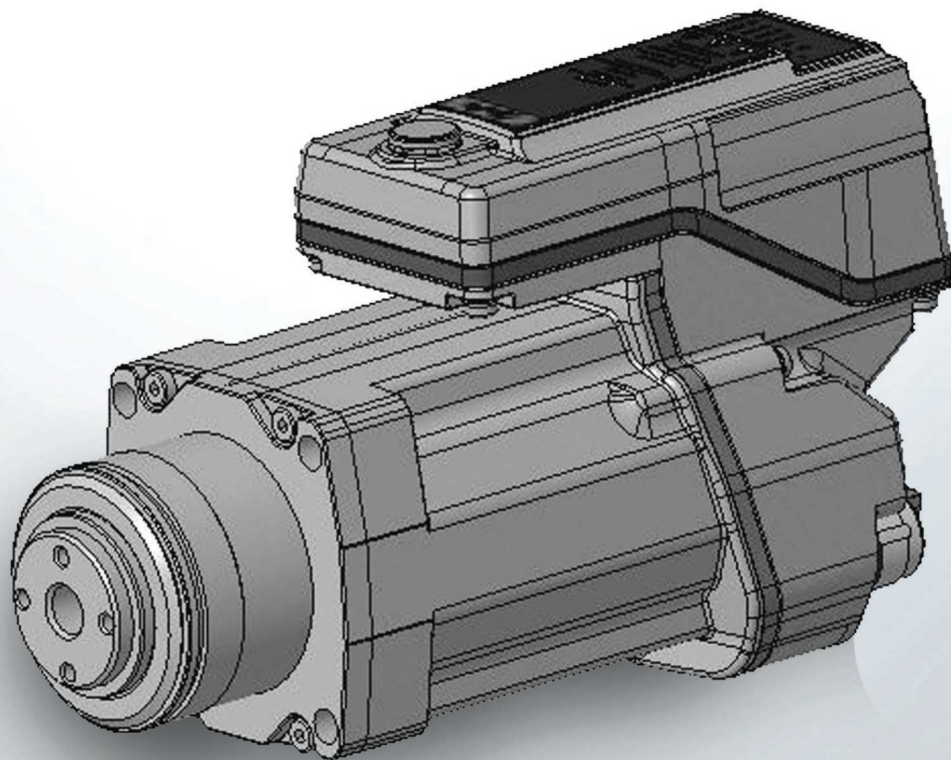


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Operating Guide

VLT® Servo Drive System ISD 511



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1 Introduction

1.1 Purpose of the Operating Guide

The purpose of this operating guide is to describe the VLT® Integrated Servo Drive ISD 511 system.

This operating guide contains information about:

- Installation
- Commissioning
- Programming
- Operation
- Troubleshooting
- Service and Maintenance

This operating guide is intended for use by qualified personnel. Read the operating guide in full to use the servo system safely and professionally, and pay particular attention to the safety instructions and general warnings.

This operating guide is an integral part of the servo system and also contains important service information. Therefore, always keep this operating guide available with the servo system.

Compliance with the information in the manual is a prerequisite for:

- Trouble-free operation
- Recognition of product liability claims

Therefore, read this operating guide before working with the ISD 511 system.

1.2 Additional Resources

Table 1: Additional Resources

Manual	Description
VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® Flex-motion™) Programming Guide	Information about the programming of the ISD 511 servo system.


1.3 Copyright

VLT® and ISD® are Danfoss registered trademarks.

1.4 Approvals and Certifications

Table 2: Product and System Approvals and Certifications

Certification	Description
IEC/EN 61800-3	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.
IEC/EN 61800-5-1	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements - Electrical, thermal, and energy.
IEC/EN 61800-5-2	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements - Functional.
IEC/EN 61508-1	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 1: General requirements.
IEC/EN 61508-2	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems.
EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems.

Certification	Description
	Part 1: General principles for design.
EN ISO 13849-2	Safety of machinery - Safety-related parts of control systems. Part 2: Validation.
IEC/EN 60529	Degrees of protection provided by enclosures (IP Code).
UL 61800-5-1	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements - Electrical, thermal, and energy.
CSA C22.2 No. 274	Standard specifying requirements for adjustable speed drives with regard to electrical, thermal, and energy safety considerations.
CE	
2014/30/EU	Electromagnetic Compatibility (EMC) Directive.
2014/35/EU	Low Voltage Directive (LVD).
(2011/65/EU) amended (EU) 2015/863	Restriction of Hazardous Substances (RoHS).
2006/42/EC	Machinery Directive (MD).
Ethernet POWERLINK®	Ethernet-based fieldbus system.
PLCopen®	Technical specification. Function blocks for motion control (formerly Part 1 and Part 2) Version 2.0 March 17, 2011.

1.5 Firmware Updates

For updates to the firmware, VLT® Servo Toolbox software and PLC libraries, contact Danfoss.

1.6 Terminology

Table 3: Terminology

Term	Description
ACM 510	Auxiliary Capacitors Module
DAM 510	Decentral Access Module that connects the ISD 511 servo drives to the servo system via a hybrid cable.
EXM 510	Expansion module for splitting system modules between 2 control cabinets.
Feed-in cable	Hybrid cable for connection from the DAM 510 to the 1st decentral drive.
ISD 511	Integrated Servo Drive
ISD 511 system components	Includes ISD 511 servo drives, PSM 510, DAM 510, and the optional ACM 510 and EXM 510.
LCP	Local control panel

Term	Description
Loop cable	Hybrid cable for connecting servo drives in daisy-chain format.
PLC	Programmable Logic Controller (external device for controlling the servo system).
PSM 510	Power Supply Module that generates a 565–680 V DC supply.
System modules	Includes PSM 510, DAM 510, and the optional ACM 510 and EXM 510.

2 Safety

2.1 Safety Symbols

The following symbols are used in this guide:

W A R N I N G

Indicates a potentially hazardous situation that could result in death or serious injury.

C A U T I O N

Indicates a potentially hazardous situation that could result in minor or moderate injury. It can also be used to alert against unsafe practices.

N O T I C E

Indicates important information, including situations that can result in damage to equipment or property.

2.2 Important Safety Warnings

The following safety instructions and precautions relate to the ISD 511 system. Read the safety instructions carefully before starting to work in any way with the servo system or its components. Pay particular attention to the safety instructions in the relevant sections of this manual.

W A R N I N G

HAZARDOUS SITUATION

If the servo drive or the bus lines are incorrectly connected, there is a risk of death, serious injury, or damage to the unit.

- Always comply with the instructions in this manual and national and local safety regulations.

W A R N I N G

HIGH VOLTAGE

The ISD 511 system contains components that operate at high voltage when connected to the electrical supply network. Not all components have indicators that indicate the presence of mains supply. Incorrect installation, commissioning, or maintenance may lead to death or serious injury.

- Installation, commissioning, and maintenance may only be performed by qualified personnel.

W A R N I N G

LEAKAGE/GROUNDING CURRENT HAZARD

Leakage/grounding currents are >3.5 mA. Improper grounding of the ISD 511 drives and the system modules may result in death or serious injury.

- For reasons of operator safety, use a certified electrical installer to ground the system correctly in accordance with the applicable local and national electrical standards and directives, and the instructions in this manual.

⚠ WARNING ⚠

DISCHARGE TIME

The servo system contains DC-link capacitors that remain charged for some time after the mains supply is switched off at the Power Supply Module (PSM 510). Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- To avoid electrical shock, fully disconnect the Power Supply Module (PSM 510) from the mains and wait for the capacitors to fully discharge before carrying out any maintenance work on the servo system or replacing components.

Minimum waiting time (minutes)
15

⚠ DANGER ⚠

RISQUE DU CHOC ÉLECTRIQUE

Une tension dangereuse peut être présentée jusqu'à 15 min après avoir coupé l'alimentation.

⚠ WARNING ⚠

UNINTENDED START

The servo system contains servo drives, the PSM 510, and DAM 510 that are connected to the electrical supply network and can start running at any time. This may be caused by a fieldbus command, a reference signal, or clearing a fault condition. Servo drives and all connected devices must be in good operating condition. A deficient operating condition may lead to death, serious injury, damage to equipment, or other material damage when the unit is connected to the electrical supply network.

- Take suitable measures to prevent unintended starts.

⚠ WARNING ⚠

UNINTENDED MOVEMENT

Unintended movement may occur immediately when parameter changes are carried out, which may result in death, serious injury, or damage to equipment.

- When changing parameters, take suitable measures to ensure that unintended movement cannot pose any danger.

⚠ CAUTION ⚠

DANGER OF BURNS

The surface of the servo drives can reach high temperatures of over 90°C during operation.

- Do not touch the servo drives until they have cooled down.

NOTICE

RCD COMPATIBILITY

The servo system contains components that can cause a DC current in the protective earthing conductor, which may result in malfunction in any devices connected to the system.

- Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, use a type B RCD or RCM device on the supply side of the system components.

NOTICE**CONNECTING/DISCONNECTING HYBRID CABLES**

Never connect or disconnect the hybrid cable to or from the servo drives when the servo system is connected to mains or auxiliary supply, or when voltage is still present. Doing so damages the electronic circuitry. Ensure that the mains supply is disconnected and the required discharge time for the DC-link capacitors has elapsed before disconnecting or connecting the hybrid cables to the PSM 510.

- To avoid electrical shock, fully disconnect the PSM 510 from the mains and wait for the discharge time to elapse before disconnecting or connecting the hybrid cables or disconnecting cables from the PSM 510.

2.3 Safety Instructions and Precautions

Compliance with the safety instructions and precautions is necessary at all times.

- Orderly and proper transport, storage, fitting, and installation, as well as careful operation and maintenance, are essential for the trouble-free and safe operation of the servo system and its components.
- Only suitably trained and qualified personnel may work on the servo system and its components or in its vicinity.
- Only use accessories and spare parts approved by Danfoss.
- Comply with the specified ambient conditions.
- The information in this manual about the use of available components is provided solely by way of examples of applications and suggestions.
- The plant engineer or system engineer is personally responsible for checking the suitability of the supplied components and the information provided in this manual for the specific application concerned:
 - For compliance with the safety regulations and standards relevant to the specific application.
 - For implementing the necessary measures, changes, and extensions.
- Commissioning the servo system or its components is not allowed until it has been ascertained that the machine, system, or plant in which they are installed conforms to the statutory provisions, safety regulations, and standards that apply to the application in the country of use.
- Operation is only allowed in compliance with the national EMC regulations for the application concerned.
- Compliance with the limit values specified by national regulations is the responsibility of the producer of the plant, system, or machine.
- Compliance with the specifications, connection conditions, and installation conditions in this manual is mandatory.
- The safety regulations and safety provisions of the country in which the equipment is used must be observed.
- To protect the user against electrical shock and to protect the servo system against overload, protective grounding is obligatory and must be performed in accordance with local and national regulations.

2.3.1 Operational Safety

- Safety-related applications are only allowed if they are explicitly and unambiguously mentioned in this manual.
- All applications that can cause hazards to people or damage to property are safety-related applications.
- The stop functions implemented in the software of the PLC do not interrupt the mains supply to the Power Supply Module (PSM 510). Therefore, they must not be used for electrical safety for the servo system.
- The servo system can be brought to a stop by a software command or a zero speed setpoint, however DC voltage remains present on the servo drives and/or mains voltage in the PSM 510. Also, when the system is stopped, it may start up again on its own if the circuitry is defective or after the elimination of a temporary overload, a problem with the supply voltage, or a problem with the system. If personal safety considerations (for example, risk of personal injury caused by contact with moving machine parts after an unintended start) make it necessary to ensure that an unintended start cannot occur, these stop functions are not sufficient. In this case, ensure that the servo system is detached from the mains network, and prevent unintended motor starting, for example by using the Safe Torque Off function.
- The servo system may start running unintentionally during parameter configuration or programming. If this poses a risk to personal safety (for example, risk of personal injury due to contact with moving machine parts), prevent unintended motor starting, for example by using the Safe Torque Off function, or by safe disconnection of the servo drives.
- In addition to the L1, L2, and L3 supply voltage inputs on the PSM 510, the servo system has other supply voltage inputs, including external auxiliary voltage. Before commencing repair work, check that all supply voltage inputs have been switched off and that the necessary discharge time for the DC-link capacitors has elapsed.

2.4 Qualified Personnel

Installation, commissioning, and maintenance may only be carried out by qualified personnel. For the purposes of this manual and the safety instructions in this manual, qualified personnel are trained personnel who are authorized to fit, install, commission, ground, and label equipment, systems, and circuits in accordance with the standards for safety technology and who are familiar with the safety concepts of automation engineering.

Additionally, the personnel must be familiar with all the instructions and safety measures described in this manual. They must have suitable safety equipment and be trained in first aid.

2.5 Due Diligence

The operator and/or fabricator must ensure that:

- The servo system and its components are used only as intended.
- The components are operated only in a perfect operational condition.
- The operating instructions are always available near the servo system in complete and readable form.
- The servo system and its components are fitted, installed, commissioned, and maintained only by adequately qualified and authorized personnel.
- These personnel are regularly instructed on all relevant matters of occupational safety and environmental protection, as well as the contents of the operating instructions and the instructions it contains.
- The product markings and identification markings applied to the components, as well as safety and warning instructions, are not removed and are always kept in a legible condition.
- The national and international regulations regarding the control of machinery and equipment, that are applicable at the place of use of the servo system, are complied with.
- The users always have all current information relevant to their interests about the servo system and its use and operation.

2.6 Intended Use

The components of the servo system are intended to be installed in machines used in industrial environments in accordance with local laws and standards.

NOTICE

- In a domestic environment, this product may cause radio interferences, in which case supplementary mitigation measures may be required.

To ensure that the product is used as intended, the following conditions must be fulfilled before use:

- Everyone who uses Danfoss products in any manner must read and understand the corresponding safety regulations and the description of the intended use.
- Do not alter hardware from its original state.
- Do not reverse-engineer software products or alter their source code.
- Do not install or operate damaged or faulty products.
- Ensure that the products are installed in conformance with the regulations mentioned in the documentation.
- Observe any specified maintenance and service intervals.
- Comply with all protective measures.
- Only fit or install the components described in this operating guide. Third-party devices and equipment may be used only in consultation with Danfoss.

2.6.1 Prohibited Application Areas

The servo system **may not** be used in the following application areas:

- Areas with potentially explosive atmospheres.
- Mobile or portable systems.
- Floating or airborne systems.
- Inhabited facilities.
- Sites where radioactive materials are present.

- Areas with extreme temperature variations or in which the maximum rated temperatures may be exceeded.
- Under water.

2.7 Forseeable Misuse

Any use not expressly approved by Danfoss constitutes misuse. This also applies to failure to comply with the specified operating conditions and applications. Danfoss assumes no liability of any sort for damage attributable to improper use.

2.8 Service and Support

Contact the local service representative for service and support.

3 System Description

3.1 Overview of the ISD 511 System

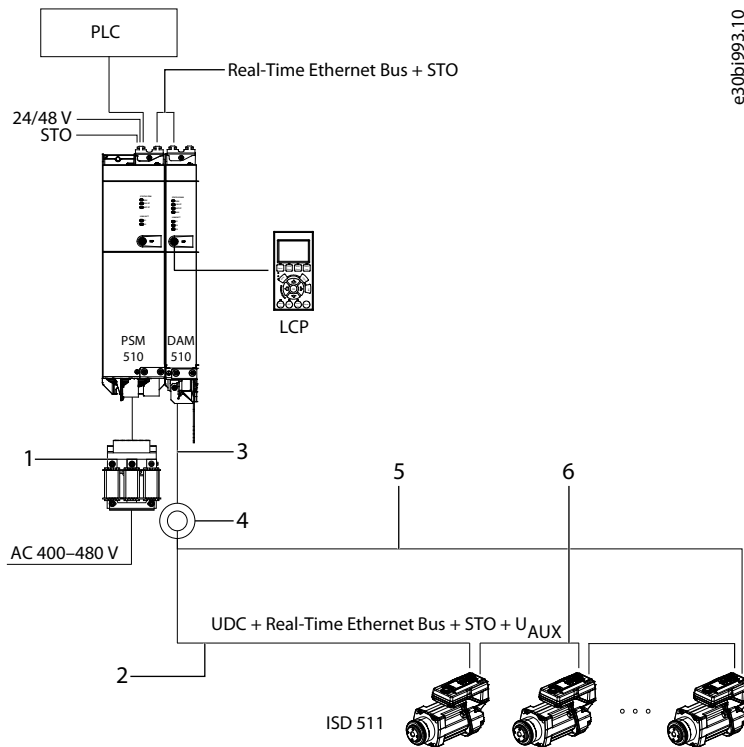


Illustration 1: Overview of the VLT® Integrated Servo Drive ISD 511 System

1	AC line choke	4	Slip ring (not provided by Danfoss)
2	Feed-in hybrid cable, maximum 6 m (not provided by Danfoss)	5	Feed-out hybrid cable, maximum 6 m (not provided by Danfoss)
3	Feed-in hybrid cable from DAM 510 to slip ring, maximum 30 m (not provided by Danfoss)	6	Loop cable, 0.235 m/0.365 m (not provided by Danfoss)

The ISD 511 is a high-performance decentral servo motion solution. In this decentral system, the ISD 511 servo drives are operated in a DC group and controlled by a PLC.

The hybrid cables used in the servo system contain the DC-link supply, the Real-Time Ethernet, U_{AUX} , and STO signals. For further information on hybrid cables, see [3.9.1 Feed Cables](#) and [3.9.2 Loop Cable](#).

A maximum of 68 ISD 511 servo drives can be connected on 1 line and a maximum of 5 ISD 511 servo drives can be grounded in 1 group via the 2 PE screws on the servo drive (see [5.3.1 Grounding the ISD 511 Servo Drive](#)). The minimum cable cross-section is 4 mm².

The ISD 511 system consists of:

- VLT® Integrated Servo Drive ISD® 511
- Power Supply Module (PSM 510)
- Decentral Access Module (DAM 510)
- Auxiliary Capacitors Module (ACM 510), optional
- Expansion Module (EXM 510), optional
- Cabling infrastructure

- Blind caps
- Software
 - Firmware for the ISD 511 servo drive
 - Firmware for the PSM 510, DAM 510, and ACM 510
 - PC software tool: VLT® Servo Toolbox
 - PLC libraries
 - DanfossMotion library for ISD 511 system for AutomationStudio™.

The system modules PSM 510, DAM 510, and ACM 510 are mounted to a backplate located in the control cabinet. DC link and the control voltage supply are integrated in the backplate. The 'click and lock' backplate concept offers easy mounting and installation. The ISD 511 servo drives are self-contained distributed drives, where the drive electronics are housed together with the motor in the same casing.

The ISD 511 servo drive comes with 2 hybrid connectors (M23) that connect power and communication signals from a hybrid cable. The motion control is integrated into the servo drive so that movements depending on a master reference can be programmed and take place independently. This reduces the required computing power of the central PLC and offers a highly flexible drive concept. Danfoss offers libraries for various IEC 61131-3 programmable PLCs. Due to the standardized and certified fieldbus interfaces of the devices, any PLC with an Ethernet POWERLINK® managing node functionality according to the standards can be used.

N O T I C E

- The ISD 511 servo drives cannot be used in servo systems from other manufacturers without changing the cabling infrastructure.
- Drives from other manufacturers cannot be used in the ISD 511 system.
- Only the components described in this manual can be fitted or installed. Third-party devices and equipment can only be used in consultation with Danfoss.
- For security reasons, do not connect the ISD 511 servo drive to the internet.
- Only configure the ISD 511 using the specified HMI or the VLT® Servo Toolbox software.
- Contact Danfoss for further information.

3.1.1 Application

The ISD 511 servo drive is a customized design for use in beverage labeling machines. The design of the flange and shaft is adapted to be efficiently mounted in a roundtable in 2 ways:

- Screwed from the bottom.
- Screwed from the top.

3.2 VLT® Integrated Servo Drive ISD 511

3.2.1 Overview of the ISD 511 Servo Drive

ISD is the abbreviation of integrated servo drive, which combines compact drive electronics together with an integrated permanent magnet synchronous motor (PMSM). This means that the entire power drive system consisting of motor, position sensor, and also power and control electronics is integrated into 1 housing. Additional circuits, such as low-voltage supply, bus drivers, and STO are implemented within the servo drive electronics.

All ISD 511 servo drives have 2 hybrid connectors (M23) that connect power and communication signals from a hybrid cable. LEDs on the top of the ISD 511 servo drive show the current status. Data transfer takes place via Real-Time Ethernet.

The flange is customized for mounting into a roundtable for a labelling application and the motor shaft is customized for mounting a turntable for picking up a bottle or similar beverage container. The shaft seal is designed for IP69K and protects the drive from liquid intrusion.

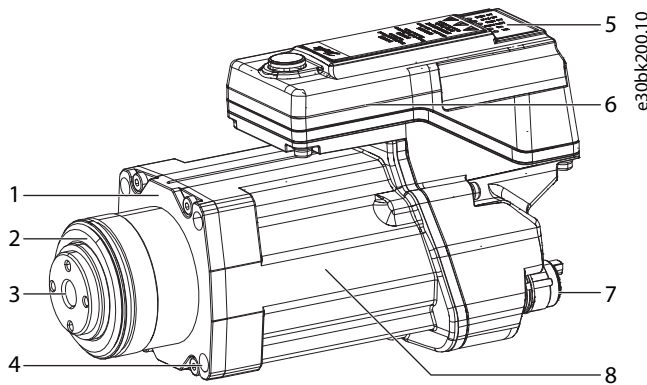


Illustration 2: Overview of the ISD 511 Servo Drive

1	Flange	5	Operating LEDs
2	Motor shaft seal	6	Electronic housing
3	Motor shaft	7	Connectors for hybrid cables (X1/X2)
4	Mounting holes	8	Motor

3.2.2 ISD 511 Servo Drive Types

NOTICE

- The Drive Configurator shows the valid configuration of servo drive variants. Only valid combinations are shown. Therefore, not all variants detailed in the type code are visible.

Table 4: Type Code ISD 511

1-3	4-6	7	8-12	13-14	15-16	17-19	20-21	22-24	25	26-29	30-32	33	34	35	36	37	38	39	40
ISD	511	X	T01C5	D6	E0	FS1	PL	S03	T	F087	N10	X	C	S	G	X	M	X	X

Table 5: Legend to Type Code

[01-03]	Product group	[20-21]	Bus system	[35]	Motor sealing
ISD	VLT® Integrated Servo Drive	PL	Ethernet POWERLINK®	S	With sealing
[04-06]	Product variant	[22-24]	Drive firmware	[36]	Surface coating
511	ISD® 511	S03	Krones labeling	G	Gray
[07]	Option	[25]	Safety	[37]	Customer branding
X	No option board	T	Safe Torque Off	X	No
[08-12]	Drive torque	[26-29]	Flange size	[38]	Packaging
T01C5	1.5 Nm	F087	87 mm	M	Multi packaging
[13-14]	Drive voltage	[30-32]	Motor speed	[39]	Country-specific
D6	600 V DC-link	N10	Rated speed 1000 RPM	X	No
[15-16]	Enclosure size	[33]	Mechanical brake	[40]	Reserved

E0	Enclosure size E0	X	No brake	X	–
[17–19]	Drive feedback	[34]	Motor shaft		
FS1	Single-turn feedback 17 bit	C	Customized shaft		

3.2.3 Motor Components

3.2.3.1 Shaft

The shaft transfers the motor force (torque) to the coupled turntable. The shaft is sealed by a shaft sealing system to achieve IP69K on the shaft side of the motor (see [11.8.1 ISD 511 Servo Drives](#) for further information).

The shaft seal must be replaced at regular intervals (see [10.3 Maintenance Tasks](#)).

3.2.3.2 Flange

The flange is customized for mounting into a roundtable for a labeling application. The diameter of the flange and the associated hole on the roundtable form a fitting connection.

The flange has a groove to house an O-ring, which can be used to prevent ingress of dirt and water, which could result in corrosion.

3.2.3.3 Cooling

The ISD 511 servo drives are self-cooling. Cooling (heat dispersal) is primarily via the flange, with a small amount dispersed by the housing.

3.2.3.4 Thermal Protection

Thermal sensors monitor the maximum allowable temperature of the motor winding and switch the motor off if the limit of 150 °C is exceeded. Thermal sensors are also present in the drive to protect the electronics against overtemperature. An error message is sent via Real-Time Ethernet to the higher-level PLC and is also shown on the LCP.

Temperature protection:

- Calculated winding temperature: Warning at 135 °C, fault at 150 °C
- Power module temperature: Warning at 130 °C, fault at 140 °C (minimum temperature –10 °C)
- Board temperature: Warning at 105 °C, fault at 110 °C

3.2.3.5 Built-In Feedback Devices

The built-in feedback device measures the rotor position. The feedback device in the ISD 511 servo drive is a BiSS-C 17-bit single-turn encoder with an accuracy of ±5.4 arcmin.

3.3 Power Supply Module (PSM 510)

3.3.1 Overview

PSM is the abbreviation for Power Supply Module. It is the power supply to the servo system. The PSM 510 supplies a DC power voltage and guarantees high-density output power. The DC-link and 24/48 V DC are distributed via the backlink in the backplates to all system modules. The PSM 510 can be controlled via Ethernet-based fieldbus.

LEDs on the front of the PSM 510 show the operating status and warnings.

N O T I C E

- The system modules are designed for use within a control cabinet. If the STO function is used, the cabinet must be rated at least IP54.
- The PSM 510 has a protection rating of IP20 according to IEC/EN 60529 (except connectors, which are IP00).
- The PSM 510 may be damaged if exposed to fluids.

All power cables are wired into the PSM 510, therefore at least 1 PSM 510 is required for each system.

The PSM 510 also performs service functions, such as voltage measuring, and is cooled by an internal fan.

The PSM 510 is available in 3 power sizes and delivers an output power of 10 kW, 20 kW, or 30 kW with 200% overload capacity for 3 seconds. To achieve an output power of up to 60 kW, 2 PSM 510 modules can be used in parallel.

An example type code for the PSM 510 is: MSD510PSM510F2P10C0D6E20PLSXXXXXXXXXXXXXX.

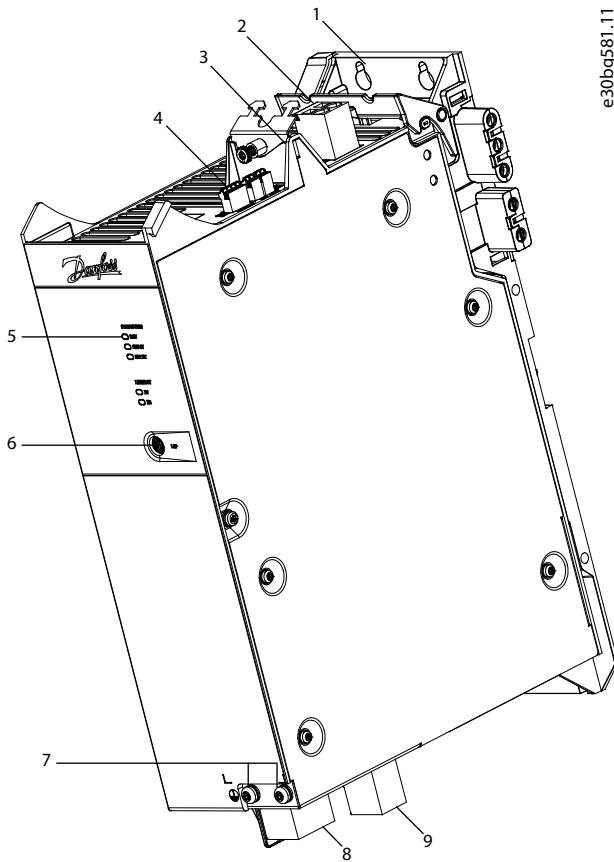


Illustration 3: PSM 510

1	Backplate	6	LCP connector
2	24/48 V input connector	7	PE screws
3	Cable relief and shielding	8	AC mains supply connector
4	Connectors: I/O, STO, relay, and Ethernet	9	Internal/external brake resistor connector
5	Operating LEDs		

3.4 Decentral Access Module (DAM 510)

3.4.1 Overview

DAM is the abbreviation for Decentral Access Module. The DAM 510 is a central interface/gateway to the decentral servo system. It is used to connect the VLT® Integrated Servo Drive ISD 511 to the servo system via a hybrid feed-in cable.

The DAM 510 supplies the decentral servo drives with DC-link, U_{AUX} , STO, and the Ethernet-based fieldbus via the hybrid feed-in cable. The DAM 510 provides functions, such as:

- Overcurrent protection of the hybrid cable
- Overvoltage protection
- Charging circuit of the DC-link
- External encoder connection
- DC-link capacitance buffer for the decentral servo drives

The DAM 510 can be controlled via Ethernet-based fieldbus.

LEDs on the front of the DAM 510 show the operating status and warnings.

NOTICE

- The system modules are designed for use within a control cabinet. If the STO function is used, the cabinet must be rated at least IP54.
- The DAM 510 has a protection rating of IP20 according to IEC/EN 60529 (except connectors, which are IP00).
- The DAM 510 can be damaged if exposed to fluids.

An example type code for the DAM 510 is: MSD510DAM510F1C015AD6E20PLSXXXXXXXXXXXXXX.

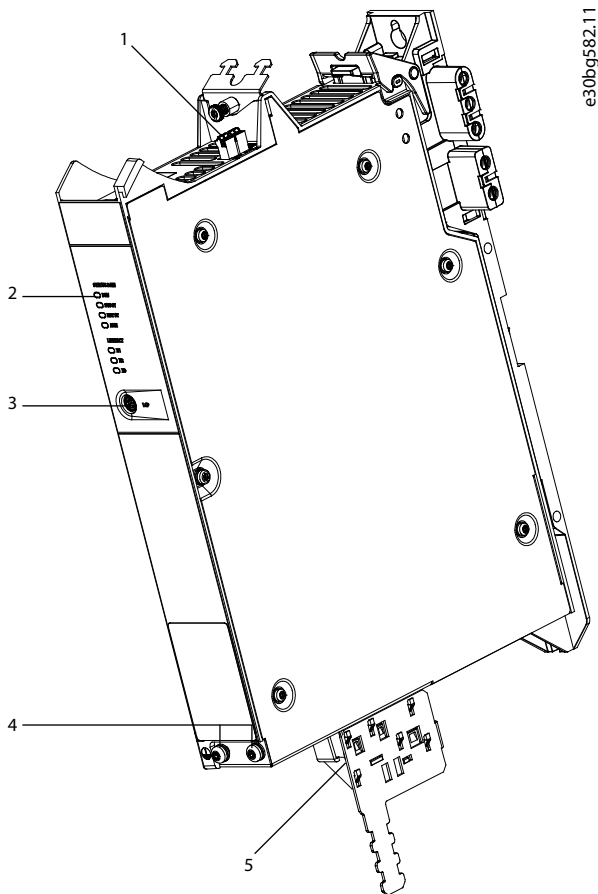


Illustration 4: DAM 510

<p>1 Connectors: STO, Ethernet, and external encoder</p> <p>2 Operating LEDs</p> <p>3 LCP connector</p>	<p>4 PE screws</p> <p>5 Connectors: UDC, AUX, STO out, and Ethernet</p>
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3.5 Auxiliary Capacitors Module (ACM 510)

3.5.1 Overview

ACM is the abbreviation for Auxiliary Capacitors Module. The ACM 510 can be connected to the ISD 511 system to store energy, enabling a controlled machine stop in emergency situations.

NOTICE

- The ACM 510 has a protection rating of IP20 according to IEC/EN 60529 (except connectors, which are IP00).
- The ACM 510 can be damaged if exposed to fluids.
- The system modules are designed for use within a control cabinet. If the STO function is used, the control cabinet must be rated at least IP54.

An example type code for the ACM 510 is: MSD510ACM510F1E00C8D6E20PLSXXXXXXXXXXXXXX.

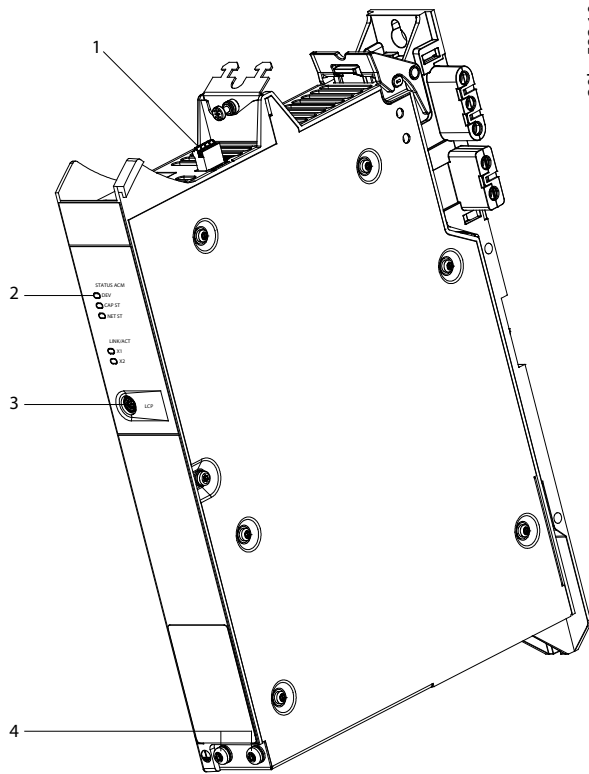


Illustration 5: ACM 510

1	Connectors: I/O, relay, and Ethernet	3	LCP connector
2	Operating LEDs	4	PE screws

3.6 Expansion Module EXM 510

The EXM 510 supports modular machine setup by splitting the system modules into 2 control cabinets. The maximum length of the cable between the EXM 510 modules is 5 m.

See [5.9.5 Connecting the Expansion Module EXM 510](#) for further information.

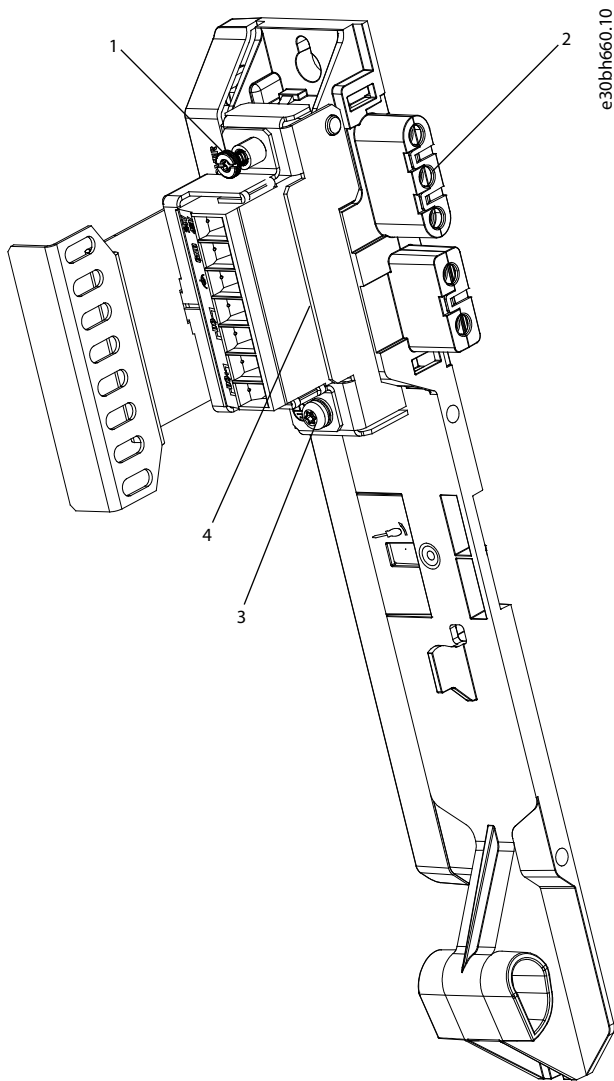


Illustration 6: EXM 510

1	EMC Shielding Plate	3	PE screw
2	Backplate	4	Expansion connector

NOTICE

- The system modules are designed for use within a control cabinet. If the STO function is used, the cabinet must be rated at least IP54.
- The EXM 510 has a protection rating of IP20 according to IEC/EN 60529.
- The EXM 510 may be damaged if exposed to fluids.

An example type code for the EXM 510 is:
 MSD510EXM510F1C062AD6E20XXXXXXXXXXXXXXXXXX

3.7 Software

The software for the servo system comprises:

- The firmware of the ISD 511 that is already installed on the device.
- The firmware of the system modules that is already installed on the system modules (except EXM 510).

- A package of PLC libraries for Automation Studio™ for operating the ISD 511 servo drives and the system modules. See [6.5.2 Creating an Automation Studio™ Project](#) for further information.
- VLT® Servo Toolbox: A Danfoss PC-based software tool for commissioning and debugging the devices.
- VLT® Backup Tool: A Danfoss PC-based software tool for backing up the devices.

3.8 Fieldbus

3.8.1 Ethernet POWERLINK®

The ISD 511 servo drives and the system modules are certified according to DS 301 V1.4.0 and support the following features:

- Work as controlled node
- Can be operated as multiplexed stations
- Support of cross-communication
- Ring redundancy supported for media redundancy

Specific ports are not assigned for Ethernet POWERLINK®.

3.9 Cables

3.9.1 Feed Cables

There are 3 feed cables used in the ISD 511 servo system. The feed cables are not provided by Danfoss but must conform to the specifications detailed in [Table 6](#).

Table 6: Feed Cables

Feed cable type	Description	Maximum length	Cross-section
Feed-in	From DAM 510 to slip ring	30 m	UDC: 2 x 2.5 mm ² U _{AUX} : 2 x 2.5 mm ² STO: 1 x 1.0 mm ² Fieldbus: 4 x 0.24 mm ² PE: 1 x 2.5 mm ²
Feed-in	From slip ring to first ISD 511 servo drive	6 m	UDC: 2 x 2.5 mm ² U _{AUX} : 2 x 2.5 mm ² STO: 2 x 0.5 mm ² Fieldbus: 4 x 0.24 mm ² PE: 1 x 2.5 mm ²
Feed-out	Slip ring to last ISD 511 servo drive	6 m	UDC: 2 x 2.5 mm ² U _{AUX} : 2 x 2.5 mm ² Fieldbus: 4 x 0.24 mm ² (optional) PE: 1 x 2.5 mm ² (optional)

3.9.2 Loop Cable

Table 7: Loop Cable

Description	Maximum length	Cross-section	Bending radius
The loop cable connects the ISD 511 servo drives in daisy-chain format in an application.	235 mm/365 mm	UDC: 2 x 2.5 mm ² U _{AUX} : 2 x 2.5 mm ² STO: 2 x 0.5 mm ² Fieldbus: 4 x 0.24 mm ²	Static: 22.5 mm Dynamic: 90 mm (occasional movements)

Description	Maximum length	Cross-section	Bending radius
		PE: 1 x 2.5 mm ²	

3.9.3 LCP Cable

The LCP cable connects the LCP to the system modules via an M8 connector.

The LCP cable can be purchased from Danfoss (see the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® FlexMotion™) Design Guide** for further information and ordering numbers).

3.10 Local Control Panel (LCP)

3.10.1 Overview of the Local Control Panel

The LCP is the graphical user interface that can be connected to the PSM 510, DAM 510, and ACM 510 for diagnostic and operating purposes using an optional cable (M8 to LCP D-SUB extension cable).

The LCP display provides the operator with a quick view of the state of the system module it is connected to. The display shows parameters and alarms/errors and can be used for commissioning and troubleshooting. It can also be used to perform simple functions, for example activating and deactivating the output lines on the DAM 510.

The LCP can be mounted on the front of the control cabinet and then connected to the system modules via SUB-D cables. The maximum cable length is 3 m.

3.10.2 Layout of the Local Control Panel

The local control panel is divided into 4 functional groups:

- A: Display area
- B: Display menu keys
- C: Navigation keys and indicator lights (LEDs)
- D: Operation keys and reset

To adjust the display contrast, press [Status] and the [▲]/[▼] keys.

3.10.2.1 A: Display area

The values in the display area differ depending on which system module the LCP is connected to.

The display area is activated when the module it is connected to receives power from the mains supply, a DC bus terminal, or U_{AUX} .

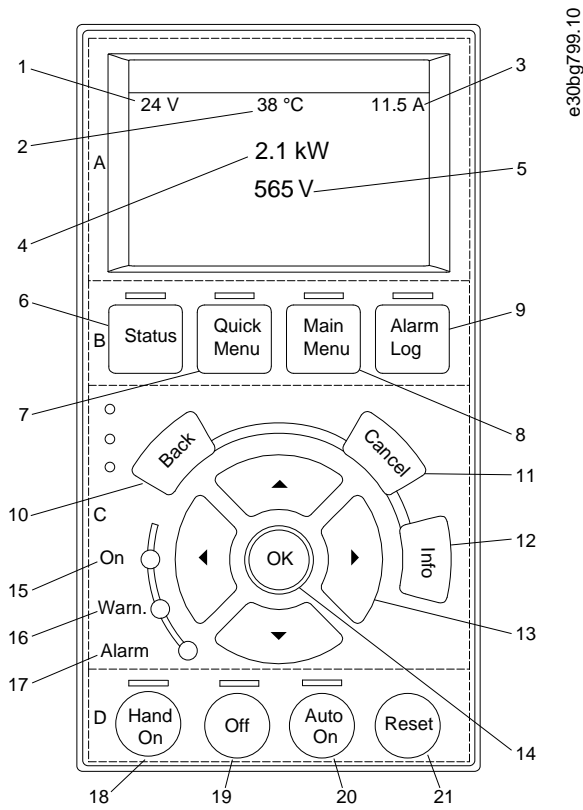


Illustration 7: Display Area when Connected to the PSM 510 and DAM 510

1	U_{AUX} line voltage
2	Temperature power board
3	Actual UDC (current)
4	Power consumption
5	Actual UDC (voltage)

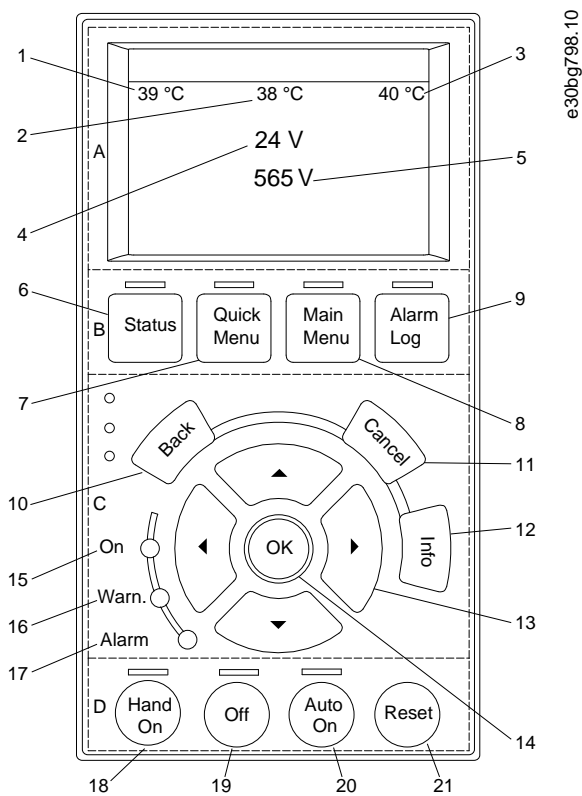


Illustration 8: Display Area when Connected to the ACM 510

1	Temperature power board
2	Temperature capacitor bank 1
3	Temperature capacitor bank 2
4	U _{AUX} line voltage
5	Actual UDC (voltage)

3.10.2.2 B: Display menu keys

Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.

Table 8: Display Menu Keys

	Key	Function
6	Status	Shows operational information.
7	Quick Menu	Allows access to parameters.
8	Main Menu	Allows access to parameters.
9	Alarm Log	Shows the last 10 alarms.

3.10.2.3 C: Navigation keys and indicator lights (LEDs)

Navigation keys are used for moving the display cursor and provide operation control in local operation. There are also 3 status LEDs in this area.

Table 9: Navigation Keys

	Key	Function
10	Back	Reverts to the previous step or list in the menu structure.
11	Cancel	Cancel the last change or command as long as the display mode is not changed.
12	Info	Press for a definition of the function being shown.
13	Navigation keys	Use the 4 navigation keys to move between items in the menu.
14	OK	Use to access parameter groups or to enable a selection.

Table 10: Indicator Lights (LEDs)

	LED	Color	Function
15	On	Green	The <i>On</i> LED activates when the module it is connected to receives power from U _{AUX} .
16	Warn	Yellow	When warning conditions are met, the yellow <i>Warn</i> LED activated and text appears in the display area identifying the problem.
17	Alarm	Red	A fault condition causes the red <i>Alarm</i> LED to flash and an alarm text is shown.

3.10.2.4 D: Operation keys and reset

The operation keys are located at the bottom of the LCP.

Table 11: Operation Keys and Reset

	Key	Function
18	Hand On	Enables the connected system modules to be controlled via the LCP.
19	Off	Puts the ISD 511 into state <i>Switch on Disabled</i> and the other system modules into state <i>Standby</i> . This only works in <i>Hand On</i> mode. <i>Off</i> mode enables transition from <i>Hand On</i> mode to <i>Auto On</i> mode.
20	Auto On	Puts the system in remote operational mode. In <i>Auto On</i> mode, the device is controlled by fieldbus (PLC). Switching between <i>Auto On</i> and <i>Hand On</i> modes is only possible when the drive is in state <i>Switch on Disabled</i> and/or the PSM 510 is in state <i>Standby</i> .
21	Reset	Resets the ISD 511 after a fault has been cleared. The reset is only possible when in <i>Hand On</i> mode.

4 Mechanical Installation

4.1 Items Supplied

The items supplied for the ISD 511 servo system are:

- ISD 511 servo drives
- Power Supply Module (PSM 510) including connectors
- Decentral Access Module (DAM 510) including connectors
- Auxiliary Capacitors Module (ACM 510) including connectors, optional
- Expansion Module (EXM 510), optional
- Local control panel (LCP), optional
- LCP cable, optional
- Blind caps for M23 connectors
- Flange protection cap
- This operating guide

Save the product packaging for use in the event of product return.

4.2 Transport

- Always use means of transport and lifting gear with sufficient load capacity to transport the servo system components.
- Avoid vibration during transport.
- Avoid heavy impacts and blows.

4.3 Inspection on Receipt

Procedure

1. After receiving the delivery, immediately check whether the items supplied match the shipping documents. Danfoss does not honor claims for faults registered later.
2. Register a complaint immediately with the carrier if there is visible transport damage.
3. Register a complaint immediately with the responsible Danfoss representative if there are visible defects or the delivery is incomplete.

4.4 Safety Measures during Installation

Always observe the safety instructions in this manual during installation. Pay particular attention to ensuring that the following points are always observed:

- Installation may only be performed by qualified personnel.
- Installation must be performed with due care and attention.
- All safety regulations and protective measures must be complied with, and the environmental conditions must be observed.
- The manual is read and understood.

4.5 Installation Environment

4.5.1 Overview

The installation must provide the following environmental conditions to allow the ISD 511 system to be operated safely and efficiently.

Contact Danfoss if it is not possible to comply with these environmental conditions.

4.5.2 ISD 511 Servo Drive

- The allowable operating ambient temperature range, humidity, and vibration levels must not be exceeded (see [11.8.1 ISD 511 Servo Drives](#)).
- Unrestricted ventilation must be available.
- The mounting structure must be suitable for the application, for example, adequately rigid and able to cope with temperatures over 90 °C.

4.5.3 System Modules

The environmental conditions for the PSM 510, DAM 510, and ACM 510 are:

- The allowable operating ambient temperature range, humidity, and vibration levels must not be exceeded (see [11.8.2 System Modules](#)).
- The minimum space required above and below the system modules is detailed in [4.7.2 Space Requirements for System Modules](#).

4.6 Preparation for Installation

4.6.1 ISD 511 Servo Drive

Make the following preparations to ensure that the servo system can be installed reliably and effectively.

Always fit couplings and other transfer components in accordance with local regulations.

Procedure

1. Provide a suitable mounting arrangement for the application, taking into account the weight of the ISD 511 servo drive.
2. Remove the protection cap on the flange.
3. Seat the motor flange flush against the mounting surface before fixing the servo drive. Misalignment shortens the life of the bearings and the coupling components and reduces heat transfer from the servo drive. Ensure that the seal is not bumped when inserting the drive into the machine as that could damage the seal resulting in impaired sealing function and reduced service lifetime.
4. Provide contact protection according to local regulations if hot surfaces can be expected during operation.
5. Ground the servo drive (see [5.3.1 Grounding the ISD 511 Servo Drive](#)).

4.6.2 System Modules

Make the following preparations to ensure that the servo system can be installed reliably and effectively.

Always fit the system modules in accordance with local regulations.

Procedure

1. Provide a suitable mounting arrangement for the application. This depends on the type and weight of the modules.
2. To avoid misalignment, ensure that the backplates are perfectly level.
3. To ensure sufficient cooling, pay attention to the specified minimum space requirements (see [4.7.2 Space Requirements for System Modules](#)).
4. Ground the modules.

4.6.3 Drilling Templates

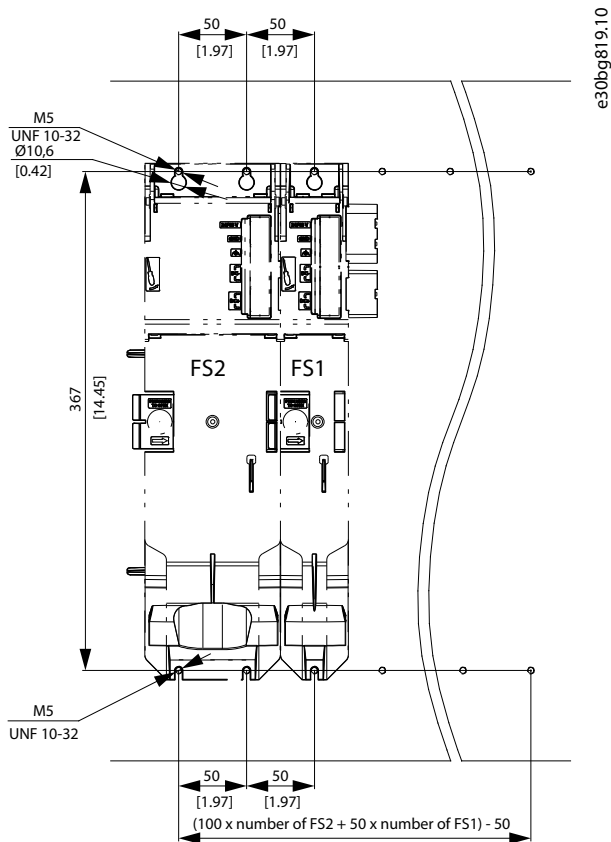


Illustration 9: Drilling templates for 50 mm and 100 mm System Modules

4.7 Installation Procedure

4.7.1 Space Requirements for ISD 511

In addition to its own dimensions, the ISD 511 servo drive needs space for the hybrid cable and the connector.

4.7.1.1 Minimum Distance for M23 Angled Connector

[Illustration 10](#) shows the minimum distance from the servo drive to the next object.

For cable installation (connecting/disconnecting the M23 angled connector on an installed device), allow a mounting space of the height of the connector plus an additional 25 mm (273 mm – 248 mm).

The minimum bending radius R_{min} for permanently static installed cable is 22.5 mm.

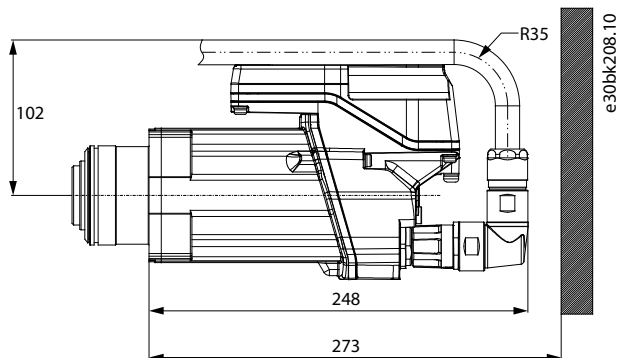


Illustration 10: Minimum Distance for M23 Angled Connector

4.7.2 Space Requirements for System Modules

The modules can be mounted next to each other but require a minimum space at the top and bottom for cooling.

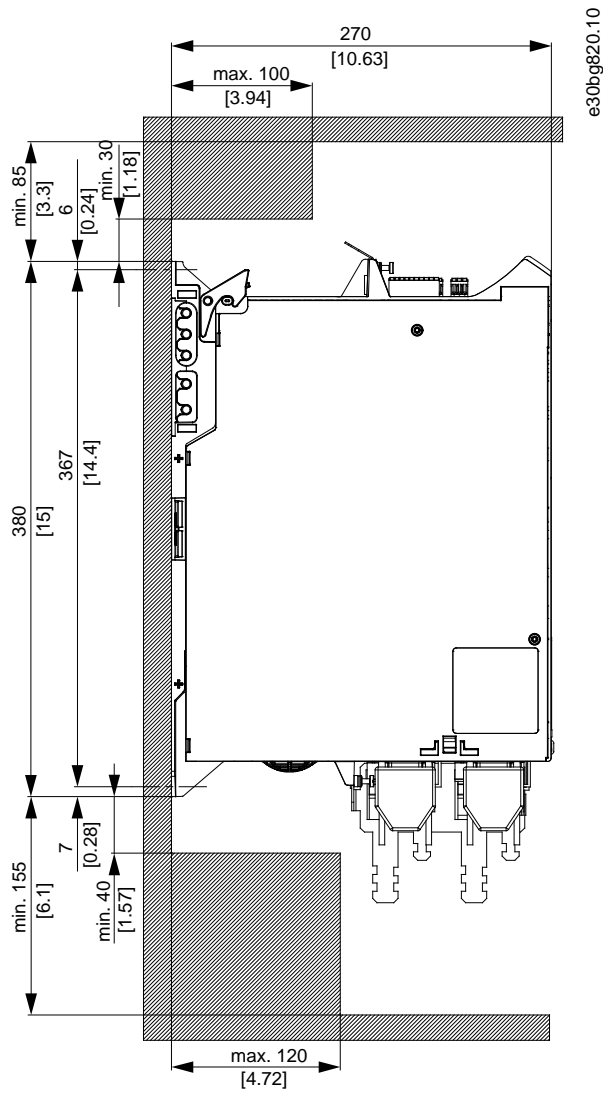


Illustration 11: Minimum Space Required at the Top and Bottom

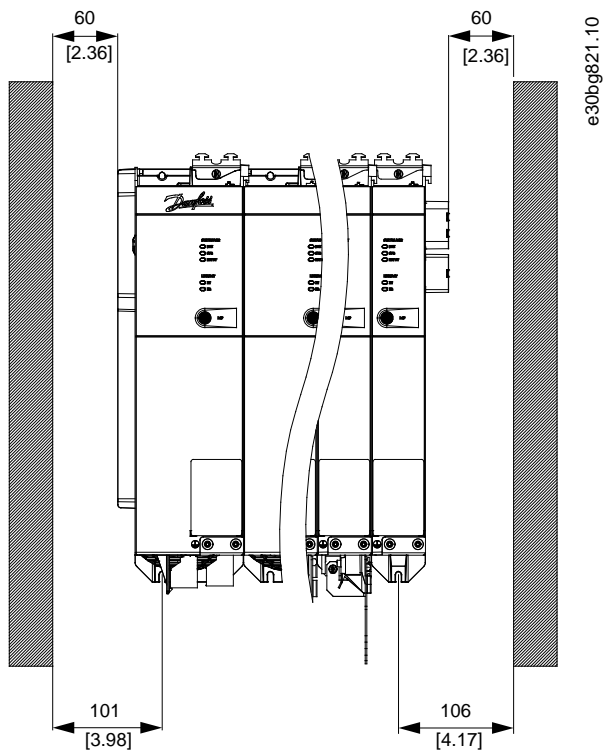


Illustration 12: Minimum Space Required at the Sides

4.7.3 Installation Aids and Tools Required

For installation of the ISD 511 servo drives and the system modules, the tools corresponding to the fixings screws (not included) are required.

4.7.4 Fitting Instructions for ISD 511 Servo Drive

4.7.4.1 Overview

The ISD 511 servo drives are delivered with plastic M23 protection caps and a shaft protection cap.

These plastic protection caps prevent damage during transport and handling. Always mount the metal protection caps if the connector is not used.

4.7.4.2 Mounting the ISD 511 to the Roundtable

Procedure

1. The ISD 511 can be mounted to the roundtable from the bottom (see [Illustration 13](#)) and the top (see [Illustration 14](#)).

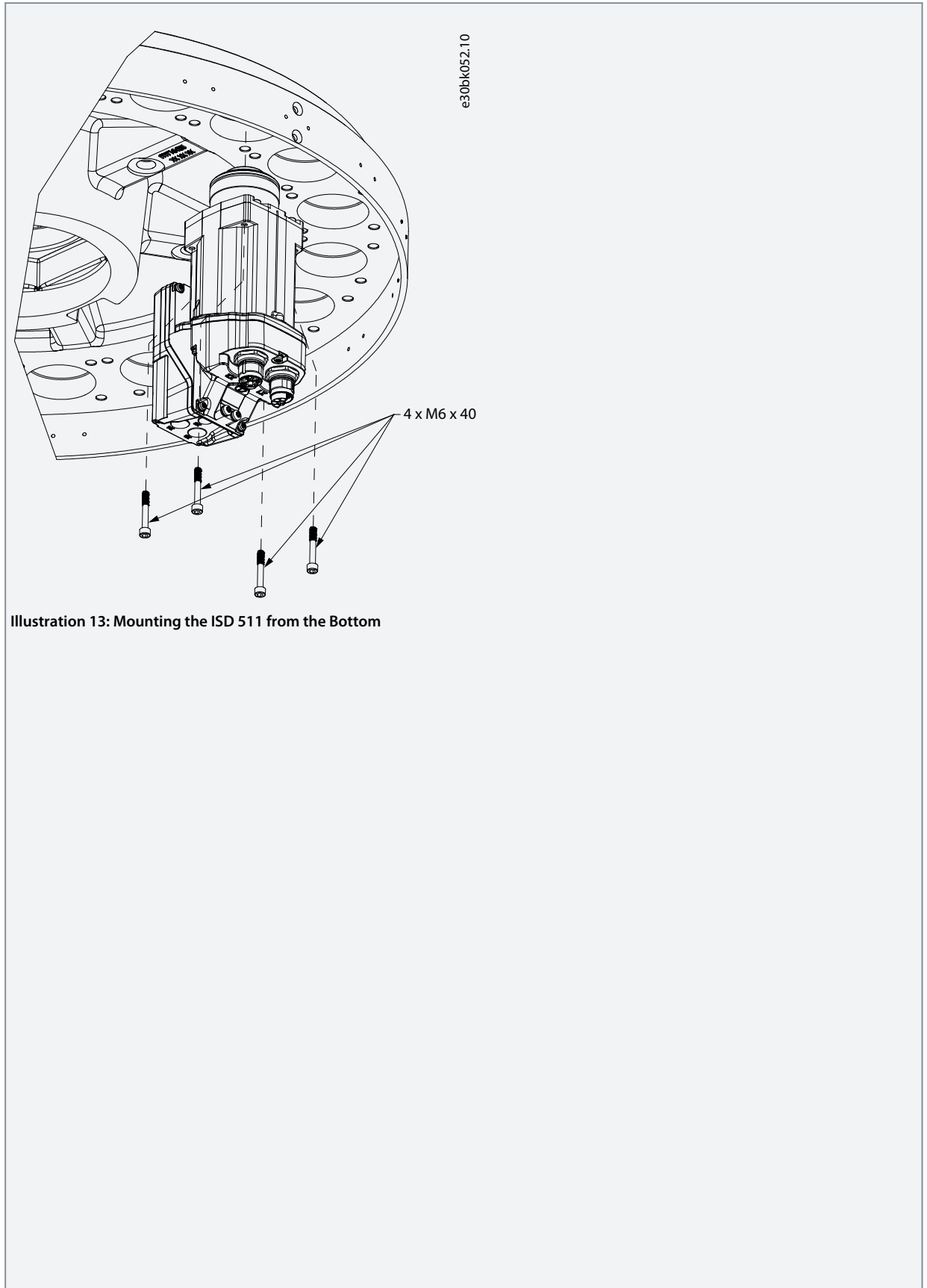
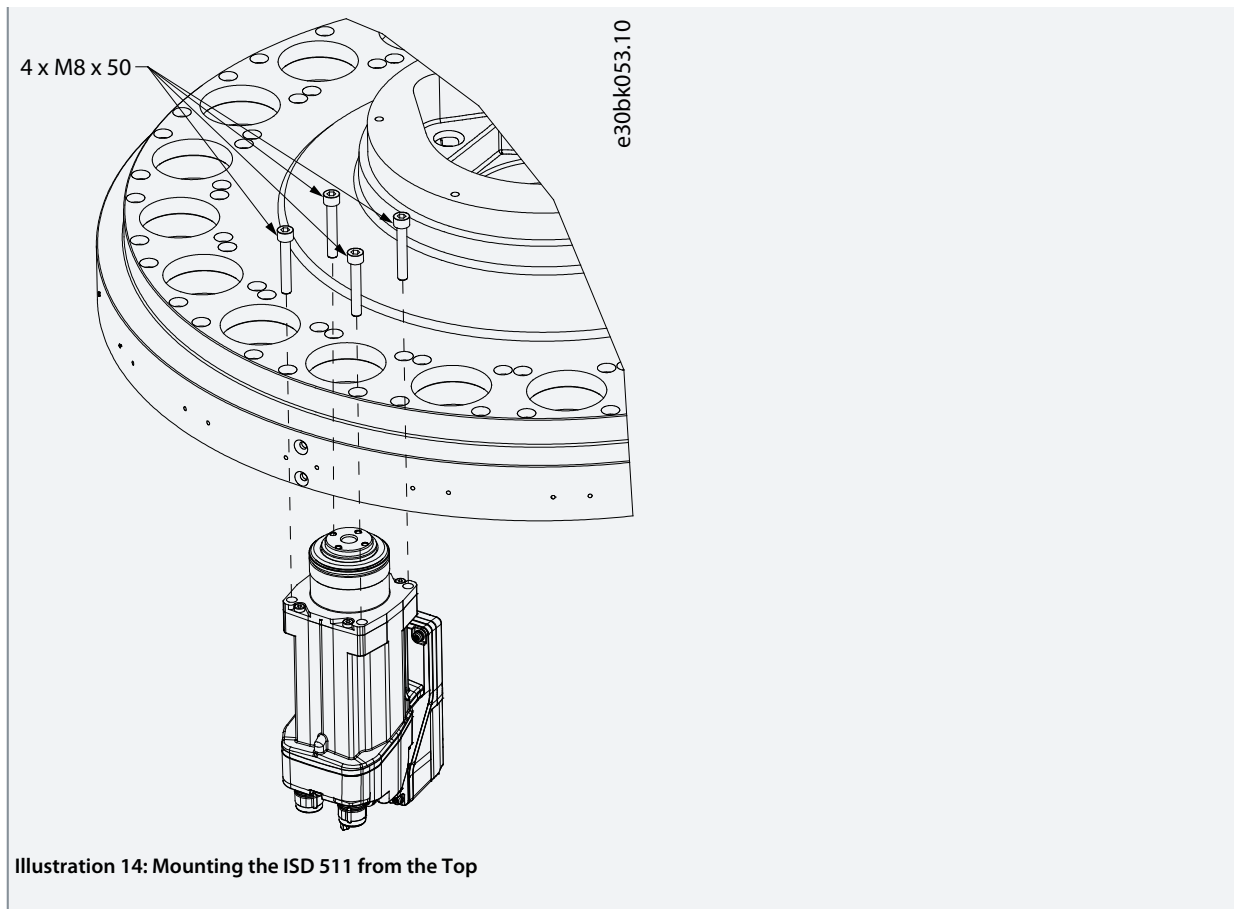


Illustration 13: Mounting the ISD 511 from the Bottom



2. Tighten the screws according to the tightening torques in [4.7.4.3 Tightening Torques for Fixing Screws](#).

4.7.4.3 Tightening Torques for Fixing Screws

Always tighten the screws uniformly and crosswise.

Mounting	Thread type/ hole size	Maximum thread length	Tightening torque
From the top	M8	23 mm in the roundtable	8–10 Nm
From the bottom	M6	15 mm in the roundtable	7–8.5 Nm

NOTICE

- The fixing screws are not supplied. See [11.3.2 Dimensions of Flange Screw for Mounting the ISD 511 Servo Drive](#).

4.7.5 Fitting Instructions for System Modules

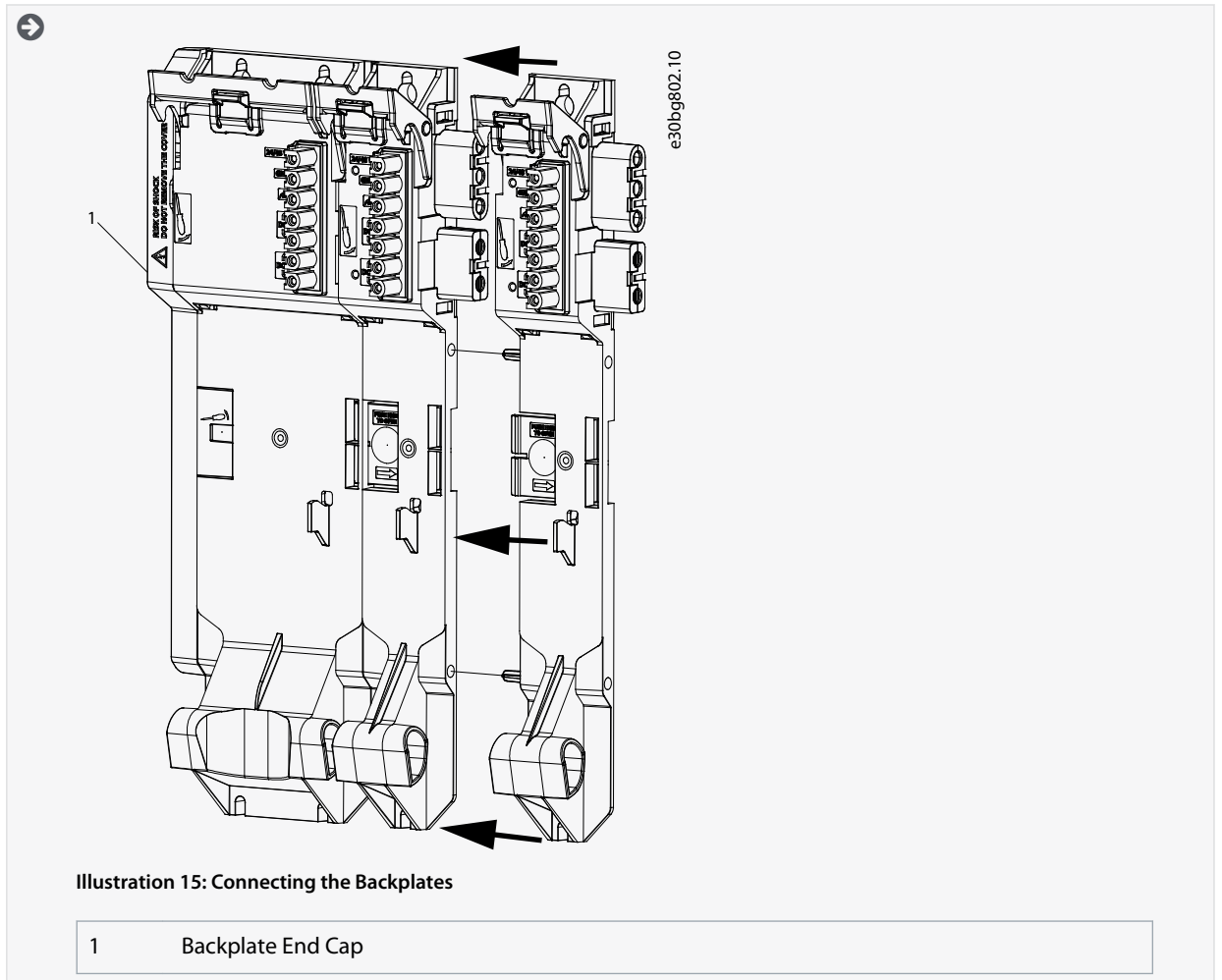
NOTICE

- Mount the system module with the highest output power next to the PSM 510. Mount the remaining system modules in descending order of output power.

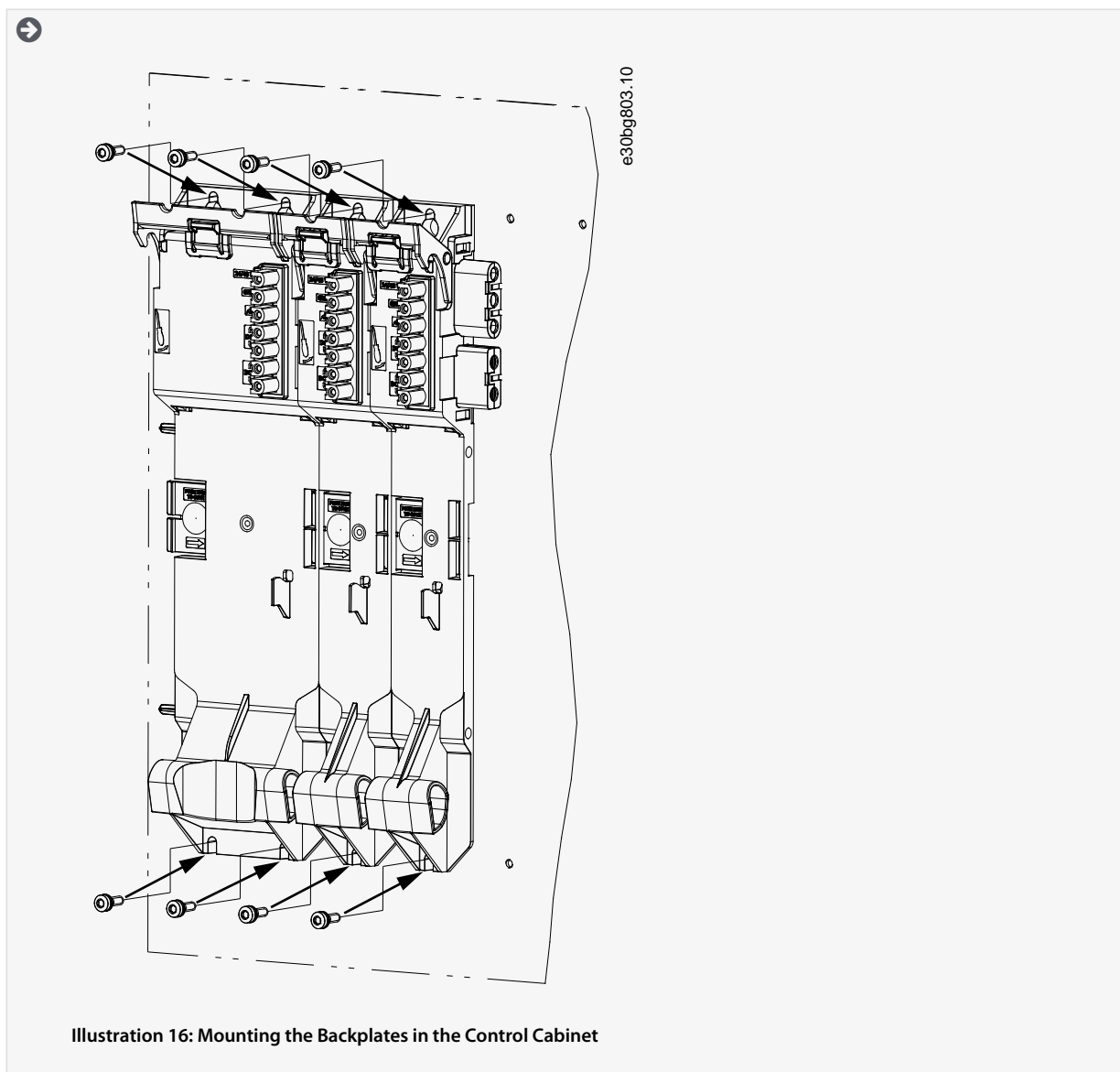
Procedure

1. Drill the holes for mounting the backplate as per the drilling template (see [4.6.3 Drilling Templates](#)).

2. Connect the backplates and the end cap via the click and lock method.

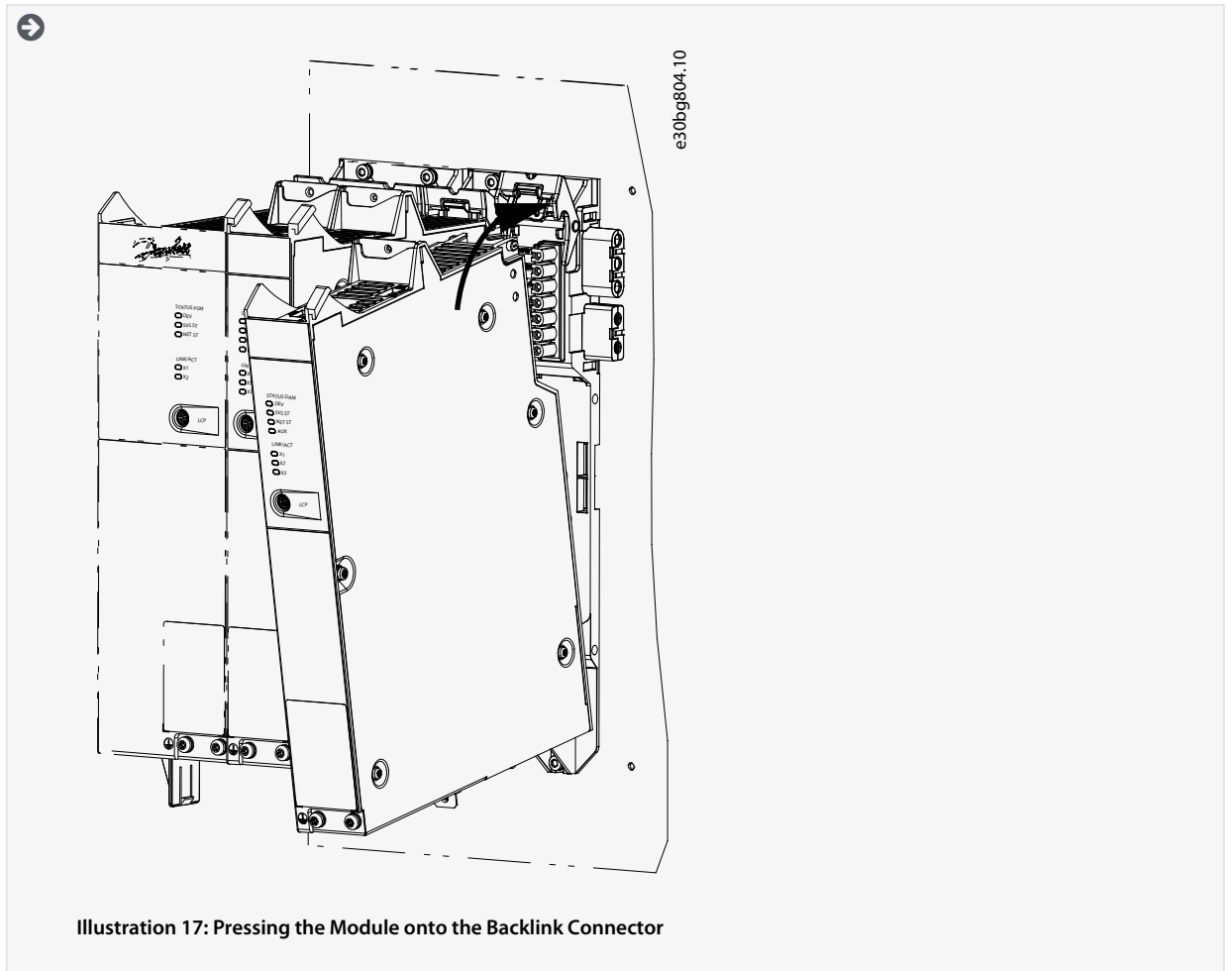


3. Mount the backplates to the mounting plate in the control cabinet using M5 screws with a minimum head diameter or washer diameter of 9.5 mm. The tightening torque is 3 Nm.

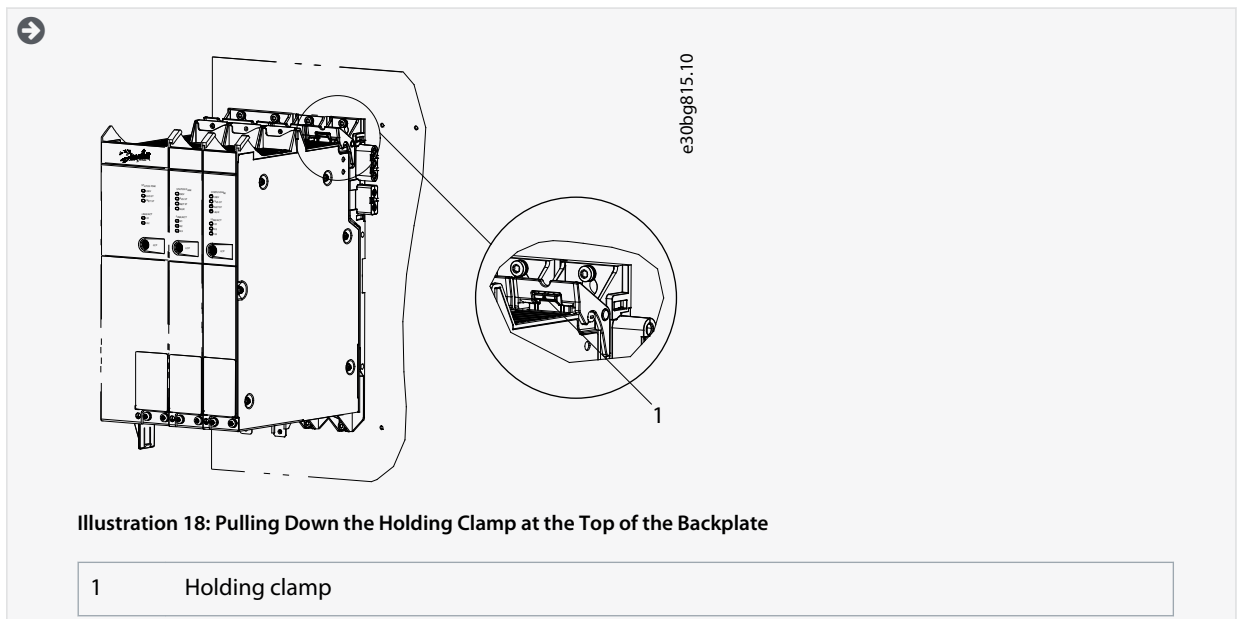


4. Slide the module onto the carrier at the bottom of the backplate.

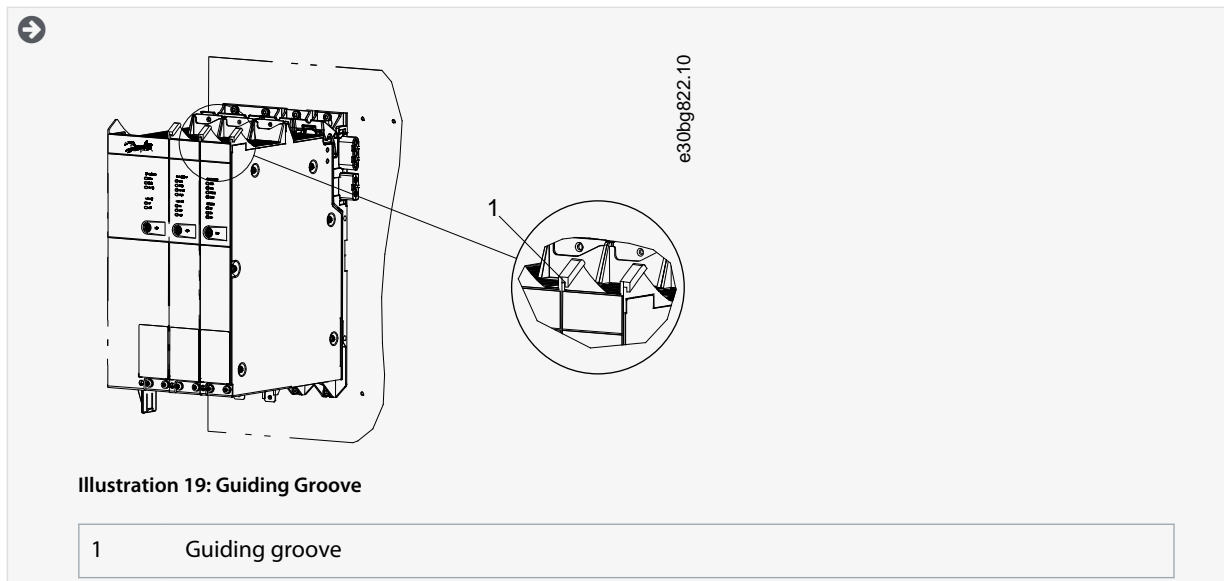
5. Press the 1st module onto the backlink connector at the top of the backplate.



6. To secure the module, pull down the holding clamp ([1] in [Illustration 18](#)) at the top of the backplate.



- Repeat steps 4, 5, and 6 for the remaining modules, ensuring that the lip at the left side of the 2nd module is inside the guiding groove at the right side of the 1st module ([1] in [Illustration 19](#)).



5 Electrical Installation

5.1 Warnings for Electrical Installation

⚠ WARNING ⚠

LEAKAGE/GROUNDING CURRENT HAZARD

Leakage/grounding currents are >3.5 mA. Improper grounding of the ISD 511 drives and the system modules may result in death or serious injury.

- For reasons of operator safety, use a certified electrical installer to ground the system correctly in accordance with the applicable local and national electrical standards and directives, and the instructions in this manual.

⚠ WARNING ⚠

HIGH VOLTAGE

The ISD 511 system contains components that operate at high voltage when connected to the electrical supply network. Not all components have indicators that indicate the presence of mains supply. Incorrect installation, commissioning, or maintenance may lead to death or serious injury.

- Installation, commissioning, and maintenance may only be performed by qualified personnel.

⚠ WARNING ⚠

HIGH VOLTAGE

Potentially lethal voltage is present on the connectors that may lead to death or serious injury.

- Before working on the power connectors (disconnecting or connecting the cable), disconnect the PSM 510 from the mains and wait for the discharge time to elapse.

5.2 Electrical Environmental Conditions

Compliance with the following electrical environmental conditions is necessary to enable safe and effective operation of the servo system:

- Only for use in TN-S, TN-C, TN-CS, TT (not corner earthed) supply earthing system
- Prospective short-circuit current: 5 kA
- Protective class I
- Grounded 3-phase mains network, 400–480 V AC $\pm 10\%$
- 3-phase frequency 44–66 Hz
- 3-phase lines and PE line
- External supply for auxiliary voltage, 24/48 V DC (PELV) $\pm 10\%$
- AC choke (see [5.9.2.1 AC Line Choke](#))
- Observe the national statutory provisions.
- The leakage current is >3.5 mA.

NOTICE

RCD COMPATIBILITY

The servo system contains components that can cause a DC current in the protective earthing conductor, which may result in malfunction in any devices connected to the system.

- Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, use a type B RCD or RCM device on the supply side of the system components.

N O T I C E

- The PSM 510, DAM 510, and optional ACM 510 and EXM 510 must be mounted in a control cabinet.

5.3 Grounding for Electrical Safety

5.3.1 Grounding the ISD 511 Servo Drive

- Ensure that the machine frame has a proper electrical connection to 1 of the 2 dedicated PE screws.

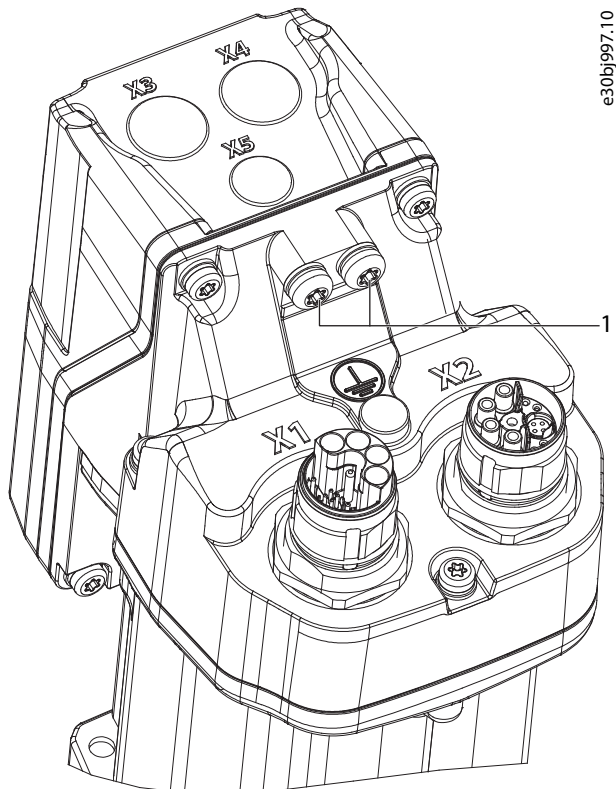


Illustration 20: PE Screws on the ISD 511 Servo Drive

1	PE screws
---	-----------

- For the ISD 511 servo drives, ensure a minimum ground wire cross-section of at least 4 mm² (minimum 70 °C, Cu).
- Keep the ground wire connections as short as possible.
- Connect the PE yellow/green wire of the feed-in cable to 1 of the PE screws on the front of the DAM 510, as depicted in [Illustration 21](#).

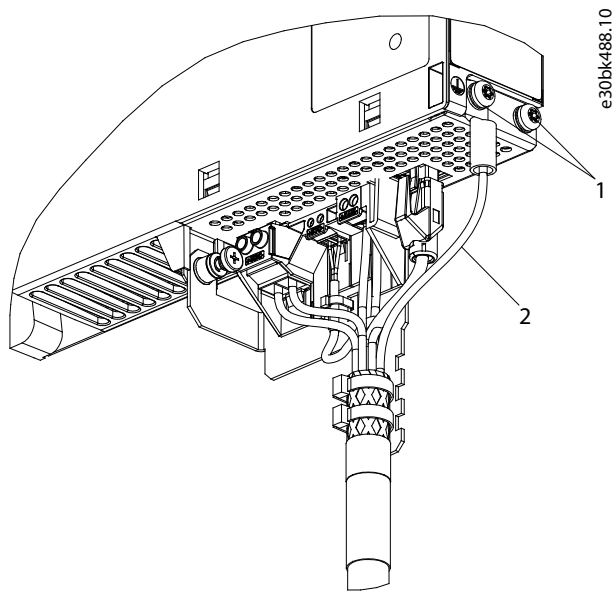


Illustration 21: Connecting the PE Wire of the Feed-in Cable

- | | |
|---|---------------------------------|
| 1 | PE screws on DAM 510 |
| 2 | PE yellow/green wire (fork lug) |

N O T I C E

- The ISD 511 servo drive has 2 PE screws. The 2nd screw can be used to loop the earthing conductor for a maximum of 5 units. If the system uses more than 5 units, ground them in groups of 5.

5.3.2 Grounding the System Modules

Do not ground the system modules in daisy-chain format. Use the grounding method shown in [Illustration 22](#).

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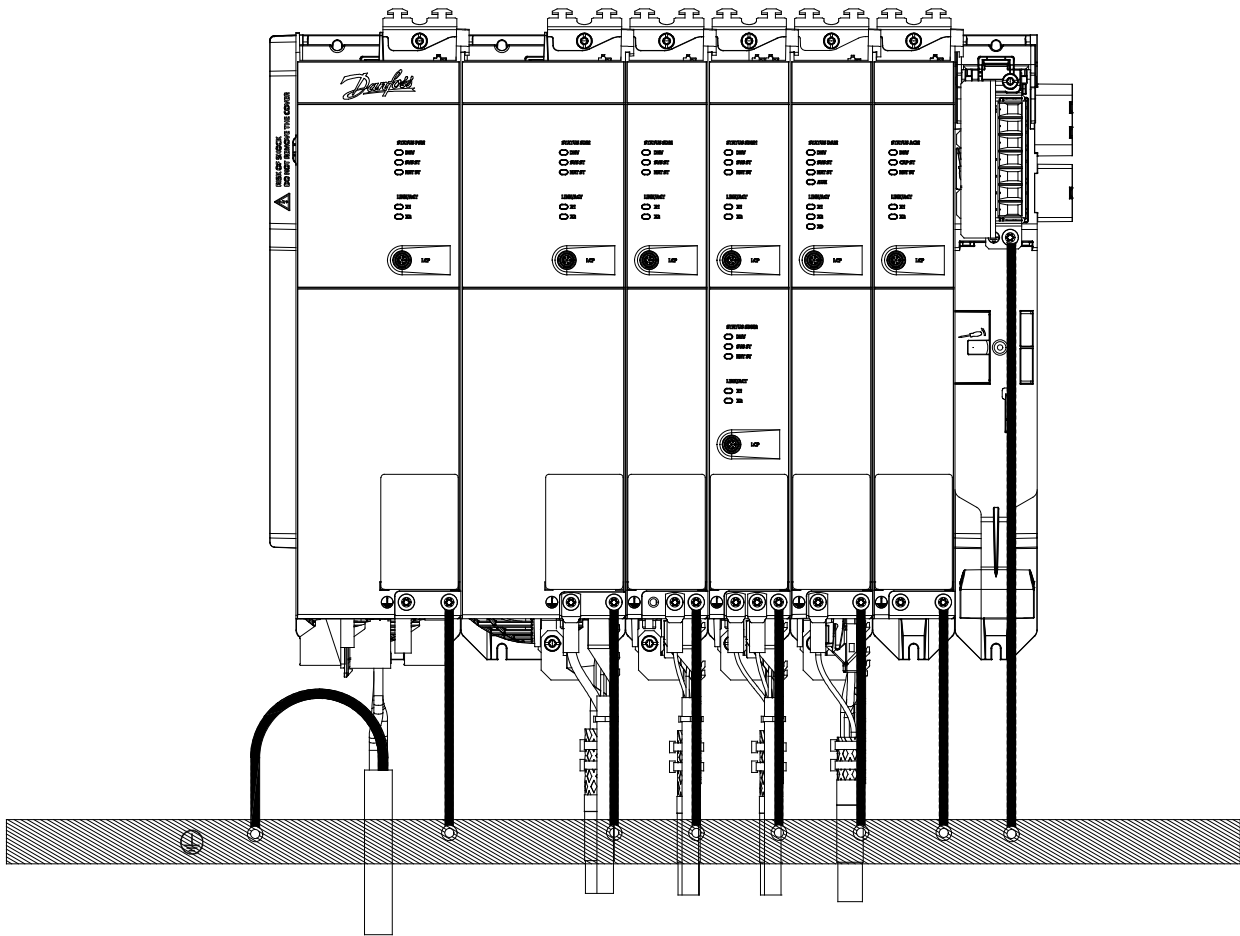


Illustration 22: Grounding for Electrical Safety

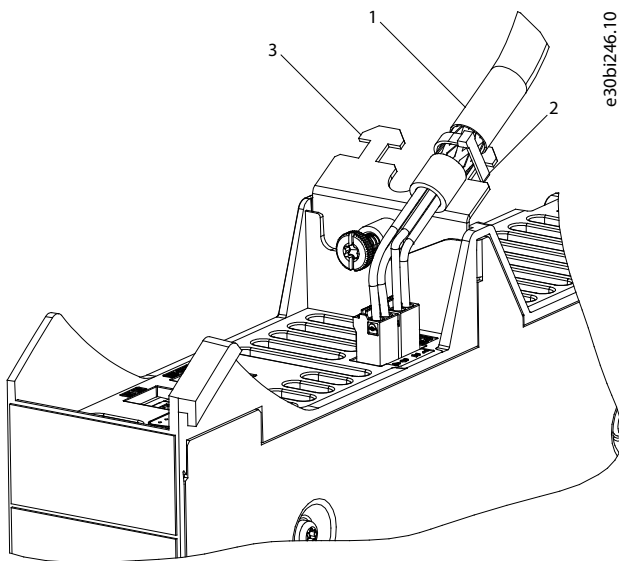
- To comply with CE requirements, ensure a minimum ground wire cross-section of at least 16 mm² (minimum 70 °C, Cu). To comply with UL requirements, ensure a minimum ground wire cross-section of 6 AWG (minimum 60 °C, Cu).
 - If a PSM 510 module with 10 kW is used, the cable cross-section can be reduced to 10 mm² (minimum 70 °C, Cu) to comply with CE requirements and 8 AWG (minimum 60 °C, Cu) to comply with UL requirements.
- Keep the ground wire connections as short as possible.
- Follow the wiring requirements in the VLT® Multiaxis Servo Drive System MSD 510 Operating Guide.

NOTICE

- If 2 separate backlinks are used (connected via 1 or 2 pairs of EXM 510 modules), the 2 grounding bars must also be connected together with a 16 mm² (6 AWG) cable cross-section.

5.4 Grounding for EMC-Compliant Installation

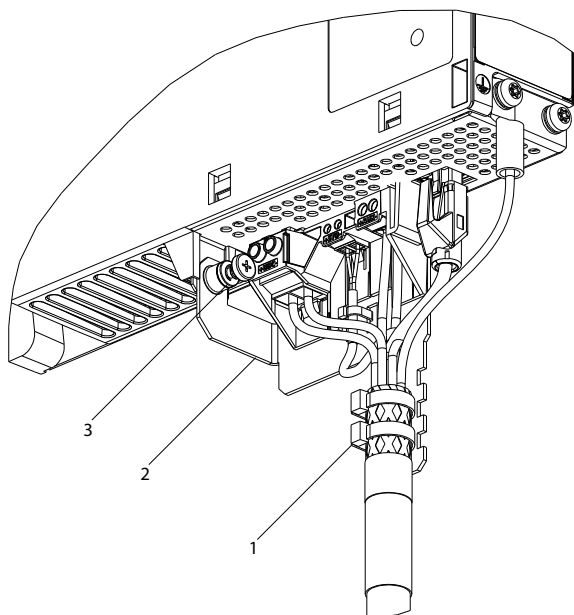
- Establish electrical connection between the cable shield and the enclosure using the I/O shielding plate on each module.



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Illustration 23: Cable Shielding on the Top of the System Modules

1	Cable	3	I/O shielding plate
2	Cable tie		



e30bi238.10

Illustration 24: Cable Shielding on the Bottom of the System Modules

1	Cable tie	3	EMC plate screw
2	EMC metal shielding plate		

- Use a cable with a shielding that has a high-coverage to reduce electrical interference.
- Do not use pigtails to connect the shielding. A 360° wire connection is recommended.

N O T I C E

POTENTIAL EQUALIZATION

- There is a risk of electrical interference when the ground potential between the servo system and the machine is different. Install equalizing cables between them. The recommended cable cross-section is 16 mm².

N O T I C E

EMC INTERFERENCE

- Use shielded cables for control wiring and separate cables for power and control wiring. Failure to isolate power and control wiring can result in unintended behavior or reduced performance.
- Ensure a minimum clearance of 200 mm between signal and power cables.
- Only cross cables at 90°.

5.5 Mains Supply Requirements

Ensure that the supply has the following properties:

- TN-S, TN-C, TN-CS, TT (not corner grounded) supply grounding system.
- For information on the use of an IT network with transformer, contact Danfoss.
- Prospective short circuit current: 5 kA.
- Protective class I.
- Grounded 3-phase mains network, 400–480 V AC $\pm 10\%$.
- 3-phase lines and PE line.
- 3-phase frequency: 44–66 Hz
- Maximum input current for 1 PSM 510 at 30 kW: 55 A_{rms}

5.5.1 Fuses

N O T I C E

- Use fuses on the supply side of the Power Supply Module (PSM 510) that comply with CE and UL requirements (see [Table 12](#)).
- When 2 PSM 510 modules are used, each PSM 510 must have its own dedicated set of fuses.

Table 12: Fuses

Model and power rating	CE Compliance (IEC 60364)	UL Compliance (NEC 2014)
	Maximum fuse type	Maximum fuse type
PSM 510 (10 kW)	gG 25 A	30 A (class T or J only)
PSM 510 (20 kW)	gG 50 A	50 A (class T or J only)
PSM 510 (30 kW)	gG 63 A	80 A (class T or J only)

5.5.2 Circuit Breakers

Use a type B or type C circuit breaker with a capacity of 1.5 times the rated current of PSM 510 to fulfill CE requirements.

N O T I C E

- Circuit breakers are not allowed in installations where C-UL is required. Only UL recommended fuses are allowed.

5.6 Auxiliary Supply Requirements

Supply the Power Supply Module (PSM 510) with a power supply unit with an output of 24/48 V DC $\pm 10\%$. The output ripple of the power supply unit must be $<250 \text{ mV}_{\text{pp}}$.

NOTICE

- Only use supply units that conform to the PELV specification.
- Use a supply that is CE-marked according to the standards EN 61000-6-2 and EN 61000-6-4 or similar for industrial use.
- The secondary circuit must be supplied from an external isolated source.

The power supply unit must be dedicated to the ISD 511 servo system, meaning that the supply is used exclusively for powering the PSM 510. The maximum cable length between the supply unit and the PSM 510 is 3 m.

5.6.1 Fuses

UL listed fuses are recommended to protect the wiring on 24/48 V DC.

Table 13: Fuses

CE Compliance (IEC 60364)	UL Compliance (NEC 2014)
Maximum fuse type	Maximum fuse type
50 A ⁽¹⁾	63 A ⁽²⁾

¹ If the maximum current is lower, a fuse with lower current rating can be used. Rating of IEC fuses: according to 100% of maximum current. Use a time delay fuse rated according to the DC voltage used.

² If the maximum current is lower, a fuse with lower current rating can be used. Rating of UL fuses: according to 125% of maximum current. Use a time delay fuse rated according to the DC voltage used.

5.7 Safety Supply Requirements

Supply the STO line with a 24 V DC supply with the following properties:

- Output range: 24 V DC $\pm 10\%$
- Maximum current: 1 A

Use a 24 V supply unit that is CE marked for industrial use. Ensure that the supply fulfills the PELV specification and is only used for the system safety input.

A common supply for auxiliary and safety supply can be used, provided the only connection point of the 2 circuits is near to the supply. This is intended to avoid interference due to a common voltage drop. The maximum cable length between the 24 V supply unit and the servo system is 3 m.

The safety supply can be looped from PSM 510 to the other system modules except for ACM 510. The cable for this is not provided. For further information, see [8.6 Installation](#).

NOTICE

- Ensure there is reinforced isolation between safety signals and other signals, supplies (mains supply), and exposed conductive parts.

5.8 UL Requirements

N O T I C E

- Integral solid-state short-circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code/Canadian Electrical Code, and any additional local codes or equivalent.
- Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 480 V maximum when protected by maximum 80 A class J or T fuses.
- To meet the UL (Underwriters Laboratories) regulations, use a UL-approved copper cable with a minimum heat-resistance of 60 °C. Use Class 1 wire only. For PSM 510 rated 30 kW and EXM 510, use a minimum heat resistance of 75 °C.
- Control Circuit Overcurrent Protection is required.

5.9 Connecting the Components

5.9.1 Connecting the ISD 511 Servo Drive

5.9.1.1 Electrical Installation Warnings for ISD 511 Servo Drive

⚠ W A R N I N G ⚠

HIGH VOLTAGE

Potentially lethal voltage is present on the connectors that may lead to death or serious injury.

- Before working on the power or signal connectors (disconnecting or connecting the cable), or performing any maintenance work, disconnect the Power Supply Module (PSM 510) from the mains and wait for the discharge time to elapse.

⚠ W A R N I N G ⚠

DISCHARGE TIME

The servo system contains DC-link capacitors that remain charged for some time after the mains supply is switched off at the Power Supply Module (PSM 510). Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- To avoid electrical shock, fully disconnect the Power Supply Module (PSM 510) from the mains and wait for the capacitors to fully discharge before carrying out any maintenance work on the servo system or replacing components.

Minimum waiting time (minutes)
15

5.9.1.2 General Instructions for Cable Installation

Avoid mechanical tension for all cables, especially regarding the range of motion of the installed servo drive.

Secure all cables in accordance with regulations and depending on conditions on site. Ensure that cables cannot come loose, even after prolonged operation.

N O T I C E

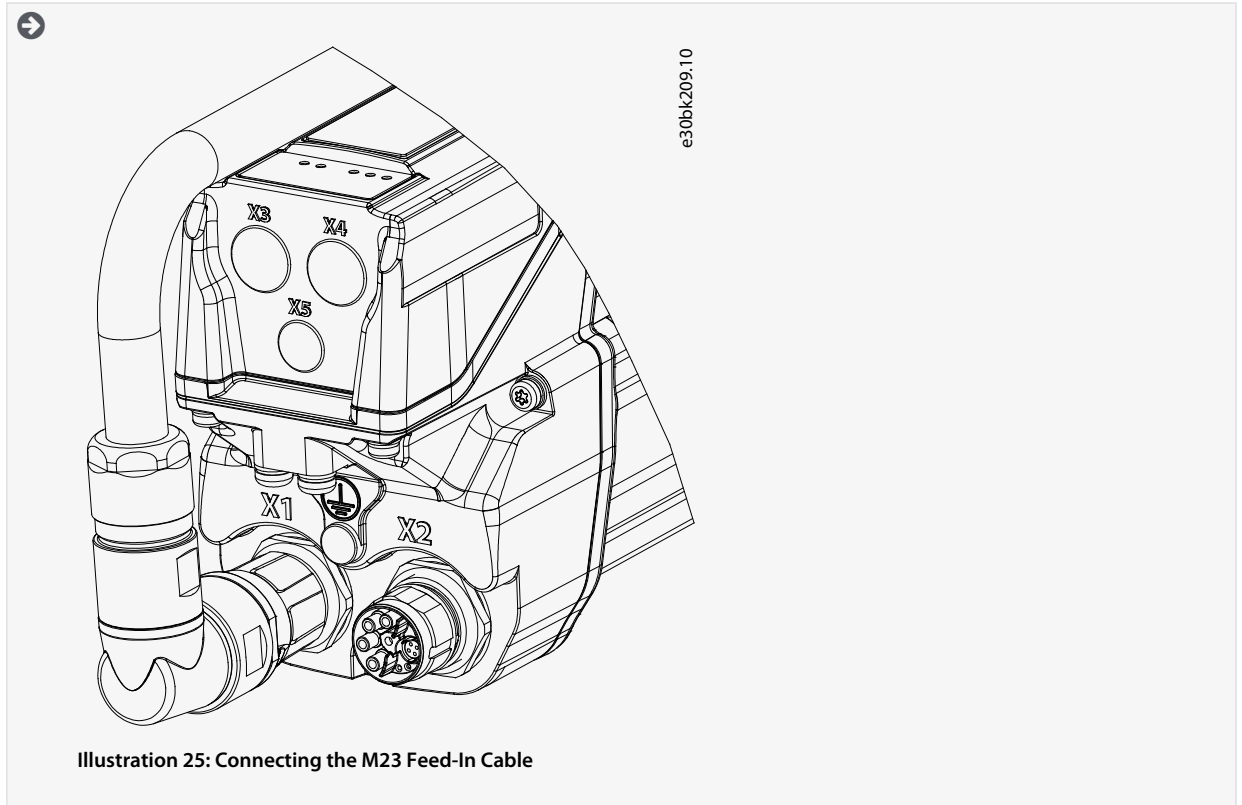
- Never connect or disconnect the hybrid cables to or from the servo drive when the supply voltage is present. Doing so damages the electronic circuitry. Observe the discharge time for the DC-link capacitors.
- Do not forcefully connect or fit the connectors. Incorrect connection causes permanent damage to the connector.

5.9.1.3 Connecting Hybrid Cables

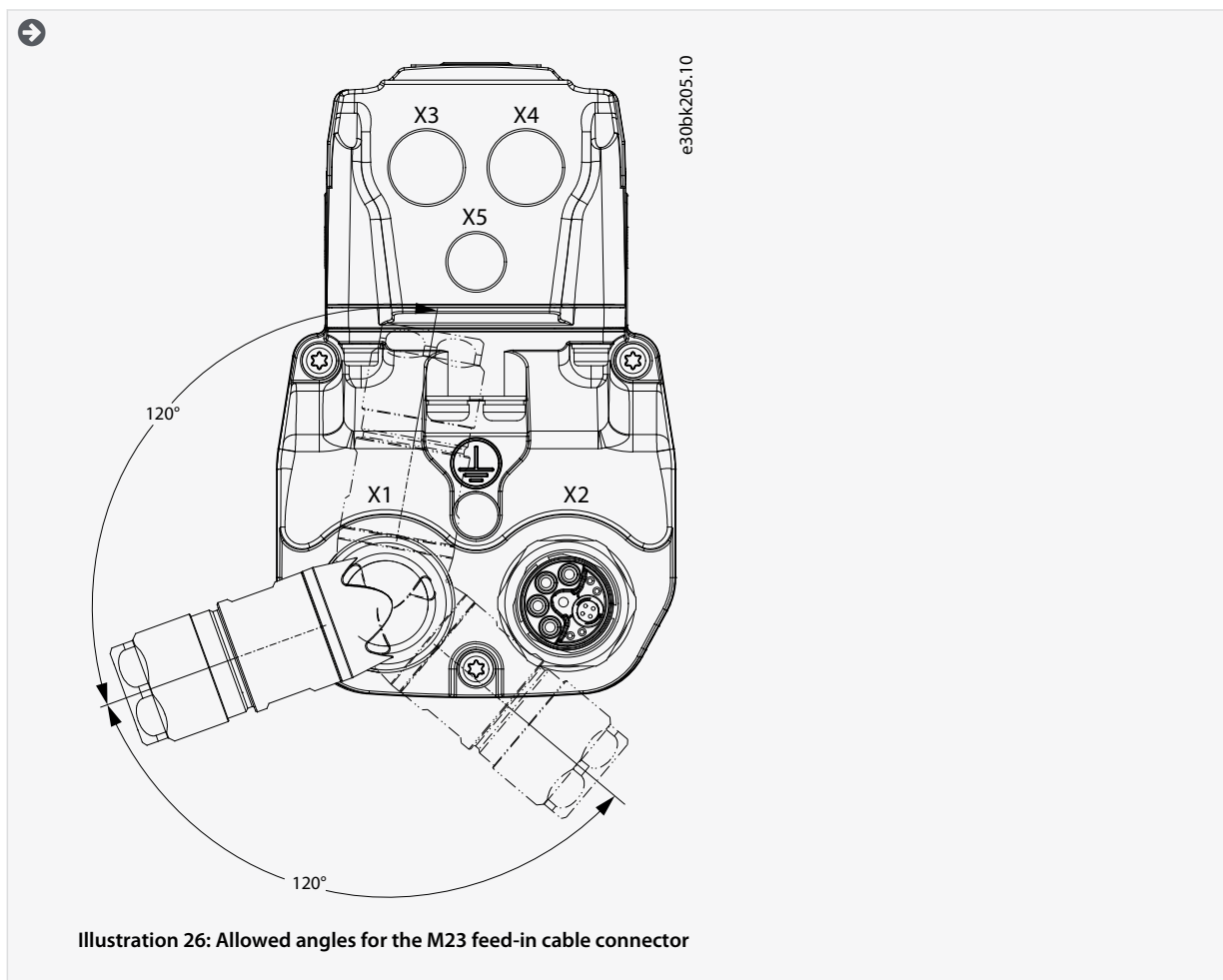
Procedure

1. Align the female connector of the M23 feed-in cable to the male input connector (X1) of the 1st ISD 511 servo drive.

2. Fully rotate the threaded ring of the cable connector counterclockwise. Use the marking OPEN as a reference for the cable connector.
3. Ensure that the marking OPEN on the cable connector is facing the servo drive.
4. Press the connector towards the electronic housing on the servo drive until the sealing on the connector is entirely covered.
5. Tighten the M23 feed-in cable connector by rotating the threaded ring clockwise out of the flat area around the OPEN marking.

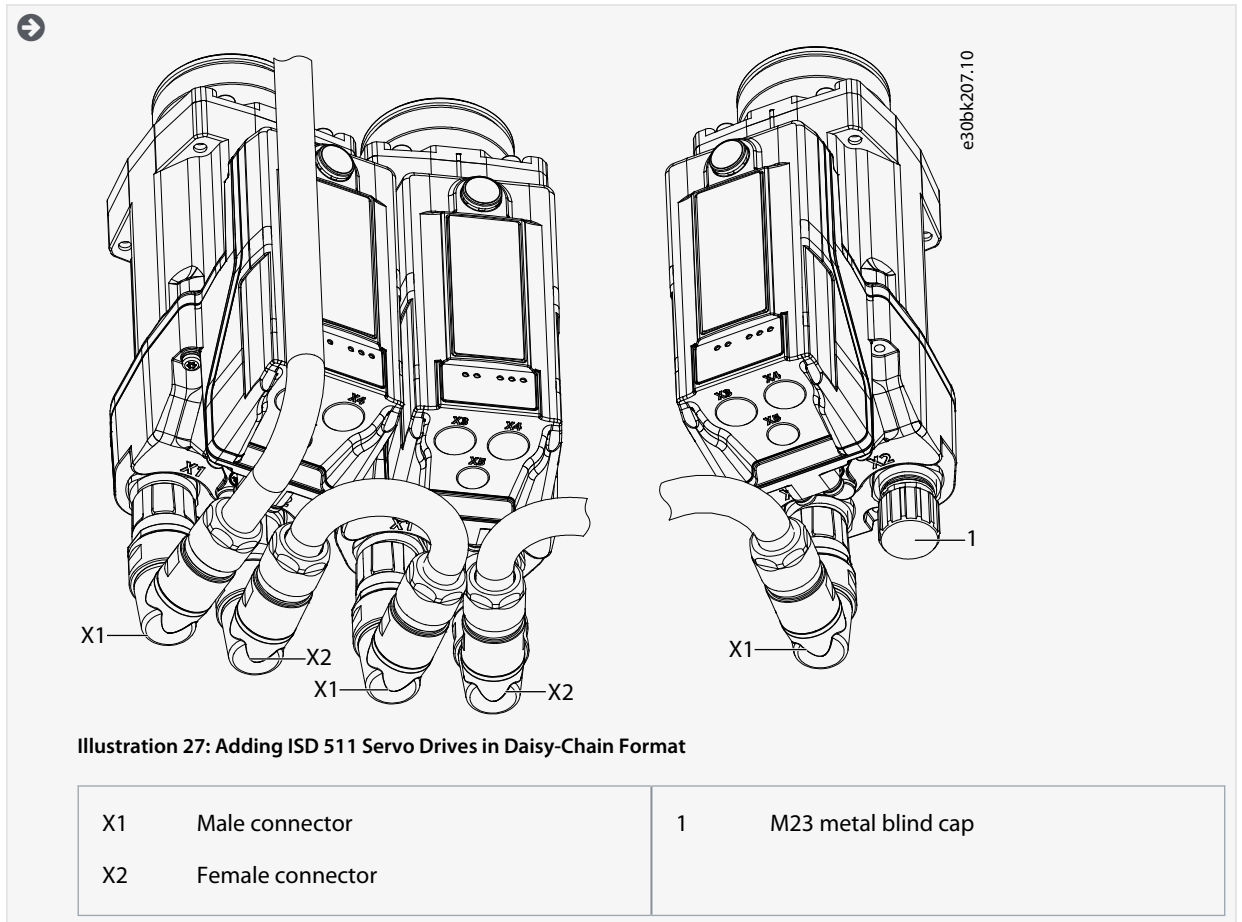


- Adjust the M23 feed-in cable connector to the desired position taking into account the allowed angles.



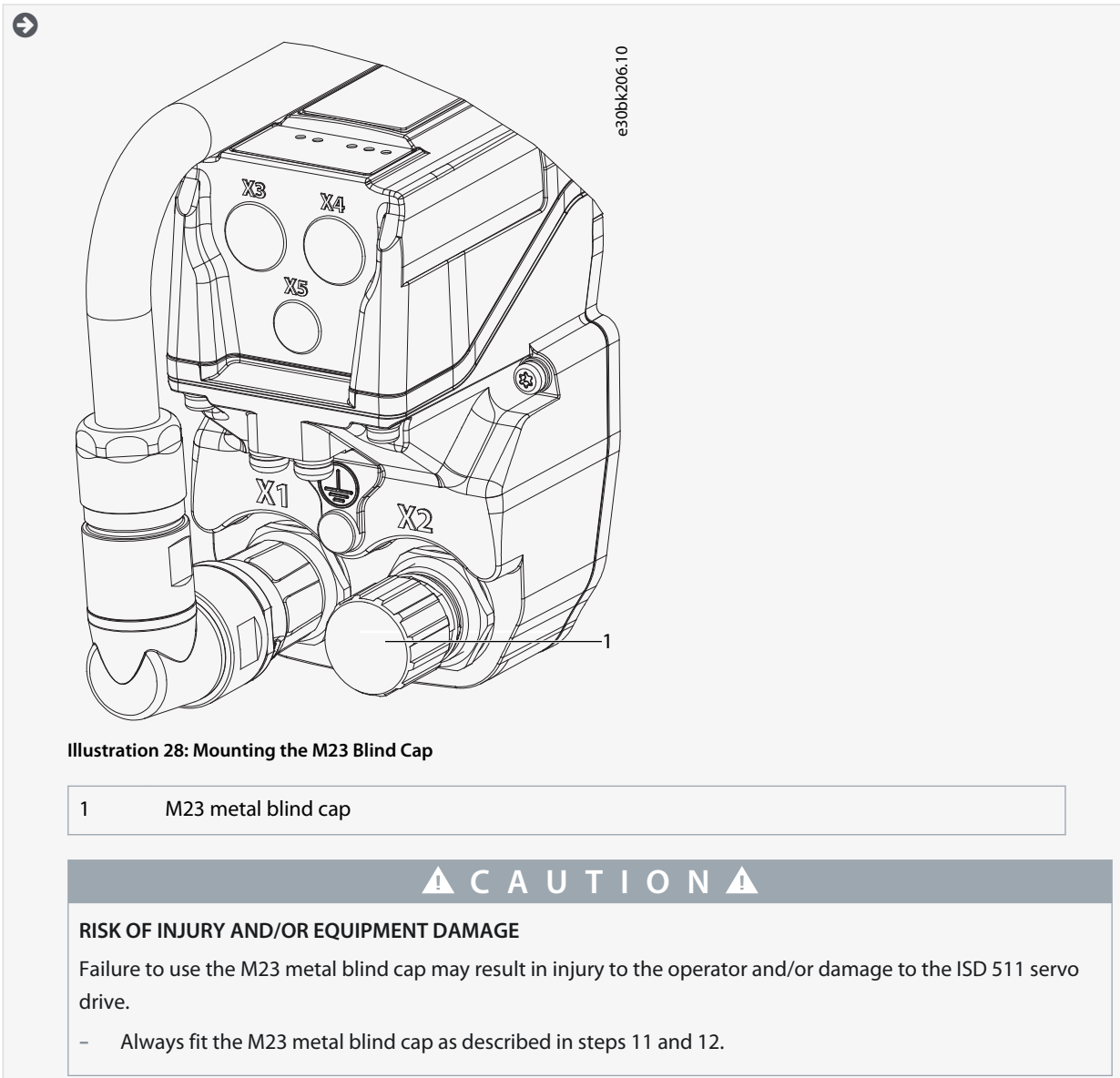
- To add more servo drives in daisy-chain format, connect the male connector of the loop cable to the female connector (X2) of the 1st servo drive.
- Connect the female connector of the loop cable to the male connector (X1) of the next servo drive, and so on.
- Tighten the threaded rings by hand as described in step 5.

10. Ensure that there is no mechanical tension on the cables.



11. Screw the M23 metal blind cap onto the unused M23 female output connector (X2) on the last servo drive in the servo system.

12. Tighten the metal blind cap until the sealing on the connector is covered.



5.9.1.4 Disconnecting Hybrid Cables

Procedure

1. Disconnect the Power Supply Module (PSM 510) from its power source (mains network and U_{AUX}).
2. Wait for the minimum discharge time to elapse.
3. Remove the connector of the feed-in cable from the Decentral Access Module (DAM 510).
4. Rotate the threaded ring on the feed-in cable connector on the servo drive counterclockwise until the marking OPEN on the cable connector is facing the servo drive.
5. Pull the connector away from the electronic housing.
6. Protective metal M23 blind caps are provided for the X1 and X2 connectors. Mount the metal blind caps after removing the corresponding connector.

5.9.2 Connecting the Power Supply Module PSM 510

5.9.2.1 AC Line Choke

It is mandatory to use a 3-phase AC line choke (see [5.9.2.1.1 Connecting 1 PSM 510 to the AC Choke](#) and [5.9.2.1.2 Connecting 2 PSM 510 Modules to the AC Choke with System Splitting](#)).

Table 14: Line Choke Characteristics for 1 PSM 510

Model	Minimum I_{rms} [A]	U_{rms} [V]	Inductance [mH]
PSM 510 (10 kW)	20	500	Minimum: 0.47 Maximum: 1.47
PSM 510 (20 kW)	40	500	Minimum: 0.47 Maximum: 1.47
PSM 510 (30 kW)	60	500	0.47 ±10%

If 2 PSM 510 modules are installed in parallel, use an AC choke as specified in [Table 15](#). See [5.9.2.1.2 Connecting 2 PSM 510 Modules to the AC Choke with System Splitting](#) for further information.

Table 15: Line Choke Characteristics for 2 PSM 510 installed in parallel

Model	Minimum I_{rms} [A]	U_{rms} [V]	Inductance [mH]
PSM 510 (2 x 30 kW)	125	500	0.24 ±10%

Danfoss recommends mounting the AC line choke close to the PSM 510.

The maximum cable length depends on the cross-section, and the required voltage and current at the DC-link.

If the AC line chokes are mounted away from the PSM 510, the maximum cable distance is 5 m.

5.9.2.1.1 Connecting 1 PSM 510 to the AC Choke

Connect the PSM 510 to the electric grid with the correct AC choke for the power size of the PSM 510.

5.9.2.1.2 Connecting 2 PSM 510 Modules to the AC Choke with System Splitting

Ensure the choke used is the correct size based on the combined power of the PSM 510 modules.

When 2 PSM 510 modules are used, the wiring between the AC line choke and each PSM 510 must be the same length within a tolerance of 0.5 m.

Connect each PSM 510 to the AC choke directly. Parallel wiring is not permitted.

If 2 AC chokes are used (1 per PSM 510) and both PSM 510 modules are mounted at the same side of the system splitting, the setup is permitted with derating equal to the AC choke's tolerance referred to 60 kW. For example, 10% derating is 54 kW.

If 2 AC chokes are used (1 per PSM 510) where 1 PSM 510 module is mounted before the splitting and 1 after the splitting, the loads must be balanced equally. Otherwise, the derating of both PSM 510 modules is equal to the AC choke's tolerance. For example, tolerance 10% + 10% means -20% derating.

If 2 AC chokes are used (1 per PSM 510) and 1 PSM 510 module is mounted before the splitting and 1 after the splitting and half of the loads are set before the system splitting and half are set after the system splitting, the setup is permitted with derating equal to the AC choke's tolerance referred to 60 kW. For example, 10% derating is 54 kW.

N O T I C E

- Further information on the EXM 510 module and wiring can be found in [11.6.13 Expansion Module Connector](#).

5.9.2.2 Connecting the Cables on the Power Supply Module PSM 510

5.9.2.2.1 Connecting the Cables on the Top of the Power Supply Module PSM 510

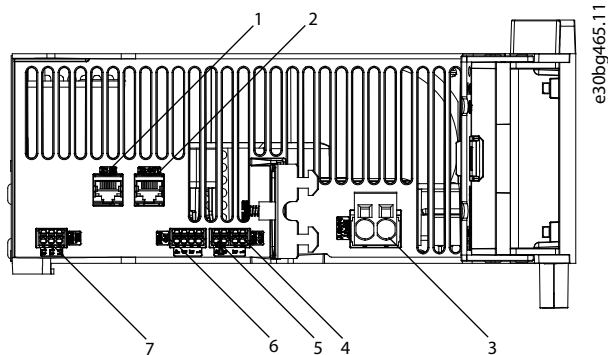


Illustration 29: Connectors on the Top of PSM 510

1	Ethernet connector IN (X1 IN)	5	STO connector OUT (STO PSM)
2	Ethernet connector OUT (X2 OUT)	6	I/O connector (I/O PSM)
3	24/48 V IN connector (INPUT 24/48 V)	7	Relay connector (REL PSM)
4	STO connector IN (STO PSM)		

Procedure

1. Connect the Ethernet cable from the PLC to the Ethernet input connector (X1 IN) [1].
2. Connect the Ethernet cable from the Ethernet output connector (X2 OUT) [2] to the next module.
3. Insert the wires into the 24/48 V IN (INPUT 24/48 V) connector.
4. Insert the 24/48 V IN connector [3].
5. Insert the wires into the STO connector IN (STO PSM) connector.
6. Insert the STO connector IN connector [4].
7. Insert the wires into the STO connector OUT (STO PSM) connector.
8. Insert the STO connector OUT connector [5].
9. If I/Os are required, insert the wires into the I/O connector and insert the connector (I/O PSM) [6].
10. If a relay is required, insert the wires into the relay connector and insert the connector (REL PSM) [7].

5.9.2.2.2 Connecting the Cables on the Bottom of the Power Supply Module PSM 510

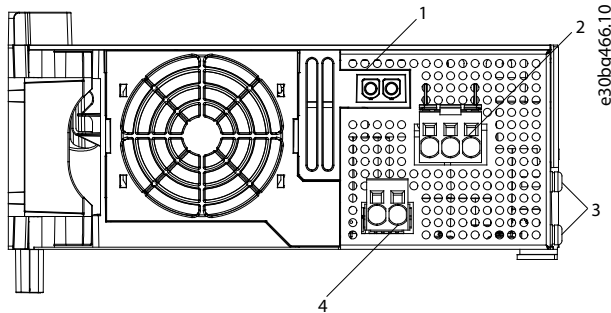


Illustration 30: Connectors on the Bottom of PSM 510

1	Holder for internal brake resistor connector when not in use	3	PE screws
2	AC mains supply connector	4	Internal/external brake resistor connector

Procedure

1. Insert the wires into the AC mains supply connector.
2. Insert the AC mains supply connector [2].
3. If an external brake resistor is required:
 - a. Unplug the internal brake resistor connector [4] and insert the external brake connector in its place.
 - b. Plug the internal brake resistor connector to the internal brake connector holder [1].
4. Connect the PSM 510 to PE using one of the PE screws on the front side [3] and a PE wire. The tightening torque is 3 Nm.

5.9.3 Connecting the Decentral Access Module (DAM 510)

5.9.3.1 Connecting the Cables on the Top of the Decentral Access Module DAM 510

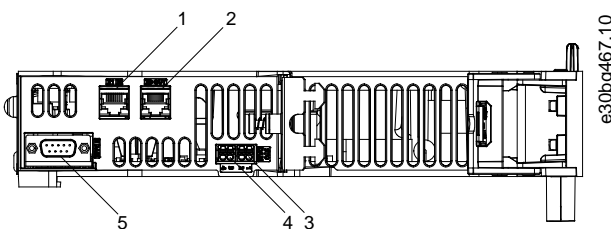


Illustration 31: Connectors on the Top of DAM 510

1	Ethernet connector IN (X1 IN)	4	STO connector OUT (STO DAM)
2	Ethernet connector OUT (X3 OUT)	5	External encoder connector (E DAM)
3	STO connector IN (STO DAM)		

Procedure

1. Connect the Ethernet cable from the output of the previous module to the input connector (X1 IN) [1].
2. Insert the wires from the STO output of the previous module into the 24 V IN (STO input) connector, see [11.6.9.2.1 STO Connectors on the Top of DAM 510](#).
3. Insert the 24 V IN (STO connector IN (STO DAM)) connector [3] into the DAM 510.
4. If required, connect the external encoder connector [5].

5.9.3.2 Connecting the Feed-In Cable

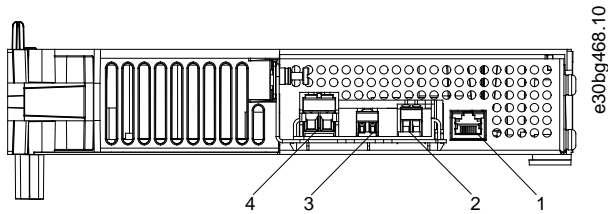


Illustration 32: Connectors on the Bottom of DAM 510

1	Ethernet connector	3	STO out connector
2	AUX connector	4	UDC connector

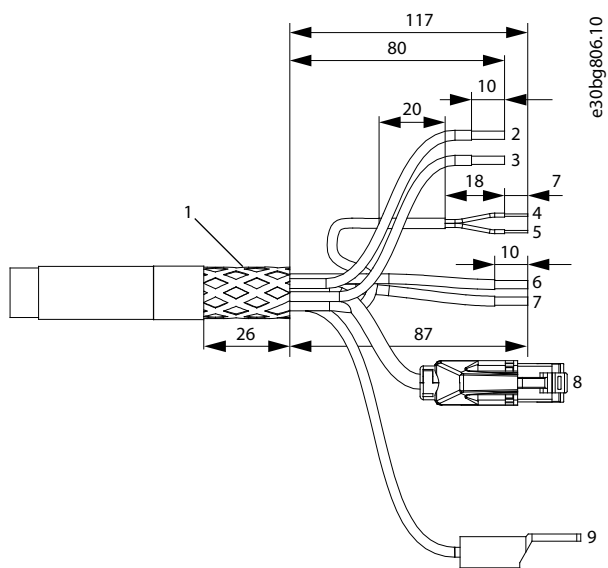


Illustration 33: Feed-In Cable

1	Shielded area	6	AUX+ (red, 2.5 mm ²)
2	UDC+ (black, 2.5 mm ²)	7	AUX- (blue, 2.5 mm ²)
3	UDC- (gray, 2.5 mm ²)	8	Ethernet/fieldbus (green, RJ45 connector)
4	STO+ (pink, 0.5 mm ²)	9	PE (yellow/green, 2.5 mm ² , fork lug)
5	STO- (gray, 0.5 mm ²)		

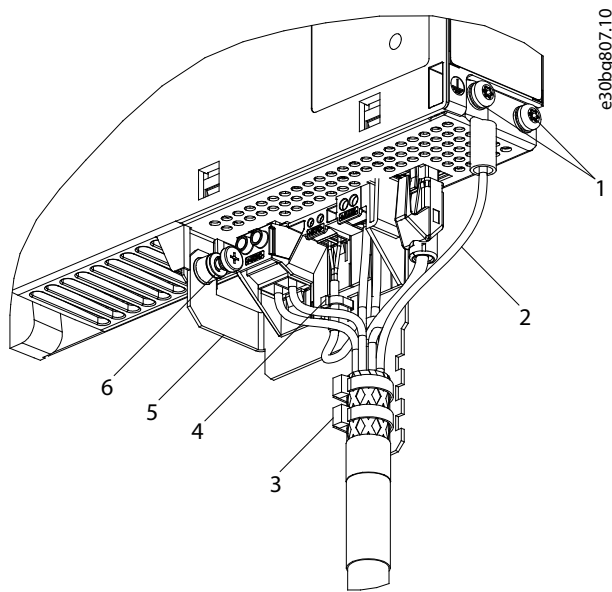


Illustration 34: Connecting the Feed-In Cable

1	Feed-in cable PE screws	4	Cable tie for STO cable
2	Bus connector	5	EMC plate
3	Cable tie for feed-in cable	6	EMC plate screw

Procedure

1. Insert the wires into the UDC, AUX, and STO connectors.
2. Secure the feed-in cable using the cable ties [3], ensuring that the shielded area is positioned exactly under the cable tie.
3. Secure the STO cable using the cable tie [4], ensuring that the shielded area is positioned exactly under the cable tie.
4. Insert the connectors on the feed-in cable into their corresponding terminal block on the DAM 510.
5. Tighten the screw on the EMC plate [6]. The tightening torque is 3 Nm.
6. Insert the RJ45 bus connector [2].
7. Connect the DAM 510 to PE using one of the PE screws on the front side [1] and a PE wire. The tightening torque is 3 Nm.
8. Connect the PE wire of the feed-in cable to the other PE screw on the DAM 510.

5.9.4 Connecting the Auxiliary Capacitors Module ACM 510

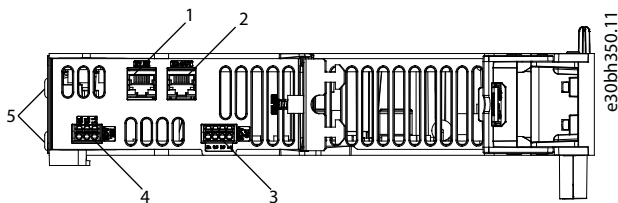


Illustration 35: Connectors on the Top of ACM 510

1	Ethernet connector IN (X1 IN)	3	I/O connector (I/O ACM)
2	Ethernet connector OUT (X2 OUT)	4	Relay connector (REL ACM)

Procedure

1. Connect the Ethernet cable from the output of the previous system module to the input connector (X1 IN) [1].
2. If I/Os are required, insert the wires into the I/O connector (I/O ACM) and insert the connector [3].
3. If a relay is required, insert the wires into the relay connector (REL ACM) and insert the connector [4].

4. Connect the ACM 510 to PE using one of the PE screws on the front side [5] and a PE wire.. The tightening torque is 3 Nm.

5.9.5 Connecting the Expansion Module EXM 510

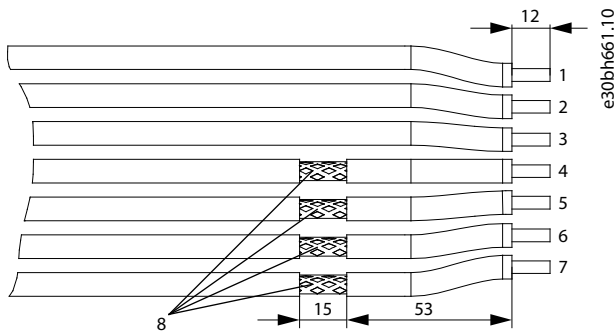


Illustration 36: Expansion Module Cable

1	24/48 V	5	DC-
2	GND	6	DC+
3	Functional earth	7	DC+
4	DC-	8	Shielded area

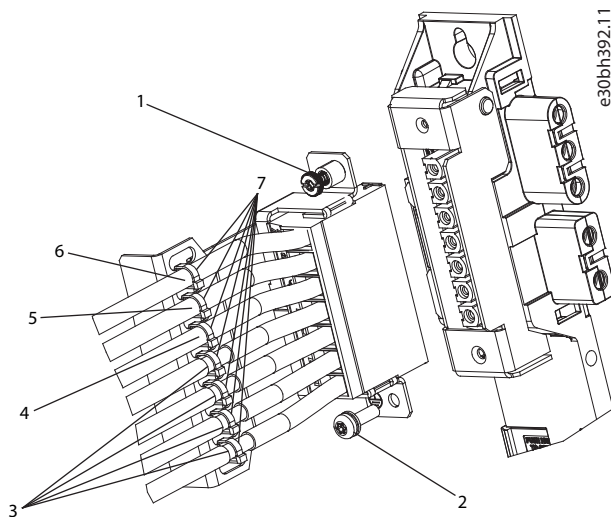


Illustration 37: Connecting the Expansion Module EXM 510

1	EMC shielding plate screw	5	GND cable
2	PE screw	6	24/48 V cable
3	DC cables	7	Cable ties
4	Functional earth cable		

NOTICE

- If 2 separate backlinks are used (connected via 1 or 2 pairs of EXM 510 modules), the 2 grounding bars must be also connected together with a 16 mm² (6 AWG) cable cross-section.
- For cable cross sections see [11.6.13.1 Cable Cross-Sections for EXM 510](#).

Procedure

1. Insert wires [3], [4], [5], and [6] into the expansion connector.

2. Secure the DC cables [3] using the cable ties [7], ensuring that the shielded area is positioned exactly under the cable tie.
3. Secure the cables [4], [5], and [6] using the cable ties [7].
4. Plug the connectors into the backplate.
5. Tighten the screw on the EMC shielding plate [1]. The tightening torque is 3 Nm.
6. Connect the EXM 510 to PE using the PE screw [2] and a PE wire. The tightening torque is 3 Nm.

5.9.6 Connecting the Brake Resistor on the PSM 510

The PSM 510 is connected to the internal brake resistor as shown in [Illustration 38](#).

Alternatively, the PSM 510 can be connected to an external brake resistor. In this case, the internal brake resistor on the PSM 510 must remain unconnected and the connector can be placed in the internal brake resistor connector holder.

Paralleling or series of brake resistors is not permitted.

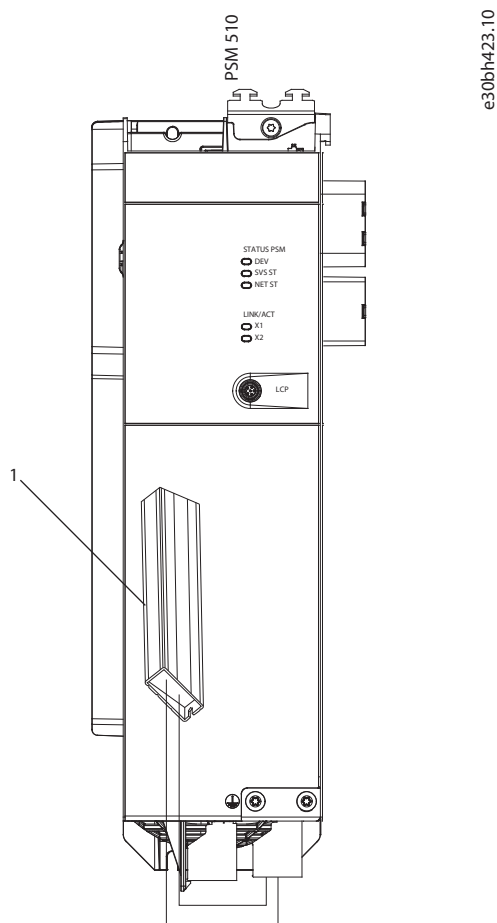


Illustration 38: Connection of Internal Brake Resistor on 1 PSM 510

1	Internal brake resistor
---	-------------------------

When using 2 PSM 510 modules, connect each PSM 510 to its own internal brake resistor as shown in [Illustration 39](#) (factory setting).

Alternative permitted configurations for 2 PSM 510 modules:

- 1 PSM 510 is connected to the internal brake resistor and the other is connected to an external brake resistor.
- Both PSM 510 modules are connected to an external brake resistor. In this case, the internal brake resistor on the PSM 510 must remain unconnected and the connector can be placed in the internal brake resistor connector holder (see [5.9.2.2.2 Connecting the Cables on the Bottom of the Power Supply Module PSM 510](#)).

Paralleling or series of brake resistors is not permitted.

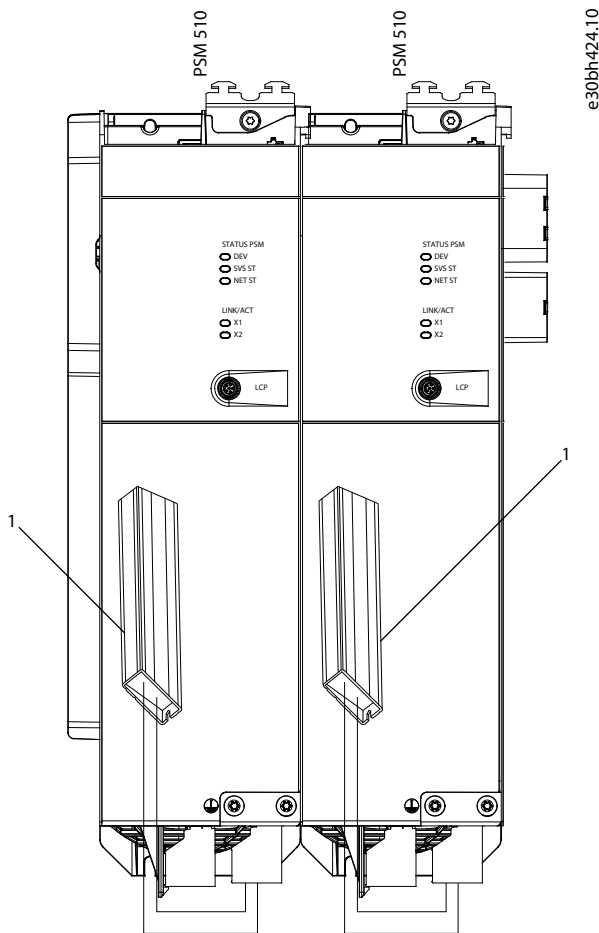


Illustration 39: Connection of Brake Resistor on 2 PSM 510 Modules in Parallel

1	Internal brake resistor
---	-------------------------

6 Commissioning

6.1 Pre-Commissioning Checklist

Always complete these checks before initial commissioning and before commencing operation after extended downtime or storage.

Procedure

1. Check that all the threaded connectors of mechanical and electrical components are firmly tightened.
2. Check that the free circulation of cooling air (inlet and outlet) is assured.
3. Check that the electrical connections are correct.
4. Ensure that contact protection is in place for rotating parts and surfaces that can become hot.
5. If using the STO functionality, conduct the functional safety concept commissioning test (see [8.8 Commissioning Test](#)).

6.2 Switching on the ISD 511 System

Complete the cabling of the servo system before applying power to the ISD 511 servo drives. This cabling provides the supply voltage and the communication signals for the servo system. This is a fundamental requirement for operation of the ISD 511 servo drives.

The servo system can be switched on in 2 ways:

- If the Power Supply Module (PSM 510) is supplied with mains, STO, and U_{AUX} , communication to the PSM 510 internal controller is established and DC-link and U_{AUX} are automatically passed on via the backlink to the DAM 510 and then passed on further to the connected servo drives.
- If the Power Supply Module (PSM 510) is only powered by U_{AUX} , then the PSM 510, DAM 510, and servo drive control units are running.

6.2.1 Procedure for Switching on the ISD 511 System

Procedure

1. Switch on U_{AUX} power to enable communication to the PSM 510, DAM 510, and ISD 511 servo drives to be established.
2. Switch on the mains.
3. Set the PSM 510 to state *Normal operation*.
4. Set the DAM 510 to state *Normal operation*.

Now the PSM 510, DAM 510 and the ISD 511 servo drives are ready for operation.

6.3 Warnings for Commissioning

⚠ WARNING ⚠

UNINTENDED START

The servo system contains servo drives, the PSM 510, and DAM 510 that are connected to the electrical supply network and can start running at any time. This may be caused by a fieldbus command, a reference signal, or clearing a fault condition. Servo drives and all connected devices must be in good operating condition. A deficient operating condition may lead to death, serious injury, damage to equipment, or other material damage when the unit is connected to the electrical supply network.

- Take suitable measures to prevent unintended starts.

6.4 ID Assignment

6.4.1 Overview

The ID assignment functionality is available using either the VLT® Servo Toolbox, the local control panel (LCP), or the dedicated library function blocks provided for Automation Studio™ programming environment.

ID assignment via the VLT® Servo Toolbox or the LCP is only possible when acyclic Ethernet POWERLINK® communication is used.

Ensure Ethernet POWERLINK® master communication is not active when using the VLT® Servo Toolbox to assign IDs to the devices. If Ethernet POWERLINK® cyclic communication is active, perform a power cycle to stop it. Disconnect the PLC and carry out a power cycle before setting IDs. Alternatively, in the POWERLINK® interface, restart the PLC in *ServiceMode* while parameter *Basic Ethernet in Service Mode* is set to *Basic Ethernet enabled*.

ID assignment via Automation Studio dedicated library function block can also be executed with cyclic Ethernet POWERLINK® communication.

6.4.2 Single Device ID Assignment

Setting a node ID to a device can be done via the VLT® Servo toolbox software or via the LCP.

6.4.2.1 Setting the Node ID for a Single Servo Drive Manually using the VLT® Servo Toolbox

When assigning an ID to a single device, use the *Device Information* window in the VLT® Servo Toolbox (see the VLT® Servo Drive System ISD 510, DSD 510, MSD 510 Programming Guide for further information).

6.4.2.2 Setting the Node ID for a Single Servo Drive Manually using the LCP

Procedure

1. Attach the LCP to the PSM 510/DAM 510 that is connected to the servo drives and system modules for which the *Node ID* should be changed.
2. Press the *Hand On* button for >1 s to make the LCP the controlling interface for the PSM 510/DAM 510.
3. Press the *Main Menu* button then scroll down to sub-menu *12-** Ethernet* and press *OK*.
4. Scroll down to sub-menu *12-6* Ethernet POWERLINK* and press *OK*.
5. Change the PSM 510/DAM 510 node ID to the desired value (between 1 and 239) by pressing the *OK* button.
6. Return to the *Main Menu* and select parameter *54-*** ID Assignment*.
7. Select parameter *54-1* Manual*.
8. PSM 510 only: In parameter *54-01 Epl id assignment line*, select either Ethernet port X1 or X2. The PSM 510 will assign IDs to the selected device via the selected port and the fieldbus network. On DAM 510, port X2 will be used automatically.
9. Select parameter *54-12 Epl ID assignment start id* then select a valid value (between 1 and 239). The value will be assigned to the device at the specified position index. The PSM 510/DAM 510 connected to the LCP is at position 0 and the 1st reachable device on the selected port is position index 1 and so on.
10. Select parameter *54-14 Manual Epl ID assignment start* and change the status from *[0] ready* to *[1] start*.
11. Press *OK* to confirm the selection then wait for the ID assignment procedure to complete.
12. Check that the ID assignment was completed successfully using parameters:
 - a. Parameter *54-15 Epl ID assignment state*
 - b. Parameter *54-16 Epl ID assignment error code*
 - c. Parameter *54-17 Epl ID assignment device count*
13. Carry out a power cycle to ensure that all ID changes are in effect and operational on the fieldbus.

If an error occurs during ID assignment, the detected error is shown on the LCP. The following errors may be reported:

- Invalid NMT state
- Invalid comment
- Invalid Ethernet port
- Invalid node ID
- ID assignment failed
- Duplicate MAC address
- Invalid SW version
- Incomplete assignment
- No device found
- Internal error

6.4.3 Multiple Device ID Assignment

Use the VLT® Servo Toolbox to set node IDs to multiple connected devices. Use the LCP to set the IDs of all the servo drives connected to a Decentral Access Module (DAM 510) or Power Supply Module (PSM 510) at the same time (the LCP must be connected to the DAM 510/PSM 510 for this purpose).

6.4.3.1 Setting the Node IDs Automatically for Multiple Servo Drives and System Modules using the VLT® Servo Toolbox

When assigning IDs to several devices (for example, when setting up a new network), use the VLT® Servo Toolbox subtool *DAM ID assignment* (see the *VLT® Servo Drive System ISD 510, DSD 510, MSD 510 Programming Guide* for further information).

6.4.3.2 Setting the Node IDs Automatically for Multiple Servo Drives using the LCP

Procedure

1. Attach the LCP to the PSM 510/DAM 510 that is connected to the servo drives and system modules for which the *Node ID* should be changed.
2. Press the *Hand On* button for >1 s to make the LCP the controlling interface for the PSM 510/DAM 510.
3. Press the *Main Menu* button then scroll down to sub-menu *12-** Ethernet* and press *OK*.
4. Scroll down to sub-menu *12-6* Ethernet POWERLINK* and press *OK*.
5. Change the PSM 510/DAM 510 *Node ID* to the desired value (between 1 and 239) by pressing the *OK* button.
6. Return to the Main Menu and select parameter *54-** ID Assignment*.
7. Select parameter *54-0* Automatic*.
8. PSM 510 only: In parameter *54-01 Epl id assignment line*, select either Ethernet port X1 or X2. The PSM 510 will assign IDs to the selected device via the selected port and the fieldbus network. On DAM 510, port X2 will automatically be used.
9. Select parameter *54-02 Epl ID assignment start id* then select a valid value (between 1 and 239). The value will be assigned to the device at the specified position index. Note that the PSM 510/DAM 510 connected to the LCP is at position 0 and the 1st reachable device on the selected port is position index 1 and so on.
10. Select parameter *54-07 Epl ID assignment direction* and select between *[0] ascending* and *[1] descending*.
11. Select parameter *54-03 Automatic Epl ID assignment start* and change the status from *[0] ready* to *[1] start*.
12. Press *OK* to confirm the selection then wait for the ID assignment procedure to complete.
13. Check that the ID assignment was completed successfully using parameters:
 - Parameter *54-04 Epl ID assignment state*
 - Parameter *54-05 Epl ID assignment error code*
 - Parameter *54-06 Epl ID assignment device count*
14. Carry out a power cycle to ensure that all ID changes are in effect and operational on the fieldbus.

If an error occurs during ID assignment, the detected error will be shown on the LCP. The following errors may be reported:

- Invalid NMT state
- Invalid comment
- Invalid ethernet port
- Invalid node ID
- ID assignment failed
- Duplicate MAC address
- Invalid SW version
- Incomplete assignment
- No device found
- Internal error

6.4.3.3 Setting the Node IDs Automatically for Multiple Servo Drives and System Modules using the LCP

Use the automatic PSM 510/DAM 510 ID assignment to automatically set the *Node IDs* on all servo drives and system modules for a specified PSM 510/DAM 510 line. This functionality is contained in parameter group *54- ** ID Assignment* in sub-group *54-0* Automatic*.

Procedure

1. Attach the LCP to the PSM 510/DAM 510 that is connected to the servo drives and system modules for which the *Node ID* should be changed.
2. PSM 510 only: Select the Ethernet port (X1 or X2) to be used for ID assignment using parameter *54-01 Epl id assignment line*.
3. Select the start ID in parameter *54-02 Epl id assignment start id*.

4. Select parameter *54-03 Automatic Epl ID assignment start* and change the status from [0] ready to [1] start.
5. Select the ID assignment start in parameter *54-03 Automatic Epl id assignment start*.
6. Check that the ID assignment was completed successfully using parameters:
 - Parameter *54-04 Epl ID assignment state*
 - Parameter *54-05 Epl ID assignment error code*
 - Parameter *54-06 Epl ID assignment device count*
7. Carry out a power cycle to ensure that all ID changes are in effect and operational on the fieldbus.

6.4.3.4 Setting the Node ID Automatically for Multiple Servo Drives using the PLC with an Automation Studio Dedicated Library Function Block

The PLC library provides a new function block called *DD_NodeIDAssignment_DAM*, which facilitates automated node ID assignment. This function block can be used to start a node ID assignment via DAM 510 with the settings given in the input variables. After sending the settings and starting the assignment, the function block polls the DAM 510 until the assignment has been completed and then returns the number of devices that got a new ID.

N O T I C E

- The DAM 510 and all devices reachable through the drive's ethernet port require 2 power cycles to successfully complete the assignment process.

6.5 Programming with Automation Studio

6.5.1 Requirements for Programming with Automation Studio™

The following files are required to integrate the ISD 511 servo drives and the PSM 510 and DAM 510 into an Automation Studio™ project:

- Package of libraries for the MSD 510 servo system: *VLT_FlexMotion_Automation_Studio_Lib_Vx.y.z.zip*
- XDD file (XML Device Description) for the ISD 511 servo drive: *0x0200008D_ISD511.xdd*
- XDD file (XML Device Description) for the Power Supply Module (PSM 510): *0x0200008D_PSM.xdd*
- XDD file (XML Device Description) for the Decentral Access Module (DAM 510): *0x0200008D_DAM.xdd*

6.5.2 Creating an Automation Studio™ Project

The procedures described in this chapter apply to Automation Studio™ Version V4.x unless otherwise specified.

Information on how to install Automation Studio™ can be found in detail in the Automation Studio™ help. Open the B&R Help Explorer and go to [Automation software → Software Installation → Automation Studio].

Information on how to create a project in Automation Studio™ can be found in detail in the Automation Studio™ help.

V4.x:

Open the B&R Help Explorer and go to [Automation Software → Getting Started → Creating programs with Automation Studio → Example project for a target system with CompactFlash].

6.5.3 Including the Servo Motion Libraries into an Automation Studio™ Project

Procedure

1. In the *Logical View*, open the menu entry [File → Import...].
2. In the next window, select the *Danfoss_VLT_ServoMotion_V_x_y_z.zip* file (according to the location on the hard drive).
3. Click on *Open*.
4. Assign the libraries to the CPU in the next window.

5. Click on *Finish*. Now the libraries are integrated into the Automation Studio™ project.

- DDS_Drive
 - Contains program organization units (POUs) defined by PLCopen® (name starting with MC_) and POUs defined by Danfoss (name starting with DD_). The Danfoss POUs provide additional functionality for the axis.
 - It is possible to combine POUs defined by PLCopen® with POUs defined by Danfoss.
 - The names of the POUs that target the servo drive all end with _DDS.
- DDS_PSM
 - Contains POUs defined by Danfoss (name starting with DD_) and provide the functionality for the Power Supply Module (PSM 510).
 - The names of the POUs that target the PSM 510 all end with _PSM.
- DDS_DAM
 - Contains POUs defined by Danfoss (name starting with DD_) and provide the functionality for the Decentral Access Module (DAM 510).
 - The names of the POUs that target the DAM 510 all end with _DAM.
- DDS_ACM
 - Contains POUs defined by Danfoss (name starting with DD_) and provide the functionality for the Auxiliary Capacitors Module (ACM 510).
 - The names of the POUs that target the ACM 510 all end with _ACM.
- DDS_BasCam
 - Contains POUs for the creation of basic CAMs.
- DDS_LabCam
 - Contains POUs for the creation of labeling CAMs.
- DDS_Intern
 - Contains POUs that are needed internally for the libraries.
 - Do not use these POUs in an application.

When integrating the DDS_Drive package, some standard libraries are integrated automatically, unless they are already part of the project.

N O T I C E

- Do not remove these libraries otherwise the Danfoss servo motion libraries will not work.

6.5.4 Constants within the DDS_Drive Library

Inside the library, the following lists of constants are defined:

- Danfoss_VLT_ServoMotion
 - Contains the version information of the library.
- DDS_AxisErrorCodes
 - Constants for error codes of the axis.
 - Error codes can be read using the function block *MC_ReadAxisError_DDS* and/or *DD_ReadAxisWarning_DDS*.
- DDS_AxisTraceSignals
 - Constants for the trace signals of the axis.
 - Intended to be used with the function block *DD_Trace_DDS*.
- DDS_BasCam
 - Constants for the creation of basic CAMs.
- DDS_CamParsingErrors

- Constants for parsing problems of a CAM.
- Error reason is returned by function block *MC_CamTableSelect_DDS*.
- *DDS_FB_ErrorConstants*
 - Constants for errors inside POU's.
 - The reason is given in an output *ErrorInfo.ErrorID* that is available in all POU's.
- *DDS_Intern*
 - Constants which are needed internally for the library.
 - They are not intended to be used in an application.
- *DDS_LabCam*
 - Constants for the creation of labeling CAMs.
- *DDS_SdoAbortCodes*
 - Constants for errors concerning reading and writing of parameters.
 - The reason is given in an output *AbortCode* that is available in several POU's.
- *PSM_ErrorCodes*
 - Constants for error codes of the Power Supply Module (PSM 510).
 - Error codes can be read using the function block *DD_ReadPsmError_PSM* and/or *DD_ReadPsmWarning_PSM*.
- *PSM_TraceSignals*
 - Constants for the trace signals of the Power Supply Module (PSM 510).
 - Intended to be used with the function block *DD_Trace_PSM*.
- *DAM_ErrorCodes*
 - Constants for error codes of the Decentral Access Module (DAM 510).
 - Error codes can be read using the function block *DD_ReadDamError_DAM* and/or *DD_ReadDamWarning_DAM*.
- *DAM_TraceSignals*
 - Constants for the trace signals of the Decentral Access Module (DAM 510).
 - Intended to be used with the function block *DD_Trace_DAM*.
- *ACM_ErrorCodes*
 - Constants for error codes of the Auxiliary Capacitors Module (ACM 510).
 - Error codes can be read using the function block *DD_ReadAcmError_ACM* and/or *DD_ReadAcmWarning_ACM*.
- *ACM_TraceSignals*
 - Constants for the trace signals of the Auxiliary Capacitors Module (ACM 510).
 - Intended to be used with the function block *DD_Trace_ACM*.

6.5.5 Instantiating *AXIS_REF_DDS* in Automation Studio™

Procedure

1. Create 1 instance of function block *AXIS_REF_DDS* (located in folder *DDS_Drive*) for every servo drive that has to be controlled or monitored.
2. To create a link to the physical servo drive, link each instance of *AXIS_REF_DDS* to 1 physical servo drive. This makes it the logical representation of 1 physical servo drive.
 - Open the *Logical View*.
 - Initialize each instance with its node number and the slot name it is connected to (for example, IF3).
 - Initialize each instance of a drive with its *DriveType*.

Example

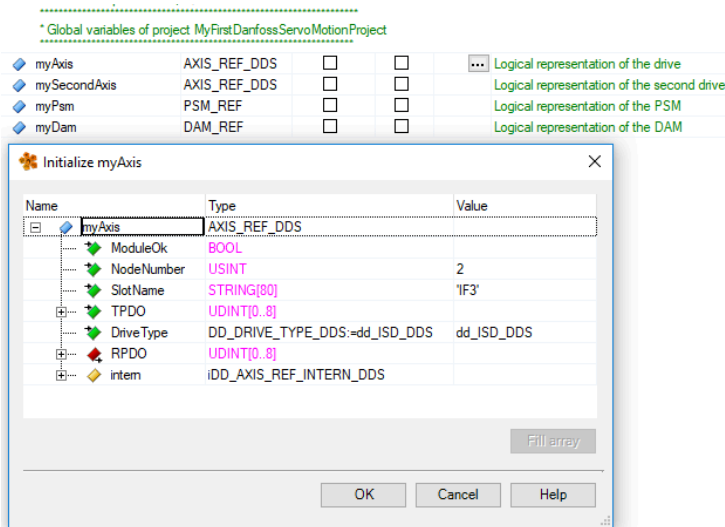


Illustration 40: Instantiation of AXIS_REF_DDS and Setting of Initial Values

6.5.6 Instantiating PSM_REF in Automation Studio™

Procedure

1. Create 1 instance of function block *PSM_REF* (located in folder *DDS_PSM*) for every Power Supply Module (PSM 510) that has to be controlled or monitored.
2. To create a link to the physical PSM 510, link each instance of *PSM_REF* to 1 physical PSM 510. This makes it the logical representation of 1 physical PSM 510.
 - Open the *Logical View*.
 - Initialize each instance with its node number and the slot name it is connected to (for example, IF3).

6.5.7 Instantiating DAM_REF in Automation Studio™

Procedure

1. Create 1 instance of function block *DAM_REF* (located in folder *DDS_DAM*) for every Decentral Access Module (DAM 510) that has to be controlled or monitored.
2. To create a link to the physical DAM 510, link each instance of *DAM_REF* to 1 physical DAM 510. This makes it the logical representation of 1 physical DAM 510.
 - Open the *Logical View*.
 - Initialize each instance with its node number and the slot name it is connected to (for example, IF3).

6.5.8 Instantiating ACM_REF in Automation Studio™

Procedure

1. Create 1 instance of function block *ACM_REF* (located in folder *DDS_ACM*) for every Auxiliary Capacitors Module (ACM 510) that has to be controlled or monitored.
2. To create a link to the physical ACM 510, link each instance of *ACM_REF* to 1 physical ACM 510. This makes it the logical representation of 1 physical ACM 510.
 - Open the *Logical View*.
 - Initialize each instance with its node number and the slot name it is connected to (for example, IF3).

6.5.9 Importing a Servo Drive into Automation Studio™

NOTICE

- For each physical servo drive, add 1 entry to the *Physical View* of Automation Studio™.

6.5.9.1 Version V4.x

Procedure

1. Select the menu entry [Tools → Import Fieldbus Device...].
2. Select the XDD file (for example, *0x0200008D_ISD511_S.xdd*) from its location on the hard drive. The device is then known to Automation Studio™.
3. Now add the servo drive to the Ethernet POWERLINK® interface of the controller in the *Physical View*:
 - Select the menu entry [Open → System Designer] to show the *System Designer*.
 - To add a hardware module to the *Physical View* or *System Designer*, select the servo drive in the group *POWERLINK* in the *Hardware Catalog* toolbox.
 - Drag the selected module to the desired position to connect it to the selected hardware module, network interface, or slot.
 - To change the node number, right-click on the device and select [Node Number → Change Node Number].

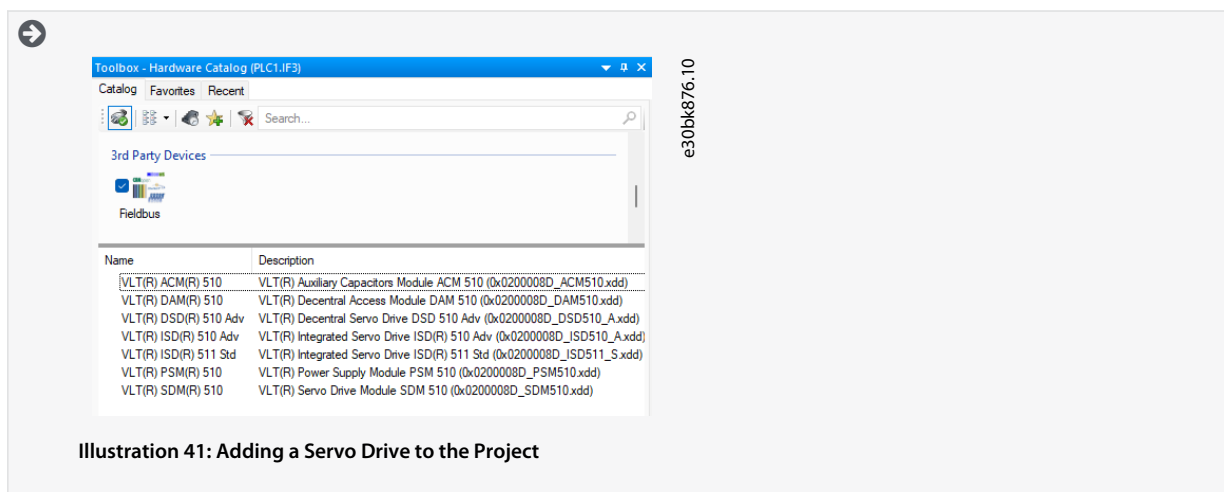


Illustration 41: Adding a Servo Drive to the Project

6.5.10 Importing PSM 510, DAM 510 and ACM 510 into Automation Studio™

NOTICE

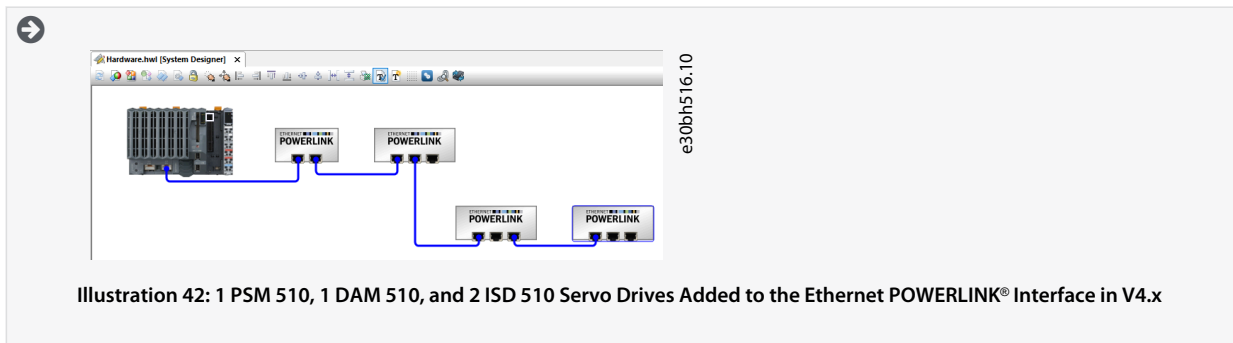
- For each physical Power Supply Module (PSM 510), Decentral Access Module (DAM 510), and Auxiliary Capacitors Module (ACM 510), add 1 entry to the *Physical View* of Automation Studio™.

6.5.10.1 Version V4.x

Procedure

1. Select the menu entry [Tools → Import Fieldbus Device...].
2. Select the XDD file for the PSM 510, DAM 510, or ACM 510 from its location on the hard drive. The device is then known to Automation Studio™.
 - Power Supply Module (PSM 510): *0x0200008D_PSM.xdd*
 - Decentral Access Module (DAM 510): *0x0200008D_DAM.xdd*
 - Auxiliary Capacitors Module (ACM 510): *0x0200008D_ACM.xdd*
3. Now add the PSM 510, DAM 510, or ACM 510 to the Ethernet POWERLINK® interface of the controller in the *Physical View*:
 - Select the menu entry [Open → System Designer] to show the *System Designer*.

- To add a hardware module to the *Physical View* or *System Designer*, select the PSM 510, DAM 510, or ACM 510 in the group *POWERLINK* in the *Hardware Catalog* toolbox.
- Drag the selected module to the desired position to connect it to the selected hardware module, network interface, or slot.
- To change the node number, right-click on the device and select [Node → Change Node Number].
PSM: Danfoss_VLT_R_PSM
DAM: Danfoss_VLT_R_DAM
ACM: Danfoss_VLT_R_ACM



6.5.11 I/O Configuration and I/O Mapping

Procedure

1. Parameterize the I/O configuration of the ISD 510/DSD 510 servo drives so that the library has access to all necessary objects.
 - Right-click on the entry of the ISD 511 servo drive and select *Open I/O Configuration* in V3.0.90 and *Configuration* in V4.x.
 - In the *Channels* section, change the *Cyclic transmission* of the following objects:
All sub-indexes of object 0x5050 (Lib pdo rx_I5050 ARRAY[]) to *Write*.
All sub-indexes of object 0x5051 (Lib pdo tx_I5051 ARRAY[]) to *Read*.
2. Parameterize the I/O configuration of the Power Supply Module (PSM 510), Decentral Access Module (DAM 510), and Auxiliary Capacitors Module (ACM 510) so that the library has access to all necessary objects.
 - Right-click on the entry of the PSM/DAM/ACM and select *Open I/O Configuration* in V3.0.90 and *Configuration* in V4.x.
 - In the *Channels* section, change the *Cyclic transmission* of the following objects:
All sub-indexes of object 0x5050 (Lib pdo rx_I5050 ARRAY[]) to *Write*.
All sub-indexes of object 0x5051 (Lib pdo tx_I5051 ARRAY[]) to *Read*.

These settings configure the cyclic communication with the device. These parameters are required for the library to work.

NOTICE

- It is possible to use copy and paste to apply the same I/O configuration to multiple devices of the same type.

- Set *Module supervised* to off for the servo drives and the PSM 510/DAM 510/ACM 510. The parameter is found in the I/O configuration of the device.

Name	Value	Description
Lib pdo rx_I5050_ARRAY		
LibPdoRx1_I5050_S01		
Cyclic transmission	Write	
Datatype	UDINT	UNSIGNED32
Init value		Set at bootup (clear to pre)
LibPdoRx2_I5050_S02		
Cyclic transmission	Write	
Datatype	UDINT	UNSIGNED32
Init value		Set at bootup (clear to pre)
LibPdoRx3_I5050_S03		
Cyclic transmission	Write	
Datatype	UDINT	UNSIGNED32
Init value		Set at bootup (clear to pre)
LibPdoRx4_I5050_S04		
LibPdoRx5_I5050_S05		
LibPdoRx6_I5050_S06		
LibPdoRx7_I5050_S07		
LibPdoRx8_I5050_S08		
LibPdoRx9_I5050_S09		
Lib pdo tx_I5051_ARRAY		
LibPdoTx1_I5051_S01		
Cyclic transmission	Read	
Datatype	UDINT	UNSIGNED32
Init value		Set at bootup (clear to pre)
LibPdoTx2_I5051_S02		
Cyclic transmission	Read	
Datatype	UDINT	UNSIGNED32
Init value		Set at bootup (clear to pre)
LibPdoTx3_I5051_S03		
Cyclic transmission	Read	
Datatype	UDINT	UNSIGNED32
Init value		Set at bootup (clear to pre)
LibPdoTx4_I5051_S04		
LibPdoTx5_I5051_S05		
LibPdoTx6_I5051_S06		
LibPdoTx7_I5051_S07		
LibPdoTx8_I5051_S08		
LibPdoTx9_I5051_S09		

Illustration 43: I/O Configuration of an ISD 511 Device

Channel Name	Data Type	Task Class	PV or Channel Name	Inverse	Simulate
ModuleOK	BOOL			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx1_I5050_S01	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx2_I5050_S02	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx3_I5050_S03	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx4_I5050_S04	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx5_I5050_S05	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx6_I5050_S06	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx7_I5050_S07	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx8_I5050_S08	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoRx9_I5050_S09	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx1_I5051_S01	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx2_I5051_S02	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx3_I5051_S03	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx4_I5051_S04	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx5_I5051_S05	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx6_I5051_S06	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx7_I5051_S07	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx8_I5051_S08	UDINT			<input type="checkbox"/>	<input type="checkbox"/>
LibPdoTx9_I5051_S09	UDINT			<input type="checkbox"/>	<input type="checkbox"/>

Illustration 44: I/O Mapping after Successful Configuration

- Map the inputs and outputs of the instance of the *AXIS_REF_DDS* function block and the physical data points of the ISD 511 servo drive (here *myAxis* is an instance of *AXIS_REF_DDS*):

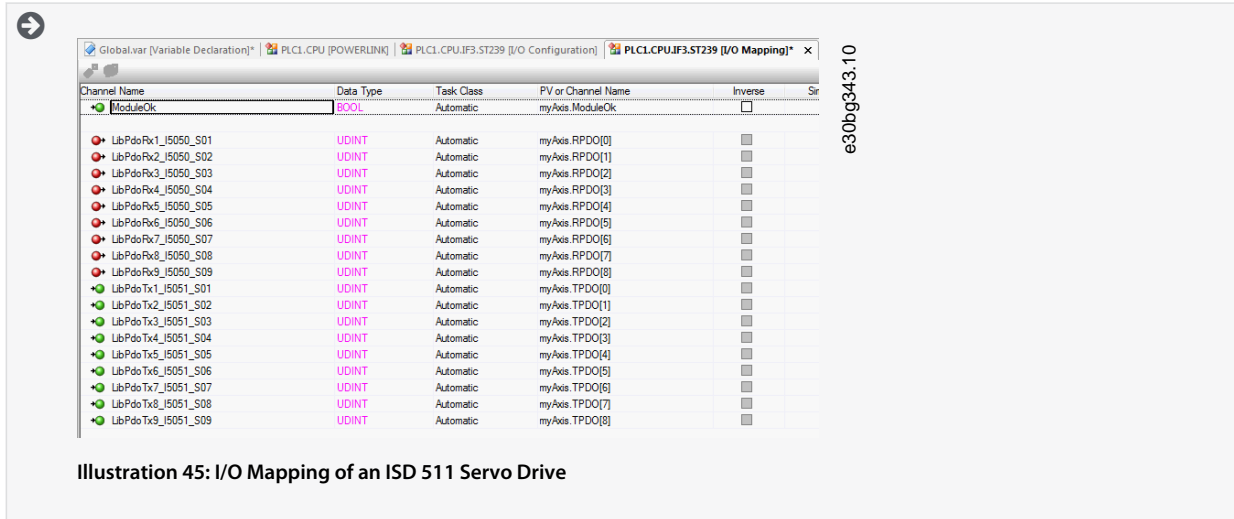


Illustration 45: I/O Mapping of an ISD 511 Servo Drive

- Map the inputs and outputs of the instance of the *PSM_REF*, *DAM_REF*, and *ACM_REF* function blocks and the physical data points of the PSM 510/DAM 510/ACM 510 accordingly.

6.5.12 Setting the PLC Cycle Time

The minimum cycle time is 400 μs. The servo system devices can run Ethernet POWERLINK® cycle times in multiples of 400 μs and multiples of 500 μs. The devices are automatically parameterized by the PLC on start-up, depending on the Ethernet POWERLINK® configuration of the physical interface.

The Ethernet POWERLINK® configuration can be accessed by right-clicking [PLK → Configuration] in the *Physical View*.

NOTICE

- Ensure that the task cycle times of the PLC program and Ethernet POWERLINK® are the same. Otherwise, data could be lost and performance reduced.

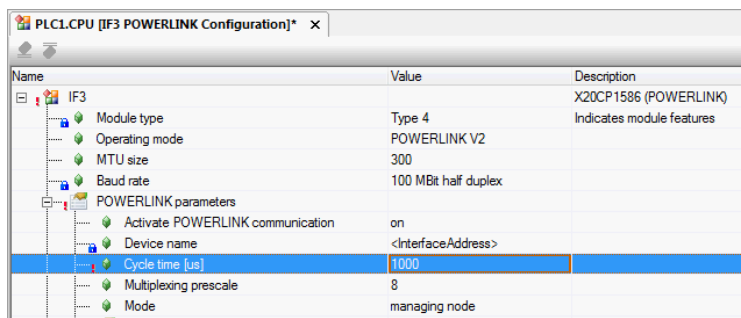


Illustration 46: Ethernet POWERLINK® Configuration Window to Parameterize Ethernet POWERLINK® Cycle Time

Procedure for setting the PLC time in Automation Studio™

- Right-click [CPU → Open Software Configuration] for V3.0.90 and [CPU → Configuration → Timing] for V4.x in the *Physical View*.
- Ensure that the PLC cycle time is the same as the Ethernet POWERLINK® cycle time.

6.5.13 Connecting to the PLC

Information on how to connect to the PLC can be found in detail in the Automation Studio™ Help.

Version V4.x:

Open the *B&R Help Explorer* and go to [Automation Software → Getting Started → Creating programs in Automation Studio → Example project for a target system with CompactFlash].

6.5.14 Programming Guidelines for Automation Studio™

Recommendations for implementation:

- Initialize parameters that usually do not change only once at the beginning of the program. In Automation Studio™, use the `_INIT` section.
- Call up function blocks that provide status or error information with *Enable* input at the beginning of the program.
- Use 1 instance of the function block *MC_Power_DDS* for every axis to control its power stage. Call up this function block in every PLC cycle.
- Use 1 instance of the function block *DD_Power_PSM* for every PSM 510 to control the DC-link voltage on the output. Call up this function block in every PLC cycle.
- Use 1 instance of the function block *DD_Power_DAM* for every DAM 510 to control the DC-link voltage on the output. Call up this function block in every PLC cycle.
- Use 1 instance of the function block *DD_Power_ACM* for every ACM 510 to control the connection between the DC-link and the ACM 510. Call up this function block in every PLC cycle.
- Call up function blocks that execute (motion) commands at the end of the program.
- Do not use any POUs from the library (folder) *DDS_Intern*.
- Do not change the reference to the axis on a function block while it is busy.

NOTICE

- The full parameter list can be found in the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® Flexmotion™) Programming Guide**.

6.6 VLT® Servo Toolbox Software

6.6.1 Overview

The VLT® Servo Toolbox is a standalone PC software designed by Danfoss. It is used for parameterization and diagnostics of the system modules. It is also possible to operate the devices in a non-productive environment.

NOTICE

- The VLT® Servo Toolbox software must be allowed for every firewall profile (private/public/domain).

The VLT® Servo Toolbox contains several subtools that provide various functionalities.

Table 16: Important Subtools

Subtool	Description
Scope	For visualization of the tracing functionality of the ISD 511, PSM 510, DAM 510, and ACM 510.
Parameter list	For reading/writing parameters.
Firmware update	For updating the firmware on the devices.
Drive control	For operating the servo drives for testing purposes.
PSM control	For operating the Power Supply Module (PSM 510) for testing purposes.
DAM control	For operating the Decentral Access Module (DAM 510) for testing purposes.
ACM control	For operating the Auxiliary Capacitors Module (ACM 510) for testing purposes.

Subtool	Description
CAM editor	For designing CAM profiles for the servo drives.
Configuration parameter	For setting up the motor and feedback parameters, and PID settings.
Drive commissioning	For motor inertia measurement.

The detailed description of the VLT® Servo Toolbox functionality and the full parameter lists can be found in the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® FlexMotion™) Programming Guide**.

6.6.2 System Requirements

To install the VLT® Servo Toolbox software, the PC must meet the following requirements:

- Supported hardware platforms: 32-bit, 64-bit.
- Supported operating systems: Windows 10, Windows 11.
- .NET framework version: 4.7.
- Minimum hardware requirements: 512 MB RAM, Intel Pentium 4 with 2.6 GHz or equivalent, 100 MB hard disk space.
- Recommended hardware requirements: Minimum 1 GB RAM, Intel Core i5/i7 or compatible.

6.6.3 Installing the VLT® Servo Toolbox Software

Administrator rights are required to install the software with the Windows operating system. If necessary, contact your system administrator.

Procedure

1. Check that your system meets the system requirements specified in [6.6.2 System Requirements](#).
2. Download the VLT® Servo Toolbox installation file from the Danfoss website.
3. Right-click on the .exe file and select *Run as administrator*.
4. Follow the on-screen instructions to complete the installation process.

6.6.4 VLT® Servo Toolbox Communication

6.6.4.1 Overview

This chapter describes the Ethernet-specific network interface settings needed by the VLT® Servo Toolbox. There are 2 basic communication methods: direct communication and indirect communication. Their particular network settings are described in the respective subchapters.

Read and perform the steps with care. Incorrect network configurations can lead to loss of connectivity of a network interface.

6.6.4.2 Firewall

Depending on the firewall settings and the fieldbus used, the messages sent and received by the VLT® Servo Toolbox may be blocked by the firewall on the VLT® Servo Toolbox host system. This may lead to a loss of communication and the inability to communicate with the devices on the fieldbus. Therefore, ensure that the VLT® Servo Toolbox is allowed to communicate through the firewall on the VLT® Servo Toolbox host system. Inappropriate changes to firewall settings may lead to security issues.

N O T I C E

- When using a dedicated network interface, the VLT® Servo Toolbox must be allowed to communicate specifically through this network interface.

6.6.4.3 Indirect Communication

6.6.4.3.1 Overview

Communication between ISD 511 devices and the VLT® Servo Toolbox through a PLC is called indirect communication. Ethernet-based fieldbus communication (marked A in the graphic) takes place between the PLC and the ISD 511 devices. However, there is non-fieldbus communication between the PLC and the VLT® Servo Toolbox host system.

In the scenario shown, the PLC has the master function and uses cyclic communication with the devices. Therefore, not all functionalities of the VLT® Servo Toolbox, for example the drive control, can be used.

The restrictions when using indirect communication are detailed in the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® Flexmotion™) Programming Guide**.

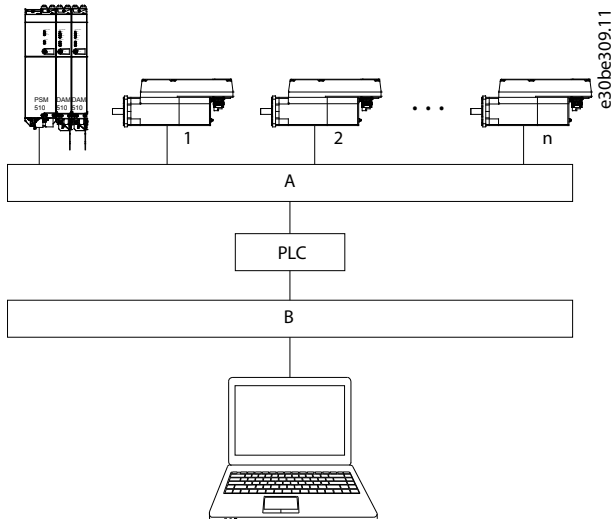


Illustration 47: Logical View of Indirect Ethernet-based Fieldbus Communication (Communication via PLC)

A	Fieldbus
B	VLT® Servo Toolbox host system

NOTICE

- The logical view only shows the connectivity from a high-level software perspective and does not reflect the actual physical topology of the network.

6.6.4.3.2 Network Settings for Indirect Communication

Any network interface can be used to communicate through a PLC. A dedicated network interface is not required.

When establishing the communication through a PLC, the VLT® Servo Toolbox configures a routing table using the selected Network Address Translation (NAT). Adding a route to the Windows routing table requires administrator privileges. Therefore, administrator credentials may be requested when initializing the connection.

6.6.4.3.3 Enabling Indirect Communication

Carry out the following steps to enable indirect communication.

NOTICE

When observing the network packets via Wireshark®, checksum offloading often causes confusion as the network packets to be transmitted are handed over to Wireshark® before the checksums have been calculated. Wireshark® shows these empty checksums as invalid, even though the packets contain valid checksums when they leave the network hardware later. Use 1 of these 2 methods to avoid this checksum offloading problem:

- Turn off the checksum offloading in the network driver if possible.
- Turn off the checksum validation of the specific protocol in the Wireshark® preferences.

Disable IPv6 on the network interfaces used for communication on the PC:

Procedure

1. Open the *Network and Sharing Center*.
2. Select *Change adapter settings*.

3. Right-click on the network interface used for fieldbus communication and select *Properties*.
4. If the TCP/IPv6 is available for the network interface, disable it.

6.6.4.4 Direct Communication

6.6.4.4.1 Overview

For Ethernet-based fieldbus communication (direct communication), the VLT® Servo Toolbox must use a dedicated network interface on the VLT® Servo Toolbox host system. Do not use this network interface simultaneously for any other communication.

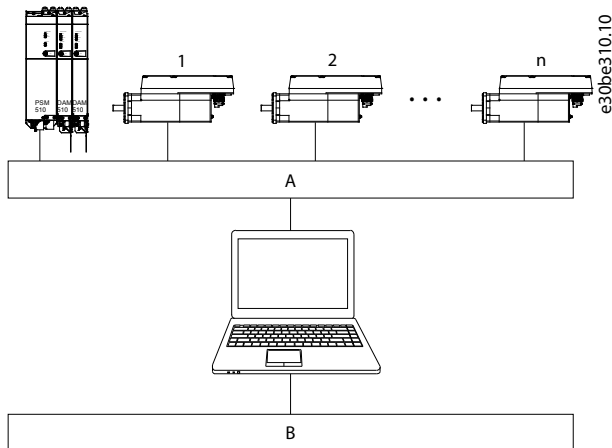


Illustration 48: Logical View of Direct Ethernet-based Fieldbus Communication

A	Ethernet-based fieldbus communication
B	VLT® Servo Toolbox host system

⚠ WARNING ⚠

- The logical view only shows the connectivity from a high-level software perspective and does not reflect the actual physical topology of the network.

6.6.4.4.2 Network Settings for Direct Communication with Ethernet POWERLINK®

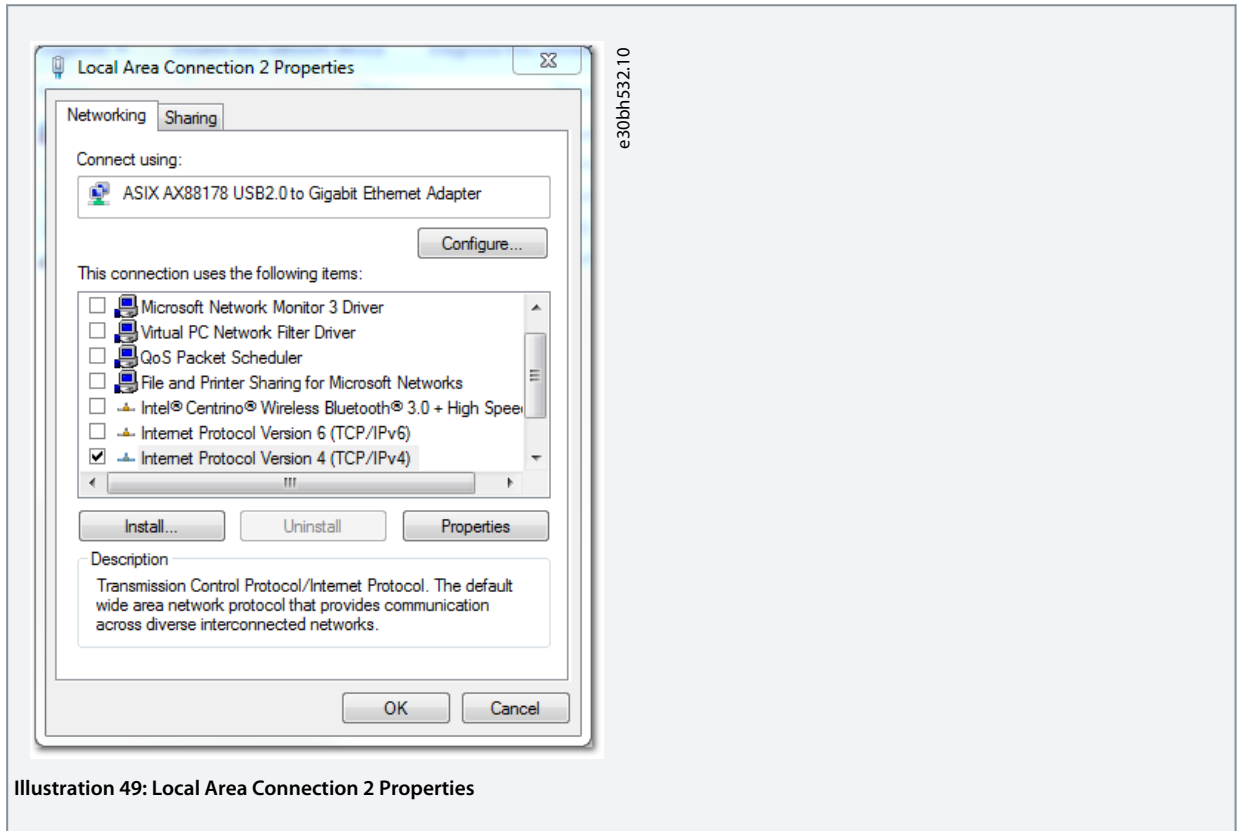
Disable all network protocols except TCP/IPv4 on the network interface used for direct Ethernet POWERLINK® communication. This prevents other PC software or the operating system using this network interface for other tasks, such as file and printer sharing and network discovery. Disabling these protocols reduces the number of non-relevant packets sent over the network interface and thus reduces the overall network load.

6.6.4.4.3 Disabling Unused Protocols on the Network Interface on the PC

Procedure

1. Open the *Network and Sharing Center*.
2. On the left, click on *Change adapter settings*.
3. Right-click on the network interface used for fieldbus communication and select *Properties*.
4. Uncheck all checkboxes except the one for *Internet Protocol Version 4 (TCP/IPv4)*.

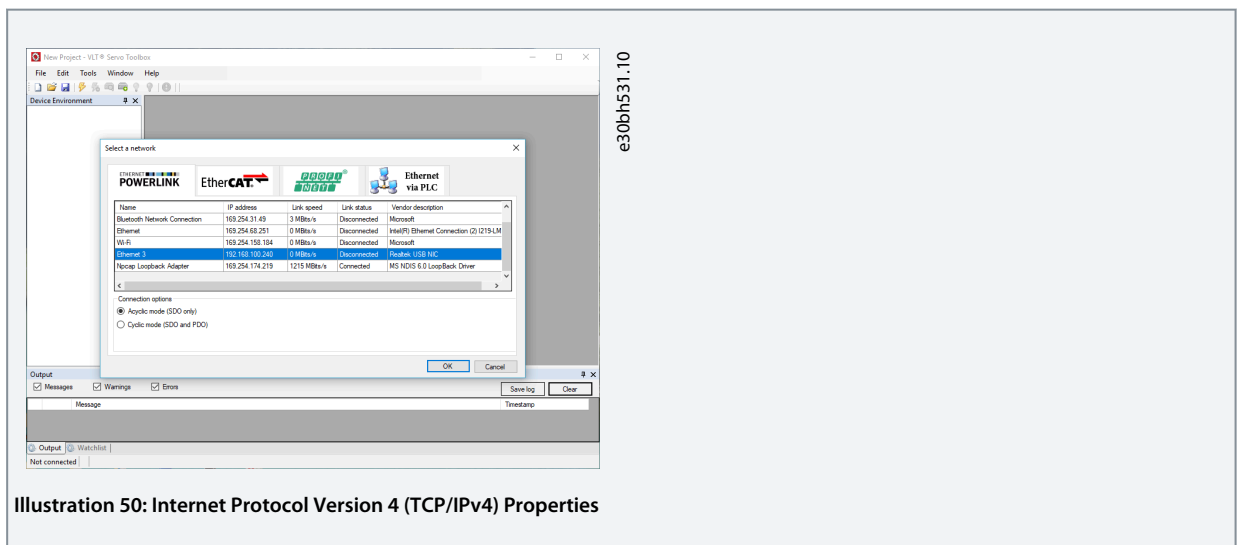
5. Disable the *IPv4 Checksum offload* on the network interfaces as described in [6.6.4.3.3 Enabling Indirect Communication](#).



6.6.4.4 Setting the Correct Ethernet POWERLINK® Master IP Address

Procedure

1. Open the *Network and Sharing Center*.
2. On the left, click on *Change adapter settings*.
3. Right-click on the network interface used for fieldbus communication and select *Properties*.
4. Click on *Internet Protocol Version 4 (TCP/IPv4)* (the checkbox must be checked) and then click on *Properties*.
5. Select *Use the following IP address* and use 192.168.100.240 as the IP address and 255.255.255.0 as the subnet mask. Leave all other fields empty.



6.7 Motion Library

6.7.1 Function Blocks

The PLC library provides function blocks that support the functionality of the servo system and comply with this standard: PLCopen® Technical Specification Function blocks for motion control (Formerly Part 1 and Part 2) Version 2.0 March 17, 2011.

In addition to the PLCopen® functionality, Danfoss offers further functions for the servo system.

The following PLCopen® characteristics apply to all function blocks:

- Commanding (using the inputs)
- Signaling (behaviour of the outputs)
- General calling conventions

NOTICE

- See the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® Flexmotion™) Programming Guide** for further information on the available function blocks and their behavior.

6.7.2 Simple Programming Template for Automation Studio

Detailed information on how to open the sample project within the ISD package in Automation Studio™ can be found in the Automation Studio™ Help. Open the B&R Help Explorer and go to [Programming → Examples → Adding sample programs] and follow the instructions for library samples.

7 Operation

7.1 Operating Modes

The ISD 511 servo drives implement several modes of operation.

The behavior of the servo drive depends on the activated mode of operation. It is possible to switch between the modes while the servo drive is enabled.

The supported modes of operation are according to CANopen® CiA DS 402 and ISD-specific modes of operation. All supported modes of operation are available for Ethernet POWERLINK®.

The various modes of operation are described in detail in the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® FlexMotion™) Programming Guide**.

Inertia measurement mode	This mode measures the inertia of an axis. It is used to measure the mechanical inertia and friction of the servo drive and the external load to optimize the control loop settings.
Profile velocity mode	In profile velocity mode, the servo drive is operated under velocity control and executes a movement with constant speed. Additional parameters, such as acceleration and deceleration, can be parameterized.
Profile position mode	In profile position mode, the servo drive is operated under position control and executes absolute and relative movements. Additional parameters, such as velocity, acceleration, and deceleration, can be parameterized.
Profile torque mode	In profile torque mode, the servo drive is operated under torque control and executes a movement with constant torque. Linear ramps are used. Additional parameters, such as torque ramp and maximum velocity, can be parameterized.
Homing mode	In homing mode, the application reference position of the servo drive can be set. Several homing methods, such as homing on actual position, homing on block, limit switch, or home switch, are available.
CAM mode	In CAM mode, the servo drive executes a synchronized movement based on a master axis. The synchronization takes place via a CAM profile that contains slave positions corresponding to master positions. CAMs can be designed graphically with the VLT® Servo Toolbox software, or can be parameterized via the PLC. The guide value can be provided by an external encoder, virtual axis, or the position of another axis. It is used as the master position within the synchronous modes.
Gear mode	In gear mode, the servo drive executes a synchronized movement based on a master axis by using a gear ratio between the master and the slave position. The guide value can be provided by an external encoder, virtual axis, or the position of another axis. It is used as the master position within the synchronous modes.
Cyclic synchronous position mode	In cyclic synchronous position mode, the trajectory generator of the position is located in the control device, not in the servo drive.
Cyclic synchronous velocity mode	In cyclic synchronous velocity mode, the trajectory generator of the velocity is located in the control device, not in the servo drive.

7.1.1 Motion Functions

Function	Description
Digital CAM switch	This functionality controls whether the digital output is enabled or disabled, depending on the axis position. It performs a function comparable to switches on a motor shaft. Forward and backward movements of the axis position are allowed. On and off compensation and hysteresis can be parameterized.
Touch probe	This functionality stores the position actual value at a rising or falling edge of the configured digital input.

7.2 Operating Status Indicators

The operating status of the ISD 511 servo drives, PSM 510, DAM 510, and ACM 510 is indicated via the LEDs on each device.

7.2.1 Operating LEDs on the ISD511 Servo Drive

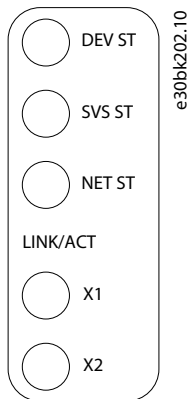


Illustration 51: Operating LEDs on ISD 511 Servo Drive

Table 17: Operating LEDs on ISD 511 Servo Drive

LED	Color	Flash status	Description
DEV ST	Green	On	Servo drive is in state <i>Operation enabled</i> .
		Flashing	Auxiliary voltage is applied.
	Red	On	Servo drive is in <i>Fault</i> or <i>Fault reaction active</i> state.
		Flashing	DC-link voltage is not applied.
SVS ST	Green	On	24 V safety supply is applied.
		Off	24 V safety supply is not applied.
NET ST	Green/red	Fieldbus dependent	Network status of the device (see corresponding fieldbus standard).
LINK/ACT X1 (Link/activity status of <i>Hybrid In (X1)</i>)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X2 (Link/activity status of <i>Hybrid Out (X2)</i>)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.

7.2.2 Operating LEDs on the PSM 510

STATUS PSM
 **DEV**

e30bg576.11

 **SVS ST**
 **NET ST**
LINK/ACT
 **X1**
 **X2**

Illustration 52: Operating LEDs on PSM 510

Table 18: Operating LEDs on PSM 510

LED	Color	Flash status	Description
DEV	Green	On	Device is in state <i>Operation enabled</i> .
		Flashing	Device is in state <i>Standby</i> or <i>Power-up</i> .
	Red	On	Device is in state <i>Fault</i> or <i>Fault reaction active</i> .
		Flashing	Input mains is not applied.
SVS ST	Green	On	24 V safety supply is applied.
		Off	24 V safety supply is not applied.
NET ST	Green/red	Fieldbus dependent	Network status of the device (see corresponding fieldbus standard). ⁽¹⁾
LINK/ACT X1 (Link/activity status of <i>In</i>)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X2 (Link/activity status of <i>Out</i>)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.

¹ POWERLINK®: Refer to the corresponding fieldbus standard.

7.2.3 Operating LEDs on the DAM 510

STATUS DAM

DEV

SVS ST

NET ST

AUX

e30b9577.11

LINK/ACT

X1

X2

X3

Illustration 53: Operating LEDs on DAM 510

Table 19: Operating LEDs on DAM 510

LED	Color	Flash status	Description
DEV	Green	On	Device is in state <i>Operation enabled</i> .
		Flashing	Device is in state <i>Standby or Power-up</i> .
	Red	On	Device is in state <i>Fault or Fault reaction active</i> .
		Flashing	DC-link is not applied at the input.
SVS ST	Green	On	24 V safety supply is applied.
		Off	24 V safety supply is not applied.
NET ST	Green/red	Fieldbus dependent	Network status of the device (see corresponding fieldbus standard). ⁽¹⁾
AUX (State of the auxiliary voltage)	Green	On	Auxiliary voltage is applied to the output connector.
		Off	Auxiliary voltage is not applied to the output connector.
	Red	On	Auxiliary voltage undervoltage detected in the hardware.
LINK/ACT X1 (Link/activity of <i>In</i>)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X2 (Link/activity status of <i>Hybrid Out</i>)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X3	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.

LED	Color	Flash status	Description
(Link/activity status of <i>Out</i>)		Off	No link.

¹ POWERLINK®: Refer to the corresponding fieldbus standard.

7.2.4 Operating LEDs on the ACM 510

STATUS ACM

- DEV
- CAP ST
- NET ST

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LINK/ACT

- X1
- X2

Illustration 54: Operating LEDs on ACM 510

Table 20: Operating LEDs on ACM 510

LED	Color	Flash status	Description
DEV	Green	On	Device is in state <i>Operation enabled</i> .
		Flashing	Device is in state <i>Standby</i> or <i>Power-up</i> .
	Red	On	Device is in state <i>Fault</i> or <i>Fault reaction active</i> .
		Flashing	DC-link is not applied at the input.
CAP ST	Green	On	Capacitors fully charged.
		Flashing	Capacitors charging/discharging.
		Off	Capacitors discharged.
NET ST	Green/red	Fieldbus dependent	Network status of the device (see corresponding fieldbus standard). ⁽¹⁾
LINK/ACT X1 (Link/activity of <i>In</i>)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X2	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.

LED	Color	Flash status	Description
(Link/activity status of <i>Out</i>)		Off	No link.

¹ POWERLINK®: Refer to the corresponding fieldbus standard.

8 Safety Concept

8.1 Functional Description

The servo system integrates the safety function Safe Torque Off (STO). The safety function is available in daisy-chain format, which is possible between all system modules except ACM 510 (cables are not included). The hybrid cable passes the STO signal from the Decentral Access Module (DAM 510) to all ISD 511 servo drives in the chain. Once STO is activated (safe state), no torque is generated on the ISD 511 servo drives. Reset of the safety function and diagnostics can be carried out via the PLC.

NOTICE

- Use STO shielded wiring.
- Use the STO function when performing mechanical work on the servo system or affected area of a machine to avoid a mechanical hazard. However, the STO function does not provide electrical safety.

8.2 Safety Precautions

⚠ WARNING ⚠

UNCONTROLLED MOVEMENT

External forces on the motor could cause an uncontrolled and hazardous movement that could result in death or serious injury.

- Equip the motor with additional measures for preventing uncontrolled and hazardous movement, for example mechanical brakes.

⚠ WARNING ⚠

RISK OF ELECTRICAL SHOCK

The STO function does **not** isolate mains voltage to the servo system or auxiliary circuits. Failure to isolate the mains voltage supply and wait for the specified discharge time to elapse could result in death or serious injury.

- Only perform work on electrical parts of the system or the ISD 511 drives after isolating the mains voltage supply and waiting for the discharge time to elapse.

⚠ WARNING ⚠

RISK OF RESIDUAL ROTATION

Due to failures in the power semiconductor of the drive, a residual rotation can result from a fault that could result in death or serious injury. The rotation can be calculated to angle = $360^\circ / (\text{number of poles})$.

- Take this residual rotation into consideration and ensure that it does not pose a safety risk.

⚠ WARNING ⚠

LED STATUS RELIABILITY

Status indicators (LEDs) are not reliable for safety functions.

- Only use status indicators for general diagnostics during commissioning and troubleshooting.

NOTICE

- After installing the STO function, perform a commissioning test. A passed commissioning test is mandatory after initial installation and after each change to the safety installation (see [8.8 Commissioning Test](#)).

NOTICE

- If required, implement a manual reset function according to EN ISO 13849-1. For automatic restart without manual reset, observe the requirements detailed in paragraph 6.3.3.2.5 of EN ISO 12100:2010 or equivalent standard.

N O T I C E

- Carry out a risk assessment to select the correct stop category for each stop function in accordance with EN 60204-1.
- When designing the machine application, consider timing and distance for coast to stop (Stop Category 0 or STO). See EN 60204-1 for further information.
- All signals connected to the STO must be supplied by a PELV supply.

8.3 Qualified Personnel for Working with Functional Safety

The STO function can only be installed, programmed, commissioned, maintained, and decommissioned by qualified personnel. Qualified personnel for the functional safety concept are qualified electrical engineers, or persons who have received training from qualified electrical engineers and are suitably experienced to operate devices, systems, plant, and machinery in accordance with the general standards and guidelines for safety technology.

Furthermore, they must:

- Be familiar with the basic regulations concerning health and safety/accident prevention.
- Have read and understood the safety guidelines given in this manual.
- Have a good knowledge of the generic and specialist standards applicable to the specific application.

Users of power drive systems (safety-related) (PDS(SR)) are responsible for:

- Hazard and risk analysis of the application.
- The overall safety of the application.
- Identifying safety functions required and allocating SIL or PL to each of the functions, other subsystems, and the validity of signals and commands from them.
- Designing appropriate safety-related control systems, such as hardware, software, and parameterization.

8.4 Applied Standards and Compliance

Use of the STO function requires that all provisions for safety, including relevant laws, regulations, and guidelines, are satisfied.

The integrated STO function complies with the following standards:

- IEC 61508-1 to 2: 2010 SIL 2
- EN 61508-1 to 2: 2010 SIL 2
- IEC 61800-5-2: 2016 SIL 2
- EN 61800-5-2: 2017 SIL 2
- EN ISO 13849-1: 2015, PL d, Cat. 3
- EN ISO 13849-2: 2012, PL d, Cat. 3

The ISD 511 can be used in the application area of EN IEC 62061:2021 and where Stop Category 0 (uncontrolled stop), according to IEC 60204-1:2016 or EN 60204-1:2018, is needed.

8.5 Abbreviations and Conventions

Table 21: Safety-related Abbreviations and Conventions

Abbreviation	Reference	Description
Cat.	EN ISO 13849-1	Category B, 1–4
DC	–	Diagnostic coverage
FIT	–	Failure in time Failure rate: 1E-9/hour
HFT	EN IEC 61508	Hardware fault tolerance HFT = n means that n + 1 faults may lead to a loss of the safety function.
MTTF _D	EN ISO 13849-1	Mean time to failure – dangerous

Abbreviation	Reference	Description
		Unit: years
PFH	EN IEC 61508	Probability of dangerous failures per hour Take this value into account if the safety device is operated in high demand mode or in continuous operating mode, where the frequency of demands for operation made on a safety-related system occurs more than once per year.
PL	EN ISO 13849-1	Performance level A discrete level used to specify the capability of safety-related parts of a system to perform safety-oriented functions under foreseeable conditions. Levels: a–e.
SFF	EN IEC 61508	Safe failure fraction [%] Proportion of safe failures and detected dangerous failures of a safety function or a subsystem as a percentage of all possible failures.
SIL	EN IEC 61508 EN IEC 62061	Safety integrity level
STO	EN IEC 61800-5-2	Safe Torque Off

8.6 Installation

Only Danfoss cables can be used for the installation of the servo system, however cables from other suppliers can be used for the user connection to the STO terminal **STO DAM (Pins 3 and 4)** on the Decentral Access Module (DAM 510).

Safety relays that have a plus and minus switching output signal can be directly connected to the servo system to activate STO.

The example in [Illustration 55](#) shows the basic connection to be made for the STO function. A suitable safety device to switch it off is not supplied by Danfoss. The STO is activated by opening STO+ and STO–.

Table 22: Activation of STO Function

STO+	STO–	STO function
24 V	GND	STO deactivated
Open	GND	STO activated
24 V	Open	STO activated
Open	Open	STO activated

NOTICE

- Do not exceed 30 V at the STO inputs.
- STO is activated if the plus input is between –3 V and +3 V.
- STO is deactivated if the plus input is between +21.6 V and +26.4 V.

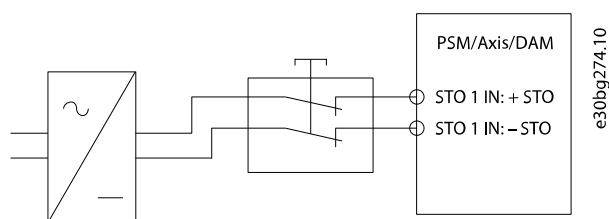


Illustration 55: Safety Relay with Plus and Minus Switching Output

Signals with test pulses must not have test pulses of >1 ms. Longer pulses may lead to reduced availability of the servo system.

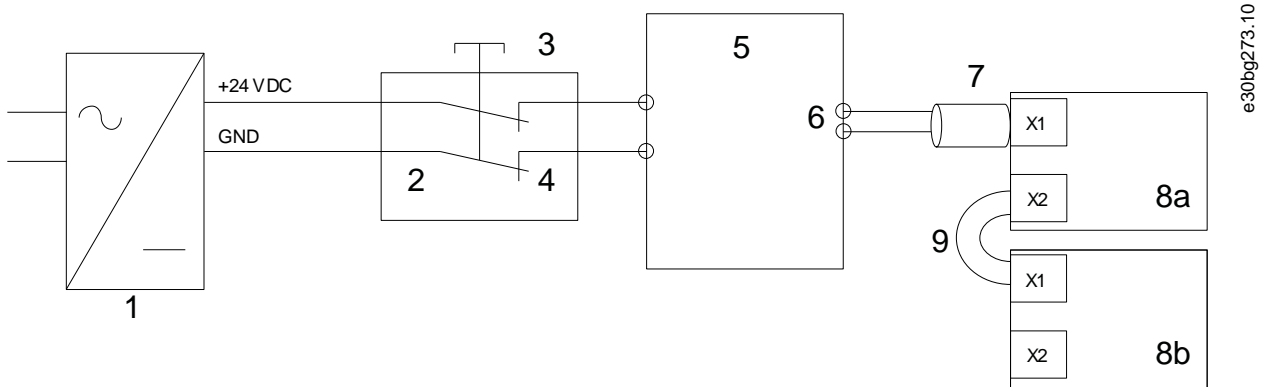
8.6.1 Protective Measures

- Install the system modules in an IP54 cabinet as per IEC 60529 or in an equivalent environment. A higher IP protection may be necessary for certain applications.
- If external influences can affect the motor axis, for example suspended loads, use additional measures, such as a safety holding brake, to eliminate hazards.

8.7 Application Example

An example of an application that can be put in Safe Torque Off mode by a safety circuit is shown in [Illustration 56](#).

Select the safety switch devices in accordance with the requirements of the application.



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Illustration 56: Application Example: Safe Torque Off Function

1	24 V DC supply	6	Hybrid cable
2	Safety device	7	Feed-in cable
3	Emergency stop button	8a	Servo drive
4	Safety device contacts	8b	Servo drive
5	Decentral Access Module (DAM 510)	9	Loop cable

8.8 Commissioning Test

NOTICE

- Perform a commissioning test for the whole servo system after installation of the STO function, after every change to the installed function, or after a safety fault.

There are 2 ways to implement the commissioning test depending on the method used to program the PLC, however the steps of the test are the same:

- Using the Danfoss Library.
- Bit-wise readout of the status.

8.8.1 Commissioning Test using Libraries

Depending on the application, 1 or both of the following libraries are required to program the commissioning test:

- Danfoss Library
 - MC_ReadAxisInfo_DDS
 - MC_ReadStatus_DDS
 - MC_ReadAxisError_DDS
 - MC_Reset_DDS

Table 23: Commissioning Test using Libraries

	Test steps	Reason for the test step	Expected result for Danfoss library
1	Run the application (all the servo drives are enabled).	Check that the application can run.	Application runs as expected.
2	Stop the application.	–	All servo drives are at speed 0 RPM.
3	Disable all the servo drives.	–	All servo drives are disabled.
4	Enable STO.	Check that STO can be activated without error.	<i>MC_ReadAxisInfo_DDS</i> output <i>SafeTorqueOff</i> = True for all servo drives on the corresponding line.
5	Disable STO.	Check that STO can be deactivated without error. No reset is required.	<i>MC_ReadAxisInfo_DDS</i> output <i>SafeTorqueOff</i> = False for all servo drives on the corresponding line.
6	Run the application (all the servo drives are enabled).	–	Application runs as expected.
7	Enable STO.	Check that errors are generated correctly when STO is activated while the servo drives are running.	Motors are torque free. Motors coast and stop after some time. <i>MC_ReadAxisInfo_DDS</i> output <i>SafeTorqueOff</i> = True and <i>MC_ReadStatus_DDS</i> output <i>ErrorStop</i> = True and <i>MC_ReadAxisError_DDS</i> output <i>AxisErrorID</i> = 0xFF80 on all enabled servo drives.
8	Try to run the application (enable 1 or more servo drives).	Checks that the STO function is working correctly.	Application does not run.
9	Disable STO.	Check that the STO start is still inhibited by the error signal.	<i>MC_ReadAxisInfo_DDS</i> output <i>SafeTorqueOff</i> = False and <i>MC_ReadStatus_DDS</i> output <i>ErrorStop</i> = True
10	Try to run the application (enable 1 or more servo drives).	Check whether reset is required.	Application does not run.
11	Send a reset signal via <i>MC_Reset(_DDS)</i> .	–	<i>MC_ReadAxisInfo_DDS</i> output <i>SafeTorqueOff</i> = False and <i>MC_ReadStatus_DDS</i> output <i>ErrorStop</i> = False
12	Try to run the application (all servo drives are enabled).	–	Application runs as expected.

8.9 Operation of the STO Function

The STO function does not require any parameterization and is always enabled.

The ISD 511 servo drive provides STO status signals via the fieldbus.

All signals transmitted via the fieldbus are not part of the safety function and can only be used for operational purposes.

See the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® Flexmotion™) Programming Guide** for:

- General information on how to access and map data objects.
- Information on a library provided to simplify the use of the fieldbus functions.

If STO is activated when the servo drive is enabled, an error code is issued.

If the drive is not enabled and STO is activated, it is not necessary to reset any STO error. It is sufficient to re-apply the supply voltage to the STO terminals, before enabling the drive.

8.9.1 Error Codes

If bit 3 of the statusword is set, this indicates any faults that occur on the servo drive. If the fault occurred because of the STO circuit, the cause of the fault can be found in object 0x603F.

Table 24: Error Codes

Error code	PROFINET® error code	Classification	Description	Reset
0xFF80	0x11E	Fault	STO activated while the servo drive was enabled, or an attempt to enable the servo drive was made while STO was activated.	Reset via the PLC.
0xFF81	0x11F	Safety fault	Servo drive internal diagnostic fault.	Carry out a power cycle.
0xFF85	0x120	Safety fault	Internal STO supply on the power card is not within limits.	Carry out a power cycle.

Error code 0xFF80/0x11E can be a normal status of the application. In this case, the servo drive requires a reset signal from the PLC. To use the STO function in an application that requires a control guard (see ISO 12100 for details), this reset information can be given automatically by the PLC. All servo drives on the same line will display this fault at the same time. Carry out a check on the PLC to compare the fault of all servo drives on 1 line.

Error code 0xFF81/0x11F means that there is a fault on the servo drive that can only be reset by carrying out a power cycle. Complete the commissioning test after the power cycle. Operation of the servo system can only be resumed if the test is completed successfully. If error code 0xFF81/0x11F or 0xFF85/0x120 is issued again, contact Danfoss Service.

8.9.2 Fault Reset

To reset faults, change bit 7 of the controlword from 0 to 1. See the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® Flexmotion™) Programming Guide** for further information.

8.10 Functional Safety Characteristic Data

Table 25: Functional Safety Characteristic Data

Data	ISD 511	PSM 510	DAM 510
General information			
Response time (from switching on the input until torque generation is disabled)	<100 ms		
Lifetime	20 years		
Data for EN/ISO 13849-1			
Performance level (PL)	d	–	–
Category	3	–	–
Mean time to dangerous failure (MTTF _D)	>100 years	–	–
Diagnostic coverage (DC)	Low	–	–
Data for IEC 61508			
Safety Integrity Level (SIL)	2	–	–
Probability of failure per hour (PFH)	<4 x 10 ⁻⁹ /h	0/h	0/h
Subsystem classification	Type A		
Diagnostic test interval	1 year		

N O T I C E

- The PSM 510, DAM 510, and ACM 510 do not contribute to the dangerous failure rate of the Danfoss system and can therefore be excluded from safety-related calculations.
- Compliance to the claimed SIL and PL is only possible if the diagnostic test is executed once per year.

8.11 Maintenance, Security, and User Accessibility

Maintenance: Test the STO safety function at least once per year as follows:

- Remove the STO input voltage.
- Verify that the motors stop running.
- Verify that no unexpected error codes appear.

Security: If security risks exist, take suitable measures to prevent them.

User accessibility: Restrict access to the ISD 511 drives and system modules if access to them could result in safety risks.

9 Diagnostics

9.1 Faults

If faults occur during the operation of the ISD 511 system, check:

- The LEDs on the servo drives for general problems relating to communication or device status.
- The LEDs on the PSM 510 and DAM 510 for general problems with communication, auxiliary supply, or STO voltage.
- The error codes.

The error codes can be read using the VLT® Servo Toolbox software, the LCP, or the PLC. The LCP only shows faults relating to the device it is connected to.

NOTICE

- If the fault cannot be eliminated by 1 of the measures listed in the troubleshooting tables, notify Danfoss Service.

Have the following information available to enable Danfoss to provide help quickly and effectively:

- Type number
- Error code
- Firmware version
- System setup (for example, number of servo drives, system modules, and lines).
- System status when the fault occurred.
- Ambient conditions.

9.2 Troubleshooting for the ISD 511 Servo Drive

9.2.1 Drive not Running/Starting Slowly

Possible cause

- Bearing wear.
- Incorrect parameter settings.
- Incorrect control loop parameters.
- Incorrect torque settings.

Troubleshooting

- Check the bearings and the shaft.
- Check the parameter settings.

9.2.2 Drive Hums and Draws High Current

Possible cause

- Drive defective.

Troubleshooting

- Contact Danfoss.

9.2.3 Drive Stops Suddenly and Restart is not Possible

Possible cause

- No drive communication.
- Servo drive in error mode.

Troubleshooting

- Check the fieldbus connection and the LEDs on the servo drive.

9.2.4 Motor Rotating in Wrong Direction

Possible cause

- Mirror mode activated.

Troubleshooting

- Check the parameter settings.

9.2.5 Motor not Generating Expected Torque

Possible cause

- Parameter error.
- Drive defective.

Troubleshooting

- Check the parameter settings.
- Contact Danfoss.

9.2.6 Drive Screaming

Possible cause

- Incorrect calibration.
- Faulty current measurement.
- Incorrect control loop parameters.

Troubleshooting

- Check the parameter settings.
- Contact Danfoss.

9.2.7 Uneven Running

Possible cause

- Defective bearing.

Troubleshooting

- Check the shaft.

9.2.8 Vibration

Possible cause

- Defective bearing.
- Incorrect control loop parameters.

Troubleshooting

- Check the shaft.
- Check the parameter settings.

9.2.9 Unusual Running Noises

Possible cause

- Defective bearing.
- Defects on connected mechanics.
- Incorrect control loop parameters.

Troubleshooting

- Check the shaft.
- Check for loose mechanical components on the connected mechanics.
- Check the parameter settings.

9.2.10 Drive Speed Drops Sharply under Load

Possible cause

- Drive is running at current limit.
- Drive is running with incorrect parameters.

Troubleshooting

- Check the application.
- Check the parameter settings (control loop parameters and user limits).

9.2.11 LEDs not Lighting Up

Possible cause

- No power supply.

Troubleshooting

- Check the power supply.

9.2.12 Drive Protection Trips Immediately

Possible cause

- Short circuit.
- Incorrect control loop parameters.

Troubleshooting

- Check the parameter settings.
- Check the wiring.
- Contact Danfoss.

9.3 Troubleshooting for the Servo System

9.3.1 LCP Display is Dark/Not Functioning

This fault applies to the ISD 511 servo drives, PSM 510, DAM 510, and ACM 510.

Possible causes

- Missing input power.
- Missing or open fuses or circuit breaker tripped.
- No power to the LCP.
- Incorrect contrast setting.
- Display is defective.

Troubleshooting

Table 26: Fault, LCP Display is Dark/Not Functioning

Possible cause	Possible solution
Missing input power.	Check the input power source.
Missing or open fuses or circuit breaker tripped.	Check the fuses and circuit breaker.
No power to the LCP.	<ul style="list-style-type: none"> • Check the LCP cable for proper connection or damage. • Replace any faulty LCP or connection cables.
Incorrect contrast setting.	Press [Status] + [▲]/[▼] to adjust the contrast.
Display is defective.	Replace the faulty LCP or connection cable.

9.3.2 Open Power Fuses or Circuit Breaker Trip

This fault applies to the PSM 510 and DAM 510.

Possible causes

- Phase-to-phase short.
- Short on backlink.
- Short on hybrid cable.
- Short on EXM 510 connector or cable.
- Short on ISD 511 connector.

Troubleshooting

- Check the cabling
- Check for loose connections.

9.3.3 DC-link Voltage Too Low (Error 0x3220/0x104)

This fault applies to all system modules.

Possible cause

- Incorrect mains input supply.

Troubleshooting

- Check that the supply voltage matches the allowed specification.

9.3.4 Current Overload Trip (Error 0x2396/0x15C)

This fault applies to the PSM 510 and the DAM 510.

Possible causes

- The sum of the servo drive current exceeds the maximum rating of the DAM 510.
- The sum of the system modules' current exceeds the maximum rating of the PSM 510.
- Short on backlink.

Troubleshooting

- Check the servo drive current consumption.
- Avoid simultaneous acceleration of all servo drives.
- Decrease the acceleration value.

9.3.5 High Cont. Power Overload (Error 0x2313/0x161)

This fault applies to the PSM 510.

Possible causes

- The PSM 510 was operating at over 140% of the nominal power rating for too long.

Troubleshooting

- Check the current consumption.

9.3.6 Continuous Power Overload (Error 0x2314/0x162)

This fault applies to the PSM 510.

Possible causes

- The PSM 510 was operating at 100–140% of the nominal power rating for too long.

Troubleshooting

- Check the current consumption.

9.3.7 AUX Overcurrent (Error 0x2391/0x125)

This fault applies to the DAM 510.

Possible causes

- The servo drives are consuming more power on the U_{AUX} line than allowed.

Troubleshooting

- Ensure that the number of servo drives on 1 line does not exceed 68.

9.3.8 AUX Overvoltage (Error 0x3292/0x133)

This fault applies to the DAM 510.

Possible causes

- Incorrect U_{AUX} supply.

Troubleshooting

- Check that the supply matches the auxiliary supply requirements.

9.3.9 AUX Undervoltage (Error 0x3294/0x135)

This fault applies to the PSM 510, DAM 510, and ACM 510.

Possible causes

- Incorrect U_{AUX} supply.
- Incorrect current dimensioning of the supply equipment.

Troubleshooting

- Check that the supply matches the auxiliary supply requirements.
- Check that the output power of the supply is sufficient.

9.3.10 Mains Phase Loss (Error 0x3130/0x12F)

This fault applies to the PSM 510.

Possible causes

- A phase is missing on the supply side.
- The voltage imbalance is too high.

Troubleshooting

- Check the supply voltages and supply currents to the device.

9.3.11 Generic Application Error (Error 0x1000/ 0x100)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Possible causes

- A generic error has occurred in the application.

Troubleshooting

- Contact Danfoss.

9.3.12 Grounding Fault

This fault applies to the PSM 510, DAM 510, and ACM 510.

Possible causes

- Grounding fault.
- When 2 PSM 510 modules are mounted in parallel and the maximum delay time for power-up is exceeded.

Troubleshooting

- Check for proper grounding and loose connections.
- Check the hybrid cables for short circuits or leakage currents.
- Check the EXM 510 connection and cable.

9.3.13 Brake Resistor Error

This fault applies to the PSM 510.

Possible causes

- Faulty brake resistor.
- Internal/external brake resistor not connected.

Troubleshooting

- Remove the power to the device, wait for the discharge time to elapse, then replace the brake resistor.

9.3.14 Brake Chopper Error

This fault applies to the PSM 510.

Possible causes

- Faulty brake chopper.
- Brake chopper power exceeds the power cycle limit.
- Incorrect parameterization.

Troubleshooting

- Check the parameterization of the brake chopper.
- Check the brake chopper connection.
- Measure the resistance of the brake chopper and compare it with the parameter settings.

9.3.15 Internal Fan Error

This fault applies to PSM 510.

Possible causes

- Fan is not mounted.
- Fan is blocked.

Troubleshooting

- Check if the fan is blocked.
- Check the fan cables for proper connection or damage.

9.4 Error Codes for ISD 511 Servo System

9.4.1 No error (0x0000 / 0x0)

This error code is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 27: No error (0x0000 / 0x0)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x0000	0x0	No error	Error	No error.	–

9.4.2 Generic application error (0x1000 / 0x100)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 28: Generic err (0x1000 / 0x100)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x1000	0x100	Generic application error	Error	Generic application error.	generic err

9.4.3 High cont. power overload (0x2313 / 0x161)

This error is valid for PSM 510.

Table 29: High cont. power overload (0x2313 / 0x161)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2313	0x161	High cont. power overload	Warning, error	High continuous power overload error.	high pwr ovlid

9.4.4 Continuous power overload (0x2314 / 0x162)

This error is valid for PSM 510.

Table 30: Continuous power overload (0x2314 / 0x162)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2314	0x162	Continuous power overload	Warning, error	Continuous power overload error.	cont pwr ovld

9.4.5 Overcurrent short circuit (0x2320 / 0x163)

This error is valid for PSM 510 and DAM 510.

Table 31: Overcurrent short circuit (0x2320 / 0x163)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2320	0x163	Overcurrent short circuit	Trip lock	Overcurrent short circuit error.	over curr short

9.4.6 Ground fault (0x2330 / 0x151)

This error is valid for PSM 510, DAM 510, and ISD 511.

Table 32: Ground fault (0x2330 / 0x151)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2330	0x151	Ground fault	Warning, error	Discharge from output phases to ground.	ground fault

9.4.7 AUX overcurrent (0x2391 / 0x125)

This error is valid for DAM 510.

Table 33: AUX overcurr (0x2391 / 0x125)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2391	0x125	AUX overcurrent	Error	Current on the AUX line has reached the overcurrent limit.	AUX overcurr

9.4.8 AUX user limit current (0x2393 / 0x127)

This error is valid for DAM 510.

Table 34: AUX user limit current (0x2393 / 0x127)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2393	0x127	AUX user limit current	Error	Current on the AUX line has reached the user-defined limit for fault.	AUX curr limit

9.4.9 AUX user limit current warning (0x2394 / 0x128)

This error is valid for PSM 510 and DAM 510.

Table 35: AUX user limit current warning (0x2394 / 0x128)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2394	0x128	AUX user limit current warning	Warning	Current on the AUX line has reached the user-defined limit for warning.	AUX curr warn

9.4.10 AUX supply failure (0x2395 / 0x129)

This error is valid for DAM 510.

Table 36: AUX supply failure (0x2395 / 0x129)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2395	0x129	AUX supply failure	Error	AUX supply failure indicated by hardware circuit..	AUX supply fail

9.4.11 Current overload trip (0x2396 / 0x15C)

This error is valid for DAM 510.

Table 37: Current overload trip (0x2396 / 0x15C)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2396	0x15C	Current overload trip	Error	Current overload trip error.	curr ovld trip

9.4.12 Power overload trip (0x2397 / 0x12B)

This error is valid for PSM 510.

Table 38: Power overload trip (0x2397 / 0x12B)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2397	0x12B	Power overload trip	Error	Power overload trip error.	pwr ovld trip

9.4.13 Mains phase loss (0x3130 / 0x12F)

This error is valid for PSM 510.

Table 39: Mains phase loss (0x3130 / 0x12F)

Code	PROFINET™ code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3130	0x12F	Mains phase loss	Error	Mains phase loss detected. This occurs when a phase on mains is missing, or when the mains is imbalanced.	phase loss

9.4.14 DC link overvoltage (0x3210 / 0x103)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 40: DC link overvoltage (0x3210 / 0x103)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3210	0x103	DC link overvoltage	Error	DC-link voltage exceeds limit.	UDC overvolt

9.4.15 DC link undervoltage (0x3220 / 0x104)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 41: DC link undervoltage (0x3220 / 0x104)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3220	0x104	DC link undervoltage	Error	DC-link voltage below limit in <i>Operation enabled</i> state.	UDC undervolt

9.4.16 DC link charging error (0x3230 / 0x152)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 42: DC link charging error (0x3230 / 0x152)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3230	0x152	DC link charging error	Error	DC-link charging error. The maximum time limit to charge the DC-link has been exceeded.	UDC charging

9.4.17 DC Link unbalanced (0x3280 / 0x153)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 43: DC Link unbalanced (0x3280 / 0x153)

Code	PROFINET™ code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3280	0x153	DC Link unbalanced	Trip lock	DC-link voltage is unbalanced. This fault indicates an internal malfunction of the DC-link.	UDC unbalance

9.4.18 UAUX high voltage (0x3291 / 0x132)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 44: UAUX high voltage (0x3291 / 0x132)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3291	0x132	U _{AUX} high voltage	Warning	U _{AUX} above warning limit.	UAUX high volt

9.4.19 UAUX overvoltage (0x3292 / 0x133)

This error is valid for DAM 510.

Table 45: UAUX overvoltage (0x3292 / 0x133)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3292	0x133	U _{AUX} overvoltage	Error	U _{AUX} above overvoltage limit.	UAUX overvolt

9.4.20 UAUX low voltage (0x3293 / 0x134)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 46: UAUX low voltage (0x3293 / 0x134)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3293	0x134	U _{AUX} low voltage	Warning	U _{AUX} below warning limit.	UAUX low volt

9.4.21 UAUX undervoltage (0x3294 / 0x135)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 47: UAUX undervoltage (0x3294 / 0x135)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3294	0x135	U _{AUX} undervoltage	Error	U _{AUX} below undervoltage limit.	UAUX undervolt

9.4.22 DC link high voltage (0x3295 / 0x136)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 48: DC link high voltage (0x3295 / 0x136)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3295	0x136	DC link high voltage	Warning	The DC-link voltage is higher than the high-voltage warning limit.	UDC high volt

9.4.23 DC link low voltage (0x3296 / 0x137)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 49: UDC low voltage (0x3296 / 0x137)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3296	0x137	DC link low voltage	Warning	The DC-link voltage is lower than the low-voltage warning limit.	UDC low volt

9.4.24 UAUX charging error (0x3297 / 0x154)

This error is valid for DAM 510.

Table 50: UAUX charging error (0x3297 / 0x154)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3297	0x154	U _{AUX} charging error	Error	Load error when U _{AUX} is charging. The maximum time limit to charge the AUX line has been exceeded.	UAUX charg err

9.4.25 DC link shutdown error (0x3298 / 0x165)

This error is valid for DAM 510.

Table 51: DC link shutdown error (0x3298 / 0x165)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3298	0x165	DC link shutdown error	Error	Error when UDC is in shutdown phase.	UDC shutdwn err

9.4.26 UAUX shutdown error (0x3299 / 0x155)

This error is valid for DAM 510.

Table 52: UAUX shutdown error (0x3299 / 0x155)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3299	0x155	U _{AUX} shutdown error	Error	Error when U _{AUX} is in shutdown phase.	UAUX shtdwn err

9.4.27 UAUX undervoltage hardware (0x329A / 0x156)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 53: UAUX undervoltage hardware (0x329A / 0x156)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x329A	0x156	U _{AUX} undervoltage hardware	Error	U _{AUX} undervoltage detected by hardware circuit.	AUX undervol HW

9.4.28 Automated fault reset failure (0x329B / 0x168)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 54: Automated fault reset failure (0x329B / 0x168)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x329B	0x168	Automated fault reset failure	Trip lock	Too many auto fault resets have been executed in intended time interval.	autoreset fail

9.4.29 Device overtemperature (0x4210 / 0x157)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 55: Device overtemperature (0x4210 / 0x157)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x4210	0x157	Device over-temperature	Warning, error	Triggered when the maximum temperature of the main device component is exceeded. PSM: Thyristor rectifier module. DAM: Maximum temperature of both high side and low side IGBTs.	overtemp device

9.4.30 Device under temperature (0x4220 / 0x138)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 56: Device under temperature (0x4220 / 0x138)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x4220	0x138	Device under temperature	Error	The device is too cold to operate.	undertemp device

9.4.31 Overtemperature: Control card (0x4291 / 0x106)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 57: Overtemperature: Control card (0x4291 / 0x106)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x4291	0x106	Overtemperature: Control card	Error	Maximum temperature of control card exceeded.	overtemp CC

9.4.32 Overtemperature: Power card (0x4292 / 0x107)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 58: Overtemperature: Power card (0x4292 / 0x107)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x4292	0x107	Overtemperature: Power card	Warning, error	Maximum temperature of power card exceeded.	overtemp PC

9.4.33 Inrush overtemperature DC link (0x4293 / 013C)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 59: Inrush overtemperature DC link (0x4293 / 0x13C)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x4293	0x13C	Inrush overtemperature: DC link	Error	Inrush fault. Too many transitions into state <i>Operation enabled</i> in a short time period.	UDC inrush

9.4.34 Inrush overtemperature AUX line (0x4294 / 0x13D)

This error is valid for DAM 510.

Table 60: Inrush overtemperature AUX line (0x4294 / 0x13D)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x4294	0x13D	Inrush overtemperature AUX line	Error	Inrush fault. Too many power-ups of the AUX voltage have occurred within a short time period.	UAUX in-rush

9.4.35 Overtemperature: Motor (0x4310 / 0x108)

This error is valid for ISD 511.

Table 61: Overtemperature: Motor (0x4310 / 0x108)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x4310	0x108	Overtemperature: Motor	Error	Overtemperature on motor.	overtemp motor

9.4.36 UAUX undervoltage (0x5112 / 0x109)

This error is valid for ISD 511.

Table 62: Charge switch failure voltage (0x5112 / 0x109)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x5112	0x109	UAUX undervoltage	Error, trip lock	Undervoltage on auxiliary voltage.	Undervolt UAUX

9.4.37 Charge switch failure voltage (0x5121 / 0x158)

This error is valid for PSM 510.

Table 63: Charge switch failure voltage (0x5121 / 0x158)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x5121	0x158	Charge switch failure voltage	Trip lock	Indicates a malfunction of the internal charge circuit.	Chg switch fail

9.4.38 Output phase U failure (0x5411 / 0x123)

This error is valid for ISD 511.

Table 64: Output phase U failure (0x5411 / 0x123)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x5411	0x123	Output phase U failure	Error	Calibration of current measurement on output phase U not successful (an excessive offset is present). Contact Danfoss.	Output phase U

9.4.39 Output phase V failure (0x5412 / 0x124)

This error is valid for ISD 511.

Table 65: Output phase U failure (0x5412 / 0x124)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x5412	0x124	Output phase V failure	Error	Calibration of current measurement on output phase V not successful (an excessive offset is present). Contact Danfoss.	Output phase V

9.4.40 Output phase W failure (0x5413 / 0x125)

This error is valid for ISD 511.

Table 66: Output phase U failure (0x5413 / 0x125)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x5413	0x125	Output phase W failure	Error	Calibration of current measurement on output phase W not successful (an excessive offset is present). Contact Danfoss.	Output phase W

9.4.41 EE Checksum Error (parameter missing) (0x5530 / 0x10A)

This error is valid for ISD 511.

Table 67: EE Checksum Error (parameter missing) (0x5530 / 0x10A)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x5530	0x10A	EE Checksum Error (parameter missing)	Trip lock	EEPROM checksum error or missing device parameter. Contact Danfoss.	eprom err

9.4.42 Parameter error (0x6320 / 0x10B)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 68: Param err (0x6320 / 0x10B)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x6320	0x10B	Parameter error	Trip lock	A parameter has an invalid value.	param err

9.4.43 Conf par ver (0x6382 / 0x15D)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 69: Configuration parameters version error (0x6382 / 0x15D)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x6382	0x15D	Configuration parameters version error	Trip lock	Configuration parameter set version mismatch: parameter set is not valid for this device. Check the configuration file sent to the device and replace it. If the error persists, contact Danfoss.	conf par ver

9.4.44 Configuration parameters limits error (0x6383 / 0x164)

This error is valid for PSM 510, DAM 510, and ACM 510.

Table 70: Configuration parameters limits error (0x6383 / 0x164)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x6383	0x164	Configuration parameters limits error	Trip lock	≥1 parameter in the configuration parameter set is out of limits.	conf par lim

9.4.45 Power EEprom configuration error (0x6384 / 0x166)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 71: Power EEprom configuration error (0x6384 / 0x166)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x6384	0x166	Power EEprom configuration error	Trip lock	The power device EEprom is corrupt or incompatible with this control board. Contact Danfoss.	conf par EE-PROM

9.4.46 Brake chopper failure (0x7111 / 0x141)

This error is valid for PSM 510.

Table 72: Brake chopper failure (0x7111 / 0x141)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7111	0x141	Brake chopper failure	Warning, error	The brake chopper is monitored during operation. A brake failure has been detected by the brake check function.	brake ch fail

9.4.47 Brake chopper overcurrent (0x7112 / 0x167)

This error is valid for PSM 510.

Table 73: Brake chopper overcurrent (0x7112 / 0x167)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7112	0x167	Brake chopper overcurrent	Trip lock	The brake chopper current exceeds the limit.	brake ch overcurr

9.4.48 Brake chopper module overload (0x7181 / 0x142)

This error is valid for PSM 510.

Table 74: Brake resistor maximum power limit (0x7181 / 0x142)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7181	0x142	Brake chopper module overload	Warning, error	The power load of the brake chopper is monitored during operation. This error appears when the maximum power limit of the brake chopper module is reached.	mod ovl

9.4.49 External brake chopper overload (0x7182 / 0x143)

This error is valid for PSM 510.

Table 75: External brake chopper overload (0x7182 / 0x143)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7182	0x143	External brake chopper overload	Warning, error	The power load of the brake chopper is monitored during operation. Depending on the configuration of <i>external brake chopper power monitoring</i> this warning or fault appears when the configured nominal external brake chopper power is reached.	ext brake ch ovl

9.4.50 Brake mains voltage too high (0x7183 / 0x159)

This error is valid for PSM 510.

Table 76: Brake mains voltage too high (0x7183 / 0x159)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7183	0x159	Brake mains voltage too high	Warning	The mains voltage is too high. Due to this, the brake chopper could be activated continuously depending on the value entered in parameter <i>brake chopper start level</i> .	brake ch high volt

9.4.51 Internal position sensor error (0x7320 / 0x10C)

This error is valid for ISD 511.

Table 77: Internal position sensor error (0x7320 / 0x10C)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7320	0x10C	Internal position sensor error	Trip lock	Absolute position sensor error. If the error persists, contact Danfoss.	int sensor err

9.4.52 External position sensor error (0x7380 / 0x10D)

This error is valid for DAM 510.

Table 78: External position sensor error (0x7380 / 0x10D)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7380	0x10D	External position sensor error	Error	External encoder data could not be read.	ext sensor err

9.4.53 Communication error (0x7500 / 0x169)

This error is valid for ISD 511.

Table 79: Communication error (0x7500 / 0x169)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7500	0x169	Communication error	Error	Communication error connection lost.	com err

9.4.54 Following error (0x8611 / 0x10E)

This error is valid for ISD 511.

Table 80: Following error (0x8611 / 0x10E)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x8611	0x10E	Following error	Warning, error	A following error has occurred. The error notification feature can be disabled via object 0x2055.	following err

9.4.55 Homing error on entering homing mode (0x8693 / 0x10F)

This error is valid for ISD 511.

Table 81: Homing error on entering homing mode (0x8693 / 0x10F)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x8693	0x10F	Homing error on entering homing mode	Warning	Could not enter homing mode (for example velocity not 0).	Homing mode fail

9.4.56 Homing error on start homing method (0x8694 / 0x110)

This error is valid for ISD 511.

Table 82: Homing error on start homing method (0x8694 / 0x110)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x8694	0x110	Homing error on start homing method	Warning	Could not start homing method (for example drive not in standstill).	Homing method fail

9.4.57 Homing error distance (0x8695 / 0x111)

This error is valid for ISD 511.

Table 83: Homing error distance (0x8695 / 0x111)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x8695	0x111	Homing error distance	Warning	Homing distance reached.	Homing distance

9.4.58 Communication interrupted (0xFF10 / 0x14F)

This error is valid for ISD 511.

Table 84: External interface power failure (0xFF10 / 0x14F)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF10	0x14F	Communication interrupted	Error	The fieldbus communication has been interrupted while the device was enabled.	comm interrupt

9.4.59 Fan feedback inconsistent (0xFF21 / 0x145)

This error is valid for PSM 510.

Table 85: Fan feedback inconsistent (0xFF21 / 0x145)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF21	0x145	Fan feedback inconsistent	Warning	Internal fan fault. Internal fan not running/mounted.	fan feedback

9.4.60 Fan lifetime critical (0xFF22 / 0x15A)

This error is valid for PSM 510.

Table 86: Fan lifetime critical (0xFF22 / 0x15A)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF22	0x15A	Fan lifetime critical	Warning	The theoretical lifetime of the fan has been exceeded.	fan lifetime

9.4.61 Timing violation 1 (0xFF60 / 0x115)

This error is valid for ISD 511.

Table 87: Timing violation 1 (0xFF60 / 0x115)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF60	0x115	Timing violation 1	Trip lock	Contact Danfoss.	timing err 1

9.4.62 Timing violation 2 (0xFF61 / 0x116)

This error is valid for ISD 511.

Table 88: Timing violation 2 (0xFF61 / 0x116)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF61	0x116	Timing violation 2	Trip lock	Contact Danfoss.	timing err 2

9.4.63 Timing violation 3 (0xFF62 / 0x117)

This error is valid for ISD 511.

Table 89: Timing violation 3 (0xFF62 / 0x117)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF62	0x117	Timing violation 3	Trip lock	Contact Danfoss.	timing err 3

9.4.64 Timing violation 4 (0xFF63 / 0x118)

This error is valid for ISD 511.

Table 90: Timing violation 4 (0xFF63 / 0x118)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF63	0x118	Timing violation 4	Trip lock	Contact Danfoss.	timing err 4

9.4.65 Timing violation 5 (0xFF64 / 0x119)

This error is valid for ISD 511.

Table 91: Timing violation 5 (0xFF64 / 0x119)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF64	0x119	Timing violation 5	Trip lock	Contact Danfoss.	timing err 5

9.4.66 Timing violation 6 (0xFF65 / 0x11A)

This error is valid for ISD 511.

Table 92: Timing violation 6 (0xFF65 / 0x11A)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF65	0x11A	Timing violation 6	Trip lock	Contact Danfoss.	timing err 6

9.4.67 Timing violation 7 (0xFF66 / 0x168)

This error is valid for ISD 511.

Table 93: Timing violation 7 (0xFF66 / 0x168)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF66	0x168	Timing violation 7	Trip lock	Contact Danfoss.	timing err 7

9.4.68 Timing violation 8 (0xFF67 / 0x16B)

This error is valid for ISD 511.

Table 94: Timing violation 8 (0xFF67 / 0x16B)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF67	0x16B	Timing violation 8	Trip lock	Contact Danfoss.	timing err 8

9.4.69 Timing violation 9 (0xFF68 / 0x16C)

This error is valid for ISD 511.

Table 95: Timing violation 9 (0xFF68 / 0x16C)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF68	0x16C	Timing violation 9	Trip lock	Contact Danfoss.	timing err 9

9.4.70 Firmware: Package description mismatch (0xFF70 / 0x11B)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 96: Firmware: Package description mismatch (0xFF70 / 0x11B)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF70	0x11B	Firmware: Package description mismatch	Trip lock	The firmware found does not match the package description.	FW pack err

9.4.71 Firmware: Power cycle needed (0xFF71 / 0x11C)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 97: Firmware: Power cycle needed (0xFF71 / 0x11C)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF71	0x11C	Firmware: Power cycle needed	Warning, error	The firmware update transfer is completed but a power cycle is required before the new firmware is active.	need power-cycle

9.4.72 Firmware: Update started (0xFF72 / 0x11D)

This error is valid for PSM 510, DAM 510, ACM 510, and ISD 511.

Table 98: Firmware: Update started (0xFF72 / 0x11D)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF72	0x11D	Firmware: Update started	Warning, error	Firmware update is in progress. Warning changes to error when an attempt is made to enable the device in this state.	FW update

9.4.73 Firmware: Update invalid (0xFF73 / 0x15B)

This error is valid for PSM 510 and DAM 510.

Table 99: Firmware: Update invalid (0xFF73 / 0x15B)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF73	0x15B	Firmware: Update invalid	Error	Invalid or corrupted firmware package update. Last valid firmware package has been loaded.	FW upd invalid

9.4.74 STO active while drive enabled (0xFF80 / 0x11E)

This error is valid for ISD 511.

Table 100: STO active while drive enabled (0xFF80 / 0x11E)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF80	0x11E	STO active while drive enabled	Error	STO activated while drive was enabled or tried to enable while STO active.	STO active

9.4.75 STO mismatch (0xFF81 / 0x11F)

This error is valid for ISD 511.

Table 101: STO mismatch (0xFF81 / 0x11F)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF81	0x11F	STO mismatch	Trip lock	Dual diagnosis of STO voltage not plausible.	STO mismatch

9.4.76 P_STO error (0xFF85 / 0x120)

This error is valid for ISD 511.

Table 102: P_STO error (0xFF85 / 0x120)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF85	0x120	P_STO error	Trip lock	P_STO voltage on the power card exceeds the limits.	P_STO error

9.4.77 Guide value reversed (0xFF90 / 0x121)

This error is valid for ISD 511.

Table 103: Guide value reversed (0xFF90 / 0x121)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF90	0x121	Guide value reversed	Error	Position guide value went backwards while the servo drive was in CAM mode.	guide val rev

9.4.78 Guide value implausible (0xFF91 / 0x122)

This error is valid for ISD 511.

Table 104: Guide value implausible (0xFF91 / 0x122)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF91	0x122	Guide value implausible	Error	Increments between succeeding values too large.	guide val impl

9.4.79 UDU GV out of range (0xFF92 / 0x291)

This error is valid for ISD 511.

Table 105: UDU GV out of range (0xFF92 / 0x291)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF92	0x291	UDU Guide Value out of range	Error	UDU Position Guide Value is outside the allowed range $[G_{\min}, G_{\max}]$	UDU GV out of range

9.4.80 UDU GV offset out of range (0xFF93 / 0x292)

This error is valid for ISD 511.

Table 106: UDU GV offset out of range (0xFF93 / 0x292)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF93	0x292	UDU Guide Value offset out of range	Error	UDU Position Guide Value offset is outside the allowed range $[-\text{abs}((G_{\min}-G_{\max})/2) \text{ to } \text{abs}((G_{\min}-G_{\max})/2)]$	UDU GV offset out of range

9.4.81 UDU Min Blending distance out of range (0xFF94 / 0x293)

This error is valid for ISD 511.

Table 107: UDU GV out of range (0xFF94 / 0x293)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF94	0x293	UDU Min Blending distance out of range	Error	UDU Min Blending distance is outside the allowed range [0 to abs (G_{min} – G_{max})]	UDU Min Blending distance out of range

9.4.82 Sign of life error (0xFF95 / 0x14E)

This error is valid for ISD 511.

Table 108: Sign of life error (0xFF95 / 0x14E)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0xFF95	0x14E	Sign of life error	Error	Sign of life error.	SOL error

10 Maintenance, Decommissioning and Disposal

10.1 Warnings

⚠ WARNING ⚠

HIGH VOLTAGE

Potentially lethal voltage is present on the connectors that may lead to death or serious injury.

- Before working on the power or signal connectors (disconnecting or connecting the cable), or performing any maintenance work, disconnect the Power Supply Module (PSM 510) from the mains and wait for the discharge time to elapse.

⚠ WARNING ⚠

DISCHARGE TIME

The servo system contains DC-link capacitors that remain charged for some time after the mains supply is switched off at the Power Supply Module (PSM 510). Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- To avoid electrical shock, fully disconnect the Power Supply Module (PSM 510) from the mains and wait for the capacitors to fully discharge before carrying out any maintenance work on the servo system or replacing components.

Minimum waiting time (minutes)
15

10.2 Inspection during Operation

10.2.1 ISD 511 Servo Drives

Carry out regular inspections during operation. Check the ISD 511 servo drives at regular intervals for anything unusual.

Pay particular attention to:

- Unusual noises.
- Overheated surfaces (temperatures up to 100 °C can occur in normal operation).
- Uneven running.
- Strong vibrations.
- Loose fastenings.
- Condition of electrical wiring and cables.
- Poor heat dispersion.

10.2.2 System Modules

Carry out regular inspections during operation.

Check:

- The cooling vents are not blocked.
- The fan is not making any unusual noises.
- The condition of electrical wiring and cables.

10.3 Maintenance Tasks

The ISD 511 servo drives are largely maintenance free. Only the shaft seal on the ISD 511 (if used) is subject to wear. The maintenance tasks must be performed by qualified personnel. No other tasks are required.

Operating Guide

Table 109: Overview of Maintenance Tasks

Component	Maintenance task	Maintenance interval	Instruction
All	Carry out a visual inspection.	Every 6 months	Check for any abnormalities on the surface.
Shaft seal on the ISD 511	Check the condition and check for leakage.	Every 6 months or 3000 operating hours. ⁽²⁾ For more instructions on replacing the shaft seal, see the <i>Krones Service Manual</i> and <i>Service Toolkit for Shaft Sealing</i> .	If damaged or worn: Replace the shaft seal.
System modules	Check the fan.	Every 12 months	Check that the fan can turn and remove any dust or dirt.
Hybrid cable	Check for damage and wear.	Every 6 months	If damaged or worn: Replace the hybrid cable.
Functional safety	Perform a system power cycle and check the STO function.	Every 12 months	Activate STO and check the status with the PLC.

² A shorter interval may be necessary depending on the application. Contact Danfoss for more information.

10.4 Repair

Do not attempt to repair the products. Defective products must be returned to Danfoss. Contact the local Danfoss sales company for information about returns.

10.5 System Module Replacement

10.5.1 Dismounting the System Modules

1. Disconnect the mains and all auxiliary supplies from the PSM 510 and wait for the discharge time to elapse.
2. Disconnect the EMC plate on the bottom of the system modules. Do not disconnect the connectors from the EMC plate.

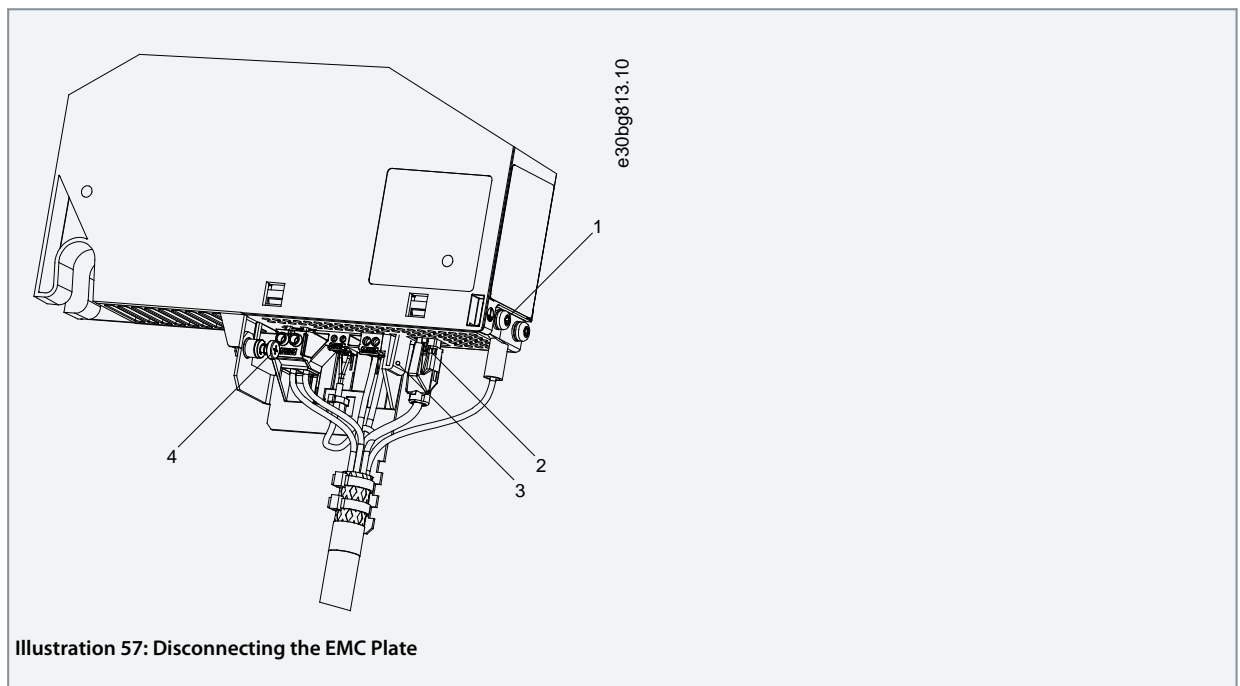


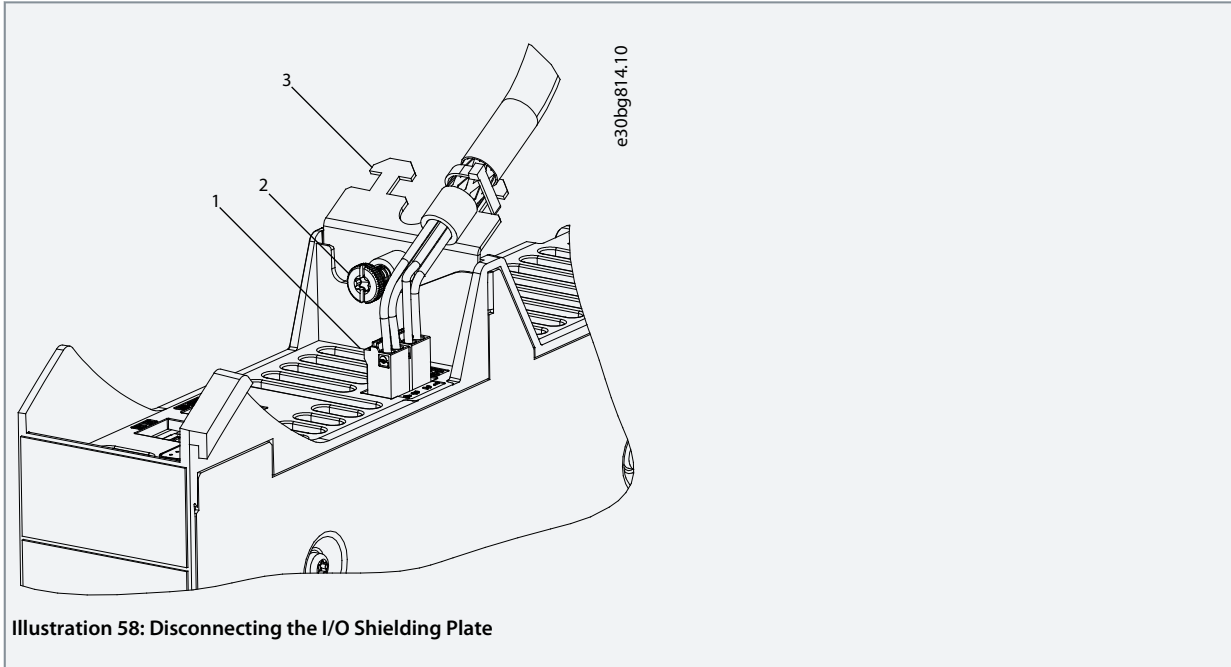
Illustration 57: Disconnecting the EMC Plate

- Unplug the RJ45 connector [2] (only on DAM 510).

Operating Guide

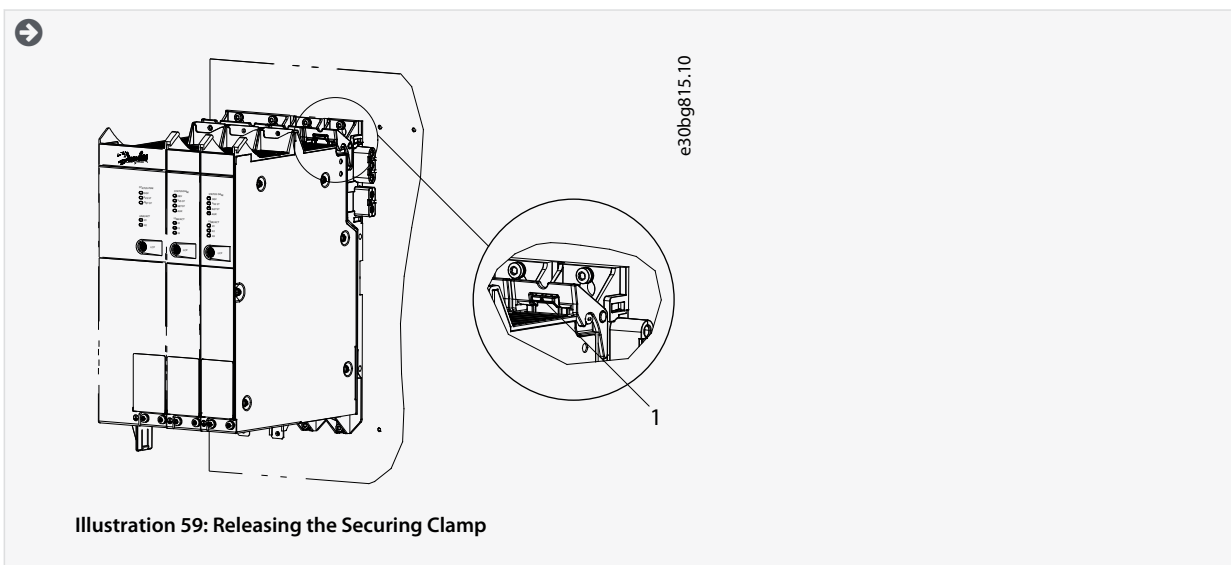
- Unscrew the screw [4] on the EMC plate.
- Press the clip [3] to release the EMC plate.
- Unscrew the PE screw [1].

3. Disconnect the I/O shielding plate on the top of the system modules:

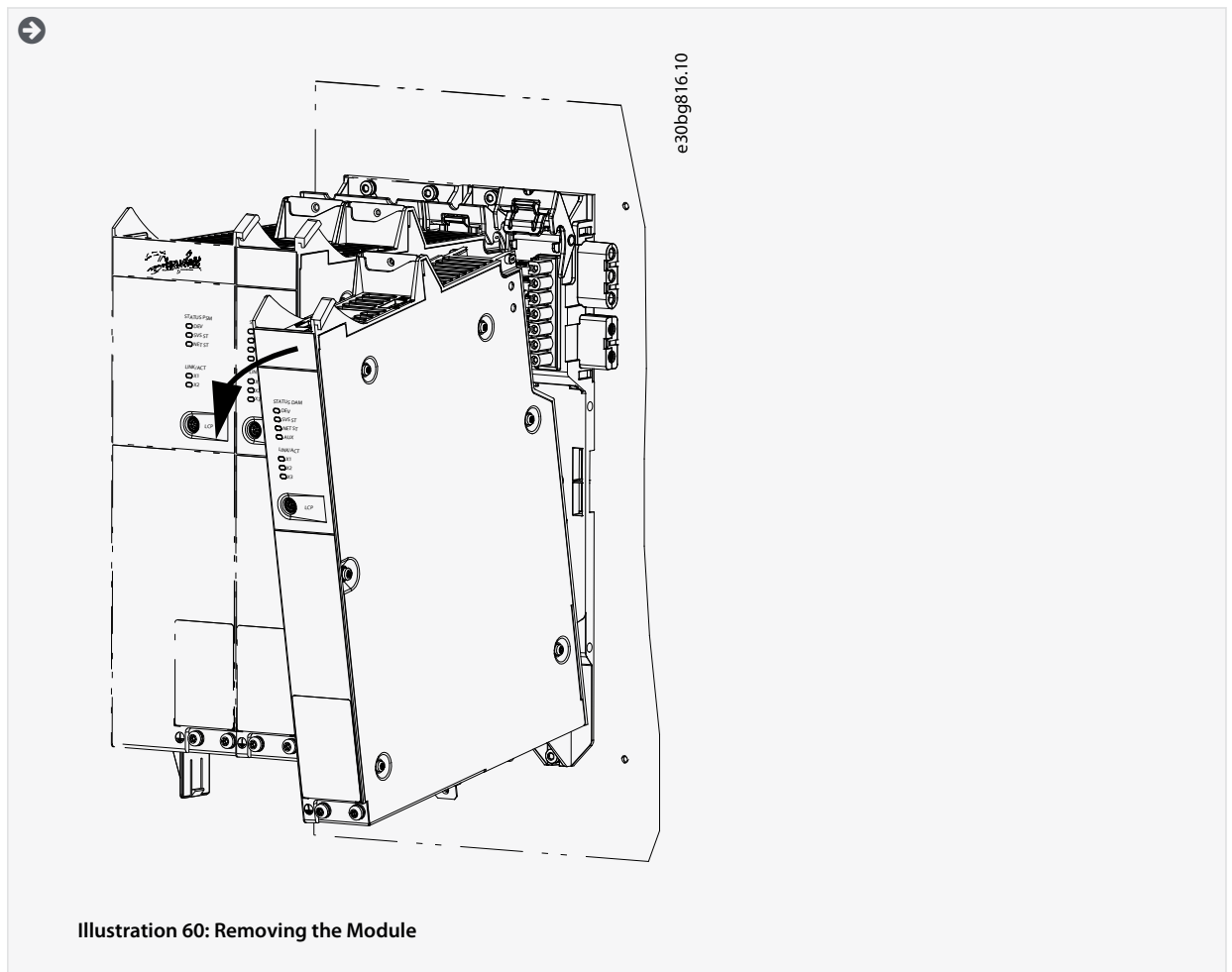


- Unplug the top connectors [1].
- Unscrew the screw [2] on the I/O shielding plate [3].
- Pull the I/O shielding plate upwards to remove it.

4. Release the securing clamp [1] at the top of the module.



5. Tilt the module forward and remove it from the backplate.



10.5.2 Fitting and Commissioning the System Modules

1. Check if preparation is required (see [4.6.2 System Modules](#)).
2. Fit the system modules (see [4.7.5 Fitting Instructions for System Modules](#)).
3. Connect the electrical cables (see chapter **Electrical Installation**).
4. Switch the system on (see [6.2 Switching on the ISD 511 System](#)).
5. Configure the system module's parameters according to the fieldbus used.
6. Conduct a test run.

10.6 Cable Replacement

10.6.1 Overview

Replace the cables when the rated number of bending cycles has been reached or the cable is damaged.

NOTICE

- Do not forcefully connect or fit the connectors. Incorrect connection causes permanent damage to the connectors.

10.6.2 Feed-In Cable Replacement

10.6.2.1 Disconnecting the Feed-In Cable

Procedure

1. Disconnect the Power Supply Module (PSM 510) from its power source (mains network and all auxiliary supplies).

Operating Guide

2. Wait for the necessary discharge time to elapse.
3. Disconnect any cables connected to the I/O ports on the ISD 511 servo drive for easier access to the feed-in cable.
4. Disconnect the PE wire from the PE screw on the Decentral Access Module (DAM 510).
5. Remove the EMC plate from the DAM 510.
6. Open the cable binder holding the STO cable.
7. Open the cable binder holding the feed-in cable on the DAM 510.
8. Loosen the feed-in cable connectors on the DAM 510.
9. Disconnect the feed-in cable from the DAM 510.
10. Disconnect all wires to the slip ring (if used).
11. Loosen the threaded ring of the connector on the servo drive.
12. Disconnect the feed-in cable from the servo drive.

10.6.2.2 Replacing the Feed-In Cable

Replace the feed-in cable with a cable of identical type and length.

10.6.2.3 Connecting the Feed-In Cable

1. Connect the female connector of the feed-in cable to the male connector of the 1st servo drive.
2. Turn the threaded rings of the connectors hand tight.
3. Ensure that there is no mechanical tension on the cables.
4. Insert the feed-in cable wires into the correct connector on the EMC plate at the bottom of the Decentral Access Module (DAM 510).
5. Secure the feed-in cable with a cable binder.
6. Secure the STO cable with a cable binder.
7. Mount the EMC plate on the DAM 510.
8. Connect the PE wire to the PE screw on the DAM 510.
9. Reconnect any cables that were connected to the I/O ports.
10. Reconnect all wires to the slip ring (if used).

10.6.3 Loop Cable Replacement

10.6.3.1 Disconnecting the Loop Cable

Procedure

1. Disconnect the Power Supply Module (PSM 510) from its power source (mains network) and all auxiliary supplies.
2. Wait for the necessary discharge time to elapse.
3. Disconnect any cables that were connected to the I/O ports.
4. Loosen the threaded rings of the loop cable connectors on both servo drives.
5. Disconnect the loop cable from the servo drives.

10.6.3.2 Replacing the Loop Cable

Replace the loop cable with a cable of identical type and length.

10.6.3.3 Connecting the Loop Cable

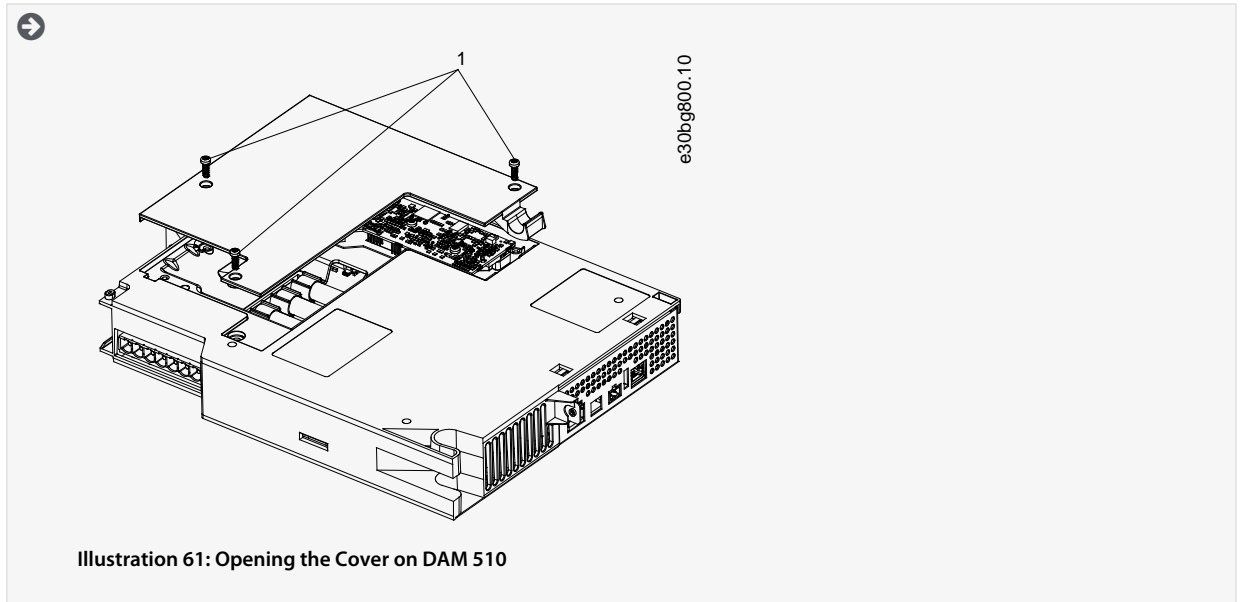
1. Connect the male connector of the loop cable to the female connector on the servo drive.
2. Connect the female connector of the loop cable to the male connector on the adjacent servo drive.
3. Turn the threaded rings hand tight on both servo drives.
4. Ensure that there is no mechanical tension on the cables.
5. Tighten the threaded rings of the connectors on both servo drives.
6. Reconnect any cables that were connected to the I/O ports on both servo drives.

10.7 Fuse Replacement in Decentral Access Module (DAM 510)

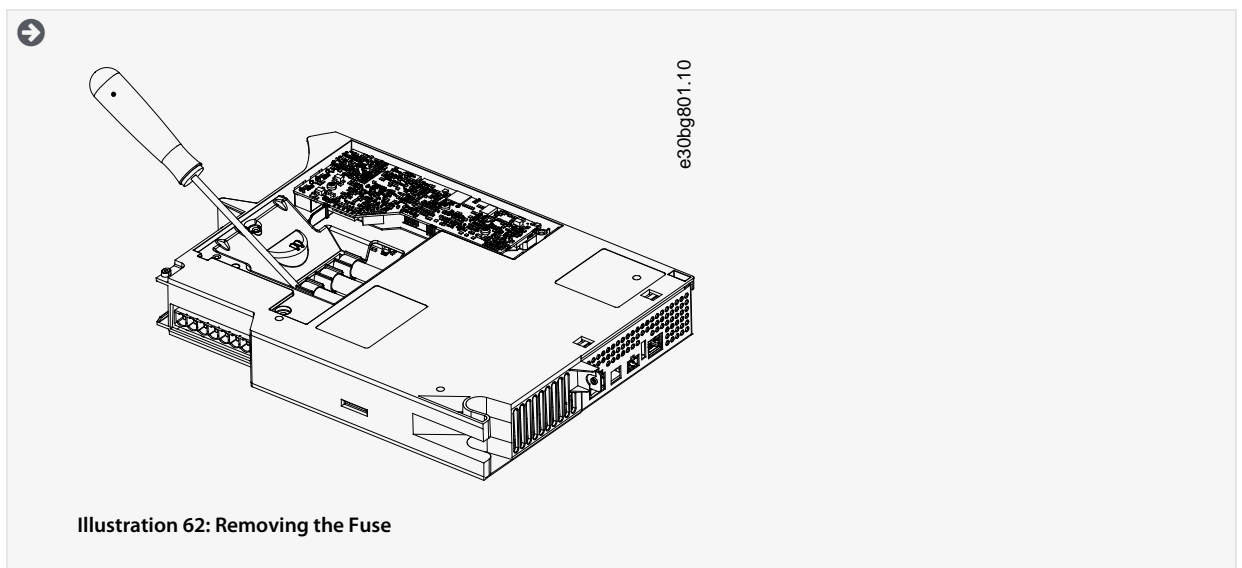
If a single fuse blows, replace all the fuses with fuses from the same batch (fuse CAT number 5012006.25, SIBA).

Procedure

1. Remove the screws [1] and remove the cover.



2. Use a screwdriver to remove the fuses and replace them with the same number of identical type fuses.



3. Replace the cover and tighten the screws. The tightening torque is 2 Nm.

10.8 Fan Replacement

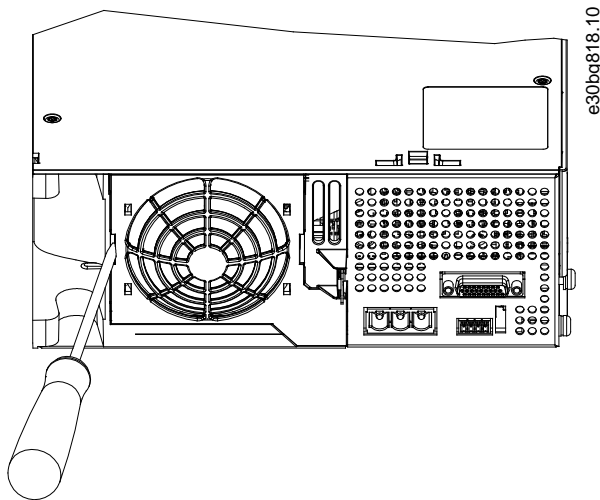


Illustration 63: Fan Replacement on 100 mm Modules

NOTICE

- See the VLT® Servo Drive System ISD 510, DSD 510, MSD 510 (VLT® Flexmotion™) Design Guide for further information on fan types.

Procedure

1. Use a screwdriver as a lever to release the fan holder.
2. Remove the fan.
3. Replace the fan with an identical type fan.

10.9 Product Returns

Danfoss products can be returned for disposal at no charge. A prerequisite for this is that they are free of deposits, such as oil, grease, or other types of contamination that hampers disposal. Furthermore, foreign materials or third-party components cannot be included with the returned product.

Ship the products free on board to the local Danfoss sales company.

10.10 Recycling

Take metals and plastics to recycling stations.

The servo drives and system modules are classified as electronic waste, and the packaging is classified as packaging waste.

10.11 Disposal

Devices containing electronic components cannot be disposed of as normal domestic waste.

Dispose of the servo drives and system modules as hazardous waste, electrical waste, recyclable waste, and so on, in accordance with applicable local regulations.

11 Specifications

11.1 Nameplates

11.1.1 Nameplates on ISD 511 Servo Drive

Check the nameplates and compare them with the order data. Use the part number for reference. The part number uniquely identifies the drive type.

Ensure that the nameplates are clearly legible.

The servo drives can be identified externally only by the original Danfoss nameplates.

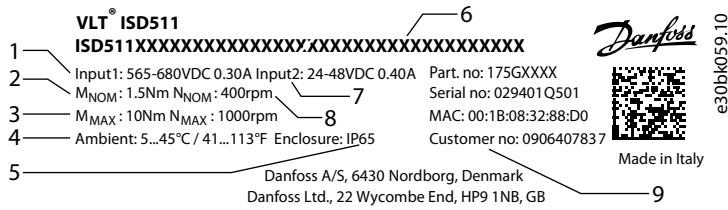


Illustration 64: Nameplate on the Bottom of ISD 511

1	Supply voltage	6	Typecode
2	Nominal torque	7	Auxiliary input voltage
3	Maximum torque	8	Rated speed
4	Ambient temperature range	9	Customer part number
5	Protection rating		



Illustration 65: Tracing and Conformity Label on the Electronic Cover of ISD 511

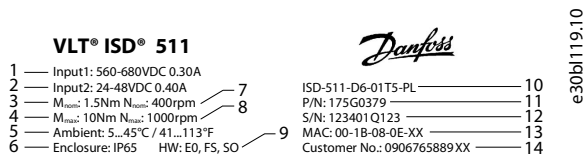


Illustration 66: Product Label on the Electronic Cover of ISD 511

1	Supply voltage	8	Maximum speed
2	Auxiliary input voltage	9	Hardware configuration
3	Nominal torque	10	Short model code
4	Maximum torque	11	Part number
5	Ambient temperature range	12	Serial number
6	Protection rating	13	MAC address
7	Rated speed	14	Customer part number

11.1.2 Nameplates on the System Modules

The following data is shown on the nameplate on the front of PSM 510.

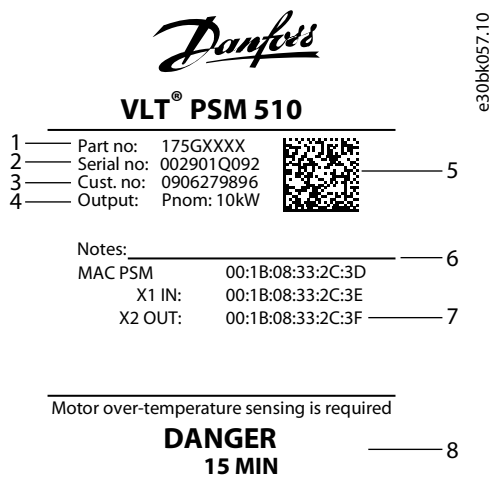


Illustration 67: Nameplate on the Front of PSM 510

1	Part number	5	Data matrix
2	Serial number	6	Notes
3	Customer part number	7	MAC addresses
4	Output	8	Warning

The following data is shown on the nameplate on the front of DAM 510.

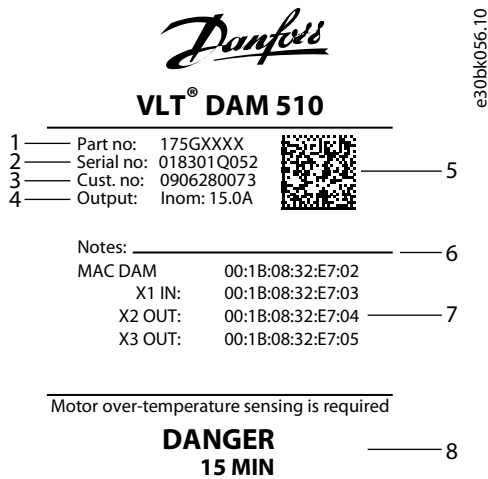


Illustration 68: Nameplate on the Front of DAM 510

1	Part number	5	Data matrix
2	Serial number	6	Notes
3	Customer part number	7	MAC addresses
4	Output	8	Warning



Illustration 69: Example Nameplate on the Side of the System Modules

1	Type code	4	Maximum power
2	Supply voltage	5	Ambient temperature range
3	Output voltage	6	U _{AUX} supply

11.2 Characteristic Data

11.2.1 Characteristic Data for ISD 511 Servo Drive

Table 110: Characteristic Data for ISD 511 Servo Drive

Specifications	Unit	Typical value	Condition
Supply voltage U_{DC}	V DC	565–680 \pm 10%	–
Supply current U_{DC}	A	0.3	At rated speed, rated torque, 560 V
Supply voltage U_{AUX}	V DC	24 V/48 V \pm 10%	–
Supply current U_{AUX}	A	0.4	At 24 V
Supply voltage U_{STO}	V DC	24 V \pm 10%	–
Supply current I_{STO}	A	0.01	At 24 V
Rated speed n_{NOM}	RPM	400	–
Rated torque M_{NOM}	Nm	1.5	S1 at 400 RPM; $T_{amb}=45\text{ }^{\circ}\text{C}$
Rated current (motor) I_{NOM}	A_{rms}	0.86	S1 at 400 RPM; $T_{amb}=45\text{ }^{\circ}\text{C}$
Rated power P_N	kW [hp]	0.0628 [0.084]	S1 at 400 RPM; $T_{amb}=45\text{ }^{\circ}\text{C}$
Stall torque M_0	Nm	2.1	–
Stall current (motor) I_0	A	1.1	–
Maximum speed n_{MAX}	RPM	1000	–
Maximum torque M_{MAX}	Nm	10	S3 at 400 RPM; 5% ED (1.5 s)
Maximum current (motor) I_{MAX}	A	6	S3 at 400 RPM; 5% ED (1.5 s)
Torque of inertia J_{mot}	Kgm^2	0.00023	–
Torque constant K_t	Nm/A_{rms}	2.4	–
Accuracy	$^{\circ}$	\pm 0.15	–
Winding resistance R_W	Ω	27.6	Phase – Phase
Winding inductance L_W	mH	108	Phase – Phase
Motor efficiency η	–	0.5	At rated speed and torque
Voltage constant EMK	V/krpm	153	–
Protective measures	–	Overload, short-circuit, and ground fault protection.	–
Maximum output frequency	Hz	590	–
Shaft diameter	mm [inch]	38.8 h8 [15.275 h8]	–
Pole pairs	–	5	–
Flange size	mm [inch]	87 [3.425]	–
Functional safety	–	–	–

Specifications	Unit	Typical value	Condition
Cooling	–	Via flange and natural convection	–
Mounting	–	Via flange	–
Weight	kg [lb]	4.2 [9.26]	–

11.2.2 Characteristic Data for Power Supply Module (PSM 510)

Table 111: Characteristic Data for PSM 510

Definition	Unit	Power size 1	Power size 2	Power size 3
Input				
Mains input voltage	V AC	400–480 ±10%, 3-phase (see 5.2 Electrical Environmental Conditions)		
Input current @ U_{MIN}	A	20	34	50
Input power	VA	12.5	22	32
U_{AUX} input voltage	V DC	24/48 ±10%		
U_{AUX} current consumption at 24 V DC	A DC	2.0		
U_{AUX} current consumption at 48 V DC	A DC	1.0		
Output				
DC-link voltage	V DC	565–680 ±10%		
DC-link capacitance	µF	1800		
Rated current I_N	A	20	40	60
Rated power P_N	kW	10	20	30
Peak power P_{max} $t < 3.0$ s)	kW	20	40	60
Internal brake resistor⁽¹⁾				
Peak power P_{max}	kW	8		
Rated power P_N	W	150		
Nominal resistance	Ω	15		
External brake resistor				
Peak power P_{max}	kW	60		
Rated power P_N	kW	7.5		
Minimum resistance	Ω	10		
General				
Protective measures	–	Overload, short-circuit, and ground fault protection		
Line filter in accordance with EN 61800-3	–	Category C3		
Cooling	–	Integrated fan		

Definition	Unit	Power size 1	Power size 2	Power size 3
Mounting	–	Wall-mounted on backplate using backlink connector		
Weight	kg	6		
Dimensions (W x H x D)	mm	137.3 x 406.3 x 270		

¹ An external brake resistor can be connected.

11.2.3 Characteristic Data for Decentral Access Module (DAM 510)

Table 112: Characteristic Data for DAM 510

Definition	Unit	Power size 1	Power size 2
Input			
DC-link	V DC	565–680 ±10%	
DC-link capacitance	µF	660	
Maximum input current	A DC	15	25
U _{AUX}	V DC	24/48 ±10%	
U _{AUX} current consumption at 24 V DC	A DC	0.5	
U _{AUX} current consumption at 48 V DC	A DC	0.3	
Output			
Output voltage	V DC	V _{OUT PSM}	
Output current DC-link	A DC	15	25
Peak current DC-link (rms value) t < 1.0 s	A _{rms}	30 for < 1 s	48 for < 1 s
Output current U _{AUX}	A DC	15	
General			
Protective measures	–	Overload, short-circuit, and ground fault protection	
Cooling	–	Natural convection	
Mounting	–	Wall-mounted on backplate using backlink connector	
Weight	kg	3.05	
Dimensions (W x H x D)	mm	84.3 x 471 x 270	

11.2.4 Characteristic Data for Auxiliary Capacitors Module (ACM 510)

Table 113: Characteristic Data for ACM 510

Definition	Unit	Value
DC-link	V DC	565–680 ±10%
DC-link capacitance	µF	2750
U _{AUX}	V DC	24/48 ±10%

Definition	Unit	Value
U _{AUX} current consumption at 24 V DC	A DC	0.5
U _{AUX} current consumption at 48 V DC	A DC	0.3
Cooling	–	Natural convection
Mounting	–	Wall-mounted on backplate using backlink connector
Weight	kg	3.54
Dimensions (W x H x D)	mm	84 x 371 x 270

11.2.5 Characteristic Data for Expansion Module (EXM 510)

Table 114: Expansion Module (EXM 510) Characteristic Data

Definition	Unit	Value
DC-link	V DC	565–680 ±10%
Maximum current	A DC	62
Mounting	–	Wall-mounted on backplate using backlink connector
Weight	kg	0.6
Dimensions (W x H x D)	mm	87 x 380 x 145

11.3 Dimensions

11.3.1 Dimensions of ISD 511 Servo Drive

All dimensions are in mm (in).

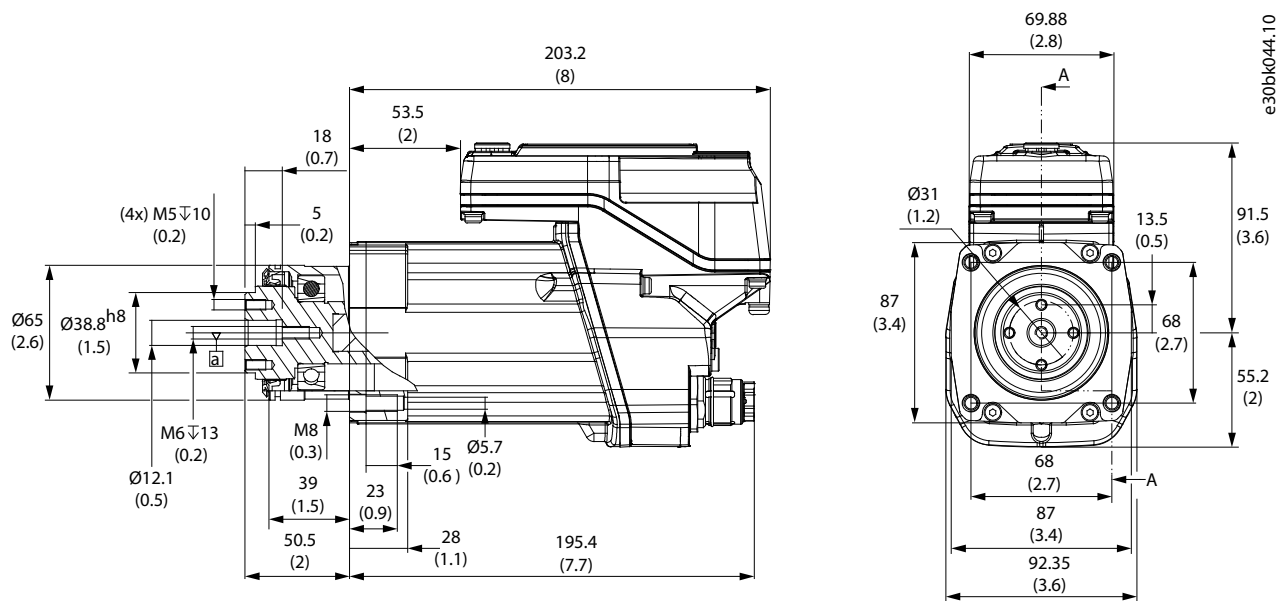


Illustration 70: ISD 511 Servo Drive Dimensions

11.3.2 Dimensions of Flange Screw for Mounting the ISD 511 Servo Drive

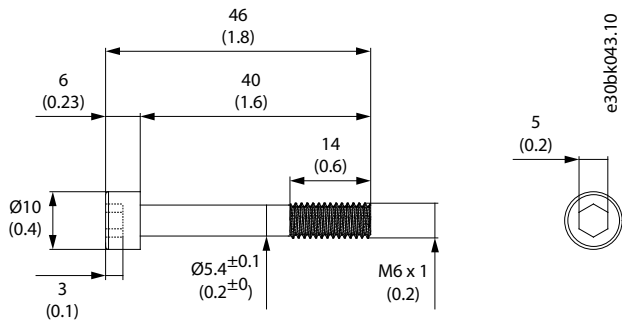


Illustration 71: Flange Screw Dimensions

11.3.3 Dimensions of Power Supply Module (PSM 510)

All dimensions are in mm [in].

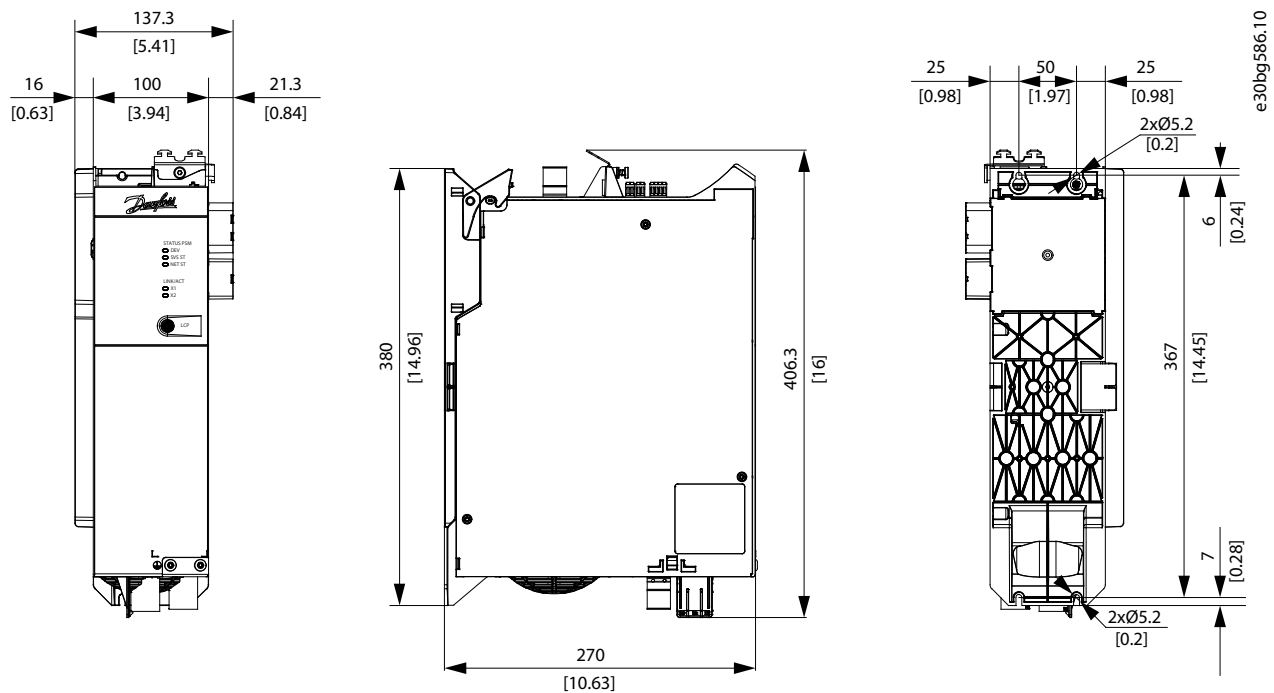


Illustration 72: Dimensions of PSM 510

11.3.4 Dimensions of Decentral Access Module (DAM 510)

All dimensions are in mm [in].

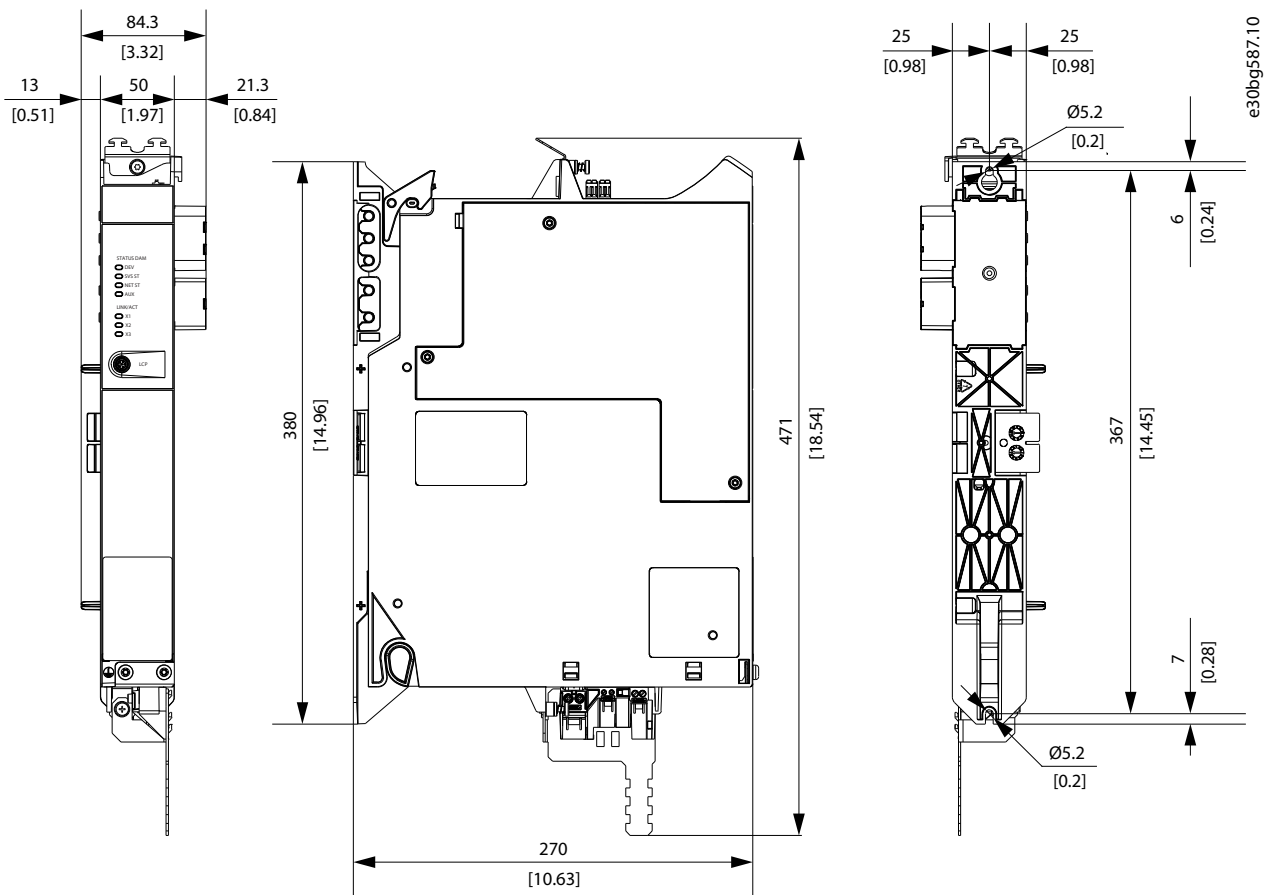


Illustration 73: Dimensions of DAM 510

11.3.5 Dimensions of Auxiliary Capacitors Module (ACM 510)

All dimensions are in mm [in].

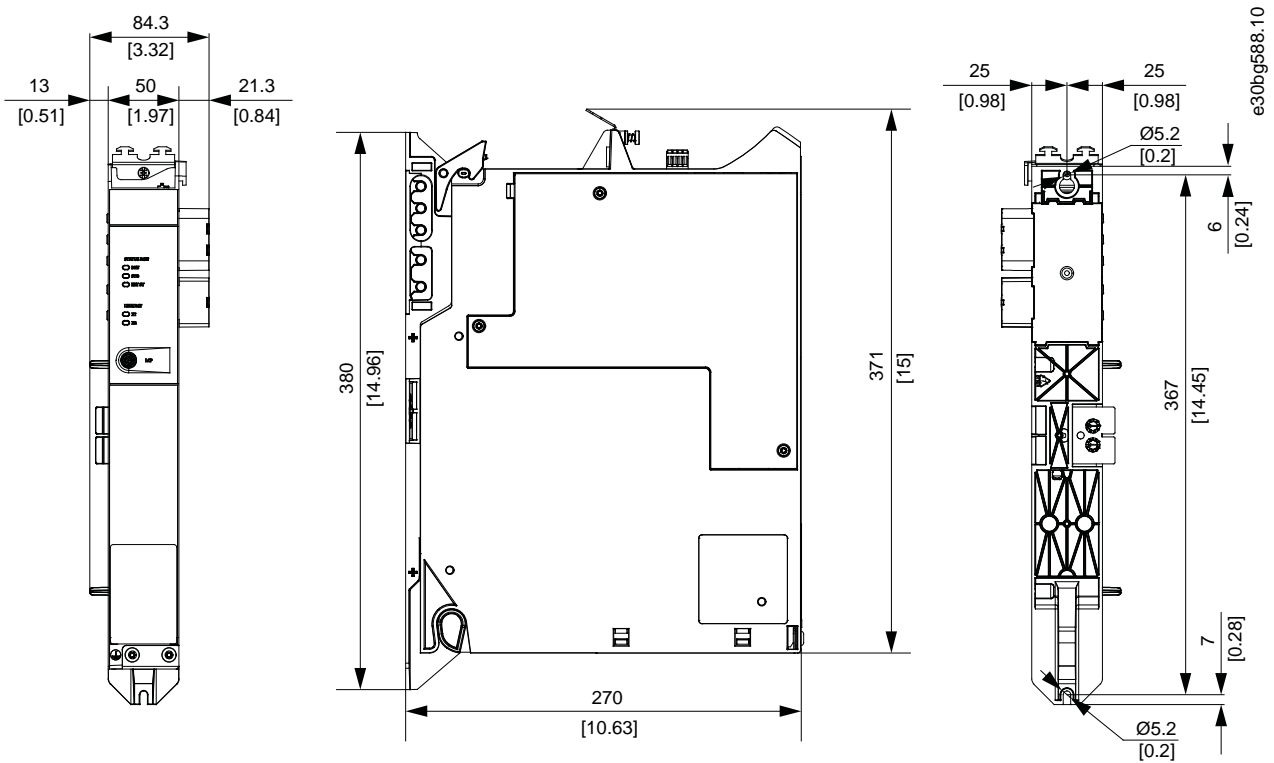


Illustration 74: Dimensions of ACM 510

11.3.6 Dimensions of Expansion Module (EXM 510)

All dimensions are in mm (in).

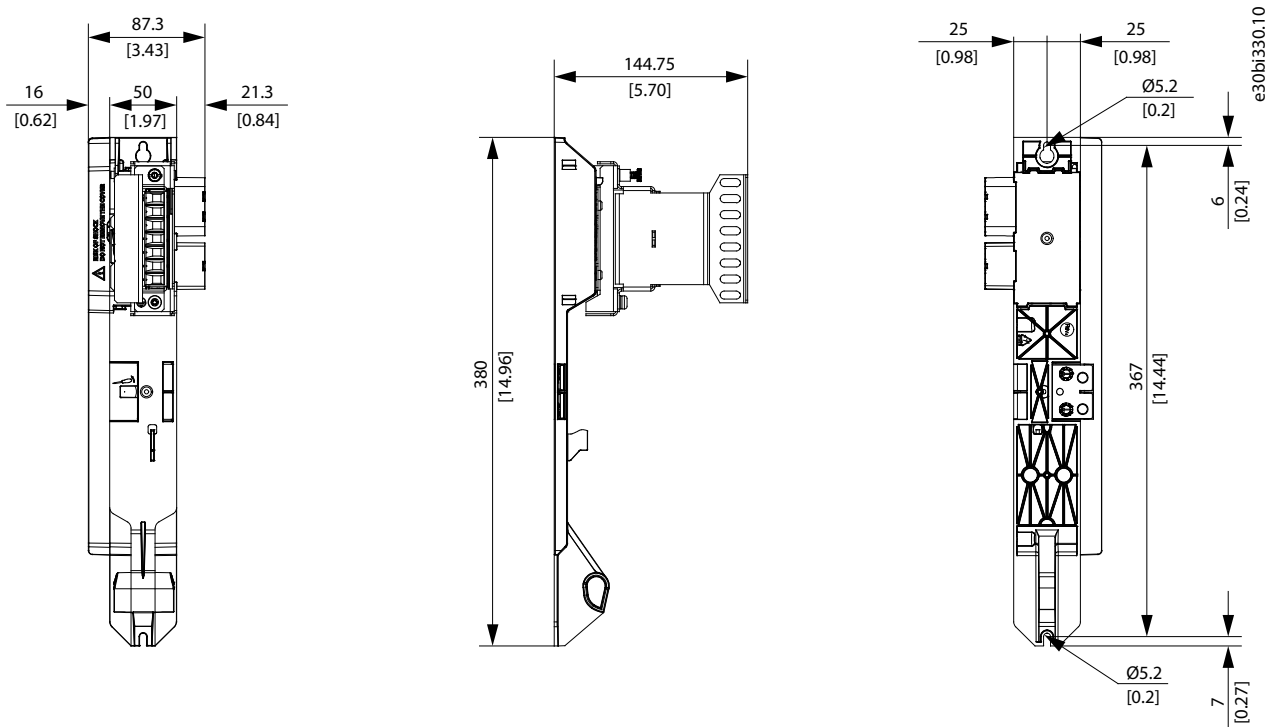


Illustration 75: Dimensions of EXM 510

11.4 Motor Overload and Overtemperature Protection

NOTICE

- A sensor which measures motor windings temperature is integrated in the motor of the ISD 511 servo drive. This issues a warning/error (0x4210) if motor overheating is detected. This prevents motor overheating in case of overloads.
- In addition to the sensor, a second protection mechanism is integrated, which protects the motor even in case of sudden overloads. As local temperature hotspots cannot be detected during a sudden overload event, they are evaluated via software by simulating the physical motor model.
- The combination of both measured temperature and evaluated local hotspot warnings provides protection against motor overheating.

11.5 Allowed Forces on the ISD 511 Servo Drive

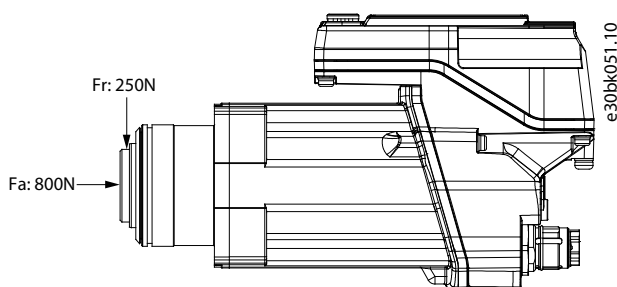


Illustration 76: Allowed Forces

The maximum axial and radial load while assembling the motor and for any mechanical device connected to the shaft, must not exceed the values shown in [Table 115](#). The shaft must be loaded slowly and in a constant manner: Avoid pulsating loads.

NOTICE

- The bearing could be permanently damaged if the maximum allowed forces are exceeded.

Table 115: Maximum Load Ratings

	Maximum radial force (Fr) in N	Maximum axial force (Fa) in N
ISD 511	250 N	800 N

The maximum radial load ratings are based on the following assumptions:

- The servo drives are operated with peak torque of the longest member of the frame size.
- Fully reversed load is applied to the end of the smallest diameter standard mounting shaft extension.
- Infinite life with standard 99% reliability.
- Safety factor = 2

11.6 Connectors on the System Modules

11.6.1 Backlink Connector

The backlink connector is at the top of the backside of all the system modules.

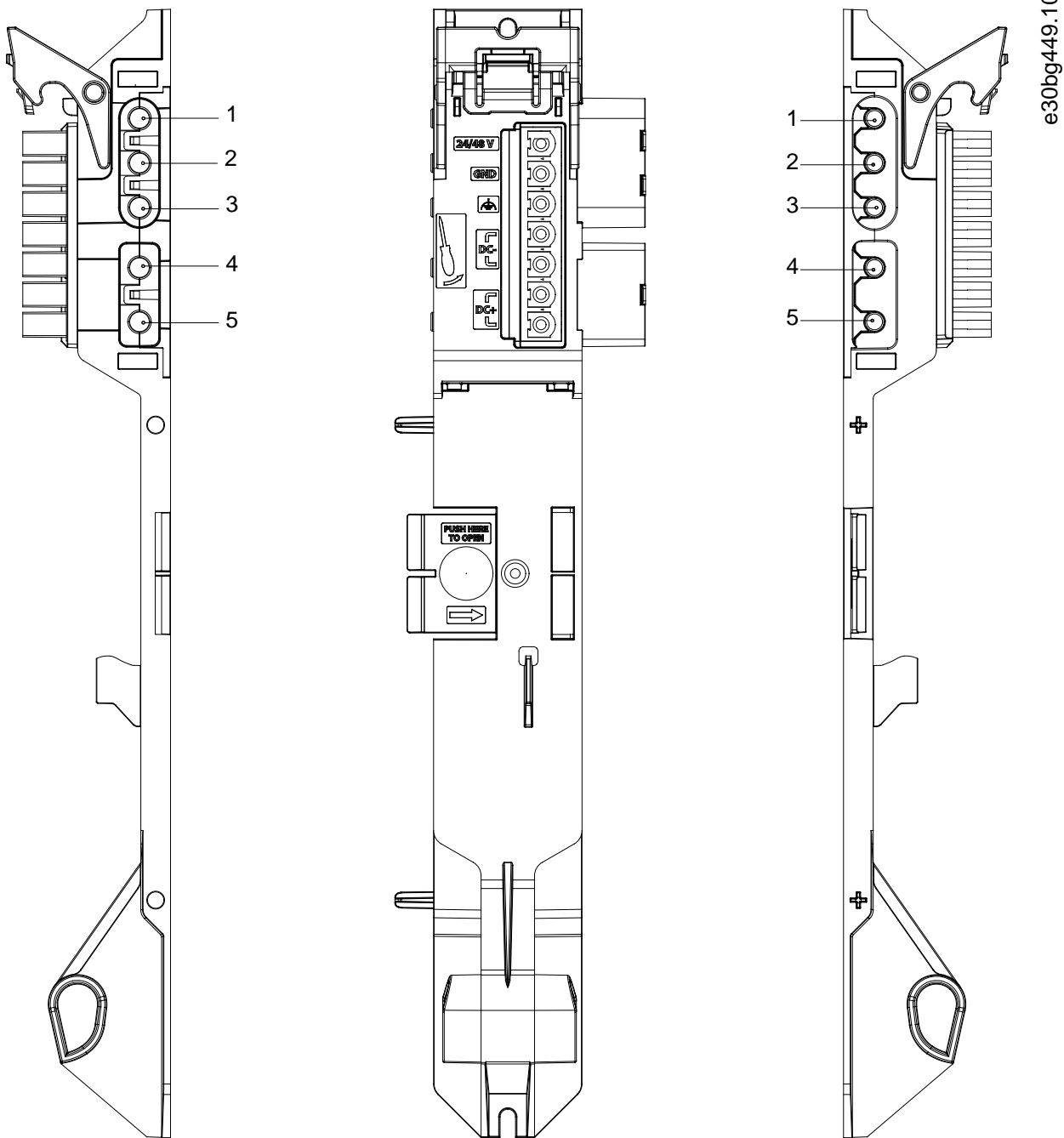


Illustration 77: Pin Assignment of Backlink Connector

Table 116: Pin Assignment of Backlink Connector

Pin	Description
1	24/48 V
2	GND
3	FE: Functional earth
4	DC-
5	DC+

11.6.2 Brake Connectors

There are brake connectors on the Power Supply Module (PSM 510).

11.6.2.1 Brake Resistor Connector on PSM 510

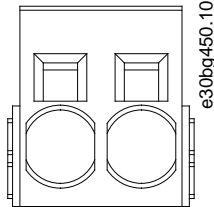


Illustration 78: Brake Connector on PSM 510

Table 117: Pin Assignment of Brake Connector on PSM 510

Pins (left to right)	Description	Notes	Ratings
1	DC+/R+	Used for connecting a brake resistor.	Nominal voltage: 560–800 V DC Maximum brake current: 80 A Conductor cross-section range: 0.75–16 mm ² (AWG 18–AWG 4)
2	R–		

NOTICE

- The maximum length of the brake cable is 30 m (shielded).

11.6.3 Ethernet Connectors

There are ethernet connectors on all the system modules.

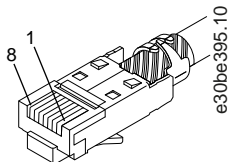


Illustration 79: Ethernet Connector

NOTICE

- Only PELV potential can be connected to the digital inputs and outputs.

11.6.3.1 Ethernet Connectors on PSM 510 and ACM 510

Table 118: Ethernet Connectors on PSM 510 and ACM 510

Connector name	Description	Pins	Ratings
X1 IN	Ethernet IN	1: TX+	According to standard 100BASE-T.
X2 OUT	Ethernet OUT1	2: TX– 3: RX+ 4: – 5: – 6: RX– 7: – 8: –	

11.6.3.2 Ethernet Connectors on DAM 510

Table 119: Ethernet Connectors on DAM 510

Connector name	Description	Pins	Ratings
X1 IN	Ethernet IN	1: TX+	According to standard 100BASE-T.
X2 OUT	Ethernet OUT1 (connection to hybrid cable)	2: TX-	
X3 OUT	Ethernet OUT2	3: RX+	
		4: -	
		5: -	
		6: RX-	
		7: -	
		8: -	

11.6.4 I/O Connectors

11.6.4.1 I/O Connector on PSM 510/ACM 510

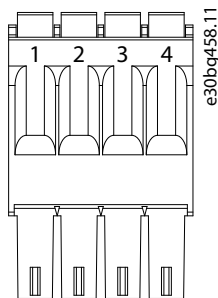


Illustration 80: I/O Connector on PSM 510 (I/O PSM) and ACM 510 (I/O ACM)

Table 120: Pin Assignment of I/O Connector on PSM 510/ACM 510

Pins	Description	Notes	Rating/parameter
1	DIN1-	Digital input	Galvanic isolated Input voltage: 0–30 V DC High (logic "1") voltage: 15–30 V DC Low (logic "0") voltage: <5 V DC Maximum input signal frequency: 50 Hz Maximum input current at 48 V: 11 mA Maximum input resistance: 4.5 KΩ
2	DIN1+		
3	DIG_OUT-	Digital output	Galvanic isolated Maximum voltage between terminals: 24 V DC or AC Maximum current: 1 A Maximum output switching frequency: 50 Hz
4	DIG_OUT+		

The conductor cross-section range is 0.2–1.5 mm² (AWG 24–AWG 16).

NOTICE

- Only PELV potential can be connected to the digital inputs and outputs.

11.6.5 UAUX Connector

The U_{AUX} connector is on the Power Supply Module (PSM 510).

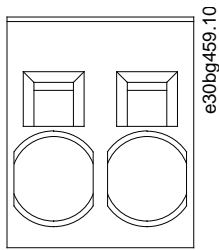


Illustration 81: U_{AUX} Connector

Table 121: Pin Assignment of U_{AUX} Connector

Pins (left to right)	Description	Notes	Rating/parameter
1	24 V AUX	Used for 24–48 V DC input to the Power Supply Module (PSM 510).	Nominal input voltage: 24 V/48 V DC ±10% Maximum current: 50 A Maximum cross-section: 16 mm ² Maximum cable length: 3 m Conductor cross-section range 0.75–16 mm ² , solid or flexible (AWG 18–AWG 4)
2	GND		

NOTICE

- Only PELV potential can be connected to the U_{AUX} input.

⚠ CAUTION ⚠

POSSIBLE LOSS OF FUNCTIONAL SAFETY PROTECTION

The functional safety feature may be affected if the U_{AUX} input exceeds 60 V.

- Ensure that the U_{AUX} input remains below 60 V.

11.6.5.1 24/48 V Cable Cross-Sections for PSM 510

Minimum cable cross-section for CE (minimum 70 °C, Cu)	16 mm ²
Minimum cable cross-section for UL (minimum 60 °C, Cu)	4 AWG

11.6.6 LCP Connector (M8, 6-pole)

There is an LCP connector on the front of all the system modules. It is used to connect the LCP directly via a cable.

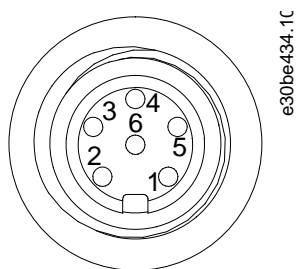


Illustration 82: LCP Connector (M8, 6 pole)

Table 122: Pin Assignment of LCP Connector

Pins	Description	Notes	Rating/parameter
1	Not connected	–	–
2	/LCP RST	Reset	Active at ≤ 0.5 V
3	LCP RS485	Positive RS485 signal	Speed: 38.4 kBd The levels fulfill the RS485 specification.
4	/LCP RS485	Negative RS485 signal	
5	GND	GND	–
6	VCC	5 V supply for LCP	5 V $\pm 10\%$ at 120 mA maximum load

N O T I C E

- Only PELV potential can be connected to the LCP input.

11.6.7 AC Mains Connector

The AC mains connector is on the bottom of the Power Supply Module (PSM 510).

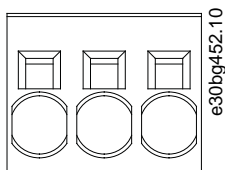


Illustration 83: AC Mains Connector

Table 123: Pin Assignment of AC Mains Connector

Pins (left to right)	Description	Notes	Rating/parameter
1	L3	Used to connect L1/L2/L3	Nominal voltage: 400–480 V AC $\pm 10\%$ Nominal power: 30 kW Maximum cross-section: 16 mm ² (AWG 4) Conductor cross-section range 0.75–16 mm ² , solid or flexible (AWG 18–AWG 4)
2	L2		
3	L1		

11.6.7.1 Mains Cable Cross-Sections for PSM 510

Table 124: Mains Cable Cross-Sections for PSM 510

	PSM 510 (10 kW)	PSM 510 (20 kW)	PSM 510 (30 kW)
Minimum cable cross-section for CE	4 mm ² (minimum 70 °C, Cu)	16 mm ² (minimum 70 °C, Cu)	16 mm ² (minimum 90 °C, Cu)
Minimum cable cross-section for UL	AWG 10 (minimum 60 °C, Cu)	AWG 6 (minimum 60 °C, Cu)	AWG 4 (minimum 75 °C, Cu)

11.6.8 Relay Connector

The relay connector is used for a user-defined reaction and is located as follows:

- Power Supply Module PSM 510: 1 relay connector
- Auxiliary Capacitors Module ACM 510: 1 relay connector

NOTICE

- Only PELV potential can be connected to the relay outputs.

11.6.8.1 Relay Connector on PSM 510/ACM 510

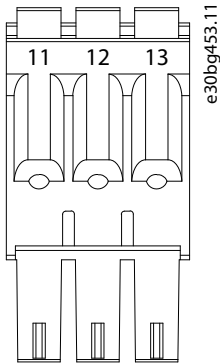


Illustration 84: Relay Connector on PSM 510/ACM 510

Table 125: Pin Assignment of Relay Connector on PSM 510 (REL PSM) and ACM 510 (REL ACM)

Pins	Description	Notes	Rating/parameter
11	NC	Normally closed, 24 V DC	Nominal current: 2 A Conductor cross-section range: 0.2–1.5 mm ² (AWG 24–AWG 16)
12	NO	Normally open, 24 V DC	
13	COM	Common	

11.6.9 STO Connectors

11.6.9.1 STO Connectors on PSM 510

There is 1 input and 1 output STO connector on the Power Supply Module (PSM 510).

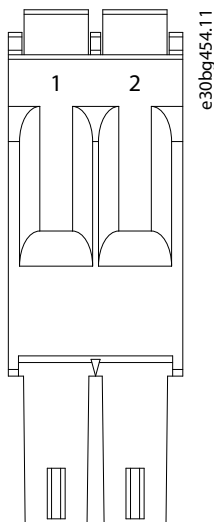


Illustration 85: STO Output Connector on PSM 510

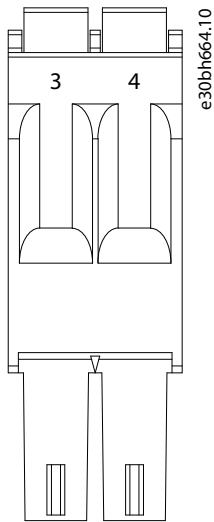


Illustration 86: STO Input Connector on PSM 510

Table 126: Pin Assignment of STO Connectors on PSM 510

Connector name	Pins	Description	Notes	Rating/parameter
STO PSM	1	STO-	Used for STO output voltage to the input of the other system modules.	Nominal voltage: 24 V DC \pm 10% Nominal current: Depends on the number of servo drives in the application. Maximum current: 1 A Conductor cross-section range: 0.2–1.5 mm ² (AWG 24–AWG 16)
	2	STO+		
	3	STO-	Used for STO input voltage.	
	4	STO+		

NOTICE

- Only PELV potential can be connected to the STO inputs.

11.6.9.2 STO Connectors on the DAM 510

11.6.9.2.1 STO Connectors on the Top of DAM 510

There is 1 input and 1 output STO connector on the top of the Decentral Access Module (DAM 510).

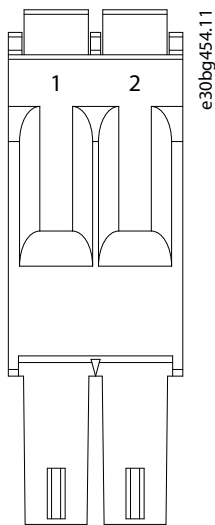


Illustration 87: STO Output Connector on the Top of DAM 510

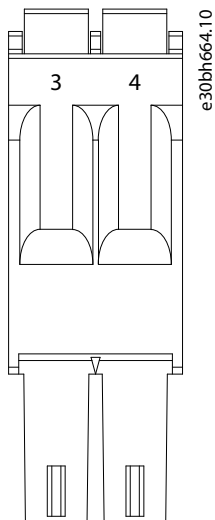


Illustration 88: STO Input Connector on the Top of DAM 510

Table 127: Pin Assignment of STO Connectors on the Top of DAM 510

Connector name	Pins	Description	Notes	Rating/parameter
STO DAM	1	STO-	Used for STO output voltage to the input of the other system modules.	Nominal voltage: 24 V DC $\pm 10\%$ Nominal current: Depends on the number of servo drives in the application. Maximum current: 1 A Conductor cross-section range: 0.2–1.5 mm ² (AWG 24–AWG 16)
	2	STO+		
	3	STO-	Used for STO input voltage.	
	4	STO+		

NOTICE

- Only PELV potential can be connected to the STO inputs.

11.6.9.2.2 STO Connector on the Bottom of DAM 510

There is 1 output STO connector on the bottom of the Decentral Access Module (DAM 510). The output is for the hybrid cable.

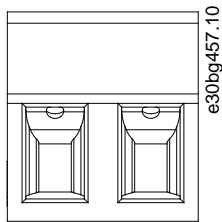


Illustration 89: STO Connector on the Bottom of DAM 510

Table 128: Pin Assignment of STO Connector on the Bottom of DAM 510

Connector name	Pins (left to right)	Description	Notes	Rating/parameter
STO DAM	1	STO+	Used for the STO output from the DAM to the hybrid cable.	Nominal voltage: 24 V DC \pm 10% Nominal current: Depends on the number of servo drives in the application. Maximum current: 1 A Conductor cross-section range: 0.2–1.5 mm ² (AWG 24–AWG 16) Plug terminal tightening torque: 0.22–0.25 Nm (1.95–2.21 in-lb)
	2	STO–		

11.6.10 UDC Connector

The UDC connector is on the bottom of the Decentral Access Module (DAM 510).

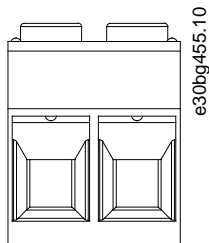


Illustration 90: UDC Connector

Table 129: Pin Assignment of UDC Connector

Pins (left to right)	Description	Notes	Rating/parameter
1	UDC+	Used to connect the DC-link voltage from the Decentral access Module (DAM 510) to the hybrid cable for the ISD line.	Nominal voltage: 560–800 V DC Nominal current: Depends on the number of servo drives in the application. Maximum current: 25 A Conductor cross-section range: 0.2–6 mm ² (AWG 24–AWG 10) Plug terminal tightening torque: 0.5–0.8 Nm (4.43–7.08 in-lb)
2	UDC–		

11.6.11 AUX Connector

The AUX connector is on the bottom of the Decentral Access Module (DAM 510).

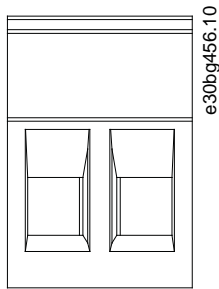


Illustration 91: AUX Connector

Table 130: Pin Assignment of AUX Connector

Pins (left to right)	Description	Notes	Rating/parameter
1	AUX+ (24/48 V)	Used to connect the AUX output from the Decentral access Module (DAM 510) to the hybrid cable for the servo drive line.	Nominal voltage: 24/48 V DC ±10% Nominal current: Depends on the number of servo drives in the application. Maximum current: 15 A Conductor cross-section range: 0.2–2.5 mm ² (AWG 24–AWG 12) Plug terminal tightening torque: 0.5–0.6 Nm (4.43–5.31 in-lb)
2	AUX– (GND)		

N O T I C E

- Only PELV potential can be connected to the AUX output.

11.6.12 External Encoder Connectors

- DAM 510: E DAM

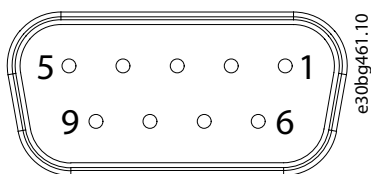


Illustration 92: External Encoder Connector

Table 131: External Encoder Connectors

Connector name	Description	Pins	Ratings/Notes
E DAM	Used to connect the external encoder to DAM 510.	See Table 132 .	Nominal voltage: 24 V DC, isolated (see Table 132) Nominal current: Depends on the number of servo drives in the application. Maximum current: 150 mA (see Table 132) Fulfill the following specifications: <ul style="list-style-type: none"> • BISS/SSI

Table 132: Pin Assignment of External Encoder Connectors (X1/X2)

Pins	Description	Notes SSI/BISS	Notes
1	24 V	24 V DC ±10% (used for powering the encoder)	Maximum current: 150 mA
2	–	–	–
3	–	–	–
4	RS422 RXD	Positive data	Bus speed: SSI: Up to 10 Mhz clock frequency with 30 m cable. BiSS: Fulfills the RS485 specification.
5	RS422 TXD	Positive data	
6	GX	Isolated ground. If encoders are powered externally, the ground of the external supply must be connected to GX.	–
7	–	–	–
8	/RS422 RXD	Negative data	Bus speed: SSI: 0.5 Mbit with 25 m cable. BiSS: Fulfills the RS485 specification.
9	/RS422 TXD	Negative data	

NOTICE

- Only PELV potential can be connected to the external encoder.

11.6.13 Expansion Module Connector

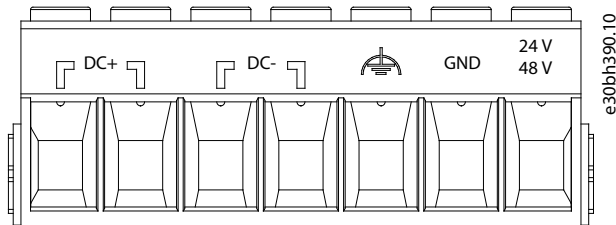


Illustration 93: Expansion Module Connector

Table 133: Pin Assignment of Expansion Module Connector

Pins (left to right)	Description	Note	Rating/parameter
1	DC+	Shield the DC cables using the cable tie on the EXM 510 EMC plate.	Nominal voltage: 560–800 V DC
2			Nominal current: Depends on the number of servo drives in the application.
3	DC–		Maximum current: 62 A ⁽¹⁾
4			Conductor cross-section range: 0.75–16 mm ² , solid or flexible (AWG 18–AWG 4)
			Only use with ferrule without plastic sleeve with CRIMPFOX 16 S.
			Use shielded conductors for UDC (DC+, DC–).
			Plug terminal tightening torque: 1.7–1.8 Nm (15.05–15.93 in-lb)

Pins (left to right)	Description	Note	Rating/parameter
5	FE (functional earth)	–	
6	GND	–	
7	24/48 V	–	

¹ The maximum current rating for 1 pair of EXM is 62 A. In systems with 2 PSM 510 modules, 2 pairs of EXM 510 modules can be used to achieve a maximum current rating of 124 A.

11.6.13.1 Cable Cross-Sections for EXM 510

Table 134: Minimum Cable Cross-Sections for EXM 510 Cables

Cable	CE	UL
DC+/DC–	16 mm ² (minimum 70 °C, Cu)	6 AWG (minimum 75 °C, Cu)
24 V, functional PE	16 mm ² (minimum 70 °C, Cu)	6 AWG (minimum 90 °C, Cu) ⁽¹⁾

¹ Minimum 75 °C is allowed if less than 45 A is measured on the cable.

11.7 Connectors on the ISD 511 Servo Drives

11.7.1 X1 and X2 Hybrid Connectors

The hybrid cable provides the supply (mains and auxiliary), the communication lines, and the safety supply for each line of servo drives. Input and output connectors are connected inside the servo drive.

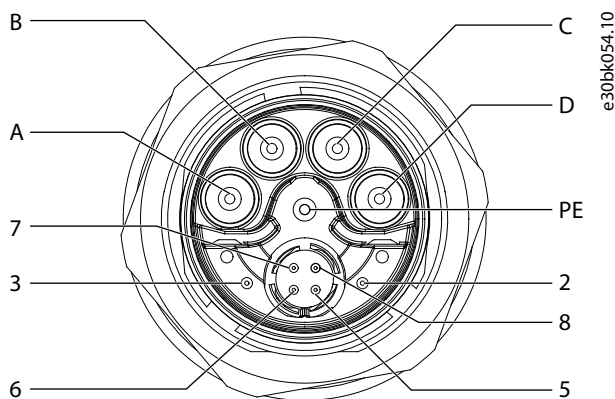


Illustration 94: Pin Assignment of X1 Male Hybrid Connector (M23)

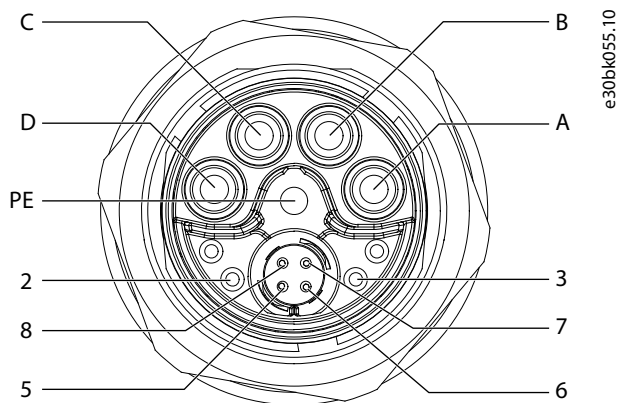


Illustration 95: Pin Assignment of X2 Female Hybrid Connector (M23)

Table 135: Pin Assignment of X1 and X2 Hybrid Connectors (M23)

Pin	Description	Notes	Rating/parameter
A	UDC-	Negative DC supply	Operating voltage: 565–680 V DC, maximum 778 V Negative DC supply (maximum -15 A/25 A)
B	UDC+	Positive DC supply	Operating voltage: 565–680 V DC, maximum 778 V Positive DC supply (maximum 15 A/25 A)
C	AUX+	Auxiliary supply	24-48 V DC±10%, 15 A Absolute maximum 55 V DC
D	AUX-	Auxiliary supply ground	
PE	PE	PE connector	15 A
2	STO+	Safety supply	24 V DC ±10%, 1 A
3	STO-	Safety supply ground	
5	TD+	Positive Ethernet transmit	According to standard 100BASE-T
6	RD-	Positive Ethernet receive	
7	TD-	Negative Ethernet transmit	
8	RD+	Negative Ethernet receive	

11.8 General Specifications and Environmental Data

11.8.1 ISD 511 Servo Drives

Table 136: General Specifications and Environmental Conditions for ISD 511

Specification	Value
IP ratings	IP65 according to EN 60529 IP69K (flange and sealing) according to ISO 20653 Indoor only
Vibration test	Class 3M7 according to IEC 60721-3-3
Maximum relative humidity	Storage/transport: 5–95% (non-condensing)
	Stationary use: 5–95% (non-condensing)

Specification	Value
Ambient temperature	Operating: 5–45 °C
	Storage/transport: –25 to +55 °C
Installation altitude	Nominal current up to 1000 m above sea level. Derating of output current (1% / 100 m) at 1000–3000 m. Operation above 3000 m is not permitted.
EMC standard for emission and immunity	EN 61800-3 (second environment)
EMC immunity functional safety	EN 61800-5-2 Annex E
Pollution degree	2
Overvoltage category	III

11.8.2 System Modules

Table 137: General Specifications and Environmental Conditions for System Modules

Specification	Value
Protection rating	IP20 according to IEC/EN 60529 (except connectors, which are IP00).
	<div style="background-color: #cccccc; padding: 5px; margin-bottom: 5px;"> <p style="margin: 0;">⚠ W A R N I N G ⚠</p> </div> <p>RISK OF ELECTRICAL SHOCK</p> <p>The IP20 rating of the PSM 510, DAM 510, and ACM 510 modules is not fulfilled if the modules are not connected to the backplate. This may result in death or serious injury.</p> <ul style="list-style-type: none"> – Do not touch the backplate when a module is removed from the backplate.
Vibration test	Random vibration: 1.14 g (2h/axis according to EN 60068-2-64)
	Sinusoidal vibration: 1.0 g (2h/axis according to EN 60068-2-6)
Maximum relative humidity	Storage/transport: 5–95% (non-condensing)
	Stationary use: 5–93% (non-condensing)
Ambient temperature range	Operating: 5–40 °C nominal, up to 55 °C with derating (see Illustration 96)
	Transport: –25 to +55 °C
	Storage: –25 to +55 °C
Installation altitude	Nominal current up to 1000 m above sea level. Derating of output current (1% / 100 m) from 1000 m to 3000 m. Operation above 3000 m is not permitted.
EMC standard for emission and immunity	EN 61800-3 (second environment)

Specification	Value
EMC immunity for functional safety	EN 61800-5-2 Annex E
Degree of pollution according to EN 60664-1	2
Overvoltage category according to EN/IEC 61800-5-1	III

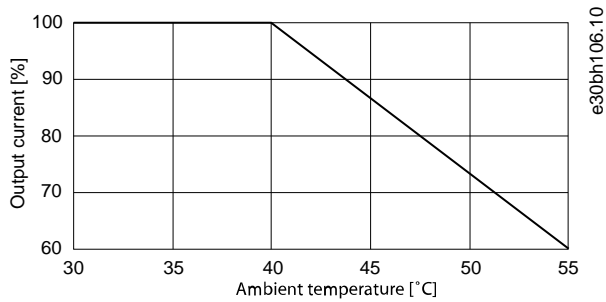


Illustration 96: Derating

11.9 Storage

Store the servo system components in a dry, dust-free location with low vibration ($v_{eff} \leq 0.2 \text{ mm/s}$).

The storage location must be free from corrosive gases.

Avoid sudden temperature changes.

Long-term storage

To recondition the electrolytic capacitors, servo drives and system components that are not in service must be connected to a supply source once per year to allow the capacitors to charge and discharge. Otherwise the capacitors could suffer permanent damage.

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VLT Servo Drive Systems Glossary

A

A-flange	The A side is the shaft side of the servomotor.
ACM	Auxiliary Capacitors Module.
Ambient temperature	The temperature in the immediate vicinity of the servo system or component.
Automation Studio™	Automation Studio™ is a registered trademark of B&R. It is the integrated software development environment for B&R controllers.
Axial force	The force in newton acting on the rotor axis in the axial direction.

B

B side	The rear side of the servo drive with the plug-and-socket connectors.
B&R	Multi-national company, specializing in factory and process automation software and systems for a wide range of industrial applications.
Bearings	The ball bearings of the servomotor.
Beckhoff®	Beckhoff® is a registered trademark of and licensed by Beckhoff Automation GmbH, Germany.
Brake	Mechanical holding brake on the servo drive.

C

CANopen®	CANopen® is a registered community trademark of CAN in Automation e.V.
CE	European test and certification mark.
CIA DS 402	Device profile for drives and motion control. CIA® is a registered community trademark of CAN in Automation e.V.
Clamping set	A mechanical device, which, for example, can be used to secure gears to a motor shaft.
Connector (M23)	Servo drive hybrid connector.
Cooling	Decentral servo drives are cooled by natural convection (without fans). All system modules except the DAM 510, ACM 510, and EXM 510 are cooled by an internal fan.

D

DAM	Decentral Access Module
DC voltage	A direct constant voltage.
DC-link	Each servo drive has its own DC-link, consisting of capacitors.
DC-link voltage	A DC voltage shared by several servo drives connected in parallel.

E

EPSCG	Ethernet POWERLINK® Standardization Group.
ETG	EtherCAT® Technology Group
Ethernet POWERLINK®	Ethernet POWERLINK® is a deterministic real-time protocol for standard Ethernet. It is an open protocol managed by the Ethernet POWERLINK® Standardization Group (EPSCG). It was introduced by Austrian automation company B&R in 2001.

F

Feed-in cable	Hybrid connection cable between the Decentral Access Module (DAM 510) and ISD 511 servo drive.
Feedback system	The feedback system measures the rotor position.
Fieldbus	Communication bus between controller and servo axis and system modules; in general between controller and field nodes.
Firmware	Software in the unit; runs on the control board.
Function block	Device functionalities are accessible via the engineering environment software.

I

IGBT	The insulated-gate bipolar transistor is a 3-terminal semiconductor device, primarily used as an electronic switch to combine high efficiency and fast switching.
IRT	Isochronous Real-Time.
ISD	Integrated Servo Drive
Installation elevation	Installation elevation above normal sea level, typically associated with a derating factor.

L

LCP	Local control panel.
Loop cable	Hybrid connection cable between 2 decentral servo drives, with 2 M23 connectors.

M

M23 connectors	Connectors (X1 & X2) for connecting the hybrid feed-in and loop cables on the B side of the ISD 511 servo drive.
Motor shaft	Rotating shaft on the A side of the servo motor, typically without a key groove.
Multi-turn encoder	Describes an absolute encoder, in which the absolute position remains known after several revolutions.

P

PELV	Protected extra low voltage is an electricity supply voltage in a range which carries a low risk of dangerous electrical shock.
PLC	A programmable logic controller is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines.
PLCopen®	The name PLCopen® is a registered trademark and, together with the PLCopen® logos, is owned by the association PLCopen®. PLCopen® is a vendor- and product-independent worldwide association that defines a standard for industrial control programming.
POU	Program organization unit. This can be a program, function block, or function.
PSM	Power Supply Module.
PWM	Pulse width modulation.

R

RCCB	Residual current circuit breaker.
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RT	Real-time.
Radial force	The force in newton acting at 90° to the longitudinal direction of the rotor axis.
Resolver	A feedback device for servomotors, typically with 2 analog tracks (sine and cosine).
S	
SIL 2	Safety Integrated Level II.
SSI	Synchronous serial interface.
STO	Safe Torque Off function. On activation of STO, the ISD 510 servo drive is no longer able to produce torque in the motor.
Safety (STO)	A servo drive safety circuit that switches off the voltages of the driver components for the IGBTs.
Scope	Scope is part of the DDS Toolbox software and is used for diagnosis. It enables internal signals to be depicted.
Single-turn encoder	Describes an absolute encoder, in which the absolute position for 1 revolution remains known.
Standstill (servo drive)	Power is on, there is no error in the axis, and there are no motion commands active on the axis.
System modules	This term includes the Power Supply Module (PSM 510), the Decentral Access Module (DAM 510), and the optional Auxiliary Capacitors Module (ACM 510).
U	
UAUX	Auxiliary supply, provides power to the control electronics of the ISD 511 servo drives and the Power Supply Module (PSM 510), Decentral Access Module (DAM 510), and Auxiliary Capacitors Module (ACM 510).
V	
VLT® Servo Toolbox	A Danfoss pc software tool used for parameter setting and diagnostics of VLT® Servo Drive systems
W	
Wireshark®	Wireshark® is a network protocol analyzer released under the GNU General Public License version 2.

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