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VARICON

Operating Instructions

Three-Phase Motor
with Integrated Frequency Converter

Standard-VARICON

Version 1.2 ■ Status: 08/2007 ■ Standard

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Revision overview

Revision of manual	Revision date
1.0	First edition 30/11/2005
1.1	01.02.2007 1. Revised edition
1.2	01.08.2007 2nd revised edition Parts A, B, C, D, E, F, H, J, M

Introduction

This manual contains the operating instructions for the VARICON three-phase AC motor and frequency inverter, which can be used in applications where drives have to be controlled.

VARICON is available as a standard version as well as in several customized versions. The following describes the version supplied. The following information includes: installation, commissioning, parameterization and notes on safety, error messages, a description of the interface and technical data.

Each chapter contains a table of contents and a separate index to help you find the information you require quickly.

- Please read the notes on safety and the warning notices carefully before you install and commission the VARICON.

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Part A

General

Table of contents

1 Notes on safety

You must observe the following notice!

Keep these Operating Instructions in a safe place for future reference, and ensure they are made available to all users!

1.1 Symbols and warning notes

Read all the safety instructions contained in the safety instructions as well as the warning labels on the machine. Ensure that the warning labels are legible at all times; replace missing or illegible labels.

1.1.1 Meaning of the symbols used

Warning – electrical hazard! Danger of death!

Electrical shocks can cause death or serious physical injury to personnel as well as pose a risk to equipment (for example, damage to the device).

Warning – general hazards! Risk of injury!

Further sources of danger are, for example, mechanical components that can cause serious physical injury to personnel. Equipment is also at risk (for example, damage to the device).

Warning – hot surfaces! Risk of injury! Risk of fire!

- *Heated surfaces can cause serious physical injury to personnel.*
- *Heated surfaces can ignite material in the immediate vicinity.*

Warning – machine starts automatically!

Under certain circumstances, the VARICON drive can start up automatically.

Caution. You must observe the following notice!

A measure that must be taken to ensure the safe and trouble-free operation of the VARICON drive.

Additional notes and information.

1.1.2 General warning notes!

Warning – electrical hazard! Danger of death!

Ensure that no unauthorized persons are able to gain access to or come into contact with the device.

Warning – electrical hazard! Danger of death!

Disconnect the device from the power supply before opening the device or the terminal box. Due to the DC-link capacitors, hazardous high voltage may remain for up to three (3) minutes after disconnecting from the power supply.

Warning – electrical hazard! Danger of death!

Be aware that live components are exposed when carrying out work in the terminal box of the VARICON drive. *It is forbidden to perform any tasks in the terminal box when the device is in operation or for three minutes after safety disconnection from the power supply. The following terminals can carry dangerous voltages even when the motor is at a standstill.*

- *Mains terminals*
- *Brake resistor supply terminals*
- *DC link supply terminal*

Warning – electrical hazard! Danger of death!

Never operate the VARICON drive when the power system is not connected to earth!

Warning – electrical hazard! Danger of death!

VARICON drives with three-phase mains connection are not compatible with residual-current circuit breakers (RCCB). They are not suitable for use in portable devices equipped with plug-and-socket connections. RCCBs alone are ***not*** *sufficient on their own to protect against dangerous shock currents!*

Caution! Automatic restart.

Operating the VARICON drive with automatic restart (please refer to Part F. Adapting parameters) can be a source of danger to operating personnel.

Warning – general hazards! Risk of injury!

Applies only to VARICON drives with 3-phase power supply:

This product can produce a direct current in the protective earth. When using a residual current device (RCD) for protection against direct or indirect contact, it is only permitted to use an RCD of Type B on the power supply side of this product. A different protective measure is necessary on the other side, for example, separation from the surrounds by means of double or reinforced isolation or isolation from the supply system by means of a transformer.

High-voltage testing!

It is only permitted to test with DC voltage.

The capacitor in the frequency inverter can be damaged from high AC currents. Consequential damage may result. A ramp can be used for testing purposes.

Increase	*max. 700 V/s*
Halting time	*1 s*
Decrease	*max. 700 V/s*

The DC voltage test value is available in table 18 of EN 50178.

Caution. You must observe the following notice!

It is permissible under the following conditions to connect the VARICON drive via a residual-current device (RCCB).

- *If the residual-current circuit breaker (RCCB) can universally detect AC und pulsating DC leakage currents.*
- *The residual-current circuit breaker (RCCB) must conform to the new design regulations in accordance with DIN VDE 0664 when operating an input voltage of 1 x 230 V with performance ratings up to 4 kVA.*

Caution. You must observe the following notice!

Secure wiring and movable components in a manner that ensures they do not come into contact with active components of the VARICON drive.

Caution. You must observe the following notice!

Remove or secure the parallel key when running trial operations.

Caution. You must observe the following notice!

Ensure sufficient distance is maintained to actuating elements, and prevent unintentional contact when the device housing is open (for example during device maintenance procedures).

Caution. You must observe the following notice!

Cyclic connection of the frequency inverter to the mains is permitted every two minutes at most.

1.1.3 Radio interference suppression, shielding, EMC

The integrated EMC filters and shielding features ensure compliance with limit values for the immediate vicinity in accordance with EN 61800-3.

1.2 Qualification of personnel

Only personnel with the necessary qualifications are permitted to commission and maintain VARICON drives. These personnel must be familiar with all of the warning notes and the corresponding measures given in these operating instructions for transport, setting up and operation.

Qualified personnel must have the necessary qualifications.

Examples:

- Training or instructions giving him or her the authority to turn on and off, earth and label electrical circuits and devices in accordance with national and international standards for safety.
- Training or instructions in accordance with national and international standards for safety in the care and use of appropriate safety equipment.
- Training in First Aid.
- Knowledge of valid national and international accident prevention regulations.

1.3 Intended use

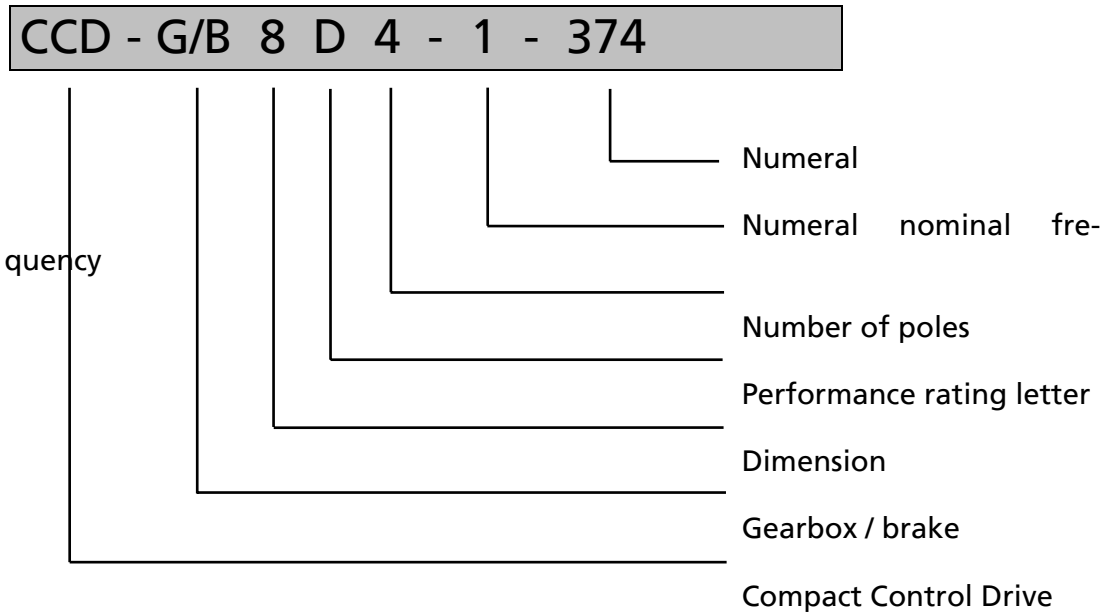
- VARICON drives are designed and constructed to meet the latest respective, recognized technical safety standards. However, danger to life and limb of the user cannot be fully ruled out. The VARICON drive must be used as a variable speed drive unit only. Any other usage of any kind is deemed to be incorrect use.
- The VARICON drive must be operated when in a technically flawless condition only.

2 General device description

The VARICON drive is a three-phase asynchronous motor with integrated frequency inverter, which makes cabling between the motor and frequency inverter superfluous. Due to the fact that radio interference suppression is already integrated (in compliance with EN 61800-3) and the VARICON drive complies with valid EMC guidelines, external mains and motor filters are unnecessary.

Installation is comparable to that of a simple three-phase motor. Default settings are optimized to suit the respective motor type to achieve best possible efficiency ratings. The drives are equipped with a PLC-compatible interface as standard. Various Fieldbus interfaces are optionally available.

Type code:



3 Mounting, Installation and Maintenance

You must observe the following notice!

The utmost attention must be paid to the work described in this chapter!

Warning – general hazards! Risk of injury!

Warning – electrical hazard! Danger of death!

3.1 Installation conditions

- To prevent accumulation of heat, ensure that there is sufficient cooling or space when mounting.
- Ensure a minimum of at least 100 mm of space between the VARICON drive and the next spatial restriction.
- The permissible ambient operating temperature is 0 °C to 40 °C (climate class 3K3). Please request design notes if prospective operating conditions vary from the above.
- The drives standard versions fulfill vibration class N in accordance with ISO 60034-14.

A version meeting vibration class R requirements is also available. A smooth shaft end can be supplied for high-speed drives.

- Keys and slots are manufactured in accordance with DIN EN 50347. The VARICON drive is dynamically balanced on two levels with a half parallel key on the end of the shaft.

➔ VARICON drive dimensions are available in Part K, Technical Data and Dimensions.

3.2 Design types

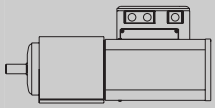
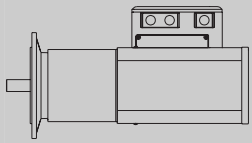
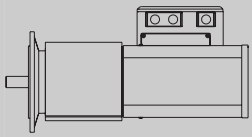
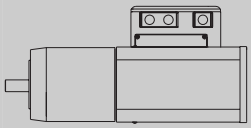
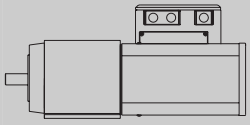
Design types to DIN EN 50347		
Design type	Graphic symbol	Explanation
With feet		Two end shields, housing with feet, exposed shaft end, mounted on base
With flange FF		Two end shields, housing without feet, exposed shaft end, flange FF is close to bearing on input side, flange mounting
With feet and flange FF		Two end shields, housing with feet, exposed shaft end, mounting flange FF is close to bearing on input side, mounted on base for flange use
With flange FT		Two end shields, housing without feet, exposed shaft end, mounting flange FT is close to bearing on input side, flange mounting
With feet and flange FT		Two end shields, housing with feet, exposed shaft end, mounting flange FF is close to bearing on input side, mounted on base for flange use

Table 3.1 Designs

3.3 Notes on maintenance

When operating in dirty conditions, regularly clean ventilation passages around the separately driven fan system. If necessary, dismount the fan hood:

- Loosen 4 x hexagonal socket head screws.
- To remove, slide the hood to the rear.

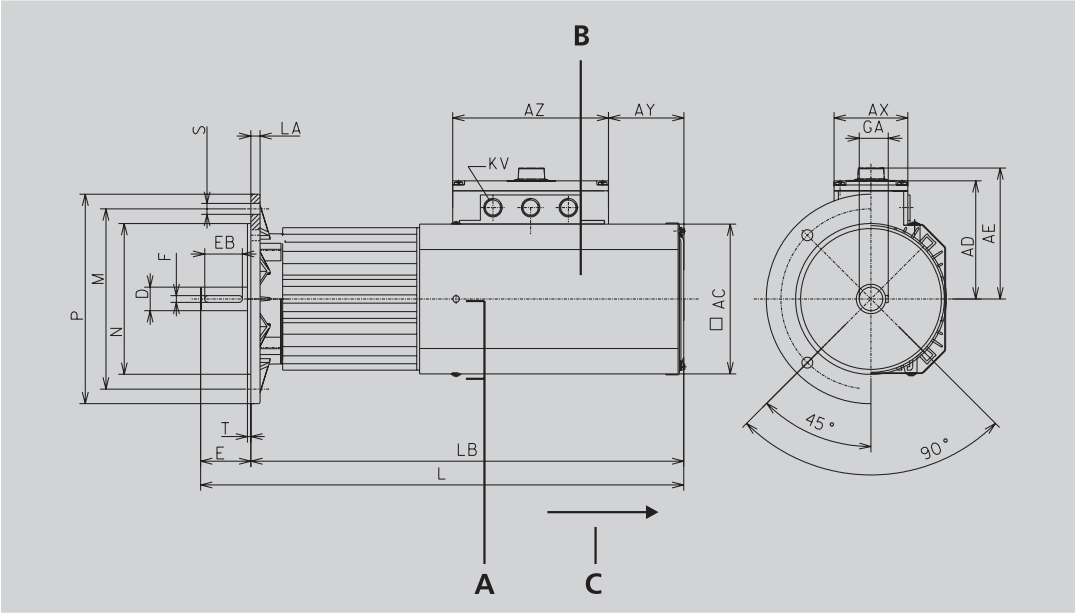


Figure 3.1 Notes on maintenance

A Fillister-head screws, M5 x 12 with hexagon socket

B Fan hood

B Direction for removing the fan hood

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Part B

Short Guide

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Notes on Safety

Warning – electrical hazard!
Danger of death!
Electrical shocks can lead to death or serious injury to personnel. Equipment is also at risk (for example, damage to the device).

Warning – general hazards!
Risk of injury!
Further sources of danger are, for example, mechanical components that can cause serious physical injury to personnel. Equipment is also at risk (for example, damage to the device).

Warning – hot surface!
Risk of injury!

Warning – machine starts automatically!

If you see this symbol in the Short Guide and require more information, please refer to the VARICON operating instructions.

VARICON – an overview

As well as containing notes on safety, the Short Guide provides the user with assistance in commissioning the basic version of the VARICON, and its subsequent operation utilising the factory settings.

Preparation

This Short Guide is an extract of the VARICON operating instructions. Read the operating instructions carefully before commissioning the VARICON.

Mechanical installation

Install the VARICON in accordance with the corresponding rules and regulations in an appropriate environment and position that precludes any danger to personnel, machines and systems during the mechanical and electrical installation.

- Ensure that the VARICON is sufficiently ventilated to allow heat loss to dissipate.
- When installing for the first time in a machine, pay particular attention to ensure the direction of rotation is correctly wired and that the correct power supply voltage is applied.

Electrical installation

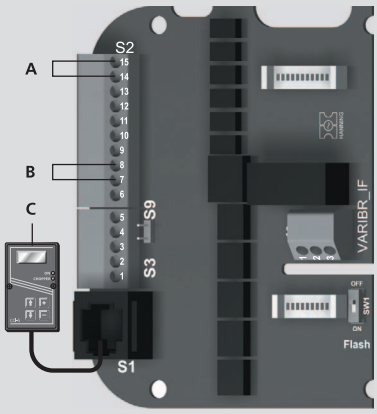
- Power supply voltage
  Please refer to the details on the rating plate for the electrical installation of the power supply.

Explaining the rating plate
For information on cross-section and power supply cable fusing, please refer to the chapter: Technical data.

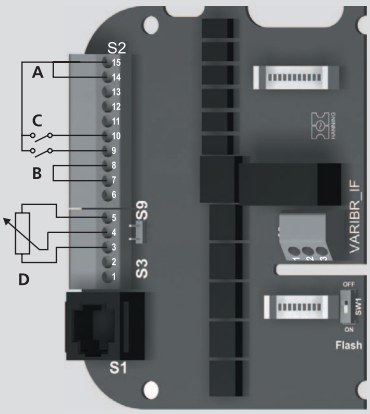
- EMC compliant installation
  It is the user's responsibility to ensure that his respective construction (final product/device) complies with the valid regulations in his country.
  The control lines must be routed separately from the mains supply lines. It is recommended to route the control lines in a separate cable duct. Use shielded lines.
  Protective measures and protective equipment must comply with valid regulations (for example, EN 60204 or EN 50178).

Necessary protective measures:
Earth the VARICON.

Standard interface



A A bridge from +24 V-OUT (terminal 15) to FREI (terminal 14)
B A bridge from GND INT (terminal 7) to DIG GND (terminal 8)
C Operating unit



A A bridge from +24 V-OUT (terminal 15) to FREI (terminal 14)
B A bridge from GND INT (terminal 7) to DIG GND (terminal 8)
C Start right (terminal 10) or Start left (terminal 9)
D Potentiometer 10 kΩ

Commissioning with... operating unit

- Both start inputs (ST-RI (terminal 10) and ST-LE (terminal 9)) are disabled (LOW or open).
- The enable input (FREI (terminal 14)) is wired active (HIGH).
- Link the reference potential of the digital inputs to GND INT by means of a bridge from GND INT to DIG GND.
- Turn on the power supply. The parameter speed is displayed. The green LED lights up continuously to signalise the operational readiness of the device.
- All operating parameters for the VARICON can be displayed one after the other (keys ↑ ↓) and altered (keys + −).
- By pressing both ↑ ↓ keys simultaneously, it is possible to switch to the parameter speed from any position.
- The name of the selected parameter is displayed in the first line. The actual value or control state is displayed in the second line.
- Set the setspeed value selection SetSpeed to the value 0 (keyboard).
- Set the mode to 1 (start) with the key.
- Alter the speed value via the parameter Speed 0 using the + − keys.

... external potentiometer

- Both start inputs (ST-RI (terminal 10) and ST-LE (terminal 9)) are disabled (LOW or open).
- The enable input (FREI (terminal 14)) is wired active (HIGH).
- Link the reference potential of the digital inputs to GND INT by means of a bridge from GND INT to DIG GND.
- A 10-kΩ potentiometer must be connected to the terminals +10V-OUT (terminal 3), A-IN+ (terminal 4) and A-IN- (terminal 5).
- Motor start via the start inputs (ST-RI or ST-LE); apply switch.
- Set the speed via the potentiometer.

To avoid interference, short cables only (up to max. 2 m) must be used to wire the enable FREI to the internal voltage supply (see connection diagram). When operating the device with an external power supply ensure that you do not connect the reference voltage with the internal voltages (GND INT, +24V-OUT).

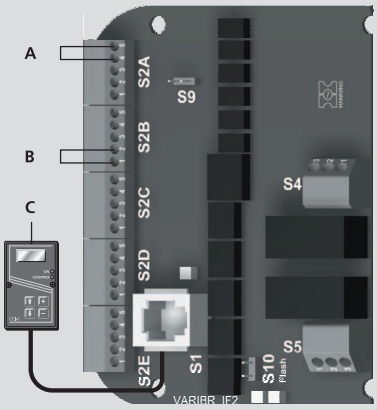
Terminal rail assignment

The inputs FREI, D-IN 0/1, ST-RE/LI and F-QUIT are PLC compatible.

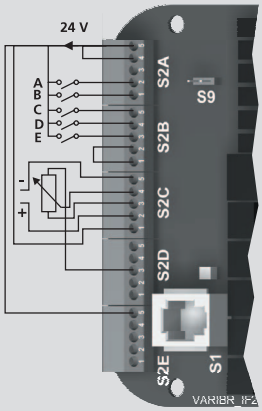
Caution. You must observe the following notice!
*In an **EMERGENCY STOP** situation, it is permitted to use this input FREI to turn **off** the clock pulse. However, the input FREI must not be used to switch the VARICON clock pulse on/off for normal operational purposes.*

Terminal	Designation	Signal level	Input/ Output	Function	Optical decoupling
1	A	0 to 5 V		RS-485 signal line **A**	
2	B	0 to 5 V		RS-485 signal line **B**	
3	+10 V-OUT	10 V / max 10 mA	---	10-V power supply to connect a potentiometer to the analogue input	
4	A-IN+	0 (2) to 10 V or 0 (4) to 20 mA	Input	Analogue setspeed selection 0 (2) to 10 V Switch selectable to 0 (4) to 20 mA (slide switch SW1 on the PCB)	
5	A-IN-	A GND	---	Reference potential for analogue input	
6/7	GND INT	GND		Ground reference of the internal power supply	Yes
8	DIG GND	GND	---	Reference potential for the inputs FREI, D-IN 0/1, ST-RE/LI and F-Quit	Yes
9	ST-LI	Active HIGH 24 V	Input	Start left	Yes
10	ST-RE	Active HIGH 24 V	Input	Start right	Yes
11	D-IN 0	Active HIGH 24 V	Input	Fixed speed selection 0	Yes
12	D-IN 1	Active HIGH 24 V	Input	Fixed speed selection 1	Yes
13	F-QUIT	Active HIGH edge 24 V	Input	Error acknowledgement	Yes
14	FREI	Active HIGH 24 V	Input	Inverter enable. This input can be used to directly enable or disable the PBM and the converter clock pulse.	Yes
15	+24 V-OUT	24 V / 70 mA	---	Internal 24 V power supply to the control inputs, if no external control voltage is available.	

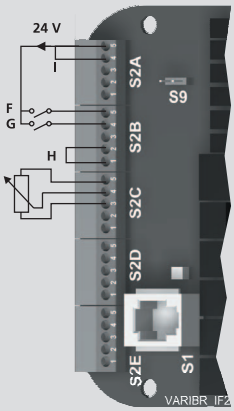
Special interface



A A bridge from +24 V EX ('A5') to 'FREI' ('A4')
B A bridge from 'GND INT' ('B1') to DIG GND ('B2')
C Operating unit



Special interface I
A Direction of rotation 1. Setpoint value source (open = left, closed = right)
B Start command 1. Setpoint value source
C 2. Setpoint value source, start right
D 2. Setpoint value source, start left
E Switch analogue setpoint value from 2 to 1



Special interface II and III
F Start right for 1. analogue setspeed
G Start left for 1. analogue setspeed

Special interface I, II and III
H Earth terminal
I Release

Commissioning with... operating unit

- The earth terminals ('GND INT' ('B1') and 'DIG GND' ('B2')) must be connected.
- The operating unit must be connected.
- Both start inputs ('ST-RE' and 'ST-LI') are disabled (0 or open).
- The enable input 'FREI' must be wired to 'A5'.
- All operating parameters for the VARICON can be displayed one after the other (keys ↑ ↓) and altered (keys ⊕ ⊖).
- It is possible to switch to the speed parameter 'Speed' from any position by pressing both buttons ↑ ↓ simultaneously.
- The name of the selected parameter is displayed in the first line. The actual value or control state is displayed in the second line.
- Set the setpoint value selection 'SetSpeed' to code value 0.
- Set the mode to start using the ⊕ key.
- To alter the speed, select the parameter 'Set Spd 0' using the ⊕ ⊖ keys.

... analog setspeed selection*

*** (e.g. external potentiometer)**

- The earth terminals ('GND INT' ('B1') and 'DIG GND' ('B2')) must be connected.
- Both start inputs ('ST-RE' and 'ST-LI') are disabled (0 or open).
- The enable input 'FREI' must be wired to 'A5'.
- All operating parameters for the VARICON can be displayed one after the other (keys ↑ ↓) and altered (keys ⊕ ⊖).
- It is possible to switch to the speed parameter 'Speed' from any position by pressing both buttons ↑ ↓ simultaneously.
- The name of the selected parameter is displayed in the first line. The actual value or control state is displayed in the second line.
- Set the setpoint value selection 'SetSpeed' to code value 135.
- Motor start: 24 volts on terminal 'A1', 'B4', or 'B5'.
- Alter the speed over the analog setpoint value selection.

Necessary protective measures:
Earth the VARICON.

Caution. You must observe the following notice!
*In an **EMERGENCY STOP** situation, it is permitted to use this input FREI to turn **off** the clock pulse. However, the input FREI must not be used to switch the VARICON clock pulse on/off for normal operational purposes.*

To avoid interference, short cables only (up to max. 2 m) use only to wire the enable 'FREI' to the internal voltage supply (see connection diagram).

When operating with an external power supply, ensure that the 'DIG GND' ('B2') is used as a reference potential for the PLC inputs and that 'GND INT' ('D3' or 'E3') is used as a reference potential for setpoint value selection, speed encoder decoupling and the digital feedback output.

Terminal rail assignment

The inputs 'D-IN 0' ('A1'), 'D-IN 1' ('A2'), 'F-QUIT' ('A3'), 'FREI' ('A4'), D-IN HAND ('B3'), 'ST-RE' ('B4') and 'ST-LI' ('B5') are PLC compatible.

Block designations

S1	Terminal for operating unit
S2A - S2E	Terminal strips, each with 5 connections
S4	1. relay connection terminals 1: NC contact, 2: Mid-position contact, 3: NO contact
S5	2. relay connection terminals (not applicable to special interfaces II and III) 1: NC contact, 2: Mid-position contact, 3: NO contact
S9	Jumper for analogue setpoint value selection 0 (4) to 20 mA
S10	Jumper to flash

Terminal (Block) S2...	Designation	Signal level	Input/ Output	Function	n/a for S-IF II	n/a for S-IF III
A1	D-IN 0	Active HIGH 24 V	Input	Fixed speed selection 0 or start input		
A2	D-IN 1	Active HIGH 24 V	Input	Fixed speed selection 1 or direction of rotation right		
A3	F-QUIT	LOW/HIGH-edge 24 V	Input	Error acknowledgement		
A4	FREI	Active HIGH 24 V	Input	Inverter enable. This input can be used to directly enable or disable the converter clock pulse.		
A5	24 V EX	24 V	Output	24 V power supply for control inputs		
B1	GND INT	GND	---	Ground reference for the internal power supply		
B2	DIG GND	GND	---	Reference potential for the inputs FREI, D-IN 0/1, D-IN HAND, ST-RE/LI and F-Quit		
B3	D-IN HAND	Active HIGH 24 V	Input	Analogue setpoint value selection	X	X
B4	ST-LI	Active HIGH 24 V	Input	Start left		
B5	ST-RE	Active HIGH 24 V	Input	Start right		
C1	V-IN	24 V	Input	Supply for analogue setpoint value selection 1 and 2, and supply for the speed encoder signal, spur lines A (D4) and B (D5)		
C2	A-IN 2+	0 (4) to 20 mA	Input	2. Analogue setspeed selection 0 (4) to 20 mA	X	X
C3	+10 V-OUT	10 V / max. 10 mA	Output	10-V supply to connect a potentiometer to the analogue input		
C4	A-IN 1+	0 (2) to 10 V or 0 (4) to 20 mA Switch selectable	Input	1. Analogue setspeed selection 0 (2) to 10 V Bi-directional to 0 (4) to 20 mA (jumper S9)		
C5	A-IN-	A GND	---	Reference potential for analogue input		
D1	I-OUT-	4 -20 mA	Output	Signalling output		X
D2	I-OUT+	4 - 20 mA	Output	Signalling output		X
D3	GND INT	GND	---	Ground reference for the		
				internal power supply		
D4	A+ OUT	0 - V-OUT (24 V)	Output	Speed encoder signal, spur line **A** (apply 24 V to C1)		
D5	B+ OUT	0 - V-OUT (24 V)	Output	Speed encoder signal, spur line **B** (apply 24 V to C1)		
E1	A	0 to 5 V	Input/output	RS 485 signal line		
E2	B	0 to 5 V	Input/output	RS 485 signal line		
E3	GND INT	GND	---	Ground reference for the internal power supply		
E4	OUT HAND	0 - V-OUT (24 V)	Output	Digital signalling output for setpoint value selection	X	X
E5	V-IN HAND	24 V	Input	Supply for signalling output OUT HAND (E4) and setpoint value selection	X	X

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Part C

Initial commissioning with the Profibus DP interface

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5 Profibus DP interface

5.1 Introduction

This capital describes how to start a Hanning VARICON drive with the Profibus DP interface for the first time.

5.2 Configuring the drive

5.2.1 Setting the Profibus DP address

The Profibus DP address for the drive is configurable. The following options are available:

- By means of the operating unit

1. Select the parameter **Address.**
2. Using the arrow keys, set the Profibus DP address in the range **from 32 to 64.**
3. Select the parameter **MemWrite**
4. Hold down the "+" key for five seconds.

- Using the Profibus DP

1. Establish communication with the preset address 32, via the Profibus DP.
2. Modify the **Address** parameter. A setting process in the parameter **MemWrite** ensures that the set address value is permanently stored in the drive. A description is found in Chapter 5.6.1 Setting a parameter, on page 5-26.

The new Profibus DP address is activated only after the next time the VARICON drive is started!

5.2.2 Device data file (GSD)

Each drive has a corresponding GSD. The file contains important information, specific to Profibus, which is needed when first starting up the drive.

The GSD can be downloaded from www.hanning-hew.de.

5.3 The Profibus interface connection

The following figure shows the layout of the connections, switches, buttons and LEDs. The corresponding functions are explained in the following sections.

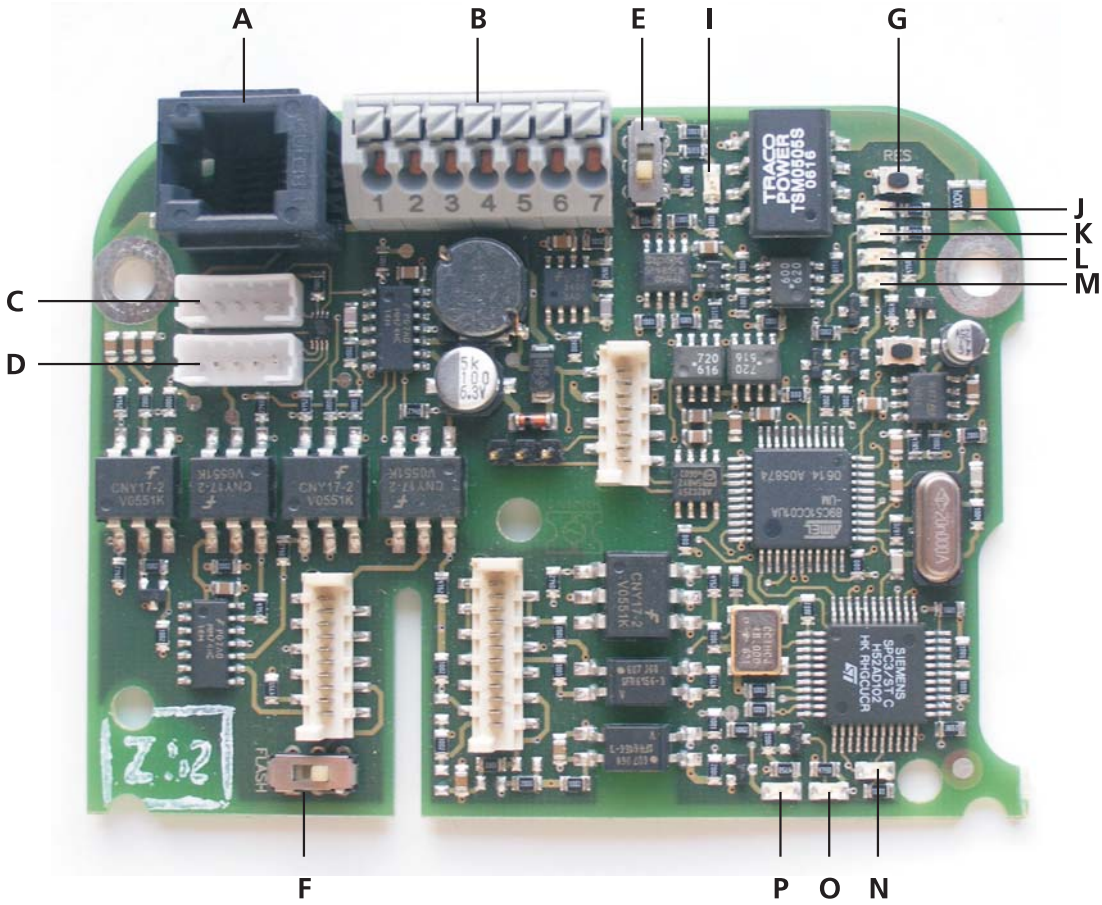

Figure 5-1 The Profibus interface connection

Operating unit connection	Profibus connection
SIO drive plug	SIO Atmel-µC plug
Switch for the Profibus terminating resistor (ON = below, OFF = above)	Switch for the Atmel-µC Flash programming
Reset button for the Atmel-µC	Boot button for the Atmel-µC
Operating LED for the separate supply of the Profibus	LED 1
LED 2	LED 3
LED 4	LED SPC3 DATAEX
LED Available	LED Operational (Ready)

Profibus interface connections

Operating unit connection

Drive parameters can be displayed and set with the operating unit.

Interface parameters cannot be displayed or set with the operating unit!

Profibus connection

1: B Lead-in

2: A Lead-in

3: +5V

4: GND

5: A Continuing line

6: B Continuing line

7: Rts (Request to Send)
When using an Optolink, this is used to switch between send and receive.

SIO drive plug

Using the correct adapter, the drive can be connected to a PC via the PC's serial port. Software available for the PC, called DrivePAR, allows you to easily set parameters for the drive. Contact a Hanning sales representative for more information.

SIO Atmel-µC plug

For internal use only.

Profibus interface switch

Switch for the Profibus terminating resistor

ON: Terminating resistor is enabled. This position must be set for each terminal device.

OFF: Terminating resistor is switched off.

Switch for the Atmel-µC Flash programming

For internal use only. Please leave this switch in the depicted position.

Profibus interface button

Reset button for the Atmel-µC

For internal use only.

Boot button for the Atmel-µC

For internal use only.

Profibus interface LEDs

Operating LED for the separate supply of the Profibus

The Profibus interface is supplied with voltage

LED 1 ...

... blinks when addresses are queried from the drive.

... lights up when addresses are successfully transferred and a communication-ready state is present.

LED 2 ...

... blinks when there are interface or drive errors.

➔ More information on the possible blinking patterns can be found in Chapter 5.7.2Patterns of LED flash codes, page 5-30.

LED 3 ...

... lights up during rapid-stop

➔ More information on the rapid-stop function can be found in Chapter Rapid stop, page 5-11, and Chapter Drive behaviour during bus malfunction, page 5-12.

LED 4 ...

... lights up while in test mode. For internal use only.

LED SPC3 DATAEX ...

... lights up during the exchange of user data with the master. During correct configuration and parameterization of the Profibus interface and the application, the slave changes to Data_Exchange status (i.e., the slave swaps user data with the master).

LED Available ...

... lights up when drive becomes available.

Drive availability can be invoked with bit 0 of control command 1.

➔ More information on the drive availability function can be found in Chapter 5.5.1 List of the supported output data (setpoint values), page 5-16, and Chapter Control command 1 (device control command) page 5-18.

LED Operational ...

... lights up when the drive is operational.

In order to successfully control the drive, the drive must show that it is operational. In addition to the LED, the operational bit is set in the device status byte.

➔ More information on the drive operational function can be found in Chapter 5.5.4 Description of the input data (actual values), page 5-21.

Notes on the LEDs 1 - 4:

After the power supply has been turned on, the LEDs 1 - 4 show the following:

- Approx. 0.3 sec. - LED test: LEDs light up briefly.
- Approx. 7 sec. - internal test: LEDs are turned off.
- At this point the interface address set by the drive is queried. When the query is successful, the LED 1 lights up continuously. When the address cannot successfully be queried from the drive (for example when communication is interrupted between the interface and the drive, or if the false internal baud rate is set incorrectly), then the LED 1 blinks and the slave is not assigned a Profibus address.
- After the Profibus address is set successfully, LED 1 lights continuously and LED 2 shows the error-status of the interface or drive. If the LED 2 is lit continuously, then there is no error. If LED 2 is blinking, then an interface or drive error has occurred. The type of error can be determined from the pattern of blinking (see Chapter 5.7.2 Patterns of LED flash codes, page 5-30). After a reset-error control command, LED 2 should be lit up continuously, since no new error has occurred.
- After a Rapid stop, LED 3 lights up and LED 2 blinks. After a reset-error control command is issued, LED 3 turns off and LED 2 lights up.
- LED 4 lights up continuously. This condition should never occur during normal operation.

5.4 Nominal value specification and setting of parameters

The interface established by the Profibus can be divided into send and receive ranges. By describing the send range through nominal values or by reading out the actual vales from the receive range, it is possible to exchange process data (device control commands, required and actual speed values) with the drive. Furthermore it is possible to fully configure the drive.

For the configuration of parameters, it is important to differentiate between interface and drive parameters. Profibus-specific functions can be set with the interface parameters. Drive-specific functions can be set with the drive parameters. Interface and drive parameters are addressed via a code number, and set or queried in the same manner. Target selection (drive or interface) in the communication control command represents the one difference.

The following information is entered in the transmission range:

transmission range	Description	
Control command 1 (device control command)	The device control command controls basic functions (for example, drive availability, drive start including direction of rotation, error acknowledgement, speed queries as well as rapid-stop command).	Process data
Control command 2 (communications control command)	The control command for communication is used to control queries and to set interface and drive parameters.	
Required nominal value	The required nominal value level is precisely adjusted by an activated controller within the scope of the controller accuracy. When the controller is deactivated, the shaft speed decreases around the load-dependent slip speed.	
Parameter code number	Here is entered the code number of an interface or drive parameter to be queried or set.	Parameter data
Parameter setpoint value	The corresponding parameter setpoint value must be given when setting an interface or drive parameter.	

Table 5-1 Transmission range

The following information is entered in the receive range:

Receive range	Description	
Device status byte	The device status byte signals the operational readiness of the drive. In addition, the issued error code is assigned to a source (interface or drive) or an action (actuating request or query). A bit of the device status byte indicates if a rapid-stop ramp is enabled or not.	Process data
Error code	Any non-zero value indicates an error. Interface or drive errors which are triggered by an actuating request or query are signaled. More detailed information about the type of error is available in the device status byte.	
Actual speed value	The speed of the ramp generator is made available when the controller is deactivated. The shaft speed is made available when the controller is activated.	
Parameter code number	This is where the code number is acknowledged of an interface or drive parameter to be queried or set.	Parameter data
Actual parameter value	The actual parameter value of a queried interface or drive parameter is available here.	
Parameter description	Based on the description of the parameter, it is possible to check if the actual value of the parameter provided is valid and if it is an interface or drive parameter.	

Table 5-2 Receive range

➔ A more detailed description of the transmission and receive interface is available in Chapter 5.5, Profibus interface, page 5-16.

5.4.1 Process data

The process data interface provides functions described in the following sections.

Start drive

To start the drive, the following steps must be carried out:

Action	Effect
Power-up drive	The drive executes a self-test. If this is successful, then LED1 lights up.
Enable drive	Set "available" in the device control command. A pre-condition is that the drive has already signaled its operational readiness with the appropriate bit in the device status byte.
Specify required speed	Describe required speed high-byte and low-byte
Select direction of rotation and start	Set bit "Start left" or Start right" in the device control command. The drive will rotate at the specified required speed.

Table 5-3 Start drive

Error

If an error occurs, the error code (in the receive range) contains a non-zero value. In conjunction with the device status byte, it is possible to locate the cause of the signaled error. The device status byte contains a description of the error code that provides exact information regarding the type of error that has occurred. The following types of errors are detailed:

- Interface error
- Drive error
- Error in actuating requests
- Error in query requests

➔ More detailed information on error code descriptions is available in Chapter Device status byte, page 5-21.

➔ General information about diagnosis and troubleshooting errors is provided in Chapter 5.7, Diagnosing and Troubleshooting Errors, page 5-29.

A signaled error can be reset using the "reset Error" bit in the device control command. To determine the error status of the drive, the "read-out drive error-code" bit must be set.

Speed query

The actual speed value can be updated once by setting the "query speed once" bit in the device control command. The actual speed value is updated cyclically if the "query speed cyclic" bit is set.

Rapid stop

When the value of the rapid-stop bit is changed from 0 to 1, the drive is brought to a standstill in accordance with the configurable rapid-stop ramp. The parameter for the rapid-stop ramp is administered by the interface.

When a rapid-stop command is triggered, the sequence of events is as follows:

- The brake ramp set in the drive is stored temporarily in the interface; the rapid-stop ramp administered by the interface is transmitted to the drive.
- Then the command "STOP mode" is transmitted to the drive.
- Once the drive has been brought to a standstill, the temporarily-stored brake ramp is transmitted back to the drive.

5.4.2 Interface parameter

General

Profibus-specific functions can be set with the interface parameters. They are addressed via a code number. During the parameterisation process, the target "interface" must be set in the control command for communication.

➔ The exact procedure for setting or querying an interface parameter is described in Chapter 5.6.1, Setting a parameter, page 5-26, and Chapter 5.6.2, Read out of a parameter, page 5-27.

The following sections contain a more detailed description of the various interface parameters.

Interface software version

The "interface software version" parameter indicates the version number of the Profibus interface software.

To determine the version of the drive software, the drive parameter must be read out with code number 15.

Drive behaviour during bus malfunction

A bus malfunction can occur, for example, when the bus cable is broken. In this case, the drive behaviour can be configured via the interface parameter "drive behaviour during bus malfunction". The following options are available:

- Sets the drive in the STOP mode.
  The drive decelerates with the adjusted brake ramp to speed 0.
- Drive status is maintained.
  The drive keeps its set speed.
- Availability is deactivated.
  The drive availability is disabled. The drive reacts with a short jolt. The clock pulse of the inverter is then turned off. Further speed-time characteristics depend on the load.
- Rapid stop.
  The drive performs a rapid stop.

Saving the "drive behaviour during bus malfunction" setting

Setting the high-order bit causes the drive behaviour during bus malfunction to be permanently saved in the interface. This remains saved even after the device is powered off.

Example: After setting the value to 8003hex, the drive reacts to a bus malfunction by performing a rapid stop. This setting is not deleted when the power supply is turned off.

Rapid-stop ramp

Drive deceleration is configured with the interface parameter "rapid-stop ramp" when a rapid stop is activated.

Speed encoder counter

The drive increments the pulses of the integrated speed encoder. This is independent of the direction of rotation. When reading out the interface parameter "speed encoder counter", the counter content is made available as a 24-bit value as follows:

Parameter – actual value high byte:	Counter content (bit 17 to bit 24)
Parameter - actual value low byte:	Counter content (bit 9 to bit 16)
Parameter - actual value supplementary byte:	Counter content (bit 1 to bit 8)

The counter content is reset with each write command on the "speed encoder counter" interface parameter.

List of interface parameters

Code Number	Remark	Preset value	During set	During query
1	**Interface software version** Actual parameter value, high byte: Main version of interface software Actual parameter value, low byte: Minor version number of interface software Actual parameter value, supplemental byte: Beta version of interface software (when equal to 0, then non-beta software)			X
2	**Drive behaviour during bus malfunction** Content of actual parameter value, low byte: 0: Sets the drive in the STOP mode 1: Drive status is maintained. 2: Availability is deactivated 3: Rapid stop ➔ Additional information about drive behaviour during bus malfunctions and permanent saving of settings can be found in Chapter Drive behaviour during bus malfunction, page 5-12.	0	X	X
3	**Rapid-stop ramp**	5000	X	X
4	**Speed encoder counter** The speed encoder counter can be queried with this code number. Actual parameter value, high byte: Counter content (bit 17 to bit 24) Actual parameter value, low byte: Counter content (bit 9 to bit 16) Actual parameter value, supplementary byte: Counter content (bit 1 to bit 8) Each write command on this code number causes the speed encoder counter to be reset. Remarks: - The speed encoder counter is installed only in special versions of the VARICON drive. - When the controller is activated, the speed encoder counter must be in the STOP mode when it is to be reset.		X	X
5	**reserved**			
6	**reserved**			
7	**reserved**			

Table 5-4 Interface parameters

➔ The exact procedure for setting or querying an interface parameter is described in Chapter 5.6.1 Setting a parameter, page 5-26, and Chapter 5.6.2 Read out of a parameter, page 5-27.

5.4.3 Drive parameter

Drive-specific functions can be set with the drive parameters. They are addressed via a code number. During the parameterisation process, the target "drive" must be set in the communication control command.

➔ The exact procedure for setting or querying a drive parameter is described in Chapter 5.6.1, Setting a parameter, page 5-26, and Chapter 5.6.2, Read out of a parameter, page 5-27.

➔ The operating instructions for the drive contain information about parameters supported by the drive. There you will find all parameter in a code table with the following information:

Column	Remark
Code	Code number
Explanation	Parameter name
Min.	Minimum parameter value
Max.	Maximum parameter value
Unit	Unit for the parameter
Query	allowed / not allowed
During set	allowed / not allowed

Table 5-5 Drive parameters

5.5 Profibus interface

5.5.1 List of the supported output data (setpoint values)

Byte	Designation
1	Control command 1 (device control command) bit 0: Available (if 1) bit 1: Start left (if 1) bit 2: Start right (if 1) bit 3: Reset error (0 => 1) bit 4: Read error code for drive (0 => 1) bit 5: Query speed once (0 => 1) bit 6: Query speed, in cycles (if 1) bit 7: Rapid stop (0 => 1) When the value of the rapid-stop bit is changed from 0 to 1, the drive is brought to a standstill in accordance with the configurable rapid-stop ramp. ➔ More detailed information on error code descriptions is available in Chapter Rapid stop, page 5-11.
2	Control command 2 (control command for communication) Bit 0: Transmit parameter (0 => 1) Bit 1: Query parameter (0 => 1) Bit 2: Transmit parameter in cycles (if 1) bit 3: Parameter query in cycles (if 1) bit 4: Parameter target (drive = 0, interface = 1) bit 5: reserved bit 6: reserved bit 7: Mirror bit The value of the mirror bit set here can be read in the device status byte. ➔ More detailed information on communication control commands are available in Chapter 5.6 Parameter protocol description, page 5-26.
3	Required speed, high byte
4	Required speed, low byte
5	Parameter code number, high byte
6	Parameter code number, low byte
7	Required value of parameter, high byte
8	Required value of parameter, low byte
9	reserved
10	reserved

Table 5-6 Supported output data (required values)

5.5.2 List of the supported input data (actual values)

Byte	Designation
1	Device status byte bit 0: Operational (set if drive is ready for operations) bit 1: Error code description (bit 1) for actual value byte 2 bit 2: Error code description (bit 2) for actual value byte 2 bit 3: Error code description (bit 3) for actual value byte 2 The possible bit combinations for error code descriptions bit 3/2/1 = 000 No error available bit 3/2/1 = 001 Byte 2 contains the interface error code bit 3/2/1 = 010 Byte 2 contains the drive error code bit 3/2/1 = 011 Byte 2 contains the actuating request error code bit 3/2/1 = 100 Byte 2 contains a query error code bit 4: Rapid-stop ramp is active bit 5: reserved bit 6: reserved bit 7: mirror bit (The value of the mirror bit set in the communication control command can be read here.)
2	Error code
3	Actual speed, high byte
4	Actual speed, low byte
5	Actual parameter code number value, high byte
6	Actual parameter code number value, low byte
7	Actual parameter value, high byte
8	Actual parameter value, low byte
9	Actual parameter value, supplementary byte
10	Parameter description bit 0: "transmit parameter" acknowledge bit 1: "query parameter" acknowledge bit 2: Parameter source (drive = 0, interface = 1) bit 3: Data valid
11	reserved
12	reserved

Table 5-7 Supported input data (actual values)

5.5.3 Description of output data (required setpoint values)

Control command 1 (device control command)

The following bits are made available by control command 1:

bit 0: Available (if 1)

The "available" bit must be set before the drive can be started. If the enable bit is revoked, the drive will coast to an uncontrolled standstill.

bit 1: Start left (if 1)

When the bit "start left" is set, the drive will start in a counter-clockwise (left) direction of rotation at the speed last set.

bit 2: Start right (if 1)

When the bit "start right" is set, the drive will start in a clockwise (right) direction of rotation at the speed last set.

bit 3: Reset error (0 => 1)

A pending error is reset when the value of the bit "reset error" is altered from 0 to 1.

bit 4: Read error code for drive (0 => 1)

When the bit "read-out error code" is altered from 0 to 1, the error code of the drive will be read out and made available in the input byte "error code". Further information about the error code is coded in the device status byte.

bit 5: Query speed once (0 => 1)

When the "query speed once" bit is altered from 0 to 1, the actual speed is updated once only.

bit 6: Query speed, in cycles (if 1)

When the "query speed in cycles" bit is set, the actual speed is updated cyclically.

bit 7: Rapid stop (0 => 1)

When the value of the "rapid stop" bit is altered from 0 to 1, the drive is set to the STOP mode in accordance with the interface parameter "rapid-stop ramp". The interface signals the "rapid stop enabled" interface error, when the rapid stop command is triggered.

Before the "rapid-stop ramp" administered by the interface is transmitted to the drive, the interface reads out the actual "brake ramp" from the drive and re-writes it when the drive is at a stand-still.

Control command 2 (communication control command)

The following bits are made available by control command 2:

bit 0: Transmit parameter (0 => 1)

When the value of the "send parameter" bit is altered from 0 to 1, the parameter described in the output data (parameter code number and Parameter setpoint value) is transmitted to the drive.

bit 1: Query parameter (0 => 1)

When the value of the "query parameter" but is changed from 0 to 1, the parameter described in the output data (parameter code number) is queried by the drive. The acquired parameter value is made available in the input data "actual parameter value".

bit 2: Transmit parameter in cycles (if 1)

As long as the "transmit parameter in cycles" bit is set, the parameters described in the output data (parameter code number and Parameter setpoint value) are transmitted cyclically to the drive.

bit 3: Parameter query in cycles (if 1)

As long as the "query parameter in cycles" bit is set, the parameter described in the output data (parameter code number) is queried cyclically by the drive. The acquired parameter value is made available in the input data "actual parameter value".

bit 4: Parameter target

0: Drive parameter

1: Interface parameter

bit 5: reserved (set to 0)

bit 6: reserved (set to 0)

bit 7: Mirror bit

The status of the mirror bit is transmitted from the control to the drive, and then sent back (mirrored) to the control. It can be read out from bit 7 of the device status byte. The status of the mirror bit received from the device status byte must be in agreement with the sent status.

The mirror bit should be set to 1 in order to quickly detect when a Profibus slave is dropped. When the same bit in the device status byte changes its status to 0, this is an indication that the Profibus communication to the slave is disrupted or the slave is disconnected.

➔ More information on the drive availability function can be found in Chapter 5.6.1, Setting a parameter, page 5-26, and Chapter 5.6.2, Read out of a parameter, page 5-27.

Required speed

The required speed of the drive is set via the "required speed" high byte and "required speed" low byte.

Parameter code number

Which interface or drive parameter is to be read or transmitted is determined via the "parameter code number" high byte and "parameter code number" low byte. The read and transmit procedure of a parameter is controlled via the bits of the control command 2 (control command for communication).

Parameter setpoint value

The "parameter setpoint value" high byte and "parameter setpoint value" low byte jointly describe a parameter setpoint value (interface or drive parameter). The read and transmit procedure of a parameter is controlled via the bits of the control command 2 (control command for communication).

5.5.4 Description of the input data (actual values)

Device status byte

The device status byte contains information about the status of the drive.

bit 0: Operational (if 1)

The "operational" bit is set when the drive is ready for operations. In the event that an error occurs, the drive resets the "operational" bit. The corresponding error code is automatically made available in the "error code" input byte.

To ensure that the drive can correctly signal that it is operational, the parameter "RL1 Set" (configuration of relay 1) must be set to "ready" (the preset value).

bits 1, 2, 3: Error code description

The following table contains the possible error code descriptions:

Bit combination	Error code description	Remarks
000	No error exists	No error has occurred.
001	Interface error	The error code indicates an interface error. ➔ "Interface error codes" support by the interface is described in Chapter 5.7.3Error codes interface, page 5-30. The interface error "bus malfunction" occurs, for example, if the bus cable is interrupted.
010	Drive error	The error code indicates a drive error. ➔ "Drive error codes" which are supported by the drive are described in Chapter 5.7.4 Drive error codes, page 5-30. They are also described in the operating instructions for the connected frequency inverter. The drive error "no availability" occurs, for example, if the drive was started with "start left/right" without the availability bit in the device control command being set beforehand.

Bit combination	Error code description	Remarks
011	Errors in actuating request	An actuating request is transmitted from the Profibus interface to the drive, in the following cases: - The required nominal value was changed. - The start left/right bit was set. - An error was reset. - The rapid-stop bit was set. - A drive parameter was altered. If an error occurs in such an actuating request, the error code contains the response of the actuating request. ➔ A list of error codes for actuating requests is found in Chapter 5.7.5Error codes with actuating requests, page 5-31.
100	Error in query request	A query request is transmitted from the Profibus interface to the drive, in the following cases: - The bit "read-out drive error code" was set. - The bit 'read-out speed' was set. - A drive parameter was queried. If an error occurs in such a query request, the error code contains the response of the query request. ➔ A list of error codes for queries is found in Chapter 5.7.6 Query error codes, page 5-31.

Table 5-8 Error code description

bit 4: Rapid-stop ramp is active (if 1)

When the "rapid-stop ramp enable" bit is set, the current brake ramp is replaced by the rapid-stop ramp.

No changes to the brake ramp should be undertaken during this time.

bit 5: reserved

bit 6: reserved

bit 7: Mirror bit

The status of the mirror bit in the communication control command is transmitted from the control to the drive, and then sent back (mirrored) to the control. It can be read out from bit 7 of the device status byte. The status of the mirror bit sent in the communication control command must be in agreement with the received status.

The mirror bit should be set to 1 (in the communication control command) in order to quickly detect when a Profibus slave is dropped. When the same bit in the device status byte changes its status to 0, this is an indication that the Profibus communication to the slave is disrupted or the slave is disconnected.

Error code

An error has occurred if the content of the "error code" byte is not equal to 0. The type of error can be determined with the assistance of the error code description (see above). The error code is updated in the following cases:

- If the drive inverts the ready signal
  (because an error has occurred or has been reset),
- If the value of the "read-out error code" bit alters from 0 to 1 in the device control command.

Actual speed

The actual speed of the drive is made available via the "actual speed" high byte and the "actual speed" low byte. For the actual speed to be updated, one of the control bits for one-time or cyclical speed updates must be set in the control command 1 (device control command).

➔ More information can be found in Chapter Speed query, page 5-11, and Chapter Control command 1 (device control command), page 5-18.

- *The parameter "actual speed" corresponds to the drive parameter "speed" with the code number 003.*
- *When in open loop operations (control = off) the frequency is signaled at the output of the ramp generator. When in closed loop control (control = on), the measured mechanical speed is signaled. In both cases, the sign corresponds to the entered direction of rotation.*

Parameter code number

In the "parameter code number" high byte and the "parameter code number" low byte, the code number of a set of queried parameter is acknowledged.

➔ The process for altering a parameter is described in Chapter 5.6.1, Setting a parameter, page 5-26.
The process for reading a parameter is described in Chapter 5.6.2, Read out of a parameter, page 5-27.

Actual parameter value

Both the "actual parameter value" high byte and the "actual parameter value" low byte make available the content of the read-out parameter.

For certain interface parameters (for example, software version or speed encoder counter), the content of "actual parameter value" supplementary byte must also be evaluated.

➔ The process for reading a parameter is described in Chapter 5.6.2, Read out of a parameter, page 5-27.

Parameter description

The "parameter description" byte includes the following information.

Bit	Remarks	
0	"Transmit parameter" acknowledge The status of the bit "transmit parameter" is acknowledged in this bit.	➔ Further information about the use of this bit can be found in Chapter 5.6.1, Setting a parameter, page 5-26, and Chapter 5.6.2, Read out of a parameter, page 5-27.
1	"Query parameter" acknowledge The status of the bit "query parameter" is acknowledged in this bit.	
2	Parameter source 0: The parameter made available is a drive parameter. 1: The parameter made available is an interface parameter.	
3	Data valid The queried parameter is valid if this bit is set.	

Table 5-9 Parameter description

5.6 Parameter protocol description

5.6.1 Setting a parameter

The following commands must be executed in order to set a parameter:

- In the transmit range, enter the "parameter code number high byte" and the "parameter code number low byte" values of the parameter to be set.
- In the transmit range, enter the "required parameter value high byte" and the "required parameter value low byte" values of the parameter to be set.
- Specify the parameter target in the communication control command.

  If a drive parameter is to be altered, the "parameter target" bit must be set to 0.

  If an interface parameter is to be altered, the "parameter target" must be set to 1.
- Initiate the transmission process.

  It is important to observe the two different transmission methods:

  One-time transmission of the parameter:

  The bit "transmit parameter" of the control command 2 (control command for communication) must be set. If the value of this control bit is altered from 0 to 1, the parameter described by the "parameter code number" and the "required parameter value" will be accepted once by the interface and evaluated. If necessary, the parameter will be forwarded to the drive. Evaluation of the parameter by the interface will be acknowledged. This takes place when the code number and the value of the parameter in the receive range are made available for assessment. In addition, the parameter source (drive or interface) is acknowledged in the "parameter description" byte and the "data valid" bit will be set.

  Cyclical transmission of the parameter:

  The bit "transmit parameter" of the control command 2 (control command for communication) must be set. When setting the control bit, the parameter described by the ‘"parameter code number" and the "required parameter value" will be accepted cyclically by the interface and evaluated. If necessary, the parameter will be forwarded to the drive. Evaluation of the parameter by the interface will be acknowledged. This takes place when the code number and the value of the parameter in the receive range are made available for assessment. In addition, the parameter source (drive or interface) is acknowledged in the "parameter description" byte and the "data valid" bit will be set.

5.6.2 Read out of a parameter

The following commands must be executed in order to query a parameter:

- In the transmit range, enter the "parameter code number high byte" and the "parameter code number low byte" values of the parameter to be queried.
- Specify the parameter target in the communication control command.

  If a drive parameter is to be queried, the "parameter – target" bit must be set to 0.

  If an interface parameter is to be queried, the "parameter – target" bit must be set to 1.
- Initiate the query process.

  It is important to note that there are two different query methods:

  One-time querying of the parameter:

  The "query parameter" bit of the control command 2 (control command for communication) must be set. If the value of this control bit is altered from 0 to 1, the parameter described by the "parameter code number" will be queried once by the interface. If necessary, the query will be forwarded to the drive. Evaluation of the parameter by the interface will be acknowledged. This takes place when the code number in the receive range is made available for assessment. The calculated parameter value is made available in the receive range. In addition, the parameter source (drive or interface) is acknowledged in the "parameter description" byte and the "data valid" bit will be set.

  Cyclical querying of the parameter:

  The bit "transmit parameter" of the control command 2 (control command for communication) must be set. When setting the control bit, the parameter described by the parameter code number will be queried cyclically by the interface. If necessary, the query will be forwarded to the drive. Evaluation of the parameter by the interface will be acknowledged. This takes place when the code number in the receive range is made available for assessment. The calculated parameter value is made available in the receive range. In addition, the parameter source (drive or interface) is acknowledged in the "parameter description" byte and the "data valid" bit will be set.

5.6.3 Rapid transmission of parameters

In order to rapidly transmit a single parameter (described here as "transmitting cyclically"), it is possible to use the processes described in Chapter 5.6.1, Setting a parameter, page 5-26, and Chapter 5.6.2, Read out of a parameter, page 5-27. The controls bits "transmit parameter cyclically" and "query parameter cyclically" are used.

However, the following must be observed if different parameters are to be rapidly transmitted one after the other: When transmitting a parameter, the evaluation of the parameter is performed when changing the "transmit parameter" or "query parameter" bit. If, following transmission of a parameter, the corresponding control bit is set to 0 for a very short period of time only, there is a danger that the interface will not register this change from 1 to 0. There two possible reasons for this.

The status 0 of the control bit was not transmitted to the interface via the Profibus, because no full bus cycle was completed during this time.

The interface computer did not register the change from 1 to 0 because it was still busy with the internal transmission of the last parameter to the drive.

In order to avoid this, the interface acknowledges the internal statuses of the two control bits "transmit parameter" and "query parameter" in the actual value "parameter description". There the bits are called "transmit parameter – acknowledge" and "query parameter – acknowledge".

In order to transmit various parameters rapidly one after the other, the "transmit parameter – acknowledge" and "query parameter – acknowledge" bits should previously have been set to 0. Only then is the interface ready to evaluate a new parameter.

5.7 Diagnosing and Troubleshooting Errors

5.7.1 General information on troubleshooting

The following types of errors are detailed:

- Interface error
  An interface error occurs when the cause is near the interface, for example, an interruption of the bus cable.
- Drive error
  A drive error occurs when the cause is near the drive, for example, an "overheated inverter".
- Error resulting from an actuating request
  This type of error can be generated if the drive is unable to carry out the actuating request, for example, because the value range of a parameter could not be maintained.
- Error resulting from a query
  This type of error can be generated if the drive is unable to perform the query, for example, because no drive parameter with the given code number exists.

When an error occurs, the corresponding error type is stored in the "error code description" of the Device status byte. The exact cause of the error is stored in "error code".

When troubleshooting, the following special characteristics should be taken into consideration:

- After the error "bus malfunction" has occurred (for example, the bus cable has been interrupted), the error must first be reset before further commands can be accepted.
- Errors that occur due to actuating requests or queries will be identified, signaled, and then stored until they are reset. Resetting the error immediately may be practical. It is, however, not absolutely necessary. Valid actuating or query commands to the drive will be carried out in spite of a signaled error message.

5.7.2 Patterns of LED flash codes

The Profibus interface status LED is lit up continuously when no error is present. Should an error occur, the frequency of the flashing provides information about the type of error.

Flashing frequency	Type of error
Continuous light	No error has occurred
Cyclical, fast flashing (once the power supply has been turned on)	The connection between the Profibus interface and the drive has been interrupted.
One flash	Interface error
Two flashes	Drive error
Three flashes	Error resulting from an actuating request
Four flashes	Error resulting from a query

Table 5-10 Blinking patterns of the status LED

5.7.3 Error codes interface

Error code	Remark
1	Bus malfunction
2	Rapid-stop enabled

Table 5-11 Error codes interface

5.7.4 Drive error codes

Drive-specific error codes are detailed in the drive's operating instructions.

5.7.5 Error codes with actuating requests

The following table contains the responses issued when an error occurs with an actuating request.

Error code	Remark
0	No error
15 $_{hex}$	Actuating request not carried out
FE $_{hex}$	Time-out during actuating request

Table 5-12 Error codes with actuating requests

5.7.6 Query error codes

The following table contains the responses issued when an error occurs with a query.

Error code	Remark
0	No error
15 $_{hex}$	Query not carried out
FE $_{hex}$	Query time-out
FF $_{hex}$	BCC error (Block Check Character)

Table 5-13 Query error codes

5.8 New Features in the VARICON Profibus Interface

5.8.1 Setting the Profibus address

With the VARICON series, a modified Profibus address must be saved using the special menu selection "Save". With older VARICON drives is was sufficient to simply exit the "Address" menu in order to save the new Profibus address.

Additional information about saving a parameter can be found in the drive instructions.

5.8.2 Pole-independent interpretation of speed.

With the VARICON series, the required speed value, the actual speed value, and the ramps are all implemented independently (according to the specification) from the pole count of the motor. With the older VARICON drives, the parameter needed to be multiplied by the pole-pair count of the drive.

5.8.3 Correctly-signed analysis of the speed-encoder pulse

With the VARICON series, speed-encoder pulses are added up correctly-signed. With the older VARICON drives, the speed-encoder pulses were added up independent of the rotational direction.

5.8.4 Mirror bit

With the VARICON series, a mirror bit is implemented.

The status of the mirror bit in the communication control command is transmitted from the control to the drive, and then sent back (mirrored) to the control. It can be read out from bit 7 of the device status byte.

The mirror bit should be set to 1 (in the communication control command) in order to quickly detect when a Profibus slave is dropped. When the same bit in the device status byte changes its status to 0, this is an indication that the Profibus communication to the slave is disrupted or the slave is disconnected.

5.8.5 Save function of the "behaviour during bus malfunction" setting

With the VARICON series, the "behaviour during bus malfunction" setting can be permanently saved in the Profibus interface.

➔ Additional information about drive behaviour during bus malfunctions and permanent saving of settings can be found in Chapter Drive behaviour during bus malfunction, page 5-12.

5.9 Configuration of the VARICON for Profibus

The following parameters are used for internal communication between the Profibus interface and the drive. The values listed below are set at the factory but should nevertheless be checked in event of communications problems.

Parameter	Value	Remark
Address:	32	Profibus address: match, if necessary. Changes will be first activated only after power is turned off and back on.
Baud rate:	9600	This baud rate is used only for internal communication between the Profibus interface and the drive. Do not adjust!
RL1:	3	This setting is necessary when the drive signals to the Profibus interface that it is operational.
Nominal:	0	Nominal value selection for the keyboard - the serial interface is used for internal communication between the Profibus interface and the drive.

Table 5-14 Parameters for internal communication

After the parameter values are adjusted, they must be manually saved. This ensures that the settings remain after the power is switched off!

5.10 Version descriptions

The following table contains descriptions of the features of the various Profibus interface software versions. The respective GSD files are also listed.

Software version	GSD Name	No. of OUT bytes	No. of IN bytes	Remarks
V1.0	V03_0008.gsd	7	9	**the first run-capable version for VARICON** ■ special properties ■ not possible to query software version ■ shutdown characteristics not possible to configure
V2.0 beta	V04_0008.gsd	9	12	**Beta version for software version 2 with the following features:** ■ possible to query software version ■ shutdown characteristics can be configured ■ The GSD file was revised in regard to the following points: - The number of output data needed to be increased from 9 to 10 bytes. - Check of version number. - Check of supported baud rates. - Check for sync. mode and freeze mode. - Check over MaxTsdr times. - Check of UserPrmDat.
V2.0 beta (1 to xx)	Hb1_0200.gsd	10	12	**Beta version for software version 2 with the following features:** ■ GSD file revised in regard to the following points: - The number of output data needed to be increased from 9 to 10 bytes.

Software version	GSD Name	No. of OUT bytes	No. of IN bytes	Remarks
V2.0 beta (1 to xx)	Hb2_0200.gsd	10	12	**Beta version for software version 2 with the following features:** ■ GSD file revised in regard to the following points: - Version designation updated to 2.0. - Repeater_Ctrl_Sig changed from 2 to 0. - Freeze-Mode changed from 0 to 1. - Sync.-Mode changed from 0 to 1. - User_Prm_Data_Len changed from 5 to 0.
V3.0	HEW_0300.gsd	10	12	**Software version 3 with the following features:** ■ GSD file is compatible with the software in all respects. ■ The software version can be queried over the bus. ■ Shutdown characteristics can be configured if bus malfunction occurs. ■ Rapid-stop function integrated. ■ Interface and drive parameters can be altered and queried via the same mechanism.
V4.0	HEW_0300.gsd	10	12	**Software version 4 with the following features:** ■ Profibus Interface for the VARICON series. ■ Extended LED diagnostics ■ Required setspeed and actual speed values are independent from the pole-pair count. ■ Shutdown characteristics during bus malfunction can be saved. ■ Implementation of the mirror bit. ■ The counter is now added up correctly with regards to the direction of rotation. ■ Changes to the Profibus address must be saved manually.

Table 5-15 Version description

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Part D

Initial commissioning with the standard interface

Version 1.2 ■ Status: 09/2007 ■ Standard

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6 Commissioning VARICON

Caution. You must observe the following notice!

Before commissioning the VARICON drive, you must read the safety information contained in Part A, General Information!

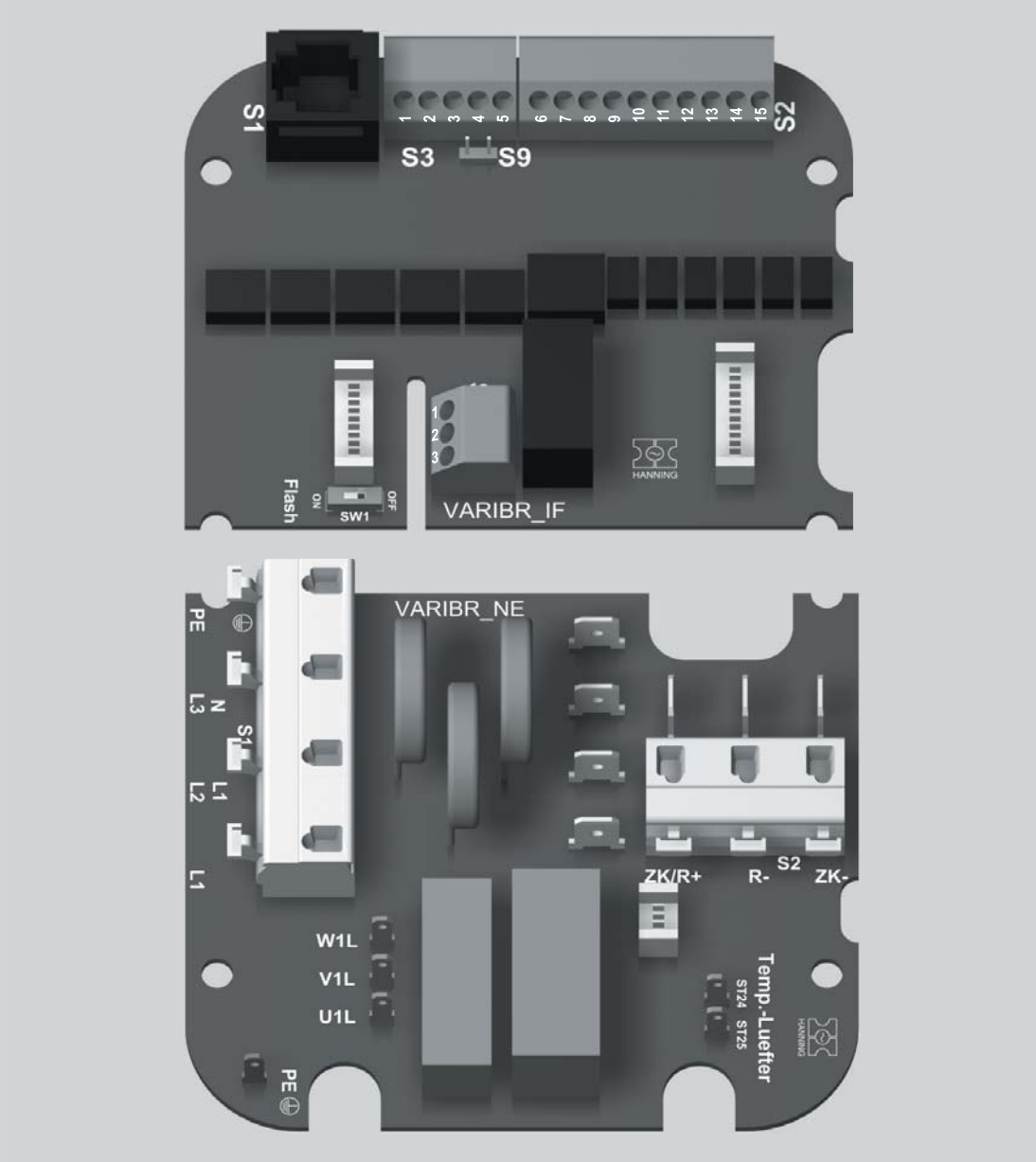

Figure 6-1 Terminal box view

6.1 Electrical connection

Warning – electrical hazard! Danger of death!

*It is **only** permitted to use the VARICON drive with a three-phase connection in a portable device equipped with plug and socket connections, when compatibility between the VARICON drive and the residual-current circuit breaker is guaranteed (please refer to EN 50178).*

- The control cables must be routed separately from the power supply cables. It is recommended that the control cables be routed through a separate cable tray. Use shielded wires.
- The terminal box cover must be opened to access the connection terminals.

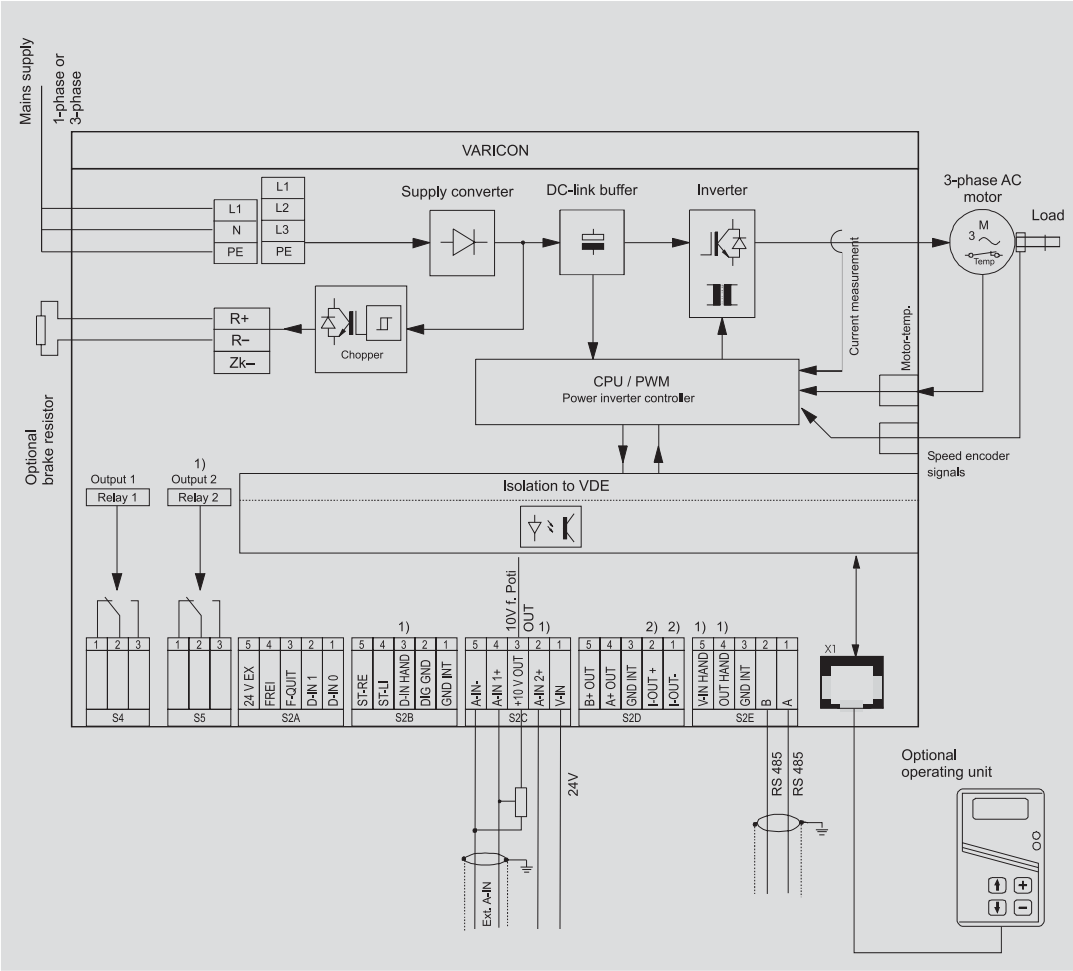

Figure 6-2 Block diagram

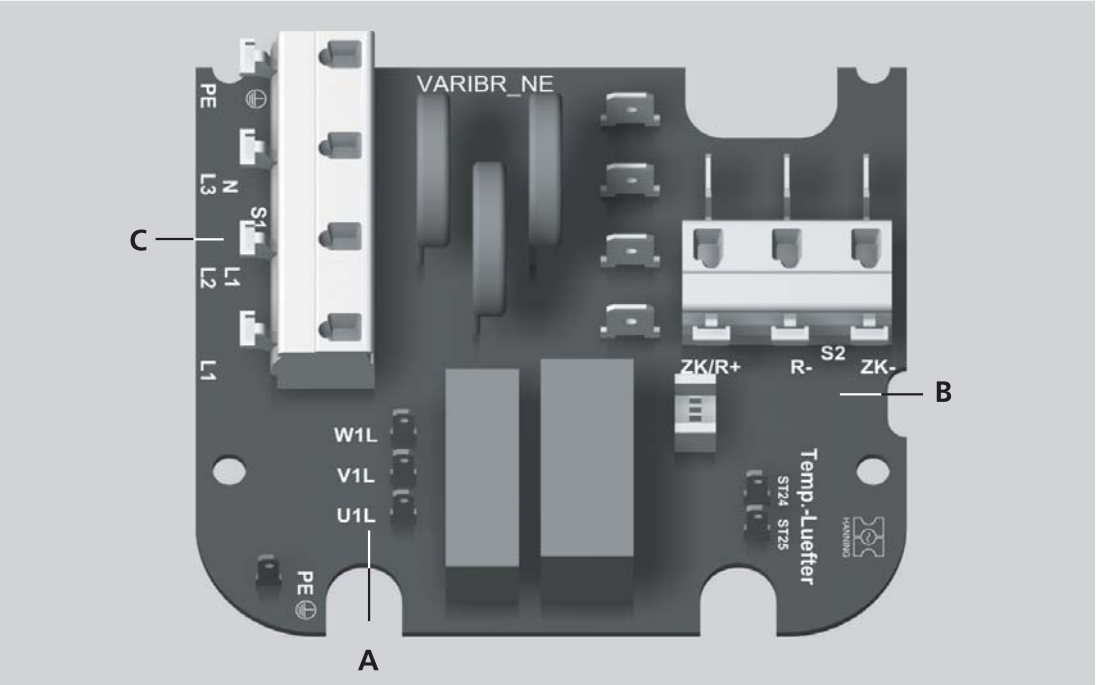

Figure 6-3 Connection terminals interface, 3-phase, 400 V

A Fan connection one- or three-phase

B DC bus and brake resistor

C Mains connection

6.1.1 Line connection

The following values apply to Figure 6-3.

	One-phase	Three-phase
Mains connection terminals:	L1 , N , PE	L1 , L2 , L3 , PE
Minimum conductor cross-section	1.5 mm^2	1.5 mm^2

Table 6-1 Conductor connection

6.1.2 Brake chopper

An external chopper resistor can be connected to the terminal **Zk/R+** (please refer to Figure 6-3).

The brake resistor order number is available in Chapter OPTIONS.

- Max. chopper turn-on time at I_{max}: 10 sec. every 60 sec. ($T \geq U^2/P_D \cdot t/R$)

Mains connection	R_{min}	I_{max}	V	P_D, t ≤ 60 s	Recommendation: R_{Brems}
1 ~ 230 V	150 Ω	2.5 A	370 V	150 W	220 Ω
3 ~ 400 V	330 Ω	2,0 A	660 V	200 W	330 Ω

Table 6-2 Mains connection for brake resistor

I_{max} for 10 sec. every 60 sec. P_D: Max. mean power

V: Chopper switch-on voltage t: Turn on time, T : Cycle time

- *The minimum value of the brake resistor must be maintained.*
- *The maximum current and the maximum mean power must be maintained.*
  The maximum line length for the brake resistor is ≤ 1 m.

6.2 Standard interfaces

In the standard version, the VARICON drive is equipped with a PLC and an RS 485 interface.

➔ The VARICON drive is optionally available with various Fieldbus interfaces. The description for all Fieldbus systems is available in Part C, Initial commissioning with the Profibus DP interface.

Connections for analog control signals (for example, entry of nominal values via potentiometer) and the connections for transmitting digital control signals with high transmission rates (for example, RS 485, Fieldbus) must always be laid using shielded cables. Route the cables of individual functional groups within the respective shielding. Connect the shielding at both ends to the respective housing (PE connection) across the shortest possible distance. Make sure that you have connections which conduct well, have a large surface area, and are suitable for high frequencies.

Caution. You must observe the following notice!

Never route control cables within a cable or shielding together with the power connection cables. Always route these separately as far as possible.

6.2.1 PLC interface SIO RS 485

The RS 485 serial interface is designed for use with two-wire technology (half-duplex operations). The interface is not equipped with its own power supply, and is isolated from the rest of the VARICON-drive electronics by opto-couplers. The master for controlling the drives (PLC/IPC) must also be equipped with an RS 485 interface based on two-wire technology.

A bus system is used to interconnect the master computer with several VARICON drives (a max. of 32). The **A**-terminals (RS 485 '+') of all of the devices (bus stations) are connected to one another, as are the **B**-terminals (RS 485 '-'). Twisted-conductor or shielded cables must be used for the transmission lines.

6.2.2 Standard interface board

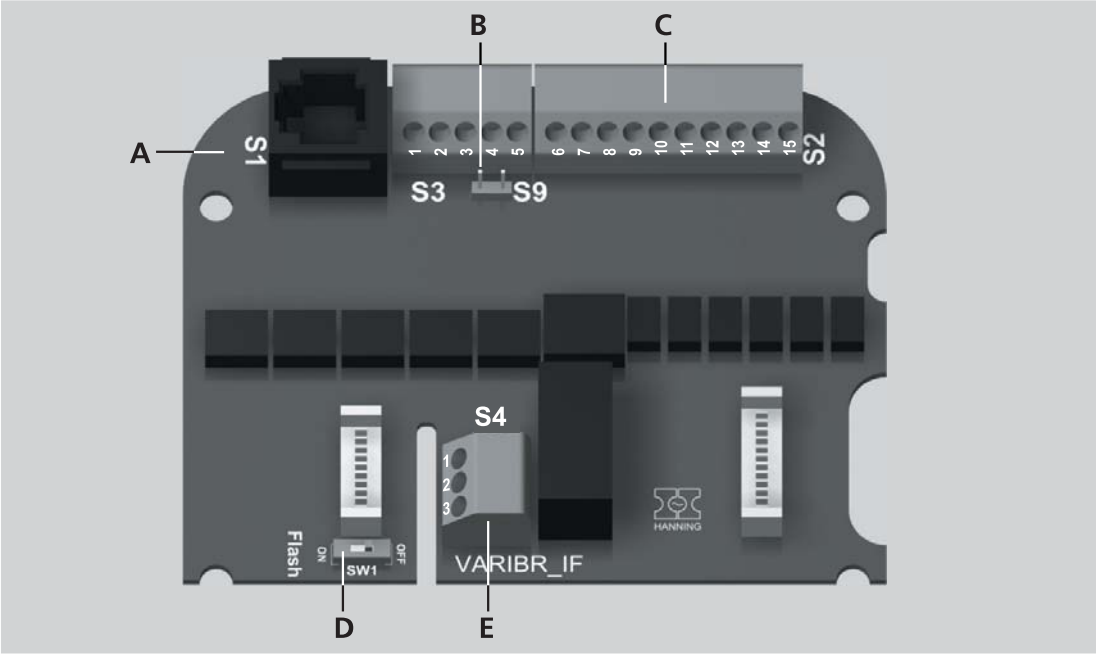

Figure 6-4 Standard interface board

A Terminal for the operating unit

B Jumper

C 15-pole terminal strip

D Flash switch

E Relay connection terminal

6.2.3 Terminal assignment

Serial interface, SIO RS 485 (terminal rail S3)

Terminal	Designation	Signal level	Function
1	A	0 to 5 V	RS 485 signal line **A**
2	B	0 to 5 V	RS 485 signal line **B**

Table 6-3 Serial interface, SIO RS 485 (terminal rail S3)

Analog setpoint value (terminal rail S8)

Terminal	Designation	Signal level	Input / output	Function
3	+10 V-OUT	10 V / max 10 mA	---	10-V power supply to connect a potentiometer to the analog input
4	A-IN+	0 (2) to 10 V or 0 (4) to 20 mA switchable	Input	Analog setpoint value selection 0 (2) to 10 V Switch selectable between 0 (4) to 20 mA (jumper S9 on PCB)
5	A-IN-	A GND	---	Reference potential for analog input

Table 6-4 Analog setpoint value (terminal rail S3)

Terminal	Designation	Signal level	Input / output	Function	Optical decoupling
6/7	GND INT	GND		Ground reference of internal power supply	Yes
8	DIG GND	GND	---	Reference potential for the inputs FREI, D-IN 0/1, ST-RE/LI and F-Quit	Yes
9	ST-LI	Active HIGH 24 V	Input	Start left	Yes
10	ST-RE	Active HIGH 24 V	Input	Start right	Yes
11	D-IN 0	Active HIGH 24 V	Input	Fixed speed selection 0	Yes
12	D-IN 1	Active HIGH 24 V	Input	Fixed speed selection 1	Yes
13	F-QUIT	LOW/HIGH edge 24 V	Input	Error acknowledgement	Yes
14	FREI	Active HIGH 24 V	Input	Inverter available The inverter clock pulse can be directly disabled or made available via this input.	Yes

Table 6-5 PLC inputs (terminal rail S2)

Auxiliary voltage (terminal rail S2)

Terminal	Designation	Signal level	Input / output	Function
15	+24 V-OUT	24 V / 70 mA	---	Internal 24 V to supply the control inputs if there is no external control voltage available.

Table 6-6 Auxiliary voltage (terminal rail S2)

PLC inputs (terminal rail S2)

The inputs FREI, D-IN 0/1, ST_RE/LI and F-QUIT are PLC compatible.

Caution. You must observe the following notice!

*In an **EMERGENCY OFF** situation, it is permitted to use the input FREI to turn off the clock pulse. The control signal FREI must not be used to switch the VARICON clock pulse ON/OFF for normal operational purposes.*

Relay (terminal rail S4)

1: NC
2: Floating
3: NO

Jumper

The jumper serves to switch the voltage to current setpoint value.

Open = voltage setpoint value

Closed = current setpoint value

6.3 Commissioning the VARICON with standard interface factory settings, external potentiometer and internal voltage setpoint supply

The VARICON drive is factory set to analog nominal value selection (0 - 10 V).

Before starting for the first time, ensure that:

- All cable connections are correctly connected.
- The earth terminals (DIG GND and GNDINT) are connected.
- Both start inputs (ST-RI and ST-LE) are disabled (LOW or open).
- The enable input (FREI) is wired 1 (HIGH).
- A 10-kΩ potentiometer (0 to +10V) has been connected to the terminals 'A-IN+', '+10V-OUT' and 'A-IN-'.

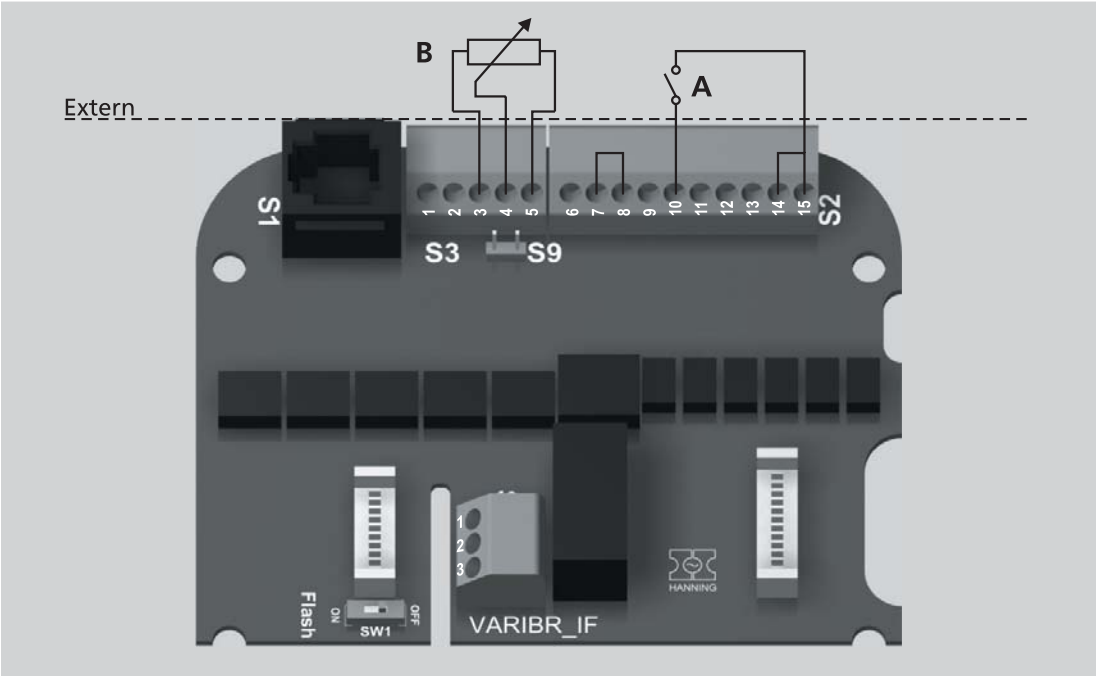

Figure 6-5 Commissioning the VARICON with standard interface, external potentiometer and internal voltage setpoint supply

A Start right (clockwise)

B Potentiometer 10 kΩ

To start up, proceed as follows:

- Turn on the power supply.
- Motor start via the start inputs ST-RE (terminal 10) or ST-LI (terminal 9); apply switch.
- Set the speed via the potentiometer.

The analog setpoint value selection can lead to an increase in interference.

To avoid interference, use only short cables (up to max. 2 m) to wire the control inputs ST-RE, ST-LI and FREI to the internal voltage supply (see connection diagram).

- *When operating with an external power supply, ensure that the DIG GND is used as a reference potential only.*

6.4 Commissioning with direct speed setting (potentiometer in terminal box cover)

The VARICON drive is factory set to operate in a clockwise direction of rotation, with setpoint value selection made via a potentiometer in the terminal box cover.

Before starting for the first time, ensure that:

- The mains connection is correctly connected.

➔ More information can be found in Chapter 6.1, Electrical connection.

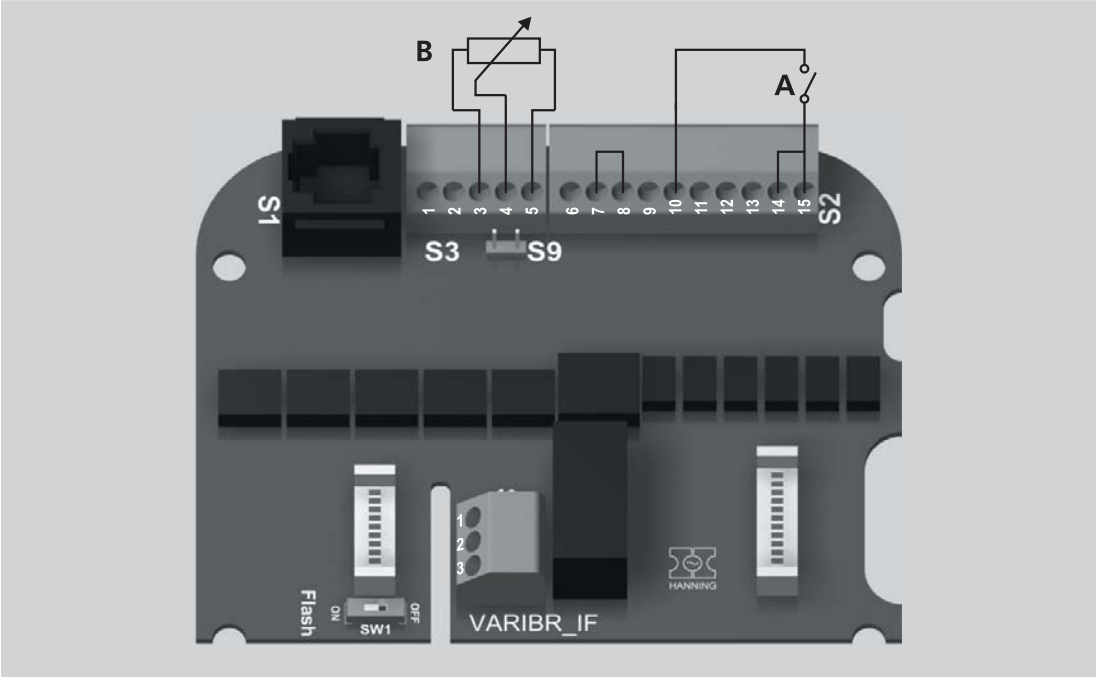

Figure 6-6 Commissioning with direct speed setting

A Start right (clockwise)

B Potentiometer in terminal box cover

To start up, proceed as follows:

- Turn on the power supply.
- Switch A, turn on start clockwise
- Set the speed via the potentiometer. The motor operates in a clockwise direction at the set speed.

6.5 Commissioning with an operating unit

Before starting for the first time, ensure that:

- All cable connections are correctly connected.
- The earth terminals (DIG GND and GNDINT) are connected.
- The operating unit is connected.
- Both start inputs (ST-RE and ST-LI) are inactive (0 or open).
- The enable input (FREI) is wired 1 (HIGH).

To avoid interference, short cables only (up to max. 2 m) must be used to wire the Enable 'FREI' to the internal voltage supply (see connection diagram).

- *When operating with an external power supply, ensure that the DIG GND is used as a reference potential only.*

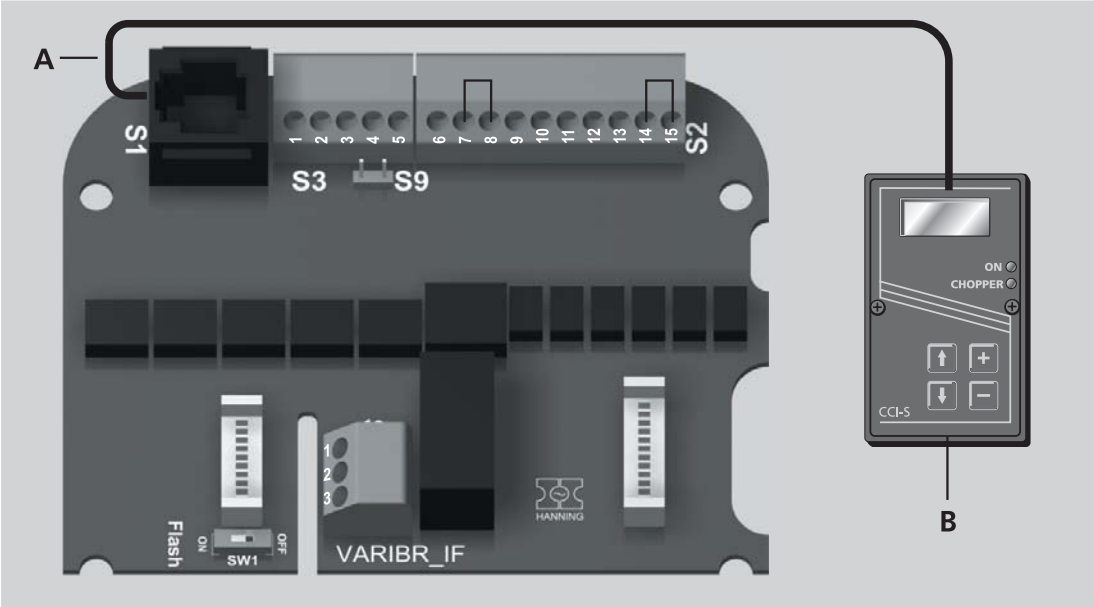

Figure 6-7 Initial commissioning of the standard interface with an operating unit

A Operating unit connection

B Operating unit

To start up, proceed as follows:

- Turn on the power supply.
- The VARICON drive can also be controlled with the keyboard of the operating unit: Setpoint value – Code = O
  All operating parameters for the inverter can be displayed one after the other (keys ↑ ↓) and altered (keys + −).

By pressing both the ↑ ↓ keys simultaneously, it is possible to switch to the parameter speed position from anywhere in the display.

The name of the selected parameter is displayed in the first line.

The actual value or control state is displayed in the second line.

- Set the setpoint value selection SetSpeed to code value 0.
- Set the mode to start using the + key.
- To alter the speed, select the parameter ‘Set Spd 0’ using the + − keys.

6.6 Commissioning with preset speeds

Before starting for the first time, ensure that:

- All cable connections are correctly connected.
- The ground connection DIG GND is connected to the earth of the controls.

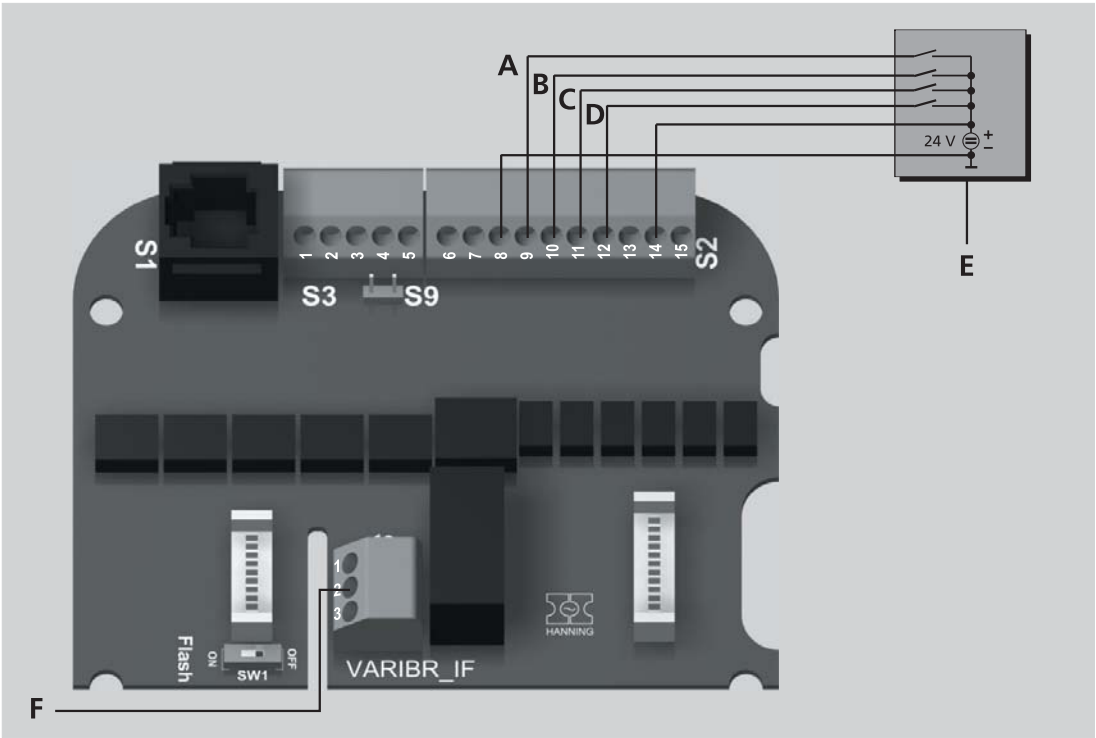

Figure 6-8 Commissioning the standard interface with preset speeds and external control inputs and outputs. External control voltage supply via, for example, PLC.

A Start counter-clockwise (left)

B Start clockwise (right)

C Setpoint nominal value selection 0

D Setpoint nominal value selection 1

E External control, for example, PLC

F Relay output 1

To start up, proceed as follows:

- Turn on the power supply.
- Set parameter nom valu 0 …nom-valu 3.
- Set setpoint value selection to code value 11.
- Programming of controls:

  - Select the fixed required speeds D-IN0 and D-IN1

  - Select start counter-clockwise, or clockwise.
- Start the external program sequence in the PLC control.

Connect the ground connection DIG GND to the earth of the controls.

6.7 Commissioning via serial interface (SIO RS 485)

Before starting for the first time, ensure that:

- All cable connections are correctly connected.
- The earth terminals (DIG GND and GND INT) are connected.
- The enable input (FREI) is wired 1 (HIGH).
- The corresponding adapter is connected to the serial interface RS 485.

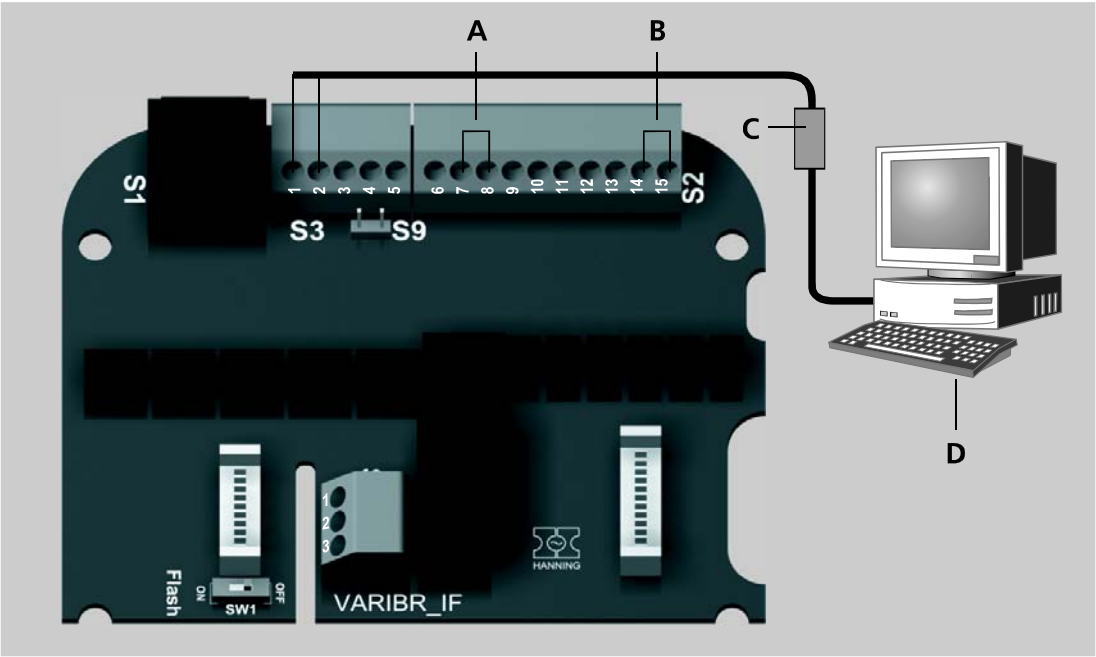

Figure 6-9 Commissioning the serial interface (PLC interface SIO RS485)

A Connection Ground DIG GND and GND INT

B Internal wiring input FREI

C Adapter for RS 485/ RS232

D Industrial PC

To start up, proceed as follows:

Master computer program with HANNING drive protocol is required (see Part I, Digital interface).

For rapid commissioning, we offer the commissioning software DrivePAR (please refer to the Chapter OPTIONS).

- Turn on the power supply.
- The baud rate is preset to 9600 (address 32). (It can be altered via SIO.)
- Set setpoint value selection = 0.
- Set parameter values.

➔ For information about setting parameters, please refer to Part F, Adapting parameters

- The VARICON drive is started by setting the start bit codes 000 from 0 to 1.

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Part E

Initial commissioning with the custom interface

Version 1.2 ■ Status: 09/2007 ■ Special

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7 Commissioning VARICON

The custom interface comes in three versions: Custom Interface I - completely assembled, Custom interface II -partially assembled, and Custom Interface III - minimally assembled.

➔ More information can be found in Chapter 7.2.1 Custom interface versions.

Caution. You must observe the following notice!

Before commissioning the VARICON drive, you must read the safety information contained in Part A, General Information!

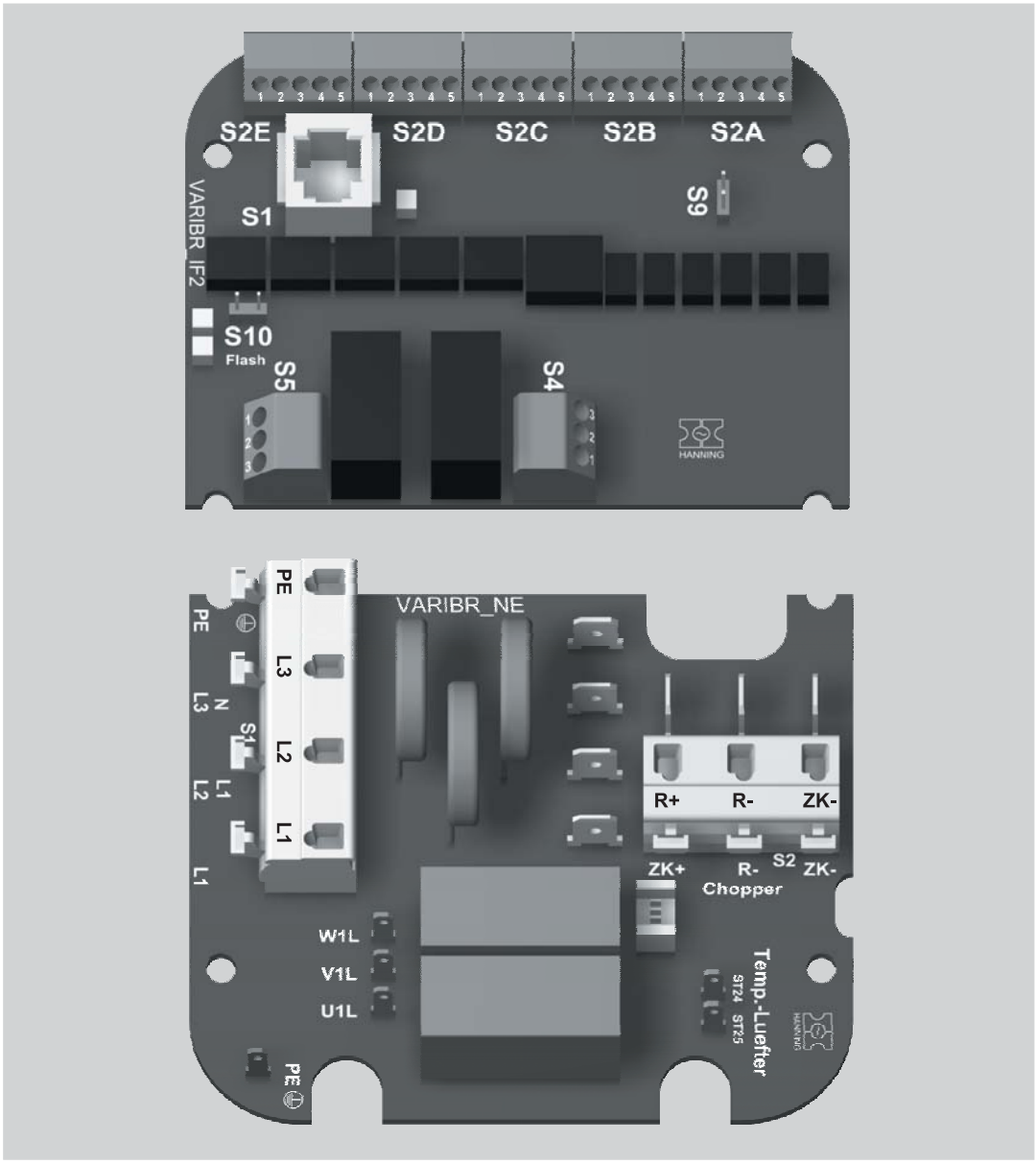

Figure 7-1 Terminal box view (three phase)
(Custom Interface II and III without relays or terminal block S5)

7.1 Electrical connection

Warning – electrical hazard! Danger of death!

*It is **only** permitted to use the VARICON drive with a three-phase connection in a portable device equipped with plug and socket connections, when compatibility between the VARICON drive and the residual-current circuit breaker is guaranteed (please refer to EN 50178).*

- The control cables must be routed separately from the power supply cables. It is recommended that the control cables be routed through a separate cable tray. Use shielded wires.
- The terminal box cover must be opened to access the connection terminals.

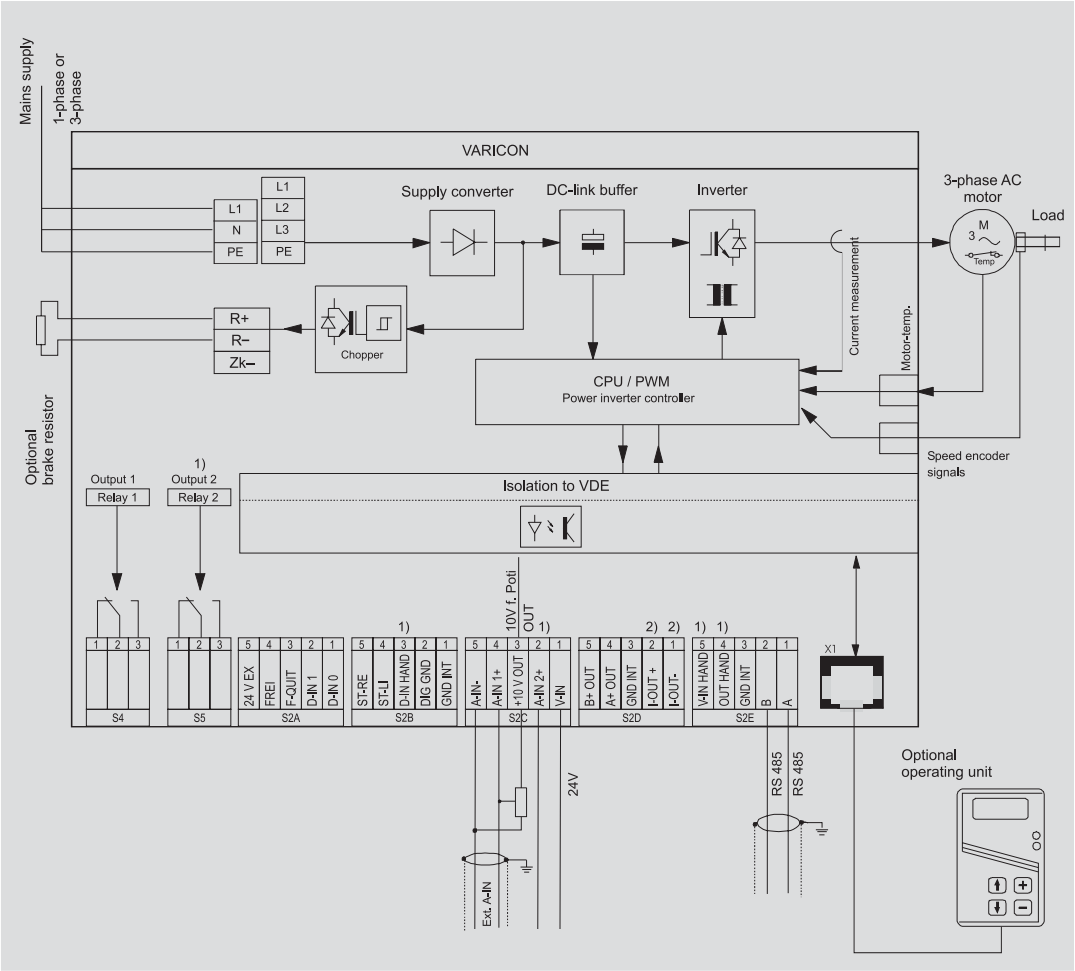

Figure 7-2 Block diagram

1) does not apply for Custom Interface II and III

2) does not apply for Custom Interface III

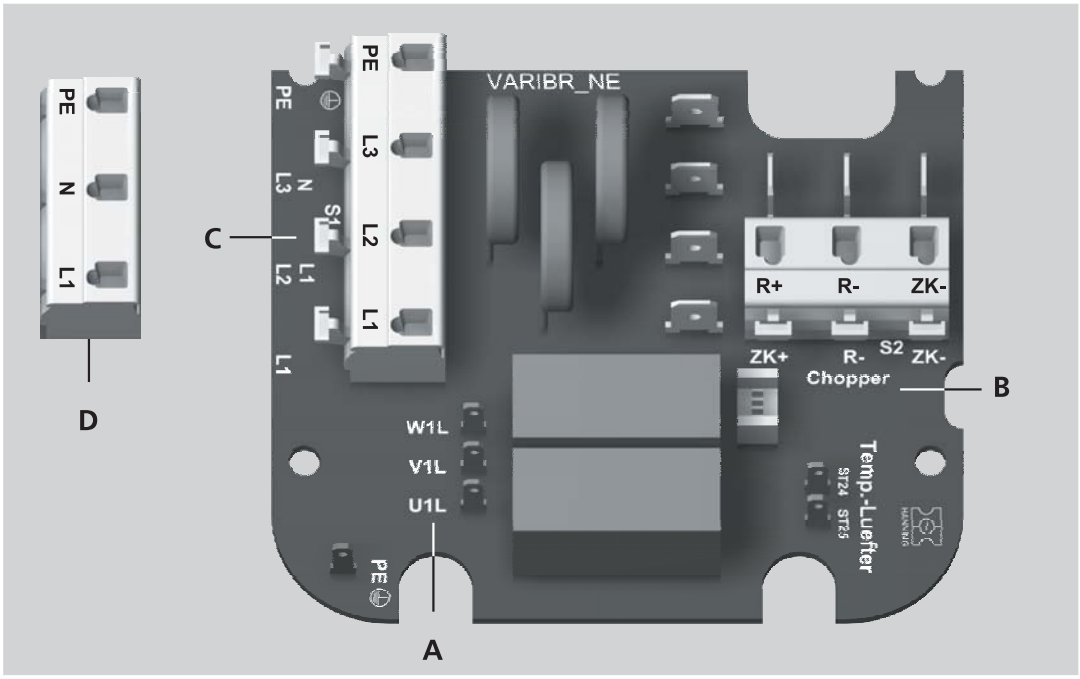

Figure 7-3 Connection terminals NE

A Fan connection one- or three-phase

B DC bus ("R+" and "ZK-")

Braking resistance ("R+" and "R-")

C Three-phase mains connection

C One-phase mains connection

7.1.1 Mains connection

The following values apply to Figure 7-3.

	One-phase	Three-phase
Mains connection terminals:	L1 , N , PE	L1 , L2 , L3 , PE
Minimum conductor cross-section	1.5 mm^2	1.5 mm^2

Table 7-1 Mains connection

7.1.2 Brake chopper

An external chopper resistor can be connected to the terminals "R+" and "R-" (refer to Figure 7-3).

➔ See Part M - Appendix - Options Chapter, concerning the part numbers of accessories for the braking resistor.

- Max. chopper turn-on time at I_{max}: 10 sec. every 60 sec. ($T \geq U^2/P_D \cdot t/R$)

Mains connection	R_{min}	I_{max}	V	P_D, t ≤ 60 s	Recommendation: R_{Brems}
1 ~ 230 V	150 Ω	2.5 A	370 V	150 W	220 Ω
3 ~ 400 V	330 Ω	2,0 A	660 V	200 W	330 Ω

Table 7-2 Connection for brake resistor

I_{max} for 10 sec. every 60 sec. P_D: Max. mean power

V: Chopper switch-on voltage t: Turn on time, T : Cycle time

- *The minimum value of the brake resistor must be maintained.*
- *The maximum current and the maximum mean power must be maintained.*
  The maximum line length for the brake resistor is ≤ 1 m.

7.2 Custom interface

The custom interface is a PLC interface equipped with a RS 485 interface. In addition it is possible to use a second analog speed setpoint value selection, the configurable output signal from 4 to 20 mA, two relay outputs as well as the digital speed-encoder pulse for the PLC.

Shielded cables should always be used when laying connections for analog control signals (for example, entry of nominal setpoint values with a potentiometer) and connections for transmitting digital control signals with high transmission rates (for example, RS 485, Fieldbus). Route the cables of individual functional groups within the respective shielding. Connect the shielding at both ends to the respective housing (PE connection) across the shortest possible distance. Make sure that you have connections which conduct well, have a large surface area, and are suitable for high frequencies.

7.2.1 Custom interface versions

- Customer Interface I - Fully-assembled
  All the functions described here are available.
- Custom Interface II - Partially-assembled
  This interface board does **not** include the following functions:
  - A second relay
  - The possibility to connect a second analog setpoint value source.
- Custom Interface III - Minimally-assembled
  This interface board does **not** include the following functions:
  - A second relay
  - The possibility to connect a second analog setpoint value source.
  - A 4 - 20 mA signal output.

Caution. You must observe the following notice!

Never route control cables within a cable or shielding together with the power connection cables. Always route these separately as far as possible.

7.2.2 SIO RS 485

The RS 485 serial interface is designed for use with two-wire technology (half-duplex operations). The interface is separated from the rest of the electronics of the VARICON drive by means of an opto coupler. The master for controlling the drives (PLC/IPC) must also be equipped with an RS 485 interface based on two-wire technology.

A bus system is used to interconnect the master computer with several VARICON drives (a max. of 32). The **A**-terminals (RS 485 '+') of all of the devices (bus stations) are connected to one another, as are the **B**-terminals (RS 485 '-'). Twisted-conductor or shielded cables must be used for the transmission lines.

7.2.3 Custom interface board

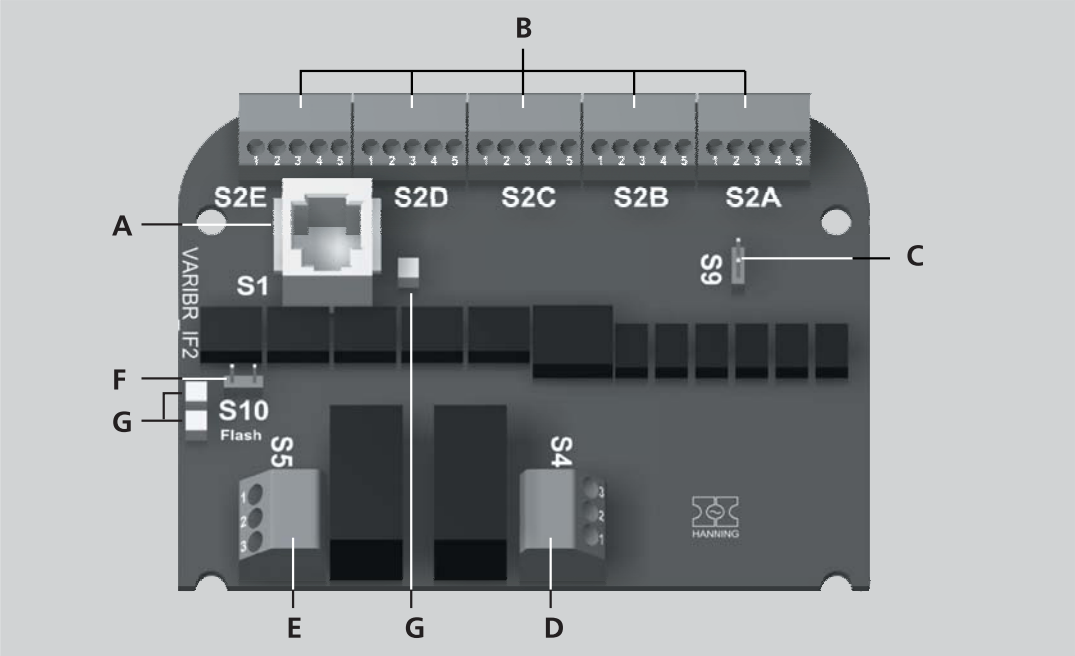

Figure 7-4 Custom interface board

A Terminal for the operating unit

B 5x5-pole control wire

C Jumper for the analog setpoint value selection 0 (4) to 20 mA

D First relay connection terminal

E Second relay connection terminal (not available in Custom Interface II and III)

F Flash jumper

G LEDs
green Relay 1
red Relay 2
yellow Rotary speed encoder A

7.2.4 Terminal Assignment (S2)

Digital inputs (PLC compatible)

Terminal	Designation	Signal level	Input / output	Function	Not applicable with Custom Interface II	Not applicable with Custom Interface III
A1	D-IN 0	Active HIGH 24 V	Input	Fixed speed selection 0, or start input		
A2	D-IN 1	Active HIGH 24 V	Input	Fixed speed selection 1 or right direction of rotation		
A3	F-QUIT	LOW/HIGH edge 24 V	Input	Error acknowledgement		
A4	FREI	Active HIGH 24 V	Input	Inverter available The inverter clock pulse can be directly disabled or made available via this input.		
A5	24 V EX	24 V	Output	24V power supply for the control inputs		
B1	GND INT	GND	---	Ground reference of internal power supply		
B2	DIG GND	GND	---	Reference potential for the inputs FREI, D-IN 0/1, ST-RE/LI and F-Quit		
B3	D-IN HAND	Active HIGH 24 V	Input	Analog setpoint value switch	X	X
B4	ST-LI	Active HIGH 24 V	Input	Start left		
B5	ST-RE	Active HIGH 24 V	Input	Start right		

Table 7-3 Digital inputs (PLC compatible)

Analog required speed value

Terminal	Designation	Signal level	Input / output	Function	Not applicable with Custom Interface II	III
C1	V-IN	24 V	Input	Supply for analog setpoint value switch 1, to 2, and supply for the speed-encoder signal track A (D4) and B (D5)		
C2	A-IN 2+	0 (4) to 20 mA	Input	2. Analog setpoint value selection 0 (4) to 20 mA	X	X
C3	+10 V-OUT	10 V / max 10 mA	Output	10-V power supply to connect a potentiometer to the analog input		
C4	A-IN 2+	0 (2) to 10 V or □0 (4) to 20 mA switchable	Input	1. Analog setpoint value selection 0 (2) to 10 V Switchable from 0 (4) to 20 mA (jumper S9)		
C5	A-IN-	A GND	---	Reference potential for analog input		

Table 7-4 Analog required speed value

Analog acknowledgment output and speed encoder

Terminal	Designation	Signal level	Input / output	Function	Not applicable with Custom Interface II	III
D1	I-OUT-	4-20 mA	Output	Signal output		X
D2	I-OUT+	4 - 20 mA	Output	Signal output		X
D3	GND INT	GND	---	Ground reference of internal power supply		
D4	A+ OUT	0 - V-OUT (24 V)	Output	Speed encoder signal track **A**		

Terminal	Designation	Signal level	Input / output	Function	Not applicable with Custom Interface II III
				(C1 assign with 24 V)	
D5	B+ OUT	0 - V-OUT (24 V)	Output	Speed encoder signal track **B** (C1 assign with 24 V)	

Table 7-5 Analog acknowledgment output and speed encoder

SIO 485 serial interface and digital output

Terminal	Designation	Signal level	Input / output	Function	Not applicable with Custom Interface II	III
E1	A	0 to 5 V	Input / output	RS 485 signal line		
E2	B	0 to 5 V	Input / output	RS 485 signal line		
E3	GND INT	GND	---	Ground reference of internal power supply		
E4	OUT HAND	0 - V-OUT (24 V)	Output	Digital signal output for setpoint value selection switch	X	X
E5	V-IN HAND	24 V	Input	Power supply for signal output OUT HAND (E4) and setpoint value selection switch	X	X

Table 7-6 SIO 485 serial interface and digital output

All inputs and outputs are optically decoupled.

PLC inputs (terminal rail S2)

The inputs FREI, D-IN 0/1, ST_RE/LI and F-QUIT are PLC compatible.

Caution. You must observe the following notice!

*In an **EMERGENCY**, it is permitted to use the input FREI to turn off the clock pulse. The control signal FREI must not be used to switch the VARICON clock pulse on/off for normal operational purposes.*

4-20 mA signal output (terminals S2D1 and S2D2)

This output can be configured via parameters 4-20 Conf (Code 49). It can be scaled with parameters 4-20 Scal (Code 58).

Jumper (S9)

The jumper serves to switch the first analog voltage to current setpoint value.

Open = voltage setpoint value selection (0 (2) - 10 V)

Closed = current setpoint value selection (0 (4) - 20 mA)

The second analog setpoint value selection is set permanently from 0 (4) to 20 mA.

Jumper (S10)

The jumper is used for disconnecting the Flash (software update)

The jumper must be open during normal operations.

7.3 Commissioning the VARICON with Customer Interface II and III, factory settings with potentiometer and internal power supply

The VARICON drive is factory set to analog setpoint value selection (0 - 10 V).

Before starting for the first time, ensure that:

- All cable connections are correctly connected.
- The earth terminals (GND INT (B1) and DIG GND (B2)) are connected.
- Both start inputs (ST-RE and ST-LI) are disabled (LOW or open).
- The available-input FREI (A4) is wired with A5.
- A 10-kΩ potentiometer has been connected to the terminals A-IN+, +10V-OUT and A-IN-.

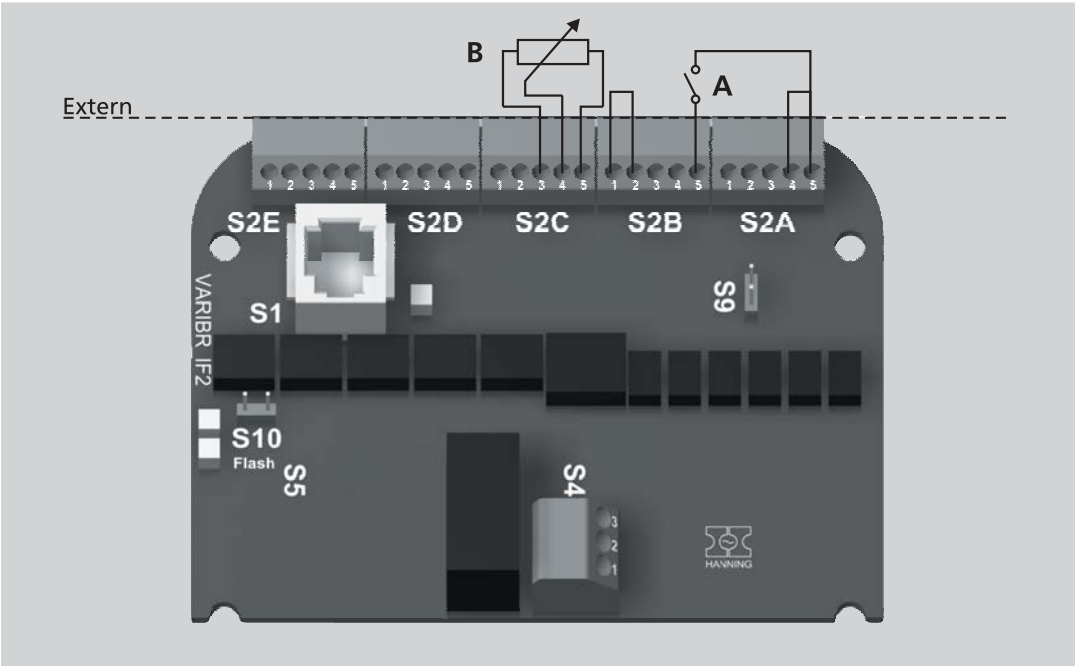

Figure 7-5Commissioning the VARICON with Customer Interface II and III, Potentiometer and internal power supply

A Start right (clockwise)

B Potentiometer 10 kΩ

To start up, proceed as follows:

- Turn on the power supply.
- Start the motor via the start inputs ST-RE (terminal B5) or ST-LI (terminal B4); then close the switch. Optional: Select the "Start" position if a "Start/ Stop" switch is available in the terminal box cover.
- Set the speed via the potentiometer. The motor then runs with the set speed.

The analog setpoint value selection can lead to an increase in interference.

To avoid interference, use only short cables (max. 2 m) to wire the control inputs ST-RE, ST-LI and FREI to the internal voltage supply (see connection diagram).

- *When operating with an external power supply, ensure that the DIG GND is used as a reference potential only.*

7.4 Commissioning with an operating unit

Before starting for the first time, ensure that:

- All cable connections are correctly connected.
- The earth terminals (GND INT (B1) and DIG GND (B2)) are connected.
- The operating unit is connected.
- Both start inputs (ST-RE and ST-LI) are disabled (0 or open).
- The available-input FREI (A4) is wired with A5.

To avoid interference, short cables only (max. 2 m) must be used to wire the Enable FREI to the internal voltage supply (see connection diagram).

- *When operating with an external power supply, ensure that the DIG GND (B2) is used as a reference potential only.*

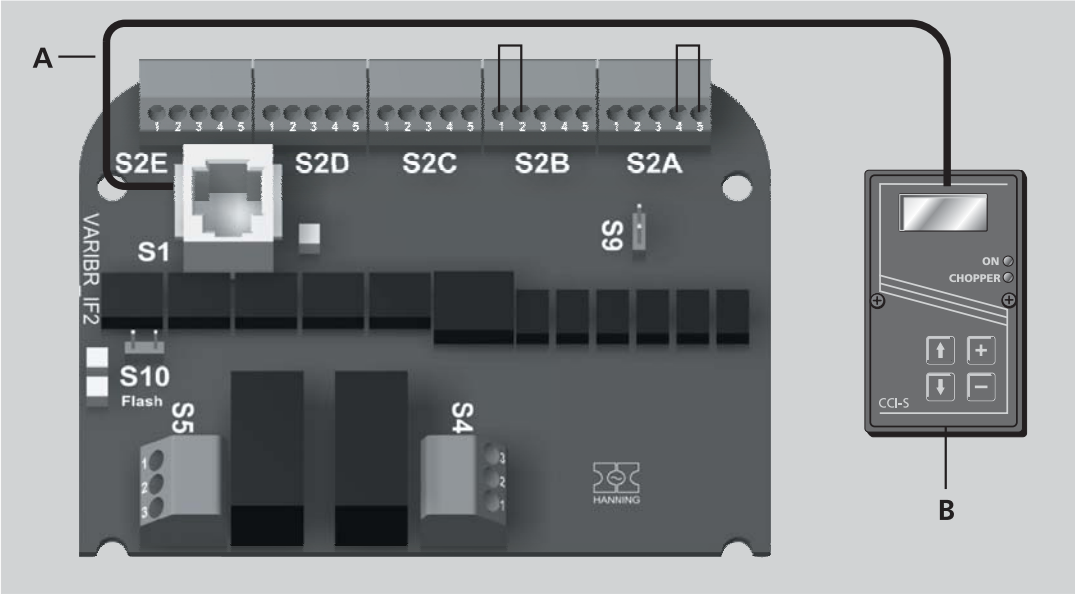

Figure 7-6 Commissioning of a VARICON with Custom Interface and operating unit

A Operating unit connection

B Operating unit

To start up, proceed as follows:

- The VARICON drive can also be controlled with the keyboard of the operating unit: Setpoint value – Code = O□
  All operating parameters for the inverter can be displayed one after the other (keys ↑ ↓) and altered (keys + −).

By pressing both ↑ ↓ keys simultaneously, it is possible to switch to the actual speed parameter from anywhere in the display.

The name of the selected parameter is displayed in the first line.

The actual value or control state is displayed in the second line.

- Set the setpoint value selection SetSpeed to code value 0.
- Start of motor: Set the mode to start using the + key.
- To alter the speed, select the parameter "Set Spd -0" using the + − keys.

7.5 Commissioning with two selectable analog setpoint value sources

This chapter will describe how to connect the internal and external power supplies and the first and second analog setpoint value sources.

To avoid interference, short cables only (max. 2 m) must be used to wire the Enable FREI to the internal voltage supply (see connection diagram).

- *When operating with an external power supply, ensure that the DIG GND is used as a reference potential only.*

Before the first start, it is necessary to prepare:

- **for the internal power supply**
  Connect the bridge between B1 and B2 (GND)
  Bridge between B4 and A5 (turn counter-clockwise (left) for the second analog nominal value setpoint)
  or bridge between B5 and A5 (turn clockwise (right) for the second analog nominal value setpoint)
  Set parameter code 022 (SetSpeed) to 135
  Bridge between A4 and A5 (available)
  Bridge between A5 and C1 (supply for analog switch 1 to 2), only for the first analog setpoint
  Bridge between A1 and A5 (start command). Optional: Select the "Start" position if a "Start/Stop" switch is available in the terminal box cover.
  Bridge between A2 and A5 (turn clockwise (right) for the first analog nominal value setpoint)
  No bridge between A2 and A5 (turn counter-clockwise (left) for the first analog nominal value setpoint).
  Bridge between E5 and A5 (supply for the signal for setpoint value selection)

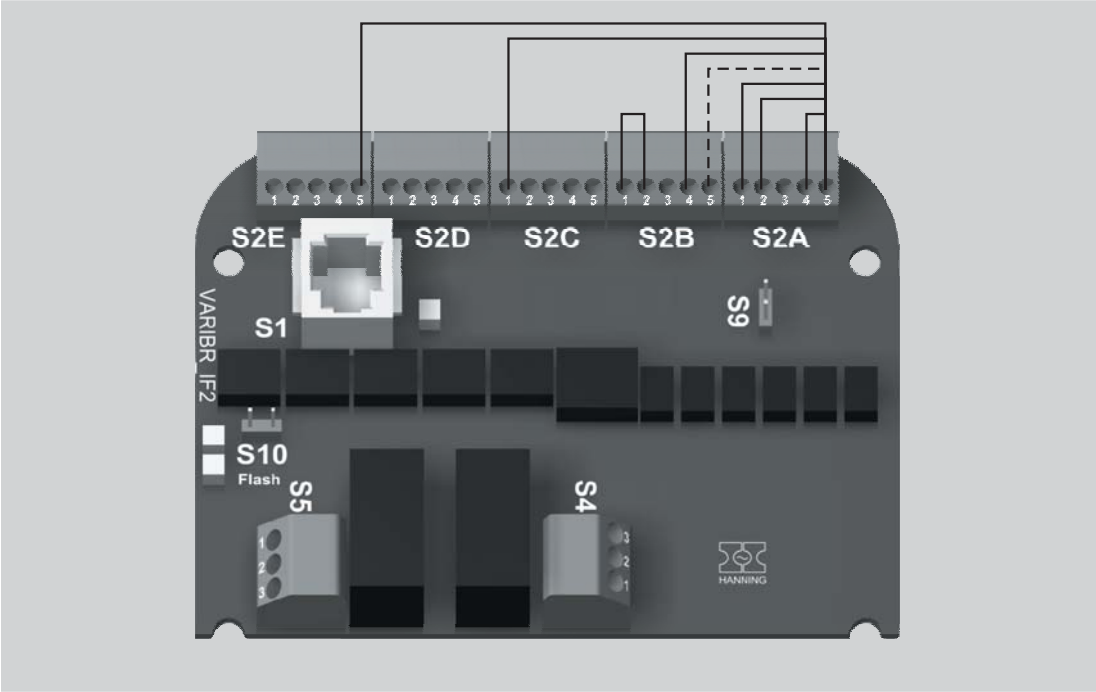

Figure 7-7 Commissioning with internal power supply

- **for the external power supply**
  Apply 24 V to terminal A4 (available)
  Apply 24 V to terminal B4 (turn counter-clockwise (left) for the second analog nominal value setpoint)
  or apply 24 V to terminal B5 (turn clockwise (right) for the second analog nominal value setpoint)
  Apply 24 V to terminal A1 (start command) for the first analog nominal value setpoint
  Apply GND on terminal B2
  Apply 24 V on terminal C1 (supply for analog switch 1 to 2)
  Apply GND on terminal B1
  Apply 24 V on terminal A2 (turn clockwise (right) for the first analog nominal value setpoint
  No voltage (turn counter-clockwise (left) for the first analog nominal value setpoint
  Apply GND to terminal B2.
  24 V on terminal E5 (supply for the signal for setpoint value selection)

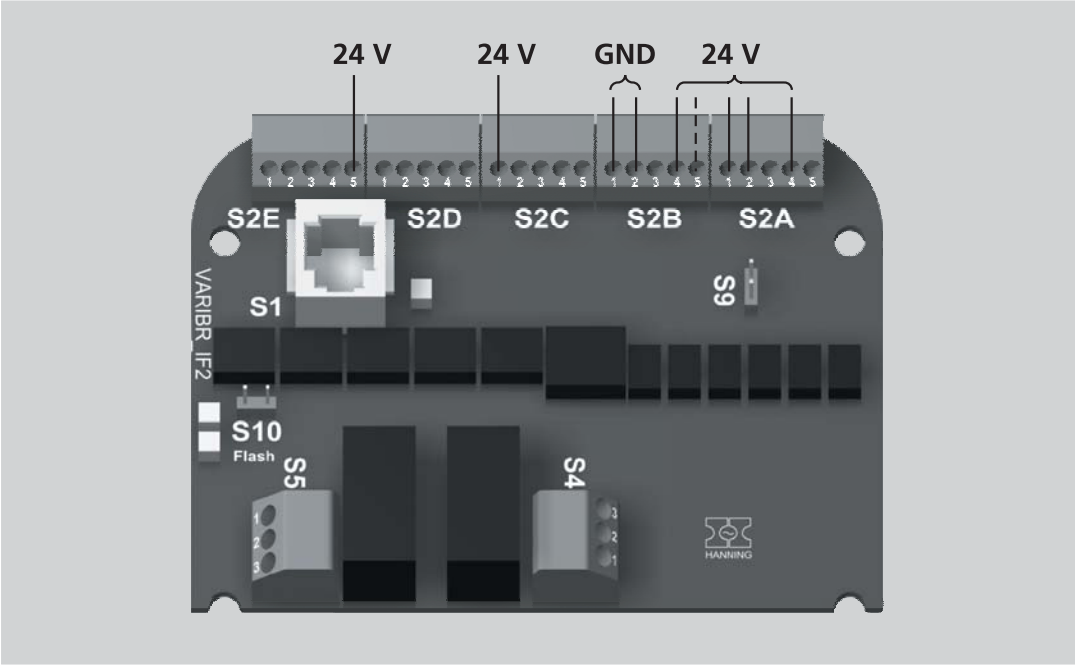

Figure 7-8 Commissioning with external power supply

- **Connect first analog setpoint value source**
  Internal: **Potentiometer setpoint value source**
  Apply GND to terminal D3
  Apply analog IN to terminal C4
  Apply 10 V to terminal C3
  External: **Setpoint value source 0 - 10V**
  Apply nom-valu (setpoint) 0 - 10V to terminal C4
  Apply GND to terminal D3
  External: **Setpoint value source 0 (4) - 20 mA**
  Apply nom-valu (setpoint) 0 (4) - 20 mA to terminal C4
  Apply GND to terminal D3
  Close jumper (S9).

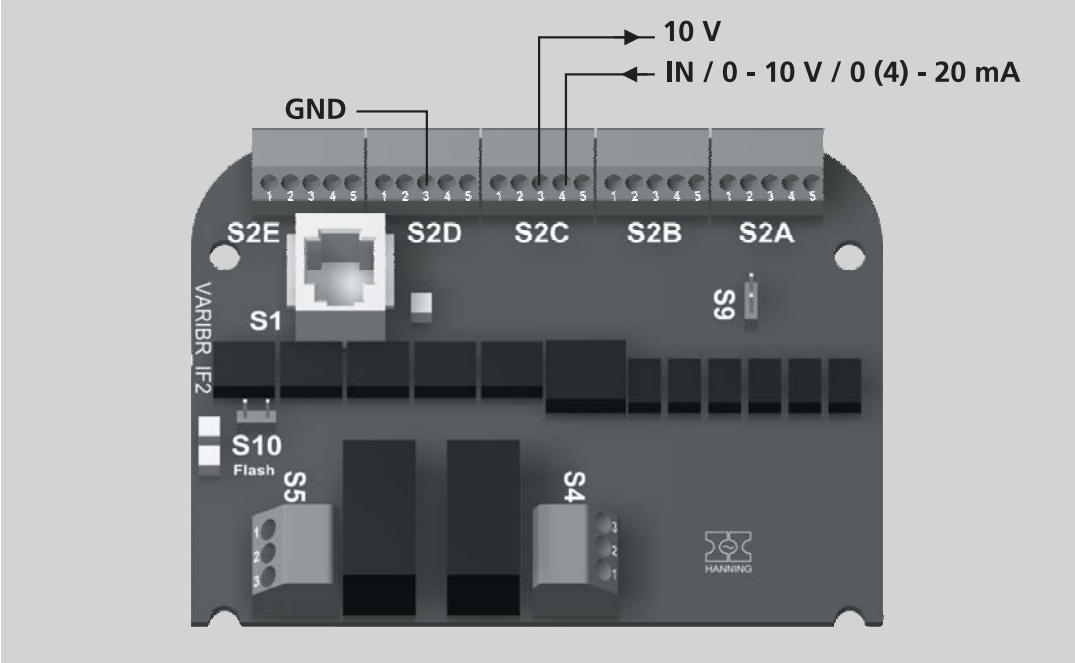

Figure 7-9 Commissioning - connecting the first analog setpoint value source

Connect second analog setpoint value source

External: Setpoint value source 0 (4) - 20 mA

Apply nom-valu (setpoint) 0 (4) - 20 mA to terminal C2

Apply GND to terminal C5

- **Activating the switching functionality**
  Apply 24 V to terminal B3 (analog setpoint value switch from 2 to 1).
  Optional: "External/Manual" switch on the terminal box cover

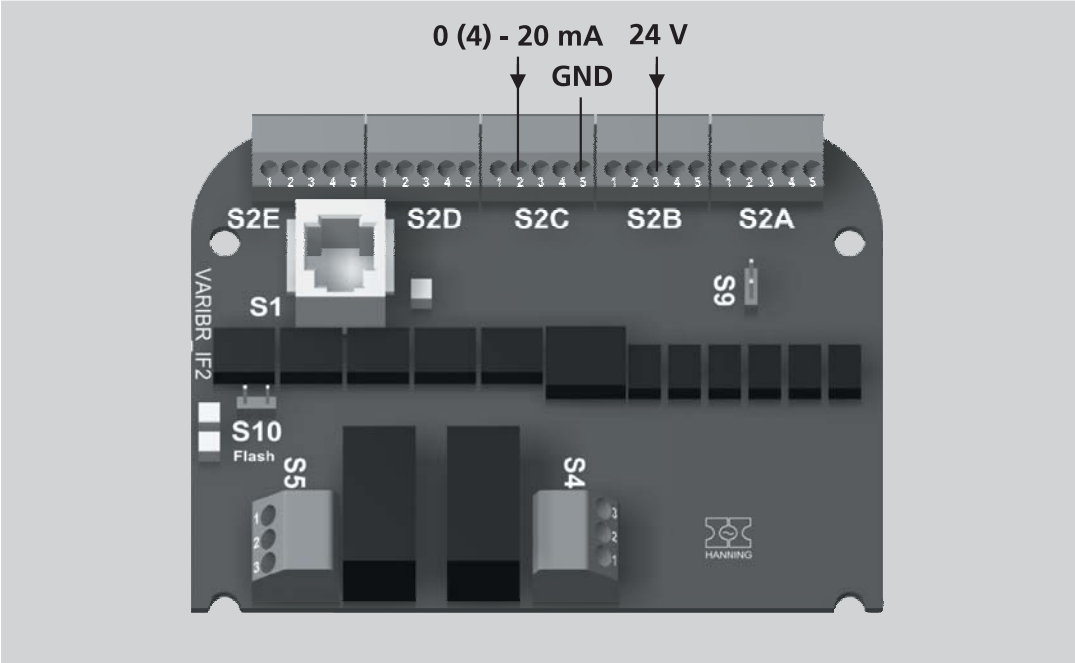

Figure 7-10 Commissioning - connecting the second analog setpoint value source

To start up the first analog setpoint value source, proceed as follows:

- Turn on the power supply.
- Apply 24 V to terminal B3 (activate switching). Optional: Select the "Manual" position if a "External/Manual" switch is available on the terminal box cover.
- Set the speed with the first analog setpoint value source. Optional: with the potentiometer.
- Start command: Apply 24 V to terminal A1 (start command). Optional: Select the "Start" position if a "Start/Stop" switch is available on the terminal box cover.

To start up the second analog setpoint value source, proceed as follows:

- Turn on the power supply.
- Disconnect 24 V to terminal B3 (de-activate switching). Optional: Select the "External" position if an "External/Manual" switch is available on the terminal box cover.
- Set the speed with the second analog setpoint value source.
- Start command: Apply 24 V to terminal B4 (counter-clockwise).
  Apply 24 V to terminal B5 (clockwise).

7.6 Commissioning with preset speeds

Before starting for the first time, ensure that:

- All cable connections are correctly connected.
- The ground connection DIG GND (B2)is connected to the earth of the controls!

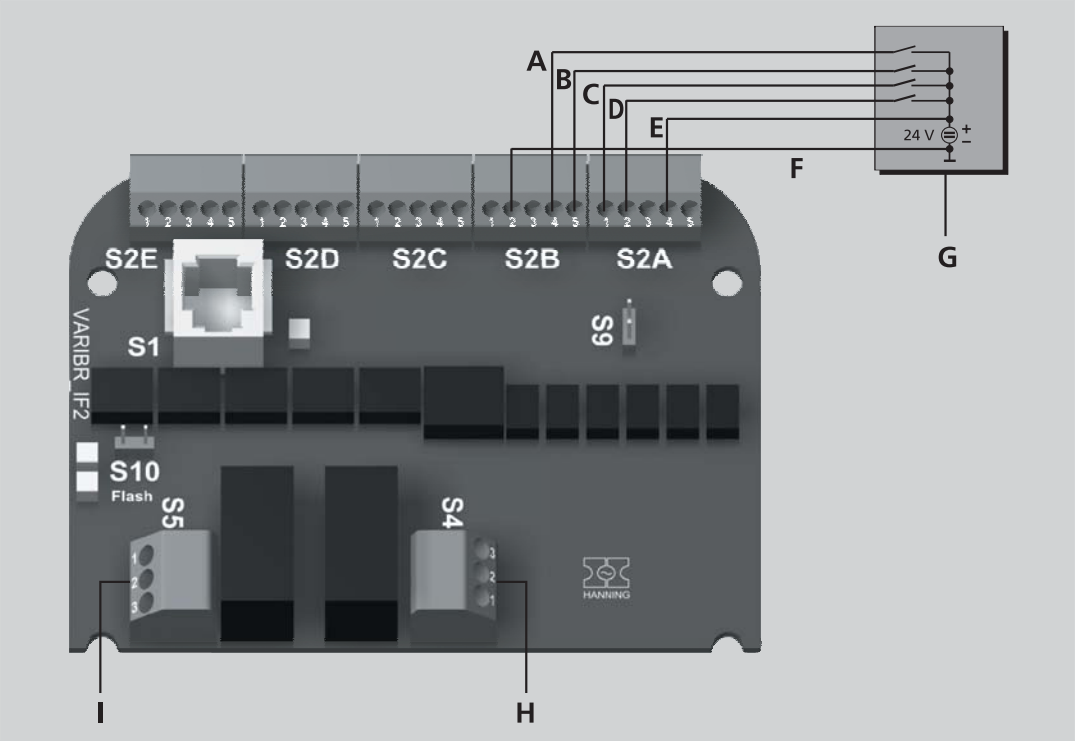

Figure 7-11 Commissioning the custom interface with preset speeds and external control inputs and outputs. External control voltage supply via, for example, PLC.

A Start counter-clockwise (left)

B Start clockwise (right)

C Setpoint value selection 0 (D-IN 0)

D Setpoint value selection 1 (D-IN 1)

E Available (release)

F Ground connection (DIG GND ... ground SPS)

G External control, for example, PLC

H Output 1

I Output 2 (Custom Interface I only)

To start up, proceed as follows:

- Turn on the power supply.
- Set the setpoint parameters "speed 0" to "speed 3".
- Set setpoint value selection parameter "SetSpeed" to code value 11.
- Programming of controls:

  - Use "D-IN 0" and "D-IN 1"
    to select the fixed required speeds.

Setspeed value	Wiring	
	D-IN0	D-IN1
Speed 0	low	low
Speed 1	high	low
Speed 2	low	high
Speed 3	high	high

- Start the external program sequence in the PLC control.

Connect the ground connection DIG GND to the earth of the controls!

7.7 Commissioning via serial interface (SIO RS 485)

Before starting for the first time, ensure that:

- All cable connections are correctly connected.
- The earth terminals (GND INT (B1) and DIG GND (B2)) are connected.
- The available-input FREI (A4) is wired with A5.
- The RS 485 serial interface is connected (E1=A; E2=B).

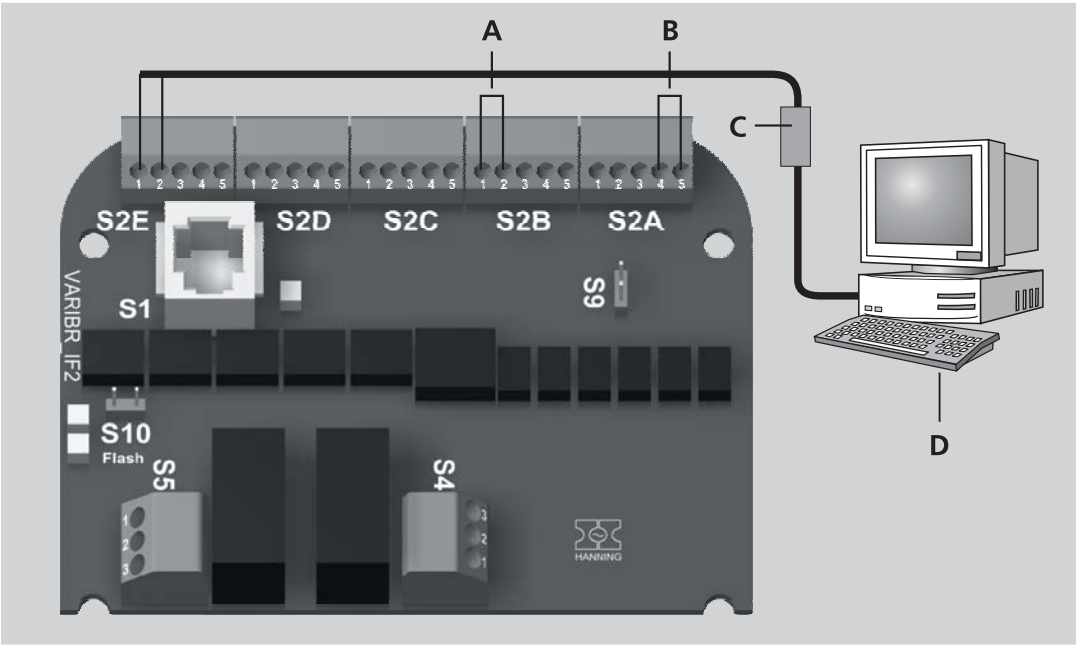

Figure 7-12Commissioning with the serial interface (SIO RS485)

A Earth connection "DIG GND" and "GND INT"

B Internal wiring input FREI

C Adapter for RS 485/ RS232 (optional)

D Industrial PC

To start up, proceed as follows:

The master computer program with the HANNING drive protocol is required (see Part I, Digital interface).

For rapid commissioning, we offer the commissioning software DrivePAR (please refer to the Part M, Appendix, Chapter Options).

- The baud rate is preset to 9600 (address 32). (It can be altered via SIO.)
- Set setpoint value selection = 0.
- Set parameter values.

➔ For information about setting parameters, please refer to Part F, Adapting parameters

- The VARICON drive is started by setting the start bit codes 000 from 0 to 1.

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Part F

Adapting parameters

Version 1.2 ■ Status: 09/2007 ■ Standard

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8 Adapting parameters

8.1 Operating unit

The operating unit is used to adapt the parameters. All VARICON operating parameters can be shown in the display and altered.

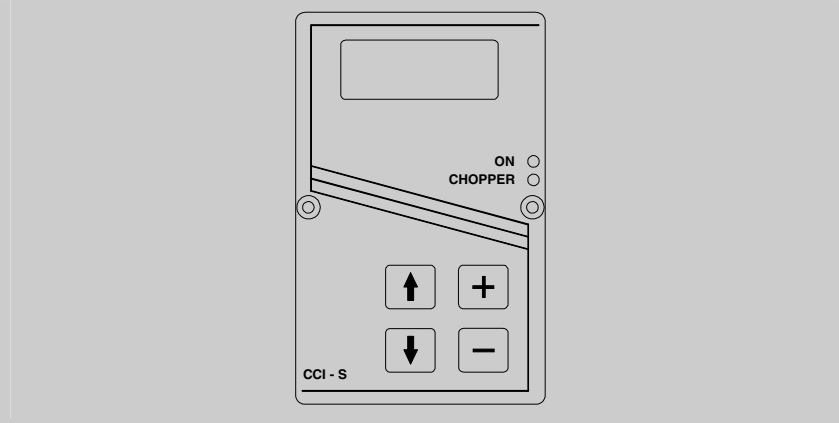


Figure 8.1 VARICON operating unit

8.1.1 Technical data

Dimensions (L x W x D)	10.8 x 6.5 x1.5 cm
Weight	90 g
Type of protection	IP 20
Maximum length of cable	200 cm
Power supply	via VARICON

Table 8-1 Technical data: operating unit

8.1.2 Display and operation

Two-line display
The designation of the selected parameter is displayed in the first line, with the current value or control state displayed in the second line.

LED*ON*
Continuously lit LED signals "ready for use".

LED *CHOPPER*
When lit, the device is operating in the chopper mode.

[↑] and [↓]
calls up and exits parameters. The parameters can be displayed one after the other in both directions.

[+] and [−]
Setting parameters. To exit the parameter display area press [↑] or [↓].

8.2 Parameter – access control

There are five access levels, which are explained as follows:

- Access level 0: Access to group A
- Access level 1: Access to groups A and B
- Access level 2: Access to groups A, B and C
- Access level 3: Access to groups A, B, C and D
- Access level 4: Access to groups A, B, C, D and E
- Access level 5: Access to groups A, B, C, D, E and F (only for service)

The parameters are listed in the order in which they are shown in the display. The access level can be set in group B. This setting is saved automatically as soon as you exit the parameter field. Access level 0 is specified for VARICON operations. It is not possible to exit access level 0 in the conventional manner if it is selected immediately after setting all operating parameters. This makes it impossible to make unintentional alterations to the other parameters.

Group E parameters are intended for Technical Service procedures; the user should use them only if explicitly requested to do so.

Access level 0 can only be exited by using the following procedure:

- Turn off the device.
- Press the ↓ key and hold it pressed; turn on the device.
- Press the + and − keys to select the required access level.
- Press the ↑ key to leave the parameters.
- The setting is saved and the VARICON can be operated in accordance with the access level.

8.2.1 Assignment table: Parameter access levels

Access level:	0	1	2	3	4	5
Group A General drive parameters	Display Direction Mode Speed I-Motor ErrorCod Speed 0 Speed 1 Speed 2 Speed 3 Accel Decel	Display Direction Mode Speed I-Motor ErrorCod Speed 0 Speed 1 Speed 2 Speed 3 Accel Decel	Display Direction Mode Speed I-Motor ErrorCod Speed 0 Speed 1 Speed 2 Speed 3 Accel Decel	Display Direction Mode Speed I-Motor ErrorCod Speed 0 Speed 1 Speed 2 Speed 3 Accel Decel	Display Direction Mode Speed I-Motor ErrorCod Speed 0 Speed 1 Speed 2 Speed 3 Accel Decel	Display Direction Mode Speed I-Motor ErrorCod Speed 0 Speed 1 Speed 2 Speed 3 Accel Decel
Group B Configuration parameters		Access Out-1 Out-2* 4-20Set 4-20 Scal Address Baud rate Time Out AutStart SetSpeed AnlOffst n-0V n-10V	Access Out-1 Out-2* 4-20Set 4-20 Scal Address Baud rate Time Out AutStart SetSpeed AnlOffst n-0V n-10V	Access Out-1 Out-2* 4-20Set 4-20 Scal Address Baud rate Time Out AutStart SetSpeed AnlOffst n-0V n-10V	Access Out-1 Out-2* 4-20Set 4-20 Scal Address Baud rate Time Out AutStart SetSpeed AnlOffst n-0V n-10V	Access Out-1 Out-2* 4-20Set 4-20 Scal Address Baud rate Time Out AutStart SetSpeed AnlOffst n-0V n-10V
Group C Control parameters			Control f-slip I-gain P-gain	Control f-slip I-gain P-gain	Control f-slip I-gain P-gain	Control f-slip I-gain P-gain
Group D Motor parameters				i-nom□ v-nom □v-boost□ f-nom □f-min□ f-max□ n-nom□ PreComp □ClockFq □MotorPTC □FanPTC □FanCtl	i-nom□ v-nom □v-boost□ f-nom □f-min□ f-max□ n-nom□ PreComp □ClockFq □MotorPTC □FanPTC □FanCtl	i-nom□ v-nom □v-boost□ f-nom □f-min□ f-max□ n-nom□ PreComp □ClockFq □MotorPTC □FanPTC □FanCtl

Access level:	0	1	2	3	4	5
Group E Service parameters	MemWrite	MemWrite	MemWrite	MemWrite	Vari-LT Varicon Restore Archive MemRead MemWrite MemReset DC Link Pow-nom v-extra f-extra EProm-No Version v-extra Status-W Pole pairs Mot-Temp Pwr.Temp CPU-Temp U0-Enhan v-BstMax f-Limit	Vari-LT Varicon Restore Archive MemRead MemWrite MemReset DC Link Pow-nom v-extra f-extra EProm-No Version Sub-vers Status-W Pole pairs Mot-Temp Pwr.Temp CPU-Temp U0-Enhan v-BstMax f-Limit
Group F Calibration parameters						i-Nom-FC ref-mode f-nom f-out Is-Slip Reg-Out Reg-In 4-20 out WP-Valid ModelCod

Table 8-2 Parameter access levels

* for custom interface I only

8.2.2 Factory setting – standard version

The VARICON drive is supplied with factory-set parameters pre-programmed to suit the respective motor type. The factory setting values can be read-out via the operating unit or via the serial interface.

8.2.3 Factory setting – customer-specific

For large-scale production, it is also possible to initialize a modified set of parameters to suit customer-specific requirements.

8.2.4 General drive parameters (Group A)

Display: language settings for the plaintext display on the operating unit.

It is possible to change the language used in the display. The following languages are available:

0 German

1 English

2 French

3 Spanish

4 Numerical

5 Russian

German:

- Disconnect the VARICON from the mains.
- Turn on the mains supply while holding the ⊟ key pressed down until **Drehzahl** is displayed.

English:

- Disconnect the VARICON from the mains.
- Turn on the mains supply while holding the ⊞ key pressed down until **Speed** is displayed.

Direction: setting the direction of rotation of the motor

Selection is made via **SetSpeed = 0 = keyboard** using the keys ⊞ (right) and ⊟ (left). Alternatively, the selection can be made via the start inputs. Reversal of direction of rotation is possible at any time; the drive decelerates in accordance with the set deceleration ramp until it reaches standstill, and then accelerates in the other direction according to the set acceleration ramp.

Mode: setting the operating start and stop status.

The function is enabled via **SetSpeed = Keyboard** using the keys ⊞ (Start) and ⊟ (stop). The setting can also be made via the external start inputs. **Start** activates the clock pulse of the frequency inverter and allows the motor to accelerate to the set speed (nominal) value. **Stop** makes the motor decelerate until it reaches standstill. It then turns off the clock pulse. The message **Stop** is first shown in the display when the motor is at a standstill! **Start/Stop** cannot be saved.

Speed: setting the required speed (1/min)

The motor speed will mirror the nominal value, delayed by the acceleration or deceleration. If **SetSpeed = Keyboard** has been selected, use the ⊞ and ⊟ keys to alter the required speed. The rotational speed is altered internally by altering the parameter **Nom-Valu 0**.

- *When operating without variable speed control, the displayed value applies to the speed of the armature with calculated synchronous speed.*
- *However, the actual speed is actually slightly less (please refer to the parameter **f-slip**).*
  The actual mechanical speed is displayed when a tachometer generator is integrated and operations are regulated (control = 1) .

I-Motor: effective motor current.

This displays the measured motor current.

ErrorCod: parameter for error acknowledgement

Zero (**0**) is displayed in the second line of the display when no error has occurred. If the event that an error occurs, the error number is displayed (please refer to Part H, Safety Functions and Error Messages). The error can be acknowledged by pressing the ⊟ key. The cause of the error must be remedied beforehand.

Speed-0 to Speed-3: nominal value parameters required for digitally setting the rotational speed.

Four discrete speeds can be pre-programmed and stored. Selection is made according to the table below via the PLC interface through the inputs **D-IN 0** and **D-IN 1**:

D–IN 1 (terminal 12)	D–IN 0 (terminal 11)	Nominal values	Code No.	Display on operating unit
LOW	LOW	Speed 0	002	Speed -0
LOW	HIGH	Speed 1	024	Speed -1
HIGH	LOW	Speed 2	025	Speed -2
HIGH	HIGH	Speed 3	026	Speed -3

Table 8-3. Rotational speed setting for nominal values 0 to 3

The **speed 0**is used in addition to the variable nominal values**SetSpeed = 0** if keyboard entry is set.

The code numbers and detailed explanation of the control codes are described in Part J, Control codes.

ACCEL: parameter for acceleration speeds.

Unit: (Rev/min)/s

CAUTION: The motor can fall out of step if the acceleration ramp is too steep.

DECEL: parameter for deceleration speeds.

Unit: (Rev/min)/s

Depending on the settings, a considerable amount of rotational kinetic energy can be fed back during deceleration. The deceleration ramp must be set at a gradient that will allow the DC link and the brake resistors to absorb the feedback energy. If the ramp is too steep, the VARICON shuts down and issues the message ***Overvoltage****.*

8.2.5 Configuration parameters (Group B)

Access: parameter for access levels to the VARICON parameters.

➔ Please refer to 8.2 Parameter – access control, page 8-5.

Out-1 + Out-2*: parameters for configuring relays.

Relay output1: parameter for configuring output 1.

Relay output2: Parameter for configuring output 2 (only available in the custom interface I)

Both outputs 1 and 2* can be assigned the following functions:

Function		Display	Relay
0	Relay permanently off	0	OFF
1	Relay permanently on	1	ON
2	Remote control via serial interface	2	-----
3	VARICON ready (no error pending)	3	ON
4	VARICON operating (clock pulse on)	4	ON
5	Motor standstill	5	ON
6	Clockwise direction	6	ON
7	Setspeed attained	7	ON
8	Chopper active	8	ON
9	Temperature warning, electronics: 71°C ± 3 °K	9	OFF
10	Over-heating, electronics : 75°C ± 3 °K	10	OFF
11	Max. current >200%	11	ON
12	Motor over-heating	12	OFF
13	Motor operating (motor frequency f ≠ 0 Hz)	13	ON

Table 8-4 Functions for relays 1 and 2

OFF the relay is turned off when in the status to be reported
ON the relay is turned on when in the status to be reported
----- adjustable

* for custom interface I only

4-20 Set: parameter for 4–20-mA configuration of the analog output (only available for customer interfaces I + II).

Configuration parameters check-back (acknowledgment) signal of actual value of analog current output, terminals S2D1 and S2D2:

Function		Display		Output 4-20mA
0	Output permanently off	0	Off	4mA
1	Output permanently on	1	On	20mA
2	Output scaled to speed control output (actual slip value)	2	RegOut	4-20mA
3	Output scaled to actual speed	3	n-meas	4-20mA
4	Output scaled to required speed (according to ramp generator)	4	RampSpd	4-20mA
5	Output scaled to required speed (before ramp generator)	5	Speed	4-20mA
6	Output scaled to the internal controlled speed	6	Reg-Out	4-20mA
7	Output remote-controlled via serial interface	7	User	4-20mA
8	Output signals inverter is ready	8	Ready	4/20mA

Table 8-5 Functions for the parameter **4-20Set**

4-20 Scal: parameter for analog configuration (for 4-20Set).

- The parameter **4–20 Scal** is scaled in revolutions per minute.
- The entered value corresponds to the desired maximum deflection.
- The speed at which the analog output is controlled (20 mA output current) can be determined in revs/min.
- Caution! Scaling will only function properly when the parameters **f–nom** and **n–nom** are correctly set.
- This scale is based on the analog configurations:

Function	Display
2	**RegOut**
3	**n-meas**
4	**RampSpd**
5	**Speed**
6	**Reg-Out**

Function 7

The setting **7 User** (via the serial interface) is permanently scaled to a range of values between 0 and 1000 (1000 = full modulation = 20 mA).

Function 8

When the analog configuration is set to **8 Ready**, the analog output signals the operational availability of the inverter.

Scaling:

- Ready for operation: 20mA
- Not ready for operation: 0 mA (4 mA)

The code numbers and detailed explanation of the control codes are described in Part J, Control codes.

Address: parameter for the device address.

Range 32 -63. The address is for selecting devices when controlled via the serial interface.

Baud rate: parameter for the transmission speed of the serial interface.

The transmission rate is measured in bit/s (baud).

- Permissible values: 1200, 2400, 4800, 9600, 19200 and 38400 baud
- PLC / RS 485 interface: max. 19 200 baud

Time Out: parameter for the transmission speed of the serial interface.

If actuating commands or requests made via the serial interface are not carried out within a set time interval, the drive is shut down and a corresponding message is shown on the display (**Error = Time Out**, error code 255). Monitoring is activated via the control command **1** on code 000, and deactivated by the **0** command. The monitoring interval can be set between 1 and 255 seconds; the factory setting '0' deactivates the monitoring function.

AutStart: parameter regulating the automatic start of the device: On/Off

When set to **SetSpeed = 0** und **AutoStart = 1**, the VARICON accelerates automatically to the selected speed when tuned on (**Speed 0** to **Speed 3**). The direction of rotation taken is saved under **Direction** .

SetSpeed: parameter for determining the method of entering the setspeed value

The following options are available to enter setspeed values:

- Keyboard or RS 485
- PLC (FI terminals)
- Analog value selection

The parameter **SetSpeed** value selection (code 022) determines if the required speed of rotation, the rotational direction and the start/stop signal should come from the control terminals or via the serial interface RS 485. It is also possible to allow a mix of both.

SetSpeed value selection is a byte size in which the bits 0, 1, 2, 3 and 7 have a certain meaning. The bits 4..6 are not used.

Setspeed value selection	Bit 7: Value 128	Bit 3: Value 8	Bit 2: Value 4	Bit 1: Value 2	Bit 0: Value 1
Function if bit = 0	Start inhibitor active	Setspeed value via RS 485 (code 002)	Setspeed value via RS 485 (code 002)	Direction via RS 485 (code 001)	Start/stop via RS 485 (code 000)
Function if bit = 1	Start inhibitor inactive	Setspeed via frequency selection, terminals 11 / 12	Setspeed set via analog input, terminals 4 / 5	Rotational direction via terminals 9 / 10	Start/stop via terminals 9 / 10

Table 8-6 Setspeed values

It is only possible to make changes when in the mode **0** or when both start inputs are ‘zero’ or ‘open’.

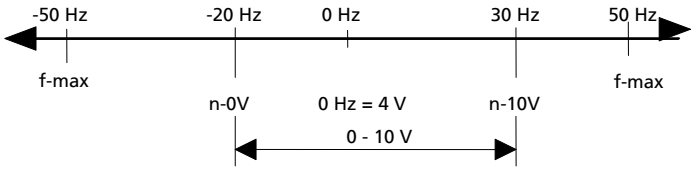
Nominal value specification configuration:

- 0 = keyboard or RS 485
  - Set speed via field ‘Speed-0’ (positive values only)
  - Start/stop and direction of rotation settings are carried out via Mode and Direction.
  - When the VARICON has been started, it is possible to alter ‘Speed-0’.

- 11 = setspeed value specification via PLC (VARICON)
  - Selection of the nominal values (Speed0...Speed-3) is made via the PLC inputs
    D-IN 0 and **D-IN 1**.
  - For reasons of safety, the VARICON with selectable direction of rotation is started via separate inputs for each direction (**ST-LI** (counter-clockwise and **ST-RE**(clockwise)). Only one input is permitted to be 1; VARICON sets to 0 = 'Stop'. if 1 is applied to both inputs.

- 7 = analog nominal value specification

  In this mode, it is possible to reverse the direction of rotation by making changes to the required analog value. To do so, set the parameters **n-0V** and **n-10V** to negative values. Negative values stand for 'anti-clockwise' direction of rotation, positive values for 'clockwise' direction of rotation. The frequency **n-0V** is assigned to the smallest analog value and **n-10V** is assigned the largest. The difference between **n-10V** and **n-0V** will then be depicted linearly on the analog range.



In order to start the VARICON, the **ST-RE input** or the **ST-LI input** must be set to **1**. The nominal value is negative if using the input ST-LI.

Characteristics of mixed operation:

It is possible to use terminal **9 or 10** to start the inverter if the direction of rotation is set via the RS 485 and Start/stop via the terminals. In this case, the terminals have nothing to do with the direction of rotation.

If the direction of rotation is set via the terminals and Start/stop via RS 485, the direction of rotation can only be influenced via terminal 9. Terminal 10 has no effect.

Start inhibitor:

The start inhibitor prevents the VARICON from immediately springing into action when the mains supply is turned on. Deactivate **both** start inputs first to disable the start inhibitor and then it can be started.

The start inhibitor is factory set to active (and also after an EEPROM initialization). If it is to be disabled, set bit 7 in **Setspeed value specification** = 1 (and then save !).

Anl-Offs: parameter for analog offset.

If the analog setpoint input is being used, zero can be assigned to either 0 mA / 0 V or to 4 mA / 2 V.

n-0V: parameter for determining the speed, with analog nominal value 0 V or 0 mA (2 V or 4 mA).

Together with **n-10V**, the parameter scales the analog nominal value input (refer to SetSpeed: parameter for determining the method of entering the setspeed value). Please observe: **n-0V** can also be greater than **n-10V**.

n-10V: parameter for determining the speed when the analog nominal value is 10 V or 20 mA.

Together with **n-0V**, the parameter scales the analog nominal value input (refer to SetSpeed: parameter for determining the method of entering the setspeed value).
Please observe: **n-10V** can also be smaller than **n-0V**.

8.2.6 Control parameters (Group C)

Tachometer

The controller is designed for the following pulse generators. 10 pulses/rotation (standard), 1024 pulses/rotation (special).

Nominal speed and nominal frequency must be set correctly.

Controller:

It is also possible to switch to variable speed control (**On = 1**) or to pure characteristic control (**Off = 0**) when the motor is running.

Ramp setting: during control operations

When operating speed control, it is possible to set any number of acceleration and deceleration ramps because the controller reliably controls the motor at the slip limit.

If the brake ramp is too steep, it is possible that problems may occur because the feedback energy to the DC link is too great. This will generate the **Error code = 2** (overvoltage). The drive is then shut down. This error message can be rectified as follows:

- Set smaller deceleration ramp.
- Set smaller slip frequency.
- Connect external brake resistor and consider reducing.

f-slip: parameter for slip frequency.

The slip frequency is the maximum frequency by which the electrical phase sequence is allowed to rotate more quickly (during motor operations) or more slowly (during generative breaking) than the motor shaft.

On the one hand, the setting must allow the motor to develop sufficient torque, and on the other ensure that under no circumstances the pull-out slip frequency is reached.

Recommended value: 2 to 2.5 fold nominal slip frequency (applies to a 2-pole, 50 Hz motor: for example, 6 to 8 Hz).

I-gain: parameter for integral gain of the controller.

The time constant of the ramp function generator is proportional to the reciprocal value of the integral gain; the actual time constant is = 327 s / I-gain.

The integral gain settings must be made to ensure that the stationary end value is reached in a best-possible time (recommended value: 100).

P-gain: parameter for proportional gain of the controller.

The actual gain is V = P-gain /256.

The gain must be set to ensure that the motor runs at the set required value as quickly as possible without oscillation in the feedback control.

The recommended value range is 500 to 700.

8.2.7 Motor parameters (Group D)

The following motor parameters have been optimized at the factory. Avoid altering the settings. Other settings could destroy the drive.

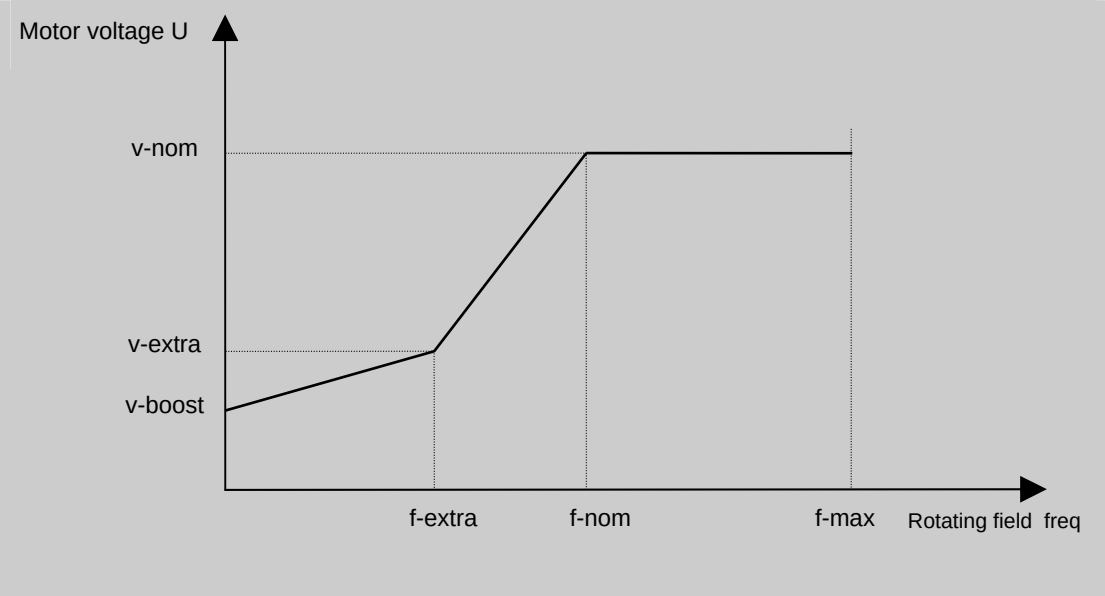


Figure 8.2 Graphic diagram of the motor parameters

i-nom: motor rated current for I^2t-calculation

The factory set motor rated current is used to calculate the I^2t limit.

v-nom: parameter for setting the scaling factor of the motor.

Set **v-nom** to the rated voltage of the motor.

v-boost: parameter for setting the starting voltage of the motor at speed 0 (boost).

v-BstMax limits v-boost (see factory setting).

The recommended value is ≈ 3-20 V.

f-nom: parameter for setting the rated frequency of the motor (vertex).

Set the nominal frequency with the display initially showing **1/min**. The motor voltage is set proportional to the frequency when the frequency is lower than **f–nom**; with higher frequencies (field weakening range) it is held steady at **v–nom**.

f-min: parameter for setting the minimum frequency.

F-min can be use to determine the minimum frequency, which will then be maintained if the actual nominal value is lower.

f-max: parameter for setting the maximum frequency.

For reasons of safety, the maximum frequency **f-Max**, which can be achieved by nominal value specification, should not be set higher than the maximum frequency *required*. When operating speed control (**Control = On**) **f-Max** must be set higher by an amount equivalent to the slip frequency **f-slip**. **F–max** is limited by the parameter **f–max–limit** (see factory settings).

n-nom: parameter for setting the units for the nominal speed of the motor to min -1.

This parameter is required for the display of speeds in units of min^{-1}. It is set at the factory in accordance with the details given on the rating plate of the VARICON.

PreComp: parameter for setting the mains pre-compensation.

Setting options available are **Yes** or **No**. **Yes** is recommended. The VARICON is equipped with mains pre-compensation that compensates variations in the mains supply voltage and starting inrushes through the 50-Hz mains frequency. The pre-compensation is only effective when the inverter is not operating at voltage output limits; as soon as the motor voltage exceeds approx. 210 V / 360 V insufficient control range is available for pre-compensation.

ClockFq: parameter for querying the clock frequency of the VARICON.

The clock frequency is selectable (16 000 Hz or 8 000 Hz).

- 16 kHz: low-noise operation
- 8 kHz: approx. 10% less loss, but with noise

MotorPTC: parameter for setting the monitoring of the motor temperature.

If the temperature of the winding is too high, the drive shuts down and issues a corresponding error message.

Fan-PTC: fan temperature monitoring.

This parameter switches the fan temperature monitoring function (**1 = On, 0 = Off**) The temperature of the fan motor is monitored by means of a thermostatic switch.

FanCtl:

The following operating modes can be set via the parameter **FanCtl**.

0 Permanently off

1 Permanently on

2 On when in standby

3 On when clock pulse on

4 Temperature controlled (>45 °C on, <42 °C off)

8.2.8 Service parameters (Group E)

Group E parameters are intended for technical service procedures; the user should not use or alter them.

Vari. LT:

Factory set.

Varicon: parameters for the software version of VARICON.

The device range (VARICON) is displayed in the top line; the drive type, CCD***, is displayed in the second line.

To display the software version in the second line, hold the ⊞ key pressed down. To display the article number of the software version in the second line, hold the ⊟ key pressed down.

Restore: parameter for restoring parameters.

A complete set of parameters is loaded from the operating unit into the VARICON. Invoking the **Restore** parameter overwrites the configuration data stored in the VARICON. It is only possible to call up this parameter when in the **Stop** mode; however, this loading procedure makes no alterations to the display language and access level settings. For reasons of safety, the ⊞ key must be kept pressed down for five seconds before this function is triggered. **o.k.** is displayed once the parameters have been successfully restored.

Archive: parameter for archiving parameters.

The **Archive** parameter provides the option of saving complete sets of parameters to the operating unit. They can be re-loaded using the **Restore** parameter. It is only possible to call up this parameter when in the **Stop** mode; however, this loading procedure makes no alterations to the display language and access level settings. For reasons of safety, the ⊞ key must be kept pressed down for five seconds before this function is triggered. **o.k**. is displayed once the parameters have been successfully archived.

MemRead: parameter for read-out from EEPROM of the frequency inverter

MemRead copies the set of parameters stored in the non-volatile memory (EEPROM) into the RAM of the frequency inerter. The '**+ key**' is displayed in the second line of the display. If the MemRead function is to be carried out, then, for reasons of safety, the ⊞ key must be kept pressed down for five seconds before this function is triggered. The operating unit displays '**+ hold**' if the ⊞ key is pressed briefly; when the restore process is started 'active' is displayed and 'ok' once the readout (MemRead) process is completed.

If an attempt is made to start **MemRead** using the ⊟ key, then ?+ will be displayed. This serves to remind the operator to press the ⊞ key.
Configuration data stored in the RAM of the frequency inverter is overwritten by invoking the 'MemRead' parameter. It is only possible to invoke this parameter when in the **Stop** mode; however, this loading procedure makes no alterations to the display language and access level settings.

MemWrite: parameter 'Save to EEPROM of the frequency inverter'

The option of saving complete sets of parameters in the EEPROM is given by the parameter **MemWrite**. They can be re-loaded by means of the parameter **MemRead**. The same rules must be observed as with **MemRead**. For reasons of safety, the ⊞ key must be kept pressed down for four seconds before this function is actually triggered.

MemReset: parameter for restoring factory settings.

MemReset provides the possibility to reset all parameters to their factory-default settings. It is only possible to call up this parameter when in the **Stop** mode; however, this loading procedure makes no alterations to the display language and access level settings. For reasons of safety, the ⊞ key must be kept pressed down for five seconds before this function is triggered. **Initial** is displayed once the parameters have been successfully restored.

DC link: parameter for displaying the measured voltage of the DC link in volts.

Factory set.

Mains: parameter for displaying the nominal mains supply voltage of the VARICON.

Factory set.

v-extra: parameter for the motor voltage in the additional characteristic control point.

The characteristic control point makes it possible, for example, to lower the gradient of the characteristic curve in the lower frequency range, and as such to prevent an over-magnetization of the motor in this range. If the characteristic curve point is not required, **v-extra** must be set to the minimum value (= **v-boost**) and **f-extra** to 0.

f-extra: parameter for determining the frequency in the additional characteristic control point.

Applicable if **v-extra** is not used. If the characteristic point is not required, **f-extra** must be set to 0.

Eprom-No: serial number of the Eprom

Factory set.

Version: software version

Factory set.

Sub_Vers: sub-version

Factory set.

Status-W: status value

Factory set.

Pole pairs: number of pole pairs

Factory set.

Mot-Temp: mkotor temperature

This displays the measured temperature of the motor.

Pwr.Temp: temperature of inverter power circuit

This displays the measured temperature of the inverter power circuit.

CPU-Temp: temperature of inverter control section

This displays the measured temperature of the inverter control section.

U_0-Enhan: starting voltage increase

When the controller is turned on, the starting voltage can be increased via the parameter
U_0-Enhan. The value 0 turns off this function. Otherwise, the following applies to the starting voltage:

v-boost enhanced =

v-boost + ((v-nom* U0-Enhan)/65535) *f-slip-nom/ f-slip

Below an explanation of the parameters:

f-slip-required	The required slip set by the controller
f-slip	The parameter determining the maximum slip
v-nom	The parameter determining the nominal voltage of the motor
U0-Enhanc	The parameter that determines the proportion of v-nom (in 1/65535), by which the starting voltage is to be maximally increased

Observe the permissible inverter and motor currents when setting.

v-BstMax: v-boost maximum

Factory set.

f-Limit: Limit frequency of the drive

Factory set.

8.2.9 Calibration parameters, (group F)

Internal parameters. User access rights withheld.

8.2.10 Example for setting parameters

In the following example the VARICON is to be operated at a maximum frequency of 75 Hz. Acceleration to this frequency should take 1.5 seconds, the brake time 3 seconds.

Setting procedure for the type CCD–8D4-1 – 4–pole:

n_{max} = 2250/min; f_{nom} = 75 Hz

f-max: 75 Hz = 2250 1/min
f-nom: 50 Hz = 1500 1/min

Accel 2250 / 1.5 = 1500 1/min s

Decel 2250 / 3 = 750 1/min s

The starting voltage **v–boost** is dependent on the required start torque.

A rule of thumb for the start with rated-load torque is:

$$u - boost = R * I \ * \frac{\sqrt{3}}{4}$$

R = winding resistance measured between two phases

I_N = nominal current of the motor

v-boost can only be set as high as **v-BstMax**.

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Part H

Safety functions
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10 Safety Functions and Error Messages

10.1 Characteristic performance when an error occurs

When an error is automatically identified, the brake ramp is circumvented and the inverter immediately enters the **0** mode. At the same time, the green LED of the operating unit flashes. The motor coasts to a standstill. The error that has occurred can be read out in coded form via the operating unit or the serial interface.

10.2 Error acknowledgement

Once the cause of the error has been rectified, the user must acknowledge the error via a control command. There are three means of acknowledging an error:

- By means of a LOW-HIGH edge at the control terminal rail S2, terminal 13 - **F-Quit**. **F-Quit** is the error acknowledgement input.
- By selecting the field **ErrorCod** on the operating unit and pressing the − key.
- Transmit an actuating command via the serial interface to code 23, error with 0-value.

All errors can be acknowledged and deleted by turning the drive off then on again.

10.3 Possible error codes

Error code	Description
0	No ERROR
1	Undervoltage_ERROR
2	Overvoltage_ERROR
4	Inverter_overtemperature_ERROR
5	Motor_overtemperature_ERROR
6	Fan_overtemperature_ERROR
8	EEPROM_ERROR
9	Inverter_peak current_ERROR
10	Inverter_overcurrent_ERROR
11	Inverter_continuous_current_ERROR
12	Motor_overcurrent_ERROR
16	Enable_ERROR
64	Short-circuit_ERROR
128	Power_On_ERROR
250	Watch_Dog_ERROR
255	Timeout_ERROR

Table 10-1 Error codes

10.3.1 Error code 1 Undervoltage_ERROR

Shutdown due to undervoltage in the DC link.

10.3.2 Error code 2 Overvoltage_ERROR

Shutdown due to overvoltage in the DC link.

The value (parameter **Decel**) has been set so high that the resulting brake speed is too fast. The DC link cannot cope with the feedback energy by itself and dumps the feedback energy to the external brake resistor (optional). If the feedback energy cannot be transformed into heat at the external brake resistor, the VARICON generates the error message **OverVolt**.

10.3.3 Error code 4 Inverter_overtemperature_ERROR

Shut down due to inverter overheat.

The temperature of the VARICON power electronics is too high. The cooling is insufficient, for example, ambient temperature too high, insufficient air circulation, dirty air grate or the internal fan is defective.

Restart the VARICON drive only when it has been allowed to cool down.

10.3.4 Error code 5 Motor_overtemperature_ERROR

Shut down due to motor over-heating.

The integrated motor temperature sensor indicates temperature rise. Restart the VARICON drive only when it has been allowed to cool down.

10.3.5 Error code 6 Fan_overtemperature_ERROR

The temperature of the fan motor is monitored by means of a thermostatic switch. The fan over-heating error is generated when the thermostatic switch is triggered. This can occur due to insufficient ventilation caused by:

- Insufficient distance to a physical restriction
- Ambient temperature >40 °C
- Dirty air grate
- Defective or blocked fan

10.3.6 Error code 8 EEPROM_ERROR:

Shutdown when an error occurs in the EEPROM memory.

The reliability of the data in the EEPROM memory is checked at the same time as every read and write operation (meaning, when turning on the line voltage and each time a parameter is altered). This error message is issued when data integrity is questionable.

This message can be acknowledged in the same manner as all other messages. All parameters must be verified before starting the VARICON drive. The factory settings should be reloaded using the parameter **MemReset**. This is then used to reconfigure the device.

This error can occur, for example, if the line voltage fails when a write operation (save) is in progress.

The message is also displayed if the archiving function has been called up, and data storage in the EEPROM of the operating unit was flawed.

10.3.7 Error code 9 Inverter_peak current_ERROR

The mentioned-above error is generated if double inverter current flows twice within a time interval of 1 ms.

10.3.8 Error code 10 Inverter_overcurrent_ERROR

The current limitation with a first order low pass and a time constant of 150 ms generates the above-mentioned error message at 150% of the inverter rated current.

10.3.9 Error code 11 Inverter_continuous_current_ERROR

The I^2t limitation, with a time constant of 123 seconds, triggers the above-mentioned error message when 120% of the inverter-rated current is exceeded.

10.3.10 Error code 12 Motor_overcurrent_ERROR

The same I^2t limitation, with a time constant of 123 seconds, triggers the above-mentioned error message when 120% of the set motor current is exceeded (code 161 can be read on the operating unit = **I_Motor** in units of 1/10 A).

10.3.11 Error code 16 Enable_ERROR

Inverter enable signal missing at the control terminal rail 3, terminal 14 (**FREI**)..

The VARICON can only be started if an active enabling signal (24 V) is applied to terminal 14 on the control terminal rail. If this signal fails during drive operations, the motor shuts down immediately and coasts to a standstill. The shutdown immediately affects the inverter power section.

- *The control signal FREI must **not** be used to switch the VARICON clock pulse ON/OFF for normal operational purposes.*
- *It is only permitted in emergencies to turn off the clock pulse using this input.*

10.3.12 Error code 64 Short-circuit_ERROR

Fast over-current recognition located in the power electronics.

10.3.13 Error code 128 Power_On_ERROR

When the software is launched, an error is recognized during the initializing phase of the inverter.

10.3.14 Error code 250 Watch_Dog_ERROR

Timer reset of the watchdog.

The inverter controller is monitored by a watchdog timer. If errors occur in the internal program run, the control is reset and the message is issued.

The inverter is again ready for operations once the error has been acknowledged. It is recommended to perform a complete cold restart by interrupting the power supply.

10.3.15 Error code 255 Timeout-ERROR

Shutdown when telegrams fail (serial interface).

This message is issued when the time between two telegrams exceeds the maximum value at the serial interface.

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Part I

Digital Interface

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11 Digital Interface

11.1 General

All of the important VARICON drive functions can be controlled by a central master computer via the serial interface.

By using corresponding line drivers, up to 32 VARICON drives can be operated via a master computer interface; at the same time, each VARICON drive can be addressed individually.

The VARICON drive usually operates in the slave mode, meaning, all data transmissions are sent by the master computer. In addition to control via the digital interface, the VARICON drive can still be controlled via both the operating unit and the control terminals.

11.2 Interface Hardware (SIO RS 485)

11.2.1 RS 485 Interface

The RS 485 serial interface is designed for use with two-wire technology (half-duplex operations). The interface is not equipped with its own power supply, and is isolated from the rest of the VARICON-drive electronics by opto-couplers. The master computer must also be equipped with an RS 485 interface based on two-wire technology.

A Fieldbus system is used to interconnect several VARICON drives (max. 32) with the master computer. The A-terminals (RS 485 '+') of all of the devices are connected to one another, as are the B-terminals (RS 485 '-'). Twisted-conductor or shielded cables must be used for the transmission lines. The shielding must be connected to the ⏚ terminal.

The maximum transmission speed is 19,200 bit/sec. The protocol used is described in chapter 11.3 Format of characters, page 11-5. To prevent interference to the transmissions, both RS-485 signal inputs are terminated in such a manner that, when idling, line A is applied to 'HIGH' and line B to 'LOW'. Idling means that none of the devices connected to the bus are active. Bus termination is not included (generally a 120 Ω terminating resistor). If necessary an external terminating resistor must be connected.

Serial interface RS 485 (terminal rail S3)

Terminal	Designation	Signal level	Function
1	A	0 to 5 V	RS 485 signal line A
2	B	0 to 5 V	RS 485 signal line B

Table 11.1 Terminal assignment for the terminal rail S3 (RS 485 interface)

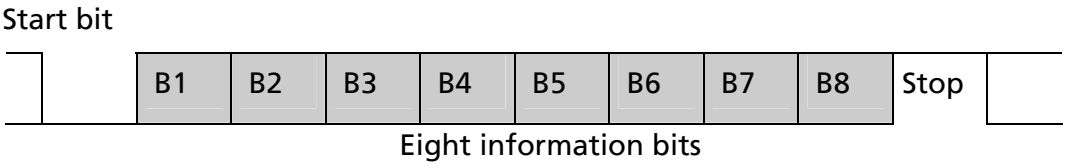
Available

Enable can also be actively signaled high on the terminal **FREI** (24 V, PLC compatible) via the RS 485 interface when operating open loop control.

11.3 Format of characters

The characters to be transmitted consist of text and control characters. The format of the characters includes the following elements:

- A start bit.
- Eight information bits:
  The eight information bits encode text and control characters. Both are taken from the 7-bit code in accordance with DIN 66003 Part 1 and extended to even parity (bit 8).
- A stop bit:
  The least-significant bit follows the start bit.



11.4 Transmission speed and device address

The baud rate and device address of the serial interface can also be set via the serial interface.

Baud rate:	Code 100
Permissible transmission values:	1200, 2400, 4800, 9600, 19200, (38400, only possible with special interface)
Device address:	Code 101
Permissible transmission values:	32 63

Table 11.2 Set baud rates

These are elementary interface parameters. The following must be observed when making settings to ensure that the communication with the VARICON drive is not interrupted:

- Response telegram - waiting time
  A waiting time of 1.2 byte widths is necessary following the transmission of the master computer telegram, before the response telegram from the VARICON drive can be started.
- SIO-Broadcast to address 99 decimal
  An actuating command sent to this address is carried out by all VARICON drives connected to the bus without check-back signal to the master computer. All control commands are permissible.
- SIO device setup to address 98 decimal
  No matter what device address is set, a VARICON drive can be set up and queried via address 98. If the device address is unknown, it can always be reset via the address 98.

*During setup procedures, **one** station only must be connected to the bus; otherwise, all operational VARICON drives would be addressed simultaneously and conflicts would result.*

- If several drives are in operation, just one frequency inverter should be connected to the master computer during setup procedures. Otherwise conflicts are possible until each individual drive has been assigned an address.
- The VARICON drive must be in the **STOP** mode.
- Before the baud rate and address can be reset, communication to the VARICON drive must be established, meaning, the values set in the VARICON drive must be known and set in the master computer. If the address and baud rate are unknown, the user must try and establish the actual values via the master computer by means of trial and error. If the address and baud rate are to be reset, the master computer must re-establish communications when the first value has been reset and record the new value before the second value can be altered.
- Actuating requests containing illegal values (for example, address is outside of the address range 32 to 63; baud rate does not correspond exactly with one of the above-named values) are acknowledged with **NAK** and the original settings are retained.
- Actuating requests with correct values are acknowledged with **ACK**. Address changes then take immediate effect. The new baud rate comes into effect approx. 10 ms following acknowledgement. The master computer must observe this waiting time before communications can be re-established operating with the newly set baud rate.
- New settings for the baud rate and address are not automatically stored in the EEPROM. To store the changes permanently, the master computer must re-establish communications using the altered interface parameters and invoke the store function (Code 019). Before the store function is invoked, it is of course possible for all other inverter parameters to be configured accordingly.
- Do **NOT** set baud rate to 38400! As standard interfaces (for example, PLC) cannot transmit with this baud rate, no further communication with the VARICON drive is possible once this value has been set. Remedy following inadvertent setting: interrupt the power supply for a short time. As the value was not stored, the original baud rate will remain valid following the short interruption to the power supply.

11.5 Communication protocol

The communication protocol corresponds to a large extent with the data protocol for standard code-based data communication in accordance with ISO 1745 (*fast select*) (DIN 66019). Only text character strings without headers are used. Error monitoring is carried out by means of parity protected transmissions of the individual 7-bit characters in accordance with DIN 66003. Parity monitoring is carried out in accordance with DIN 66219 (even parity).

11.5.1 Control characters used in accordance with DIN 66003:

The control characters used in accordance with DIN 66003 are supplemented with even parity (bit 8) in accordance with DIN 66022 Part 1. Their meaning in the communication protocol is as follows:

ENQ (05H): *Enquiry*

EOT (04H): End of transmission. This control character ends the transmission. The station receiving the communication enters the wait mode.

ACK (06H): Acknowledge If the transmitted data has been received and identified as valid as well as free of errors, the VARICON drive transmits an acknowledge signal, **ACK**, to the master computer.

NAK (15H): Negative acknowledge. If the transmitted data has been received with errors or identified as invalid the VARICON drive transmits a negative acknowledge signal, **ACK**, to the master computer.

STX (02H): Start of text. The character **STX** appears at the head of the transmitted text.

ETX (03H): End of text. **ETX** marks the end of the text.

Sequence of communication

The VARICON drive is controlled by means of two types of telegrams:

- The request-to-send (*enquiry*) telegram
- The *select* telegram

11.5.2 The request-to-send (*enquiry*) telegram)

With the 'request-to-send', the master computer requests the VARICON drive to transmit data in accordance with ISO 1745. The VARICON drive transmits the requested data to the master computer in the response telegram.

The 'request-to-send' essentially contains the device address, the code number of the data to be transmitted and the enquiry control character.

Enquiry telegram:

1 byte | 1 byte | 3 bytes | 1 byte

EOT (04H): *End of transmission* means that the next bytes belong to a different telegram.

ADR: 1-byte address (an ASCII character) of the VARICON-drive.

Range: 32 to 63 dec. (20H to 3FH). The data that follows will only be accepted by the VARICON drive if the address corresponds to the one set in the VARICON drive.

CODE: Code number of a VARICON control parameter.

Range: 000 to 099 (three-digit decimal number, ASCII code). The most significant digit is transmitted first. The meaning of the individual code numbers are detailed in Part J (Control Codes).

ENQ (05H): *Enquiry* requests the VARICON drive to transmit the data denoted with CODE.

Response telegram of the VARICON drive

Once the VARICON drive has received a valid code number, it transmits the following response telegram:

STX: Start of text

TEXT: Message content

ETX: End of text

BCC: *Block Check Character* for data integrity

The requested data is contained in the text. The text has the following structure:

CODE: Code number of a VARICON control parameter.

=: Equals sign (3DH).

VAL: Value of the corresponding VARICON parameter.

VAL must fulfill the following conditions:

- ASCII characters used:
  - minus sign - (2DH)
  - the digits 0 to 9 (30H .. 39H)
- Length: max. five characters; six characters for negative values.
- The minus sign must immediately follow the equals sign, and is permitted to be used only once in VAL.
- The values must be transmitted **left-justified**. This means that the most significant position follows the equals or minus sign.
- Leading zeros can be left out (exception: 0 as value).

If a code number is invalid, the VARICON drive responds with the control character **NAK**. The VARICON drive transmits no response to other serious errors (for example, wrong address, parity errors).

BCC data integrity

In addition to the parity bit, data integrity is ensured by the *Block Check Character* (BCC).

- *To allow the VARICON drive to respond, ensure that the master computer releases the transmission line immediately following completion of 'request-to-send' (more precisely: upon completion of the **ENQ** control character belonging to the stop bit). The delay time until the beginning of the return transmission with **STX** or **NAK** is approx. 2 to 10 ms.*
- *The VARICON drive occupies the transmission line for a further 5 ms (max.) following completion of the **BCC**.*

11.5.3 Select telegram

With *select*, the master computer requests a slave station to receive data in accordance with ISO 1745. For the VARICON drive that means a new setpoint value (nom-valu) or a control command is about to be transmitted.

Following successful transmission of the select telegram, meaning, following acceptance of the new setpoint value or having carried out the action requested by the control command, the VARICON drive responds with **ACK**.

Fast selection is used for the actuating request; that means that the message content (text) immediately follows the selected address. Selection is the prerogative of the master computer.

The actuating request essentially contains the device address and the message content.

Select telegram:

EOT (04H): *End of transmission* means that the next bytes belong to a different telegram.

ADR: 1-byte address (an ASCII characters) of the VARICON-drive

range: 32 to 63 dec. (20H to 3FH).
The data that follows will only be accepted by the VARICON drive if the address corresponds to the one set in the VARICON drive.

STX (02H): *Start of text*

TEXT: Message content with the new setpoint value or control command.

ETX (03H): *End of text*

BCC: *Block Check Character* for data integrity purposes

The requested data is contained in the text. The text has the following structure:

TEXT	=	CODE	=	VAL

CODE: Code number of a VARICON control parameter.
Range: 000 to 099 (three-character decimal number, ASCII coded).
The most-significant digit is transmitted first.

=: Equals sign (3DH).

VAL: Value of the corresponding VARICON parameter.

VAL must fulfill the following conditions:

- Used ASCII character:
  - minus sign - (2DH)
  - the digits 0 to 9 (30H .. 39H)
- Length: max. five characters; six characters for negative values.
- The minus sign must immediately follow the equals sign, and is permitted to be used only once in VAL.
- The values must be transmitted left-justified. This means that the most significant position follows the equals or minus sign.
- Leading zeros can be left out (exception: 0 as value).

Response telegram of the VARICON drive

The VARICON drive responds to the actuating request with the control character **ACK** or **NAK**.

ACK (06H): Control command or alteration to setpoint carried out.

NAK (15H): Disrupted communication. No control command or alteration to the setpoint has been carried out.

Possible causes:

- Invalid code number
- False value range
- Illegal actuating request
- False Block Check Character
- The VARICON drive transmits no response to other serious errors (for example, wrong address, parity errors).

BCC data integrity

In addition to the parity bit, data integrity is secured by the *Block Check Character* (BCC).

BCC — All characters between **STX** (exclusive) and **ETX** (inclusive) are combined byte-for-byte by means of XOR, and are issued as one byte.

- *Ensure that the master computer does not interpret the BCC as a control character.*
- *The parity bit and the Block Check Character (BCC) are used to check the vertical parity as well as the longitudinal parity. Thus, up to three bit-errors can be clearly identified in a single byte.*
- *To allow the VARICON drive to respond, you must ensure that the master computer releases the transmission line immediately following completion of 'request-to-send' (more precisely: upon completion of the BCC belonging to the stop bit). The delay time until the beginning of the return transmission with **ACK** or **NAK** is approx. 2 to 10 ms. This is approx. 1 second for a store command (code 019).*
- *The VARICON drive occupies the transmission line for a further 5 ms (max.) following completion of the response.*

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HANNING

moving ideas

Part J

Control Codes

Table of contents

12 Control codes tables

12.1 General

All settings on the VARICON that can be made using the operating keys can also be made via the serial interface. All information provided in the display can also be called up via the serial interface.

Any address in the 32 to 63 range can be selected; however, each address must be assigned only once on a transmission line.

Please observe:

Whereas VARICON always responds to a request-to-send, the following conditions must be fulfilled for actuating requests to be accepted.

1. They must not contain errors, meaning, the error code must be 0. Otherwise, the only actuating request that will be accepted is the error-code reset.
2. For reasons of safety, some parameters dictate that the VARICON must be in the **Stop** mode. The parameters concerned are contained in the respective descriptions.
3. The parameters **Start/Stop** (Code 000) and **direction of rotation** (Code 001) can only be set within the parameter **setspeed value selection** = keyboard = 0 (Code 022).
4. The value of the parameter **maximum frequency limit** (code 111) limits the parameter **maximum frequency** (code 012).
5. The value of the parameter **starting voltage limit** (code 113) limits the parameter **starting voltage** (code 007).
6. Possible transmission values are 1200, 2400, 4800, 9600 and 19200 (baud rates).

Control commands based on undocumented code numbers are not permitted; these codes are reserved for manufacturer tests.

Individual parameters are selected via code numbers. There follows an overview in table format, which contains the parameters based on the sequence of the code-numbers. The overview also contains the device version numbers for which the displayed parameters are valid. The page reference helps to find the parameter descriptions quickly.

The parameter descriptions contain, for example, information if actuating requests and requests-to-send (query) are valid. Further minimum and maximum values are provided that the individual parameters can accept. VARICON ignores actuating requests with values exceeding the given limit values (check-back signal NAK). Parameters with numeral values are transmitted in plain text; logical parameters (for example, yes/no, on/off) are represented by the values 0 and 1.

Special software versions!

User-specific VARICON drives have an article number, and are usually equipped with special software versions. Certain command code parameters are exclusively available in the special software. Control code parameters for the special software versions are separately marked in the overview. Information pertaining to which codes are valid for which user-specific drive in the special software versions is contained in Chapter 12.2.

12.2 VARICON control codes

12.2.1 Overview

Code	Parameter designation	Explanation	Displayed on operating unit	V.	Page
000	Mode	Start/Stop	Mode	X	12-8
001	Direction	Direction of rotation	Direction	X	12-8
002	Speed 0	Speed 0	Speed -0	X	12-8
003	Speed	Speed - actual value	Speed	X	12-8
004	Accel	Acceleration ramp	Accel	X	12-9
005	Decel	Brake ramp	Decel	X	12-9
006	f-min	Minimum frequency	f-min	X	12-9
007	v-boost	Starting voltage	v-boost	X	12-9
008	v-extra	Voltage in extra point of characteristic curve	v-extra	X	12-9
009	v-nom	Rated voltage	v-nom	X	12-10
010	f-extra	Frequency in extra point of characteristic curve	f-extra	X	12-10
011	f-nom	Nominal frequency	f-nom	X	12-10
012	f-max	Maximum frequency	f-max	X	12-10
013	n-nom	Rated speed	n-nom	X	12-10
014	I-gain	Control integral gain	I-gain	X	12-10
015	Version	Software version	Version	X	12-11
016	Control	Control On/Off	Control	X	12-11
017	PreComp	System pre-compensation Yes/No	PreComp	X	12-11
018	MemRead	Read all parameters	MemRead	X	12-11
019	MemWrite	Write all parameters	Save	X	12-11
020	Pole pairs	Motor pole-pair number	Pole pairs	X	12-12
021	AutoStart	Autostart On/Off	AutStart	X	12-12

Code	Parameter designation	Explanation	Displayed on operating unit	V.	Page
022	SetSpeed	Selection of source of setspeed value	SetSpeed	X	12-12
023	Error code	Error code	ErrorCod	X	12-13
024	Speed 1	Speed 1	Speed -1	X	12-13
025	Speed 2	Speed 2	Speed -2	X	12-14
026	Speed 3	Speed 3	Speed -3	X	12-14
030	UZW	DC link voltage	UZW	X	12-14
032	f-slip	Slip frequency	f-slip	X	12-14
034	P-gain	Control proportional gain	P-gain	X	12-14
035	ClockFq	Chopper frequency 8/16 kHz	ClockFq	X	12-15
036	Anl-Offs	Analogue offset On/Off	Anl-Offs	X	12-15
037	SetMains	Nominal mains voltage	SetMains	X	12-15
039	f-out	Control frequency	f-out	X	12-15
041	Out-1	Configuration output 1	Out-1	X	12-15
042	Out-2	Configuration output 2	Out-2	O	12-15
043	Time Out	Time Out	Time Out	X	12-16
044	Out-1 remote	Remote control output 1	----	X	12-17
045	Out-2 remote	Remote control output 2	----	O	12-17
046	MotorPTC	Activate motor PTC	MotorPTC	X	12-17
047	n-0V	Setpoint value at analogue 0V	n-0V	X	12-17
048	n-10V	Setpoint value at analogue 10V	n-10V	X	12-18
049	4-20 Conf	4-20 mA configuration	4-20 Conf	O	12-18
050	MemReset	MemReset	MemReset	X	12-18
051	Status word	Operating status	Status-W	X	12-19
055	Starting voltage increase	Load dependent increase of the starting voltage for the characteristic curve	U0-Enhan		12-20
058	4–20 Scal	Scaling of the 4-20 mA configuration	4–20 Scal	O	12-20

Code	Parameter designation	Explanation	Displayed on operating unit	V.	Page
060	Fan control	Fan On/Off	FanCtl	X	12-21
061	Fan-PTC	Activate fan-PTC	Fan-PTC	X	12-21
100	Baud rate	Baud rate	Baud rate	X	12-22
101	Address	Device address	Address	X	12-22
102	Display language	Display language selection	Display	X	12-22
103	Access level	Access level	Access	X	12-22
104	Power section ident. no.	Power section identification.	Vari-LT	X	12-22
111	f-Max Limit	Maximum frequency limit	f-Limit	X	12-23
113	v-BstMax	Starting voltage limit	v-BstMax	X	12-23
117-124	Model code	Model code in 8 ASCII characters	Varicon	X	12-23
139	Motor temperature	Displays motor temperature	Mot-Temp	X	12-23
140	Temperature of inverter power section	Displays the temperature of the power section of the inverter	Pwr.Temp	X	12-23
141	Temperature of inverter cpu	Displays the temperature of the inverter on the control section	CPU-Temp	X	12-23
156	I-motor	Effective motor current	I-motor	X	12-24
161	Nominal current of motor	Nominal motor current for I^2t	i-nom	X	12-24
418	Restore	Restore parameter from operating unit	Restore	X	12-24
419	Archive	Archive parameter in operating unit	Archive	X	12-24
901	Software item number	EPROM article number, last 3 digits	Eprom-No	X	12-24
903	Sub-version number	EPROM sub-version	Sub-Vers.	X	12-24

Table 12-1 Overview of control codes
V. = Version
X = all interface versions
O = for custom interface I only
--- = not displayed on operating unit.

12.2.2 Explanation of the parameters

Control commands based on undocumented code numbers are not permitted; these codes are reserved for manufacturer tests.

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
000	Start/Stop	0	1		Permis-sible	Permissi-ble	Standard

- 1 = Start
- When queried, the actual status is signaled. '0' is signaled only when the drive is at a standstill (speed = 0).
- Actuating request permissible only under 'setspeed value selection' = 0 = 'keyboard' (code 022= 0).

Displayed on operating unit `Modus`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
001	Direction of rotation	0	1	1/min	Permis-sible	Permissi-ble	Standard

- 1 = Right
- When queried, the required direction of rotation is signaled.
- Actuating request permissible only under 'setspeed value selection' = 0 = 'keyboard' (code 22= 0).

Displayed on operating unit `Direction`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
002	Speed 0	0	32767	1/min	Permis-sible	Permissi-ble	Standard

Displayed on operating unit `Speed -0`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
003	Speed - actual value	- 32767	32767	1/min	Permis-sible	Permissi-ble	Standard

- When in open loop operations ('Control' = '0'), the speed is signaled at the output of the ramp generator.

- When in closed loop control ('Control'= = '1'), the measured mechanical *speed of rotation is signaled.

Displayed on operating unit `Speed`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
004	Acceleration ramp	1	45871	(Rev/min)/s	Permissible	Permissible	Standard

Displayed on operating unit `Accel`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
005	Brake ramp	1	45871	(Rev/min)/s	Permissible	Permissible	Standard

Displayed on operating unit `Decel`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
006	Minimum frequency	0	32767	1/60 Hz	Permissible	Permissible	Standard

Displayed on operating unit `f-min`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
007	Starting voltage	0	*	Volt	Permissible	Permissible	Standard

Displayed on operating unit `v-boost`

- dependent on type

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
008	Voltage in extra point of characteristic curve	Value v-boost (code 007)	*	Volt	Permissible	Permissible	Standard

- The voltage in the extra point of the characteristic curve must not be lower than the starting voltage.

Displayed on operating unit `v-extra`

* dependent on type

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
009	Rated voltage	0	268/468	Volt	Permissible	Permissible	Standard

- In the 'Max' column, the first value applies to the 230-V inverter and the second to the 400-V inverter.

Displayed on operating unit `v-nom`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
010	Frequency in extra point of characteristic curve	0	32767	1/min	Permissible	Permissible	Standard

Displayed on operating unit `f-extra`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
011	Nominal frequency	0	32767	1/min	Permissible	Permissible	Standard

Displayed on operating unit `f-nom`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
012	Maximum frequency	0	32767	1/min	Permissible	Permissible	Standard

Displayed on operating unit `f-max`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
013	Rated speed	0	32767	1/min	Permissible	Permissible	Standard

- Actuating request permissible when in the 'Stop' mode only.

Displayed on operating unit `n-nom`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
014	Control integral gain	0	32767		Permissible	Permissible	Standard

- Integration time constant of the speed controller
  Ti = 327.68 s / I-gain.

Displayed on operating unit `I-gain`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
015	Version	1	999		Permis-sible	Not per-missible	Standard

- Software version

Displayed on operating unit `Version`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
016	Control On/Off	0	1		Permis-sible	Permissi-ble	Standard

- 1 = On

Displayed on operating unit `Control`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
017	System pre-compensation Yes/No	0	1		Permis-sible	Permissi-ble	Standard

- 0 = No

Displayed on operating unit `PreComp`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
018	MemRead	1	1		Not per-missible	Permis-sible	Standard

- Reads all parameters from the EEPROM.
- Actuating request permissible when in the '0' mode only.

Displayed on operating unit `MemRead`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
019	Write	1	1		Not per-missible	Permis-sible	Standard

- Saves all parameters to the EEPROM.
- The write operation takes approx. 1 second. Then the check-back signal (ACK) is issued.

Displayed on operating unit `Save`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
020	Pole pairs	1	255		Permissible	Not permissible	Standard

- Read only

`Pole pairs`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
021	Autostart On/Off	0	1		Permissible	Permissible	Standard

- 0 = Off

Displayed on operating unit `AutoStart`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
022	Setspeed value selection	0	135		Permissible	Permissible	Standard

Displayed on operating unit `SetSpeed`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
023	Error code	0	255		Permis-sible	Permissi-ble	Standard

When an error occurs, the VARICON shuts down the connected drive and issues a corresponding error code. This can be queried, and used to determine the cause of the error.

- The following error codes are possible

0	No ERROR
1	Undervoltage_ERROR
2	Overvoltage_ERROR
4	Inverter_overtemperature_ERROR
5	Motor_overtemperature_ERROR
6	Fan_overtemperature_ERROR
8	EEPROM_ERROR
9	Inverter_peak current_ERROR
10	Inverter_overcurrent_ERROR
11	Inverter_continuous_current_ERROR
12	Motor_overcurrent_ERROR
16	Enable_ERROR
64	Short-circuit_ERROR
128	Power_On_ERROR
250	Watch_Dog_ERROR
255	Timeout_ ERROR

Table 12-2 Parameter **Error Code**

An actuating request with the value 0 is used to acknowledge and reset the error code. Values other than 0 are not valid for this actuating request.

Displayed on operating unit `ErrorCod`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
024	Speed 1	0	32767	1/min	Permis-sible	Permissi-ble	Standard

Displayed on operating unit `Speed -1`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
025	Speed 2	0	32767	1/min	Permis-sible	Permissi-ble	Standard

Displayed on operating unit `Speed`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
026	Speed 3	0	32767	1/min	Permis-sible	Permissi-ble	Standard

Displayed on operating unit `Speed -3`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
030	DC link voltage	188	410/710	Volt	Permis-sible	Permissi-ble	Standard

- In the 'Max' column, the first value applies to the 230-V inverter and the second to the 400-V inverter.

Displayed on operating unit `UZW`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
032	Slip frequency	0	32767	1/60 Hz	Permis-sible	Permis-sible	Standard

- System deviation – deviation range

Displayed on operating unit `f-slip`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
034	Control propor-tional gain	0	32767		Permis-sible	Permis-sible	Standard

- P = P–gain / 256
- Integration time constant of the speed controller Ti = 327.68 s / I-gain.

Displayed on operating unit `P-gain`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
035	Chopper frequency 8/16 kHz	8000	16000		Permissible	Not permissible	Standard

- Factory set

Displayed on operating unit `ClockFq`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
036	Analogue offset On/Off	0	2		Permissible	Permissible	Standard

- 0 = 0 mA/0V, 2 = 4 mA/2V

Displayed on operating unit `Anl-Offs`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
037	Nominal mains voltage	0	480	Volt	Permissible	Not permissible	Standard

Displayed on operating unit `SetMains`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
039	Control frequency	- 32767	32767	1/60 Hz	Permissible	Not permissible	Standard

- Control frequency of the inverter.

Displayed on operating unit `f-out`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
041	Configuration output 1	0	13		Permissible	Permissible	Standard
042	Configuration output 2	0	13		Permissible	Permissible	Special

Configuration relay output 1 + 2:

- Configuration switching output 1 + 2:

No.	Function
0	Output off
1	Output on
2	Remote control via serial interface
3	Inverter ready for operation
4	Inverter in operation
5	Motor standstill
6	Clockwise direction
7	Setspeed attained
8	Chopper active
9	Temperature warning
10	Temperature rise inverter
11	Operating at load limit
12	Motor over-heating
13	Motor turning

Table 12-3 Functions of outputs 1 + 2

- The factory setting is 3.

Displayed on operating unit

`Out-1` (as configured)

`Out-2` (as configured)

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
043	Time Out	0	255		Permissi-ble	Permis-sible	Standard

- 0 = Off

Displayed on operating unit `Time Out`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
044	Remote control output 1:	0	1		Permis-sible	Permissible	Standard

Remote control output 1:

- The control command is effective only if the output has been configured to ‘remote control’, during query procedures, the actual switching status of the output is signaled (output can be configured as necessary).

Not displayed on operating unit

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
045	Remote control output 2	0	1		Permis-sible	Permis-sible	Special

- 1 = On
- The control command is effective only if the output has been configured to ‘remote control’, during query procedures, the actual switching status of the output is signaled (output can be configured as necessary).

Not displayed on operating unit

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
046	Activate motor PTC	0	1		Permissi-ble	Permissi-ble	Standard

- 1 = active

Displayed on operating unit `MotorPTC`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
047	Setpoint value at analogue 0V	-32700	32700	1/min	Permissi-ble	Permissi-ble	Standard

- Required speeds

Displayed on operating unit `n-0V`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
048	Setpoint value at analogue 10 V	-32700	32700	1/min	Permissible	Permissible	Standard

- Required speeds

Displayed on operating unit `n-10V`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
049	4-20 mA configuration	0	8		Permissible	Permissible	Special

Displayed on operating unit `4-20 Conf`

Function	
0	Output permanently off
1	Output permanently on
2	Output scaled to speed control output (actual slip value)
3	Output scaled to actual speed
4	Output scaled to required speed (according to ramp generator)
5	Output scaled to required speed (before ramp generator)
6	Output scaled to the internal controlled speed
7	Output remote-controlled via serial interface
8	Output signals inverter is ready

Table 12-4 Functions for the parameter **4-20 Conf**

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
050	MemReset	815	815		Not permissible	Permissible	Standard

- Actuating request permissible when in the 0 = ‘Stop’ mode only.
- Control command with transmission value 815 reinstates the factory setting.

Displayed on operating unit `MemReset`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
051	Status word	0	65535		Permissi-ble	Not per-missible	Standard

- The status word contains 16 internal, coded control bits. The bits are set by activating the respective function (1).

Bit	'1' if
0	always 0
1	Temperature warning 10 °C or less below shutdown temperature
2	Temperature rise inverter
3	Brake ramp stopped (voltage too high)
4	Chopper active
5	Enable issued
6	Clock pulse turned on
7	General error
8	Frequency 0 / standstill
9	Setspeed attained
10	Direction of rotation counter-clockwise (negative)
11	Device for 115 V mains voltage
12	Device for 400 V mains voltage

Table 12-5 Bit assignment for the parameter **status word**

Not displayed on operating unit

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
055	Starting voltage increase	0	65535		Permissible	Permissible	Standard

v-boost enhanced =

v-boost + ((v-nom* U0-Enhan)/65535) *f-slip-required/ f-slip

Below an explanation of the parameters:

f-slip-required	The required slip set by the controller
f-slip	The parameter determining the maximum slip
v-nom	The parameter determining the nominal voltage of the motor
U0-Enhan	the parameter that determines the proportion of v-nom (in 1/65535), by which the starting voltage is to be maximally increased.

Displayed on operating unit `U0-Enhan`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
058	Scaling of the 4-20 mA configuration	0	32700		Permissible	Permissible	Special

Displayed on operating unit `4–20 Scal`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
060	Fan control On/Off	0	4		Permissi-ble	Permis-sible	Standard

- The following operating modes are possible

Value	Displayed on operating unit	Fan function
0	Off	Permanently turned off
1	On	Permanently turned on
2	Ready	Turned on when available
3	Running	Turned on when clock pulse on
4	Auto	Temperature controlled On when > 45 °C Off when < 42 °C

Table 12-6 Bit assignment for the parameter **Fan On/Off**

- The factory setting is 3.
- The actual status of the fan can be queried via the parameter **status word** (see bit 14, code 051, Page 12-19).

Displayed on operating unit `FanCtl`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
061	Fan-PTC	0	1		Permissi-ble	Permissi-ble	Standard

Displayed on operating unit `Fan-PTC`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
100	Baud rate	1200	19200	Bit/s	Permissi-ble	Permissi-ble	Standard

- Actuating request permissible when in the mode = '0' only.
- Possible transmission values are 1200, 2400, 4800, 9600 and 19200 (baud rates).
- You must observe the notes contained in Part I, Digital interface, Chapter 11.4 Transmission speed and device address.

Displayed on operating unit `Baud rate`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
101	Device address	32	63		Permissi-ble	Permissi-ble	Standard

- Actuating request permissible when in the mode = '0' only.
- You must observe the notes contained in Part I, Digital interface, Chapter 11.4 Transmission speed and device address.

Displayed on operating unit `Address`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
102	Display language	0	5		Permissi-ble	Permissi-ble	Standard

- 0 = German; 1 = English; 2 = French; 3 = Spanish; 4 = numerical; 5 = Russian

Displayed on operating unit `Display`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
103	Access level	0	5		Permissi-ble	Permissi-ble	Standard

Displayed on operating unit `Access`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
104	Power section ident. no.	0	65535		Permis-sible	Not permis-sible	Standard

Displayed on operating unit `Vari-LT`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
111	Maximum frequency limit	0	32767	1/min	Permissible	Not permissible	Standard

Displayed on operating unit `f-Limit`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
113	Starting voltage limit	0	*	Volt	Permissible	Not permissible	Standard

Displayed on operating unit `v-BstMax`

* dependent on type

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
117-124	Model code	0	65535		Permissible	Not permissible	Standard

- Device type identification

VARICON plain text display in 8 ASCII characters

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
139	Motor temperature	-55	175	°C	Permissible	Not permissible	Standard

Displayed on operating unit `Mot-Temp`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
140	Temperature of inverter power section	-61	127	°C	Permissible	Not permissible	Standard

Displayed on operating unit `Pwr.Temp`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
141	Temperature of inverter cpu	-61	127	°C	Permissible	Not permissible	Standard

Displayed on operating unit `CPU-Temp`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.

156	Effective motor current	1/10 A	Permis-sible	Not permis-sible	Standard

Displayed on operating unit `I-motor`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
161	Nominal current of motor	5	150	1/10 A	Permis-sible	Not permis-sible	Standard

Displayed on operating unit `i-nom`

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
418	Restore				*	Permissible*	Standard

Displayed on operating unit `Restore`

- only together with operating unit

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
419	Archive				*	permissible*	Standard

Displayed on operating unit `Archive`

* only together with operating unit

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
901	EPROM articel number	0	999		Permissi-ble	Not permissi-ble	Standard

Last 3 digits of the article number

Code	Explanation	Min.	Max.	Unit	Query	During set	Article No.
903	EPROM sub-version	65	90		Permissi-ble	Not permis-sible	Standard

Displayed on operating unit `Sub-Vers.`

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Part K

Technical Data and Dimensions

Version 1.2 ■ Status: 09/2007 ■ Standard

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13 Technical data

13.1 Standard drives

VARICON		0.18 / 0.25 / 0.37 / 0.55 kW	0.75 / 1.1 / 1.5 kW
Mains input	Voltage Frequency RFI filter acc. to EN 61800-3 External fusing	1~ AC 230 V ±10% (3 ~ AC 400 V ±10%) 47-63 Hz Integrated limit value characteristic 'B' 5 AT / 8 AT (5AT)	16 AT (8AT)
Output	Switching frequency	16 kHz	
Environment	Temperature Cooling Site altitude	0-40 °C Fan cooled Up to 1000 m above MSL	
Protective functions	Overload Over-heating Voltage monitoring Voltage fluctuation compensation Stall protection (internal speed control)	with current limit Temperature sensor in motor and frequency inverter Shutdown at over- or undervoltage Frequency boost in event of overvoltage Voltage pre-control by slip monitoring	
Brake chopper	Transistor and measuring circuit external resistor	Integrated, I_{max} = 2 A for 10 s (all 60 sec.) I_{max} = 0.5 A in continuous operation > 150 Ω	
Mechanical construction	Type of protection	IP54 / optional IP55	
Standards		DIN EN 60034; DIN EN 50178; DIN EN 61800-3 IEC 60072/DIN 42948	

Table 13-1 Technical data for VARICON 0.18 kW to 1.1 kW

You must observe the following notice!

No condensation permitted!
Please contact the manufacturer when operating under harsh environmental conditions.

VARICON		1.5 kW / 2.2 kW	3.0 kW
Mains input	Voltage Frequency RFI filter acc. to EN 61800-3 External fusing	3~ AC 400 V ±10% 47-63 Hz Integrated limit value characteristic 'B' 8 AT	12.5 AT
Output	Switching frequency	16 kHz	
Environment	Temperature Cooling Site altitude	0-40 °C Fan cooled Up to 1000 m above MSL	
Protective functions	Overload Over-heating Voltage monitoring Voltage fluctuation compensation Stall protection (internal speed control)	By current limitation Temperature sensor in motor and frequency inverter Disconnection in event of overvoltage or undervoltage Frequency boost in event of overvoltage Voltage pre-control by slip monitoring	
Brake chopper	Transistor and measuring circuit external resistor	Integrated > 330 Ω	
Mechanical construction	Type of protection	IP54 / optional IP55	
Standards		DIN EN 60034; DIN EN 50178; DIN EN 61800-3 IEC 60072/DIN 42948	

Table 13-2 Technical data for VARICON 1.5 kW to 3.0 kW

You must observe the following notice!

No condensation permitted!
Please contact the manufacturer when operating under harsh environmental conditions.

13.2 Motor data

Rated data [KW]	Type	Rated torque [Nm]	Rated speed [1/min]	Rated speed range [1/min]	Moment of inertia [kgm²]	System efficiency [%]	Mains input rated current [A]	Weight [kg]
0.18 at 1~ AC 230 V ±10% (400 V ± 10%)	CCD-8A2-2	0.3	5800	0-9000	0.00029	60	2.0 (1.0)	8.4
	CCD-8A4-2	0.6	2900	0-4500	0.00055	61	2.0 (1.0)	8.4
	CCD-8A4-1	1.2	1400	0-2250	0.00092	60	1.9 (1.0)	8.5
	CCD-8A6-1	1.9	900	0-1500	0.00092	60	2.2 (1.1)	8.5
0.37 at 1~ AC 230 V ± 10% (400 V ± 10%)	CCD-8A2-2	0.6	5800	0-9000	0.00029	64	3.8 (1.7)	9.5
	CCD-8A4-2	1.2	2900	0-4500	0.00055	64	3.6 (1.6)	10.0
	CCD-8A4-1	2.5	1400	0-2250	0.00092	62	4.5 (2.0)	11.5
	CCD-8A6-1	3.8	910	0-1500	0.00092	62	5.0 (2.3)	12.0
0.55 at 1~ AC 230 V ± 10% (400 V ± 10%)	CCD-8D2-2	0.9	5770	0-9000	0.00037	66	5.6 (2.4)	10.4
	CCD-8D4-2	1.8	2900	0-4500	0.00089	68	5.4 (2.3)	11.2
	CCD-8D4-1	3.7	1400	0-2250	0.00116	69	5.3 (2.3)	11.9
	CCD-8D6-1	5.8	900	0-1500	0.00152	63	5.9 (2.6)	12.8
0.75 at 1~ AC 230 V ± 10% (400 V ± 10%)	CCD-8F2-2	1.2	5800	0-9000	0.00047	68	7.4 (3.8)	10.7
	CCD-8F4-2	2.5	2890	0-4500	0.00116	68	7.4 (3.8)	11.9
	CCD-8F4-1	5.2	1380	0-2250	0.00157	72	7.6 (4.0)	13.4
1.1 at 1~ AC 230 V ± 10% (400 V ± 10%)	CCD-8G2-2	1.8	5800	0-9000	0.00064	70	10.6 (6.1)	12.2
	CCD-8G4-2	3.6	2910	0-4500	0.00188	68	10.9 (6.3)	14.4
	CCD-8G4-1	7.6	1380	0-2250	0.00225	69	10.9 (6.3)	18.0
0.75 at 3~ AC 400 V ± 10%	CCD-8F6-1	8.7	900	0-1500	0.00188	72	4.8	15.2
1.1 at 3~ AC 400 V ± 10%	CCD-9G6-1	11.5	910	0-1500	0.00623	71	7.2	22.1
1.5 at 3~ AC 400 V ± 10%	CCD-8H2-2	2.6	5820	0-9000	0.00083	71	7.3	14.2
	CCD-8H4-2	4.9	2900	0-4500	0.00230	70	7.3	17.0
	CCD-9H4-1	10.4	1370	0-2250	0.00479	71	5.8	20.8
	CCD-10H6-1	16.0	900	0-1500	0.00810	74	9,1	25.2
2.2 at 3~ AC 400 V ± 10%	CCD-9I4-2	7.3	2890	0-4500	0.00220	72	8.4	24.2
	CCD-10I4-1	15.0	1400	0-2250	0.00479	81	8.5	26.1
3.0 at 3~ AC 400 V ± 10%	CCD-10K4-2	10.0	2860	0-4500	0.00291	83	8.9	26.5

Table 13-3 Motor data

13.2.1 Shaft end dimensions

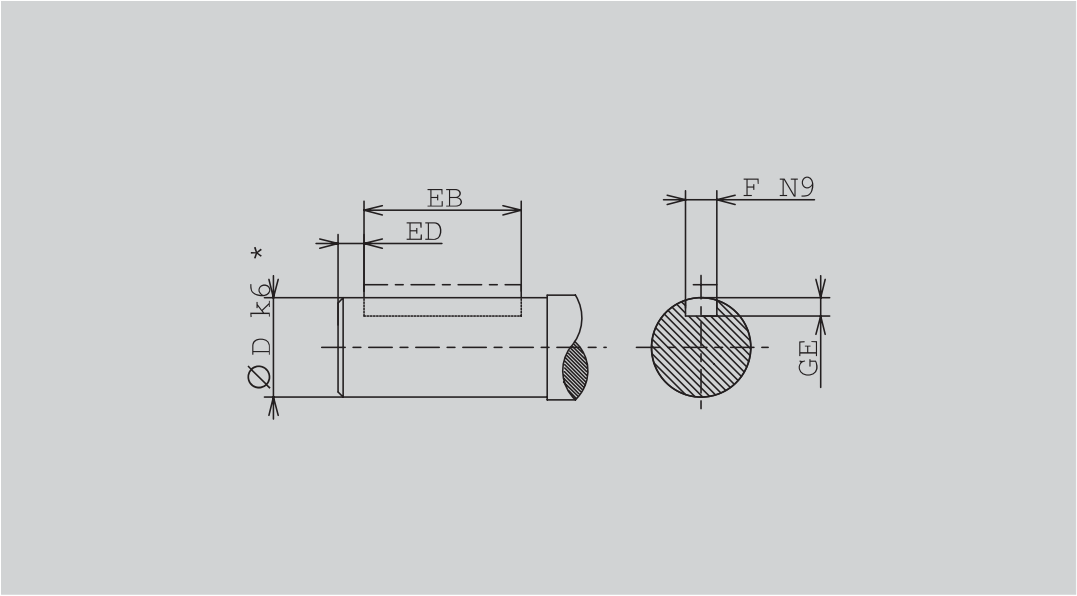

Figure 13-1 Shaft end dimensions

Size	Shaft end	ED	EB	F N9	GE +0.2	Centre hole □DIN 332	Parallel key cross-section
CCD8	∅ 19 x 40	5	30	6	3.5	DM6	6 x 6
CCD8	∅ 24 x 50	5	40	8	4.1	DM8	8 x 7
CCD9	∅ 24 x 50	5	40	8	4.1	M8	8 x 7
CCD10	∅ 28 x 60	5	45	8	4.1	M10	8 x 7

Table 13-4 Shaft end dimensions

13.3 Dimensions for foot and flange versions

13.3.1 Flange version FF

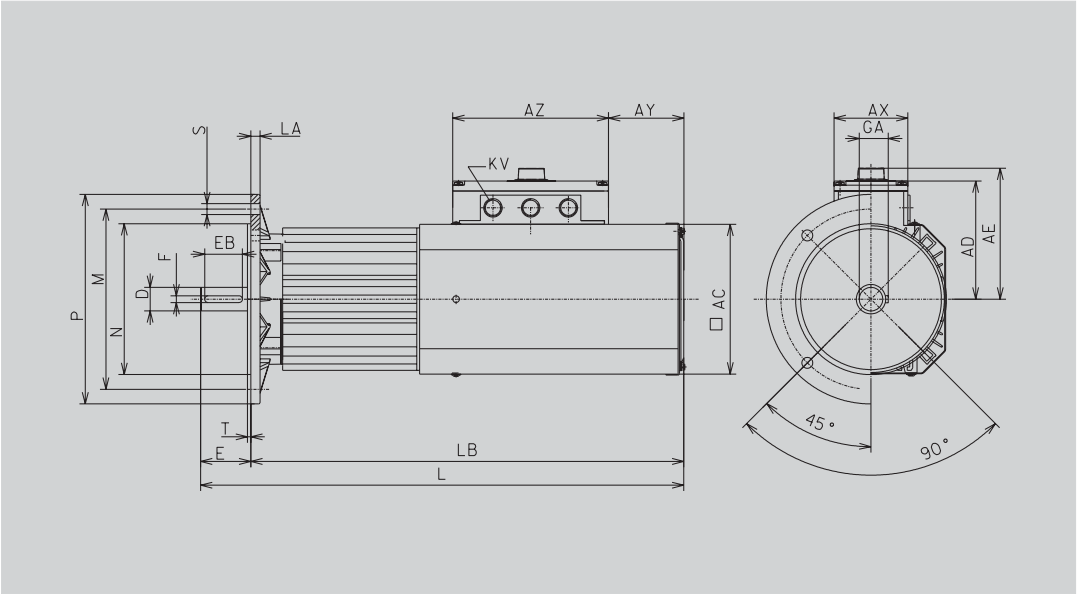

Figure 13-2 Flange version FF

Dimension	Flange	M	N	P	T	S	LA*	L*	LB	AC	AE	AX	AY*	AZ	AD*	D	E	EB	GA	F	KV
CCD-8A... CCD-8C... CCD-8D2-2 CCD-8D4-2 CCD-8F2-2	FF130 FF165	130 165	110 130	160 200	3.5 3.5	9 11	9 10	435.5 424.5	395.5 384.5	141 141	164 164	106 106	55 55	167 167	144 144	19 19	40 40	30 30	21.5 21.5	6 6	3x M20
CCD-8D4-1 CCD-8D6-1 CCD-8F4-2 CCD-8F4-1 CCD-8G2-2 CCD-8H2-2	FF130 FF165	130 165	110 130	160 200	3.5 3.5	9 11	9 10	465.5 454.5	425.5 414.5	141 141	164 164	106 106	55 55	167 167	144 144	19 19	40 40	30 30	21.5 21.5	6 6	
CCD-8F6-1 CCD-8G4-2 CCD-8G4-1 CCD-8H4-2	FF130 FF165	130 165	110 130	160 200	3.5 3.5	9 11	9 10	505.5 494.5	465.5 454.5	141 141	164 164	106 106	55 55	167 167	144 144	19 19	40 40	30 30	21.5 21.5	6 6	
CCD-9G6-1 CCD-9H4-1 CCD-9I4-2	FF165	165	130	200	3.5	11	10	595	545	181	174	112	94	167	154	24	50	40	26.9	8	
CCD-10H6-1 CCD-10I4-1 CCD-10K4-2	FF215	215	180	250	4.0	13	11	605	545	181	174	112	94	167	154	28	60	45	30.9	8	

* With IP55 versions, the fan hood is 45 mm longer

13.3.2 Flange version FT

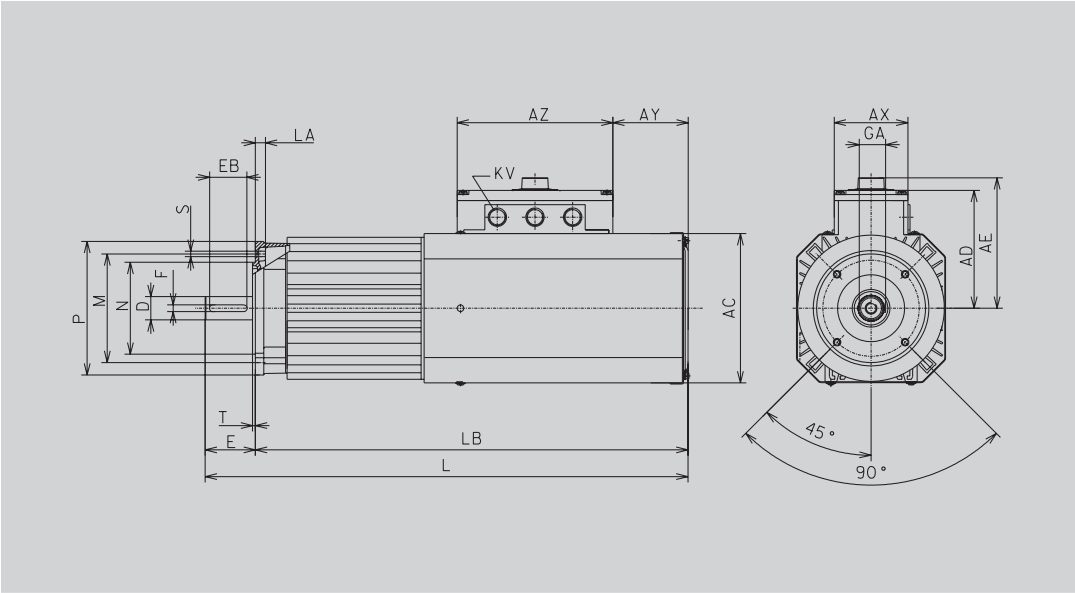

Figure 13-3 Flange version FT

Dimension	Flange	M	N	P	T	S	LA	L	LB	AC	AE	AX	AY	AZ	AD	D	E	EB	GA	F	KV
CCD-8A... CCD-8C... CCD-8D2-2 CCD-8D4-2 CCD-8F2-2	FT85 FT100 FT115 FT130	85 100 115 130	70 80 95 110	105 120 140 160	2.5 3.0 3.0 3.5	M6 M6 M8 M8	11 11 11 14	424.5 424.5 424.5 424.5	384.5 384.5 384.5 384.5	141 141 141 141	164 164 164 164	106 106 106 106	55 55 55 55	167 167 167 167	144 144 144 144	19 19 19 19	40 40 40 40	30 30 30 30	21.5 21.5 21.5 21.5	6 6 6 6	3x M20
CCD-8D4-1 CCD-8D6-1 CCD-8F4-2 CCD-8F4-1 CCD-8G2-2 CCD-8H2-2	FT85 FT100 FT115 FT130	85 100 115 130	70 80 95 110	105 120 140 160	2.5 3.0 3.0 3.5	M6 M6 M8 M8	11 11 11 14	454.5 454.5 454.5 454.5	414.5 414.5 414.5 414.5	141 141 141 141	164 164 164 164	106 106 106 106	55 55 55 55	167 167 167 167	144 144 144 144	19 19 19 19	40 40 40 40	30 30 30 30	21.5 21.5 21.5 21.5	6 6 6 6	
CCD-8F6-1 CCD-8G4-2 CCD-8G4-1 CCD-8H4-2	FT85 FT100 FT115 FT130	85 100 115 130	70 80 95 110	105 120 140 160	2.5 3.0 3.0 3.5	M6 M6 M8 M8	11 11 11 14	494.5 494.5 494.5 494.5	454.5 454.5 454.5 454.5	141 141 141 141	164 164 164 164	106 106 106 106	55 55 55 55	167 167 167 167	144 144 144 144	19 19 19 19	40 40 40 40	30 30 30 30	21.5 21.5 21.5 21.5	6 6 6 6	
CCD-9G6-1 CCD-9H4-1 CCD-9I4-2	FT85 FT100 FT115 FT130	85 100 115 130	70 80 95 110	105 120 140 160	2.5 3.0 3.0 3.5	M6 M6 M8 M8	11 16.5 16.5 16.5	582 582 582 582	532 532 532 532	180 180 180 180	174 174 174 174	112 112 112 112	92 92 92 92	167 167 167 167	154 154 154 154	24 24 24 24	50 50 50 50	40 40 40 40	26.9 26.9 26.9 26.9	8 8 8 8	
CCD-10H6-1 CCD-10I4-1 CCD-10K4-2	FT115 FT130	115 130	95 110	140 160	3.0 3.5	M8 M8	10 12	605 605	545 545	180 180	174 174	112 112	92 92	167 167	154 154	28 28	60 60	45 45	30.9 30.9	8 8	

13.3.3 Foot version

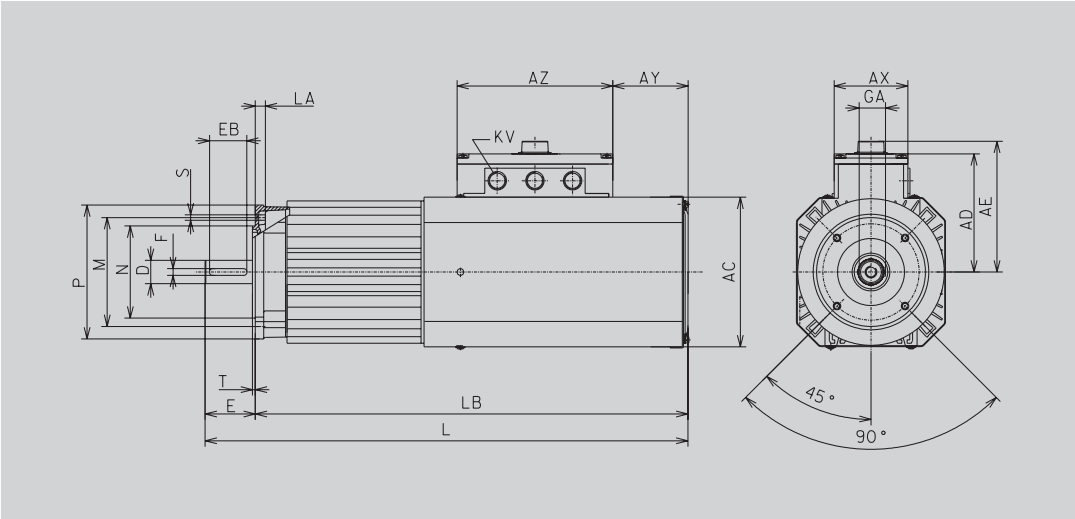

Figure 13-4 Foot version

Dimension	H	L	AE	AD	AC	A	B	C	K	S	AA	AB	HA	BB	D	E	EB	GA	F	AX	AY	AZ	KV
CCD-8A... CCD-8C... CCD-8D2-2 CCD-8D4-2 CCD-8F2-2	80	424.5	164	144	141	125	70	50	12	10	23	148	9	103	19	40	30	21.5	6	106	55	167	3x M20
CCD-8D4-1 CCD-8D6-1 CCD-8F4-2 CCD-8F4-1 CCD-8G2-2 CCD-8H2-2	80	454.5	164	144	141	125	100	50	12	10	23	148	9	133	19	40	30	21.5	6	106	55	167	
CCD-8F6-1 CCD-8G4-2 CCD-8G4-1 CCD-8H4-2	80	494.5	164	144	141	125	100	50	12	10	23	148	9	173	19	40	30	21.5	6	106	55	167	
CCD-9G6-1 CCD-9H4-1 CCD-9I4-2	90	548.5	174	154	180	140	125	56	12	10	24	164	10	172	24	50	40	26.9	8	112	92	167	
CCD-10H6-1 CCD-10I4-1 CCD-10K4-2	100	584	174	154	180	160	140	63	15	12	27	187	12	190	28	60	45	30.9	8	112	92	167	

13.3.4 Standards and regulations

IEC/CEI	EN/HD	DIN/VDE	Contents
IEC 60027-4	-	DIN 1304-7	Symbols used for electrical machines
IEC 60034-1	EN 60034-1	DIN EN 60034-1 / VDE 0530-1	Rotating electrical machines: - Rating and performance
IEC 60034-2	EN 60034-2	DIN EN 60034-2 / VDE 0530-2	- Methods for determining losses and efficiency of rotating electrical machinery
IEC 60034-5	EN 60034-5	DIN EN 60034-5 / VDE 0530-5	- Degrees of protection provided by the integral design of rotating electrical machines (IP code)
IEC 60034-6	EN 60034-6	DIN EN 60034-6 / VDE 0530-6	- Methods of cooling (IC code)
IEC 60034-7	EN 60034-7	DIN EN 60034-7 / VDE 0530-7	- Classification of types of construction, mounting arrangements and terminal box position (IM code)
IEC 60034-8	EN 60034-8	DIN EN 60034-8 / VDE 0530-8	- Terminal markings and direction of rotation
IEC 60034-9	EN 60034-9	DIN EN 60034-9 / VDE 0530-9	- Noise limits
IEC 60034-11	-	-	- Thermal protection
IEC 60034-12	EN 60034-12	DIN EN 60034-12 / VDE 0530-12	- Starting performance of three-phase cage induction motors, excluding pole-changing motors
IEC 60034-14	EN 60034-14	DIN EN 60034-14 / VDE 0530-14	- Mechanical vibrations of certain machines of shaft heights of 56 mm and higher
IEC 60038	HD 472 S1	DIN IEC 60038 / VDE 0175	IEC standard voltages
IEC 60072	EN 50347	DIN EN 50347	General purpose three-phase induction motors having standard dimensions and outputs; frame numbers 56 to 315 and flange numbers 65 to 740
IEC 60072	-	DIN EN 50347	Tolerances of shaft extension run-out and of mounting flanges for rotating electrical machinery
IEC 60085*	HD 566	DIN IEC 60085 / VDE 0301-1	Thermal evaluation and classification of electrical insulation
IEC 60445	EN 60445	DIN EN 60445 / VDE 0197	Identification of equipment terminals and of terminations of certain designated conductors
-	EN 55014-2	DIN EN 55014-2 / VDE 0875-14-2	Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 2: Interference immunity
-	EN 50178	DIN EN 50178 / VDE 0160	Electronic equipment for use in power installations
IEC 61800-3	EN 61800-3	DIN EN 61800-3 / VDE 0160-103	Adjustable speed electrical power drive systems – Part 3 EMC requirements and specific test methods

* IEC 15E / 205 / CD:2002

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16 Options

16.1 Options

The following list provides an overview of optional accessories.

Article	Article number	Remark
Operating unit	753900334	For setting and transmitting parameters, including extension cable
Brake resistor	754000100	Intrinsically safe
Interface adapter	753000060	RS 485 / RS 232
DRIVE PAR Software	761000060	For setting and transmitting parameters
Terminal box cover		Please refer to overview
CANopen Bus		On request

Table 16-1 Optional accessories

16.2 Terminal box cover and interface types (combinations)

The following terminal box covers are available:

Standard terminal box cover

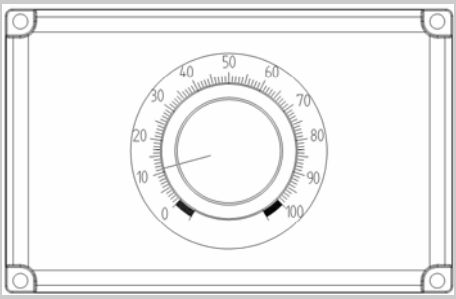
Standard interface, custom interface and Profibus DP

1 ~ 230 V power supply

3 ~ 400 V power supply

Article no.: 2515121 (black)

Standard terminal box cover with potentiometer

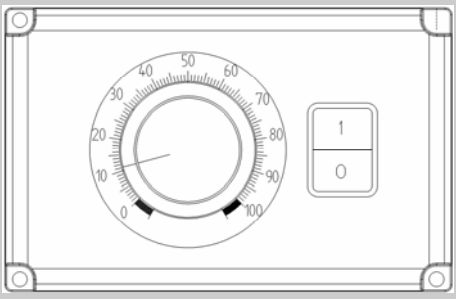


Standard interface and custom interface

3 ~ 400 V power supply

Article no.: 753000105 (blue), black on request

Standard terminal box cover with potentiometer and mains switch

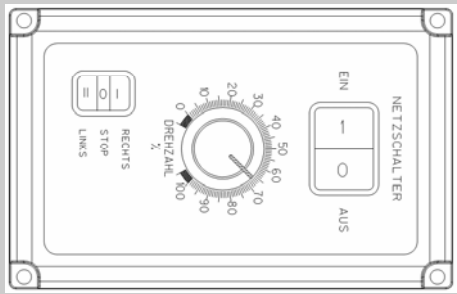


Standard interface and custom interface

1 ~ 230 V switchable power supply

Article no.: 753000510 (blue), 753000519 (black)

Standard terminal box cover with potentiometer, mains switch, right/stop/left switch

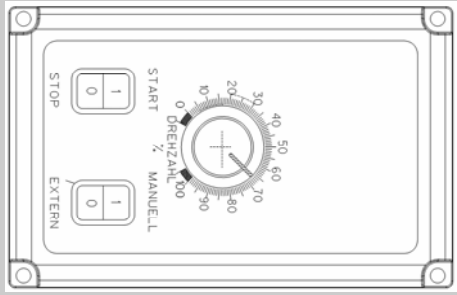


Standard interface and custom interface

1 ~ 230 V switchable power supply

Article no.: 753000511 (black)

Standard terminal box cover with potentiometer, start/stop switch, manual/external switch

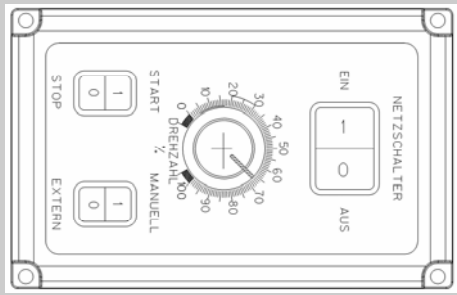


For custom interface I only

3 ~ 400 V power supply

Article no.: 753000512 (grounded)

Standard terminal box cover with potentiometer, start/stop switch, manual/external switch and mains switch



For custom interface I only

1 ~ 230 V power supply

Article no.: 753000517 (grounded)

17 Individual settings of the parameters

Type: VARICON CCD ..... Application: .....

Company: ..... Contact person: .....

..... Tel.: .....

	Parameter	Unit	Setting
Group A General Drive parameters	Display	-	
	Direction	-	
	Modus	-	
	Speed:	1/min / Hz	
	I-motor	A	
	ErrorCod	-	
	Speed -0	1/min / Hz	
	Speed -1	1/min / Hz	
	Speed -2	1/min/s / Hz/s	
	Speed -3	1/min/s / Hz/s	
	Accel	Rev/min/s	
	Decel	Rev/min/s	
Group B Configuration parameters	Access	-	
	Out-1	-	
	Out-2	-	
	4-20 Conf	-	
	4–20 Scal	-	
	Address	-	
	Baud rate	Bit/s	
	Time Out	-	
	AutStart	-	
	SetSpeed	-	
	Anl-Offs	-	
	n-0V	1/min	
	n-10V	1/min	

	Parameter	Unit	Setting
Group C Control parameters	Control	-	
	f-slip	Hz	
	I-gain	-	
	P–gain	-	
Group D Motor parameters	i-nom	A	
	v-nom	V	
	v-boost	V	
	f-nom	1/min / Hz	
	f-min	1/min / Hz	
	f-max	1/min / Hz	
	n-nom	1/min	
	PreComp	-	
	ClockFq	-	
	MotorPTC	-	
	Fan-PTC	-	
	FanCtl	-	
Group E Service parameters	Vari-LT	-	
	Varicon	CCD ...	
	Restore	-	
	Archive	-	
	MemRead	-	
	MemWrite		
	MemReset		
	UZW	V	
	SetMains	V	
	v-extra	V	
	f-extra	Hz	
	Eprom-No		
	Version		
	Sub_Vers		
	Status-W		
	Pole pairs		

	Parameter	Unit	Setting
	Mot-Temp		
	Pwr.Temp		
	CPU-Temp		
	U0-Enhan		
	v-BstMax		
	f-Limit		

Date: _____

18 Troubleshooting checklist

18.1 Description of error

Date: .....

Customer:

.....

Contact person: .....Tel.: .....

Drive data (motor rating plate)			
Type: VARICON CCD -.....			
Rated voltage:	 V	Rated current:	..... A
Output:	..... kW		
Rated speed:	..... 1/min.	Maximum speed:	..... 1/min.
Other details:			
.....			

Electronics data (rating plate electronics, near terminal box cover)					
Interface:	.....				
Type:	VARICON	 V	..... A	Art. No.:	753 74

18.1.1 Description of application:

.....

.....

.....

.....

18.1.2 Description of error:

.....

.....

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.....

18.2 Error diagnosis

Problem	Possible source of error
Mains connection	Check mains connection, mains fuse
Mains fuse trips	- Thermal over-current circuit breaker has not cooled down - After switching off, wait at least 60 sec. until restarting
Drive does not reach the set speed	- Acceleration ramp is set too steep - Mech. load to great - V / f characteristic curve is incorrectly set
Drive gets too hot	- V / f characteristic curve is incorrectly set - Output performance to great - Grate of separately driven fan is dirty - Separately driven fan is defective - Ambient temperature is too high

Table 18.1 Error check list

18.2.1 Check the earth connections and wire routing

		Yes	No
1	Is the incoming protective earth of the power supply cable connected directly to the interface PCB (PE terminal)? (Power supply cable fed through the right-hand PG13.5 cable gland)	(x)	
2	Was the correct cross-section for the protective earth conductor connections installed? (0.25 – 1.5 mm^2 for control inputs, 1.5 – 2.5mm^2 for mains and chopper connections)	(x)	
3	Is the protective earth of the PLC control inputs/outputs connected directly to the terminal A2? (Control cable fed through the left-hand PG9 (medium PG11) cable gland)	(x)	
4	Is the protective earth of the control cable SIO connected directly to the terminal A1? (Control cable fed through the middle PG11 (left-hand PG9) cable gland)	(x)	
5	Is the protective earth of the control cable of the analog input connected directly to terminal 15 or terminal 17? (Control cable fed through the middle PG11 (left-hand PG9) cable gland.)	(x)	
6	Have all of the connection cables inside the terminal box been routed in front of the terminals (with short connection lengths)?	(x)	
7	Have all earth and protective conductor connections been screwed tight?	(x)	
8	Is the external brake resistor (or chopper circuit) connected?	(x)	
9	Have all PG cable glands been tightened and is the strain relief of the connection cables guaranteed?	(x)	
10	Have all unneeded grommets been sealed with PG blind grommets?	(x)	

(x) = correct

Table 18-2 Cable routing checklist

18.2.2 Drive control checklist

		Yes	No
1	Are all analog setpoint values preset?		
2	Control via a serial interface RS 485?		
3	Were shielded cables used for the inputs and outputs of 1 and 2?	(x)	
4	Are the relay outputs wired?		
5	Are PLC inputs being used?		
6	Is the external zero potential (GND EXT) connected with the internal safety earth (GND INT) ?		
7	Is there an external 24-V power supply available?		
8	Is the internal +24V supply being used, for example, to enable (FREI)?		
9	Is the variable speed control being used (Control = On)?		
10	Is the operating unit connected?		
11	Is the zero potential of the external control voltage earthed?		

(x) = correct

Table 18-3 Drive control checklist

18.2.3 General

		Yes	No
1	Have ferrules been used for all connections?	(x)	
2	Has the encoder setting (code 114, 115) been checked?	(x)	
3	The drive runs with *f-max* (code 012).		
4	The drive runs with *f-slip* (code 032).		
5	Are there switching elements in the systems supply cable?		
6	Are switching operations performed in the systems supply cable only when the clock pulse is turned off?	(x)	
7	Is the **potentiometer** option installed in the terminal box cover?		
8	Has the auxiliary-driven fan been checked for correct function (contamination, stream of air)?	(x)	
9	In which mounting position has the drive been installed?		
10	Does the motor display loud running noises (or heavy vibration)?		(x)

(x) = correct

Table 18-4 General checklist

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