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Rexroth

POWERDRIVE
HDD and HDS
Drive Controllers

Project Planning Manual

SYSTEM200

DOK-POWDRV-HDD+HDS****-PR02-EN-P

Rexroth
Indramat

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Purpose of Documentation This document assists
- in the construction of the electronics
- when mounting the drive into the control cabinet
- when installing the drive package

Record of Revisions

Description	Release Date	Notes
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Supplementary documentation

Note: The following documentation is not required in its entirety for project planning.

"Electromagnetic Compatibility (EMC) in Drive and Control Systems"
- Project Planning Manual -
DOK-GENERL-EMV********-PRxx-EN-P

"DIAX04 HVE and HVR 2nd Generation Power Supply Units"
- Applications -
DOK-POWER*-HVE+HVR**G2-Awxx-EN-P

"POWERDRIVE Digital AC Motors MHP"
- Project Planning Manual -
DOK-MOTOR*-MHP********-PRxx-EN-P

"POWERDRIVE Main Spindle Motors ADP"
- Project Planning Manual -
DOK-MOTOR*-ADP********-PRxx-EN-P

Changes form previous version:
DOK-POWDRV-HDD+HDS**-PR01-EN-P**

Where?	What?
Chapter 2	"Important directions for use" ➔added
Chapter 3	"Safety Instructions" ➔added
Total document	Drive Controller HDS15.2 ➔added
Chapter 5	"Calculation of the drive controller losses" ➔added
Chapter 7	"Connector X1, bus connection" ➔added
Chapter 7	"Connector X2, X3, interface to control" ➔Note added
Chapter 7	"Connector X4, starting lockout" ➔added
Chapter 7	"Connector X5, motor connection" ➔added
Chapter 7	"Connector X6, holding brake, motor temperature monitor" ➔over-worked
Chapter 7	Connector order ➔changed
Chapter 7	"Controller supply voltage" ➔added
Chapter 7	"Operating of CNC controlled halt" ➔added
Chapter 7	"Timing sequence at switch on and switch off" ➔added

Fig. : Changes

Note: The list may be incomplete. The author withholds the right to make small changes which do not appear in this list.

Inhaltsverzeichnis

1 Introducing the System

1.1 The POWERDRIVE Drive Package

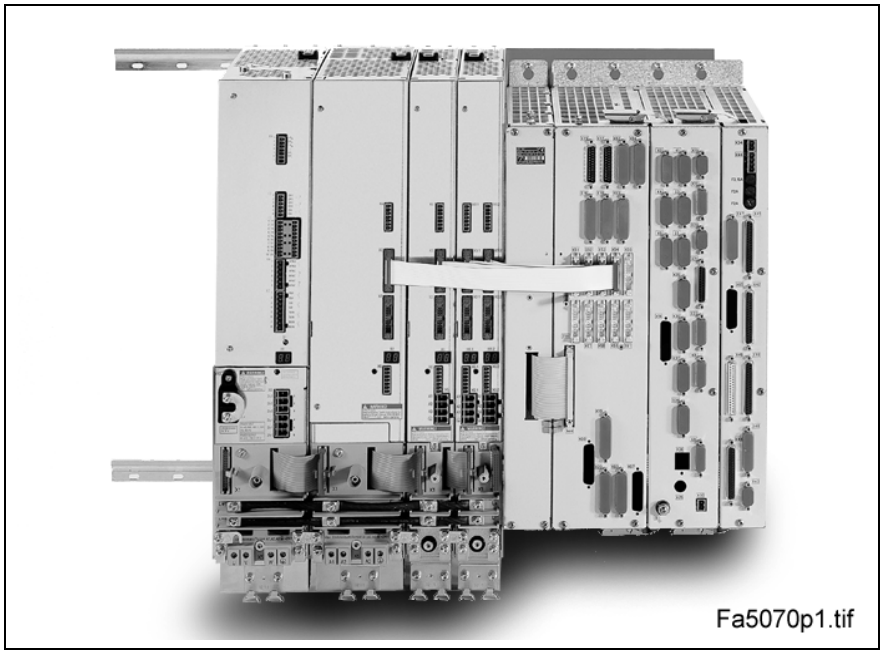


Fig. 1-1: Drive system POWERDRIVE with TNC430M

The modular concept of an Rexroth Indramat POWERDRIVE enables a flexible combination of AC drives to create compact drive packages using a shared standard supply unit on a TNC 410M, TNC 426M or TNC 430M Heidenhain control.

The HDD and HDS drive controllers create, together with the MHP and ADP AC motors, rapid-response drives, suitable as servo and main drives and capable of being used in such tasks as machine tools, textile, printing and packaging machines, or in robotics and handling machines.

1.2 Individual Components of POWERDRIVE Drives

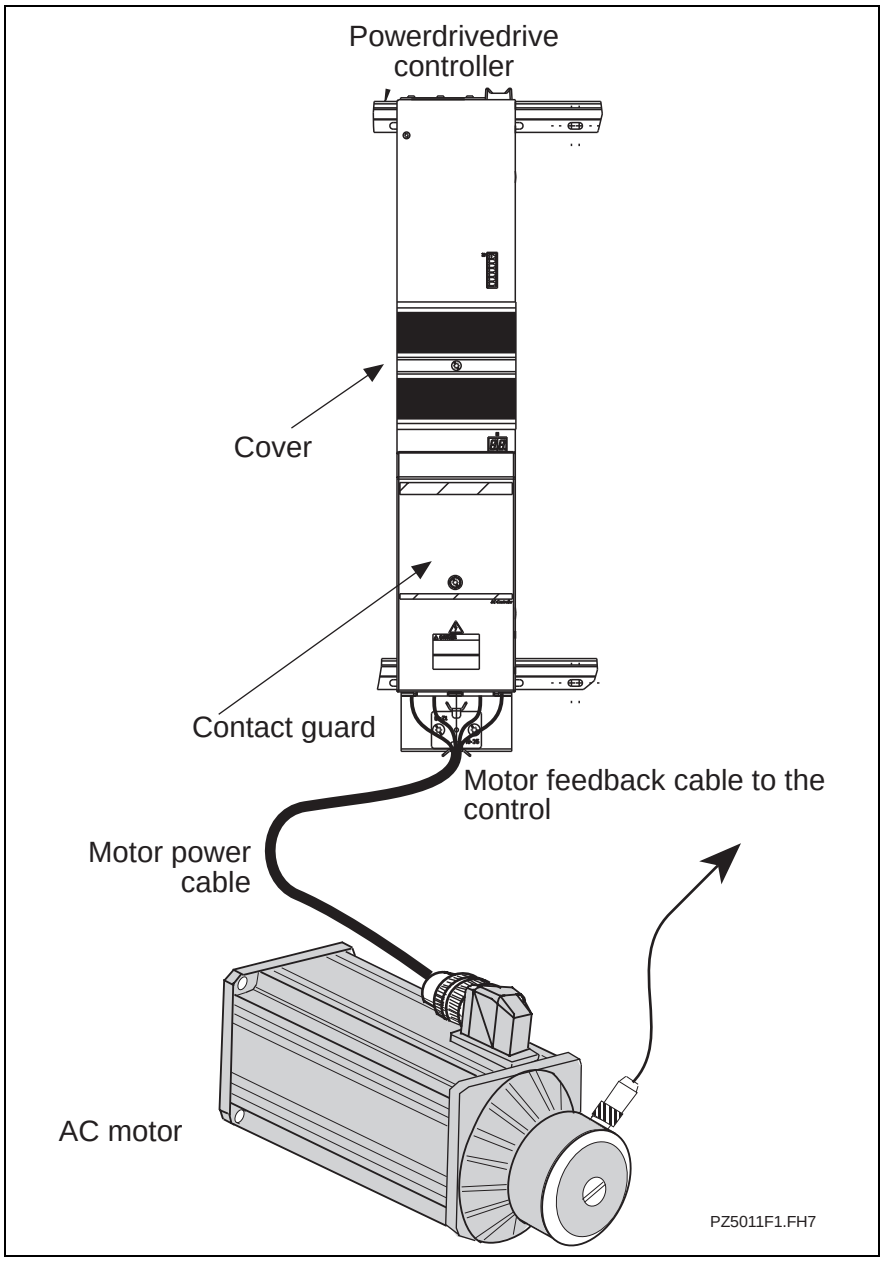


Fig. 1-2: The individual components of the drive

1.3 Supply Units

HDD and HDS drive controllers are intended to be connected to an HVE or HVR supply module. These supply all the needed signal voltages as well as the power supply for the controllers.

For details on connecting HVE and HVE supply modules, see document "DOK-POWER*-HVE+HVR**G2-AWxx-EN-P".

2 Important directions for use

2.1 Appropriate use

Introduction

Rexroth Indramat products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: Rexroth Indramat, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth Indramat products, make sure that all the pre-requisites for an appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

Areas of use and application

Drive controllers made by Rexroth Indramat are designed to control electrical motors and monitor their operation.

Control and monitoring of the motors may require additional sensors and actors.

Note: The drive controllers may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

Every drive controller has to be programmed before starting it up, making it possible for the motor to execute the specific functions of an application.

The drive controllers of the ECODRIVE03 family are designed for use in single or multiple-axis drive and control applications.

To ensure an application-specific use, the drive controllers are available with differing drive power and different interfaces.

Typical applications of drive controllers belonging to the ECODRIVE03 family are:

- handling and mounting systems,
- packaging and foodstuff machines,
- printing and paper processing machines and
- machine tools.

The drive controllers may only be operated under the assembly, installation and ambient conditions as described here (temperature, system of protection, humidity, EMC requirements, etc.) and in the position specified.

2.2 Inappropriate use

Using the drive controllers outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as “inappropriate use".

Drive controllers may not be used if

- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures or if
- Rexroth Indramat has not specifically released them for that intended purpose. Please note the specifications outlined in the general safety instructions!

3 Safety Instructions for Electric Servo Drives and Controls

3.1 Introduction

Read these instructions before the equipment is used and eliminate the risk of personal injury or property damage. Follow these safety instructions at all times.

Do not attempt to install, use or service this equipment without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation of the equipment prior to working with the equipment at any time. If you do not have the user documentation for your equipment contact your local Rexroth Indramat representative to send this documentation immediately to the person or persons responsible for the safe operation of this equipment.

If the product is resold, rented or transferred or passed on to others, then these safety instructions must be delivered with the product.

WARNING

Inappropriate use of this equipment, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in product damage, personal injury, severe electrical shock or death!

3.2 Explanations

The safety warnings in this documentation describe individual degrees of hazard seriousness in compliance with ANSI:

Warning symbol with signal word	Degree of hazard seriousness The degree of hazard seriousness describes the consequences resulting from non-compliance with the safety guidelines.
 **DANGER**	Bodily harm or product damage will occur.
 **WARNING**	Death or severe bodily harm may occur.
 **CAUTION**	Death or severe bodily harm may occur.

Fig. 3-1: Classes of danger with ANSI

3.3 Hazards by inappropriate use

DANGER

High voltage and high discharge current! Danger to life, risk of severe electrical shock and risk of injury!

DANGER

Dangerous movements! Danger to life and risk of injury or equipment damage by unintentional motor movements!

WARNING

High electrical voltage due to wrong connections! Danger to life, severe electrical shock and severe bodily injury!

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

CAUTION

Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!

CAUTION

Risk of injury due to inappropriate handling! Bodily injury caused by crushing, shearing, cutting and mechanical shock or improper handling of pressurized systems!

CAUTION

Risk of injury due to inappropriate handling of batteries!

3.4 General Information

- Rexroth Indramat GmbH is not liable for damages resulting from failure to observe the warnings given in these documentation.
- Order operating, maintenance and safety instructions in your language before starting up the machine. If you find that due to a translation error you can not completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this equipment.
- Trained and qualified personnel in electrical equipment:
  Only trained and qualified personnel may work on this equipment or within its proximity. Personnel are qualified if they have sufficient knowledge of the assembly, installation and operation of the product as well as an understanding of all warnings and precautionary measures noted in these instructions.
  Furthermore, they should be trained, instructed and qualified to switch electrical circuits and equipment on and off, to ground them and to mark them according to the requirements of safe work practices and common sense. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The equipment is designed for installation on commercial machinery.

European countries: see directive 89/392/EEC (machine guideline).

- The ambient conditions given in the product documentation must be observed.
- Use only safety features that are clearly and explicitly approved in the Project Planning manual.
  For example, the following areas of use are not allowed: Construction cranes, Elevators used for people or freight, Devices and vehicles to transport people, Medical applications, Refinery plants, the transport of hazardous goods, Radioactive or nuclear applications, Applications sensitive to high frequency, mining, food processing, Control of protection equipment (also in a machine).
- Start-up is only permitted once it is sure that the machine, in which the product is installed, complies with the requirements of national safety regulations and safety specifications of the application.
- Operation is only permitted if the national EMC regulations for the application are met.
  The instructions for installation in accordance with EMC requirements can be found in the INDRAMAT document "EMC in Drive and Control Systems”.
  The machine builder is responsible for compliance with the limiting values as prescribed in the national regulations and specific EMC regulations for the application.

European countries: see Directive 89/336/EEC (EMC Guideline).

U.S.A.: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must consult the above noted items at all times.

- Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.

3.5 Protection against contact with electrical parts

Note: This section refers to equipment with voltages above 50 Volts.

Making contact with parts conducting voltages above 50 Volts could be dangerous to personnel and cause an electrical shock. When operating electrical equipment, it is unavoidable that some parts of the unit conduct dangerous voltages.

DANGER

High electrical voltage! Danger to life, severe electrical shock and severe bodily injury!

⇒ Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain or repair this equipment.

⇒ Follow general construction and safety regulations when working on electrical installations.

⇒ Before switching on power the ground wire must be permanently connected to all electrical units according to the connection diagram.

⇒ Do not operate electrical equipment at any time if the ground wire is not permanently connected, even for brief measurements or tests.

⇒ Before working with electrical parts with voltage potentials higher than 50 V, the equipment must be disconnected from the mains voltage or power supply.

⇒ The following should be observed with electrical drives, power supplies, and filter components:

Wait five (5) minutes after switching off power to allow capacitors to discharge before beginning work. Measure the voltage on the capacitors before beginning work to make sure that the equipment is safe to touch.

⇒ Never touch the electrical connection points of a component while power is turned on.

⇒ Install the covers and guards provided with the equipment properly before switching the equipment on. Prevent contact with live parts at any time.

⇒ A residual-current-operated protective device (r.c.d.) must not be used on an electric drive! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.

⇒ Equipment that is built into machines must be secured against direct contact. Use appropriate housings, for example a control cabinet.

European countries: according to EN 50178/1998, section 5.3.2.3.

U.S.A: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA) and local building codes. The user of this equipment must observe the above noted instructions at all times.

To be observed with electrical drives, power supplies, and filter components:

DANGER

High electrical voltage! High leakage current! Danger to life, danger of injury and bodily harm from electrical shock!

⇒ Before switching on power for electrical units, all housings and motors must be permanently grounded according to the connection diagram. This applies even for brief tests.

⇒ Leakage current exceeds 3.5 mA. Therefore the electrical equipment and units must always be firmly connected to the supply network.

⇒ Use a copper conductor with at least 10 mm² cross section over its entire course for this protective connection!

⇒ Prior to startups, even for brief tests, always connect the protective conductor or connect with ground wire. High voltage levels can occur on the housing that could lead to severe electrical shock and personal injury.

European countries: EN 50178/1998, section 5.3.2.1.

USA: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must maintain the above noted instructions at all times.

3.6 Protection by protective low voltage (PELV) against electrical shock

All connections and terminals with voltages between 5 and 50 Volts on INDRAMAT products are protective low voltages designed in accordance with the following standards on contact safety:

- International: IEC 364-4-411.1.5
- EU countries: see EN 50178/1998, section 5.2.8.1.

WARNING

High electrical voltage due to wrong connections! Danger to life, severe electrical shock and severe bodily injury!

⇒ Only equipment, electrical components and cables of the protective low voltage type (PELV = Protective Extra Low Voltage) may be connected to all terminals and clamps with 0 to 50 Volts.

⇒ Only safely isolated voltages and electrical circuits may be connected. Safe isolation is achieved, for example, with an isolating transformer, an opto-electronic coupler or when battery-operated.

3.7 Protection against dangerous movements

Dangerous movements can be caused by faulty control or the connected motors. These causes are be various such as:

- unclean or wrong wiring of cable connections
- inappropriate or wrong operation of equipment
- malfunction of sensors, encoders and monitoring circuits
- defective components
- software errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitors in the drive components make faulty operation almost impossible. Regarding personnel safety, especially the danger of bodily harm and property damage, this alone should not be relied upon to ensure complete safety. Until the built-in monitors become active and effective, it must be assumed in any case that some faulty drive movements will occur. The extent of these faulty drive movements depends upon the type of control and the state of operation.

DANGER

Dangerous movements! Danger to life and risk of injury or equipment damage!

⇒ Personnel protection must be secured for the above listed reason by means of superordinate monitors or measures.

These are instituted in accordance with the specific situation of the facility and a danger and fault analysis conducted by the manufacturer of the facility. All the safety regulations that apply to this facility are included therein. By switching off, circumventing or if safety devices have simply not been activated, then random machine movements or other types of faults can occur.

Avoiding accidents, injury or property damage:

⇒ Keep free and clear of the machine's range of motion and moving parts. Prevent people from accidentally entering the machine's range of movement:

- use protective fences
- use protective railings
- install protective coverings
- install light curtains or light barriers

⇒ Fences must be strong enough to withstand maximum possible momentum.

⇒ Mount the emergency stop switch (E-stop) in the immediate reach of the operator. Verify that the emergency stop works before startup. Don't operate the machine if the emergency stop is not working.

⇒ Isolate the drive power connection by means of an emergency stop circuit or use a start-inhibit system to prevent unintentional start-up.

⇒ Make sure that the drives are brought to standstill before accessing or entering the danger zone.

⇒ Secure vertical axes against falling or slipping after switching off the motor power by, for example:

- Mechanically securing the vertical axes
- Adding an external brake / clamping mechanism
- Balancing and thus compensating for the vertical axes mass and the gravitational force

The standard equipment motor brake or an external brake controlled directly by the servo drive are not sufficient to guarantee the safety of personnel!

⇒ Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:

- maintenance and repair work
- cleaning of equipment
- long periods of discontinued equipment use

⇒ Avoid operating high-frequency, remote control and radio equipment near electronics circuits and supply leads. If use of such equipment cannot be avoided, verify the system and the plant for possible malfunctions at all possible positions of normal use before the first start-up. If necessary, perform a special electromagnetic compatibility (EMC) test on the plant.

3.8 Protection against magnetic and electromagnetic fields during operations and mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious health hazard to persons with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

⇒ Persons with pacemakers, metal implants and hearing aids are not permitted to enter following areas:

- Areas in which electrical equipment and parts are mounted, being operated or started up.
- Areas in which parts of motors with permanent magnets are being stored, operated, repaired or mounted.

⇒ If it is necessary for a person with a pacemaker to enter such an area, then a physician must be consulted prior to doing so. Pacemaker, that are already implanted or will be implanted in the future, have a considerable deviation in their resistance to interference. Due to the unpredictable behavior there are no rules with general validity.

⇒ Persons with hearing aids, metal implants or metal pieces must consult a doctor before they enter the areas described above. Otherwise health hazards will occur.

3.9 Protection against contact with hot parts

CAUTION

Housing surfaces could be extremely hot!
Danger of injury! Danger of burns!

⇒ Do not touch surfaces near the source of heat! Danger of burns!

⇒ Wait ten (10) minutes before you access any hot unit. Allow the unit to cool down.

⇒ Do not touch hot parts of the equipment, such as housings, heatsinks or resistors. Danger of burns!

3.10 Protection during handling and installation

Under certain conditions unappropriate handling and installation of parts and components may cause injuries.

CAUTION

Risk of injury through incorrect handling!
Bodily harm caused by crushing, shearing, cutting and mechanical shock!

⇒ Observe general instructions and safety regulations during handling installation.

⇒ Use only appropriate lifting or moving equipment.

⇒ Take precautions to avoid pinching and crushing.

⇒ Use only appropriate tools. If specified by the product documentation, special tools must be used.

⇒ Use lifting devices and tools correctly and safely.

⇒ Wear appropriate protective clothing, e.g. safety glasses, safety shoes and safety gloves.

⇒ Never stay under suspended loads.

⇒ Clean up liquids from the floor immediately to prevent personnel from slipping.

3.11 Battery safety

Batteries contain reactive chemicals in a solid housing. Inappropriate handling may result in injuries or equipment damage.

CAUTION

Risk of injury through incorrect handling!

⇒ Do not attempt to reactivate discharged batteries by heating or other methods (danger of explosion and corrosion).

⇒ Never charge batteries (danger from leakage and explosion).

⇒ Never throw batteries into a fire.

⇒ Do not dismantle batteries.

⇒ Handle with care. Incorrect extraction or installation of a battery can damage equipment.

Note: Environmental protection and disposal! The batteries contained in the product should be considered as hazardous material for land, air and sea transport in the sense of the legal requirements (danger of explosion). Dispose batteries separately from other refuse. Observe the legal requirements given in the country of installation.

3.12 Protection against pressurized Systems

Certain Motors (ADS, ADM, 1MB etc.) and drives, corresponding to the information in the Project Planning manual, must be provided with and remain under a forced load such as compressed air, hydraulic oil, cooling fluid or coolant. In these cases, improper handling of the supply of the pressurized systems or connections of the fluid or air under pressure can lead to injuries or accidents.

CAUTION

Danger of injury when pressurized systems are handled by untrained personnel!

⇒ Do not attempt to disassemble, to open or to cut a pressurized system.

⇒ Observe the operation restrictions of the respective manufacturer.

⇒ Before the disassembly of pressurized systems, lower pressure and drain off the fluid or gas.

⇒ Use suitable protective clothing (for example protective eyewear, safety shoes and gloves)

⇒ Remove any fluid that has leaked out onto the floor immediately.

Note: Environmental protection and disposal! The fluids used in the operation of the pressurized system equipment is not environmentally compatible. Fluid that is damaging to the environment must be disposed of separate from normal waste. Observe the national specifications of the country of installation.

4 HDD / HDS Drive Controllers

4.1 Drive Controller Type Codes

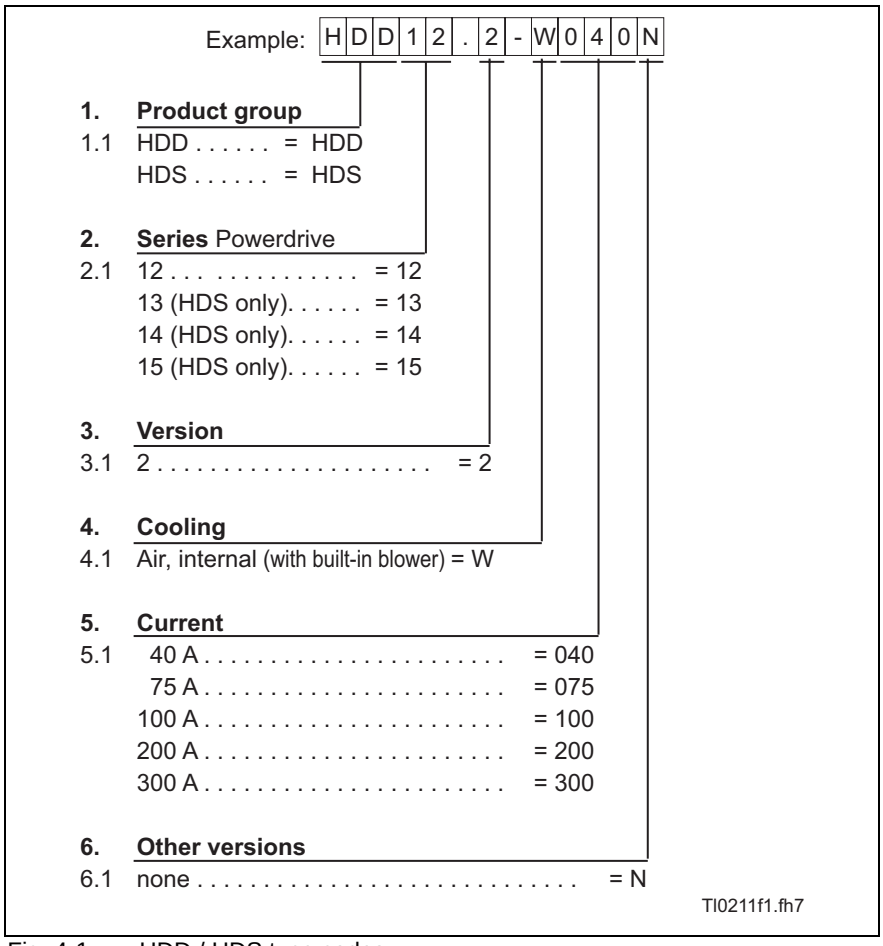


Fig. 4-1: HDD / HDS type codes

An Overview of Technical Data

Designation	Symbol	Unit	HDD12.2-W040N	HDS12.2-W040N	HDS13.2-W075N	HDS13.2-W100N	HDS14.2-W200N	HDS15.2-W300N
Current type	I_{typ}	A	**40**	**40**	**75**	**100**	**200**	**300**
Peak current	(Peak value) I_{peak} (rms value)	A	**40** per axis 28.3	**40** 28.3	**75** 53	**100** 70.7	**200** 141.4	**300** 212.1
Continuous current 4kHz*)	(Peak value) I_{cont} (rms value)	A	**15** per axis 10.6	**20** 14.2	**40** 28.3	**50** 35.4	**120** 84.9	**175** 123.7
Power loss with I_{cont}	P_v	W	**95** per axis	**125**	**220**	**280**	**800**	**1200**
Weight	M	kg	**8**	**7,5**	**11**	**11**	**19**	**25**
Power consumption for signal processing from 24V source	P_{24V}	W	**40**	**20**	**20**	**20**	**20**	**20**

Fig. 4-2: An overview of technical data

*) Cycle frequency of power section

Conditions of Use		
allowed ambient temperature range with nominal data	° C	+5 to +45
maximum allowable ambient temperature with reduced nominal data	° C	55
Storage and transport temperature	° C	-30 to +85
Installation elevation without derated nominal data	m above sea level	max. 1000
Insulation class		C as per DIN VDE 0110
Protection category		IP 10 per DIN 40 050

Fig. 4-3: Technical data - HDD and HDS

5 Planning the Control Cabinet

5.1 Ambient Conditions and Installation Elevation

Nominal data

The specified nominal data for the controllers apply to

- ambient temperatures of +5° to +45° C
- installation elevations of 0 to 1000 m above sea level

Exceeding nominal data

If the controllers are to be used above the specified range, then the "Load factor" must be taken into consideration. This reduces the power data.

⇒ In such cases, check whether the power data is sufficient for your application. To determine the load factors, use Fig. 3-1. Values that exceed those specified for temperature or installation elevation are not allowed!

WARNING

Damage to units and loss of guarantee!

Controllers used outside of specified conditions can be damaged as a result. Doing so also means that the user forfeits the guarantee.

⇒ Therefore, comply with the following instructions!

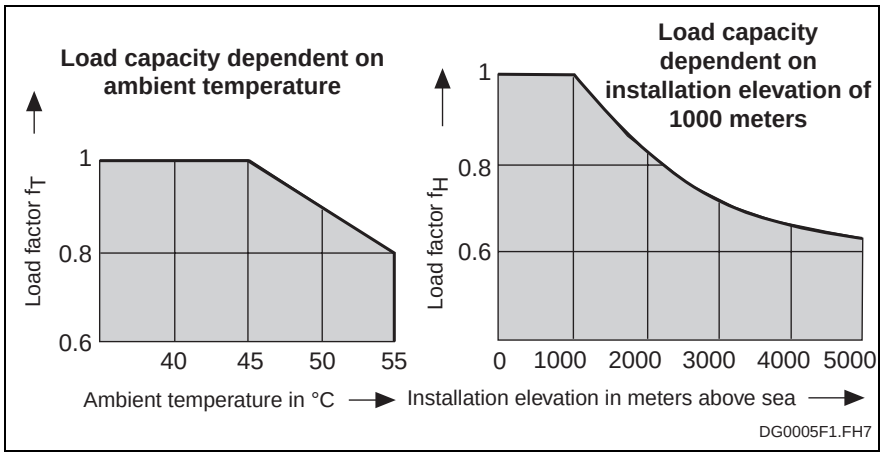


Fig. 5-1: Load factors as dependent on ambient temperature and installation elevation

If **either** the ambient temperature **or** the installation elevation lie above nominal data:

⇒ Multiply the nominal data specified in the technical data by the load factor determined.

⇒ Ensure that the reduced nominal data are not exceeded by your application.

If **both** the ambient temperature **and** the installation lie above the nominal data:

⇒ Multiply the determined load factors f_T and f_H .

⇒ Multiply the value determined above by the nominal data specified in the technical data overview for controllers.

⇒ Make sure that the reduced nominal data are not exceeded by your application.

Protection category

The controller meets the demands as set forward for protection category IP10 as per EN 60 529, ed. 10.91 (DIN VDE 0470-1).

It has been designed to be mounted into a control cabinet or closed housing (as per DIN VDE 0160, ed. 05.88 section 5.5.1.3 and 6.5.1.3).

Note: When building the control cabinet make sure that you comply with all safety guidelines respective contact protection (for industrial equipment see, e.g., EN 60204 / DIN VDE 0113, section 1).

5.2 Using Coolers in the Control Cabinet

The controller may only be operated without a reduction of rated data up to an ambient temperature of 45°C. This means that it might be necessary to use a cooler.

CAUTION

Damage to controller is possible.
Operating safety of machine is endangered.
⇒ Note the following instructions.

Avoid dripping or spraying water

Due to the very principle of a cooler, condense water develops. Note the following:

- Always arrange the coolers so that any forming condense water does not drip onto electronic equipment within the control cabinet.
- Place the coolers so that the blower of the cooler does not spray any condense water that might collect onto electronic equipment.

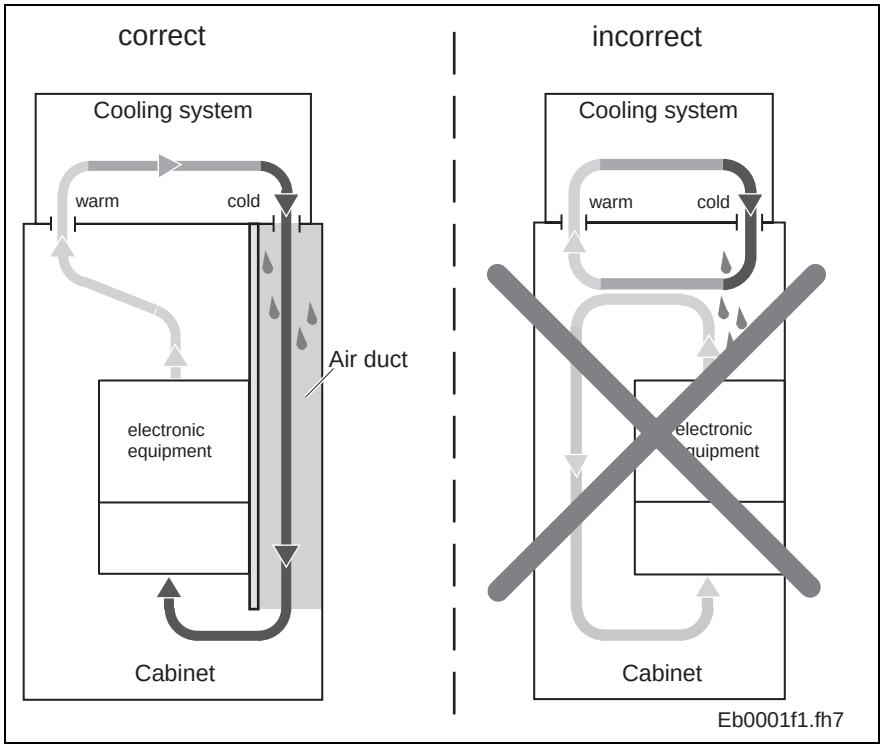


Fig. 5-2: Arranging coolers on the control cabinet

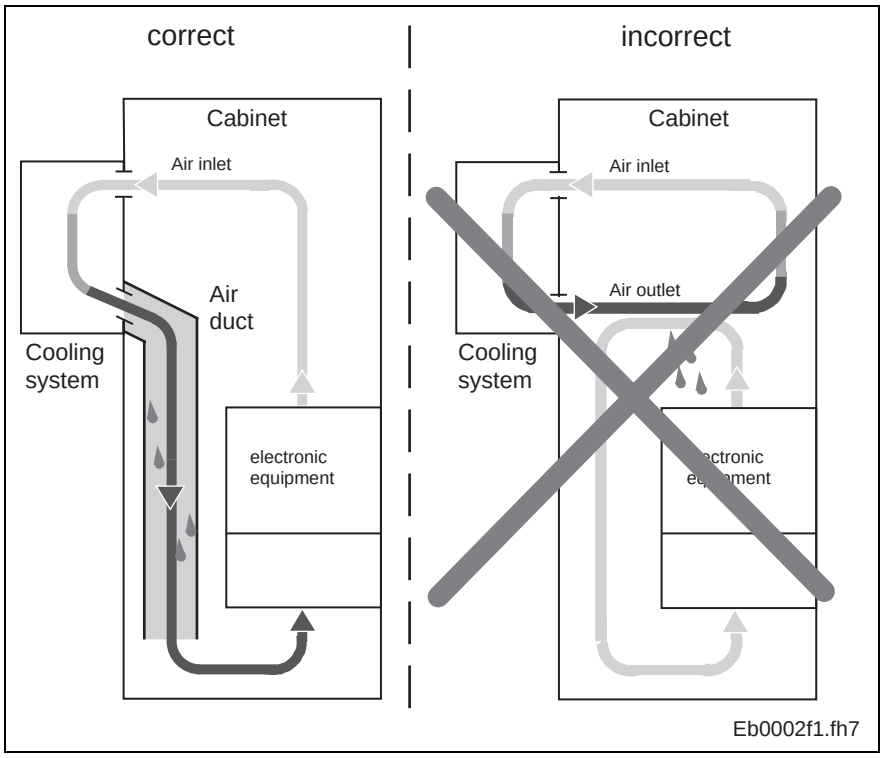


Fig. 5-3: Arranging coolers on the front of the control cabinets

Avoiding condensation

- Set coolers to a temperature setting of 40° C and no lower!
- Coolers with self-adjusting temperature must be set so that the inside cabinet temperature is not cooler that of the outside. Set temperature limit to 40° C!
- Only use well-sealed cabinets to avoid condensation caused by warm-humid outside air entering the cabinet.
- If the control cabinet must be operated with doors open (during startups, servicing, etc.), then make sure that after the doors are closed the controller is at no time cooler than the air in the cabinet. Condensation could form in this case. It is, therefore, necessary to run the cooler even when the machine is off until the temperature inside the cabinet and that of the installed units is the same.

5.3 Dimensional Sheets

Use the mounting tracks with type designation SUP-M01-HD (part number: 271274) to mount the drive controller in the cabinet. The tracks only come in a length of 750 mm and need to be shortened to the required length at the time of mounting.

The mounting tracks are themselves mounted by screwing them onto the mounting panel. It suffices to screw every other screw into place to have the track firmly in place.

The same set of holes can be used to mount the control (without track).

CAUTION

Damage to unit from incorrect mounting orientation

Danger of overheating

⇒ The machines may only be operated in one of the mounting orientations specified.

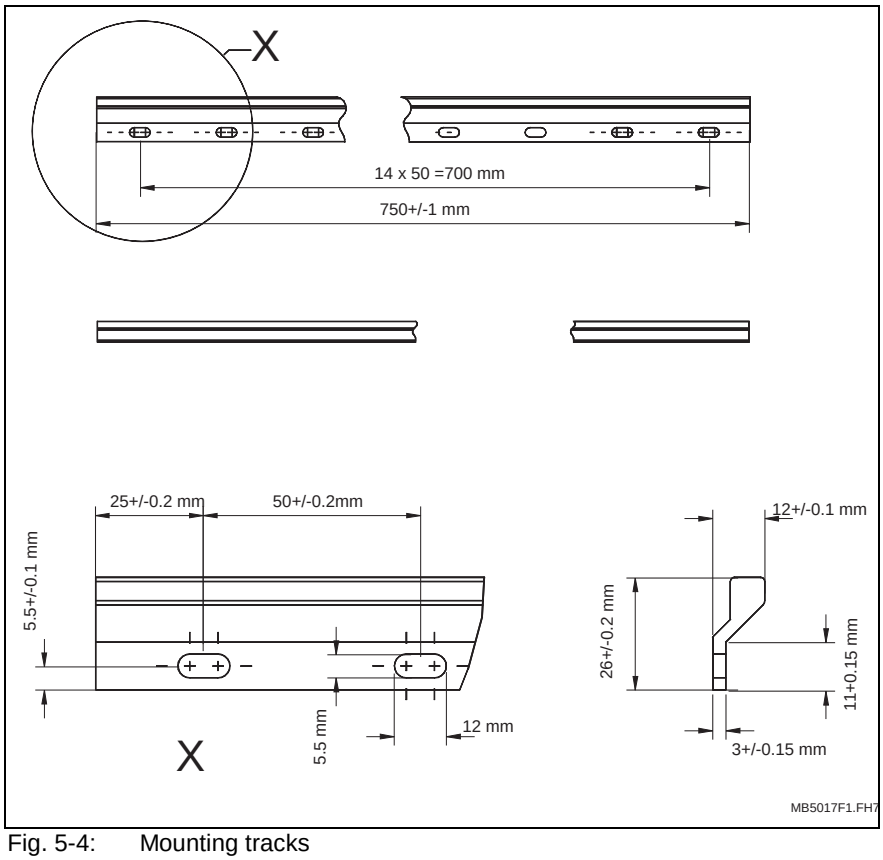


Fig. 5-4: Mounting tracks

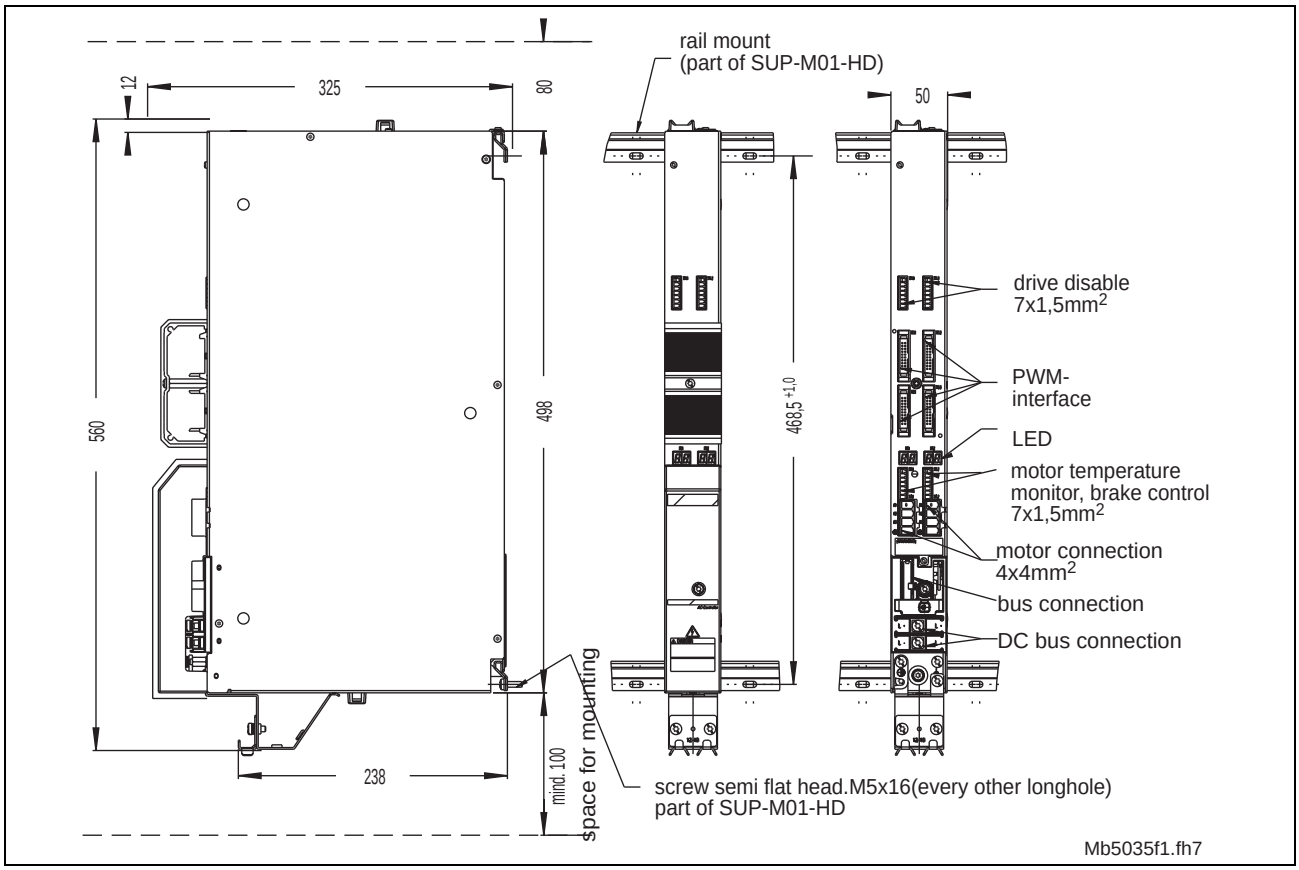


Fig. 5-5: Dimensional sheet for HDD12.2

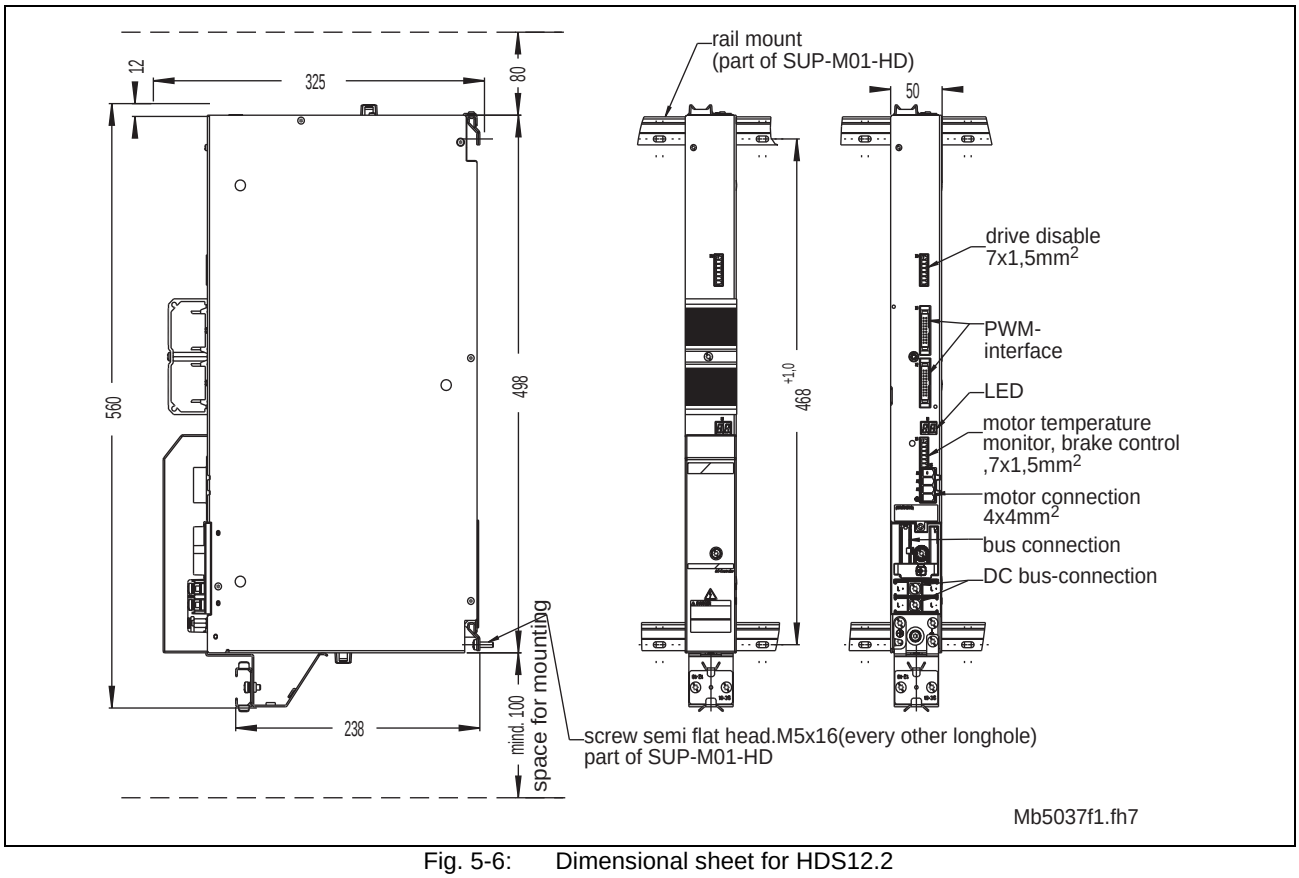


Fig. 5-6: Dimensional sheet for HDS12.2

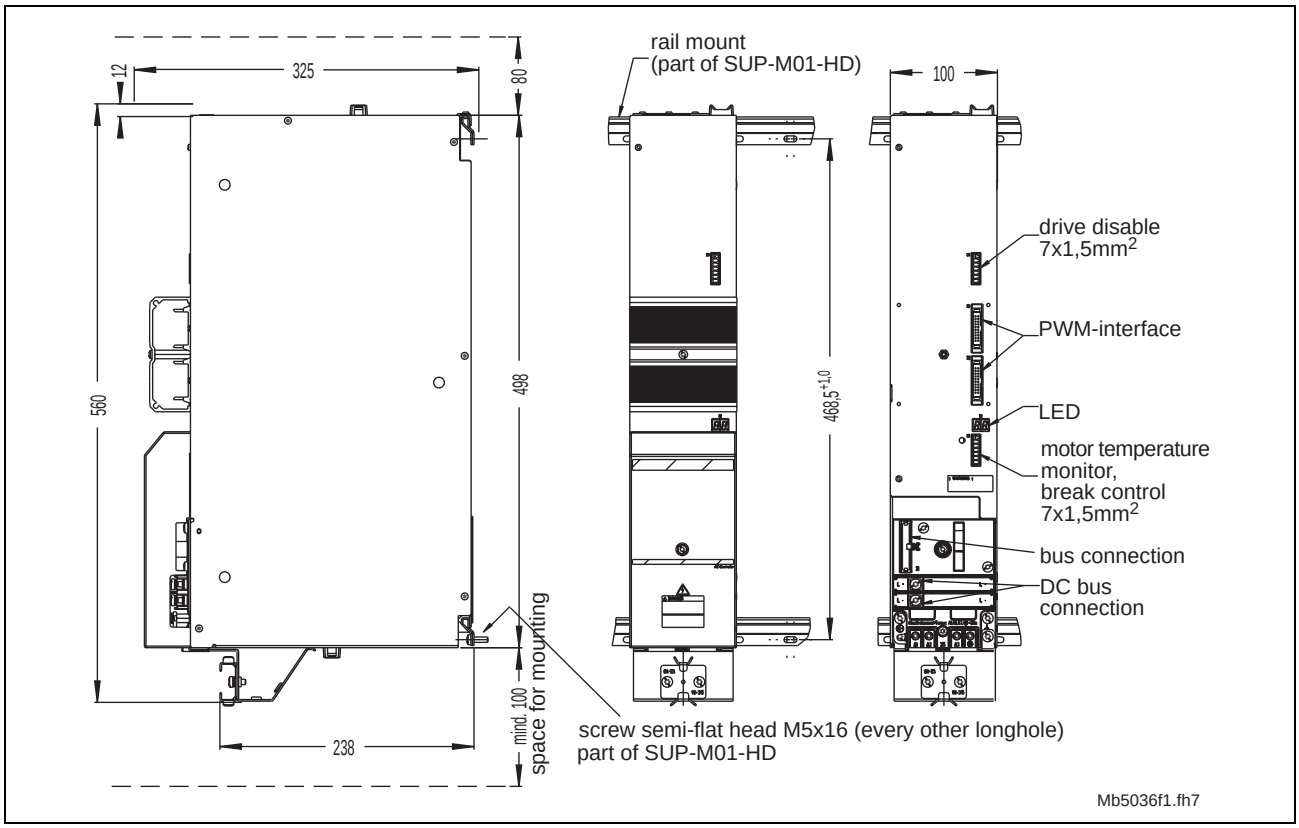


Fig. 5-7: Dimensional sheet for HDS13.2

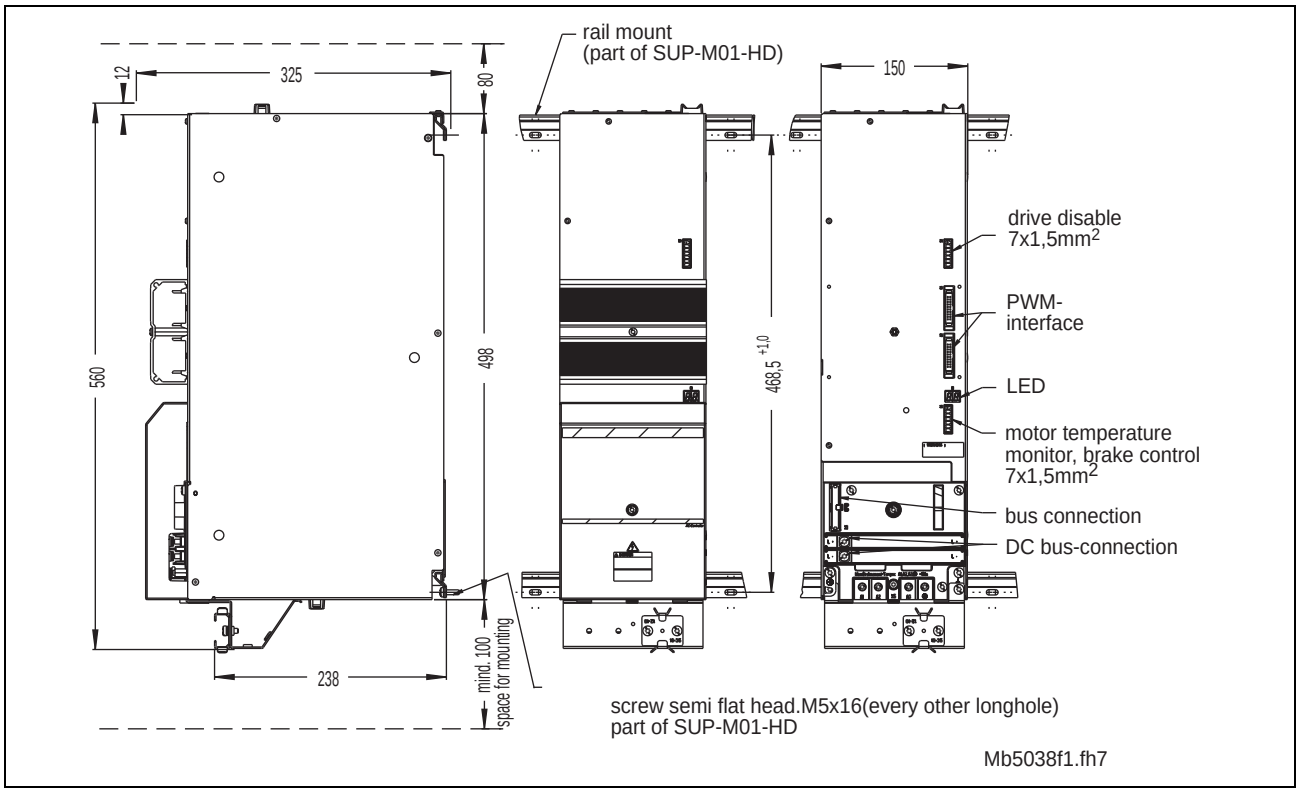


Fig. 5-8: Dimensional sheet for HDS14.2

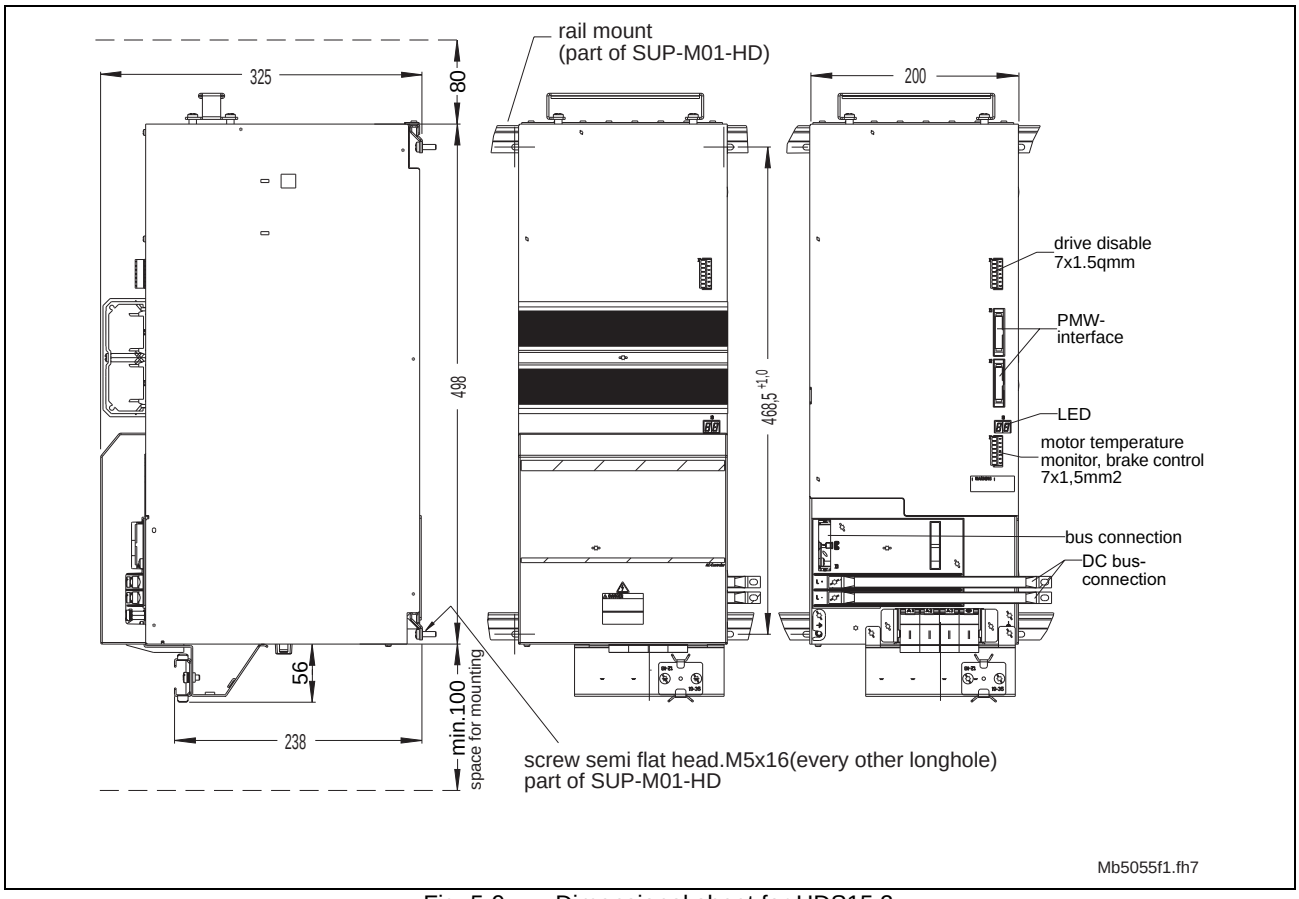


Fig. 5-9: Dimensional sheet for HDS15.2

5.4 Calculation of the drive controller losses

The power loss of a drive system radiated to the control cabinet is calculated from the sum of the losses of the supply unit, the losses of the series switching device, and the losses of each drive controller.

Please observe the documentation "DOK-POWER*-HVE+HVR**G2-AWxx-EN-P" when determining the losses of the supply unit and those of the series switching devices.

The power loss of a drive controller is composed of

- the losses for the control unit (see section 4-2: "An Overview of Technical Data")
- the basic losses of the power section
- the current-related losses of the power section.

The power loss of the power section is calculated using the mean continuous current of the controller on the basis of the following diagrams.

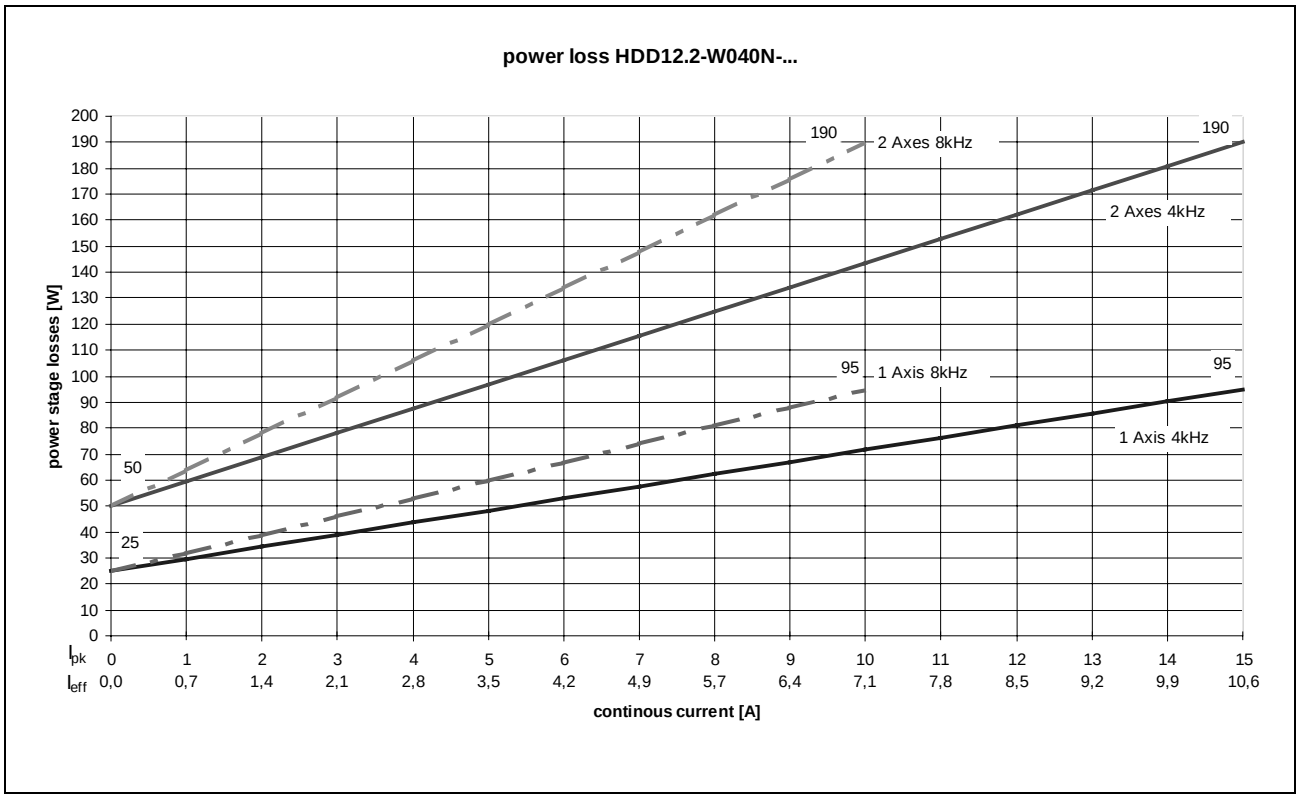


Fig. 5-10: Power loss HDD12.2W040N-…

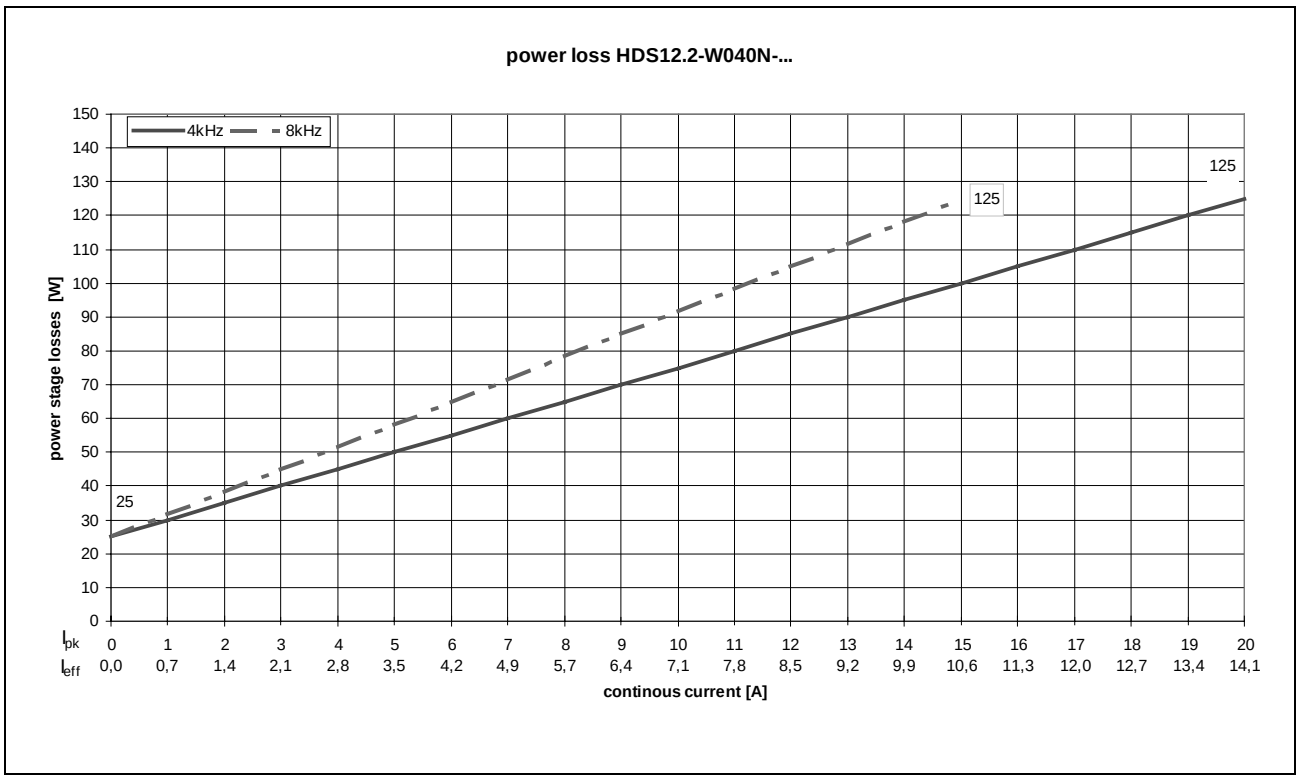


Fig. 5-11: Power loss HDS12.2W040N-

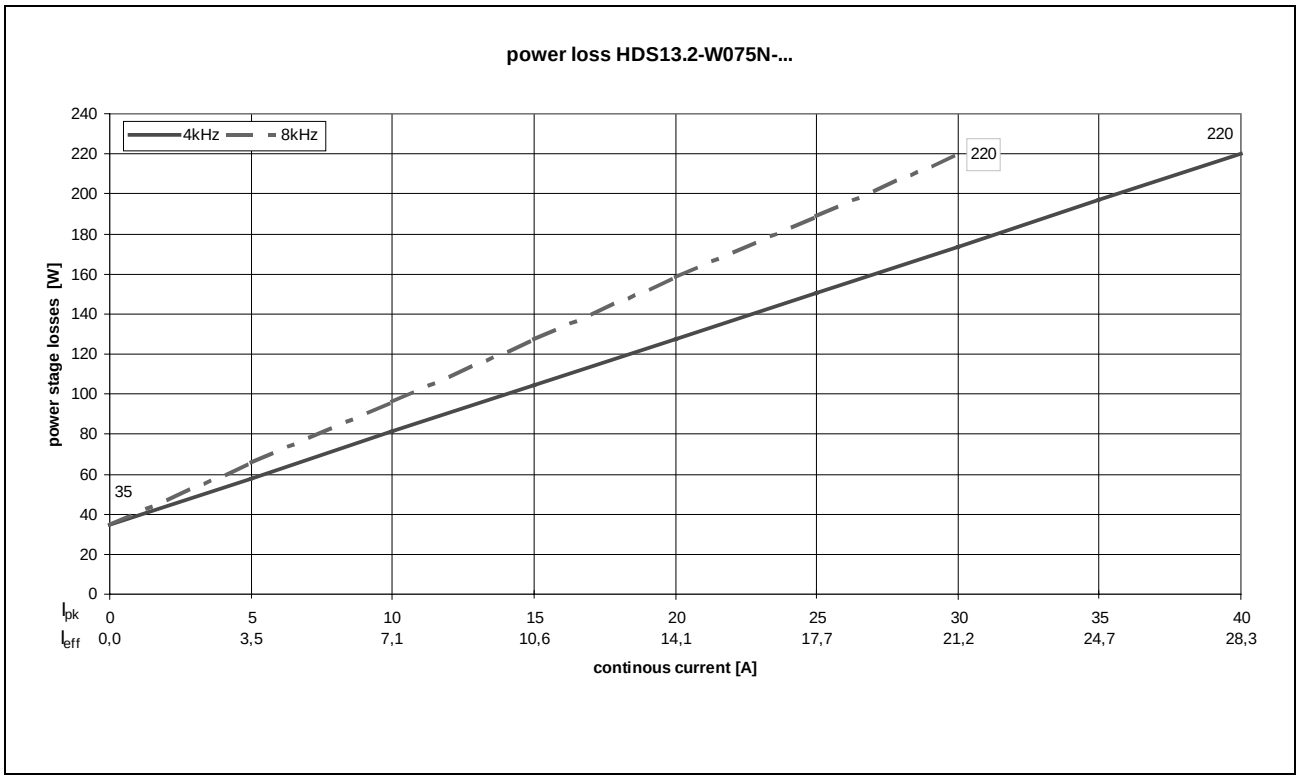


Fig. 5-12: Power loss HDS13.2W075N-…

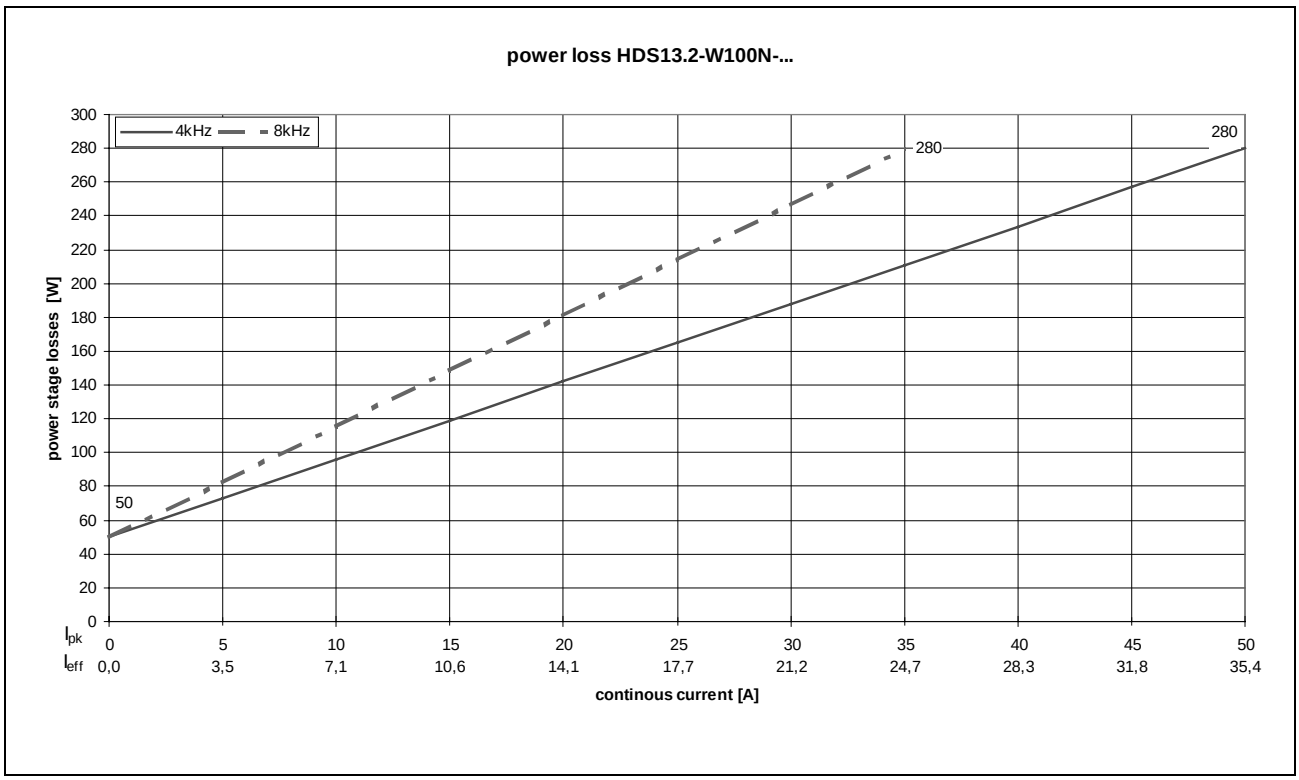


Fig. 5-13: Power loss HDS13.2W0100N-…

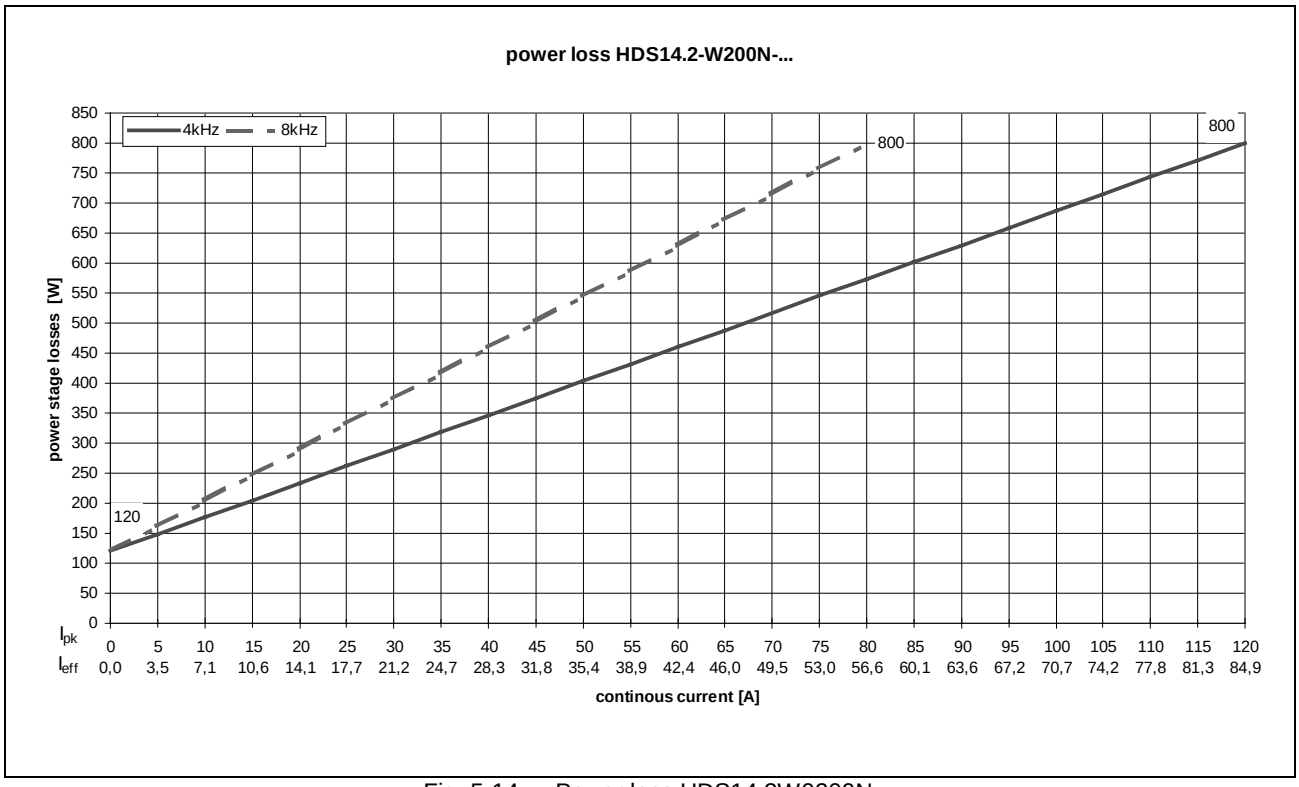


Fig. 5-14: Power loss HDS14.2W0200N-…

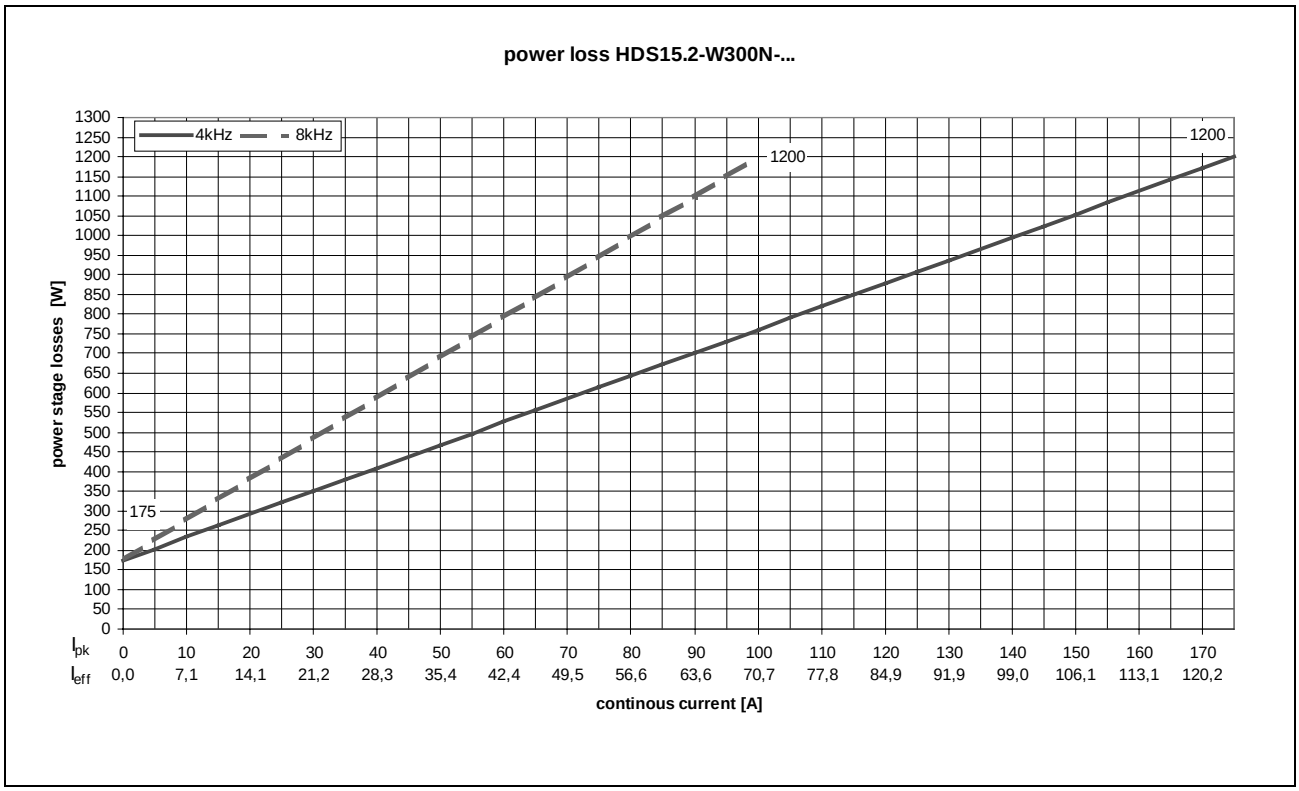


Fig. 5-15: Power loss HDS15.2W0300N-…

Example calculation for a 4-axis drive system.

1. Drive	HDS14.2-W200N-HS32 (Spindle)	continuous current		53A rms
		Controller power loss		20W
		Drive stage power loss (4kHz)		545W
			Total 1	**565.0W**
2. Drive	HDS13.2-W100N-HS30	continuous current		30Apk
		Controller power loss		20W
		Drive stage power loss (4kHz)		188W
			Total 2	**208.0W**
3. Drive	HDD12.2-W040N-HD12	Axis 1	continuous current	6Apk
		Axis 2	continuous current	3Apk
		Controller power loss		40W
		Loss Axis 1 (4kHz)		53W
		Loss Axis 2 (4kHz)		39W
			Total 3	**132W**
Total drive controller losses				**905.0W**
Total losses from supply-units				**950W**
Power to be dissipated by the control cabinet				**1871.6W**

These power losses must be dissipated either via the metal structure of the cabinet itself or by means of a built in cooling system.

Notes

6 Connecting Leads

Conductor arrangement

- Maintain a clearance of at least 100 mm between power cables and control or signal cables (e.g., feedback cables) or
- break the cable channel down with metallic divisions (see picture).

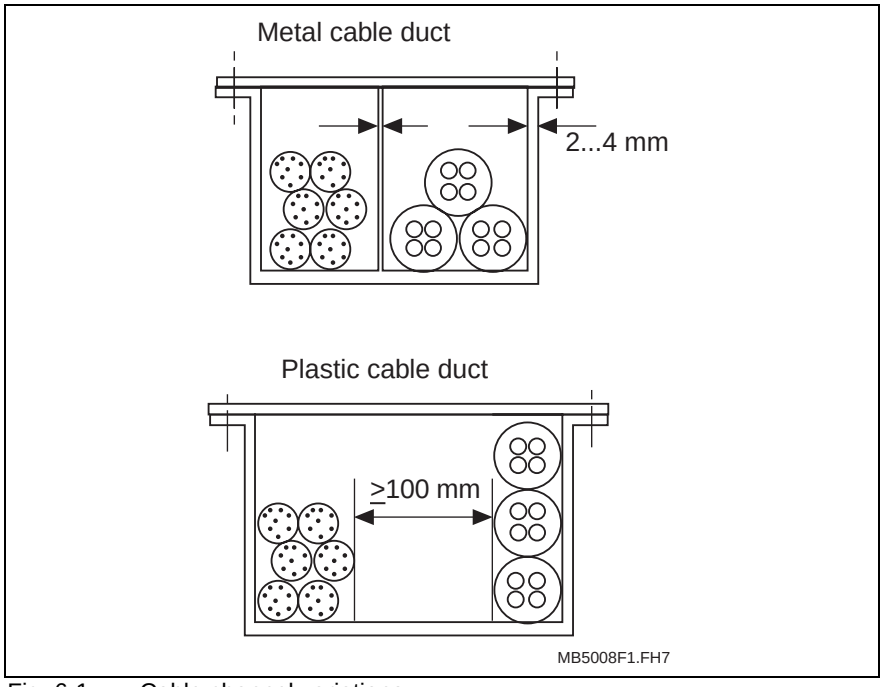


Fig. 6-1: Cable channel variations

- Do not route control or signal cables near high-frequency equipment, magnetic fields (transformers, chokes and so on) or high-voltage lines.

Line lengths

- Maximum motor cable length: 75 meters
- Maximum feedback cable connection length: 75 meters

CAUTION

Error in the control of motors or movable parts
Mechanical injuries
⇒ Clamping points or couplings reduce the maximum line lengths. Note the following information!

The line lengths specified apply to:

- direct connections between drive controllers and motors
- standard Rexroth Indramat cables and
- ambient temperatures of ≤ 40° C as per EN 60 204

6.1 Eliminating Interference Sources within the Control Cabinet

To maintain the limits set forth for class B (radio interference suppression level N) in accordance with DIN VDE 0470-1, edition dated 11/92 and table 1 as per DIN EN 55014, edition 12/93 at the machine (especially for operation within residential and light industrial areas), the following applies:

- Route motor power cables shielded or use shielded motor power cables.
- Use the shield attachment on the controllers.
- Use a suitable interference suppression filter in the mains supply leads of the machine or plant and make sure it is properly mounted and operated.

If inductive loads (e.g., chokes, contactors or relays) are applied per each contact or semi-conductor, then these loads must be interference suppressed:

- Use free-wheeling diodes with three-phase operations.
- Use contactor-type related RC interference suppression circuit with a.c. operations.
- Mount the suppression devices in direct proximity to the inductance (e.g., contactor coil). The suppression effect could otherwise be significantly decreased.
- Do not use varistors as suppressor circuits.

If high-frequency devices are used (e.g., components of eloxidating devices), then

- mount these outside the cabinet separately and wire them accordingly (possibly a separate cabinet if conditions should call for this).

Note: For details, see the project planning manual "Electromagnetic Compatibility (EMC) in AC Drives", doc. type DOK-GENERL-EMC********-PRxx-EN-P.

Only the manufacturer of the machine can check whether the EMC limits are being maintained or not.

7 Planning the Electrical Connections

7.1 General Information

The electrostatic loads of persons and/or tools could damage either drive controllers or PCBs when discharging. Therefore, please note the following:

CAUTION

Error in controlling motors and moving parts!

Electrostatic loads endanger electronic equipment and their operating safety.

⇒ Bodies coming into contact with components and PCBs must be discharged by grounding!

These bodies can be:

- the soldering iron used for soldering
- the human body (grounded by touching a conductive, grounded object)
- parts and tools (placed on a conductive surface)

Endangered parts may only be stored or transported in conductive packaging.

Note: The diagrams of Rexroth Indramat should only be used by a Machine Manufacturer to create terminal diagrams for a facility. When wiring a facility, an End user should only use the diagrams of the Machine Manufacturer.

General notes

- Route signal lines separately from load lines to avoid interference.
- Conduct analog signals (e.g., command/actual values) via shielded leads.
- Mains, DC bus and power lines should not be connected to low voltages or come into contact with them.
- When carrying out any high voltage or external voltage testing of the machine all signal and power connections to the drive components must be removed. This protects the electronic components (allowed as per EN 60204-1). Rexroth Indramat drive components are high-voltage and insulation tested as per EN 50178.

CAUTION

Potential damage of the controller device by connecting and disconnecting the connections with mains power on!

⇒ Do not connect and disconnect connections if the mains power is on

7.2 Connecting the Basic Unit

Overview

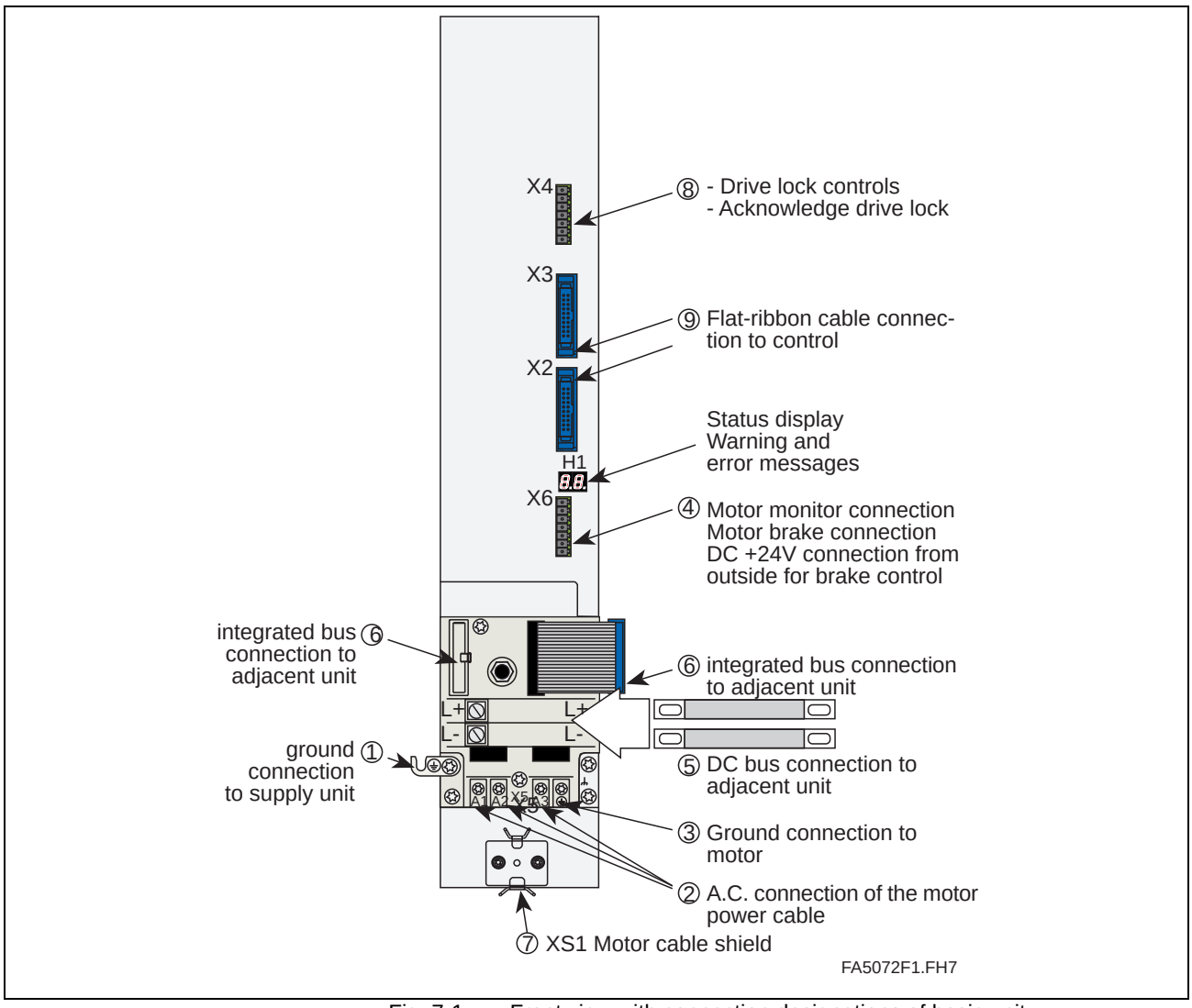


Fig. 7-1: Front view with connection designations of basic unit

For explanations on points ① to ⑨ see the following pages.

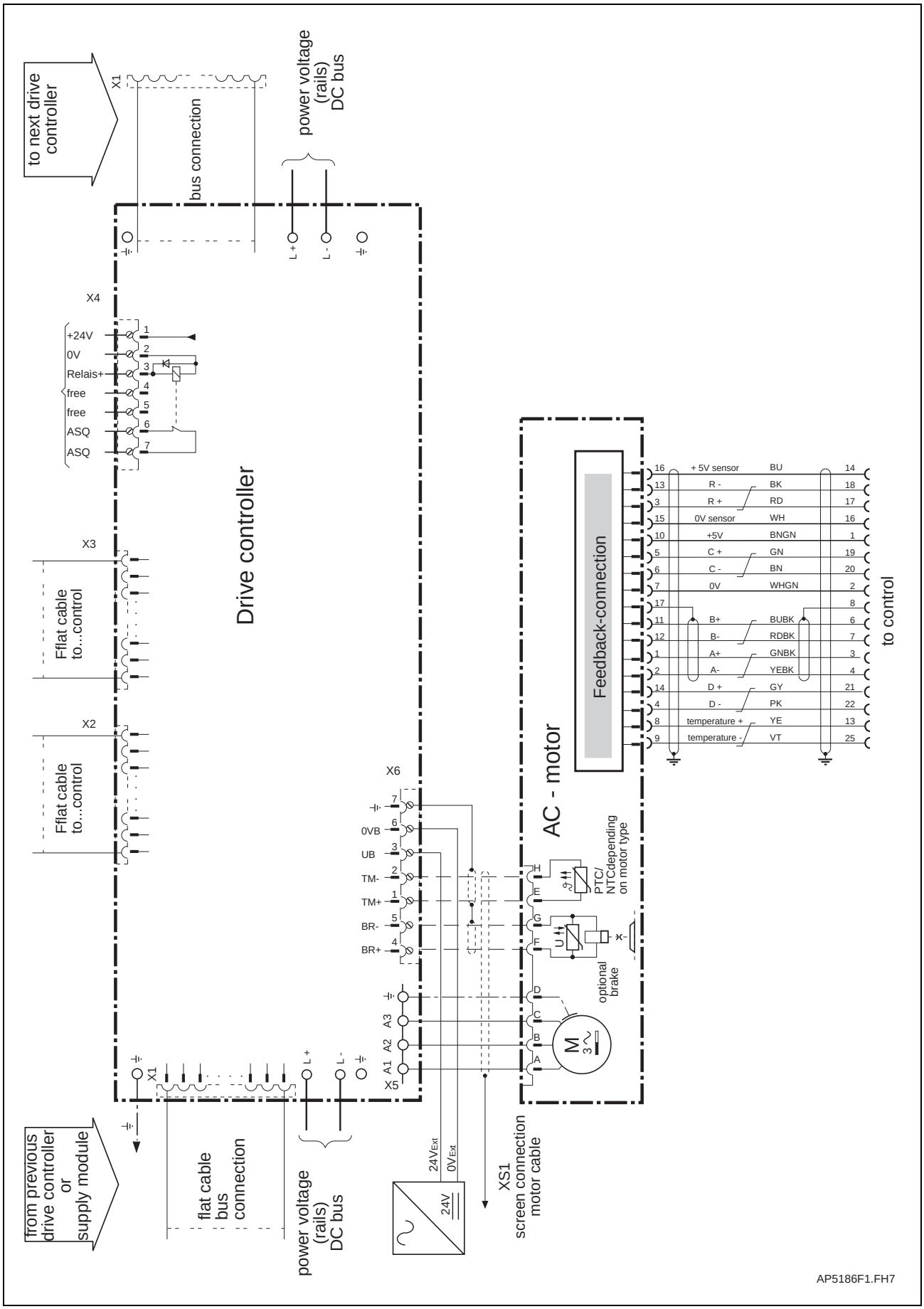


Fig. 7-2: An HDS drive controller with connections labelled

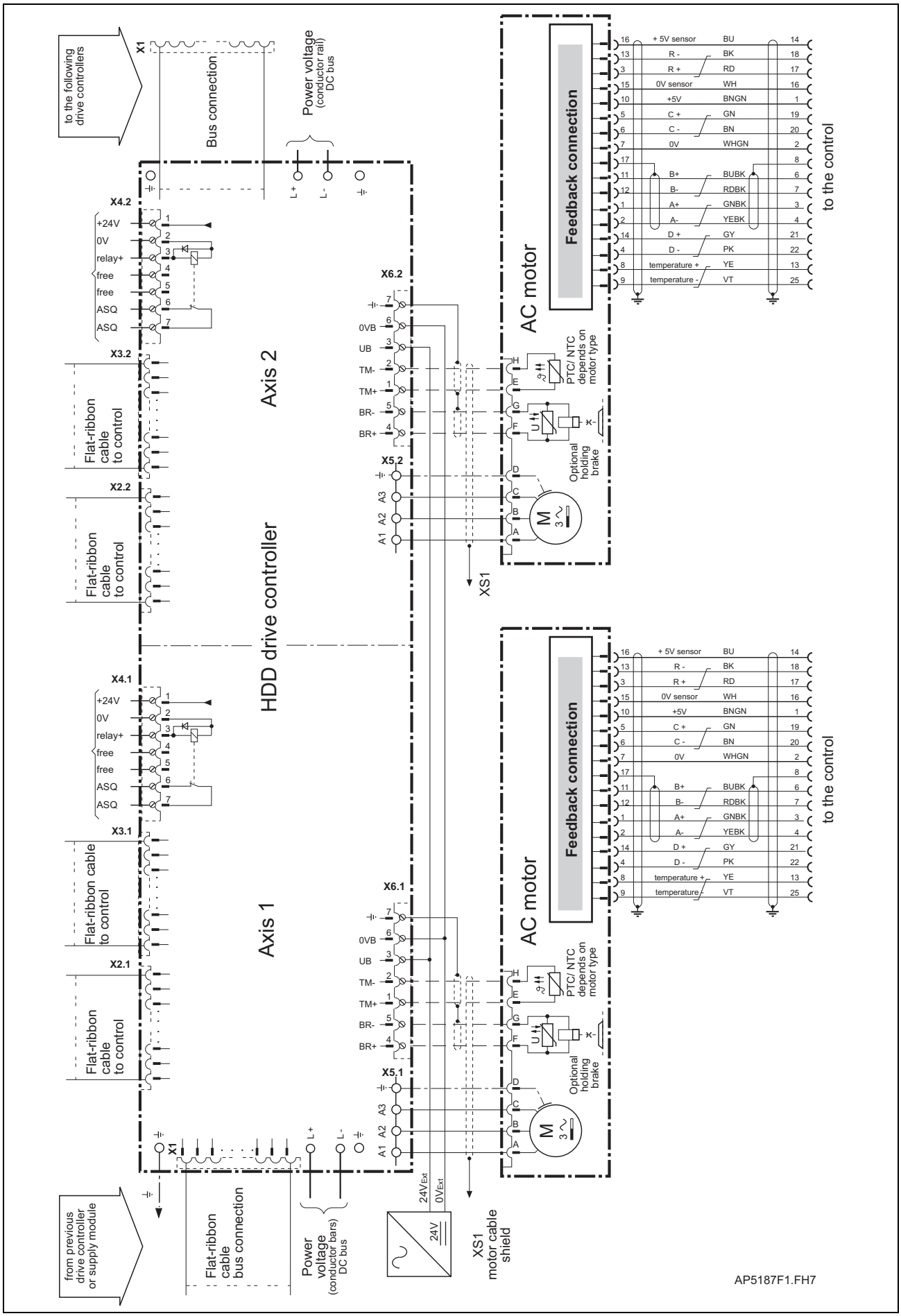


Fig. 7-3: An HDD drive controller with connections labelled

X1, Connector for integrated bus connections from the neighboring unit

Technical description of connector

Illustration

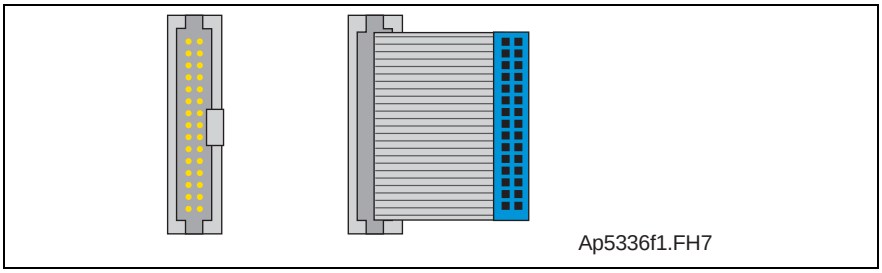


Fig. 7-4: Connector X1

Design

Type	No. of pins	Design
FBK connector	30	Connector at the unit
FBK bushing	30	Bushing at the FBK

Fig. 7-5: Design

⑥ **Connector X1, Bus connection**

The control electronics of the drive controller receive their power via connector X1. The connection starts at the supply unit and runs to the drive controller with the help of the flat-ribbon cable integrated into the units. Maximum length here also equals one meter (if extensions are used)!

Note: This is an internal connection between the supply unit and the drive controller.

X2,X3, Interface to control

Technical description of connector

Illustration

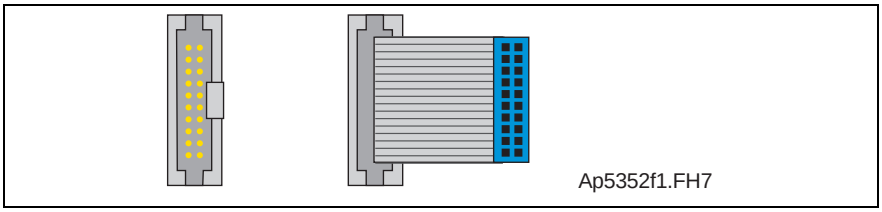


Fig. 7-6: Connector X2, X3

Design

Type	No. of pins	Design
FBK connector	20	Connector at the unit
FBK bushing	20	Bushing at the FBK

Fig. 7-7: Design

⑨ **Connector X2, X3 Interface to control**

The signal exchange of the control with the drive control uses plug-in connector X2 or X3. Only one connector per machine axis may be occupied.

An error message is generated if both connectors of an axis are occupied.

The machine parameters of the control are used to allocate a controller axis to the feedback unit of a motor.

The arrangement of the controller axis must be so that the flat-ribbon cable connections are as short as possible (direct arrangement at the control).

Note: The ribbon cable is supplied with the Heidenhein system.

X4, Starting lockout

Technical description of connector

Illustration

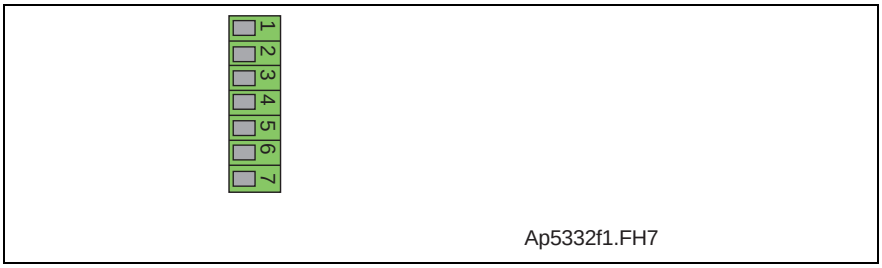


Fig. 7-8: Connector X4

Design

Type	No. of pins	Design
Screw-type terminal	11	Pins at the unit

Fig. 7-9: Design

Connection cross section

Cross section single wire [mm²]	Cross section multi core wire [mm²]	Cross section in AWG gauge no.:
0,14 - 1,5	0,14 - 1,5	28 - 16

Fig. 7-10: Connection cross section

⑧ Connector X4, starting lockout

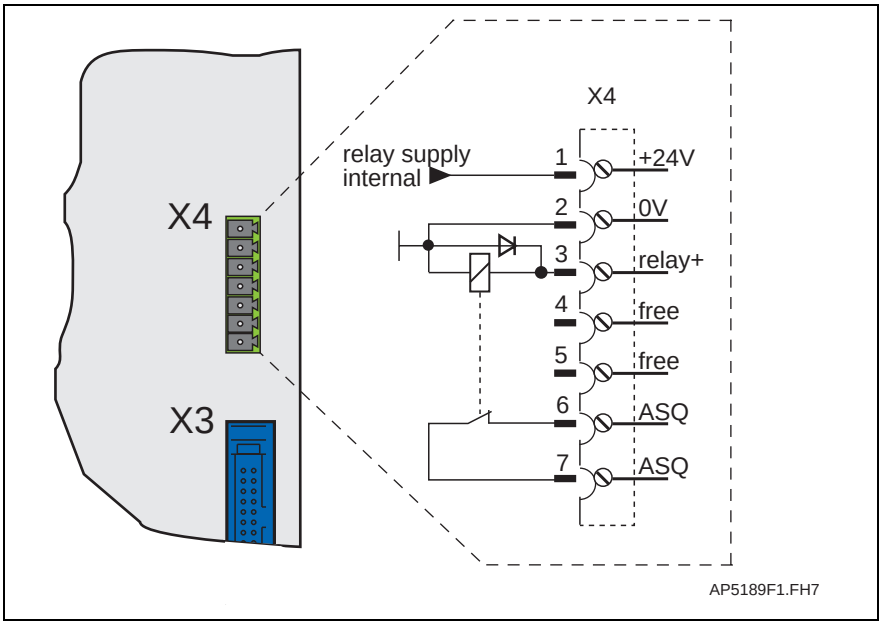


Fig. 7-11: Connector assignment X4

Starting lockout, relay+, ASQ, ASQ

The starting lockout is a safety mechanism to secure against unintentional startups of the connected motor in the event an error. It serves to securely switch off separate working areas within a machine or plant.

Note: A starting lockout does not bring moving devices to a standstill.

+24V, 0V, Relay+:

- Relay+: control input for relay coil
- Voltage: DC 20 to 30 V
- Power: 1.5 W

To release the drive, the drive lockout release at relay + must be supplied with 24V. This voltage is at X4 pin1. If this internal voltage source is used, then X4 pin2 does not have to be connected. If an external 24V is the voltage source, then it must be connected to X4 pin3 relay+ and X4 pin2 0V.

ASQ, ASQ:

Potential-free feedback contact which acknowledges the actuating of the starting lockout to an external control.

Braking capacity: DC 24 V, 1 A (maximum = duration)

The actuation of the relay of the starting lockout in the drive controller is confirmed by the closing of the potential-free feedback contact (output ASQ - ASQ) to the external control.

X5, Motor and DC bus connection

Technical description of connector

Illustration

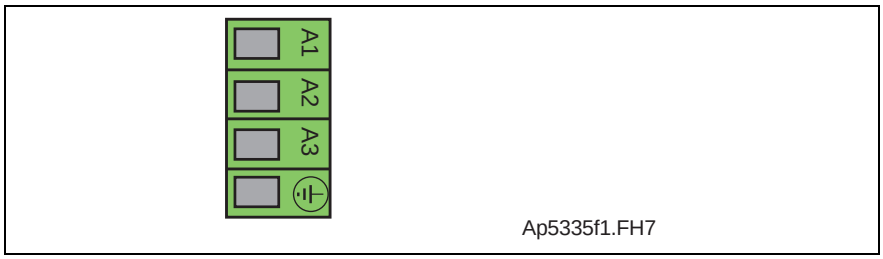


Fig. 7-12: Connector X5 HDS12, HDD12

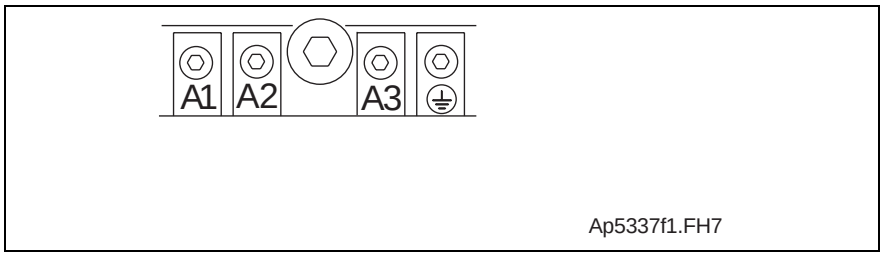


Fig. 7-13: Connector X5 HDS13, HDS14

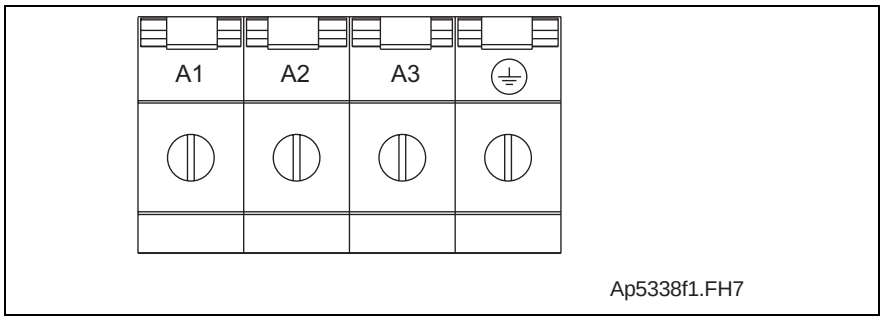


Fig. 7-14: Connector X5 HDS15

Design

Type	No. of pins	Design
Screw-type terminal	4	Bushing on connector

Fig. 7-15: Design

Connection cross section

	Cross section single wire [mm²]	Cross section multi core wire [mm²]	Cross section in AWG gauge no.:
HDD12, HDS12	0,2-4	0,2-4	24-10
HDS13	2,5-10	4-16	12-4
HDS14	2,5-16	2,5-35	12-2
HDS15	16-50	16-50	6-0

Fig. 7-16: Connection cross section:

Tightening torque

	DC bus	Motor connection
HDD12, HDS12	3 Nm	0,5 - 0,6 Nm
HDS13	3 Nm	2 Nm
HDS14	3 Nm	4 Nm
HDS15	3 Nm	6 Nm

Fig. 7-17: Tightening torque

②+③+④ **Motor power cable connections**

Rexroth Indramat motor power cables should be used to connect drive controller and motor.

Inside an Rexroth Indramat motor power cable there are

- three supply lines for the motor power connection and
- one line for the ground conductor connection
- a separately shielded pair of lines for the motor temperature monitor
- a separately shielded pair of lines for the motor holding brake
- and a complete shield mounted to the shield attachment.

The motor power cable is available as a standard cable from Rexroth Indramat. The cable can also be made of four twisted individual supply lines (3 phases, 1 grounded conductor) with a separately conducted, shielded supply line for temperature monitoring and the brake connection.

For supplementary technical information on connections and diameters, see the relevant motor description.

Cable lengths

Maximum cable lengths equal 75 meters if Rexroth Indramat cables are used.

⑤ **DC bus connection**

Adjacent drive controllers are generally connected via the litz wires (shipped with the drive).

If it should not be possible to use these connecting litz wires, then establish the connection with twisted supply lines that are as short as possible (maximum length of one meter, maximum diameter 16 mm²).

X6, motor temperature monitoring and Holding brake

Technical description of connector

Illustration

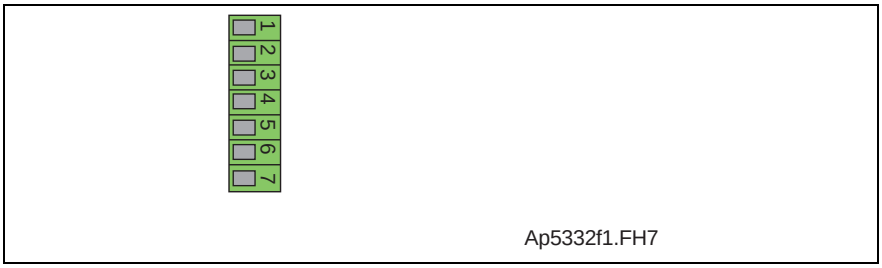


Fig. 7-18: Connector X6

Design

Type	No. of pins	Design
Screw-type terminal	7	Pins at the unit

Fig. 7-19: Design

Connection cross section

Cross section single wire [mm²]	Cross section multi core wire [mm²]	Cross section in AWG gauge no.:
0,14 - 1,5	0,14 - 1,5	28 - 16

Fig. 7-20: Connection cross section

DANGER

Dangerous movements! Persons at risk by falling or dropping axles!

⇒ The serially delivered motor holding brake or any external motor holding brake activated by the drive controller by itself does not provide adequate personal protection!

⇒ Personal protection must be ensured by primary failsafe measures:

The dangerous zone must be blocked off by a safety fence or safety grates.

After the motor is switched off, vertical axles must be additionally protected from falling or dropping, e.g. as follows:

- by mechanically locking the vertical axle,
- by an external braking, catching or clamping unit,
- by adequately counterbalancing the weight of the load.

④ Connector X6, holding brake, motor temperature monitor

The drive controller controls the motor holding brake. As long as this function is not available from the control manufacturer it is necessary to use an external device. In this case, connect the external brake voltage **directly** to the brake connections BR+ and BR- which are on the motor and switch these using an external circuit.

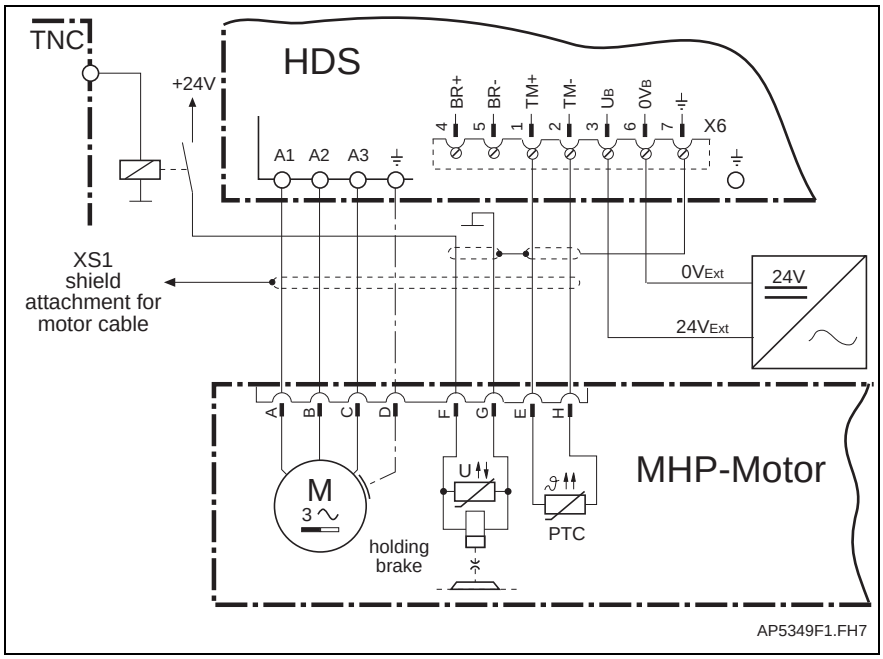


Fig. 7-21: Motor cable, holding brake and temperature monitor connections for MHP motors

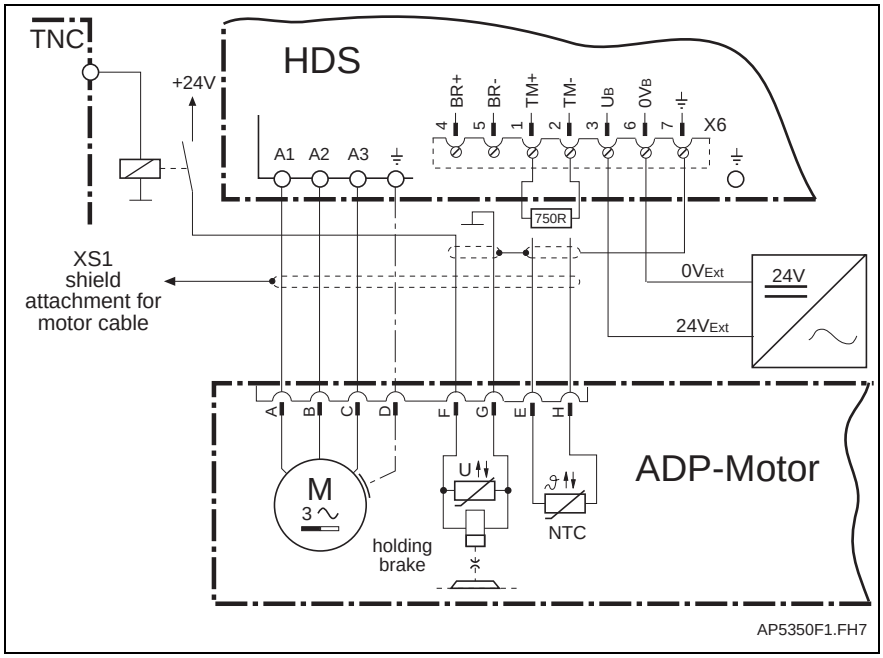


Fig. 7-22: Motor cable, holding brake and temperature monitor connections for ADP motors

Note: When using ADP motors the temperature sensor cable can not be connected to X6. Instead a 750R resistor should be connected between X6.1 and X6.2.

With ADP motors the temperature signal transmitted via the motor cable is only used in the controller.

Note: If a motor holding brake is used, then it is necessary to connect an external 24V three-phase voltage source.

The current consumption of the holding brake is listed in the project planning manual of AC motors.

Note: The internal brake control switch can only supply 2A maximum.

The AC motor holding brake is not a working brake. It wears down after about 20,000 motor revolutions against the closed brake.

Note: To release a holding brake in an MHP AC servo motor, apply the DC +24V +/- 10 % directly to the motor. The voltage to release the brake must either applied to X6/3 (+24V) and X6/6 (0V) or directly to the motor. It must be ensured that the brake will release even if longer motor power cables are used (voltage drop with long motor power cables can be compensated by increasing supply voltage (up to DC +26.5V) and/or with a regulated voltage supply at X6/3 and X6/6).

XS1, shield attachment for motor cable

⑦ **Connector XS1, shield** The entire motor cable shield is placed on shield bracket XS1 using the supplied clips. The cable diameter is matched by selecting an appropriate clip bracket on the mounting panel. The output direction of the cable can be either vertical or horizontal and this can be selected and set by moving the mounting panel as needed.

Ground connections to the supply module

① **grounding clip**

HDD and HDS drive controllers are equipped with two ground connections (earthing) to the supply module, namely,

- on the back wall of the unit and the mounting rails as well as
- the front of the grounding clip (see illustration)

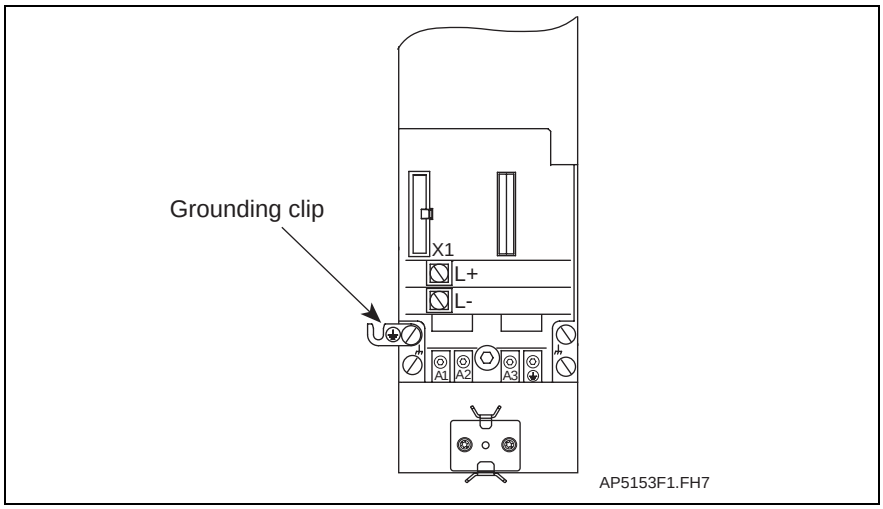


Fig. 7-23: Controller ground connections

See also section 10-1: "Mounting the Drive Controller " for supplementary information.

Controller voltage supply

When using the POWERDRIVE systems the controller voltage must be supplied via an intermediate module UV 101 B from Heidenhain.

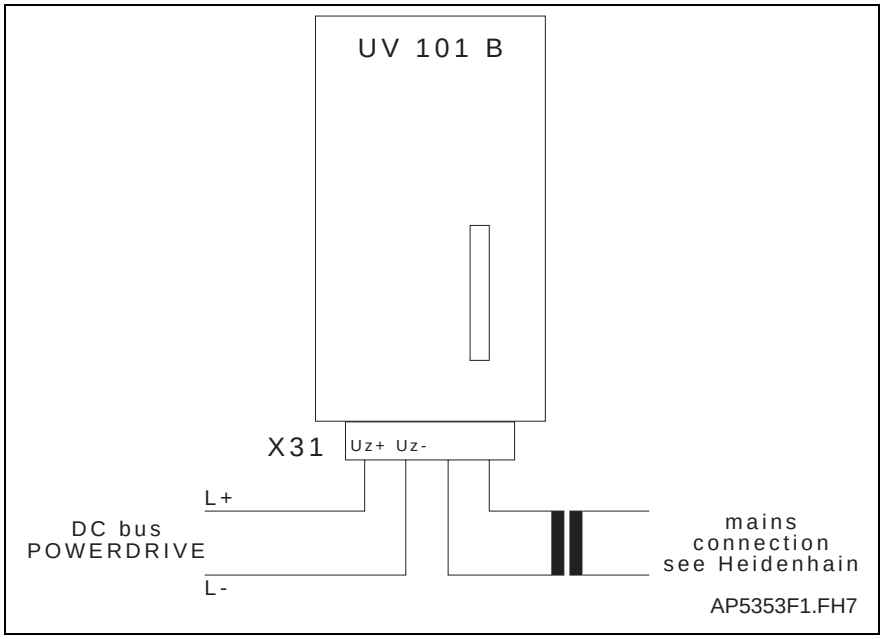


Fig. 7-24: UV 101 B

Operation of CNC controlled halt

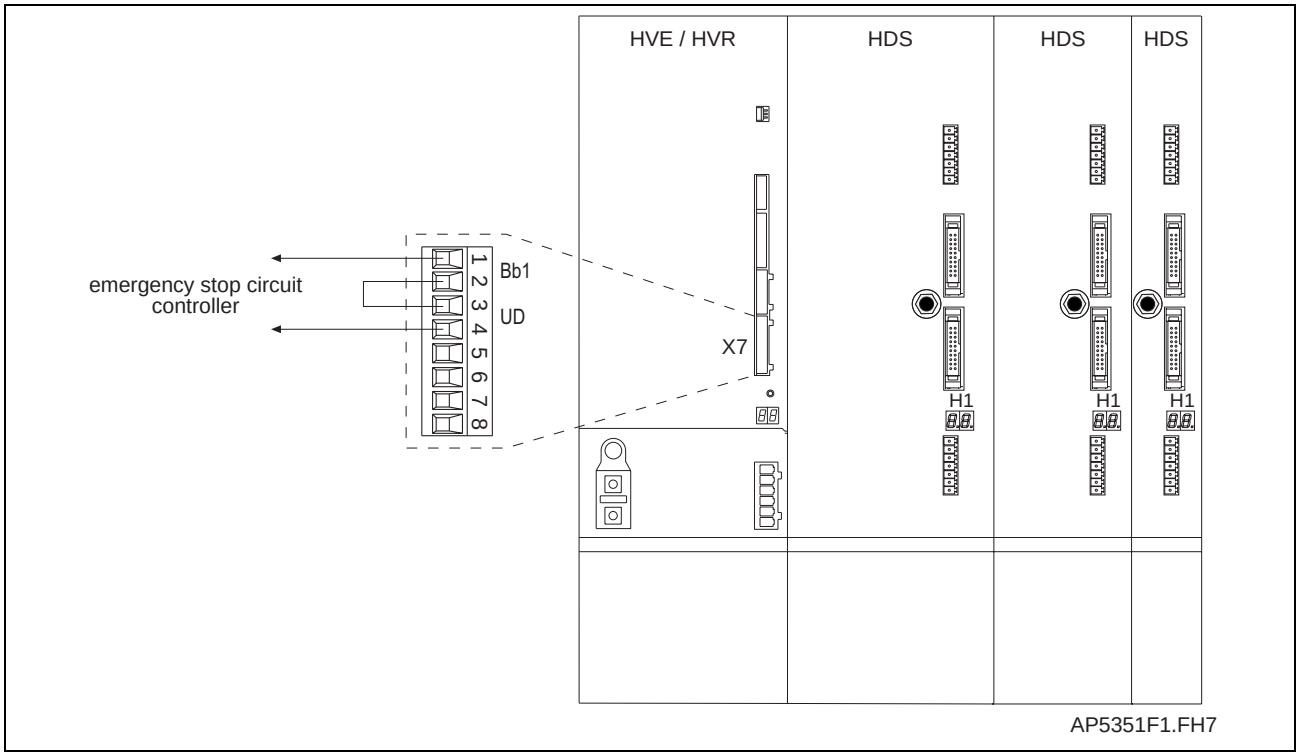
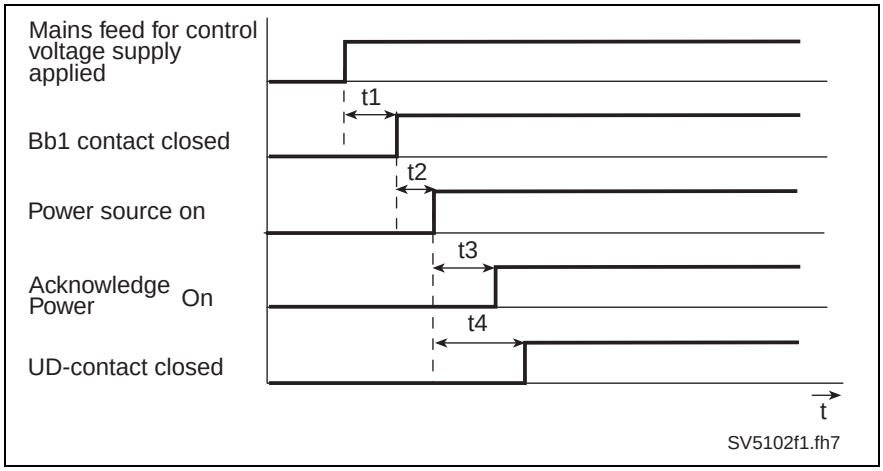


Fig. 7-25: Example: emergency stop circuit

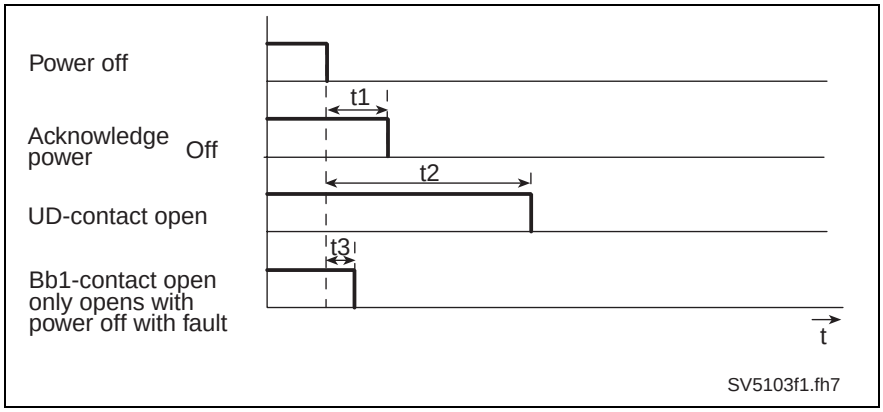
See also documentation:
"DOK-POWER*-HVE-HVR**G2-AWxx-EN-P".

Timing sequence at switch on and switch off



t1: depends on parametrized function of the drives
t2: depends on the reaction time of the PLC
The following values are valid for a maximum additional capacitance of 10 mF or 20 mF respectively!
t3: on-delay of K1 mains contactor in the unit (max. 3,6 ms [*1])
t4: time to build up DC bus voltage (max. 4,1 s [*1])

Fig. 7-26: Chronological sequence when powering unit up



t1: off-delay of the K1 mains contactor in the unit (max. 100 ms)
t2: depends on reduction of DC bus voltage (max. 500 ms)
t3: only opens with power shutdown due to a fault (fault in supply unit, drive controller or due to mains failure) (max. 25 ms)

Fig. 7-27: Chronological sequence when shutting down the unit

8 Transport and Storage

8.1 General Notes

Transport

- Use suitable transportation equipment.
- Use shock-absorbent supports if excessive shocks and vibrations could occur during transport.
- Electrostatically-endangered parts (e.g., plug-in modules) may only be transported in conductive packaging.

Storage

- Permissible temperature range for storage and transport: -30° C to +85° C
- Store dry, dust and shock free.
- Electrostatically-endangered parts (e.g., plug-in modules) may only be transported in conductive packaging.

Notes

9 Identifying the Merchandise

9.1 Delivery Slip and Barcode Sticker

The delivery slip lists the merchandise of the entire delivery by name and order designation.

There are barcode stickers which identify the delivery itself on the packaging of the controller.

Fig. 9-1: Barcode sticker on packaging of HDD / HDS (example)

9.2 Type Plate of Drive Controllers

Position of type plates

The controller is clearly identified by two type plates (see Fig. 9-2) :

- Type plate of drive controller (on the top of the unit).

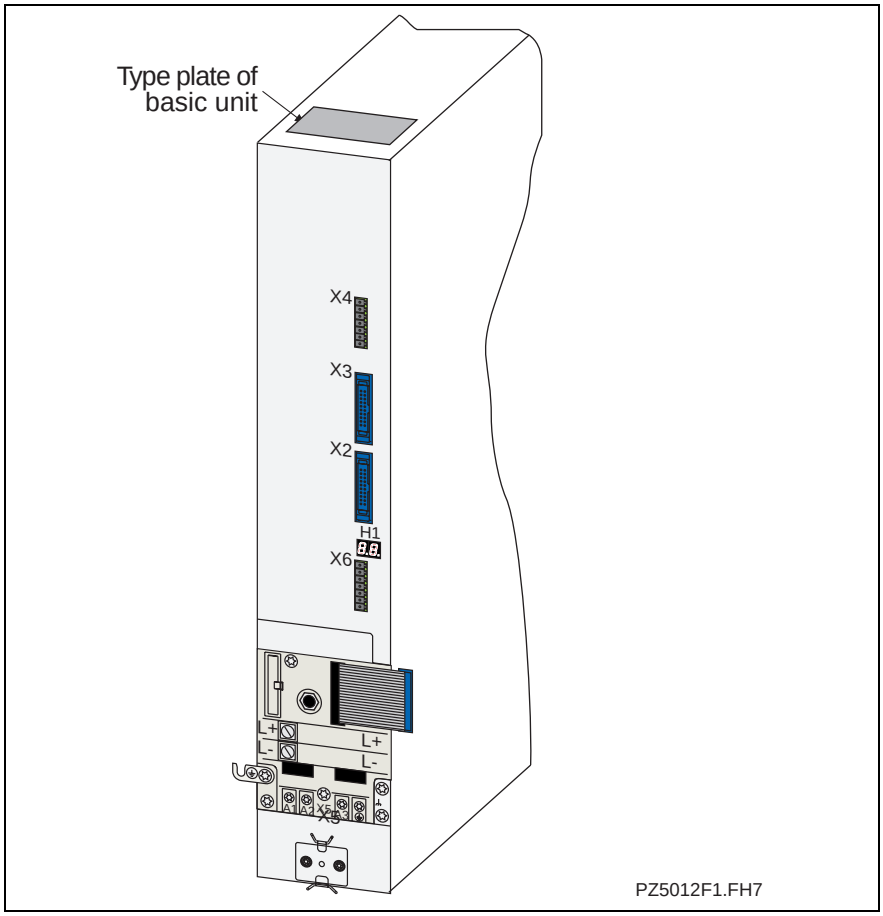


Fig. 9-2: Position of type plates on the unit

9.3 Other Type Plates

Standard cables

The order number and the length of the cable are on the cable label (cable marker).

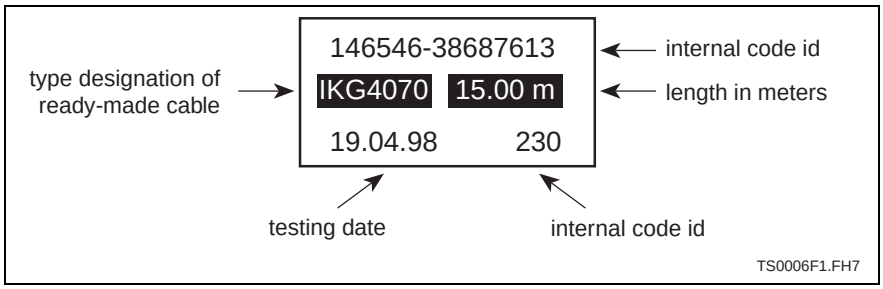


Fig. 9-3: Example: label for a standard cable

Cable parts

The order designation is printed on the cable.

10 Mounting and Installation

10.1 Mounting the Drive Controller

Note: Please note the mounting instructions (see sec. 5-1)

Arranging the controllers

Arrange the drives with higher power needs and high currents as close to the supply unit as possible. Place the drive package directly to the left of the control.

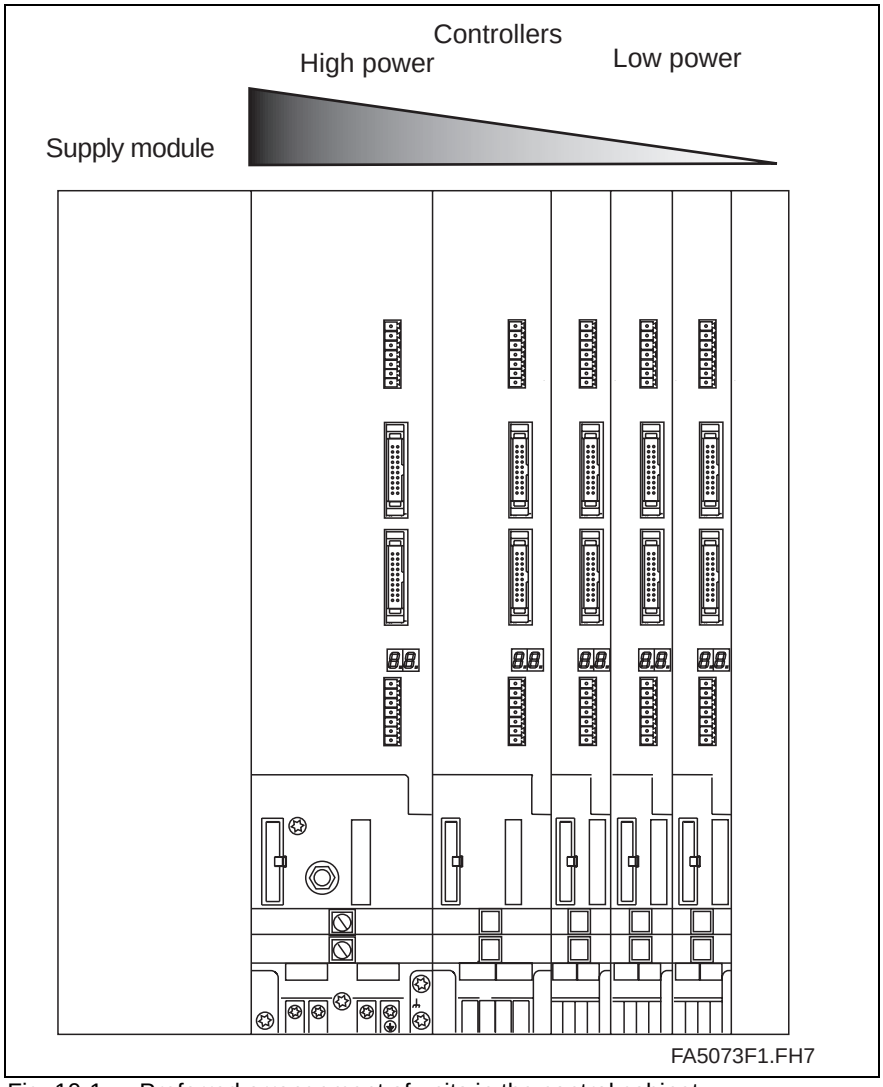


Fig. 10-1: Preferred arrangement of units in the control cabinet

Fastening the mounting rails

Mounting rails support the entire drive package. To be able to take up the generated forces, it is necessary to fasten the rails in at least every second slot using an M5 screw.

As the mounting rails also conduct the potential compensation of the drives, there must be good contact of the mounting rails and the mounting panel. Therefore, it may be necessary to remove any paints or finishes on the panel within the area of mounting!

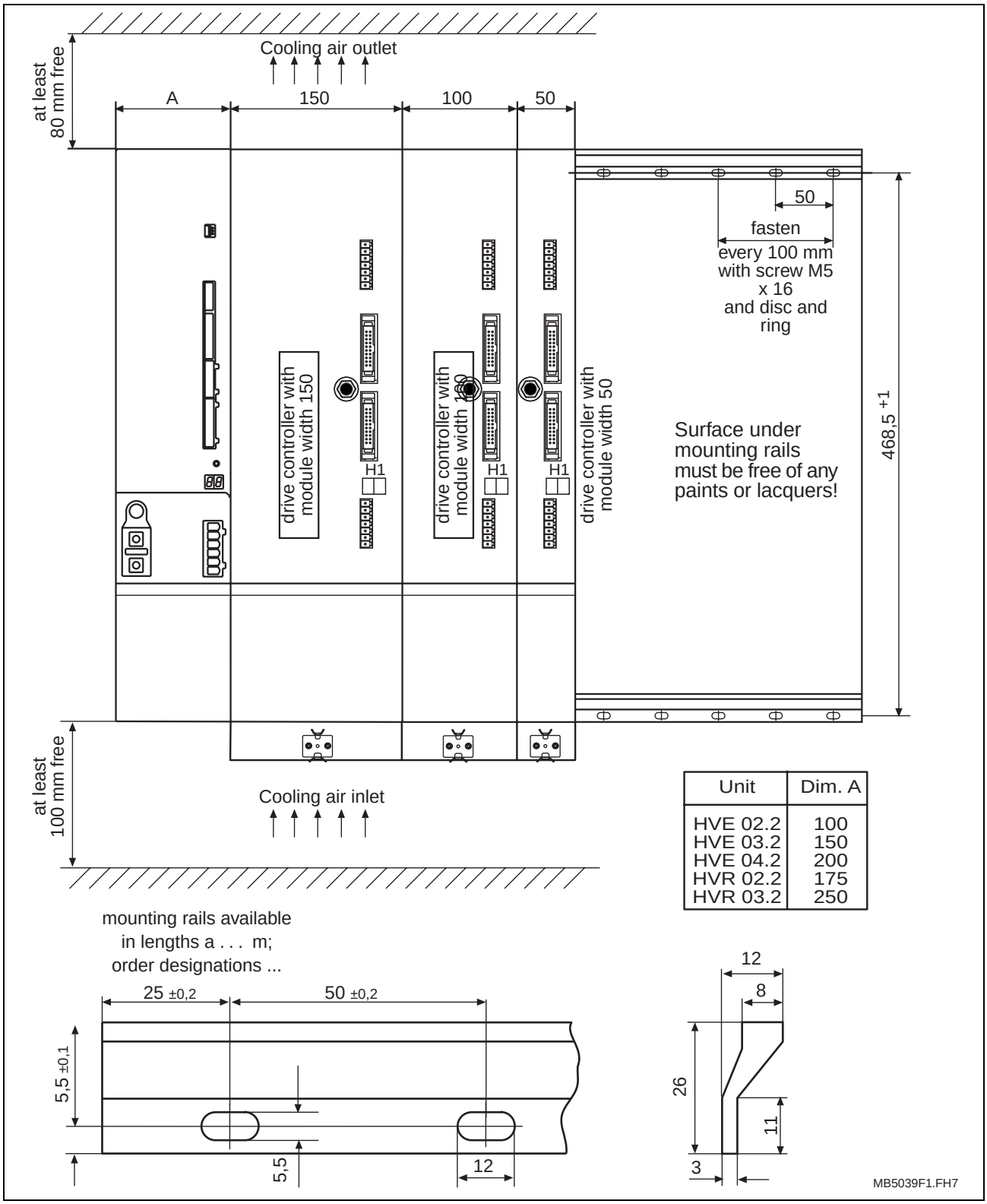


Fig. 10-2: Mounting the unit and fastening the mounting rails

The bore grid of the mounting rails can also be used to fasten the control.

Mounting the drive controller

1. Hang the drive controller onto the mounting rails.
2. Push drive controller next to the adjacent unit.
3. Tighten clamping screw (see Fig. 10-3).

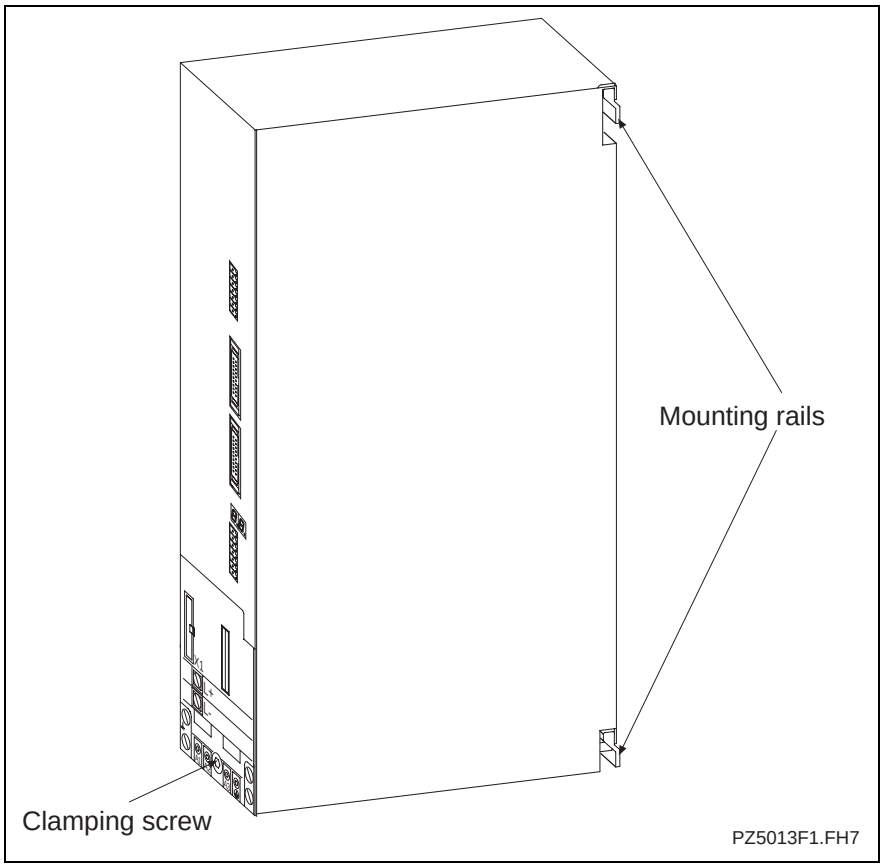


Fig. 10-3: Mounting the drive controller

10.2 Installation

- Establish a ground connection with a grounding clip on the lower edge of the controller.
- DC bus connection for the power connections must be released on the underside of the unit and power connection to adjacent unit or supply unit must be established.
- Close bus connection to adjacent unit using the integrated flat-ribbon cable.
- Connect flat-ribbon cables of X2 or X3 to relevant control connection.
- Connect motor power cable with protective conductor and shield.
- Connect motor temperature sensor and holding brake (optional).

10.3 Machine Parameters for the Control

If the required parameters have not been made available by the control manufacturer, then it is necessary to make the following entires into the machine parameter blocks of the controls:

Machine parameter	Peak current I-MAX (A eff.)	Nominal current I-N (A eff.)		Current sensor voltage U-IMAX (V)
		4kHz	8kHz	
HDD12.2-W040N	28,3	10,6	7,1	5,66
HDS12.2-W040N	28,3	14,2	10,6	5,66
HDS13.2-W075N	53	28,3	21,2	5,66
HDS13.2-W100N	70,7	35,4	24,7	5,66
HDS14.2-W200N	141,4	84,9	56,6	5,66
HDS15.2-W300N	212,1	123,7	70,7	5,66

The specified currents are rms values.

MP 2180: PWM frequency.

The standard switching frequency of the power section equals 4000Hz.

If some applications need a different frequency, then the values of the allowed nominal current must be linearly interpolated in the above specified range.

MP 2190: DC bus voltage.

The DC bus voltage must be entered in terms of the supply unit used.

Supply unit	Mains input voltage		
	3 x 400VAC	3 x 440VAC	3 x 480VAC
HVE (all types)	560	620	680
HVR (all types)	750	750	750

11 Service and Checks

11.1 Error Diagnoses

The following diagnoses are displayed on PowerDrive units on the 7-segment H1 display:

Description of the diagnosis	Display
Internal initialization of the unit.	. .
Drive is ready to receive power. No drive error or warning are pending.	bb
Power voltage is on. Drive ready to output power.	Ab
Drive is enabled. The control can run the axis.	AF
Drive lockout activated. To run this axis, actuate the AS relay. This message only generated if drive in state Ab or AF.	AS
Error: overtemperature in power section Shutdown in 30 seconds of pending warning.	18
Error: overvoltage in power section DC bus voltage >= +900V	25
Warning: overtemperature in power section Heatsink temperature >= +115°C Shutdown of power section in 30 seconds.	50
Warning: Motor temperature too high Motor temperature >= +145°C	51
Error: Overcurrent in power section Type current >= 2*I_{nenn}	60
Error: Brake monitor Supply voltage of motor brake too low Motor brake current too high	68
Error: Internal supply voltage ±15V not within tolerance	69
Error: Internal supply voltage +10V too small	71
Error: Two flat-ribbon cables coming from control have been inserted into one axis.	88

Order of the Diagnostics Display

Commissioning:

After switching on the control voltage of the drive, only the two display points will initially light up.

After the initialization has been successful, and if no error or warning are pending, then the display reads **bb**.

If the AS relay is connected and the power voltage at the supply unit has been brought into load, then the drive controllers read **Ab**.

After the control has applied the enable, then the drive controller reads **AF**.

Warnings:

As long as a warning is applied, the drive displays the diagnoses in the H1 display, but no other response ensues.

Exception: If the warning *overtemperature in power section* is applied longer than 30 seconds and there is no reaction from the control during this time, then the error message *overtemperature in power section* is generated and a power shutdown is started.

Error:

If an error occurs, then it is stored and shown in the H1 display.

The error and status display are cleared by a negative flanke from /SH2 from the control. This is only possible if the control is switched off and then on again.

If a warning and an error are both pending simultaneously, then the error has priority and is displayed.

If more than one error occurs at the same time, then only the first is displayed.

Supply and additional components:

Detailed diagnoses of the supply and additional components can be read off at the relevant units.

There is neither a reading nor a reaction at the drive with supply unit warnings, e.g., *heatsink overtemperature prewarning.*

In the case of a *feedback overload warning* from HVR supply units, the power end stages of the drive controller are locked for a short time. The drive does not display this nor does it signal this to the control.

The drive enable of the drive controller is removed is the supply unit signals an error. A message for the connected control is also generated.

Connectionerror:

If the control connects two PWM connectors to one drive axis, then an error is generated and diagnosis **88** displayed.

Diagnostic Notes

The definition of the error messages and the notes on troubleshooting are the same for all POWERDRIVE controllers.

Diagnoses via the Hotline

If you cannot clear a drive controller problem yourself, then please contact your local Rexroth Indramat customer service office.
See attachment: Customer Service Locations - Sales & Service Facilities

If problems with the controls should occur, then please contact the manufacturer of the control.

To ensure a quick and safe elimination of problems and errors, please note the following prior to contacting Indramat customer service.

- Note the type of the controller, motor and gearboxes,
- the fault state and
- any fault and diagnostic displays.

11.2 Repair and Replacing Units

Repair

If the drive needs to be repaired, it applies:

- Repairs may only be made by Rexroth Indramat customer service or trained personnel.

Unit or component replacement

If a part of a POWERDRIVE unit must be replaced, then it is not necessary to parametrize or set the drive controller.

11.3 High-Voltage and Insulation Checks

Rexroth Indramat drive components are high-voltage and insulation checked in accordance with DIN VDE 0160.

Notes

12 Index

I

L

M

N

O

P

R

S

T

U

X

Notes

13 Sales & Service Facilities

Deutschland – Germany

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