Rexroth
Bosch Group

Rexroth ServoDyn D
Connectivity Manual

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Edition 06

Mounting guidelines

Title	Rexroth ServoDyn D Connectivity Manual
Type of Documentation	Mounting guidelines
Document Typecode	DOK-SERV*D-IF*MANUAL**-MA06-EN-P
Purpose of Documentation	The present manual provides information on the installation of the ServoDyn D drive modules.

Record of Revisions

Description	Release Date	Notes
DOK-SERV*D-IF*MANUAL**-MA06-EN-P	08.2004	

Validity   The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The given information does not release the user from the obligation of own judgement and verification. It must be remembered that our products are subject to a natural process of wear and aging.

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Safety instructions

1   Safety instructions

Please read this manual before commissioning the ServoDyn D inverters. Store this manual in a place to which all users have access at any time.

1.1   Intended use

This manual contains information required for the intended use of this product.

The drive inverters described

- have been developed, manufactured, tested and documented in compliance with the safety standards. These products pose no danger to persons or property if they are used in accordance with the handling stipulations and safety notes prescribed for their configuration, mounting, and proper operation.
- comply with the requirements of
  - the EMC Directives (89/336/EEC, 93/68/EEC and 93/44/EEC)
  - the EMC product standard EN 61800-3 + A11
  - the Low-Voltage Directive (73/23/EEC)
  - the harmonized standards EN 50178 (VDE 0160) and EN 60146-1-1 (VDE 0558-11)
- are designed for operation in industrial environments, i.e.
  - no direct connection to public low-voltage power supply,
  - connection to the medium- or high-voltage system via a transformer.

  In residential environments, in trade and commerce as well as small enterprises class A equipment may only be used if the following warning is attached:

☞ **This is a Class A device. In a residential area, this device may cause radio interference. In such case, the user may be required to introduce suitable countermeasures, and to bear the cost of the same.**

Before putting the drive inverters into operation, ensure that the machine which the inverters are to be installed in meets the stipulations of the machinery directive (98/37/EEC, 98/79/EEC) and the EMC directive (89/336/EEC).

The faultless, safe functioning of the product requires proper transport, storage, erection and installation as well as careful operation.

Safety instructions

1.2   Qualified personnel

The requirements as to qualified personnel depend on the qualification profiles described by ZVEI (central association of the electrical industry) and VDMA (association of German machine and plant builders) in:
Weiterbildung in der Automatisierungstechnik
edited by: ZVEI and VDMA
MaschinenbauVerlag
Postfach 71 08 64
D-60498 Frankfurt.

The present manual is designed for **drive technicians**.

Programming, start and operation as well as the modification of program parameters is reserved to properly trained personnel! This personnel must be able to judge potential hazards arising from programming, program changes and in general from the mechanical, electrical, or electronic equipment.

Interventions in the hardware and software of our products, unless described otherwise in this manual, are reserved to our specialized personnel.

Tampering with the hardware or software, ignoring warning signs attached to the components, or non-compliance with the warning notes given in this manual may result in serious bodily injury or material damage.

Only electrotechnicians as recognized under IEV 826-09-01 (modified) who are familiar with the contents of this manual may install and service the products described.

Such personnel are
● those who, being well trained and experienced in their field and familiar with the relevant norms, are able to analyze the jobs being carried out and recognize any hazards which may have arisen.
● those who have acquired the same amount of expert knowledge through years of experience that would normally be acquired through formal technical training.

With regard to the foregoing, please note our comprehensive range of training courses. Please visit our website at http://www.boschrexroth.com for the latest information concerning training courses, teachware and training systems. Personal information is available from our Didactic Center Erbach,
Telephone: (+49) (0) 60 62 78-600.

Safety instructions

1.3   Safety markings on products

     Warning of dangerous electrical voltage!

     Electrostatically sensitive components!

     Warning of hazardous light emissions
(optical fibre cable emitters)!

     Lug for connecting PE conductor only!

     Connection of shield conductor only

Safety instructions

1.4   Safety instructions in this manual

DANGEROUS ELECTRICAL VOLTAGE
This symbol is used to warn of a **dangerous electrical voltage.** The failure to observe the instructions in this manual in whole or in part may result in **personal injury**.

DANGER
This symbol is used wherever insufficient or lacking compliance with instructions may result in **personal injury**.

CAUTION
This symbol is used wherever insufficient or lacking compliance with instructions may result in **damage to equipment or data files**.

☞   This symbol is used to draw the user's attention to special circumstances.

★   This symbol is used if user activities are required.

Safety instructions

1.5   Safety instructions concerning the described product

DANGER
Danger of life through inadequate EMERGENCY-STOP devices!
EMERGENCY-STOP devices must be active and within reach in
all system modes. Releasing an EMERGENCY-STOP device must
not result in an uncontrolled restart of the system!
First check the EMERGENCY-STOP circuit, then switch the sys-
tem on!

DANGER
Danger for persons and equipment!
Test every new program before starting up a system!

DANGER
Retrofits or modifications may adversely affect the safety of the
products described!
The consequences may include severe injury, damage to equip-
ment, or environmental hazards. Possible retrofits or modifica-
tions to the system using third-party equipment therefore have to
be approved by Rexroth.

DANGER
Health hazards through destroyed electrical components!
Do not destroy any built-in components. Dispose of destroyed
components in a proper manner.

DANGER
Do not look directly into the LEDs in the optical fiber connection.
Due to their high output, this may result in eye injuries.
When the inverter is switched on, do not look into the LED or the
open end of a short connected lead.

DANGER
Please note your local, system-specific regulations and require-
ments as well as the proper use of tools, hoisting and transport
equipment as well as the applicable standards, regulations, and
accident prevention regulations.

Safety instructions

DANGEROUS ELECTRICAL VOLTAGE
Unless described otherwise, maintenance works must be performed on inactive systems! The system must be protected against unauthorized or accidental reclosing.
Measuring or test activities on the live system are reserved to qualified electrical personnel!

DANGEROUS ELECTRICAL VOLTAGE
Lethal voltages of up to 375 V DC against ground on all power connections and DC link connections!

The drives must not be switched on unless all covers have been fitted! When the drive has been disconnected from mains, wait for up to 5 minutes until the system is de-energized before removing any covers.
The drive must always be examined for safe isolation from supply!

CAUTION
Use only spare parts approved by Rexroth!

CAUTION
Danger to the module!
All ESD protection measures must be observed when using the module! Prevent electrostatic discharges!

The following protective measures must be observed for modules and components sensitive to electrostatic discharge (ESD)!

- Personnel responsible for storage, transport, and handling must have training in ESD protection.
- ESD-sensitive components must be stored and transported in the prescribed protective packaging.
- ESD-sensitive components may only be handled at special ESD-workplaces.
- Personnel, working surfaces, as well as all equipment and tools which may come into contact with ESD-sensitive components must have the same potential (e.g. by grounding).
- Wear an approved grounding bracelet. The grounding bracelet must be connected with the working surface through a cable with an integrated 1 MΩ resistor.
- ESD-sensitive components may by no means come into contact with chargeable objects, including most plastic materials.
- When ESD-sensitive components are installed in or removed from equipment, the equipment must be de-energized.

Safety instructions

1.6   Documentation, software release and trademarks

Documentation

The present manual provides information on the installation of the ServoDyn D drive modules.

Manuals	Part no. German	English	French	Italian
Servo motors SF, SR	1070066 004	1070066 024	1070066 048	1070066 046
Asynchronous motors DU	1070066 007	1070066 027	–	–
ServoDyn D, Configuration - Manual for overview and rating	1070066 009	1070066 029	1070066 059	1070066 049
ServoDyn D, Connectivity Manual	1070066 010	1070066 030	1070066 060	1070066 050
ServoDyn D, - Parameter manual (without CANopen)	1070066 018	1070066 038	1070066 068	1070066 058
ServoDyn D, Servodyn-M - Parameter manual CANopen	1070066 094	1070066 095	–	–
ServoDyn D with SERCOS interface - Parameter and commissioning manual	1070066 011	1070066 031	–	1070066 051
ServoDyn D with analog interface - Commissioning manual	1070066 014	1070066 034	–	–
ServoDyn D with CANrho interface - Commissioning manual	1070066 017	1070066 037	–	–
ServoDyn D with motion control - Commissioning manual	1070066 015	1070066 035	–	–
ServoDyn D with PROFIBUS-DP - Commissioning manual	1070066 090	1070066 091	–	–
ServoDyn D Frequency inverters DM/DS..8001 (ASM) Parameter and commissioning manual	1070066 008	1070066 028	–	1070066 053
Diagnostics, maintenance	1070066 012	1070066 032	1070066 062	1070066 052
RSU, Redundant safety monitoring	1070066 006	1070066 026	1070066 081	1070066 082
EMC manual	1070066 072	1070066 074	1070066 075	1070066 076
External load switching module EBX	1070066 077	1070066 080	–	–

Release

- The current software release number can be viewed by selecting parameter S-0-0030 with the DSS-D Commissioning and Service System, or in the "Software" field of the module configuration display (DIAGNOSTICS ▶ MODULE CONFIGURATION).

- For information concerning the current DSS software release, refer to HELP ▶ ABOUT...

Safety instructions

- The current VM..B,C,D,F software release can only be read from the 7-segment display during test operation. For this purpose, turn dip switch "T" on the VM's personality module "on":

  The following appears in a running, flashing display:
  "**Cxx.ZZ.ddmmyyyy**"

  Where: **xx** = software release number
  ZZ = (internal)
  dd = software creation day
  mm = software creation month
  yyyy = software creation year

Trademarks

All trademarks of software installed on Rexroth products upon delivery are the property of the respective manufacturer.

Upon delivery, all installed software is copyright-protected. The software may only be reproduced with the approval of Rexroth or in accordance with the license agreement of the respective manufacturer.

MS-DOS® and Windows™ are registered trademarks of Microsoft Corporation.

PROFIBUS® is a registered trademark of the PROFIBUS Nutzerorganisation e.V. (user organization).

SERCOS interface™ is a registered trademark of Interessengemeinschaft SERCOS interface e.V. (Joint VDW/ZVEI Working Committee).

Switch cabinet structure

2   Switch cabinet structure

2.1   Drive components

Mains connection module Type NAA

Contains all required fuses and power-up components for supply modules VM..B,C,D,F with current regeneration, NAA optionally with integrated mains filter.

The mains voltage of 3 x 400...460 V a.c. is directly connected here. Communication with the supply module takes place via control lines which can be plugged into the supply module.

NAA modules with an additional filter with symmetrical effect are available for connection to a public network.

Line wiring module Type NV

Contains fuses, mains contactor and an optional mains filter for supply modules VMA..K.

The mains voltage of 3 x 400...460 VAC is directly connected to this module.

Mains filter

Required interference suppression measure as specified in the EMC Directive (89/336 EEC). Thus, limit class A (B on request) for radio interference in accordance with EN 55 011 (VDE 0875) is complied with.

Line reactor Type NE

The line reactor type NE should be installed between the mains connection module and supply modules VM...B,C,D,F with current regeneration. It decouples the d.c. link from the mains.

Supply modules VMA..K with ballast switches do not require a line reactor.

Backplane modules Type RM

The backplane modules facilitate the mounting and wiring of VMA..B,C,D and DMA..A,B,D inverter modules.

They contain the following connections:

● the terminal block for the power connections
● connection terminals for the brake connection
● conductor bars for the link connection
● earthing link for the PE conductor connection

Switch cabinet structure

The backplane modules also bear the fan units for heat sink ventilation of the inverter modules.

The supply modules and three-phase modules are slotted into the backplane modules, plugged into the terminal blocks and locked.

Supply module Type VMA..K

The VMA..K supply module is directly connected to 3 x 400...460 VAC using the line wiring module. It generates a d.c. link voltage of 670 V from the mains voltage.

The link connection to the DM..K three-phase modules is established via covered conductor bars.

Supply module Type VMA..KR

The VMA..KR supply module is connected to the 3 x 400...460 VAC via the mains connection module and the line reactor. It generates a d.c. link voltage of 670 V from the mains voltage.

The link connection to the DM..K three-phase modules is established via covered conductor bars.

Supply modules Type VMA...B,C,D

The supply modules VMA..B,C,D are connected to the 3 x 400...460 V AC via the mains connection module and the line reactor. They generate a d.c. link voltage of 670 V from the mains voltage.

The link connection to the three-phase modules DMA..A,B,D is established via conductor bars integrated in the backplane modules. When combined with DM..K in compact mechanics, the d.c. link connection is achieved with the d.c. link connection accessory.

Supply module Type VMW..F

The VMW 180F supply module is designed for a maximum output of 120 kW and equipped with an integrated water cooling. It is directly connected to the 3 x 400...460 VAC mains network via the mains connection module and the line reactor.

The DC link connection to the three-phase current modules is made by covered current bars. If combined with modules without water cooling, the DC link connection must be made using the DC link accessory including a fuse.

Switch cabinet structure

Three-phase modules Type DM..K and Type DM..A,B,D,F

The servo motors type SF and SR or asynchronous motors type DU as well as asynchronous standard motors or special motors, such as high-frequency spindles, built-in motors or linear motors are operated using the DM three-phase modules.

Inverter modules with **SERCOS interface** contain the entire software on the plug-in Personality Module. Furthermore, a Memory Card can be used as a standard.

Inverter modules with **other interfaces** have an integrated software package.

24 V load power supply unit

The VMA supply module must be supplied from an external 24 V d.c. load power supply unit in accordance with EN 61131 (mean value 20.4 – 28.8 V).

CAUTION
Overvoltage!
The 24 VDC must satisfy the 'safety separation' requirements. The requirements in accordance with the overvoltage category III should be noted on the primary side !

In the inverters, the extra-low-voltage circuits are safety-separated from the mains circuit (safety separation to EN 50178).

Switch cabinet structure

2.2   Installation compartment

The ServoDyn D inverter modules are installed in a switch cabinet.
Their component depth is fairly low, i.e. 270 mm or 290 mm, depending
on the mechanics.
The switch cabinets must at least conform to the IP 54 protection stan-
dard (dust filter in front of the air inlet and air outlet).

The inverters are mounted in a vertical position with the terminals to the
bottom.
The cooling air flow passes through the modules from the bottom to the
top and must not be obstructed by other switch cabinet components or
parts. In addition, a minimum clearance of 100 mm should be provided
both above and below the inverter.
No minimum lateral clearance need be provided.

The air temperature inside the cabinets may be between 0...+55 °C (de-
rating above 45 °C).
+55 °C is the maximum permitted supply air temperature for the upper-
most inverter if several inverters are stacked one above the other.
Constructive measures have to be taken to ensure the appropriate air
flow direction in the switching cabinet in this case.

CAUTION
Danger for product!
The ambient air must be free from high concentrations of dust,
acids, alkalis, corrosives, salts, metal vapors etc.
Condensation on the modules is not permitted!

Condition in direct environment

For safety separation, the requirements of pollution degree 2 must not
be exceeded.
For a definition of the pollution degree, refer to HD 625.1 and EN 50178.

Switch cabinet structure

2.3   Layout of the drive components

The following points must be considered in the layout of the drive components:

- All inverter modules in a d.c. link should be structured in one row if possible. A multiple-row structure is however also possible if the appropriate accessories are used (cf. page 3–14).

- A maximum of 9 three-phase modules can be added to one VMA supply module. This depends on:
  - the rated power of the VM supply module
  - the 24 V power input of all modules and all backplane modules. The maximum load on any supply module is 14 A (for power input data, refer to page 5–17)
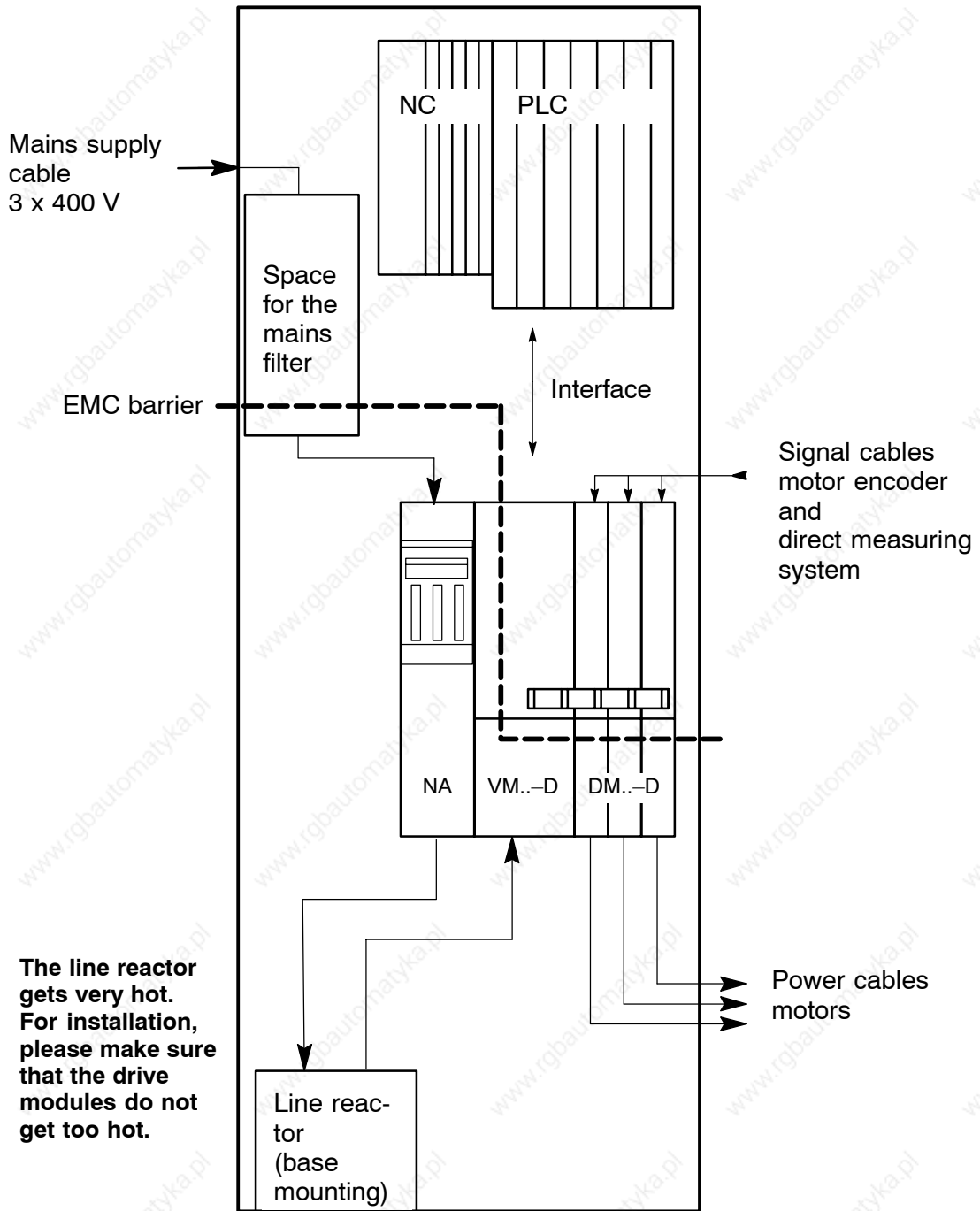
- Space requirements:
  Depth = 288 mm,   222 mm in the case of cold module mounting
  Width =   50 mm grid,   72 mm in the case of cold module mounting
  Height = 521.5 mm, 704 mm provides clearance for ventilation
                                   (DMA..A,B,D)
                   588 mm (DMW ..F)
                   452.5 mm, 600 mm provides clearance for ventilation
                                   (DM..K)

- The mains connection module or the optional line wiring module is mounted on the left-hand side.

- The supply module is positioned to the right of it, all further inverter modules are arranged to the right of the VMA supply module.

- Line reactors for upright installation must be fastened vertically in order to ensure cooling by natural convection.

- The power cables and control lines should be separately laid to ensure EMC (distance >100 mm). The following scheme can be adopted in the case of larger cabinets:
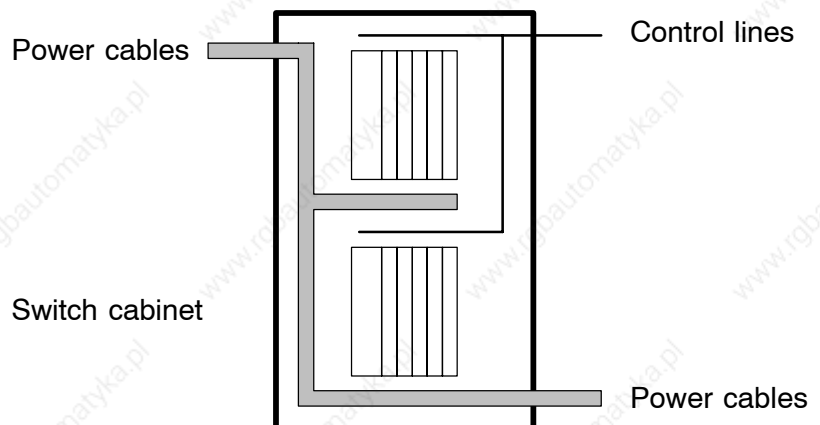
- The mains supply cable is connected to the top side of the NAA or the NV module.

- The motors' power cables are connected to bottom side of the module. They should enter the switch cabinet from the bottom.

- Control lines to the modules' front connectors are led upward into a cable duct on the top side of the inverter module.

Switch cabinet structure

- All drive components and electronic components such as CNC or PLC components should be arranged separately (distance > 100 mm).

Mains supply
cable
3 x 400 V

Space
for the
mains
filter

EMC barrier

NC   PLC

Interface

Signal cables
motor encoder
and
direct measuring
system

NA   VM..–D   DM..–D

☞ **The line reactor
gets very hot.
For installation,
please make sure
that the drive
modules do not
get too hot.**

Line reac-
tor
(base
mounting)

Power cables
motors

Basic switch cabinet structure, example of a possible layout

Switch cabinet structure

2.3.1   Installation in compliance with UL/CSA

A UL/CSA certification for the U.S. and Canada is available for a large number of ServoDyn D inverter types. These modules are listed in the **"Product Identity 23 MB"**, **File No. E214694**.

☞ **For available components with UL/CSA approval, refer to "Servo-Dyn D, Configuration manual", part number on page 1–7.**

Installation in compliance with UL/CSA

In order to obtain a UL/CSA-compliant installation, the following must be noted in addition to the use of the certified components:

- Systems may only be used in environments with pollution severity 2.
- Observe the tightening torques on the connection terminals.
- The insulated copper wires must be specified for 60/75°C as a minimum.
- Only use insulated cable of class 1 or equivalent,
  e.g. according to UL Style 1015 (on motor side, H07: U_0/U: 600/1000 V) and UL Style 1007 or 1569 (on mains side, H05: U_0/U: 300/500 V)
- Suitable for installation in symmetrical supply networks with a short-circuit current of $\leq$ 10 kA with max. 460 V +10 %.

Operation in compliance with UL/CSA

For UL/CSA-compliant operation, the bimetal function (I^2t monitoring) must be activated in the inverters using parameter P-0-0053 in order to provide motor protection:

- I_N of the motor is automatically retrieved from the electronic rating plate to the I^2t- monitoring function.
- P-0-0053 is only used to set the desired time constant:
  Factory setting: 0.0 (deactivated)
  Normal setting range: 100...150
                                    (corresponds to release characteristics of bimetal relay)

Switch cabinet structure

Notes:

Installation

3 Installation

3.1 Standard installation

All inverter modules are installed in a vertical position with the terminals to the bottom. They should be connected on a level metal surface using two or four screws or bolts depending on size. The recommended size is M5. A conductive connection to the mounting surface must be established via the screws or bolts.

VMA..K / DM..K

The modules in compact mechanics and the NV line wiring module are directly mounted, all electrical connections can be plugged in. Combination with DMA..A,B,D modules is possible.
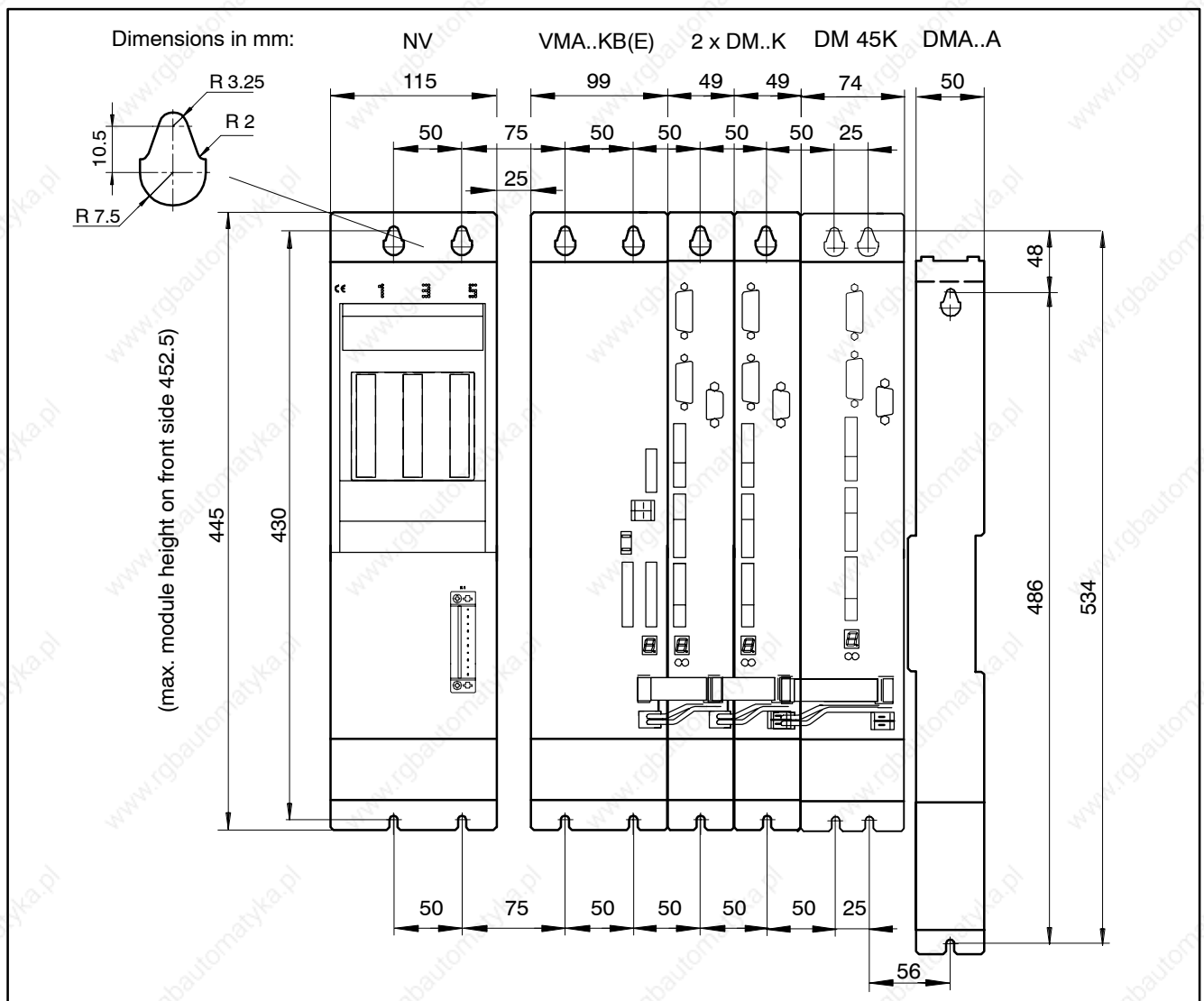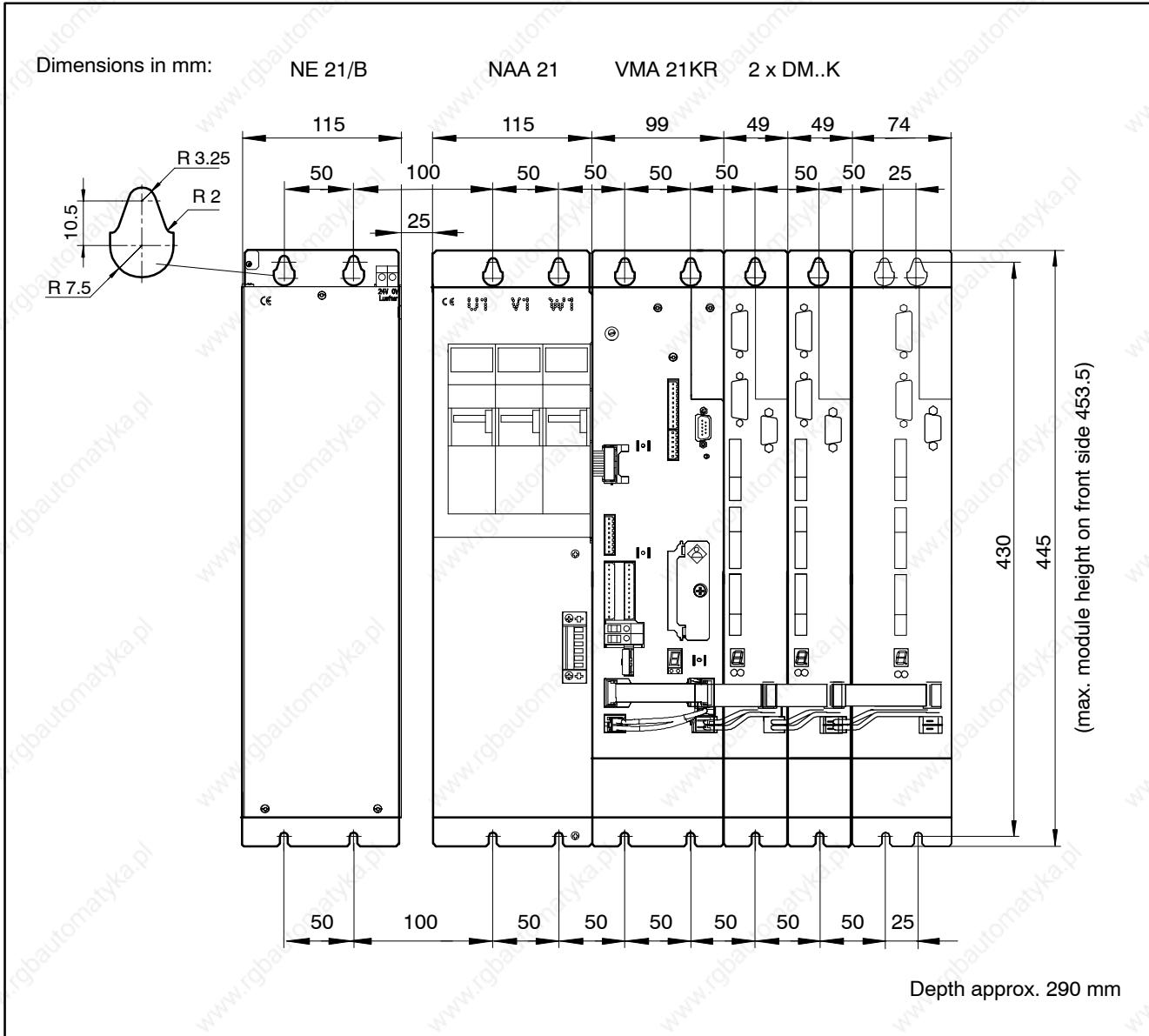

☞ **The distance between the line wiring module NV and the supply module must be 25 mm when installing the units.**
Otherwise, the mains filter in the line wiring module will heat up too much if the supply module is continuously operated at nominal load, resulting in reduced performance data.

Installation

VMA..KR / DM..K

The modules in compact mechanics, the NAA mains connection module and the NE line reactor are directly mounted, the electrical connections at the inverters can be plugged in.
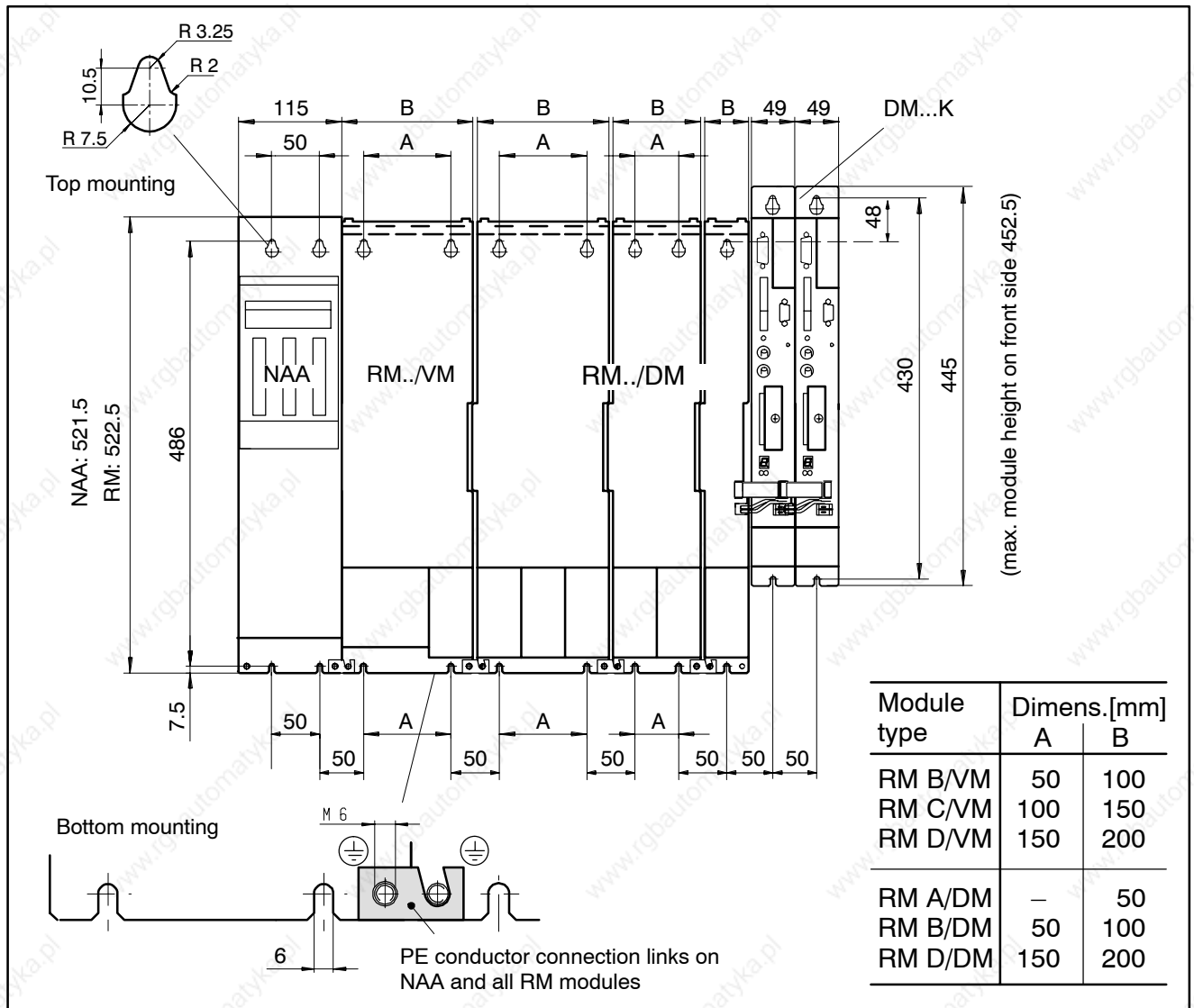Combination with DMA..A,B,D modules is possible.

Dimensions in mm: NE 21/B   NAA 21   VMA 21KR   2 x DM..K

Depth approx. 290 mm

☞ **The distance between line reactor NE 21/B and the mains connection module NAA must be 25 mm when installing the units. Otherwise, the mains filter in the mains connection module will heat up too much if the line reactor is continuously operated at nominal load, resulting in reduced performance data.**
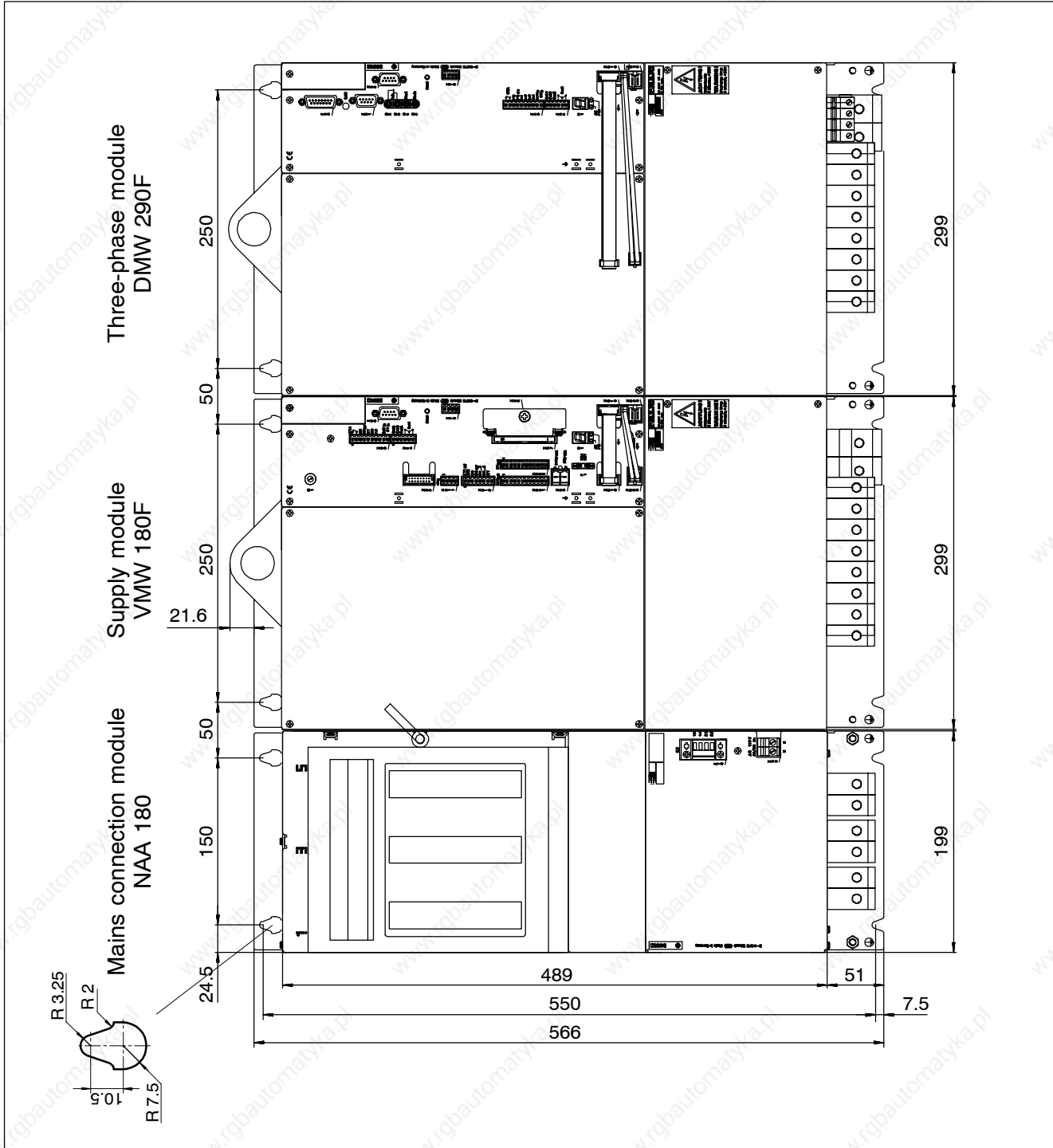
Installation

VMA..B,C,D / DMA..A,B,D

You only need the backplane modules and the NAA module for installation. Combination with DM...K modules is possible.

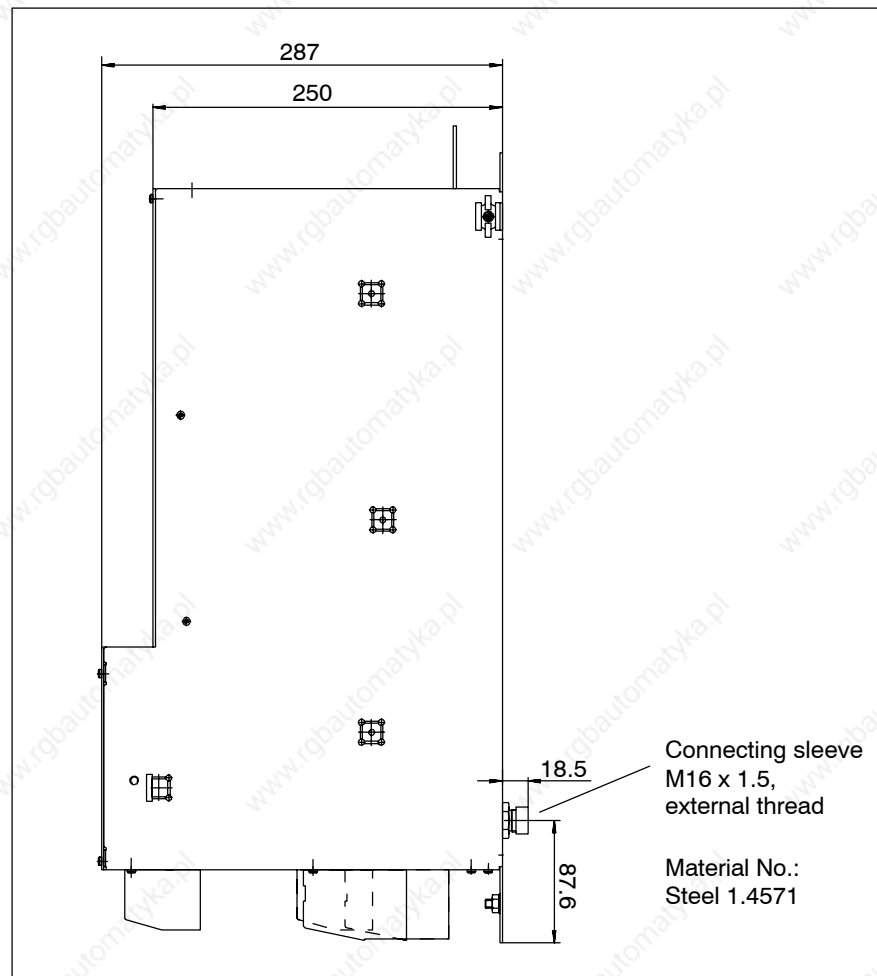| Module type	Dimens.[mm]	
	A	B
RM B/VM	50	100
RM C/VM	100	150
RM D/VM	150	200
RM A/DM	–	50
RM B/DM	50	100
RM D/DM	150	200

Installation

3.2 Mounting of VMW..F / DMW..F with water cooling

VMW and DMW are equipped with water cooling. They are installed together with a standard NAA module.

Installation

3.2.1   Cooling water connection

The cooling water is connected to the stainless steel fitting M16 x 1.5
(material no. 1.4571) on the back side of the inverters:

- In order to avoid contact corrosion, please do not use any screwed
  joints containing nickel, copper, brass or steel. We recommend stain-
  less steel or chromium-plated designs.

- In order to avoid the formation of algae, do not use any transparent
  tubing.

- Regularly remove any type of deposits inside the water lines.

☞ **Any air remaining in the heat sink will be washed out, venting is not
necessary.**

Installation

Operating conditions

- Water inlet temperature: 10...40°C
- Water quantity needed: min. 5 l/min
- Water pressure: max. 5 bar
- Pressure loss per inverter: max. 0.6 bar
- Temperature rise:
  - DMW 290F: f_s = 8 kHz 6 K/100 A
    f_s = 4 kHz 4 K/100 A
  - VMW 180F: 4.5 K/100 A

Water quality

In order to guarantee safe operation, the cooling water must satisfy the following conditions regarding soluble chemicals and insoluble substances:

- Concentration of hydrogen ions: pH 7...9
- Total hardness D_{max}: 10° (German)
  (1° German = 1.25 Engl. deg. = 1.05 US degrees = 1.8 French degrees)
- Chlorides: max. 20 mg/l
- Nitrates: max. 10 mg/l
- Sulfates: max. 100 mg/l
- Insoluble substances: max. 250 mg/l
- Specific resistance: min. 2000 Ω/cm

Tap water will in most cases satisfy these requirements.
If your tap water has inadmissible properties, a closed cooling water circuit must be used in which the cooling water can be permanently checked.

☞ **In closed cooling water circuits, an algaecide must furthermore be added to the water. Check the cooling water regularly.**

Please note that the specific resistance of the cooling water may change if an anticorrosive agent or an antifreeze is used in a recirculating cooling system.

☞ **The water inlet temperature should not be below 20 °C. Condensation on the water-conducting components, particularly the power semiconductors, should be avoided.**

Failures that are due to the bad cooling water quality, or damages caused by condensation, are not covered by the guaranty.
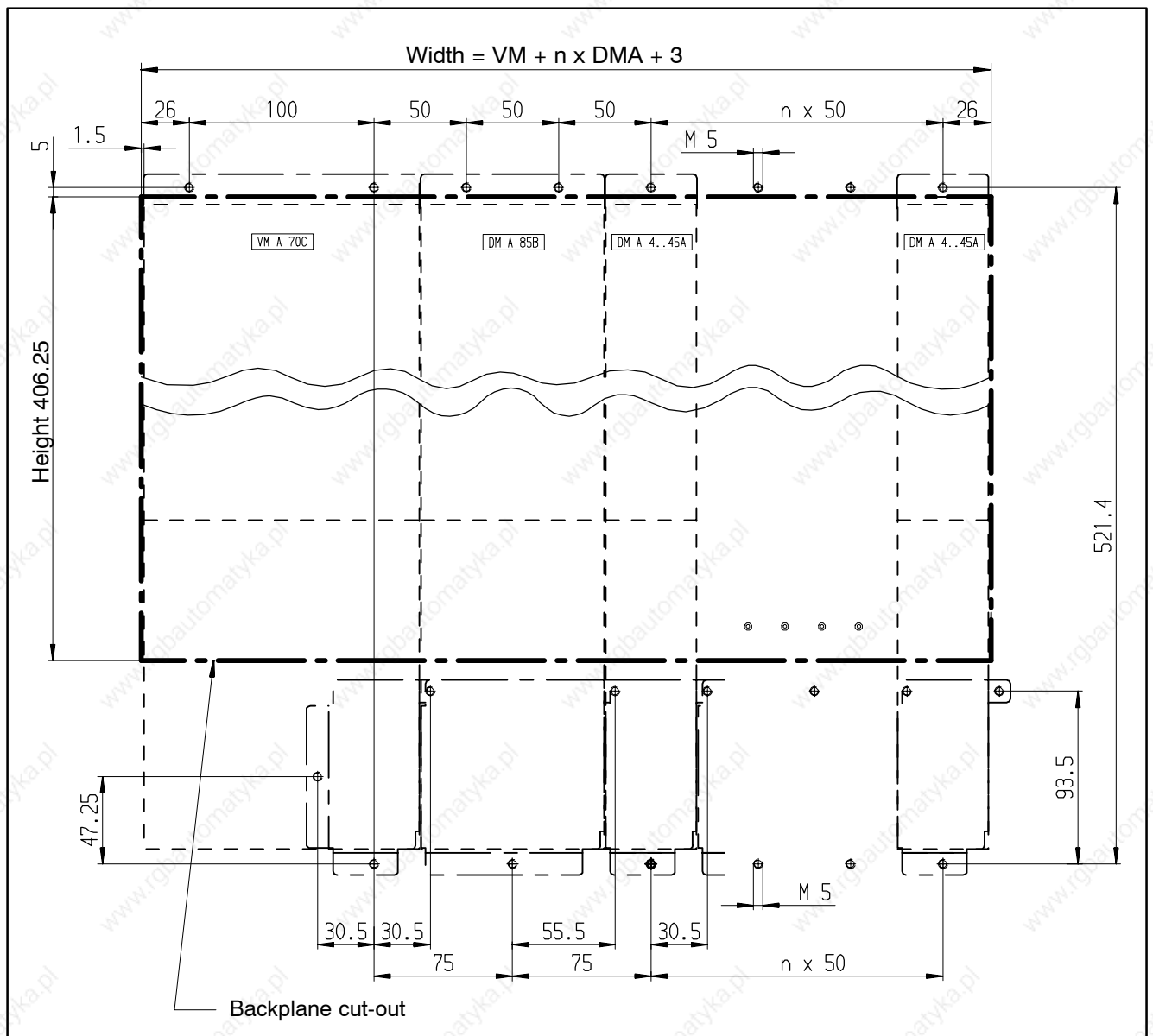
Installation

3.3 Cold module installation

For cold module installation, the inverter modules are fastened so that the heat sinks protrude through the mounting plate and thus from the switch cabinet.

Cold module installation guarantees almost complete heat dissipation outside of the switch cabinet. This means that the temperature inside the switch cabinet remains within permissible limits even without additional ventilation or cooling measures.

Design IP 20

The special design without sealing against the inside of the switch cabinet (protection standard IP 20) must be cooled with an enclosed ventilation system in order to guarantee the switch cabinet's protection standard IP 54.

Backplane cut-out

Installation

3.4   Link connection

The d.c. link voltage generated by the supply module is transmitted to the three-phase module via conductor bars.

3.4.1   VMA..K und DM..K

★   The d.c. link connection is achieved with conductor bars "C" and "D" at the front side of the modules:

1. Release fastening screw below the cover, unhinge and remove cover upward.

2. Release screws of pre-assembled conductor bars, push bars below the fastening screws of the adjoining left module and tighten screws again.

C

D
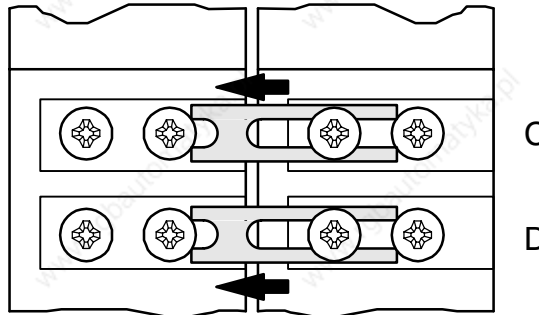
CAUTION
Tighten the d.c. link joints with 3 Nm to protect the power unit.

1. Remove right-hand end cover from cover of **VMA..K** by slightly bending the metal sheet.

2. Insert this end cover as shock-protection cover with covered cable bushings into the cover of the **last DM..K to the right-hand side.**

3. Reinstall all covers.
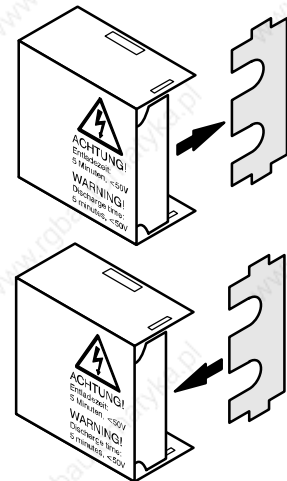
DANGEROUS ELECTRICAL VOLTAGE
Conductor bars carry a hazardous voltage during operation.
The shock-protection covers must always be installed at both ends of any module row.

Installation

3.4.2   VMA..B,C,D and DMA..A,B,D with backplane modules

The conductor bars are captivated in the backplane module terminal blocks.

★   Mounting using a SW 4 Allan key:

1. Unscrew the clamps (1).
2. Unscrew the clamps (2), move the conductor bars into the adjoining terminal block and tighten the screws.
3. Fasten the second end of the conductor bar using the terminal clamp (1).
4. Cover the right backplane module terminal block of every module row with the terminal block end cover from the VMA supply module accessory set. There is a second cover in the link terminal accessory set which can be used if there are two module rows.

DANGEROUS ELECTRICAL VOLTAGE
Conductor bars carry a hazardous voltage during operation.
It is absolutely necessary to attach the terminal block end cover to the right end of each module row.
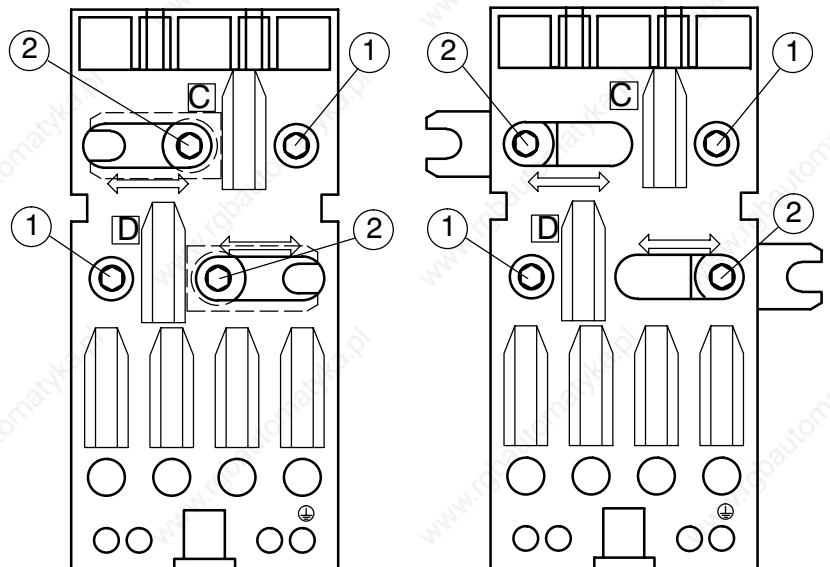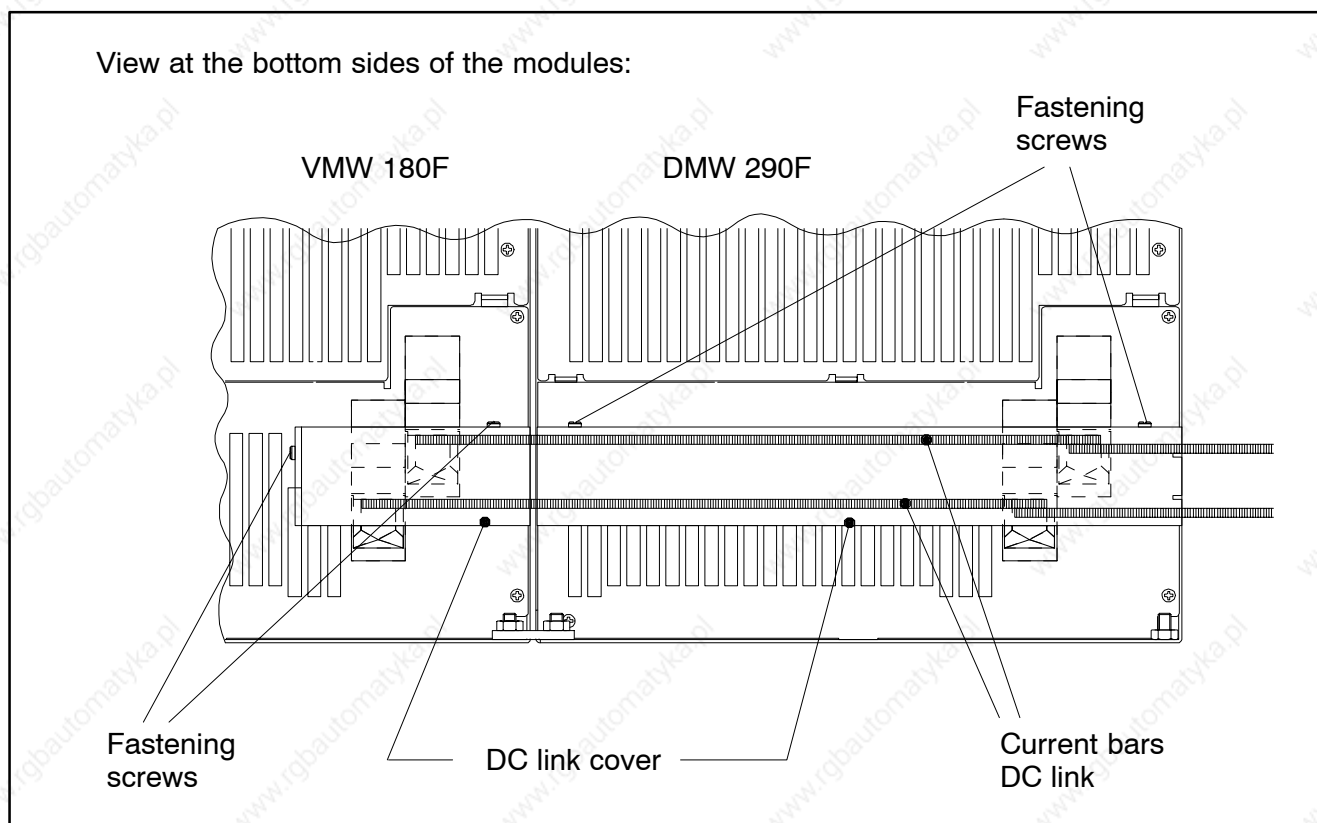
CAUTION
Tighten the d.c. link joints with 5 Nm to protect the power unit.

Installation

3.4.3   VMW..F and DMW..F with water cooling

★   The DC link connection is made on the bottom side of the modules using the current bars provided:

1. Insert current bars into terminals "C" and "D" and tighten them firmly.
2. Put the plastic cover from the accessories over the current bars and screw it down to the metal brackets provided.

View at the bottom sides of the modules:

VMW 180F   DMW 290F   Fastening screws

Fastening screws   DC link cover   Current bars DC link

CAUTION
Tighten the d.c. link joints with 18 Nm to protect the power unit.

Installation

3.4.4   DC link connection

The DC link connection (DC link) is an externally accessible DC link ter-
minal, via which the DC link can be flexibly extended. Possible options:

● CD link on the right, left (for backplane modules)

● DC link for compact mechanics, on the right, left

● DC link connection with integrated fuse (for water-cooled modules).

Module combination

DC link option for combining modules with compact mechanics and
modules with a backplane module.
The DC link connection is available for compact mechanics and for
backplane modules, for both left-sided and right-sided installation.
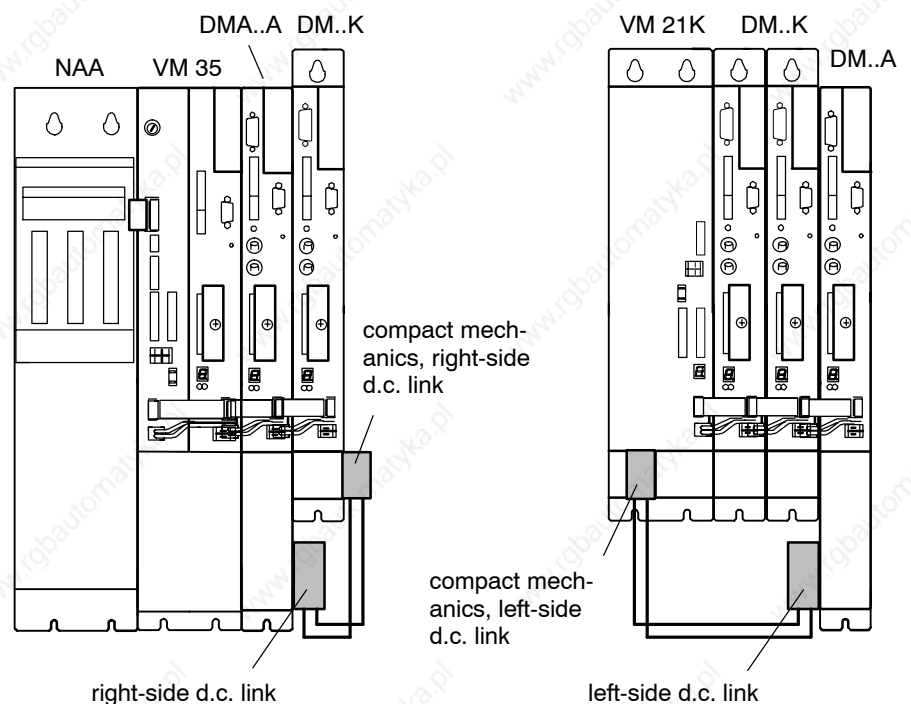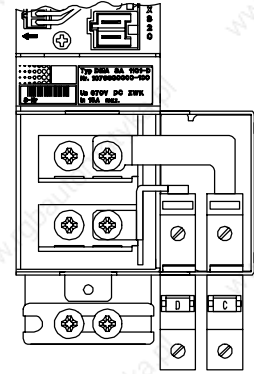

Additional DM..K module

★   The d.c. link connection is made using the right-side d.c. link:

1. Remove end cover of the terminal block of
   the backplane modules and cover of the d.c.
   link.

2. Insert d.c. link from the right side into the ter-
   minal block of the backplane module and
   make connection using the d.c. link bars.
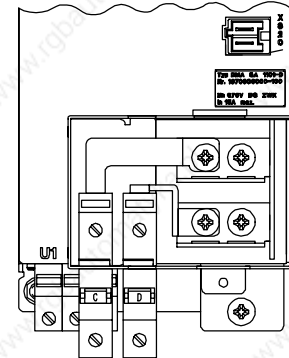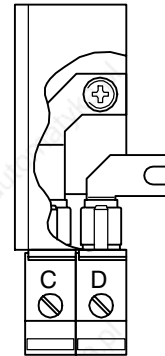
3. Reinstall d.c. link cover.
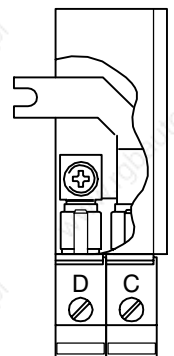
Installation

4. Remove cover from DM..K and cover from the right-side d.c. link for compact mechanics.

5. Insert d.c. link from the right side into the terminal block of the compact mechanics and make connection using the d.c. link bars. The minimum cross-section of the flexible cable depends on the modules connected downstream.

6. Reinstall DC link cover and screw it down with screw M3 x 6.

Additional DMA..A,B,D module

★   The d.c. link connection is made using the left-side d.c. link:

1. Remove cover of the d.c. link.

2. Insert d.c. link from the left side into the terminal block of the backplane module and make connection using the d.c. link bars. The other side of the terminal block must be protected with an end cover.

3. Reinstall the cover.

4. Remove cover from VM..K and cover and cover from the left-side d.c. link for compact mechanics.

5. Insert d.c. link from the left side into the terminal block of the VM..K and make connection using the d.c. link bars.
The minimum cross-section of the flexible cable depends on the modules connected downstream.

6. Reinstall DC link cover and screw it down with screw M3 x 6.

DANGEROUS ELECTRICAL VOLTAGE
Conductor bars carry a hazardous voltage during operation.
It is important to reinstall the complete shock-protection covers.

Installation

DC link with integrated fuse option for combining water-cooled modules and other modules.

NAA 180   VMW ..F

leads to any other
DC link connection
(cf. above)

DC link
with integrated fuse
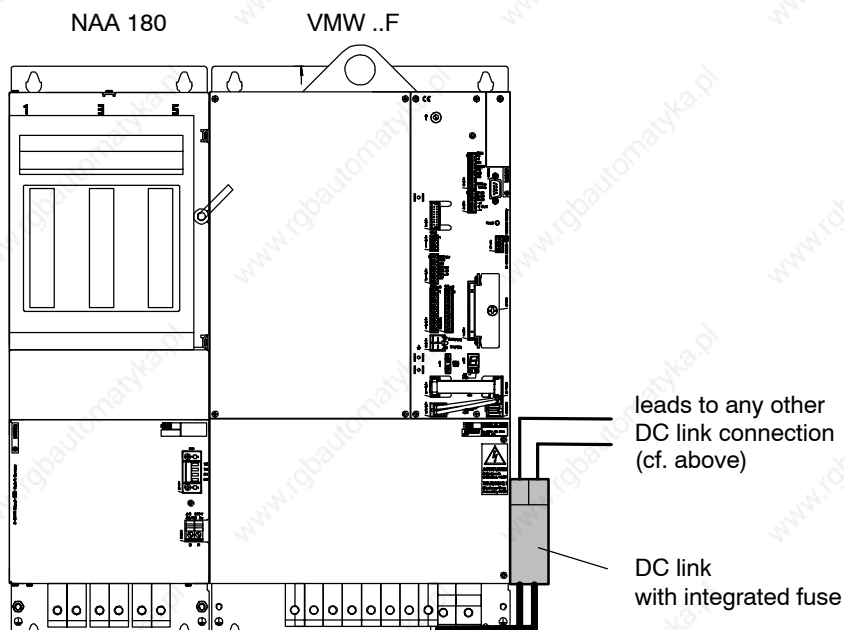
☞ **The fuse of the DC link connection with integrated fuse must match the service conditions of the module combination. A 100 A fuse is delivered together with the unit.**

★ Make DC link connection using the DC link with integrated fuse:

1. Insert fuse holder into lateral slots on the inverter and screw them down there.
2. Insert the current bars into the terminals and tighten them there (3.7 Nm).
3. Remove protective film from the cover, place cover on the fuse holders and screw it down.
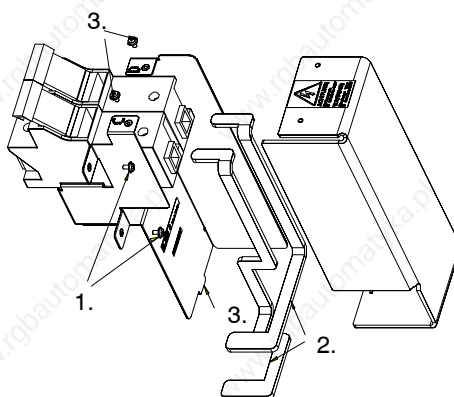
Installation

Two-row module arrangement

- Using the **DC link connection** option, DMA..A,B,D with backplane module can be operated in two rows on top of each other at one DC link.
  In order to ensure the shortest possible line routing, the far right end of each module row is equipped with a right-hand DC link.

- Using the **DC link connection compact mechanics** DM..K modules can be operated in two rows on top of each other at one DC link.
  In order to ensure the shortest possible line routing, the far right end of each module row is equipped with a right-hand DC link compact mechanics.

☞ **The flexible DC link leads must be twisted and shielded in order to avoid interference.**
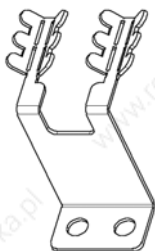
For extending the signal cross-connection X810 and the 24V cross-connection X820, prefabricated cables are available.
The shield connection 1070 084 345 should be additionally used for the 24V extension in compact mechanics.

Installation

3.5   Protective earth connection between the modules

VMA..B,C,D / DMA..A,B,D

★   The protective earth connection between the modules mentioned above is established via the earthing links, which are mounted on the bottom right of each inverter module or backplane module:

1. Unscrew the earthing links' fastening nuts
2. Mount the modules
3. Swing the link over to the adjoining module and screw it down on both sides.
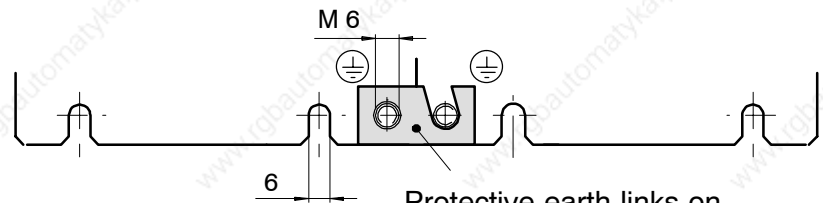
Protective earth links on
NAA and all RM modules
Tightening torque 5 Nm.

VMA..K / DM..K

★   The protective earth connection between modules in compact mechanics is made using an earth bar at each DM...K and a link at the NV:

1. Release screws of pre-assembled protective earth bar at the module front side, push bar below the fastening screw of the adjoining module to the left.
2. Reinstall the protective earth conductor bar.
3. Swing link at the mounting side of NV towards VMA...K and screw it down at both sides.
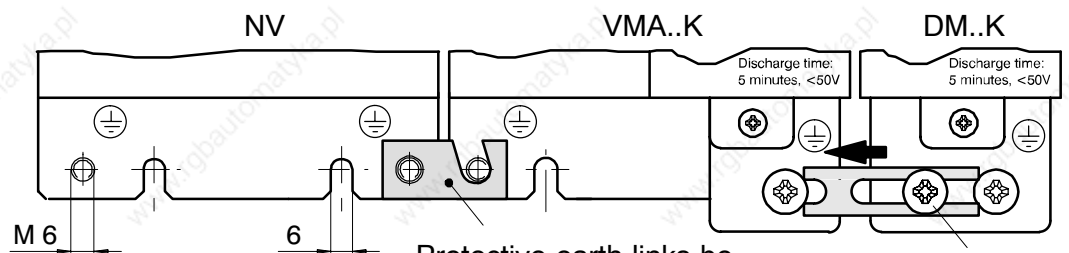
Protective earth links between NV and VMA...K modules.
Tightening torque 5 Nm.

Tightening torque 3 Nm.

Installation

VMW..F / DMW..F

★   The protective conductor connection between water-cooled modules is ensured by a PE bar included in the accessories which is to be bolted to the bottom side of the housings of both modules.
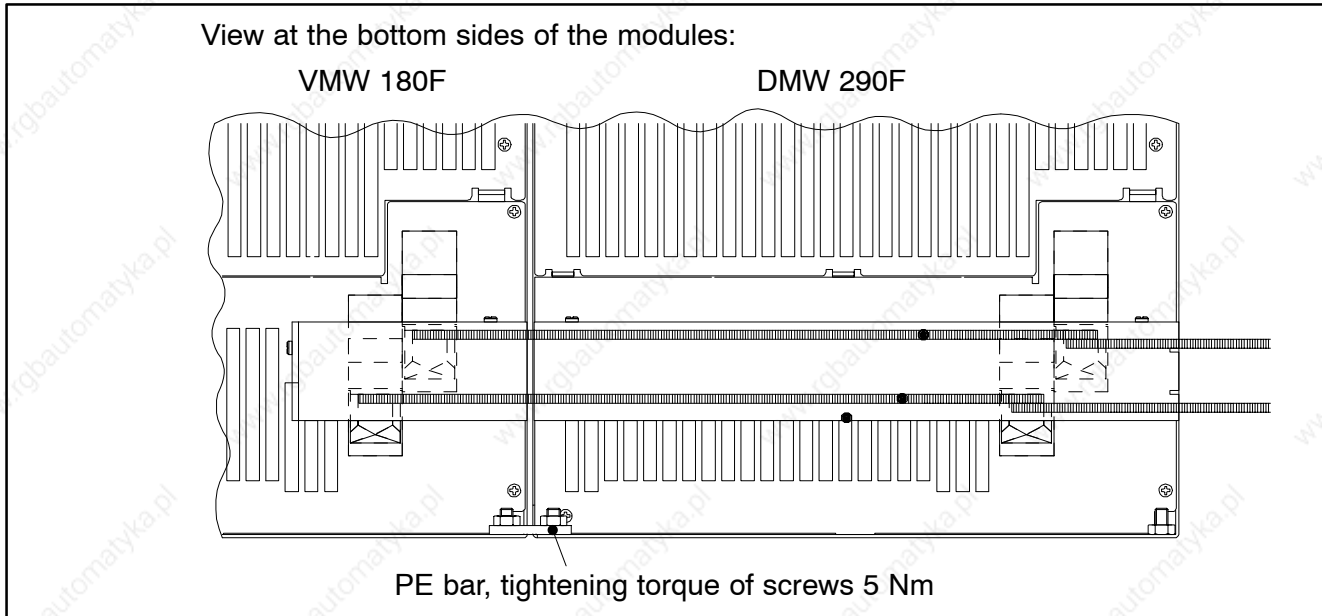

View at the bottom sides of the modules:
VMW 180F   DMW 290F

PE bar, tightening torque of screws 5 Nm

3.6   Connection cables

The power cables leading to the terminal block should be combined with strain relief.

Logic cables to the front connectors and power cables must not be laid together. They may be installed above the inverter module in a cable duct.

CAUTION
To protect the power unit from destruction, the tightening torque for the power connections U, V, W must not exceed 12 Nm.

PE   1U1 2U1 1V1 2V1 1W1 2W1 PE
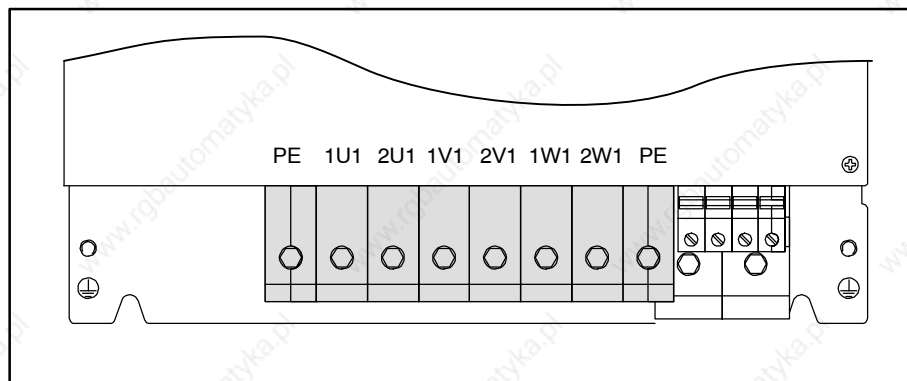
Connection overview

4   Connection overview

4.1   NV, VMA..K and DM with analog interface
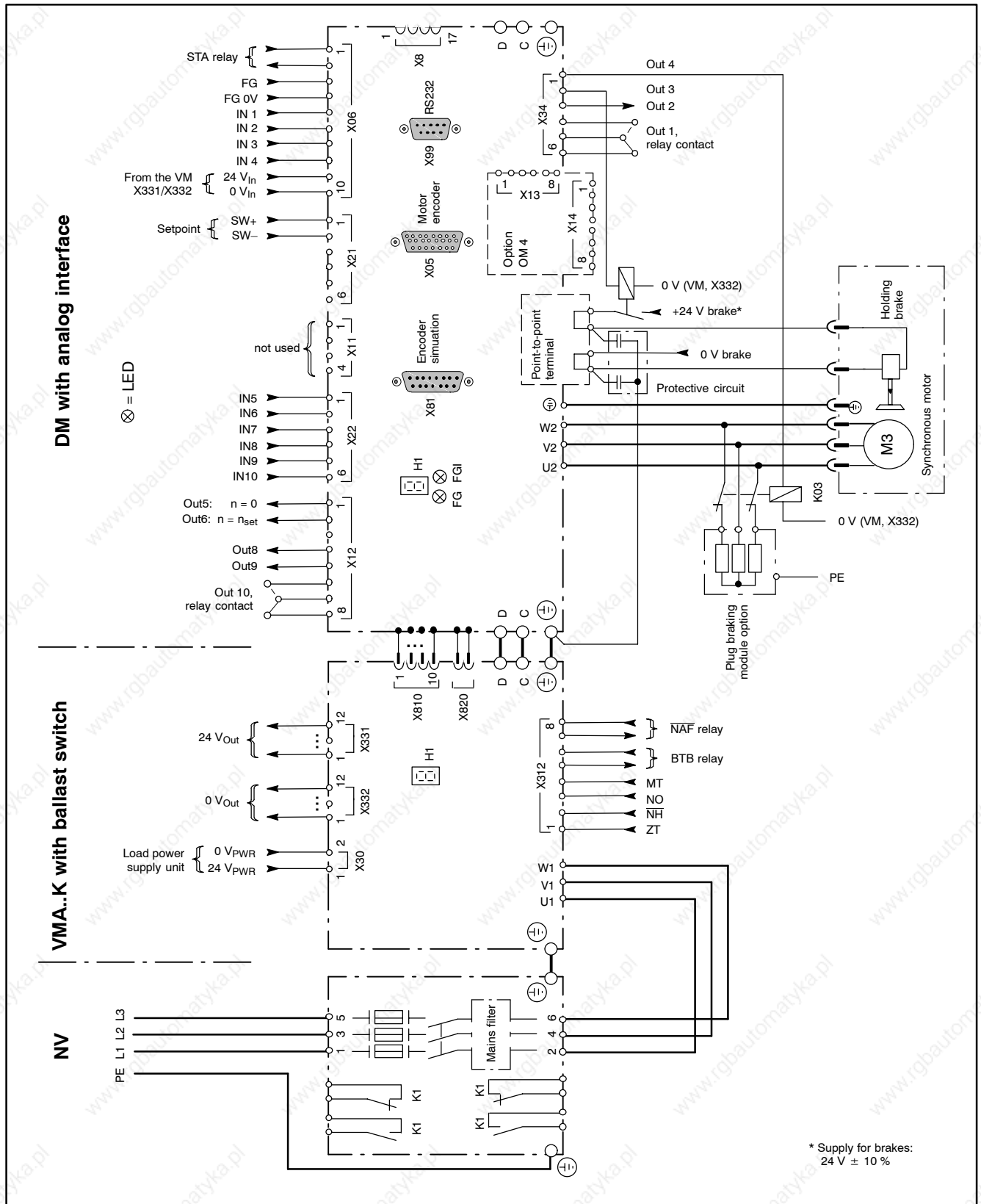
Connection overview

4.2 NV, VMA..K and DM with Motion Control
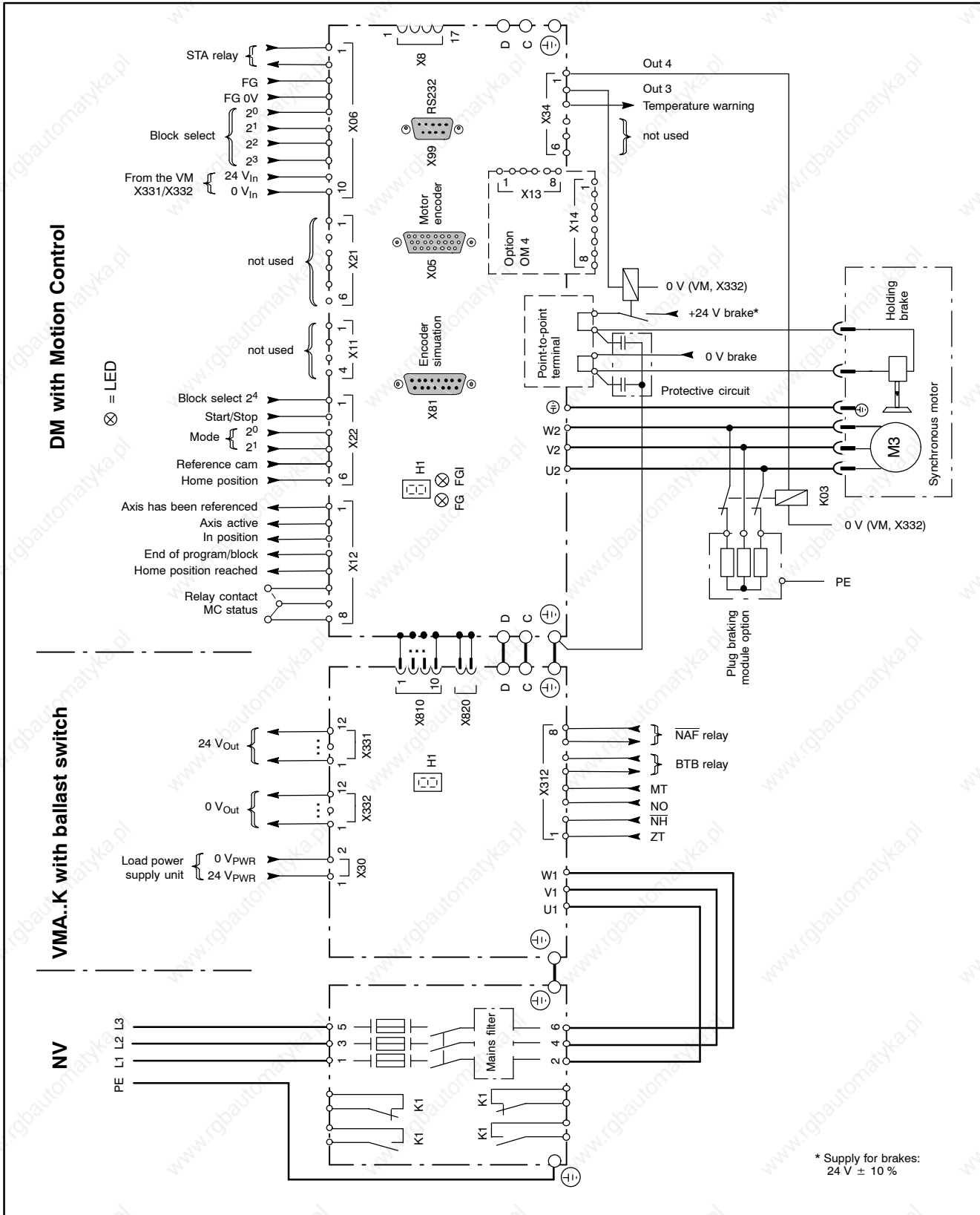
Connection overview

4.3   NV, VMA..K and DM with PROFIBUS-DP

* Supply for brakes:
24 V ± 10 %
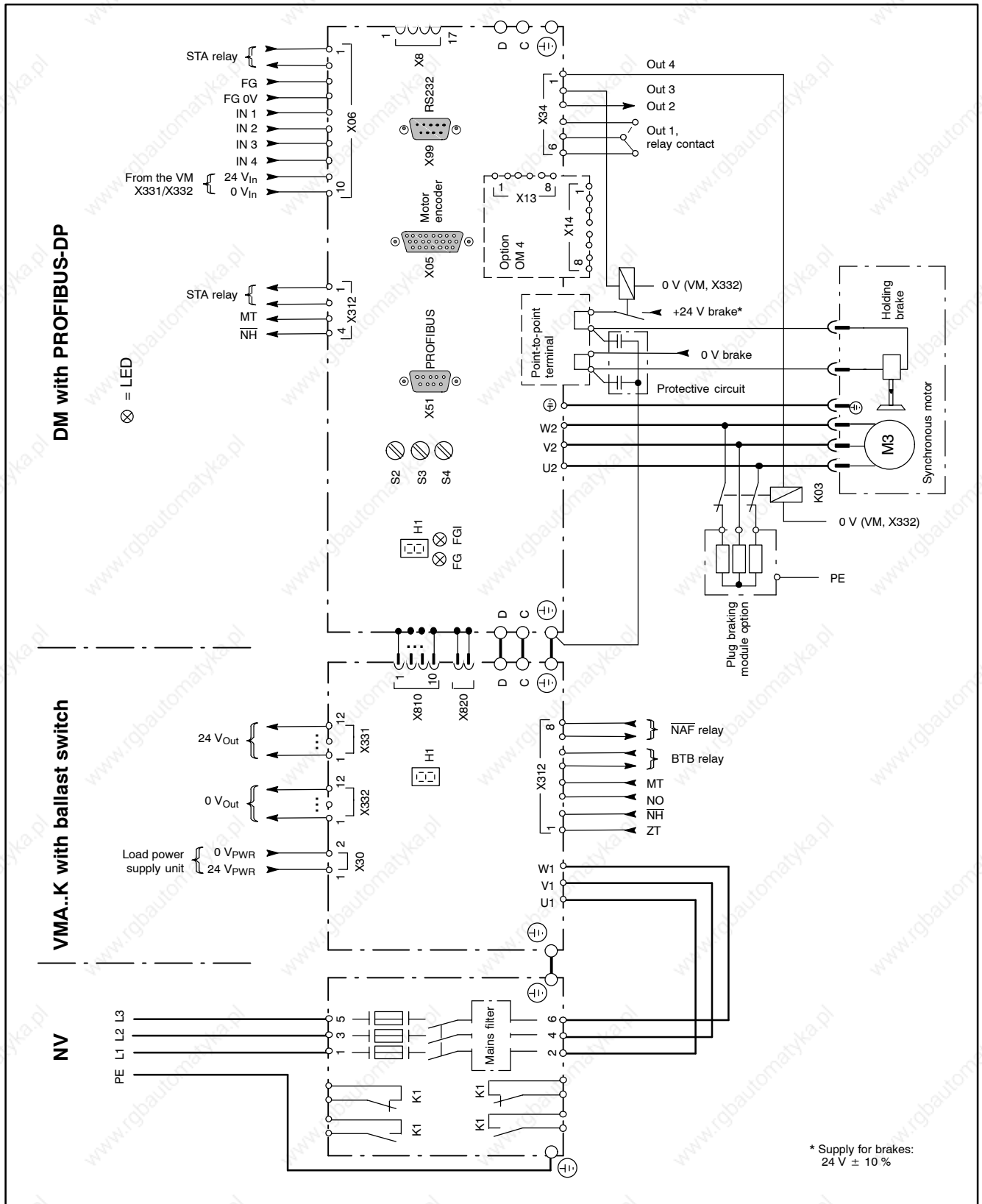
Connection overview

4.4   NV, VMA..K and DM...8001 frequency inverter with analog interface
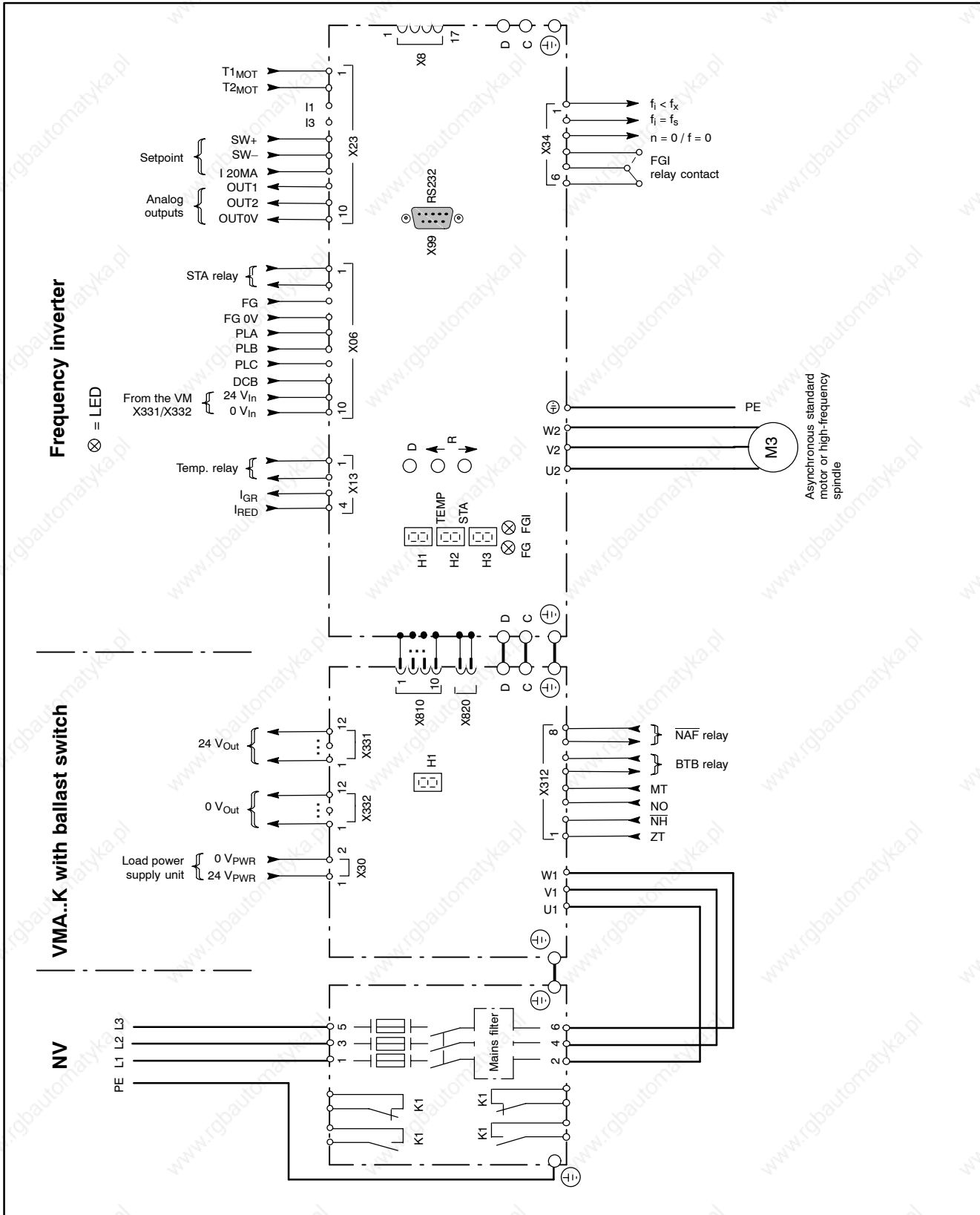
Connection overview

4.5   NAA, VMA with current regeneration and DM with SERCOS interface
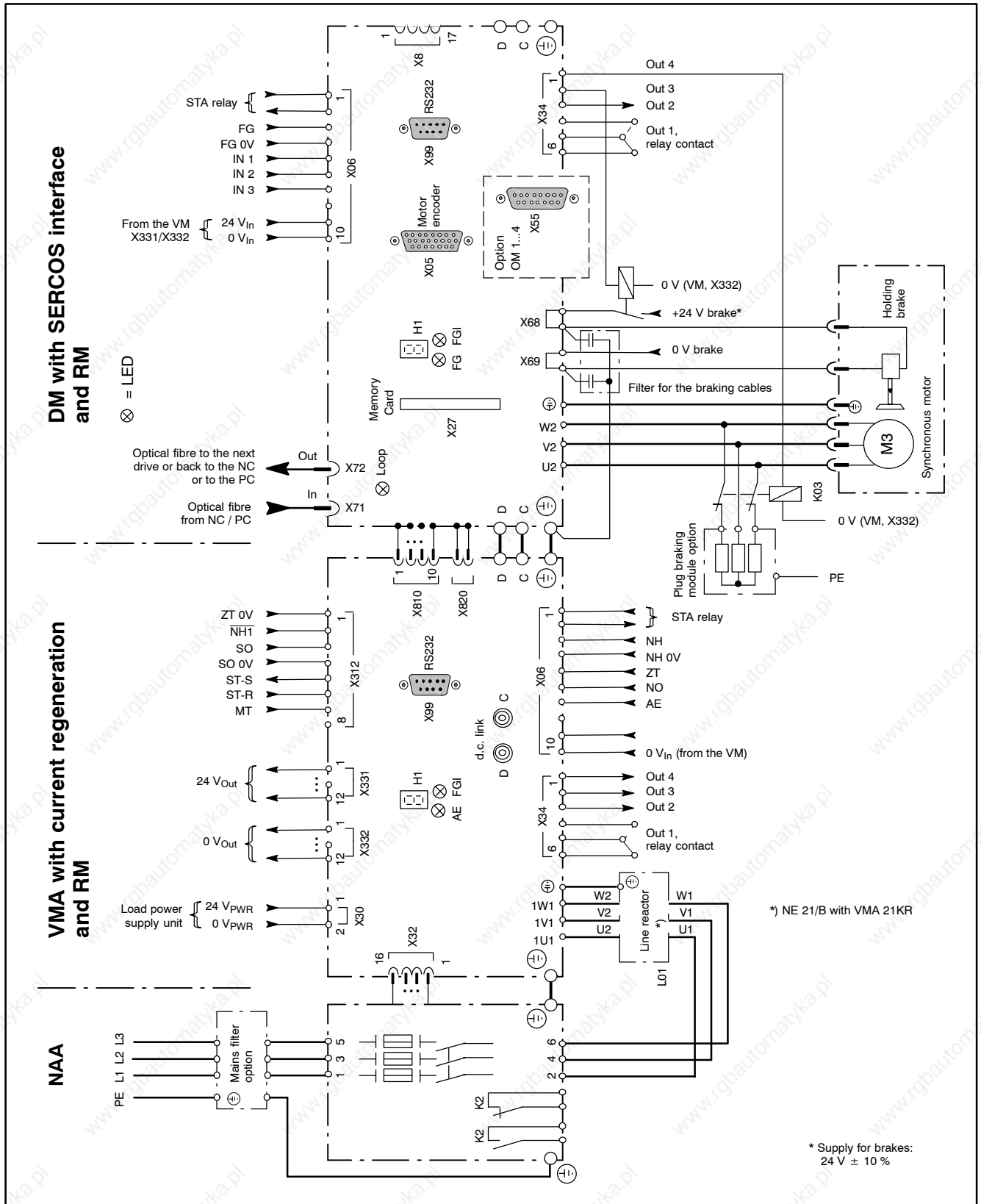
Connection overview

4.6   NAA, VMW with current regeneration and DMW with CAN bus
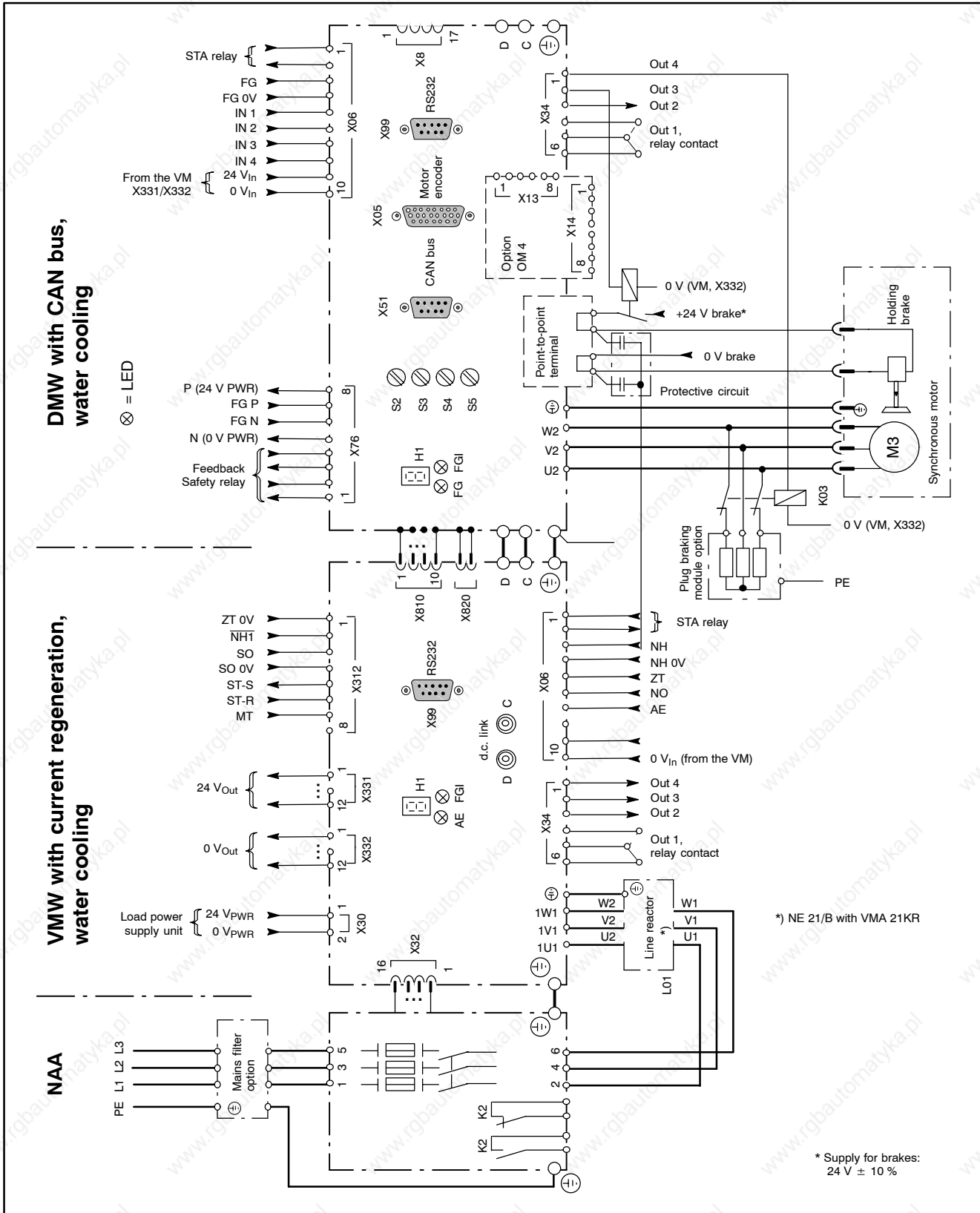
Power connection

5   Power connection

5.1   Earthing

CAUTION
Inverter modules may only be operated with an earthed neutral system.
Systems not directly earthed (IT protective system) must not be used for operation, as air clearances and leakage paths in the module may be overloaded.
Operation at asymmetrical mains systems (TT protective system, one mains phase is earthed) is not permissible!

DIN VDE 0100-300 defines mains systems subject to their type of earth connection.

Accordingly, in an IT protective system, all active parts are separated from earth, or one point is connected to earth via a resistor.

The exposed conductive parts of an electrical system are either

● earthed separately, or

● earthed jointly, or

● jointly connected to the system earth.

☞ **Please note the information on earthing in the ServoDyn D EMC manual, for part no. refer to page 5–3.**

Protective earthing of inverters

DANGEROUS ELECTRICAL VOLTAGE
The only permissible protective measure in accordance with EN 50 178 is a protective earth connection.
The protective conductor must at least have the same area as the mains feeder.
Earthing only one end of the DC link when operating by means of an isolating transformer is prohibited!

Earth connections in the switch cabinet must be designed in the form of a grid mesh.
The module housing and mounting plate of the switch cabinet must be earthed. The connection between the line filter and the supply module should be as short as possible.
The protective earth cross-section must at least correspond to the cross-section of the line feeder of the supply module.

Power connection

| ⚠ | **DANGER**
Dangerous shock currents through inappropriate protective earth connections!
Do not impair protective earth connections by mechanical, chemical or electro-chemical influences. The connection must be firm and lasting. |

Earthing scheme
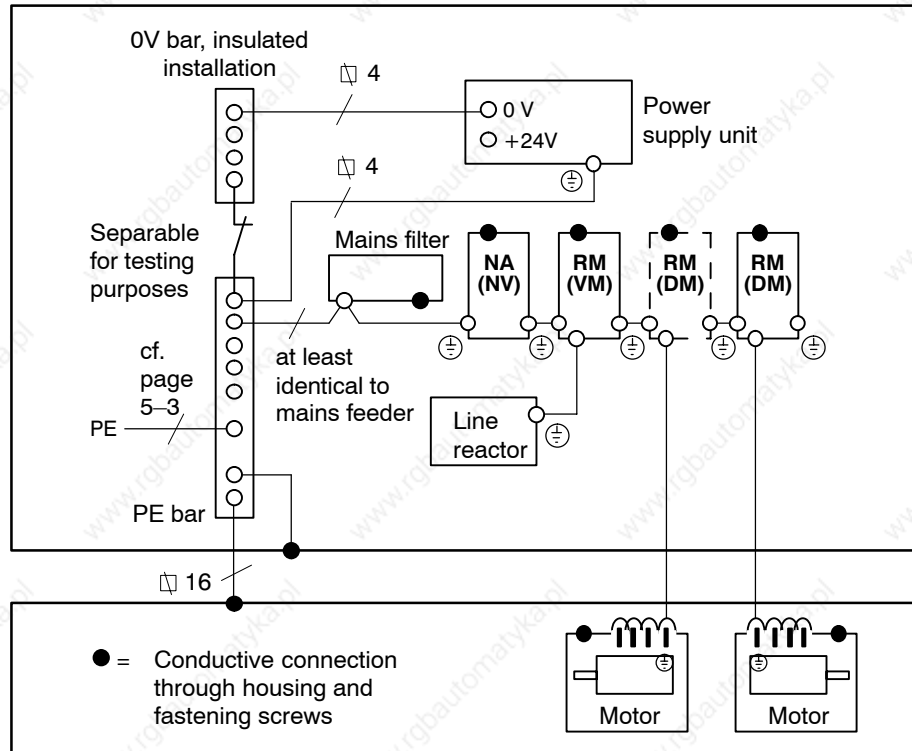
Protective earthing of motors

In accordance with DIN VDE 0160, the protective earth conductor cross-section must be rated for $\sqrt{3}$ times the rated load of the power conductors.

If at least two motors are used by the machine which are connected to each other via the housing, the PE conductor cross-section has grown accordingly in size and the condition mentioned above is satisfied.

☞ **For DM...K modules, the earth conductor of the motors is fitted with a cable lug and squeezed under the fastening screw of the earth bar.**

Power connection

PE bar

The cross-section of the PE bar and mounting plate earth conductor must be selected one size bigger than the line feeder of the supply module.

24 V power supply unit

The PE connection and the secondary circuit earthing (non-isolated) must be designed in accordance with the secondary current, but must have a cross-section of at least 1.5 mm^2.

0 V bar

The 0V bar must have an insulated structure and may be earthed in a single point only.
This measure is designed to avoid 24V operating currents in the earth and shield connections.

5.2   Electromagnetic compatibility (EMC)

☞ **Please note the information given in the ServoDyn D EMC manual:**

Language	Part no.
German	1070 066 072
English	1070 066 074
French	1070 066 075
Italian	1070 066 076

Power connection

5.3   Earth-leakage circuit-breaker

Inverters incorporate switched power units which are always asso-
ciated with capacitive leakage currents against earth. The leakage cur-
rents may depend on the number of inverters, the earthing conditions
as well as the design and length of motor power cables.

Mains filters and shielded cables used to improve the electromagnetic
compatibility (EMC) increase the leakage currents further. For this rea-
son, no earth-leakage circuit-breakers with nominal leakage currents of
less than 300 mA may be used.

DANGEROUS ELECTRICAL VOLTAGE
**Personnel protection is only guaranteed if earth-leakage circuit-
breakers with nominal leakage currents of less than 30 mA are
used.**

☞ **Inductors and/or capacitors present in the electric circuit may lead
to spurious trips. If radio interference suppression filters are used,
spurious trips can only be avoided by installing an isolating trans-
former.**

DANGEROUS ELECTRICAL VOLTAGE
**If a pulse power current sensitive e.l.c.b. type A in accordance
with IEC-755 (VDE 0664) is used, its protective function is not
guaranteed for inverters with a 3-phase mains connection (B6 cir-
cuit).**

The protection of all electrical components connected together with in-
verters with a 3-phase mains connection to a pulse power current sensi-
tive e.l.c.b. may be adversely affected.
Therefore, you should either install an isolating transformer with a pro-
tective device and earthing in the mains feeder, or use a universal cur-
rent sensitive e.l.c.b. type B which also provides safety disconnection in
the event of DC leakage currents.

Power connection

5.4 Mains supply

DANGEROUS ELECTRICAL VOLTAGE
The only permissible protective measure in accordance with EN 50 178 is a protective earth connection.
The protective conductor must at least have the same area as the mains feeder.
Earthing only one end of the DC link when operating by means of an isolating transformer is prohibited!

CAUTION
Inverter modules may only be operated with an earthed neutral system.
Systems not directly earthed (IT protective system) must not be used for operation, as air clearances and leakage paths in the module may be overloaded.
Operation at asymmetrical mains systems (TT protective system, one mains phase is earthed) is not permissible!

The mains supply is connected directly to the NV line wiring module or the NAA mains connection module via a mains filter.

- Supply voltage $U = 400...460\ V \pm 10\ \%$, 48...62 Hz
- Voltage drop between no-load and full-load $\Delta U = \text{max. } 5\ \%$
- The power electronics are excluded from the permitted total system voltage dip for max. 10 ms required under EN 60204.
  In the event of a power failure, the drive is switched off, and an alarm is issued. For measures to be taken, refer to section 8.3.
- Voltage peaks: Between conductors $\leqq 1\ kV$
  Conductor to ground $\leqq 4\ kV$
- The lightning protector which limits the transient overvoltage to 4 kV is a prerequisite in the sub-distribution. All air clearances and leakage paths are designed for 4 kV (conductor to ground impulse withstand voltage).
- The power connection is designed in accordance with the requirements laid down in overvoltage category 3.

Power connection

Autotransformer

If the actual mains voltage is not identical with the specified supply voltage, an isolating transformer or an autotransformer with the following specifications may be used:

3-phase autotransformer to UL standard for inverter input	VM 21KR / 21KB,E	VM 35B	VM 70C	VM 90D	VM W 180F
Inverter clock frequency	8/10 kHz	8 kHz	8 kHz	8 kHz	8 kHz
Ripple current I_{pp}	8/25 A	10 A	17 A	25 A	
Output	16 kW	25 kW	42 kW	60 kW	125 kW
Primary voltage	actual mains voltage				
Secondary voltage	3 x 400 V				
Secondary current	24 A	35 A	70 A	90 A	180 A
Short-circuit voltage uk	1.5 %	1.5 %	1.0 %	0.8 %	0.8 %
Protection standard	IP 00				
Insulation class	H/40				

5.4.1   Connection of VMA..KB, VMA..KE (with ballast switch)

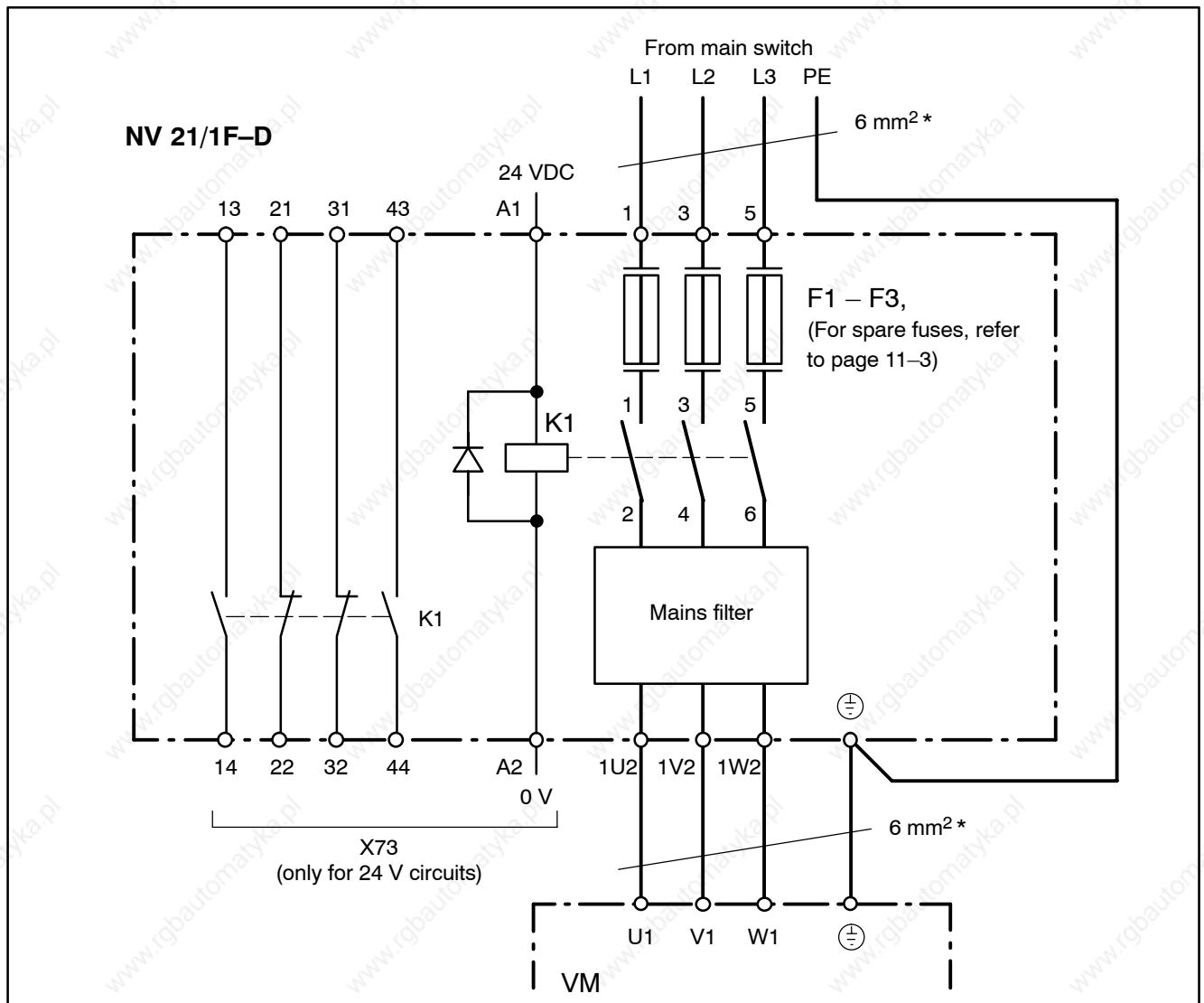Supply modules with ballast switch are connected via the NV line wiring module and a mains filter.
NV modules with an integrated mains filter comply with radio interference limit class A in accordance with EN 55011 (VDE 0875).

☞ **UL class 1 power cables (e.g. UL Style 1007 or 1569 on mains side, H05: U_0/U: 300/500 V) and a UL/CSA recognized ballast resistor have to be used for UL/CSA-certified drive inverters.**
This is to ensure that the entire system meets the UL/CSA requirements.

CAUTION
In order to protect the VMA..K from damage, a mains filter may only be installed between the mains contactor and the inverter.

Power connection

NV line wiring module

NV 21/1F–D

From main switch

L1 L2 L3 PE

6 mm² *

13 21 31 43 | A1 | 24 VDC | 1 3 5

F1 – F3,
(For spare fuses, refer to page 11–3)

K1

1 3 5

K1

2 4 6

Mains filter

14 22 32 44 | A2 | 1U2 1V2 1W2

0 V

X73
(only for 24 V circuits)

6 mm² *

U1 V1 W1

VM

* According to EN 60204 Part 1/1993, Tab. 5 for installation in the cable duct at an ambient temperature of 45°C

☞ **Back-up fuses in special designs (encapsulated fuses) are used in NV modules with UL certification. They must not be used in standard modules without UL certification and vice versa.**

Power connection

5.4.2   Connection of VMA..KR, VMA..B,C,D and VMW..F (with current regeneration)

Supply modules with current regeneration have to be connected via the mains filter, line reactor NE and the mains connection module NAA.

☞ **UL class 1 power cables (e.g. UL Style 1007 or 1569 on mains side, H05: U_0/U: 300/500 V) have to be used for UL/CSA-certified drive inverters.**
This is to ensure that the entire system meets the UL/CSA requirements.

External mains filter

A mains filter in the mains supply cable must be provided so that **limit class A** (B on request) for radio interference can be complied with in accordance with EN 55 011 (VDE 0875). Some NAA modules are optionally available with an integrated mains filter.

Furthermore, a mains connection module with an additional filter should be selected for connection to a public network which contains an additional filter with symmetric effect and provides interference suppression for the mains current elements at switching frequency.

The external filter size must correspond to the supply module output.

☞ **Due to the mains pollution caused by shielded motor cables, the permissible length of the motor cables is limited depending on the mains filter used (also refer to Configuration manual, part no. on page 1–7).**
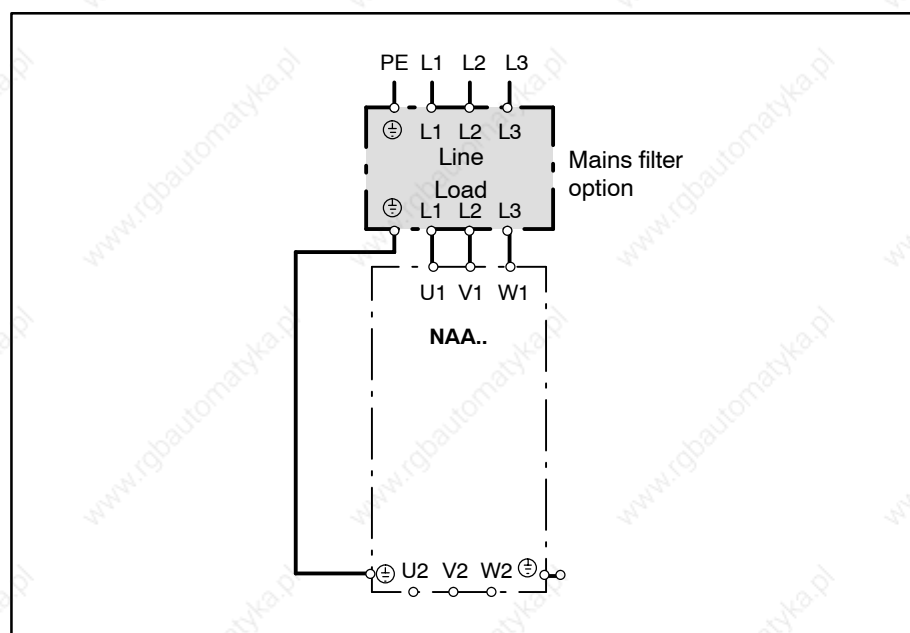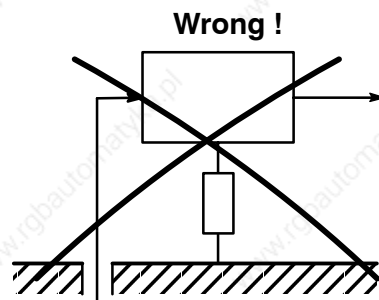
Power connection

Mains filters are rated for permanent operation at full rated current up to 40°C. In the event of other ambient temperatures, the admissible operating current can be derived from the following diagram.
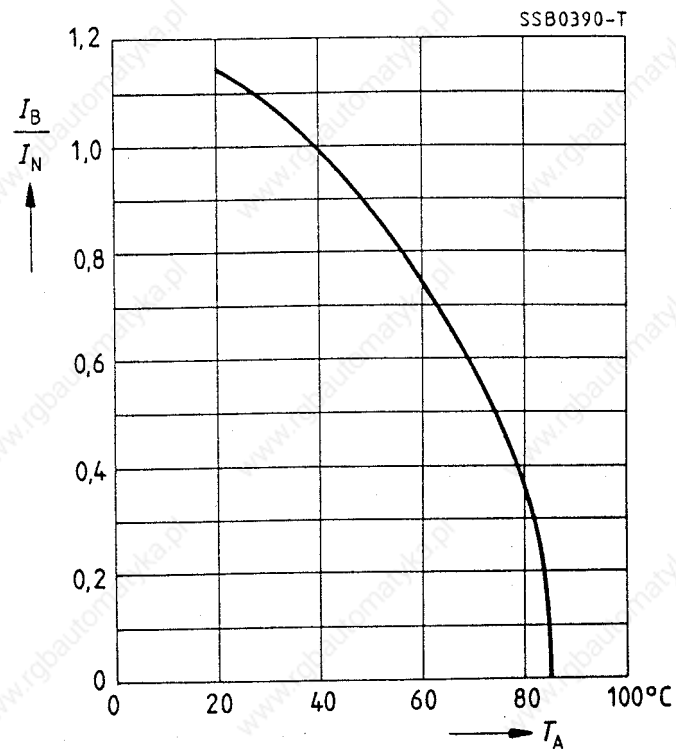

In order to avoid the formation of vagabond voltages in the supplying mains due to conducted interference, the mains filter must be installed in the incoming feeder of the drives (cf. section 2.3).

The filter must be installed directly at the partition wall so as to ensure that the leads coming from outside can be run through the partition wall and further to the filter along the shortest possible way.

☞ **The effectiveness of the filter is basically determined by the quality of the filter's earth connection:**

Wrong !   **Right**

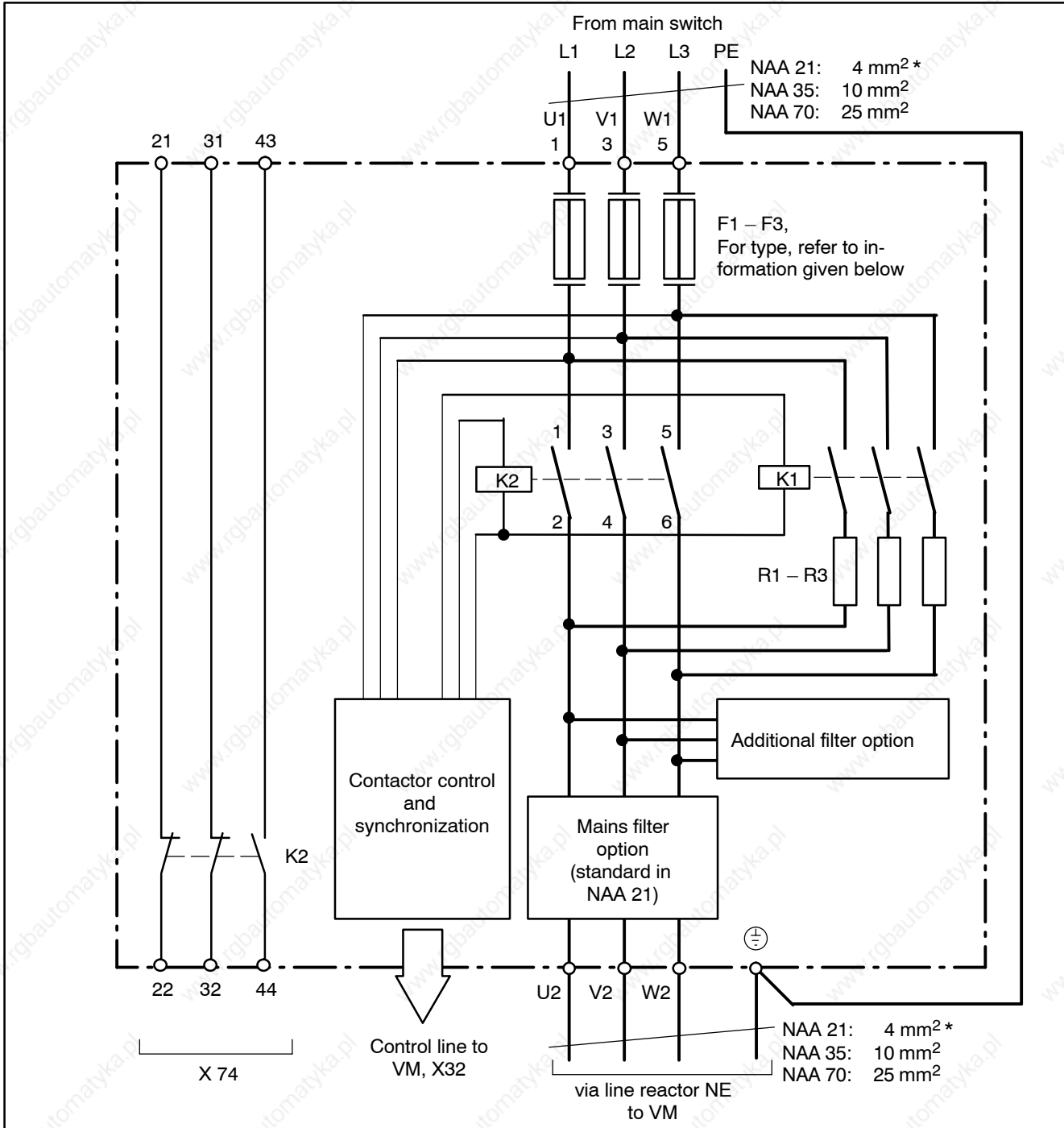Earth connection by means of connection lead to the metal housing
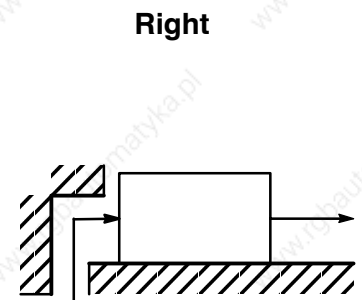
Flat chassis earth connection to the metal housing

Power connection

NAA 21, NAA 35 and NAA 70 mains connection modules

NAA 21 with integrated mains filter, optional for NAA 35. Another optional item is an integrated additional filter for connection to the public network.

* According to EN 60204 Part 1/1993, Tab. 5 for installation in the cable duct at an ambient temperature of 45°C

Fuses:
NAA 21,	UL-certified:	3 x FERRAZ encapsulated fuse, very quick acting, 50 A/690 V
NAA 35,	standard:	3 x Jean Müller M00üf1, very quick acting, 63 A/660 V
	UL-certified:	3 x FERRAZ encapsulated fuse, very quick acting, 63 A/690 V
NAA 70,	standard:	3 x Jean Müller M00üf1, very quick acting, 100 A/660 V
	UL-certified:	3 x FERRAZ encapsulated fuse, very quick acting, 100 A/690 V

(For part numbers, refer to page 11–3)

Power connection

Power connection to VMA..KR and VMA..B,C

Between the NAA mains connection module and the supply module
with current regeneration a line reactor NE is installed.

The supply module must be considered when choosing the size of the
line reactor (refer to manual "Configuration").
The line reactor is equipped with cable ends which can be shortened to
the required length. We recommend using plug connectors for terminal
connection.

CAUTION
A reversed phase sequence or winding direction of a line reactor
will destroy the mains connection module.
Please ensure proper wiring.
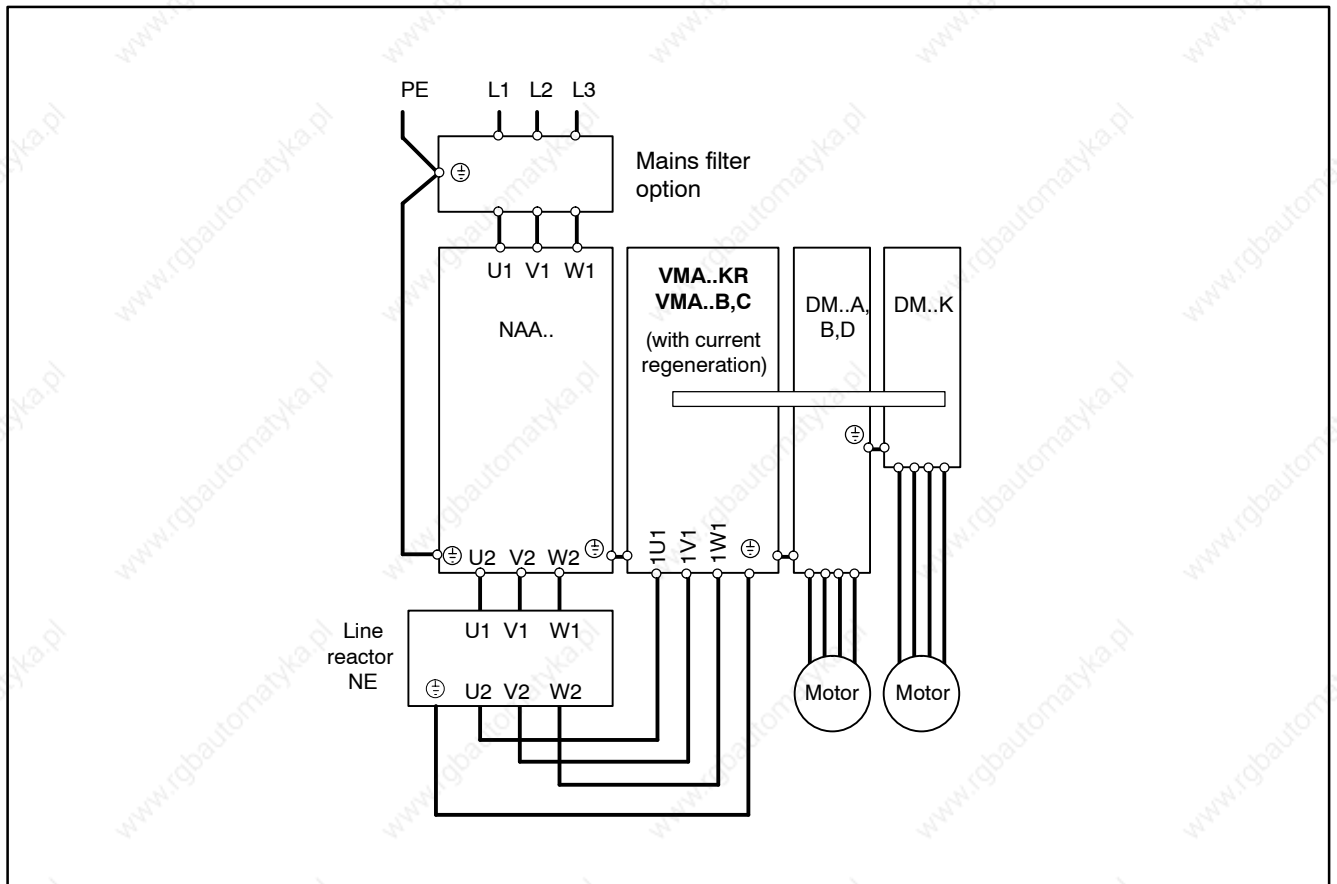
Power connection

NAA 90 mains connection module
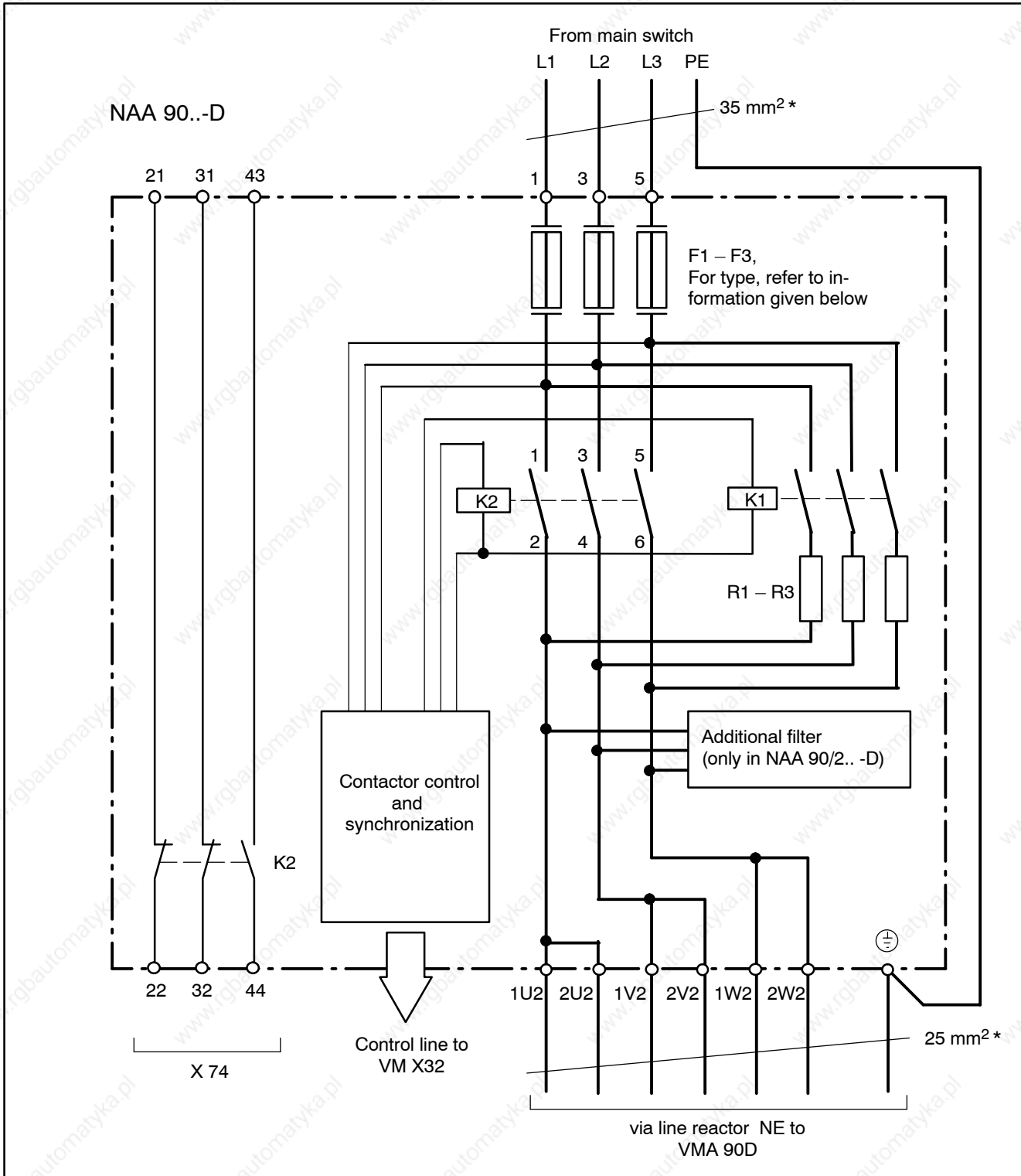
* According to EN 60204 Part 1/1993, Tab. 5 for installation in the cable duct at an ambient temperature of 45°C

Fuses: NAA 90:   3 x Jean Müller M00üf1, very quick acting, 125 A/660 V
(For part numbers, refer to page 11–3)

Power connection

Power connection to VMA 90D

The NE 70 line reactors are connected between the mains connection
module and the supply module with current regeneration.

CAUTION
**A reversed phase sequence or winding direction of a line reactor
will destroy the mains connection module.**
Please ensure proper wiring.

Power connection

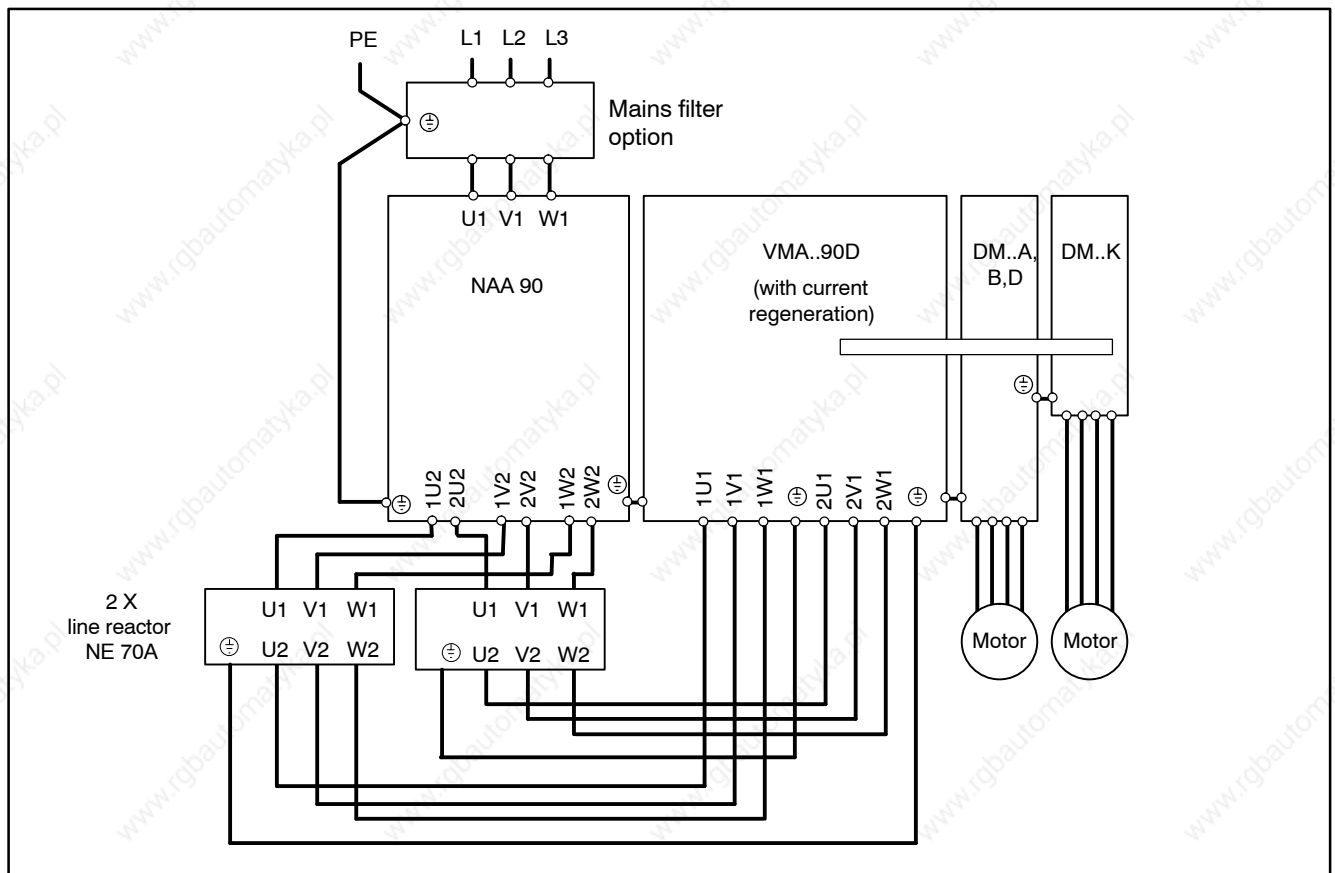## NAA 180 mains connection module

* According to EN 60204 Part 1/1993, Tab. 5 for installation in the cable duct at an ambient temperature of 45°C

Fuses: NAA 180: 3 x Jean Müller M00üf1, very quick acting, 250 A/660 V
         (For part numbers, refer to page 11–3)
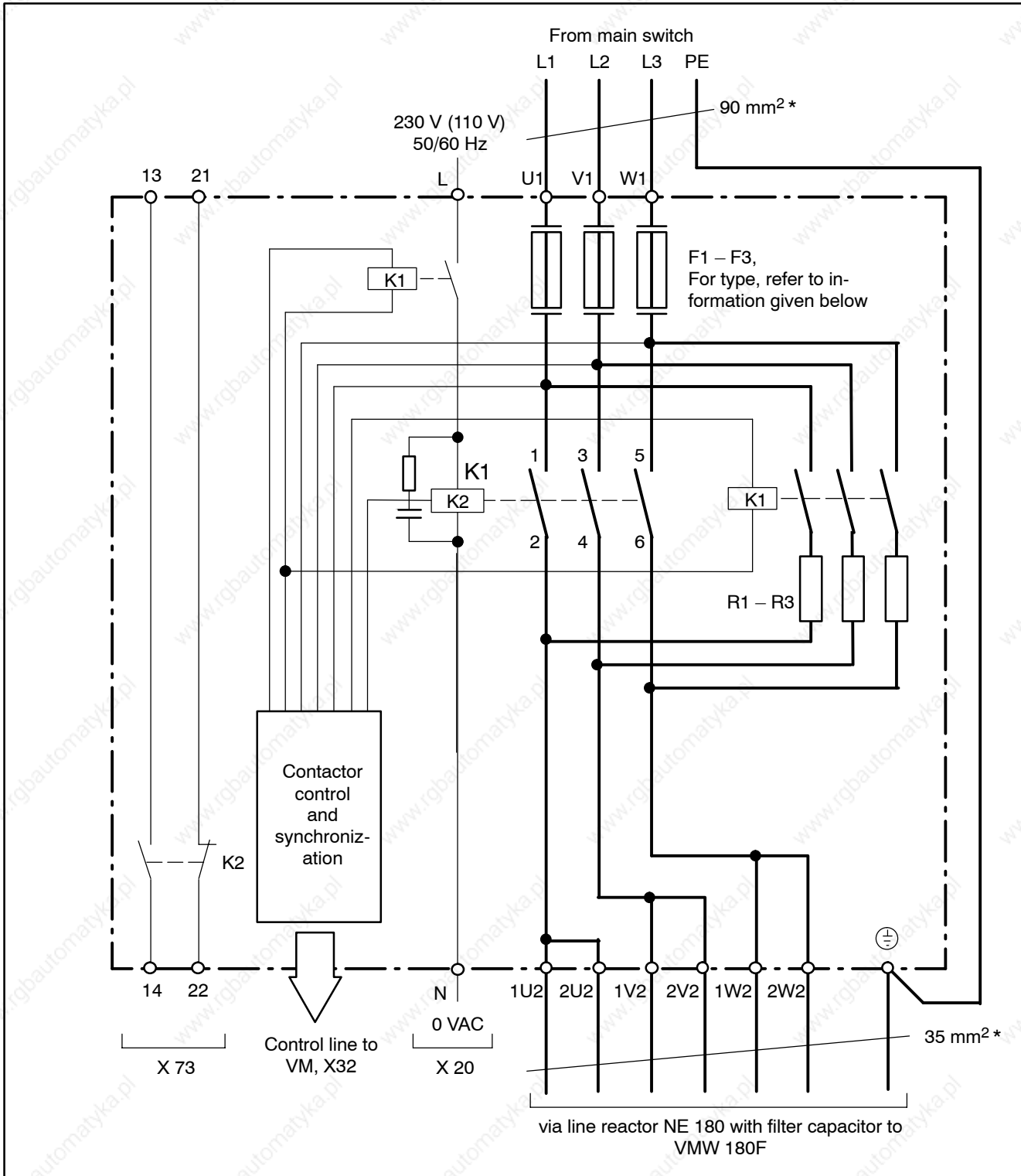
Power connection

Power connection to VMW 180F

The NE 180 line reactor is installed between the mains connection module and the supply module with current regeneration.

A filter capacitor is additionally required. Due to the high surface temperature of the line reactor, the distance between the filter capacitor and the line reactor must be 1 m min. Cable length 2 m max.

CAUTION
A reversed phase sequence or winding direction of a line reactor will destroy the mains connection module.
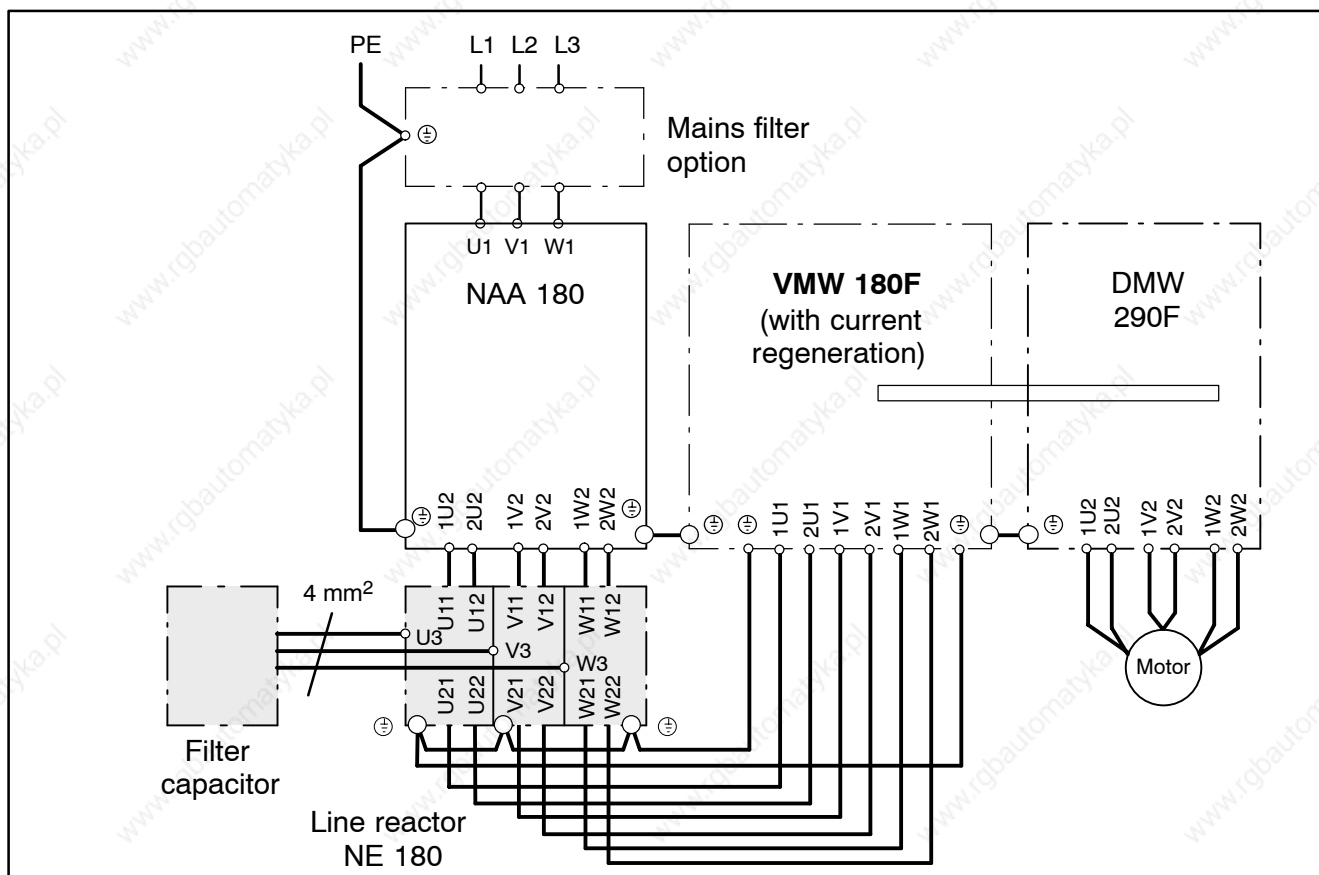**Please ensure proper wiring.**

Power connection

5.5   Ballast resistor connection

Without UL/CSA requirements:

The external ballast resistor EB-TA with 10 Ω/1.5 kW is connected to terminals R+, R of the VMA 21KE supply module which is not UL/CSA listed.

Operation in compliance with UL/CSA:

An external UL/CSA recognized ballast resistor has to be connected to terminals R+, R of the UL/CSA listed VMA 21KE supply module.

Required data:

Value: 10 $\Omega \pm$ 10%

Voltage: max. 800 V

Power: P $\geq$ 1200 W

Energy: P $\geq$ 60 kWs

Potential suppliers: Danotherm, Fritzlen, Koch

CAUTION
The power supply module monitors the ballast resistor load. Ballast resistors could be damaged, if they are dimensioned with too small power and energy.

Ballast resistor connection
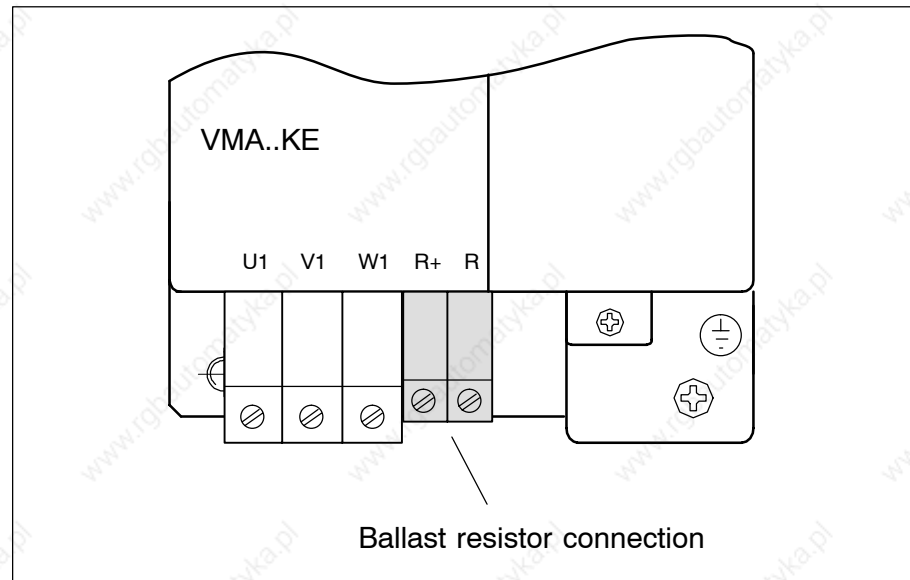
- Conductor cross-section: 2.5 mm^2
- Cable length: max. 10 m

☞ **UL class 1 power cables (e.g. UL Style 1007 or 1569 on mains side, H05: U_0/U: 300/500 V) have to be used for UL/CSA-certified drive inverters.**

Power connection

5.6   24 V supply

The supply modules require a 24 V supply from an external 24 VDC load
power supply module in accordance with EN 61 131 (20.4 − 28.8 V). A
stabilized power supply unit is not required.
The input terminals are protected by miniature fuse F1 20 A/32 V.
Spare fuse, part no. 1070 917 667
The 0 V$_{PWR}$ connection is internally floating against ground. If the 0 V
are to be grounded, the ground connection has to be made, e.g., at the
external 24 V power supply unit.

DANGEROUS ELECTRICAL VOLTAGE
The 24 VDC must satisfy the 'safety separation' requirements.
The requirements in accordance with the overvoltage category III
should be noted on the primary side!

In the inverters, the extra-low-voltage circuits are safety-separated from
the mains circuit (safety separation to EN 50178).

CAUTION
Contact system destroyed!
Connector X30 may only be inserted or removed while the unit is
disconnected from power. Furthermore, the connection screws
have to be firmly tightened. Use a screw driver with a blade size
0.6 x 3.5 for this purpose.

DANGER
The drives coast to a standstill if the 24 V supply is interrupted!
This can be avoided by taking one of the following measures:
● **use a buffered 24 V power supply unit (no 100% safety)**
● **plug braking of the motors with KSB (plug braking) module**
● **use motors with a holding brake.**

The 24 VDC supplied to the VM are passed on:
● via the 24V cross-connection X820 to the logic and driver supply of
the inverter modules and the fan supply of the backplane modules
● via the 24V outputs X331/X332 for the supply of all module outputs
of the axis modules.

Power connection

Due to the cross-connection to the axis modules, the number of inverters that can be connected is limited:

● **maximally 9 axes** per VM
● **maximally 14 A** power input (24 VDC) per VM

Module type	Backplane module	24 VDC current input
VMA 21K	–	1.0 A
VMA 21KR	–	2.1 A
VMA 35B	RMB/VM	2.3 A
VMA 70C	RMC/VM	2.7 A
VMA 90D	RMD/VM	3.1 A
VMW 180F	–	2.5 A
DMA 4K	–	0.89 A
DMA 8K	–	0.89 A
DMA 15K	–	0.89 A
DMA 30K	–	1.03 A
DMA 45 K	–	1.4 A
DMA 4A	RMA/DM8	1.0 A
DMA 8A	RMA/DM8	1.14 A
DMA 15A	RMA/DM30	1.14 A
DMA 30A	RMA/DM30	1.23 A
DMA 45A	RMA/DM45	1.32 A
DMA 85B	RMB/DM	1.35 A
DMA 140D	RMD/DM	1.58 A
DMW 290F	–	2.5 A
Total of one drive set		**max. 14 A**

Power connection

5.7   Motor connection

DANGEROUS ELECTRICAL VOLTAGE
Due to the permanent magnet excitation, the power connector carries a hazardous high voltage if the rotor is rotating and the motor is not electrically connected!
The unit must be completely de-energized and halted before commencing any connection or installation work.

Motor cables

We recommend using prefabricated Bosch motor cables for the SF and SR servo motors. Depending on the individual case, these cables are available as

- Standard cables, shielded
- Standard cables, unshielded
- UL power cable

☞ **UL class 1 power cables (e.g. UL Style 1510 on motor side, H07: U_0/U: 600/1000 V) have to be used for UL/CSA-certified drive inverters. This is to ensure that the entire system meets the UL/CSA requirements.**

CAUTION
**Damage to cables due to inadmissible movements.**
Please note the technical data of the cables specified in the "Configuration manual", part no. on page 1–7.

Cable bushing (metal flange)

For cable bushings, e.g. leading into the switch cabinet, a metal flange may be used in connection with a cable extension and a coupling. The connector housing is clamped and sealed to IP 65 when installed.

Flange: Zinc diecasting, nickel-plated
Gasket: Viton, black
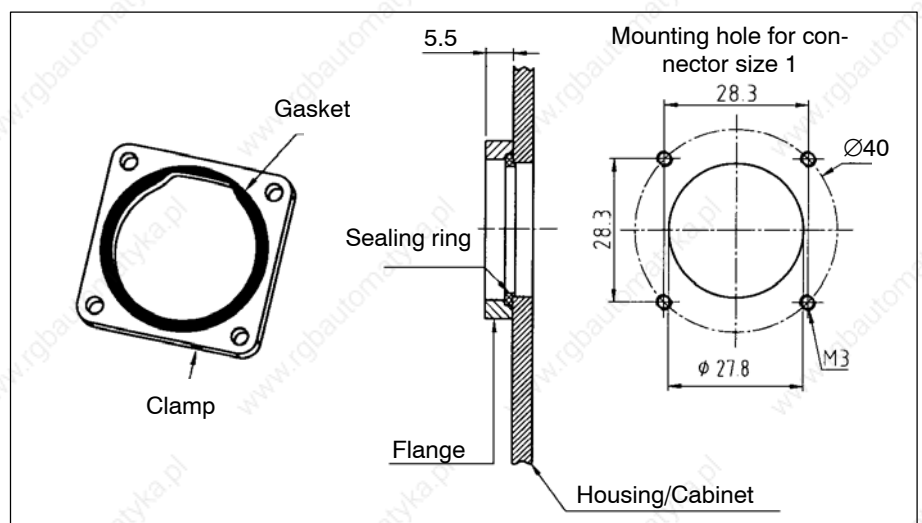
Power connection

5.7.1 SF, SR servo motors power and brake connection

☞ **CAUTION**
Damages at the inverter or encoder by inserting or removing plug-in connections on live systems!
**Switch the drive off beforehand.**

☞ **Please note that unshielded motor cables may inject voltages into other cables laid in parallel due to capacitive injection mechanisms.**
Noticeable voltages are particularly injected in unused brake cores. In accordance with IEC 1201, the line capacitance is not sufficient to generate lethal voltages (at a cable length of 100 m approx. 15 nF between cores, a dangerous value would be 28 nF at 400 V). Insulate the open ends of the brake cores.
If cables are laid in parallel, injection is approx. 10 times lower.
Shielded motor cables do not produce injections.
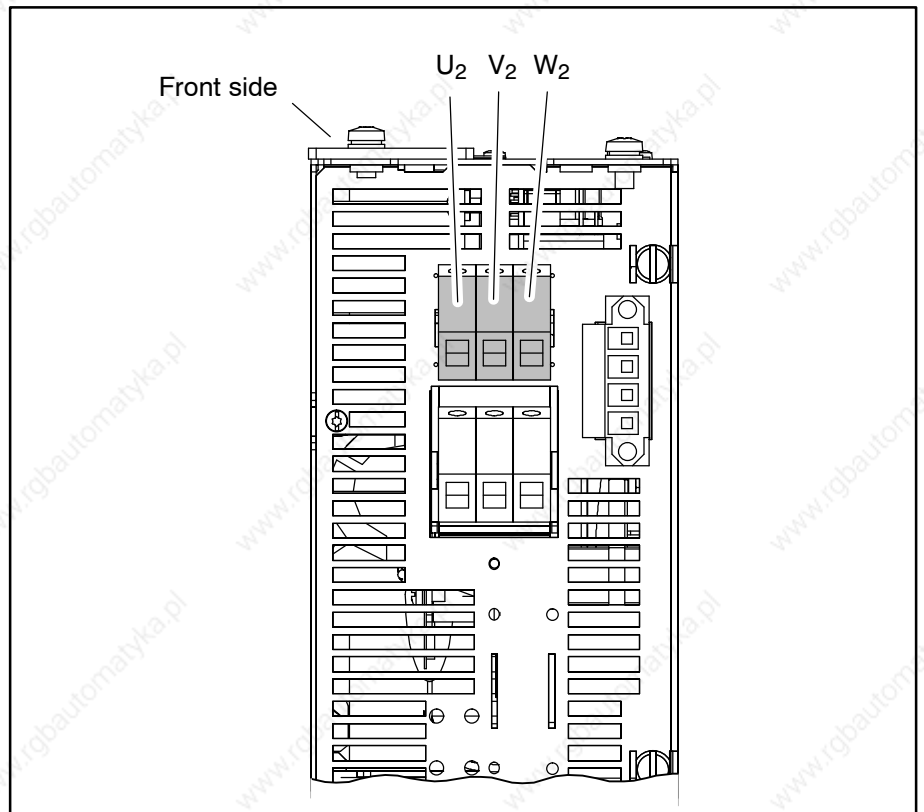
DM..K
Power connection using plugs at the bottom side of the housing.
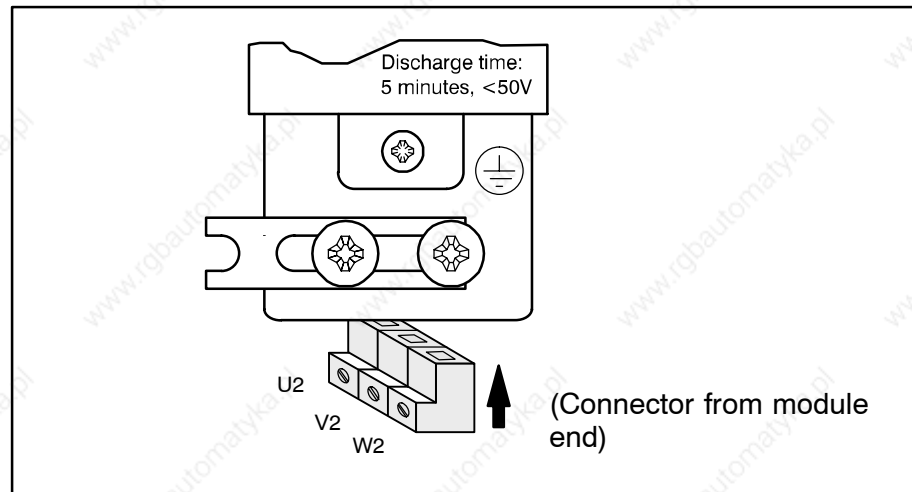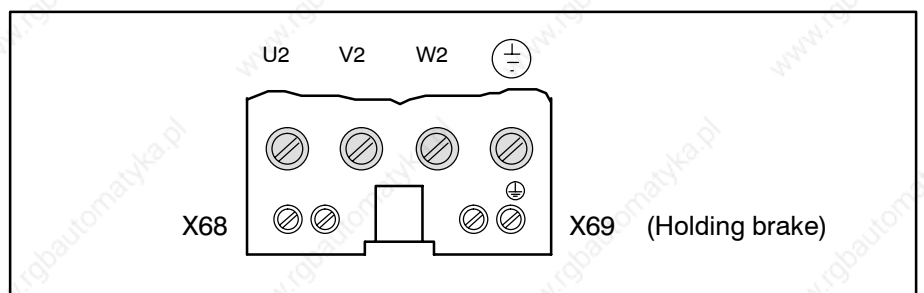
Power connection

DM 45K
Motor connection using terminals at the bottom side of the housing.

DMA..A,B,D
Power connection to terminal block of the RM backplane module using plug connectors.
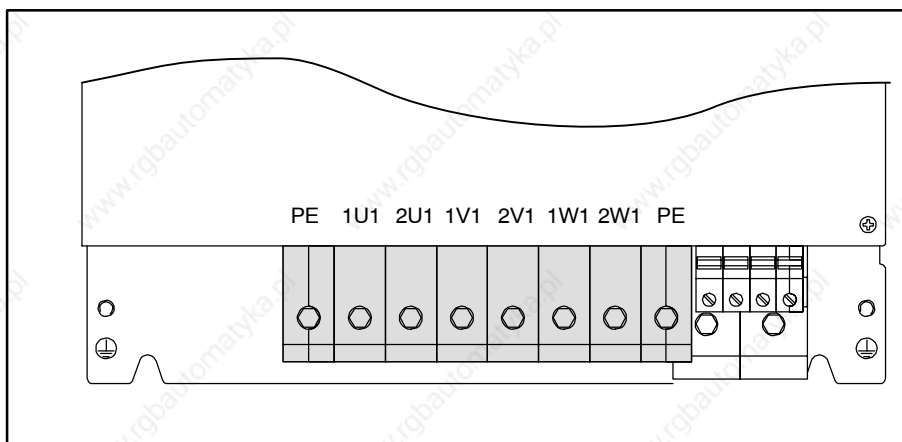Screw tightening torque: 3.0 Nm

Power connection
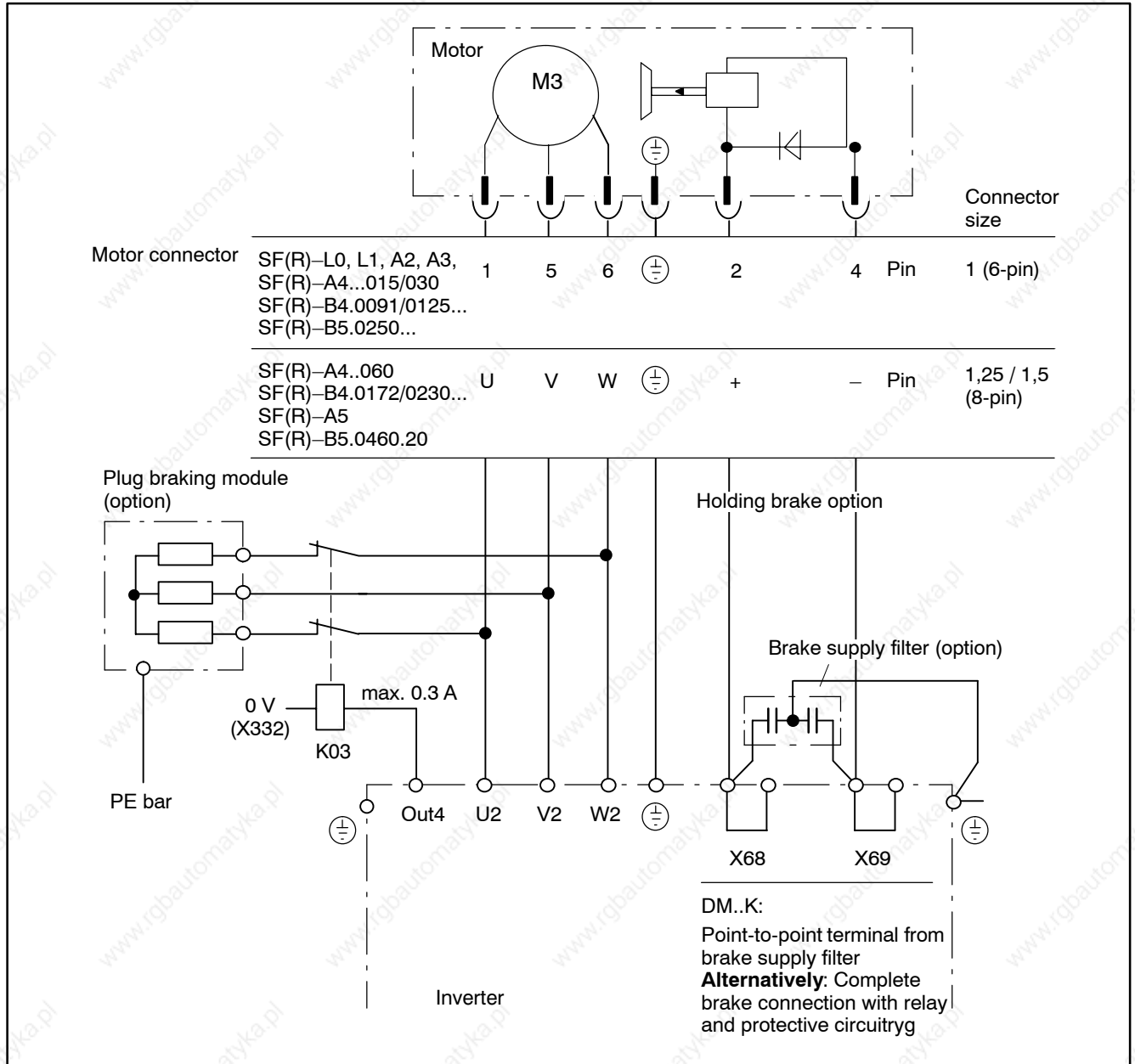
DMW 290F

Power connection to terminal block at the bottom side using plug connectors.

Screw tightening torque: 12.0 Nm

Power connection

Motor connector		Pin	Connector size
SF(R)–L0, L1, A2, A3, SF(R)–A4...015/030 SF(R)–B4.0091/0125... SF(R)–B5.0250...	1 5 6 (⊥) 2 4	Pin	1 (6-pin)
SF(R)–A4..060 SF(R)–B4.0172/0230... SF(R)–A5 SF(R)–B5.0460.20	U V W (⊥) + –	Pin	1,25 / 1,5 (8-pin)

Plug braking module (option)

Holding brake option

Brake supply filter (option)

0 V
(X332)   max. 0.3 A

K03

PE bar

(⊥)   Out4   U2   V2   W2   (⊥)

X68   X69   (⊥)

DM..K:

Point-to-point terminal from brake supply filter
Alternatively: Complete brake connection with relay and protective circuitryg

Inverter

Rated voltage of the motor power cables:
$U_0/U = 600/1000$ VAC.

DANGEROUS ELECTRICAL VOLTAGE
Motor leads and brake leads are led in a multi-conductor cable.
The cores of the brake lead must have the same insulation as the
cores of the motor lead ($U_0/U = 600/1000$ VAC).
If no holding brake is connected, the open ends of the brake lead
must be insulated!

☞ **For connection cross-sections and more information on the leads,**
please refer to the "Configuration" and "SF, SR servo motors"
manuals.

Power connection

Shield connection at the DM..K
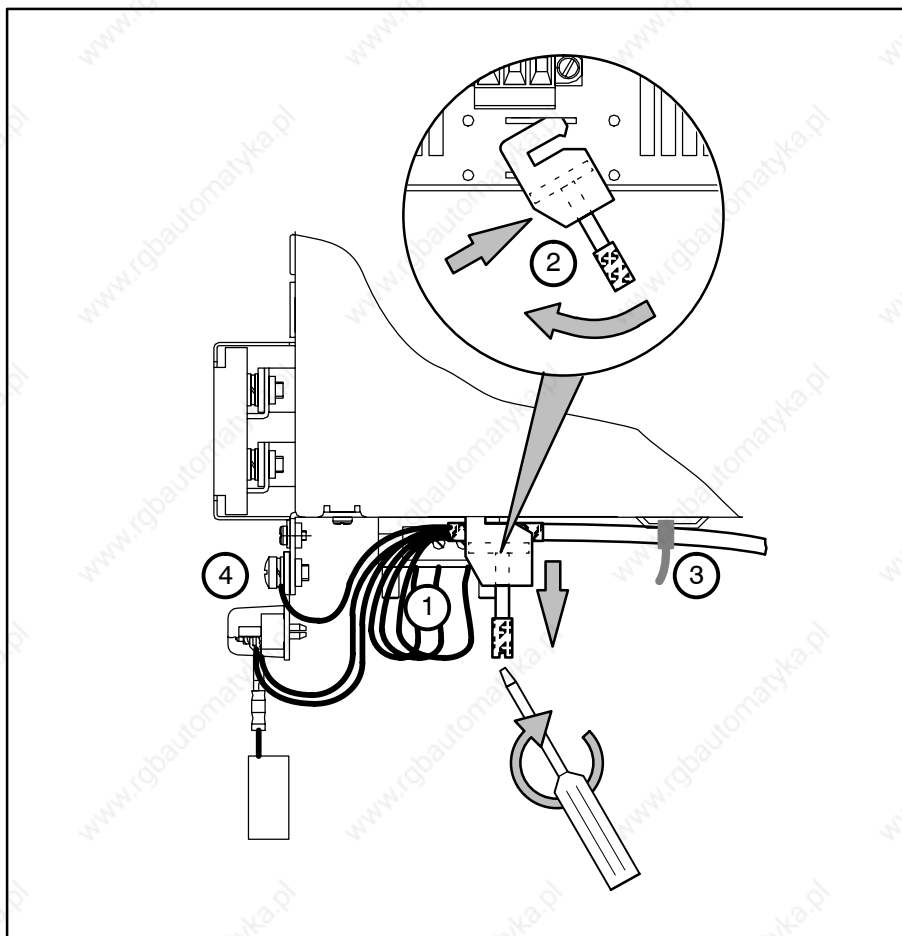
1. Connect power cables with connector ① on bottom side of housing.

2. Insert shield connection link ② into mounting slots on the bottom side of housing and push backwards until the stop.

3. Tighten link on the strapped shield end of the cable.

4. Fasten motor cable with cable strap ③ at bottom side of housing.

5. Finally make the PE connection ④.
    The following can be installed for brake supply:
    - protective circuitry with point-to-point terminal (cf. page 5–26) or
    - brake connection with relay and protective circuitry (cf. page 5–27).

Power connection

## Shield connection at the DM..A,B,D,F

A shield connector has to be additionally fitted to the backplane module in order to connect a shielded power cable.

For part numbers of the conductor areas, cf. page 11−1.

The cable must be fastened to the module using a metallic cable strap, e.g. metallic cable strap made by Rittal:

125 x 4.6 (No. SZ 2598.125) or
200 x 4.6 (No. SZ 2598.200).

Shield connector for brake cable

Shield connector for power cable
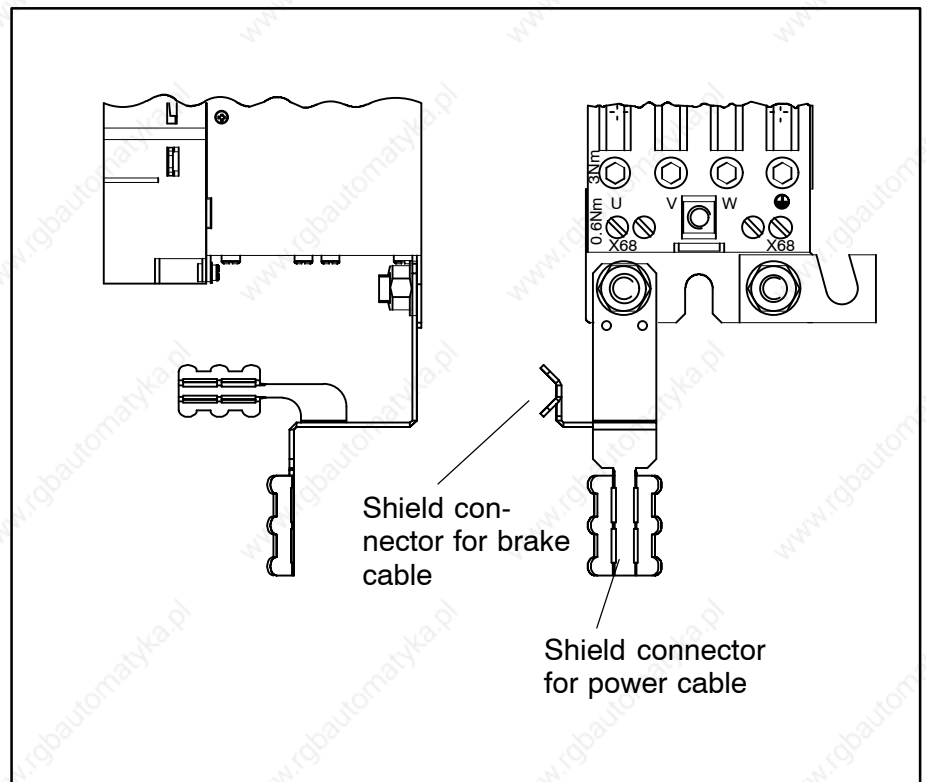
Power connection

Brake supply filter

Capacitive influences on the 24 V line for the holding brake may cause a delay in the brake disengagement. In order to avoid such interferences, please use the brake supply filter designed for this purpose.

Please note the different designs for DMA..A,B,D,F and DM..K.

The brake filter for DM...K includes an additional point-to-point terminal which is to be plugged onto the module, thus providing for brake connection diretly to the module.
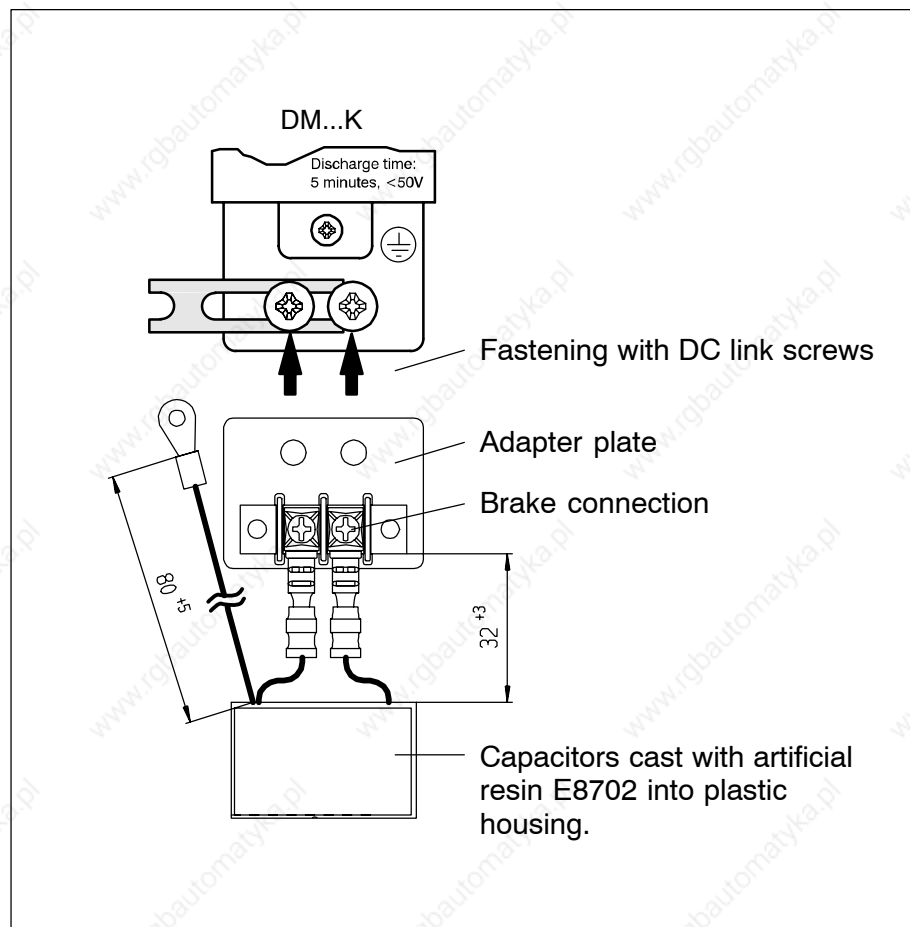
Power connection

MBC brake connection with relay and protective circuitry

These accessories eliminate interference and facilitate brake control, because they contain an additional relay.
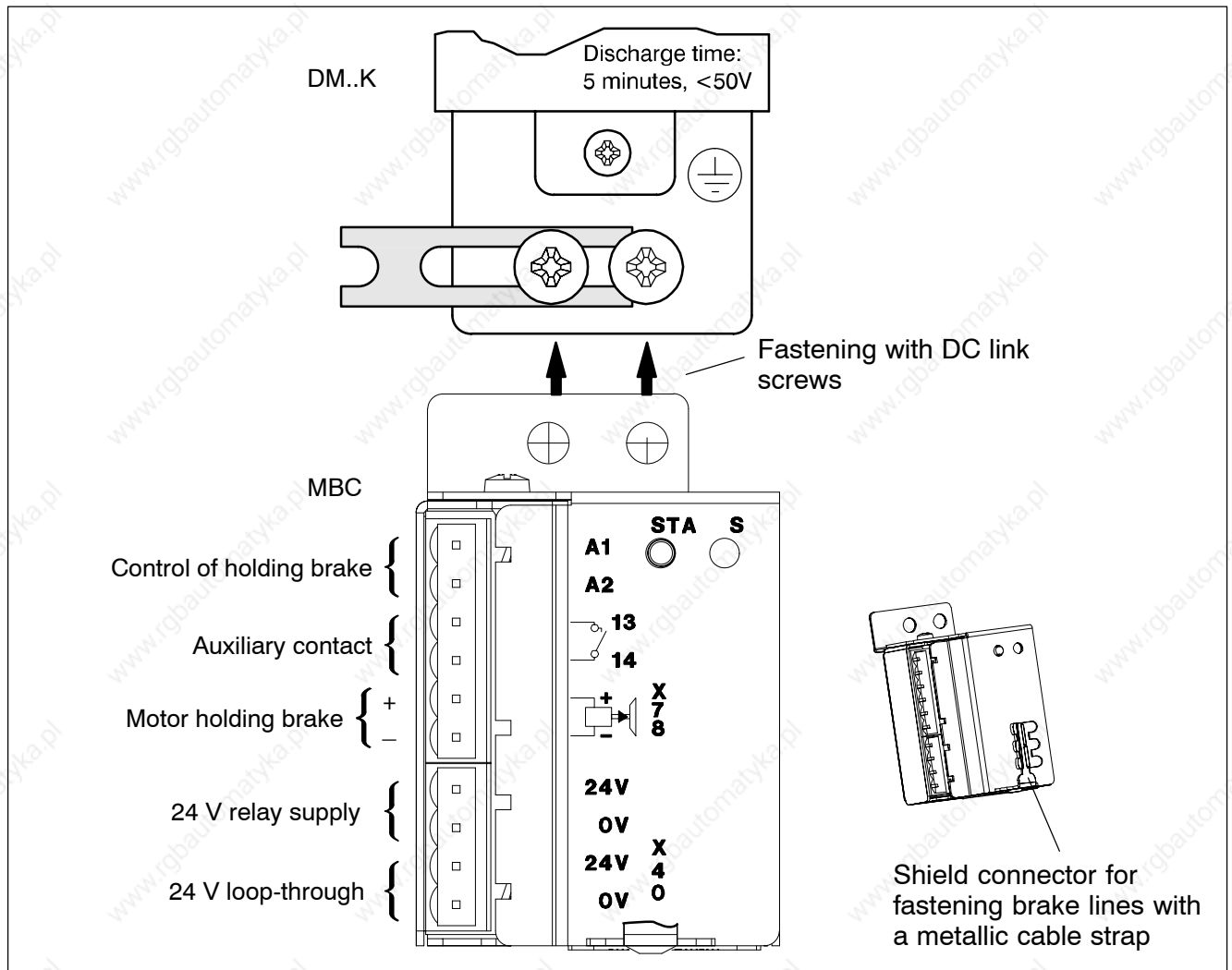
X78   A1, A2   Control

Active with +24 V.
A1:   Holding brake control signal from DM, X34.2 (Out3)
A2:   0 V from VM, X332

☞ **For UL-conformant drive installations:**
If A1, A2 are not controlled via the DM, the voltage supply must comply with UL Class II.

13, 14   Auxiliary contact

Freely available auxiliary contact of the control relay.

+, −   Holding brake

Connection of motor brake line.

Power connection

X40   **24 V, 0 V**   **Voltage supply**

24 VDC voltage supply of the control relay.
The 24 V are looped through to the next module via the 2nd pair of terminals.

STA   **LED, green**

The LED is on if the holding brake of the motor has been vented, i.e. when control is active.

S   **Key**

The brake can be vented using the S key if no external control signal is present.

Power connection

5.7.2 DU asynchronous motor power connection

Motor end

The following electrical connections are made in the terminal box:
- Power
- External fan
- Holding brake option

Cable entry is through two heavy-gauge conduit threads.
The terminal box is located on the top as standard and can be turned by
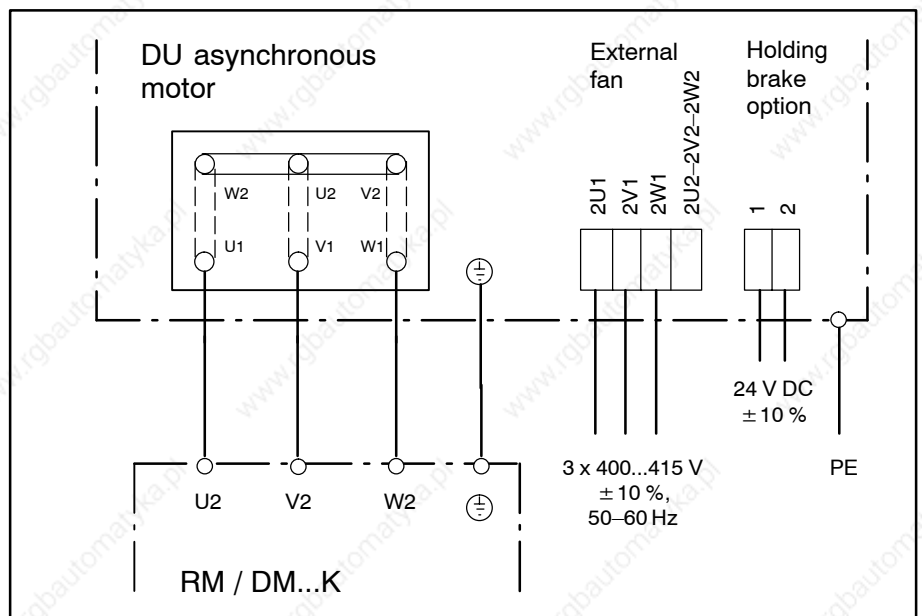4 x 90°. Circuit diagram on the terminal box lid.

Module end

DMA..A,B,D:
Power connection with plug connectors at the RM backplane module
terminal block. Screw tightening torque   3.0 Nm

DM..K:
Power connection using plugs at the bottom side of the housing.

Star connection,
to be used for motors size 90

Δ connection,
to be used for motors size 100 ... 160

CAUTION
**The contacts of the motor contactor may weld together if opened
under excessive load!**
**The motor contactor may only be opened when n = 0 and enabling
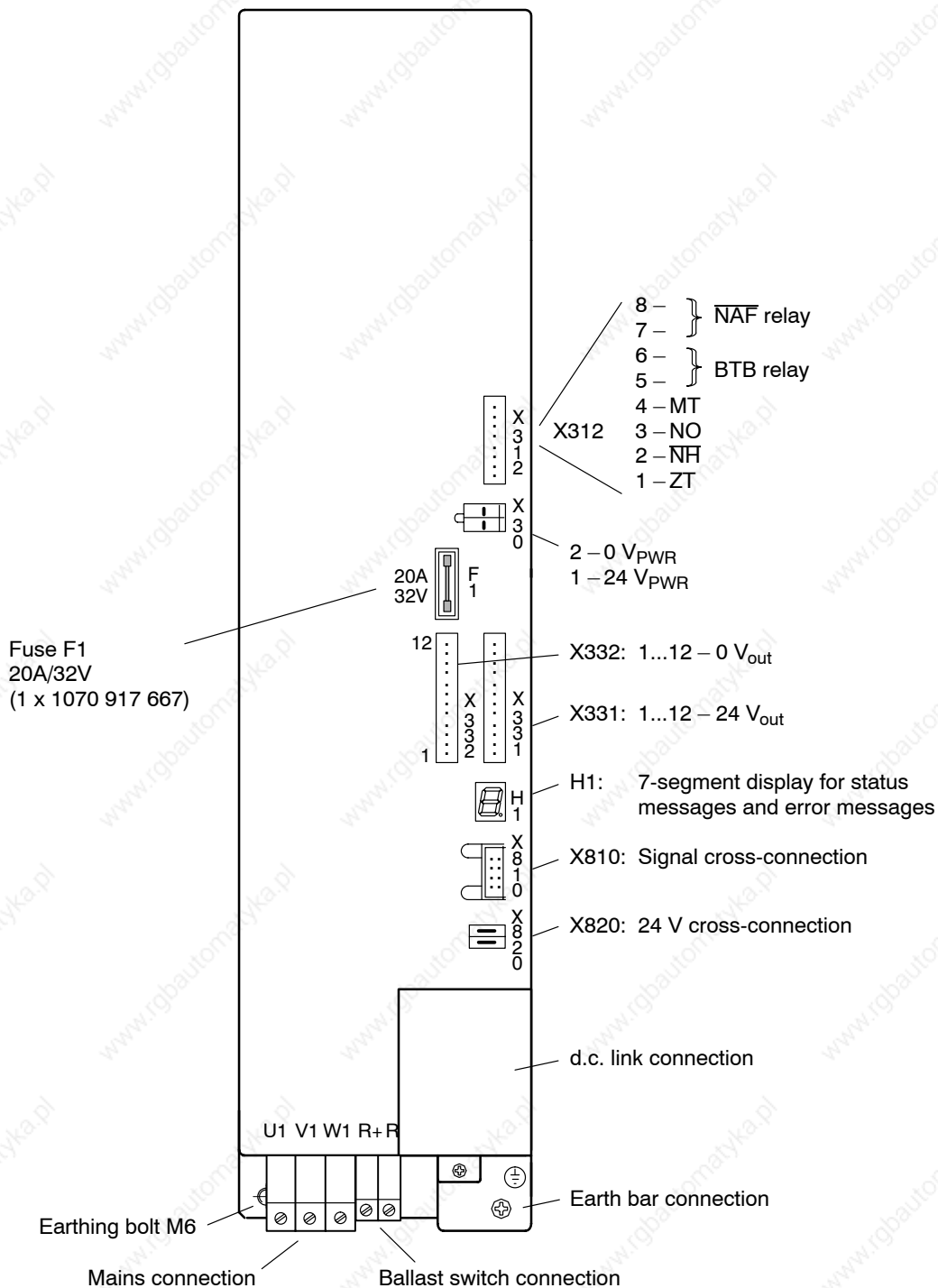has been cancelled.**

Power connection

Notes:

VMA..KB, VMA..KE supply module control connections

6 Control connections on supply modules

6.1 VMA..KB, VMA..KE supply module control connections (with ballast switch)

8 – ⎫ $\overline{\text{NAF}}$ relay
7 – ⎭
6 – ⎫ BTB relay
5 – ⎭
4 – MT
3 – NO
2 – $\overline{\text{NH}}$
1 – ZT

X312

X330
2 – 0 V$_{PWR}$
1 – 24 V$_{PWR}$

20A
32V   F1

Fuse F1
20A/32V
(1 x 1070 917 667)

12

X332: 1...12 – 0 V$_{out}$

X332   X331

X331: 1...12 – 24 V$_{out}$

1

H1   H1: 7-segment display for status messages and error messages

X810   X810: Signal cross-connection

X820   X820: 24 V cross-connection

d.c. link connection

U1 V1 W1 R+ R

Earthing bolt M6

Earth bar connection

Mains connection   Ballast switch connection

VMA..KB, VMA..KE supply module control connections

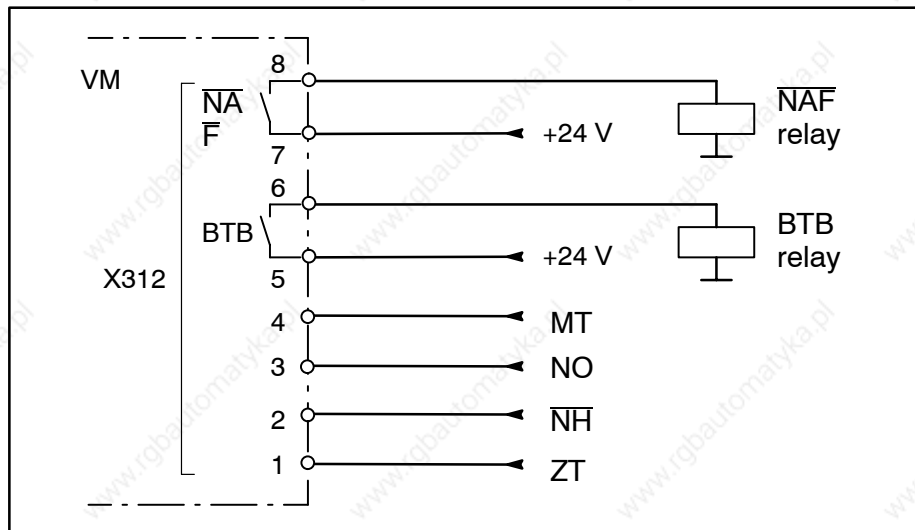## 6.1.1   Terminal strips

Terminal strip X30
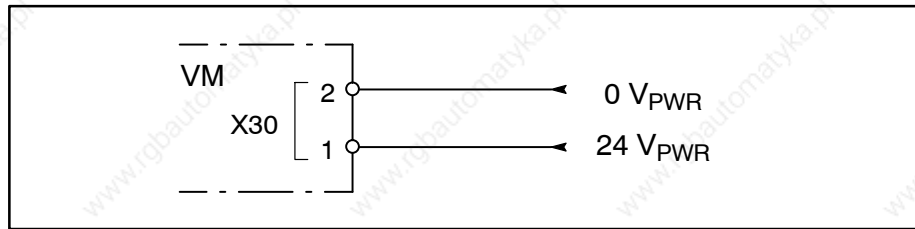
X30.1/2   24V$_{PWR}$, 0V$_{PWR}$ 24 V module supply (power)

Power supply to the module is provided by an external 24 VDC load power supply unit according to section 5.6.

Terminal strip X312

X312.1   ZT   Dead-man's key

Optocoupler input for dead-man's key,
active with +24VDC (16...30V).

Dead man's key without 2-channel evaluation, i.e. RSU functionality not possible.

X312.2 $\overline{NH}$ Emergency-Stop (drive halt)

Optocoupler input for the Emergency-Stop function,
active with 0VDC.

If this signal is LOW, the motor is halted as defined in parameter P-0-0004:

● within the shortest time possible (S-0-0138)

● drive-controlled via ramp S-0-0260

VMA..KB, VMA..KE supply module control connections

- setpoint-controlled by master
- drive-controlled via ramp P-0-0260 (for SERCOS interface only).

When halted, the torque is removed from all motors.
For connection, cf. page 6–5.

X312.3   NO   Normal operating mode

Optocoupler input, active with +24VDC (16...30V).

X312.3 is to be permanently wired to 24V to specify normal mode as fixed mode. Maximum speed monitoring of the drives is thus always active.
For connection, cf. page 6–5.

No 2-channel special operating mode, i.e. RSU functionality not possible.

X312.4   MT   Measuring probe input

Optocoupler input for the measuring probe of the machine, active with +24V.
Can be used as a setpoint interface in connection with SERCOS interface only.

The signal is transmitted to the DMs through the X810 module cross-connection. The signal propagation delay between the measuring probe and the axis in question is < 5 μs.

X312.5/6   BTB   Ready

Floating relay contact. Max. load 24 V/1000mA.
The contact closes when:
- 24V module supply active
- no error in VM
- d.c. link is active

In the occurrence of the following malfunctions, the BTB contact is immediately opened, the VM output stage and the output stages of the axes are inhibited:
- d.c. link undervoltage (< 400 V)
- d.c. link overvoltage (> 750 V)
- ballast switch overload
- power supply unit fault
- module overtemperature
- ambient overtemperature

The BTB contact is a group error message. It must be evaluated by the start logic of the mains contactor in order to prevent that mains voltage is still active in the event of an error although the VM is switched off (cf. page 6–5).

VMA..KB, VMA..KE supply module control connections

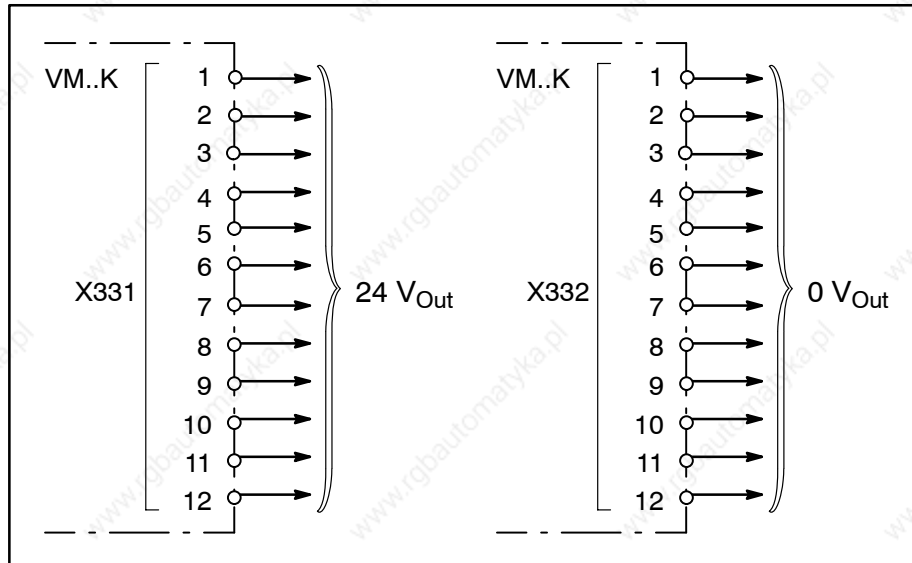### X312.7/8 $\overline{\text{NAF}}$ **Mains failure**

Floating relay contact. Max. load 30 VDC/1000 mA.

The contact immediately opens in the event of:

- mains failure

$\overline{\text{NAF}}$ can be evaluated as a warning, e.g. for further processing by a PLC.

Terminal strips X331, X332

X331   24 V_{Out} **Module supply**

X332   0 V_{Out} **Module supply**

X331, X332 are the reference potential of the X312 terminal block and serve for the supply of the interface inputs and outputs at the drive modules.

X331, X332 must be wired to:

all three-phase modules   X06.9:   24 V_{In}
                           X06.10:   0 V_{In}

☞ **X331 can be loaded with 3 A max. If higher loads are applied, the current limitation becomes active, and voltage breaks down.**

X810 plug-in connection

Signal cross-connection of all drive modules.
The ribbon cable of the adjoining module on the right is inserted into connector X810.

VMA..KB, VMA..KE supply module control connections

X820 plug-in connection

24V cross-connection of all drive modules.
For 24V supply of the drive modules, the cable of the adjoining module
on the right is inserted into connector X820.

CAUTION
Contact system destroyed!
Connector X820 of the 24 V cross-link may only be inserted or re-moved while the unit is disconnected from power.
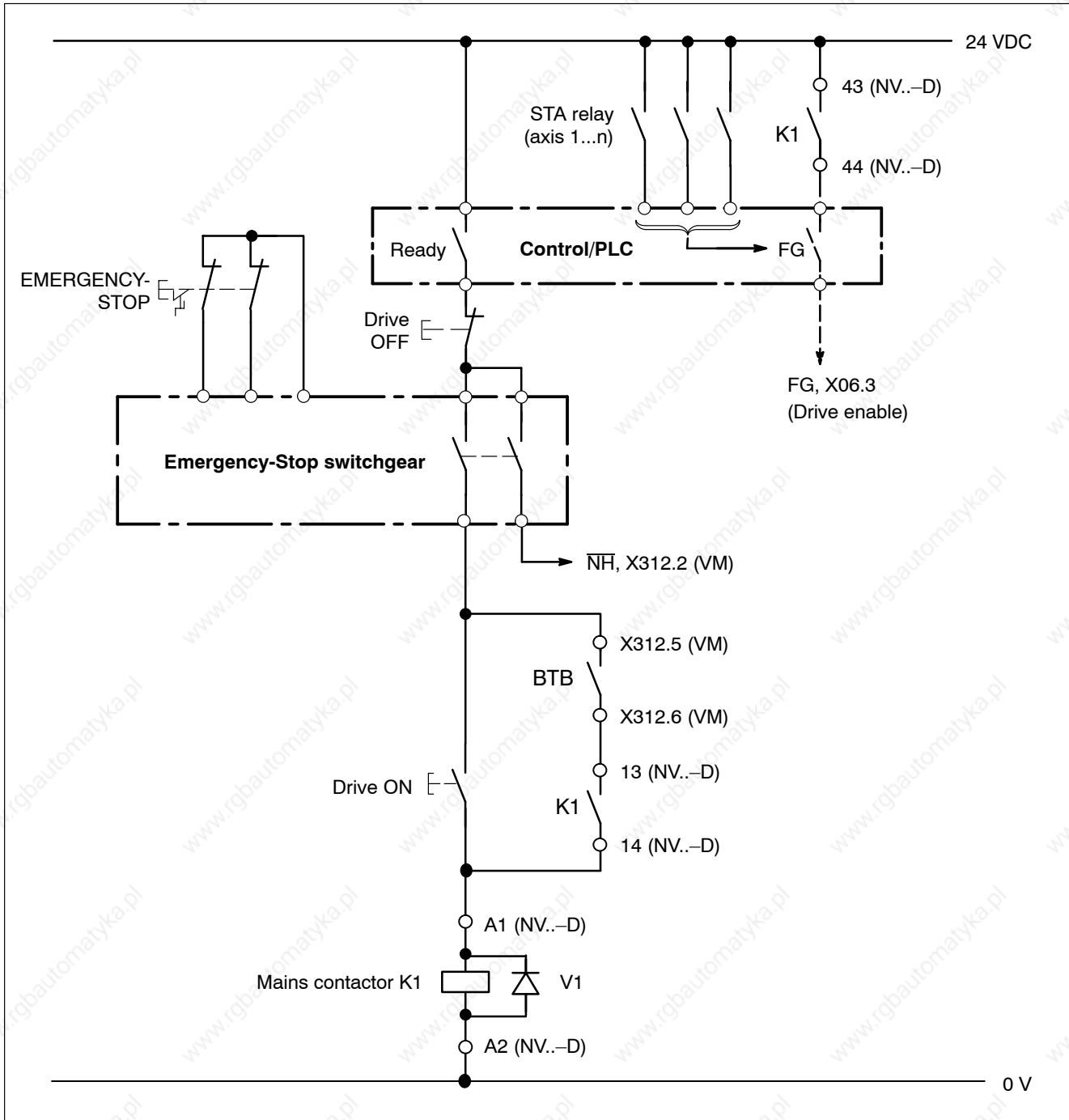
6.1.2   Start logically linked to EMERGENCY-STOP switchgear

DANGER
The VM should be isolated from the supplying mains in the event of a fault!
For this purpose, switch the BTB contact of the VM unit into the latching function of the K1 mains contactor.

VMA..KB, VMA..KE supply module control connections

Start logically linked for inverters with analog interface, Motion Control, CAN bus, PROFIBUS-DP
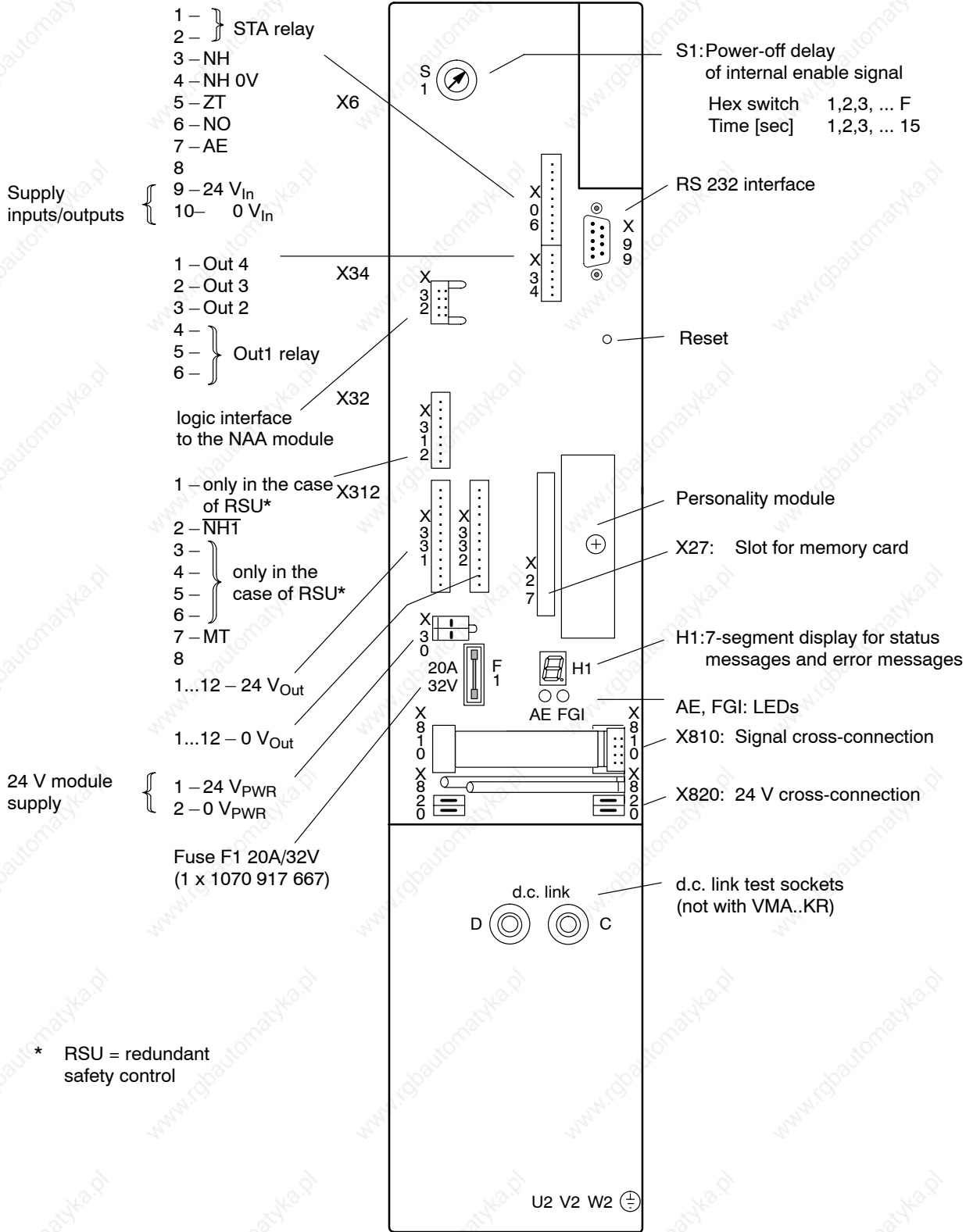

☞ **In case of EMERGENCY-STOP, inverters enabled with FG/FGI signal "VM switched off with active control (F98)".
This message can be acknowledged by setting FG again.**

VMA..KB, VMA..KE supply module control connections

Start logically linked for inverters with SERCOS interface
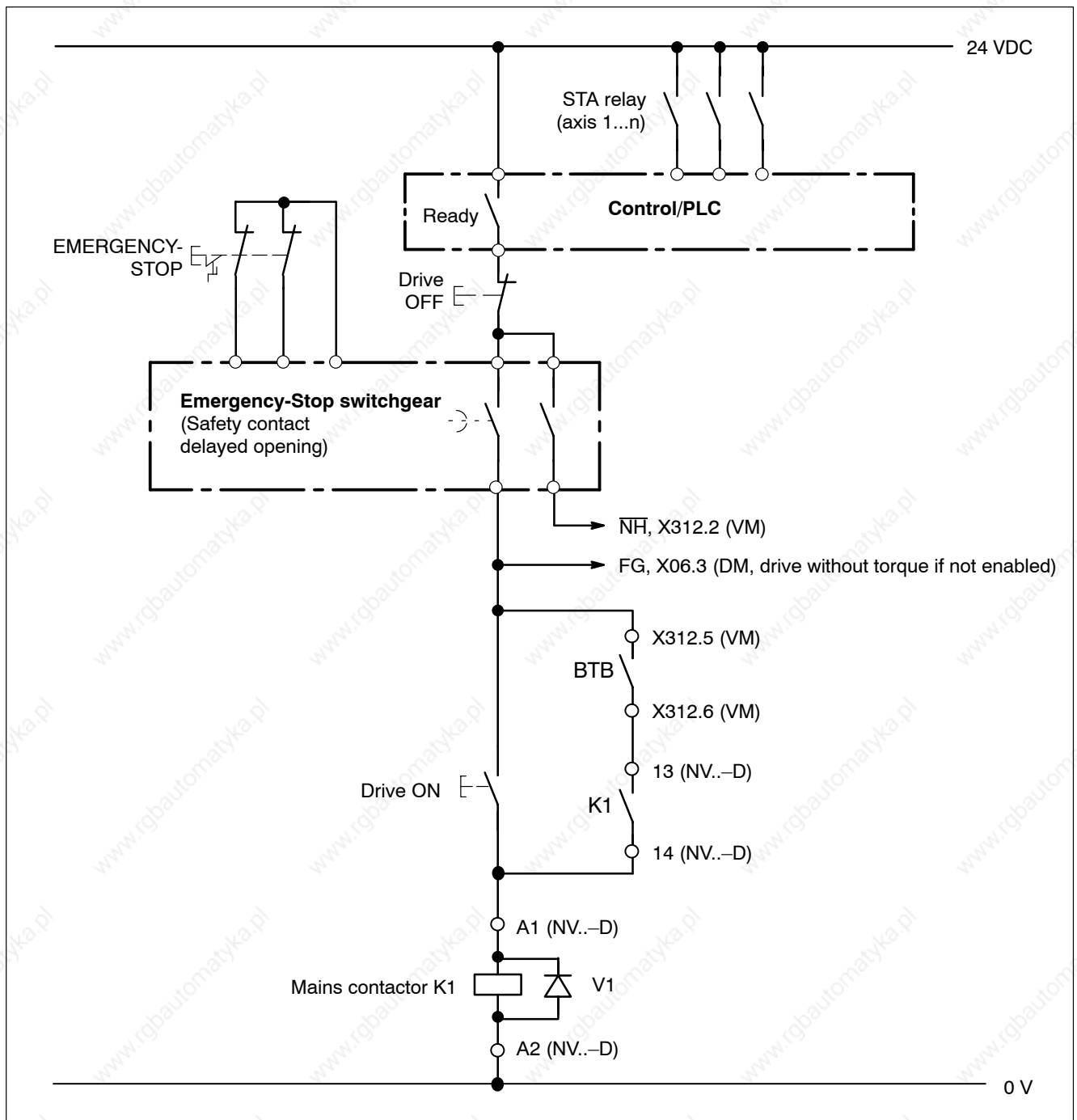
☞ **In case of EMERGENCY-STOP, inverters enabled with FG/FGI signal "VM switched off with active control (F98)".**
This message can be acknowledged with "Reset diagnostics class 1".

VMA..KR, VMA..B,C,D and VMW..F control connections

6.2 VMA..KR, VMA..B,C,D and VMW..F control connections (with current regeneration)

### Figure shows VMA 35B, interface is identical for all modules

1 – ⎫
2 – ⎬ STA relay
3 – NH
4 – NH 0V
5 – ZT
6 – NO
7 – AE
8
9 – 24 V$_{In}$
10 – 0 V$_{In}$

Supply inputs/outputs { 9 – 24 V$_{In}$; 10 – 0 V$_{In}$

X6

1 – Out 4
2 – Out 3
3 – Out 2
4 –
5 – ⎫ Out1 relay
6 – ⎭

X34

logic interface to the NAA module

X32

1 – only in the case of RSU*
2 – $\overline{NH1}$
3 –
4 – only in the
5 – case of RSU*
6 –
7 – MT
8

X312

1...12 – 24 V$_{Out}$

1...12 – 0 V$_{Out}$

24 V module supply { 1 – 24 V$_{PWR}$; 2 – 0 V$_{PWR}$

Fuse F1 20A/32V (1 x 1070 917 667)

20A 32V F1

AE FGI

d.c. link
D ⊚ ⊚ C

* RSU = redundant safety control

S1: Power-off delay of internal enable signal

| Hex switch | 1,2,3, ... F |
| Time [sec] | 1,2,3, ... 15 |

RS 232 interface

Reset

Personality module

X27: Slot for memory card

H1: 7-segment display for status messages and error messages

AE, FGI: LEDs

X810: Signal cross-connection

X820: 24 V cross-connection

d.c. link test sockets (not with VMA..KR)

U2 V2 W2 ⏚

VMA..KR, VMA..B,C,D and VMW..F control connections

6.2.1   Terminal strips

For wiring, see section 6.2.2 .

Terminal strip X06
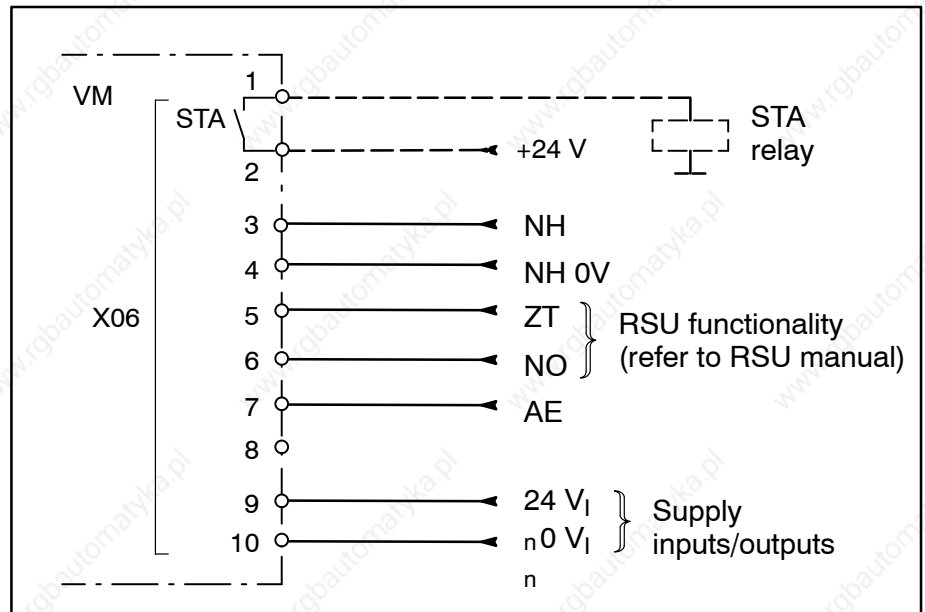
X06.1/2   STA   Status message

Floating relay contact. Max. load 24 V / 1000 mA.

The contact closes, if:
- 24 V module supply active
- no error occurs in the VM
  (central enable FGZ is disabled by overvoltage, undervoltage or by axes standstill after Emergency-Stop)
- Temperature switch-off limit not exceeded
- d.c. link control is active

If an error occurs the STA contact is immediately opened, the VM output stage and axes output stages are disabled and the mains contactors are switched off.
The STA contact is a group error message. It does not concern safety and need not be evaluated.

VMA..KR, VMA..B,C,D and VMW..F control connections

X06.3/4   **NH / NH 0V**   **Emergency-Stop, channel 2**

Optocoupler input for Emergency-Stop function,
active with LOW level.

If NH (X06.3) is LOW (contact is open), all axes are halted as defined in
parameter P-0-0004:

● within the shortest time possible
● drive-controlled via ramp S-0-0260
● setpoint-controlled by master

When halted, the torque is removed from all motors.
For connection, cf. page 6–17.

X06.6   **NO**   **Normal operating mode**
                               7-segment display:

Optocoupler input, active with +24 V DC (16...30 V).

X06.6 is to be permanently wired to 24 V to specify normal mode as fixed
mode. Maximum speed monitoring of the drives is thus always active.
Upon LOW level, all drives are switched off and cannot be switched on
again before RESET has been activated.
For connection, cf. page 6–17.

Changing over to "Set-up" special mode is only possible with the RSU
option. Refer to "RSU, Redundant safety monitoring" manual.

X06.7   **AE**   **Drive on / RESET**
                               Display by means of the "AE" and "FGI" LEDs

Optocoupler input to switch the drive on and to clear errors on the VM.
Active with +24 V DC (16...30 V), both LEDs illuminate when the drive is
on.
For connection refer to page 6–17.

AE must be operated for at least 0.1s.
An active error message is cleared if the error has been corrected. If sev-
eral errors have occurred the error with the higher next priority is then
displayed.
The VM will be automatically activated if no more errors exist and the
Emergency-Stop channels have not been interrupted:

● The mains contactors in the NAA module are switched on
● The d.c. link voltage controller is activated
● VM initiates central enable FGZ
● STA contact is closed.

The On key is controlled against manipulation. The On key is only
switched on by a positive edge if the Emergency-Stop channels remain
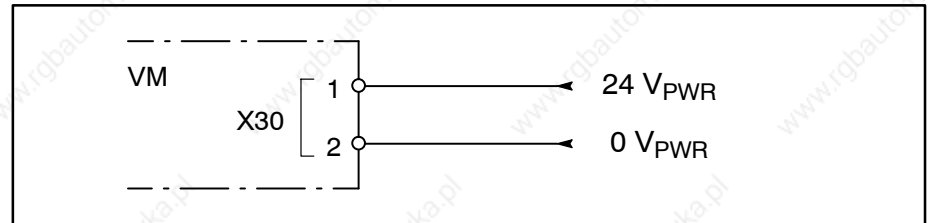uninterrupted.

VMA..KR, VMA..B,C,D and VMW..F control connections

X06.9/10 **24V$_{In}$, 0V$_{In}$**   **Supply of the outputs**

Input and output supply voltage at X06 and X34, to be connected to one
of the supply voltage outputs at the VM (X331, X332).

Terminal strip X30

**X30.1/2** **24V$_{PWR}$, 0V$_{PWR}$**   **24 V module supply (Power)**

Power supply to the module is provided by an external 24 VDC load
power supply unit according to section 5.6.

Terminal strip X32

The mains connection module control cable is plugged into the X32 ter-
minal strip. The mains connection module is thus connected to the VM.

VMA..KR, VMA..B,C,D and VMW..F control connections

Terminal strip X34
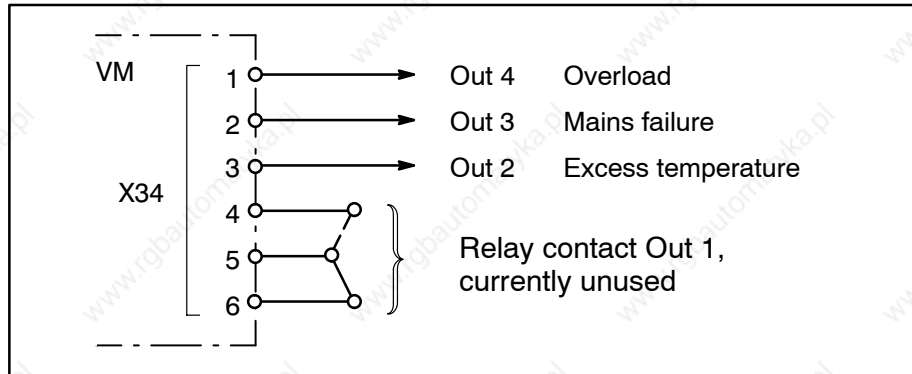
| X34.1 | Out 4 | Overload |
| | | 7-segment display: |
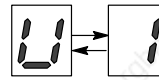
Digital output +24 V.
The output signal changes from +24 V to LOW level if the supply module reaches its current limit or interrupts the d.c. link controller during supply and/or regeneration.
This can occur if:

● maximum power P_{max} > 140 % (rms) or

● rated power P_N > 100 %

CAUTION
If overload occurs the VM could switch off the drives without delay due to overcurrent (supply) or overvoltage (regeneration).
The VM load should be immediately reduced.

Out 4 can be evaluated as a warning, e.g. for further processing in the PLC.

| X34.2 | Out 3 | Mains failure |
| | | 7-segment display: |
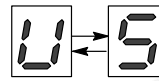
Digital output +24 V.
The output signal changes from +24 V to LOW level, if $U_{Mains\ rms}$ is < 70 % for >3 ms, i.e. at least 2 phases in the supply mains have broken down.

The power unit in the supply module is immediately disabled if an error occurs.

VMA..KR, VMA..B,C,D and VMW..F control connections

CAUTION
If mains failure occurs the VM could switch off the drives without delay due to overcurrent (supply) or overvoltage (regeneration). The d.c. link must be immediately boosted (supply operation) or unloaded (regeneration operation).

Out 3 can be evaluated as a warning, e.g. for further processing in the PLC.

Irrespective of this, the VM sends a warning to the axis modules via the module cross-connection so that measures can be taken immediately to provide d.c. link support.

When the mains supply returns and "Drive On" is active, the power unit is enabled, and the DC link voltage control is resumed.
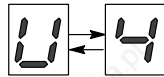
☞ **In the case of a 1-phase mains failure (U4 display) the VM continues to function. Power is reduced however to 66 %.**
The VM bridges frequent 1-phase short-term failures in this way. Overload can result from a long-term failure.

X34.3   **Out 2**   **Excess temperature 7-segment display:**
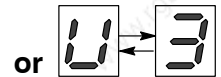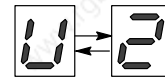
Digital output +24 V.

The output signal changes from +24 V to LOW level if the prewarning limit for

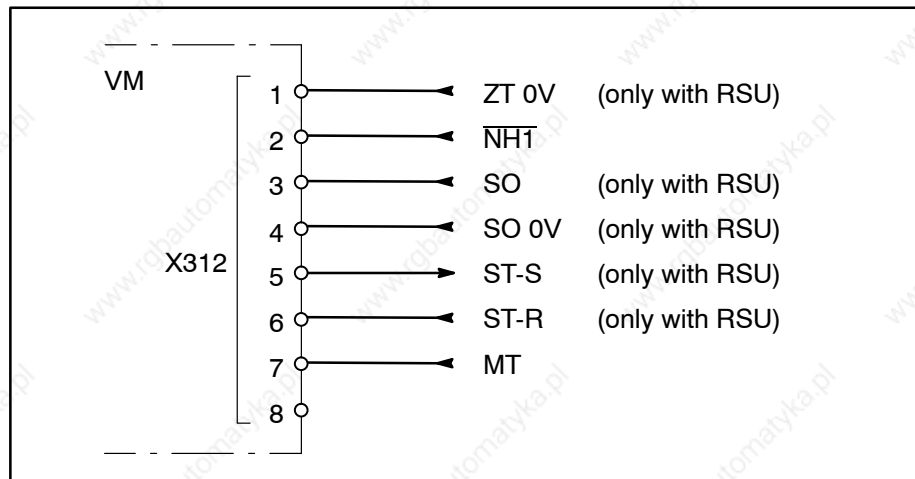• the heat sink temperature (U2) or

• the ambient temperature (U3)

is exceeded.

When the switch-off limit is reached, the STA status relay is opened.

	Prewarning limit	Cut-off limit
Heat sink temperature	> 75˚C	> 80˚C
Ambient temperature	> 45˚C	> 55˚C

VMA..KR, VMA..B,C,D and VMW..F control connections

Terminal strip X312

☞ **For a description of those terminals which are only needed for the RSU option, please refer to the "RSU, Redundant safety monitoring" manual.**

X312.2 $\overline{\text{NH1}}$ **Emergency-stop 1, channel 1**

Optocoupler input for the Emergency-Stop function, active with LOW level.

If LOW level is present at X312.2, all connected inverters are braked. For connection, cf. page 6–17.

X312.7   **MT**   **Measuring probe input**

Optocoupler input, active with +24 V.

Input for the machine measuring probe.
The signal is transmitted to the DMs via the X810 module cross-connection. The measuring signal propagation delay to the appropriate axis is < 5 μs.

VMA..KR, VMA..B,C,D and VMW..F control connections

Terminal strips X331, X332
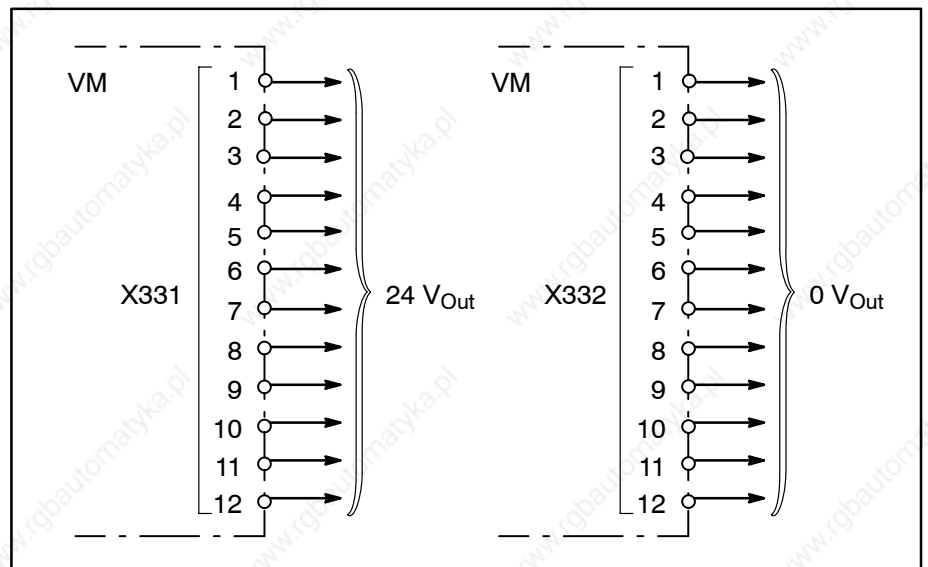
| X331 | 24 V$_{Out}$ | **Module supply** |

| X332 | 0 V$_{Out}$ | **Module supply** |

X331, X332 provide the reference potential for the X06, X34, X312 terminal strips and supply only the drive modules' interface inputs and outputs. X331, X332 should be connected to:

- X06 on the VM: X06.9:   24 V$_{In}$
                     X06.10:   0 V$_{In}$
- X06 on the DMs: X06.9:   24 V$_{In}$
                     X06.10:   0 V$_{In}$

☞ **X331 can be loaded with 3 A max. If higher loads are applied, the current limitation becomes active, and voltage breaks down.**

X810 plug-in connection

Signal cross-connection of all drive modules.
The ribbon cable from the adjoining module on the right is plugged into the X810 connector. The VM's ribbon cable must remain plugged.

VMA..KR, VMA..B,C,D and VMW..F control connections

X820 plug-in connection

24 V cross-connection of all drive modules.
The cable from the adjoining module on the right is plugged into the X820 connection to provide the 24 V supply to the drive and backplane modules.
The VM's ribbon cable must remain plugged.

WARNING!
Contact system destroyed!
Connector X820 of the 24 V cross-link may only be inserted or removed while the unit is disconnected from power.

---

d.c. link

D ⊚   ⊚ C

d.c. link test sockets (not with VMA..KR)

The d.c. link continues to carry a hazardous voltage of up to 670 V after the power supply has been switched off.
The d.c. link voltage must be tested at the d.c. link test sockets before dismounting the modules.

DANGEROUS ELECTRICAL VOLTAGE
Lethal voltage at the d.c. link connections of the backplane modules!

Before dismounting the inverter modules, wait for a discharge time of 5 minutes and check the d.c. link at the d.c. measuring sockets for zero voltage.

7-segment display for d.c. link voltage >50 V:
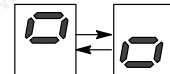
After the power supply has been disabled the one-digit 7-segment display continues to flash as shown above until the d.c. link voltage has fallen under 50 V.
The modules may only be dismounted if the display no longer flashes **and** $\leqq$ 50 V has been measured at the d.c. test sockets.

VMA..KR, VMA..B,C,D and VMW..F control connections

6.2.2 Wiring of VMA..KR, VMA..B,C,D and VMW..F with EMERGENCY-STOP switchgear
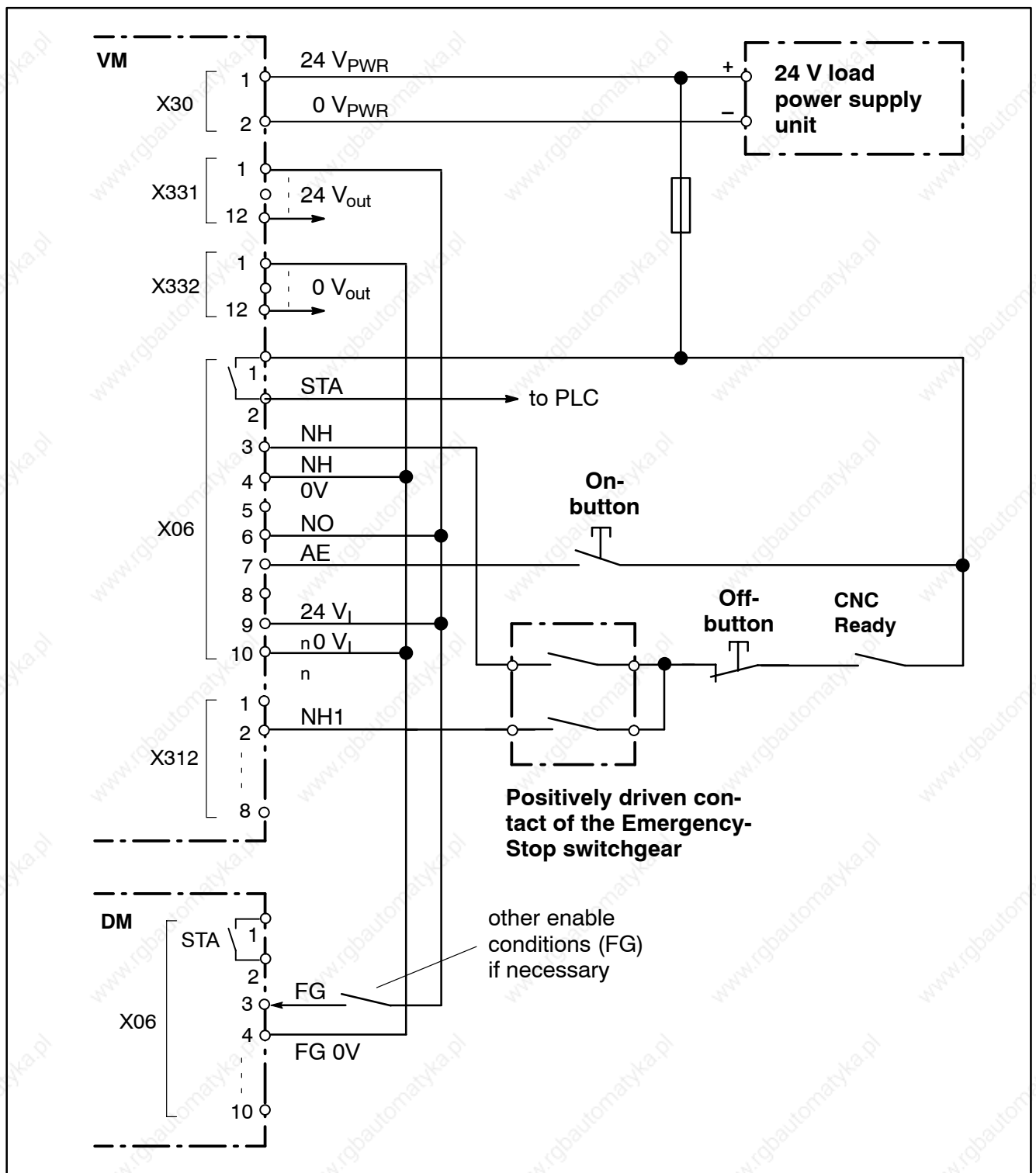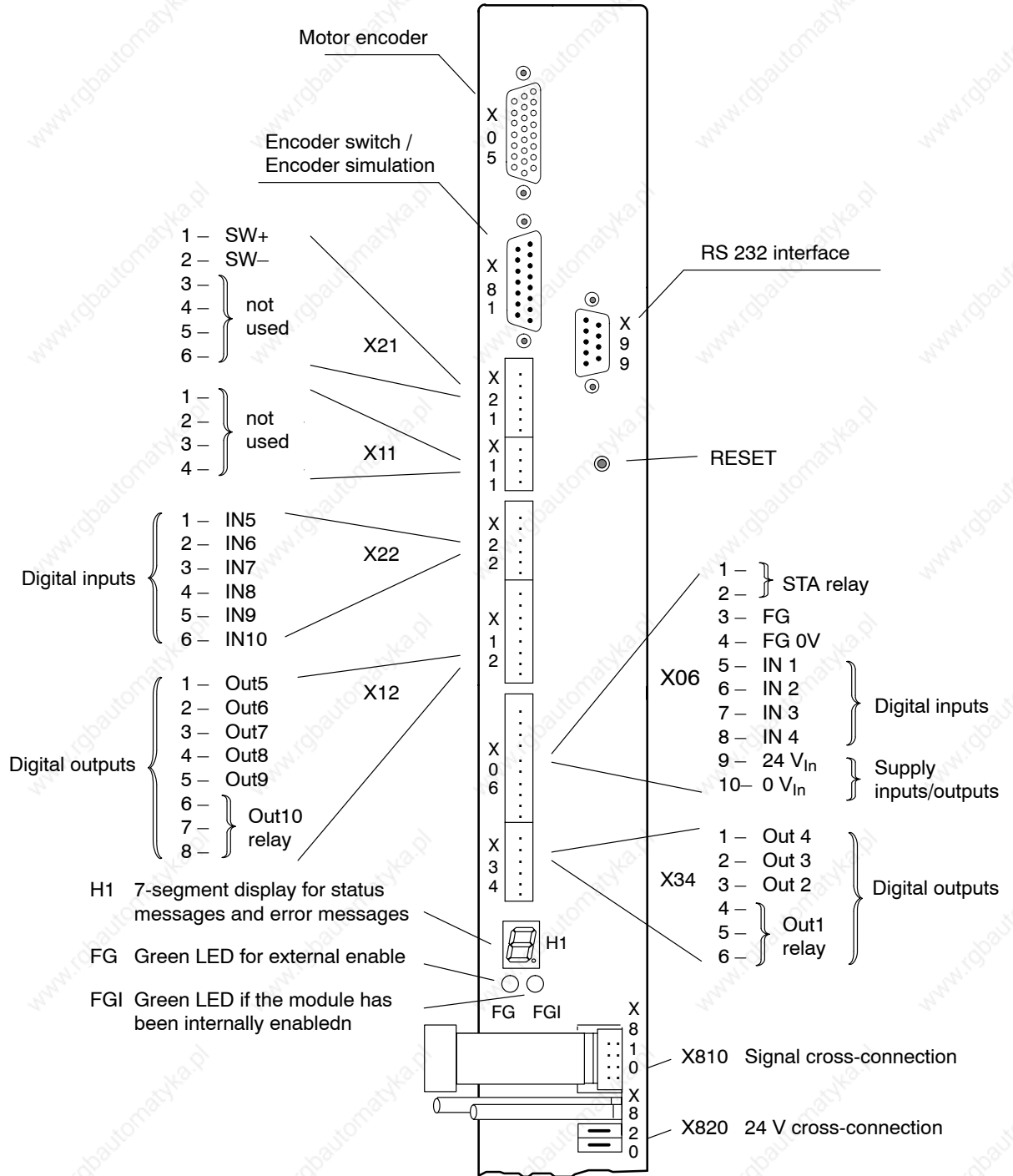
VMA..KR, VMA..B,C,D and VMW..F control connections

Notes:

DM control connections (analog/MC)

7   DM control connections

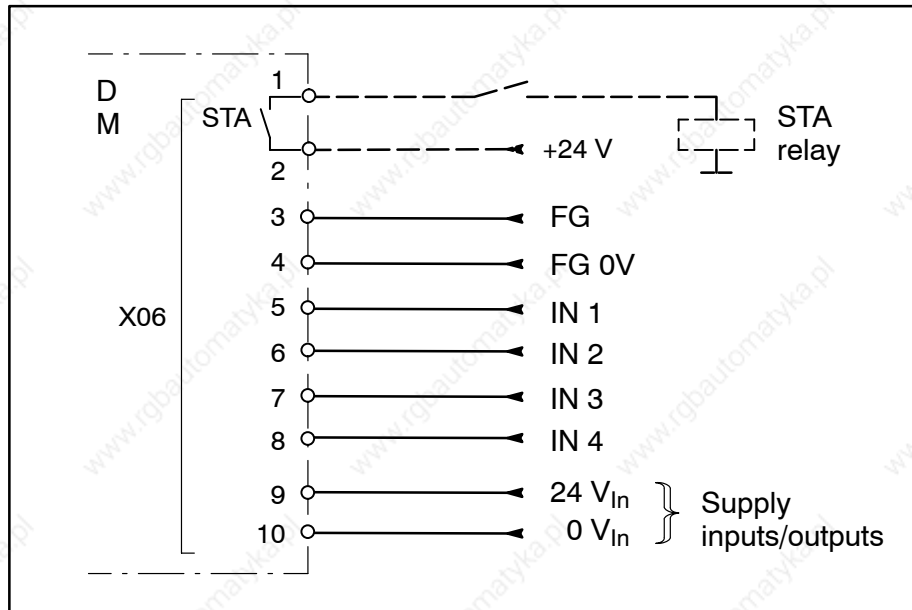## 7.1   Connection of analog interface or positioning function (MC)

DM control connections (analog/MC)

7.1.1   Inputs

Terminal strip X06   **Inverter with analog interface/Motion Control**

X06.1/2   STA   Status message

Floating relay contact. Max. load 24 V / 1000 mA.
The contact closes if the following conditions have been fulfilled:

- 24 V supply is available
- No errors in the DM (hardware)

In case of a malfunction, the STA contact is immediately opened and the
output stage is blocked. The STA contact can be evaluated as a group
error message.

**X6.4/3   FG   External enable
Display via LED "FG"**

Optocoupler input. Active with +24 V, 10 mA (15...30 V, 5...14 mA).

If a high level exists at X6.3 with regard to X6.4 the controller and axis are
enabled via the internal enable FGI if:

- Central enable available via VM
- no errors are active in the DM (LED display "FGI").

DM control connections (analog/MC)

X06.5/6/7   IN 1, IN 2, IN 3   24 V inputs

Optocoupler inputs.
Active with +24 V DC (15...30 V) with regard to X6.10.
Input current typically 17 mA.

Assignment	Functionality	
	Servo function	**Positioning function**
Default setting:		
X06.5 (IN 1)	–	Block select: Coded position number 2^0 (bit 1)
X06.6 (IN 2)	Start signal for output of the absolute encoder position using X81. Cf. page 8–9.	Block select: Coded position number 2^1 (bit 2)
X06.7 (IN 3)	–	Block select: Coded position number 2^2 (bit 3)

X06.8   IN 4   24 V input

Optocoupler input.
Active with +24VDC (15...30V) with respect to X6.9.
Input current typically 13 mA.

IN4 is a high-speed input that may be used:
- as normal input
- for synchronizing the module to the external signal that can be applied to this input.

Assignment	Functionality	
	Servo function	**Positioning function**
Default setting:		
X06.8 (IN 4)	High-speed input	Block select: Coded position number 2^3 (bit 4)

X06.10/9   24 V_{In}, 0 V_{In} Supply of the outputs

Supply voltage of the outputs at X34. This must be connected to one of the 24 V-outputs of the VM (X331/X332).

DM control connections (analog/MC)

Terminal strip X21
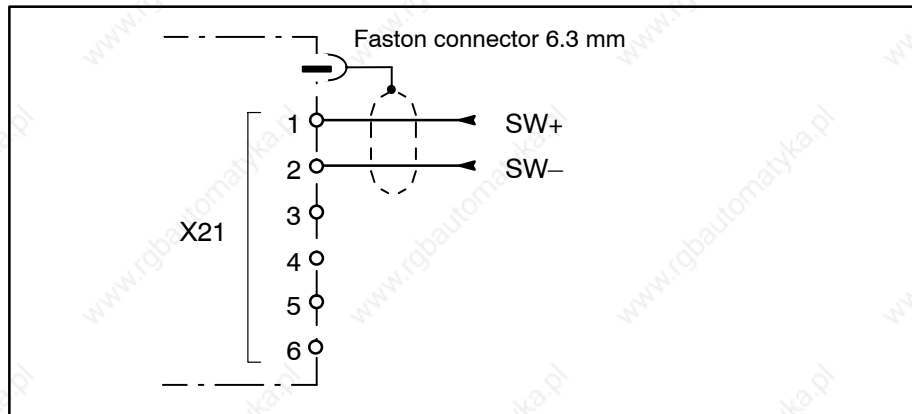
X21.1/2   SW+/SW–   Setpoint input

Input voltage range $\pm 10V$, input resistance ≥ 20 kΩ.

Assignment	Functionality	
	Servo function	**Positioning function**
X21.1, 2 (SW+,–)	Analog setpoint: ● 12-bit resolution for **DM.....33xx – D** ● 16-bit resolution for **DM.....4xxx – D**	not used (setpoints are stored in the positioning table)

● Always connect both poles of the setpoint cable, differential input.
● The direction of rotation is determined by the polarity.
● If intermediate terminals or connectors are used for wiring, the shield continuity must not be interrupted. Connect the shield conductor to $\frac{\perp}{=}$ at the point of separation.

DM control connections (analog/MC)

Terminal strip X22
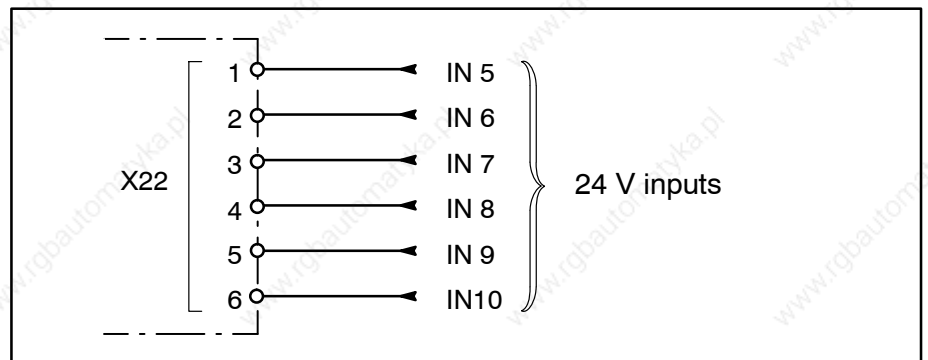
X22.1–6   IN 5 – IN 10   24 V inputs

Optocoupler inputs.
Active with +24 VDC (15...30V) with respect to X6.10.
Input current typically 13 mA.

Assignment	Functionality	
	Servo function	**Positioning function**
Default setting:		
X22.1 (IN 5)	–	Block select: Coded position number 2^4 (bit 5)
X22.2 (IN 6)	–	Start and stop movement
X22.3 (IN 7)	–	Mode selection: 2^0 (bit 1), cf. page 8–12
X22.4 (IN 8)	–	Mode selection: 2^1 (bit 2), cf. page 8–12
X22.5 (IN 9)	–	Reference cam
X22.6 (IN 10)	–	Home position (cancels the traversing movement, clears the distance to go and sets the output signal X12.3, position reached)

DM control connections (analog/MC)

7.1.2   Outputs

Terminal strip X12
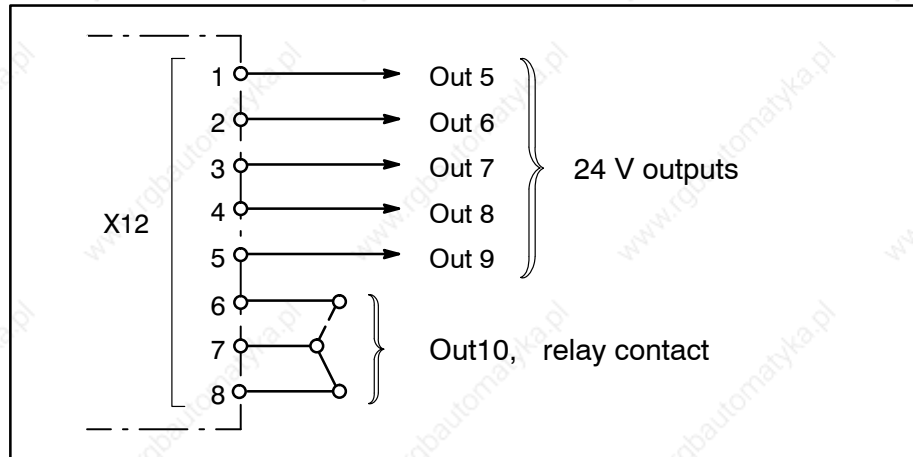
X12.1–5   Out 5 – Out 9   24 V outputs

Driver outputs, max. load 24V/0.5 A.

Assignment	Functionality	
	Servo function	**Positioning function**
X12.1 (Out 5)	Standstill monitoring $n = 0$	Axis has been referenced
X12.2 (Out 6)	Speed monitoring $n = n_{set}$	Axis active
X12.3 (Out 7)	–	In position
X12.4 (Out 8)	–	End of program/block
X12.5 (Out 9)	–	Home position reached (new inputs are now possible)

X12.6/7/8   Out10   Programmable relay contact

Floating relay contact, can be connected as a normally-closed contact or a normally-open contact. Max. load 24 V/1000 mA.

Assignment	Functionality	
	Servo function	**Positioning function**
X12.6–8 (Out 10)	–	MC status message

☞ **For more information on the MC functions, please refer to the Application instructions on page 8–12.**

DM control connections (SERCOS interface)

7.2   Connection with SERCOS interface

Motor encoder

Optional measuring system

1 – ⎫
2 – ⎬ STA relay
3 – FG
4 – FG 0V
5 – IN 1
6 – IN 2
7 – IN 3
8
9 – 24 V$_{In}$
10 – 0 V$_{In}$

Programmable inputs

Supply inputs/outputs

X06

RS 232 interface

X05

X55

X06

X99

1 – Out 4
2 – Out 3
3 – Out 2
4 – ⎫
5 – ⎬ Out1 relay
6 – ⎭

Programmable outputs

X34

X34

Loop   Red LED if error occurs in the SERCOS interface ring

RESET

X71   SERCOS interface cable input

X72   SERCOS interface cable output

Loop

In

Out

X71

X72

Slot for memory card

Personality module

X27

H1   7-segment display for status messages and error messages

FG   Green LED for external enable

FGI   Green LED if the module has been internally enabled

H1

FG   FGI

X810   Signal cross-connection

X820   24 V cross-connection

X810

X820

DM control connections (SERCOS interface)

Terminal strip X06   **(Inverter with SERCOS interface)**
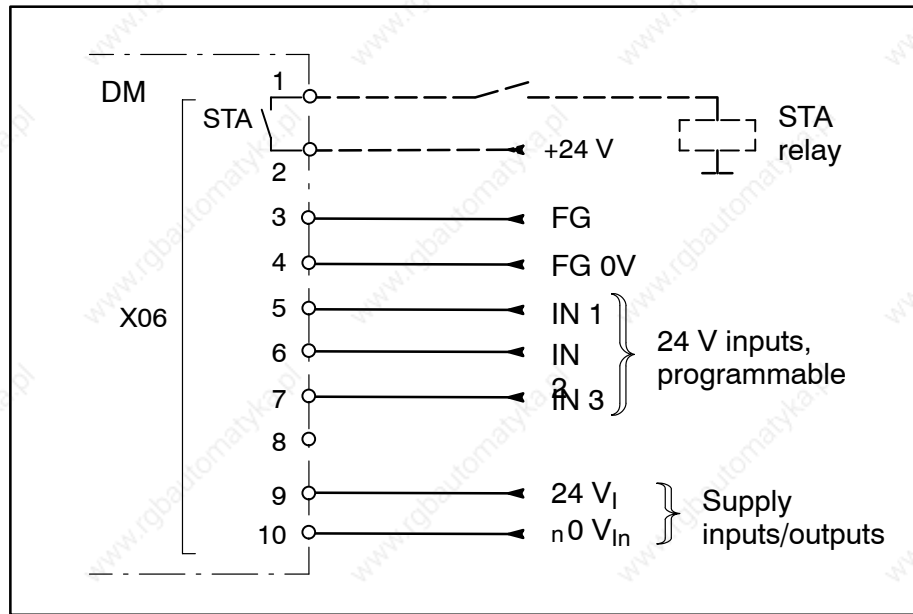
X06.1/2	**STA**	**Status message**

Floating relay contact. Max. load 24 VDC / 1000 mA.
The contact signals its readiness for interface operation. It closes if the following conditions have been fulfilled:

- 24 V supply is available
- No errors in the DM

In case of a malfunction, the STA contact is immediately opened and the output stage is blocked. The STA contact can be evaluated as a group error message.

X6.4/3	**FG**	**External enable**
		Display via LED "FG"

Optocoupler input. Active with +24 VDC (16...30 V).

If a high level exists at X6.3 with regard to X6.4 the controller and axis are enabled via the internal enable signal FGI (display via LED "FGI"). The following conditions must first of all be fulfilled:

- Central enable available via VM
- Software enable available via the SERCOS interface ("Drive enable" and "Drive on").

DANGER
When the external enable signal FG is deactivated the motor always comes to a stop without setpoint control!
Activate plug braking or an integrated holding brake in this case. You should always use the software enable functions "Drive enable" and "Drive on" (cf. Section 8.1) to switch the drives.

DM control connections (SERCOS interface)

X06.5/6/7   **IN 1, IN 2, IN 3**   **Programmable 24 V inputs**

Optocoupler inputs.
Active with +24 V DC (16...30 V) with regard to X6.10.
Input current typically 17 mA.

Assignment:
- **X6.5:**   Reference point switch
- **X6.6:**   Limit switch, positive traverse direction
- **X6.7:**   Limit switch, negative traverse direction

X06.9/10   **24 V$_{In}$, 0 V$_{In}$**   **Supply of the outputs**

Voltage supply to the outputs at X34. This must be connected to one of
the 24 V-outputs on the VM (X331, X332).

SERCOS interface connection (X71/72)

The complete data exchange between the drives and the higher-level
control takes place via the SERCOS interface.
An optical fibre in accordance with the SERCOS interface specifications
must also be connected.
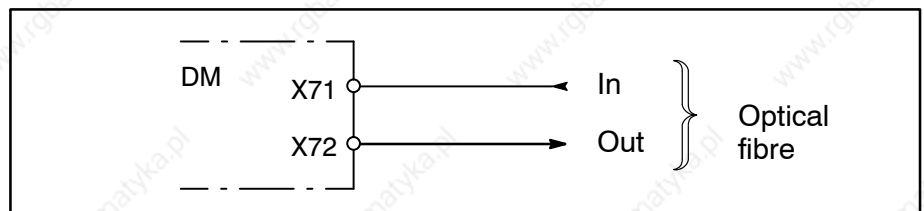
The connectors used comply with the F-SMA standard in accordance
with IEC 874-2.
The optical fibre is made of plastic and has a step index profile. Optical
fibre cores and cables can be used.

DANGER
Do not look directly into the LEDs in the optical fiber connection.
Due to their high output, this may result in eye injuries.
When the inverter is switched on, do not look into the LED or the
open end of a short connected lead.

DM control connections (CAN bus)

7.3   Connection with CAN bus

Motor encoder

X05

Green LED for CAN operation
(off = interrupted)

○ CAN

CAN bus

X51

RS 232 interface

X99

Axis address
(hexadecimal)

S2
S3 Adr

Baudrate:

S4 Baud

S5 Mode

Mode:

0 = 1000 kBaud
1 =   800 kBaud
2 =   500 kBaud
3 =   250 kBaud
4 =   125 kBaud
5 =   100 kBaud
6 =   50 kBaud
7 =   20 kBaud
8 =   10 kBaud
9 to F = 1000 kBaud

0 = CAN open
1 = CAN rho

RESET

1 –
2 – } STA relay
3 – FG
4 – FG 0V
5 – IN 1
6 – IN 2
7 – IN 3   } Digital inputs
8 – IN 4
9 – 24 V$_{In}$ } Supply
10– 0 V$_{In}$ } inputs/outputs

X06

X06

X34

1 – Out 4
2 – Out 3
3 – Out 2   } Digital outputs
4 –
5 – } Out1
6 – } relay

X34

H1   7-segment display for status
      messages and error messages

H1

FG   Green LED for external enable

FGI   Green LED if the module has
      been internally enabled

FG   FGI

X810

X810   Signal cross-connection

X820

X820   24 V cross-connection

DM control connections (CAN bus)

Terminal strip X06   **(Inverter with CAN bus)**

X06.1/2   STA   Status message

Floating relay contact. Max. load 24 VDC / 1000 mA.
The contact closes if the following conditions are met:

- 24 V supply is available
- No errors in the DM

In case of a malfunction, the STA contact is immediately opened and the
output stage is blocked. The STA contact can be evaluated as a group
error message.

**X6.4/3   FG   External enable
                                Display via LED "FG"**

Optocoupler input. Active with +24 VDC, 10 mA (15...30 V, 5...14 mA).

If a high level exists at X6.3 with regard to X6.4 the controller and axis are
enabled via the internal enable signal FGI if:

- Central enable available via VM
- no errors are active in the DM (LED display "FGI").

DM control connections (CAN bus)

X06.5/6/7   IN 1, IN 2, IN 3   24 V inputs

Optocoupler inputs.
Active with +24 VDC (15...30 V) with regard to X6.10.
Input current typically 17 mA.

Assignment	
Default setting:	
X06.5 (IN 1)	–
X06.6 (IN 2)	–
X06.7 (IN 3)	–

X06.8   IN 4   24 V input

Optocoupler input.
Active with +24VDC (15...30V) with respect to X6.10.
Input current typically 13 mA.

IN4 is a high-speed input that may be used:
- as normal input
- for synchronizing the module to the external signal that can be applied to this input.

Assignment	
Default setting:	
X06.8 (IN 4)	High-speed input

X06.10/9   24 V$_{In}$, 0 V$_{In}$ Supply of the outputs

Supply voltage of the outputs at X34. This must be connected to one of
the 24 V outputs of the VM (X331/X332).

DM control connections (CAN bus)

CAN bus connection (X51)
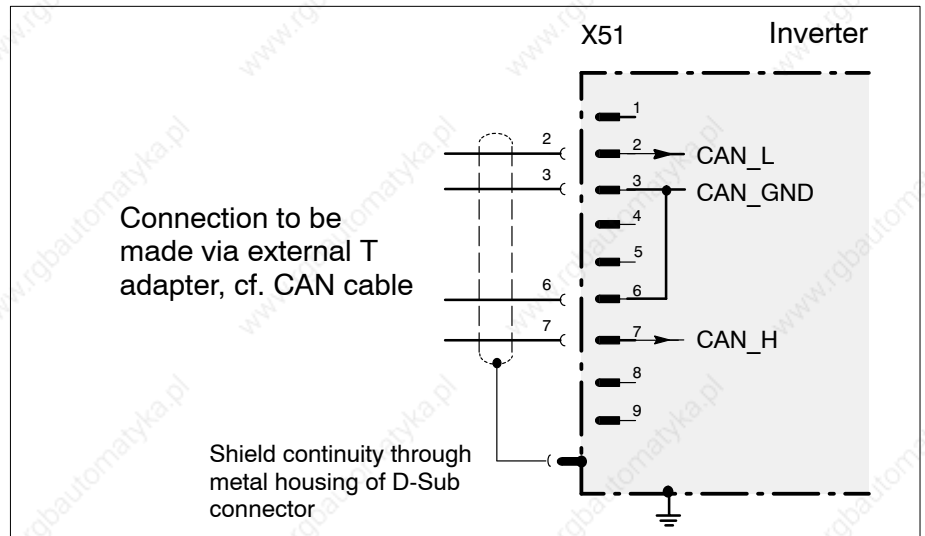
CAN cable

Both physical ends of the CAN cable must be equipped with a terminating resistor with typ. 120 Ω. The ready-made CAN cables from Bosch are therefore different on the drive side:

- Through-way plug, black
  (T adapter between the cable ends) and

- Terminating plug, green
  (T adapter with terminating resistor)

The admissible length of the cable connecting the control unit and the drives depends on the baudrate setting, part no. on request:

Baudrate	Total cable length
1000 kbits/s	25 m
800 kbits/s	50 m
500 ... 10 kbits/s	100 m
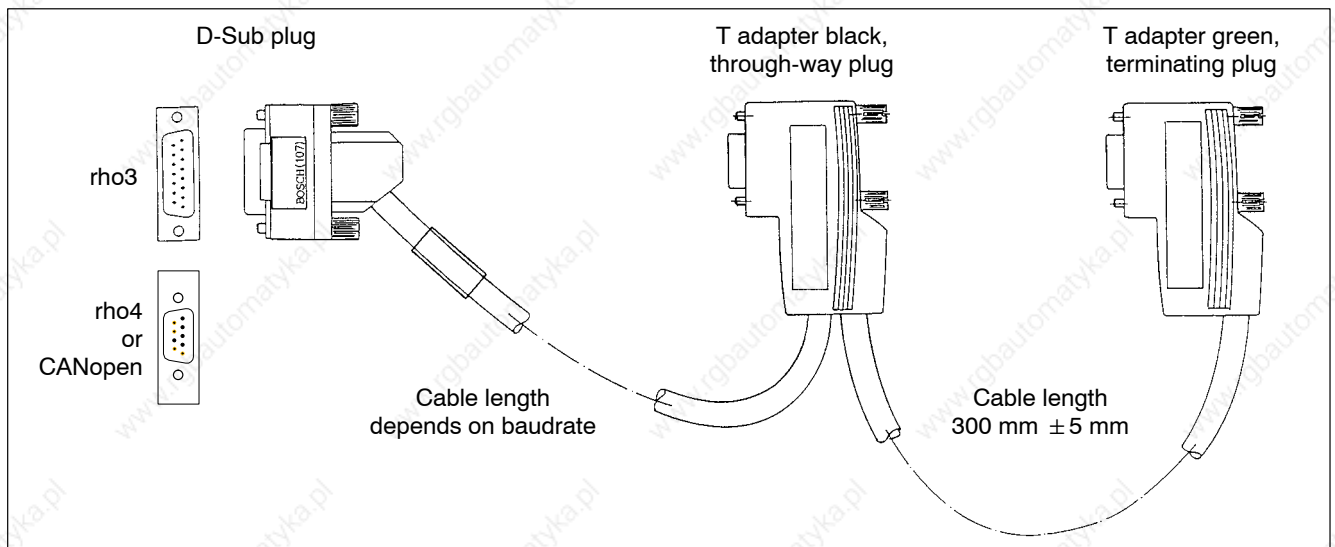
DM control connections (CAN bus)

For self-made CAN cables, the following connector assignment must be
observed. The 15-pin female connector of rho3 covers 2 bus systems:

CAN cable for rho3 control (1 bus system occupied)
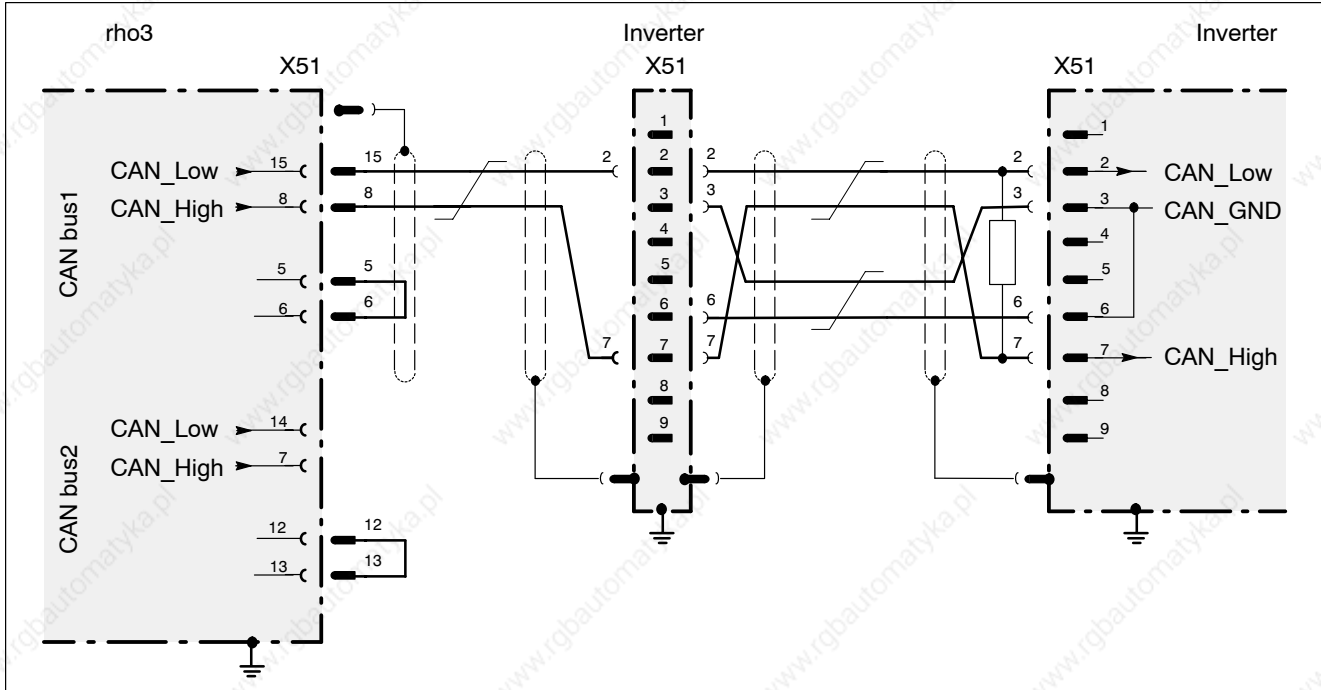
CAN cable for rho4 control or any other control unit with CANopen
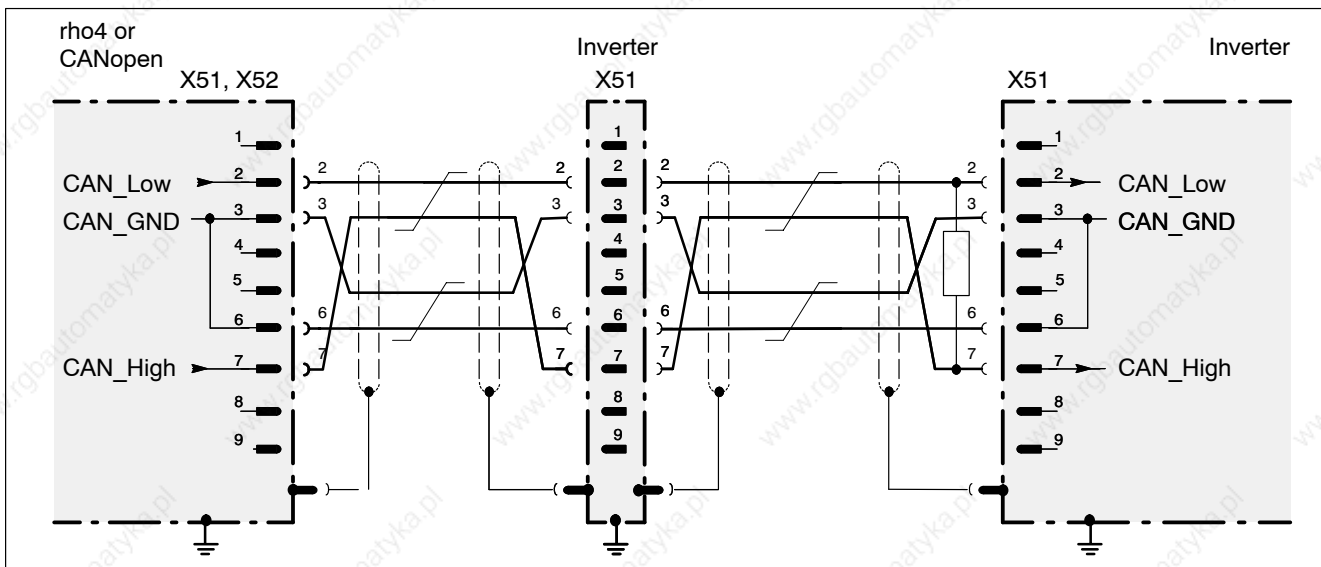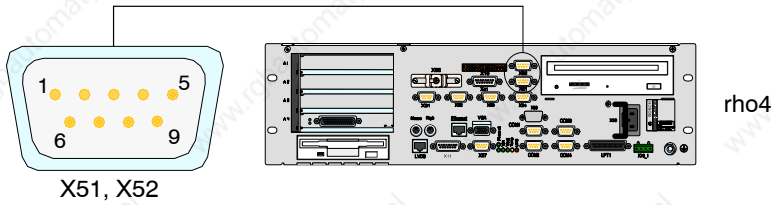
DM control connections (CAN bus)

> Rexroth CAN connectors have been prepared for use with jumpers or terminating resistors, so that the cables can be connected as shown below.

CAN connectors at the drives

Through-way connector, black
part no. 1070 919 029

Terminating connector, green,
part no. 1070 919 030
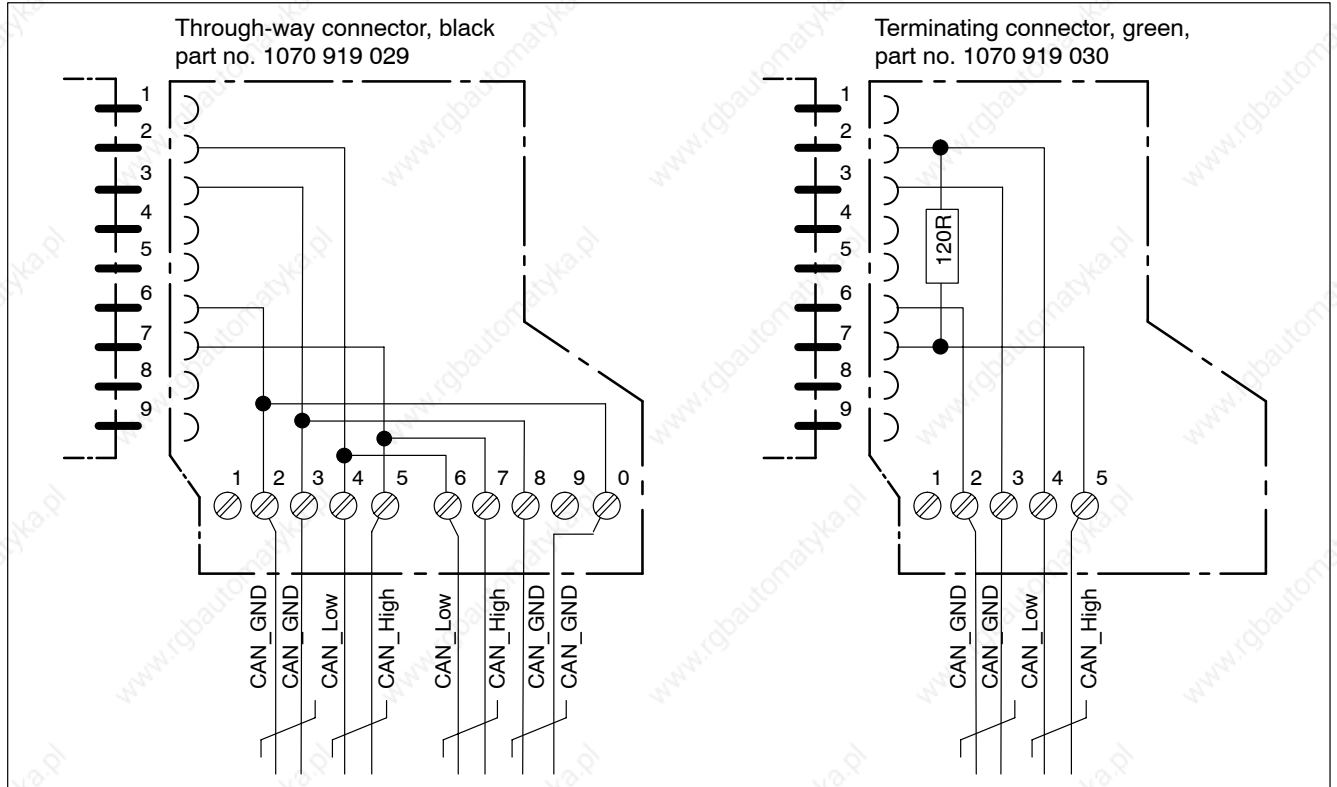
Rotary switches S2...S5

> ServoDyn D with CAN bus can be operated with the CANrho protocol or the CANopen protocol. All CAN-specific settings are adjusted with rotary switches S2...S5 on the front panel:

Axis address	Hexadecimal switch position									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9...F**
S2	LOW axis address (random)									
S3	HIGH axis address (random)									
Baudrate [kbits/s]										
S4	1000	800	500	250	125	100	50	20	10	1000
Mode										
S5	CANopen	CANrho	not used							F = test

CAN display

Green LED	Meaning
off	CAN bus is interrupted
flashing	Only receiving the synchronization telegram
on	CAN bus works

DM control connections (PROFIBUS-DP)

7.4   **Connection with PROFIBUS-DP**

Motor encoder

X05

Green LED for PROFIBUS operation
(off = interrupted)

PROFIBUS

PROFIBUS-DP

X51

RS-232 interface

X99

Axis address
(hexadecimal)

S2

S3

Mode:

S4

0 = Normal operation
F = Test mode

RESET

1 – ⎱ STA relay
2 – ⎰

3 – FG
4 – FG 0V

X06

5 – IN1
6 – IN2   ⎱ Digital inputs
7 – IN3
8 – IN4

X06

9 – 24V$_{In}$ ⎱ Supply
10– 0V$_{In}$ ⎰ inputs/outputs

X34

H1   7-segment display for status
messages and error messages

1 – Out4
2 – Out3
3 – Out2   ⎱ Digital outputs

H1

FG   Green LED for external enable

4 – ⎱
5 – ⎰ Out1
6 –   relay

X34

FGI   Green LED if the module has
been internally enabled

FG FGI

X810

X810   Signal cross-connection

X820

X820   24 V cross-connection

DM control connections (PROFIBUS-DP)

Terminal strip X06   **(Inverter with PROFIBUS-DP)**

X06.1/2	STA	Status message

Floating relay contact. Max. load 24 VDC / 1000 mA.
The contact closes if the following conditions are met:

- 24 V supply is available
- No errors in the DM

In case of a malfunction, the STA contact is immediately opened and the output stage is blocked. The STA contact can be evaluated as a group error message.

X6.4/3	FG	External enable
		Display via LED "FG"

Optocoupler input. Active with +24 VDC, 10 mA (15...30 V, 5...14 mA).

If a high level exists at X6.3 with regard to X6.4 the controller and axis are enabled via the internal enable signal FGI if:

- Central enable available via VM
- no errors are active in the DM (LED display "FGI").

DM control connections (PROFIBUS-DP)

X06.5/6/7 IN 1, IN 2, IN 3   24 V inputs

Optocoupler inputs.
Active with +24 VDC (15...30 V) with regard to X6.10.
Input current typically 17 mA.

Assignment	
Default setting:	
X06.5 (IN 1)	–
X06.6 (IN 2)	–
X06.7 (IN 3)	–

X06.8 IN 4   24 V input

Optocoupler input.
Active with +24VDC (15...30V) with respect to X6.10.
Input current typically 13 mA.

IN4 is a high-speed input that may be used:
- as normal input
- for synchronizing the module to the external signal that can be applied to this input.

Assignment	
Default setting:	
X06.8 (IN 4)	High-speed input

X06.10/9 24 V$_{In}$, 0 V$_{In}$ Supply of the outputs

Supply voltage of the outputs at X34. This must be connected to one of the 24 V outputs of the VM (X331/X332).

DM control connections (PROFIBUS-DP)

PROFIBUS-DP connection (X51)

D-Sub connector, 9-pin

Type:	RS-485; field bus connection to EN 50170 Part 2 (DP)
Cable length:	depending on transmission rate used, max. 100 m at 12 Mbits/s
Cable type:	screened, min. core cross-section 0.14 mm^2
Transmission rate:	automatic detection, max. 12 Mbits/s
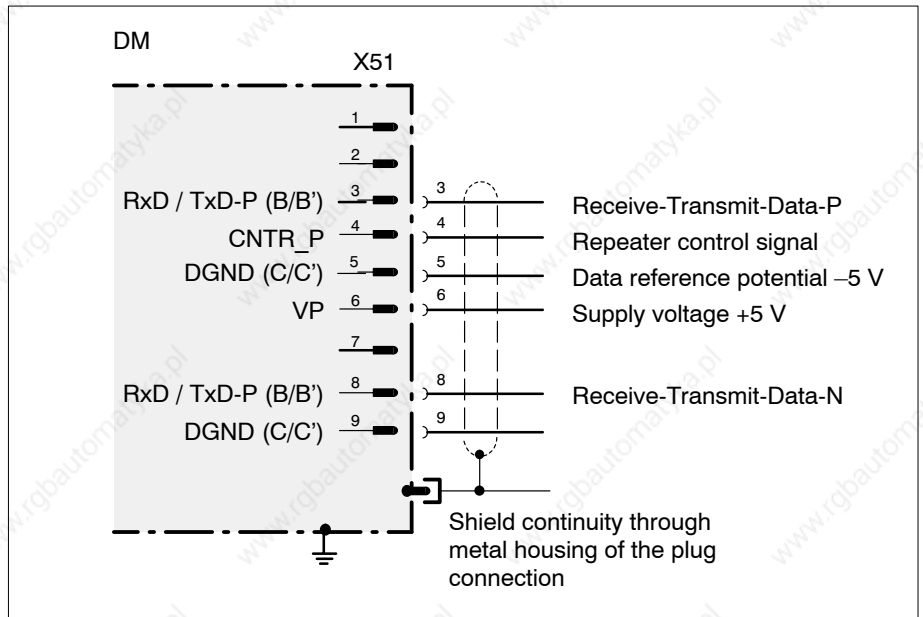
Rotary switches S2...S4

Axis address	Hexadecimal switch position		
	0	**1...E**	**F**
S2	LOW axis address (random)		
S3	HIGH axis address (random)		
Mode			
S4	Normal operation	not used	Test

PROFIBUS-DP display

Green LED	Meaning
off	PROFIBUS-DP is interrupted
on	PROFIBUS-DP bus works

DM...8001 (ASM) control connections

7.5   Connection DM..8001 frequency inverter with analog interface
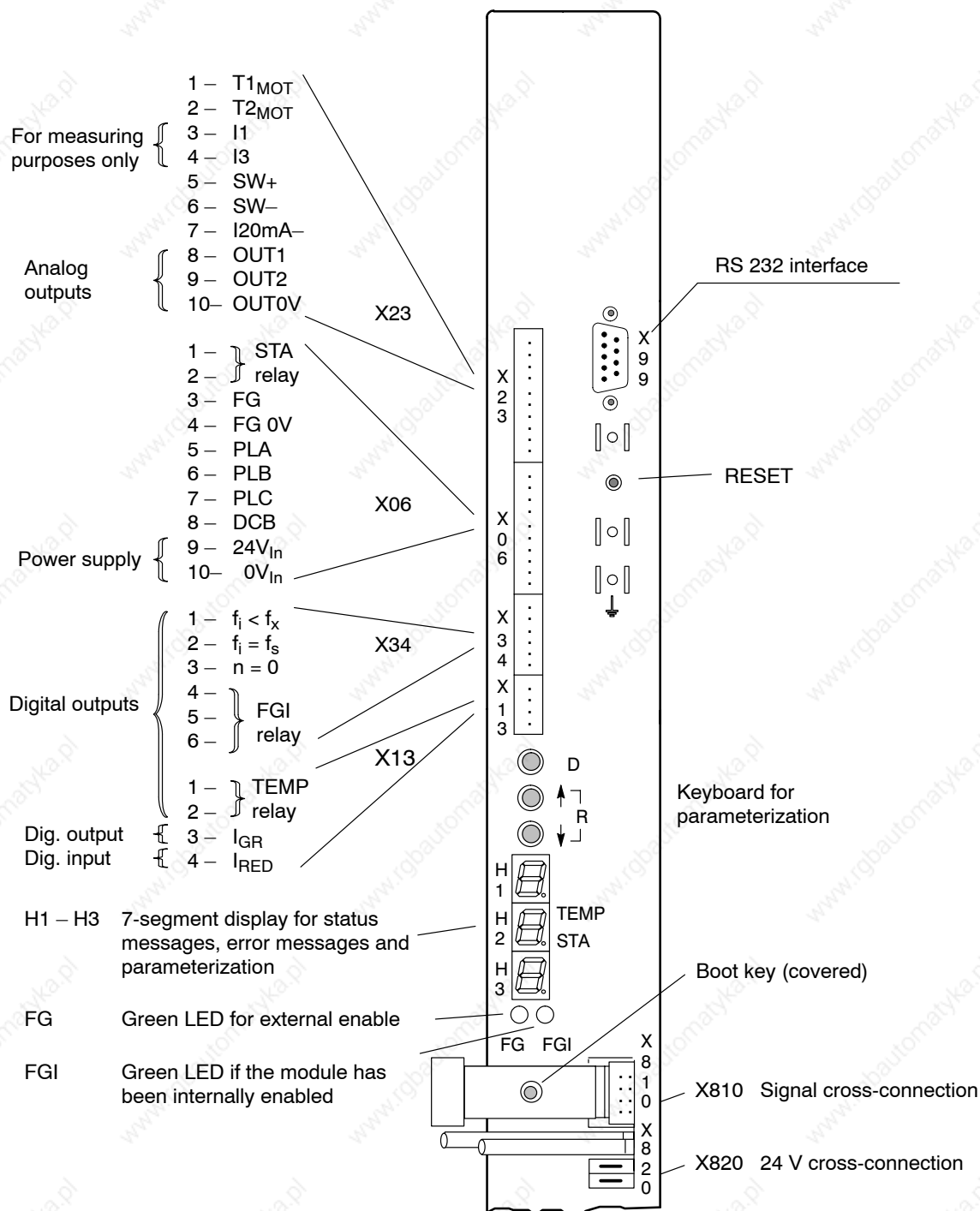
☞ **In order to change parameters after the inverter has been booted
(7-segment display = "H"), press the boot key in the housing recess
below the two LEDs with a pointed object.
For this purpose, carefully press down the signal cross-link X810,
which covers up the button.**

DM...8001 (ASM) control connections

Terminal strip X06   **(Frequency inverter)**
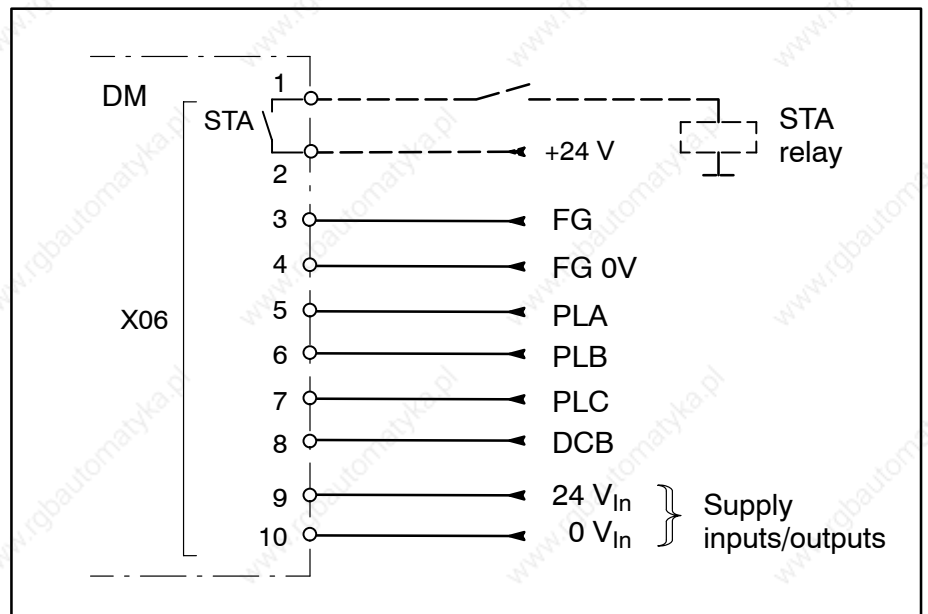
X06.1/2	STA	Status message

Floating relay contact. Max. load 24 VDC / 1000 mA.
Display via 7-segment display.

The contact closes if the following conditions have been fulfilled:
- 24 V supply is available
- No errors in the DM

In case of a malfunction, the STA contact is immediately opened and the output stage is blocked. The STA contact can be evaluated as a group error message.

X6.4/3	FG	External enable

Optocoupler input. Active with +24 VDC, 10 mA (15...30 V, 5...14 mA).
Display via LED.

If a high level exists at X6.3 with regard to X6.4 the controller and axis are enabled via the internal enable FGI if :
- Central enable available via VM
- no errors are active in the DM (LED display "FGI").

The behavior of the internal enable signal FGI when FG has been switched off can be selected with P19, P20:
- FGI is switched off immediately, the motor is halted without setpoint control, or
- FGI is switched off with a delay when $f = 0$ or $n = 0$ (with active standstill monitoring) has been reached.

DM...8001 (ASM) control connections

☞ **CAUTION**
A contactor in the motor lead must not be opened before the internal enable signal FGI has been switched off. Please use the FGI contact for triggering this function (cf. page 7–27)

X6.5/6/7   PLA, PLB, PLC   Select parameter list

Optocoupler input. Active with +24 VDC.

The parameter list selected with this function is active for motor operation and can be programmed via the keyboard.

Terminal strip			Active
X6.5 (PLA)	X6.6 (PLB)	X6.7 (PLC)	parameter list
–	–	–	PL 1
1	–	–	PL 2
–	1	–	PL 3
1	1	–	PL4
–	–	1	PL5
1	–	1	PL 6
–	1	1	PL 7
1	1	1	PL8

1 = HIGH level,   – = LOW level

X06.8   DCB   Direct current brake

Optocoupler input. Active with +24 VDC.

For as long as 24 V are active, the motor is braked with a direct current in accordance with parameter P22 if:
● Parameter P21 is set to 'dc1' or 'dc2'
● External enable FG available
● Output frequency < start frequency P24

☞ **For more features of direct current braking, please refer to manual 'Frequency inverters DM/DS..8001 (ASM)', part number on page 1–7.**

X06.10/9   24 V$_{In}$, 0 V$_{In}$ Supply of the outputs

Supply voltage of the outputs at X34. This must be connected to one of the 24 V outputs of the VM (X331/X332).

DM...8001 (ASM) control connections

Terminal strip X13
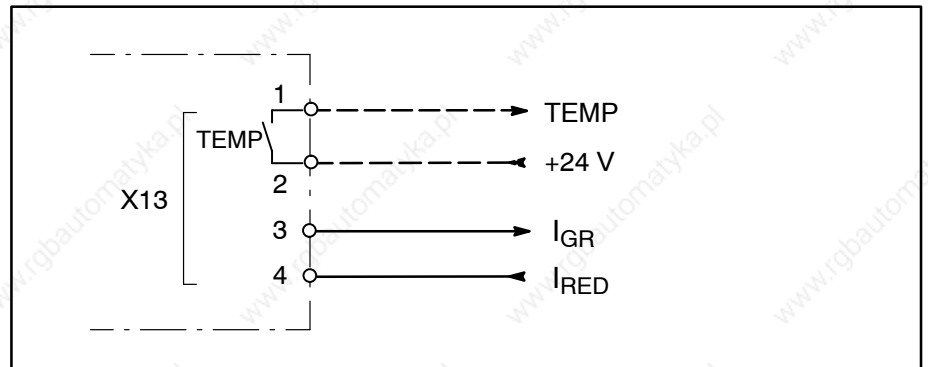
X13.1/2	**TEMP**	**Temperature warning**

Floating relay contact, normally-open contact.
Max. load 24 VDC/1000 mA. Display via 7-segment display.

The temperature warning refers to:
- The heat sink temperature of the inverter
- The motor temperature, if motor temperature sensors are connected, or the bimetal function (P43) is active.

The contact closes when the warning temperature is exceeded.

X13.3	**I_{GR}**	**Limit current, stability warning**

Driver output, short-circuit-proof. Max. load 24 V /0.5 A

- **Limit current**

  The output changes to LOW level if the limit current I_{max} is exceeded. At the same time, the acceleration ramp is reduced, and there is danger that the motor may become electrically instable.

- **P33 active: Stability warning**

  The output changes to LOW level, if the warning limit specific of the motor is exceeded.
  Also refer to 'Frequency inverters DM/DS..8001 (ASM)' manual, part number on page 1–7.

X13.4	**I_{RED}**	**Current reduction**

Optocoupler input. Active with +24 VDC.

The signal I_{red} reduces the maximum current of the module.
The amount of limitation can be selected in parameter P18.

DM...8001 (ASM) control connections

Terminal strip X23
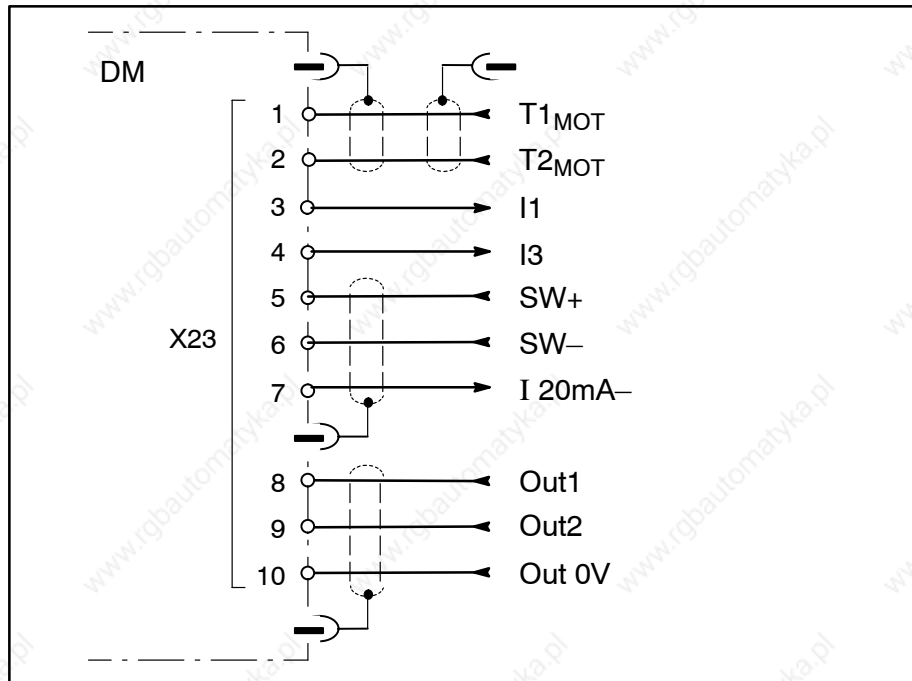
| X23.1/2 | T1$_{MOT}$, T2$_{MOT}$ | **Motor temperature sensors** |

Input without electrical isolation, referred to 24 V potential.

- 5V supply voltage
- operating resistance $\geq$ 1.6 kΩ
- resetting resistance $\leq$ 1.0 kΩ

DANGEROUS ELECTRICAL VOLTAGE
You should use input X23.1/2 only if the motor temperature sensors meet the requirements on ”Safety separation” to EN 50178.

PTC sensors or thermostatic switches may be used as temperature sensors.
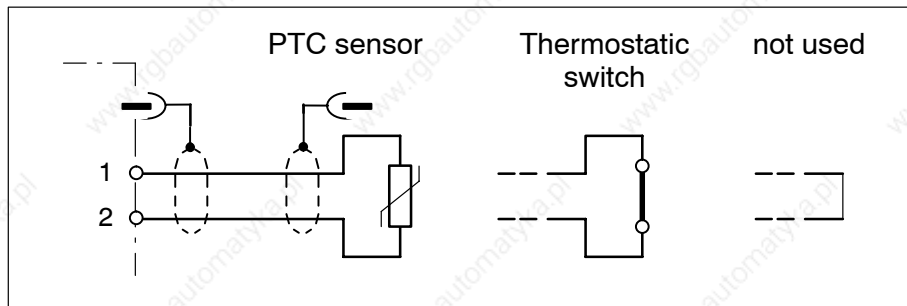
CAUTION
Malfunctions and destroyed inputs through unshielded connection leads!
Only use shielded cables and connect shield at both ends.

DM...8001 (ASM) control connections

X23.3/4   **I1, I3**   **Measuring outputs for actual current values**

Short-circuit-proof analog outputs 0...+10 V, only for measuring pur-
poses.
Output resistance: approx. 1 kΩ.

I1: Actual current value, phase 1
    10 V $\triangleq$ peak current

I3: Actual current value, phase 3
    10 V $\triangleq$ peak current

X23.5/6/7   **SW+, SW–, I 20mA–**   **Setpoint input**

Analog input, 10-bit resolution.
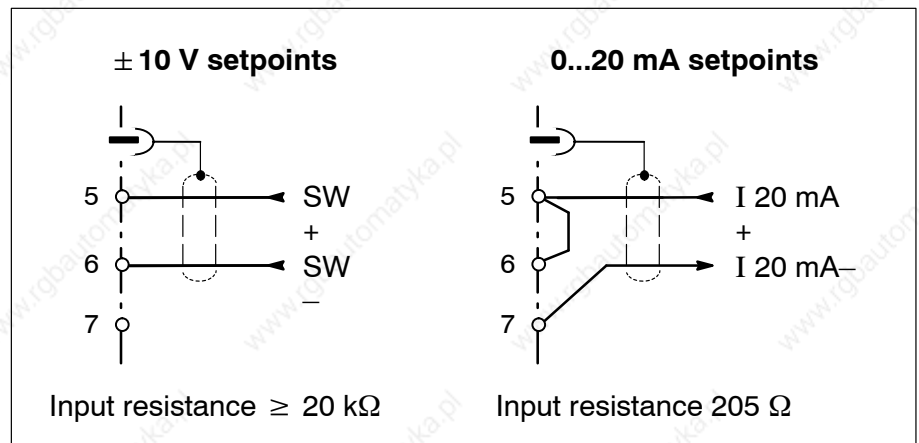
☞ **It is only possible to use either the voltage or the current setpoint
  input. If the voltage input is used, X23.7 must not be connected.**

- Always connect both poles of the setpoint cable, differential input.
- The voltage/current setpoints for maximum setpoints can be adjusted
  (parameters P15, P16).
  Unipolar setpoints are equally possible.
  e.g. 0...+10 V with $f = f_{max}$ adjustment to +10 V
                        $f = 0$ adjustment to +5 V
- In the event of a bipolar setpoint, the motor's direction of rotation is
  determined by the polarity.
  A positive setpoint means clockwise rotation if motor cables are
  properly connected and when looking at the drive side of the shaft.
- If intermediate terminals or connectors are used for wiring, the shield
  continuity must not be interrupted. Connect the shield conductor to
  $\perp$ at the point of separation.

DM...8001 (ASM) control connections

X23.8/9/10   Out1, Out2, Out 0V Analog outputs, programmable

Short-circuit-proof analog outputs 0...+10 V.
8-bit resolution, output resistance approx. 1 kΩ.

Programming/Default setting:

Output (reference potential X23.10)	Assignment	
	via parameters	Setting ex works
X23.8 (Out1)	P40	AA1 (total current)
X23.9 (Out2)	P39	AA0 (actual output frequency)

Both outputs can be assigned the data AA0 ... AA9 listed in the following table.
Level 0... +10 V, current and power signals can be adjusted (P41, P42).

Assignment		10 V ≙ ... [ ] = Setting ex works					
		DM..4K DM..8K	DM..15K	DM..30K DM..30A	DM..45K DM..45A	DM..85B	DM..140D
Actual output frequency (AA0)	[Hz]	max. output frequency (P02)					
Total current, rms (AA1)	[A]	Scaling with P41:					
Active current, rms (AA2)	[A]	0.9...15 [9.5]	1.5...25 [15.9]	3.1...50 [31.8]	4.7...75 [47.7]	9.5...150 [95.4]	12.7...200 [127]
Reactive current, rms (AA3)	[A]						
Motor voltage (AA4)	[V]	1000 V					
d.c. link voltage (AA5)	[V]						
Total output (AA6)	[kVA]	Scaling with P42:					
Shaft output (AA7)	[kW]	0.4...7.5 [7.5]	0.7...12.5 [12.5]	1.5...25 [25]	2.3...37.5 [37.5]	4.6...75 [75]	6.2...100 [100]
Utilization rate (AA8)	[%]	200 %					
Heat sink temperature (AA9)	[°C]	100 °C					

☞ **The following applies in general to the programming of the frequency inverter via the DSS-D:**
Press Boot key prior to any parameter change (refer to page 7–20). All values displayed at the drive in alpha-numerical format are stored as purely numerical values in the DSS-D. When making entries, you should therefore omit the letters, e.g. enter "7" in the DSS instead of "AA7" for the shaft output.

DM...8001 (ASM) control connections

Terminal strip X34
(Frequency inverter)
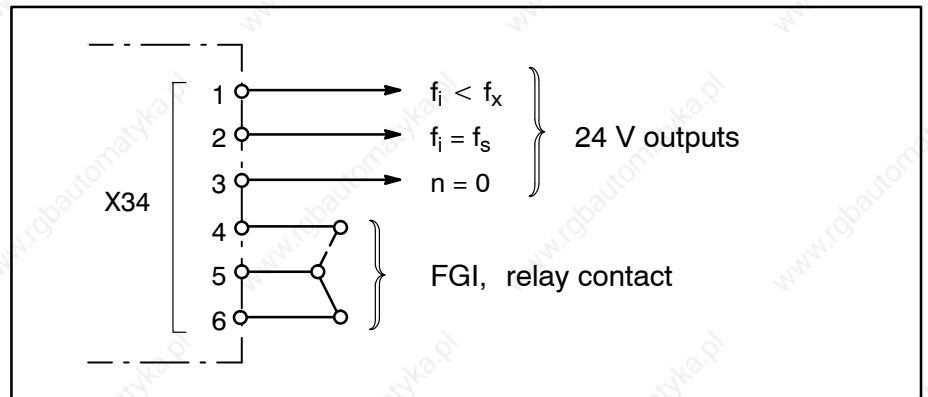
X34.1 $f_i < f_x$ **Frequency warning (reference frequency)**

Driver output, short-circuit-proof. Max. load 24 V/0.5 A.

The signal changes to LOW level if the actual output frequency falls
below a reference frequency set with P38. The STA contact remains
closed.

X34.2 $f_i = f_s$ **Frequency warning (set frequency)**

Driver output, short-circuit-proof. Max. load 24 V/0.5 A.

The signal changes to LOW level if the actual output frequency equals
the set frequency.

X34.3   n = 0   **Standstill monitoring**

Driver output, short-circuit-proof. Max. load 24 V/0.5 A.

The signal changes to HIGH level if the motor has reached $n = 0$ min^{-1}
and stands for approx. 1.5 sec. when external enable FG has been re-
moved.

X34.4/5/6   FGI   **Internal enable**

Floating relay contact, can be connected as n.c.c. or n.o.c.
Max. load 24 VDC / 1000mA. Display via LED.

The contact operates (pin 5/6 open) for as long as internal enable is pres-
ent (cf. page 7–21).

DM control connections

7.6 Standard connection of X34 (analog interface, SERCOS interface, CAN bus, PROFIBUS-DP)

Terminal strip X34
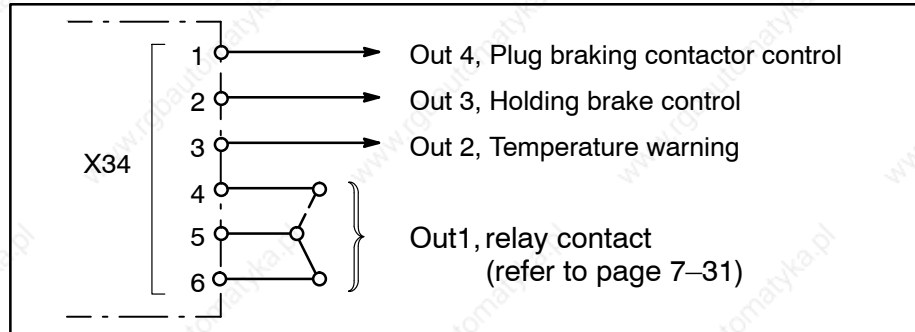
X34.1   Out 4   Plug braking contactor control

Driver output, short-circuit-proof. Max. load 24 V / 0.3 A.

This signal is used to control the plug braking contactor K03, 0 V connection of the plug braking contactor at X332 of the VM.
Plug braking serves to brake synchronous motors as fast as possible if the motors cannot be actively braked because of a power voltage or control failure.
Motor braking is effected by suitable plug braking modules which short-circuit the motor winding, cf. Servo motors SF, SR manual.

The normally-closed contact of the KSB (plug braking) contactor must be designed as a make contact.
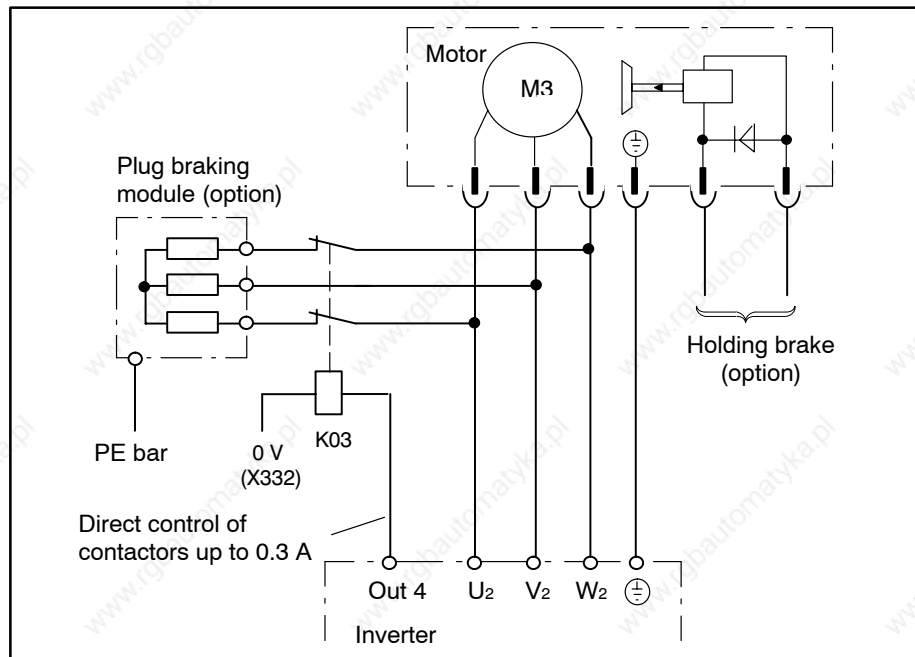
☞ **In the case of contactors with a power input > 0.3 A an amplifier, e.g. a relay, must be inserted to control the contactor.**

DM control connections

| | **X34.2** | **Out 3** | **Holding brake control** |

Driver output, short-circuit-proof. Max. load 24 V / 0.3 A.

In the case of holding brakes, control of the FG enable signal, the set-point and the holding brake must be synchronized. The holding brake may only be activated when the axes have come to a standstill.
Exception: Emergency braking operations e.g. when the supply module breaks down.

The required chronological order has already been established by means of the holding brake control signal. The motor's holding brake is controlled by means of a contactor which must be set up externally, braking contactor 0 V connection at X332 on the VM supply module.

CAUTION
The holding brake must not be operated unless the axis has come to a stop!
If the holding brake is not controlled via module output Out 3, proper timing as described in the Servo motors SF, SR manual must be ensured.

DM control connections
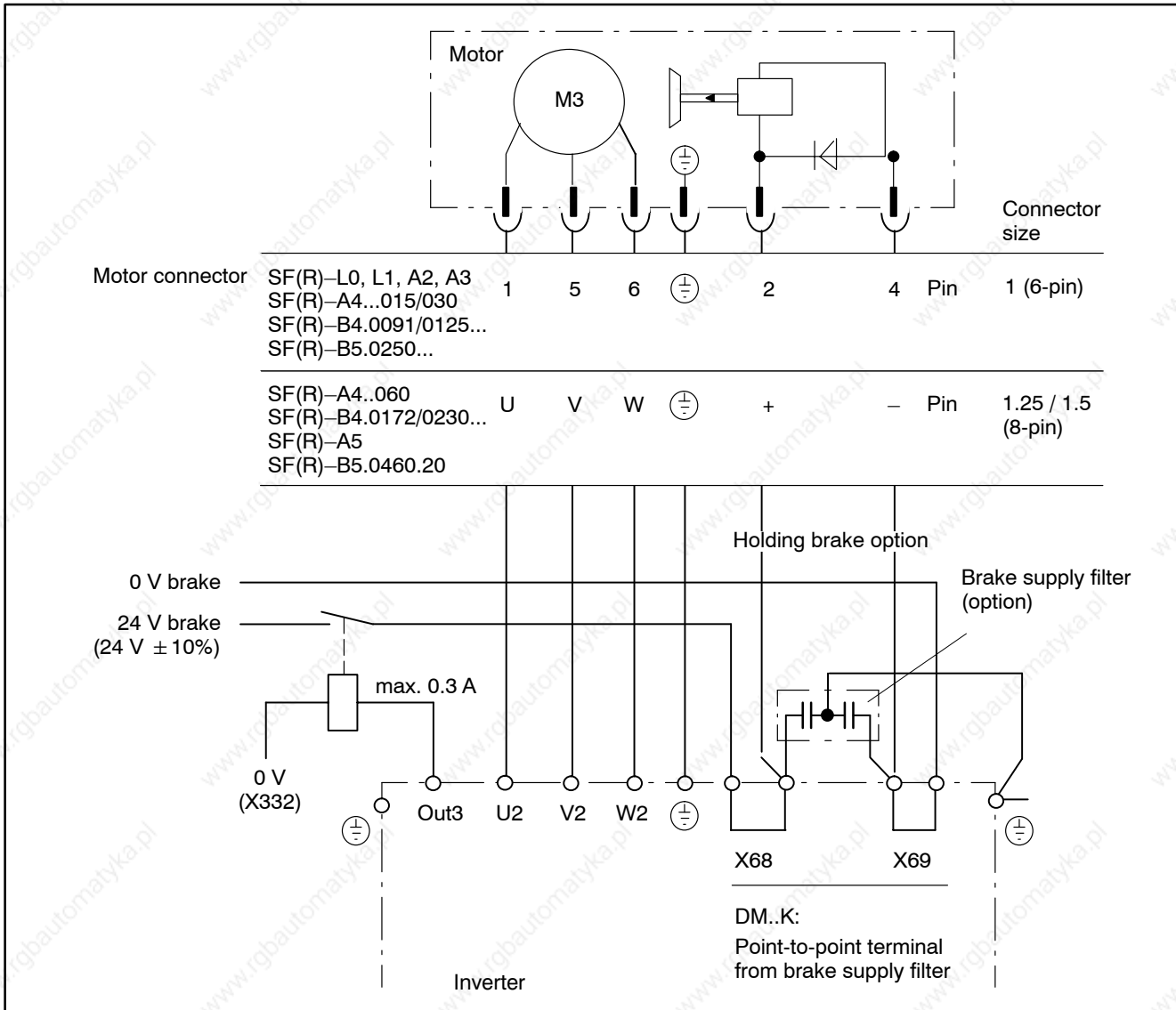
Motor connector	Connector size
SF(R)–L0, L1, A2, A3 SF(R)–A4...015/030 SF(R)–B4.0091/0125... SF(R)–B5.0250...	1 5 6 ⏚ 2 4 Pin 1 (6-pin)
SF(R)–A4..060 SF(R)–B4.0172/0230... SF(R)–A5 SF(R)–B5.0460.20	U V W ⏚ + – Pin 1.25 / 1.5 (8-pin)

Holding brake option

Brake supply filter (option)

0 V brake

24 V brake (24 V ±10%)

max. 0.3 A

0 V (X332)

Out3 U2 V2 W2

X68   X69

DM..K:
Point-to-point terminal from brake supply filter

Inverter

☞ **In the case of contactors with a power input > 0.3 A an amplifier, e.g. a relay, must be inserted to control the contactor.**

DM control connections

Connection with MBC (brake connection with relay and protective circuitry)
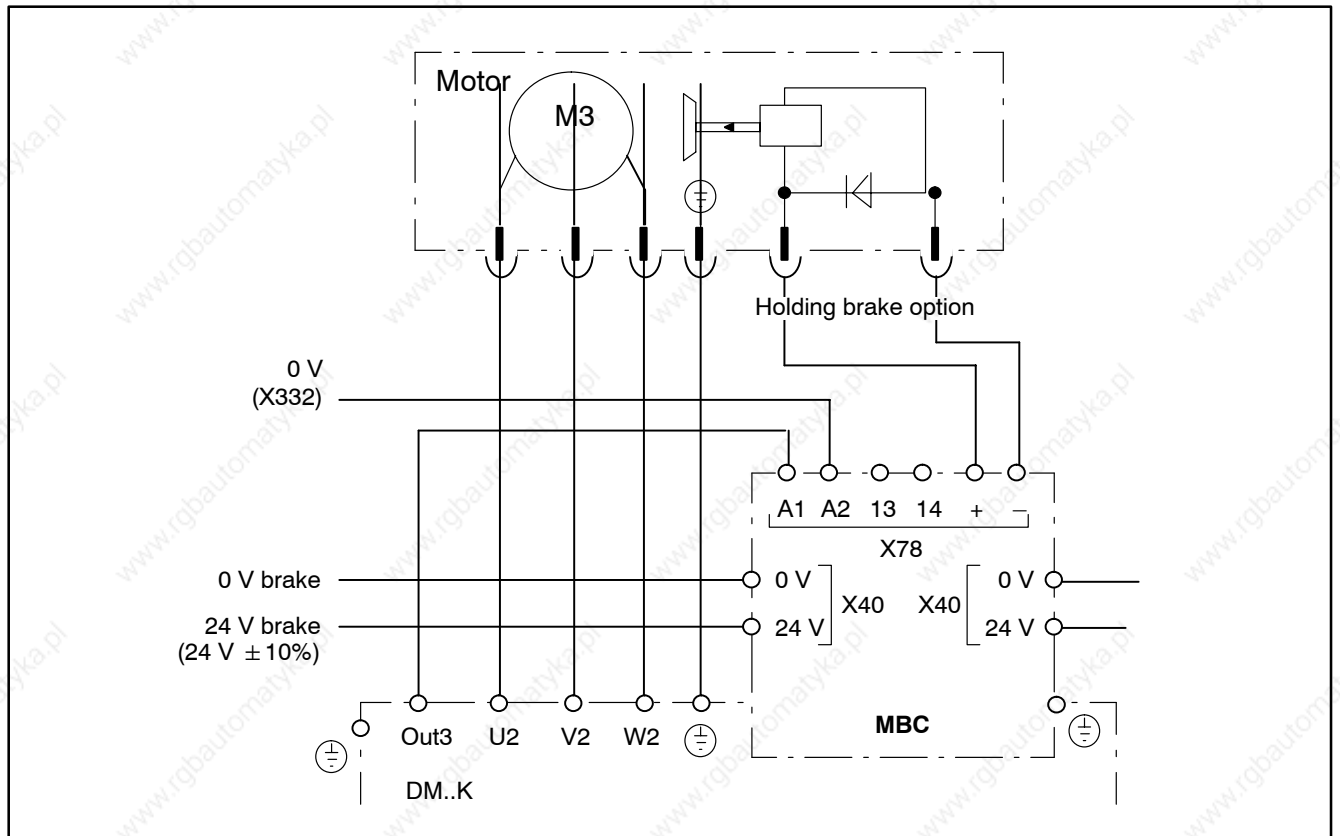
X34.3	**Out 2**	**Temperature warning**

The temperature warning refers to:

- The heat sink temperature of the inverter
- The motor temperature.

When the warning temperature is exceeded, the warning signal changes from 24 V to LOW level. The warning temperature can be set in the range of 70...95% of the admissible temperature range.

X34.4/5/6	**Out 1**	**Relay contact**

Floating relay contact, to be connected as n.c.c. or n.o.c.
Max. load: 24V/1000mA.

Assignment	Interface		
	Analog interface	**SERCOS interface**	**Other types**
Default setting: **X34.4/5** (n.o.c.)	Finished message following the output of the absolute encoder position available in the drive via X81. Cf. page 8–9.	Feedback FGI (no FGI = output stage disabled)	not programmable

DM control connections

7.7 Standard terminal strip X76 for water-cooled DMW modules

Terminal strip X76
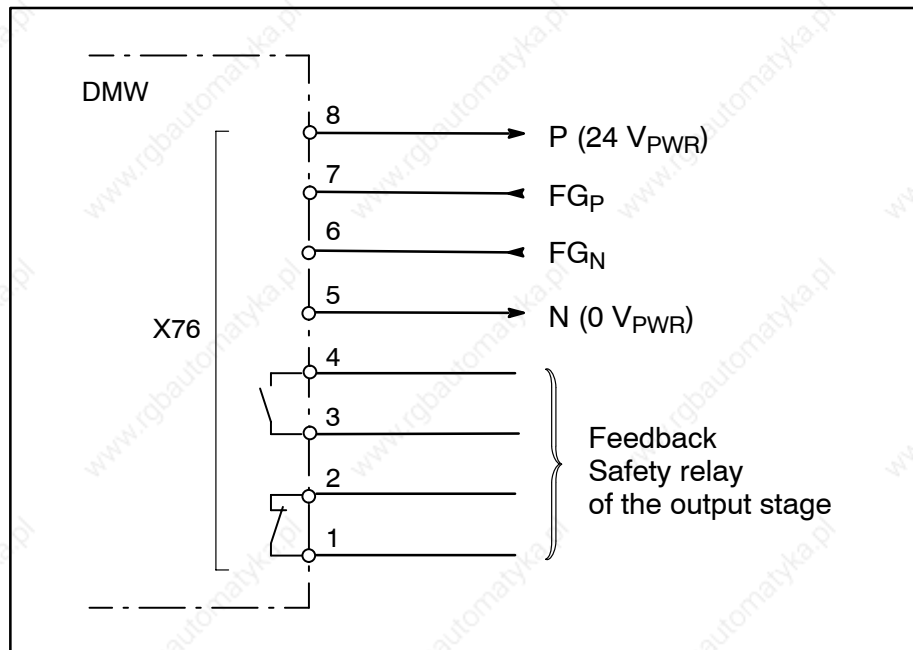
X76.1/2   Normally-closed contact   Safety relay feedback

Ready contact (floating). Max. load 30 VDC/2000 mA.

The X76.1/2 relay contact is opened when the internal safety relay activates the output stage.

X76.3/4   Normally-open contact   Safety relay feedback

Ready contact (floating). Max. load 30 VDC/2000 mA.

The X76.1/2 relay contact is closed when the internal safety relay activates the output stage.

X76.5   N   0 V$_{PWR}$

Same potential as X30.2 at the VM.
To be bridged with pin 6 if Safe Shutdown of the output stage is not required.

X76.6/7   FG$_N$/FG$_P$ Activating the power output stage

Energy supply to the power output stage is activated or deactivated by a 24 V signal. Use this input to isolate one energy supply channel. A motor contactor is no longer needed in this case. The safety relay is monitored by the positively driven contacts X76.1/2 and X76.3/4.
If this function is not needed, pin 6 and pin 7 have to be bridged with pin 5 and pin 8, respectively.

DM control connections

X76.8	**P**	**24 V$_{PWR}$**

Same potential as X30.1.
To be bridged with pin 7 if Safe Shutdown of the output stage is not required.

7.8   Module cross-connections

X810 plug-in connection

Signal cross-connection of all drive modules.

The ribbon cable from the adjoining module on the right is plugged into the X810 connector.

X820 plug-in connection

24 V cross-connection of all drive modules.

The cable from the adjoining module on the right is plugged into the X820 connection to provide the 24 V supply to the inverter and backplane modules.

ACHTUNG
Contact system destroyed!
Connector X820 of the 24 V cross-link may only be inserted or removed while the unit is disconnected from power.

DM control connections

7.9   RS 232 for commissioning and service system connection (DSS-D)

All VM modules with current regeneration and all DM modules are equipped with an RS232 serial interface.
This interface serves for connecting the DSS-D commissioning and service system to the individual modules.

Front panel X99

Sub-D connector, 9-pin

Transmission rate: 9600 bits/s
Parameters: even parity, 8 data bits, 2 stop bits
Handshake: Software handshake (X_{ON}, X_{OFF})
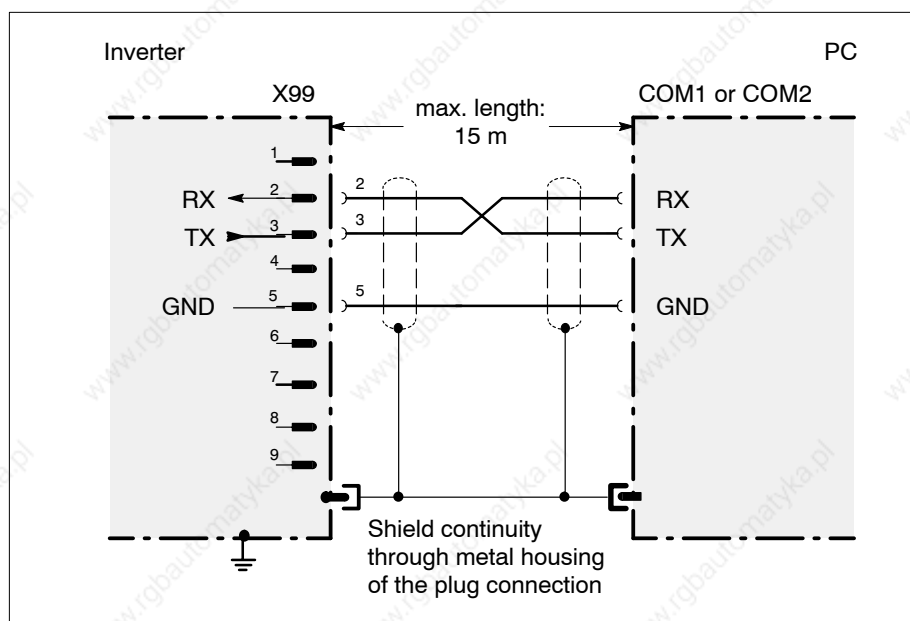
RX   Receive Data
TX   Transmit data, data transmission to DSS
GND signal ground

☞ **In order to avoid interference problems during commissioning, we recommend running the connection cable through an annular core.**
Use the folding ferrite coil, part no. 1070 918 766.

DM control connections

7.9.1   Motor encoder (X05)

Each inverter module (except for ASM) is equipped with one of the following encoder interfaces:

- for gear encoders or
  single-turn encoders (STG) or
  multi-turn encoders (MTG)
- for resolvers (SR motors)

Every encoder interface comprises:

- encoder signals for position control and fine interpolation
- serial bidirectional interface to facilitate the transmission of motor data and absolute position (no absolute position for resolvers)
- encoder power supply
- additional connections for recording the motor winding temperature

The following gear encoders with an integrated electronic rating place are permitted:

- Type **KWG2EP** made by Messrs. VS-sensorik
- Type **WG05–B** made by Messrs. Woelke

CAUTION
All plug connectors to the encoder may only be plugged or unplugged when the drive is off so as to avoid damage to the inverter or to the encoder!
Switch the drive off beforehand!

Encoder cables

We recommend using prefabricated Bosch encoder cables for the SF and SR servo motors. Depending on the individual case, these cables are available as

- Standard cable
- Highly flexible cable
- UL-conformant cable

☞ **UL encoder cables have to be used for UL/CSA-certified drive inverters in order to ensure that the entire system meets the UL/CSA requirements.**

CAUTION
Damage to cables due to inadmissible movements.
Please note the technical data of the cables specified in the "Configuration" manual, part no. on page 1–7.

DM control connections

Prefabricated encoder cables, shielded					Standard	Highly flexible
	No of cores	Dimensions [kg/m]	For motor type	Encoder system	Part no. (5 m length)*	Part no. (5 m length)*
Cable	17 cores	0.14	SF, DU	ECN (single-turn) EQN (multi-turn)	1070 919 827	1070 920 850
			SR, other types	Resolver, gear encoder	1070 917 094	1070 920 989
Extension with coupling	17 cores	0.14	SF	ECN (single-turn) EQN (multi-turn)	1070 920 506	1070 921 262
UL-conformant cable ⒞Ⓤ𝗅ᵤₛ	17 cores	0.16	SF, DU	ECN (single-turn) EQN (multi-turn)	1070 921 697	1070 921 701
			SR, other types	Resolver, gear encoder	on request	on request

* Part no. of cable lengths 7, 10, 12, 15, 20, 25, 35, 50, 100 m on request

Cable bushing (metal flange)

For cable bushings, e.g. leading into the switch cabinet, a metal flange may be used in connection with a cable extension and a coupling. The connector housing is clamped and sealed to IP 65 when installed.

Flange: Zinc diecasting, nickel-plated
Gasket: Viton, black
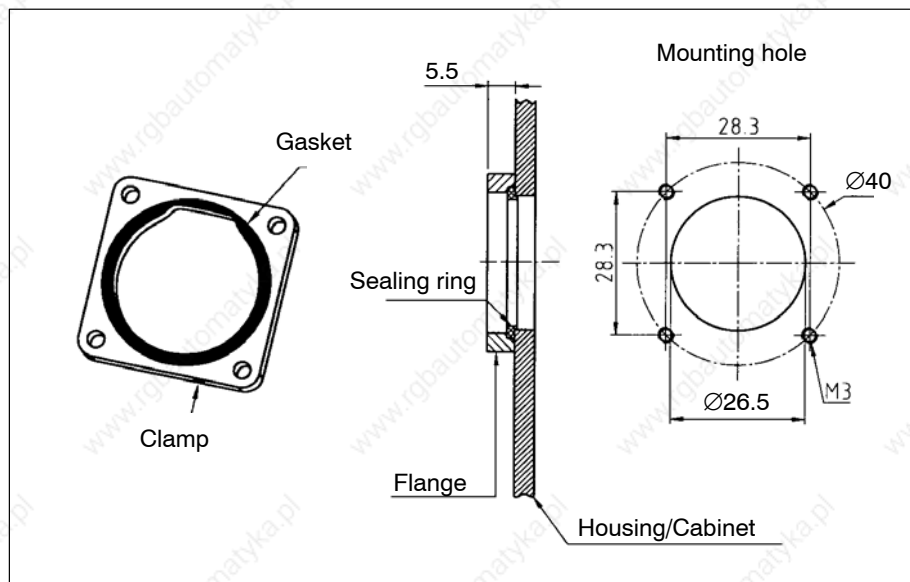
DM control connections

Pin assignment for encoder cable STG/MTG

DM	Socket X5, 26-pin		Flange socket 17-pin	Motor types SF and DU

Conductive connection between inner shield T and outer shield

Pin	Signal	Color	0.14	Pin	Color	Signal
1		BN	0.14	5	or	
2		GN	0.14	6	blu	
3		RD	0.14	3	whi	
		Inner shield T				
4		Inner shield A		11		
5	UA+	GN	0.14	15	gn/blk	UA+
6	UA –	YE	0.14	16	yel/blk	UA –
22	GND	Inner shield B			blu/blk	
23	UB+	BU	0.14	12	red/blk	UB+
24	UB –	RD	0.14	13		UB –
8		GY	0.14			ECN 1313 (STG),
9		WH	0.14			EQN 1325 (MTG)
7		Inner shield R				RCN 1313
10		BU	0.14	4	whi	0V-sensor
18	0V	BNBU	0.5	10	whi/gn	0V
19		GY	0.14	1	blu	5V-sensor
26	+5V	BNRD	0.5	7	brn/gn	+5V
13				2		
14						
15						
16						
17						
11		GY	0.14	14	grey	Data
12		PK	0.14	17	pink	Data_N
20		VT	0.14	8	vio	Timing
21		YE	0.14	9	yel	Timing_N
25						

Inner shields A, B, R to be connected with insulation to outer shield.

Outer shield

Shield continuity through metal housing of the plug connection

Max. length 100 m

☞ **The outlined pin assignment only applies to cables and motor encoders supplied by Rexroth.**

DM control connections

Pin assignment for encoder cable for gear encoder and resolver
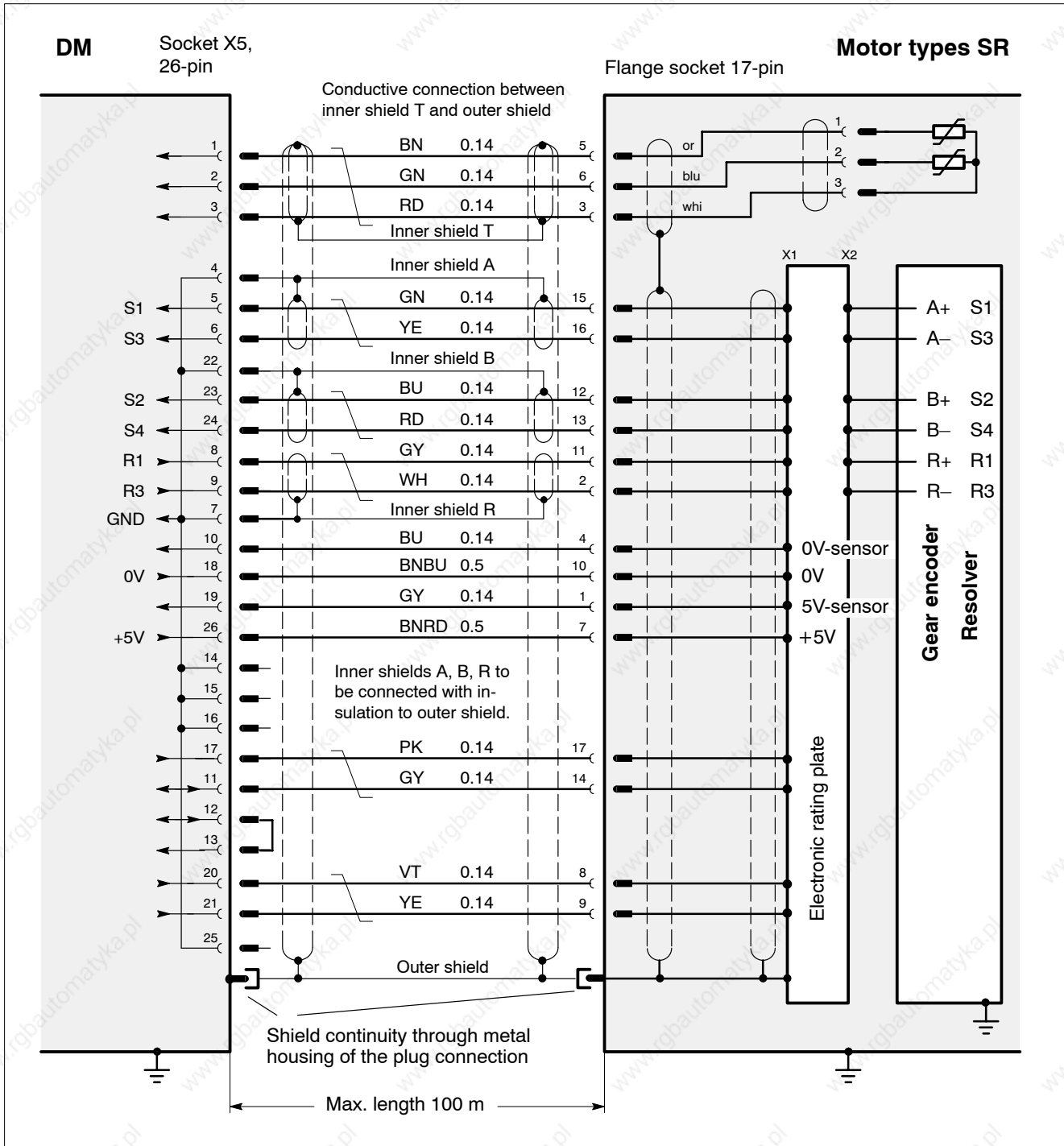
☞ **The outlined pin assignment only applies to cables and motor encoders supplied by Rexroth**

DM control connections

7.10 Encoder switch / encoder simulation (X81)

The X81 D-Sub connector provides the encoder signals of the motor:

- for inverters with an analog interface
- for inverters with positioning function (MC)

Encoder switch

If motors with integrated incremental encoders or gear encoders are used, X81 represents an encoder switch.

Encoder simulation

If SR motors with integrated resolvers are connected, X81 provides the resolver position data as standard incremental signals.

Output signals	U_{A1}, U_{A2}, $U_{A0.}$ $\overline{U_{A1}}$, $\overline{U_{A2}}$, $\overline{U_{A0.}}$ $\overline{U_{AS}}$
Signal level	Driver to RS 422 $U_{High} \geqq 2.5$ V where $-I_{High} = 20$ mA $U_{Low} \leqq 0.5$ V where $I_{Low} = 20$ mA
Maximum load	$-I_{High} \leqq 20$ mA $I_{Low} \leqq 20$ mA
Operating times	Rise time $\quad t_+ \leqq 100$ ns Fall time $\quad t_- \leqq 100$ ns
Voltage supply	5 V $\pm$ 5%
Power input	$\leqq 50$ mA without load
Min. edge interval a	$\geqq 100$ ns (programmable with DSS-D, depends on output frequency)
Output frequency	$\leqq 1$ MHz (programmable with DSS-D, depends on line number and max. motor speed)
Line number	$\leqq 16\ 383$ (programmable with DSS-D, depends on max. motor speed)
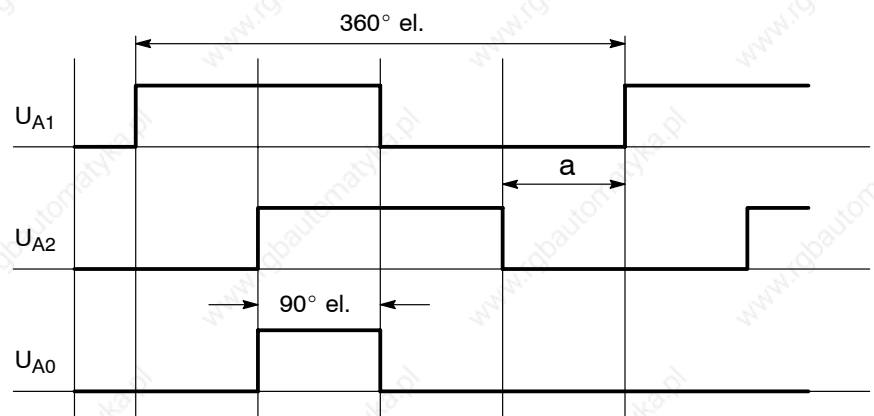
DM control connections

Pin assignment for encoder switch/encoder simulation
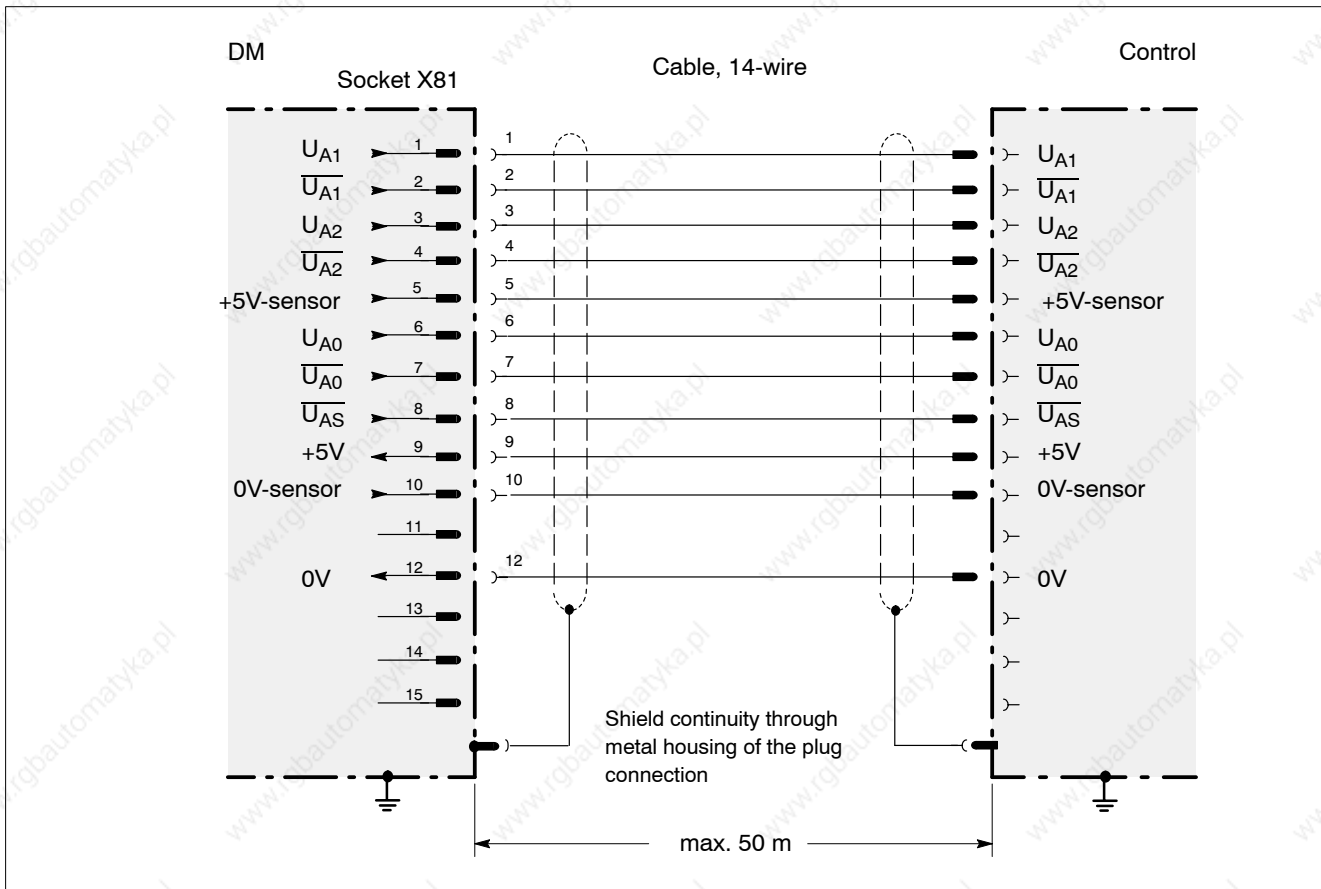
Prefabricated cables are available for connection; for part numbers, refer to page 11–1.

DM control connections

7.11   Direct measuring system connection (X55)

Differing direct position measuring systems can be connected via various option modules type OM to inverters with SERCOS interface:

- OM 01–D   Incremental measuring systems with sinusoidal current signals
- OM 02–D   Digital incremental measuring systems
- OM 03–D   Incremental measuring systems with sinusoidal voltage signals, or
absolute measuring systems with EnDat or I^{2}C interface

Direct measuring system option module

Socket X55:
OM 01, 02: D-Sub, 15-pin
OM 03:   D-Sub, 26-pin
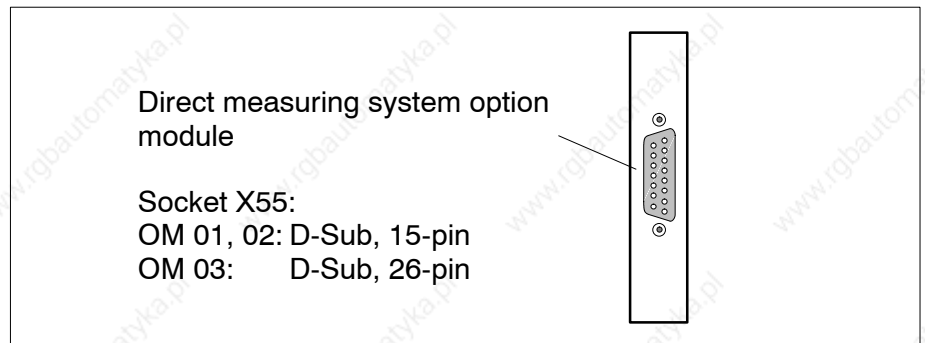
CAUTION
Damages at the inverter or measuring system by inserting or removing plug-in connections on live systems!
Switch the drive off beforehand!

☞ **Exchanging the signal leads to facilitate direction change is not permissible due to the assignment of the reference pulse.**
A counting direction change is achieved by setting the appropriate parameters.

DM control connections

OM 01   **Incremental measuring systems with sinusoidal current signals**

This option module contains an integrated EXE module with five-times interpolation.

Technical data

- Input for measuring system with +5 V power supply and sinusoidal current signals 7...16 μA_{pp}
- Signal input: Difference amplifier
- Power supply: +5 V +1%/–5%
- max. permissible power input
  of the measuring system: $\leq$ 300 mA
- EXE separation factor: 5-times interpolation
- Pulse multiplication: programmable x1, x2, x4
- max. input frequency: $\leq$ 50 kHz
- Measuring system monitoring: Response to input signals in channels I_{e1} or $I_{e2} \leq$ 4.3 μA
- max. cable length: $\leq$ 20 m or shorter, cf. manufacturer's data
- Pin assignment: see manual "Interface Conditions"

Signal diagram
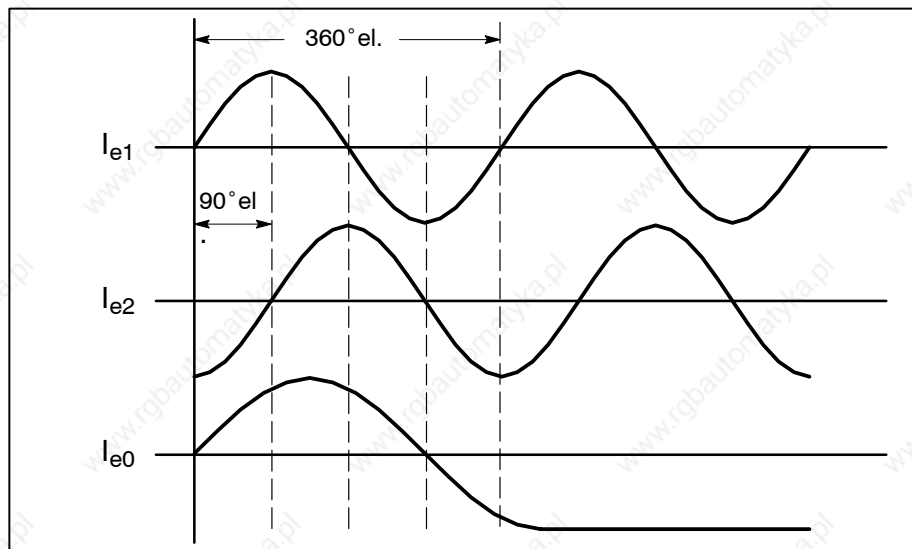
Heidenhain measuring systems which fulfill the following conditions can generally be used (For further information, refer to manual "Configuration ServoDyn D"):

- Measuring system for 5 V power supply from option module
- Sinusoidal current signals 7...16 μA_{pp}
- Power input $\leqq$ 300 mA
- Max. output frequency 50 kHz

DM control connections

The cable shield must have a continuous connection from the front panel of the option module to the measuring system.

Pin assignment OM 01 for measuring systems with sinusoidal current signals
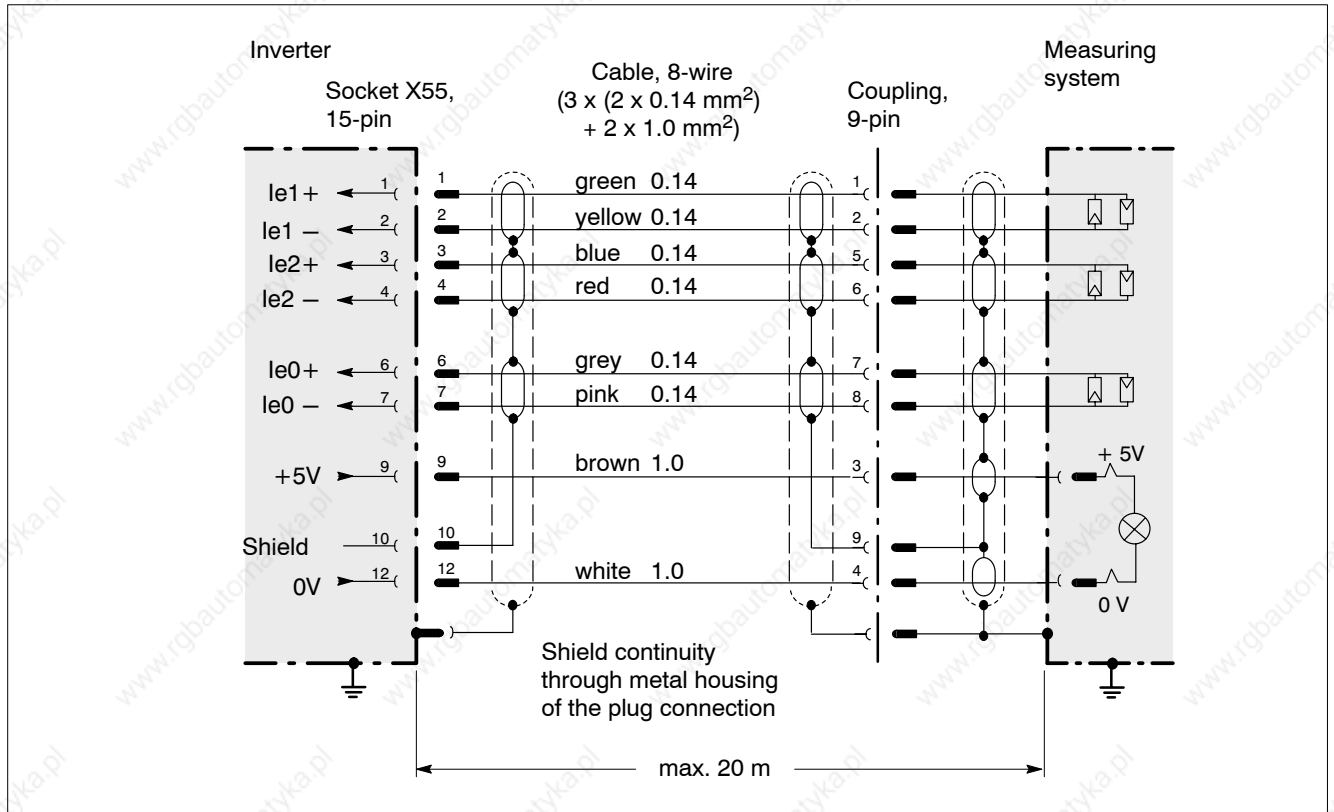
☞ **Metal connector covers must be used for the 9-pin coupling (Heidenhain-ID-No. 228 562 01 or 237 525 04) on the measuring system side and the 15-pin sub-D connector on the option module! Cable shielding must have large-surface contact with the strain-relief clamp!**
For prefabricated cables, refer to page 11–1.

DM control connections

OM 02 Digital incremental measuring systems

Technical data

- Input for measuring system with +5 V power supply and square-wave signal output with line driver to RS422

- Signal input: Difference amplifier, $R_i \approx 120\ \Omega$

- Power supply: $+5\ V\ \pm\ 3\ \%$, regulated via sensor leads

- max. permissible power input of the measuring system: ≤ 300 mA

- Pulse multiplication: programmable x1, x2, x4

- max. input frequency: ≤ 1 MHz

- min. edge interval a between active counting pulses: ≥ 150 ns

- min. edge interval b in case of sense of rotation reversal: ≥ 0 ns

- min. safety clearance c for reference signal: ≥ 100 ns

- Measuring system monitoring: a) for cophasal state of channels UA1, UA2 or UA0 $\geq 1.2\ \mu s$
  b) Evaluation of $\overline{UAS}$

- max. cable length ≤ 50 m or shorter if required by manufacturer

- Pin assignment   see manual "Interface Conditions"

Signal diagram
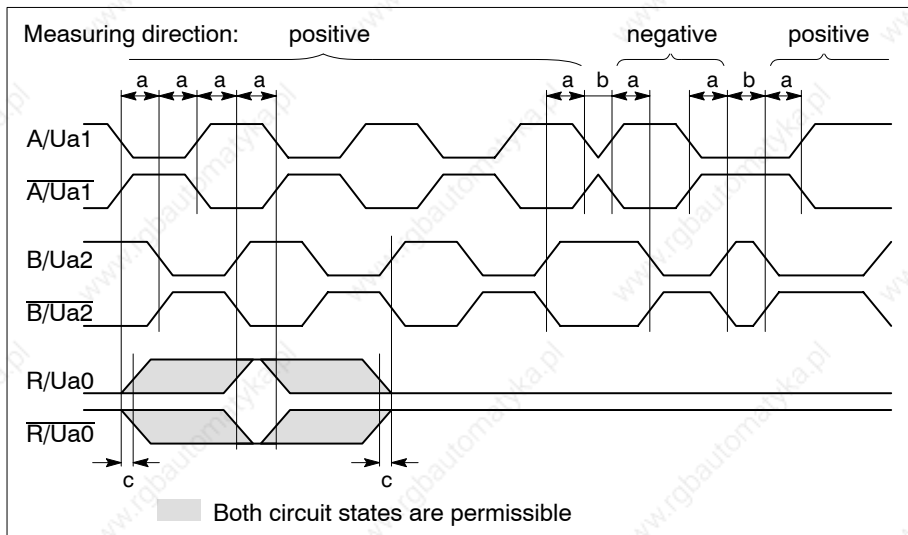
DM control connections

Heidenhain measuring systems which fulfill the following conditions can generally be connected to the option module OM 02 (for recommended types, refer to "Configuration" manual):

- Measuring system for 5 V power supply from the option module
- Square-wave signal output
- Line drivers acc. to RS 422
- Power input $\leqq$ 300 mA
- Min. edge interval between active counting pulses $\geqq$ 150 ns

The cable shield must have a continuous connection from the front panel of the option module to the measuring system.

A measuring system error is signalled to the OM 02-D option module by means of an input signal $\overline{Uas}$, or when the connected measuring systems/EXEs switch their output stages to the tri-state status (high-resistance).
Open $\overline{Uas}$ inputs are set to HIGH potential by internal pull-up resistors (= no measuring system error present).

Pin assignment OM 02 for measuring systems with square-wave signals

max. 50 m
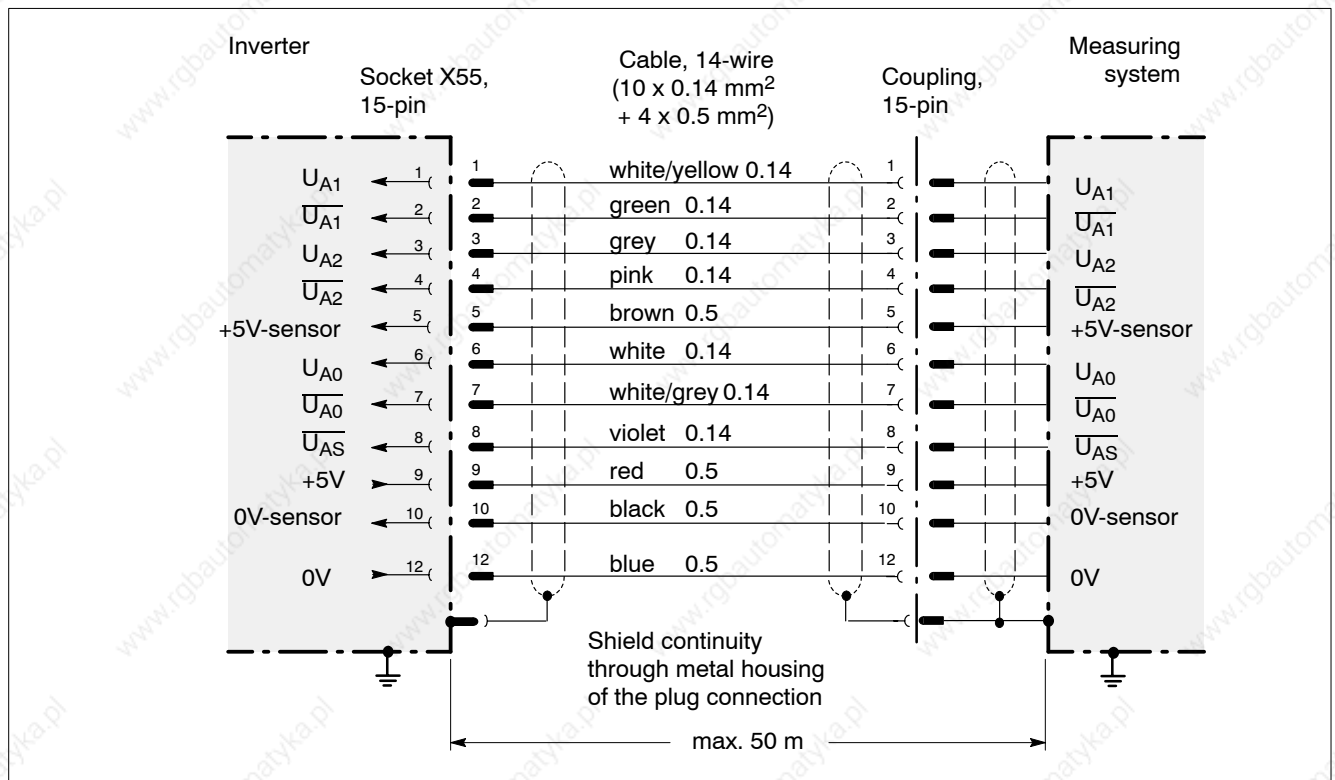
DM control connections

Permissible pulse-shape electronics (EXE)

Heidenhain EXEs can also be connected subject to the following conditions (For further information, refer to manual "Configuration ServoDyn D"):

- EXEs for 5 V power supply from the option module
  or for external 230 V AC voltage supply
- Square-wave signal output
- Line drivers acc. to RS 422
- Max. power input for measuring system **and** EXE with 5 V supply: $\leqq$ 300 mA
- Min. edge interval between active counting pulses $\geqq$ 150 ns

Please follow the manufacturer's recommendations when combining measuring systems and EXEs. Measuring systems and EXEs with internal monitoring are preferably used.

The connection between the measuring system and the EXE is effected via a cable supplied by Heidenhain.
The cable shield must have a continuous connection from the front panel of the option module to the measuring system.
The correct wiring of the $\overline{Uas}$ signal must be checked.

Pin assignment OM 02 for pulse-shape electronics (EXE)
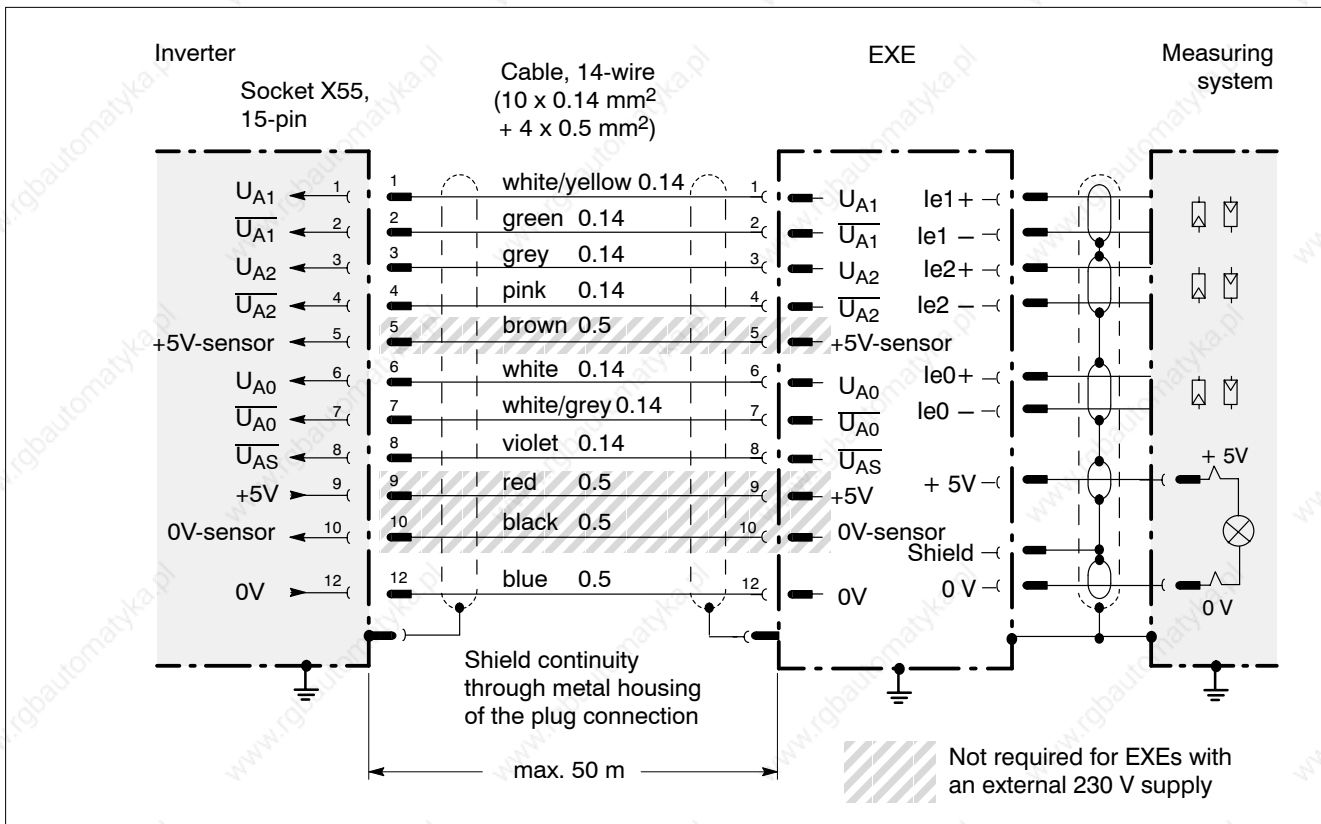
DM control connections

OM 03 **Incremental measuring systems with sinusoidal voltage signals, absolute measuring systems with EnDat or I²C interface**

The OM 03 supports measuring systems without a serial interface, with EnDat or I²C interface.
It is available in 2 different versions with different input frequencies:

- OM 03:   ≤ 500 kHz
- OM 03 (125 kHz):   ≤ 125 kHz

The following direct measuring systems may be connected:

- High-resolution rotary encoders
- Linear scales
- Gear encoders

All measuring systems must meet the following interface requirements:
(For further information, refer to manual "Configuration ServoDyn D"):

- Measuring system for 5 V power supply from option module
- Incremental signals 1 V_{pp}
- Power input ≤ 300 mA
- Signal frequency ≤ 125 kHz / 500 kHz
- Cable length ≤ 100 m

Signal diagram
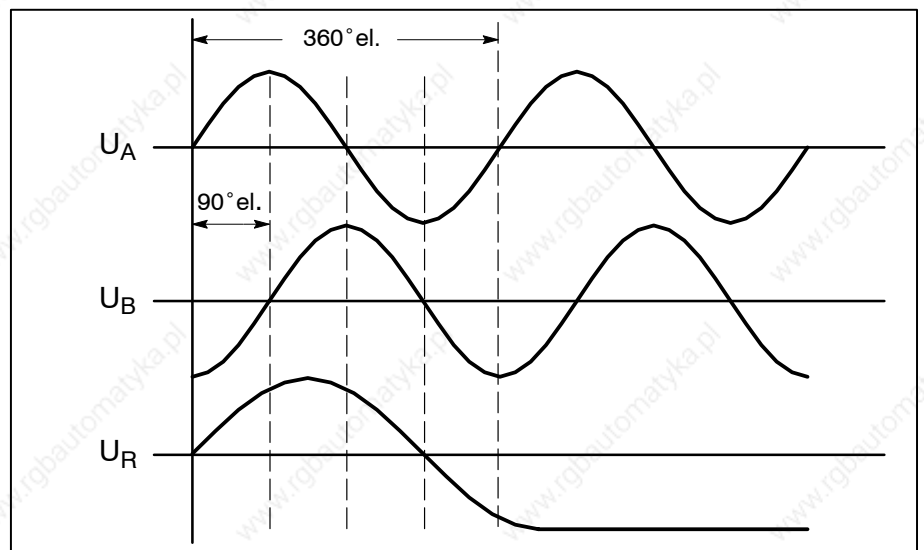
The external cable shield must have a continuous connection from the front panel of the option module to the measuring system.
The inner cable shields A, B and R must be connected with insulation to the outer shield.

DM control connections

Pin assignment OM 03 for measuring systems with EnDat interface
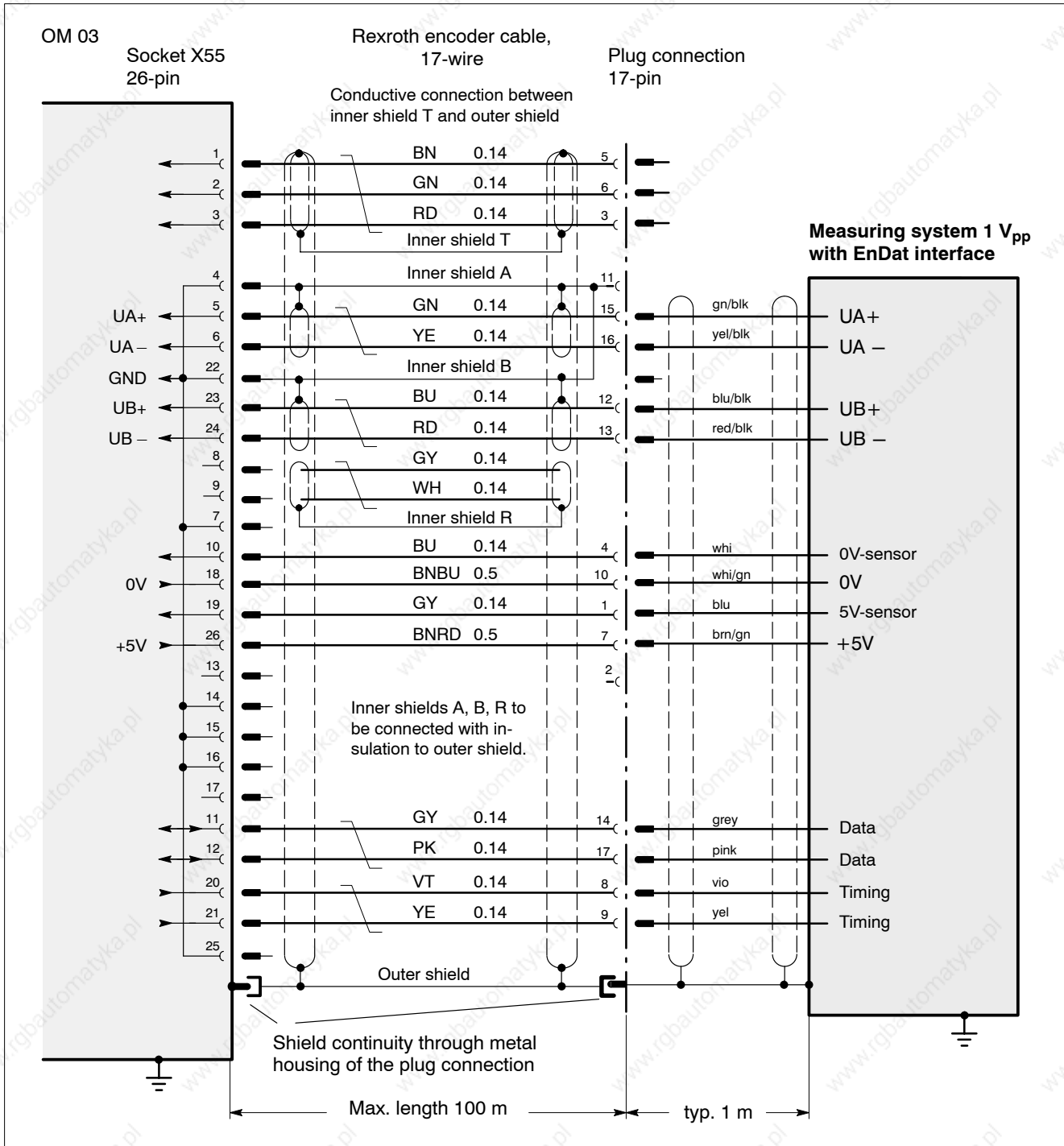
DM control connections

Pin assignment OM 03 for measuring systems without interface or with I^{2}C interface

OM 03

Socket X55
26-pin

Rexroth encoder cable,
17-wire

Conductive connection between
inner shield T and outer shield

Plug connection
17-pin

**Measuring system 1 V$_{pp}$
without interface or with
I^{2}C interface**

Pin	Wire	Size	Pin
1	BN	0.14	5
2	GN	0.14	6
3	RD	0.14	3

Inner shield T

Inner shield A

S1	5	GN	0.14	15	UA+
S3	6	YE	0.14	16	UA −

Inner shield B

	22			
S2	23	BU	0.14	12	UB+
S4	24	RD	0.14	13	UB −
R1	8	GY	0.14	11	UR+
R3	9	WH	0.14	2	UR −
GND	7				

Inner shield R

	10	BU	0.14	4	0V-sensor
0V	18	BNBU	0.5	10	0V
	19	GY	0.14	1	5V-sensor
+5V	26	BNRD	0.5	7	+5V

e.g. gear encoder

Inner shields A, B, R to
be connected with in-
sulation to outer shield.

	17	PK	0.14	17	I^{2}C
	11	GY	0.14	14	Data
	12				
	13				
	20	VT	0.14	8	Timing
	21	YE	0.14	9	Timing
	25				

Electronic rating plate

Outer shield

Shield continuity through metal
housing of the plug connection

optionally for
I^{2}C interface

Max. length 100 m   typ. 1m

DM control connections

7.12   High-speed analog outputs OM 04

The OM 04 option module can be used for:
- all axis inverters except frequency inverter DM..8001 (ASM)
- Supply module with current regeneration.

Terminal strip X13
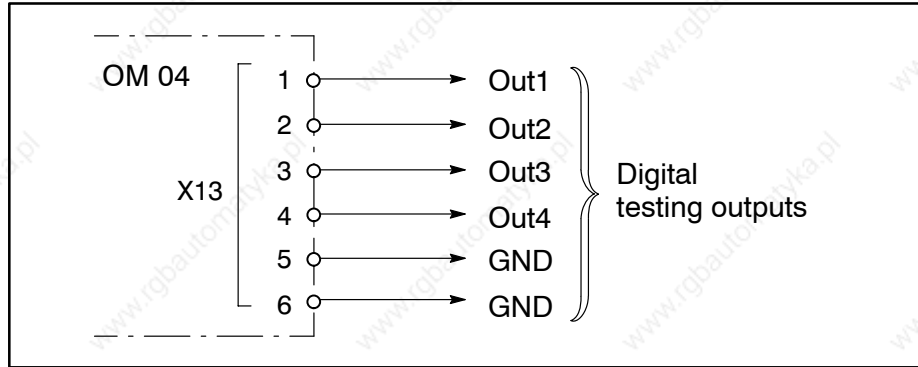
X13.1–4   D_Out1 to D_Out4 Programmable 5 V testing outputs

Output resistance 120 Ω, short-circuit-proof.
The test signals at X13 are designed for service personnel.

Terminal strip X14
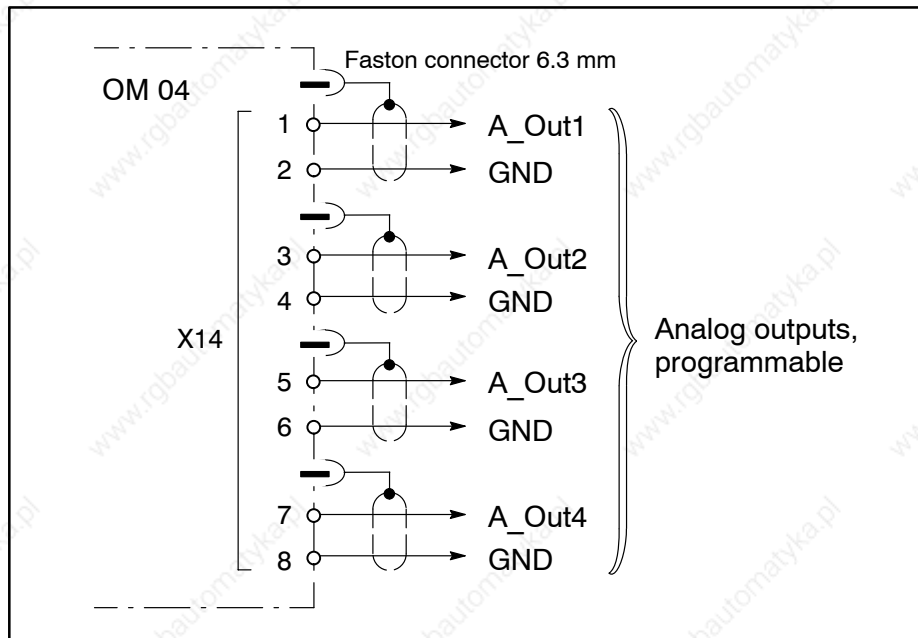
DM control connections

X14.1–4 A_Out1 to A_Out4 Programmable HS-analog oputputs

Output voltage range ± 10 V, output resistance $100\ \Omega$, short-circuit-proof.
The programmable high-speed analog signals serve as measured value output.

- 12-bit resolution
- Accuracy $\pm$ 0.3% of the final value
- max. connectable cable length 10 m

When the module is switched on, the outputs are not defined until initialization. During initialization, they are reset to zero.

Default setting	Analog interface, SERCOS interface CAN bus PROFIBUS-DP	Positioning function (MC)	VMA..KR, VMA..B,C,D VMW..F
X14.1/2 (A_Out1)	Speed setpoint S-0-0036	–	–
X14.3/4 (A_Out2)	Actual speed S-0-0040	–	Mains current setpoint q (standardized to VM-dependent maximum value)
X14.5/6 (A_Out3)	Torque setpoint S-0-0080	–	Actual DC link voltage (standardized to 1000 V)
X12.7/8 (A_Out4)	Torque actual value S-0-0084	–	Heat sink temperature (standardized to 100 °C)

DM control connections

Notes:

Application instructions

8   Application instructions

8.1   Drive with SERCOS interface

8.1.1   Cycle power to the drive

24 V hardware signals:

- **Drive On AE** (X06.7 on the VM...B,C,D,F supply module only)
  switches on the drive assembly power on the supply module.

- **Enable external FG** (X06.3 on the DM)
  Hardware enable for each axis:
  - Without the FG signal the motor torque is zero and the motor
    comes to a stop without setpoint control.
  - Braking is effected by means of a plug braking module or
    by using a holding brake integrated into the motor.

☞ **The holding brake can only be operated at standstill, in order to
avoid dangerous wear and tear. Refer to the motor manual.**

SERCOS interface signals (Rexroth PLC command designations):

- **Drive enable**   **(Drive inhibit)**
  Software enable for each axis:
  - The software signals "Drive on" and "Drive $\overline{\text{hold}}$" function only with
    Drive enable.
  - Without "Drive enable" the motor torque is zero and the motor
    comes to a stop without setpoint control.
  - Braking possible via a plug braking module

- **Drive on**   **(Drive off)**
  switches the internal Enable signal:
  - switches on the torque when "Drive enable" has been given
  - With Drive on, the setpoints become active after the "Waiting time
    Drive on" has elapsed. This is necessary for controlling a holding
    brake (cf. motor manual)
  - Deceleration of drive in accordance with P-0-0004 with "Waiting
    time Drive off" for brake control. Followed by torque switch off.

- **Drive $\overline{\text{hold}}$**   **(Feed inhibit)**
  Shut-down drive with setpoint control, if "Drive on" is activated:
  - taking into consideration P-0-0004
  - drive remains under control

Application instructions

Sequence diagram with SERCOS interface: Cycle on / off
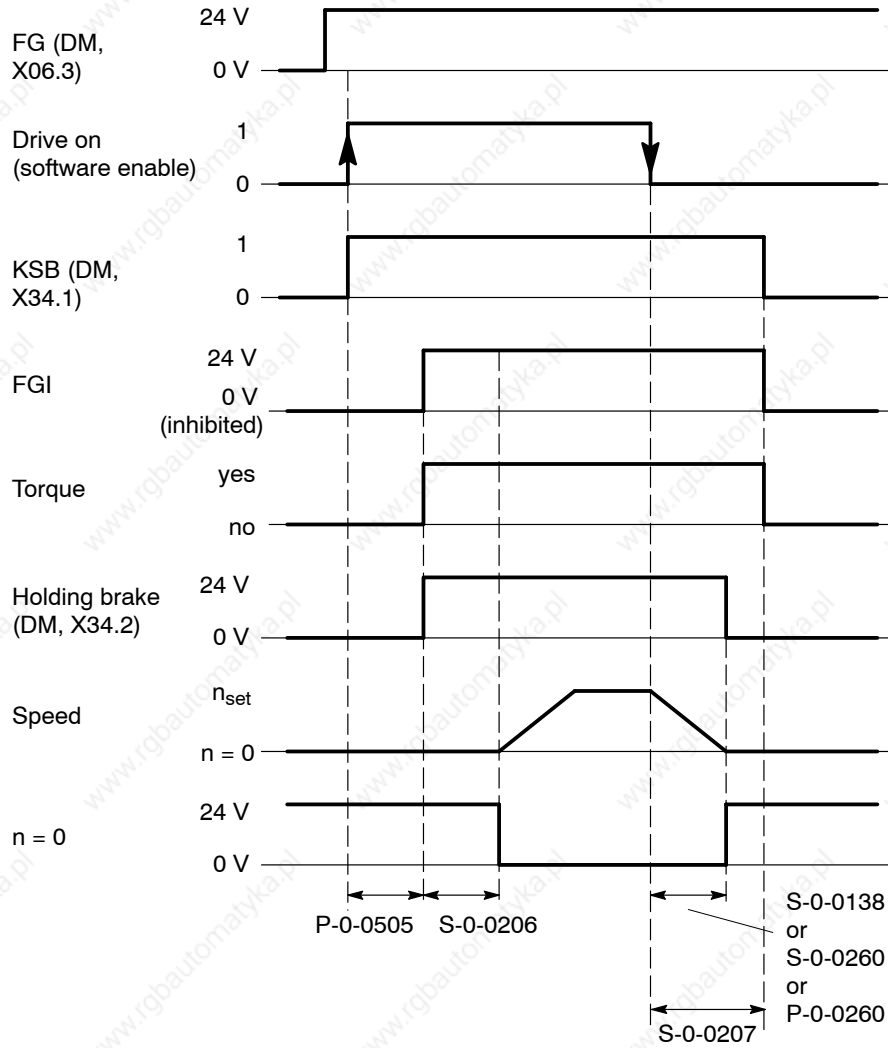
- ● FG   off: drive comes to a stop without setpoint control
- ● "Drive on"   off: drive is braked according to preselection in
                            P-0-0004
- ● "Drive enable"   off: drive comes to a stop without setpoint control

Application instructions

Sequence diagram with SERCOS interface: Cycle off / on upon entering a protective zone

DANGER
Do not use for suspended axes!
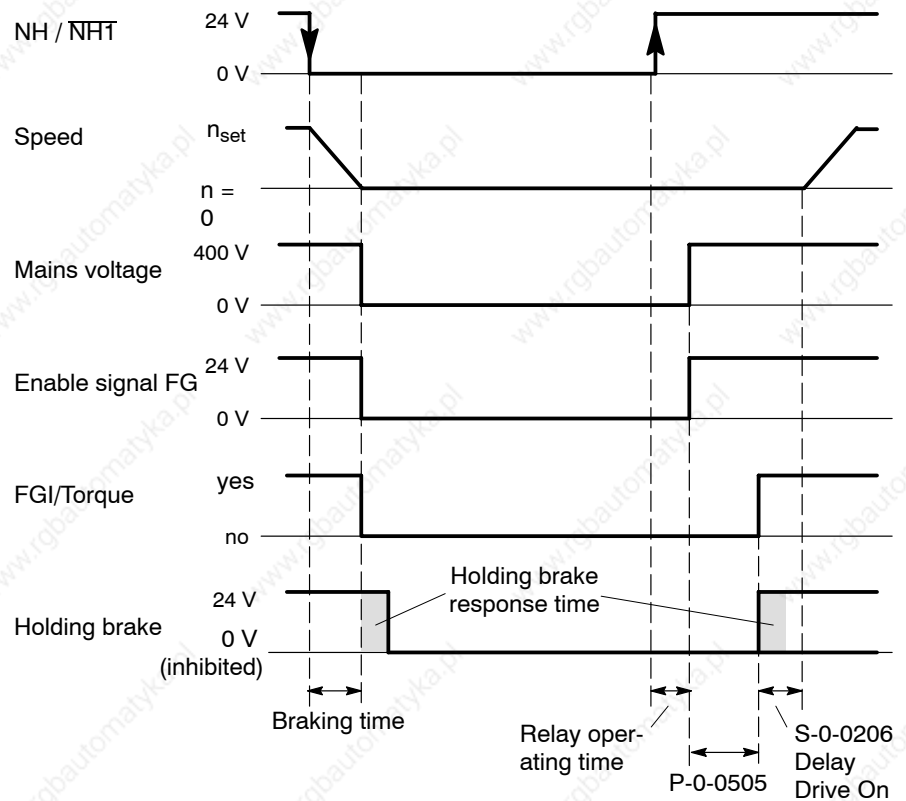
Cycle off

The FG enable signal must remain active during the braking time via a time relay before the mains voltage and FG are switched off, otherwise, the holding brake will engage immediately.

Cycle on:

The mains voltage and FG are connected simultaneously. In order to avoid a VM error which may occur because the DC link is no longer fully charged, there must be a delay before activating the internal enable signal. This is done with the help of parameter P-0-0505 (KSB (plug braking) enable delay).

The internal enable signal (FGI) applies a torque to the motor and releases the holding brake. The response time of the holding brake is typically 80 ms with the relay connected in series. No traversing command may be carried out during this time. For this purpose, parameter S-0-0206 (Waiting time drive on) is set (typically 100 ms).

Application instructions

8.1.2   EMERGENCY-STOP

Emergency-Stop tripping delay

To initiate EMERGENCY-STOP, the Emergency-Stop inputs of the supply modules must be interrupted:

- For NH and $\overline{NH1}$ with a VM with current regeneration, refer to page 6–17
- For NH with a VM with ballast switch, refer to page 6–5

By activating EMERGENCY-STOP, the system automatically changes over from position control of the master (CNC) to speed control in the drive and the function "Drive halt" is initiated, which can be defined individually for each axis in P-0-0004:

- Braking within shortest possible time (S-0-0138)
- Braking drive-controlled via ramp (S-0-0260)
- Braking drive-controlled via separate halting ramp (P-0-0260)
- Braking setpoint-controlled by the master

The supply module does not interrupt the power supply unless all axes have been halted, but not later than the tripping delay time. This time can be selected by switch S1 on the front panel of the VM unit and has to be matched to the braking behavior of the largest axis/spindle.

Scale	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Time [sec]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

(0 = not permissible)   = Default Setting

S1 changes become effective:

- after pressing reset, or
- after disconnecting and restoring the 24 V supply.

☞ **The control remains active during the tripping delay. The supply module then cuts the power off and the drives come to a stop without setpoint control.**
The chosen time setting must be as short as possible.

⚠ **DANGER**
In the event of a supply module failure, the motors have no torque and come to a stop without setpoint control!
Activate plug braking or an integrated holding brake in this case.

Application instructions

Sequence diagram with SERCOS interface: EMERGENCY-STOP

The following signals (PLC commands) have to be given:

- External enable FG   (24 V to X06.3, DM module)
- Drive enable (Drive inhibit)   (drive control word, bit 14 = 1)
- Drive on (Drive off)   (drive control word, bit 15 = 1)
- Drive $\overline{\text{hold}}$ (Feed inhibit)   (drive control word, bit 13 = 1)

⚠️ **DANGER**
Drive braking cannot be controlled without enable FG and "Drive enable".
The 24 V supply to the module must be maintained.

NH / $\overline{\text{NH1}}$: 24 V → 0 V

Status word, bit 14: 1 → 0 → 1

Status word, bit 15: 1 → 0

Holding brake: 24 V → 0 V (inhibited)

Plug braking module: 24 V → 0V

FGI/Torque: yes → no

Speed: n_{set} → n = 0

VM supply module power: on → off

S-0-0138 or S-0-0260 or P-0-0260

All drives to n = 0, max. time is that set by S1
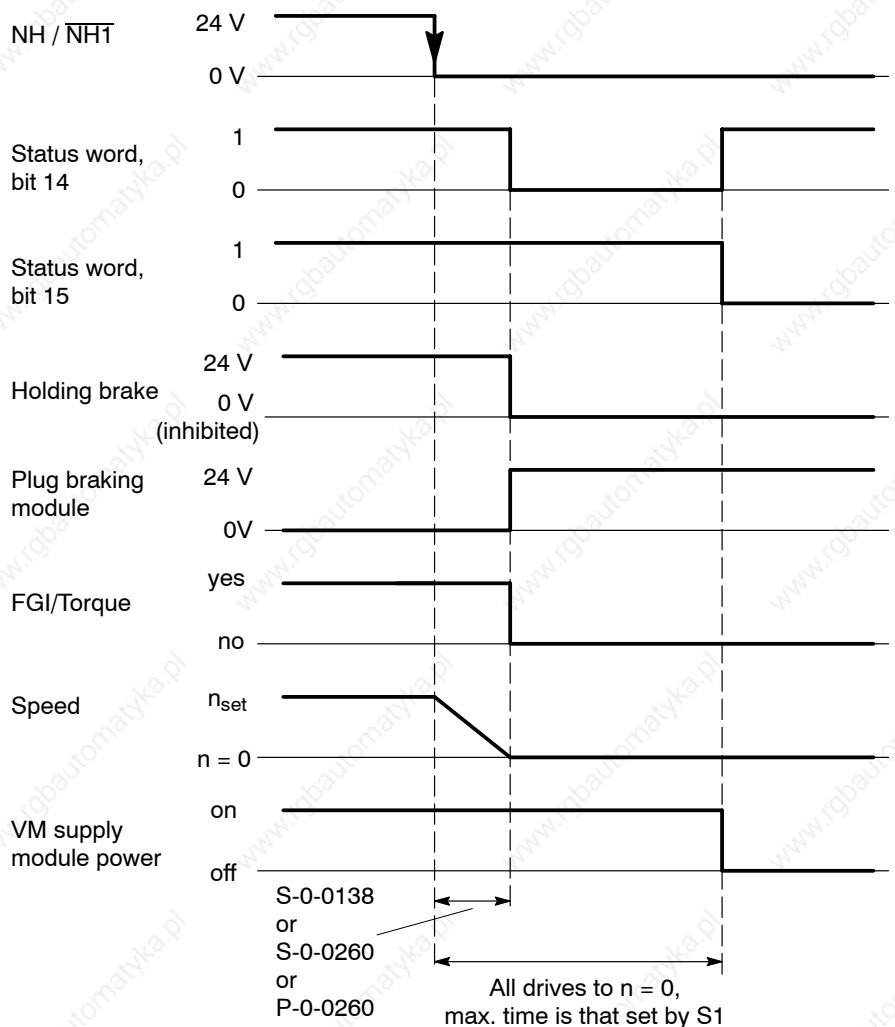
Application instructions

8.2   Drive with analog interface, MC, CAN bus, PROFIBUS-DP

24 V hardware signals:

- **Drive On AE** (X06.7 on the VM...B,C,D supply module only)
  switches on the drive assembly power on the supply module.

- **Enable external FG** (X06.3 on the DM)
  Hardware/software enable for each axis:
  When FG is switched off, the motor is braked as specified in P-0-0125.

☞ **The holding brake may only be operated at standstill, in order to avoid dangerous wear and tear. Refer to the motor manual.**

Sequence diagram
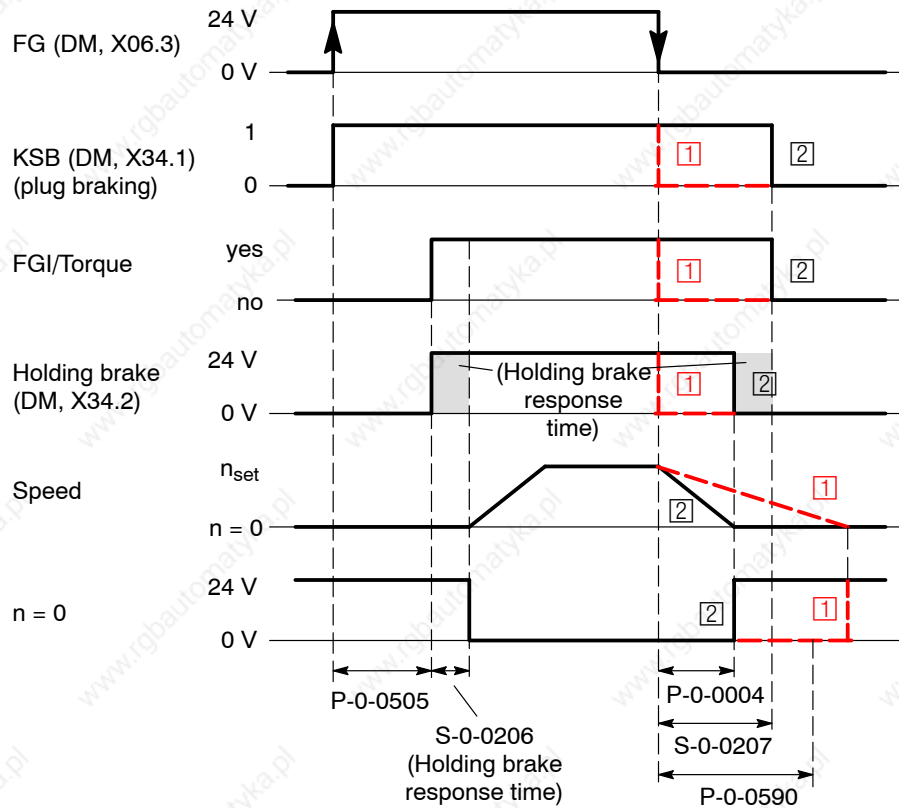
Halting the drive in accordance with parameter P-0-0125:

1 :   Motor comes to a stop without setpoint control

2 :   Halting as specified in P-0-0004
       (shortest possible time S-0-0138 or ramp S-0-0260 or P-0-0260)

Maximum time until the output stage is switched off: P-0-0590, if activated.

Application instructions

8.3   Mains voltage failure

Complete failure

⚠️

DANGER
**In the event of a power failure on a supply module with current re-
generation, the motors have no torque and come to a stop without
setpoint control!**
Dangers can be avoided by taking one of the following measures:

In the event of a power failure or "Main switch off", the supply module de-
tects undervoltage, output Out3 on the X34.2 terminal strip changes to
0 V.

★   You may perform **"Drive halt"**:

- by evaluating Out3 through an auxiliary relay in the EMERGENCY-
  STOP circuit, or
- by evaluating Out3 through a PLC input which initiates "Drive $\overline{\text{Halt}}$".

If axes are moving when the power fails, the energy generated when
braking the motors must be released. As this can no longer by done by
current regeneration, the motors are shut down by the mechanical hold-
ing brake.
The holding brakes are immediately engaged if the 24 V voltage fails too
upon a failure of the mains voltage. Braking the drives with setpoint con-
trol is not possible with this option.

★   **Halt drives with setpoint control** is possible by taking additional
    measures:

- The 24 V voltage supply must be backed by a UPS for the drives, a
  buffer time of 2 sec is sufficient.
- The EBX ballast switching module must be used in order to release
  the braking energy.

Refer to Figure on the next page.

Application instructions

Sequence diagram with SERCOS interface: Voltage failure with UPS and EBX
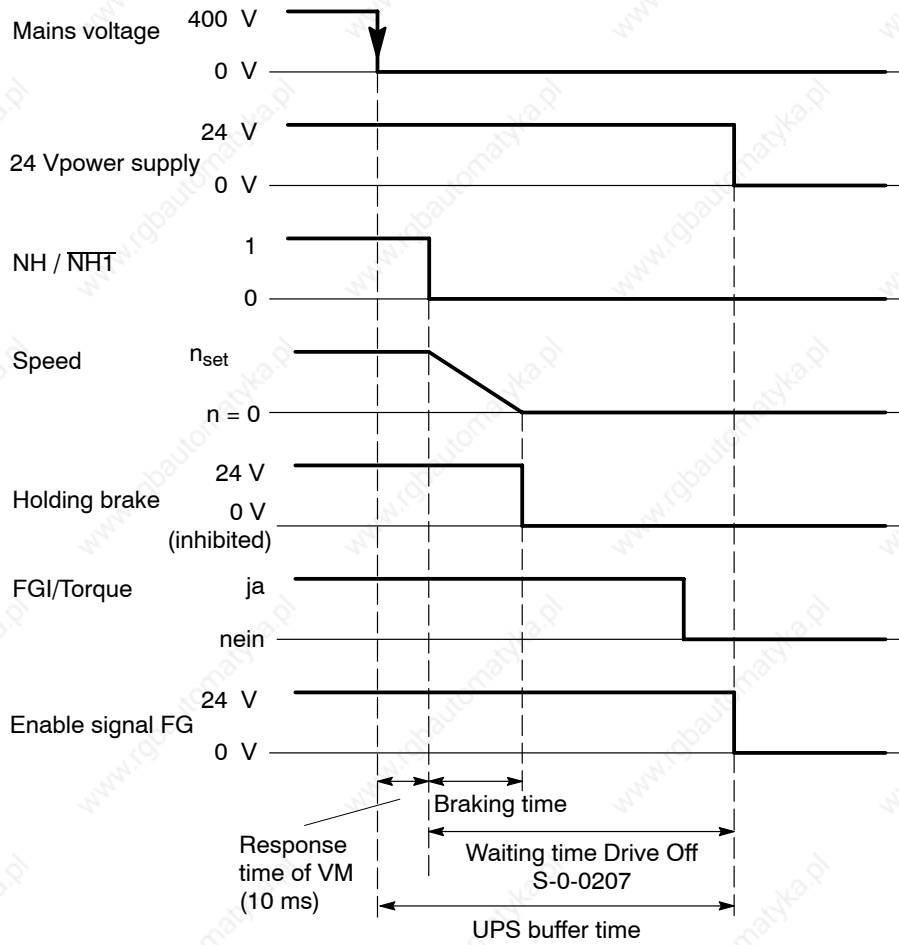
Short-time failure

In the event of a 1-phase mains failure, the VM continues to operate, however, at a reduced power of 66%. Frequent 1-phase short-time failures can thus be bridged by the VM.

A long 1-phase failure my result in a VM overload. If "Drive halt" is to be performed in this case, output Out4 on terminal strip X34.1 must be looped into the EMERGENCY-STOP circuit or evaluated by the PLC. Once the "Drive halt" function has been initiated, it will be completed even though the mains voltage should return in the meantime.

When the mains power returns and "Drive on" is active, the DC link control will be resumed.

Application instructions

8.4   Transmission of the absolute encoder position with X81

The transmission of the absolute encoder position is used for ServoDyn
D with analog interface.

Function chart
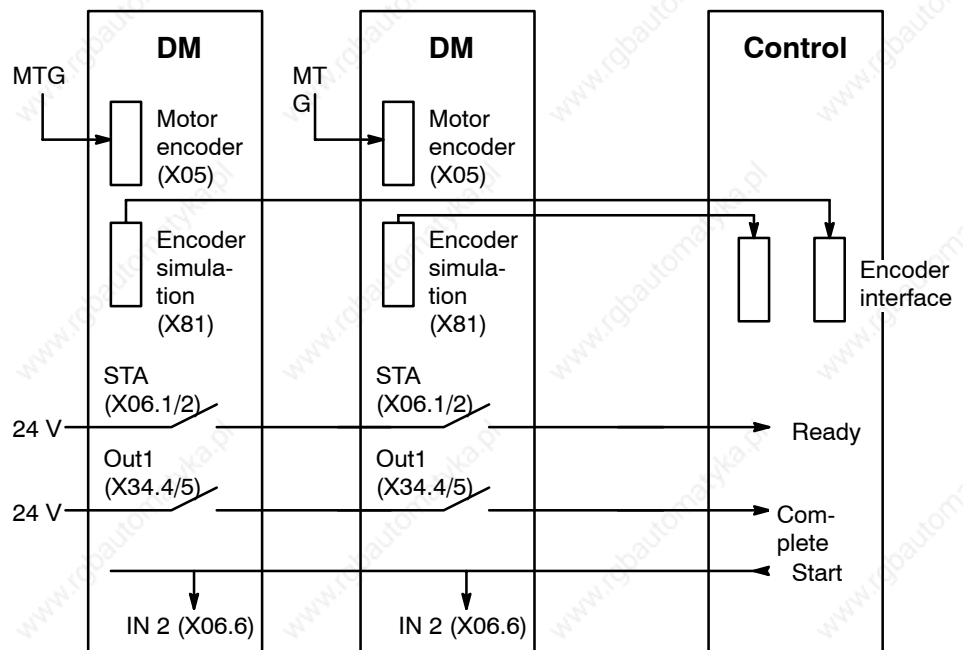
MTG = multiturn absolute value encoder

★   **Sequence of transmission of the absolute encoder position:**

- The drive signals ready status through the STA status relay.
- No enable signal is output for the drives and the control.
- The control outputs a 24V start signal for IN 2 (only 1st pulse takes
  effect).
  IN2 may only be output if:
  - STA of the axis has been output and
  - Out 1 = 0, i.e. no Complete message.
- With the start signal at IN2, the drive starts transmitting the impulses
  of the absolute position to the control
  (connection between encoder simulation − encoder interface).
- When transmission is complete, the drive sets the relay contact Out1,
  thus generating a 24V signal as Complete message for the control
  (finished). The relay contact Out1 must be used as normally-open
  contact. It can only be reset by RESET or by toggling the 24 V supply
  to the drive off/on.
- When the control has received the Complete message, it can enable
  the drive.

Application instructions

Status   STA

Start   IN 2

Complete   Out1

External enable   FG

Counter start-up to absolute position | Operation with setpoint
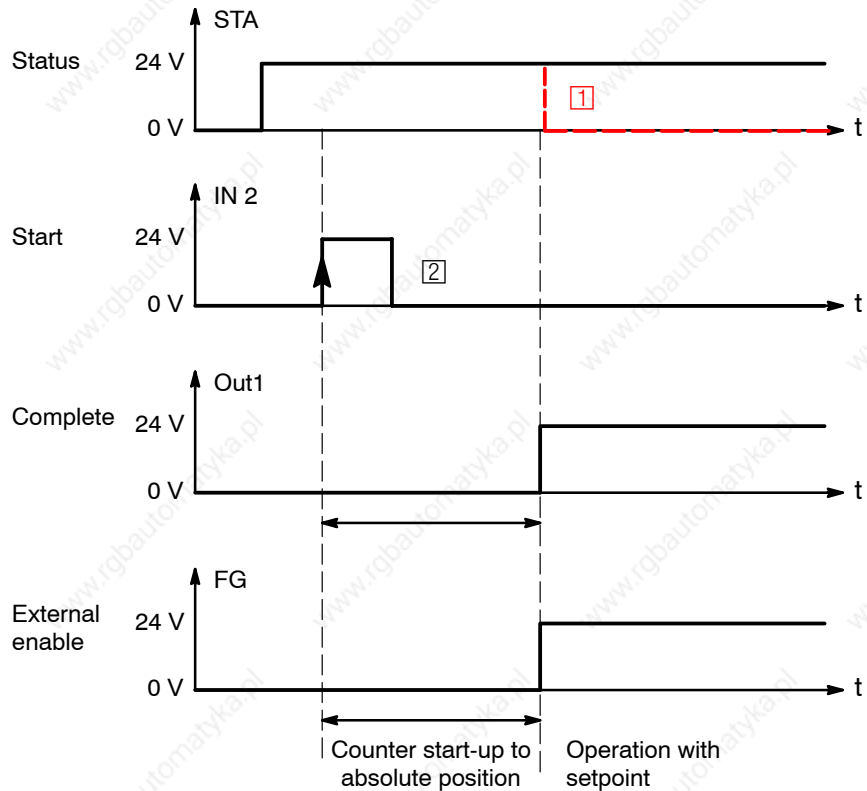
[1]   If the status relay is switched off due to an error when the counter has started up, transmission of the absolute value is no longer affected. Out1 remains high, transmission does not have to be restarted.

[2]   Start impulse will be sufficient as of software version 0.005.

Application instructions

Sequence on the control side

```
        ┌─────────────────────┐
        │  Set position counter │
        │     to "zero"        │
        └─────────────────────┘
                  │
                  ▼
             ╱─────────╲      No
            ╱ STA contact ╲ ──────►
            ╲  closed ?   ╱
             ╲─────────╱
                  │ Yes
                  ▼
             ╱─────────╲      No
            ╱  Out 1 = 0 ? ╲ ──────►
            ╲           ╱
             ╲─────────╱
                  │ Yes
                  ▼
        ┌─────────────────────┐
        │  Starting edge IN2   │
        └─────────────────────┘
                  │
                  ▼
             ╱─────────╲      No
            ╱ Transmission ╲ ──────►
            ╲ completed?  ╱
             ╲─────────╱
                  │ Yes
                  ▼
        ┌─────────────────────┐
        │  Activate position   │
        │     controller       │
        │ Activate software limit │
        │      switches        │
        └─────────────────────┘
                  │
                  ▼
        ┌─────────────────────┐
        │  Set drive enable FG │
        └─────────────────────┘
```
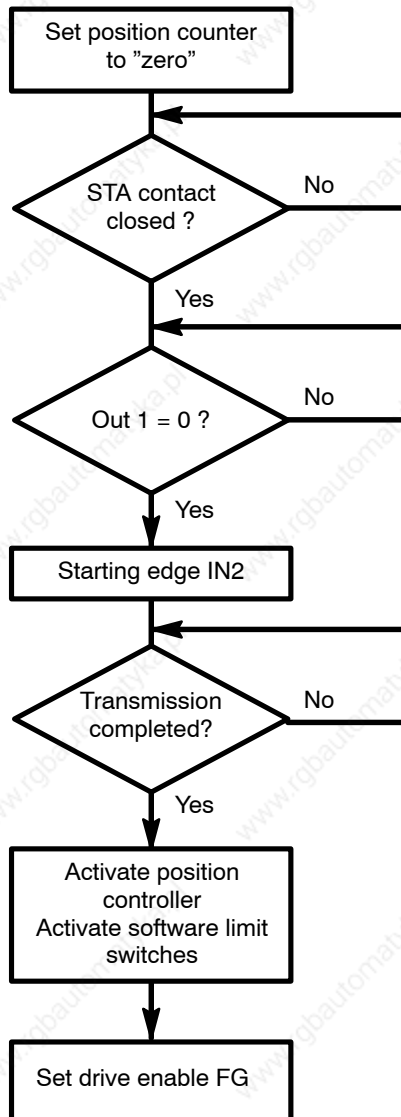
Application instructions

8.5 Drives with positioning function

ServoDyn D drives with positioning functions can be operated from the MC user interface (DSS-MC) of the DSS-D commissioning and service system. Refer to "Commissioning manual with motion control", part no. on page 1–7.

This user interface offers password-protected change-over between operation by the hardware inputs and operation by the DSS-MC.

☞ **During operation by the MC user interface, all hardware inputs and outputs are inhibited, except IN 9 (reference cam input).**

The following modes may be selected via the user interface or hardware inputs IN 7 and IN 8:

Mode		Bit pattern of hardware inputs	
		IN 8	IN 7
Automatic		0	0
Referencing		0	1
Jogging	Jog –	1	0
	Jog +	1	1

8.5.1 Jogging mode

In jogging mode, the drive can be traversed manually without referencing and without processing certain blocks.

Hardware inputs Jog+/Jog–

If 24 V are present at input IN 6 (start motion) and Jog+ or Jog– are activated (cf. above), the drive traverses in the direction thus specified until IN 6 is reset to 0 V.

The jogging speed is set with S-0-0259/S-0-0260 and can be influenced with S-0-0108 (feedrate override).

The override value 0 – 100% can be set using the MC user interface.

MC user interface

When the user interface is enabled, command buttons "+", "–" start an axis movement in the corresponding direction. The override value can be set in the range 0 – 100%.

The MC user interface displays the positions traversed to.

Application instructions

8.5.2   Referencing

For automatic operation, the axis must have been referenced.
The output signal "Axis has been referenced" is cleared when referencing is started, and set when referencing has been properly completed.

- Referencing direction according to S-0-0147, bit 0
- Referencing speed according to S-0-0041
- Referencing acceleration according to S-0-0042

**Referencing movement
in referencing direction**
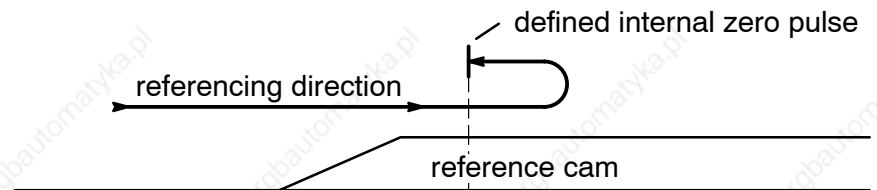
**Referencing movement
when axis has reached the cam**
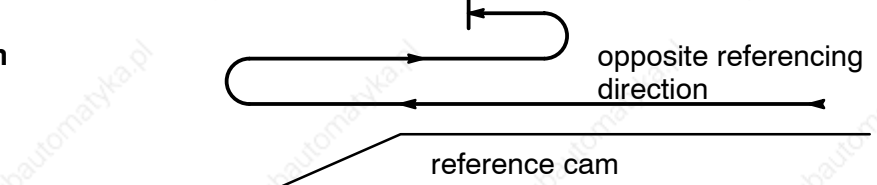
☞ **Motors with absolute encoders do not have to be referenced.**

Signal behavior
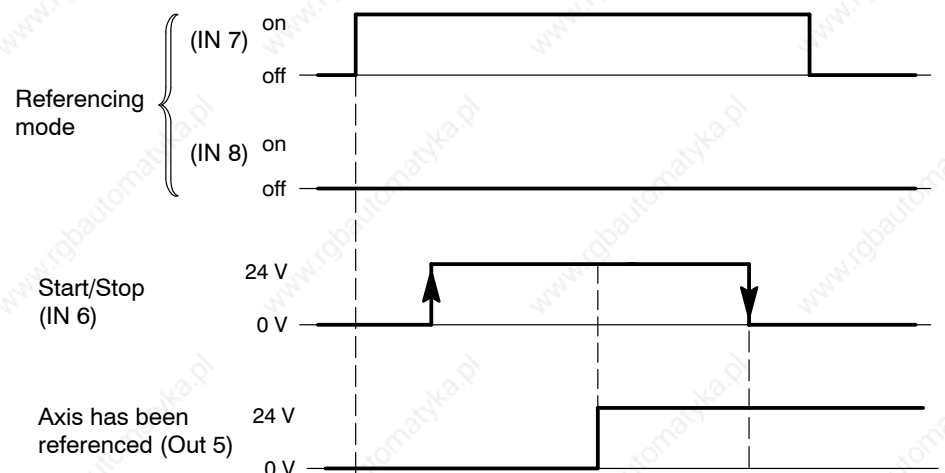
Application instructions

8.5.3 Automatic mode

In automatic mode, the user program is processed in the form of a position table. The position table can be created with the help of the MC user interface. It is automatically stored in the drive (example):

Block no.	Position absolute / incremental [mm]	Speed [mm/sec]	Acceleration [mm/sec^2]	Deceleration [mm/sec^2]
0	145a	1000	2000	2000
1	−20i	500	20	2000

.... etc.,
max. 32 blocks (= positions)

With **absolute** position data, the target position is indicated, with **incremental** position data, the axis performs a relative movement by the specified value.

Examples of the syntax of position "100":

absolute:	100
	100a
	100abs
incremental:	100i
	100⊔ ... ⊔i
	100incremental

Signal behavior

In automatic mode, the Start/Stop command initiates processing of the table set selected at inputs IN 1 − IN 5. Each block is released again, so that any block order can be selected.

Application instructions

Axis has been referenced (Out 5)	24 V / 0 V			
Mode =Automatic (IN 7)	on / off			
(IN 8)	on / off			
Start/Stop (IN 6)	24 V / 0 V			
End of program/block (Out 8)	24 V / 0V			
Axis active (Out 6)	24 V / 0V			
In position (Out 7)	24 V / 0 V			
Speed	n_{set} / $n = 0$			

Process block 1 | Block end/ transition | Block 2 with block interruption by IN 6 (STOP)
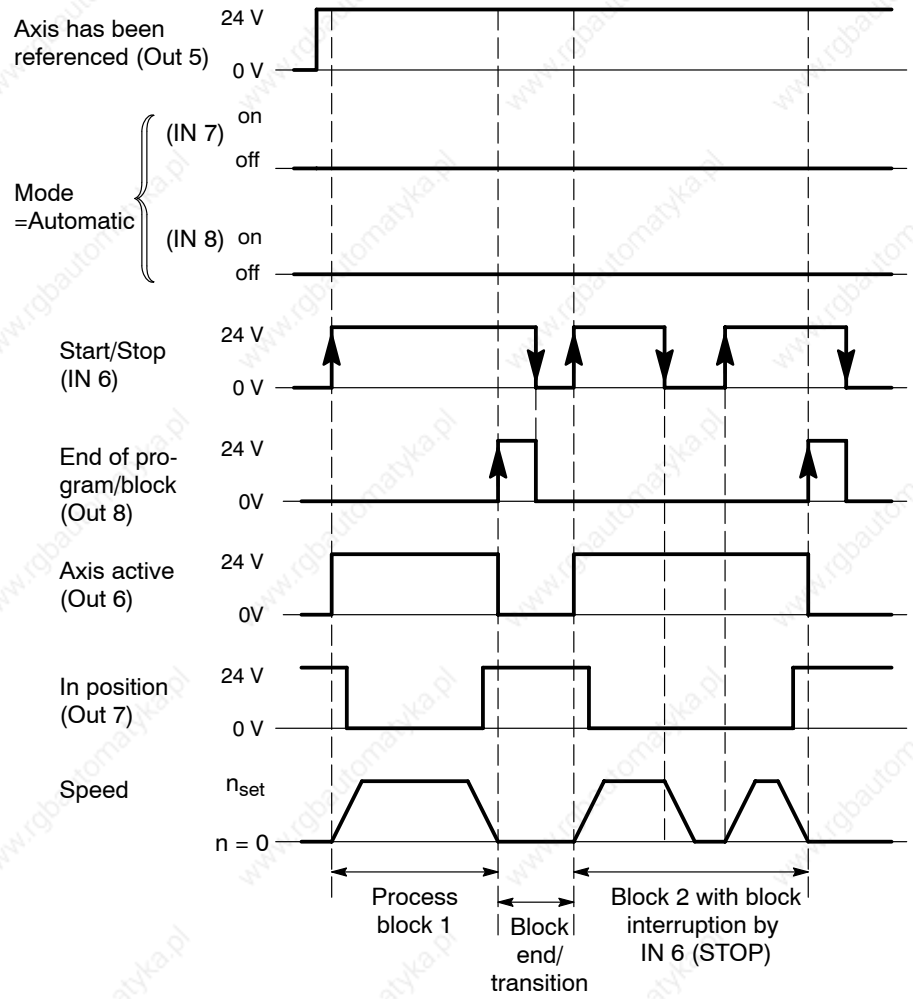
Application instructions

Notes:

Personality module

9 Personality module

The personality module is used in:

- supply modules VM with current regeneration
- three-phase modules DM with SERCOS interface.

☞ **CAUTION**
Damages possible by improper handling!
The Personality Module must not be inserted or removed unless the drive is switched off.

FEPROM

This plug-in board for the computer motherboard contains the FEPROM memory for the operating software and parameters and the dip switches for the basic setting for the SERCOS interface.

The personality module determines the drive inverter's behavior and can take control of the drive characteristics following a module exchange when simply plugged into the new module.

DIP switch on PM..A

No function in VM

on
off

M L T B D   7 6 5 4 3 2 1 0   Address

on
off
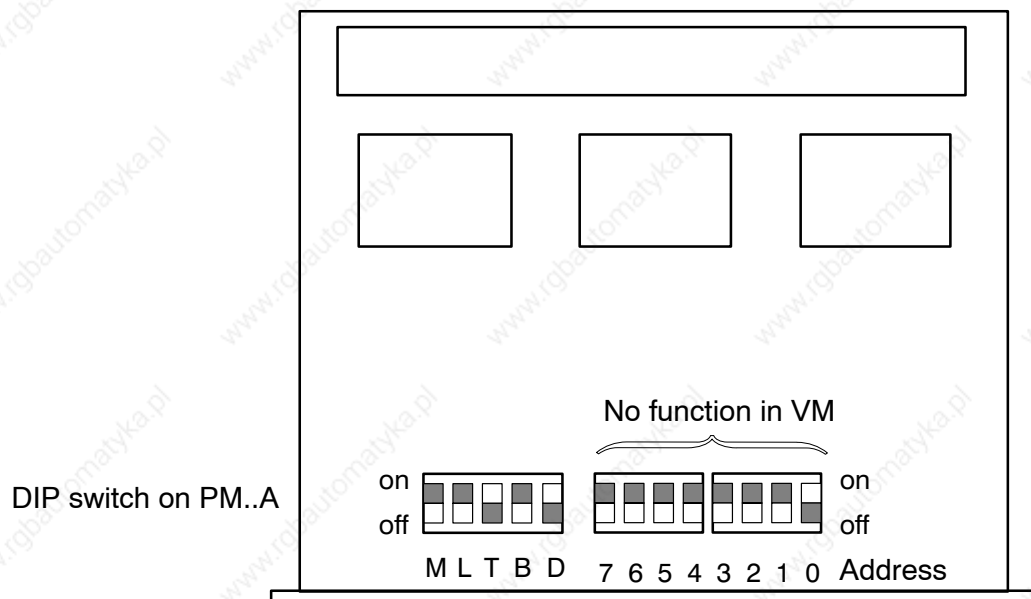
Personality module

DIP switches, Personality Module for DM

These switches must be set and tested before commissioning:

DIP switch	Function
M on/off	Select master function: SERCOS interface is master (default) / DSS-D is master
L on/off	Length of the optical fibre at the SERCOS interface transmitter: Cable up to a length of 10 m, limited transmission performance (default) / Cable exceeding the length of 10 m, high transmission performance
T on/off	Test SERCOS interface: Test mode / Normal operation (default)
B on/off	Data transmission rate:: 2 Mbaud (default) / 4 Mbaud
D on/off	Combination with RSU modules: Operation together with RSU modules (cf. RSU manual) / Operation together with standard modules (default)

SERCOS interface module address:

7	6	5	4	3	2	1	0	
on								0
off								1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Significance

								Example address:
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	1	1	3
0	0	0	0	0	1	0	0	4

Not allowed are:

- "On" setting for all DIP switches
- "Off" setting for all DIP switches

Personality module

DIP switches, Personality Module for VM

These switches must be set and tested before commissioning:

DIP switch	Function
M on ▣ off ☐	Not used.
L on ▣ off ☐	Not used.
T on ☐ off ▣	7-segment display: Display VM software release Display VM operating status (default)
B on ▣ off ☐	EMERGENCY-STOP delay time: 10 ms (default) 200 ms
D on ☐ off ▣	Not used.

Personality module

Notes:

Dimensioned drawings

10   Dimensioned drawings

10.1   VMA..KB/E and DM..K with line wiring module NV
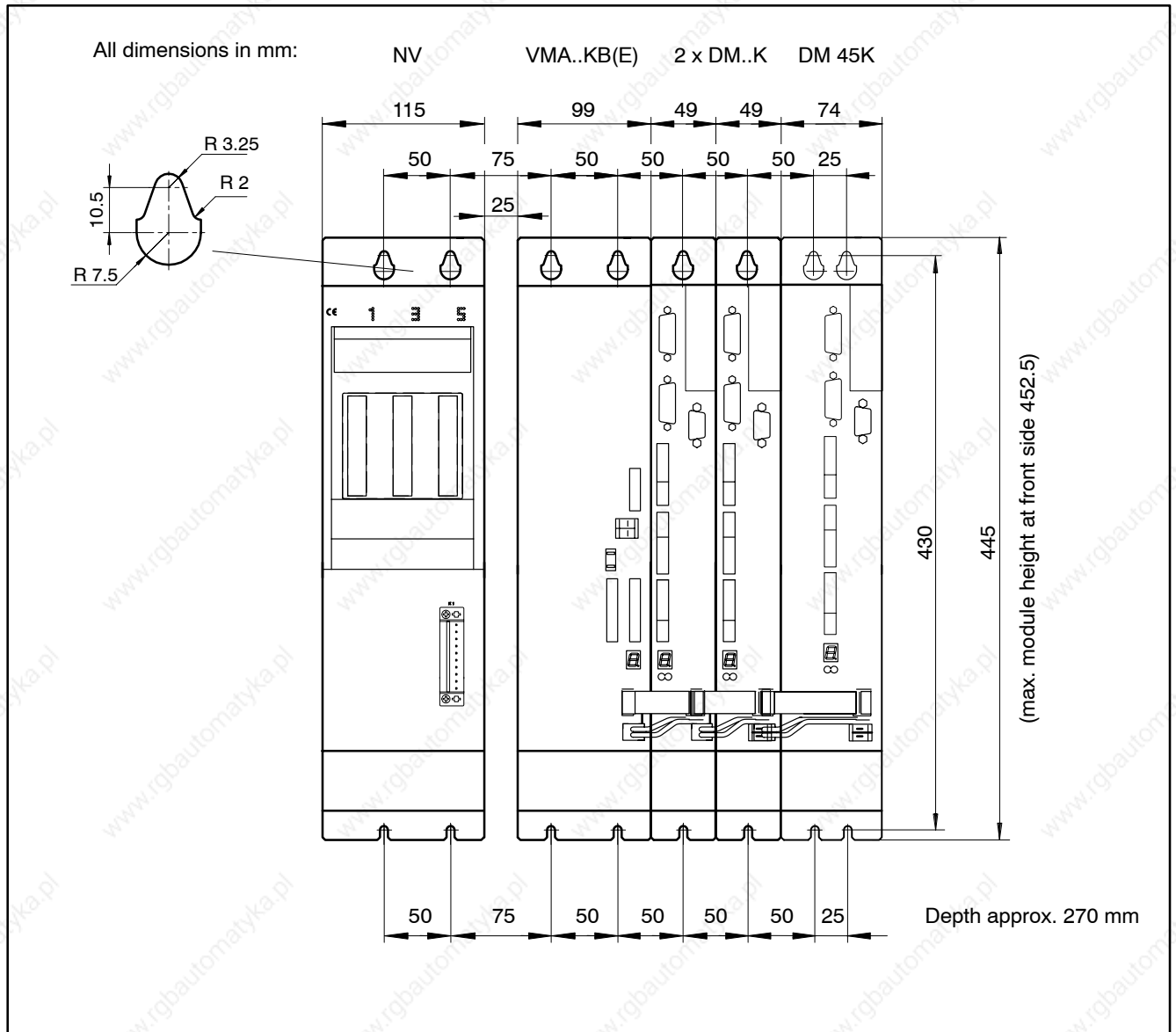
☞ **The distance between the line wiring module NV and the supply module must be 25 mm when installing the units.**
Otherwise, the mains filter in the line wiring module will heat up too much if the supply module is continuously operated at nominal load, resulting in reduced performance data.

Dimensioned drawings

10.1.1 VMA 21KR with mains connection module NAA 21 and NE 21/B
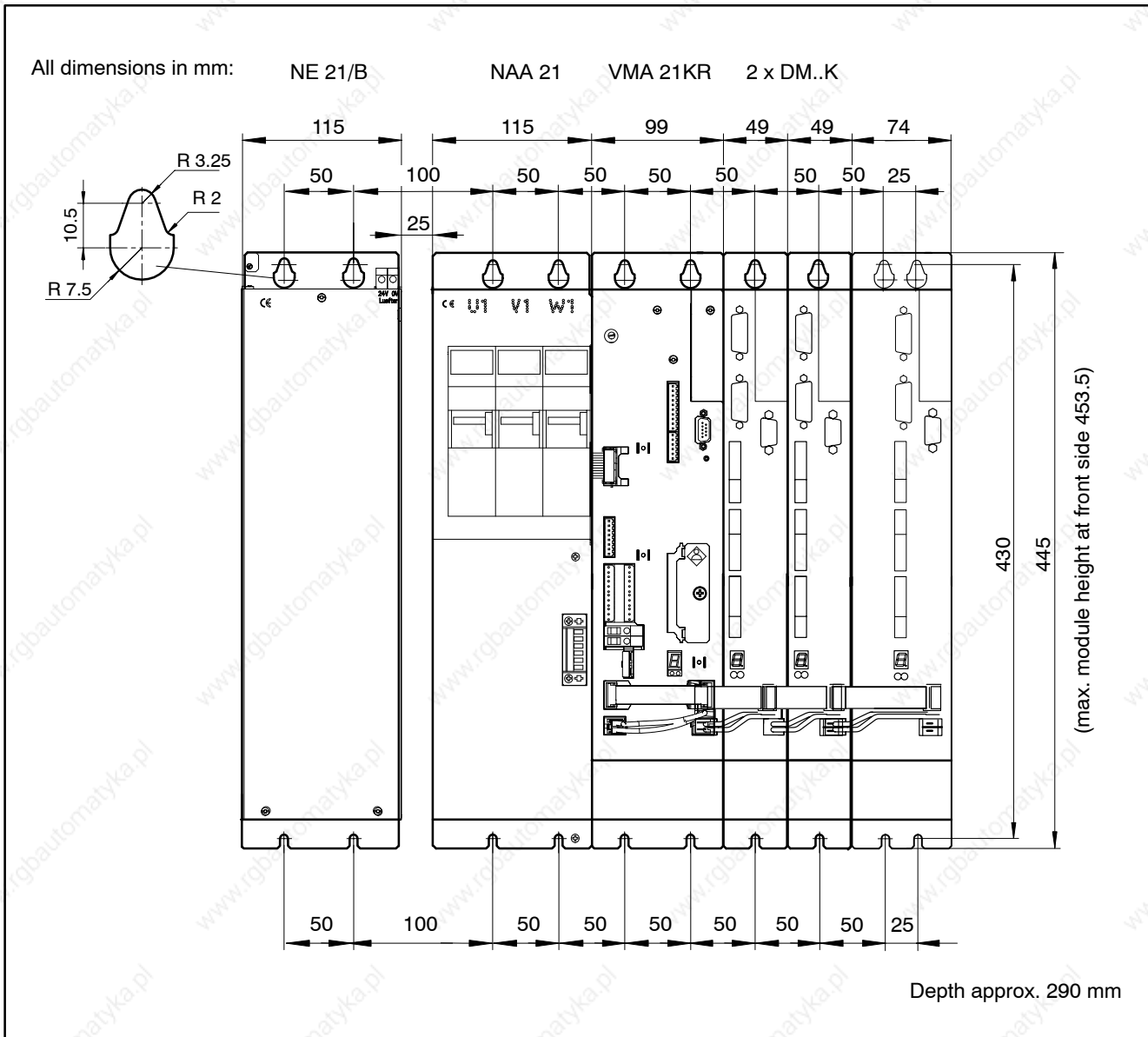
☞ **The distance between line reactor NE 21/B and the mains connection module NAA must be 25 mm when installing the units. Otherwise, the mains filter in the mains connection module will heat up too much if the line reactor is continuously operated at nominal load, resulting in reduced performance data.**

Dimensioned drawings

10.2 Backplane modules with mains connection module NAA35...90

| Module | Dimensions [mm] | |
type	A	B
RM B/VM	50	100
RM C/VM	100	150
RM D/VM	150	200
RM A/DM	–	50
RM B/DM	50	100
RM D/DM	150	200
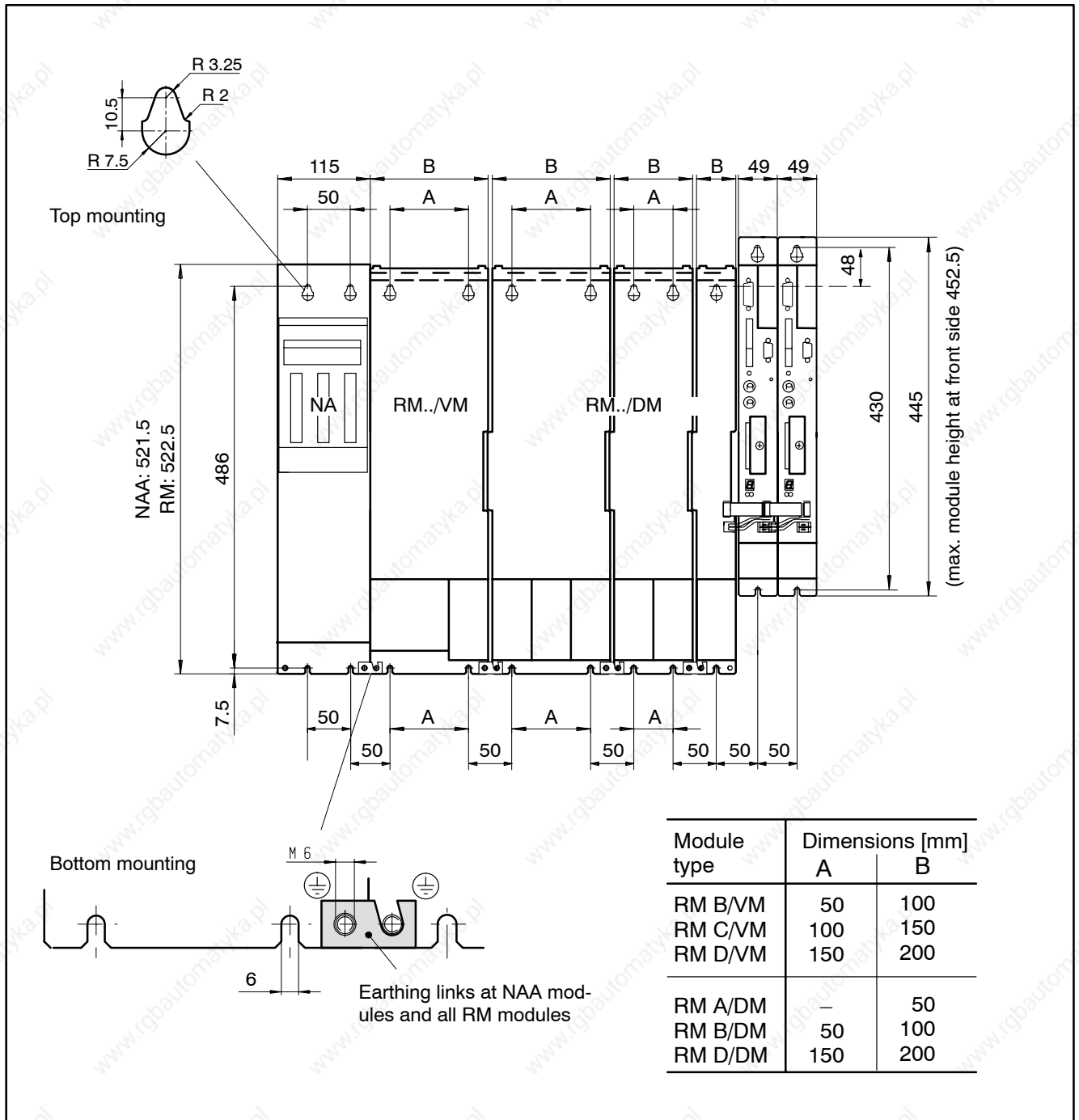
Dimensioned drawings

10.3 VMA..B,C,D and DMA..A,B,D

Module type	Dim. B [mm]
VMA 35B	99
VMA 70C	149
VMA 90D	199
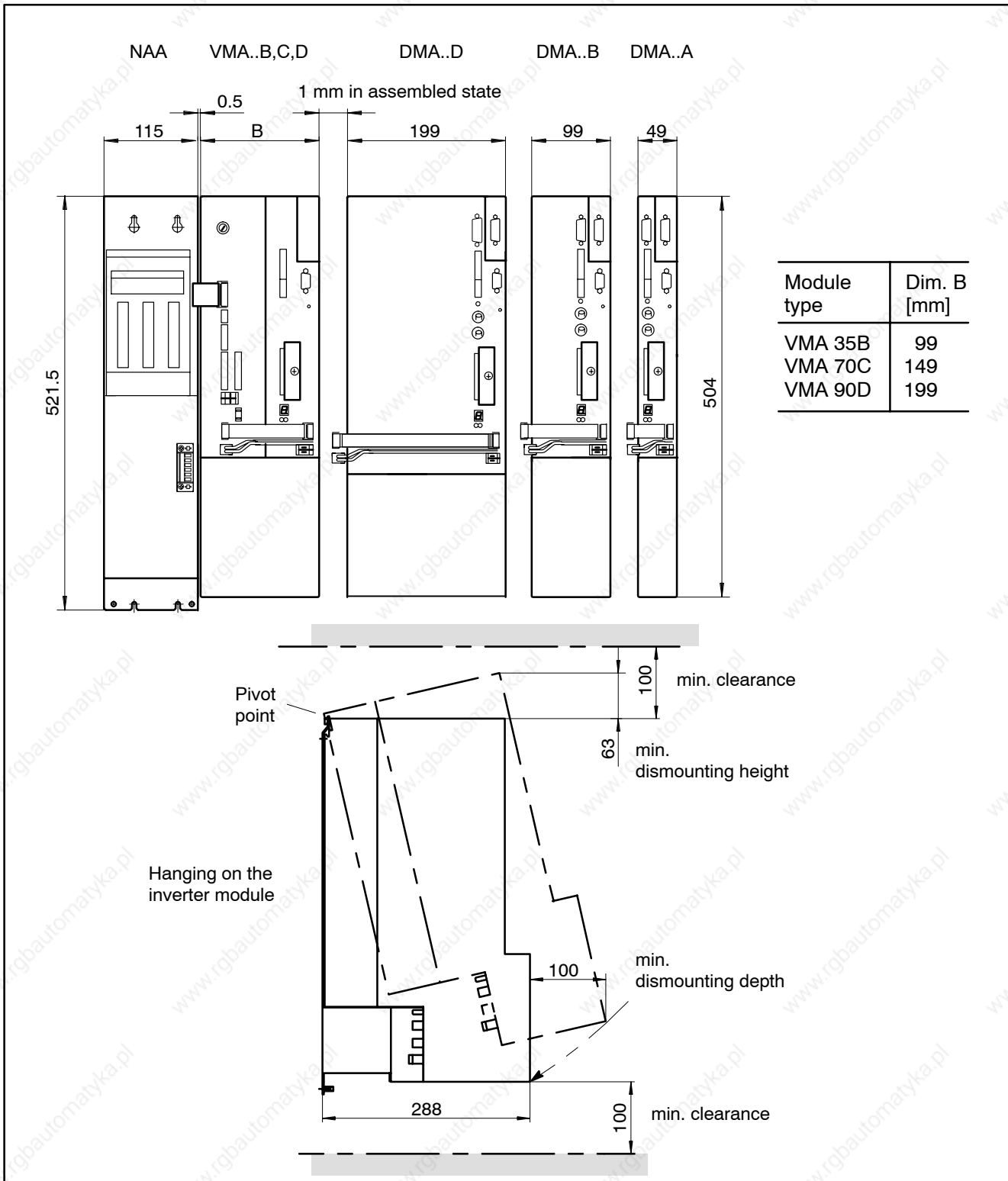
Dimensioned drawings

10.4   Modules with water cooling

Three-phase module DMW 290F

Supply module VMW 180F

Mains connection module NAA 180

All dimensions in mm:

250

50

250

21.6

50

150

24.5

299

299

199

489

550

566

51

7.5

R 3.25
R 2
R 7.5
10.5

18.5

87.6

287

250
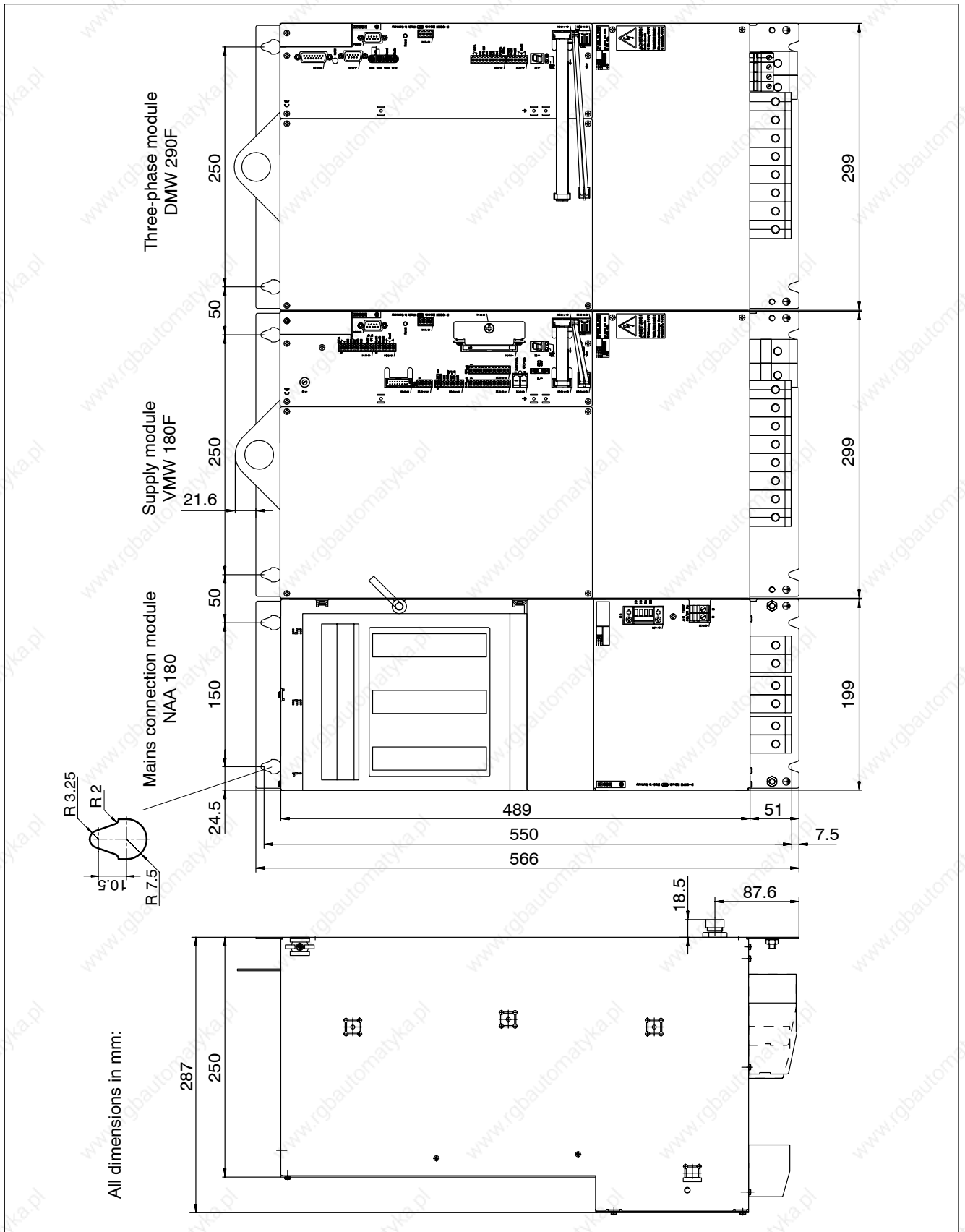
Dimensioned drawings

10.5   Line reactors NE

10.5.1   NE 21/B
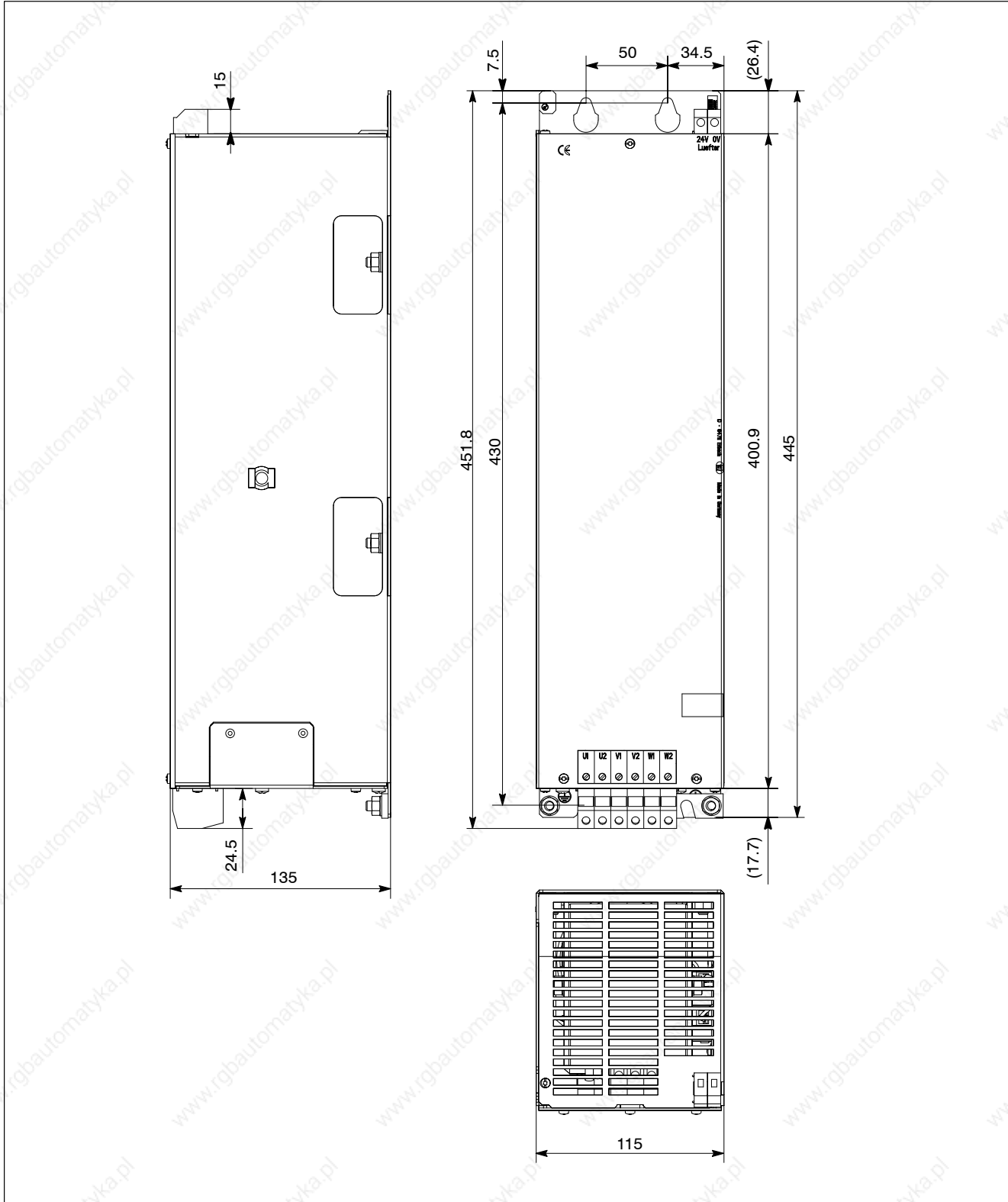
Dimensioned drawings

10.5.2   NE 21/C
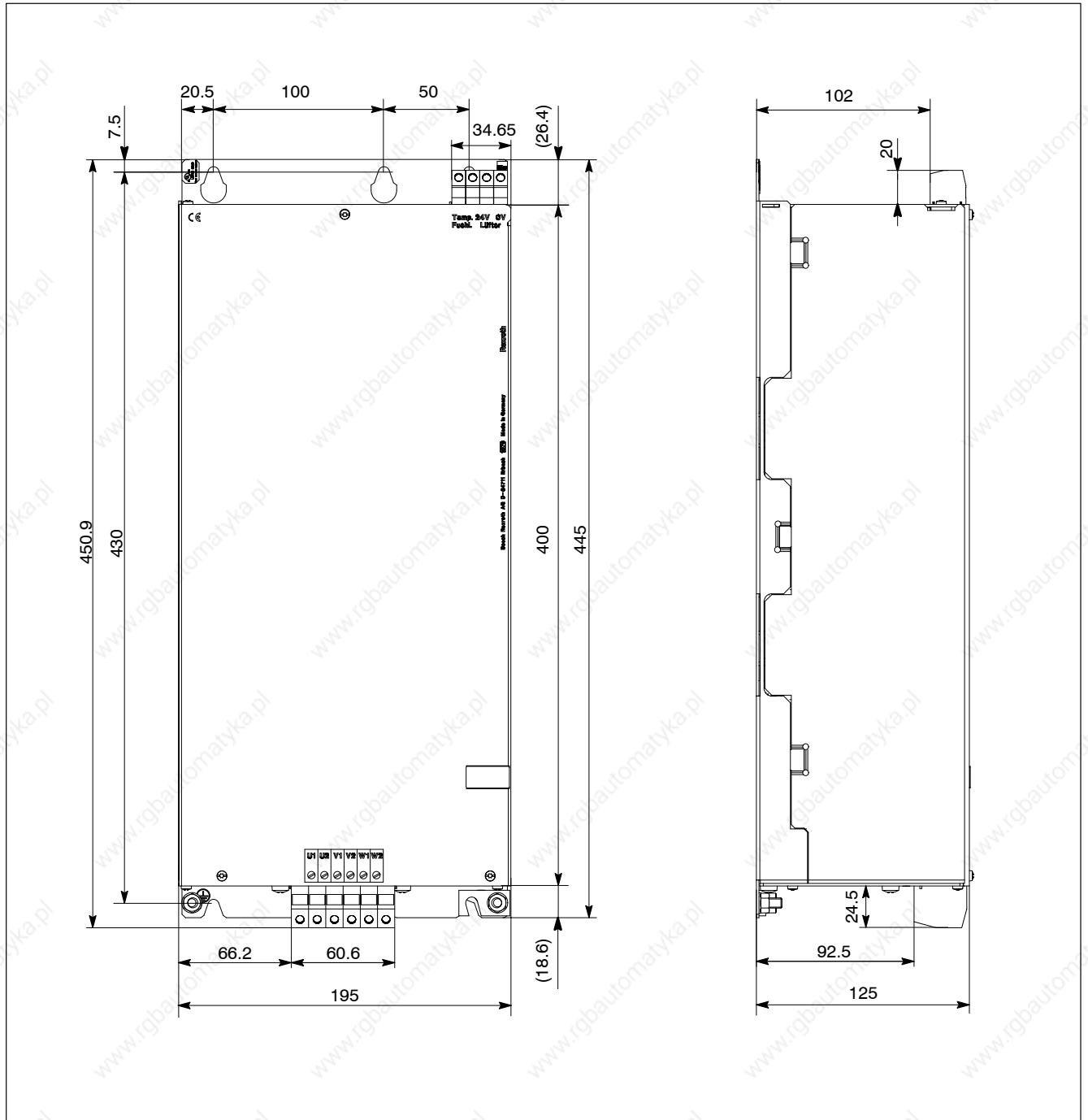
Dimensioned drawings

10.5.3 NE 35/A ... NE100/A
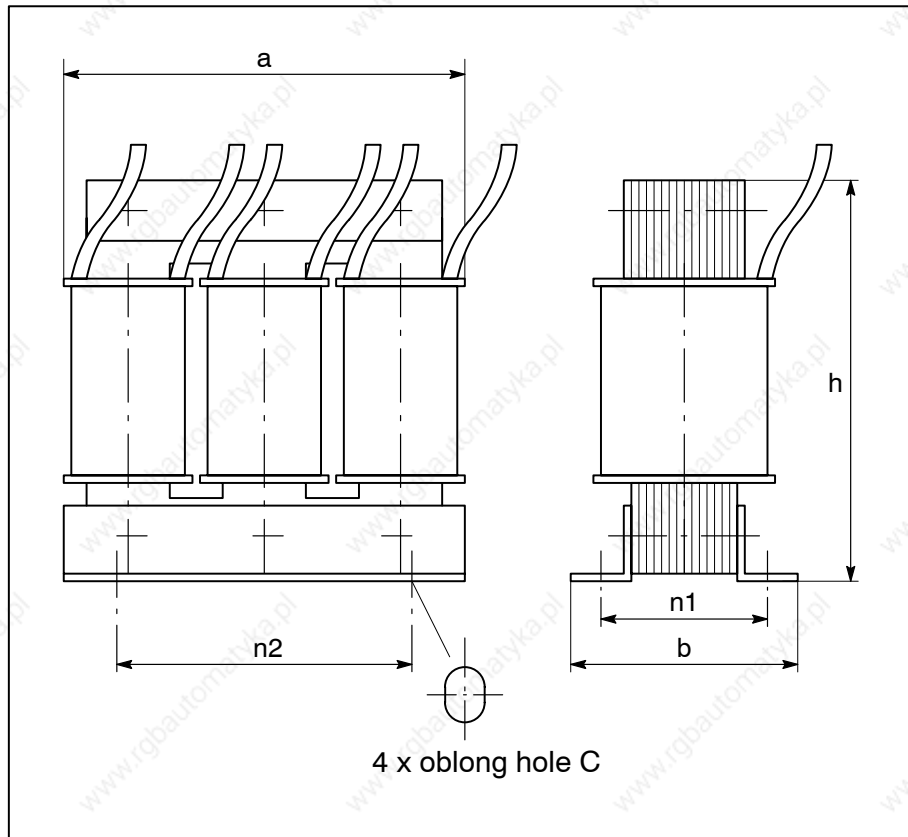
Type	a [mm]	b [mm]	h [mm]	n2 [mm]	n1 [mm]	C [mm]	Mass [kg]
NE 35/A	215	115	220	180	80	9 x 11	15
NE 70/A(A1)	242	135	250	190	115	10 x 17	23
NE 100/A	310	165	280	240	134	10 x 18	47

Dimensioned drawings

10.5.4   NE 180/A

Terminal UK16
with end support-
ing plate
U3 (V3) (W3)

Rating plate
(SMP/7701.52/SS/JJ
400uH/180A/8KHz/38kg
1070921520)

PE connection M12

Weight: approx. 39 kg
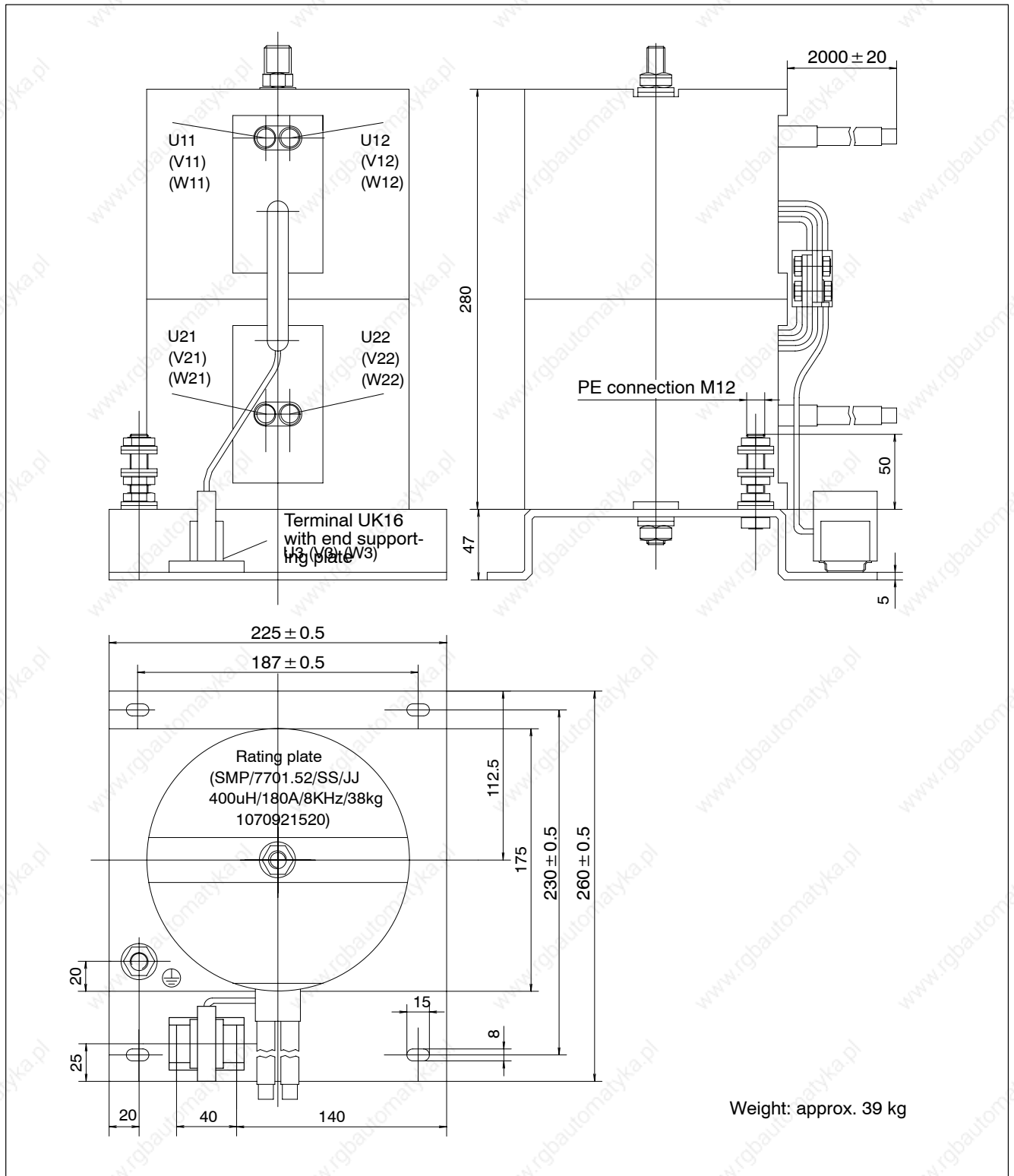
Dimensioned drawings

10.6   Filter capacitor

Torque for connections: 2.5 Nm

250

30.5

60

22

123.3

121

PE connection M6
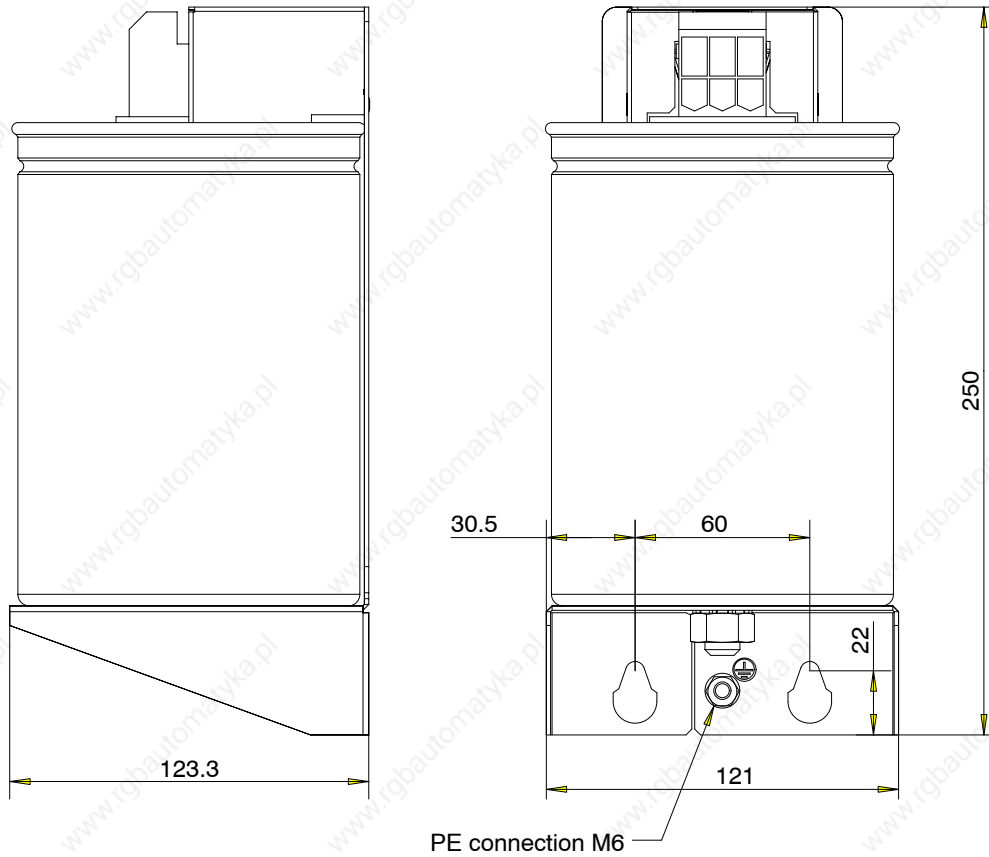
Dimensioned drawings

10.7   Mains filter
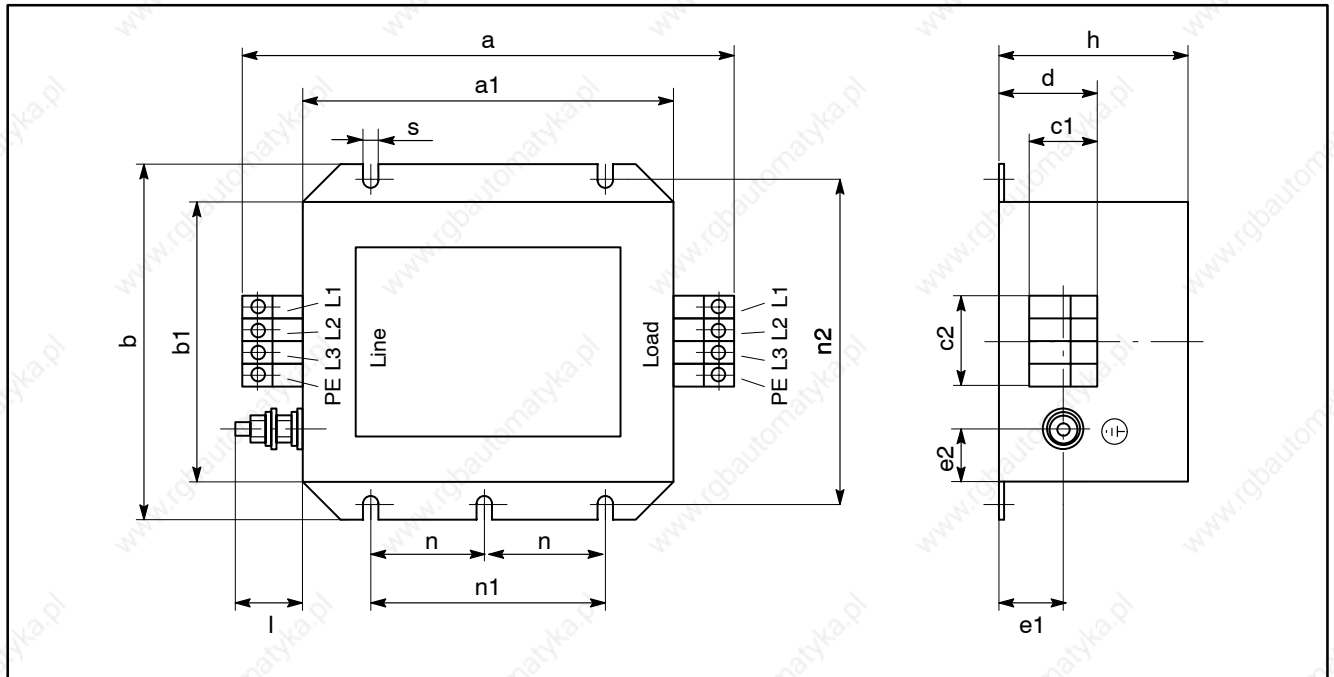
Mains filter, Limit class A, UL recognized								
Rated current [A]	16	25	36	50	80	120	150	180
Part no. 1070 ...	918 475	918 476	918 477	918 478	918 479	919 011	920 600	920 599
Dimensions								
a [mm]	163 max.	216 max.			300 max.	348 max.		404 max.
a1 [mm]	141 max.	166 max.			221 max.	261 max.		301 max.
b [mm]	113 max.	156 max.			171 max.			
b1 [mm]	86 max.	126 max.			141 max.			
h [mm]	81 max.	91 max.			141 max.			
n [mm]	–	–					–	82.5 ± 0.2
n1 [mm]	70 ± 0.2	80 ± 0.2			115 ± 0.2			–
n2 [mm]	100 ± 0.3	140 ± 0.3			155 ± 0.3			
s [mm]	5.5 ± 0.1	6.6 ± 0.2			$6,6 \pm 0.2$			
c1 [mm]	20.5 ± 0.5	31 ± 0.5			48 ± 0.5	54 ± 0.5		74 ± 0.5
c2 [mm]	41 max.				–	–		–
d [mm]	36 ± 1	46 ± 1			90 ± 1	97 ± 1		105 ± 1
e1 [mm]	25 ± 1	30 ± 1			62 ± 0.8	65 ± 0.8		62 ± 0.8
e2 [mm]	12.5 ± 1	22.5 ± 1			$18 \pm 0,5$			16 ± 0.5
Terminal connector	4 mm^2	10 mm^2			25 mm^2	50 mm^2		95 mm^2
l [mm] (ground)	22.5 ± 1, M6				32 ± 1, M10			

Dimensioned drawings

Mains filter, reinforced
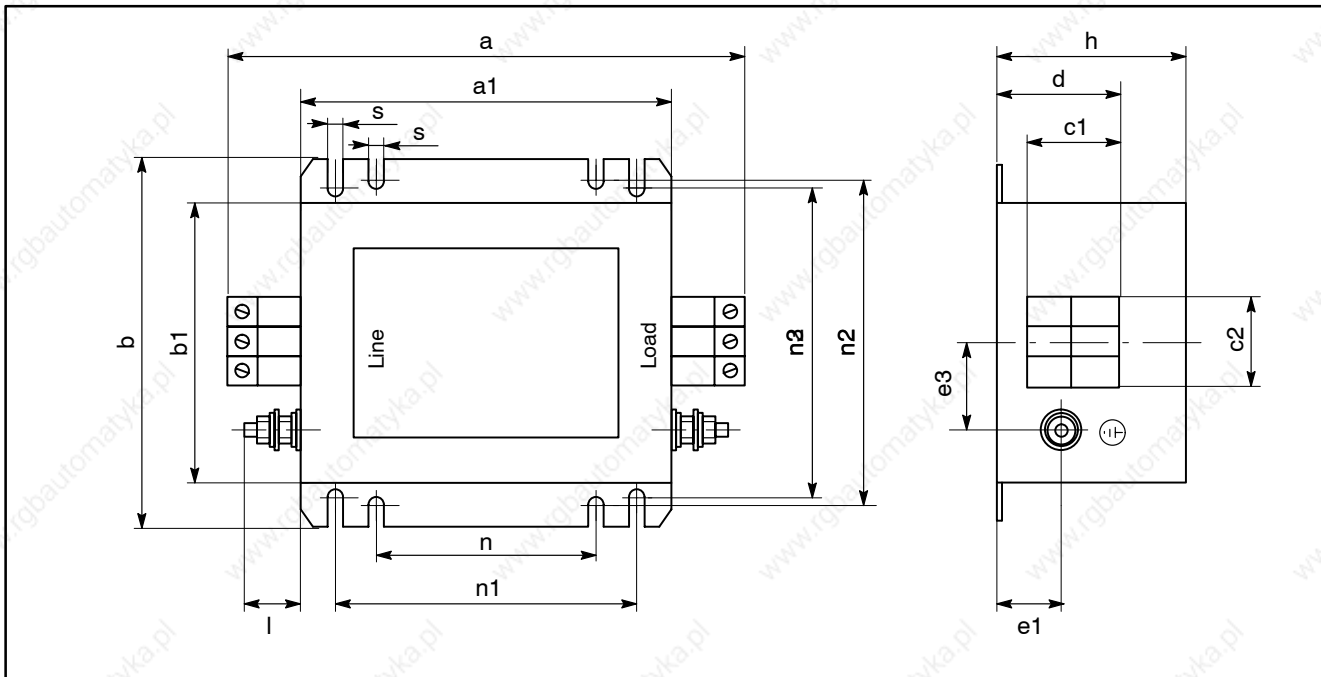
Mains filter, reinforced,	Limit class A, UL recognized
Rated current [A]	36
Part no.	1070 920 963
Dimensions	
a [mm]	215 max.
a1 [mm]	166 max.
b [mm]	115 ± 1
b1 [mm]	122 max.
h [mm]	86 max.
n [mm]	80 ± 0.2
n1 [mm]	115 ± 0.2
n2 [mm]	140 ± 0.3
n3 [mm]	135 ± 0.3
s [mm]	6.6 ± 0.2
c2 [mm]	41 max.
d [mm]	40 ± 1
e1 [mm]	18 ± 1
e3 [mm]	39 ± 0.3
Terminal connector	10 mm^2
l [mm] (ground)	M6

Dimensioned drawings

Special filters, 36 A and 65 A

Dimensioned drawings

10.8   Dimensioned drawing, plug braking modules

Part no.	1070 913 544	1070 913 545	1070 913 546	1070 913 547	1070 914 767	1070 913 862
R_x (±10%)	8R2 57 Ws	3R3 293 Ws	5R6 261 Ws	3R3 785 Ws	1R 785 Ws	1R 4085 Ws
Dimension A Dimension B	95 mm 163 mm					110 mm 126 mm

35 mm top hat rail to DIN EN 50022

42

35

100

58

tie-bar

Circuit diagram

R_x R_x R_x 2.5 mm

U   V   W   PE

10.9   Dimensioned drawing, external ballast switch

515

92

123

542

9

ø5.5

600

64

10 OHM MADE IN GERMANY

Part no. 1070 914 826
Mass: 4.6 kg

Part numbers

11   Part numbers

11.1   Accessories

Designation		Part no.
Line reactor NE	NE 21/B (module-type construction) UL-recognized	1070 085 276[UL]
	NE 35/A	1070 917 639
	NE 35/A, UL-recognized	1070 921 889[UL]
	NE 70/A	1070 917 638
	NE 70/A, UL-recognized	1070 921 888[UL]
	NE 70/A1	on request
	NE 180/A	1070 921 520
Filter capacitor	for NE 180	1070 084 982
Mains filter, class A	16 A, UL-recognized	1070 918 475[UL]
	25 A, UL-recognized	1070 918 476[UL]
	36 A, UL-recognized	1070 918 477[UL]
	50 A, UL-recognized	1070 918 478[UL]
	80 A, UL-recognized	1070 918 479[UL]
	120 A, UL-recognized	1070 919 011[UL]
	150 A, UL-recognized	1070 920 600[UL]
	180 A, UL-recognized	1070 920 599[UL]
	36 A reinforced, UL-recognized	1070 920 963[UL]
	80 A, reinforced	on request
	36 A special filter	1070 921 416
	65 A special filter	1070 921 417
	Mains filter class B	on request
External ballast switch for VM 21KE		1070 914 826
Ballast module for VM..B,C,D,F	EBX 460 – D	1070 083 214
Plug braking modules (KSB modules)		refer to 'Configuration' manual
Cables, made-to-measure	Encoder cable Power cable	refer to 'Configuration' manual
	Encoder simulation, 14-wire	1070 919 938 (2 m) 1070 919 939 (3 m) 1070 919 940 (5 m)
	Direct measuring system OM1 / OM2, 8-wire	1070 919 935 (2 m) 1070 919 936 (3 m) 1070 919 937 (5 m)

Part numbers

Designation		Part no.
Shield connection link for power cable	DM..K DM..A,B,D,F (1.5 – 6 mm^2) DM..A,B,D,F (10 – 16 mm^2)	1070 919 053 1070 083 463 1070 083 822
Cable bushing (metal flange)	Encoder cable Power cable	1070 920 201 1070 920 202
Mating connector encoder simulation		1070 083 525
MBC, brake connection	DM..K, with relay and protective circuit	1070 084 352
Protective circuit holding brake	DM..A,B,D DM..K, with point-to-point terminal	1070 917 448 1070 078 595
Optical fibres for SERCOS interface, made-to-measure		refer to 'Configuration' manual
CAN cable for rho3, D-sub 15-pin CAN cable for rho4, CANopen, D-sub 9-pin		refer to 'Configuration' manual
DC link connection: (compact mechanics)	right-side connection left-side connection	1070 081 987 1070 081 716
(backplane modules)	right-side connection left-side connection	1070 075 903 1070 075 004
(water-cooled modules)	with fuse 100 A	1070 084 466
Signal cross-connection link X810, extension 200 mm extension 2 m		1070 077 661 1070 079 798
24 V signal cross-connection link X820, extension 2 m Shield connection for extension		1070 077 660 1070 084 345
Terminal block end cover for RM..D		1070 077 018
Commissioning and service system DSS-D, CD-ROM		1070 083 817
Connection cable for PC, 5 m with 9-pole D-Sub connector		1070 077 753

Part numbers

11.2   Options

Designation		Part no.
Option modules direct measuring system:	OM 01 –D OM 02 –D OM 03 –D OM 03 –D (125 kHz, preferred option)	1070 070 937 1070 070 939 1070 078 337 1070 081 927
Option module analog outputs:	OM 04 –D	1070 078 832
Cable, made-to-measure	OM 01 and OM 02	1070 919 935
Mating connector	OM 03	1070 077 197

11.3   Accessories for built-in motors

Designation		Part no.
NTC resistor for motor winding, 600 mm long		1070 076 937
Encoder (as for SF motors)	ECN 1313 (single-turn) EQN 1325 (multi-turn) Cable module including installation box	1070 919 193 1070 919 192 1070 919 781

11.4   Spare fuses

Designation		Part no.
NTC resistor for motor winding, 600 mm long		1070 076 937
Fuse for 24 V power supply	VM (20 A/32 V)	1 x 1070 917 667
Fuses for three-phase current supply	NAA 21, UL/CSA-certified NAA 35 NAA 35, UL/CSA-certified NAA 70 NAA 70, UL/CSA-certified NAA 90 NAA 180 NV 20 NV 21, UL/CSA-certified	3 x 1070 921 621 3 x 1070 917 648 3 x 1070 920 862 3 x 1070 917 649 3 x 1070 921 418 3 x 1070 918 481 3 x 1070 919 804 3 x 1070 918 727 3 x 1070 920 862

Part numbers

Notes:

Appendix

A   Appendix

A.1   Index

Rexroth
Bosch Group