Vector Frequency Inverter DV51
and
Keypad DEX-KEY-6...

Hardware and Engineering

05/05 AWB8230-1540GB

MOELLER

Think future. Switch to green.

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Warning!
Dangerous electrical voltage!

Before commencing the installation

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

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

Contents

About this manual

This manual describes the DV51 series frequency inverters.

It contains special information which is required for engineering, installation and operation of the DV51 frequency inverters. The features, parameters and functions are described in detail and illustrated with examples of the most important applications. All given details relate to the specified hardware and software versions.

Abbreviations and symbols

The following abbreviations and symbols are used in this manual:

EMC	**E**lectro**m**agnetic **c**ompatibility
ESD	**E**lectro**s**tatic **d**ischarge
HF	**H**igh **F**requency
IGBT	**I**nsulated **G**ate **B**ipolar **T**ransistor
PES	**PE** – connection (earth) of the **s**creen (cable)
PNU	**P**arameter **Nu**mber
DS	Factory **d**efault **s**etting

All measurements are in millimetres unless otherwise stated.

To improve the clarity of the illustrations, the enclosures of the frequency inverter and other safety components may not be shown in some figures. However, the frequency inverter must always be operated in the enclosure with all necessary safety components fitted.

Read the manual carefully before you install and operate the frequency inverter. We assume that you have a good knowledge of engineering fundamentals and that you are familiar with the electrical systems and the principles which apply, and are able to read, understand and apply information contained in technical drawings.

▶ indicates instructions to be followed

→ Indicates useful tips and additional information.

▽ **Caution!**
Warns about the possibility of minor material damage.

⚠ **Warning!**
Warns about the possibility of major material damage and minor injury.

⚠ **Warning!**
Warns about the possibility of major material damage and severe injury or death.

To improve readability, the title of the chapter is indicated on the top of the left-hand page and the current section is indicated on the top of the right-hand page. Pages where chapters commence and blank pages at the end of the chapter are an exception.

1 About the DV51 series

System overview

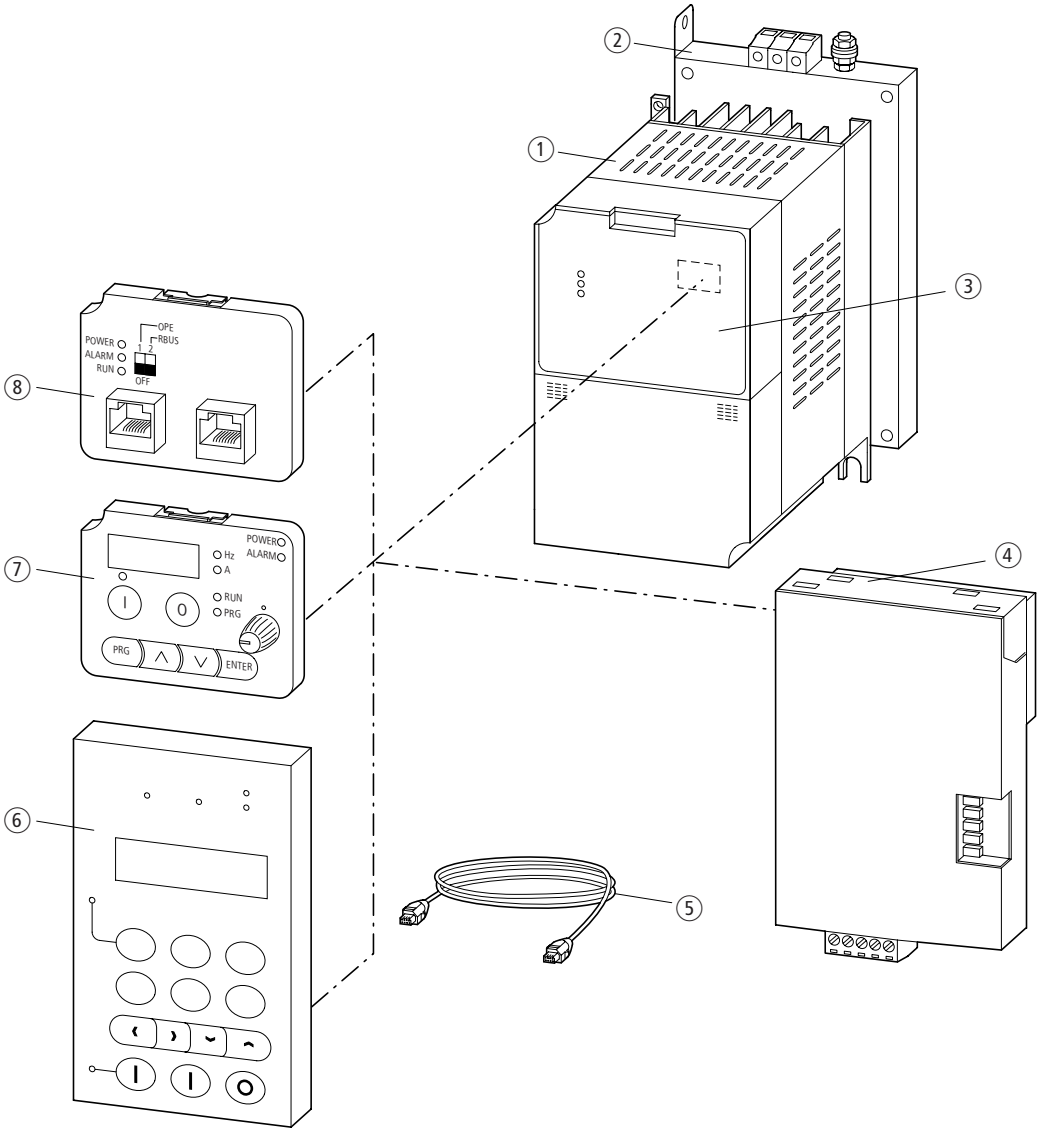


Figure 1: System overview

① DV51-... frequency inverter
② DE51-LZ... RFI filters
③ Cover with built-in DE51-KEY-FP LED display
④ DE51-NET-CAN, DE51-NET-DP Bus system switching (CANopen, PROFIBUS DP)
⑤ DEX-CBL-...-ICS connection cables
⑥ DEX-DEY-10 external keypad
⑦ DEX-DEY-61, DEX-DEY-6 keypad for use external or internal
⑧ DEV51-NET-TC optional T adapter

Type code

Type codes and part numbers of the DV51 series frequency inverters:

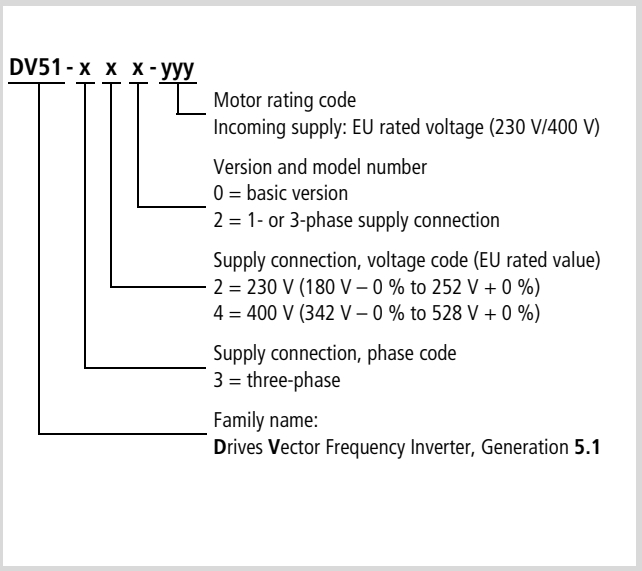


Figure 2: Type codes of the DV51 frequency inverters

Examples:

DV51-320-3K0	The DV51 frequency inverters
	Three-phase mains supply voltage: 230 V
	Assigned motor rating: 3 kW at 230 V
DV51-322-075	The DV51 frequency inverters
	Single-phase or three-phase supply: 230 V
	Assigned motor rating: 0.75 kW at 230 V
DV51-340-5K5	The DV51 frequency inverters
	Three-phase mains supply voltage: 400 V
	Assigned motor rating: 5.5 kW at 400 V

Rating and nameplate

The electrical connection ratings are printed on the terminal shroud.

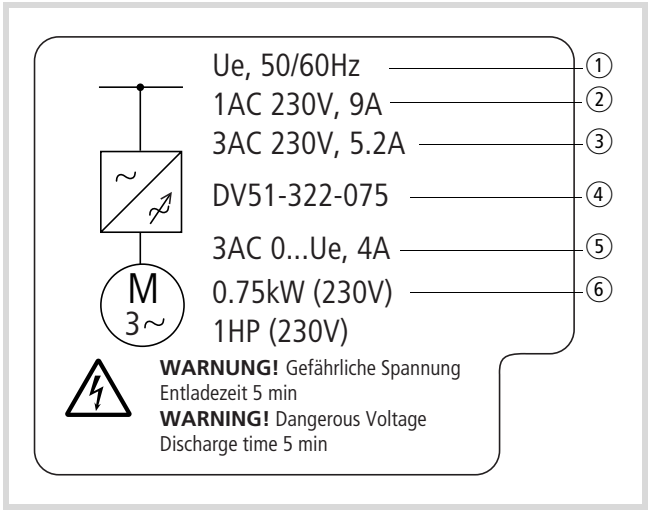


Figure 3: Terminal shroud example

① Ue = rated voltage (mains supply voltage) 230 V
50/60 Hz = mains frequency

② 9A = phase current at single-phase connection

③ 5.2A = phase current at three-phase connection

④ DV51-322-075 = type reference

⑤ 3AC = three-phase output voltage in range from zero to mains supply voltage (Ue) rated current 4 A

⑥ 0.75 kW = assigned motor rating at rated voltage (230 V) or 1 HP (horse power)

The DV51's rating is recorded on the nameplate on the unit's side.

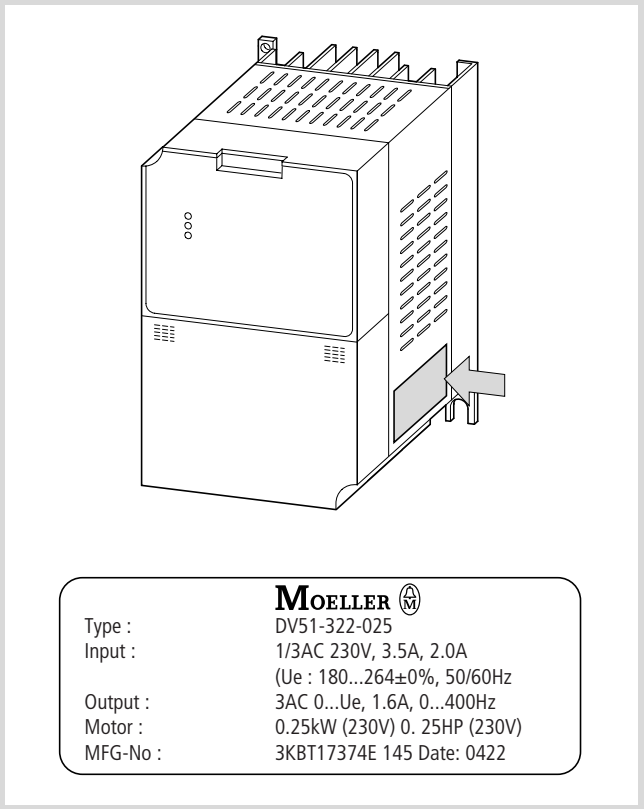


Figure 4: Nameplate of DV51 frequency inverter

The labelling has the following meaning (example):

Type	Part number:	DV51-322-025
Input	Mains input values: phases, rated voltage, phase current and permissible voltage range, mains frequency	1AC 230 V, 3.5 A 3AC 230 V, 2.0 A (Ue: 180–264 V±0 %, 50/60 Hz)
Output	Motor output values: phases, voltage range, rated current, frequency range	3AC 0–Ue, 1.6 A, 0–400 Hz
Motor	Assigned motor rating at specified rated voltage:	0.25 kW (230 V) 0.25 HP (230 V)
MFG-No	Manufacturer number and date	3KBT17374E 145 Date: 0422

Inspecting the items supplied

The DV51 frequency inverters have been carefully packaged and prepared for delivery. The devices must be transported only in their original packaging with a suitable transport system (see weight details). Observe the instructions and the warnings on the side of the packaging. This also applies after the device is removed from the package.

Open the packaging with suitable tools and inspect the contents immediately after delivery to ensure that they are complete and undamaged. The package should contain the following items:

- one DV51 frequency inverter
- installation instructions AWA8230-2147
- a CD with:
  – this manual in PDF format in English and other languages
  – the parameterization software for Windows PCs (95 to XP).

For the parameterization software you will need the connection cable with the DEX-CBL-2M0-PC interface converter (not included as standard).

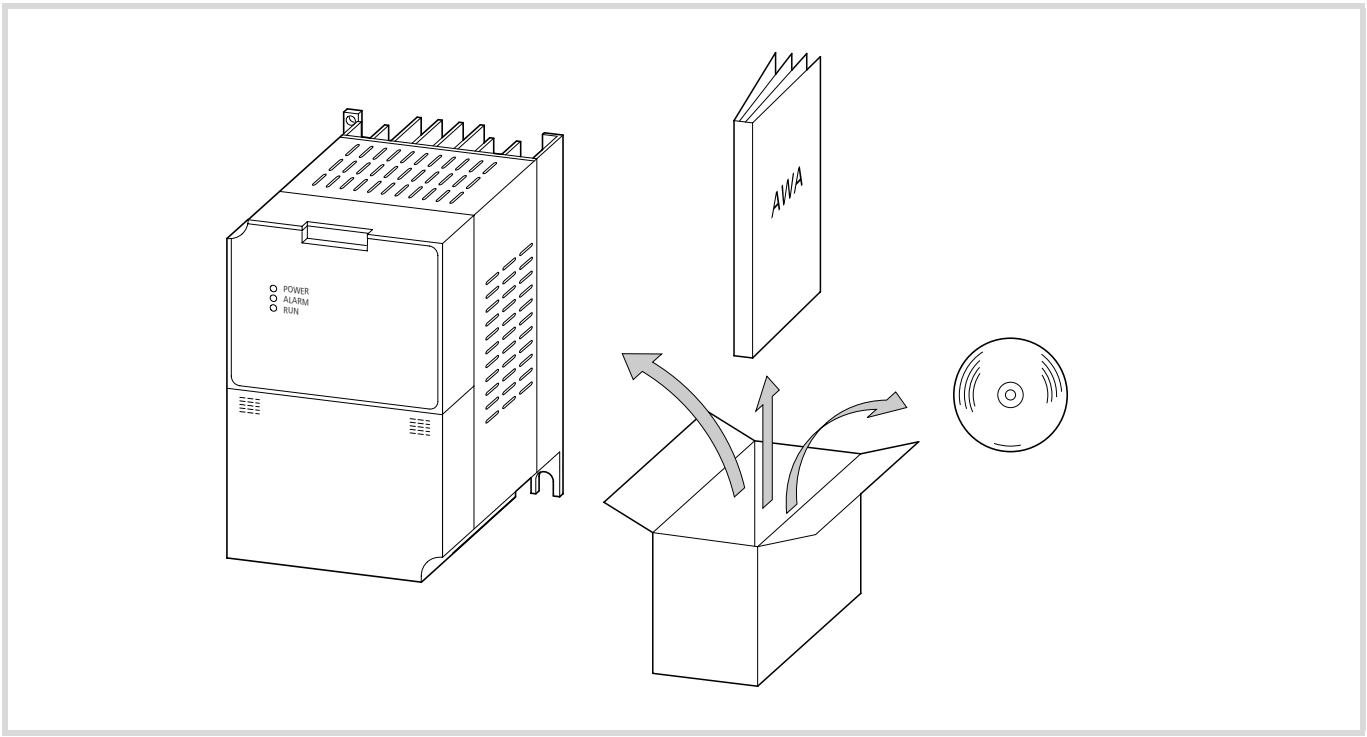


Figure 5: Equipment supplied

→ Check the nameplate attached to the frequency inverter (→ section "Rating and nameplate", page 6) to ensure that the frequency inverter is the type you have ordered.

Layout of the DV51

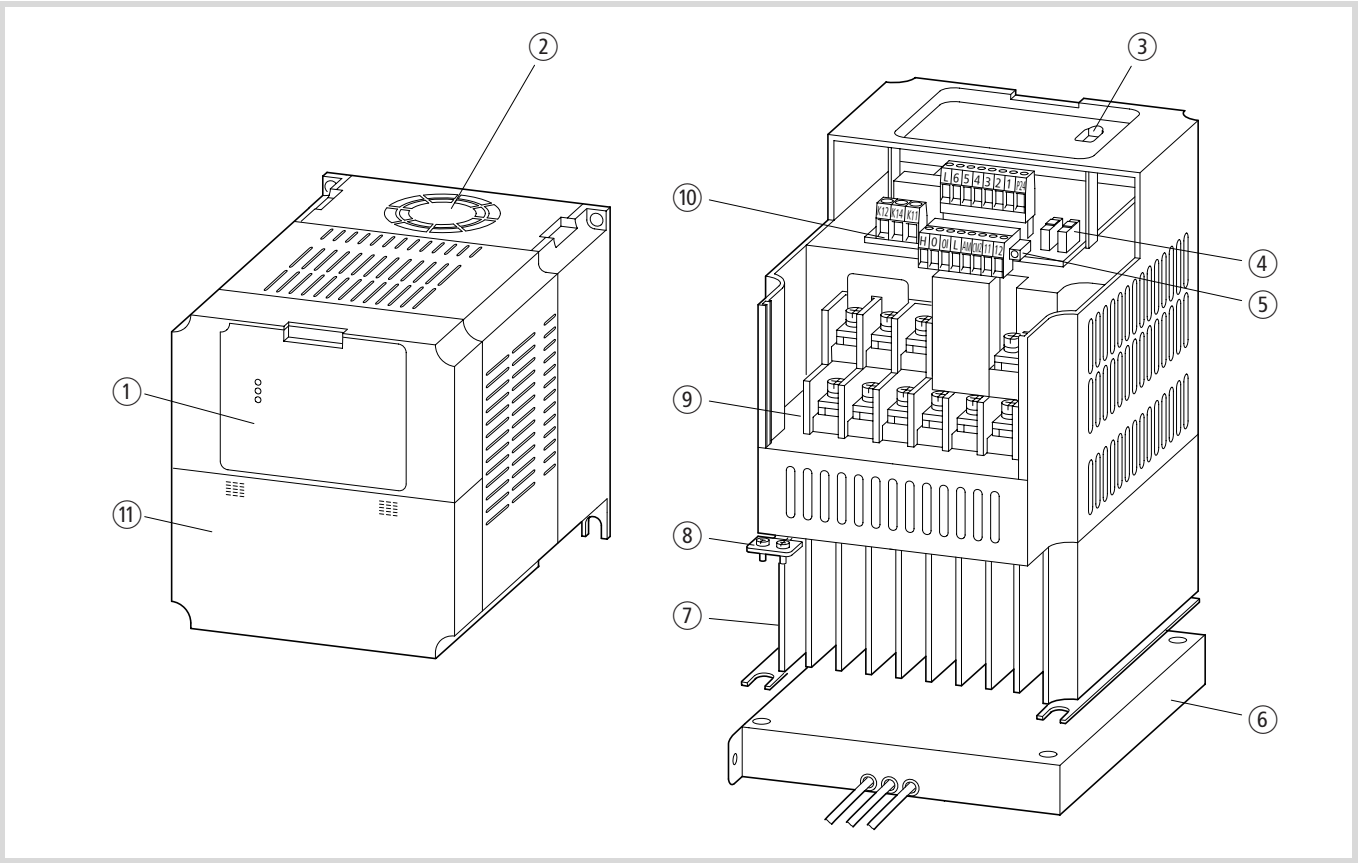


Figure 6: Overview of the DV51

① Cover with built-in LED display (DE51-KEY-FP)
② Device fan (DV51...1K5 to ...7K5 only)
③ RJ 45 communication interface (Modbus)
④ Microswitches
⑤ Plug-in control signal terminals
⑥ Earth connection (PE)
⑦ Optional radio interference filter
⑧ Heat sink
⑨ Power terminals
⑩ Signalling relay terminals
⑪ Terminal shroud (control section, power section)

Features of the frequency inverters

The DV51 frequency inverters convert the voltage and frequency of an existing three-phase supply to a DC voltage and use this voltage to generate a three-phase supply with adjustable voltage and frequency. This variable three-phase supply allows stepless variability of three-phase asynchronous motors.

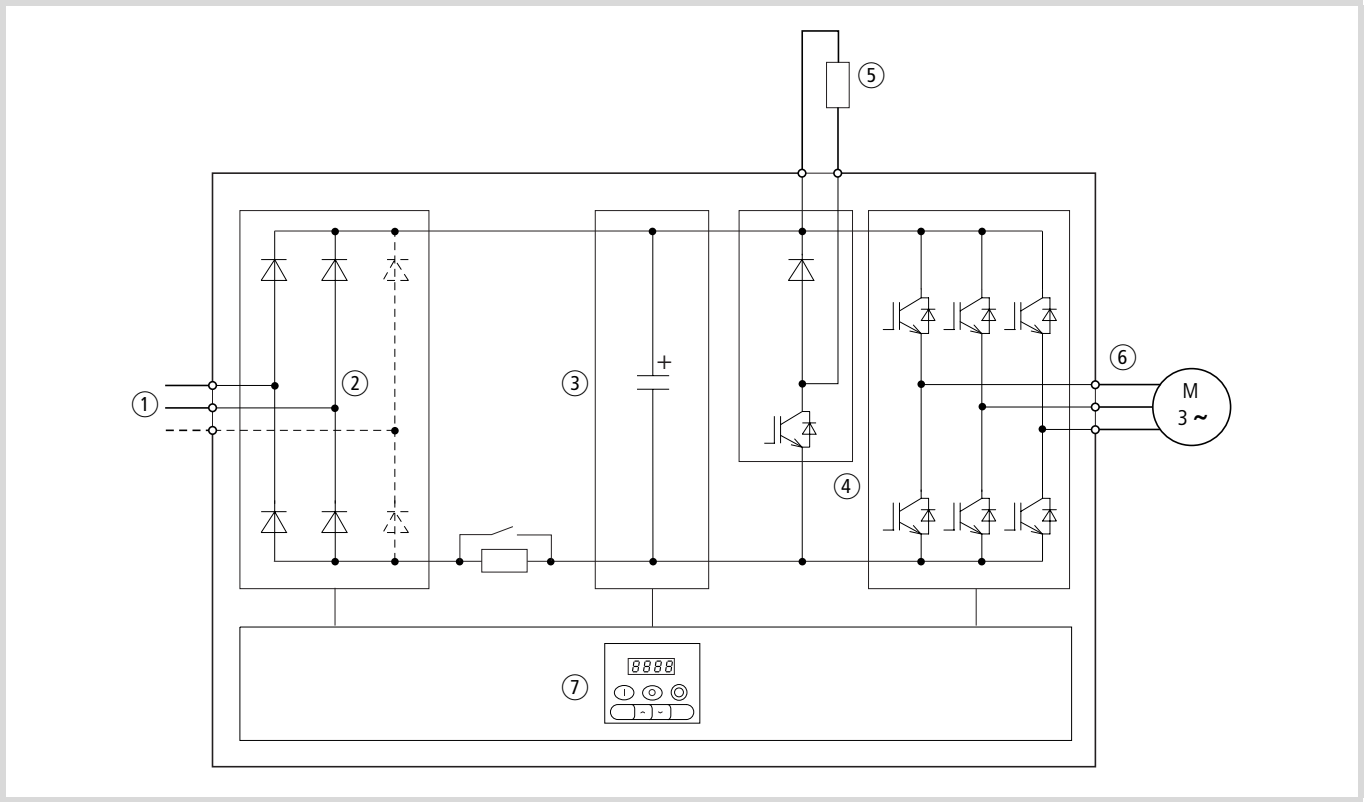


Figure 7: Function diagram of the frequency inverter

① Mains input

Mains voltage U_e (EU rated voltage):
DV51-320 3 AC 230 V, 50/60 Hz
DV51-322 1/3 AC 230 V, 50/60 Hz
DV51-340 3 AC 400 V, 50/60 Hz

② The bridge rectifier converts the AC voltage of the electrical supply to a DC voltage.

③ The DC link contains a charging resistor, smoothing capacitor and switched-mode power supply unit. It enables coupling of the DC bus voltage and the DC current supply (U_{ZK}) = $\sqrt{2}$ × mains voltage (U_e)

④ IGBT power inverter:

The power inverter converts the DC voltage of the internal DC link to a variable three-phase alternating voltage with variable frequency. The built-in braking transistor allows braking of motors with a high moment of inertia in conjunction with the external braking resistor or during extended regenerative operation.

⑤ Optional: external braking resistance

⑥ Output voltage (U_2), motor connection:
three-phase, variable alternating voltage, 0 to 100 % of input voltage (U_e)

Output frequency (f_2): variable from 0 to 400 Hz

Rated output current (I_{2N}):
1.6 to 32 A (230 V series), 1.5 to 16 A (400 V series) with about 1.5 times starting current for 60 s, at an operating frequency of 5 kHz and an ambient temperature of 40 °C. Starting torque: 200 % at 1 Hz.

Motor connection, assigned shaft power (P_2):
0.25 to 7.5 kW at 230 V
0.37 to 7.5 kW at 400 V

⑦ Configurable control section with interface (RJ 45, Modbus).

Selection criteria

Select a suitable frequency inverter according to the rated motor current. The output rated current of the frequency inverter must however, be greater than or equal to the rated motor current.

The following drive data is assumed to be known:

- Type of motor (three-phase asynchronous motor),
- Mains voltage = supply voltage of the motor (for example 3 ~ 400 V),
- Rated motor current (guide value, dependent on the circuit type and the supply voltage)
- Load torque (square-law, constant, with 1.5 times the starting torque)
- Ambient temperature (rated value 40 °C).

→ If several motors are connected in parallel to the output of a frequency inverter, the motor currents are geometrically added, i.e. separately by active and reactive current components. Select a frequency inverter with a sufficient rating to allow it to supply the total required current.

→ If a motor switches during operation on the output of a frequency inverter, the current draws a multiple of its rated current. When you select a frequency inverter, make sure that the starting current plus the sum of the currents of the running motors will not exceed the rated output current of the frequency inverter.

For the frequency inverter's rated output current, see the technical data in the appendix from page 117.

Intended use

The DV51 frequency inverters are not domestic appliances. They are designed only for industrial use as system components.

The DV51 frequency inverters are electrical apparatus for controlling variable speed drives with three-phase motors. They are designed for installation in machines or for use in combination with other components within a machine or system.

After installation in a machine, the frequency inverters must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of Machinery Safety Directive (MSD) 89/392/EEC and meets the requirements of EN 60204. The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives.

The CE markings on the DV51 frequency inverter confirm that, when used in a typical drive configuration, the apparatus complies with the European Low Voltage Directive (LVD) and the EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

In the described system configurations, DV51 frequency inverters are suitable for use in public and non-public networks. Depending on their location of use, external filtering may be necessary.

A connection to IT networks (networks without reference to earth potential) is permissible only to a limited extent, since the device's built-in filter capacitors connect the network with the earth potential (enclosure). On earth free networks, this can lead to dangerous situations or damage to the device (isolation monitoring required).

On the output of the frequency inverter (terminals U, V, W) you must not:

- connect voltage or capacitive loads (for example phase compensation capacitors),
- connect multiple frequency inverters in parallel,
- make a direct connection to the input (bypass).

Observe the technical data and terminal requirements. Refer to the equipment nameplate or label and the documentation for more details.

Any other usage constitutes improper use.

From DV5 to DV51

The vector frequency inverter DV51 is a development of the proven DV5 series. It shares its basic functions, terminal markings, menu structure, etc. with its predecessor, but features additional, new functions. The following list gives a short overview of the most important changes.

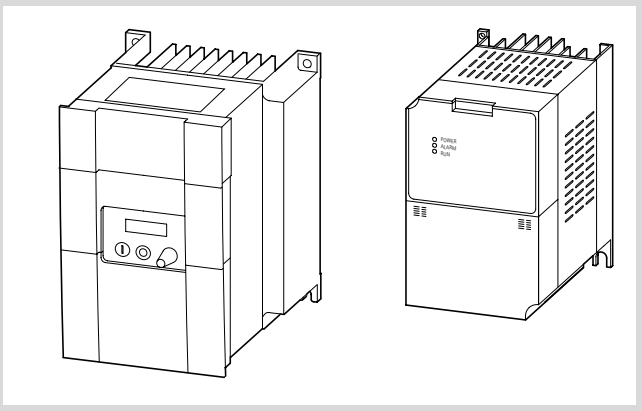


Figure 8: Comparison of DV5 with DV51

- Reduced the enclosure size and fewer enclosure versions.
- Compact design without built-in keypad. The DEX-KEY-6 keypad is available as an option and can also be used remotely, for example mounted on a control panel door with optional mounting frame DEX-MNT-K6.
- Modbus interface RS 485 with 19.2 kbit/s. An optional plug-in T adapter (DEV51-NET-TC) is available.
- Plug-in fieldbus modules for CANopen (Option DE51-NET-CAN) and PROFIBUS DP (Option DE51-NET-DP).
- Plug-in control terminals
- The parameter numbers (PNU) have been retained but – like the DF6 and DV6 seies – now have an added, fourth digit. For example A0 becomes A001 and C03 is now C003.
- The new logic function allows logic linking (AND, OR, XOR) of the digital inputs and outputs as well as the addition and multiplication of the analog setpoints and actual values.
- The new intelligent sensorless vector control (iSLV) makes auto tuning and the alignment of the motor parameters unnecessary.
- Because of the units' modular design and extensive communication capability, the control hierarchy can now be defined with microswitches (485/OPE and TM/PRG).

Service and warranty

In the unlikely event that you have a problem with your Moeller frequency inverter, please contact your local sales office.

When you call, have the following information ready:

- Exact frequency inverter part number (→ nameplate)
- Date of purchase
- Exact description of the problem which has occurred with the frequency inverter.

If some of the information printed on the nameplate is not legible, give only the information that is clearly legible.

Information concerning the guarantee can be found in the Moeller General Terms and Conditions of Sale.

2 Engineering

This section describes the features of the DV51 and the requirements and standards relating to the following issues:

- Connection to power supply
- EMC Directive for PDS drive systems

Features of the DV51

General			
Standards			EN 50178, IEC 61800-3, EN 61800-3 incl. A11
Ambient temperature[a]			
Operating temperature		°C	–10 to +40 with rated current I_e without reduced performance, up to 50 with clock frequency reduced to 2 kHz and output current reduced to 80 % I_e
Storage, transportation		°C	–25 to +70
Mechanical shock resistance			Impacts and vibration: up to 5.9 m/s² (0.6 g) at 10 to 55 Hz
Pollution degree			VDE 0110 Part 2, pollution degree 2
Climatic proofing			Class 3K3 according to EN 50178 (non-condensing, average relative humidity 20 to 90 %)
Installation altitude		m	0 to 1000 m above sea level
Mounting position			Vertically suspended
Free surrounding areas			100 mm above and below device
Emitted interference			IEC/EN 61800-3 (EN 55011 group 1, class B)
Noise immunity			IEC/EN 61800-3, industrial environment
Insulation resistance			Overvoltage category III according to VDE 0110
Leakage current to PE		mA	> 3.5 (to EN 50178)
Degree of protection			IP 20
Protection against direct contact			Finger and back-of-hand proof
Protective isolation against switching circuitry			Safe isolation from the mains. Double basic isolation (to EN 50178)
Protective measures			Overcurrent, earth fault, overvoltage, undervoltage, overload, overtemperature, electronic motor protection: I^2t monitoring and PTC input (thermistor or thermostat)
Power section			
DV51-320-…			
Rated operational voltage		V AC	230
Rated voltage	U_e	V	3 AC 180 to 264 V ± 0 %
DV51-322-…			
Rated operational voltage		V AC	230
Rated voltage	U_e	V	1/3 AC 180 to 264 V ± 0 %
DV51-340-…			
Rated operational voltage		V AC	400
Rated voltage	U_e	V	3 AC 342 to 528 V ± 0 %
Mains frequency		Hz	50/60 (47 to 63 ± 0 %)
Modulation method			Pulse width modulation (PWM), *U*/*f* characteristic control, vector control
Switching frequency			5 kHz, adjustable from 2 to 14 kHz
Output voltage		V	3 AC U_e
Output frequency		Hz	0 – 50, max. 400

Frequency resolution		Hz	0.1 at digital reference values/maximum frequency/1000 at analog reference values
Frequency error limit at 20 °C ± 10 K			±0.01 % of maximum frequency at digital reference values, ±0.1 % of maximum frequency at analog reference values
Permissible overcurrent			150 % for 60 s, every 600 s
Torque during start			From 1 Hz: 200 % or higher
DC braking			0 to 100 %, range 0.5 to 60 Hz, braking duration 0 to 60 s
Braking transistor			Dynamic braking with external resistor (approx. 150 to 80 %)
Control section			
Internal voltages			
Control		V ⎓	24, max. 30 mA
Setpoint value definition		V ⎓	10, max. 10 mA
Analog and digital actuation			
Analog outputs			• 1 output • 0 – 10 V ⎓, max. 1 mA • Resolution 8 bit
Analog inputs			• 1 input, 0 to 9.6 V ⎓ (10 V normal), • Input impedance 10 kΩ • 1 input, 4 to 19.6 mA (20 mA normal), • Load resistor: 250 Ω • Resolution: 10 bit
Digital inputs			• 6 inputs, user-configurable • Up to 27 V ⎓ • Input impedance 4.7 kΩ
Digital outputs			• 2 outputs • max. 27 V ⎓, max. 1 mA
Serial interface			RS 485 (Modbus RTU, up to 19.2 Kbit/s)
Relay, changeover contact			• 250 V AC, max. 2.5 A (resistive load) • 250 V AC, max. 0.2 A (inductive load, p.f. = 0.4) • AC 100 V AC, minimal 10 mA
			• 30 V DC, max. 3 A (resistive load) • 30 V DC, max. 0.7 A (inductive load, p.f. = 0.4) • 5 V DC, min. 100 mA
Keypad (optional)			DEX-KEY-6, DEX-KEY-61
Operation			• 4 function keys for setting parameters • 2 function keys for actuation
Display			Four-digit 7-segment display and 8 LEDs (status indication)
Potentiometer			Reference input (for DEX-KEY-6)

1) If the frequency inverter is to be installed in a control panel, enclosure or similar installation, the temperature within the enclosure or control panel is considered to be ambient temperature T_a.
All power section ratings are based on an operating frequency of 5 kHz (default) and an ambient temperature of +40 °C, during operation of a four-pole three-phase asynchronous motor.

The illustration below shows an overview of the connections.

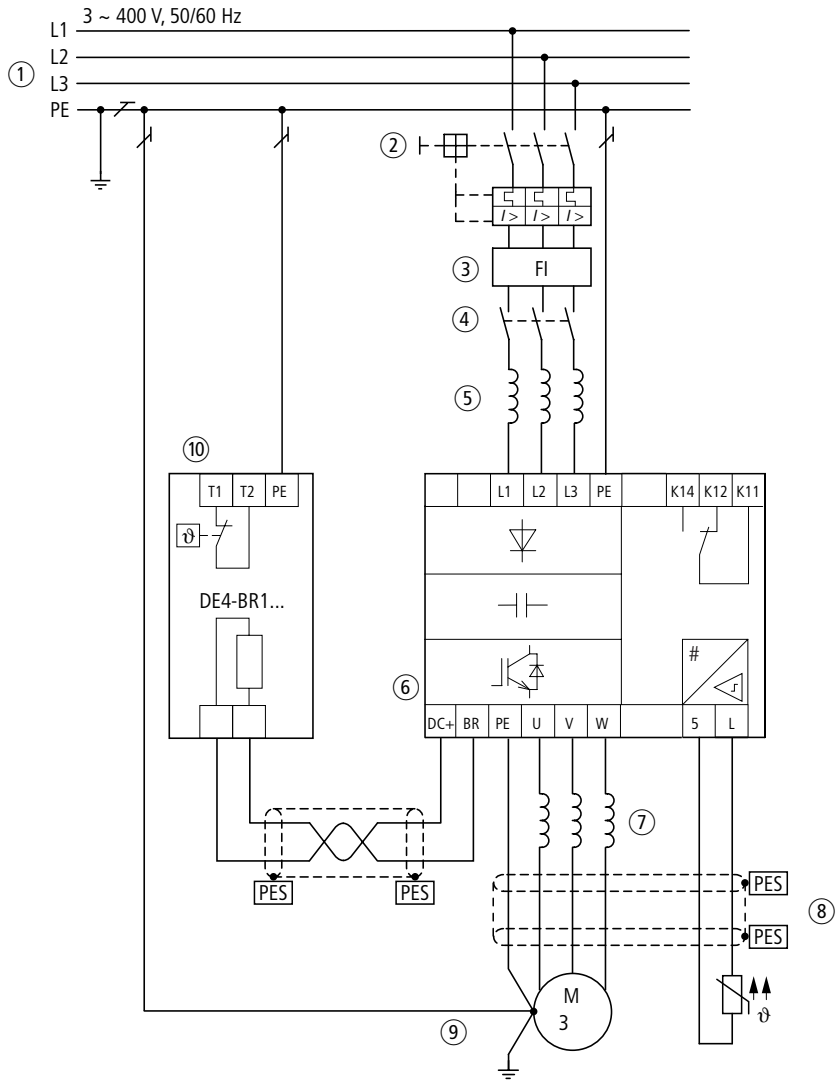


Figure 9: Power input connection overview

① Network configuration, mains voltage, mains frequency
interaction with p.f. compensation systems

② Fuses and cable cross-sections, line protection

③ Protection of persons and domestic animals with residual-current protective devices

④ Mains contactor

⑤ Line reactor, radio interference filter, line filter

⑥ Frequency inverter: mounting, installation
Power connection
EMC measures
Circuit examples

⑦ Motor filter
d*u*/d*t* filter
sinusoidal filter

⑧ Motor supply cables, cable lengths, shielding, motor protection,
Thermistor connection: terminals 5 and L

⑨ Motor connection
Parallel operation of multiple motors on a single frequency inverter

⑩ Braking units: terminals DC+ and DC–
Braking resistors: terminals BR and DC+
DC bus voltage coupling: terminals DC+ and DC–
DC infeed: terminals DC+ and DC–

Connection to power supply

The DV51 frequency inverters can not be used in every network configuration without limitations (network configuration according to IEC 364-3).

Warning!
Use only components (cables, FI switches, chokes, filters and contactors) that match the frequency inverter's rated values. Otherwise there is a danger of fire.

Mains configurations

Networks with earthed centre point (TT/TN networks):

- DV51 frequency inverters can be used without limitations in TT and TN networks. The ratings of the DV51 frequency inverters must, however, be observed.

→ If many frequency inverters with a single-phase supply are connected to the same supply network, they should be distributed symmetrically over all three phases and the load placed on the common neutral connection (mains r.m.s. current) must be taken into account. If necessary, the cross-section of the neutral pole must be increased, if it conducts the total current of all single-phase devices.

Networks with isolated centre point (IT networks):

- The use of DV51 frequency inverters in IT networks is only permissible to a limited extent. In this case, a suitable device (isolation monitor) to monitor earth faults and isolates the frequency inverter from the mains must be used.

Caution!
With an earth fault in an IT system, the capacitors of the frequency inverter which are switched to earth are subject to a very high voltage. Therefore, safe operation of the frequency inverter cannot be guaranteed. The situation can be remedied with an additional isolating transformer with an earthed centre point on its secondary, which is then used to supply the input of the frequency inverter. This constitutes an individual TN system for the frequency inverter.

Mains voltage, mains frequency

The ratings of the DV51 frequency inverters cover European and American standard voltages:

- 230 V, 50 Hz (EU) and 240 V, 60 Hz (USA) for DV51-320 and DV51-322,
- 400 V, 50 Hz (EU) and 460 V, 60 Hz (USA) for DV51-340

The permitted mains voltage range is:

- 230/240 V: 180 V – 0 % to 252 V + 0 %
- 380/460 V: 342 V – 0 % to 528 V + 0 %

The permissible frequency range is 47 Hz –0 % to 63 Hz +0 %.

The motor rating to mains voltage assignments are listed in the appendix, paragraph "Technical data", page 117.

Interaction with compensation equipment

The DV51 frequency inverters absorb only a small fundamental reactive power from the AC supply. Compensation is therefore unnecessary.

Caution!
Operate DV51 series frequency inverters on mains with p.f. correction equipment only when this equipment is damped with chokes.

Fuses and conductor cross-sections

The fuse ratings and cable cross-sections required for the network connection depend on the rating of the frequency inverter and the drive's operating mode.

Caution!
The voltage drop under load conditions should be considered when selecting the cable cross-section. Compliance to further standards (for example VDE 0113, VDE 0289) is the responsibility of the user.

The recommended fuses and their assignment to the DV51 frequency inverters are listed in the appendix, paragraph "Cables and fuses", page 123.

The national and regional standards (for example VDE 0113, EN 60204) must be observed and the necessary approvals (for example UL) at the site of installation must be fulfilled.

When the device is operated in a UL-approved system, use only UL-approved fuses, fuse bases and cables.

The leakage currents to earth (to EN 50178) is greater than 3.5 mA. The connection terminals marked PE and the enclosure must be connected to the earth circuit.

Caution!
The prescribed minimum cross-sections of PE-conductors (EN 50178, VDE 0160) must be observed. Use a PE conductor whose cross-section is as least as large as the terminal capacity of the power terminals.

Residual current circuit-breakers

To protect persons and domestic animals, residual current circuit-breakers according to VDE 0100; (RCCBs, also called earth-leakage circuit breakers or ELCBs) oruniversal current sensitive RCCBs according to EN 50178 and IEC 755 must be used.

	Identification on the residual-current circuit-breakers		
Logo			
Type	alternating current sensitive (RCCB, Type AC)	pulse current sensitive (RCCB, Type A)	universal current sensitive (RCCB, Type B)

The Frequency inverters contain a built-in mains rectifier. On a frame fault, this can cause a fault DC to inhibit tripping of the AC or pulse-current sensitive residual-current circuit-breaker, thereby preventing it from fulfilling its protective function. We therefore recommend the use of:

- pulse-current sensitive RCCBs with a rated fault current ≧ 30 mA for frequency inverters with a single-phase supply;
- universal RCCBs with a rated fault current ≧ 300 mA for frequency inverters with a three-phase supply.

The approximate fault current values of the DV51 frequency inverters and their assigned radio interference filters are listed in the appendix, paragraph "RFI filters", page 124.

Spurious tripping of a residual-current circuit breaker can be caused by the following:

- capacitive compensation currents in the cable screens, particularly with long, screened motor cables,
- simultaneous connection of multiple frequency inverters to the mains supply,
- the use of additional chokes and filters (radio interference filters, line filters).

Caution!
Residual-current circuit-breakers must be installed only on the primary side between the incoming supply and the frequency inverter.

Warning!
Use only cables, residual-current circuit breakers and contactors with a suitable rating. Otherwise there is a danger of fire.

Mains contactor

The mains contactor is connected to the mains side input cables L1, L2, L3 or L and N (depending on its type) and allows the DV51 frequency inverter on the supplying network to be switched on and off during operation and to be disconnected in the event of a fault.

Mains contactors and their assignment to the DV51 frequency inverters are listed in the appendix, paragraph "Mains contactors", page 126.

Current peaks

In the following cases, a relatively high peak current can occur on the primary side of the frequency inverter (i.e. on the supply voltage side), which, under certain conditions, can destroy the frequency inverter's input rectifier:

- Imbalance of the voltage supply greater than 3 %.
- The maximum power output of the point of supply must be at least 10 times greater than the maximum frequency inverter rating (about 500 kVA).
- If sudden voltage dips in the supply voltage are to be expected, for example when:
  - a number of frequency inverters are operated on a common supply voltage.
  - a thyristor system and a frequency inverter are operated on a common supply voltage
  - power factor correction devices are switched on or off

In these cases, a mains reactor with about 3 % voltage drop at rated operation should be installed.

Line reactor

The line reactor (also called commutating or mains choke) is connected to the mains side input cables L1, L2 and L3, or L and N (depending on type). It reduces the harmonics and therefore – by up to 30 % – the apparent mains current.

A mains reactor also limits any current peaks caused by potential dips (for example caused by p.f. correction equipment or earth faults) or switching operations on the mains.

The mains reactor increases the lifespan of the DC link capacitors and consequently the lifespan of the frequency inverter. Its use is also recommended:

- with single-phase supplies (DV51-322),
- with derating (temperatures above +40 °C, sites of installation more than 1000 m above sea level),
- for parallel operation of multiple frequency inverters on a single mains supply point,
- for DC link coupling of multiple frequency inverters (interconnected operation).

Mains reactors and their assignment to the DV51 frequency inverters are listed in the appendix, paragraph "Line reactor", page 128.

Line filters

Line filters are a combination of line reactors and radio interference filters in a single enclosure. They reduce the current harmonics and dampen high frequency radio interference levels.

Radio interference filters only dampen high frequency radio interference levels.

Caution!
When line filters or radio interference filters are used, the leakage current to earth increases. Observe this point when residual-current circuit-breakers are used.

EMC compliance

The DV51 frequency inverters operate with fast electronic switches (IGBTs). Radio interference may therefore occur on the frequency inverter's output, which may affect other electronic devices, such as radio receivers and instruments, located in the direct vicinity. To protect against this radio frequency interference (RFI), the devices should be screened and installed as far away from the frequency inverter as possible.

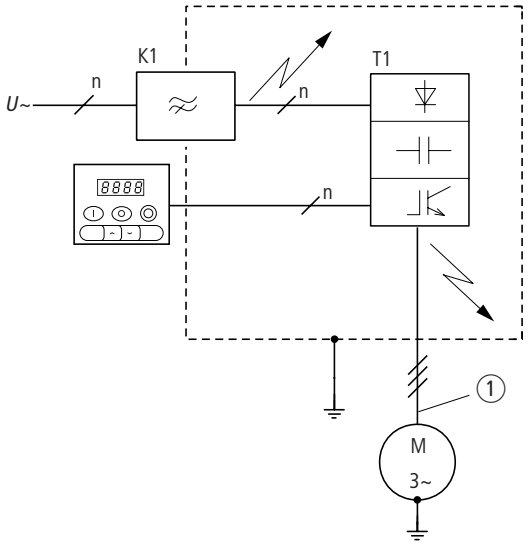


Figure 10: DV51 and radio interference filter in a sealed enclosure

K1: RFI filter

T1: Frequency inverter

① Screened motor cable

EMC Directive for PDS drive systems

(PDS = Power Drive System)

In Europe, the EMC Directive must be adhered to by law.

The EMC product standard for drive systems is IEC/EN 61800-3 and EN 61800-3 including A11 (02/2001). This standard must also be maintained by law. The generic standards do not apply to drive systems, although many values are the same.

EN 61800-3 does not apply to the frequency inverter itself, but to a complete drive system including cable and motor. A drive system can consist of more than one drive. EN 61800-3 regards drive systems that consist of several drives as **a single** drive system.

Declarations of conformity relate to a "typical drive system" with given cable length, motor and filter for a single drive. The drive system's manufacturer is responsible for the complete drive system.

Interference immunity

If you use DV51 frequency inverters in European Union (EU) countries, you must observe EMC Directive 89/336/EEC. This includes compliance with the following conditions:

Supply (mains) voltage for the frequency inverter:

- Voltage fluctuation ±10 % or less
- Voltage imbalance ±3 % or less
- Frequency variation ±4 % or less

If one of the conditions listed here cannot be fulfilled, you must install an appropriate line reactor (→ section "Line reactor" in the appendix, page 128).

Emitted interference and radio interference suppression

Used with the assigned radio interference filters, the DV51 frequency inverters meet the requirements of the EMC Product Standard IEC/EN 61800-3 for domestic use (first environment) and therefore also for the higher limit values of industrial environments (second environment).

Table 1: Definitions in IEC/EN 61800-3

	Unrestricted putting into circulation	**Restricted putting into circulation (engineering required)**
First environment Power supply from the public mains, which also supplies households.	Includes public buildings and private households.	Rare special cases in which the user may have to implement additional measures.
Second environment Power supply from a network that does not supply households.	Typical for installation in machines by professional control system producers.	Typical for selected special installation and high-performance drive systems.

Table 2: Limit values in IEC/EN 61800-3

	Unrestricted putting into circulation	Restricted putting into circulation (engineering required)
First environment Power supply from the public mains, which also supplies households.	Corresponds with CISPR 11 Class B	Corresponds with CISPR 11 Class A Group 1 and Warning
Second environment Power supply from a network that does not supply households.	Corresponds with CISPR 11 Class A Group 2 and Warning	Corresponds with CISPR 11 Class A Group 2 or EMC plan

To ensure adherence to the limit values, observe the following points:

- Reduce performance-related interference with line filters and/or radio interference filters including line reactors.
- Reduce electromagnetic emission interference by screening motor cables and signal cables.
- Ensure compliance with installation guidelines (EMC-compliant installation).

EMC interference class

With frequency inverters, performance related and emitted interference increase with the switching frequency. The frequency of occurrence of performance-related interference also increase with longer motor cables. When the respective radio interference filter is used, the IEC/EN 61800-3 standard is complied to as follows:

- Limit values for emitted interference corresponding to first environment, interference immunity according to second environment (restricted and unrestricted putting into circulation) = universal use in both environments.
- The maximum cable length in both environments is 50 m at 5 kHz operating frequency. Observe installation instructions (→ section "EMC measures in the control panel", page 26).
- Single-phase frequency inverters can not be operated on the public mains (They exceed the maximum harmonics values in IEC/EN 61000-3-2, even with chokes fitted). The values can be maintained only with an inverter on the mains side.

For further information, see paragraph "EMC compliance", page 25.

Motor and circuit type

The stator winding of the motor can be connected as a star or delta configuration in accordance with the rating data on the nameplate.

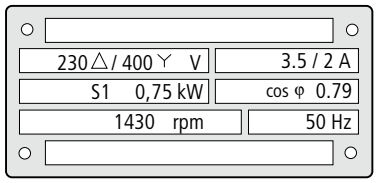


Figure 11: Example of a motor nameplate

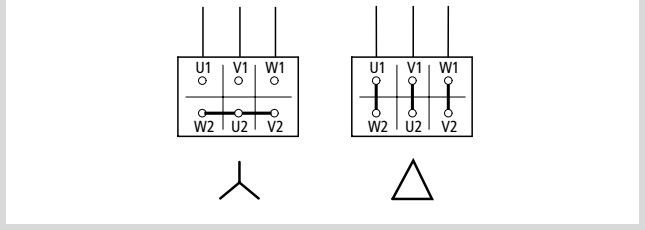


Figure 12: Connection types

Table 3: Assignment of frequency inverters to example motor circuit (Fig.11)

Frequency Inverters	DV51-322-075	DV51-322-075	DV51-340-075	DV51-340-1K5
Mains voltage	3-phase 230 V	Single-phase 230 V	3-phase 400 V	3-phase 400 V
Mains current	5.2 A	9 A	3.3 A	5 A
Motor circuit	Delta	Delta	Star	Delta
Motor current	3.5 A	3.5 A	2 A	3.5 A
Motor voltage	3 AC 0 to 230 V	3 AC 0 to 230 V	3 AC 0 to 400 V	3 AC 0 to 230 V
Motor speed	1430 r.p.m.	1430 r.p.m.	1430 r.p.m.	2474 r.p.m.
Motor frequency	50 Hz	50 Hz	50 Hz	87 Hz

Connecting motors in parallel
The DV51 series frequency inverters allow parallel operation of more than one motor. The following connection types are possible:

- Vector control mode (SLV): up to two motors with the same rating.
- *U/f* control: several motors with the same or different ratings. The sum of all motor currents must be less than the frequency inverter's rated current.
- *U/f* control: parallel control of several motors. The sum of the motor currents plus the motors' inrush current must be less than the frequency inverter's rated current.

→ By default, DV51 frequency inverters are supplied with control mode SLV (Sensorless Vector Control) enabled. In this mode, only two motors with identical rating can be connected in parallel. To operate more than two motors in parallel, use the Constant Torque Curve mode (→ PNU A044, or PUN 244,).

Parallel operation at different motor speeds can be implemented only by changing the number of pole pairs and/or changing the motor's transmission ratio.

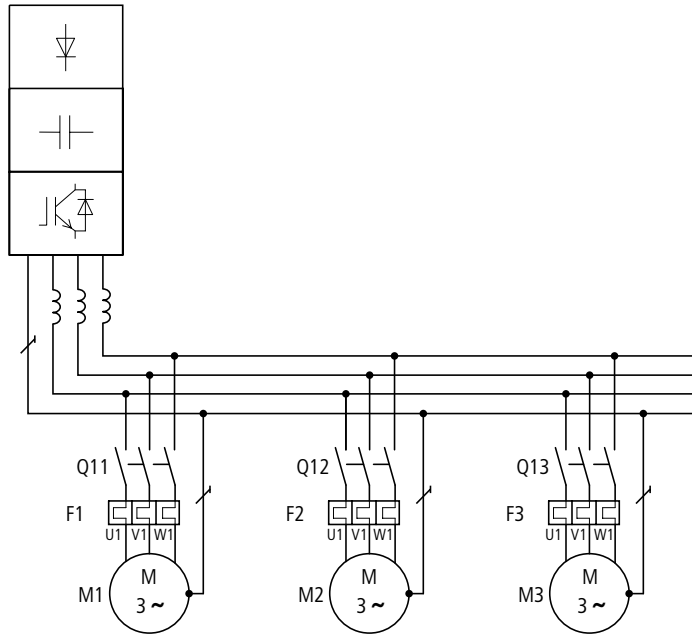


Figure 13: Parallel connection of several motors to one frequency inverter

▽ **Caution!**
If a frequency inverter controls a number of motors in parallel, the contactors for the individual motors must be designed for AC-3 operation. Do not use the mains contactors listed in the table in the appendix (paragraph "Mains contactors", page 126). These mains contactors are only designed for the mains (primary) currents of the frequency inverter. If contactors of this size are used in the motor circuit, the contacts could weld.

Connecting motors in parallel reduces the load resistance at the frequency inverter output and the total stator inductivity, and increases the leakage capacitance. As a result, the current distortion is larger than it is in a single-motor circuit. To reduce the current distortion, motor reactors or → section "Motor reactor"page 129→ section "Sine-wave filter"page 130 sine-wave filters can be connected at the frequency inverter output.

Example:
Copper wire winder

- 16 motors
- P = 60 W
- I = 0.21 A
- U = 400 V
- p.f. = 0.7
- Direct starting current: 2 A

If a wire breaks during winding, the corresponding motor is automatically switched off. When the wire is rejoined, the motor can be started up again. Only one motor can be started up at a time.

Frequency inverter selection:

15 motors in operation:	15 x 0.21 A	= 3.15 A
Connect one motor:		2.00 A
		5.15 A

DV51-340-2K2, rated current 5.5 A.

DEX-LM3-008 motor reactor

→ Constant Torque Curve control mode (→ PNU A044, or PUN 244,) necessary.

→ The current consumption of all motors connected in parallel must not exceed the frequency inverter's rated output current I_{2N}.

→ Electronic motor protection can not be used when operating the frequency inverter with several parallel connected motors. You must, however, protect each motor with thermistors and/or overload relays.

→ The use of motor-protective circuit-breaker at the frequency inverter's output can lead to nuisance tripping.

If motors with widely differing ratings (for example 0.37 kW and 2.2 kW) are connected in parallel to the output of a frequency inverter, problems may arise during starting and at low speeds. Motors with a low motor rating may be unable to develop the required torque due to the relatively high ohmic resistance of their stators. They require a higher voltage during the start phase and at low speeds.

When an individual motor is switched into the frequency inverter's output, it behaves as if is connected directly to the electrical mains. When you select a frequency inverter, take into account the highest possible inrush current and use a motor reactor or a sinusoidal filter.

Motor cables

To ensure EMC, use only screened motor cables. The length of the motor cables and related components has an influence on control mode and operating behaviour. In parallel operation (multiple motors connected to the frequency inverter output), the resulting cable lengths l_{res} must be calculated:

$$l_{res} = \Sigma l_M \times \sqrt{n_M}$$

Σl_M: Sum of all motor cable lengths

n_M: Number of motor circuits

→ With long motor cables, the leakage currents caused by parasitic cable capacities can cause the "earth fault" message. In this case, motor filters must be used.

To optimize drive behaviour, keep the motor cables as short as possible.

→ If the cable from frequency inverter to motor is longer than about 10 m, the existing thermal relays (bimetallic relays) may malfunction due to high frequency harmonics. Install a motor reactor at the frequency inverter's output in this case.

Motor reactors, du/dt filters, sinusoidal filters

Motor reactors compensate for capacitive currents with long motor cables and with grouped drives (multiple connection of parallel drives to a single inverter).

The use of motor reactors is recommended for (observe the manufacturers' instructions):

- grouped drives
- three-phase asynchronous motors with a maximum frequencies above 200 Hz,
- reluctance or permanent-field synchronous motors with a maximum frequency above 120 Hz.

d*u*/d*t* filters are used for limiting the rate of voltage rise at the motor terminals to values below 500 V/ms. They should be used for motors with unknown or insufficient electric strength for the insulation.

▽ **Caution!**
During the engineering phase, keep in mind that the voltage drop across motor filters and d*u*/d*t* filters can be up to 4 % of the frequency inverter's output voltage.

When sinusoidal filters are used, the motors are supplied with near-sinusoidal voltage and current.

▽ **Caution!**
During the engineering phase, keep in mind that the sinusoidal filter must be matched to the output voltage and to the frequency inverter's clock frequency.

The voltage drop across the sinusoidal filter can be up to 15 % of the frequency inverter's output voltage.

Bypass operation
To allow operation of a motor with both the frequency inverter and directly from the mains, the incoming supplies must be mechanically interlocked:

Caution!
Changeover between the frequency inverter and the mains supply must take place at zero voltage.

Warning!
The frequency inverter outputs (U, V, W) must not be connected to the mains voltage (destruction of the device, risk of fire).

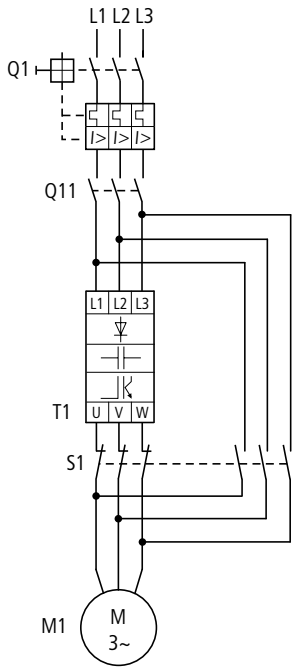


Figure 14: Bypass motor control

Caution!
Switch S1 must switch only when frequency inverter T1 is at zero current.

→ Contactors and switches (S1) in the frequency inverter's output and for DOL starting must be dimensioned for AC-3 and the motor's rated power.

3 Installation

The DV51 frequency inverters are designed for installation in a control panel or a metal enclosure (for example to IP 54).

→ During installation or assembly of the frequency inverter, cover up all ventilation slots and openings to ensure that no foreign bodies enter the device.

To allow connection of the power and control signal terminals, make sure that the terminal shroud can always be opened and closed without impediment.

→ Weights and dimensions of the DV51 are listed in the appendix in paragraph "Weights and dimensions", page 121.

Fitting the DV51

The DV51 frequency inverters must be mounted vertically on a non-flammable background.

Mounting position

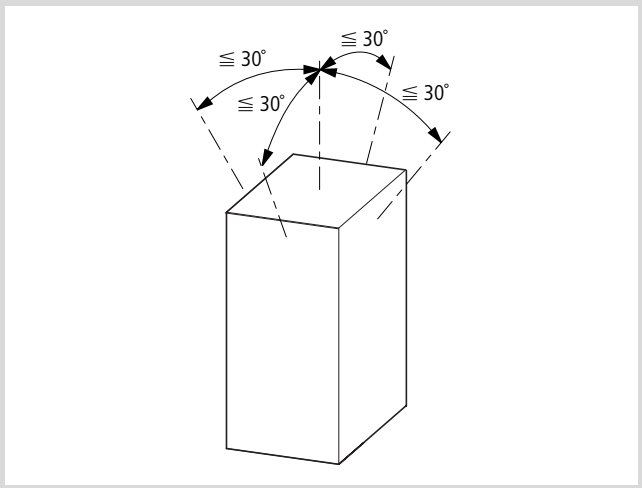


Figure 15: Mounting position

Fitting dimensions

A free space of at least 100 mm is required above and below the device to allow air circulation for cooling. The horizontal distance to the next device should be at last 10 mm.

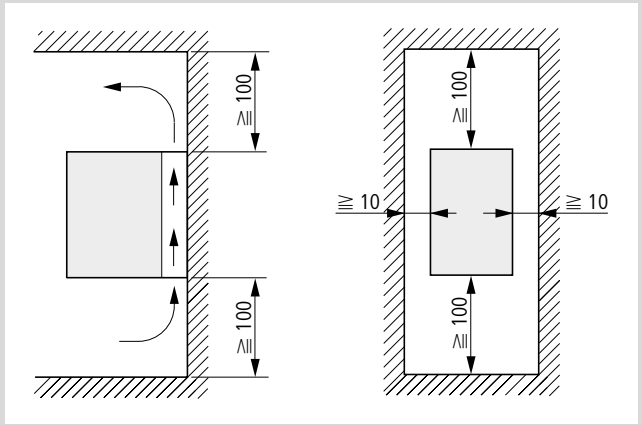


Figure 16: Fitting dimensions in the control panel

→ Minimum free space for installation of DV51 inside an enclosure.

When you mount a DV51 in an individual enclosure, for example to increase its degree of protection, the distances to the enclosure walls must be at least as shown below.

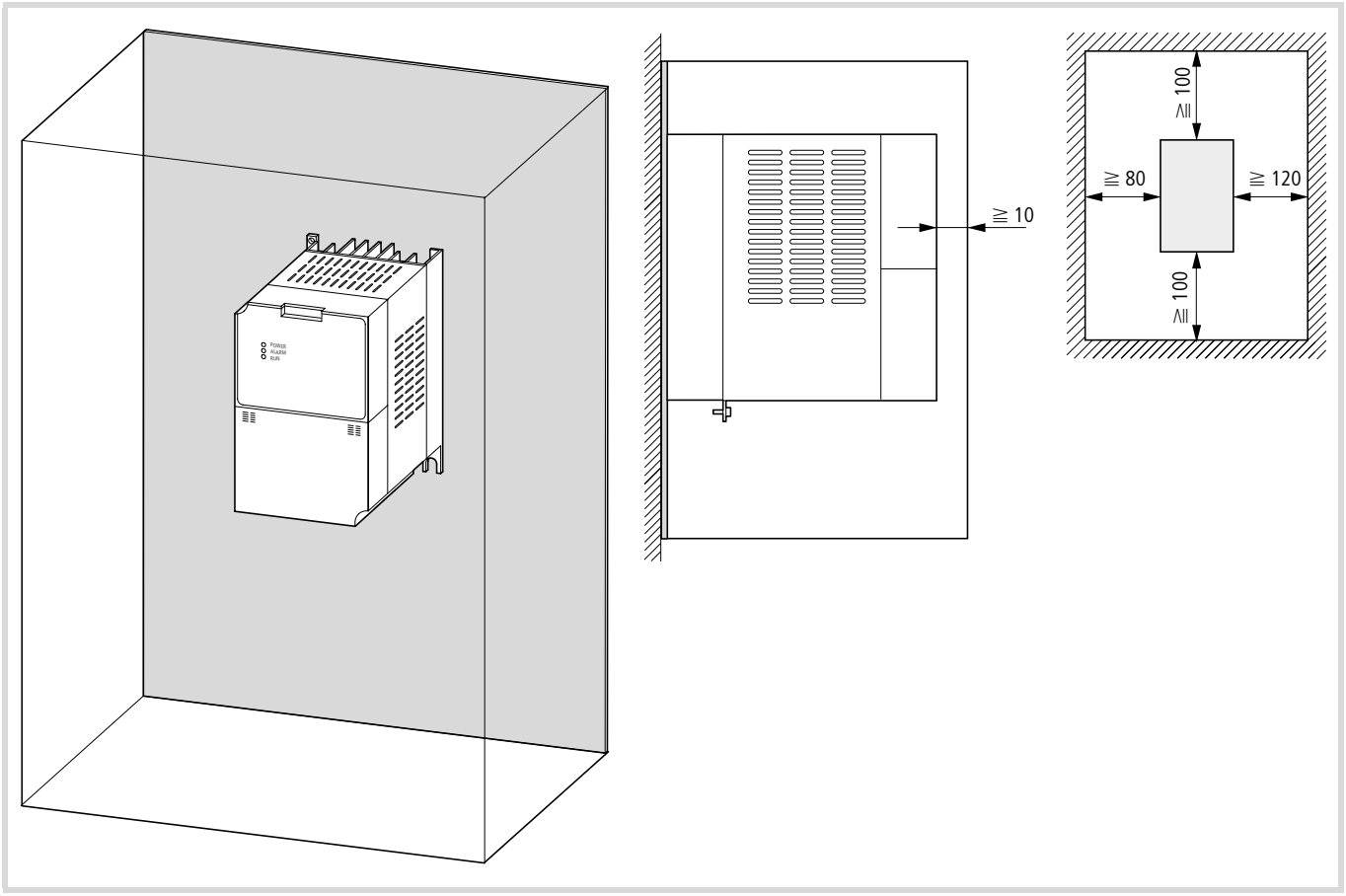


Figure 17: Minimum fitting dimensions in a full enclosure (local installation)

Mounting the DV51

Mount the DV51 frequency inverter as shown in Fig.18 and tighten the screws to the following torque values (→ table 4):

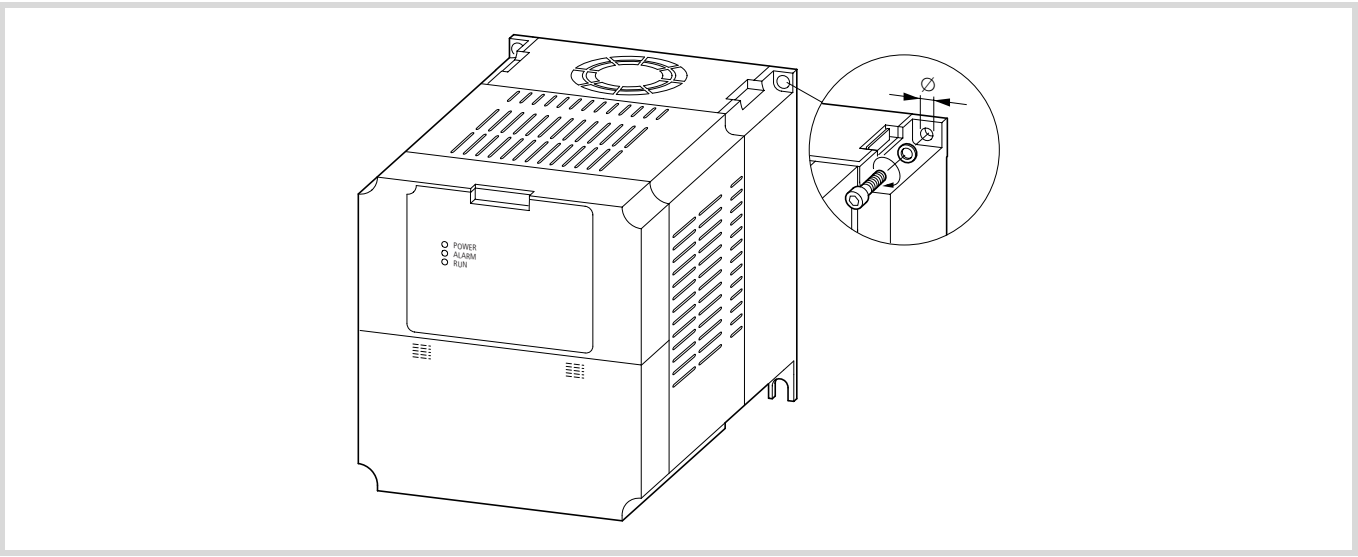


Figure 18: Securing the DV51

Table 4: Tightening torques of the mounting screws

∅ [mm]		Nm	ft lbs
5	M4	3	2.6

EMC compliance

EMC-compliant installation

We recommend the following measures for EMC compliant installation:

- Installation of the frequency inverter in a metallic, electrically conducting enclosure with a good connection to earth.
- Installation of a radio interference filter on the input of and immediately adjacent to the frequency inverter.
- Screened motor cables (short cable lengths).

▶ Earth all conductive components and the enclosure using as short a cable as possible.

Fitting a radio-interference (RFI) filter

The RFI filter should be installed immediately adjacent to the frequency inverter. The connection cable between the frequency inverter and filter should be as short as possible. Screened cables are required if the length exceeds 30 cm.

The mounting surfaces for the frequency inverter and radio interference filter should be as free as possible from paint and oil residue.

The assigned DE51-LZ... radio interference filters (→ section "RFI filters" in the appendix, page 124) can be mounted under (footprint) or next to (book-type) the DV51 frequency inverter.

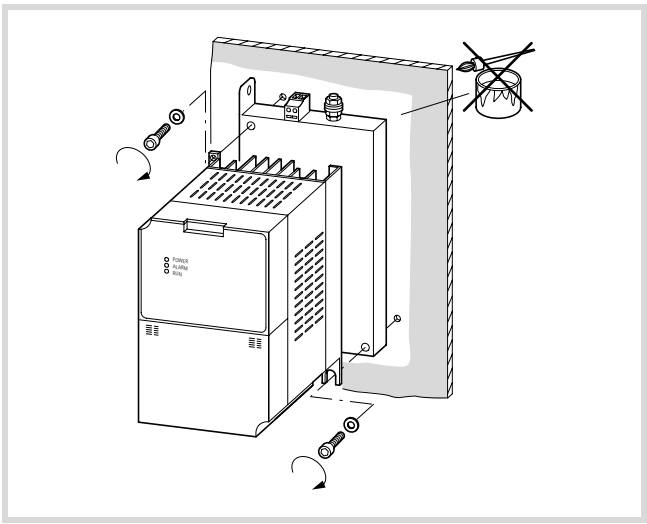


Figure 19: Footprint mounting

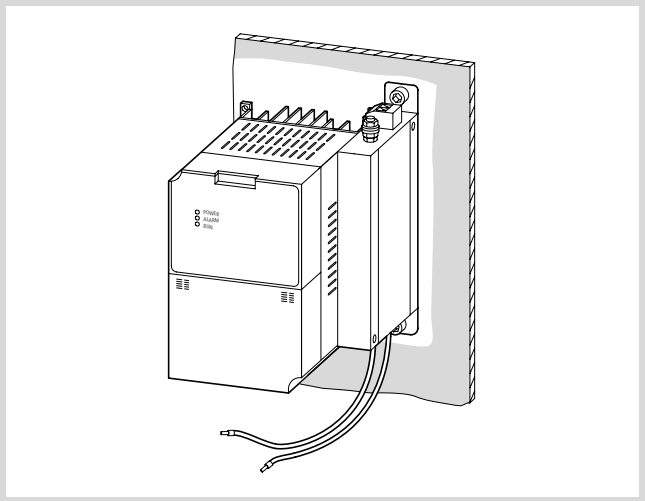


Figure 20: Book-type mounting (on right side in the example)

On the mains side, connect the RFI filter through the filter's screw terminals. Connect the filter's output lines inside the frequency inverter's power section after removing the terminal shroud.

Radio interference filters produce leakage currents which, in the event of a fault (phase failure, load unbalance), can be larger than the rated values. The filters must be earthed before use in order to avoid dangerous voltages. As the leakage currents are high frequency interference sources, the earthing measures must be undertaken with low resistance's on surfaces which as large as possible.

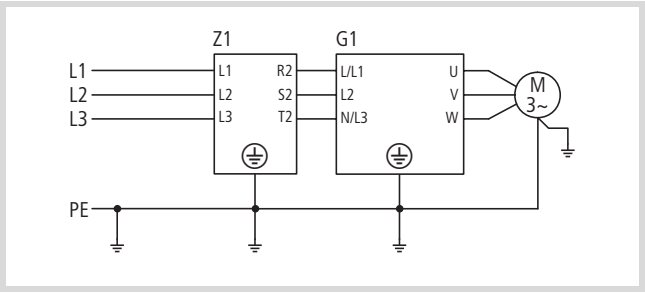


Figure 21: RFI filter connection

K1: RFI filter

T1: Frequency inverter

With leakage currents ≧ 3.5 mA, the VDE 0160 and EN 60335 stipulate that either:

- the protective conductor must have a cross-section ≧ 10 mm^2, or
- the protective conductor is monitored to ensure continuity, or
- an additional protective conductor is also installed.

For DV51 frequency inverters, use the assigned DE51-LZ... filters.

EMC measures in the control panel

EMC compliance should already be ensured in the engineering phase: making changes during installation invariably results in higher costs.

To ensure an EMC-compliant setup, connect all metallic components of the devices and of the control cabinet with each other using a large cross-section conductor with good HF conducting properties. Do not make connections to painted surfaces (Eloxal, yellow chromated). Connect mounting plates to each other, and the cabinet doors with the cabinet using contacts with large surface areas and short HF wires.

An overview or all EMC measures can be seen in the following figure.

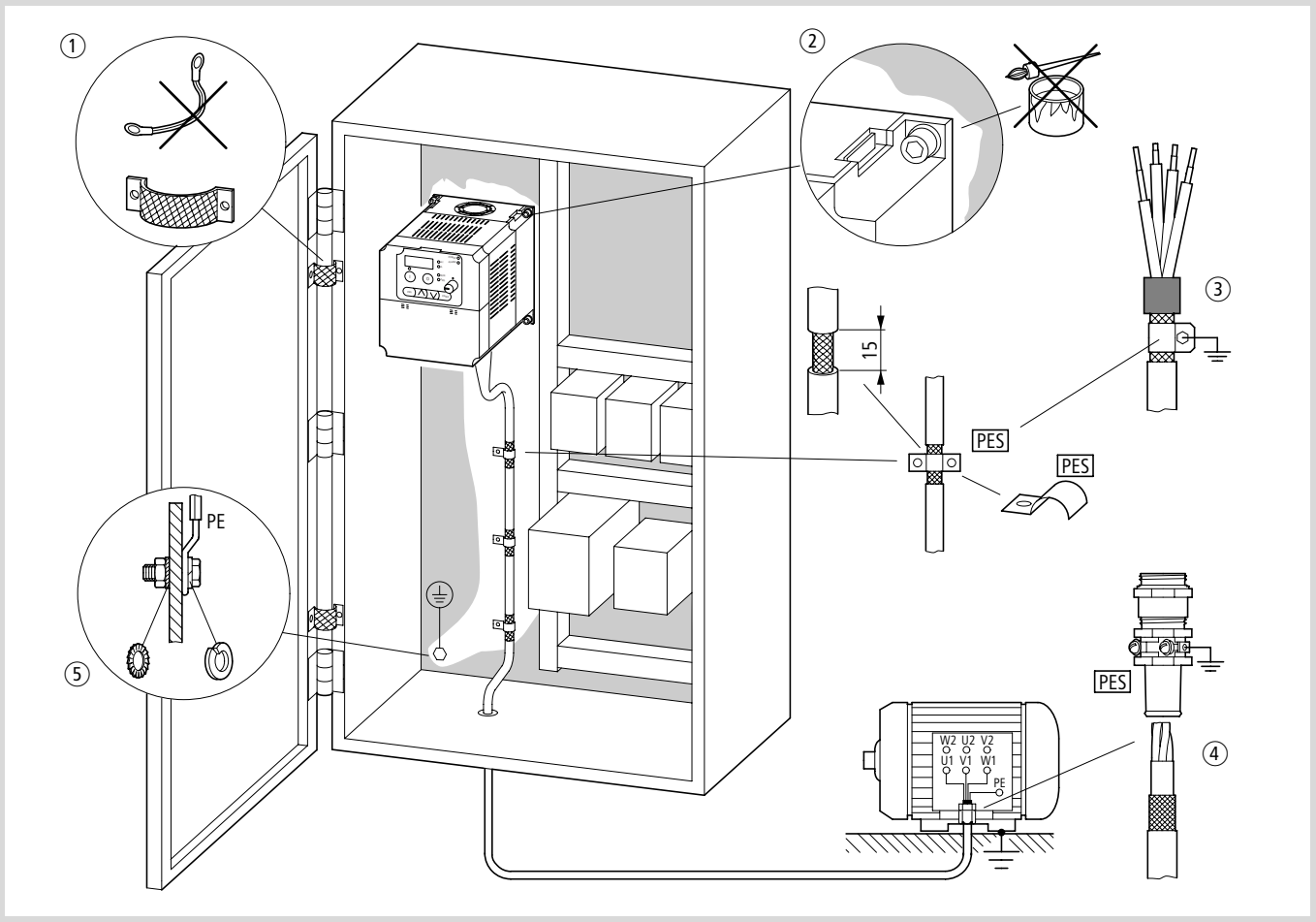


Figure 22: EMC-compliant setup

① Large-area connection of all metallic control panel components.
② Mounting surfaces of frequency inverter, RFI filter and cable screen must be free from paint.
③ Connect screens of cables at frequency inverter's output with earth potential (PES) across large surface area.
④ Large-area cable screen contacts with motor.
⑤ Large-area earth connection of all metallic parts.

Fit additional RFI filters or mains filters and frequency inverters as closely as possible to each other and on a single metal plate (mounting plate).

Lay cables in the control cabinet as near as possible to the ground potential. Cables that hang freely act as antennas.

To prevent transfer of electromagnetic energy, lay interference-suppressed cables (for example mains supply before the filter) and signal lines as far away as possible (at least 10 cm) from HF-conducting cables (for example mains supply cable after a filter, motor power cable). This applies especially where cables are routed in parallel. Never use the same cable duct for interference-suppressed and HF cables. Where unavoidable, cables should always cross over at right angles to each other.

Never lay control or signal cables in the same duct as power cables. Analog signal cables (measured values, setpoints and correction values) must be screened.

Earthing

Connect the ground plate (mounting plate) with the protective earth using a short cable. To achieve the best results, all conducting components (frequency inverter, mains filter, motor filter, line reactor) should be connected by an HF wire, and the protective conductor should be laid in a star configuration from a central earthing point. This produces the best results.

Ensure that the earthing measures have been correctly implemented (→ fig. 23). No other device which has to be earthed should be connected to the earthing terminal of the frequency inverter. If more than one frequency inverter is to be used, the earthing cables should not form a closed loop.

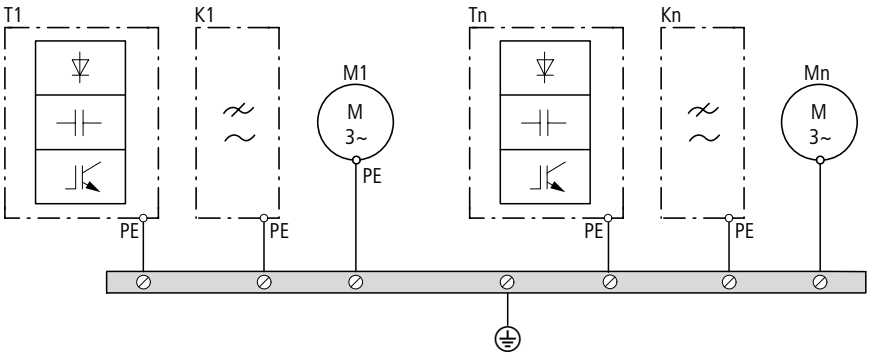


Figure 23: Star-type point to point earthing

All conductive components (frequency inverter, line filter, line reactor, motor reactor, etc.) should have a large-surface connection with the earth potential (mounting plate).

Cable routing

→ Lay the control and signal cables separately from the mains and motor cables.

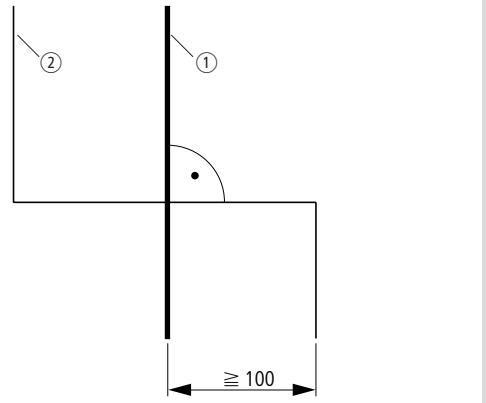


Figure 24: Crossover of signal and power cables

Example: DV51

① Power cable: L1, L2, L3 or L and N, PE, U, V, W, L+, DC+, DC–, BR

② Control and signal cables: H, O, OI, L, AM, 1 to 6 , CM2, P24
Relay control cable: K11, K12, K14

If you are routing power and control cables in parallel, keep a distance of at least 100 mm between them.

Screening

Unscreened cables behave like antennae, i.e. they act as transmitters and receivers. To ensure EMC-compliant connection, screen all interference-emitting cables (frequency inverter/motor output) and interference-sensitive cables (analog setpoint and measured value cables).

The effectiveness of the cable screen depends on a good screen connection and a low screen impedance. Use only screens with tinned or nickel-plated copper braiding, braided steel screens are unsuitable. The screen braid must have an overlap ratio of at least 85 percent and an overlap angle of 90°.

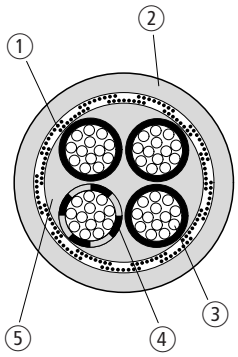


Figure 25: Sample motor cable

① C screen braid
② PVC outer sheath
③ Strands (CU-strands)
④ PVC core insulation
3 × black, 1 × green–yellow
⑤ Textile braid and PVC inner material

The screened cable between frequency inverter and motor should be as short as possible. Connect the screen to earth at both ends of the cable using a large contact surface connection.

Lay the cables for the supply voltage separately from the signal cables and control cables.

Never unravel the screening or use pigtails to make a connection.

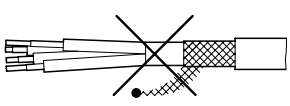


Figure 26: Inadmissible screen grounding (pigtails)

If contactors, maintenance switches, motor protection relays, motor reactors, filters or terminals are installed in the motor cabling, interrupt the screen near these components and connect it to the mounting plate (PES) using a large contact surface connection. The free, unscreened connecting cables should not be longer then about 100 mm.

Example: Maintenance switch

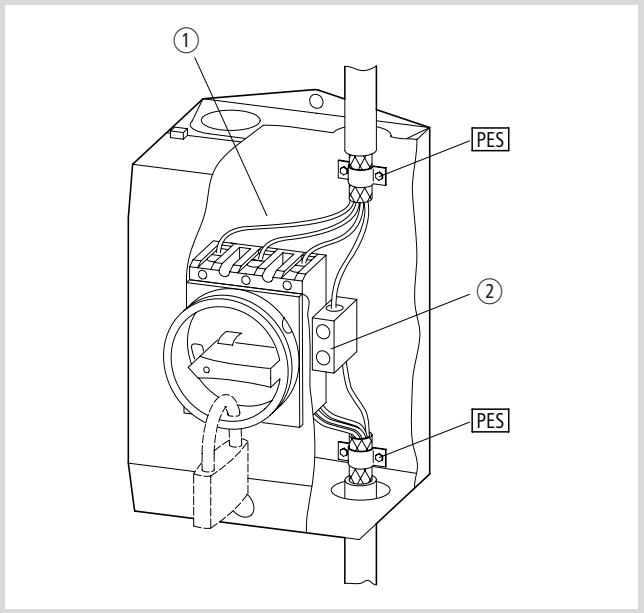


Figure 27: Maintenance switch, for example **T… in an enclosure**

① Metal plate, for example MBS-12 (→ Installation instructions AWA1150-2249)

② insulated PE terminal

In an EMC compliant control cabinet (metal enclosed, damped to about 10 dB), the motor cables do not need to be screened provided that the frequency inverter and motor cables are separated and partitioned from the other control system components. The motor cable screening must then be connected via a large surface area connection at the control cabinet (PES).

The control cable and signal (analog setpoint and measured value) cable screens must be connected only at one cable end. Connect the screen to ground using low impedance connection to a large area contact surface. Digital signal cable screens must be connected at both cable ends, also with large-surface, low-resistance connections.

Electrical connection

This section describes how to connect the motor and the supply voltage to the power terminals, and the signal cables to the control terminals and the signalling relay.

Warning!
Carry out the wiring work only after the frequency inverter has been correctly mounted and secured. Otherwise, there is a danger of electrical shock or injury.

Warning!
Carry out wiring work only under zero voltage conditions.

Warning!
Use only cables, residual-current circuit-breakers and contactors with the permissible rating. Otherwise there is a danger of fire.

Connecting the power section

To connect the power supply, motor cables and control signal cables, take off the terminal shroud.

Front cover
The electrical connections of the DV51 are made through plug-in control signal terminals and combination terminal screws in the power section, which is normally covered by a terminal shroud.

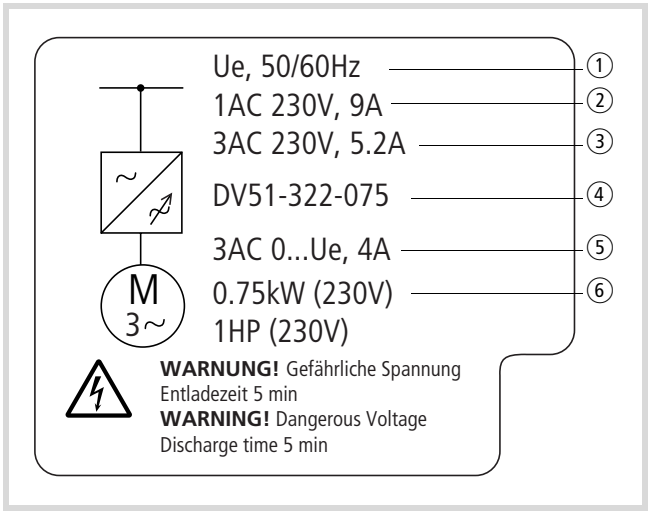


Figure 28: Terminal shroud example

① Ue = rated voltage (mains supply voltage) 230 V
50/60 Hz = mains frequency

② 9A = phase current at single-phase connection

③ 5.2A = phase current at three-phase connection

④ DV51-322-075 = type reference

⑤ 3AC = three-phase output voltage in range from zero to mains supply voltage (Ue) rated current 4 A

⑥ 0.75 kW = assigned motor rating at rated voltage (230 V) or 1 HP (horse power)

Opening the terminal shroud

→ Complete the following steps with the tools stated and without the use of force.

To open the terminal shroud:

▶ Press down on the latches 1.
▶ Then pull the terminal shroud downwards 2.

On devices DV51-…-5K5 and DV51-…-7K5, the terminal shroud hinges downwards and can be removed in its lowered position.

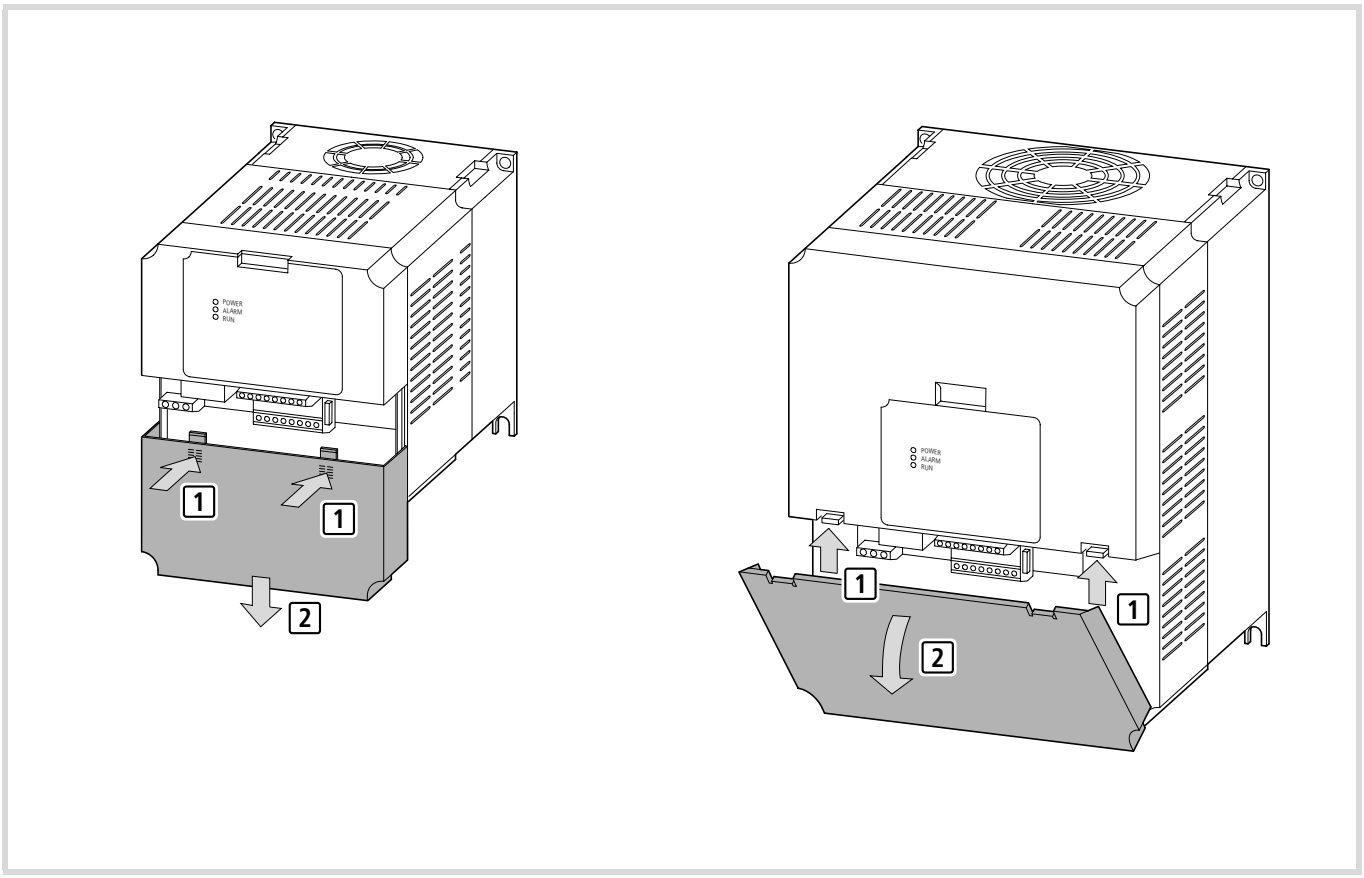


Figure 29: Opening the terminal shroud

▶ Pull out the cable retainer.

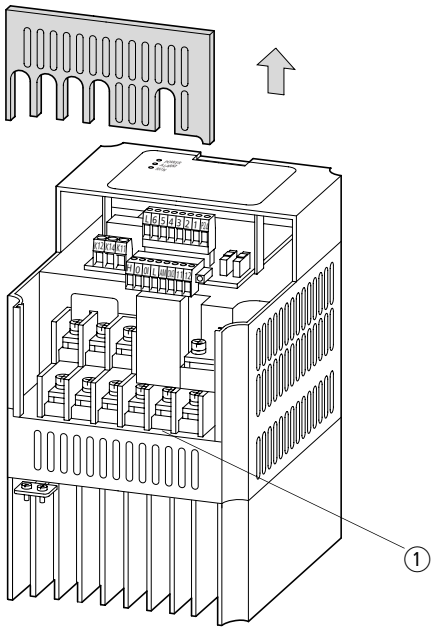


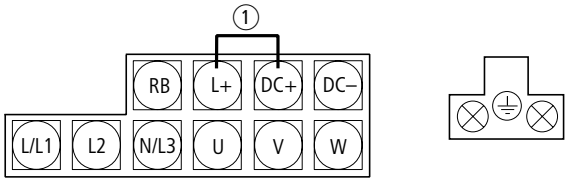
Figure 30: Removing the terminal shroud

① Power terminals

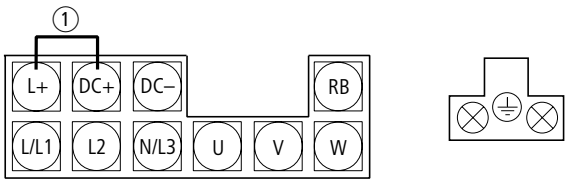
Arrangement of the power terminals

The arrangement of power terminals depends on the size of the power section.

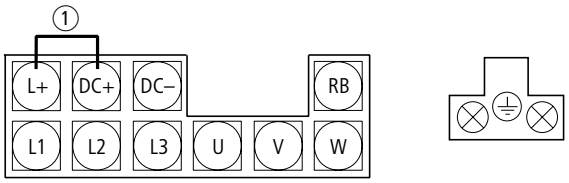
DV51-322-025
DV51-322-037
DV51-322-055



DV51-322-075
DV51-322-1K1
DV51-322-2K2
DV51-320-4K0



DV51-340-037
DV51-340-075
DV51-340-1K5
DV51-340-2K2
DV51-340-3K0
DV51-340-4K0



DV51-340-5K5
DV51-320-5K5
DV51-340-7K5
DV51-320-7K5

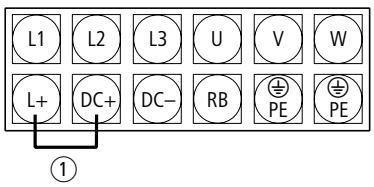
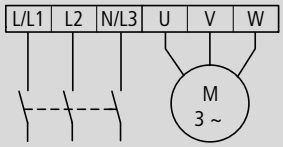


Figure 31: Arrangement of the power terminals

① Internal connection. Remove if a DC link choke is used.

Table 5: Description of the power terminals

Terminal designation	Function	Description
L, L1, L2, L3, N	Supply voltage (mains voltage)	• Single-phase mains voltage: Connection to L and N • Three-phase mains voltage: Connection to L1, L2, L3
U, V, W	Frequency inverter output	Connection of a three-phase motor
L+, DC+	External direct voltage reactor	Terminals L+ and DC+ are bridged with a jumper. If a DC link choke is used, the jumper must be removed.
DC+, DC–	Internal DC link	These terminals are used for connecting an optional external braking resistor and for DC linking and supplying DC to multiple frequency inverters.
RB, DC+	External braking resistance	To these terminals, an optional external braking resistor can be connected to the built-in braking transistor.
⏚, PE	Earthing	Enclosure earthing (prevents dangerous voltages on metallic enclosure elements in the event of a malfunction).



Connecting the power terminals

Warning!
Select a frequency inverter that is suitable for the available supply voltage (→ section "Appendix", page 117):

- DV51-320: Three-phase 230 V (180 to 264 V ± 0 %)
- DV51-322: Single- or three-phase 230 V (180 to 264 V ± 0 %)
- DV51-340: Three-phase 400 V (342 to 528 V ± 0 %)

Warning!
Never connect output terminals U, V and W to mains voltage. Danger of electrical shock or fire.

Warning!
Each phase of the frequency inverter's supply voltage must be protected with a fuse (danger of fire).

Warning!
Ensure that all power cables are firmly secured in the power section.

Warning!
The frequency inverter must be earthed. Danger of electrical shock or fire.

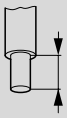
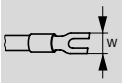
Warning!
Do not connect any cables to unmarked terminals in the power section. Some of these terminals do not have a function (dangerous voltages) DV51or are reserved for internal use.

Tightening torques and conductor cross-sections

Warning!
Tighten the screws on the terminals correctly (→ table 6) so that they do not come loose unintentionally.

▶ Screw on the cables tightly according to Table 6.

Table 6: Tightening torques and cable cross-sections for the power terminals (combination and terminal screws)

L, L1, L2, L3, N, L+, DC+, DC–, RB, U, V, W, PE	 mm²	AWG	 mm	 mm		 Nm	ft-lbs	⊕
DV51-322-025 DV51-322-037 DV51-322-055	1.5	16	6 – 8	7.6	M3.5 M4 (PE)	1.3	0.6	1
DV51-340-037 DV51-340-075 DV51-340-1K5 DV51-340-2K2	1.5	16	8 – 10	10	M 4	1.3	0.9	1
DV51-322-075 DV51-322-1K1 DV51-340-3K0 DV51-340-4K0	2.5	14	8 – 10	10	M 4	1.3	0.9	1
DV51-320-4K0 DV51-322-1K5 DV51-340-5K5 DV51-340-7K5	4	12	12 – 14	13	M 5	2	1.5	2
DV51-320-5K5 DV51-322-2K2	4	10	12 – 14	13	M 5	2	1.5	2
DV51-320-7K5	6	8	12 – 14	13	M 5	2 – 2.2	2 – 2.2	2

Connecting the supply voltage

▶ Connect the supply voltage to the power terminals:
- Single-phase supply voltage: L, N and PE
- Three-phase supply voltage: L1, L2, L3 and PE
- DC supply and DC link coupling: DC+, DC– and PE.

▶ Refit the cable retainer.

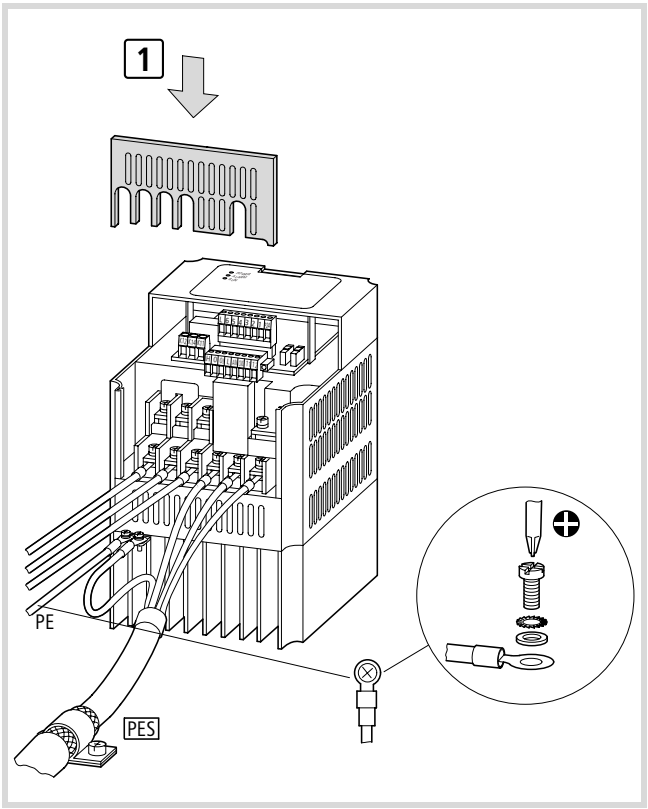


Figure 32: Connecting cables to the power terminals

Example: Connecting the motor supply cable

- ▶ Connect the motor cable to the U, V, W and PE terminals:
- ▶ Connect the mains voltage or the RFI filter outputs to the following terminals:
  - – L, N and PE for single-phase power supply,
  - – L1, L2, L3 and PE for three-phase power supply.

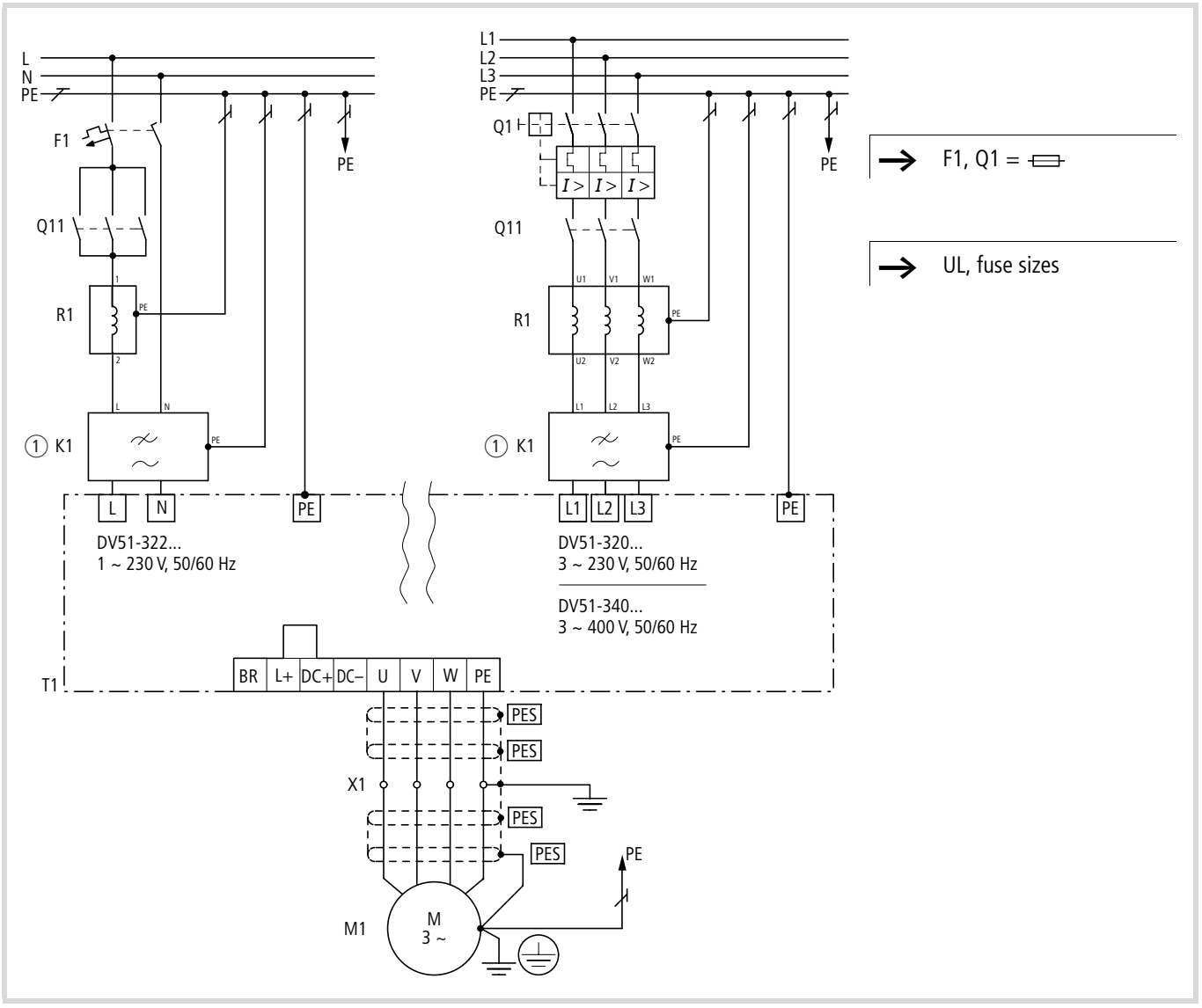


Figure 33: Power terminal connection example

F1, Q1: Line protection
Q11: Mains contactor
R1: Line reactor
① optional
K1: RFI filter
T1: Frequency inverter
M1: Motor
X1: Terminals (for example control panel)

Line protection (F1, Q1)
The mains-side is protected to the current strengths listed here.

Table 7: Fused 230 V and 400 V power supply

Model	1 h	3 h
230 V		
DV51-320-3K7	–	30 A
DV51-320-5K5	–	40 A
DV51-320-7K5	–	50 A
DV51-322-025 DV51-322-037 DV51-322-055	10 A	10 A
DV51-322-075 DV51-322-1K1	15 A	15 A
DV51-322-1K5	20 A	15 A
DV51-322-2K2	30 A	20 A
400 V		
DV51-340-037	–	3 A
DV51-340-075	–	6 A
DV51-340-1K5 DV51-340-2K2	–	10 A
DV51-340-3K0 DV51-340-4K0	–	15 A
DV51-340-5K0	–	20 A
DV51-340-7K5	–	25 A

Fuse elements: → section "Cables and fuses", page 123.

→ Observe the electrical connection data (rating data) on the motor's rating label (nameplate).

⚠ **Warning!**
If motors are used whose insulation is not suitable for operation with frequency inverters, the motor may be destroyed.

If you use a motor reactor or a sinusoidal filter here, the rate of voltage rise can be limited to values of approx. 500 V/µs (DIN VDE 0530, IEC 2566).

By default, the DV51 frequency inverters have a clockwise rotation field. Clockwise rotation of the motor shaft is achieved by connecting the motor and frequency inverter terminals as follows:

Motor	DV51
U1	U
V1	V
W1	W

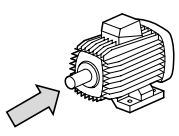


Figure 34: To determine direction of rotation, view from here

In frequency inverter operation with the DV51, you can reverse the direction of rotation of the motor shaft by:

- exchanging two of the phases connected to the motor,
- actuating terminal 1 (FWD = clockwise rotating field) or 2 (REV = anticlockwise rotating field (default)),

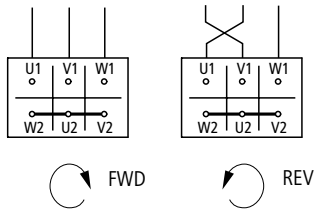


Figure 35: Reversing the direction of rotation

The speed of a three-phase motor is determined by the number of pole pairs and the frequency. The output frequency of the DV51 frequency inverter is indefinitely variable from 0 to 400 Hz.

Pole-changing three-phase motors (Dahlander pole-changing motors), rotor-fed three-phase commutator shunt motors (slipring rotor) or reluctance motors, synchronous motors and servo motors can be connected, provided they are approved for use with frequency inverters by the motor manufacturer.

⚠ **Warning!**
The operation of a motor at speeds higher than the rated speed (see nameplate) can cause mechanical damage to the motor (bearings, unbalance) and the machinery to which it is connected and can lead to dangerous operating conditions!

▽ **Caution!**
Uninterrupted operation in the lower frequency range (less than approx. 25 Hz) can lead to thermal damage (overheating) of self-ventilated motors. Possible remedies include over-dimensioning and external cooling independent of motor speed.

Observe the manufacturers recommendations for operation of the motor.

Connecting a signalling relay

The signalling relay consists of a floating contact (changeover switch). The contacts are connected to terminals K11, K12 and K14.

The illustration to the right indicates the position of the signalling relay terminals.

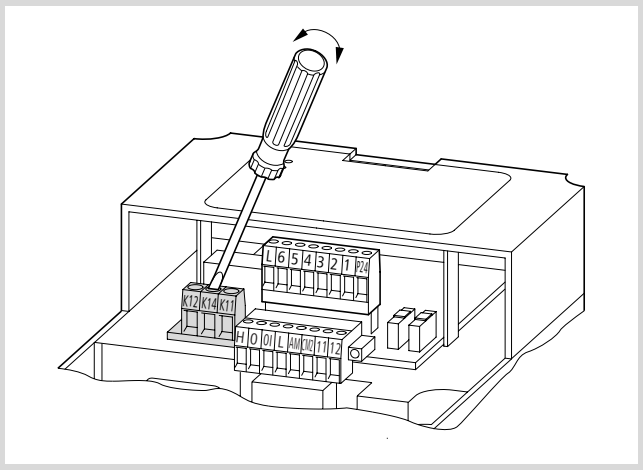
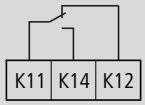


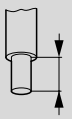
Figure 36: Position signalling relay terminals

Table 8: Description of the signalling relay terminals

Terminal designation	Description[1)]
K11 K12 K14	Default settings: • Operating signal: K11-K14 closed. • Fault message or power supply off: K11-K12 closed Characteristics of the relay contacts: • Maximum 250 V AC/2.5 A (resistive) or 0.2 A (inductive, power factor = 0.4); minimum 100 V AC/10 mA • Maximum 30 V DC/3.0 A (resistive) or 0.7 A (inductive, power factor = 0.4); minimum 5 V DC/100 mA 

1) You can assign the digital output functions to the signalling relay (PNU C021).

Table 9: Conductor cross-sections, tightening torques and required tools for the signalling relay terminals

					
					M3
n	mm²	mm	AWG	mm	Nm
1 ×	0.14 to 1.5	6	6 to 16	0.4 × 2.5	0.5 to 0.6
2 ×	0.14 to 0.75	6	–	0.4 × 2.5	0.5 to 0.6

Control signal terminals

The plug-in type control signal terminals are arranged on two levels, the lower level being secured with two screws for strain relief.

ESD measures
Discharge yourself on an earthed surface before touching the control signal terminals and the circuit board to prevent damage through electrostatic discharge.

Connecting the control signal terminals

Wire the control signal terminals to suit their application.

Caution!
Never connect terminal P24 with terminals L, H, OI or FM.

Use twisted or screened cables for connecting to the control signal terminals. Earth the screen on one side with a large contact area near the frequency inverter. The cable length should not exceed 20 m. For longer cables, use a suitable signal amplifier.

The illustration to the right shows the positions and layout of the individual control signal terminals.

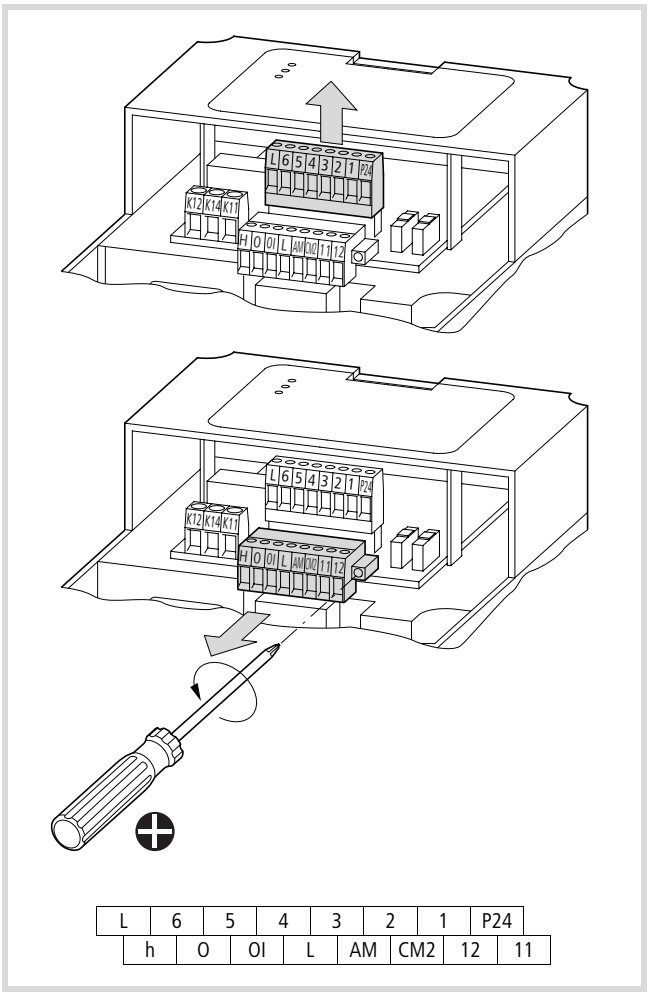
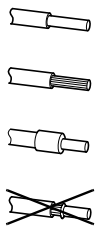
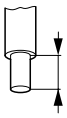


Figure 37: Position of control signal terminals

Table 10: Connection options for control signal terminals

mm²	AWG	mm	mm	M2 Nm	ft-lbs
0.14 – 0.75	18 – 28	5	0.4 × 2.5	0.22 – 0.25	0.16

The control signal terminals take solid and stranded cables without ferrule.

If the use of ferrules is required, use only ferrules with push-on sleeves.

Function of the control signal terminals

Table 11: Meaning of the control signal terminals

No.	Function	Level	DS	Technical data, description
L	Common reference potential	0 V	–	Reference potential for the internal voltage sources P24 and H
6	Digital input	HIGH = +12 to +27 V LOW = 0 to +3 V	2CH = second parameter set	PNP logic, configurable, R_i = 5 kΩ Reference potential: terminal L
5	Digital input		RST = reset	PNP logic, configurable, R_i = 33 kΩ Reference potential: terminal L
4	Digital input		FF2 (FF3) = fixed frequency 1 (3)	PNP logic, configurable, R_i = 5 kΩ Reference potential: terminal L
3	Digital input		FF1 (FF3) = fixed frequency 2 (3)	
2	Digital input		REV = anticlockwise rotation	
1	Digital input		FWD = clockwise rotation	
P24	Output control voltage	+24 V	–	Supply voltage for actuation of digital inputs 1 to 6. Load carrying capacity: 30 mA Reference potential: terminal L
h	Output reference voltage	+10 V ⎓	–	Supply voltage for external reference value potentiometer. Load carrying capacity: 10 mA Reference potential: terminal L
O	Analog input	0 to +10 V ⎓	Frequency setpoint value (0 to 50 Hz)	R_i = 10 kΩ Reference potential: terminal L
OI	Analog input	4 to 20 mA	Frequency setpoint value (0 to 50 Hz)	R_B = 250 Ω Output: terminal L
L	Common reference potential	0 V	–	Reference potential for the internal voltage sources P24 and H
AM	Analog output	0 to +10 V ⎓	Frequency actual value (0 to 50 Hz)	Configurable, DC voltage, 0 to 10 V corresponds to set final frequency (50 Hz). Load carrying capacity: 1 mA Reference potential: terminal L
CM2	Reference potential, transistor output	Up to 27 V ⎓	–	Connection: Reference potential (0 V) of the external voltage source for the transistor outputs, terminals 11 and 12. Load carrying capacity: up to 100 mA (sum of terminals 11 + 12)
12	Transistor output	Up to 27 V = CM2	RUN (operation)	Configurable, open collector Load carrying capacity: up to 50 mA
11	Transistor output		Frequency setpoint reached	

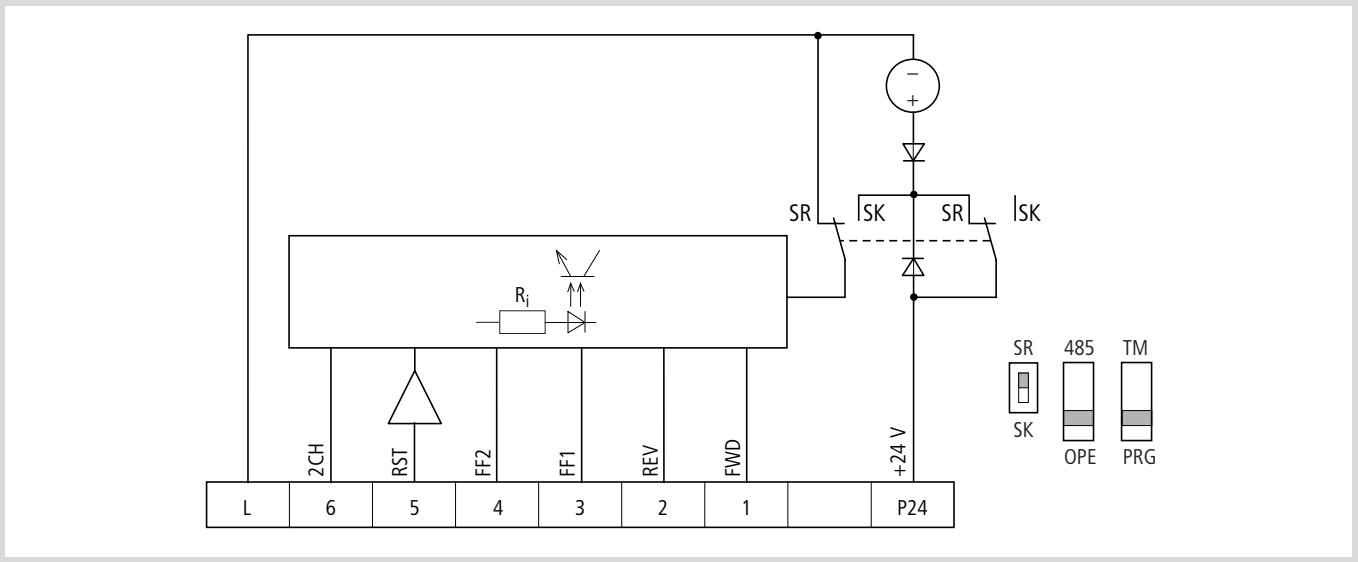


Figure 38: Upper control signal terminal bank

Inputs 1 to 6 all have the same function and mode of operation except for terminal 5, which can also be configured as thermistor input.

Inputs 1 to 6 are optically isolated and metallically isolated from the built-in control section (CPU). They are actuated with +24 V. You can use the device's internal control voltage from terminal P24 or an external voltage source.

Actuation of inputs 1 to 6 can be configured for special control circuits and national circuit types. Table 12 shows the various versions in dependence of the SR/SK microswitch. This switch is located to the right of the control signal terminals and has two switching contacts:

- SR = source, positive switching logic (default settings)
- SK = sink, negative switching logic

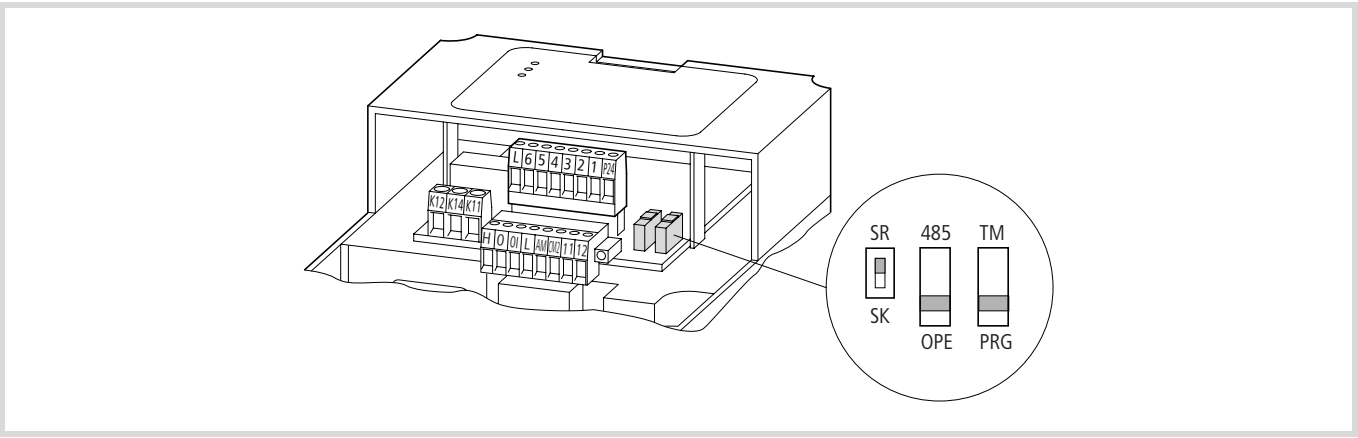
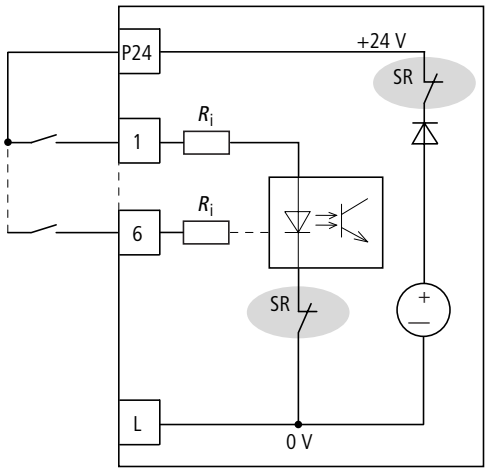
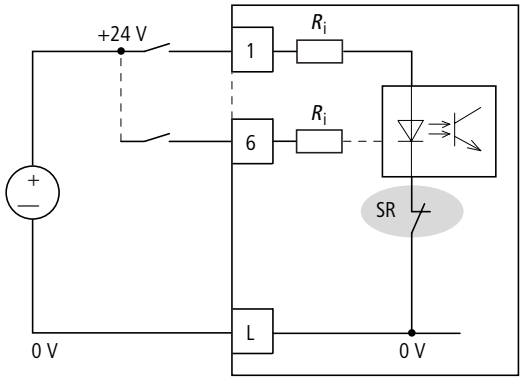
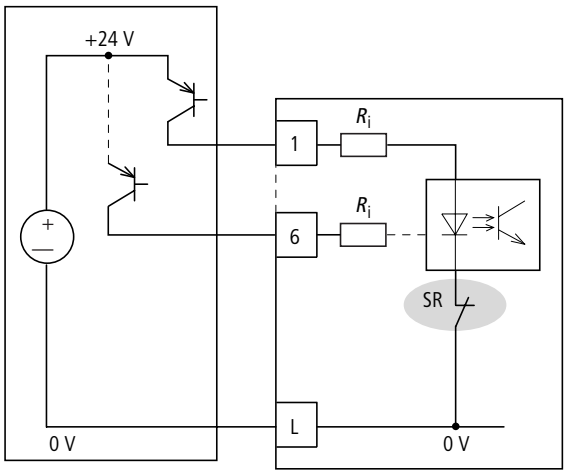
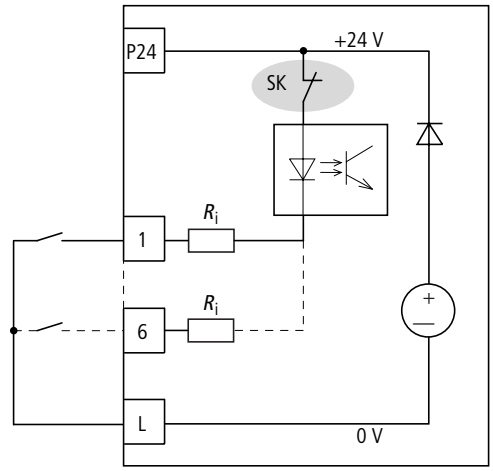
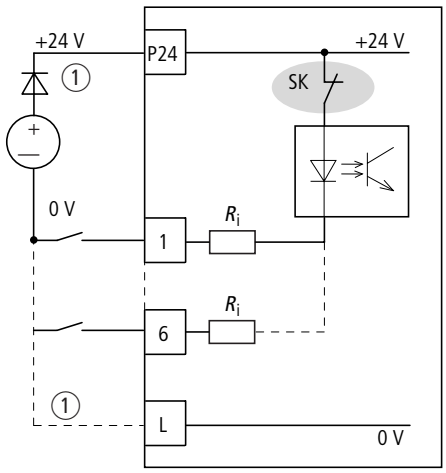
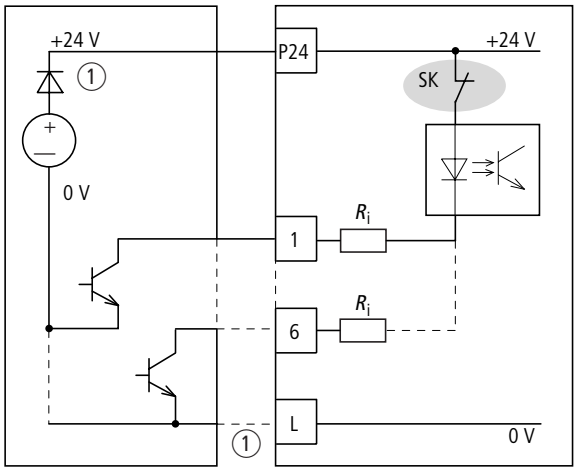


Figure 39: Position of microswitches

Warning!
Before you switch on the internal or external control voltage, check the position of the SR/SK switch. An incorrect setting can damage the control input.

Table 12: Actuation of inputs 1 to 6

Circuit example	SR/SK switch	Description
	SR	• Operation with internal control voltage • Standard circuit
	SR	• Operation with external control voltage +24 V) • Standard circuit • Reference point terminal L
	SR	• Operation with external control voltage from an electronic device (for example PLC, easy) • Reference point terminal L

Circuit example	SR/SK switch	Description
	SK	Operation with internal control voltage
	SK	• Operation with external control voltage +24 V) • Reference point terminal L ① If reference point L is connected with the 0 V potential of the external voltage source, the external 24 V potential should be decoupled through a diode.
	SK	• Operation with external control voltage from an electronic device (for example PLC, easy) • Reference point terminal L ① If reference point L is connected with the 0 V potential of the external voltage source, the external 24 V potential should be decoupled through a diode.

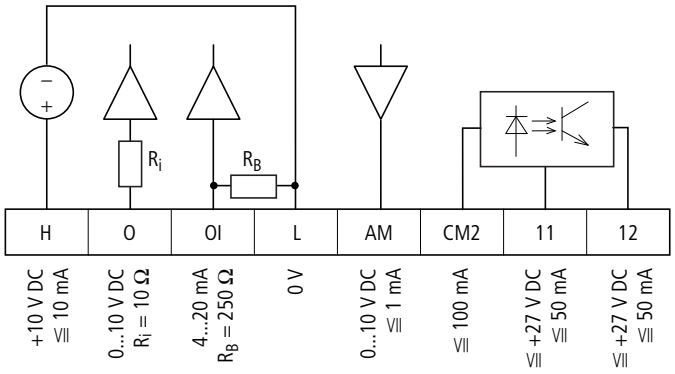
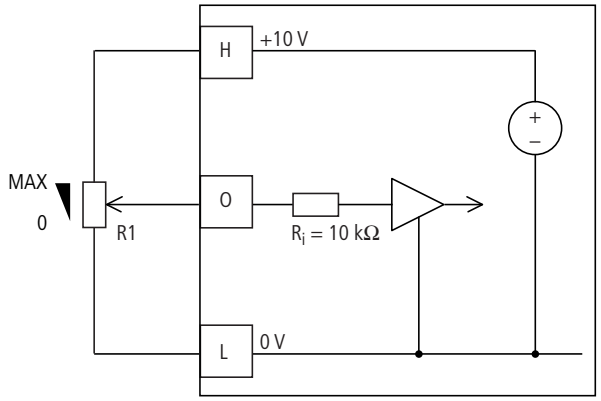
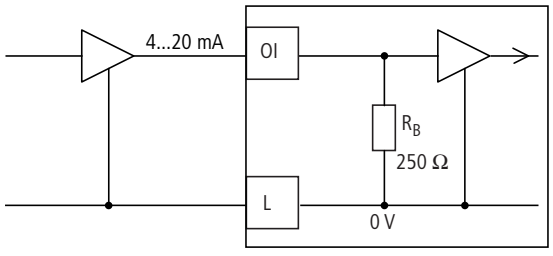


Figure 40: Lower control signal terminal bank

→ All analog inputs and outputs use terminal L as reference potential and are therefore also connected to the reference potential of digital inputs 1 to 6.

Terminal H outputs +10 V (max. 10 mA) to provide the setpoint voltage for supplying an external potentiometer. Reference point is terminal L.

Table 13: Actuating the analog inputs

Circuit example	Description
	• Frequency reference input (default = 0 to 50 Hz) through an external potentiometer (recommended fixed resistance 1 to 5 kΩ). • Standard circuit
	• Frequency reference input (default = 0 to 50 Hz) through an external 4 to 20 mA current signal. • Standard circuit

→ At the default setting, the input signals at terminals O (0 to 10 V) and OI (4 to 20 mA) are added to the frequency reference input. You can select the reference source with parameter PNU A005 (AT selection) and activate it through a control signal terminal (PNU C00x = 16).

Terminal AM supplies an analog reference signal from 0 to +10 V (default = 0 to 50 Hz). The reference potential is terminal L. The analog signal can be configured with parameters PNU B080, C028 and C086.

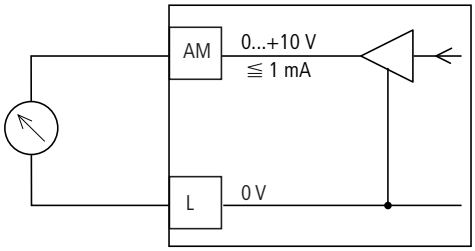


Figure 41: Example: analog measuring instrument

→ To increase operational reliability, screen analog and digital control signal cables and lay them well away from the power cables.

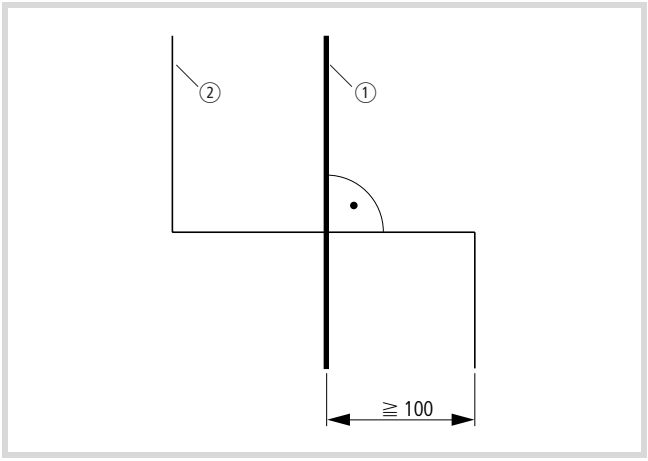


Figure 42: Crossover of signal and power cables

① Power cables: L1, L2, L3, PE, U, V, W, L+, DC+, DC–BR,

② Signal cables: H, O, OI, L, FM,1 to 6 , CM2, P24, K11, K12, K14

The following figure shows a sample protective circuit for the control signal terminals.

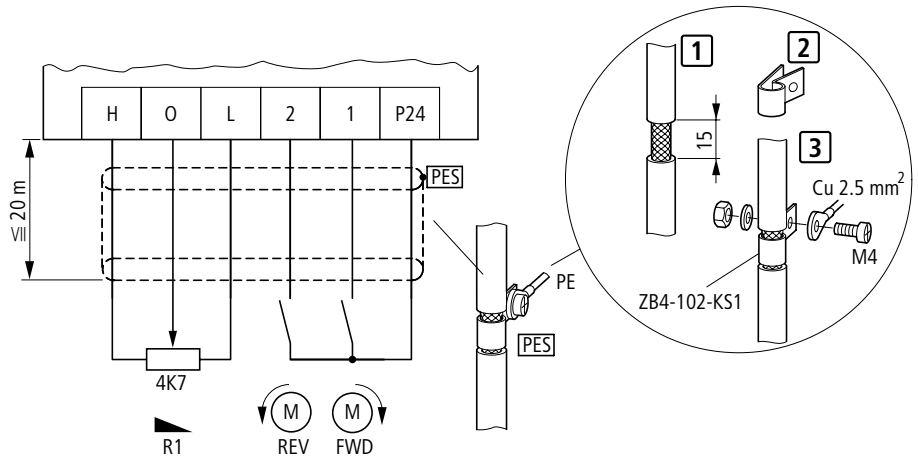


Figure 43: Control terminal connection (factory setting)

→ With the optional ZB4-102-KS1, you can connect the control cable screens at one end. Order this item separately.

If a relay is connected to one of the digital outputs 11 or 12, connect a freewheel diode in parallel to the relay to prevent destruction of the digital outputs through the self-induced e.m.f. which results when the relay is switched off.

The two digital outputs 11 and 12 contain optically decoupled open-collector transistors. Up to 50 mA can be applied to each of them. Their common reference potential is terminal CM2 (max. 100 mA).

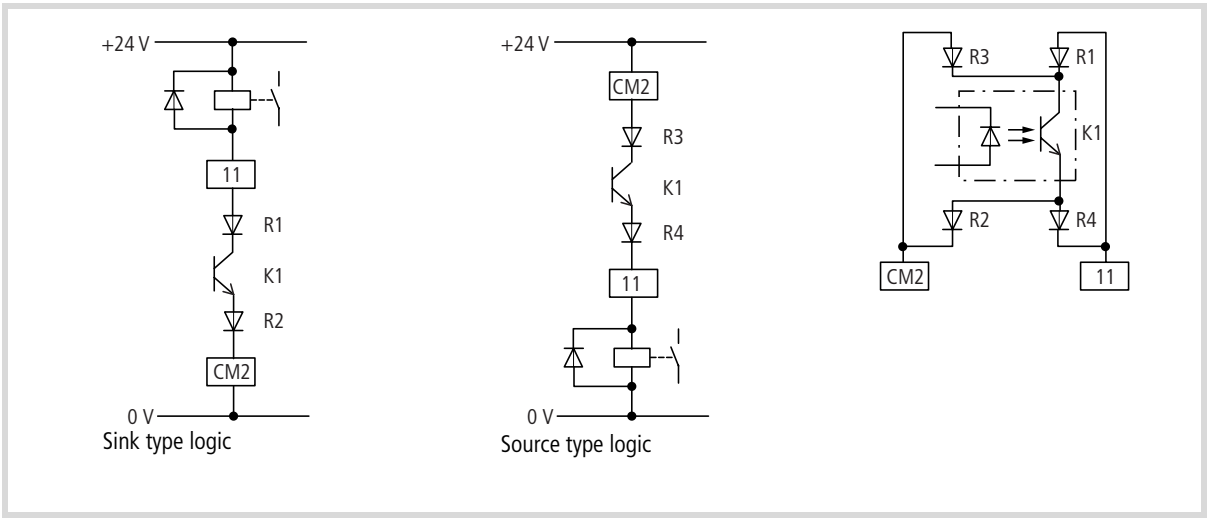


Figure 44: Digital outputs

Internal diode matrix R1 to R4 allows the connection in sink-type or source-type logic (→ fig. 44).

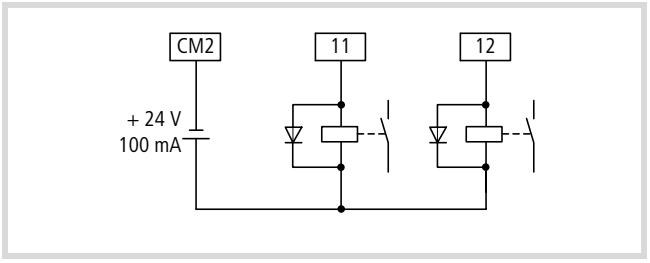


Figure 45: Relay with freewheeling diode (for example ETS-VS3)

→ Use relays that switch reliably at 24 V ⎓ and a current of about 3 mA.

4 Using the DV51

This section describes how to take the DV51 frequency inverter into operation and what you should observe during its operation.

Operational warnings

Warning!
If the supply voltage recovers after an intermittent failure, the motor may restart automatically if a start signal is still present. If personnel is endangered as a result, an external circuit must be provided which excludes a restart after voltage recovery.

Warning!
If the frequency inverter has been configured so that the stop signal is not issued through the OFF key on the LCD keypad, pressing the OFF key will not switch off the motor. A separate Emergency-Stop switch must be provided in this case.

Warning!
Maintenance and inspection of the frequency inverter may only be undertaken at least 5 minutes after the supply voltage has been switched off. Failure to observe this point can result in electric shock as a result of the high voltages involved.

Warning!
Never pull on the cable to unplug connectors (for example for fan or circuit boards).

Warning!
If a reset is carried out after a fault, the motor will start again at once automatically if a start signal is applied simultaneously. To avoid the risk of serious or fatal injury to personnel, you must ensure that the start signal is not present before acknowledging a fault message with a reset.

Warning!
When the supply voltage for the frequency inverter is applied while the start signal is active, the motor will start immediately. Make sure therefore that the start signal is not active before the supply voltage is switched on.

Warning!
Do not connect or disconnect cables or connectors during operation while the supply voltage is switched on.

Caution!
To prevent a risk of serious or fatal injury to personnel, never interrupt the operation of the motor by opening the contactors installed on the primary or secondary side.

→ The START key is functional only if the corresponding parameters of the frequency inverter have been configured accordingly .

→ If motors are to be operated at frequencies above the standard 50 or 60 Hz, consult the motor manufacturer to make sure that the motors are suitable for operation at higher frequencies. The motors could otherwise incur damage.

Block diagram

The following block diagram shows all terminals of the DV51.

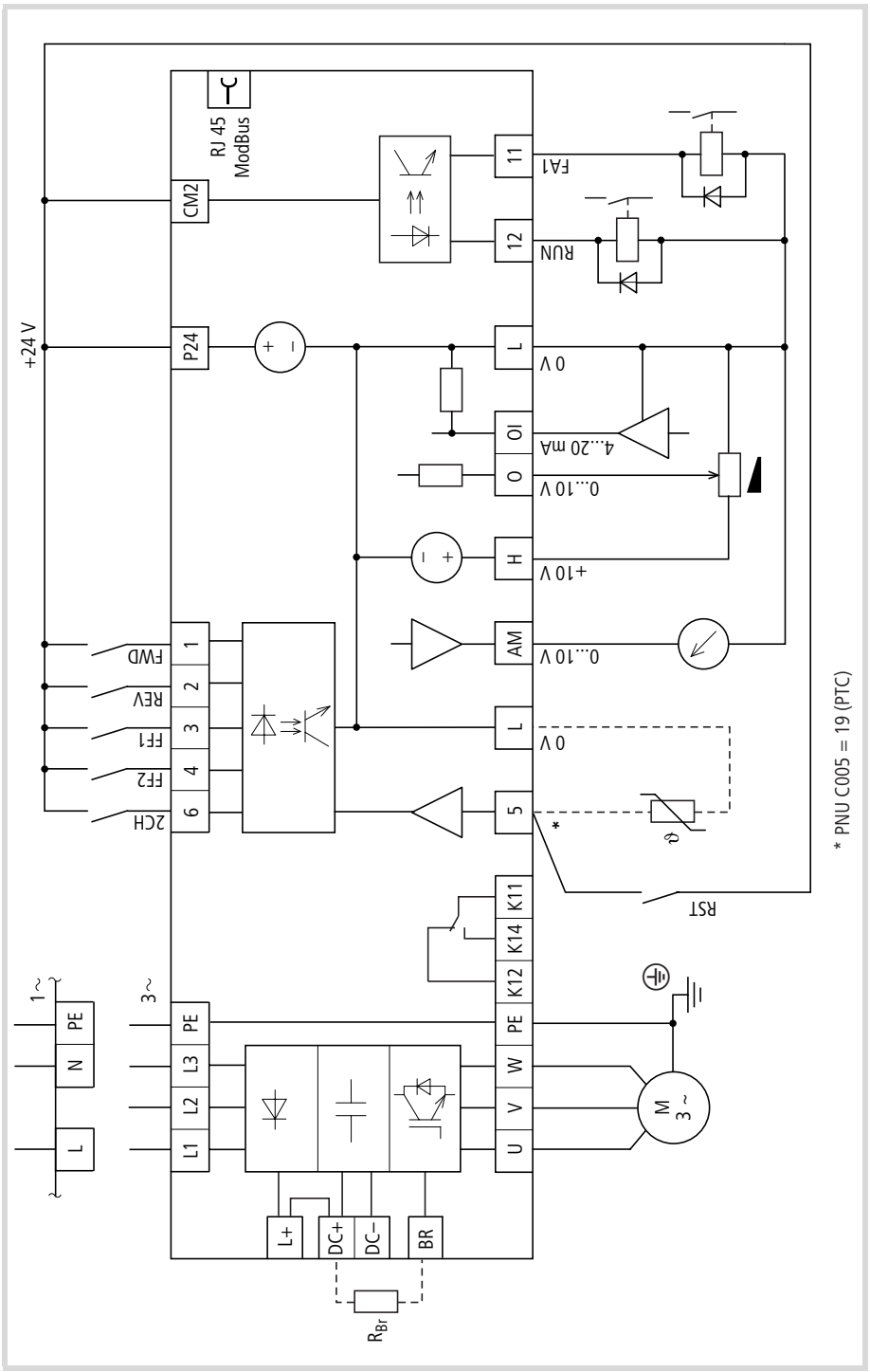


Figure 46: Block diagram, DV51

Power terminals

L, L1, L2, L3, N Supply (mains) voltage

U, V, W Frequency inverter output

L+, DC+ External DC choke

BR, DC+ External braking resistor

DC+, DC– Internal DC link

⏚, PE Positive earth

Control signal terminals

P24 Control voltage output, +24 V

1 Digital input

2 Digital input

3 Digital input

4 Digital input

5 Digital input

6 Digital input

L Common 0 V reference potential

H Reference voltage output, +10 V

O Analog input, 0 to +10 V

OI Analog input, 4 to 20 mA

AM Analog output, 0 to 10 V

K11 Signalling relay terminal

K12 Signalling relay terminal (NC)

K14 Signalling relay terminal (NO)

CM2 Reference potential, transistor output

12 Transistor output, max. 27 V

11 Transistor output, max. 27 V

RJ 45 Interface connection for expansion

Initial starting

Observe the following points before you take the frequency inverter into operation:

- The frequency inverter must be installed vertically on a non-flammable surface (for example a metal surface).
- Remove any residue from wiring operations – such as pieces of wire – and all tools from the vicinity of the frequency inverter.
- Ensure that all terminal screws have been tightened sufficiently.
- Make sure that the cables connected to the output terminals are not short-circuited or connected to earth.
- Make sure that the power lines L1 and N or L1, L2 and L3 and the frequency inverter outputs U, V and W are connected correctly.
- The earth terminal must be connected correctly.
- Only the terminals marked as earthing terminals must be earthed.
- The control lines must be connected correctly.
- Make sure that the frequency inverter and the motor are correct for the mains voltage.
- Check the position of the microswitches.
- Never operate the frequency inverter with opened power section covers (without fitted terminal shroud).
- The configured maximum frequency must match the maximum operating frequency of the connected motor.

▽ **Caution!**
Do not carry out h.v. tests as this could destroy the built-in overvoltage filters fitted between the mains voltage terminals and earth.

→ Sparkover voltage and insulation resistance tests (megger tests) have been carried out by the manufacturer.

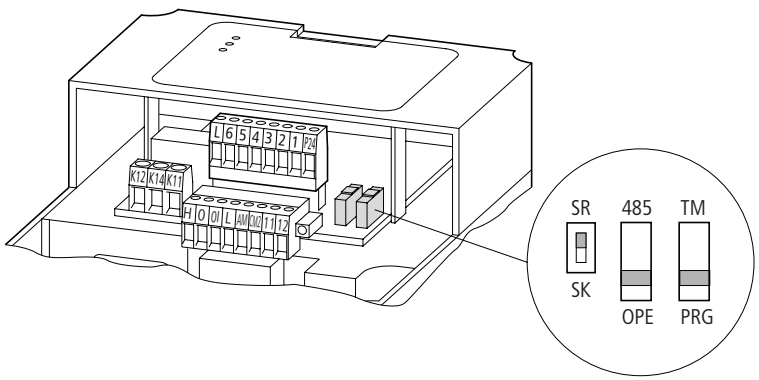


Figure 47: Default settings of microswitches

Table 14: Function of the microswitches

Switch	Function	Description, default setting
SR/SK	SR	SR = source, positive switching logic. Activate by applying control voltage (+24 V)
485/OPE	OPE	OPE = operator keypad (Optional: DEX-KEY-6…, DEX-KEY-10)
TM/PRG	PRG	PRG = program In this switch position, the control signal and reference value sources set with PNU A001 (A201) and A002 (A202) are taken into account. In the default configuration, these are input values at the control signal terminals. In switch position TM (= control terminals) only the reference value input through the control signal terminals is accepted, regardless of the value of PNU A001 and A002.

By default, the parameters of the DV51 frequency inverters are configured to fulfill the following requirements:

- Motor ratings: voltage, current and frequency of a normal, surface-cooled, four-pole three-phase asynchronous motor.
- Sensorless vector control: control signals via control signal terminals and linear speed changes via an external, analog potentiometer.
- Maximum speed: 1500 r.p.m. at 50 Hz (DV51-320: 1800 r.p.m. at 60 Hz).
- Acceleration and deceleration time = 10 seconds.

For settings for more complex applications, see the parameter list (page 136).

The basic versions of the DV51 frequency inverters contain an operating state LED.

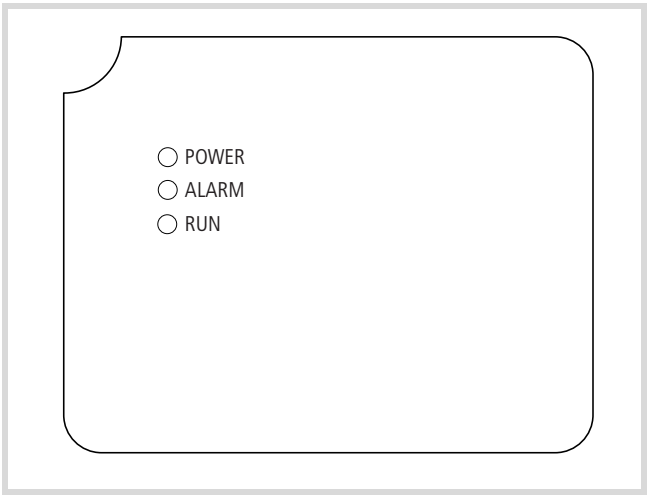


Figure 48: LED display (DEV51-KEY-FP)

LED	Display	Explanation
POWER	Red	LED is lit when the frequency inverter has power.
ALARM	Red	LED is lit when an alarm message is issued.
RUN	Green	LED lit when frequency inverter operational (Enable signal for clockwise/anticlockwise operation, terminal 1 or 2) or running.

Standard operation, actuation with default settings

Connect cables as shown below.

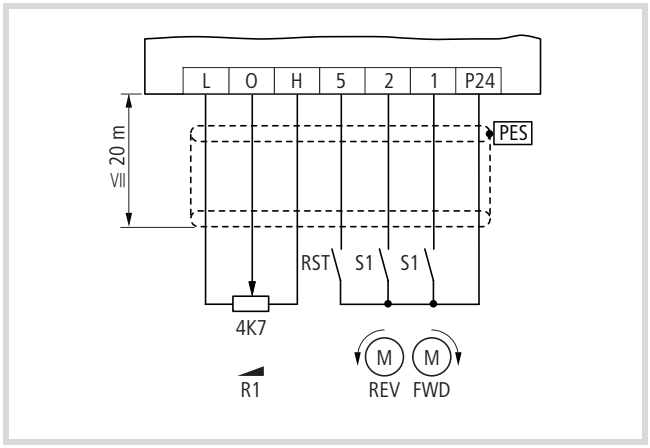


Figure 49: Active inputs in default setting

→ The Reset signal (RST) is also issued when you switch the supply voltage off (POWER LED off).

Table 15: Meaning of the control signal terminals

No.	Function	Level	DS	Technical data, description
L	Common reference potential	0 V	–	Reference potential for the internal voltage sources P24 and H
5	Digital input	HIGH = +12 to +27 V LOW = 0 to +3 V	Reset	PNP logic, configurable, R_i = 33 kΩ Reference potential: terminal L
2	Digital input		REV = anticlockwise rotation	
1	Digital input		FWD = clockwise rotation	
P24	Output control voltage	+24 V	–	Supply voltage for actuation of digital inputs 1 to 6. Load carrying capacity: 30 mA Reference potential: terminal L
h	Output reference voltage	+10 V ⎓	–	Supply voltage for external reference value potentiometer. Load carrying capacity: 10 mA Reference potential: terminal L
O	Analog input	0 to +10 V ⎓	Frequency setpoint value (0 to 50 Hz)	R_i = 10 kΩ Reference potential: terminal L
L	Common reference potential	0 V	–	Reference potential for internal voltage sources P24, H and analog inputs

With the default settings (→ fig. 49) you can:

- start and stop the motor (S1 or S2),
- reverse the direction of rotation (S2 or S1),
- reset (RST) fault signals (ALARM),

- control the motor speed (0 to 50 Hz, or 0 to 60 Hz for DV51-320-…) with potentiometer R1 through the analog reference value input.

Switches and potentiometer are not included as standard with the frequency inverter.

Caution!
During initial operation, check the following to prevent damage to the motor:

- Is the direction of rotation correct?
- Does a fault (ALARM LED) occur during acceleration or deceleration?
- Is the motor speed correct?
- Does any unusual motor noise or vibration occur?

▶ Switch on the supply voltage.

The POWER LED is lit.

▶ Close switch S1 (FWD = clockwise rotation).

The frequency inverter generates a clockwise rotating field and the motor, if connected normally, rotates in a clockwise direction.

▶ With potentiometer R1, you can change the frequency and therefore the motor speed.

▶ Open switch S1.

The motor speed is reduced to zero.

▶ Close switch S2 (REV = anticlockwise rotation).

The frequency inverter generates an anticlockwise rotating field and the motor, if connected normally, rotates in an anticlockwise direction.

▶ With potentiometer R1, you can change the frequency and therefore the motor speed.
▶ Open switch S2.

The motor speed is reduced to zero.

If both switches S1 and S2 are closed, the motor will not start. The motor speed reduces to zero during operation if you close both switches.

If a fault has occurred due to overcurrent or overvoltage, increase the acceleration or deceleration time. To do this, you need an optional keypad (DEX-KEY-6… or DEX-KEY-10) or the Drive Soft configuration software. The software is included on the CD-ROM supplied with the frequency inverter. To reset fault signals, close RST.

Output terminals

By default, the control signal outputs have the functions described below.

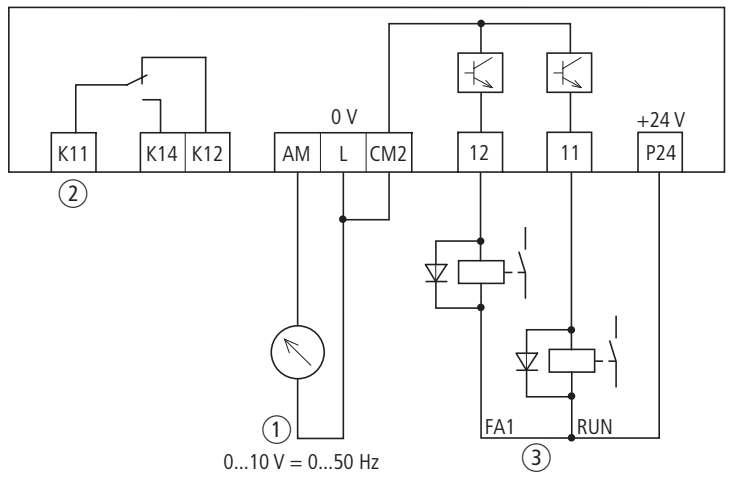


Figure 50: Active outputs with default settings

① Frequency indication, 0 to 10 V = 0 to 50 Hz
② AL fault message
③ FA1 = frequency reached (setpoint = actual value)
RUN = Run signal

→ Relay for direct connection to the digital outputs as shown in Figure 50, for example ETS-VS3.

Table 16: Meaning of the control signal terminals

No.	Function	Value	DS	Technical data, description
P24	Output control voltage	+24 V	–	Supply voltage Load carrying capacity: 30 mA Reference potential: terminal L
12	Transistor output	Up to 27 V = CM2	00 = RUN: Run signal	Configurable, open collector Load carrying capacity: up to 50 mA each
11	Transistor output		01 = FA1: frequency achieved	
CM2	Reference potential, transistor output	0 V[1)] +24 V[1)]	–	Common reference potential for transistor outputs 11 and 12; max. load carrying capacity 100 mA (total of terminals 11 and 12)
L	Common reference potential	0 V	–	Reference potential (0 V) for internal voltage source P24 and H, for analog inputs O and OI, and for analog output AM.
AM	Analog output	0 to +9.6 V	Frequency actual value (0 to 50 Hz)	Configurable DC voltage output, 10 V corresponds with the set end frequency (50 Hz). Accuracy: ±5 % from final value Load carrying capacity: 1 mA Reference potential: terminal L
K11	Relay contact	• Up to 250 V AC/2.5 A • Up to 30 V DC/3.0 A	05 = AL: fault signal	• Operating signal: K11-K14 closed. • Fault message or power supply off: K11-K12 closed
K12	Break contact			
K14	Make contact			

1) "Sink-type logic" connection: reference potential 0 V
"Source-type logic" connection: reference potential +24 V
(→ page44)

5 Optional keypad DEX-KEY-6…

The optional keypad DEX-KEY-6… is available in two versions:

- DEX-KEY-6, with reference value potentiometer;
- DEX-KEY-61, without reference value potentiometer.

These keypads provide access to all inverter parameters and therefore allow user-specific adjustment of the settings of frequency inverters DF51, DV51, DF6 and DV6.

LEDs and a four-digit digital display indicate the operating status, operational data and parameter values. With the pushbuttons, you can change the parameter values and control frequency inverter operation (Start/Stop). The frequency setpoint value can be adjusted with the potentiometer (DEX-KEY-6 only).

→ The DEX-KEY-6… keypads are not included with the frequency inverter.

Type code

Type codes and part numbers of keypads DEX-KEY-6…:

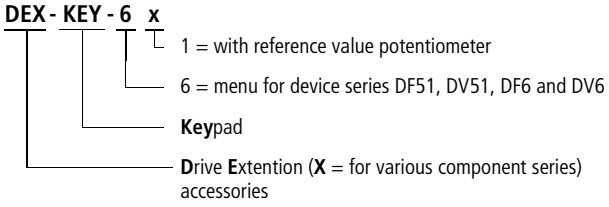


Figure 51: Key to part numbers, keypads DEX-KEY-6…

Equipment supplied

Open the packaging with suitable tools and inspect the contents immediately after delivery to ensure that they are complete and undamaged. The package should contain the following items:

- One keypad DEX-KEY-6 or DEX-KEY-61
- The mounting instructions AWA8240-2148
- One RJ 45 plug-in adapter (DEX-CON-RJ45)

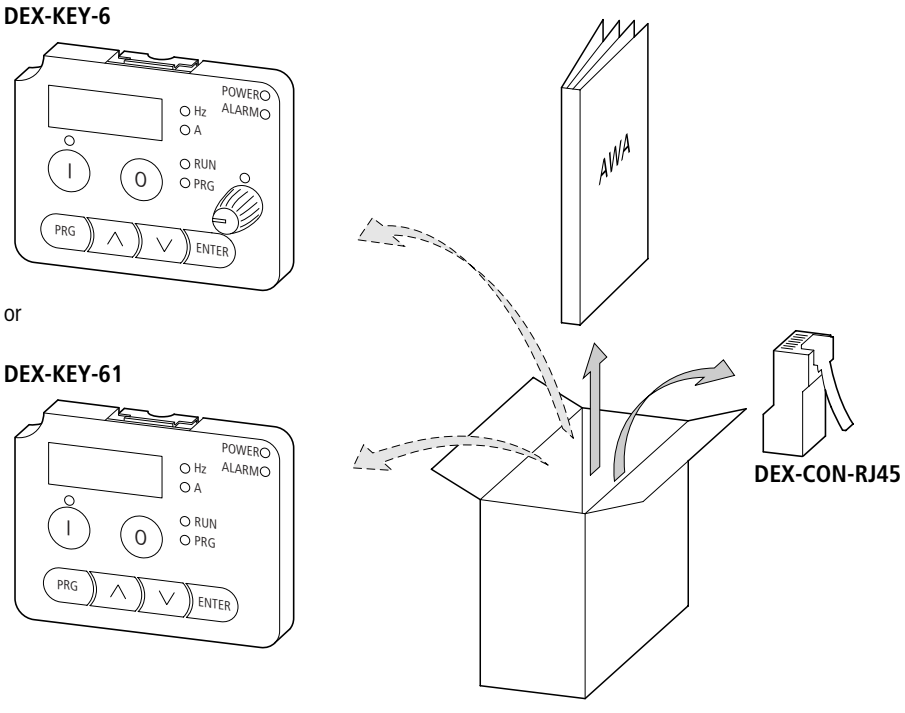


Figure 52: Equipment supplied, keypad DEX-KEY-6…

Layout of the DEX-KEY-6…

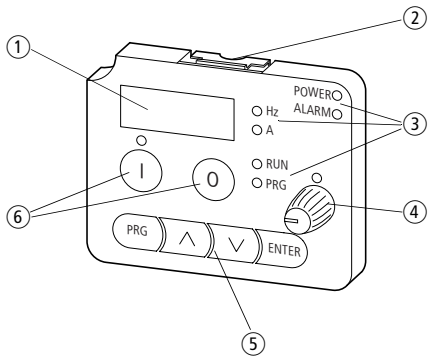


Figure 53: Layout of the DEX-KEY-6…

① 4 digit digital display
② Fixing clip (only for use when mounting in DV51)
③ LED status display
④ Reference value potentiometer (only with DEX-KEY-6)
⑤ Keyboard for altering parameters
⑥ Pushbuttons (Start, Stop)

Fitting a keypad in the DV51

The keypad can be plugged in to frequency inverters of the DV51 series instead of the factory mounted LED display DEV51-KEY-FP.

The DV51 frequency inverter and the keypad are connected with an RJ-45 connector. Adapter DEX-CON-RJ45 is factory mounted and allows a direct connection with keypads DEX-KEY-6… Before you connect the cable, remove the DEX-CON-RJ45.

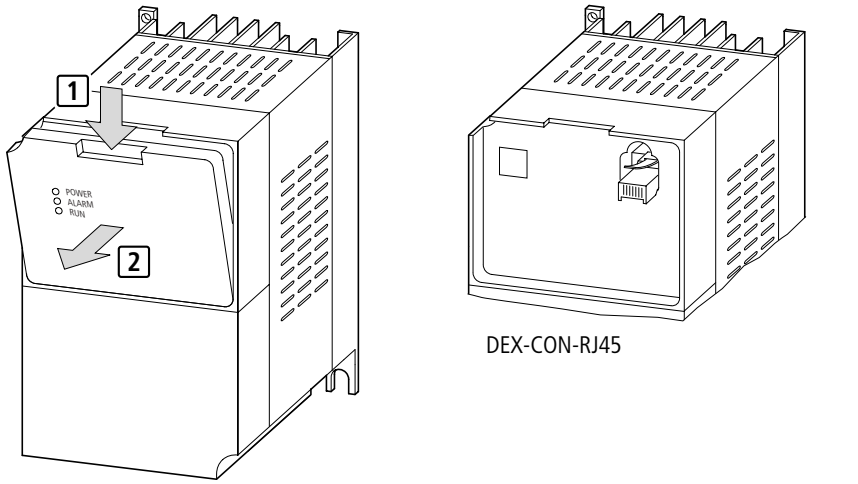


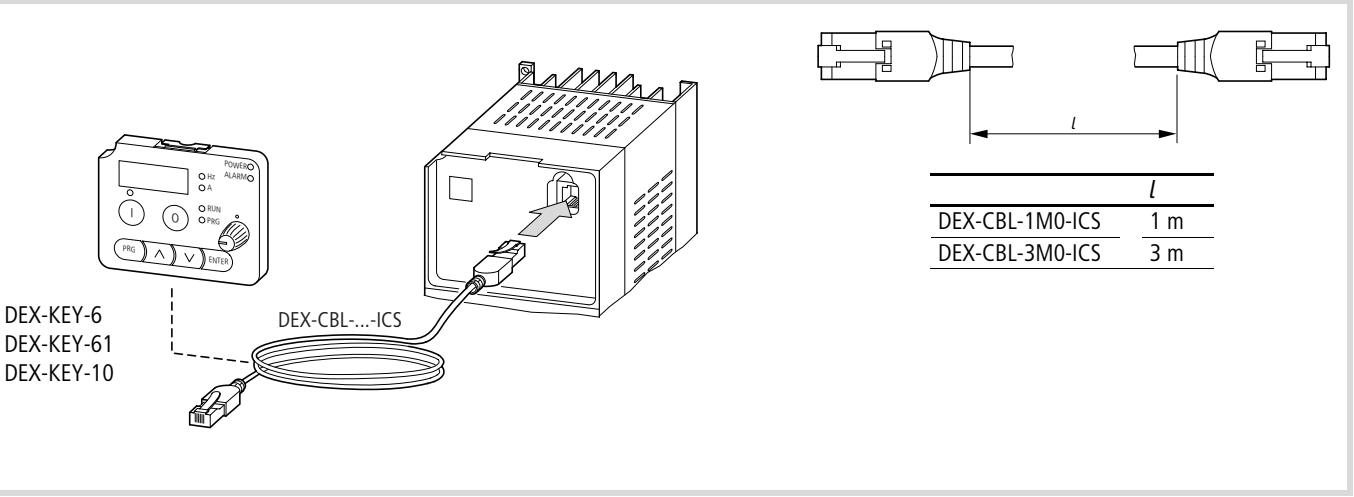
Figure 54: Fitting keypad DEX-KEY-6… in DV51

→ No tools are required to fit and remove the optional keypads, LED displays and plug-in adapters.

▽ **Caution!**
Fit and remove the keypad, LED display or plug-in adapter only under no volt conditions and without using force.

Keypad and connection cable

Together with the optional connection cable DEX-CBL-…-ICS the keypad provides remote access to the parameters of frequency inverters DF51, DV51, DF6 and DV6.

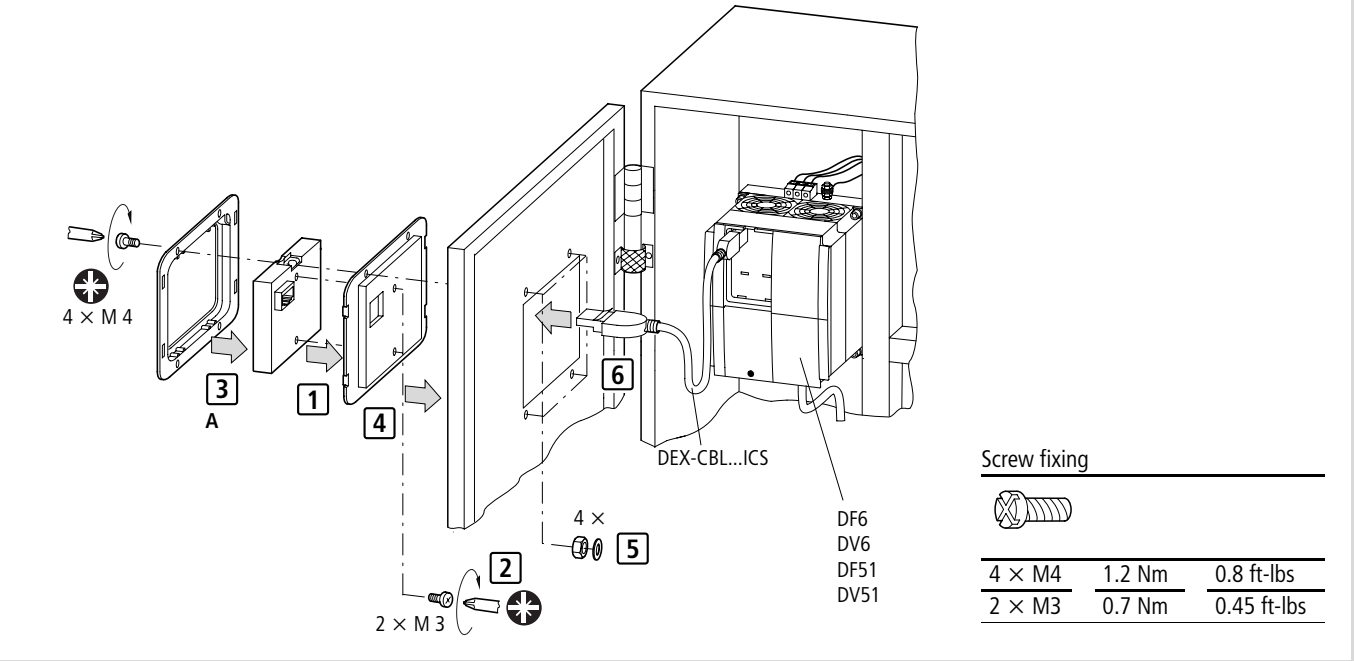


	l
DEX-CBL-1M0-ICS	1 m
DEX-CBL-3M0-ICS	3 m

Figure 55: Frequency inverter with connection cable DEX-CBL-…-ICS

Optional mounting frame DEX-MNT-K6

Mounting frame DEX-MNT-K6 is available for external mounting of the keypad (for example in the panel door). Please order the mounting frame separately.



Screw fixing

4 × M4	1.2 Nm	0.8 ft-lbs
2 × M3	0.7 Nm	0.45 ft-lbs

Figure 56: External keypad with mounting frame DEX-MNT-K6

Equipment supplied, mounting frame

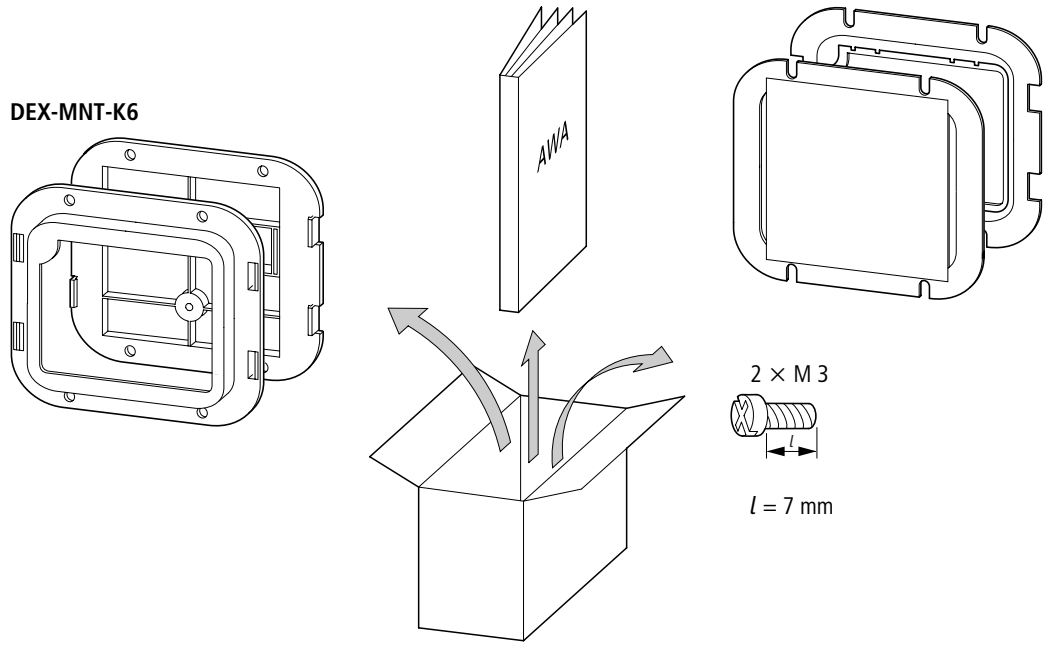


Figure 57: Equipment supplied

Fitting the mounting frame

The mounting frame can be fitted in one of two ways:

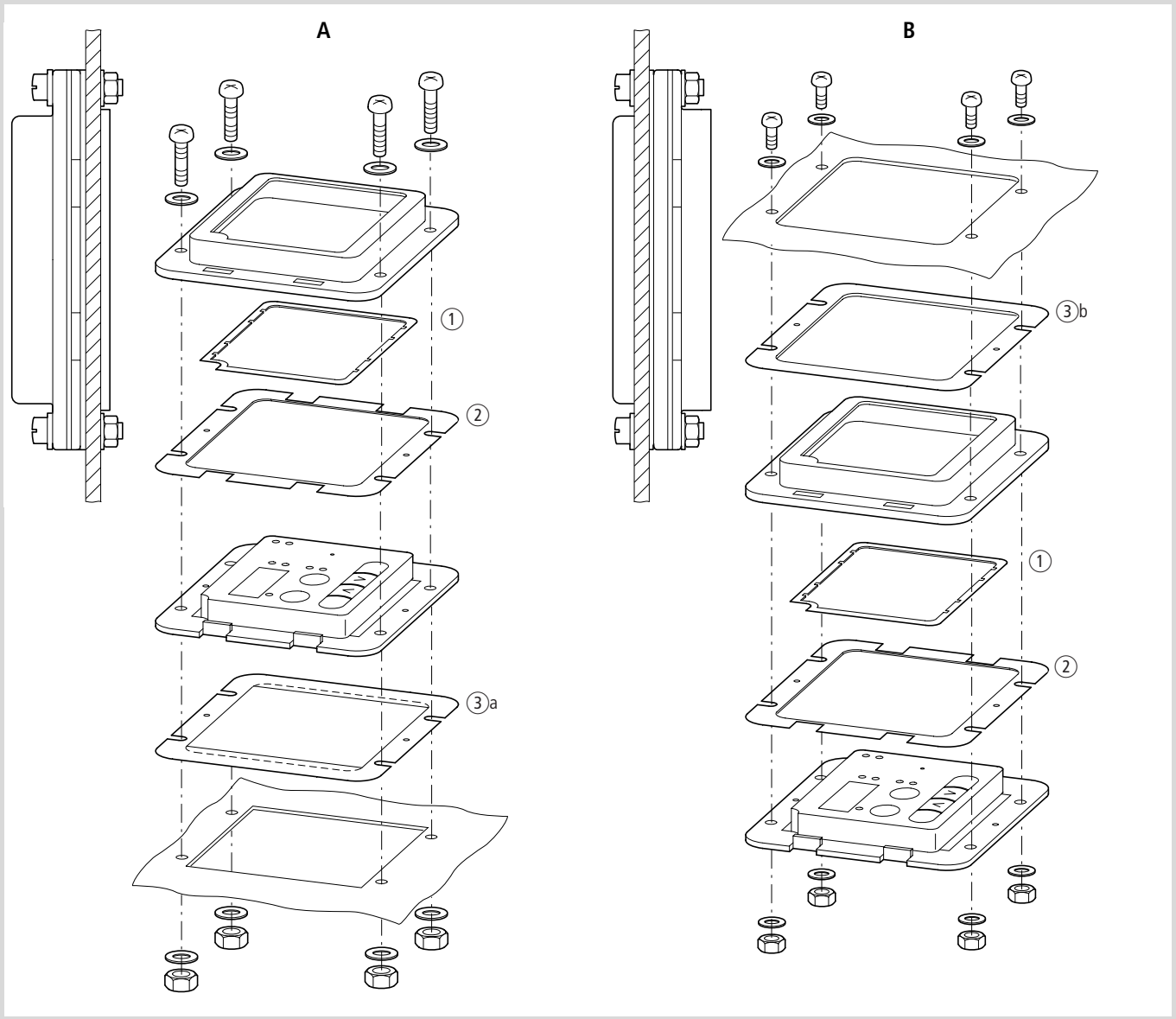


Figure 58: Fitting the mounting frame

A on top of the mounting surface (panel mounting)

B behind the mounting surface (waterproof mounting)

Mounting method A

Mounting in a panel door or on a control desk with standard-size punching tool for instruments (67 mm square hole).

Mounting method B

Mounting in a waterproof enclosure (IP 54, NEMA4). Only possible with DEX-KEY-61, keypad **without** potentiometer.

Mounting the keypad and fitting a gasket

To mount keypad DEX-KEY-6 or DEX-KEY-61 in the mounting frame, the supplied, self-adhesive gasket must be used for both mounting methods.

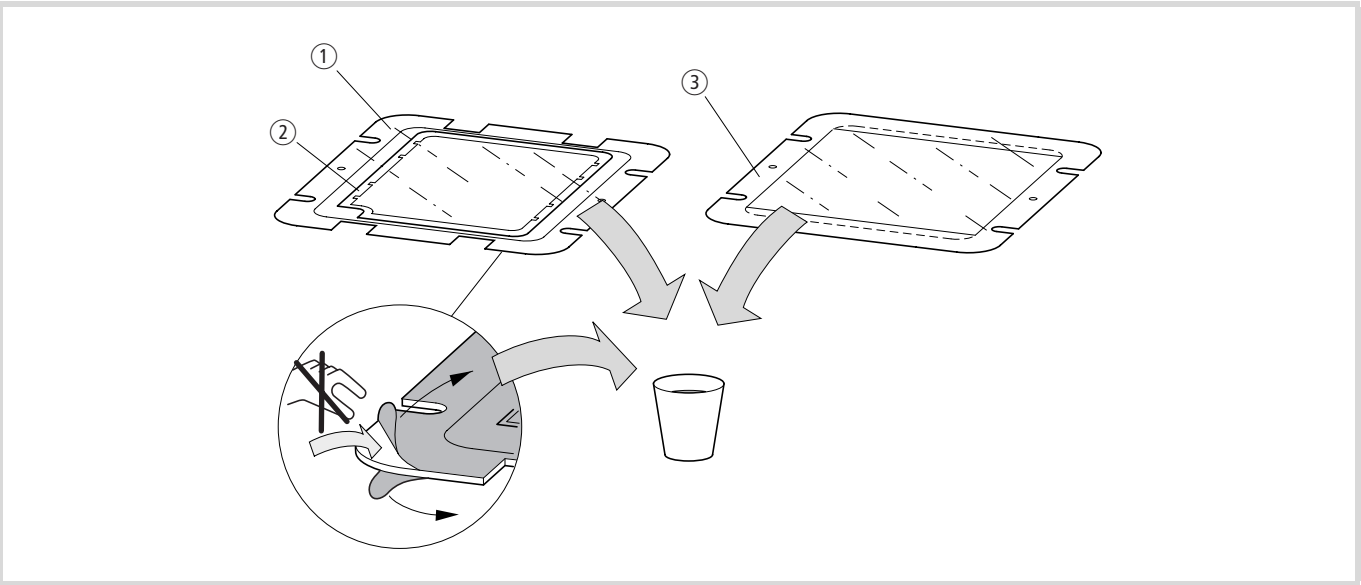


Figure 59: Self-adhesive gasket

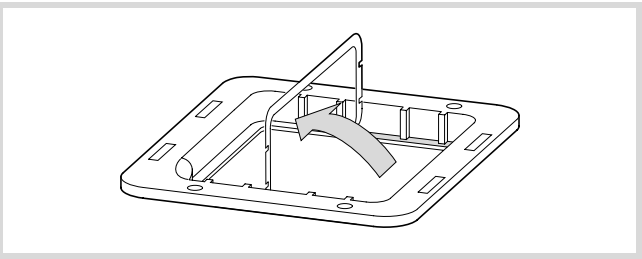


Figure 60: Apply gasket to inside of front frame

► Apply the gasket to the inside of the front frame and remove the second protective foil.

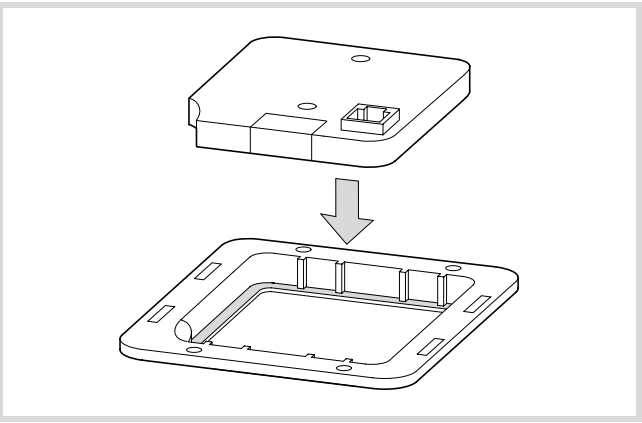


Figure 61: Fitting keypad DEX-KEY-6…

► Fit keypad DEX-KEY-6… in the mounting frame.

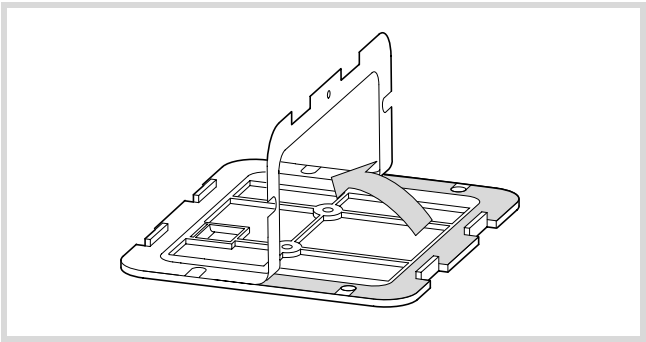


Figure 62: Applying the gasket to the inside of the frame

► Apply the corresponding gasket to the inside of the frame and remove the second protective foil.

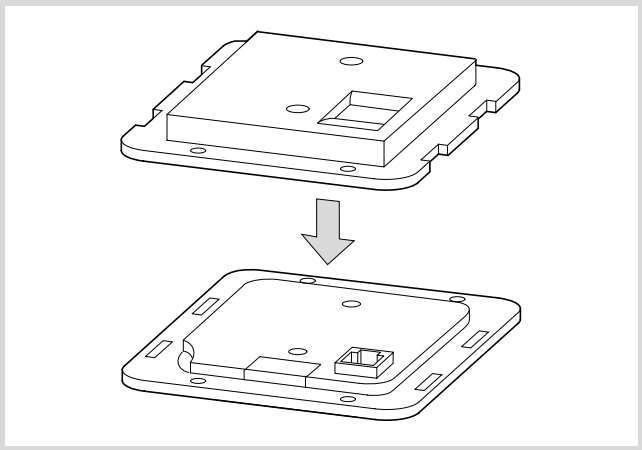


Figure 63: Joining the frames

- ▶ Press the mounting frame and the front frame (complete with keypad) together until the side fixings engage.
- ▶ Fix the mounting frame to the keypad using the two screws (M3 × 7 mm, 1.5 Nm).

Depending on the application (control panel door or waterproof mounting), apply the second gasket to the mounting frame or the front frame.

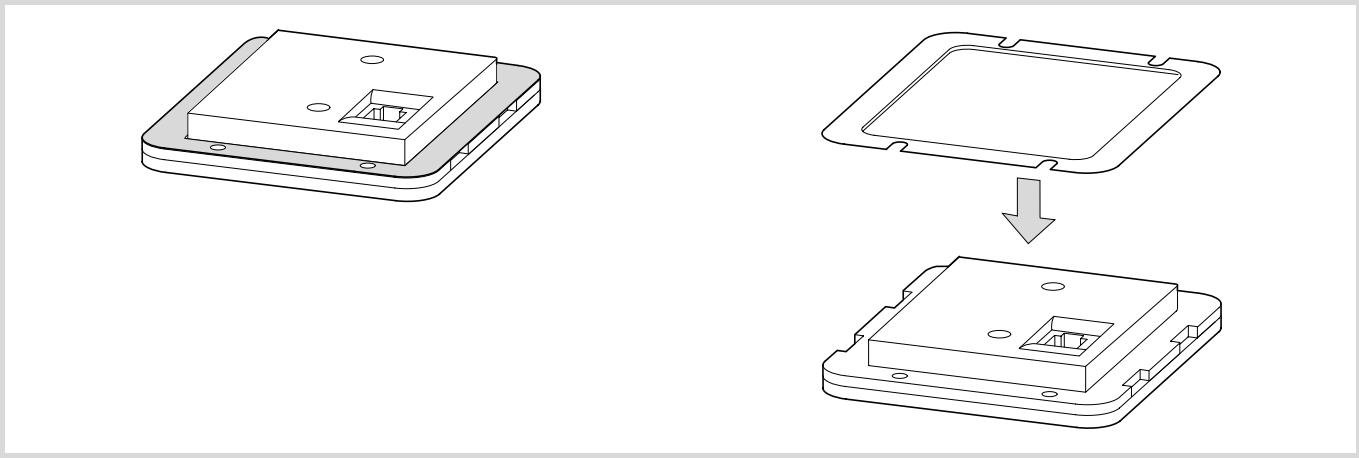


Figure 64: Gasket for control panel door mounting

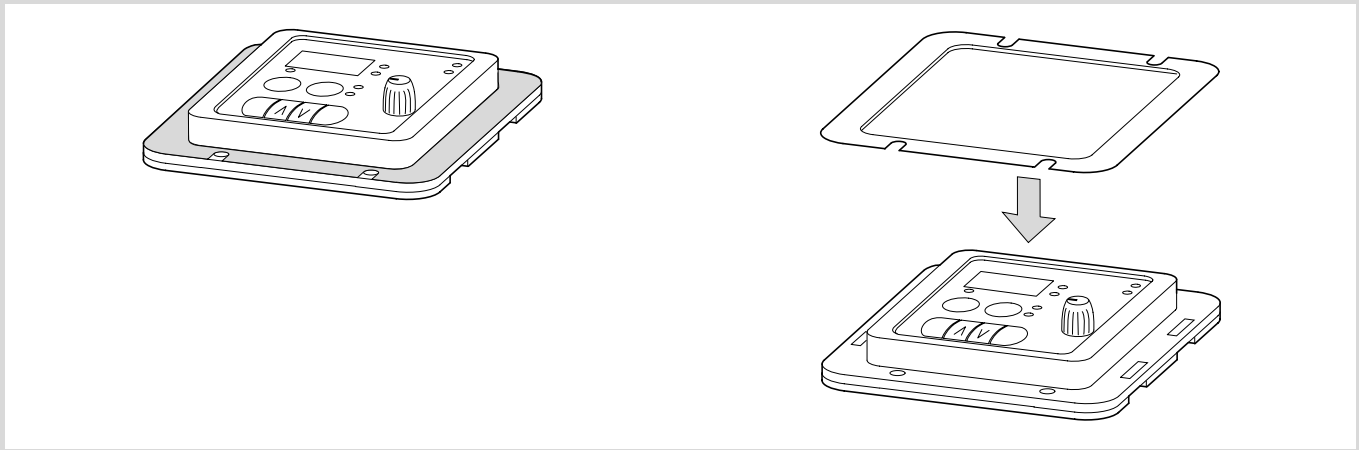


Figure 65: Gasket for waterproof mounting

- ▶ Apply the second gasket depending on the mounting method.

→ Remove the second protective foil only when finally mounting the keypad.

Features of keypad DEX-KEY-6…

The following sections describe the configuration and operation of frequency inverter DV51 with keypad DEX-KEY-6 and DEX-KEY-61.

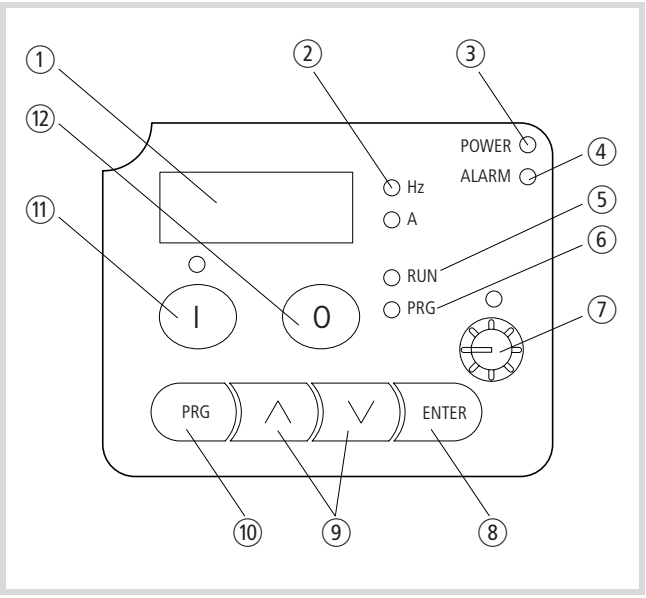


Figure 66: Keypad view

For an explanation of each of the elements, see Table 17.

Table 17: Explanation of the operation and display elements

Number	Name	Explanation
①	Four-digit digital display	Display for frequency, motor current, PNU, fault messages, etc.
②	Hz or A LED	Display in ①: output frequency (Hz) → PNU d001 (DS) or output current (A) → PNU d002.
③	POWER LED	LED is lit when the frequency inverter has power.
④	LED ALARM	LED is lit when a fault signal occurs.
⑤	RUN LED	LED lit in **RUN mode** when the frequency inverter is ready for operation or is in operation.
⑥	PRG LED	LED is lit when the input/change of parameter mode is active.
⑦	Potentiometer and LED	Frequency reference value setting LED is lit when the potentiometer is enabled → PNU A001 = 00.
⑧	ENTER key (ENTER)	Saving entered or changed parameters values.
⑨	Arrow keys (∧) (∨)	Selecting functions, changing numeric values (∧) Increase (∨) Reduce
⑩	PRG key (PRG)	Programming mode. Selection and activation of the specified parameter (PNU)
⑪	START pushbutton and LED (I)	Motor start with the selected direction; disabled by default. LED is lit when the pushbutton is enabled → PNU A002 = 02
⑫	STOP key (O)	Stop the running motor and acknowledge a fault signal (RST = Reset). Enabled by default, even when actuation is through terminals.

DS = default setting
PNU = parameter number

→ The STOP pushbutton ⑫ is active in all operating modes (→ PNU b087).

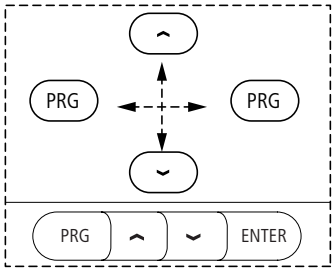


Figure 67: Navigation within the menu

Use the PRG key to change the display between main menu, parameters and value range.

To scroll through the individual parameters, digits and functions, use the Up and Down arrow buttons.

→ The changes you make remain saved in (non-retentive memory) as long as the frequency inverter DV51 is supplied with power (POWER LED is lit). The changes are saved permanently (in EEPROM) only when you press the ENTER key.

Controlling the DV51 with keypad DEX-KEY-6

The following example compares the input of control commands (FWD = Start/Stop) and the frequency reference value (R1) using keypad DEX-KEY-6 and the standard connection (→ figure 68).

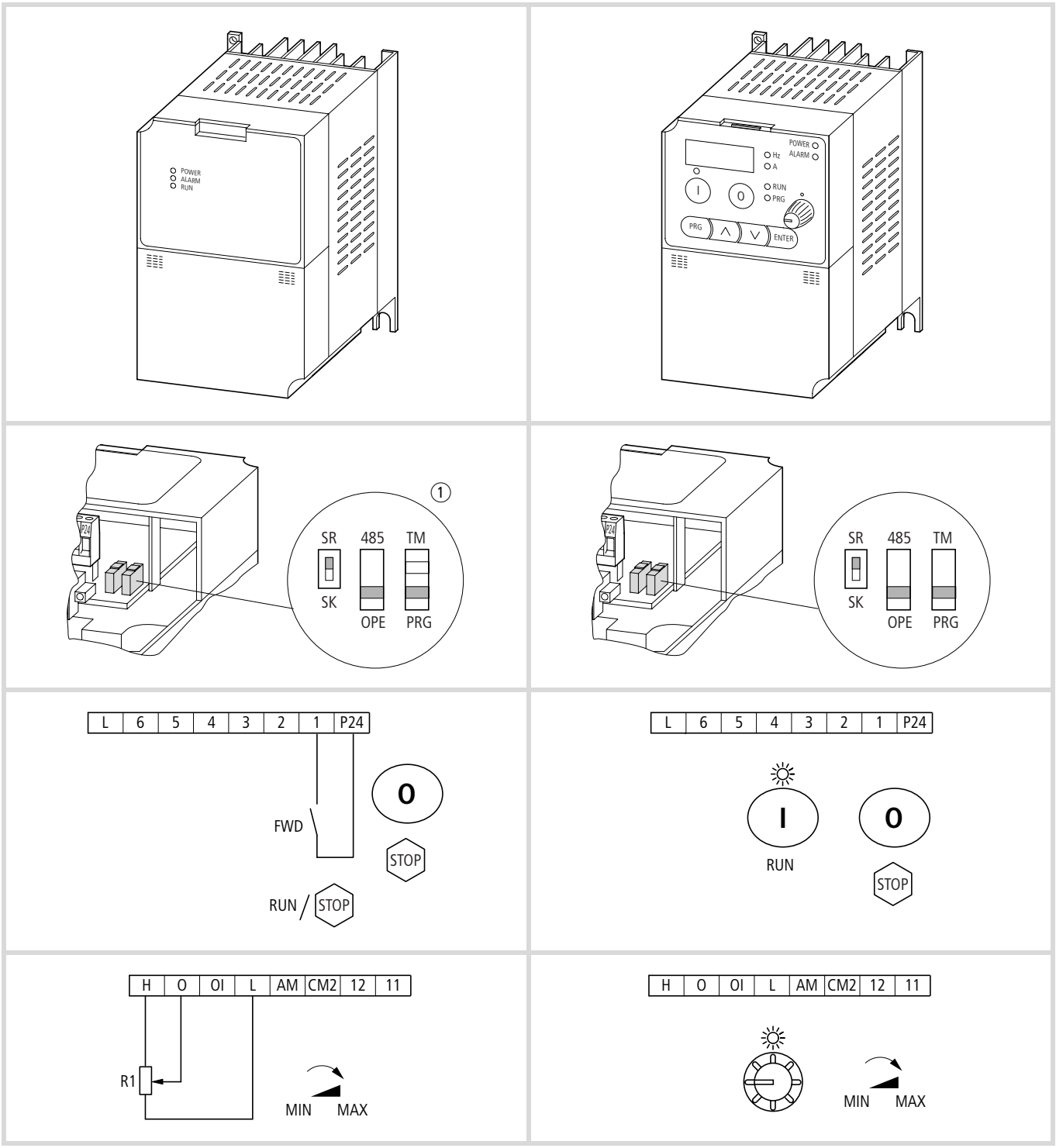


Figure 68: Comparison, standard connection (default setting) with control via the keypad

① In switch position TM, the frequency inverter accepts only control signals and reference value inputs through the control terminals (→ table 14, page 47).

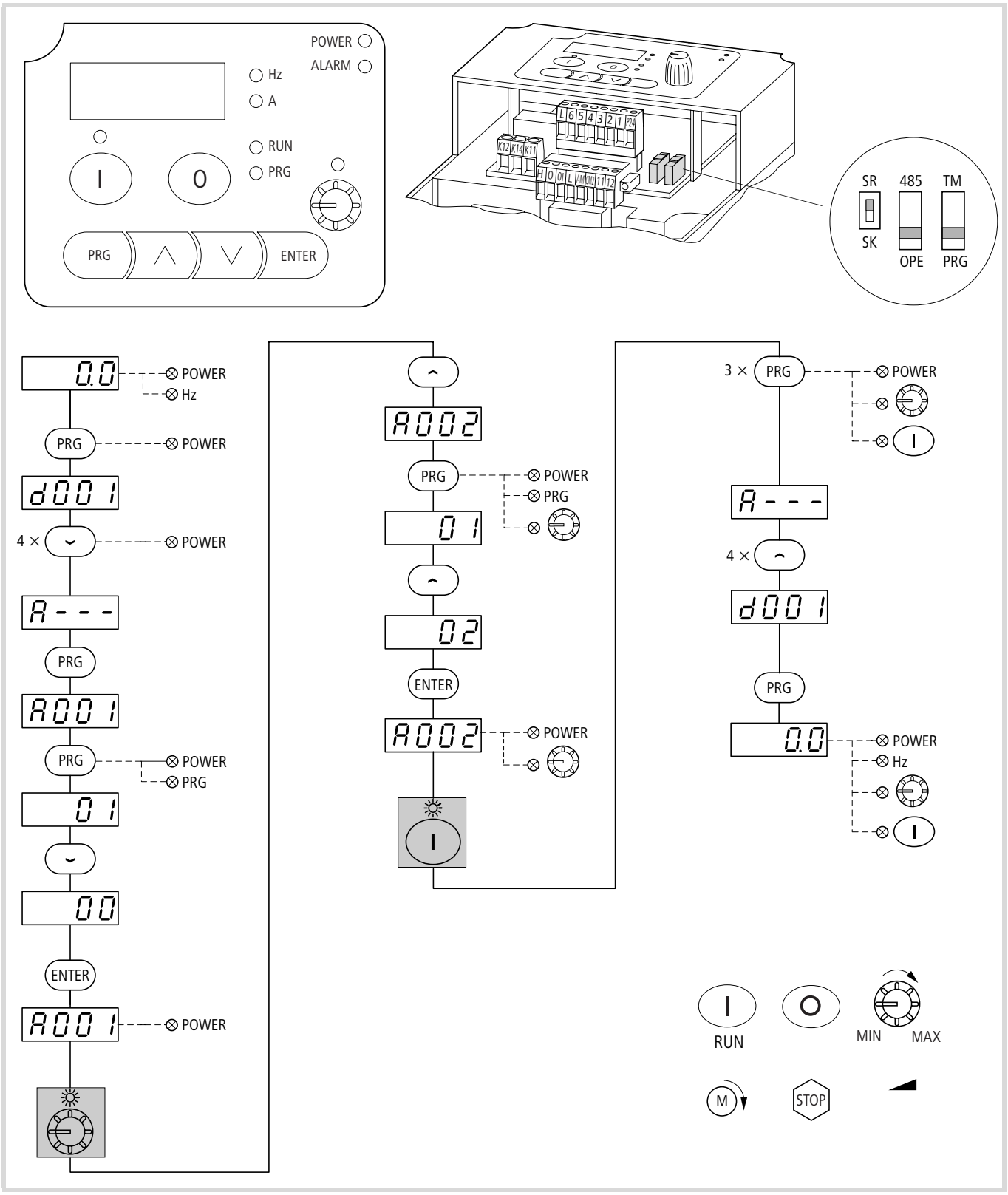


Figure 69: Reference values and control signals via keypad

→ Micro switch TM/PRG must be in the PRG position.

With these parameters the DV51 frequency inverter can be operated through the control signal terminals without commands.

Menu overview

The following illustration shows the sequence in which the parameters appear on the display.

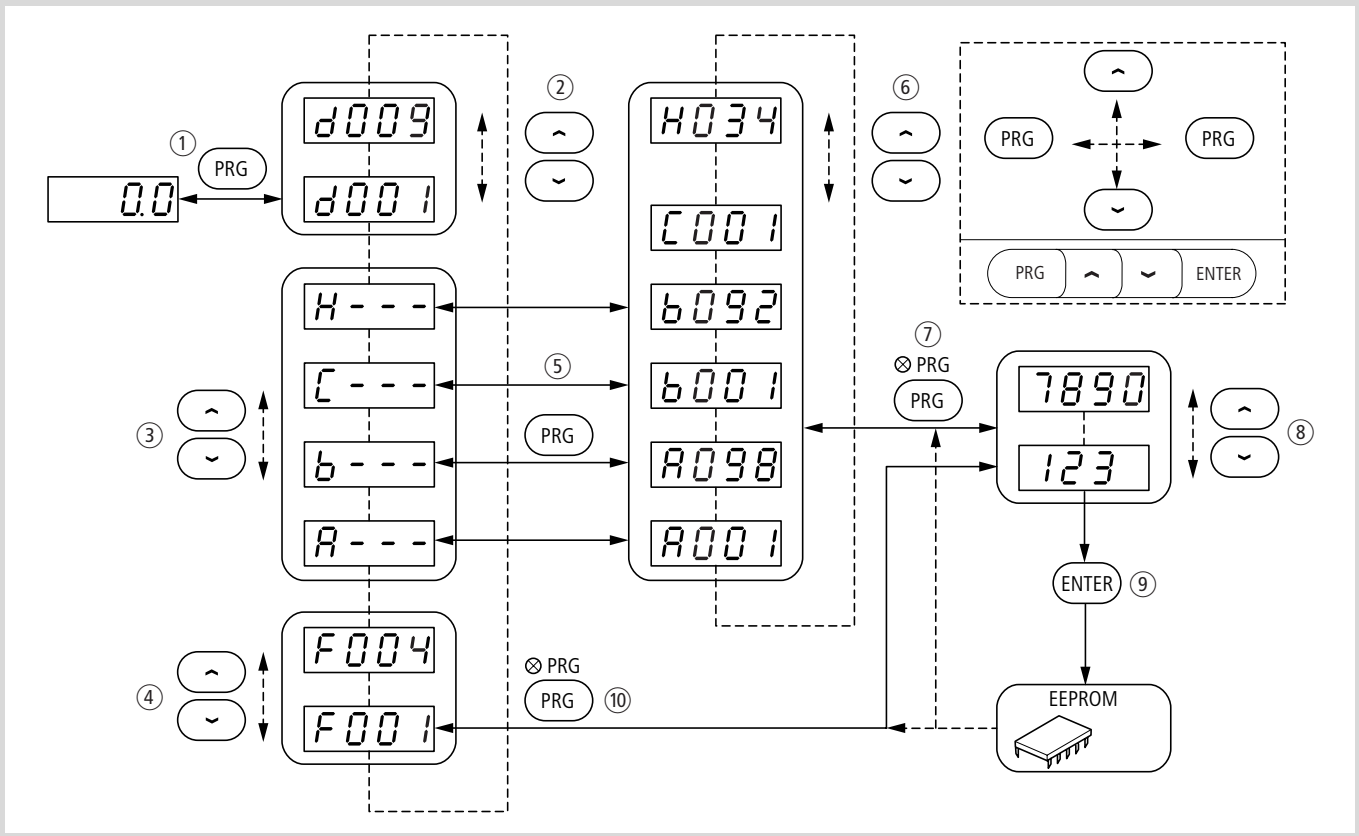


Figure 70: Navigation within the menu

① Change between the four-position digital display and the display parameters
② Select the display parameter
③ Selection in the main menu
④ Select the basic parameter
⑤ Change between main menu and the parameter level
⑥ Select a parameter (PNU)
⑦ Change between parameters (PNU) and value range
⑧ Select in value range (digits 0 to 9, functions)
⑨ Save values and return to parameter (PNU)
⑩ Return to main menu

Here is a short overview of the most important parameters. This overview is supplied with every device and when necessary can be affixed to the inside of the terminal shroud.

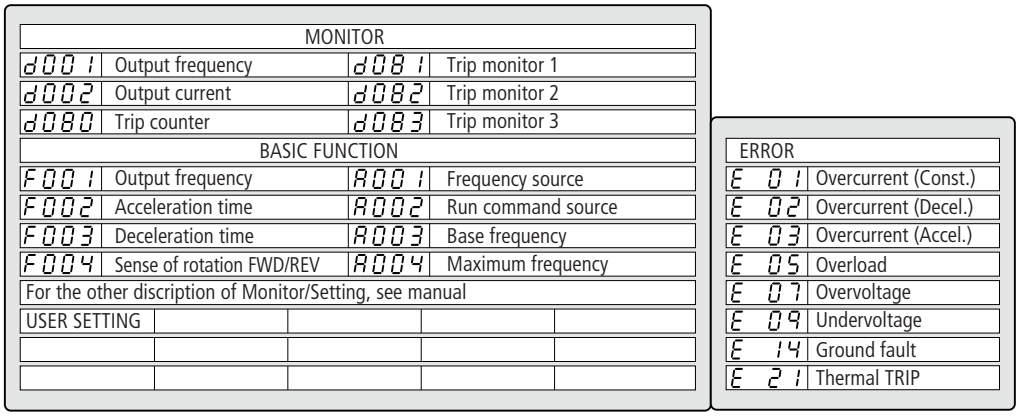


Figure 71: Label for the terminal shroud

Table 18: Brief description of the parameters

MONITOR		**Display values**	Preset values (user)
d001	Output frequency	Output frequency in Hz	
d002	Output current	Output current in A	
d080	Trip counter	Total number of occurred faults	
d081	Trip monitor 1	First fault (last fault warning)	
d082	Trip monitor 2	Second fault	
d083	Trip monitor 3	Third fault	
BASIC FUNCTION		**Basic functions**	
F001	Output frequency	Setpoint frequency	
F002	Acceleration time	Acceleration time 1	
F003	Deceleration time	Deceleration time 1	
F004	Sense of rotation FWD/REV	Direction of rotation	
A001	Frequency source	Frequency setpoint definition	
A002	Run command source	Start signal input	
A003	Base frequency	Base frequency	
A004	Maximum frequency	Maximum end frequency	
ERROR		**Error messages**	
E 01	Overcurrent (Const.)	Overcurrent in the power output element in static operation	
E 02	Overcurrent (Decel.)	Overcurrent in the power output element during the delay	
E 03	Overcurrent (Accel.)	Overcurrent in the power output element during the acceleration	
E 05	Overload	Overload	
E 07	Overvoltage	Overvoltage	
E 09	Undervoltage	Undervoltage	
E 14	Ground fault	Ground fault	
E 21	Thermal trip	Overtemperature	

→ The following example assumes the default settings.

Example for changing acceleration time 1: PNU F02
The frequency inverter is in display mode: LED POWER is lit and the display shows 0.0 Hz ①.

▶ Press the PRG key.

The display changes to d001.

▶ Press the DOWN key seven times until F002 appears on the display.
▶ Press the PRG key.

The LED PRG lights.

The set acceleration time 1 in seconds appears on the display (default value: 10.00).

▶ With the UP and DOWN arrow buttons change the set values, for example to 5.0.

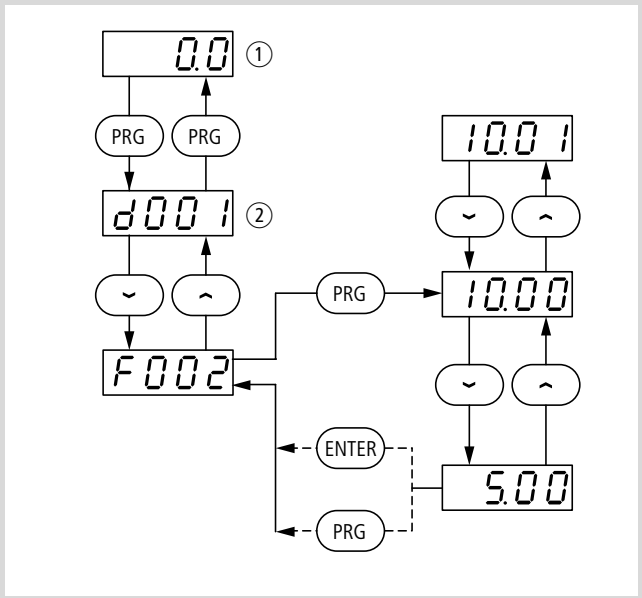


Figure 72: Change acceleration time 1

① Display value (default setting = 0.0 Hz)
② parameter to the displayed value ①

Hold the DOWN button to change the display value at logarithmically increasing step widths.

There are now two possibilities:

▶ Press the ENTER key to save the displayed value.
Press the PRG key to save the displayed value to non-retentive memory. When the power supply is switched off (LED POWER off), the value is lost.

F002 appears in the display and the LED PRG goes out.

▶ Press the UP button seven times until d001 appears.
▶ Press the PRG key.

0.0 appears again in the display and the LED Hz lights up. You have reduced the acceleration time from 10 s to 5 s.

You can also change the parameter values of groups B and C and H as described in the example.

Example for changing the base frequency: PNU A004
▶ Press the PRG- pushbutton.
▶ Press the DOWN button until the main menu A--- shows in the display.
▶ Press the PRG key.

The display changes to d001.

▶ Press the UP button until A004 shows in the display.
▶ Press the PRG key.

The LED PRG lights. The value set under PNU A004 appears in the display (default value: 50).

▶ With the UP and DOWN arrow buttons change the set values, for example to 60 Hz.

As this is a limited operating parameter, you must press the ENTER key to accept it. If you press the PRG key, the new value is discarded.

The display shows A004.

▶ Press the PRG button until A--- shows in the display.
▶ Press the UP button until d001 shows in the display.
▶ Press the PRG key.

The frequency inverter changes to 0.0 Hz. You have changed the end frequency to 60 Hz, i.e. the previous reference value of 0 to 50 Hz now corresponds with 0 to 60 Hz. At 50 Hz (PNU A003) the maximum output voltage is reached. Between 50 Hz and 60 Hz only the output frequency, and therefore the motor speed, changes.

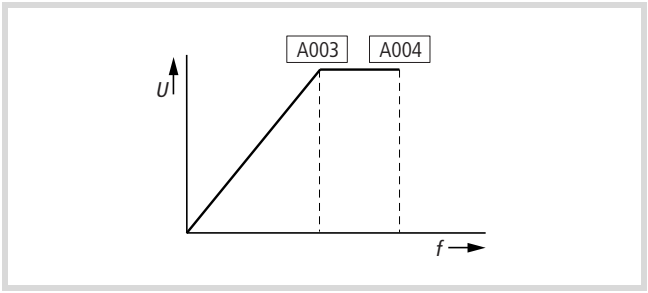


Figure 73: End frequency 60 Hz

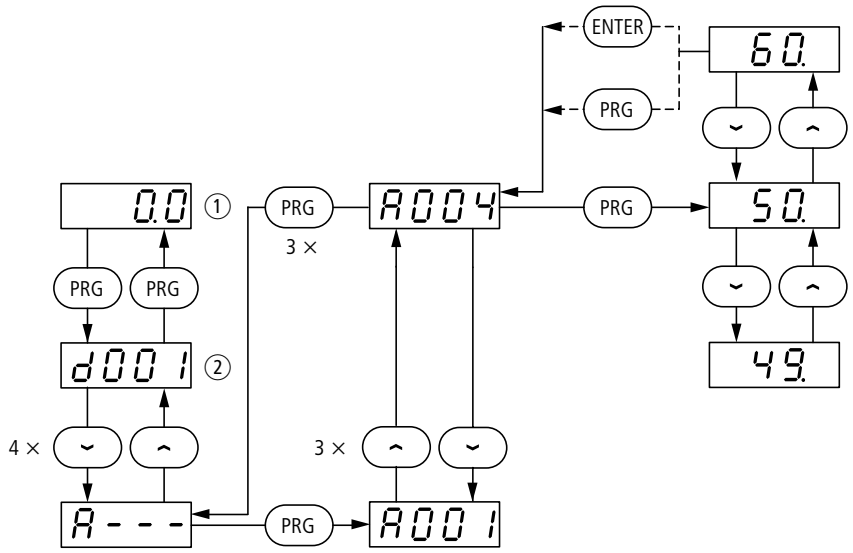


Figure 74: Change end frequency (example with default setting)

① Display value 0.0 Hz

② parameter to the displayed value ①

6 Messages

This section lists the messages frequency inverter DV51 issues and explains their meaning.

Fault messages

When seeing a fault the frequency inverter DV51 switches off its output and a fault message appears in the display. To acknowledge the fault message:

- Press the STOP pushbutton (optional keypad),
- activate the digital input configured as RST,
- switch off the power supply.

Display	Cause	Description
E 01	Overcurrent in the inverter in static operation	In the following cases, the output current is too high: • The frequency inverter's output is short-circuited • The motor is blocked • An excessive load is suddenly applied to the output.
E 02	Overcurrent in the inverter during deceleration	
E 03	Overcurrent in the inverter during acceleration	
E 04	Overcurrent in the inverter at standstill	
E 05	Overload	The internal electronic motor protection has switched off the output voltage because of an overload.
E 07	Overvoltage	Overvoltage in regenerative mode.
E 08	EEPROM fault	The program memory is not operating reliably due to radio frequency interference, a control voltage short-circuit (P24–L) or excessive temperature. If the supply voltage is switched off while the RST input is active, an EEPROM fault occurs when the supply voltage is reapplied.
E 09	Undervoltage	Insufficient DC voltage (error-free electronics function not possible; potential problems such as overheating of motor and insufficient torque).
	Processor malfunction	Processor is not working correctly, for example through RFI or excessive temperature.
E 12	External fault message	An external fault signal is applied to a digital input configured as EXT input.
E 13	Restart inhibit activated	The mains voltage was switched on or an intermittent interruption in the supply voltage has occurred while unattended start protection (input USP) was active.
E 14	Ground fault	Earth faults between the U, V or W terminals and earth are being reliably detected. A protective circuit prevents destruction of the frequency inverter at startup, but does not protect the operating personnel.
E 15	Mains overvoltage	The mains voltage exceeds the permissible value. Shutdown about 100 s after activation of power supply.
E 21	Overtemperature	The built-in temperature sensor in the power section is measuring an operating temperature above the permissible limit value.
E 22	Processor malfunction	Processor is not working correctly, for example through RFI or excessive temperature.
E 35	PTC fault message	The resistance of the externally fitted PTC thermistor connected to the PTC input (digital input configured as PTC input) is too high.
... ...U	Standby mode	The frequency inverter is in standby mode because the input voltage is too low.

Fault message register

Frequency inverter DV51 possesses a fault register to which the three most recent fault messages are saved. In addition to fault messages E 01 to E 35, the frequency inverter saves the following information at the time of the last fault:

- Output frequency
- Output current
- Internal DC link voltage

▶ Go to one of the display parameters PNU d008 or d009.

► Press the PRG key.

If a fault message has been saved, it appears on the display, for example E 07.

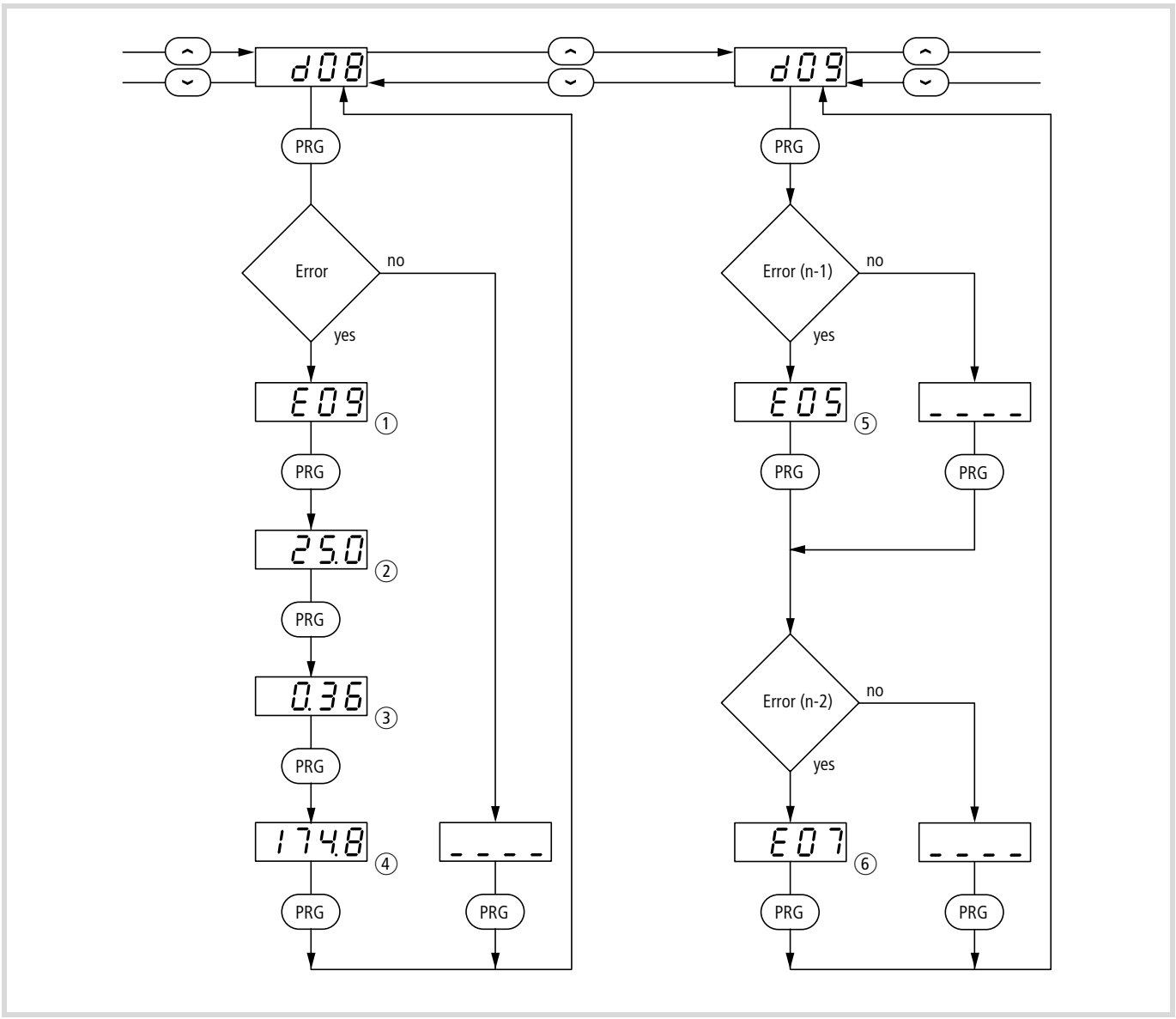
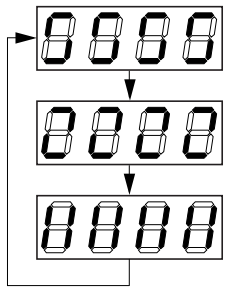
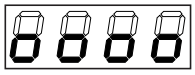
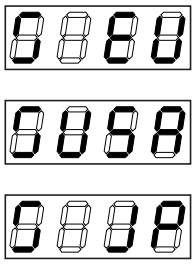
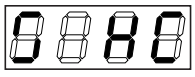


Figure 75: Data in the fault register

① Last fault indication type, number of fault indication
② Output frequency
③ Output current
④ Internal DC link voltage
⑤ Type of the last but one fault message
Type of the third from last fault message
Power-on time (total time)

Other messages

This section describes the signals issued by the DV51 frequency inverter, for example in standby mode when mains power is switched off.

Display	Cause
	Initialization after activation of power supply or at active Reset signal (activated digital input configured as RST).
	The mains voltage has been switched off.
	The waiting time before the automatic restart expires.
	The default settings are selected and the frequency inverter is in its initialization phase. The values for the European market (EU) are being initialized. For non-European models, versions for North America (USA) and Japan (JP) are available.
	Initialization of the fault history register.
	Copy station – copying in progress.
	No data available, for example display under PNU d081 and d086, when the fault register is empty or the display under PNU d004, when PID control is not active.

Warning

Conflicting parameter input (for example minimum operating frequency PNU A062 > end frequency PNU A004). The PRG LED also flashes until the parameter is corrected.

The following warnings may be issued:

Display	Function		
H001 H201	Maximum operating frequency, PNU A061 (A261)	>	End frequency, PNU A004 (A204, A304)
H002 H202	Minimum operating frequency, PNU A062 (A262)	>	
H004 H204	Rated motor frequency, PNU A003 (A203, A303)	>	
H005 H205	Frequency reference value, PNU F001 or PNU A020 (A220, A320)	>	
H006 H206	Fixed frequencies 1 to 15, PNU A021 to A035	>	
H012 H212	Minimum operating frequency, PNU A062 (A262)	>	Maximum operating frequency, PNU A061 (A261)
H015 H215	Frequency reference value, PNU F001 or PNU A020 (A220, A320)	>	
H016 H216	Fixed frequencies 1 to 15, PNU A021 to A035	>	
H021 H221	Maximum operating frequency, PNU A061 (A261)	<	Minimum operating frequency, PNU A062 (A262)
H025 H225	Frequency reference value, PNU F001, PNU A020 (A220, A320)	<	
H031 H231	Maximum operating frequency, PNU A061 (A261)	<	Increased start frequency, PNU b082
H032 H232	Minimum operating frequency, PNU A062 (A262)	<	
H035 H235	Frequency reference value, PNU F001 or PNU A020 (A220, A320)	<	
H036	Fixed frequencies 1 to 15, PNU A021 to A035	<	
H037	Jog frequency, PNU A038	<	
H085 H285	Frequency reference value, PNU F001 or PNU A020 (A220, A320)	=	Frequency jump 1 to 3 ± jump width, PNU A063 to A068[1)]
H086	Fixed frequencies 1 to 15, PNU A021 to A035	=	

Display	Function		
H091 H291	Maximum operating frequency, PNU A061 (A261)	>	User-definable *U*/*f* characteristic, frequency 7, PNU b112
H092 H292	Minimum operating frequency, PNU A062 (A262)	>	
H095 H295	Frequency reference value, PNU F001 or PNU A020 (A220, A320)	>	
H096	Fixed frequencies 1 to 15, PNU A021 to A035	>	
H110	User-definable *U*/*f* characteristic, frequency 1 to 6, PNU b100, b102, b104, b106, b108, b110	>	
	User-definable *U*/*f* characteristic, frequency 2 to 6, PNU b102, b104, b106, b108, b110	<	User-definable U/f characteristic, frequency 1, PNU b100
	User-definable *U*/*f* characteristic, frequency 1, PNU b100	>	User-definable *U*/*f* characteristic, frequency 2, PNU b102
	User-definable *U*/*f* characteristic, frequency 3 to 6, PNU b104, b106, b108, b110	<	
	User-definable *U*/*f* characteristic 1 and 2, PNU b100 and b102	>	User-definable *U*/*f* characteristic, frequency 3, PNU b104
	User-definable *U*/*f* characteristic, frequency 4 to 6, PNU b106, b108, b110	<	
	User-definable *U*/*f* characteristic, frequency 1 to 3, PNU b100, b102, b104	>	User-definable *U*/*f* characteristic, frequency 4 PNU b106
	User-definable *U*/*f* characteristic, frequency 5 and 6, PNU b108 and b110	<	
	User-definable *U*/f characteristic, frequency 1 to 4, PNU b100, b102, b104, b106	>	User-definable *U*/f characteristic, frequency 5, PNU b108
	User-definable *U*/f characteristic, frequency 6, PNU b110	<	
	User-definable *U*/f characteristic, frequency 1 to 5, PNU b100, b102, b104, b106, b108	>	User-definable *U*/f characteristic, frequency 6, PNU b110
H120	Electronic motor protection, frequency 2 and 3, PNU b017 and b019	<	Electronic motor protection, frequency 1, PNU b015
	Electronic motor protection, frequency 1, PNU b015	>	Electronic motor protection, frequency 2, PNU b017
	Electronic motor protection, frequency 3, PNU b019	<	
	Electronic motor protection, frequency 1 and 2, PNU b015 and b017	>	Electronic motor protection, frequency 3, PNU b019

1) The frequency jump is automatically set to the smallest value (frequency jump width).

The warning is cancelled as soon as the above conditions no longer apply. The input data is then reset to the default settings (initialization).

7 Serial interface (Modbus)

This section describes the mounting and function of the serial interface.

General information about Modbus

Modbus is a centrally polled bus system in which the master (PLC) controls the entire data flow on the bus. Internode communication between the individual stations (slaves) is not possible.

Every data transfer is initiated by a request from the master. Only one signal at a time can be transferred along the bus line. Slaves cannot initiate a transmission; they can only respond to a request.

Two types of dialog are possible between master and slave:

- The master sends a message to a slave and waits for a response.
- The master sends a message to all slaves and does not wait for a response (broadcast).

Caution!
The master cyclically polls slaves' fault messages. It is therefore advisable to send device-specific and safety-relevant fault messages directly through the control signal terminals (for example fault indication relays DV51).
Example:
A short-circuit in the motor conductor at the output of the DV51 switches on the mechanical brake directly.

The RS 485 port

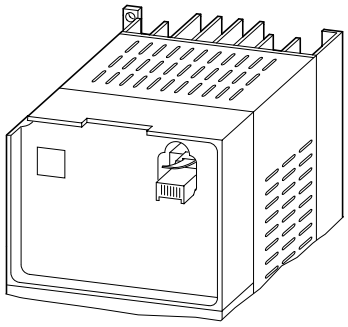


Figure 76: RS 485 interface (RJ 45 socket)

The DV51's built-in RS 485 port supports the Modbus RTU protocol and therefore allows a direct network connection without an additional interface module.

Communications in a Modbus network

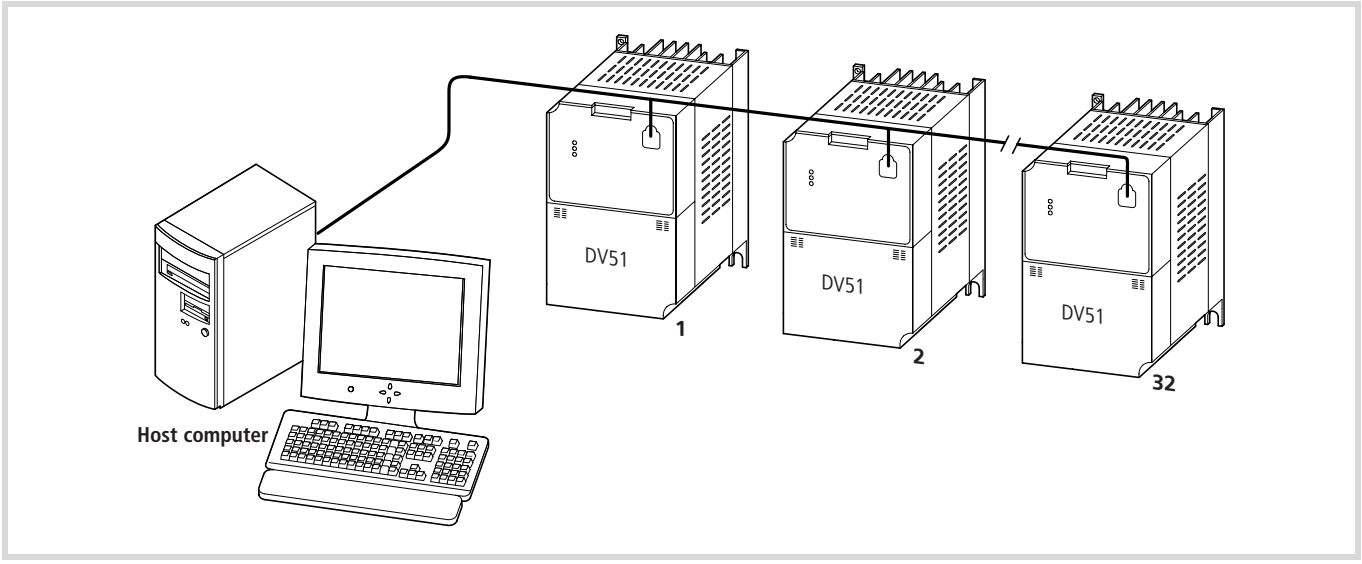


Figure 77: Modbus network with DV51

Figure 77 shows a typical arrangement with a host computer (master) and any number of DV51 frequency inverters (up to 31 stations). Each frequency inverter has a unique address in the network. The addresses are defined through PNU C072 and is independent of its physical position within the network.

Table 19: Technical features of the serial interface

Name	Specification	User adjustable
Baud rate (data transfer speed)	4800/9600/19200 Bit/s	Yes
Communication mode	Asynchronous	No
Character code	Binary	No
LSB positioning	LSB first transmission	No
Data bits	8 bit (Modbus RTU mode)	(ASCII mode not possible)
Parity	None/even/uneven	Yes
Stop bits	1 or 2 bits	Yes
Data traffic	starting the control (host, master)	No
Communications fault (waiting time to fault indication)	0 to 1000 ms	Yes
Address	Addressing from 1 to 32	Yes
Interface	RS 485, differential transmission	No
Connection	RJ 45 socket	–
Twisted pair cable	Twisted, double screened cable	–
Fault monitoring	Overflow, test code, CRC-16, horizontal parity	–

Connecting to a Modbus network

The DV51 is connected through its RJ 45 socket. Remove the standard LED display DEV51-KEY-FP and the RJ 45 plug connector DEX-CON-RJ45.

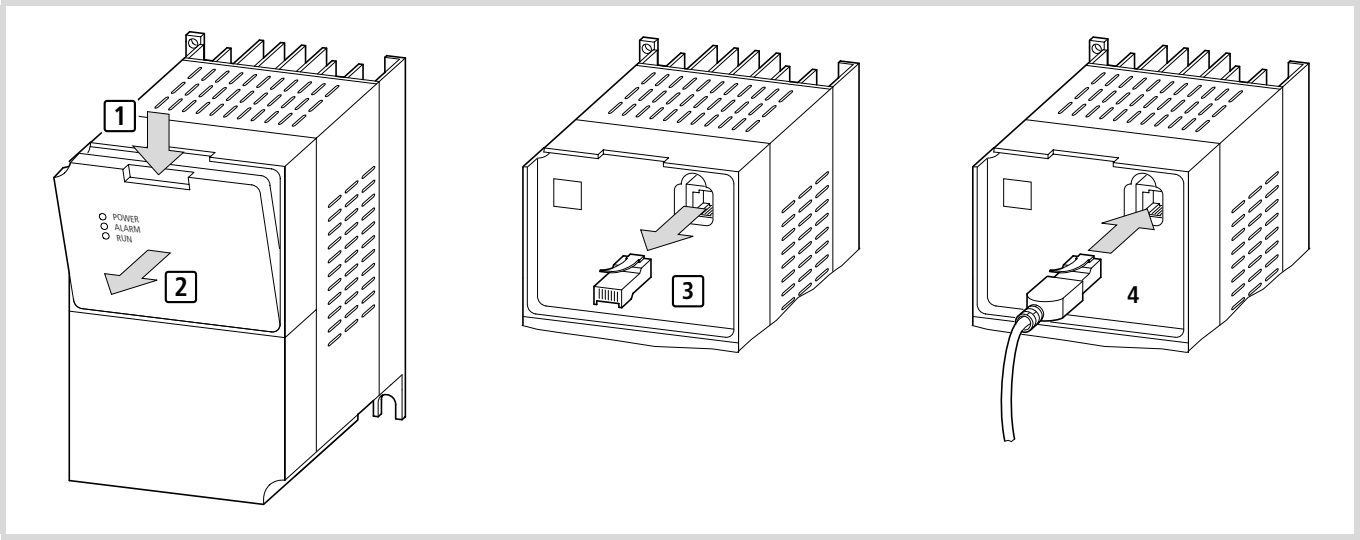


Figure 78: Plugging in the connection cable

- ▶ Press the interlock down 1.
- ▶ Remove the LED display DEV51-KEY-FP 2.
- ▶ Pull out the RJ 45 plug connector DEX-CON-RJ45 3.
- ▶ Plug the communications cable into the RJ 45 socket, which is now free 4.

→ Keep the RJ 45 plug connector DEX-CON-RJ45. It may be required for other optional add-ons.

→ In place of the direct communications cable, you can use the optional T adapter DEV51-NET-TC (→ section "Optional T adapter DEV51-NET-TC", page 109).

→ No tools are required to fit and remove the optional keypads, LED displays and plug-in adapters.

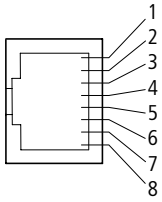
Caution!
Fit and remove the keypad, LED display or plug-in adapter only under no volt conditions and without using force.

→ The network cable must have a bus termination resistor (120 ohm) connected at each physical end to prevent reflections and the resulting transmission faults.

The DV51 frequency inverter has no internal bus termination resistor. When a DV51 is connected at the end of a bus conductor, the bus termination must be connected externally (pin 5 and 6). Keep in mind the network conductor's impedance.

→ Do not connect terminals 1 to 4, 7 and 8. They are used by the DV51 system for internal data transfer.

Table 20: PIN allocation, RJ 45 (RS 485)



Pin	Name	Description
1	–	Not connected
2	–	Not connected
3	–	Not connected
4	–	Not connected
5	SP	Send/receive, positive data channel
6	SN	Send/receive, negative data channel
7	–	Not connected
8	–	Not connected

→ Optional DEV51-NET-TC: RJ 45 T adapter with bus termination resistor, → section "Optional T adapter DEV51-NET-TC", page 109

Parameter settings for Modbus

Prerequisites for correct operation with Modbus-RTU are:

- The PLC (master) is fitted with a serial interface RS 485 and with the required driver software for Modbus-RTU.
- The parameters of the DV51 frequency inverters (slaves) are set for communication via Modbus. For reliable setting of some user-defined parameters, you will need the master's (i.e. the host PC's) settings, such as the baud rate.

→ Parameters PNU C071 to C078 can not be altered through the bus. They must be initially set using a keypad (DEX-KEY-…) or a PC.

Table 21: Required parameter settings

PNU	Run	b031 = 10	Function	Value range		DS	Page	Required settings
A001	–	–	Frequency reference value source selection	00:	Potentiometer of optional keypad DEX-KEY-6	01		03
				01:	Analog input O/OI			
				02:	Optional keypad DEX-KEY-… (PNU F001 or A020)			
				03:	Serial interface (Modbus)			
				10:	Calculated value			
A002	–	–	Start signal source selection	01:	Digital input (FWD/REV)	01		03
				02:	START button (optional keypad DEX-KEY-…)			
				03:	Serial interface (Modbus)			

PNU	Run	b031 = 10	Function	Value range		DS	Page	Required settings
C071	–	✓	Communication – baud rate	04:	4000 bit/s	06		Dependent on the setting of the PLC (master) setting
				05:	9600 bit/s			
				06:	19200 bit/s			
C072	–	✓	Communication – address	1 – 32		1		Individual address in network. Each address must be unique.
C074	–	✓	Communication – parity	00:	None	00		Dependent on the PLC (master)
				01:	Even			
				02:	Odd			
C075	–	✓	Communication – stop bits	1:	1 bit	1		Dependent on the PLC (host, master)
				2:	2 bits			
C076	–	✓	Communication – behaviour of frequency inverter on communication errors	00:	Switch off on fault signal E60	02		Individual
				01:	Decelerate to standstill at deceleration ramp and then switch off with error E60.			
				02:	Disable devices			
				03:	FRS: Free run stop (free coasting, = controller inhibit)			
				04	DEC: Braking to 0 Hz at set deceleration ramp			
C077	–	✓	Communication – set monitoring time (watchdog).	0 – 99.99 s		0.00		Individual
C078	–	✓	Communication – waiting time to output of a fault signal	0 – 1000 ms		0		Individual

→ The values in the "Required settings" column (such as baud rate, bus address and parity) must be taken into account for communications through Modbus.

Setting the OPE/485 DIP switch

By default, the RS 485 interface DV51 frequency inverters' RS 485 interface is set for operation with a keypad (DEX-KEY-…). In this control mode, you can set parameters PNU C071 to C078 for bus operation using a keypad (DEX-KEY-…) or a PC. To save these changes, press the ENTER key on the keypad or use the Save command of the DrivesSoft software.

- ▶ To set up the interface for communications through Modbus, switch off the power supply.
- ▶ Set the microswitch OPE/485 to position 485.

With this setting, Modbus communications begin when the DV51 frequency inverter's power supply is switched on (POWER LED is lit). The changed parameter values apply immediately.

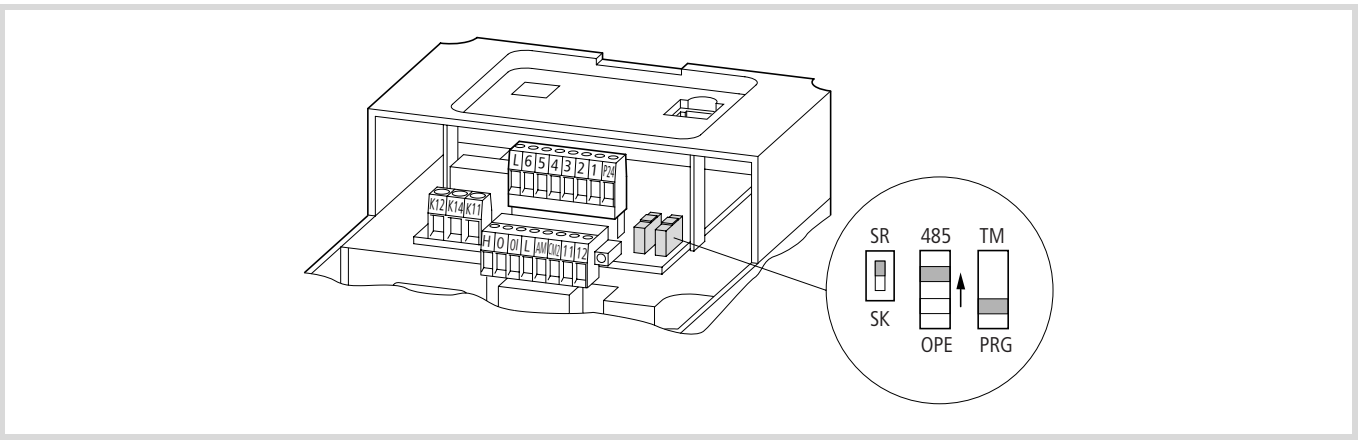


Figure 79: Microswitch OPE/485

The network protocol

Transmission

Transmission takes place in RTU mode. The message contains no header or end characters and conforms to the following syntax:

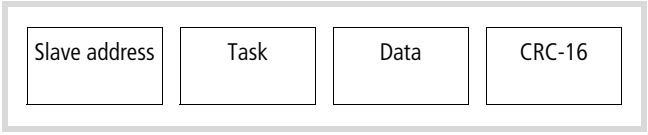


Figure 80: RTU mode

CRC-16: Block parity test character (cyclic redundancy check)

The data is transmitted in binary code. The end of the telegram is recognized by a pause in transmission of at least 3.5 characters (latency).

The data transmission between a PLC and the frequency inverter (DV51) has the following pattern:

- Request – the PLC sends a protocol (Modbus) frame to the frequency inverter.
- Response – after the cyclic waiting time defined by the system (plus the time in PNU C078), the frequency inverter responds with a protocol (Modbus) frame to the PLC.

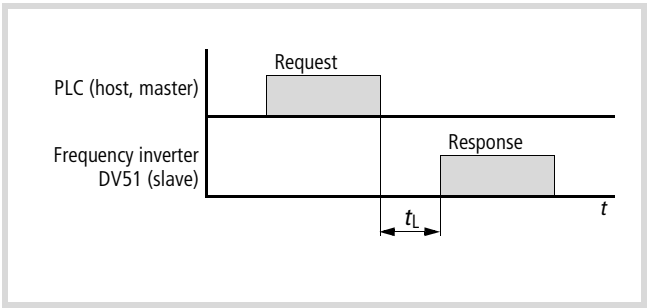


Figure 81: Error checking

t_L: Latency (waiting time plus PNU C078)

→ The frequency inverter (slave) sends a response only if it has previously received a request from the master.

The protocol (Modbus) frame has the following structure:

- Header (non-operative mode)
- Slave address
- Function code
- Data
- Error check
- Trailer (non-operative mode)

Structure of request

Slave address:

- Here the slave address (1 to 32) of the recipient frequency inverter is entered. (Only the frequency inverter with this address can respond to the request).
- Slave address 0 is used for broadcasting (sending a message to all bus stations). In this mode no single station can be addressed and slaves can not respond.

Data format:

The DV51 frequency inverters' data format corresponds to the Modbus data format:

Data name	Description
Coil	1-bit binary data, which can be allocated and changed
Holding register	16-bit binary data, which can be allocated and changed

Function names and numbers

→ In this manual, the following standard English names and designations for Modbus are used

Table 22: Specified function of the DV51:

Function code dec	Function code hex	Function	Modbus standard name	Maximum data size (vavailable bytes per message)	Maximum number of data elements per message
1	01	Read variable bit (coils)	Read multiple coil status	4	32 coils (in bits)
3	03	Read word variables (register)	Read multiple holding registers	4	4 registers (in bytes)
5	05	Write a bit variable (coil)	Force single coil	1	1 coil (in bits)
6	06	Write a word variable (register)	Force single register	1	1 register (in bytes)
8	08	Connection test	Loop back diagnostic test (00: return query data)	–	–
15	0F	Write multiple bit variables (coils)	Force multiple coil	4	32 coils (in bits)
16	10	Write multiple word variables (register)	Force multiple registers	4	4 registers (in bytes)

Data elements: 1 byte = 8 bit

Fault testing

Modbus RTU uses cyclic block testing, also called CRC (cyclic redundancy checking) to check the data transfer for errors. The CRC code is a 16-bit data word consisting of 8-bit data blocks of any length. The CRC checksum is generated with generated polynomial CRC-16 (X16 + X15 + X2 + 1).

Non-operational mode (header and trailer):

The latency is the time between the request from the master and the response from the frequency inverter (slave), i.e. the time in which the changeover between transmission and reception takes place. At least 3.5 characters (24-bit rest time) of latency are always required. If the time is shorter, is the frequency inverter does not respond. The actual latency is the sum of the rest time (3.5 characters) and PNU C078 (waiting time until fault message).

Structure of response

Required transfer time

- The time between receiving a request from the master and the frequency inverter's response consists of the rest time (3.5 characters) and PNU C078 (the waiting time to the fault message).
- Once the master has received a response from the frequency inverter, it must wait for at least the rest time before it can send a new request.

Normal response

- If the master's request contains the loopback function (08_{hex}), the frequency inverter returns the same content.
- If the request contains a write register function (05_{hex}, 06_{hex}, $0F_{hex}$ or 10_{hex}), the frequency inverter returns the request as its response.
- If the request contains a read register function (01_{hex}, hex or 03_{hex}), the frequency inverter returns the read data with the slave address and function code as its response.

Response in fault condition

If the request contains an error (except for a transmission error), the frequency inverter responds with an exception message and does not perform an action.

The exception message can be evaluated in the user program. It consists of the sum of the enquiry's function code and code 80_{hex}.

Structure of exception message:

- Function code
- Exception code
- CRC-16

Exception code hex	Description
01	The operation is not supported
02	The specified address does not exist
03	The data format is not supported
21	The number of the holding register is too high
22	• The function for changing register contents can not be used during frequency inverter operation. • The function sends an ENTER command during operation • The function writes to the register during operation • The function writes to read-only register or coil

No response

In the following cases, the frequency inverter ignores the request and does not send a reply:

- On receiving a broadcast request
- If the request contains a transmission error
- If the slave address in the request does not match the inverter's address
- If the time interval between the data blocks is less than 3.5 characters
- If the data length is invalid

→ The master must be programmed to repeat the request if it does not receive a response within a specified time.

Explanation of function codes

Read coil status [01_{hex}]:
This function reads the status (On/Off) of the selected coils. For example: reading input signal terminals 1 to 6 of the DV51 with slave address 8. In this example, the inputs have the following states.

Name	Function					
Digital input	[1]	[2]	[3]	[4]	[5]	[6]
Coil status	ON	ON	ON	OFF	ON	OFF

Request

No.	Name	Example hex
1	Slave address (broadcast is disabled)	08
2	Function code	01
3	Coil start number (High byte)	00
4	Coil start number (Low byte)	07
5	Number of coils (High byte) If this value is 0 or greater than 32, a fault message with code 03_{hex} is issued.	00
6	Number of coils (Low byte). If this value is 0 or greater than 32, a fault message with code 03_{hex} is issued.	06
7	CRC-16 (High byte)	0D
8	CRC-16 (Low byte)	50

Response

No.	Name	Example hex
1	Slave address	08
2	Function code	01
3	Data size (in bytes)	01
4	Coil data. Number of selected bit variables (data size)	17
5	CRC-16 (High byte)	12
6	CRC-16 (Low byte)	1 A

The data range of the response contains the states of coils 7 to 14.

The status is given by 17_{hex} (00010111_{bin}). COIL 7 is the least significant bit (LSB)

Term	Data							
Coil number	14	13	12	11	10	9	8	7
Coil status	OFF	OFF	OFF	ON	OFF	ON	ON	ON

If a read coil lies outside the specified range, the remaining bytes to be transmitted have a zero value to indicate the out-of-range value.

If a coil can not be given as a normal value, an exception message (page …) is generated.

Reading the holding registers [03_{hex}]

This function reads the content of a series of consecutive holding registers with specified register addresses.

Example:
Reading three set parameters of a frequency inverter DV51 with slave address 5 and the following content:

DV51 command	d001 (N)	d002 (N-1)	d003 (N-2)
Register number	1002_{hex}	1003_{hex}	1003_{hex}
Messages	Output frequency 50 Hz	Output current 0.13 A	Clockwise rotating field

Request:

No.	Name	Example hex
1	Slave address (broadcast disabled)	05
2	Function code	03
3	Register start number (High byte)	10
4	Register start number (Low byte)	02
5	Number of holding register (High byte)	00
6	Number of holding register (Low byte)	03
7	CRC-16 (High byte)	CRC
8	CRC-16 (Low byte)	CRL

Answer:

No.	Name	Example hex
1	Slave address	05
2	Function code	03
3	Data length (in bytes)[1)]	06
4	Register start number (High byte)	01
5	Register start number (Low byte)	F4
6	Register start number + 1 (High byte)	00
7	Register start number +1 (Low byte)	32
8	Register start number + 2 (High byte)	00
9	Register start number +2 (Low byte)	01
10	CRC-16 (High byte)	CRC
11	CRC-16 (Low byte)	CRC

1) Number of data bytes needed for a response to the request; here 6 bytes to return the content of three holding registers.

The reply record looks as follows:

Response memory	4	5	6	7	8	9
Register number	+ 0 (High byte)	+ 0 (Low byte)	+ 1 (High byte)	+ 1 (Low byte)	+ 2 (High byte)	+ 2 (Low byte)
Register status	01_{hex}	$F4_{hex}$	00_{hex}	32_{hex}	00_{hex}	01_{hex}
Messages	Output frequency 50 Hz		Output current 0.13 A (5 % of 2.6 A)		Direction of rotating field • 01 = clockwise • 02 = anticlockwise	

If the read register status command cannot be run correctly, an exception message is generated (→ page82).

Writing to coil [05_{hex}]

This function writes data to a single coil. You can change the coil's status as follows:

Data	Coil status	
	Off → On	On → Off
Change data (High byte)	FF_{hex}	00_{hex}
Change data (Low byte)	00_{hex}	00_{hex}

Example:
This example writes the start signal for a frequency inverter with slave address 10 to coil number 1.

Precondition: PNU A002 has the value 03.

Request:		
No.	**Name**	**Example hex**
1	Slave address (broadcast disabled)	0 A
2	Function code	05
3	Coil start number (High byte)	00
4	Coil start number (Low byte)	01
5	Change data (High byte)	FF
6	Change data (Low byte)	00
7	CRC-16 (High byte)	DC
8	CRC-16 (Low byte)	81

Answer:		
No.	**Name**	**Example hex**
1	Slave address	0 A
2	Function code	05
3	Coil start number (High byte)	00
4	Coil start number (Low byte)	01
5	Change data (High byte)	FF
6	Change data (Low byte)	00
7	CRC-16 (High byte)	DC
8	CRC-16 (Low byte)	81

If the data written to the selected coil contains errors, an exception message is issued (→ page82).

Writing to holding register [06_{hex}]

This function writes data to a selected holding register.

Example.

- Reference input (PNU A020). Write 50 Hz as first fixed frequency to the frequency inverter with slave address 5.
- Reference frequency 50 Hz is transferred in the form of value 500 ($01\,F4_{hex}$) as reference input 0 (PNU A020) to holding register $003A_{hex}$. The first value is 0.1 Hz.

Request:

No.	Name	Example hex
1	Slave address (broadcast disabled)	05
2	Function code	06
3	Register start number (High byte)	00
4	Register start number (Low byte)	3 A
5	Change data (High byte)	01
6	Change data (Low byte)	F4
7	CRC-16 (High byte)	A8
8	CRC-16 (Low byte)	54

Response:

No.	Name	Example hex
1	Slave address	0 A
2	Function code	05
3	Register start number (High byte)	00
4	Register start number (Low byte)	3 A
5	Change data (High byte)	01
6	Change data (Low byte)	F4
7	CRC-16 (High byte)	A8
8	CRC-16 (Low byte)	54

If the data written to the selected coil contains errors, an exception message is issued (→ page82).

Loopback [08_{hex}]

This function tests the transfer between master and slave (response loop).

Example:
Sending any test data (request) to the frequency inverter with slave address 1 and return of this data (response) for the loopback test.

Request:

No.	Name	Example hex
1	Slave address (broadcast disabled)	01
2	Function code	08
3	Test control bit (High byte)	00
4	Test control bit (Low byte)	00
5	Data (High byte)	Any
6	Data (Low byte)	Any
7	CRC-16 (High byte)	CRC
8	CRC-16 (Low byte)	CRC

Response:

No.	Name	Example hex
1	Slave address	0 A
2	Function code	05
3	Test control bit (High byte)	00
4	Test control bit (Low byte)	00
5	Data (High byte)	Any
6	Data (Low byte)	Any
7	CRC-16 (High byte)	CRC
8	CRC-16 (Low byte)	CRC

The test control bit (00_{hex}, 00_{hex}) can be used only for echoing; it is not available for other commands.

Writing to coils [$0F_{hex}$]

This function writes data to successive coils.

Example:
State change of digital inputs 1 to 6 of a frequency inverter with slave address 5. The inputs have the following state:

Name	Data					
Digital input	1	2	3	4	5	6
Coil number	7	8	9	10	11	12
Status of digital input	ON	ON	ON	OFF	ON	OFF
Change data (binary)	1	1	1	0	1	0

Request:

No.	Name	Example hex
1	Slave address (broadcast disabled)	05
2	Function code	0F
3	Coil start number (High byte)	00
4	Coil start number (Low byte)	07
5	Number of coils (High byte)	00
6	Number of coils (Low byte)	06
7	Byte number[1)]	02
8	Change data (High byte)[1)]	17
9	Change data (Low byte)[1)]	00
10	CRC-16 (High byte)	DA
11	CRC-16 (Low byte)	EF

1) The change data is a group of High bytes and Low bytes whose sum must be an even number. If it is odd, a 1 is added to make it even.

Response:

No.	Name	Example hex
1	Slave address	05
2	Function code	0F
3	Data volume in bytes	00
4	Coil data. Number of selected bit variables (data size)	07
5	Number of coils (High byte)	00
6	Number of coils (Low byte)	06
7	CRC-16 (High byte)	65
8	CRC-16 (Low byte)	8C

Writing to holding register [10_{hex}]

This function writes data in consecutive holding registers.

Example:

- Acceleration time 1 (PNU F002). Write 3000 Hz as value to the frequency inverter with slave address 1.
- A value of 3000 seconds is transferred to holding registers 0024_{hex} and 0025_{hex} in the form of the value 300000 ($493E0_{hex}$). The first value is 0.01 s.

Request:

No.	Name	Example hex
1	Slave address (broadcast disabled)	01
2	Function code	10
3	Start address (High byte)	00
4	Start address (Low byte)	24
5	Number of holding registers (High byte)	00
6	Number of holding registers (Low byte)	02
7	Byte number[1)]	04
8	Change data 1 (High byte)	00
9	Change data 1 (Low byte)	04
10	Change data 2 (High byte)	93
11	Change data 2 (Low byte)	E0
12	CRC-16 (High byte)	DC
13	CRC-16 (Low byte)	FD

1) The number of changing data bytes is entered here, not the number of the holding register.

Response:

No.	Name	Example hex
1	Slave address	01
2	Function code	10
3	Start address (High byte)	00
4	Start address (Low byte)	24
5	Number of holding registers (High byte)	00
6	Number of holding registers (Low byte)	02
7	CRC-16 (High byte)	01
8	CRC-16 (Low byte)	C3

If the data written to the selected holding registers contains errors, an exception message is issued (→ page82).

Exception message

In the Modbus protocol only the master manages the data exchange. It addresses each slave separately and waits for a response (except in broadcasting, in which it does not wait for a reply).

If the slave does not respond within a specified time (the latency), the master declares it not present. If a transmission error occurs, the master repeats the request.

If a slave receives an incomplete message it sends an exception message to the master. The master then decides whether it resends the data or not.

The exception message contains the following fields:

- Function code
- Exception code
- CRC-16

The function code of the exception message is formed by adding 80_{hex} to the request's function code.

Function code	
Request hex	Exception response hex
01	11
03	13
05	15
06	16
0F	1F
10	90

The exception code describes the reason for the exception response:

Exception code hex	Description
01	The function is not supported.
02	The address was not found.
03	The data format is not permissible.
21	The number of the holding register is too high.
22	The register's content must not be changed while the frequency inverter is in RUN mode: • The function sends an ENTER command during operation • The function writes to the register during operation • The function writes to read-only register or coils

Saving new register data (ENTER function)
The data transmitted to the frequency inverter with function "Force single register" or "Force multiple registers" (06_{hex}, 10_{hex}) is initially saved only in temporary memory. If the frequency inverter is switched off (POWER = Off), this data is lost. After a restart, the frequency inverter would then load the previously saved data data.

With the ENTER function, the new data is saved permanently.

Sending the ENTER command
Write the selected data to holding register 0901_{hex} with function "Force single register" (06_{hex}).

→ The ENTER function requires a long time. You can query its status with the "Force data" coil ($001A_{hex}$).

The frequency inverter's memory has a limited service life (about 100000 write cycles). Frequent use of the ENTER function reduces its lifespan.

Modbus register

Coil register (bit variables)

The tables below contain the basic registers for DV51 frequency inverters in Modbus networks. The access rights are indicated with "ro" and "rw":

- ro = read-only value.
- rw = read/write value.

Coil number hex	Name	Access rights	Description
0000	(reserved)	ro	
0001	Start command	rw	0 = STOP 1 = RUN (disabled when PNU A003 = 03)
0002	Direction of rotation	rw	0 = REV 1 = FWD (disabled when PNU A003 = 03)
0003	External fault (EXT)	rw	1 = Fault signal
0004	Reset fault signal (RST)	rw	1 = Reset
0005	(reserved)	rw	–
0006	(reserved)	rw	–
0007	Digital input 1	rw	0 = OFF 1 = ON[1)]
0008	Digital input 2	rw	0 = OFF 1 = ON[1)]
0009	Digital input 3	rw	0 = OFF 1 = ON[1)]
000 A	Digital input 4	rw	0 = OFF 1 = ON[1)]
000B	Digital input 5	rw	0 = OFF 1 = ON[1)]
000C	Digital input 6	rw	0 = OFF 1 = ON[1)]
000D	(do not use)	ro	

Coil number hex	Name	Access rights	Description
000E	RUN/STOP Status	ro	0 = STOP (connected with PNU d003) 1 = RUN
0000F	FWD/REV status	ro	0 = FWD 1 = REV
0010	Frequency inverter ready	ro	0 = not ready 1 = ready
0011	(reserved)	ro	–
0012	(reserved)	ro	–
0013	(reserved)	ro	–
0014	Alarm signal	ro	0 = no fault signal 1 = fault signal
0015	PID difference signal	ro	0 = OFF 1 = ON
0016	Overload signal	ro	0 = OFF 1 = ON
0017	Frequency reached signal	ro	0 = OFF 1 = ON
0018	Frequency reached signal at constant speed	ro	0 = OFF 1 = ON
0019	RUN mode signal	ro	0 = OFF 1 = ON
001 A	Force data	ro	0 = normal status 1= force
001B	CRC fault	ro	0 = no fault signal[2)] 1 = fault signal
001C	Overflow error	ro	0 = no fault signal[2)] 1 = fault signal
001D	Bus frame fault	ro	0 = no fault signal[2)] 1 = fault signal
001E	Parity fault	ro	0 = no fault signal[2)] 1 = fault signal
001F	Checksum error signal	ro	0 = no fault signal[2)] 1 = fault signal

1) The default state is On when one of the control signal terminals (digital inputs) or a coil is set to On. The control signal terminals have the highest priority. If the master can not reset the coil, it must be switched off through the control signal terminals to set the coil status to Off.

2) Transmission errors are held until they are reset. Errors can be reset during frequency inverter operation.

Holding register (word variable)

MSB = **m**ost **s**ignificant **b**it
LSB = **l**east **s**ignificant **b**it

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
2	0000	Frequency setpoint input	rw	Active when PNU A001 = 03 (value range: 0 to 4000)		0.1 [Hz]
3	0000	Status of frequency inverter	ro	00:	Initialization	–
				01:	(Reserved)	
				02:	STOP mode	
				03:	RUN mode	
				04:	FRS, free coasting (free run stop)	
				05:	JOG, jog mode	
				06:	DB, DC braking	
				07:	Ready for operation	
				08:	AL, fault signal	
				09:	Undervoltage	
4	0000	Reserved	ro	–		–
5	0000	Actual value signal PV input	rw	Active when PNU A076 = 02 (value range: 0 to 1000)		0.1 [%]
6	Reserved		–	–		–
…						
10						
11	d080	Indication – total number of occurred faults	ro	–		1 [times]
12	d081	Indication – fault 1 (last fault signal)	ro	Fault signal E…		–
13	d081		ro	Reserved		–
14	d081		ro	Frequency (Hz)		0.1 [Hz]
15	d081		ro	Reserved		–
16	d081		ro	Current (A)		0.1 [%]
17	d081		ro	Internal DC link voltage (VDc)		1 [V]
18	d081		ro	Total operating hours in RUN mode		–
19	d081		ro	Total operating hours in RUN mode		1 [h]
1 A	d081		ro	Total Power On time, power supply connected (h)		–
1B	d081		ro	Total Power On time, power supply connected (h)		1 [h]

Holding register hex	Function code	Name	Access rights	Value range	Manipulated variable
1C	d082	Indication – fault 2	ro	Fault signal E…	–
1D	d082		ro	Reserved	–
1E	d082		ro	Frequency (Hz)	0.1 [Hz]
1F	d082		ro	Reserved	–
20	d082		ro	Current (A)	0.1 [%]
21	d082		ro	Internal DC link voltage (VDc)	1 [V]
22	d082		ro	Total operating hours in RUN mode	–
23	d082		ro	Total operating hours in RUN mode	1 [h]
24	d082		ro	Total Power On time, power supply connected (h)	–
25	d082		ro	Total Power On time, power supply connected (h)	1 [h]
26	d083	Indication – fault 3	ro	Fault signal E…	–
27	d083		ro	Reserved	–
28	d083		ro	Frequency (Hz)	0.1 [Hz]
29	d083		ro	Reserved	–
2 A	d083		ro	Current (A)	0.1 [%]
2B	d083		ro	Internal DC link voltage (VDc)	1 [V]
2C	d083		ro	Total operating hours in RUN mode	1 [h]
2D	d083		ro	Total operating hours in RUN mode	–
2E	d083		ro	Total Power On time, power supply connected (h)	1 [h]
2F	d083		ro	Total Power On time, power supply connected (h)	–
30	Reserved		–	–	–
…					
1000					
1001	d001	Reserved	ro	–	–
1002	d001	Output frequency display	ro	0.0 – 400.0 Hz (0.1 Hz)	0.1 [Hz]
1003	d002	Output current display	ro	0.0 – 999.9 A (0.1 A)	0.1 [%]
1004	d003	Direction of rotation display	ro	F: Clockwise (forward) rotating field O: STOP R: Anticlockwise (reverse) rotating field	–
1005	d004	PID feedback display (MSB)	ro	0.00 – 99.99 (0.01 %) 100.0 – 999.9 (0.1 %) 1000 – 9999 (1 %) 0.0 – 400.0 Hz (0.1 Hz)	0.01
1006	d004	PID feedback display (LSB)	ro		
1007	d005	Indication – status of digital inputs 1 to 6	ro	–	–
1008	d006	Indication – status of digital outputs 11, 12 and K1	ro	–	–
1009	d007	Indication – scaled output frequency (MSB)	ro	0.00 – 9999 (0.01/0.1/1/10 Hz)	0.01
100 A	d007	Indication – scaled output frequency (LSB)	ro		
100B	d012	Reserved	ro	–	–
100C	d013	Indication – output voltage	ro	0 – 600 V (1 V)	1 [%]

Holding register hex	Function code	Name	Access rights	Value range	Manipulated variable
100D	d014	Reserved	ro	–	–
100E	d016	Indication – operation time counter (MSB)	ro	0 – 9999 (1 h) 10000 – 99990 (10 h) 100000 – 999000 (1000 h)	1 [h]
100F		Indication – operation time counter (LSB)			
1010	d017	Indication – mains On time	ro	0 – 9999 (1 h) 10000 – 99990 (10 h) 100000 – 999000 (1000 h)	1 [h]
1011					
1012	–	Reserved	rw	–	–
1013	–	Reserved	rw	–	–
1014	F002	Acceleration time 1 (MSB)	rw	0.01 – 99.99 (0.01 s) 100.0 – 999.9 (0.1 s) 1000 – 3000 (1 s)	0.01 [s]
1015	F002	Acceleration time 1 (LSB)			
1016	F003	Deceleration time 1 (MSB)	rw	0.01 – 99.99 (0.01 s) 100.0 – 999.9 (0.1 s) 1000 – 3000 (1 s)	0.01 [s]
1017	F003	Deceleration time 1 (LSB)	rw		
1018	F004	Direction of rotation – function of START key (optional keypad DEX-KEY-…)	rw	00: Clockwise rotating field (FWD) 01: Anticlockwise rotating field (REV)	–
1019	A001	Frequency reference value source selection	rw	00: Potentiometer of optional keypad DEX-KEY-6 01: Analog input O/OI 02: Optional keypad DEX-KEY-… (PNU F001 or A020) 03: Serial interface (Modbus) 10: Calculated value	–
101 A	A002	Start signal source selection	rw	01: Digital input (FWD/REV) 02: START button (optional keypad DEX-KEY-…) 03: Serial interface (Modbus) 04: Potentiometer of optional keypad DEX-KEY-6	–
101B	A003	Base frequency	rw	30 – 400 Hz, up to value of PNU A004 [Hz]	1 [Hz]
101C	A004	End frequency (f_{max})	rw	30 – 400 Hz	1 [Hz]
101D	A005	Analog input – selection (AT)	rw	00: Analog input O/OI 01: The locked range (PNU A011 to A015 or A101 to A105) and analog inputs O and OI 02: Analog input O and the potentiometer of optional keypad DEX-KEY-6 03: Analog input OI and the potentiometer of optional keypad DEX-KEY-6	–
101E	A006	Reserved	rw	–	–
101F	A011	Reserved	rw	–	–
1020	A011	Analog input (O-L) – frequency at minimum reference value	rw	0 – 400 Hz	0.1 [Hz]

Holding register hex	Function code	Name	Access rights	Value range	Manipulated variable
1021	A012	Reserved	rw	–	–
1022	A012	Analog input (O-L) – frequency at maximum reference value	rw	0 – 400 Hz	0.1 [Hz]
1023	A013	Analog input (O-L) – minimum reference value (offset)	rw	0 – 100 %	1 [%]
1024	A014	Analog input (O-L) – maximum reference value (offset)	rw	0 – 100 %	1 [%]
1025	A015	Analog input (O-L) – selection of starting frequency applied to the motor at minimum reference value	rw	00: Value of PNU A011 01: 0 Hz	–
1026	A016	Analog input – filter time constant	rw	1 – 8	1 [times]
1027	A019	Reserved	rw	–	–
1028	A020	Reserved	rw	–	–
1029	A020	Frequency reference input – reference value through keypad, PNU A001 must equal 02	rw	0 – 400 Hz	0.1 [Hz]
102 A	A021	Reserved	rw	–	–
102B	A021	Frequency reference input – fixed frequency (1)	rw	0 – 400 Hz	0.1 [Hz]
102C	A022	Reserved	rw	–	–
102D	A022	Frequency reference input – fixed frequency (2)	rw	0 – 400 Hz	0.1 [Hz]
102E	A023	Reserved	rw	–	–
102F	A023	Frequency reference input – fixed frequency (3)	rw	0 – 400 Hz	0.1 [Hz]
1030	A024	Reserved	rw	–	–
1031	A024	Frequency reference input – fixed frequency (4)	rw	0 – 400 Hz	0.1 [Hz]
1032	A025	Reserved	rw	–	–
1033	A025	Frequency reference input – fixed frequency (5)	rw	0 – 400 Hz	0.1 [Hz]
1034	A026	Reserved	rw	–	–
1035	A026	Frequency reference input – fixed frequency (6)	rw	0 – 400 Hz	0.1 [Hz]
1036	A027	Reserved	rw	–	–
1037	A027	Frequency reference input – fixed frequency (7)	rw	0 – 400 Hz	0.1 [Hz]
1038	A028	Reserved	rw	–	–
1039	A028	Frequency reference input – fixed frequency (8)	rw	0 – 400 Hz	0.1 [Hz]

Holding register hex	Function code	Name	Access rights	Value range	Manipulated variable
103 A	A029	Reserved	rw	–	–
103B	A029	Frequency reference input – fixed frequency (9)	rw	0 – 400 Hz	0.1 [Hz]
103C	A030	Reserved	rw	–	–
103D	A030	Frequency reference input – fixed frequency (10)	rw	0 – 400 Hz	0.1 [Hz]
103E	A031	Reserved	rw	–	–
103F	A031	Frequency reference input – fixed frequency (11)	rw	0 – 400 Hz	0.1 [Hz]
1040	A032	Reserved	rw	–	–
1041	A032	Frequency reference input – fixed frequency (12)	rw	0 – 400 Hz	0.1 [Hz]
1042	A033	Reserved	rw	–	–
1043	A033	Frequency reference input – fixed frequency (13)	rw	0 – 400 Hz	0.1 [Hz]
1044	A034	Reserved	rw	–	–
1045	A034	Frequency reference input – fixed frequency (14)	rw	0 – 400 Hz	0.1 [Hz]
1046	A035	Reserved	rw	–	–
1047	A035	Frequency reference input – fixed frequency (15)	rw	0 – 400 Hz	0.1 [Hz]
1048	A038	Jog mode – jog mode reference value	rw	0 – 9.99 Hz	0.01 [Hz]
1049	A039	Jog mode – motor stop method	rw	00: Free coasting 01: Deceleration ramp 02: DC braking	–
104B	A042	Boost – manual voltage boost[1)]	rw	0 – 20 %	0.1 [%]
104C	A043	Boost – transition frequency for maximum voltage boost[1)]	rw	0 – 50 %	0.1 [%]
104D	A044	*U*/*f* characteristic	rw	00: Constant torque curve 01: Reduced torque curve 02: SLV active	–
104E	A045	*U*/*f* characteristic – output voltage	rw	0 – 255	1 [%]
104F	A046	SLV – gain factor for automatic voltage compensation	rw	0 – 255	1 [%]
1050	A047	SLV – gain factor for automatic slip compensation	rw	0 – 255	1 [%]
1051	A051	DC braking	rw	00: OFF: Disabled 01: ON: Enabled	–
1052	A052	DC braking – starting frequency	rw	0 – 60 Hz	0.1 [Hz]

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
1053	A053	DC braking – waiting time	rw	0 – 5 s		0.1 [s]
1054	A054	DC braking – braking torque	rw	0 – 100 %		1 [%]
1055	A055	DC braking – braking duration	rw	0 – 60 s		0.1 [s]
1056	A056	DC braking – behaviour on activation of the digital input (DB)	rw	00:	Timed braking according to value of PNU A055	–
				01:	Continuous operation	
1057	A057	Reserved	rw	–		–
1058	A058	Reserved	rw	–		–
1059	A059	Reserved	rw	–		–
105 A	A061	Maximum operating frequency	rw	0 – 400 Hz		0.1 [Hz]
105B	A062	Minimum operating frequency	rw	0.5 – 400 Hz		0.1 [Hz]
105C	A063	Reserved	rw	–		–
105D	A063	Frequency jump (1)	rw	0 – 400 Hz		0.1
105E	A064	Frequency jump (1) – jump width	rw	0 – 10 Hz		0.1 [Hz]
105F	A065	Reserved	rw	–		–
1060	A065	Frequency jump (2)	rw	0 – 400 Hz		0.1
1061	A066	Frequency jump (2) – jump width	rw	0 – 10 Hz		0.1 [Hz]
1062	A067	Reserved	rw	–		–
1063	A067	Frequency jump (3)	rw	0 – 400 Hz		0.1
1064	A068	Frequency jump (3) – jump width	rw	0 – 10 Hz		0.1 [Hz]
1065	A069	Reserved	rw	–		–
1066	A069	Reserved	rw	–		–
1067	A070	Reserved	rw	–		–
1068	A071	PID control	rw	00:	OFF: Disabled	–
				01:	ON: Enabled	
1069	A072	PID controller – P-component	rw	0.2 – 5.0		0.1
106 A	A073	PID controller – I-component	rw	0.00 – 100 s		0.1 [s]
106B	A074	PID controller – D-component	rw	0.00 – 100 s		0.1 [s]
106C	A075	PID controller – reference value factor PV	rw	0.01 – 99.99		0.01
106D	A076	PID controller – actual value signal PV input	rw	00:	Analog input OI	–
				01:	Analog input O	
				02:	Serial interface (Modbus)	
				10:	Calculated value (PNU A143)	

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
106E	A077	PID controller – invert input signals	rw	00:	OFF: disabled	–
				01:	ON: Enabled	
106F	A078	PID controller – output signal limit	rw	0 – 100 %		0.1 [%]
1070	A081	Output voltage (AVR function)	rw	00:	ON: Enabled	–
				01:	OFF: Disabled	
				02:	DOFF: Disabled during deceleration	
1071	A082	Output voltage (AVR motor rated voltage)	rw	DV51-32…-…: 200, 215, 220, 230, 240		–
				DV51-340-…: 380, 400, 415, 440, 460, 480		
				Default setting depends on series		
1072	A085	Reserved	rw	–		–
1073	A086	Reserved	rw	–		–
1074	A092	Acceleration time 2 (MSB)	rw	0.01 – 3000 s		0.01 [s]
1075	A092	Acceleration time 2 (LSB)	rw	0.01 – 3000 s		
1076	A093	Deceleration time 2 (MSB)	rw	0.01 – 3000 s		0.01 [s]
1077	A093	Deceleration time 2 (LSB)	rw	0.01 – 3000 s		
1078	A094	Acceleration time, specify signal for changeover from acceleration time 1 to acceleration time 2	rw	00:	Digital input (2CH)	–
				01:	Frequency (PNU A095 or A096)	
1079	A095	Reserved	rw	–		–
107 A	A095	Acceleration time, frequency for changeover from ramp time 1 to ramp time 2	rw	0.0 – 400 Hz		0.1 [Hz]
107B	A096	Reserved	rw	–		–
107C	A096	Deceleration time, frequency for changeover from ramp time 1 to ramp time 2	rw	0.0 – 400 Hz		0.1 [Hz]
107D	A097	Acceleration time, characteristic	rw	00:	linear	–
				01:	S curve	
107E	A098	Deceleration time, characteristic	rw	00:	linear	–
				01:	S curve	
107F	A101	Reserved	rw	–		–
1080	A101	Analog input (OI-L), frequency at minimum reference value	rw	0 – 400 Hz		0.1 [Hz]
1081	A102	Reserved	rw	–		–
1082	A102	Analog input (OI-L), frequency at maximum reference value	rw	0 – 400 Hz		0.1 [Hz]
1083	A103	Analog input (OI-L), minimum reference value (offset)	rw	0 – 100 %		1 [%]

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
1084	A104	Analog input (OI-L), maximum reference value (offset)	rw	0 – 100 %		1 [%]
1085	A105	Analog input (OI-L), selection of starting frequency applied to the motor at minimum reference value	rw	00:	Value from PNU A101	–
				01:	0 Hz	
1086	A111	Reserved	rw	–		–
1087	A111	Reserved	rw	–		–
1088	A112	Reserved	rw	–		–
1089	A112	Reserved	rw	–		–
108 A	A113	Reserved	rw	–		–
108B	A114	Reserved	rw	–		–
108C	A131	Reserved	rw	–		–
108D	A132	Reserved	rw	–		–
108E	A141	Calculator – select input A	rw	00:	Value of optional keypad DEX-KEY-…	–
				01:	Potentiometer of optional keypad DEX-KEY-6	
				02:	Analog input (O)	
				03:	Analog input (OI)	
				04:	Serial interface (Modbus)	
108F	A142	Calculator – select input B	rw	Values → PNU A141		–
1090	A143	Calculator – operation	rw	00:	Addition (A plus B)	–
				01:	Subtraction (A minus B)	
				02:	Multiplication (A times B)	
1091	A145	Calculator – offset frequency	rw	0 – 400 Hz		0.1 [Hz]
1092	–	Reserved	rw	–		–
1093	A146	Calculator – offset frequency, prefix	rw	Value from PNU A145		–
				00:	plus	
				01:	minus	
1094	A151	Reserved	rw	–		–
1095	A151	Potentiometer (optional keypad), starting frequency	rw	0 – 400 Hz		0.1 [Hz]
1096	A152	Reserved	rw	–		–
1097	A152	Potentiometer (optional keypad), frequency at maximum reference value	rw	0 – 400 Hz		0.1 [Hz]
1098	A153	Potentiometer (optional keypad), minimum reference value (offset)	rw	0 – 100 %		1 [%]
1099	A154	Potentiometer (optional keypad), maximum reference value (offset)	rw	0 – 100 %		1 [%]

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
109 A	A155	Potentiometer (optional keypad), selection of starting frequency applied to motor at minimum reference value.	rw	00:	Value from PNU A151	–
				01:	0 Hz	
109B	–	Reserved	rw	–		–
…						
10A4						
10A5	b001	POWER, restarting mode after power supply interruption	rw	00:	0 Hz Start	–
				01:	Automatic restart at set starting frequency after expiry of time set with PNU b003.	
				02:	After the time set with PNU b003 has elapsed, the frequency inverter synchronizes to the current motor rotation speed and the motor is accelerated to the current reference value in the set ramp times.	
				03:	After the time set under PNU b003 has elapsed, the inverter synchronizes to the current motor rotation speed and the motor brakes to a stop in the set deceleration time. A fault message is then displayed.	
10A6	b002	POWER, permissible power supply downtime	rw	0.3 – 25 s		0.1 [s]
10A7	b003	POWER, waiting time before automatic restart after power supply failure	rw	0.3 – 100 s		0.1 [s]
10A8	b004	POWER, generate undervoltage fault signal, direct de-energizing on power supply failure	rw	00:	OFF, disabled	–
				01:	ON, enabled	
10A9	b005	POWER, number of automatic restarting attempts after undervoltage fault signal	rw	00:	16 restarts	–
				01:	No limit	
10AA	b006	Reserved	rw	–		–
10AB	b007	Reserved	rw	–		–
10AC	–	Reserved	rw	–		–
10AD	b012	Thermal overload, tripping current	rw	0.2 – 1.2 × I_e [A] 0.2 – 1.2 × I_e [A]		0.01 [%]
10AE	b013	Thermal overload, characteristic (torque curve)	rw	00:	Reduced torque 1	–
				01:	Constant torque	
				02:	Reduced torque 2	
10AF	b015	Reserved	rw	–		–
10B0	b016	Reserved	rw	–		–
10B1	b017	Reserved	rw	–		–
10B2	b018	Reserved	rw	–		–
10B3	b019	Reserved	rw	–		–
10B4	b020	Reserved	rw	–		–

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
10B5	b021	Motor current limitation – function	rw	00:	OFF, disabled	–
				01:	ON, enabled in acceleration phase and at constant speed	
				02:	Enabled only at constant speed	
10B6	b022	Motor current limitation, tripping current	rw	0.1 – 1.5 × I_e [A] Default, dependent on frequency inverter's rated current (I_e)		0.01 [%]
10B7	b023	Motor current limitation, deceleration time constant	rw	0.1 – 3000 s		0.1 [s]
10B8	b024	Reserved	rw	–		–
10B9	b025	Reserved	rw	–		–
10BA	b026	Reserved	rw	–		–
10BB	b028	Motor current limitation, limit current selection	rw	00:	Value of PNU b022	–
				01:	Analog input O-L	
10BC	b031	Parameter access inhibit (access rights)	rw	00:	Access to all parameters blocked, except PNU b031, when digital input SFT is enabled (→ PNU C001: 15)	–
				01:	Access to all parameters blocked, except PNU b031 and F001, when digital input SFT is enabled (→ PNU C001: 15)	
				02:	Access to all parameters blocked, except PNU b031	
				03:	Access to all parameters blocked, except PNU b031 and F001	
				10:	Extended access rights to parameters in RUN mode.	
10BD	b032	Reserved	rw	–		1 [%]
10BE	b034	Reserved	rw	–		–
10BF	b035	Reserved	rw	–		–
10C0	b036	Reserved	rw	–		–
10C1	b037	Reserved	rw	–		–
10C2	b040	Reserved	rw	–		–
10C3	b041	Reserved	rw	–		–
10C4	b042	Reserved	rw	–		–
10C5	b043	Reserved	rw	–		–
10C6	b044	Reserved	rw	–		–
10C7	b045	Reserved	rw	–		–
10C8	b046	Reserved	rw	–		–
10C9	b050	Reserved	rw	–		–
10CA	b051	Reserved	rw	–		–
10CB	b052	Reserved	rw	–		–
10CC	b053	Reserved	rw	–		–
10CD	b053	Reserved	rw	–		–
10CE	b054	Reserved	rw	–		–

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
10CF	b080	Analog output AM, gain factor	rw	0 – 255		1 [%]
10D0	b081	Reserved	rw	–		–
10D1	b082	Increased starting frequency (e.g. at high static friction)	rw	0.5 – 9.9 Hz		0.1 [%]
10D2	b083	Carrier frequency	rw	2 – 14 kHz		0.1 [%]
10D3	b084	Initializing – function	rw	00:	Clear fault register	–
				01:	Load default settings (DS)	
				02:	Clear fault register and load default settings (DS)	
10D4	b085	System settings (country-specific default settings for initialization)	rw	00:	Japan	–
				01:	Europe	
				02:	USA	
10D5	b086	Frequency indication scaling factor for value in PNU d007	rw	0.1 – 99.9		0.1
10D6	b087	STOP button, (optional keypad DEX-KEY-…)	rw	00:	Enabled	–
				01:	Disabled	
10D7	b088	Motor restart after removal of the FRS signal	rw	00:	Restart with 0 Hz	–
				01:	Restart with the determined output frequency (current motor speed)	
10D9	b090	Braking transistor, permissible percentage duty factor within a 100 s interval	rw	0 – 100 %		–
				0 – 100 %		
				0 – 100 %		
10DA	b091	STOP button, (optional keypad DEX-KEY-…), selection of motor stop on actuation	rw	00:	DEC, braking to 0 Hz with deceleration ramp	–
				01:	FRS, free coasting down to 0 Hz	
10DB	b092	Device fan, configuration	rw	00:	Built-in fan always running	–
				01:	Built-in fan running, automatic Off 5 min after stop signal	
				02:	Built-in fan, temperature-controlled actuation	
10DC	b095	Braking transistor, control	rw	00:	Function disabled	–
				01:	Enabled in RUN mode	
				02:	Always enabled	
10DD	b096	Braking transistor, starting voltage threshold	rw	330 – 395 V (U_e = 230 V)		1 [V]
				660 – 790 V (U_e = 400 V)		
				Default, dependent on rated voltage of DV51 (U_e)		
10DE	b098	Reserved	rw	–		–
10DF	b099	Reserved	rw	–		–
10E0	b100	Reserved	rw	–		–
10E1	b101	Reserved	rw	–		–
10E2	b102	Reserved	rw	–		–
10E3	b103	Reserved	rw	–		–

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
10E4	b104	Reserved	rw	–		–
10E5	b105	Reserved	rw	–		–
10E6	b106	Reserved	rw	–		–
10E7	b107	Reserved	rw	–		–
10E8	b108	Reserved	rw	–		–
10E9	b109	Reserved	rw	–		–
10EA	b110	Reserved	rw	–		–
10EB	b111	Reserved	rw	–		–
10EC	b112	Reserved	rw	–		–
10ED	b113	Reserved	rw	–		–
10EE	b120	Reserved	rw	–		–
10EF	b121	Reserved	rw	–		–
10F0	b122	Reserved	rw	–		–
10F1	b123	Reserved	rw	–		–
10F2	b124	Reserved	rw	–		–
10F3	b125	Reserved	rw	–		–
10F4	b126	Reserved	rw	–		–
10F5	b130	Internal DC link, stop deceleration ramp on overvoltage in the internal DC link	rw	00: 01:	OFF, disabled ON, enabled	–
10F6	b131	Internal DC link, switching threshold for stopping the deceleration ramp (PNU b130 = 01)	rw	330 – 395 V (U_e = 230 V) 660 – 790 V (U_e = 400 V) Default, dependent on rated voltage of DV51 (U_e)		1 [V]
10F7	b140	Suppress stop on overcurrent	rw	00: 01:	OFF, disabled ON, enabled	–
10F8	b150	Clock frequency, automatic clock frequency reduction on overtemperature	rw	00: 01:	OFF, disabled ON, enabled	–
10F9	b160	Inverter, reduce inverter's response time (RDY) to a control signal	rw	00: 01:	OFF On	–
10FA … 1102	–	Reserved	rw	–		–

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
1103	C001	Digital input 1 – function	rw	00:	FWD: Clockwise rotating field	–
				01:	REV: Anticlockwise rotating field	
				02:	CF1: Fixed frequency selection, bit 0 (LSB)	
				03:	CF2: Fixed frequency selection, bit 1	
				04:	CF3: Fixed frequency selection, bit 2	
				05:	CF4: Fixed frequency selection, bit 3 (MSB)	
				06:	JOG: Jog mode	
				07:	DB: DC braking	
				08:	SET: Select second parameter set	
				09:	2CH: Second time ramp	
				11:	FRS: Free run stop (free coasting, = controller inhibit)	
				12:	EXT: External fault message	
				13:	USP: Unattended start protection	
				15:	SFT: Parameter access inhibit	
				16:	AT: change over to analog input OI	
				18:	RST: Reset fault signal	
				19:	PTC: PTC thermistor input (digital input 5 only)	
				20:	STA: Three-wire control start signal	
				21:	STP: Three-wire control stop signal	
				22:	F/R: Three-wire control, direction of rotation	
				23:	PID: Activate PID control	
				24:	PIDC: Reset integral component of PID control	
				27:	UP: Acceleration (motor potentiometer)	
				28:	DWMN: Deceleration (motor potentiometer)	
				29:	UDC: Motor potentiometer, reset saved value of motor potentiometer to 0 Hz	
				31:	OPE: Operator keypad	
				50:	ADD: Add value from PNU A145 to frequency reference value.	
				51:	F-TM: Digital input, increase priority (shorter response time).	
				52:	RDY: Inverter, reduce response time to control signals	
				53:	SP-SET: Second parameter set with special functions	
				255:	-- (no function)	
1104	C002	Digital input 2 – function	rw	Values → PNU C001		–
1105	C003	Digital input 3 – function	rw	Values → PNU C001		–
1106	C004	Digital input 4 – function	rw	Values → PNU C001		–
1107	C005	Digital input 5 – function	rw	Values → PNU C001		–

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
1108	C006	Digital input 6 – function	rw	Values → PNU C001		–
1109	C007	Reserved	rw	–		–
110 A	C008	Reserved	rw	–		–
110B	C011	Digital input 1 – logic	rw	00:	Signal triggers switching	–
				01:	Low signal triggers switching	
110C	C012	Digital input 2 – logic	rw	Values → PNU C011		–
110D	C013	Digital input 3 – logic	rw	Values → PNU C011		–
110E	C014	Digital input 4 – logic	rw	Values → PNU C011		–
110F	C015	Digital input 5 – logic	rw	Values → PNU C011		–
1110	C016	Digital input 6 – logic	rw	Values → PNU C011		–
1111	C017	Reserved	rw	–		–
1112	C018	Reserved	rw	–		–
1113	C019	Reserved	rw	–		–
1114	C021	Digital output 11 – signal	rw	00:	RUN: In operation	–
				01:	FA1: Reference frequency reached	
				02:	FA2: Frequency signal – output frequency exceeds value in PNU C042 (during acceleration ramp) or PNU C043 (during deceleration ramp)	
				03:	OL: Overload warning – motor current exceeds value in PNU C041.	
				04:	OD: PID controller deviation – reference/ actual value differential exceeds signalling threshold in PNU C044.	
				05:	AL: Fault – fault/alarm message	
				06:	Dc: Warning – Reference value at input O (0 to 10 V) lower than value in PNU b082 or current signal at input OI below 4 mA.	
				07:	FBV: Warning – reference/actual value differential of PID controller exceeds the tolerance range in PNU C044.	
				08:	NDc: Fault/warning dependent on PNU C076 – communication watchdog timer has expired: communications are interrupted.	
				09:	LOG: Show result of logic link performed through PNU C143.	
				10:	ODc: Warning – reference value at input O (0 to 10 V) higher than maximum value or current signal at input OI above as 20 mA.	
1115	C022	Digital output 12 – signal	rw	Values → PNU C021		–
1116	C023	Reserved	rw	–		–
1117	C024	Reserved	rw	–		–
1118	C025	Reserved	rw	–		–
1119	C026	Relay K1 – signal	rw	Values → PNU C021		–
111 A	C027	Reserved	rw	–		–

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
111B	C028	Analog output AM – indication/reading	rw	00: 01:	f-Out: Current output frequency I-Out: Current output current	–
111C	C029	Reserved	rw	–		–
111D	C031	Digital output 11 – logic	rw	00: 01:	Normally open contact (NO) Normally closed contact (NC)	–
111E	C032	Digital output 12 – logic	rw	Values → PNU C031		–
111F	C033	Reserved	rw	–		–
1120	C034	Reserved	rw	–		–
1121	C035	Reserved	rw	–		–
1122	C036	Relay K1 (K11-K12) – logic	rw	Values → PNU C031		–
1123	C040	Reserved	rw	–		–
1124	C041	Output function – threshold for overload warning (OL)	rw	0 – 2 × I_e [A] Default, dependent on frequency inverter's rated current (I_e)		0.01 [%]
1125	C042	Reserved	rw	–		–
1126	C042	Output function – signalling threshold for frequency signal FA2 during acceleration	rw	0 – 400 Hz		0.1 [Hz]
1127	C043	Reserved	rw	–		–
1128	C043	Output function – signalling threshold for frequency signal FA2 during deceleration	rw	0 – 400 Hz		0.1 [Hz]
1129	C044	Output function – signalling threshold for maximum permissible PID controller deviation of actual value from reference value	rw	0 – 100 %		0.1 [%]
112 A	C045	Reserved	rw	–		–
112B	C045	Reserved	rw	–		–
112C	C046	Reserved	rw	–		–
112D	C046	Reserved	rw	–		–
112E	C052	PID controller – switch-off threshold for second stage of PID controller	rw	0 – 100 %		0.1 [%]
112F	C053	PID controller – switch-on threshold for second stage of PID controller	rw	0 – 100 %		0.1 [%]
1130	C055	Reserved	rw	–		–
1131	C056	Reserved	rw	–		–
1132	C057	Reserved	rw	–		–
1133	C058	Reserved	rw	–		–
1134	C061	Reserved	rw	–		–
1135	C062	Reserved	rw	–		–
1136	C063	Reserved	rw	–		–

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
1137	C070	Reserved	rw	–		–
1138	C071	Communication – baud rate	ro	04:	4000 bit/s	–
				05:	9600 bit/s	
				06:	19200 bit/s	
1139	C072	Communication – address	ro	1 – 32		–
113 A	C073	Reserved	ro	–		
113B	C074	Communication – parity	ro	00:	None	–
				01:	Even	
				02:	Odd	
113C	C075	Communication – stop bits	ro	1:	1 bit	–
				2:	2 bits	
113D	C076	Communication – behaviour of frequency inverter on communication errors	rw	00:	Switch off on fault signal E60	–
				01:	Decelerate to standstill at deceleration ramp and then switch off with error E60.	
				02:	Disable devices	
				03:	FRS: Free run stop (free coasting, = controller inhibit)	
				04:	DEC: Braking to 0 Hz at set deceleration ramp	
113E	C077	Communication – set monitoring time (watchdog).	rw	0 – 99.99 s		0.1 [s]
113F	C078	Communication – waiting time to output of a fault signal	ro	0 – 1000 ms		0.1 [s]
1140	C079	Reserved	ro	–		–
1141	C081	Analog input O – reference value signal compensation	rw	0 – 200 %		0.1 [%]
1142	C082	Analog input OI – reference value signal compensation	rw	0 – 200 %		0.1 [%]
1143	C083	Reserved	rw	–		–
1144	C085	Thermistor compensation (digital input 5)	rw	0 – 200 %		0.1 [%]
1145	C086	Analog output AM – offset compensation	rw	0 – 10 V		0.1 [%]
1146	C087	Reserved	rw	–		–
1147	C088	Reserved	rw	–		–
1148	C091	Debug mode – parameter error	ro	00:	Do not show parameter	–
				01:	Show parameter	
1149	C101	Motor potentiometer – reference value for motor potentiometer after power supply interruption	rw	00:	Clear last value and use default for PNU F001	–
				01:	Use saved motor potentiometer value set with UP/DWN keys	

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
114 A	C102	Reset function (RST) – response to a Reset signal	rw	00:	On rising edge, reset fault and stop motor if in RUN	–
				01:	On falling edge, reset fault and stop motor if in RUN	
				02:	On rising edge, reset fault only	
114B	C103	Reserved	rw	–		–
114C	C111	Reserved	rw	–		–
114D	C121	Reserved	rw	–		–
114E	C122	Reserved	rw	–		–
114F	C123	Reserved	rw	–		–
1150	C141	Logic function – select input A	rw	00:	RUN: In operation	–
				01:	FA1: Reference frequency reached	
				02:	FA2: Frequency signal – output frequency exceeds value in PNU C042 (during acceleration ramp) or PNU C043 (during deceleration ramp)	
				03:	OL: Overload warning – motor current exceeds value in PNU C041.	
				04:	OD: PID controller deviation – reference/ actual value differential exceeds signalling threshold in PNU C044.	
				05:	AL: Fault – fault/alarm signal	
				06:	Warning: Reference value at input O (0 to 10 V) lower than value in PNU b082 or current signal at input OI below 4 mA.	
				07:	FBV: Warning – reference/actual value differential of PID controller exceeds the tolerance range in PNU C044.	
				08:	NDc: Fault/warning (dependent on PNU C076) – communication watchdog timer has expired: communications are interrupted.	
				10:	ODc: Warning – reference value at input O (0 to 10 V) higher than maximum value or current signal at input OI above as 20 mA.	
1151	C142	Logic function – select input B	rw	Values → PNU C141		–
1152	C143	Logic function – select link [LOG]	rw	00:	[LOG] = A AND B	–
				01:	[LOG] = A OR B	
				02:	[LOG] = A XOR B	
1153	C144	Digital output 11 – deceleration time (On)	rw	0 – 100 s		0.1 [s]
1154	C145	Digital output 11 – deceleration time (Off)	rw	0 – 100 s		0.1 [s]
1155	C146	Digital output 12 – deceleration time (On)	rw	0 – 100 s		0.1 [s]

Holding register hex	Function code	Name	Access rights	Value range	Manipulated variable
1156	C147	Digital output 12 – deceleration time (Off)	rw	0 – 100 s	0.1 [s]
1157	C148	Relay K1 – deceleration time (On)	rw	0 – 100 s	0.1 [s]
1158	C149	Relay K1 – deceleration time (Off)	rw	0 – 100 s	0.1 [s]
1159 … 1162	–	Reserved	rw	–	–
1163	H001	Reserved	rw	–	–
1164	H002	Reserved	rw	–	–
1165	H003	Motor – assigned rating [kW]/{HP} at rated voltage (U_e)	rw	0.2; 0.4; 0.55; 0.75; 1.1; 1.5; 2.2; 3.0; 4.0; 5.5; 7.5; 11.0 {0.2; 0.4; 0.75; 1.5; 2.2; 3.7; 5.5; 7.5; 11.0} Default depends on rated voltage and type rating of DV51.	–
1166	H004	Motor – number of poles	rw	2, 4, 6, 8	–
1167	H005	Reserved	rw	–	–
1168	H006	Motor – stabilization constant	rw	0 – 255	1 [%]
1169	H007	Motor – voltage class	rw	200 V (230 V) 400 V Default, dependent on rated voltage and type raring of DV51	–
116 A	H020	Reserved	rw	–	–
116B	–	Reserved	rw	–	–
116C	H021	Reserved	rw	–	–
116D	–	Reserved	rw	–	–
116E	H022	Reserved	rw	–	–
116F	–	Reserved	rw	–	–
1170	H023	Reserved	rw	–	–
1171	–	Reserved	rw	–	–
1172	H024	Reserved	rw	–	–
1173	–	Reserved	rw	–	–
1174	H030	Reserved	rw	–	–
1175	–	Reserved	rw	–	–
1176	H031	Reserved	rw	–	–
1177	–	Reserved	rw	–	–
1178	H032	Reserved	rw	–	–
1179	–	Reserved	rw	–	–
117 A	H033	Reserved	rw	–	–
117B	–	Reserved	rw	–	–
117C	H034	Reserved	rw	–	–
117D	–	Reserved	rw	–	–
117E	H050	Reserved	rw	–	–

Holding register hex	Function code	Name	Access rights	Value range	Manipulated variable
117F	H051	Reserved	rw	–	–
1180	H052	Reserved	rw	–	–
1181	H060	Reserved	rw	–	–
1182	H070	Reserved	rw	–	–
1183	H071	Reserved	rw	–	–
1184	H072	Reserved	rw	–	–
1185	H080	Reserved	rw	–	–
1186	H081	Reserved	rw	–	–
1187	Reserved		–	–	–
…					
1500					
1501	F202	Acceleration time 1 (second parameter set) (MSB)	rw	0.01 – 99.99 (0.01 s) 100.0 – 999.9 (0.1 s) 1000 – 3000 (1 s)	0.01 [s]
1502	F202	Acceleration time 1 (second parameter set) (LSB)			
1503	F203	Deceleration time 1 (second parameter set) (MSB)	rw	0.01 – 99.99 (0.01 s) 100.0 – 999.9 (0.1 s) 1000 – 3000 (1 s)	0.01 [s]
1504	F203	Deceleration time 1 (second parameter set) (LSB)	rw		
1505	–	Reserved	rw	–	–
…					
1509					
150 A	A201	Frequency reference value source selection (second parameter set)	rw	00: Potentiometer of optional keypad DEX-KEY-6 01: Analog input O/OI 02: Optional keypad DEX-KEY-… (PNU F001 or A020) 03: Serial interface (Modbus) 10: Calculated value	–
150B	A202	Start signal source selection (second parameter set)	rw	01: Digital input (FWD/REV) 02: START button (optional keypad DEX-KEY-…) 03: Serial interface (Modbus) 04: Potentiometer of optional keypad DEX-KEY-6	–
150C	A203	Base frequency (second parameter set)	rw	30 – 400 Hz, up to value of PNU A004 [Hz]	1 [Hz]
150D	A204	End frequency (f_{max}) (second parameter set)	rw	30 – 400 Hz	1 [Hz]
150E	A220	Reserved	rw	–	
150F	A220	Frequency reference input – reference value through keypad, PNU A001 must equal 02 (second parameter set)	rw	0 – 400 Hz	0.1 [Hz]

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
1510	A241	–	rw	–		–
1511	A242	Boost – manual voltage boost (second parameter set)[1)]	rw	0 – 20 %		0.1 [%]
1512	A243	Boost – transition frequency for maximum voltage boost (second parameter set)[1)]	rw	0 – 50 %		0.1 [%]
1513	A244	*U*/*f* characteristic (second parameter set)	rw	00:	Constant torque curve	–
				01:	Reduced torque curve	
				02:	SLV active	
1514	A245	*U*/*f* characteristic – output voltage (second parameter set)	rw	0 – 255		1 [%]
1515	A246	SLV – gain factor for automatic voltage compensation (second parameter set)	rw	0 – 255		–
1516	A247	SLV – gain factor for automatic slip compensation (second parameter set)	rw	0 – 255		–
1517	A261	Maximum operating frequency (second parameter set)	rw	0 – 400 Hz		0.1 [Hz]
1518	A262	Minimum operating frequency (second parameter set)	rw	0.5 – 400 Hz		0.1 [Hz]
1518	A292	Acceleration time 2 (second parameter set) (MSB)	rw	0.01 – 3000 s		0.01 [s]
1519	A292	Acceleration time 2 (second parameter set) (LSB)	rw	0.01 – 3000 s		
151 A	A293	Deceleration time 2 (second parameter set) (MSB)	rw	0.01 – 3000 s		0.01 [s]
151B	A293	Deceleration time 2 (second parameter set) (LSB)	rw	0.01 – 3000 s		
151C	A294	Acceleration time, specify signal for changeover from acceleration time 1 to acceleration time 2 (second parameter set)	rw	00:	Digital input (2CH)	0.1 [Hz]
				01:	Frequency (PNU A095 or A096)	
151D	A295	Reserved	rw	–		–
151E	A295	Acceleration time, frequency for changeover from ramp time 1 to ramp time 2 (second parameter set)	rw	0.0 – 400 Hz		0.1 [Hz]
151F	A296	Reserved	rw	–		–

Holding register hex	Function code	Name	Access rights	Value range		Manipulated variable
1520	A296	Deceleration time, frequency for changeover from ramp time 1 to ramp time 2 (second parameter set)	rw	0.0 – 400 Hz		
1521	–	Reserved	rw	–		–
…						
1525						
1526	b212	Thermal overload, tripping current (second parameter set)	rw	0.2 – 1.2 × I_e [A] 0.2 – 1.2 × I_e [A]		0.01 [%]
1527	b213	Thermal overload, characteristic (torque curve) (second parameter set)	rw	00:	Reduced torque 1	–
				01:	Constant torque	
				02:	Reduced torque 2	
1528	b221	Motor current limitation – function (second parameter set)	rw	00:	OFF, disabled	–
				01:	ON, enabled in acceleration phase and at constant speed	
				02:	Enabled only at constant speed	
1529	b222	Motor current limitation, tripping current (second parameter set)	rw	0.1 – 1.5 × I_e [A] Default, dependent on frequency inverter's rated current (I_e)		0.01 [%]
152 A	b223	Motor current limitation, deceleration time constant (second parameter set)	rw	0.1 – 3000 s		0.1
152B	b228	Motor current limitation, limit current selection (second parameter set)	rw	00:	Value of PNU b022	–
				01:	Analog input O-L	
152C	–	Reserved	rw	–		–
…						
1530						
1531	C201	Digital input 1 – function (second parameter set)	rw	Values → PNU C001 (1103_{hex})		–
1532	C202	Digital input 2 – function (second parameter set)	rw	Values → PNU C001 (1103_{hex})		–
1533	C203	Digital input 3 – function (second parameter set)	rw	Values → PNU C001 (1103_{hex})		–
1534	C204	Digital input 4 – function (second parameter set)	rw	Values → PNU C001 (1103_{hex})		–
1535	C205	Digital input 5 – function (second parameter set)	rw	Values → PNU C001 (1103_{hex})		–
1536	C206	Digital input 6 – function (second parameter set)	rw	Values → PNU C001 (1103_{hex})		–
1537	C207	Reserved	rw	–		–
1538	C208	Reserved	rw	–		–
1539	C241	Output function – threshold for overload warning (OL) (second parameter set)	rw	0 – 2 × I_e [A] Default, dependent on frequency inverter's rated current (I_e)		0.01 [%]

Holding register hex	Function code	Name	Access rights	Value range	Manipulated variable
153 A	–	Reserved	rw	–	–
…					
153E					
153F	H202	Reserved	rw	–	–
1540	H203	Motor – assigned rating [kW]/{HP} at rated voltage (U_e) (second parameter set)	rw	0.2; 0.4; 0.55; 0.75; 1.1; 1.5; 2.2; 3.0; 4.0; 5.5; 7.5; 11.0 {0.2; 0.4; 0.75; 1.5; 2.2; 3.7; 5.5; 7.5; 11.0} Default depends on rated voltage and type rating of DV51.	–
1541	H204	Motor – number of poles (second parameter set)	rw	2, 4, 6, 8	–
1542	H205	Reserved	rw	–	–
1543	H206	Motor – stabilization constant (second parameter set)	rw	0 – 255	1 [%]
1544	H207	Motor, voltage class (second parameter set)	rw	200 V (230 V) 400 V Default, dependent on rated voltage and type raring of DV51	–

① Note: When a fault message is issued, the associated operational data is saved and can be read with the ENTER function.

8 Optional T adapter DEV51-NET-TC

The optional T adapter DEV51-NET-TC allows direct connection of the frequency inverter DV51 to an RS 485 network. In addition to three RJ 45 sockets, the DEV51-NET-TC contains lenses for the DV51's built-in Power, Alarm and Run LEDs and a microswitch for changing the interface over from OPE (operator, keypad DEX-KEY-…) to RS 485 (Modbus RTU).

→ T adapter DEV51-NET-TC is not included as standard with the frequency inverters.

Type code

Type code and part number of T adapter DEV-NET-TC:

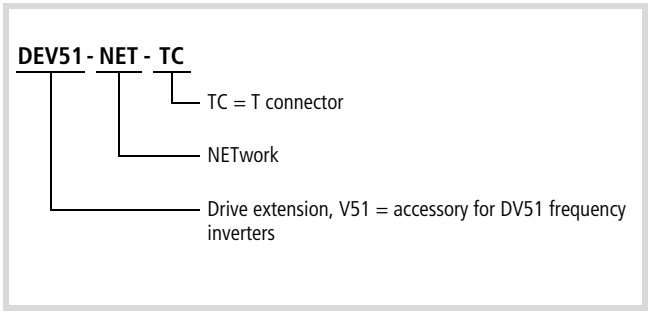


Figure 82: Type code of T adapter DEV51-NET-TC

Equipment supplied

Open the packaging with suitable tools and inspect the contents immediately after delivery to ensure that they are complete and undamaged. The package should contain the following items:

- T adapter DEV51-NET-TC
- Mounting instructions AWA8240-2259

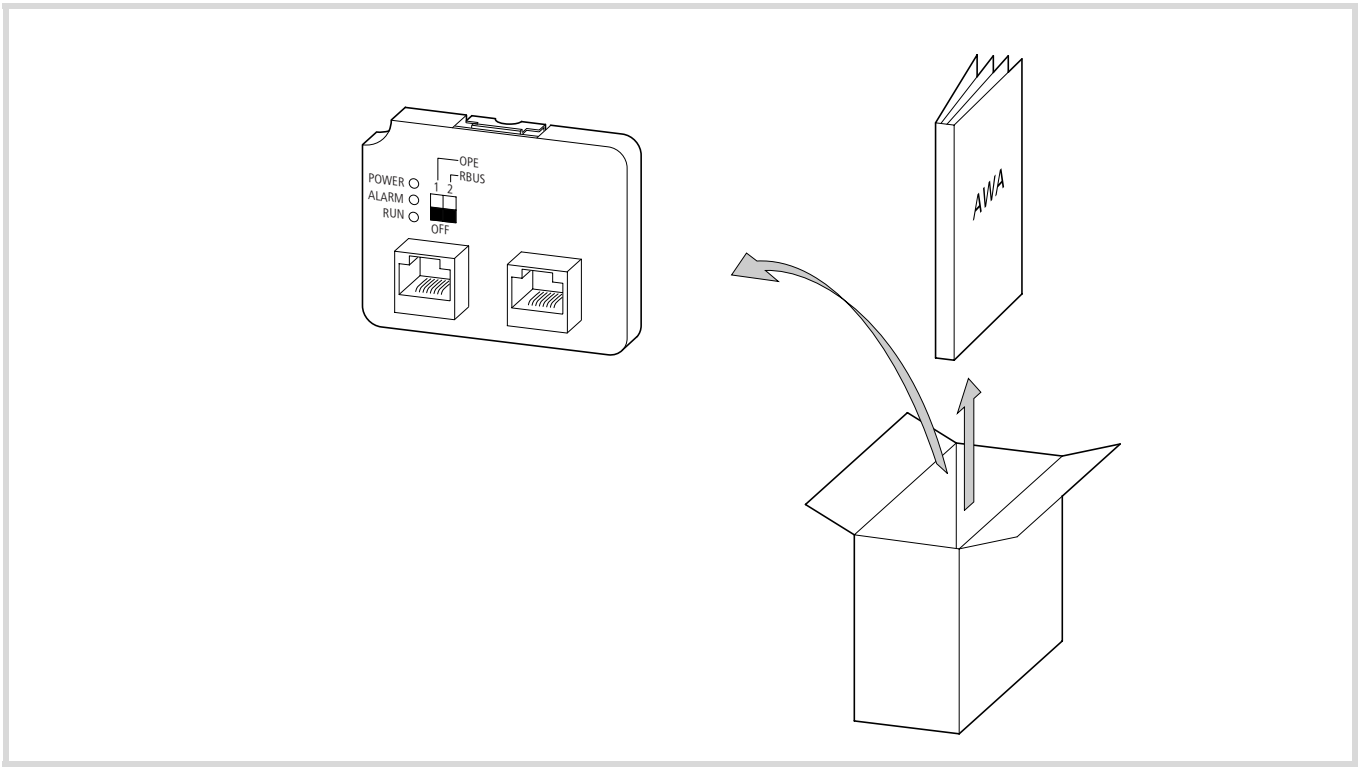


Figure 83: Equipment supplied, T adapter DEV51-NET-TC

Layout of the DEV51-NET-TC

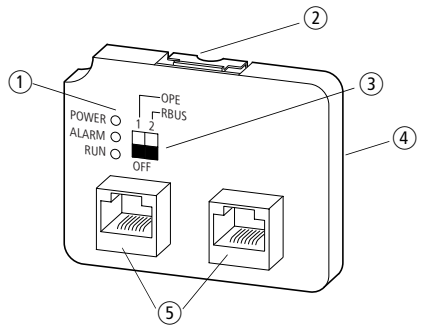


Figure 84: Layout of the DEV51-NET-TC

① Lenses for the DV51's LEDs
② Fixing clip (only for use when mounting in DV51)
③ Microswitch
④ Socket for direct connection with DV51 (on reverse, not visible in illustration)
⑤ Front sockets

T adapter DEV51-NET-TC

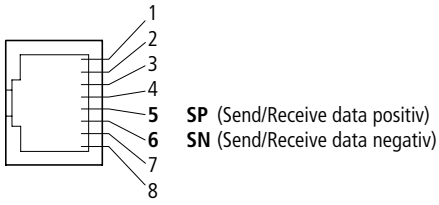


Figure 85: RJ 45 socket

Connections 1, 2, 3, 4, 7, 8: not assigned

Maximum data transfer rate: RS 485, ≦ 19200 bit/s, 8-bit (Modbus RTU)

Fitting the T adapter to DV51

You can fit adapter DEV51-NET-TC to frequency inverters of the DV51 series instead of the standard LED display DEV51-KEY-FP. It functions as a T connector. The sockets at the front ⑤ each have the same function.

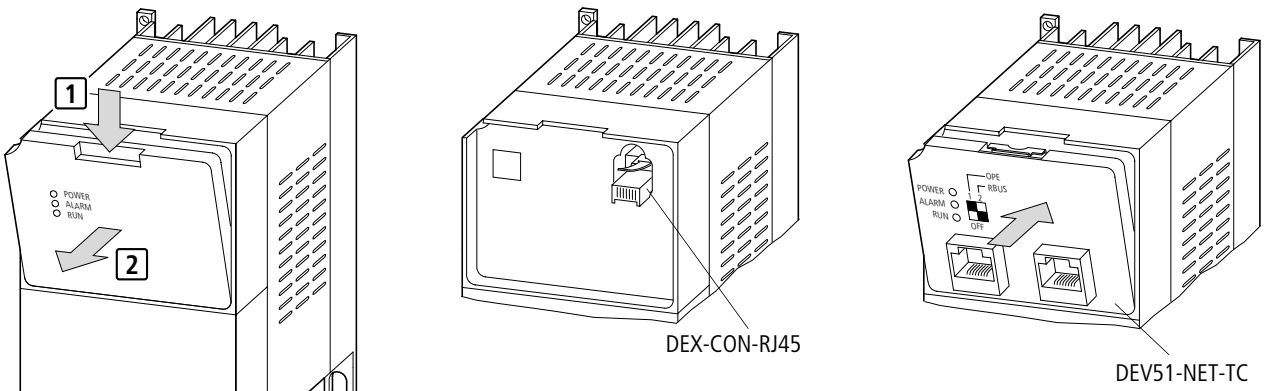


Figure 86: Fitting T adapter DEV51-NET-TC to DV51

→ No tools are required to fit and remove T adapter DEV51-NET-TC.

▽ **Caution!**
Fit T adapter DEV51-NET-TC only with the frequency inverter under no-voltage conditions and without using force.

Interface activation

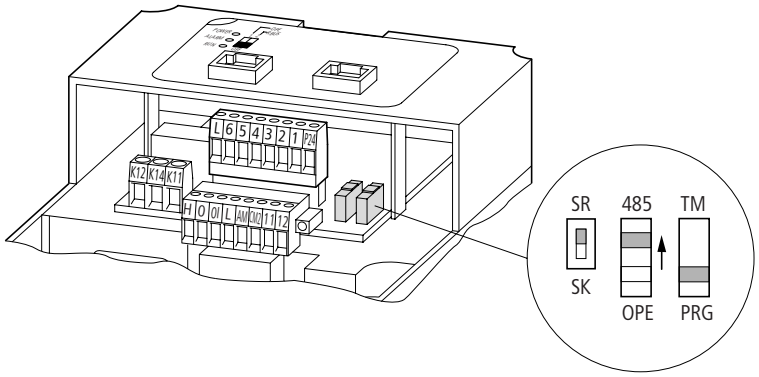


Figure 87: Activating the RJ 45 interface for bus operation

OPE = keypad (operator)

485 = RS 485 (Modbus RTU)

→ For communications through Modbus, use only pins 5 and 6 for the connection. The DV51 needs the remaining pins for its internal data transfer. Do not use them.

→ Make sure that only pins 5 and 6 (twisted pair, screened) are connected on the connection cable. Conductors connected to pins 1 to 4 and 7 to 8 can act as aerials and cause interference in the DV51 or the data traffic.

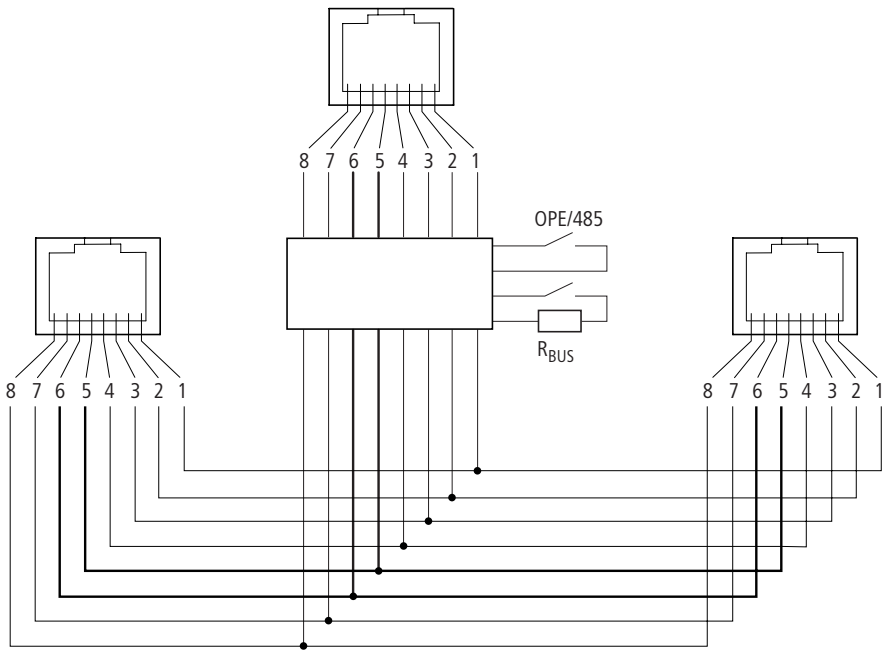


Figure 88: T adapter connections

R_{BUS} = 120 Ω

Connecting the keypad

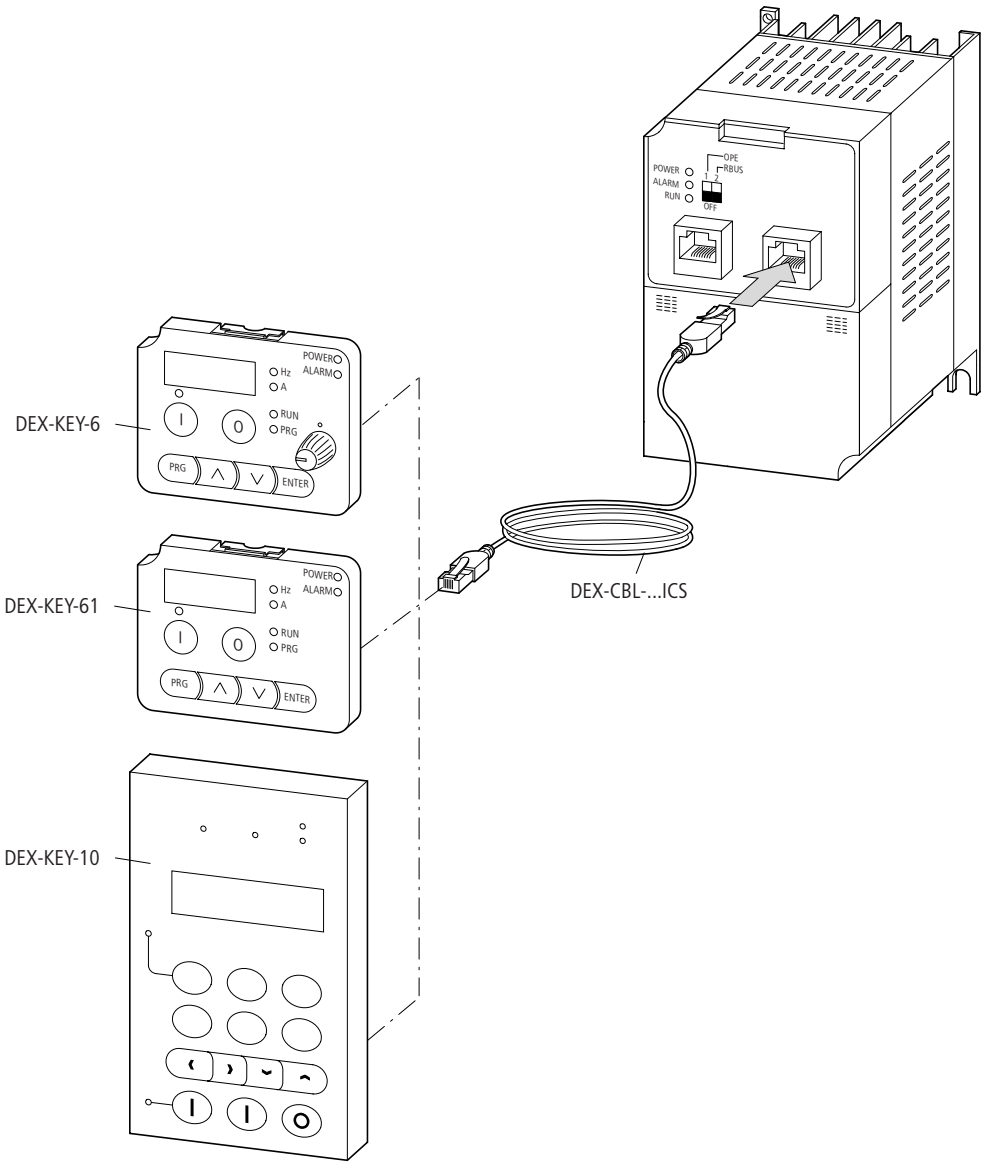
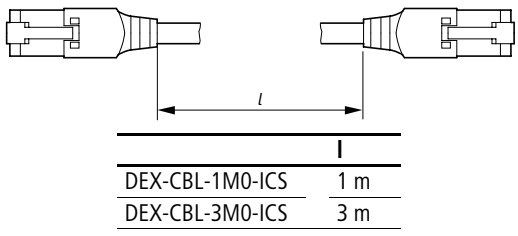


Figure 89: Connecting the keypad



	l
DEX-CBL-1M0-ICS	1 m
DEX-CBL-3M0-ICS	3 m

Figure 90: DEX-CBL-1M0-ICS, DEX-CBL-3M0-ICS

Circuit example

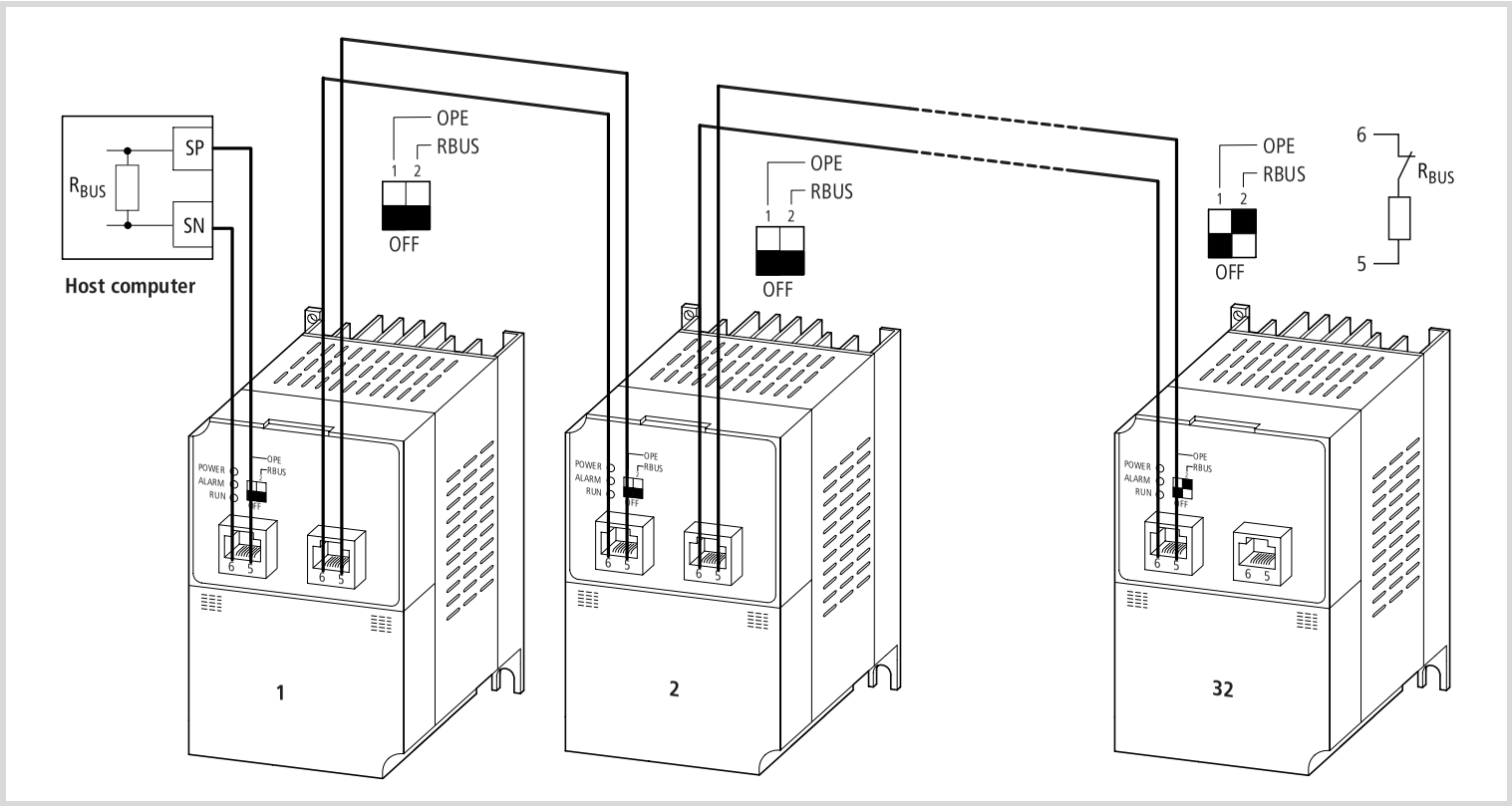


Figure 91: Connecting the keypad

→ For a functional description of the interface, see section 7, page 71.

9 Troubleshooting

Fault	Condition	Possible cause	Remedy
The motor does not start.	There is no voltage present at outputs U, V and W.	Is voltage applied to terminals L, N and/or L1, L2 and L3? If yes, is the ON lamp lit?	Check terminals L1, L2, L3 and U, V, W. Switch on the supply voltage.
		Is the LED display on the keypad indicating a fault message (E ...)?	Analyze the cause of the fault message (→ section "Messages", page 65). Acknowledge the fault message with the reset command (for example by pressing the STOP key).
		Has a start signal been issued?	Issue the start signal with the START key (optional keypad) or through the FWD/REV input.
		Has a setpoint frequency been entered under PNU F01 (for control through operator panel only)?	Enter a setpoint frequency under PNU F01.
		Are the setpoint definitions through the potentiometer correctly wired to terminals H, O and L?	Check that the potentiometer is connected correctly.
		Are inputs O and OI connected correctly for external setpoint input?	Check that the setpoint signal is correctly connected.
		Are the digital inputs configured as RST or FRS still active?	Deactivate RST and/or FRS. Check the signal on digital input 5 (default setting: RST).
		Has the correct source for the setpoint frequency (PNU A01) been set? Has the correct source for the start signal (PNU A02) been set?	Correct PNU A01 accordingly. Correct PNU A02 accordingly.
	There is voltage present at outputs U, V and W.	Is the motor blocked or is the motor load too high?	Reduce the load acting on the motor. Test the motor without load.
The motor turns in the wrong direction.	–	Are output terminals U, V and W correctly connected? Does the connection of terminals U, V and W correspond with the direction of rotation of the motor?	Connect output terminals U, V and W correctly to the motor according to the required direction of motor rotation (generally the sequence U, V, W causes clockwise operation).
		Are the control signal terminals correctly wired?	Control signal terminal FWD for clockwise operation and REV for anticlockwise operation.
		Has PNU F04 been correctly configured?	Set the desired direction of rotation under PNU F04.
The motor will not start.	–	No setpoint value is applied to terminal O or OI.	Check the potentiometer or the external setpoint generator and replace if necessary.
		Is a fixed frequency accessed?	Observe the sequence of priority: the fixed frequencies always have priority over inputs O and OI.
		Is the motor load too high?	Reduce the motor load as the overload limit will prevent the motor reaching its normal speed if there is an overload.
The motor does not operate smoothly.	–	Are the load changes on the motor too high?	Select a frequency inverter and motor with a higher performance. Reduce the level of load changes.
		Do resonant frequencies occur on the motor?	Mask these frequencies with the frequency jumps (PNU A063 to A068) or change the pulse frequency (PNU b083).

Fault	Condition	Possible cause	Remedy
The drive speed does not correspond with the frequency	–	Is the maximum frequency set correctly?	Check the set frequency range or the set voltage/ frequency characteristic.
		Are the rated speed of the motor and the gearbox reduction ratio correctly selected?	Check the rated motor speed or the gearbox reduction ratio.
The saved parameters do not correspond to the entered values.	Entered values have not been saved.	The supply voltage was switched off before the entered values were saved by pressing the ENTER key.	Re-enter the affected parameters and save the input again.
		After the supply voltage was switched off, the entered and saved values are transferred into the internal EEPROM. The supply voltage should remain off for at least six seconds.	Enter the data again and switch off the supply voltage for at least six seconds.
	The values of the copy unit were not accepted by the frequency inverter.	After copying the parameters of the external keypad DEX-KEY-10 into the frequency inverter, the supply voltage was left on for less than six seconds.	Copy the data again and leave the supply voltage on for at least six seconds after completion.
It is not possible to make any inputs.	The motor cannot be started or stopped or setpoint values cannot be set.	Are PNU A01 and A02 set correctly?	Check the settings of PNU A01 and A02.
	No parameters can be set or changed.	Has software parameter protection been activated?	To allow parameter changes, disable parameter protection with PNU b31.
		Has the hardware parameter protection been activated?	Disable the digital input configured as SFT.
The electronic motor protection activates (fault message E05).		Is the manual voltage boost set too high? Were the correct settings made for the electronic motor protection?	Check the boost setting and the electronic motor protection setting.

To be observed when saving changed parameters:

After saving changed parameters with the ENTER key, no inputs can be made using the frequency inverter's keypad of the for at least six seconds. If a key is pressed before this time elapses or if the reset command is issued or the frequency inverter is switched off, the data may not be correctly saved.

Appendix

Technical data

General technical data of the DV51

The table below contains the technical data for all DV51 frequency inverters.

		DV51
Protection class according to EN 60529		IP 20
Overvoltage category		III
Secondary side: Frequency range		0 to 400 Hz With motors which are operated at rated frequencies above 50/60 Hz, the maximum possible motor speed should be observed.
Frequency error limits (at 25 °C ±10 °C)		• Digital setpoint value: ±0.01 % of the maximum frequency • Analog setpoint value: ±0.1 % of the maximum frequency
Frequency resolution		• Digital setpoint value: 0.1 Hz • Analog setpoint value: Maximum frequency/1000
Voltage/frequency characteristic		Constant, reduced or increased SLV torque
Permissible overcurrent		150% for 60 seconds (once every 10 minutes)
Acceleration/deceleration time		0.1 to 3000 s at linear and non-linear characteristic (applies also for second acceleration/deceleration time)
Inputs		
Frequency setting	LCD keypad	Setting through keys or potentiometer
	External signals	• 0 to 10 V⎓, input impedance 10 kΩ • 4 to 20 mA, load impedance 250 Ω • Potentiometer ≧ 1 kΩ, recommended 4.7 kO
Clockwise/anticlockwise operation (start/stop)	LCD keypad	START key (for Start) and OFF key (for Stop); default setting = clockwise operation
	External signals	Digital control inputs programmable as FWD and REV
Digital control inputs programmable as		• FWD: Start/stop clockwise rotating field • REV: Start/stop anticlockwise rotating field • FF1 to FF4: Fixed frequency selection • JOG: Jog mode • AT: Use setpoint value 4 to 20 mA • 2CH: Second time ramp • FRS: Free run stop • EXT: External fault message • USP: Unattended start protection • RST: Reset • SFT: Software protection • PTC: PTC thermistor input • DB: DC braking active • SET: Second parameter set active • UP: Remote control, acceleration • DWN: Remote access, deceleration
Outputs		
Digital signalling outputs programmable as		• FA1/FA2: Frequency reached/exceeded • OL: Overload • AL: Fault • RUN: Motor operational • OD: PID deviation exceeded

	DV51
Frequency and current monitoring	• Connection of an analog display device: 0 to 10 V⎓, up to 1 mA for frequency or current • Connection of a digital frequency meter
Signalling relay	Relay contacts as two-way switch
Further features (not a complete listing)	• Automatic voltage regulation • Unattended start protection • Variable amplification and output voltage reduction • Frequency jumps • Minimum/maximum frequency limitation • Output frequency display • Fault history register available • Freely selectable pulse frequency: 2 to 14 kHz • PID control • Sensorless vector control • On/OFF fan control • Second parameter set selectable
Safety features	• Overcurrent • Overvoltage • Undervoltage • Overtemperature • Earth fault (on Power On) • Overload • Electronic motor protection • Current transformer fault • Dynamic braking function (regenerative)
Ambient conditions	
Ambient temperature	–10 to +50 °C From about +40 to +50 °C, the pulse frequency should be reduced to 2 kHz. The output current should be less than 80 % of the rated current in this case.
Temperature/humidity during storage	–25 to 70 °C (for short periods only, for example during transport) 20 to 90 % relative humidity (non condensing)
Permissible vibration	Maximum 5.9 m/s² (= 0.6 g) at 10 to 55 Hz
Installation height and location	Maximum 1000 m above sea level in a housing or control panel (IP 54 or similar)
Optional accessories	• Remote operating units DEX-KEY-10, DEX-KEY-6 and DEX-KEY-61 • Line reactor to improve the power factor • RFI filter • Motor reactor • Sine-wave filter • Braking resistance

Technical data specific to the DV51-322

The table below contains the technical data specific to the single- and three-phase 230 V series (current, voltage, torque values, etc.)

DV51-322-…		018	037	055	075	1K1	1K5	2K2
Maximum permissible active power of motor in kW; data for four-pole three-phase asynchronous motors		0.18	0.37	0.55	0.75	1.1	1.5	2.2
Maximum permissible apparent motor power in kVA	230 V	0.6	1.0	1.1	1.5	1.9	3.1	4.2
	240 V	0.6	1.0	1.2	1.6	2.0	3.3	4.5
Primary side: Number of phases		Single-phase/three-phase						
Primary side: Rated voltage		180 V ~ –0 % to 264 V ~ +0 %, 47 to 63 Hz						

DV51-322-…		018	037	055	075	1K1	1K5	2K2
Secondary side: Rated voltage		Three-phase 200 to 240 V ~ Corresponding to the primary side rated voltage If the primary voltage drops, the secondary voltage also drops.						
Primary side: Rated current in A	Single-phase	3.5	5.8	6.7	9.0	11.2	17.5	24.0
	Three-phase	2.0	3.4	3.9	5.2	6.5	10.0	14.0
Primary side: Rated current in A		1.6	2.6	3.0	4.0	5.0	8.0	11.0
Torque at startup (with SLV)		> 200 %						
Braking torque								
With feedback to the capacitors Reduced braking torque at frequencies above 50 Hz.		Approx. 100 %				Approx. 70 %		Approx. 20 %
With external braking resistance		Approx. 150 %						Approx. 100 %
With DC braking		Braking occurs at frequencies below the minimum frequency (minimum frequency, braking time and braking torque are user-definable)						
	External signals	Digital control inputs programmable as FWD and REV						
Fan		–	–	–	–	–	–	✓

Technical data specific to the DV51-320

The table below contains the technical data specific to the three-phase 230 V series (current, voltage, torque values, etc.)

DV51-320-…		4K0	5K5	7K5
Maximum permissible active power of motor in kW; data for four-pole three-phase asynchronous motors		4.0	5.5	7.5
Maximum permissible apparent motor power in kVA	230 V	6.3	9.6	12.7
	240 V	6.6	9.9	13.3
Primary side: Number of phases		Three-phase		
Primary side: Rated voltage		180 V ~ –0 % to 264 V ~ +0 %, 47 to 63 Hz		
Secondary side: Rated voltage		Three-phase 200 to 240 V ~ Corresponding to the primary side rated voltage If the primary voltage drops, the secondary voltage also drops.		
Primary side: Rated current in A	Three-phase	20.0	30.0	40.0
Primary side: Rated current in A		15.9	24.0	32.0
Torque during start		100 % or above (with activated torque boost)		
Braking torque				
With feedback to the capacitors Reduced braking torque at frequencies above 50 Hz.		Approx. 100 %		Approx. 70 %
With external braking resistance		Approx. 100 %	Approx. 80 %	
With DC braking		Braking occurs at frequencies below the minimum frequency (minimum frequency, braking time and braking torque are user-definable)		
Fan		✓	✓	✓

Technical data specific to the DV51-340

The table below contains the technical data specific to the three-phase 400 V series (current, voltage, torque values, etc.)

DV51-340-…	037	075	1K5	2K2	3K0	4K0	5K5	7K5
Maximum permissible active power of motor in kW; data for four-pole three-phase asynchronous motors	0.37	0.75	1.5	2.2	3.0	4.0	5.5	7.5
Maximum permissible apparent motor power in kVA for 460 V	1.1	1.9	3.0	4.2	6.2	6.6	9.9	12.2
Primary side: Number of phases	Three-phase							
Primary side: Rated voltage	342 V ~ –0 % to 528 V ~ +0 %, 47 to 63 Hz							
Secondary side: Rated voltage	Three-phase 360 to 460 V ~ Corresponding to the primary side rated voltage If the primary voltage drops, the secondary voltage also drops.							
Primary side: Rated current in A	2.0	3.3	5.0	7.0	10.0	11.0	16.5	20.0
Primary side: Rated current in A	1.5	2.5	3.8	5.5	7.8	8.6	13.0	16.0
Torque at startup with SLV	> 200 %				> 180 %			
Braking torque								
With feedback into the capacitors: reduced braking torque at frequencies exceeding 50 Hz.	Approx. 100 %			Approx. 70 %	Approx. 20 %		Approx. 30 %	
With external braking resistance	Approx. 150 %			Approx. 100 %			Approx. 80 %	
With DC braking	Braking occurs at frequencies below the minimum frequency (minimum frequency, braking time and braking torque are user-definable)							
Fan	–	–	✓	✓	✓	✓	✓	✓

Weights and dimensions

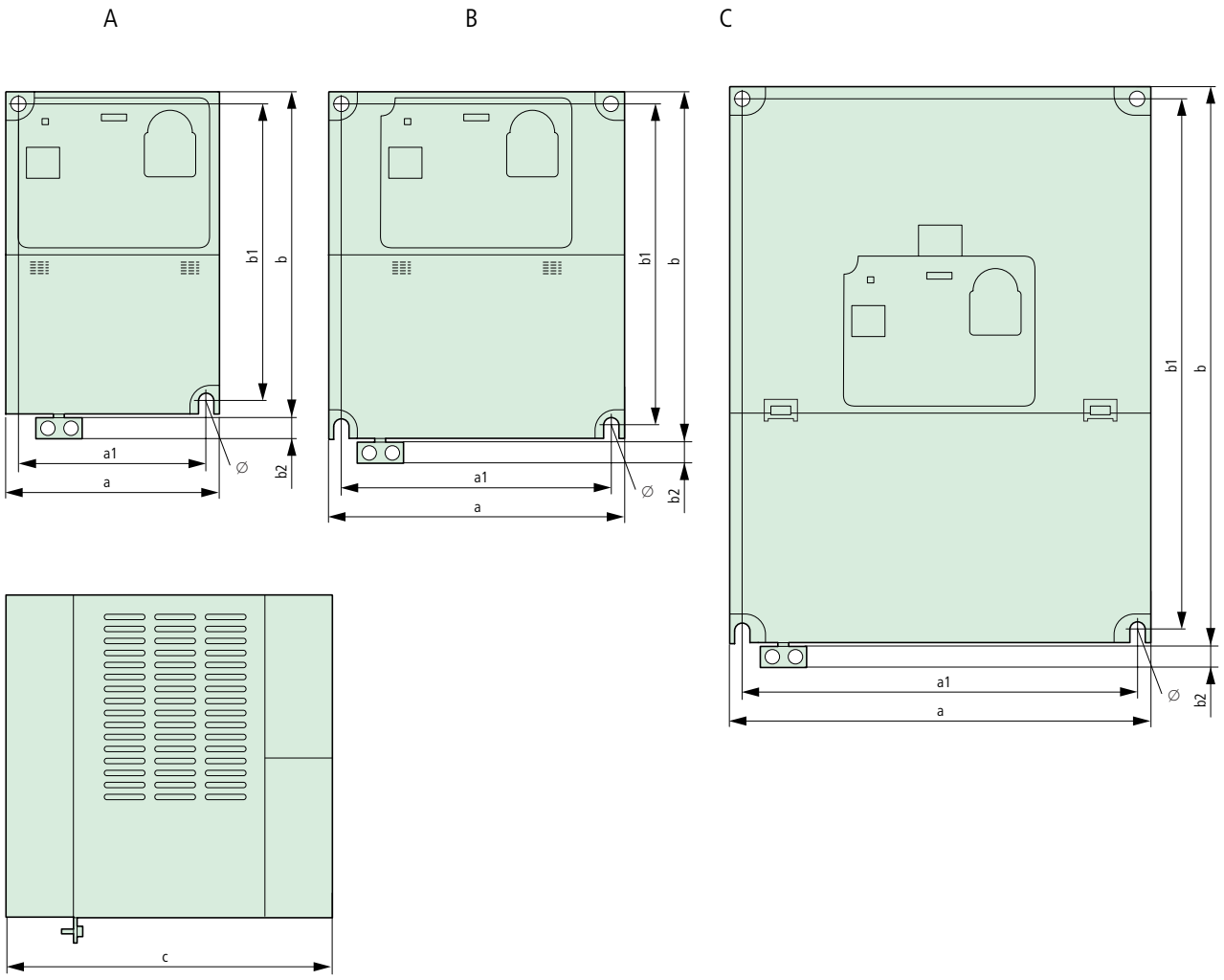


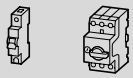
Figure 92: Dimensions and frame size, DV51

DV51-	a	a1	b	b1	b2	c	Ø	[lbin]	kg	
320-4K0	110	98	130	118	10	166	5	4.4	1.8	B
320-5K5	180	164	220	205	–	155	6	12.13	5.5	C
320-7K5	180	164	220	205	–	155	6	12.57	5.7	C
322-025	80	67	120	110	10	103	5	1.75	0.7	A
322-037	80	67	120	110	10	117	5	2.09	0.85	A
322-055	80	67	120	110	10	117	5	2.09	0.95	A
322-075 322-1K1	110	98	130	118	10	139	5	3.09	1.3	B
322-1K5	110	98	130	118	10	166	5	4.4	1.8	B
322-2K2	110	98	130	118	10	166	5	4.2	1.8	B

DV51-	a	a1	b	b1	b2	c	Ø	[lbin]	kg	
340-037	110	98	130	118	10	139	5	3.09	1.3	B
340-075	110	98	130	118	10	166	5	3.09	1.7	B
340-1K5 340-2K2 340-3K0 340-4K0	110	98	130	118	10	166	5	4.19	1.8	B
340-5K5	180	164	220	205	–	155	6	12.13	5.5	C
340-7K5	180	164	220	205	–	155	6	12.57	5.7	C

Cables and fuses

The cross-sections of the cables and line protection fuses used must correspond with local standards.

DV51-	Connection to power supply				 L1, L2, L3, N, U, V, W, PE (2x)	
		VDE	UL[1]	Moeller	mm²	AWG
320-4K5	3-phase 230 V AC	M32A	30 A	PKM0-25	6	12
320-5K5		M32A	40 A	PKZM4-40	10	10
320-7K5		M40A	50 A	PKZM4-40	10	8
322-018	1/3-phase 230 V AC	M10 A	10 A	FAZ-1N-B10, PKZM0-10	1.5	15
322-037	1/3-phase 230 V AC	M10 A	10 A	FAZ-1N-B10, PKZM0-10	1.5	15
322-055	1/3-phase 230 V AC	M10 A	10 A	FAZ-1N-B10, PKZM0-10	1.5	15
322-075	1/3-phase 230 V AC	M16 A	15 A	FAZ-1N-B16, PKZM0-16	2.5	13
322-1K1	1/3-phase 230 V AC	M20 A	20 A	FAZ-1N-B20, PKZM0-20	2.5	13
322-1K5	1-phase 230 V AC	M25 A	25 A	FAZ-1N-B25	4.0	11
	3-phase 230 V AC	M16 A	15 A	PKZM0-16	4.0	11
322-2K2	Single-phase 230 V	M40 A	40 A	FAZ-1N-B40	4.0	11
	3-phase 230 V AC	M25 A	25 A	PKZM0-25	4.0	11
340-037	3-phase 400 V AC	M10 A	10 A	PKZM0-10	1.5	15
340-075		M10 A	10 A	PKZM0-10	1.5	15
340-1K5		M10 A	10 A	PKZM0-10	1.5	15
340-2K2		M10 A	10 A	PKZM0-10	1.5	15
340-3K0		M16 A	15 A	PKZM0-16	2.5	13
340-4K0		M16 A	15 A	PKZM0-16	2.5	13
340-5K5		M25 A	25 A	PKZM0-25	4.0	11
340-7K5		M25 A	25 A	PKZM0-25	4.0	11

1) Tripping characteristic "H" or "K5" (approved fuses and fuse holders)

For supply voltage and motor cables which exceed about 20 m in length, use cables with a larger cross-section.

Control cables should be screened and have a maximum cross-section of 0.75 mm².

For the cable which is to be connected to the signal output, use a cable cross-section of 0.75 mm². Strip about 5 to 6 mm off the cable ends. The external diameter of the signal cable should be no more than 2 mm, except for the connection to the signalling relay.

RFI filters

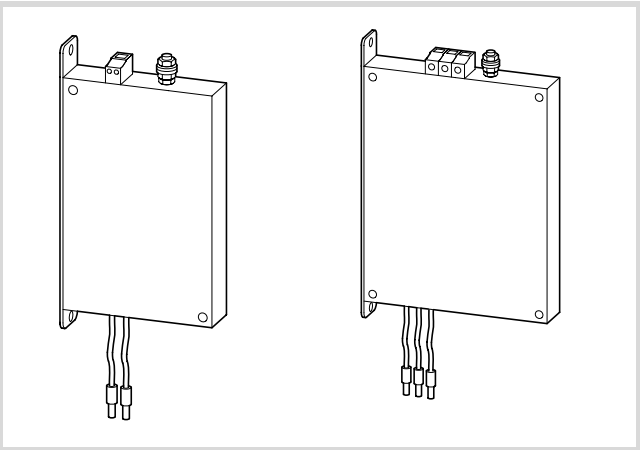


Figure 93: Single- and three-phase RFI filters

→ Radio interference filters DE51-LZ1 and DE51-LZ3 can be side- or footprint-mounted to the frequency inverter (→ section "Fitting a radio-interference (RFI) filter" page 25).

RFI filters have discharge currents to earth, which, in the event of a fault (phase failure, load unbalance), can be higher than the rated values. To avoid dangerous voltages, the filters must be earthed before use.

For leakage currents ≧ 3.5 mA standards EN 61800-5-1 and EN 50178 specify the following:

- the protective conductor must have a cross-section ≧ 10 mm^2 or
- a second protective conductor must be connected, or
- the continuity of the protective conductor must be monitored.

→ For mobile applications, a plug connector is permissible only when a second, permanently installed, earthing conductor is installed.

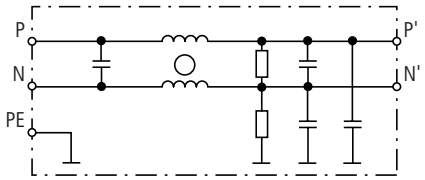


Figure 94: Block diagram, DE51-LZ1

Table 23: Frequency inverter assignments and technical data for DE51-LZ…

DV51-	Rated mains voltage 50/60 Hz	RFI filter	Rated current A	Overload current[1)] A	Maximum leakage current at rated operation mA	Maximum contact current on fault at interruption PE mA	 PE and N[2)], PE and 2 phase conductors[3)] mA	Power loss of RFI filter at rated operation W
320-4K0	3 ~ 230 V + 10 %							
320-5K5								
320-7K5								
322-018 322-037 322-055	1 ~ 230 V + 10 %	DE51-LZ1-007-V2	7	10.5	18	25	47	5
322-075 322-1K1		DE51-LZ1-012-V2	12	18	19	26	51	7
322-1K5 322-2K2		DE51-LZ1-024-V2	24	36	18	24	48	14

DV51-	Rated mains voltage 50/60 Hz	RFI filter	Rated current A	Overload current[1)] A	Maximum leakage current at rated operation mA	Maximum contact current on fault at interruption PE mA	 PE and N[2)], PE and 2 phase conductors[3)] mA	Power loss of RFI filter at rated operation W
340-037 340-075 340-1K5 340-2K2	3 ~ 400 V + 10 %	DE51-LZ3-007-V4	7	10.5	11	4	156	6
340-3K0 340-4K0		DE51-LZ3-011-V4	11	16.5	35	5	198	9
340-5K5 340-7K5		DE51-LZ3-020-V4	20	30	46	5.5	210	16

1) 150 % for 60 s, every 30 min
2) with DE51-LZ1
3) with DE51-LZ3

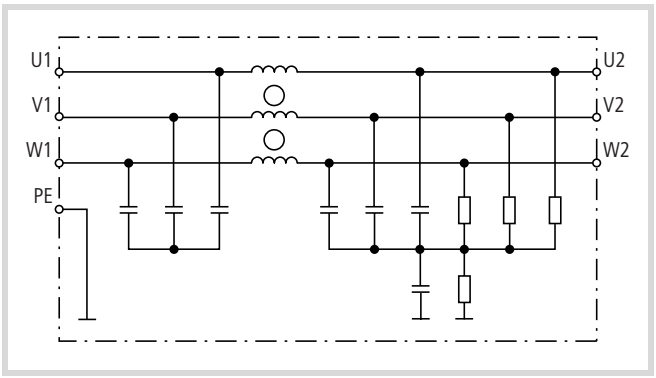


Figure 95: Block diagram, DE51-LZ3

Table 24: Performance features of DE51-LZ…

Ambient temperature	Up to +40 °C
Climatic proofing	IEC 25/085/21
Terminal capacity	0.2 – 4 mm²

Weights and dimensions

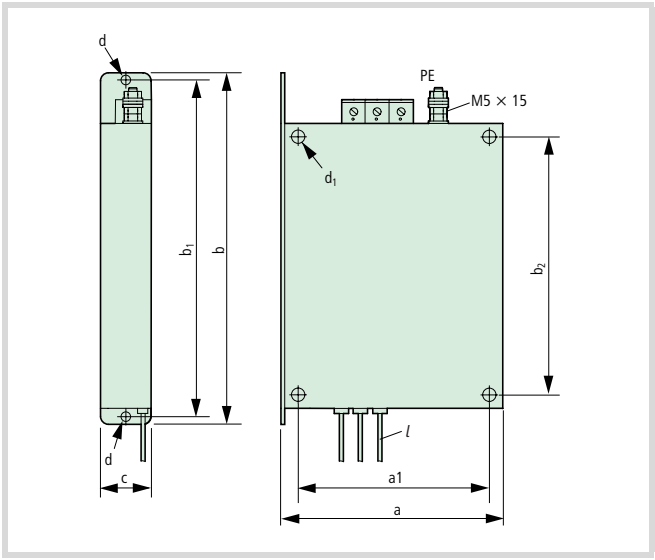


Figure 96: Dimensions

Part no.	a mm	a1 mm	b mm	b1 mm	b2 mm	c mm	d mm	d1 mm	 kg	l mm
DE51-LZ1-007-V2	80	67	170	160	110	27	5	2 × 6	0.45	160
DE51-LZ1-012-V2	110	98	180	170	118	35	5	4 × 6	0.5	180
DE51-LZ1-024-V2	110	98	180	170	118	35	5	4 × 6	0.67	180
DE51-LZ3-007-V4	110	98	180	170	118	35	5	4 × 6	0.7	180
DE51-LZ3-011-V4	110	98	180	170	118	35	5	4 × 6	0.75	180
DE51-LZ3-020-V4	180	164	285	269	205	40	6.3	4 × 6.5	1.2	250

Mains contactors

→ The mains contactors listed here assume the network's rated current (I_{LN}) without line reactor or mains filter. Their selection is based on the thermal current (AC-1).

▽ **Caution!**
Jog mode must not be used through the mains contactor (rest period ≧ 180 s between switching off and on)

→ For single-phase mains connection, the use of paralleling link DILM12-XP1 is recommended to ensure even loading of all contact decks.

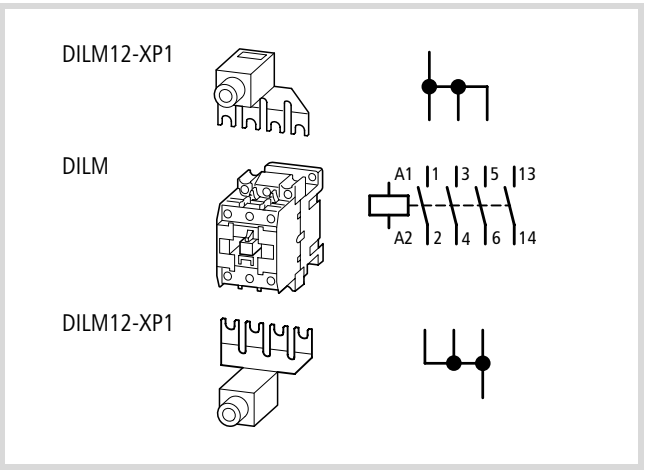


Figure 97: Mains contactor at single-phase connection

DV51-	DV51 phase current	Mains contactor		DV51 starting current (RC load current at maximum input voltage)
		Conventional thermal current $I_{th} = I_e$ AC-1 at 60 %, open	Part no.	
	I_{LN} [A]	I_{th} AC-1 [A]		I_0 [A]
Connection 1 ~ 230 V (240 V g 10 %)				
322-025	3.5	20	DILM7	31.9
322-037	5.8			
322-055	6.7			
322-075	9			
322-1K1	11.2			
322-1K5	17.2			
322-2K2	24		DILM7 + DILM12-XP1[1)]	

1) For single-phase mains connection of the DV51-322-2K2, all three contacts must be connected through paralleling link DILM12-SP1.

Connection 3 ~ 230 V (240 V g 10 %)				
320-4K0	22	35	DILM17	31.9
320-5K5	30	35	DILM17	
320-7K5	40	40	DILM25	16
322-025	2	20	DILM7	31.9
322-037	3.4			
322-055	3.9			
322-075	5.2			
322-1K1	6.5			
322-1K5	10			
322-2K2	14			

DV51-	DV51 phase current	Mains contactor		DV51 starting current (RC load current at maximum input voltage)
		Conventional thermal current I_{th} = I_e AC-1 at 60 %, open	Part no.	
	I_{LN} [A]	I_{th} AC-1 [A]		I_0 [A]
3 ~ 400 V connection				
340-037	2	20	DILM7	63.7
340-075	3.3			
340-1K5	5			
340-2K2	7			
340-3K0	10			
340-4K0	11			
340-5K5	16.5			
340-7K5	20	35	DILM17	31.9

Line reactor

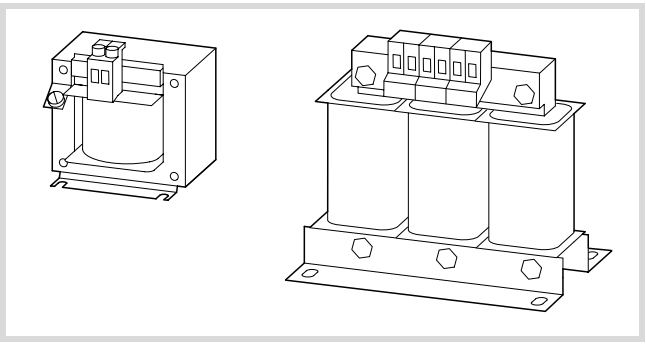


Figure 98: DEX-LN... line reactors

→ When the frequency inverter is operating at its rated current limit, the line reactor causes a reduction of the frequency inverter's greatest possible output voltage (U_2) to about 96 % of the mains voltage (U_{LN}).

DV51-	Mains voltage	Maximum input voltage V AC_{rms}	Mains current (I_{LN}) of the DV51 without line reactor	Assigned line reactor
320-4K0	3 ~ 230 V	240 V + 10 %	22	DEX-LN3-025
320-5K5			30	DEX-LN3-040
320-7K5			40	DEX-LN3-040
322-025	1 ~ 230 V	240 V + 10 %	3.5	DEX-LN1-006
322-037			5.8	DEX-LN1-006
322-055			6.7	DEX-LN1-009
322-075			9	DEX-LN1-009
322-1K1			11.2	DEX-LN1-013
322-1K5			17.5	DEX-LN1-018
322-2K2			24	DEX-LN1-024
322-025	3 ~ 230 V	240 V + 10 %	2	DEX-LN3-004
322-037			3.4	
322-055			3.9	
322-075			5.2	DEX-LN3-006
322-1K1			6.5	DEX-LN3-006
322-1K5			10	DEX-LN3-010
322-2K2			14	DEX-LN3-016
340-037	3 ~ 400 V	480 V + 10 %	2	DEX-LN3-004
340-075			3.3	DEX-LN3-004
340-1K5			5	DEX-LN3-006
340-2K2			7	DEX-LN3-010
340-3K0			10	
340-4K0			11	
340-5K5			16.5	DEX-LN3-016
340-7K5			20	DEX-LN3-025

→ For technical data for the DEX-LN series line reactors, see installation instructions AWA8240-1711

→ Line reactors reduce the magnitude of the current harmonics up to about 30 % and increase the lifespan of frequency inverters and upstream-connected switching devices.

Motor reactor

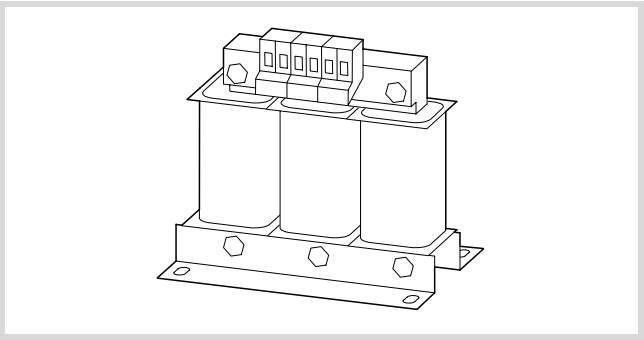


Figure 99: Motor reactor DEX-LM…

DV51-	Maximum output voltage	Rated operational current (motor current) I_e [A]	Assigned motor reactor
320-4K0	3 ~ 240 V + 10 %	17.5	DEX-LM3-035
320-5K5		24	
320-7K5		32	
322-025		1.6	DEX-LM3-005
322-037		2.6	
322-055		3	
322-075		4	
322-1K1		5	
322-1K5		8	DEX-LM3-008
322-2K2		11	DEX-LM3-011
340-037	3 ~ 480 V + 10 %	1.5	DEX-LM3-005
340-075		2.5	
340-1K5		3.5	
340-2K2		5.5	DEX-LM3-008
340-3K0		7.8	
340-4K0		8.6	DEX-LM3-011
340-5K5		13	DEX-LM3-016
340-7K5		16	

→ For technical data for the DEX-LN series mains reactors, see installation instructions AWA8240-1711

Sine-wave filter

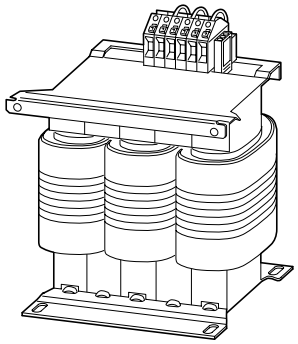


Figure 100: Sine-wave filter SFB 400/...

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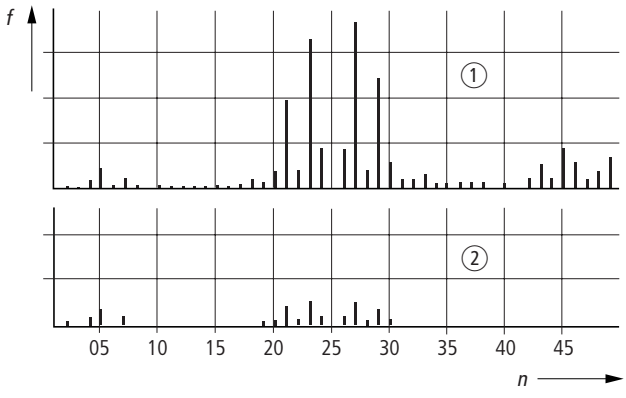


Figure 101: High frequency components of the output voltage

① Without sine-wave filter
② With sine-wave filter
f: Rotating field frequency

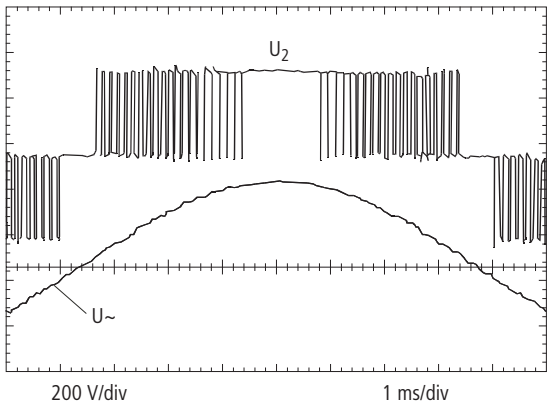


Figure 102: Output voltage to motor

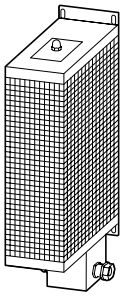
U~:Sinusoidal voltage to be simulated
U_2: Inverter output voltage

DV51-	Maximum output voltage	Rated operational current (motor current) I_e [A]	Assigned sine-wave filter
320-4K0	3 ~ 240 V + 10 %	17.5	SFB 400/16.5[1] (SFB 400/23.5)
320-5K5		24	SFB 400/23.5
320-7K5		32	SFB 400/32
322-025		1.6	SFB 400/4
322-037		2.6	
322-055		3	
322-075		4	
322-1K1		5	SFB 400/10
322-1K5		8	
322-2K2		11	SFB 400/10[1] (SFB 400/16.5)
340-037	3 ~ 480 V + 10 %	1.5	SFB 400/4
340-075		2.5	
340-1K5		3.5	
340-2K2		5.5	SFB 400/10
340-3K0		7.8	
340-4K0		8.6	
340-5K5		13	SFB 400/16.5
340-7K5		16	

1) At continuous 100 % motor load, use a sine-wave filter of the next higher (current) rating here.

→ For technical data for the SFB400/… series sine-wave filters, see the manufacturer's instructions.

Braking resistance



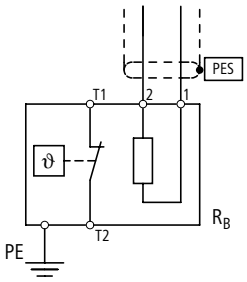


Figure 103: Braking resistance DE4-BR1…

Resistor with thermostat

Ingress protection: IP 20

→ For technical data for the braking resistors, see the Main Catalogues.

Example for assigned resistors DE4-BR1…

DV51-	Assigned motor rating	DC link voltage			Assigned braking resistor			
	P	(PNU b096)	R_{min}	ED_{max}		R_{Bges}	P_D[1]	ED
	kW		Ω	%		Ω	W	%
320-4K0	4	370 V DC (330 – 395 V)	100	100	4 × DE4-BR1-240-285 (serial/parallel)	120	1140	29
320-5K5	5.5		50	70	6 × DE4-BR1-100-200 (serial/parallel)	50	1200	22
320-7K5	7.5		50	70	8 × DE4-BR1-100-200 (serial/parallel)	50	1600	21
322-025	0.25		100	80	DE4-BR1-200-100	200	100	40
322-037	0.37		100	80	DE4-BR1-200-100	100	100	27
322-055	0.55		100	80	DE4-BR1-100-200	100	200	36
322-075	0.75		35	39	DE4-BR1-100-200	100	200	27
322-1K1	1.1		35	39	DE4-BR1-082-245	82	245	22
322-1K5	1.5		35	70	2 × DE4-BR1-082-245 (parallel)	41	490	33
322-2K2	2.2		35	100	2 × DE4-BR1-082-245 (parallel)	41	490	22
340-037	0.37	740 V DC (660 – 790 V)	180	36	DE4-BR1-200-100	200	100	27
340-075	0.75		180	60	DE4-BR1-240-285	240	285	38
340-1K5	1.5		180	90	2 × DE4-BR1-100-200 (serial)	200	400	27
340-2K2	2.2		100	67	2 × DE4-BR1-082-245 (serial)	164	490	22
340-3K0	3		100	100	3 × DE4-BR1-370-215 (parallel)	123	645	22
340-4K0	4		100	100	4 × DE4-BR1-240-285 (serial/parallel)	120	1140	29
340-5K5	5.5		50	70	6 × DE4-BR1-100-200 (serial/parallel)	50	1200	22
340-7K5	7.5		50	70	8 × DE4-BR1-100-200 (serial/parallel)	50	1600	21

1) P_D = continuous braking power of resistor or resistor combination

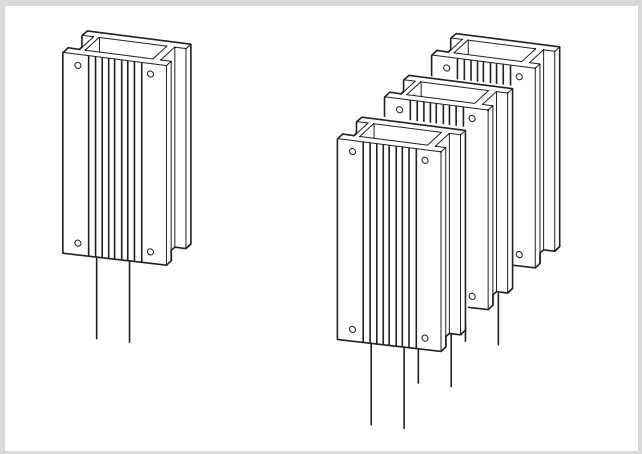


Figure 104: Braking resistance BDW…

Ingress protection: IP 65

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→ For technical data for the BDW series braking resistors, see the manufacturer's instructions from Koch.

Example for assigned resistors BWD…

DV51-	Assigned motor rating	DC link voltage			Assigned braking resistor[1]			
	P	(PNU b096)	R_{min}	ED_{max}		R_{Bges}	P_D[2]	ED
	kW		Ω	%		Ω	W	%
320-4K0	4	370 V DC (330 – 395 V)	100	100	4 × BWD600100 (serial/parallel)	100	960	24
320-5K5	5.5		50	70	6 × BWD500300 (parallel)	50	1200	22
320-7K5	7.5		50	70	8 × BWD500430 (parallel)	54	1600	21
322-025	0.25		100	80	BWD250100	100	100	40
322-037	0.37		100	80	BWD250100	100	100	27
322-055	0.55		100	80	BWD500100	100	200	36
322-075	0.75		35	39	2 × BWD250100 (parallel)	50	200	27
322-1K1	1.1		35	39	2 × BWD500100 (parallel)	50	400	36
322-1K5	1.5		35	70	2 × BWD600100 (parallel)	50	480	32
322-2K2	2.2		35	100	2 × BWD600100 (parallel)	50	480	22

DV51-	Assigned motor rating	DC link voltage			Assigned braking resistor[1]			
	P	(PNU b096)	R_{min}	ED_{max}		R_{Bges}	P_D[2]	ED
	kW		Ω	%		Ω	W	%
340-037	0.37	740 V DC (660 – 790 V)	180	36	BWD250200	200	100	27
340-075	0.75		180	60	BWD500200	200	200	27
340-1K5	1.5		180	90	2 × BWD500430 (parallel)	215	400	27
340-2K2	2.2		100	67	2 × BWD600200 (parallel)	100	480	22
340-3K0	3		100	100	3 × BWD600300 (parallel)	100	720	24
340-4K0	4		100	100	4 × BWD600100 (serial/parallel)	100	960	24
340-5K5	5.5		50	70	6 × BWD500300 (parallel)	50	1200	22
340-7K5	7.5		50	70	8 × BWD500430 (parallel)	54	1600	21

1) Short-circuit proof, intrinsically safe resistor in anodized aluminium (thermostat as optionally available).

2) P_D = continuous braking power of resistor or resistor combination

Abbreviations of parameters and functions

Designation Message	Function, description	
	German	English
2CH	Zweite Zeitrampe	2-stage acceleration and deceleration
AL	Fehlermeldung	Alarm signal
AT	Auswahl der analogen Sollwertquelle (AT = Strom-Sollwert 4 bis 20 mA)	Analog input voltage/current select
AVR	Automatische Spannungsregelung	Automatic voltage regulation
EXT	Eingang für externe Störmeldungen	External Trip
FA…	Frequenzwert-Meldung (eingestellter Wert erreicht bzw. überschritten)	Frequency arrival
FF…	Festfrequenz (fester Sollwert)	Fixed Frequency
FRS	Reglersperre (der Motor läuft ungeführt aus)	Free-run Stop
FWD	Rechtsdrehfeld (vorwärts)	Forward Run
JOG	Tippbetrieb	Jogging
OD	Meldung bei PID-Regelabweichung	Output deviation for PID control
OL	Überlast-Meldung	Overload advance signal
FM	Frequenzanzeige	Frequency monitor
PTC	Thermistor, Kaltleiter	Positive temperature coefficient
REV	Reversieren (rückwärts, Linksdrehfeld)	Reverse Run
RST	Rücksetz-Befehl	Reset
RUN	Lauf-Meldung	Running signal
SFT	Software-Schutz gegen das Überschreiben von Parametern	Software lock function
USP	Wiederanlaufsperre	Unattended start protection

Standard form for user-defined parameter settings

Parameter list for DV51 frequency inverters.

For a detailed description of the parameters, see the specified page in the manual (AWB8230-1540G).

Frequency inverters DV51-322-… (single- and three-phase mains connection, rated voltage 230 V, 50/60 Hz) and DV51-340-… (three-phase mains connection, rated voltage 400 V, 50/60 Hz) work with the European operating system. The default settings are listed in the DS column. The DV51-320-… devices can be used only on three-phase AC mains (200/215/220/230/240 V, 50/60 Hz) and are supplied with the US version of the operating system. The default values that apply here are shown in curly brackets {xx}.

PNU = parameter number displayed on the LCD keypad.

RUN = access rights to parameters in RUN mode (RUN LED is lit):

b031 = 10 = extended access rights to parameters in RUN mode (RUN LED is lit):

- ✓ = enabled.
- – = disabled.

Here you can list application-specific user settings in the free setpoint value columns.

→ The parameters of the second parameter set (PNU **2**…) always have the figure "2" in the first place and a grey background in the table . On keypad DEX-KEY-… they are displayed only when this function is enabled (→ PNU C001 = 08: SET).

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
A001	–	–	Frequency reference value source selection	00: Potentiometer of optional keypad DEX-KEY-6 01: Analog input O/OI 02: Optional keypad DEX-KEY-… (PNU F001 or A020) 03: Serial interface (Modbus) 10: Calculated value	01		
A201	–	–	Frequency reference value source selection (second parameter set)	Value → PNU A001	01		
A002	–	–	Start signal source selection	01: Digital input (FWD/REV) 02: START button (optional keypad DEX-KEY-…) 03: Serial interface (Modbus)	01		
A202	–	–	Start signal source selection (second parameter set)	Value → PNU A002	01		
A003	–	–	Base frequency	30 – 400 Hz, up to value of PNU A004 [Hz]	50 {60}		
A203	–	–	Base frequency (second parameter set)	30 – 400 Hz, up to value of PNU A004 [Hz]	50 {60}		
A004	–	–	End frequency (f_{max})	30 – 400 Hz	50 {60}		
A204	–	–	End frequency (f_{max}) (second parameter set)	Values → PNU A004	50 {60}		
A005	–	–	Analog input – selection (AT)	On active AT signal (→ PNU C001 = 16) a changeover takes place between: 00: Analog input O/OI 01: The locked range (PNU A011 to A015 or A101 to A105) and analog inputs O and OI 02: Analog input O and the potentiometer of optional keypad DEX-KEY-6 03: Analog input OI and the potentiometer of optional keypad DEX-KEY-6	00		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
A011	–	✓	Analog input (O-L) – frequency at minimum reference value	0 – 400 Hz	0.0		
A012	–	✓	Analog input (O-L) – frequency at maximum reference value	0 – 400 Hz	0.0		
A013	–	✓	Analog input (O-L) – minimum reference value (offset)	0 – 100 %	0.0		
A014	–	✓	Analog input (O-L) – maximum reference value (offset)	0 – 100 %	100.		
A015	–	✓	Analog input (O-L) – selection of starting frequency applied to the motor at minimum reference value	00: Value of PNU A011 01: 0 Hz	01		
A016	–	✓	Analog input – filter time constant	1 – 8	8		
A020	✓	✓	Frequency reference input – reference value through keypad, PNU A001 must equal 02	0 – 400 Hz	0.0		
A220	✓	✓	Frequency reference input – reference value through keypad, PNU A001 must equal 02 (second parameter set)	0 – 400 Hz	0.0		
A021	✓	✓	Frequency reference input – fixed frequency (1)	0 – 400 Hz	0.0		
A022	✓	✓	Frequency reference input – fixed frequency (2)	0 – 400 Hz	0.0		
A023	✓	✓	Frequency reference input – fixed frequency (3)	0 – 400 Hz	0.0		
A024	✓	✓	Frequency reference input – fixed frequency (4)	0 – 400 Hz	0.0		
A025	✓	✓	Frequency reference input – fixed frequency (5)	0 – 400 Hz	0.0		
A026	✓	✓	Frequency reference input – fixed frequency (6)	0 – 400 Hz	0.0		
A027	✓	✓	Frequency reference input – fixed frequency (7)	0 – 400 Hz	0.0		
A028	✓	✓	Frequency reference input – fixed frequency (8)	0 – 400 Hz	0.0		
A029	✓	✓	Frequency reference input – fixed frequency (9)	0 – 400 Hz	0.0		
A030	✓	✓	Frequency reference input – fixed frequency (10)	0 – 400 Hz	0.0		
A031	✓	✓	Frequency reference input – fixed frequency (11)	0 – 400 Hz	0.0		
A032	✓	✓	Frequency reference input – fixed frequency (12)	0 – 400 Hz	0.0		
A033	✓	✓	Frequency reference input – fixed frequency (13)	0 – 400 Hz	0.0		
A034	✓	✓	Frequency reference input – fixed frequency (14)	0 – 400 Hz	0.0		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
A035	✓	✓	Frequency reference input – fixed frequency (15)	0 – 400 Hz	0.0		
A038	✓	✓	Jog mode – jog mode reference value	0 – 9.99 Hz	1.00		
A039	–	✓	Jog mode – motor stop method	00: Free coasting 01: Deceleration ramp 02: DC braking	00		
A042	✓	✓	Boost – manual voltage boost[1)]	0 – 20 %	5.0		
A242	✓	✓	Boost – manual voltage boost (second parameter set)[1)]	0 – 20 %	0.0		
A043	✓	✓	Boost – transition frequency for maximum voltage boost[1)]	0 – 50 %	3.0		
A243	✓	✓	Boost – transition frequency for maximum voltage boost (second parameter set)[1)]	0 – 50 %	0.0		
A044	–	–	*U/f* characteristic	00: Constant torque curve 01: Reduced torque curve 02: SLV active	02		
A244	–	–	*U/f* characteristic (second parameter set)	Values → PNU A044	02		
A045	–	–	*U/f* characteristic – output voltage	20 – 100 %	100		
A245	–	–	*U/f* characteristic – output voltage (second parameter set)	Values → PNU A045	100		
A046	✓	✓	SLV – gain factor for automatic voltage compensation	0 – 255	100		
A246	✓	✓	SLV – gain factor for automatic voltage compensation (second parameter set)	0 – 255	100		
A047	✓	✓	SLV – gain factor for automatic slip compensation	0 – 255	100		
A247	✓	✓	SLV – gain factor for automatic slip compensation (second parameter set)	0 – 255	100		
A051	–	✓	DC braking	00: OFF: Disabled 01: ON: Enabled	00		
A052	–	✓	DC braking – starting frequency	0 – 60 Hz	0.5		
A053	–	✓	DC braking – waiting time	0 – 5 s	0.0		
A054	–	✓	DC braking – braking torque	0 – 100 %	0.		
A055	–	✓	DC braking – braking duration	0 – 60 s	0.0		
A056	–	✓	DC braking – behaviour on activation of the digital input (DB)	00: Timed braking according to value of PNU A055 01: Continuous operation	01		
A061	–	✓	Maximum operating frequency	0 – 400 Hz	0.0		
A261	–	✓	Maximum operating frequency (second parameter set)	0 – 400 Hz	0.0		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
A062	–	✓	Minimum operating frequency	0.5 – 400 Hz	0.0		
A262	–	✓	Minimum operating frequency (second parameter set)	0 – 400 Hz	0.0		
A063	–	✓	Frequency jump (1)	0 – 400 Hz	0.0		
A064	–	✓	Frequency jump (1) – jump width	0 – 10 Hz	0.5		
A065	–	✓	Frequency jump (2)	0 – 400 Hz	0.0		
A066	–	✓	Frequency jump (2) – jump width	0 – 10 Hz	0.5		
A067	–	✓	Frequency jump (3)	0 – 400 Hz	0.0		
A068	–	✓	Frequency jump (3) – jump width	0 – 10 Hz	0.5		
A071	–	✓	PID control	00: OFF: Disabled 01: ON: Enabled	00		
A072	✓	✓	PID controller – P-component	0.2 – 5.0	0.1		
A073	✓	✓	PID controller – I-component	0.0 – 150 s	0.1		
A074	✓	✓	PID controller – D-component	0.00 – 100 s	0.01		
A075	–	✓	PID controller – reference value factor PV	0.01 – 99.99	1.00		
A076	–	✓	PID controller – actual value signal PV input	00: Analog input OI 01: Analog input O 02: Serial interface (Modbus) 10: Calculated value (PNU A143)	00		
A077	–	✓	PID controller – invert input signals	00: OFF: disabled 01: ON: Enabled	00		
A078	–	✓	PID controller – output signal limit	0 – 100 %	0.0		
A081	–	–	Output voltage (AVR function)	00: ON: Enabled 01: OFF: Disabled 02: DOFF: Disabled during deceleration	00		
A082	–	–	Output voltage (AVR motor rated voltage)	DV51-32…-…: 200, 215, 220, **230**, 240 DV51-340-…: 380, **400**, 415, 440, 460, 480 Default setting depends on series	230/400		
A092	✓	✓	Acceleration time 2	0.01 – 3000 s	15.00		
A292	✓	✓	Acceleration time 2 (second parameter set)	0.01 – 3000 s	15.00		
A093	✓	✓	Deceleration time 2	0.01 – 3000 s	15.00		
A293	✓	✓	Deceleration time 2 (second parameter set)	0.01 – 3000 s	15.00		
A094	–	–	Acceleration time, specify signal for changeover from acceleration time 1 to acceleration time 2	00: Digital input (2CH) 01: Frequency (PNU A095 or A096)	00		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
A294	–	–	Acceleration time, specify signal for changeover from acceleration time 1 to acceleration time 2 (second parameter set)	00: Digital input (2CH) 01: Frequency (PNU A295 or A296)	00		
A095	–	–	Acceleration time, frequency for changeover from ramp time 1 to ramp time 2	0.0 – 400 Hz	0.0		
A295	–	–	Acceleration time, frequency for changeover from ramp time 1 to ramp time 2 (second parameter set)	0.0 – 400 Hz	0.0		
A096	–	–	Deceleration time, frequency for changeover from ramp time 1 to ramp time 2	0.0 – 400 Hz	0.0		
A296	–	–	Deceleration time, frequency for changeover from ramp time 1 to ramp time 2 (second parameter set)	0.0 – 400 Hz	0.0		
A097	–	–	Acceleration time, characteristic	00: linear 01: S curve	00		
A098	–	–	Deceleration time, characteristic	00: linear 01: S curve	00		
A101	–	✓	Analog input (OI-L), frequency at minimum reference value	0 – 400 Hz	0.0		
A102	–	✓	Analog input (OI-L), frequency at maximum reference value	0 – 400 Hz	0.0		
A103	–	✓	Analog input (OI-L), minimum reference value (offset)	0 – 100 %	0.		
A104	–	✓	Analog input (OI-L), maximum reference value (offset)	0 – 100 %	100.		
A105	–	✓	Analog input (OI-L), selection of starting frequency applied to the motor at minimum reference value	00: Value from PNU A101 01: 0 Hz	01		
A141	–	✓	Calculator – select input A	00: Value of optional keypad DEX-KEY-… 01: Potentiometer of optional keypad DEX-KEY-6 02: Analog input (O) 03: Analog input (OI) 04: Serial interface (Modbus)	02		
A142	–	✓	Calculator – select input B	Values → PNU A141	03		
A143	–	✓	Calculator – operation	00: Addition (A plus B) 01: Subtraction (A minus B) 02: Multiplication (A times B)	00		
A145	✓	✓	Calculator – offset frequency	0 – 400 Hz	0.0		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
A146	–	✓	Calculator – offset frequency, prefix	Value from PNU A145 00: plus 01: minus	00		
A151	–	✓	Potentiometer (optional keypad), starting frequency	0 – 400 Hz	0.0		
A152	–	✓	Potentiometer (optional keypad), frequency at maximum reference value	0 – 400 Hz	0.0		
A153	–	✓	Potentiometer (optional keypad), minimum reference value (offset)	0 – 100 %	0		
A154	–	✓	Potentiometer (optional keypad), maximum reference value (offset)	0 – 100 %	100		
A155	–	✓	Potentiometer (optional keypad), selection of starting frequency applied to motor at minimum reference value.	00: Value from PNU A151 01: 0 Hz	01		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
b001	–	✓	POWER, restarting mode after power supply interruption	00: 0 Hz Start 01: Automatic restart at set starting frequency after expiry of time set with PNU b003. 02: After the time set with PNU b003 has elapsed, the frequency inverter synchronizes to the current motor rotation speed and the motor is accelerated to the current reference value in the set ramp times. 03: After the time set under PNU b003 has elapsed, the inverter synchronizes to the current motor rotation speed and the motor brakes to a stop in the set deceleration time. A fault message is then displayed.	00		
b002	–	✓	POWER, permissible power supply downtime	0.3 – 25 s	1.0		
b003	–	✓	POWER, waiting time before automatic restart after power supply failure	0.3 – 100 s	1.0		
b004	–	✓	POWER, generate undervoltage fault signal, direct de-energizing on power supply failure	00: OFF, disabled 01: ON, enabled	00		
b005	–	✓	POWER, number of automatic restarting attempts after undervoltage fault signal	00: 16 restarts 01: No limit	00		
b012	–	✓	Thermal overload, tripping current	0.2 – 1.2 × I_e [A] Depending on frequency inverter's rated current (I_e)	xx		
b212	–	✓	Thermal overload, tripping current (second parameter set)	0.2 – 1.2 × I_e [A] Default, dependent on frequency inverter's rated current (I_e)	xx (I_e)		
b013	–	✓	Thermal overload, characteristic (torque curve)	00: Reduced torque 1 01: Constant torque 02: Reduced torque 2	01		
b213	–	✓	Thermal overload, characteristic (torque curve) (second parameter set)	Values → PNU b013	01		
b021	–	✓	Motor current limitation – function	00: OFF, disabled 01: ON, enabled in acceleration phase and at constant speed 02: Enabled only at constant speed	01		
b221	–	✓	Motor current limitation – function (second parameter set)	Values → PNU b021	01		
b022	–	✓	Motor current limitation, tripping current	0.1 – 1.5 × I_e [A] Default, dependent on frequency inverter's rated current (I_e)	I_e × 1.5		

PNU	RUN	b031 = 10	Name	Value range		DS	Page	User setting
b222	–	✓	Motor current limitation, tripping current (second parameter set)	Values → PNU b022		$I_e \times 1.5$		
b023	–	✓	Motor current limitation, deceleration time constant	0.1 – 3000 s		1.0		
b223	–	✓	Motor current limitation, deceleration time constant (second parameter set)	0.1 – 3000 s		1.0		
b028	–	✓	Motor current limitation, limit current selection	00:	Value of PNU b022	00		
				01:	Analog input O-L			
b228	–	✓	Motor current limitation, limit current selection (second parameter set)	00:	Value of PNU b222	00		
				01:	Analog input O-L			
b031	–	✓	Parameter access inhibit (access rights)	00:	Access to all parameters blocked, except PNU b031, when digital input SFT is enabled (→ PNU C001: 15)	01		
				01:	Access to all parameters blocked, except PNU b031 and F001, when digital input SFT is enabled (→ PNU C001: 15)			
				02:	Access to all parameters blocked, except PNU b031			
				03:	Access to all parameters blocked, except PNU b031 and F001			
				10:	Extended access rights to parameters in RUN mode.			
b080	✓	✓	Analog output AM, gain factor	0 – 255		100		
b082	–	✓	Increased starting frequency (e.g. at high static friction)	0.5 – 9.9 Hz		0.5		
b083	–	–	Carrier frequency	2 – 14 kHz		5.0		
b084	–	–	Initializing – function	00:	Clear fault register	00		
				01:	Load default settings (DS)			
				02:	Clear fault register and load default settings (DS)			
b085	–	–	System settings (country-specific default settings for initialization)	00:	Japan	01 {02}		
				01:	Europe			
				02:	USA			
b086	✓	✓	Frequency indication scaling factor for value in PNU d007	0.1 – 99.9		1.0		
b087	–	✓	STOP button, (optional keypad DEX-KEY-…)	00:	Enabled	00		
				01:	Disabled			
b088	–	✓	Motor restart after removal of the FRS signal	00:	Restart with 0 Hz	00		
				01:	Restart with the determined output frequency (current motor speed)			
b090	–	✓	Braking transistor, permissible percentage duty factor within a 100 s interval	0 – 100 %		00		
				0 %: Braking transistor disabled				
				> 0 %: Braking transistor enabled				

PNU	RUN	b031 = 10	Name	Value range		DS	Page	User setting
b091	–	–	STOP button, (optional keypad DEX-KEY-…), selection of motor stop on actuation	00:	DEC, braking to 0 Hz with deceleration ramp	00		
				01:	FRS, free coasting down to 0 Hz			
b092	–	–	Device fan, configuration	00:	Built-in fan always running	00		
				01:	Built-in fan running, automatic Off 5 min after stop signal			
				02:	Built-in fan, temperature-controlled actuation			
b095	–	✓	Braking transistor, control	00:	Function disabled	00		
				01:	Enabled in RUN mode			
				02:	Always enabled			
b096	–	✓	Braking transistor, starting voltage threshold	330 – 395 V (U_e = 230 V)		360/720		
				660 – 790 V (U_e = 400 V)				
				Default, dependent on rated voltage of DV51 (U_e)				
b130	–	✓	Internal DC link, stop deceleration ramp on overvoltage in the internal DC link	00:	OFF, disabled	00		
				01:	ON, enabled			
b131	✓	✓	Internal DC link, switching threshold for stopping the deceleration ramp (PNU b130 = 01)	330 – 395 V (U_e = 230 V)		380/760		
				660 – 790 V (U_e = 400 V)				
				Default, dependent on rated voltage of DV51 (U_e)				
b140	–	✓	Suppress stop on overcurrent	00:	OFF, disabled	00		
				01:	ON, enabled			
b150	–	✓	Clock frequency, automatic clock frequency reduction on overtemperature	00:	OFF, disabled	00		
				01:	ON, enabled			
b160	✓	✓	Inverter, reduce inverter's response time (RDY) to a control signal	00:	OFF	00		
				01:	On			

PNU	RUN	b031 = 10	Name	Value range		DS	Page	User setting
C001	–	–	Digital input 1 – function	00:	FWD: Clockwise rotating field	00		
				01:	REV: Anticlockwise rotating field			
				02:	CF1: Fixed frequency selection, bit 0 (LSB)			
				03:	CF2: Fixed frequency selection, bit 1			
				04:	CF3: Fixed frequency selection, bit 2			
				05:	CF4: Fixed frequency selection, bit 3 (MSB)			
				06:	JOG: Jog mode			
				07:	DB: DC braking			
				08:	SET: Select second parameter set			
				09:	2CH: Second time ramp			
				11:	FRS: Free run stop (free coasting, = controller inhibit)			
				12:	EXT: External fault message			
				13:	USP: Unattended start protection			
				15:	SFT: Parameter access inhibit			
				16:	AT: change over to analog input OI			
				18:	RST: Reset fault signal			
				19:	PTC: PTC thermistor input (digital input 5 only)			
				20:	STA: Three-wire control start signal			
				21:	STP: Three-wire control stop signal			
				22:	F/R: Three-wire control, direction of rotation			
				23:	PID: Activate PID control			
				24:	PIDC: Reset integral component of PID control			
				27:	UP: Acceleration (motor potentiometer)			
				28:	DWMN: Deceleration (motor potentiometer)			
				29:	UDC: Motor potentiometer, reset saved value of motor potentiometer to 0 Hz			
				31:	OPE: Operator keypad			
				50:	ADD: Add value from PNU A145 to frequency reference value.			
				51:	F-TM: Digital input, increase priority (shorter response time).			
				52:	RDY: Inverter, reduce response time to control signals			
				53:	SP-SET: Second parameter set with special functions			
				255:	-- (no function)			
C201	–	–	Digital input 1 – function (second parameter set)	Values → PNU C001		00		
C002	–	–	Digital input 2 – function	Values → PNU C001		01		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
C202	–	–	Digital input 2 – function (second parameter set)	Values → PNU C001	01		
C003	–	–	Digital input 3 – function	Values → PNU C001	02 {16}		
C203	–	–	Digital input 3 – function (second parameter set)	Values → PNU C001	02		
C004	–	–	Digital input 4 – function	Values → PNU C001	03 {13}		
C204	–	–	Digital input 4 – function (second parameter set)	Values → PNU C001	03		
C005	–	–	Digital input 5 – function	Values → PNU C001	18 {09}		
C205	–	–	Digital input 5 – function (second parameter set)	Values → PNU C001	18		
C006	–	–	Digital input 6 – function	Values → PNU C001	09		
C206	–	–	Digital input 6 – function (second parameter set)	Values → PNU C001	09		
C011	–	–	Digital input 1 – logic	00: Signal triggers switching 01: Low signal triggers switching	00		
C012	–	–	Digital input 2 – logic	Values → PNU C011	00		
C013	–	–	Digital input 3 – logic	Values → PNU C011	00		
C014	–	–	Digital input 4 – logic	Values → PNU C011	00		
C015	–	–	Digital input 5 – logic	Values → PNU C011	00		
C016	–	–	Digital input 6 – logic	Values → PNU C011	00		

PNU	RUN	b031 = 10	Name	Value range		DS	Page	User setting
C021	–	–	Digital output 11 – signal	00:	RUN: In operation	01		
				01:	FA1: Reference frequency reached			
				02:	FA2: Frequency signal – output frequency exceeds value in PNU C042 (during acceleration ramp) or PNU C043 (during deceleration ramp)			
				03:	OL: Overload warning – motor current exceeds value in PNU C041.			
				04:	OD: PID controller deviation – reference/actual value differential exceeds signalling threshold in PNU C044.			
				05:	AL: Fault – fault/alarm message			
				06:	Dc: Warning – Reference value at input O (0 to 10 V) lower than value in PNU b082 or current signal at input OI below 4 mA.			
				07:	FBV: Warning – reference/actual value differential of PID controller exceeds the tolerance range in PNU C044.			
				08:	NDc: Fault/warning dependent on PNU C076 – communication watchdog timer has expired: communications are interrupted.			
				09:	LOG: Show result of logic link performed through PNU C143.			
				10:	ODc: Warning – reference value at input O (0 to 10 V) higher than maximum value or current signal at input OI above as 20 mA.			
C022	–	–	Digital output 12 – signal	Values → PNU C021		00		
C026	–	–	Relay K1 – signal	Values → PNU C021		05		
C028	–	–	Analog output AM – indication/ reading	00:	f-Out: Current output frequency	00		
				01:	I-Out: Current output current			
C031	–	–	Digital output 11 – logic	00:	Normally open contact (NO)	01, 00		
				01:	Normally closed contact (NC)			
C032	–	–	Digital output 12 – logic	Values → PNU C031		01, 00		
C036	–	–	Relay K1 (K11-K12) – logic	Values → PNU C031		01		
C041	–	✓	Output function – threshold for overload warning (OL)	0 – 2 × I_e [A] Default, dependent on frequency inverter's rated current (I_e)		I_e		
C241	–	✓	Output function – threshold for overload warning (OL) (second parameter set)	0 – 2 × I_e [A] Default, dependent on frequency inverter's rated current (I_e)		I_e		
C042	–	✓	Output function – signalling threshold for frequency signal FA2 during acceleration	0 – 400 Hz		0.0		
C043	–	✓	Output function – signalling threshold for frequency signal FA2 during deceleration	0 – 400 Hz		0.0		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	User setting
C044	–	✓	Output function – signalling threshold for maximum permissible PID controller deviation of actual value from reference value	0 – 100 %	3.0		
C052	–	✓	PID controller – switch-off threshold for second stage of PID controller	0 – 100 %	100		
C053	–	✓	PID controller – switch-on threshold for second stage of PID controller	0 – 100 %	0.0		
C071	–	✓	Communication – baud rate	04 4000 bit/s 05: 9600 bit/s 06: 19200 bit/s	06		
C072	–	✓	Communication – address	1 – 32	1		
C074	–	✓	Communication – parity	00: None 01: Even 02: Odd	00		
C075	–	✓	Communication – stop bits	1: 1 bit 2: 2 bits	1		
C076	–	✓	Communication – behaviour of frequency inverter on communication errors	00: Switch off on fault signal E60 01: Decelerate to standstill at deceleration ramp and then switch off with error E60. 02: Disable devices 03: FRS: Free run stop (free coasting, = controller inhibit) 04: DEC: Braking to 0 Hz at set deceleration ramp	02		
C077	–	✓	Communication – set monitoring time (watchdog).	0 – 99.99 s	0.00		
C078	–	✓	Communication – waiting time to output of a fault signal	0 – 1000 ms	0		
C081	–	✓	Analog input O – reference value signal compensation	0 – 200 %	100		
C082	✓	✓	Analog input OI – reference value signal compensation	0 – 200 %	100		
C085	✓	✓	Thermistor compensation (digital input 5)	0 – 200 %	100		
C086	✓	✓	Analog output AM – offset compensation	0 – 10 V	0.0		
C091	✓	✓	Debug mode – parameter error	00: Do not show parameter 01: Show parameter	00		
C101	–	✓	Motor potentiometer – reference value for motor potentiometer after power supply interruption	00: Clear last value and use default for PNU F001 01: Use saved motor potentiometer value set with UP/DWN keys	00		

PNU	RUN	b031 = 10	Name	Value range		DS	Page	User setting
C102	–	✓	Reset function (RST) – response to a Reset signal	00:	On rising edge, reset fault and stop motor if in RUN	00		
				01:	On falling edge, reset fault and stop motor if in RUN			
				02:	On rising edge, reset fault only			
C141	–	–	Logic function – select input A	00:	RUN: In operation	00		
				01:	FA1: Reference frequency reached			
				02:	FA2: Frequency signal – output frequency exceeds value in PNU C042 (during acceleration ramp) or PNU C043 (during deceleration ramp)			
				03:	OL: Overload warning – motor current exceeds value in PNU C041.			
				04:	OD: PID controller deviation – reference/actual value differential exceeds signalling threshold in PNU C044.			
				05:	AL: Fault – fault/alarm signal			
				06:	Warning: Reference value at input O (0 to 10 V) lower than value in PNU b082 or current signal at input OI below 4 mA.			
				07:	FBV: Warning – reference/actual value differential of PID controller exceeds the tolerance range in PNU C044.			
				08:	NDc: Fault/warning (dependent on PNU C076) – communication watchdog timer has expired: communications are interrupted.			
				10:	ODc: Warning – reference value at input O (0 to 10 V) higher than maximum value or current signal at input OI above as 20 mA.			
C142	–	–	Logic function – select input B	Values → PNU C141		01		
C143	–	–	Logic function – select link [LOG]	00:	[LOG] = A AND B	00		
				01:	[LOG] = A OR B			
				02:	[LOG] = A XOR B			
C144	–	✓	Digital output 11 – deceleration time (On)	0 – 100 s		0.0		
C145	–	✓	Digital output 11 – deceleration time (Off)	0 – 100 s		0.0		
C146	–	✓	Digital output 12 – deceleration time (On)	0 – 100 s		0.0		
C147	–	✓	Digital output 12 – deceleration time (Off)	0 – 100 s		0.0		
C148	–	✓	Relay K1 – deceleration time (On)	0 – 100 s		0.0		
C149	–	✓	Relay K1 – deceleration time (Off)	0 – 100 s		0.0		

PNU	RUN	b031 = 10	Name	Value range	DS	Page
d001	✓	✓	Output frequency display	0.0 – 400.0 Hz (0.1 Hz)	–	
d002	✓	✓	Output current display	0.0 – 999.9 A (0.1 A)	–	
d003	✓	✓	Direction of rotation display	• F: Clockwise (forward) rotating field • O: STOP • R: Anticlockwise (reverse) rotating field	–	
d004	✓	✓	PID feedback display	• 0.00 – 99.99 (0.01 %) • 100.0 – 999.9 (0.1 %) • 1000 – 9999 (1 %)	–	
d005	✓	✓	Indication – status of digital inputs 1 to 6	–	–	
d006	✓	✓	Indication – status of digital outputs 11, 12 and K1	–	–	
d007	✓	✓	Indication – scaled output frequency	0.00 – 9999 (0.01/0.1/1/10 Hz)	–	
d013	✓	✓	Indication – output voltage	0 – 600 V (1 V)	–	
d016	✓	✓	Indication – operation time counter	• 0 – 9999 (1 h) • 10000 – 99990 (10 h) • 100000 – 999000 (1000 h)	–	
d017	✓	✓	Indication – mains On time	• 0 – 9999 (1 h) • 10000 – 99990 (10 h) • 100000 – 999000 (1000 h)	–	
d080	✓	✓	Indication – total number of occurred faults	0 – 65530	–	
d081	✓	✓	Indication – fault 1 (last fault signal)	Values at time of power Off: • Fault signal E… • Frequency (Hz) • Current (A) • Internal DC link voltage (VDc) • Total operating hours in RUN mode • Total Power On time, power supply connected (h)	–	
d082	✓	✓	Indication – fault 2	Values → PNU d081	–	
d083	✓	✓	Indication – fault 3	Values → PNU d081	–	

PNU	RUN	b031 = 10	Name	Value range	DS	Page	Reference value
F001	✓	✓	Reference frequency – input through optional keypad DEX-KEY-…	0.0 – 400 Hz (0.1 Hz)	0.0		
F002	✓	✓	Acceleration time 1	• 0.01 – 99.99 (0.01 s) • 100.0 – 999.9 (0.1 s) • 1000 – 3000 (1 s)	10.00		
F202	✓	✓	Acceleration time 1 (second parameter set)	Values → PNU F002	10.00		
F003	✓	✓	Deceleration time 1	• 0.01 – 99.99 (0.01 s) • 100.0 – 999.9 (0.1 s) • 1000 – 3000 (1 s)	10.00		

PNU	RUN	b031 = 10	Name	Value range	DS	Page	Reference value
F203	✓	✓	Deceleration time 1 (second parameter set)	Values → PNU F003	10.00		
F004	✓	✓	Direction of rotation – function of START key (optional keypad DEX-KEY-…)	• 00: Clockwise rotating field (FWD) • 01: Anticlockwise rotating field (REV)	00		

PNU	RUN	b031 = 10	Name	Value range	DS	Page
H003	–	–	Motor – assigned rating [kW]/ {HP} at rated voltage (U_e)	0.2; 0.4; 0.55; 0.75; 1.1; 1.5; 2.2; 3.0; 4.0; 5.5; 7.5; 11.0 {0.2; 0.4; 0.75; 1.5; 2.2; 3.7; 5.5; 7.5; 11.0} Default depends on rated voltage and type rating of DV51.	–	
H203	–	–	Motor – assigned rating [kW]/ {HP} at rated voltage (U_e) (second parameter set)	Values → PNU H003		
H004	–	–	Motor – number of poles	2, 4, 6, 8	4	
H204	–	–	Motor – number of poles (second parameter set)	Values → PNU H004	4	
H006	✓	✓	Motor – stabilization constant	0 – 255	100	
H206	✓	✓	Motor – stabilization constant (second parameter set)	Values → PNU F006	100	
H007	–	–	Motor – voltage class	00: • 200 V (230 V) 01: • 400 V Default, dependent on rated voltage and type raring of DV51	–	
H207	–	–	Motor, voltage class (second parameter set)	Values → PNU H007	–	

UL® cautions, warnings and instructions

Preparation for wiring

Warning!
"Use 60/75 °C Cu wire only" or equivalent.

Warning!
"Open Type Equipment".

Warning!
"A Class 2 circuit wired with Class 1 wire" or equivalent.

Warning!
"Suitable for use on a circuit capable of delivering not more than 5000 r.m.s. symmetrical amperes, 240 V maximum".

Warning!
"Suitable for use on a circuit capable of delivering not more than 5000 r.m.s. symmetrical amperes, 480 V maximum".

Determination of wire and fuse sizes

The maximum motor current in your application determines the recommended wire size. The following table gives the wire size in AWG. The "Power Lines" column applies to the inverter input power, output wires to the motor, the earth ground connection, and any other component. The "Signal Lines" column applies to any wire connecting to the two green 7 and 8-position connectors just inside the front enclosure panel.

DV51-	Motor output		Wiring		Applicable equipment
	kW	HP	Power lines	Signal lines	Fuse (class J) rated 600 V
320-4K0	4.0	5	AWG 12/3.3 mm²	18 to 28 AWG/0.14 to 0.75 mm² shielded wire. Use 18 AWG/ 0.75 mm² wire for the alarm signal wire (K11, K12, K14 terminals).	30 A
320-5K5	5.5	7 ½	AWG 10/5.3 mm²		40 A
320-7K5	7.5	10	AWG 8/8.4 mm²		50 A
322-018	0.18	¼	AWG 16/1.3 mm²		10 A
322-037	0.37	½			
322-055	0.55	¾			
322-075	0.75	1	AWG 14/2.1 mm²		15 A
322-1K1	1.1	1 ½	AWG 14/2.1 mm²		15 A
322-1K5	1.5	2	AWG 12/3.3 mm²		20 A (single-phase) 15 A (three-phase)
340-037	0.37	½	AWG 16/1.3 mm²		3 A
340-075	0.57	1			6 A
340-1K5	1.5	2			10 A
340-2K2	2.2	3			10 A
340-3K0	3.0	4	AWG 14/2.1 mm²		15 A
340-4K0	4.0	5	AWG 14/2.1 mm²		15 A
340-5K5	5.5	7 ½	AWG 12/3.3 mm²		20 A
340-7K5	7.5	10	AWG 12/3.3 mm²		25 A

→ Field wiring must be made by a UL-listed and CSA-certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed by using the crimping tool specified by the connector manufacturer.

→ Be sure to consider the capacity of the circuit-breaker to be used.

→ Be sure to use larger wires for the power lines if the distance exceeds 20 meters.

Terminal dimensions and tightening torque

The terminal screw dimensions for all inverters are listed in Table (→ Page) and Table (→ Page). This information is useful in sizing spade lug or ring lug connectors for wire terminations.

When connecting wiring, use the tightening torque listed in the above mentioned tables to safely attach wiring to the connectors.

⚠ **Warning!**
When PNU b12 (level of electronic thermal setting) is set to device FLA, device provides Solid State motor overload protection at 115 % of device FLA or equivalent.

This PNU b12 (level of electronic thermal setting) is a variable parameter.

Fuse (class J) rated 600 V	→	UL Listed Fuse (class J) rated 600 V

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