Module Carrier MDM 011-O, 021-O, 031-O and 041-O

Contents

1 Overview

The module carrier MDM serves as a mount in the control cabinet for the individual modules. To be as flexible as possible and make the most effective use of the control cabinet space, module carriers are available for 2- 5 modules. These have a connection for an external regen resistor.

MDD 100 is a complete servo drive system for low to mid power range, which was designed for multi-axis applications with low, middle and high performance.

It is fully integrated into the LASAL operating system and designed for 1 to 8 axes.

Depending on the motor and power module used, the system is either a 1-phase 230 VAC or 3-phase 400 - 800 VAC system.

Four different axis modules are available; a single axis module for 230 VAC and 400 VAC, and a double axis module for 230 VAC and 400 VAC that have a scalable output current range for the two axes.

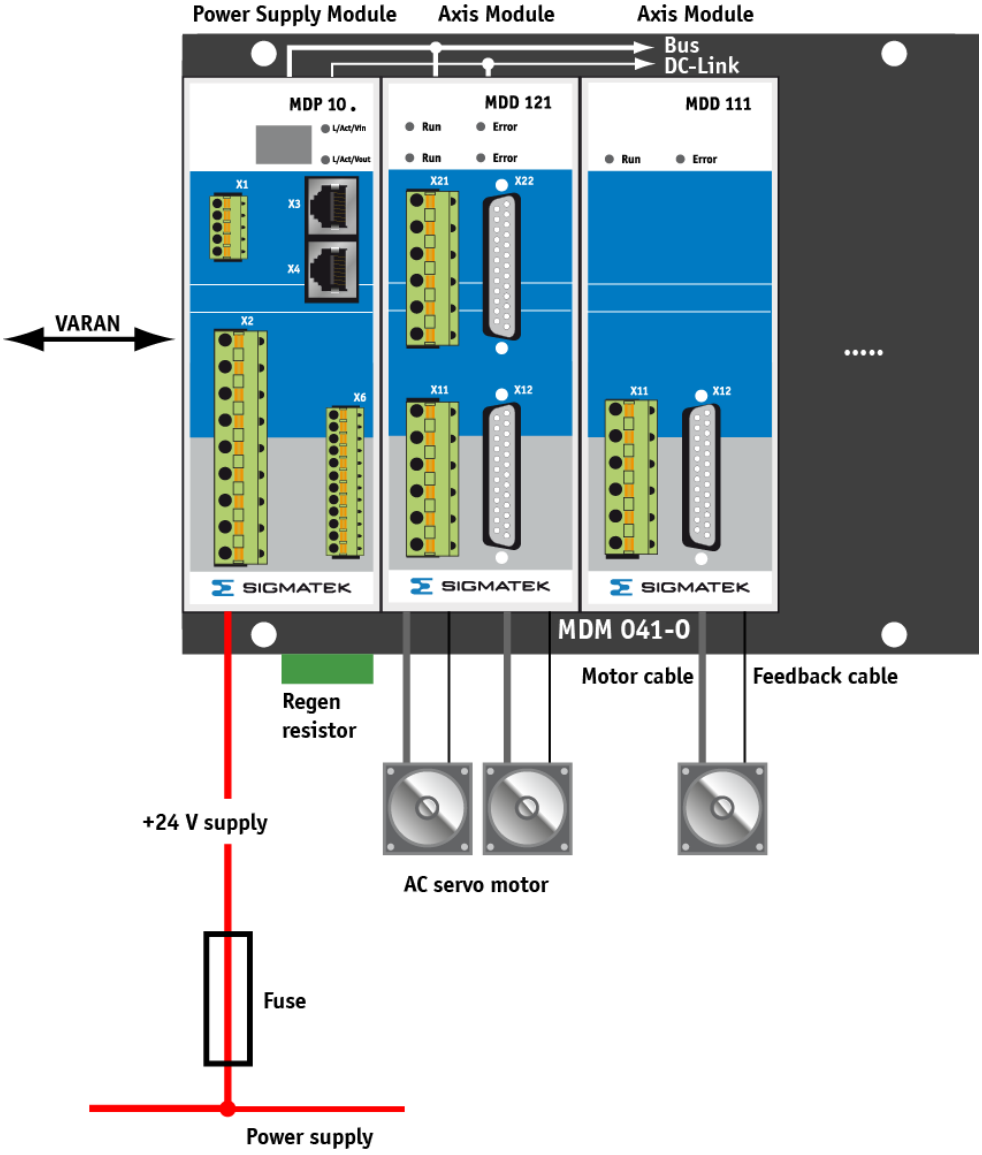
The power and axis modules are mounted on a module carrier, which is installed onto the mounting plate of the control cabinet.

The current, speed and position control of up to 8 axes functions with a cycle time of 62.5 µs. MDD 100 is highly flexible when it comes to the connection of various feedback systems.

VARAN connects the servo drive with the machine control.

With their high safety level, integrated Safety functions such as "Safe Torque Off" STO and "Safe Stop 1" SS1 simplify the integration of the safety concept of the machine.

1.1 Servo Drive System Components



2 General

2.1 About this Handbook

This handbook describes the MDM 041-O module carrier.

The following information is provided:

- Technical data of the module carrier
- Description of the Safety functions
- Assembly and Installation
- Description of interfaces
- Setting the servo amplifier
- Accessories
- Transport, Storage, Maintenance, Disposal

Abbreviations used in this handbook

Abbreviations	Meaning
AWG	American gauge wire
BGND	Mass for the 24V auxiliary and braking supply
CE	Communité Européenne
CLOCK	Clock signal
EMV	Electromagnetic tolerance
EN	European Norm
IGBT	Insulated Gate Bipolar Transistor
LED	Light emitting diode
PELV	Protected Extra Low Voltage
RES	Resolver
V AC	Alternating current
V DC	Direct current

2.2 Symbols Used in this Handbook

Danger! **Electric Shock** Danger of electric shock and its effects

Caution! **General** General warning, see handbook

Warning! **Hot Surface** Temperatures over 80°C (176°F)

Important Note See handbook

2.3 Safety Guidelines

To avoid injury or material damage, it is important to read the documentation provided before installation and startup of the servo drive system. The technical data and connection instructions (specification label and documentation) must be followed.

Only qualified personnel may perform tasks such as transportation, assembly, Initial startup and maintenance. Qualified personnel are persons familiar with the transportation, setup, assembly, initial startup and operation of the product.

The machine manufacturer must perform a safety analysis for the entire machine. With the appropriate measures, the manufacturer ensures that no injuries or damage can be caused by unexpected movements.

Improper operation of the servo amplifier or failure to follow the following guidelines and improper handling of the safety equipment can cause damage to the machine, personnel injury, and electrical shock or in extreme cases, death.

Notes

Danger! Electric shock

After disconnecting the servo drive system from the voltage supply, a waittime of 5 minutes is required before voltage carrying components of the amplifier (i.e. terminals) can be touched or connectors removed. After turning off the voltage supply, the internal capacitors can have dangerous voltage levels for up to 5 minutes. For safety purposes, measure the voltage in the intermediate circuit and wait until the voltage is below 40 V.

The electrical connectors of the servo drive system cannot be removed while voltage is applied.

The possibility for arcing exists and could cause injury as well as damage to the contacts.

When using a ground fault interrupter in the circuit, a type B GFI-switch must be used. If an FI switch of Type "A" is used, A DC leakage current could cause it to malfunction.

Failure to follow these instructions can lead to death, serious injury or damage to the machine.

Caution General

The use of the servo drive system is defined by EN61800-3. The product can lead to EMC problems in residential areas. In such a case, the user must take additional filtering measures.

The servo drive contains components sensitive to electrostatic, which can be damaged by improper handling. Before touching the servo drive system, the user must discharge their body by touching a grounded object with a conductive surface. Contact with highly insolated material (synthetic fiber, plastic foil etc.) must be avoided. The servo drive is must be place on a conductive surface.

Opening the device is not allowed. During operation, all covers and cabinet doors must be closed; the danger of death or serious damage to health or material exists. This presents the danger of severe health or material damage or death.

According to their protection type, servo amplifiers can contain blank components that are conductive. Control and power connections can have a voltage even when the motor is not turning.

The servo drive system has a ground leakage current greater than 3.5 mA. Particular focus must therefore be given to grounding the servo drive system. See technical data for the power module.

The +24V auxiliary supply voltage as well as the +24V-BR voltage supply for the holding brake must be galvanically separated as protective extra-low voltage PELV according to EN 60950.

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

CAUTION! Hot surface

During operation, the housing of the servo drive system can get hot and reach temperatures of over 80 °C (176 °F).

The temperature of the housing and module carrier must be checked before touching and it may be necessary to wait until it is below 40 °C (104 °F).

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

Caution! Electromagnetic Fields (EMF)

Mortal danger!

Due to the electromagnetic fields generated during operation of the servo drive system, people with pacemakers or implants are particularly at risk if they are in the immediate vicinity of the device.

Caution must therefore be take to ensure that such persons maintain the necessary safety distance of at least 2 m.

2.4 Conformity with European Guidelines and Norms

Servo amplifiers are components, which are designed for installation in electrical systems/machines for industrial use. When installing into machines/systems, the servo amplifier should not be operated until it has be determined that the machine/system meets the requirements of the EG-machine guideline 2006/42/EG and the EG-EMC guideline 2004/108/EG.
Servo amplifiers are components, which designed for installation into electrical systems/machines for industrial use.

Note: The machine manufacturer must perform a safety analysis for the entire machine. The manufacturer must take appropriate measures to ensure that no injuries or damage can be caused by unexpected movements.

CE – Conformity

With the supply of servo amplifiers within the European community, compliance with the EG-EMC 2004/108/EG and low voltage 2006/95/EG guidelines is mandatory.

The harmonized standard EN 61800-5-1 (Electrical Power Amplifier Systems with Adjustable Speed - part 5-1: Requirements for the Safety of Electrical, Thermal and Energetic Demands) was included with the 2006/95/EG low voltage guideline for this servo drive system.

The harmonized standard EN 61800-3 (Electrical Power Amplifier systems with Adjustable Speed - Part 3: EMC Product Norm including Special Test Processes) was included with the EMC guideline 2004/108/EG for this servo drive system.

To meet the EMC conditions for installation, the documentation contains detailed information on:

- Shielding
- Ground Connection
- Wiring in the control cabinet
- Filters (as required)

The servo amplifiers from the MDD 100 series were tested with the system components and the corresponding defined configuration described in this document. Each change in the configuration and installation described in this document requires new measurements to ensure the requirements are met.

2.5 Designated Use

The servo amplifier from SIGMATEK GmbH & Co KG was designed and produced with state of the art technology. The products are completely tested before delivery; especially for reliability. It is a built-in component for electrical systems, which can only be operated as an integral part of such systems. Before installation of the product, the following conditions for designated use must be met:

- Each user of the product must read and understand the safety instructions for designated and non-designated use.
- The machine manufacture must perform a safety analysis of the machine to ensure that no injury or damage is caused to personnel and equipment by unexpected movements.
- The servo amplifier must be operated under the assembly and installation conditions described in this document. The environmental conditions (temperature, protection type, humidity, voltage input, EMC and mounting position) must be especially observed.
- The amplifier can only be operated in a control cabinet with **at least IP54**.
- The servo drive can only be operated in original condition (no mechanical or electrical changes).
- Mechanical or electrical defects or defective components may be not be mounted or operated.
- The servo amplifier is designed to regulate the torque, speed or position controller circuits of synchronous motors.
- The specified rated voltage of the motor must be at least as high as the power supply voltage of the servo drive system (230 V, 400 V or 480 V).
- The servo drive was designed for use in an industrial environment. If the product is used in residential areas, the power supply must be equipped with an additional filter.
- The MDP 101-1 and MDP 102-1 power modules cannot be used with the MDD 111-1 MDD 121-1 axis modules.

b

2.6 Non-Designated Use

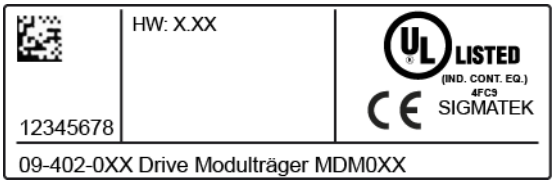
If a servo amplifier is operated in according with the environmental conditions described in this document, it is "designated use".

- Because of salt-containing and conductive contamination, the servo amplifier cannot be used on ships (sea operation) or in offshore applications.

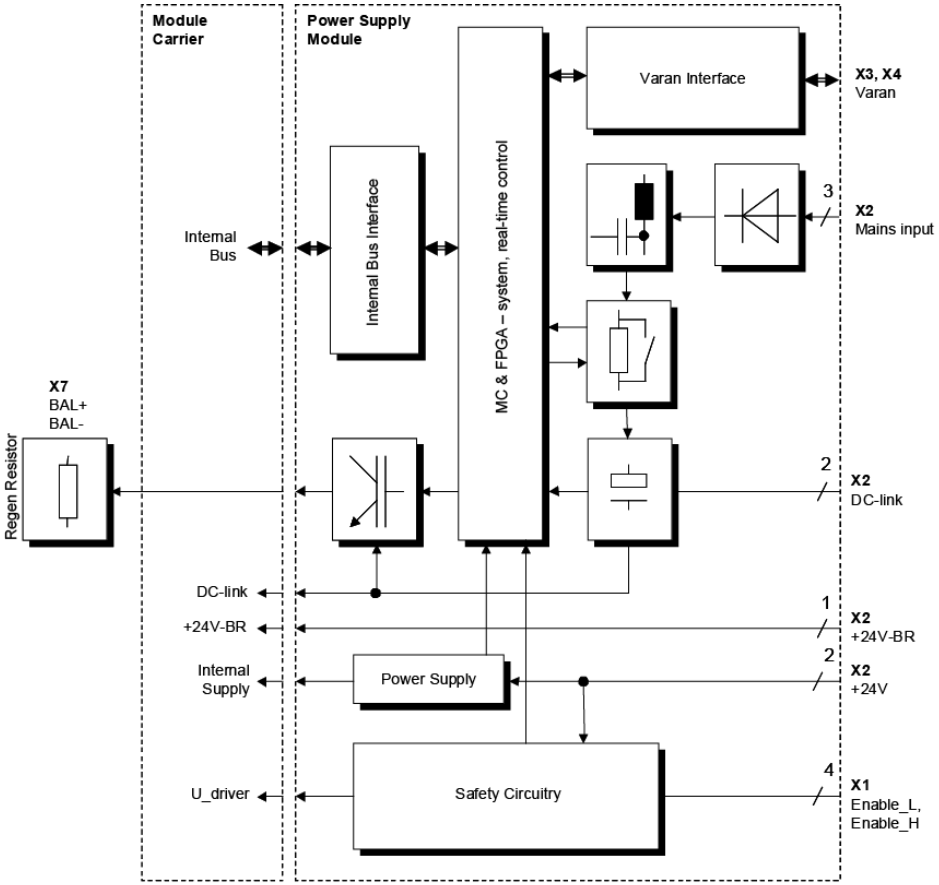
- The servo amplifier cannot be operated under any environmental conditions other than those described in this documentation (overheated, without a control cabinet, incorrect installation, etc.)

Extreme caution is needed in production facilities, in which conductive material such as carbon fiber, graphite, and cast iron chips or similar material is used. In such cases, the control cabinet must be hermetically sealed (no ventilation with fan filters) or placed outside of the contaminated area. Especially during the initial start-up, the danger posed by open control cabinet doors is extremely high. Contaminated servo amplifiers may no longer be used.

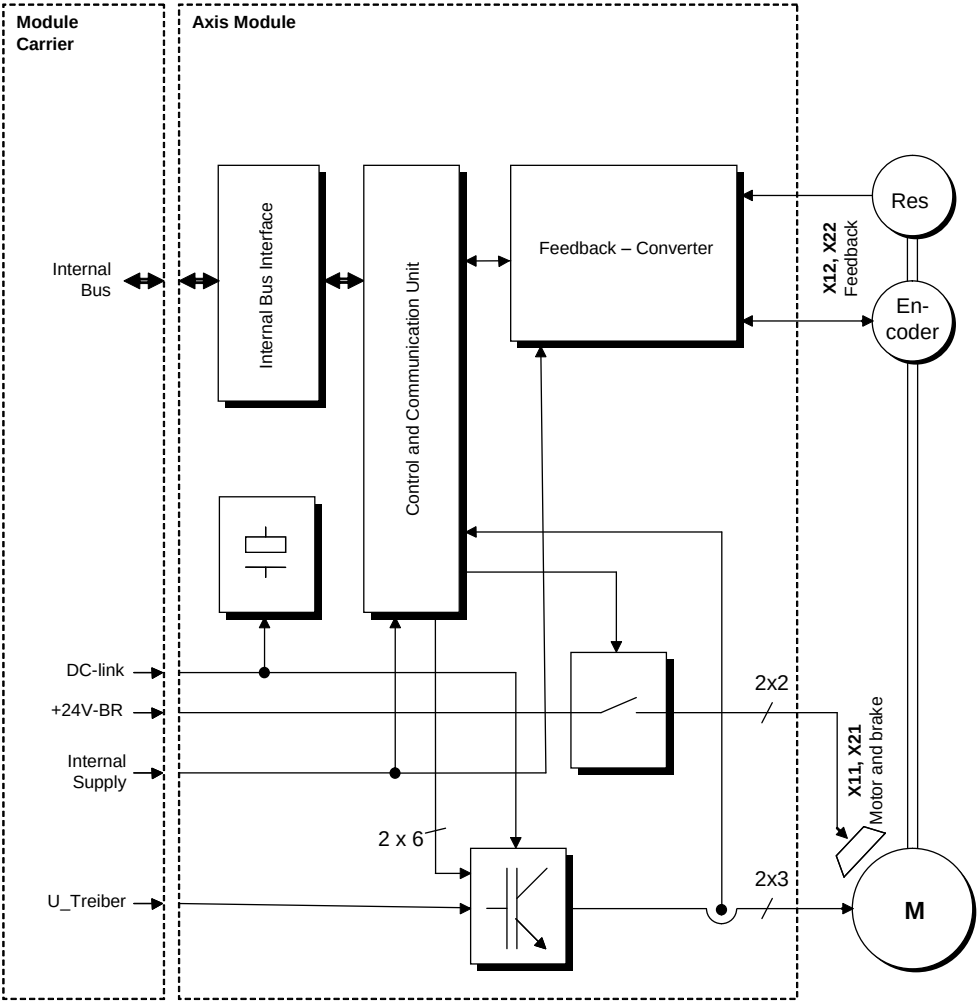
2.7 Series Etiquette



2.8 Block Diagram and Concept



Block Diagram of the power module (Regen resistor **EXTERNAL**)



Block diagram of the axis module

Hardware

- The power supply is connected with the rectifier, input filter and input current limit.
- DC link connector to connect the intermediate circuit with the other servo drives for energy distribution.
- Regen circuit with external regen resistor.
- Auxiliary voltage input for the internal supply of the electronics.
- For safety reasons, a separate supply input is provided for the holding brakes.
- Integrated safety functions
- Micro controller system with communication unit.
- IGBT - output stage (short-circuit proof) with galvanically isolated current measuring
- Feedback inputs for Resolver and high-resolution encoder systems
- 8 digital capture inputs for recording the actual position of the selected axis.

MDD 100 concept

- Servo drive system consisting of different components - Power module for up to eight logic axes
  - Axis module in different configurations
    - Single axis module
    - Double axis module
  - Module carrier in different configurations for 1 to 4-axis modules
- Auto range function for increasing the resolution of the actual current value
- Broad supply voltage range of 3 x 230 $VAC_{-10\%}$ ... 3 x 480 V $AC^{+10\%}$ powered by TN or TT supplies with grounded neutral line. TT systems without a grounded neutral line require additional measures
- Load circuit for limiting the maximum load current when engaging the mains contact
- Fuse installed by user (phase failure is monitored by the drive)
- 24 V auxiliary supply, galvanically isolated for internal power.
- Separate 24 V input for holding brake
- Integrated EMC filter (power input, 24 V auxiliary voltage and supply for holding brakes), Class A (industrial environment)
- Safety functions STO (Safe Torque Off) and SS1 (Safe Stop 1) with performance level "e" in accordance with ISO 13849 and SIL 3 in accordance with 62061
- All shielding connections on housing
- Protective functions against:
  - Under / over voltage in the intermediate circuit
  - Several short circuit conditions
  - Phase error in the main voltage supply
  - Regen resistor over heating
  - Over temperature (heat sink, environment and motor)

Overload protection is integrated into drive. The load current is limited to 100 % of the peak output current. The thermal motor protection is implemented with an I^2T regulator.

The integrated contactless short-circuit detector does not serve as branch circuit protection Branch circuit protection must be installed according to manufacturer instructions as well as NEC (National Electric Code) and additional local guidelines.

Software function

- Modified space vector modulation (SVM) to reduce loss in the output stages.
- Field oriented current controller (update time 62.5 µs)
- Feedback detection and speed controller (updated time 62.5 µs)
- Spline interpolation and position controller (update time 62.5 µs)
- Full synchronization up to the output stage to the control frequency with cycle times of 250 µs, 500 µs and 1 ms to 8 ms
- The servo amplifier has no volatile data storage medium. After activation, the machine control must send the parameters to the servo amplifier.

2.9 Technical Data of the Module Carrier

	DIM	MDM 011-O	MDM 021-O	MDM 031-O	MDM 041-O
Article number		09-402-011-O	09-402-021-O	09-402-031-O	09-402-041-O
Rated Data					
Resistance value of the external regen resistor	Ω	25 – 50			
Number of axis modules	-	1	2	3	4
Mechanics					
Height	mm	187.5			
Width	mm	120	180	240	300
Depth	mm	18			
Weight	kg	0.6	0.8	1	1.2
G-VMAINS =230 (rated supply voltage = 230 V)					
Start-up limit	V_{DC}	420			
Switch-off level	V_{DC}	400			
Over voltage protection	V_{DC}	450			
Max. rated power of the external regen resistor	W	500			
G-VMAINS = 400 (rated supply voltage = 400 V)					
Start-up limit	V_{DC}	730			
Switch-off level	V_{DC}	690			
Over voltage protection	V_{DC}	800			
Max. Rated power of the external regen resistor	W	850			
G-VMAINS = 480 (rated mains voltage = 480 V)					
Start-up limit	V_{DC}	850			
Switch-off level	V_{DC}	810			
Over voltage protection	V_{DC}	900			
Max. Rated power of the external regen resistor	W	1000			
General					
Standard		UL 508C			

2.10 Environmental Conditions, Ventilation and Mounting

Storage conditions	⇨ Page 51
Transport conditions	⇨ Page 51
Environment temperatures during operation	0 to +45 °C (32 to 113 °F) at rated data +45 to 55°C (113 to 131°F) with power reduction of 2,5% / K
Humidity during operation	Relative humidity 85 %, non-condensing
Altitude	Up to 1000 m above NN at rated values 1000 to 2500 m over NN with 1.5 % reduction 100 m
Pollution degree	Contamination degree 2
Protection Class of the servo drive system housing	IP 20
Mounting position	⇨ Page 30
Ventilation	Forced ventilation with controlled internal fan

2.11 Auxiliary supply voltage

The power supply for the control cabinet, which is used for the +24 V auxiliary voltage and the holding brake supply (+24 V-BR), must provide a galvanically isolated SELV output voltage in according with EN60950.

Because of the starting current of the servo drive system, the rated current must be at least 5 A when the auxiliary voltage is turned on.

3 Installation

3.1 Important Guidelines

- When using a ground fault interrupter in the circuit, a type B GFI-switch must be used. If a FI switch of Type "A" is used, A DC ground fault could cause it to malfunction.
- The servo amplifier and motor must be grounded according to the guidelines. Uncoated mounting plates must be used in the control cabinet.

- The MDD 100 servo drive system has a ground leakage current greater than 3.5 mA. Special guidelines for grounding must therefore be followed:

  a) Stationary machine supply connection:
  - Parallel protective ground wiring of X2/Pin4 and with the same cross section on the module carrier.
  - Connection of the protective ground wire with a cross section of 10 mm² Cu or 16 mm² Al on the module carrier, or
  - Automatic disconnection of the supply with an interruption of the protective ground wire, or

  b) Variable machine supply connection:
  Connection to a plug for industrial applications in accordance with IEC 60309 and a minimum protective ground wire cross section of 2.5 mm² as part of a multi-wire power cable. Sufficient stress relief must be provided.

- Before installation, the servo amplifier must be mechanically tested. If damage from transportation is determined, for example, the amplifier cannot be used. Electronic components cannot be handled.
- The rated voltage and current specifications of the servo amplifier and motor must match. The electrical connection must correspond to the schematic on page 24 the following.
- The main supply can under no circumstances exceed the maximum allowed values for the servo drive system. Attention should be paid to different power supply options.

- The external fuse for the main supply, the +24V auxiliary and +24 V-BR holding brake supply must meet the specifications in the chapter "External Fuse" on page 35.
- The motor and control lines should be laid with a minimum distance of 100 mm. This reduces the effect of noise in the control cable, which is caused by the high noise generation of the motor cable. A shielded motor and feedback cable must be used, by which the shielding is applied to both cables.
- The correct mounting position is vertical, as described on page 24.
- The ventilation in the control cabinet must provide sufficient cool and filtered air. See environmental conditions on page **Fehler! Textmarke nicht definiert.**.
- **Any post-delivery changes made to the servo drive, with the exception of the parameters, result in the loss of warranty.**
- During the initial start-up of the servo drive system, the peak current of the individual axes must be tested. Small motors can be damaged quickly if the servo amplifier settings are too high (e.g. a 1 A motor with a 10 A amplifier without 1 A limit).

3.2 Important Safety Functions Guidelines

- All control components (switches, relays, PLC, etc.) and the control cabinet must comply with ISO 13849 standards. This includes:
  - Door switches, etc. minimum of IP54
  - Control cabinet with minimum IP54
- Appropriately insulated ferrules
- All cables that affect safety (e.g. control cables for the ENABLE_L and ENABLE_H inputs) must be laid in a cable duct outside of the control cabinet.
  Short or crossed circuits in the signal lines must be avoided! See EN ISO 13849

- All safety-relevant wires (e.g. control cable) must for example, be placed in a cable duct when they extend outside of the control cabinet.
- Terminal 3 on connector X1 is labeled as "reserved" and cannot be placed externally.
- With the use of the safety function SS1 (Safe Stop !), the minimum turn-off delay is 0.4 seconds. Subsequent actions that require the STO (Safe Torque Off) function (i.e. manual access to the machine), can only be released after 1 second.
- If external forces influence axes that are used with the STO safety function (e.g. hanging load), additional measures must be taken (such as an electromagnetic double-surface spring brake, instead of a permanent magnet brake).

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

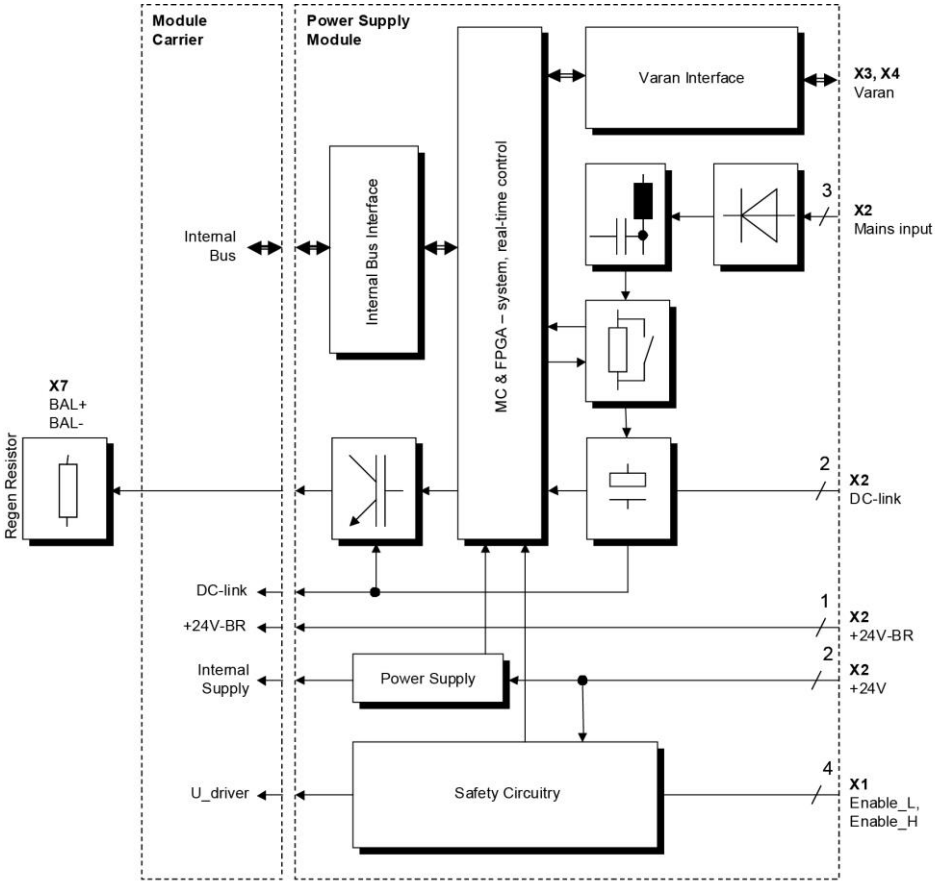
The main power supply for the servo amplifier must be disconnected using the main switch for the following instances:

- Cleaning, maintenance or repairs
- Extended still-stand periods

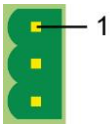
Failure to follow the above safety measures can lead to severe injuries.

3.3 Planning the Control Cabinet

3.3.1 Connection Diagram and Pin Layout of the Module Carrier

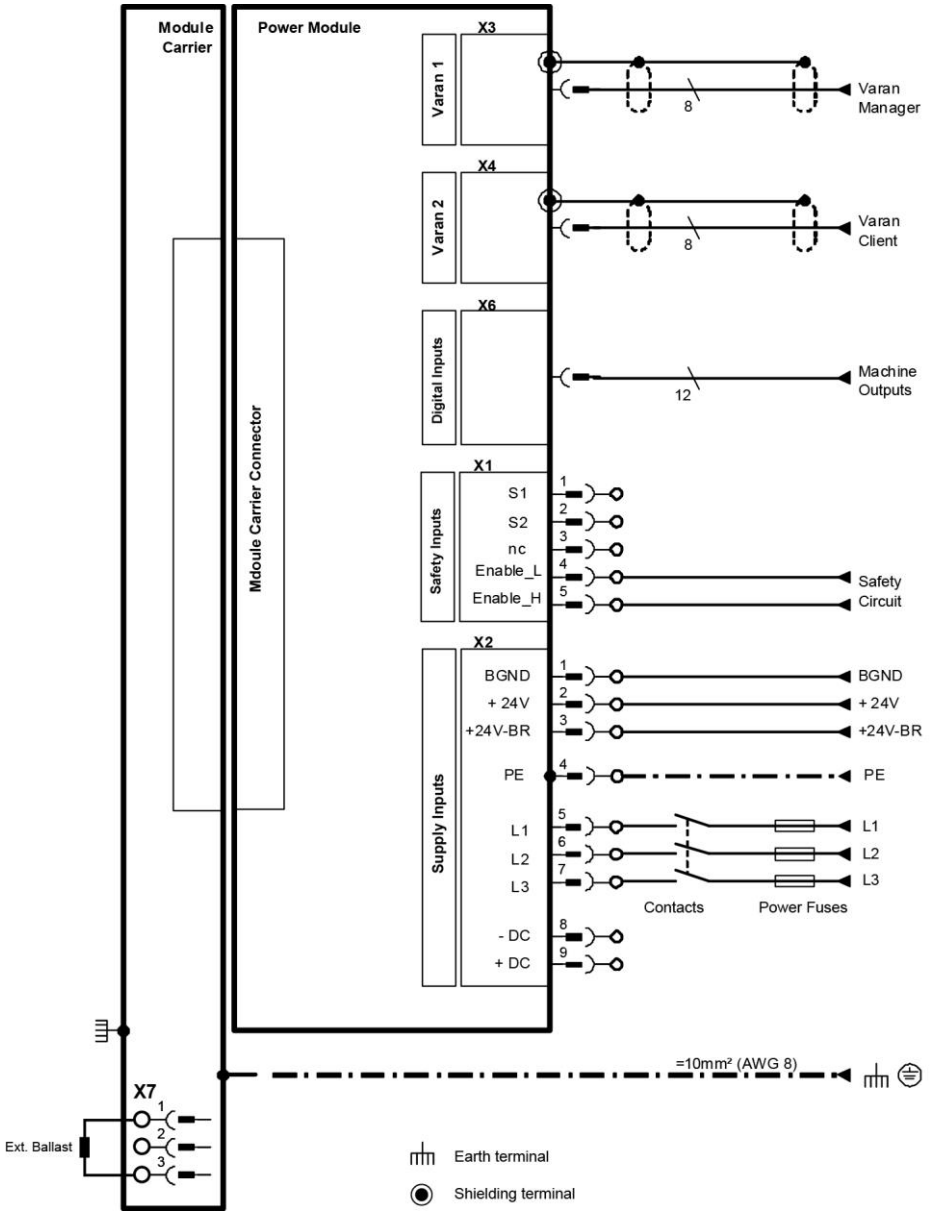


X7: External regen resistance



Pin	Function
1	BAL+
2	n.c.
3	BAL-

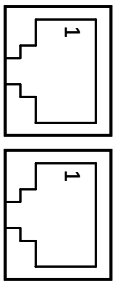
3.3.2 Connection Diagram and Pin Layout of the Power Module



Safety Input
X1

S1	1
S2	2
reserved	3
Enable_L	4
Enable_H	5

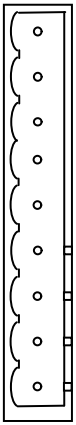
Varan 1
X3



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	-

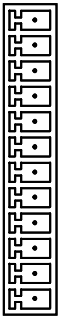
Varan 2
X4

Supply Input
X2



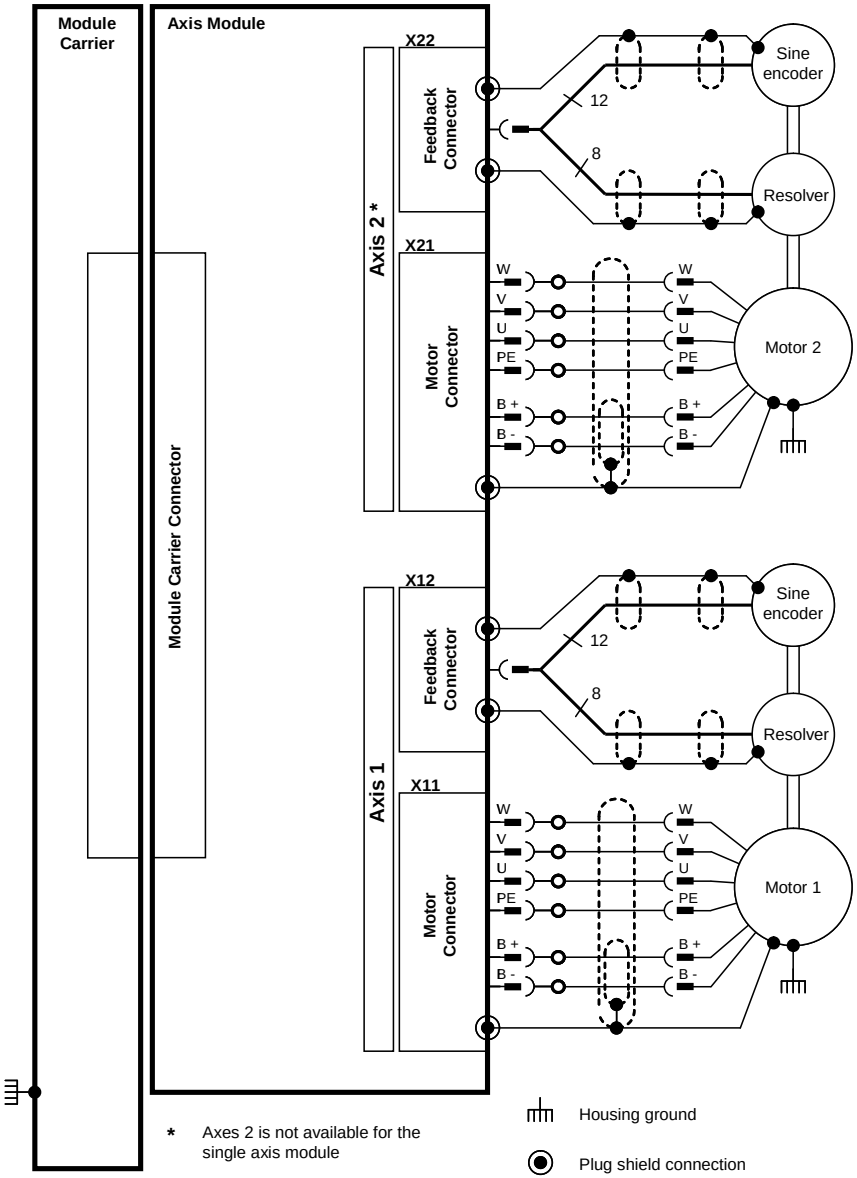
BGND	1
+24V	2
+24V-BR	3
PE	4
L1	5
L2	6
L3	7
- DC	8
+ DC	9

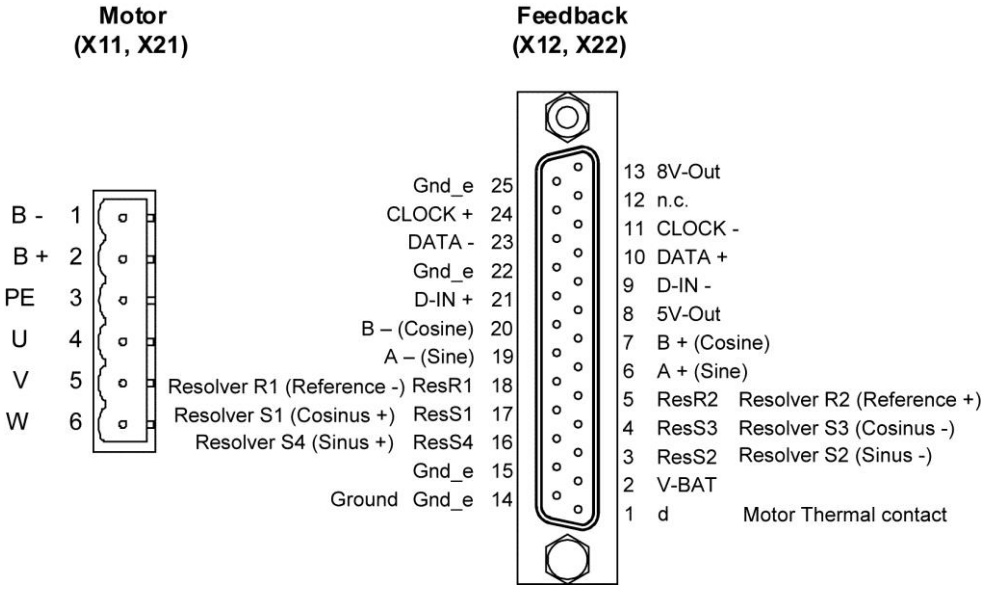
Digital Input
X6



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

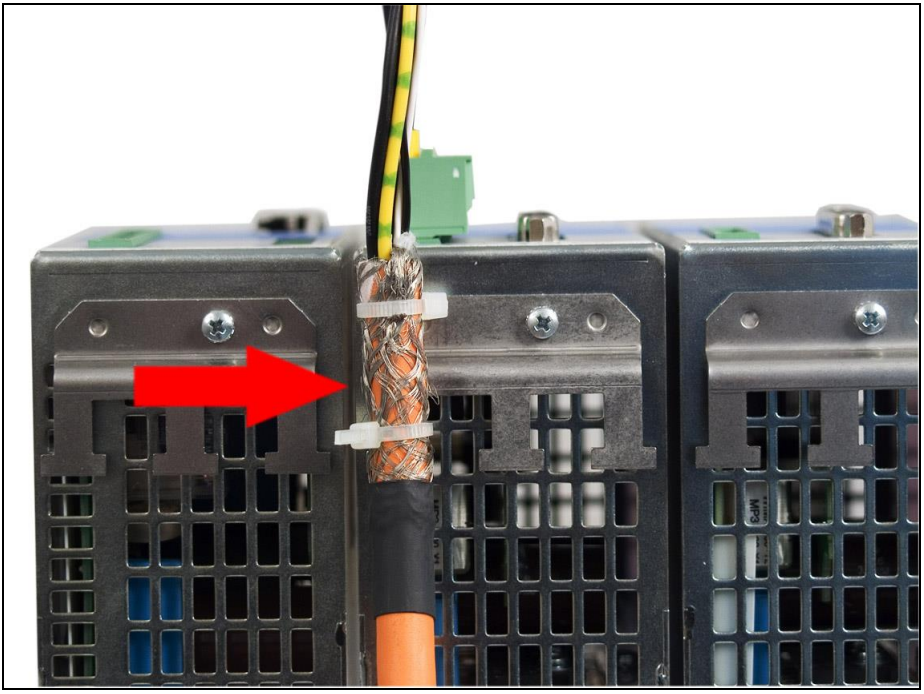
3.3.3 Connection Diagram and Pin Layout of the Axis Module



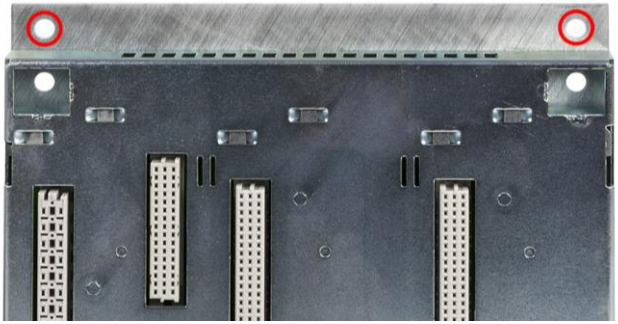

Motor
(X11, X21)
B - 1
B + 2
PE 3
U 4
V 5
W 6
Feedback
(X12, X22)
Gnd_e 25
CLOCK + 24
DATA - 23
Gnd_e 22
D-IN + 21
B – (Cosine) 20
A – (Sine) 19
Resolver R1 (Reference -) ResR1 18
Resolver S1 (Cosinus +) ResS1 17
Resolver S4 (Sinus +) ResS4 16
Gnd_e 15
Ground Gnd_e 14
13 8V-Out
12 n.c.
11 CLOCK -
10 DATA +
9 D-IN -
8 5V-Out
7 B + (Cosine)
6 A + (Sine)
5 ResR2 Resolver R2 (Reference +)
4 ResS3 Resolver S3 (Cosinus -)
3 ResS2 Resolver S2 (Sinus -)
2 V-BAT
1 d Motor Thermal contact

3.3.4 Ground

A mounting device is located on the MDD module, which is used for stress relief on one side and shielding on the other. The cable shielding is laid here.

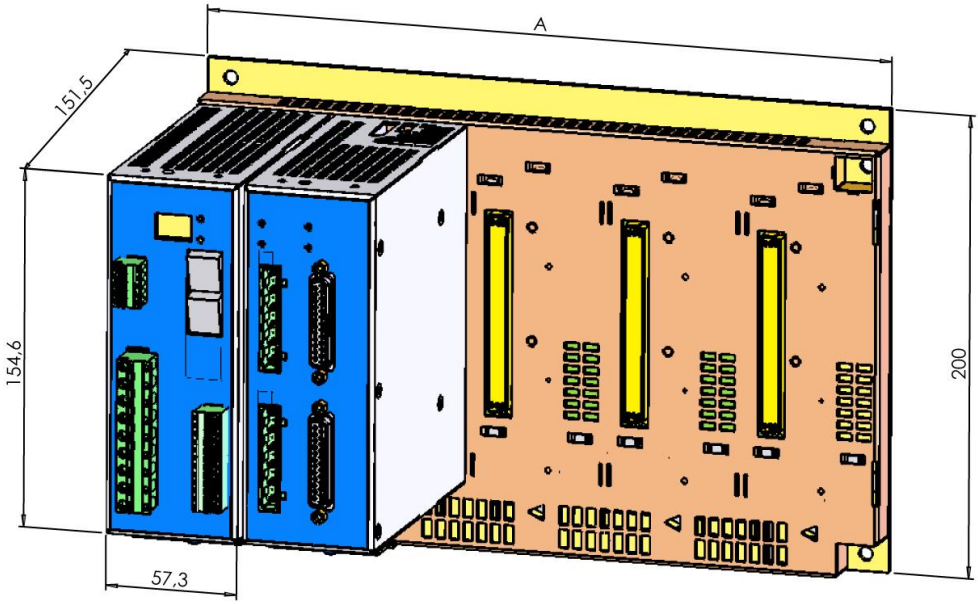


The grounding can be done with an eyelet through the right or the left drill hole.



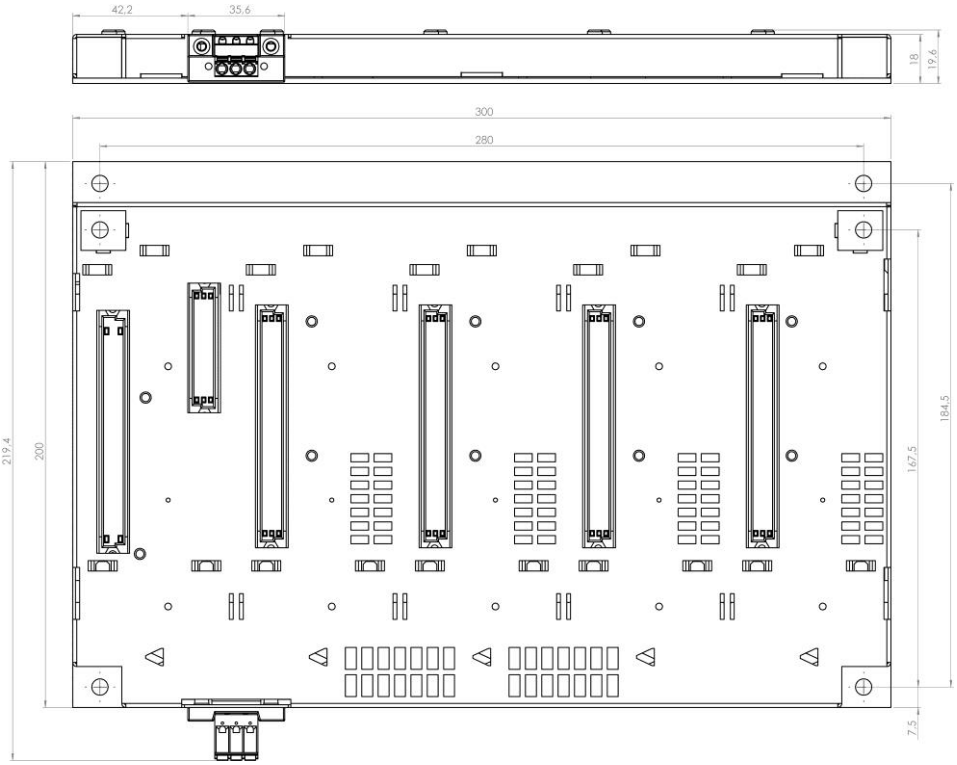
The entire MDD System is grounded over the module carrier in the control cabinet.

3.3.5 Mechanical Dimensions and Mounting



The mechanical dimensions of the servo drive system shown above are:

A Depending 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
300 mm for MDM 041-O



The mechanical dimensions for the module carrier to mount on the mounting plate of the control cabinet are:

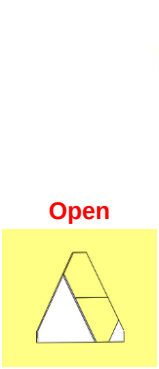
A 280 mm for MDM 041-O

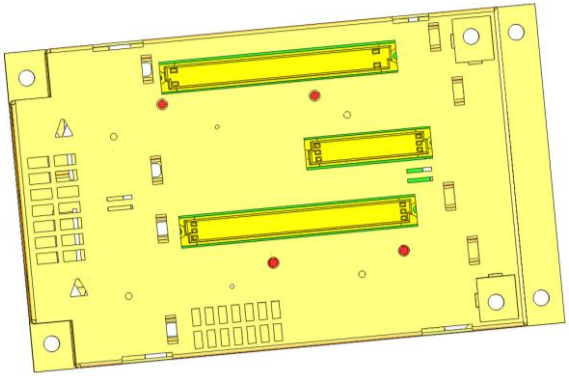
The cable duct placed under the module carrier must be mounted with a minimum clearance of 10 mm.
The cable duct must above the module carrier must have a clearance of 40 mm. This required for heat sink ventilation.

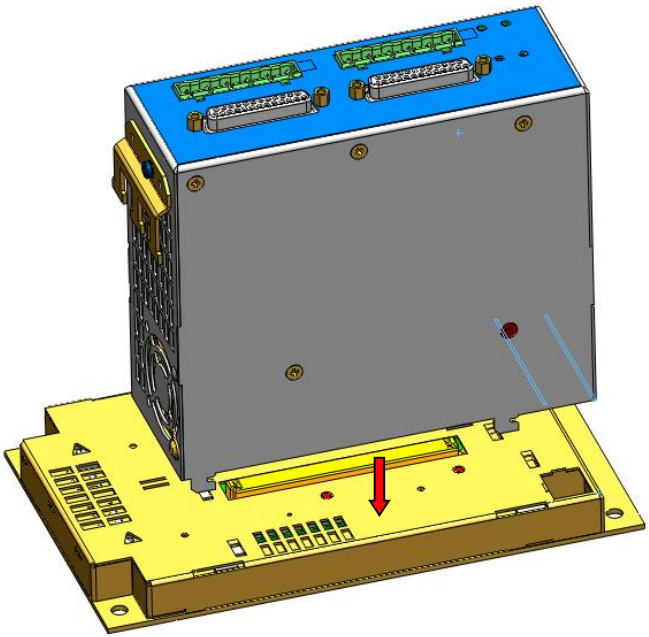
The specified installation clearances can be reduced under some conditions. Provided that the appropriate measures and technical precautions are taken to dissipate the heat generated from loss.

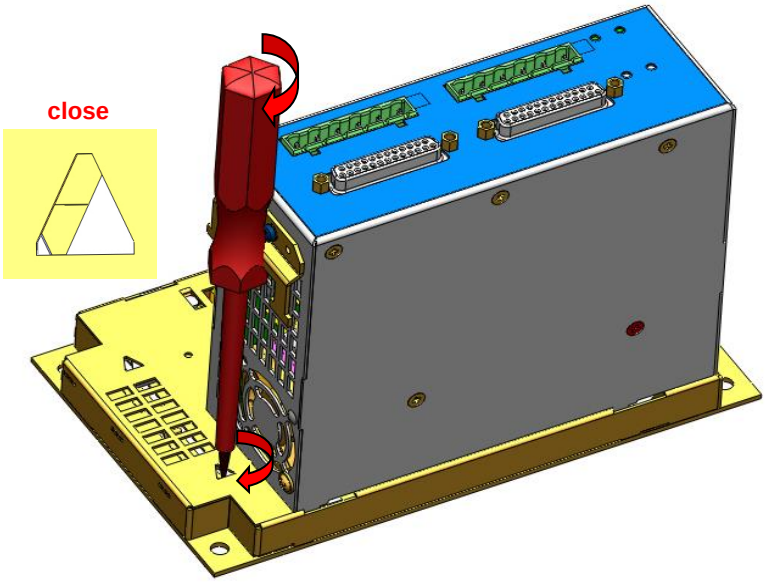
Mounting material: 4 DIN 912, M5 socket head screws
Required tool: 4 mm Allen key

3.3.6 Mounting the Modules








close

3.3.7 Connector Layout

All servo drive system connections (except for the ground terminal) are connector plugs. With this method, the cable connection is simplified and the amplifier can be more easily exchanged. In addition, the option is provided to produce prefabricated cable sets for high machine volumes.

The following is the technical data for the applicable connectors:

Connectors	Type	Wire Size	Max. Tightening Torque
X1	Phoenix FMC1.5/5-ST-3.5	0.2 – 1.5 mm² (16 – 24 AWG)	Spring terminal connector
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 FMC1.5/12-ST-3.5	0.2 – 1.5 mm² (16 – 24 AWG)	Spring terminal connector
X7	Phoenix FKC 2.5/3-ST-5.08	1 – 2.5 mm² (14 – 16 AWG)	Spring terminal connector
X12 – X22:	D-Sub 25 with metal housing	0.25 – 0.5 mm² (20-22 AWG)	Solder or Crimp Connection
X11 – X21:	GMSTB2.5HCV/9-ST-7.62	1 – 2.5 mm² (14 – 16 AWG)	0.56-0.79 Nm (5-7 inch lb)
Ground terminal	M5	10 mm² (8 AWG)	3.5 Nm (31 inch lb)

3.3.8 Cable Types

According to EN 60204 or AWG: 310-16 of the NEC column 60 ° C or 75 ° C is recommended:

Signal		Cable Analysis
power plug	Maximal 2.5 mm² (14 AWG)	600 V, 105 °C (221 °F)
Intermediate circuit voltage	Maximal 2.5 mm² (14 AWG)	1000 V, 105 °C (221 °F)
Motor cable	1.0mm² (16 AWG), shielded, max. 25m, capacitance <150 pF/ m	600 V, 105 °C (221 °F)
Holding brake	Min. 0.5mm² (18 AWG), component of the motor cable, shielded separately, monitor voltage loss	600 V, 105 °C (221 °F)
Resolver Feedback with thermo contacts	4x2x0.25 mm² (22 AWG) twisted pair, shielded, max.25m, capacitance <120 pF/ m	
EnDAT® encoder	4x2x0.25 mm² (22 AWG) twisted pair, shielded, max.25m, capacitance <120 pF/ m	
+24 V and +24 V-BR input	Maximum2.5 mm² (14 AWG), monitor voltage loss	
Regen resistor	Maximal 2.5 mm² (14 AWG)	1000 V, 105 °C (221 °F)

Note: Use 60/75 °C copper wires only!

3.3.9 External Fuse

The fuse for the main and 24 V supplies is selected according to customer requirements.

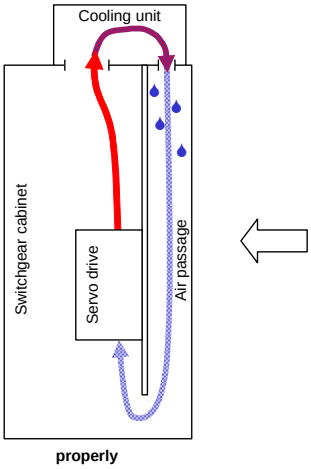
Signal	Fuses, Time delays
Main supply (L1-L3) Suitable for used with a circuit, which supplies no more the 5000 rms symmetrical Amperes and max. 528 V with an RK5 fuse with a rated current of 15 A.	The value of the fuse depends on the average power consumption of the connected servo drive system. Max. 12 A (slow) using with 2.5 mm² (14 AWG) (FRS-25) wires
24 V-DC inputs (+24 V, +24 V-BR to BGND)	Limited to 12 A (slow) using 2.5 mm² / AWG 14

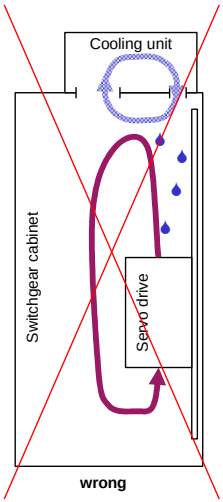
3.3.10 Using Cooling Devices

The Servo amplifier functions up to an ambient temperature of 45° C (55° C with reduced power). Under some circumstances, a cooling device is required.

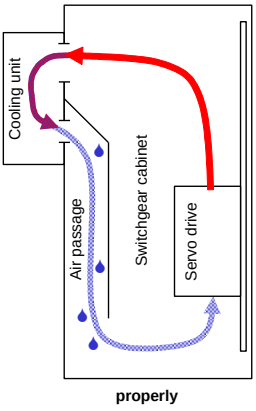
Note: A cooling device always produces condensation water. Important points must therefore be observed:

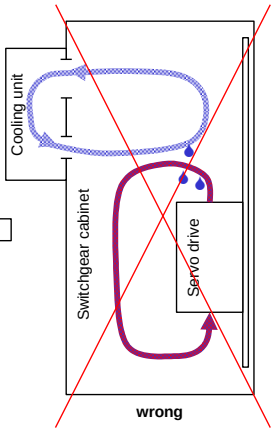
- Cooling units must be mounted in such a way that no condensation water can drip into the control cabinet.
- Cooling units must be installed so that condensation water is not distributed over electrical or electronic components.





Cooling device mounted in the top of the control cabinet





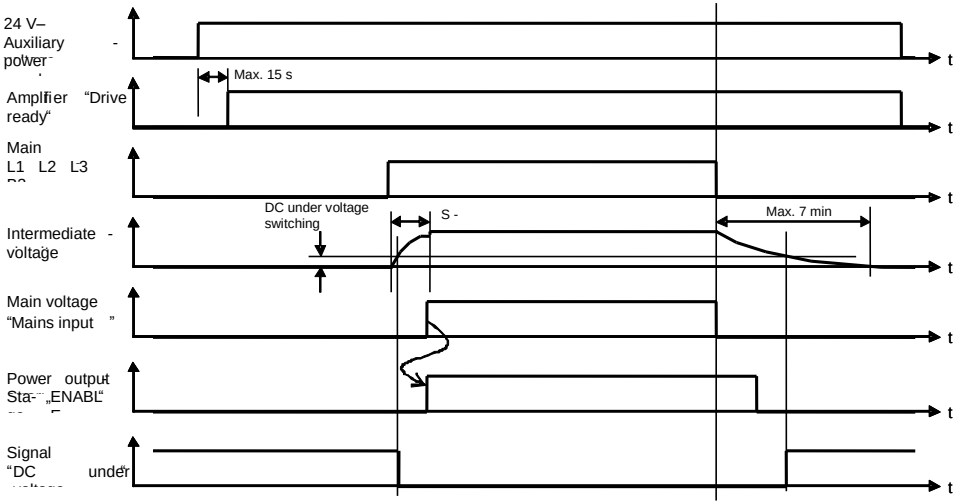
Cooling device mounted in the cabinet door

Condensation water can also be avoided as follows:

- The switch point of the temperature regulator should be just below the building temperature.
- In damp environments, the proper seals should be used in the control cabinet.
- If electronic components are colder than the air in the control cabinet, condensation water can form; especially when the cabinet door is opened during servicing.

3.3.11 On/Off response of the Servo Drive System

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



5 seconds after being turned 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.

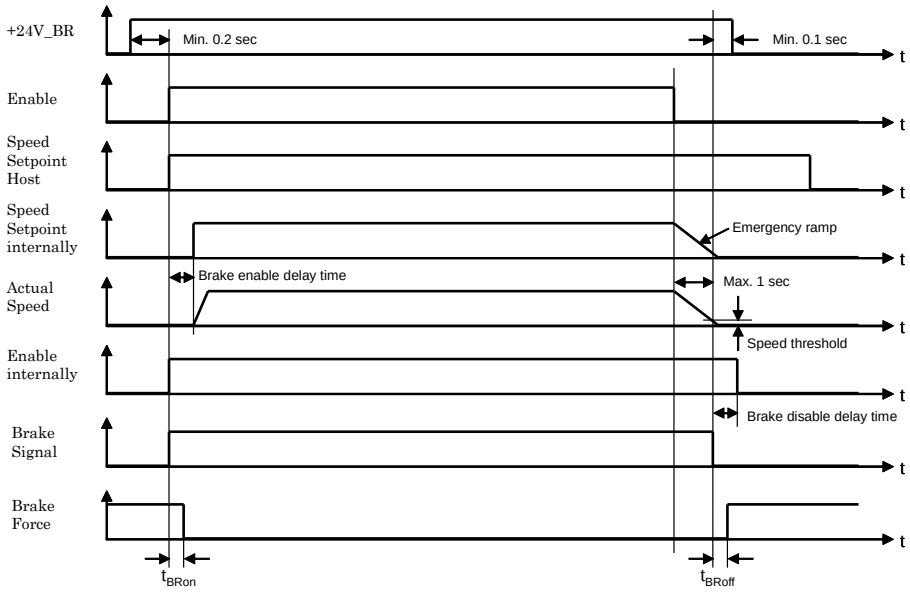
Since the servo amplifier has volatile memory, received parameters must be stored in the host controller. The advantage here is in the automatic download of program data when an amplifier is changed.

If the main supply is turned on, the capacitors in the intermediate circuit are loaded. Approximately 0.7 seconds are needed.

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 5 minutes, the intermediate circuit is discharged.

3.3.12 Holding brake control



The above diagram shows the handling of the holding brake.

A standard holding brake with 24 VDC and maximum 1 A can be operated directly on the servo amplifier.

The current circuit has high functional safety, but provides **no personnel protection.**

4 Safety Function

The MDD 100 servo drive system supports the safety functions SS (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.

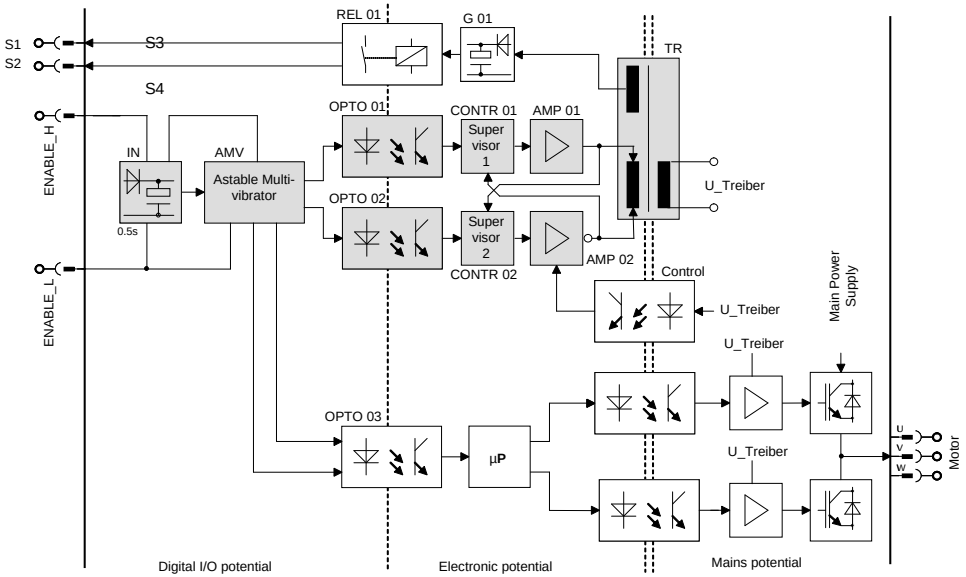
The relay output S1/S2 can be used to provide the status of the safety function. It is not safety-relevant, but can be used to test the external safety function.

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_Driver.

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_Driver 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

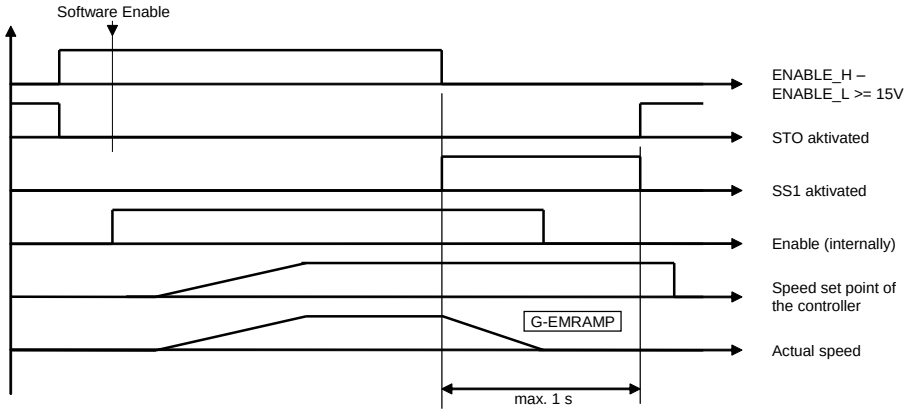
The relay output S1/S2 is closed when the servo amplifier is supplied with 24 V and the safety function is active. The two blocks are not safety-relevant.

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 • **Safety status of the drive system**, when a safe output is used by a Safety PLC. Also when ENABLE_L is connected to "Ext.GND.
Low	Open		
Low	High	Open	**Drive system ready**



Timing Diagram

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.

4.3 FunctionTest

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.

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 functionality

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 when ENABLE_L is connected to "Ext.GND and a 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.

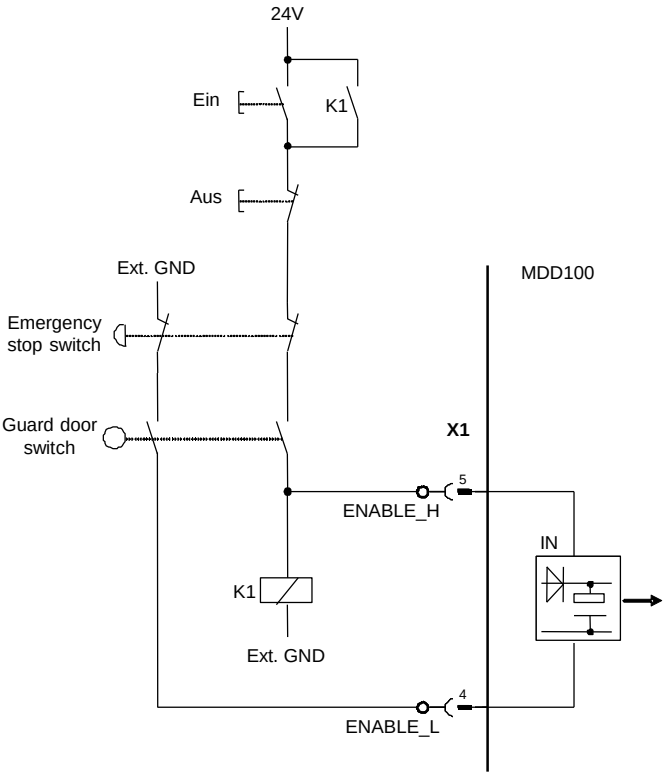
4.4 Example Connection with Switch Contacts

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 connected 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.

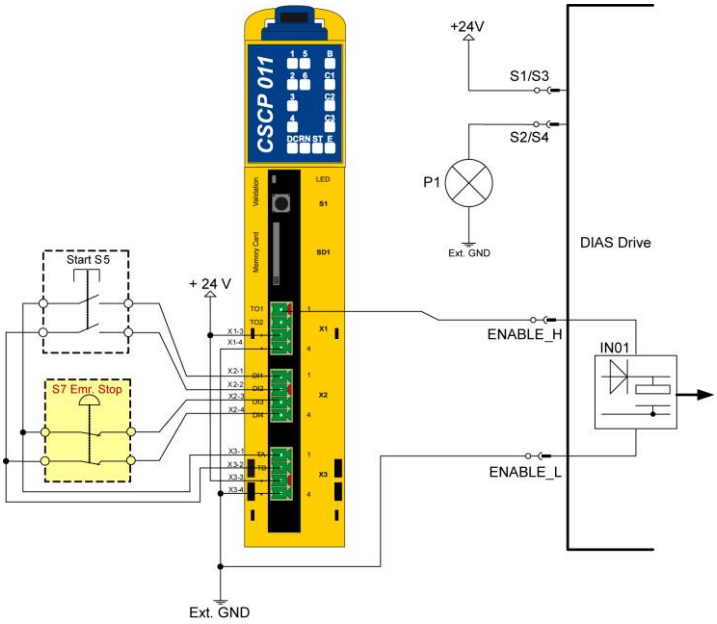
4.5 Example: Safety PLC Application

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.

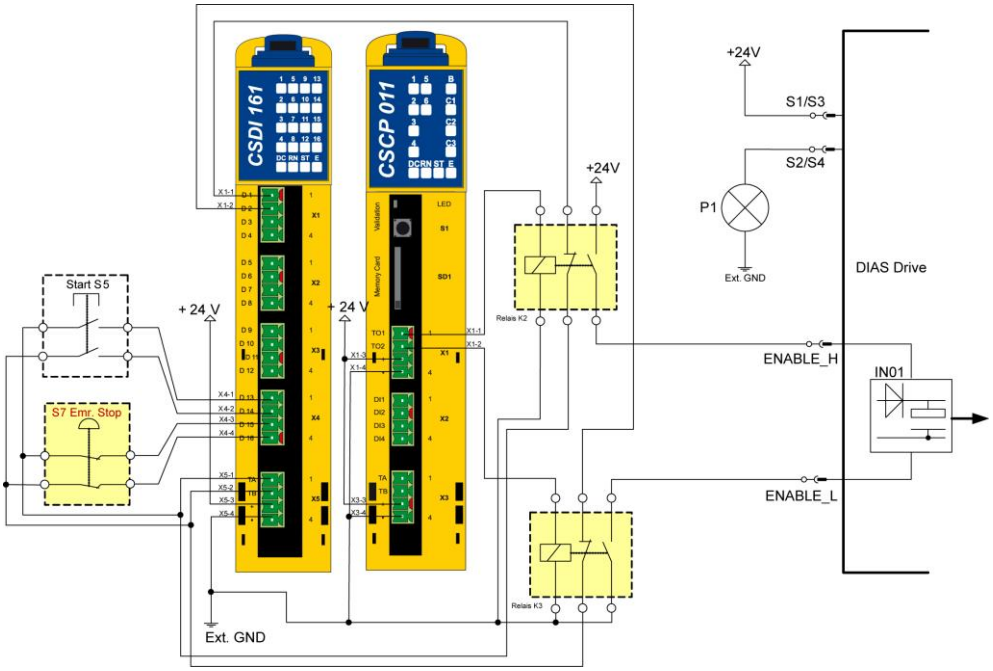
There are two types of error-safe outputs.

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".



2. Two-channel error-safe relay input with which the + output is connected to ENABLE_H and the - output to ENABLE_L.



5 Maintenance

The servo drive is maintenance-free.

Note: Opening the housing results in the loss of warranty.

Dirt on the housing can be removed with isopropyl alcohol or similar products.

- Contamination in the device must be removed by the manufacturer.
- The protective grate (fan) can be cleaned with a dry brush.
- Spraying or submerging is not recommended.

5.1 Exchange and Repair

Repair: repair of the servo drive system must be performed by the manufacturer.

Exchange: if a servo drive system component must be exchanged, the following points must be followed (no special tools needed for installation).

Turn off the control cabinet supply and remove the servo drive system fuses.

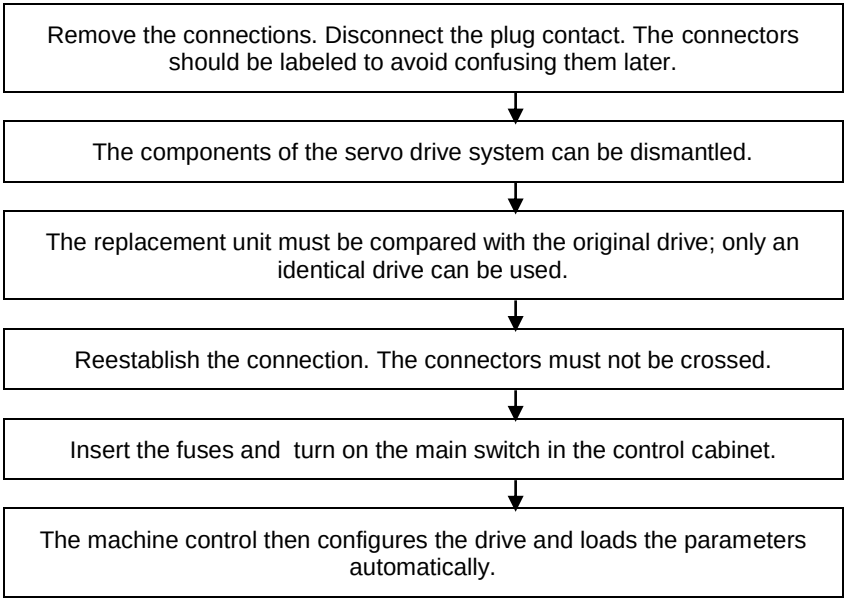
↓

After disconnecting the servo drive system from the main voltage supply, a wait-time of 5 minutes is required before current-conducting components in the drive (i.e. contacts) can be touched or connectors removed. Capacitors can contain dangerous voltages for up to 5 minutes after the supply voltage is removed. For safety purposes, measure the voltage in the intermediate circuit and wait until the voltage is below 40 V.

↓

During operation, the heat sink of the servo drive system can reach temperatures of over 80° C (176° F). The heat sink temperature should be checked before handling and it may be necessary to wait until it is below 40° C (104° F).

↓


Remove the connections. Disconnect the plug contact. The connectors should be labeled to avoid confusing them later.
The components of the servo drive system can be dismantled.
The replacement unit must be compared with the original drive; only an identical drive can be used.
Reestablish the connection. The connectors must not be crossed.
Insert the fuses and turn on the main switch in the control cabinet.
The machine control then configures the drive and loads the parameters automatically.

6 Appendix

6.1 Transport, Storage and Disposal

Transport:

- For transport, the original recyclable packaging from the manufacturer must be used.
- During transport dropping should be avoided.
- The storage temperature must be between –25 to +70°C (-13...158°F), change max. 20K/h.
- Maximum 95 % humidity, non-condensing
- The components of the servo drive system contain parts sensitive to electrostatic, which can be damaged by improper handling. Before touching, the user must discharge their body by touching a grounded object with a conductive surface. Contact with highly insolated material (synthetic fiber, plastic foil etc.) must be avoided. The servo drive system components must be placed on a conductive surface.
- If the packaging is damaged, the drive must be visually inspected for damage. If damaged, the transport company and the manufacturer must be informed. The drive should not be installed and operated if damaged!

Packaging:

- Recyclable cardboard with liner
- Labeling: Type label on the outside of the housing

Storage:

- Only the original recyclable packaging from the manufacturer can be used.
- The components of the servo drive system contain parts sensitive to electrostatic, which can be damaged by improper handling. Before touching, the user must discharge their body by touching a grounded object with a conductive surface. Contact with highly insolated material (synthetic fiber, plastic foil etc.) must be avoided. The servo drive system components must be placed on a conductive surface.
- A maximum of 10 servo drive system components can be stacked on top of one another.

- The storage temperature must be between -25 to 55 °C (-13...158 °F), changes max. 20K/h.
- The maximum humidity is 95%, non-condensing.
- 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 power module supplied with 230 VAC, single phase at terminals L1 / L2 for 30 minutes.

Disposal:

- The servo drive systems components can be disassembled by removing the screws in its main components (heat sink, steel housing, circuit boards).
- Disposal should be carried out by certified companies.

6.2 Correcting Errors

Errors and warnings are indicated by the LED and bus system.
The "Status Register" list helps to correct errors.

6.2.1 LED Display

Each axis module of the MDD 100 servo drive system has two LEDs per axis, which show the status of the respective axis.

LED		Description
Green	**Red**	
On	**On**	Controller in boot mode (Firmware missing or damaged).
1 Hz blink signal	**Off**	Ready to power up, no activation
8 Hz blink signal	**Off**	Output current is limited by I2T (one or more axes)
On	**Off**	Operation
On	**1 Hz blink signal**	Warning
Off	**On**	Error

6.2.2 Drive Malfunctions

Drive Malfunctions	Cause	Solution
– **When the motor is turning in the clockwise direction (observe the motor shaft) I-FPOS is reduced**	– Feedback system is connected incorrectly	- Connect feedback system according to schematic diagram
– **Motor does not turn** – **Motor reaches limit, however, without torque**	- Motor is not connected with the correct phase	- Connect motor with the correct phase
– **The motor "spins through"** – **The torque is too low or differs with the directions**	- M-ROFF is set to the wrong value - Motor or feedback connection wrong	- Set M-ROFF to the correct value - Connect motor and feedback correctly
– **Motor stops at certain positions**	- M-POL or M-RPOL set incorrectly - The motor cable has a break - Not all wires in the motor cable are connected	- Set M-POL and M-RPOL according to the motor data. - Replace motor cable (especially the drag chains) - Connect all wires of the motor cable
– **The motor oscillates**	- Controller amplification too high - Break in the feedback cable shielding	- Reduce V-KP or P-KV - Replace the feedback cable (especially the drag chains)

6.2.3 Status Register

With I-Status, the status of the MDD 100 can be read. All error and status information is contained in a 32-bit variable. The drive system response can be changed by setting the appropriate bits in ***G-MASKE1***, ***G-MASKE2***, ***G-MASKW*** and ***G-MASKD***.
According to the mask settings, the amplifier detects errors, warnings, or does respond. The individual bits have standard values and limitations in the mask assignments.

Bit	Error	Cause	Solution
0	**Single-phase operation**	– The main voltage supply is single phase only	– Check the amplifier fuse – Check electrical connection
1	**Error in the main voltage supply**	– Amplifier is "enabled" without main power applied	– Check in main supply fuse – Check electrical connection – Amplifier is enabled before the intermediate circuit is loaded
2	**Reserved**		
3	**DC over voltage**	– Internal brake resistor defective	– Exchange the module carrier
4	**DC under voltage**	–The main voltage supply for the released amplifier is too low	– Disable the servo amplifier before the intermediate circuit voltage. Below G-VBUSM
5	**Reserved**		
6	**Holding brake error**	– No holding brake connected with parameters ***M-BRAKE*** = 1 – Stop brake short circuited lines – Holding brake short circuited	– Motor used with holding brake – Check holding brake cable – Change M-BRAKE parameter to 0 as long as a motor without brakes is used. – Check connector and motor cable –Check holding brake
7	**Brake switch error**	– Defective internal stop brake switch – No holding brake connected with parameters ***M-BRAKE*** = 1	– Exchange the axis module – Motor used with holding brake – Change M-BRAKE parameter to 0 as long as a motor without brakes is used. – Check connector and motor cable –Check holding brake

8	**Reserved**		
9	**Motor temperature**	– Motor temperature switch is triggered – Cable or connector break in the feedback	– Check cause (Motor too small, poor environmental conditions) – Check feedback cable and connector, exchange if necessary
10	**Ambient temperature**	– Internal temperature too high	– Improve control cabinet ventilation, check mounting position and compare it with the specifications of this instructions.
11	**Heat sink temperature**	– Heat sink temperature too high	– Improve control cabinet ventilation, check mounting position and compare it with the specifications of this instructions
12	**Feedback error**	– Feedback cable broken – Feedback defective – Bad feedback connection	– Check feedback cable and replace if necessary – Exchange feedback – Check feedback connection
13	**Commutation error error**	– Incorrect motor phase position – Incorrect motor connection or wrong feedback cable	– Check the M-ROFF parameter – Check motor connection
14	**Motor over speed**	– Incorrect motor phase position – Incorrect motor connection or wrong feedback cable – Over shoot (greater than 1.2 * V-NMAX)	– Check M-ROFF – Check motor connection – Check feedback cable – Optimize controller circuit
15	**Drag error**	– P-PEMAX drag error window too small	– Increase P-PEMAX and/or optimize controller circuit
16	**Trajectory error**	– The speed setting, which was calculated using the change in the position set value by the control of results in more than 10000 min^{-1}	– Check ***P-PSCALE*** and ***P-SSCALE*** parameters and the reference value
17	**Host communication**	– No new values were transmitted for two successive cycles – Internal communication error with the interface	– Synchronization is not engaged, check A-CTIME and the cycle time of the control – Check A-STIME – Communication interrupted, check – see also I-DERROR
18	**Amplifier error E2 (I-DERROR)**	– Various internal errors	– see also I-DERROR – Contact manufacturer

19	**Amplifier error E1 (I-DERROR)**	– Various internal errors	– see also I-DERROR – Contact manufacturer
		Error – Power output stage: – Motor cable has a ground fault – The motor has a ground fault – Output stage defective	– Check motor cable, exchange if necessary – Exchange the motor – Exchange amplifier
		Regen circuit error – Regen resistor has a ground fault – Regen output defective	– Check regen resistor – Exchange amplifier
20	**"Enable locked" error**	– The amplifier is "enabled" in the software when one of safety inputs is not ready.	– Enable amplifier only if ENABLE_L is low and ENABLE_H is high.
21	**Driver voltage error**	– The amplifier is "enabled" in the software when one of safety inputs is not ready.	– Enable amplifier only if ENABLE_L is low and ENABLE_H is high.
22	**DC over voltage and brake resistance limit reached.**	– Brake resistance power is insufficient. Brake resistance power has been reached and the resistor deactivated.	
23	**Brake voltage error voltage power supply:**	– Stop brake voltage 24V-BR missing.	– If the motor has a holding brake, the amplifier can only be "enabled" when 24V-BR is applied to the brake.
24	**Reserved**		
25	**I2t error**	– I-I2T has exceeded the warning value A-I2TERR .	– Increase A-I2TERR.
26	**Motor temperature warning**	– I-TEMPM has exceeded the warning value A-TEMPMW.	– Increase A-TEMPMW.
27	**Motor parameter error**	– For motors with EnDAT® or HIPERFACE® encoders, no M – parameters were found in the encoder.	– Encoder was not loaded with M-parameters. – Encoder defective. – Signal lines or connector defective, incorrectly wired or there are breaks in the cables.

28	**Multi-turn error**	– For EnDAT® or HIPERFACE® Multi-turn encoders, an error has occurred during the extension to >4096 turns.	– Motor with a multi-turn encoder was exchanged – Encoder defective.
29	**Total power limit reached**	– The power of all axes has exceeded the maximum load.	Reduce load – Drive power too low
30	**Reserved**		
31	**Fan error**	– The fan does not reach the minimum rotation speed.	– Exchange axis module.

7 Recommended Shielding for VARAN

The VARAN real-time Ethernet bus system exhibits a very robust quality in harsh industrial environments. Through the use of IEEE 802.3 standard Ethernet physics, the potentials between an Ethernet line and sending/receiving components are separated. In the event of an error, the VARAN Manager resends messages to a bus participant immediately. The shielding described below is mainly recommended.

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

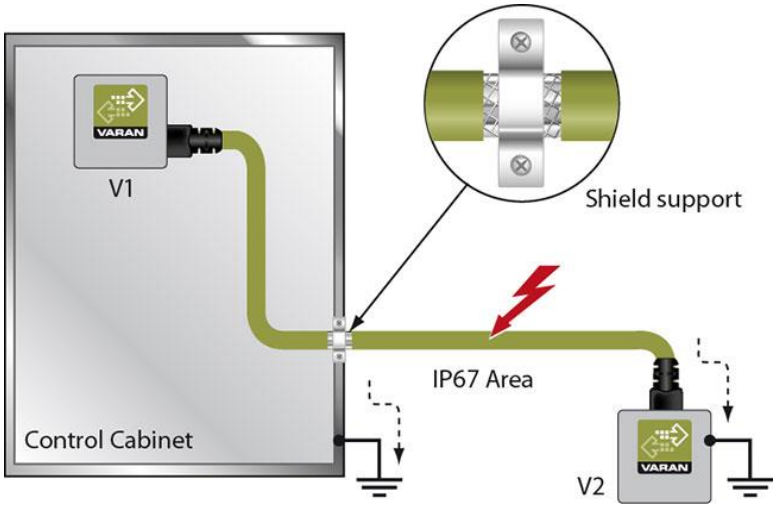
SIGMATEK recommends the use of CAT5e industrial Ethernet bus cables.

An S-FTP cable should be used for the shielding.
An S-FTP bus is a symmetric, multi-wire cable with unshielded pairs. For the entire shielding, a combination of foil and braiding is used. A non-laminated variant is recommended.

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

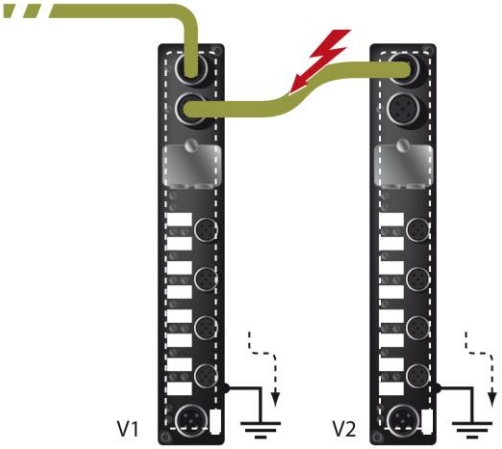
7.1 Wiring from the Control Cabinet to an External VARAN component

If the Ethernet lines are connected from a VARAN component to a VARAN node located 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.



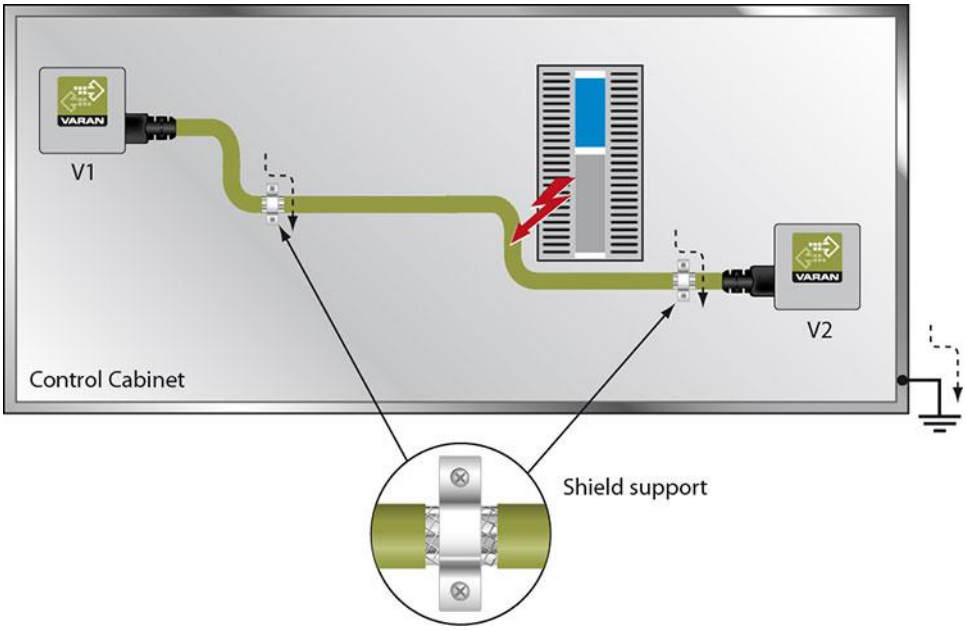
7.2 Wiring Outside of the Control Cabinet

If a VARAN bus line must be connected outside of the control cabinet only, no additional shield support is required. A requirement therefore, is that only IP67 modules and connectors can be used outside the control cabinet. These components are very robust and noise resistant. The shielding for all sockets in IP67 modules is electrically connected internally or over the housing, whereby voltage spikes are not deflected through the electronics.



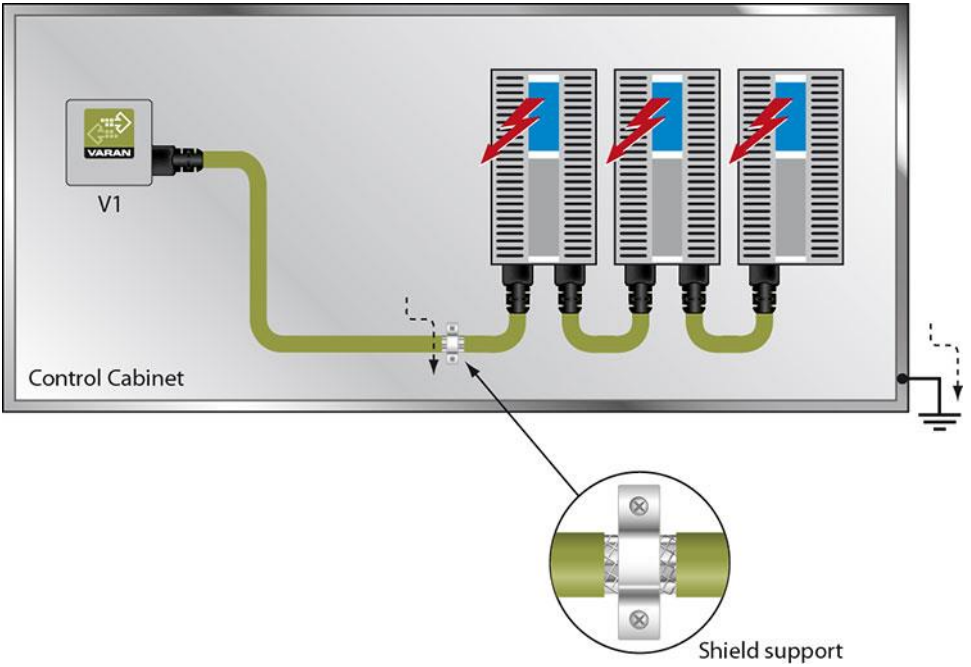
7.3 Shielding for Wiring Within the Control Cabinet

Sources of strong electromagnetic noise located within the control cabinet (drives, Transformers, etc.) can induce interference in a VARAN bus line. Spike voltages are dissipated 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 for all electronic components be connected within the control cabinet.



7.4 Connecting Noise-Generating Components

With the connection of power components, which generate strong electromagnetic interference, it is also critical to ensure correct shielding. The shielding should be placed before a power element (or group of power elements).



7.5 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 of both cabinets. Noise can be thereby stopped from reaching the electronics within the control cabinet.