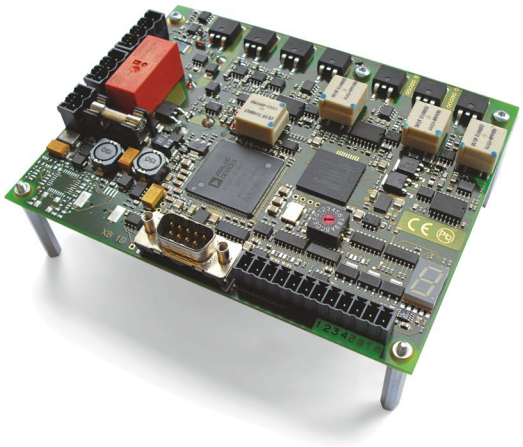
SIEB & MEYER

# Drive Amplifier SD2B / SD2B plus

## Hardware Description

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# 1 About this Manual

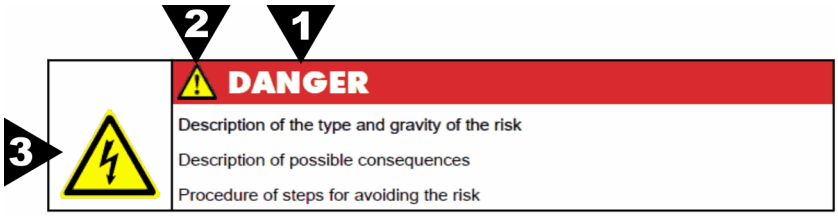


This chapter descirbes symbols, signal words and abbreviations used in this manual.

More documentation can be downloaded from the SIEB & MEYER website under http://www.sieb-meyer.de/downloads.html.

## 1.1 Illustration of Warnings

Depending on their degree of risk, warnings are classified into different levels. In the manual, the different levels and types of dangers are represented as follows:




[1] Risk level (signal word/warning color)
Classification of the risk

[2] Safety symbol
Risk of injury

[3] Risk symbol
Graphic representation of the source of risk

### Risk levels

| Risk Level | Description |
|---|---|
| DANGER | Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. |
| WARNING | Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. |
| CAUTION | Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage. |
| NOTICE | Indicates a hazardous situation which, if not avoided, may result in property damage. |

### Risk symbols

| Risk symbol | Description |
|---|---|
|  | General hazardous situation |
|  | Risk of injury due to electric shock |
|  | Risk of injury due to hot surfaces |

| Risk symbol | Description |
|---|---|
|  | Potentially risk of injury when working on machines with open covers/ doors |
|  | Risk of injury due to flying objects |
|  | Destruction risk of electrostatically sensitive components |
|  | Risk of property damage |

## 1.2 Illustration of General Notices

| Symbol | Description |
|---|---|
|  | Hint with additional, further information |
|  | Tip with suggestions and useful information |

## 1.3 Abbreviations

| | |
|---|---|
| FPAM | flux pulse amplitude modulation |
| HSBLOCK | high-speed block commutation |
| HSPAM | high-speed pulse amplitude modulation |
| HSPWM | high-speed pulse width modulation |
| n.c. | not connected |
| OSSD | Output Signal Switching Device |
| PAM | pulse amplitude modulation |
| PWM | pulse width modulation |
| SERVO | servo control |
| STO | safety function: Safe Torque Off |
| SVC | sensorless vector control |
| VF | V/f Characteristic Curve |
| VCC | voltage at the common collector |
| VECTOR | vector control |

# 2 General Information



This manual describes the drive amplifiers of the series SD2B / SD2B plus. These devices allow operation of high-dynamic servo motors as well as synchronous and asynchronous high-frequency spindles.

The devices are equipped with interfaces for different sensor systems and allow the operation of motors with Hall and incremental sensors. Motor systems without any sensors are also supported, whereas different customized control methods are available. In addition, the devices can drive rotary and linear motors. Thus, the number of device variants is reduced for the machine manufacturer.

This manual provides information on:

- Safety instructions and application advice
- Notes about the electromagnetic compatibility
- Description of the device (block diagram, type plate, module designation)
- Technical data, dimensions
- Connector pin assignment
- Wiring examples
- Status and error messages
- General information regarding the wiring (cables and line cross-sections)

This manual has the following demands on the trained staff of machine manufacturers:

| | |
|---|---|
| Transport: | only by skilled employees familiar with handling electrostatically sensitive components. |
| Installation: | only by experts with electromechanical experience |
| Initial operation: | only by experts with experience in the fields of electrical engineering / drive technology |

Information concerning the initial operation and parameterization of the digital drive amplifier can be found in the manual of the software *drivemaster2*.

More documentation can be downloaded from the SIEB & MEYER website under http://www.sieb-meyer.de/downloads.html.

# 3 Safety Instructions

These safety instructions include important information regarding your safety and must be observed during installation and operation of SIEB & MEYER devices. Read them carefully and keep them for later use.

Also adhere to safety instructions in the product documentation and on the device.



## 3.1 Standards and Regulations

SIEB & MEYER devices comply with the regulations of the following standards and directives:

- Low-Voltage Directive 2014/35/EU:
  EU declaration of conformity, DIN EN 61800-5-1
- EMC Directive 2014/30/EU:
  EU manufacturer's certificate, DIN EN 61800-3
- Machinery Directive 2006/42/EC:
  EU manufacturer's certificate, DIN EN 61800-5-2 (safety functions)

SIEB & MEYER products are no products according to the EU Machinery Directive. The appropriate use of SIEB & MEYER devices in machines and installations is prohibited until the manufacturer of the machine or installation confirms the CE conformity of the complete machine or installation.

If the mechanics or the electronics of the device are modified, the conformity with the EC/EEC directives and thus the CE label will expire.

## 3.2 Working on the Device

**⚠ WARNING**

**Trained staff only**

To avoid risks of serious injuries and material damage any works regarding installation, initial operation and maintenance must be carried out by trained staff only. Furthermore, electricians who connect feed-in systems must be approved by the local DSO (distribution system operator).

Trained staff, according to this fundamental safety instruction, are persons familiar with the installation, mounting, initial and permanent operation of the product and they are qualified appropriately for the work. The standards DIN VDE 0100 and DIN VDE 0110 as well as the national accident prevention regulations shall be considered!

When installing feed-in systems adhere to all applicable regulations, special safety instructions and technical connection conditions of the local DSO.

**DANGER**

**Risk of serious damage to property and personal injury may occur:**

- when covers are removed illegally,
- due to improper use,
- when either the installation or the operation is incorrect

Observe the corresponding notes and information in the product documentation of your device.

**WARNING**

**Risk of injuries and material damage due to illegal modifications**

Only change the settings of the device after having contacted SIEB & MEYER.

All Information and advice attached to the device, such as safety instructions or danger warnings and technical data (type plate) are:

- not to be removed
- not to be damaged
- to be kept readably (no covers, no paint over or the like)

## 3.3 Appropriate Use

Use the device according to its appropriate use only. Consider the corresponding information regarding the application fields of the device in the product documentation.

The device is intended for use within an enclosed cabinet by the OEM or end user to comply with pollution degree 2 or equivalent environmental conditions. That means: Ensure to avoid conductive impurities and humidity during the operation.

SIEB & MEYER products are **not** suitable for use in areas exposed to explosion hazards (ATEX zones) without approriate housing.

### Terms according to DIN EN 61800

Before initial operation, make sure that the machine will not expose danger (e.g. runaway moves). The conformity with the safety standards DIN EN 60204-1 and DIN EN 61800-5-1 must be ensured.

The manufacturer of the system or the machine has to meet the requirements of the legal values regarding the Electromagnetic Compatibility (EMC). SIEB & MEYER units can be operated in industrial areas, provided that the attached EMC information has been taken into consideration.

SIEB & MEYER tests all products in its own EMC laboratory to ensure that the products meet the respective standards, when they are installed properly.

Installation of the device differing from the product documentation and the manual "EMC Guidelines" means that the machine manufacturer has to carry out new measurements to comply with the regulations.

SIEB & MEYER devices meet the requirements of the Low-Voltage Directive 2014/35/EU. The harmonized standards of DIN EN 50178 and DIN EN 60204-1 in

combination with the standards DIN EN 60947 and DIN EN 61800-5-1 are applied consequently.

Technical data and the connection specification can be found in the respective product documents.

**Line filters**

If adequate interference suppression measures are applied and the appropriate use in industrial applications of the device is ensured SIEB & MEYER devices comply with the EMC Directive EMC Directive 2014/30/EU in terms of the EMC Product Standard (PDS) DIN EN 61800-3.



The use of line filters helps reaching the following:

- Resistance to interference. The electronic system is protected against high-frequency disturbances, possibly infiltrated via the mains cable.
- Protection against radiation. High-frequency disturbances are reduced to legally authorized measure. This prevents effects of the transients to adjacent components or devices.
- Products, not equipped with an integrated AC supply line filter must be operated with an upstream line filter.
- Using SIEB & MEYER devices in residential or business areas as well in small businesses requires additional interference suppression.
  For detailed information refer to the manual "EMC Guidelines", chapter "EMC Product Standard DIN EN 61800-3 for PDS".

Refer to the product documentation of your device to find out whether or not your device is equipped with a line filter. For detailed information on line filters refer to the manual "EMC Guidelines".

## 3.4 Reasonably Foreseeable Misuse

The Machinery Directive defines a "reasonably foreseeable misuse" as "use of machinery in a way not intended in the instructions but which may result from predictable human behavior".

SIEB & MEYER products are no products according to the EU Machinery Directive.

During design and construction of the machine as well as in the operation manual the machine manufacturer is obliged to give consideration to the intended (appropriate) use of the machine and risks arising from reasonably foreseeable misuse of the machine.

To avoid injuries and material damage any use, installation and setup of SIEB & MEYER products by non-experts which exceed the technical data specified in the product documentation (high voltages, temperatures etc.) is considered to be not intended use and forbidden. Adhere to the safety instructions on the device and in the product documentation.

## 3.5 Transport and Storage

Avoid improper mechanical load of the device. The following points must especially be taken into consideration:

- Protect the device against mechanical damage (max. acceleration = 40 m/s²).
- Protect the device against dirt and humidity.

Make sure that **dust plugs are plugged on optical fiber connectors equipped with them during transport of the device**. Otherwise, recommissioning is potentially not possible.
- Never touch electronic components.

The following climatic conditions apply to the storage. If required, appropriate measures must be taken to ensure these climatic conditions (installation of heating/air conditioning systems etc.):
- The storage area must be clean (dust-free, if possible), dry and well-ventilated.
- No storage in the open.
- The storage temperature must be in the range of −25 °C to +55 °C (−13 °F to +131 °F). Shortly it may be +70 °C (+158 °F).
- The relative humidity on the storage premises must be in the range of 5 % to 75 % (no bedewing).
- Sudden changes of the temperature or the humidity should be prevented.
- Avoid stacking of the devices during transport and storage.

The maximum storage period is 2 years. Electrolytic capacitors produce high leakage currents when a voltage is applied after a long storage period without applied voltage and must be reformed. For this, the operating voltage is applied via a 1 kΩ series resistor for one hour. Please contact the SIEB & MEYER service department for details.

## 3.6 Installation

**NOTICE**

**Damage of electrostatically sensitive components due to improper handling**

Never touch electronic components.

Consider specific mounting instructions for your device.

**Mechanical installation conditions for the system according to DIN EN 61800-2:**

Vibrations must remain within the limit values of the IEC 60721-3-3, class 3M1, standard for fixed equipment.

| Frequency [Hz] | Amplitude [mm] | Acceleration [m/s²] |
|---|---|---|
| 2 ≤ *f* < 9 | 0,3 | Not applicable |
| 9 ≤ *f* < 200 | Not applicable | 1 |

*Tab. 1: Vibration limits of the system*

Vibrations which exceed these limits, or the use on mobile equipment, are considered as **abnormal mechanical conditions**.

**Operating conditions:**

The following requirements are to be considered for the installation and the operation of the device. Noncompliance with theses requirements is regarded as **abnormal operating condition**:
- The device is conceived according to DIN EN 61800-1 / DIN EN 50178 for the dirt level 2. That means: Ensure to avoid conductive impurities during the operation.
- Devices with air cooling only can be loaded to their maximum up to a height of 1000 m above MSL (3281 ft above MSL). For an operation in areas higher than

1000 m (3281 ft) above MSL the capacity must be reduced by 1.5 % per 100 m (328 ft).
The maximum site altitude is 2000 m (6562 ft) above MSL.

- The device must be protected against harmful gas, oil vapor and salty air at the place of installation.
- The ambient air must not contain aggressive, grinding, electrically conductive or flammable substances as well as any amount of dust.
- The maximum relative humidity during operation is 85% (no condensation).
- The admissible ambient temperature during operation is +5 °C to +40 °C (+41 °F to +104 °F). Extreme and sudden changes of the temperature should be prevented.
  - Ensure power derating for devices used under ambient temperatures over +40 °C (+104 °F) (see technical data). The following applies:-1.5 % per 1 °C.Note: F=C×9/5+32; C=(F-32)×5/9
  - Devices with polyester film at the front panel: The polyester films must not be exposed to direct sunlight for extended periods of time. In conditions of high humidity (>80 %) the ambient temperature must not exceed +40 °C (+104 °F). The polyester films must not come in contact with benzyl alcohol or methylene chloride.
- Make sure that the aeration elements are free and open, so that the air circulation is not restricted.



## 3.7 Electrical Connection

**DANGER**

**Risk of serious injuries due to touch voltages**

After electric devices have been switched off touch voltages may occur depending on the device up to 4 minutes. Longer construction-related discharge times are possible. Refer to the product documentation of your device.

All work at and within the units must only be carried out, when the units are turned off, the mains supply is cut and the DC bus is completely discharged.

Never touch energized parts after a device has been switched. off.

Consider the applicable VDE regulations and accident prevention regulations (e.g. VBG 1 and VBG 4).

**DANGER**

**Risk of serious injuries due to improper connection to earth**

Incorrect or insufficient connection of the system to earth may cause dangerous currents.

Connection to earth must be realized according to the instructions in the product documentation of your device.

The electrical installation must be carried out according to the relevant electrical codes (e.g. appropriate wire gauges, fuse protection and connections of ground conductors must be considered).

SIEB & MEYER device are conceived for connection to TN mains. For detailed information regading the connection to TN mains or other mains refer to the manual "EMC Guidelines", chapter "Connection to Different Supply System Types".

Recommendations for the installation complying EMC (e.g. shields, connection to earth and line installations) can be found in the technical manuals of your device (only for machine manufacturers). The manufacturer of the system or machine has to meet the requirements of the legislation regarding the EMC.

- Consider that the mains supply must be protected via an overload release with restricted guidance for each mains phase. The mains line should only be connected, when the work is completed.
- Before turning on the unit the first time, make sure that the connected machine will not have runaway axes.
- Never connect capacitive loads to the output phases of the servo amplifiers and frequency converters.
- Prevent cable loops. Therefore, the units must only be connected to earth at the provided PE connection for the mains supply line and the racks only at the provided earth screw.

**DANGER**

**Connection of the power supply unit**

This product may cause touch current in the protective earthing conductor. The current in the protective earthing conductor can exceed 3.5 mA AC or 10 mA DC.

Pay attention to the local safety regulations for electric equipment with high leakage currents, in particular the minimum cross-section of the protective earthing conductor.

**Operation with residual current device (RCD)**

For detailed information regarding the operation with residual current device (RCD) refer to the manual "EMC Guidelines", chapter "Safety-relevant Aspects, Residual Current Device (RCD)".

## 3.8 Operation

**WARNING**

**Risk of serious injuries due to moving machine parts**

During the operation of an installation with open doors or removed covers, persons may seriously be injured by moving machine parts.

Keep the doors closed during the operation and do not remove covers.

**WARNING**

**Risk of injuries and material damage due to flying parts**

Persons may be injured or material be damaged, if screws of the front panels and housing parts are not fastened.

Before the initial operation of the installation ensure that all screws are tightened.

**WARNING**

**Risk of burn due to hot surfaces**

During operation the units can have hot surfaces according to their protection system. In particular this applies to ventilation inlets and outlets.

Never touch device parts during operation apart from operating units.

When using ferrite rings temperatures may exceed 80°C in some cases.

Only use cables suitable for temperatures over 90 °C. This corresponds to the flammability rating UL 94V-0, RTI 105°C.

Consider the relevant notes in the manual.

Systems, into which servo amplifiers and frequency converters are mounted, possibly must be equipped with additional protective devices according to the valid safety instructions (e.g. law about technical material, rules for prevention of accidents, etc.).

## 3.9 Maintenance

The unit must be checked regularly for cleanness and functionality depending on the ambient pollution. This applies in particular for installed fans.

## 3.10 Disposal

Make sure to consider country-specific waste and disposal laws and statutes for the disposal of packing material, used batteries and irreparable devices.

SIEB & MEYER products meet the requirements of the following directive:

- 2011/65/EU (EU-directive RoHS 2 on the restriction of the use of hazardous substances in electrical and electronic equipment)

SIEB & MEYER products do not exceed the limits of the directive 2011/65/EU for hazardous substances.

SIEB & MEYER products labeled with the adjacent symbol also meet the regulations of the following directive:

- SJ/T 11364-2014 (China RoHS 2 on the restriction of the use of hazardous substances in electrical and electronic equipment)

SIEB & MEYER products labeled with the symbol above do not exceed the limits of the directive SJ/T 11364-2014 for hazardous substances.

## 3.11 Legal Warranty

SIEB & MEYER products are liable to a legal warranty of at least one year. Any claims for the products beyond this warranty shall be declared in an additional contractual agreement between SIEB & MEYER and the customer.

Claims for damages are excluded:

- due to improper use of the device
- when the device has been installed nonstandard or improperly, especially by electricians without license
- when the device has been employed although the protection equipment was defective
- when the maximum permissible input voltage has been exceeded
- due to improper operation
- when the device or its equipment have been modified
- when the device was affected by foreign material or force majeure

**NOTICE**

**Due diligence of the machine manufacturer**

A first programming carried out by SIEB & MEYER does not release the machine manufacturer from his duty to check the programmed values for correctness.

# 4 Unit Assembly Complying EMC

The EU guidelines for electromagnetic compatibility (EMC) must be considered for the initial operation of all SIEB & MEYER devices.

The manual "EMC Guidelines" is available in German and English and includes:

- EMC rules
- information regarding the professional grounding and wiring
- safety-relevant aspects
- extracts from the EMC product standard
- possibilities for the connection to different supply system types

**Availability:**

- PDF file under www.sieb-meyer.de/downloads.html

# 5 Drive Amplifier SD2B / SD2B plus

## 5.1 Type Plate

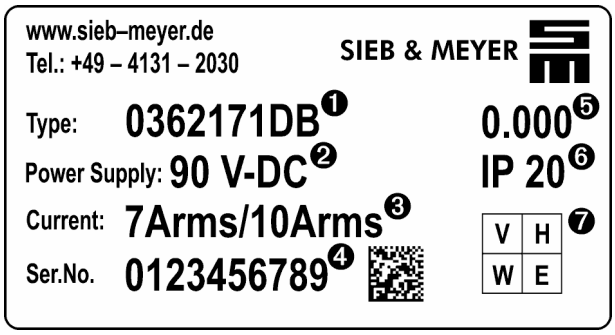
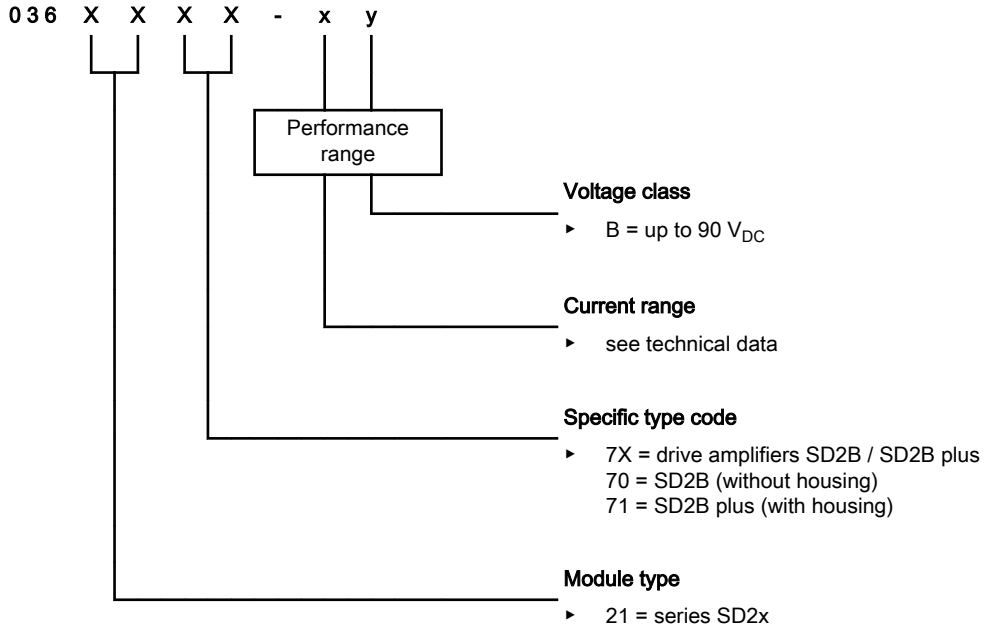



*Fig. 1: Example of type plate (SD2B plus)*

| No. | Meaning | Explanation |
|---|---|---|
| ❶ | Device designation | Composed of module type and performance range as letter code |
| ❷ | Supply voltage | Indicates the maximum voltage range (if this row is left blank, an external power supply unit is necessary) |
| ❸ | Rated current/peak current | Applies to the output stage; indicated as RMS value |
| ❹ | Serial number | Indicates the individual number of the device |
| ❺ | Device version | Indicates the version of the hardware; if no version is existent, 0.000 is indicated here |
| ❻ | IP Code | Indicates the level of protection of the device against touching or intrusion of solid objects (1st digit) and water ingress (2nd digit) |
| ❼ | QA label | |

# 5.2 Device Designation

e.g.**0362170DB** **3.000**
Device type Device version






### Device version X.XXX

Serial counter. If no version is existent, 0.000 is indicated here. If a device is exchanged by a device of another version, please contact SIEB & MEYER to check whether the devices are compatible or not.

In addition the device version indicates the update capability of the internal device software, e.g. BIOS, FPGA or Firmware.

## 5.3 Functional Overview of the Device Variants

The following tables show the properties and the supported drive function of the devices SD2B and SD2B plus.

| General properties | | SD2B (0362170DB) | SD2B plus (0362171DB) |
|---|---|---|---|
| Max. output power S1[1] | | 660 VA | 940 VA |
| Mains supply: External DC power supply | | ✓ | ✓ |
| DC link: fix[2] | | ✓ | ✓ |
| Interfaces | X9 (I/O) | ✓ | – |
| | X11 (USB) | – | ✓ |
| | X14 (I/O, safety) | – | ✓ |
| | X15/X16 (encoder 0/1) | – | ✓ |

[1] The maximum output power S1 applies at a voltage supply of 80 $V_{DC}$.

[2] The fix DC voltage supply depends on the used external power supply unit.

| Drive function (up to … kHz output frequency) | | | SD2B (0362170DB) | SD2B plus (0362171DB) |
|---|---|---|---|---|
| SERVO / VECTOR | SERVO | | – | ✓ (up to 2 kHz) |
| | SVC | | ✓ (up to 2 kHz) | ✓ (up to 2 kHz) |
| HSBLOCK / FPAM | HSBLOCK (with sensor) | PWM (Hall) | – | ✓ (up to 6 kHz) |
| | | PAM (Hall) | – | – |
| | FPAM (sensorless) | | – | – |
| HSPWM | | | – | – |
| HSPAM / VF | VF-PWM | | ✓ (up to 2 kHz) | ✓ (up to 2 kHz) |
| | VF-PAM | | – | – |

# 6 Device variant SD2B

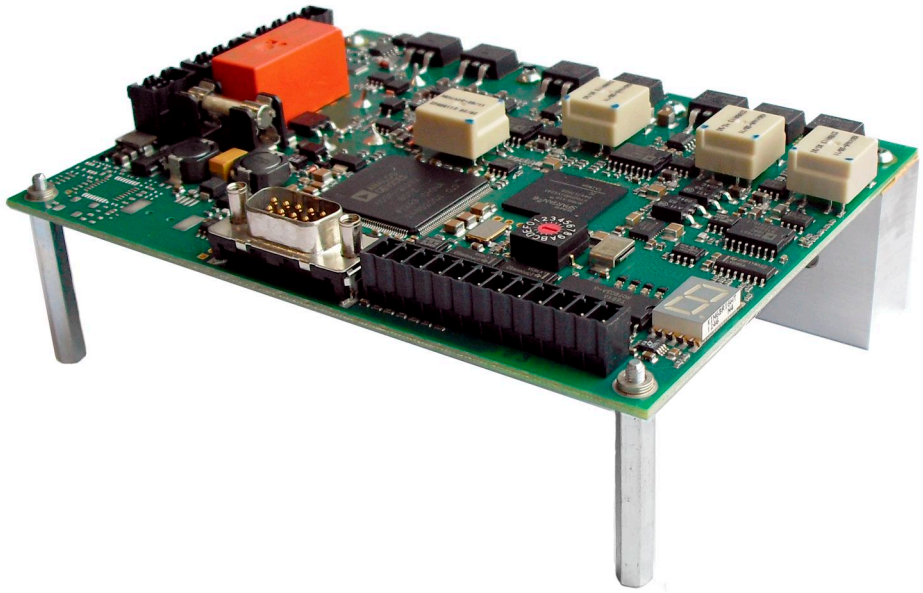


*Fig. 2: Device view of SD2B (0362170DB)*



## 6.1 Operating Instructions

With its single-board design the device is to be integrated into the customer's electrical construction on a sufficient cooling surface.

**DANGER**

**Operating voltages above 48 V**

In order to avoid personal injuries provide for protection against contact when operating voltages above 48 V are reached (e.g. install the device in a switch cabinet).

**WARNING**

**Hot surfaces**

During operation the heat sink and components can reach temperatures above 80 °C.

Do not touch the device during operation.

Make sure that there are no combustible materials near by the device and that the heat sink is not covered during mounting and operation.

Take measures to protect the device against contamination, in particular due to conductive or aggressive materials. Contamination can cause malfunctions and short-circuits.

## 6.2 Block Diagram

The following block diagram shows the functional groups and connection options of the device.

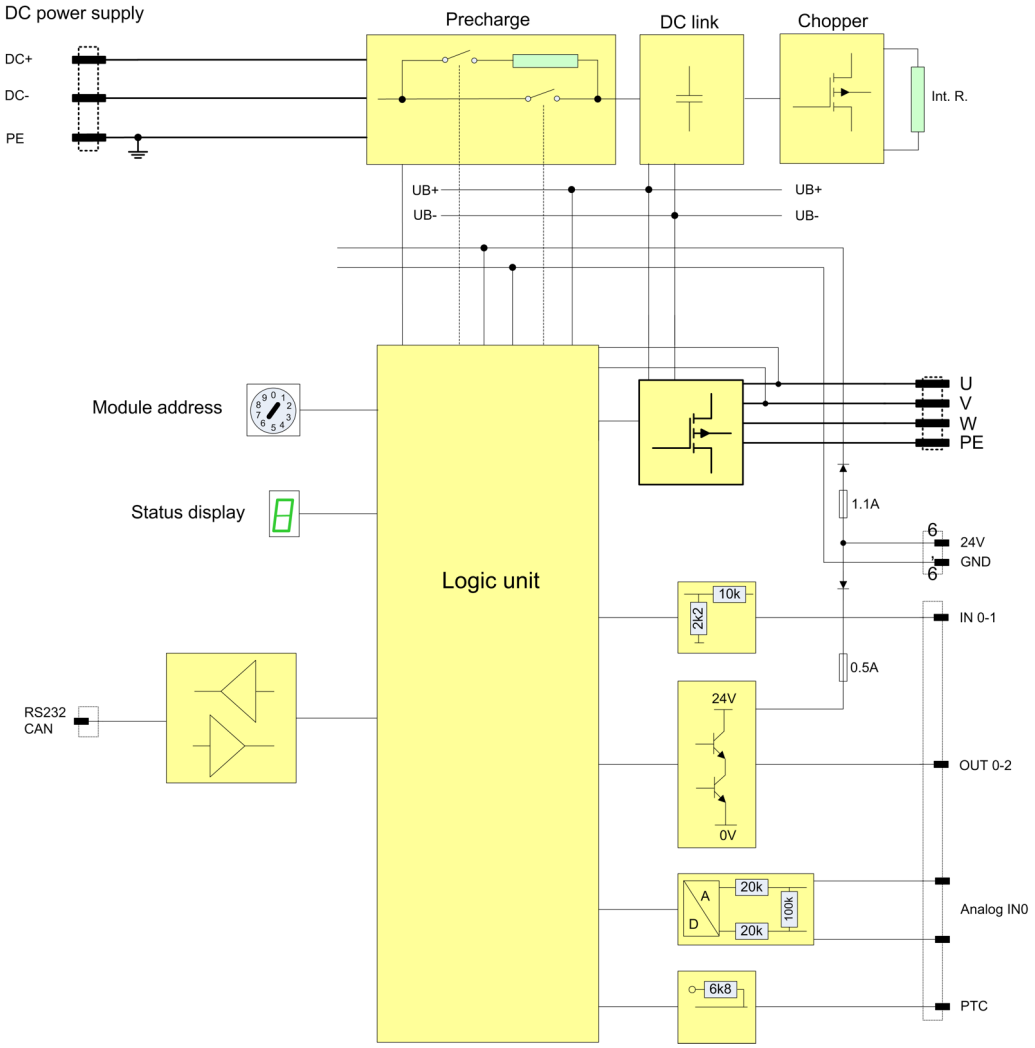



*Fig. 3: Block diagram SD2B*

# 6.3 Dimensions/Mounting

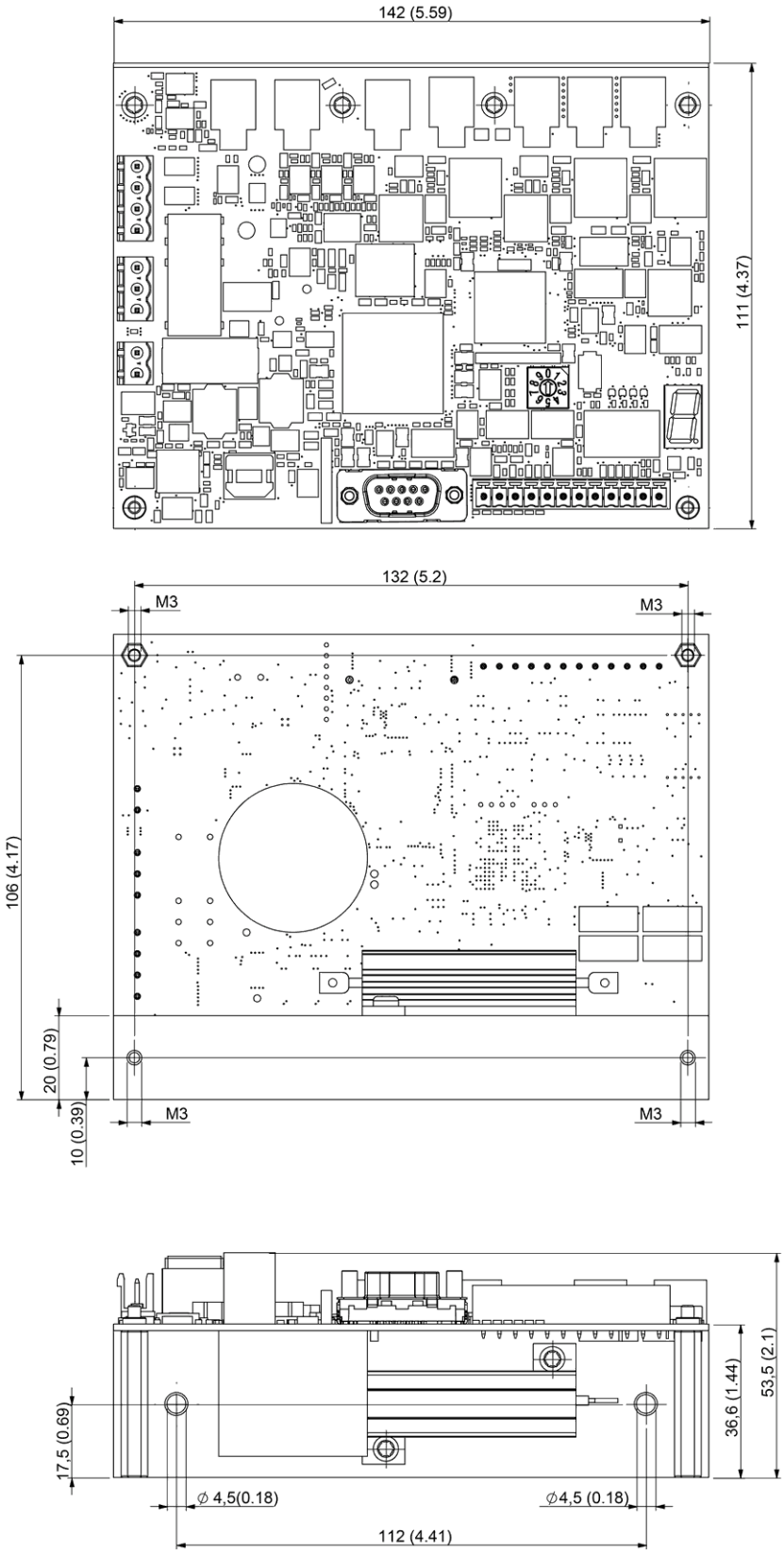



*Fig. 4: Dimensions SD2B in mm (inch)*

- vertical mounting at spacers and heat sink: 4 M3 bolts
- wall mounting at heat sink: 2 M4 bolts

# 6.4 Technical Data

| Device variant | | 0362170DB | | |
|---|---|---|---|---|
| **Parameterized supply voltage(1)** | | **24 $V_{DC}$** | **48 $V_{DC}$** | **80 $V_{DC}$** |
| Continuous phase current of output stage (±3 %) | | 7 $A_{rms}$ (when mounted to cooling surface of the installation)(2) | | |
| Peak phase current of output stage (±3 %) | | 10 $A_{rms}$ (when mounted to cooling surface of the installation)(2) | | |
| Max. time for peak current | | 10 s | | |
| Max. output frequency | | 2000 Hz | | |
| Output frequency stability | | ≤ 0.2 % | | |
| Supply voltage(3) | | 24 $V_{DC}$ (-10 %) to 24 $V_{DC}$ (+15 %) | 24 $V_{DC}$ (-10 %) to 48 $V_{DC}$ (+15 %) | 24 $V_{DC}$ (-10 %) to 80 $V_{DC}$ (+15 %) |
| Output voltage | | 16 $V_{AC}$ | 33 $V_{AC}$ | 55 $V_{AC}$ |
| Output power *S* | *S* at $I_{rated}$ (7 $A_{rms}$) | 190 VA | 390 VA | 660 VA |
| | *S* at $I_{rated}$ (10 $A_{rms}$) | 270 VA | 550 VA | 940 VA |
| Logic supply(4) | | 18 – 28 $V_{DC}$ (0.5 A) | | |
| Internal ballast resistor | | 22 Ω / 50 W | | |
| Maximum braking power | | 50 W | 200 W for 5 s | 450 W for 2 s |
| Ballast threshold | | 35 $V_{DC}$ | 65 $V_{DC}$ | 100 $V_{DC}$ |
| Overvoltage threshold | | 40 $V_{DC}$ | 70 $V_{DC}$ | 110 $V_{DC}$ |
| Undervoltage threshold | | 15 $V_{DC}$ | | |
| Ambient temperature range | | 5 °C to 50 °C at a maximum relative humidity of 85 % (without moisture condensation)<br>100 % rated current up to max. 40 °C. At higher temperatures the power must be reduced by 1.5 % per 1 °C. | | |
| IP Code | | IP00 | | |

(1) Adjustable via software *drivemaster2* : from device version 4.100 and software version 1.14.100 onwards For SD2B / SD2B plus with a device version < 4.100 the column **80 $V_{DC}$** applies. Device version 4.0xx can be reconfigured to reach version 4.100, see “TIE_SD2B_AdjustableSupplyVoltage.pdf”.

(2) Minimum size of cooling surface: 6 dm² (natural convection)

(3) Admissible voltage ripple: max. 10 %
The supply voltage is protected by a fuse on the device: 10 A medium slow (5 × 20 mm)

(4) The logic voltage is necessary to maintain the error messages. It is protected by an electronic fuse on the device.

**NOTICE**

**Voltage peaks during braking operation**

During braking of high inertial masses and/or when using short braking times the DC main voltage can increase significantly depending on the parameterized supply voltage.

- supply voltage 24 $V_{DC}$ → max. overvoltage 40 $V_{DC}$
- supply voltage 48 $V_{DC}$ → max. overvoltage 70 $V_{DC}$
- supply voltage 80 $V_{DC}$ → max. overvoltage 110 $V_{DC}$

The connected power supply unit must be designed for this voltage. If not, you need to decouple the main voltage by means of a blocking diode to avoid damage to the power supply unit (see connection example page 48).

## 6.5 Connectors



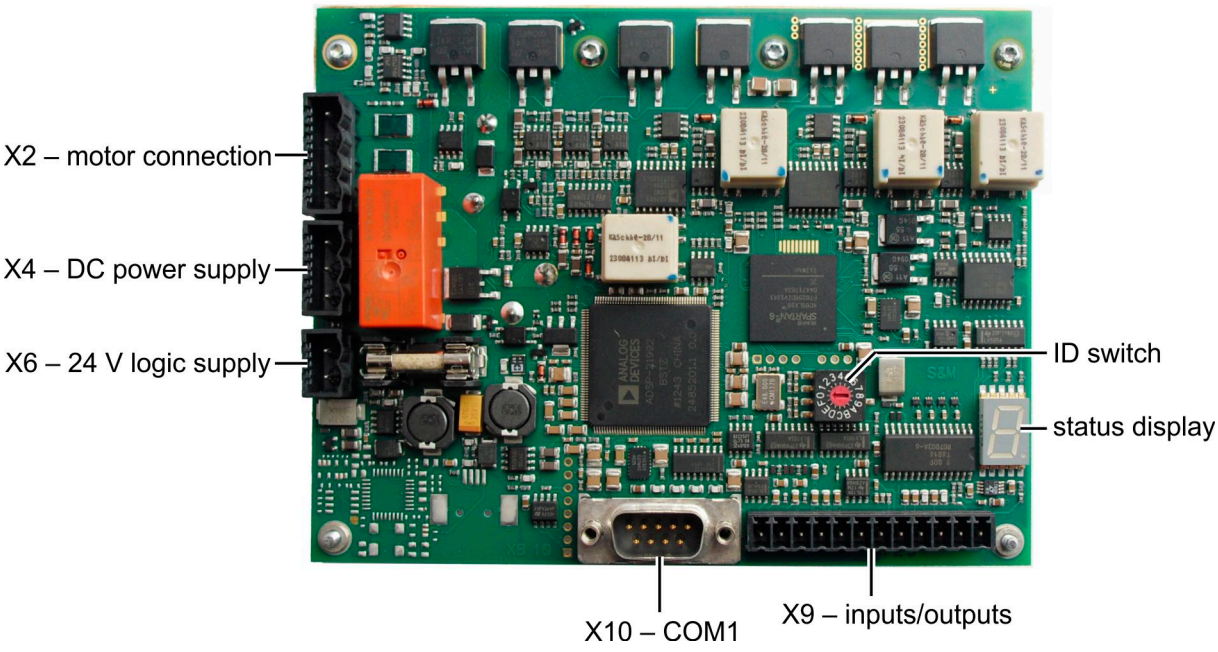



*Fig. 5: Connectors of SD2B (top view)*

You can order the appropriate connector kit for SD2B at SIEB & MEYER (article No. 32299576).

6

# 7 Device variant SD2B plus


*Fig. 6: Device view of SD2B plus (0362171DB)*

## 7.1 Block Diagram

The following block diagram shows the functional groups and connection options of the device.

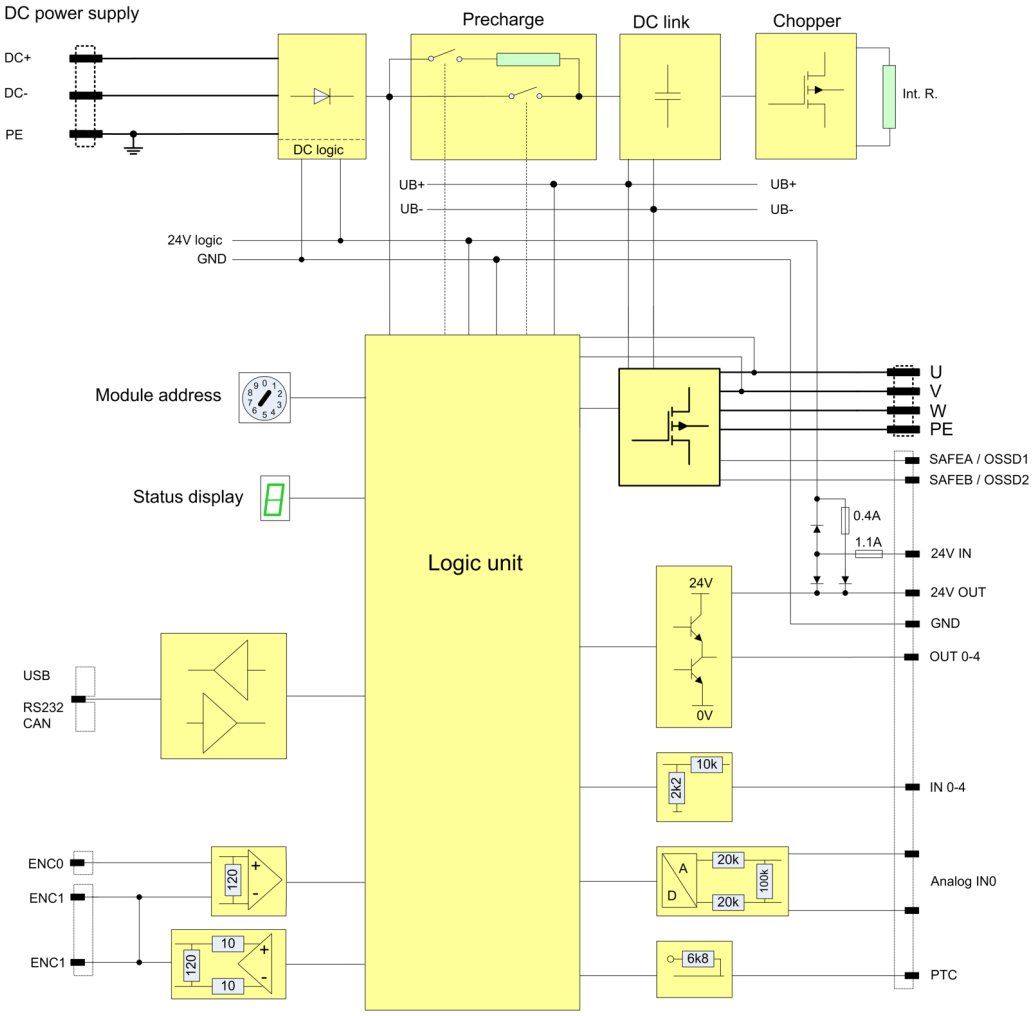



*Fig. 7: Block diagram SD2B plus*

# 7.2 Dimensions/Mounting

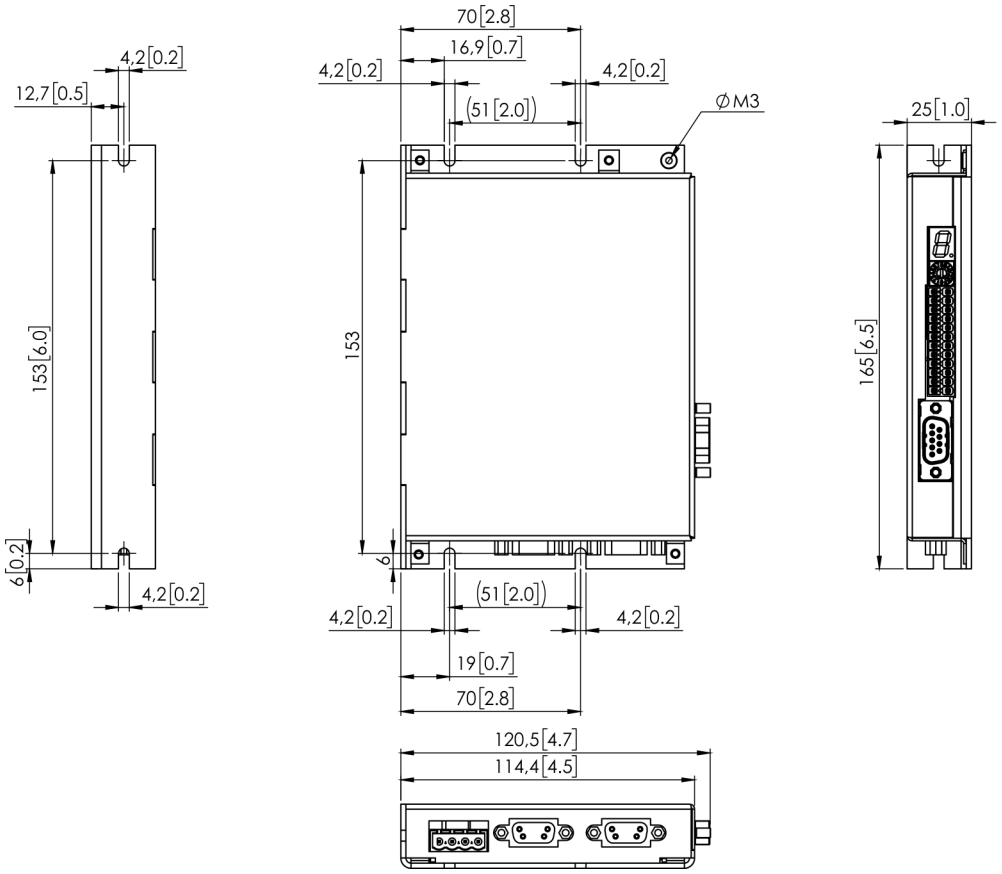



*Fig. 8: Dimensions SD2B plus in mm [inch]*

### Mounting Instructions

- The device is mounted horizontally or vertically to a mounting wall. The mounting surface is used for cooling.
- The mounting surface must be able to dissipate a heat output of 25 W at a housing temperature of 60 °C for each device.
- With vertical mounting several device can be mounted next to each other without any space in-between.

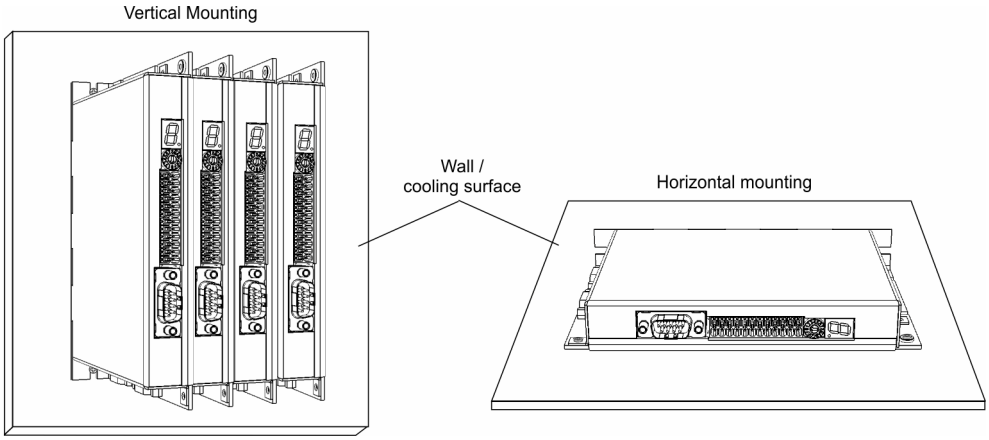



*Fig. 9: Mounting options*

# 7.3 Technical Data

| Device variant | | 0362171DB | | |
|---|---|---|---|---|
| **Parameterized supply voltage(1)** | | **24 $V_{DC}$** | **48 $V_{DC}$** | **80 $V_{DC}$** |
| Continuous phase current of output stage (±3 %) | | 10 $A_{rms}$ (when mounted to cooling surface of the installation)(2) | | |
| Peak phase current of output stage (±3 %) | | 12 $A_{rms}$ (when mounted to cooling surface of the installation)(2) | | |
| Max. time for peak current | | 10 s | | |
| Max. output frequency | | 2000 Hz | | |
| Output frequency stability | | ≤ 0.2 % | | |
| Supply voltage(3) | | 24 $V_{DC}$ (-10 %) to 24 $V_{DC}$ (+15 %) | 24 $V_{DC}$ (-10 %) to 48 $V_{DC}$ (+15 %) | 24 $V_{DC}$ (-10 %) to 80 $V_{DC}$ (+15 %) |
| Output voltage | | 16 $V_{AC}$ | 33 $V_{AC}$ | 55 $V_{AC}$ |
| Output power *S* | *S* at $I_{rated}$ (10 $A_{rms}$) | 270 VA | 560 VA | 940 VA |
| | *S* at $I_{rated}$ (12 $A_{rms}$) | 330 VA | 680 VA | 1140 VA |
| Logic supply(4) | | 18 – 28 $V_{DC}$ (0.5 A) | | |
| Internal ballast resistor | | 22 Ω / 50 W | | |
| Maximum braking power | | 50 W | 200 W for 5 s | 450 W for 2 s |
| Ballast threshold | | 35 $V_{DC}$ | 65 $V_{DC}$ | 100 $V_{DC}$ |
| Overvoltage threshold | | 40 $V_{DC}$ | 70 $V_{DC}$ | 110 $V_{DC}$ |
| Undervoltage threshold | | 15 $V_{DC}$ | | |
| Max. power loss | | 25 W | | |
| Ambient temperature range | | 5 °C to 50 °C at a maximum relative humidity of 85 % (without moisture condensation)<br>100 % rated current up to max. 40 °C. At higher temperatures the power must be reduced by 1.5 % per 1 °C. | | |
| IP Code | | IP20 | | |

(1) Adjustable via software *drivemaster2* : from software version 1.14.100 onwards

(2) Minimum size of cooling surface: 6 dm² (natural convection)

(3) Admissible voltage ripple: max. 10 %

(4) The logic voltage is necessary to maintain the error messages. It is protected by an electronic fuse on the device.

# 7.4 Connectors

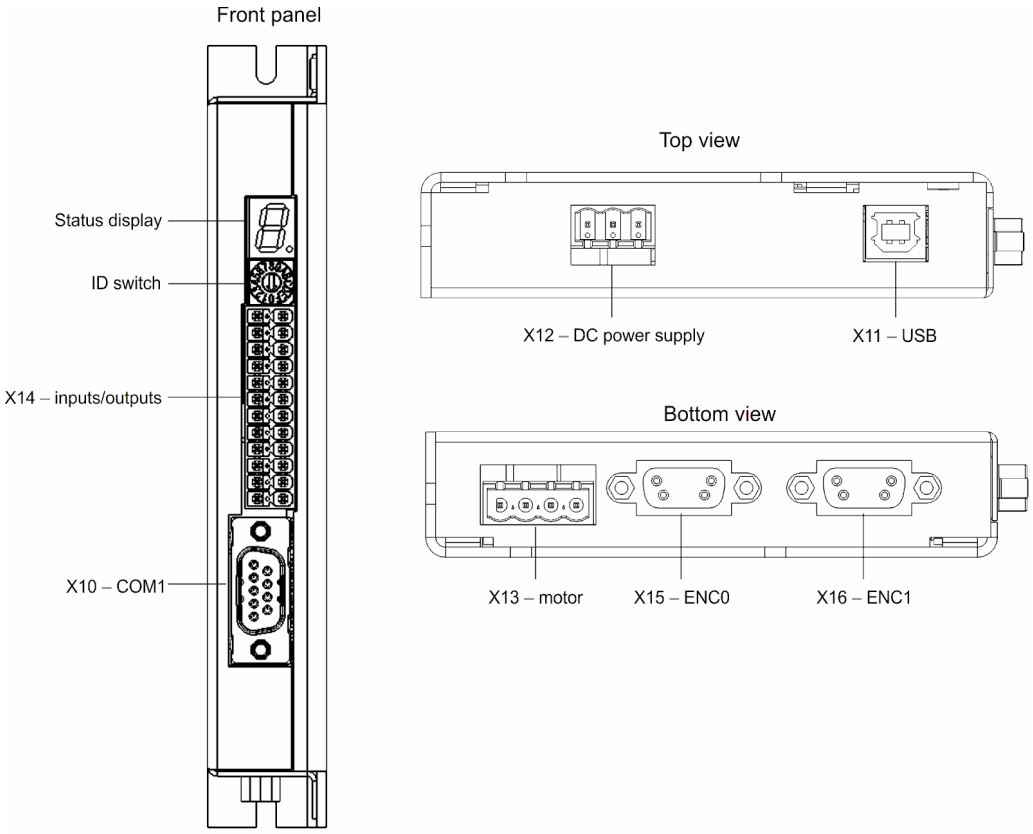



*Fig. 10: Connectors of SD2B plus*

You can order the appropriate connector kit for SD2B plus at SIEB & MEYER (article No. 32299587).

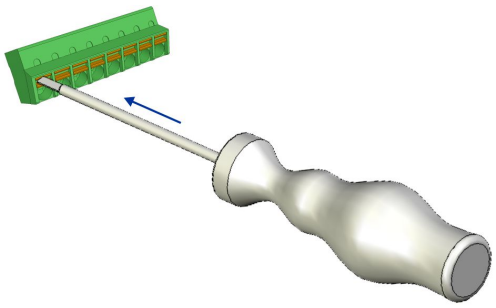
# 8 Connector Pin Assignment

## 8.1 Operation of the Terminal Connectors

### 8.1.1 Spring-cage Connection

The individual conductors are fixed in the terminal by means of spring-cage connection. In order to plug and unplug a conductor proceed as follows:

- Push a screwdriver into the designated groove above the chamber to operate the spring-cage connection as shown in the figure.
- Put the conductor into the chamber / remove the conductor from the chamber.
- Release the screwdriver.



Solid wires or conductors with ferrules can be put directly into the chamber without the help of a screwdriver.

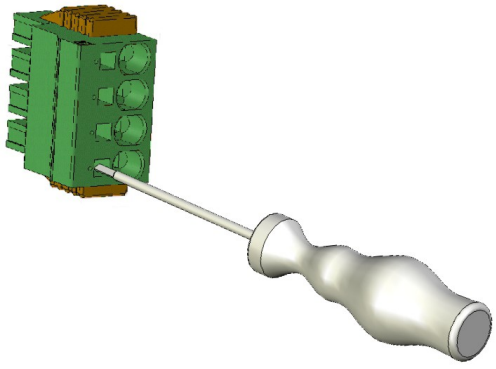


### 8.1.2 Push-in Technology

Terminals using the push-in connection technology (PIT) work on the pressure spring principle:

The contact spring presses the cable against the conducting copper bar. The special spring profile allows direct and tool-free wiring of solid and stranded cables previously assembled with ferrule or compressed conductor ends.

- When the cable is inserted into the clamping unit the spring opens automatically.
- To open the clamp and loosen the cable use a screw driver.



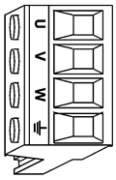
## 8.2 ID switch

⇨ Set the address for the module by means of the address selection switch.
16 adresses are available: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

The addresses of several devices in a system must be different from each other to ensure that they can be identified by the software.

## 8.3 X2 – Motor Connection

4-pole Combicon connector, suitable for mating connector MSTB 2,5/ 4-ST-5,08 (Phoenix)

| Mating connector X2 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
|  | 1 | O | U | Motor phase U |
| | 2 | O | V | Motor phase V |
| | 3 | O | W | Motor phase W |
| | 4 | | PE | Protective conductor |

Specification of terminal connections
- Conductor cross-section solid/stranded: 0.75 – 2.5 mm²
- Tightening torque: 0.5 – 0.6 Nm

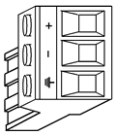
**Related topics**

Connection example: "X2/X13 – Motor Phases", page 47

## 8.4 X4 – DC Power Supply



3-pole Combicon connector, suitable for mating connector MSTB 2,5/ 3-ST-5,08 (Phoenix)

| Mating connector X4 | Pin | Name | Meaning |
|---|---|---|---|
|  | 1 | DC+ | DC power supply + |
| | 2 | DC− | DC power supply − |
| | 3 | PE | Protective conductor |

Voltage range: 24 to 80 $V_{DC}$, voltage ripple max. 10 %

Specification of terminal connections
- Conductor cross-section solid/stranded: 0.75 – 2.5 mm²
- Tightening torque: 0.5 to 0.6 Nm

**NOTICE**

**Wiring error**

To prevent wiring errors and subsequent damage to the device you must always wire all pins (incl. pin 2 / DC−) with adequate conductor cross-section.

**NOTICE**

**Voltage peaks during braking operation**

During braking of high inertial masses and/or when using short braking times the DC main voltage can increase significantly depending on the parameterized supply voltage.

- supply voltage 24 $V_{DC}$ → max. overvoltage 40 $V_{DC}$
- supply voltage 48 $V_{DC}$ → max. overvoltage 70 $V_{DC}$
- supply voltage 80 $V_{DC}$ → max. overvoltage 110 $V_{DC}$

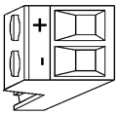
The connected power supply unit must be designed for this voltage. If not, you need to decouple the main voltage by means of a blocking diode to avoid damage to the power supply unit (see connection example page 48).

**Related topics**

Connection example: "X4/X6 – DC Power Supply Unit", page 48

## 8.5 X6 – Logic Supply

2-pole Combicon connector, suitable for mating connector MSTB 2,5/ 2-ST-5,08 (Phoenix)

| Mating connector X6 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
|  | 1 | I | +24V | Logic supply +24 $V_{DC}$ (0.5 A) |
| | 2 | I/O | GND | Ground<br>Always connect GND. |

Voltage range: 24 $V_{DC}$, voltage ripple max. 10 %

Specification of terminal connections

- Conductor cross-section solid/stranded: 0.2 to 2.5 mm²
- Tightening torque: 0.5 to 0.6 Nm

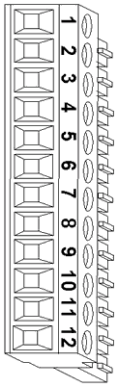
**Related topics**

Connection example: "X4/X6 – DC Power Supply Unit", page 48

## 8.6 X9 – Inputs/Outputs

The available functions of the inputs and outputs are different depending on the drive function. You must set the desired function for each input/output in the software *drive-master2*.

12-pole Mini-Combicon connector, suitable for mating connector MC 1,5/ 12-ST-3,81 (Phoenix)

| Mating connector X9 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
|   | 1 | I | IN0 | Digital 24 $V_{DC}$ input |
| | 2 | I | IN1 | |
| | 3 | O | OUT0 | Digital output(1)<br>▸ low-side driver: max. 500 mA, max. 40 V<br>▸ high-side driver: max. 100 mA |
| | 4 | O | OUT1 | |
| | 5 | O | OUT2 | |
| | 6 | O | VCC_10 | 10 V voltage supply for analog input |
| | 7 | I/O | GND | Ground |
| | 8 | I | Temp | Temperature sensor of the motor (against GND) |
| | 9 | I | AIN0+ | ±10 V analog input |
| | 10 | I | AIN0− | Reference point of AIN0+ (pin 9) |
| | 11 | I/O | GND | Ground |
| | 12 | I/O | GND | Ground |

(1) You can set the desired type of the output driver in the software *drivemaster2*.

Specification of terminal connections
- Conductor cross-section solid/stranded: 0.14 to 1.5 mm²
- Tightening torque: 0.22 to 0.25 Nm

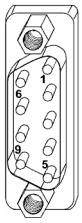
**Related topics**

Connection examples: "X9 – Inputs/Outputs", page 49

Connection example: "X9/X14 – Temperature Sensor of the Motor", page 50

## 8.7 X10 – COM1 / Operating Terminal

9-pole male submin D connector

| X10 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
|   | 1 | O | VCC | 5.3 V (power supply for optional operating terminal, short-circuit proof) |
| | 2 | I | RX | Receive data |
| | 3 | O | TX | Transmit data |
| | 4 | I/O | CAN_L | CAN_L |
| | 5 | I/O | GND | Ground |
| | 6 | I | RX2 | Receive data 2 |
| | 7 | O | TX2 | Transmit data 2 |
| | 8 | I/O | CAN_H | CAN_H |
| | 9 | I/O | GND | Ground |

Stud bolt flange: max. tightening torque = 0.7 Nm

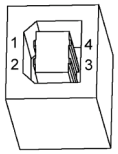
**Related topics**

Connection examples: "X10 – Bus Connection", page 51

## 8.8 X11 – USB

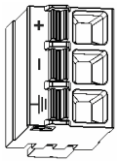
Communication interface to the connected PC

4-pole female USB connector, type B

| X11 | Pin | I/O | Name | Description |
|---|---|---|---|---|
|  | 1 | - | VCC | 5 V voltage supply for USB |
| | 2 | I/O | DN | Data− |
| | 3 | I/O | DP | Data+ |
| | 4 | I/O | GND | Ground |

## 8.9 X12 – DC Power Supply

3-pole Combicon connector, suitable for mating connector FKCN 2,5/ 3-ST-5,08 (Phoenix)

| Mating connector X12 | Pin | Name | Meaning |
|---|---|---|---|
|  | 1 | DC+ | DC power supply + |
| | 2 | DC− | DC power supply − |
| | 3 | PE | Protective conductor |

Voltage range: 24 to 80 $V_{DC}$, voltage ripple max. 10 %

Specification of terminal connections
- Conductor cross-section solid: 1 to 1.5 mm²
- Conductor cross-section stranded: 1 to 2.5 mm²
- Connection method: push-in spring connection (handling: see page 39)

**NOTICE**

**Wiring error**

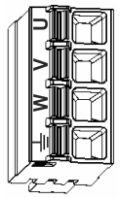
To prevent wiring errors and subsequent damage to the device you must always wire all pins (incl. pin 2 / DC−) with adequate conductor cross-section.

**Related topics**

Connection example: "X12/X14 – DC Power Supply Unit", page 53

## 8.10 X13 – Motor Connection

4-pole Combicon connector, suitable for mating connector FKCN 2,5/ 4-ST-5,08 (Phoenix)

| Mating connector X13 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
|  | 1 | O | U | Motor phase U |
| | 2 | O | V | Motor phase V |
| | 3 | O | W | Motor phase W |
| | 4 | | PE | Protective conductor |

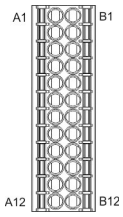
Specification of terminal connections
- Conductor cross-section solid: 1 – 1.5 mm²
- Conductor cross-section stranded: 1 – 2.5 mm²
- Connection method: push-in spring connection (handling: see page 39)

**Related topics**

Connection example: "X2/X13 – Motor Phases", page 47

## 8.11 X14 – Inputs/Outputs / Safety Circuit (STO)

2 ×12-pole Mini-Combicon connector, suitable for mating connector DFMC 1.5/12-ST-3.5 (Phoenix)

| Mating connector X14 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
|  | A1 | I/O | GND | Ground |
| | A2 | I | 24V IN | Logic feed-in 24 V |
| | A3 | O | 24V OUT(1) | Logic supply 24 V |
| | A4 | O | 24V OUT(1) | Logic supply 24 V |
| | A5 | I | SAFE B / OSSD2 | Enable of the safety circuit<br>▸ Permanent load approx. 15 mA/24 V<br>▸ Startup peak current is negligible under normal conditions. |
| | A6 | I | SAFE A / OSSD1 | Enable of the safety circuit<br>▸ Continous load at 24 V > 160 mA/24 V, dependent on the device performance<br>▸ Startup peak current per device can exceed 8 A/24 V during the first 2 ms. |
| | A7 | I/O | GND | Ground |
| | A8 | O | OUT4 | Digital output |
| | A9 | O | OUT3 | Digital output |
| | A10 | O | OUT2 | Digital output |
| | A11 | O | OUT1 | Digital output |
| | A12 | O | OUT0 | Digital output |
| | B1 | I/O | GND | Ground |
| | B2 | I/O | GND | Ground |

| Mating connector X14 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
| | B3 | I | A IN− | Reference point for AIN+ (pin B4) |
| | B4 | I | A IN+ | Analog input |
| | B5 | I | VCC10 | 10 V supply voltage |
| | B6 | I | TEMP | Motor temperature (to be connected towards GND) |
| | B7 | I/O | GND | Ground |
| | B8 | I | IN4 | Digital input |
| | B9 | I | IN3 | Digital input |
| | B10 | I | IN2 | Digital input |
| | B11 | I | IN1 | Digital input |
| | B12 | I | IN0 | Digital input |

(1) The 24 V output is not suited to supply external safety circuits because an external voltage source is necessary to comply with the applicable standards.

The power supply unit is only activated when SAFE A and SAFE B are connected. If the safety function is not required, pin A5 and pin A6 must be bridged to pin A4.

Specification of terminal connections
- Conductor cross-section solid/stranded: 0.2 to 1.5 mm²
- Connection method: spring-cage connection (handling: see page 39)

**Related topics**

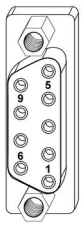
Connection examples: "X14 – In/Out / STO", page 53
Connection example: "X9/X14 – Temperature Sensor of the Motor", page 50
Connection example: "X12/X14 – DC Power Supply Unit", page 53
Safety function STO: "Safety Circuit / Restart Lock (STO)", page 75



## 8.12 X15 – Encoder 0

Encoder 0 input, e.g. for length measuring systems

9-pole female submin D connector

| X15 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
|  | 1 | I | UA+ | Track A+ |
| | 2 | I | UA- | Track A- |
| | 3 | I | UN+ | Zero pulse+ |
| | 4 | I | UN- | Zero pulse- |
| | 5 | I/O | GND | Ground |
| | 6 | I | UB+ | Track B+ |
| | 7 | I | UB- | Track B- |
| | 8 | O | VCC_ENC | 5.3 V supply voltage |
| | 9 | I | ERR | Measuring system error |

Stud bolt flange: max. tightening torque = 0.7 Nm

**Related topics**

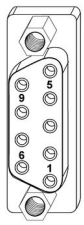
Connection example: "X15, X16 – Incremental Encoder with TTL Signals", page 56

## 8.13 X16 – Encoder 1 / Encoder Emulation

Encoder 1 input and encoder emulation output e.g. for depth measuring systems

Hall sensor input (5.3 V), PULSE IN (5.3 V)

9-pole female submin D connector

| X16 | Pin | I/O | Name | Meaning |
|---|---|---|---|---|
|  | 1 | I/O | UA+ | Track A+ |
| | 2 | I/O | UA- | Track A- |
| | 3 | I/O | UN+ | Zero pulse+ |
| | 4 | I/O | UN- | Zero pulse- |
| | 5 | I/O | GND | Ground |
| | 6 | I/O | UB+ | Track B+ |
| | 7 | I/O | UB- | Track B- |
| | 8 | O | VCC_ENC | 5.3 V supply voltage |
| | 9 | I | ERR | Measuring system error |

Stud bolt flange: max. tightening torque = 0.7 Nm

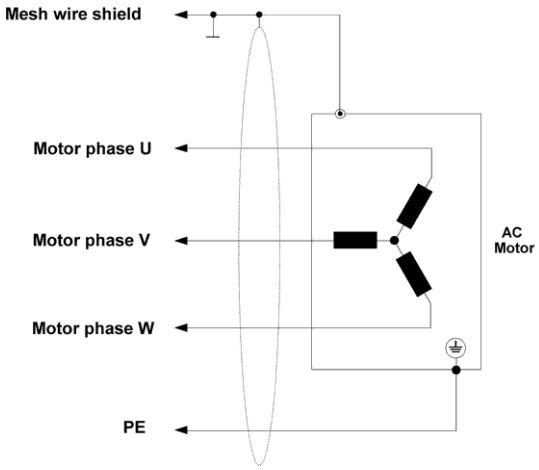
**Related topics**

Connection example: "X15, X16 – Incremental Encoder with TTL Signals", page 56
Connection example: "Encoder Emulation", page 57
Connection example: "Hall Sensor 5.3 V", page 58
Connection example: "PULSE IN 5.3 V", page 58

# 9 Connection Examples

The following sections provide connection examples for the individual connectors of the device.

## 9.1 X2/X13 – Motor Phases




Ground the motor housing in the machine!

**DANGER**

**Dangerous shock currents**

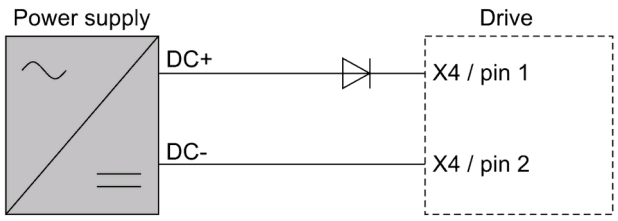
Earthing and shielding measures are required to protect devices and persons. To ensure the safety of the operator earthing must be carried out with low impedance. With respect to the ground connection one of the following actions must be done:

- connect the motor housing to the ground of the machine or
- connect the ground terminal of the motor connector to the central ground point of the machine.

Consider the following with regard to shielding: Always use shielded motor cables!

## 9.2 X4 – Decoupling of the Main Voltage

Decoupling of the main voltage by means of a blocking diode:

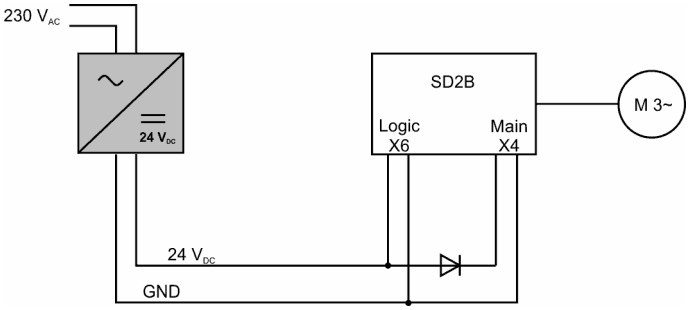



You can order the appropriate blocking diode module at SIEB & MEYER (article No. 036210082). For a description of the module and more connection examples refer to the technical information “TIE_036210082_Blocking-Diode_SD2B.pdf”.

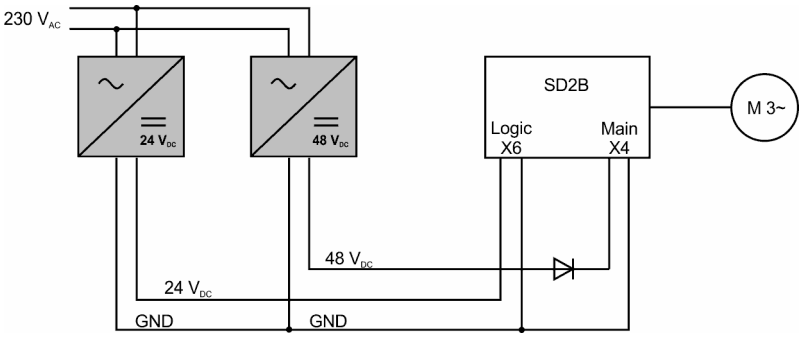
## 9.3 X4/X6 – DC Power Supply Unit

The following examples show different options for the connection of the power supply unit to SD2B for main and logic supply.

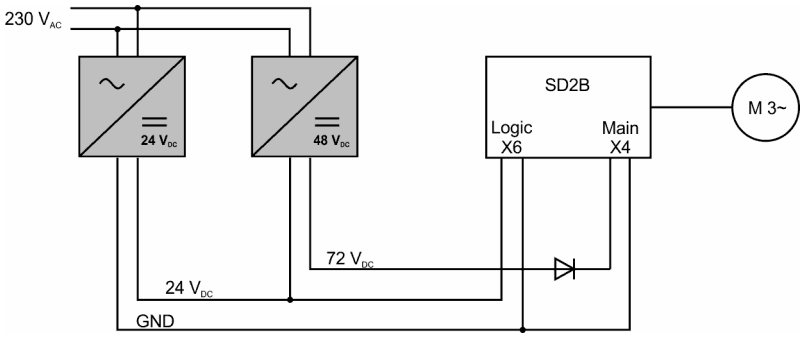
Setup 1: 24 $V_{DC}$ logic and main voltage supply (one power supply unit)




Setup 2: 24 $V_{DC}$ logic supply and 48 $V_{DC}$ main voltage supply (two power supply units)



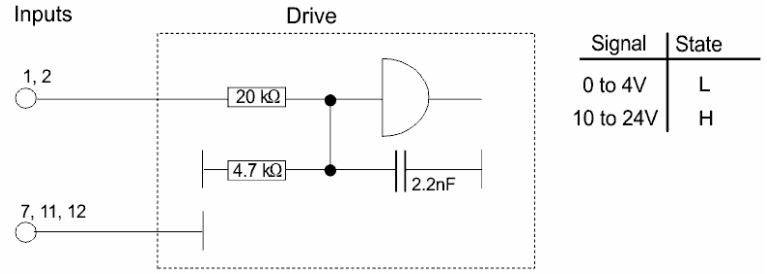
Setup 3: 24 $V_{DC}$ logic supply and 72 $V_{DC}$ main voltage supply (two power supply units connected in series)




# 9.4 X9 – Inputs/Outputs

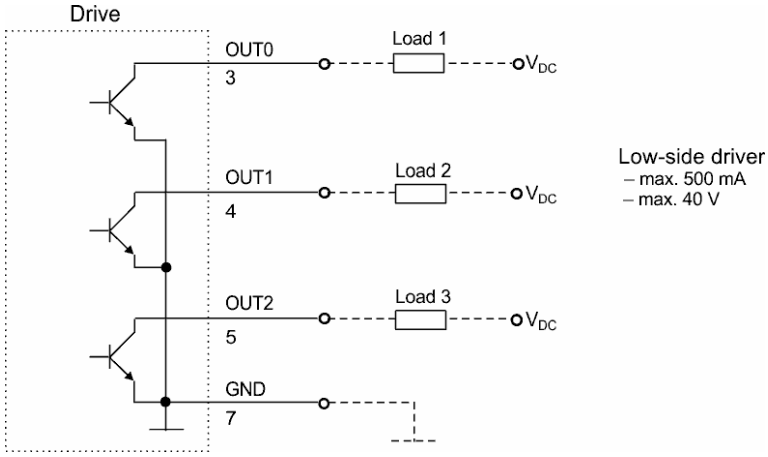
## 9.4.1 Digital Inputs

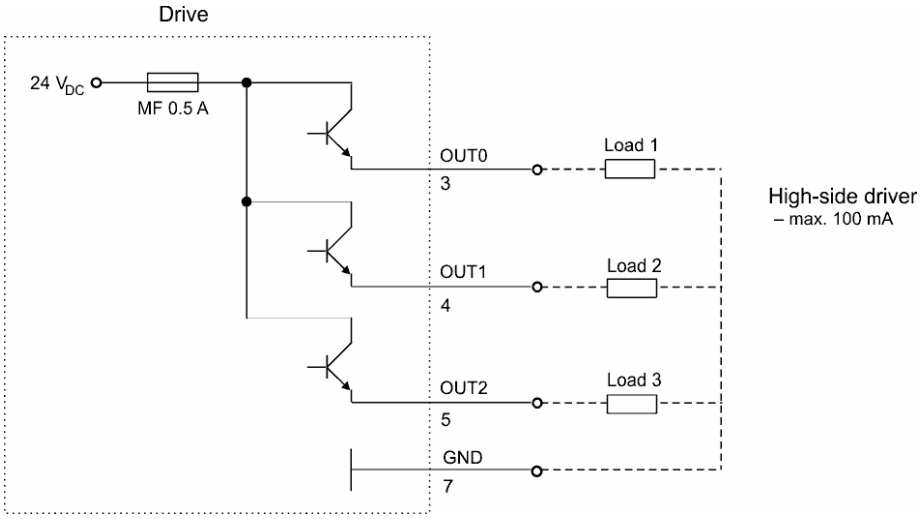
The meanings of the digital inputs can be defined by parameters.



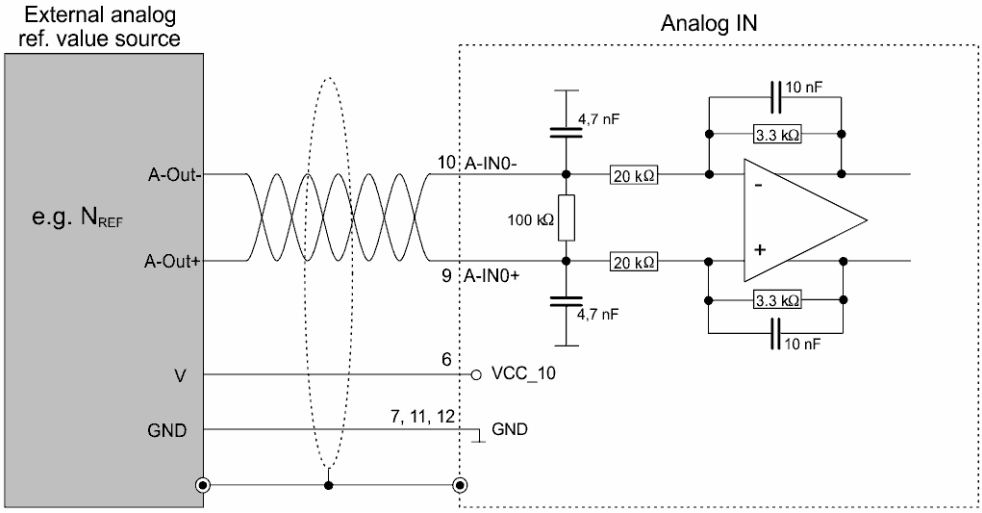

## 9.4.2 Digital Outputs

The output driver can operate as low-side driver or as high-side driver. You can set the desired driver type in the software *drivemaster2*.






## 9.4.3 Analog Input




Voltage interface with input voltage range: ±10 V

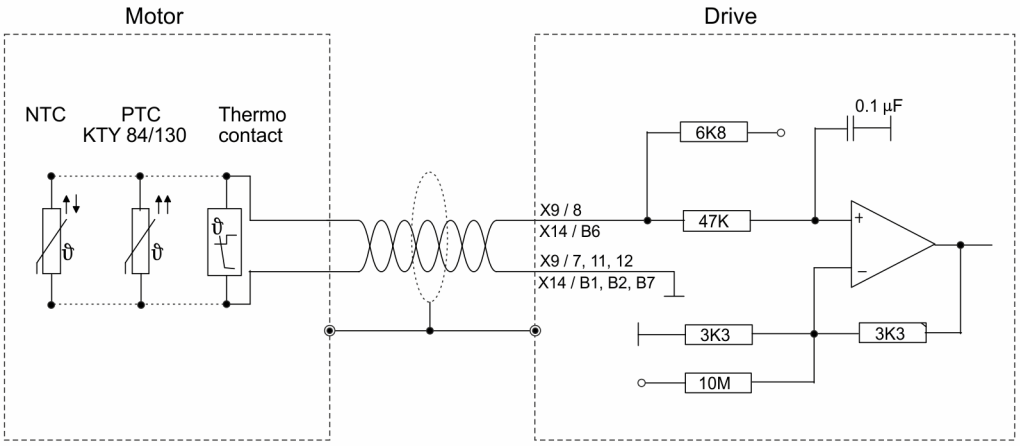
Can also be connected to potentiometer (500 Ω – 5 kΩ)

# 9.5 X9/X14 – Temperature Sensor of the Motor

INPUT/OUTPUT: The thermal motor protection is evaluated via these connectors.

The drive amplifier supports evaluating the temperature monitoring integrated in the motor. The NTC/PTC behavior of the monitoring is defined in the software (motor parameters). The controller is deactivated as soon as the critical motor temperature is reached.

You can configure “None”, “PTC / Thermo switch”, “NTC”, “KTY84/130”, “KTY83/122” and “PT1000”.

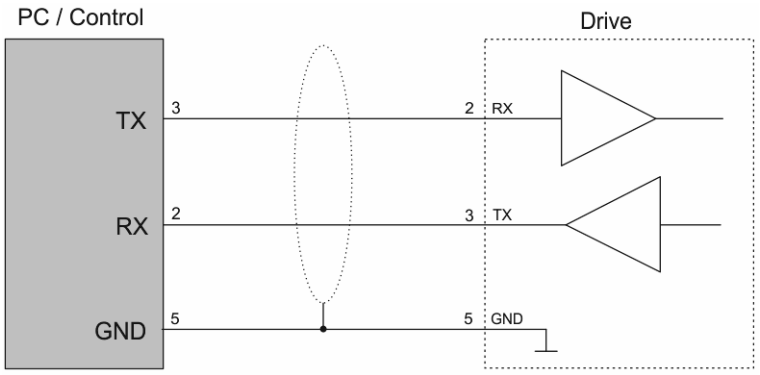



The temperature sensor must have an internal resistor between 250 Ω and 2 kΩ.

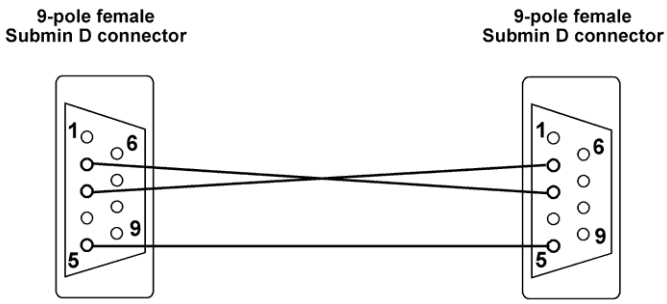
If no motor temperature sensor is connected, the input must be connected with GND.

## 9.6 X10 – Bus Connection

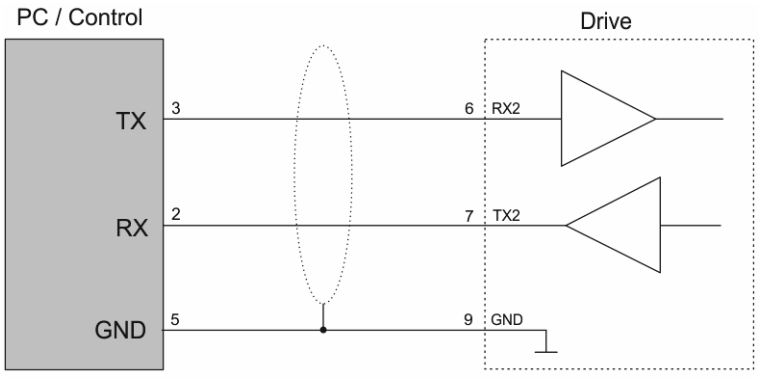
### 9.6.1 COM1 – RS232




If you connect X10 to a standard RS232 interface of a PC (9-pole male submin D connector), the used cable must look like this:

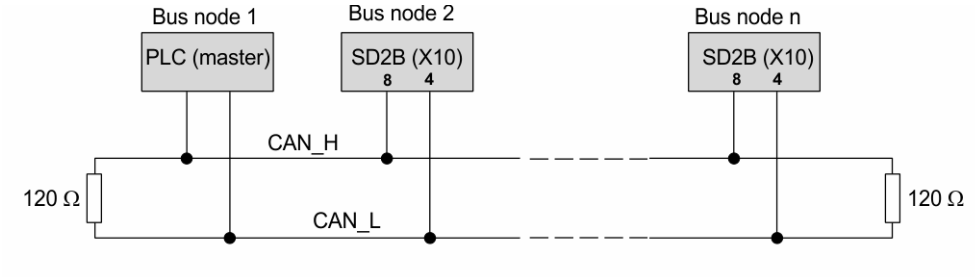


Additional RS232 connection available:




## 9.6.2 CAN Bus

The CAN interface is designed according to ISO 11898. It is a two-wire connection with differential signals. ISO 11898 specifies a bus cable with two signal lines, CAN_H and CAN_L. The lines have a rated impedance of 120 Ohm. The signal lines are connected to a terminating resistor (120 Ohm) at both ends of the bus cable (see figure).

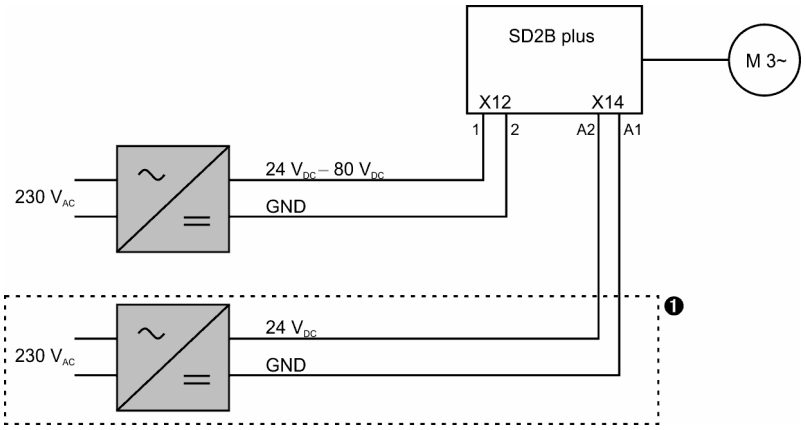



The total length of the bus cable must not exceed the specified lengths. The following table indicates physical limitations valid for specific transmission rates:

| Baud rate | Max. bus length |
|---|---|
| 50 kBd | 1000 m |
| 125 kBd | 500 m |
| 250 kBd | 250 m |
| 500 kBd | 100 m |
| 1000 kBd | 25 m |

The number of bus nodes is also limited by the specification according to ISO 11898. The limiting value is between 32 and 100 bus nodes. depending on the used cable and transmission rate. For further information on the maximum number of bus nodes refer to the document “CAN Physical Layer” by the user organization CiA e. V.

# 9.7 X12/X14 – DC Power Supply Unit

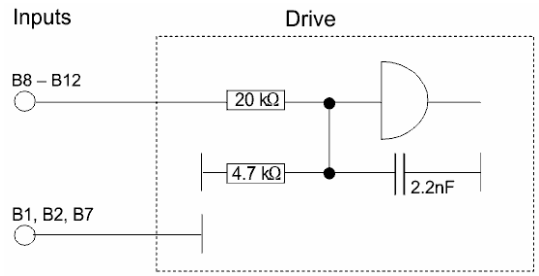



❶ The logic supply at X14 is required under the following conditions:
- maintaining the error messages after switch-off is desired
- higher output currents of the digital outputs (> 20 mA), see connection example section 9.8.2 "Digital Outputs", page 54

# 9.8 X14 – In/Out / STO

## 9.8.1 Digital Inputs

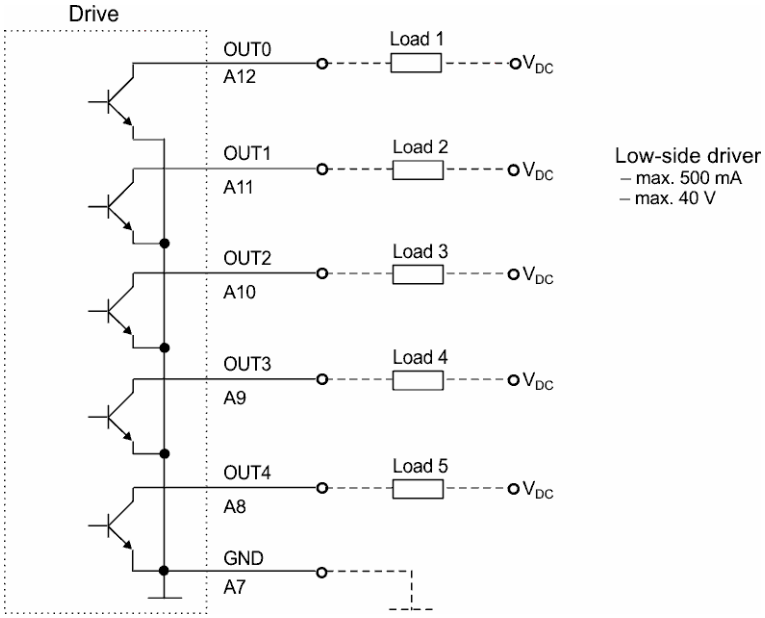
The meanings of the digital inputs can be defined by parameters.

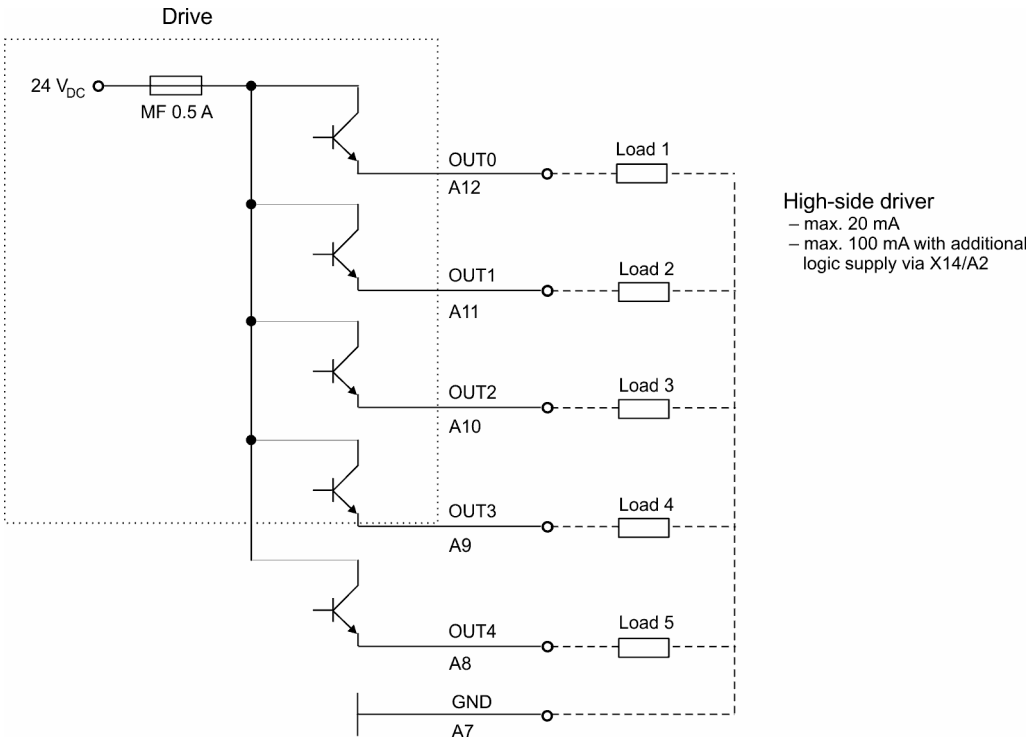



| Signal | State |
|---|---|
| 0 to 4V | L |
| 10 to 24V | H |

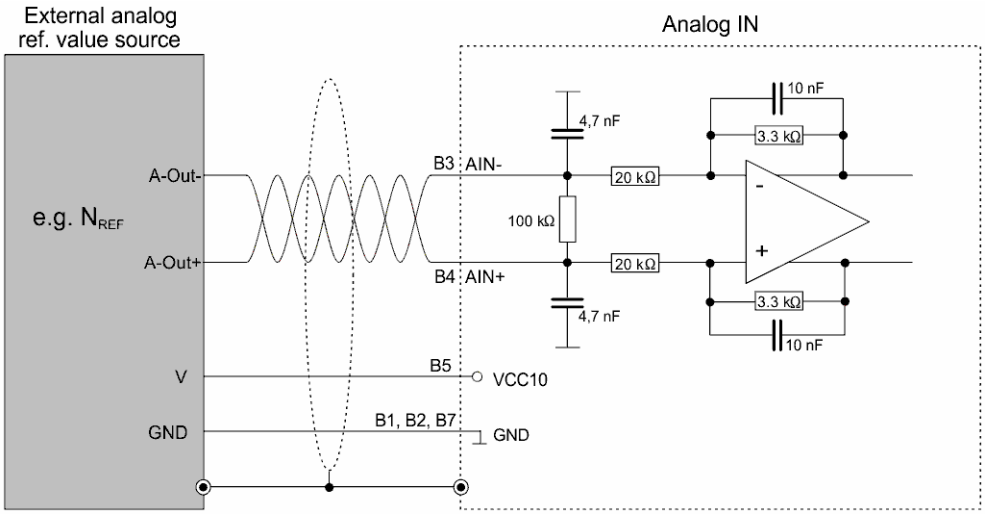
## 9.8.2 Digital Outputs

The output driver can operate as low-side driver or as high-side driver. You can set the desired driver type in the software *drivemaster2*.



## 9.8.3 Analog Input




Voltage interface with input voltage range: ±10 V

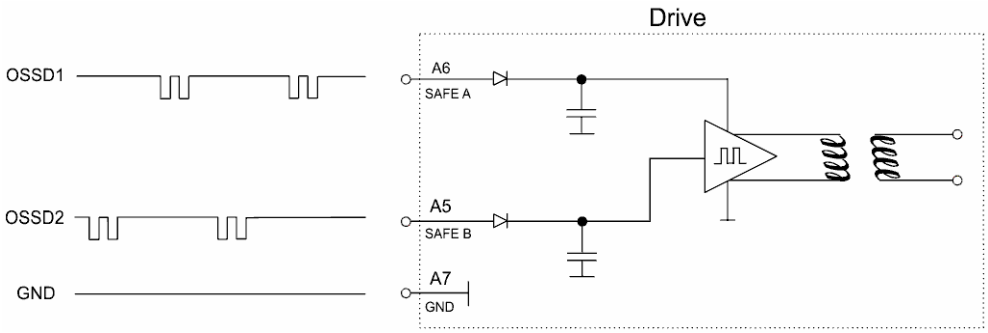
Can also be connected to potentiometer (500 Ω – 5 kΩ)

## 9.8.4 safety circuit (STO)

See also chapter 13 "Safety Circuit / Restart Lock (STO)", page 75.

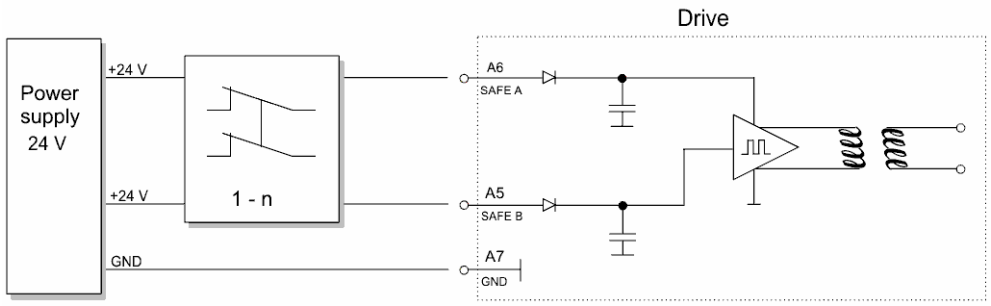
### 9.8.4.1 Wiring with OSSD

OSSD = Output Signal Switching Device

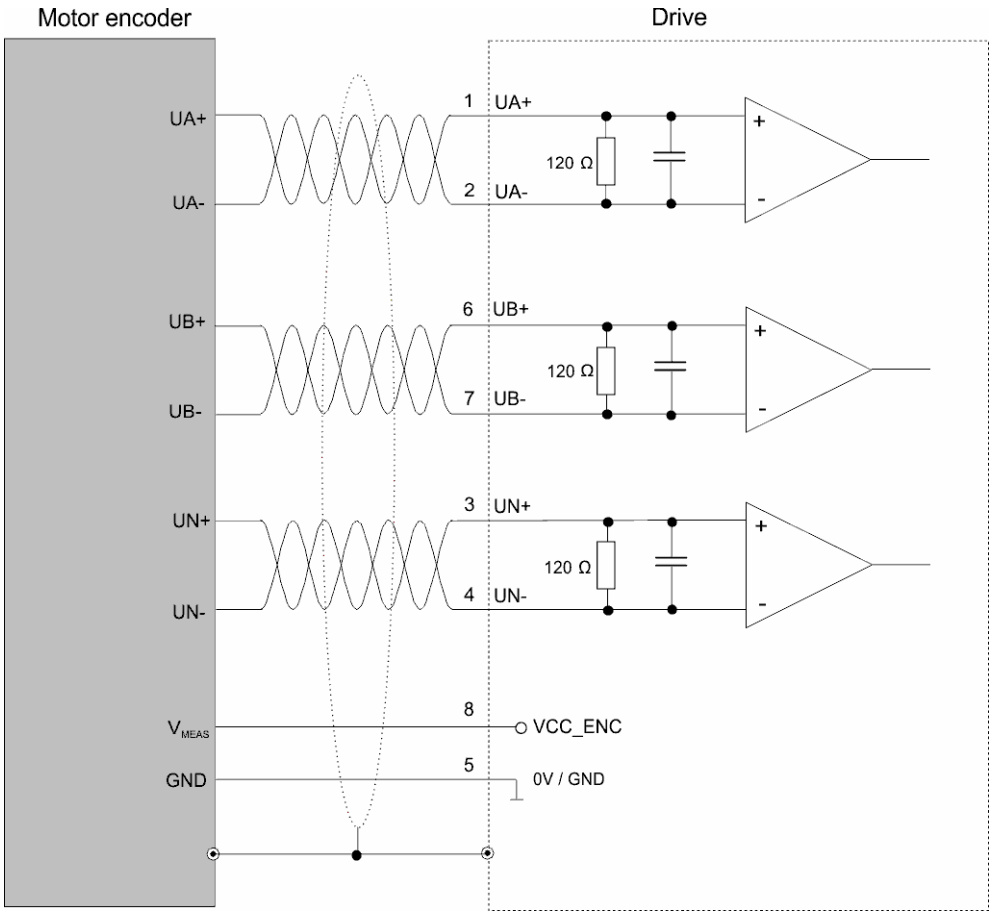


### 9.8.4.2 Wiring without OSSD

OSSD = Output Signal Switching Device



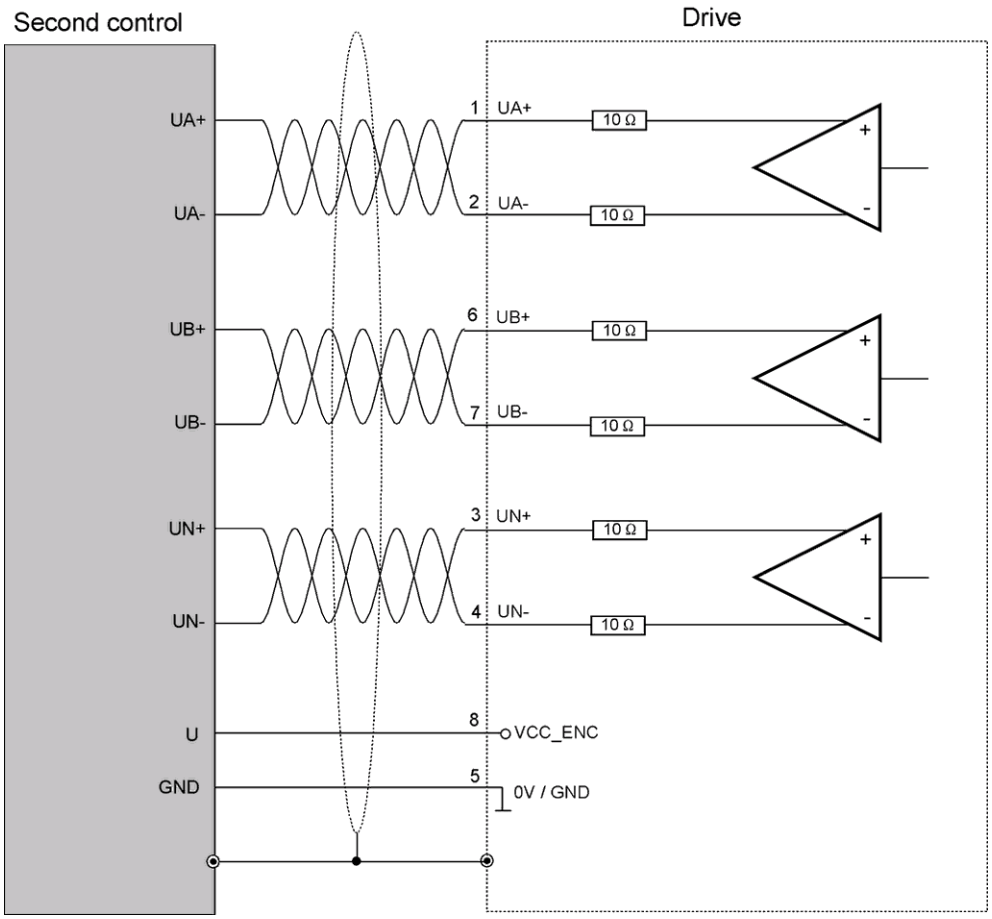

## 9.9 X15, X16 – Incremental Encoder with TTL Signals




Encoder signals: 5V

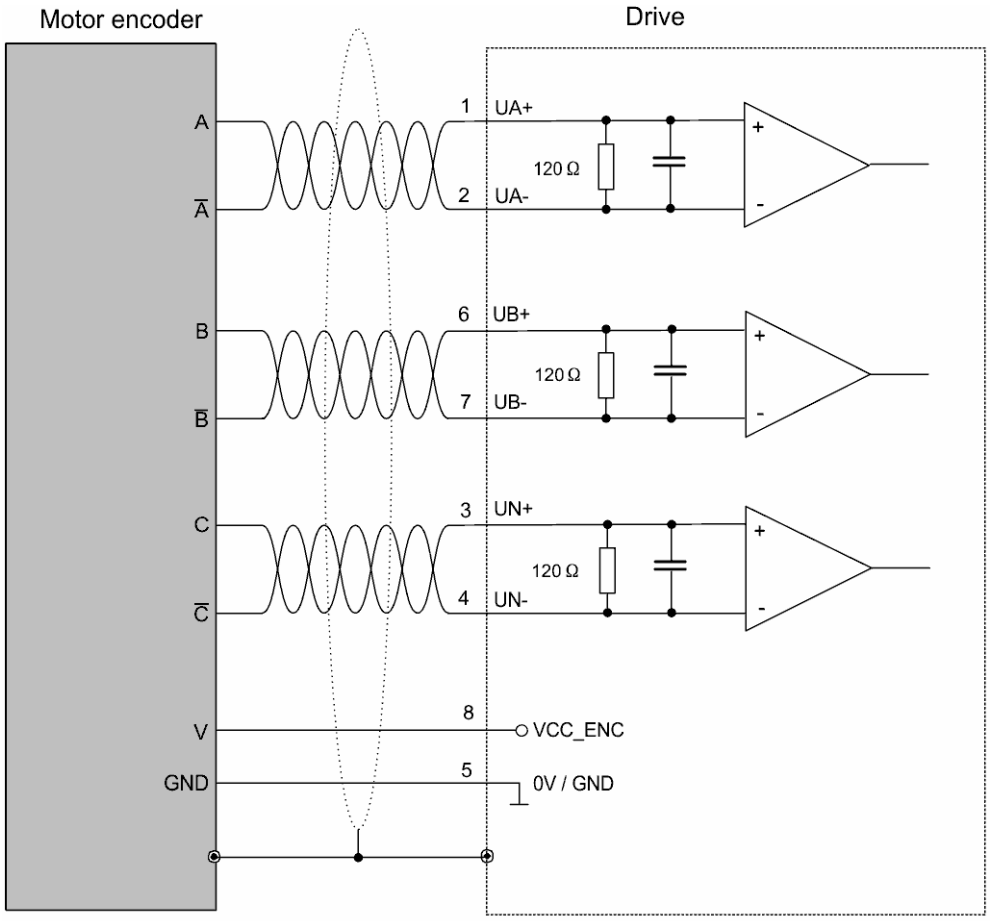
# 9.10 X16 – ENC1/EMU

## 9.10.1 Encoder Emulation

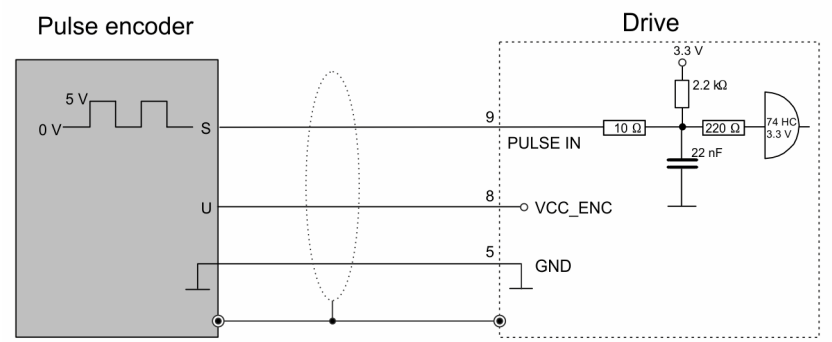



The transmission meets the requirements of the standard TIA/EIA-422-B with a voltage differential of at least. ±0.9 V.

## 9.10.2 Hall Sensor 5.3 V




## 9.10.3 PULSE IN 5.3 V



# 10 Status Display and Error Messages

The 7-segment display shows status and error messages.

A status message is made up of 1 to 5 digits and displayed as sequence. All messages end with dot behind the last digit. When the first digit is 'E.', there is a permanent error. If the cause of an error can be specified, the display indicates the actual error code followed by a hyphen and a one-digit sub error code.

Devices with older firmware do not feature the sub error code.

Examples:

1. 

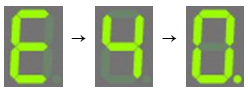
   Permanent display 0
   - Controller is switched off.
   - No error.

2. 

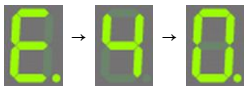
   Permanent display 1
   - Controller is switched on.
   - No error.

3. 

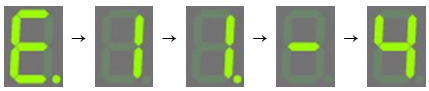
   Permanent display 1.
   - Controller is switched on.
   - No error.
   - Dot calls additional attention to PI limit.

4. 

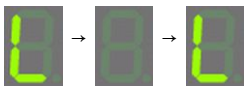
   Sequential display
   - Controller is switched off due to error E40.
   - The error is not present anymore.

5. 

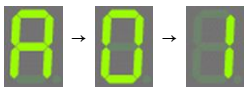
   Sequential display
   - Controller is switched off due to error E40.
   - The error is still present (indicated by the dot behind 'E').

6. 

   Sequential display
   - Controller is switched off due to error E11.
   - The error is still present (indicated by the dot behind 'E').
   - Sub error code 4 is indicated as cause.

7. 

   Sequential display
   - Controller is in boot loader mode: Display appears short-time when the device is booted and when the system software is loaded.

8. 

   Sequential display
   - Drive address: During booting of the devices the set address of the drive is displayed short-time (here A01)



## 10.1 List of the Operating States

| Code | Description |
|---|---|
| 0 | Ready to switch on |
| 1 | Controller active |
| 1. | Controller active, controller is limited / PI limit |
| 2 | Mains 'Ready for operation' not present yet |
| L | Boot loader active (during boot / software load) |

# 10.2 List of Drive Error Messages

The following messages apply to the entire SD2x drive series. According to the device type or operating mode, certain messages may not appear.

| Code | Error message | | Error reaction | Possible reason | |
|---|---|---|---|---|---|
| E03 (0x103) (259*d*) | Interpolation error (interpolated position control) | | Motor is stopped by quick stop ramp and drive is disabled (controlled standstill). | ▸ Faulty motion profile of the higher-ranking control | |
| | 1 | Acceleration limit exceeded | | | |
| | 2 | Speed limit exceeded | | | |
| | 3 | Index error | | | |
| E05 (0x105) (261*d*) | Error caused by warning | | Motor is stopped by quick stop ramp and drive is disabled (controlled standstill). | ▸ Parameter-driven monitoring stopped the drive. | |
| E06 (0x106) (262*d*) | Digital Input 'External Hardware' | | Motor is stopped by parameter-driven ramp and drive is disabled (controlled standstill). | Monitoring of external hardware: | |
| | 0 | Digital input | | 0 | Digital input “External Hardware OK” is not connected to 24 V. |
| | 1 | Analog input 0: broken cable | | 1 | Minimum current monitoring of analog input 0 has triggered. |
| | 2 | Analog input 1: broken cable | | 2 | Minimum current monitoring of analog input 1 has triggered. |
| | 3 | Analog input 0 and 1: broken cable | | 3 | Minimum current monitorings of analog inputs 0 and 1 have triggered. |
| E07 (0x107) (263*d*) | Error in internal hardware | | Motor is stopped by quick stop ramp and drive is disabled (controlled standstill). | ▸ Overload in digital outputs<br>▸ SD2B plus: Operating voltage not available | |
| E09 (0x109) (265*d*) | Hiperface / EnDat OEM data incorrect | | No "Ready" for startup | ▸ Number of motor pole pairs in EnDat/Hiperface encoder does not match the parameter set. | |
| E10 (0x10A) (266*d*) | drive-setup-tool heartbeat | | Motor is stopped by quick stop ramp and drive is disabled (controlled standstill). | ▸ *drive-setup-tool* was not able to communicate with the drive in the parameterized monitoring time. | |
| E11 (0x10B) (267*d*) | Communication / bus system error<br>▸ [1] SERVOLINK 4<br>▸ [2] DNC 8 Byte<br>▸ [3] CAN bus<br>▸ [4] EtherCAT | | Motor is stopped by parameter-driven ramp and drive is disabled (controlled standstill). | Monitoring of bus communication led to switch-off: | |
| | 1 | Faulty telegram ID [1] | | 1 | Faulty reference value telegram |
| | 2 | Zero data telegram[1] | | 2 | Higher-ranking control not active |
| | 3 | CRC error [1] | | 3 | Check sum error, interferences during transmission |
| | 4 | Synchronization error [1, 4] | | 4 | Drive telegram not synchronized |
| | 5 | Configuration error [4] | | 5 | Faulty configuration of mailbox, PDO, watchdog or synchronization |
| | 6 | NMT error [2, 3, 4] | | 6 | Control channel of bus system was not active during switch-on (pre-operational) |
| | 7 | Addressing error [4] | | 7 | Faulty drive address |

| Code | Error message | | Error reaction | Possible reason | |
|---|---|---|---|---|---|
| | 8 | Node Guarding [3] | | 8 | Communication node monitoring: monitoring time expired (configurable) |
| | 9 | EEPROM error [4] | | 9 | Error in EtherCAT EEPROM |
| | 10 | Heartbeat / Watchdog [2, 3, 4] | | 10 | Heartbeat monitoring: monitoring time expired (configurable) |
| E12 (0x10C) (268*d*) | Mains 'Ready for operation' is missing | | Motor is stopped by parameter-driven ramp and drive is disabled (controlled standstill). | ▸ | Power output stage was switched on, when mains supply was disconnected/interrupted. |
| E15 (0x10F) (271*d*) | Endat / Hiperface communication faulty | | Motor is stopped by quick stop ramp and drive is disabled (controlled standstill). | ▸ | Communication of EnDat/Hiperface is faulty. |
| E17 (0x311) (785*d*) | FPGA power output stage shut-down | | Motor is stopped immediately. | ▸ | Overload in power supply unit |
| E18 (0x312) (786*d*) | Error in spindle selection | | Motor is stopped immediately. | ▸ | Spindle selection was not valid at “Switch on”. |
| E25 (0x319) (793*d*) | Power supply load too high | | Drive is stopped by limitation of motor torque. | ▸ | Output power of drive is greater than rated power of power supply unit, since the dimensioning of drive and motor are not compatible. |
| E26 (0x31A) (794*d*) | Motor temperature too high | | Motor is stopped by error ramp and current limitation. | ▸ | Wrong parameters entered for the motor or wrong dimensioning of the motor |
| E27 (0x31B) (795*d*) | Ambient temperature too high | | Motor is stopped by error ramp and current limitation. | ▸ | Insufficient device cooling |
| E28 (0x31C) (796*d*) | Power output stage temperature too high | | Motor is stopped by error ramp and current limitation. | ▸ | Insufficient cooling of power output stage (heat sink) |
| E29 (0x31D) (797*d*) | Motor load too high (Motor I²t) | | Motor is stopped by error ramp and current limitation.(1) | ▸<br>▸ | Average motor load is too high due to mechanical problems<br>Wrong dimensioning of the motor |
| E30 (0x31E) (798*d*) | Power output stage load too high (I²t) | | Motor is stopped by error ramp and current limitation.(1) | ▸<br>▸ | Average load of output stage is too high due to mechanical problems<br>Wrong dimensioning of the drive |
| E31 (0x31F) (799*d*) | Speed error or slip too high | | SERVO / VECTOR: Drive is limited by current monitoring via short-circuit of the motor phases. (1)<br>HSPWM: Drive is stopped by error ramp and current limitation. | ▸ | Motor is not able to comply with the set speed (e.g. defective motor, mechanical problems, wrong parameters), failure of the measuring system |
| E33 (0x521) (1313*d*) | Power supply load monitoring -> mains voltage too high | | Power supply unit will be disconnected from mains. | ▸<br>▸<br>▸ | Parameterized mains voltage does not match the connected voltage<br>Device connected incorrectly<br>Heavy fluctuation of the power supply towards overvoltage |
| E34 (0x522) (1314*d*) | Power supply load monitoring -> mains voltage too low | | Power supply unit will be disconnected from mains. | ▸ | DC link was not precharged to the minimum voltage level in the set time period; mains voltage is connected to the short-circuited DC link |

| Code | Error message | Error reaction | Possible reason |
|---|---|---|---|
| E35 (0x523) (1315*d*) | Error in external power supply unit | Drive is immediately disabled, motor coasts to standstill. | ▸ Error message from external power supply unit; power supply is switched off. |
| E36 (0x524) (1316*d*) | Encoder 0 monitoring | Motor is stopped by current monitoring via short-circuit of the motor phases. | ▸ Connection of encoder 0 is faulty<br>▸ Broken cable |
| E37 (0x525) (1317*d*) | Ballast circuit load ($I^2t$ ballast resistor) | Drive is immediately disabled, motor coasts to standstill. | Ballast circuit load due to: |
| | 1 $I^2t$ | | 1 Wrong dimensioning, too much energy supplied to $R_{Ballast}$, broken cable, no bridge at $R_{Ballast}$ (int./ ext.) |
| | 2 (VCE) desaturation detection<br>or: DC DC converter overload *(only 0362144xy)* | | 2 Bridge at $R_{Ballast}$ is not correct, short circuit of insulation etc.<br>Or: internal hardware fault *(only 0362144xy)* |
| E37 (0x525) (1317*d*) | DC DC converter overload *(only 0362161xy)* | Power supply unit will be disconnected from mains. | ▸ Overload at voltage converter of DC link |
| E38 (0x526) (1318*d*) | Actual speed value greater than overspeed threshold | Motor is stopped by current monitoring via short-circuit of the motor phases.(1) | ▸ Wrong parameters<br>▸ Motor connected incorrectly |
| E39 (0x527) (1319*d*) | Tracking error monitoring and motor slowdown | Motor is stopped by current monitoring via short-circuit of the motor phases.(1) | ▸ Wrong parameters<br>▸ Motor connected incorrectly<br>▸ Mechanical problems |
| E40 (0x528) (1320*d*) | Motor feedback | Motor is stopped by current monitoring via short-circuit of the motor phases.(1) | ▸ Connection of motor feedback faulty<br>▸ Broken cable |
| E41 (0x529) (1321*d*) | Motor phase lost | Motor is stopped by current monitoring via short-circuit of the motor phases.(1) | Motor connection/configuration is faulty: |
| | 1 No motor connected | | 1 No motor connected / incorrect wiring, broken cable |
| | 2 Wrong motor connected | | 2 Wrong parameters |
| E42 (0x52A) (1322*d*) | Overvoltage in DC link | Drive is immediately disabled, motor coasts to standstill. | ▸ No ballast resistor is connected or ballast resistor is dimensioned too small, i.e. X41/X63 not connected |
| E43 (0x52B) (1323*d*) | Undervoltage in DC link | Drive is immediately disabled, motor coasts to standstill. | ▸ DC link not connected |
| E44 (0x52C) (1324*d*) | Commutation lost<br>The following list of error messages includes a note for which drive function the error might appear.<br>▸ [1] HSBLOCK<br>▸ [2] FPAM<br>▸ [3] SVC<br>▸ [4] HSPWM<br>▸ [5] VF | Drive is immediately disabled, motor coasts to standstill. | The error E44 is triggered in case of wrong current feed of the motor during operation without sensor.<br>Possible reason: wrong parameter setting or overload of the motor. The error depends on the drive function. For details refer to the corresponding setup instructions. |
| | 1 EMF monitoring[1, 2, 3 4] | | |
| | 2 Flux monitoring[4] | | |
| | 3 Over current monitoring[4] | | |

| Code | Error message | | Error reaction | Possible reason | |
|---|---|---|---|---|---|
| | 4 | Under flux monitoring[4] | | | |
| | 5 | Minimum speed monitoring[1, 2, 3] | | | |
| | 6 | Error during alignment[1, 2] | | | |
| | 7 | Current limitation V/f oscillates[5] | | | |
| E45 (0x52D) (1325*d*) | Short circuit in power output stage | | Drive is immediately disabled, motor coasts to standstill. | Short circuit of the power output stage due to: | |
| | 1 | Internal short circuit | | 1 | Faulty drive control |
| | 2 | (VCE) desaturation detection | | 2 | Wrong parameters, output stage defective, broken cable, short circuit etc. |
| | 3 | Short to ground | | 3 | Short to ground of a motor phase |
| | 4 | Current measuring range | | 4 | Wrong parameters, output stage defective, broken cable, short circuit etc. |
| | 5 | Overload motor | | 5 | Drive function V/f: incorrect parameter setting of “Flying restart” |
| E46 (0x52E) (1326*d*) | 1 | Safety circuit (Safety X10) | Drive is immediately disabled, motor coasts to standstill without control. | 1 | Safety circuit STO is activated when the output stage is active; input SAFE A and/or input SAFE B were triggered. |
| | 2 | Initialization error: internal hardware of safety controller | | 2 | Safety function SFM/SLOF: error in according hardware components of the safety controller |
| | 3 | Incorrect data/parameters in process sequence | | 3 | Safety function SFM/SLOF: faulty PLC telegrams |
| | 4 | Error in function parameters for a functional part | | 4 | Safety function SFM/SLOF: parameter is out of limits |
| | 5 | Timeout of monitoring functions | | 5 | Safety function SFM/SLOF: error in according hardware components |
| | 6 | Monitoring of OSSD signals and output stage enable | | 6 | Safety function SFM/SLOF:<br>▸ wrong OSSD signals<br>▸ defective OSSD relay<br>▸ defective multiplexer |
| | 7 | Monitoring of motor phases | | 7 | Safety function SFM/SLOF: defective motor cable (broken cable) |
| | 8 | Frequency exceeded | | 8 | Safety function SFM/SLOF:<br>▸ set reference speed value is too high<br>▸ limit value for Safe Limited Output Frequency is parameterized incorrectly<br>▸ OSSD signals are set incorrectly |
| | 9 | Communication error between DSP and safety controller | | 9 | Safety function SFM/SLOF: communication between DSP and safety controller is disturbed |

| Code | Error message | Error reaction | Possible reason |
|---|---|---|---|
| E47 (0x52F) (1327*d*) | Drive parameters not activated | Power output stage can not be activated. | ▸ Drive start is not acknowledged by master yet (configurable by parameters in software). |
| E55 (0x737) (1847*d*) | Firmware stopped by ESC | Device stops in BIOS. | ▸ During boot-up the device received an ESC sequence at the serial interface. |
| E56 (0x738) (1848*d*) | Device configuration | Device stops in BIOS. | ▸ During boot-up the device detected that hardware, firmware parameters and logic are not consistent; a detailed error description is received by a parameter download. |
| E57 (0x739) (1849*d*) | Faulty or no firmware | Device stops in BIOS. | ▸ During boot-up the device detected no firmware or a faulty firmware. |
| E58 (0x73A) (1850*d*) | FPGA watchdog triggered | Device stops in BIOS. | ▸ FPGA process monitoring has been triggered; please contact SIEB & MEYER. |
| E59 (0x73B) (1851*d*) | No drive parameters loaded | Device stops in BIOS. | ▸ Device is not parameterized (status of delivery). |
| E60 (0x73C) (1852*d*) | Drive parameters incorrect | Device stops in BIOS. | ▸ Parameter set of the device is not valid (CRC error). |
| E61 (0x73D) (1853*d*) | Logic coding missing or incorrect | Device stops in BIOS. | ▸ Logic programming of the device is not valid. |
| E62 (0x73E) (1854*d*) | Error in electronic type plate | Device stops in BIOS. | ▸ Type plate is not programmed or faulty; please contact SIEB & MEYER. |

(1) For servo motors with commutation via an incremental motor measuring system the warning W17 “Unknown commutation angle ” is signaled. After a restart of the device the phasing of the motor measuring system starts automatically (magnetic alignment).



## 10.3 List of Warning Messages

Warning messages are not displayed on the device display. They can only be seen in the software *drivemaster2* via “Diagnosis → Errors and warnings”.

| Code | Description |
|---|---|
| W00 | Digital input 'Quick stop' active |
| W01 | Digital input 'Positive limit switch' active |
| W02 | Digital input 'Negative limit switch' active |
| W03 | Voltage of mains supply not OK |
| W04 | Power output stage load greater than parameterized warning threshold W04 (power output stage I²t) |
| W05 | Motor load greater than parameterized warning threshold W05 (motor I²t) |
| W06 | Power output stage temperature greater than parameterized warning threshold W06 |
| W07 | Motor temperature greater than parameterized warning threshold W07 |
| W08 | DC link voltage greater than parameterized warning threshold W08 |
| W09 | DC link voltage less than parameterized warning threshold W09 |
| W10 | Speed controller in current limitation / PI limit |

| Code | Description |
|---|---|
| W11 | Position/tracking error greater than parameterized warning threshold W11 |
| W12 | Speed error greater than parameterized warning threshold W12 |
| W13 | Tracking error of the current too great |
| W14 | Ambient temperature greater than parameterized warning threshold W14 |
| W15 | Ballast resistor load greater than parameterized warning threshold W15 (ballast resistor $I^2t$) |
| W16 | Safety circuit is active |
| W17 | Unknown commutation angle |
| W18 | Hiperface / EnDat OEM data not valid |
| W19 | Dirt signal encoder input 0 |
| W20 | Dirt signal encoder input 1 |
| W21 | Dirt signal encoder input 2 |
| W22 | Power supply unit load greater than 90% of the rated power |
| W23 | Reserved |
| W24 | Current or current rise greater than warning threshold W24 (warning current) |
| W25 | Reference speed less than minimum motor speed |
| W26 | Current greater than warning threshold W26 (warning overload current) |
| W27 | Reserved |
| W28 | Reserved |
| W29 | Reserved |
| W30 | Reserved |
| W31 | Reserved |

## 10.4 Message of the Quick Stop Functions

| Code | Description |
|---|---|
| H01 | Digital input "Switch on" waits for positive edge to switch the drive on (This function is only active when the input is set as "Switch on type 2 (with positive edge)".) |
| H03 | Software function "Quick stop" |
| H04 | Digital input "Quick stop" |
| H07 | Software positioning error "Negative limit" |
| H08 | Software positioning error "Positive limit" |
| H09 | Bus system "Quick stop" (The quick stop bit is set to 0) |
| H11 | Digital input "Negative limit switch" |
| H12 | Digital input "Positive limit switch" |
| H13 | Digital input "Speed Enable" |

# 11 General Information Regarding the Wiring

## 11.1 Cable Requirements

The cables described in this chapter meet the SIEB & MEYER requirements for cables and connectors in order to ensure their proper function.

**NOTICE**

**Risk of cable damage due to mechanical loads**

Cables that are exposed to mechanical loads, e.g. trailing chains or similar, must be suited for this purpose. Otherwise, damage may occur. SIEB & MEYER cables are not suitable for trailing chains!

The machine manufacturer must ensure that only cables are used that are suitable for this purpose.

In general, the following principles apply for the cables (see also documentation “Unit Assembly Complying EMC”)

- Motor and signal cables must not be wired in the same cable protection hose!
- Motor cables must have a wire-meshed shield. They must be wired separately from signal cables.
- Signal lines must have a wire-meshed shield. Differential signals should only be transmitted with twisted-pair lines. They must be wired separately from motor cables.
- The cable shields must be connected to the connector shell inside of the connectors. In the switch cabinet they should be connected to a ground bus.
- Cable shields not ending in a connector inside of the switch cabinet such as motor cables must be connected to the ground bus.
- Both ends of the shield of shielded cables must generally be connected to the shell.



The line cross-sections should be selected carefully: The maximum admissible current should not be exceeded at the maximum ambient temperature (see technical data). **DIN VDE 0298-4** defines the admissible values for the individual line cross-sections which must absolutely be taken into account.

The current carrying capacity in connection with the line cross-section of copper conductors isolated with PVC or cables according to DIN VDE 0298-4 for different types of wiring are indicated in the following table: All values are related to an ambient temperature of +40 °C and an operating temperature at the conductor of 70 °C.

| Conductor cross-section A [mm²] | Admissible current I [A] | | |
|---|---|---|---|
| | B2 wiring(1) | E wiring (3 cable leads) (2) | F wiring (3 cable leads) (3) |
| 0.75 | 7.6 | 10.4 | – |
| 1.00 | 9.6 | 12.4 | – |
| 1.50 | 12.2 | 16 | – |
| 2.50 | 16.5 | 22 | – |
| 4 | 23 | 30 | – |

| Conductor cross-section A [mm²] | Admissible current I [A] | | |
|---|---|---|---|
| | B2 wiring(1) | E wiring (3 cable leads) (2) | F wiring (3 cable leads) (3) |
| 6 | 29 | 37 | – |
| 10 | 40 | 52 | – |
| 16 | 53 | 70 | – |
| 25 | 67 | 88 | 96 |
| 35 | 83 | 110 | 119 |
| 50 | 100 | 133 | 145 |
| 70 | 130 | 171 | 188 |
| 95 | 150 | 207 | 230 |
| 120 | 175 | 240 | 268 |
| 150 | – | 277 | 309 |
| 185 | – | 317 | 356 |
| 240 | – | 374 | 422 |
| 300 | – | 433 | 488 |
| 400 | – | – | 570 |
| 500 | – | – | 652 |
| 630 | – | – | 744 |

(1) B2 wiring: wiring in installation tubes or closed installation channels.

(2) E wiring: Free wiring of one cable with a min. distance of 0.3 × cable diameter to the wall.

(3) F wiring: Free wiring of several cables with a min. distance of 1 × cable diameter to the wall.

*Tab. 2: Current carrying capacity according to DIN VDE 0298-4*

For detailed information refer to the standard IEC 60364-5-52 and the documents of the cable manufacturer.

The following correction factors are provided for deviating ambient temperatures:

| Ambient temperature T [°C] | Correction factor |
|---|---|
| 30 | 1.15 |
| 35 | 1.08 |
| 40 | 1.00 |
| 45 | 0.91 |
| 50 | 0.82 |
| 55 | 0.71 |
| 60 | 0.58 |



### Cross-sections of round conductors

The standard values of the cross-section of round copper conductors as well as the approximate ratio of metric ISO and AWG/MCM values are shown in the following table.

Standardized cross-sections of round conductors:

| ISO cross-section [mm²] | AWG/MCM | |
|---|---|---|
| | Value | Equivalent cross-section [mm²] |
| 0.2 | 24 | 0.205 |
| – | 22 | 0.324 |
| 0.5 | 20 | 0.519 |
| 0.75 | 18 | 0.82 |

| ISO cross-section [mm²] | AWG/MCM | |
|---|---|---|
| | Value | Equivalent cross-section [mm²] |
| 1.0 | – | – |
| 1.5 | 16 | 1.3 |
| 2.5 | 14 | 2.1 |
| 4.0 | 12 | 3.3 |
| 6.0 | 10 | 5.3 |
| 10 | 8 | 8.4 |
| 16 | 6 | 13.3 |
| 25 | 4 | 21.2 |
| 35 | 2 | 33.6 |
| 50 | 0 | 53.5 |
| 70 | 00 | 67.4 |
| 95 | 000 | 85.0 |
| – | 0000 | 107.2 |
| 120 | 250 MCM | 127 |
| 150 | 300 MCM | 152 |
| 185 | 350 MCM | 177 |
| 240 | 500 MCM | 253 |
| 300 | 600 MCM | 304 |

The line corresponds to a value when the connection possibilities are taken into account.

### 11.1.1 Motor Cable

**DANGER**

**Dangerous shock currents**

Earthing and shielding measures are required to protect devices and persons. To ensure the safety of the operator earthing must be carried out with low impedance. With respect to the ground connection one of the following actions must be done:

- connect the motor housing to the ground of the machine or
- connect the ground terminal of the motor connector to the central ground point of the machine.

Consider the following with regard to shielding: Always use shielded motor cables!

**NOTICE**

**Disturbing ground loops**

Incorrect connection of protective earth connections in motor cables may cause disturbing ground loops and malfunction of the motor.

Connect the protective earth conductors additionally led in motor cables directly to the shield line and label them with ⏚ or PE.

If the procedure turns out to be impracticable, omit the earth conductor connection in the motor cables and wire a separate earth conductor in parallel to the motor cables.

Ensure that the cable is returned to the drive! Do not wire the cable with another ground loop.

✓ The described measures prevent disturbing ground loops.

Use shielded cables for the motor in order to keep interference as low as possible.

The cable shield must be connected large-area with 360° shield termination. In addition, the motor cable should be as short as possible to reduce electromagnetic radiation and capacitive currents.

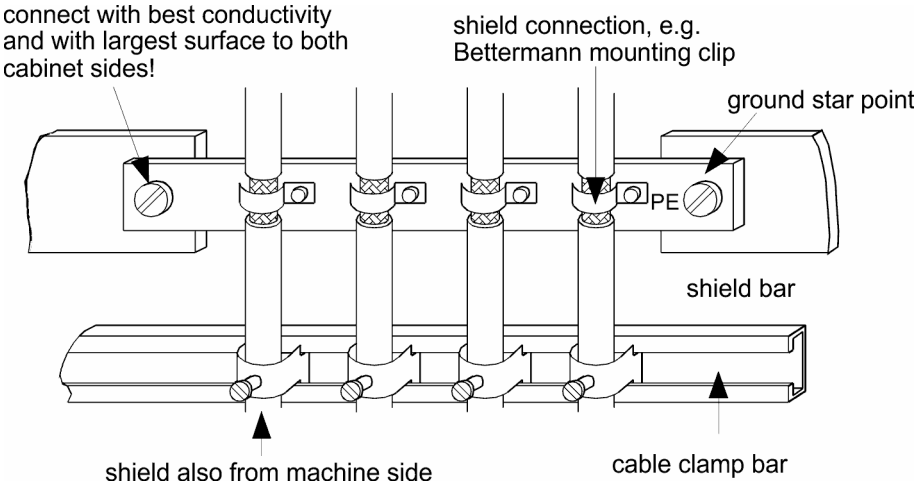



*Fig. 11: Motor connection*

**Requirements to the motor cable**

The maximum admissible length of the motor cable is 100 m. The capacity must not exceed 5.2 nF.

Example: If the cable capacity is 0.26 nF per meter, the maximum admissible length of the motor cable is 20 m.

# 12 Electric Performance Dimensioning

Experience shows that questions arise during the dimensioning of a drive when selecting output stages and power supplies. This chapter shall make clear the physical background and shall help to dimension correctly the electronic components.

## 12.1 Components

The following sections provide information on the electric performance dimensioning of the drive components (output stage, power supply unit and motor).

### 12.1.1 Output Stage

The output stage of a drive amplifier is specified by the following details:

#### Voltage range

The maximum DC link voltage is limited by the used transistors and capacitors and the minimum space between the strip conductors.

When an output stage with a maximum admissible DC link voltage of 325 $V_{DC}$ (class C) is used, i.e. with an AC power supply of 230 $V_{AC}$, the components will have an electric strength of 600 $V_{DC}$. The reserve is necessary in order to prevent damage in the case of voltage peaks and the DC link voltages during the deceleration.

#### Current range

The current range specifies the maximum admissible currents. Distinction is made between peak and rated current:

- The **peak current** is only admissible for a short time (mostly 5 seconds) and depends on the used transistors and their number.
- The **rated current** can be provided continuously by the output stage. Its value depends on the cooling of the transistors, that means: the capacity of the used heat sink and its ventilation.
- Due to the higher load of the power semiconductors in the output stage during a static rotating field or low rotating field frequencies (f ≤ 5 Hz) the rated current will be reduced by the factor √2 within this frequency range for the SIEB & MEYER devices of the series SD2, SD2S and SD2T.

### 12.1.2 Power Supply

The power supply is specified by the following details:

#### Voltage range

The maximum supply voltage is limited by the used transistors, diodes and capacitors and the minimum space between the strip conductors.

### Current range

The current range specifies the maximum admissible currents. Distinction is made between peak and rated current:

- The **peak current** is only admissible for a short time (mostly 1 second) and depends on the used diodes and their number.
- The **rated current** can be provided continuously by the power supply unit. Its value depends on the cooling of the diodes, that means: the capacity of the used heat sink and its ventilation.

### Power

In practice, a maximum permanent power is specified for power supply units, since the supply voltage is assumed to be constant. As the limitation in the power supply unit is determined by the load carrying capacity of the diodes, the maximum permanent power depends on the supply voltage and the type of supply.

Examples:

- Power supply 230 $V_{AC}$, 2 phases, max. permanent current of the diodes 6 A
  230 $V_{AC}$ × 2 × 6 A = 2.76 kW
- Power supply 400 $V_{AC}$, 3 phases, max. permanent current of the diodes 6 A
  400 $V_{AC}$ × 3 × 6 A = 7.20 kW

The maximum peak current depends on the type of diode used.

The protection is calculated as follows:

$$\frac{\text{Power}}{\text{Input voltage}} = \frac{2.76\,\text{kW}}{230\,V_{AC}} = 12\,A_{rms}$$

## 12.1.3 Motor

The motor is specified by the following details:

### Peak current

The peak current defines the max. allowed motor current. The peak current is only allowed for a short period of time (between 1 and 30 Sekunden) and depends on the used magnetic material and the thickness of the windings. Normally, the motor manufacturer defines the peak current applying during downtimes and during a rotating field. Generally, the values given on the motor data sheet are RMS values. SIEB & MEYER specifies currents as sine peak amplitudes.

The RMS values are calculated by dividing these values by the factor √2.

### Rated current

The rated current can be applied permanently to the motor. The value depends on the cooling of the motor, the windings and the max. allowed motor temperature. Normally, the motor manufacturer defines the rated current applying during downtimes and during a rotating field. Generally, the values given on the motor data sheet are RMS values. SIEB & MEYER specifies currents as sine peak amplitudes.

The RMS values are calculated by dividing these values by the factor √2.

The current version of the software drivemaster2 allows switching between the RMS value and the sine peak amplitude (see “Settings → Program settings → View”). When switching the view, the existing values are automatically converted into the new unit. The default setting is the RMS value.

### Motor voltage

The motor voltage is the voltage directly available at the motor. The value of the motor voltage depends on the used electric components. In case of a three-phase power supply with power choke, controlled drive amplifier and a motor choke, voltage drops of approx. 4 %, 8 % and 1 % of the mains voltage will result. Additional voltage losses of approx. 2 % can be observed in a soft net.

### Example

The following example uses a controlled drive amplifier with a mains choke at a mains voltage of 400 V. The following motor voltage will result:

$U_{Motor}$ = 400 V − (400 V * 12 %) = 352 V

### Voltage constant

Due to its inductance the motor generates a countervoltage which is opposite to the supplied voltage. This voltage is proportional to the speed and defined in 'volt per 1000 revolutions'. Generally, the values are RMS values measured between the connection pins.

Example
- DC link voltage: 325 V
- e.m.f.: 1000 mV/min

A voltage of only 225 V is available to control the motor at 1000 rpm. The theoretical max. speed of the motor is 3250 rpm. At this speed no torque will be available anymore, since no current can be applied anymore.

### Torque constant

The torque constant specifies the relation between the motor current and the motor torque (Nm/A). The torque constant results from the required max. speed, dynamic characteristics, efficiency and the quality of the magnetic material.

### Inductive winding resistance

The inductive winding resistance (ωL) is the result of the individual number of windings of the total winding. During period of downtimes the resistance is zero. It increases with the frequency.

### Ohmic winding resistance

The ohmic winding resistance R is the results from the length and the thickness of wire. During periods of downtimes it specifies the winding resistance alone.

### Electric time constant

The elctric time constant is the quotient of the inductive and ohmic resistance (τ = L/R).

### Motors for tightening systems

Generally, motors for tightening systems are high-dynamic motors characterized by high maximum speeds, high peak torque values, low inertia of masses and small rated torque values. This results in a small voltage constant, small inductance values, thin windings and low rotor diameters. Due to the low inductance value motors in tightening systems are operated at a high pulse with modulation frequency (PWM frequency 16 kHz) to keep the current ripple as small as possible.

## 12.2 Power Consumption of a Drive

If a constant torque is taken from the drive, the power consumption will depend on the current speed.

Examples:
- Preset torque: 30 Nm
- DC link voltage: 300 V
- Voltage constant: 50 mV / min (50 V / 1000 rpm)
- Coil resistance: 1 Ω
- Torque constant: 1 Nm / A

From this results a motor current of:

$$I = \frac{30\,Nm}{1\,Nm\ /\ A} = 30\,A$$

The motor requires a voltage of V = 1 Ω × 30 A = 30 V

**0 rpm, standstill**

From this results a power of P = 30 V × 30 A = 0.9 kW.

At a DC link voltage of 300 V an input current results from the supply voltage of I = P / 300 V = 3 A.

Thus, considerably less current flows in the power supply unit than in the motor. This calculation is very important especially for nut setting applications, since the high torques and thus currents are only required for low speeds.

**2000 rpm**

At 2000 rpm the motor requires a voltage of V = R × I + e.m.f. × n = 1 Ω × 30 A + 50 V / (1000 rpm) × (2000 rpm) = 130 V.

From this results a power of P = 130 V × 30 A = 3.9 kW.

At a DC link voltage of 300 V an input current results from the supply voltage of I = P / 300 V = 13 A.

Thus, a considerable higher current flows in the power supply at a speed of 2000 rpm than at standstill.

**5400 rpm**

At 5400 rpm the motor requires a voltage of V = R × I + e.m.f. × n = 1 Ω × 30 A + 50 V / (1000 rpm) × (5400 rpm) = 300 V.

From this results a power of P = 300 V × 30 A = 9 kW.

At a DC link voltage of 300 V an input current results from the supply voltage of I = P / 300 V = 30 A.

Thus, the same current flows in the power supply unit and in the motor at a speed of 5400 rpm. It must be considered that the currents flowing in the motor phases are lower by factor √3 than the currents calculated above.

The examples clearly show that the expected motion profile must be considered when dimensioning the power supply unit. An exact dimensioning can only be achieved by integrating the motion profile.

The same applies for conceiving the output stage and the motor.

# 13 Safety Circuit / Restart Lock (STO)

- *according to EN ISO 13849-1:2008-12, DIN EN 62061:2005 SIL 3*

The restart lock is provided for preventing an unintentional start of a speed-variable drive from the standstill and can, for example, be used in the machine function “safe stop”. It comprises a restart lock tested according to EN ISO 13849-1:2008-12 (VDE 0113) and a stop function according to EN 60204-1:2007-6, stop category 0. A stop category 1 can be achieved by using a tested, safe emergency stop device with delay or a safe PLC according to DIN EN 60204-1. The stop functions are defined according to DIN EN 60204-1 (VDE 0113) paragraphs 9.2.2, 9.2.5.3.

There are three categories of stop functions:

| | |
|---|---|
| Category 0 | Standstill by immediate interruption of the energy supply to the machine drives, i.e. uncontrolled standstill. |
| Category 1 | The machine is decelerated to standstill without disconnecting the energy supply between motor and drives (i.e. a controlled standstill). The energy supply is interrupted at that moment the machine is at a secure standstill. |
| Category 2 | The energy supply between motor and drives is not interrupted (a controlled standstill). |

Every machine must be equipped with a stop function according to category 0. Stop functions according to category 1 and/or 2 must be integrated into the machine if they are necessary for safety and/or operational reasons.

The disadvantages of the disconnection can be eliminated by the consequent use of electronic elements. The standard EN 60204-1:2007-6 “Safety of machinery - Electrical equipment of machines” also allows the use of electronic equipment for the stop function in case of an emergency, if these – under application of the standardsEN ISO 13849-1:2008-12 and/or DIN EN 62061:2005 – meet the same safety requirements as required according to DIN EN 60204-1.

This checked safety circuit was conceived according to the concept paper by Drivecom “Technical Guide for Safety Drives” from 04/23/2004. The concept paper was checked by the BIA and the TÜV Rheinland: It was confirmed that the required standards and regulations were met.

The standstill of the machine must be caused by a high-ranking control before and the stop function of at least category 2 must be ensured.

The restart lock interrupts the energy supply between drive and motor by deactivating the output stage control. Thus, any rotation of the motor is made impossible.

The advantage of this circuit is that a single drive can be locked safely in an installation with several drives while other drives remain in operation. Besides, a drive can be locked without having to charge the DC link electrolytic capacitor at a new restart.

**DANGER**

**Danger due to electric shock**

The restart lock does not galvanically separate the output stages from the motor. Thus, the restart lock does not protect against electric shock.

The complete machine must always be galvanically separated from the mains by use of the main switch(DIN EN 60204-1 5.3) for any interruptions of the operation, maintenance, repair or cleaning work at the machine or system.

All mounting locations for safety devices of the control system as well as components mounted outside have to correspond to an IP code IP54, if mounted correctly.

## 13.1 Functional Description of the Restart Lock

The restart lock locks the respective drive of an installation. All further drive modules (servo amplifiers / frequency converters) remains ready for operation.

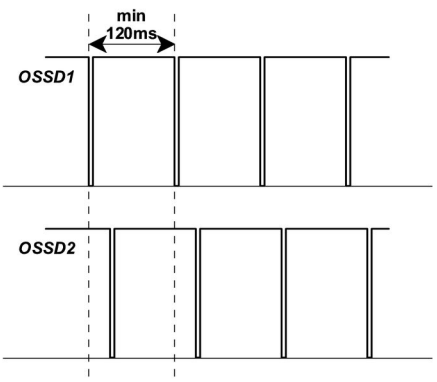
A TÜV checked safety circuit accesses relevant control of the output stage transistors of the drive to be locked by interrupting the voltage supply of the controls. Thus, no control pulses can be passed on to the transistors of the output stages and the motor is at a secure standstill.

### OSSD (Output Signal Switching Device)

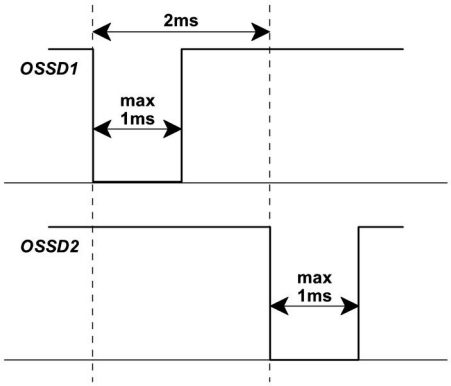
Part of the contactless protective unit (German abbreviation = BWS) which is connected with the machine control and which switches over into the OFF state, when the sensor unit is triggered during the intended operation. (Source IEC 61496-1).

The OSSD signal is a pulsed signal, of which the phase position is shifted in relation to the different channels. All error can be detected by checking the pulse pattern, short-circuit for supply, cross-circuit or defect of the device. This ensures a very high safety level (SIL 4).

**OSSD test frequency**



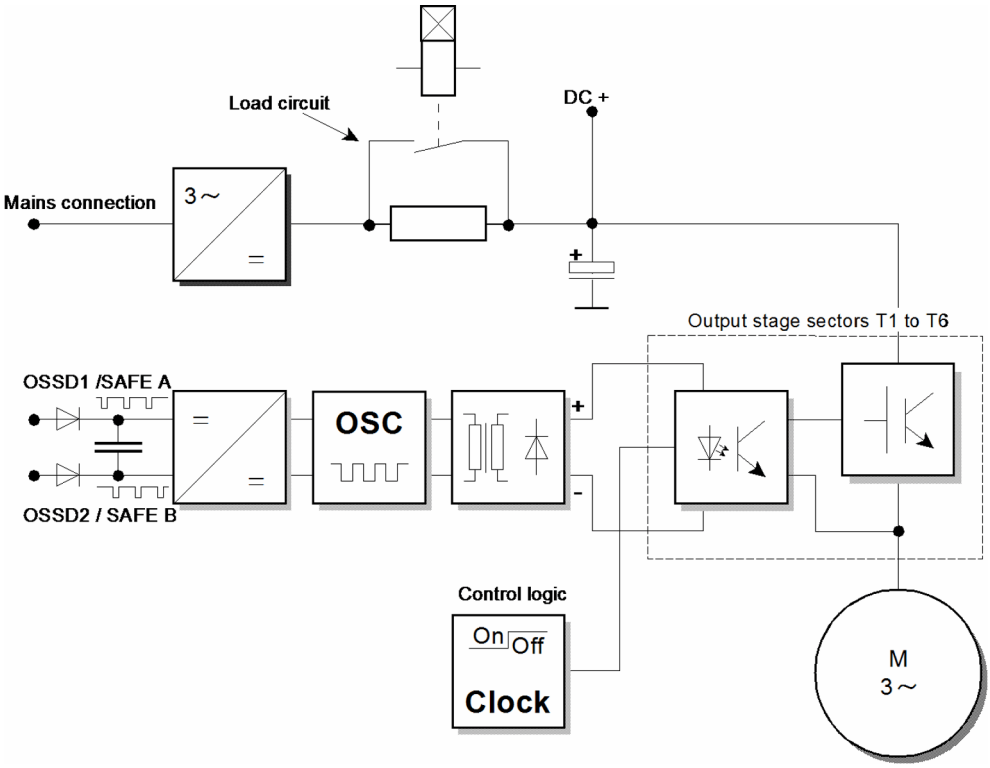

**OSSD test pulse width**




The TÜV checked safety circuit is controlled by the OSSD1+2 signal or via one or several emergency stop switch devices. See also section 13.2 "Wiring Example", page 77

If the OSSD signals or at least one of the +24 V conductors fail, the safety circuit switches the pulse pattern of the output stage control sectors off. The response time of the restart lock is **max. 4 ms**.

The restart lock must only be controlled when
- the drive is at a secure standstill (stop category 2),
- the higher-ranking control has deactivated the drive module,
- (reference speed value 0)
- the holding brake of the motor has been arrested.




**DANGER**

**No torque when restart lock is active**

The motor cannot provide a torque when the restart lock is activated. Thus non-self-locking drives could be released.

Non-self-locking drives as hanging loads must be blocked with a mechanical brake.

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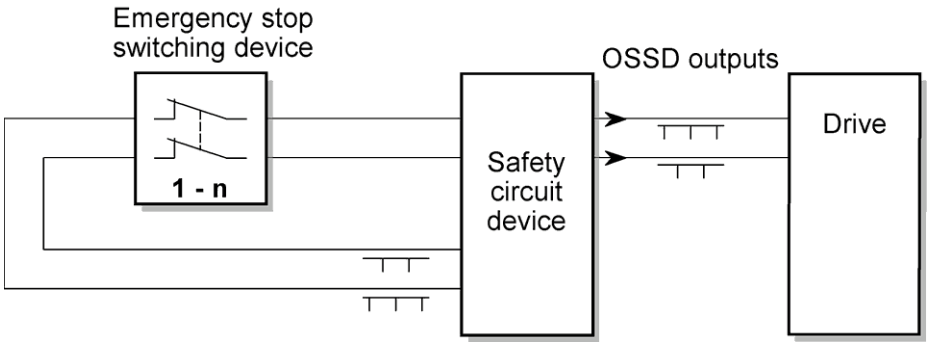
## 13.2 Wiring Example

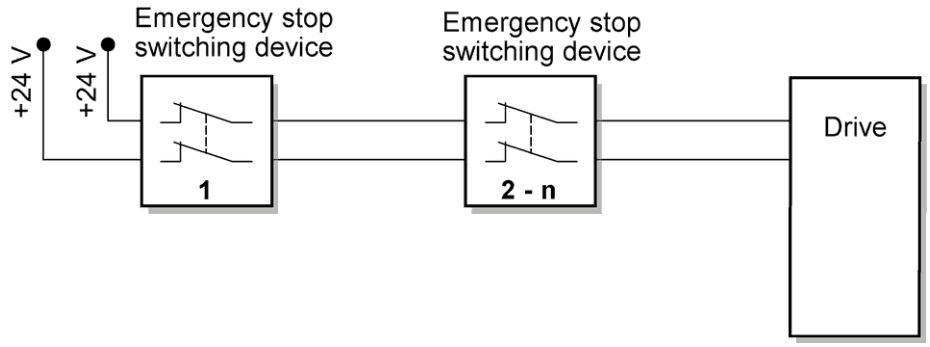
Combining a safe emergency stop command device, an OSSD safety switch device or a light barrier with OSSD outputs and the safe switching off of the pulse patterns allows creation of an error detection circuit, which achieves a safe stop (according to stop function category 0+1), which meets the safety requirements according to SIL 3 (EN ISO 13849-1). This circuit allows connecting several emergency stop devices in parallel, which are permanently monitored.

**Circuit with OSSD (SIL 3)**




The following figure shows a circuit without OSSD safety device, whilst only safety directed command devices with forcibly opened contacts in two-channel design are used. SIL 3 (according to EN ISO 13849-1) is achieved. It is also possible to cascade several different safe emergency stop devices, position switches or door locks to one safety circuit.

**Circuit without OSSD (SIL 3)**




The safety switch device as well as the emergency stop device have to be certificated as safety devices of at least level SIL 3 to obtain safety level SIL 3 according to EN ISO 13849-1.

In order to obtain the safety level SIL 3 according to EN ISO 13849-1the circuit and the layout have been dimensioned according to IEC 60664-1:2008-01. Supporting material according to IEC 60249 covered by a nonaging protective coat of lacquer according to IEC 60664-3:2003-09 have been used. The conformity of standard have been tested and approved by the TÜV-Nord CERT.

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## 13.3 Requirements and Standards

The following parameters are achieved according to the safety case:

- according to EN ISO 13849-1:2008-12
  - MTTFd: >100 years
  - DC = 99%
  - Category 4
  - Performance Level e
- according to EN 61508-1:2010 and EN 61800-5-2:2014-06
  - PFH = 0
  - SFF = 100 % (if there are PFH values, then SFF<100%)
  - HFT = 0

The safety concept K1 meets the requirements of SIL 3 according to the standards named above.

### Requirements according to DIN EN 61800-5-2:2014-06

When connected appropriately, the safety concept K1 does not supply any share of dangerous, undetected errors in the safety chain for the function STO.

Thus the stop function 0+1 according to EN 60204-1:2007-6 is realized.

# 14 Appendix

## 14.A Specification of Device Firmware

For the drive amplifiers of the series SD2B / SD2B plus the following firmware is available at present.

| Firmware | F11001vxxxxx UF / SVC |
|---|---|
| **SERVO / VECTOR** | ✓ |
| Sensorless vector control (SVC), synchronous | ✓ |
| **HSPAM / VF, asynchronous rotary** | ✓ |
| Sensorless | ✓ |
| Flying Restart | ✓ |
| Current-controlled startup | ✓ |
| **Operating modes** | |
| Velocity mode 1 | ✓ |
| **Control and setpoint channels** | |
| Analog + digital inputs | ✓ |
| Serial interface / RS485 / USB | ✓ |
| CAN bus | ✓ |
| DNC 8 Byte | ✓ |
| Internal setpoints | ✓ |
| Motor Potentiometer | ✓ |
| **Others** | |
| Multi parameter sets | ✓ |
| Winding Detection | ✓ |
| Field weakening | ✓ |
| Current controlled ramps | ✓ |

14.A

# 14.B Manufacturers

## 14.B.1 SIEB & MEYER Accessories

In the following you find all accessories for SD2B / SD2B plus that you can order at SIEB & MEYER.

Consider the information on accessories suitable for your device in the technical manual.

### 14.B.1.1 Connectors of the Series SD2B / SD2B plus

| SIEB & MEYER article number | Description | Device variant |
|---|---|---|
| 32299576 | Connector kit with mating connectors for motor connection, DC power supply, logic and inputs/outputs manufactured by Phoenix Contact | 0362170DB (SD2B) |
| 32299587 | Connector kit with mating connectors for motor connection, DC power supply and inputs/outputs manufactured by Phoenix Contact | 0362171DB (SD2B plus) |

### 14.B.1.2 Blocking Diode

| SIEB & MEYER article number | Description |
|---|---|
| 036210082 | Module with blocking diode to decouple the main voltage of SD2B (0362170DB) |

### 14.B.1.3 Operating Terminal

| SIEB & MEYER article number | Description |
|---|---|
| 0362150 | Plug-on operating terminal |
| 0362153 | Operating terminal for switch cabinet installation |
| 32299567 | Switch cabinet kit for operating terminal 0362150 |

### 14.B.1.4 USB>RS232/485 Converter 050201

The USB>RS232/485 Converter can be ordered at SIEB & MEYER as an optional accessory for device configuration. This converter is developed especially for the amplifier series SD2x. Via the converter the devices can communicate with a PC without RS232 or RS485 interface.

A short USB cable is supplied with the converter. The connection cable to the drive amplifiers must be ordered additionally or built by yourself with suitable length.

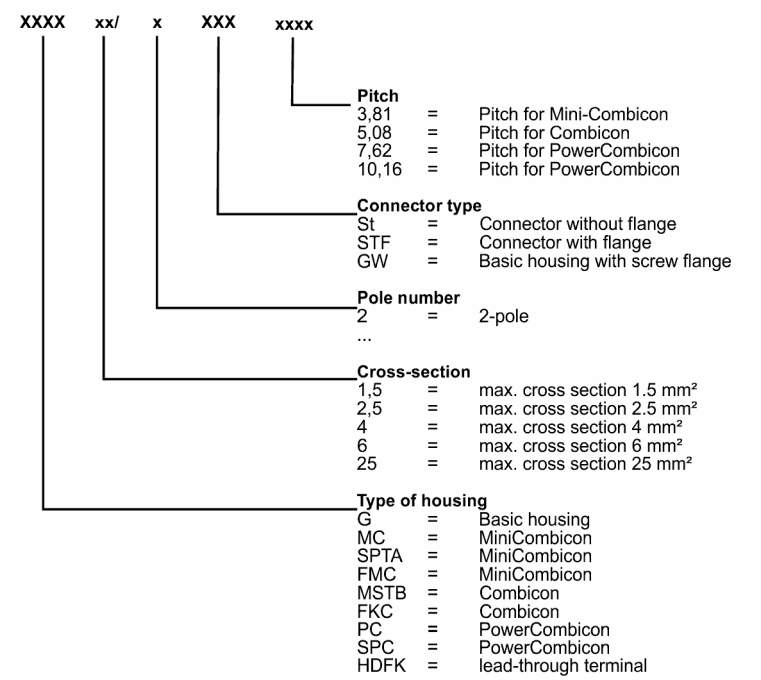
| SIEB & MEYER article number | Description |
|---|---|
| 050201 | USB>RS232/485 converter |
| K362103xxxR01 (xxx = cable length in dm) | RS232 device connection cable to the converter 050201 |

For further information refer to the document “USB_Converter_050-20-1.pdf”.

## 14.B.2 Phoenix Contact

http://www.phoenixcontact.com

### Order key for Phoenix connectors




Labeled connectors can be ordered at SIEB & MEYER.

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