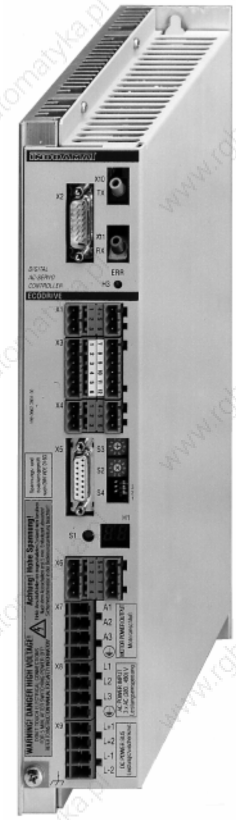

ECODRIVE

DKC02.1 Drive Controller

Project Planning Manual

DOK-ECODRV-DKC02.1****-PRJ2-EN-P

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Dept. ENA (VS, HE)

Validity The contents of this documentation and the availability of the product are subject to change.

What is this document for?

It supplies information on:

- planning the mechanical control cabinet
- planning the electrical system in the control cabinet
- logistic handling of the equipment
- preparing the resources for start-up

Supplementary documentation

"ECODRIVE Servo drives DKC with MKD"
- Selection Lists -
DOK-ECODRV-DKC+MKD****-AUS1-EN-P
for selecting the motor/controller combination.

"MKD Digital AC Motors"
- Project Planning Manual -
DOK-MOTOR*-MKD********-PRJ2-EN-P
for a detailed description of the servomotors and for the selection of the required cable.

"ECODRIVE DKC02.1 Drive Controller"
- Function Description -
DOK-ECODRV-SSE-02VRS**-FKB1-EN-P
for testing and selecting the functions.

"EMC in Drive and Control Systems"
- Project Planning Manual -
209-0049-4305-02 DOK-GENERL-EMV********-PRJ1-EN-P/04.96
for the EMC-compliant planning and installation of the drive system (EMC= Electromagnetic Compatibility).

“Fiber Optic Cable - Handling”
- Applications -
209-0090-4101-05 DE/10.94
for planning the fiber optic transmission links and selecting the fiber optic cables and FSMA plug-in connector.

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1 Introduction to the system

1.1 Application features

The drive system with the ECODRIVE drive controllers is the most cost-effective solution offering the highest functionality for almost any field of application in which translatory or rotary motions are to be automated.

Outstanding performance data, an extensive range of functions as well as an excellent price-to-performance ratio represent the salient features of this drive system.

Product features in terms of the technical applications are:

- universal implementation
- lower total costs
- digital drive concept
- highly dynamic operation
- cost-effective direct connection to the power connection
- software travel limit switch
- absolute or incremental position detection
- integrated holding brake control
- increased operating safety
- adjustable error response
- automatic parameter matching
- easy startup operation

1.2 Overview of the functions

ECODRIVE

ECODRIVE is a digital, intelligent drive family for AC servodrives.

ECODRIVE AC servodrives are microprocessor-controlled, brushless three-phase drives with servocontroller characteristics.

The drives are monitored, parameterized, diagnosed, and controlled entirely digitally by means of a signal processor which accurately measures the rotor position in the entire speed range.

ECODRIVE consists of:

- a DKC drive controller
- a MKD AC motor

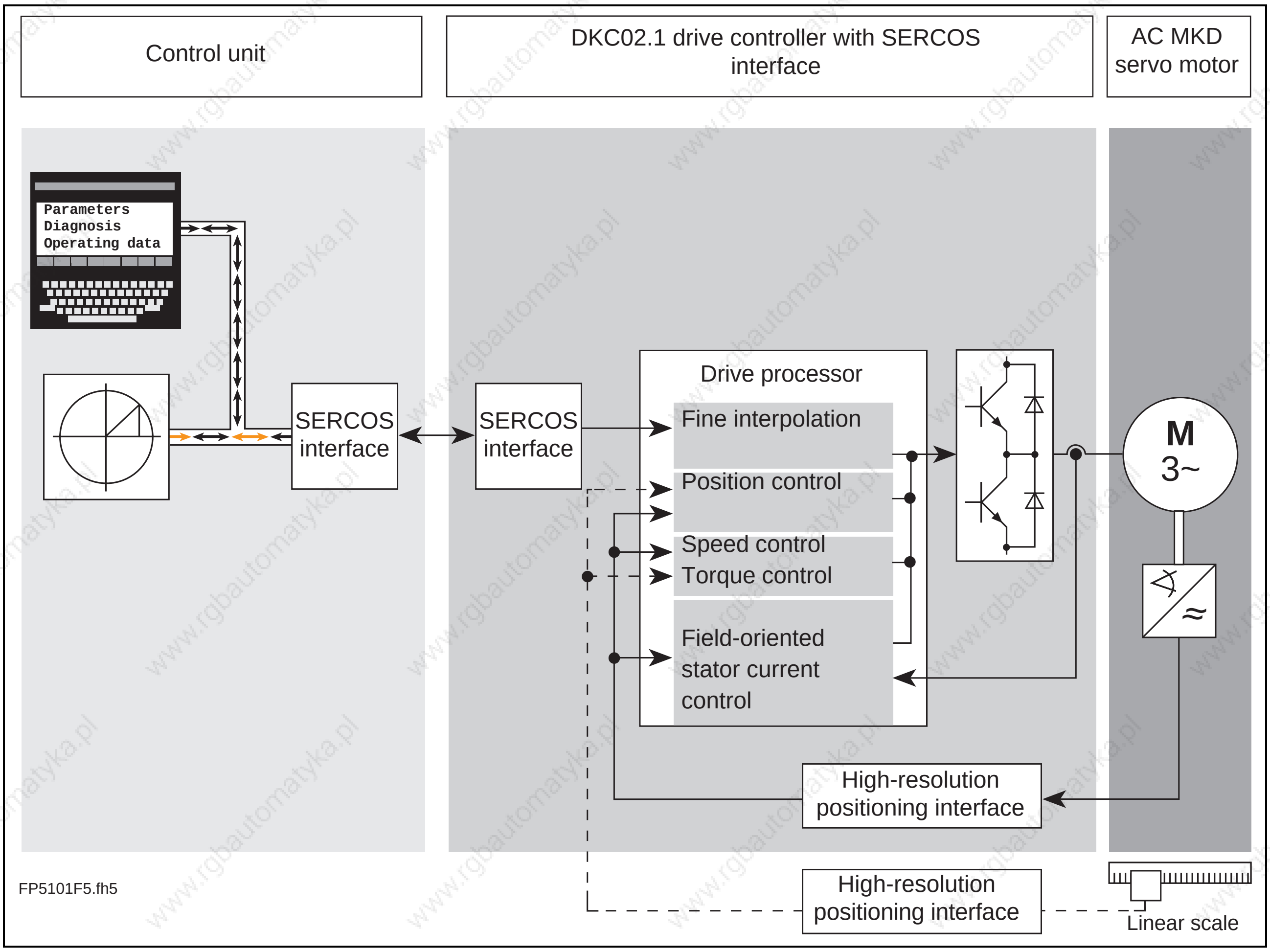


Fig. 1-1: Interworking of the control, digital drive controller, and AC motor

SERCOS interface

The drive controller DKC02.1 features the SEROS interface as control interface.

The SERCOS interface is a serial real-time communication system. The control and drives are interconnected in a ring via a fiber optic cable. Data is exchanged serially between the control and drives over this fiber optic cable.

This drive interface has been the international standard for CNC machines since 1995.

Features of the SERCOS interface

The SERCOS interface offers users the following features which are important for data transmission between bus systems.

- The ring structure reduces the wiring to a minimum. Fiber optic cables ensure the highest possible noise immunity while at the same time offer high data transfer rates.
- All exchangable data, parameters and commands used in operation have been standardized.
- The SERCOS interface makes it possible to conduct an extensive diagnosis and parameterize the drives via terminals from SERCOS interface compatible controls. This reduces startup times and downtimes considerably.
- Drives and CNC controls from various manufacturers can be used together in any combination.

Drive controller

The drive controller comprises:

- the SERCOS interface as a control interface
- the operating modes: position control, position control and interpolation in the drive (target position is preset), speed control, and torque control
- a drive-internal referencing procedure is available for creating a reference dimension.
- travel limit switch inputs and axis limit values which can be parameterized are available for limiting the travel range.
- two measuring probe inputs are available for measuring.
- mechanical translatory elements such as gear ratios or feed constants are adapted in the drive.
- all position, speed, and acceleration data can be weighted independently of the axis kinematics.
- connection for analyzing data from an external encoder (voltage signals 1Vss) if a measuring system must be directly connected to the machine element. the indirect position is always present via the motor feedback.
- connection for three-phase lines 3 x AC 380 ...480 V, 50...60 Hz

Drive data

Minimum SERCOS cycle time:	2 ms
Data rate:	2 or 4 Mbit/s
Internal position control cycle time	500 µs
Resolution of the signal period of an external measuring system:	2048-fold
Maximum frequency for 1Vss signals of the external measuring system:	200 kHz

For technical data, refer to page 4-2.

Motor

The digital AC motor MKD is a permanent electromagnetic excitation motor with electronic commutation.

The MKD motors are equipped with measuring systems (motor feedback) used for indirect actual position detection.

The MKD motors can be optionally equipped with absolute encoder measuring systems.

A data storage is present in the motor feedback that contains the motor parameters and thus ensures adjustment to the motor drive controller without the risk of damaging the motor. It also makes startup operation quick and easy.

For detailed information on the motor, please refer to the project planning manual "MKD Digital AC Motors".

Notes

2 Safety instructions for electrical drives

Please read the following instructions carefully before initial startup. These safety instructions must be observed at all times.

If the product is transferred to a third-party, the safety instructions must be included.

WARNING

Improper use of this equipment and non-compliance with the safety instructions provided can result in damage, personal injury or, in extreme cases, death.

2.1 General

INDRAMAT GmbH is not liable for any damages resulting from failure to observe the safety instructions in this document.

- Documentation in the relevant national language should be obtained before initial startup if the language in this documentation is not perfectly understood.
- Proper transport, correct storage, assembly, and installation as well as care in operation and maintenance are prerequisites for optimum and safe operation of this equipment.
- Qualified personnel:

  Only qualified personnel should be permitted to operate this equipment or work in its immediate vicinity. Personnel is considered qualified if it has sufficient knowledge of the assembly, installation, and operation of the product as well as all warnings and precautionary measures in this documentation.

  Furthermore, personnel should be trained, instructed or authorized to switch electrical circuits on and off and to ground and mark them in accordance with the requirements of safety engineering. Personnel should possess adequate safety equipment and be trained in first aid.
- Use only replacement parts approved by the manufacturer.
- All safety regulations and requirements for the specific application must be followed.
- The equipment is designed to be installed in machines for commercial use.
- Startup is only permitted once it is sure that the machine in which the products are installed complies with the requirements of the national safety regulations and safety specifications of the application. European countries: EC Directive 89/392/EEC (Machine Guideline)
- Operation is only permitted if the national EMC regulations for the specific application have been met.
  European countries: EC Directive 89/336/EEC (EMC Guideline)

  The instructions for installation in accordance with EMC requirements can be found in the document "EMC Drive and Control Systems."

  The responsibility for adherence to the limiting values required by national regulations lies with the manufacturer of the equipment or machine.
- Technical specifications as well as the connection and installation requirements can be found in the product documentation and must be observed under all circumstances.

2.2 Protection against contact with electrical parts

Note: Only relevant for devices and drive components with voltages exceeding 50 volts.

Coming into contact with components carrying voltages greater than 50 volts can be dangerous. Certain parts are under dangerous voltage when operating electrical devices.

DANGER

High Voltage!
Danger to life or risk of bodily injury!

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

⇒ Before switching on power, be sure that the ground wire is permanently connected to all electrical units according to the connection diagram.

⇒ At no time may electrical equipment be operated if the ground wire is not permanently connected to the proper terminals, even for brief measurements or tests.

⇒ Disconnect the equipment from the power supply line or the voltage source before beginning work. Secure equipment from reclosure.

⇒ Wait 5 minutes after switching off power to allow capacitors to discharge before using the equipment. Measure the voltage of the capacitors before beginning work in order to eliminate dangers arising from touching components.

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

⇒ Cover live parts properly before switching the equipment on so they cannot be touched. Covers provided with the equipment must be installed before operating the equipment to prevent contact with live parts. The equipment may only be operated with the covers designed for shock-hazard protection.

⇒ A GFCI protective device (ground fault circuit interrupter) cannot be used for AC drives! Protection against indirect contact must be ensured by other means, for example, by using an overcurrent protection device in accordance with relevant standards. European countries: in accordance with EN 50178/ 1994, section 5.3.2.3

⇒ For installation equipment protection against indirect contact must be ensured using an external housing, such as a control cabinet. European countries: in accordance with EN 50178/1994, section 5.3.2.3

WARNING

High discharge current!

Danger to life or risk of bodily injury!

⇒ All units and the motors must first be connected to a grounding point with the ground wire or must be grounded themselves before switching on power.

⇒ The discharge current is greater than 3.5 mA. A permanent connection to the power supply system is therefore required for all units. European countries (EN 50178/1994, section 5.3.2.3).

⇒ Before startup operation always connect the protective conductor or the ground conductor. Otherwise the housing may harbor high voltages.

2.3 Protection against shocks caused by safety extra-low voltage (SELV)

All connectors and terminals on INDRAMAT products with voltages from 5 to 50 volts are safety extra-low voltages offering a shockproof design to meet the following standards:

- international: IEC 364-4-411.1.5
- European countries in the EC: EN 50178/1994, section 5.2.8.1

WARNING

High electrical voltages due to incorrect connections!

Danger to life or risk of bodily injury!

⇒ Only equipment and lines carrying protective extra low voltage (PELV) may be connected to connectors and terminals with voltages ranging from 0 to 50 volts.

⇒ Connect only voltages and circuits safely isolated from dangerous voltages. Isolation can be achieved, for example, by using safe isolation transformers, optocouplers or power supply independent battery operation.

2.4 Protection against dangerous movements

Dangerous movements can be caused if the connected motors are not controlled correctly.

There are various causes of dangerous movements:

- faulty wiring or cable connections
- operating the components improperly
- defective measured value transmitters and primary detectors
- defective components
- errors in the software

These errors can occur just after the equipment has been switched on or after an indefinite period of time.

The monitors in the drive components virtually exclude failure in the connected drives. However, personnel safety requires that additional measures be taken to ensure correct operation. Faulty drive motions which are influenced by the type of control and the operating status cannot be entirely excluded until the installed monitors take effect.

DANGER

Dangerous movements!

Danger may result in equipment damage, personal injury or death!

⇒ Personal safety must be ensured by higher-level, monitoring at the installation or precautionary measures for the reasons listed above. These are provided by the plant manufacturer according to the specific conditions of the plant based on a danger and malfunction analysis. The safety regulations in effect for the plant are included herein.

Avoiding accidents:

⇒ Stay away from the machine's movement area. Possible measures to be taken to prevent access by unauthorized persons:
  - protective fences
  - protective railings
  - protective coverings
  - light barrier

⇒ Fences and coverings should be strong enough to withstand the maximum possible momentum.

⇒ Mount the emergency stop (E-stop) switch at an easily accessible place in the immediate vicinity. Verify that the E-stop switch works before starting operation.

⇒ Isolate the drive power connection by means of an E-stop circuit or use a starting lock-out to prevent unintentional startup.

⇒ Make sure that the drives have been shut down before accessing or entering the danger zone.

⇒ Disable electrical power to the equipment using a master switch and secure against reclosure during:
  - maintenance and repair work
  - equipment cleaning
  - long downtime periods

⇒ Avoid operating high-frequency, remote control, and radio equipment near electrical equipment and their supply leads. If the use of such equipment cannot be avoided, verify that the system and plant are in perfect working order in all working situations before initial operation. If necessary, the plant must undergo special EMC testing.

2.5 Protection against magnetic and electromagnetic fields during operation and assembly

Magnetic and electromagnetic fields near current-carrying conductors and permanent magnets pose a serious health hazard for persons with pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with pacemakers, metal implants and hearing aids in the immediate vicinity of electrical equipment.

⇒ Persons with pacemakers and metal implants must not be permitted access to the following areas:

- Areas in which electrical equipment and parts are mounted, operated or put into operation.
- Areas in which motor parts with permanent magnets are stored, repaired or mounted.

⇒ If it becomes necessary for a person with a pacemaker to enter such an area, this must be approved by a physician beforehand.

Implanted pacemakers or those to be implanted have a varying degrees of resistance to interference, making it impossible to establish any general guidelines.

⇒ Persons with metal implants or metal splitters as well as hearing aids should consult a physician before entering such areas since they represent a health hazard.

2.6 Protection during handling and assembly

Handling or assembling drive components improperly may lead to personal injury.

CAUTION

Risk of injury due to improper handling!
Bodily injury may be caused by crushing, shearing, cutting, and pounding forces.

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

⇒ Use suitable assembly and transport equipment.

⇒ Take precautions to prevent pinching and crushing.

⇒ Use only suitable tools. Use special tools as prescribed.

⇒ Employ lifting devices and tools according to the manufacturers' instructions.

⇒ If necessary, use suitable protective equipment (for example goggles, safety shoes, protective gloves).

⇒ Do not stand under suspended loads.

⇒ Remove any leaking liquids on the floor immediately to prevent slipping.

2.7 Safe battery usage

Batteries consist of reactive chemicals contained in a solid case. Improper use can therefore lead to injuries or equipment damage.

CAUTION

Risk of injury due to improper handling!

⇒ Do not attempt to reactivate empty batteries by heating them or by any other means (danger of explosion or corrosion).

⇒ Do not recharge batteries because they may leak or explode.

⇒ Do not dispose of batteries by throwing them into a fire.

⇒ Do not attempt to disassemble batteries.

⇒ Do not damage the electrical components installed in the equipment.

Note: Environmental protection and disposal! The batteries contained in the product are considered hazardous material for land, sea, and air transport according to the legal regulations (danger of explosion). Dispose used batteries separately from other waste. Observe the national regulations in the country of installation.

Notes

3 Selecting the components

3.1 Overview of the required components

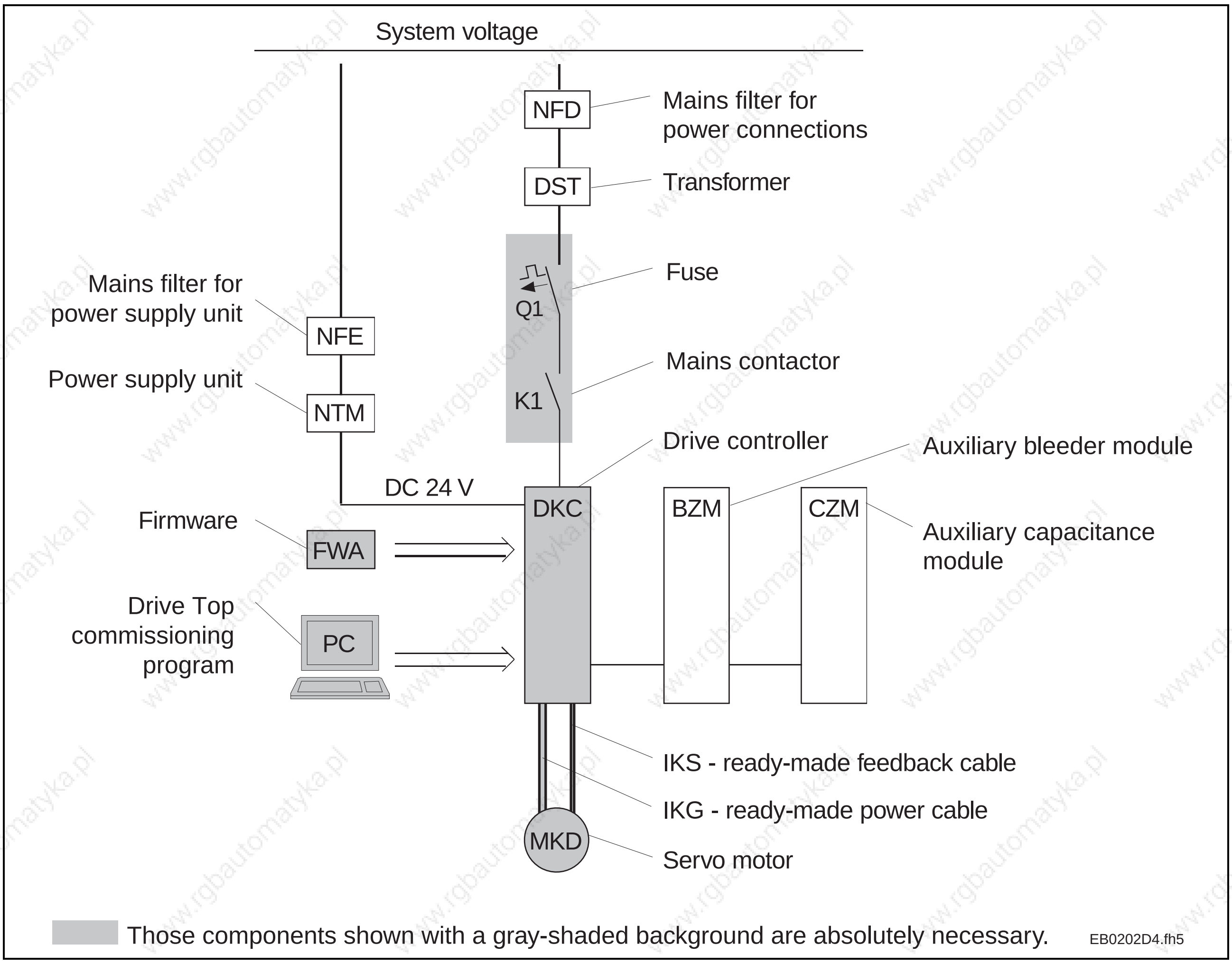


Fig. 3-1: Overview of the required components

3.2 Selection procedure

Dimensioning and selecting the drive

⇒ Dimension the drive according to how it is to be used. A document for this is under preparation.

⇒ Select motor/drive combination (DKC + MKD) using the "Selection Data" documentation (see pg. 3, supplementary documentation).

Compiling the required data

⇒ Enter the values obtained from dimensioning and enter the drives selected into table Fig. 3-2.

⇒ Calculate the continuous regenerative power according to the specifications in Chapter 5 and enter them into table Fig. 3-2.

Selecting the required components

⇒ For DKC02.1**** use firmware "FWA-ECODRV-SSE-02VRS-MS".

⇒ Select ready-made cables for the connection between DKC and MKD by using the document "MKD Digital AC Motors" - (see pg. 3 of the supplementary documentation).

⇒ Select fuse protector Q1 (see Chapter 11).

⇒ Select line contactor K1 (see Chapter 11).

Determining components which may be additionally required

⇒ Check the rated line voltage. If, in the case of the DKC**.*-040-7, the rated line voltage falls below or exceeds 3xAC (380-460)V ±10%, select a DST transformer (see Chap. 9).

⇒ Check the DC24V control voltage supply for the DKC. If DC24 Volt ± 20 % is not available, then select a suitable NTM (see chapter 7).

⇒ Check the DC24V voltage for the motor holding brake. If DC24 Volt ± 10 % is not available, then select a suitable NTM power supply (see chapter 7).

⇒ Check the continuous regenerative power. If it exceeds 0.15 kW, then consider option with BZM auxiliary bleeder module (see chapter 5).

⇒ Check the continuous regenerative peak power. If it exceeds 10 kW, then consider solution with the BZM auxiliary bleeder module (see chapter 5).

⇒ If the continuous regenerative power exceeds approx. 0,15 kW and the drive system energy content is less than 200W, using an auxiliary module CZM can be economical. This makes it possible to reduce the power dissipation for the cabinet by an amount equal to the continuous regenerative power (see Chapter 6).

⇒ Check the EMC conditions. INDRAMAT recommends the use of NFD or NFE mains filters to maintain EMC values (see Chapter 8).

3.3 Compiling the required data

	Designation	Symbol	Values/Units
Mounted mechanical system data	Effective load torque	M_{EFF}	.... in Nm
	Acceleration torque	M_{ACC}	.... in Nm
	Operating torque	M_{BEARB}	.... in Nm
	Motor speed used	n_{NUTZ}	.... in min-1
	Load moment of inertia (reduced to motor shaft)	J_{LAST}	.... in kgm²
	Maximum rotary energy in the mechanical system (E-stop case)	$W_{ROT,MAX}$	.... in Ws
	Continuous regenerative power	P_{RD}	.... in kW
	Motor/controller combination		DKC.................................. MKD..................................
Motor data	Continuous torque at standstill	M_{DN}	.... in Nm
	Maximum torque	M_{MAX}	.... in Nm
	Short-term operation torque	M_{KB}	.... in Nm
	Motor inertia	J_M	.... in kgm²
	Maximum motor speed	n_{MAX}	.... in min-1
	Power consumption of the motor holding brake (if present) Refer to the project planning manual MKD Motors	$I_{N,HB}$	.... in A
Line conditions	Required power line connection	S_{AN}	.... in kVA
	Required rated line voltage	U_N	.... in V
	DKC current consumption	$I_{N,DC}$	0.7 in A

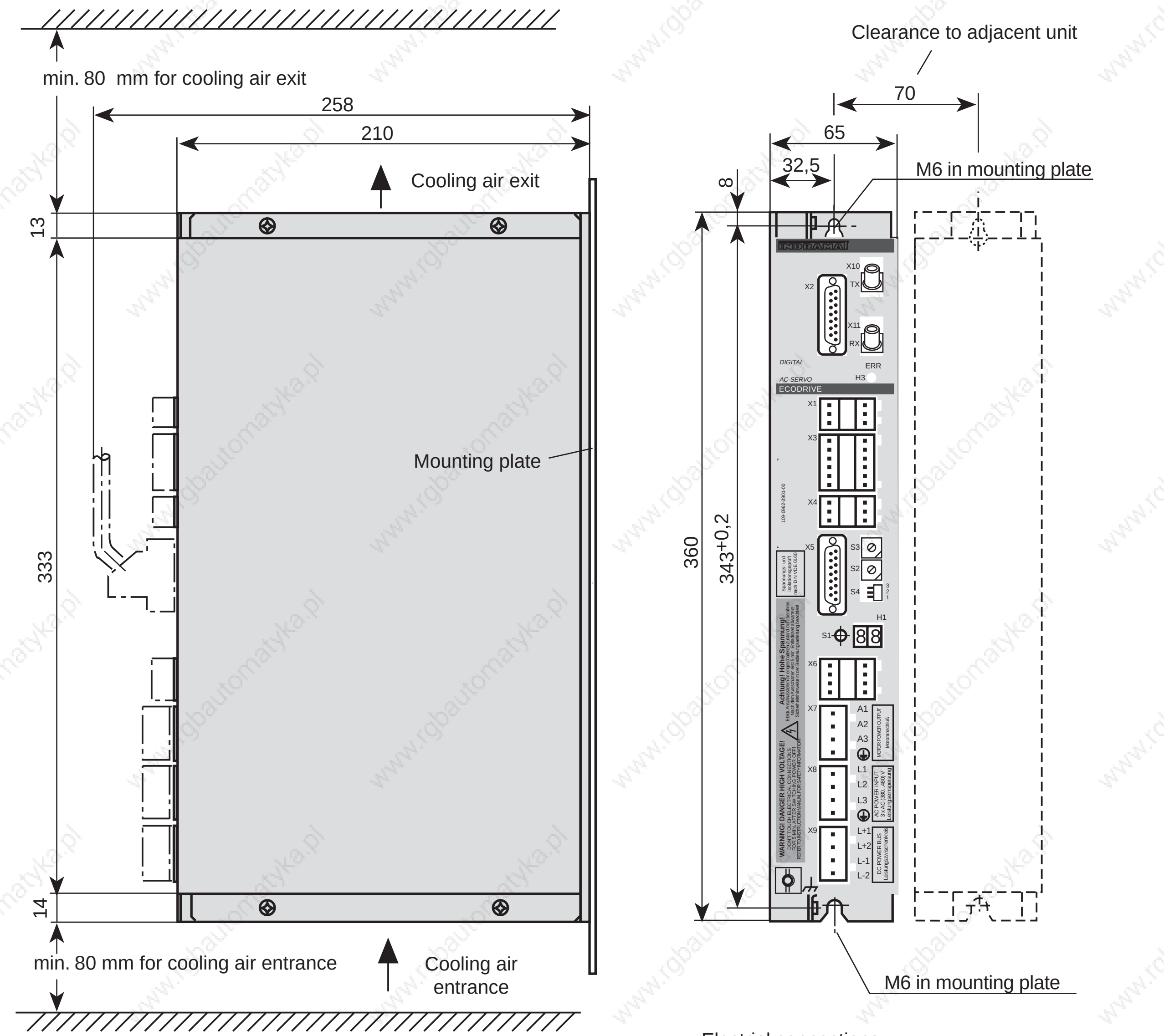
Fig. 3-2: Data required for selecting the components

Notes

4 ECODRIVE DKC drive controllers

4.1 Hardware

Dimensional data and installation dimensions



Electrial connections:

X2, X5: D-Sub-connector

X1, X3, X4, X6: Screw-down push-in terminals
0,2 ... 2,5 mm^2 fixed or flexible; AWG 24-12

X7, X8, X9: Screw-down push-in terminals
0,2 ... 4 mm^2 fixed or flexible; AWG 24-10

X10, X11: LWL-connector

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Fig. 4-1: Dimensional data and installation dimensions for the DKC02.1

Technical data

Power connection / Power section

Designation	Symbol	Unit	DKC02.1-040-7-FW
Operating mode at the mains			three-phase
Mains input voltage	U_N	V	3 x AC (380 ... 480) ± 10%
Maximum conn. voltage	S_{MAX}	kVA	4,8 ... 9
Making current	I_{EIN}	A	9 ... 12
Mains frequency	f_N	Hz	50...60
Switching frequency (selectable)	f_S	kHz	4 or 8
Continous current at f_S = 4 kHz 1)	I_{CONT}	A	16
Continous current at f_S = 8 kHz 1)	I_{CONT}	A	12,5
Rated current	I_{TYP}	A	40
Peak current	I_{PEAK}	A	40
Power disspation, without bleeder dissipation	P_V	W	180
Peak bleeder output DKC	$P_{BM,DKC}$	kW	10 (Permissble load cycle equals 0.5 sec. on, 33 sec. off.)
Continous bleeder output DKC	$P_{BD,DKC}$	kW	0,15
Maximum feedback energy DKC	$W_{MAX,DKC}$	kWs	5,0
Storage energy DKC	$W_{ZW,DKC}$	Ws	15
DC bus capacitance	C_{DKC}	mF	0,15
DC bus voltage 2)	U_{ZW}	V	DC 500...800

1) The drive data for 4 and 8 kHz switching. frequencies are listed in the document "ECODRIVE DKC servo drive" - Selection Data.
2) Value dependent on power input voltage

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Fig. 4-2: Technical data for the power connection and power section

DC 24V voltage supply

Designation	Symbol	Unit	DKC02.1-040-7-FW
Control voltage connection for DKC			
Input voltage	$U_{N,DC}$	V	DC (19,2 ... 28,8) V
Maximum ripple content	w	%	must not exceed the input voltage range
Current consumption	$I_{N,DC}$	A	0,7
Voltage connection for holding brake			
Input voltage	$U_{N,HB}$	V	DC (21,6 ... 26,4) V
Maximum ripple content	w	%	must not exceed the input voltage range
Current consumption	$I_{N,HB}$	A	please see MKD dokumentation

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Fig. 4-3: Technical data DC +24V voltage supply

Additional connection of the DC24 power supply

The DKC drives should be firmly connected to the DC24V power supply; preferred method Fig. 4-4

They can also be connected to the DC24V power supply in a switchable manner Fig. 4-5

Preferred method: The power supply is firmly connected to the attached DKC

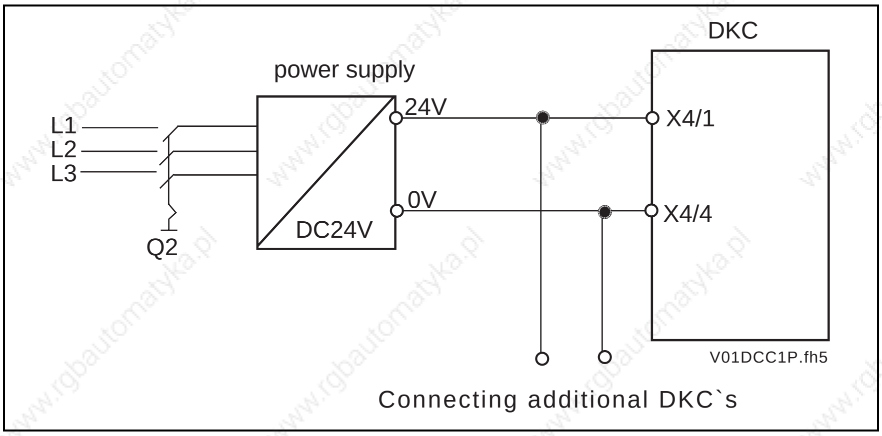

Fig. 4-4: Principle for connecting the DC24V control voltage by switching on the power supply via Q2, **preferred method**

The power supply is connected to the attached DKC in a switchable manner

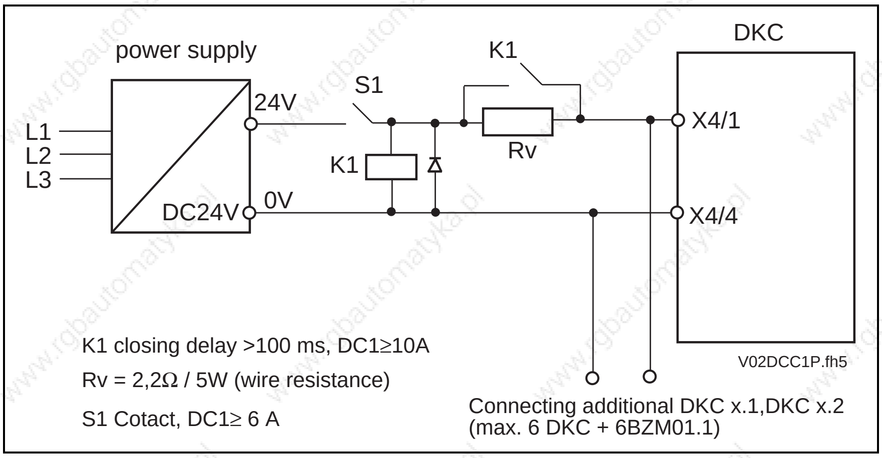

Fig. 4-5: Principle for connection the 24V via S1 with a starting current limiter

Ambient and operating conditions

Ambient temperature and installation altitude

Selection lists are indicated for each motor controller documentation (see page 3 of the supplementary documentation).

The selection lists data apply within the given ambient and installation conditions (see).

Under different conditions, the continuous torque at standstill M_{dN} and the short-term operating torque M_{KB} are reduced according to the diagrams (see Fig. 4-6). If deviating ambient temperatures and higher installation altitudes occur simultaneously, both load factors must be multiplied.

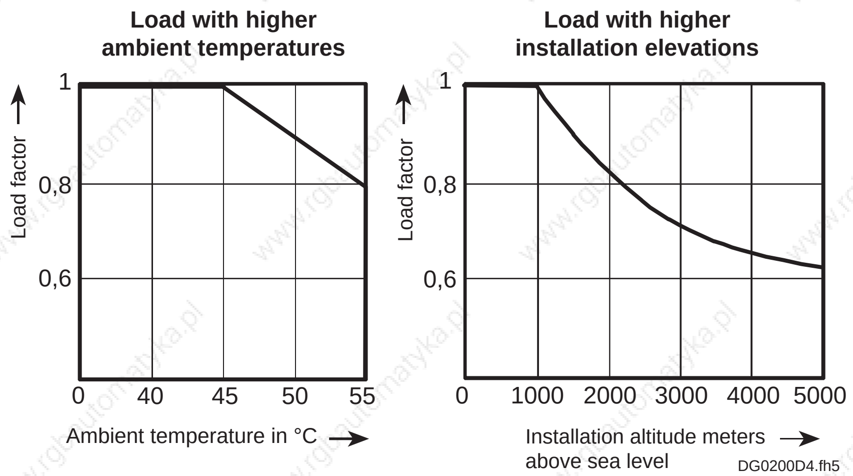

Fig. 4-6: Load utilization as a value dependent upon ambient temperature and installation altitude

Designation	Symbol	Unit	DKC02.1-040-7-FW
Ambient and installation conditions			
Cooling the power section			internal blower cooling
Permissible ambient temperature with nominal data	T_{UM}	°C	+0...+45
Max. permissible ambient temperature with reduced nominal data	$T_{UM,MAX}$	°C	+55 The values indicated in the selection data for M_{DN} and M_{KB}, drop in the range of +45 to +55°C by 2% per °C of rise in temperature.
Storage and transport temperature	T_L	°C	-30...+85
Max. installation elevation with nominal data		m	1000
Max. permissible relative humidity		%	95
Max. permissible absolute humidity		g/m³	25
Degree of contamination	Non-conductive dirt contamination, no condensation		
Protection category	IP20, as per EN 60529 = DIN VDE 0470-1-1992 (IEC 529-1989) stationary use in control cabinets		
Weight	m	kg	4.4

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Fig. 4-7: Ambient and operating conditions

Type code and rating plate

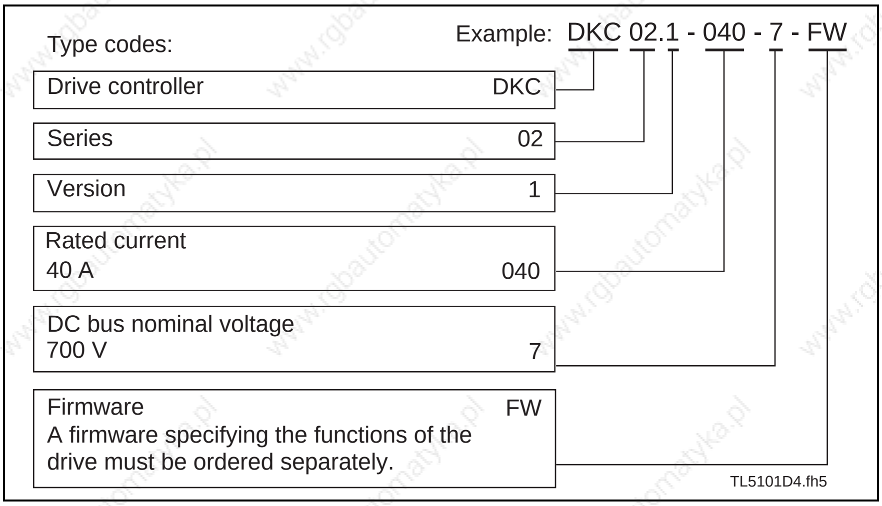


Fig. 4-8: DKC type code

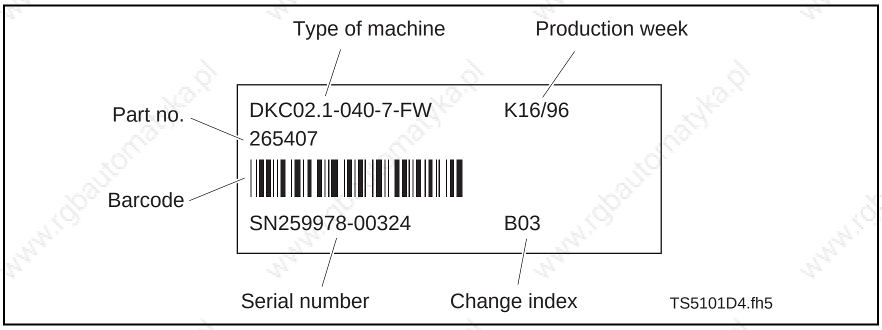


Fig. 4-9: DKC rating plate

4.2 Firmware

The firmware contained in the drive controller determines the functional features of the ECODRIVE drive controllers.

Firmware "FWA-ECODRV-SSE-02VRS-MS" is available for the DKC02.1-***.

The firmware has its own order number. This means that it is always possible to order the identical firmware version.

The firmware is updated constantly to eliminate any bugs without altering the functionality. It is identified on the type code as the firmware release version.

If newer functions are added, then the index of the firmware version is incremented (see type codes).

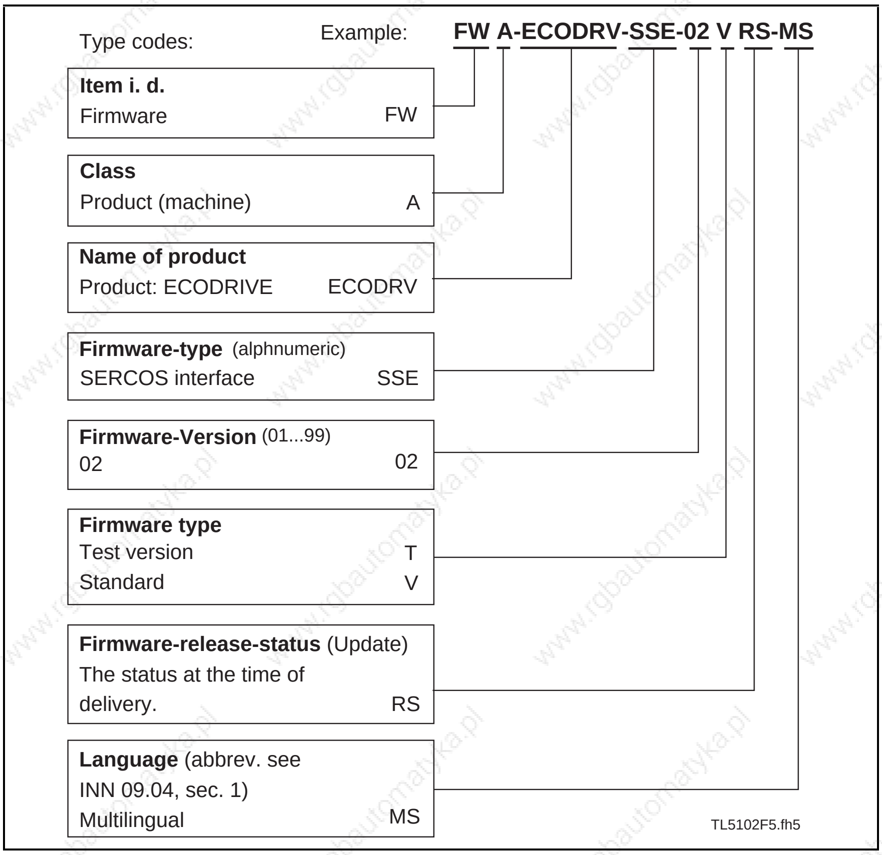


Fig. 4-10: ECODRIVE firmware type code

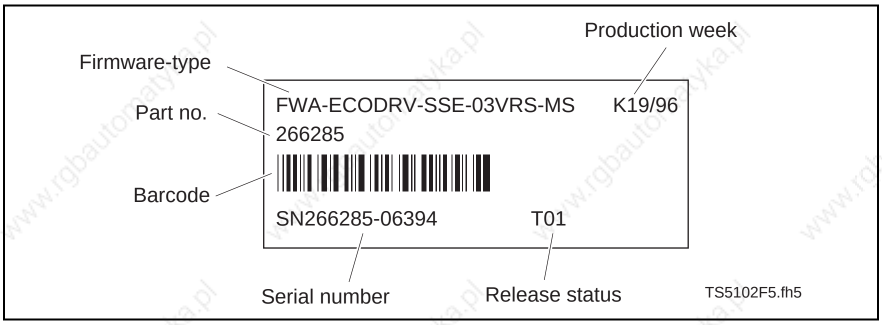
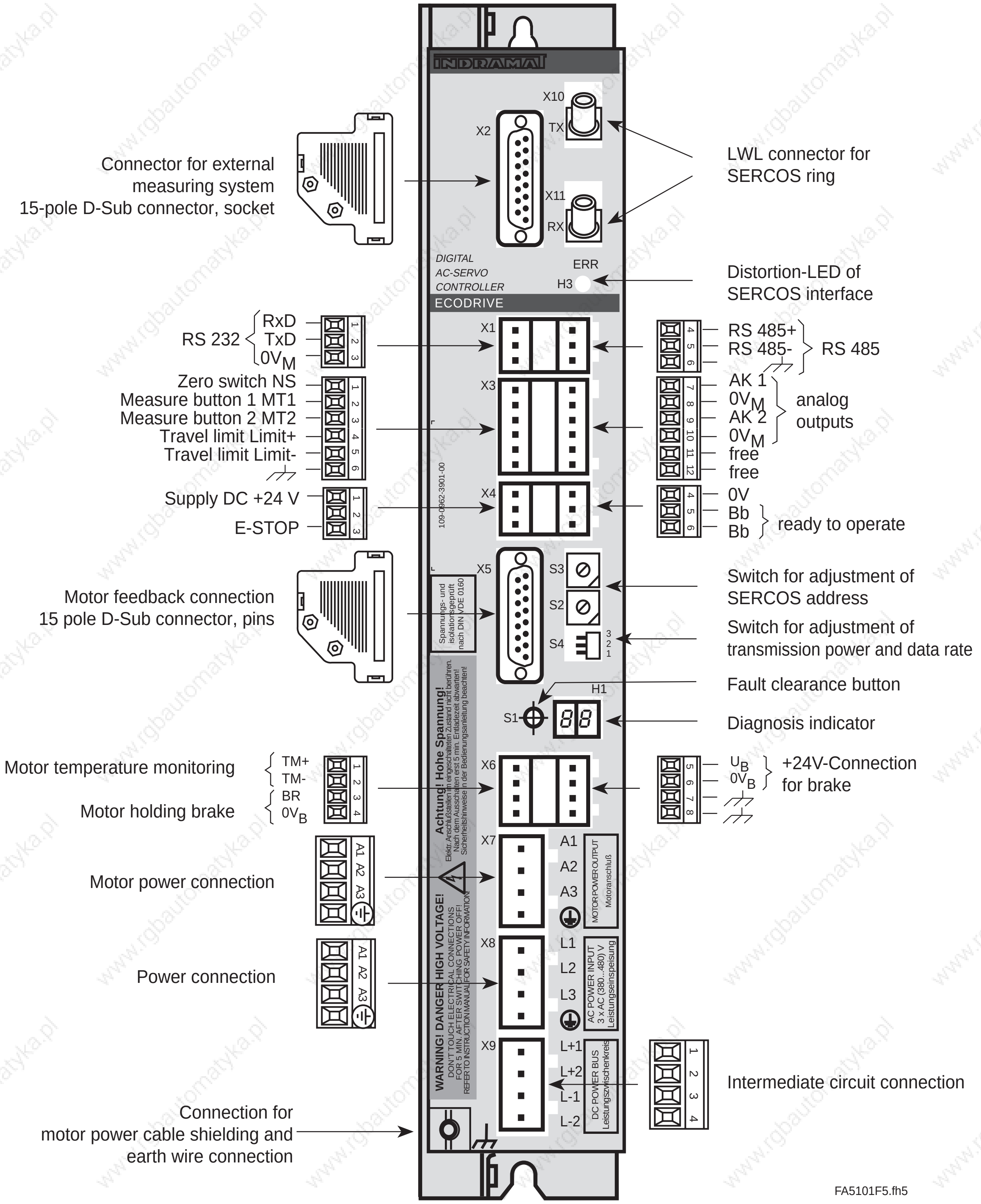


Fig. 4-11: Firmware type code

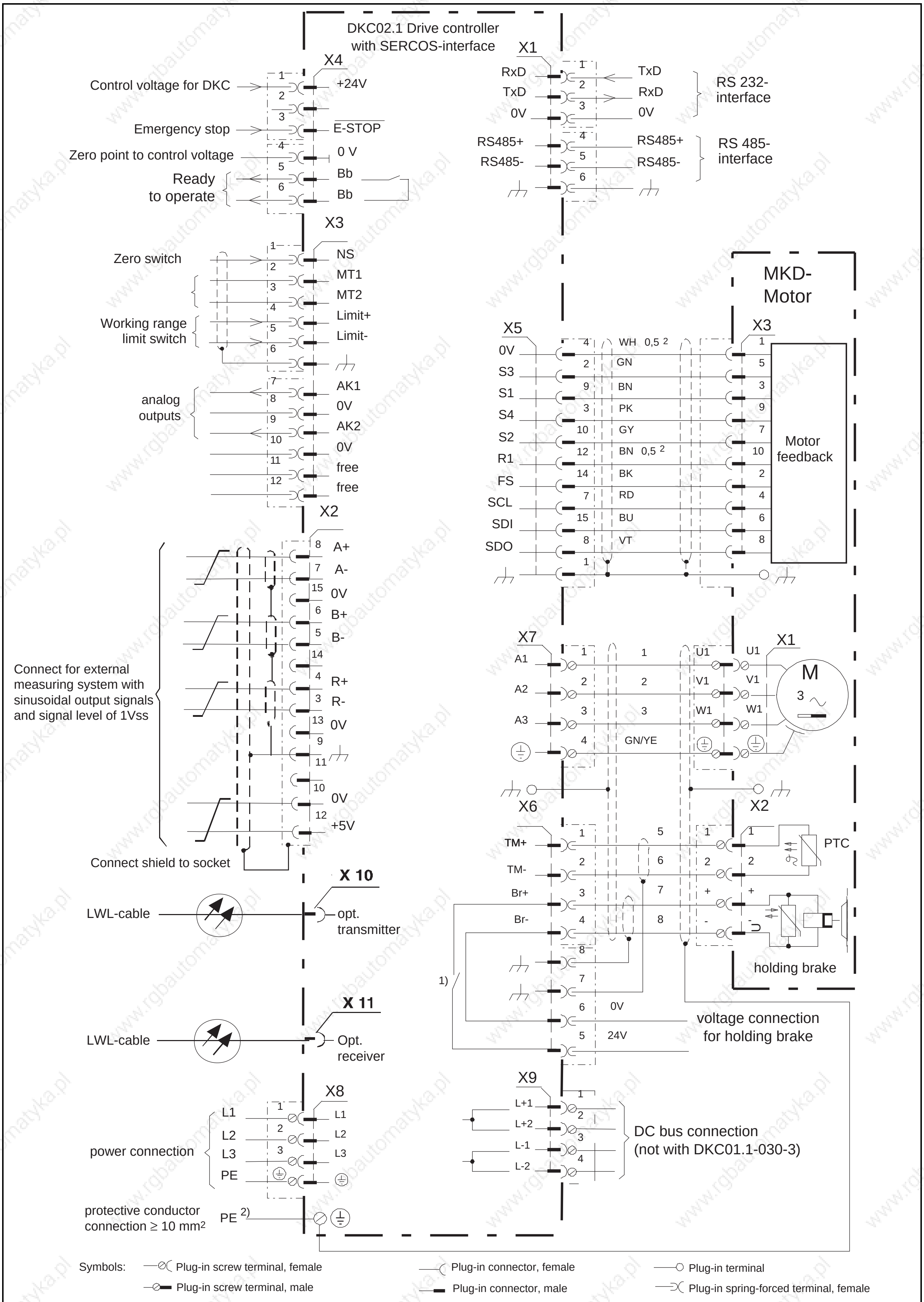
4.3 An overview of the electrical connections

Front view with supply terminals and overall connection diagram



On delivery of the drive controllers all plug connections are attached to the unit. The connector INS0439 for motor feedback connection and the connector INS0519 for an external measuring system are included in the pagage.

Fig. 4-12: Front view of the DKC with supply terminals



1) Switching capacity DC 24 V/ 2,5 A

2)The ground connector of units with discharge currents > 3,5 mA must be at least 10 mm² for mechanical reasons. (DIN VDE 0160/EN 50178)

Fig. 4-13: Overall connection diagram DKC02.1

4.4 Electrical connections

The electrical connections are described below:

- grouped according to numbers of the supply terminal strip (for example, X1, X2 etc.)
- and then according to the functions.

Serial interface X1

Maximum wire cross section which can be connected: 2.5 mm^2

At present, the serial interface does not offer any functions for the user. The interface only offers developers of the unit diagnostic possibilities.

X2 external measuring system

maximum cable cross section which can be connected: 0.5 mm^2

This interface offers the option of connecting an external measuring system directly mounted to the machine element. The measuring system can be a rotary encoder as well as a linear encoder. Measuring systems with sinusoidal output signals and a signal level of 1Vss (Heidenhain voltage interface) can be connected.

Supply voltage for an external measuring system

Output voltage X2/12:	DC +5 V (± 5%)
max. load on the output X2/12:	150 mA

Signal form

approximate sinussoidal signals

Resolution

The signal period supplied by the measuring system is sampled 2048 times.

Voltage signals

Signal voltage:	A,B,R	1 Vss
max. frequency for measuring system signals:	A, B	200 kHz

Cable length

max. cable length:	50 m

Signal input circuit

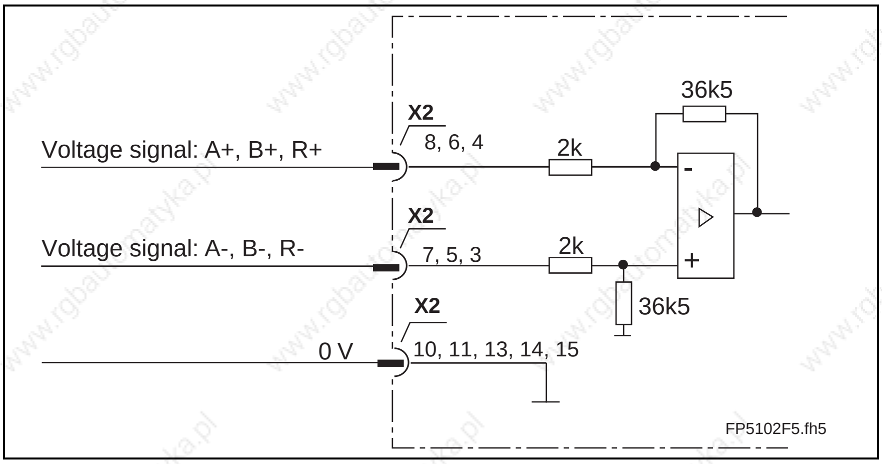
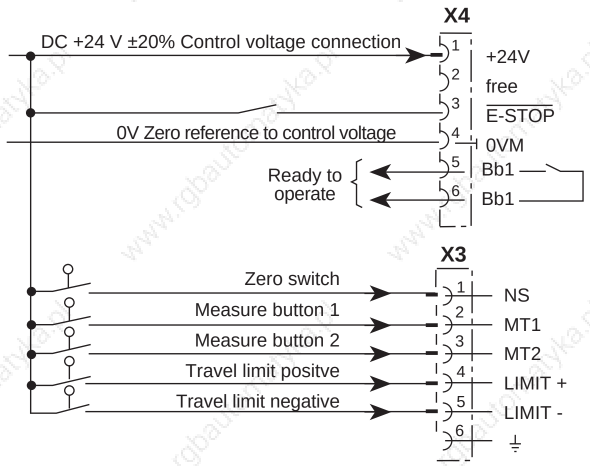


Fig. 4-14: Input circuit for the signals A,B,R

X3 zero switch, sensor, travel limit switch, diagnostic outputs

Maximum wire cross section which can be connected: 2.5 mm^2

Zero switch, sensor, travel limit switch



Input voltage	min.	max.
HIGH	16 V	30 V
LOW	-0,5 V	8 V
Input resistance	ca. 8 kOhm	

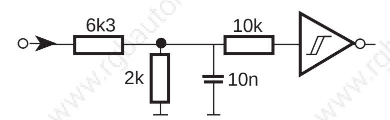


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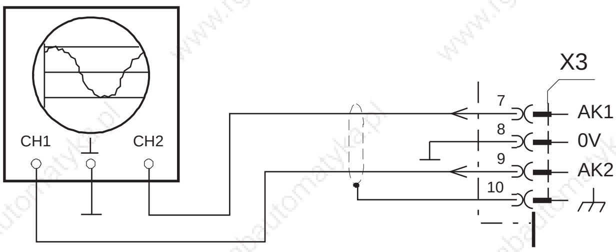
Fig. 4-15: Inputs for zero switch, sensor, and travel limit switch

Diagnostic outputs



Outputs:

Output voltage AK1-0V; AK2-0V	min. - 10 V	max. + 10 V
DA-transformer	8 Bit	
Resolution per bit	78 mV	

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Fig. 4-16: Connection assignments of the diagnostic outputs

X4 24V control voltage supply, E-stop (emergency stop), stand-by operation

Maximum wire cross section which can be connected: 2.5 mm^2

24 control voltage supply

Voltage at X4/1:	DC +24 V (± 20%)
Current consumption X4/1:	0.6 A

An error message is displayed if there is a 20% drop in the 24 V.

Note: If the 24 V control voltage fails, the motor will coast torque-free (unbraked).

DANGER

Dangerous movements!

Danger may result in equipment damage, personal injury or death!

⇒ Keep clear of the machine's movement area. Possible measures to be taken to prevent access by unauthorized persons:
- protective fence
- protective railing
- protective covering
- light barrier

⇒ Fences and coverings should be strong enough to withstand the maximum possible momentum.

E-Stop

The E-stop input can be used as a second, redundant shutdown input. It serves to trigger a shutdown independent of NC and SERCOS.

Requirement:

The E-stop input is available if the E-stop function in the software is activated (see function description).

If no voltage is applied to the E-stop input, the error response will be executed which can be set in the drive controller.

The SERCOS interface offers all the options necessary for reliable operation. Even a complete communication failure between the control and drive has been taken into account and results in a defined error response.

For applications

- in which communication failures between the NC part of the control and the SERCOS master module have to be stored (see [1])
- in which the connected SPS does not sufficiently monitor the E-stop circuit and thus does not trigger a drive response in time (see [2])

it is necessary to obtain an error response from the drive as fast as possible.

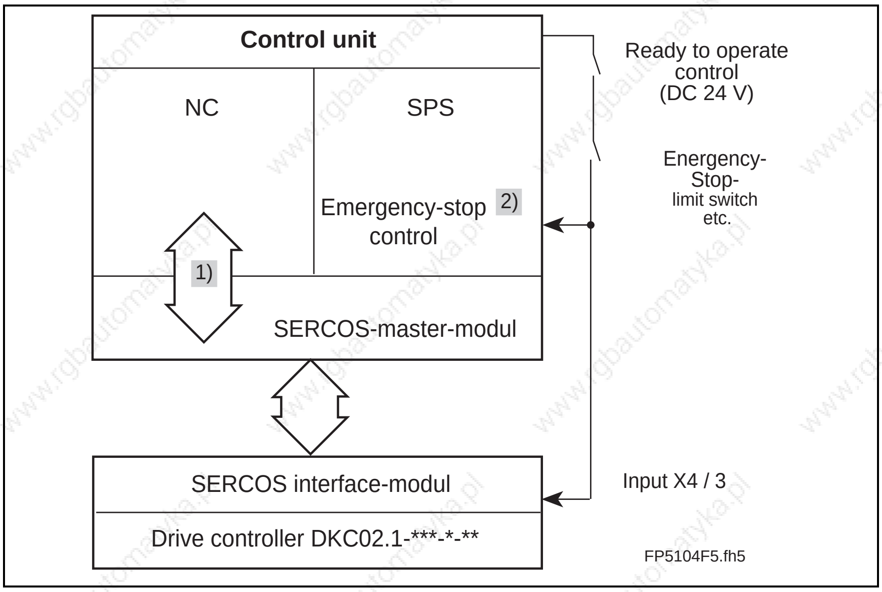

Fig. 4-17: Function E-stop

For the precise mode of operation, please refer to the function description of the DKC02 (see page 3 of the supplementary documentation).

Stand-by operation

The stand-by operation contact closes if the drive controller is ready for input power.

The input power is ready:

- if the control voltage is applied and
- if all monitors report that they are functioning properly

Switching voltage	DC +24 V
Current carrying capacity:	max. 1 A

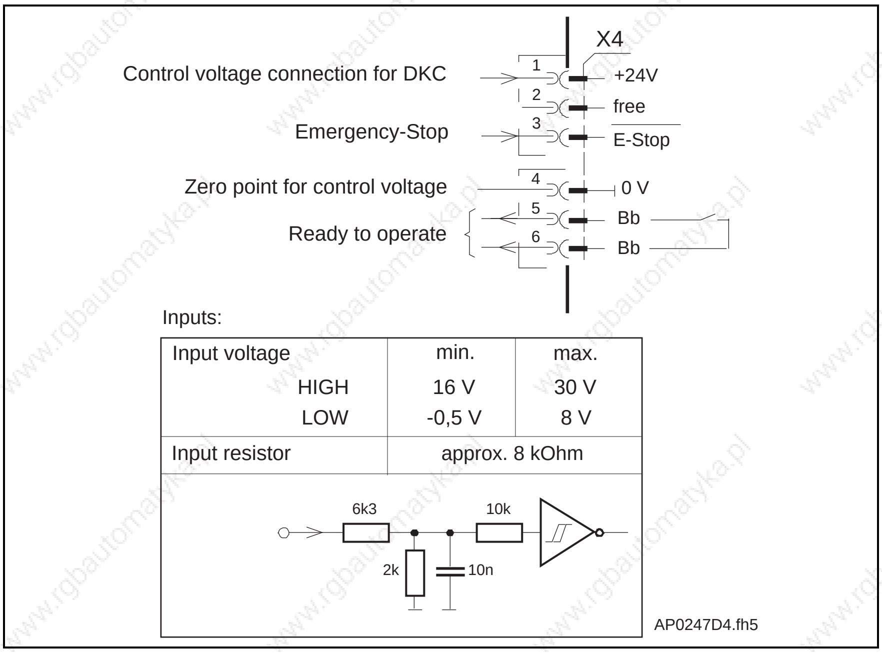

Fig. 4-18: Terminals for the control inputs, control voltage, stand-by contacts, and E-stop connections

X5 connection for motor feedback

Maximum wire cross section which can be connected: 0.5 mm^2

INDRAMAT feedback cables are preferred for the connection.

Feed back cable

Maximum cable length: 75 m

WARNING

No warranty!
Use of non-INDRAMAT cables voids the warranty for the entire drive system.

⇒ Use only INDRAMAT cables!

X6 motor temperature, motor holding brake, 24V supply for the motor holding brake

Maximum wire cross section that can be connected: 2.5 mm^2

Motor temperature monitor

The motors are equipped with a PTC resistor for monitoring the temperature. The connection leads are contained in the motor power cable.

Motor holding brake

If the MKD motor is equipped with a holding brake, a DC +24 V (± 10 %) voltage supply must be connected to X5/5.6.

The current consumption of the holding brake can be found in the motor documentation (see page 3 of the supplementary documentation), beacuse the current consumption is dependent on the type of motor.

Note: The holding brake of MKD motors is not intended to be a service brake. It is worn out after approx. 20,000 revolutions against the closed brake armature plate.

X7 motor power connection

Maximum wire cross section that can be connected: 4 mm^2

Motor cable

Maximum cable length: 75 m

Mount the entire shield of the motor power cable to the drive controller using the screw (at the bottom of the unit, see Fig. 4-12).

WARNING

No warranty!
Use of non-INDRAMAT cables voids the warranty for the entire drive system.

⇒ Use only INDRAMAT cables!

X8 power connection

Maximum wire cross section that can be connected: 4 mm^2

Line input voltage: 3 x AC 380 ... 480 V (± 10%), 50 ... 60 Hz

X9 DC bus connection

Maximum wire cross section that can be connnected: 4 mm^2

DC bus connection for connecting:

an auxiliary bleeder module BZM01.1

- or -

an auxiliary capacitance module CZM01.1

- or -

additional DKC drive controllers

For connection assignments, please refer to the overall connection diagram Fig. 4-13. The connection diagrams are located with the respective additional components.

X10/X11 SERCOS interface connection

X10: Tx, transmitter X11: Rx, receiver

When planning the fiber optic cable ring, please consult the description "Fiber Optic Cable - Handling" (see pg. 3 of the supplementary documentation). In it you will find a list of fiber optic plugs, cables and accessories.

The fiber optic plugs for X10 and X11 are not included in the drive controller.

4.5 Switches

Switches S2, S3

Switches S2, S3

SERCOS address

The SERCOS address of the drive is determined by two decade switches. The address can be a number ranging from 1 to 99.

Example:

switch position S3 = 9 (decadic value)

switch position S2 = 1 (digit value)

SERCOS address = 9 * 10 + 1 = 91

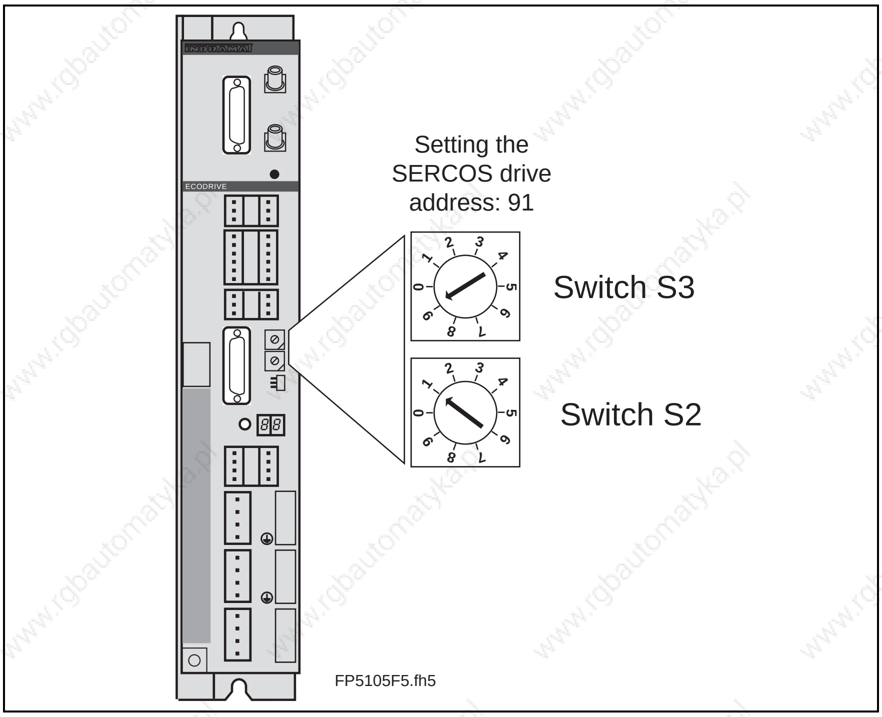

Fig. 4-19: Setting the drive address using the decade switch

Switch S4

Data rate, transmitter power

The transmitter power and the data rate for the SERCOS interface are set with the switch S4.

On delivery, the DKC is set to an average transmitter power (-4,5 dBm) and the lowest data rate(2 Mbit/s).

Switch position

The switches are in the OFF position if when the switch lever is facing the rear (rear panel). Switch S4/1 is down (see marking on the unit).

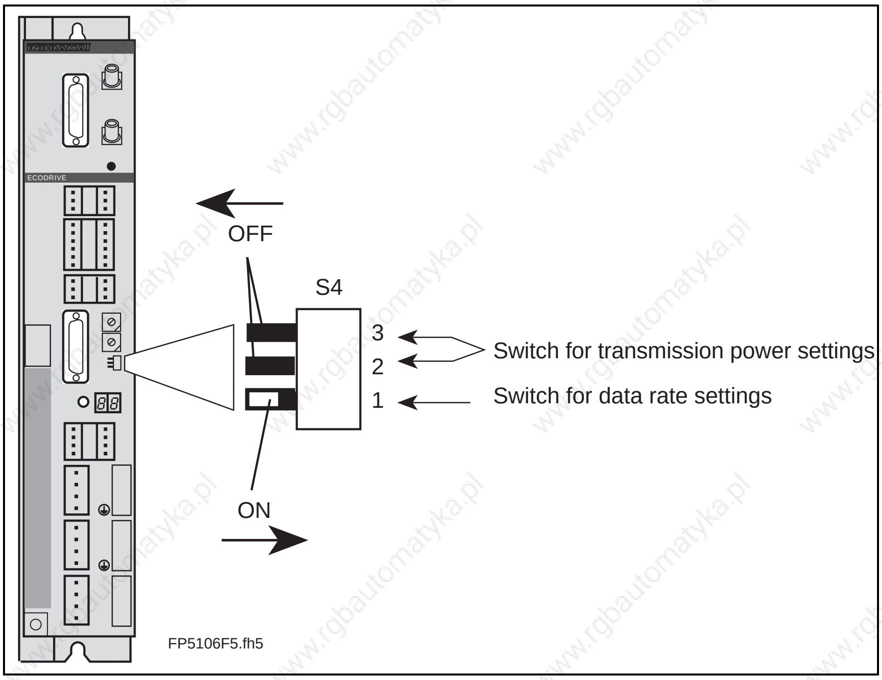

Fig. 4-20: Position of the switch for data rate and transmitter power demonstrating how to switch it ON and OFF.

Data rate

The data rate is set with the switch S4/1.

Position of switch S4/1	Data rate in Mbit/s
OFF	2
ON	4

Fig. 4-21: Relationship between switch position S4/1 and the data rate

Transmitter power

The transmitter power is set with the switches S4/2 and S4/3.

The following table demonstrates the relationship between switch position and transmitter power.

Position of switch S4/2	Position of switch S4/3	Transmitter power at an opt. high level in dBm	Transmitter power at an opt. high level in µW
OFF	OFF	-7	200
OFF	ON	-4,5	350
ON	OFF	-1	800
ON	ON	0	1000

Fig. 4-22: Relationship between switch position S4/2, S4/3 and the

5 BZM auxiliary bleeder module

5.1 Dimensioning the components relevant for regeneration

For each application, it is necessary to check whether the

- continuous regenerative power
- peak regenerative power
- regenerative energy

available from the application can be sufficiently absorbed by the bleeder (brake resistance).

If the available regenerative energy and the regenerative energy from the mechanics exceeds the absorbing capabilities of the bleeder built into the unit, this capability can be increased on the DKC**.*-040-7-FW by using the following hardware configurations.

- A drive controller and auxiliary bleeder module connected via the DC bus circuit. (1 DKC + 1 BZM)
- Several drives connected via the DC bus circuit. (up to 6 DKCs)
- Several drive controllers and an auxiliary bleeder modules connected via the DC bus circuit. (up to 6 DKCs + 1 BZM)

1 DKC + 1 BZM

1. Continuous regenerative power

$$P_{RD} \leq P_{BD,\,DKC} + P_{BD,BZM}$$

$$P_{RD} = \frac{\Sigma W_{rot} + \Sigma W_{pot}}{t_z * 1000}$$

$$W_{rot} = \frac{J_{Last} + J_M}{2} \cdot \left(n_{Nutz} \cdot \frac{2 \cdot \pi}{60}\right)^2 \cdot z_{dec}$$

$$W_{pot} = m_{last} \cdot g \cdot h \cdot z_{ab}$$

2. Peak regenerative power

$$P_{RS} \leq P_{BM,\,DKC} + P_{BM,BZM}$$

P_{RS} - > see selection lists for the servodrives

3. Regenerative energy (a single braking in the E-stop position)

$$W_{pot,\,max} + W_{rot,\,max} \leq W_{max,\,DKC} + W_{max,\,BZM}$$

$W_{max,\,DKC}$ - > see Fig. Technical Data DKC

$W_{max,\,BZM}$ - > see Fig. Technical data BZM

P_{RD}:	continuous regenerative power from the mechanical system generated in continuous operation in kW
$P_{BD,\,DKC}$:	continuous regenerative power which the drive controller can process in continuous operation in kW
$P_{BD,\,BZM}$:	continuous regenerative power that the auxiliary module can process in continuous operation, in kW
P_{RS}:	peak regenerative power in kW
W_{rot}:	rotary energy in Ws
W_{pot}:	potential energy in Ws
$W_{rot,\,max}$:	max. occurring rotary energy in the E-stop position in Ws
$W_{pot,\,max}$:	max. occurring potential energy in the E-stop position in Ws
t_z:	cycle time in s
J_{Last}:	load torque in kgm²
J_M:	motor inertia, in kgm²
m_{Last}:	load weight in kg
$W_{max,\,BZM}$:	storable energy in the BZM in kWs
$W_{max,\,DKC}$:	storable energy in the DKC in kWs
g:	gravitational acceleration 9.81 ms²
h:	lowering dimension in m
n_{Nutz}:	motor speed used in min^{-1}
z_{ab}:	number of drops per cycle
z_{dec}:	number of braking actions per cycle

Fig. 5-1: Check the conditions for regenerative power and regenerative energy in a DKC connected to a BZM via the DC bus

up to 6 DKCs

1. Continuous regenerative power

$$\sum P_{RD} \leq 0,8 * \sum P_{BD,DKC}$$

$$P_{RD} = \frac{\sum W_{rot} + \sum W_{pot}}{t_Z * 1000}$$

$$W_{rot} = \frac{J_{Last} + J_M}{2} \cdot \left(n_{Nutz} \cdot \frac{2 \cdot \pi}{60} \right)^2 \cdot z_{dec}$$

$$W_{pot} = m_{last} \cdot g \cdot h \cdot z_{ab}$$

2. Peak regenerative power

$$\sum P_{RS} \leq 0,8 * P_{BM,DKC}$$

P_{RS} -> see Selection lists for the servodrives

3. Regenerative energy (a single braking in the E-stop position)

$$\sum W_{pot,max} + \sum W_{rot,max} \leq 0,8 * \sum W_{max,DKC}$$

$W_{max,DKC}$ -> see Fig. Technical Data DKC

P_{RD} :	continuous regenerative power from the mechanical system generated in continuous operation in kW
$P_{BD,DKC}$:	continuous regenerative power that the drive controller can process in continuous operation in kW
P_{RS} :	peak regenerative power in kW
W_{rot} :	rotary energy in Ws
W_{pot} :	potential energy in Ws
$W_{rot,max}$:	max. occurring rotary energy in the E-stop position in Ws
$W_{pot,max}$:	max. occurring potential energy in the E-stop position in Ws
t_z :	cycle time in s
J_{Last} :	load torque in kgm²
J_M :	motor inertia, in kgm²
m_{Last}:	load weight in kg
$W_{max,BZM}$:	storable energy in BZM 01.1 in kWs
$W_{max,DKC}$:	storable energy in the DKC in kWs
g:	9.81 ms²
h:	lowering dimension in m or number of braking actions
n_{Nutz} :	motor speed used in min^{-1}
z_{ab}:	number of drops per cycle
z_{dec}:	number of braking actions per cycle

Fig. 5-2: Check the conditions for regenerative power and regenerative energy with several DKCs connected via the DC bus

up to 6 DKCs + 1 BZM

1. Continuous regenerative power

$$\sum P_{RD} \leq 0{,}8 * \sum P_{BD,DKC} + \sum P_{BD,BZM}$$

$$P_{RD} = \frac{\sum W_{rot} + \sum W_{pot}}{t_z * 1000}$$

$$W_{rot} = \frac{J_{Last} + J_M}{2} \cdot \left(n_{Nutz} \cdot \frac{2 \cdot \pi}{60} \right)^2 \cdot z_{dec}$$

$$W_{pot} = m_{last} \cdot g \cdot h \cdot z_{ab}$$

2. Peak regenerative power

$$\sum P_{RS} \leq 0{,}8 * P_{BM,\,DKC} + P_{BM,\,BZM}$$

P_{RS} -> see selection lists for the servodrives

3. Regenerative energy (a single braking in the E-stop position)

$$\sum W_{pot,\,max} + \sum W_{rot,\,max} \leq 0{,}8 * \sum W_{max,\,DKC} + \sum W_{max,\,BZM}$$

$W_{max,DKC}$ -> see Fig. Technical data DKC

$W_{max,BZM}$ -> see Fig. Technical data BZM

P_{RD}:	continuous regenerative power from the mechanical system generated in continuous operation in kW
$P_{BD,\,DKC}$:	continuous regenerative power that the drive controller can process in continuous operation in kW
P_{RS}:	peak regenerative power in kW
W_{rot}:	rotary energy in Ws
W_{pot}:	potential energy in Ws
$W_{rot,\,max}$:	max. occurring rotary energy in the E-stop position in Ws
$W_{pot,\,max}$:	max. occurring potential energy in the E-stop position in Ws
t_z:	cycle time in s
J_{Last}:	load torque in kgm²
J_M:	motor inertia, in kgm²
m_{Last}:	load weight in kg
$W_{max,\,BZM}$:	storable energy in BZM 01.1 in kWs
$W_{max,\,DKC}$:	storable energy in the DKC in kWs
g:	9.81 ms²
h:	lowering dimension in m or number of braking actions
n_{Nutz}:	motor speed used in min^{-1}
z_{ab}:	number of drops per cycle
z_{dec}:	number of braking actions per cycle

Fig. 5-3: Check the conditions for regenerative power and regenerative energy in a DKC connected to a BZM via a DC bus

5.2 Dimensional data and installation dimensions

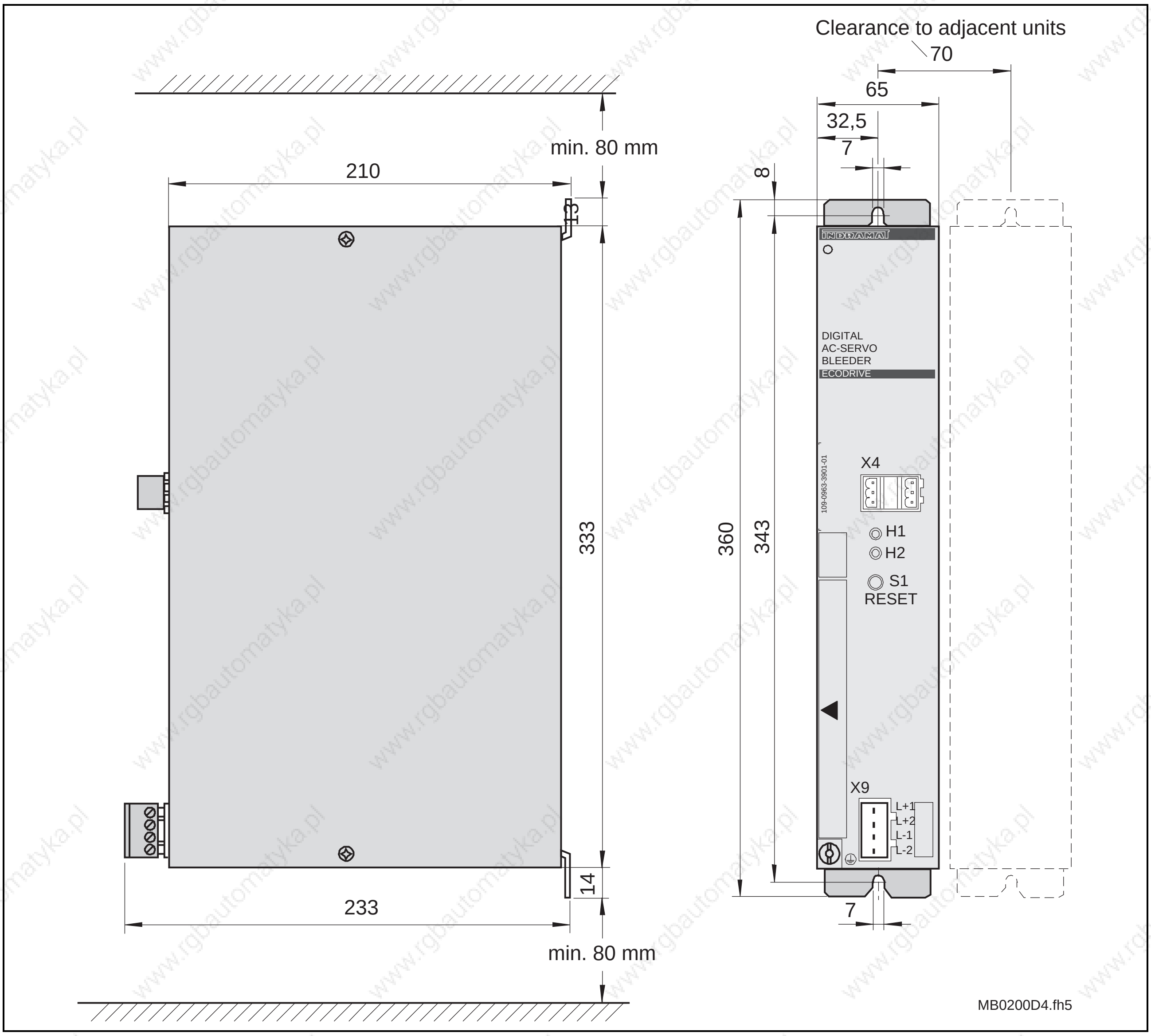

Fig. 5-4: Dimensions of the auxiliary bleeding module BZM01.1

The BZM is delivered with screw-down push-in terminals.

5.3 Technical data

Designation	Symbol	Unit	Value
Continuous bleeder output	$P_{BD,BZM}$	kW	1
Peak bleeder output	$P_{BM,BZM}$	kW	40 (perm. load cycle on for 1s, off for 40s)
Maximum feedback energy	$W_{MAX,BZM}$	kWs	40
Control voltage	$U_{N,BZM}$	V	DC 24 V ±20%
Current consumption of the 24 V connection	$I_{N,BZM}$	mA	90

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Fig. 5-5: Technical data for the BZM

5.4 Front view

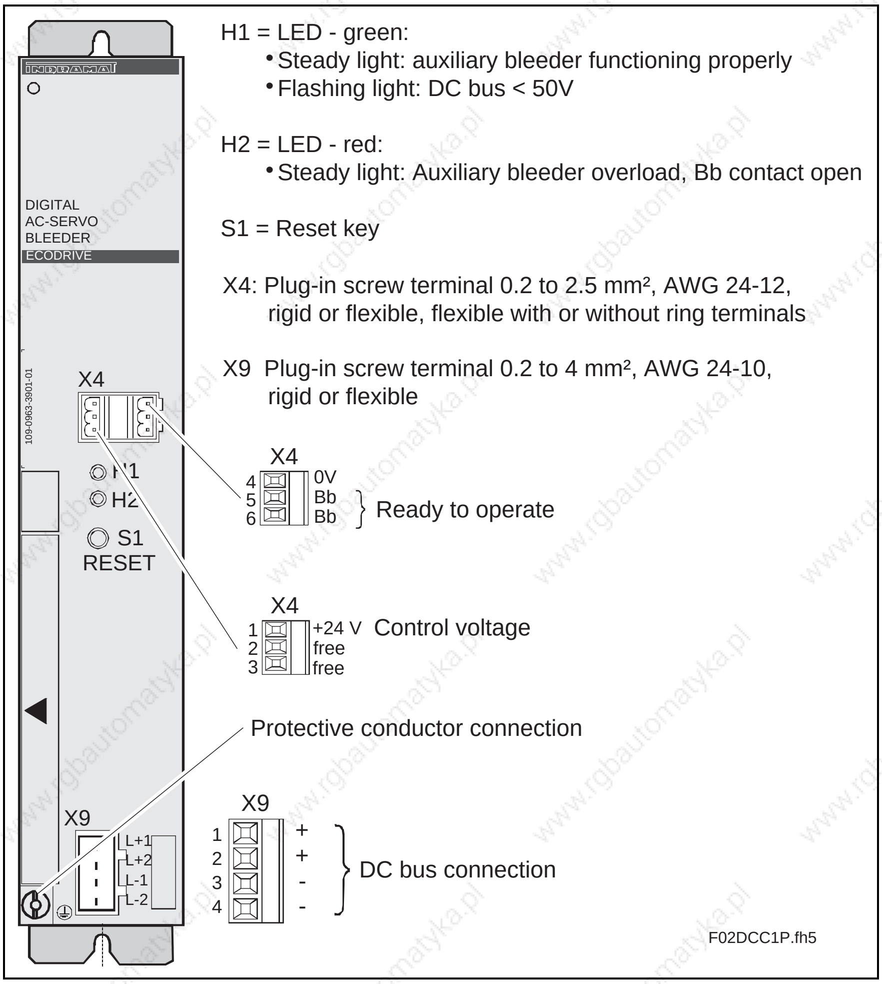


Fig. 5-6: Front view of the auxiliary bleeder module BZM01.1 with supply terminals

5.5 Electrical connection

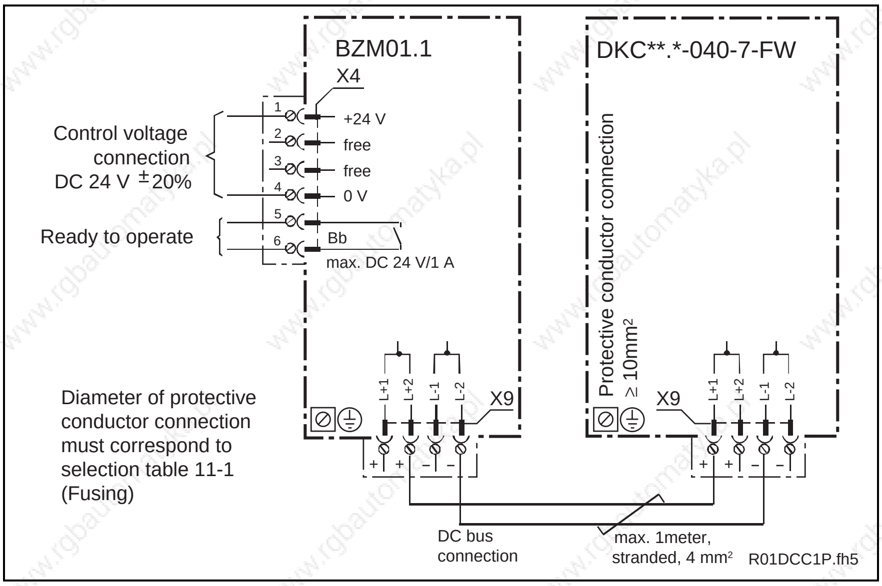


Fig. 5-7: Connection assignment for the auxiliary bleeding module BZM01.1

5.6 Type code and rating plate

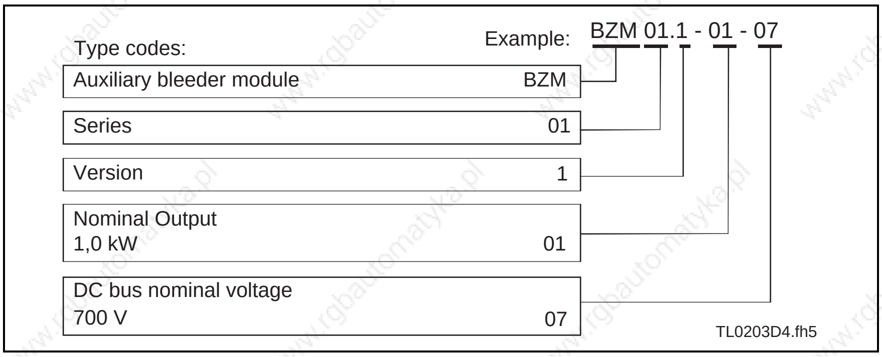


Fig. 5-8: Type code

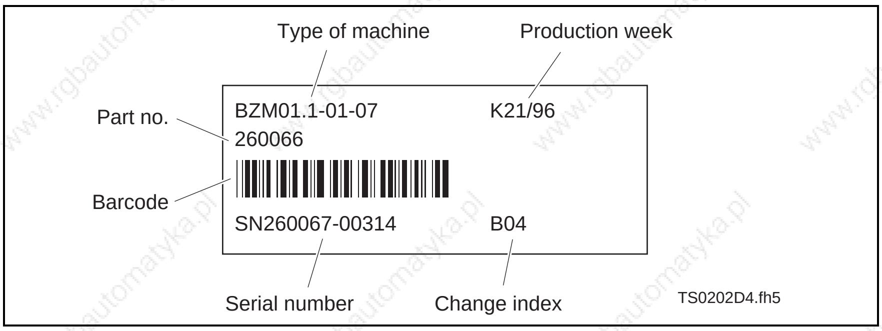


Fig. 5-9: Rating plate

Notes

6 CZM auxiliary capacitance module

6.1 Dimensioning

When braking the drive, the rotary energy available in the mechanics is released as regenerative energy in the DC bus of the DKC. It can be

- released in the form of heat via the bleeder module or auxiliary bleeder integrated into the DKC

- or -

- stored as energy in the DKC with a connected auxiliary capacitance module and reused for subsequent acceleration procedures. This reduces the power dissipated in the cabinet, and its own energy consumption is reduced.

For successful implementation while avoiding an unnecessary power loss in the cabinet, note the following:

$$W_{rot} \leq W_{ZW,\ DKC+CZM}$$

Fig. 6-1: Condition for avoiding power dissipation from the regenerative energy

Calculating the rotary energy of an application

$$W_{rot} = \frac{J_{Last} + J_M}{2} \cdot \left(n_{Nutz} \cdot \frac{2 \cdot \pi}{60} \right)^2$$

W_{rot}: rotary energy of the application in Ws
n_{Nutz}: maximum effective speed in min-1
J_{Last}: load torque of the application in kgm²
J_M: motor inertia

Fig. 6-2: calculating the rotary energy

Storable energy in the DKC with a connected CZM01.1

$$W_{ZW,\ DKC+CZM} = \frac{C_{DKC} + C_{CZM}}{2} \cdot \left(U_B^2 - U_{ZW}^2 \right) \cdot 10^{-3}$$

$W_{ZW,\ DKC+CZM}$: storable energy in the DKC with CZM in Ws
C_{CZM}: capacity of the CZM in mF (value = 1.0 mF)
C_{DKC}: DC bus capacity of the DKC in mF (value = 0.15 mF)
U_B: response threshold of the bleeder in DKC in V (value = 820)
U_{ZW}: nominal voltage (DC bus) in V (UZW = (√2) • 0.98 U_N)
U_N: line voltage (effective value) in V

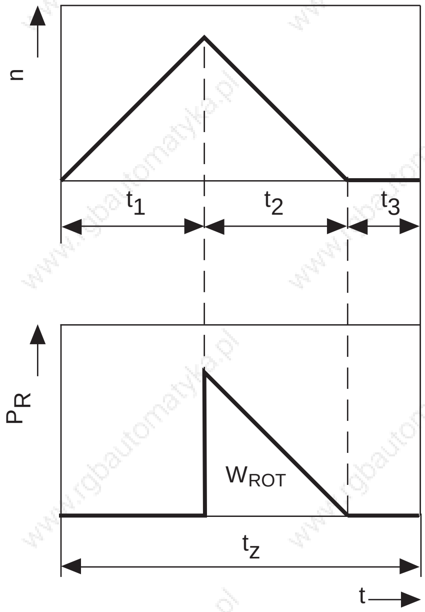
Fig. 6-3: Calculating the storable energy with a CZM01.1

Application example

DKC01.-40-7 with AC motor MKD 071 B with the following data:

Designation	Value
Rotor inertia of the MKD 071 B	J_M = 0.00087 kgm²
Maximum effective motor speed	n_{NUTZ} = 3200 min-1
Load inertia of the application	J_{LAST} = 0.00261 kgm²
Cycle time	tZ =0.8 s
Line voltage	U_N = 400 V

Fig. 6-4: Technical data for application example DKC02.1 with MKD



t_1 = Accel time in seconds
t_2 = Delay time in seconds
t_3 = Dwell time in seconds
t_z = Cycle time in seconds
W_{ROT} = Rotary energy in Ws
n = RPM in min^{-1}
P_{RS} = Peak feedback output in kW
P_{RD} = Average of the regenerated power ir a during cycle (continous regenerated power)

$$P_{RD} = \frac{W_{ROT}}{t_z}$$

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Fig. 6-5: Calculating the regenerative power in the processing cycle

This produces the following results:

W_{ROT} = 195 Ws

$W_{ZW,\ DKC+CZM}$ = 209 Ws

This indicates that the condition $W_{ROT} \leq W_{ZW,\ DKC+CZM}$ has been fulfilled. If the same amount of energy were released via a bleeder, then, due to the cycle time, a continuous regenerative power of 243 Watts would result. This would remain within the cabinet in the form of dissipated power.

6.2 Dimensional data and installation dimensions

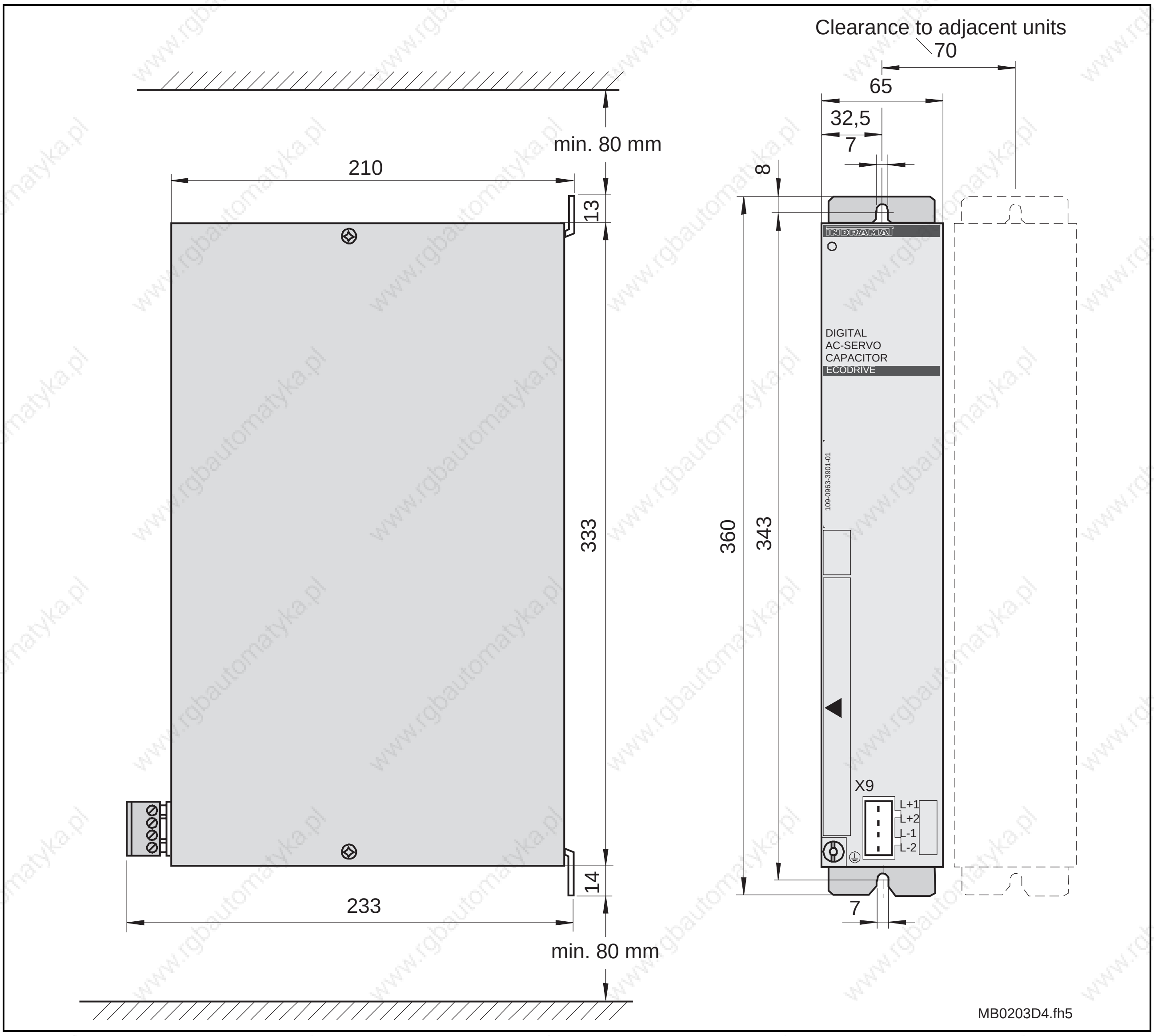

Fig. 6-6: Dimensions for the auxiliary capacitance modules CZM01.1

6.3 Front view

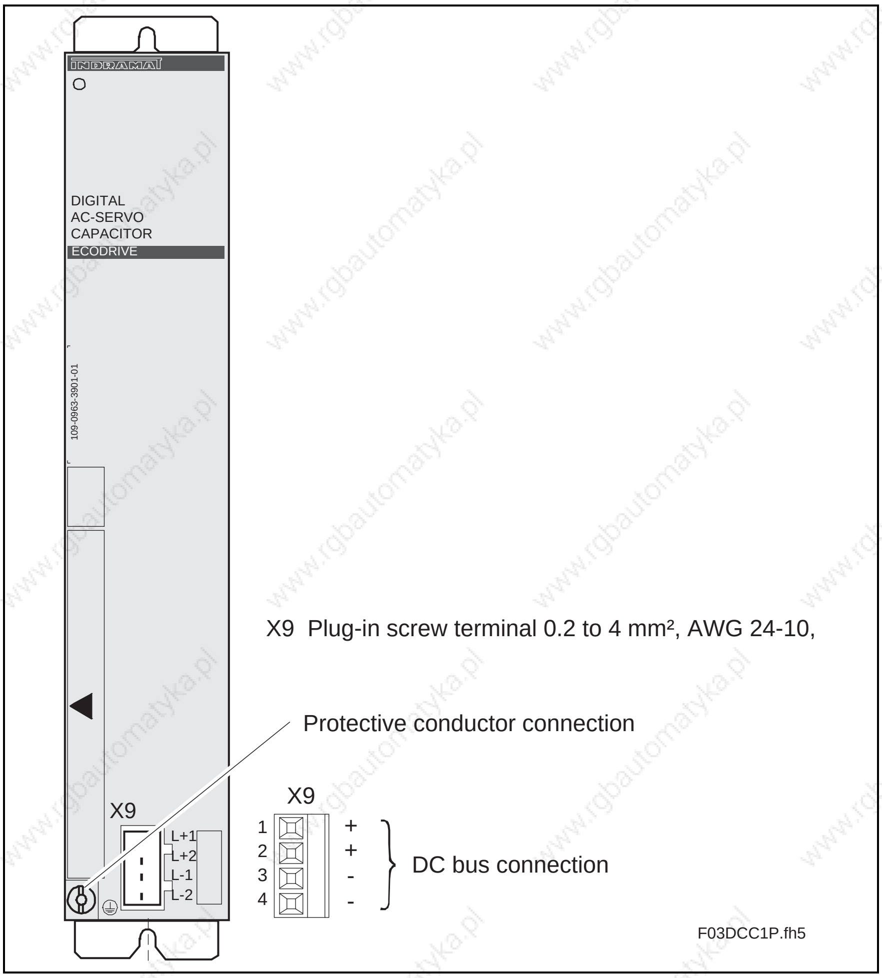

Fig. 6-7: Front view of the auxiliary capacitance module CZM01.1

6.4 Electrical connection

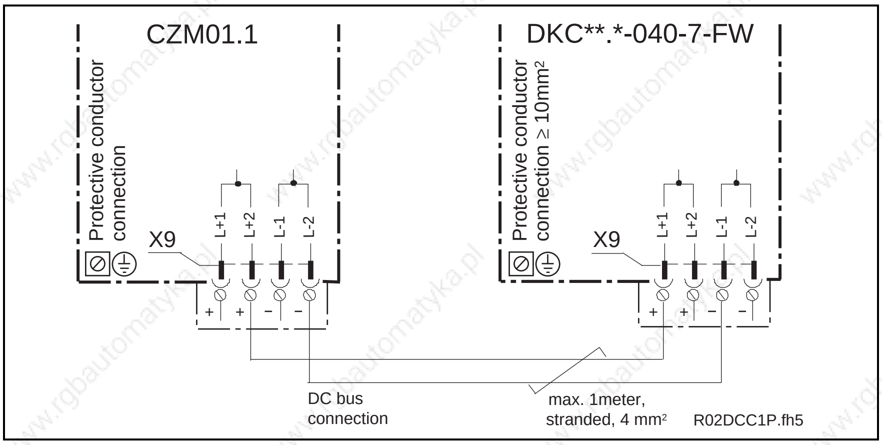

Fig. 6-8: Connecting the auxiliary capacitance module CZM01.1

6.5 Type code and rating plate

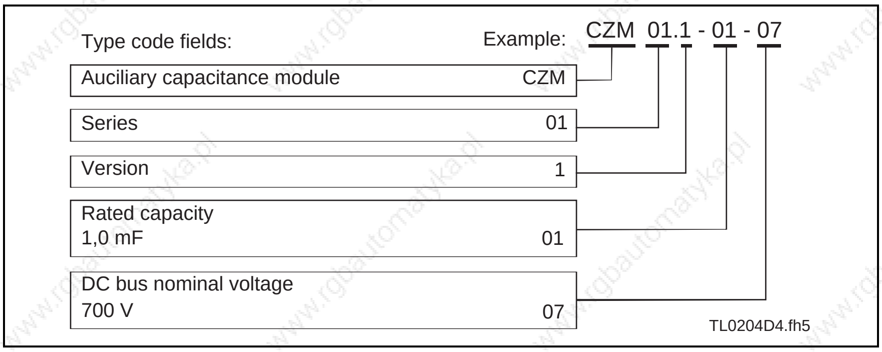

Fig. 6-9: Type code

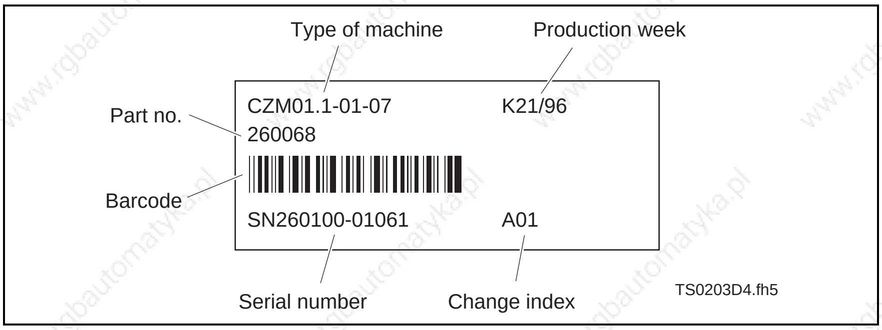

Fig. 6-10: Rating plate

Notes

7 DC24V power supplies NTM

7.1 Application recommendations

If there is no external DC24V control voltage available, then INDRAMAT recommends the use of NTM power supply units.

Features

- The power supplies contain an overvoltage safety switch with automatic shutdown. After the automatic shutdown device has responded, operation can be resumed by switching the power supply off and on again briefly.
- The power supplies always function with a starting current limiter. However, if you switch on and off again within a period of 10 s, the starting current limit may not work!
- The NTM01.1-024-004 and NTM01.1-024-006 power supplies make it possible to measure the voltage applied to the load via sensor cables. If there is a voltage drop, the power supply will increase the output voltage accordingly.

Fuse protector Q2

INDRAMAT recommends a 10A automatic circuit breaker of 10 A with tripping characteristics for DC24V NTM power supplies.

Interference suppression

Please use the line filter NFE01.1-250-006 for interference suppression (see page 8-3).

7.2 Technical data

Designation	Symbol	Unit	NTM01.1-024-002	NTM01.1-024-004	NTM01.1-024-006
Nominal current of the 24 V output for the 45°C ambient temperature	I_N	A	2.1	3.8	5.5
Output for 45°C ambient temperature	P_{OUT}	W	50	100	150
Input current at 230 (115) V	I_{IN}	A	0.61 (1.2)	1.2 (2.2)	1.9 (3.2)
Inrush current at 230 (115) V in the mains supply lead when powering up. Make sure fuse has proper size.	I_{EIN}	A	32 (16)	32 (16)	32 (16)
Input voltage	U_N	V	Standard AC 170 to 265 by rearranging a bridge AC 85...132		
RF interference suppression filter			NFE01.1-250-006 (recommended interference suppression filter to maintain EMC values)		

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Fig. 7-1: Technical data for DC24V NTM power supplies

7.3 Dimensional data and installation dimensions

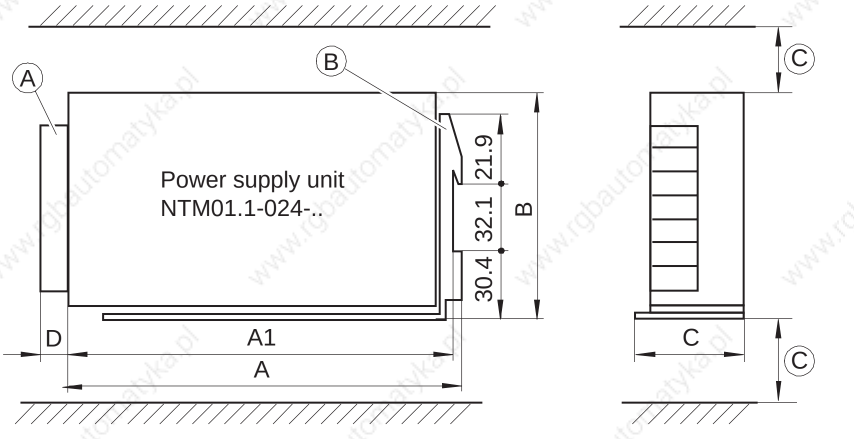

Table of dimensions

INDRAMAT Type of power unit	A	A1	B	C	D
NTM01.1-024-002	173	168.7	100	45	17
NTM01.1-024-004	202	197.7	97	51	20
NTM01.1-024-006	212	207.7	97	70	20

(A) Connecting block
(B) L-rails DIN 50
(C) > 20 mm cooling clearance

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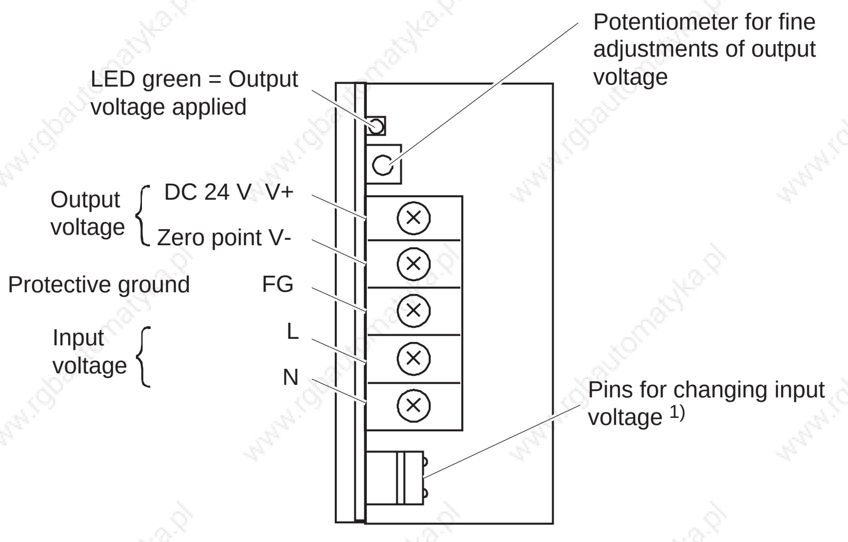
Fig. 7-2: Dimensional sheet DC +24V NTM power supplies

7.4 Front views



1) Pins not connect = input voltage AC (200-240) V
Pins connect = input voltage AC (100-120) V

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Fig. 7-3: Front view and terminal designations of the power supply NTM01.1-024-002

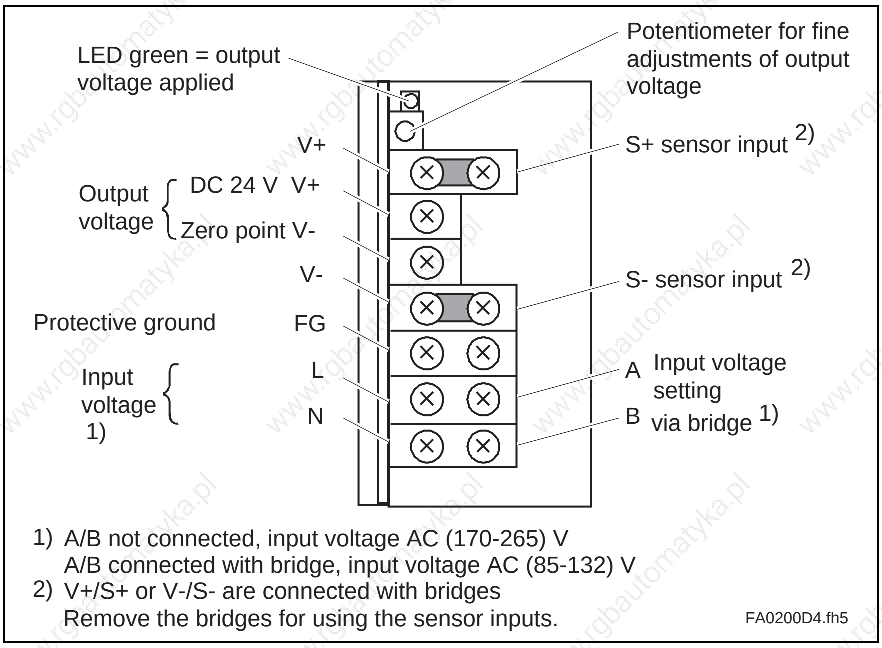


Fig. 7-4: Front view and terminal designations of the power supplies NTM01.1-024-004 and NTM01.1-024-006

7.5 Electrical connection

Always use the NTM together with the line filter NFE01.1-230-006.

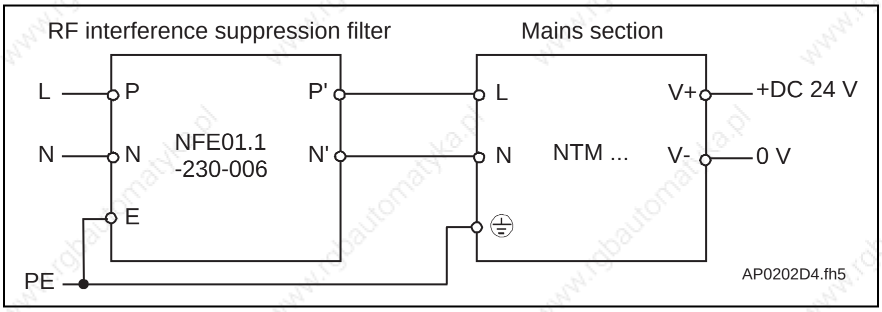


Fig. 7-5: Connecting the power supply to a line filter

Note: The bridge circuits V+/S+ and V-/S- must be removed if sensor inputs are used.

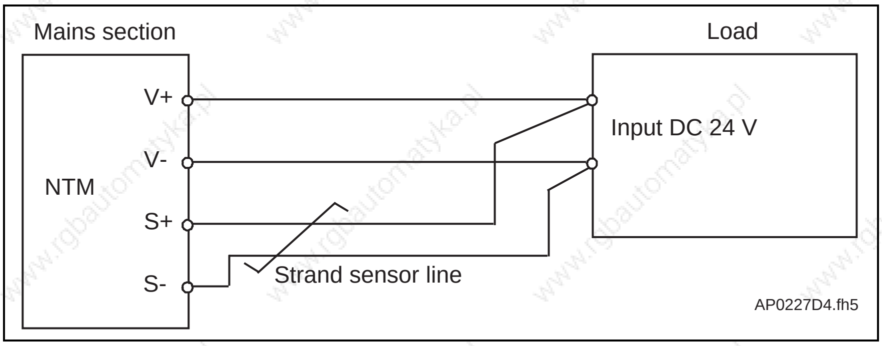


Fig. 7-6: Connecting the sensor leads NTM01.1-024-004 and NTM01.1-024-006

7.6 Type code

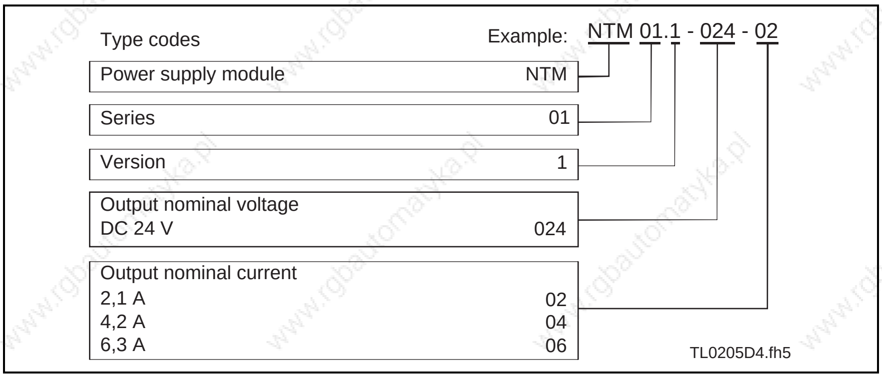


Fig. 7-7: Type code

8 Line filter NFD/ NFE

8.1 Selection

The filters listed here are designed for the DKC drive controller power connection.

Please see Chap. 8.4, for information on the line filter for interference suppression on the DC24V NTM power supply.

Technical data for line filters

Max. connection voltage 1)	Rated line current I_{NETZ} 2)	Phase number	Line filter type description 3)	Supply terminals		Brush shunt		Power dissipa-tion	Weight
in V	in A			mm²	AWG	mm²	AWG	in W	n kg
AC 480 V +10%	7.5	3	NFD02.1-480-008	6	10	--	--	8,7	1,5
AC 480 V +10%	16	3	NFD02.1-480-016	6	10	1,34	16	9	1,7
AC 480 V +10%	30	3	NFD02.1-480-030	10	6	5,37	10	14	1,8
AC 480 V +10%	55	3	NFD02.1-480-055	10	6	6	13,5	20	3,1
AC 230 V +10%	4.7	1	NFE01.1-250-006	Soldering/ FASTON tab 6.3x0.8		--	--	1	0,245

1) Line frequency (50-60 Hz)

2) max. continuous powers at the power connection at an ambient temperature of 45°C

3) Degree of protection IP10

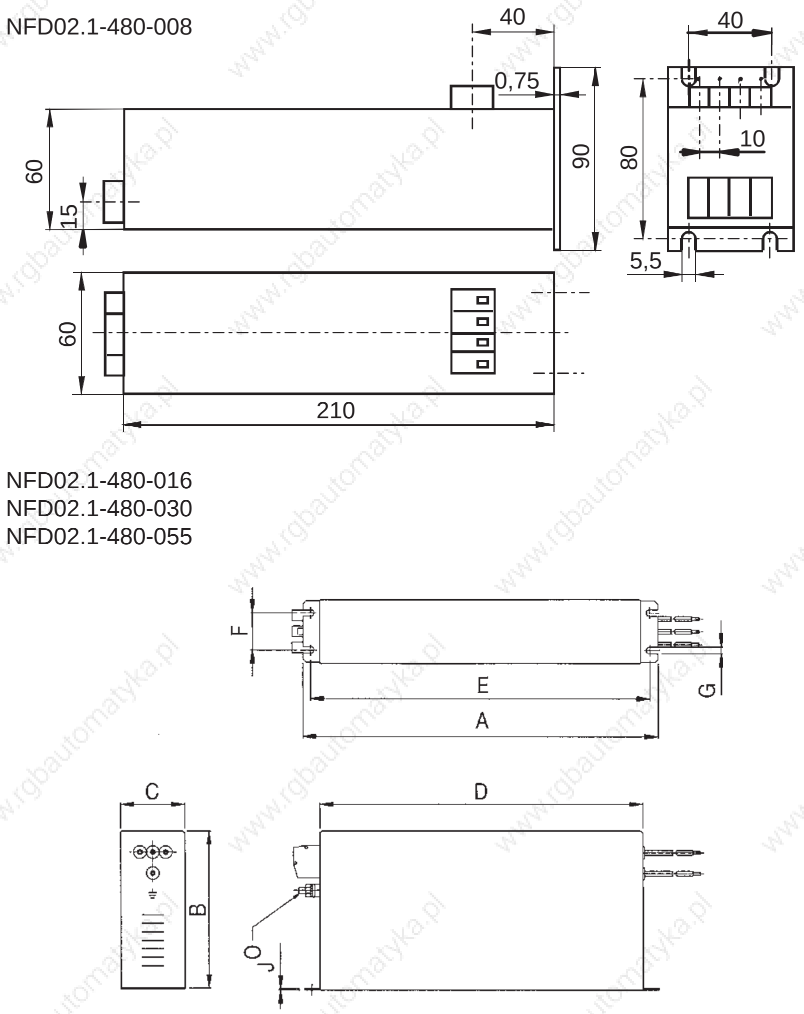
Fig. 8-1: Technical data for line filters

Ambient conditions for line filters

Operating frequency	from DC to 60 Hz at 40 °C
Power dissipation	measured 2 or 3 x R $I^2_{Nenn\ DC}$
Temperature range	-25...+85°C
Overload	1,5 I_{Nenn} 1 min per hour
Saturation reaction	Reduction of the filter attenuation by 6 dB at 2.5 to 3 times the rated current.
Test voltage	L/N -> PE or L -> PE: 2800 VDC 2s at 25°C L -> PE or 2125 VDC 2s at 25°C
Reduction in current at an excess temperature	$I = I_N * \sqrt[2]{(85 - \Theta)/40}$; Θ Ambient temperature in °C ; I_N in reference to 45°C
Degree of protection	IP 10

Fig. 8-2: Ambient conditions for line filter NFD and NFE (horizontal construction)

8.2 Dimensional data and installation dimensions



Dimen-sion	NFD02.1-480			
	...-016	...-030	...-055	Tolerance
A	305	335	329	±1
B	142±0.8	150±1	185±1	±1.5
C	55	60	80	±0.6
D	275±0.8	305	300	±1
E	290	320	314	±0.5
F	30	35	55	±0.3
G	6.5	6.5	6.5	±0.2
H	300	400	500	±15
J	1+0.1	1+0.1	1.5	±0.2
K	-	-	-	-
L	9	9	12	±1
M	-	-	-	-
O	M5	M5	M6	-

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Fig. 8-3: Dimensional data, installation dimensions of the NFD, NFE line filte rs

Notes on assembly

The mounting plate or the control cabinet housing to which the DKC is mounted are the preferred locations for assembly.

DANGER

Live parts (greater than 50 V)!

Electric shock on contact!

⇒ Before startup operation, the protective ground conductor must first be permanently connected to the filter and then grounded!

⇒ Before touching bare connection leads and terminals, isolate the filter with the connected consumers from the power source or switch them off. Allow time for discharging! Do not work on connecting cables until then!

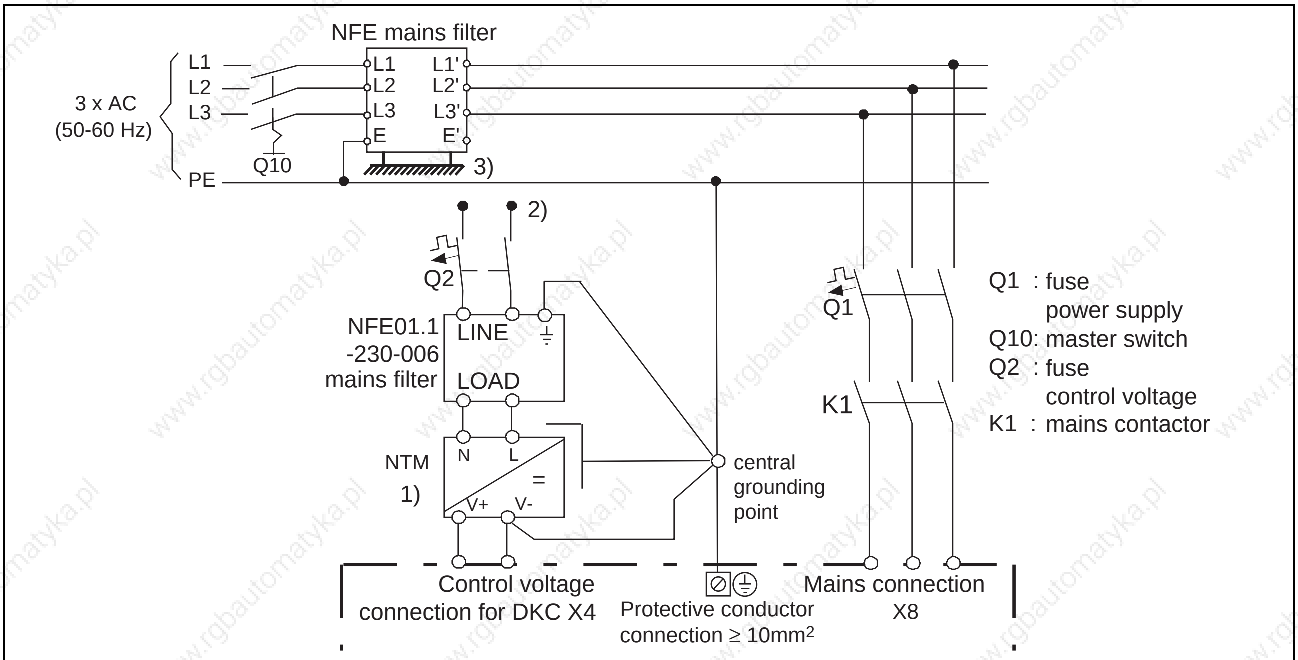
⇒ Due to the high discharge current of the filter, operation is not permitted without a connected protective conductor! This is why the filter may only be operated with a permanently protective conductor with a cross section ≥10 mm^2!

⇒ Remove any paint or coatings from the mounting points of the filter.

⇒ Use a tooth-lock washer with galvanized or tin-plated screws.

8.3 Electrical connection

Observe the recommendations made in the documentation "EMC in Drive and Control Systems" - Project Planning Manual"", when installing and mounting the line filter!



1) The use switch-mode power sections (NTM) requires the preliminary switching of the NFE 01.1-230-006 mains filter
2) AC 230 V connecting voltage (+10% -15%) (50 to 60 Hz)
3) Mounting on mounting panel of DKC is recommended

Fig. 8-4: Three-phase line filter connection with NFD01.1 or NFD02.1

8.4 Line filters for DC24V NTM power supplies

When using the NTM power supply, use the NFE01.1-250-006 line filter for interference suppression.

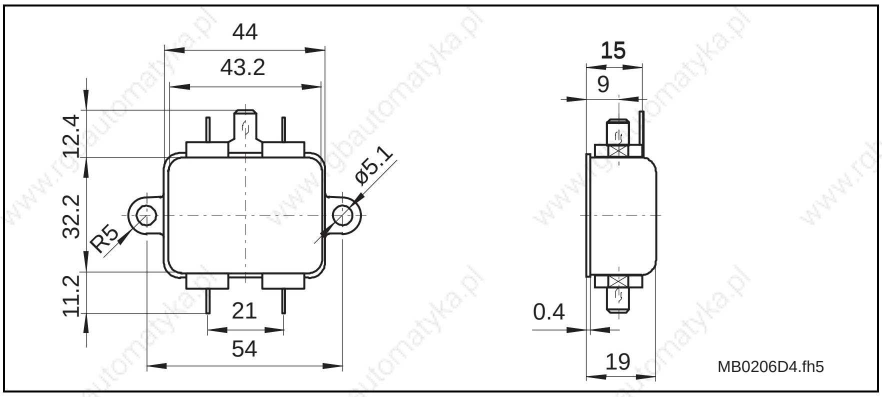


Fig. 8-5: Dimension drawing: line filter NFE01.1-250-006

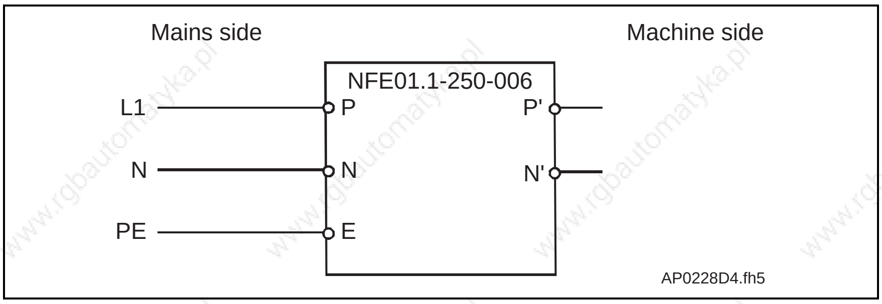


Fig. 8-6: Contact assignment of the line filter NFE01.1-250-006

The line filter is connected via 6.3-1 tab receptacles in accordance with DIN 462 545.

8.5 Type code

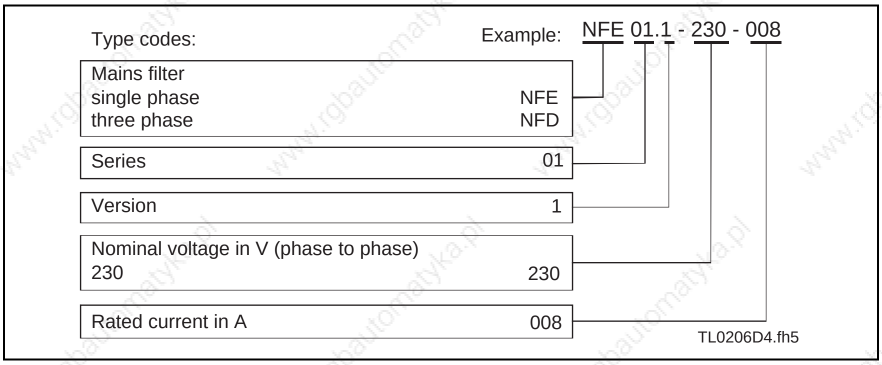


Fig. 8-7: Type code

9 DST / DLT transformers

9.1 Selection

Transformers are only needed if the systems voltage exceeds the permitted rated voltage of the DKC.

Grounded power supply lines

For grounded power supply lines, the line voltage is matched to the rated voltage of the units using autotransformers which are suitable for **one specific output voltage range** (see Fig. 9-1).

Ungrounded power supply lines

To match the voltage for ungrounded power supply lines, always connect isolating transformers to prevent excess voltages between the outer conductor and ground.

This document does not offer a product program to select suitable isolating transformers. (Request this information if needed)

9.2 Autotransformers for DKC**.*-040-7-FW

Select an autotransformer suited to both the line voltage and the power requirements of the system.

Proceed with the selection as follows:

⇒ Determine the rating group and read the gearing ratio "i" using the required rated line voltage range from the diagram in Fig. 9-1.

⇒ Calculate the actual transformer output voltage using the rated line voltage and the gearing ratio "i".

⇒ Check drive data. The output voltage of the transformer affects the drive data. See documentation "ECODRIVE Servodrives DKC with MKD"- Selection lists - (see pg. 3 of the supplementary documentation).

⇒ Select a three-phase autotransformer via the required connected load.

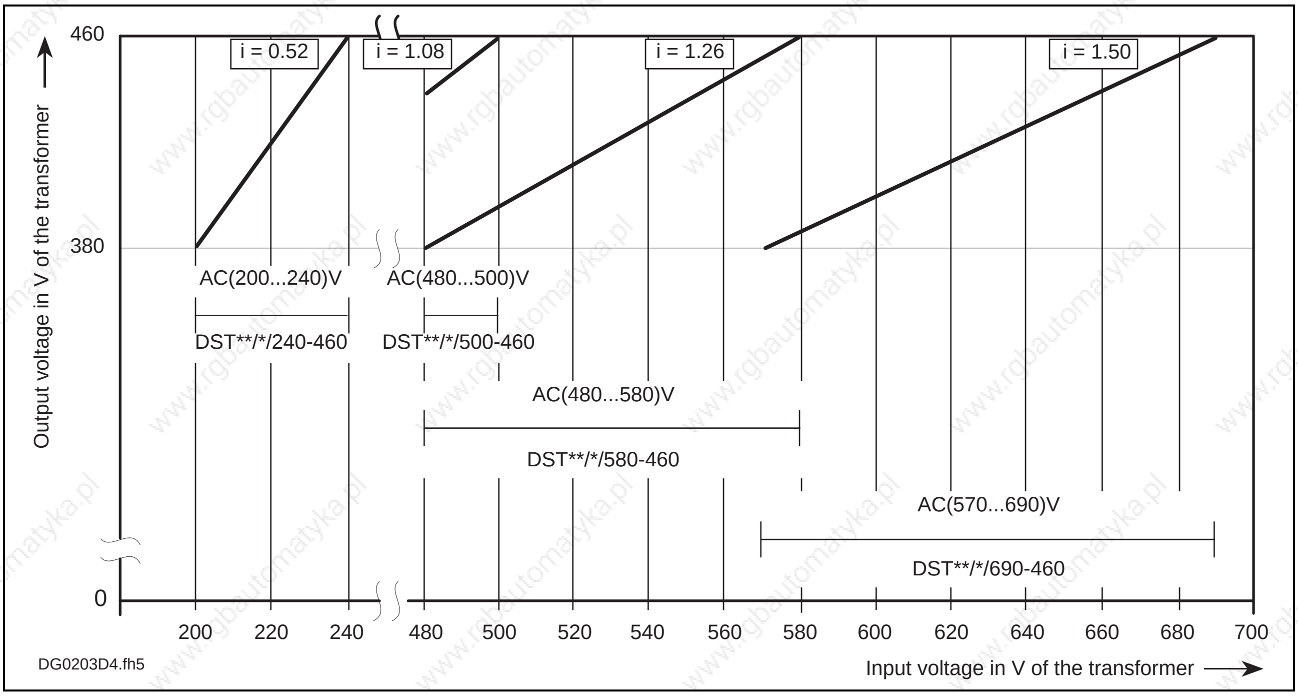
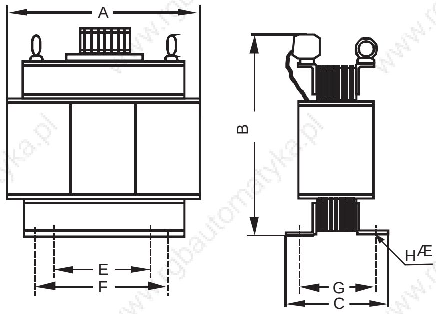


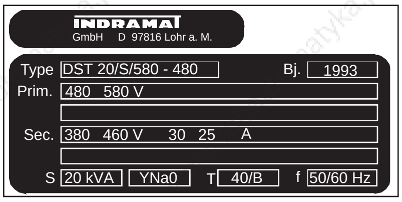
Fig. 9-1: Classification of three-phase autotransformers into rating groups

DST autotransformer with secondary or output voltage AC (380 to 460) V

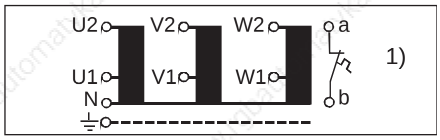
Standing version for mounting with base: DST..,../S



Rating plate (example)



Block diagram



1)Temperature switch max. load:
DC 24V/1A; AC 230V/1A

Type designation DST...	Conn. output in KVA	Trans-mission ratio	Dimensions in mm							Power loss in W	max. conn. dia. in mm^2	Weight in kg
			A	C	B	F	E	G	HØ			
Input voltage: AC (200...240) V ±10%												
4/S/240-460	4	0.52	240	150	260	170	110	120	11	120	10	24.5
7,5/S/240-460	7.5		335	175	365	230	160	145	11	225	10	55
12,5/S/240-460	12.5		360	190	395	250	170	160	11	310	10	70
25/S/240-460	25		480	195	500	356	-----	158	13	500	35	135
50/S/240-460	50		580	265	540	400	270	215	18	750	70	195
Input voltage: AC (480...500) V ±10%												
4/S/500-460	4	1.08	180	105	190	125	80	75	7	160	4	8.5
7,5/S/500-460	7.5		205	130	210	145	95	95	7	260	4	13
12,5/S/500-460	12.5		240	140	260	170	110	110	11	440	10	22
25/S/500-460	25		300	155	325	210	140	125	11	750	16	36
50/S/500-460	50		335	175	365	230	160	145	11	1050	35	53
Input voltage: AC (480...580) V ±10%												
4/S/580-460	4	1.26	240	130	260	170	110	100	11	140	4	18
7,5/S/580-460	7.5		240	140	260	170	110	110	11	260	4	22
12,5/S/580-460	12.5		300	155	325	210	140	125	11	375	10	37
25/S/580-460	25		360	190	395	250	170	160	11	625	10	72
50/S/580-460	50		420	215	450	280	190	155	14	1000	35	95
Input voltage: AC (570...690) V ±10%												
4/S/690-460	4	1.5	240	140	260	170	110	110	11	140	10	22
7,5/S/690-460	7.5		300	155	325	210	140	125	11	225	10	37
12,5/S/690-460	12.5		335	175	365	230	160	145	11	375	10	57
25/S/690-460	25		420	205	450	280	190	145	14	500	16	88
50/S/690-460	50		480	222	500	356	-----	185	13	750	35	178

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Fig. 9-2: DST autotransformers for the DKC**.1-40-7-FW for matching the line voltage

9.3 Electrical connection of the DKC via transformer

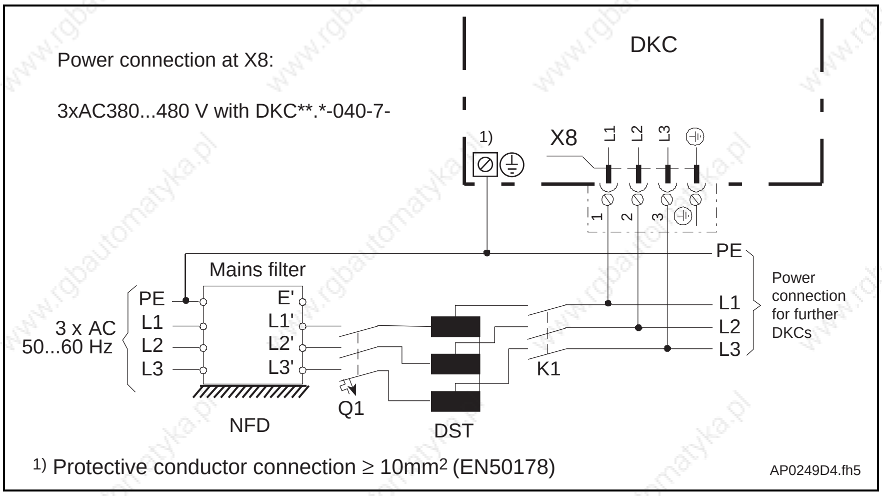

Fig. 9-3: Power connection via a three-phase autotransformer

9.4 Type code

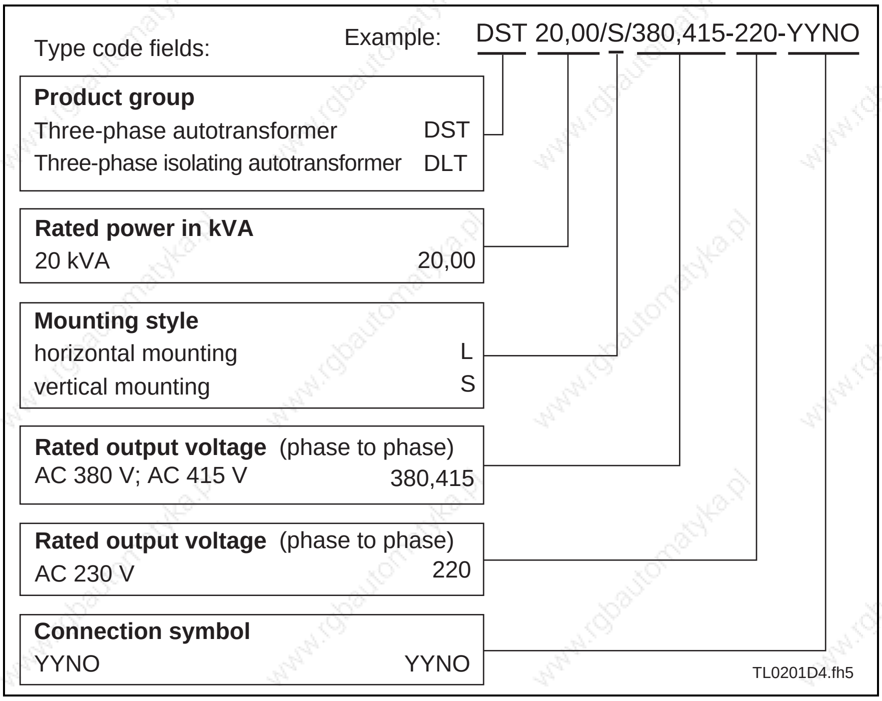

Fig. 9-4: Type codes for transformers

10 Planning the control cabinet

10.1 Notes on installing the control cabinet

When planning the control cabinet, it is necessary to take the technical data of the drive components into account.

Power dissipation

Power dissipation is determined by the current load and the continuous regenerative power. The actual power dissipation is dependent on the respective cycle load. The AC motor implemented has been laid out for this load cycle.

On the average, the maximum continuous current at standstill I_{dN} of the AC motor will flow through the drive controller.

Determining power dissipation

⇒ See the motor documentation for the continuous current at standstill I_{dN} (see "MKD Digital AC Motors"- Project Planning -).

⇒ Using the I_{dN} value of the motor selected, find the value in the diagram in Fig. 10-1 for the power dissipation $P_{V,\ DKC}$.

⇒ Convert the continuous regenerative power found in Tab. Fig. 3-2 with the factor 0.8. as bleeder-dependent power dissipation $P_{V,\ Bleeder}$ in the DKC.

⇒ Add both dissipation values ($P_{V,DKC}$ and $P_{V,Bleeder}$). Use the total ($P_{V,ges}$) for planning the control cabinet.

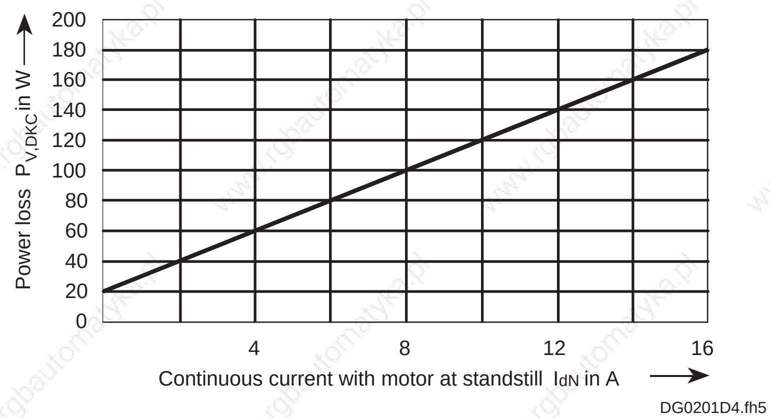

Fig. 10-1: Determining the power dissipated in the control cabinet

10.2 Using heat-exchange units in the control cabinets

Improperly installed and operated heat-exchange units are a risk to the drive components installed in the control cabinet due to the condensation and condensed water which these may cause!

Risk of condensation

Humid air enters the cabinet and, as it cools, condenses onto the installed drive components.

Risk of condensation

If the heat-exchange unit is not properly installed in the control cabinet, accumulating condensing water can drip into the installed drive components or be sprayed into them by the cold air current.

Avoiding condensation

Proper use of the heat-exchange units:

- When using heat heat-exchange units, the cabinets must be well sealed so that moisture cannot form caused by humid outside air entering the cabinets!
- In the event that the control cabinets are operated with open doors (startup operation, servicing, etc.), ensure that the drive components are never cooler than the air in the control cabinets after the doors have been closed. Otherwise, condensation may occur. For this reason, it is important that the heat-exchange unit continues to operate when the system has been shut down to ensure that temperature within the control cabinet does not deviate from that of the drive components.
- Set the heat-exchange unit to a permanent temperature of 40 °C. Not lower!
- Heat-exchangers with follow-up temperature must be set so that the temperature inside the cabinet is never lower than the outside temperature. Set the temperature limit to 40 °C!

Avoiding dripping and sprayed water

The heat-exchange units must be arranged in such a way that condensed water that may accumulate cannot drip into the installed drive components. Units on top of the cabinet require a special design!

Make sure that the control cabinet is constructed in such a way that the blower of the cooling unit cannot spray condensed water which may have collected, onto the drive components!

Summary

- Ensure that no condensed water can drip into the installed drive components!
- Make sure that the temperature of the heat-exchange unit has been properly set!

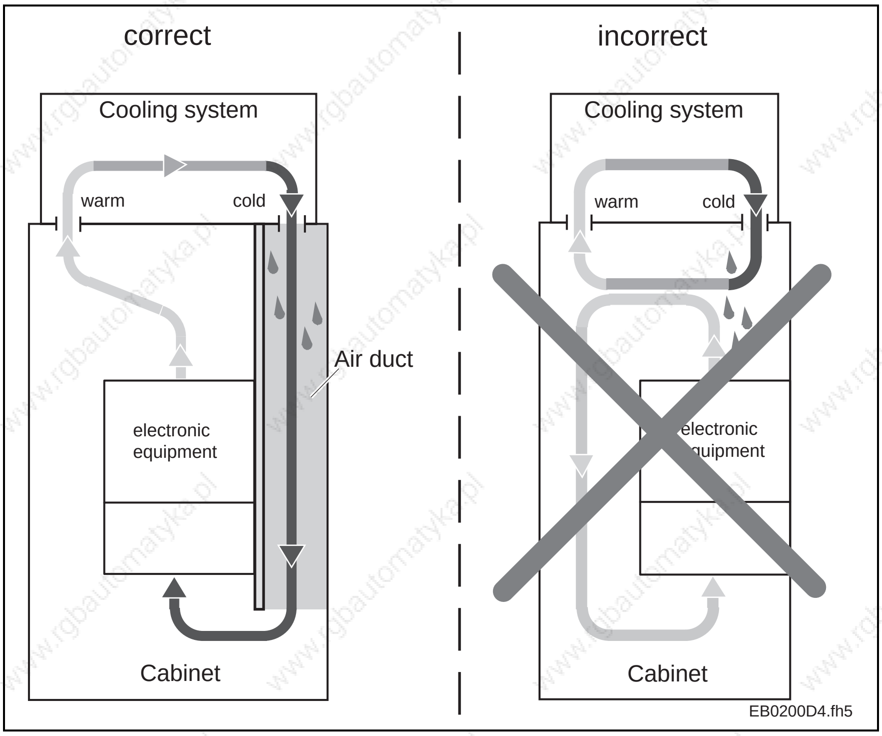

Fig. 10-2: Arranging the heat-exchange unit on the top of the control cabinet

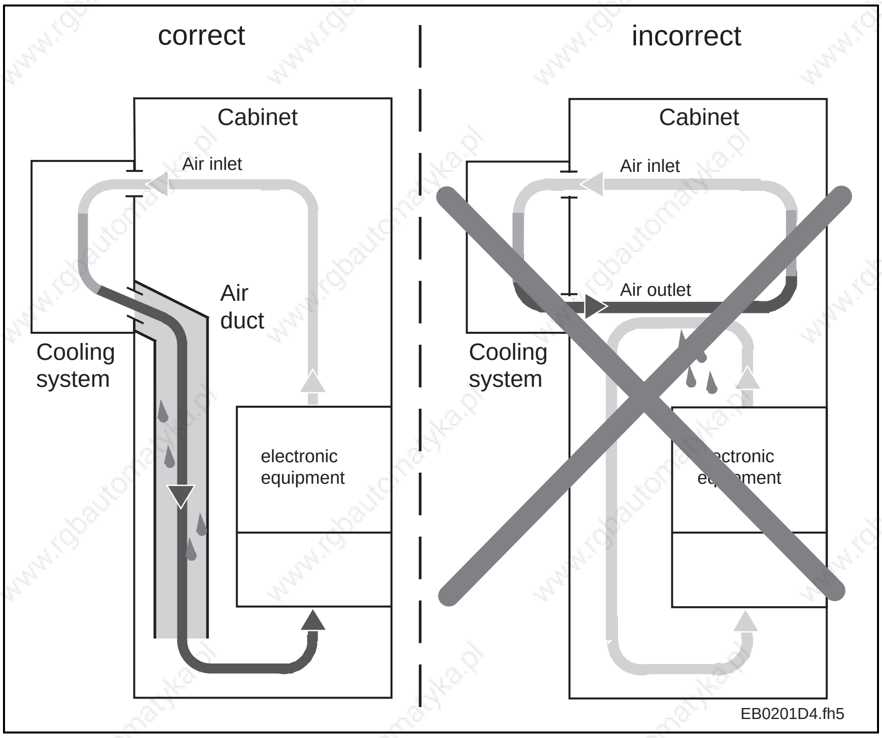

Fig. 10-3: Arranging the heat-exchange unit at the front of the control cabinet

10.3 Interference suppression measures and EMC

The assembly and installations regulations laid out in the project planning document "EMC for Drive and Control systems" must be adhered to in order to fulfill the legal EMC requirements.

11 Power connection

11.1 Direct power connection

The drives controller DKC**.1-040-7-FW can be connected directly to grounded three-phase current lines with AC 380...480 V, ±10 %. Only a fuse protector Q1, a line contactor K1, and normally a line filter are required in the power input line.

If the line voltage exceeds the permitted input voltage range, then the voltage must be matched by means of an autotransformer which, in turn, has also been laid out for a specified voltage range (see Chapter 9-1).

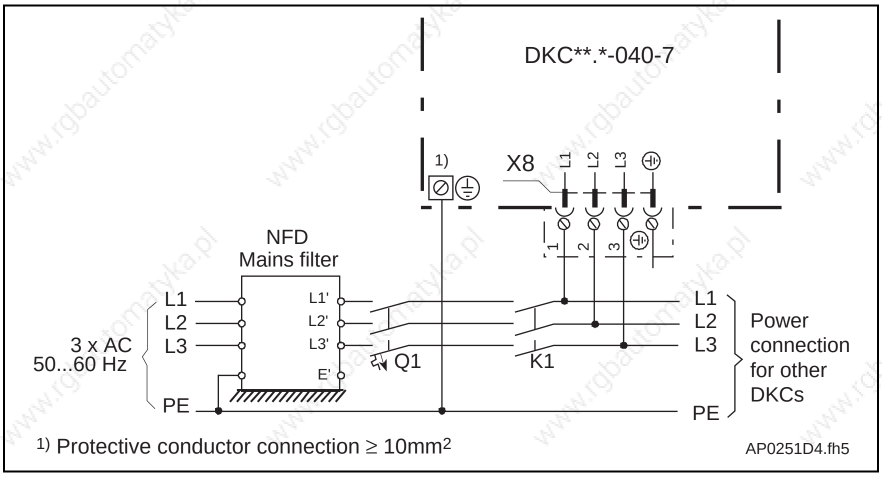

Fig. 11-1: Direct three-phase power connection

11.2 Line contactor/fuse protector

A selection table (Fig. 11-5) is available to facilitate the selection of a suitable line contactor and fuse protector for the power connection.

Calculating the phase current at the power connection

To be able to select a suitable line contactor and a suitable power connection fuse protection, the phase current I_N at the power connection must first be calculated.

The phase current I_N at the power coonnection is determined from the power supplied by the power line S_{AN} .

Locate the power connection output in the selection lists of the drive components, or calculate it according to formula Fig. 11-3. For several drive controllers, add the individual power connection output values.

$$P_{DC} = \frac{M_{EFF} \cdot n_{MITTEL} \cdot 2\pi}{60} \cdot k$$

P_{DC}: DC bus power in W
M_{EFF}: effective torque in Nm
n_{MITTEL}: average speed in min-1
k: factor for motor and controller efficiency = 1.25

Fig. 11-2: Calculating the DC bus power

$$S_{AN} = P_{DC} \cdot F$$

F: factor for the connected load
F: 2.6 for P_{DC} = 500 W
F: 1.95 for P_{DC} = 2000 W

Fig. 11-3: Calculating the power connection output

Three-phase connection: $$I_N = \frac{S_{AN}}{U_N \cdot \sqrt{3}}$$

I_N: phase current on the line side in A
S_{AN}: power connection output in VA
U_N: voltage between the phases of the power line in V

Fig. 11-4: Calculating the phase current at the power line

Selecting the fuse protector Q1 and line contactor K1

Fuse protector Q1

The fuse protector must be rated 1.5 times higher than the actual current at the power connection I_N.

Fuse protection can be implemented using:

- an automatic circuit breaker (power circuit breaker) or
- a power circuit breaker or
- safety fuses.

Line contactor K1

Select the line contactor according to the phase current at the power line and the rated line voltage.

The rated current of the line contactor must be 1.5 times higher than the actual phase current at the power line.

For a rated line voltage of 3 x 400 V, 50 Hz, , the line contactors listed in the selection table are recommended depending on the phase current I_N.

Selection table

The types specified in the selection table are from the Siemens company and serve as examples.

Phase current	Line cross section (1)	Recommended fuse protection: Automatic circuit breaker (tripping characteristic C)		Recommended fuse protection: Power circuit breaker			Recommended fuse protection: Safety fuse (class gl)		Recommended line contactor (for U_N = 3 x 400 V, 50 Hz)		
I_N in A	mm²	Cur-rent in A	N(3)	Siemens type	Setting value in A	N (3)	Cur-rent in A	N (3)	Siemens type	Nominal operating current	N (3)
up to 8.7	1,0	10	5	3VU1300 - .ML00	10	12	10	4	3TF40	12	7
up to 11	1,5	16	7	3VU1300 -.MM00	16	19	16	6	3TF41	16	10
up to 15	2,5	20	9	3VU1300 -.MP00	20	24	20	9	3TF42	22	13
up to 21	4,0	32	15	3VU1300 -.MP00	25	30	32	14	3TF43	32	19

(1) Values apply to PVC insulated multi-wire cables in protective pipes and installation ducts with an ambient te m-perature of 45 °C (in accordance with EN 60204-1/1992)

(2) The current was fixed based on operating mode AC 3 for a line voltage of AC 400 V, 50 Hz.

(3) N = maximum number of connectable drives taking the starting current into consideration. If more drives are connected than indicated, a fuse protector or line contactor with a higher current rating must be selected.

Fig. 11-5: Selection table for fuse protector Q1 and line contactor K1

11.3 Control circuit to the power connection

The control circuit recommended by INDRAMAT represents the function principle.

The choice of the control and its efficiency depends on the range of functions and the course of efficiency of the entire system or machine. Therefore, it is the manufacturer's responsibility to make this choice.

Stand-by contact

The stand-by message is output over a relay contact (make contact). If the stand-by contact closes, the drive is then ready for input power. It is thus used as a condition for connecting the line contactor (see Fig. 11-6)

Switching states

The ready-for-operation contact opens when:

- there is no control voltage for the DKC,
- 24 V are not applied a the E-stop input if the E-stop function is activated (see function description).
- if there are faults in the drive.

E-stop

Requirement:

The E-stop input is available if the E-stop function in the software is activated (see function description).

If during the following events:

- the limit switch trips
- the E-stop is pressed
- power is switched off (power off)

it becomes necessary to activate the internal drive error response as fast as possible, use the E-stop function.

If the E-stop function is not used, the drive-internal error response will not be activated until the line contactor K1 opens and as a consequence is recognized as "undervoltage in the DC bus" in the drive controller.

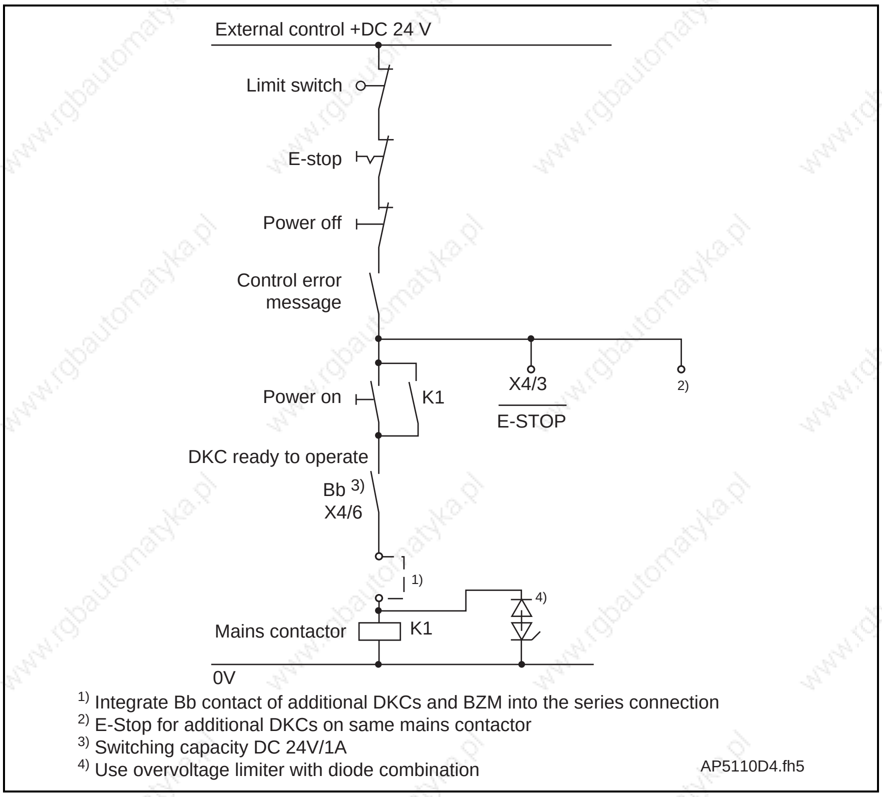

Fig. 11-6: Principal control circuit to the DKC

11.4 Reaction of the drive to malfunctions

Power failure

If during a power failure the 24V control voltage for the drive controller is buffered, the motor can be brought to a standstill by braking.

If during a power failure there is no 24 V control voltage, the motor becomes torque-free and coasts to a standstill.

DANGER

Dangerous movements!
Danger may result in equipment damage, personal injury or death!

⇒ Stay away from the machine's movement area. Possible measures to be taken to prevent access by unauthorized persons:
- protective fence
- protective railing
- protective covering
- light barrier

⇒ Fences and coverings should be strong enough to withstand the maximum possible momentum.

---

24 V control voltage failure for the DKC

If the 24 V control voltage for the DKC fails, the motor can no longer be brought to a standstill by braking. The motor becomes torque-free and coasts to a standstill.

DANGER

Dangerous movements!
Danger may result in equipment damage, personal injury or death!

⇒ Stay away from the machine's movement area. Possible measures to be taken to prevent access by unauthorized persons:
- protective fence
- protective railing
- protective covering
- light barrier

⇒ Fences and coverings should be strong enough to withstand the maximum possible momentum.

Fatal errors

If fatal errors occur in the drive system, the motor can no longer be stopped by braking. The motor becomes torque-free and coasts to a standstill.

An example of a fatal error is when the bridge fuse blows. (see function description).

DANGER

Dangerous movements!
Danger may result in equipment damage, personal injury or death!

⇒ Stay away from the machine's movement area. Possible measures to be taken to prevent access by unauthorized persons:
 - protective fence
 - protective railing
 - protective covering
 - light barrier

⇒ Fences and coverings should be strong enough to withstand the maximum possible momentum.

Other errors

If other errors occur, such as "excess amplifier temperature", the motor can be stopped (see function description).

11.5 Protection against indirect contact

As a result of the high capacitive leakage currents via the cable insulation, it is not possible to install a GFCB device in the input power line (compliant to DIN VDE 0160, section 6.5).

Thus, protection against indirect contact must be achieved by other means.

The drive system components have a protective grounded housing. This makes protection against indirect contact possible by grounding.

Notes

12 Preparing for Startup

Required equipment

SERCOS PC interface

The digital drives are generally started up via the terminal of a SERCOS interface compatible control It this is not possible, operation can be started via the INDRAMAT SERCOS PC interface.

The following options are offered using the startup resource "SYSDA"

- menu-driven startup
- positioning the axes with speed control
- diagnosis for eliminating malfunctions
- administration of parameters
- execution of commands
- oscilloscope for recording measurement protocols

The following startup equipment is included in the delivery contents:

- plug-in card for IBM compatible PCs (SERCOS PC interface DPS 3)
- floppy disk with the user program "ISYS"
- hand-held terminal HT4
- documentation no. 209-0069-4322

Measuring devices

The measuring devices below are required:

- multifunction device for measuring voltage
- an oscilloscope or recorder for recording test logs during startup operation for prototypes).

Personal protection

Note: Chapter 2 must be read carefully and observed before startup.

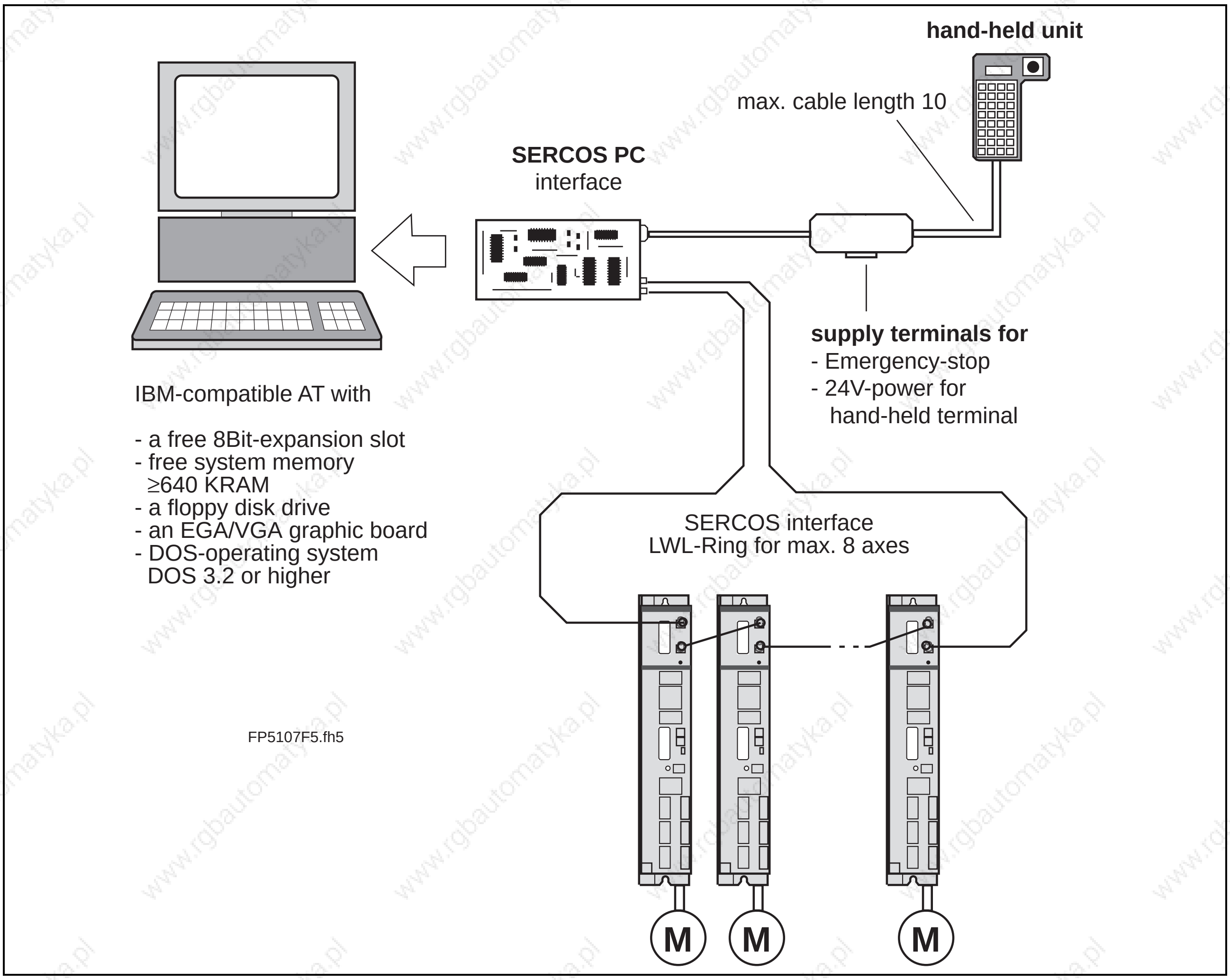

Fig. 12-1: Startup equipment for AC drives with SERCOS interface

13 Condition of the drive components on delivery

Packaging

Packaging units ECODRIVE components are delivered in separate packaging units.

Accessories are fastened to the unit.

Packaging materials INDRAMAT will take packaging materials back. The customer is liable for return transport costs.

Packaging labels The bar-code label on the packaging identifies the contents and the order number.

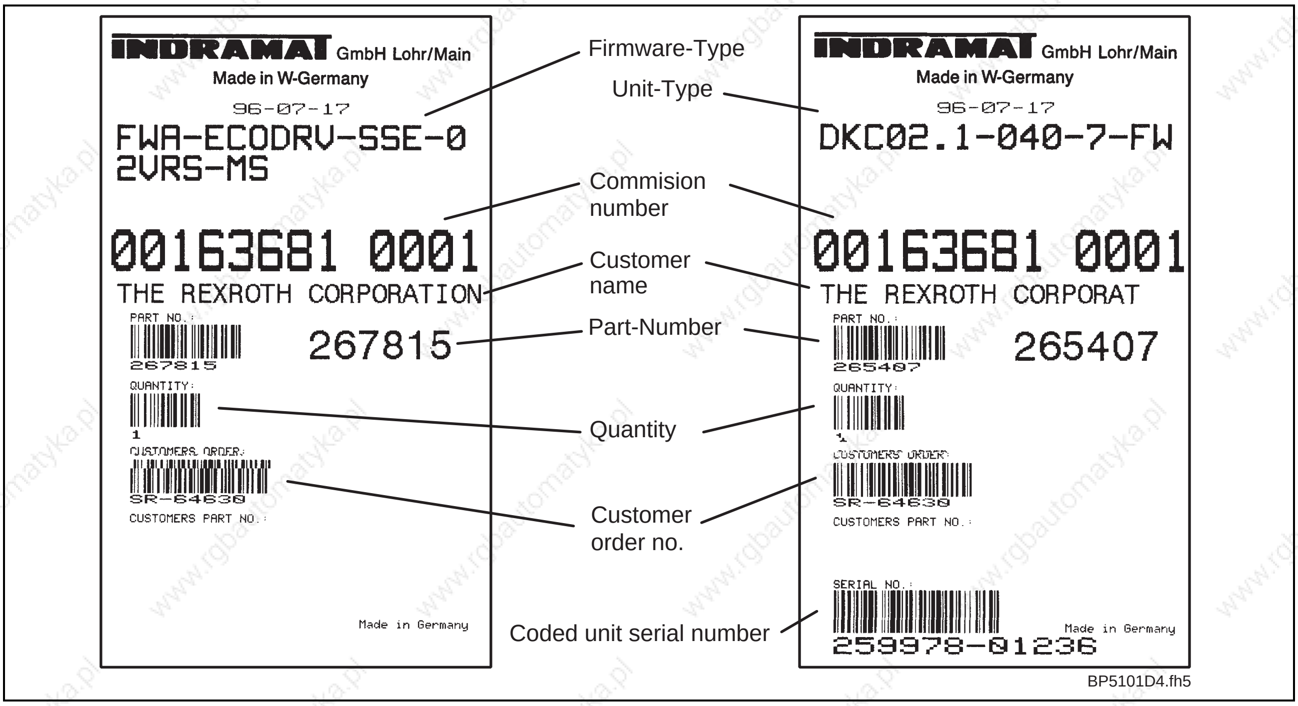

Fig. 13-1: Structure of the bar-code label on the packaging

Accompanying documents

An envelope containing a delivery notice in duplicate is attached to one of delivered packages. These are the only shipping documents unless special arrangements were made when the order was placed.

Either the delivery notice or the freight papers will list the total number of packages or transport containers included in the shipment.

Notes

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Directory of customer service locations

Germany

Sales Region Central	Sales Region East	Sales Region West	Sales Region North
INDRAMAT GmbH D-97816 Lohr am Main Bgm.-Dr.-Nebel-Str. 2 Telephone: 09352/40-0 Telefax: 09352/40-4885	INDRAMAT GmbH D-09120 Chemnitz Beckerstraße 31 Telephone: 0371/3555-0 Telefax: 0371/3555-230	INDRAMAT GmbH D-40849 Ratingen Hansastraße 25 Telephone: 02102/4318-0 Telefax: 02102/41315	INDRAMAT GmbH D-22085 Hamburg Fährhausstraße 11 Telephone: 040/227126-16 Telefax: 040/227126-15
Sales Region South	**Sales Region Southwest**		**INDRAMAT Service Hotline**
INDRAMAT GmbH D-80339 München Ridlerstraße 75 Telephone: 089/540138-30 Telefax: 089/540138-10	INDRAMAT GmbH D-71229 Leonberg Böblinger Straße 25 Telephone: 07152/972-6 Telefax: 07152/972-727		INDRAMAT GmbH Telephone: D-0172/660 040 6 -oder- Telephone: D-0171/333 882 6

Customer service locations in Germany

Europe

Austria	Austria	Belgium	Denmark
G.L.Rexroth Ges.m.b.H. Geschäftsbereich INDRAMAT A-1140 Wien Hägelingasse 3 Telephone: 1/9852540-400 Telefax:1/9852540-93	G.L.Rexroth Ges.m.b.H. Geschäftsbereich INDRAMAT A-4061 Pasching Randlstraße 14 Telephone: 07229/64401-36 Telefax: 07229/64401-80	Mannesmann Rexroth N.V.-S.A. Geschäftsbereich INDRAMAT B-1740 Ternat Industrielaan 8 Telephone: 02/5823180 Telefax: 02/5824310	BEC Elektronik AS DK-8900 Randers Zinkvej 6 Telephone: 086/447866 Telefax: 086/447160
England	**Finnland**	**France**	**France**
Mannesmann Rexroth Ltd. INDRAMAT Division Cirencester, Glos GL7 1YG 4 Esland Place, Love Lane Telephone: 01285/658671 Telefax: 01285/654991	Rexroth Mecman OY SF-01720 Vantaa Riihimiehentie 3 Telephone: 0/848511 Telefax: 0/846387	Rexroth - Sigma S.A. Division INDRAMAT F-92632 Gennevilliers Cedex Parc des Barbanniers 4, Place du Village Telephone: 1/41475430 Telefax: 1/47946941	Rexroth - Sigma S.A. Division INDRAMAT F-69634 Venissieux - Cx 91, Bd 1 Joliot Curie Telephone: 78785256 Telefax: 78785231
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Spain	**Spain**	**Sweden**	**Switzerland**
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Other European customer service locations

Other international locations

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China Rexroth (China) Ldt. A-5F., 123 Lian Shan Street Sha He Kou District Dalian 116 023 P.R. China Telephone: 0411/46 78 930 Telefax: 0411/46 78 932	Honkong Rexroth (China) Ldt. 19 Cheung Shun Street 1st Floor, Cheung Sha Wan, Kowloon, Honkong Telephone: 741 13 51/-54 und 741 14 30 Telex: 3346 17 GL REX HX Telefax: 786 40 19 786 07 33	India Mannesmann Rexroth (India) Ltd. INDRAMAT Division Plot. 96, Phase III Peenya Industrial Area Bangalore - 560058 Telephone: 80/839 21 01 80/839 73 74 Telex: 845 5028 RexB Telefax: 80/839 43 45	Japan Rexroth Co., Ltd. INDRAMAT Division I.R. Building Nakamachidai 4-26-44 Tsuzuki-ku, Yokohama 226 Japan Telephone: 045/942-72 10 Telefax: 045/942-03 41
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Other international customer service locations

Notes

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