

MSD Power Supply Unit (PSU)

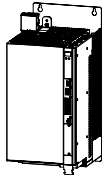
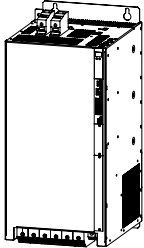
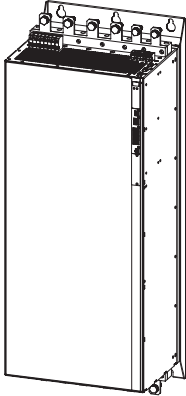
Operation Manual



Multi-Axis System

Supply unit with sinusoidal regeneration



Size (BG)	Size 5	Size 6A	Size 7
Device	G396-026 G396-050	G396-075 G396-110	G396-250 G396-360
Figure			

MSD Servo Drive high-performance drives

The modularity of the MSD Servo Drive guarantees optimum integration into the machine process. Whether in high-speed field bus communication with the central multi-axis machine controller or with distributed programmable Motion Control intelligence in the servo drive, the MSD Servo Drive is a master of both.

MSD Power Supply Unit (PSU) Operation Manual Multi-Axis System

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The German version is the original of this Operation Manual.

Subject to technical change without notice

The content of our documentation was compiled with the greatest care and attention, and based on the latest information available to us.

We should nevertheless point out that this document cannot always be updated simultaneously with the on-going technical development of our products.

Information and specifications may be subject to change at any time. For information on the latest version please refer to drives-support@moog.com.

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1 General

The product CD from Moog contains the complete documentation for the related product series. The documentation for a product series includes the Operation Manual (hardware description), device help (software description) as well as further user manuals (e.g. field bus description and specifications). The documents are available in the formats PDF or HTML.

1.1 Target group

Dear user,

the documentation forms part of the device and contains important information on operation and service. It is aimed at all persons who undertake mounting, installation, commissioning and servicing work on the product.

1.2 Prerequisites

Prerequisites for the usage of devices from Moog:

- The documentation on the devices is to be stored so it legible, accessible at all times and for the entire life of the product.
- Read and ensure you understand the documentation on your device.
- Qualification: to prevent injury or damage, personnel may only work on the device if they have electrical engineering qualifications.
- Knowledge required:
 - National health and safety regulations (e.g. DGUV A3 in Germany)
 - Mounting, installation, commissioning and operation of the device

Work in other areas, for example transport, storage and disposal is only allowed to be undertaken by trained personnel.



NOTE

This Operation Manual only applies to the supply unit for the MSD Multi-Axis System (referred to in the following as the supply unit or MSD Power Supply Unit).

1.3 Reference documents

Document	Contents	ID no. Format
MSD Single-Axis Servo Drive Compact-Operation Manual	Safety, mechanical installation, electrical installation, commissioning, diagnostics, specifications, certification and applicable standards, technical data	CA97555-001 PDF
MSD Servo Drive AC-AC Servo Drive Single-Axis System - Operation Manual	Safety, mechanical installation, electrical installation, commissioning, diagnostics, specifications, certification and applicable standards, technical data	CA65642-001 PDF
MSD Servo Drive DC-AC Servo Drive Multi-Axis System - Operation Manual	Safety, mechanical installation, electrical installation, commissioning, diagnostics, STO, operation with Servo drive as supply, planning, application example, specifications, certification and applicable standards, technical data	CA97554-001 PDF
MSD Power Supply Unit (PSU) Multi-Axis System - Operation Manual	Safety, mechanical installation, electrical installation, commissioning, diagnostics, specification, certification and applicable standards, technical data	CA97556-001 PDF
MSD Servo Drive Sercos II - User Manual	Safety, commissioning, communication phases, parameter interface, error, warning and status messages, operation modes, weighting, referencing, touchprobe, parameter lists	CA65648-001 PDF
MSD Servo Drive Sercos III - User Manual	Safety, installation and connection, commissioning and configuration, parameterisation, data transmission, scaling and weighting, functionality, error message and diagnostics, parameter lists	CA97557-001 PDF
MSD Servo Drive Field bus systems CANopen/EtherCAT - User Manual	Safety, commissioning, data transmission, operation modes, referencing, parameters, technical data	CA65647-001
MSD Servo Drive Field bus systems PROFIBUS/PROFINET - User Manual	Description and configuration of the parameters for the MSD Servo Drive on the PROFIBUS/PROFINET field bus system	CA65645-001 PDF
Modular Multi-Axis Servo Drive System - MSD-Ordering Catalog	Information, notes on ordering, specifications and technical data on: MSD Single-Axis Servo Drive Compact, MSD Single-Axis System, MSD Multi-Axis System, safety technology, communication, technology, function packages, accessories and motors	CDL 29950-en PDF
MSD Servo Drive - Device Help	Description of the software functionality MSD Servo Drive, firmware versions: - MSD Single-Axis Servo Drive Compact from V1.30-xx - MSD Single-Axis System from V3.25-xx - MSD Multi-Axis System from V3.25-xx	CB40859-001 PDF und HTML
Program help Moog DRIVEADMINISTRATOR 5 PC user software	Context-sensitive help for Moog DRIVEADMINISTRATOR version 5.x graphic PC user software for initial commissioning and serial commissioning, operation, diagnostics and project management	CB19692-001

1.4 Order code

The MSD Power Supply Unit has the article designation G396-xxx-xxxxxxx. This provides information on the related variant of the MSD Power Supply Unit supplied. The significance of the individual characters of the article designation is given in the following order code.

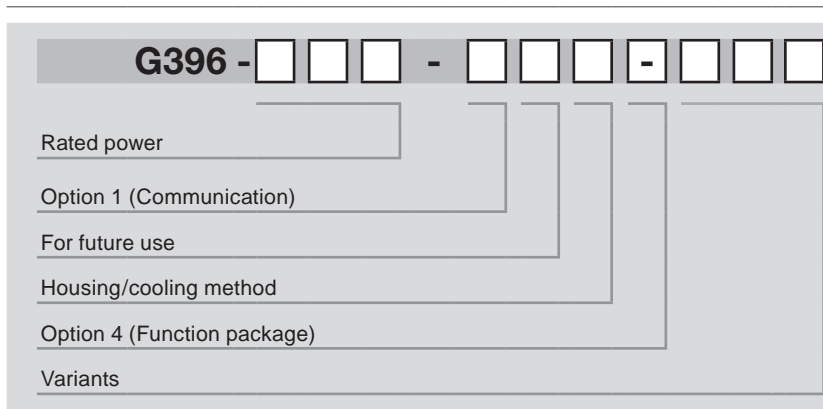


Figure 1.1 Order code MSD Power Supply Unit

1.5 Data on manufacture

On the rating plate for the MSD Power Supply Unit you will find the serial number, from which you can identify the date of manufacture based on the following key. For the location of the rating plate on the MSD Power Supply Unit refer to chap. 4.3 FF.



Figure 1.2 MSD Servo Drive hardware rating plate

1.6 Scope of supply

The scope of supply includes:

- MSD Power Supply Unit
- Pre-assembled DC link cables up to Size 5
- Product CD with booklet (safety and application instructions for electrical equipment in 25 languages)

Mains connection set required

The mains connection set is required for the intended use of the MSD Power Supply Unit. The scope of supply includes:

- Mains filter
- Input choke with film capacitor
- Step-up choke
- Shield plates and clamps (only for the sizes Size 5 and Size 6A)

1.7 Pictograms

The pictograms used in this Operation Manual signify the following for the user:



NOTE

Useful information or reference to other documents.

1.(digit)

ACTION TO BE TAKEN

Action undertaken by the user or the system.

You will find the pictograms used in this Operation Manual for "safety instructions and warnings" in *chapter 2 Safety*.

1.8 Disclaimer

Following the documentation on the devices from Moog is a prerequisite:

- For safe operation.
- To achieve stated performance features and product characteristics.

Moog does not accept any liability for injuries, damage or financial losses that result from the failure to follow the documentation.

1.9 Disposal

Follow the applicable national regulations! If necessary, dispose of individual parts, depending on their characteristics and existing national regulations, e.g. as:

- Electrical waste
- Plastic
- Metal

Or engage a certified disposal organisation with scrapping

1.10 Helpline/Support & Service

Our Helpline will help you with fast, specific assistance if you have any technical queries relating to project planning or commissioning your device.

Address: Moog GmbH
Hanns-Klemm Straße 28
D-71034 Böblingen
Phone: +49 7031 622-0
E-mail: drives-support@moog.com

If you need service assistance, the Moog specialists will be pleased to be of assistance.

Service - Please contact us:

Phone: +49 7031 622-0
E-mail: info.gemany@moog.com

2 Safety

2.1 Overview

Our devices are state-of-the-art and comply with recognised safety regulations, nevertheless hazards can arise. In this chapter:

- We provide information on residual risks and hazards that can emanate from our devices on usage as intended.
- We warn about the foreseeable misuse of our devices.
- We refer to the necessary care and measures to be taken to prevent risks.

2.2 Measures for your safety



NOTE

Please only install and place in operation your device taking into account the documentation for the related device family!

Our devices are quick and safe to operate. For your own safety and for the safe function of your device, please be sure to observe the following points:

- 1. Follow safety instructions for the devices:**
Follow all safety instructions and warnings in the entire documentation related to the device series.
- 2. Electric drives are dangerous:**
 - Due to electrical voltages up to 480 V AC and up to 900 V DC
 - Even 10 min. after switching off the mains supply, dangerously high voltages of ≥ 50 V may still be present (capacitor charge). So check that electrical power is not present! See also the warning label on the front panel on the device.
 - Rotating parts
 - Automatically starting drives.
 - Hot components and surfaces

3. Protection against magnetic and/or electromagnetic fields during installation and operation.

Persons fitted with heart pacemakers, metallic implants and hearing aids etc. must not be allowed access to the following areas:

- Areas in the immediate vicinity of electrical equipment!
- Areas in which electronics components and servo drives are installed, repaired and operated!
- Areas where motors are installed, repaired and operated!
Motors with permanent magnets pose particular hazards.

4. During installation observe the following:



- Comply with connection conditions and technical data as per the documentation and the rating plate!
- Comply with standards and directives on electrical installation, such as cable cross-section, shielding, etc.!
- Do not touch electronic components and contacts!
Electrostatic discharge can harm people and destroy components!
- Take protection measures and use protective devices as per the applicable regulations (e.g. IEC/EN 60204 or IEC/EN 61800-5-1)!
- Take "device earthing" protection measure!

5. Ambient conditions

- Follow the instructions on the transport, storage and correct operation of the devices stated in the Operation Manual in "A Appendix".

2.3 General safety instructions and warnings

Hazards may emanate from our devices. For this reason it is imperative you follow the safety instructions and warnings in this document.




DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none"> • Carelessness will result in serious injuries or death. Follow safety instructions and warnings in this document and on the device.
WARNING!	Risk of injury due to electrical power!
	<ul style="list-style-type: none"> • Carelessness may result in serious injuries or death. Follow safety instructions and warnings in this document and on the device.
CAUTION!	Risk of injury or damage to the device due to incorrect operation!
	<ul style="list-style-type: none"> • Carelessness may result in minor injuries or damage. Follow safety instructions and warnings in this document and on the device.
WARNING!	Risk of injury due to hot surfaces and components!
	<ul style="list-style-type: none"> • Carelessness may result in serious burns. Electronic components may become hot during operation! Follow safety instructions and warnings in this document and on the device!
Caution!	Damage due to electrostatic discharge!
	<ul style="list-style-type: none"> • Electrostatic discharge can destroy components. Do not touch electronic components and contacts! Follow safety instructions and warnings in this document and on the device!
DANGER!	Risk of injury due to rotating parts on the motor!
	<ul style="list-style-type: none"> • Carelessness will result in serious injuries or death. Follow safety instructions and warnings in this document.

Pay attention to **special safety instructions and warnings** that are given here in the document before a specific action and that warn the user about a **specific hazard!**



NOTE:

The pictograms may also be used on their own with the signal word, e.g. in the connection diagrams, however they have the same function as in the complete warning.

DANGER	WARNING	CAUTION
		

2.4 Intended use

Our devices are components intended for stationary electrical systems and machines in the industrial and commercial sector.

CE The supply unit for the MSD Servo Drive Multi-Axis System conforms to the **Low Voltage Directive 2014/35/EU**

Tested and certified according to applicable standards (see declaration of conformity in chap. 2.8).

This supply unit is only allowed to be combined with the axis controllers in the MSD Servo Drive Multi-Axis System.

When installed in machines it is prohibited to start up intended operation until it has been ascertained that the completed machine fully complies with the provisions of the Machinery Directive (2006/42/EC); compliance with IEC/EN 60204 is mandatory.

Starting up intended operation is only permitted on compliance with the EMC Directive 2014/30/EU

The devices meet the requirements of the harmonised product standard IEC/EN 61800-5-1.

2.4.1 The MSD Servo Drive Multi-Axis System

The MSD Power Supply Unit is intended for use in a MSD Multi-Axis System. The multi-axis system comprises at least one MSD Power Supply Unit with the mains connection set and several MSD Servo Drives DC-AC connected to it. In motor operation the supply unit draws energy from the supply system and makes it available to the DC-AC Servo Drives connected via the DC link. In regenerative operation the energy is stored in the DC link. Temporarily surplus energy is fed back to the supply system in sinusoidal form by the supply unit.

2.4.2 Repair

Only have repairs undertaken by authorised repair shops. Unauthorised opening and incorrect intervention could lead to death, injury or damage. The warranty provided by Moog will be rendered void.

2.5 Misuse

Our devices are:

- Not intended for installation in vehicles. Deployment of the device in mobile equipment is classed as non-standard ambient conditions, and is permissible only by special agreement.
- Not intended for installation in environments with harmful oils, acids, gases, vapours, dusts, radiation etc.
- Not approved for usage in special applications (e.g. in potentially explosive atmospheres or areas in which there is a risk of fire).
- Not approved for usage outside a switch cabinet
- Not approved for the generation of high-frequency onboard networks for which the device is not designed

2.6 Responsibility

Electronic devices are not fail-safe. The installer and/or operator of a complete machine or system is responsible:

- For ensuring the drive is rendered safe if the device fails
- For ensuring the safety of personnel and machinery
- For ensuring the complete machine is in correct working order
- For the risk assessment on the complete machine or system according to EN ISO 12100 (formerly EN ISO 14121) and EN ISO 13849-1 (formerly DIN EN 954-1)

Pay attention to the topic of "Electrical equipment of machines" in EN 60204-1:2006 "Safety of machinery". The safety requirements on electrical machines defined there are intended to protect personnel and machinery or systems.

The emergency stop function (as per IEC/EN 60204) shuts down the supply of power to a machine, which results in the drives coasting down in an uncontrolled manner. To avert hazards, check whether it is appropriate:

- To keep individual drives in operation
- To initiate specific safety procedures
- To incorporate a Safe Torque Off function (Safe Torque Off: movement stop by "switching off the electrical supply" - STO)

2.7 Relevant laws, standards and directives applied

For information on the laws, standards and directives applied by Moog, refer to the declaration of conformity.



NOTE:

Depending on the specific application for the devices, other laws, standards and directives with provisions on "Safety" may apply. If necessary, contact the machine or system manufacturer.



NOTE:

Due to possible output frequencies > 600 Hz, the servo drives fall under Dual Use Regulation (EU) no. 1382/2014 dated 22 October 2014 item 3A225. Export authorisation is therefore required for non-EU countries. Please note the information in the delivery documents.

2.8 Declaration of conformity

EU DECLARATION OF CONFORMITY
IN ACCORDANCE WITH EN ISO/IEC 17050-1 | PAGE 1 OF 1

DOCUMENT NO. MRQ48239-001 REV. C (TRANSLATION OF ORIGINAL)

The Manufacturer Moog GmbH	Hanna-Kloemmer-Str. 25 - 71254 Boeblingen - Germany +49 7031 822 0 +49 7031 822 100 info.germany@moog.com http://www.moog.de
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DECLARES UNDER SOLE RESPONSIBILITY that the following product has been manufactured in conformity with the requirements of the Directive 2014/35/EU [Low Voltage Directive] of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.

MSD POWER SUPPLY UNIT (PSU)	
Product type	G396

Following harmonized standard has been applied	EN 61800-5-1: 2007 + A1:2017 - Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------

10/30/2020	Moog GmbH, Boeblingen	Thomas Czappel	
Date	Site	Managing Director	Signature



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WHAT MOVES YOUR WORLD

3 Mechanical installation

The device is designed only for installation in a stationary switch cabinet. The switch cabinet must as a minimum provide IP4x protection.

3.1 Notes for mechanical installation

WARNING!	Risk of injury due to hot surfaces on the device!
	<ul style="list-style-type: none"> • Carelessness may result in serious burns. <p>The device and especially the heat sink heat up significantly during operation and can reach temperatures of up to +100 °C (+212 °F). The chokes connected also heat up during operation and can reach temperatures of up to +145 °C (+293 °F). Prior to starting work, make sure the device has cooled down.</p> <p>On touching there is a risk of burns to the skin. For this reason provide protection against touching.</p> <p>During mounting maintain an appropriate distance to neighbouring assemblies.</p>
CAUTION!	Damage to the device due to incorrect installation conditions!
	<p>The device may suffer irreparable damage.</p> <p>For this reason</p> <ul style="list-style-type: none"> • Moisture must not be allowed to enter the device • There must not be any aggressive or conductive substances in the ambient air • Foreign bodies such as drilling chips, screws, washers etc. must not be allowed to fall into the device • The ventilation openings must not covered



NOTE:

The supply unit must not be installed in areas where it would be permanently exposed to vibration. You will find further information in Table A.16 in the appendix.



NOTE:

On installing the supply unit in a MSD Multi-Axis System, it is also imperative the Operation Manual for the DC-AC Servo Drives is followed.

3.1.1 Arrangement and mounting

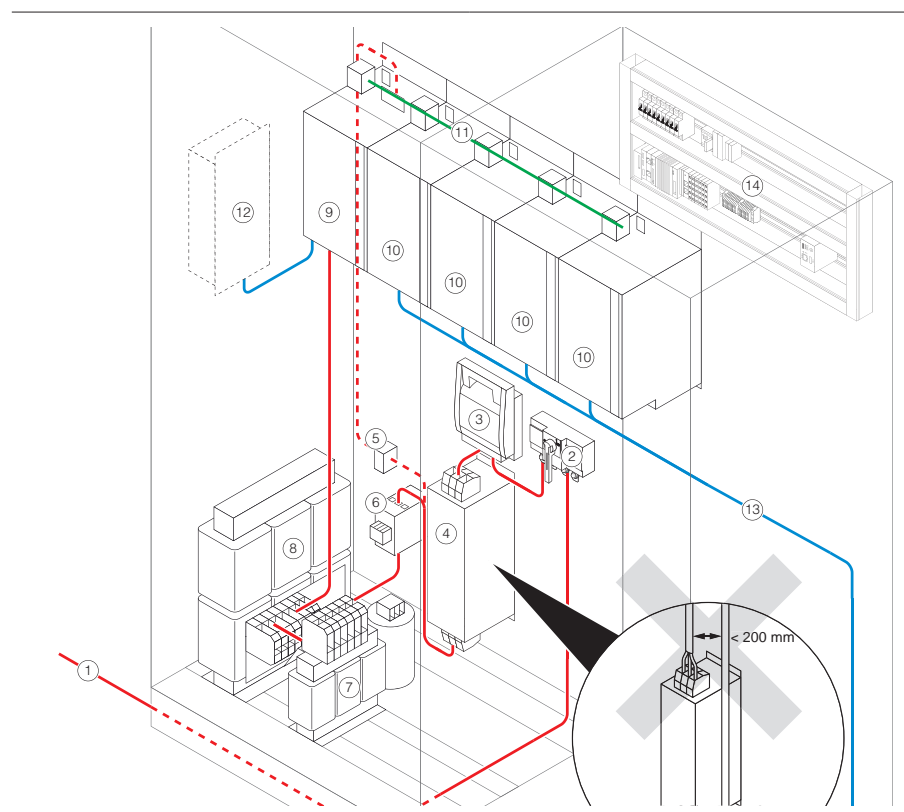
The following guidelines apply in principle to the supply unit and DC-AC Servo Drive:

- The backing plate must be well-earthed.
- To attain the best result for effective EMC installation you should use a chromated or galvanised backing plate. If backing plates are varnished, remove the coating from the contact area! The devices have a galvanised sheet steel back panel.
- Maximum pollution degree 2 according to IEC/EN 60664-1. You will find further information on ambient conditions in Table A.14 in the appendix.
- Cooling air must be able to flow through the device without restriction.
- On installation in cabinets with convection (= heat loss is dissipated to the outside via the switch cabinet walls), always fit an internal air circulation fan.
- Devices with different housing variants (wall mounting and liquid cooling) can be mounted side-by-side in any combination.
- Devices with the liquid cooling housing variant have a spacer on the rear in place of the heat sink. As a consequence it is possible to connect devices with the wall mounting housing variant using pre-assembled DC link cables without additional compensation measures in relation to the device depth.
- Between the devices, minimum distances as per Table 3.1 and Table 3.2 are to be met.
- The maximum distance between the devices up to size Size 5 is defined by the pre-assembled connection cables supplied and is 2 mm (for exceptions see Table 3.1 and Table 3.2).

3.2 Switch cabinet layout

The positioning of the components in the switch cabinet has a significant effect on the trouble-free system and machine function. You should take into account the following points in your planning:

- Evaluate the assemblies used in relation to EMC.
- Divide the switch cabinet into zones with different power and interference levels.
- For devices susceptible to interference, maintain a distance of at least 200 mm (7.87 in) from the following components:
 - Servo drive
 - Input and output chokes, transformers
 - Mains, motor, DC power supply and braking resistor cables (even if shielded)
 - Relay and contactors (even if interference-suppressed)
- For small distances use separators for shielding; fasten the separators directly and conductively to the backing plate.
- If a motor contactor or motor choke is used, the component should be positioned directly at the servo drive.
- Do not use fluorescent lamps in switch cabinets, as they emit high-frequency interference.
- Fit contactors, relays, solenoid valves, switched inductors and capacitors with suppressors.
- The mains filter must be mounted on the backing plate as close as possible to the feed point and with large surface area contact. The backing plate must be connected to the central earthing point with a low-impedance connection. No unfiltered cables are allowed to be laid on the mains input side of the filter so that no interference can be coupled into the cables.



Key

- | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| 1) Mains cable | 6) Mains contactor |
| 2) Main switch | 7) Input choke with capacitor connected |
| 3) Fuses | 8) Step-up choke |
| 4) Mains filter | 9) MSD Power Supply Unit |
| Cables without interference suppression must be laid at a distance of at least 200 mm (7.87 in) from the mains input side of the filter so that no interference can be coupled into the cables. | |
| 5) Circuit breaker | 10) MSD Servo Drive DC-AC |
| | 11) DC power supply via DC link cable |
| | 12) Braking resistor |
| | 13) Motor cables |
| | 14) Controller |

Figure 3.1 Example: arrangement in the switch cabinet

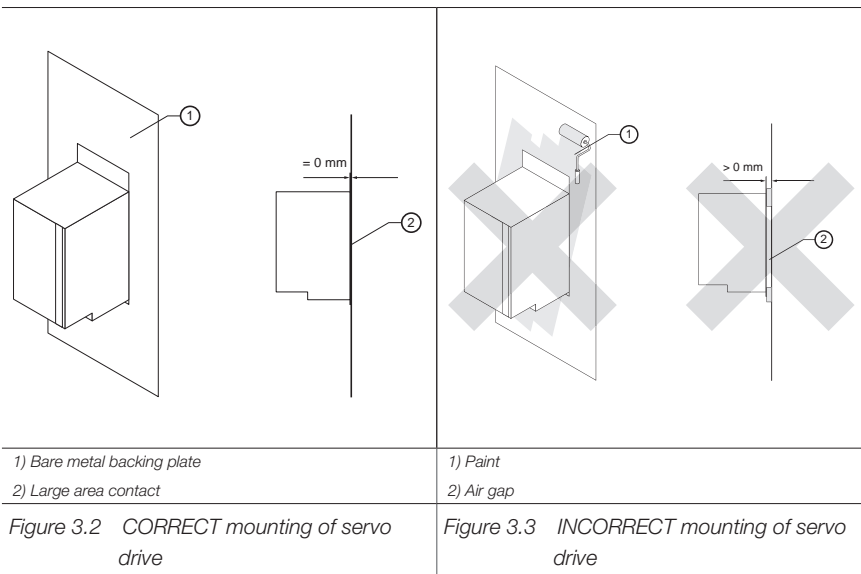


NOTE:

Arrange the controller separated from the power area to prevent EMC coupling mechanisms.

Control cables, signal cables and cable shields have been omitted for clarity.

- Use bare metal backing plates.
- The rear of the servo drive must have good contact to the switch cabinet ground. The contact area must be bare metal to establish a good ground connection to the switch cabinet ground. There must not be an air gap between the rear wall of the servo drive and the wall of the switch cabinet.
- The bases of the chokes must have good contact to the switch cabinet ground. The contact area must be bare metal to establish a good ground connection to the switch cabinet ground.



3.3 Mounting MSD Power Supply Unit, wall mounting housing variant

Arrange the devices starting from the supply unit to the right or left sorted in descending order by power rating to minimise thermal interaction. Pay attention to the notes on effective EMC installation prior to mounting the devices and components in the switch cabinet.

1.
 - Align the supply unit Size 5 and all MSD Servo Drive DC-AC in a line along the top edge of the devices (see line A in Figure 3.4). This action is necessary to be able to make the DC link connections.
 - Align the supply unit Size 6A and all MSD Servo Drive DC-AC in a line along the top edge of the devices (see line A in Figure 3.5). This action is necessary to be able to make the DC link connections. Move down the mounting bores for the supply unit Size 6A and the MSD Servo Drive DC-AC Size 6A by approx. 20 mm (0.79 in) (see red line B in Figure 3.5). It is imperative you pay attention to the information in Table 3.1 on the mounting distances.

Mark out the position of the tapped holes on the backing plate.
Cut a thread for each fixing screw in the backing plate.

2. Note the mounting distances. Also pay attention to the bending radius of the connection cables. For dimensional drawings/hole spacing see Figure 3.6 and Table 3.1.
3. Mount the supply unit vertically and butt-mounted in a row on the backing plate. The contact area must be bare metal.

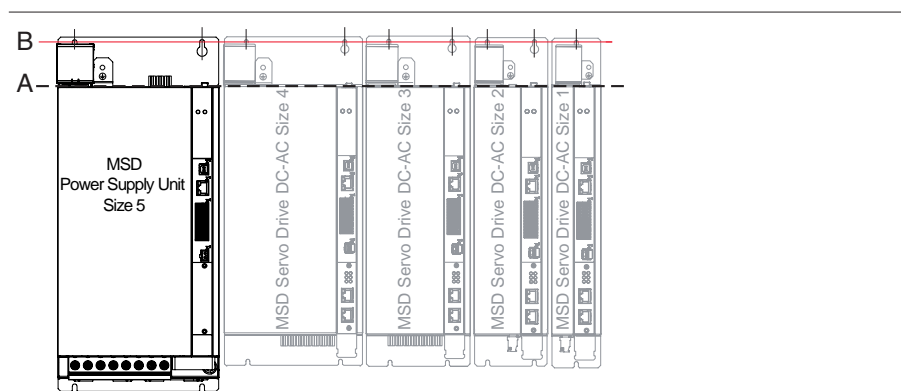


Figure 3.4 Butt mounting axis group, wall mounting with supply unit Size 5

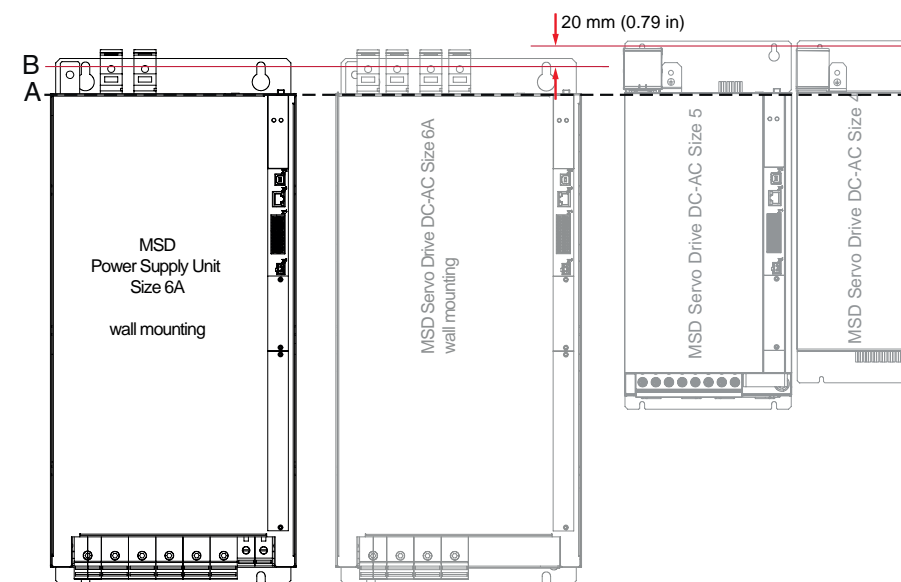


Figure 3.5 Butt mounting axis group, wall mounting with supply unit Size 6A

3.3.1 Dimensions, wall mounting housing variant

Size	Size 5	Size 6A
Device	G396-026 G396-050	G396-075 G396-110
Weight kg (lb)	13 (28.7)	32 (70.6)
B (width)	190 (7.48)	280 (11.02)
H (height) ¹⁾	345 (13.58)	540 (21.26)
D (depth) ¹⁾	238 (9.37)	322 (12.68)
A	150 (5.91)	200 (7.87)
C	406.5 (16)	581 (22.87)
C1	6 (0.24)	10 (0.39)
H1	418.5 (16.48)	600 (23.62)
H2	15 (0.59)	20 (0.79)
H3	64 (2.52)	166 (6.54)
D Ø	5.6 (0.22)	9.5 (0.37)
Fastening screws	4 x M5	4 x M8
E	Direct side by side mounting, maximum 2 mm (0.08 in)	Direct side by side mounting, maximum 2 mm (0.08 in) / 40 ²⁾
F ³⁾	≥180 (7.09)	
G ³⁾	≥300 (11.81)	≥500 (19.69)

All dimensions in mm (in),

1) Without terminals, connectors

2) Mounting distance Size 6A to other Size 6A

3) Also pay attention to the bending radius of the connection cables

Table 3.1 Dimensions, wall mounting housing variant



NOTE:

On butt mounting devices with different drive powers you should arrange the devices in descending order by power rating (e.g., viewed from the left, Size 4-Size 3-Size 2-Size 1). This arrangement will minimise the thermal interaction. The supply unit must always be fitted beside the servo drive with the highest power.

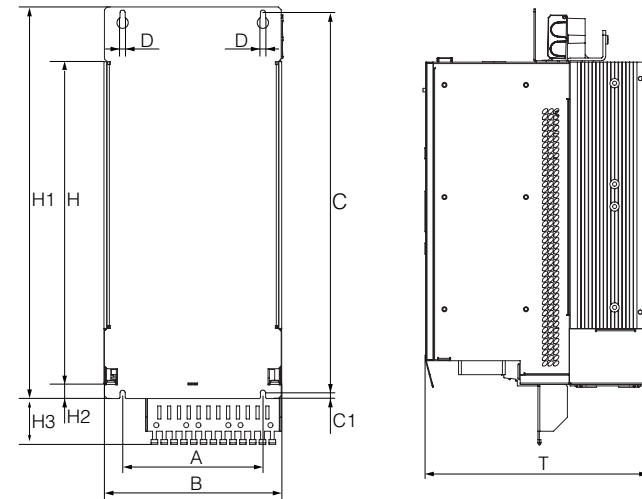


Figure 3.6 Dimensional drawing wall mounting housing variant Size 5 + Size 6A (symbolic depiction)

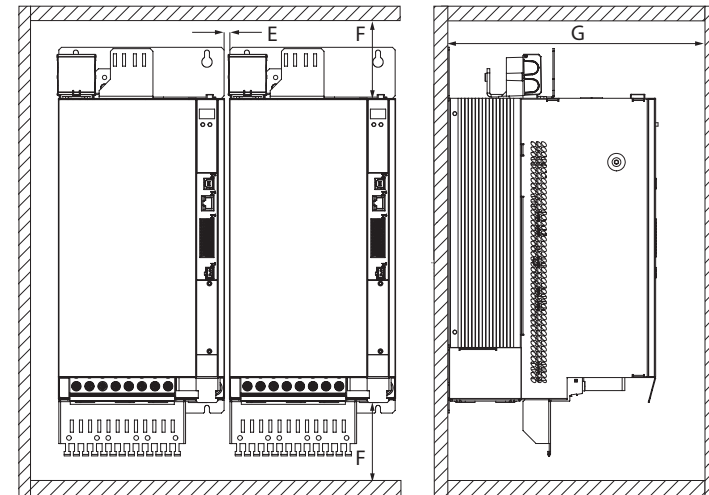


Figure 3.7 Mounting distance wall mounting housing variant Size 5 + Size 6A (symbolic depiction)

3.4 Mounting MSD Power Supply Unit, liquid cooling housing variant

Arrange the devices starting from the supply unit to the right (up to MSD Servo Drive DC-AC Size 5) or left (from MSD Servo Drive DC-AC Size 6A) sorted in descending order by power rating to minimise thermal interaction. Pay attention to the notes on effective EMC installation prior to mounting the devices and components in the switch cabinet.

1.
 - Align the supply unit Size 5 and all MSD Servo Drive DC-AC in a line along the top edge of the devices (see line A in Figure 3.8). This action is necessary to be able to supply the DC power using the pre-assembled cables.
 - Align all MSD Servo Drive DC-AC and the supply unit Size 6A in a line along the top edge of the devices (see line A in Figure 3.9). Move down the mounting bores for DC-AC Servo Drive Size 6A and the supply unit Size 6 by approx. 20 mm (0.79 in) (see red line B in Figure 3.9). This action is necessary to be able to make the DC link connections.
 - Align all MSD Servo Drive DC-AC and the supply unit Size 7 in a line along the top edge of the devices (see line A in Figure 3.10). Move down the mounting bores for the supply unit Size 7 by approx. 28 mm (1.10 in) and for the DC-AC Servo Drive Size 6A by approx. 20 mm (0.79 in) (see red line B in Figure 3.10). In addition, a distance of ≥ 40 mm (1.58 in) must be maintained at the side (in the figure to the right of the supply unit Size 7). This action is necessary to be able to make the DC link connection.

Mark out the position of the tapped holes and the pipe fittings on the backing plate. Drill holes and cut a thread for each fixing screw in the backing plate. Note the mounting distances. Also pay attention to the bending radius of the connection cables. For dimensional drawings/hole spacings see Figure 3.8 to Figure 3.10 and Table 3.2.

2.
 - 3. Mount the supply unit vertically and butt-mounted in a row on the backing plate. The contact area must be bare metal.

4.
 - On screwing the hose connections (not included in the scope of supply) into the pipe fittings, lock the pipe fittings using a 22 mm (0.87 in) open-ended wrench to prevent damage due to the application of torque to the device. Pay attention to a perfectly sealed connection without leaks (e.g. using Teflon sealing tape). You will find further notes on the liquid cooling in chap. A.4, p. 80.

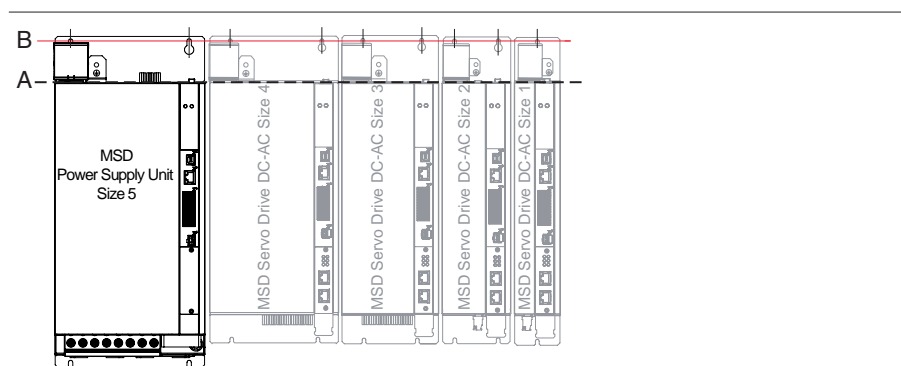


Figure 3.8 Butt mounting axis group with liquid cooling and supply unit Size 5

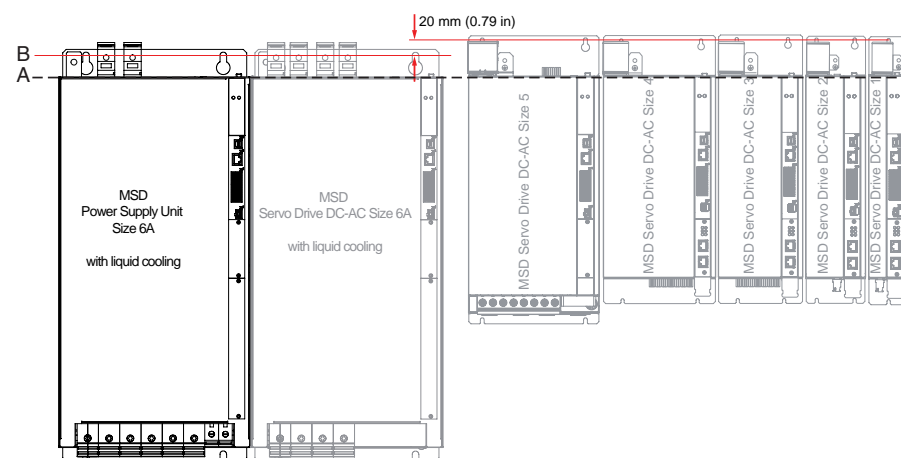


Figure 3.9 Butt mounting axis group with liquid cooling and supply unit Size 6A

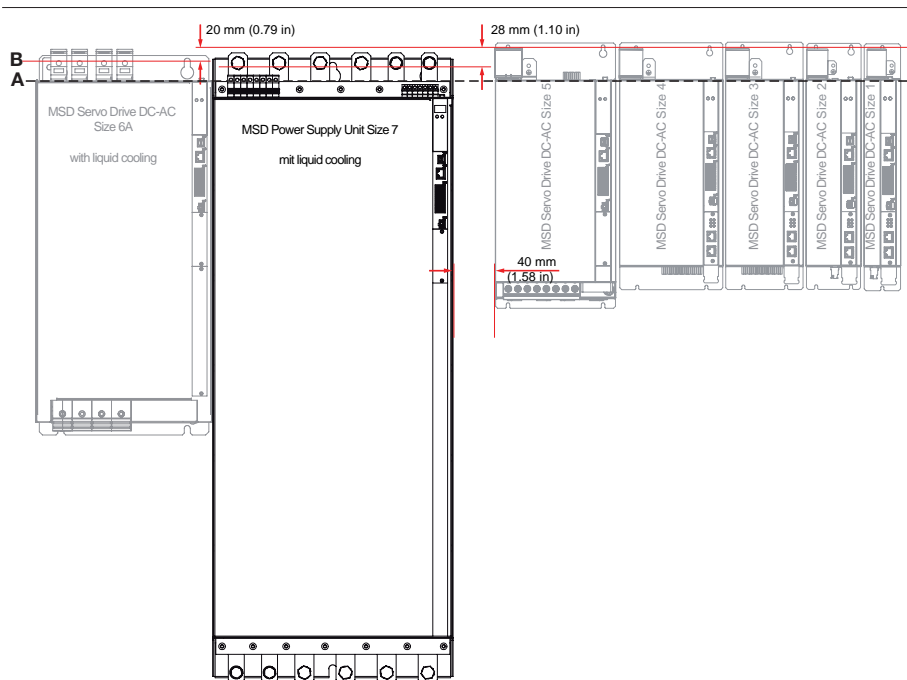


Figure 3.10 Butt mounting axis group with liquid cooling and supply unit Size 7

3.4.1 Dimensions, liquid cooling housing variant

Size	Size 5	Size 6A	Size 7
Device	G396-026 G396-050	G396-075 G396-110	G396-250 G396-360
Weight kg (lb)	13 (28.7)	32 (70.6)	90 (198.5)
B (width)	190 (7.48)	280 (11.02)	380 (14.96)
H (height) ¹⁾	345 (13.58)	540 (21.26)	855 (33.66)
D (depth) ¹⁾	238 (9.37)	285 (11.22)	287 (11.3)
A	150 (5.91)	200 (7.87)	150 (5.91)
A1	40 (1.57)	65 (2.56)	69 (2.72)
A2		70 (2.76)	
C	406.5 (16)	581 (22.87)	955 (37.6)
C1	6 (0.24)	10 (0.39)	14 (0.55)
H1	418.5 (16.48)	600 (23.62)	980 (38.58)
H2	15 (0.59)	20 (0.79)	62 (2.44)
H3	54 (2.13)	56.5 (2.22)	124 (4.88)
H4	64 (2.52)	166 (6.54)	-
T1		74 (2.89)	
DØ	6.5 (0.26)	10 (0.37)	12 (0.47)
Fastening screws	4 x M6	4 x M8	6 x M10
S Female thread		3/8 inch	
D1 Ø Bore for pipe fitting		48 (1.89)	
E ²⁾	Direct butt mounting)	Butt mounting ≥ 9 mm (≥ 40 mm distance see Figure 3.10)	
F ^{2) 3)}	≥180 (7.09)		
G ^{2) 3)}	≥300 (11.81)	≥500 (19.69)	≥500 (19.69)

All dimensions in mm (in)

1) Without terminals/connections

2) See Figure 3.13, Figure 3.14

3) Also pay attention to the bending radius of the connection cables

4) Without/with busbars

Table 3.2 Dimensions, liquid cooling housing variant

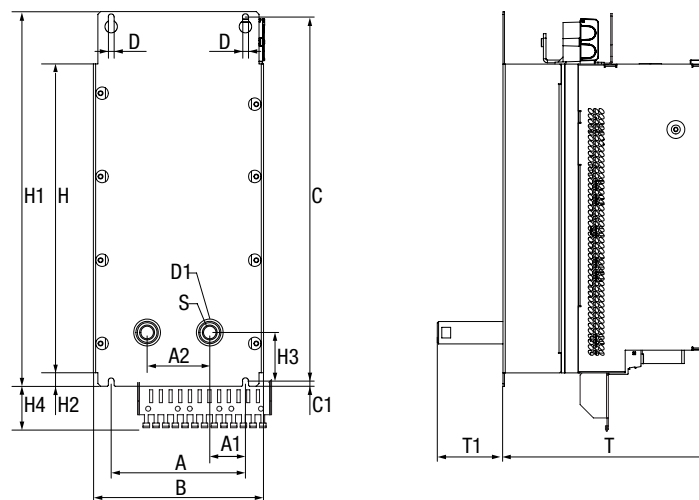


Figure 3.11 Dimensional drawing, liquid cooling housing variant Size 5 + Size 6A (symbolic depiction)

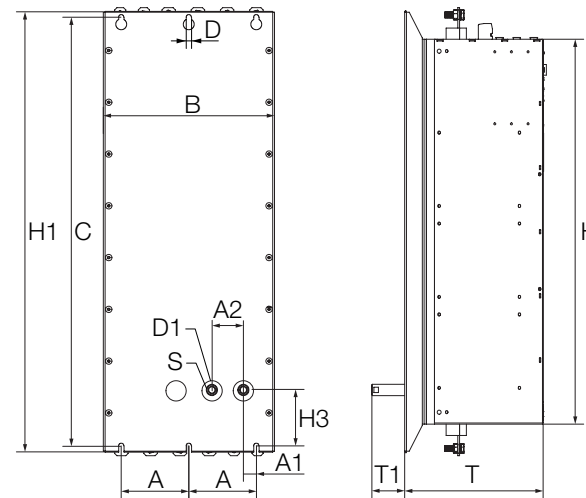


Figure 3.12 Dimensional drawing, liquid cooling housing variant, based on Size 7 as an example

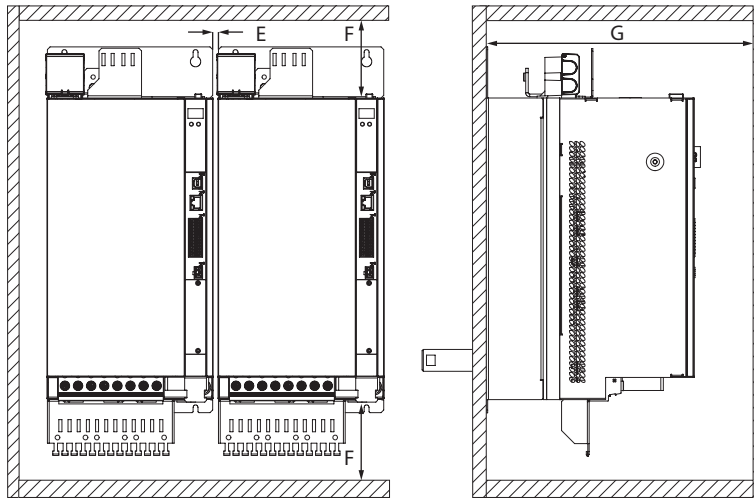


Figure 3.13 Mounting distance, liquid cooling housing variant Size 5 + Size 6A (symb. depiction)



NOTE:

On butt mounting devices with different drive powers you should arrange the devices in descending order by power rating (e.g., viewed from the left, Size 4-Size 3-Size 2-Size 1). This arrangement will minimise the thermal interaction. The supply unit must always be fitted beside the servo drive with the highest power.

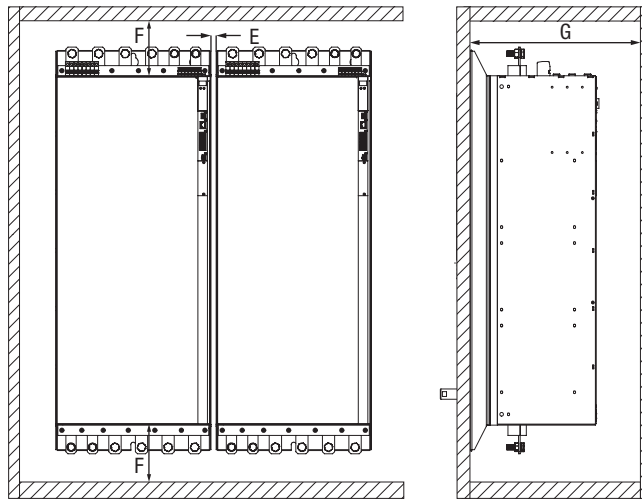


Figure 3.14 Mounting distance, liquid cooling housing variant, based on Size 7 as an example

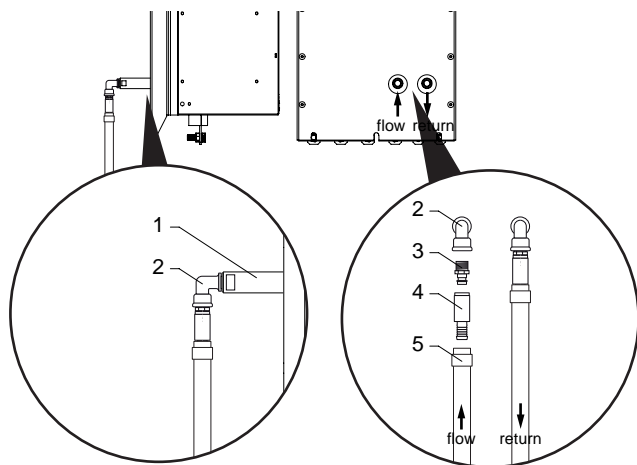
3.5 Cooling circuit connection



NOTE:

Connect the flow from the liquid cooling to the connection marked. The cooling circuit must be bled prior to commissioning. You will find further notes on the liquid cooling in the appendix chap. A.4.

The device has a capacity of approx. 0.5 l of coolant. After the disconnection of the connections, liquid may be left in the device and escape if the device is tipped. We recommend the usage of a self-sealing liquid coupling (not included in the scope of supply) to prevent the coolant escaping and to make it possible to disconnect and connect in the filled state. The cooling circuit connection set (CB37132-001) can be ordered separately.



- 1) Liquid connection with 3/8 inch female thread
 - 2) 90° elbow fitting with 3/8 inch female thread and male thread
 - 3) Self-sealing liquid coupling
 - 4) Self-sealing quick-release connection with hose connection
 - 5) PUR (polyurethane) hose with clip
- Items 2 to 5 are not included in the scope of supply.

Figure 3.15 Cooling circuit connection

3.6 Mounting step-up choke

Arrange the components and cables from the cooling circuit connection set at a distance >100 mm (3.94 in) from the step-up choke to minimise interaction due to stray magnetic flux and to ensure adequate air circulation for heat dissipation.

1. Position the step-up choke as close as possible to the supply unit. Pay attention to the bending radius of the connection cables. For dimensional drawings/hole spacing see Figure 3.16 and Figure 3.17 and Table 3.3.
2. Mount the step-up choke on the mounting rail. The thread surface area will provide good contact. The contact area must be bare metal to establish a good ground connection to the switch cabinet ground.

3.6.1 Dimensions

For size	Size 5		Size 6A		Size 7	
For device	G396-026	G396-050	G396-075	G396-110	G396-250	G396-360
B (width)	239 (9.41)	299 (11.77)	335 (13.19)	380 (14.96)	540 (21.26)	454 (17.87)
H (height)	273 (10.75)	300 (11.81)	344 (13.54)	399 (15.71)	447 (17.6)	671 (26.42)
T (depth)	124 (4.88)	135 (5.31)	158 (6.22)	200 (7.87)	283 (11.14)	268 (10.55)
A	185 (7.28)	210 (8.27)	248 (9.76)	280 (11.02)	356 (14.02)	300 (11.81)
A1	75 (2.95)	95 (3.74)	122 (4.8)	127 (5)	144 (5.67)	188 (7.4)
D1 Ø	10 x 18 (0.39 x 0.71)	12 x 20 (0.47 x 0.79)	12 x 20 (0.47 x 0.79)	12 x 20 (0.47 x 0.79)	12 x 20 (0.47 x 0.79)	12 x 20 (0.47 x 0.79)
D2 Ø	-	-	-	-	13 (0.51)	13 (0.51)
Fastening screws	4 x M8	4 x M10	4 x M10	4 x M10	4 x M10	4 x M10
Weight kg (lb)	16 (35.3)	27 (59.5)	37.5 (82.7)	56 (123.5)	97 (213.9)	127 (280)

All dimensions in mm (in) and not including terminals/connectors

Table 3.3 Dimensions, step-up choke



NOTE:

The step-up choke is only intended for installation in a switch cabinet because the filter is designed in degree of protection IP00 without protection against touching.

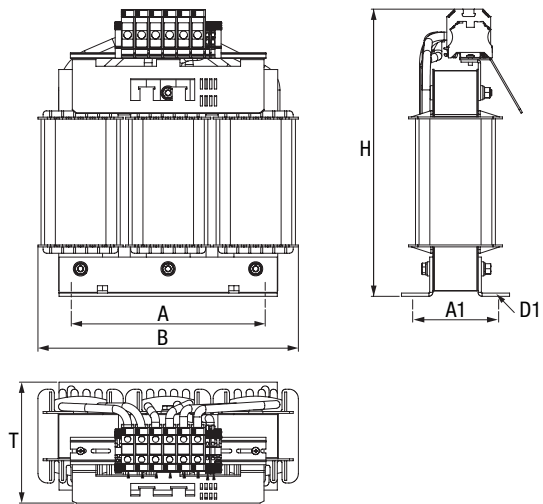


Figure 3.16 Dimensional drawing, step-up choke, based on Size 5 and Size 6A as an example

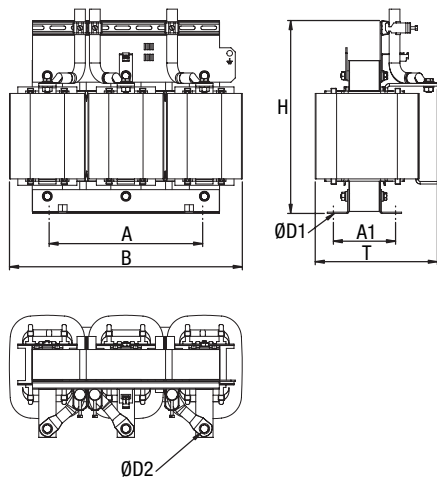


Figure 3.17 Dimensional drawing, step-up choke, based on Size 7 as an example

3.6.2 Cooling the step-up choke

The step-up choke is a primary source of heat and is to be treated as a hotspot component. This component is cooled by natural air convection (gravity circulation). To exploit effectively this physical effect, this component should be mounted in the lower plinth area of the switch cabinet on robust mounting rails (that permit unhindered air flow from below).

On selecting the position, the area of the air inlet at the filter mat or, even better, at the fan blowing in air is to be recommended.



NOTE:

It is imperative you wire the temperature sensor integrated into the winding on the step-up choke to terminal X5 for temperature monitoring!

3.7 Mounting input choke with film capacitor

1. Arrange the components such that adequate air circulation is ensured for heat dissipation. As the film capacitor has a viscous filling, the input choke must be installed with the film capacitor upright. Pay attention to the bending radius of the connection cables. For dimensional drawings/hole spacing see Figure 3.18, Figure 3.19 and Table 3.4.
2. Mount the input choke on the mounting rail. The thread surface area will provide good contact. The contact area must be bare metal to establish a good ground connection to the switch cabinet ground.

3.7.1 Dimensions

For size	Size 5		Size 6A		Size 7	
For device	G396-026	G396-050	G396-075	G396-110	G396-250	G396-360
B (width)	289 (11.38)	289 (11.38)	342 (13.46)	348 (13.7)	297 (11.69)	357 (14.06)
H (height)	252 (9.92)	268 (10.55)	292 (11.5)	321 (12.64)	347 (13.66)	565 (22.24)
T (depth)	119 (4.69)	136 (5.35)	175 (6.89)	175 (6.89)	319 (12.56)	308 (12.13)
A	156 (6.14)	156 (6.14)	176 (6.93)	176 (6.93)	224 (8.82)	310 (12.2)
A1	63 (2.48)	80 (3.15)	95 (3.74)	95 (3.74)	145 (5.71)	146 (5.75)
D1 Ø	7 x 13 (0.27 x 0.51)	7 x 13 (0.28 x 0.51)	9 x 13 (0.35 x 0.51)	9 x 13 (0.35 x 0.51)	10 x 18 (0.39 x 0.71)	12 x 20 (0.47 x 0.79)
D2 Ø	-	-	-	-	13 (0.51)	13 (0.51)
Fastening screws	4 x M6	4 x M6	4 x M8	4 x M8	4 x M8	4 x M8
Weight kg (lb)	10.5 (23.2)	14 (30.9)	20 (44.1)	22 (48.5)	45 (99.2)	71 (156.6)

All dimensions in mm (in) and not including terminals/connectors

Table 3.4 Dimensions, input choke



NOTE:

The input choke is only intended for installation in a switch cabinet because the filter is designed in degree of protection IP00 without protection against touching.

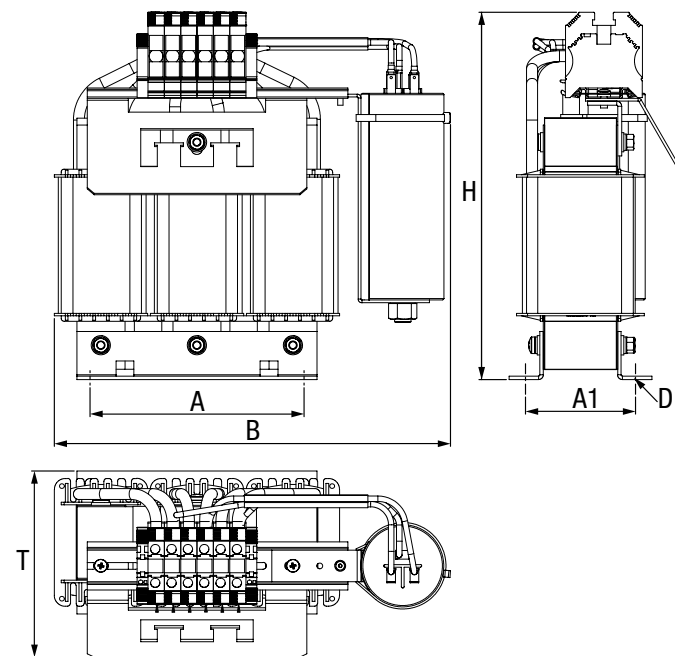


Figure 3.18 Dimensional drawing, input choke, based on Size 5 as an example

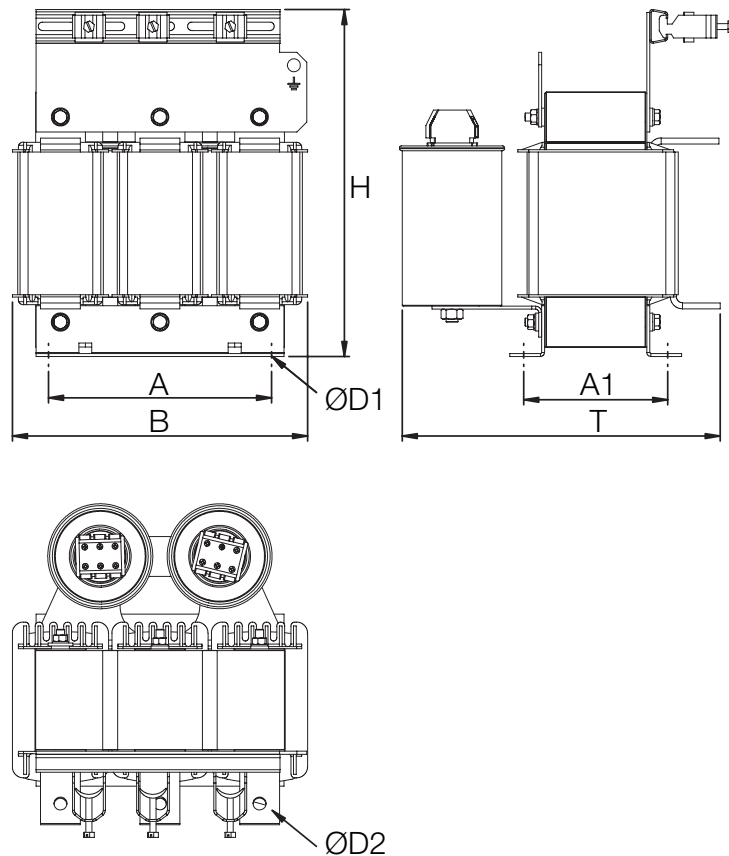


Figure 3.19 Dimensional drawing, input choke, based on Size 7 as an example (G396-250)

3.8 Mounting mains filter

1. Arrange the components such that adequate air circulation and heat dissipation is ensured.
Pay attention to the bending radius of the connection cables.
For dimensional drawings/hole spacing see Figure 3.20 and Table 3.5.
2. Mount the mains filter on the backing plate
The thread surface area will provide good contact. The contact area must be bare metal.

3.8.1 Dimensions

For size	Size 5		Size 6A		Size 7	
	G396-026	G396-050	G396-075	G396-110	G396-250	G396-360
For device	FFU 3 x 56 K	FFU 3 x 80 K	FFU 3 x 130 K	FFU 3 x 180 K	FN 3359- 400-99	FN 3359- 600-99
Type						
B (width)	85 (3.35)	80 (3.15)	90 (3.54)	130 (5.12)	260 (10.24)	260 (10.24)
H (height)	250 (9.84)	270 (10.63)	270 (10.63)	380 (14.96)	300 (11.81)	300 (11.81)
T (depth)	90 (3.54)	135 (5.31)	150 (5.91)	180 (7.09)	115 (4.53)	135 (5.31)
A	60 (2.36)	60 (2.36)	65 (2.56)	102 (4.02)	235 (9.25)	235 (9.25)
C	235 (9.25)	225 (8.86)	255 (10.04)	365 (14.37)	120 (4.72)	120 (4.72)
G Ø	5.4 (0.21)	6.5 (0.26)	6.5 (0.26)	6.5 (0.26)	12 (0.47)	12 (0.47)
Mounting screws	M5	M6	M6	M6	M10	M10
Weight kg (lb)	1.9 (4.2)	2.6 (5.7)	4.2 (9.3)	6.0 (13.2)	10.5 (23.2)	11 (24.3)

All dimensions in mm (in) and not including terminals/connectors

Table 3.5 Dimensions, mains filter



NOTE:

The mains filter is only intended for installation in a switch cabinet because the filter is designed in degree of protection IP00 without protection against touching.

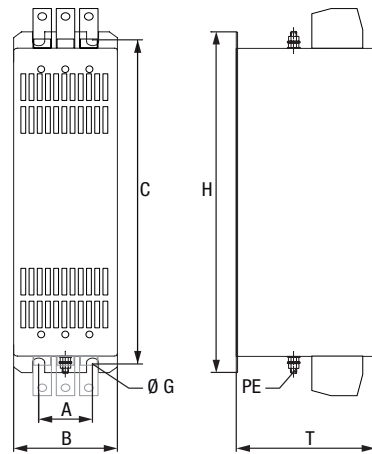


Figure 3.20 Dimensional drawing, mains filter for Size 5 and Size 6A (Fig. differs from the original)



NOTE:

If the axis controllers are supplied by the PSU, situations may occur which render the mains input filter ineffective. The use of a common-mode filter in the DC link supply of the axis controllers is an effective remedy here.

The use is always recommended!

For detailed information on the use of common-mode filters, see Chapter 4.2.5 or refer to the Mounting instruction Common Mode Filter CMR (ID no.: CC86353-200).

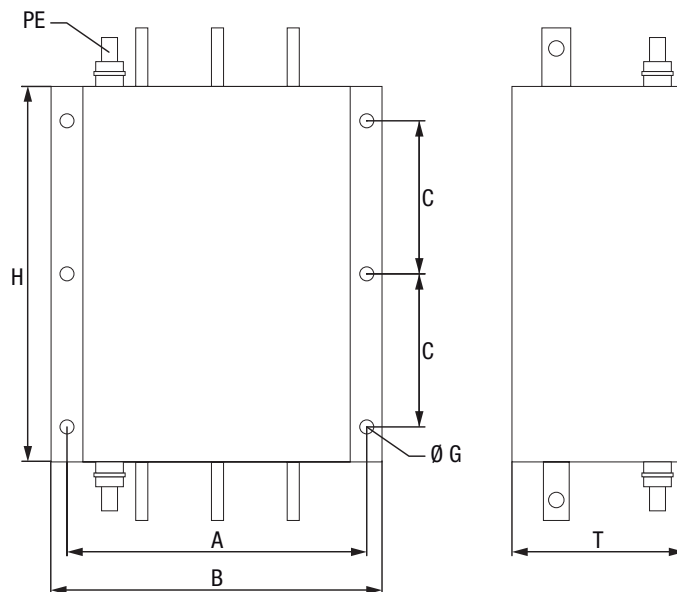





Figure 3.21 Dimensional drawing, mains filter for Size 7 (Fig. differs from the original)

4 Electrical installation

4.1 Before you start

It is imperative you pay attention to the following warnings and safety instructions prior to and during installation.

DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none"> Carelessness will result in serious injuries or death. <p>Never make or disconnect electrical connections while they are electrically live! Before making any change the device is to be disconnected from the mains. Even 30 minutes after switching off the mains supply dangerously high voltages of ≥ 50 V may still be present (capacitor charge). The discharging time depends on the controllers connected to the multi-axis system. So check that electrical power is not present!</p> <p>Only once the DC link voltage has dropped to less than +50 V DC (to be measured on size Size 5 and Size 6 at terminals X11/L+ and X11/L- and on size Size 7 at terminals X11/ZK+ and X11/ZK-) are you allowed to work on the device.</p> <p>Any existing additional DC link connections as well as the connections for all components in the mains input area are to be checked in relation to each other and in relation to earth to ensure they are not carrying any electrical power. If necessary, all cable connections are to be discharged using suitable means.</p>
Warning!	Risk of injury due to electrical power!
	<ul style="list-style-type: none"> Carelessness may result in serious injuries or death. <p>A dangerous voltage may be present at the device, even if the device does not emit any visual or audible signals/indications, e.g. for Size 5 and Size 6A: with mains voltage on terminal X12 or X21 switched on and no control supply +24 V on X9, X10; or for Size 7: with mains voltage on terminal X12 or X45 and no control supply +24 V on X44. So check that electrical power is not present!</p>

WARNING!	Risk of injury due to hot surfaces on the device!
	<ul style="list-style-type: none"> Carelessness may result in serious burns. <p>The device and especially the heat sink heat up significantly during operation and can reach temperatures of up to +100 °C (+212 °F). The chokes connected also heat up during operation and can reach temperatures of up to +145 °C (+293 °F). Prior to starting work, make sure the device has cooled down.</p> <p>On touching there is a risk of burns to the skin. For this reason provide protection against touching.</p> <p>During mounting maintain an appropriate distance to neighbouring assemblies.</p>



NOTE:

On installing the MSD Servo Drive Multi-Axis System, it is imperative the operation manual for the DC-AC Servo Drives is also followed.

4.2 Effective EMC installation

4.2.1 Cable type

- Use only shielded mains, motor and signal cables as shown in Figure 4.7, p. 34. For all shielded connections, use cables with double copper braiding with 60 to 70 % coverage.

4.2.2 Routing of cables

You should take into account the following points on laying the cables:

- Route mains, motor and signal cables separated from one another. Maintain a distance of at least 200 mm.
- For smaller distances use separators for shielding; fasten the separators directly and conductively to the backing plate.
- Route the cables close to ground potential. On the usage of cable ducts made of plastic, the cable ducts must be fastened directly to the backing plates or the frame. Open space must not be spanned, as otherwise the cables could act like antennae.
- Avoid unnecessary cable lengths and "loops of spare cable".
- Route long cables in places not be susceptible to interference. Otherwise coupling points may be created.
- Route motor cables without interruptions (e.g. not via terminals) and lay them by the shortest route out of the switch cabinet.
- Twist wires for the same electrical circuit.
- Ideally, route the signal cables separated from encoder cables.
- All signal cables should be combined and routed away upward.
- Avoid extending cables via terminals.



NOTE:

Please be aware that the supply unit is not designed for electromagnetic environment class 3 (IEC/EN 61000-2-4). Further measures are essential to achieve this environment class! For further information please consult your project engineer.

4.2.3 Earthing measures

All earthed points and components must be routed directly to the central earthing point (e.g. PE rail, main earth) with as low an impedance as possible and with good conductivity. In this way an earthing system is produced that connects all connections to the earthing point in a star topology. This central earthing point is to be clearly defined. This earthing point can be extended to the entire backing plate with an effective EMC connection.

You should take into account the following points for the earthing:

- Earthed surfaces act as shielding measures and reduce electromagnetic fields in the surrounding area. For this reason metal surfaces should be connected to ground with low-impedance HF connections. In terms of EMC it is not the cross-section of the cable that is definitive, but the surface over which high frequency currents (caused by the skin effect) can flow away.
- Connect the protective earth conductors for the components in the switch cabinet using a star topology.
- Avoid the use of connectors.
- Also connect the walls and doors of the switch cabinet to earth.
- Earth unused cores at one end so that there is no electrostatic charging.
- Free contact areas of paint and corrosion and make large area connections.
- The usage of metallised elements is to be preferred over painted components; it will then not be necessary to remove the paint. The MSD Power Supply Unit has a galvanised sheet steel back panel.
- For further information on the cross-section of the protective earth conductor see "4.5 Connection of the protective earth conductor".

4.2.4 Shielding measures

You should take into account the following points for the shielding measures:

- Use only shielded mains, motor and signal cables as shown in Figure 4.7, p. 34. For all shielded connections, use cables with double copper braiding with 60 to 70 % coverage.
- Connect the shield at both ends using a large area connection. Extending the shield to the earthing point using a wire (pigtail) reduces the shielding effect by up to 90 %.

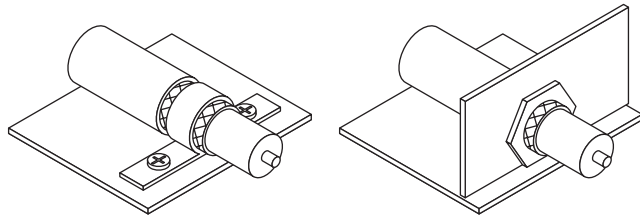


Figure 4.1 CORRECT shield connection

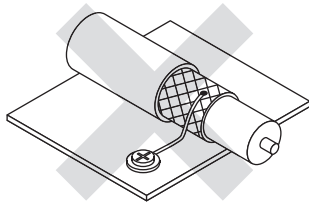


Figure 4.2 INCORRECT shield connection - do not extend to the earthing point (pigtail)

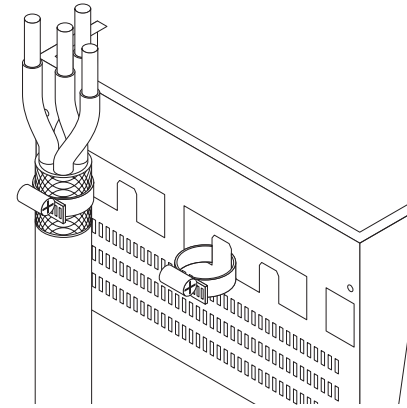


Figure 4.3 MSD Servo Drive shield connection

- Do not strip back too far the shield.
- Shields are not allowed to be used to carry power, e.g. as a substitute for the N or PE conductor.
- The shielding effect can be improved by laying in metal ducts/tubes.
- Shields must be connected at both ends. Additional connection at multiple points is recommended, otherwise potential equalisation currents may flow in physically extensive installations.
- The bases of the chokes must have good contact to the switch cabinet ground. The contact area must be bare metal to establish a good ground connection to the switch cabinet ground.

4.2.5 Use of common mode filters

If the servo drives are supplied by the PSU, situations may occur which render the mains input filter ineffective. The use of a common mode filter in the DC link supply of the servo drives is an effective remedy here.

Recommendation:

The common mode choke should be used if

- a. There are more than 3-4 DC-AC servo drives in the network

or

- b. the motor cable lengths per servo drive are greater than 10 m or in total of all axes be more than 30 m (98.43 ft).



NOTE:

Typical servo cables have approx. 0.47 nF/m, corresponds to a permissible total leakage capacitance of approx. 15 nF.

Note that values of 1 nF/m or more can easily be achieved with cables with larger cross-sections (> 35 mm² (0.054 in²)).

See also condition "d".

or

- c. In which users use special motors that have a higher parasitic capacitance to earth.
Typical servo motors have approximately 10 nF.

or

- d. the total leakage capacitance is > 45 nF
Rule of thumb for total discharge capacity:

$$C_y = \text{sum of cable lengths} \times 0.47 \frac{\text{nF}}{\text{m}} + \text{sum of all leakage capacities} \leq 45 \text{ nF}$$



NOTE:

Further information and technical data on the use of common mode filters can be found in the Mounting instruction Common Mode Filter CMR (ID no.: CC86353-200).

4.3 Overview of the connections

In the following you can see the layout where you can find the corresponding positions of the connectors and terminals. For improved clarity we have added an abbreviation to the designation for the connectors and terminals.

4.3.1 Layout, Size 5 (G396-026 and G396-050)

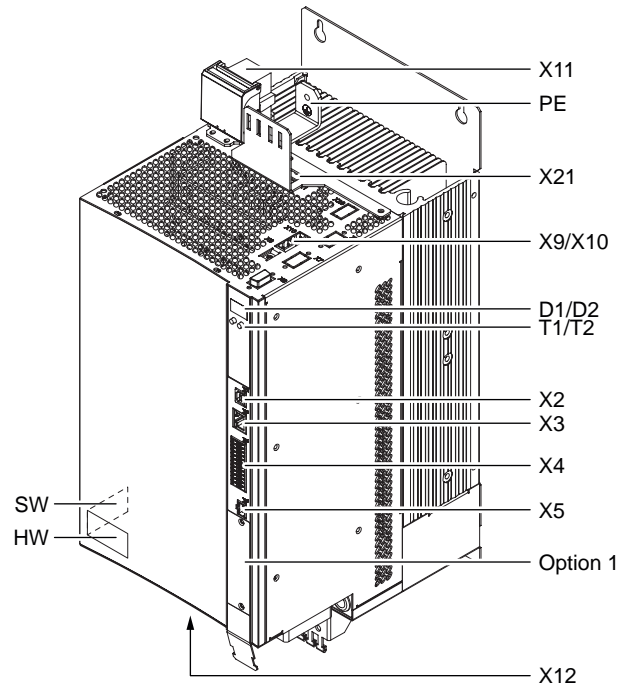


Figure 4.4 Layout, Size 5

4.3.2 Layout, Size 6A (G396-075 and G396-110)

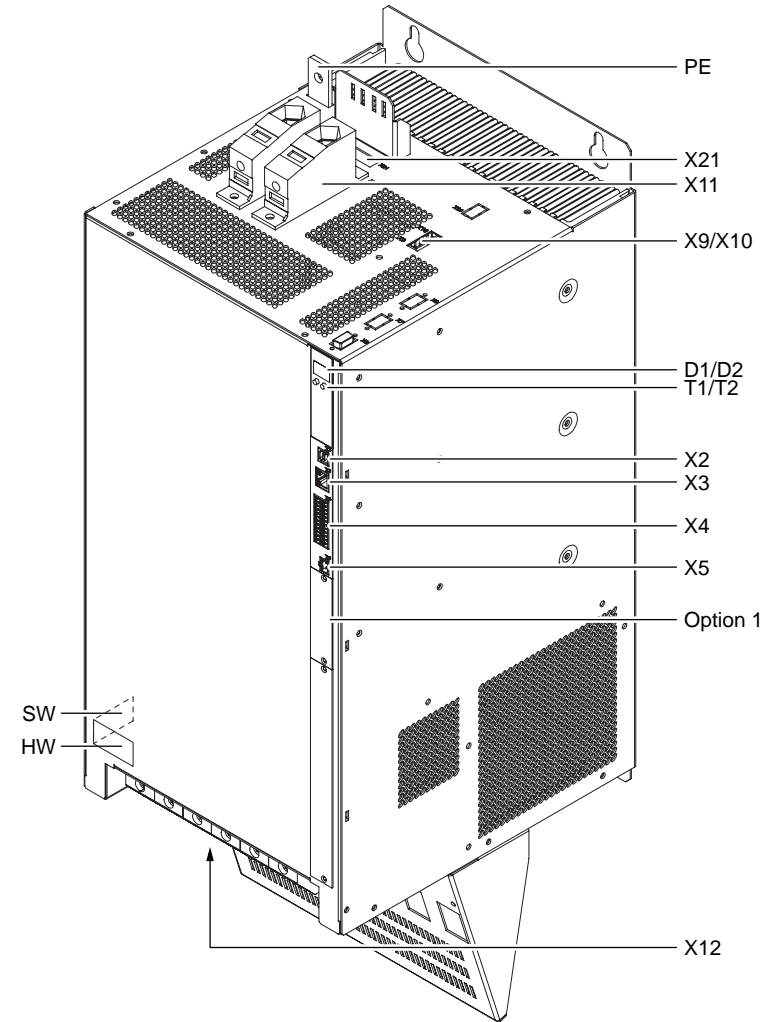


Figure 4.5 Layout, Size 6A

4.3.3 Overview of connections, Size 5 and Size 6A

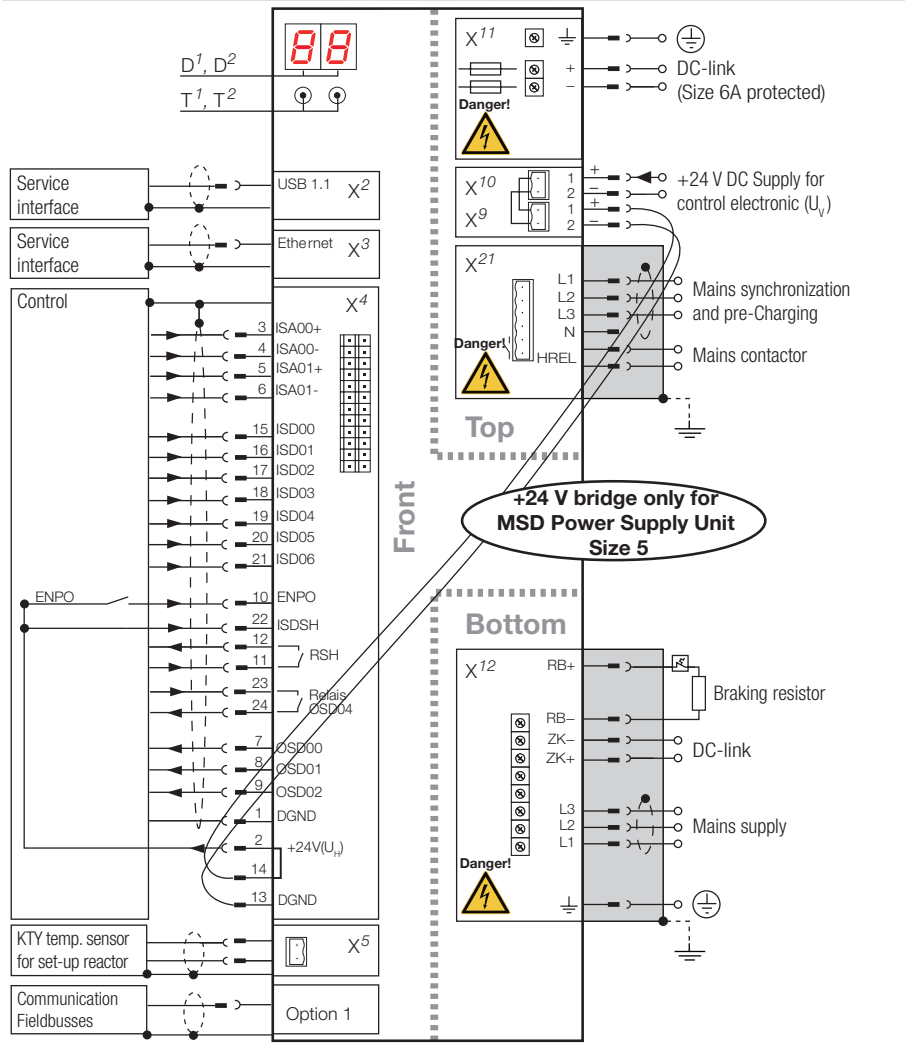


Figure 4.6 Overview of connections, Size 5 and Size 6A

No.	Designation	Function	Page
D1, D2	7-segment display	Device state indication	p. 68
T1, T2	Button	Service functions	p. 67
Option 1	Communication	Optional module for field bus e.g. SERCOS, PROFIBUS-DP, EtherCAT or CANopen	p. 54
X2	USB 1.1 interface	Service interface, Plug & Play connection to PC	p. 54
X3	Ethernet interface	Service interface, fast TCP/IP connection (RJ45)	p. 54
X4	Control connections	8 digital inputs, 3 digital outputs, 1 additional relay output	p. 51
X5	Connection for temperature monitoring	KTY temperature sensor for step-up choke	
X10, X9	Connection for control supply U_v	Supply voltage for the servo drive control electronics, 24 V DC	p. 44
X11	DC power supply	Connection for DC power supply (Size 6A protected), PE connection	p. 48 p. 40
X12	Power connection	AC mains connection (supply and regeneration), PE connection with shield plate, braking resistor, (connection for DC power supply, supply unit Size 6A to MSD Servo Drive DC-AC Servo Drive Size 6, 6A)	p. 46 p. 40 p. 54 p. 50
X21	Connection for mains synchronisation/ DC link precharging; auxiliary relay	Mains synchronisation, DC link precharging, switching on mains after precharging	p. 45
SW, HW	Rating plates	Rating plates for software and hardware	p. 33
	Shield connection to earth	Possible via shield plate (optional)	-

Table 4.1 Key to overview of connections, Size 5 and Size 6A

4.3.4 Connection diagram, Size 5

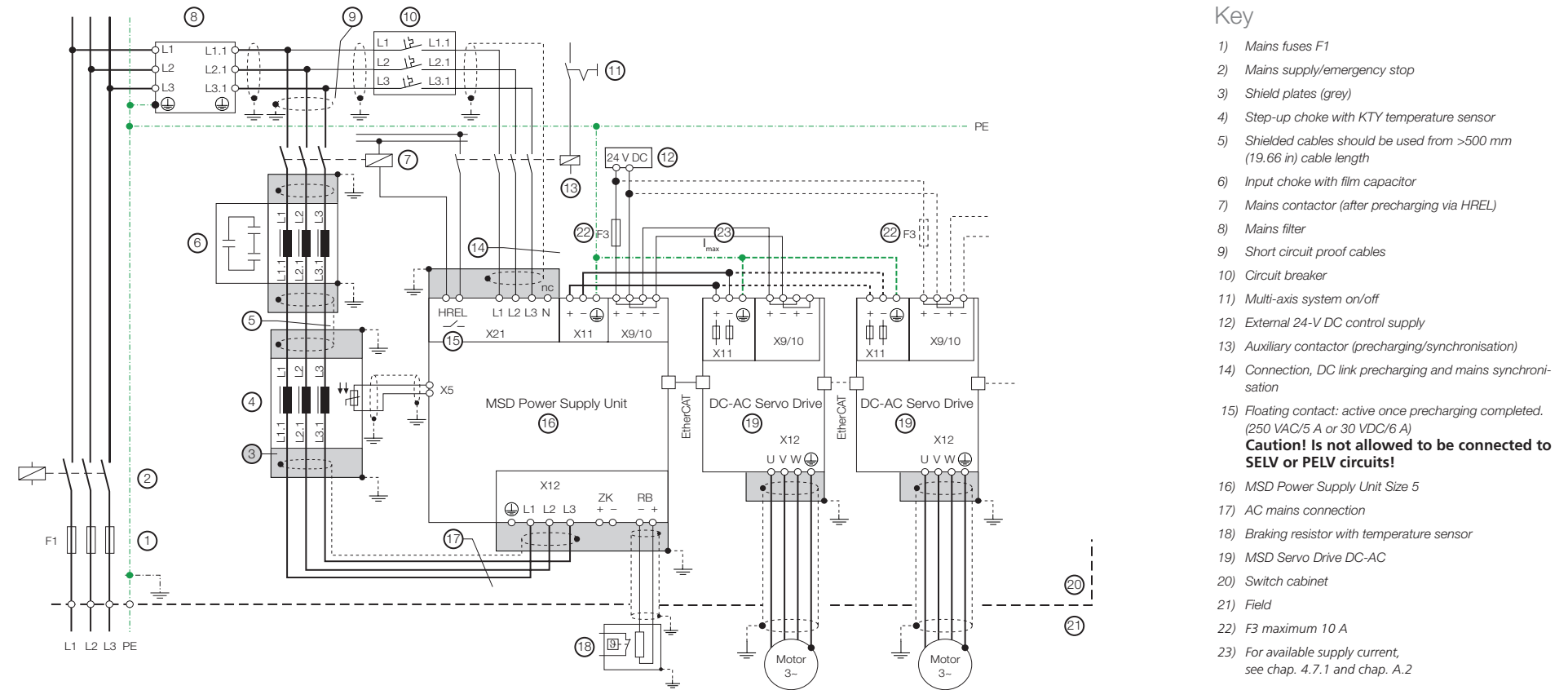


Figure 4.7 Overview connection diagram, supply unit (schematic depiction)



NOTE:

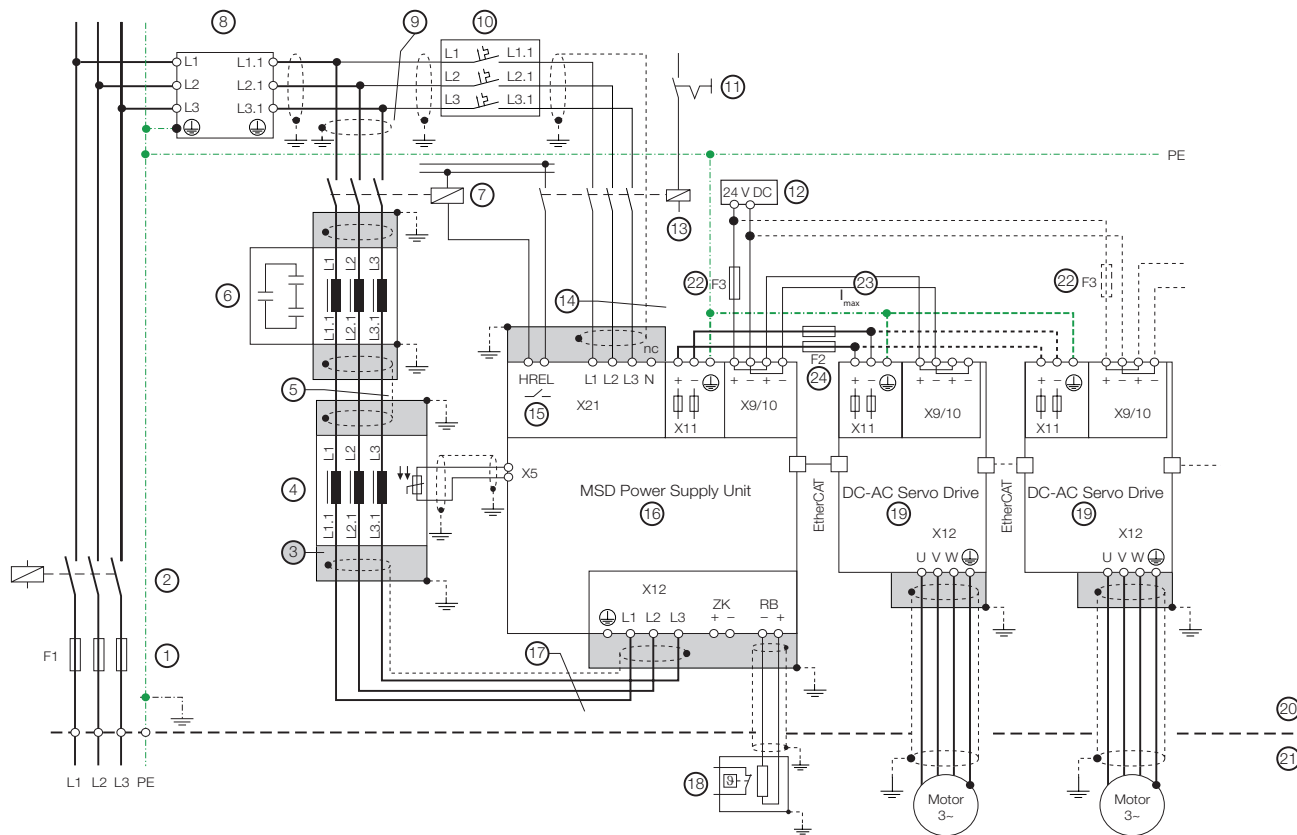
Figure 4.7 only shows a schematic depiction of the connection diagram. The position of the terminals may vary depending on the device. Incorrect wiring can cause irreparable damage to the supply unit.



NOTE:

You will find a selection of possible mains contactors, circuit breakers and fuses in chap. A.11, p. 85.

4.3.5 Connection diagram, Size 6A



Key

- 1) Mains fuses F1
- 2) Mains supply/emergency stop
- 3) Shield plates (grey)
- 4) Step-up choke with KTY temperature sensor
- 5) Shielded cables should be used from >500 mm (19.66 in)) cable length
- 6) Input choke with film capacitor
- 7) Mains contactor (after precharging via HREL)
- 8) Mains filter
- 9) Short circuit proof cables
- 10) Circuit breaker
- 11) Multi-axis system on/off
- 12) External 24-V DC control supply
- 13) Auxillary contactor (precharging/synchronisation)
- 14) Connection, DC link precharging and mains synchronisation
- 15) Floating contact: active once precharging completed. (250 VAC/5 A or 30 VDC/6 A)
Caution! Is not allowed to be connected to SELV or PELV circuits!
- 16) MSD Power Supply Unit Size 6A
- 17) AC mains connection
- 18) Braking resistor with temperature sensor
- 19) MSD Servo Drive DC-AC
- 20) Switch cabinet
- 21) Field
- 22) F3 maximum 10 A
- 23) For available supply current, see chap. 4.7.1 and chap. A.2
- 24) For F2 DC fuse, see chap. 4.8.2

Figure 4.8 Overview connection diagram, supply unit (schematic depiction)



NOTE:

Figure 4.8 only shows a schematic depiction of the connection diagram. The position of the terminals may vary depending on the device. Incorrect wiring can cause irreparable damage to the supply unit.



NOTE:

You will find a selection of possible mains contactors, circuit breakers and fuses in chap. A.11, p. 85.

4.3.6 Layout, Size 7 (G396-250 and G396-360)

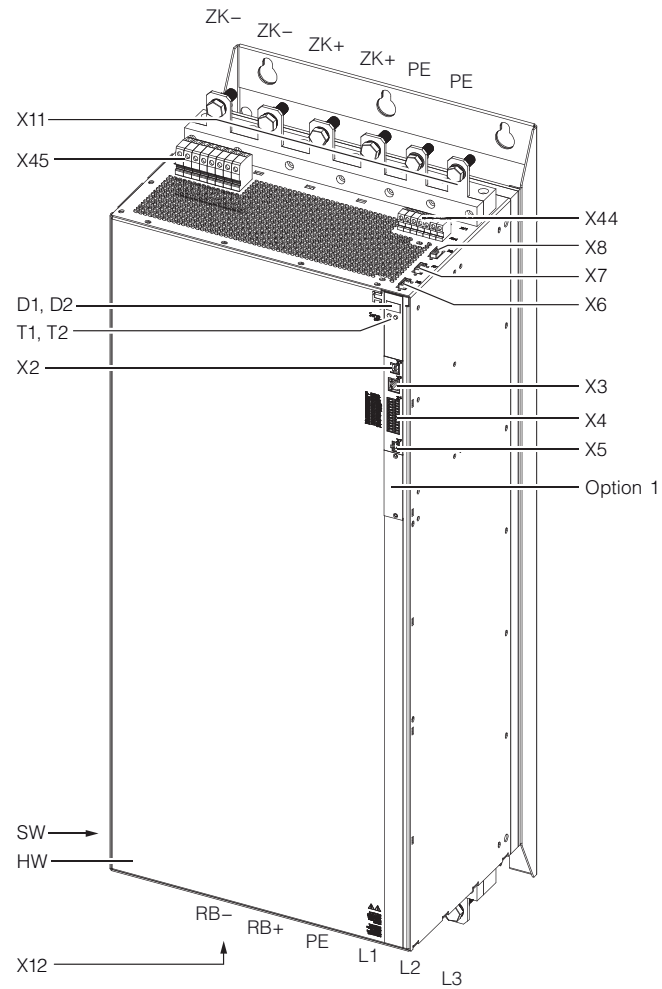


Figure 4.9 Layout, G396-xxx Size 7

4.3.7 Overview of connections, Size 7

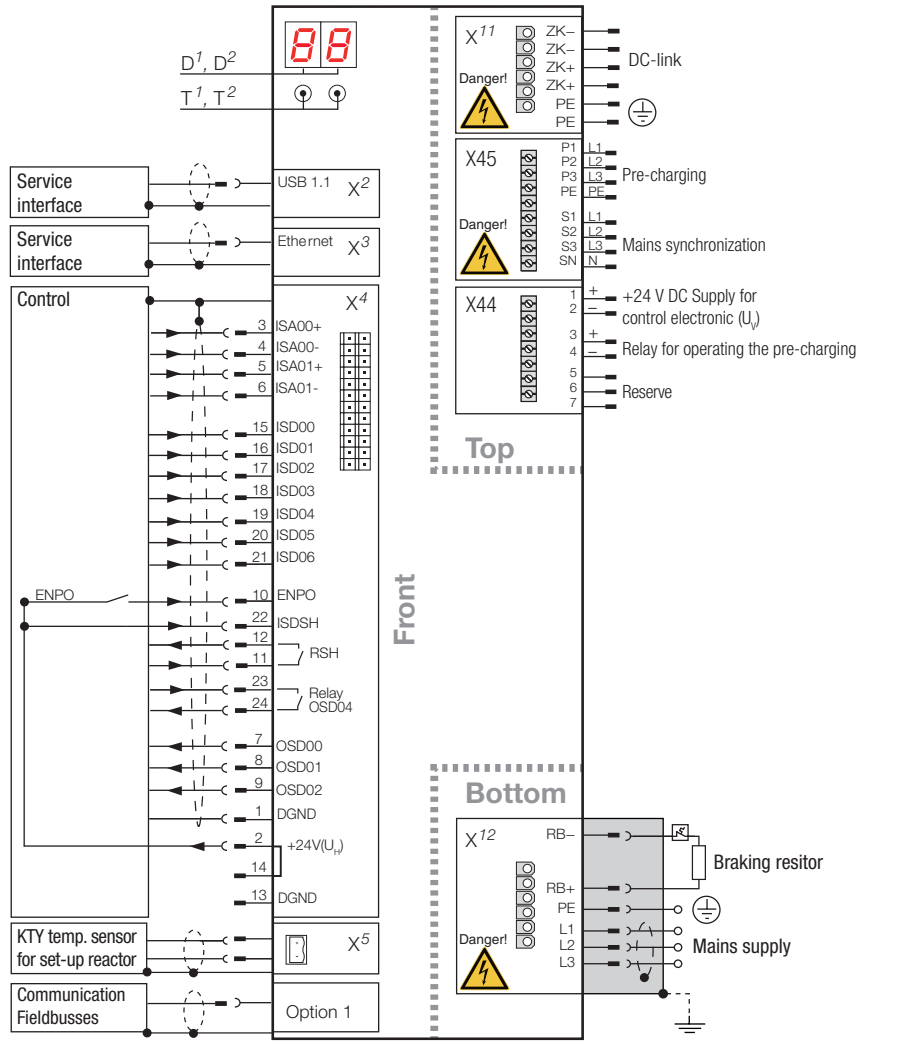


Figure 4.10 Overview of connections, Size 7

No.	Designation	Function	Page
D1, D2	7-segment display	Device state indication	p. 68
T1, T2	Button	Service functions	p. 67
Option 1	Communication	Optional module, no function	p. 54
X2	USB 1.1 interface	Service interface, Plug & Play connection to PC	p. 54
X3	Ethernet interface	Service interface, fast TCP/IP connection (RJ45)	p. 54
X4	Control connections	8 digital inputs, 3 digital outputs, 1 additional relay output	p. 51
X5	Connection for temperature monitoring	KTY temperature sensor for step-up choke	
X6	Option	No function	-
X7	Option	No function	-
X8	Option	No function	-
X11	DC power supply	Connection for DC link, PE connection	p. 48
X12	Power connection	braking resistor, PE connection, precharging, mains synchronisation	p. 54 p. 40 p. 45
X44	Connection for control supply, relay	+24-V supply for control electronics, relay for operating the precharging (terminals 5 to 7: not connected)	p. 45
X45	Connection for pre-charging, mains synchronisation	Connection for precharging DC link, mains synchronisation	p. 39 p. 46
SW, HW	Rating plates	Rating plates for software and hardware	p. 37
⏏	Shield connection to earth	Possible via shield plate (optional)	-

Table 4.2 Key to overview of connections, Size 7

4.3.8 Connection diagram and precharging, Size 7

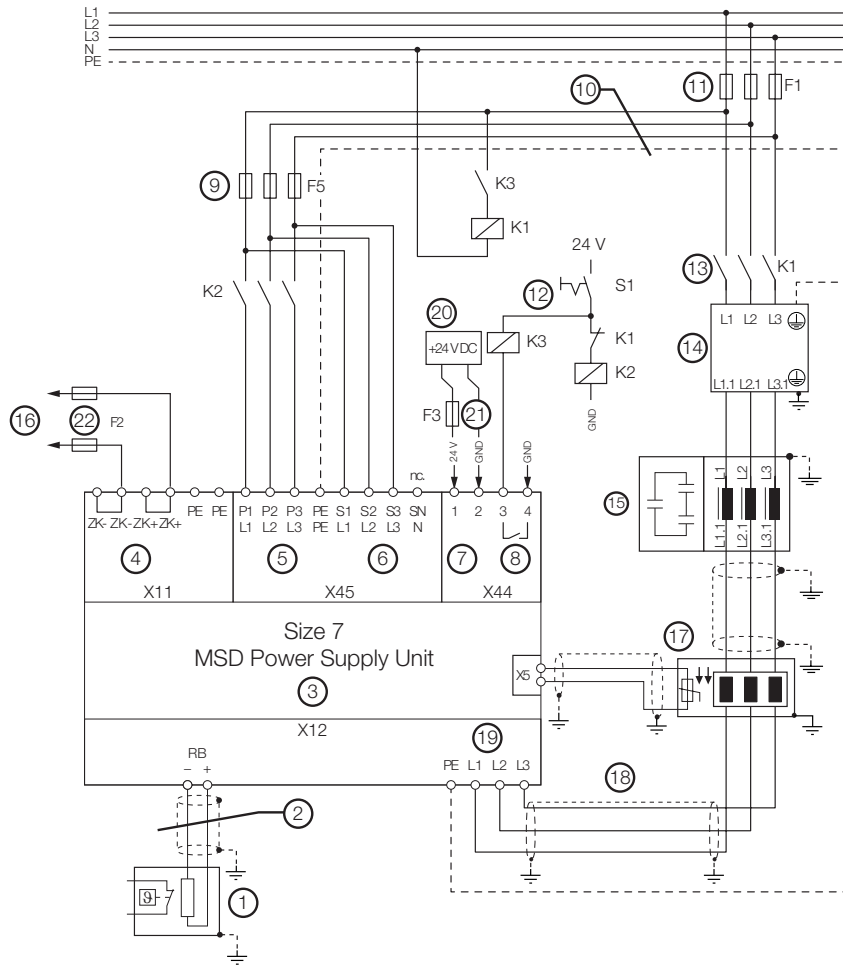


Figure 4.11 Connection diagram Size 7 - shown without DC-AC Servo Drive

Key:

- | | |
|----------------------------------------------------------------|-----------------------------------------------------|
| 1) Braking resistor with temperature sensor | 13) Mains supply/emergency stop |
| 2) Short circuit proof cables | 14) Mains filter |
| 3) MSD Power Supply Unit Size 7 | 15) Input choke (including film capacitor) |
| 4) Connection for DC power supply for DC-AC Servo Drive | 16) Power supply, DC-AC Servo Drive |
| 5) Connection for DC link precharging | 17) Step-up choke with KTY temperature sensor |
| 6) Connection for mains synchronisation | 18) As short as possible, if necessary lay shielded |
| 7) External +24-V DC control supply | 19) AC mains connection |
| 8) Internal relay (active, once DC link precharging completed) | 20) Ext. 24 V control supply |
| | 21) Fuse F3 maximum 10 A |
| | 22) Fuses F2, for DC fuses see chap. |

Caution! Must be connected to SELV or PELV potential!

Figure 4.11 Connection diagram Size 7 - shown without DC-AC Servo Drive



NOTE:

The figure only shows a schematic depiction of the connection diagram. The position of the terminals may vary depending on the device. Incorrect wiring can cause irreparable damage to the supply unit.



NOTE:

You will find a selection of possible mains contactors, circuit breakers and fuses in chap. A.11, p. 85.

The switching over of the DC link precharging to the mains is realised externally on Size 7 devices. The connection diagram in Figure 4.11 is only an example. No exceptional cases are taken into account.

Wire the precharging circuit according to the standards using short circuit proof cables. The connection ratings for the internal relay for the terminals X44/3, 4 are $U_{max} = 30 \text{ V DC}$, $I_{max} = 6 \text{ A}$. For this reason use an auxiliary contactor K3 to switch the main contactor K1.

4.4 Mains On/Off control process

Precharging the DC link

Switch S1 "Mains supply On" is switched on. The precharging contactor K2 closes and the DC link is precharged via precharging resistors on terminal X45. The main contactor K1 remains open initially.

Precharging completed (details see chapter 4.7.3 and 4.7.4)

At a defined DC link voltage the contact on the internal relay on terminal X44/3,4 is closed. The auxiliary contactor K3 closes and switches on the main contactor K1. The precharging contactor K2 is opened via an auxiliary contact (normally closed contact) on K1.

The MSD Servo Drive changes to ready to operate.

Switching off

Via switch S1 "Mains supply Off" the regenerative unit is completely disconnected from the mains.



CAUTION!

X45/P1,P2,P3 are not allowed to be connected to X45/S1,S2,S3 using jumpers! The synchronisation connections X45/S1,S2,S3 must be permanently connected to the supply system.

CAUTION!	Shutdown of the pre-charging!
	To protect the servo drive from thermal overload, make sure that the pre-charging of the DC link is not switched on for more than 2 minutes without the main contactor is active. The pre-charging of the DC link is not designed for high power consumption during the operation.
	Ignoring of this rule may destroy the device!

4.5 Connection of the protective earth conductor

The leakage current is > 3.5 mA. This situation results in the following minimum requirements for the protective earth conductor cross-section as a function of the phase conductor cross-section, as per IEC/EN 61800-5-1.

Cross-section of the phase conductors [mm ² (in ²)]	Minimum cross-section of the corresponding protective earth conductor [mm ² (in ²)]
Q ≤ 16 (0.03)	Q however at least 10 (0.015) (Cu)
16 (0.03) < Q ≤ 35 (0.05)	16 (0.03)
Q > 35 (0.05)	Q/2

Table 4.3 Protective earth conductor cross-section

4.5.1 Protective earth conductor (X11) supply unit Size 5

Earth each supply unit and each DC-AC Servo Drive!

1. Connect the PE connection X11/PE on the supply unit to the PE rail (main earth) in the switch cabinet.
Select the protective earth conductor cross-section according to Table 4.3. For this purpose use a dedicated protective earth conductor (screw M5).
2. Connect in series the PE connection X11/PE on the supply unit to the PE connections X11/PE on the butt-mounted DC-AC Servo Drives.
For this purpose use the pre-assembled protective earth conductors.
3. Please take into account the local and national regulations and conditions. The minimum cross-section of the protective earth conductor must comply with the local safety requirements for protective earth conductors for equipment with high leakage current.

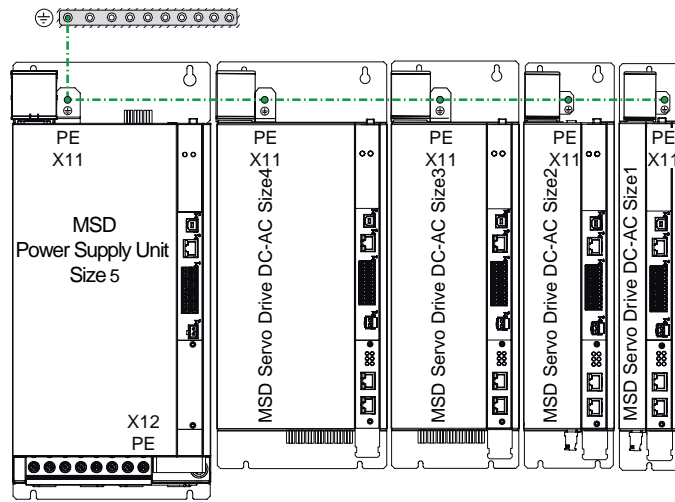


Figure 4.12 Schematic: connection of the protective earth conductor

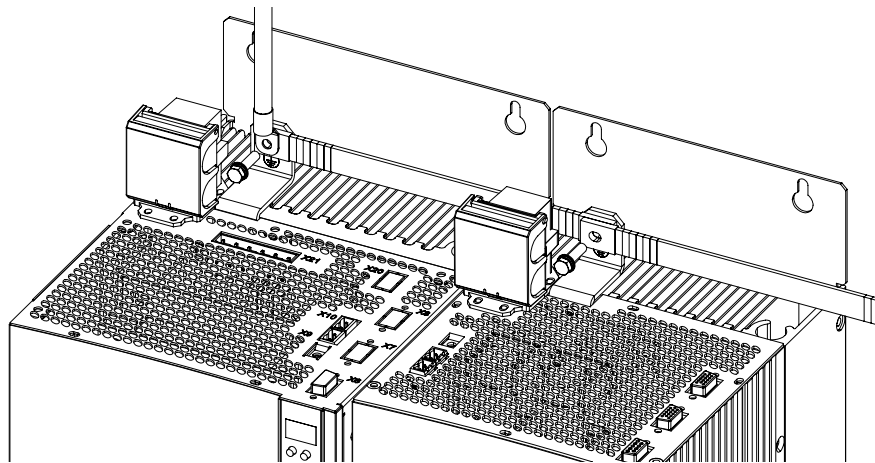


Figure 4.13 Detail: connection of the protective earth conductor

4.5.2 Protective earth conductor (X11), supply unit Size 6A

1. Earth the supply unit Size 6A and each DC-AC Servo Drive Size 6A separately. Connect the PE connection X11/PE on the supply unit to the PE rail (main earth) in the switch cabinet. For this purpose use a dedicated protective earth conductor. Select the protective earth conductor cross-section according to chap. 4.5.
2. Earth all other DC-AC Servo Drives Size 5 to Size 1 via a common protective earth conductor! Connect in series all other PE connections X11/PE on the butt-mounted DC-AC Servo Drives. Connect the PE connection X11/PE on the first DC-AC Servo Drive in a row to the PE rail (main earth) in the switch cabinet. For this purpose use the pre-assembled protective earth conductors.

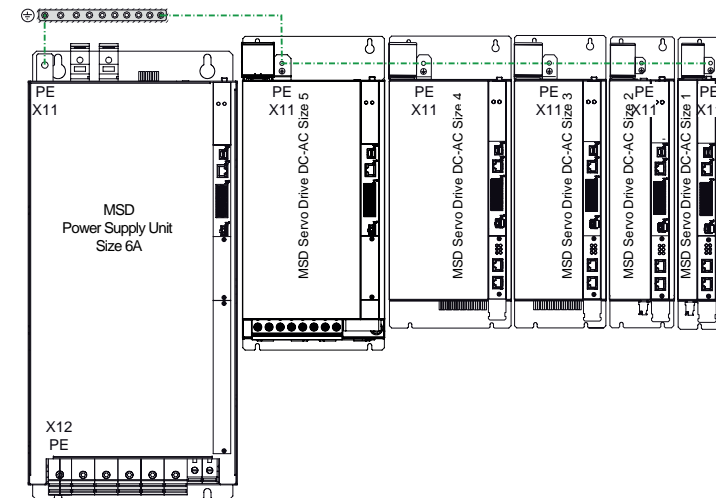


Figure 4.14 Schematic: connection of the protective earth conductor with supply unit Size 6A

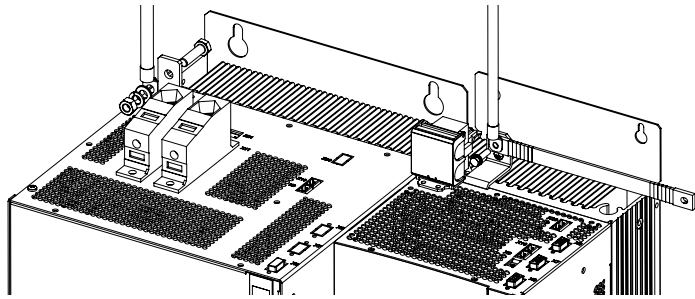


Figure 4.15 Detail: connection of the protective earth conductor

4.5.3 Protective earth conductor (X11) supply unit Size 7

1. Earth the supply unit and each DC-AC Servo Drive Size 7 and Size 6A separately! Connect the PE connection X11/PE on the supply unit to the PE rail (main earth) in the switch cabinet. Select the protective earth conductor cross-section according to chap. 4.5.
2. Earth all other DC-AC Servo Drives Size 5 to Size 1 via a common protective earth conductor! Connect in series all other PE connections X11/PE on the butt-mounted DC-AC Servo Drives. Connect the PE connection X11/PE on the first DC-AC Servo Drive in a row to the PE rail (main earth) in the switch cabinet. For this purpose use the pre-assembled protective earth conductors.

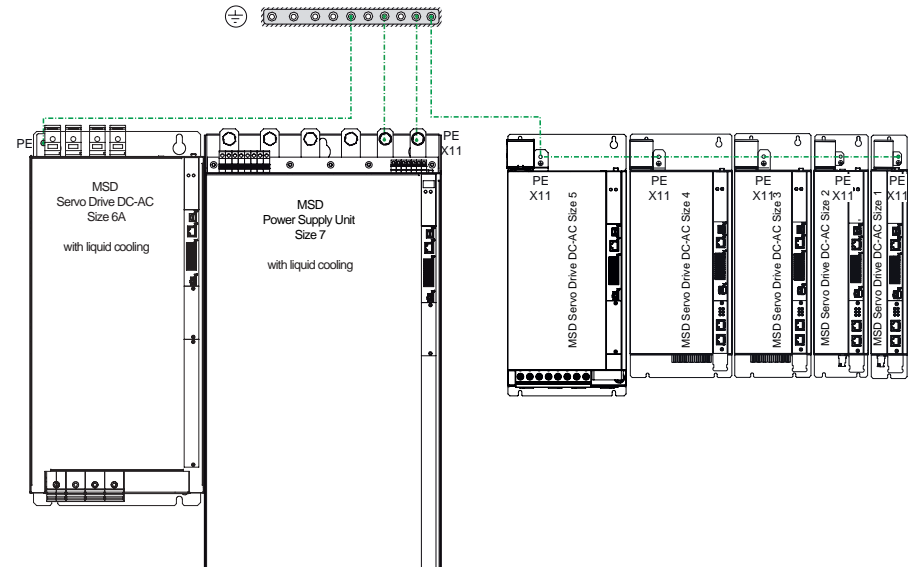



Figure 4.16 Schematic: connection of the protective earth conductor with supply unit Size 7

4.5.4 Protective earth conductor connection other components

1. Connect the PE connections on all other components, such as mains filters, chokes etc. in a star topology to the PE rail (main earth) in the switch cabinet. During this process also take into account the instructions in chap. 4.5

DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none"> • Carelessness will result in serious injuries or death. <p>Never make or disconnect electrical connections while they are electrically live! Before making any change the device is to be disconnected from the mains. Dangerously high voltages ≥ 50 V can be present on the DC link connections and other components in the mains input area after power off. So check that electrical power is not present! See chap. 4.1</p>

4.6 Electrical isolation concept

The control electronics with their logic (μP), the inputs and outputs, are electrically isolated from the power section (power supply/DC link). All control connections are designed as safety extra low voltage/protective extra low voltage (SELV/PELV) circuits and are only allowed to be operated with +5 V to +50 V as per the relevant specification. This provides reliable protection against electric shock on the control side. The control electronics therefore require a separate control supply that corresponds to the requirements of a SELV/PELV.

The overview opposite shows the potential references for the individual connections in detail. This concept also delivers higher operational safety and reliability of the supply unit.

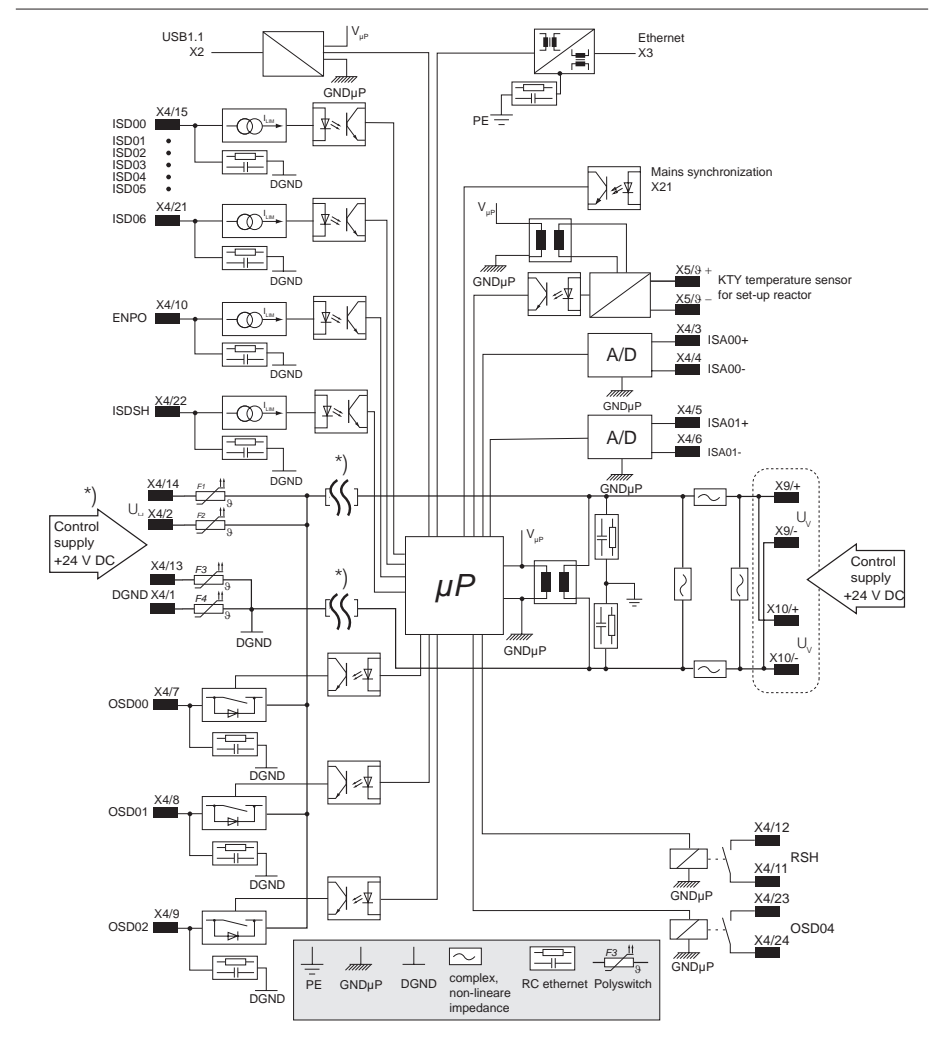
SELV = Safety Extra Low Voltage

PELV = Protective Extra Low Voltage



NOTE:

The terminal X5 (for KTY on the step-up choke) represents a special case in relation to insulation and isolation. The temperature sensor for the step-up choke must be designed as a minimum with a basic insulation in relation to the choke winding as per IEC/EN 61800-5-1.



*) For Size 5, also connect the 24 V DC control supply to control terminals. Internal connection is not available.

Figure 4.17 Electrical isolation concept, Size 5 and Size 6A

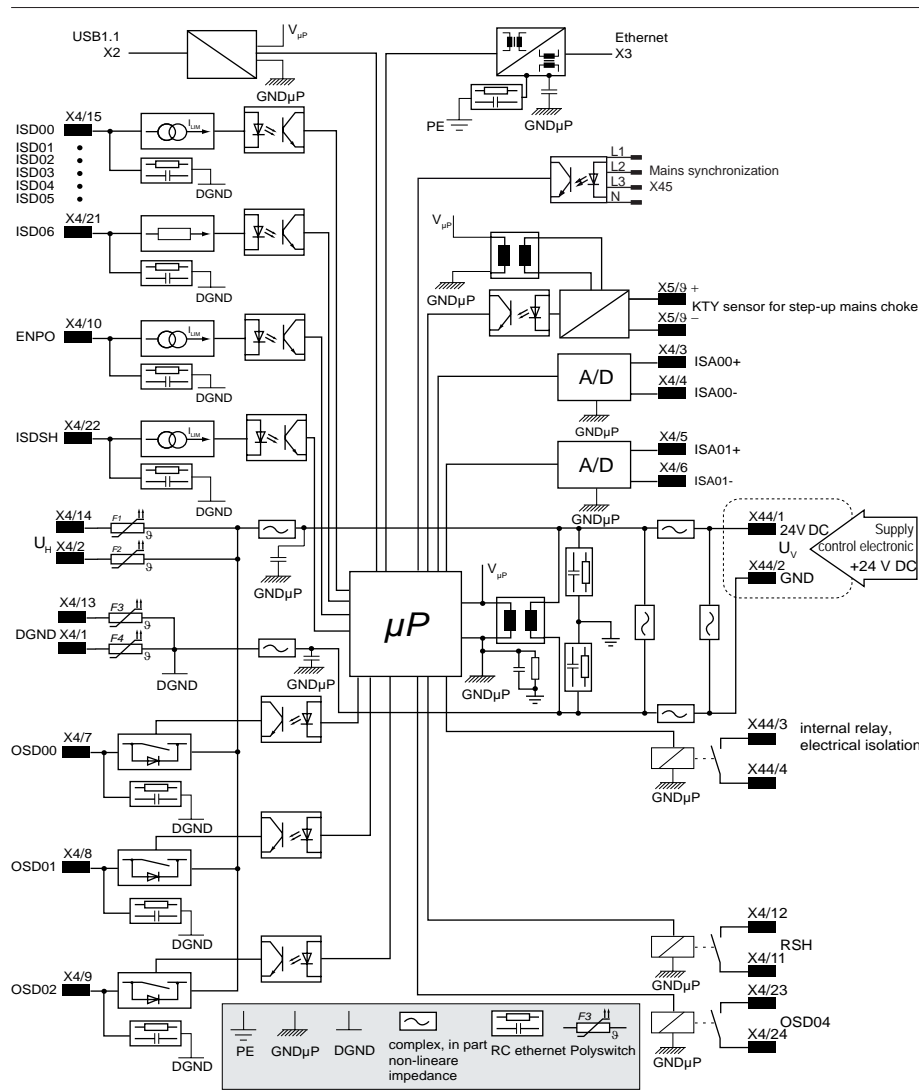


Figure 4.18 Electrical isolation concept, Size 7

4.7 Connection of the supply voltages

The supply of power to the MSD Servo Drive is separate for the control section and power section. The control supply is always to be connected first in the sequence so that the operation of the MSD Servo Drive can be checked first and the device parameters configured for the planned application.

DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none"> Carelessness will result in serious injuries or death. <p>Dangerous voltage may be present at the device, even if the device is not emitting any visual or audible signals/indications (e.g. with mains voltage applied to terminal X12 and no control supply +24 V DC on X9/X10)! Prior to working on the device, check there is no supply of electrical power present. See chap. 4.1</p>

4.7.1 Control supply 24 V DC (X9, X10) for Size 5 and Size 6A

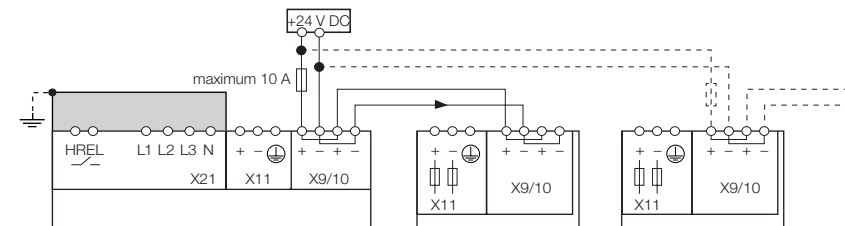


Figure 4.19 Connection for control supply

NOTE: By means of suitable measures provide adequate cable protection (e.g. fuse 10 A gG). If the permissible current carrying capacity is exceeded, an additional separate control supply must be connected.

NOTE: Along with the control section, the external control supply also supplies the digital inputs and outputs ($I_{\text{CONTROL SECTION}} + I_{\text{VO}}$). Also pay attention to the current drawn by all axis controllers on starting and in operation. See chap. A.2, p. 79.

NOTE:
Do not use the connector as a "switch" for a reset.



Specification, control supply	
Control supply	<p>X9 </p> <ul style="list-style-type: none"> • $U_V = +24 \text{ V DC } -20 \% +10 \%$, stabilised and smoothed. • For maximum starting/continuous current see Table A.10, p. 79 • Fuse protection for the terminal maximum 10 A • Internal polarity reversal protection • The power supply unit used must have safe and reliable isolation in relation to the mains as per EN 50178 or IEC/EN 61800-5-1 • Connected internally to X10
	<p>X10 </p> <ul style="list-style-type: none"> • Connected internally to X9

Table 4.4 Specification, control supply Size 5 and Size 6A

4.7.2 Control supply 24 V DC (X44) for Size 7

NOTE:
Along with the control section, the external control supply also supplies the digital inputs and outputs ($I_{\text{CONTROL SECTION}} + I_{\text{I/O}}$). Also pay attention to the current drawn by all axis controllers on starting and in operation. See chap. A.2

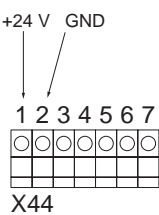
Specification, control supply X44/ 1 + 2	
Control supply	<p></p> <ul style="list-style-type: none"> • $U_V = +24 \text{ V DC } -20 \% +10 \%$, stabilised and smoothed. • For maximum starting/continuous current see Table A.10, p. 79 • Fuse protection for the terminal maximum 10 A • Internal polarity reversal protection • The power supply unit used must have safe and reliable isolation in relation to the mains as per EN 50178 or IEC/EN 61800-5-1

Table 4.5 Specification, control supply Size 7

4.7.3 Precharging and mains synchronisation (X21) for Size 5 and Size 6A

The DC link is precharged via the terminal X21/L1,L2,L3 (see Figure 4.7 and Figure 4.8). At a defined DC link voltage the contact on the internal relay on terminal X21/HREL is closed. The mains contactor closes and connects the supply system to terminal X12/L1,L2,L3. The supply unit is synchronised with the mains via the terminal X21/L1,L2,L3. For technical data on the mains contactor, see chap. A.11.

NOTE:
The cable must be protected using a circuit breaker. During installation pay attention to the correct conductor phase angle, see Figure 4.7 and Figure 4.8. For technical data on the circuit breaker, see chap. A.12

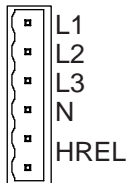

Specification, precharging and mains synchronisation X21	
Precharging and mains synchronisation (L1, L2, L3)	<p></p> <ul style="list-style-type: none"> • $U = 400/460/480 \text{ V AC}$ • $I_{\text{Precharging}} = 20 \text{ A}$ (decreasing over a period of $< 1.5 \text{ s}$) • $I_{\text{Synchronisation}} < 100 \text{ mA}$ • Cable cross-section = 1.0 to 1.5 mm² (0.002 to 0.0023 in²) • (N: not used)
Auxiliary relay (HREL)	<ul style="list-style-type: none"> • Max ratings for connection • $U_{\text{Max}} = 30 \text{ V DC} / I_{\text{Max}} = 6 \text{ A}$

Table 4.6 Specification, precharging and mains synchronisation Size 5 and Size 6A

Caution!	Risk of injury or damage to the device due to incorrect operation!
	<ul style="list-style-type: none"> • Carelessness may result in minor injuries or damage. <p>For safety reasons the connection X21/HREL on Size 5 and Size 6A is not allowed to be connected to SELV/ PELV circuits.</p>

4.7.4 Precharging (X44) and mains synchronisation (X45) for Size 7

The regenerative unit is synchronised with the mains via the terminals X45/S1,S2,S3,SN.

The regenerative unit in the Size 7 is pre-charged via the terminals X45/ P1, P2, P3. This contact is disconnected again from the main after pre-charging by means of an auxiliary contact on the mains contactor, see Figure 4.11.



NOTE:

The cable must be protected, see chap. A.10 and chap. A.12. During installation pay attention to the correct conductor phase angle.

Specification, mains synchronisation X45		
Mains synchronisation (S1,S2,S3,SN)	<p>X45</p>	<ul style="list-style-type: none"> • U = 400/460/480 V AC • $I_{\text{Synchronisation}} < 100 \text{ mA}$ • Cable cross-section = 1.0 to 1.5 mm² (0.002 to 0.0023 in²)

Table 4.7 Specification, mains synchronisation Size 7

Specification, precharging auxiliary relay X44/ 3 + 4		
Precharging auxiliary relay (HREL)	<p>X44</p>	<ul style="list-style-type: none"> • Connection ratings • U_{max} = 30 V • I_{max} = 6 A

Table 4.8 Specification, precharging auxiliary relay Size 7

Caution!	Risk of injury or damage to the device due to incorrect operation!
	<ul style="list-style-type: none"> • Carelessness may result in minor injuries or damage. <p>For safety reasons, during operation the connection X44/3+4 must be connected to SELV/PELV potential.</p>

4.7.5 Connection, mains 400/480 V AC (X12)

Note the following points:

- Switching the mains power:
 - In the event of excessively frequent switching of the precharging, the device protects itself by means of high-impedance decoupling from the mains. After a rest phase of a few minutes the device is ready to start once again.
- TN system and TT system: operation is allowed:
 - For device with phase conductor voltage 3 x 400 V AC, 3 x 460 V AC and 3 x 480 V AC if
 1. The star point of the supply system is earthed and
 2. The supply system is compliant with the maximum overvoltage category III as per IEC/EN 61800-5-1 with a system voltage (phase conductor → star point) of maximum 277 V.
- IT system (isolated star point): operation is not allowed!
 - If there is an earth fault the voltage is approx. twice as high. Clearances and creepages as per IEC/EN 61800-5-1 are no longer maintained.



NOTE:

You will find further information on current carrying capacity, technical data and ambient conditions in the appendix.

For connection diagrams for Size 5, Size 6A and Size 7, see from chap. 4.3.3 and following text

Procedure:

1. Define the cable cross-section according to local regulations and conditions. Use shielded cables where necessary and as shown in the connection diagrams.

Wire the supply unit to the mains supply as per connection diagram
2. For further information on the permissible connection cross-sections and torques, see chap. A.3, chap. A.6 and chap. A.7. For data on the components, see chap. A.7, p. 82 and following text.

Residual current device

Due to the leakage currents to be expected, the supply unit is not designed for usage with a residual current device.

If local regulations nevertheless require the installation of a residual current device, the following applies:

- In the event of a fault the supply unit can generate DC fault currents without a zero crossing. The supply unit is therefore only allowed to be operated with RCDs¹⁾ of type B for AC fault currents, pulsating or smooth DC fault currents. The RCD used must also be suitable for operation with inverters and servo drives. RCMs²⁾ can also be used for monitoring tasks.

1) Residual Current Device
2) Residual Current Monitor

Mains connection conditions

So that the trouble-free operation of a MSD Power Supply Unit on the supply system is ensured, there is a minimum requirement on the short circuit power on the mains connection. The transition to the mains filter is defined as the mains connection

The requirement is to be met to prevent degradations on the supply unit as well as malfunctions in other devices that are connected in parallel to this mains connection and to make possible a reliable operating state.


The term short circuit power is a theoretical value for an apparent power that occurs in an electrical system if a short circuit is caused at a transition point.

MSD Supply Unit	Short circuit ratio R_{sc} ¹⁾	Minimum requirements on the short circuit power on the mains connection for trouble-free operation
G396-026 ($S_n = P_n = 26$ kW)	30 to 50	800 kVA to 1300 kVA
G396-050 ($S_n = P_n = 50$ kW)		1500 kVA to 2500 kVA
G396-075 ($S_n = P_n = 75$ kW)		2250 kVA to 3750 kVA
G396-110 ($S_n = P_n = 110$ kW)		3300 kVA to 5500 kVA
G396-250 ($S_n = P_n = 250$ kW)	30 to 50	10000 kVA
G396-360 ($S_n = P_n = 360$ kW)		10000 kVA

1) R_{sc} is defined as the short circuit ratio of the short circuit power (S_k) at the mains connection to the rated power (S_n) of the MSD Power Supply Unit ($R_{sc} = S_k/S_n$).

Table 4.9 Mains connection conditions

4.8 Connection of the DC power supply

DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none">• Carelessness will result in serious injuries or death. <p>The cover for terminal X11 (DC connection) on sizes Size 1 to Size 5 is to be closed after fitting the pre-assembled connection cables. Operation without a cover is not allowed.</p>

4.8.1 Connection, DC power supply (X11) Size 5

1. Connect terminal X11/+ on the supply unit to terminal X11/+ on the next DC-AC Servo Drive in the row.
Connect the DC power supply cable on the DC-AC Servo Drive to the next DC-AC Servo Drive in the row.
For this purpose use the pre-assembled DC power supply cables.
2. Connect terminal X11/- on the supply unit to terminal X11/- on the next DC-AC Servo Drive in the row.
Connect the DC power supply cable on the DC-AC Servo Drive to the next DC-AC Servo Drive in the row.
For this purpose use the pre-assembled DC power supply cables.
3. Close the touch protection on the DC link terminals X11.
You will find further information in the MSD Servo Drive DC AC Operation Manual.

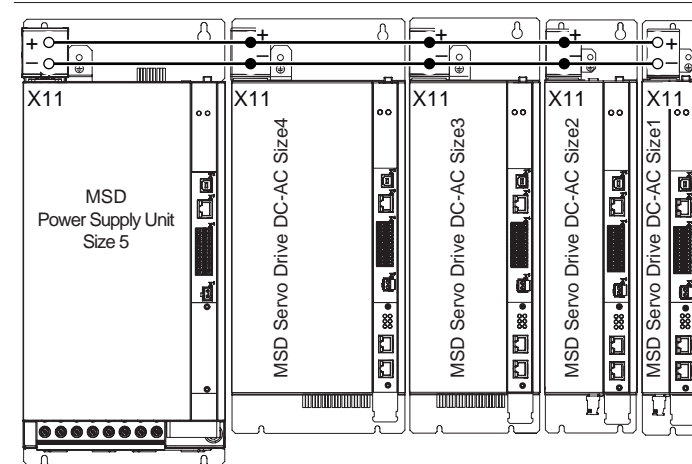


Figure 4.20 Schematic: connection, DC power supply Size 5 to DC-AC Servo Drives

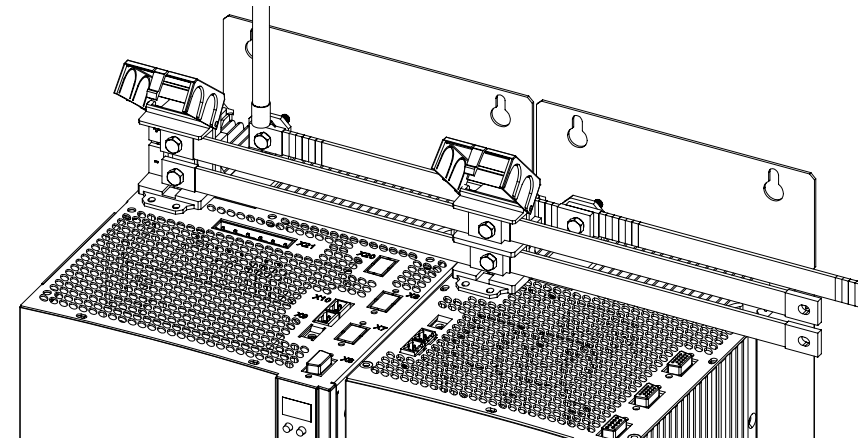


Figure 4.21 Detail: connection, DC power supply Size 5



NOTE:

You will find the permissible connection cross-sections and tightening torques in chap. A.3

4.8.2 Connection, DC power supply Size 6A and Size 7

Connect the DC link terminals ZK+ and ZK- on the supply unit Size 6A or Size 7 to the corresponding terminal on the next DC-AC Servo Drive in the row.

Use suitable, in-house assembled DC connection cables for this purpose. The cables must be short circuit proof and should be laid bundled in parallel; preferably use a shielding sleeve for the shielding. The length of 2 m should not be exceeded.

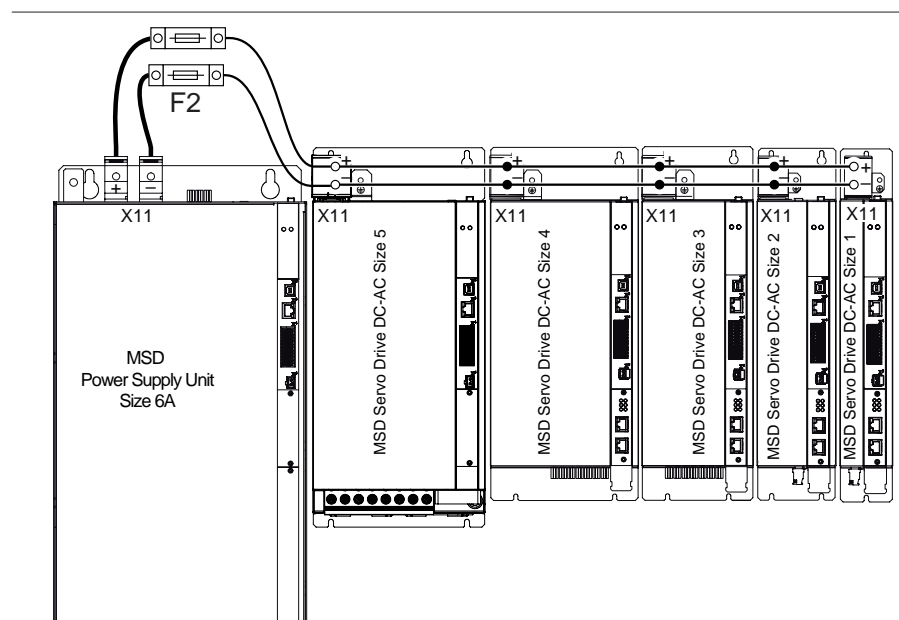
Define the cable cross-section to suit the application, however use as a minimum 50 mm² (0.078 in²) CU. Pay attention to the local situation and conditions.

During the dimensioning of the DC connection cables, please take into account that the DC currents can be up to 1.4-times the mains side input current. Given corresponding design, cable protection for the DC connection cables can be provided by the mains fuses F1.

If the design of the DC connection cables is different (e.g. reduction of the cable cross-section), the cables must be protected by means of additional DC link fuses (see F2 in Figure 4.22).

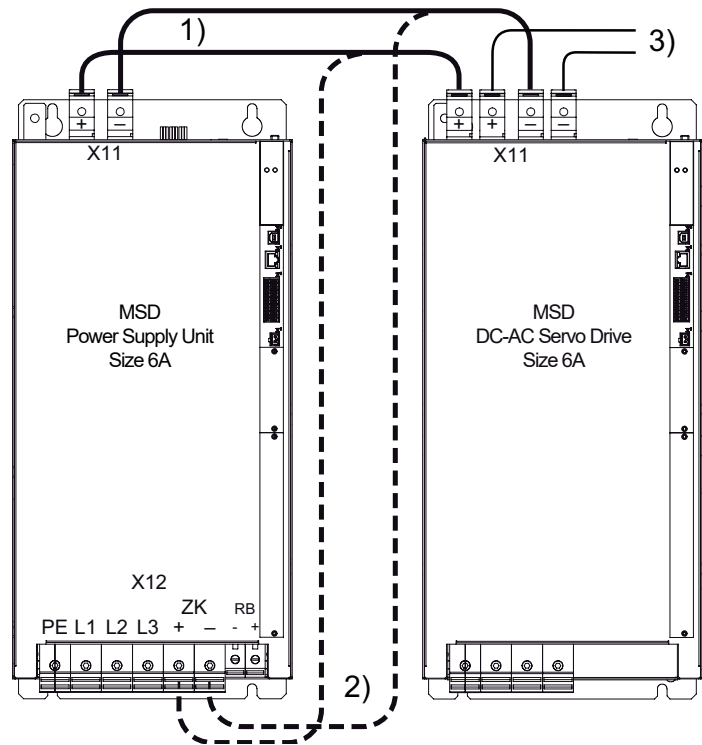
The DC link fuses are to be dimensioned to suit the current load and the cross-sections selected and must be suitable for 900 V DC. Use utilisation class gPV, gR, gRL or gS.

For typical examples, see following pages Figure 4.23 to Figure 4.26 . For information on further combinations, please contact your project engineer or our helpline, see "1.10 Service & Helpline" .



F2 = DC fuses maximum 160 A/ min. 900 V DC, utilisation class gPV, gR, gRL, (gS)

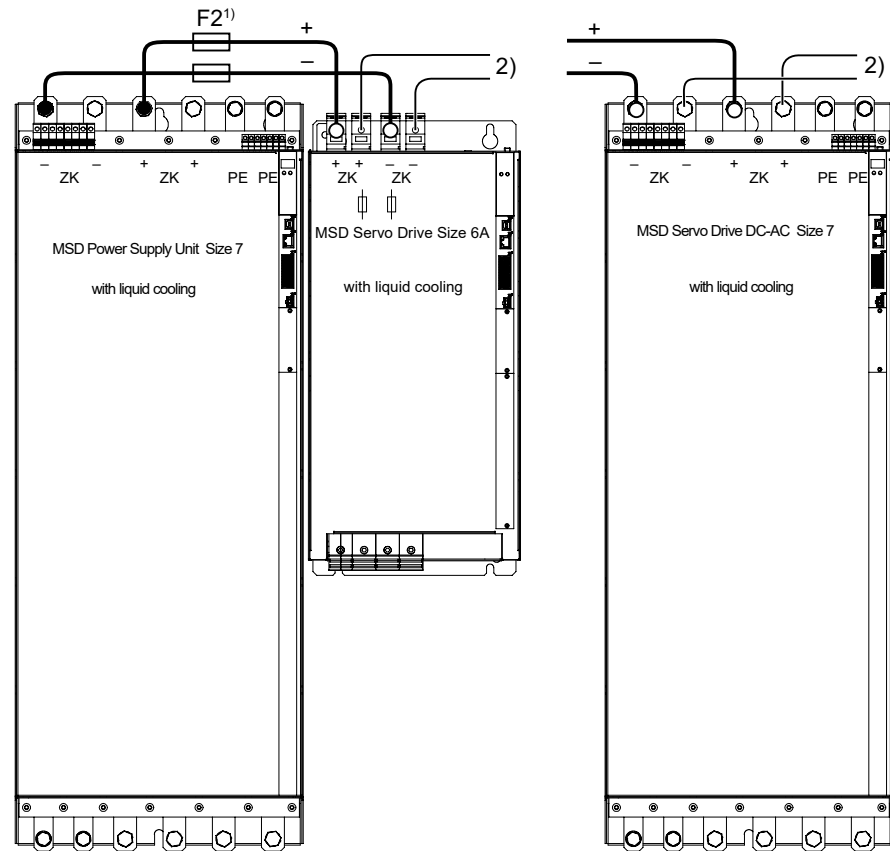
Figure 4.22 Schematic: connection, DC power supply, Size 6A to smaller DC-AC Servo Drives



- 1) Shortest connection
- 2) Alternatively, the DC link connection on terminal X12 can be used.
- 3) For the connection of further axis controllers Size 5 and smaller, see Figure 4.22

Figure 4.23 Schematic: connection, DC power supply, Size 6A to Size 6A

On a supply unit Size 7 the DC connection X11/ZK is not protected internally.



- 1) DC fuses required.
- 2) For the connection of further servo drive Size 5 and smaller, see Figure 4.22

Figure 4.24 Schematic: connection, DC power supply, Size 7 to Size 6A/ Size 7.

4.9 Control connections (X4)

1. Check whether a complete device setup is already available, i.e. whether the drive has already been configured.
2. If so, a special control terminal assignment applies. It is imperative you contact your project engineer to obtain the terminal assignment!
3. Choose a terminal assignment.

Wire the control terminals using shielded cables. The following are imperative: 24 VDC to X4/22 and ENPO X4/10 as start signal.
4. Earth the cable shields over a large area at both ends. Rigid conductor sizes: 0.2 to 1.5 mm² (0.0003 to 0.0023 in²) Flexible conductor sizes with ferrules: 0.2 to 1.5 mm² (0.0003 to 0.0023 in²)
5. Leave all contacts open (inputs inactive).
6. Check all connections again! Continue with commissioning in chap. 5 on page 60.

Note the following points:

- Always wire the control terminals with shielded cables.
- Route mains, motor and signal, DC power supply and braking resistor cables separated from one another. Maintain a distance of at least 200 mm (7.87 in).
- A cable type with double copper braiding, with 60 to 70 % coverage, must be used for all shielded connections.

4.9.1 Specification, control connections

Des.	Term.	Specification	Electrical isolation
Analogue inputs			
ISA0+ ISA0- ISA1+ ISA1-	X4/3 X4/4 X4/5 X4/6	No function	No
Digital inputs			
ISD00 ISD01 ISD02 ISD03 ISD04 ISD05 ISDSH	X4/15 X4/16 X4/17 X4/18 X4/19 X4/20 X4/22	<ul style="list-style-type: none"> • Frequency range <500 Hz • Terminal scan cycle in = 1 ms • Switching level low/high: ≤4.8 V / ≥18 V • At 24 V typ. 3 mA 	Yes
ISD06	X4/21	<ul style="list-style-type: none"> • Frequency range ≤500 Hz • Switching level low/high: ≤4.8 V / ≥18 V • I_{max} at 24 V = 10 mA, R_{IN} approx. 3 kΩ • Internal signal delay < 2 μs suitable as trigger input for quickly saving the actual position 	Yes
ENPO	X4/10	<ul style="list-style-type: none"> • Frequency range <500 Hz • Response time approx. 10 ms • Switching level low/high: ≤4.8 V / ≥18 V • At 24 V typ. 3 mA 	Yes
Digital outputs			
OSD00 OSD01 OSD02	X4/7 X4/8 X4/9	<ul style="list-style-type: none"> • Short circuit proof • I_{max} = 50 mA, PLC-compatible • Terminal scan cycle in = 1 ms • High-side driver 	Yes

X4

Table 4.10 Specification of the control connections

Des.	Term.	Specification	Electrical isolation						
Relay outputs									
REL	X4/23 X4/24	<ul style="list-style-type: none"> Relay, 1 NO contact Functions can be selected as for digital outputs 25 V / 1.0 A AC, $\cos \varphi = 1$ 30 V / 1.0 A DC, $\cos \varphi = 1$ Switching delay approx. 10 ms Cycle time 1 ms 	<table border="1"> <tr> <td></td> <td>X4/23</td> <td></td> </tr> <tr> <td></td> <td>X4/24</td> <td></td> </tr> </table> Yes		X4/23			X4/24	
	X4/23								
	X4/24								
RSH RSH	X4/11 X4/12	No function	Yes						
Auxiliary voltage									
+ 24 V	X4/2 X4/14	<ul style="list-style-type: none"> Auxiliary voltage for supplying the digital control inputs $U_H = U_V - \Delta U$ (ΔU typically approx. 1.2 V), no irreparable damage in event of short circuit (+24 V -> GND), however device may shut down briefl . $I_{max} = 80$ mA (per pin) with self-resetting circuit breaker (polyswitch) 	Yes						
Digital ground									
DGND	X4/1 X4/13	<ul style="list-style-type: none"> Reference ground for 24 V, with self-resetting circuit breaker (polyswitch) 	Yes						

Table 4.10 Specification of the control connections



NOTE:

If high currents flow via the ground terminals, high-impedance isolation from the device ground due to the self-resetting fuse is possible. This can result in the malfunction of the system (avoid currents circulating in the wiring).

4.9.2 Standard terminal assignment

Terminal assignment with the factory setting

X4	Des.	X4	Des.
● 24	REL	● 12	RSH
● 23	REL	● 11	RSH
● 22	ISDSH	● 10	ENPO
● 21	ISD06	● 9	OSD02
● 20	ISD05	● 8	OSD01
● 19	ISD04	● 7	OSD00
● 18	ISD03	● 6	ISA1-
● 17	ISD02	● 5	ISA1+
● 16	ISD01	● 4	ISA0-
● 15	ISD00	● 3	ISA0+
● 14	+24 V	● 2	+24 V
● 13	DGND	● 1	DGND

Figure 4.25 Control terminals, standard assignment (initial commissioning)



NOTE:

The safety function STO (Safe Torque OFF) is not required for the MSD Power Supply Unit, as no motors are connected. To be able to start the supply unit, a jumper must be placed between X4/14 and X4/22. The safety function STO is used for MSD Servo Drive DC-AC.

4.10 Functions of the digital inputs

The following functions can be selected for the digital inputs ISD00 to ISD06:

Value	Value name	Description
0	MPRO_INPUT_FS_OFF	No function
1	MPRO_INPUT_FS_START	Start regulation
2	MPRO_INPUT_FS_E_EXT	External error on another device
3	MPRO_INPUT_FS_WARN	External warning on another device
4	MPRO_INPUT_FS_RSERR	Reset error message

Table 4.11 Functions that can be selected for the digital inputs ISD00 to OSD06

4.11 Functions of the digital outputs

The following functions can be selected for the digital outputs OSD00 to OSD02:

Value	Value name	Description
0	OUTPUT_FS_OFF	No function
1	OUTPUT_FS_ERR	General error
2	OUTPUT_FS_ACTIV	Regulation in operation
3	OUTPUT_FS_S_RDY	Device initialised
4	OUTPUT_FS_PRE-CHARGE_RDY	Device precharged
5	OUTPUT_FS_C_RDY	Device ready (DC link voltage present)
6	OUTPUT_FS_REF	Setpoint for the DC link voltage reached
7	OUTPUT_FS_E_FLW	No function
8	OUTPUT_FS_LIMIT	Setpoint limiting for the DC link voltage active (the voltage is outside the defined range).
9	OUTPUT_FS_UDC_GT_UDCX	Actual value of the DC link voltage is higher than defined in parameter P-0740 voltage threshold
10	OUTPUT_FS_P_LIM_ACTIV	No function

Value	Value name	Description
11	OUTPUT_FS_UDC_LIM_ACTIV	Setpoint limiting for the DC link voltage active (the voltage is outside the defined range).
12	OUTPUT_FS_I_LIM_ACTIV	No function
13	OUTPUT_FS_ENMO	No function
14	OUTPUT_FS_PLC	No function
15	OUTPUT_FS_WARN	General warning
16	OUTPUT_FS_WUV	Warning, undervoltage in the DC link (defined in P-0730 [0,1])
17	OUTPUT_FS_WOV	Warning, overvoltage in the DC link (defined in P-0730 [2,3])
18	OUTPUT_FS_WIIT	Warning, I _{2t} power stage protection threshold reached (defined in P-0730 [6,7])
19	OUTPUT_FS_WOT_PTC	Warning KTY sensor for step-up choke (defined in P-0730 [12,13])
20	OUTPUT_FS_WOTI	Warning, supply unit heat sink temperature (defined in P-0730 [08,9])
21	OUTPUT_FS_WOTD	Warning, supply unit internal temperature (defined in P-0730 [10,11])
22	OUTPUT_FS_WLIS	Warning, apparent current limit exceeded (defined in P-0730 [4,5])
23	OUTPUT_FS_WLVOLT	Warning, DC link voltage limit exceeded (defined in P-0730 [14,15])
24	OUTPUT_FS_COM_1MS	Set the outputs via COM option in 1 ms cycle
25	OUTPUT_FS_COM_NC	Set the outputs via COM option in NC cycle
26	OUTPUT_FS_SH_S	No function
27	OUTPUT_FS_BC_FAIL	Brake chopper fail error (error = LOW)
28	OUTPUT_FS_WLPOW	Active power limit exceeded (defined in P-0730 [16,17])
29	OUTPUT_FS_GRID_OK	Mains OK (frequency AND voltage within the tolerance window = HIGH)

Table 4.12 Functions that can be selected for the digital outputs OSD00 to OSD02

4.12 Specification, USB interface (X2)

The service and diagnostic interface X2 is designed as a USB V1.1 interface. It is only suitable for connecting a PC for commissioning, service and diagnostics using the software Moog DRIVE ADMINISTRATOR 5.

Technical specification

- USB 1.1 standard - full speed device interface
- Connection via commercially available USB interface cable type A to type B (see also MSD Servo Drive Ordering Catalog)

4.13 Specification, Ethernet interface (X3)

The service and diagnostic interface X3 is designed as an Ethernet interface. It is only suitable for connecting a PC for commissioning, service and diagnostics using the software Moog DRIVE ADMINISTRATOR 5.

Technical specification

- Transfer rate 10/100 Mbits/s BASE-T
- Transmission profile IEEE802.3 complian
- Connection via commercially available crosslink cable (see also MSD Servo Drive Ordering Catalog)

4.14 Option 1


Depending on the MSD Servo Drive variant, Option 1 is factory-configured with various options. Field bus options such as EtherCAT or SERCOS are available.

You will find all available options in the MSD Servo Drive Ordering Catalog. The user manuals for the respective options provide detailed information on commissioning.

4.15 Braking resistor (X12/RB)

In regenerative operation, e.g. when braking the motors, energy is fed to the DC link in the multi-axis system and fed back to the mains via the supply unit. If it is not possible to feed back the electrical power to the mains (e.g. mains failure), the internal braking transistor is switched on and the regenerated power is converted into heat via a braking resistor.


4.15.1 Connection of the external braking resistor

DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none">• Carelessness will result in serious injuries or death. <p>Terminal RB+ is permanently connected to DC link potential (>300 V DC). The connection is not protected internally in the device. Never make or disconnect electrical connections while they are electrically live! Before making any change the device is to be disconnected from the mains. Even 30 minutes after switching off the mains supply dangerously high voltages of ≥ 50 V may still be present (capacitor charge). The discharging time depends on the number of controllers connected to the multi-axis system. So check that electrical power is not present! See chap. 4.1</p>



NOTE:

The external braking resistor must be monitored by the controller. The temperature of the braking resistor is monitored by a temperature sensor (Klixon). In the event of overtemperature, the supply unit must be disconnected from the mains. All servo drives in the system must also be deactivated.

WARNING!	Risk of injury due to hot surfaces on the braking resistor!
	<ul style="list-style-type: none">• Carelessness may result in serious burns. <p>The braking resistor may become hot during operation! For this reason maintain an adequate clearance to neighbouring assemblies or install the braking resistor outside the switch cabinet.</p>





NOTE:

- The external braking resistor is only allowed to be installed with a supply unit that does not have an internal braking resistor.
- Be sure to follow the installation instructions for the external braking resistor.
- The minimum permissible connection resistance for the supply unit must not be infringed. For technical data on the design of the braking resistors, see Appendix Table A.2, p. 75, Table A.5, p. 76 and Table A.8, p. 78.
- The cable cross-section is dependent on the braking resistor's power rating, see Table A.3, Table A.6 and Table A.9
- The cables are to be protection by suitable means.

4.16 Overview of the step-up choke connections

In the following you will find the layout with the corresponding positions and labels on the terminals. The temperature is evaluated using a KTY sensor via terminal X5. At +145 °C (+293 °F) the supply unit is shut down. For technical data on the step-up choke, see chap. A.7, p. 82.

DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none"> • Carelessness will result in serious injuries or death. <p>The choke is only intended for installation in a switch cabinet, as with IP00 protection it offers no protection against direct or indirect touching.</p>
WARNING!	Risk of injury due to hot surfaces on the choke!
	<ul style="list-style-type: none"> • Carelessness may result in serious burns. <p>The choke may reach a temperature of up to +145 °C (+293 °F) during operation! Only touch the choke with gloves or after a longer cooling phase.</p>

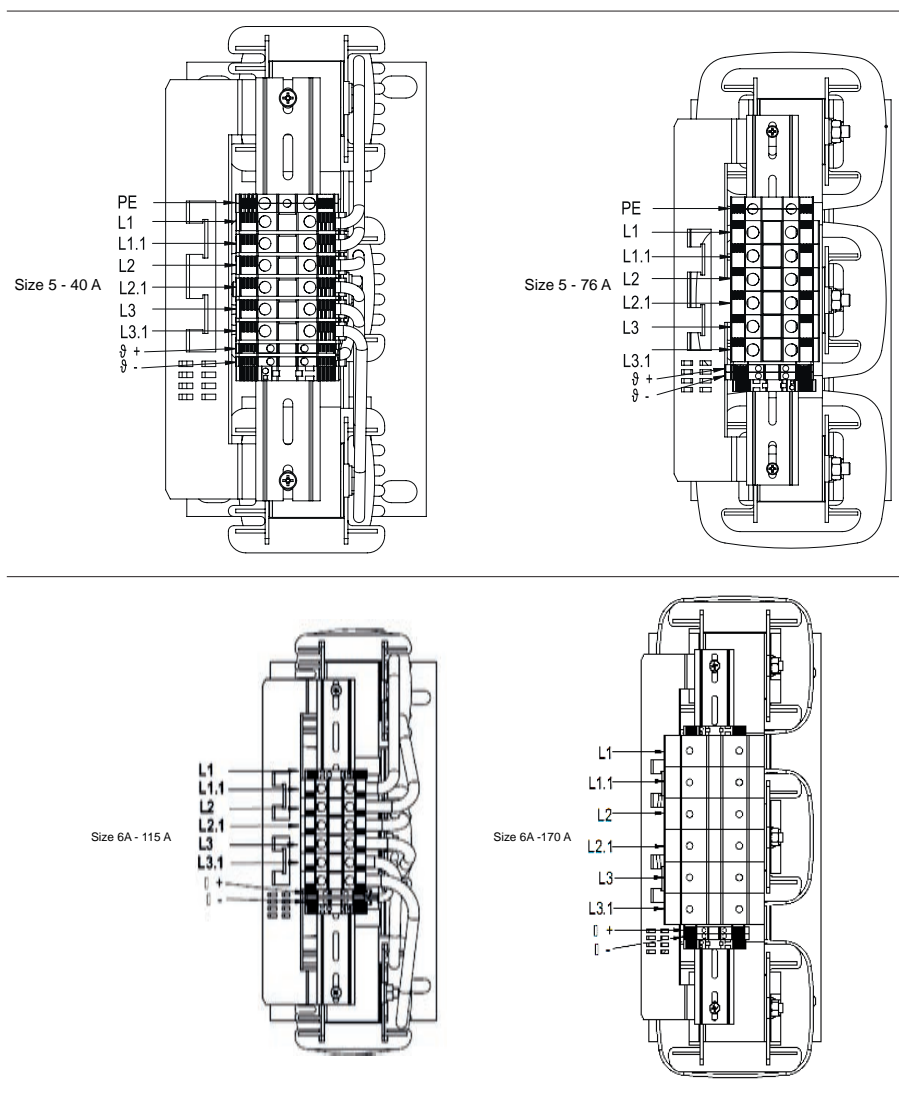


Figure 4.26 Connections, step-up choke for Size 5 and Size 6A

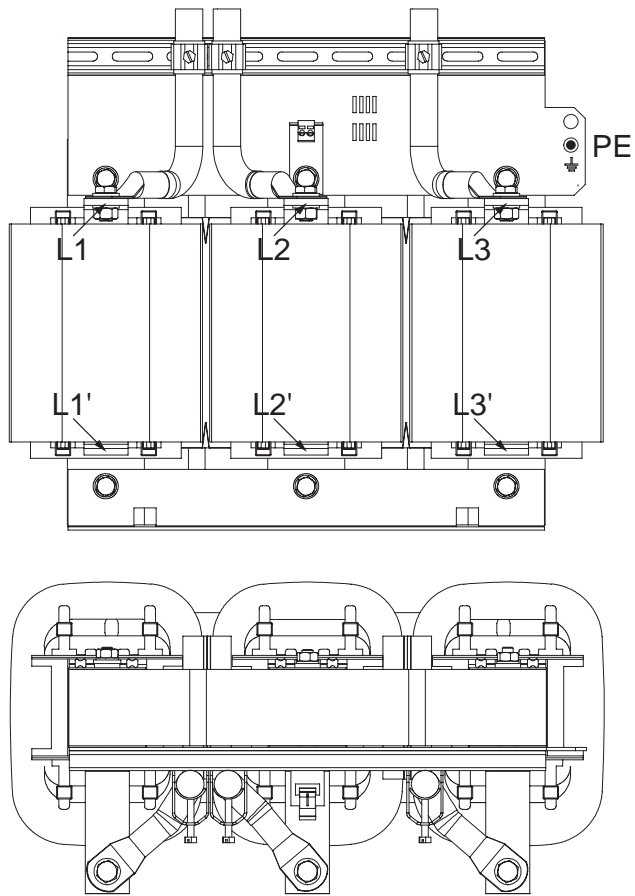

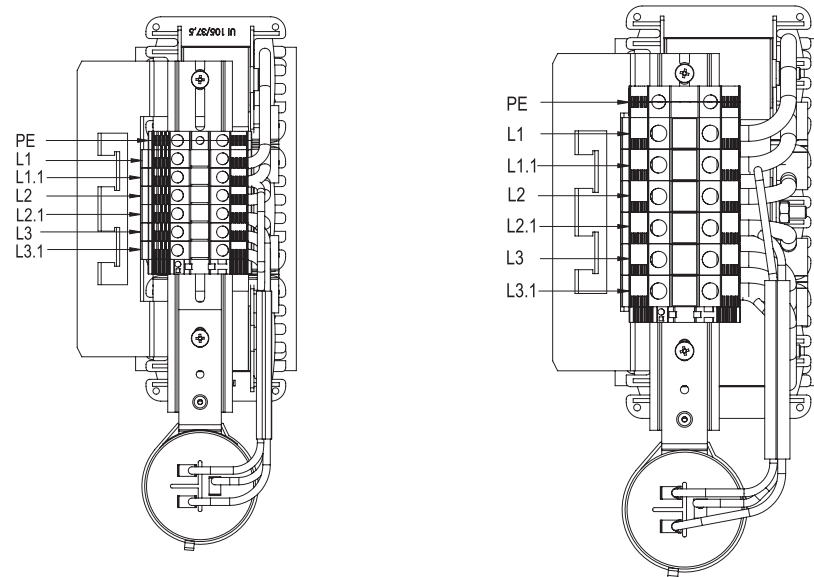


Figure 4.27 Step-up choke for Size 7

4.17 Overview of the input choke connections

In the following you will find the layout with the corresponding positions and labels on the terminals. For technical data on the input choke, see chap. A.8, p. 83

DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none"> • Carelessness will result in serious injuries or death. <p>The choke is only intended for installation in a switch cabinet, as with IP00 protection it offers no protection against direct or indirect touching.</p>



Size 5 - 40 A

Size 5 - 76 A

Figure 4.28 Connections, input choke for Size 5 and Size 6A

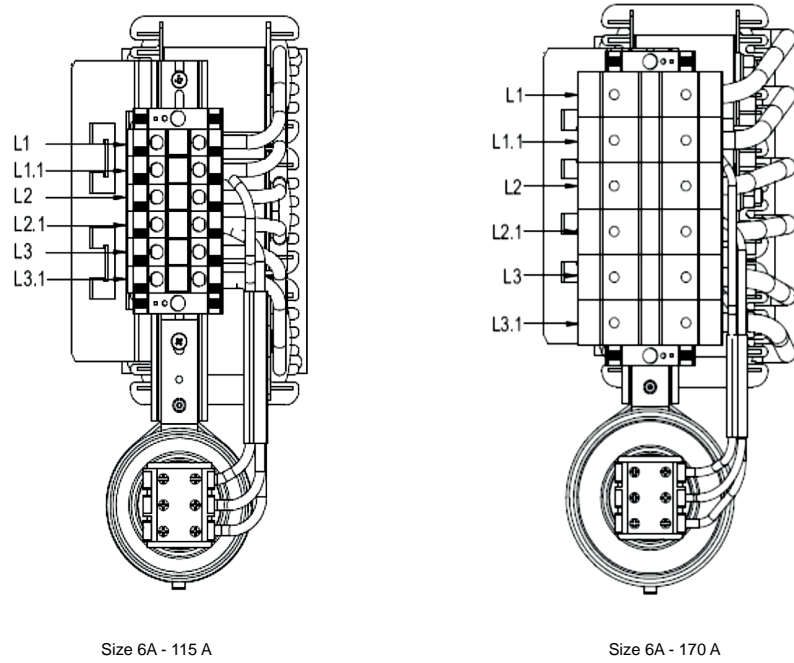


Figure 4.28 Connections, input choke for Size 5 and Size 6A

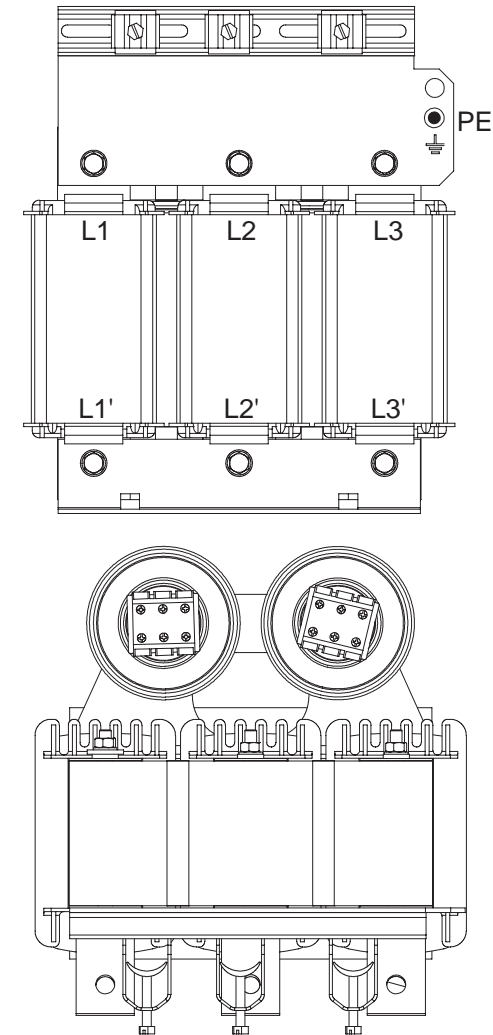


Figure 4.29 Connections, input choke for Size 7

4.18 Overview of the mains filter connection

In the following you will find the layout with the corresponding positions and labels on the terminals. For technical data on the mains filter, see chap. A.9, p. 84.

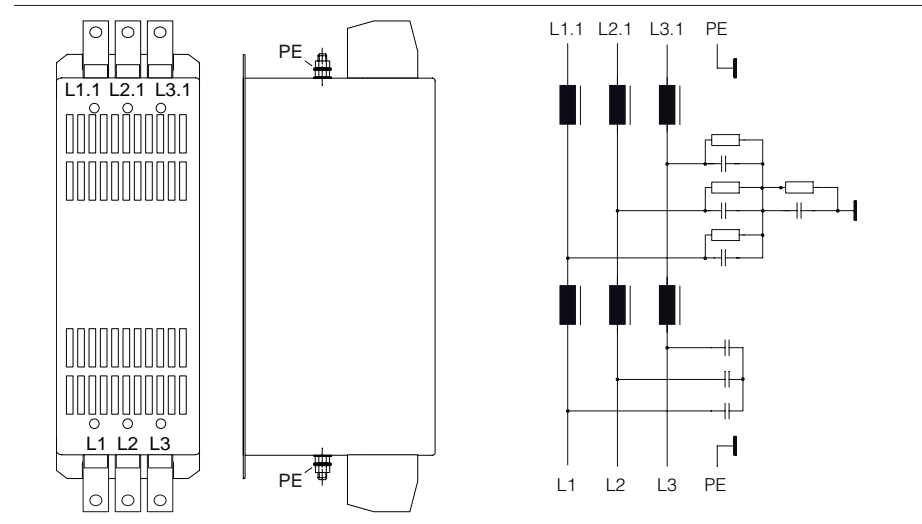


Figure 4.30 Connections, mains filter for Size 5 and Size 6A

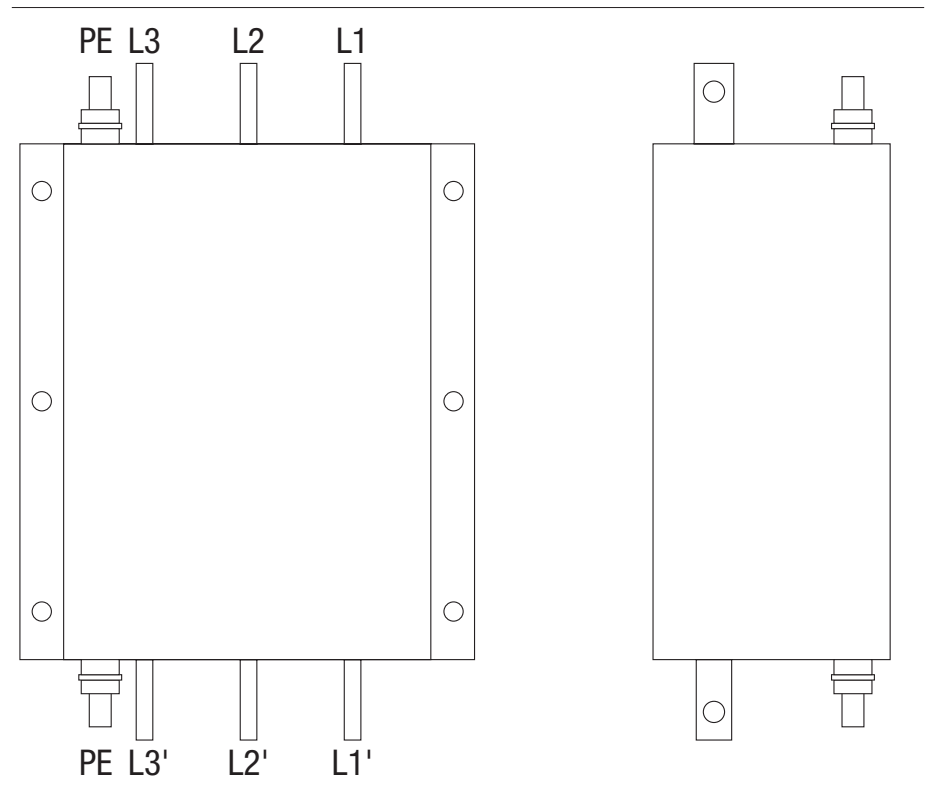



Figure 4.31 Mains filter, based on Size 7 as an example

5 Commissioning


5.1 Notes for operation

CAUTION!	Damage to the device due to incorrect installation conditions!
	<p>The device may be irreparably damaged due to detrimental ambient conditions during operation.</p> <p>For this reason</p> <ul style="list-style-type: none">• Moisture must not be allowed to enter the device• There must not be any aggressive or conductive substances in the ambient air• Foreign bodies such as drilling chips, screws, washers etc. must not be allowed to fall into the device• Cooling openings must not be covered, i.e. cooling air must be able to flow unhindered through the device and the mains connection components.

Further information on ambient conditions can be found in the appendix.

5.2 Initial commissioning (operation via terminals)

The commissioning of the supply unit is described in the following. During this process the device is controlled via the control terminal X4. The setpoint for the DC link voltage is specified internally as a fixed value. Commissioning is divided into the following steps

DANGER!	Risk of injury due to electrical power!
	<ul style="list-style-type: none">• Carelessness will result in serious injuries or death. <p>Never make or disconnect electrical connections while they are electrically live! Before making any change the device is to be disconnected from the mains. Dangerously high voltages ≥ 50 V can be present on the DC link connections and other components in the mains input area after power off. So check that electrical power is not present! See chap. 4.1.</p>

1. Wiring the components
See chap. 4.3, p. 32 and subsequent information.
2. Switch on control voltage
External +24-V supply voltage
See chap. 4.7.1, p. 43 Size 5 and Size 6A. See chap. 4.7.2, p. 44 Size 7.
3. Establish communication with Moog DRIVEADMINISTRATOR 5
You will find information on installation in the Installation Manual Moog DRIVEADMINISTRATOR 5 as well as in the online help.
4. Adapt to the parameters for the supply system
5. Automatic identification of the DC link capacitance and the equivalent time constant for the current regulation
6. Configure the drive parameters for the DC link capacitance
See chap. 5.2.7, p. 63.
7. Configure the controller parameters for the DC link voltage
See chap. 5.2.8, p. 64.
8. Set monitoring of the braking resistor
See chap. 5.2.9, p. 64.
9. Switch on the mains supply voltage via main switch
10. Switch on the regulation
Start with ENPO set to HIGH.

5.2.1 System requirements

- Supply unit installed.
You will find details on initial commissioning in chap. 5.2.2, p. 60
- Completion of the work in chap. 4 "Electrical installation" and chap. 3 "Starting Moog DRIVEADMINISTRATOR 5" in the Installation Manual Moog DRIVEADMINISTRATOR 5
- Connection between PC and MSD Power Supply Unit (Ethernet or USB)



NOTE:

During commissioning, please follow the safety instructions in chap. 2

5.2.2 Wiring the components

1. For complete wiring the cable connections, the communication and service connections must be connected using the related cables and wires at the terminals provided for this purpose. Pay attention to adequate shielding.

= selected setting/component

Connections	Terminals	Terminal identifier	Cable type
Control supply	X9/10	+24 V DC / pin 1 = + , pin 2 = -	Standard
Precharging/mains synchronisation, auxiliary relay	X21	L1/L2/L3 (400/460/480 V _{AC}) HREL	Standard shielded
Mains supply	X12	L1/L2/L3/PE (400/460/480 V _{AC})	Standard shielded

See chap. 4.3, p. 32

Table 5.1 Power supply

Connection	Socket	Designation	Cable type
USB	X2	USB A	CC-USB 03
TCP / IP (Ethernet)	X3	RJ45	CC_ECL 03

Table 5.2 Communication with the PC with user software Moog DRIVEADMINISTRATOR 5

Connection	Terminals	Terminal identifier	Cable type
+24 V DC	X4/22	ISDSH	Standard shielded
ENPO (Start)	X4/10	ENPO	Standard shielded

See chap. 4.9, p. 50

Table 5.3 Communication via terminals

5.2.3 Switching on control voltage (+24 VDC)

2. To initialise the supply unit and to configure the parameters, it is necessary initially to apply only the +24 V DC control supply to X9 or X10. Pay attention to correct polarity.

After switching on successfully, you can read two states on the 7-segment display.

D1	D2	Action	Reaction	Explanation
0	0	Switch on the ext. +24 V control voltage	Initialisation OK	Initialisation time <5 s
!	!	Not ready to switch on	No DC link voltage	Device is initialised

Table 5.4 Switch-on status of the MSD Servo Drive (on connection of the +24 V control supply)

5.2.4 Communication with Moog DRIVEADMINISTRATOR 5

3. The user software Moog DRIVEADMINISTRATOR 5 must be installed on a PC. The PC can be connected to the servo drive via USB or Ethernet (TCP/IP).

You will find a detailed description of Moog DRIVEADMINISTRATOR 5 in the online help for Moog DRIVEADMINISTRATOR 5.



NOTE:

The communication link between PC and servo drive can only be established after the servo drive has completed its initialisation. "88" or "0" is no longer indicated on the display D1/D2.



NOTE:

The supply unit parameters are pre-configured in the factory and matched to the mains connection set. The factory parameter configuration is only allowed to be changed by trained specialist personnel. The parameter changes described in the following adapt the supply unit to the parameters of the supply system and to the number and type of the DC-AC Servo Drives connected to the DC terminals X11.



NOTE:

The firmware in the supply unit must be compatible with Moog DRIVEADMINISTRATOR 5. If the establishment of the communication fails, the compatibility must be checked.

5.2.5 Setting mains voltage and mains frequency of the supply system

- The supply unit parameters are configured in the factory for a system with 3 x 400 V AC (50 Hz). If the supply unit is to be operated on such a system, you can continue with step 5. If the supply unit is to be operated on a different system, the parameters **P-0307** mains voltage and **P-0452** mains frequency must be set to the corresponding values.



NOTE:

Only the fixed mains voltages 400 V, 460 V and 480 V and the mains frequencies 50 Hz and 60 Hz can be set.

The supply unit regulates the DC link voltage to an internally specified fixed setpoint. At an input voltage of 400 V_{AC} the DC link voltages 650 and 770 V_{DC} are possible. At an input voltage of 460 and 480 V_{AC} the DC link voltage 770 V_{DC} is possible.

- Set the mains voltage **P-0307**.

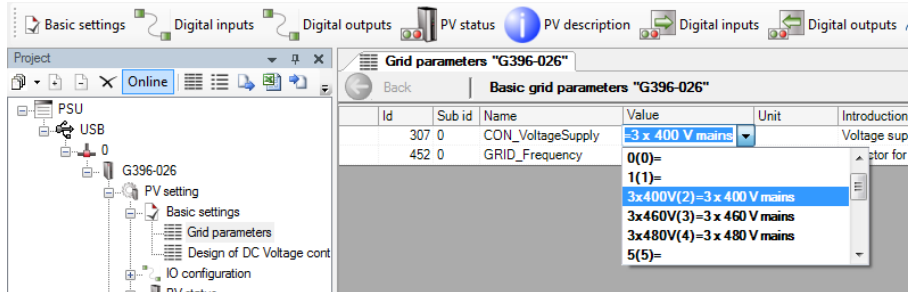


Figure 5.1 Parameter editor - parameter **P-0307**

- Set the mains frequency **P-0452**.
- Set automatic mains frequency detection parameter **P-0449** to 1.

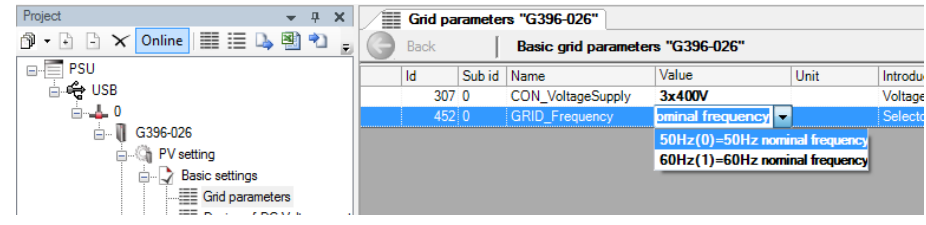


Figure 5.2 Parameter editor - parameter **P-0452**



NOTE:

So that the parameters are also effective after a restart, the modified settings must be saved in the device in non-volatile memory and a +24-V reset undertaken.

Saving setting

- To save the parameter setting in the device, please click the "Save setting in device to non-volatile memory" button.
- In addition, it is possible to save the parameter data set as a file on the PC connected. For this purpose click the "Save actual device setting to file", select the required folder and accept the save process by clicking the "Save" button using the mouse.

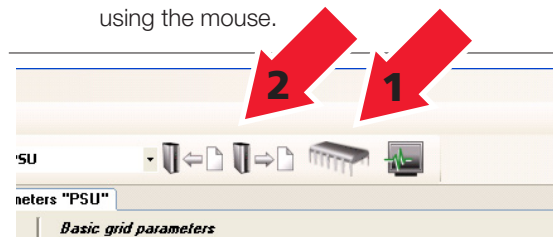


Figure 5.3 Saving setting

5.2.6 Automatic identification of the DC link capacitance and the equivalent time constant for the current regulation

5. The DC voltage regulator in the supply unit regulates the DC link voltage to an internally specified fixed setpoint. The regulation is dependent on the DC link capacitance in the multi-axis system and the equivalent time constant for the current regulation. Both values can and should be determined using the automatic identification



NOTE:

The maximum overall capacitance of the multi-axis system DC link for a MSD Power Supply Unit Size 5 (incl.) must not exceed 10,000 μF , for Size 6A (incl.) 20,000 μF and for Size 7 (incl.) 25,000 μF .

- Prior to starting the automatic identification, set the setpoint for the DC link voltage to $700 V_{\text{DC}}$ in parameter **P-0410** "CON_VCON_VdcRef".
- Start the automatic identification by setting parameter **P-1501** "SCD_AT_VdcCAP_Con" to START(2).

As soon as the parameter changes to the value READY(0), the identification procedure is complete.

The values determined for the total DC link capacitance (**P-1500**) and the equivalent time constant for the current regulation (**P-0406**) are now available for the configuration of the DC voltage regulator.



NOTE:

In the next step the value determined for the total DC link capacitance (**P-1500**) chap. 5.2.7, p. 63 must be checked for plausibility and, if necessary, replaced with the value known. The setpoint for the DC link voltage (**P-0410**) chap. 5.2.8, p. 64 should also be set.

5.2.7 Setting DC link capacitance

6. The settings for the DC voltage regulator depend on the DC link capacitance of the entire multi-axis system. You will find the DC link capacitances in the operation manuals for the supply unit and the DC-AC Servo Drive in the technical data in the chapter Appendix.

- Add together the DC link capacitances of all drives connected to the multi-axis system.
- Set the total value for the DC link capacitance in **P-1500** (in μF).



NOTE:

The maximum overall capacitance of the multi-axis system DC link for a MSD Power Supply Unit Size 5 (incl.) must not exceed 10,000 μF , for Size 6A (incl.) 20,000 μF and for Size 7 (incl.) 25,000 μF .

- Set the relative controller dynamic performance for the voltage regulator in **P-0405**.
Recommended value: 100 %.



NOTE:

In all circumstances the parameter **P-0405** must be activated by "double-clicking" the "value" field and using the "Enter" key, even if you do not make any change. Otherwise the automatic configuration of the voltage regulator will not be undertaken.

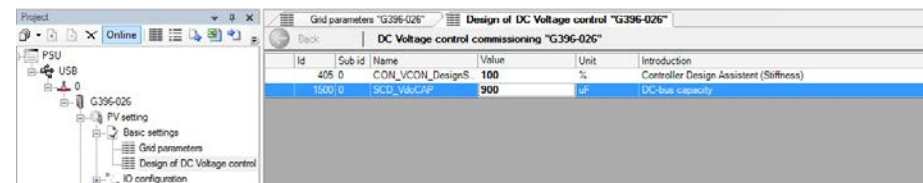


Figure 5.4 Parameter editor - parameter **P-0405** and **P-1500**



NOTE:

So that the parameters are also effective after a restart, the modified settings must be saved in the device in non-volatile memory and a +24-V reset undertaken.

All the necessary parameter configuration work has then been completed

5.2.8 Setting DC link voltage

7. The supply unit regulates the DC link voltage to an internally specified fixed setpoint. At an input voltage of 400 V_{AC} the DC link voltages 650 and 770 V_{DC} are possible. At an input voltage of 460 and 480 V_{AC} the DC link voltage 770 V_{DC} is possible.

- Set the DC link voltage to 650 or 770 V_{DC} in **P-0410**.

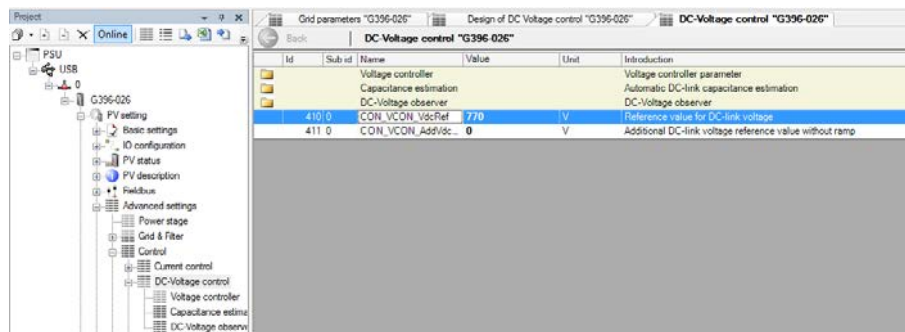


Figure 5.5 Parameter editor - parameter **P-0410**

5.2.9 Setting monitoring of the braking resistor

8. Set the braking resistor.

- Set the braking resistor:
 - **P-0741** resistance
 - **P-0742** rated power
 - **P-0743** maximum energy
 - **P-0745** threshold for warning
- Set the parameter **P-0410** to 1 to activate the braking resistor.

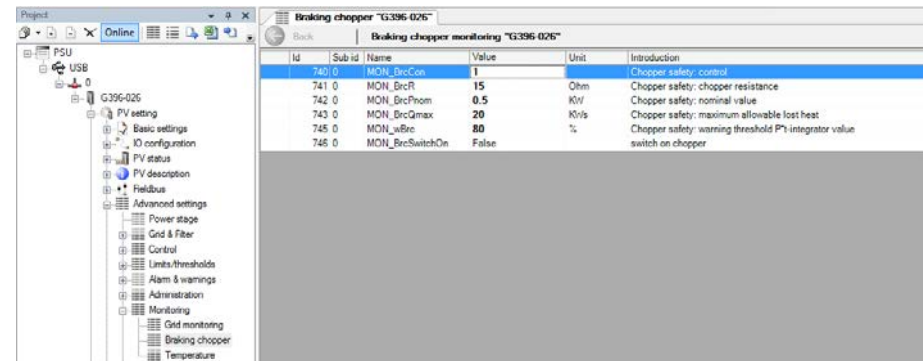


Figure 5.6 Parameter editor - parameter **P-0740**

If the brake chopper is operated (DC link voltage ≥ 820 V) the power converted in the braking resistor is integrated.

$$P = \frac{(820 \text{ V})^2}{\text{MON_BrcR}}$$

If the brake chopper is not operated, the power is integrated using the value configured in the parameters for the brake chopper rated power (MON_BrcPnom).

On reaching the shut-off threshold MON_BrcQmax a device error (ErrID=>24, Location=>01) is triggered and the operation of the brake chopper inhibited.



NOTE:

Any pre-heating of the braking resistor is not taken into account!

5.2.10 Switching on mains supply voltage



NOTE:

Prior to switching on, check the wiring for correct phase angle.

-
9. The mains can now be switched on using the main switch. Once the precharging of the DC link has been completed, the indication on the display in the supply unit changes from the value 1 to the value 2.
-

5.2.11 Switching on regulation

-
10. After precharging the DC link, the regulation can be enabled by activating the input ENPO (X4/10). The supply unit now synchronises the regulation with the mains voltage. The display indicates the value 4 during this phase. After successful synchronisation, the regulation becomes active and the stipulated setpoint for the DC link voltage is set. The display indicates the value 5.
The actual DC link voltage measured is indicated via the parameter **P-0332** in the area "Parameter list > PSU status > Actual values > DC Voltage" in the parameter tree. If, on average, this value corresponds to the stipulated setpoint, the supply unit has been successfully placed in operation.
-

5.3 Diagnostics

5.3.1 Malfunctions and warnings in Moog DRIVEADMINISTRATOR 5

The parameters **P-0031** ErrorStack and **P-0033** ActualError contain additional information on an error or warning that has occurred. You can obtain this information via the "Device state monitor" in Moog DRIVEADMINISTRATOR 5.



NOTE:

You will find more detailed information in the Operation Manual MSD Servo Drive DC-AC.

5.4 Integrated control unit

The integrated control unit permits diagnostics on the servo drive. The control unit comprises the following elements, all located on the front of the device:

- 2-digit 7-segment display (D1, D2)
- Two buttons (T1, T2)

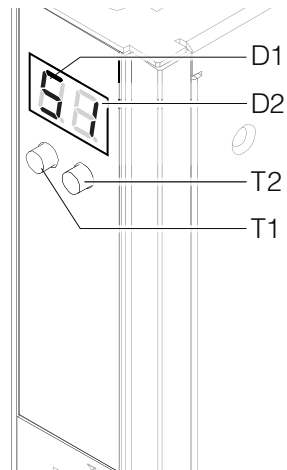


Figure 5.7 Integrated control unit

The following functions and displays are available:

- Indication of the device status (see chap. 6.1, p. 71)
The device status is indicated after switching on the control supply. If no input is made via the keypad for 60 seconds, the display switches back to the indication of the device status.
- Indication of the device error status (see chap. 6.1.1, p. 71)
On the occurrence of an error in the device, the display is immediately switched to the indication of the error code.
- Parameter setting (indication "PA") (see chap. 5.4.3, p. 68)
Resetting device parameters to their factory setting
- Ethernet IP address setting (indication "IP") (see chap. 5.4.4, p. 68)
Ethernet IP address and subnet mask setting
- Field bus settings (indication "Fb") (see chap. 5.4.5, p. 69)
E.g. field bus address setting

5.4.1 Function of buttons T1 and T2

These buttons are used to activate the different menus and to control the corresponding functions.

Button	Function	Comment
T1 (left)	<ul style="list-style-type: none"> • Activate the menu (exit the device status display) • Scroll through the menus/sub-menus • Set values - left segment display (D1) 	The button T1 can be held pressed for any length of time because the display will only scroll through the menu commands available at the corresponding level. No settings will be changed.
T2 (right)	<ul style="list-style-type: none"> • Selection of chosen menu • Set values - right segment display (D2) 	The button T2 must not be held pressed for any length of time because the display will change from one menu level to the next within the menu structure and then change the parameter that is reached at the end. You should therefore always release the button T2 after each change in display.
T1 and T2 together	<ul style="list-style-type: none"> • Menu level up • Accept selection • Acknowledge 	After pressing T1 and T2 at the same time, the value applied flashes for five seconds. During this time the save procedure can still be aborted by pressing any button, without applying the value set. Otherwise the new value will be saved after five seconds
General		<ul style="list-style-type: none"> • The time the button needs to be held depressed until an action is executed is approx. 1 second. • If there is no action by the user for a period of 60 seconds, the display returns to the indication of the device status.

Table 5.5 Function of buttons T1 and T2

5.4.2 Display

The following table defines various indications and items of status information provided via the display.







Display	Meaning
	Menu entries ("PA" in this case serves as an example, for further possible entries see chap. 5.4.4, p. 68 chap. 5.4.5, p. 69)
	[Flashing decimal points] Selected function in progress
	[Two dashes] Entry/function not available
	[OK] Action executed successfully, no errors
	[Error] <ul style="list-style-type: none"> • Action via control unit not executed successfully, "Er" flashes alternately with the error number (see chap. 5.4.3, p. 68) • Device error indication, "Er" flashes alternately with error number and error location (see "MSD Servo Drive Device Help")
	Numerical values ("10" in this case serves as an example) <ul style="list-style-type: none"> • Data set and error numbers are shown in decimal on the Parameter menu (PA). • All other values are displayed in hexadecimal. In these cases the 10 displayed would represent the decimal value 16.

Table 5.6 Meaning of display



NOTE:

If no input is made via the keyboard for a period of 60 s, the display returns to the indication of the device status.

5.4.3 Parameter menu (PA)

The following functions are available on the Parameter menu:

- Reset device to factory settings

Menu level 1	2	Parameter	Value range	Meaning	Explanation
PA	Pr	-	-	Parameter reset	Reset device settings to factory settings.

Table 5.7 Parameter menu

Error messages displayed during user data entry

A failed user action is indicated by an error message. The message consists of the alternating display of "Er" and the error number.



NOTE:

The error messages displayed during user data entry should not be confused with drive error messages. You will find detailed information on the error codes and on error management in the device help.

Error number	Meaning
00	File System No Error
01	File System Any file system error
02	File System command rejected
03	File System function parameter invalid
04	File System create file error
05	File System open file error
17	Parameter reset to factory settings failed
18	Parameter write access failed
19	Save parameter data set non volatile failed
20	Not all parameters written
21	Error while reset to factory settings

Table 5.8 Error messages displayed during user data entry

5.4.4 Ethernet IP address menu (IP)

An Ethernet TCP/IP port is available as a service and diagnostics interface.

The IP address is set in the factory to 192.168.39.5. It can be changed using the PC software Moog DRIVEADMINISTRATOR 5 or via the display.

Menu level 1	2	Parameter	Value range	Meaning	Explanation
IP	lu	b0	00..FF	IP address update byte 0	Setting for byte 0 of the IP address in hexadecimal format (e.g. "05" in 192.168.39.5)
		b1	00..FF	IP address update byte 1	Setting for byte 1 of the IP address in hexadecimal format (e.g. "27" in 192.168.39.5)
		b2	00..FF	IP address update byte 2	Setting for byte 2 of the IP address in hexadecimal format (e.g. "A8" in 192.168.39.5)
		b3	00..FF	IP address update byte 3	Setting for byte 3 of the IP address in hexadecimal format (e.g. "C0" in 192.168.39.5)
	lr	-	-	IP reset to factory setting	Reset IP address to factory setting (192.168.39.5)
	Su	b0	00..FF	Subnet mask update byte 0	Setting for byte 0 of the subnet mask in hexadecimal format (e.g. "00" in 255.255.255.0)
		b1	00..FF	Subnet mask update byte 1	Setting for byte 1 of the subnet mask in hexadecimal format (e.g. "FF" in 255.255.255.0)
		b2	00..FF	Subnet mask update byte 2	Setting for byte 2 of the subnet mask in hexadecimal format (e.g. "FF" in 255.255.255.0)
		b3	00..FF	Subnet mask update byte 3	Setting for byte 3 of the subnet mask in hexadecimal format (e.g. "FF" in 255.255.255.0)
	Sr	-	-	Subnet mask reset to factory setting	Reset subnet mask to factory setting (255.255.255.0)

Table 5.9 IP address menu

Example configuration of the subnet mask

In this example the subnet mask is changed from 255.255.255.0 to 122.255.255.0.

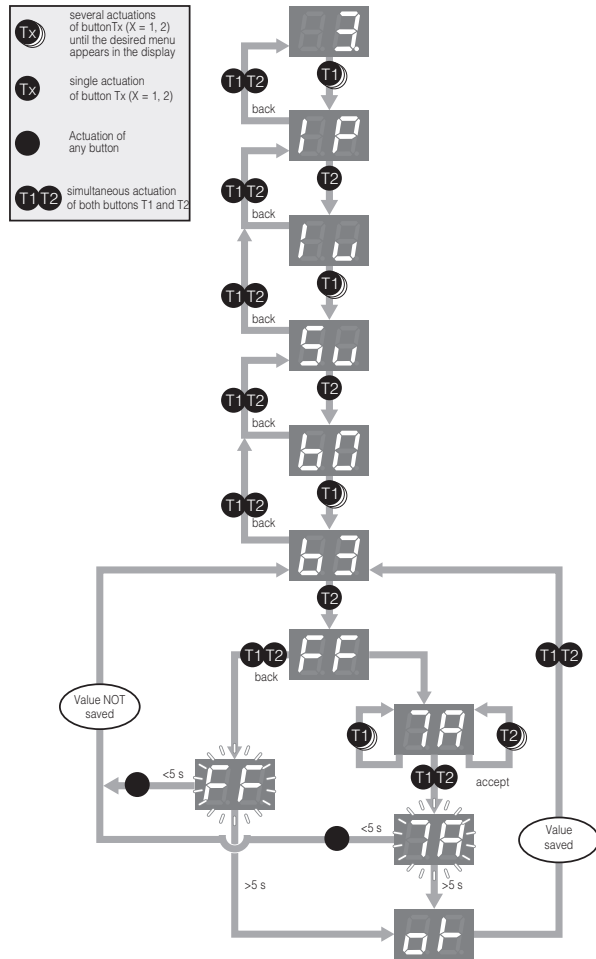


Figure 5.8 Example configuration of the subnet mask



NOTE:

- During the flashing phase after step 7 the save procedure can still be aborted by pressing any button, without applying the value set. Otherwise the new value will be saved after five seconds
- The modified IP address is only effective after restarting the control electronics (+24-V reset).

5.4.5 Field bus address menu (Fb)

The functions available on this menu item depend on the device's communication option. For detailed information refer to the relevant specification

Menu level	Parameter	Value range	Meaning	Explanation	
1	2				
Fb	Ad	-	00..xx or --	Field bus address	Setting for field bus address (only if field bus option used), otherwise indication "- _" (The maximum value that can be programmed depends on the option)
	Po	-	0..3 or --	Transmit power	Setting for fibre-optic power output (only with SERCOS II option), otherwise display "- _"

Table 5.10 Field bus address menu

6 Diagnostics

6.1 Device states

The device states can be read on the 7-segment display (D1, D2).

Display	Meaning	Parameter
System states		
88	Device in reset state	
0	Self-initialisation on device startup	(Start)
1 ¹⁾	Not ready to switch on (no DC link voltage)	(NotReady-ToSwitchOn)
2 ¹⁾	Switch on disabled (ENPO not set) (DC link precharged to ideal DC link voltage, power stage not ready)	(SwitchOnDisabled)
3	Ready to switch on (ENPO set) (power stage ready)	(ReadyToSwitchOn)
4	Switched on (DC link voltage will be increased to setpoint / soft start active)	(SwitchedOn)
5	Supply unit ready (setpoint for the DC link voltage reached)	(OperationEnabled)
7	Fault reaction active	(FaultReactionActiv)
Er	Fault (for list of faults see chap. 6.2, p. 72)	(Fault)

1) This not a "safe indication" in the context of IEC/EN 61800-5-2.

Table 6.1 Device states



NOTE:

The safety function STO (Safe Torque OFF) is not required for the MSD Power Supply Unit, as no motors are connected. To be able to start the supply unit, a jumper must be placed between X4/14 and X4/22. If this jumper is forgotten, there is a flashing point on the device display. The safety function STO is used for MSD Servo Drive DC-AC.

6.1.1 Errors

If there is an error, the following is displayed alternately: ER > 02 > 05 * ER > 02 > 05 to

Display	Meaning	Explanation
Er	Error	ER = "Malfunction"
02	Error name:	02 = "Error in the parameter list"
05	Error description:	05 = "Function for checking the actual parameter list"

Table 6.2 Indication if there is an error



NOTE:

The errors can be reset according to their programmed reaction (ER) or only by means of a 24 V reset (X9/10) (ER.).



NOTE:

Errors marked with a point can only be reset once the cause of the error has been rectified.

6.2 Error list

Error messages (error number, error location, error text) for the supply unit are listed in the following table. In there is an error, the display on the supply unit changes cyclically between the indications "Er", ">Error number<", ">Error location<". The error messages can be acknowledged by switching the input ENPO (X4/10).

Error number	Error location	Error text
01		Runtime error
	00	Unknown runtime error
02		Error in parameter list
	00	Unknown runtime error
	01	Parameter initialisation failed
	02	Parameter virgin initialisation failed
	03	Error in parameter saving routine
	04	Error in paralist while adding a new parameter
	05	Parameter check failed
	06	Parameter ID is multiply define
03		Under voltage
	00	Unknown error
	01	Undervoltage detected
	08	Device cannot be used in this voltage level
04		Overvoltage detected
	00	Unknown error
	01	Overvoltage detected
05		Over current
	00	Unknown error
	01	Overcurrent (hardware) detected
	02	Overcurrent (software) detected
	03	Overcurrent (software) detected

Error number	Error location	Error text
06		Overtemperature PTC
	00	Unknown error
	01	PTC temp. to high
	02	PTC DIN2 error detected (shortcut, resistance smaller 50 Ohm)
07	03	PTC DIN3 error detected (overtemperature, resistance higher than 3500 Ohm)
	04	PTC DIN1 error detected (hysteresis after over temperature, resistance higher than 1650 Ohm)
08		Overtemperature powerstage cooler
	00	Unknown error
09	01	Overtemperature inverter detected
	08	Overtemperature PSU interior
10	00	Unknown error
	01	Overtemperature PSU interior detected
	09	Error grid
11	00	Unknown grid error
	01	Grid frequency out of range
	02	Grid voltage out of range
12	03	Timeout during synchronization
	10	Error I2t power amplifie
13	00	Unknown error
	01	I2t power amplifier detecte
14		External error at digital input detected
	00	Unknown external error
15	01	External error triggering at digital input
	12	Error in CAN option
16	00	Unknown CAN option error
	01	CAN option: BusOff error
	02	CAN option: Guarding error

Table 6.3 Error list

Error number	Error location	Error text
	03	CAN option: Message transmit failed
	04	CAN option: Heartbeat error
	05	CAN option: Illegal address
	06	CAN option: mapping error
	07	CAN option: Sync / RxPDO timeout error
13		Error in SERCOS option
	00	Unknown SERCOS error
	01	SERCOS option: Error while hardware initialisation
	02	SERCOS option: Illegal communication phase
	03	SERCOS option: Optical fiber break
	04	SERCOS option: Receive data disturbed
	05	SERCOS option: MST failure
	06	SERCOS option: MDT failure
	07	SERCOS option: 2 devices with same address in the ring
	08	SERCOS option: Phase upshift failure
	09	SERCOS option: Phase downshift failure
	10	SERCOS option: Phase switching without ready acknowledge
	11	SERCOS option: Error while parameter initialisation
	12	SERCOS option: Run time error
	13	SERCOS option: Watchdog failure
	14	SERCOS option: Error in parameter data
14		Error in EtherCAT option
	00	Unknown EtherCat option error
	01	Sync manager 0 watchdog error
15		Parameter error
	00	Unknown Parameter error
	01	Error while init current monitoring
	02	Error while initializing control
	03	Drive commissioning: Watchdog failure via service tool access

Error number	Error location	Error text
	04	Drive initialization: Unexpected error during drive initialization
16		DC voltage tracking error
	00	Unknown VoltageDiff error
	01	Maximum voltage difference detected
	02	Reserved
17		Fatal error
	00	Unknown fatal error
	01	Error while power stage initialisation
	02	Error while power stage initialisation
	03	Error while power stage initialisation
	04	Error while power stage initialisation
	05	Error while power stage initialisation
	06	Error while power stage initialisation
	07	Cannot switch off brake transistor. Disconnect power supply immediately!
	08	Hardware identification failure
18		CPU error
	00	Unknown TC error
	01	Reserved
	02	Reserved
	03	FPU, Error in floating point unit
	04	FPU, Error in floating point unit
19		Control initialisation error
	00	Unknown error during initialisation of control
	01	Invalid calibration value (Division by Zero)
	02	Reserved
	03	Reserved
	04	Reserved
20		PLC error

Table 6.3 Error list

Error number	Error location	Error text
	00	User defined error in the PLC program detected.
21		Error in PROFIBUS option
	00	PROFIBUS option: Unknown error
	01	PROFIBUS option: process data timeout
22		Task overload
	00	Internal timing error
	01	Internal timing error
	02	Internal timing error
23		Power fail detected
	00	Power fail detected
24		Error braking chopper
	00	Unknown braking chopper error
	01	P*t-integrator value exceeds maximum

Table 6.3 Error list

You will find further information on error management in the MSD Servo Drive Device Help.

A Appendix

A.1 Technical data, supply unit

Size	Size 5					
Device	G396-026			G396-050		
Mains input voltage ($\pm 10\%$) [V _{AC}]	400		460 / 480		400 / 480	
Regulated DC link voltage [V _{DC}]	650	770	770	650	770	770
Input, mains side						
Continuous current [A _{AC eff}]	40	40	34	76	76	64
Peak current ¹⁾ [A _{AC}]	80	80	68	144	144	120
Switching frequency [kHz]	12			4		
Continuous power [kW]	27.5			52.5		
Power dissipation ²⁾ [W]	1010					
Asymmetry of mains voltage [%]	$\pm 3\%$ maximum					
Frequency [Hz]	50/60					
DC link output						
Continuous current [A _{DC}]	40	34	34	76	64	64
Peak current ¹⁾ [A _{DC}]	80	68	68	144	122	122
Continuous power [kW]	26			50		
Peak power ¹⁾ [kW]	52			94		
DC link capacitance [μ F]	900					

Note: Technical data apply for wall mounting and liquid cooling housing variants as a function of the mains input voltage and the regulated DC link voltage

1) For 10 s,

2) Approximate values

Table A.1 Technical data, supply unit Size 5

Size	Size 5	
Device	G396-026	G396-050
Brake chopper power electronics ¹⁾		
Response threshold ²⁾ [VDC]	820	
Peak braking power [kW] software/hardware-side	90/99	
Minimum ohmic resistance of an externally installed braking resistor	7.5 Ω	
Continuous chopper power [kW]	2	

1) Optional for liquid cooling: internal braking resistor (mounted on the base of the cooler) on request

2) Minimum switch-on time 250 μ s

Table A.2 Technical data, brake chopper power electronics Size 5



NOTE:

The maximum overall capacitance of the multi-axis system DC link for a MSD Power Supply Unit Size 5 (incl.) must not exceed 10,000 μ F.

Connection	Size	Size 5	
	Device	G396-026	G396-050
X11/L+, L-	Screw size	M5 Only use the pre-assembled connection cables supplied.	
	Tightening torque	2.5 to 4.5 Nm (22 to 39.8 lb-in)	
X11/PE	Screw size	M5 Only use the pre-assembled connection cables supplied.	
	Tightening torque	2.5 to 4.5 Nm (22 tot39.8 lb-in)	
X12/ L1,L2,L3, PE, RB+, RB-, ZK+, ZK-	Cable cross-section	1.5 to 35 mm ² (0.0023 to 0.05 in ²) (AWG 15 to AWG 2)	
	Tightening torque	2.5 to 4.5 Nm (22 to 39.8 lb-in)	

Note (applies only for X12):

Figures apply for rigid cables or flexible cables with or without ferrules.

Table A.3 Terminals, Size 5

Size	Size 6A					
Device	G396-075			G396-110		
Mains input voltage ($\pm 10\%$) [V _{AC}]	400		460 / 480	400		460 / 480
Regulated DC link voltage [V _{DC}]	650	770	770	650	770	770
Input, mains side						
Continuous current [A _{AC,eff}]	115	115	96	170	170	142
Peak current ¹⁾ [A _{AC}]	195	195	163	245	245	204
Switching frequency [kHz]	8			4		
Continuous power [kW]	80			118		
Power dissipation ²⁾ [W]	2500					
Asymmetry of the mains voltage	$\pm 3\%$ maximum					
Frequency [Hz]	50/60					
DC link output						
Continuous current [A _{DC}]	115	97	97	170	144	144
Peak current ¹⁾ [A _{DC}]	195	165	165	246	207	207
Continuous power [kW]	75			110		
Peak power ¹⁾ [kW]	127			160		
DC link capacitance [μ F]	4240					
Internal fuse (X11)	200 A			200 A		

Note: Technical data apply for wall mounting and liquid cooling housing variants as a function of the mains input voltage and the regulated DC link voltage

1) For 10 s

2) Approximate values

Table A.4 Technical data, Size 6A

Size	Size 6A	
Device	G396-075	G396-110
Brake chopper power electronics ¹⁾		
Response threshold ²⁾ [V _{DC}]	820	
Peak braking power [kW] software/hardware-side	143/157	
Minimum ohmic resistance of an externally installed braking resistor	4.7 Ω	
Continuous chopper power [kW]	10	

1) Optional for liquid cooling; internal braking resistor (mounted on the base of the cooler) on request

2) Minimum switch-on time 250 μ s

Table A.5 Brake chopper power electronics, Size 6A



NOTE:

The maximum overall capacitance of the multi-axis system DC link for a MSD Power Supply Unit Size 6A (incl.) must not exceed 20,000 μ F.

Connection	Size	Size 6A	
	Device	G396-075	G396-110
X11/L+, L-	Cable cross-section	Use the pre-assembled connection cables supplied or 35 to 95 mm ² (0.05 to 0.15 in ²) (AWG 2 to AWG 3/0) ¹⁾	
	Tightening torque	25 to 30 Nm (221 to 265 lb-in)	
X11/PE	Screw size for ring cable lug	M8	
	Tightening torque	10 to 12 Nm (88 to 106 lb-in)	
X12/L1, L2, L3	Cable cross-section	50 to 150 mm ² (0.08 to 0.23 in ²) (10 to 95 mm ² (0.02 to 0.15 in ²) ²⁾ (AWG 0 to AWG 5/0) ¹⁾	50 to 150 mm ² (0.08 to 0.23 in ²) (AWG 0 to AWG 5/0) ¹⁾
	Tightening torque	25 to 30 Nm (221 to 265 lb-in)	
X12/PE	Cable cross-section	35 to 95 mm ² (0.05 to 0.15 in ²) (AWG 2 to AWG 3/0) ^{1) 3)}	
	Tightening torque	25 to 30 Nm (221 to 265 lb-in)	
X12/RB+, RB-	Cable cross-section	25 to 50 mm ² (0.04 to 0.08 in ²) (AWG 4 to AWG 0) ¹⁾	
	Tightening torque	6 to 8 Nm (53 to 70 lb-in)	
X12/ZK+, ZK-	Cable cross-section	50 to 150 mm ² (0.08 to 0.23 in ²) (AWG 0 to AWG 5/0) ¹⁾	
	Tightening torque	25 to 30 Nm (221 to 265 lb-in)	

1) Flexible cable with/without ferrule

2) With optional profile inserts on G396-075 to reduce the diameter

3) The protective earth conductor cross-section depends on the cross-section of the phase conductor (see chap. 4.5, p. 39)

The minimum cross-section of the connection cables depends on the local regulations, conditions as well as on the rated current of the supply unit.

Table A.6 Terminals, Size 6A

Size	Size 7					
	G396-250			G396-360		
Mains input voltage ($\pm 10\%$) [V _{AC}]	400		460 / 480	400		460 / 480
Regulated DC link voltage [V _{DC}]	650	770	770	650	770	770

Input, mains side

Continuous current [A _{AC,eff}]	375	375	313	540	540	450
Peak current ¹⁾ [A _{AC}]	565	565	470	565	565	565
Switching frequency [kHz]	4			4		
Continuous power [kW]	260			374		
Power dissipation ²⁾ [W]	3300			4100		
Asymmetry of the mains voltage	$\pm 3\%$ maximum					
Frequency [Hz]	50/60					

DC link output

Continuous current [A _{DC}]	385	325	325	553	468	468
Peak current ¹⁾ [A _{DC}]	577	487	487	577	487	487
Continuous power [kW]	250			360		
Peak power ¹⁾ [kW]	375			375		
DC link capacitance [μ F]	7200					

Note: Technical data apply for power stage switching frequency 4 kHz and as a function of the mains input voltage and the regulated DC link voltage

1) For 10 s

2) Approximate values

Table A.7 Technical data, Size 7

Size Device	Size 7	
	G396-250	G396-360
Brake chopper power electronics ¹⁾		
Response threshold ²⁾ [V _{DC}]	820	
Peak braking power [kW] software/hardware-side	210/-	
Minimum ohmic resistance of an externally installed braking resistor	3.2 Ω	
Continuous chopper power [kW]	10	

¹⁾ Internal braking resistor (mounted on the base of the cooler) on request

²⁾ Minimum switch-on time 250 μs

Table A.8 Brake chopper power electronics, Size 7



NOTE.

The maximum overall capacitance of the multi-axis system DC link for a MSD Power Supply Unit Size 7 (incl.) must not exceed 25,000 μF.

Connection	Size Device	Size 7	
		G396-250	G396-360
X11/ZK+, ZK-	Screw size for ring cable lug	M12	
	Tightening torque	25 to 30 Nm (221 to 265 lb-in)	
X11/PE ¹⁾	Screw size for ring cable lug	M10	
	Tightening torque	20 to 25 Nm (177 to 221 lb-in)	
X12/L1, L2, L3	Screw size for ring cable lug	M12	
	Tightening torque	25 to 30 Nm (221 to 265 lb-in)	
X12/PE ¹⁾	Screw size for ring cable lug	M12	
	Tightening torque	25 to 30 Nm (221 to 265 lb-in)	
X12/RB+, RB-	Screw size for ring cable lug	M10	
	Tightening torque	20 to 25 Nm (177 to 221 lb-in)	

¹⁾ The protective earth conductor cross-section depends on the cross-section of the phase conductor (see chap. 4.5, p. 39)

The minimum cross-section of the connection cables depends on the local regulations, conditions as well as on the rated current of the supply unit.

Table A.9 Terminals, Size 7

A.2 Current required for the control supply

Size	Size 5	Size 6A	Size 7
Device	G396-026 G396-050	G396-075 G396-110	G396-250 G396-360
Terminal	X9, X10		X44
Wall mounting			
Typ. starting current	7 A	10 A	-
Continuous current	2.5 A	8 A	-
Liquid cooling			
Typ. starting current	7 A	8 A	4 A
Continuous current	2 A	2 A	2 A

Table A.10 Current required for the control supply


A.3 Pre-assembled connection cables

For devices of size Size 5, pre-assembled connection cables are available for the DC link coupling. For devices of sizes Size 6A and Size 7, connection cables must be specified by the customer. Define the cable cross-section according to local regulations and conditions. It is dependent on the cable protection, the type of cable laying and the ambient temperature.

Type	L	Cross-section	Model	Connection
DC link Size 5	193 mm (7.6 in)	20 mm ² (0.03 in ²)	Flat copper braid covered with double heatshrink sleeve	Flat lug with hole Ø 5.5 mm (0.22 in) on both ends
Sketch				

Table A.11 Technical data, pre-assembled connection cables

A.4 Hydrological data for the liquid cooling

CAUTION!	Damage to the device due to condensation on the cooling plate
	<ul style="list-style-type: none"> Carelessness can cause condensation on the cooling plate and as a consequence irreparable damage to the device! <p>The temperature of the cooling plate is not allowed to be more than +10 °C (+50 °F) below the ambient temperature.</p>



NOTE: Adequate cooling medium heat dissipation is to be ensured by the user.

Requirements	Limits	
Coolant quality	Recommended: tap water + corrosion inhibitor Corrosion protection through: 10-20 % vol Ethylene glycol	
	Limit concentrations:	
	Calcium	< 50 ppm
	Magnesium	< 50 ppm
	Total alkaline earth ions	< 100 ppm
	Chlorides	< 25 ppm
Soiling	Sulphates	< 25 ppm
	The coolant must be as pure as possible to ensure the channels are not clogged. With a suspended matter concentration of more than 15 mg/dm ³ , continuous purification is recommended.	
Coolant temperature	The coolant temperature can be between +5 °C (+41 °F) and +40 °C (+104 °F). However, the coolant temperature must not be more than 10 °K below the ambient temperature to prevent condensation on the heat sink.	
Cooler and cooler connection material	Aluminium	

Table A.12 Requirements, liquid cooling



NOTE: Do not use material combinations with contact corrosion in the cooling circuit, such as aluminium and copper. This can lead to leaks and blockages of the cooling lines.

Size	Size 5	Size 6A	Size 7
Device	G396-026 G396-050	G396-075 G396-110	G396-250 G396-360
Coolant pressure (rated value / maximum value)	1 bar / 2 bar		
Coolant flow rate ¹⁾ (rated value approx. / maximum value approx.)	8 l per min / 11 l per min	11 l per min / 13 l per min	12 l per min / 14 l per min

1) For devices without internal braking resistor

Table A.13 Hydrological data for the liquid cooling



NOTE: The requirements on liquid-cooled devices as per IEC/EN 61800-5-1 are to be ensured by the user. On this issue pay attention in particular to the requirements in chapter 3.5 / 4.2.2 / 4.2.3 / 4.5

A.5 Dynamic temperature monitoring

Should the coolant flow rate collapse or not become established, the power stage could overheat. For this reason the servo drives Size 5 and Size 6A are equipped with dynamic monitoring of the heat sink temperature and servo drive Size 7 is equipped with static monitoring or the temperature of the power stage; this monitoring shuts down the servo drive in the event of overtemperature. Independent of the temperature gradient, the servo drive shuts down at the following heat sink temperature:

Size	Size 5	Size 6A	Size 7
Device	G396-026 G396-050	G396-075 G396-110	G396-250 G396-360
Shutdown of the device at a heat sink temperature	+65 °C (+149 °F)		+90 °C (+194 °F)

Table A.13 Dynamic monitoring of the heat sink temperature

A.6 Ambient conditions

Ambient conditions	MSD Servo Drive
Protection	Size 6A/7 IP20 except terminals (IP00), Size 5 IP10 except terminals (IP00)
Accident prevention regulations	As per the local regulations (in Germany e.g. DGUV A3)
Installation altitude	Up to 1000 m (3,280 ft) above MSL, over 1000 m (3,280 ft) above MSL with power reduction (1 % per 100 m, maximum 2000 m (6,561 ft) above MSL)
Pollution degree	2 (according to IEC/EN 60664-1)
Type of mounting	Built-in unit, only for vertical mounting in a switch cabinet with min. IP4x protection, when using STO safety function min. IP54.

Table A.14 Ambient conditions

Climatic conditions	MSD Servo Drive	
In transit	As per IEC/EN 61800-2, IEC/EN 60721-3-2 class 2K3 ¹⁾	
	Temperature	-25 °C to +70 °C (-13 °F to +158 °F)
	Relative atmospheric humidity	95 % at maximum +40 °C (+104 °F)
In storage	As per IEC/EN 61800-2, IEC/E 60721-3-1 classes 1K3 and 1K4 ²⁾	
	Temperature	-25 °C to +55 °C (-13 °F to +131 °F)
	Relative atmospheric humidity	5 to 95 %
In operation	As per IEC/EN 61800-2, IEC/EN 60721-3-3 class 3K3 ³⁾	
	Temperature	-10 °C to +40 °C (+14 °F to +104 °F), up to 55 °C (+131 °F) with power reduction (2 % per °C)
	Relative atmospheric humidity	5 to 85 % without condensation

- 1) The absolute humidity is limited to maximum 60 g/m³. This means, at +70 °C (+158 °F) for example, that the relative atmospheric humidity may only be maximum 40%.
- 2) The absolute humidity is limited to maximum 29 g/m³. So the maximum values for temperature and relative atmospheric humidity stipulated in the table must not occur simultaneously.
- 3) The absolute humidity is limited to maximum 25 g/m³. That means that the maximum values for temperature and relative atmospheric humidity stipulated in the table must not occur simultaneously.

Table A.15 Climatic conditions, MSD Servo Drive

Mechanical conditions	MSD Servo Drive		
Vibration limit in transit	As per IEC/EN 61800-2, IEC/EN 60721-3-2 class 2M1		
	Frequency [Hz]	Amplitude [mm (in)]	Acceleration [m/s ²]
	2 ≤ f < 9	3.5 (0.14)	Not applicable
	9 ≤ f < 200	Not applicable	10
Shock limit in transit	As per IEC/EN 61800-2, IEC/EN 60721-3-2 class 2M1		
	Drop height of packed device maximum 0.25 m (0.82 ft)		
	As per IEC/EN 61800-2, IEC/EN 60721-3-3 class 3M1		
Vibration limits for the system ¹⁾	Frequency [Hz]	Amplitude [mm (in)]	Acceleration [m/s ²]
	2 ≤ f < 9	0.3 (0.01)	Not applicable
	9 ≤ f < 200	Not applicable	1

1) Note: The devices are only designed for stationary use.

Table A.16 Mechanical conditions, MSD Servo Drive



NOTE:

According to EN ISO 13849-2 the switch cabinet must have IP54 protection or higher on using the STO (Safe Torque OFF) safety function.



NOTE:

The supply unit and the DC-A Servo Drives must not be installed in areas where they would be permanently exposed to vibration.

A.7 Technical data, step-up choke

For size	Size 5		Size 6A	
For device	G396-026	G396-050	G396-075	G396-110
Rated AC current	3 x 40 A	3 x 76 A	3 x 115 A	3 x 170 A
Supply voltage	3 x 400 VAC to 3 x 480 VAC			
Designed for active power (step-up operation $650 V_{DC}/770 V_{DC}$)	26 kW	50 kW	75 kW	110 kW
Power dissipation at 100 % duty factor	225 W	440 W	400 W	930 W
Frequency	50/60 Hz			
Protection	IP00, installation in a switch cabinet necessary			
Temperature sensor	KTY84-130			
Power connections				
Cable cross-section (flexible without / with ferrule)	1.5 to 16 mm ² (0.0023 to 0.025 in ²) 1.5 to 16 mm ² (0.0023 to 0.025 in ²) (AWG 18 to AWG 6)	2.5 to 35 mm ² (0.004 to 0.05 in ²) 2.5 to 35 mm ² (0.004 to 0.05 in ²) (AWG 12 to AWG 0)	2.5 to 35 mm ² (0.004 to 0.05 in ²) 2.5 to 35 mm ² (0.004 to 0.05 in ²) (AWG 12 to AWG 0)	16 to 120 mm ² (0.025 to 0.19 in ²) 16 to 95 mm ² (0.025 to 0.15 in ²) (AWG 4 to kcmil 250)
Tightening torque	1.5 to 2.4 Nm (13.2 to 21.2 lb-in)	4 to 5 Nm (35.4 to 44.2 lb-in)	4 to 5 Nm (35.4 to 44.2 lb-in)	12 to 20 Nm (106.2 to 177 lb-in)
KTY sensor				
Cable cross-section (flexible with ferrule)	0.5 to 2.5 mm ² (0.0008 to 0.004 in ²) (AWG 30 to AWG 12)			
Tightening torque	0.4 to 0.8 Nm (3.5 to 7.0 lb-in)			

Table A.17 Technical data, step-up choke

For size	Size 7	
For device	G396-250	G396-360
Rated AC current	3 x 375 A	3 x 540 A
Supply voltage	3 x 400 VAC to 3 x 480 VAC	3 x 400 VAC to 3 x 480 VAC
Designed for active power (step-up operation $650 V_{DC}/770 V_{DC}$)	250 kW	360 kW
Power dissipation at 100 % duty factor	714 W	1050 W
Frequency	50/60 Hz	50/60 Hz
Connection to copper straps	Cable lug	Cable lug
Protection	IP00, installation in a switch cabinet necessary	
Temperature sensor	KTY84-130	KTY84-130
Power connections		
Connection lug for ring cable lug	Ø 13 mm ² (0.02 in ²)	
Screws for ring cable lug	The screw size and tightening torque depend on the ring cable lug used.	
Tightening torque		
KTY sensor		
Cable cross-section (flexible with ferrule)	0.5 to 2.5 mm ² (0.0008 to 0.004 in ²) (AWG 20 to AWG 13)	
Tightening torque	0.4 to 0.8 Nm (3.5 to 7.0 lb-in)	

Table A.18 Technical data, step-up choke

A.8 Technical data, input choke

For size	Size 5		Size 6A	
For device	G396-026	G396-050	G396-075	G396-110
Rated AC current	3 x 40 A	3 x 76 A	3 x 115 A	3 x 170 A
Supply voltage	3 x 400 VAC to 3 x 480 VAC			
Power dissipation at 100 % duty factor	120 W	144 W	180 W	174 W
Frequency	50/60 Hz			
Protection	IP00, installation in a switch cabinet necessary			
Installation position	Capacitors with liquid or viscous filling must be installed upright with terminals pointing upward.			
Power connections				
Cable cross-section (flexible without / with ferrule)	1.5 to 16 mm ² (0.0023 to 0.025 in ²) 1.5 to 16 mm ² (0.0023 to 0.025 in ²) (AWG 18 to AWG 6)	2.5 to 35 mm ² (0.004 to 0.05 in ²) 2.5 to 35 mm ² (0.004 to 0.05 in ²) (AWG 12 to AWG 0)	2.5 to 35 mm ² (0.004 to 0.05 in ²) 2.5 to 35 mm ² (0.004 to 0.05 in ²) (AWG 12 to AWG 0)	16 to 120 mm ² (0.025 to 0.19 in ²) 16 to 95 mm ² (0.025 to 0.15 in ²) (AWG 4 to kcmil 250)
Tightening torque	1.5 to 2.4 Nm (13.2 to 21.2 lb-in)	4 to 5 Nm (35.4 to 44.2 lb-in)	4 to 5 Nm (35.4 to 44.2 lb-in)	12 to 20 Nm (106.2 to 177 lb-in)

Table A.19 Technical data, input choke

For size	Size 7	
For device	G396-250	G396-360
Rated AC current	3 x 375 A	3 x 540 A
Supply voltage	3 x 400 VAC to 3 x 480 VAC	3 x 400 VAC to 3 x 480 VAC
Power dissipation at 100 % duty factor	280 W	525 W
Frequency	50/60 Hz	50/60 Hz
Connection to copper straps	Cable lug	Cable lug
Protection	IP00, installation in a switch cabinet necessary	
Installation position	Capacitors with viscous filling must be installed upright with terminals pointing upward.	
Power connections		
Connection lug for ring cable lug	Ø 13 mm ² (0.02 in ²)	
Screws for ring cable lug	The screw size and tightening torque depend on the ring cable lug used.	
Tightening torque		

Table A.20 Technical data, input choke

A.9 Technical data, mains filter

For size	Size 5		Size 6A	
For device	G396-026	G396-050	G396-075	G396-110
Type	FFU 3 x 56 K	FFU 3 x 80 K	FFU 3 x 130 K	FFU 3 x 180 K
Rated AC current ¹⁾	3 x 56 A _{eff}	3 x 80 A _{eff}	3 x 130 A _{eff}	3 x 180 A _{eff}
Supply voltage	3 x 400 V _{AC} to 3 x 480 V _{AC}			
Degree of protection	IP20			
Power connections (L1,L2,L3)				
Maximum cable cross-section for the terminals	16 mm ² (0.025 in ²)	25 mm ² (0.04 in ²)	50 mm ² (0.08 in ²)	95 mm ² (0.15 in ²)
Tightening torque	2 Nm	4 Nm	6 Nm	15 Nm
Protective earth conductor connections (PE)				
Thread	M6		M10	
Tightening torque	6 to 8 Nm (53.1 to 70.8 lb-in)		15 to 20 Nm (132.7 to 177 lb-in)	

1) Rated AC current at +40 °C (+104 °F) ambient temperature

Table A.21 Connections, mains filter for Size 5 and Size 6A

For size	Size 7	
For device	G396-250	G396-360
Type	FN 3359-400-99	FN 3359-600-99
Rated AC current ¹⁾	3 x 438 A _{eff}	3 x 657 A _{eff}
Supply voltage	3 x 400 VAC to 3 x 480 VAC	
Connection	Busbar	

1) Rated AC current at +40 °C (+104 °F) ambient temperature

Table A.22 Technical data, mains filter for Size 7

For size	Size 7	
For device	G396-250	G396-360
Protection	IP 00	
Power connections (L1,L2,L3)		
Connection lug for ring cable lug	Ø 10.5 mm (0.41 in)	
Tightening torque	The screw size and tightening torque depend on the ring cable lug used.	
Protective earth conductor connections (PE)		
Thread	M12	
Tightening torque	The screw size and tightening torque depend on the ring cable lug used.	

1) Rated AC current at +40 °C (+104 °F) ambient temperature

Table A.22 Technical data, mains filter for Size 7

A.10 Technical data, mains fuse

For size	Size 5		Size 6A	
For device	G396-026	G396-050	G396-075	G396-110
Stipulated mains fuse F1, utilisation class gG	3 x 63 A	3 x 100 A	3 x 160 A	3 x 200 A

Table A.23 Technical data, mains fuse

For size	Size 7	
For device	G396-250	G396-360
Fuses F1 utilisation class gRL	3 x 400 A (Siba 202.1234.400)	3 x 630 A (Siba 202.1334.630)
Fuses 2, slow blow	6 A	6 A

Table A.24 Technical data, mains fuse

A.11 Technical data, mains contactor

We recommend the utilisation of the following mains contactors. Alternative products must be technically equivalent!

For size	Size 5		Size 6A	
For device	G396-026	G396-050	G396-075	G396-110
Type	Siemens 3RT1035-1BB40	Siemens 3RT1045-1BB40	Siemens 3RT1054-1NB36	Siemens 3RT1056-6NB36
Coil voltage	24 V _{DC}	24 V _{DC}	24 V _{DC}	24 V _{DC}
Rated current AC-3 up to 500 V	40 A	80 A	115 A	185 A

Table A.25 Technical data, mains contactor for Size 5 and Size 6A

For size	Size 7	
For device	G396-250	G396-360
Type	Siemens 3RT1075-6AB36	Siemens 3RT1076-6AB36
Coil voltage	24 V _{DC}	24 V _{DC}
Rated current AC-3 up to 500 V	400 A	500 A

Table A.26 Technical data, mains contactor for Size 7

A.12 Technical data, circuit breaker

We recommend the following circuit breakers for system protection. Alternative products must be technically equivalent!

For size	Size 5		Size 6A	
For device	G396-026	G396-050	G396-075	G396-110
For size	Size 5	Size 6A		
For device	G396-026	G396-050	G396-075	G396-110
Type	Siemens 3RV1721-1ED10		Siemens 3RV1721-1GD10	
Rated current up to AC 500 V +10 %	4 A		6.3 A	

Table A.27 Technical data, circuit breaker

For size	Size 7	
For device	G396-250	G396-360
Type	Siemens 3RV1721-1GD10	
Rated current up to AC 500 V +10 %	6.3 A	

Table A.28 Technical data, circuit breakers for system protection

A.13 UL certification

The description of all measures to maintain UL approval is to be found in the document
“UL-Certification” (ID no.: CC36842-001)

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