Hardware and Engineering

DE6-IOM-ENC
Encoder Interface Module

01/04 AWB8240-1431GB

1st published 2004, edition date 01/04

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Warning!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit the device.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- Depending on their degree of protection, frequency inverters may contain live bright metal parts, moving or rotating components or hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may cause the failure of the device and may lead to serious injury or damage.
- The applicable national accident prevention and safety regulations apply to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.

- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
  - Other independent devices for monitoring safety-related variables (speed, travel, end positions etc.).
  - Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).
  - Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs.

Contents

About this Manual

This manual describes the DE6-IOM-ENC encoder interface module.

This manual contains special information that you need for configuring, installing and operating the DE6-IOM-ENC encoder interface module in connection with the DV6 frequency inverters.

The features, parameters and functions are described in detail, with examples for the most important applications. All information applies to the specified hardware and software versions.

This manual is available as a PDF file on the Drives Centre CD, which is supplied as standard with all DF5, DV5, DF6 and DV6 series frequency inverters. To view the file, you need a PC with Windows 95, 98, ME, 2000, NT or XP.

You can also download this manual from the Internet at:
ftp://ftp.moeller.net/DRIVES/index.html

Abbreviations and symbols

The following abbreviations and symbols are used in this manual:

ACR	Closed-loop current control (**A**utomatic **C**urrent **R**egulation)
APR	Closed-loop position control (**A**utomatic **P**osition **R**egulation)
ASR	Closed-loop speed control (**A**utomatic **S**peed **R**egulation)
AVR	Closed-loop voltage control (**A**utomatic **V**oltage **R**egulation)
DS	**D**efault **s**ettings
EMC	**E**lectro**m**agnetic **c**ompatibility
ESD	**E**lectro**s**tatic **d**ischarge
PES	**P**ositive **e**arth connection of the cable **s**creen
PNU	**P**arameter**nu**mber
ro	**R**ead-**o**nly parameter value
rw	**R**ead/**w**rite parameter value

All measurements are in millimetres unless otherwise stated.

In some of the illustrations, the enclosure of the frequency inverter and other components affecting equipment safety have been omitted for improved clarity. During operation, however, the enclosure and all components that affect equipment safety must always be correctly fitted.

Before installing and operating the DE6-IOM-ENC encoder interface module, thoroughly read this manual as well as the manual of the associated DV6 frequency inverter. We assume that you have a good working knowledge of engineering fundamentals and that you are familiar with electrical systems and principles and can correctly interpret and apply the information contained in technical drawings.

▶ Indicates instructions to be followed

→ Indicates useful tips and additional information

Caution!
Warns of a hazardous situation that could result in damage to the product or components.

Caution!
Warns of the possibility of major material damage and minor injury.

Warning!
Warns of the possibility of major material damage and serious or fatal injury.

To improve legibility, the title of the current section is given at the top of each left-hand page and the current subsection at the top of each right-hand page. The two exceptions are the title page of each section and the blank pages at the end of each section.

1 About the module

System overview

The DE6-IOM-ENC encoder interface module is an optional add-on for the DV6 series vector frequency inverters. The illustration below shows additional components of the DV6 series.

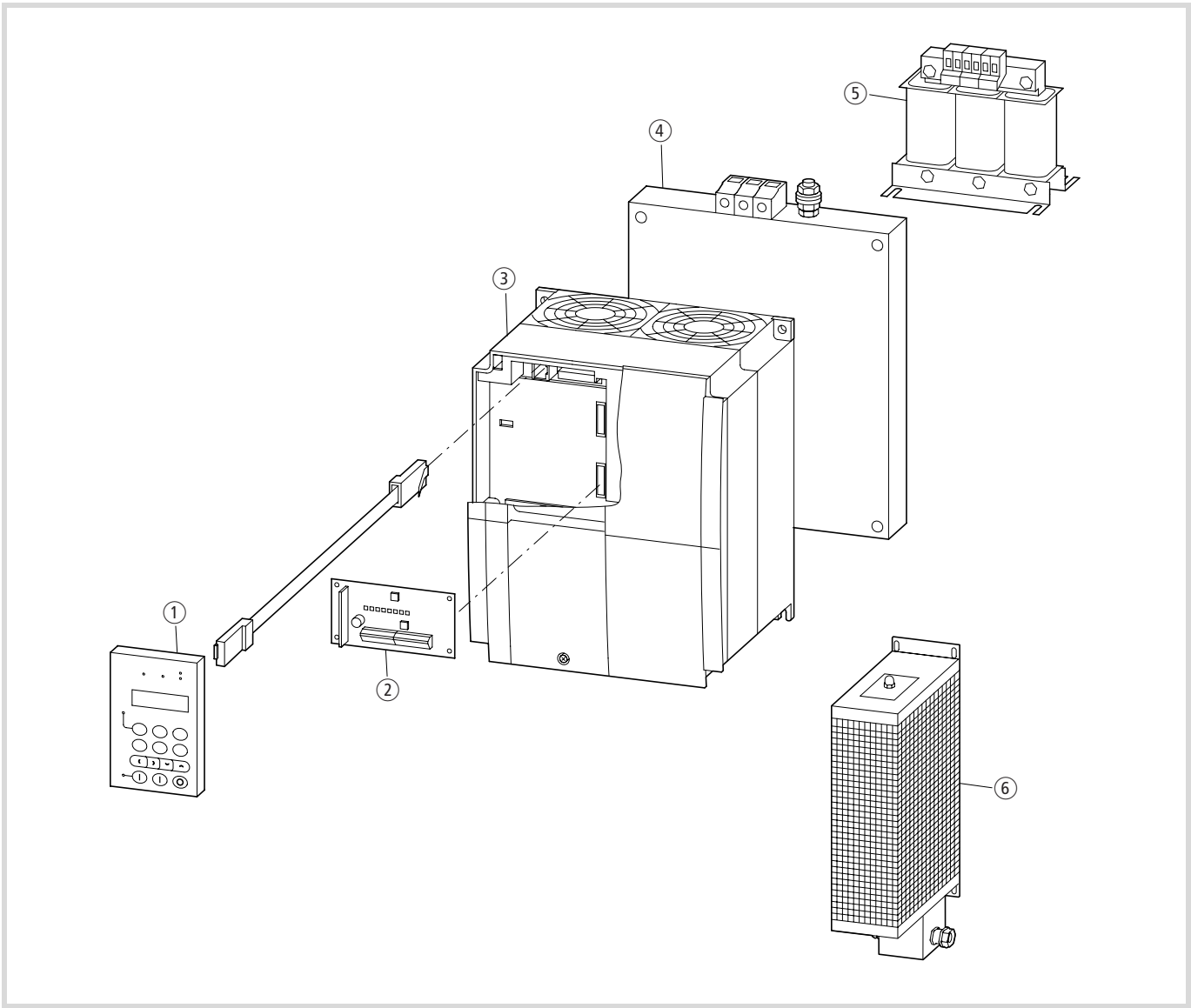


Figure 1: System overview

① DEX-KEY-10 external keypad
② Expansion module, for example DE6-IOM-ENC
③ DV6 frequency inverter
④ DE6-LZ... RFI filter
⑤ Mains choke
⑥ Braking resistor

Type code

Key to type references and type designation for the encoder module:

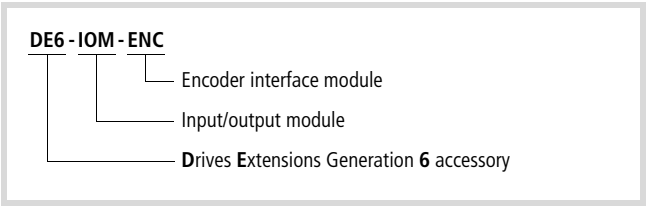


Figure 2: Key to DE6-IOM-ENC type reference

Equipment supplied

The DE6-IOM-ENC encoder interface module is packaged and dispatched with great care. The device must be transported only in its original packaging with suitable means of transportation. Observe the instructions and the warnings on the side of the packaging. This also applies after the device has been removed from its packaging.

▶ Open the packaging with suitable tools and inspect the contents immediately on receipt to ensure that they are complete and undamaged.

The package should contain the following items:

- One DE6-IOM-ENC encoder interface module
- The installation instructions, AWA8240-1955
- Two ferrite rings
- Two fixing screws (M3 × 8 mm).

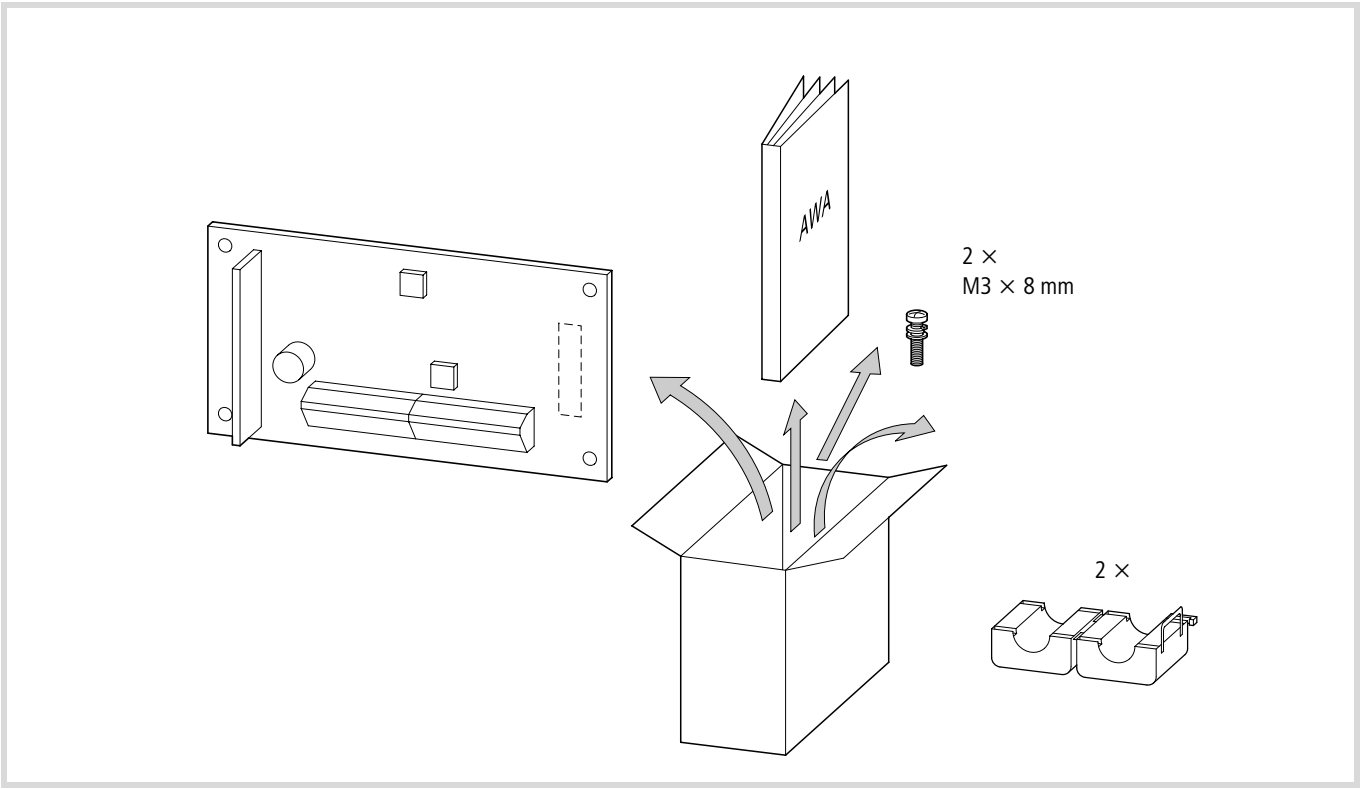


Figure 3: DE6-IOM-ENC package contents

Setup

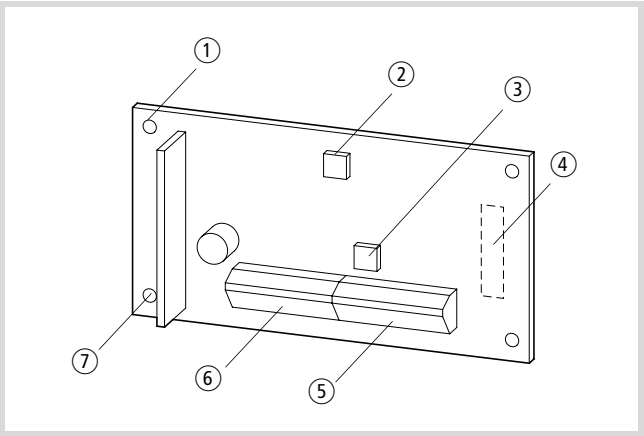


Figure 4: Designation of the DE6-IOM-ENC

① Hole for the fixing screw (M3 × 8 mm)
② DIP switch SWENC, activates open-circuit monitoring of the encoder connection cables at TM1
③ DIP switch SWR, activates the terminating resistors at TM2
④ Plug connector to the DV6 vector frequency inverter
⑤ TM2, terminal strip (reference value input, actual value output)
⑥ TM1, terminal strip (encoder actual value input)
⑦ Hole for fixing the module to the plastic pins in the DV6.

Manufacturer's Declaration

In industrial use, the DE6-IOM-ENC encoder interface module is termed "device" or "module". It is a component, and not a stand-alone or connectable device as defined in the EC Machinery Safety Directive. Its mode of operation is defined only through its integration in the user's system.

The user is responsible for ensuring that the system into which the device is incorporated complies with the applicable legal requirements.

Intended use

The DE6-IOM-ENC encoder interface module must be used only as an add-on for DV6 series vector frequency inverters.

Any other usage constitutes improper use.

The DE6-IOM-ENC does not have independent functionality and achieves its function only through its connection to a DV6 and in combination with an incremental encoder.

Used together with an encoder, the DE6-IOM-ENC can read the speed of a motor or machine component and – using the DV6 vector frequency inverter – balance out any speed error. In addition to regulating the speed of individual drives, the DE6-IOM-ENC can provide synchro control (electrical shaft) and ratio control (electrical drive) of multiple motors.

Operate the DE6-IOM-ENC module only in perfect working condition. Changes or modification are prohibited.

Use the DE6-IOM-ENC module only under the operational conditions described in this manual.

This manual must be made available to all persons that work with the DE6-IOM-ENC module. It must be kept complete and in a clearly readable condition at all times.

Disposal

The PCB with fitted components of the DE6-IOM-ENC encoder interface module consists of a range of different materials that must be separated for disposal.

The following materials can be recycled:

- Packaging
- Installation instructions (AWA)
- Screws and ferrite rings
- Plastic parts

Features of the encoder interface module

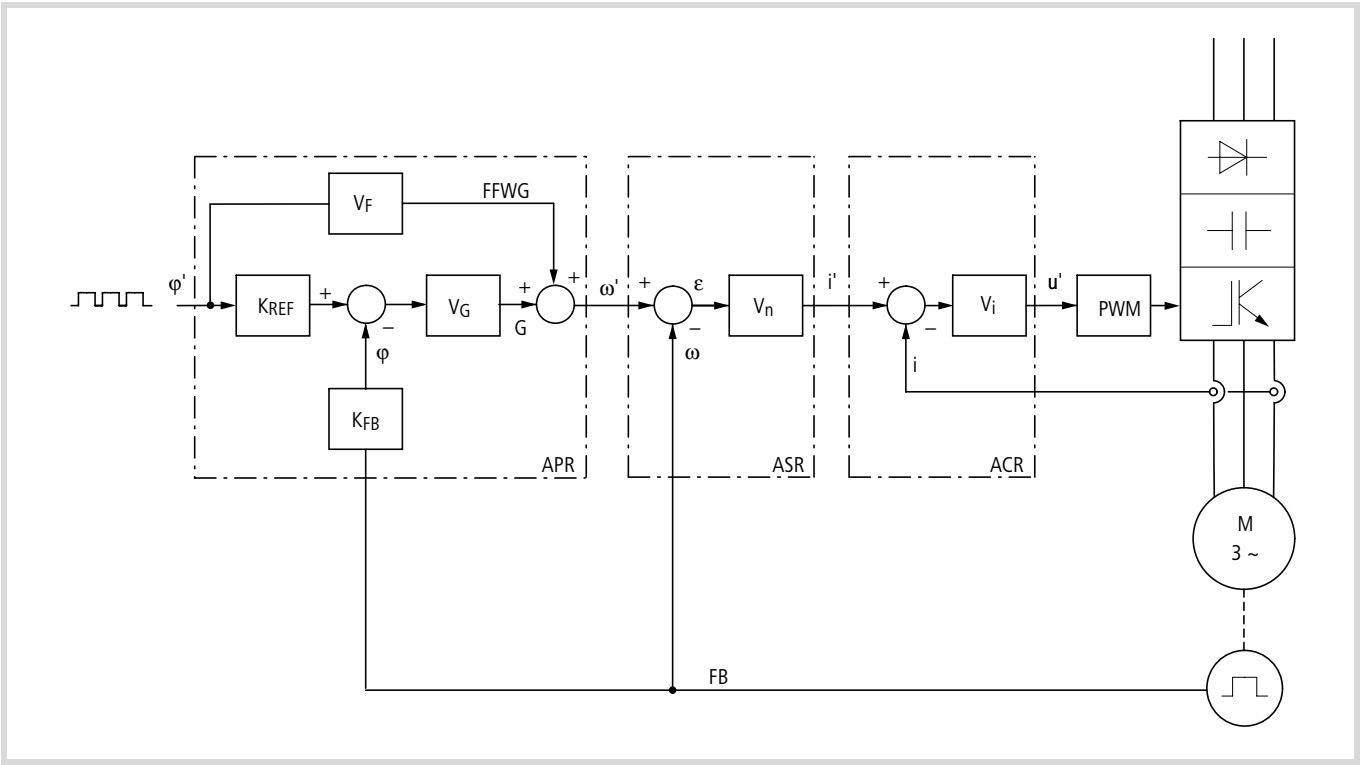


Figure 5: Block diagram

To activate the encoder interface module, set PNU A044 to 05 [V2]. The DV6 frequency inverter can now be operated in two control modes, which you can select with PNU P010:

- PNU P010 = 00
  Closed-loop speed control (ASR)
- PNU P010 = 01
  Closed-loop position control (APR)

In ASR mode, the speed reference value ω' is provided as an analog or digital value. Any speed error $\varepsilon = \omega' - \omega$ is automatically corrected by the speed controller V_n.

For APR, reference value φ' is provided as a pulse signal (master) and transmitted through amplifier V_F as a feed-forward gain (FFWG) signal. Position errors $\varphi' - \varphi$ are corrected automatically through control circuit gain V_G. Compensation for transmission and reduction ratios is made possible by the electronic drive with K_{REF} in the reference value or K_{FB} in the actual value.

2 Installation

Installation DE6-IOM-ENC in the DV6 frequency inverter

Warning!
Before you open the enclosure of the DV6 frequency inverter and perform the installation steps described below, make sure that the power has been disconnected and the DV6 is no longer live.

ESD measures
Protect your devices and assemblies from electrostatic discharge.
Before touching electronic assemblies or devices, discharge yourself and any tools on an earthed surface.

Caution!
Before you fit or remove the module, make sure that none of the devices are live.

Caution!
Do not apply force when performing any of the actions described here.

▶ Take off the lower enclosure cover.

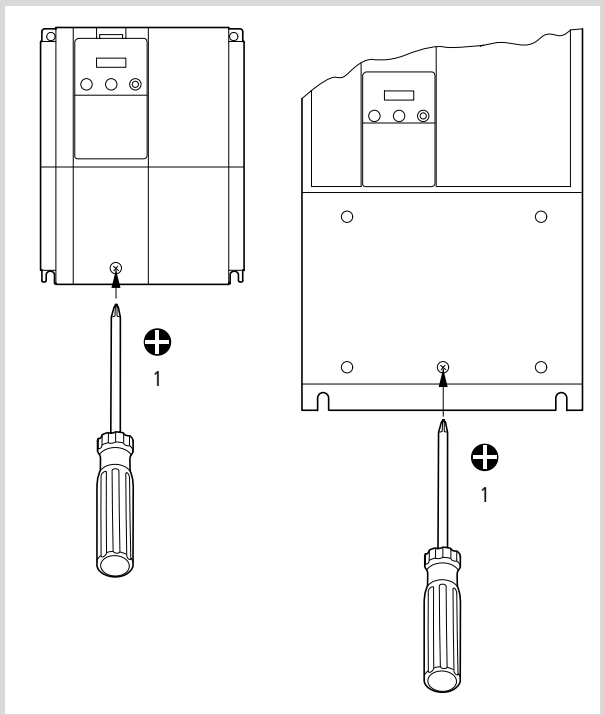


Figure 6: Removing the lower enclosure cover

▶ Remove the upper enclosure cover as follows:
- Take off the operator panel and the panel blanking cover, 1 and 2.
- Undo the screws of the upper enclosure cover 3.
- Take off the upper enclosure cover 4.

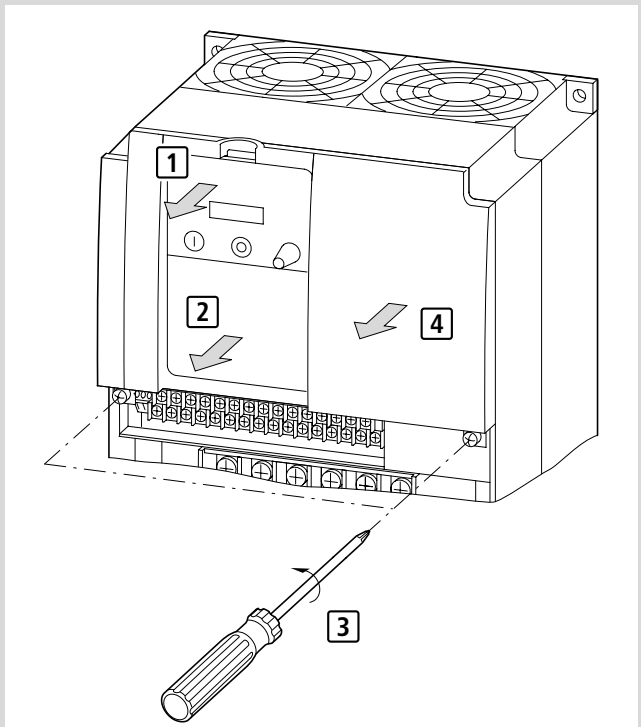


Figure 7: Removing the upper enclosure cover

▶ Choose one of the two add-on module slots.

→ If you are also planning to fit the DE6-NET-DP PROFIBUS DP interface card to the frequency inverter, use the upper slot for the DE6-IOM-ENC.

▶ Secure the DE6-IOM-ENC to the two plastic pins by
– inserting the plug connector to the DV6 and
– securing it with the two screws (M3 × 8 mm, included with product).

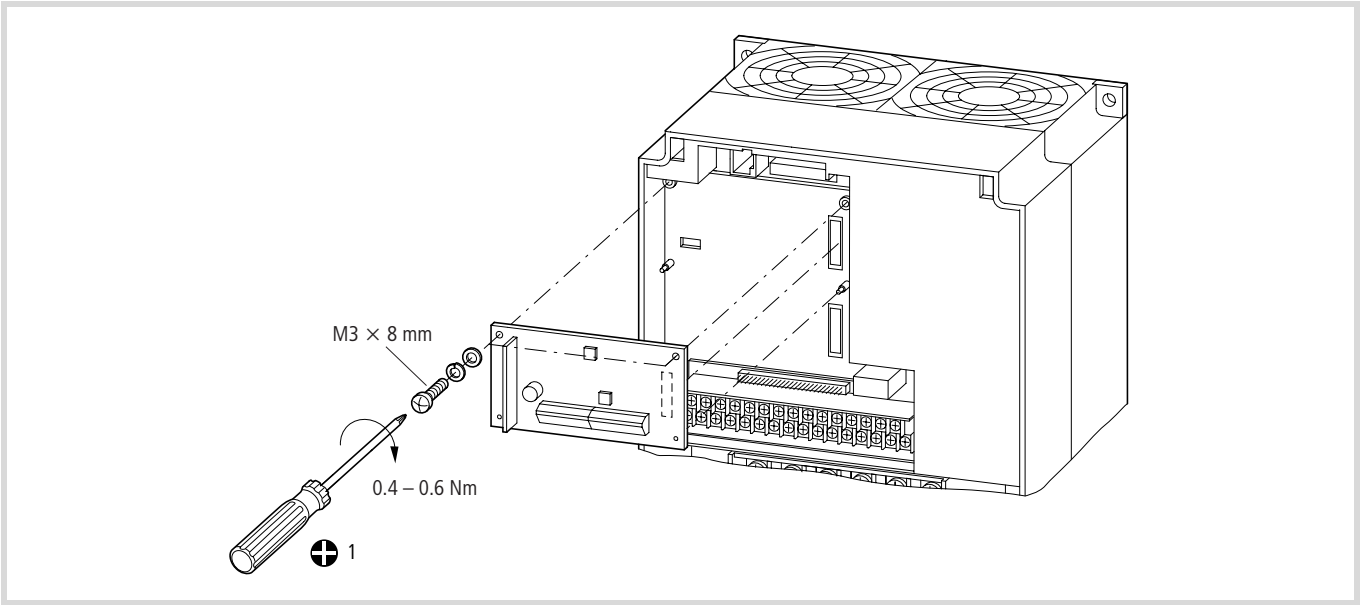


Figure 8: Fitting the DE6-IOM-ENC

Electrical connection

Terminal assignment, TM1 and TM2

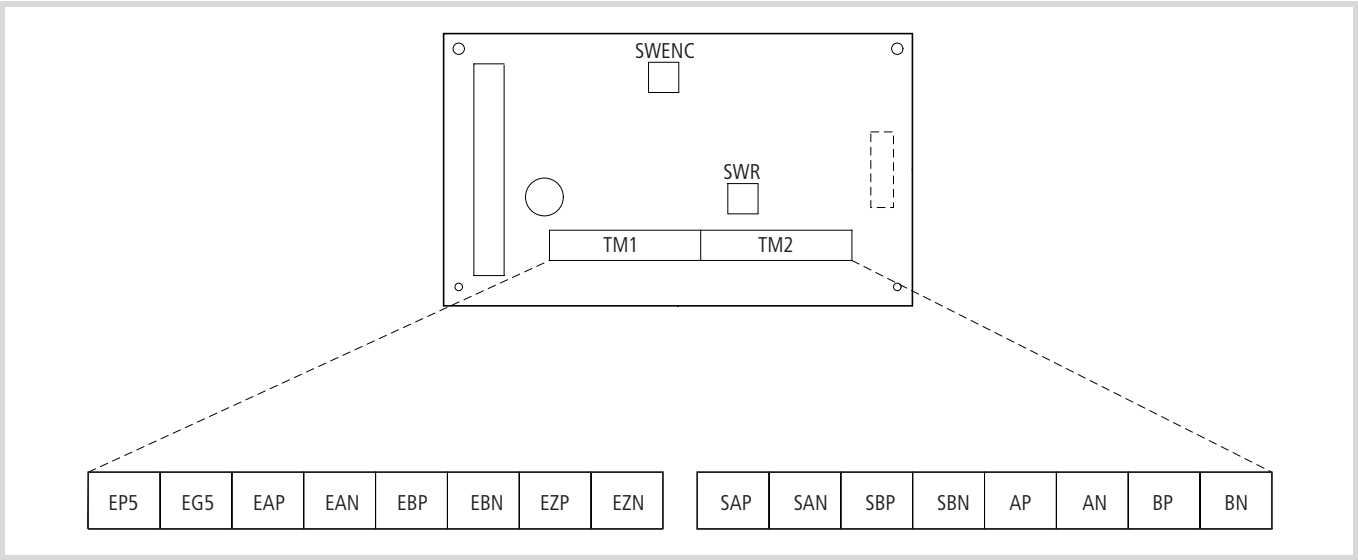


Figure 9: Terminal assignment

Terminal	Function	Remark	Specification
EP5	Output: Supply voltage for incremental encoder	+ 5 V ⎓ (EP5)	5 V ⎓,
EG5		Reference potential (EG5)	max. 150 mA
EAP	Channel A, signal A (→ fig. 10)	Actual value input, incremental encoder	5 V ⎓,
EAN	Channel A, signal $\overline{A}$ (→ fig. 10)		R_i = 4.7 kΩ,
EBP	Channel B, signal B (→ fig. 10)		(optocoupler input)
EBN	Channel B, signal $\overline{B}$ (→ fig. 10)		Transistor–transistor logic (TTL) with inverted signals, based on RS 422 standard
EZP	Channel Z, signal Z (→ fig. 10)	Signals Z and $\overline{Z}$ are required only for the orientation function.	
EZN	Channel Z, signal $\overline{Z}$ (→ fig. 10)		
SAP	Channel A, signal A	Setpoint value input Pulse pattern as for inputs EAP to EBN Pulse train input (slave) from a leading master signal, such as encoder or output signal from another frequency inverter: DE6-IOM-ENC: AP, AN, BP, BN (→ section "Setpoint input through pulse train inputs SAP, SAN, SBP and SBN", page 37).	5 V ⎓, Bus terminating resistor, 150 kΩ (SWR-1-2), Transistor–transistor logic (TTL) with inverted signals, based on RS 422 standard
SAN	Channel A, signal $\overline{A}$		
SBP	Channel B, signal B		
SBN	Channel B, signal $\overline{B}$		
AP	Channel A, signal A	Output signal: The signals applied to the actual value input (EAP to EBN) are output 1:1 here, for example for actuating a slave drive	5 V ⎓, Transistor–transistor logic (TTL) with inverted signals, based on RS 422 standard
AN	Channel A, signal $\overline{A}$		
BP	Channel B, signal B		
BN	Channel B, signal $\overline{B}$		

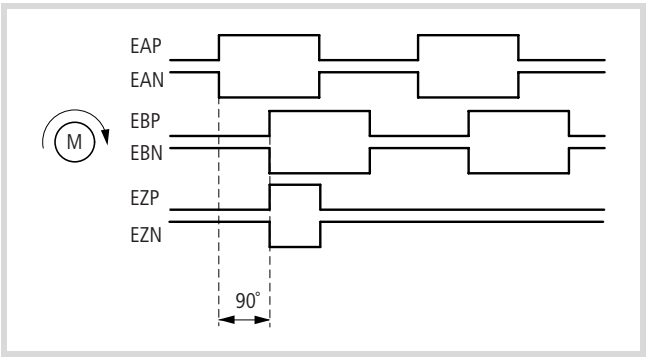


Figure 10: DE6-IOM-ENC input signals

DIP switches SWENC and SWR

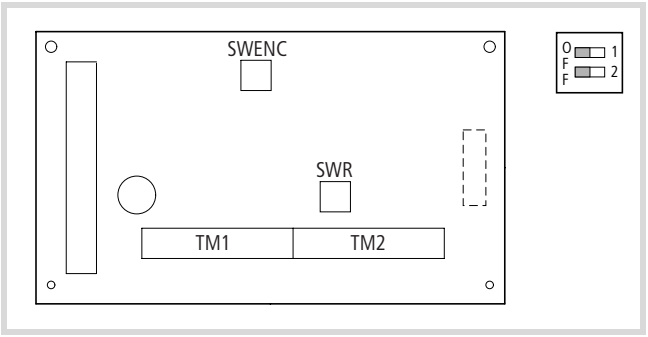


Figure 11: DIP switches: SWENC and SWR

DIP switch		Function		DS
SWENC	-1	ON	Open-circuit monitoring for channel A (EAP, EAN) and channel B (EBP, EBN) active	OFF
		OFF	Open-circuit monitoring for channel A (EAP, EAN) and channel B (EBP, EBN) not active	
	-2	ON	Open-circuit monitoring for channel Z (EZP, EZN) active	OFF
		OFF	Open-circuit monitoring for channel Z (EZP, EZN) not active	
SWR	-1	ON	Terminating resistor (150 Ω) connected between SAP and SAN.	OFF
		OFF	No terminating resistor between SAP and SAN.	
	-2	ON	Terminating resistor (150 Ω) connected between SBP and SBN.	OFF
		OFF	No terminating resistor between SBP and SBN.	

→ Make sure that the sensor phase sequence matches the phase sequence of the motor's U, V and W power connections.

→ Use only screened cables, for example "servo cables", to connect the motor.

Selection checklist for DIP switches SWENC and SWR
By default, all switches are set OFF.

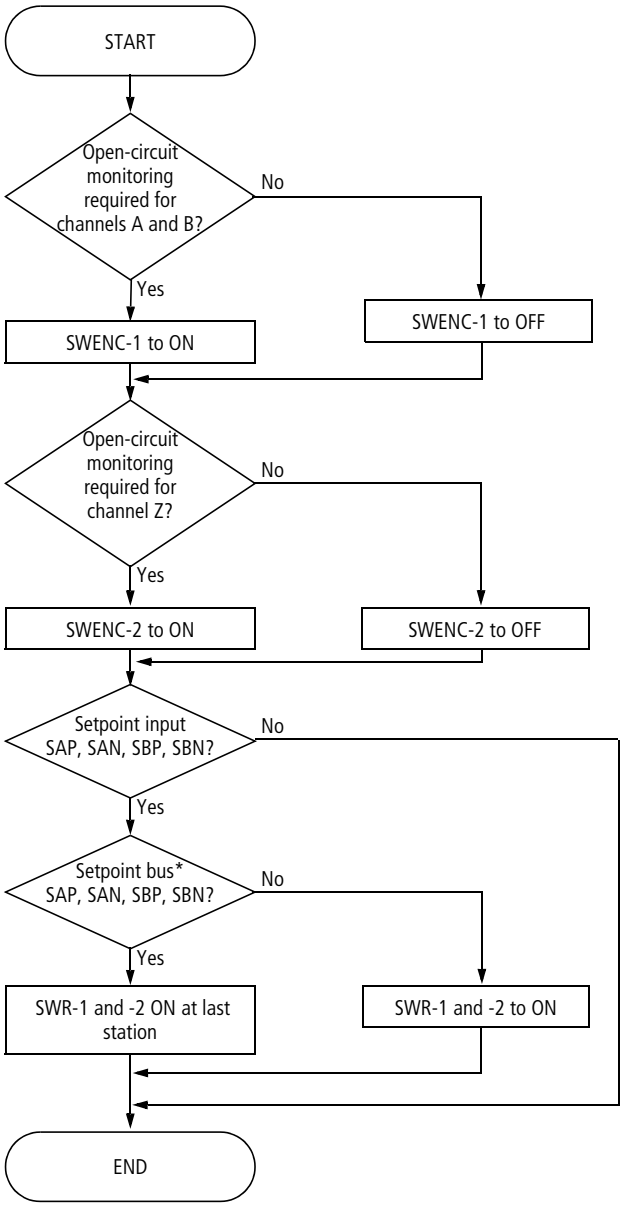


Figure 12: Checklist for drive-specific settings

* → fig. 16, page 17

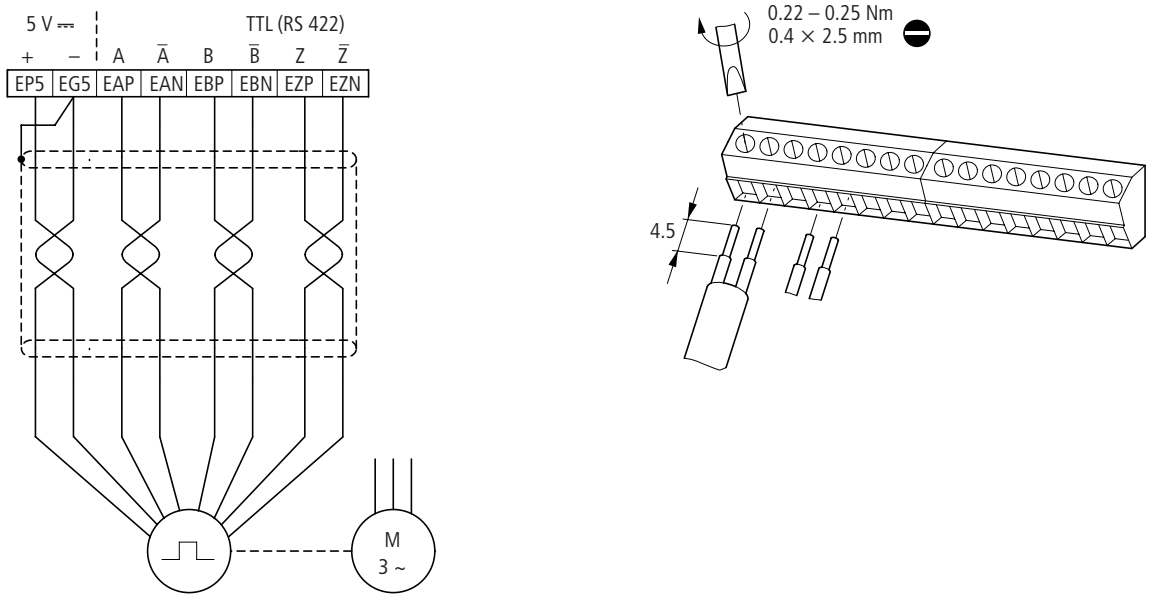


Figure 13: Connection example, control signal terminals TM1

n	mm²	mm²	AWG	mm²	mm²
1 ×	0.14 to 1.0	0.14 to 1.5	26 to 16	0.25 to 0.5	0.25 to 0.5
2 ×	0.14 to 0.2	0.14 to 0.5	–	0.25 to 0.5	0.25 to 0.5

EMC compliance

To achieve good interference immunity and fault-free operation, observe the following additional points:

- The insulated strands of the signal cable should be twisted.
- The screen braid of the signal cable must be insulated (with a rubber sleeve) at the encoder end. It must **not** be connected with PE. At the frequency inverter (DE6-IOM-ENC) end, connect the screen braid to the potential of terminal EG5.

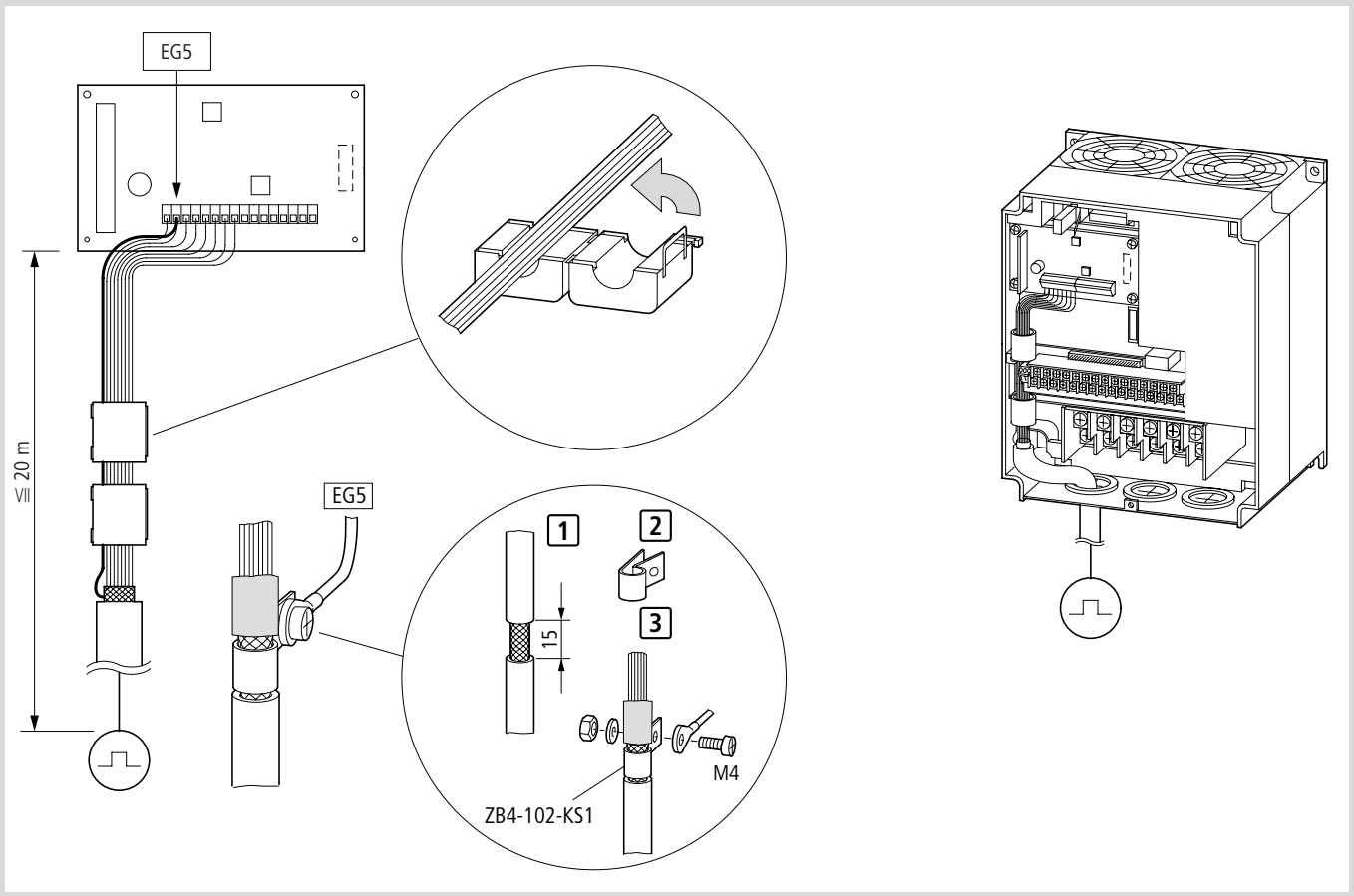


Figure 14: Connection and installation

→ The ZB4-102-KS1 mounting accessories are not supplied with the product and must be ordered separately (Order No.: 081038).

To increase interference immunity, feed the strands of the signal cable to the DE6-IOM-ENC through the two ferrite rings (without screen braid). Depending on the signal cable diameter, secure the ferrite rings with cable ties.

If the encoder signals are sent on, for example, to a second DV6 frequency inverter (output terminal AP to BN to input SAP to SBN), separate the ferrite rings (→ fig. 15).

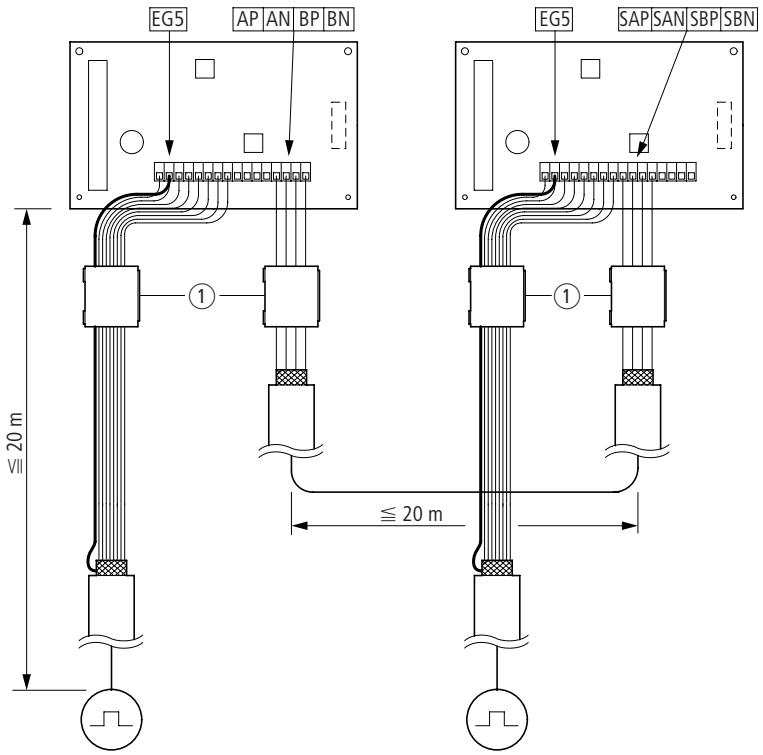


Figure 15: Master–slave operation

① Ferrite rings

To increase interference immunity when you make the connection to input terminals SAP to SBN, switch on the terminating resistors with switch SWR (signal reflection).

→ If several DE6-IOM–ENC units are connected in parallel to a single master through input terminals SAP to SBN (reference value bus), the terminating resistors must be switched on only at the physical end of this bus line, since the bus line signals are otherwise attenuated.

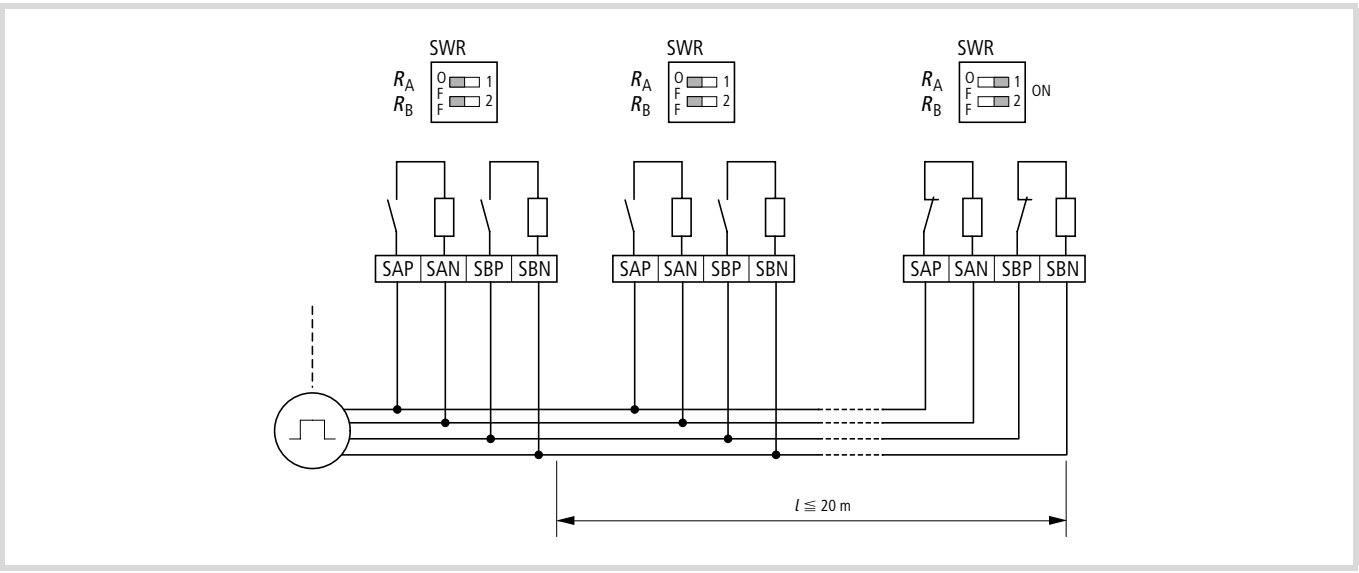


Figure 16: Setpoint value bus

$R_A = R_B = 150\ \Omega$

The cable length should not exceed 20 m. For longer lengths, use larger cross-sections ($\geqq 0.75\ mm^2$) or signal amplifiers.

Keep the distance between the signal lines and the power cables as large as possible ($\geqq 100$ mm) and cross them over only at right angles and only where absolutely necessary.

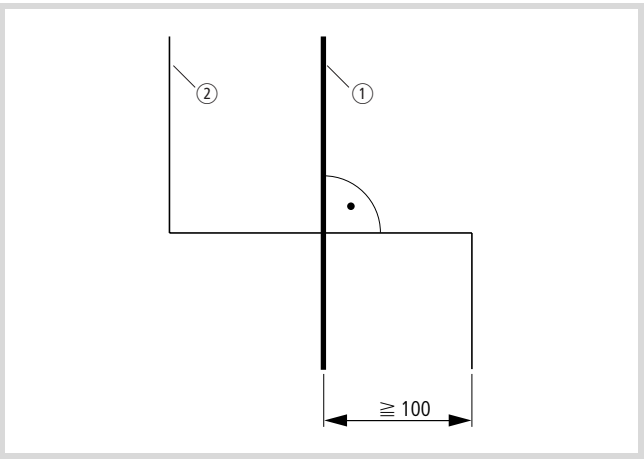


Figure 17: Crossover of signal and power cables

① Power lines: L1, L2, L3, U, V, W, DC+, DC-, BR, etc.

② Signal and control signal lines: H, O, OI, ..., K12, K14 and EP5, EG5, EAP ... BP, BN, etc.

3 Programming the control signal terminals

This section covers only the functions that you can assign to the digital inputs and outputs of the DV6 with fitted DE6-IOM-ENC encoder module. For all other functions, see the DV6 manual, AWB8230-1415..., section "Programming the control signal terminals".

Overview

The following functions can be assigned to digital inputs 1 to 8, digital outputs 11 to 15 or to signalling relay terminals K11, K12 and K14.

Name	Value[1)]	Function	Description	→ page
Digital inputs 1 to 8			Parameterizing PNU C001 to C008	
ORT	45	Orientation	Orientation run for determining the STOP position (zero position).	21
LAC	46	Inhibit ramp function	LAC inhibits the linear acceleration and deceleration ramp.	23
PCLR	47	Clear position error	PCLR clears the position error pulse counter.	24
STAT	48	Setpoint definition through module	STAT switches pulse train inputs SAP, SAN, SBP and SBN to the reference value input of the APR (closed-loop position control).	24
Programmable digital outputs 11 to 15			Parameterizing PNU C021 to C025	
DSE	22	Speed error exceeded	The DSE signal is output when the deviation of the actual speed from the reference value is greater than the value in PNU P027.	26
POK	23	Positioning completed	The POK signal is issued when positioning/orientation is completed.	27
ZS	21	Frequency switching threshold	The ZS signal is output when the actual speed falls below the frequency set with PNU C063.	27

1) Enter this value in the corresponding parameter to activate the function.

Programmable digital inputs 1 to 8

By default, programmable digital inputs 1 to 8 are configured as make contacts. If, therefore, you want to activate the function of an input terminal, you must close the corresponding input (i.e. connect the input terminal to terminal P24). Conversely, to deactivate the input terminal, the input must be opened.

Table 1: Digital inputs 1 to 8

PNU	Terminal	Adjustable in RUN mode		Value	DS
		Normal	Extended		
C001	1	–	✓	→ table 2	18
C002	2				16
C003	3				06
C004	4				11
C005	5				09
C006	6				03
C007	7				02
C008	8				01

For a detailed description of the input functions, see the pages listed in Table 2 of manual AWB8230-1415… for frequency inverter DV6-340-…

Table 2: Functions of the digital inputs

Value	Function	Description	→ page[1)]
01	REV	Start/stop anticlockwise	69
02	FF1	First fixed frequency input	69
03	FF2	Second fixed frequency input	
04	FF3	Third fixed frequency input	
05	FF4	Fourth fixed frequency input	
06	JOG	Jogging mode	79
07	DB	DC braking	88
08	SET	Selection of the second parameter set	86
09	2CH	Second acceleration and deceleration time	74
11	FRS	Motor shutdown and free run stop (coasting)	75
12	EXT	External fault	76
13	USP	Restart inhibit	77
14	CS	Heavy starting duty	91
15	SFT	Parameter protection	83
16	AT	Select analog input	73
17	SET3	Third parameter set	86
18	RST	Reset	78
20	STA	Pulse start (3-wire)	96
21	STP	Pulse stop (3-wire)	96
22	F/R	Direction of rotation (3-wire)	96
23	PID	Activation of PID control	95
24	PIDC	Reset integral component	95
26	CAS	PI controller changeover	87
27	UP	Acceleration (motor potentiometer)	84
28	DWN	Deceleration (motor potentiometer)	84
29	UDC	Reset frequency (motor potentiometer)	84
31	OPE	Setpoint value via keypad	93
32	SF1	Bitwise frequency selection	71
33	SF2		
34	SF3		
35	SF4		
36	SF5		
37	SF6		
38	SF7		
39	OLR	Current limit switch over	90
40	TL	Torque limitation active	94
41	TRQ1	Bitwise control of the torque limits PNU b041 to b044	94
42	TRQ2		94
43	PPI	P or PI control	98
44	BOK	Brake Enable confirmation	100
45	ORT	Orientation	21[2)]
46	LAC	Ramp function off	23[2)]
47	PCLR	Clear positioning error	24[2)]
48	STAT	Setpoint input through add-on module	24[2)]
no	NO	No function	–

1) → manual AWB8240-1415… for vector frequency inverter DV6-340-…

2) This manual

In connection with the DE6-IOM-ENC, you can assign the following functions to digital inputs 1 to 8 of the DV6:

- ORT: Orientation
- LAC: Inhibit ramp function
- PCLR: Clear position error
- STAT: Setpoint definition through module

Orientation (ORT)

If you activate the digital input configured as ORT together with the Start command, DV6 begins the positioning sequence. The ORT function is used mainly for setting the zero position in machining centres.

→ The ORT function requires an encoder with Z-channel.

▶ Program one of the digital inputs 1 to 8 as ORT by entering the value 45 for the corresponding parameter (C001 to C008).

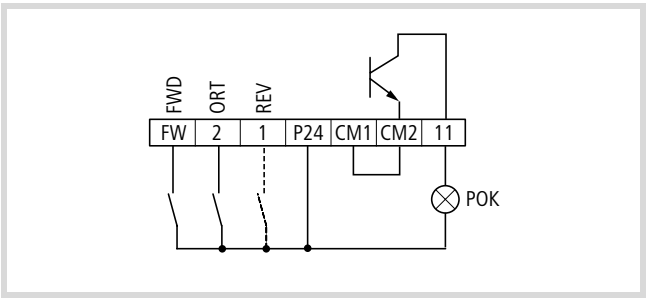


Figure 18: Digital input 2 configured as ORT (orientation) and FW as FWD (start/stop clockwise operation). Output 11 configured as POK.
Connection example in "Sink type logic" → page 65

Output 11 (POK) signals when positioning/orientation is completed.

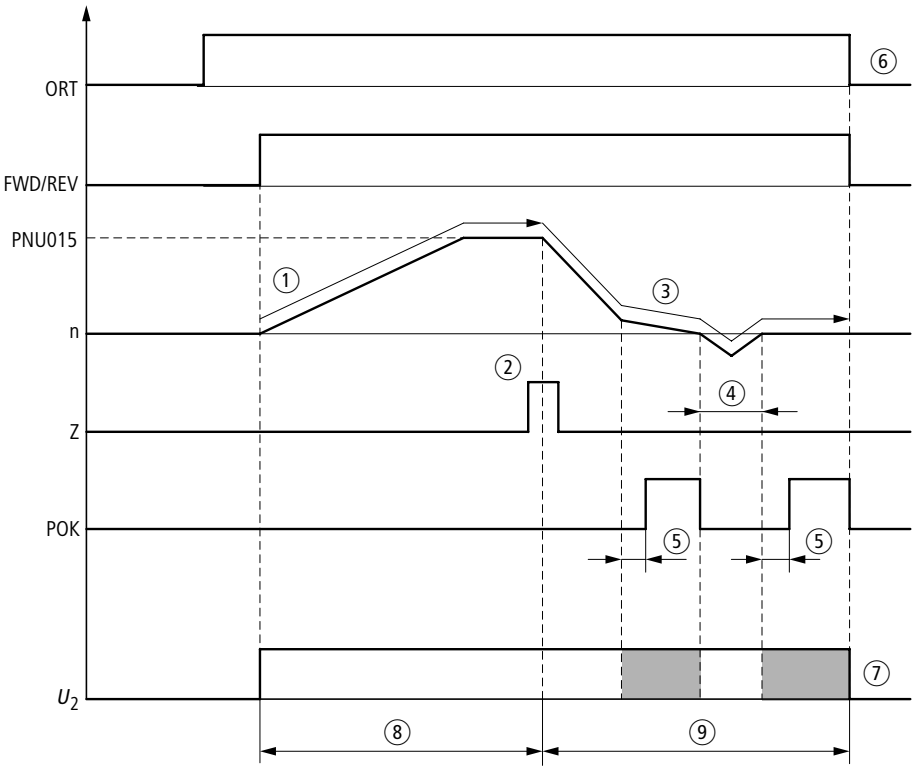


Figure 19: Function chart for ORT (orientation)

① Acceleration with the ramp time set with PNU F002 to the orientation speed set with PNU P015.

② The Z-pulse initiates orientation. The drive decelerates with the ramp time set with PNU F003.

③ If the set ramp time (PNU F003) is too short or the control circuit gain (PNU P023) is too high, the orientation run overshoots the STOP position.

④ The frequency inverter tries to hold the motor in the STOP position (PNU P014) and automatically corrects any overshoot.

⑤ POK signal output. The runtime delay can be set with PNU P018.

⑥ Cancellation on STOP position overshoot. When ORT is cancelled, the drive stops and the orientation/positioning function is cancelled.

⑦ The DV6 switches the output voltage off.

⑧ Closed-loop speed control (ASR)

⑨ Positioning/orientation (ASP)

Warning!
Danger of electric shock and automatic rotation of the motor shaft.

During the orientation phase (digital inputs ORT and FWD/REV are active), do not touch the following parts:
- The motor shaft
- Connected machine components
- Electrical connections of the frequency inverter
- Electrical motor connections

The frequency inverter continues to control the motor even when the motor is at standstill.

PNU	Name	Adjustable in RUN mode		Value	Function	DS
		Normal	Extended			
F002	Acceleration time 1	✓	✓	0.01 to 3600 s	Resolution of 0.01 s at an input of 0.01 to 99.99 Resolution of 0.1 s at 100.0 to 999.9 Resolution of 1 s at 1000 to 3600 s	30.0
F003	Deceleration time 1	✓	✓	0.1 to 3600 s	Resolution of 0.01 s at an input of 0.01 to 99.99 Resolution of 0.1 s at 100.0 to 999.9 Resolution of 1 s at 1000 to 3600	30.0
P014	Orientation: STOP position	–	✓	0 to 4095 pulses	Number of pulses (per motor shaft revolution) from channel A to the STOP position (→ section "Positioning example")	0
P015	Orientation: Speed	–	✓	0 to 120 Hz	Output frequency of the orientation speed	5
P023	Control circuit gain	–	✓	0 to 100	Control circuit gain (V_G) during closed-loop position control (APR) and for Electrical Drive function	0.5

Positioning example

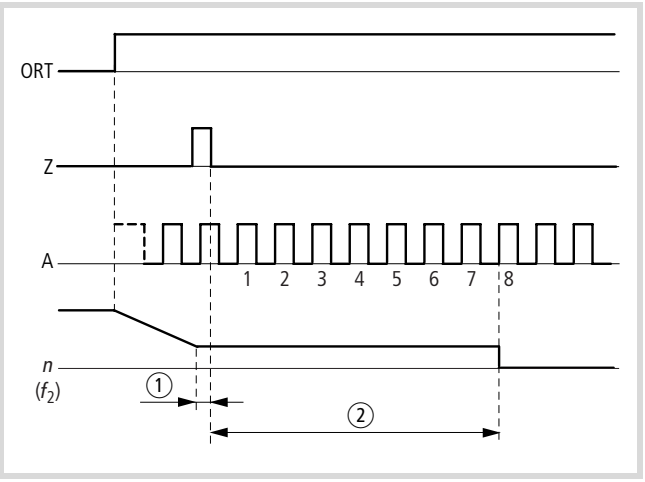


Figure 20: Positioning example

ORT: Speed reduction with the deceleration time set with PNU F003 to the value set with PNU P015.

① Orientation: The orientation mode starts when the output frequency (f_2) has reached the value set with PNU P015.

② Positioning

PNU	Name	Value	Function
P011	Pulses per encoder revolution	1024	Matching the encoder's technical specifications
P012	Control method	00	Closed-loop speed control (ASR)
P014	Orientation: STOP position	32	$P014 = 4096 \times \frac{\text{A-pulses}}{P011} = 4096 \times \frac{8}{1024} = 32$
P015	Orientation: Speed	2	Output frequency 2 Hz as orientation speed
P016	Orientation: Direction of rotation	00	Forward (clockwise) operation (FWD) Orientation
P017	Orientation: End position	12	Permissible deviation of A-pulses at the STOP position, in this example 8 ± 3 pulses PNU P017 = 3 × 4 = 12 (4 = fixed multiplier for internal calculation)
F003	Deceleration time 1	3	The set deceleration time 1 (3 seconds) applies also to the reduction after ORT to the positioning speed set with PNU P015.

Inhibit ramp function (LAC)

The active LAC digital input inhibits the linear acceleration and deceleration ramp of the DV6.

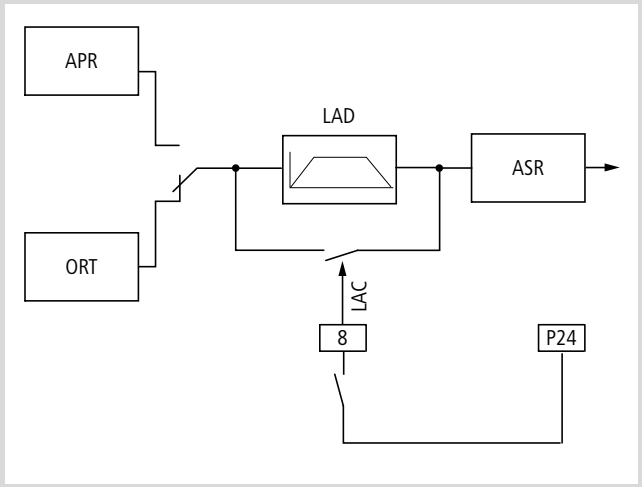


Figure 21: Configure digital input 8 as LAC (inhibit ramp function).

APR = **A**utomatic **P**osition **R**egulation

LAD = **L**inear **A**cceleration/**D**eceleration ramp

ORT = Orientation control

▶ Program one of the digital inputs 1 to 8 as LAC by entering the value 46 for the corresponding parameter (C001 to C008).

The times set with PNU F002 (acceleration) and PNU F003 (deceleration) affect the accuracy with which a position is approached. Due to the actual speed of movement, even optimum set values can lead to deviations. The ramp times should therefore be kept as short as possible or inhibited when the position is reached by activating the LAC (**LA**D **C**ancellation) input.

Setpoint input through STAT

STAT (**Sta**rt **T**rain) starts pulse counting on the slave drive.

▶ Program one of the digital inputs 1 to 8 as STAT by entering the value 48 for the corresponding parameter (C001 to C008).

To implement an "electronic drive" or a slave drive, the pulses of the reference input value (φ') are read through terminals SAP, SAN, SBP and SBN when the STAT input is active. The drive follows the direction of rotation specified by the signal phase sequence, irrespective of the Start signal at the FWD or REV input.

With the STAT input active, the DV6 counts the pulses even if no start signal is applied to FWD or REV. (Memory depth is 1 000 000 pulses.)

→ If the start signal is subsequently applied to FWD or REV, the drive makes good the missed pulses at maximum speed (PNU A061).

When the PCLR input is activated, the pulses already counted (STAT before FWD/REV) are cleared (→ section "Clearing the positioning error (PCLR)", page 24).

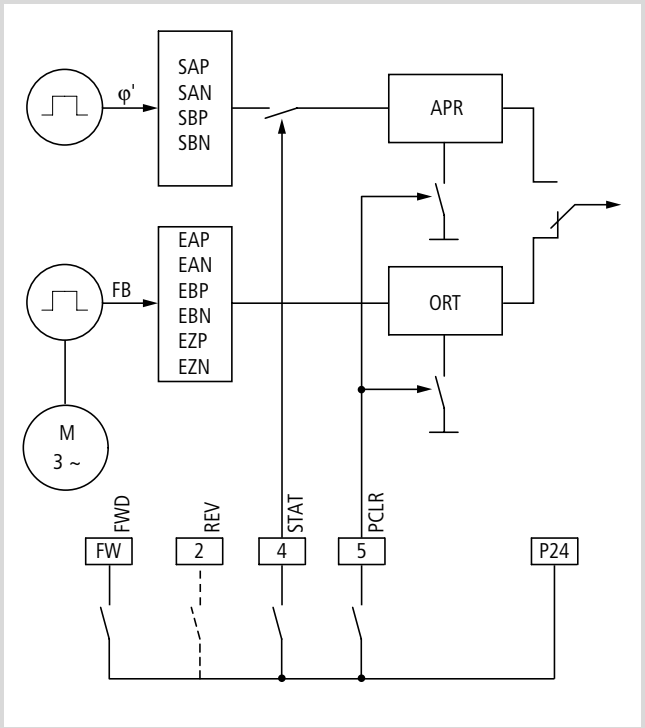


Figure 22: Digital input 4 configured as STAT (reference input through module), 5 as PCLR (clear positioning error), 2 as REV (start/stop reverse operation) and FW as FWD (start/stop forward operation).

ORT = Orientation control

The digital input configured as STAT switches the pulses to the reference value input. The digital input configured as PCLR clears the APR and ORT pulse counters.

Clearing the positioning error (PCLR)

PCLR (**P**ulse **Cl**ea**r**) clears the pulse memory.

▶ Program one of the digital inputs 1 to 8 as PCLR by entering the value 47 for the corresponding parameter (C001 to C008).

When the PCLR digital input is activated, the reference input variable pulses (φ') are saved (→ fig. 22), even if no start signal is applied to FWD/REV. In addition, the pulses are saved when the Stop (zero) position is overshot during orientation or positioning. When the actual position is reached or the slave drive has been corrected, you can clear the saved pulses by activating the PCLR digital input.

Signal sequence on reaching the STOP position

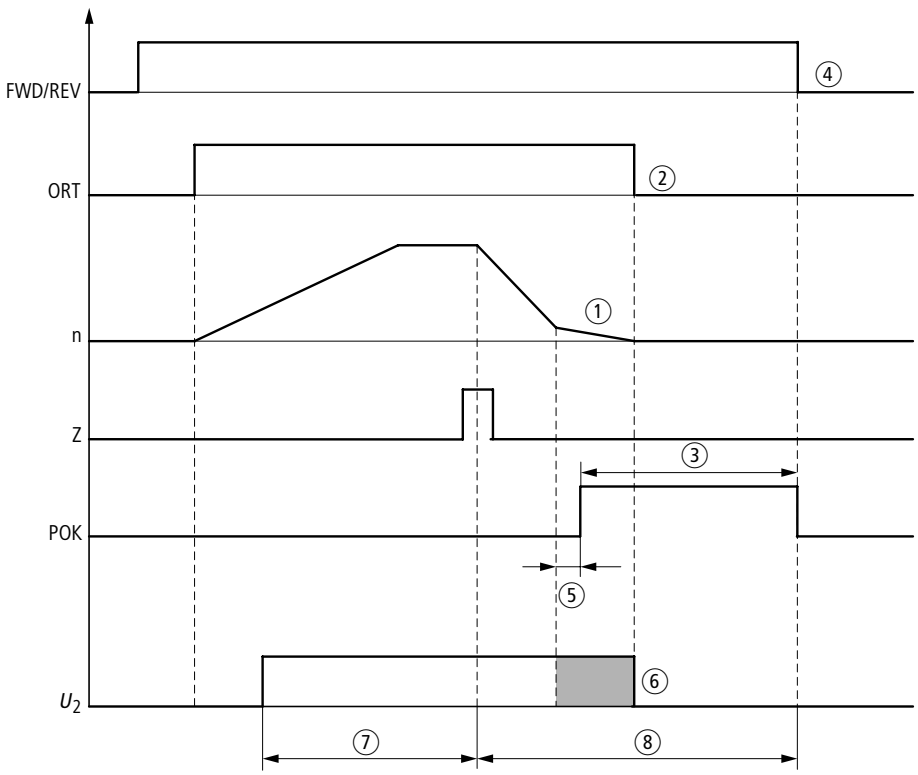


Figure 23: Signal sequence on reaching the STOP position

① STOP position reached
② ORT digital input deactivated
③ POK signal
④ Start signal deactivated
⑤ Deceleration time PNU P018 for POK signal output
⑥ The DV6 switches the output voltage off
⑦ Closed-loop speed control (ASR)
⑧ Positioning/orientation (ASP)

When the STOP position is reached ① and the ORT input is disabled ②, the POK signal ③ remains active until the start signal (FWD/REV) is disabled ④. The output voltage ⑥ of the DV6 is disconnected together with the POK signal.

Programmable digital outputs 11 to 15

In connection with the DE6-IOM-ENC, you can assign the following functions to digital outputs 11 to 15 of the DV6:

- DSE: Speed error exceeded
- POK: Positioning
- ZS: Frequency switching threshold

For a detailed pin assignment of the digital outputs, see manual AWB8230-1415 for vector frequency inverter DV6 and the technical information in Section "Logic of digital outputs 11 to 15", page 65.

Speed error exceeded (DSE)

The digital output configured as DSE (**D**eviation **S**peed **E**rror) is activated when the permissible speed error (PNU P027) has been exceeded.

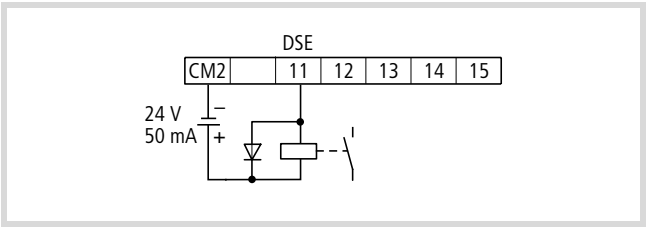


Figure 24: Digital output 11 configured as DSE (speed error exceeded)

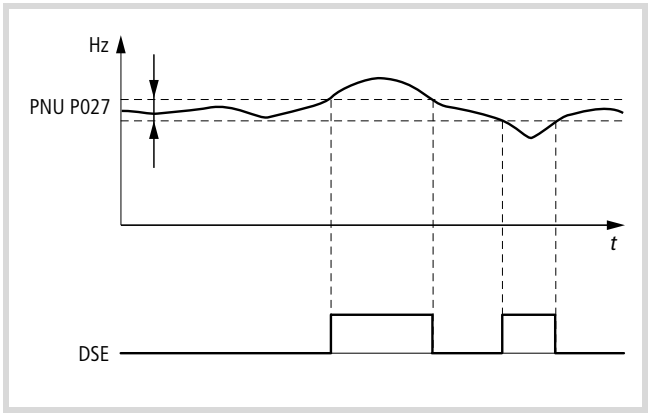


Figure 25: Function chart, DSE (speed error exceeded)

► If you configure a programmable digital output as DSE, you must also, in PNU P027, enter the speed error above which the DSE signal will activate.

► Program one of the digital outputs 11 to 15 as DSE output by entering the value 22 in the corresponding PNU (C021 to C025) or in PNU C026 for signalling relay contacts K11-K12.

PNU	Name	Adjustable in RUN mode		Value	Function	DS
		Normal	Extended			
P027	Speed error/tripping threshold	–	✓	0 to 120 Hz	Setting range of the permissible speed error. This function can be **deactivated** by entering 0.	7.5

Positioning (POK)

The digital output configured as POK (**P**osition **OK**) becomes active when the STOP position has been reached and the error lies within the tolerance limits (PNU P017).

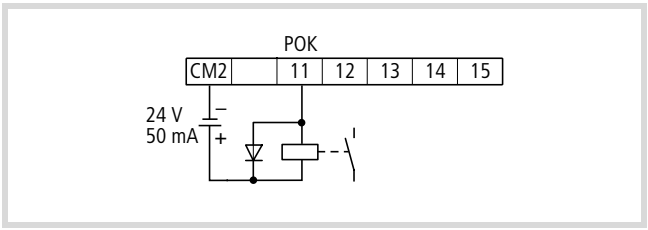


Figure 26: Digital output 11 configured as an POK (positioning)

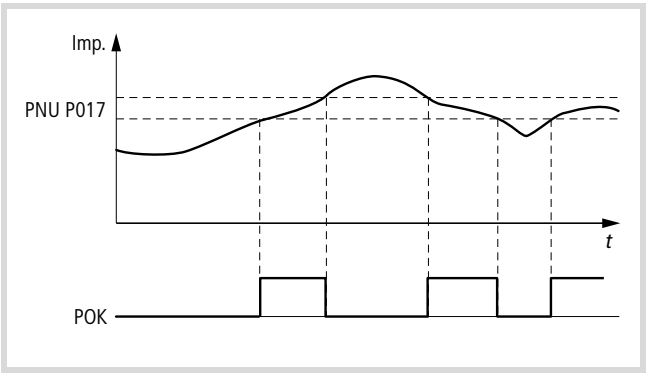


Figure 27: Function chart, POK (Positioning)

- ▶ If you configure a programmable digital output as POK, you must also, in PNU P017, enter a tolerance outside which the DSE signal will activate.
- ▶ Program one of the digital outputs 11 to 15 as POK output by entering the value 23 in the corresponding PNU (C021 to C025) or in PNU C026 for signalling relay contacts K11-K12.

PNU	Name	Adjustable in RUN mode		Value	Function	DS
		Normal	Extended			
P017	Positioning tolerance	–	✓	0 to 10000 pulses	The digital output configured as POK is active if the entered tolerance range is maintained.	5
P018	Delay for POK	–	✓	0 to 9.9 s	Delay for the POK signal (attenuation, sensitivity)	0

Frequency switching threshold (ZS)

The digital output configured as ZS (**Z**ero **S**peed) becomes active when the frequency falls below the frequency set with PNU C063. Depending on the U/f characteristic selected with PNU A044, one of the following frequencies is used as measurement variable:

- Output frequency (PNU A044 = 00 to 04),
- Encoder speed (PNU A044 = 05).

With PNU C063 = 0 Hz the ZS digital output is activated as "Zero speed signal".

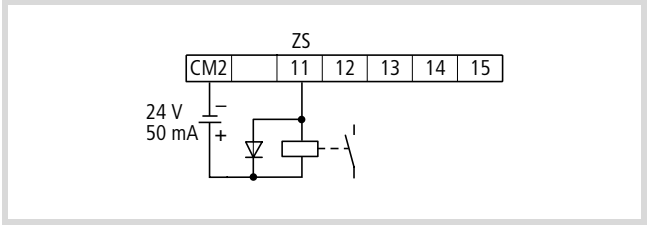


Figure 28: Digital output 11 configured as ZS (frequency switching threshold)

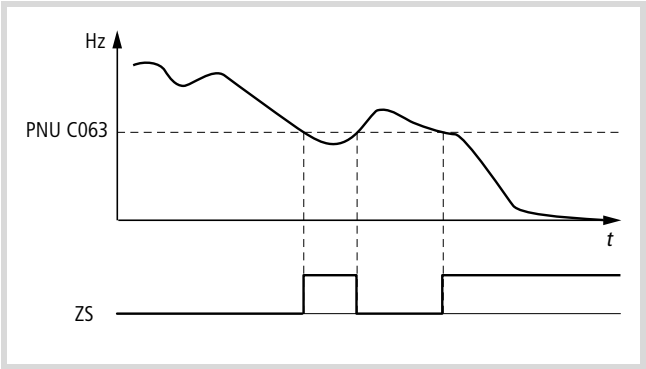


Figure 29: Function chart, ZS (frequency switching threshold)

- If you configure a programmable digital output as ZS, you must also, in PNU C063, enter the frequency switching threshold, below which the ZS signal will activate.
- Program one of the digital outputs 11 to 15 as POK output by entering the value 21 in the corresponding PNU (C021 to C025) or in PNU C026 for signalling relay contacts K11–K12.

PNU	Name	Adjustable in RUN mode		Value	Function	DS
		Normal	Extended			
C063	Frequency switching threshold	–	✓	0 to 100 Hz	Switching threshold for the reference/actual value comparison	0.00

4 Functions

→ The technical procedures and circuit examples contained in the manual are provided as suggestions only. It is up to the user to verify that they can be applied to specific applications.

⚠ **Caution!**
Take appropriate measures to ensure that no personal injury or material damage can arise if the DE6-IOM-ENC module fails.

→ The function descriptions and application examples below take only the parameters and settings required for the selected function into account.

It is assumed that the default settings of the DV6 vector frequency inverter for the connected motor (→ manual AWB8230-1415...) have not been changed.

→ A ✓ in the column headed "Adjustable in RUN mode" indicates that the parameter can be adjusted during active operation.

To activate the extended RUN mode, enter the value 10 in PNU b031, → manual AWB8230-1415...).

General default settings

- Before you commission the DE6-IOM-ENC add-on module, set parameters H001 to H034 (motor data, SLV, autotuning). The required activities are described in the manual for the DV6 (AWB8230-1415..., section "SLV and Autotuning").
- Activate the control algorithms of the fitted DE6-IOM-ENC encoder interface module in PNU A044 (value 05).

PNU	Name	Adjustable in RUN mode		Value	Function	DS	DEX-KEY-10
		Normal	Extended				
A044	*U*/*f* characteristic	–	–	00	Linear *U*/*f* characteristic (constant torque)	00	>A044 Control 1st VC
				01	Quadratic *U*/*f* characteristic (reduced torque)		>A044 Control 1st VP
				02	User-definable		>A044 Control 1st FREE-V/f
				03	Sensorless vector control (SLV)[1] is active		>A044 Control 1st SLV
				04	0 Hz SLV[1] is active		>A044 Control 1st 0SLV
				05	Vector control[1] with DE6-IOM-ENC add-on module		>A044 Control 1st V2

1) In this control mode, the clock frequency should be set to at least 2.1 kHz (PNU b083).

Motor temperature monitoring

For variable-speed drives, the motors are operated mainly in speed ranges below the reference point, which results in a temperature rise in the rotor winding. This effect is increased by the reduced self-ventillation (through the fan on the motor shaft) at low motor speeds. The winding temperature should therefore always be monitored.

In general, the winding temperature is monitored with PTC thermistors in the motor windings. The total cold resistance of these sensors is about 1.5 kΩ (guideline value) and increases to 2.7 to 3.1 kΩ at higher temperatures.

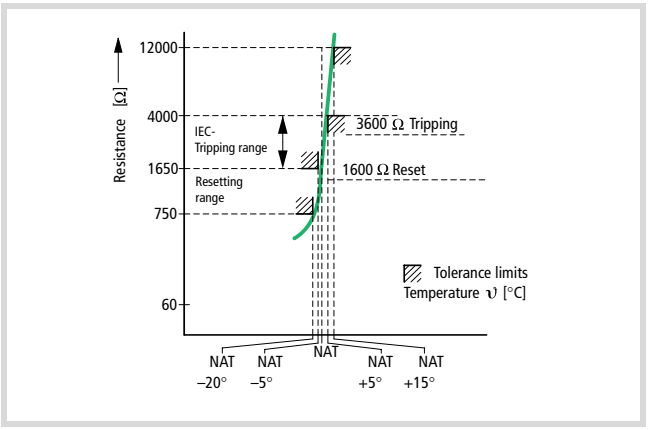


Figure 30: PTC characteristics

NAT = rated tripping temperature

The series-connected PTC sensors, which you can connect to terminals TH and CM1 of the DV6 vector frequency inverter, allow an automatic speed correction of deviations caused by temperature changes.

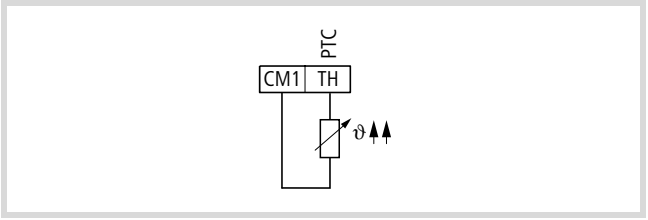


Figure 31: Connection, terminal TH

To connect the thermistor, use a twisted cable and do not route this cable together with the motor supply cables. Any thermistor connection cables laid inside a motor cable should be screened.

PNU	Name	Adjustable in RUN mode		Value	Function	DS	DEX-KEY-10
		Normal	Extended				
b098	Temperature sensor selection	–	✓	00	No temperature monitoring	00	>b098 THERM SELECT OFF
				01	PTC		>b098 THERM SELECT PTC
				02	NTC		b098 THERM SELECT NTC
b099	Resistance tripping threshold	–	✓	0 to 9999 Ω	If the threshold value entered here is exceeded, fault signal E35 is issued. The output voltage for the motor is switched off and the motor coasts to a halt.	3000	>b099 THERM LEVEL 3000ohm
C085	Thermistor matching	✓	✓	0 to 1000	Scaling factor for input terminal TH.	105	>C085 THERM ADJUST 0105.0
P025	Temperature compensation	–	✓	00	Not active	00	>P025 FEEDBACK R2-ADJ
				01	Active		>P025 FEEDBACK R2-ADJ ON

PI controller

For closed-loop vector control, Pl control is normally used, so that the difference between reference speed and actual speed remains close to zero. Through a digital input configured as PPI, you can change over from Pl to P control (for programming the digital inputs, see manual AWB8230-1415..., PNU C001 to C008). The proportional gain for P control (Kpp: determines the speed error) is set with PNU H052 (or PNU H072).

Proportional gain (Kpp) and speed error have the following relationship:

$$\text{Speed error} = \frac{10}{\text{Kpp input value}}\ [\%]$$

Speed error and nominal speed have the following relationship:

$$\text{Speed error} = \frac{\text{Speed error at rated-load torque}}{\text{Synchronous speed at rated frequency}}$$

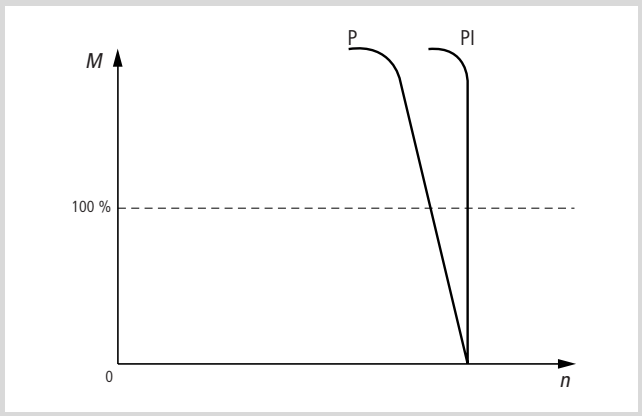


Figure 32: Function chart for PI and P control

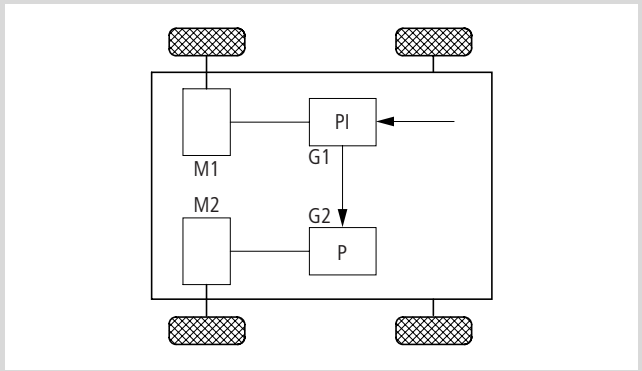


Figure 33: Example: traction drive (master/slave)

Automatic speed control

Closed-loop vector control with speed feedback allows a highly accurate speed control, even at varying loads. The motor speed is measured using an incremental encoder and transmitted to the frequency inverter using signals A, $\overline{A}$, B and $\overline{B}$. The phase sequence of channels A and B must correspond with the phase sequence of power connections U, V and W of the motor. Signals Z and $\overline{Z}$ are not required here.

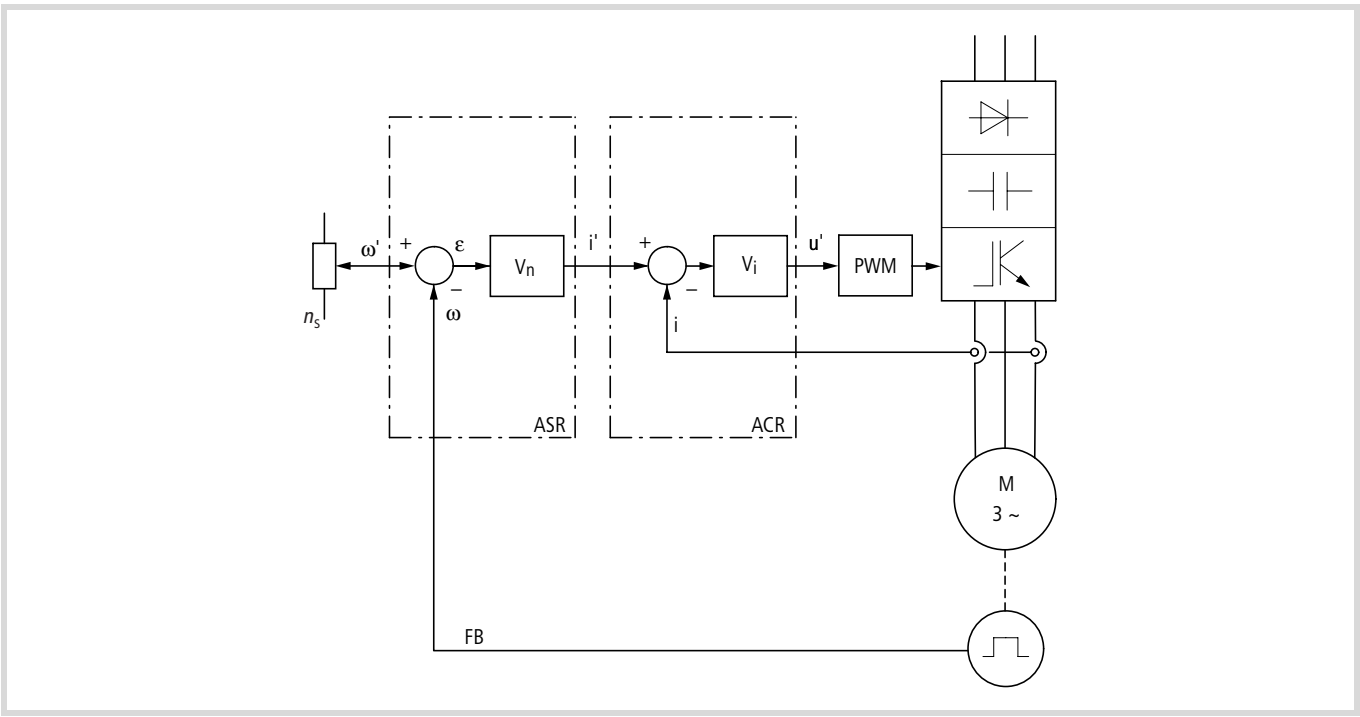


Figure 34: Block diagram: closed-loop speed control

n_S = reference speed

Example – traction drive:

- The reference speed is provided at terminal O in the form of a 0 to 10 V analog signal.
- With FWD or REV, the start signal is issued and the direction of rotation specified.
- The end position approach (creep speed) is activated through S1, the reference speed input being switched over to fixed frequency FF1 (5 Hz) and PI control to the values optimized for this speed (CAS: PNU H050/H051 to H070/H071).
- Excessive speed deviations (of the actual value from the reference value) and encoder signal open circuits are signalled by digital output 11 (DSE) through relay K1.
- Thermistors connected to terminals TH and CM1 monitor the motor winding temperature. Speed fluctuations caused by temperature changes can be compensated with the settings in parameters PNU P025, C085, b098 and b099.
- Motor rating and number of motor poles must be entered as stated on the motor's rating plate. The motor constants can be entered through the autotuning function (PNU H001). The determined motor constants are written to PNU H030 to H034.

Warning!
Autotunig during motor operation. Automatic motor start without speed limitation, for a few seconds in both directions, when PNU H001 contains the value 02 and a start signal (FWD or REV) is applied.

DIP switch			DS	Setting
SWENC	-1	Open-circuit monitoring, channel A (EAP, EAN), and channel B (EBP, EBN). • OFF: Not active • ON: Active	OFF	ON
	-2	Open-circuit monitoring, channel Z (EZP, EZN) • OFF: Not active • ON: Active	OFF	–

→ The following parameters, listed here in alphanumeric order, contain some of the required settings for the example given here. It is assumed that the default settings of the DV6 vector frequency inverter for the connected motor (as listed in manual AWB8230-1415...) have not been changed.

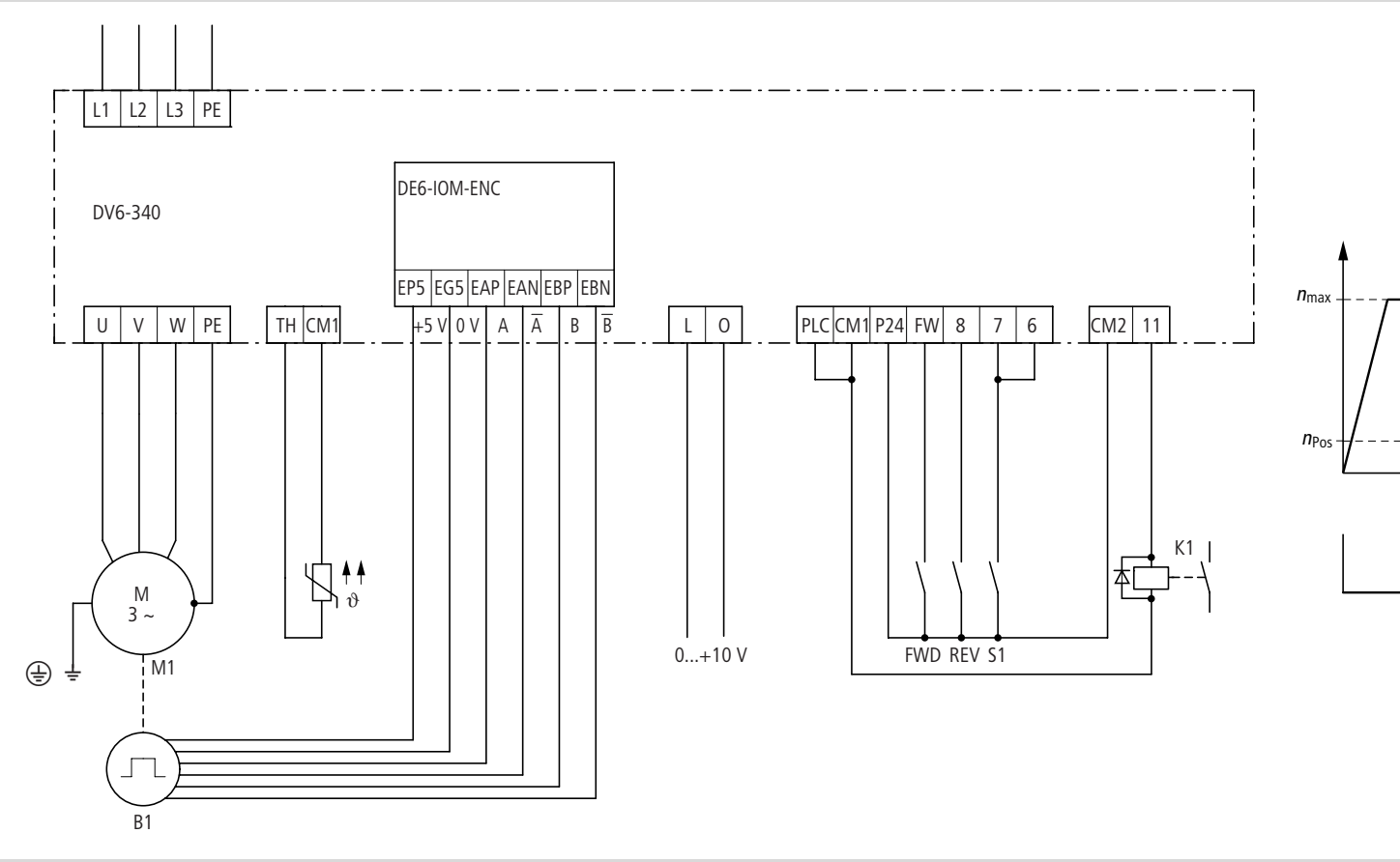


Figure 35: Closed-loop speed control

Parameter list for closed-loop speed control of a traction drive. The square brackets contain the expressions displayed on the DEX-KEY-10.

Warning!
Autotunig during motor operation. Automatic motor start without speed limitation, for a few seconds in both directions, when PNU H001 contains the value 02 and a start signal (FWD or REV) is applied.

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
A001	Defined frequency setpoint	–	–	00 to 05	01 [TERM]: Input 0 to +10 V through analog input O	01	>A001 F-SET SELECT TERM	01 [TERM]
A021	First fixed frequency	✓	✓	0 to 400 Hz	Fixed frequency FF1 (value: 5 Hz) activated with S1 through digital input 7 (→ C007).	0.00	>A021 SPEED 01S 0000.00Hz	**5.00** **[0005.00Hz]**
A044	*U/f* characteristic	–	–	00 to 05	05 [V2]: Vector control (closed-loop) with DE6-IOM-ENC add-on module.	00	>A044 Control 1st VC	**05** **[V2]**
b098	Temperature sensor selection	–	✓	00 to 02	Temperature monitoring with NTC thermistor (connected to terminals TH and CM1).	00	>b098 THERM SELECT OFF	**02** **[NTC]**
b099	Tripping resistance threshold	—	✓	0 to 9999?	Temperature monitoring threshold value.	3000	>b099 THERM LEVE 3000ohm	–
C006	Function of digital input 6	–	✓	01 to 48	26 [CAS]: S1 activates PI control changeover from PNU H050/H051 to H070/H071.	03	>C006 IN-TM 6 CF2	**26** **[CAS]**
C007	Function of digital input 7	–	✓	01 to 48	02 [CF1]: S1 activates fixed frequency FF1 (→ A021).	02	>C007 IN-TM 7 CF1	02 [CF1]
C008	Function of digital input 8	–	✓	01 to 48	01 [RV]: Enable reverse operation; activated with REV switch.	01	>C008 IN-TM 8 RV	01 [RV]
C021	Signal at digital output 11	–	✓	00 to 26	22 [DSE]: signals excessive speed error (→ P027) and switches relay K1 on.	01	>C021 OUT-TM 11 FA1	**22** **[DSE]**
C085	Thermistor matching	✓	✓	0 to 1000	Scaling factor for thermistor input TH.	105	>C085 THERM ADJUST 0105.0	
H001	Autotuning mode	–	–	00 to 02	• 00 [NOR]: Autotuning not active • 01 [NRT]: Autotuning: motor standstill • 02 [AUT]: Autotuning/motor operation	00	>H001 AUX AUTO NOR	–
H002	Motor data	–	–	00 to 02	• 00 [NOR]: Standard motor • 01 [AUT]: Use autotuning data • 02 [ON-AUT]: Use current autotuning data	00	>H002 AUX DATA NOR	–

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
H003	Motor rating	–	–	0.2 to 160 kW	Shaft rating of assigned motor	xxx[1)]	>H003 AUX K 000.00kW	–
H004	Number of motor poles	–	–	2, 4, 6, 8	Number of motor poles	4	>H004 AUX P 4P	–
H005	Motor constant	✓	✓	0.01 to 99	The response speed of the speed controller increases in proportion with this value.	1.59	>H005 AUX KP 01.590	–
H006	Motor stabilization constant	✓	✓	0 to 255	Reduce this value if the current fluctuates. To disable this function, enter the value 0.	100	>H006 AUX KCD 00100	–
H020	Motor constant R1	–	–	0 to 65.53?	Default settings for the assigned motor ratings.	xxx[1)]	>H020 AUX R1 00.000ohm	–
H021	Motor constant R_2	–	–	0 to 65.53?		xxx[1)]	>H021 AUX R2 00.000ohm	–
H022	Motor constant L	–	–	0 to 655.3 mH		xxx[1)]	>H022 AUX L 000.00mH	–
H023	Motor constant I_0	–	–	0 to 655.3 A_{rms}		xxx[1)]	>H023 AUX I0 000.00A	–
H024	Motor constant J	–	–	1 to 1000 Nm		xxx[1)]	>H024 AUX J 0000.000	–
H030	Motor constant R1	–	–	–	Contains the values determined with autotuning (PNU H001). Do **not** change these values.	–	>H030 AUX A-R1 00.000ohm	ro
H031	Motor constant R_2	–	–	–			>H031 AUX A-R2 00.000ohm	ro
H032	Motor constant L	–	–	–			>H032 AUX A-L 000.00mH	ro
H033	Motor constant I_0	–	–	–			>H033 AUX A-I0 000.00A	ro
H034	Motor constant J	–	–	–			>H034 AUX A-J 0000.000	ro
H050	PI controller P component	✓	✓	0 to 1000 %	PI controller for vector control (closed-loop)	100	>H050 AUX KSP 0100.0%	–
H051	PI controller I component	✓	✓	0 to 1000 %		100	>H051 AUX KSI 0100.0%	–

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
H070	PI controller P component	✓	✓	0 to 1000 %	Second value range of PI control (CAS) for closed-loop vector control, activated with S1 through digital input 6 (→ C006)	100	>H070 AUX CH-KSP 0100.0%	–
H071	PI controller Change over integral component	✓	✓	0 to 1000 %		100	>H071 AUX CH-KSI 0100.0%	–
P001	Fault signals, slot 1	–	✓	00, 01	• 00 [TRP]: Fault signal and trip • 01 [RUN]: Ignore fault signal The fault signals from the DE6-IOM-ENC module in slot 1 can be viewed with E60 to E69.	00	>P001 OPTION1 SELECT TRP	–
P002	Fault signals, slot 2	–	✓	00, 01	• 00 [TRP]: Fault signal and cancellation • 01 [RUN]: Ignore fault signal The fault signals from the DE6-IOM-ENC module in slot 2 can be viewed with E70 to E79.	00	>P002 OPTION2 SELECT TRP	–
P011	Number of pulses per revolution	–	–	128 to 65000	Pulses per revolution (up to 100 kHz)	1024	>P011 FEEDBACK ENC-P 01024Pls	–
P012	Control method	–	–	00, 01	• 00 [ASR]: Closed-loop speed control • 01 [APR]: Electronic drive	00	>P012 FEEDBACK CONTROL ASR	00 [ASR]
P025	Temperature compensation	–	✓	00, 01	• 00 [OFF]: Not active • 01 [ON]: Active	00	>P012 FEEDBACK R2-ADJ OFF	–
P026	Speed monitoring, tripping threshold	–	✓	0 to 150 %	Monitoring of highest permissible output frequency. When the value entered here is reached or exceeded, fault signal E61 or E71 is issued. Example: end frequency PNU A004 = 50 Hz (100 %); maximum permissible value 60 Hz → set PNU P026 to 120 %. Input value 0: the function is not active.	135	>P026 FEEDBACK OSPD 135.0%	–
P027	Speed error, tripping threshold	–	✓	0 to 120 Hz	If the speed error (deviation of actual from reference speed) exceeds the value entered here, signal DSE is issued. DSE can be issued on a digital output (11 to 15 and relay K11-K12; PNU C021 to C026, value 22). Input value 0: the function is not active. An input value of 0 is not permissible if speed monitoring P026 is used.	7.5	>P027 FEEDBACK NER 007.5Hz	–

1) Default value (xxx) depends on frequency inverter type rating.

Setpoint input through pulse train inputs SAP, SAN, SBP and SBN

Through pulse train inputs SAP, SAN, SBP and SBN, you can specify the speed and direction of rotation of a slave drive, for example through an encoder or a PLC. This allows the use of a master–slave function for electronic drives, synchro control, ratio control, slave drives, etc. The type of reference input is specified with PNU P013.

PNU	Name	Adjustable in RUN mode		Value	Function	DS
		Normal	Extended			
P013	Pulse reference value through SAP, SAN, SBP and SBN	–	–	00	Pulse train, dual-channel, 90°	00
				01	Pulse train plus direction of rotation	
				02	Pulse train without direction of rotation	

→ Input voltage (pulses) to SAP, SAN, SBP and SBN: 5 V ⎓ (TTL) with inverted signals, based on RS 422 standard.

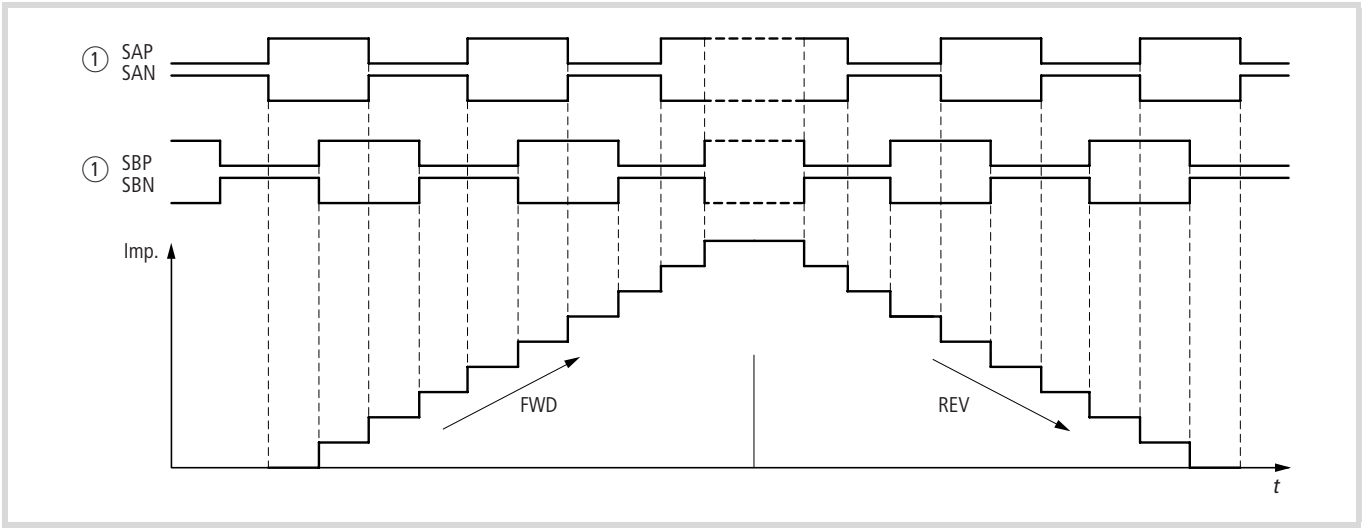


Figure 36: Mode 00 [MD0]: Pulse train, dual-channel, 90°

① Encoder signal

When you connect a dual-channel encoder with a pulse train offset by 90° as master, enter the value 00 in PNU P013. The speed of the slave drive is determined through the signal sequence of channel A (SAP, SAN) and channel B (SBP, SBN) by the pulse frequency (max. 100 kHz) and the direction of rotation.

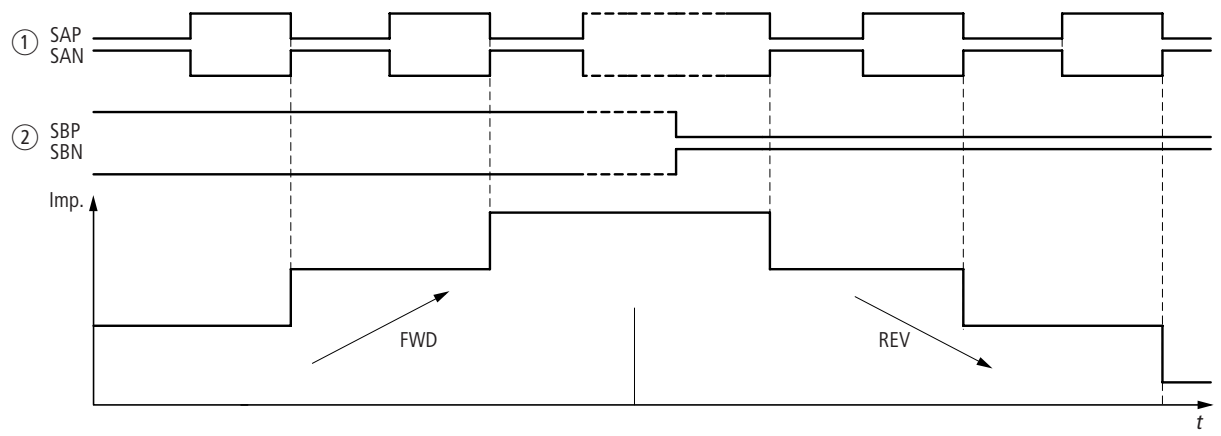


Figure 37: Mode 01 [MD1]: Pulse train plus direction of rotation

① Encoder signal

② Direction reversal through channel B

When you connect a single-channel encoder (master or PLC), enter the value 01 in PNU P013. Forward rotation (FWD) of the slave drive is activated with a 5 V DC signal on channel B (SBP, SBN). If the signal on channel B is cancelled, the direction of the slave drive is reversed (REV).

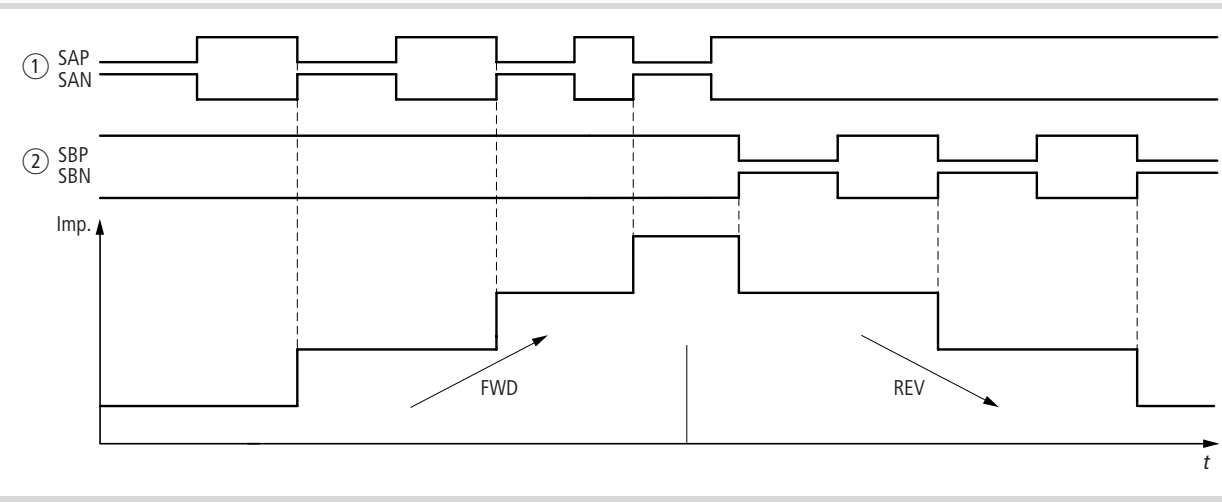


Figure 38: Mode 02 [MD2]: Pulse train or direction of rotation

① Encoder signal, forward rotation (FWD)

② Encoder signal, reverse rotation (REV)

With PNU P013 = 02, the slave drive receives a separate pulse train input for each direction of rotation (single-channel encoder):

Channel A: FWD (forward)
Channel B: REV (reverse)

The deselected direction of rotation must be inhibited with a 5 V DC signal.

Electronic drive

The Electronic Drive function allows a synchronization of the speed of a connected drive (the slave) to the speed of another drive (the master). This is termed synchro control or speed ratio control.

The slave drive's motor speed is measured using an incremental encoder and transmitted to the frequency inverter using signals A, $\overline{A}$, B and $\overline{B}$. The phase sequence of channels A and B must correspond with the phase sequence of power connections U, V and W of the motor. Signals Z and $\overline{Z}$ are not required here.

The signals from the master drive (A, $\overline{A}$, B and $\overline{B}$) are issued to the slave drive as reference values through the inputs of the DE6-IOM-ENC module (SAP, SAN, SBP and SBN). The slave drive's frequency inverter controls the connected motor through the output frequency to synchronize the pulses from the master drive (SAP, SAN, SBP and SBN) and the pulses from the slave drive (EAP, EAN, EBP and EBN).

PNU	Name	Adjustable in RUN mode		Value	Function	DS
		Normal	Extended			
P019	Electronic drive	–	✓	00	Transmission intervention in feedback (FB)	00
				01	Transmission intervention in the reference value (REF)	
P020	Transmission ratio, numerator	–	✓	1 to 9999	The numerator to denominator ratio must lie in the range of 0.02 to 20: $\frac{1}{50} \leqq \frac{\text{Numerator}}{\text{Denominator}} \leqq 20$	1
P021	Transmission ratio, denominator	–	✓	1 to 9999		1
P022	Positive feedback gain	–	✓	0 to 655.3	Feed-forward gain (FFWG) of reference value (REF), irrespective of current actual value (FB)	0
P023	Control circuit gain	–	✓	0 to 100	Interference gain (G = gain). The amplified differential signal of the actual/reference value comparison is directly dependent on current actual value FB.	0.5

Transmission ratio

The transmission ratio of the electronic drive is evaluated with parameter PNU P020 (numerator) and PNU P021 (denominator). The transmission intervention is defined with parameter PNU P019.

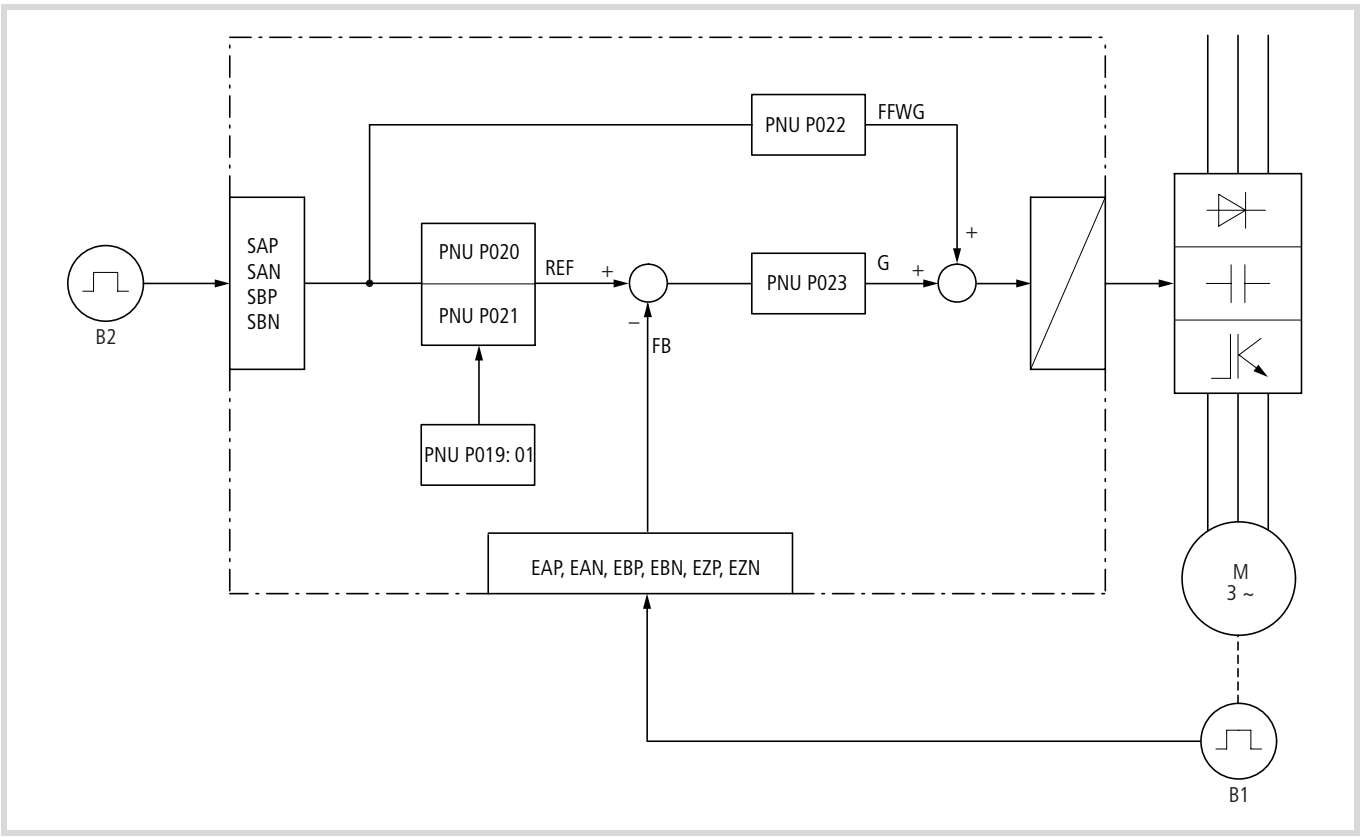


Figure 39: Transmission intervention in the reference value of the master drive, PNU P019 = 01 [REF]

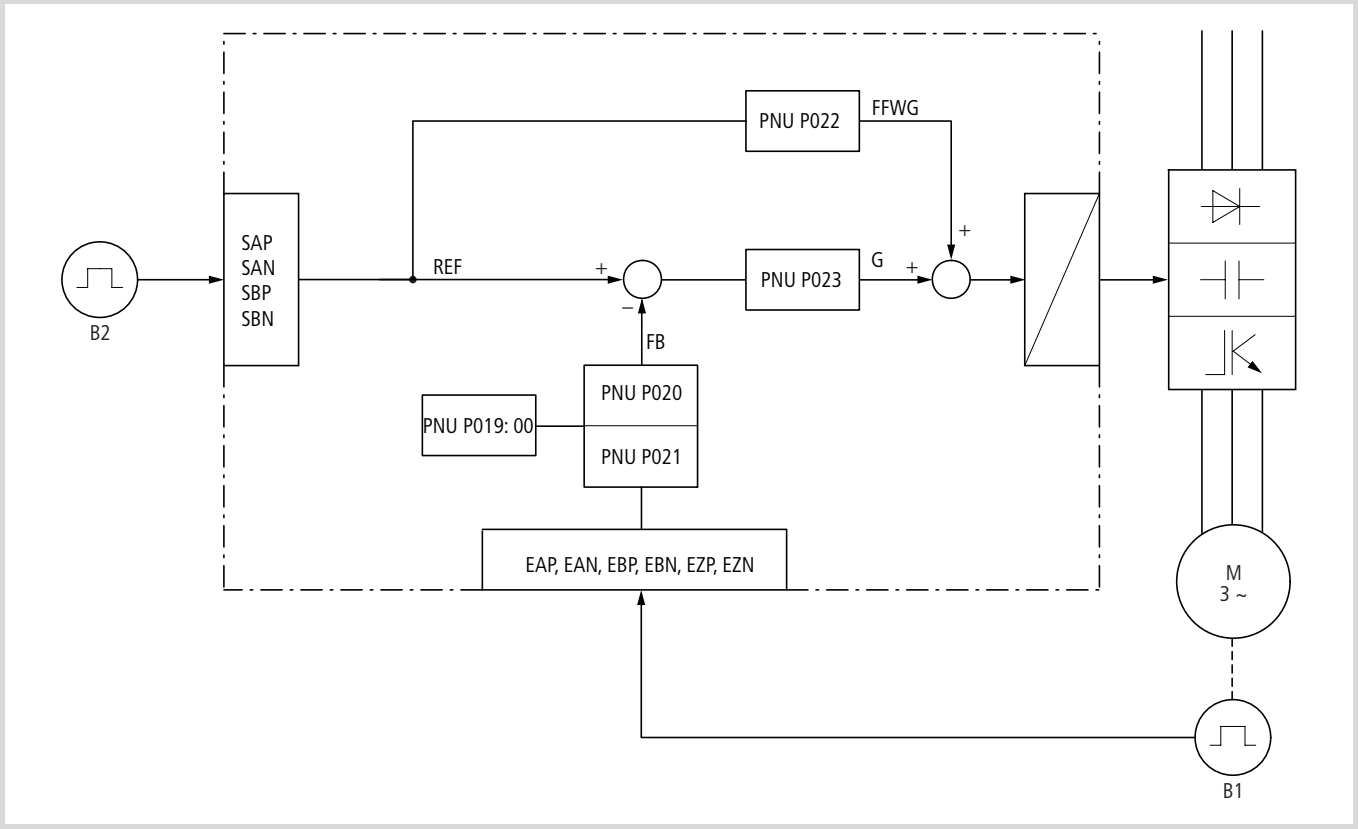


Figure 40: Transmission intervention in the feedback circuit (slave), PNU P019 = 00 [FB]

Example 1:
Pulse generator B1 and B2 with 1024 pulses/revolution each

Electronic drive	**PNU**	**Intervention in the reference value**		**Intervention in the actual value**	
Transmission intervention	P019	01 [REF]	01 [REF]	00 [FB]	00 [FB]
Transmission ratio, numerator	P020	1024	2048	1024	2048
Transmission ratio, denominator	P021	2048	1024	2048	1024
Ratio, slave drive/master drive		0.5	2	2	0.5

Example 2:
Pulse generator B1 and B2 with different pulse rates (→ fig. 41)

The diameter of the slave drive depends on the application and can range from d_1 = 200 mm to d_{11} = 400 mm.

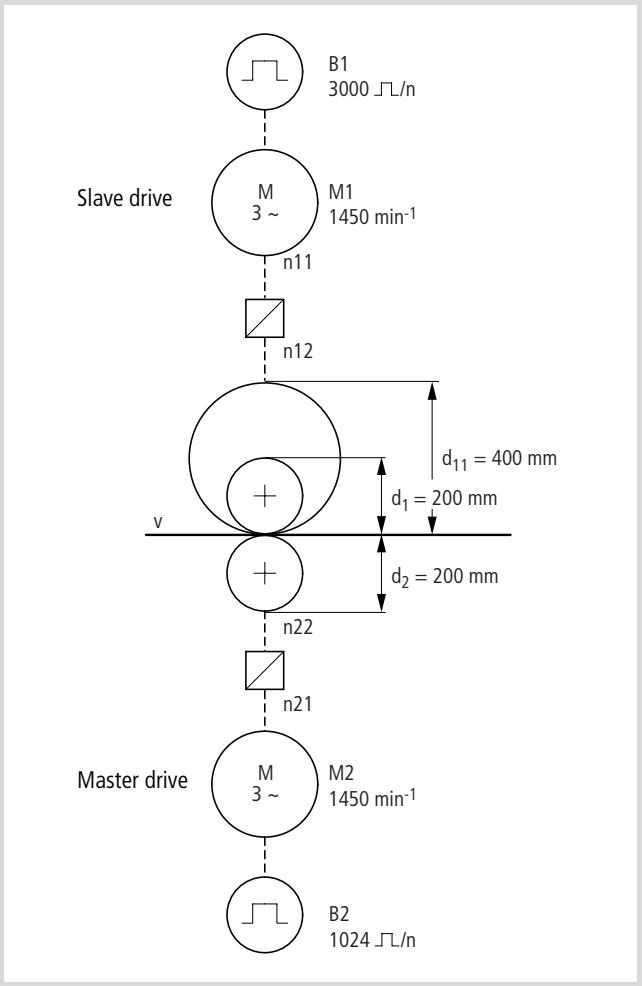


Figure 41: Different pulse rates/revolution

⎍⎍/n = pulses per revolution

$$n = \frac{1000 \times i \times v}{\pi \times d}$$

$$v = \frac{n \times \pi \times d}{1000 \times i}$$

$$v = \frac{1450 \times \pi \times 200}{1000 \times 12.5}$$

$$v = 72.885 \text{ m/min}$$

Max. speed at rated r.p.m. (1450 min^{-1}).

v = [m/min]

n = [min^{-1}]

d = [mm]

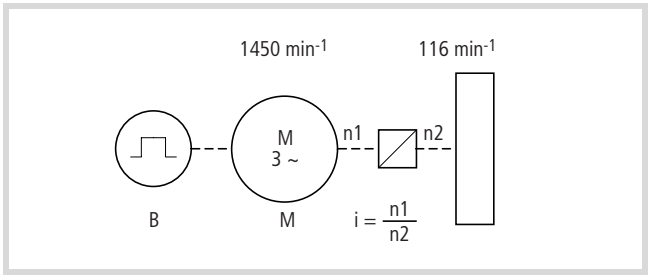


Figure 42: Drive motor

$$i = \frac{n1}{n2} = \frac{1450}{116} = 12.5$$

The encoder of the slave drive (B1) supplies 3000 pulses/revolution, the encoder of the master drive (B2) 1024 pulses/revolution.
Roller diameter d1 = d2 = 200 mm

Parameter setting of the slave drive
(control scheme: → fig. 43):

- Transmission intervention, PNU P019: 00 (FB)
- Transmission ratio, numerator PNU P020: 1024
- Transmission ratio, denominator PNU P021: 3000

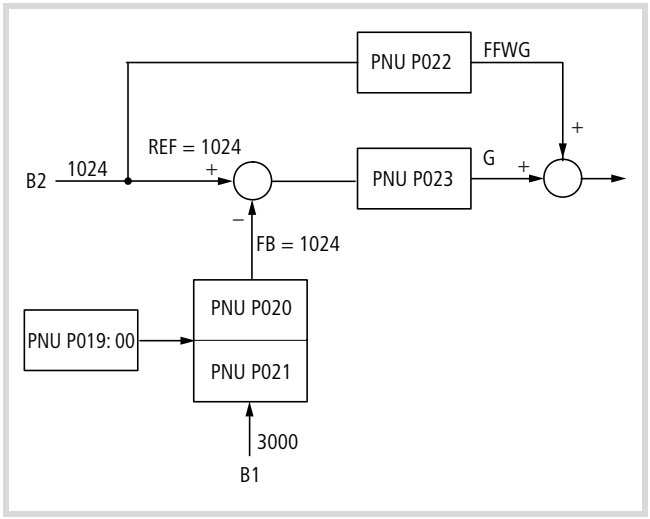


Figure 43: Control scheme, slave drive

Table 3: Overview of settings and functions at diameter d1 = d2 = 200 mm

PNU	Function	Set value/function		Description
		Master drive	Slave drive	
A044	*U*/*f* characteristic	05 [V2]	05 [V2]	Vector control (closed-loop) with DE6-IOM-ENC add-on module
P011	Number of pulses per revolution	1024	3000	Pulses per revolution (≦ 100 kHz)
P012	Control method	00 [ASR]	01 [APR]	00 [ASR] = closed-loop speed control, 01 [APR] = electronic drive
P013	Pulse train, reference value through SAP, SAN,SBP, SBN	00 [MD0]	00 [MD0]	Pulse train (dual-channel, 90°), depending on the encoder type (example: default setting)
P019	Electronic drive	–	00 [FB]	→ fig. 43
P020	Transmission ratio: numerator	–	1024	Pulse value matching (B1, B2). Syncronous operation ratio **1 : 1**
P021	Transmission ratio: denominator	–	**3000**	
P022	Positive feedback gain	×	×	Depending on application. Note: On commissioning, optimize the master drive before the slave drive.
P023	Control circuit gain	×	×	

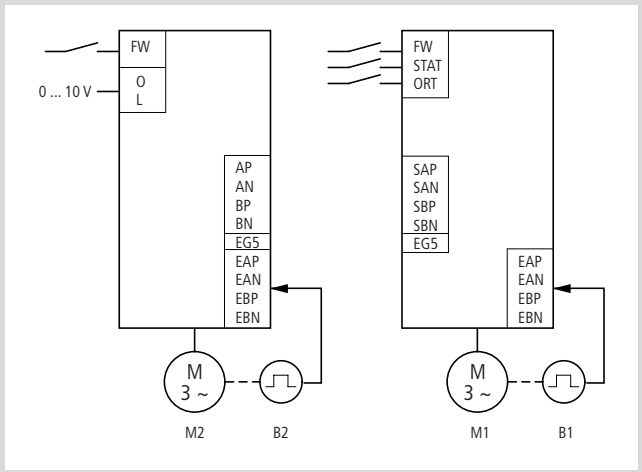


Figure 44: Block diagram for examples 1 and 2

Master drive (B2 = 1024 pulses/rev)	**Slave drive (B1 = 3000 pulses/rev)**
DV6	DV6
Closed-loop speed control (ASR)	**Electronic drive (APR)**
DE6-IOM-ENC	DE6-IOM-ENC

Example 3:
Defaults as in example 2. For the slave drive, diameter d11 = 400 mm is entered here (→ fig. 41).

$$n11 = \frac{1000 \times i \times v_{max}}{\pi \times d11} = \frac{1000 \times 12.5 \times 72.885}{\pi \times 400} = 725\ min^{-1}$$

The encoder of the slave drive (B1) supplies 3000 pulses/revolution, the encoder of the master drive (B2) 1024 pulses/revolution. Because the ratio of the diameters is 2:1, the transmission ratio between master and slave drive should also be 2:1.

Parameter setting of the slave drive
(control scheme: → fig. 40):

- Transmission intervention PNU P019: 00 (FB)
- Transmission ratio, numerator PNU P020: 1024
- Transmission ratio, denominator PNU P021: 3000/2 = 1500

Master drive (d2 = 200 mm)		**Slave drive (d11 = 400 mm)**	
n_2	**B2**	**n_1**	**B1**
min^{-1}	**Pulses**	**min^{-1}**	**Pulses**
1	1024	0.5	1500
2	2048	1	3000
…	…	…	…
1450	1536000	725	2250240

Table 4: Overview of settings and functions at diameter d11 = 200 mm and d2 = 200 mm

PNU	Function	Set value/function		Description
		Master drive	Slave drive	
A044	*U/f* characteristic	05 [V2]	05 [V2]	Vector control (closed-loop) with DE6-IOM-ENC add-on module
P011	Number of pulses per revolution	1024	3000	Pulses per revolution (≦ 100 kHz)
P012	Control method	00 [ASR]	01 [APR]	00 [ASR] = closed-loop speed control, 01 [APR] = electronic drive
P013	Pulse train, reference value through SAP, SAN,SBP, SBN	00 [MD0]	00 [MD0]	Pulse train (two-channel 90°), depending on the encoder type (example: default setting)
P019	Electronic drive	–	00 [FB]	→ fig. 43
P020	Transmission ratio: numerator	–	1024	Pulse value matching (B1, B2). Syncronous operation ratio **1 : 2**
P021	Transmission ratio: denominator	–	**1500**	
P022	Positive feedback gain	×	×	Depending on application. Note: On commissioning, optimize the master drive before the slave drive.
P023	Control circuit gain	×	×	

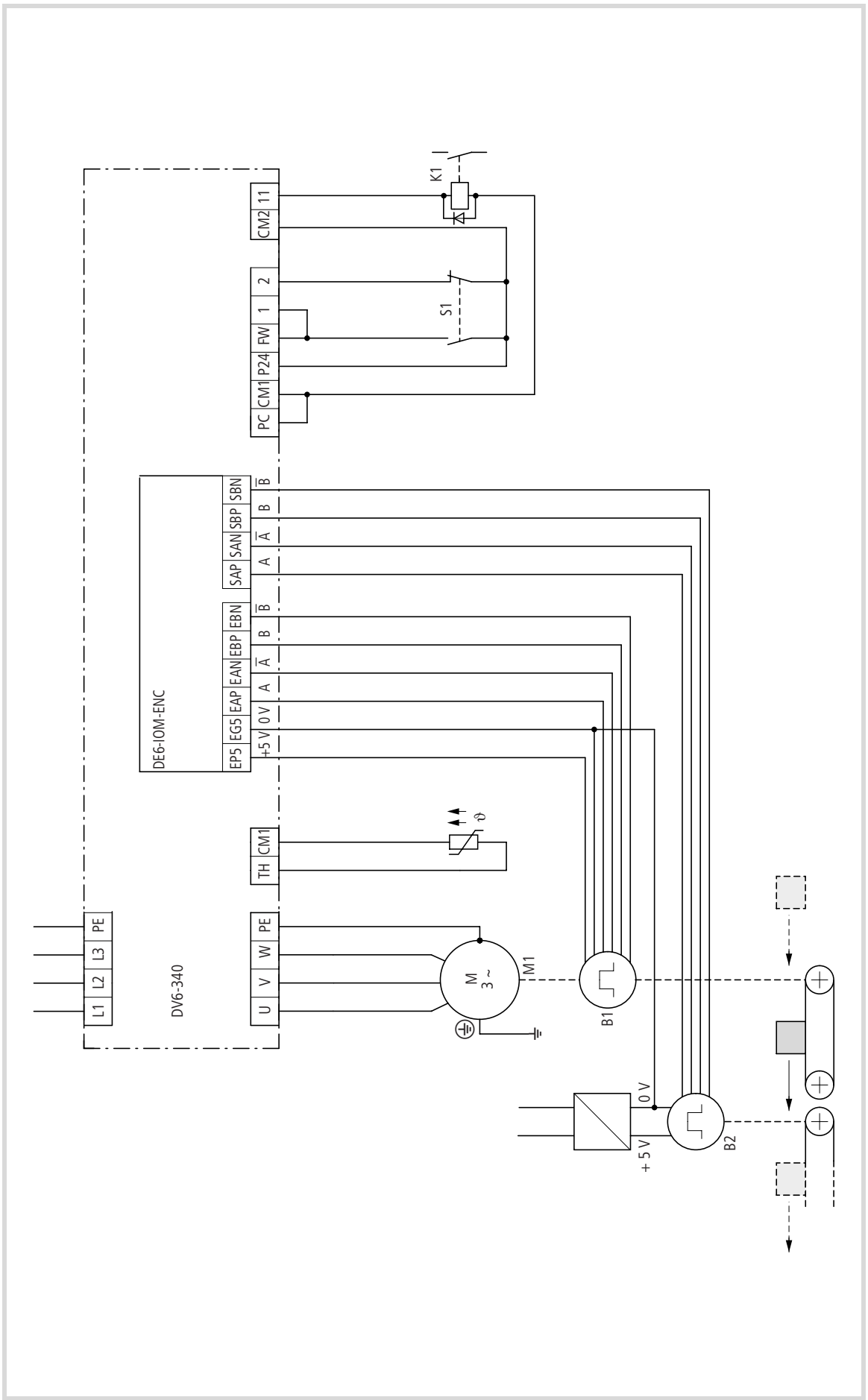


Figure 45: Slave drive

Slave drive

Example – conveyor belt system:

- The main belt runs continually with variable speed.
- The slave belt is loaded at standstill and accelerated to the speed of the master belt when the Enable signal is issued. The speed ratio between master and slave drive is 1:1. When the load has been transferred from the slave to the master belt, the slave drive is stopped again. The acceleration and deceleration times are set in parameters PNU F002 and F003.
- The reference speed for the slave drive is specified by the master drive through an encoder with external power supply. For increased interference immunity, the 0 V connection of this power supply is connected to terminal EG5 of the DE6-IOM-ENC.
- Switch S1 starts the slave drive through digital input FW. At the same time, B2 enables the encoder signal for the slave drive through digital input 1 (STAT). With the break contact of S1, the Clear signal for the positioning error is cancelled through digital input 2 (PCLR).
- On the slave drive, open-circuit monitoring of encoder channel A and B is enabled through DIP switch SWENC-1 (ON). With DIP switch SWR-1 (ON) and SWR-2 (ON), a terminating resistor is connected by B2 into encoder channels A and B.
- Excessive speed deviations (of the actual value from the reference value) and encoder signal open circuits are signalled by digital output 11 (DSE) through relay K1.
- Thermistors connected to terminals TH and CM1 monitor the motor winding temperature. Speed fluctuations caused by temperature changes can be compensated with the settings in parameters PNU P025, C085, b098 and b099.
- Speed deviations (actual value from reference value) are signalled through output 11 (DSE) and relay K1.
- Motor rating and number of motor poles must be entered as stated on the motor's rating plate. The motor constants can be entered through the autotuning function (PNU H001). The determined motor constants are written to PNU H030 to H034.

⚠ **Warning!**
Autotunig during motor operation. Automatic motor start without speed limitation, for a few seconds in both directions, when PNU H001 contains the value 02 and a start signal (FWD or REV) is applied.

DIP switch		Function	DS	Setting
SWENC	-1	Open-circuit monitoring, channel A (EAP, EAN), and channel B (EBP, EBN). • OFF: Not active • ON: Active	OFF	ON
	-2	Open-circuit monitoring, channel Z (EZP, EZN) • OFF: Not active • ON: Active	OFF	–
SWR	-1	Terminating resistor (150 Ω) connected between SAP and SAN. • OFF: Not switched on • ON: Switched on	OFF	ON
	-2	Terminating resistor (150 Ω) connected between SBP and SBN. • OFF: Not switched on • ON: Switched on	OFF	ON

→ The following parameters, listed here in alphanumeric order, contain some of the required settings for the example given here. It is assumed that the default settings of the DV6 vector frequency inverter for the connected motor (as listed in manual AWB8230-1415...) have not been changed.

Without the PCLR signal at digital input 2, the pulses from master drive B2 would be saved to the slave drive during the load time (standstill). With the Enable signal FW, the slave drive would then accelerate to its maximum speed until the saved pulse difference to the master drive is eliminated (so that B1 = B2) before decelerating to the speed of the master drive.

Parameter list for the slave drive of a conveying system. The square brackets contain the expressions displayed on the DEX-KEY-10.

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
A044	*U/f* characteristic	–	–	00 to 05	05 [V2]: Vector control (closed-loop) with DE6-IOM-ENC add-on module.	00	>A044 Control 1st VC	05 [V2]
b098	Temperature sensor selection	–	✓	00 to 02	Temperature monitoring with NTC thermistor (connected to terminals TH and CM1).	00	b098 THERM SELECT OFF	02 [NTC]
b099	Tripping resistance threshold	–	✓	0 to 9999 Ω	Temperature monitoring threshold value.	3000	>b099 THERM LEVEL 3000ohm	–
C001	Function of digital input 1	–	✓	01 to 48	48 [STAT]: Reference input through DE6-IOM-ENC add-on module.	18	>C001 IN-TM 1 RS	48 [STAT]
C002	Function of digital input 2	–	✓	01 to 48	47 [PCLR]: Clear position error	16	>C002 IN-TM 2 AT	47 [PLCR]
C021	Signal at digital output 11	–	✓	00 to 26	22 [DSE]: Signals excessive speed error (→ P027) and switches relay K1 on.	01	>C021 OUT-TM 11 FA1	22 [DSE]
C085	Thermistor matching	✓	✓	0 to 1000	Scaling factor for thermistor input TH.	105	>C085 THERM ADJUST 0105.0	–
H001	Autotuning mode	–	–	00 to 02	• 00 [NOR]: Autotuning not active • 01 [NRT]: Autotuning: motor standstill • 02 [AUT]: Autotuning/motor operation	00	>H001 AUX AUTO NOR	–
H002	Motor data	–	–	00 to 02	• 00 [NOR]: Standard motor • 01 [AUT]: Use autotuning data • 02 [ON-AUT]: Use current autotuning data	00	>H002 AUX DATA NOR	–
H003	Motor rating	–	–	0.2 to 160 kW	Shaft rating of assigned motor	xxx[1)]	>H003 AUX K 000.00kW	–
H004	Number of motor poles	–	–	2, 4, 6, 8	Number of motor poles	4	H004 AUX P 4P	–
H005	Motor constant	✓	✓	0.01 to 99	The response speed of the speed controller increases in proportion to this value.	1.59	>H005 AUX KP 01.590	–
H006	Motor stabilization constant	✓	✓	0 to 255	Reduce this value if the current fluctuates. To disable this function, enter the value 0.	100	>H006 AUX KCD 00100	–

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
H020	Motor constant R1	–	–	0 to 65.53 Ω	Default settings for the assigned motor ratings.	xxx[1)]	>H020 AUX R1 00.000ohm	–
H021	Motor constant R_2	–	–	0 to 65.53?		xxx[1)]	>H021 AUX R2 00.000ohm	–
H022	Motor constant L	–	–	0 to 655.3 mH		xxx[1)]	>H022 AUX L 000.00mH	–
H023	Motor constant I_0	–	–	0 to 655.3 A_{rms}		xxx[1)]	>H023 AUX IO 000.00A	–
H024	Motor constant J	–	–	1 to 1000 Nm		xxx[1)]	>H024 AUX J 0000.000	–
H030	Motor constant R1	–	–	–	Contains the values determined with autotuning (PNU H001). Do **not** change these values.		>H030 AUX A-R1 00.000ohm	ro
H031	Motor constant R_2	–	–	–			>H031 AUX A-R2 00.000ohm	ro
H032	Motor constant L	–	–	–			>H032 AUX A-L 000.00mH	ro
H033	Motor constant I_0	–	–	–			>H033 AUX A-I0 000.00A	ro
H034	Motor constant J	–	–	–			>H034 AUX A-J 0000.000	ro
H050	PI controller P component	✓	✓	0 to 1000 %	PI controller for vector control (closed-loop)	100	>H050 AUX KSP 0100.0%	–
H051	PI controller I component	✓	✓	0 to 1000 %		100	>H051 AUX KSI 0100.0%	–
P001	Fault signals, slot 1	–	✓	00, 01	• 00 [TRP]: Fault signal and cancellation • 01 [RUN]: Ignore fault signal The fault signals from the DE6-IOM-ENC module in slot 1 can be viewed with E60 to E69.	00	>P001 OPTION1 SELECT TRP	–
P002	Fault signals, slot 2	–	✓		• 00 [TRP]: Fault signal and cancellation • 01 [RUN]: Ignore fault signal The fault signals from the DE6-IOM-ENC module in slot 2 can be viewed with E70 to E79.	00	>P002 OPTION2 SELECT TRP	–
P011	Number of pulses per revolution	–	–	128 to 65000	Pulses per revolution (up to 100 kHz)	1024	>P011 FEEDBACK ENC-P 01024Pls	–

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
P012	Control method	–	–	00, 01	• 00 [ASR]: Closed-loop speed control • 01 [APR]: Electronic drive	00	>P012 FEEDBACK CONTROL ASR	00 [APR]
P013	Pulse train, reference value through SAP, SAN, SBP, SBN	–	–	00 to 02	• 00 [MD0]: Pulse train (dual-channel, 90°) • 01 [MD1]: Pulse train plus direction of rotation • 02 [MD2]: Pulse train or direction of rotation	00	>P013 FEEDBACK PULSE MD0	00 [MD0]
P019	Electronic drive	–	✓	00, 01	Ratio intervention: • 00 [FB]: In feedback (actual value) • 01 [REF]: In the reference value	00	>P019 FEEDBACK EGRP FB	00 [FB]
P020	Transmission ratio: numerator	–	✓	1 to 9999	The numerator to denominator ratio must lie in the range of 0.02 to 20. [N = numerator, D = denominator	1	>P020 FEEDBACK EGR-N 00001	–
P021	Transmission ratio: denominator	–	✓	1 to 9999		1	>P021 FEEDBACK EGR-D 00001	–
P022	Positive feedback gain	–	✓	0 to 655.3	Increase this value to reduce the speed error between master and slave drive. Excessively high values result in speed fluctuations.	0	>P022 FEEDBACK FFWG 000.00	Example: value = 2
P023	Control circuit gain	–	✓	1 to 100	Increase this value to increase the control circuit gain. Excessively high values result in speed overshoot at startup or to speed fluctuations during operation.	0.5	>P023 FEEDBACK G 000.50	Example: value = 2
P025	Temperature compensation	–	✓	00, 01	00 [OFF]: Not active 01 [ON]: Active	00	>P012 FEEDBACK R2-ADJ OFF	–
P026	Speed monitoring, tripping threshold	–	✓	0 to 150 %	Monitoring of highest permissible output frequency. When the value entered here is reached or exceeded, fault signal E61 or E71 is issued. Example: end frequency PNU A004 = 50 Hz (100 %); maximum permissible value 60 Hz => set PNU P026 to 120 %. Input value 0: the function is not active.	135	>P026 FEEDBACK OSPD 135.0%	–

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
P027	Speed error, tripping threshold	–	✓	0 to 120 Hz	If the speed error (deviation of actual from reference speed) exceeds the value entered here, signal DSE is issued. DSE can be issued on a digital output (11 to 15 and relay K11-K12; PNU C021 to C026, value 22). Input value 0: the function is not active. An input value of 0 is not permissible if speed monitoring PNU P026 is used.	7.5	>P027 FEEDBACK NER 007.5Hz	–

1) Default value (xxx) depends on frequency inverter type rating.

Positioning

Parameter for closed-loop position control (APR)

PNU	Name	Adjustable in RUN mode		Value	Function	DS
		Normal	Extended			
P014	Orientation: STOP position	–	✓	0 to 4095 pulses	Location of end position[1)2)]	0
P015	Orientation: Speed	–	✓	0 to 120 Hz	Frequency (= speed) to reach STOP position[3)]	5
P016	Orientation: Direction of rotation	–	–	00	Clockwise rotation (FWD)[2)3)]	00
				01	Anticlockwise rotation (REV)[2)3)]	
P017	Positioning tolerance	–	✓	0 to 10000 pulses	The digital output configured as POK is active if the entered tolerance range is maintained.	5
P018	Delay for POK	–	✓	0 to 9.9 s	Delay for the POK signal (attenuation, sensitivity)	0
P023	Control circuit gain	–	✓	0 to 100	Interference gain (G = gain). The amplified differential signal of the actual/reference value comparison is directly dependent on current actual value FB[4)].	0.5

1) The drive always requires two revolutions, (i.e. two Z pulses) to determine the end position. The direction of rotation from which the STOP position is approached (Z pulse) is of no consequence here.

   The orientation run to the STOP position always requires 4096 pulses per revolution (0 to 4095), irrespective of the encoder's pulse rate. One revolution takes the drive from its current position to the zero position (Z position = signal EZP-EZN). The DV6 frequency inverter issues a FWD signal for this purpose. The number of revolutions is calculated by dividing 4096 by the encoder's pulse rate.

2) To determine the end position, the motor must be moved only in the direction of rotation set with PNU P016.

3) Excessive orientation speed values (PNU P015) result in a shutdown with fault message "Overvoltage".

4) During orientation/positioning, the reference value signal (REF) is zero. To improve the positioning accuracy, increase the value in PNU P023. If the motor becomes unstable, reduce the value.

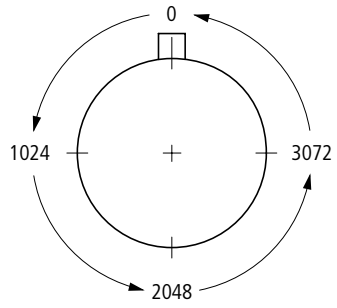


Figure 46: Orientation to the end position

0 = reference position for Z pulse
Motor shaft, viewed from load side

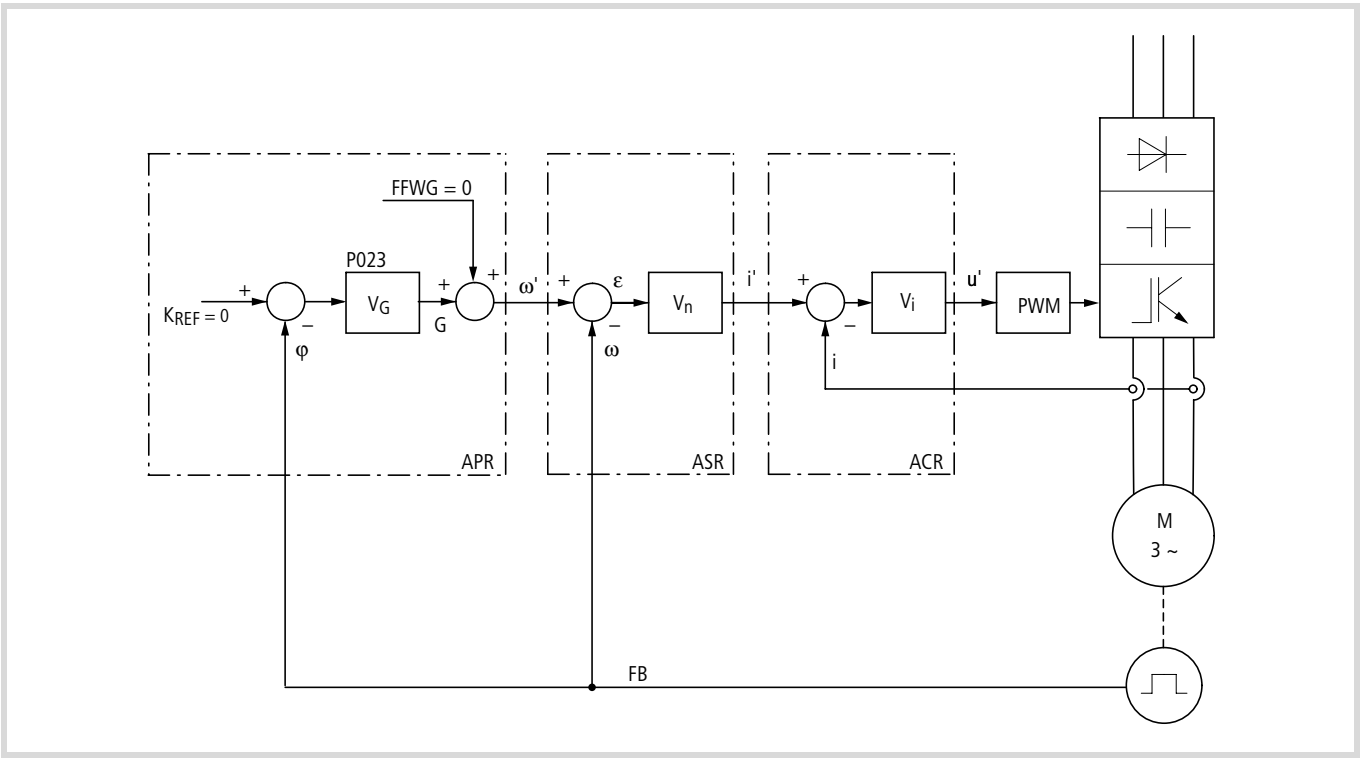


Figure 47: Positioning block diagram

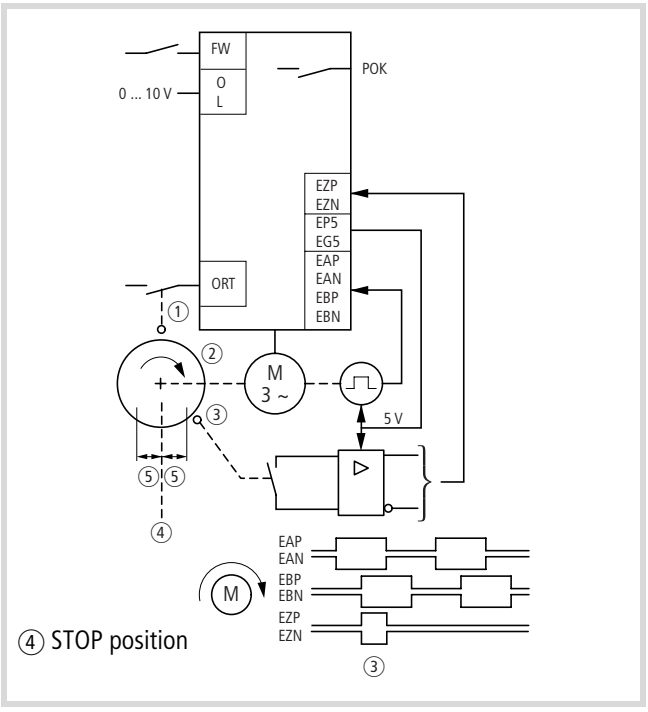


Figure 48: Positioning block diagram

① Starts the orientation function. The motor speed is reduced to the orientation speed set with PNU P015 in the ramp time set with PNU F002.

② Orientation speed

③ Z pulse The frequency inverter counts the pulses on the A channel until the STOP position is reached. The required number of pulses to the STOP position is set with PNU P017.

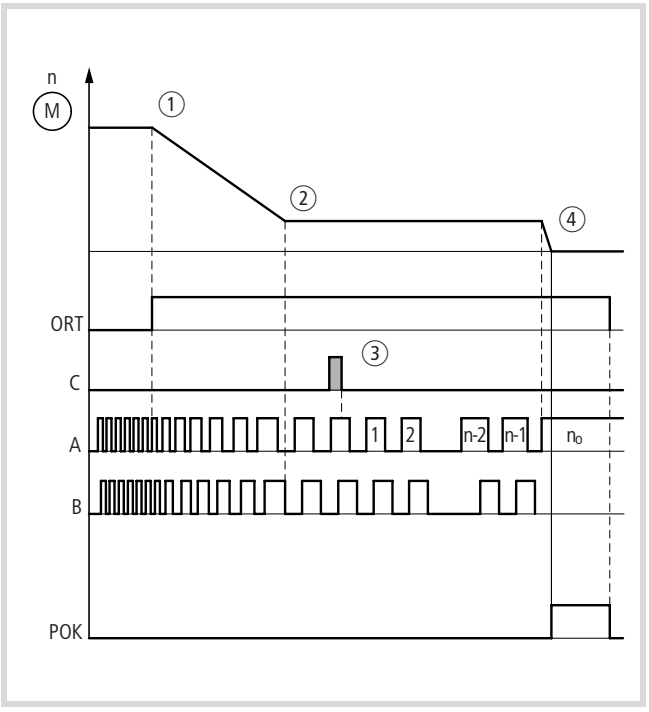


Figure 49: Positioning sequence

④ The drive stops. The DV6 issues the POK signal and triggers the orientation (ORT) function.

⑤ The delay of the POK signal can be set with PNU P018.

Parameter list for positioning a rotary disk. The square brackets contain the expressions displayed on the DEX-KEY-10.

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
A044	*U/f* characteristic	–	–	00 to 05	05 [V2]: Vector control (closed-loop) with DE6-IOM-ENC add-on module.	00	>A044 Control 1st VC	05 [V2]
b098	Temperature sensor selection	–	✓	00 to 02	Temperature monitoring with NTC thermistor (connected to terminals TH and CM1).	00	b098 THERM SELECT OFF	02 [NTC]
b099	Tripping resistance threshold	–	✓	0 to 9999?	Temperature monitoring threshold value.	3000	>b099 THERM LEVEL 3000ohm	–
C001	Function of digital input 1	–	✓	01 to 48	45 [ORT]: Orientation through DE6-IOM-ENC add-on module.	18	>C001 IN-TM 1 RS	45 [ORT]
C021	Signal at digital output 11	–	✓	00 to 26	23 [POK]: Position reached signal	01	>C021 OUT-TM 11 FA1	23 [POK]
C085	Thermistor matching	✓	✓	0 to 1000	Scaling factor for thermistor input TH.	105	>C085 THERM ADJUST 0105.0	–
F002	Acceleration time 1	✓	✓	0.01 to 3600 s	Set function/description, → AWB8230-1415, page 125	30.0	>F002 ACCEL TIME1 0030.00s	5
F003	Deceleration time 1	✓	✓	0.01 to 3600 s	Set function/description, → AWB8230-1415, page 125	30.0	>F002 DECEL TIME1 0030.00s	3
H001	Autotuning mode	–	–	00 to 02	• 00 [NOR]: Autotuning not active • 01 [NRT]: Autotuning: motor standstill • 02 [AUT]: Autotuning/motor operation	00	>H001 AUX AUTO NOR	–
H002	Motor data	–	–	00 to 02	• 00 [NOR]: Standard motor • 01 [AUT]: Use autotuning data • 02 [ON-AUT]: Use current autotuning data	00	>H002 AUX DATA NOR	–
H003	Motor rating	–	–	0.2 to 160 kW	Shaft rating of assigned motor	xxx[1)]	>H003 AUX K 000.00kW	–
H004	Number of motor poles	–	–	2, 4, 6, 8	Number of motor poles	4	H004 AUX P 4P	–
H005	Motor constant	✓	✓	0.01 to 99	The response speed of the speed controller increases in proportion to this value.	1.59	>H005 AUX KP 01.590	–
H006	Motor stabilization constant	✓	✓	0 to 255	Reduce this value if the current fluctuates. To disable this function, enter the value 0.	100	>H006 AUX KCD 00100	–

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
H020	Motor constant R1	–	–	0 to 65.53 Ω	Default settings for the assigned motor ratings.	xxx[1)]	>H020 AUX R1 00.000ohm	–
H021	Motor constant R_2	–	–	0 to 65.53 Ω		xxx[1)]	>H021 AUX R2 00.000ohm	–
H022	Motor constant L	–	–	0 to 655.3 mH		xxx[1)]	>H022 AUX L 000.00mH	–
H023	Motor constant I_0	–	–	0 to 655.3 A_{rms}		xxx[1)]	>H023 AUX IO 000.00A	–
H024	Motor constant J	–	–	1 to 1000 Nm		xxx[1)]	>H024 AUX J 0000.000	–
H030	Motor constant R1	–	–	–	Contains the values determined with autotuning (PNU H001). Do **not** change these values.		>H030 AUX A-R1 00.000ohm	ro
H031	Motor constant R_2	–	–	–			>H031 AUX A-R2 00.000ohm	ro
H032	Motor constant L	–	–	–			>H032 AUX A-L 000.00mH	ro
H033	Motor constant I_0	–	–	–			>H033 AUX A-I0 000.00A	ro
H034	Motor constant J	–	–	–			>H034 AUX A-J 0000.000	ro
H050	PI controller P component	✓	✓	0 to 1000 %	PI controller for vector control (closed-loop)	100	>H050 AUX KSP 0100.0%	–
H051	PI controller I component	✓	✓	0 to 1000 %		100	>H051 AUX KSI 0100.0%	–
P001	Fault signals, slot 1	–	✓	00, 01	• 00 [TRP]: Fault signal and cancellation • 01 [RUN]: Ignore fault signal The fault signals from the DE6-IOM-ENC module in slot 1 can be viewed with E60 to E69.	00	>P001 OPTION1 SELECT TRP	–
P002	Fault signals, slot 2	–	✓		• 00 [TRP]: Fault signal and cancellation • 01 [RUN]: Ignore fault signal The fault signals from the DE6-IOM-ENC module in slot 2 can be viewed with E70 to E79.	00	>P002 OPTION2 SELECT TRP	–
P011	Number of pulses per revolution	–	–	128 to 65000	Pulses per revolution (up to 100 kHz)	1024	>P011 FEEDBACK ENC-P 01024Pls	1024

PNU	Name	Adjustable in RUN mode		Value	Set function/description	DS	DEX-KEY-10	Input value
		Normal	Extended					
P012	Control method	–	–	00, 01	• 00 [ASR]: Closed-loop speed control • 01 [APR]: Electronic drive	00	>P012 FEEDBACK CONTROL ASR	00 [APR]
P013	Pulse train, reference value through SAP, SAN, SBP, SBN	–	–	00 to 02	• 00 [MD0]: Pulse train (dual-channel, 90°) • 01 [MD1]: Pulse train plus direction of rotation • 02 [MD2]: Pulse train or direction of rotation	00	>P013 FEEDBACK PULSE MD0	00 [MD0]
P014	Orientation: STOP position	–	✓	0 to 4095 pulses	Required STOP position. Number of pulses (n) on the A channel after Zero pulse detected (in our example ③). Example: Stop after 300 A pulses: $P014 = 4096 \times \frac{300}{P011} = 4096 \times \frac{300}{1024}$ P014 = 1200	00	>P014 FEEDBACK POS 00000P1s	1200
P015	Orientation: Speed	–	✓	0 to 120 Hz	Output frequency as orientation speed	5	>P015 FEEDBACK FC 005.00Hz	2.5
P016	Orientation: Direction of rotation	–	–		Forward (clockwise) operation (FWD) for orientation	00	>P016 FEEDBACK TURN FW	00
P017	Orientation: End position	–	✓	0 to 10000	Permissible deviation of the A pulses at the STOP position $P017 = n_0 \times 4$ Example value: ± 4 $P017 = 4 \times 4 = 16$	5	>P017 FEEDBACK L 00005P1s	16
P018	Orientation: Wait time, POK signal	–	✓	0 to 9.9 s	Delay for the POK signal (attenuation, sensitivity)	0	>P018 FEEDBACK TW 000.00s	0.5

Example – Positioning control with slave drive:
The speed ratio between the two drives is 3 : 1. The slave drive stops when the main drive encoder no longer issues pulses.

Parameter setting of the slave drive
(control scheme: → fig. 50):

- Transmission intervention PNU P019: 01 (REF)
- Transmission ratio, numerator PNU P020: 1024
- Transmission ratio, denominator PNU P021: 3 × 1024 = 3072

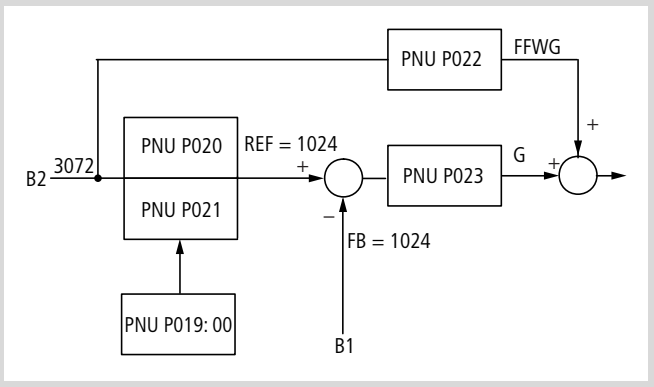


Figure 50: Control scheme, slave drive

- Both encoders are supplied with 5 V from the DV6 frequency inverters and supply 1024 pulses per revolution.
- The speed for the orientation phase corresponds with 3 Hz.
- The master drive stops 22 pulses after the Z pulse (EZP, EZN). This Z pulse is provided by a positioning controller.
- An error of ± 5 pulses at the STOP position is permissible.

→ Before commissioning and making the parameter settings described below, it is advisable to check the motor constants PNU H020 to H024 (motor rating to frequency inverter assignment) and whether autotuning (PNU H001) is enabled.

Overview of settings and functions

PNU	Function	Adjustable value/function		Description
		Master drive	Slave drive	
A044	U/f characteristic	05 [V2]	05 [V2]	Vector control (closed-loop) with optional DE6-IOM-ENC module
P011	Number of pulses per revolution	1024	1024	Pulses per revolution (≦ 100 kHz)
P012	Control method	01 [APR]	01 [APR]	Electronic drive
P013	Pulse train, reference value through SAP, SAN, SBP, SBN	00 [MD0]	00 [MD0]	Pulse train (dual-channel, 90°), depending on the encoder type and the positioning control (example: standard controller)
P014	Orientation: STOP position	88	–	4096 × (22/1024) = 88
P015	Orientation: Speed	3	–	Hz
P016	Orientation: Direction of rotation	00 [FW]	–	Clockwise rotation (FWD)
P017	Orientation: End position	5	✓	Permissible error at the STOP position
P019	Electronic drive	–	01 [REF]	→ fig. 50
P020	Transmission ratio: numerator	–	1024	Pulse value matching (B1, B2). Synchronization ratio 3:1. P021 = 3 × 1024 = 3072
P021	Transmission ratio: denominator	–	3072	
P022	Positive feedback gain	×	×	Depending on application. Note: On commissioning, optimize the master drive before the slave drive.
P023	Control circuit gain	×	×	

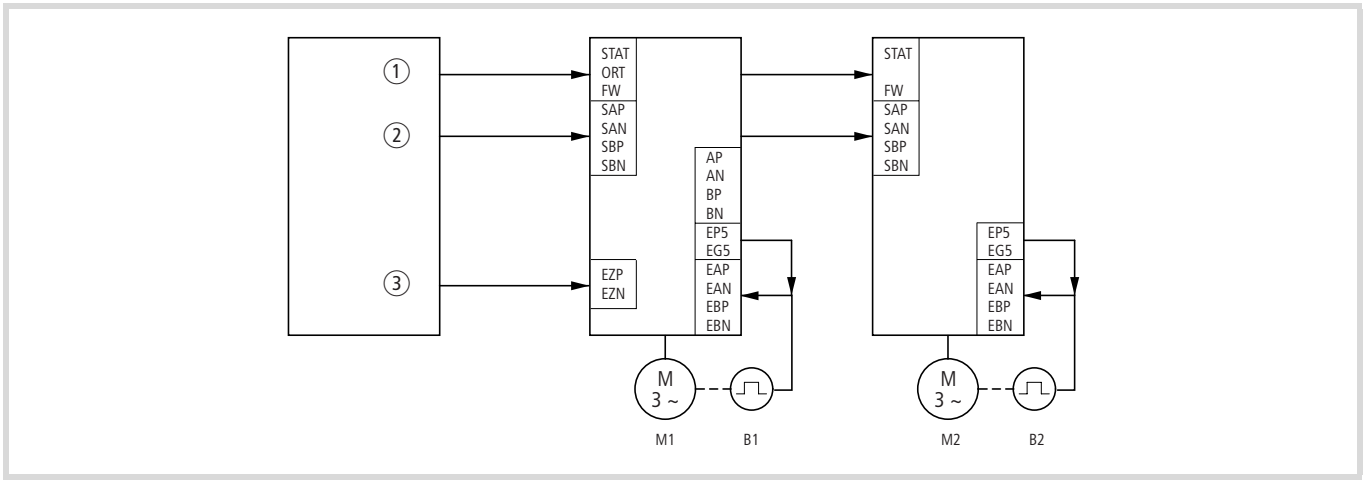


Figure 51: Block diagram

① Control
② Setpoint
③ Z pulse

Control	Master drive	Slave drive (M1 : M2 = 3 : 1)
PLC	DV6	DV6
Positioning	**Electronic drive (APR)**	**Electronic drive (APR)**
	DE6-IOM-ENC	DE6-IOM-ENC

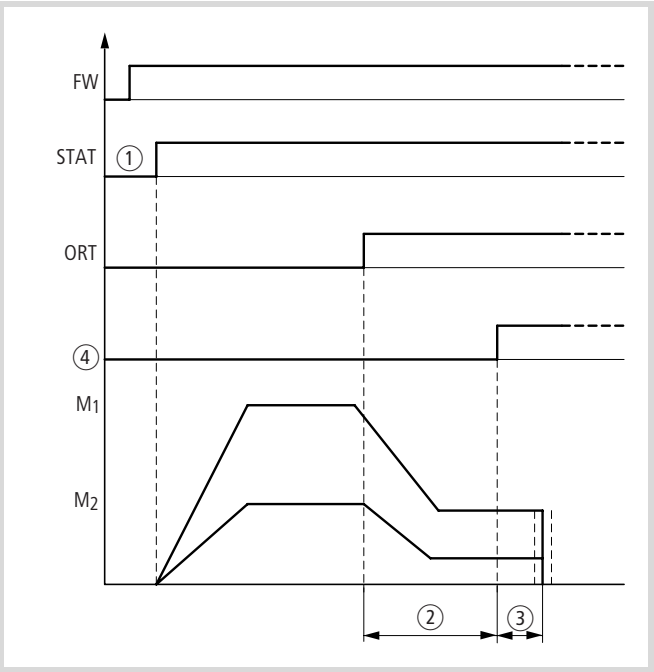


Figure 52: Time sequence

① Setpoint input through SAP, SAN, SBP and SBN

② Orientation phase. Speed reduction to the value set with PNU P015.

③ Positioning. After the Z pulse, 22 A pulses (PNU P014) to the STOP position with the permissible error of ± 5 pulses (PNU P017)

④ Z pulse

Parameterization with Drives-Soft

The equipment supplied with the DV6 frequency inverter includes a CD with the following content:

- Manuals in the form of PDF files (several languages, including German and English)
- The Drives-Soft parameterization software

→ Drives-Soft can be run on any PC with the Windows operating system (95, 98, 2000, ME or NT). To connect the PC to the DV6, you will need the DEX-CBL-2M0-PC connecting cable with interface converter.

→ If you already have an older version of Drives-Soft on your PC, uninstall it before you install the new version.

Drives-Soft provides a convenient, easy way of parameterizing DV6 vector frequency inverters and DEX-IOM-ENC encoder interface modules. To use Drives-Soft:

▶ Start the program
▶ Select the DV6 type you want to parameterize.

You can make the following settings both online and offline (i.e. with and without a connection to the DV6).

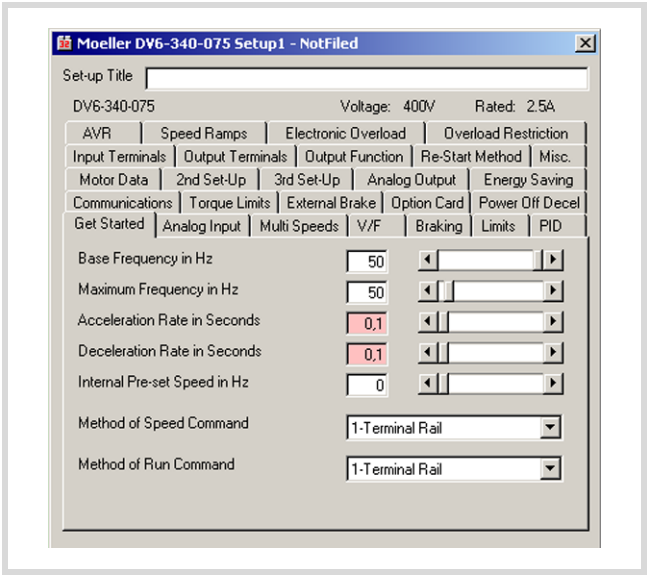


Figure 53: Basic settings

On the **Get Started** tab, you can set the drives' operating parameters, such as acceleration and deceleration times (PNU F002 and F003).

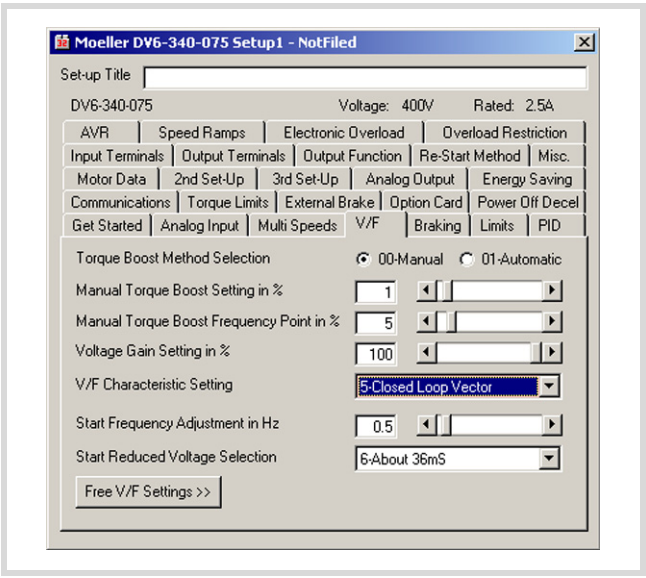


Figure 54: *V/f* actuation

In the **V/f Characteristic Setting** field on the **V/f** tab, select option 5, Closed Loop Vector.

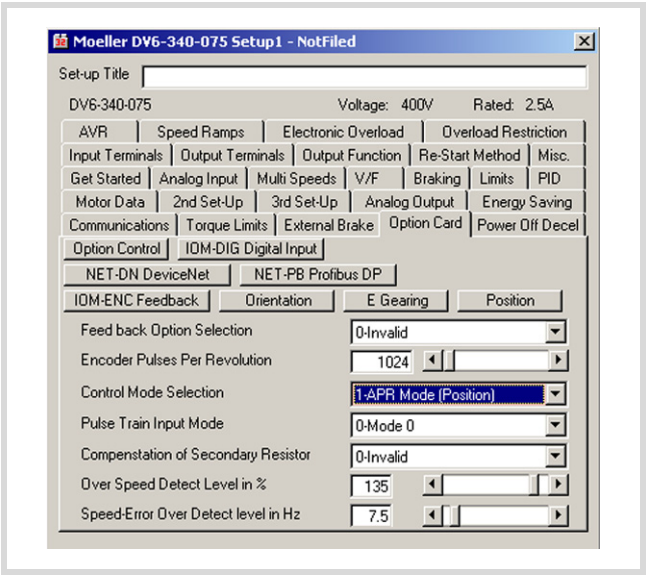


Figure 55: Options tab

On the **Option Card** tab, you can define the settings for the encoder interface module:

- Enable feedback (PNU P010)
- Encoder pulses per revolution (PNU P11)
- Control mode (PNU P012): ASR = closed-loop speed control
- Pulse train input mode (PNU P013): Pulse train, reference value through SAP,SAN, SBP and SBN.
- Secondary resistance compensation (PNU P025): Temperature compensation.
- Overspeed detection level in % (PNU P026): Speed monitor tripping level.
- Speed error in Hz (PNU P027)

To make additional settings, click the Orientation, E Gearing or Position buttons.

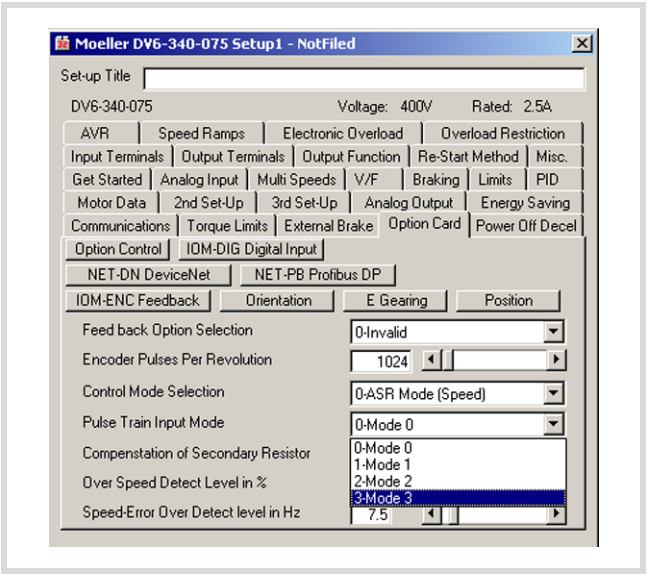


Figure 56: Reference input through pulse train inputs SAP, SAN, SBP and SBN

Description of the settings → page 37:

0-Mode 0 [MD0] Dual-channel, 90° pulse train
1-Mode 1 [MD1] Pulse train plus direction of rotation
2-Mode 2 [MD2] Pulse train or direction of rotation
3-Mode 3 Not used (reserve)

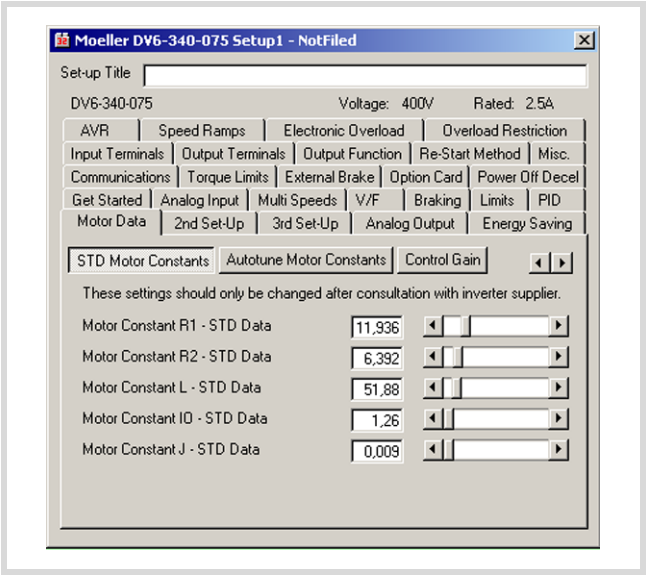


Figure 57: Motor Data

The **Motor Data** tab shows the H-parameters, which define the assigned motor constants (depending on the rating of the DV6) and the motor constants determined with autotuning (PNU H001, only in online mode).

→ Before you make any changes here, check the data sheets of the motor suppliers.

→ Do **not** change the values determined with autotuning.

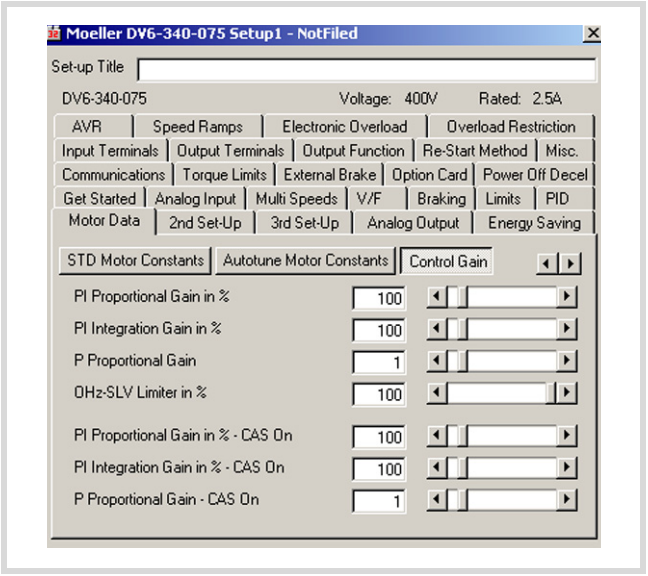


Figure 58: Control gain

To view or edit the PI values of the speed controller (PNU H050, H051, etc.) click the Control Gain button.

→ Don't forget to save your changes!

→ Note that all changes are stored in non-permanent memory: when you disconnect the power supply or the connecting cables, all data is lost.

Fault signals

The fault signals from the DV6 vector frequency inverter are described in manual AWB8230-1415... The fault messages listed here are issued only in connection with the DEX-IOM-ENC. With PNU P001 and P002 you can program the frequency inverter's behaviour in the event of a fault.

PNU	Name	Adjustable in RUN mode		Value	Function	DS
		Normal	Extended			
P001	Fault slot 1	–	✓	00	Fault signal issued	00
				01	No fault signal	
P002	Fault slot 2	–	✓	00	Fault signal issued	00
				01	No fault signal	

The following faults always cause a fault signal, even if PNU P001 or P002 is set to 01:

- E60, E70: Incremental encoder open circuit
- E69, E79: Faulty connection between frequency inverter and DE6-IOM-ENC.

Fault message	Name	Cause	Remedy
E 60[1)] E 70[1)]	Incremental encoder open circuit	The connection between incremental encoder and DE6-IOM-ENC module is interrupted.	Check the incremental encoder signals and the connection to the DE6-IOM-ENC module.
		• The incremental encoder is faulty. • The encoder does not match the required specification (→ section "Encoder", page 64).	Replace the incremental encoder.
		The incremental encoder has no Z channel.	Set DIP switch SWENC-2 to OFF
E 61[1)2)] E 71[1)2)]	Speed too high	The current speed is above the specified speed by the factor set with PNU P026.	Change the values in PNU H005 and H024/H034 so that the drive does not overshoot.
E 62[1)] E 72[1)]	Positioning error	The deviation of the actual position from the reference position is more than 1 000 000 pulses.	Increase the value in PNU P023 (Position Loop Gain). Reduce the number of pulses per second on channels SAP, SAN, SBP and SBN.
E 69[1)] E 79[1)]	Faulty connection	Faulty connection between frequency inverter and DE6-IOM-ENC.	Check the connection between the DE6-IOM-ENC module and the DV6 frequency inverter.

1) Fault signals E70, E71, E72 and E79 are shown when the fault occurs in connection with an add-on module in slot 2.

2) Even if these fault signals can be acknowledged while the motor is coasting to a halt, the fault message may reoccur in the remaining deceleration time. You should therefore acknowledge the fault only once the motor has come to a complete stop.

Warnings

Warnings are displayed when contradicting parameters values are entered (for example minimum operating frequency PNU A062 > end frequency PNU A004). In addition, the PRG LED flashes until the parameters are corrected.

The warnings from the DV6 vector frequency inverter are described in manual AWB8230-1415... The following warnings may appear in connection with the DE6-IOM-ENC encoder interface module:

Display	Function		
H009	Orientation speed, PNU P015	>	End frequency, PNU A004 (A204, A304)

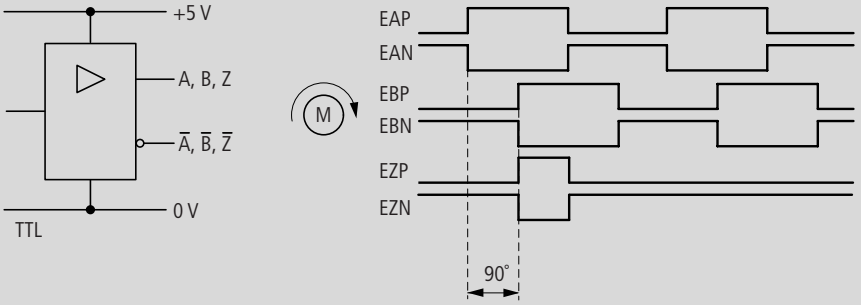
Appendix

Technical data

Name		Specification
Closed-loop speed control	Encoder	• 1024 pulses per revolution (incremental encoder feedback) • Power supply/pulse voltage: 5 V DC • Max. 100000 pulses per second (100 kHz) • Input resistance $R_i = 4.7\ k\Omega$
	Control method	PI/P control, P and I components separately adjustable
Positioning	Positioning reference value	• Mode 00: Pulse train (dual-channel, 90°) • Mode 01: Pulse train plus direction of rotation • Mode 02: Pulse train or direction of rotation • Max. 100 kHz
	Electronic drive	• Transmission ratio, numerator/denominator, adjustable from 1 to 9999 • $^1/_{50} \leqq$ numerator/denominator $\leqq 20$
Orientation	Stop position	4096 pulses (0 to 4095) divided by the number of pulses per motor shaft revolution
	Orientation run	Speed and direction of rotation adjustable
Protection functions		• Open-circuit monitoring – incremental encoder • Speed monitoring (PNU P026) • Positioning error • Faulty connection between DV6 and DE6-IOM-ENC

Encoder

For correct operation of the DE6-IOM-ENC add-on module, rotary encoders that meet the following specifications must be used:

Pulse rate[1)]	1024 per revolution (recommended)
Maximum pulse rate	100000 per second (100 kHz)
Supply voltage	5 V ⎓ ± 5 %. At higher supply voltages, the encoder should contain a voltage regulator to match the input voltage to 5 V ⎓.
Output signal	Optically isolated TTL (transistor–transistor logic) with inverted signals, based on RS 422 standard.
	
	Pulse train, shown for clockwise direction of rotation looking at the motor shaft. The Z channel is needed only for the orientation function.
Output amplitude	$U_{Low} \leqq 0.5$ V, $U_{High} \geqq 2.5$ V
Maximum length of connection cable	< 100 m[2)]

1) Observe manufacturer's maximum speed and frequency data

2) Use the connecting cables recommended by the encoder manufacturer.

→ When selecting an encoder, consider the mechanical and environmental conditions (ambient temperature, vibrations, degree of protection, etc.)

Example for encoder for 5 V DC power supply:

- ERN 420 rotary transducer
  Manufactured by Dr. Johannes Heidenhain GmbH, Trannrent, Germany;
- OG 90 DN...TTL digital tachometer
  Manufactured by Hübner Elektromaschinen AG, Berlin, Germany;
- ITD 40A4 rotary transducer
  Manufactured by Thalheim Tachometerbau & Co. KG, Eschwege, Germany.

Logic of digital outputs 11 to 15

The digital outputs of the DV6 vector frequency inverter are transistor outputs. With them, the DV6 can be connected to sink-type logic (USA, Japan) or source-type logic (EU).
The reference potential for all digital outputs is CM2.

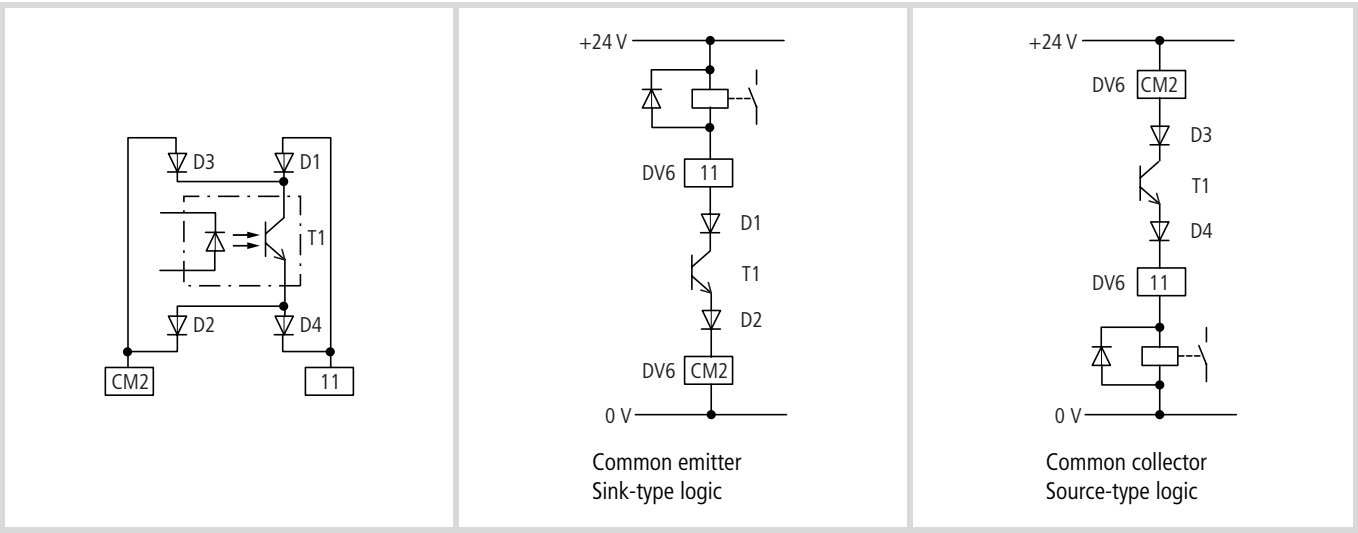


Figure 59: Digital output as sink-type or source-type logic

List for user-defined parameter settings

The table below contains the specific parameters for operating the add-on DE6-IOM-ENC encoder interface module. For a detailed description of these parameters, see the indicated pages in this manual (AWB8240-1431). In the free Setpoint columns, you can list the changes you have made from the default settings.

PNU	Function	Value range	DS	Page	Setpoint
A044	*U/f* characteristic	• 00: Constant torque curve • 01: Reduced torque curve • 02: *U/f* user-definable • 03: Sensorless vector control active • 04: 0 Hz sensorless vector control active • **05: Vector control with optional DE6-IOM-ENC module**	00	29	
C001 to C008	Function of digital input 1 Function of digital input 8	Function of digital input 1 • 01: REV, anticlockwise rotation • 02: FF1, first fixed frequency input • 03: FF2, second fixed frequency input • 04: FF3, third fixed frequency input • 05: FF4, fourth fixed frequency input • 06: JOG, jog mode • 07: DB, DC braking • 08: SET, second parameter set • 09: 2CH, second time ramp • 11: FRS, controller inhibit • 12: EXT, external fault • 13: USP, unattended start protection • 14: CS, heavy mains starting • 15: SFT, parameter protection • 16: AT, Analog input selection • 17: SET3, third parameter set • 18: RST, reset • 20: STA, three-wire control start signal • 21: STP, three-wire control stop signal • 22: STA, three-wire control direction • 23: PID, activate PID control • 24: PIDC, reset I component of PID control • 26: CAS: PI controller changeover • 27: UP, acceleration (remote access) • 28:DWN, deceleration (remote access) • 29: UDC, Reset frequency (remote access) • 31: OPE, reference value through keypad • 32 to 38: Bitwise fixed frequencies • 39: OLR, change over current limit • 40: Torque limitation active • 41: TRQ1, torque limitation 1 active • 42: TRQ2, torque limitation 2 active • 43: PPI, PI to P control mode changeover • 44: BOK, brake enable confirmation • 45: ORT, orientation • 46: LAC, ramp function Off • 47: PCLR, clear positioning error • 48: STAT, reference input through optional module • NO: No function	18	68[1)]	

1) Pages from AWB8230-1415

PNU	Function	Value range	DS	Page	Setpoint
C021 to C025	Signal to digital output 11 Signal to digital output 15	• 00: RUN signal • 01: FA1, frequency reached • 02: FA2, frequency exceeded • 03: OL, overload • 04: OD, PID error exceeded • 05: AL, fault • 06: FA3, frequency reached (1) • 07: OTQ, torque reached (exceeded) • 08: IP, mains failure, immediate stop • 09: UV, undervoltage • 10: TRQ, torque limitation • 11: ONT, Mains On time exceeded • 12: RNT, Running time exceeded • 13: THM, motor thermal overload • 19: BRK, enable signal for external brake • 20:BER, brake fault • 21: ZS, zero frequency • 22: DSE, speed error exceeded • 23: POK, positioning • 24: FA4, frequency exceeded (2) • 25: FA5, frequency reached (2) • 26: OL2, overload alarm 2	01	104[1)]	
C026	Signal to relay terminals K11-K12	Values → PUN C021	05	118[1)]	
C027	Output, FM output	• 00: Output frequency, PWM signal • 01: Output current • 02: Torque, SLV control only • 03: Output frequency, FM signal • 04: Output voltage • 05: Inverter input power • 06: Thermal load ratio • 07: Ramp frequency	00	59[1)]	
C028	Output, AM output	• 00: Output frequency, PWM signal • 01: Output current • 02: Torque, SLV control only • 04: Output voltage • 05: Inverter input power • 06: Thermal load ratio • 07: Ramp frequency	00	58[1)]	
C029	Output, AMI output	Values → PNU C028	00	59[1)]	
C031 to C035	Digital output 11 Digital output 15	• 00: Make contact • 01: Break contact	00	101[1)]	
H001 to H034	Parameters H001 to H034 (motor data, SLV, autotuning) must be defined before the DE6-IOM-ENC add-on module is taken into operation (→ DV6 manual AWB8230-1415…, section "SLV and Autotuning").				
H050	P component of PI control	0 to 1000 %	100.0	48	
H051	I component of PI control	0 to 1000 %	100.0	48	
H052	P component of P control	0.00 to 10.00 %	1.00	31	
H060	0 Hz sensorless vector magnetization current	0 to 100 %	100	175[1)]	
H070	P component of PI control with changeover	0 to 1000 %	100.0	36	
H071	I component of PI control with changeover	0 to 1000 %	100.0	36	

1) Pages from AWB8230-1415

PNU	Function	Value range	DS	Page	Setpoint
H072	P component of P control with changeover	0.00 to 10.00 %	1.00	31	
P001	Fault signal from the add-on module in slot 1	• 00: Trip (motor stop) • 01: No trip	00	61	
P002	Fault signal from the add-on module in slot 2	• 00: Trip (motor stop) • 01: No trip	00	61	
P010	DE6-IOM-ENC add-on module	• 00: Inhibited • **01: Enable**	00	8	
P011	Number of pulses per revolution (encoder)	128 to 65000 pulses/revolution (max. 100 kHz)	1024	48	
P012	Control method	• 00: Closed-loop speed control (ASR) • 01: Closed-loop position control (APR)	00	49	
P013	Pulse reference value through SAP, SAN, SBP and SBN	Mode: • 00: Pulse train (dual-channel, 90°) • 01: Pulse train plus direction of rotation • 02: Pulse train or direction of rotation	00	37	
P014	Orientation: STOP position	0 to 4095 pulses	0	22	
P015	Orientation: Speed	0 to 120 Hz	5	22	
P016	Orientation: Direction of rotation	• 00: Clockwise rotation (FWD) • 01: Anticlockwise rotation (REV)	00	51	
P017	Orientation: End position	0 to 10000 pulses	5	51	
P018	Orientation: Wait time, POK signal	0 to 9.99 s	0	51	
P019	Electronic drive	Ratio: • 00: In feedback (FB) • 01: In the reference value (REF)	00	39	
P020	Transmission ratio: numerator	1 to 9999	1	39	
P021	Transmission ratio: denominator	1 to 9999	1	39	
P022	Positive feedback gain	0 to 655.3	0.00	39	
P023	Control circuit gain	0 to 100	0.50	22	
P025	Temperature compensation, thermistor	• 00: Not active • 01: Active	00	30	
P026	Speed monitoring, tripping threshold	0 to 150 %	135	49	
P027	Speed error, tripping threshold	0 to 120 Hz	7.50	50	

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