant has been defined and whether the display of reference and current values with temperature should be converted accordingly, or whether no refrigerant has been defined (bar) and the setpoints and current values should be displayed as pressure.

The selected option is displayed with a *.

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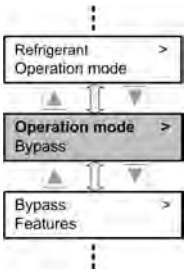
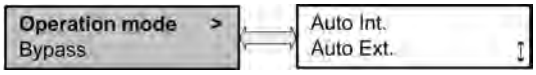
4.12.4 Operating mode

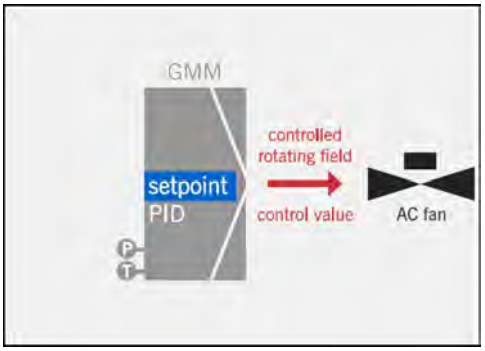
The operating mode can be set in this mode.
The active mode is shown with a *.



4.12.4.1 Auto internal

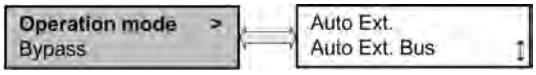
In this mode, control is automatic on the basis of the setpoint defined internally. This setpoint is entered in the **Setpoints** menu option.

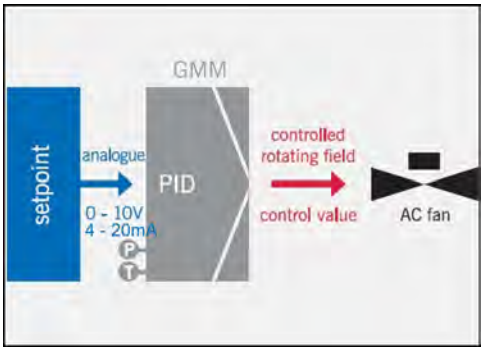




4.12.4.2 Auto external

In this mode, control is automatic on the basis of the setpoint defined externally by the analogue input. Which input delivers the setpoint and which the actual value is defined in the IO configuration.





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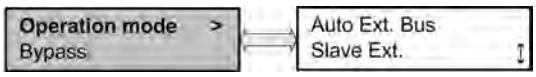
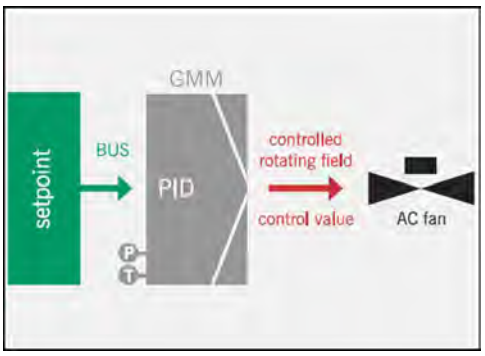
4.12.4.3 Auto external BUS

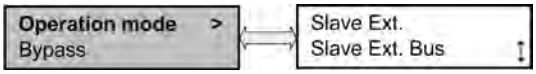
In this mode the setpoint is specified via BUS.
A Güntner Communication Module (GCM module) is required for this operating mode.

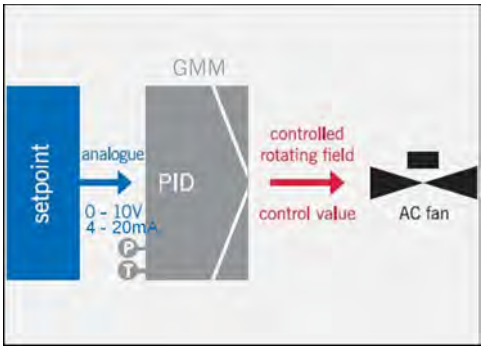




4.12.4.4 Slave external

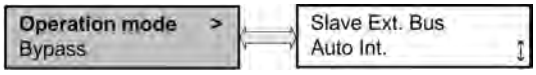
In this mode, there is no internal control. Instead the control value on the slave input is scaled and forwarded directly to the fans. Which input is to be used as the slave input is defined in the I/O configuration.

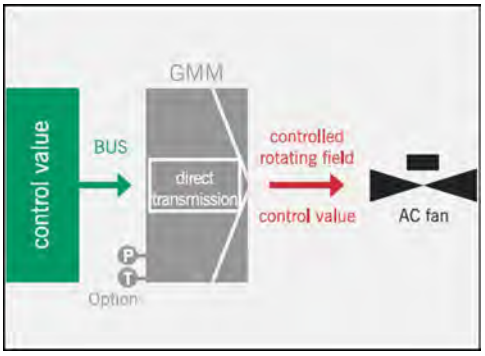




4.12.4.5 Slave external BUS

In this mode the control value is specified via BUS.
A Güntner Communication Module (GCM module) is required for this operating mode.





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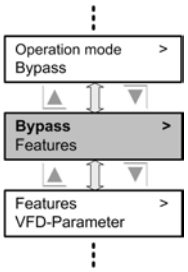
4.12.5 Bypass

The bypass function can be activated or deactivated in this service option. If the function has been activated, the control value for bypass mode can be set.

This function is used to maintain operation in the event of a fault in a GMM component.



The Hardware bypass function continues to be used to bypass the frequency converter at full load and therefore relieve it.

4.12.5.1 Bypass switching

The are two kinds of bypass; the software and the hardware bypass, in the following they are called **software** bypass and **hardware** bypass .

The **software** bypass function has the effect that if there is a fault in the GRCF controller, the fans will run at the speed specified here. This speed is activated automatically 10 s after the connection to the GRCF is lost.

The **HW** bypass is a function that bridges the frequency converter when the control value exceeds a configurable value. It is used to switch the full voltage to the fans, without the loss of the frequency converters.

The HW bypass can also be activated in the event of a frequency converter fault.

ADVICE

After modifying the bypass function you should switch the fans off and back on.

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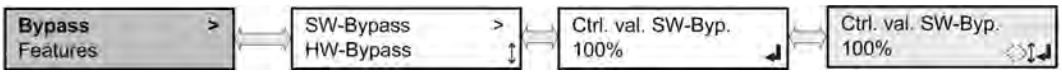
4.12.5.2 Software bypass (SW bypass)



The following variants can be set with the SW bypass:

Bypass operation OFF
Control value 0%
... if the GRFC is defective or the connection to the frequency converters is damaged:
→ all fans stop

Bypass operation ON
Control value > 0% (e.g. 100%)
... if the GRFC is defective or the connection to the frequency converters is damaged:
→ all fans run at a speed of 100%, for example

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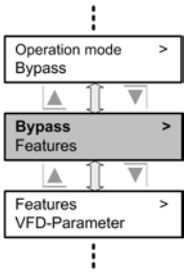
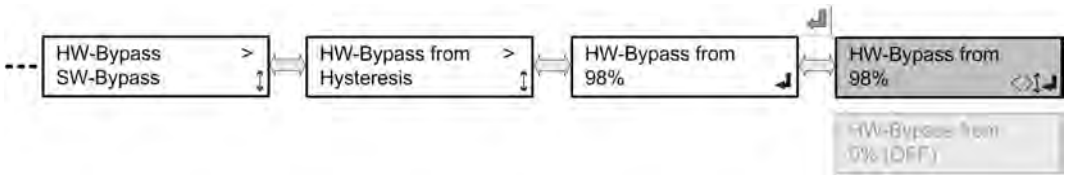
4.12.5.3 Hardware bypass (HW bypass)

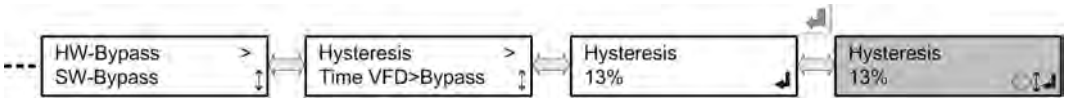
The HW bypass is used to relieve the frequency converter or is activated if a frequency converter is damaged.
The following parameters can be set with the HW bypass:



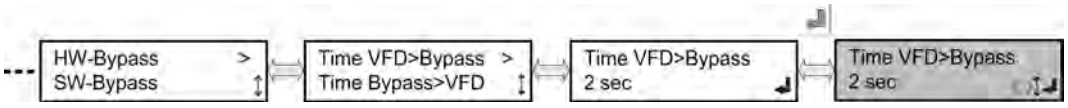
HW bypass from
... Setting, from which control value the frequency converter is switched off and the bypass protection is switched on and whether this is activated if a frequency converter is damaged.
0% → OFF



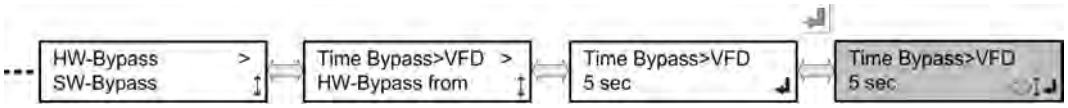
Hysteresis
... Setting of the value at which the control value must be below the "HW bypass from" value to switch back to frequency converter operation
98% → ON with control signal 98%



FC time > bypass
... Delay time setting with which the bypass operation is switched
Delay time→Time that the fans require to stop



Bypass time > FC
... Delay time between bypass switch drop-out and switching on the frequency converter operation protection
Delay time→ Time selection high enough so the fans almost no longer turn, so the frequency converter cannot be smoothly synchronised with its own phase system.



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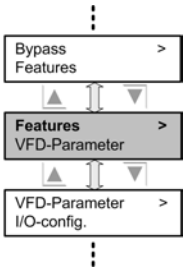
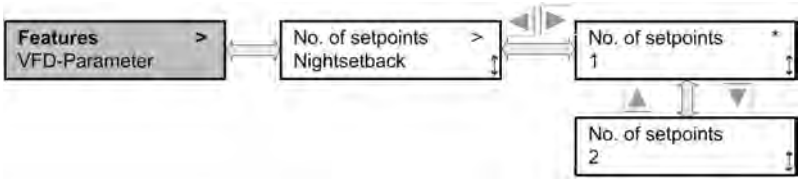
4.12.6 Features

The special functions, such as number of setpoints, the night limiter or set-point displacement, or the subcooler function, can be selected in this service menu option.



4.12.6.1 Number of setpoints

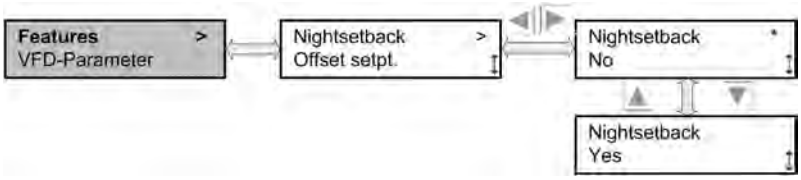


The number of setpoints is set here. The minimum number is 1 setpoint on which control is performed. If 2 setpoints are selected, switchover is via digital input **DI3**. If the input is open, setpoint 1 is used for control.

If the **DI3** input is connected with **+24V,** setpoint 2 is used for control.

Two different setpoints can consequently be determined for summer and winter operation, for example.

4.12.6.2 Nightsetback



A night limiter is generally activated or deactivated in this service option. The night limiter value is set with the **Night limiter** menu option. The night limiter, i.e. activation and deactivation and the control value, can also be programmed in the normal operating menu. The night limiter can be activated both via digital input **DI2** and via the activation and deactivation time. Both activations can take place in parallel. If the activation and deactivation times are the same, activation is only via the digital input **DI2**.

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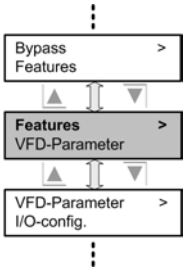
4.12.6.3 Offset setpoint



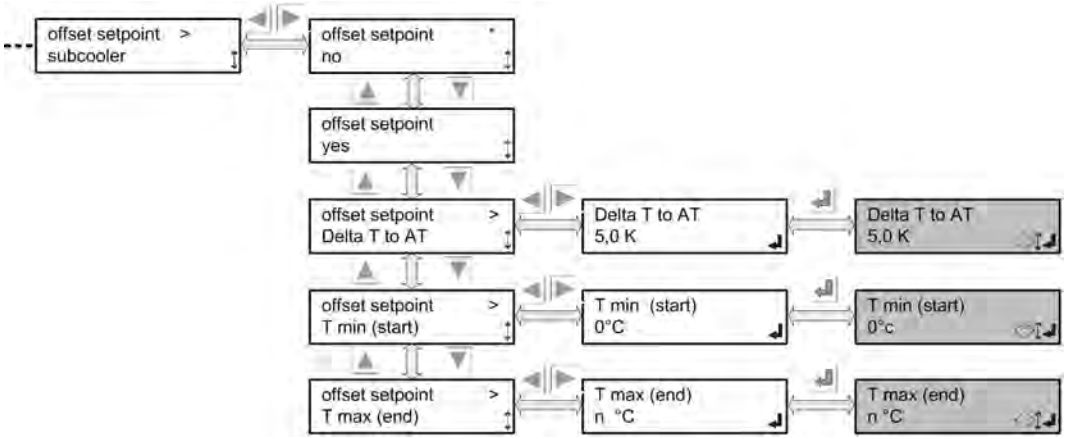
It is beneficial in order to ensure the optimum energy operation to displace the setpoint under certain circumstances, depending on the external temperature.

Setting the min. condensation temperature can cause rising external temperatures, so that the external temperature is above the setpoint. If the system is now only to be operated at partial load, raising the setpoint can save energy on the fans. Without a displacement these fans would always be controlled with 100%, as the high external temperature (above the setpoint) means this setpoint cannot be reached.

The temperatures Tmin external and Tmax external can be set in the menu. The range between Tmin external and Tmax external marks the range to be displaced into. The ΔT, which defines the offset between the setpoint and the external temperature, must also be defined.

Example:	Setpoint	= 25°C
	ΔT	= 5 K
	Tmin external	= 20°C
	Tmax external	= 40°C

In this example the setpoint must always be 5 K above the external temperature. The displacement therefore begins at 20.1°C external temperature. At this point the setpoint is displaced to 25.1°C. Tmin external and Tmax external limits mark the range in which the displacement works. In this example the setpoint is displaced at 20°C at the earliest, provided the setpoint is low enough. The max. value where the setpoint can be displaced to is at 45°C in this example.



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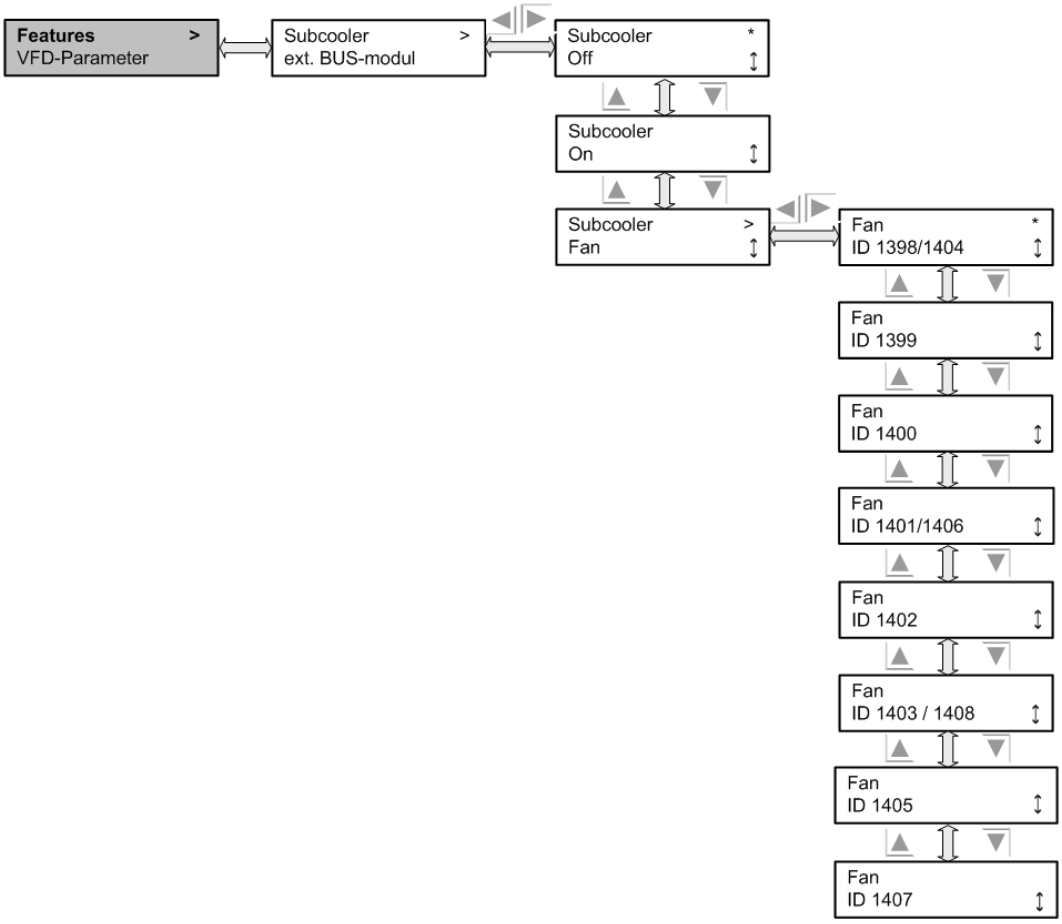
4.12.6.4 Subcooler function

This function allows a separate EC fan to be operated as subcooler. The control value for the subcooler fan (0..10V = 0..100%) is given via the "AO2" output to the fan.

This subcooler runs constantly, independent of the regulation of the control unit with the set speed. It is activated like the regulated fans via the enable.

The subcooler function can be switched on and off in the functions menu.

The fan type used is selected in the selection menu.



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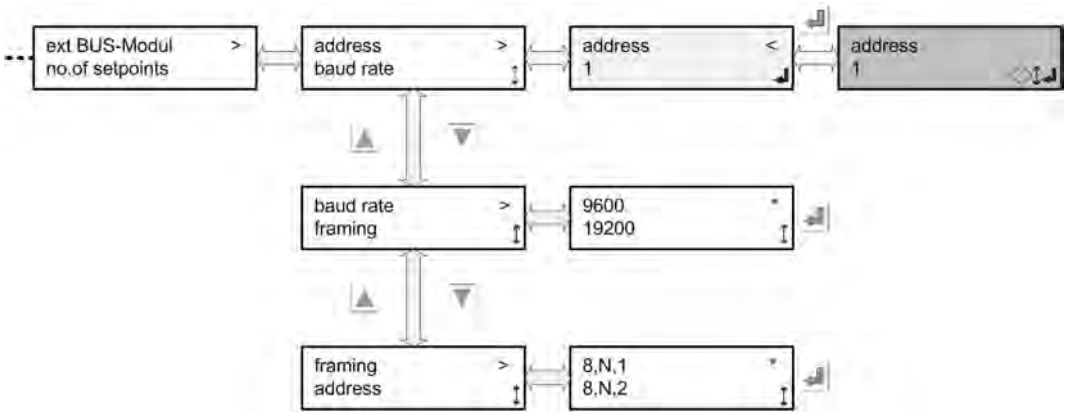
4.12.6.5 External BUS module



These functions allow you to change the interface parameters of the connected bus module.

The following parameters can be changed for a Modbus RTU module:

Address:	1....247
Baud rate:	1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200 Baud
Framing:	8,E,1 (8 Bit, even parity, 1 Stop Bit) 8,N,1 (8 Bit, no parity, 1 Stop Bit) 8,N,2 (8 Bit, no parity, 2 Stop Bit) 8, O,1 (8 Bit, odd parity, 1 Stop Bit)

Only the fieldbus address can be changed for a Profibus (0....126); the baud rate is set automatically.

ADVICE

Turn off the power to GMM + bus module after every address change. Only then will the new parameters be accepted.

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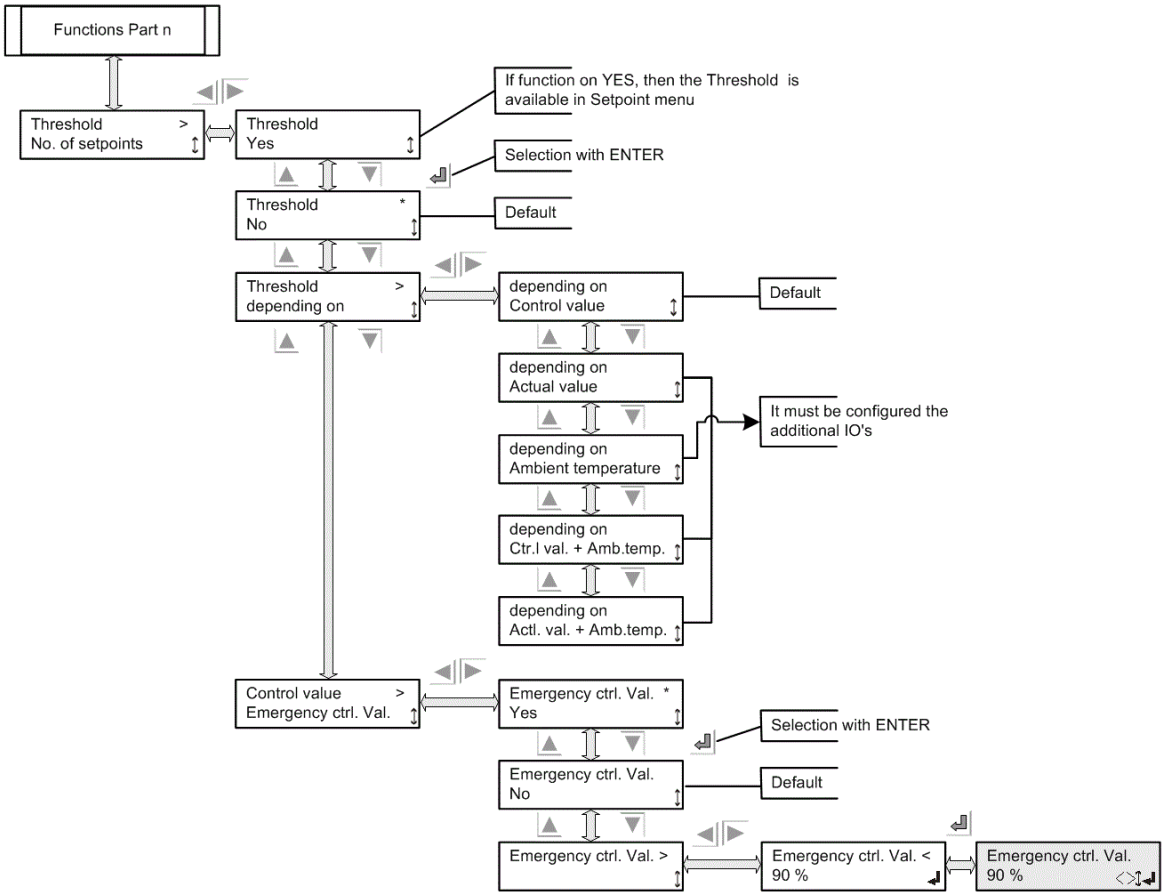
4.12.6.6 Threshold value

Using the threshold value function, the threshold value relay (digital output DO4, contact 41/44) can be tripped depending on various parameters.

The function must first be activated and pre-configured in the Service menu for this.
The respective threshold values can then be set in the Setpoints menu.
The function is deactivated by default.



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YES/NO threshold value:
The function can be switched on or off here. Only when the function is switched on is this active and offered in the Setpoints menu.

Threshold value depends on:
What the function depends on can be configured here.

Depends on control value:
The threshold value relay is tripped when the control value is greater than the configured threshold value.

Depends on actual value:
The threshold value relay is tripped when the actual value is greater than the configured threshold value.

Depends on control value + Ext. temp..:
The threshold value relay is tripped when the control value AND the external temperature are greater than the configured threshold values.

Depends on actual value + ext. temp.:
The threshold value relay is tripped when the actual value AND the external temperature are greater than the configured threshold values.

Emergency control value Yes/No/Emergency control value:
The emergency control value is issued as a control value when the following conditions are satisfied:
- Threshold value function is active
- Threshold value condition(s) exceeded
- Emergency control value function is active
- Emergency control value is greater than its calculated control value (e.g. with control operation or bypass value with sensor fault)
- Manual mode is not active
- External enable provided

The emergency control value can be reduced to an active night limiter if necessary.

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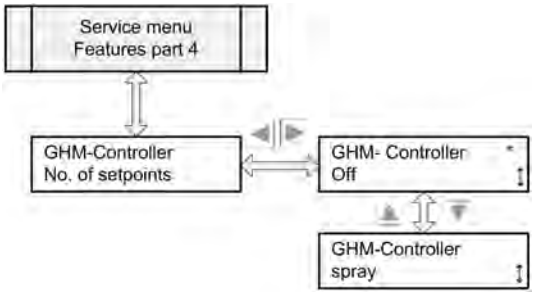
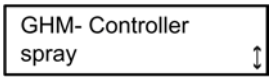
4.12.6.7 GHM Controller

When a GMM is coupled with a GHM spray via the CAN bus, this function has to be activated for the GMM (master).
The GMM is then responsible for the control and monitoring of the GHM.

If the connection fails, an entry is made in the GMM alarm history (and that of the GHM).

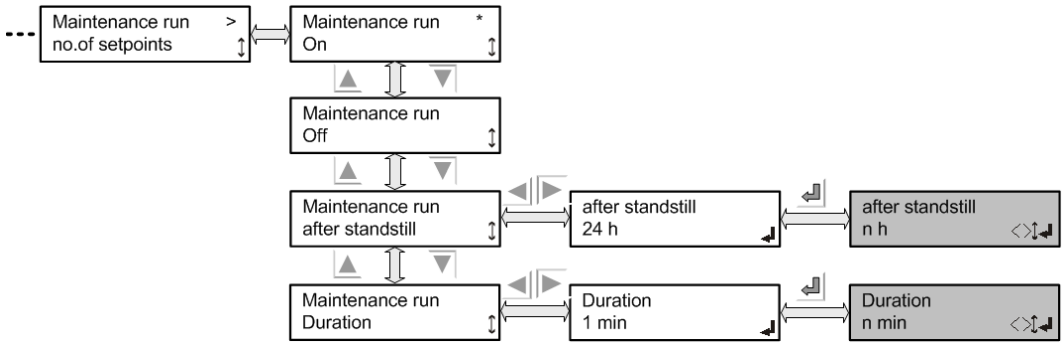


If the GHM spray function is activated, this will be displayed in the status menu:



If the function is corrupt (e.g. GHM is off), GHM-NOK will be displayed in the Info menu. Furthermore, a priority 2 incident report is issued and an entry made in the alarm history.

4.12.6.8 Maintenance run



A maintenance run is activated in response to the length of time the fans have been stationary. Its purpose is to prevent them from becoming jammed.

Activation of a maintenance run after the configured standstill period depends on the following conditions being fulfilled:
a) Manual operation is deactivated
b) Control value of the PID controller = 0, i.e. no speed request
c) No fault pending

The controller does not need to be enabled, because the speed control is often enabled only when cooling has been requested. Otherwise the maintenance cycle would effectively be disabled and a maintenance run would never happen.

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If a speed request is made during a maintenance run , the maintenance process will be aborted and the controller will return to normal operation. In such cases, maintenance is considered to have been performed, because the fans have been in operation.

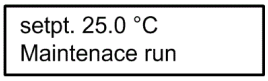
A maintenance run is carried out at full speed, but this will be reduced by an active night limit.

The following parameters can be set up:

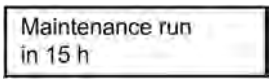
“Maintenance run On/Off”:
Default = **On**
This is used to turn the function on or off.

“Maintenance run after standstill”:
Default: **24 hrs**, min=1, max = 1000 hrs
If the fans have not been in operation at all during this configured period then a maintenance run will be started.

“Duration of maintenance run ”:
Default =**1 min**, min = 1 min, max = 10 min
This is used to specify the duration of a maintenance run.



The Info menu display “**Maintenance run**” flashes while a maintenance cycle is in operation.



Status menu display: “**Maintenance run in: nnn h**”
This shows the remaining required stationary period before the next maintenance cycle.

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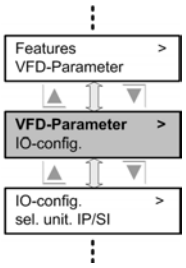
4.12.7 Frequency converter parameters

ADVICE

New FC parameters will not be accepted unless you first switch MAINS OFF and then MAINS ON.



4.12.7.1 Number of frequency converters (FC)

The number of frequency converters that are connected on a GMM is entered under this point. A maximum of nine FCs can be connected.

4.12.7.2 Boost voltage

A start voltage in the range of 0- 100V, which is present with frequencies > 0Hz on the fan, is set here.

The voltage boost is shown with "VB" in the U/f characteristic curve graphic.

4.12.7.3 Motor voltage

The fans' nominal voltage is entered here. The frequency converter's output voltage is limited to this voltage.

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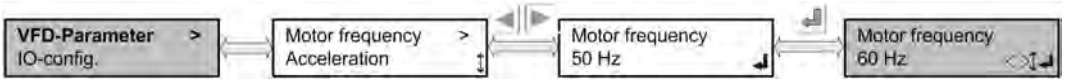
4.12.7.4 Motor frequency

The fans' nominal frequency is entered here. The fan speed is controlled up to this frequency. Values between 45Hz and 60Hz can be set here.
This value must agree with the information on the fans' type plate



4.12.7.5 Acceleration

The acceleration with which the fans run up to their new control value is entered here.

4.12.7.6 Delay

The negative acceleration with which the fans slow down to their new control value is entered here.

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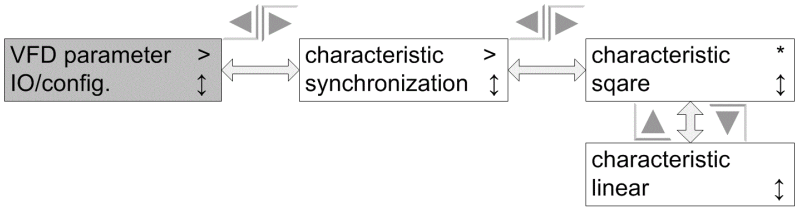
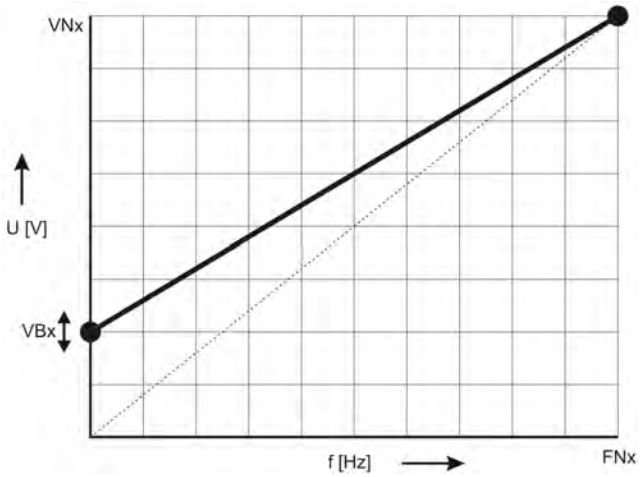
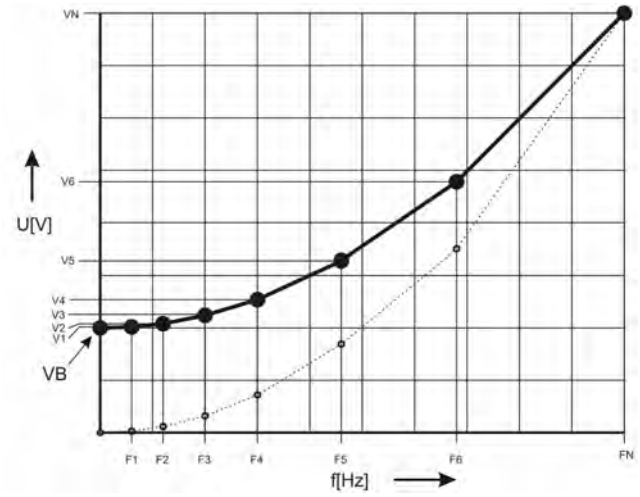
4.12.7.7 Characteristic curve

Switching is made here between linear and square fan characteristic curve.





Linear U/f characteristic curve with voltage boost (VB)



Square U/f characteristic curve and voltage boost (VB)

Linear/square fan characteristic curve explanation:

With the linear fan characteristic curve, the magnetic flow of an asynchronous fan and therefore the torque remains constant over the entire speed range (magn. flow = V/f).

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However, as fans require less torque at low speeds, it makes sense to reduce the torque to save energy. This can be achieved with a higher reduction in the voltage with lower frequencies, i.e. with a square characteristic curve.

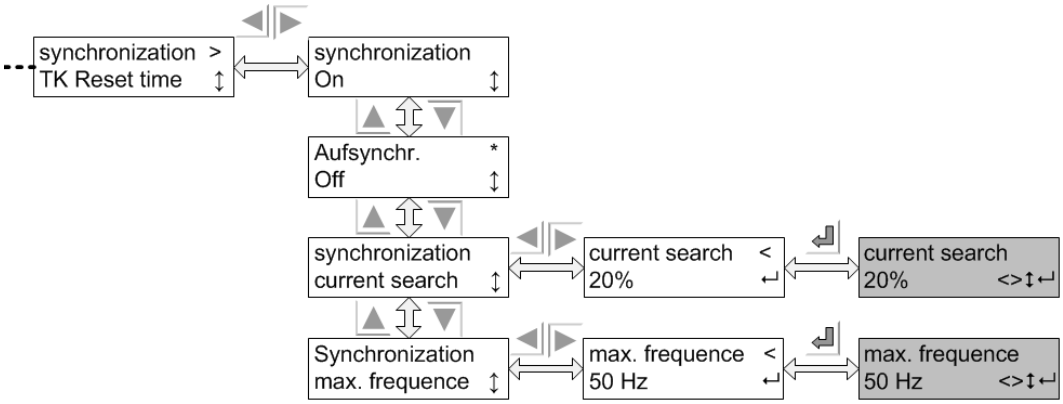
The voltage boost is switched off with a 0Hz output frequency.

4.12.7.8 Synchronisation

This parameter allows synchronisation of the frequency converter to be configured for the AC motor's rotary field.
When switching from hardware bypass mode to frequency converter mode, it may happen that the potentially rotating AC motor is in generator mode.

If synchronisation is now enabled, the frequency converter determines the rotational frequency of the motor and adjusts the rotational frequency to be generated to this.

The maximum search current and the maximum search frequency can be defined.



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4.12.7.9 TC reset time

If a thermocontact error has been detected, the respective fan is separated from the output stage. You can switch the fan back to the output stage after a cooling down phase (TC reset time). The time that must pass to activate a thermocontact RESET is entered here. If the 0 min. value is entered, there is no thermocontact RESET.

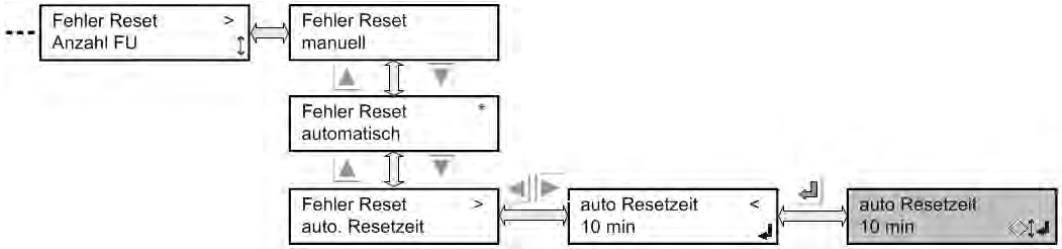
It must be noted that the failed fan or fans may possibly be switched on in running operation. This can cause a power overload on the FC. (See Connections , Page 27)
The user is responsible for activating this function.
A GRCF motor can therefore be switched back in automatic operation.

4.12.7.10 Error reset

This function can be used to automatically acknowledge errors caused by the frequency converter.

If the function is set to “automatic”, then, at the end of the specified “auto. reset time”, the GRCF attempts to acknowledge the error to the GFQD.

If the function is set to “manual”, errors reported by GFQD can be acknowledged manually by pressing the X key.



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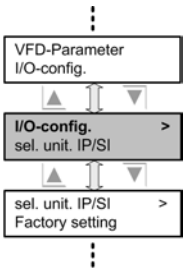
4.12.8 I/O configuration

This menu option is used to configure the analogue and digital inputs and outputs.
Selected functions can be assigned to the inputs and outputs.



4.12.8.1 Analogue inputs

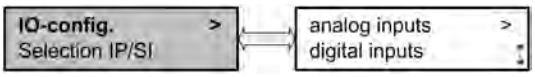
The analogue inputs are measurement inputs for recording temperature or pressure values.

These inputs can also be used to prescribe control values (slave mode).

Terminals **AI1** and **AI2** are two current inputs (4-20mA).

Input **AI2** can be switched over to serve as input for a temperature sensor.

Terminal **AI3** has an input for the GTF210 temperature sensor.
There is an input for 0-10 V DC on terminal **AI4** .



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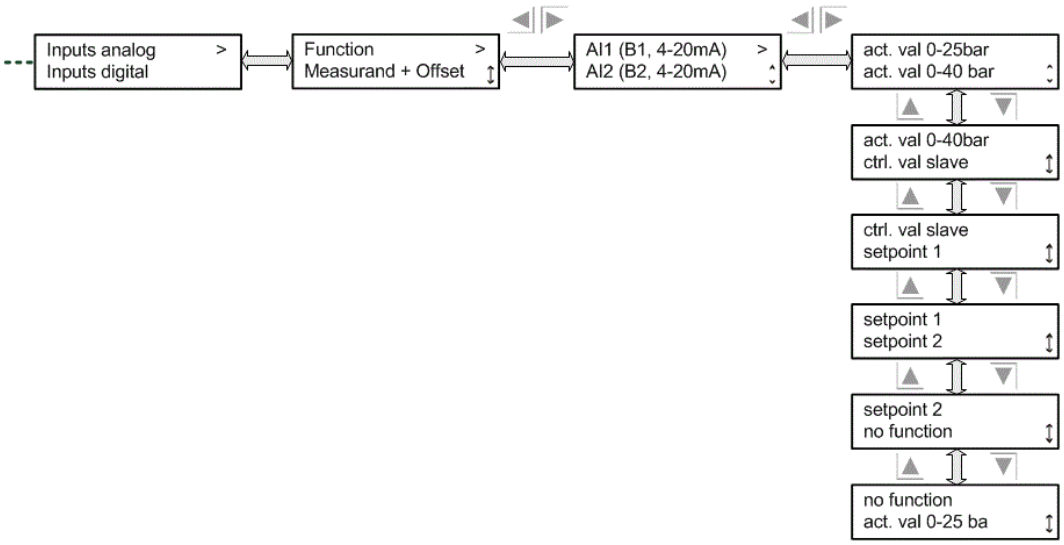
4.12.8.1.1 Current inputs AI1



Actual value means that the current measurement is signalled on this input. With pressure sensor **GSW4003** this is the current corresponding to the pressure. Make sure that **"Auto Int" mode has been selected** in the Operating mode menu. There is a special situation if both current inputs are configured as the actual value. The current input delivering the greatest measurement signal is then selected **(MAX selection)**. A **Actual value** of **0-25 bar** or **0-40 bar** can be selected with the current input

Slave control value means that the control signal for the fans follows this input. With current input this means that 4 mA generates a control signal of 0%, and 20mA input current a control signal of 100% on the fans. Make sure that the "Slave ext" mode has been selected in the Operating mode menu.

Setpoint 1 means that setpoint 1 on which internal control is performed is specified via the current input. The current input is scaled to the set actual value (see table Error messages and warnings , Page 104). The origin of the actual value still has to be configured. Make sure that the "Auto ext" mode has been selected in the Operating mode menu.

Setpoint 2 is offered only if the number of setpoints has been configured as **2** (see Number of setpoints, Page 71). If setpoint 2 is configured, the same applies as described with **Setpoint 1** .

No function is selected if this input is to be inactive.

The same essentially applies to **current input 2** as to current input **1**, except that there are still two additional setting options.

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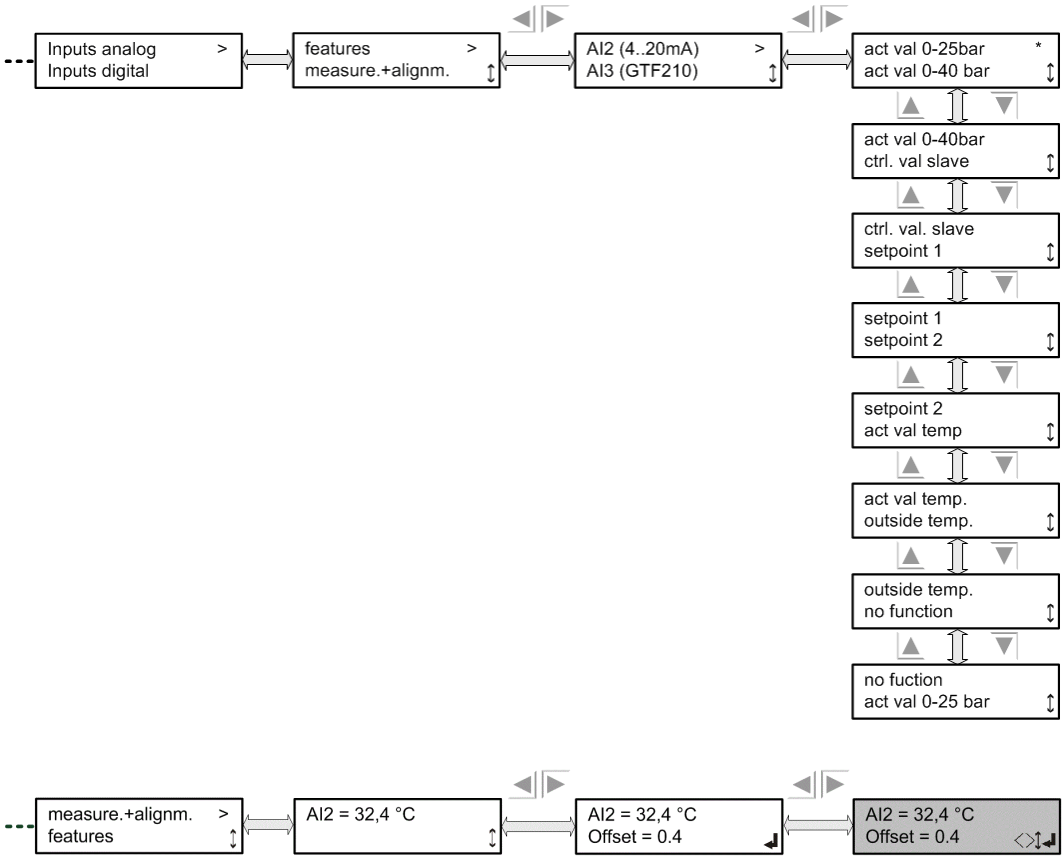
4.12.8.1.2 Switchover input AI2



ADVICE

The Service menu enables you to adjust the temperature sensors by specifying an offset for the configured temperature inputs AI2 and AI3.

The following functions exist in addition to the functions offered with input AI1:
act. val. temp. means that a temperature sensor with 4..20mA current output (-30°C to +70°C) is connected on this current input. Function as described for **actual value**.

outside temp. means that a temperature sensor with 4..20mA current output (-50°C to +50°C) is connected on this current input. This input is used exclusively for recording external temperature.

act val. GTF210 means that a GTF210 temperature sensor is connected to this input. Please note! This function is only available with the corresponding software version.

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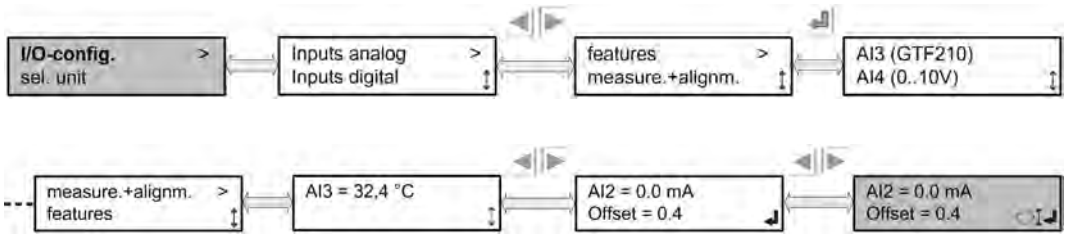
4.12.8.1.3 AI3 input temperature sensor



ADVICE

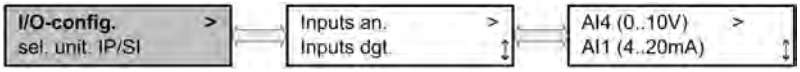
The Service menu enables you to adjust the temperature sensors by specifying an offset for the configured temperature inputs AI2 and AI3.

act val GTF210 means that a **GTF210** temperature sensor is connected to this input.

outside temp. means that a **GTF210** temperature sensor is connected to this input to record the external temperature. The measurement range is -30°C to +70°C. It is ensured that only 1 external temperature can be selected.

No function is selected if this input is to be inactive.

4.12.8.1.4 0..10V AI4 input



act. val 0.10V means that the current value (0-10V) for the controller should be connected to this input. Make sure that the **mode** “Auto Int” has been selected from the Operating mode menu.

ctrl. val slavesignifies that the fans are addressed in response to the input signal (0-10V). The characteristic curve is linear from 0-100%. A 10V signal corresponds to a control value of 100% for the fans. Make sure that the **mode “Slave Ext” has been selected from the** Operating mode menu.

setpoint 2 is offered only if the number of setpoints has been configured as **2** (see Number of setpoints, Page 71). If setpoint 2 is configured, the same applies as described for **Setpoint 1** .

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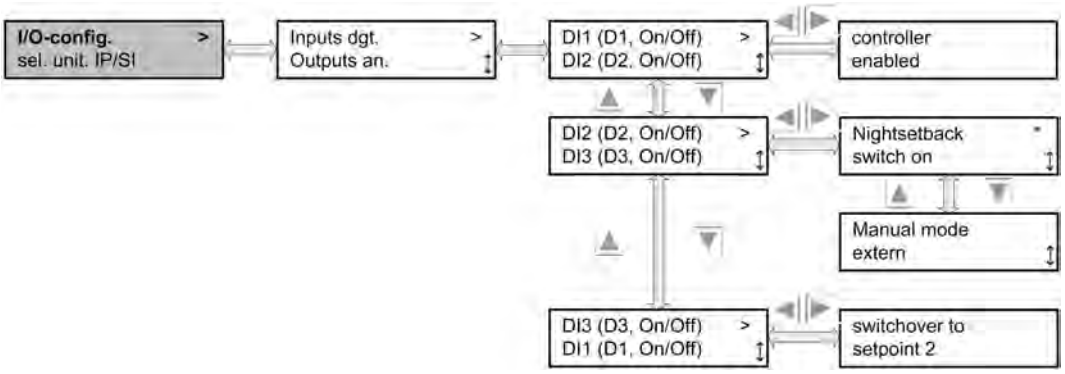
4.12.8.2 Digital inputs

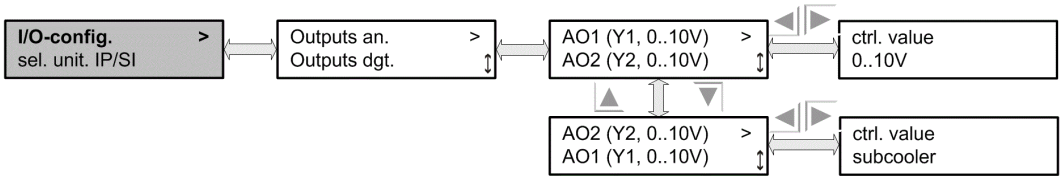
The digital inputs on terminals **DI1**, **DI2** and **DI3** are control inputs.

Their function is permanently assigned according to the diagram below.



The inputs are active when they are connected to **+24V** . They can only be switched with potential-free contacts (e.g. relay contact).

4.12.8.3 Analogue outputs



The analogue outputs can output a voltage of 0-10 V DC. Fixed functions are assigned to analogue outputs 1 and 2. Output 1 issues the control signal from 0-100% scaled as a 0-10V signal.

Output 2 issues the control signal for the subcooler, when the function is selected.

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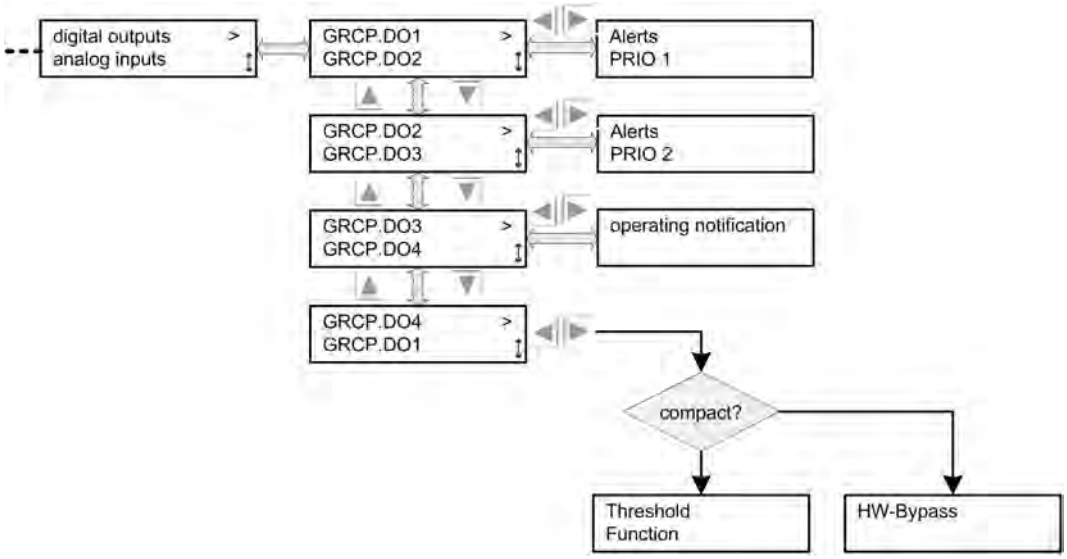
4.12.8.4 Digital outputs



The digital outputs are relay contacts. Each output has a 250V/1A two-way contact. The alarm outputs Prio 1 and Prio 2 are **connected as failsafe** contacts, i.e. the contact is closed when there is no current.

Fixed functions are assigned to the digital outputs.

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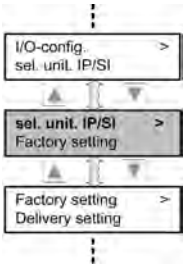
4.12.9 SI/IP selection

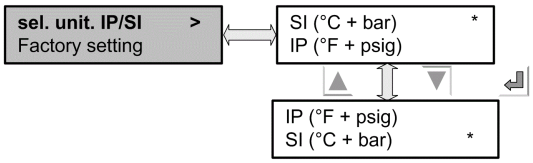
The units system can be selected here.



4.12.9.1 SI/IP units system

Unit selection for pressure and temperature.

International units →	**SI** (**S**ystème **i**nternational d´ unités)
Anglo-American units →	**IP** (**Imp**erial System)



The selected unit of measurement is marked with a *****.

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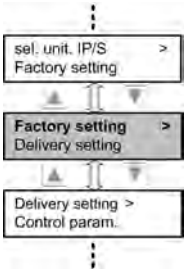
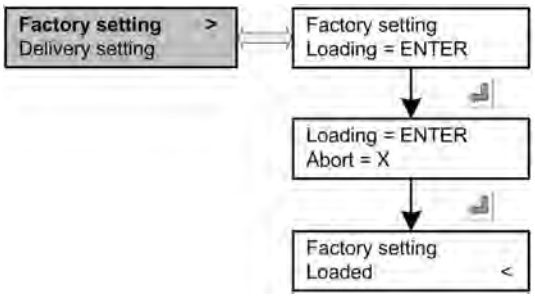
4.12.10 Factory setting

The control can be reset to factory settings here.



4.12.10.1 Control reset (factory setting)



ADVICE

Any changes made locally will be deleted. Factory commissioning values will be retained. The control functions and the bypass are reset to their default values.

See Factory setting, Page 102

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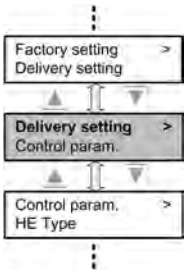
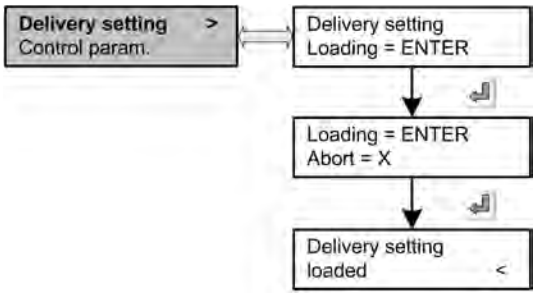
4.12.11 Delivery condition

The control can be reset to delivery condition here.
Commissioning is then not necessary.



4.12.11.1 Control reset (delivery condition)



ADVICE

Any changes made locally and the **commissioning values** will be cleared. Once this function has been completed, a completely new factory commissioning must be carried out.

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5 Faults and troubleshooting

5.1 General notes

Most faults that occur during commissioning are due to wiring faults or defective sensors. It is only in the rarest of cases that the speed controller itself is defective. Check the following points before ordering a replacement:

Status info menu:

• Is a fault displayed in the info menu? (You can always return to the Info menu by pressing **X**).

• If **NO**, then go to **Test point 2.**

• If the message “Equipment failure” is displayed, there is a fault in the frequency converter(s).

Please check if the voltage supply is present on the frequency converter.

• For other error messages see Table Error messages and warnings , Page 104

TEST POINT 2:

Mains connection:

• Are all phases present? Rotary field OK?

Sensor connection:

• Is the sensor connected correctly? Cf "Sensor connection" section

• Sensor OK? (Measure! Pressure: 4-20mA, Temp.: 1.2-2.7kΩ, default signal: 0-10V)

• Are the sensor cables laid in the immediate vicinity of the mains or motor cable? Consider increasing the distance!

• Are the sensor cables shielded? If not – swap for shielded cables!

• Is the shielding applied unidirectionally on the controller?

Fuses:

• Is the fuse on the controller supply OK?

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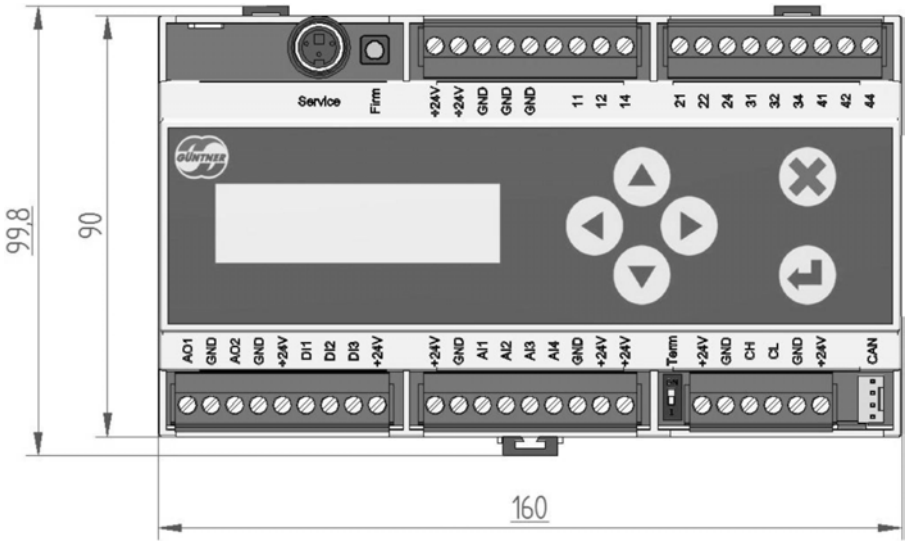
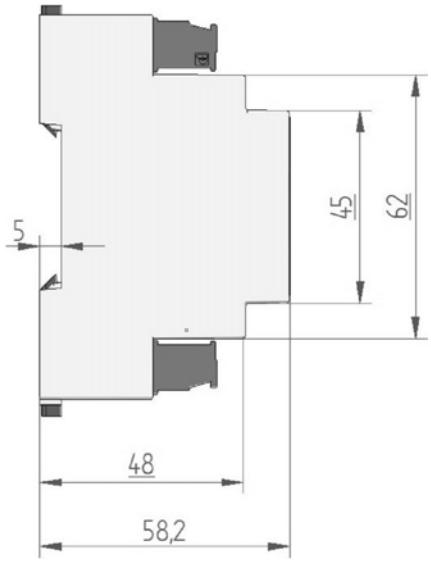
6 Technical data

6.1 Dimensions and weight

Dimensions of GRCF.1

You will find the casing dimensions below. All dimensions are given in millimetres.





Dimensions of casing GRCF.1

Weight:
ca. 340g

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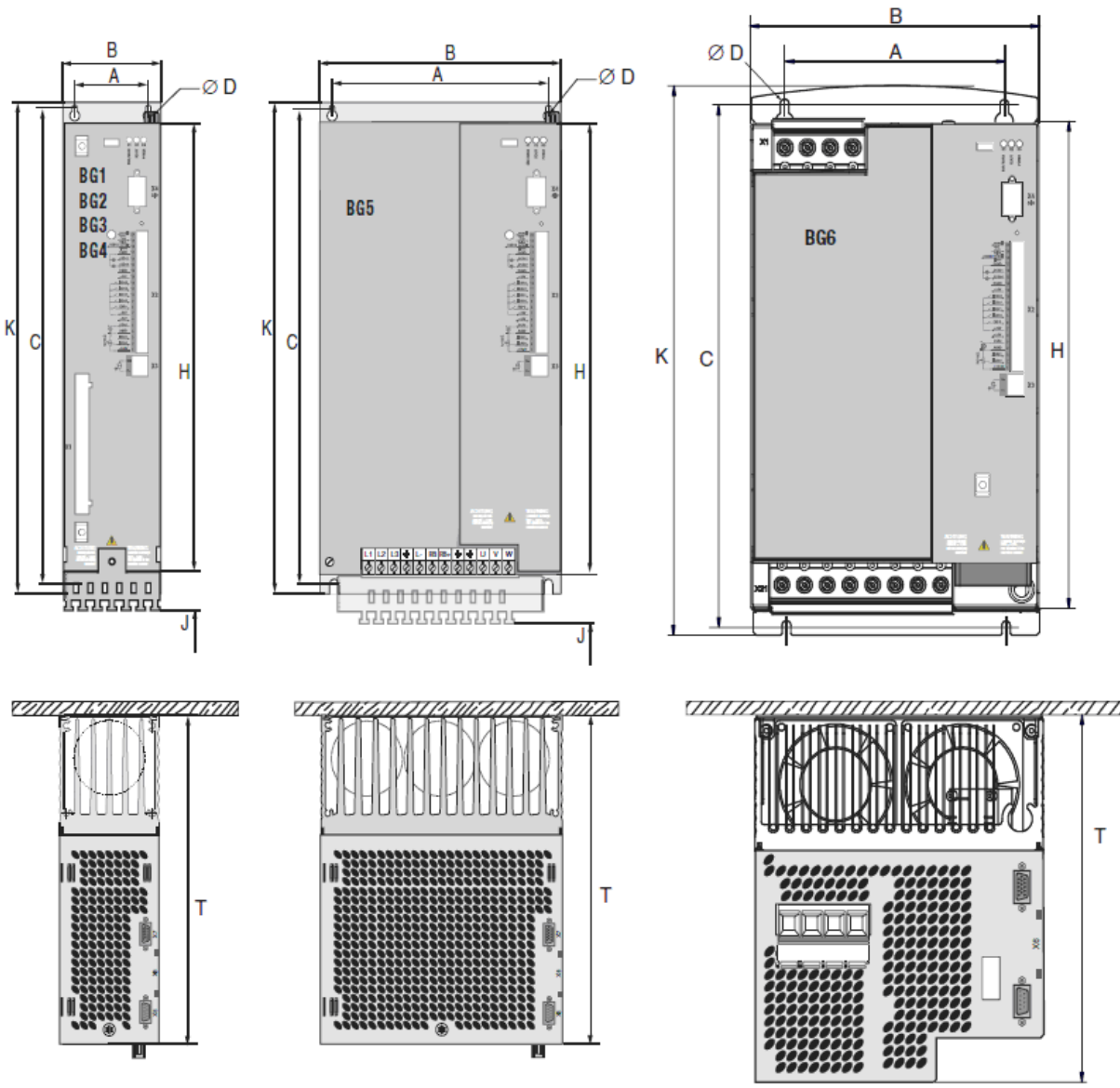
Dimensions of GFQD.1



Dimensions of GFQD.1

	BG2	BG3	BG4	BG5	BG6
Weight [kg]	3.5	4.4	6.5	7.2	13
W width [mm]	70	70	120	170	190
H height [mm]	247	300	300	300	348
D depth [mm]	220	218	218	218	230
A [mm]	40	40	80	130	150
C [mm]	260	320	320	320	365

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	BG2	BG3	BG4	BG5	BG6
D Ø [mm]	4.8	4.8	4.8	4.8	5.6
J [mm]	45	45	45	55	-
K [mm]	270	330	330	330	382

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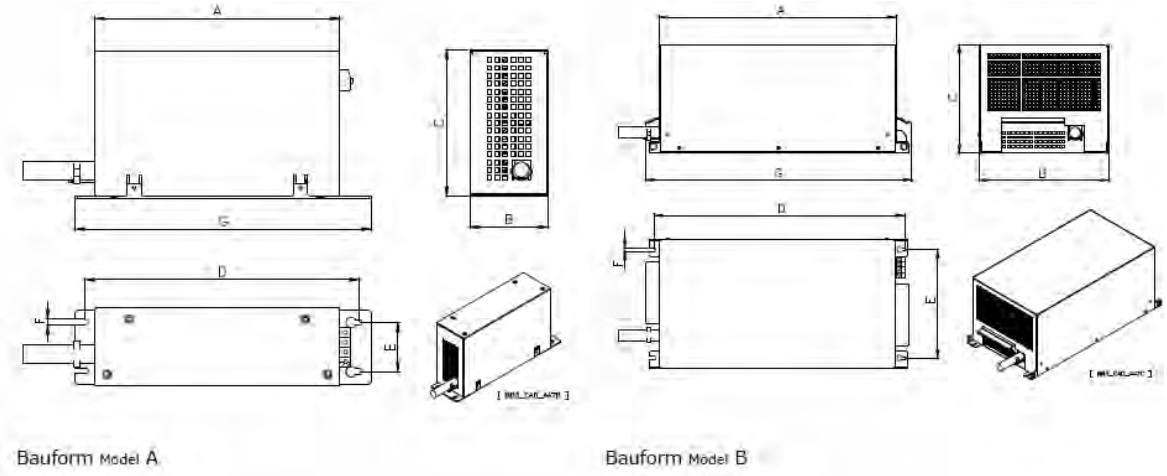
Dimensions of GSIF.1



Type	BAAN no.	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	De-sign	Weight [kg]
GSIF013.1	57111	250	80	150	280	50	6	302	A	3.2
GSIF025.1	57102								A	4.7
GSIF040.1	57103	290		170	320			342	A	7.4
GSIF060.1	57104								A	8.1
GSIF100.1	57105	320	135	200	355	100	6.5	372	A	11
GSIF165.1	57106								A	17
GSIF240.1	57107	370	260	200	400	230		430	B	25
GSIF320.1	57108	400	280		430			460	B	27
GSIF400.1	57109	450	310	250	480	250		510	B	34
GSIF500.1	57112	500			530			560	B	45
GSIF600.1	57110	550			580			610	B	56

Remark:

Details of the structural layout shown in this sketch are not binding.

General tolerances as per DIN 7168-m

Subject to modification.

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7 Electrical properties of the components

Electrical properties of GRCF.1				
	Min	**Type**	**Max**	**Unit**
Voltage supply	21	24	30	V
Current consumption		80	250[1]	mA
Digital inputs				
High level	15	24	30	V
Low level	-3	0	5	V
Relay outputs				
Voltage DC		24	30	V
Voltage AC			250	V
Current resistive load 24V DC/250V AC			1	A
Current inductive load 24V DC/250V AC			1	A
Switch cycles, mechanical	$1*10^6$			Switching cycles
Switch cycles, electrical	$1*10^5$			Switching cycles
Voltage input				
Dielectric strength	-24		30	V
Measuring range	0		12	V
Resolution			10	bit
Fault			1	%[2]
Input resistor:		230		kΩ
Current input				
Dielectric strength	-24		30	V
Measuring range	0		21	mA
Resolution			10	bit
Fault			1	%[2]
Input resistance (without protective circuit)		130		Ω

Electrical properties of GRCF.1

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	Min	Type	Max	Unit
Voltage output				
Voltage range	0		10	V
Load resistance		>=100		kΩ
Resolution			10	bit
Fault			2.5	%[2]
Short protection		Yes		
Potential separation		No		
Temperature input				
Dielectric strength	-24		30	V
Measuring range	-30		100	°C
Resolution			10	bit
Precision			3	%[2]
CAN bus				
Dielectric strength	-24		24	V
Transmission rate		125		kbit/s
Galvanic separation		No		

Electrical properties of GRCF.1

1. The maximum current consumption includes supplying two attached pressure transponders and one attached temperature sensor.

2. Of the appropriate range

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Electrical properties of GFQD.1					
Type	**BAAN no.**	**Power [kW]**	**Current [A]**	**Size**	**Power loss [W]**
GFQD010.1	5204114	0.375	1.0	BG2	30
GFQD010.1 UL	5204115	0.375	1.0	BG2	30
GFQD022.1 UL	5204116	0.75	2.20	BG2	70
GFQD041.1 UL	5204117	1.5	4.10	BG2	112
GFQD057.1 UL	5204118	2.2	5.70	BG2	148
GFQD078.1 UL	5204119	3	7.80	BG3	162
GFQD100.1 UL	5204120	4	10.00	BG3	207
GFQD140.1 UL	5204121	5.5	14.00	BG4	268
GFQD170.1 UL	5204122	7.5	17.00	BG4	325
GFQD240.1 UL	5204123	11	24.00	BG5	400
GFQD320.1 UL	5204124	15	32.00	BG5	510
GFQD450.1 UL	5204125	22	45.00	BG6	610

Electrical properties of GFQD.1

Mains voltage 3 x 400V(-15%) ... 3 x 460V(+10%)

Frequency 50/60 Hz +/-10%

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8 External control value scaling

The dependencies of the external control value specs for the actual value regulations are explained in this table. A 0 ..10V external voltage can, for example, specify a temperature control value. 0V is then equal to a temperature of 0°C and a voltage of 10V is equal to a control value temperature of 100°C.

Current value	Setpoint internal, depending on current value	Setpoint external Current 4 .. 20mA	Setpoint external Voltage 0 .. 10V
Pressure 0 ..25 bar	Pressure 0 .. 50 bar	4mA = 0 bar 20mA = 50 bar	0V = 0 bar 10V = 5 bar
Temperature 0 .. 100°C	Temperature -30 .. 100°C	4mA = 0°C 20mA = 100°C	0V = 0°C 10V = 100°C
Voltage 0 .. 10V	Voltage 0 .. 10V	4mA = 0V 20mA = 10V	0V = 0V 10V = 10V

External control value scaling

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9 Factory setting

	Dry cooler		Condenser with refrigerant		Condenser without refrigerant	
Units	**SI**	**IP**	**SI**	**IP**	**SI**	**IP**
Language	English					
Setpoint 2 present	No					
Night-time operation	No					
Bypass	Yes					
Setpoint displacement	No					
Operating mode	Automatic internal					
Kp	10.0	10.0	10.0	10.0	20.0	2.0
Ti	25 sec.	25 sec.	25 sec.	25 sec.	40 sec.	40 sec.
Td	0 sec.					
Base control value	0%					
Start control value	0%					
Setpoint 1 (2)	30°C	86°F	40°C (25°C CO2)	104°F (77°F CO2)	12.5 bar	181 psig
Threshold value 1	100%					
Night limiter	100%					
Manual mode control value	0%					
Setpoint displace-ment Δ T	5 K					
External temperature displacement min.	0°C	32°F	0°C	32°F	0°C	32°F
External temperature displacement max.	50°C	122°F	50°C	122°F	50°C	122°F
External temperature dependent disp.	off					
Subcooler function	off					
Heating function	off					
Number of frequency converters	1					

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	Dry cooler		Condenser with re-frigerant		Condenser without refrigerant	
Units	**SI**	**IP**	**SI**	**IP**	**SI**	**IP**
Motor voltage	400V					
Motor frequency	50Hz					
Acceleration	2 Hz/s					
Delay	2 Hz/s					
HW Bypass VZ on	2s					
HW Bypass VZ off	5s					
Maintenance run function	On					
Duration of mainte-nance run	1 min					
Maintenance run after stop	24 h					

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10 Error messages and warnings

The table shows which signal relay (**PRIO 1** or **PRIO 2**) is tripped with which message on the display.

* There is a pause of 5 seconds between the flash codes.

Messages/warnings on the display	PRIO 1	PRIO 2	Explanation
Display dark, GMM off	x		GMM has no supply voltage
Unit fault	x		All fans off or faulty; no cooling at heat exchanger; is displayed if all FCs are faulty.
No sensor selected			No sensor activated in the I/O configuration
Sensor fault x		x	The sensor with no. x is defective, or the signal is out of range
not enabled			DI1 (enable) not wired
Setpoint 2			Control is on setpoint 2, DI3 is connected
nightsetback			Night limiter is on, DI2 is switched on or active via clock
VFD n: not onli.		x	Frequency converter n not present
VFD n: KK-TEMP		x	Frequency converter n temperature warning
VFD n: TK-error		x	Thermal-contact switch FC n was activated ISD01
VFD n: not enab.		x	Frequency converter n not enabled (Input ENPO on FC not active), but enable is set on GRCF.1
VFD n: E-BUS xx	x		CAN connection to FC n interrupted or no mains on FC n
VFD n: E-CPU xx	x		Frequency converter n collective faults
VFD n: E-OFF 1	x		Frequency converter n DC link voltage 0V
VFD n: E-OC xx	x		Frequency converter n overcurrent
VFD n: E-OV xx	x		Frequency converter n overvoltage
VFD n: E-OLM xx	x		Frequency converter n IxIxt current too high
VFD n: E-OLI xx	x		Frequency converter n Ixt current too high
VFD n: E-OTI xx	x		Frequency converter n excess temperature
VFD n: E-PLS xx	x		Frequency converter n parameter plausibility
VFD n: E-PAR xx	x		Frequency converter n parameter errors
VFD n: E-FLT xx	x		Frequency converter n floating point error
VFD n: E-PWR xx	x		Frequency converter n output stage unknown
VFD n: E-CAN xx	x		Frequency converter n CAN communication
VFD n: E-EEP xx	x		Frequency converter n EEPROM error
VFD n: protect.		x	Circuit breaker FC n was triggered ISD02

Error messages / warnings on the display

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Messages/warnings on the display	PRIO 1	PRIO 2	Explanation
VFD n: rot.field		x	Rotary field on the FC n is not connected correctly ISD00

Error messages / warnings on the display

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xx	= Fault type, can help with detailed diagnosis	
ii	= Input number	
PRIO 1	= Relay contacts 11/12	
PRIO 2	= Relay contacts 21/22	
Operating message	= Relay contacts 31/34	if control signal > 0%
Hard bypass operation	= Relay contacts 41/42	

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11 Troubleshooting tips

Errors	Possible cause, suggested solution
Fans are not turning	If when the controller is switched on and appears in the Info menuas , check the **operating mode** and the **I/O configuration**. The operating mode appears on the far right of the 2nd line (A = automatic, S = slave mode, H = manual mode). The wrong input function has been chosen for the selected operating mode in the I/O configuration. (See I/O configuration, Page 84). • If the setpoint and the actual value appear in the Info menu, but the setpoint shown does not match the set setpoint, check the mode for any setpoint that may have been set externally. (See Operating mode, Page 66) • Check the power supply and the cable to the fan for faults (cable break etc.). • Has the sensor failed? Check: • **2-wire pressure sensor**: Must deliver 4-20 mA (check with ampmeter). • **Temperature sensor**: Measure the impedance; it must be between 1200 and 2700 Ohm. Lower values indicate a short circuit or similar fault (e.g. water in the terminal box), higher values indicate a loose connection or cable break. • **Standard signal**: May be between 0 and 10V. If it is permanently at 0V, a defect is probable.
Fan does not reach its maximum speed or runs too slowly in normal operation	• Is the limiter active? The maximum fan speed is limited to the speed set here. Check the setting! • The control system may be incorrectly set up. • The fan speed increases when you increase the setpoint. If this does not help, you can adjust the Kp factor carefully: if the Kp factor is increased, the fan will reach its maximum speed quicker. **NOTE**: too great an increase in the Kp factor can lead to "oscillation"! If this happens, reduce the Kp factor again. • Is the sensor delivering a correct signal? If it is too low, the fan will not reach the requisite speed. Check: • **Temperature sensor**: Has the sensor been installed correctly? An incorrect value will be recorded near heat sources or e.g. in direct sunlight. Check the sensor and wiring! (Cable break? Has a wire come loose from the connection terminals?) • **Standard signal** 0-10V: Measure the signal on the terminals using a multimeter. It must be between 0 and 10V. Is the polarity correct? • **Pressure transmitter**: The 2-wire sensor delivers 4-20 mA; check this value (ammeter). If the value is not within this range or remains constant even when the pressure changes, the pressure transmitter is defective.

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