BECKER

VARIAIR UNIT

Operating instructions

Frequency converter VAU 7.5/3

28100241400 03/14

Safety and application information for frequency converters

1. General

During operation, frequency converters can have – depending on their type of protection – electrically charged, uncovered, and possibly even moving or rotating parts, as well as hot surfaces.

There is a risk of serious injury for persons or material damage if unauthorised removal of the required covers, improper usage or erroneous installation or operation occurs.

Further information can be found in the documentation.

All tasks for transport, installation and startup as well as for servicing should be carried out by **qualified technicians** (IEC 364 or CENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN VDE 0110 and national accident prevention regulations).

Qualified technicians in the sense of these basic safety guidelines are persons that are familiar with the set up, assembly, commissioning and operation of the product and have the appropriate qualifications for their tasks.

2. Intended use

Frequency converters are components that are intended for installation into electrical systems or machines.

When being installed into machines, the commissioning of the frequency converters (i.e. the starting of the specified normal operation) is not permitted until it has been determined that the machine complies with the stipulations of the valid machine regulations including EMC directive; EN 60204 must be observed.

The frequency converters comply with EC Machinery Directive 2006/42/EC.

The technical data as well as the specifications on the technical connection conditions can be found on the specification plate and in this manual and must be observed.

3. Transport, storage

The instructions on transport, storage and proper handling must be observed.

4. Installation

The setting up and the cooling of the devices needs to be done according to the directives of the corresponding documentation.

The frequency converters need to be protected from inappropriate conditions. In particular components may not be bent and/or insulation dimensions may not be changed during transport and handling. The touching of electronic components and contacts must be avoided.

Frequency converters contain electrostatically-endangered components that can be easily damaged by improper handling. Electrical components may not be damaged mechanically or destroyed (possibility of health hazards!).

5. Electrical connection

When working on frequency converters that are electrically charged, the valid national accident prevention regulations must be observed.

The electrical installation is to be carried out according to the pertinent regulations (e.g. cable cross-sections, fuses, earth lines). Any information that exceeds that is included in the documentation.

Information on EMC-compliant installation – such as insulation, earthing, arrangement of filters and the laying of lines – can be found in Chapter 2.4. These instructions must also always be observed with CE-marked frequency converters. The responsibility of complying with the limits required by the EMC regulations lies with the manufacturer of the system or machine.

6. Operation

Systems into which the frequency converters are installed may, if necessary, be equipped with additional monitoring and protective devices according to the valid safety regulations, i.e. laws for technical tools and appliances, accident preventions regulations, and so forth.

After frequency converters are disconnected from the supply voltage, electrically charged parts and line connections may not be touched immediately because of charged capacitors. Observe the appropriate signs on the frequency converters concerning this.

During operation all covers must be kept closed.

7. Maintenance and service

Observe the manufacturer's documentation.

These safety instructions must be retained.

Table of Contents

1 General

1.1. Safety and installation instructions

VAU 7.5/3 frequency converters are components for use in industrial high-voltage systems and are operated with voltages that can cause serious injuries or even death if touched.

- Installations and maintenance may only be performed by qualified electricians and only when the device is free of voltage. The operating instructions have to be available for these persons at all times and be dutifully observed by them.
- The local regulations on installing electrical systems as well as the accident prevention regulations must be observed.
- The device is charged with dangerous voltage for up to 5 minutes after being switched off. Opening the device or the removal of covers or the operating part is therefore not permitted for 5 minutes after the voltage for the device has been switched off. Before switching on the power supply voltage all covers need to be reattached.
- Even if the motor is at a standstill (for instance because of electronic blockage, blocked drive or output terminal short circuit) the power cable terminals, motor terminals and terminals for the brake resistance may still carry dangerous voltages. Motor standstill does not mean that there is a galvanic separation from the network.
- **Notice**, under certain setting conditions, the converter can start up automatically when switched on on the network side.
- There are highly sensitive MOS semiconductor devices on the circuit boards that are especially sensitive to static electricity. Therefore, please avoid touching the circuit boards or components with your hands or with metallic objects. Only the screws of the terminal strips may be touched by insulated screwdrivers when wires are connected.
- The frequency converter is intended for a firm connection and may not be operated without an effective earth connection that complies with the local regulations for high leakage currents (> 3.5 mA). VDE 0160 prescribes the laying of a second earth line or an earth cross-section of at least 10 mm^2.
- If personal or fire protection is required when using the FC, all-current sensitive residual-current devices (type B RCD) must be used (in accordance with VDE 0664). They provide reliable protection for the high-frequency AC currents and smooth and pulsating DC residual currents that occur during FC operation. Conventional type A residual-current devices are not suitable for this purpose.
- VAU 7.5/3 frequency converters are maintenance-free under normal operating conditions. If the air is dusty, the cooling surfaces should be cleaned regularly with compressed air.

WARNING! DANGER TO LIFE!

The power pack may still be charged with voltage for up to 5 minutes after being switched off from the mains. Converter terminals, motor feeder lines and motor terminals may carry voltage.

Touching open or exposed terminals, lines and device parts can cause serious injuries and even death!

	**CAUTION** - Children and the general public should not have access to or contact with the device. - The device may be used only as intended by the manufacturer. Unauthorised modifications and the use of spare parts and auxiliaries that are not sold or recommended by the manufacturer of the device can cause fires, electrical shocks and injuries. - Store these operating instructions where they are easily accessible and place them in every user's hands.
	The heat sink and other metallic parts can reach temperatures of more than 70 °C. Keep sufficient space to neighbouring components. When working on the components allow for sufficient cooling time.

Warning:	This is a product of the limited sales class acc. IEC 61800-3. In a residential environment this product can cause high-frequency interferences, in which case the user can be required to take suitable measures. A suitable measure would be the employment of a recommended line filter.

1.2 Certifications

1.2.1 European EMC guidelines

CE If the VAU 7.5/3 frequency converter is installed according to the recommendations of these operating instructions, it fulfils all requirements of the EMC regulations according to the EMC product standards for motor driven systems EN 61800-3.
(See also chapter 8 Electromagnetic compatibility [EMC].)

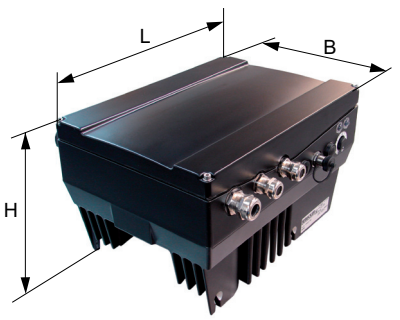
VAU 7.5/3 frequency converters are equipped with motor overload protectors. Further technical details can be found in the Chapter **6** Technical specifications.

2 Assembly and installation

2.1 Suitable ambient conditions

Elevation of the installation:	Up to 1000 m above sea level / above 1000 m with reduced power (1% per 100 m) (max. 2000 m)
Ambient temperature:	-10 °C to +50 °C
Relative humidity:	≤ 96%, condensation not permissible
Vibration and shock resistance:	According to FN 942 017 Part 4; 5.3.3.3 Combined Test 2; 5…200 Hz for sinusoidal vibrations
Electromagnetic compatibility:	Immune to interference according to DIN EN 61800-3
Cooling:	Surface cooling: Free convection; optionally with integrated fan

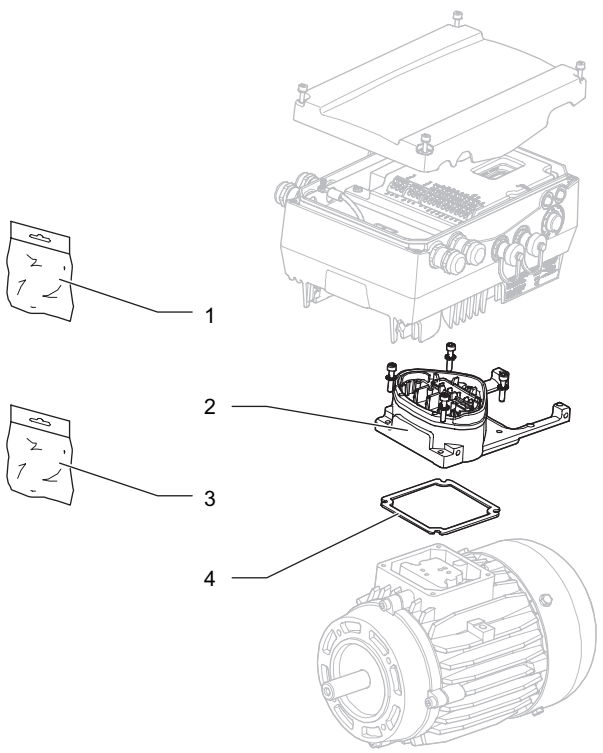
2.2 Dimensions of the VAU 7.5/3

Device type	L	W	H	Weight approx. [kg]
VAU 7.5/3	307	233	181	8.7
	all dimensions in [mm]			including adapter plate

2.3 Mechanical connection

The following parts must be available for installation of the frequency converter:

1. Poly bag with fastening screws
2. Adapter plate with connection terminal. When ordering, specify the intended application, as there are a number of versions of the adapter plate.
3. Poly bag with connection material for the terminal block
4. Seal; glued under the adapter plate before assembly.



2.4 Wiring regulations

The converter has been designed for industrial environments in regards to interference radiation. In these environments, high values of electromagnetic interference can affect the converter. Generally, a proper installation guarantees an interference-free and riskless operation. To keep within the limits of the EMC directives, the following notes should be observed.

1. Make sure that all devices are well earthed by short earth lines with greater cross-sections that are connected at a common earthing point or earthing rail. It is especially important that each control device connected to the frequency converters (e.g. an automation device) is connected to the same earthing

point as the converter itself by short lines with greater cross-sections. Flat lines (e.g. metal brackets) are preferred, because they feature a lesser impedance at high frequencies.

2. As far as possible, shielded lines should be used for the control circuits. The shield should be neatly ended at the line's end and care should be taken that the wires do not run unshielded for longer lengths.
3. The pilot wires should be laid as far away as possible from the power lines, using separate cable ducts for example. If lines cross, they should do so at an angle of 90° if possible.
4. Make sure that the gates in the surroundings are interference-suppressed, either by an RC circuit in case of AC voltage relays or by free-wheeling diodes in case of DC voltage relays, whereby the interference-suppression unit needs to be attached to the safety coils. Varistors for limiting overvoltages are also effective. This suppression shielding is important in particular when the gate is controlled by the relays in the converter.
5. Furthermore ensure a wiring that is EMC-compliant. (also see Chap. 7 EMC)

When installing the converter, the safety regulations may not be violated under any circumstances.

	**NOTE** The pilot wires and the power lines need to be laid out separately. Under no circumstances should they be lain in the same conduit / installation duct. The test equipment for high-voltage insulations may not be used for cables that are connected to the frequency converters.

2.5 Electrical connection

	**WARNING** **THESE DEVICES HAVE TO BE EARTHED.** A reliable operation of the device requires that it is properly mounted and put in operation by qualified personnel observing the instructions in this manual. In particular, the general and the regional assembly and safety regulations for working on high-voltage systems (e.g. VDE) as well as the respective regulations on the proper application of tools and the use of personal safety equipment must be observed. There may be dangerously high voltage at the power input even when the converter is not in operation. Always use an insulated screwdriver when working at these terminal panels. Make sure that the input voltage source is de-energised before you open the terminal box cover.

Ensure that the frequency converter is operated only at the matching connection voltage. At the power input side, no special fuses are needed at the frequency converter; it is recommended to use the usual network fuses (see Technical specifications) and a mains switch/gate.

All cables need to be inserted with appropriate screw connections into the frequency converter and be relieved against tension.

Before switching on the supply voltage, all covers need to be reattached.

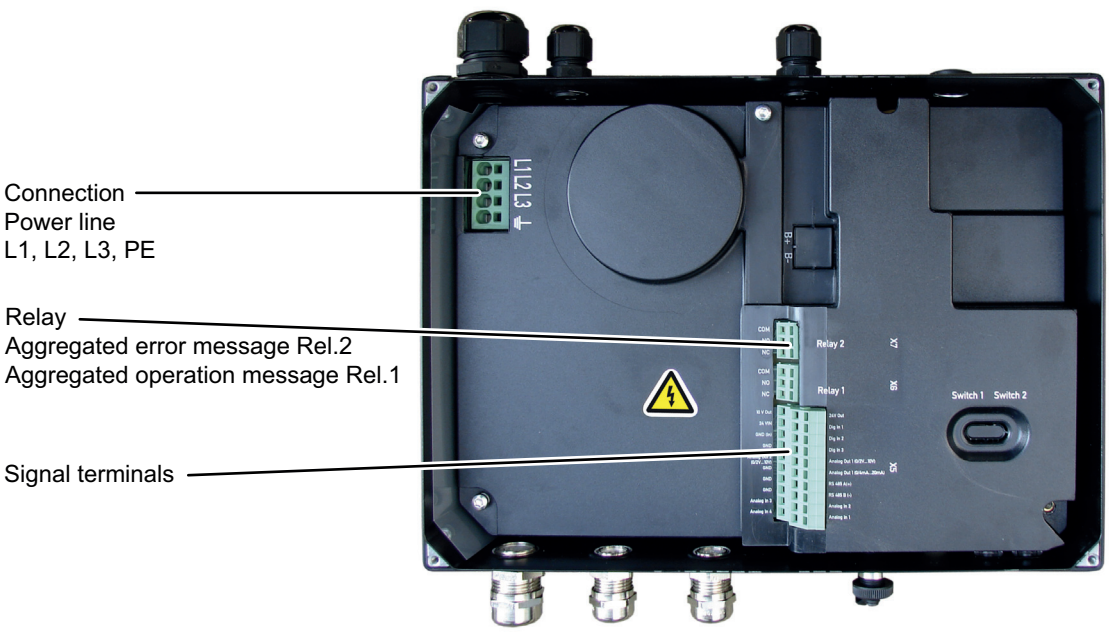
Note: When using certain wire end ferrules, the maximum connected wire cross-section may be reduced.

The following needs to be observed:

1. Make sure that the power source supplies the correct voltage and is constructed for the necessary current (see Chapter 6 Technical specifications).
2. Make sure that suitable power switches are installed with the specified nominal power range between power source and converter.
3. Connect mains voltage directly to the mains terminals L1, L2, L3 and the earth (PE).

2.5.1 Connection room

After opening the terminal box cover, you will find all the connection terminals of the frequency converter in the connection area.



2.5.2 Mains connection

	Terminal	Connection
	L1, L2, L3	Mains power supply phase L1, L2, L3
	PE	Mains power supply earth line PE

Conductor cross-section of the mains power supply: 0,25 -4 mm² (wire-end ferrule with plastic shroud)
Stripping length: 15 mm

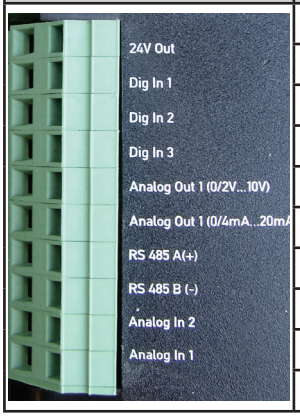
2.5.3. Control signals

All control terminals are labelled with readable text.
Conductor cross-section of the signal lines: 0,25 - 1,5 mm² (wire-end ferrule with plastic shroud)
Stripping length: 7 mm

Connection terminals of the bottom row of the double-decker terminal block:

	Terminal	Connection
	10 V Out	Int. voltage supply
	24 V IN	Ext. voltage supply
	GND (In)	Ground (ext. voltage supply)
	GND	Ground
	Analog Out 2 (0 V…10 V)	Analog voltage output
	GND	Ground
	GND	Ground
	GND	Ground
	Analog In 3	Analog input 3
	Analog In 4	Analog input 4

Connection terminals of the top row of the double-decker terminal block:

	Terminal	Connection
	24 V Out	Int. voltage supply
	Dig In 1	Setpoint value enable
	Dig In 2	Programmable P 156
	Dig In 3	Programmable P 157
	Analog Out 1 (0 V…10 V)	Analog voltage output
	Analog Out 1 (4 mA…20 mA)	Analog current output
	RS 485 A(+)	Serial interface RS485 line A
	RS 485 B(-)	Serial interface RS485 line B
	Analog In 2	Analog input 2
	Analog In 1	Analog input 1

NOTE

All control voltages refer to a common reference potential (GND).

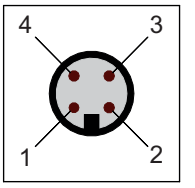
24 V can be taken from the respective terminals. The sum of the currents may not exceed 100 mA (see Chapter 6 – Technical specifications).

2.5.4 RS485 interface

The RS485 interface is designed as a two-wire model acc. to EIA RS485 (data lines A and B) and provides the communication with the frequency converter.

The interface is network compatible according to the standard mentioned above in a network with up to 31 participants.

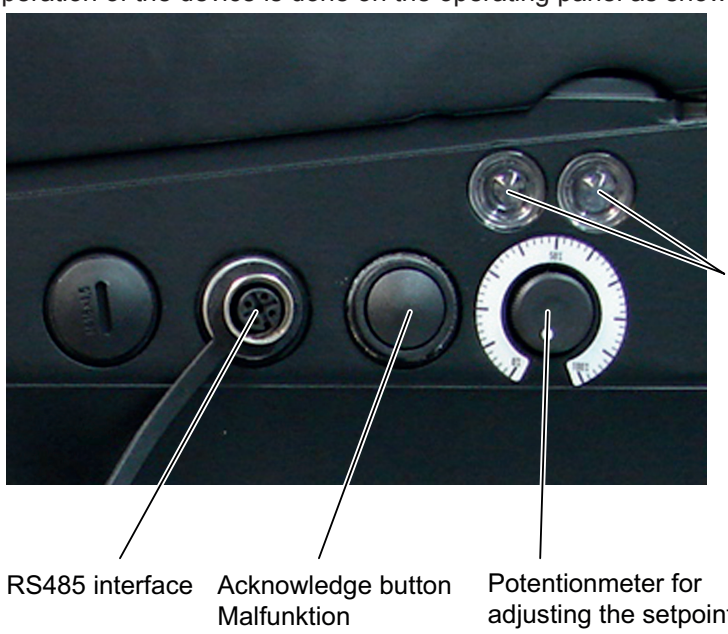
The transfer rate as well as the slave address can be set by appropriate parameters.

Pin assignment M12:	M12	Description	
	1	24 V	 Pin (bus in)
	2	RS 485 A(+)	
	3	GND	
	4	RS 485 B(-)	

3. Operation and displays

3.1 Local operation and display elements

The local operation of the device is done on the operating panel as shown.



Using the potentiometer, the current setpoint value can be increased or decreased.

A malfunction can be acknowledged by pressing the Acknowledgement button.
A red LED indicates a malfunction.

3.2 Display of the LED flash codes

The following table provides an overview.

Red LED	Green LED	Status
○	●	Operation
✳	●	With optional BUS module: BUS operation (active BUS connection)
●	○	Malfunction
✳	✳	With optional BUS module: BUS module is ready for operation
○	✳	Initialisation
Legend: ○ **LED off,** ● **LED on,** ✳ **LED flashes,** ✳ **LED flashes quickly**		

3.3 Digital interface

The function of the digital inputs can be adapted by appropriate parameters to application specifications.

WARNING: Every function may be used at only one input!

3.3.1 Digital inputs

- **Digital input 1**
  Parameter: 007 / 053 / 062 / 065 / 155
- **Digital input 2**
  Parameter: 053 / 062 / 065 / 155 / 156
- **Digital input 3**
  Parameter: 053 / 062 / 065 / 155 / 157

3.4 Analog interfaces

3.4.1 Analog inputs

Analog input 1–4

The analog inputs 1, 2, 3 and 4 can be used as current or voltage inputs and can be scaled between 0–10 V / 2–10 V / 0–20 mA / 4–20 mA.

- **Analog input 1**
  Parameter: 005 / 006 / 022 / 023 / 025 / 026 / 027 / 042 / 062 / 065 / 154 / 162
- **Analog input 2**
  Parameter: 005 / 006 / 031 / 032 / 034 / 035 / 036 / 042 / 062 / 065 / 154 / 162 / 165 / 166 / 171 / 172
- **Analog input 3**
  Parameter: 005 / 042 / 062 / 065 / 154 / 158 / 159 / 162 / 167 / 168 / 173 / 174
- **Analog input 4**
  Parameter: 005 / 042 / 062 / 065 / 154 / 160 / 161 / 162 / 169 / 170 / 175 / 176

3.4.2 Analog outputs

- **Analog output 1**
  The analog output 1 can be used as a voltage output (0–10 V) or as a current output (4–20 mA).
  Various different connection terminals are available for the appropriate usage.
  NOTICE: Only one of the two terminals may be used!
  Parameter: 042 / 043
- **Analog output 2**
  Function: Like analog output 1.
  Parameter: 162 / 163

3.5 Potential-free contacts

Relay (Rel.1) AOM – aggregated operation message

The relay is designed as a changer so that a normal opened as well as a normal closed contact can be used.
Parameter: 062 / 063 / 064 / 094 / 095

Relay 2 (Rel.2) AEM – aggregated error message

Function: Like relay 1
Parameter: 065 / 066 / 067 / 096 / 097

4. Start-up

General

If the power supply is applied to the converter, then it is ready for operation

after a couple of moments. In this status, the converter can be set for the requirements of the application; i.e. parameterised. A detailed description of each parameter follows in chapter 5.

Not until the parameters have been set by qualified personnel may the motor be started by an enable signal.

NOTE

Certain parameters do not become effective until the mains voltage has been turned off and on again. In this case, the frequency converter needs to be without voltage for at least 60 seconds.

The converter is not equipped with a main switch for the mains and is therefore constantly energised when it is connected to the mains voltage.

With certain parameter settings, it may be possible that the device starts up directly after the mains voltage is switched on.

4.1 Basic settings

The frequency converter made by GBB is always parameterised with a basic setting that matches the type of device on which the frequency converter is mounted or intended for mounting.

This includes primarily all controller settings and regulator characteristics, temperature, speed and other limit values as well as the basic electrical coordination between frequency converter and motor.

That is why it is essential to operate the frequency converter only on the device type for which it was supplied. Otherwise, contact qualified service personnel.

If desired by the customer, application-specific parameters can be pre-installed so that the device can be put into operation promptly.

Basically, to operate a frequency-controlled device, preliminary settings need to be made on the user side as they are described in the following chapters.

4.2 Operation mode pressure/vacuum

For the correct behaviour of the device during the application it needs to be appropriately set for whether the device is to be operated in pressure or vacuum mode.

Some device types can be operated only as pressure or vacuum devices. With others the application depends on the selected outlet connection of the device.

In both cases, it needs to be ensured that the set operation mode matches the actual application to avoid damages to the device.

The operation mode selection is done for the device by an appropriate parameterisation.

4.3 Operation mode (regulation)

The type of control significantly determines the behaviour of the device in the application.

Unless specified differently by the operator, the device is preset to the speed-controlled operation mode.

Switching can be made by an appropriate parameterisation.

4.3.1 Speed-controlled mode

In speed-controlled mode, the speed is directly specified as the setpoint at which the device should be run. The device runs up to this speed and retains this speed even when the working point of the application is changed.

4.3.2 Sensorless regulation

With the sensorless regulation, a direct regulation of a process variable, e.g. pressure or vacuum, is possible without this being necessarily measured by a sensor.

The frequency converter is capable – with appropriate parameterisation – of calculating the process variable from internal factors and to readjust it according to the specified value.

The necessary map parameters have already been set at delivery according to the device types.

For the pressure or vacuum regulation, the (relative) pressure difference can be specified directly and as a positive value respectively for pressure and vacuum operation.

4.3.3 Process control (sensor-guided)

An appropriate sensor is necessary for the process control, which needs to be attached to the analog input.

The physical type of the process variable depends only on the type of the sensor used.

The specification of the setpoint is done as a percentile value relative to the maximum measured value of the sensor used.

Notice: If an absolute pressure sensor is used for regulation in vacuum mode, then the corresponding measured value needs to be inverted for a correct control mode.

When using the process controller it may be necessary to adjust the regulator parameters to the behaviour of the control system in case the regulation behaviour is not satisfactory with the preset values. The process controller is designed as a PID controller.

4.4 Setpoint value source

The setpoint for the speed, the sensorless regulation or the process control can be set in different manners, e.g. by the analog inputs or the RS485 interface.

Which manner should be selected specifically for the application needs to be set in the appropriate parameters for the main setpoint source.

Unless specified differently by the operator, the analog input is set as the main nominal value source.

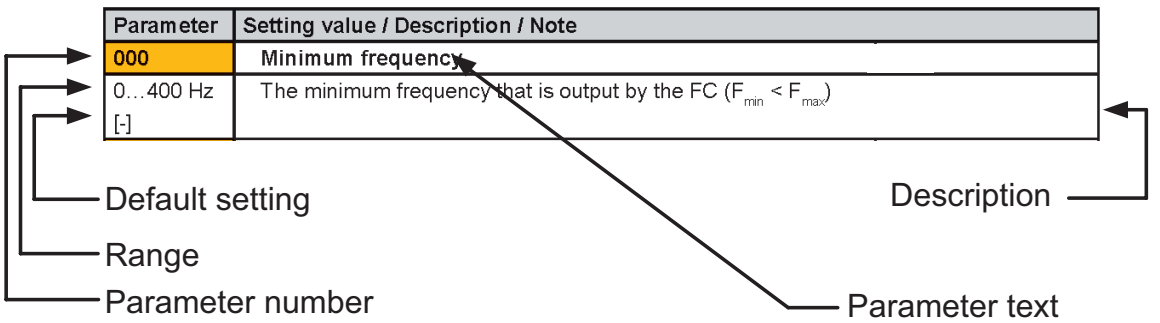
4.5 Start/stop source

The enabling of the device to start the startup and for shutting down can also be done in different manners (digital input or RS485 interface). Which manner is implemented is determined by the parameters of the start/stop source.

5 Parametrisation

Availability of the parameters

Enabling various password levels allows you to view and edit various parameters using the KombiTool. You can find all parameters on the following table pages (Chap 5.1 …).



5.1 Parameter description

In the following the abbreviation FC is used for frequency converter.

Parameter	Setting value / Description / Note
000	**Minimum frequency**
0…400 Hz [-]	The minimum frequency that is output by the FC (F_{min} < F_{max})
001	**Maximum frequency**
5…400 Hz [-]	The maximum frequency that is output by the FC (F_{min} > F_{max})
003	**Run-down (brake) time**
0.1…1000 s [-]	Time from f_{max} (see P001) to standstill
004	**Run-up time**
0.1…1000 s [-]	Time from standstill to f_{max} (see P001)
005	**Primary setpoint source**
0…11 [0]	Specifies the source from which the setpoint value should be read. 0 = internal potentiometer 1 = analog input 1 2 = analog input 2 3 = manual control unit 4 = serial interface RS-485 (USS or SAS protocol) 8 = PID fixed setpoint value (parameter 083) 10 = analog input 3 11 = analog input 4

Parameter	Setting value / Description / Note
006	**Actual value source** for sensor-guided PID control
0; 1 [0]	Selection of the input source from which the actual value is read for the PID process controller: 0 = analog input 1 1 = analog input 2
007	**Primary start/stop source ➡ enable**
0…9 int [0]	Selection of the source for the SW enable: 0 = digital input 1 1 = digital input 2 2 = digital input 3 7 = serial interface RS-485 (USS or SAS protocol) 9 = autostart
008	**Operation mode**
0…3 [0]	Selection of the operation mode 0 = speed-controlled mode 1 = sensor-guided PID controller 3 = sensorless (internal) pressure regulation
009 / 010 **011 / 012** **013 / 014** **015**	**Fixed frequency 1…7**
0…400 Hz [0]	Depending on the switching pattern of digital inputs 1-3, the blower is switched to the corresponding fixed frequency. Switching to fixed frequency via digital inputs, DigIn1 (enable) must always be set. DigIN. 2 (P156=4) ➡ fixed freq. 3: P11= f_{01} DigIN. 3 (P157=4) ➡ fixed freq. 5: P13 = f_{02} DigIN. 2 (P156=4) & DigIN. 3 (P157=4) ➡ fixed freq. 7: P15 = f_{03}
022 / 031	**Filter time** (analog input 1 / analog input 2)
0.02…1.00 s [0,02]	Time constant in seconds for input filter
023 / 032	**Lost motion** (analog input 1 / analog input 2)
0…100 % [0]	Lost motion in per cent of the range end value
025 / 034	**Input type** (analog input 1 / analog input 2)
1; 2 [1]	Switching of the analog input as voltage or current input: 1: Voltage input; 2: Current input
026 / 035	**%-min-value** (analog input 1 / analog input 2)
0…100 % [0]	Specifies the minimum value of the analog input as per cent of range end value: Example: **0**…10 V or **0**…20 mA ➡ **0%**…100% **2**…10 V or **4**…20 mA ➡ **20%**…100%

Parameter	Setting value / Description / Note
027 / 036	**%-max-value** (analog input 1 / analog input 2)
0…100 % [0]	Specifies the maximum value of the analog input as per cent of range end value: Example: 0…**10 V** or 0…**20 mA** ➡ 0%…**100%** 2…**10 V** or 4…**20 mA** ➡ 20%…**100%**
037	**PID controller** (KP: P component)
0…100 [1]	Proportional amplification of the PID controller
038	**PID controller** (KI: I component)
0…100 1/s [1]	Integral component of the PID controller
039	**PID controller** (KD: D component)
0…100 s [0]	Differential component of the PID controller
042 / 162	**Function** (analog output 1 / analog output 2)
0…54 [5]	Selection for signal at the analog output: 1 = U_d (link voltage) 2 = U_N (mains voltage) 3 = U_{Motor} (motor voltage) 4 = I_{Motor} (motor current) 5 = f_{ACT} (actual frequency) 8 = IGBT temperature 9 = internal temperature 10 = analog input 1 11 = analog input 2 12 = f_{NOM} (nominal frequency) 50 = P_d (link power) 51 = analog input 3 52 = analog input 4 53 = value from GBB function 54 = dp_{ACT} (calculated actual pressure)
043 / 163	**Minimum value** (analog output 1 / analog output 2)
-10000… 10000 [0]	Minimum value with respect to the selected process variable that is displayed at analog output as 0 V (or 4 mA). Example: **0**..10 V (**min**ValueAOut .. maxValueAOut)
080 / 164	**Maximum value** (analog output 1 / analog output 2)
-10000… 10000 [-]	Maximum value with respect to the selected process variable that is displayed at analog output as 10 V (or 20 mA). Example: 0..**10** V (minValueAOut .. **max**ValueAOut)

Parameter	Setting value / Description / Note
053	**Acknowledge function**
0…3 [0]	Selection of source for error acknowledgement. **Note:** Acknowledgement can be performed using button 0 = no acknowledgement via digital input 1 = digital input 1 2 = digital input 2 3 = digital input 3
054	**Auto acknowledge** (automatic restart after a malfunction)
0…1000 s [0]	Activation of auto acknowledgement 0 = no automatic acknowledgement 1–1000 = time (in seconds) after which the automatic malfunction reset is performed
109	**Auto acknowledge** (number)
0…500 [0]	Maximum number of automatic acknowledge procedures can be selected ➡ 0 means unlimited automatic acknowledge possible
062 / 065	**Function** (relay 1 / relay 2)
0…59 [19 / 10]	Selection of the process variable that causes the relay to be switched on or off when the value drops below or rises above the limit values 1 = U_d (link voltage) 2 = U_N (mains voltage) 3 = U_{Motor} (motor voltage) 4 = I_{Motor} (motor current) 5 = f_{ACT} (actual frequency) 8 = IGBT temperature 9 = internal temperature 10 = malfunction (switches for malfunction) aggregated error message 11 = malfunction inverted (switches OFF in case of malfunction) 13 = Digital IN 1 14 = Digital IN 2 15 = Digital IN 3 18 = ready 19 = operation (aggregated operation message) 50 = current limit active 51 = nominal frequency reached 52 = setpoint cannot be achieved (control deviation) 53 = Analog IN 1 > Limit value 1 ➡ (Relay 1: P63 / P64 Relay 2: P66 / P67) 54 = Analog IN 2 > Limit value 2 ➡ (Relay 1: P165 / P166 Relay 2: P171 / P172) 55 = Analog IN 3 > Limit value 3 ➡ (Relay 1: P167 / P168 Relay 2: P173 / P174) 56 = Analog IN 4 > Limit value 4 ➡ (Relay 1: P169 / P170 Relay 2: P175 / P176) 57 = function 53, 54, 55 or 56 active 58 = malfunction or function 57 active 59 = temperature limit active (temperature protection)

Parameter	Setting value / Description / Note
063 / 066	**Switch-on threshold** (Relay 1 / Relay 2)
0…10000 [0]	Switch-on threshold with respect to the selected process variable for relay function 1, 2, 3, 4, 5, 8, 9, 53 (value specified in physical units: A, V, Hz, °C)
064 / 067	**Switch-off threshold** (Relay 1 / Relay 2)
0…10000 [0]	Switch-off threshold with respect to the selected process variable for relay function 1, 2, 3, 4, 5, 8, 9, 53 (value specified in physical units: A, V, Hz, °C)
068	**Fan IGBT temp**
40…200 °C [-]	IGBT temperature limit in °C at which the fan is switched on
069	**Internal temperature of switch-ON threshold for fan**
40…200 °C [-]	Internal temperature limit in °C at which the fan is switched on
082	**PID inverse**
0; 1 [0]	Inverts the actual value of the PID process controller (important for absolute pressure sensor in the vacuum area) 0 = not inverted 1 = PID actual value is inverted
083	**PID fixed setpoint value**
0…100 % [0]	Fixed setpoint value for the PID process controller ➡ must be selected in P005 / 8 = (PID fixed setpoint value)
086	**Motor current limit** (% value of the motor rated current)
0…250 % [-]	When this limit is exceeded the speed is reduced
087	**Motor current limit** (time for which overcurrent is permissible)
0…100 s [-]	When this limit is exceeded the speed is reduced
094	**On-delay relay 1**
0…99 s [1]	
095	**Drop-out delay, relay 1**
0…99 s [1]	
096	**On-delay relay 2**
0…99 s [1]	
097	**Drop-out delay relay 2**
0…99 s [1]	
098	**ID/USS/SAS address**
0…31 [0]	Device address for USS/SAS bus operation

Parameter	Setting value / Description / Note
099	**Field bus address**
0…31 [0]	For use of the optional field bus module, e.g. CANopen
100	**Field bus – baud rate**
0…4 [2]	For use of the optional field bus module, e.g. CANopen 0 = 9600 baud, 1 = 19200 baud, 2 = 38400 baud, 3 = 57600 baud, 4 = 115200 baud
102	**Bus Timeout (USS Timeout)**
0…100 s [0]	Maximum time between two USS telegrams (RS485) / bus timeout If the primary setpoint source and/or the primary start/stop source has been set to RS485 and a value greater than 0 has been entered, then the frequency converter expects a telegram at the RS485 interface at the delay time that is at most the entered time, otherwise it switches to error status. If the value 0 is entered, then there is no monitoring of the telegram traffic.
109 ➡ 054	
110	**USS /SAS baud rate** (RS485 interface)
0…3 [0]	0 = 9600 baud, 1 = 19200 baud, 2 = 38400 baud, 3 = 57600 baud
150	**Converter type**
0…10000 [101]	Only described by GBB; specifies the converter in the KombiTool
151	**Hardware status**
0…10000 [1]	
152	**Software status**
0…10000 [1]	
153	**GBB identifier**
0…10000 [-]	Only described by GBB; specifies an identifier of the parameter set

Parameter	Setting value / Description / Note
154	**Alternative setpoint source**
0…11 [0]	Specifies the source from which the setpoint value should be read. 0 = internal potentiometer 1 = analog input 1 2 = analog input 2 3 = manual control unit 4 = serial interface RS-485 (USS or SAS protocol) 8 = PID fixed setpoint value (see parameter 083) 10 = analog input 3 11 = analog input 4
155	**Alternative start/stop source ➡ Enable**
0…9 [0]	Selection of the source for the setpoint value enable: 0 = digital input 1 1 = digital input 2 2 = digital input 3 7 = serial interface RS-485 (USS or SAS protocol) 9 = autostart
156 / 157	**Function** (digital input 2 / digital input 3)
0…10 [0]	Additional functions for digital inputs 2+3 **Notice**: Do not configure digital inputs 2+3 with the same function! Switch level: Low < 5V / High > 15V 0 = no function 1 = switch to alternative setpoint value source (P154) + alternative start/stop source (P155) 2 = switch pressure (0 V) / vacuum (24 V) 3 = switch (according to P008) regulation (0 V) / speed-controlled mode (24 V) 4 = switch to fixed frequency 5 = switch to emergency operation ➡ Setpoint value source potentiometer, enable digital input 1 and speed-controlled mode 6 = Alarm 1 24 V: Alarm trigger ➡ FC malfunctions, malfunction indication 7 = Alarm 2 24 V: Alarm trigger ➡ FC malfunctions, malfunction indication 8 = stop via ramp 9 = immediate stop (no current) 10 = switch to GBB function
158 / 160	**Input type** (analog input 3 / analog input 4)
1; 2 [1]	Switching of the analog inputs as voltage or current input: 1 = voltage input; 2 = current input

Parameter	Setting value / Description / Note
159 / 161	**%-min-value** (analog input 3 / analog input 4)
0…100 % [0]	Specifies the minimum value of the analog inputs 3 + 4 as per cent of range end value: Example: **0**…10 V or **0**…20 mA ➡ **0%**…100% **2**…10 V or **4**…20 mA ➡ **20%**…100% **Note**: %-max value: 100% at 10 V / 20 mA (e.g. 10 V at A_{in} ➡ setpoint f_{max} 100Hz)
162 ➡ 042 **163 ➡ 043** **164 ➡ 044**	
165 / 171	**Limit value analog input 2: Switch**-on threshold (relay 1 / relay 2)
0…10000 [0]	Switch-on threshold with respect to the selected process variable (value specified in physical units: mA, V (0…20 mA / 0…10 V)) see parameter 62/65 relay function: 54
166 / 172	**Limit value analog input 2: Switch**-off threshold (relay 1 / relay 2)
0…10000 [0]	Switch-on threshold with respect to the selected process variable (value specified in physical units: mA, V (0…20 mA / 0…10 V)) see parameter 62/65 relay function: 54
167 / 173	**Limit value analog input 3:** Switch-**on** threshold (relay 1 / relay 2)
0…10000 [0]	Switch-on threshold with respect to the selected process variable (value specified in physical units: mA, V (0…20 mA / 0…10 V)) see parameter 62/65 relay function: 55
168 / 174	**Limit value analog input 3:** Switch-**off** threshold (relay 1 / relay 2)
0…10000 [0]	Switch-on threshold with respect to the selected process variable (value specified in physical units: mA, V (0…20 mA / 0…10 V)) see parameter 62/65 relay function: 55
169 / 175	**Limit value analog input 4:** Switch-**on** threshold (relay 1 / relay 2)
0…10000 [0]	Switch-on threshold with respect to the selected process variable (value specified in physical units: mA, V (0…20 mA / 0…10 V)) see parameter 62/65 relay function: 56
170 / 176	**Limit value analog input 4:** Switch-**off** threshold (relay 1 / relay 2)
0…10000 [0]	Switch-on threshold with respect to the selected process variable (value specified in physical units: mA, V (0…20 mA / 0…10 V)) see parameter 62/65 relay function: 56
177	**Pressure/vacuum mode**
0;1 [0]	Selection of the pressure or vacuum side: 0 = pressure; 1 = vacuum

Parameter	Setting value / Description / Note
178	**Minimum pressure**
0…1000 mbar [0]	– (potentiometer all the way to the left) in sensorless regulation operating mode
179	**Maximum pressure**
0…1000 mbar [-]	– (potentiometer all the way to the right) in sensorless regulation operating mode
180 / 181 **182**	**Pressure-temperature curve** (K0 / K1 / K2)
-1000… 1000 W/Hz [-]	Temperature limit
183 / 184 **185**	**Vacuum temperature curve** (K0 / K1 / K2)
-1000… 1000 W/Hz [-]	Temperature limit
186	**Maximum time for exceeding the temperature limit**
0…32767 s [30]	
187 / 188 **189 / 190** **191 / 192**	**Values for the pressure curves** (K1 / K2 / K3 / K4 / K5 / K6)
[-]	For operation mode internal regulation in pressure mode
193 / 194 **195 / 196** **197 / 198**	**Values for the vacuum curves** (K1 / K2 / K3 / K4 / K5 / K6)
[-]	For operation mode internal regulation in vacuum mode
1011 **1012** **1013** **1014**	**Error group 1** **Error group 2** **Error group 3** **Error group 4**
0...32768	see Chapter 6.1 (error messages)

6 Troubleshooting

Any malfunction causes the frequency converter to be switched off and thereby shuts down the entire device.
The error message can be acknowledged only when the error no longer exists!
The following possibilities exist to reset an error message (acknowledge):

1) By switching the power supply off and on again
2) By an appropriately programmed digital input

3) By an acknowledgement via the RS485 interface or the field bus module
4) By automatic acknowledgement (parameter 54+109)
5) By a button

6.1 Table of possible error messages

The error code can now be found using the KombiTool.

	Code	No.	Error name	Error description	Possible cause/ remedy
Error group 1	1	1	Undervoltage 24 V Application	Supply voltage of application less than 19 V	Overload of the 24 V supply
	2	2	Overvoltage 24 V Application	Supply voltage of application greater than 31 V	Internal 24 V supply not OK or external supply not OK
	128	8	Communication Application<>power	The internal communication between the application and power board is not OK	EMC disturbances
	512	10	Parameter distributor	The internal distribution of parameters failed during initialisation	Parameter set not complete
	1024	11	System error	Controller electronics is supplied by ext. 24 V Power supply is not supplied with mains voltage	Switch on mains voltage, switch off 24 V
	4096	13	Cable break Analog In 1 (2–10 V)	Current or voltage smaller than the lower limit of analog input 1	Cable break, defective external sensor
	8192	14	Cable break Analog In 2 (2–10 V)	Current or voltage smaller than the lower limit of analog input 2	Cable break, defective external sensor
	16384	15	Blockage	Motor blocked	Mechanical defect or overload
	32768	16	Alarm 1	Customer-specific error via function of digital inputs	Depends on application
Error group 2	1	17	Alarm 2	Customer-specific error via function of digital inputs	Depends on application
	16	21	Bus timeout	Setpoint value specification via bus no retriggering of bus timeout	Interruption of the bus line
	31	22	Max. auto acknowl-edgement	The maximum number of automatic acknowledgements has been exceeded	
	64	23	External error 1	External errors can be generated via digital inputs	
	128	24	External error 2	External errors can be generated via digital inputs	

	Code	No.	Error name	Error description	Possible cause/ remedy
Error group 3	1	32	Trip IGBT	Protection of the IGBT module from overcurrent triggered	Short circuit in the motor or motor feeder/control-ler settings
	2	33	Overvoltage link	The maximum link voltage has been exceeded	Return supply through motor in generator operation/mains voltage too high
	4	34	Undervoltage link	Voltage has dropped below the minimum link voltage	Mains voltage too low
	8	35	Overtemperature motor	Motor PTC has been tripped	Motor overload (e.g. torque high at low speed) / ambient tem-perature too high
	16	36	Mains interruption		A phase is missing / mains voltage inter-rupted
	64	38	IGBT module overtemperature	IGBT module overtemperature	Cooling not sufficient, small speed and high torque, cycle frequency too high
	132	39	Overcurrent	Maximum output current of converter exceeded	
	256	40	FC overtemperature	Inner temperature too high	Cooling not sufficient, small speed and high torque, cycle frequency too high
	1024	42	I^2T motor protection shutdown	The internal I2T motor protection (configurable) tripped	Continuous overload
	2048	43	Earth fault	Earth fault of a motor phase	Insulation fault
	8192	45	Motor connection interrupted	No motor current despite activation by FC	No motor connected
	16384	46	Motor parameters	Plausibility check of motor parameters failed	Parameter set not OK
	32768	47	Drive controller parameters	Plausibility check of drive controller parameters failed	Parameter set not OK
Error group 4	1	48	No valid motor type plate data		Motor type plate data not yet entered (delivery condition)
	2	49	Overload		

7 Technical specifications

7.1 General data

Function	Specification
Recommended motor nominal power [kW] / 4-pole standard motor	7.5
Ambient temperature for nominal power [°C]	-10 to +50
Mains voltage [V]	3 AC 400 V~ -15% … 480 +10%, 50/60 Hz
Rated current, eff. [A] [IN at 8 kHz/400 V]	17,8
Maximal current eff.	150% of the rated current for 60 sec
Switching frequency of the power stage [kHz]	4, 8, 16, (default setting 8)
Rotating field frequency [Hz]	0–400
Protective function	Undervoltage, overvoltage, I^2 t limit, short circuit, motor temperature, converter temperature, tilt protection
Dimensions [L x W x H in mm]	307x233x181
Weight including adapter plate [kg]	8.7
Type of protection [IPxy] according to DIN EN 60529	55
EMC certificates according to DIN EN 61800-3; VDE 0160-103:2005-07	C2

7.2 Interface specifications

Name	Function
Digital inputs 1-4	- Switching level Low < 5V / High > 15V - Imax (at 24 V) = 3mA - Rin = 8.6kΩ
Analog inputs 1, 2, 3, 4	- 0–10 V - 2–10 V - 0–20 mA - 4–20 mA
Relay 1, 2	1 changeover contact (NO/NC) Maximum switching power: - for resistive load (cos φ = 1): 5 A at ~230 V or = 30 V - for inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A at ~ 230 V or = 30 V Maximum response time: 7 ms ±0.5 ms Electrical life time: 100 000 switching cycles

Analog output 1 (current)	Short-circuit proof - I out = 0…20 mA - Load = 500Ω
Analog output 1 (voltage)	- Short-circuit proof - Uout = 0…10 V - Imax = 10 mA
Voltage supply 24 V	- Auxiliary voltage U = 24 V DC - Short-circuit proof - Imax = 100 mA - External supply of 24 V possible
Voltage supply 10 V	- Auxiliary voltage U = 10 V DC - Short-circuit proof - Imax = 30 mA

8 EMC limit value classes

NOTE:	Please note that the EMC limit value classes are only achieved if the standard switching frequency (cycle frequency) of 8 kHz is maintained. For wall mounting the length of the (large surface on both sides) shielded motor cable (max. 3 m) must not exceed the permissible limits! For EMC-compliant wiring, on both sides (drive-controller and motor side) EMC screws must also be used.

8.1 Classification according to IEC/EN 61800-3

Interference transmission: C2

Interference resistance: second environment

Warning:	In a residential environment, this product can cause high-frequency interferences, in which case the user may be required to take suitable measures.

For every environment of the driver controller category, the basic technical standards define the testing procedure and values that must be complied with.

Definition of environment

First environment (residential, commercial and industrial area):

All "areas" that are directly supplied via a public low-voltage connection, such as:

- Residential area, such as houses, condominiums, etc.
- Retail, such as shops, supermarkets
- Public facilities, such as theatres, train stations
- Outdoor areas, such as filling stations and parking lots
- Light industry, such as workshops, laboratories, small businesses

Second environment (industry):

Industrial environment with its own supply network, which is separated from the public low-voltage network by a transformer.

8.2 Standards and directives

The following apply in particular:

- Directive on electromagnetic compatibility
  (Directive 2004/108/EC of the Council EN 61800-3:2004)
- Low voltage directive
  (Directive 2006/95/EC of the Council EN 61800-5-1:2003)
- Product standards list

9 Maintenance and service notes

VAU7.5/3 frequency converters are maintenance-free under normal operating conditions. Please observe the "General data" in chapter 7.1.

If the frequency converter is operated where the air is dusty, the cooling surfaces should be cleaned regularly with blast air. If air intake filters are installed in the switch cabinet, then they too need to be cleaned or replaced regularly.

In case of repairs, please contact the local sales office:

If a frequency converter is sent in for repairs, then no guarantee can be given for any attached parts such as the power cable, potentiometer, external displays and so forth.

Please remove all non-original parts from the frequency converter.

Furthermore all ducts porting cooling water need to be drained (blow out with blast air).

10 KombiTool

The KombiTool is the configuration and diagnostic software for the frequency converters approved by Gebr. Becker.

The communication between the computer and a frequency converter must be performed using a suitable interface converter.

The KombiTool is not part of the scope of delivery but can be ordered separately if necessary. For additional information, please contact the local sales office.