



# Smart connections.

## Operating manual

**VERTIMO Drive Controller** 

#### Legal notice

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#### General note on gender equality

KOSTAL is aware of how language impacts on gender equality and always make an effort to reflect this in documentation. Nevertheless, for the sake of readability we are unable to use non-gender-specific terms throughout and use the masculine form instead.

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#### **Target group**

These operating instructions should be used in conjunction with the quick setup guide provided with the product. They provide additional information about advanced product applications and uses. The reader should be familiar with the content of the quick setup guide and in particular should follow all the warnings and assembly guidelines it contains.

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#### Declaration of conformity

KOSTAL Industrie Elektrik GmbH herewith declares that the VERTIMO product range conforms to the relevant safety regulations of the Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU and was developed and manufactured in accordance with the following harmonised FU standards:

EN 61800-5-1: 2007	Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy.
EN 61800-3: 2004 / A1:2012	Adjustable speed electrical power drive systems. EMC requirements and specific test methods
EN 55011: 2007	Limits and methods of measurement for determining electromagnetic emissions (EMC) from industrial, scientific and medical (ISM) equipment
EN60529: 1992	Specifications for protection classes provided by housings

#### Electromagnetic compatibility

All VERTIMO systems have been developed taking into account the strictest EMC guidelines. All versions, that are intended for operation with single-phase 230 V or three-phase 400 V supplies and for use within the European Union, are fitted with an internal EMC filter. This EMC filter is designed to reduce the emissions fed back into the power supply by the cabling in order to meet harmonised EU standards. The installer must ensure that the equipment/system in which the product is integrated, complies with the EMC standards of the country in question and/or the relevant category. In the European Union, devices in which this product is fitted must comply with the EMC Directive 2014/30/EU. These operating instructions should ensure implementation of the applicable standards.

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The manufacturer is not liable for damage incurred during or as a result of transport, receipt, installation or commissioning of the device. There are also no grounds for liability in the case of damage and consequences resulting from improper, negligent or incorrect installation or setting of operating parameters on the drive controller, incorrect installation, unacceptable accumulations of dust, dampness, corrosive substances, excessive vibrations/jolting or ambient temperatures beyond those stated in the design specification.

The distributor responsible for the region may offer differing terms and conditions if he deems this appropriate and is the first point of contact for all matters relating to warranty.

#### These operating instructions contain the original instructions. All non-German versions are translations of these original instructions.

At the time these instructions went to print, all contents were correct. In the interest of striving for continual improvement, the manufacturer reserves the right to change product specifications, ratings or the content of these operating instructions without notice.

#### These operating instructions apply to firmware version 3.07.

KOSTAL Industrie Elektrik GmbH pursues a policy of continuous improvement, and while every effort is taken to provide precise and up-to-date details, the information in these operating instructions only serves as a guide and does not form part of any contract.



These instructions provide guidance for correct installation. KOSTAL Industrie Elektrik GmbH assumes no responsibility for compliance with or failure to observe the applicable national or regional regulations for correctly installing this drive controller or the associated equipment. Failure to observe these regulations may result in injury or damage to property.



ten (10) minutes until the capacitors have discharged to a safe voltage level. Failure to comply with this cautionary measure may result in severe injuries or even death. This equipment may only be installed, adjusted and maintained by qualified specialist personnel who are familiar with the design, how to operate the equipment and the associated risks. Before continuing, carefully read these instructions and

all other relevant manuals. Failure to comply with this cautionary measure may result in severe injuries or even death.

## 1 Safety notices

### 1.1 Important safety information

Carefully read and observe the following IMPORTANT SAFETY INFORMATION and all warnings and notices provided elsewhere in these instructions.



#### Danger: Indicates the risk of electric shock, which may result in damage to the equipment, injuries or even death if appropriate preventative actions are not taken.

This drive controller (VERTIMO) is intended for integration in complete equipment or systems as part of a permanent installation. If improperly installed, the device may represent a safety risk. The VERTIMO drive controller uses high electrical voltages and currents, carries a large amount of stored electrical energy and is used to control and regulate machines and systems, the design of which means that they may cause injuries. Particular attention must be made to electrical installation and system design so that risks can be avoided both during normal operation and in the event of a malfunction. This product may only be installed and maintained by qualified electricians.

System design, installation and commissioning may only be carried out by people suited to do so on the basis of their knowledge and practical experience. This safety information and the information in these instructions should be read carefully and all information observed with regard to transport, storage and use of the VERTIMO drive controller, including the environmental limitations stated.

Do not perform dielectric strength tests or withstand voltage tests on the VERTIMO drive controller. The device should be disconnected from the power supply before any electrical measurements are taken.

Risk of electric shock! Ensure that the VERTIMO drive controller is VOLTAGE-FREE before starting any work.

The terminals and internal components of the device are still subject to high voltage up to 10 minutes after disconnecting from the grid. Before starting any work, use a multimeter to check whether all feed-in terminals are voltage-free.

If the drive controller is connected to the grid via plug connectors, at least 10 minutes must pass after the grid is shut down before making the connection.

Ensure correct earthing. The earthing cable must be designed for the maximum grid residual current, which is normally limited by fuses or motor protection switches. Sufficiently rated fuses or line circuit breakers must be fitted in the grid supply to the drive controller. These ratings must satisfy local legislation and regulations.

Check the cable connections and correct earthing in accordance with local specifications or recommendations. The drive controller's leakage current may be 3.5 mA or higher; therefore, the earthing cable must be designed for the maximum grid residual current, which is normally limited by fuses or motor protection switches. Sufficiently rated fuses or line circuit breakers must be fitted in the grid supply to the drive controller. These ratings must satisfy local legislation and regulations.

Do not work on control lines while the drive controller or external control lines are energised.



Danger: Indicates a potential (non-electrical) dangerous situation, which may result in damage to property if appropriate preventative actions are not taken.

Within the European Union, all machinery in which this product is used must comply with the Machinery Directive 2006/42/EC. The machine manufacturer in particular is responsible for providing a main grid switch and ensuring that the electrical system complies with the EN60204-1 standard.

The level of integrity provided by the control input functions of the VERTIMO drive controller, such as stop/start, forwards/backwards and maximum speed, are not sufficient for use in safety-critical applications without independent protection channels. All applications in which a malfunction may result in injury or death must undergo a risk assessment and additional measures may have to be put into place as a result.

If the enable signal is active, the driven motor may start when the power supply is switched on.

The STOP function will not eliminate potentially lethal high voltage. Ensure that the drive controller is VOLTAGE-FREE and wait 10 minutes before undertaking any work on it. Never undertake any work on the drive controller, motor or motor cables while input current is still present.

The VERTIMO drive controller can be programmed so that the driven motor is operated at a speed above or below the value reached when the motor is connected directly to the grid supply. Obtain confirmation from the manufacturer of the motor and driven machine of suitability for operation above the intended speed range before starting up the machine.

Avoid activating the automatic error reset function for systems if this may result in a potentially dangerous situation.

VERTIMO drive controllers are only designed for use indoors.

When installing the drive controller ensure that sufficient cooling is provided. Once the drive controller is in its installation position, do not undertake any drilling because drilling dust and shavings may cause damage.

Prevent the ingress of conductive or flammable foreign particles. Combustible materials must not be stored in the vicinity of the drive controller.

The relative humidity must not exceed 95% (non-condensing).

Supply voltage and frequency and the number of phases (1 or 3) must correspond to the factory settings of the VERTIMO drive controller.

Never connect the main power supply to the U, V or W output terminals.

Do not install any automatic switching devices between drive controller and motor.

If there are control lines in the vicinity of power cables, they must be kept at least 100 mm apart. The lines and cables should also cross at an angle of 90°. All terminals must be tightened to the specified torque.

Never undertake repairs on the VERTIMO drive controller. If you suspect errors or faults, contact your regional KOSTAL Industrie Elektrik sales partner for assistance.

## 2 General information and ratings

### 2.1 Drive controller article numbers

Each drive controller can be identified by its article number. This number can be found on the delivery label and type plate. Please always quote the article numbers when placing orders.

200 – 240 V + / - 10%	1-phase inpu	t - 3-phase ou	ıtput		
Size	kW	HP	А	Article code	Article no.
A	0.37	0.5	2.3	VERA2100037F-SAMC661	10346126
А	0.37	0.5	2.3	VERA2100037FAMC661	10346127
А	0.75	1	4.3	VERA2100075F-SAMC661	10346130
A	0.75	1	4.3	VERA2100075FAMC661	10346131
A	1.5	2	7	VERA2100150F-SAMC661	10346134
A	1.5	2	7	VERA2100150FAMC661	10346135
В	1.5	2	7	VERB2100150FBSAMC661	10346195
В	1.5	2	7	VERB2100150FB-AMC661	10346196
В	2.2	3	10.5	VERB2100220FBSAMC661	10346199
В	2.2	3	10.5	VERB2100220FB-AMC661	10346200
380 – 480 V + / - 10%	3-phase inpu	t - 3-phase ou	ıtput		
Size	kW	HP	А	Article code	Article no.
А	0.75	1	2.2	VERA4300075F-SAMC661	10346151
А	0.75	1	2.2	VERA4300075FAMC661	10346188
А	1.5	2	4.1	VERA4300150F-SAMC661	10346191
А	1.5	2	4.1	VERA4300150FAMC661	10346192
В	1.5	2	4.1	VERB4300150FBSAMC661	10346203
В	1.5	2	4.1	VERB4300150FB-AMC661	10346204
В	2.2	3	5.8	VERB4300220FBSAMC661	10346207
В	2.2	3	5.8	VERB4300220FB-AMC661	10346208
В	4	5	9.5	VERB4300400FBSAMC661	10346211
В	4	5	9.5	VERB4300400FB-AMC661	10346212
С	5.5	7.5	14	VERC4300550FBSAMC661	10346215
С	5.5	7.5	14	VERC4300550FB-AMC661	10346216
С	7.5	10	18	VERC4300750FBSAMC661	10346219
С	7.5	10	18	VERC4300750FB-AMC661	10346220
С	11	15	24	VERC4301100FBSAMC661	10346223
С	11	15	24	VERC4301100FB-AMC661	10346224
D	15	20	30	VERD4301500FBSAMC661	10346225
D	15	20	30	VERD4301500FB-AMC661	10346226
D	18.5	25	39	VERD4301850FBSAMC661	10346227
D	18.5	25	39	VERD4301850FB-AMC661	10346228
D	22	30	46	VERD4302200FBSAMC661	10346229
D	22	30	46	VERD4302200FB-AMC661	10346230

### 2.2 Converter identification using the article code

The article code (see below) describes all information on the converter and options installed in the factory.

VERTIMO											
VER											
	Baugröße	/Size									
	A	Baugröße A	Size A								
	В	Baugröße B	Size B								
		Baugröße D	Size C Size D								
		Badgrobe B	OIZC D								
		Eingangsspa	annung / Inpu	ut voltage							
		21	230 V 1 AC								
		43	400 V 3 AC								
			Motorennen	nleistung / R	lated motor	power					
			00037	0.37 kW	Code/100	= power i	in kW				
			00075	0.75 KW	Code/100	= power i	in kW				
			00220	2.2 kW	Code/100	= power i	in kW				
			00400	4.0 kW	Code/100	= power i	in kW				
			00550	5.5 kW	Code/100	= power i	in kW				
			00750	7.5 kW	Code/100	= power i	in kW				
			01500	15.0 kW	Code/100	= power i	in kW				
			01850	18.5 kW	Code/100	= power i	in kW				
			02200	22.0 kW	Code/100	= power i	in kW				
				EMV-Filter	/ EMC filter						
				-	ohne	without	or				
					EIVIV-FIILEI		er				
					Bremscho	pper / Bra	ake choppe	er			
					-	ohne		without			
					В	Bremsch	opper	Brake ch	opper		
						Bediene	lemente / (	Control e	lements		
						-	ohne	without			
						s	Schalter	Switch			
							Anzeigee	lomonto	/ Display		
							Δ	Anzeige	Display		
								, anzoigo	Diopidy		
								Feldbus	systeme /	Fieldbus syst	tems
								МС	Modbus F	RTU + CANop	en
									Schutzar	t / Protection	class
									66	IP66	
										Generation	
										_1	1st generation
VER	A	21	00037	F	В	S	A	МС	66	1	

7

## 3 Mechanical installation

#### 3.1 General

- The VERTIMO drive controller must be installed vertically on a level, flame-resistant and vibration-free installation surface using the integrated mounting holes or a DIN standard clamping plate (sizes A and B only).
- Never store combustible materials in the vicinity of the drive controller.
- Ensure that the cooling air gaps described in Sections 3.3 and 3.4 remain free at all times.
- The ambient temperature of the VERTIMO must not exceed the limit values stated in Section 10.1.
- Ensure appropriate, clean cooling air, which is free from humidity and impurities.

## 3.2 UL-compliant installation

Information about UL-compliant installations can be found in Section 10.4 on page 40.

### 3.3 Mechanical dimensions



Size	ļ	4	E	3	ĺ.	)	E			-	0	ì	ŀ					J	W	eight
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
Α	232.0	9.13	207.0	8.15	189.0	7.44	25.0	0.98	162.0	6.37	161.0	6.34	148.5	5.85	4.0	0.16	8.0	0.31	2.5	5.5
В	257.0	10.12	220.0	8.67	200.0	7.87	28.5	1.12	182.0	7.316	188.0	7.40	176.0	6.93	4.2	0.17	8.5	0.33	3.5	7.7
С	310.0	12.20	276.5	10.89	251.5	9.90	33.4	1.31	238.0	9.37	211.0	8.30	197.5	7.78	4.2	0.17	8.5	0.33	7.0	15.4
D	360.0	14.17	322.0	12.67	300.0	11.08	33.4	1.31	275.0	10.82	240.0	9.44	226.0	8.89	4.2	0.17	8.5	0.33	9.5	20.9

Mountir	ng bolts		Torques	
Sizes		Sizes	Check terminals	Power connections
All sizes	4 x M4 (#8)	1, 2, 3	0.8 Nm (7 lb-in)	1.5 Nm (13 lb-in)
		4	0.8 Nm (7 lb-in)	4.1 Nm (36 lb-in)

#### **Guidelines for installation** 3.4

- Before installation ensure that the installation site selected • satisfies the ambient conditions for the drive controller stated in Section 10.1
- The drive controller should be installed vertically on a level . surface.
- The minimum installation spacing stated in the table below must be observed.
- The installation site and means of attachment should be suited to the weight of the drive controller.
- Mark the drill holes using either the drive controller as a template or the dimensions provided above.
- To comply with the protective class, the corresponding cable glands must be used. The recesses for power and motor cables are already integrated in the housing. You will find the recommended cable gland sizes above. Recesses for control cables can be drilled as needed.
- The mounting location should be free from vibration.
- Do not mount the drive in any area with excessive humidity, corrosive airborne chemicals or potentially dangerous dust particles. •
- Avoid mounting close to high heat sources.
- The drive must not be mounted in direct sunlight. If necessary, install a suitable shade cover.
- The mounting location must be free from frost.
- Do not restrict the flow of air through the drive heatsink. The drive generates heat which must be naturally allowed to dissipate. Correct air clearance around the drive must be observed.
- If the location is subject to wide ambient temperature and air pressure variation, install a suitable pressure compensation valve in the drive gland plate.

#### Note:

If the drive has been in storage for a period longer than 2 years, the DC link capacitors must be reformed.

Drive	X top & bottom		Y both sides			Drive	Cable gland size				
size	mm	in	mm	in		size	Power cable	Motor cable	Control cable		
А	200	7.87	10	0.39		А	M20 (PG13.5)	M20 (PG13.5)	M20 (PG13.5)		
В	200	7.87	10	0.39		В	M25 (PG21)	M25 (PG21)	M20 (PG13.5)		
С	200	7.87	10	0.39		С	M25 (PG21)	M25 (PG21)	M20 (PG13.5)		
D	200	7.87	10	0.39		D	M32 (PG29)	M32 (PG29)	M20 (PG13.5)		
Note											

Above are guidelines only and the operating ambient temperature of the drive MUST be maintained within the limits shown in section 10.1 Environmental at all times.

The typical thermal loss of the drive controller is 3% of the operating load conditions.

The dimensions stated above are simply guidelines.

The ambient temperature of the drive controller MUST always be within the stated range.



## 3.5 Gland plate and lock off

The use of a suitable gland system is required to maintain the appropriate IP / Nema rating.

The gland plate has pre moulded cable entry holes for power and motor connections suitable for use with glands as shown in the following table. Where additional holes are required, these can be drilled to suitable size. Please take care when drilling to avoid leaving any particles within the product.

#### Cable Gland recommended hole sizes & types:

	Power & Motor Cables					
Drive Size	Hole size	Metric cable gland	PG cable gland			
A	22	M20	PG13.5			
B & C	29	M25	PG21			
D	40	M40	PG29			

- UL-compliant protection ("type") is only given if the cables are installed using a UL-recognised gland bush or inlet fitting for a flexible conduit system that satisfies the required degree of protection.
- In the case of electrical installation conduit systems, all glands must have the values specified by NEC.
- Not intended for installation with rigid cable conduit systems.

#### Grid disconnector lock

In models with a switch, the grid disconnector can be locked in the "Off" position with the aid of a standard 20 mm padlock (padlock not part of the scope of delivery).



## 3.6 Removing the terminal cover

To access the terminals, the front cover of the drive controller must be removed as shown.

 Image: Performance of the product permits access to the terminals, as shown below.

 Image: Performance of the product permits access to the terminals, as shown below.

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 Image: Performance of the performance of terminals, as shown below.

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### 3.7 Routine maintenance

The drive controller should be integrated into the routine maintenance schedule to ensure optimum operating conditions at all times. This includes:

- The ambient temperature must be equal to or less than the value stated in the "Ambient conditions" Section (insert link).
- The cooling element's fans turn with ease and are free of dust.
- The Enclosure in which the drive is installed should be free from dust and condensation; furthermore ventilation fans and air filters should be checked for correct air flow.

All electrical connections should also be checked to ensure that all screwed terminals are connected tightly and that the supply lines are not displaying signs of heat damage.

#### Power supply & control cables 4

#### 4.1 **Terminal compartment wiring**

#### 4.1.1 Connection points for size A

#### Single-phase supply



Connection points for sizes A, B, C and D 4.1.2

Single-phase supply

10101 . EMC 0 (0 0 0

Three-phase supply



Three-phase supply 10101 P Α D EMC 0 13 0  $\cap$ 0 0 0 000

- Incoming Power Connections see section 4.4. Incoming Power Connection for more information. Α -
- Motor Connections see section 4.5. Motor Connection for more information. В -
- Control Terminal Connections see section 4.10. Control Terminal Connections for more information. С -
- Brake Resistor see section 4.13. Optional Brake Resistor for more information. D -



### 4.2 Circuit diagram

#### 4.2.1 IP66 (Nema 4X) without switch (option)



#### 4.2.2 IP66 (Nema 4X) with switch (option)



	Code	Section	Page
А	Protective conductor connection	4.3	12
В	Input power supply	4.4	14
С	Selecting fuses/circuit breakers	4.4.2	14
D	Optional input coil	4.4.3	15
E	EMC-compliant installation	4.12	18
F	Internal disconnect / isolator	3.5	14
G	Optional brake resistor	4.13	18
Н	Motorconnection	4.5	15
	Analogue output	4.10.1	17
J	Relay output	4.10.2	17
K	Use of the REV/0/FWD selector switch (switched version only)	4.8	16
L	Analogue inputs	4.10.3	17
М	Digital inputs	4.10.4	17

## 4.3 Protective conductor connection (PE)

#### Earthing guidelines

The earthing terminal of each VERTIMO drive controller must be individually and DIRECTLY connected to the earthing bus (via the filter, if installed). In this setup, the earthing connectors of the drive controller must not be looped from one drive controller to another or to or from another device. The earth loop impedance must comply with the relevant regional safety regulations. For compliance with the UL regulations, UL-compliant ring cable lugs must be used for all earth connections.

The drive controller's earthing must be connected with the system earthing. The earthing impedance must meet the requirements of national and local safety guidelines and/or the industry's electrical codes. The integrity of all earth connections should be checked on a regular basis.

#### Protective conductor

The cross-section of the potential equalisation line must be sized for the grid connection line.

#### Safety earthing

This is the safety earthing required for the drive controller according to the code. One of these points must be connected with steel on an adjacent building (bar, beam), an earth spike in the ground or a busbar. The earthing points must meet the requirements of national and local safety guidelines and/or the industry's electrical codes.

#### Motor earthing

The motor mass must be connected to the drive controller's earthing terminals.

#### Earth fault monitoring

All drive controllers may cause a leakage current to earth. VERTIMO drive controllers were developed for the smallest possible leakage current in accordance with international standards. The current level depends on the length and type of motor cable, the effective clocking frequency, the earthing connections used and the radio interference filter (RIF) installed. If using a residual current circuit breaker, the following conditions apply:

- Use a type B device
- The device must be suitable for protecting equipment with a proportion of DC in the leakage current
- One residual current circuit breaker should be used for each VERTIMO drive controller

#### Cable shielding (connection)

The terminal for the safety earthing provides an earthing point for the motor's cable shielding. The motor's cable shielding, which is connected to this terminal (drive side), should also be connected with the motor frame (motor side). Use a shield connection terminal or EMI terminal to connect the shielding with the protective conductor connection.

### 4.4 Input power supply

#### 4.4.1 Cable selection

- For a single-phase supply, the power supply should be connected to terminals L1/L and L2/N.
- For a three-phase supply, the power supply should be connected to terminals L1, L2 and L3. The phase sequence is irrelevant.
- For the purpose of compliance with CE and EMC specifications, see Section 4.12 EMC-compliant installation on page 18.
- IEC61800-5-1 stipulates a fixed installation with a suitable disconnecting device installed between the VERTIMO
  and the AC power source. This must comply with the local safety standards (e.g. in Europe the Machinery Directive EN60204-1).
- All cables should be rated in line with local regulations. Guidelines concerning dimensioning are provided in Section 10.2.

#### 4.4.2 Selecting fuses/circuit breakers

- In order to protect the cabling of the input current cable, fuses should be installed in accordance with the data provided in Section 10.2 Rated output table. All fuses should be rated in line with local regulations. Type gG (IEC 60269) or UL type J fuses are generally sufficient, but type aR may also be needed in some cases. The fuses must respond in less than 0.5 seconds.
- Where permitted by local guidelines, B characteristics line circuit breakers with equivalent values can be used instead of fuses provided that the switching capabilities are sufficient for the installation.
- The maximum permissible short-circuit current of the VERTIMO supply voltage terminals according to IEC60439-1 is 100 kA.

#### 4.4.3 Optional input coil

- An optional input coil should be installed in the supply cable for drive controllers in the following conditions:
  - o The input grid impedance is low or the residual/short-circuit current is high
  - The grid has drops in voltage
  - $\circ$   $\,$  The grid has phase asymmetry (3-phase drive controllers)
  - The drive controller is supplied with power via a busbar/brush drive system (as for gantry cranes).
- For all other installations, an input coil is recommended to protect the drive controller from faults in the power supply.

### 4.5 Motor connection

- Unlike operating directly via the power grid, drive controllers produce rapidly switching output voltages (PWM) on the motor. No further preventative measures are needed for motors developed for operation with variable-speed drives. However, if the quality of the insulation is not known, the motor manufacturer should be contacted as preventative measures may be required.
- The motor should be connected to terminals U, V and W on the VERTIMO drive controller using a suitable three- or four-wire cable. If using a two-wire cable where the shielding is acting as the earth wire, this must have at least the same cross-section as the phase wire if made from the same material. If using a four-wire cable, the earth wire must have at least the cross-section of the phase wire and be made from the same material.
- The motor mass must be connected to the drive controller's earthing terminals.
- Maximum permitted motor cable length for all models: 100 metres if shielded or 150 metres if not shielded.
- Where multiple motors are connected to a single drive using parallel cables, an output choke must be installed.

### 4.6 Motor terminal box connection

Do not install any mechanical or electro-mechanical switching devices between the drive and motor. Where a local isolator is installed close to the motor, this should be interlocked with the drive control circuit to ensure the drive is disabled when the motor is isolated.

Most all-purpose motors are coiled for operation with a dual voltage supply. Details on this can be found on the type plate of the motor. A STAR or DELTA configuration is usually selected for the operating voltage during installation of the motor. The STAR variant always provides the higher voltage value of the two.

Supply voltage	Voltage according to type plate		Connection		
230	230 / 400	Dolta			
400	400 / 690	Deita			
400	230 / 400	Star			

### 4.7 Control terminal connection

All analogue signal cables should be shielded. We would therefore recommend twisted-pair conductors.

- Where possible, all power and control cables are to be routed separately and never in parallel.
- The same cable should not be used for the signal level of different voltages, e.g. 24 V DC and 110 V AC.
- The maximum torque for control terminals is 0.5 Nm.
- Diameter for cable inlet of control line:  $0.05 2.5 \text{ mm}^2 / 30 12 \text{ AWG}.$

### 4.8 Use of the REV/0/FWD selector switch (switched version only)

By adapting the parameter settings, the VERTIMO can be configured for various applications and not just forwards or reverse running. This could usually be the case for manual/off/auto applications (also known as local/remote control) for the HVAC and pump industry.

The integrated switch operates in parallel with drive terminal 2 (T2) and terminal 3 (T3) as digital input 1 and digital input 2. By default, the integrated switch is enabled.

If required, the built in control switch may be disabled using the following method:

- 1) Set correct value in P-14 to enable advanced parameter access, e.g. 201
- 2) Go to "P-00" and make sure drive is in stop condition (not running, not tripped).
- 3) Press and hold "STOP" button for about 1s, drive will show "Lc-OFF" or "Lc-On" message.
- 4) Use "UP" or "DOWN" key to select the option: "Lc-OFF" means integrated switches are enabled. "Lc-On" means the switches are locked/disabled.
- 5) Press the "STOP" button again to exit.



	Switch position		Parame	eters to set	Comments
	ownen position		P-12	P-15	ooniniteittä
Reverse running	STOP	Forwards running	0	0	Default factory configuration Forwards or reverse running with speed control by local POT
STOP	STOP	Forwards running	0	5.7	Forwards running with speed control by local POT Reverse running deactivated
Preset speed 1	STOP	Forwards running	0	1	Forwards running with speed control by local POT Preset speed 1 provides a speed set in P-20 with "vibration"
Reverse running	STOP	Forwards running	0	6.8	Forwards or reverse running with speed control by local POT
Auto operation	STOP	Manual operation	0	4	Manual operation - speed control by local POT Auto operation 0 - speed control by means of analogue input 2, e.g. via PLC with a 4-20 mA signal.
Operation with speed control	STOP	Operation with PI control	5	1	With speed control, the speed is regulated by local POT With PI control, the local POT regulates the PI target value
Operation with preset speed control	STOP	Operation with PI control	5	0, 2, 4, 5, 812	With preset speed control, the preset speed is defined in P- 20 With PI control, the PI target value can be regulated via POT (P-44=1)
Manual operation	STOP	Auto operation	3	6	Manual operation - speed controlled by local POT Auto – speed value comes from Modbus
Manual operation	STOP	Auto operation	3	3	Manual operation - speed value comes from preset speed 1 (P-20) Auto - speed value comes from Modbus

NOTE

To be able to adjust the P-15 parameter, advanced menu access via P-14 must be set (default value is 101)

## 4.9 Using the internal Pot (Schalteroption)

On switched drives, the built in pot (indicated) may be used to directly control the signal level applied to analog input 1, and therefore the output frequency (motor speed). To select the built in pot as the signal source for analog input 1, set P-16 = 8 In-pot.



#### 4.10 Control terminal connections

Standard connections	Connection control	Signal	Description
	1	+24 V DC output	+24 V DC output, 100 mA. Do not connect an external voltage source to this terminal.
	2	Digital input 1	Positive logic "Logic 1": 8 V 30 V DC
	3	Digital input 2	"Logic 0": 0 V 4 V DC (see P-12, P-15)
	4	Digital input 3/ Analogue input 2	Digital: 8 to 30 V Analogue: 0 to 10 V, 0 to 20 mA or 4 to 20 mA (see P-12, P-15)
L S	5	+10 V output	+10 V, 5 mA, for external potentiometer (1 k $\Omega$ minimum)
	6	Analogue input 1/ Digital input 4	Analogue: 0 to 10 V, 0 to 20 mA or 4 to 20 mA Digital: 8 to 30 V (see P-12, P15, P-16)
	7	GND	Ground, internally connected to terminal 9
	8	Analogue output/ digital output	Analogue: 0 to 10 V, 20 mA maximum (see P-25) Digital: 0 to 24 V
	9	GND	Ground, internally connected to terminal 7
	10	NO relay	Contact 250 VAC, 6A / 30 VDC, 5A
	11	COM relay	intended for ohmic load

#### 4.10.1 Analogue output

The analogue output function can be configured using parameter P-25, which is described in Section 6.2 "Advanced parameters" on page 22. Depending on parameter selection, the output provides two operating modes.

- Analogue mode
  - Output is a 0 10 V DC signal, 20 mA max. load current
- Digital mode
  - o Output is a 24 V DC signal, 20 mA max. load current

#### 4.10.2 Relay output

The relay output function can be configured using parameter P-18, which is described in Section 6.2 "Advanced parameters" on page 22.

#### 4.10.3 Analogue inputs

There are two analogue inputs available, which can also be used as digital inputs if necessary. The signal formats are selected by means of parameters as follows

- Analogue input 1 format selection parameter P-16
- Analogue input 2 format selection parameter P-47

These parameters are described in detail in Section 6.2 "Advanced parameters" on page 22.

The function of the analogue input, e.g. for target speed value or PID actual value, is defined using the P-15 parameter. The function of this parameter and the options available are explained in Section 7.4 on page 32. The analogue and digital inputs macro functions can be found on page 29.

#### 4.10.4 Digital inputs

There are up to four digital inputs available. The function of the inputs is defined using the P12 and P-15 parameters, which are explained in Section 7.4 Macro configuration of the analogue and digital input on page 29.

## 4.11 Thermal motor overload protection

#### 4.11.1 Internal thermal overload protection

The drive controller has an internal function protecting against thermal motor overload; if the value exceeds 100% of the parameter defined in P-08 for a specific amount of time (e.g. 150% for 60 sec.), the drive controller is shut down in response to an error and the "I.t-trP" message is issued.

### 4.11.2 Motor PTC connection

If a motor PTC is used, the connection should be made as follows:

Control terminal strip	Additional information
	<ul> <li>Compatible thermistor: PTC type, 2.5 kΩ trip value</li> <li>The setting for P-15 must be selected such that the digital input 3 is defined as the external shutdown function, e.g. P-15 = 3. Further information can be found in Section 7.</li> <li>Set P-47 = "Ptc-th"</li> </ul>

Refer to section 7. Analog and Digital Input Macro Configurations for further information regarding configuration of the input functions.

## 4.12 EMC-compliant installation

Category	Supply cable type	Motor cable type	Control cable	Maximum permitted length for control cables
C16	Shielded <sup>1</sup>	Shielded <sup>1.5</sup>		1M / 5M <sup>7</sup>
C2	Shielded <sup>2</sup>	Shielded <sup>1, 5</sup>	Shielded⁴	5M / 25M <sup>7</sup>
C3	Unshielded <sup>3</sup>	Shielded <sup>2</sup>		25M / 100M <sup>7</sup>

<sup>1</sup> A shielded cable for a fixed installation with the main supply voltage used in that case. The minimum requirement is for braided or twisted shielded cables where the shielding covers at least 85% of the cable surface and which have a low HF signal impedance. Installation in an appropriate steel or copper pipe is also permitted.

<sup>2</sup> A suitable cable with a concentric protective conductor for a fixed installation with the main supply voltage used in that case. Installation in an appropriate steel or copper pipe is also permitted.

- <sup>3</sup> A suitable cable for a fixed installation with the respective main supply voltage. A shielded cable is not needed.
- <sup>4</sup> A shielded cable with low-resistance shielding. Twisted-pair cables are recommended for analogue signals.

<sup>5</sup>The cable shield should be connected to the motor using an EMC-compliant cable gland in order to create as large a connection as possible to the motor housing. To achieve this, connect the shielding of the motor cable to the drive controller's internal earthing terminal.

<sup>6</sup> Only the standard for conducted emissions of category C1 is met here. Additional measures may be needed to satisfy the standard for radiated emissions of category C1s. Please contact your dealer for further assistance.

<sup>7</sup> Reliable cable length with extra external EMC filter.

## 4.13 Optional brake resistor

VERTIMO drive controllers of size B and larger may have a brake transistor. An external resistance can then be connected to the drive controller in applications requiring more brake torque.

As shown, the brake transistor should be connected with the "+" and "BR" terminals, see circuit diagram 4.2

Setting parameter P.34 to > 0 activates the brake chopper function (optional), see Chapter 6

The voltage level at these terminals may exceed 800 VDC The drive controller may still be energised even after the main supply has been disconnected. Therefore, wait 10 minutes after switching off until the unit is fully discharged and only then connect to these terminals 4

Suitable resistors and tips on how to select them can be provided by your KOSTAL sales contact.



Thermal overload / brake resistor with internal overtemperature switch

It is highly recommended to equip the drive with a main contractor and provide and use an additional thermal overload protection for braking resistor.

The contractor should be wired so that it opens in case the resistor overheats, otherwise the drive will not be able to interrupt the main supply if the brake chopper remains closed (short-circuited) in a faulty situation.

It is also recommended to wire the thermal overload protection to a digital input of the drive as an External Trip.



The voltage level at these terminals may exceed 800 VDC.

Stored charge may be present after disconnecting the mains power.

Allow a minimum of 5 minutes discharge after power off before attempting any connection to these terminals.

## 5 Operation

### 5.1 Managing the keypad

The drive controller is configured and its operation monitored via the keypad and/or display.

$\bigcirc$	NAVIGATION	Used to display real-time data, access the parameter configuration and save changes	
$\square$	UP	Used to increase the speed in real-time mode and the parameter values in editing mode	
$\square$	DOWN	Used to decrease the speed in real-time mode and the parameter values in editing mode	
$\bigcirc$	RESET / STOP	For restarting after the drive controller is shut down in response to error. Used in keypad mode to stop the drive controller.	
	START	Used in keypad mode to start the drive controller or to reverse the direction of rotation (if bidirectional keyboard mode is activated).	

### 5.2 Display operation

5±0P	H 50.0	E.5 R	P 1.50	1500
Drive controller stopped/deactivated	Drive controller started / in operation, display shows the output frequency (Hz)	Press navigation key for less than 1 second. The display shows the motor current (A)	Press navigation key for less than 1 second. The display shows the motor rating (kW)	If P-10 > 0, press the navigation key for less than 1 second to display the motor speed (rpm)

### 5.3 Changing parameters



### 5.4 Making parameters read-only

StoP	P-00	P-01	P00-08	330	StoP
	$ \textcircled{\begin{tabular}{c} & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & $				
Press and hold navigation key for more than 2 seconds.	Select P-00 using the Up/Down key	Select the desired parameter for read access using the Up/Down key.	Select the desired parameter for read access using the Up/Down key.	Press navigation key for less than 1 second to display the value.	Press for more than 2 seconds to return to the operation display.

#### 5.5 Resetting parameters



#### 5.6 Resetting an error



## 5.7 LED display

The VERTIMO has an in-built 6-digit 7-segment LED display. The following methods are used to display certain warnings:



#### 5.7.1 Meaning of the LED

LED segments	Behaviour	Meaning
a, b, c, d, e, f	Flashing all together	Overload, motor output current exceeds P-08
a and f	Flashing alternately	Mains Loss (Incoming AC power has been removed)
а	Flashing	Fire Mode Active

## 6 Parameters

## 6.1 Default parameters

Par.	Descriptio	on and a second s		Minimum	Maximum	Default	Units
P-01	Maximum	frequency/speed		P-02	500.00	50.0 (60.0)	Hz/rpm
	Maximum	output frequency or maximum motor speed - Hz or	r rpm. If P-1	0 >0, the values a	re entered/dis	played in rpm	
P-02	Minimum	frequency/speed		0.0	P-01	0.0	Hz/rpm
	Minimum s	speed limitation – Hz or rpm. If P-10 >0, the values a	are entered/	displayed in rpm			
P-03	Accelerati	ion ramp time		0.00	600.0	5.0	S
	Acceleratio	on ramp time from zero Hz / rpm to rated speed (P-	09) in secor	nds.			
P-04	Delay ram	ıp time		0.00	600.0	5.0	S
	Delay ram	p time from nominal speed (P-09) to standstill in sec	conds. P-24	is used if the valu	ue is set to 0.0	0.	
P-05	Stop mod	e / response to interruption in the power supply		0	3	0	-
	Selects the	e drive controller's interruption mode and how it res	ponds to po	ower failure during	g operation.		
	Setting	Upon deactivation	Upon	power failure			
	0	Bamp stop (P-04)	Ride	through (energy r	recovery from	the load to mail	intain
	•		opera	ition)			
	1	Freewheeling	Freew	/heeling			
	2	Ramp stop (P-04)	Rapic	I ramp stop (P-24	1), freewheelir	ng if P-24 = 0	
	3	Ramp stop (P-04) with AC motor flow braking	Rapid	ramp stop (P-24)	, freewheeling	if P-24 = 0	
P-06	Energy op	timisation		0	1	0	-
	0: Deactiv	ated					
	1: Activate	ed. If activated, the energy optimisation function att	empts to re	duce the total ene	ergy consumpt	ion of the drive of	controller
	intended f	by reducing the output voltage at a constant speed	cortain time	at constant spee	ad. The energy	oplimisation iu	nction is
	whether th	ere is constant or variable torque.		at constant spee		or load, regardle	55 01
P-07	Rated mo	tor voltage / counter EMF at rated speed (PM / E	BLDC)	0	250 / 500	230 / 400	V
	With induc	tion motors, this parameter is to be set to the rated	voltage of	the motor (type pl	ate) in volts.		
	For perma	nent-magnet or brushless motors, it should be set t	to counter E	MP at rated spee	d.		
P-08	Rated mo	tor current		Depending o	n the rated o	utput of the	А
				d	rive controller		
	This param	neter is to be set to the rated current of the motor (t	ype plate)				
P-09	Rated mo	tor frequency		10	500	50 (60)	Hz
	This param	neter is to be set to the rated frequency of the moto	or (type plate	e)			
P-10	Rated mo	tor speed		0	30000	0	rpm
	As an optio	on, this parameter can be set to the rated speed of	the motor (t	ype plate). If this	parameter is se	et to the default	value of
	zero, all sp	beed-related values are displayed in Hz and the mot	for's slip col	mpensation (which	n maintains mo	otor speed at a c	constant
	shows the	motor speed in estimated rom. All speed-related p	arameters	such as minimum	and maximum	speed presets	need etc
	are also di	splayed in rpm.	arametere, t			opood, procere	
	Note: If th	e P-09 value is changed, the P-10 value is reset to	0				
P-11	Low-frequ	ency torque-increase current		0.0 Dep	ends on	Depends on	%
				C	drive	drive	
				COI	ntroller	controller	
	The low-fre	equency torque can be increased using this parame	eter. A dispr	oportionate increa	ase in voltage (	boost) may resu	It in a high
	motor curr	ent and/or an increased risk of shutdown caused b	y overcurre	nt/motor overload	(for more deta	alls, see Section	11.1)
	This param	neter is used in combination with P-51 (motor contra	ol mode) as	tollows:			
	P-51	P-11 O The increase in voltage is coloulated autor	matically an	oording to outo tu	no data		
		Interincie ase in voltage - P-11 x P-07 This voltage	Itane is ann	lied at 0 Hz and re	ne uala Auced in a line	ear fashion up to	P-09/2
	1	All Increase in voltage = $P-11 \times P-07$ . This vol	Itage is app	lied at 0 Hz and re	educed in a line	ear fashion up to	P-09/2
	2, 3, 4	All Boost current level = 4*P-11*P-08					
	The follow	ing applies to IM motors: If P-51 = 0 or 1 an appror	oriate settin	a for usual operat	ion can be fou	nd by running th	e motor
	with verv lo	ow or no load conditions at around 5 Hz and by adi	usting P-11	until the motor cu	irrent is roughl	y the magnetisa	tion current
	(if known)	or if this is in the range shown below.	5			,	
	Size A: 60	- 80% of rated motor current					
	Size B: 50	- 60% of rated motor current					
	Size C: 40	- 50% of rated motor current					
	Size D: 35	- 45% of rated motor current					

D 40	Description			Minimum	Maximum	Default	Units	
P-12	Source for primary comm	and		0	9	0	-	
	0: Connection control. The	e drive controller displays	an immediate response to th	ne signals sent	to the contro	l connection	s.	
	1: Keyboard control in one direction. The drive controller can be operated in a forwards direction only using an internal or remote							
	keyboard.							
	2: Keyboard control in two	directions. The drive cor	ntroller can be operated in a	forwards or re	evere directio	n using an ex	ternal or	
	remote keyboard. Pressing	the Start key on the keypa	ad causes operation to swite	h back and fo	rth between f	orwards and	reverse.	
	3: Modbus network contro	J. Control via Modbus RT	U (RS485) with the aid of int	ernal accelera	tion/decelera	tion ramps.		
	4: Modbus network contro	JI. Control Via Modbus RI	U Interface (RS485) with the	aid of interna	acceleration/	deceleration	ramps,	
	5: Pl control Liser Pl control	ol with external feedback	signal					
	6: Analogue PI sum contro	of with external recubacks	feedback signal and totallin	a with analog	ie input 1			
	7: CANopen control. Cont	rol via CAN (RS485) with th	he aid of internal acceleratio	n/deceleratior	ramps.			
	8: CANopen control. Control	rol via CAN interface (RS4)	85) with the aid of internal a	cceleration/de	celeration ran	nps, updated	via CAN.	
	9: Slave mode. Control via	linked VERTIMO drive cor	ntroller in master mode. Slav	e - drive contr	oller address	must be > 1		
	Note If P-12 =1, 2, 3, 4, 7,	8 or 9, an activation signal	still has to be provided at the	ne control tern	ninals, digital i	input 1		
P-13	Selection of operating mo	de		0	2	0	-	
	0: Industry mode. Intended	for most standard applic	ations, parameters are inten	ded for operat	tion at consta	nt speed, 15	0%	
	overload is permitted for 60	seconds, rotating start is	deactivated.					
	1: Pump mode. Intended for	or most pump applications	s, parameters are intended for	or operation at	t variable spe	ed, 110% ov	erload is	
	permitted for 60 seconds, r	otating start is deactivated	1.					
	2: Fan mode. Intended for	most pump applications, p	parameters are intended for	operation at v	ariable speed	, 110% overl	oad is	
	permitted for 60 seconds, r	otating start is deactivated	l.	1				
	Setting	Application	Current limit (P-54)	Torque		Rotation	start (P-33)	
				cnaracteris				
		<u> August</u>	1500/	Constant				
		(-onoral	15119/6	Variable		0	Off	
	0	Bump	150%	Vari	ahla	0	Off	
		General Pump Fan	110%	Vari	able	0	Off Off On	
P-14	0 1 2 Access code for advance	Pump Fan	110% 110%	Vari Vari	able able 65535	0	Off Off On	
P-14	0 1 2 Access code for advance	Pump Fan d menu	110% 110%	Vari Vari 0	able 65535	0 0 0	Off Off On - ed in P-37	
P-14	0 1 2 Access code for advance Permits access to advance (default: 101) in order to vie	Pump Fan d menu d and sophisticated group w and adapt advanced pa	110% 110% s of parameters. This param	Vari Vari 0 eter must be s	able able 65535 set to the valu	0 0 2 0 1e programm v and adapt	Off Off On - ed in P-37	
P-14	0 1 2 Access code for advanced Permits access to advanced (default: 101) in order to vie sophisticated parameters. I	Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b	110% 110% s of parameters. This param trameters and to the value of the changed to P-37 by the u	Vari Vari o teter must be s f P-37 + 100 ir ser.	able able 65535 set to the value order to view	0 0 2 0 1e programm v and adapt	Off Off On - ed in P-37	
P-14	0 1 2 Access code for advanced Permits access to advanced (default: 101) in order to vie sophisticated parameters. I	Pump Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b	110% 110% s of parameters. This parameters and to the value of the val	Vari Vari 0 leter must be s f P-37 + 100 ir ser.	able able 65535 set to the valu	0 0 2 0 v and adapt	Off Off On - ed in P-37	
P-14	0 1 2 Access code for advanced Permits access to advanced (default: 101) in order to vie sophisticated parameters. I	Pump Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b	110% 110% s of parameters. This param rameters and to the value o be changed to P-37 by the u	Vari Vari eter must be s f P-37 + 100 ir ser.	able able 65535 set to the valu	0 0 2 e programm v and adapt	Off Off On - ed in P-37	
P-14	0         1         2         Access code for advanced         Permits access to advanced         (default: 101) in order to vie         sophisticated parameters. I	Pump Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b	110% 110% s of parameters. This param trameters and to the value o be changed to P-37 by the u	Vari Vari o leter must be s f P-37 + 100 ir ser.	able able 65535 set to the valu n order to view	0 0 2 0 ie programm v and adapt	Off Off On - ed in P-37	
P-14	0 1 2 Access code for advanced Permits access to advanced (default: 101) in order to vie sophisticated parameters. I Advanced paramet	Pump Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b	110% 110% s of parameters. This param rameters and to the value of the changed to P-37 by the u	Vari Vari o teter must be s f P-37 + 100 ir ser.	able able 65535 set to the value n order to view	0 0 2 0 ie programm v and adapt	Off Off On - ed in P-37	
P-14 6.2 Par. P-15	0         1         2         Access code for advanced         Permits access to advanced         (default: 101) in order to vie         sophisticated parameters. I         Advanced parameter         Description         Selection of digital input fu	Pump Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b	110% 110% s of parameters. This param rameters and to the value of the changed to P-37 by the u	Vari Vari o teter must be s f P-37 + 100 ir ser.	able able 65535 set to the value order to view	0 0 2 0 le programm v and adapt	Off Off On - ed in P-37 Units	
P-14 6.2 Par. P-15	0         1         2         Access code for advanced         Permits access to advanced         (default: 101) in order to vie         sophisticated parameters. I         Advanced parameters         Description         Selection of digital input fu         Defines the function of the d	Pump Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b ters	110% 110% 110% s of parameters. This parameters and to the value or use changed to P-37 by the u Minimur 0 the control mode setting in	Vari Vari o teter must be s f P-37 + 100 ir ser.	able able 65535 set to the value order to view aum De ction 0 for mo	0 0 2 0 1e programm v and adapt	Off Off On - ed in P-37 Units -	
P-14 6.2 Par. P-15 P-16	0 1 2 Access code for advanced Permits access to advanced (default: 101) in order to vie sophisticated parameters. I Advanced parameters Description Selection of digital input fu Defines the function of the d Signal format for analogue	Pump Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b ters nction igital inputs depending on input 1	110% 110% s of parameters. This param rameters and to the value of the changed to P-37 by the under the value of the control mode setting in the control mode setting in the setting in th	Vari Vari o teter must be s f P-37 + 100 ir ser. n Maxim 17 P-12. See Sec	able 65535 set to the value n order to view num De ction 0 for mo	0 0 2 0 e programm v and adapt efault 0 ore informatic 0-10	Off Off On - ed in P-37 Units - n.	
P-14 5.2 Par. P-15 P-16	0         1         2         Access code for advanced         Permits access to advanced         (default: 101) in order to vie         sophisticated parameters. I         Advanced parameters. I         Description         Selection of digital input fu         Defines the function of the d         Signal format for analogue         U = U = 0 to 10 V signal fur	Pump Fan d menu d and sophisticated group w and adapt advanced pa f desired, the code must b ters ters inction igital inputs depending on input 1	130%         110%         110%         s of parameters. This parameters and to the value of the value of the changed to P-37 by the under the changed to P-37 by the under the control mode setting in th	Vari Vari 0 eter must be s f P-37 + 100 ir ser. n Maxim 17 P-12. See Ser iee below the analogue	able 65535 set to the value n order to view num De ction 0 for mo	0 0 2 0 e programm v and adapt efault 0 ore informatic 0-10	Off Off On - ed in P-37 Units - n. -	

35 = 200.0%, P-39 = 50.0%.

R D-2D = 0 to 20 mA signal
 Y - 2D = 4 to 20 mA signal; the VERTIMO drive controller switches off and displays an error code Y-2DF if the signal strength falls below 3 mA.

b  $\square$  -  $\square$  = 0 to 10 V signal, bi-directional operation. The drive controller will run the motor in the reverse rotation direction once the analogue reference = < 0.0% following the application of scaling and offset. E.g. for bi-directional control of a 0 – 10 V signal, set P-

r 4-20 = 4 to 20 mA signal; the VERTIMO drive controller travels at the preset speed 1 (P-20) if the signal strength falls below 3 mA. E 20-4 = 20 to 4 mA signal; the VERTIMO drive controller switches off and displays an error code 4-20F if the signal strength falls below 3 mA.

r = 20 - 4 = 20 to 4 mA signal; the VERTIMO drive controller travels at the preset speed 1 (P-20) if the signal strength falls below 3 mA. U = 10 - 0 = 10 to 0 V signal (unipolar). The drive controller is run at maximum frequency/speed once the analogue reference = < 0.0% following the application of scaling and offset.

P-17 Maximum effective switching frequency 4 32 8 kHz Sets the drive controller's maximum effective switching frequency. If "rEd" is displayed, the switching frequency is reduced to the value of P00-32 as a result of the drive controller's excess cooler temperature.

KOSTAL
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Par.	Description	Minimum	Maximum	Default	Units			
P-18	Function selection for relay output	0	9	1	-			
	Selection of function assigned to relay output. Logic 1 = relay active.	Contact betweer	terminals 10 and	d 11 closed.				
	0: Drive controller enable (enable). Logic 1 if the motor is enabled.							
	1: Drive controller OK. Logic 1 if energised and there are no drive controller errors.							
	With target frequency (speed). Logic 1 if the output frequency matches the target value.							
	3: Drive controller shutdown in response to error. Logic 1 if the drive	e controller has a	an error.		5.40			
	4 : Output frequency >= threshold value. Logic 1 if the output freque	ency exceeds the	e adjustable thre	shold value from	P-19.			
	5: Output current >= threshold value. Logic 1 if the output frequence	xceeds the adjus	stable threshold \	Value from P-19.	- D 10			
	<b>7 : Output requency &lt; threshold value</b> Logic 1 if the motor current fall	s below the adju	etable threshold	value from P-10	II F-19.			
	8: Analogue input 2 > threshold value. Logic 1 if the signal sent to a	naloque input 2 é	exceeds the three	shold value from	P-19			
	<b>9: Drive controller ready.</b> Logic 1 if the <b>drive controller</b> is ready, no	errors present.						
P-19	Relay threshold value	0.0	200.0	100.0	%			
	Adjustable threshold value, which is used in conjunction with settings	4 to 8 from P-18	B.					
P-20	Preset frequency / speed 1	-P-01	P-01	5.0	Hz/rpm			
P-21	Preset frequency / speed 2	-P-01	P-01	25.0	Hz/rpm			
P-22	Preset frequency / speed 3	-P-01	P-01	40.0	Hz/rpm			
P-23	Preset frequency / speed 4	-P-01	P-01	P-09	Hz/rpm			
	Preset speeds / frequencies, which have been selected by the digital i	inputs depending	g on the setting f	or P-15.				
	If $P-10 = 0$ , the values are entered in Hz. If $P-10 > 0$ , the values are en	tered in rpm.						
	Note Changing the P-09 value resets all values to the default factory	settings.						
P-24	2nd delay ramp time (fast stop)	0.00	600.0	0.00	s			
	This parameter can be used to program an alternative delay ramp in the	ne drive controlle	er.					
	This is automatically selected in the event of power failure if P-05 = 2	or 3. The drive c	ontroller is stopp	ed by freewheel	ing if the value			
	is set to 0.00.							
	If a setting via P-15 with a fast stop function is used, this ramp is again	n used.						
	If $P-24 > 0$ , $P-02 > 0$ , $P-26 = 0$ and $P-27 = P-02$ for this purpose, this is	ramp is used for	acceleration and	deceleration wi	hen running at			
	ninimum speed. This in turn allows an alternative ramp to be selected	i when running o	utside the norma	a speed range, v	vnich may			
P-25	Function selection for analogue output	0	11	8	-			
. 20	Digital output mode. Logic $1 = +24 \text{ V DC}$							
	0: Drive controller enable (enable). Logic 1 if VERTIMO drive controlle	er is enabled (in o	operation).					
	1: Drive controller <b>OK.</b> Logic 1 if the drive controller has no errors.		specater.).					
	2: With target frequency (speed). Logic 1 if the output frequency ma	tches the target	value.					
	3: Drive controller shutdown in response to error. Logic 1 if the drive	e controller has a	in error.					
	4: Output frequency >= threshold value. Logic 1 if the output freque	ency exceeds the	e adjustable thre	shold value from	P-19.			
	5 : Output current >= threshold value. Logic 1 if the motor current e	xceeds the adjus	stable threshold v	value from P-19.	5.40			
	6 : Output frequency < threshold value. Logic 1 if the output frequent	ncy falls below th	e adjustable thre	eshold value from	n P-19.			
	7: Output current < inreshold value. Logic 111 the motor current fail	s below the adju	Istable threshold	value from P-19				
	Analogue output mode							
	<b>6:</b> Output irequency (motor speed). 0 to P-01, resolution of 0.1 Hz							
	<b>10: Output power.</b> 0 – 200% of rated motor power.							
	<b>11: Load current.</b> 0 – 200% of P-08, resolution of 0.1 A							
P-26	Skin frequency hysteresis band	0.0	P-01	0.0	Hz/rom			
P-27	Skip frequency centre point	0.0	P-01	0.0	Hz/rpm			
	The skip frequency function is used to avoid the VERTIMO drive contr	oller operating a	t a certain output	t frequency. for	example at a			
	frequency which causes mechanical resonance in a particular machine	e. Parameter P-2	27 defines the ce	ntre point of the	skip			
	frequency band, and is used in conjunction with P-26. The VERTIMO	output frequency	will ramp throug	gh the defined b	and at the			
	rates set in P-03 and P-04 respectively, and will not hold any output fr	requency within t	the defined band	. If the frequency	y reference			
	applied to the drive controller is within the band, the VERTIMO output	frequency will re	emain at the uppe	er or lower limit	of the band.			
P-28	V/F characteristic adaptation of voltage	0	P-07	0	V			
P-29	V/F characteristic adaptation of frequency	0.0	P-09	0.0	Hz			
	This parameter, in combination with P-28, sets a frequency point at w	hich the voltage	set in P-29 is ap	plied to the moto	or. When using			
	this function, care should be exercised in order to avoid overheating a	ind damage to th	ne motor.					

. Description	Minimum	Maximum	Default	Units
0 Start mode & automatic restart			Edge-r	-
Index 1: Start mode & automatic restart			Edge-r	-
Index 1: Start mode & automatic restart         Selects whether the drive is to start automatically when the active input is a function for the automatic restart.         Ed9E-r: After switching on or after a reset, the drive controller does not start the input must be closed after switching on/resetting.         RULo-D: After switching on or after a reset, the drive controller starts automatically when the active input is a function for the automatic restart.         RULo-D: After switching on or after a reset, the drive controller starts automatically and the start and the start are and the start automatically and the starts automaticaly and the starts automatical and the starts aut	 active and while rt if digital input atically if digital tart are made at bes not restart e rive controller m 0 de, is being use	 starting is bloc 1 remains clos input 1 is close intervals of 20 ven at the last a bust be switche	Edge-r ed. Also con ed. To be able ed. seconds. attempt, a shu d off in order 1 0 15, 16 & 17.	figures the to do this tdown in to be able
<ul> <li>is active if the input is closed.</li> <li>Index 3: Input type in emergency mode</li> <li>Defines the input type if the setting for P-15, including emergency mode, is</li> <li>0: Permanent input. For the duration of the input signal, the drive controller supported depending on setting for index 2).</li> <li>1: Temporary input. Emergency mode is activated during a temporary sign on setting for index 2. The drive controller remains in emergency mode until the drive controller remains in emergency</li></ul>	0 being used, e.g er remains in em nal at the input. il deactivated/sv	1 g. settings 15, 1 ergency mode NO or NC mod vitched off.	0 6 & 17. (NO or NC op e is supported	eration
1 Selection of start mode using kounsel	0	7	1	
0: Minimum speed, keypad start 1: Last speed, keypad start 2: Minimum speed. terminal activation 3: Last speed, terminal activation 4: Current speed, keypad start 5: Preset speed 4, keypad start 6: Current speed, terminal start 7: Preset speed 4, terminal start				
2 Index 1: Duration	0.0	25.0	0.0	s
Index 2: Direct current feed-in mode	0	2	0	-
Index 1: Defines the time for which a direct current is fed into the motor. The Index 2: Configures the function for direct current feed-in as follows:- 0: Direct current feed-in during stop. Following a stop command, direct cu set in P-59 once the output frequency has reached 0.0 Hz for the time set in has reached a complete stop before the drive controller switches off. Note If the drive controller is in standby mode before switching off, the direct 1: Direct current feed-in during start. Direct current is fed into the motor in according to the current value set in P-59 for the time set in index 1 before the active during this phase. This can be used to ensure that the motor is at a st 2: Direct current feed-in during start & stop. Direct current feed-in is used	e direct current f urrent is fed into index 1. This ma t current feed-in nediately after ne output freque andstill before s for settings 0 a	eed-in value ca the motor acco ay be useful for h is deactivated the drive contr ency increases. tarting. nd 1.	in be adapted ording to the c r ensuring that l oller is activat The output st	in P-59. current valu the motor ed age remair
3 Rotating start		2	0	
	U	2	U	
<ol> <li>Activated. If activated, the drive controller tries to establish whether the m controlling the motor to its current speed. There may be short delay if startin</li> <li>Activated in the case of shutdown in response to an error, drop in vol activated in the following circumstances, otherwise it is deactivated.</li> </ol>	notor has alread g motors from s <b>tage or freewh</b> o	y started to rota tandstill. <b>eeling stop.</b> Th	ate at the start ne rotating star	t and begii rt is only

Par.	Description	Minimum	Maximum	Default	Units				
P-34	Brake chopper active (not size 1)	0	4	0	-				
	0: Deactivated								
	<b>1: Active with software protection.</b> Activates the internal brake chopper with software protection for a resistor with a rated output of 200 W.								
	<b>2:</b> Active without software protection. Activates the internal brake chopper without software protection. An external device should be installed for thermal protection.								
	3: Active with software protection. As with setting 1, where the brake chopper is only active while the target frequency value is								
	being changed, and inactive when operating at constant speed.								
	being changed, and inactive when operating at constant speed.			larget nequen	cy value is				
P-35	Scaling of analogue input 1 / slave speed scaling	0.0	2000.0	100.0	%				
	Scaling of analogue input 1. The value of the analogue input signal is multi	olied by this fact	orifea P-16	is set to a sign	al of 0-10 V				
	and the scaling factor is set to 200%, a 5 V input signal ensures that the driv <b>Slave speed scaling.</b> When operating in slave mode (P-12 = 9), the operating speed, multiplied by this factor, and is limited by the minimum and maximum $(P_{12} = 1)^{1/2}$	e controller runs ig speed of the c n speeds.	at maximum fr	requency/spee is the same as	d (P-01) the master				
P-36	Configuration of serial communication		See belov	v					
	Index 1: Address	0	63	1	-				
	Index 2: Baud rate	9.6	1000	115.2	kbps				
	Index 3: Protection from an interruption in communication	0	3000	t 3000	ms				
	This parameter has three sub-settings, which are used to configure the seria are	I Modbus RTU c	communication.	These sub-pa	rameters				
	1st index: Drive controller address: Range : 0 - 63, default: 1								
	<ul> <li>2nd index: Baud rate &amp; network type: Selects the baud rate and network type for the internal RS485 communication port.</li> <li>For Modbus RTU: Baud rates of 9.6, 19.2, 38.4, 57.6, 115.2 kbps are available.</li> <li>For CAN open: Baud rates of 125, 250, 500 &amp; 1000 kbps are available.</li> <li>3rd index: Watchdog timeout: Defines the time during which the drive controller runs without receiving a valid command telegram.</li> </ul>								
	at register 1 (drive controller check word) once the drive controller has been activated. Setting 0 deactivates runtime monitoring. Setting a value of 30, 100, 1000 or 3000 defines the time restriction in milliseconds for operation. A ' <i>L</i> ' suffix selects shutdown in response to an error if communication is lost. A ' <i>r</i> ' suffix means that the drive controller stops by freewheeling (output deactivated								
	immediately), but there is no shutdown in response to an error.								
P-37	Definition of access code	0	9999	101	-				
	Defines the access code, which has to be entered in P-14 in order to access	parameters abo	ove P-14.						
P-38	Parameter access lock	0	1	0	-				
	<b>0: Unlocked.</b> All parameters can be displayed and/or modified. <b>1: Locked.</b> Parameter values can be displayed but not modified, with the ex	ception of P-38.							
P-39	Offset of analogue input 1	500.00	500.00	0.0	%				
	Sets an offset for the analogue input as a percentage of the complete input r This parameter works in conjunction with P-35 and the resultant value can b	ange. This is the	en applied to th 00-01.	e analogue inp	ut signal.				
	The resultant value is defined as a percentage according to the following sta P00-01 = (applied signal value (%) - P-39) x P-35)	tement:-							
P-40	Index 1: Scaling factor display	0,000	16,000	0,000	-				
	Index 2: Scale source display	0	3	0	-				
	Allows the user to program the VERTIMO to display an alternative output uni motor speed (RPM) or the signal value of the PI actual value when operating	t, which is scale in PI mode.	d either using t	he output frequ	uency (Hz),				
	Index 1: Is used to set the scaling multipliers. The selected source value is n	nultiplied by this	factor.						
	Index 2: Defines the scaling source as follows:-								
	<b>0: Motor speed</b> . Scaling is applied to the output frequency if P-10 = 0; or to	the motor speed	d if P-10 > 0.						
	<ol> <li>Motor current. Scaling is applied to the value of the motor current (amps)</li> <li>Analogue input 2 signal strength. Scaling is applied to the signal strengt</li> </ol>	h of analogue in	put 2, internally	represented a	IS				
	<ul> <li>0 - 100%</li> <li>3: PI actual value. Scaling is applied to the PI actual value selected in P-46.</li> </ul>	internally repres	sented as 0 - 10	0%					

Par.	Description	Minimum	Maximum	Default	Units
P-41	PI controller – proportional gain	0.0	30.0	1.0	-
	PI controller – proportional gain. Higher proportional gain values resuldue to minor modifications to the feedback signal. Too high a value m	t in significant chang ay result in instability	es to the drive co /.	ontroller outpu	It frequency
P-42	The integral time of the PI controller	0.0	30.0	1.0	S
	The integral time of the PI controller. Higher values produce a more at activates slowly.	tenuated response ir	n systems where	the entire pro	cess
P-43	Operating mode of PI controller	0	1	0	-
	<ul> <li>0: Direct operation. Use this mode if the actual value signal is falling</li> <li>1: Reverse operation. Use this mode if the actual value signal is falling</li> <li>2: Direct operation, wake-up at full speed. As 0 setting, but the PI of</li> <li>3: Reverse operation, wake-up at full speed. As 0 setting, but the PI of</li> </ul>	and the motor speed g and the motor spe putput is set to 100% I output is set to 100%	I is to increase. ed is to decrease when restarting % when restarting	e. from standby ng from standl	by
P-44	Source selection of PI reference (target value)	0	1	0	-
P-45	To select the source of the PID value/target value <b>0: Digital target value.</b> P-45 is used <b>1: Analogue input 1 target value.</b> Analogue input 1 signal strength, the target value. <b>Digital PI target value</b>	ne signal value which	n can be read in F 100.0	200-01 is used	d as the %
	If P-44 = 0, this parameter is used to preset the digital target value for	the PI controller as a	a % of the feedb	ack signal ran	ge.
P-46	Selection of PI actual value source	0	5	0	-
	<ul> <li>0: Analogue input 2 (terminal 4) signal value which can be read in P00</li> <li>1: Analogue input 1 (terminal 6) signal value which can be read in P00</li> <li>2: Motor current. Scaled as % of P-08.</li> <li>3: DC intermediate circuit voltage scaled 0 - 1000 V = 0 - 100%</li> <li>4: Analogue 1 - analogue 2. The value of analogue input 2 is subtract is limited to 0.</li> <li>5: Greatest (analogue 1 - analogue 2). The greatest of two analogues</li> </ul>	D-02. D-01 ted from analogue 1	to produce a dif	ferential signa	I. The value
P-47	Signal format for analogue input 2			-	U0-10
	U D- ID = 0 to 10 V signal R D-2D = 0 to 20 mA signal E $4-2D = 4$ to 20 mA signal; the VERTIMO experiences a shutdown in signal strength falls below 3 mA r $4-2D = 4$ to 20 mA signal, the VERTIMO travels at the preset speed E $2D-4 = 20$ to 4 mA signal, the VERTIMO drive controller experiences code $4-2DF$ if the signal strength falls below 3 mA r $2D-4 = 20$ to 4 mA signal, the VERTIMO travels at the preset speed Ptc-th = to be used for the motor thermistor measurement, valid with 3 kQ, reset 1 kQ	response to an error 1 (P-20) if the signal s a shutdown in resp 1 (P-20) if the signal any settings for P-1	and displays the strength falls belonse to an error strength falls belonse to an error strength falls belongth	e error code 4- low 3 mA and displays t low 3 mA put 3 as E-trip	20F if the he error . Trip value:
P-48	Timer for standby mode	0.0	25.0	0.0	s
	If standby mode is activated by the setting P-48 > 0.0, after a period of switches into standby mode for the time set in P-48. In standby mode	of running at minimur , the display shows	m speed (P-02), t БЕлdbУ and outpu	he drive contr t to the motor i	oller s activated.
P-49	PI control wake-up error level	0.0	100.0	5.0	%
0.50	If the drive controller is running in PI control mode (P-12 = 5 or 6) and P-49 can be used to define the PI error level (e.g. the difference betwee drive controller restarts after switching into standby mode. This allows remain in standby mode until the actual value falls sufficiently.	standby mode is act een target value and s the drive controller	tivated (P-48 > 0. actual value), wh to ignore minor a	.0), then ich is needed actual value er	before the rors and
P-50	User output relay hysteresis	0.0	100.0	0.0	%
	Sets the hysteresis level for P-19 to prevent the output relay chattering	g when close to the t	threshold.		

## 6.3 Sophisticated parameters

Par.	Description	Minimum	Maximum	Default	Units					
P-51	Motor control mode	0	5	0	-					
	0: Asynchronous motor vector speed control									
	1: V/t mode									
	2: PMSM vector speed control (for permanent-magnet synchronous motors)									
	3: BLUC motor vector speed control (for brushless DC motors)									
	5: LSPM vector speed control (for line start permanent-magnet synchronous motors)									
P-52	Auto-tune of motor parameters 0 _ 1 _ 0									
	0: Deactivated									
	1: Activated. If activated, the drive controller immediately measures the data	needed for op	timum operatio	on from the mo	otor. Ensure					
	that all motor-related parameters are set correctly before activating this paran	neter for the fir	rst time.							
	This parameter can be used to optimise performance when $P-51 = 0$ .									
	Auto-tuning is not needed when $P-51 = 1$ .	aquirad motor	aattinga hava	boon ontorod						
D 52	Vootor opened amplification			50 0	0/					
P-53	Vector speed amplification	D & Loopditi	200.0	50.0	<sup>70</sup>					
	51 – 1		ons at the sam	e time. Not ac	live when P-					
P-54	Maximum current limit value	0.0	175.0	150.0	%					
1 04	Defines the maximum current limitation in the vector control modes	0.0	110.0	100.0	/0					
P-55	Motor stator resistance	0.00	655 35	_	0					
1 00	Motor stator resistance in ohms. Determined by auto-tuning, there is not norm	nally any need	to adjust							
P-56	Motor stator inductance of d axis (I sd)		6553.5	-	mH					
	Determined by auto-tuning, there is not normally any need to adjust.	Ŭ								
P-57	Motor stator inductance of a axis (Lsa)	0	6553.5	-	mH					
	Determined by auto-tuning, there is not normally any need to adjust.	, j								
P-58	Direct current feed-in speed	0.0	P-01	0.0	Hz/rpm					
	Sets the speed of the feed-in direct current when braking to a stop and allows	the direct cu	rrent to be fed	in before the c	trive					
	controller reaches a speed of zero - if desired.									
P-59	Feed-in direct current	0.0	100.0	20.0	%					
	Sets the level of the brake current of the direct current feed-in which is applie	d according to	the condition	s set in P-32 a	and P-58					
P-60	Motor overload management		-	-	-					
	Index 1: Betention of thermal overload	0	1	0	1					
		U		U						
	1: Activated When activated the motor protection information calculated	d by the drive	controller is r	retained after	the main					
	power supply has been disconnected from the drive controller.									
	Index 2: Reach the thermal overload limit 0 1 0 1									
	0: It trp. If the overload accumulator reaches the limit value, the drive controll	er performs a '	"It trp" shutdov	wn in response	e to an error					
	in order to avoid damaging the motor.									
	1: Reduction of maximum current limit value. When the overload accumula	tor reaches 90	%, the output	current limit is	s reduced					
	internally to 100% of P-08 to avoid a "It.trp" shutdown in response to an error	r. The value is	again reset to	the setting for	P-54 when					
	the accumulator reaches 10%									

## 6.4 P-00 "Read-only" parameters

Par.	Description	Explanation
P00-01	1st analogue input value (%)	100% = maximum input voltage
P00-02	2nd analogue input value (%)	100% = maximum input voltage
P00-03	Target speed value input (Hz / RPM)	Displayed in Hz if P-10 = 0, otherwise in RPM
P00-04	Status of digital input	Status of digital input of drive controller
P00-05	User PI output (%)	Displays the value of the user PI output
P00-06	DC ripple of bus (V)	Measured DC ripple of bus
P00-07	Applied motor voltage (V)	Value of RMS voltage applied to the motor
P00-08	Intermediate circuit voltage (V)	Internal intermediate circuit voltage
P00-09	Cooling element temperature (°C)	Temperature of cooling element in °C
P00-10	Operating hours since date of manufacture. (Hours)	Not affected by restoring the default factory parameters
P00-11	Total operating hours since last shutdown in response to error 1 (hours)	Run time clock stopped by drive controller deactivation (or shutdown in response to an error). Is only reset upon the next activation if the shutdown was in response to an error. It will also be reset upon the next activation if the power failed.
P00-12	Total operating hours since last shutdown in response to error 2 (hours)	Run time clock stopped by drive controller deactivation (or shutdown in response to an error). Is only reset upon the next activation if the shutdown was in response to an error (not if shut down in response to undervoltage) - is not reset when powering up/down unless a shutdown in response to error occurred before shutting down
P00-13	Shutdown in response to error log	Shows the last 4 instances of tripping with date stamp
P00-14	Operating hours since the last deactivation (hours)	Run time clock stopped by drive controller deactivation. Value is reset during next activation
P00-15	Log of intermediate circuit voltage (V)	Last 8 values before shutdown in response to an error, 256 ms sample time
P00-16	Cooling element temperature log (V)	Last 8 values before shutdown in response to an error, 30 s sample time
P00-17	Motor current log (A)	Last 8 values before shutdown in response to an error, 256 ms sample time
P00-18	Log of DC ripple of bus (V)	Last 8 values before shutdown in response to an error, 22 ms sample time
P00-19	Log of internal drive controller temperature (°C)	Last 8 values before shutdown in response to an error, 30 s sample time
P00-20	Internal drive controller temperature (°C)	Current internal ambient temperature in °C
P00-21	CANopen process data input	Incoming process data (RX PDO1) for CANopen: PI1, PI2, PI3, PI4
P00-22	CANopen process data output	Outgoing process data (RX PDO1) for CANopen: PO1, PO2, PO3, PO4
P00-23	Accumulated time with cooling element $> 85 \degree$ C (hours)	Accumulated total operating hours and minutes with a cooling element temperature above 85 °C
P00-24	Accumulated time with an internal drive controller temperature of $> 80$ °C (hours)	Accumulated total operating hours and minutes with an internal drive controller temperature above 80 °C
P00-25	Estimated rotor speed (Hz)	In the vector control modes, estimated rotor speed in Hz
P00-26	kWh counter / MWh counter	Total number of kWh / Mwh consumed by drive controller.
P00-27	Total operation time of drive controller fan (hours)	Time, displayed in HH:MM:ss. The first value shows the time in hours, press "UP" to show MM:ss.
P00-28	Software version and checksum	Software version and checksum. "1" on LH side indexes the I/O processor, "2" indexes the power level
P00-29	Drive controller type designator	Drive power, drive controller type and software version codes
P00-30	Drive controller serial number	One-off drive controller serial number
P00-31	Motor current Id/Ig	Shows the magnetising current (Id) and torque current (Iq). Press "UP" to display Iq

Par.	Description	Explanation					
P00-32	Actual PWM switching frequency (kHz)	Actual switching frequency used by the drive controller					
P00-33	Counter for critical errors – O-I	These parameters log the number of specific errors which occur and are useful for diagnosis purposes.					
P00-34	Counter for critical errors – O-volt						
P00-35	Counter for critical errors – U-volt						
		These parameters log the number of specific errors which occur and are useful for					
P00-36	Counter for critical errors – O-temperature (hrs./cooling element)	diagnosis purposes					
P00-37	Counter for critical errors – b O-I (chopper)						
P00-38	Counter for critical errors – O-hEAt (control)						
P00-39	Modbus counter for communication errors						
P00-40	CANbus counter for communication errors						
P00-41	I/O processor for communication errors						
P00-42	Power level of uC communication errors						
P00-43	Switch-on time of drive controller (service life) (hours)	Total life of drive controller with applied voltage					
P00-44	Phase U current offset & ref	Internal value					
P00-45	Phase V current offset & ref	Internal value					
P00-46	Phase W current offset & ref	Internal value					
P00-47	Index 1: Total activation time emergency mode	Total activation time of emergency mode					
	Index 2: Activation counter for emergency	Show how frequently emergency mode has been activated					
•	mode						
P00-48	Oscilloscope channel 1 & 2	Display signals for first oscilloscope channels 1 & 2					
P00-49	Oscilloscope channel 3 & 4	Display signals for first oscilloscope channels 3 & 4					
P00-50	Boot loader and motor control	Internal value					

## 7 Macro configuration of the analogue and digital input

## 7.1 Overview

The VERTIMO takes a macro approach to simplifying configuration of the analogue and digital inputs. There are two main parameters, which determine the input functions and drive controller behaviour:

- P-12 Selects the drive controller's main control source and determines how the drive controller's output frequency is primarily controlled.
- P-15 Assigns the macro functions to the analogue and digital inputs.

Additional parameters can then be used to further adapt the settings, e.g.

- P-16 Is used to select the format of the analogue signal, which is linked to analogue input 1, e.g. 0 10 V, 4 20 mA.
- **P-30** Determines whether the drive is to start automatically after switching on if the active input is present.
- **P-31** If keypad mode is activated, this parameter determines the output frequency / speed at which the drive controller is to start following the activation command and also whether the Start key on the key pad has to be pressed for this to happen or whether the active input alone starts the drive controller.
- P-47 Is used to select the format of the analogue signal, which is linked to analogue input 2, e.g. 0 10 V, 4 20 mA.

The tables below provide an overview of the functions of each terminal macro function and a simplified connection diagram for each one.

## 7.2 Circuit diagram - example



## 7.3 Macro functions guide key

Function	Explanation					
STOP	Latched Input, Open the contact to STOP the drive					
RUN	Latched input, Close the contact to Start, the drive will operate as long as the input is maintained					
FWD 🕚	Latched Input, selects the direction of motor rotation FORWARD					
REV 🕚	Latched Input, selects the direction of motor rotation REVERSE					
RUN FWD 🕚	Latched Input, Close to Run in the FORWARD direction, Open to STOP					
RUN REV 🕓	Latched Input, Close to Run in the REVERSE direction, Open to STOP					
ENABLE       Hardware Enable Input.         In Keypad Mode, P-31 determines whether the drive immediately starts, or the keypad start key must be pressed.         In other modes, this input must be present before the start command is applied via the fieldbus interface.						
START 1	Normally Open, Rising Edge, Close momentarily to START the drive (NC STOP Input must be maintained)					
^START^	Simultaneously applying both inputs momentarily will START the drive (NC STOP Input must be maintained)					
STOP ]	Normally Closed, Falling Edge, Open momentarily to STOP the drive					
START I FWD	Normally Open, Rising Edge, Close momentarily to START the drive in the forward direction (NC STOP Input must be maintained)					
	Normally Open, Rising Edge, Close momentarily to START the drive in the reverse direction (NC STOP Input must be maintained)					
^FAST STOP (P-24^	When both inputs are momentarily active simultaneously, the drive stops using Fast Stop Ramp Time P-24					
FAST STOP (P-24)	Normally Closed, Falling Edge, Open momentarily to FAST STOP the drive using Fast Stop Ramp Time P-24					
	Normally Closed, External Trip input. When the input opens momentarily, the drive trips showing E- Er , P oror					
	PEc-Eh depending on P-47 setting					
Fire Mode	Activates Fire Mode, see section 7.8 Fire Mode on page 34					
Analogue Input Al1	Analog Input 1, signal format selected using P-16					
Analogue Input Al2	Analog Input 2, signal format selected using P-47					
AI1 REF	Analog Input 1 provides the speed reference					
AI2 REF	Analog Input 2 provides the speed reference					
P-xx REF	Speed reference from the selected preset speed					
PR-REF	Preset speeds P-20 – P-23 are used for the speed reference, selected according to other digital input status					
PI-REF	PI Control Speed Reference					
PI FB	Analog Input used to provide a Feedback signal to the internal PI controller					
KPD REF	Keypad Speed Reference selected					
INC SPD	Normally Open, Close the input to Increase the motor speed					
DEC SPD	Normally Open, Close input to Decrease motor speed					
FB REF	Selected speed reference from Fieldbus (Modbus RTU / CAN Open / Master depending on P-12 setting)					
(NO)	Input is Normally Open, Close momentarily to activate the function					
(NC)	Input is Normally Closed, Open momentarily to activate the function					

## 7.4 Macro functions - terminal mode (P-12 = 0)

P-15		DI1		D	12	DI3 / AI2		D	DI4 / AI1			
	0	1		0	1	0		1	0		1	
0	STOP	OPERATION	Forward	ls rotation	Reverse rotation	AI1 REF		P-20 REF	Analo	gue inp	out Al1	1
1	STOP	OPERATION	Al1	REF	PR-REF	P-20		P-21	Analog	gue inp	out Al1	1
2	STOP	OPERATION	l	012	DI3		PF	R	P-20 - P	-23	P-01	2
				0	0		P-2	20				
				1	0		P-2	21				
				0	1		P-2	22				
				1	1		P-2	23				
3	STOP	OPERATION	ŀ	AI1	P-20 REF	E-TRIP		OK	Analogue input Al1			3
4	STOP	OPERATION	ŀ	AI1	AI2	Analo	gue	input Al2	Analog	gue inp	out Al1	4
5	STOP	Forwards	S	ГОР	Reverse running	Al1		P-20 REF	Analog	gue inp	out Al1	1
		running										
		^	FAST	STOP (P-24	4)^							
6	STOP	OPERATION	Forward	ls rotation	Reverse rotation	E-TRIP		OK	Analog	gue inp	out Al1	3
7	STOP	Forwards	S	ΓΟΡ	Reverse running	E-TRIP		OK	Analog	gue inp	out Al1	3
		running										
		^	FAST	STOP (P-24	1)^				1			
8	STOP	OPERATION	FO	RWARDS	REVERSE RUNNING	DI3		DI4		PR		2
			RU	JININING		0		0		P-2	0	
						1		0		P-2	1	
						1		1		P-2	2	
٥	STOP	START		STOP	START REVERSE	1		I		F-2		2
9	0101	FORWARDS		0101	RUNNING	DI3		DI4		PR		-
		RUNNING										
		^F	AST STC	P (P-24)	Λ	0		0		P-2	0	
						1 0			P-2	1		
						0		1		P-22		
	(10)	07407		0700	(10)	1		1	P-23			
10	(NO)	SIARI		STOP	(NC)	AI1 REF		P-20 REF	Ana	logue II	nput Al1	5
11	(NO)		CARDS	STOP	(NC)	(NO)		START REVERS	E Ana	logue II	nput Al1	6
			G	FAST ST	OP (P-24)	l						
12	STOP	OPERATION	FAS	STOP (P-	OK	AI1 REE	- P-20 REF		Analogue input Al1		7	
	0.0.	01 2.0011		24)	011	/		0	Analogue input An		.put/ iii	•
13	(NO)	START		STOP	(NC)	(NO)		START REVERS	E KPD	REF	P-20 REF	13
		FORWARDS						RUNNING				
		RUNNING										
	OTOD			FAS	ST STOP (P-24)			A	DIO	DIA	DD	
14	510P	OPERATION			DIZ	E-TRIP		UK		014	PR P-20	11
									1	0	P-20	
									0	1	P-22	
									1	1	P-23	
15	STOP	OPERATION	P	P-23 REF Al1		En	nerge	ency mode	Ana	logue ii	nput Al1	1
16	STOP	OPERATION	P-23 REF P-21 REF		En	nerge	ency mode	FORW	/ARDS	REVERS	2	
								RUN	NING	Е		
											RUNNIN	
	0705	ODEDATION			DIO	-			BIA	DH	G	<u> </u>
17	STOP	OPERATION			DI2	En	nerge	ency mode	DI2	DI4	PR	2
									0	0	P-20	
										1	P-21	
									1	1	P-23	
18	STOP	OPERATION	FORWARDS ひ REVERSE び			Emergency operation			Analogue input Al1			1

### 7.5 Macro functions - keypad mode (P-12 = 1 or 2)

D 1F	DI1		D	012	DI	3 / AI2	DI4 /	Diagram			
P-15	0	1	0	1	0	1	0	1			
0	STOP	ACTIVATED	-	INCREASE SPEED	-	REDUCE	FORWARDS	REVERSE	8		
						SPEED	RUNNING	RUNNING			
				۸ START۸							
1	STOP	ACTIVATED		PI speed value							
2	STOP	ACTIVATED	-	INCREASE SPEED	-	REDUCE	KPD REF	P-20 REF	8		
						SPEED					
				۸	START	A					
3	STOP	ACTIVATED	-	INCREASE SPEED	E-TRIP	OK	-	REDUCE SPEED	9		
				۸		START		A			
4	STOP	ACTIVATED	-	INCREASE SPEED	KPD REF	AI1 REF	A	1	10		
5	STOP	ACTIVATED	FORWARDS	ORWARDS REVERSE KPD REF AI1 REF AI1							
			RUNNING	RUNNING							
6	STOP	ACTIVATED	FORWARDS	REVERSE	E-TRIP	OK	KPD REF	P-20 REF	11		
			RUNNING	RUNNING							
7	STOP	FORWARDS	STOP	REVERSE	E-TRIP	OK	KPD REF	P-20 REF	11		
		RUNNING		RUNNING							
		^FAS1	STOP (P-24)	^							
8	STOP	FORWARDS	STOP	REVERSE	KPD REF	AI1 REF	A	1			
		RUNNING									
		Ŭ									
14	STOP	OPERATION	-	-	E-TRIP	OK	-	-			
15	STOP	OPERATION	PR REF	KPD REF	Emerge	ency mode	P-23	P-21	2		
16	STOP	OPERATION	P-23 REF	KPD REF	Emerge	ency mode	FORWARDS	REVERSE	2		
							RUNNING Ù	RUNNING Ư			
17	STOP	OPERATION	KPD REF	P-23 REF	Emerge	ency mode	FORWARDS	REVERSE	2		
18	STOP	OPERATION	AI1 REF	KPD REF	Emergen	cy operation	A	1	1		
				9, 10, 11, 12, 13	= 0						

### 7.6 Macro functions - fieldbus control mode (P-12 = 3, 4, 7, 8 or 9)

D 15		DI1	DI	2	DI3 /	AI2	DI4 /	All	Diagram	
P-15	0	1	0	1	0	1	0	1		
0	STOP	ACTIVATED	FB R	EF (fieldbus	s speed value,	Modbus RT	U / CAN / master-slave	defined by P-12)	14	
1	STOP	ACTIVATED				PI speed	1 value		15	
3	STOP	ACTIVATED	FB REF	P-20 REF	E-TRIP	OK	Analogue	3		
5	STOP	ACTIVATED	FB REF	PR REF	P-20	P-21	Analogue	input Al1	1	
		^	START (P-	-12 = only 3	3 or 4 )′	<b>L</b>				
6	STOP	ACTIVATED	FB REF	Al1 REF	E-TRIP	ОК	Analogue	3		
		^-START (P-1	12 = only 3 c	or 4 )-^						
7	STOP	ACTIVATED	FB REF	KPD	E-TRIP	OK	Analogue	input Al1	3	
				REF						
		^-START (P-1	12 = only 3 c	or 4 )-^						
14	STOP	ACTIVATED	-	-	E-TRIP	OK	Analogue	input AI1	16	
15	STOP	ACTIVATED	PR REF	FB REF	Emergene	cy mode	P-23	P-21	2	
16	STOP	ACTIVATED	P-23 REF	FB REF	Emergency mode		Analogue	input Al1	1	
17	STOP	ACTIVATED	FB REF	P-23 REF	Emergeno	cy mode	Analogue	1		
18	STOP	ACTIVATED	VATED AI1 REF FB REF Emergency mode Analogue input AI1							
					2, 4, 8, 9, 10,	11, 12, 13 =	= 0			

## 7.7 Macro functions - PI control mode by user (P-12 = 5 or 6)

D 15		DI1	Γ	012	DI3 ,	/ AI2	DI4 / AI1		Diagram
P-13	0	1	0	1	0	1	0	1	
0	STOP	ACTIVATED	PI REF	P-20 REF	A	12	Al1		4
1	STOP	ACTIVATED	PI REF	AI1 REF	Al2 (F	PI FB)	Al1		4
3, 7	STOP	ACTIVATED	PI REF	P-20	E-TRIP	OK	AI1 (PI FB)		3
4	(NO)	START	(NC)	STOP	Al2 (F	PI FB)	A	11	12
5	(NO)	START	(NC)	STOP	PI REF P-20 REF		Al1 (	PI FB)	5
6	(NO)	START	(NC)	STOP	E-TRIP OK		Al1 (PI FB)		
8	STOP	OPERATION	FORWARDS	REVERSE	AI2 (PI FB) AI1		4		
			RUNNING	RUNNING					
14	STOP	OPERATION	-	-	E-TRIP	OK	Al1 (	PI FB)	16
15	STOP	OPERATION	P-23 REF	PI REF	Emergen	icy mode	Al1 (	PI FB)	1
16	STOP	OPERATION	P-23 REF	P-21 REF	Emergen	icy mode	Al1 (	PI FB)	1
17	STOP	OPERATION	P-21 REF	P-23 REF	Emergen	icy mode	Al1 (	PI FB)	1
18	STOP	OPERATION	AI1 REF	PI REF	Emergency mode AI1 (PI FB) 1				1
				2, 9, 10, 11, 12, 13	= 0				
NOTE	P1 Setpoir	nt source is sel	ected by P-44 (defa	ult is fixed value in P-	45, Al 1 may	also be sele	cted).		
NOIE	P1 Feedba	ack source is se	elected by P-46 (def	ault is AI 2. other opti	ions may be	selected).			

## 7.8 Emergency operation

The emergency mode function was developed to ensure permanent drive controller operation under emergency conditions until the drive controller is no longer able to maintain operation. In accordance with the setting for P-30 index 2, the input for this function can be normally open (closed to activate the mode) or normally closed. For this purpose, a temporary or permanent input may be selected using P-30 index 3. This input can be connected to a fire alarm system so that in the event of a fire in the building, the drive controller operation is maintained for as long as possible in order to remove smoke or retain the air quality in the building.

The emergency mode function is activated when P-15 = 15, 16 or 17, with digital input 3, which was assigned for activation of emergency operation.

The emergency mode function deactivates the following protective functions in the drive controller:-

O-t (cooling element overheating), U-t (underheating of the drive controller), Th-FLt (no thermistor on cooling element), E-trip (external shutdown in response to error), 4-20 F (4-20 mA error), Ph-Ib (phase asymmetry), P-Loss (error when input phase is lost), SC-trp (error due to interruption in communication), I\_t-trp (error due to accumulated overload)

The following errors result in the drive controller shutting down in response to an error, automatically resetting and restarting:-

O-volt (intermediate circuit overvoltage), U-volt (intermediate circuit undervoltage), h O-I (error due to rapid overcurrent), O-I (temporary overcurrent at drive controller output), Out-F (drive controller output error, output stages error)

## 8 Modbus RTU communication

#### 8.1 Introduction

The VERTIMO can be connected to a Modbus RTU network by way of the RJ45 connection on the front of the drive controller.

### 8.2 Modbus RTU specifications

Protocol	Modbus RTU
Error check	CRC
Baud rate	9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps (default)
Data format	1 start bit, 8 data bits, 1 stop bit, no parity.
Physical signal	RS 485 (2-wire)
User interface	RJ45
Supported function codes	<ul> <li>03 write multiple holding registers</li> <li>06 write individual holding registers</li> <li>16 write multiple holding registers (only supported for registers 1 – 4)</li> </ul>

### 8.3 RJ45 connector configuration

When using the MODBUS control, the analogue and digital inputs can be configured as shown in Section 7.6.





#### Warning:

This is not an Ethernet connection. Do not connect it directly with an Ethernet port.

#### 8.4 Modbus tab

Register Number	Par.	Typ e	Supported function codes		ted on s	Function		Function		Function		Function		Function		Function		Range	Explanation
			03	06	16	Low byte	High byte												
1	-	R/W	~	~	~	Drive controller control command		03	16-bit word. Bit 0: Low = stop, high = allow operation Bit 1: Low = delay ramp 1 (P-04), high = delay ramp 2 (P-24) Bit 2: Low = no function, high = reset error Bit 3: Low = no function, high = freewheel stop request										
2	-	R/W	✓	~	~	Modbus target speed reference value		05000	Target frequency value x10, e.g. 100 = 10 Hz										
4	-	R/W	~	~	~	Acceleration and de	celeration time	060000	Ramp time in seconds x 100, e.g. 250 = 2.5 seconds										
6	-	R	~			Error code	Drive controller status		Low byte = drive controller error code, see Section 11.1 High byte = U drive controller status as follows:- 0: Drive controller stopped 1: Drive controller working 2: Shutdown of drive controller in response to error										
7		R	~			Output frequency (m	notor)	020000	Output frequency in Hz x 10, e.g. 100 = 10 Hz										
8		R	~			Output current (moto	or)	0480	Output current (motor) in amps x 10, e.g. 10 = 1.0 amp										
11	-	R	~			Status of digital inpu	ıt	015	Shows the status of the 4 digital inputs Lowest bit = 1 input 1										
20	P00-01	R	~			Value of analogue in	put 1	01000	Analogue input: % of the full scale x 10, e.g. 1000 = 100%										
21	P00-02	R	~			Value of analogue in	put 2	01000	Analogue input: % of the full scale x 10, e.g. 1000 = 100%										
22	P00-03	R	~			Speed value		01000	Shows the target value for frequency x10, e.g. 100 = 10.0 Hz										
23	P00-08	R	~			Intermediate circuit	voltage	01000	Intermediate circuit voltage in volts										
24	P00-09	R	~			Drive controller temp	perature	0100	Drive controller cooling element temperature in °C										

All parameters which can be configured by the user are accessible as holding registers and can be read or written using the appropriate Modbus command. The register number for each parameter of P-04 to P-60 is defined as 128 + parameter number, so that for example the register number for P-15 is 128 + 15 = 143. Internal scaling is used for some parameters. For further details, please contact your sales partner at KOSTAL Industrie Elektrik GmbH.

## 9 CAN communication

## 9.1 CAN communication

The CAN communication profile in the VERTIMO is implemented according to the specification DS301 version 4.02 of CAN in automation (www.can-cia.de). Specific device profiles such as DS402 are not supported.

The CAN communication function is enabled by default after power up. However in order to use any control functions through CAN, the following setting is required: P-12 = 7 or 8.

The CAN communication baud rate can be set by using parameter P-36 (Index 2). Available baud rates are: 125 kbps, 250 kbps, 500 kbps, 1 Mbps. (with default setting as 500 kbps).

The Node ID is set up through drive address parameter P-36 (Index 1) with the default value of 1.

The tables below show the Index and Sub Index required to address each parameter. All User Adjustable parameters are accessible by CAN, except those that would directly affect the communications.

All parameter values can be read from the drive and written to, depending on the operating mode of the drive – some parameters may not be changed whilst the drive is enabled.

VERTIMO provides the following default COB-ID and functions:

Туре	COB-ID	Funktion
NMT	000h	Network management
Sync	080h	Synchronous message. COB-ID can be configured to other value.
Emergency	080h + Node address	Emergency message.
PDO1 (TX)	180h + Node address	Process data object.
PDO1 (RX)	200h + Node address	PDO1 is pre-mapped and enabled by default.
PDO2 (TX)	280h + Node address	COB-ID can be configured to other value.
PDO2 (RX)	300h + Node address	PDO2 is pre-mapped and disabled by default. Transmission mode, COB-ID and mapping can be configured.
SDO (TX)	580h + Node address	SDO abannal can be used for drive parameter access
SDO (RX)	600h + Node address	SDO channel can be used for unve parameter access.
Error Control	700h + Node address	Guarding and Heartbeat function are supported. COB-ID can be configured to other value.

#### Note X

The VERTIMO SDO channel only supports expedited transmission.

X The VERTIMO can only support up to 2 Process Data Objects (PDO). All PDOs are pre-mapped; however PDO2 is disabled by default. The table below gives the default PDO mapping information.

X Customer configuration (mapping) will NOT be saved during power down. This means that the CANopen configuration will restore to its default condition each time the drive is powered up.

#### 9.1.1 PDO default mapping

	Objects No.	Mapped Object	Lenght	Mapped Function	Transmission Type
	1	2000 h	Unsigned 16	Control command register*	
RX	2	2001 h Integer 16 Speed reference		Speed reference	254
PDO1	3	2003 h	Unsigned 16	User ramp reference	Valid immediately
	4	0006 h	Unsigned 16	Dummy	
	1	200 Ah	Unsigned 16	Drive status register	a= /
ΤХ	2	200 Bh	Integer 16	Motor speed Hz	254
PDO1	3	200 Dh	Unsigned 16	Motor current	Send after receiving
	4	2010 h	2010 h Integer 16 Drive temperature		RX PDO T
	1	0006 h	Unsigned 16	Dummy	
RX	2	0006 h	Unsigned 16	Dummy	054
PDO2	3	0006 h	Unsigned 16	Dummy	254
	4	0006 h	Unsigned 16	Dummy	
	1	2011 h	Unsigned 16	DC bus voltage	
TX	2	2012 h	Unsigned 16	Digital input status	254
PDO2	3	2013 h	Integer 16	Analog input 1 (%)	234
	4	2014 h	Integer 16	Analog input 2 (%)	

\* Drive control can only be achieved when P-12=7 or 8 provided that P-31 = 0, 1, 4 or 5.

#### 9.1.2 PDO transmission type

Various transmission modes can be selected for each PDO. For RX PDO, the following modes are supported:

Transmission Type	Mode	Description
0 - 240	Synchronous	The received data will be transferred to the drive active control register when the next sync message is received.
254, 255	Asynchronus	The received data will be transferred to the drive active control register immediately without delay.

#### For TX PDO, the following modes are supported:

Transmission Type	Mode	Description
0	Acyclic synchronous	TX PDO will only be sent out if the PDO data has changed and PDO will be transmitted on reception of SYNC object.
1 - 240	Cyclic synchronous	TX PDO will be transmitted synchronously and cyclically. The transmission type indicates the number of SYNC object that are.
254	Asynchronous	TX PDO will only be transferred once corresponding RX PDO has been received.
255	Asynchronous	TX PDO will only be transferred anytime if PDO data value has changed.

#### 9.1.3 CAN Open Specific Object Table

Index	Sub Index	Function	Access	Туре	PDO Map	Default Value
1000 h	0	Device Type	R	U32	N	0
1001 h	0	Error Register	R	U8	N	0
1002 h	0	Manufacturer Status Register	R	U16	N	0
1005 h	0	COB-ID Sync	RW	U32	N	0000080 h
1008 h	0	Manufacturer Device Name	R	String	Ν	ODE3
1009 h	0	Manufacturer Hardware Version	R	String	Ν	x.xx
100 Ah	0	Manufacturer Software Version	R	String	Ν	x.xx
100 Ch	0	Guard Time (1 ms)	RW	U16	Ν	0
100 Dh	0	Life Time Factor	RW	U8	Ν	0
1014 h	0	COB ID EMCY	RW	U32	Ν	00000080h+Node ID
1015 h	0	Inhibit Time Emergency (100 µs)	RW	U16	Ν	0
1017 h	0	Producer Heartbeat Time (1ms)	RW	U16	Ν	0
	0	Identity Object No. Of entries	R	U8	Ν	4
	1	Vendor ID	R	U32	Ν	0x000031A
1018 h	2	Product Code		U32	N	Drive Dependent
	3	3 Revision Number		U32	Ν	x.xx
	4	Serial Number	R	U32	Ν	Drive Dependent
	0	SDO Parameter No. Of entries	R	U8	Ν	2
1200 h	1	COB-ID Client - > Server (RX)	R	U32	Ν	00000600h+Node ID
	2	COB-ID Server - > Client (TX)	R	U32	Ν	00000580h+Node ID
	0	RX PDO 1 comms param. no. of entries	R	U8	Ν	2
1400 h	1	RX PDO 1 COB-ID	RW	U32	Ν	40000200h+Node ID
	2	RX PDO transmission type	RW	U32	Ν	254
	0	RX PDO 2 comms param. no. of entries	R	U8	Ν	2
1401 h	1	RX PDO 2 COB-ID	RW	U32	Ν	C0000300h+Node ID
	2	RX PDO 2 transmission type	RW	U8	Ν	0
	0	RX PDO 1 1 mapping/no. of entries	RW	U8	Ν	4
	1	RX PDO 1 1 st mapped object	RW	U32	Ν	20000010h
1600 h	2	RX PDO 1 2nd mapped object	RW	U32	Ν	20010010h
	3	RX PDO 1 3rd mapped object	RW	U32	Ν	20030010h
	4	RX PDO 1 4th mapped object	RW	U32	Ν	00060010h

Continues on next page

Index	Sub Index	Function	Access	Туре	PDO Map	Default Value
	0	RX PDO 2 1 mapping/no.of entries	RW	U8	Ν	4
	1	RX PDO 2 1st mapped object	RW	U32	Ν	00060010h
1601 h	2	RX PDO 2 2nd mapped object	RW	U32	Ν	00060010h
	3	RX PDO 2 3rd mapped object	RW	U32	Ν	00060010h
	4	RX PDO 2 4th mapped object	RW	U32	Ν	00060010h
	0	TX PDO 1 comms parameter number of entries	R	U8	Ν	3
1000 1	1	TX PDO1 COB-ID	RW	U32	Ν	40000180h+Node ID
1800 h	2	TX PDO 1 transmission type	RW	U8	Ν	254
ſ	3	TX PDO 1 Inhibit time (100 μs)		U16	Ν	0
	0	TX PDO 2 comms param no. of entries	R	U8	Ν	3
1001	1	TX PDO 2 COB-ID	RW	U32	Ν	C0000280h+Node ID
1801 h	2	TX PDO 2 transmission type	RW	U8	Ν	0
	3	TX PDO 2 Inhibit time (100 μs)	RW	U16	Ν	0
	0	TX PDO 1 mapping/no. of entries	RW	U8	Ν	4
	1	TX PDO 1 1st mapped object	RW	U32	Ν	200A0010h
1A00 h	2	TX PDO 1 2nd mapped object	RW	U32	Ν	200B0010h
	3	TX PDO 1 3rd mapped object	RW	U32	Ν	200D0010h
	4	TX PDO 1 4th mapped object	RW	U32	Ν	20100010h
	0	TX PDO 2 mapping/no. of entries	RW	U8	Ν	4
	1	TX PDO 2 1st mapped object	RW	U32	Ν	20110010h
1A01h	2	TX PDO 2 2nd mapped object	RW	U32	Ν	20120010h
	3	TX PDO 2 3rd mapped object	RW	U32	Ν	20130010h
		TX PDO 2 4th mapped object	RW	U32	Ν	20140010h

### 9.2 Additional information relating to CAN or Modbus or both

#### 9.2.1 Drive control word format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
High byte									Low	byte					

Bit 0: Run/Stop command: Set to 1 to enable the drive. Set to 0 to stop the drive.

**Bit 1:** Fast stop request. Set to 1 to enable drive to stop with 2nd deceleration ramp.

Bit 2: Reset request. Set to 1 in order to reset the drive if drive is under trip condition.

User must clear this bit when drive is under normal condition to prevent un-expected reset.

Bit 3: Coast stop request. Set to 1 to issue a coast stop command.

For normal operation, Bit 3 has the highest priority, bit 0 has the lowest priority (bit 3>bit 1>bit 0). For example if user set command as 0x0009, drive will do a coast stop rather than run. For normal run/start, just set this register to 1.

**NOTE** Start/stop (bit 0), fast stop (bit 1) and coast stop (bit 3) only works if P-31= 0 or 1. Otherwise, start/stop function is controlled by drive control terminals. Reset function (bit 2) works all the time as long as drive is operated under Modbus control mode (P-12 = 3 or 4).

#### 9.2.2 Speed Reference Format

Speed reference value is transferred with one decimal place (200 = 20.0 Hz). The maximum speed reference value is limited by P-01. Either register 2 or register 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

#### 9.2.3 Acceleration/Deceleration Ramp Time

Active only when P-12 = 4, this register specifies the drive acceleration and deceleration ramp time. The same value is applied simultaneously to the acceleration and deceleration ramp times. The value has two decimal places, e.g. 500 = 5.00 seconds.

#### 9.2.4 Drive status and error code Word

High byte gives drive error code. (Valid when the drive is tripped, see 0 for further details)

Low byte gives drive status information as follows:

Bit 0: 0 = Drive Stopped, 1 = Drive Running

Bit 1: 0 = OK, 1 = Drive Tripped

Bit 5: 0 = OK, 1 = In Standby Mode

Bit 6: 0 = Not Ready, 1 = Drive Ready to Run (not tripped, hardware enabled and no mains loss condition)

## 10 Technical data

#### **10.1 Environment**

Ambient operating temperature range: -10 ... 40 °C (frost- and condensation-free)Ambient storage temperature range: -40 ... 60 °CMaximum altitude: 2000 m Reduction at 1000 m: 2.5% / 100 mMaximum humidity: 95%, non-condensing

### 10.2 Rated output table

Size	kW	HP	Input current	Fuse / MCB (type B)		Maximum cable size		Output current	Recommended brake
									resistance
				Non-UL	UL	mm	AWG	Α	Ω
200 – 240 (+/- <sup>-</sup>	10%) V 1	-phas	e input, 3-pha	ase output					
A	0.37	0.5	3.7	10	6	8	8	2.3	-
A	0.75	1	7.5	10	10	8	8	4.3	-
A	1.5	2	12.9	16	17.5	8	8	7	-
В	1.5	2	12.9	16	17.5	8	8	7	100
В	2.2	3	19.2	25	25	8	8	10.5	50
380 – 480 (+/- <sup>-</sup>	10%) V 3	8-phas	e input, 3-pha	ase output					
A	0.75	1	3.5	6	6	8	8	2.2	-
A	1.5	2	5.6	10	10	8	8	4.1	-
В	1.5	2	5.6	10	10	8	8	4.1	250
В	2.2	3	7.5	16	10	8	8	5.8	200
В	4	5	11.5	16	15	8	8	9.5	120
С	5.5	7.5	17.2	25	25	8	8	14	100
С	7.5	10	21.2	32	30	8	8	18	80
С	11	15	27.5	40	35	8	8	24	50
D	15	20	34.2	40	45	16	5	30	30
D	18.5	25	44.1	50	60	16	5	39	22
D	22	30	51.9	63	70	16	5	46	22

**Note** The cable sizes shown correspond to the maximum possible sizes that may be connected to the drive controller. Cables should be selected at the time of installation and in accordance with the local wiring codes or guidelines.

#### 10.3 Single-phase operation of three-phase drive controllers

All drive controllers designed for a three-phase mains supply can be operated in single-phase networks with up to 50% of the rated output current.

In such cases, the AC power supply should only be connected to terminals L1 (L) and L2 (N).

## 10.4 Additional information on UL conformity

VERTIMO is designed to comply with UL requirements. To ensure full compliance, the following must be fully observed.

Requirements on the in	nput power supply					
Supply voltage	200 – 240 RMS volts for units which have been rated as 230 volts, permissible deviation of +/- 10%. Maximum of 240 RMS volts					
	380 – 480 RMS volts for units which have been rated as 400 volts; permissible deviation of +/- 10%, maximum of 500 RMS volts					
Asymmetry	Maximum of 3% voltage de	viations permitted betw	een phase-to-phase volt	age		
	All VERTIMO variants have phase asymmetry monitoring. A phase asymmetry of > 3% results in the drive controll shutting down in response to an error. For input supplies with a supply asymmetry of more than 3% (usually the Indian sub-continent & parts of Asia-Pacific, including China), KOSTAL Industrie Elektrik recommends installing input coils.					
Frequency	50 - 60 Hz +/- 5% deviation	ו				
Short-circuit power	Voltage value	Min. kW (HP)	Max. kW (HP)	Maximum short-circuit current		
	230 V	0.37 (0.5)	11 (15)	100 kA RMS (AC)		
	400 / 460 V	0.75 (1)	22 (30)	100 kA RMS (AC)		
	All drive controllers in the ta maximum short-circuit curro voltage, as long as protection	ble above are suitable f ent values stated above on with fuses of class J	or use with a mains grid in amps, symmetrically is provided.	that is able to supply no more than the with the specified maximum supply		
Requirements regardir	ng mechanical installation					
All VERTIMO variants ar	e intended for installation in c	ontrolled environments	that meet the limit condi	tions shown in Section 10.1.		
The drive controller can	be operated within the tempe	erature range specified ir	n the Section 10.1.			
IP66 (NEMA 4X) units; ir	stallation permitted in enviror	nments with degree of c	ontamination 2.			
Requirements on the e	lectrical installation					
The input current supply	connection must correspond	to Sections 4.4 and 4.5	5.			
Suitable power and mot local codes.	or cables should be selected	in accordance with the o	data shown in Section 10	0.2 and the NEC or other applicable,		
Motor cable	A 75 °C copper cable type	must be used.				
Mains cable connection	and torque are shown in Sec	tions 3.3.				
Integrated "solid-state" compliance with the NE	short-circuit protection does C and additional local codes.	not provide branch circu Rated values are showr	uit protection. Branch cire	cuit protection must be provided in		
Temporary overvoltage to phase), must be suita that withstands 4 kV.	protection must be installed of ble for overvoltage category l	n the grid side of the de Il and must provide prot	evice, must be 480 volts rection in the event of a r	(phase to ground) and 480 volts (phase rated surge voltage with a voltage peak		
UL-listed cable shoes m	ust be used for all bus bars a	nd grounding connectio	ns.			
General requirements						
The VERTIMO provides	motor overload protection in	accordance with NEC (L	JSA).			
In cases where no motor thermistor is connected or used, monitoring of the thermal overload memory must be activated by means of the setting P-50 = 1.						
If a motor resistor is connected and this is connected to the drive controller, the connection must be set up in accordance with the information given in the section "Motor thermistor connection" of this quick setup guide.						
UL-compliant ingress protection ("type") is only given if the cables are installed using a UL-recognised gland bush or inlet fitting for a flexible line system that satisfies the required degree of protection.						
In the case of electrical installation conduit systems, all glands must have the values specified by NEC.						

Not intended for installation with rigid cable conduit systems.

## 10.5 EMC filter disconnect

Drives with an EMC filter have an inherently higher leakage current to Ground (Earth). For applications where tripping occurs the EMC filter can be disconnected (on IP20 units only) by completely removing the EMC screw on the side of the product.

#### Remove the screw as indicated right

The Optidrive product range has input supply voltage surge suppression components fitted to protect the drive from line voltage transients, typically originating from lightning strikes or switching of high power equipment on the same supply.

When carrying out a HiPot (Flash) test on an installation in which the drive is built, the voltage surge suppression components may cause the test to fail. To accommodate this type of system HiPot test, the voltage surge suppression components can be disconnected by removing the VAR screw After completing the HiPot test, the screw should be replaced and the HiPot test repeated. The test should then fail, indicating that the voltage surge suppression components are once again in circuit.



## **11 Problem solving**

## 11.1 Messages relating to the error codes

Error codes	No.	Description	Proposed remedy
no-Fit	00	No error	Not needed
01-ь	01	Brake channel overcurrent	Check condition of external brake resistor and connection (wiring).
OL-br	02	Overload of brake resistor.	The drive controller has switched off by means of a shutdown in response to an error in order to prevent damage to the brake resistor.
0-1	03	Overcurrent at output.	Temporary overcurrent at drive controller output. Excessive load or shock loading of motor. Note: The drive controller cannot be reset immediately after a shutdown in response to an error. An integrated time delay should enable error rectification and/or prevent damage to the drive controller.
I_t-trP	04	Motor thermally overloaded (I2t).	After more than 100% of the value in P-08 was provided for a certain amount of time, a shutdown in response to error was triggered for the converter to prevent damage to the motor.
P5-ErP	05	Power level of shutdown in response to error.	Check for short circuits on motor and connecting cables.
0-volt	06	Intermediate circuit overvoltage	Check whether the supply voltage is within the permitted tolerance for the drive controller. If the error occurs during a delay or stopping, increase the delay time in P-04 or install an appropriate brake resistor and activate the dynamic brake function with P-34.
U-vort	07	Intermediate circuit undervoltage	The incoming supply voltage is too low. This error occurs routinely when shutting down the current of the drive controller. If this happens during operation, check the input voltage and all components in the supply line for the grid feed-in heading towards the drive controller.
0-t	08	Overheating of the cooling element	The drive controller is too warm. Check whether the ambient temperature around the drive controller is within its specifications. Ensure that sufficient cooling air can circulate around the drive controller. Increase the housing ventilation, if necessary. Ensure that sufficient cooling air can get into the drive controller, and that the lower inlet vents and upper outlet vents are not blocked or clogged up.
U-F	09	Undertemperature	This error occurs at an ambient temperature of less than -10 °C. To start the drive controller, this value must be increased to above -10 °C.
P-dEF	10	The default parameters set in the factory were loaded.	
E-tr iP	11	External shutdown in response to error	E-trip queried at digital input 3. A normally closed contact has opened for some reason. If there is a motor thermistor connected, check whether the motor is too warm.
50-065	12	Loss of communication on internal bus	Check the communication connection between the drive controller and external devices. Ensure that every drive controller in the network has its own address.
FLE-dc	13	DC ripple too high	Check that all incoming supply phases are present and symmetrical.
P-L055	14	Error in event of loss of the input phase	Check that all incoming supply phases are present and symmetrical.
h 0-1	15	Overcurrent at output.	Check for short circuits on motor and connecting cables. <b>Note</b> : The drive controller cannot be reset immediately after a shutdown in response to an error. An integrated time delay should enable error rectification and/or prevent damage to the U drive controller.
Eh-FLE	16	Defective thermistor at cooling element	
dAFu- L	17	Internal memory error. (IO)	Press the Stop key. Should the error persist, please contact your supplier.
4-20 F	18	4-20 mA signal lost	Check the analogue input connection/connections.
dAF4-E	19	Internal memory error. (DSP)	Press the Stop key. Should the error persist, please contact your supplier.
F-Ptc	21	Error at motor PTC thermistor input	Overheating of connected motor thermistor, check cabling connections and motor.
FAn-F	22	Cooling fan error (IP66 only)	Check/replace the cooling fan.
D-HEAF	23	Internal drive controller temperature too high	Ambient temperature of drive controller too high, check whether appropriate cooling is being provided.

Continues on next page

	No	Description	Proposed remedy
OUL-F	26	Output error	Indicates an error at the drive controller's output, such as a missing phase, unbalanced motor phase currents etc. Check the motor and connections.
AFE-01	40	Auto-tune error	The motor parameters measured by the auto-tune are not correct.
AFE-05	41		Check the motor cable and connections for continuity.
AFE-03	42		Check that all three phases of the motor are present and symmetrical.
AFE-DA	43		
AFE-02	44		
5C-FO I	50	Error due to loss of communication on Modbus	Check the incoming Modbus RTU connection cable. Check whether at least one register is being queried in cycles within the timeout limit set in P-36 index 3.
SC-F02	51	Shutdown in response to error due to loss of CANopen communication	Check the incoming CAN connection cable. Check whether cyclic communication is taking place within the timeout limit set in P- 36 index 3.

Note: Following an over current or overload trip (3, 4, 5, 15), the drive may not be reset until the reset time delay has elapsed to prevent damage to the drive.

### 11.2 Resetting a fault

When the drive trips, and a fault message is displayed, it can be reset in one of the following ways:

- X Completely remove the incoming power supply, and allow the power to power off completely. Re-apply the power.
- X Remove and reapply the enable input.
- X Press the stop / Reset button.
- X If Modbus or CAN are in use, set the reset bit in the control word from 0 to 1.

In the event of O-I, hO-I or I.t-trp faults, in order to prevent damage that may occur through repeatedly enabling the drive into a fault condition, these trips cannot be reset immediately. A delay time according to the following table must be allowed before reset is possible.

First Trip	2 seconds delay before reset is possible
Second Trip	4 seconds delay before reset is possible
Third Trip	8 seconds delay before reset is possible
Fourth Trip	16 seconds delay before reset is possible
Fifth Trip	32 seconds delay before reset is possible
Subsequent Trips	64 seconds delay before reset is possible

# Smart connections.

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