2 Configuration and Connection Examples

DANGER

The device must be disconnected from its voltage supplies (24 V DC electronics supply and DC link / mains voltage) before the control and encoder leads are connected or disconnected!

2.1 Compact PLUS type units

2.1.1 Single-axis drive

The single-axis drive (see Fig. 2-1) is used if only single-drive tasks need to be accomplished or if power equalization through several axes is either undesired or not possible.

For this purpose, a converter is used that is directly connected to the 3-phase supply via an external main contactor, a line filter and a line reactor as necessary. Any regenerative energy is stored in the capacitor module or reduced in the braking resistor.

2.1.2 Multi-axis drive up to 3 axes

In the case of multi-axis drives (see Fig. 2-2) a converter (AC-AC) can be combined with inverters (DC-AC). The converter rectifies the line voltage and supplies the inverters with direct voltage via the DC link bus module. The power supply integrated in the converter further provides the 24 V supply voltage for the electronics of a maximum of 2 inverters.

CAUTION

If more than 2 inverters are connected, the 24 V supply for the electronics must be provided by an external power supply.

The total rated output currents of the inverters supplied by a converter must not exceed the rated output current of the feeding converter (in the case of 6SE7021-0EP60 only half the rated output current).

The regenerative energy generated in one axis can either be used up by the other motors, stored in the capacitor module or reduced in the braking resistor.

2.1.3 Multi-axis drive

In the case of multi-axis drives (see Fig. 2-3) with more than 3 axes, several inverters are connected to the line voltage via a common rectifier unit.

An external power supply is required for the 24 V supply voltage for the inverter electronics.

The regenerative energy originating in one axis can be used by the other motors, stored in the capacitor module or dissipated in the braking resistor.

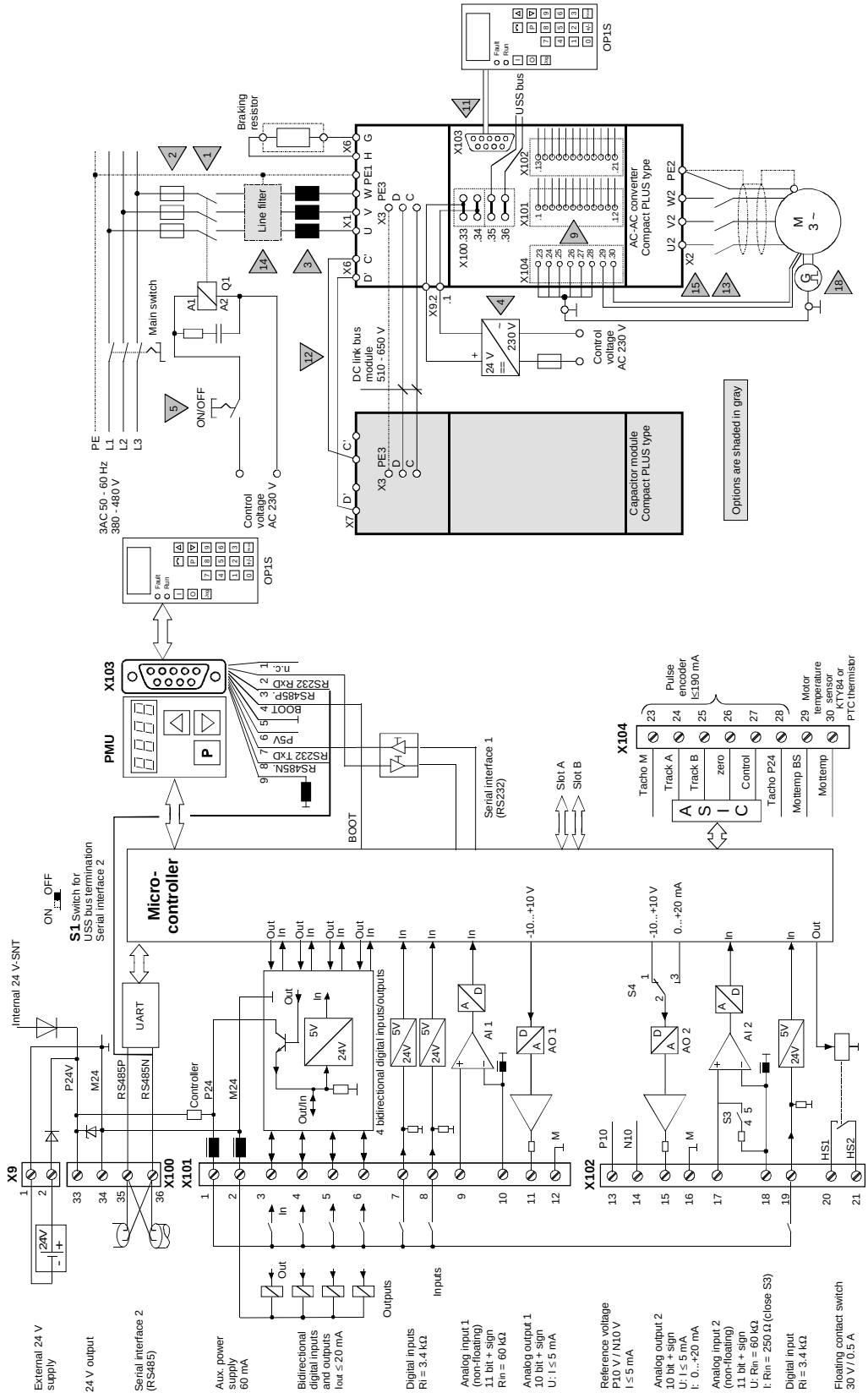


Fig. 2-1 Configuration example of a single-axis drive of the Compact PLUS type

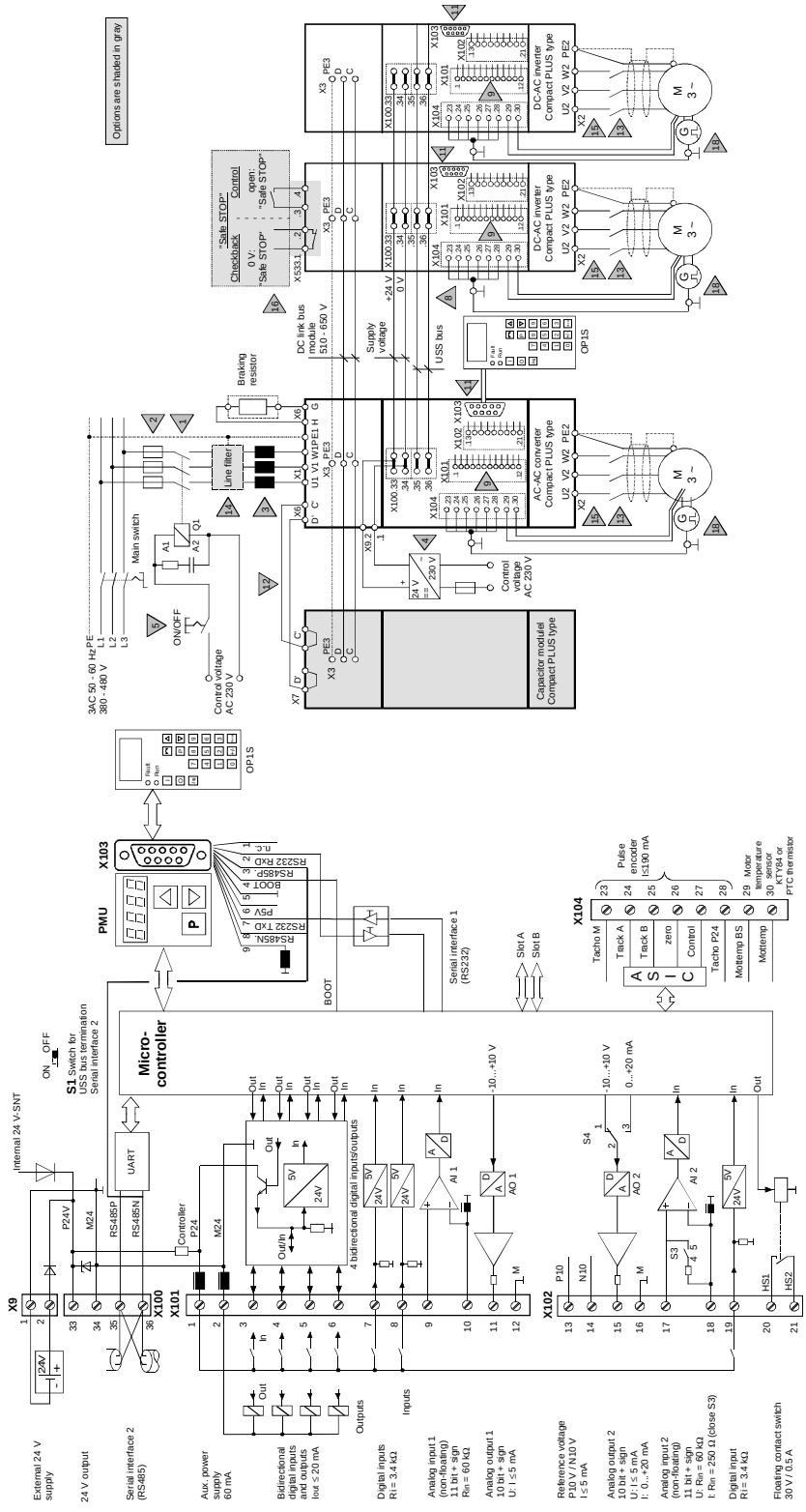


Fig. 2-2 Configuration example of a multi-axis drive with up to 3 axes of the Compact PLUS type

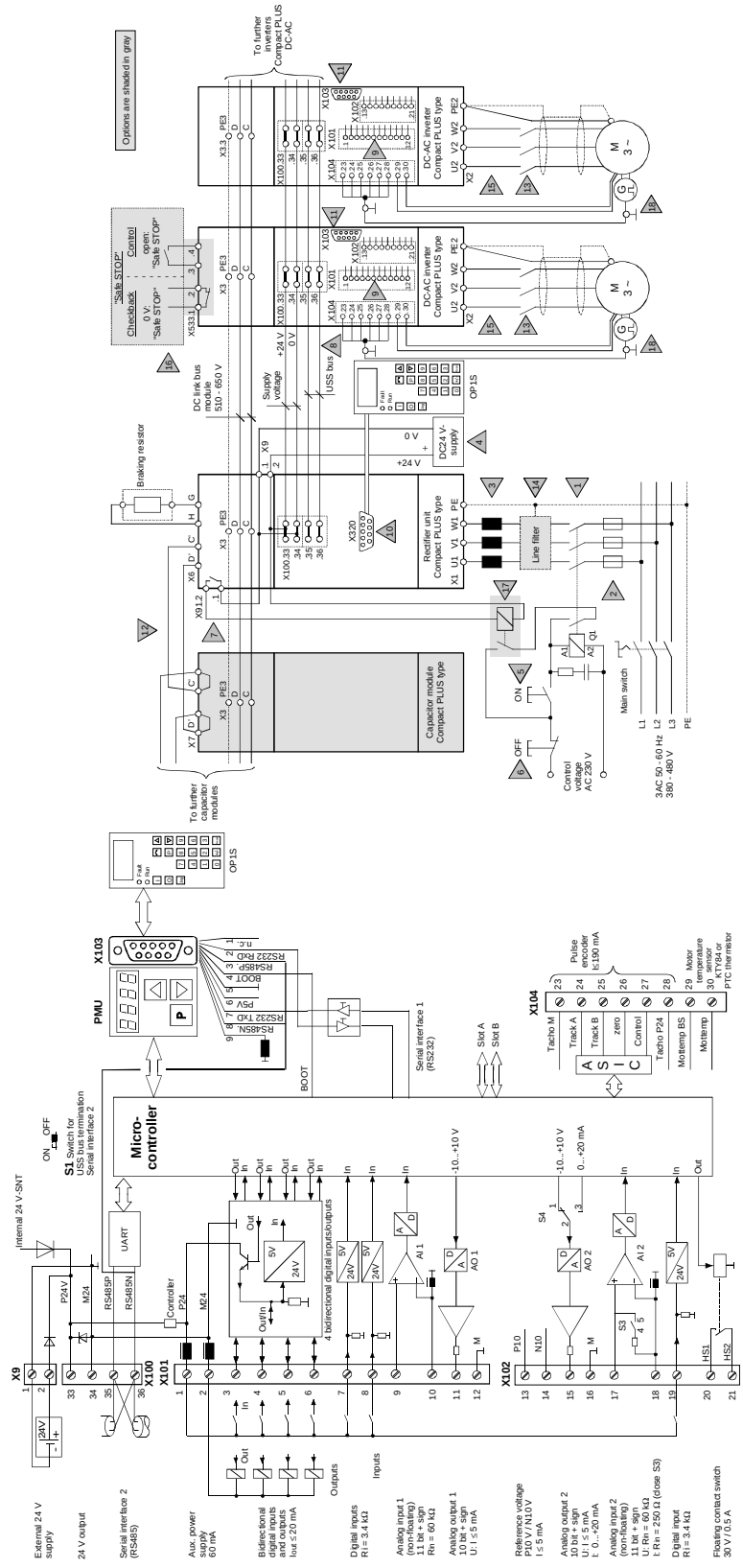


Fig. 2-3 Configuration example of a multi-axis drive with rectifier unit of the Compact PLUS type

2.1.4 Configuration and Connection Examples (Compact PLUS)

NOTE

The following explanations refer to the numbered gray triangles in Figs. 2-1 to 2-3. These figures are just examples of possible configurations of drives. The necessary individual components have to be clarified according to the specific task.

The information and notes required for dimensioning the individual components and the respective order numbers can be found in the Catalog.

1) Line contactor Q1

All the equipment is connected to the line via the line contactor, which is used to separate it from the line if required or in the event of a fault. The size of the line contactor depends on the power rating of the connected converter or inverter.
If the line contactor is controlled from the converter, the main contactor checkback time P600 should be set to at least 120 ms.

2) Line fuses

According to their response characteristic and to suit the requirements, the line fuses protect the connected cables and also the input rectifier of the unit.

3) Line commutating reactor

The line commutating reactor limits current spikes, reduces harmonics and is necessary for keeping system perturbations to within the limits laid down by VDE 0160.

4) 24 V power supply

The external 24 V supply is used to maintain the communication and diagnostics of the connected-up units even with powered-down line voltage.

The following criteria apply regarding dimensioning:

- A current of 1 A must be provided for the rectifier unit, and a current of 2 A for each inverter connected.
- When the 24 V supply is powered up, an increased inrush current will be generated that has to be mastered by the power supply.
- No controlled power supply unit has to be used; the voltage must be between 20 V and 30 V.

5) ON/OFF

In the case of a single drive and a multi-axis drive without a rectifier unit, a switch is used to energize or de-energize the line contactor. When they are switched off, the drives are not brought to a controlled standstill, but are braked only by the load.

In the case of a multi-axis drive with a rectifier unit, a pushbutton is used to energize the line contactor. The line contactor is kept energized by means of a lock-type contact connected to the fault signaling relay of the rectifier unit, as long as no fault is detected at the rectifier unit.

6) OFF switch

Operating the OFF switch causes the line contactor to open immediately.

The drives are not brought to a controlled standstill, but are braked only by the load.

7) Fault signaling relay

If a fault occurs in the rectifier unit, a fault message is output via the connecting contacts of the signaling relay.

When the 24 V supply is connected, the relay closes as long as no fault is present.

In the event of a fault, the lock of the line contactor is opened, the contactor drops out and the drives coast down.

8) Internal USS bus

The USS bus is used for the internal communication of the units and only has to be connected if it is required.

9) X101

The digital inputs and outputs and the analog input and output have to be assigned according to the requirements of the drives.

CAUTION: Terminal X101.1 may **not** be connected with the external 24V supply.

10) X320 interface of the rectifier unit

The X320 interface of the rectifier unit serves only for permanently connecting the user-friendly OP1S operator control panel and for connection to the on-line inverters.

Please refer to the relevant operating instructions for the applicable measures and notes for correct operation.

11) X103 serial interface

The serial interface is used to connect the user-friendly OP1S operator control panel or a PC. It can be operated either according to the RS232 or the RS485 protocol.

Please refer to the relevant operating instructions for the applicable measures and notes for correct operation.

12) Precharging the capacitor module

When a capacitor module is used, the terminals for precharging the capacitors must be connected.

13) Output contactor

The use of an output contactor is purposeful if a motor needs to be electrically isolated from the converter/inverter with the DC link charged.

14) Line filter

Use of a line filter is necessary if the radio interference voltages generated by the converters or rectifier units need to be reduced.

15) Motor supply line

The Siemens cables described in the catalog should be used for connecting the converter and the motor to each other.

16) Safe STOP (Option)

The "Safe Stop" option enables the power supply for the transmission of pulses into the power section to be interrupted by a safety relay. This ensures that the unit will not generate a rotating field in the connected motor.

17) Auxiliary contactor

The auxiliary contactor is used to interrupt the self-holding condition of the main contactor in the event of a fault signal. It must be used if the control voltage for line contactor Q1 is 230 V AC.

The auxiliary contactor is not required if a line contactor with a control voltage of 24 V DC is used.

18) Pulse generator

Used to acquire the motor speed and allows speed-controlled operation with the highest degree of dynamic response and precision.

Braking resistor

The brake choppers are already included in the Compact PLUS rectifier units and converters. Only a suitable external braking resistor has to be connected up, if required.

See also Chapter 11.7.

Encoder cable

You will find preassembled encoder cables in Catalog DA65.10, chapter 3. Please note that different encoder cables are required for encoders and multiturn encoders. If the wrong encoder cable is used for one or the other, fault F051 (during operation) or alarm A018 or A019 is generated.

DANGER

The encoder cable must only be connected and plugged in when the converter is disconnected from the supply (24 V and DC link). Damage to the encoder could result if this advice is not heeded.

2.2 Compact and chassis-type units

2.2.1 Water-cooled units

If you are using **water-cooled** MASTERDRIVES please note that the permissible operating pressure depends on the construction type.

Type B to G Operating pressure ≤ 1 bar. Operating pressures above 1 bar not permitted! If the system is to be operated at higher pressure, the pressure on each unit must be reduced to 1 bar initial pressure.

Type ≥ J Operating pressure ≤ 2.5 bar. Operating pressures above 2.5 bar not permitted! If the system is to be operated at higher pressure, the pressure on each unit must be reduced to 2.5 bar initial pressure.

2.2.2 Single units

The following two configuration examples show the wiring of a converter (AC-AC) and an inverter (DC-AC).

The mains and motor connections and the connection to the braking unit and fan can be seen on the right-hand side of the diagram.

The control terminal strips of the CUVC control board (Vector Control) are shown enlarged for clarity on the left-hand side of the diagram.

Fig. 2-2 shows wiring examples for analog and digital inputs and outputs.

You will also find descriptions of the terminals in the operating instructions in the chapter entitled "Connecting-up".

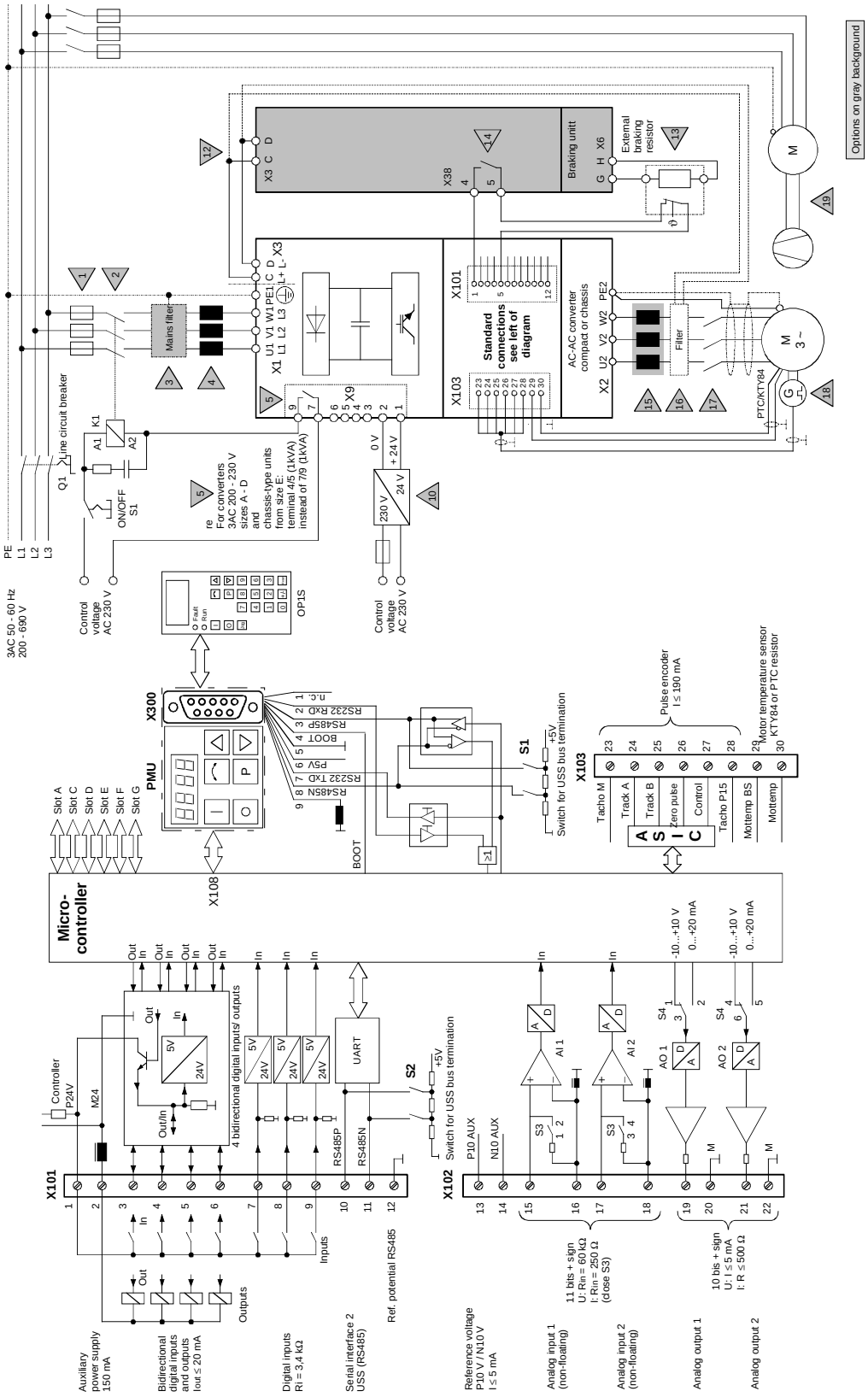


Fig. 2-4 Configuration example for compact or chassis-type unit (AC-AC)

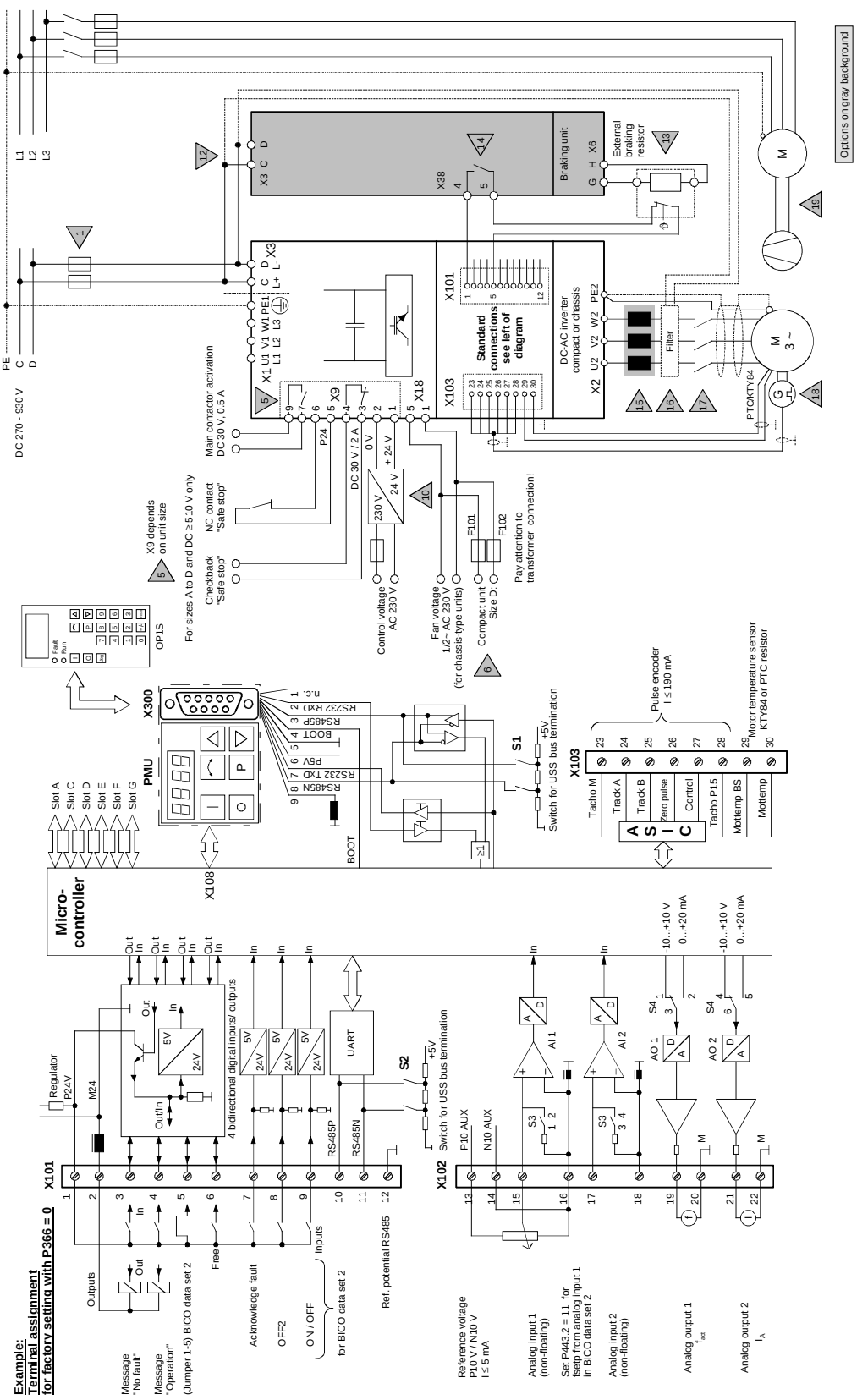


Fig. 2-5 Configuration example for compact or chassis-type unit (DC-AC)

2.2.3 Configuration example with rectifier/regen.feedback unit

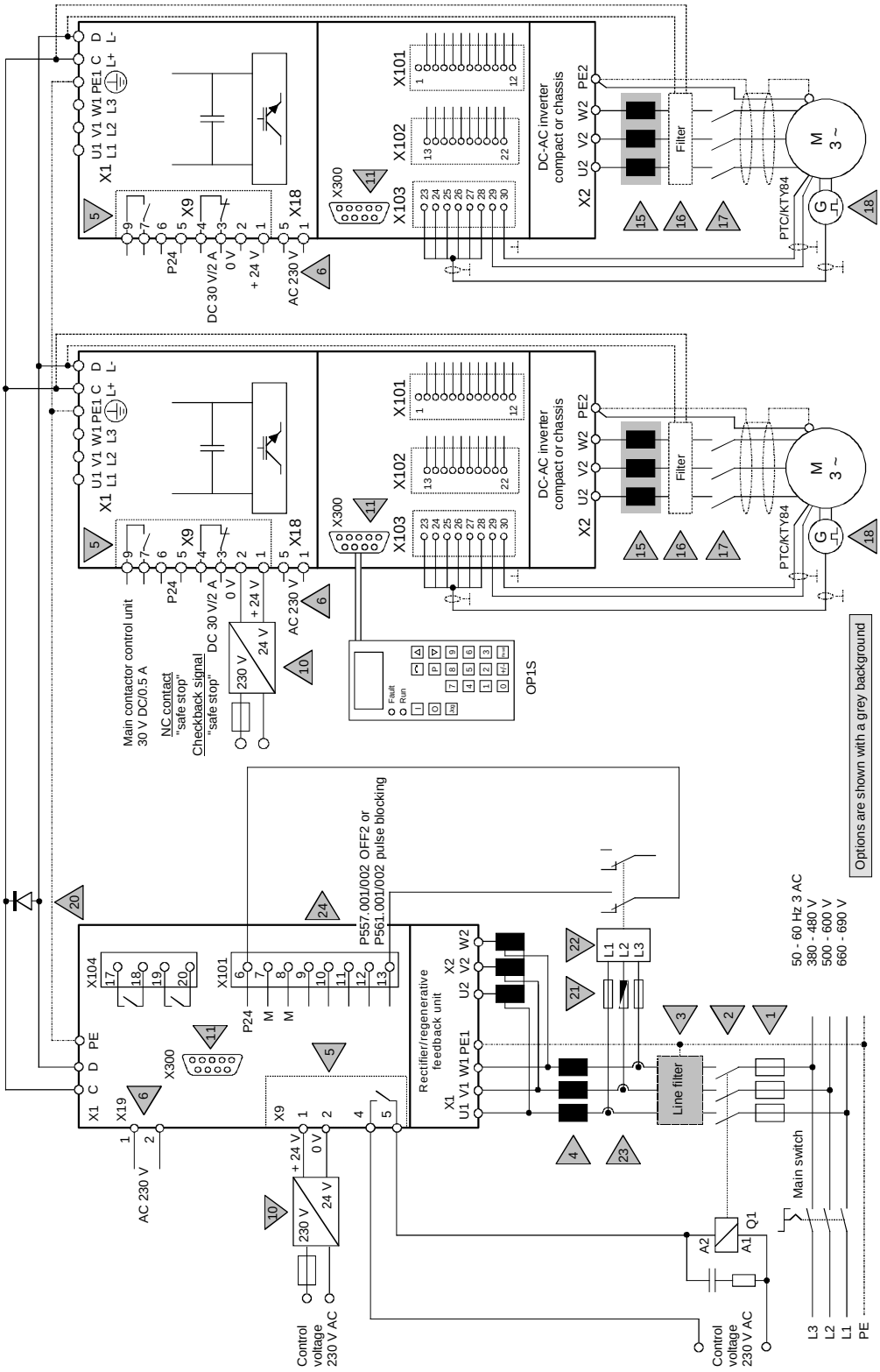


Fig. 2-6 Configuration example with rectifier/regenerative feedback unit

2.2.4 Explanations relating to the configuration examples (Compact and chassis-type units)

NOTE

The following explanations refer to the numbered gray triangles in Figs. 2-1 to 2-3. These diagrams each show a drive configuration example. The need for the individual components must be clarified according to the given application.

In the catalog you will find the necessary information and notes concerning the ratings of the individual components and the pertinent order numbers.

1) Line fuses

The line fuses afford protection against short circuit and, depending on their utilization category (gL, gR or aR), also protect the connected conductors and rectifier or input rectifier of the unit.

2) Line contactor K1

The converter or rectifier units, or infeed/regenerative feedback unit is connected to the power supply via the line contactor and disconnected in case of need or in the event of a fault.

The system is dimensioned according to the output of the connected converter, rectifier unit or rectifier/regenerative feedback unit.

3) Radio interference suppression filter

A radio interference suppression filter is required whenever the radio interference voltages originating from converters or rectifier units must be reduced according to EN 61800-3.

4) Line commutating reactor

The line commutating reactor limits current peaks and reduces harmonics. It is also required, among other things, for compliance with the permissible system perturbations according to EN 50178 and compliance with the radio interference suppression voltages.

5) Control terminal strip X9

The X9 1/2 control terminals are provided with a connection for supplying devices requiring an external 24 V DC control voltage.

Terminals X9 7/9 on the compact units (inverters) and X9 4/5 on the chassis units (converter and inverter) allow the output of an isolated digital signal, e.g. to control a main contactor.

Function "SAFE STOP" on compact inverters and input units (converters and inverters) with option K80

With the "SAFE STOP" function, a safety relay can be used to interrupt the power supply for pulse transmission in the power section. This ensures that the inverter cannot operate the connected motor.

6) Fan power supply for inverter devices

On all chassis and compact units of type D, a supply voltage of 230 V AC 50/60 Hz is required for the fans. The chassis units are connected via X18:1.5 and the compact units are connected directly to fan fuses F101 and F102.

10) 24 V auxiliary power supply

The external 24 V power supply serves to back up the communications and diagnostics functions of the connected devices when the line voltage is switched off. Rectifier units always require an external 24 V power supply.

The following criteria apply to dimensioning:

- Currents (see Catalog DA65.10)
- When the 24 V supply is switched in, an inrush current has to be dealt with by the power supply.
- There is no need to install a stabilized power supply; the voltage range must be kept between 20 V and 30 V.

11) X300 serial interface

The serial interface is used for connecting the OP1S operator pane or a PC. It can be operated according to the RS232 or the RS485 protocol, as desired.

Please refer to the operating instruction for information concerning proper operation.

15) Output reactors

Limit the capacitive currents arising from long motor cables and make it possible to operate motors situated a long way from the converter/inverter.
(See Catalog DA65.10 Chapter 6).

16) Sine wave filter du/dt-Filter

Limit the rate of voltage rise occurring at the motor terminals and the voltage peak (du/dt-Filter) or generate a sinusoidal voltage characteristic (sine wave filter) at the motor terminals (see Catalog DA65.10, Chapter 6).

17) Output contactor

An output contactor serves a useful purpose wherever, with charged DC link, a motor has to be electrically isolated from the convert/rectifier unit.

18) Pulse generator

Used to acquire the motor speed and allows speed-controlled operation with the highest degree of dynamic response and precision.

19) Motor fan

Is to be operated in the case of separately ventilated motors.

20) Freewheeling diode

For protection of the connected inverters against commutation failure.

21) Fuse

To protect the signal cables of a phase failure relay.

22) Phase failure relays

Types suitable for a system voltage of 400 V 3 AC:

- Siemens 5TT3407 suitable for TN systems
- Dold IL9079001 suitable for TN, TT and IT systems
  Address: E. Dold & Söhne KG, PF 1251, D 78114 Furtwangen
  Tel.: +49 7723/6540, Fax.: +49 7723/654356

The maximum response delay time is 20 ms.

The phase failure relays must be connected according to their construction type.

23) Voltage transformer

If the supply voltage deviates from 400 V, voltage transformers with a primary voltage corresponding to supply voltage U1 and U2 = 400 V on the secondary side must be used.

The voltage transformers should correspond to class 0.5 or 1; size 3 VA

Transformers available on request from:

Ritz Messwandler GmbH & Co.
Salomon-Heine-Weg 72
D-20251 Hamburg
Tel.: +49 40/51123-0, Fax.: +49 40/51123-111

ELGE Elektro-Apparate GmbH
Grenzweg 3
D-91233 Neunkirchen
Tel.: +49 9123/6833

24)

The output of the phase failure relay controls a digital input of the rectifier/regenerative feedback unit on the CUR. Depending on the requirements of the system, this input is assigned function AUS2 (trip command with direct pulse disable P557.i) and disables the thyristors to avoid a commutation failure very effectively.

2.3 Examples of motor junction wiring

2.3.1 Shielded cabling meeting EMC requirements to maintain EMC limit values

The limit values of class A for industrial plants are met with the cabling as shown in Fig. 2-7 and Fig. 2-8.

The limit values of class B1 for public networks are met with the cabling as shown in Fig. 2-8.

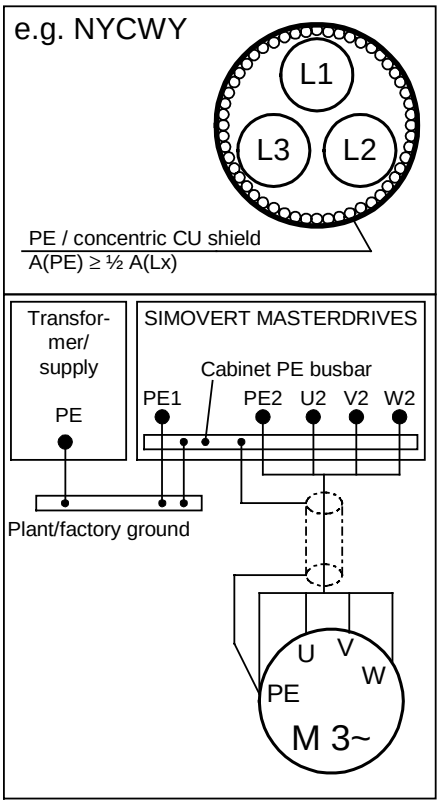


Fig. 2-7 *Protodur power cable:*
NYCY -0.6/1kV
NYCWY -0.6/1kV

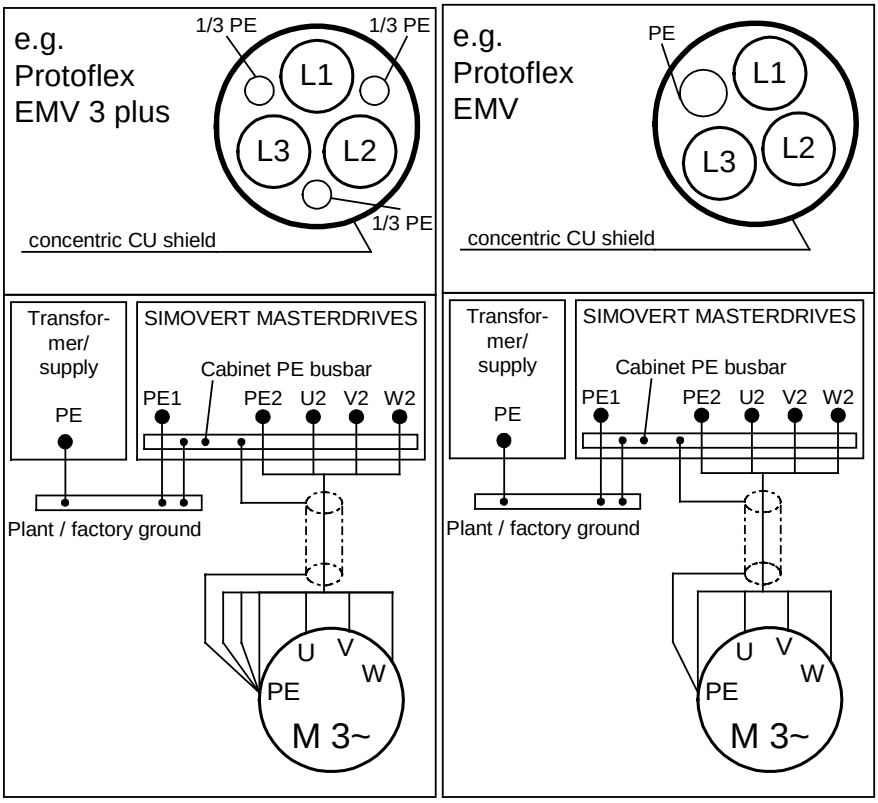


Fig. 2-8 Protoflex power cable 2YSLCY-J -0.6/1kV

2.3.2 Unshielded cabling

Cabling installed according to the following figure is sufficient for technical operation of the drive.

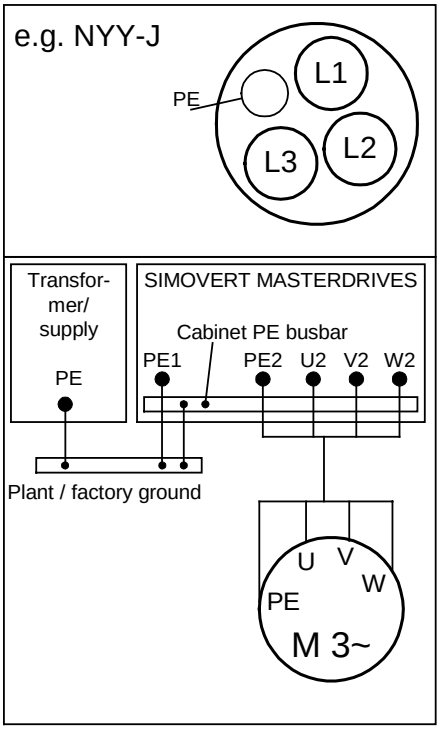


Fig. 2-9 Protodur power cable NYY-J -0.6/1kV

2.4 "Safe STOP" function

NOTICE

The "SAFE STOP" function of SIMOVERT MASTERDRIVES (also known as "Starting lockout" in SIMODRIVE 611) satisfies EN 60 204-1/DIN VDE 0113 Part 1 Section 5.4, "Devices for switching off and preventing unexpected starting", but does not satisfy Section 5.3, Main switch function (isolating from the power supply). The main switch function can be performed only by the use of an electrically isolating switching element. The "SAFE STOP" function is also suitable for implementing the stop function according to Category 0 and 1 as defined by EN 60 204-1 / VDE 0113 Part 1, Section 9.2.2.
The requirements for the behavior of the control functions in the case of a fault (EN 60204-1, Section 9.4) are met by fulfillment of the requirements of EN 954-1 acc. to Category 3.

Purpose of the "SAFE STOP" function

The SAFE STOP function is supplied as standard with SIMOVERT MASTERDRIVES of the compact series of inverter units in sizes A to D (with the exception of converters and inverters for 270 V DC to 310 V DC). In the case of chassis units and Compact PLUS units, this function is obtainable in the form of the K80 option.

The "SAFE STOP" function prevents unexpected starting from standstill of the connected motor. The "SAFE STOP" function should not be activated until after the drive is at standstill, because otherwise no further braking is possible. That is why the drive must be brought to standstill and secured by means of an external machine control. The "SAFE STOP" function interrupts the power supply used to drive the IGBT modules.

NOTICE
Residual risk

A residual risk remains in the event of two faults occurring at the same time. The drive can then turn through a small angle (permanent-field synchronous servomotors, e. g. 1FT6, 1FK6: 4-pole 90°, 6-pole 60°, 8-pole 45°; asynchronous motors: in the remanence range max. 1 slot division, or about 5° to15°).

The "SAFE STOP" function does not electrically isolate the equipment and therefore gives not protection from "electric shock".

The whole machine must be isolated from the supply system by opening the main switch (EN 60204/5.3) in the event of production shutdowns or for maintenance, repair and cleaning work on the machine or plant.

When used with the positively-driven signal contacts of the compact inverter units, the "SAFE STOP" function has to be connected to terminal strip X9: 3/4 (chassis units: terminal strip X533: 1/2) in the line contactor circuit or EMERGENCY OFF circuit. If there is any doubt as to whether the SAFE STOP relay is functioning correctly with respect to the operating mode of the machine, the drive concerned must be electrically isolated from the power supply, e. g. by means of a line contactor. The "SAFE STOP" function and the associated mode of operation must not be used again until after the fault has been remedied.

NOTICE

When the "SAFE STOP" function is activated, it is possible in some cases for the "Operating" status signal to be generated at the converter/inverter. But the pulses are **not** released and so the motor **cannot** turn. A hazard is therefore **ruled out**.

From the control, with the aid of 'Checkback SAFE STOP' (X9 Pin 3/4; X533 Pin 1/2), make sure that the SAFE STOP function cannot be deactivated in converter statuses other than 'READY FOR OPERATION' or 'READY FOR SWITCHING ON'.

In order that the converter/inverter control recognizes the 'SAFE STOP' status and proceeds to process this status in the sequencing control, a binary input of the CUVC control unit must be activated, thereby generating the OFF2 command (cf. P555...P557) and hence a starting lockout.

When the OFF2 command is activated via "SAFE STOP", the converter status changes to 'Starting lockout'.

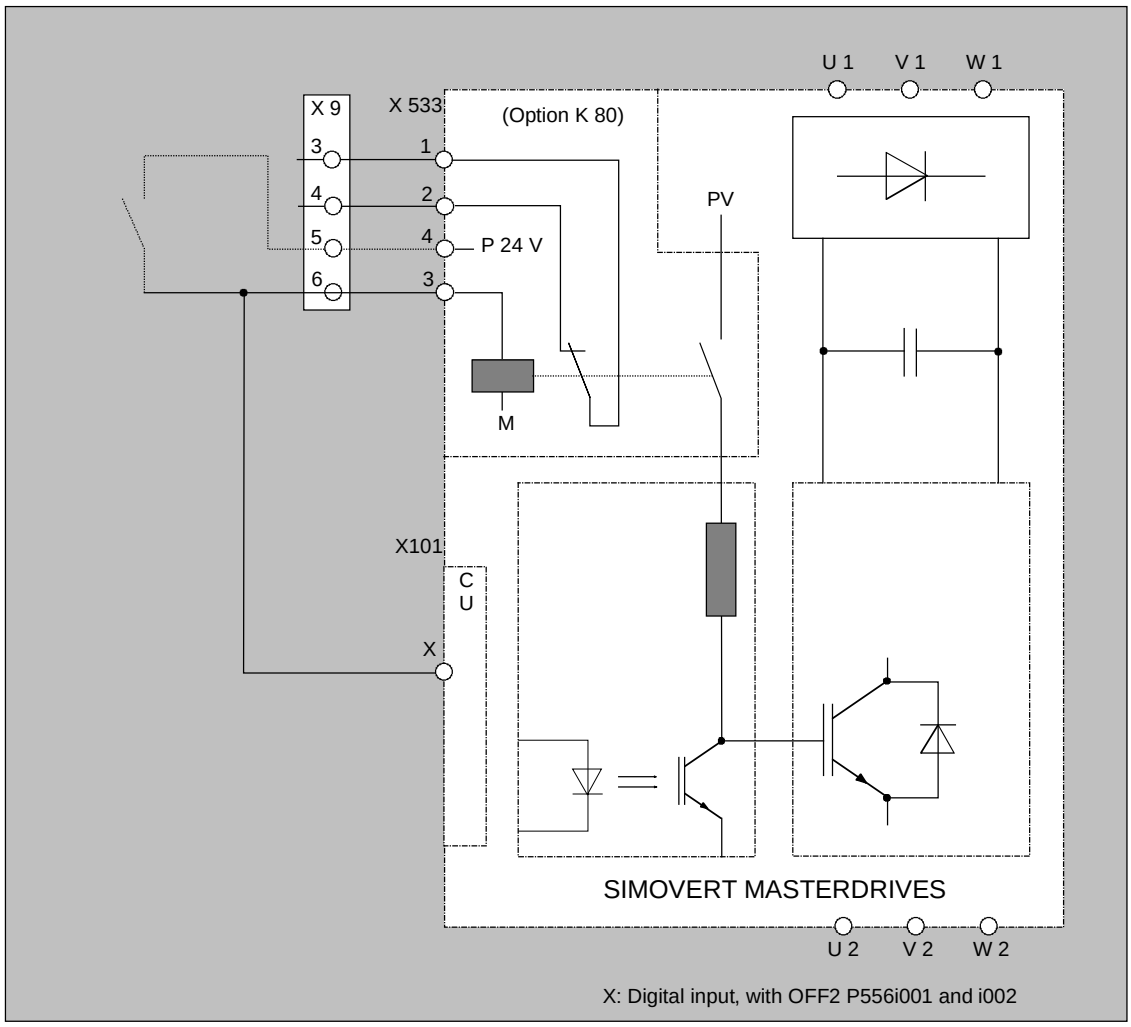


Fig. 2-10 Configuration of the "Safe STOP" function in a SIMOVERT MASTERDRIVES unit

Operating principle of "SAFE STOP"

The power supply to the individual motor windings is controlled by means of the inverter power sections. A pulse formation logic drives the 6 IGBT power transistors in a rotating-field-oriented pattern.

In each transistor arm, an optocoupler/fiber optic cable is connected between the control logic and the control amplifier of the power section for potential isolation.

As it cannot be ruled out that the inverter electronics will generate a pulse pattern capable of producing a rotating field (without a start command being present), a method was found of safely preventing the pulse pattern from reaching the ignition and control inputs of the IGBTs. The "SAFE STOP" ACTIVE function implements an electrical separation (interrupt) between the power supply and the driver electronics of the IGBT inverter, thereby preventing the motor from turning. The "SAFE STOP" function is activated by an external NO contact and is active when the "SAFE STOP relay" has dropped out. In the event of failure of the "SAFE STOP" function, the "SAFE STOP" checkback contacts must separate the drive from the power supply by means of a line contactor or the EMERGENCY STOP circuit.

No rotating-field-oriented operation of the power transistors is possible while the "SAFE STOP" function is active. Simultaneous welding of two IGBTs is the worst case leading to the residual risk described in the above.

NOTICE

- The motor can no longer develop torque while the "SAFE STOP" function is activated. Non-self-locking drives must be secured by means of a mechanical brake.
- The "SAFE STOP" function is not suitable for bringing a running motor to a standstill as quickly as possible, because this function turns off the control pulses and so the motor is braked only by the load.

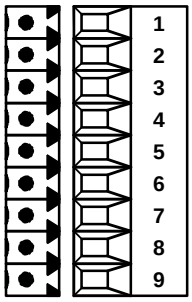
Advantage: The "SAFE STOP" function makes it unnecessary to provide motor contactors.

Connection of the "SAFE STOP" function

In the case of compact inverter units, the "SAFE STOP" function is addressed via terminal strip X9:5/6, while in the case of chassis units it is addressed via terminal strip X533:3/4. When dropped out, the SAFE STOP relay activates the "SAFE STOP" function.

Closure of terminals X9:3/4, or terminals X533:1/2 signifies that the "SAFE STOP" function is active. These terminals provide a potential-free signal of the status of the "SAFE STOP" function.

X9

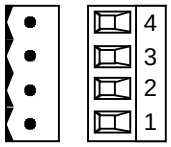


Terminal	Designation	Description	Range
1	+24 V (in)	24 V voltage supply	DC 24 V ≤ 2.5 A
2	0 V	Reference potential	0 V
3	Contact 1	"Safe STOP" checkback	2 A
4	Contact 2	"Safe STOP" checkback	DC30 V
5	P24 DC	"Safe STOP" supply voltage	10...30 mA
6	Switched signal	"Safe STOP" control input	DC 30 V
7	HV control	Main contactor control	
8	Not connected	Not used	
9	HV control	Main contactor control	DC30 V, 0.5 A

Connectable cross-section: 1.5 mm² (AWG 16)

Table 2-1 Terminal connections of external aux. voltage supply DC 24 V, Safe STOP, main contactor control for compact units

X533



Terminal	Designation	Description	Range
4	P24 DC	"Safe STOP" supply voltage	DC24 V
3	Switched signal	"Safe STOP" control input	30 mA
2	Contact 2	"Safe STOP" checkback	DC 30 V
1	Contact 1	"Safe STOP" checkback	2 A [1)]

Connectable cross-section: 2.5 mm² (AWG 12)

Table 2-2 Terminal connections of the K80 Option "Safe STOP" on chassis units

1) Compact PLUS tpye: 1 A