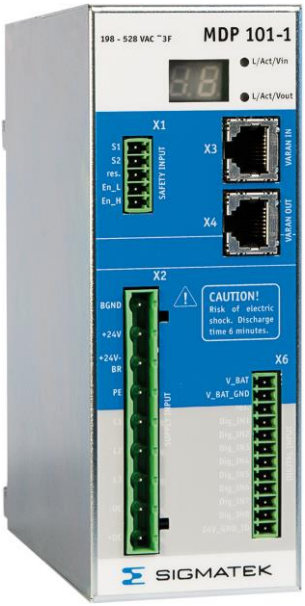
Power Supply Module 400 V/480 V MDP 101-1

1 Overview



The MDP 101 is a power supply module with a 3 kVA rating at an input voltage of 400/480 V.

MDD 100 is a small to midsize power range servo drive system, especially developed for multi-axial applications in the low, middle and high performance range.

It is fully integrated in the Lasal operating system and has 1 to 8 servo axes.
Depending on the supply module used and the motor type, the system is a 1-phase 230 VAC or a 3-phase 400-480 VAC system.

Four axis modules are available, two single-axis modules for 230 V and 400 V and two dual-axes module for 230 V and 400 V, which have a scalable output current range of the 2 axes.

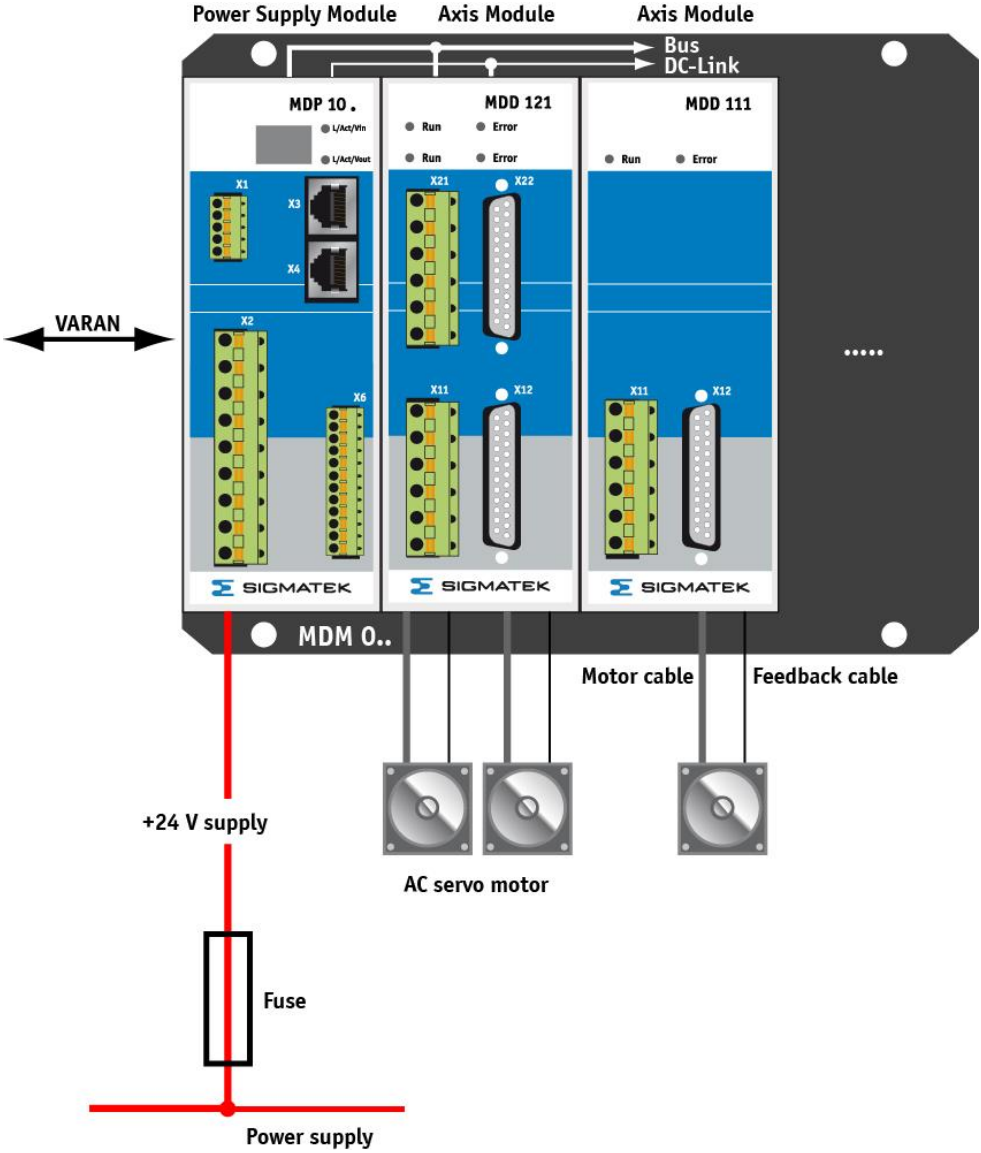
The supply module and the axes modules are put on a module carrier, which is mounted on the mounting plate of the cabinet.

The current, speed, and position control of the up to 8 axes work with a cycle time of 62.5 µs. MDD 100 has a high flexibility in connection of various feedback systems.

VARAN connects the servo drive system to the machine controller.

Integrated safety functions “Safe Torque off” STO and “Safe Stop 1” SS1 with a high safety level ease the integration into the safety concept of the machine.

1.1 Components of a servo system



2 General

2.1 About this manual

The manual describes the MDP 101-1 power supply module 400 V/480 V.

The information provided is:

- Technical Data for the power supply module 400 V/480 V
- Description of the safety function
- Assembly and Installation
- Interface description
- Setup of the servo drive
- Accessories
- Transport, storage, maintenance, disposal

Abbreviations used in this manual

Abbreviation	Meaning
AWG	American gauge wire
BGND	Earth of 24 V help and break supply voltage
CE	Communauté Européenne (Mark for conformity with EU directives (Manufacturer's self-declaration))
CLOCK	Clock pulse signal
EMV	Electromagnetic compatibility
EN	European standard
IGBT	Insulated Gate Bipolar Transistor
LED	Light Emitting Diode
PELV	Protected extra low voltage
RES	Resolver
SELV	SELV Safety Extra Low Voltage
V AC	AC voltage
V DC	DC voltage

2.2 Symbols Used

The following symbols are used in the operator documentation for warning and danger messages, as well as informational notes:

DANGER

Danger indicates that death or serious injury **will occur**, if the specified measures are not taken.

⇨ To avoid death or serious injuries, observe all guidelines.

Danger indique une situation dangereuse qui, faute de prendre les mesures adéquates, **entraînera** des blessures graves, voire mortelles.

⇨ Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

WARNING

Warning indicates that death or serious injury **can** occur, if the specified measures are not taken.

⇨ To avoid death or serious injuries, observe all guidelines.

Avertissement d'une situation dangereuse qui, faute de prendre les mesures adéquates, **entraînera** des blessures graves, voire mortelles.

⇨ Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

CAUTION

Caution indicates that moderate to slight injury **can** occur, if the specified measures are not taken.

⇨ To avoid moderate to slight injuries, observe all guidelines.

Attention indique une situation dangereuse qui, faute de prendre les mesures adéquates, **peut** entraîner des blessures assez graves ou légères.

⇨ Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

INFORMATION

Provides important information on the product, handling or relevant sections of the documentation, which require attention.

Warnung vor gefährlicher elektrischer Spannung

Danger for ESD-sensitive components.

Les signes de danger pour les composants sensibles aux décharges électrostatiques.

Hot surfaces

Danger for persons with pacemakers, implanted defibrillators or other active implants.

2.3 Safety Instructions

The safety instructions must be read before installation and set-up of the servo drive system, to prevent injury or material damage. It is fundamental that the technical data and information for connection requirements be followed (on the nameplate and in the documentation).

Only qualified personnel are permitted to perform activities such as transport, installation, setup and maintenance. Properly qualified persons are those who are familiar with the transport, assembly, installation, setup and operation of the product.

The manufacturer of the machine must generate a safety analysis for the entire machine. The manufacturer has to take appropriate measures to ensure that unforeseen movements cannot cause injury or equipment damage.

Inappropriate handling of the servo drive system or ignoring the warnings below and inappropriate engagement in the safety arrangement can result in equipment damage, personal injury, electric shock or death in an extreme situation.

Annotations

Danger! Shock current

Wait at least 7 minutes after disconnecting the servo drive system from the mains supply voltage before touching live sections of the equipment (e.g. contacts) or undoing connections. Capacitors can still have dangerous voltages levels for up to 7 minutes after switching off the supply voltages. To be sure, measure the voltage in the DC-link circuit and wait until it has fallen below 40 V.

Never remove the electrical connections to the servo drive system while it is under voltage.

There is a danger of electrical arcing with damage to contacts and danger to personnel.

If a leakage current sensor is used in the mains supply of the servo drive system, a leakage current sensor RCD type B must be used. If a RCD type A or AC is used, there is a risk, that the DC ground current of the servo drive will inhibit the leakage current sensor.

Failure to follow any one of these instructions will result in death, serious injury or equipment damage.

General

In a domestic environment this product may cause high frequency interference in which case interference suppression measures may be required.

The servo drive contains electrostatically sensitive components that can be damaged by improper handling. Before touching the servo drive system, discharge your own body by touching a grounded object with a conductive surface. Contact with highly insulating materials (synthetic fibers, plastic films, etc.) must be avoided. The servo drive must be placed on a conductive surface.

Opening the device is not permitted. During operation, all covers and control cabinet doors must be kept closed. There is a risk of death or serious damage to health or property.

During operation, servo amplifiers may have live, bare parts in accordance with their degree of protection. Control and power connections can carry voltage even if the motor is not rotating.

The servo drive system has a ground leakage current greater than 3.5 mA. Therefore, special attention must be paid to the grounding of the servo drive system. See technical data of the power supply modules.

The +24 V auxiliary power supply and the +24V-BR power supply for the holding brake must be electrically isolated as protective extra-low voltage (PELV) in accordance with EN 60950.

Failure to observe these precautions can result in serious injury and machine damage.

Caution! Hot surface

During operation, the housing of the servo drive can become hot and may reach temperatures above 80 °C (176 °F).

Especially the rear side of the module carrier will get hot, if the system is not mounted on a mounting plate in the cabinet. This is due to the related dissipated breaking energy in the ballast resistor. See technical data of module carrier.

Check (measure) the housing and the module rack temperature and wait until it has cooled down below 40 °C (104 °F) before touching it.

Failure to observe this precaution can result in severe injury

2.4 Prescribed Use

The safety module "Safe Restart Lock" in an integral component of the DIAS Drive MDP 101-1 and is already installed with delivery; it meets the conditions required for safe operation according to SIL 3 in compliance with IEC 62061 and according to PL e in compliance with EN 13849-1.

CAUTION

Safety modules can only be powered by supplies that meet the requirements for SELV or PELV in compliance with EN60294.

Installation, mounting, programming, initial start-up, operation, maintenance and discarding of safety modules can only be performed by qualified personnel.

Qualified personnel in this context are people, who have completed training or have trained under supervision of qualified personnel and have been authorized to operate and maintain safety-related equipment, systems and facilities in compliance with the strict guidelines and standards of safety technology.

For your own safety and the safety of others, use safety modules for their designated purpose.

Designated use also applies to correct EMV installation.

Non-designated use in this context applies to

- Any changes made to the Safety modules or the use of damaged modules
- The use of the Safety modules outside of technical framework described in these operating instructions
- The use of the Safety modules outside of the technical data described in these operating instructions.

In addition, observe the warnings in the other sections of this operating manual. These instructions are visibly emphasized with a symbol.

The servo amplifier from SIGMATEK GmbH & Co KG was designed and produced with state of the art technology. Before delivery, the products are completely tested for reliability. It is a built-in component for electrical systems, which can only be operated as an integral part of such systems. Before the products are installed, the following requirements must be fulfilled to meet the prescribed use.

- Anyone who works with the products in any way has to read and understand the safety instructions, the prescribed use and the non-prescribed use.
- The machine builder has to generate a risk analysis for the machine to ensure that unforeseen movements cannot cause injury or damage to personnel or property.
- The servo drive has to operate under the mounting and installation conditions described in this operating manual, especially the environmental conditions (temperature, protection class, humidity, mains input, EMC and the mounting position)
- It must be mounted in a closed switchgear cabinet with **minimum IP54**.
- The servo drive has to be used in the way in which they are delivered (without any mechanical or electrical modification).
- Do not mount or start-up mechanically or electrically damaged or faulty components.
- The servo drive is intended to control synchronous servo, linear, torque and asynchronous motors in closed loop control of torque, speed or position.
- The rated voltage of the motor must be at least as high as the setting of the mains input voltage (230 V, 400 V or 480 V) of the servo drive system.
- Only motors with star-connection may be used.
- The servo drive is developed for usage in an industrial environment. If it is used in residential areas, then an additional EMV filter must be installed in the mains input line
- Power supply modules MDP101-1 and MDP 102-1 are to be used with axis modules MDD111-1 and MDD121-1 only.
- Drives must be used with motors provided with over temperature sensing.

2.5 Non-prescribed Use

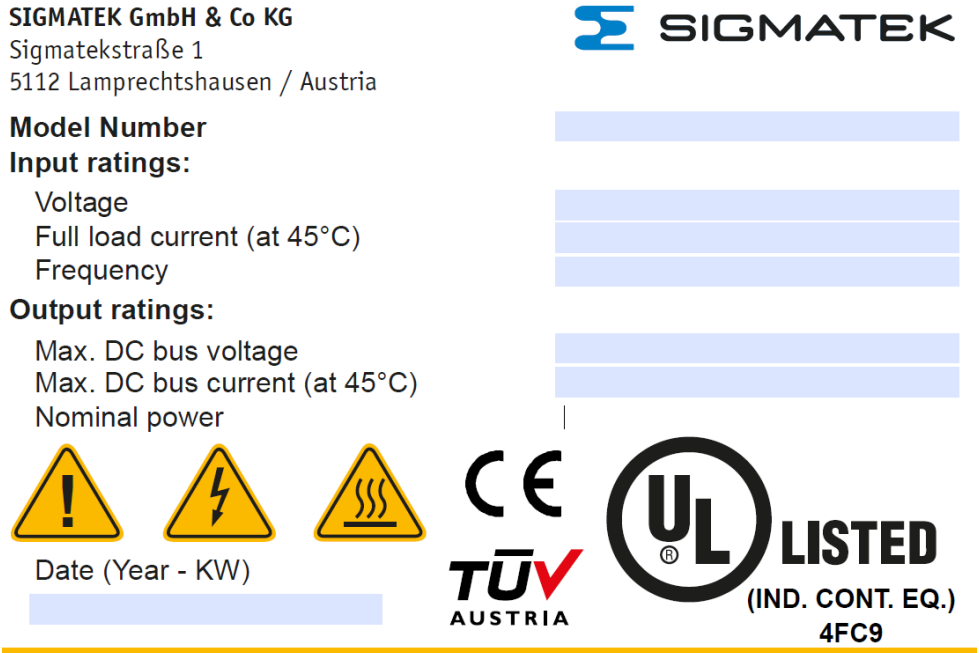
“Prescribed use” means, that the servo drive system is used according to the environmental conditions described in this operating manual.

- It must not be used in electrical equipment on ships (service afloat) or in offshore applications because of the conductive pollution.
- It must not be used in environmental conditions that do not meet the conditions described in this operating manual (too hot, without closed switchgear cabinet, wrong mounting position, etc.)

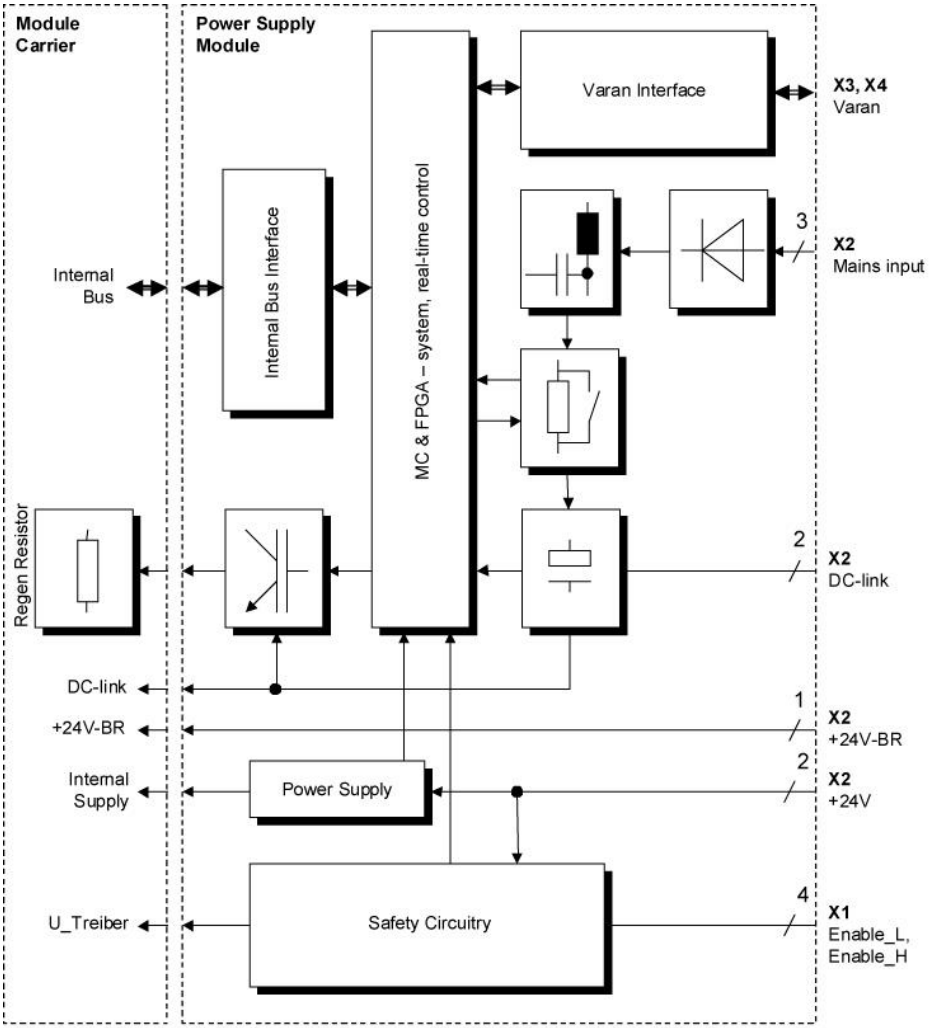
CAUTION

When used in environments with conductive pollution, e.g. in production plants where conductive material such as carbon fiber, graphite, chips from cast iron or similar occurs, care must be taken to ensure safe installation of the drive, as its IP54 housing protection class is not suitable for such environments. In such cases, the control cabinet must be hermetically sealed (no forced ventilation with air filter) or placed outside the contamination area. Dirty servo amplifiers must no longer be used.

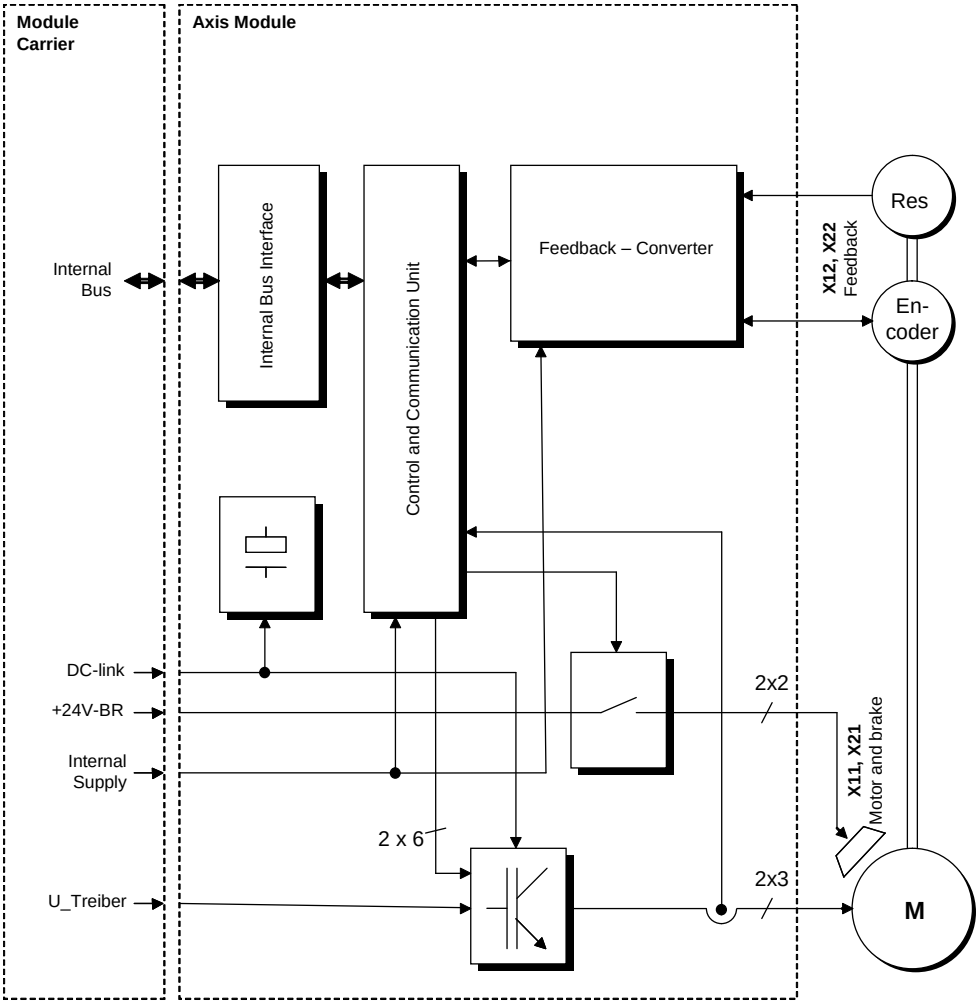
2.6 Nameplate



2.7 Block Diagram and Concept



Block diagram of the Power Supply Module



Block diagram of the Axis Module

Hardware

- Mains input is fed to the power rectifier, the input filter and the inrush circuit
- DC-link connection for connecting the DC-link to other drives for power distribution
- Regen unit with internal regen resistor.
- Auxiliary power supply input for the internal supply
- Separate power supply input for the holding brake for safety reasons
- Integrated safety functions
- Micro controller system with communication unit
- IGBT – power stage with isolated current measurement (short circuit protected)
- Feedback converter for resolver and high resolution feedback devices
- 8 digital Capture-inputs to record the momentary actual position of the selected axis.

Concept of the MDD 100

- Servo drive system contains of different components
  - Power supply module for up to eight logical axes
  - Axis module in different configurations
    - Single axis module
    - Dual axis module
  - Module carrier in different configurations for one to 4 axis modules
- Auto range function to optimize the resolution of the actual current
- Wide mains input voltage range 3 x 230VAC$_{-10\%}$ … 3 x 480VAC$^{+10\%}$ directly from TN-system or TT-system with grounded neutral point mains. TT-systems with ungrounded or missing neutral point need additional circuitry.
- Inrush circuitry to limit the maximum charge current at switch on of the mains contactor
- Fusing provided by the user (phase failure detection in the drive)
- 24 V auxiliary supply input, electrically isolated for internal supply
- Separate 24 V input for holding brake supply
- Input EMI – filter for AC-input, 24 V auxiliary supply and holding brake supply for class A (industrial environment)
- Safety functionality STO (Safe Torque off) and SS1 (Safe Stop 1) with performance level “e” according to ISO 13849 and SIL3 according to EN 62061
- All shield connections at the housing
- Protection functions against:
  - DC-link under/over voltage
  - Several short circuit conditions
  - Phase failure of the mains input
  - Overheating of the regen resistor
  - Over temperature protection (heat sink, ambient and motor)

The overload protection is provided internally by the drive. The load current is limited to 100 % of peak output current. For the thermal protection of the motor the I^2T regulation is used.

Note for installation in USA/Canada:

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes.

Software functionality

- Modified space vector modulation (SVM) technique to reduce the power stage losses
- Field oriented current controller (update time 62.5 µs)
- Feedback converter and speed controller (update time 62.5µs)
- Spline interpolator and position controller (update time 62.5 µs)
- Full synchronization down to the power stage, to the beat of the host controller with cycle times of 250 µs, 500 µs, 1 ms and every ms up to 8 ms
- The servo drive has no non-volatile data memory. So after switch-on, the parameters have to be send via the host communication to the servo drive

2.8 Technical Data Power Supply Module 400 V/480 V

	DIM	MDP101-1
Article number		09-403-101-1
Hardware version		3.x
Rated Data		
Rated mains voltage (symmetrically to ground) maximum 5000 rms symmetrical amps (L1, L2, L3)	V_{AC}	3 x 230 $V_{-10\%}$ - 480 $V^{10\%}$, 45 – 65 Hz
Maximum peak current at switch on of the mains contactor (limited by the inrush circuit)	A	3
Rated installed power for S1 operation	kVA	3
Rated installed power for S1 operation for input voltage < 400 V	VA	3 kVA – 7.5 W * (400 – input voltage/V)
Rated DC-link voltage	V_{DC}	290 - 680
Over voltage protection threshold of DC-link voltage	V_{DC}	450, 800, 900
Auxiliary supply voltage +24 V	V_{DC}	22 - 30
Maximum leakage current	mA	30
Power of additional supply voltage +24 V	W	Max. 50
Holding brake supply voltage +24 V-BR	V_{DC}	23 - 26 (depending on type of selected holding brake)
Output stage losses	W/Arms	2 W per ampere in the DC link
Regen Circuit		
DC-Link capacitance	µF	135
***G-VMAINS* = 230 (rated mains voltage = 230 V)**		
Switch-on threshold	V_{DC}	420
Switch-off level	V_{DC}	400
Over voltage protection	V_{DC}	450
Peak power of the internal regen resistor (max. 1sec)	kW	5.3
***G-VMAINS* = 400 (rated mains voltage = 400 V)**		
Switch-on threshold	V_{DC}	730
Switch-off level	V_{DC}	690
Over voltage protection	V_{DC}	800
Peak power of the internal regen resistor (max. 1sec)	kW	21
***G-VMAINS* = 480 (rated mains voltage = 480 V)**		
Switch-on threshold	V_{DC}	850
Switch-off level	V_{DC}	810

Over voltage protection	V_{DC}	900

Peak power of the internal regen resistor (max. 1sec)	kW	27
Safety Input		
Input voltage between ENABLE_H (+) and ENABLE_L (-)	V	Typically 24, max 30 V
Signal level between ENABLE_H (+) and ENABLE_L (-)	V	Low ≤ +5, High ≥ +15
Input current	mA	Typically 10 at 24 V
Switching delay times of the inputs	s	Switch-on about 0.02 Switch-off minimum 0.5, maximum 1 s
Relay output (S1, S2)	-	NO (normally open)
Switching capacity	-	Max. 30 V_{DC} , 42 V_{AC}, 100 µA to 0.5A
Digital Input		
Input voltage Dig_IN1 to Dig_IN8	V	Typically 24, max 30 V
Signal level	V	Low ≤ +5, High ≥ +15
Input current	mA	Typically 10 at 24 V
Switching delay times of the inputs	ms	Typically 0.1
Internal fusing		
Auxiliary supply 24 V (+24 V to BGND)	-	Electronic fuse
Holding brake supply 24 V-BR (+24 V-BR to BGND)	-	Electronic fuse
Regent resistor	-	Electronic protection
Resolver specification		
Exciter frequency f_{err}	kHz	8
Exciter voltage U_{Ref}	U_{eff}	2,8
Number of poles m	-	2, 4, 6, .., 32
Resolver voltage $U_{sin/cos, max}$	U_{eff}	1,9
Plug types		
Safety Inputs (X1)	-	Phoenix FK-MCP1,5/ 5-ST-3,5
Power Supply (X2)	-	Phoenix GMSTB 2,5HCV/ 9-ST-7,62
VARAN Bus (X3, X4) (maximum length: 100 m)	-	RJ 45
Digital Inputs (X6)	-	Phoenix FK-MCP1,5/ 12-ST-3,5
Mechanics		
Height	mm	155
Width	mm	60
Depth with module carrier (without/with plugs)	mm	152/195
Weight	kg	1.2

General		
Article number		09-403-101-1
Standard		UL 508C, NMMS.E336350

2.9 Safety conformity

Safety Integrity Level according to IEC EN 62061	SIL 3	
Performance Level according to EN ISO 13849-1	PLe	
Probability of failure per hour	PFH_D [10^{-9}]	0,3
Mean time to dangerous failure	$MTTF_D$ symmetrized [Years]	High
Proof Test Interval [Years]	20	

2.10 Ambient conditions, ventilation and mounting

Storage conditions	⇨ page 70
Transport conditions	⇨ page 70
Ambient temperature in operation	0 to +45 °C (32 to 113 °F) at rated data +45 to 55 °C (113 to 131 °F) with power derating of 2.5 % / K
Humidity in operation	Relative humidity 85 %, no condensation
Site altitude	Up to 1000 m above sea level at rated data 1000 to 2500 m above sea level with derating of 1.5 % / 100 m
Pollution degree	2
Servo drive enclosure protection class	IP 20
Mounting position	⇨ page 31
Ventilation	Forced ventilation by controlled internal fan

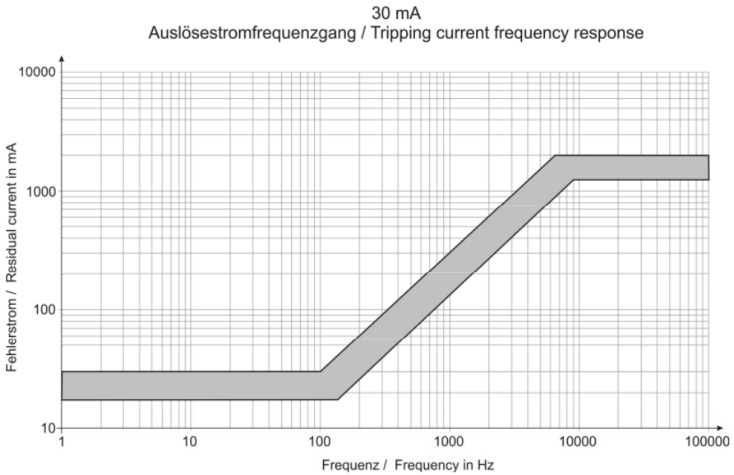
2.11 Auxiliary Power Supply

The power supply that is used for the +24 V auxiliary power supply voltage and the holding brake supply (+24 V-BR) must be a power supply with a galvanically isolated SELV output voltage according to EN60950. Due to the inrush current of the drive during switch-on, the current rating must be at least 5 A.

3 Installation

3.1 Important instructions

- If a leakage current sensor is used in the mains supply of the servo drives, a leakage current sensor RCD type B has to be used in any case. If a RCD type A or AC is used, there is a risk, that the DC ground current of the servo drive inhibits the leakage current sensor. High-frequency leakage currents occur, which must be taken into consideration when selecting the FI (e.g. Schrack ID-B 4/XX/XX-B). Trigger diagram:



- Take care, that the servo drive and the motor are grounded properly. Use uncoated, zinc plated mounting plates (subplates).

- The servo drive system MDD 100 has a high leakage current higher than 3.5 mA. Therefore particular attention has to be taken on the grounding of the servo drive system:

  a) Stationary machine mains supply connection:
  - Parallel connection of the protective conductor on X2/Pin4 and at the module carrier with the same gage wire size, or
  - Ground the MDD 100 with a minimum wire size of 10 mm² (AWG 8) at the module carrier, or
  - Automatically switch-off of the mains supply at cable break of the protective conductor

b) Variable machine mains supply connection:
Mains connection with industry connector according to EN 60309 and a minimum wire cross section of the protective conductor of 2.5 mm² (AWG 13) as part of a multi-conductor supply cable. Use an adequate pull relief.

- Check the mechanics of the servo drive. If the housing is damaged e.g. by transport, don't use it. Don't touch electronic components in the drive.
- Compare the rated voltage and current of the servomotor to the data of the servo drive. Do the wiring according to the Connection diagram, page 27.
- Make sure, that the mains input voltage, under any condition, not exceeds the maximum rating of the servo drive. Note also Possibilities of mains supply.
- Define the external fusing of the mains input, 24 V auxiliary supply and holding brake supply according to External fusing, page 34.
- Route the motor and control cables separately (distance about 100 mm). This improves the noise level of the control signals because of the high radiation of the motor cables. Use only screened motor and feedback cable with shield connections on both ends.
- The prescribed mounting position is vertical as shown on page 31.
- The airflow in the switchgear cabinet has to be in a way, that the servo drives has enough cool and filtered air. See Ambient conditions page 20.
- Any modification of the servo drive will invalidate the warranty, except setting the software functions by parameter.
- At start-up of the servo drive, check the setting of the peak current of the servo drive. Especially small motors are damaged very quickly, if the setting of the servo drive is too high (e.g. a 1 A – motor and the 6 A-unit, not reduced to 1 A!)
- In no-load condition, the intermediate circuit voltage can, over a period of time, reach a value of up to 740 V. This causes no damage to the module.
- Shelf life:
  < 1 year: no limitations
  ≥ 1 year: The intermediate circuit capacitors of the servo drive system must be reformed before the initial start up. In addition all electrical connections must be removed and the supply module supplied with 230 V for 30 minutes, single phase at terminals L1 and L2.

3.2 Important Instructions for the Safety Function

- All control components (switches, relays, PLC, etc.) and the control cabinet must comply with the requirements of the ISO 13849. This includes:
  - Door – switches, etc. with protection class IP54 as minimum
  - Control cabinet with protection class IP54 as minimum
- For the 24 V supply use only PELV/SELV power supplies.
- Use adequate insulated wire end sleeves
- External source voltage at the inputs ENABLE_L and ENABLE_H has to be excluded in the cabinet and outside. Make sure, that short circuits between single cables are excluded! See also EN ISO 13849.
- All safety-relevant cables (e. g. control cable) has to be installed e. g. in a cable duct, if pass outside the control cabinet
- The connector pin X1 / 3 is marked as “reserved” and must not be connected externally
- If the safety function SS1 (Safe Stop 1) is used, the minimum switch-off time is 0.4 s. Following actions which need the safety function STO (Safe Torque off) e.g. manually engagement into the machine, must not be released before 1 s
- When an external force is likely to act with the function ”safe restart lock” (e.g. force to the load by hanging load) additional measures have to be provided (e.g. double-disc spring set brake, instead of permanent magnetic-excited brake)

Failure to observe this precaution can result in severe injury and equipment damage.

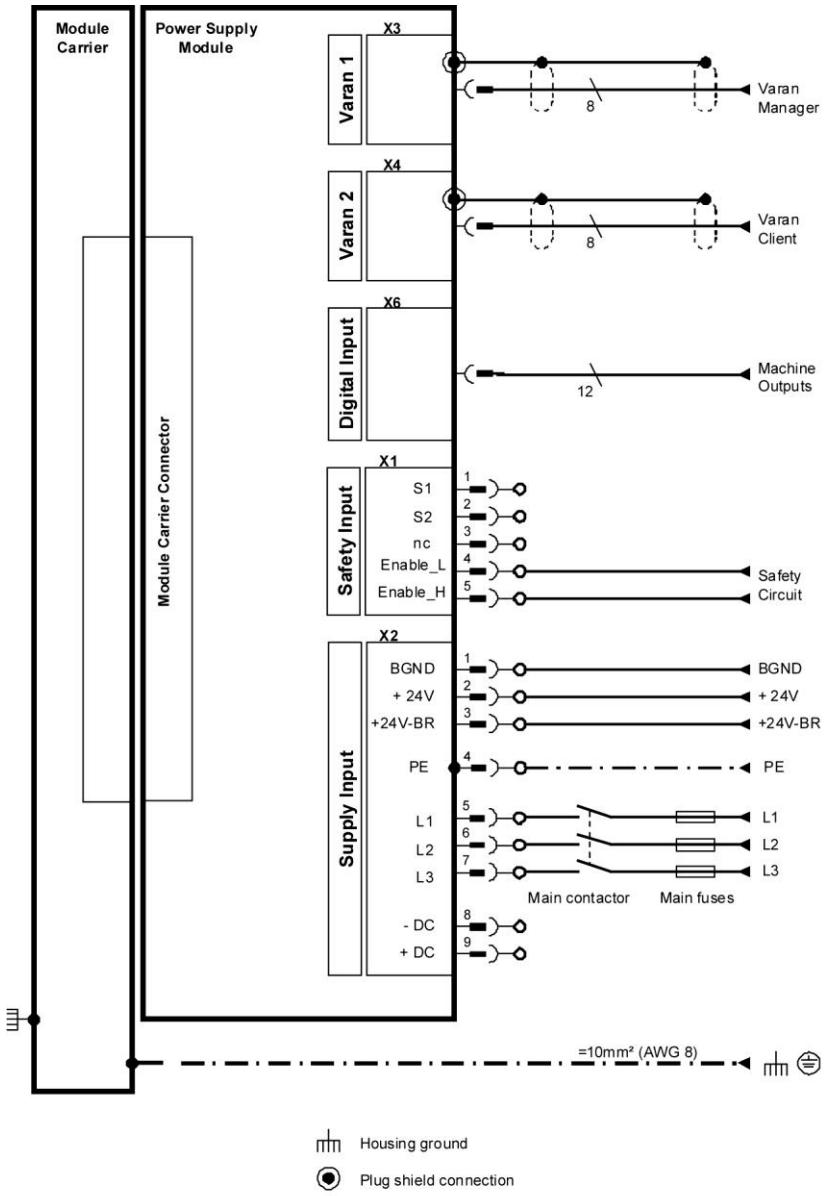
The mains supply voltage of the servo drive system has to be switched off by the main switch in following cases.

- Taking measures for cleaning, maintenance and repair
- Taking out of service for a longer time

Failure to observe this precaution can result in severe injury and equipment damage.

3.3 Planning of the switchgear cabinet

3.3.1 Connection diagram and pin assignment of power supply module

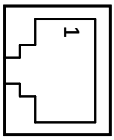


Connector layout of X1, X2, X3, X4 and X6

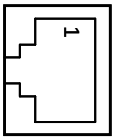
Safety Input
X1

S1	1
S2	2
reserved	3
Enable_L	4
Enable_H	5

Varan 1
X3



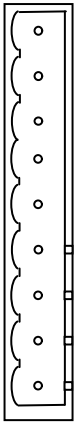
1	TX/RX+
2	TX/RX-
3	RX/TX+
6	RX/TX-
4,5,7,8	-



1	TX/RX+
2	TX/RX-
3	RX/TX+
6	RX/TX-
4,5,7,8	-

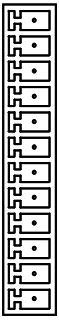
Varan 2
X4

Supply Input
X2



BGND	1
+24V	2
+24V-BR	3
PE	4
L1	5
L2	6
L3	7
- DC	8
+ DC	9

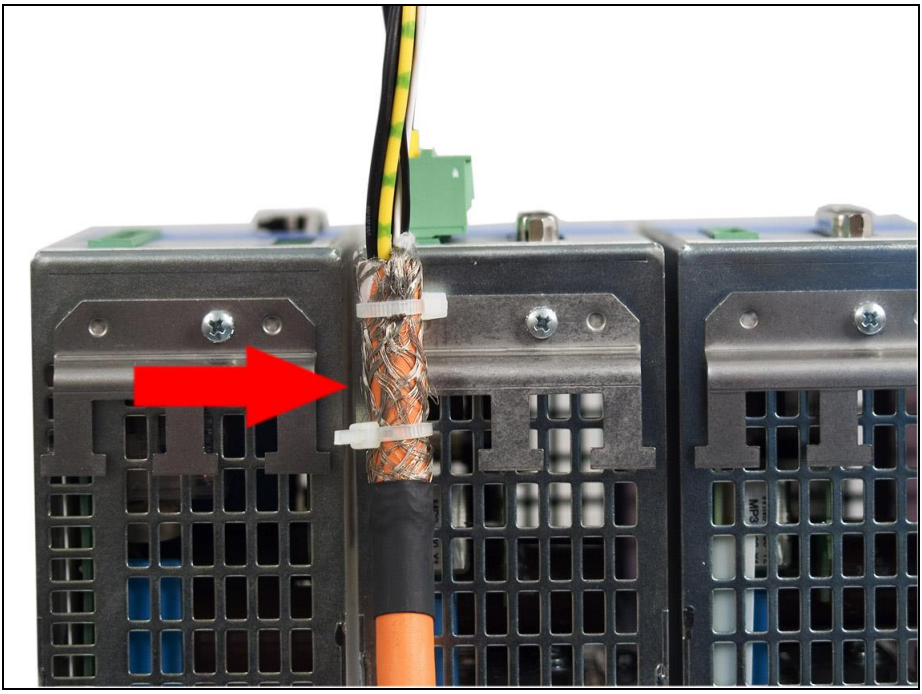
Digital Input
X6



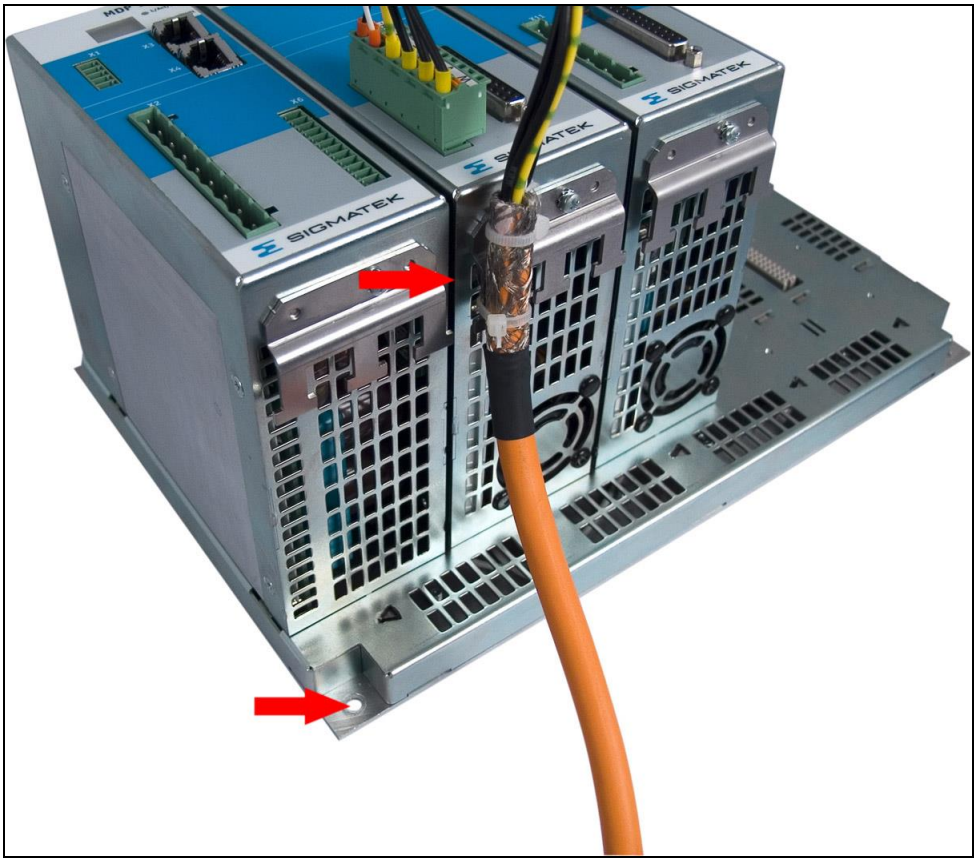
12	V_BAT
11	V_BAT_GND
10	reserved
9	Dig_IN1
8	Dig_IN2
7	Dig_IN3
6	Dig_IN4
5	Dig_IN5
4	Dig_IN6
3	Dig_IN7
2	Dig_IN8
1	24V_GND_IO

3.3.2 Ground

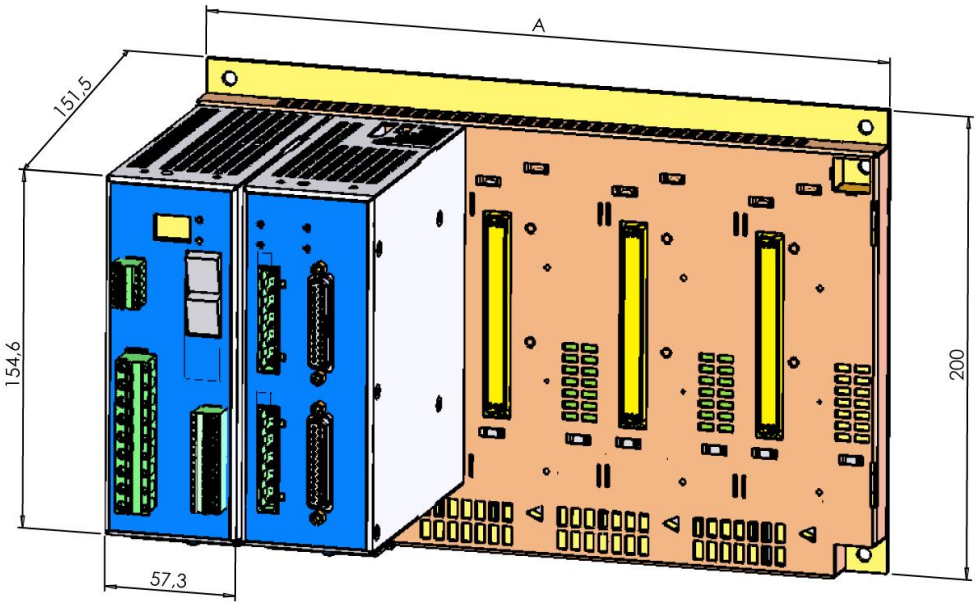
On the MDD module a mounting bracket is found, which serves as stress relief as well as shielding. Here, the cable shield is connected.



The entire MDD System is grounded over the module carrier in the control cabinet.

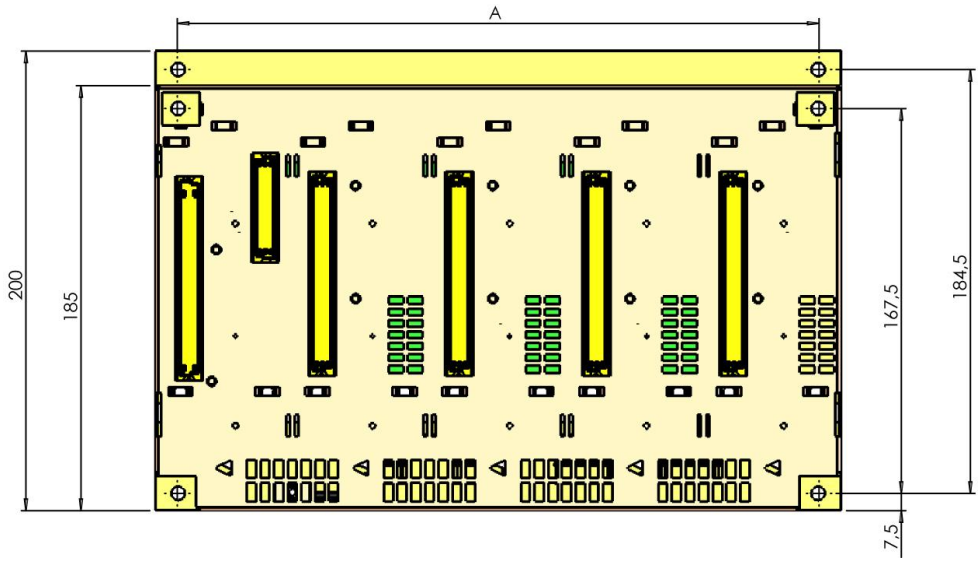


3.3.3 Mechanical construction and mounting



The mechanical dimensions of the servo drive system above are:

A depends on the selected module carrier
120 mm for MDM 011
180 mm for MDM 021
240 mm for MDM 031
300 mm for MDM 041



The mechanical dimensions of the module carrier and the fastening on the mounting plate of the cabinet above are:

A	depends on the selected module carrier 100 mm for MDM 011 160 mm for MDM 021 220 mm for MDM 031 280 mm for MDM 041

The cable ducts below must be placed with a minimum distance of 10 mm to the module carrier.
The cable duct above must be placed with a distance of 40 mm to the module carrier. This is necessary to get enough air through the heat sink.

The specified installation clearances can be reduced under some conditions. Provided that the appropriate measures and technical precautions are taken to dissipate the heat generated from loss.

Fastening material:	4 hexagon socket screws to DIN 912, M5
Torque:	5-6 Nm
Tool required:	4 mm Allen key

3.3.4 Connector properties

All connections of the servo drive system (except the ground bolt) are plugging style connectors. This makes it easier to install the cables and to replace a drive. Never the less it also opens the possibility to create cable sets for high volume machines.
The mechanical properties of the interface connectors are:

Connector	Type	Wire size	Max. screw torque
X1	Phoenix FK-MCP1,5/ 5-ST-3,5	0.2 – 1.5 mm² (16 – 24 AWG)	Cage clamp
X2	Phoenix GMSTB2,5HCV/ 9-ST-7,62	1 – 2.5 mm² (14 – 16 AWG)	0,56-0,79 Nm (5-7 inch lb)
X3, X4	RJ 45	-	-
X6	Phoenix FK-MCP1,5/ 12-ST-3,5	0.2 – 1.5 mm² (16 – 24 AWG)	Cage clamp
X12, X22	D-Sub 25 with metal housing	0.25 – 0.5 mm² (20-22 AWG)	Solder or crimp
X11, X21	GMSTB2,5HCV/6-ST-7,62	1 – 2.5 mm² (14 – 16 AWG)	0,56-0,79 Nm (5-7 inch lb)
Ground bolt	M5	10 mm² (8 AWG)	3.5 Nm (31 inch lb)

3.3.5 Wire sizing

According to EN 60204 (for AWG: table 310-16 of the NEC 60°C or 75°C column), we recommend

Signal		Cable rating
AC mains input	Maximum 2.5 mm² (14 AWG)	600 V,105 °C (221 °F)
DC-link	Maximum 2.5 mm² (14 AWG)	1000 V,105 °C (221 °F)
Motor cable	1.0 mm² (16 AWG), shielded, max.25m, capacitance <150pF/m	600 V,105 °C (221 °F)
Holding brake	Min. 0.5 mm² (18 AWG), part of the motor cable, shielded separately, check voltage drop	600 V,105 °C (221 °F)
Resolver with thermal contact	4x2x0.25 mm² (22 AWG), twisted pairs, shielded, max.25 m, capacitance <120 pF/m	
EnDat® encoder	7x2x0.25 mm² (22 AWG) twisted pairs, shielded, max.10 m, capacitance <120 pF/m	
+24 V and +24 V-BR input	Maximum 2.5 mm² (14 AWG), check voltage drop	

Note: Use 60/75 °C Copper conductors only!

3.3.6 External Fusing

The AC-mains and 24 V – fuses are calculated depending on customer needs.

Signal	Fuses, time delay
AC mains input (L1-L3)	Size fuses to the average power, needed by the servo drives, connected to the circuit. Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 528 Volts maximum when protected by RK5 Class Fuses rated 10 A / 600 V.
24 VDC input (24 V, 24 V-BR to BGnd)	Limited to 12 A time delay at 2.5 mm² / 14 AWG

3.3.7 MDP 101-1 Mains Supply Options

The servo drive system MDD 100 has a high leakage current higher than 3.5 mA. Therefore particular attention has to be taken on the grounding of the servo drive system:

a) Stationary machine mains supply connection:

- Parallel connection of the protective conductor on X2/Pin4 and at the module carrier with the same gage wire size, or
- Ground the MDD 100 with a minimum wire size of 10 mm² (AWG 8) at the module carrier, or
- Automatically switch-off of the mains supply at cable break of the protective conductor

b) Variable machine mains supply connection:

Mains connection with industry connector according to EN 60309 and a minimum wire cross section of the protective conductor of 2.5 mm² (AWG 13) as part of a multi-conductor supply cable. Use an adequate pull relief.

If a leakage current sensor is used in the mains supply of the servo drive system, a leakage current sensor RCD type B must be used.
If a RCD type A or AC is used, there is a risk, that the DC ground current of the servo drive will inhibit the leakage current sensor.

Grounded mains

The power supply module can be connected directly to mains with grounded star point or grounded phase conductor in the defined voltage range without galvanic isolation.

Ungrounded mains

If the power supply module is connected to ungrounded mains (IT-system), there is a risk of damaging the drive by unacceptable over voltages.
The servo drive can be protected against over voltage by

- Using a galvanically isolated transformer with a grounded star point on the secondary side. This guaranties the highest level of protection.
- Installing a surge protection unit in the input of the switchgear cabinet

The servo drive is tested according to EN 61800-3 with following levels:

- The periodic over voltage at the mains input L1, L2, L3 between the phases and against ground must not exceed 1000 V (peak value).

- Transient over voltages (<50µs) must not exceed 1000 V (peak value) between the phases and 2000 V against ground.

Note: Ungrounded mains always need additional surge protection in the mains input.

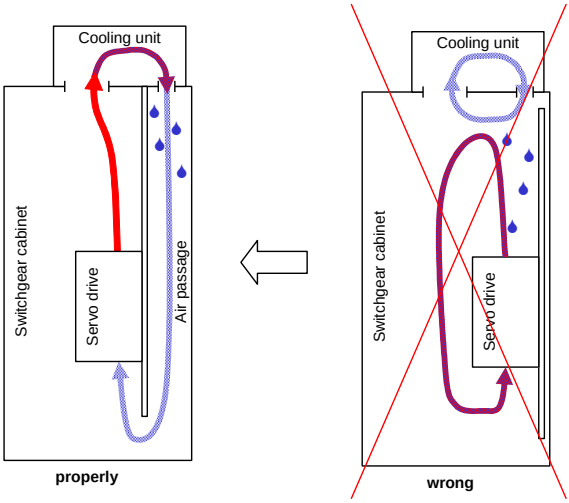
High voltage mains If the mains voltage exceeds the maximum allowed input voltage of the power supply module, a transformer has to be used to bring it into the specified range.

3.3.8 Usage of cooling units

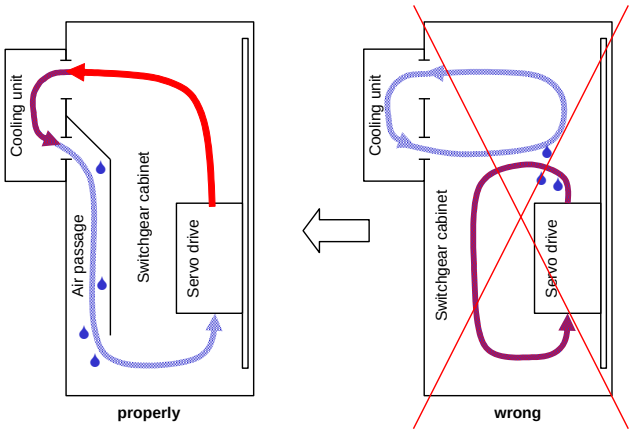
The servo drive system operates up to 45 °C (55 °C with power reduction) ambient temperature. This means, that there could be a need to use a cooling unit.

Note: Principally, the usage of a cooling unit can and will produce condensation water. So it is important to observe following:

- Mount cooling units in a way that condensation water does not leak into electronic devices in the switchgear cabinet.
- Mount cooling units, by which amassed condensation water cannot be sprayed into electronic devices by the fan of the cooling unit.



Cooling unit on top of the switchgear cabinet



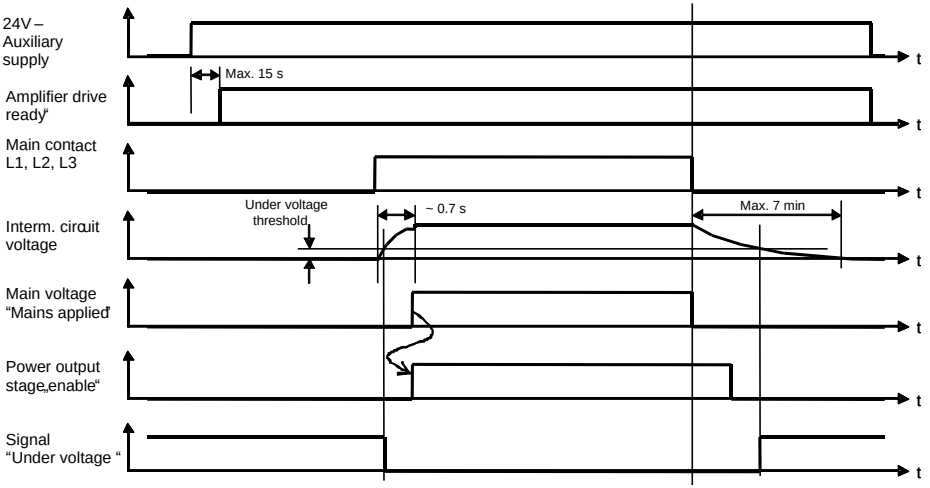
Cooling unit in the door of the switchgear cabinet

Avoid condensation also by observing the following rules:

- Set the set point of the temperature control of the cooling unit minimal to the temperature of the factory building.
- Use only properly sealed switchgear cabinets to avoid condensation by the moist external air.
- Especially during installation or servicing while the machine is running with open switchgear cabinet doors, make sure that the temperature of the electronic devices is not cooler than the air in the switchgear cabinet. This will generate condensation in the electronic devices.

3.3.9 Turn on/off response of the servo amplifier

The turn on/off response of the servo amplifier is shown below.



5 seconds after turning on the 24 V auxiliary supply (start time of the micro controller), the "Drive ready" signal is set to high.

The above image shows when the 24 V auxiliary supply activates the system through turning on the main switch and the main supply is engaged later.
This, however, is not absolutely necessary. The main supply can also be activated with the 24 V auxiliary supply at the same time.

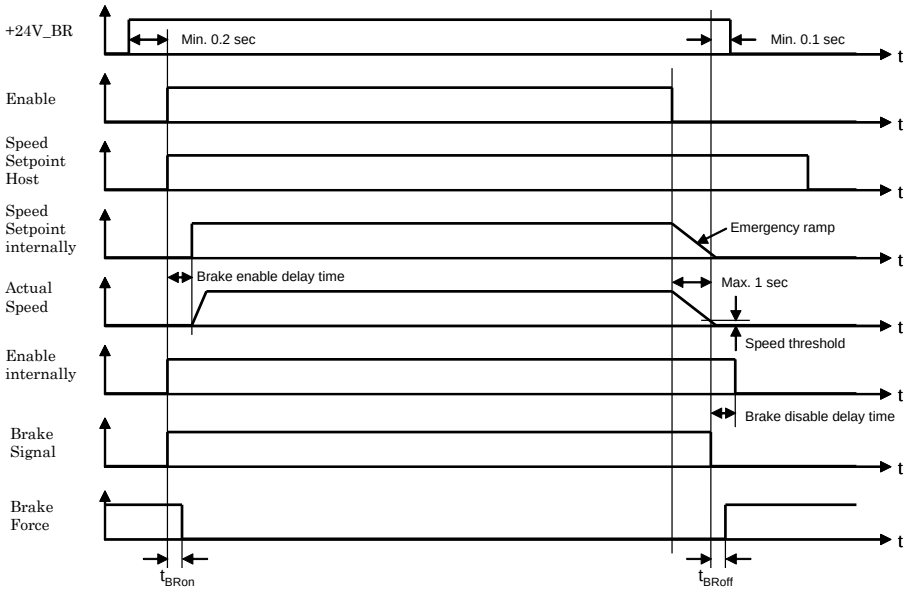
Since the memory of the servo amplifier is volatile, received parameters must be stored in the host controller. The advantage here lies in the automatic download of program data when an amplifier is changed.

If the main supply is turned on, the capacitors in the intermediate circuit are charged. This requires approximately 0.7 seconds.

If the main supply is turned off, the current of intermediate circuit is maintained and can be used for controlled braking of the motor. If the motor is slowed, the energy is returned to the intermediate circuit.

If the motor is stopped, the "enable" signal can be removed. After 7 minutes, the intermediate circuit is discharged.

3.3.10 Holding brake control



The figure above shows the processing of the holding brake.

A standard holding brake with 24 VDC input voltage and maximum 1 A can be directly executed by the servo drive.

The circuit has a high level of functional safety, but is not personnel safe.

4 Safety Function

The MDD 100 servo drive system supports the safety functions SS1 (Safe Stop 1) and STO (Safe Torque Off), and meets the requirements for Category 4 Performance Level "e" according to EN ISO 13849-1 and SIL3 according to EN 62061.
For his purpose, the servo amplifier has two safe inputs ENABLE_L und ENABLE_H.

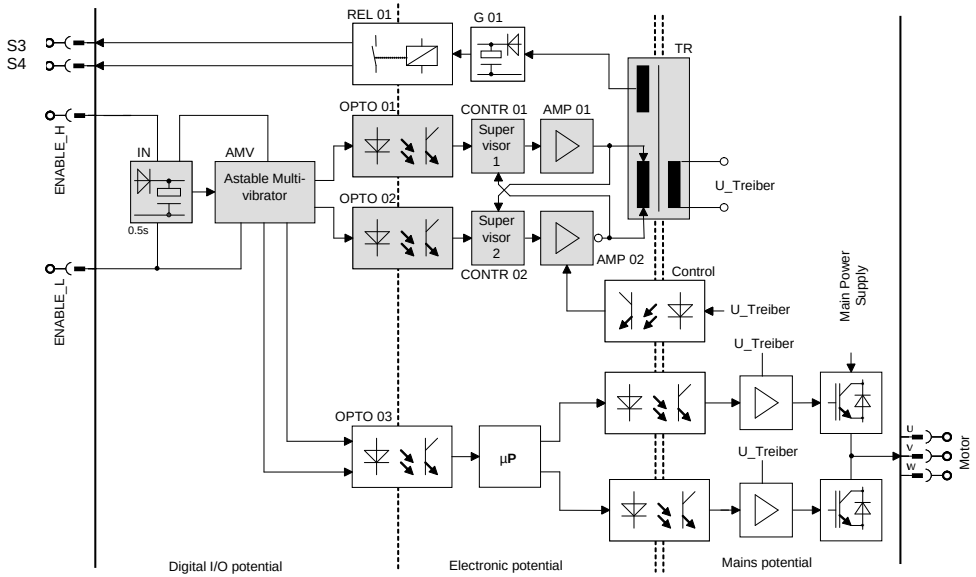
The relay output S1/S2 can be used to provide the status of the safety function. It is not safety-relevant, but can be used to test the external safety function.

The stop brake control is not a component of the safety function. If a safe shutdown of the stop brake is required, the +24 V-BR brake supply must also be shut down externally.

For the 24 V supply, only PELV/SELV can be used.

4.1 Implementation

The following block diagram gives an overview of the internal switching circuit.



Block diagram for safe restart lock

The blocks in the diagram above have the following functions:

4.1.1 Block IN

The input block IN generates the supply voltage for the AMV block. This is formed from the voltage difference between ENABLE_H and ENABLE_L. Power is therefore available shortly after the appropriated signal is applied to ENABLE_H and ENABLE_L. The voltage difference between ENABLE_H and ENABLE_L must exceed the minimum HIGH signal.

The LOW signal ranges from 0 V to +5 V.
The High signal ranges from +15 V to +30 V.

If the input voltage is disconnected, the block maintains the supply voltage for the AMV block for approximately 400 ms. Because the differential voltage is supplied to the OPTO03 block without a delay, the motor can be actively slowed before the amplifier goes into the safe status by disabling U_Treiber.

4.1.2 Blocks AMV, OPTO 01 and OPTO 02

As long as the AMV block is powered by the IN input block, it generates a pulse with a constant frequency that is transmitted to the sequential electronics through blocks OPTO 01 and OPTO 02.

4.1.3 Blocks CONTR 01, CONTR 02, AMP 01, AMP 02 and TR

These blocks form a safe switching power supply, which generates the driver voltage for U_Treiber through the transformer TR01. It is ensured that the switching supply cannot transmit any energy when no control signal is sent from the AMV block over OPTO 01 and OPTO 02.

4.1.4 Blocks G01 and REL01

The relay output S1/S2 is closed when the servo amplifier is supplied with 24 V and the safety function is active. The two blocks are not safety-relevant.

4.2 Function

The safety functions in the DIAS Drive are controlled over two digital inputs.

The following table shows the status that the ENABLE_L and ENABLE_H inputs must assume to enable normal operation or trigger the safety function.

Input Status		**Relay output S3/S4**	**Description**
ENABLE_L	**ENABLE_H**		
Open	Open	When the servo amplifier is supplied with 24 V, the inputs are closed after a minimum delay 0.4 of seconds and a maximum of 1 seconds	**Safe status of the drive system**
Low	Low	When the servo amplifier is supplied with 24 V, the inputs are closed after a minimum delay 0.4 of seconds and a maximum of 1 seconds	• Single channel safe status only when using classic I/O technology • **Safe status of the drive system,** when a safe output is used by a Safe PLC, also when ENABLE_L is connected with „Ext. GND“
Low	Open		
Low	High	Open	**Drive system ready**

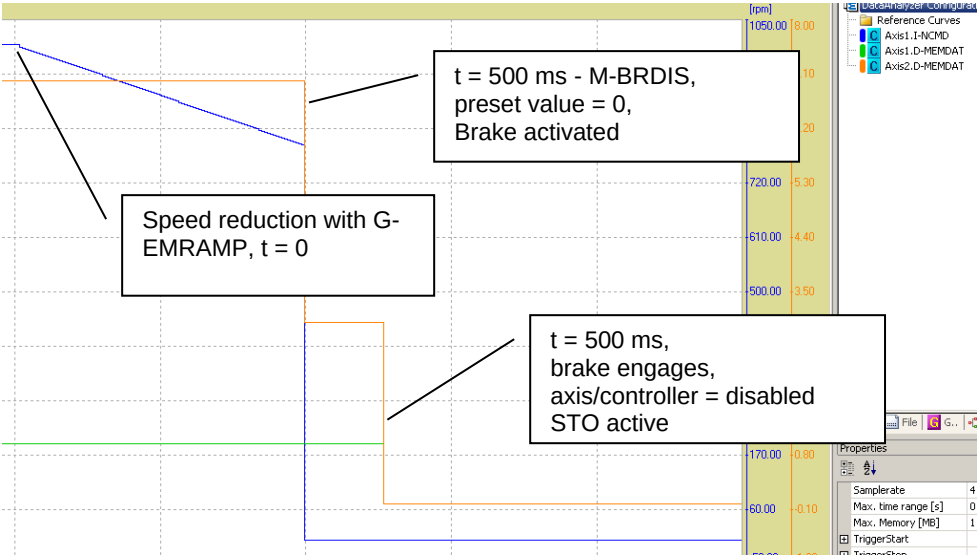
If the ENABLE_L and ENABLE_H are changed from any status to the "Drive Ready" status, the servo amplifier is not immediately enabled. In addition, in the software (**K-EN** = 1) or the corresponding bit in the "control word" must be set so that the software "enable" can be set and the drive therefore switched to the operational mode.

Controlled shut down (K-EN = 0):

If the actual speed reaches < 1% of min(N-NMAX, V-NMAX) or the ramp time exceeds 1 second, the brake is activated and the pre-set speed (I-NCMD) is immediately set to 0 (to support the braking effect). After 1 second + M-BRDI, the brakes engage and the controller/output stage is disabled.

Shut-down after opening the safety circuit:

If the actual speed reaches < 1% of min(N-NMAX, V-NMAX) or the ramp time exceeds 500 ms, the brake is activated and the pre-set speed (I-NCMD) is immediately set to 0 (to support the braking effect). After 500 ms + M-BRDI, the brakes engage and the controller/output stage is disabled.



Time response with an open safety circuit

4.3 Function Test

The safety function test is required to ensure correct operation. The entire safety circuit must be tested for full functionality.
Tests must be performed at the following times:

- After installation
- In regular intervals, or at least once a year.
- After each change on the machine control

If the function test results in an invalid machine status, the error must be found and corrected before the safety function is retested. If the error reoccurs during the function test, the machine can no longer be operated.

Failure to follow the above safety measures can lead to severe injuries and damage.

4.3.1 Test Conditions

The total safety circuit must be tested for functionability

The function test is performed from the following start condition:

- An operation-ready servo drive system
- Safe input ENABLE_L is LOW and ENABLE_H is HIGH
- Software application is running
- Motor(s) running

Depending on the wiring:

1. Both the ENABLE_L and ENABLE_H inputs are opened

   or if ENABLE_L is connected to "Ext. GND" and the safe output of a Safety PLC is used for ENABLE_H.

2. ENABLE_H is open or LOW (depending on the wiring).

The motor speed is expected to slow to null and the relay output S1/S2 to close after a minimum delay of 0.4 s and a maximum of 1s when the servo drive is supplied with 24 V.

The servo drive system should go into safe mode.

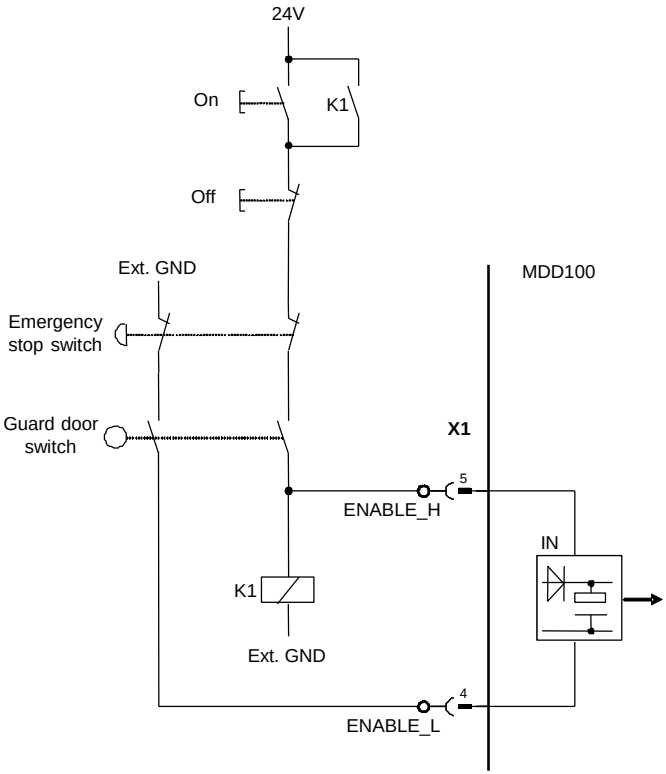
4.4 Example Connection with Switching Contacts

To meet the requirements of safety category 4, performance level "e" for EN 13849-1 and SIL3 according to EN 62061, a two-channel control must be provided for the safety functions.

The wiring for both connections must be provided with protective insulation (to avoid the "external voltage supply" error).

For ENABLE_H this means, the other signals that can have a 24 V potential must be wired separately.

For ENABLE_L this means, the other signals that can have "Ext. GND" potential must be wired separately. Because the 24 V auxiliary voltage in the control cabinet is normally grounded, caution must be taken to avoid a short-circuit with PE. The can occur through, for example, wiring in a cable duct.



The schematic shows the possible wiring for use of conventional switch contacts.

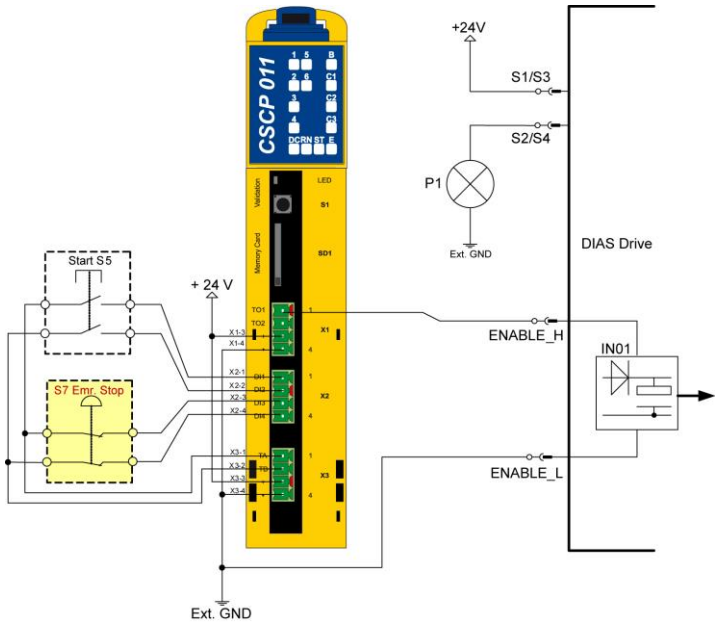
4.5 Example: Safety PLC Application

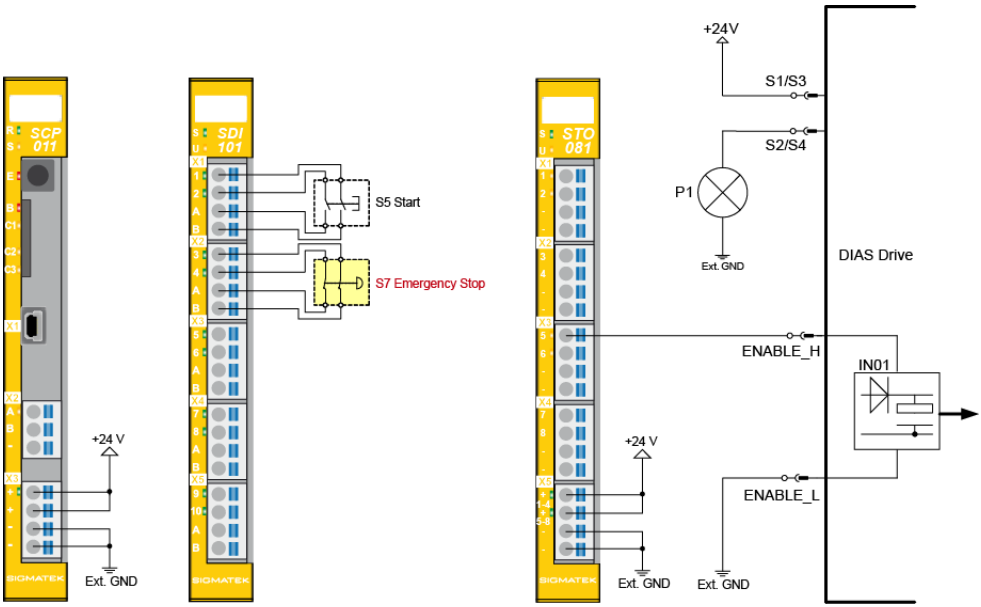
To meet the requirements of safety category 4, performance level "e" for EN 13849-1 and SIL 3 according to EN 62061, an error-proof output of a safety PLC must be used.

There are two Types of error-safe outputs.

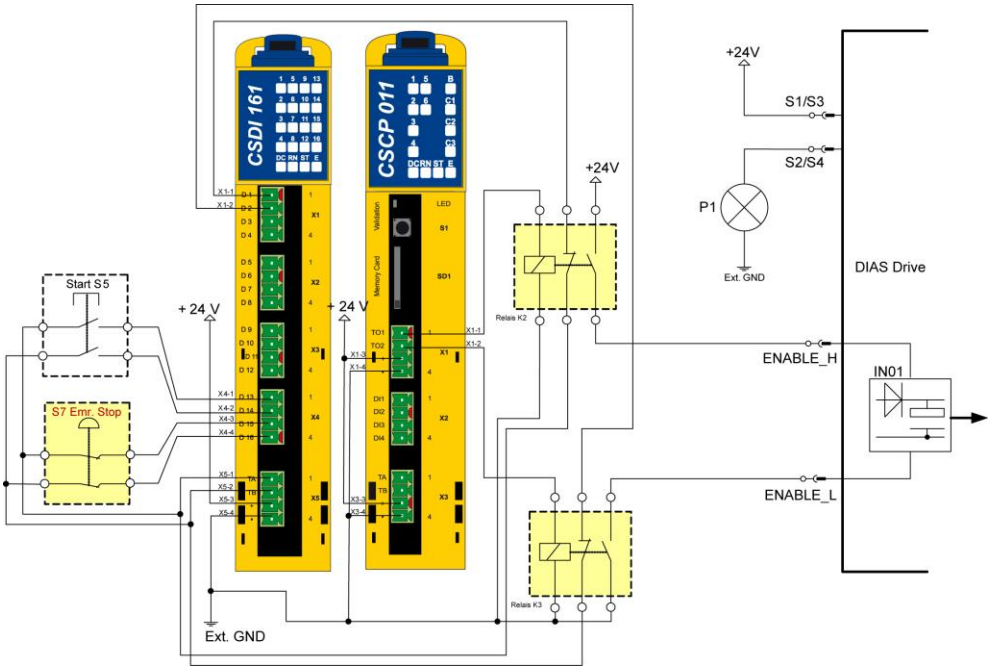
1. A simple error-safe output, which functions based on "Ext. GND" only. This is then connected to the ENABLE_H input. The wiring for both connections must be provided with protective insulation (to avoid the "external voltage supply" error).

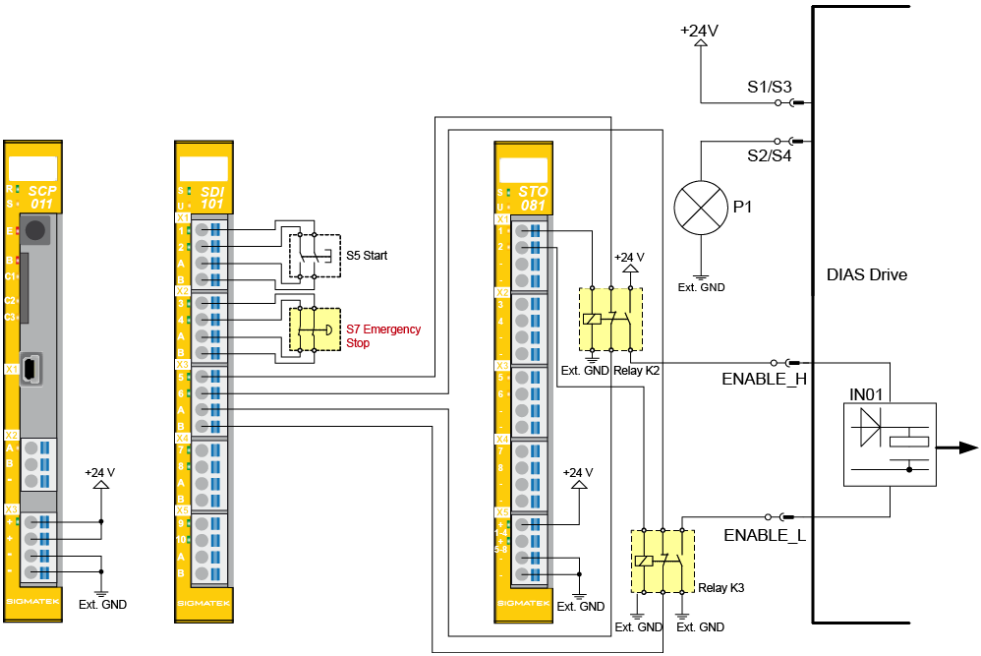
   In this case, ENABLE_L is connected to "Ext. GND"




SCP 011
SDI 101
STO 081
S5 Start
S7 Emergency Stop
+24 V
Ext. GND
+24V
S1/S3
S2/S4
P1
Ext. GND
DIAS Drive
ENABLE_H
IN01
ENABLE_L
+24 V
Ext. GND
Ext. GND

2. Two-channel error-proof relay output, with which the + output is connected to ENABLE_H and the – output to ENABLE_L.




SCP 011
SDI 101
STO 081
+24V
S1/S3
S2/S4
P1
Ext. GND
DIAS Drive
S5 Start
S7 Emergency Stop
+24 V
Ext. GND
Relay K2
ENABLE_H
IN01
ENABLE_L
Relay K3
Ext. GND
Ext. GND
Ext. GND
+24 V
Ext. GND
+24 V
Ext. GND

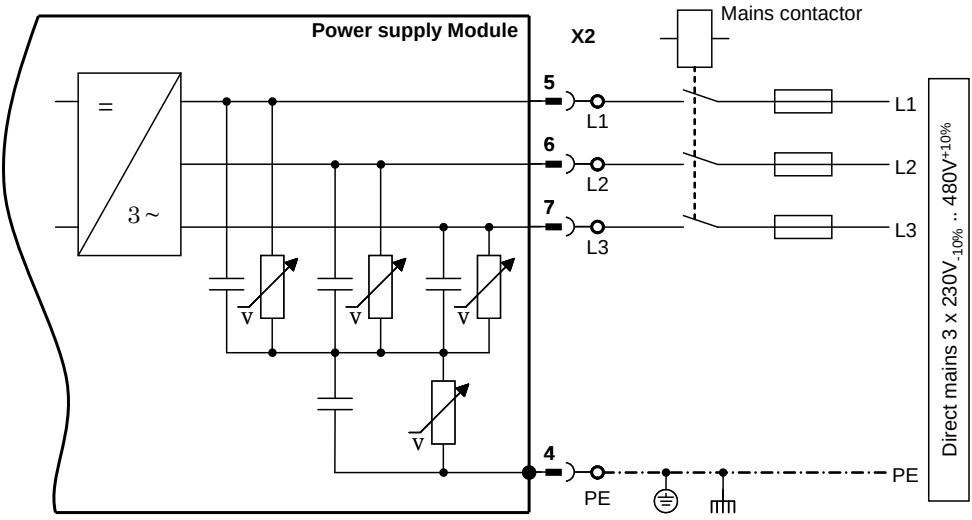
5 Interfaces

5.1 Mains Input (X2)

The mains input is prepared for direct mains 230 VAC or 230 VAC to 480 VAC input voltage, depending on the selected power supply module. If the neutral point of the connected mains is not grounded, an over voltage protection unit has to be installed in the input of the switchgear cabinet (⇨ page 37).

Note: If the DC-link of two or more MDD 100 systems are linked with the same supply voltage, the mains inputs must also be linked.

3-phase connection of the MDP 101-1 power supply module:



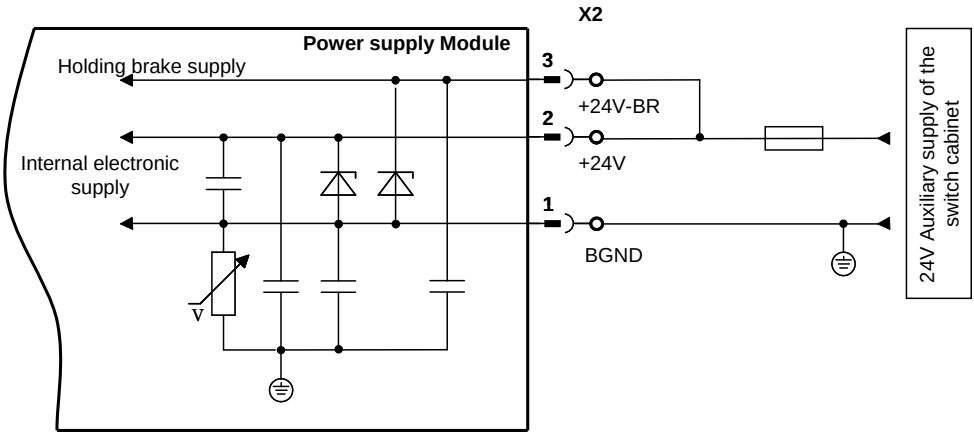
5.2 Auxiliary 24 V and Holding Brake supply (X2)

Note: Only use power supply with galvanic isolated SELV output voltage!

If a 24 V auxiliary power supply is installed in the switchgear cabinet for relays, contactors or other devices, this 24 V can be used to supply also the servo drive (notice the current rating of the power supply).

The drive has an additional input for the holding brake supply so that this supply can be switched off independently from the auxiliary supply of the drive.

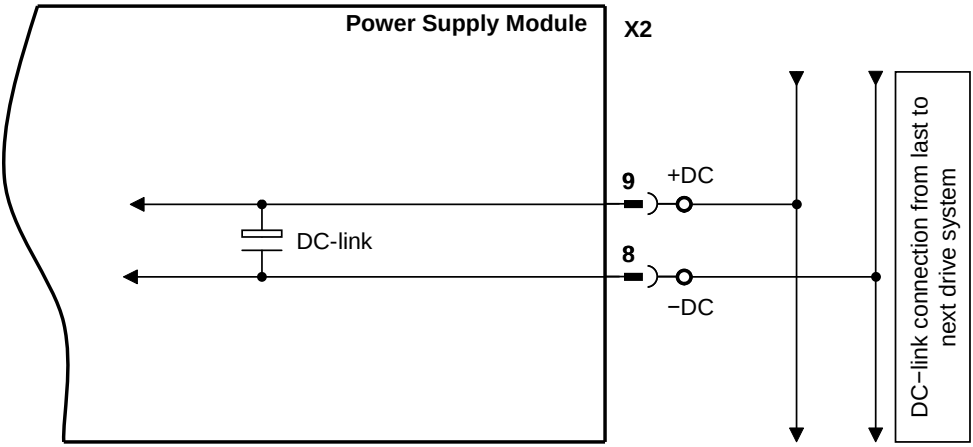
Note, that the return of the 24 V power supply has to be grounded near the power supply.



5.3 DC-link (X2)

When several drives are connected together, the DC-link connection enables power sharing between different axes.

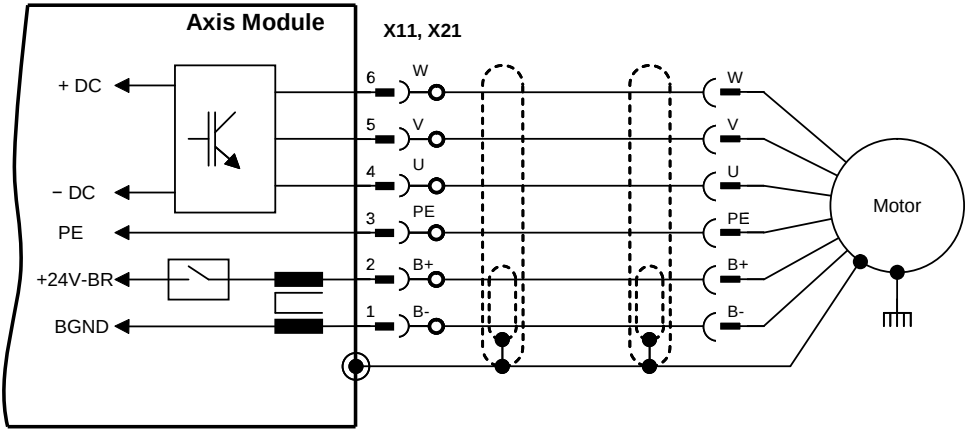
Note: If the DC-link of several servo drives is connected together, the mains input must also be connected in parallel to the drives connected of the group. Be careful with fusing of the whole system. Please contact the support department for further information.



5.4 Motor Connector (X11, X21)

5.4.1 Standard Configuration

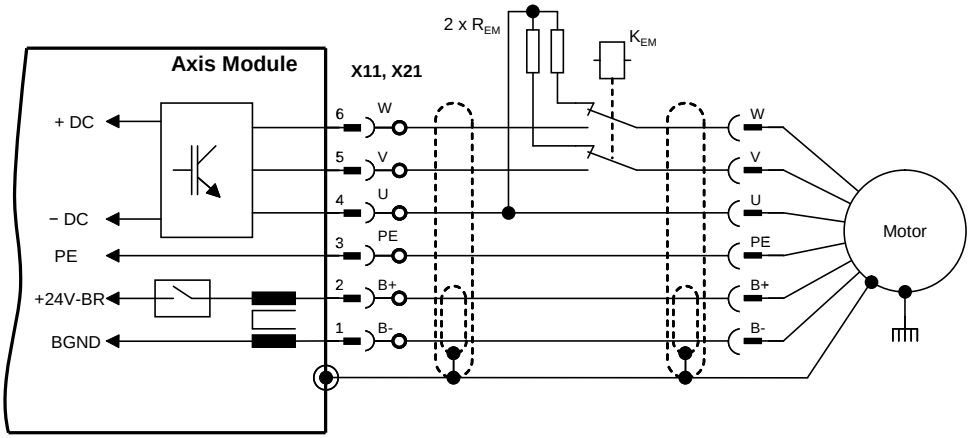
The motor cable length is limited to 20 m. If a longer motor cable is required, use an addition motor choke in the output of the servo drive.



5.4.2 Classic Emergency Stop Function (stop category 0)

The motor cable length is limited to 20m. If a longer motor cable is required, use an addition motor choke in the output of the servo drive.

Note: The contactor K_{EM} has to be switched on, before the servo drive is enabled and to be switched off minimal 1ms after disable.



The resistance and wattage of the resistors R_{EM} are calculated using following formulas:

$$R_{EM}[\Omega] = \frac{\max SPEED \cdot K_{Erms}}{I_{\max} \cdot 0.8} \qquad P_{EM}[W] = \frac{(I_{\max} \cdot 0.8)^2 \cdot R_{EM}}{10}$$

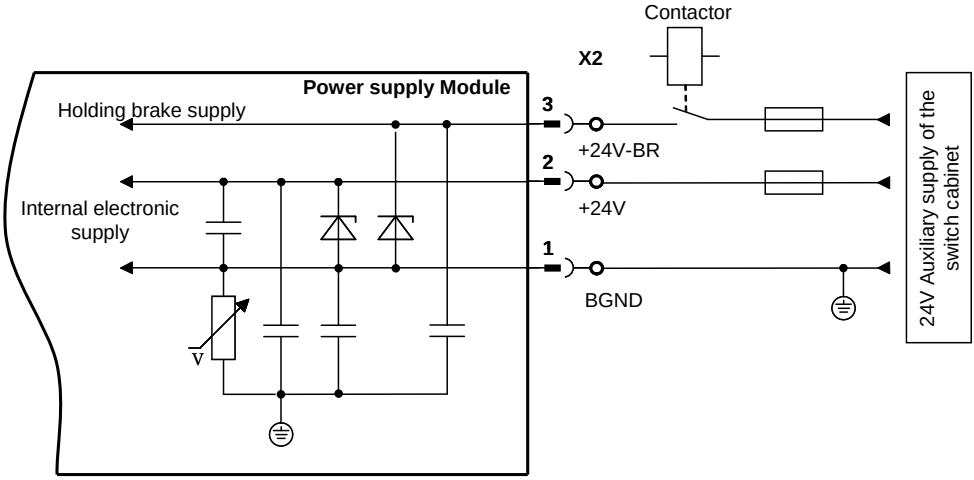
maxSPEED	maximum application speed [rpm]
I_{max}	maximum allowed rms current of the motor [A]
K_{Erms}	Voltage const. of the motor [V*min]

5.4.3 Personnel Safe Holding Brake Control

The servo drive has a high level of functional safety of the control of the holding brake.

If it is necessary to have a personnel-safe control for the holding brake, this requires one or two additional safety contacts in compliance with the safety standards in the +24 V-BR - line.

Even in this case a mechanical defect in the holding brake can cause injury and/or machine damage.



5.5 Feedback (X12, X22)

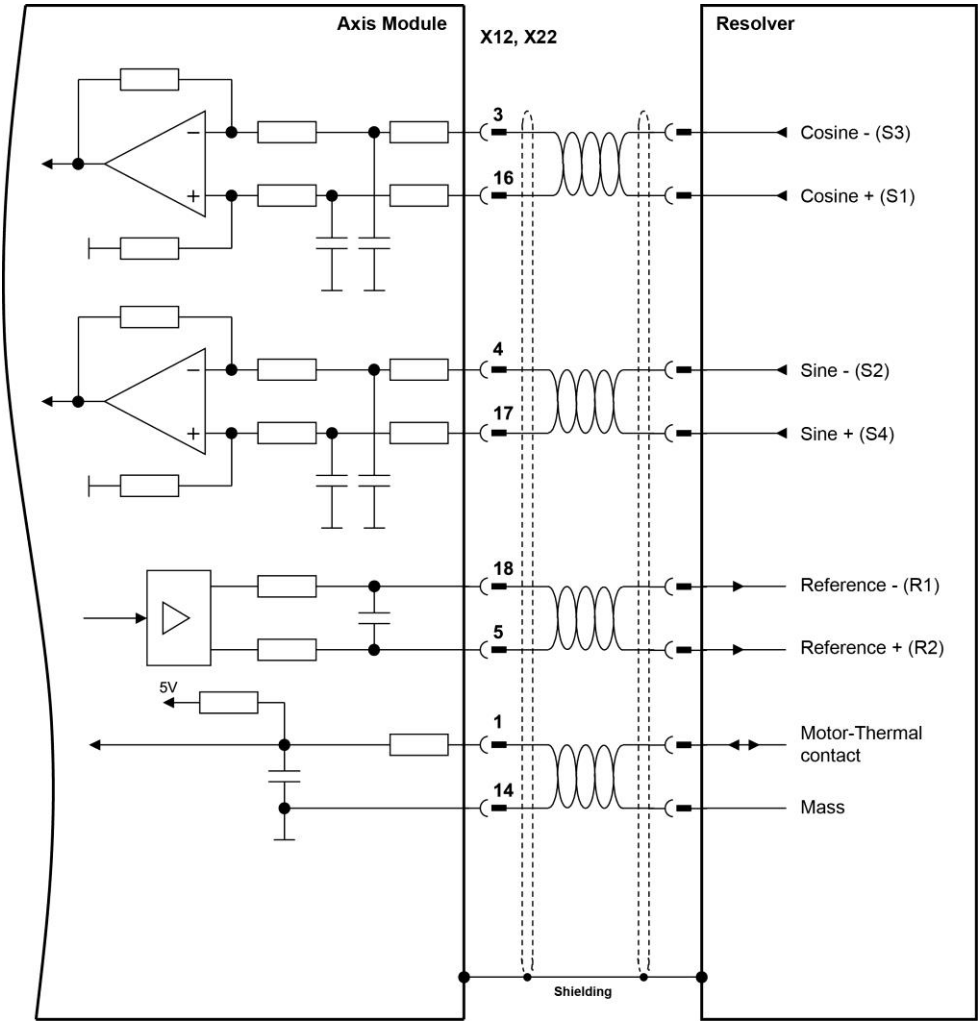
The servo drive has feedback inputs for several different feedback devices.

- Resolver Feedback with thermal contact in the motor winding
- EnDat® encoder (single and multiturn)
- Hiperface® encoder (single and multiturn)
- Sin/Cos & TTL encoder
- Sanyo Denki absolute encoder
- Panasonic encoder
- BiSS C encoder

For EnDat, Hiperface, Sin/Cos, TTL and Sanyo Denki encoder systems, a maximum number of 8192 feedback signals per mechanical rotation is supported (M-RPULSE).

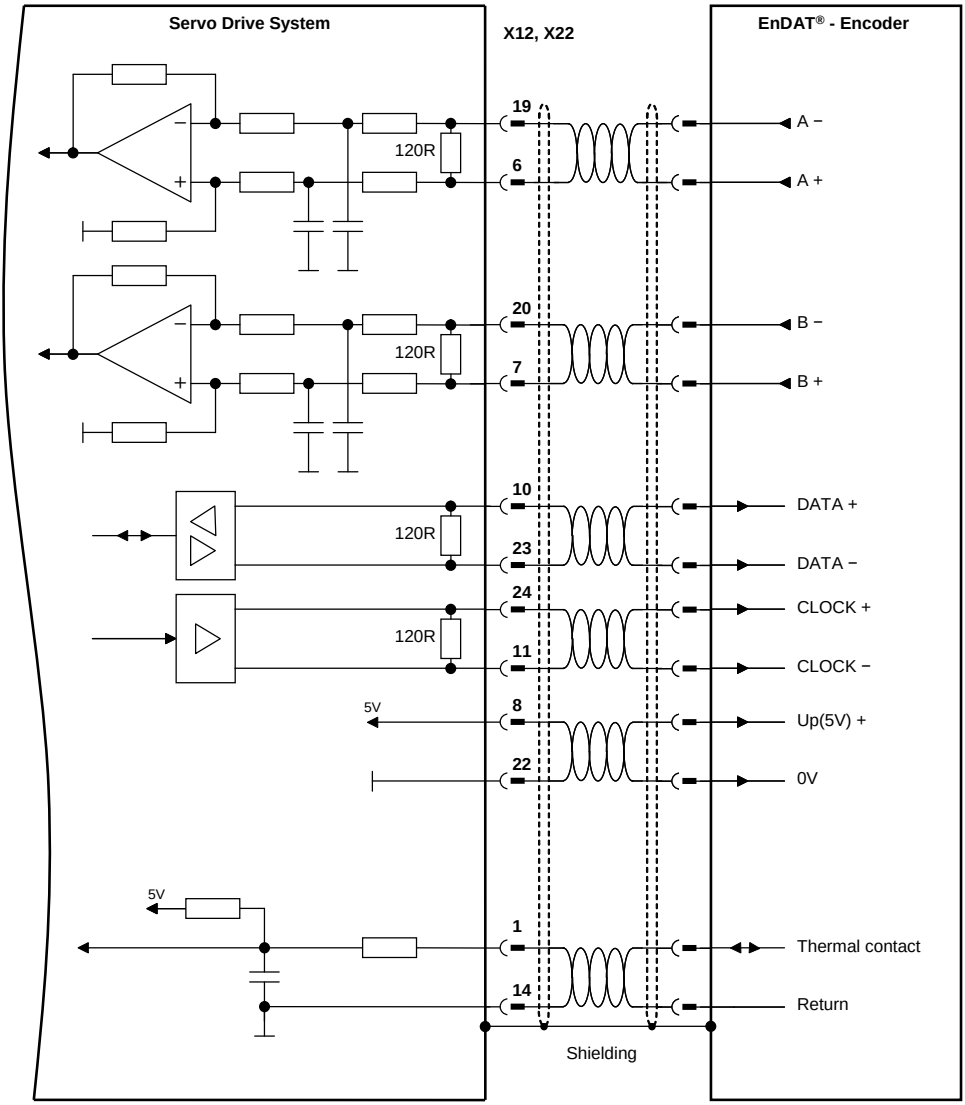
5.5.1 Resolver Feedback

The standard feedback system for servomotors is resolver feedback. The servo drive allows evaluation of single speed (2-pole) and also multi speed resolvers (up to 32-pole). The maximum cable length is limited to 50 m.
If a thermal contact is used in the motor, the signal is also connected via the resolver cable.



5.5.2 EnDat® Feedback

One of the high-resolution feedback systems for servomotors is the encoder with EnDat interface. The maximum cable length is limited to 10 m. If a thermal contact is used in the motor, the signal is also connected via the encoder cable.



The Maximum cable length is 10 m, with the exception of the following encoders:

Type code description	Motor type	Encoder Type	Max. Length
LA	AKM2 – AKM3	ECI 1118	8,2 m
LB	AKM2 – AKM3	EQI 1130	6,9 m
DB	AKM2 – AKM4	EQN 1125	9,4 m

When using EnDAT® with the MDD 100, the cable length must be taken into consideration (voltage drop)!

Formula for calculating the cable length (max. 10 m):
$(A * U) / (\rho * I * 2) = L_{cable}$

Example of cable length calculation:
For **AKM2**xx - xxxx**DB**xx (ECN 1125 encoder with 4.75 V minimum supply and 14 A maximum current):

Maximum voltage drop = 5 V – 4.75 V = 0.25 V
$(0.18\ mm^2 * 0.25\ V) / (0.017\ \Omega * mm^2/m * 0.14\ A * 2) = 9.4\ m$

Table for EnDat® encoder cable lengths:

Type code description	Motor type	Encoder Type	Encoder Performance	Max. Length
DA	AKM2-4	ECN 1113	4,75 V 110 mA	10 m
DA	AKM5-8	ECN 1313	3,6 V 110 mA	10 m
DB	AKM2-4	EQN 1125	4,75 V 140 mA	9,4 m
DB	AKM5-8	EQN 1325	3,6 V 140 mA	10 m
LA	AKM2-3	ECI 1118	4,75 V 160 mA	8,2 m
LA	AKM4-8	ECI 1319	3,6 V 170 mA	10 m
LB	AKM2-3	EQI 1130	4,75 V 190 mA	6,9 m
LB	AKM4-8	EQI 1331	3,6 V 170 mA	10 m

Derivation of the formula:
$R = U / I$ Maximum resistance, calculated via the encoder power
$R = \rho * L_{wire} / A$ wire resistance over the entire wire length

Applied:
$R = \rho * Lwire / A$

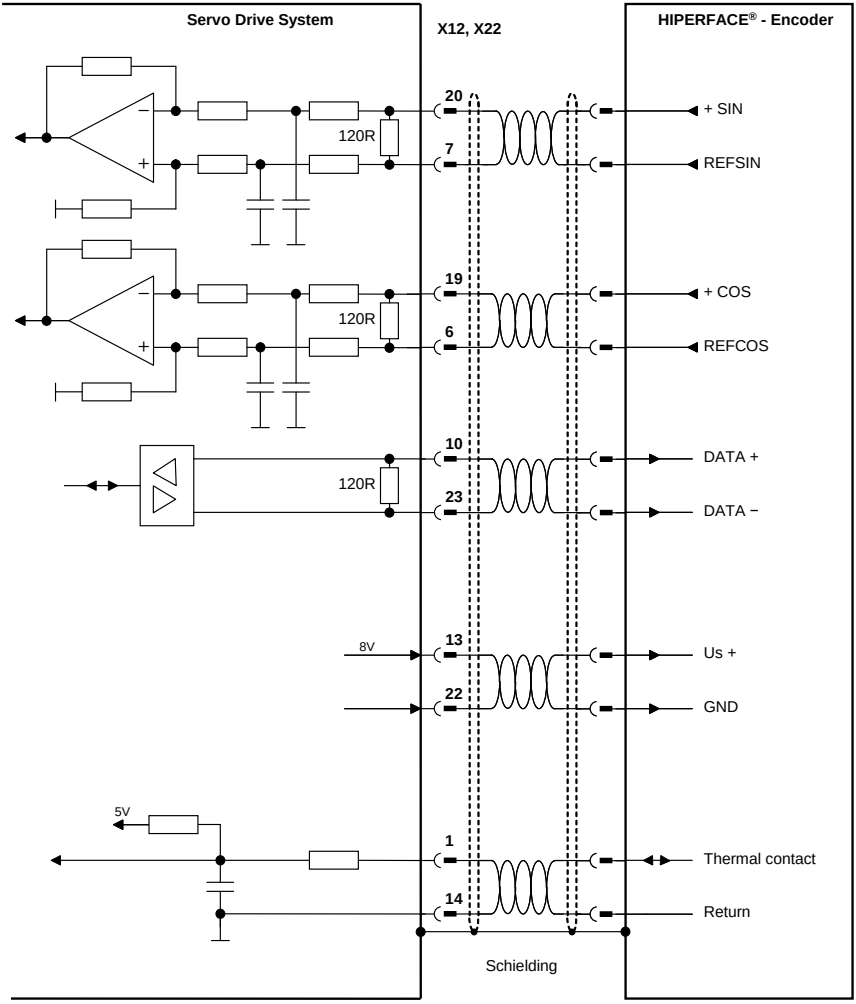
Solved for the maximum wire length calculation:
$(A * U) / (\rho * I) = L_{wire}$

Cabel length is halved since the supply and GND line form the entire length.
$L_{Cable} = L_{wire} / 2$

Legend:
U = Voltage drop (5 V supply – minimum encode supply)
R = Wire resistance
I = Maximum required encoder current
ρ (rho) = Specific resistance of the wire (0.017 Ω for copper)
L_{wire} = Entire wire length (supply line + ground line)
L_{cable} = Entire cable length (L_{wire} / 2)
A = Encoder cable cross section

5.5.3 Hiperface® Feedback

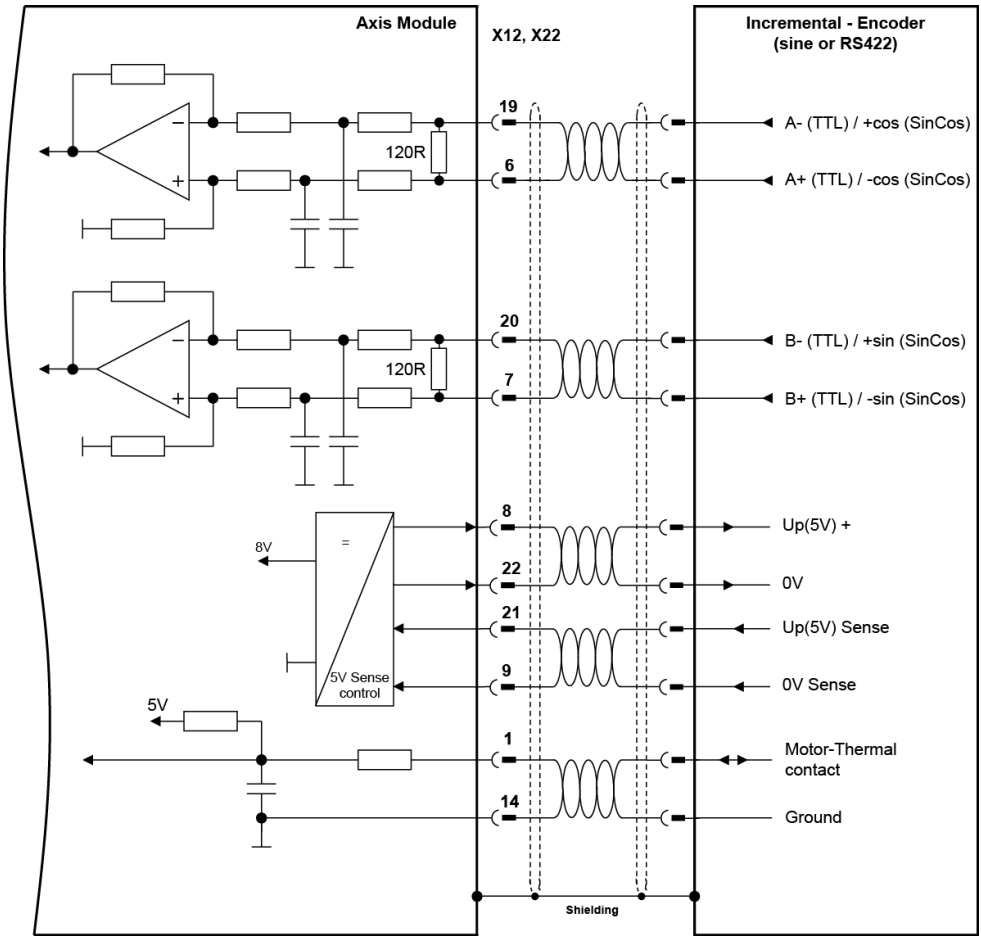
An encoder with Hiperface® interface is a high-resolution interface for servomotors. The maximum cable length is limited to 25 m. If a thermal contact is used in the motor, the signal is also connected via the encoder cable.



5.5.4 Sine Encoder Feedback

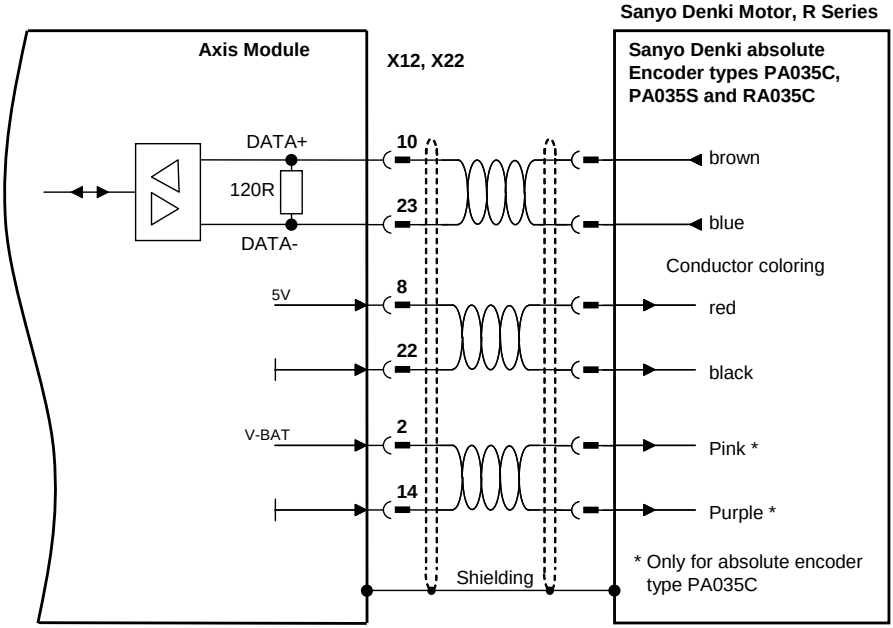
A sine encoder is a high-resolution feedback system, used with linear or torque servomotors. The maximum cable length is limited to 10 m. If a thermal contact is used in the motor, the signal is also connected via the encoder cable.

The upper frequency limit for TTL encoders is 100 kHz. The reference signal is not evaluated in the drive.

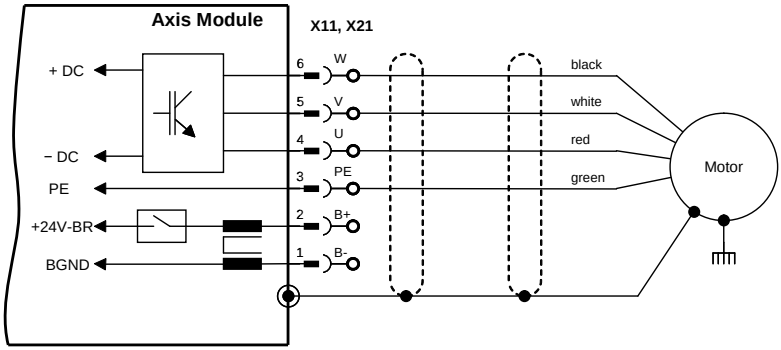


5.5.5 Sanyo Denki Motor

A Sanyo Denki motor with an absolute encoder with no battery can be connected to the MDD 100. The maximum cable length is limited to 25 m. The battery type is in preparation.



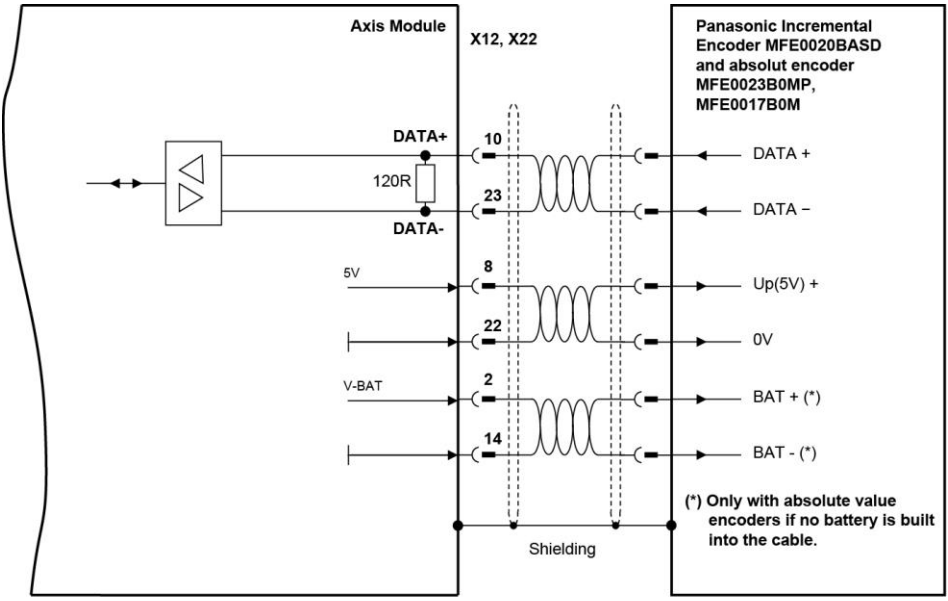
Cable twisted pair, shielded, shield on both sides grounded
Length <10m use 0.25mm²
Length <25m use 0.5mm² cable



5.5.6 Panasonic Feedback

The Panasonic feedback analysis is supported starting with FW version 1.84 in combination with the MDD FPGA version v22 (see parameter I-HC).

The maximum cable length is 25 m.

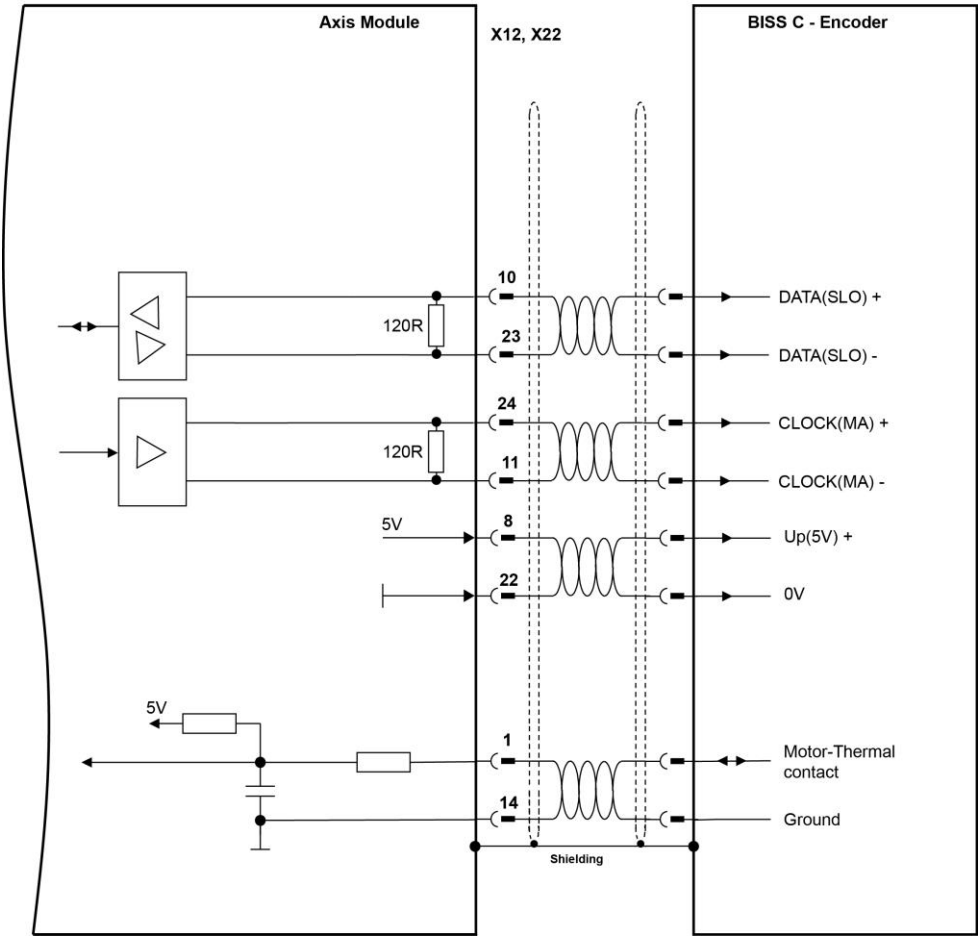


Shielded, twisted-pair cable, shielding connected on both sides
Length < 10 m, wire cross section 0.25 mm²
Length < 25 m, wire cross section 0.5 mm²

5.5.7 BiSS C Feedback

The BiSS C analysis is supported starting with FW version 1.84 in combination with the MDD FPGA version v22 (see parameter I-HC).

The maximum cable length is 10 m.
If a thermos contact is used the signal is wired via the feedback cable.



6 Maintenance

The servo drive does not require any maintenance.

Note: Opening the enclosure invalidates the warranty

If the casing is dirty, clean with Isopropanol or similar cleaning agent.

- Dirt inside the unit must be cleaned by the manufacturer
- Dirty protective grill (fan) may be cleaned with a dry brush
- Do not immerse or spray.

6.1 Disassembly, Replace and Repair

Repair: The repair of the servo drive has to be done by the manufacturer.

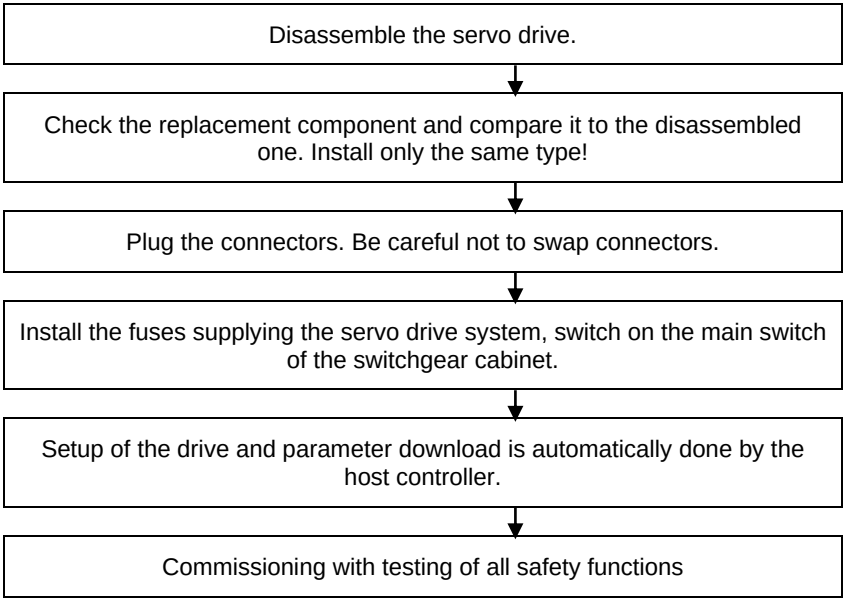
Replace: If a component of the servo drive system has to be replaced, notice following checklist (no special mounting tools are required):

Switch off the main switch of the switchgear cabinet and remove the fuses supplying the servo drive system

Wait at least 7 minutes after disconnecting the servo drive system from the mains supply voltage before touching live sections of the equipment (e.g. contacts) or undoing connections. Capacitors can still have dangerous voltages present up to 7 minutes after switching off the supply voltages. To be sure, measure the voltage in the DC-link circuit and wait until it has fallen below 40 V.

During operation, the heat sink of components of the servo drive system can become hot and may reach temperatures above 80 °C (176 °F). Check (measure) the heat sink temperature and wait until it has cooled below 40 °C (104 °F) before touching it.

Remove the connectors. Make sure, that the identification is clear, not to swap the connectors at installation of the replacement.


Disassemble the servo drive.
Check the replacement component and compare it to the disassembled one. Install only the same type!
Plug the connectors. Be careful not to swap connectors.
Install the fuses supplying the servo drive system, switch on the main switch of the switchgear cabinet.
Setup of the drive and parameter download is automatically done by the host controller.
Commissioning with testing of all safety functions

7 Appendix

7.1 Transport, Storage and Disposal

Transport:

- Use only the manufacturer's original recyclable packaging
- Avoid shocks
- Maximum temperature range -20 to +70 °C (-13...158 °F), maximum 20 K/hr rate of change
- Maximum 95 % relative humidity, not condensing
- The servo drive contains electro statically sensitive components, which can be damaged by incorrect handling. Discharge yourself before touching the servo amplifier. Avoid contact with highly insulating materials (artificial fabrics, plastic films etc.). Place the servo drive on a conductive surface.
- If the packaging is damaged, check the unit for visible damage. In this case, inform the shipper and the manufacturer. Do not install and operate the unit in this case!

Packaging:

- Card box, can be recycled
- Labeling: nameplate outside at the box

Storage:

- Only in the manufacturer's original recyclable packaging
- The servo amplifiers contain electro statically sensitive components, which can be damaged by incorrect handling. Discharge yourself before touching the servo amplifier. Avoid contact with highly insulating materials (artificial fabrics, plastic films etc.). Place the servo amplifier on a conductive surface.
- Maximum stacking height 10 card boxes.
- Storage temperature range -20 to +55 °C (-13...131 °F), maximum 20 K/hr rate of change
- Maximum relative humidity 95 %, not condensing.

- Storage duration:
  < 1 year: without restriction
  ≥ 1 year: capacitors must be re-formed before operating the servo drive. To re-form, remove all electrical connections, and supply the servo amplifier for about 30 min. from 230 VAC, single-phase, on terminals L1 / L2.

Disposal:

- The servo drives can be reduced to its principal components by removing the screws (aluminum heat sink, steel housing sections, electronics boards)

If you wish to dispose of the device, it is essential to comply with the national disposal regulations.

The device must not be disposed of with household waste.

7.2 Troubleshooting and Fault Elimination

Faults and warnings can be detected by LED and bus system.
The list “Status Register” helps you eliminate the errors.

7.2.1 Seven Segment Display

Display	Description
8.8.	Initialization of the display
XX	During start-up the FPGA version is shown
bt	Controller scans the bootloader
rn	Controller is in normal operating mode
Er	A fatal internal error was detected

7.2.2 LED Indication

Each axis module of the MDD 100 servo drive system has two LEDs for each axis, which display the status of the corresponding axis.

LED		Description
Green	**Red**	
On	**On**	Controller in boot mode (no or damaged firmware)
1 Hz flashing	**Off**	Ready to switch on, no enable
8 Hz flashing	**Off**	Output current limited by I2T limitation (one or more axes)
On	**Off**	Running
On	**1 Hz flashing**	Warning condition
Off	**On**	Fault condition

7.2.3 Malfunction of the Drive

Malfunction of the drive	Cause	Remedy
– ***I-FPOS* shows decrementing values when the motor rotates clockwise (view of the motor shaft)**	– Feedback system is not connected correctly	– Connect feedback system according to drawing (see page 58)
– **Motor does not rotate** – **Motor current is at the limit without torque**	– Motor is not connect in correct orientation	– Connect motor in correct relation to terminals U, V, W
– **The motor casts without set point** – **The motor torque is too low or different in the both directions**	– *M-ROFF* is not set to the right value – Motor and/or feedback connection is wrong	– Set *M-ROFF* to the right value – Connect motor and feedback correctly
– **The motor stops in certain positions**	– The setting of *M-POL* and/ or *M-RPOL* is not correct – The motor cable has a broken wire – Not all wires of the motor cable are connected	– Set *M-POL* and *M-RPOL* according to the to the data of the motor – Replace motor cable (especially with drag chains) – Connect all wires of the motor cable
– **The motor oscillates**	– Control gain too high – Shielding of the feedback cable has a break	– Reduce *V-KP* and/or *P-KV* – Replace feedback cable (especially with drag chains)

7.2.4 Status Register

The MDD 100 has a status register, read by *I-STATUS*. It is a 32-Bit variable that contains all error and status information. The internal behavior of the drive to the different bits can be set by ***G-MASKE1***, ***G-MASKE2***, ***G-MASKW*** and ***G-MASKD***. According to the setting of the different masks, the drive detects an error, warning or does not react at all. The different bits have default values and also limitations on attribution to the masks.

Bit	Fault	Cause	Remedy
0	**One mains phase**	– No 3-phase supply from the mains	– check fuses in the mains – check electrical supply
1	**Mains fault**	– Drive system is enabled without mains applied	– check fuses in the mains – check electrical supply – Drive is enabled, before DC – link charged and vice versa
2	**Not used**		
3	**DC over voltage**	– internal regen resistor damaged	– replace module rack
4	**DC under voltage**	– mains supply voltage too low when drive is enabled	– disable drive before the DC-link voltage crosses the under voltage threshold set by ***G-VBUSM***
5	**Not used**		
6	**Holding brake fault**	– No holding brake connected with ***M-BRAKE* = 1** – Short circuit at the holding brake output	– Connect motor with holding brake – Check wiring of the holding brake – Set ***M-BRAKE*** = 0 if no brake is at the motor – Check wiring of the holding brake – Check holding brake
7	**Brake switch fault**	– No holding brake connected with ***M-BRAKE* = 1** – Internal brake supply switch is defect	– Connect motor with holding brake – Set ***M-BRAKE*** = 0 if no brake is at the motor – replace drive
8	**Not used**		
9	**Motor temperature**	– motor thermostat has switched off – break in feedback cable or connectors	– check why the motor became so hot (undersized, bad environmental conditions) – check feedback cable and connectors, replace it, if necessary

10	**Ambient temperature**	– internal temperature too high	– improve ventilation in the cabinet and check mounting position according to this manual
11	**Heat sink temperature**	– heat sink temperature too high	– improve ventilation in the cabinet, check mounting position according to this manual or use a cooling unit
12	**Feedback fault**	– feedback cable has a break – feedback device defect – feedback connector not properly stucked	– replace feedback cable – replace feedback device – stuck feedback connector properly
13	**Commutation fault**	– wrong phasing of the motor – Wrong wiring of motor or feedback cable	– Check ***M-ROFF*** – Check wiring
14	**Motor over speed**	– wrong phasing of the motor – Wrong wiring of motor or feedback cable – High speed overshoot (more than 1.2 * ***V-NMAX***)	– Check ***M-ROFF*** – Check wiring – Optimise control loops
15	**Following error**	– Following error window ***P-PEMAX*** too small	– Increase ***P-PEMAX*** and/or optimise control loops
16	**Trajectory error**	– Position change results in speed set point of > 10000 rpm	– Check setting of ***P-PSCALE*** and ***P-SSCALE*** and position set point generation of the controller
17	**Host communication**	– Two set point or actual value telegrams in series were wrong or not sent – Internal communication error in combination with the used option board	– Synchronisation is not locked. Check ***A-CTIME*** and accuracy of the cycle time of the controller – ***A-STIME*** is not set right – Communication is disturbed – See also ***I-DERROR***
18	**Drive Error E2**	– Different internal faults	– See also ***I-DERROR*** – Contact manufacturer
19	**Drive Error E1**	Different internal faults	– See also ***I-DERROR*** – Contact manufacturer

		Power stage fault: – motor cable has (ground) short circuit – motor has (ground) short circuit – power stage is damaged	– replace motor cable – replace motor – replace drive
		Regen fault: – regen resistor has (ground) short circuit – regen power stage is damaged	– replace module rack – replace drive
20	**Enable locked fault**	– Drive is software enabled without enabling the safety function	– Enable drive only if ENABLE_H = high and ENABLE_L = low
21	**Driver voltage fault**	– The supply voltage of the power stage drivers is switched off, when the drive is enabled	– Enable drive only if ENABLE_H = high and ENABLE_L = low
22	**DC over voltage and regen limitation**	– regen power is insufficient. Regen power limit was reached and the regen resistor was switched off.	
23	**Brake supply fault**	– Holding brake supply +24 V-BR is not supplied when software enable is set (***M-BRAKE*** = 1)	– When the motor has a holding brake, enable the drive only when the holding brake input +24 V-BR is supplied
24	**Brake enable fault**	– not available	
25	**I2t fault**	– When *I-I2T* exceeds the warning level ***A-I2TERR***	– Increase the level ***A-I2TERR***
26	**Motor temperature warning**	– When motor temperature ***I-TEMPM*** exceeds the warning level ***A-TEMPMW***	– Increase the warning level ***A-TEMPMW***
27	**Motor Parameter Error**	– When a feedback system with parameter storage has no valid data	– Store valid data in the feedback – Replace Motor
28	**Multiturn Revolution Error**	– When the multiturn EnDat or Hiperface encoder has a overflow	– Multiturn range exceeds the 4096 revolutions – Multiturn range has to adjusted to the range of the machine

29	**Max. Sum Power Limitation**	– When the sum output power of all axes exceeds the power supply limitation	– Servo drive system meets not the demands of the Application
30	**reserved**		
31	**Fan error**	– The fan does not reach the minimum rotation speed.	– Exchange axis module.

8 VARAN Recommended Shielding

The VARAN real-time Ethernet bus system offers robust performance in harsh industrial environments. Through the use of IEEE 802.3 standard Ethernet physics, the potential between an Ethernet line and sending/receiving components is kept separate. The VARAN Manager resends messages to a bus participant immediately when an error occurs. It is principally recommended that the shielding guidelines below be followed.

For applications in which the bus line is run outside the control cabinet, correct shielding is required. This is especially important, if due to physical requirements, the bus lines must be placed next to sources of strong electromagnetic noise. It is recommended that whenever possible, to avoid wiring VARAN-Bus lines parallel to power cables.

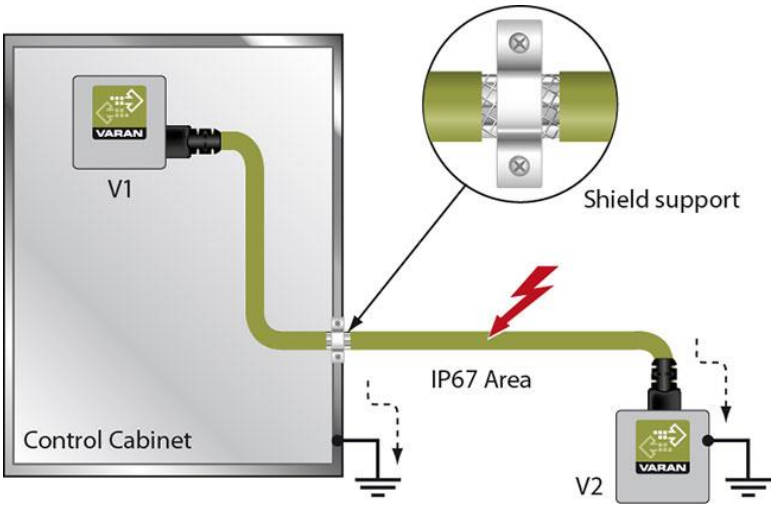
SIGMATEK recommends the use of **CAT5e** industrial Ethernet bus lines.

For the shielding variants, an **S-FTP bus line** is recommended, which is a symmetric, multi-wire cable with unshielded pairs. For the total shielding, a combination of foil and braiding is used; it is recommended that an unvarnished variant be used.

The VARAN cable must be secured at a distance of 20 cm from the connector for protection against vibration!

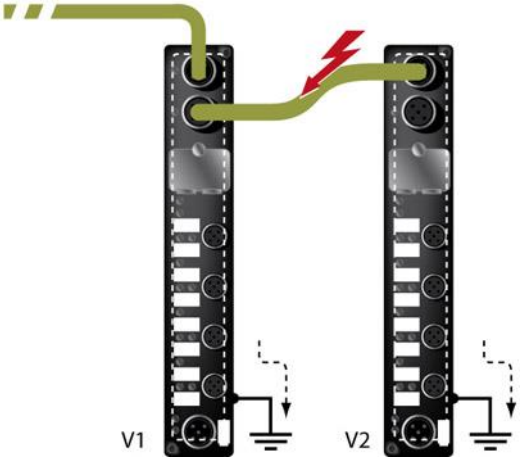
8.1 Wiring from the Control Cabinet to an External VARAN Component

If the Ethernet lines are connected from a VARAN component to a VARAN node outside the control cabinet, the shielding should be placed at the entry point to the control cabinet housing. All noise can then be deflected from the electronic components before reaching the module.



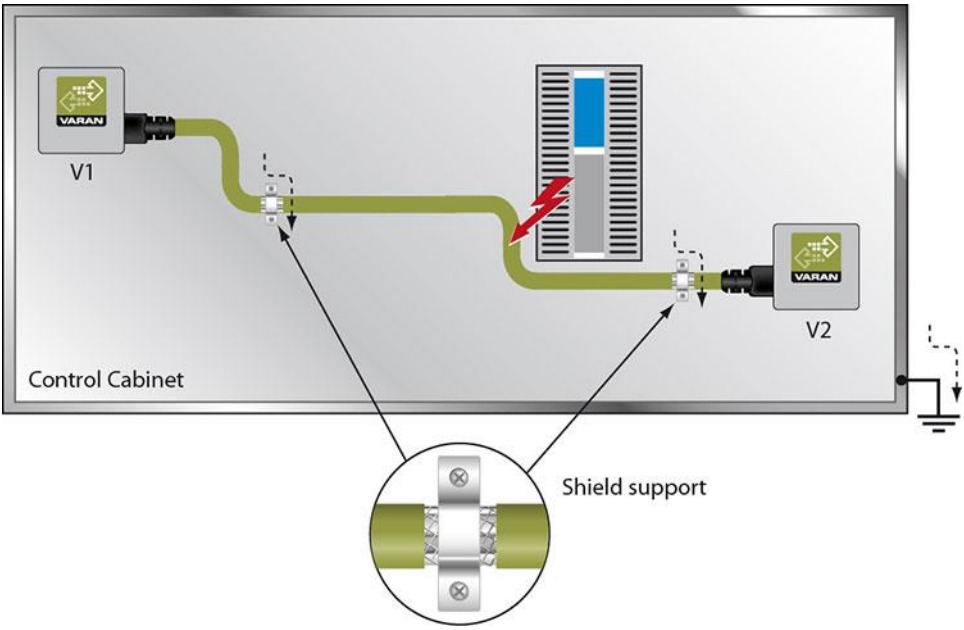
8.2 Wiring Outside of the Control Cabinet

If a VARAN bus cable must be placed outside of the control cabinet only, no additional shield connection is required. This requires that only IP67 modules and connectors be used. These components are very robust and noise resistant. The shielding for all sockets in IP67 modules are internally connected to common bus or electrically connected to the housing, whereby the deflection of voltage spikes does not flow through the electronics.



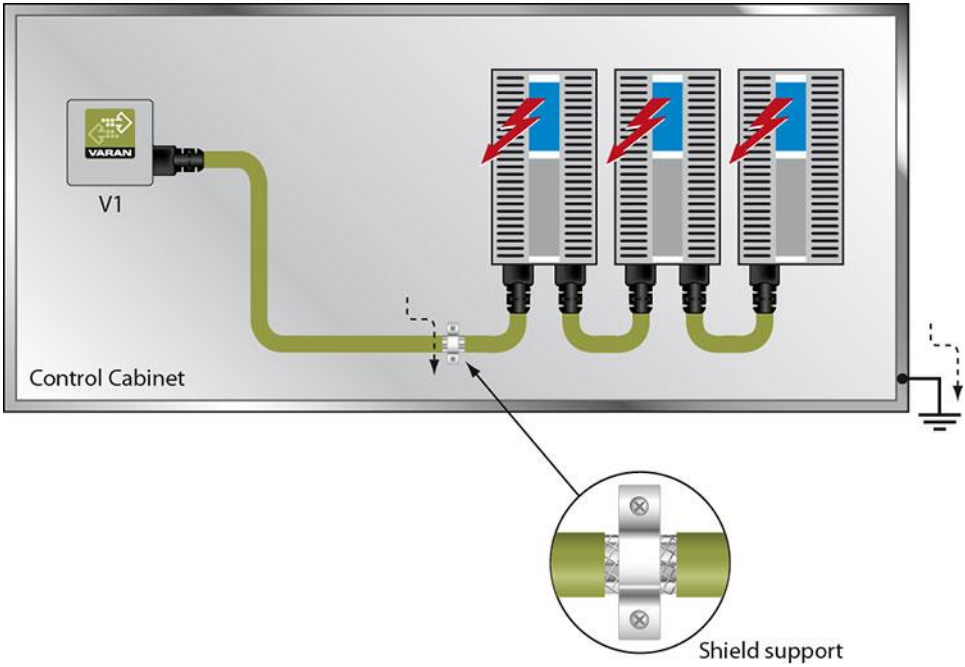
8.3 Shielding for Wiring Within the Control Cabinet

Sources of strong electromagnetic noise located within the control cabinet (drives, Transformers, etc.) can induce interference in a VARAN bus line. Spike voltages are deflected over the metallic housing of a RJ45 connector. Noise is conducted through the control cabinet housing without further action from the electronic components To eliminate sources of noise during data transfer, it is recommended that the shielding from all electronic components be connected within the control cabinet.



8.4 Connecting Noise-Generating Components

With the connection of power components that generate strong electromagnetic noise, it is also critical to ensure correct shielding. The shielding should be placed before a power component (or a group thereof).



8.5 Shielding Between Two Control Cabinets

If two control cabinets must be connected over a VARAN bus, it is recommended that the shielding be located at the entry points to both cabinets. Noise can thereby be kept from reaching the electronics within the control cabinet.