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Servodyn-D

Configuration manual



Edition 105

Rexroth
Bosch Group

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Servodyn-D

Configuration manual

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1 Safety Instructions

Please read this manual on the configuration of the Servodyn-D drives series. 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.

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1.2 Qualified personnel

The requirements as to qualified personnel depend on the qualification profiles described by ZVEI (Zentralverband Elektrotechnik und Elektronikindustrie – German Electrical and Electronic Manufacturers' Association) and the VDMA (Verband deutscher Maschinen- und Anlagenbau – German Engineering Federation) in:
Weiterbildung in der Automatisierungstechnik
edited by: ZVEI and VDMA
MaschinenbauVerlag
Postfach 71 08 64
60498 Frankfurt/Germany

The present manual is designed for **drive technicians**. They need special knowledge on the machine concept and the resulting drive characteristics.

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 training program. For up-to-date information, web shop for teachware and online seminar booking, please refer to http://www.bosch.de/at/didactic or call our training center at (+49) 60 62 78-258.

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.

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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

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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.

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1.5 Safety instructions concerning the product described



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 system 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 equipment, or environmental hazards. Possible retrofits or modifications to the system using third-party equipment therefore have to be approved by Bosch.



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 requirements as well as the proper use of tools, hoisting and transport equipment as well as the applicable standards, regulations, and accident prevention regulations.

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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 Bosch!



CAUTION
Observe all precautions for ESD protection when handling modules and components! Avoid electrostatic discharge!

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.

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1.6 Documentation, software release and trademarks

Documentation

The present manual provides information on the drive configuration procedure for Servodyn-D.

Overview of available documentation	Part no. German	English	French	Italian
Servo motors SF, SR	1070 066 004	1070 066 024	1070 066 048	1070 066 046
Asynchronous motors DU	1070 066 007	1070 066 027	–	–
Servodyn-D, Configuration Manual for overview and rating	1070 066 009	1070 066 029	1070 066 059	1070 066 049
Servodyn-D, Interface conditions	1070 066 010	1070 066 030	1070 066 060	1070 066 050
Servodyn-D, Interface conditions, Stand alone version	1070 066 016	1070 066 036	1070 066 066	1070 066 056
Servodyn-D, Parameter manual (without CANopen)	1070 066 018	1070 066 038	1070 066 068	1070 066 058
Servodyn-D, Servodyn-M Parameter manual CANopen	1070 066 094	1070 066 095	–	–
Servodyn-D with SERCOS interface Parameter and commissioning manual	1070 066 011	1070 066 031	–	1070 066 051
Servodyn-D with analog interface Commissioning manual	1070 066 014	1070 066 034	–	–
Servodyn-D with CANrho interface Commissioning manual	1070 066 017	1070 066 037	–	–
Servodyn-D with motion control Commissioning manual	1070 066 015	1070 066 035	–	–
Servodyn-D with PROFIBUS-DP Commissioning manual	1070 066 090	1070 066 091	–	–
Servodyn-D DM/DS..8001 (ASM) Parameter and commissioning manual	1070 066 008	1070 066 028	–	–
Diagnostics, maintenance	1070 066 012	1070 066 032	1070 066 062	1070 066 052
RSU, Redundant safety monitoring	1070 066 006	1070 066 026	1070 066 081	1070 066 082
EMC manual	1070 066 072	1070 066 074	1070 066 075	1070 066 076
External load switching module EBX	1070 066 077	1070 066 080	–	–

Release

- The current software release number of the inverter 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...

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- The current VMA..KR and 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

Modifications

Modifications in the present manual as compared to the previous edition are marked by black vertical bars in the margin.

Trademarks

All trademarks of software installed on Bosch 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 Bosch 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.

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2 The fully digital inverter system Servodyn-D

2.1 Features of the inverter system

The Servodyn-D inverter system has a modular structure and comprises supply and axis modules as well as different functions and various interfaces.
For small powers, stand-alone inverters with an integrated supply unit are alternatively available which offer the same functions and interfaces.

The inverters have a digital closed-loop control for the position, speed and current. Different motors can be operated with the same hardware:

- **Synchronous motors type SF** for sinusoidal current with an integrated absolute encoder for speed and position control
- **Synchronous motors type SR** for sinusoidal current with integrated resolver for speed and position control
- **Synchronous linear motors** with absolute length measuring system LC 181
- **Asynchronous motors type DU** with integrated absolute encoder
- **Asynchronous motors** with absolute encoder or gear encoder
- **Built-in motors** with absolute encoder or gear encoder
- **Asynchronous standard motors** without an encoder for U/f characteristic control.

When used in conjunction with synchronous motors, the system meets the highest demands on dynamics, speed setting range, synchronizing and positioning accuracy.

Advantages

- Modular design
- Compact design for 300 mm control cabinet depth
- Mechanics optimized for power output
- Inverters with backplane modules for cold module engineering
- Direct power supply connection
- Supply modules for supply-friendly infeed and regeneration (cos ϕ = 1 and power factor $\sim$1)
- Three-phase modules of same construction with IGBT output stages for brushless synchronous and asynchronous motors
- Automatic commissioning via 'electronic rating plates' of drive modules and motors
- Position control in three-phase modules
- Integrated, redundant 2-channel safety structure with certificate (RSU)

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2.2 Construction of the inverter system

Stand-alone inverter:

- Inverter with supply unit — DS..K
  With suitable:
  - Line wiring modules — NV
  - Synchronous motors — SF and SR
  - Optional direct measuring system/analog outputs — OM
  - Personality module for SERCOS interface — PM
  - Memory card for SERCOS interface — MC
  - Mains filters in suitable sizes

Modular inverter:

- Power supply modules
  - with internal or external ballast switch — VMA..K
  - with energy recoveryfor compact mechanics — VMA..KR
  - with energy recovery for backplane module — VMA..B,C,D
  - with energy recovery and water cooling — VMW..F

  With suitable:
  - Line wiring module for VMA..K — NV
  - Mains connection module for VMs with energy recovery — NAA
  - Line reactor for VMs with energy recovery — NE
  - Mains filters in suitable sizes

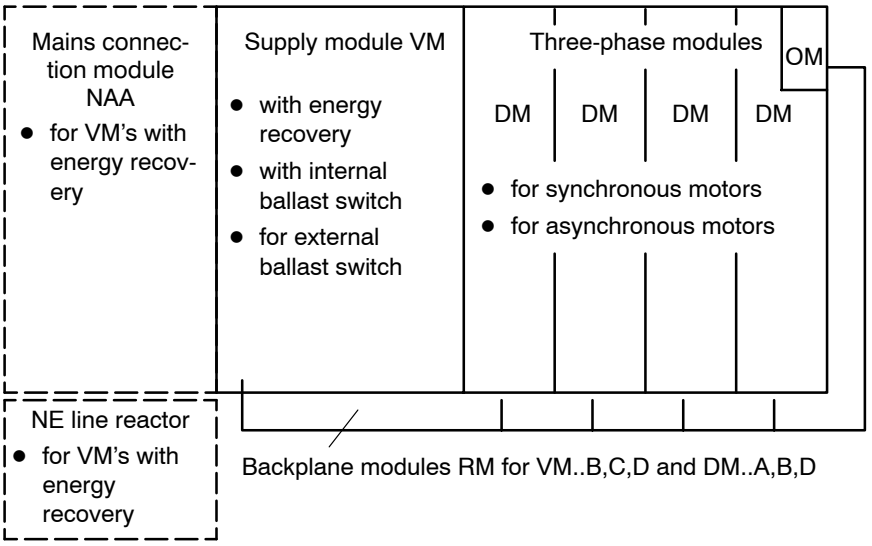
- Three-phase modules
  - compact mechanics — DM..K
  - for backplane module — DMA..A,B,D
  - with water cooling — DMW..F

  With suitable:
  - Synchronous motors — SF and SR
  - Asynchronous motors — DU
  - Optional direct measuring system/analog outputs — OM
  - Personality module for SERCOS interface — PM
  - Memory card for SERCOS interface — MC

- Backplane modules
  - for VM..B,C,D and DM..A,B,D — RM

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The modular inverters are linked via the DC link as well as control cables.



2.2.1 Mechanical structure

The IGBT output stages used for all modules are available with three different mechanics, depending on the current output, which may be combined as necessary.

Compact mechanics without backplane module

Output stages for a maximum current up to 35 A:

- width mostly in 50 mm modular dimension
- height 430 mm
- DC link connection through busbars
- supply module with internal/external ballast switch and integrated start-up circuit

Mechanics with backplane module

Output stages for a maximum current up to 140 A:

- width mostly in 50 mm modular dimension
- height 521 mm
- inverter module can be plugged into the backplane module
- integrated DC link connection
- supply module with mains-friendly infeed and energy recovery

Mechanics with water cooling

Output stages for a maximum current up to 290 A:

- width 300 mm
- height 521 mm
- DC link connection through busbars or cables
- supply module with mains-friendly infeed and energy recovery

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2.2.2 Functional design

Various functionalities can be selected regardless of the mechanical option. This feature ensures that your system performance is optimally matched to the interface.

SERCOS interface

Powerful processor board with 32-bit signal processor for fully digital position, speed and current control.
The SERCOS interface features, i.a., real-time processing, fault-resistant optical fibres and free combination of drives and controls of any manufacturer.

- **Cycle times**
  Position controller: 500 µs (servo)
  1 ms (spindle)
  Speed controller: 250 µs
  Current controller: 125 µs

- **Personality module**
  For inverter modules with SERCOS interface, the entire software is contained within the plug-in personality module. This includes: the operating system, inverter-specific and system-specific data, the module address for SERCOS interface and the setting for the transmitting power of the optical fibre. For inverters with RSU (redundant safety monitoring), safety-relevant data is also included.
  Recommissioning after unit exchange is therefore possible without further auxiliary equipment.

- **Memory card**
  The memory card is a credit card-size storage medium.
  It contains a flash EPROM and its applications include archiving, transmission of system-specific parameters or performing firmware updates.
  The memory card can be installed as a standard in all inverter modules with SERCOS interface.
  Every firmware status is kept on a memory card and can be re-ordered at any time.

The interface can be programmed by the NC or through the standard serial interface using the DSS-D commissioning and service system.

Analog interface

Processor board with fully digital position, speed and current control by VeCon chip. The analog setpoint values have a resolution of 12 bits, for high demands alternatively even 16 bits.

- **Cycle times**
  Speed controller: 62.5 µs
  Current controller: 62.5 µs

Inverter modules with an analog interface contain an integrated complete software package. They are programmed through the standard serial interface using the DSS-D commissioning and service system.

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Motion control

- **Positioning**
  Processor board with 24V control inputs and fully digital closed-loop position, speed and current control by VeCon chip:
  Up to 32 positioning blocks with target position as well as speed, acceleration and deceleration can be specified.

CAN bus

PC board with fully digital closed-loop position, speed, and current control by VeCon chip and CAN bus:

- with **CANrho protocol** in connection with the rho3 and rho4 robot controls made by Bosch;
- with **CANopen protocol** according to drive profile.

PROFIBUS-DP

PC board with fully digital closed-loop position, speed, and current control by VeCon chip and with PROFIBUS-DP according to IEC 1158-2.
The following modes may be selected:

- Block-controlled operation (positioning mode with max. 32 traversing blocks)
- Interpolation in drive (positioning mode via PROFIBUS-DP)
- Velocity control
- Velocity control with actual value feedback.

RSU, redundant safety monitoring

Servodyn-D drives equipped with Personality Modules with RSU capability offer a certified, redundant, 2-channel safety monitoring feature.
Condition:

- axis modules with SERCOS interface
- in connection with a supply module capable of energy recovery, and
- a mains connection module

Using these Servodyn-D inverters, safety relevant parts of category 3 to EN 954-1 can be implemented. They feature:

- a safe reduced speed in special mode
- a safe standstill in special mode
- monitoring of the maximum speed.

☞ **Please also refer to the RSU manual (cf. page 1–7) for project engineering involving RSU drives.**

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2.3 Function of the inverter system

Supply modules

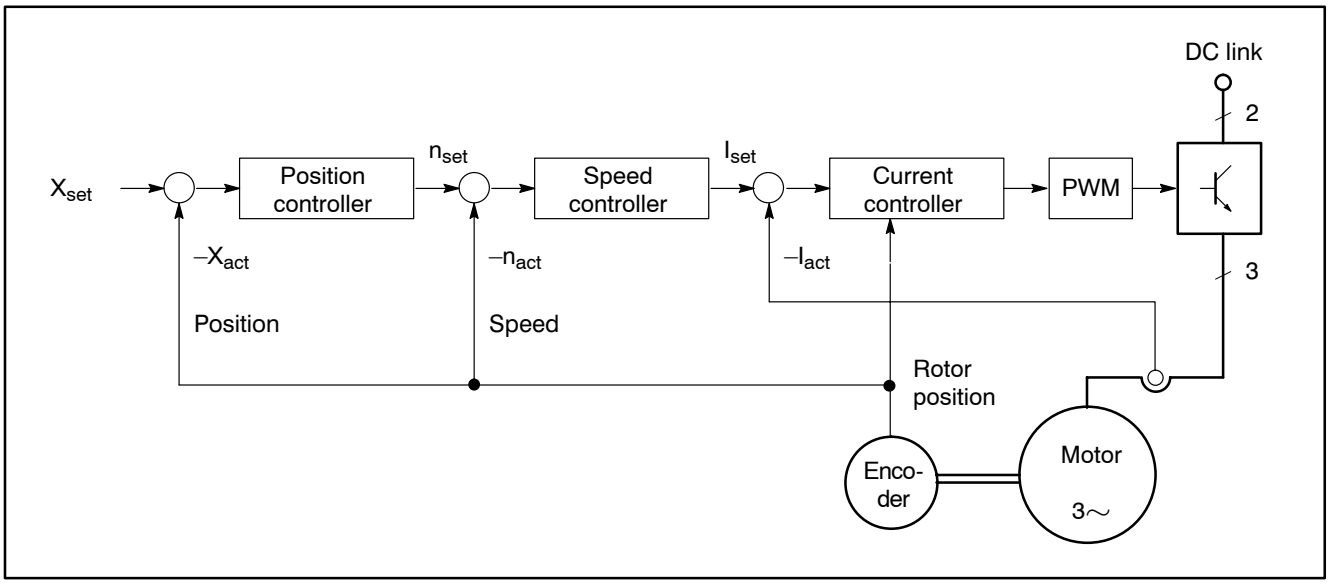
The supply modules rectify the 3 x 400...460 V AC line voltage and generate a stabilized DC link voltage.
In 4-quadrant operation, the energy generated by the braking of the motor is fed back into the supply system (cos ϕ = 1) in a supply-friendly manner or converted into heat by a ballast switch.

The 24 V supply is connected to the supply module where it is distributed to the three-phase modules.

Three-phase modules

The Bosch servo motors type SF and SR, asynchronous motors type DU, synchronous linear motors or built-in motors with defined encoders are operated with the three-phase modules. The three-phase modules have the same hardware, however, their software is different.
The electronic rating plates of the IGBT inverter output stage and the connected motor contain all necessary drive data and automatically set the parameters for drive control of the motor-module combination used.

The position, speed and current controllers are fully digital and designed in a cascade structure.



System-specific parameters are changed and archived from a PC with an RS232 interface using the DSS-D commissioning and service system.

Stand-alone inverters

Stand-alone inverters incorporate the functions of the supply module **and** the three-phase module described above. They are designed in compact mechanics with an integrated ballast switch.

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Setpoint interface

SERCOS interface

SERCOS = **SE**rial **R**ealtime **CO**mmunication **S**ystem
according to EN 41 009

SERCOS interface is a serial realtime communication system between the control unit and the drives and was developed as a standardization proposal in a joint VDW/ZVEI working committee (DIN IEC/TC 44).

SERCOS interface is defined as a ring structure of optical fibres. Each ring links an NC control unit with several drives.
The maximum number of drives is dependent on the required communication cycle time, the preselected operating data range and the data rate. With a cycle time of 1 ms, 8 drives can thus be connected to a single optical fiber ring. The number of drives per control unit can be increased by using several optical fiber rings.

SERCOS interface offers the following advantages:

- Installation and commissioning ease
- Standardized connection system, procedures, formats and weighting facilitate interaction between control units and drives from various manufacturers.
- Fast response times; setpoints and actual values can be processed in the same cycle.
- High interference immunity through optical waveguides
- Minimum number of optical waveguides through ring structure
- Various drive operating modes possible

Three-phase modules with SERCOS interface support the speed, position and interpolation interfaces.

Analog interface

± 10 V speed interface with an optional resolution of 12 or 16 bits.
Standard encoder simulation for transmission of the actual position values.

CAN bus

- CANrho protocol with position change inputs from the rho3 or rho4 robot controls made by Bosch.
- CANopen protocol with position, speed, or torque setpoints, depending on the operating mode.

PROFIBUS-DP

- Interpolation in drive:
  In this positioning mode, the position, velocity, acceleration and deceleration are input via PROFIBUS-DP.
- Velocity control without/with actual value feedback:
  In this mode, velocity/speed setpoints are input.

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2.4 Marks, certifications

2.4.1 CE-marking

Low-Voltage Directive

The CE marking confirms compliance of drive modules of the Servodyn-D series with the Low-Voltage Directive. The rating and construction satisfy the requirements of EN 50178.

Machinery directive

The CE marking confirms compliance of drive modules of the Servodyn-D series with the Machinery Directive. The rating and construction satisfy the requirements of EN 60204-1.

EMC directive

Concerning the EMC Directive, the exception stipulated in the German EMC Act, EMVG Art. 6, Subs. (9), is applicable, cf. below.
The following must be noted with respect to the operational system (cf. EMC manual):

- Requirements on EMC noise emission
  - Conducted noise
    Depending on the application (industrial environment or domestic application), a suitable mains filter is to be provided in the power supply line.
    The cubicle construction should be designed so as to ensure the efficiency of the mains filter to the greatest possible extent.
  - Radiated noise
    Depending on the application (industrial environment or domestic application), a suitable switch cabinet with EMC shielding has to be provided.
    For the motor leads, shielded cables should be preferably used which are grounded on both ends of the shield.

- Required interference immunity
  The rating and construction satisfy the requirements of the EMC product standard EN 61800-3 for application in industrial environments.

EMVG 18.09.1998

Art. 6 Exceptions and special determinations

(9) Apparatuses, systems, and components covered by Subs. 3, which are exclusively manufactured and designed as accessories or spare parts for further processing by companies or persons with expert knowledge in the field of electromagnetic compatibility, are exempted from compliance with the protection requirements and the requirements of Art. 4 Subs. 1 Nos. 1 to 3 and 5. The operational unit which contains apparatuses, systems or components defined in the 1st sentence above, shall satisfy the provisions of this law.

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2.4.2 EU design type certification

The certification covers Servodyn-D with redundant safety monitoring RSU. RSU complies with the requirements concerning:

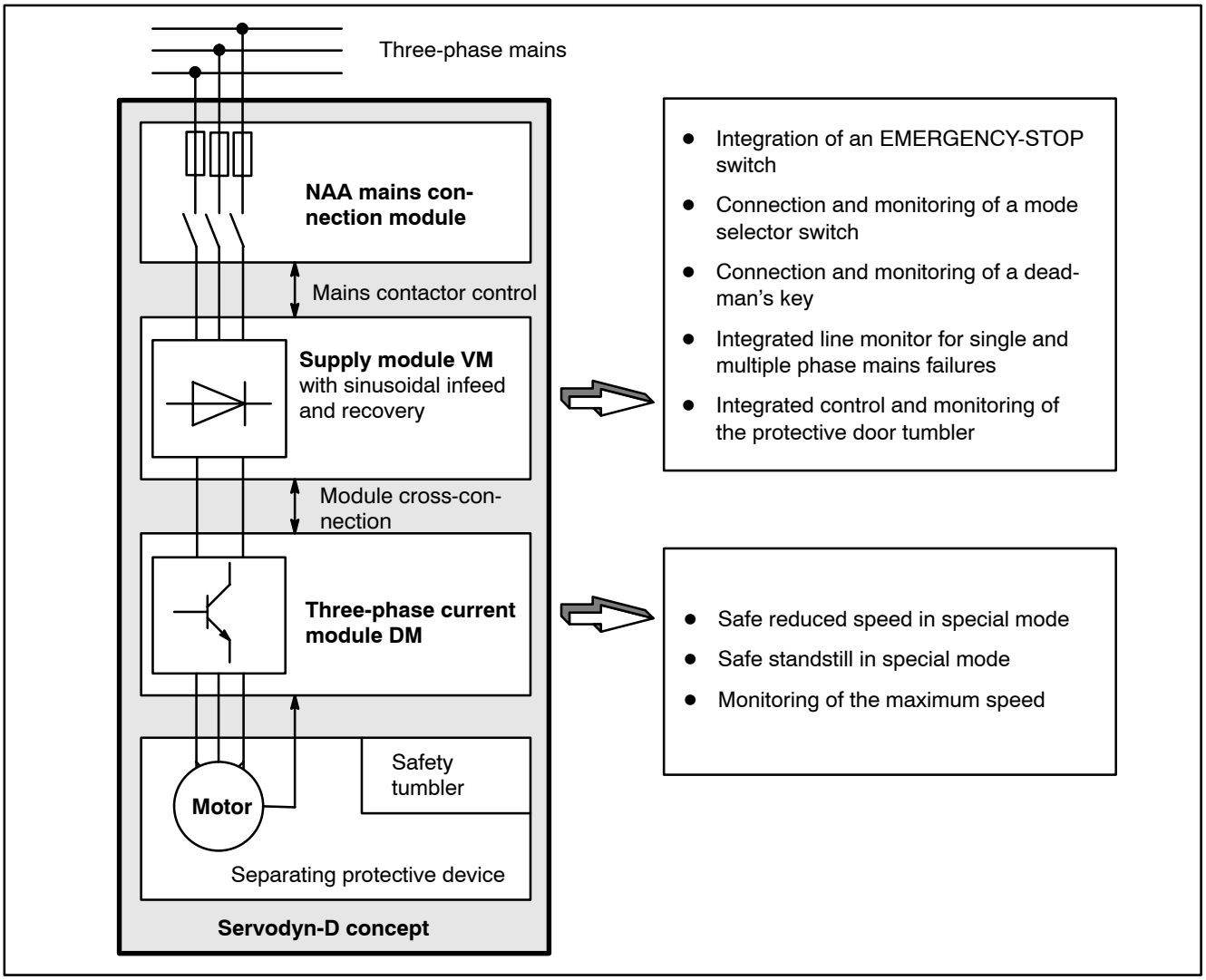
- **Safety-relevant parts of controllers** in accordance with EN 954-1 Category 3, as required by
  - EN 12415 (safety of turning machines)
  - EN 12417 (safety of machining centres)
- **Control functions in the event of a fault** according to EN 60204-1

In the special mode, the integrated 2-channel safety structure monitors all axis and spindle movements. It is available for:

- Three-phase modules with SERCOS interface (firmware release as of V0.040)
- in connection with supply modules with energy recovery capability (firmware release as of V0.040) and
- mains connection module NAA

This concept has been certified, i.e. additional monitoring equipment is not necessary.

☞ **For more information, refer to Servodyn-D with Redundant Safety Monitoring manual, part no. in Section 1.6.**



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2.4.3 UL/CSA certification

For a number of Servodyn-D modules in compact mechanics, a UL/CSA certification is available for the U.S. and Canada (refer to sections 3.2 and 8). These modules are listed in the **"Product Identity 23 MB", File No. E214694**.

☞ **For available components with UL/CSA approval, refer to section 8.**

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.
- Note tightening torques of the connection terminals as specified in Interface Conditions manual, for part no. refer to page 1–7.
- The insulated copper wires must be specified for 60/75°C as a minimum.
- Only insulated Class 1 wires or equivalent may be used,
  e.g. to UL Style 1015 (on motor side, H07: U_0/U: 600/1000 V) and UL Style 1007 or 1569 (on supply side, H05: U_0/U: 300/500 V)
- Suitable for installation in symmetrical supply networks with a short-circuit current of ≦ 10 kA with max. 460 V +10 %.

Operation in compliance with UL/CSA

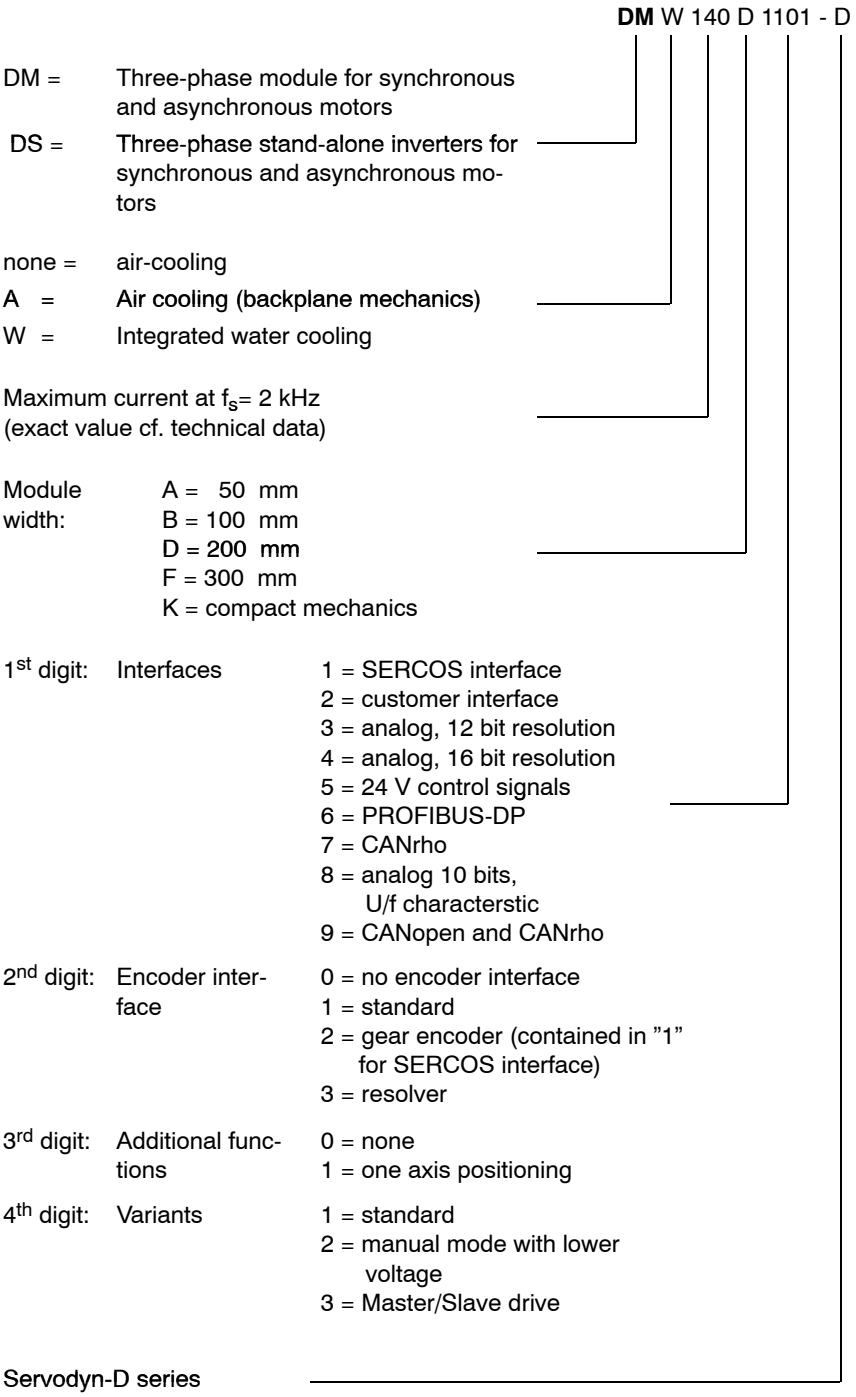
For UL/CSA-compliant operation, the bimetal function (I^2t monitoring) must be activated in the inverters using parameter P-0-0053 in order to provide motor protection.

- 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 (disabled)
  Customary setting range: 100...150
  (corresponds to release characteristics of bimetal relay)

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3 Drive functions

3.1 Type designations



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3.2 Overview of module varieties

Designations / Part numbers of three-phase modules

Setpoint interface	**SERCOS interface** (position and speed interface)		**Analog interface** (speed and torque interface)			
			12 bit resolution	16 bit resolution		
Encoder interface	Resolver	STG or MTG or gear encoder	Resolver	STG or MTG	Gear encoder, STG or MTG	
Additional function	–	–	–	–	–	
Compact mechanics						
DM 4K	DM 4K 1301 1070 081 563	DM 4K 1101 1070 080 952	DM 4K 3301 1070 077 616	DM 4K 4101 1070 077 604	–	
DM 8K	DM 8K 1301 1070 081 564 1070 084 649[UL]	DM 8K 1101 1070 080 953 1070 084 647[UL]	DM 8K 3301 1070 077 617 1070 084 635[UL]	DM 8K 4101 1070 077 605 1070 084 633[UL]	–	
DM 15K	DM 15K 1301 1070 081 565 1070 084 663[UL]	DM 15K 1101 1070 080 954 1070 084 662[UL]	DM 15K 3301 1070 077 618 1070 084 656[UL]	DM 15K 4101 1070 077 606 1070 084 655[UL]	–	
DM 30K	DM 30K 1301 1070 081 566 1070 084 675[UL]	DM 30K 1101 1070 080 955 1070 084 674[UL]	DM 30K 3301 1070 077 619 1070 084 668[UL]	DM 30K 4101 1070 077 607 1070 084 667[UL]	–	
DM 45K	DM 45K 1301 1070 079 439 1070 084 909[UL]	DM 45K 1101 1070 083 111 1070 084 907[UL]	DM 45K 3301 1070 079 441 1070 084 917[UL]	DM 45K 4101 1070 079 440 1070 084 919[UL]	–	
Mechanics for backplane module						
DMA 4A	DMA 4A 1301 1070 081 567	DMA 4A 1101 1070 080 956	–	DMA 4A 4101 1070 078 596	–	
DMA 8A	DMA 8A 1301 1070 081 568	DMA 8A 1101 1070 080 957	–	DMA 8A 4101 1070 078 597	–	
DMA 15A	DMA 15A 1301 1070 081 569	DMA 15A 1101 1070 080 958	–	DMA 15A 4101 1070 078 598	–	
DMA 30A	DMA 30A 1301 1070 081 570	DMA 30A 1101 1070 080 959	DMA 30A 3301 1070 077 620	DMA 30A 4101 1070 077 608	DMA 30A 4201 1070 077 612	
DMA 45A	DMA 45A 1301 1070 081 571	DMA 45A 1101 1070 080 960	DMA 45A 3301 1070 077 621	DMA 45A 4101 1070 077 609	DMA 45A 4201 1070 077 613	
DMA 85B	DMA 85B 1301 1070 081 572	DMA 85B 1101 1070 080 961	DMA 85B 3301 1070 077 622	DMA 85B 4101 1070 077 610	DMA 85B 4201 1070 077 614	
DMA 140D	DMA 140D 1301 1070 081 573	DMA 140D 1101 1070 080 962	DMA 140D 3301 1070 077 623	DMA 140D 4101 1070 077 611	DMA 140D 4201 1070 077 615	
Integrated water cooling						
DMW 290F	DMW 290F 1301 1070 084 161	DMW 290F 1101 1070 084 160	DMW 290F 3301 1070 084 162	DMW 290F 4101 1070 084 163	–	
Stand-alone inverters						
DS 15K	DS 15K 1301 1070 081 562	DS 15K 1101 1070 080 947	DS 15K 3301 1070 079 659	DS 15K 4101 1070 079 658	–	
DS 15K with manual mode	DS 15K 1302 1070 084 184	DS 15K 1102 1070 084 183	DS 15K 3302 1070 084 185	DS 15K 4102 1070 084 186	–	
DS 45K with manual mode	DS 45K 1302 1070 079 431	DS 45K 1102 1070 079 430	DS 45K 3302 1070 079 433	DS 45K 4102 1070 079 432	–	

[UL] = with UL/CSA certification

STG = Single-turn encoder

MTG = Multi-turn encoder

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(For more varieties, please refer to next page)

	Motion Control (24V control signals)		**PROFIBUS-DP**	
	Resolver	STG or MTG	Resolver	STG or MTG
	Positioning control		Positioning control	
	DM 4K 5311 1070 078 616	DM 4K 5111 1070 078 608	DM 4K 6311 1070 084 443	DM 4K 6111 1070 084 430
	DM 8K 5311 1070 078 617 1070 084 639^{UL}	DM 8K 5111 1070 078 609 1070 084 637^{UL}	DM 8K 6311 1070 084 444 1070 084 931^{UL}	DM 8K 6111 1070 084 431 1070 084 925^{UL}
	DM 15K 5311 1070 078 618 1070 084 658^{UL}	DM 15K 5111 1070 078 610 1070 084 657^{UL}	DM 15K 6311 1070 084 445 1070 084 932^{UL}	DM 15K 6111 1070 084 432 1070 084 926^{UL}
	DM 30K 5311 1070 078 619 1070 084 670^{UL}	DM 30K 5111 1070 078 611 1070 084 669^{UL}	DM 30K 6311 1070 084 446 1070 084 933^{UL}	DM 30K 6111 1070 084 433 1070 084 927^{UL}
	DM 45K 5311 1070 079 443 1070 084 923^{UL}	DM 45K 5111 1070 079 442 1070 084 921^{UL}	DM 45K 6311 1070 084 447 1070 084 934^{UL}	DM 45K 6111 1070 084 434 1070 084 928^{UL}
	–	–	–	–
	–	–	–	–
	–	–	–	–
	DMA 30A 5311 1070 078 652	DMA 30A 5111 1070 078 612	–	–
	DMA 45A 5311 1070 078 653	DMA 45A 5111 1070 078 613	DMA 45A 6311 1070 084 449	DMA 45A 6111 1070 084 436
	DMA 85B 5311 1070 078 654	DMA 85B 5111 1070 078 614	DMA 85B 6311 1070 084 450	DMA 85B 6111 1070 084 437
	DMA 140D 5311 1070 078 655	DMA 140D 5111 1070 078 615	DMA 140D 6311 1070 084 451	DMA 140D 6111 1070 084 438
	DMW 290F 5311 1070 084 165	DMW 290F 5111 1070 084 164	DMW 290F 6311 1070 084 452	DMW 290F 6111 1070 084 439
	DS 15K 5311 1070 079 661	DS 15K 5111 1070 079 660	DS 15K 6311 1070 084 453	DS 15K 6111 1070 084 440
	DS 15K 5312 1070 084 188	DS 15K 5112 1070 084 187	DS 15K 6312 1070 084 935	DS 15K 6112 1070 084 929
	DS 45K 5312 1070 079 435	DS 45K 5112 1070 079 434	DS 45K 6312 1070 084 455	DS 45K 6112 1070 084 442

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Designations / Part numbers of three-phase modules

Setpoint interface	**CAN bus** (CANopen and CANrho protocol)				**Frequency inverter** (U/f characteristic) Analog 10 bits
Encoder interface	Resolver		STG or MTG		–
Additional function	–	Positioning control	–	Positioning control	–
Compact mechanics					
DM 4K	DM 4K 9301 1070 083 678	DM 4K 9311 1070 083 698	DM 4K 9101 1070 083 673	DM 4K 9111 1070 083 693	DM 4K 8001 1070 080 448
DM 8K	DM 8K 9301 1070 083 679 1070 084 653[UL]	DM 8K 9311 1070 083 699 1070 084 911[UL]	DM 8K 9101 1070 083 674 1070 084 651[UL]	DM 8K 9111 1070 083 694 1070 084 953[UL]	DM 8K 8001 1070 080 449 1070 084 645[UL]
DM 15K	DM 15K 9301 1070 083 680 1070 084 665[UL]	DM 15K 9311 1070 083 700 1070 084 912[UL]	DM 15K 9101 1070 083 675 1070 084 664[UL]	DM 15K 9111 1070 083 695 1070 084 954[UL]	DM 15K 8001 1070 080 450 1070 084 661[UL]
DM 30K	DM 30K 9301 1070 083 681 1070 084 948[UL]	DM 30K 9311 1070 083 701 1070 084 913[UL]	DM 30K 9101 1070 083 676 1070 084 945[UL]	DM 30K 9111 1070 083 696 1070 084 955[UL]	DM 30K 8001 1070 080 451 1070 084 673[UL]
DM 45K	DM 45K 9301 1070 083 682 1070 084 949[UL]	DM 45K 9311 1070 083 702 1070 084 914[UL]	DM 45K 9101 1070 083 677 1070 084 946[UL]	DM 45K 9111 1070 083 697 1070 084 956[UL]	DM 45K 8001 1070 079 446 1070 084 943[UL]
Mechanics for backplane module					
DMA 4A	–	–	–	–	–
DMA 8A	–	–	–	–	–
DMA 15A	–	–	–	–	–
DMA 30A	–	–	–	–	DMA 30A 8001 1070 080 452
DMA 45A	DMA 45A 9301 1070 083 686	DMA 45A 9311 1070 083 706	DMA 45A 9101 1070 083 683	DMA 45A 9111 1070 083 703	DMA 45A 8001 1070 080 453
DMA 85B	DMA 85B 9301 1070 083 687	DMA 85B 9311 1070 083 707	DMA 85B 9101 1070 083 684	DMA 85B 9111 1070 083 704	DMA 85B 8001 1070 080 454
DMA 140D	DMA 140D 9301 1070 083 688	DMA 140D 9311 1070 083 708	DMA 140D 9101 1070 083 685	DMA 140D 9111 1070 083 705	DMA 140D 8001 1070 080 455
Integrated water cooling					
DMW 290F	DMW 290F 9301 1070 084 168	DMW 290F 9311 on request	DMW 290F 9101 1070 084 167	DMW 290F 9111 on request	DMW 290F 8001 1070 084 166
Stand-alone inverters					
DS 15K	DS 15K 9301 1070 083 690	DS 15K 9311 1070 083 710	DS 15K 9101 1070 083 689	DS 15K 9111 1070 083 709	DS 15K 8001 1070 080 456
DS 15K mit Einrichtbetrieb	DS 15K 9302 1070 084 191	DS 15K 9312 1070 084 915	DS 15K 9102 1070 084 190	DS 15K 9112 1070 084 957	DS 15K 8002 1070 084 189
DS 45K with manual mode	DS 45K 9302 1070 083 692	DS 45K 9312 1070 083 712	DS 45K 9102 1070 083 691	DS 45K 9112 1070 083 711	DS 45K 8002 1070 079 437

[UL] = with UL/CSA certification

STG = Single-turn encoder

MTG = Multi-turn encoder

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4 Determining the drive rating

4.1 General technical data – inverter

Operating temperature range	0 °C to +45 °C 46 °C to +55 °C with derating
Storage temperature range	–25 °C to +70 °C
Degree of protection	IP20 according to EN 60 529
Climatic category	3K3 according to EN 60 721
Resistance to vibration	frequency range: 2...150 Hz displacement: 1 mm at 2...13.2 Hz acceleration: 0.7 g at 13.3...48.6 Hz displacement: 0.075 mm at 48.6...58.1 Hz acceleration: 1 g at 58.1...150 Hz (EN 60068-2-6 is complied with)
Resistance to shock	15 g iaw DIN IEC 68-2-27, no functional disturbance
Installation altitude	≦ 1000 m above sea level, derating up to max. 3000 m above sea level

Servodyn modules must only be installed in switch cabinets which conform to protection standard IP 54 (with dust filters at air entries and exits).
The surrounding air must be free from high levels of dust, acid, lye, corrosive materials, salt, metal vapors, etc.



CAUTION
Damages through incorrect handling !
Drive components must only be transported in the intended packaging. Assembly, installation and commissioning may only be carried out by qualified personnel.

Observe the hazard warnings in this manual and attached to the unit to prevent injury to persons or damage to equipment.

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4.2 Procedure for determining the drive rating

☞ **In accordance with EN 60 204-1, the availability of the system (machine) must be ensured even at supply voltage of 0.9 U_N. This must be considered during configuration!**

see section

	Servo motors SF, SR			Asynchronous motors type DU

4.3.1	• Determine torque/speed
	• Versions, options:
	  • plain shaft/slot and spring
	  • vibration severity grade
	  • output flange design
	  • encoder system
	  • holding brake
	  • surface cooling
			4.4	• Determine power/torque/ speed
				• Versions, options:
				  • vibration severity grade
				  • flange accuracy
				  • output flange design
				  • holding brake

	DM / DS three-phase current modules

3
4.1
4.3.2
4.4
4.5
4.6
4.7
4.8
	• Modular (DM) or stand-alone (DS, with supply unit)
	• Determine module size through rated current/peak current, depending on operating frequency and ambient temperature.
	• Select function:
	  • setpoint interface (SERCOS interface, analog interface, Motion control (24 V control signals), PROFIBUS-DP, CANrho, CANopen)
	  • encoder interface
	  • frequency inverter
	• Plug braking module option

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	Connecting cables / mating connector

4.9	• Power connection to the motor
	  • prefabricated cable with integrated connectors: DM/DS module → SF/SR motor, or
	  • cable by the meter + mating connector motor + module mating connector for DM..K or DS..K + assembly tool
	• Encoder connection
	  • prefabricated cable with integrated connectors: DM module → SF/SR/DU motor, or
	  • cable by the metre + mating connector motor and module + assembly tool
	• Protective circuit for brake line for motors with holding brake
	• For DMA..K: alternative brake connection including braking relay
	• Optical fibres with connectors (only for SERCOS interface)
	  • control unit → module, module → module, module → control unit
	• CAN cable with transit and/or terminating connector, length depending on baud rate
	• Cables or mating connectors, as necessary, for
	  • encoder simulation (for analog interface and Motion control)
	  • OM 1...3 direct measuring system (for SERCOS interface)

	Power supply modules VMA
4.1 5.1	• Specify size of module via continuous rating/peak output • Internal or external ballast switch or energy recovery

	Mains connection module NAA
5.5.1	• Only for VM with energy recovery • Select same type size as for supply module VM • Other versions, options: • integrated additional filter (if necessary with external mains filter)

	Line wiring module NV
5.5.2	• Optionally for VM with internal/external ballast switch • Select same type size as for supply module VM

	Line reactor NE
5.5.3	• For NAA and VM with energy recovery only • Select same type size as for supply module VM (Exception: 2 x NE70 for each VM 90) • NE 180 only with an additional filter capacitor

	Mains filter
5.5.4	• Design according to supply module output

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	Backplane modules RM

6.1
6.2
	● Only for VM..B,C,D and DM..A,B,D
	● Various designs for VM and DM
	● Specify according to module width
	● Other versions, options:
	  ● Cold module assembly
	  ● DC link connection
	  (for combining both mechanical systems, or for two-row module arrangement)

	Personality Module PM

6.3	● One personality module for each VM with energy recovery
	  ● with/without RSU (redundant safety monitoring)
	● One personality module for each DM with SERCOS interface
	  ● with/without RSU

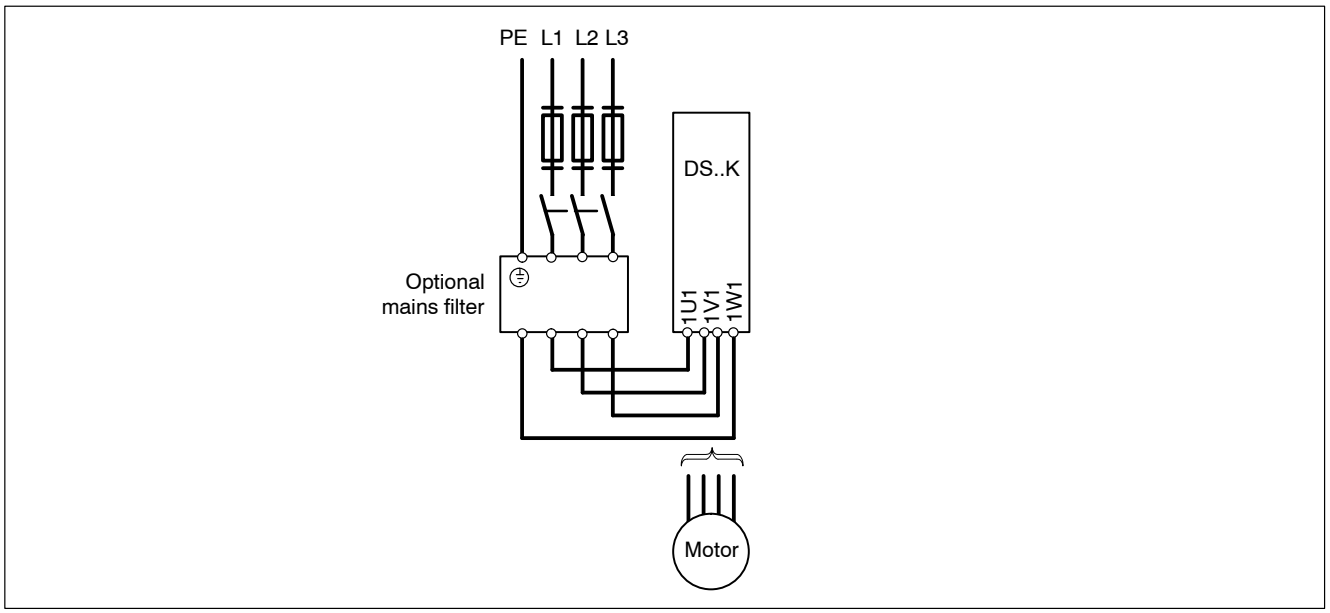
	Memory card MC
6.4	● Optionally for software updates for VM with energy recovery and DM/DS with SERCOS interface ● With software for VM or SM or FO or without software

	Commissioning and service system DSS-D
6.5	● Necessary for commissioning and diagnosis

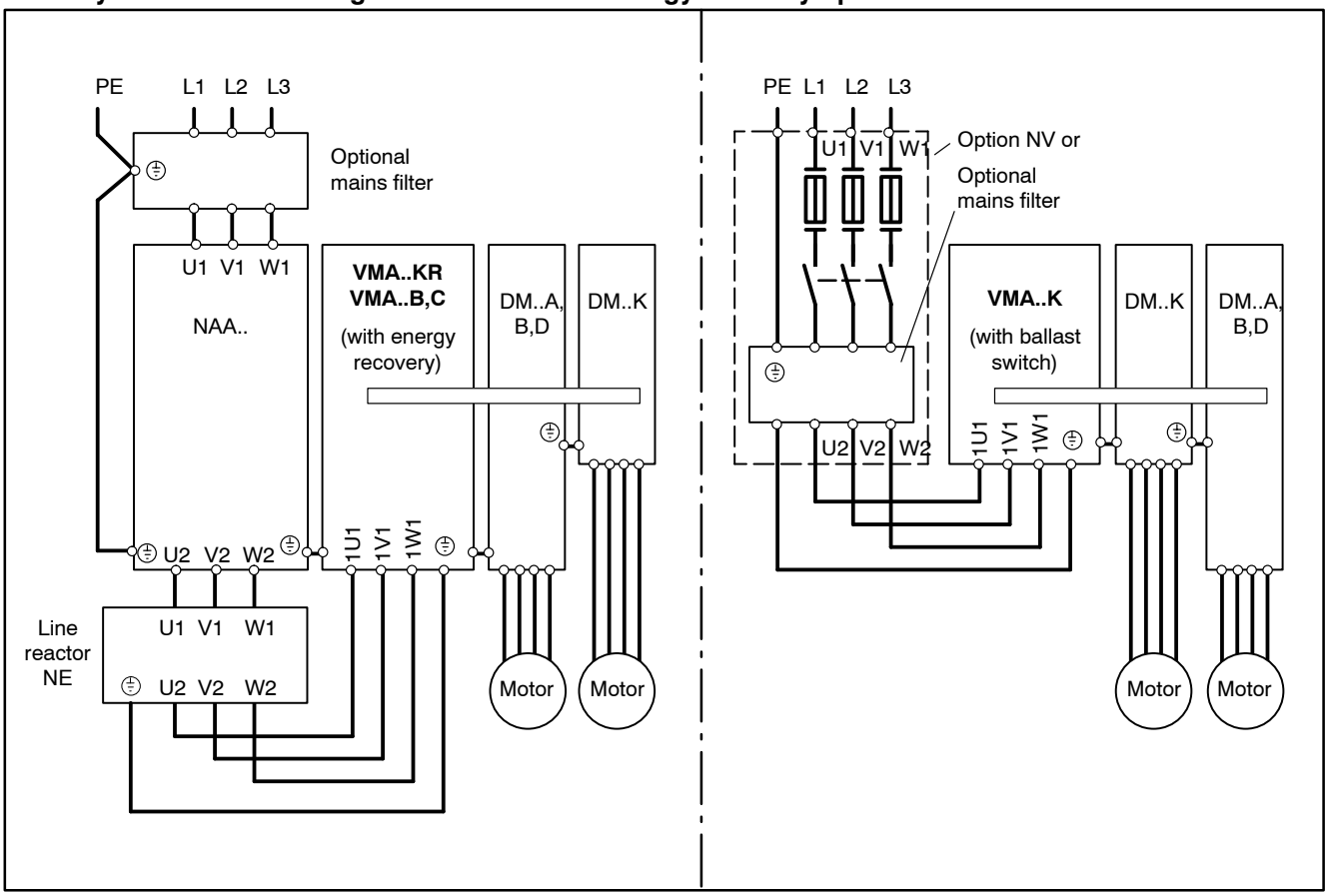
	Option modules OM
6.6	● Specify direct measuring system (OM1, OM2, OM3) for SERCOS interface only ● High-speed analog outputs (OM4), not for frequency inverters

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Servodyn-D – stand-alone inverter

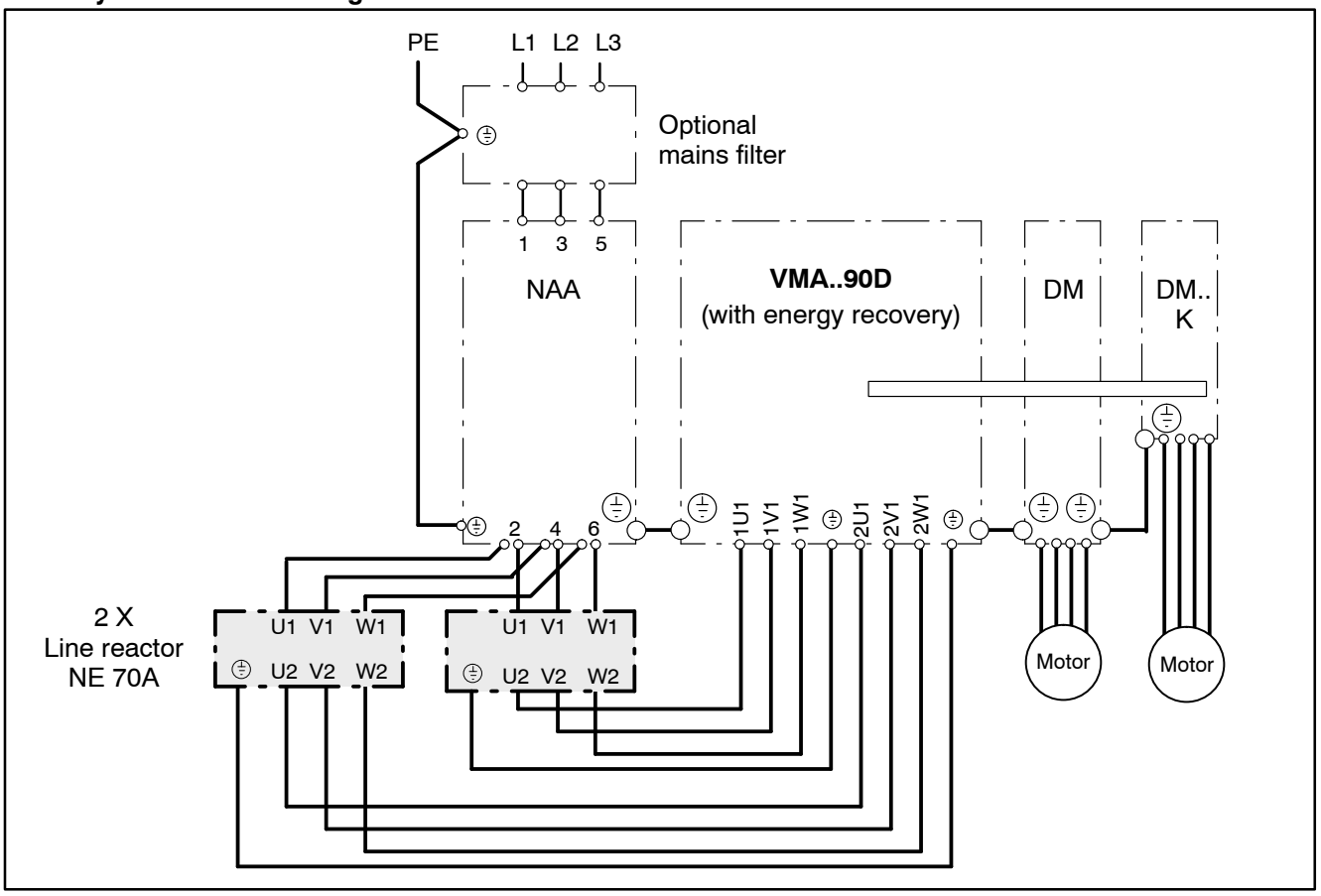


Servodyn-D – modular design with and without energy recovery up to VMA 70 C

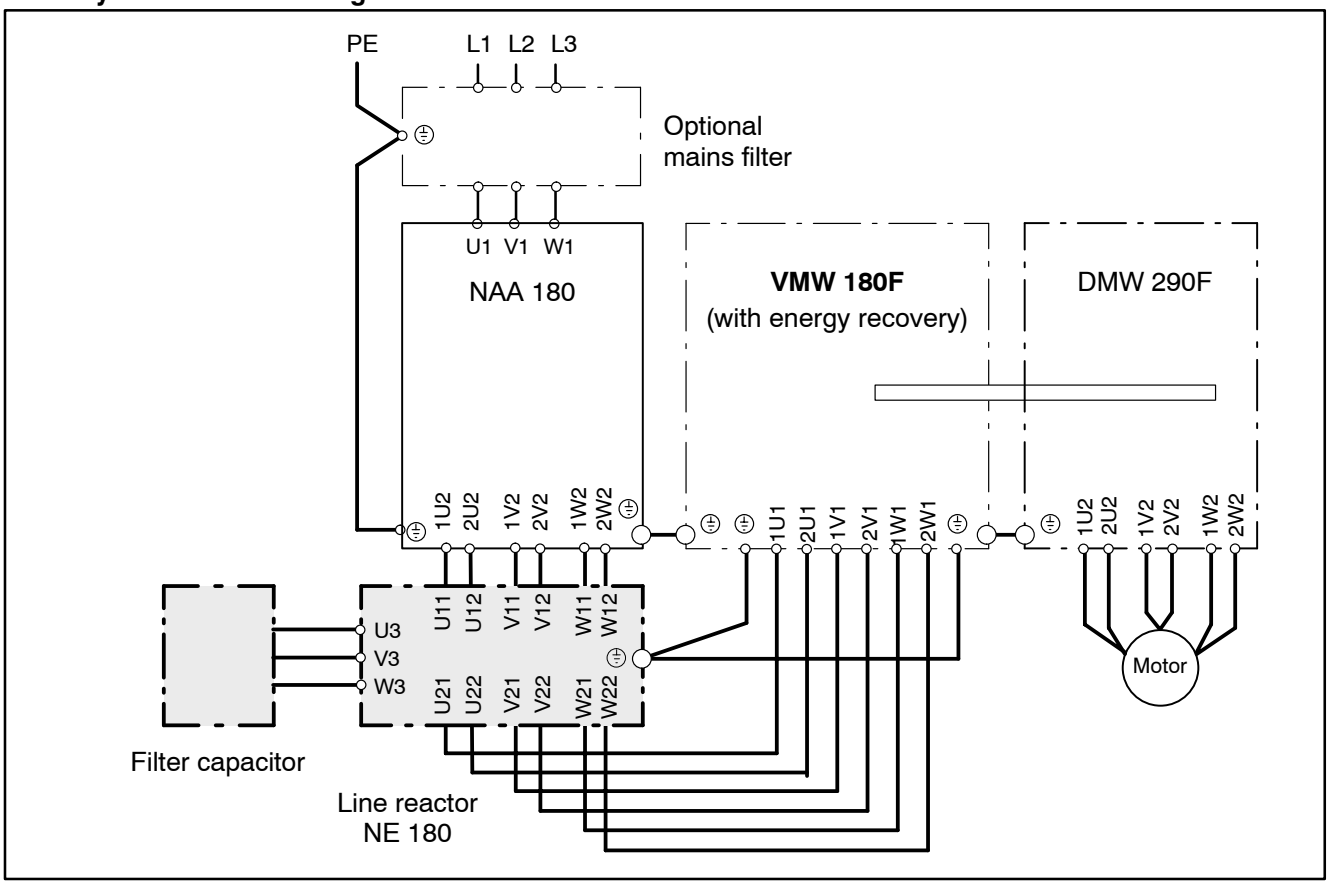


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Servodyn-D – modular design with VM 90D



Servodyn-D – modular design with VM W180F



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4.3 Servo motors SF, SR

4.3.1 SF(R) motor rating

To define the motor-module combination, a suitable motor and then the suitable three-phase module is selected.

- A servo motor is preselected using the S1 characteristic curves.
- If motor M_{max} is reached in the application, the preselection must be checked by calculating the rms torque and the mean speed.

  This requires the following information:
  - cycle time t_{total} of a processing cycle
  - interval t_i as part of the processing cycle
  - the required torque M_i in the respective interval

Preselect motor type SF(R) according to S1 characteristic curve.

M_{max} (n_{max}) ≦ $M_{max\ motor}$ (n_{max}) ?

Yes

Calculate rms torque:

$$M_{rms} = \sqrt{\frac{\sum_i M_i^2 \cdot t_i}{t_{total}}} \quad \text{at } n_m$$

Calculate mean speed n_m:

$$n_m = \frac{\sum_i n_i \cdot t_i}{t_{total}}$$

Is M_{rms} (n_m) within the S1 curve?

Yes

Check whether smaller motor is possible, otherwise motor selection ends

No

Select larger motor

No

Select larger motor

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4.3.2 Motor-module combination

Different combinations on request if technically possible.

□ = S1, clock frequency 4 kHz
■ = S1, clock frequency 8 kHz

Servo motors SF, SR without forced-air cooling		**Rating for maximum continuous load**										
Type	I_0 [A_{rms}]*	DM.. 4K	DM.. 8K	DM.. 15K	DM.. 30K	DM.. 45K	DM.. 30A	DM.. 45A	DM.. 85B	DM.. 140D	DS.. 15K	DS.. 45K
SF(R)–A4.0125.015	5,2		□	■	■						■	
SF(R)–A5(B5).0250.020	10,4				□	■	■	■				■
SF(R)–A5(B5).0460.020	20,8					□		□	■	■		□
SF(R)–A5.0700.020	34,1								□	■		
SF(R)–A2.0013.030	0,9	■									■	
SF(R)–A2.0020.030	1,3	■									■	
SF(R)–A2.0026.030	1,7	■									■	
SF(R)–A2.0041.030	2,7	■	■								■	
SF(R)–A3.0042.030	2,8	■	■	■							■	
SF(R)–A3.0068.030	4,5		□	■	■						■	
SF(R)–A3.0093.030	6,4			■	■						■	
SF(R)–A4.0091.030	6,6			■	■		■				■	
SF(R)–A4.0125.030	10,4				□	■	■	■				■
SF(R)–A4.0172.030	14,1				□	■	□	■	■			■
SF(R)–A4(B4).0230.030	16,2				□	■	□	■	■			■
SF(R)–A5(B5).0250.030	16,1					■	□	□	■			■
SF(R)–A5.0460.030	29,1								□	■		
SF(R)–A5.0700.030	45,5								□	■		
SR–L0.0002.060	0,45	■									■	
SR–L0.0004.060	0,65	■									■	
SR–L0.0008.060	1,2	■									■	
SR–L0.0009.060	1,3	■									■	
SF(R)–L1.0008.060	1,1	■									■	
SF(R)–L1.0012.060	1,65	■									■	
SF(R)–L1.0016.060	2,2	■									■	
SF(R)–L1.0023.060	3,16	□	■								■	
SF(R)–A2.0013.060	1,7	■									■	
SF(R)–A2.0020.060	2,6	■	■								■	
SF(R)–A2.0026.060	3,4	□	■	■							■	
SF(R)–A2.0041.060	5,6		□	■	■						■	
SF(R)–A3.0042.060	5,5			■	■						■	
SF(R)–A3.0068.060	9,4			□	□	■	■	■			□	■
SF(R)–A3.0093.060	13,5				□	■	□	■	■			■
SF(R)–A4(B4).0091.060	14,1				□	■	□	■	■			■
SF(R)–A4(B4).0125.060	19					□	□	□	■			□
SF(R)–A4(B4).0172.060	28,4								■	■		
SF(R)–A4(B4).0230.060	28,4								■	■		

* I_0 = standstill current, rms

☞ **Maximally 9 axes per VM because of load on module cross-connection.**

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Different combinations on request if technically possible.

□ = S1, clock frequency 4 kHz
■ = S1, clock frequency 8 kHz

Servo motors SF, SR with forced-air cooling		**Rating for maximum continuous load**										
Type	I_0 [A_{rms}]*	DM.. 4K	DM.. 8K	DM.. 15K	DM.. 30K	DM.. 45K	DM.. 30A	DM.. 45A	DM.. 85B	DM.. 140D	DS.. 15K	DS.. 45K
SF(R)–A4(B4).0125.015	7,3			■	■						■	
SF(R)–A5.0700.020	51,7									■		
SF(R)–A2.0041.030	3,5	□	■								■	
SF(R)–A3.0042.030	3,4	□	■								■	
SF(R)–A3.0068.030	5,0		□	■							■	
SF(R)–A3.0093.030	7,5			□	■						■	
SF(R)–A4(B4).0091.030	9			□	■		■				□	
SF(R)–A4(B4).0125.030	13				□	■	□	■				■
SF(R)–A4(B4).0172.030	17					□	□	□				□
SF(R)–A4(B4).0230.030	21					□		□	■			□
SF(R)–A5.0460.030	40								□	■		
SF(R)–A5.0700.030	69,4									□		
SF(R)–A3.0093.060	17					□	□	□				□

* I_0 = standstill current, rms

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4.4 Asynchronous motors DU

To define the motor-module combination, a suitable motor and then the suitable three-phase module is selected.

A type DU motor is preselected using the characteristic curve in the motor manual according to the following criteria:

- Required maximum speed
- Required output at maximum speed
- Required torque up to transition speed

□ = S1, clock frequency 4 kHz
■ = S1, clock frequency 8 kHz
○ = S6-60%, clock frequency 4 kHz
● = S6-60%, clock frequency 8 kHz
△ = S6-40%, clock frequency 4 kHz
▲ = S6-40%, clock frequency 8 kHz

Frame size	Asynchronous motors DU	Rated power P_N [kW]	Speed range n_N - n_{max} [min^{-1}]	Rated torque M_N [Nm]	Rated current I_N [A]	Motor/module combination							
						DM 30K	DM 45K	DS 45K	DMA 30A	DMA 45A	DMA 85B	DMA 140D	DMW 290F
90	90 L	4.2	1800 - 9000[1]	22	11	□○	■●▲	■●▲	■●△	■●▲			
100	100 M 100 L 100 U	6.6 9.0 12	1800 - 9000[2]	35 48 63.5	15.5 20 25		■○△ □○	■●△ □	□○	■○△ □○	■●▲ ■●▲ ■●△	■●▲	
132	132 S 132 M 132 L	15 18.5 22	1500 - 6500[3]	95.5 118 140	29 37 42						■○△ □○ □○	■●▲ ■●▲ ■●▲	
160	160 S 160 M 160 L	30 37 45	1500 - 6000[3]	191 235 286	51 63 76							■●△ ■○△ □○	●▲ ■●▲ ■●▲
180	180 S 180 M 180 L	55 63 75	1500 - 6000	350 401 478	98 113 136								■●△ ■○△ ■○

[1] Higher maximum speed option: 15.000 min^{-1}, with gear encoder 18.000 min^{-1}
[2] Higher maximum speed option: 15.000 min^{-1}
[3] Higher maximum speed option: 12.000 min^{-1}

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4.5 Asynchronous standard motors

To define the motor-module combination, a motor offering the desired performance range and then the suitable three-phase module (frequency inverter) is selected.

□ = S1, clock frequency 2 kHz
▒ = S1, clock frequency 4 kHz
■ = S1, clock frequency 8 kHz

Motor			Frequency inverter										
Power [kW]	Frame size	Rated current, typ. [A]	DM 4K	DM 8K	DM 15K	DM 30K	DM 45K	DMA 30A	DMA 45A	DMA 85B	DMA 140D	DS 15K	DS 45K
0.25 – 0.37 0.55 – 0.75 1.1 1.5	90	0,8 – 1 1,5 – 2 2,9 3,7	■ ■ □ ▒	■ ■ ■ ▒	■ ■							■ ■ ■ ■	
2.2 3.0 4.0 5.5	100	5,2 6,9 8,9 11,8		▒ □	■ ■ ▒ □	■ ■ ■ ▒	■	■ ■	■			■ ■	■
7.5 11 15 18.5	132	15,6 23 30 38				□	■ ▒	▒	▒ ▒	■ ■ ▒			■ ▒
22 30 37 45	160	43 58 72 85								▒	■ ■ ▒ □		

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4.6 Stand-alone inverter DS

4.6.1 Technical data

Module type	Unit	DS 15K		DS 45K	
Supply voltage	VAC	3 x 400 ... 460 ± 10%, 48 ... 62 Hz			
Rated voltage	VAC	400, 50 Hz			
f_s = 4 kHz (ϑ_{amb} =45°C)		max. OL	max. CL	max. OL	max. CL
Maximum current	A_{rms}	17	14	47.5	35.5
Rated current	A_{rms}	6.0	11	11	23
Derating through output adjustment	A/kW	0.65		0.5	
Derating 45...55°C	A/K	0.3		0.7	
f_s = 8 kHz (ϑ_{amb} =45°C)		max. OL	max. CL	max. OL	max. CL
Maximum current	A_{rms}	15	11	35	25.5
Rated current	A_{rms}	4.4	8.5	7	18
Derating through output adjustment	A/kW	0.45		0.5	
Derating 45...55°C	A/K	0.2		0.7	
Rated power with f_s = 4 kHz, ϑ_{amb} = 45°C	kW	3.5		10	
Peak output at f_s = 4 kHz	kW	6.0		19	
Ballast switch		internal		internal	
Max. one-time braking energy	Ws	1000		6250	
Max. continuous braking power	W	100		250	
Power demand from 24 V power supply module	A	24 VDC to DIN 19 240			
		max. 14		max. 1.6	
Max. power loss with f_s = 4 kHz	W	120		240	
Mass	kg	5.9		9.4	
Personality Module PM		only with SERCOS interface			
Optional mains connection through		NV 20			
Rated power at ϑ_{amb} = 45°C	kW	24			
Mass	kg	10.6			

f_s = switching frequency; ϑ_{amb} = ambient temperature; ϑ_K = heat sink temperature;

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Band width of current values

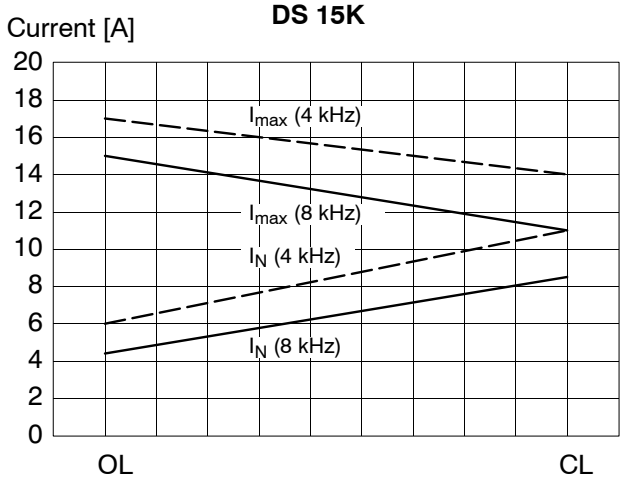
Maximum overload (OL):

Depending on the heat sink and ambient temperature, the module automatically limits the **maximum current** depending on the thermal limit of the power semiconductor.

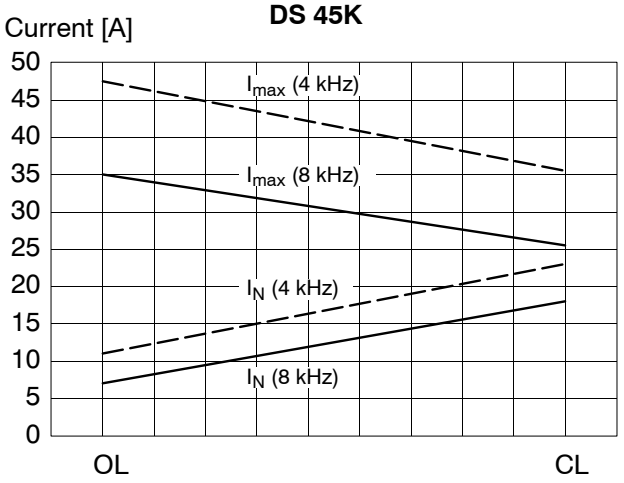
Maximum continuous load (CL):

The maximum permissible **rated current** is available at the thermal limit of the heat sink. In order to protect the power semiconductor, the maximum current is reduced.
There is always a floating transition between the two load conditions.

DS 15K



DS 45K



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4.6.2 Braking power

The integrated ballast switch should not be overloaded by the braking energy of the connected motor.

The braking energy depends:

- on the mechanical energy of rotation of the connected motor
- on the number of braking processes per time unit.

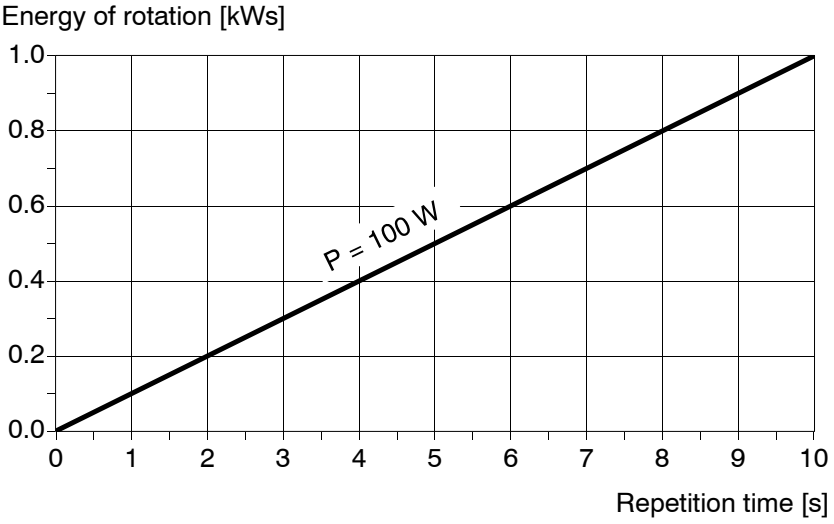
★ Calculate the **energy of rotation** by the following formula:

$$Wrot = \tfrac{1}{2} J \left(\frac{\{2 \times \pi \times n\}}{60} \right)^2 [Ws]$$

$Wrot$ = energy of rotation
J = total moment of inertia in kgm^2
n = motor speed in min^{-1}

★ Calculate the required **repetition time** on the basis of the operating cycle.

★ Use the characteristic to make sure that the intersection between the energy of rotation and the required repetition time is below the curve.



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4.7 Three-phase modules DM

4.7.1 Technical data DM..K

Module type	DM 4K		DM 8K		DM 15K		DM 30K		DM 45K	
Band width of maximum current values*	max OL	max CL	max OL	max CL	max OL	max CL	max OL	max CL	max OL	max CL
Rating plate data UL varieties:										
Input	–		670 V, 2.5 A dc		670 V, 6 A dc		670 V, 8.5 A dc		670 V, 17 A dc	
Output			3ph 400 V, 0 – 800 Hz, 8 kHz							
	–		2.4 A		5.8 A		8.2 A		16.5 A	
DC link voltage	670 VDC regulated / 715 VDC non-regulated									
f_s = 4 kHz, ϑ_{amb} = 45°C										
Maximum current [A_{rms}]	6.6	6.4	10	9.6	18	15	29	21	47.5	35.5
Rated current [A_{rms}]	1.4	4.0	2.1	5.7	4.9	11	5.8	14	10	23.5
Derating 45...55°C [A/K]	0.15		0.15		0.32		0.35		0.6	
f_s = 8 kHz, ϑ_{amb} = 45°C (factory setting)										
Maximum current [A_{rms}]	6.6	4.7	10	7.1	15	11	22	14	35	25.5
Rated current [A_{rms}]	0.8	2.5	1.1	3.6	2.9	7.4	3.6	9.7	6.5	16.5
Derating 45...55°C [A/K]	0.1		0.1		0.23		0.24		0.5	
Resolution of actual position value: Single-turn encoder (STG) Multi-turn encoder (MTG) Resolver	20 bits 32 bits 12 bits									
Possible connections direct position measuring system with SERCOS interface	Incremental encoder with factor 4, f_{limit} = 1 MHz Sine encoder with EXE and factor 20, f_{limit} = 50 kHz Sine/cosine encoder with interpolation factor 4096, f_{limit} = 800 kHz									
Power demand from 24 V power supply module[A]	0.89		0.89		0.89		1.03		1.4	
Max. power loss [W]	96.5		96.5		121		156		205	
Mass [kg]	6.0								6.7	
Module width [mm]	50								75	

* for a description, refer to page 4–15

f_s = switching frequency;

ϑ_{amb} = ambient temperature;

ϑ_K = heat sink temperature;

Band width of current values

Maximum overload (OL):

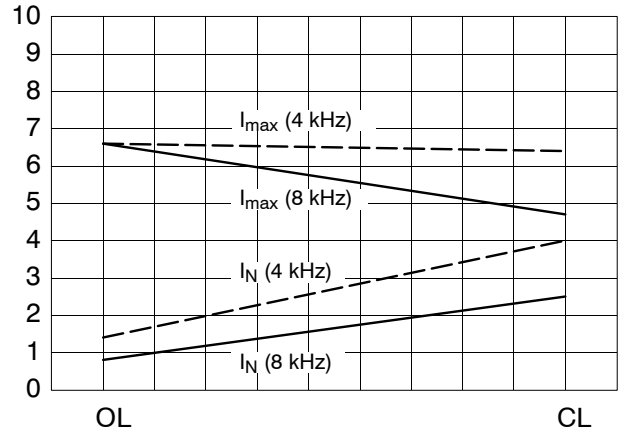
Depending on the heat sink and ambient temperature, the module automatically limits the **maximum current** depending on the thermal limit of the power semiconductor.

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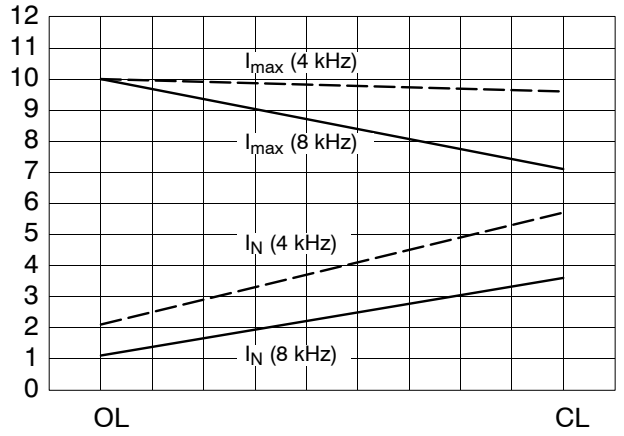
Maximum continuous load (CL):

The maximum permissible **rated current** is available at the thermal limit of the heat sink. In order to protect the power semiconductor, the maximum current is reduced.
There is always a floating transition between the two load conditions.

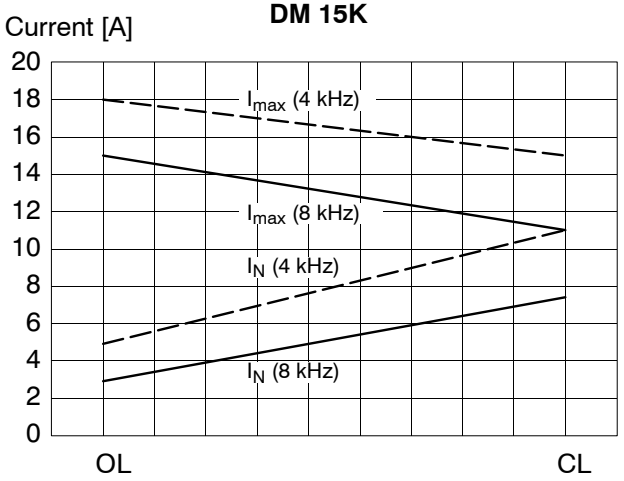
DM 4K



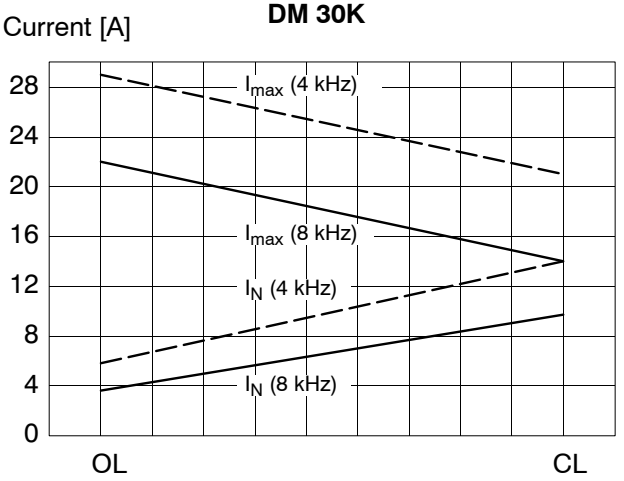
DM 8K



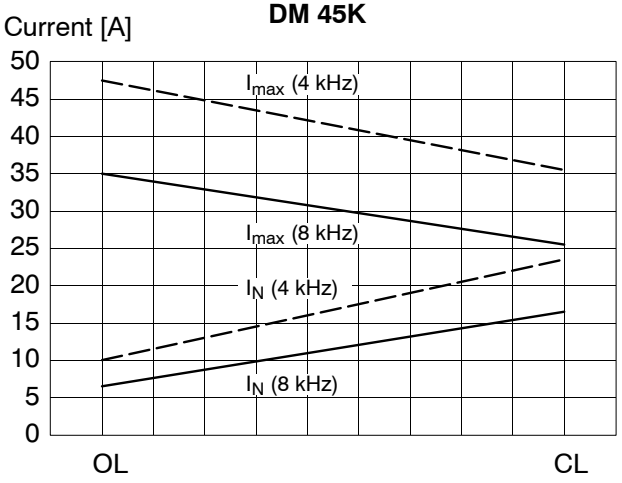
DM 15K



DM 30K



DM 45K



Alle Angeben für ϑ_{amb} = 45°C

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4.7.2 Technical data of DMA..A,B,D,F

Module type	DMA 4A		DMA 8A		DMA 15A		DMA 30A		DMA 45A		DMA 85 B		DMA 140D		DMW 290F**	
Band width of maximum current values*	max OL	max CL	max OL	max CL	max OL	max CL	max OL	max CL	max OL	max CL	max OL	max CL	max OL	max CL	max OL	max CL
DC link voltage	670 VDC regulated / 715 VDC non-regulated															
f_s = 4 kHz																
Maximum current [A_{rms}]	5.6	5.6	11	11	18	14	35	28	51	39	86	64	141	106	292	212
Rated current [A_{rms}]	2.7	5.6	2.7	5.7	6.1	13	8.9	18	10	23	22	47	42	87	148	212
Derating 45...55°C [A/K]	0.15		0.15		0.35		0.46		0.65		1.25		2.25		4.3	
f_s = 8 kHz (ex works)																
Maximum current [A_{rms}]	5.6	5.6	11	9.6	14	9.6	32	23	44	31	63	44	117	84	207	136
Rated current [A_{rms}]	1.7	3.3	1.7	3.3	3.7	8.5	5.1	12	6.1	15	12	31	25	60	106	136
Derating 45...55°C [A/K]	0.08		0.08		0.24		0.35		0.45		0.95		1.75		3.3	
Resolution of actual position value: Single-turn encoder (STG) Multi-turn encoder (MTG) Resolver	20 bits 32 bits, 4096 revolutions, absolute 12 bits															
Possible connections direct position measuring system with SERCOS interface	Incremental encoder with factor 4, f_{limit} = 1 MHz Sine encoder with EXE and factor 20, f_{limit} = 50 kHz Sine/cosine encoder with interpolation factor 4096, f_{limit} = 800 kHz															
Power demand from 24 V power supply module [A]	1.0		1.14		1.14		1.23		1.32		1.35		1.58		2.5	
Max. power loss in switch cabinet [W]	94.3		97.7		185		180		220		380		700		380	
Mass [kg]	7.3										11.5		19.3		40	
Module width [mm]	50										100		200		300	
Backplane modules																
Type	RMA/DM 8				RMA/DM 30				RMA/ DM 45		RMB/DM		RMD/DM		not necessary	
Number of fans	–				1				2		2		2			

* for a description, refer to page 4–18

** Power data for water inlet temperature = 40°C;
temperature increase of cooling water: f_s = 8 kHz 6 K/100 A
f_s = 4 kHz 4 K/100 A

f_s = switching frequency
ϑ_{amb} = ambient temperature
ϑ_K = heat sink temperature

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Band width of current values

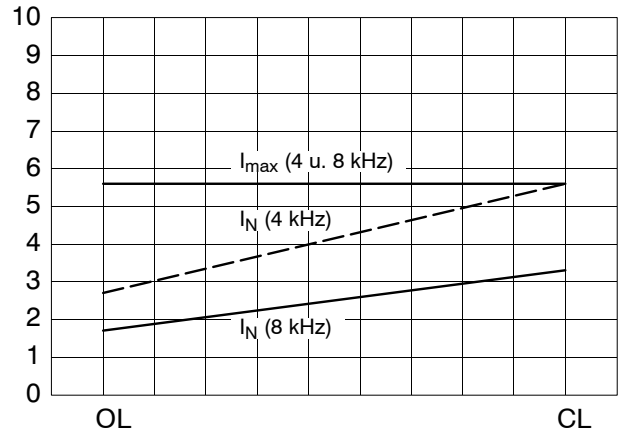
Maximum overload (OL):

Depending on the heat sink and ambient temperature, the module automatically limits the **maximum current** depending on the thermal limit of the power semiconductor.

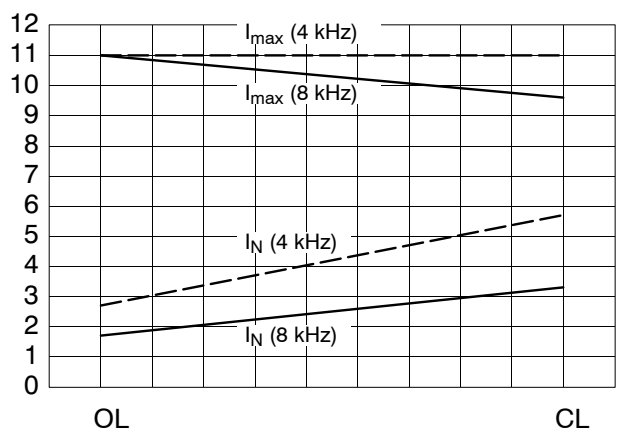
Maximum continuous load (CL):

The maximum permissible **rated current** is available at the thermal limit of the heat sink. In order to protect the power semiconductor, the maximum current is reduced.
There is always a floating transition between the two load conditions.

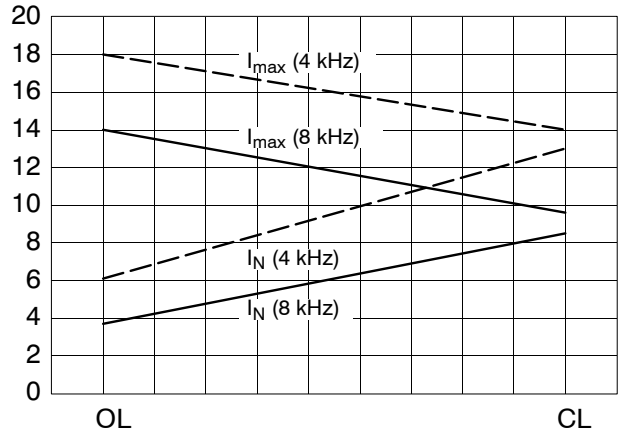
DM 4A



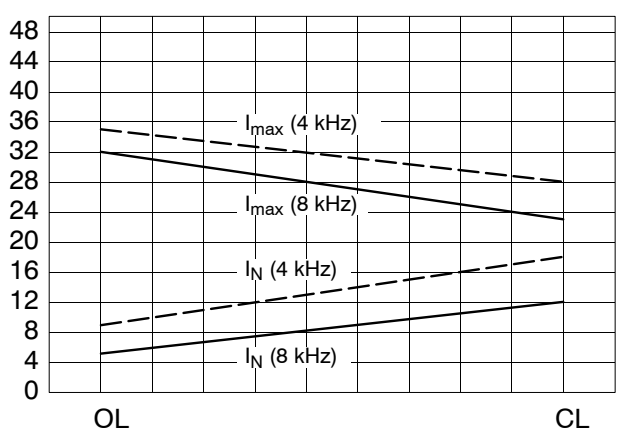
DM 8A



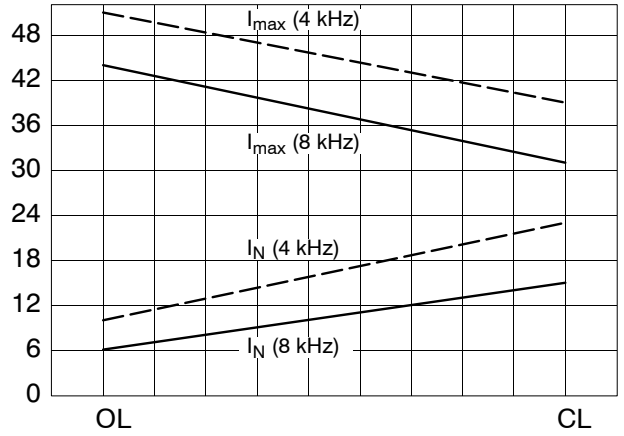
DM 15A



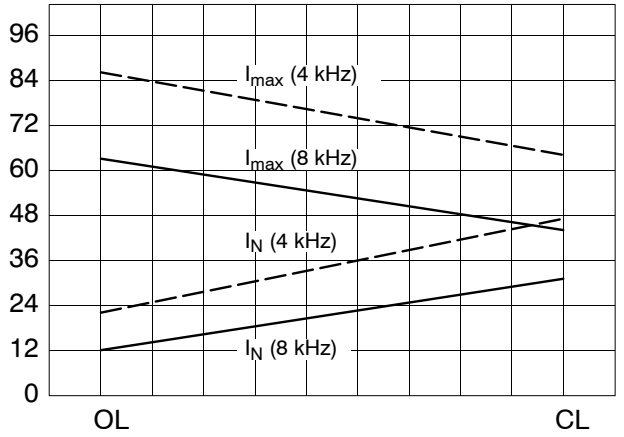
DM 30A



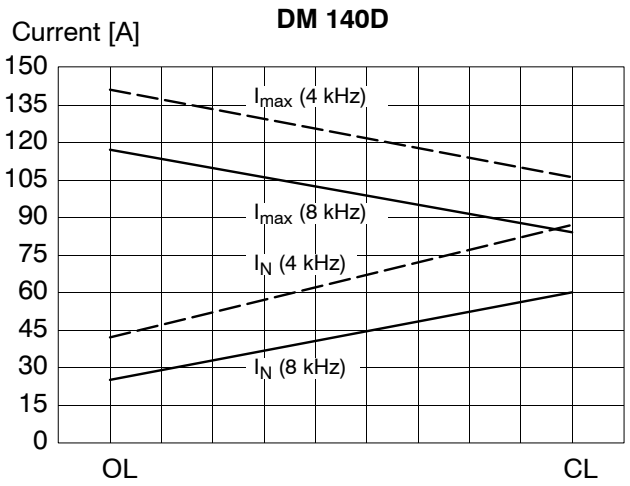
DM 45A

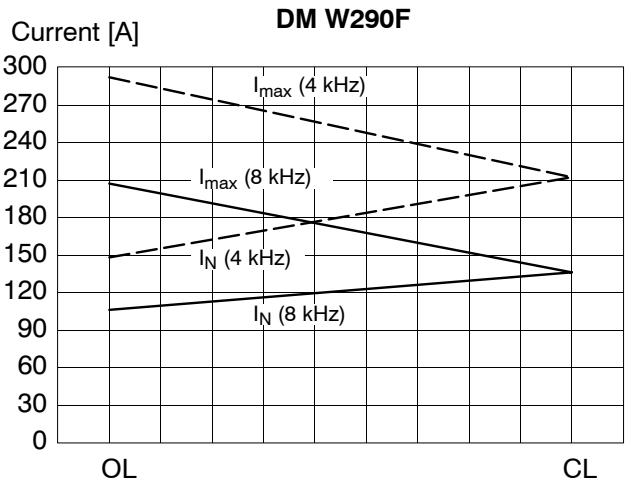


DM 85B



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Water cooling

Operating conditions:

- Water inlet temperature: 10...40°C
- Required water quantity: min. 5 l/min
- Water pressure: max. 5 bar
- Pressure loss per inverter: max. 0.6 bar
- Temperature rise:
  - DM W290F: f_s = 8 kHz 6 K/100 A
    f_s = 4 kHz 4 K/100 A
  - VM W180F: 4.5 K/100 A

In order to guarantee continuous operation, the cooling water must satisfy the following conditions:

- pH: 7...8.5
- Degree of hardness D_{max}: 5.6° (German)
  (1° German = 1.25 UK deg. = 1.05 US deg. = 1.8 French deg.)
- Chlorides: max. 20 mg/l
- Nitrates: max. 10 mg/l
- Sulfates: max.100 mg/l
- Insoluble components: max. 250 mg/l

Tap water usually meets these conditions.

☞ **In closed cooling water circuits, an algaecide must furthermore be added to the water. Check the cooling water regularly. Condensation on the water-conducting components should be avoided.**

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4.8 Plug braking

Synchronous motors type SF, SR can be braked immediately using the plug braking option if the motors cannot be actively braked due to an operating voltage or control failure.
For each motor, one plug braking module is used.

Motor type	Resistance R_x [Ohm]	Maximum energy in short-time operation [Ws]	Part no.
SR–L0	Direct short-circuit without resistor		
SF(R)–L1	Direct short-circuit without resistor		
SF(R)–A2	1,0	785	1070 914 767
SF(R)–A3. ... .030 SF(R)–A3.0042.060	5,6	261	1070 913 546
SF(R)–A3.0068.060 SF(R)–A3.0093.060	3,3	293	1070 913 545
SF(R)–A4.125.015 SF(R)–A(B)4. ... .030	1,0	785	1070 914 767
SF(R)–A4.0091.060 SF(R)–A4.0125.060	3,3	785	1070 913 547
SF(R)–A(B)4.0172.060 SF(R)–A(B)4.0230.060 SF(R)–A(B)5. ... .020 SF(R)–A(B)5. ... .030	1,0	4085	1070 913 862

R_x (+10%)	Each module has 3 resistors. For individual resistors, refer to table above.
Conductor cross-section	max. 4 mm^2
Test voltage	2500 V AC
Ambient temperature	max. 55°C
Mounting	on 35 mm top hat rail to DIN
Degree of protection	IP 20

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4.9 Cables

4.9.1 Motoranschlussleitungen

We recommend using prefabricated power and encoder cables made by Bosch for all motors.



CAUTION
Cable damages through inadmissible movement.
Please note the following technical data. Different installation methods are subject to consultation with Bosch.

The technical data are for engineering reference only. The suitability for the intended application shall be verified by the user.

Encoder cables, Standard

- **Operating temperature:**
  fixed installation: –50°C to +80°C
  flexible installation: –20°C to +70°C
  The cable must not touch the motor surface.
- **Tensile strength:**
  fixed installation: max. 50 N/mm^2 conductor area
  flexible horizontal installation: max. 20 N/mm^2 conductor area
- Suitable for drag chains if **horizontal** energy drag chains are used
  - **Acceleration:** max. 12 m/sec^2
  - **Speed:** max. 100 m/min
  - **Horizontal traversing path:** max. 5 m at 5 m/sec^2
    max. 2.5 m at 12 m/sec^2
  - **Bending radius:** max. 12 x external diameter
    (10 million bending operations guaranteed)
  - **Torsion:** max. ±30°/m
- External sheath: TPU
- Resistance to oil:
  after ageing 7 days/90° and 70° (diesel, biodiesel)
  Change in tensile strength ± 40 %
  Change in elongation at tear ± 30 %
- Halogen-free iaw DIN VDE 0472 part 815
- Color **green** similar to RAL 6018,
  in accordance with DESINA, with Bosch part number printed on.

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Prefabricated encoder cables, shielded

	No of cores	Mass [kg/m]	Outer diameter [mm]	For motor type	Encoder system	Part no. (5 m long)*	Part no. yard ware
Cable	17 cores	0.14	10,0 ±0,3	SF, DU	ECN (Single-turn) EQN (Multi-turn)	1070 919 827	1070919255
				SR, other	Resolver, Gear encoder	1070 917 094	
Extension with coupling	17 cores	0.14	10,0 ±0,3	SF, DU	ECN (Single-turn) EQN (Multi-turn)	1070 920 506	
UL cable c UL us	17 cores	0.16	10,0 ±0,3	SF, DU	ECN (Single-turn), EQN (Multi-turn)	1070 921 697	1070921634
				SR, other	Resolver, Gear encoder	on request	

* Part nos. of cable lengths 7, 10, 12, 15, 20, 25, 35, 50, 100 m on request.

☞ **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.**

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Encoder cables, high performance

- **Operating temperature:**
  fixed installation: –50°C to +80°C
  flexible installation: –20°C to +70°C
  The cable must not touch the motor surface.

- **Tensile strength:**
  fixed installation: max. 50 N/mm^2 conductor area
  flexible horizontal installation: max. 20 N/mm^2 conductor area

- Suitable for drag chains if **horizontal or vertical** energy drag chains are used
  - **Acceleration:** max. 20 m/sec^2
  - **Speed:** max. 100 m/min
  - **Horizontal traversing path:** max. 25 m at 5 m/sec^2
    max. 10 m at 12 m/sec^2
    max. 6 m at 25 m/sec^2
  - **Vertical traversing path:** max. 5 m
  - **Bending radius:** min. 10 x external diameter
    (10 million bending operations guaranteed)
  - **Torsion:** max. ±180°/30 cm
    (combined permanent bending and torsional strain,
    1 million cycles guaranteed)

- External sheath: TPU

- Resistance to oil:
  after ageing 7 days/90° and 70° (diesel, biodiesel)
  Change in tensile strength ± 40 %
  Change in elongation at tear ± 30 %

- Halogen-free iaw DIN VDE 0472 part 815

- Color **green** similar to RAL 6018,
  in accordance with DESINA, with Bosch part number printed on.

Prefabricated encoder cables, shielded (high performance)

	No of cores	Mass [kg/m]	Outer diameter [mm]	For motor type	Encoder system	Part no. (5 m long)*	Part no. yard ware
Cable	17 cores	0.14		SF, DU	ECN (Single-turn), EQN (Multi-turn)	1070 920 850	1070920561
				SR, other	Resolver, Gear encoder	1070 920 989	
Extension with coupling	17 cores	0.14		SF, DU	ECN (Single-turn), EQN (Multi-turn)	1070 921 262	
UL cable c UL us	17 cores	0.16	10,0 ±0,3	SF, DU	ECN (Single-turn), EQN (Multi-turn)	1070 921 701	1070921635
				SR, other	Resolver, Gear encoder	on request	

* Part nos. of cable lengths 7, 10, 12, 15, 20, 25, 35, 50, 100 m on request.

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☞ **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.**

Power cables, shielded

- **Operating temperature:**
  fixed installation: –50°C to +80°C
  flexible installation: –20°C to +60°C
  The cable must not touch the motor surface.

- **Tensile strength:**
  fixed installation: max. 50 N/mm^2 conductor area
  flexible horizontal installation: max. 30 N/mm^2 conductor area (max. 20 N/mm^2 with UL listed cables)

- Suitable for drag chains if **horizontal** energy drag chains are used
  - **Acceleration:** max. 20 m/sec^2
  - **Speed:** max. 100 m/min
  - **Horizontal traversing path:** max. 5 m at 5 m/sec^2
    max. 2.5 m at 12 m/sec^2
    max. 1.5 m at 20 m/sec^2
  - **Bending radius:** min. 10 x external diameter (cables up to 4 mm^2)
    max. 12 x external diameter (cables with 6 or 10 mm^2)
    (10 million bending operations guaranteed with 12 x external diameter)
  - **Torsion:** max. ±30°/m

- External sheath: TPU

- Resistance to oil:
  after ageing 7 days/90° and 70° (diesel, biodiesel)
  Change in tensile strength ± 40 %
  Change in elongation at tear ± 30 %

- Halogen-free iaw DIN VDE 0472 part 815

- Color **orange** similar to RAL 2003,
  in accordance with DESINA, with Bosch part number printed on.

☞ **UL class 1 power cables (e.g. UL Style 1015, cf. table) have to be used for UL/CSA-certified drive inverters.**
This is to ensure that the entire system meets the UL/CSA requirements.

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Conductor cross-sections iaw EN 60 204 Part 1/1993, Table 5, for installation in a cable duct at an ambient temperature of 40 °C)

Prefabricated power cables with connectors, total shield and brake control shielded separately

Connector size	Motor type	Cable cross section [mm²]	Mass [kg/m]	Inverter (cf. page 4–8)	Part no. (5 m long)* Standard cable, shielded	UL cable, shielded c UL us
1	SR–L0... SF(R)–L1... SF(R)–A2... SF(R)–A3...030 SF(R)–A3.0042.060 SF(R)–A3.0068.060 SF(R)–A4.0125.015 SF(R)–A4.0091.030 SF(R)–A4.0125.030 SF(R)–A4.0172.030 SF(R)–B5.0250.020	4 x 1.5	0.2 (0.25[UL])	DM..K DS..K	1070 920 513 Extension with coupling: 1070 920 898	on request
				DM..A,B,D	1070 920 866 Extension with coupling: 1070 920 898	on request
	SF(R)–A3.0093.060 SF(R)–A4.0230.030 SF(R)–B4.0091.060 SF(R)–B4.0125.060	4 x 2.5	0.27 (0.32[UL])	DM..K DS..K	1070 920 870	on request
				DM..A,B,D	1070 920 867	on request
	SF(R)–B5.0250.030	4 x 4.0	0.29	DM..K DS..K	1070 920 871	on request
				DM..A,B,D	1070 920 868	on request
1.25	SF(R)–A5.0250.020	4 x 1.5	0.2	DM..K DS..K	1070 920 972	–
				DM..A,B,D	1070 920 967	–
	SF(R)–A4.0091.060 SF(R)–A4.0125.060	4 x 2.5	0.27	DM..K DS..K	on request	–
				DM..A,B,D	1070 920 968	–
	SF(R)–A5.0460.020 SF(R)–A5.0250.030	4 x 4.0	0.29	DM..K DS..K	1070 920 973	–
				DM..A,B,D	1070 920 969	–
	SF(R)–A4.0172.060 SF(R)–A4.0230.060	4 x 6.0	0.49	DM..A,B,D	1070 920 970	–
1,5	SF(R)–B4.0230.030	4 x 4,0	0,29	DM..K DS..K	on request	on request
				DM..A,B,D	on request	on request
	SF(R)–B4.0172.060 SF(R)–B4.0230.060 SF(R)–B5.0460.020	4 x 6.0	0.49	DM..A,B,D	1070 920 872	on request
	SF(R)–A5.0460.030 SF(R)–A5.0700.020	4 x 10	0.67		1070 920 873	on request
	SF(R)–A5.0700.030	4 x 16	0.94		1070 920 874	on request

Conductor cross-section for brake: 2 x 1,5 mm² for all cables

[UL] Data for UL cables

* Part nos. of cable lengths 7, 10, 12, 15, 20, 25, 35, 50, 100 m on request
For admissible cable lengths, please refer to page 4–28.

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Power cables, unshielded

- **Operating temperature:**
  fixed installation: –50°C to +80°C
  flexible installation: –20°C to +70°C
  The cable must not touch the motor surface.

- **Tensile strength:**
  fixed installation: max. 50 N/mm^2 conductor area
  flexible horizontal installation: max. 20 N/mm^2 conductor area

- Suitable for drag chains if **horizontal or vertical** energy drag chains are used
  - **Acceleration:** max. 20 m/sec^2
  - **Speed:** max. 100 m/min
  - **Horizontal traversing path:** max. 25 m at 5 m/sec^2
    max. 10 m at 12 m/sec^2
    max. 6 m at 25 m/sec^2
  - **Vertical traversing path:** max. 5 m
  - **Bending radius:** min. 10 x external diameter (10 million bending operations guaranteed)
  - **Torsion:** max. ±30°/m

- External sheath: TPU

- Resistance to oil:
  after ageing 7 days/90° and 70° (diesel, biodiesel)
  Change in tensile strength ± 40 %
  Change in elongation at tear ± 30 %

- Halogen-free iaw DIN VDE 0472 part 815

- Color **orange** similar to RAL 2003,
  in accordance with DESINA, with Bosch part number printed on.

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Conductor cross-sections iaw EN 60 204 Part 1/1993, Table 5, for installation in a cable duct at an ambient temperature of 40°C)

Prefabricated power cables with connectors, unshielded

Connector size	Motor type	Cable cross section [mm²]	Mass [kg/m]	Inverter (cf. page 4–8)	Part no. (5 m long)* Standard cable, unshielded
1	SR–L0... SF(R)–L1... SF(R)–A2... SF(R)–A3...030 SF(R)–A3.0042.060 SF(R)–A3.0068.060 SF(R)–A4.0125.015 SF(R)–A4.0091.030 SF(R)–A4.0125.030 SF(R)–A4.0172.030 SF(R)–B5.0250.020	4 x 1.5	0.2	DM..K DS..K	1070 920 154 Extension with coupling: 1070 920 507
				DM..A,B,D	1070 920 074 Extension with coupling: 1070 920 507
	SF(R)–A3.0093.060 SF(R)–A4.0230.030 SF(R)–B4.0091.060 SF(R)–B4.0125.060	4 x 2.5	0.27	DM..K DS..K	1070 920 875
				DM..A,B,D	1070 920 084
	SF(R)–B5.0250.030	4 x 4.0	0.29	DM..K DS..K	1070 920 876
				DM..A,B,D	1070 920 483
1.25	SF(R)–A5.0250.020	4 x 1.5	0.2	DM..K DS..K	1070 920 164
				DM..A,B,D	1070 920 094
	SF(R)–A4.0091.060 SF(R)–A4.0125.060	4 x 2.5	0.27	DM..K DS..K	on request
				DM..A,B,D	1070 920 104
	SF(R)–A5.0460.020 SF(R)–A5.0250.030	4 x 4.0	0.29	DM..K DS..K	1070 920 971
				DM..A,B,D	1070 920 114
	SF(R)–A4.0172.060 SF(R)–A4.0230.060	4 x 6.0	0.49	DM..A,B,D	1070 920 124
1,5	SF(R)–B4.0230.030	4 x 4,0	0,29	DM..K DS..K	on request
				DM..A,B,D	on request
	SF(R)–B4.0172.060 SF(R)–B4.0230.060 SF(R)–B5.0460.020	4 x 6.0	0.49	DM..A,B,D	1070 920 473
	SF(R)–A5.0460.030 SF(R)–A5.0700.020	4 x 10	0.67		1070 920 134
	SF(R)–A5.0700.030	4 x 16	0.94		1070 920 144

Conductor cross-section for brake: 2 x 1,5 mm² for all cables

* Part nos. of cable lengths 7, 10, 12, 15, 20, 25, 35, 50, 100 m on request
For admissible cable lengths, please refer to page 4–28.

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Maximum length of power cable

Inverter type	Unshielded cable		Shielded cable		
	without brake control	with brake control	without brake control	with brake control: without separate shield	with brake control: with separate shield
DM..4A, DM..8A	100 m	25 m	25 m		
DM..15A, DM..15K			50 m	25 m	50 m
DM..30A and above			100 m	25 m	100 m

This table is based on the following values for the service capacitance of cables with an area of 1.5 mm^2 and 2.5 mm^2:

- unshielded cable: core/core ≈ 100 pF/m
- shielded cable: core/core ≈ 200 pF/m
  core/shield ≈ 300 pF/m

Point of separation of motor cables

The following components are available for separating encoder cables and power cables at a switch cabinet bushing:

- **Standard cable** for installation in the switch cabinet leading from the inverter to the point of separation
- **Extension cable** for installation between the point of separation and the motor
- **Metal flanges** for the encoder cable and the power cable for sealing the switch cabinet bushing to achieve IP67.

4.9.2 Control of holding brake

Capacitive influences on the 24 V cable for the holding brake may cause a delay in the brake disengagement.
In order to avoid such interferences, please use the protective circuit (RC element) designed for this purpose:

- **Protective circuit for DM..A,B,D** Part no.: 1070 917 448
  to be installed at the terminal strip

- **Protective circuit for DM..K** Part no.: 1070 078 595
  with additional point-to-point terminal which is to be plugged onto the module.

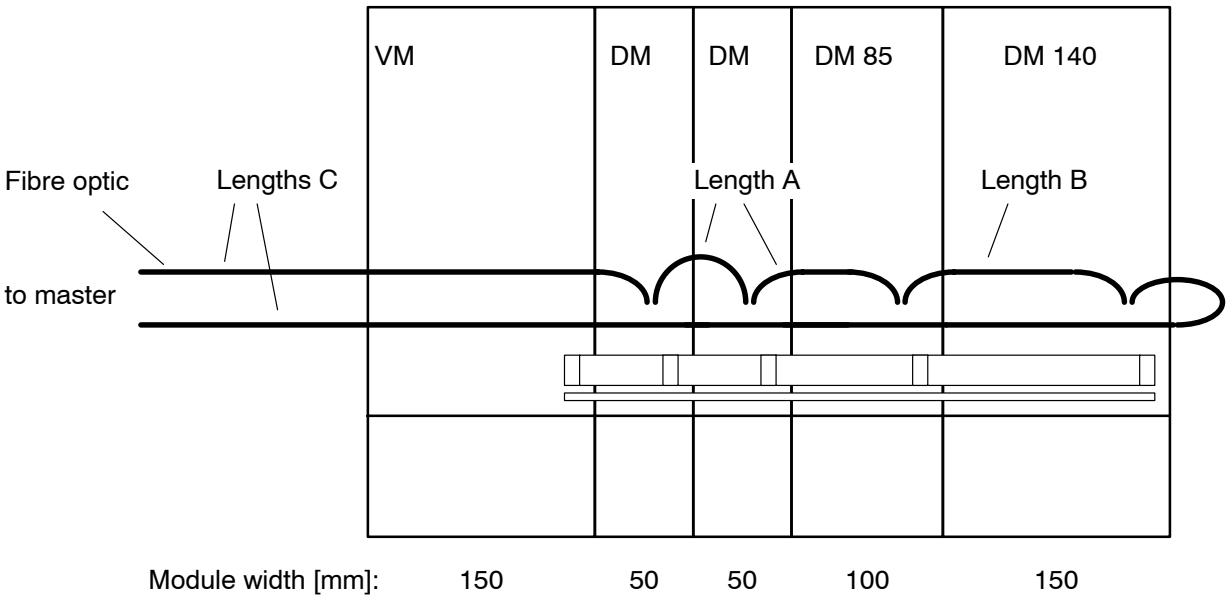
For DM..K, a package solution including the brake relay is furthermore available which does not require any additional installation.

- **Brake connection for DM..K** Part no.: 1070 084 352
  with protective circuitry and brake relay to be plugged onto the module.

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4.9.3 Fibre optics for SERCOS interface

The fibre optics are used to interconnect all inverter modules with SERCOS interfaces and to close the circuit with a control or a PC as master.
For each three-phase module, one fibre optic is used for connecting the module to the left-hand neighboring module. The first DM module of the set and the last DM module are connected to the master.



Ready line, double-ended with connectors:

Lengths		Use	Part no.:
A	23 cm	DM 4A to DM 85B (without strain-relief clamp)	1070 917 886
B	33 cm 43 cm	DM 140D (without strain-relief clamp) DM W290F (without strain-relief clamp)	1070 917 884 on request
C	2 m 5 m 10 m	Connection to master (without strain-relief clamp)	1070 917 885 1070 917 887 1070 918 956

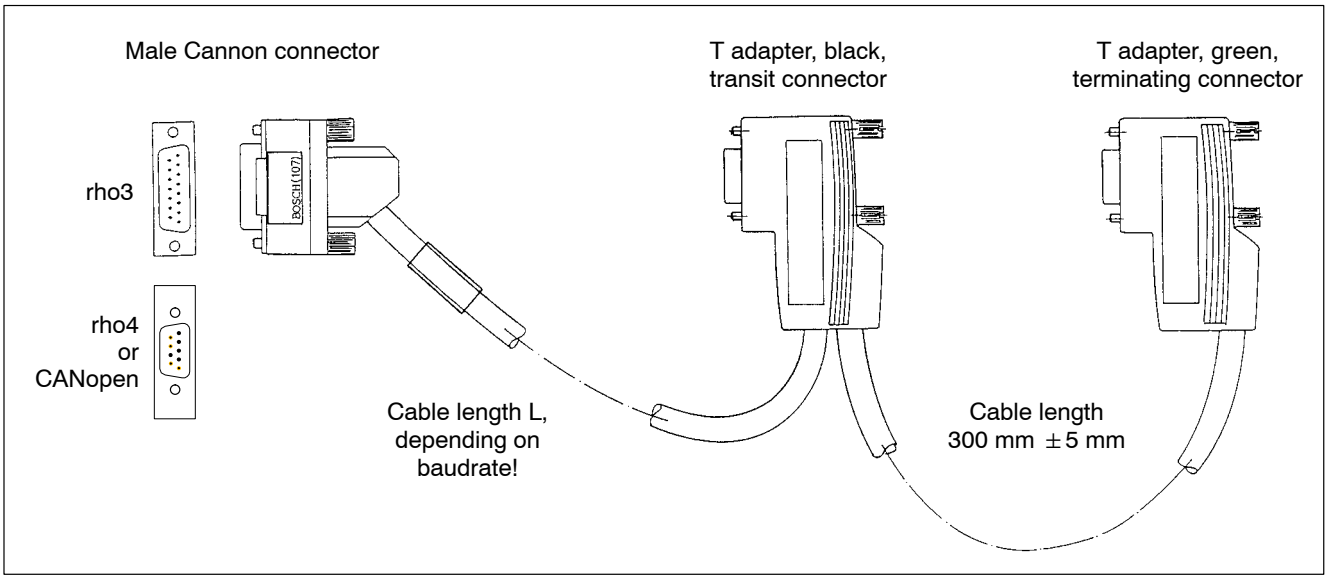
☞ **For extensions of the module cross-connection X810 (signal lead) and X820 (24V lead), please refer to part numbers on page 8–4.**

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4.9.4 Cable for CAN bus

We recommend using prefabricated power and encoder cables made by Bosch for the CAN bus. The permissible cable length between the controller and the drives depends on the baudrate setting.

Baudrate	Total cable length
1000 Kbit/s	25 m
800 Kbit/s	50 m
500 ... 10 kBit/s	100 m



Prefabricated CAN cables, shielded

Connector system, control unit side	Number of axes	Part no. (cable length L = 2.5 m)*
Cannon, 15-pin (rho3)	2	1070 919 941
	3	1070 919 944
	4	1070 919 947
	5	1070 919 950
	6	1070 919 953
Cannon, 9-pin (rho4, CANopen)	2	1070 919 956
	3	1070 919 959
	4	1070 919 962
	5	1070 919 965
	6	1070 919 968
	7	1070 919 971
	8	1070 919 974

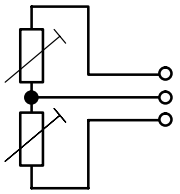
* Part numbers of cable lengths L = 3.5 and 5 m on request

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4.10 Built-in motors with Servodyn-D

Conditions for operating a built-in motor:

- Two **NTC resistors**, 600 mm long (2 x part no. 1070 076 937) are integrated in the winding overhangs U and V of the stator winding for temperature monitoring.



- One motor encoder specific for the installation facilities:
  - **Single-turn encoder ROC 413** with electronic rating plate, Messrs. Heidenhain (refer to section 4.10.1).
    Suitable prefabricated cable subassembly including installation box, angular, part no. 1070 919 781.

  - **Gear encoder KWG2EP** with electronic rating plate, Messrs. VS-Sensorik (refer to section 4.10.2).

Encoder type	Gear type	
	Module m	Number of teeth
KWG2EP-13K	0.3	256
KWG2EP-13G	0.3	512
KWG2EP-15K	0.5	256
KWG2EP-15K	0.5	512

Address: VS Sensorik GmbH,
Max-Planck-Str. 3, D-85716 Unterschleißheim,
Tel: (+49) -89 3 10 50 16, Fax: (+49) -89 3 10 33 83

  - **Gear encoder MiniCoder GEL 244K** without electronic rating plate, Messrs. Lenord & Bauer (cf. section 4.10.3).

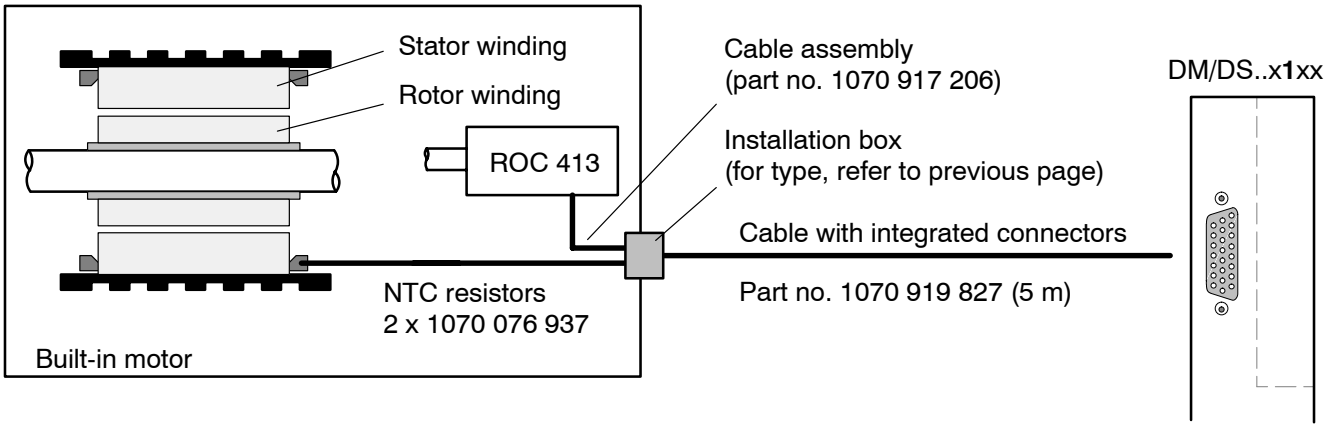
Address: Lenord & Bauer
Dohlenstr. 32, D-46145 Oberhausen
Tel: (+49) -208 99 63-0, Fax: (+49) -208 67 62 92

- **Installation box** of plug-in encoder system for gear encoder
  - Fa. Interconnectron, Deggendorf, Type:
    - SEA B 17A MR EN 000 02 (90° angular), or
    - SEF A 17A MR EN 000 03 (straight)

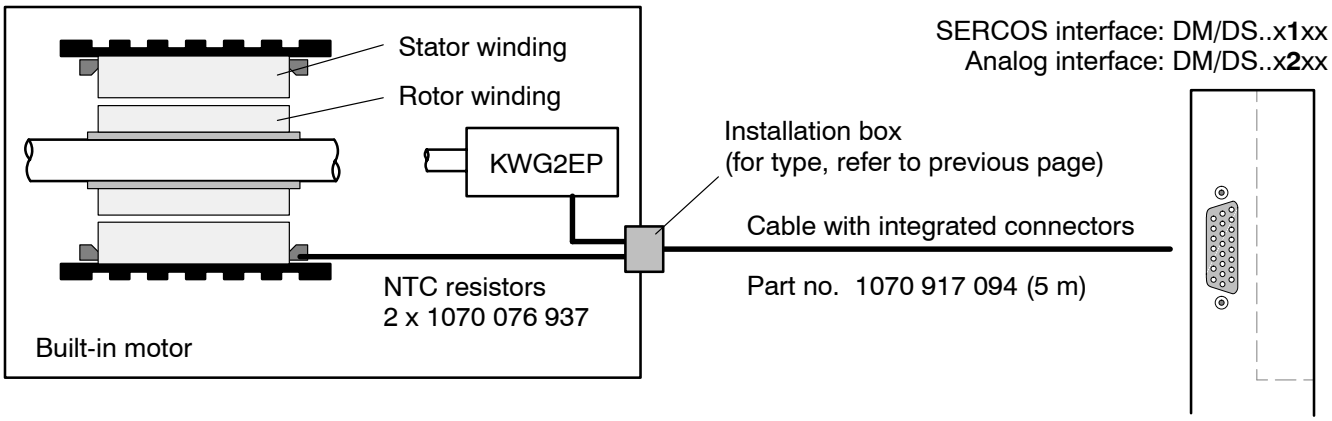
  - Fa. Intercontec Pfeiffer GmbH, Type:
    - A EW C 086 NN 00 00 0007 000 (90° angular), or
    - A EG A 086 MR 04 00 0005 000 (straight)

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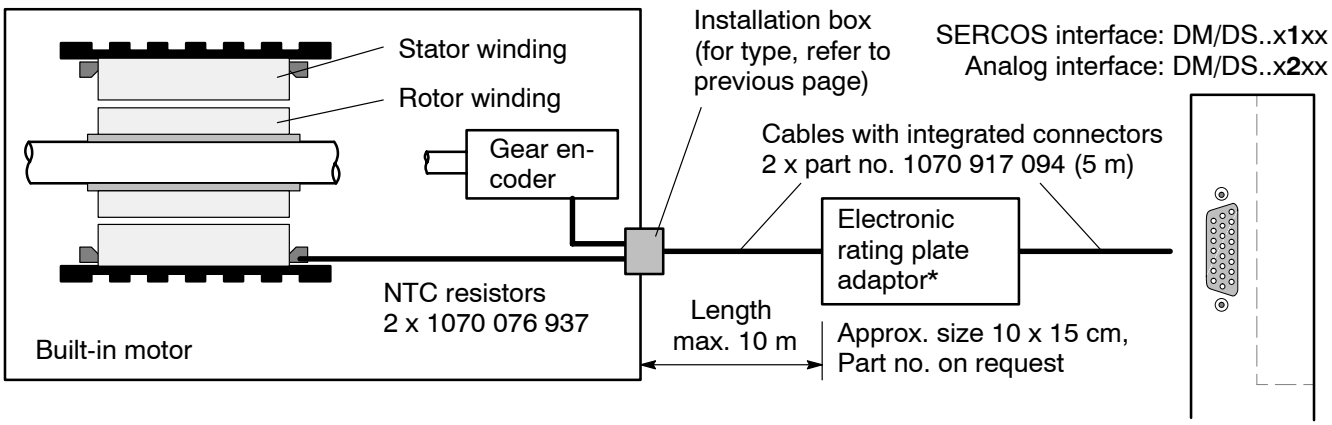
4.10.1 Built-in motor with single-turn encoder type ROC 413



4.10.2 Built-in motor with gear encoder type KWG2EP



4.10.3 Built-in motor with gear encoder type MiniCoder GEL 244K



* Electronic rating plate adaptor only with analog interface; with other interfaces, data storage in the inverter, For connection, refer to section 4.10.2.

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4.11 Linear motors with Servodyn-D

- Servodyn-D may be used to operate synchronous linear motors of different manufacturers.
- Standard inverters with SERCOS interface for linear motors up to a nominal force of 6600 N.
- Their use is subject to an absolute length measuring system with EnDat interface, e.g. type LC 181.

Motor/module combinations:

Linear motors				**Design (S1, clock frequency 8 kHz)**					
Machining force		Rated current, typically		Motor/module combination					
F_N [N]	F_{max} [N]	I_N [A]	I_{max} [A]	DM.. 15K	DM.. 30K	DM.. 30A	DM.. 45A	DM.. 85B	DM.. 140D
790	1720	5.6	14	■	■	■			
1580	3450	11	28			■	■		
1475	3250	11	28			■	■		
2200	4850	15	37				■	■	
2950	6500	22	56					■	■
2400	5300	16	40				■	■	
3600	7920	21	54					■	■
4800	10600	32	80					■	■
3300	7300	22	56					■	■
4950	10900	34	85						■
6600	14500	45	112						■

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Notes:

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5 Voltage supply

5.1 Supply module

5.1.1 Determining the VM rating

Supply modules are configured for the required rated power. A corresponding reserve should be provided for process-related, short-time overloads.

Calculating the rated power

The rated power is determined by the rms rated current of the module and the rated voltage at the installation site (see Technical Data in section 5.1.2).

☞ **For supply voltages which deviate from 400 V AC, observe the variant values for the rated power!**

1. Calculate the required rated power per axis:

Asynchronous motors with spindle characteristic curve (load at high speed):

$$P_N = \frac{P_W}{0.8}$$

P_N = Rated power
P_W = Shaft output according to motor characteristic curve
0.8 = Total efficiency

Servo motors type SF, SR with spindle characteristic curve (load at rated speed):

$$P_W = \frac{M_N\,[Nm] \cdot 2\pi \cdot n_N\,[min^{-1}]}{60}\ [W]$$

$$P_N = \frac{P_W}{0.8}$$

M_N = Torque at n_N according to motor characteristic curve
n_N = Rated speed according to motor data

Servo motors type SF, SR with servo characteristic curve

$$P_W = \frac{M\,[Nm] \cdot 2\pi \cdot n\,[min^{-1}]}{60}\ [W]$$

$$P_N = \frac{P_W}{0.8}$$

M = Torque at n according to motor characteristic curve
n = Operating speed of application

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2. Establish rated power of supply module:

   Take into account simultaneity factor K_1...K_9 per axis. A factor of approximately 0.8 per axis can be assumed.

$$P_{NVM} = K_1 \cdot P_{Naxis1} + K_2 \cdot P_{Naxis2} + ... + K_9 \cdot P_{Naxis9}$$

☞ **A maximum of 9 axes may be connected to one VM, refer to section 5.2.**

3. Select supply module:

   The supply module must reach the calculated rated power P_{NVM}. Select the suitable supply module from the data table on page 5–6, taking into consideration the ambient temperature and the installation altitude.
   In cases of heavy load it should also be checked whether the peak output made available by the supply module is sufficient.

Calculating the peak output

The peak output for process-related, short-time overloads is limited by preloading of the power section: if, for example, the power unit was preloaded with the rated rms power, no further overload is possible (peak output = rated power).

☞ **For supply voltages which deviate from 400 V AC, observe the variant values for the peak output!**

1. Calculate the required peak output per axis:

Asynchronous motors:

$$P_{max} = \sqrt{3} \cdot I_{max} \cdot U_N \cdot 0.9$$

P_{max} =	Peak output
I_{max} =	Maximum current of module according to section 4.7.1 and 4.7.2
U_N =	Motor voltage (DU motors: U_N = 415 V)
0.9 =	cos ϕ

Servo motors:

$$P_{max} = \frac{M_{max}\,[Nm] \cdot 2\pi \cdot n\,[min^{-1}]}{60 \cdot 0.8}\ [W]$$

M_{max} =	Max. torque with n_0 according to motor characteristic curve
n =	Operating speed of application
0.8 =	Total efficiency

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2. Establish peak output of supply module:
   When specifying the required peak output of the supply module, it is vital that the actual simultaneity factor is K_1...K_9 is taken into account. This is because a simultaneous occurrence of the peak outputs of all axes can generally be avoided through appropriate programming of the movement sequence.
   However, if the supply module should reach its peak output, an overload can be avoided through a programmable reduction of the current limit in the axes.

$$P_{maxVM} = K_1 \cdot P_{maxaxis1} + K_2 \cdot P_{maxaxis2} + ... + K_9 \cdot P_{maxaxis9}$$

☞ **The simultaneity factors must be known before the peak output can be calculated.**

Calculating the brake rating

Supply modules with energy recovery (VM..B,C,D,F) feed back the braking energy to the supply network, therefore, their braking power need not be considered.
Only for supply modules with an integrated ballast switch (VM..K), overloads in the braking power are not permissible.

The braking energy depends:

- on the mechanical energy of rotation of all axes
- on the number of braking processes per time unit.

In any case, the limit value of the supply module must not be exceeded.

★ Add up the **energy of rotation** of all axes by the following formula.

$$Wrot = \tfrac{1}{2} J \left(\frac{\{2 \times \pi \times n\}}{60} \right)^2 [Ws]$$

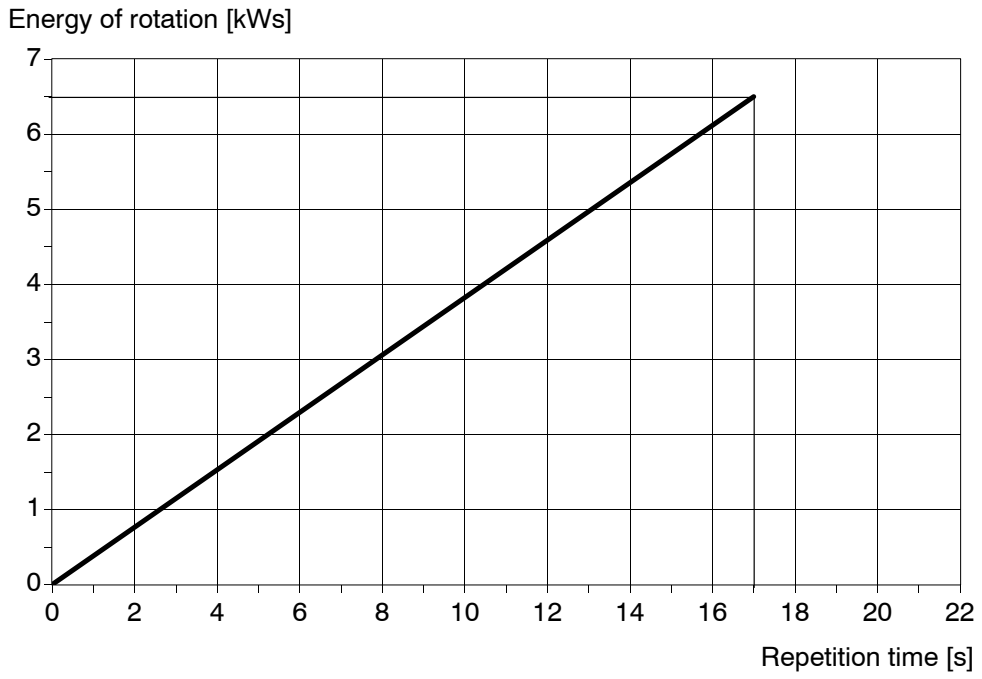
$Wrot$ = energy of rotation of all axes
J = total moment of inertia in kgm^2
n = motor speed in min^{-1}

★ Calculate the required **repetition time** on the basis of the operating cycle.

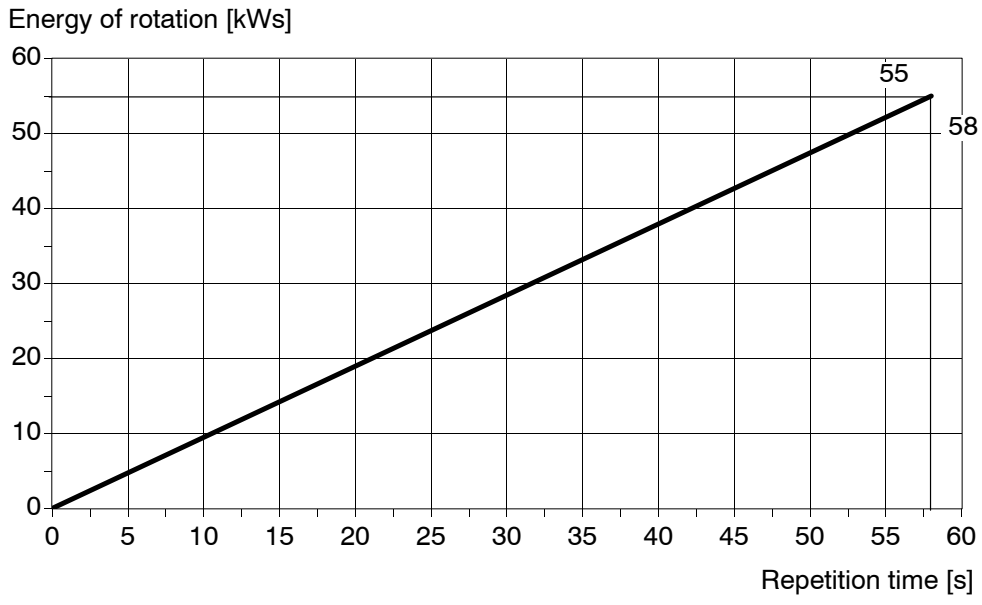
★ Use the following characteristics to make sure that the intersection between the total energy of rotation and the required repetition time is below the curve.
If the intersection is above this curve, a VM with energy recovery has to be used.

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VMA 21 KB with internal ballast switch P = 400 W

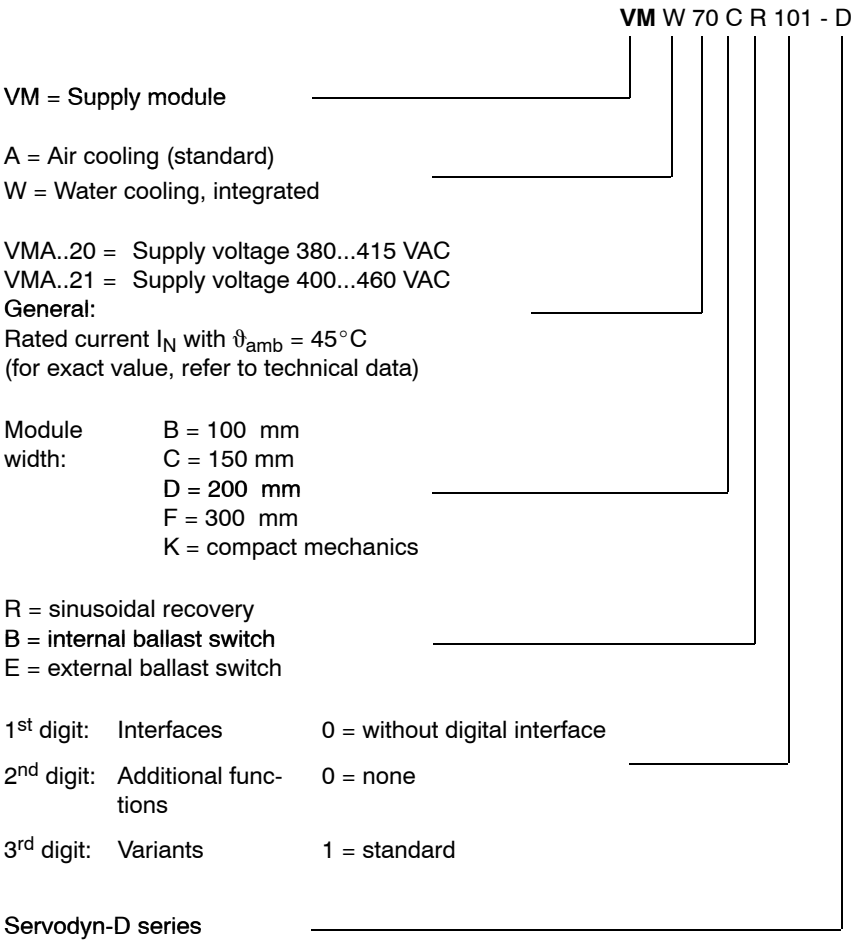


VMA 21KE with external ballast switch P = 1000 W



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5.1.2 Technical data: supply module VM



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		VMA..K			VMA..B,C,D,F with mains-friendly energy recovery			
Module type	Unit	VMA 21KB[1)]	VMA 21KE[1)]	VMA 21KR	VMA 35B	VMA 70C	VMA 90D	VMW 180F[2)]
Rating plate data UL variety: Input Output		3ph, 50/60 Hz 460 V, 20 A 670 V, 24 A	–	–	–	–	–	–
Supply voltage	VAC	3 x 400...460 ± 10%, 48...62 Hz						
Rated voltage	VAC	400, 50 Hz						
DC link voltage	VDC	670, regulated						
Rated current I_N (mains) with ϑ_{amb} = 45°C	A	23		23	35	68	83	180
Rated power P_N with ϑ_{amb} = 45°C Derating 45...55°C	kVA W/K	16 0,62		16 0,60	24 0,95	47 1,30	57 1,75	124 3,30
Peak output	kVA	20		20	34.6	70	97	146
Ballast switch		internal	external	–	-	-	-	-
Max. one-time braking energy	Ws	6500	58000	–	-	-	-	-
Max. continuous braking power	W	400	1000	–	-	-	-	-
Power demand from 24 V power supply	A	24 VDC according to EN 61 131 1.0		2.1	2.3	2.7	3.1	2.5
Max. power loss in switch cabinet	W	220		200	460	800	970	380[3)]
Mass	kg	15.0		8.0	11.1	14.3	18	40
Module width	mm	100				150	200	300
Backplane modules Type		not necessary			RMB/VM	RMC/VM	RMD/VM	not neces-sary
PM personality module		–		PM VM	PM VM			
Mains connection module/ Line wiring module		NV20 or NV21		NAA 21	NAA 35	NAA 70	NAA 90	NAA 180
Rated power at ϑ_{amb} = 45°C	kVA	24		16	24	47	62	124
Line reactor NE		not necessary		NE 21	NE 35	NE70	NE70/1	2 x NE 70	NE 180
Rated power at ϑ_{amb} = 45°C	kVA	-		16	24	41.7	47	57 (2 x 41.7)	125
Max. power loss	W	-		120	250	380	400	500	240

ϑ_{amb} = ambient temperature

1) VM 20K with identical performance data for a supply voltage of 380...415 VAC (without UL)

2) Performance data for water inlet temperature = 40 °C, for water cooling prerequisites, refer to page 4–19.

3) Temperature rise of the cooling water: 4.5K/100A

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5.2 24 V power supply

5.3 Determining the power supply rating

The VM supply module and the DS inverter must be supplied by an external 24V DC load power supply module in accordance with EN 61 131 (mean value 20.4 – 28.8 V).



CAUTION
The 24VDC input voltage must conform to the requirements of 'safety separation'.
It is particulary important that the requirements of overvoltage category III are observed.

In a modular design, the 24 VDC supplied to the unit are transmitted by the VM:

- 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.

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
VMA W180F	–	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**

☞ **For the 24 VDC power input of the stand-alone inverters, refer to Technical data, page 4–12.**

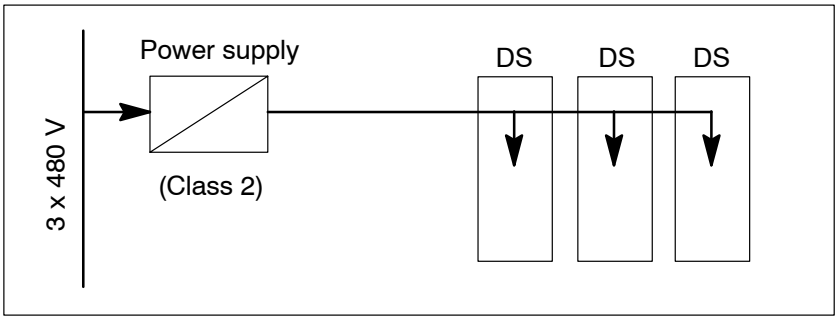
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5.4 Additional requirements for UL/CSA

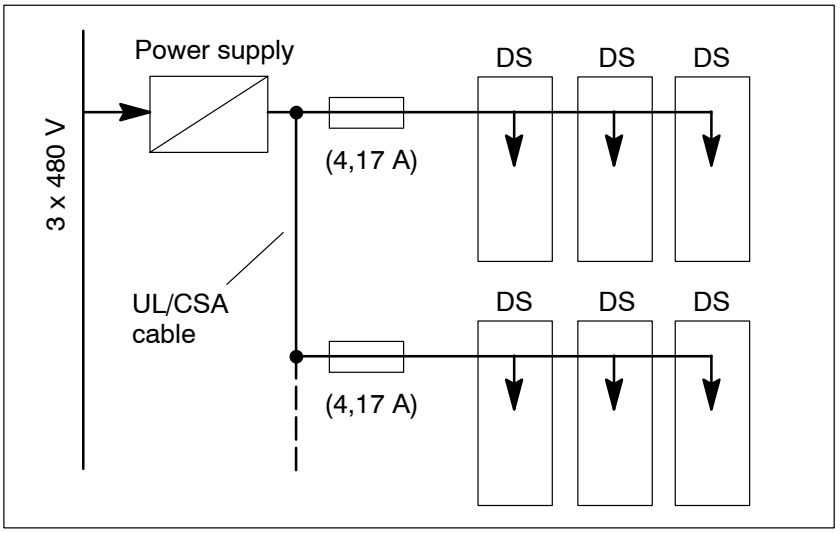
Additional measures must be taken for the 24V supply in order to guarantee UL/CSA-compliant operation.

Stand-alone inverter DS

- **24 V/100 VA**
  - Use class 2 power supply to UL 1310, max. 3 inverters possible

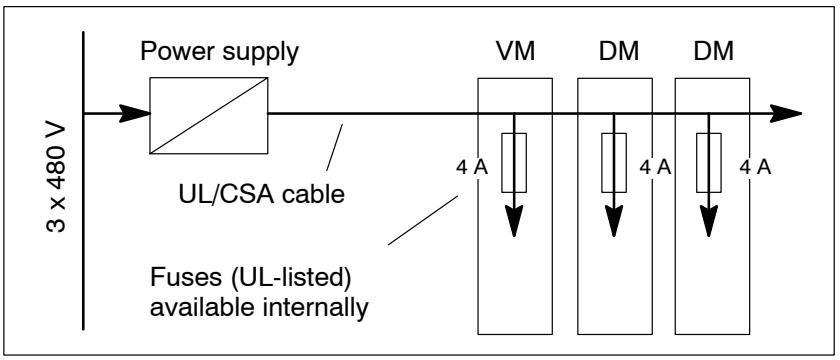


- **24 V/20 A**
  - Use fuse 4,17 A, UL-listed (3 inverters per fuse)
  - Fuse cable in UL/CSA-compliant design



Modular inverters DM

- **24 V/20 A**
  - VM cable in UL/CSA-compliant design



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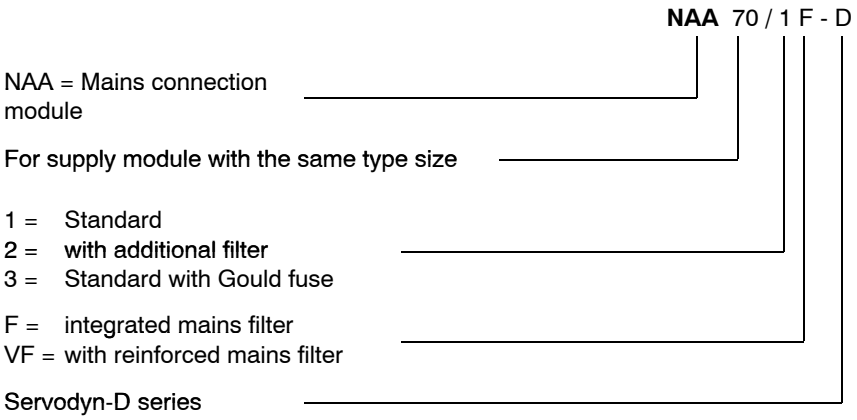
5.5 Line connection

- A **VM with energy recovery** is connected to the supplying mains via a mains connection module NA and a line reactor NE.
- A **VM with internal/external ballast switch** or a **stand-alone inverter** is connected to the supplying mains via the line wiring module NV.

5.5.1 Mains connection module NA

The mains connection module is selected depending on the type size of the supply module with energy recovery.

Mains connection modules with an **additional filter** (NAA ../2..-D) include an additional filter with symmetrical effect for the interference suppression of the switching rate-dependent content in the mains current. They shall be preferably used when connecting the system to a public network.



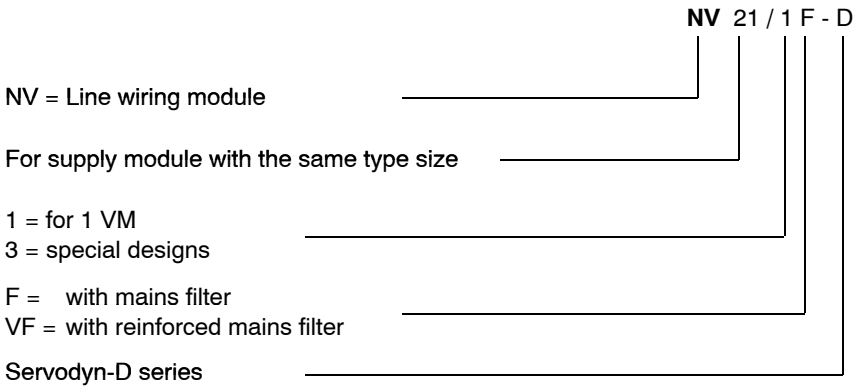
Module type	Unit	NAA 21	NAA 35	NAA 70	NAA 90	NAA 180
for supply modules		VMA 21KR	VMA 35B	VMA 70C	VMA 90D	VMW 180F
Supply voltage	VAC	3 x 400...460 ± 10%				
Rated voltage	VAC	400				
System frequency	Hz	48...62				
Rated power with ϑ_{amb} = 45°C	kVA	16	24	47	62	124
Fuse	Type	FERRAZ capsule-type fuse, extra fast 50 A/690 V	Jean Müller M00üf1, high-speed 63 A/660 V	Jean Müller M00üf1, high-speed 100 A/660 V	Jean Müller M00üf1, high-speed 125 A/660 V	Jean Müller M1üf1, high-speed 250 A/660 V
	Part number	3 x 1070 921 621	3 x 1070 917 648	3 x 1070 917 649	3 x 1070 918 481	3 x 1070 919 804
Power contactor		integrated				
Charging connection		integrated				
Electronic functioning		Transforming of synchronisation voltage, coding				
Mains filter		Integrated, depending on design, cf. page 5–12				
Cooling		Natural convection				
Mass	kg	8.5	8.4	8.4	8.4	13

ϑ_{amb} = ambient temperature

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5.5.2 Line wiring module NV

The NV is selected with an internal/external ballast switch depending on the type size of the supply module.



Module type	Unit	NV 20..	NV 21/1F	NV 21/3F
for inverter		VMA 21K or DS..K		
Rating plate data UL variety: Input Output		–	3ph 50/60 Hz, 460 V, 25 A 3ph 50/60 Hz, 460 V, 25 A	3ph 50/60 Hz, 460 V, 32 A Output1: 3ph 50/60 Hz, 460 V, 16 A Output2: 3ph 50/60 Hz, 460 V, 16 A
Supply voltage	VAC	3 x 400...460 ± 10%		
Rated voltage	VAC	400		
System frequency	Hz	48...62		
Rated power with ϑ_{amb} = 45°C	kVA	24		
Fuse LTL00	Type	Jean Müller M00üf2, high-speed 35 A/500 V		
	Part number	3 x 1070 918 727		
Power contactor		integrated		
Mains filter		integrated, cf. page 5–12		
Cooling		Natural convection		
Mass	kg	10.6	10.6	

ϑ_{amb} = ambient temperature

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5.5.3 Line reactor NE

The line reactor type NE is installed between the mains connection module NAA and the supply module with energy recovery. It decouples the DC link from the mains power supply.

NE 70 / A1 - D

NE = Line reactor

For supply module with the same type size
(for higher power, refer to table)

Design:
1st digit: A = standing, without cover
B = modular design in housing
2nd digit: 1 = reinforced design

Servodyn-D series

Type	Unit	NE 21/B	NE 35/A	NE 70/A	NE 70/A1	2 x NE 70/A	NE 180/A
for supply modules		VMA 21KR	VMA 35B	VMA 70C		VMA 90D*	VMW 180F
Supply voltage	VAC	3 x 400...460 ± 10%					
Rated voltage	VAC	400					
System frequency	Hz	48...62					
Rated power with ϑ_{amb} = 45°C	kVA	16	24	41.7	47	57 (2 x 41.7)	125
Inductance	mH	1.8	1.0	0.7	0.7	2 x 0.7	0.4
Max. power loss	W	120	250	380	400	500	3 x 240
Connection	m	Terminals	Cables, length 1 m each				Cables, length 2 m each
Mass	kg	11	15	23	25	2 x 23	39

ϑ_{amb} = ambient temperature
* For one VM, two NEs shall be connected as shown in the circuit diagram on page 4–6.

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5.5.4 External mains filter

An external mains filter is to be provided in the supply cable in order to ensure compliance with the EMC directive (89/336/EEC).
Thus, limit class A (B on request) for radio interference is satisfied in accordance with EN 55 011 (VDE 0875).

The 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.

Class A mains filter	Part no.	Rated voltage [VAC]	Rated current [A]	Power loss [W]	Mass [kg]	Max. total length of motor power cable shielded
Mains filter, UL/CSA listed	1070 918 475	3 x 480	16	9	2.3	25 m
	1070 918 476		25	12	3.9	
	1070 918 477		36	15	4.5	
	1070 918 478		50	15	5.0	
	1070 918 479		80	20	10.3	
	1070 919 011	3 x 440	120	33	11.7	25 m
	1070 920 600		150	27	10.0	
	1070 920 599		180	39	13.0	
	1070 920 963 (on request)	3 x 480	36	15	2.1	150 m
			80	24	4.5	
NV 20/1F	1070 078 431	3 x 480	35	28		25 m
NV 20/1VF	1070 084 594		36	28		150 m
NV 21/1F	1070 084 067		35	28		25 m
NAA 35/1F	1070 080 861	3 x 480	36	41		25 m
NAA 35/1VF	1070 083 958		36	41		150 m
NAA 35/2F	1070 080 402		36	42		25 m
NAA 35/2VF	1070 083 959		36	42		150 m
Special filter	1070 921 416	3 x 440	36	22	25	300 m
	1070 921 417		65	32	30	

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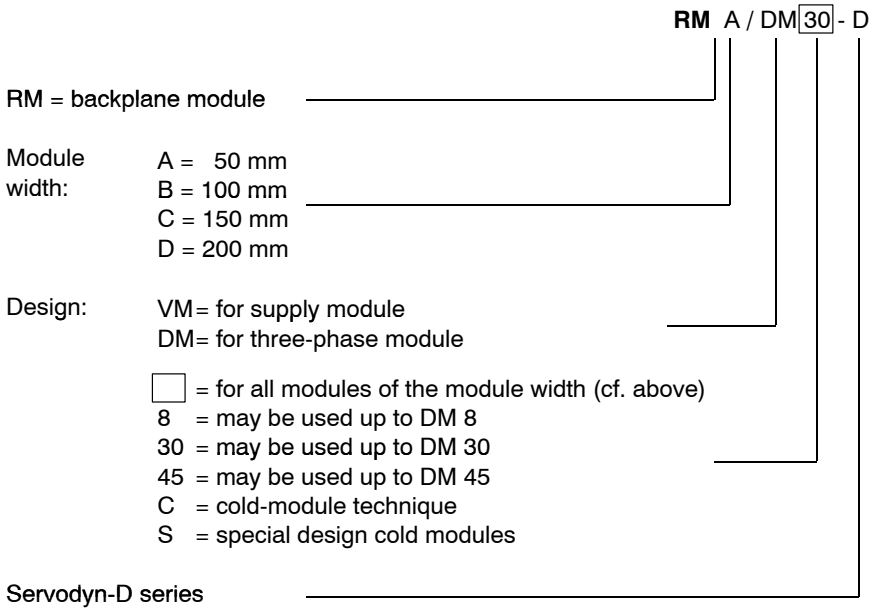
6 Accessories, options

6.1 Backplane modules RM

Backplane modules are necessary for supply modules type VM...B,C,D and for three-phase modules type DM...A,B,D.
They are selected according to the DM module used and according to the module width:

Inverter modules	Backplane modules		Design	
	Standard	Cold module	Number of fans (standard design)	Width
VMA 35B VMA 70C VMA 90D	RMB/VM RMC/VM RMD/VM	RMB/VMC RMC/VMC RMD/VMC	1 2 2	100 mm 150 mm 200 mm
DMA 4A DMA 8A	RMA/DM8	RMA/DMC	–	50 mm
DMA 15A DMA 30A	RMA/DM30		1	
DMA 45A	RMA/DM45		2	
DMA 85B	RMB/DM	RMB/DMC		100 mm
DMA 140D	RMD/DM	RMD/DMC		200 mm

Type designation



Cold module special design IP20

When the cold module is installed, the heat sinks of the inverters protrude from the switch cabinet through the mounting plate.
The cold module special design includes an assembly kit IP20 without seal to the switch cabinet interior space. Therefore, it can only be used if a closed ventilation duct is used outside the switch cabinet for cooling the modules.

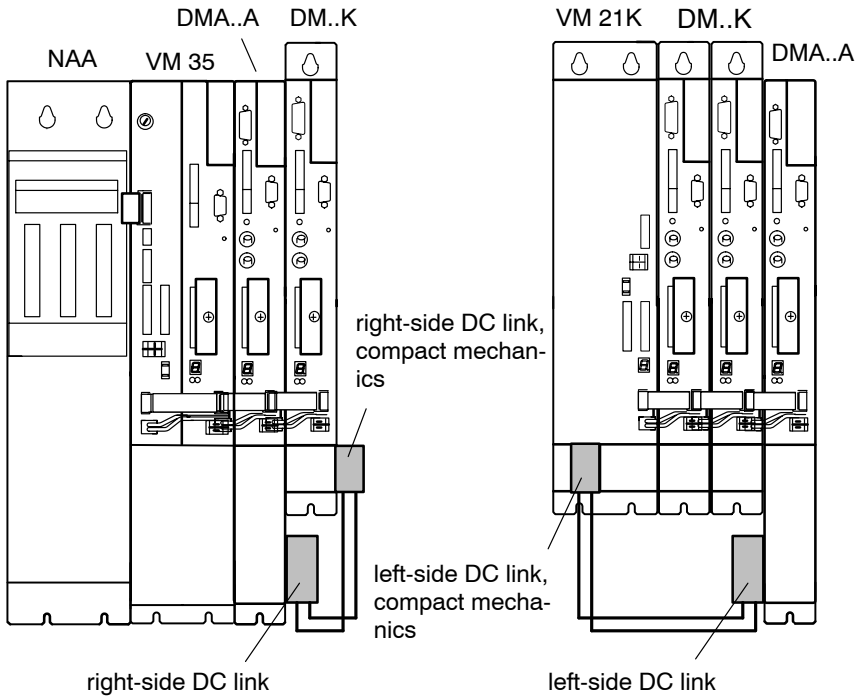
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6.2 DC link connection

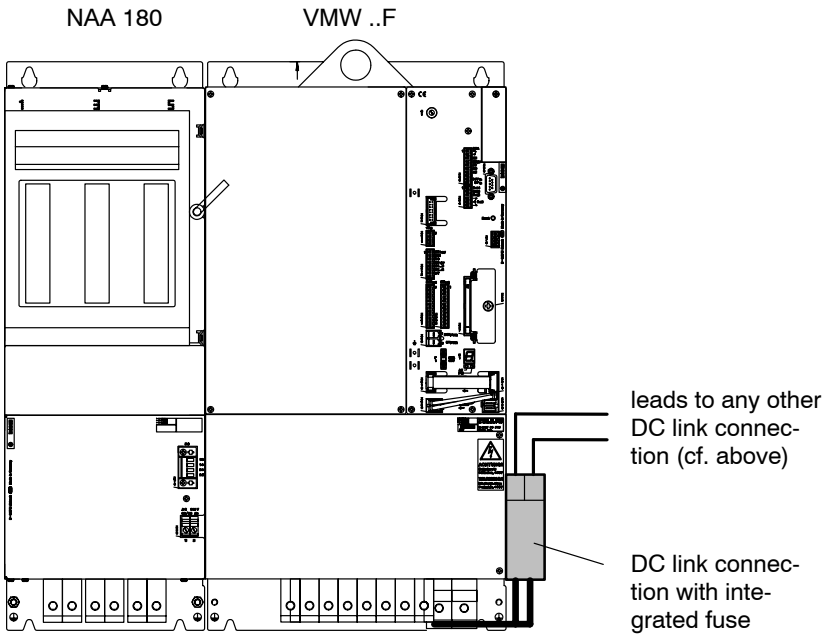
The DC link connection (DC link) makes available an externally accessible DC link terminal, via which the DC link can be flexibly extended.

Module combinations

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.



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



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☞ **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.**

Two-row module arrangement

- Using the **DC link connection** option, DM..A,B,D with backplane module can be operated in two rows on top of each other at one 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.

For extending the signal cross-connection X810 and the 24V cross-connection X820, prefabricated cables are available. For part numbers, refer to page 8–4.

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6.3 Personality module

For the following inverter modules, a separate personality module must be ordered and plugged into the inverter:

Inverter module	Personality module	Used for
VMA..B,C,D,F VMA..KR	PM VMA..–D	▶ for supply module
DM..K and DM..A,B,C, F with SERCOS interface	PM SMA..–D	▶ for synchronous motor SF, SR
	PM FOA..–D	▶ asynchronous motor DU or ▶ synchronous motor SF, SR without field-weakening range, but with full spindle functionality

Type designation

PM VM A / 00 0 - D

PM = Personality Module

VM = for supply module
SM = for synchronous motors
FO = for asynchronous motors, regulated
OS = without software

A = Standard
S = with RSU
(redundant safety monitoring)

00 = Standard
02 = absolute endless axis

Customer-specific variants

Servodyn-D series

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6.4 Memory Card

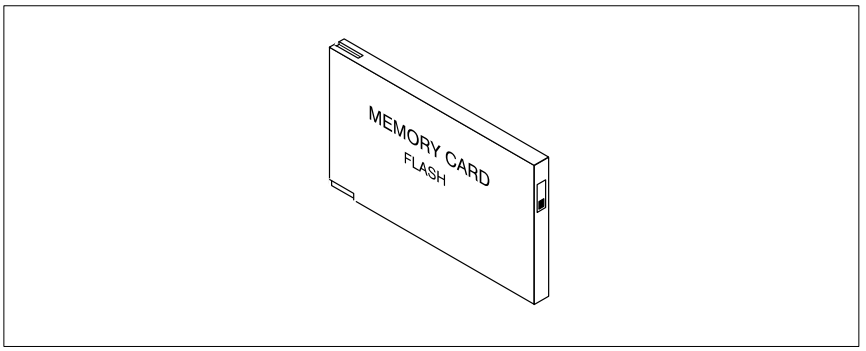
The Memory Card is a firmware data carrier for the following drive inverters:

- VMA 21KR with energy recovery
- VMA..B,C,D,F with energy recovery
- DM..K and DM..A,B,C,F with SERCOS interface

The following Memory Cards are available for firmware updates and for factory settings of parameters:

- VM for supply modules
- SM with servo functions
- FO with spindle functions
- OS without software

☞ **Each firmware version is stored on a separate Memory Card and can also be ordered retroactively, if new versions have been introduced. However, no maintenance will be provided for old firmware versions.**



Type designation

MC VM x.xx A 00 - D

MC= Memory Card

VM= for supply module
SM= for servo functionality
FO = for spindle functionality
OS = without software

Firmware version

A = Standard

Customer-specific variants

Servodyn-D series

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6.5 Commissioning and service system DSS-D

The DSS is a program for commissioning, diagnostics and services of all DM and DS modules.

The following functions are included in the DSS-S:

- drive parameter setting
- parameter archivation
- software download (not for SERCOS interface)
- display of operating data
- status and diagnostics information display
- setpoint value generator
- oscillograph function

Conditions for using the DSS-D:

- IBM-compatible PC
- operating system Windows 95, 98, NT
- 4 MB RAM
- 15 MB fixed disk memory available
- free COM port



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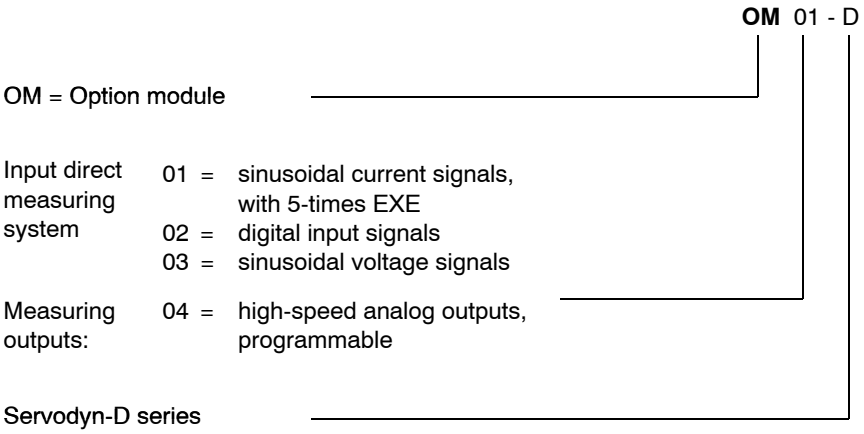
6.6 Option modules

Option modules are additional modules with different functions. Every axis module, except DM/DS..8001 (frequency inverter with U/f characteristic), has a slot for an option module.

The application range of option modules furthermore depends on the set-point interface selected:

Setpoint interface	**Input direct measuring system (OM 01, 02, 03)**	**Measuring outputs (OM 04)**
SERCOS interface	●	●
Analog interface	OM 03	●
Motion control	–	●
CAN bus	–	●
PROFIBUS-DP	–	●
Frequency inverter (anlog 10 bit)	–	–

Type designation



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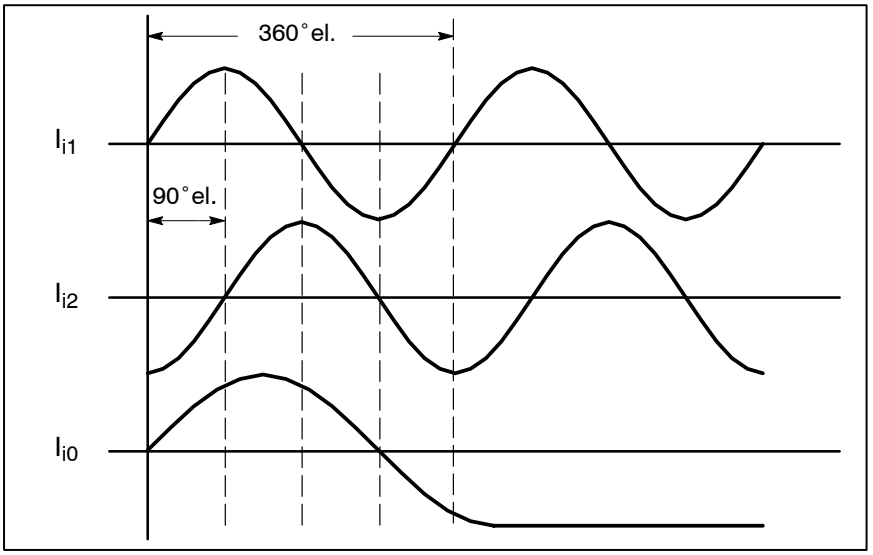
6.6.1 OM 01-D for incremental measuring systems with sinusoidal current signals

Option module with integrated **EXE with 5-times interpolation.**
Encoders with sinusoidal output signals (Heidenhain quasi-standard 11 μA_{pp}) can be connected to the inputs.

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: ≤ 300 mA
- EXE separation factor: 5-times interpolation
- Pulse multiplication: programmable x1, x2, x4
- max. input frequency: ≤ 50 kHz
- Measuring system monitoring: Response to input signals in channels I_{i1} or $I_{i2} \leq$ 4.3 µA
- max. cable length: ≤ 20 m or shorter, cf. manufacturer's data
- Pin assignment: see manual "Interface Conditions"

Signal diagram for measuring system with sinusoidal current signals



Permissible measuring systems

In principle, Heidenhain measuring systems can be connected subject to the following conditions:

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

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Recommended types

Owing to frequent modifications and the increasing range of types, the following list is intended as a guide only.
Other measuring systems are available on request.

- **Angular position measuring systems**
  - RON 255, RON 705, RON 706, ROD 250, ROD 700
- **Linear measuring systems**
  - LS103, LS107, LS405, LS406, LS704

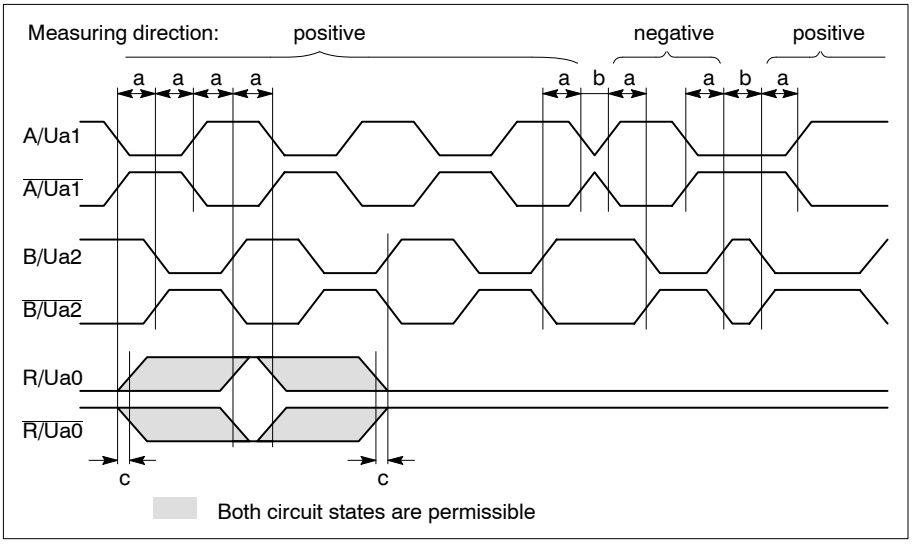
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6.6.2 OM 02-D for digital incremental measuring systems

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 ± 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. flank clearance a between active counting pulses: ≥ 150 ns
- min. flank clearance b with spindle reverse: ≥ 0 ns
- min. safety clearance c for reference signal: ≥ 100 ns
- Measuring system monitoring: a) for cophasal state of channels UA1, UA2 or UA0 ≥ 1,2 µs
  b) Evaluation of $\overline{UAS}$
- max. cable length: ≤ 50 m or shorter if required by manufacturer
- Pin assignment: see manual "Interface Conditions"

Signal diagram for digital measuring system



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Permissible measuring systems

In principle, Heidenhain measuring systems can be connected subject to the following conditions:

- Measuring system for 5 V power supply from option module
- Square-wave signal output
- Line driver to RS 422
- Power input ≤ 300 mA
- Min. flank clearance between active counting pulses ≥ 150 ns

Permissible pulse shape electronics (EXE)

Heidenhain EXEs can also be connected subject to the following conditions:

- Power supply: 5 V from option module or
  230 V AC external
- Square-wave signal output
- Line driver to RS 422
- Max. power input for measuring system **and** EXE with 5V supply: ≤ 300 mA
- Min. flank clearance between active counting pulses ≥ 150 ns

Recommended types

Owing to frequent modifications and the increasing range of types, the following list is intended as a guide only.
Other measuring systems are available on request.

- **Angular position measuring system**
  - Angular position measuring systems for direct connection:
    RON 275, ROD 271
  - Angular position measuring systems via pulse shape electronics EXE 602E, EXE 604C (+5V):
    RON 255, RON 705, RON 706, ROD 250, ROD 700
  - Angular position measuring systems via pulse shape electronics (230 V):
    see Heidenhain recommendations

- **Linear measuring systems**
  - Linear measuring systems for direct connection:
    LS323, LS623
  - Linear measuring systems via pulse shape electronics EXE602E, EXE604C (+5V):
    LS103, LS107, LS405, LS406, LS704,
  - Linear measuring systems via pulse shape electronics (230 V):
    see Heidenhain recommendations

- **Pulse shape electronics (EXE)**
  - With 5 V supply from option module:
    EXE602E, EXE604C
  - With external 230 V supply:
    EXE702, EXE816

☞ **Measuring systems and EXEs must be combined in accordance with the manufacturers' instructions.**
Measuring systems and EXEs with internal monitoring are preferred.

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6.6.3 OM 03-D for incremental measuring systems with sinusoidal voltage signals and absolute measuring systems with EnDat interface

The OM 03 option module provides for the connection of the following direct measuring systems:

- high-resolution rotary encoders
- linear scales
- gear encoders
- absolute measuring systems with an I^2C or EnDat interface.

Technical Data

• Interpolation resolution:	12 bits
• Signal input:	Difference amplifier, $R_i \approx 120\ \Omega$
• Power supply:	+5 V ± 3 %, regulated via sensor leads
• max. permissible power input of the measuring system:	≤ 300 mA
• max. input frequency:	≤ 500 kHz, alternatively ≤ 125 kHz (preferably used, cf. part no. on page 8–4)
• Measuring system monitoring:	UA and UB ≥ 0.2 V_{PP}
• Serial interface:	Line driver and receiver according to RS 422/485
• Transmission rate:	EnDat: approx. 500 kBaud I^2C: approx. 80 kBaud
• max. cable length:	≤ 100 m
• Pin assignment	see manual ”Interface Conditions”

Permissible measuring systems

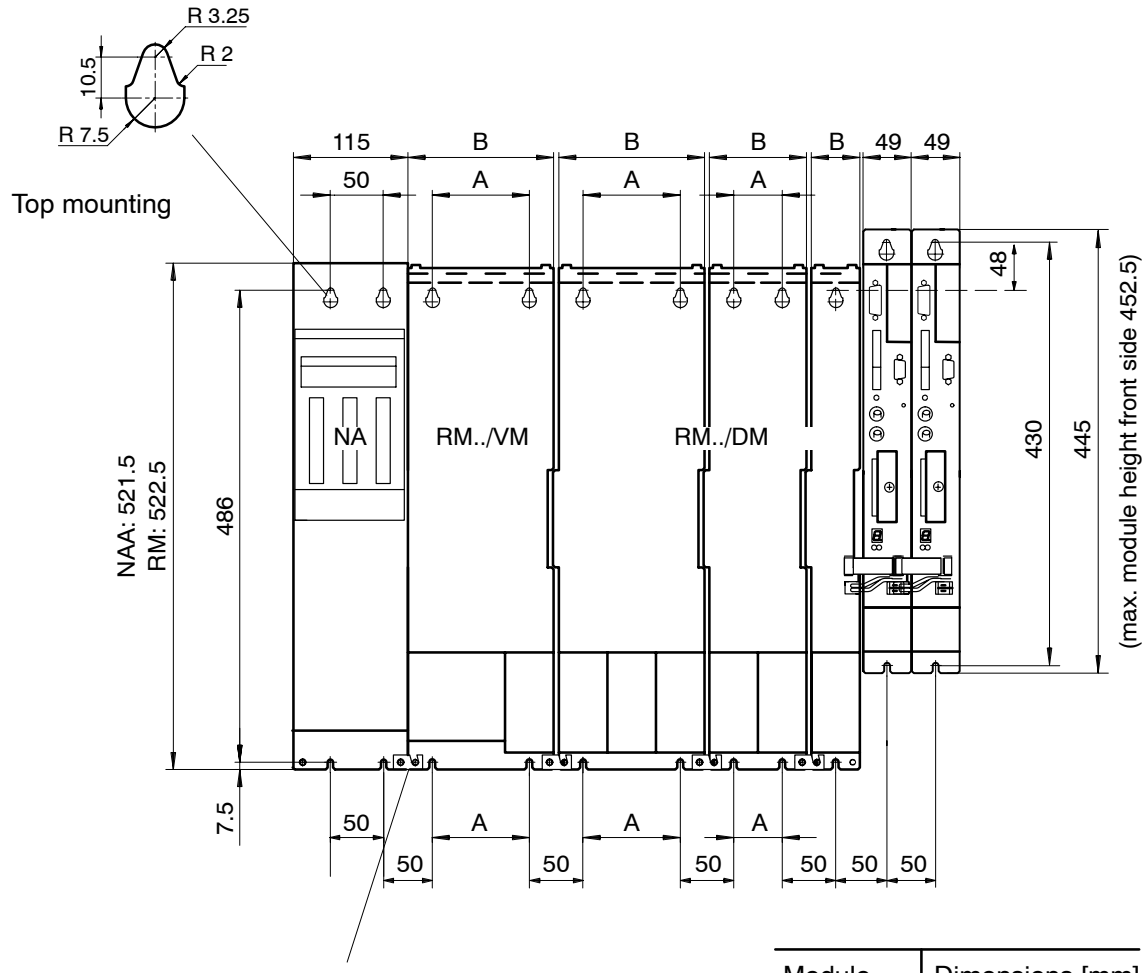
All measuring systems must meet the following interface requirements:

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

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7 Dimensioned drawings

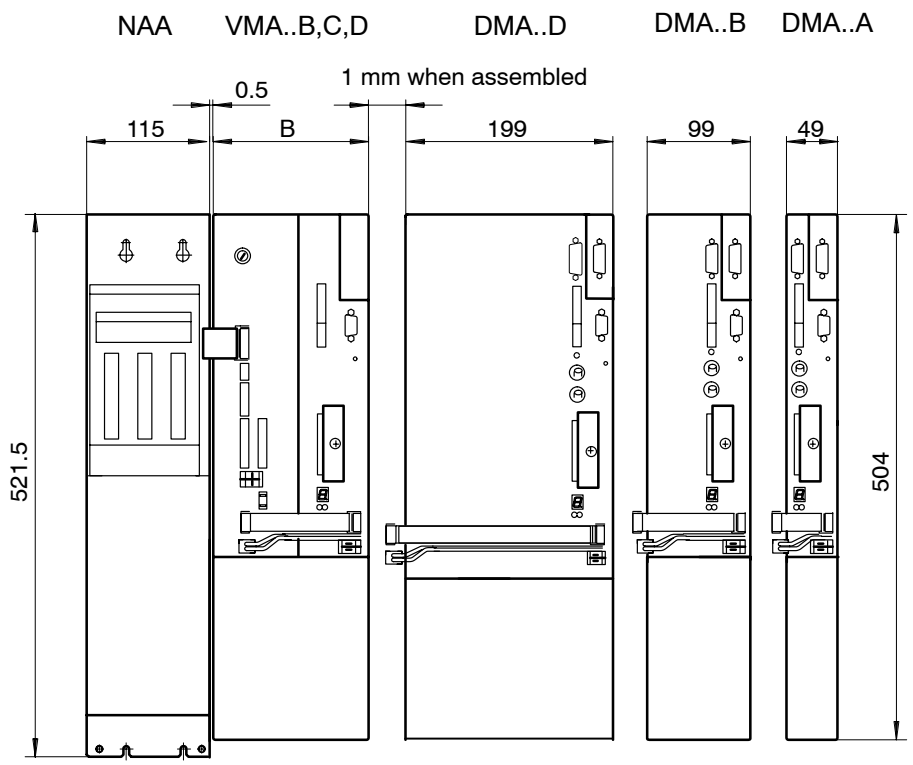
7.1 Backplane modules with mains connection module NAA



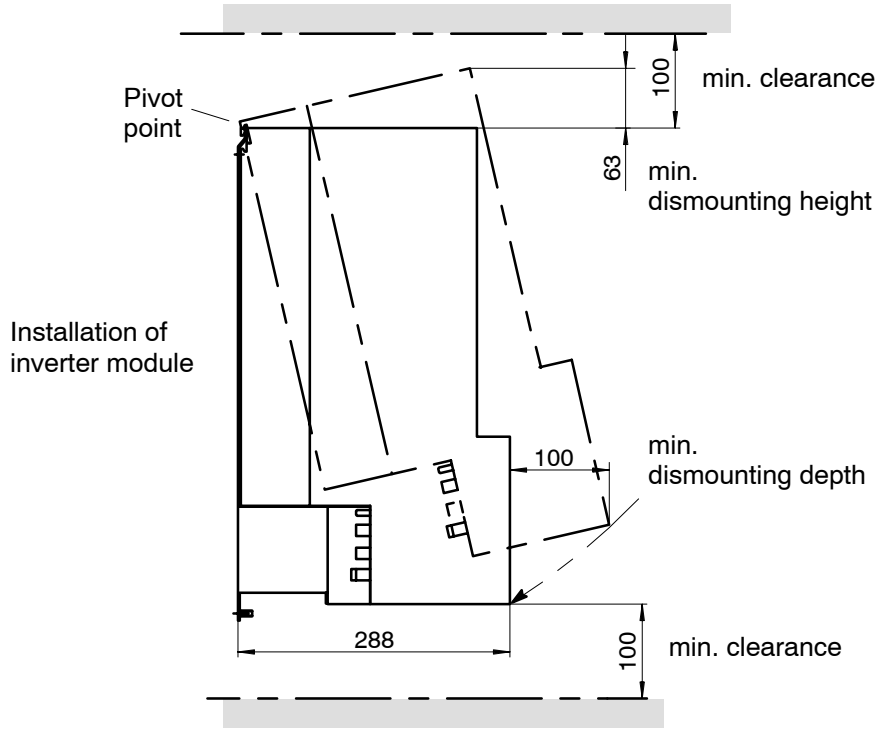
Module type	Dimensions [mm] A	B
RM B/VM	50	100
RM C/VM	100	150
RM D/VM	150	200
RM A/DM	–	50
RM B/DM	50	100
RM D/DM	150	200

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7.2 Supply modules VMA..B,C,D, three-phase modules DMA..A,B,D

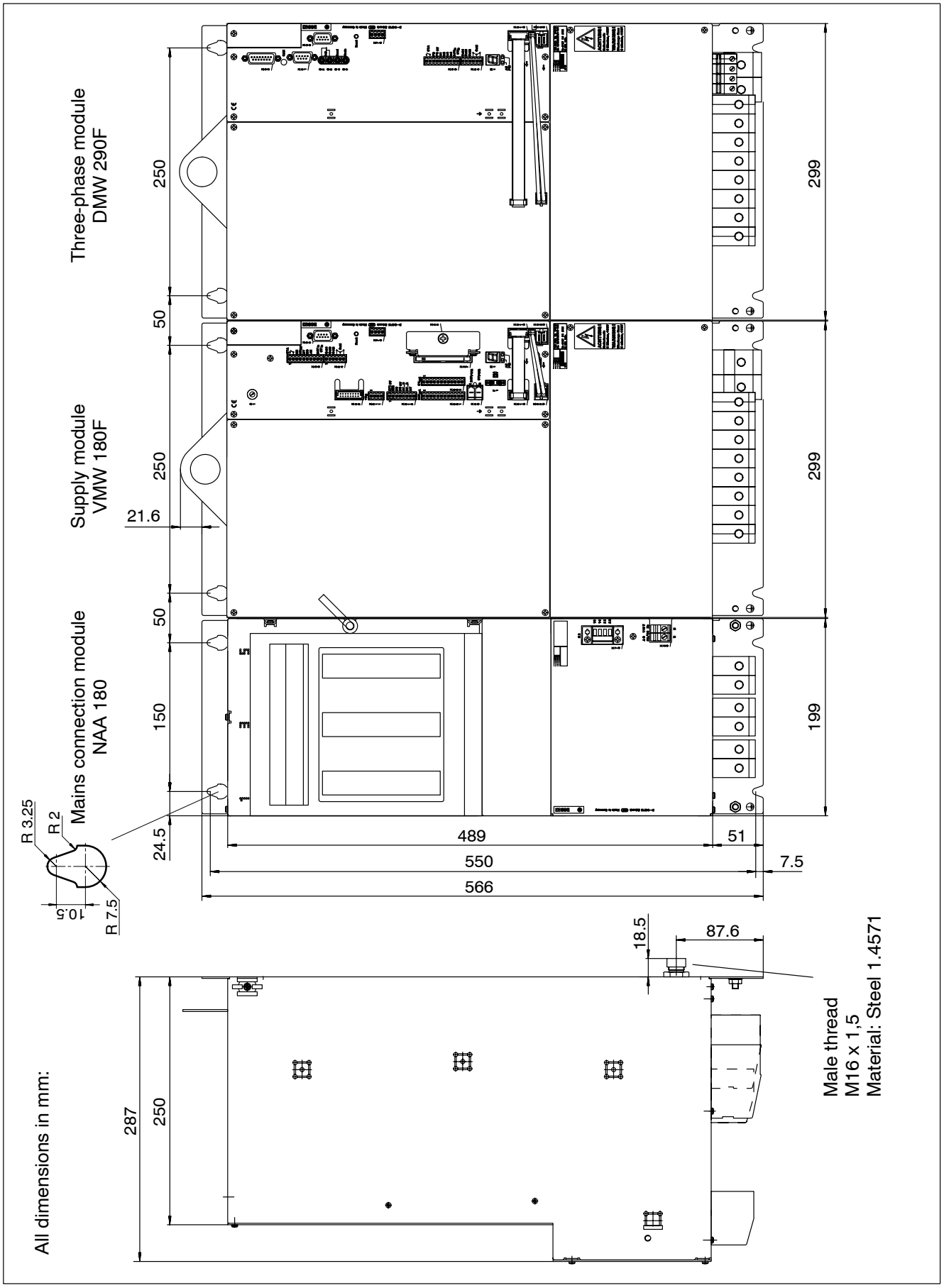


Module type	Dim. B [mm]
VMA 35B	99
VMA 70C	149
VMA 90D	199



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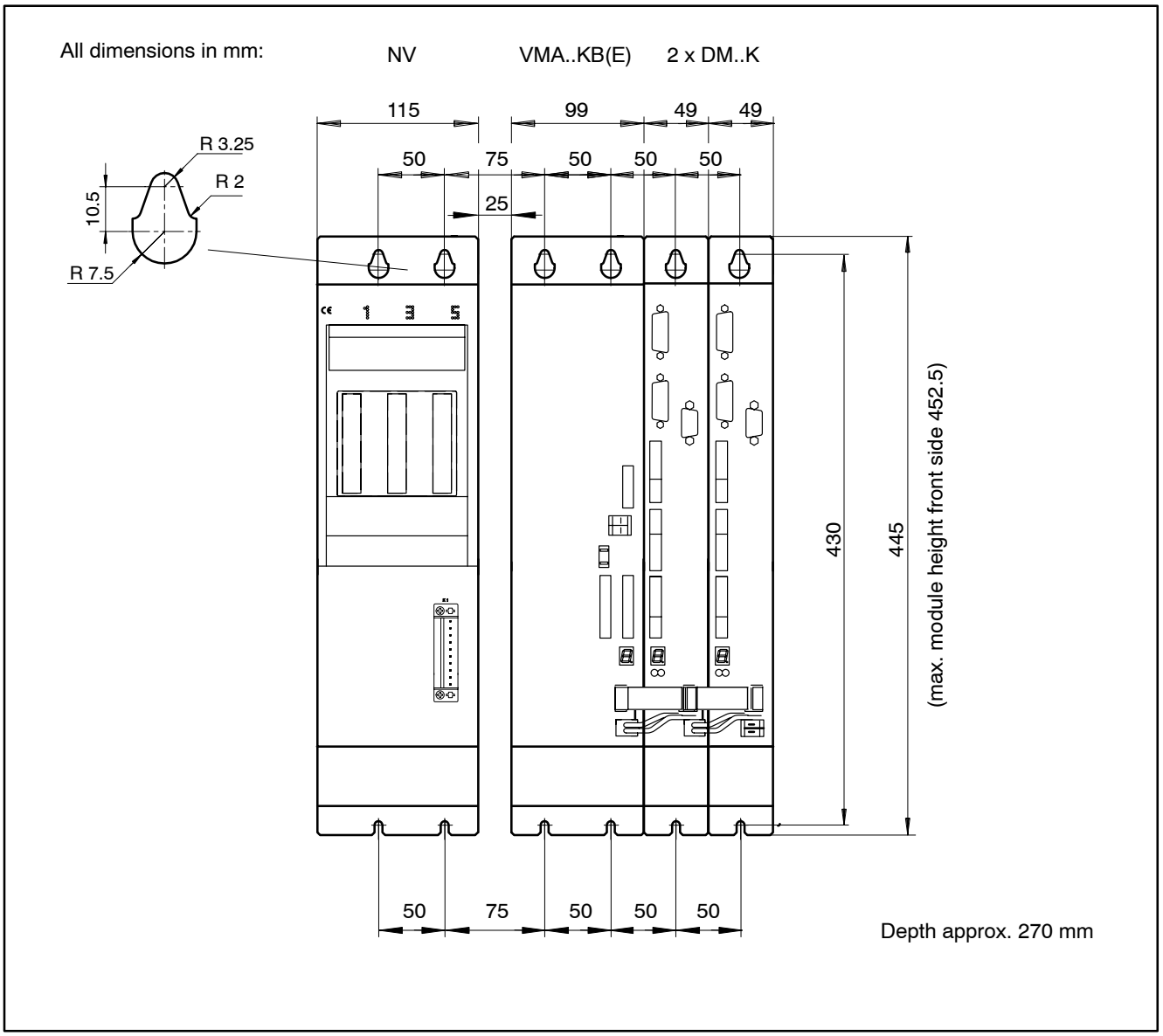
7.3 Modules with water cooling



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7.4 Compact mechanics

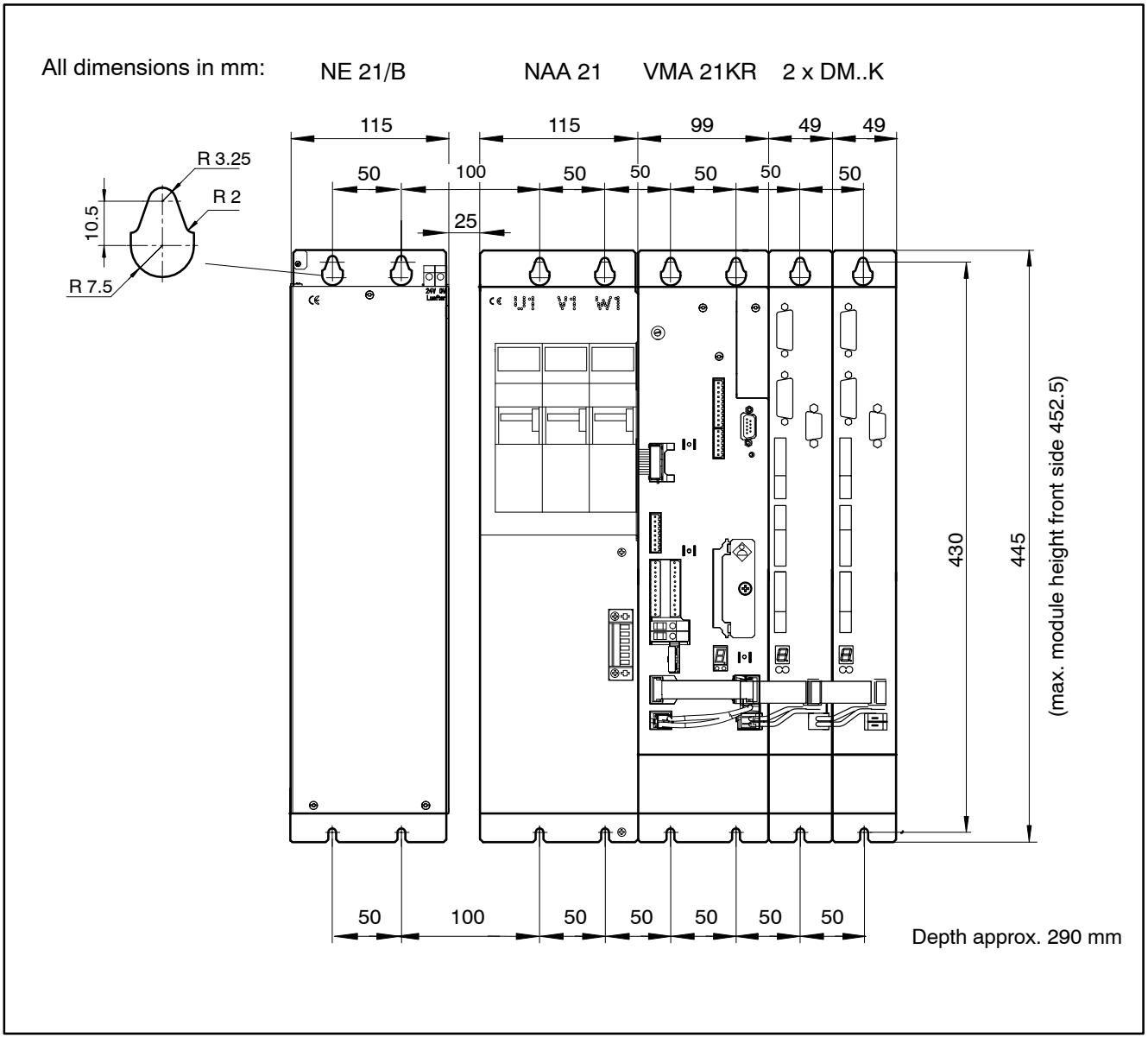
7.4.1 VMA 21KB or VMA 21KE with line wiring module NV



☞ **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.

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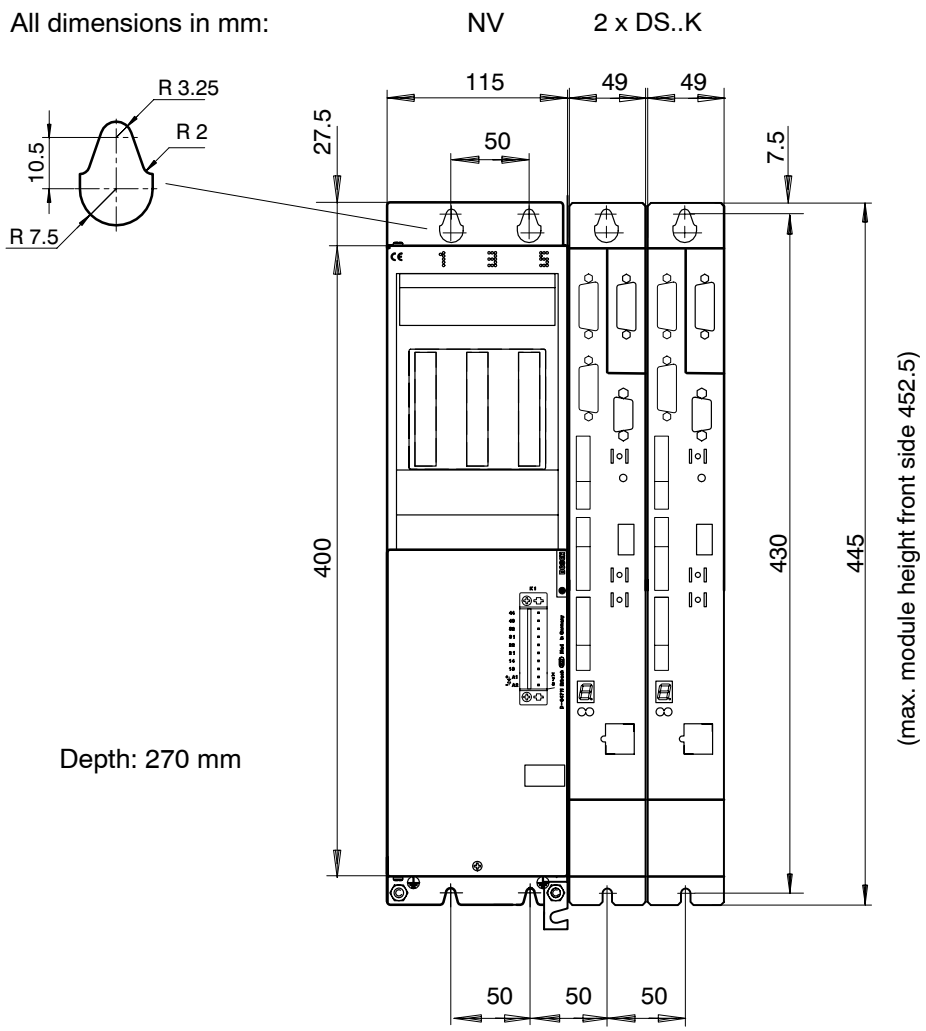
7.4.2 VMA 21KR with mains connection modules NAA 21 and NE 21/B



☞ **The distance between the 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.**

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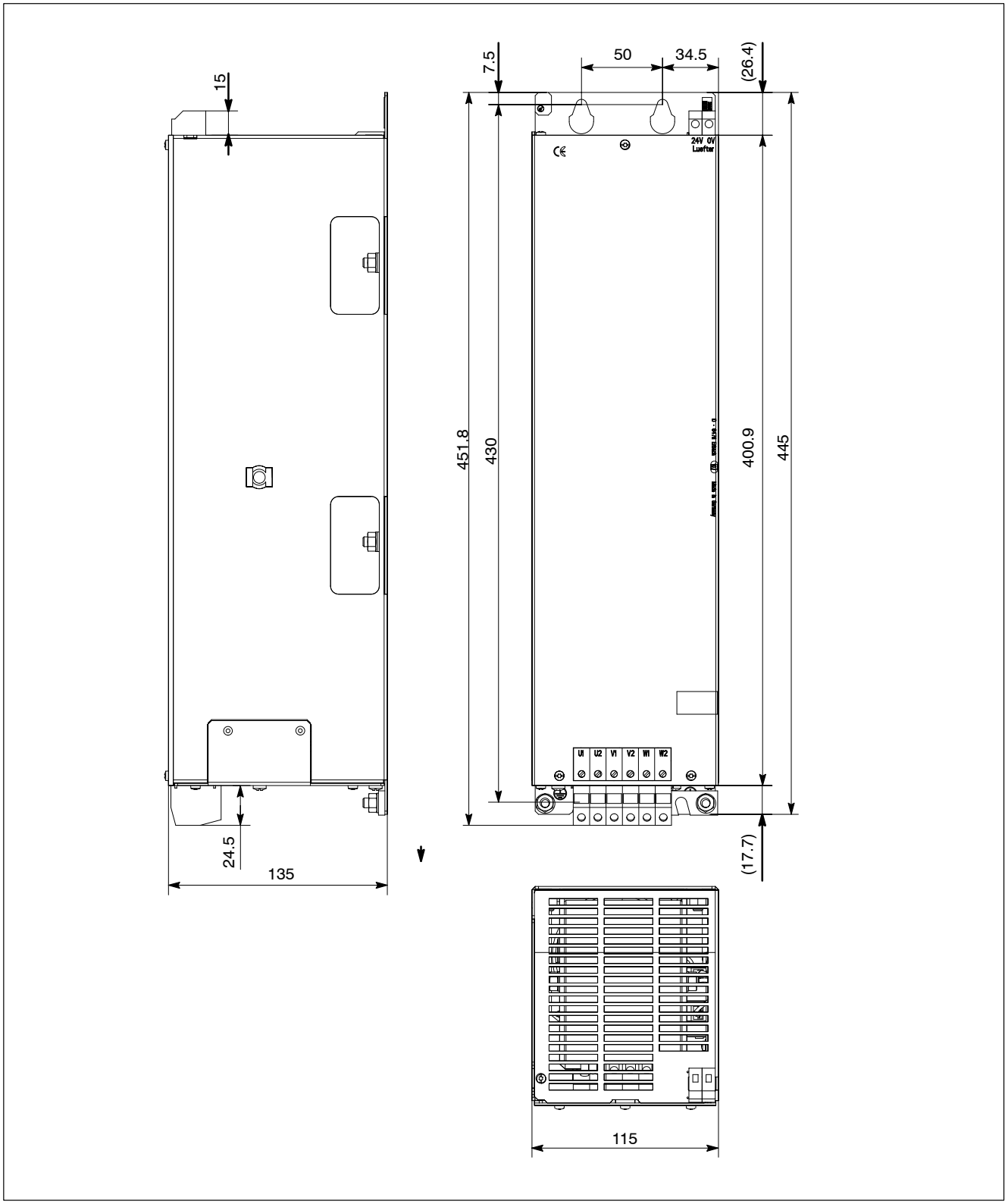
7.5 Stand-alone inverter with line wiring module NV



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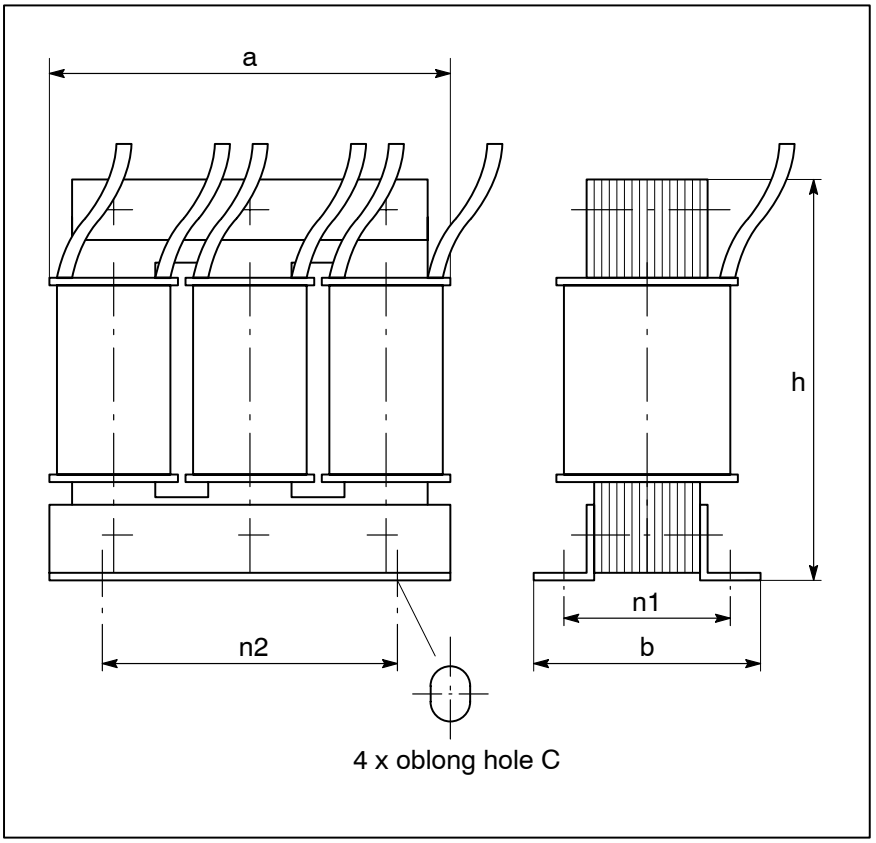
7.6 Line reactors NE

7.6.1 NE 21/B



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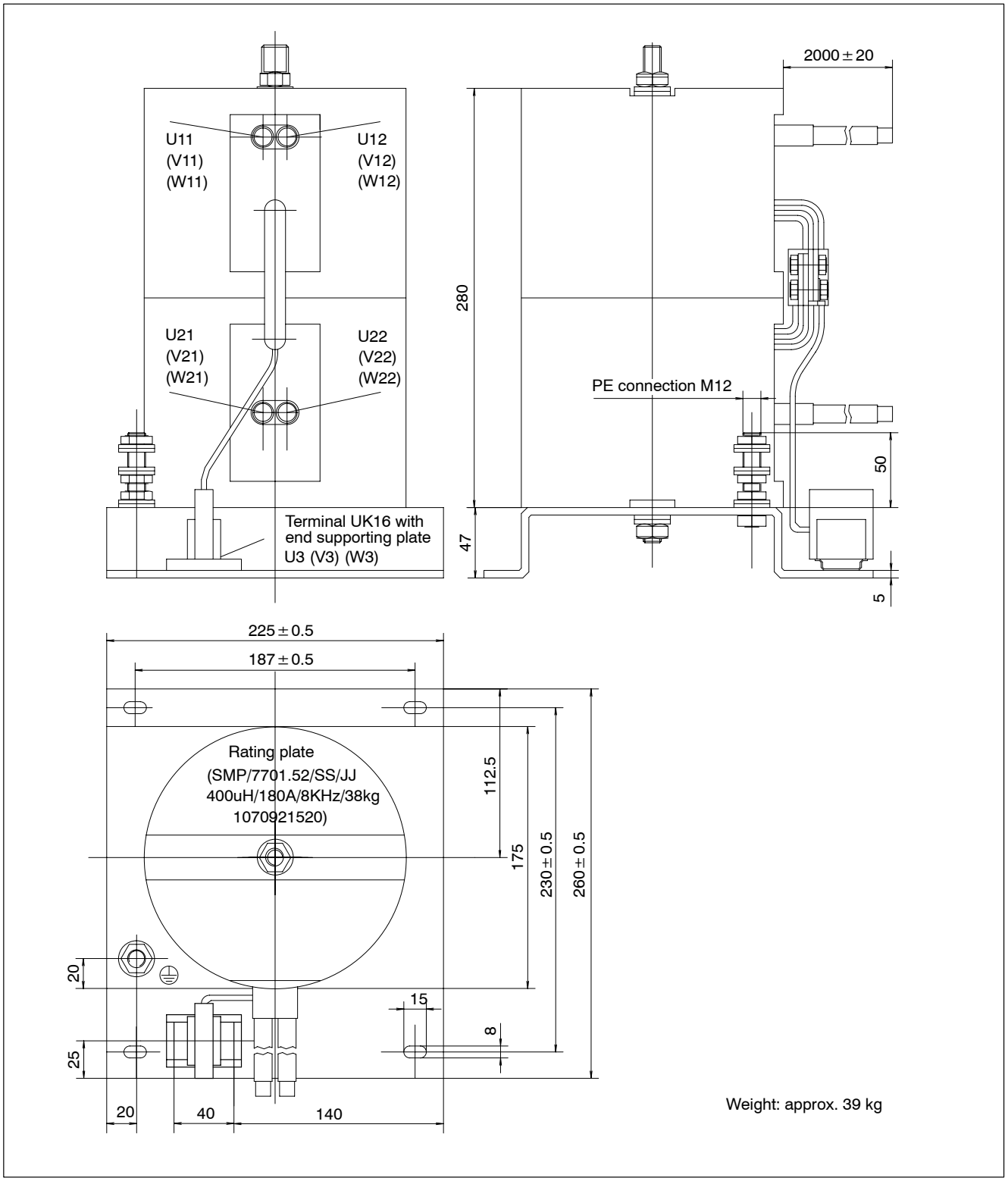
7.6.2 NE 35/A ... NE100/A



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

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7.6.3 NE 180/A

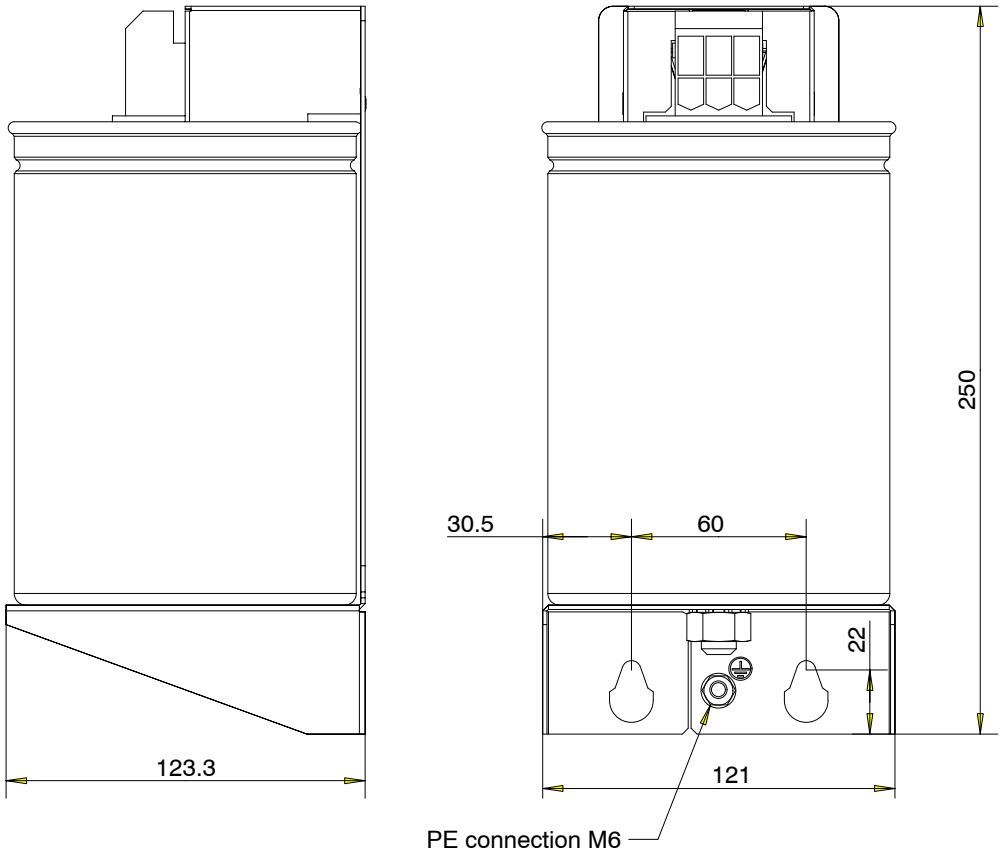


Weight: approx. 39 kg

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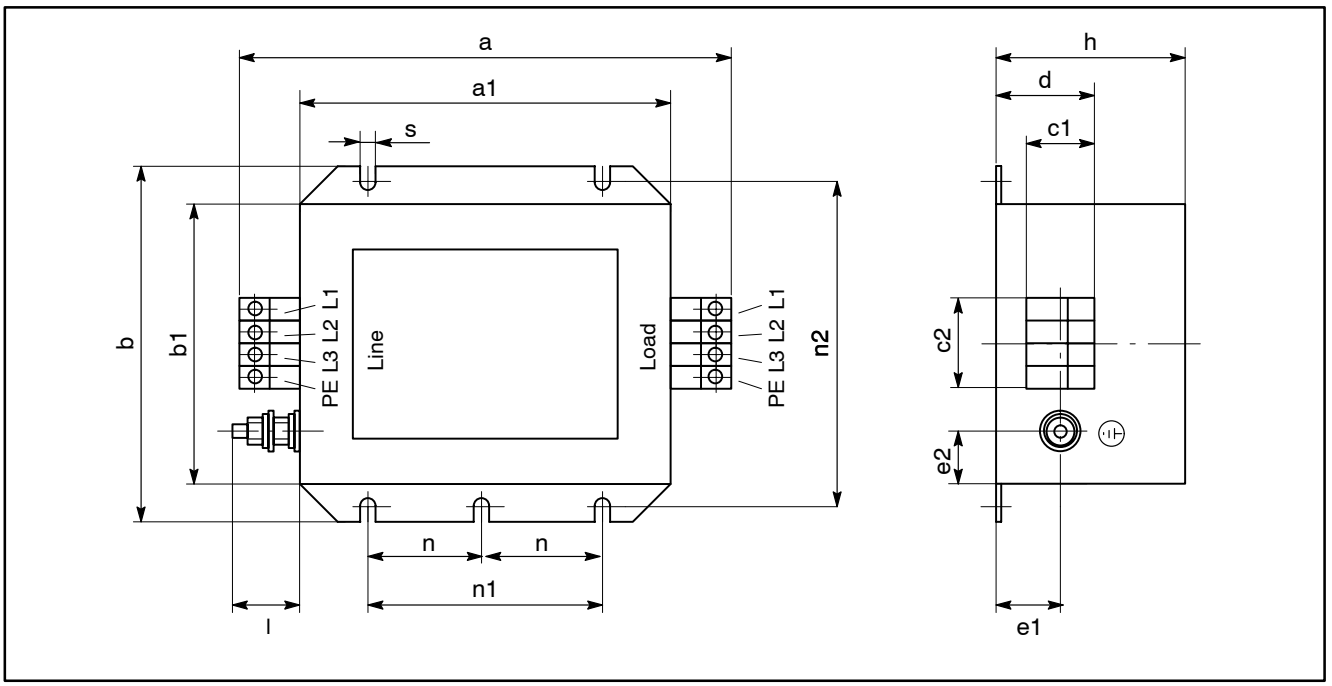
7.7 Filter capacitor

Torque for connections: 2.5 Nm



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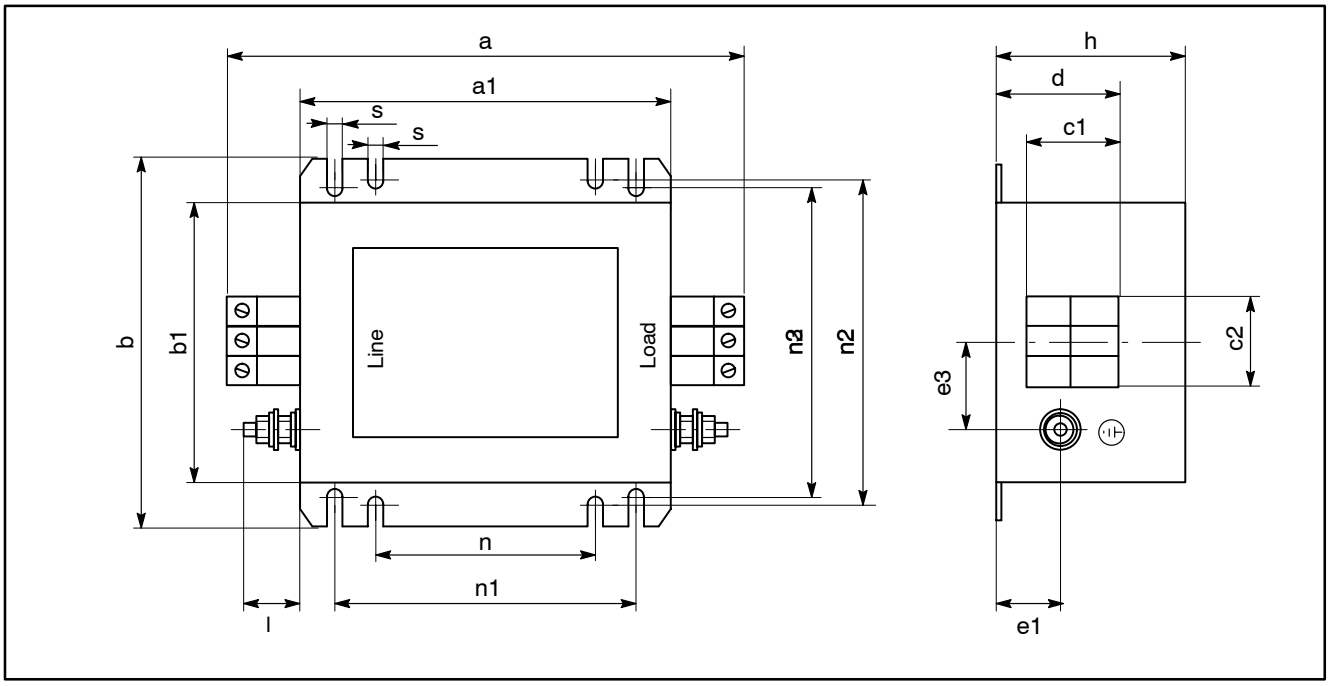
7.8 Mains filter



Mains filter, UL/CSA listed, limit class A								
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 ±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 ±0.5			16 ±0.5
Terminal connector	4 mm²	10 mm²			25 mm²	50 mm²		95 mm²
l [mm] (ground)	22.5 ±1, M6				32 ±1, M10			

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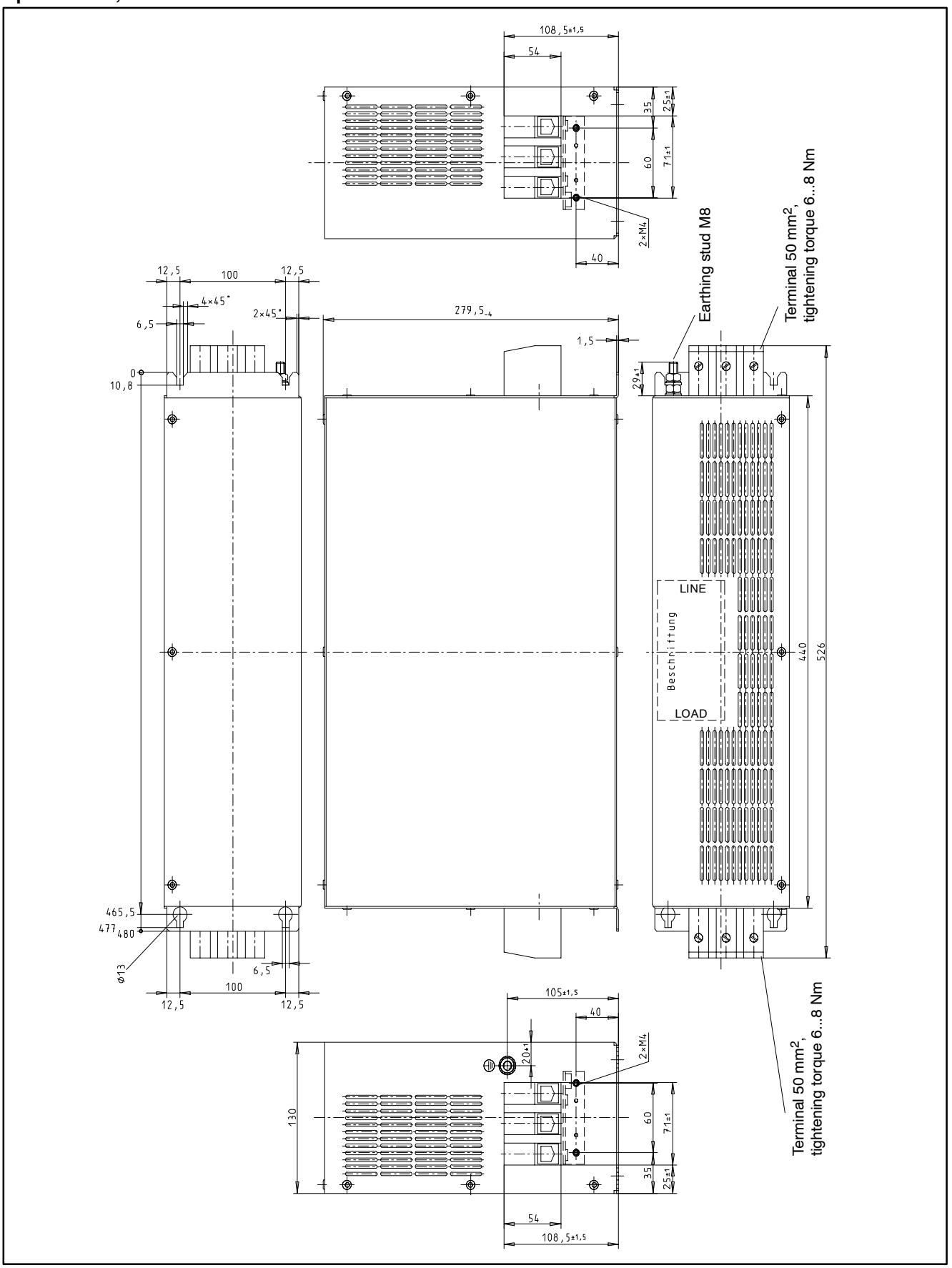
Mains filter, reinforced



Mains filter, reinforced (limit class A)	
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

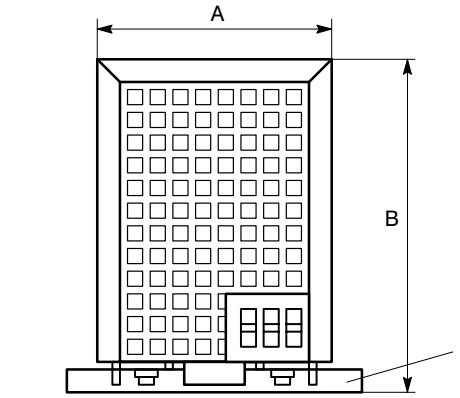
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Special filter, 36 A and 65 A



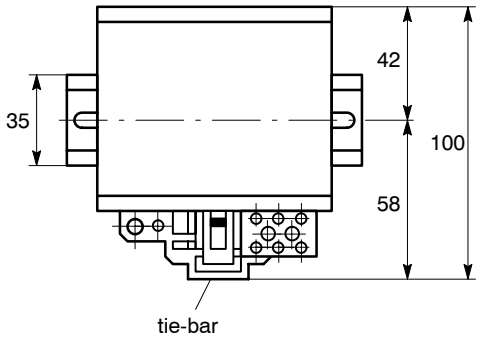
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7.9 Dimensioned drawing, plug braking modules

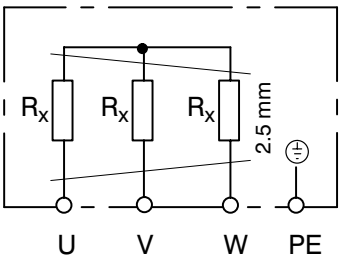


Part no.	1070 913 544	1070 913 545	1070 913 546	1070 913 547	1070 914 767	1070 913 862
R_x (±10%)	8R2 57 Ws	3R3 293 Ws	5R6 261 Ws	3R3 785 Ws	1R 785 Ws	1R 4085 Ws
Dimension A	95 mm					110 mm
Dimension B	163 mm					126 mm

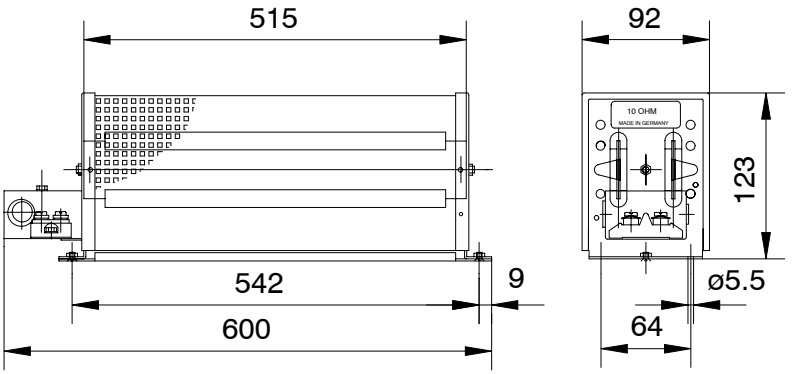
35 mm top hat rail to DIN EN 50022



Circuit diagram



7.10 Dimensioned drawing, external ballast switch



Part no. 1070 914 826
Mass 4,6 kg

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8 Part numbers

☞ **UL/CSA-certified components are marked by UL in the following tables.**

8.1 Drive components

Designation		Part no.
Stand-alone inverter	Various functionalities	cf. overview section 3.2
Three-phase modules	Various functionalities	cf. overview section 3.2
Supply modules	VMA 21KB 001 – D	1070 084 850 UL
	VMA 21KB 001 – D	1070 083 177
	VMA 21KE 001 – D	1070 083 179
	VMA 21KR 001 – D	1070 084 284
	VMA 21KE 001 – D	1070 084 851 UL
	VMA 35BR 001 – D	1070 070 785
	VMA 70CR 001 – D	1070 070 783
	VMA 90DR 001 – D	1070 070 784
	VMW 180FR 001 – D	1070 080 888
Line wiring modules	NV 20/1VF – D	1070 084 594
	NV 20/3F – D	1070 077 941
	NV 21/1F – D	1070 084 067 UL
	NV 21/3F – D	1070 084 068 UL
Mains connection modules	NAA 21/1F – D	1070 084 826 UL
	NAA 35/1 – D	1070 075 122
	NAA 35/1VF – D	1070 083 958
	NAA 35/2 – D	1070 075 125
	NAA 35/2VF – D	1070 083 959
	NAA 35/3 – D	1070 083 378
	NAA 70/1 – D	1070 075 123
	NAA 70/2 – D	1070 075 126
	NAA 90/1 – D	1070 077 777
	NAA 90/2 – D	1070 077 776
	NAA 180/1 – D	1070 080 890
Line reactors	NE 21/B – D	1070 085 276
	NE 35/A – D	1070 917 639
	NE 70/A – D	1070 917 638
	NE 70/A1 – D	on request
	NE 180/A – D	1070 921 520

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Designation		Part no.
Backplane modules	RM B/VM – D	1070 075 830
	RM C/VM – D	1070 075 115
	RM D/VM – D	1070 075 149
	RM A/DM 8 – D	1070 077 135
	RM A/DM 30 – D	1070 075 544
	RM A/DM 45 – D	1070 070 962
	RM B/DM – D	1070 070 963
	RM D/DM – D	1070 070 965
(Cold module IP20)	RM C/VM S – D	1070 075 248
	RM A/DM S – D	1070 075 244
	RM B/DM S – D	1070 075 245
Personality module	PM VMA/000 – D	1070 075 250
	PM SMA/000 – D UL	070 084 858
	PM FOA/000 – D UL	1070 084 863
	PM OSA/000 – D	1070 075 683
(absolute endless axis)	PM SMA/020 – D UL	1070 084 860
	PM FOA/020 – D UL	1070 084 865
	PM OSA/020 – D	1070 081 647
(RSU)	PM VMS/000 – D	1070 080 410
	PM SMS/000 – D UL	1070 084 857
	PM FOS/000 – D UL	1070 084 862
(RSU + absolute endless axis)	PM SMS/020 – D UL	1070 084 859
	PM FOS/020 – D UL	1070 084 864
Memory card, 1 MB Flash	MC OS – D (without SW)	1070 917 668
	MC VM 0.42 A00 (incl. RSU)	1070 085 513
	MC VM x.xx A00 (current SW)	1070 078 559
	MC SM 0.46 A00	1070 084 117
	MC FO 0.46 A00	1070 084 118
	MC SM 0.47 A00	1070 084 473
	MC FO 0.47 A00	1070 084 474
with UL/CSA certification	MC SM 0.48 A00	1070 084 861
	MC FO 0.48 A00	1070 084 866

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8.2 Accessories

Designation		Part no.
Spare fuses for:	NAA NV	cf. section 5.5.1 cf. section 5.5.2
Class A mains filters, UL/CSA listed	16 A 25 A 36 A 50 A 80 A 120 A 150 A 180 A 36 A, reinforced 80 A, reinforced	1070 918 475[UL] 1070 918 476[UL] 1070 918 477[UL] 1070 918 478[UL] 1070 918 479[UL] 1070 919 011[UL] 1070 920 600[UL] 1070 920 599[UL] 1070 920 963[UL] on request
Class A mains filters	36 A special filter 65 A special filter Class B mains filters	1070 921 416 1070 921 417 on request
Filter capacitor	necessary for NE 180	1070 084 982
External ballast switch for VM 21KE		1070 914 826
Ballast module for VMA..B,C,D,F	EBX 460 – D	1070 083 214
Plug braking modules		cf. section 4.8
Cable assembly	Encoder cable Power cable Encoder simulation, 14-core Direct measuring system OM1 / OM2, 8-core	cf. section 4.9.1 cf. section 4.9.1 1070 919 938 (2 m) 1070 919 939 (3 m) 1070 919 940 (5 m) 1070 919 935 (2 m) 1070 919 936 (3 m) 1070 919 937 (5 m)
Cable bushing (metal flange)	Encoder cable Power cable	1070 920 201 1070 920 202
Brake connection MBC	DM..K, with relay and protective circuit	1070 084 352
Protective circuit for holding brake	DM..A,B,D DM..K, with point-to-point terminal	1070 917 448 1070 078 595
Optical cable assembly for SERCOS interface		cf. section 4.9.3
CAN cable for rho3, Cannon 15-pin CAN cable for rho4, CANopen, Cannon 9-pin		cf. section 4.9.4
DC link connection: (compact mechanics)	right-hand connection left-hand connection	1070 081 987 1070 081 716
(backplane modules)	right-hand connection left-hand connection	1070 075 903 1070 075 004
(Modules with water cooling)	with fuse 100 A	1070 084 466

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Designation	Part no.
Signal cross-connection X810, Extension 200 mm Extension 2 m	 1070 077 661 1070 079 798
24-V cross-connection X820, Extension 2 m	1070 077 660
Commissioning and service system DSS–D, CD-ROM	1070 073 817
Connection cable for PC, 5 m with 9-pin Cannon connector	1070 077 753

8.3 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 assembly	OM 01 and OM 02	1070 919 935
Mating connector	OM 03	1070 077 197

8.4 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

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