MSD Servo Drive

Operation Manual

Single-Axis Servo Drive Compact

C2 to C5

2.0 A to 16.0 A

C2 C3 C4 C5

MSD Single-Axis Servo Drive Compact Operation Manual

ID no.: CA97555-001, Rev. 5.9

Date: 05/2025

Applicable as from firmware version: V124-01

The German version is the original of this Operation Manual.

MSD Single-Axis Servo Drive Compact high-performance drives

The modularity of the MSD Single-Axis Servo Drive Compact guarantees you 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 Single-Axis Servo Drive Compact is a master of both.

We reserve the right to make technical changes.

This Operation Manual has been prepared based on EN IEC/IEEE 82079-1. The content 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 in line with ongoing technical developments in our products.

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

Table of contents

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. They documents are available in PDF.

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 under Date 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. DG UV regulation 3 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.

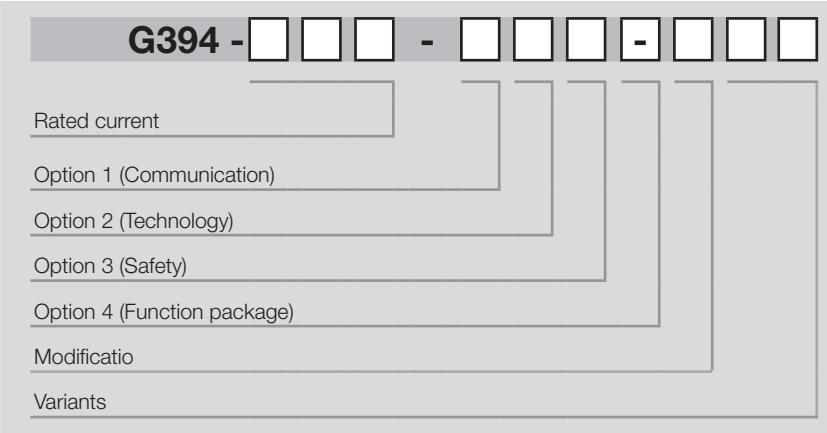
NOTE
This Operation Manual applies to the MSD Single-Axis Servo Drive Compact (referred to in the following as the servo drive). This manual does not replace the Operation Manuals for the MSD Single- and Multi-Axis Servo Drive.

1.3 Reference documents

Document	Contents	ID no. Format
MSD Servo Drive 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 AC-AC Servo Drive as supply, planning, application example, specifications certification and applicable standards, technical data	CA97554-001 PDF
MSD Power Supply Unit 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/Profine User Manual	Description and configuration of the parameters for the MSD Se vo Drive on the PROFIBUS/PROFINET field bus syste	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 V125-xx - MSD Single-Axis System from V125-xx - MSD Multi-Axis System from V125-xx	CB40859-001 PDF and HTML
Program help Moog DriveAdminsitrator 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 Single-Axis Servo Drive Compact has the article designation *G394-xxx-xxx-xxx*. The provides information on the related variant of the supplied MSD Servo Drive. The significance of the individual characters of the article designation is given in the following order code.
You will find the complete order code with all values in the MSD Ordering Catalog.



1.5 Production data

On rating plates for the MSD Single-Axis Servo Drive Compact 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 servo drive refer to "Figure 4.1 Layout MSD Single-Axis Servo Drive Compact C2 to C4" and "Figure 4.2 Layout MSD Single-Axis Servo Drive Compact C5".

Fig. 1.0 MSD Single-Axis Servo Drive Compact hardware rating plate

1.6 Scope of supply

The scope of supply includes:

- MSD Single-Axis Servo Drive Compact
- Terminal kit for control and power terminals (depending on device power and variant)
- Set with shield connecting plates and fixing material
- Product CD with booklet

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

Processing step undertaken by the user or the system.

You will find the pictogram used in this Operation Manual for "General 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 GmbH 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 Center

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

The Helpline is available by e-mail, telephone or telefax:

E-Mail: drives-support@moog.com

Phone: +49 7031 622 0

If you need further assistance, our specialists at the Service & Support Center will be happy to help.

E-Mail: info.germany@moog.com

Phone: +49 7031 622 0

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 For your safety

NOTE

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 functioning 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 800 V DC
- Dangerously high voltages of ≥50 V may still be present 10 min. after the power is cut (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 fi lds 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 against electric shock according to IEC 60364-4-41:2005/AMD1, section 411.3. As a protection measure, use additional protective equipotential bonding as described in appendix D of IEC 60364-4-41.
- 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

DANGER!	Risk of injury due to electrical power!
	• **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!
	• **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!
	• **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!
	• **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!
	• **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!
	• **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 devices in the product range MSD Single-Axis Servo Drive Compact conform to the **Machinery Directive 2006/42/EC**

Tested and certified in accordance with applicable standards (see declaration of conformity in chap. 2.8).

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 fulfil the demands of the harmonised product standard IEC/EN 61800-5-1.

You will find information on the installation of your device in chapter "3 Mechanical installation".

2.4.1 Repair

Only have repairs undertaken by authorised repair shops. Unauthorised opening and incorrect intervention could lead to death, physical injury or material damage. The warranty provided by Moog would thereby 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 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 IEC/EN 60204-1:2006 "Safety of machinery".

- The safety requirements on electrical machines defined the e are intended to protect personnel and machinery or systems.
- The emergency stop function (as per IEC/EN 60204-1) 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, Dateards 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.

NOTE:

The KEBA drive controllers described here do not fall under the Ecodesign Regulation (EU)2019/1781 (efficiency class IE2) because at least one of the following points applies if used as intended:

- Operation exclusively for servomotors with speed/position feedback
- Supply with DC voltage
- Supply with single-phase AC voltage
- Supply with low voltage <100 V

2.8 Declaration of conformity

EU DECLARATION OF CONFORMITY

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

DOCUMENT NO. MRO37051-001-REV. H (TRANSLATION OF ORIGINAL)

The Manufacturer Moog GmbH	Hanns-Klemm-Str. 28 – 71034 Boeblingen - Germany +49 7031 622 0 +49 7031 622 100 info.germany@moog.com http://www.moog.de

DECLARES UNDER SOLE RESPONSIBILITY that the following products has been manufactured in conformity with the requirements of the Directive 2006/42/EC (Machinery-Directive) of the European Parliament and of the Council on machinery and the Directive 2014/30/EU (EMC-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 electromagnetic compatibility.

MODULAR MULTI-AXIS SERVO DRIVE SYSTEM (MSD)	
Product types	G392/G393/G395/G397 BG 1 - 7 G394 C2 - C5
Following harmonized standards has been applied	EN ISO 13849-1:2008 + AC:2009 EN 62061:2005 + AC:2010 + A1:2013 EN 61800-3:2004 + A1:2012 EN 61800-5-1:2007 + A1:2017 EN 61800-5-2:2007 EN 61508 Parts 1-7:2010 EN 50178:1997 EN 60204-1:2006 + A1:2009 + AC:2010 (Interfaces)
Quality Manager	R. Lohse Richard Kohse

March 01, 2023	Moog GmbH Boeblingen	Thomas Czeppel	Thomas Czeppel
Date	Site	Managing Director	Signature

WHAT MOVES YOUR WORLD

MOOG

3 Mechanical installation

3.1 Notes for operation

CAUTION	Damage to the device due to incorrect installation conditions!
	**The device may be destroyed** For this reason • 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 enter the device • The ventilation openings must not covered

Note the following points:

- Cooling air must be able to flow through the device without restriction.
- On installation in switch cabinets with convection (= heat loss is discharged to the outside via the cabinet walls), always fit an internal air circulation fan.
- The backing plate must be well-earthed.
- The device is intended only for vertical installation in switch cabinets. The switch cabinet must provide IP4x protection as a minimum.
- To attain the best result for effective EMC installation you should use a chromated or galvanized backing plate. If backing plates are varnished, remove the coating from the contact area!
  The devices themselves have an aluminium back panel.
- Maximum pollution degree 2 according to IEC/EN 60664-1
- The devices must not be installed in areas where they are exposed to continuous vibration. You will find more information in the appendix, Table A.9.
- The device heats up during operation and the temperature on the heat sink may reach +100 °C (+212 °F). Pay attention to this aspect for neighbouring components.

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.

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

3.2 Wall mounting

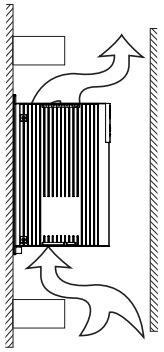
Step	Action	Comment
1.	Mark out the position of the tapped holes on the backing plate. Cut a thread for each fixing screw in the backing plate.	Dimensional drawings/hole spacing see Figure 3.1, Figure 3.2 The thread surface area will provide you with good, full-area contact.
2.	Mount the servo drive **vertically** on the backing plate.	Observe the mounting clearances! The contact area must be bare metal.
3.	Mount the other components, such as the mains filter, mains choke etc., on the backing plate.	The cable between mains filter and servo drive may be 300 mm (11.81 in) long.
4.	You will find the next steps for the electrical installation in chapter 4.	

Table 3.1 Mechanical installation

NOTE

Forced cooling by external air flow is necessary for all sizes of the MSD Single-Axis Servo Drive Compact. The air must be able to flow unhindered through the device. If a temperature cut-out occurs, the cooling conditions must be improved.

Air flow: at least 1.2 m/s (3.93 ft/s)



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3.2.1 Dimensions of the devices

Size	C2	C3	C4	C5
MSD Single-Axis Servo Drive Compact	G394-030 G394-020	G394-059 G394-035	G394-080 G394-065	G394-120 G394-160
Weight	1.0 kg (2.2 lb)	1.5 kg (3.3 lb)	2.8 kg (6.2 lb)	5.9 kg (13 lb)
B (width)	55 (2.17)			90 (3.54)
H (height)[1)]	210 (8.27)		290 (11.42)	291 (11.47)
T (depth)[1)]	142 (5.59)	189 (7.44)	235.5 (9.27)	
A	27.5 (1.08)			20 (0.79)
A1	-	-	40 (1.57)	50 (1.97)
C	225 (8.86)		305 (12.01)	313 (12.32)
C1	5 (0.20)			6 (0.24)
D Ø	4.8 (0.19)			
H1	235 (9.25)		315 (12.40)	324 (12.76)
Screws	2 x M4		4 x M4	

All dimensions in mm (in)

1) without terminals/connections

Table 3.2 MSD Single-Axis Servo Drive Compact dimensions - see Figure 3.1 and Figure 3.2

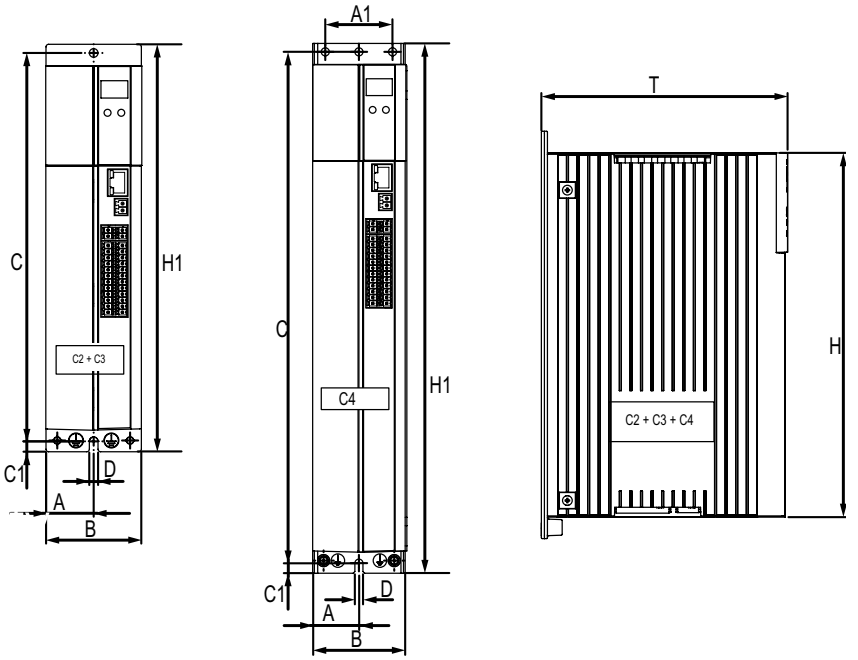


Figure 3.1 Dimensional drawing C2, C3, C4

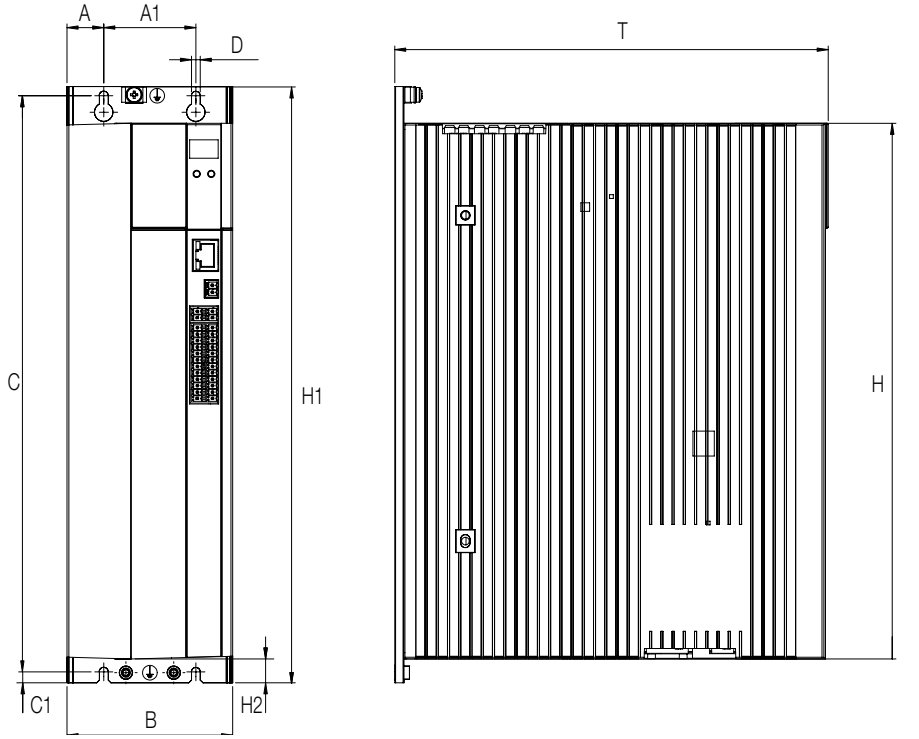


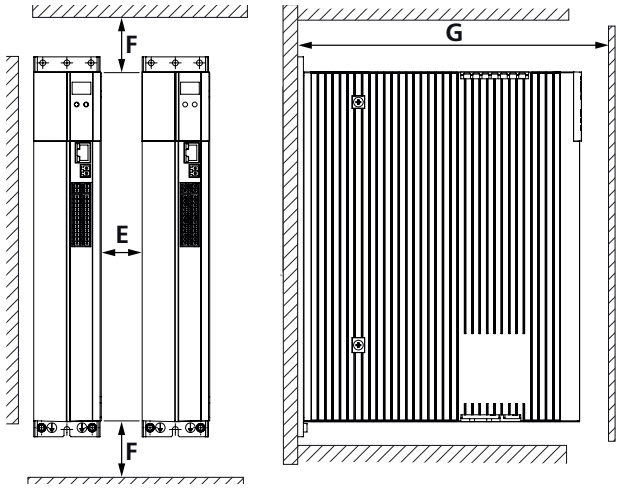
Figure 3.2 Dimensional drawing C5

3.2.2 Mounting clearances

The minimum distances specified in the table apply for devices of the same power. When butt mounting devices with different drive power you should arrange the devices according to their power (e.g., viewed from the left, C5-C4-C3-C2). This arrangement will minimise the thermal interaction.

NOTE

If MSD Single-Axis Servo Drive Compact devices are attached to other product ranges, corresponding measures must be taken to prevent the devices affecting each other thermally.

Size	C2	C3	C4	C5
MSD Single-Axis Servo Drive Compact	G394-030 G394-020	G394-059 G394-035	G394-080 G394-065	G394-120 G394-160
E	Direct butt mounting			
F [1]	≥100 (3.94)	≥150 (5.90)		
G [1]	≥235 (9.25)		≥280 (11.02)	
Drawing: Dimensions in mm (in)				

1) The bend radius of the connecting cables must be taken into account

Table 3.3 MSD Single-Axis Servo Drive Compact mounting clearances

4 Electrical installation

4.1 Notes for installation

DANGER	Risk of injury due to electrical power!
	• **Carelessness will result in serious injuries or death.** Never wire or disconnect electrical connections while these are live! Always disconnect the power before working on the device. Dangerously high voltages of ≥50 V may still be present 10 min. after the power is cut (capacitor charge). So check that electrical power is not present! Work on the device must only be carried out after the DC link voltage has dropped below a residual voltage of 50 V (indicated by monitoring LED H1 and to be measured on terminals X1/L- and L+). A dangerous voltage may be present at the device, even if the device does not emit any visual or audible signals/indications (e.g. with mains voltage applied to terminal X3 and missing control supply +24 V on X2)!

WARNING!	Risk of injury due to hot surfaces on the device (heat sink)!
	• **Carelessness may result in serious burns.** The device and especially the heat sink heat up significantly during operation and can reach temperatures of up to +100 °C (+212 °F). Before starting work, make sure the device has cooled down. On touching there is a risk of burns to the skin. For this reason provide protection against touching. During mounting maintain an appropriate distance to neighbouring assemblies.

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The following general guidelines apply for the installation of servo drives:

- *Compliance with the EMC product standard*
  - Commissioning (i.e. starting intended operation) is only permitted on compliance with the EMC product standard IEC/EN 61800-3. The installer/operator of a machine and/or system must provide proof of compliance with the protection targets stipulated in the standard.
- *Cable type*
  - Use only shielded mains, motor and signal lines with double copper braiding with 60 to 70 % coverage.
- *Routing cables*
  - Route mains, motor and signal cables separated from one another. If possible, keep a distance of at least 0.2 m (0.66 ft), otherwise use separators. They should not run in parallel. If crossovers are unavoidable, they should wherever possible be configured perpendicular (at a 90° angle).
  - Always route the motor cable without interruptions and the shortest way out of the switch cabinet. If a motor contactor for example is used, the component should be directly mounted to the servo drive and the shielding of the motor cable should not be stripped back too far.
  - If possible signal lines should only enter from one side into the switch cabinet.
  - Lines of the same electric circuit must be twisted.
  - Avoid unnecessary cable lengths and loops.
- *Earthing measures*
  - Earthing measures of relevance for the servo drive are described in section “4.6 Protective earth conductor connection”.
- *Shielding measures*
  - Do not strip the cable shields back too far, and lay them with large area connections both on the component and on the backing plate or on the PE rail (main earth) for the backing plate.
- *External components*
  - Place larger loads near the supply.
  - Contactors, relays, solenoid valves (switched inductances) must be wired with suppressors. The wiring must be directly connected to the respective coil.
  - Any switched inductance should be at least 0.2 m (0.66 ft) away from the process controlled assemblies.
- *Additional information* can be found in the corresponding connection description.
  If you require further detailed information on installation you should consult the Moog Helpline (see Chapter 1.10).

4.2 Overview of the connections

In the following you will find the layouts with the corresponding positions of connectors and terminals. For better clarity we have added an abbreviation of the designation for the connectors and terminals.

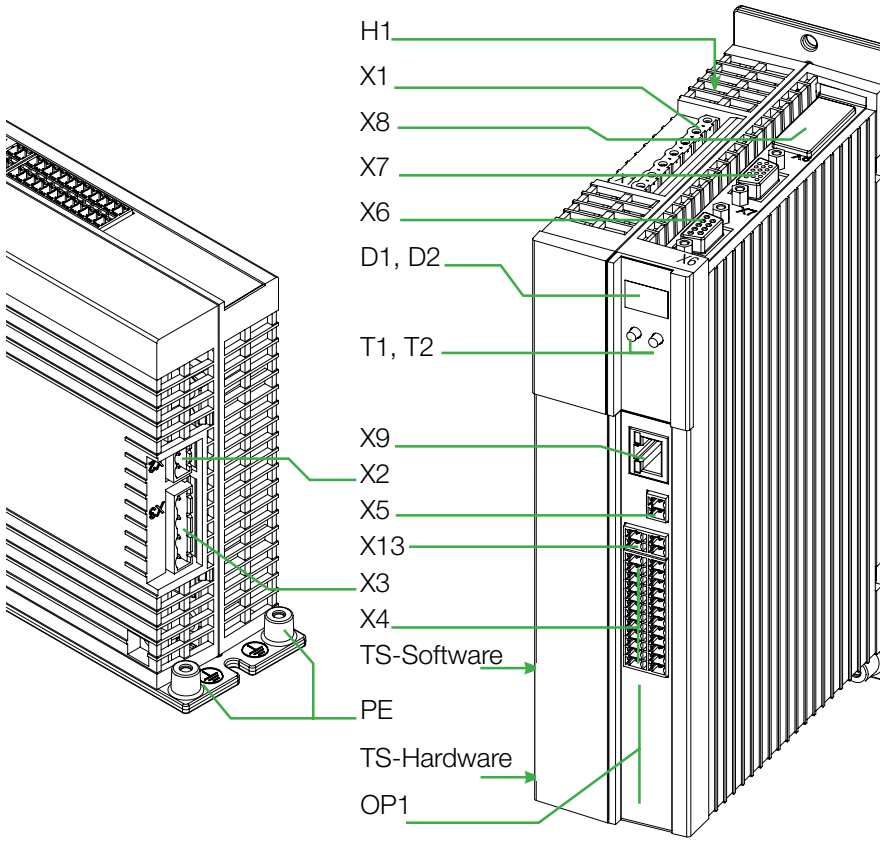

Figure 4.1 Layout MSD Single-Axis Servo Drive Compact C2 to C4

Number	Designation
D1, D2	7-segment display
H1	Indicator LED for link voltage (only size C2 to C4)
OP1	Installation space for Option 1 (Communication)
T1, T2	Button
X1	Power connections (only size C2 to C4)
X2	Connection for control supply U_V
X3	AC mains connection
PE (bottom)	Device protective earth conductor connection
X4	Control terminals
X5	Motor temperature monitoring
X6	Resolver connection
X7	Connection for high-resolution encoders
X8	Option 2 (Technology)
X9	Ethernet interface
X13	Connection for motor brake

Table 4.1 Key to layout MSD Single-Axis Servo Drive Compact C2 to C4

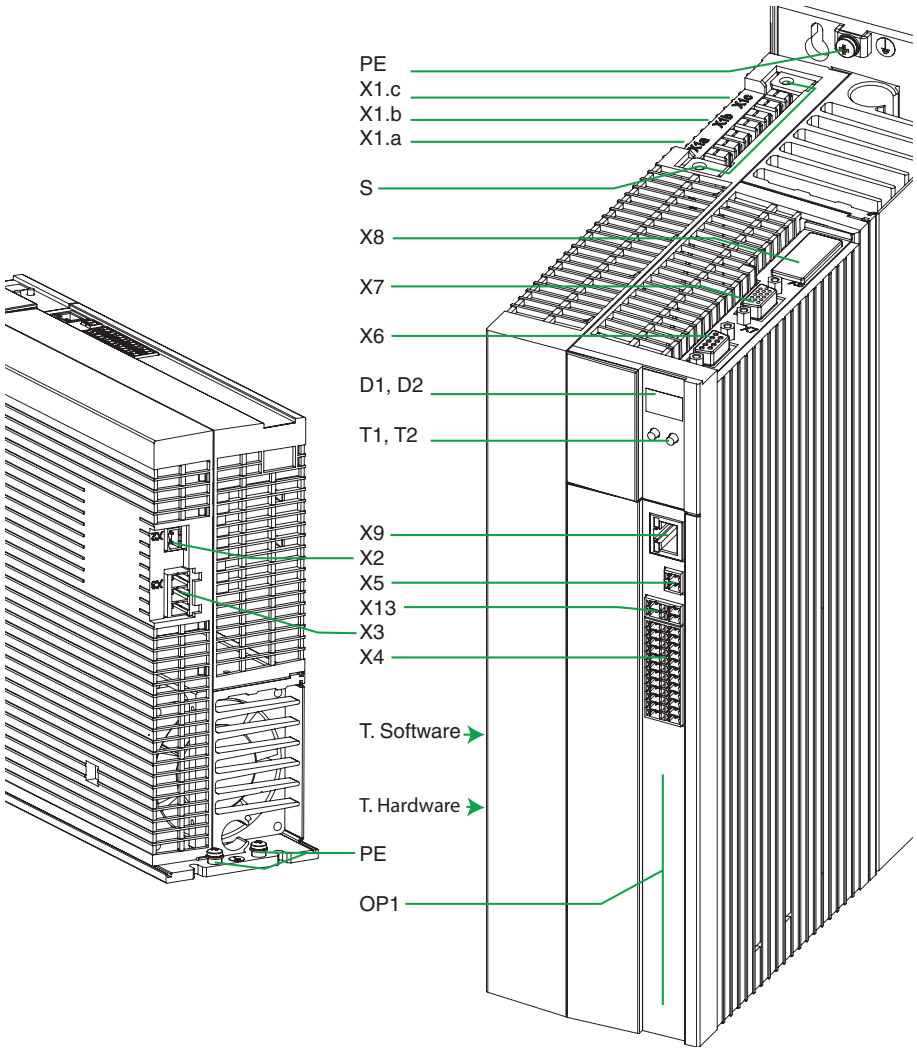

Figure 4.2 Layout MSD Single-Axis Servo Drive Compact C5

Number	Designation
D1, D2	7-segment display
OP1	Installation space for Option 1 (Communication)
T1, T2	Button
PE (top)	Motor PE connection
X1.a	Motor connection (only size C5)
X1.b	Measuring point for DC link voltage (only size C5)
X1.c	Connection for braking resistor (only size C5)
X2	Connection for control supply U_v
X3	AC mains connection
PE (bottom)	Device protective earth conductor connection
X4	Control terminals
X5	Motor temperature monitoring
X6	Resolver connection
X7	Connection for high-resolution encoder
X8	Option 2 (Technology)
X9	Ethernet interface
X13	Connection for motor brake
S	Receptacle for shield plate (see “Detail 1: Motor cable C5” on page 23)
T. Software	Software rating plate
T. Hardware	Hardware rating plate

Table 4.2 Key to layout MSD Single-Axis Servo Drive Compact C5

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4.3 Connection diagram C2 to C4

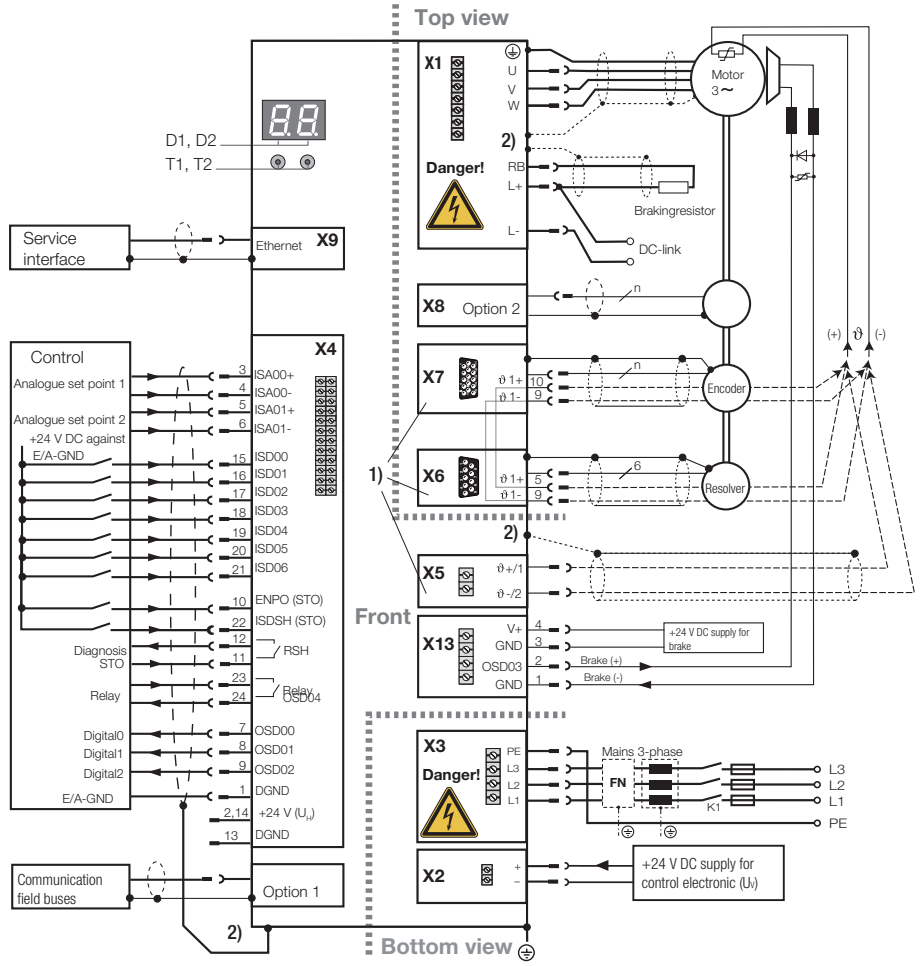


Figure 4.3 Connection diagram C2 to C4

Number	Designation	Details
D1, D2	7-segment display	Page 48
T1, T2	Button	Page 48
X1	Connection for motor, braking resistor and measurement of DC link voltage	Page 38
X2	Connection for control supply	Page 27
X3	Connection for AC power supply	Page 30
X4	Control terminals	Page 31
X5	Connection for motor temperature monitoring[1)]	Page 37
X6	Connection for resolver [1)]	Page 35
X7	Connection for high-resolution encoder [1)]	Page 36
Option 1	Communication	Page 33
PE	PE connection	Page 26
X8 (Option 2)	Technology	Page 33
X9	Ethernet interface	Page 33
X13	Connection for motor brake	Page 33
1)	The temperature sensor for the motor winding can be connected either via the encoder cables (X6 or X7) or to terminal X5	
2)	Screen connections via separate shield plates	Page 23
⏚	Connection for housing PE conductor	Page 26

Table 4.3 Key to connection diagram C2 to C4

4.4 Connection diagram C5

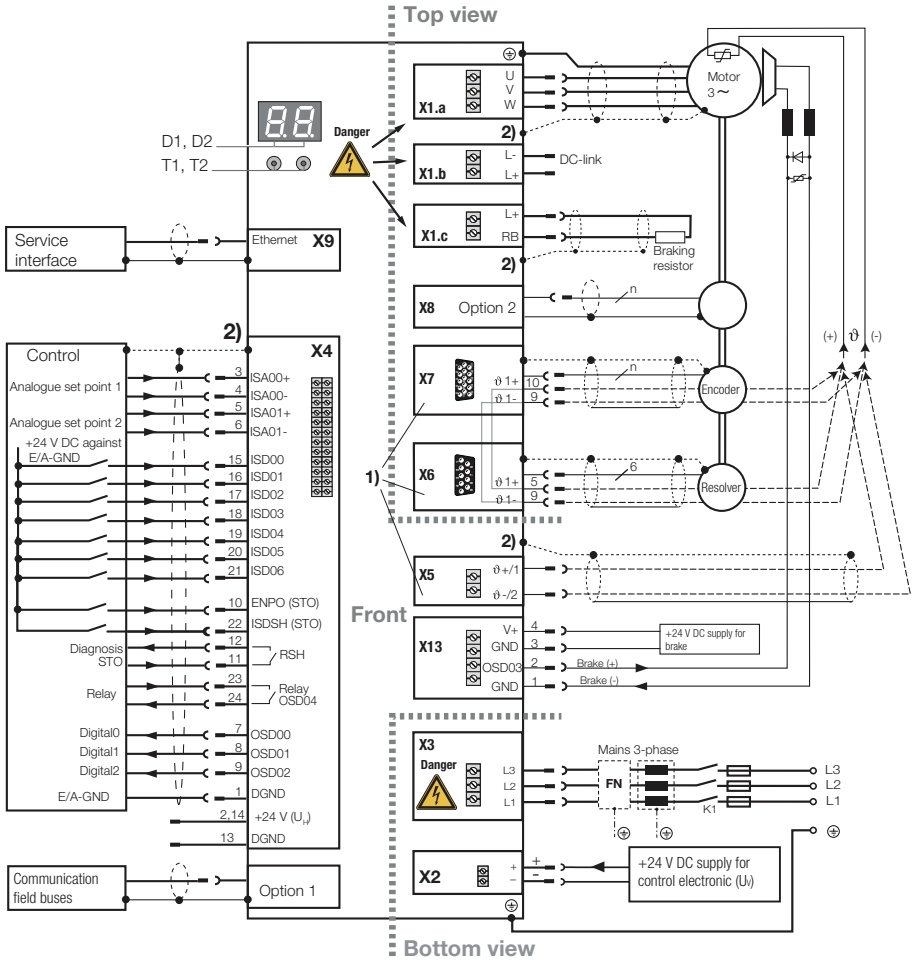


Figure 4.4 Connection diagram MSD Single-Axis Servo Drive Compact C5

Number	Designation	Details
D1, D2	7-segment display	Page 48
T1, T2	Button	Page 48
X1.a	Connection for motor	Page 37
X1.b	Measuring point for DC link voltage	-
X1.c	Connection for braking resistor	Page 37
X2	Connection for control supply	Page 27
X3	Connection for AC power supply	Page 30
X4	Control terminals	Page 31
X5	Connection for motor temperature monitoring[1)]	Page 37
X6	Connection for resolver [1)]	Page 35
X7	Connection for high-resolution encoder [1)]	Page 36
Option 1	Communication	Page 33
PE	Connection for PE conductor	Page 26
X8 (Option 2)	Technology	Page 33
X9	Ethernet interface	Page 33
X13	Connection for motor brake	Page 33
1)	The temperature sensor for the motor winding can be connected either via the encoder cables (X6 or X7) or to terminal X5.	
2)	Screen connections via separate shield plates	Page 22

Table 4.4 Key to connection diagram

4.5 Effective EMC installation

4.5.1 Interference immunity of servo drives

NOTE

This is a restricted availability product in accordance with IEC/EN 61800-3. This product may cause radio interference in domestic environments; in such cases the operator may need to take appropriate countermeasures.

External radio frequency interference suppression filters (CB09937-001 to CB09940 001, CB09942-00, for C5 provisional CA71185-001) are available for the servo drives. With the measurement method specified and the exte nal mains filte , these servo drives conform to the EMC product standard IEC/EN 61800-3 for "First environment" (residential C2) and "Second environment" (industrial C3).

4.5.2 Specimen setup

The specimen setup presented on the following pages is intended to illustrate the key measures necessary to ensure an effective EMC installation.

NOTE

The specimen setup merely presents a recommendation, and does not automatically guarantee compliance with applicable EMC directives. The installer/operator of a machine and/or system must provide proof of compliance with the protection targets stipulated in the standard.

Overview

Figure 4.5 presents an overview of the minimum components required:

A. Backing plate with cable ducts
B. MSD Single-Axis Servo Drive Compact
C. Mains filter
D. Mains choke
E. Distributor rail for AC power supply and control supply (+24 V DC)

The layout and cabling are based on the requirements in section 4.1 The numbered red arrows refer to four very important detailed notes presented on the following pages.

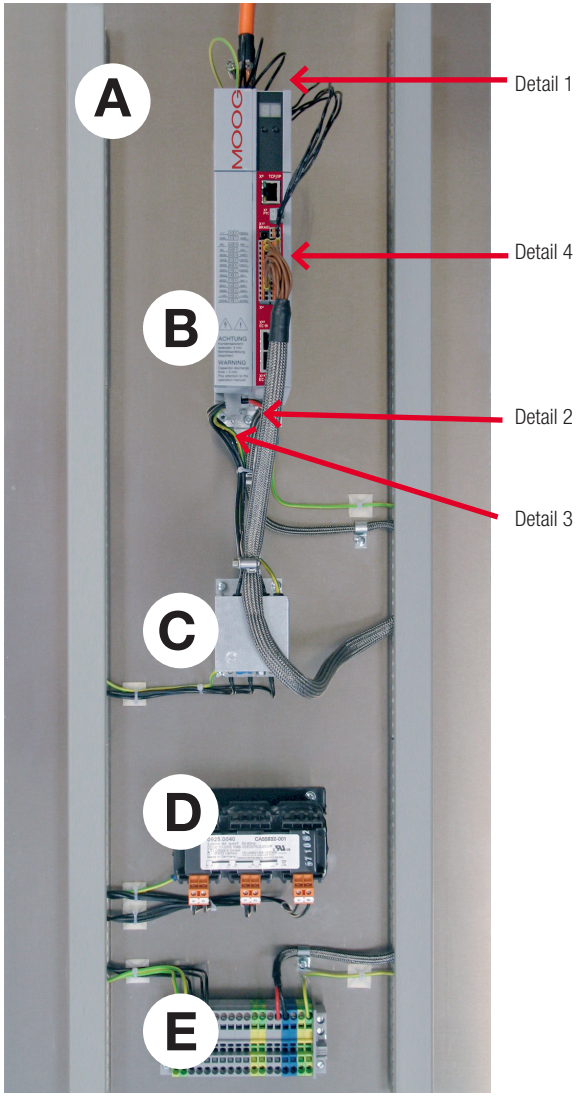


Figure 4.5 Specimen setup - Overview

Detail 1: Motor cable

Make sure that on devices C2 to C4 the motor connection is connected to terminal (X1) and on devices C5 to terminal (X1a, X1b, X1c):

- Fasten the shield connection plate supplied (shield plate for C2 to C4 see Figure 4.6, shield plate for C5 see Figure 4.7) to the top of the device. Ensure the plate is in contact over a large area with the heat sink on the MSD Single-Axis Servo Drive Compact and with the backing plate. Use a serrated washer.

Figure 4.6 Shield plate C2 to C4

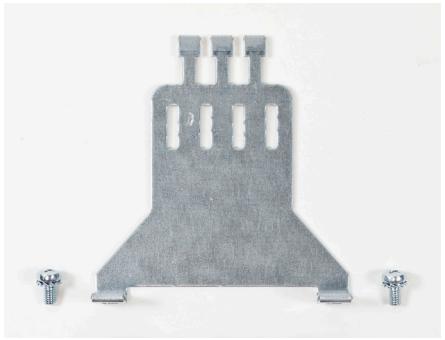


Figure 4.7 Shield plate C5

- Strip the shielding of the motor cable back only as short as absolutely necessary.
- Connect the motor cable shield over a large area to the shield connection plate using the clamp supplied.

NOTE

Ready made motor cables are available for Moog Servo Motors. For details refer to the MSD Ordering Catalog or to the Servo Motors Ordering Catalog.

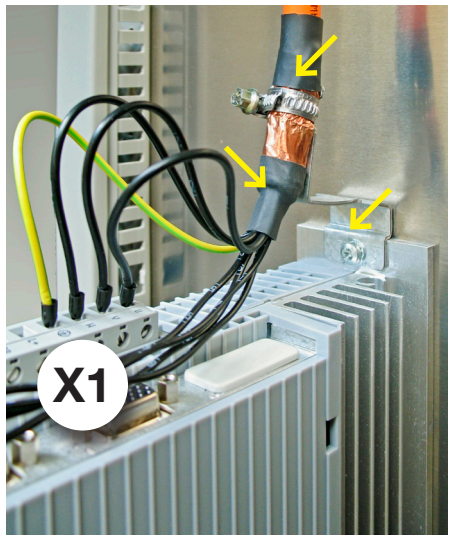


Figure 4.8 Detail 1: Motor cable C2 to C4

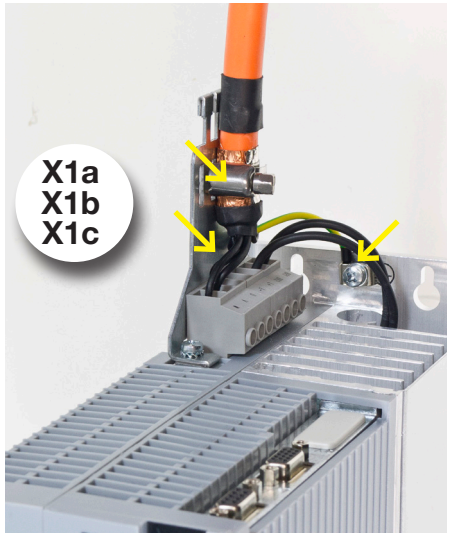


Figure 4.9 Detail 1: Motor cable C5

Detail 2: Control supply (+24 V DC)

At the connection for the control voltage (X2) pay attention to:

- Secure the second of the two shield connection plates supplied to the mount on the bottom of the unit using the screw. Ensure the plate is in contact over a large area with the heat sink on the MSD Single-Axis Servo Drive Compact and with the backing plate. Use a serrated washer.
- Pull a shielding sleeve over the control supply cable and strip it back only as short as necessary before the control supply connection (X2).
- Connect the shielding sleeve on the control supply cable with a large area connection to the shield connection plate using the clamp supplied.

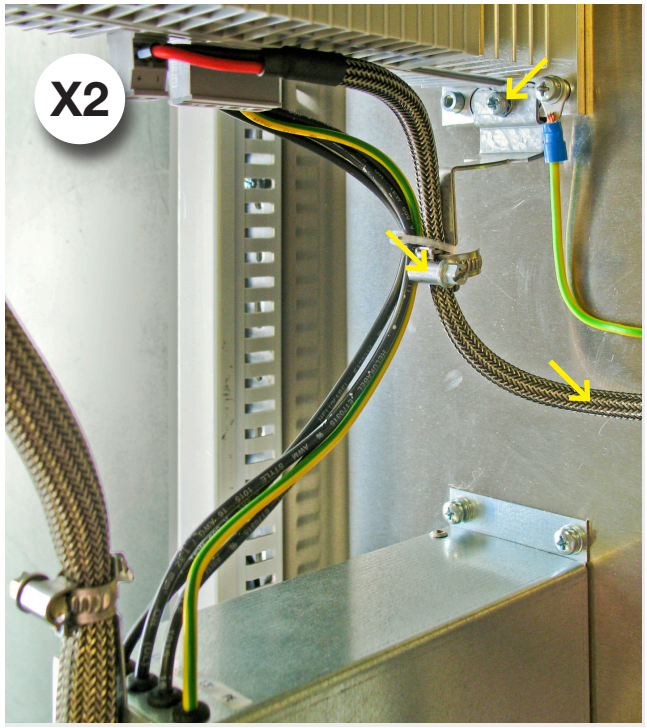


Figure 4.10 Specimen setup - Detail 2: Control supply

Detail 3: Mains filter and mains connection

At the output of the mains filter and the AC mains connection X3):

- Connect the litz wire on the output of the mains filter directly to the AC mains connection (X3) on the MSD Single-Axis Servo Drive Compact. The litz wires must **not** be extended, so the mains filter should be installed correspondingly close to the MSD Single-Axis Servo Drive Compact. But be sure to maintain the necessary minimum clearance (see “Table 3.3 MSD Single-Axis Servo Drive Compact mounting clearances”).
- Fix the litz wire to the shield connection plate using a cable tie as necessary.
- The leakage current of the MSD Single-Axis Servo Drive Compact is >3.5 mA. So:
  - Connect the protective earth conductor from the output of the mains filter to conne tion (X3) on the MSD Single-Axis Servo Drive Compact C2 to B4 or to the housing of the MSD Single-Axis Servo Drive Compact C5 **and**
  - One of the PE connections on the heat sink on the MSD Single-Axis Servo Drive Compact using a cable of at least the same cross-section to the main earth for the distributor rail.

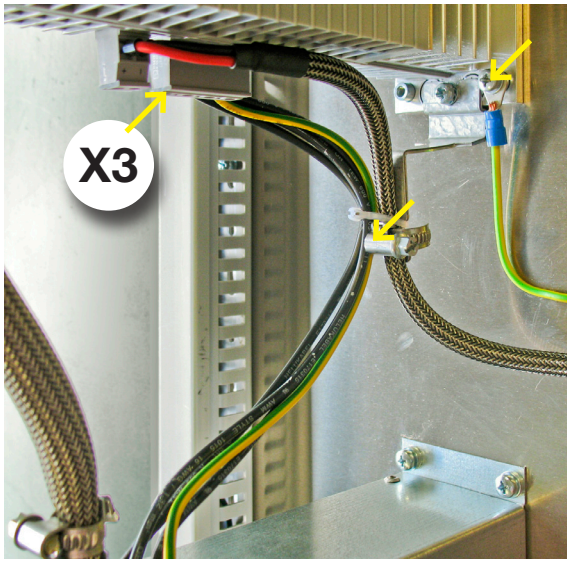


Figure 4.11 Specimen setup - Detail 3: Mains filter and mains connection

Detail 4: Control cables

At the control terminals (X4) of the MSD Single-Axis Servo Drive Compact, C2 to C4:

- Strip the shielding of the control cables back only as short as absolutely necessary.
- Connect the shield on the control cables with a large area connection to the shield connection tab on the mains filter using the clamp supplied If this is not possible, connect the control cable shield directly to the backing plate with a large area connection directly adjacent to the MSD Single-Axis Servo Drive Compact.

Figure 4.12 Specimen setup - Detail 4: Control cables C2 to C4

At the control terminals (X4) of the MSD Single-Axis Servo Drive Compact, C2 to C5 pay attention to:

- Fasten the shield connection plate supplied (for control terminal shield plate for C5 see Figure 4.14) to the underside of the device. Ensure the plate is in contact over a large area with the heat sink on the MSD Single-Axis Servo Drive Compact and with the backing plate. Use a serrated washer.
- Strip the shield on the control cables back only as far as absolutely necessary.
- Connect the shield on the control cables with a large area connection to the shield connection plate using the clamp supplied.

Figure 4.13 Specimen setup - detail 4: Control cables C5

Figure 4.14 Control terminal shield plate C5

4.6 Protective earth conductor connection

Step	Action	PE mains connection according to IEC/EN 61800-5-1
1.	Earth each of the servo drives! Connect the terminal ⏚ in a **star configuration and with a large area connection** to the PE rail (main earth) in the switch cabinet.	As the leakage current >3.5 mA, the following applies to the PE connection:: • Mains connection ≥10 mm² (0.02 in²) copper: protective earth conductor cross-section to suit the cross-section of the mains power cables Also comply with local and national regulations and conditions for equipment with high leakage current. 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.
2.	Also connect the protective earth conductor connections on all other components, such as mains choke, filter, etc. in a **star configuration and with a large area connection** to the PE rail (main earth) in the control cabinet.	

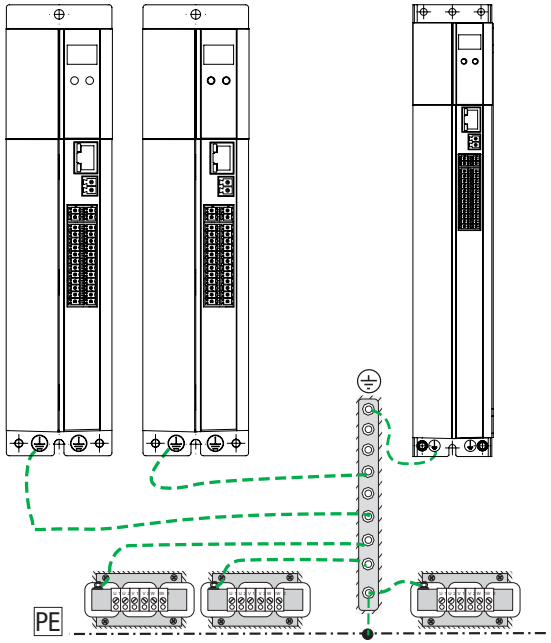


Figure 4.15 Star configuration layout for the PE conductor

4.7 Electrical isolation concept

The control electronics, with their logic (µP), the encoder terminals and the inputs and outputs, are electrically isolated from the power section (power supply/DC link). All control terminals are designed as safety extra-low voltage/protective extra-low voltage (SELV/PELV) circuits and must only be operated with such SELV/PELV voltages, as per the relevant specification. This p ovides reliable protection against electric shock on the control side.

A separate control supply, compliant with the requirements of a SELV/PELV, is therefore needed.

The overview opposite shows the potential references for the individual connections in detail.

This concept also delivers higher operational safety and reliability of the servo drive.

SELV = Safety Extra Low Voltage
PELV = Protective Extra Low Voltage

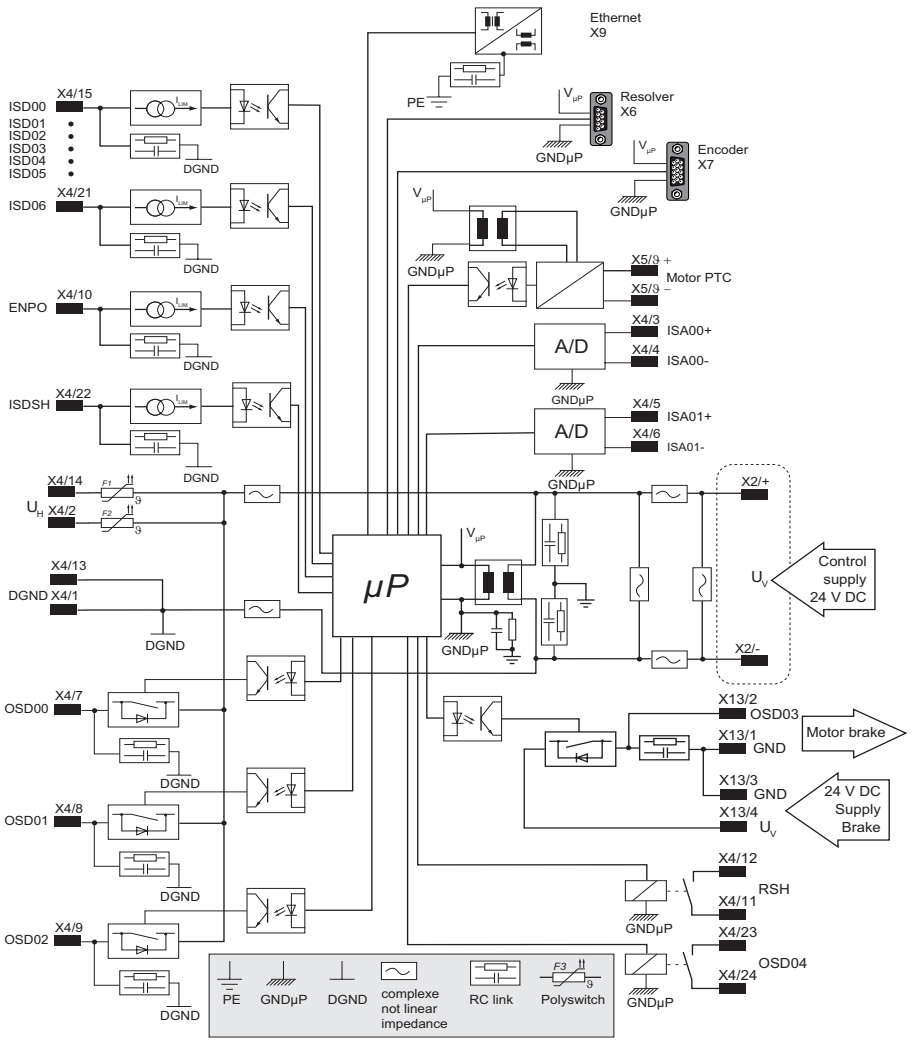


Figure 4.16 Electrical isolation concept MSD Single-Axis Servo Drive Compact

4.8 Connection of the supply voltages

The supply of power to the MSD Single-Axis Servo Drive Compact is separate for the control and power sections. The control supply should always be connected **first**, so that the device parameters can be set with Moog DriveAdministrator 5 and, above all, the device set to the correct supply for the power section.

CAUTION!	**Damage to the device due to incorrect operation!**
	• **Carelessness can cause damage to the device.** Only when the mains voltage has been pre-set in the device firmware and the device has been restarted (if the mains voltage or switching frequency has been changed) may the mains power supply for the supply for the power section be activated.

4.8.1 Connection of control supply (+24 V DC)

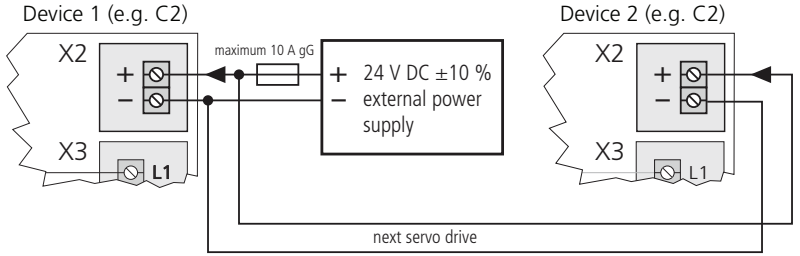


Figure 4.17 Connection of control supply MSD Single-Axis Servo Drive Compact

Control supply (Specification)		
Control supply	X2/+ X2/-	• U_V = +24 V DC ±10 %, stabilised and filtered • I_V = 2 A (C2 to C5) • Internal polarity reversal protection • The power supply unit used must have a safe and reliable isolation against the mains system acc. to EN 50178 or IEC/EN 61800-5-1

Table 4.5 Specification of control supply MSD Single-Axis Servo Drive Compact

NOTE

Suitable measures must generally be applied to provide adequate cable protection.

DANGER	Risk of injury due to electrical power!
	• **Carelessness will result in serious injuries or death.** When the mains voltage is switched on at terminal X3 and there is no control supply (+24 V DC at X2), a dangerous voltage is present on the device with no visual signal on the display or acoustic indication by fan noise. If visible in the installed state, LED H1 (see Figure 4.1) indicates whether voltage is present on the device. Even if H1 is completely off, X1 must be checked to ensure no electrical power is present.

NOTE

The start-up current for the supply voltage for the C2 to C5 may be 2-3 times the operation current for a short time.

4.8.2 Connection of mains supply

Procedure:

Step	Action	Comment
1.	Specify the cable cross-section depending on the maximum current and ambient temperature.	Cable cross-section according to local regulations and conditions.
2.	Wire the servo drive with the mains filte *), maximum cable length 0.3 m (1.0 ft) (with non-shielded cable)!	
3.	Wire the mains choke*) (if installed)	Reduces the distortion (THD) in the system and prolongs the life of the servo drive.
4.	Install a mains isolating device K1 (power circuit breaker, contactor, etc.).	Do not switch on the power!
5.	Use mains fuses (duty class gG) to isolate all poles of the servo drive from the mains supply.	For compliance with equipment safety requirements as per IEC/EN 61800-5-1

*) optional

DANGER!	Risk of injury due to electrical power!
	• **Carelessness will result in serious injuries or death.** Never wire or disconnect electrical connections while these are live! Always disconnect the power before working on the device. Dangerously high voltages of ≥50 V may still be present 10 min. after the power is cut (capacitor charge). So check that electrical power is not present!

CAUTION!	Risk or injury or damage to the device due to incorrect earth leakage circuit breaker!
	• **Carelessness may result in injuries or damage.** If local regulations require the installation of a residual current device, the following applies: In the event of a fault the servo drive is able to generate DC leakage currents without zero crossing. Servo Drives therefore must only be operated with residual current devices (RCDs) 1) type B for AC fault currents, pulsating or smooth DC fault currents, which are suitable for servo drive operation, see IEC 60755. RCMs 2) can also be used for monitoring purposes.

1) residual current protective device
2) residual current monitor

Note the following points:

Switching the mains power:

- In the event of excessively frequent switching the device protects itself by means of high-resistance decoupling from the mains. After a rest phase of a few minutes the device is ready to start once again.

TN and TT system: Operation is permitted if:

- In the case of single-phase devices for 1 x 230 V AC the supply system conforms to the maximum overvoltage category III as per IEC/EN 61800-5-1.
- In the case of three-phase devices with phase conductor voltages 3 x 230 V AC, 3 x 400 V AC, 3 x 460 V AC and 3 x 480 V AC
- **The star point** of the supply system **is earthed** and
- The supply system conforms to the maximum overvoltage category III as per IEC/EN 61800-5-1 at a system voltage (phase conductor → neutral point) of maximum 277 V.

IT system: Operation is **not** permitted!

- In case of an earth fault the voltage is approx. twice as high. Clearances and creepages to IEC/EN 61800-5-1 are no longer maintained.

Connection of the servo drives via a mains choke is imperative:

- Where the servo drive is used in applications with disturbance variables corresponding to environment class 3, as per IEC/EN 61000-2-4 and above (harsh industrial environment)
- In the case of single-phase mains supply
- For compliance with IEC/EN 61800-3

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

NOTE

Please be aware that the MSD Single-Axis Servo Drive Compact is not designed for the mains quality in for 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.

NOTE

The minimum cross-section of the mains power cable depends on the local regulations and conditions, as well as on the rated current of the servo drive.

CAUTION!	**Damage to the device due to incorrect operation!**
	• **Carelessness can cause damage to the device.** Only when the mains voltage has been pre-set in the device firmware and the device has been restarted (if the mains voltage or switching frequency has been changed) may the mains power supply for the power section be activated.

4.8.3 Connected load and mains fuse

Servo Drive	Device rated power [1] [kVA]		Maximum cable cross-section [2] of the terminal [mm²]		Specified mains fuse, duty class gG [A]
	With mains choke (4% u_K)	Without mains choke	Ferr. with insul .[3]	Ferr. w/o insul. [3]	
G394-030	1.3	1.6	2.5	2.5	1 x 16 maximum (1-phase) 3 x 16 maximum (3-phase)
G394-020	1.5	1.9			3 x. 6 maximum
G394-059	2.6	3.2	2.5	2.5	1 x 16 maximum (1-phase) 3 x 16 maximum (3-phase)
G394-035	2.7	3.3			3 x 10 maximum
G394-080	3.5	4.3	4	4	1 x 20 maximum (1 phase) 3 x 20 maximum (3 phase)
G394-065	5.0	6.1			3 x 16 maximum
G394-120	8.1	10.5	4	6	3 x 32 maximum
G394-160	10.2	13.2			3 x 40 maximum

1) At 3 x 230 V AC or 3 x 400 V AC mains voltage and FT ≥ 8 kHz

2) The minimum cross-section of the mains power cable depends on the local regulations and conditions, as well as on the rated current of the servo drive.

3) Ferr. with insul. = Ferrule with plastic insulation, Ferr. w/o insul. = Ferrule without plastic insulation

Table 4.6 Connected load and mains fuse

Mains supply for C2 and C3 devices

NOTE
Before commissioning, the value of the connected mains voltage must be set on the servo drive (factory setting = 3 x 230 V AC / 3 x 400 V AC).

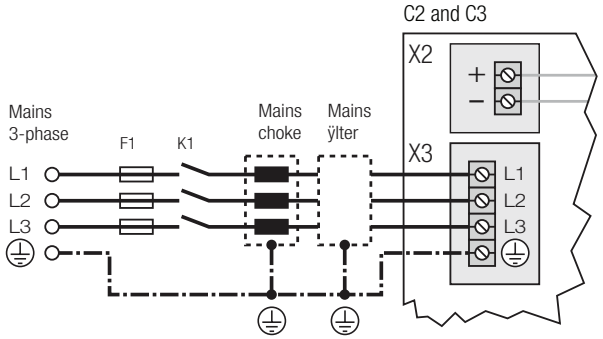


Figure 4.18 Connection C2 and C3 mains supply 3 x 230 V (G394-030, G394-059) or 3 x 400 V (G394-020, G394-035) depending on device design

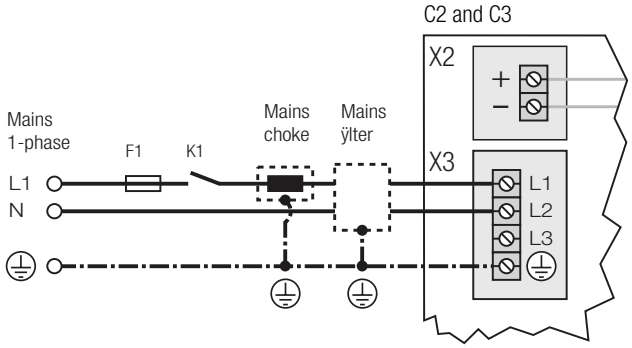


Figure 4.19 Connection C2 and C3 mains supply 1 x 230 V) (G394-030, G394-059)

Mains supply for C4 devices

NOTE
Before commissioning, the value of the connected mains voltage must be set on the servo drive (factory setting = 3 x 230 V AC / 3 x 400 V AC).

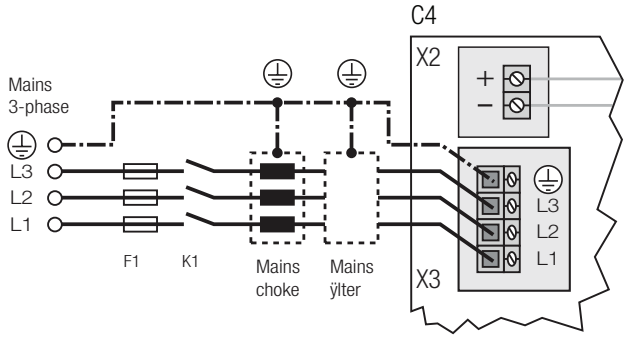


Figure 4.20 Connection of C4 to mains supply 3 x 230 V (G394-080) or 3 x 400 V (G394-065) depending on device design

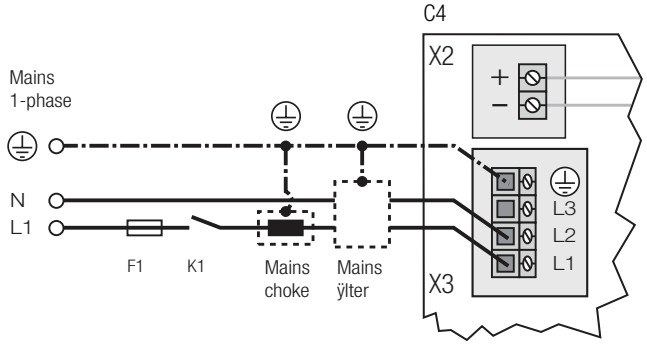


Figure 4.21 Connection of C4 to mains supply 1 x 230 V (G394-080)

Mains supply for C5 devices

NOTE:
Before commissioning, the value of the connected mains voltage must be set on the servo drive (factory setting = 3 x 400 V AC).

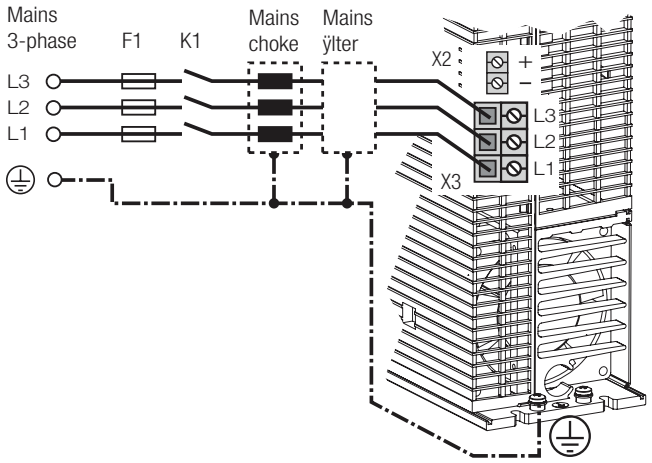


Figure 4.22 Connection of C5 to mains supply 3 x 400 V (G394-120, G394-160) depending on device design

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!**

4.9 Control connections

Step	Action	Comment
1.	Check whether complete device settings are already available, i.e. whether the drive has already been configured	
2.	If this is the case, a special control terminal assignment applies. Please contact your project engineer to obtain the terminal assignment!	
3.	Choose a terminal assignment.	Initial commissioning
4.	Wire the control terminals with shielded cables. The following is imperative: STO request X4/22, ENPO X4/10 and a start signal (with control via terminal).	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: - Ferrule without plastic sleeve: 0.2 to 1.5 mm² (0.0003 to 0.0023 in²) - Ferrule with plastic sleeve: 0.2 to 0.75 mm² (0.0003 to 0.0012 in²)
5.	Keep all contacts open (inputs inactive).	
6.	Check all connections again!	

Note the following points:

- Always wire the control terminals with shielded cables.
- Lay the control cables separately from the mains power and motor cables.
- A cable type with double copper braiding, with 60 to 70 % coverage, must be used for all shielded connections.

4.9.1 Specification of cont ol connections

Des.	Term.	Specification	Electrical isolation
Analog inputs			
ISA0+ ISA0- ISA1+ ISA1-	X4/3 X4/4 X4/5 X4/6	• U_{IN} = ±10 V DC • Resolution 12 bits; R_{IN} approx. 101 kΩ • Terminal scan cycle in "IP mode" = 125 µs, otherwise = 1 ms • Tolerance: U ±1 % of the measuring range end value	no
Digital inputs			
ISD00 ISD01 ISD02 ISD03 ISD04	X4/15 X4/16 X4/17 X4/18 X4/19	• Frequency range <500 Hz • Terminal scan cycle in = 1 ms • Switching level Low/High: ≤4.8 V / ≥18 V • $U_{IN\ max}$ = +24 V DC +20 % • I_{IN} at +24 V DC = typ. 3 mA	yes
ISD05 ISD06	X4/20 X4/21	• Frequency range ≤500 kHz • Switching level Low/High: ≤4.8 V / ≥18 V • $U_{IN\ max}$ = +24 V DC +20 % • $I_{IN\ max}$ max at +24 V DC = 10 mA, R_{IN} approx. 3 kΩ • Internal signal delay < 2 µs suitable as trigger input for quickly saving actual position	yes
ENPO	X4/10	• Disable restart inhibit (STO) and enable power stage = High level • OSSD support • 10 ms • Switching level Low/High: ≤4.8 V / ≥18 V • $U_{IN\ max}$ = +24 V DC +20 % • I_{IN} at +24 V DC = typ. 3 mA	yes
Digital outputs			
OSD00 OSD01 OSD02	X4/7 X4/8 X4/9	• No destruction in case of short-circuit (+24 V DC -> DGND), but device may briefly shut down • I_{max} = 50 mA, PLC-compatible • Terminal scan cycle in = 1 ms • High-side driver	yes

X4

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

Table 4.7 Specification of control connections X4

Des.	Term.	Specification		Electrical isolation
STO "Safe Torque Off"				
ISDSH (STO)	X4/22	• "Request STO" input = Low level • OSSD support • Switching level Low/High: ≤4.8 V / ≥18 V • $U_{IN\ max}$ = +24 V DC +20 % • I_{IN} at +24 V DC = typ. 3 mA		yes
RSH RSH	X4/11 X4/12	Diagnostics STO, both cut-off channels active, one NO contact with automatically resetting circuit-breaker (polyswitch) • 25 V / 200 mA AC, cos φ = 1 • 30 V / 200 mA DC, cos φ = 1	X4/12 X4/11	yes
Relay outputs				
REL	X4/23 X4/24	Relay, 1 NO contact • 25 V / 1.0 A AC, cos φ = 1 (AC1) • 30 V / 1.0 A DC, cos φ = 1 (DC1) • Switching delay approx. 10 ms • Cycle time 1 ms	X4/23 X4/24	
Auxiliary voltage				
+24 V	X4/2 X4/14	• Auxiliary voltage output (U_H) for feeding the digital control inputs • $U_H = U_V$-ΔU (ΔU typically approx. 1.2 V), no destruction in case of short circuit (+24 V DC -> DGND), but device may briefly shut down • I_{max} = 80 mA (per pin) with self-resetting circuit breaker (polyswitch)		yes
Digital ground				
DGND	X4/1 X4/13	Reference ground for +24 V DC		yes

X4

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

Table 4.7 Specification of control connections X4

4.9.2 Connection of motor brake X13

Connector X13 is intended for connection of a motor brake.

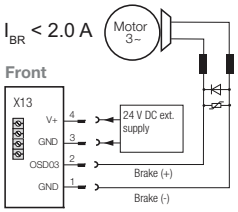
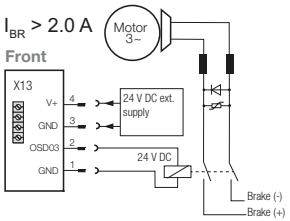
Des.	Term.	Connection	Specification
OSD03 GND GND V+	X13/2 X13/1 X13/3 X13/4	I_{BR} < 2.0 A  I_{BR} > 2.0 A 	• Short-circuit proof • External control supply +24 V DC (I_{IN} = 2.1 A) required via X13/3 (GND) and X13/4 (V+) • $U_{BR} = U_V - \Delta U$` ($\Delta U$` typically approx. 1.4 V) • To actuate a motor holding brake up to I_{BR} = 2.0 A maximum • Overcurrent causes cyclic shutdown • Also usable as configurable digital outpu • Cable break monitor: With the brake driver switched on, cable break is detected at output currents < 200 mA. The cable break monitoring can be disabled.

Table 4.8 Specification of the terminal connections X13

NOTE:

For brakes with higher current requirements (> 2.0 A), a relay must be provided. The cable break monitoring on X13 is then no longer usable and must be provided externally.

4.10 Specification, Ethernet interface

The service and diagnostic interface X9 is designed as a TCP/IP Ethernet interface. It is suitable for connection of a PC for commissioning, service and diagnostics and for programming of the servo drive.

The following software can communicate with the servo drive via the Ethernet interface:

- Moog DriveAdministrator 5 for commissioning, service and diagnostics on the MSD Single-Axis Servo Drive Compact
- CoDeSys 3.x programming system for programming the MSD Single-Axis Servo Drive Compact in the languages of IEC/EN 61131-3. For this purpose a servo drive licence is required.

Specification of interface

- Transfer rate 10/100 Mbits/s BASE
- Line protocol IEEE802.3 compliant
- Connection via standard commercially available crosslink cable, CAT 5

4.11 Option 1

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

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

4.12 Option 2

Option 2 can be factory-configu ed with various technology options. Additional or special encoders can be evaluated here for example.

You will find all available options in the MSD Ordering Catalog. The User Manuals for the respective options provide detailed information on commissioning.

4.13 Encoder connection

All encoder connections are located on the top of the unit.

Motor, encoder and cable allocation

Compare the rating plates of the components. Make absolutely sure you are using the correct components according to variant A, B or C!

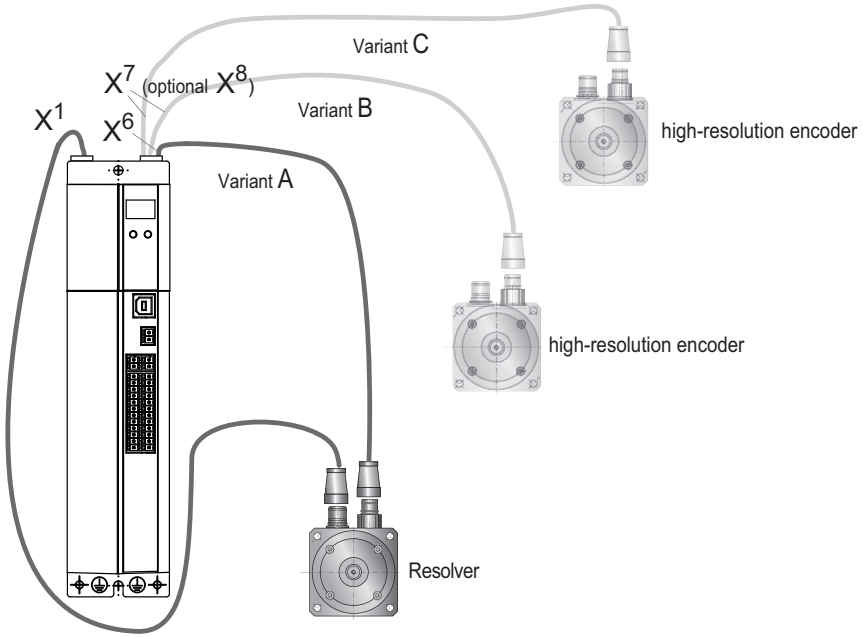


Figure 4.23 Motor/encoder cable assignment

NOTE:

Do not split the encoder cable, for example to route the signals via terminals in the switch cabinet. The knurled screws on the D-Sub connector housing must be tightly locked!

	Motor (with installed encoder)	Encoder cable	Servo drive connection
Variant A	With resolver without further options	C08335-013-yyy	X6
Variant B	Sin/Cos single-/multi-turn encoder with SSI/EnDat interface	CA58876-002-yyy	X7
Variant C	Sin/Cos single-/multi-turn encoder with HIPERFACE® interface	CA58877-002-yyy	X7

Table 4.9 Variants of motors, encoder type and encoder cable

4.13.1 Ready made encoder cables

The specifications can only be assu ed on the usage of Moog system cables.

Encoder cab	C08335	-	013	-	yyy[1]
Ready made cab					
Resolver cable					
Encoder cable SSI, EnDat	CA58876		002		
Encoder cable Hiperface®	CA58877		002		
Encoderystem					
Version					
Cable le (m)					

1) yyy stand for length in meters; standard length; Standardlängen: 1 m (3.28 ft), 5 m (16.40 ft), 10 m (32.80 ft), 15 m (49 ft), 20 m (65 ft), 50 m (164 ft). Further length on request

Encoder cabl C08335-013-yyy[1] Order code

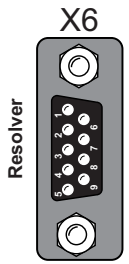
Technical data

	C08335-013-yyy [1]	CA58876-002-yyy [1]	CA58877-002-yyy [1]
Encoder system	Resolver	G3, G5, G12.x (Single-/multi-turn with SSI/EnDat interface)	G6, G6.x (Single-/multi-turn with HIPERFACE® interface)
Drive-end assignment (sub-D connector)	1 = S3 2 = S1 3 = S2 4 = n.c. 5 = PTC+ 6 = R1 7 = R2 8 = S4 9 = PTC-	1 = A- 2 = A+ 3 = VCC (+5 V) 4 = DATA+ 5 = DATA- 6 = B- 8 = GND 11 = B+ 12 = VCC (Sense) 13 = GND (Sense) 14 = CLK+ 15 = CLK- 7, 9, 10 = n.c.	1 = REFCOS 2 = +COS 3 = Us 7 – 12 V 4 = Data+ EIA485 5 = Data- EIA485 6 = REFSIN 7 = Bridge to PIN 12 8 = GND 11 = +SIN 12 = Bridge to PIN 7 9, 10, 13, 14, 15 = n.c.
Suitable for energy chains	yes		
Minimum bending radius	90 mm (3.54 in)	100 mm (3.93 in)	90 mm (3.54 in)
Temperature range	-40 to +85 °C (-40 to +185 °F)	-35 to +80 °C (-31 to +176 °F)	-40 to +85 °C (-40 to +185 °F)
Cable diameter approx.	8.8 mm (0.34 in)		
Outer sheath material	PUR		
Resistance	Oil, hydrolysis and microbe resistant (VDE0472)		
Approvals	UL style 20233, +80 °C (+176 °F) - 300 V, CSA-C22.2N.210-M90, +75 °C (+167 °F) - 300 V FT1		

Table 4.10 Technical data encoder cable

4.13.2 Resolver connection X6

A resolver is connected to slot X6 (9-pin D-Sub socket).

Figure	X6/Pin	Function
	1	ResolverS3 differential input (reference to Pin X6-2)
	2	Resolver S1 differential input (reference to Pin X6-1)
	3	Resolver S2 differential input (reference to Pin X6-8)
	4	Supply voltage 5 ... 12 V, internally connected to X7/3
	5	ϑ+ (PTC, KTY, Klixon) internally connected to X7/10 [1]
	6	Ref+ analog excitation
	7	Ref- analog excitation (ground reference point for pin 6 and pin 4)
	8	Resolver S4 differential input (reference to Pin X6-3)
	9	ϑ- (PTC, KTY, Klixon) internally connected to X7/9 [1]

1) Be sure to pay attention to the note headed "ATTENTION" in Table 4.14!

Table 4.11 Pin assignment X6 resolver connection

CAUTION	Damage to the device due to incorrect insulation of the motor winding!
	• **Carelessness can cause damage to the motor/device** The motor temperature sensor must, in relation to the motor winding, on connection to X5 be provided with **basic insulation**, on connection to X6 or X7 with **reinforced insulation** as per IEC/EN 61800-5-1.

4.13.3 Connection for high-resolution encoder

The interface X7 enables evaluation of the following encoder types.

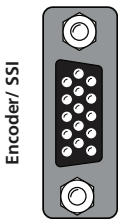
Figure	Function
X7  Encoder/ SSI	Sin/Cos encoder with zero pulse e.g. Heidenhain ERN1381, ROD486
	Heidenhain Sin/Cos encoder with EnDat interface e.g. 13 bit single-turn encoder (ECN1313.EnDat01) and 25 bit multi-turn encoder (EQN1325-EnDat01)
	Heidenhain encoder with digital EnDat interface Single- or multi-turn encoder
	Sin/Cos encoder with SSI interface e.g. 13 bit single-turn and 25 bit multi-turn encoder (ECN413-SSI, EQN425-SSI)
	Sick-Stegmann Sin/Cos encoder with HIPERFACE® interface Single- and multi-turn encoder, e.g. SRS50, SRM50

Table 4.12 Suitable encoder types on X7

NOTE:

- The usage of encoders not included in the range supplied by Moog requires special approval by Moog.
- The maximum signal input frequency is 500 kHz.
- Encoders with a power supply of 5 V ±5 % must have a separate sensor cable connection. The encoder cable detects the actual supply voltage at the encoder; it is then possible to compensate for the voltage drop on the cable. Only by using the sensor cable is it ensured that the encoder is supplied with the correct voltage. The sensor cable must always be connected.

Select the cable type specified by the motor or encoder manufacturer. During this process bear in mind the following boundary conditions:

- Always used shielded cables. Connect the shield at both ends.
- Connect the differential track signals A/B, R or CLK, DATA using twisted pairs.
- Do not cut the encoder cable, for example to route the signals via terminals in the switch cabinet.

X7 Pin	Sin/Cos and TTL	Sin/Cos absolute value encoder SSI/EnDat	Absolute value encoder EnDat (digital)	Absolute value encoder HIPER-FACE®
1	A-	A-	-	REFCOS
2	A+	A+	-	+COS
3	+5 V DC ±5 %, IOUT maximum = 250 mA (150 mA for hardware versions 0..1), monitoring via sensor cable			7 to 12 V (typ. 11 V) maximum 100 mA
4	R+	Data +	Data +	Data +
5	R-	Data -	Data -	Data -
6	B-	B-	-	REFSIN
7	-	-	-	U_S switch
8	GND	GND	GND	GND
9	ϑ- (PTC, KTY, Klixon) internally connected to X6/9 [1]			
10	ϑ+ (PTC, KTY, Klixon) internally connected to X6/5 [1]			
11	B+	B+	-	+SIN
12	Sense +	Sense +	Sense +	U_S switch
13	Sense -	Sense -	Sense -	-
14	-	CLK+	CLK+	-
15	-	CLK -	CLK -	-

1) Be sure to pay attention to the note headed "ATTENTION" in Table 4.14!

The sum of the currents tapped at X7/3 and X6/4 must not exceed the specified value!

After connecting pin 7 to pin 12, a voltage of 11.8 V is set on X7, pin 3!

Table 4.13 Pin assignment of the X7 terminal connection

NOTE:

The encoder supply on X7/3 is short-circuit proof on both 5 V and 11 V operation. The drive remains in operation enabling the generation of a corresponding error message on evaluating the encoder signals.

4.14 Motor connection

Step	Action	Comment
1.	Specify the cable cross-section depending on the maximum current and ambient temperature.	Cable cross-section according to local and country-specific regulations and conditions
2.	Connect the shielded motor cable to terminals X1/ U, V, W and connect the motor to earth at ⏚.	Connect the shield at both ends to reduce interference emissions.
3.	Wire the motor temperature sensor and activate temperature evaluation using Moog DriveAdministrator. See also related note.	Connect the shield at both ends to reduce interference emissions.

4.14.1 Motor temperature sensor

Connection servo drive	Type of sensor	Insulation
X5	Temperature switch (Klixon), PTC	Sensor with basic insulation
X6	Temperature switch (Klixon), PTC, KTY	Sensor with reinforced insulation
X7	Temperature switch (Klixon), PTC, KTY	Sensor with reinforced insulation

Table 4.14 Motor temperature sensor terminal configuratio

CAUTION	Damage to the device due to incorrect insulation of the motor winding!
	• **Carelessness can cause damage to the motor/device** The motor temperature sensor must, in relation to the motor winding, on connection to X5 be provided with **basic insulation**, on connection to X6 or X7 with **reinforced insulation** as per IEC/EN 61800-5-1.

NOTE:

In the event of a short-circuit or earth fault in the motor cable, the power stage is disabled and an error message is issued.

4.14.2 Connection of the servo motors

For connection of the servomotor product range please use the ready made motor cable.

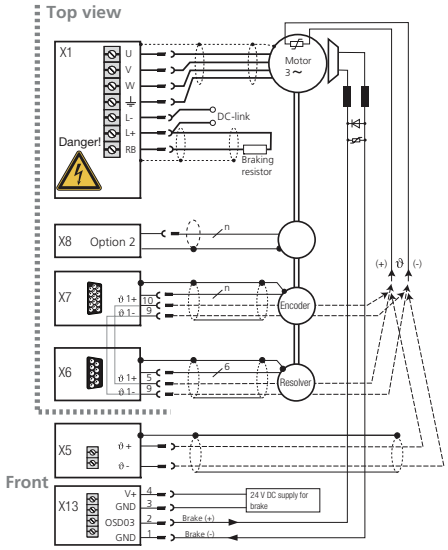


Figure 4.24 Connection of the motor, C2 to C4

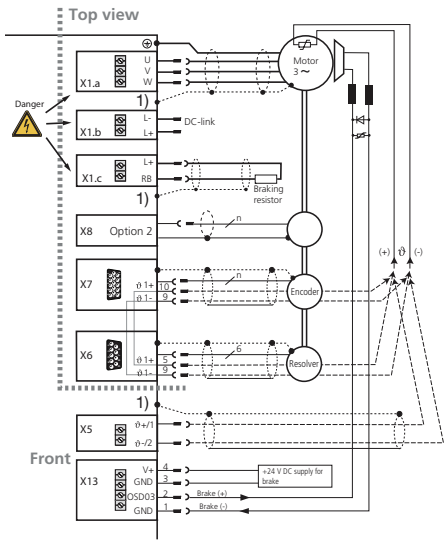


Figure 4.25 Connection of the motor , C5

DC link: Connection on C2 to C4 X1/L+, L- Connection on C5 X1.b/ L+, L-

CAUTION!	Damage to the device due to DC link coupling!
	• **Carelessness can cause damage to the device** Coupling together the DC links on several drive units is not allowed.

Ready made motor cable

C08336	-	xxx	yyy[1)]
Ready made motor cable			
		Version	
			Cable length (m)

1) yyy stands for length in meters; standard length: 1 m (3.28 ft), 5 m (16.40 ft), 10 m (32.80 ft), 15 m (49 ft), 20 m (65 ft), 50 m (164 ft). Weitere Further length on request

Motor cable C08336-xxx-yyy	Order code

Technical data

Technical data	C08336-xxx-yyy[1),2)]		CB05708-xxx-yyy[1),2)]		CA44958-xxx-yyy[1),2)]		CB00076-xxx-yyy[1),2)]		CA98676-xxx-yyy[1),2)]	
Continuous rated current	10 A		TBD		44 A		61 A		82 A	
Cable cross-section	4 x 1,5 mm² + 2 x 1 mm² (4 x 0.0024 in² + 2 x 0.0016 in²)		4 x 4 mm² + 2 x 1,5 mm² (4 x 0.0062 in² + 2 x 0.0023 in²)		4 x 6 mm² + 2 x 1,5 mm² (4 x 0.0093 in² + 2 x 0.0023 in²)		4 x 10 mm² + 2 x 1,5 mm² (4 x 0.00155 in² + 2 x 0.0023 in²)		4 x 16 mm² + 2 x 1,5 mm² (4 x 0.0248 in² + 2 x 0.0023 in²)	
Temperature range	-40 bis +125 °C (-40 to +275 °F)		TBD		-50 bis +90 °C (-58 to +194 °F)		TBD		TBD	
Wiring	Connector pin	Wiring	Connector pin	Wiring	Connector pin	Wiring	Connector pin	Wiring	Connector pin	Wiring
	2	U	2	U	U	U	U	U	U	U
	4	VV	4	VV	V	VV	V	VV	V	VV
	1	WWW	1	WWW	W	WWW	W	WWW	W	WWW
	PE	yellow / green	PE	yellow / green	PE	yellow / green	PE	yellow / green	PE	yellow / green
	5	Brake + / white	5	Brake + / white	+	Brake - / white	+	Brake + / white	+	Brake + / white
	6	Brake - / black	6	Brake - / black	-	Brake - / black	-	Brake - / black	-	Brake - / black
	Connector housing	Monitor	Connector housing	Monitor	Connector housing	Monitor	Connector housing	Monitor	Connector housing	Monitor
Connector type	Size 1		Size 1		Size 1,5		Size 1,5		Size 1,5	

1) yyy stands for length in meters; standard length: 1 m (3.28 ft), 5 m (16.40 ft), 10 m (32.80 ft), 15 m (49 ft), 20 m (65 ft), 50 m (164 ft). Further length on request
2) xxx-001 for standard configuration option, further options on request

Table 4.15 Technical data motor cab

NOTE:

Cores 5 and 6 (PTC) are required only for motors in which the motor PTC cannot be connected via the encoder cable. In the case of servomotors with resolver, the PTC is connected via the resolver cable.

4.14.3 Electronic overload protection for the motor

The motor protection function acquires the motor frequency, the motor current and other parameters. Depending on these parameters and the rated motor current, the motor protection triggers the overload protection function:

- As I^2T monitoring with programmable motor current, the permissible multiple of the rated motor current, the trigger time and the speed-dependency of the rated motor current.
- The I^2T integrator acts as a thermal memory for the system. The thermal memory is retained while the motor is shut down and if the device is switched on.
- The devices do not retain the thermal memory if switched off, i.e. the electronic motor overload protection is reset by switching off the power supply.

The electronic motor overload protection can be increased by using a motor temperature sensor.

NOTE:

You will find detailed information about the function and configuration of the parameters for the motor protection function in the Device Help (ID no.: CB40859-001).

4.14.4 Switching in the motor cable

CAUTION!	Damage to the device due to switching in the motor cable!
	• **Carelessness can cause damage to the device** Switching in the motor cable must take place with the power switched off and the power stage disabled, as otherwise problems such as burned contactor contacts or power stage damage may occur.

To ensure unpowered switch-on, you must make sure that the contacts on the motor contactor are closed before the drive controller power stage is enabled. At the moment the contactor is switched off it is necessary for the contact to remain closed until the drive controller power stage is shut down and the motor current is 0. This is achieved by using appropriate safety delays for the switching of the motor contactor in the control sequence for your machine.

NOTE:

Despite these measures, the possibility cannot be ruled out that the servo drive may malfunction during switching in the motor cable.

4.15 Brake chopper connection

In regenerative operation, e.g. when braking the drive, the motor feeds energy back to the servo drive. This increases the voltage in the DC link. If the voltage exceeds a threshold value, the internal braking transistor is activated and the regenerated power is converted into heat by means of a braking resistor.

4.15.1 Protection in case of brake chopper fault

WARNING!	Risk of injury due to hot surfaces caused by a faulty brake chopper!
	• **Carelessness may result in serious burns or damage.** If the brake chopper is overloaded the internal brake chopper transistor may be switched on continuously, which will result in the overheating of the device and the braking resistor. Temperatures of up to +250 (+482 °F) may be reached. To prevent more serious damage we recommend the activation of the following software function: You can activate this function by assigning BC_FAIL(56) to any digital output (Moog DriveAdministrator 5 ▶ Subject area "I/O configuration" ▶ Digital outputs ▶ OSD00 to OSD02). In the event of a fault the selected output then switches from 24 V to 0 V. This signal ensures that the servo drive is safely disconnected from the mains supply.

For detailed information on setting parameters refer to the "MSD Device Help".

4.15.2 Design with integrated braking resistor (C3+4+5)

For servo drives with an integrated braking resistor **(model G394-xxx-xxx-xx2/xx4)** only the peak braking power is stated in the appendix. The permissible continuous braking power must be calculated. It depends on the effective utilisation of the servo drive in the corresponding application.

CAUTION!	Damage to the device with integrated braking resistor due to connection of an ext. braking resistor!
	• **Carelessness can cause damage to the device** No additional external braking resistor may be connected to servo drives G394-059/-080/-020/-035/-065/-120/-160 with integrated braking resistor.

The servo drive is thermally designed in such a way that no energy input by the internal braking resistor is permitted during continuous operation at rated current and at maximum ambient temperature.

Consequently, a servo drive design featuring an integrated braking resistor only makes sense when the effective servo drive utilisation is ≤80 % or the braking resistor is designed for one-off emergency stop. In the event of an emergency stop, only the thermal capacity of the braking resistor can be used for a one-off braking action. The permissible energy W_{IBr} can be taken from the following table.

Device	Technology	Rated resistance R_{BR}	Peak braking power P_{PBr}	Pulse energy W_{IBr}	K1 5)
G394-059	Wire resistance	100 Ω	1500 W *1)*	150 Ws	120
G394-035		420 Ω	1000 W *2)* 1300 W *3)* 1400 W *4)*	140 Ws	50
G394-080		90 Ω	1690 W *1)*	6000 Ws	170
G394-065			4700 W *2)* 6170 W *3)* 6500 W *4)*	6000 Ws	120
G394-120		90 Ω	4700 W *2)* 6170 W *3)* 6500 W *4)*	6000 Ws	120
G394-160		90 Ω	4700 W *2)* 6170 W *3)* 6500 W *4)*	6000 Ws	120

1) Data referred to 1 x 230 V AC mains voltage (BR switch-on threshold 390 V DC)

2) Data referred to 3 x 400 V AC mains voltage (BR switch-on threshold 650 V DC)

3) Data referred to 3 x 460 V AC mains voltage (BR switch-on threshold 745 V DC)

4) Data referred to 3 x 480 V AC mains voltage (BR switch-on threshold 765 V DC)

5) K1 = Factor for the calculation of the permissible continuous braking power, see next page

Table 4.16 Data of the integrated braking resistor (design G394-xxx-xxx-xx2/xx4)

If the drive is not permanently operated at its power limit, the reduced power dissipation of the drive can be used as braking power.

NOTE:

The rest of the calculation assumes that the servo drive is used at maximum permissible ambient temperature. This means that any additional energy input for the internal braking resistor due to a lower ambient temperature will be neglected.

Method to calculate the continuous braking power:

- Calculation of effective servo drive utilisation in a cycle T:

$$I_{eff} = \sqrt{\frac{1}{T}\int_0^T i^2\,dt}$$

- Determination of permissible continuous braking power based on unused drive power:

$$P_{DBr} = \left(1 - \frac{I_{eff}}{I_N}\right) \times K1$$

Marginal conditions

- A single braking action must not exceed the maximum pulse energy of the braking resistor.

$$W_{IBr} \geq P_{PBr} \times T_{Br}$$

- The continuous braking power calculated for the device must be greater than the effective braking power of a device cycle.

$$P_{DBr} \geq \frac{1}{T}\int_0^T P_{PBr}\,dt_{Br}$$

This results in the minimum permissible cycle time T with calculated continuous braking power:

$$T = \frac{P_{PBr}}{P_{DBr}} \times \int_0^T dt_{Br}$$

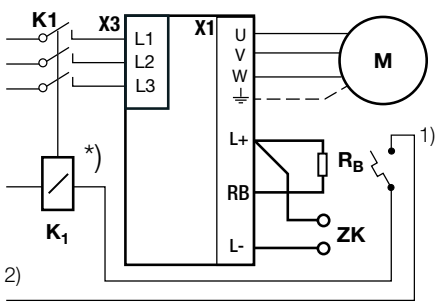
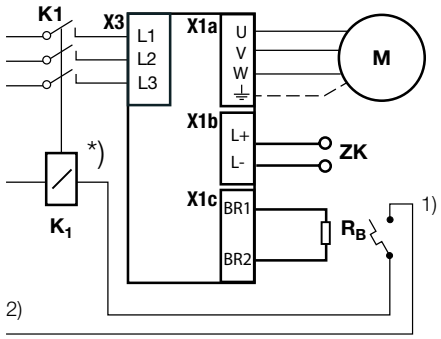
The maximum total on-time of the braking resistor over a specified cycle time T with calculated continuous braking power is:

$$T_{BrSum} = \frac{P_{PBr}}{P_{DBr}} \times T$$

4.15.3 Connection of an external braking resistor

NOTE

- Be sure to follow the installation instructions for the external braking resistor.
- The temperature sensor (bimetallic switch) on the braking resistor must be wired in such a way that the power stage is deactivated and the connected servo drive is disconnected from the mains supply if the braking resistor overheats.
- The minimum permissible connection resistance of the servo drive must not be infringed, for technical data see appendix.
- The braking resistor must be connected using a shielded cable. The cables are to be protected by suitable means.

Size C2 to C4	Size C5
	

*) Depending on how the temperature sensor is connected, the nature and magnitude of the control voltage, the power required by the mains contactor, it may be necessary to provide an auxiliary contactor.
1) Temperature switch, temperature sensor, bimetallic switch
2) Control voltage
ZK DC Link

Figure 4.26 Connection of braking resistor

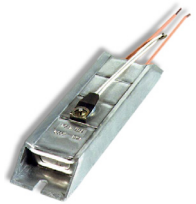
DANGER!	**Risk of injury due to electrical power!**
	• **Carelessness will result in serious injuries or death.** Never wire or disconnect electrical connections while these are electrically live! Always disconnected the power before working on the device. Even 10 min. after switching off the mains supply, dangerously high voltages of ≥50 V may still be present (capacitor charge). So check that electrical power is not present!

WARNING!	**Risk of injury due to hot surfaces on the ext. braking resistor!**
	• **Carelessness may result in serious burns.** The braking resistor heats up very significantly during operation and can reach temperatures of up to +250 °C (+482 °F). On touching there is a risk of serious burns to the skin.

CAUTION	**Damage to the ext. braking resistor due to lack of temperature monitoring!**
	• **Carelessness can result in overheating of the ext. braking resistor!** The external braking resistor must be monitored by the control. The temperature of the braking resistor is monitored by a temperature watchdog (Klixon). In the event of overheating the servo drive must be disconnected from the mains supply.

CAUTION!	**Damage to the device with integrated braking resistor due to connection of an ext. braking resistor!**
	• **Carelessness can cause damage to the device** No additional external braking resistor may be connected to servo drives G394-059/-080/-020/-035/-065/-120/-160 with integrated braking resistor.

Available braking resistors (excerpt)

Article designation	Continuous braking power	Resis-tance[1)]	Peak braking power [2)]	Protection	Figure
CA59737-001	35 W	90 Ω	6250 W	IP54	
CA59738-001	150 W		6250 W	IP54	
CA59739-001	300 W		6250 W	IP54	
CA59740-001	1000 W		6250 W	IP65	Example: CA59737-001

1) Tolerance ±10 %

2) Is the maximum possible braking power depending on the ON-time and cycle time

Table 4.17 Technical data - braking resistors

NOTE:

The available braking resistors with the exact specifications, in particular with regard to surface temperature, maximum system voltage and high-voltage strength, are set out in the Installation Manual Braking resistor and MSD Ordering Catalog. See “1.3 Reference documents”.

5 Commissioning

5.1 Notes for operation

CAUTION	Damage to the device due to damaging ambient conditions!
	**The device may be irreparably damaged due to harmful ambient conditions during operation.** For this reason • 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 the device • The ventilation openings must not covered

WARNING	Risk of injury due to hot surfaces on the device!
	• **Carelessness may result in burns.** The device heats up during operation and the temperature on the heat sink may reach +100 °C (+212 °F). On touching there is a risk of burns to the skin.

5.2 Initial commissioning

Once the MSD Single-Axis Servo Drive Compact has been installed as described in chapter "3 Mechanical installation" and wired with all required power supplies and external components as described in chapter "4 Electrical installation", initial commissioning can performed in the following sequence:

Step	Action	Comment
1.	Install and start PC software	see Installation Manual Moog DriveAdministrator 5
2.	Switching on control supply	see section 5.2.1
3.	Establish connection between PC and servo drive	see section 5.2.2
4.	Parameter configuration	see section 5.2.3
5.	Control drive using Moog DriveAdministrator 5	see section 5.2.4

Table 5.1 Initial commissioning step table

NOTE:
Details on STO (Safe Torque Off) have not been taken into account for initial commissioning, see chapter "7 Safe Torque Off (STO)".

5.2.1 Switching on control supply

2.	To initialise and set parameters initially only switch on the +24 V DC control supply. Do **not** yet switch on the AC mains supply.

Display indication after switching on the control supply

D1	D2	Action	Explanation
		Switching on the external +24 V DC control supply	Initialisation in progress
		Initialisation completed	Not ready for starting

Table 5.2 Switch-on status of the MSD Single-Axis Servo Drive Compact (with +24 V DC control supply)

NOTE:

Details on the control supply can be found in chapter "4.8.1 Connection of control supply (+24 V DC)".

5.2.2 Establishing connection between PC and servo drive

3.	The PC can be connected to the servo drive via Ethernet (TCP/IP). Connect PC and servo drive with an Ethernet connecting cable.

NOTE:

- Initialisation
  The communication link between PC and servo drive can only be set up after the servo drive has completed its initialisation.
- TCP/IP configuratio
  If the PC does not recognise the servo drive connected, please check the settings for the Ethernet interface
  (see Installation Manual Moog DriveAdministrator 5).

5.2.3 Parameter configuration

4.	The commissioning wizard in Moog DriveAdministrator 5 is provided for making the settings for the drive system. Start the wizard.

NOTES:

- Moog DriveAdministrator Help
  A detailed description of Moog DriveAdministrator 5 as well as the commissioning wizard can be found in the Moog DriveAdministrator 5 help.
- Motor dataset
  When using Moog servo motors, motor dataset are available.

5.2.4 Controlling drive using Moog DriveAdministrator 5

5.	Switch on the AC mains supply. Then enable the power stage and activate the control. The drive should be tested without the coupled mechanism.

DANGER!	**Risk of injury due to rotating parts on the motor!**
	• **Carelessness will result in serious injuries or death.** Before commissioning motors with feather keys in the end of the shaft, the keys must be reliably secured against throwing out, as far as this is not already prevented by drive elements such as belt pulleys, couplings or similar.

CAUTION!	**Damage to the system/machine due to uncontrolled or inappropriate commissioning!**
	**Carelessness may result in damage to the system/machine.** • It is imperative attention is paid to the limitations of the movement range. You are responsible for a safe process. Moog will not assume liability for any damage that occurs

Important information for the usage of motors!

- Certain motors are only intended for operation on the servo drive. Direct connection to the mains supply can cause irreparable damage to the motor.
- The motor surfaces may become extremely hot. No temperature sensitive parts may touch or be fastened to these areas, appropriate measures to prevent physical contact must be taken wherever necessary.
- The temperature sensor installed must be connected to the terminals of the temperature monitoring system for the servo drive also during the test run to avoid overheating of the motor.
- The motor holding brake (if installed) should be checked for correct function before commissioning the motor. Motor holding brakes are only designed for a limited number of emergency braking operations. Use as a service brake is not allowed.

Display indication after switching on the AC mains supply

D1	D2	Action	Reaction	Explanation
5	2	Switching on the AC mains supply	Servo drive ready, power stage ready, control deactivated	Device is ready for switching on

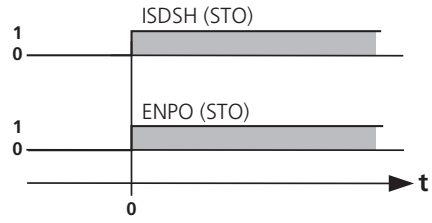
Table 5.3 Display D1/D2 after switching on the AC mains supply

NOTE:

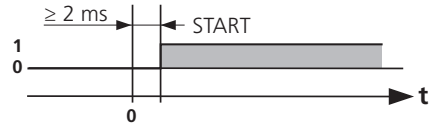
- Inputs "ISDSH" and "ENPO"
  For step 1 in table 5.1 at least the two inputs "ISDSH" and "ENPO" on terminal X4 must be connected.
- Manual mode window
  Step 2 in Figure 5.1 is best undertaken via the "Manual mode" window in Moog DriveAdministrator 5, details can be found in Moog DriveAdministrator help.
- Configuration of inputs/output
  If step 2 is to be implemented via the inputs on terminal X4, the sources for "START CONTROL" and speed setpoint must be configured accordingly in "Inputs/Outputs" in Moog DriveAdministrator 5.

Power-up sequence for starting the drive

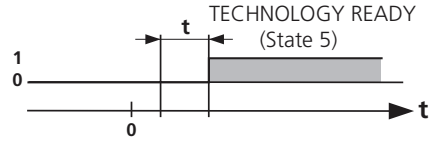
1. Deactivate the safety function "STO" by setting the inputs "ISDSH" and "ENPO" (see chapter "4 Installation")



2. Activate "START CONTROL" at the earliest 2 ms after step 1 and specify the speed setpoint



3. Monitor your system or plant and check the drive behaviour.



t = motor dependent delay

Figure 5.1 Power-up sequence

Display indication after starting the drive

D1	D2	Action	Reaction	Explanation
8	3	Enabling "STO" and power stage "ENPO"	Ready for switching on	Power stage ready

Table 5.4 D1/D2 indication during activation of motor

CAUTION!	Damage to the device due to incorrect operation!
⚠	• **Carelessness may result in damage.** Before the next step "Enable start" you must specify a plausible setpoint, because the pre-set setpoint is transferred to the drive directly after the motor control has started.

D1	D2	Action	Reaction	Explanation
H	5	"Start" enabled	Technology ready	Motor energised, control active

Table 5.5 D1/D2 indication during activation of motor

Details for optimising the drive on your application can be found in the Moog DriveAdministrator help and in the MSD Servo Drive Device Help.

5.3 Serial commissioning

An existing parameter data set can be transferred to other MSD Single-Axis Servo Drive Compact using Moog DriveAdministrator 5. Details can be found in the Moog DriveAdministrator help.

5.4 Integrated control unit

The built-in control unit permits diagnostics on the MSD Single-Axis Servo Drive Compact. The control unit comprises the following elements, all located on the front of the device:

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

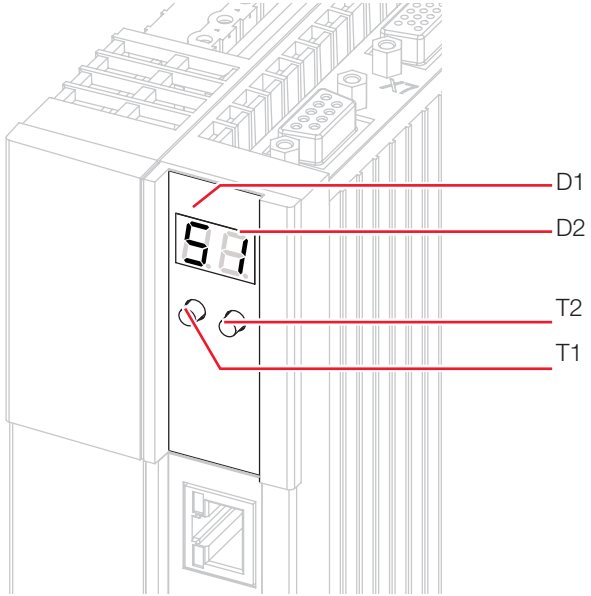


Figure 5.2 Integrated control unit MSD Single-Axis Servo Drive Compact

The following functions and displays are available:

- Indication of the device status (see chapter "6.1 Device states")
  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 state (see chapter "6.2 Error indication")
  On the occurrence of an error in the device, the display is immediately switched to the indication of the error code.
- Parameter configuration (indication "PA") (see chapter 5.4.3)
  Resetting device parameters to their factory setting
- Ethernet IP address configuration (indication "IP") (see chapter 5.4.4)
  Ethernet IP address and subnet mask setting
- Field bus settings (indication "Fb") (see section 5.4.5)
  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)	• Activation of 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 options for the corresponding level. No settings will be changed.
T2 (right)	• 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	• Menu level up • Accept selection • Acknowledge	After pressing T1 and T2 at the same time, the value applied flashes for five second. 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		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 device status display.

Table 5.6 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, further possible entries see sections 5.4.4 and 5.4.5)
	[Flashing decimal points] Selected function in action
	[Two dashes] Entry/function not available
	[OK] Action executed successfully, no errors
	[Error] Action via control unit **not** executed successfully, “Er“ flashes alternately with error number (see section 5.4.3) Display device error, “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) In the parameter menu (PA) error numbers are shown in **decimal**. All other values are displayed in **hexadecimal**. In these cases the 10 displayed would represent the decimal value 16.

Table 5.7 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)

On the Parameter menu the device settings can be reset to the factory setting.

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

Table 5.8 Parameter menu

Error numbers

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

NOTE:

The error messages displayed during user input should not be confused with drive error messages. For detailed information on the error codes and on error management refer to the "MSD Servo Drive Device Help".

Error number	Meaning
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 5.9 Error numbers

5.4.5 Ethernet IP address menu (IP)

An Ethernet TCP/IP port is available as a service and diagnostics interface. The IP address is set by default to 192.168.39.5 and the subnet mask to 255.255.255.0. Both can be changed using the IP address menu.

Menu level 1	Menu level 2	Parameter	Value range	Meaning	Explanation
IP	Iu	b0	00..FF	IP address update byte 0	Setting for byte 0 of the IP address in hexadecimal format (e.g. "05" for 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" for 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" for 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" at **192**.168.39.5)
	Ir	-	-	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" at 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" at 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" at 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" at **255**.255.255.0)
	Sr	-	-	Subnet mask reset to factory setting	Reset subnet mask to factory setting (255.255.255.0)

Table 5.10 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.

NOTE:

During the flashing phase the save procedure can still be aborted by pressing any button, without applying the valus set. Otherwise the new value will be saved after five seconds.

Changes on the IP address menu are only applied when the control electronics are subsequently restarted.

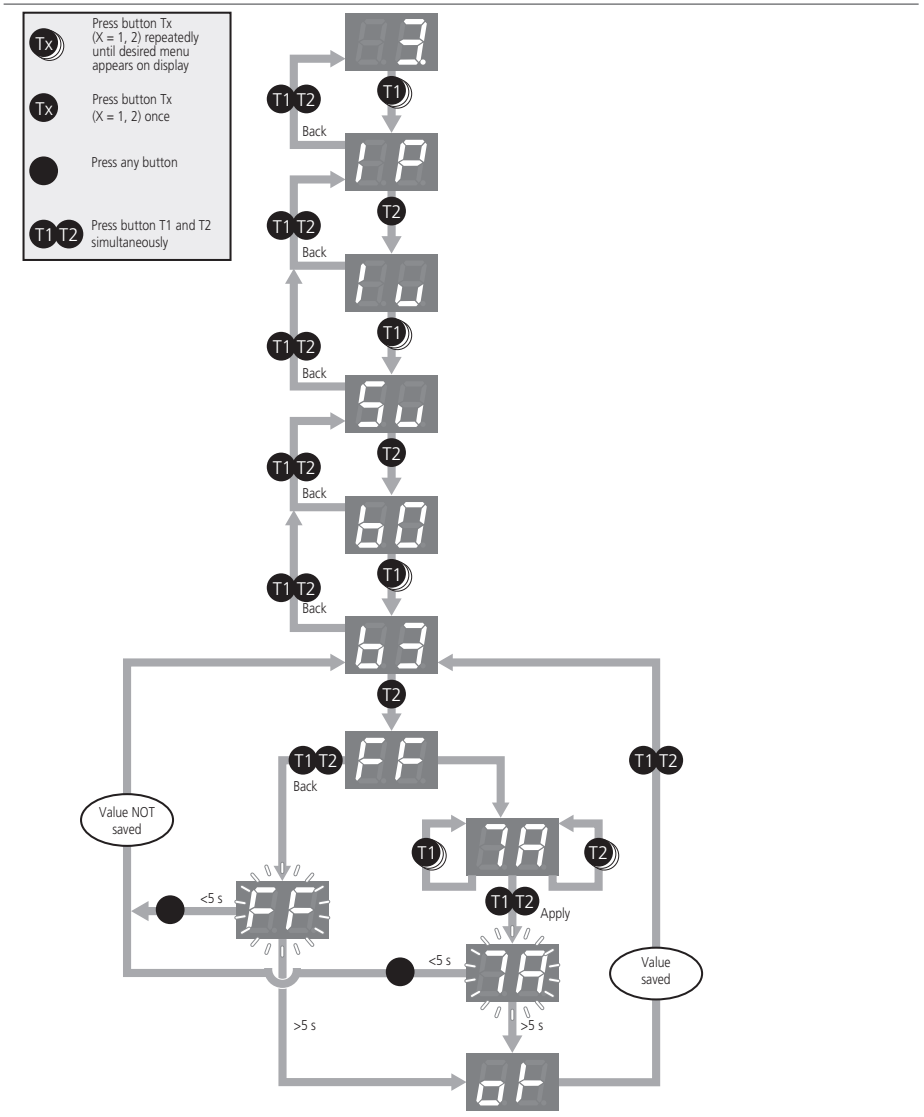


Figure 5.3 Example configuration of the subnet mask

5.4.6 Field bus address menu (Fb)

The functions available on this menu item depend on the device expansion module. For detailed information refer to the relevant specification

Menu level 1	Menu level 2	Param-eter	Value range	Meaning	Explanation
Fb	Ad	-	00..xx or - -	Field bus address	Setting for field bus addres (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 dindication "- -"

Table 5.11 Field bus address menu

Example configuration of the field bus address

In this example the field bus address is changed from 1 to 23.

NOTE:

Changes on the field bus add ess menu are only applied when the control electronics are subsequently restarted.

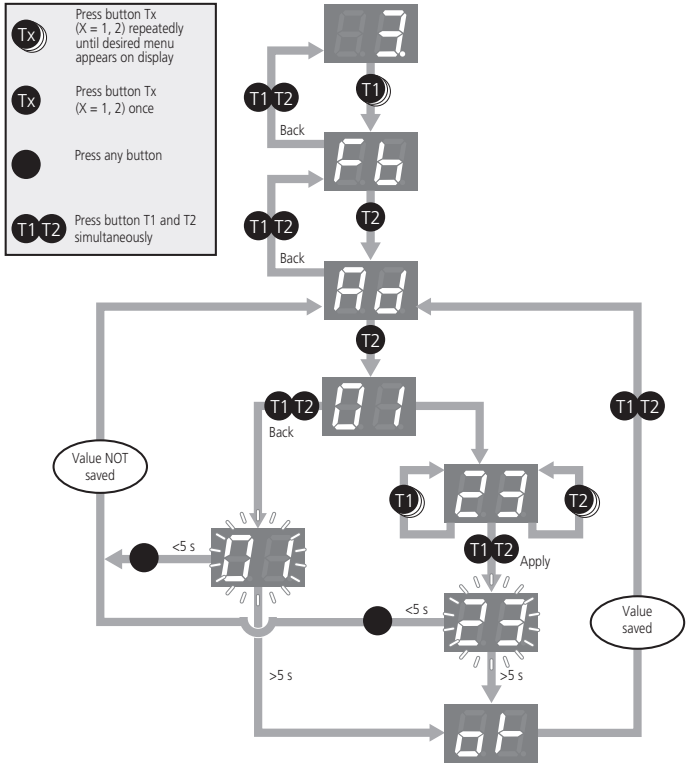


Figure 5.4 Example configuration of the field bus address

6 Diagnostics

The device states and error indications are shown on the device using the 7-segment display on the integrated control unit.

6.1 Device states

Display	System status
	Device in reset state
	Self-initialisation on device startup
 *)	Not ready to switch on (no DC link voltage) [1]
 *)	Start inhibit (DC link OK, power stage not ready [1]
	Ready to switch on (power stage ready)
	Switched on (power applied to drive) [2]
	Drive ready (power applied to drive and drive ready for reference value input) [2]
	Quick-stop [2]
	Error response active [2]

*) Not a “safe indication” as specified in IEC/EN 61800-5-2.

1) **S.** flashes if the function STO (Safe Torque Off) is active, indication extinguishes if function is inactive.

2)The point flashes if the power stage is active.

Table 6.1 Device states

6.2 Error indication

The specific error codes are indicated via the 7-segment display. Each error code comprises the alternating sequence ▶"Er" ▶error number ▶ error location.

Display	Meaning
	Device error
↓ Display changes after approx. 1 s	
	Error number (decimal) Example: 05 = Overcurrent
↓ Display changes after approx. 1 s	
	Error location (decimal) Example: 01 = Hardware monitoring
↑ Display changes back to ER after approx. 1 s	

Table 6.2 Indication of the error code

NOTE:

The errors can be reset in accordance with their programmed reaction (ER) or only via a +24 V reset (X2) (ER.). Errors marked with a point can only be reset once the cause of the error has been rectified.

6.3 Error codes

NOTE:

For detailed information on the error codes and on error management refer to the "MSD Device Help".

6.4 Status and error indication in MDA5

Click the "Device status" button in the header for the MDA5 to open the "Device status" window.

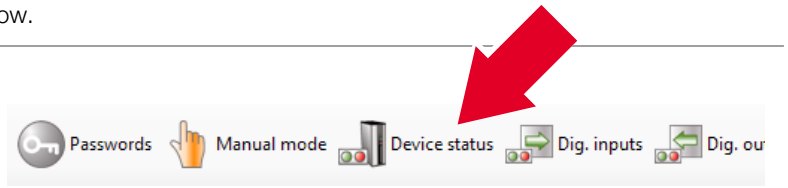


Figure 6.1 "Device status" button in the header

Use the "Error history..." button to retrieve information on the last 20 errors that have occurred.

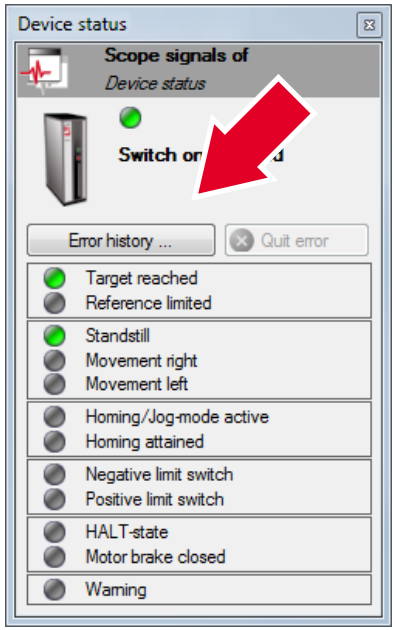


Figure 6.2 "Device status" window

On the occurrence of an error, a "pop-up" window appears immediately with more detailed information on the actual error.

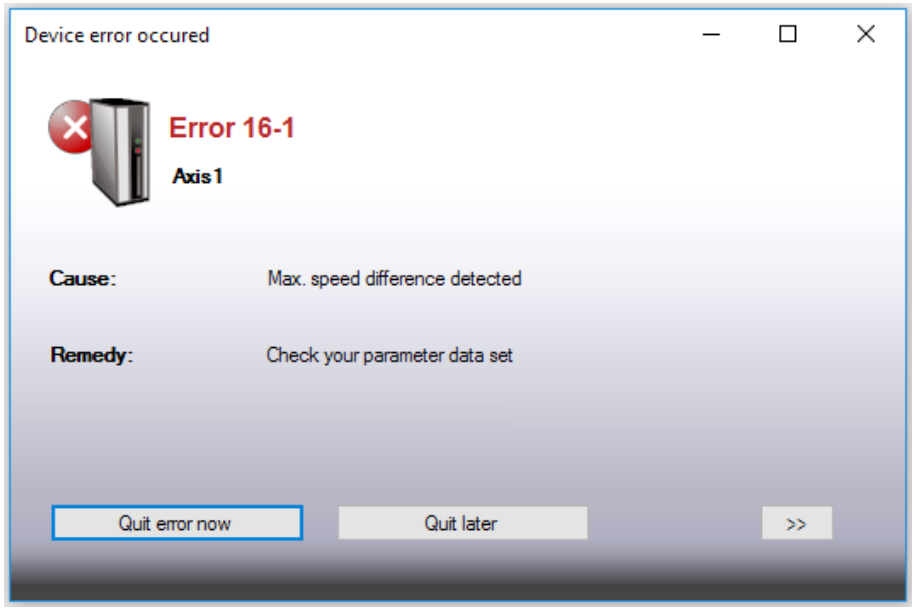


Figure 6.3 Error message

“Alarms & Warnings details” contains detailed information on an error or a warning that has occured.

1. Double-click in the project tree “Alarms & Warnings (Details)”.

NOTE:
You will find further information in the Program Help for “Moog DriveAdministrator 5”.

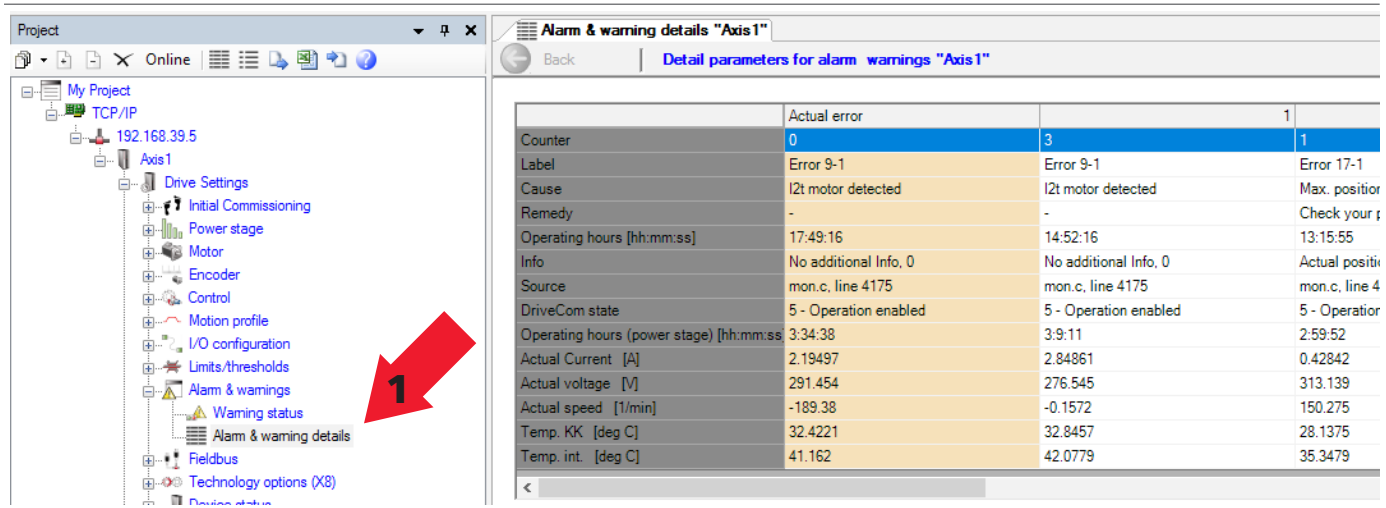


Figure 6.4 Parameter 31 "Alarms & Warnings (Details)"

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7 Safe Torque Off (STO)

NOTE:
You will find all information on the “STO” function in the 24-language document “Description of the STO Safety Function” (ID no. CB19388).

A Appendix

A.1 Servo drive current loads

The maximum permissible servo drive output current and the peak current are dependent on the mains voltage, the motor cable length, the power stage switching frequency and the ambient temperature. If the conditions change, the maximum permissible servo drive current Icarrying capacity also changes.

MSD Single-Axis Servo Drive Compact for 1 x 230 V

Device	Switching frequency of the power stage [kHz]	Ambient temperature max. [°C (°F)]	Rated current I_N [A_{eff}]	Overload capacity 1 x 230 V AC				Overload capacity 3 x 230 V AC			
				Overcurrent		Peak current		Overcurrent		Peak current	
				[A_{eff}]	For time [s]	[A_{eff}]	For time [s]	[A_{eff}]	For time [s]	[A_{eff}]	For time [s]
G394-030	4	+45 (+113)	3.0	6.0	10 [2]	9.0	0.1 [2]	6.0	10	9.0	0.1[2]
	8	+40 (+104)	3.0	6.0	10 [2]	9.0 [1]	0.1[1] [2]	6.0	10	9.0 [1]	0.1[1] [2]
	16	+40 (+104)	2.0	4.0	10 [2]	9.0 [1]	0.1[1] [2]	4.0	10	9.0[1]	0.1[1] [2]
G394-059	4	+45 (+113)	5.9	11.8	10 [2]	[3]	[3]	11.8	10	17.7	0.1[1] [2]
	8	+40 (+104)	5.9	11.8	10 [2]	[3]	[3]	11.8	10	17.7 [1]	0.1[1] [2]
	16	+40 (+104)	5.9	11.8	10 [2]	[3]	[3]	11.8	10	17.7 [1]	0.1[1] [2]
G394-080	4	+45 (+113)	8.0	16.0	10 [2]	[3]	[3]	16.0	10	24.0	0.1[1] [2]
	8	+40 (+104)	8.0	16.0	10 [2]	[3]	[3]	16.0	10	24.0 [1]	0.1[1] [2]
	16	+40 (+104)	5.4	10.8	10 [2]	[3]	[3]	10.8	10	24.0 [1]	0.1[1] [2]

1) With activation of the function "Automatic power stage switching frequency change to 4 kHz".

2) Shutdown as per I^2T characteristic

3) Operation at this operating point is not possible

Data apply for a motor cable length ≤ 10 m (32.80 ft). Maximum permissible motor cable length 30 m (98 ft). All current ratings with recommended mains choke.

Table A.1 Rated current and peak current, C2 to C4 (1/3 x 230 V AC)

MSD Single-Axis Servo Drive Compact C2 to C4 for 400 / 460 / 480 V

Device	Power stage switching frequency	Ambient temperature	Overload capacity 400 V AC					Overload capacity 460 V AC					Overload capacity 480 V AC				
			Rated current I_N	Overcurrent		Peak current		Rated current I_N	Overcurrent		Peak current		Rated current I_N	Overcurrent		Peak current	
	[kHz]	max. [°C (°F)]	[A_{eff}]	[A_{eff}]	For time [s]	[A_{eff}]	For time [s]	[A_{eff}]	[A_{eff}]	For time [s]	[A_{eff}]	For time [s]	[A_{eff}]	[A_{eff}]	For time [s]	[A_{eff}]	For time [s]
G394-020	4	+45 (+113)	2.0	4.0	10 [2]	6.0	0.1 [2]	2.0	4.0	10 [2]	6.0	0.1 [2]	2.0	4.0	10 [2]	6.0	0.1 [2]
	8	+40 (+104)	2.0	4.0	10 [2]	6.0 [1]	0.1 [1] [2]	2.0	4.0	10 [2]	6.0 [1]	0.1 [1] [2]	1.7	3.4	10 [2]	6.0 [1]	0.1 [1] [2]
	16	+40 (+104)	0.7	1.4	10 [2]	6.0 [1]	0.1 [1] [2]	0.7	1.4	10 [2]	6.0 [1]	0.1 [1] [2]	[3]	[3]	10 [2]	[3]	0.1 [1] [2]
G394-035	4	+45 (+113)	5.5	7.1	10 [2]	10.5	0.1 [1] [2]	4.8	6.2	10 [2]	9.2	0.1 [1] [2]	4.6	6.0	10 [2]	8.8	0.1 [1] [2]
	8	+40 (+104)	3.5	7.0	10 [2]	10.5 [1]	0.1 [1] [2]	3.5	7.0	10 [2]	9.2 [1]	0.1 [1] [2]	2.6	5.2	10 [2]	8.8 [1]	0.1 [1] [2]
	16	+40 (+104)	2.9	5.8	10 [2]	10.5 [1]	0.1 [1] [2]	2.2	4.4	10 [2]	9.2 [1]	0.1 [1] [2]	[3]	[3]	[3]	[3]	[3]
G394-065	4	+45 (+113)	8.5	13.0	10 [2]	19.5	0.1 [1] [2]	7.4	11.3	10 [2]	17.0	0.1 [1] [2]	7.0	10.7	10 [2]	16	0.1 [1] [2]
	8	+40 (+104)	6.5	13.0	10 [2]	19.5 [1]	0.1 [1] [2]	6.5	11.3	10 [2]	17.0 [1]	0.1 [1] [2]	6.5	10.7	10 [2]	16 [1]	0.1 [1] [2]
	16	+40 (+104)	4.0	8.0	10 [2]	19.5 [1]	0.1 [1] [2]	2.4	4.8	10 [2]	17.0 [1]	0.1 [1] [2]	1.9	3.8	10 [2]	16 [1]	0.1 [1] [2]

1) With activation of the function "Automatic power stage switching frequency change to 4 kHz".

2) Shutdown as per I^2t characteristic

3) Operation at this operating point is not possible

Data apply for a motor cable length ≤ 10 m (32.80 ft). Maximum permissible motor cable length 30 m (98 ft).

Table A.2 Rated current and peak current, C2 to C5 (400 / 460 / 480 V AC)

Servo Drive	Power stage switching frequency	Ambient temperature	At mains voltage 400 V				At mains voltage 460 V				At mains voltage 480 V				Overload factor ≥5 Hz	For time [1]
			Rated current	Peak current [Aeff]			Rated current	Peak current [Aeff]			Rated current	Peak current [Aeff]				
				At rotating field frequency increasing linearly		During intermittent operation		At roating field frequency increasing linearly		During intermittent operation		At rotating field frequency increasing linearly		During intermittent operation		
	[kHz]	[°C/(°F)]	[Aeff]	0 Hz	Up to 5 Hz	> 5 Hz	[Aeff]	0 Hz	Up to 5 Hz	> 5 Hz	[Aeff]	0 Hz	Up to 5 Hz	> 5 Hz	[%]	[s]
G394-120	4	+45 (+113)	13	31,6	39		11,5	26	34,5		11	26,5	33		200 (300)	10 (0,1)
	8	+40 (+104)	12	20,6	28,8		10,5	16,3	25,2		10	15	24		200 (240)	10 (0,1)
	16		10,5	11,1	17,7		8	8,2	12,8		7,5	7,5	12		150 (160)	10 (0,1)
G394-160	4	+45 (+113)	20	43,4	60		20	36,1	60		20	30,5	60		200 (300)	10 (0,1)
	8	+40 (+104)	16	25,4	33,6		15	17,4	31,5		14	16,2	29,4		200 (210)	10 (0,1)
	16		9	11,4	15,3		6,5	8,1	11		6	6,8	10,2		160 (170)	10 (0,1)

1) Shutdown as per I^2t characteristic

Data apply for a motor cable length ≤ 10 m (32.80 ft).

Table A.3 Rated current and peak current, C5 (400 / 460 / 480 V AC)

A.2 Technical data MSD Single-Axis Servo Drive Compact

G394-030, G394-059 and G394-080

Technical data \ Designation		G394-030	G394-059	G394-080
Output, motor side				
Voltage		3 phase U_{Mains}		
Rated current effective (I_N)		3.0 A [1) 2)]	5.9 A [1) 2)]	8.0 A [1) 2)]
Peak current (2 x I_N / 3 x I_N)		see tables A.1 and A.2		
Rotating field frequenc		0 ... 400 Hz		
Switching frequency of power stage		4, 8, 16 kHz		
Input, mains side				
Mains voltage		(1 x 230 V AC / 3 x 230 V AC) -20 %/+15 %		
Device connected load (with mains choke)		1.3 kVA [1)]	2.6 kVA [1)]	3.5 kVA [1)]
Current consumption (with mains choke)	1 x 230 V AC	5.4 A	10.6 A	14.4 A
	3 x 230 V AC	3.3 A	6.5 A	8.8 A
Asymmetry of mains voltage		±3 % maximum		
Permissible mains frequency		50/60 Hz ±10 %		

1)Valuesa referred to output voltage 230 V AC and switching frequency 8 kHz,

2) For rated current refer to table A.1 or table A.2 !

3) On design with integrated braking resistor (G394-xxx-xxx-xx2/xx4). Connection of an external braking resistor is not permitted.

4) Braking resistor always integrated. Connection of an external resistor is permissible.

Table A.4 Technical data G394-030, G394-059 and G394-080

Technical data \ Designation	G394-030	G394-059	G394-080
Power loss at I_N	75 W [1)]	150 W [1)]	200 W [1)]
DC link			
Brake chopper switch-on threshold	390 V DC [1)]		
DC link capacitance	880 µF	1320 µF	1760 µF
Minimum ohmic resistance of an externally installed braking resistor	72 Ω [4)]	72 Ω [3)]	72 Ω [3)]
Brake chopper continuous power with external braking resistor	2.1 kW		
Peak brake chopper with external braking resistor	2.1 kW		
Internal braking resistor	550 Ω (PTC) [4)]	100 Ω [3]	90 Ω [3)]
Brake chopper continuous power with internal braking resistor	0 W	Dependent on the effective utilisation of the servo drive in the specific application see chapter 4.15.2	
Peak brake chopper with internal braking resistor	400 W	1500 W	1700 W

1)Values referred to output voltage 230 V AC and switching frequency 8 kHz,

2) For rated current refer to table A.1 or table A.2 !

3) On design with integrated braking resistor (G394-xxx-xxx-xx2/xx4). Connection of an external braking resistor is not permitted.

4) Braking resistor always integrated. Connection of an external resistor is permissible.

Table A.4 Technical data G394-030, G394-059 and G394-080

NOTE:
You will find more information on the brake chopper switch-on threshold in chapter "4.15 Brake chopper connection".

G394-020, G394-035 and G394-160

Designation / Technical data	G394-020	G394-035	G394-065	G394-120	G394-160
Output, motor side[1)]					
Voltage	3 phase U_{Mains}				
Rated current effective (I_N)	2.0 A [1) 2)]	3.5 A [1) 2)]	6.5 A [1) 2)]	13.0 A [1) 2)]	16.0 A [1) 2)]
Peak current (2 x I_N / 3 x I_N)	see table A.3 and A.4 and A.5				
Rotating field frequenc	0 ... 400 Hz				
Switching frequency of power stage	4, 8, 16 kHz				
Input, mains side					
Mains voltage	(3 x 400 V AC / 3 x 460 V AC / 3 x 480 V AC) ±10 %				
Device connected load (with mains choke)	1.5 kVA [1)]	2.7 kVA [1)]	5.0 kVA [1)]	8.1 kVA [1)]	10.2 kVA [1)]
Current consumption (with mains choke)	2.2 A [1)]	3.9 A [1)]	7.2 A [1)]	13.5 A [1)]	16.8 A [1)]
Asymmetry of mains voltage	±3 % maximum				
Frequency	50/60 Hz ±10%				

1)Values referred to output voltage 400 V AC and switching frequency 8 kHz,

2) For rated current refer to table A.3 and A.4 and A.5!

3) On design with integrated braking resistor (G394-xxx-xxx-xx2/xx4). Connection of an external braking resistor is not permitted.

4) Braking resistor always integrated. Connection of an external resistor is permissible.

5) On design C5 with integrated braking resistor (G394-xxx-xxx-xx2/xx4). Connection of an external braking resistor is only permitted if int. braking resistor is disconnected. Parallel operation of both resistors is not permitted!

Table A.5 Technical data G394-020 to G394-160

Designation / Technical data	G394-020	G394-035	G394-065	G394-120	G394-160
Power loss at I_N	42 W [1)]	80 W [1)]	150 W [1)]	263 W [1)]	316 W [1)]
DC link					
Brake chopper switch-on threshold	650 V DC [1)]				
DC link capacitance	220 µF	330 µF	440 µF	680 µF	1120 µF
Minimum ohmic resistance of an externally installed braking resistor	230 Ω	180 Ω [3)]	72 Ω [3)]	35 Ω [3)]	25 Ω [3)]
Brake chopper continuous power with external braking resistor	1.8 kW	2.3 kW	5.9 kW	12.0 kW	16.9 kW
Peak brake chopper with external braking resistor	1.8 kW	2.3 kW	5.9 kW	12.1 kW	16.9 kW
Internal braking resistor	7500 Ω (PTC) [4)]	420 Ω [3)]	90 Ω [3)]	90 Ω [5)]	90 Ω [5)]
Brake chopper continuous power with internal braking resistor	0 W	Dependent on the effective utilisation of the servo drive in the specific application see chapter 4.15.2			
Peak brake chopper with internal braking resistor	200 W [1)]	1000 W [1)]	4700 W [1)]	4700 W [1)]	4700 W [1)]

1)Values referred to output voltage 400 V AC and switching frequency 8 kHz,

2) For rated current refer to table A.3 and A.4 and A.5!

3) On design with integrated braking resistor (G394-xxx-xxx-xx2/xx4). Connection of an external braking resistor is not permitted.

4) Braking resistor always integrated. Connection of an external resistor is permissible.

5) On design C5 with integrated braking resistor (G394-xxx-xxx-xx2/xx4). Connection of an external braking resistor is only permitted if int. braking resistor is disconnected. Parallel operation of both resistors is not permitted!

Table A.5 Technical data G394-020 to G394-160

NOTE:
You will find more information on the brake chopper switch-on threshold in refer to chapter "4.15 Brake chopper connection".

A.3 Power connections

Feature	C2	C3	C4	C5
Cable cross-section (flexible with ferrule) [mm² / in²]	0.25 - 2.5 / 0.00038 - 0.0038	0.25 - 2.5 / 0.00038 - 0.0038	0.25 - 4 / 0.00038 - 0.0062 *)	0.25 - 4 / 0.00038 - 0.0062 *)
Tightening torque [Nm / lb-in]	Not specifie	0.5 / 4.42	0.7 / 6.19	0.7 / 6.19

*) For ferrule without plastic sleeve up to 6 mm² possible

Table A.6 Technical data, terminals for motor cable C2 to C5

A.4 Current required for the control supply

Housing variant	Size	Continuous current [A]
Air cooling	C2	0.4 1)
	C3	0.5 1)
	C4	0.5 1)
	C5	0.6 1)

1) Pay attention to supply voltage 24 V basic device not including options fitted Table 4.5 on page 27

Table A.7 Current required for the control supply

A.5 Ambient conditions

Ambient conditions	MSD Single-Axis Servo Drive Compact
Protection	C4 IP20 except terminals (IP00), C2/C3/C5 IP10 except terminals (IP00)
Accident prevention regulations	According to local regulations (in Germany e.g. DGUV V3)
Mounting height	Up to 1,000 m (3,280 ft) above MSL, over 1,000 m (3,280 ft) above MSL with power reduction (1 % per 100 m (328 ft), maximum 2,000 (6,500 ft) above MSL)
Pollution degree	2
Type of installation	Built-in unit, only for vertical installation in a switch cabinet with minimum IP4x protection, when using STO safety function minimum IP54

Table A.8 Ambient conditions MSD Single-Axis Servo Drive Compact

Climatic conditions		MSD Single-Axis Servo Drive Compact
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 humidity	95 % at maximum +40 °C (+104 °F)
in storage	As per IEC/EN 61800-2, IEC/EN 60721-3-1 class 1K3 and 1K4 2)	
	Temperature	-25 °C to +55 °C (-13 °F to +131 °F)
	Relative humidity	5 to 95 %
in operation	As per IEC/EN 61800-2, IEC/EN 60721-3-3 class 3K3 3)	
	Temperature	-10 °C to +45 °C (+14 °F to +113 °F) (4 kHz), up to +55 °C (+131 °F) with power reduction (2 %/°C) -10 °C to +40 °C (+14 °F to +104 °F) (8, 16 kHz), up to +55 °C (+131 °F) with power reduction (2 %/°C)
	Relative humidity	5 to 85 % without condensation

1) The absolute humidity is limited to max. 60 g/m³. This means, at +70 °C (+158°F) for example, that the relative humidity may only be max. 40 %.

2) The absolute humidity is limited to max. 29 g/m³. So the maximum values for temperature and relative humidity stipulated in the table must not occur simultaneously.

3) The absolute humidity is limited to max. 25 g/m³. That means that the maximum values for temperature and relative humidity stipulated in the table must not occur simultaneously.

Table A.9 Climatic conditions MSD Single-Axis Servo Drive Compact

Mechanical conditions		MSD Single-Axis Servo Drive Compact	
Vibration limit in transit	As per IEC/EN 61800-2, IEC/EN 60721-3-2 class 2M1		
	Frequency [Hz]	**Amplitude [mm (in)]**	**Acceleration [m/s² / in/s²]**
	2 ≤ f < 9	3.5 (0.14)	Not applicable
	9 ≤ f < 200	Not applicable	10 / 393.70
	200 ≤ f < 500	Not applicable	15 / 590.55
Shock limit in transit	As per IEC/EN 61800-2, IEC/EN 60721-3-2 class 2M1		
	Drop height of packed device max. 0.25 m		
Vibration limit of the system[1)]	As perIEC/EN 61800-2, IEC/EN 60721-3-3 class 3M1		
	Frequency [Hz]	**Amplitude [mm (in)]**	**Acceleration [m/s² / in/s²]**
	2 ≤ f < 9	0.3 (0.01)	Not applicable
	9 ≤ f < 200	Not applicable	1 / 39.70

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

Table A.10 Mechanical conditions MSD Single-Axis Servo Drive Compact

CAUTION!	Damage to the device due to incorrect operation!
	• **Failure to observe the ambient conditions may result in damage.** • No continuous vibration! The servo drives must not be installed in areas where they would be permanently exposed to vibration. • Control cabinet minimum IP54 for STO! According to EN ISO 13849-2 the switch cabinet must have IP54 protection or higher on using the STO (Safe Torque OFF) safety function. • Observe cooling conditions! Forced cooling by external air flow necessary. Air must be able to flow unhindered through the device (air flow at least 1.2 m/s (3.93 ft/s)) If a temperature cut-out occurs, the cooling conditions must be improved

A.6 Permissible motor cable lengths

You will also find details on the topic of "electromagnetic compatibility" in the chapter 4.1 and 4.5.

The table below shows the permissible motor cable lengths while complying with the standard EN 61800-3.

Category		Switching frequency		
		4 kHz	**8 kHz**	**16 kHz**
C2	"First environment" (residentia)	10 m	10 m	10 m
C3	"Second environment" (industrial)	30 m	30 m	30 m

Note:
- The following devices are only approved for category C3: SO24.012.x und SO24.016.x
- Standard can only be met with an external filter (no internal filter fitted)

Table A.11 Permissible motor cable lengths

A.7 UL certification

The description of all measures to maintain UL certification is to be found in the document "UL-Certification" (ID No: CC36842-001).

Glossary

Symbols

A

B

C

D

E

F

H

I

L

M

N

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Nevertheless we would like to point that this document cannot always be updated parallel to the technical further development of our products.

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