Operating Guide

VLT® Multiaxis Servo Drive MSD 520

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1 Introduction

1.1 Purpose of the Operating Guide

The purpose of this operating guide is to describe the VLT® Multiaxis Servo Drive MSD 520 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 guide is a prerequisite for:

- Trouble-free operation
- Recognition of product liability claims

Therefore, read this operating guide before working with the VLT® Multiaxis Servo Drive MSD 520 System.

1.2 Additional Resources

Table 1: Additional Resources

Guide	Description
VLT® Servo Drive System ISD520/DSD520 Operating Guide.	Information about the installation, commissioning, and operation of the system.
Advanced Functional Safety for VLT® FlexMotion™	Information about the installation, commissioning, operation, programming, and troubleshooting of the Advanced Functional Safety option for VLT® FlexMotion™

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1.4 Document Version

The original language of this guide is English.

Version	Remarks
AQ448939736224, version 01	First release

1.5 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. 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.

Table 2: Product and System Approvals and Certifications - (continued)

Certification	Description
CE	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.
Ethernet PROFINET®	Ethernet-based fieldbus system.
Ethernet PROFIsafe®	Safety profile for sending safety-critical data via PROFINET.
Ethernet EtherCAT® EtherCAT®	Ethernet-based fieldbus system. EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
Safety over EtherCAT® (FSoE) Safety over EtherCAT®	Safety profile for sending safety-critical data over EtherCAT®. Safety over EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
PLCopen®	Technical specification. Function blocks for motion control (formerly Part 1 and Part 2) Version 2.0 March 17, 2011.

1.6 Areas of Application

Potential areas of application are:

- Food and beverage machines
- Packaging machines
- Pharmaceutical machines
- Applications running with a group of servo drives

1.7 Software

Updates to the firmware, VLT® Servo Toolbox software, and PLC libraries may be available. Download the available updates from the VLT® Servo Toolbox (danfoss.com) website.

The VLT® Servo Toolbox software or the PLC libraries can be used to install the firmware on the system components.

1.8 Terminology

Table 3: Terminology

Term	Description
DSD 520	Decentral Servo Drive.
DVC	Decisive Voltage Class.
EXM 520	Expansion module.
Feed-in cable	Hybrid cable which connects the PSM 520 to the 1st servo drive.

Table 3: Terminology - (continued)

Term	Description
ISD 520	Integrated Servo Drive.
LCP	Local control panel.
Loop cable	Hybrid cable for connecting servo drives in daisy-chain format.
MSD 520	Multiaxis Servo Drive.
PLC	Programmable Logic Controller (external device for controlling the servo system).
PSM 520	Power Supply Module.
SDM 521	Servo Drive Module (single axis).
SDM 522	Servo Drive Module (double axis).
Servo drives	SDM 521/SDM 522, ISD 520/DSD 520.
System components	Includes PSM 520, SDM 521/SDM 522, EXM 520, ISD 520/DSD 520.
System modules	Includes PSM 520, SDM 521/SDM 522, EXM 520.
V_{IN} PSM	Input of PSM 520 (V AC).
V_{OUT} PSM	Output of PSM 520 (V DC).

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation and products.

⚠ DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

	ISO warning symbol for general warnings
	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electric shock
	Symbol for indicating the required discharge time of the capacitors in the product.
	ISO action symbol for referring to the instructions

2.2 Important Safety Warnings

The following safety instructions and precautions relate to the MSD 520 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 guide.

⚠ WARNING

HAZARDOUS SITUATION

If the servo system components, 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 guide and national and local safety regulations.

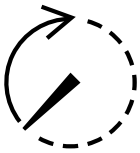
⚠ WARNING

HIGH VOLTAGE

The servo 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



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 520). 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 electric shock, fully disconnect the Power Supply Module (PSM 520) 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

⚠ WARNING

TOUCH CURRENT HAZARD

The touch current is the electric current passing through a person when touching conductive accessible parts of an electrical device. This is > 3.5 mA. Improper grounding of the system components may result in death or serious injury.

- For reasons of personal 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 guide.
- The minimum size of the PE conductor shall comply with the local safety regulations for high touch current.

⚠ WARNING

RISK OF ELECTRIC SHOCK

More than 1 disconnect switch is required to de-energize the equipment before servicing (Mains and Auxiliary supply). Failure to switch off both sources of supply before performing service or repair work could result in death or serious injury.

- Ensure both sources of supply are de-energized before servicing.

⚠ WARNING

ELECTRIC SHOCK HAZARD

The system modules are open type and provide protection against direct contact to hazardous live parts.

- These are intended to be installed inside a supplementary enclosure to improve protection against electric shock, thus ensuring over time no direct contact to hazardous live parts.

⚠ WARNING

FIRE HAZARD

The system modules are open type and do not provide comprehensive mitigation for fire hazard.

- These are intended to be installed inside a supplementary enclosure or in a restricted-access area which provides appropriate protection against the spread of fire.

⚠ WARNING

UNINTENDED START

The servo system is 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 80 °C (176 °F) during operation.

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

⚠ CAUTION

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 520.

- To avoid electrical shock, fully disconnect the PSM 520 from the mains and wait for the discharge time to elapse before disconnecting or connecting the hybrid cables or disconnecting cables from the PSM 520.

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 device (RCD) is used for protection against electric shock, only an RCD of Type B is allowed on the supply side of this product. All upstream RCD, up to the supply transformer, shall be of Type B.
- Recommended RCD sensitivity is 300 mA. For complex systems with more than 10 drives, it is recommended to consider RCD with lower sensitivity (>300 mA, for example, 500 mA).

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 guide 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 guide 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 guide 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 electric shock and to protect the servo system against overload, protective grounding is obligatory and must be performed in accordance with local and national regulations.

2.4 Operational Safety

- Safety-related applications are only allowed if they are explicitly and unambiguously mentioned in this guide.
- 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 520). 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 520. 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 risks (such as injury from moving parts after an unintended start) must be prevented, 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 (STO) 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 (STO) function, or by safe disconnection of the servo drives.
- In addition to the L1, L2, and L3 supply voltage inputs on the PSM 520, the servo system has other supply voltage inputs, including external auxiliary voltage. Before commencing repair work, check that all supply voltage inputs are switched off and that the necessary discharge time for the DC-link capacitors has elapsed.

2.5 Qualified Personnel

Installation, commissioning, and maintenance may only be carried out by qualified personnel. For the purposes of this guide and the safety instructions in this guide, 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.

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

2.6 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.

2.7 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

- This equipment is not intended for use in residential locations and may not provide adequate protection to radio reception in such locations.
- This product is not intended to be used on a low voltage public network which supplies residential premises, and radio frequency interference is expected if used on such a network.
- 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.

2.8 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.

2.9 Foreseeable 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.

2.10 Service and Support

Contact the local service representative for service and support.

3 System Description

3.1 Overview of the VLT® Multiaxis Servo Drive System MSD 520

The VLT® Multiaxis Servo Drive System MSD 520 is a high-performance central servo motion solution.

The open system supports the real-time Ethernet protocols:

- EtherCAT®
- Ethernet POWERLINK®
- PROFINET®

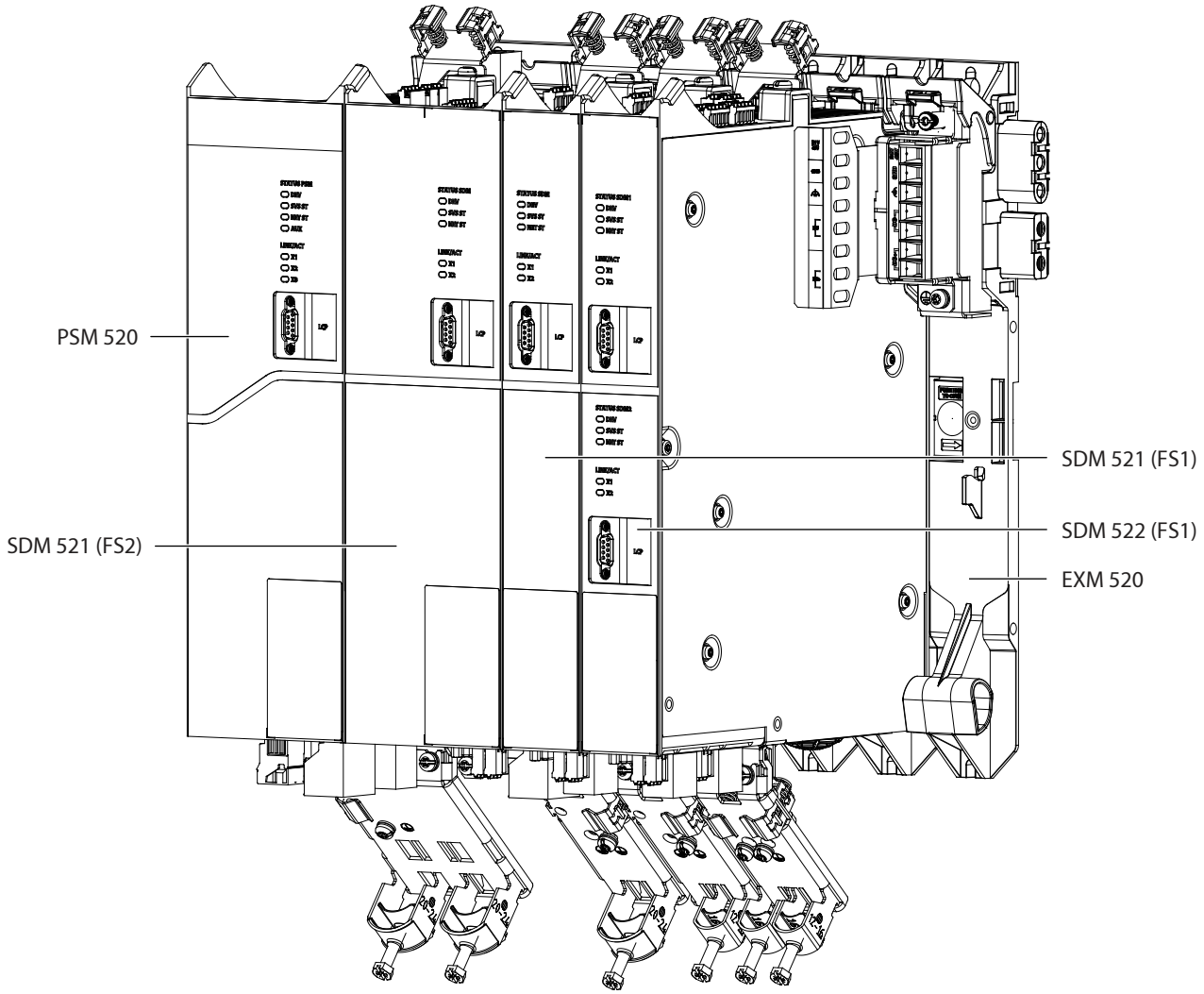


Figure 1: MSD Modules

The system comprises:

- Power Supply Module (PSM 520)
  - Available with DAM option
- Drive Modules:
  - Single-axis Servo Drive Module (SDM 521)
  - Double-axis Servo Drive Module (SDM 522)

- Expansion Module (EXM 520)
- Software:
  - Firmware for the Power Supply Module (PSM 520)
  - Firmware for the Servo Drive Modules (SDM 521 and SDM 522)
  - Pc software tool: VLT® Servo Toolbox
  - PLC libraries for Automation Studio™, TwinCAT®, SIMOTION SCOUT®, and TIA Portal®

The SDM 521 modules are available in 2 enclosure (frame) sizes with widths of (FS1) 50 mm (2.0 in) or (FS2) 100 mm (3.9 in) depending on the power size.

Depending on the application, the system can be used exclusively as a central system, or together with Danfoss Decentral Servo Drives (ISD 520 and DSD 520) as a mixed system. Use of an AC choke is mandatory, for further information see 5.9.1 AC Line Choke.

The system modules PSM 520, SDM 521/SDM 522, and EXM 520 are mounted to a backplate inside 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.

NOTICE

- The system modules cannot be used in servo systems from other manufacturers. Drives from other manufacturers cannot be used in the MSD 520 system.
- Contact Danfoss for further information.

NOTICE

- The system modules have a protection rating of IP20 according to IEC/EN 60529 (except connectors, which are IP00). They are only designed for use within a control cabinet. The system modules can be damaged if exposed to fluids.

NOTICE

- Only the components described in this guide may be fitted or installed. Third-party devices and equipment may be used only in consultation with Danfoss.
- For security reasons, do not connect the system components to the internet.
- Only configure the system components using the specified HMI or the VLT® Servo Toolbox software.
- Contact Danfoss for further information.

3.2 Applications and Module Limits

3.2.1 Application Examples

There are numerous potential areas of application for the servo system including, but not limited to, the examples in Table 4.

Table 4: Application Examples

Category	Machine type
Beverage machines	Filling
	PET blow-moulding
	Capping
	Labeling

Table 4: Application Examples - (continued)

Category	Machine type
Food and beverage packaging machines	Flow wrapping
	Bag maker
	Tray sealing
	Shrink wrapping
Industrial and pharmaceutical packaging machines	Palletization
	Top loader
	Cartoning
	Tube filling
	Blister machine
	Liquid filling
	Solid dosing

3.2.2 Maximum Number of Modules

The maximum number of modules in the VLT® Multiaxis Servo Drive MSD 520 System is:

- PSM 520: 2 per system
- SDM 521/SDM 522: Depends on the current rating and output power of the servo drive modules and the AUX current consumption during operation. Contact Danfoss for further information about the maximum number of servo drive modules.

3.3 Power Supply Module PSM 520

3.3.1 Overview of PSM 520

PSM is the abbreviation for Power Supply Module. It is the power supply to the servo system. The PSM 520 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 DAM option (factory-mounted option) of the PSM 520 is used to supply the decentral servo system with power and fieldbus. The PSM 520 can be controlled via Ethernet-based fieldbus.

Indicator lights (LEDs) on the front of the PSM 520 show the operating status and warnings.

NOTICE

- The MSD 520 system is designed for use within a control cabinet. If the STO function or another safety function is used, the cabinet must be rated at least IP54.
- The PSM 520 has a protection rating of IP20 according to IEC/EN 60529 (except connectors, which are IP00).
- The PSM 520 can be damaged if exposed to fluids.

NOTICE

- The connectors at the top side do not fulfill strain relief requirements. When using digital I/Os, configure the logic values that ensure that the system enters a known state if a wire disconnects.

All power cables are wired into the PSM 520, therefore at least 1 PSM 520 is required for each system.

The PSM 520 also performs service functions, such as voltage measuring, and is cooled with an internal fan.

The PSM 520 incorporates a brake chopper and internal brake resistor, at the same time there is the possibility to connect an external brake resistor.

The PSM 520 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 s. To achieve an output power of up to 60 kW, 2 PSM 520 modules can be used in parallel.

An example type code for the PSM 520 is: MSD-520SAPS04-30P0EC. Definition of PSM 520 type codes, refer to Table 6.

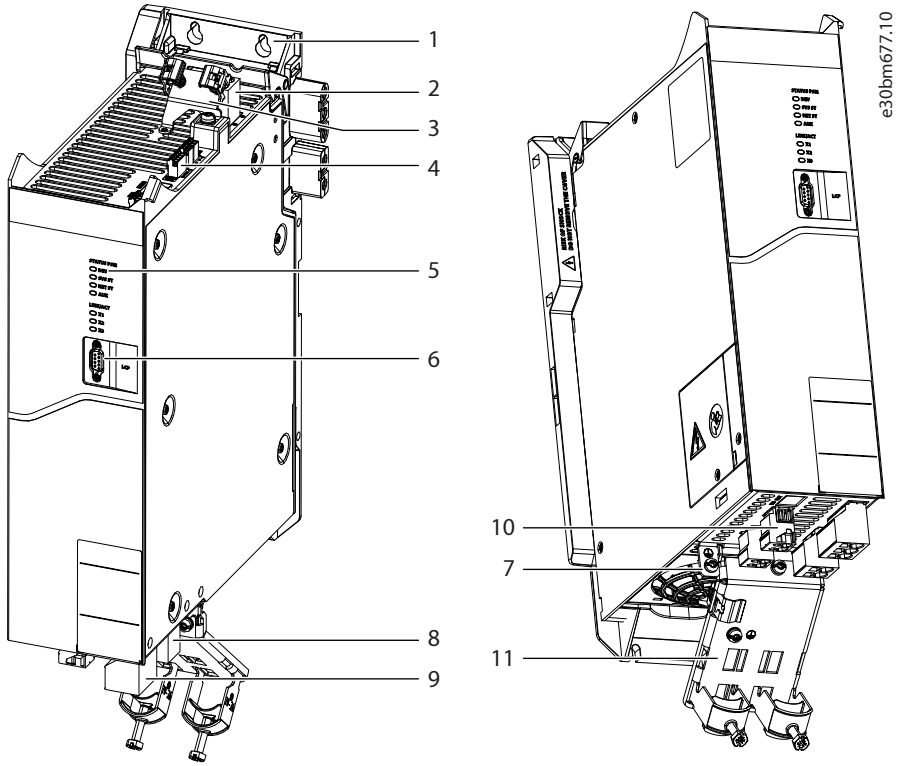


Figure 2: Power Supply Module PSM 520

1	Backplate	2	24/48 V input connector
3	Cable relief and shielding	4	Connectors: Digital input, STO, relay, and Ethernet
5	Operating indicator lights (LEDs)	6	LCP connector
7	PE screws	8	External brake resistor
9	AC mains supply	10	DAM option connectors: AUX, Ethernet, STO, and UDC
11	Cable relief and shielding		

3.3.2 PSM 520 Types

NOTICE

- The type code defines the specification of the module included in the delivery. It is shown on the product label and the package label.
- The type code is made of standard codes and plus codes. Each part of the type code corresponds to the data in the order.
- The Drive Configurator shows the valid configuration variants.
- Only selected options are visible in the type code. Standard characteristics do not appear.

Table 5: Type Code for PSM 520 (Example)

1	2	3	4	5	6	+	+	+	+	+	+	+	+	+
Product group	Product category	Product type	Mains voltage	Output	Communication interface	Functional safety	Option board	Integrated brake chopper	Integrated common-mode filter	DC fuses and devices	Standard I/Os	Product software	Technical documentation	Packaging
MSD-520	SA	PS	A4	–30P0	PL	See Table 6.								

Table 6: Legend Table for Type Code PSM 520

1	**Product group**
MSD-520	VLT® Multiaxis Servo Drive 520
2	**Product category**
SA	Air-cooled
3	**Product type**
PS	Power supply module
4	**Mains voltage**
A4	208–480 V AC
D6	600 V DC
5	**Output**
-10P0	10 kW
-20P0	20 kW
-30P0	30 kW
6	**Communication interface**
PL	Ethernet POWERLINK®
EC	EtherCAT®
PN	PROFINET®

+	**Functional safety**
+BEF1	Hard wired STO (standard)
+	**Option board**
+CTXX	Without option board (standard)
+	**Integrated brake chopper**
+ACBC	Yes (with integrated resistor)
+	**Integrated common-mode filter**
+AIC1	Yes (with integrated filter)
+	**DC fuses and devices**
+AKXX	Without (standard)
+AKD1	DAM option 12 A
+AKD2	DAM option 20 A
+AKD3	DAM option 28 A
+	**Standard I/Os**
+BDS1	With basic I/Os
+	**Product software**
+ECXXX	Latest released version (standard)
+	**Technical documentation**
+EGXX	Without (standard)
+EGIN	Installation guide
+	**Packaging**
+TACB	Cardboard box (standard)

3.3.3 Connectors on the Top of PSM 520

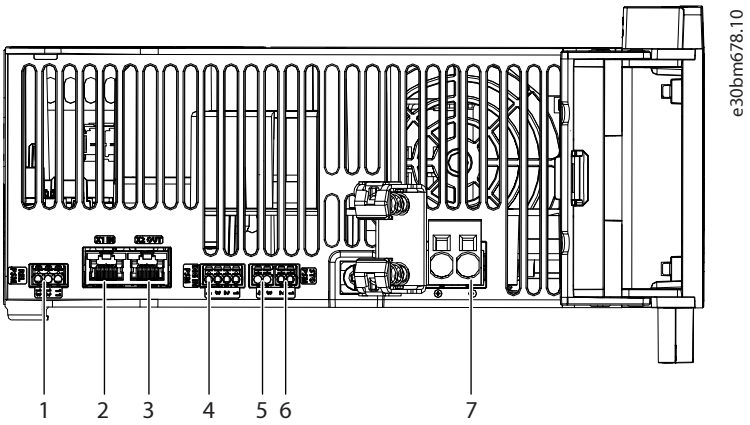


Figure 3: Connectors on the Top of Power Supply Module PSM 520

1	Relay connector	2	Ethernet connector IN
3	Ethernet connector OUT	4	Digital input
5	STO connector OUT	6	STO connector IN
7	24/48 V IN connector		

3.3.4 Connectors on the Bottom of PSM 520

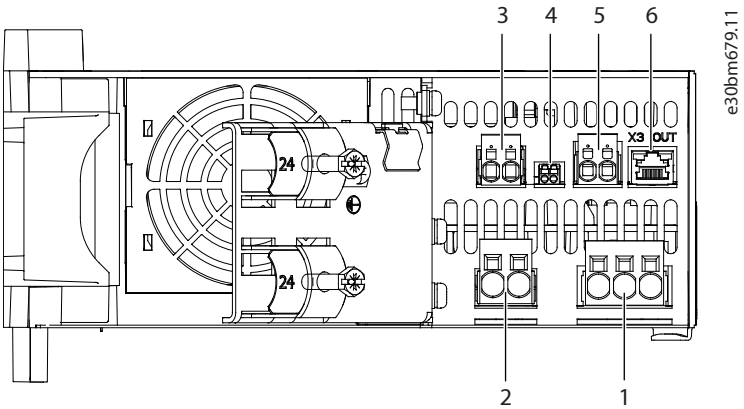


Figure 4: Connectors on the Bottom of Power Supply Module PSM 520

1	AC mains supply connector	2	External brake resistor connector
3	UDC connector	4	STO connector
5	AUX connector	6	Ethernet connector

The connectors 3–6 are only available if the DAM option is mounted.

3.3.5 DAM Option

The Decentral Access Module (DAM) option is a central interface/gateway to the decentral servo system, which is an optional feature to the PSM 520. The DAM option board is used to connect the Danfoss VLT® Integrated Servo Drive (ISD) 520 and VLT® Decentral Servo Drive (DSD) 520 to the servo system via a hybrid feed-in cable.

The DAM option board supplies the decentral servo drives with DC link, UAUX, STO, and the Ethernet-based fieldbus via the hybrid feed-in cable.

Functions that the DAM option board provides:

- Overcurrent protection of the hybrid cable.

- Short-circuit protection of the hybrid cable.
- Under-/overvoltage protection of the AUX voltage on the hybrid cable.
- Overcurrent protection of the AUX voltage on the hybrid cable.

Current sizes for DAM option:

- AUX 15 A_{rms}, DC-link 12.8 A (+AKD1).
- AUX 15 A_{rms}, DC-link 20 A (+AKD2).
- AUX 25 A_{rms}, DC-link 28 A (+AKD3).

Refer to the fuse datasheet for overload capability.

Table 7: Type Code for PSM 520 with DAM Option (Example)

1	2	3	4	5	6	+	+	+	+	+	+	+	+	+
Product group	Product category	Product type	Mains voltage	Output	Communication interface	Functional safety	Option board	Integrated brake chopper	Integrated common-mode filter	DC fuses and devices	Standard I/Os	Product software	Technical documentation	Packaging
MSD-520	SA	PS	A4	–30P0	EC	–	–	–	–	+AKD3	–	–	–	–

Definition of PSM 520 type codes, refer to Table 6.

3.4 Servo Drive Module SDM 521/SDM 522

3.4.1 Overview of SDM 521/SDM 522

SDM is the abbreviation for Servo Drive Module. The SDM 521 is a single-axis servo drive available in 5 power sizes and 2 enclosure sizes (FS1 is 50 mm (2.0 in) and FS2 is 100 mm (3.9 in)). The SDM 522 is a double-axis servo drive available in 3 power sizes and 1 enclosure size (FS1, 50 mm (2.0 in)). A double-axis module operates 2 servo motors independently. The SDMs are equipped by default with digital I/Os and Safe Torque Off (STO) and support several motor feedback encoders.

NOTICE

- The MSD 520 system is designed for use within a control cabinet. If the STO function or another safety function is used, the cabinet must be rated at least IP54.
- The SDMs have a protection rating of IP20 according to IEC/EN 60529 (except connectors, which are IP00).
- The SDMs can be damaged if exposed to fluids.

NOTICE

- The connectors at the top side do not fulfill strain relief requirements. When using digital I/Os, configure the logic values that ensure that the system enters a known state if a wire disconnects.

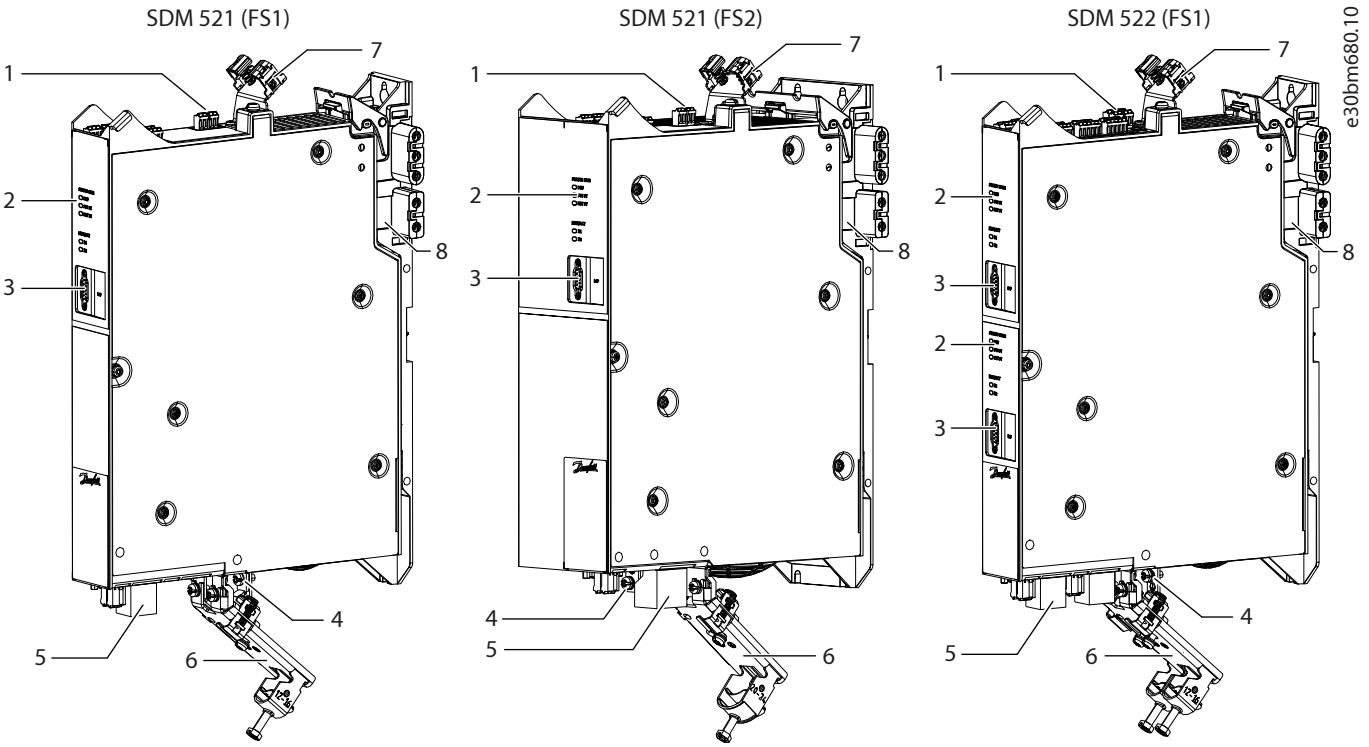


Figure 5: Servo Drive Module SDM 521/SDM 522

1	Connectors: I/O, STO, relay, and Ethernet	2	Operating indicator lights (LED)
3	LCP Connector	4	PE screws
5	Connectors: Motor, motor feedback, thermistor, and brake	6	Cable relief and shielding
7	Cable relief and shielding	8	Back plate

3.4.2 SDM 521/SDM 522 Types

NOTICE

- The type code defines the specification of the module included in the delivery. It is shown on the product label and the package label.
- The type code is made of standard codes and plus codes. Each part of the type code corresponds to the data in the order.
- The Drive Configurator shows the valid configuration variants.
- Only selected options are visible in the type code. Standard characteristics do not appear.

Table 8: Type Code for SDM 521/SDM 522 (Example)

1	2	3	4	5	6	+	+	+	+	+	+	+	+	+
Product group	Product category	Product type	Mains voltage	Output	Communication interface	Functional safety	Option board	DC fuses and devices	Standard I/Os	Motor feedback	Motor brake control	Product software	Technical documentation	Packaging
MSD-520	SA	AS	D6	–40A0	EC	See Table 9.								

Table 9: Legend Table for Type Code SDM 521/SDM 522

1	**Product group**	**+**	**Functional safety**
MSD-520	VLT® Multiaxis Servo Drive 520	+BEF1	Hard-wired STO (standard)
2	**Product category**	+BEFS	VLT® FlexSafety™ over fieldbus
SA	Air-cooled	**+**	**Option board**
3	**Product type**	+CTXX	Without option board (standard)
AS	Axis single module	+CTIO	Standard I/O option board
AD	Axis double module	+CTSO	Safe I/O board
4	**Mains voltage**	**+**	**DC fuses and devices**
A4	208–480 V AC	+AKFX	With DC-link fuses (standard)
D6	600 V DC	**+**	**Standard I/Os**
5	**Output**	+BDS1	With basic I/Os
-02A5	2.5 A	**+**	**Motor feedback**
-05A0	5.0 A	+FFMF	Multi feedback (standard)
-10A0	10 A	**+**	**Motor brake control**
-20A0	20 A	+IDBS	With brake control (standard)
-40A0	40 A	**+**	**Product software**
6	**Communication interface**	+ECXXX	Latest released version (standard)
PL	Ethernet POWERLINK®	**+**	**Technical documentation**
EC	EtherCAT®	+EGXX	Without (standard)
PN	PROFINET®	+EGIN	Installation guide
		+	**Packaging**
		+TACB	Cardboard box (Standard)

3.4.3 Components

3.4.3.1 Cooling

The Servo Drive Modules SDM 521 and SDM 522 are cooled with a speed-controlled internal fan.

3.4.4 Connectors on SDM 521

3.4.4.1 Connectors on the Top of SDM 521

For SDM 521 enclosure size 1 (FS1), 50 mm (2.0 in) and enclosure size 2 (FS2), 100 mm (3.9 in).

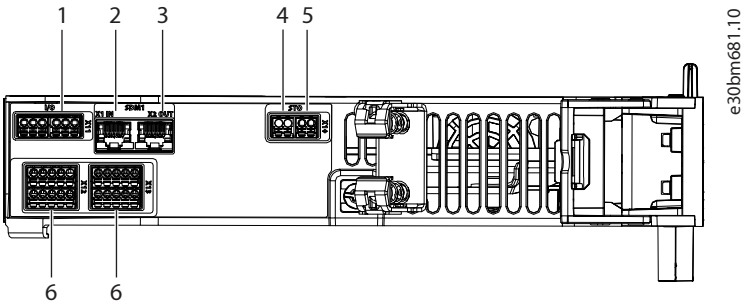


Figure 6: Servo Drive Module SDM 521, Enclosure Size 1 (FS1)

1	I/O connector	2	Ethernet connector IN
3	Ethernet connector OUT	4	STO connector OUT
5	STO connector IN	6	Safe I/O connector

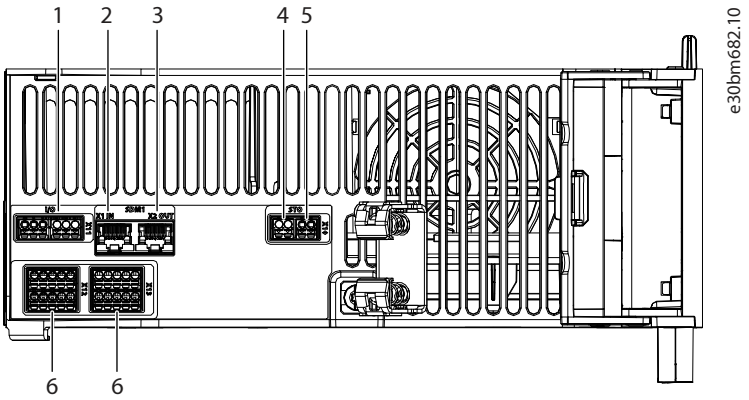


Figure 7: Servo Drive Module SDM 521, Enclosure Size 2 (FS2)

1	I/O connector	2	Ethernet connector IN
3	Ethernet connector OUT	4	STO connector OUT
5	STO connector IN	6	Safe I/O connector

3.4.4.2 Connectors on the Bottom of SDM 521

For SDM 521 enclosure size 1 (FS1), 50 mm (2.0 in) and enclosure size 2 (FS2), 100 mm (3.9 in).

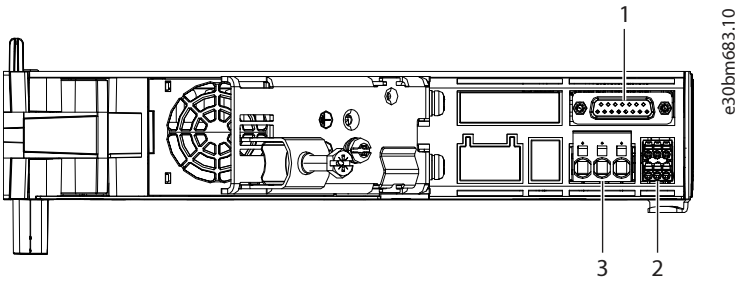


Figure 8: Servo Drive Module SDM 521, Enclosure Size 1 (FS1)

1	Motor feedback connector	2	Motor brake, thermistor and motor feedback (single wire/1-cable technology) connector
3	Motor connector		

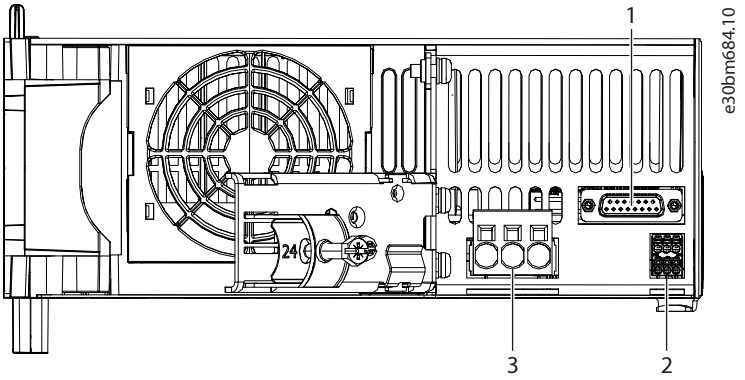


Figure 9: Servo Drive Module SDM 521, Enclosure Size 2 (FS2)

1	Motor feedback connector	2	Motor brake, thermistor and motor feedback (single wire/1-cable technology) connector
3	Motor connector		

3.4.5 Connectors on SDM 522

3.4.5.1 Connectors on the Top of SDM 522

For SDM 522 enclosure size 1 (FS1), 50 mm (2.0 in).

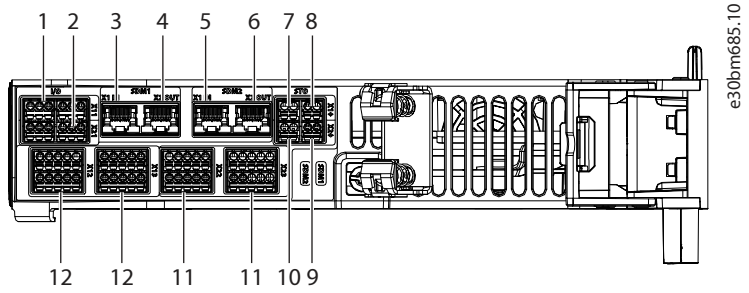


Figure 10: Servo Drive Module SDM 522, Enclosure Size 1 (FS1)

1	I/O Connector SDM1	2	I/O Connector SDM2
3	Ethernet connector IN SDM1	4	Ethernet connector OUT SDM1
5	Ethernet connector IN SDM2	6	Ethernet connector OUT SDM2
7	STO Connector OUT SDM1	8	STO Connector IN SDM1
9	STO Connector IN SDM2	10	STO Connector OUT SDM2
11	Safe I/O SDM2	12	Safe I/O SDM1

3.4.5.2 Connectors on the Bottom of SDM 522

For SDM 522 enclosure size 1 (FS1), 50 mm (2.0 in).

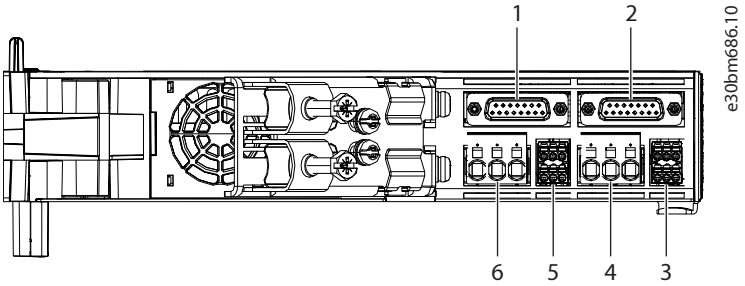


Figure 11: Servo Drive Module SDM 522, Enclosure Size 1 (FS1)

1	Motor feedback connector SDM2	2	Motor feedback connector SDM1
3	Motor brake, thermistor and motor feedback (single wire/1-cable technology) connector	4	Motor connector SDM1
5	Motor brake, thermistor and motor feedback (single wire/1-cable technology) connector	6	Motor connector SDM2

3.5 Expansion Module (EXM 520)

The EXM 520 supports modular machine setup by splitting the system modules into 2 control cabinets. The maximum length of the cable between the EXM 520 modules is 5 m (16.4 ft).

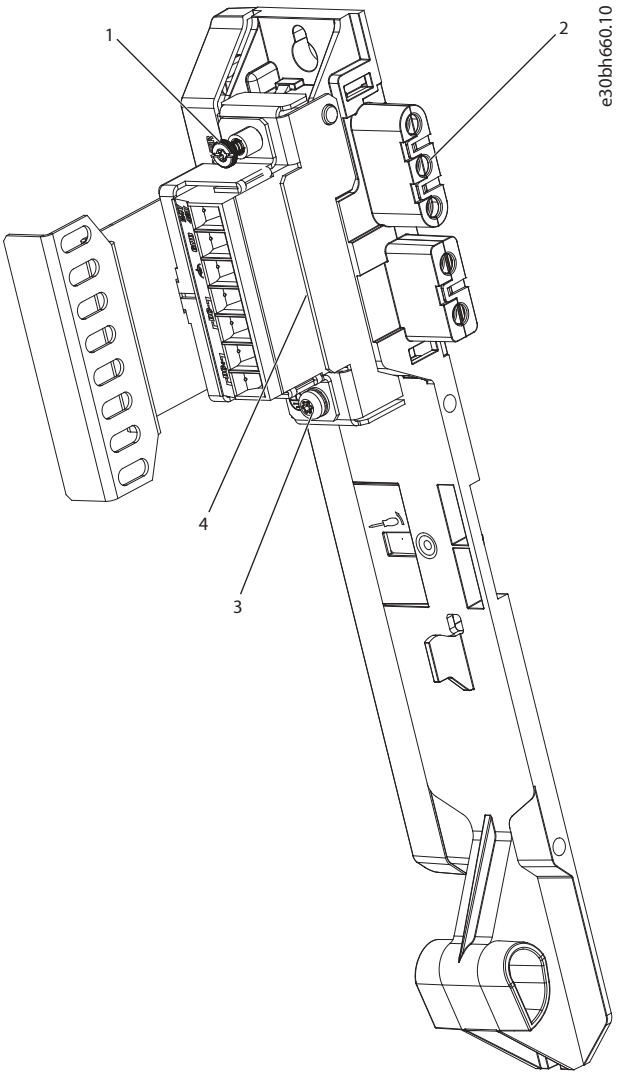


Figure 12: Expansion Module EXM 520

1	EMC shielding plate	2	Backplate
3	PE screw	4	Expansion connector

NOTICE

- The system modules are designed for use within a control cabinet. If the STO function or another safety function is used, the cabinet must be rated at least IP54.
- The EXM 520 has a protection rating of IP20 according to IEC/EN 60529 (except connectors, which are IP00).
- The EXM 520 can be damaged if exposed to fluids.

3.6 Local Control Panel (LCP)

3.6.1 Overview of the Local Control Panel

The LCP is the graphical user interface for diagnostic and operating purposes. It is available as an option and can be connected to the system modules using an optional cable (M8 connector on ISD 520 and DSD 520 and a D-SUB connector on the system modules).

The LCP display provides the operator with a quick view of the state of the system modules, depending on which device 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 option and opening the mechanical brake on the SDM 521/522.

The LCP can be mounted on the front of the control cabinet. Use a mounting set (available as an accessory) and connect it to the modules via M8 to SUB-D cables (available as an accessory).

NOTICE

- Further information on the accessory code numbers can be found in the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Design Guide*.
- Further information on the LCP functions can be found in the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Programming Guide*.

3.6.2 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.

3.6.3 A: Display Area

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

The display area is activated when the module is connected to receive power from U_{AUX}.

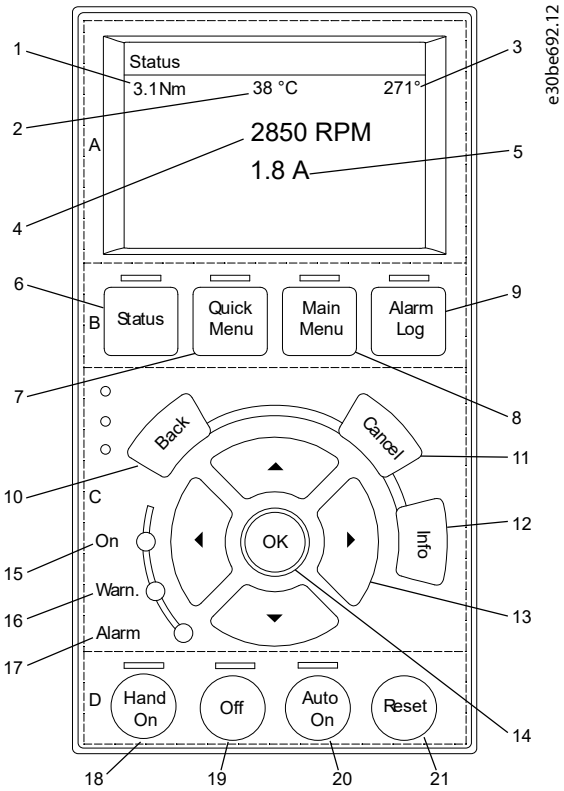


Figure 13: Display Area when Connected to the Power Supply Module PSM 520

Table 10: Legend Table for Display Area when Connected to the Power Supply Module PSM 520

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

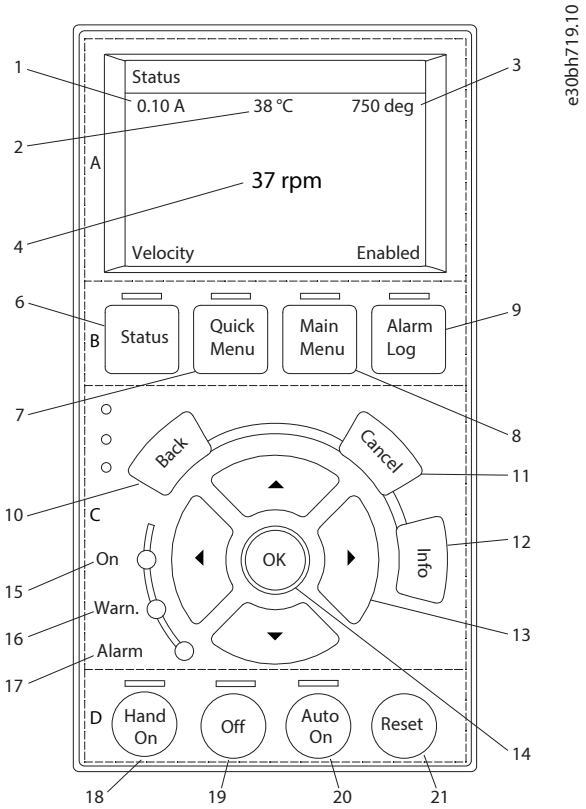


Figure 14: Display Area when Connected to the Servo Drive Modules SDM 521/SDM 522

Table 11: Legend Table for Display Area when Connected to the Servo Drive Modules SDM 521/SDM 522

	Description
1	Current actual value
2	Temperature power board
3	Position actual value
4	Actual velocity

3.6.4 B: Display Menu Keys

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

Table 12: 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.

3.6.5 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 indicator lights (LEDs) in this area.

Table 13: Navigation Keys

	Key	Function
10	Back	Reverts to the previous step or list in the menu structure.
11	Cancel	Cancels 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 14: Indicator Lights (LEDs)

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

3.6.6 D: Operation Keys and Reset

The operation keys are at the bottom of the LCP.

Table 15: Operation Keys and Reset

	Key	Function
18	Hand On	Enables the connected MSD 520 servo drive or PSM 520 to be controlled via the LCP.
19	Off	Puts the MSD 520 servo drive into state *Switch on Disabled* and the PSM 520 into state *Standby*. This only works in hand-on mode. *Off* mode enables transition from hand-on mode to auto-on mode.
20	Auto On	Puts the system in remote operational mode. In auto-on mode, the device is controlled with fieldbus (PLC). Switching between auto-on and hand-on modes is only possible when the drive is in state *Switch on Disabled*and/or the PSM 520 is in state *Standby*.
21	Reset	Resets the MSD 520 servo drive or PSM 520 after a fault has been cleared. The reset is only possible when in hand-on mode.

3.7 Cables

3.7.1 Hybrid Cable Specifications

3.7.1.1 Hybrid Cable

All dimensions are in mm.

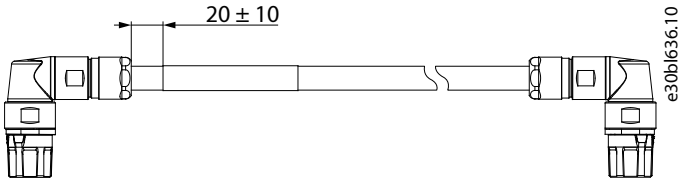


Figure 15: Hybrid Loop Cable

Pre-configured hybrid cables are used to connect the ISD 520/DSD 520 servo drives to the PSM 520 with DAM option.

There are 2 types of hybrid cables that are available with both angled and straight M23 connectors:

- Feed-in cable for connecting the 1st ISD 520/DSD 520 servo drive of a group to the connection point on the PSM 520 with DAM option.
- Loop cable for connecting the ISD 520/DSD 520 servo drives in daisy-chain format in an application.

Both these cables are provided by Danfoss and are available in various lengths. See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Design Guide* for further information.

Both ends of the loop cable are fitted with M23 connectors.

The feed-in cable is fitted with an M23 connector at the output end for connection to the 1st ISD 520/DSD 520 servo drive. At the input end, it is pigtailed and the connectors are mounted on the corresponding terminals on the DAM option.

Table 16: Hybrid Cables

Cable type	Shielded/unshielded	Notes
Feed-in cable	Shielded	Hybrid cable (overall shield with additional fieldbus and safety section shield).
Loop cable		

NOTICE

- Hybrid cables are available in 2 cross-sections: 2.5 mm^2 (16 A) and 4 mm^2 (25 A for CE and UL, 20 A for CSA).
- See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Design Guide* for further information.

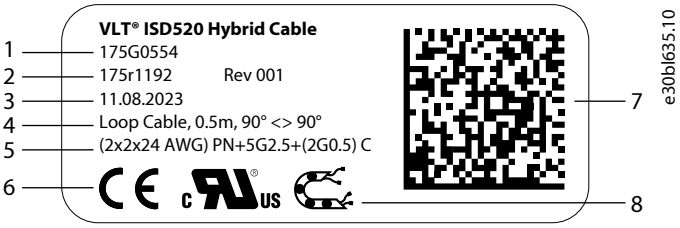


Figure 16: Example of a Hybrid Cable Product Label

1	Article number	2	Specification number
3	Production date	4	Cable configuration
5	Cable specification	6	Approvals
7	Data matrix code containing article number and production date	8	Cable characteristics, for example, drag chain

3.7.1.2 Minimum Bending Radius for Hybrid Cable

Table 17: Minimum Bending Radius

	Static cable	Dynamic cable
Cable diameter	13.8 mm	15.6 mm
Permanent installation	25 mm bending radius	5 x cable diameter
Flexible installation	Not allowed	12 x cable diameter

3.7.2 Ethernet Cable

Table 18: Ethernet Cable Recommendations

Characteristic	Specification
Ethernet standard	Standard Ethernet (in accordance with IEEE 802.3), 100Base-TX (Fast Ethernet)
Cable type	S/FTP (shielded foiled twisted pair), ISO (IEC 11801 or EN 50173), CAT 5e or 6
Damping	23.2 dB (at 100 Mhz and 90 m (295.3 ft) each)
Crosstalk damping	24 dB (at 100 Mhz and 90 m (295.3 ft) each)
Return loss	10 dB (100 m (328.1 ft) each)
Surge impedance	100 Ω
Maximum cable length	90 m (295.3 ft) between switches or network devices

NOTICE

- Ground the Ethernet cable through the RJ45 connector. Do not ground it on the strain relief.

3.7.3 LCP Cable

The LCP cable is used to connect an LCP to a system module via the M8 connector on the front of each system module.

The LCP cable can be purchased from Danfoss.

For further information on the LCP cable and code numbers, see the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Design Guide*.

3.7.4 Cable Layout and Routing

3.7.4.1 Modules Connections

The system modules are connected via the backlink connector. For further information, see 11.5.2 Backlink Connector.

Connect the real-time Ethernet fieldbus to the 1st module in the MSD 520 system using a standard Ethernet cable. (The standard Ethernet cable is not provided).

Use the Ethernet loop cables provided by Danfoss to connect to the other modules in daisy-chain format.

3.7.4.2 Maximum Cable Lengths

Table 19: Maximum Cable Lengths

Cable type	Specification	Maximum length
Hybrid cable	M23 Feed-in	35 m (114.8 ft)
	M23 Loop	20 m (65.6 ft)
	Fieldbus extension	Length: 2 m (6.6 ft) Maximum length to next port: 90 m (295.3 ft)
	Maximum cable length per line	90 m (295.3 ft)
Motor cable	–	Maximum length without additional output filter or choke: 30 m (98.4 ft) Maximum length with additional output filter or choke: 80 m (262.5 ft)
Feedback cable	–	80 m (262.5 ft)
Expansion module cable	–	5 m (16.4 ft)

3.7.4.3 Wiring of Output Filter

The SDM 521/SDM 522 modules use an IGBT transistor as an output element. These semiconductors generate the correct voltage for the motor switching at a relatively high speed (4–6 kV/µs) with unloaded IGBT. Under certain circumstances, this high switching speed can cause extra voltage stress on the main insulation of the motor. Usually, this is not a problem for motors designed for a 400 V supply. Such motors are typically designed for a voltage level of 1200 V, which exceeds the induced stress of the variable frequency drive. There may be cases where a dU/dt or sine-wave filter is required to avoid exceeding the allowable voltage stress.

NOTICE

- In certain cases, verify the rating of the motor in variable frequency drive application with the motor manufacturer.

NOTICE

FILTER SWITCHING FREQUENCY

Set the switching frequency parameter to correspond to the value printed on the product label of the filter and the output voltage level.

- Do not increase the switching frequency above the rated value of the filter. Decreasing switching frequency to a value lower than the rated value is allowed.

Select the filters so their rated current is larger than the drive rated current. This ensures that the filters thermally withstand the same overload specifications as the drive. In addition, the filter must be properly selected to withstand the drive operation conditions, and the maximum output frequency.

Figure 17 illustrates the wiring connections between the SDM 521/SDM 522, output filter, and electric motor.

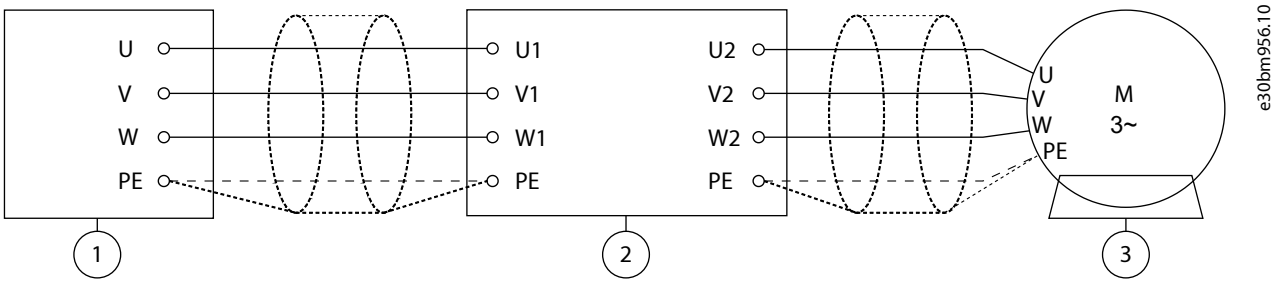


Figure 17: Wiring Diagram of Output Filter

1	SDM 521/SDM 522	2	Output filter
3	Electric motor		

The filter is cooled with natural air convection. During assembly, ensure that the filter is placed inside a ventilated enclosure to avoid overheating and equipment damage.

The maximum motor cable length of 80 m (262.5 ft) includes the total distance from the drive to the motor, with the filter installed in between.

3.8 Software

The software for the servo system comprises:

- The firmware of the system modules that is already installed on the system modules (except EXM 520).
- A package of PLC libraries for Automation Studio™ for operating the MSD 520 devices. See 6.11.2 Creating an Automation Studio™ Project for further information.
- A PLC library for TwinCAT® 2 and 3 for operating the MSD 520 devices. See 6.12.2 Creating a TwinCAT® Project for further information.
- A PLC library for SIMOTION SCOUT® for operating the MSD 520 devices. See 6.14.3 Creating a SIMOTION SCOUT® Project for further information.
- A PLC library for TIA Portal® for operating the MSD 520 devices.
- VLT® Servo Toolbox: A Danfoss PC-based software tool for commissioning and debugging the devices.

3.9 Fieldbus

3.9.1 Overview

The servo system has an open system architecture realized by fast Ethernet (100BASE-T) based communication. The system supports EtherCAT®, Ethernet POWERLINK®, and PROFINET® fieldbuses.

In productive environments, communication to the devices always takes place via a PLC that acts as a master. The system components can be controlled by these communication methods:

- Using the VLT® Servo Motion libraries (available for TwinCAT®, Automation Studio® and SIMOTION SCOUT®, TIA Portal®, and CODESYS®).
- Using the NC axis functionality of TwinCAT® (ISD 520/DSD 520 and SDM 521/SDM 522 only).
- Using the CiA DS 402 standard by reading and writing to objects.
- Using application class 1 (AC1), (AC 4) PROFINET® only.

The system components can be operated with the following cycle times.

- EtherCAT® and Ethernet POWERLINK® fieldbuses:
  - 400 µs and multiples of it (for example, 800 µs and 1200 µs).
  - 500 µs and multiples of it (for example, 1 ms).
- PROFINET® fieldbus:
  - IRT : 1 ms, 2 ms and 4 ms
  - RT: 1 ms and multiples of it.

When the cycle time is a multiple of 400 µs and 500 µs, the time base of 500 µs is used.

The servo drives are certified for fieldbuses according to the corresponding rules and regulations. The servo drives conform to the CANopen® CiA DS 402 Drive Profile.

3.9.2 EtherCAT®

The system components support the following EtherCAT® protocols:

- CANopen® over EtherCAT® (CoE)
- File Access over EtherCAT® (FoE)
- Ethernet over EtherCAT® (EoE)

The system components support distributed clocks. To compensate for the failure of a communication cable section in the system, cable redundancy is available for all fieldbuses. See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT®FlexMotion™) Design Guide* for further information.

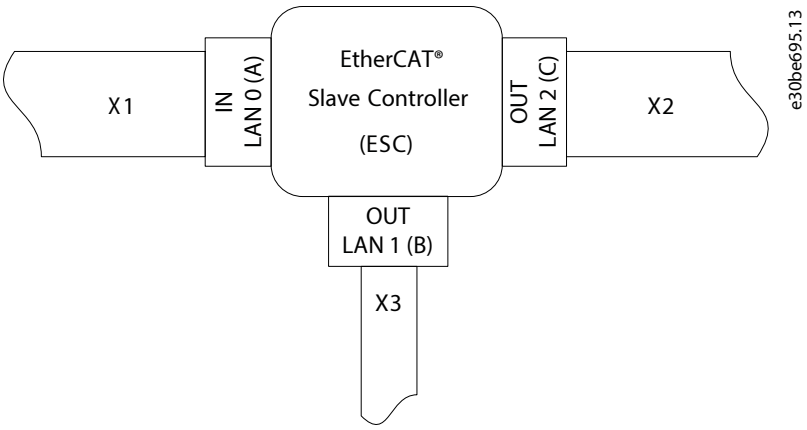


Figure 18: EtherCAT® Port Assignment for the ISD 520/DSD 520 Servo Drive

X1	M23 hybrid cable connector to PSM 520 with DAM option board or previous servo drive (EtherCAT® IN).	X2	M23 hybrid cable connector to the next servo drive (EtherCAT® OUT 1 (B)).
X3	Logical port 1: M8 Ethernet cable connector to other EtherCAT® slaves, for example, EtherCAT® encoder (EtherCAT® OUT 2 (C)). The connector is only available on the advanced servo drives.		

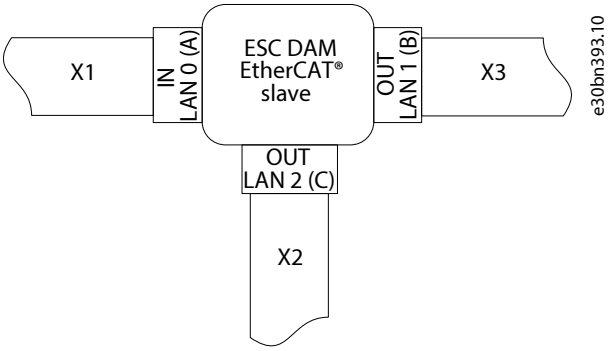


Figure 19: EtherCAT® Port Assignment for the PSM 520 with DAM Option Board

X1	RJ45 cable connector to the previous slave or to the main device (PLC).	X2	RJ45 to M23 hybrid feed-in cable to the 1st ISD 520/ DSD 520 servo drive (EtherCAT® OUT 2 (C)).
X3	RJ45 cable connector to the PLC (cable redundancy) or next slave (EtherCAT® OUT 1 (B)).		

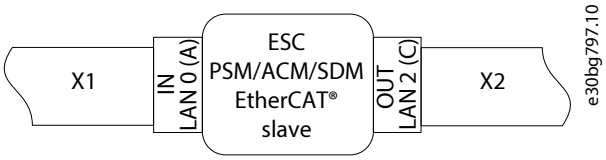


Figure 20: EtherCAT® Port Assignment for the Power Supply Module (PSM 520), Servo Drive Module SDM 521/SDM 522

X1	RJ45 cable connector to the PLC or previous slave (EtherCAT® IN (A)).	X2	RJ45 cable connector to the PLC (cable redundancy) or next slave (EtherCAT® OUT (C)).

3.9.3 Ethernet POWERLINK®

The system components conform to DS 301 V1.1.0 and support the following features:

- Work as a 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®.

3.9.4 PROFINET®

The system components support PROFINET® conformance class C as per IEC 61158-5-10:2014, IEC 61158-6-10:2014, IEC 61784-2:2014, and IEC 61784-5-3:2013. All the system components act as I/O devices in a PROFINET®network.

The following features are supported:

- I/O Device - Device controlled by the I/O-Controller
- Dynamic module configuration
- Net load class II
- Ring redundancy (MRPD) as client

PROFINET® fieldbus devices are always connected as network components via switches that are integrated in the fieldbus device.

There are 2 ports on the ISD 520/DSD 520 servo drives, SDM 521/SDM 522 servo drive modules and, PSM 520 with DAM option board.

4 Mechanical Installation

4.1 Items Supplied

Depending on the application, the items supplied for the system are:

- VLT® Power Supply Module PSM 520
- VLT® Servo Drive Module SDM 521 (Single axis)
- VLT® Servo Drive Module SDM 522 (Double axis)
- VLT® Expansion Module EXM 520
- AC choke (see 5.9.1 AC Line Choke)
- This operating guide
- Feed-in (hybrid) cable
- Loop (hybrid) cable

NOTICE

- The hybrid feed-in and loop cables are required when ISD 520/DSD 520 servo drives are used in the servo system.

The packaging unit depends on the number of modules delivered. Keep the packaging for potential return of the product.

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 guide during installation.

- Ensure that installation is performed by qualified personnel.
- Carry out installation with due care and attention.
- Comply with all safety regulations and protective measures and observe the environmental conditions.
- Ensure that this guide is read and understood.

4.5 Installation Environment

4.5.1 System Modules

The environmental conditions for the system modules are:

- The allowable operating ambient temperature range, humidity, and vibration levels must not be exceeded (see 11.6 General Specifications and Environmental Conditions for MSD 520 System).
- The minimum space required above and below the system modules is detailed in 4.7.1 Space Requirements for System Modules.

4.6 Preparation for Installation

4.6.1 Preparation for Installation of 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 4.7.1 Space Requirements for System Modules.
4. Ground the modules.

4.6.2 Drilling Templates

Dimensions in Figure 21 are in mm [in].

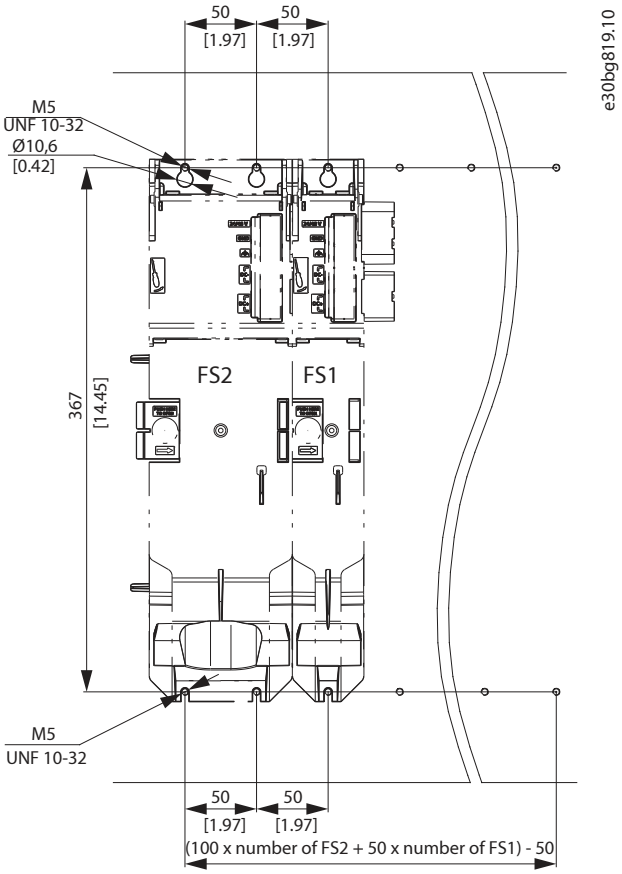


Figure 21: Drilling Templates for (FS1) 50 mm (2.0 in) and (FS2) 100 mm (3.9 in) System Modules

Pay attention to the precision of the drilling pattern if multiple modules are mounted next to each other. Even small deviations can accumulate, leading to difficult assembly or misalignment.

4.7 Installation Procedure

4.7.1 Space Requirements for System Modules

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

Ensure that there is enough open space around the product to allow proper air circulation.

All dimensions are in mm [in]

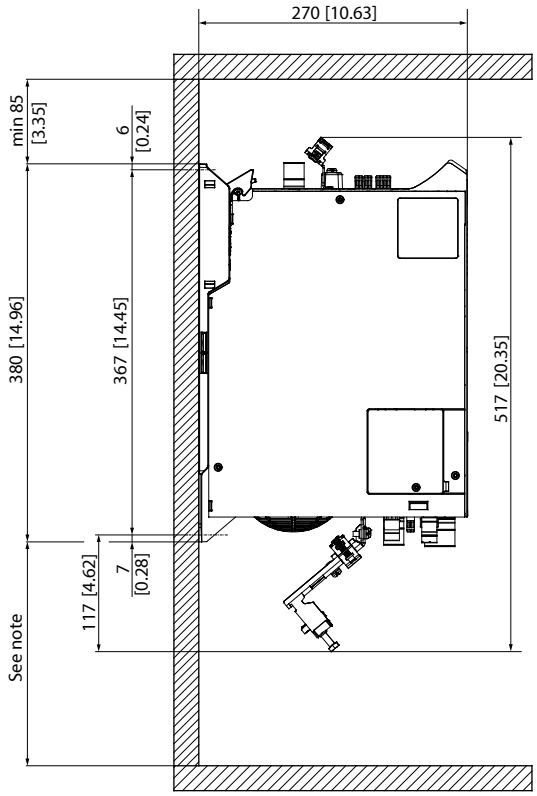


Figure 22: Minimum Space Required at the Top and Bottom

NOTE: Observe minimum spacing based on cable diameter and direction of run.

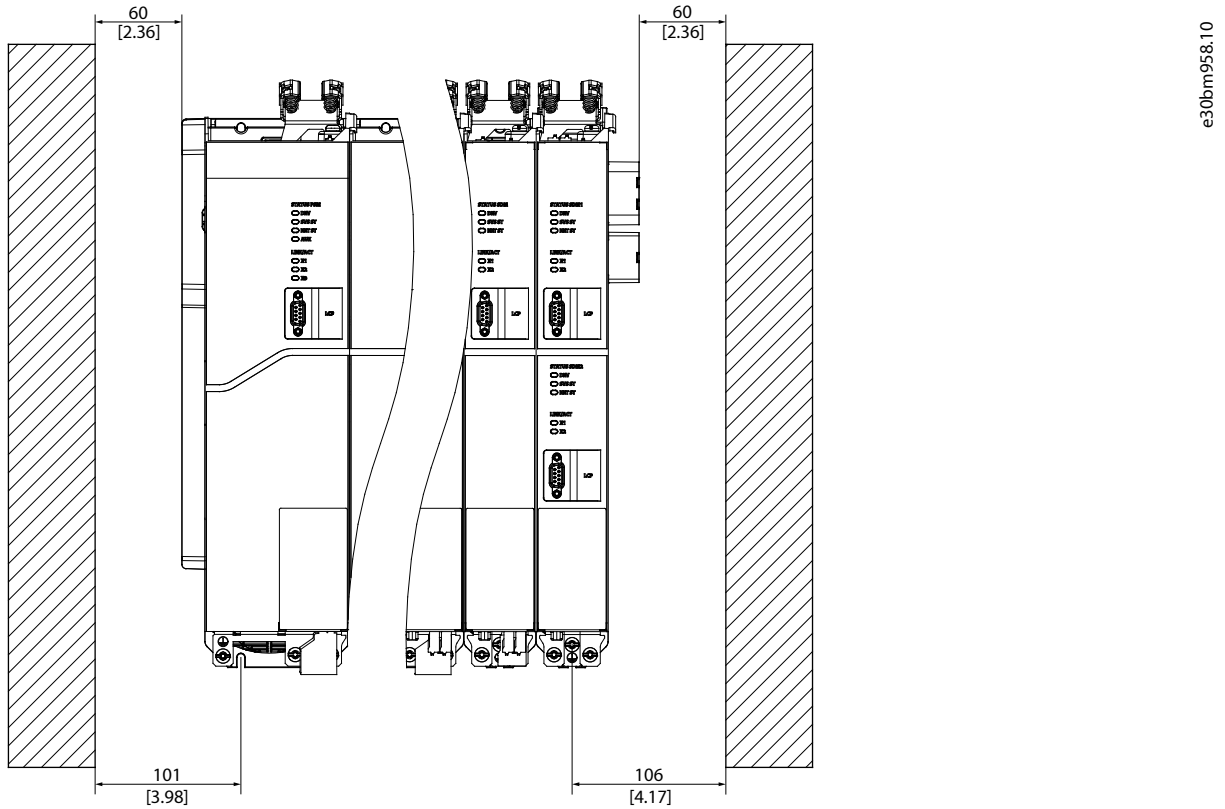


Figure 23: Minimum Space Required at the Sides

4.7.2 Installation Aids and Tools Required

For installation of the system modules, the tools corresponding to the fixings screws (not included) are required.

4.7.3 Fitting Instructions for System Modules

NOTICE

- Mount the system module with the highest output power next to the PSM 520. Mount the remaining system components in descending order of output power.

Procedure

1. Drill the holes for mounting the backplate according to the drilling template.

   See 4.6.2 Drilling Templates for detailed dimensions and positioning.

2. Connect the backplates via the click-and-lock method.

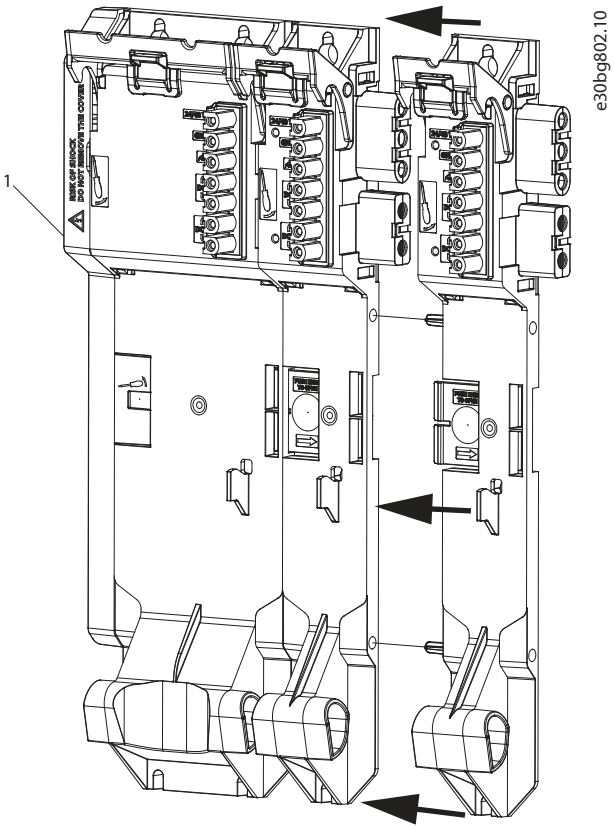


Figure 24: Connecting the Backplates

1	Backplate end cap

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 (0.37 in).

   Torque 3.0 Nm (26.6 in-lb)

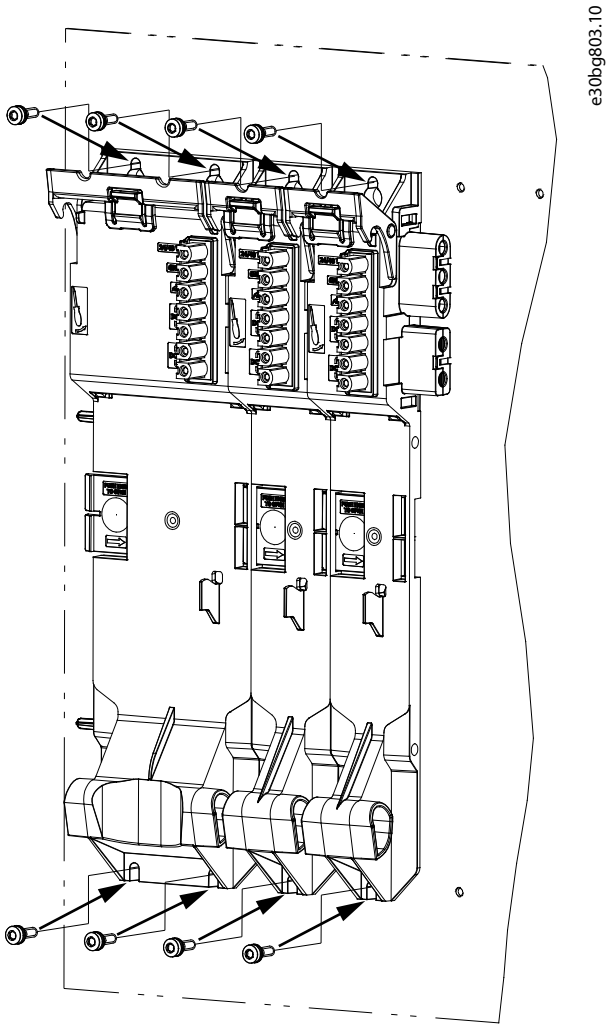


Figure 25: Mounting the Backplates in the Control Cabinet

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.

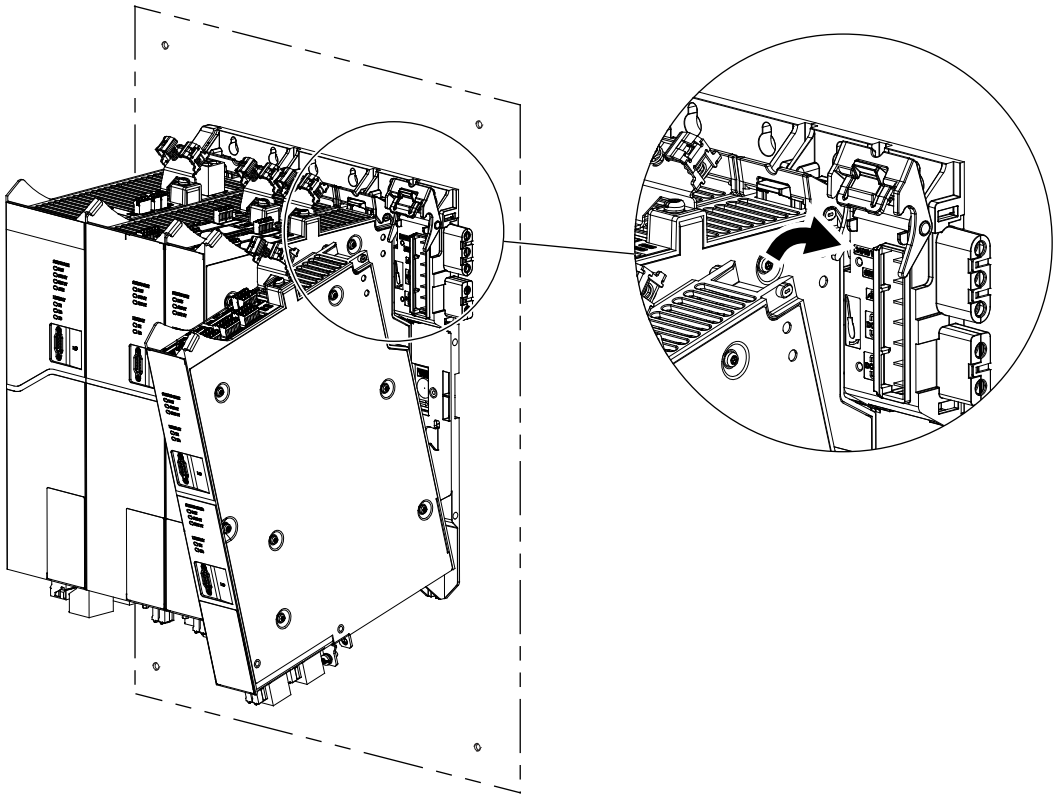


Figure 26: Pressing the Module onto the Backlink Connector

6. To secure the module, pull down the holding clamp at the top of the backplate.

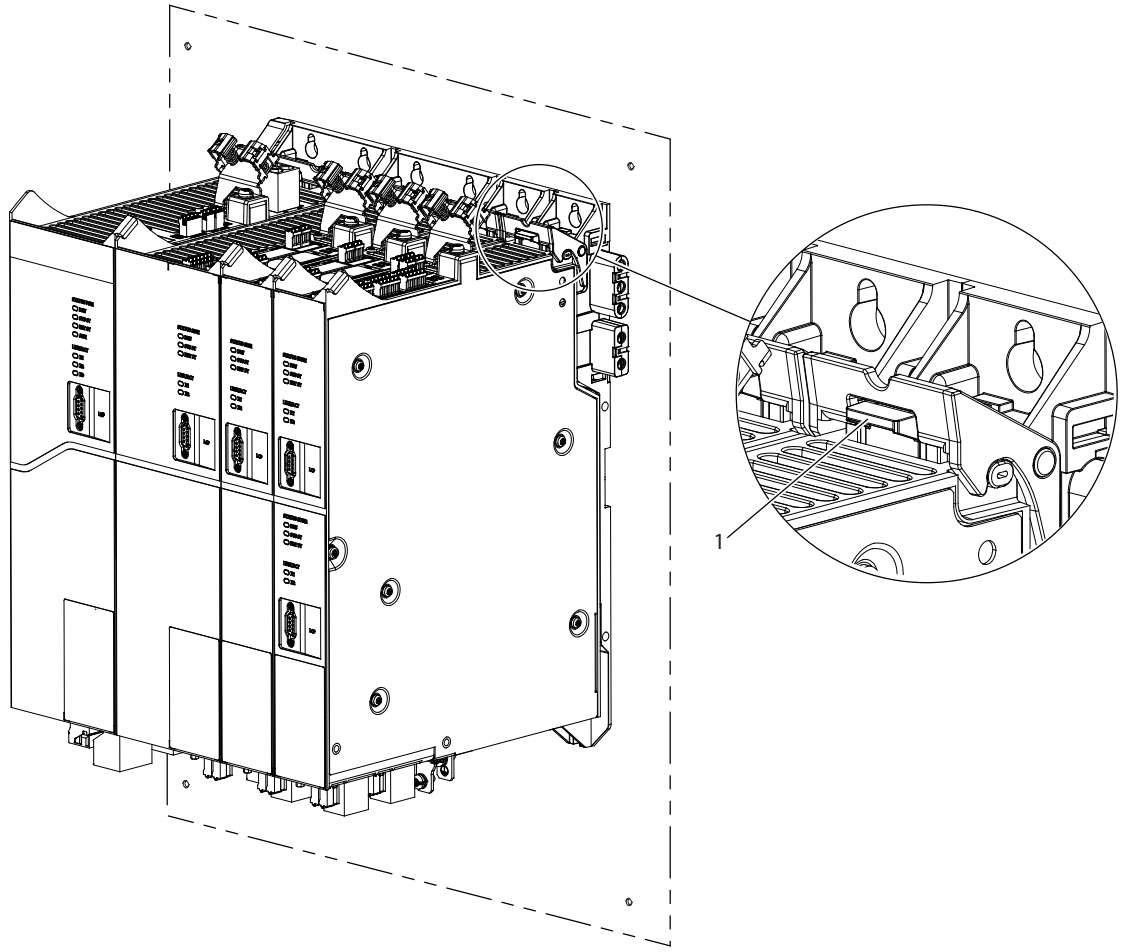


Figure 27: Pulling Down the Holding Clamp at the Top of the Backplate

1	Holding clamp

7. For the remaining modules repeat steps 4, 5, and 6.

Ensure that the lip at the left side of the 2nd module is inside the guiding groove at the right side of the 1st module.

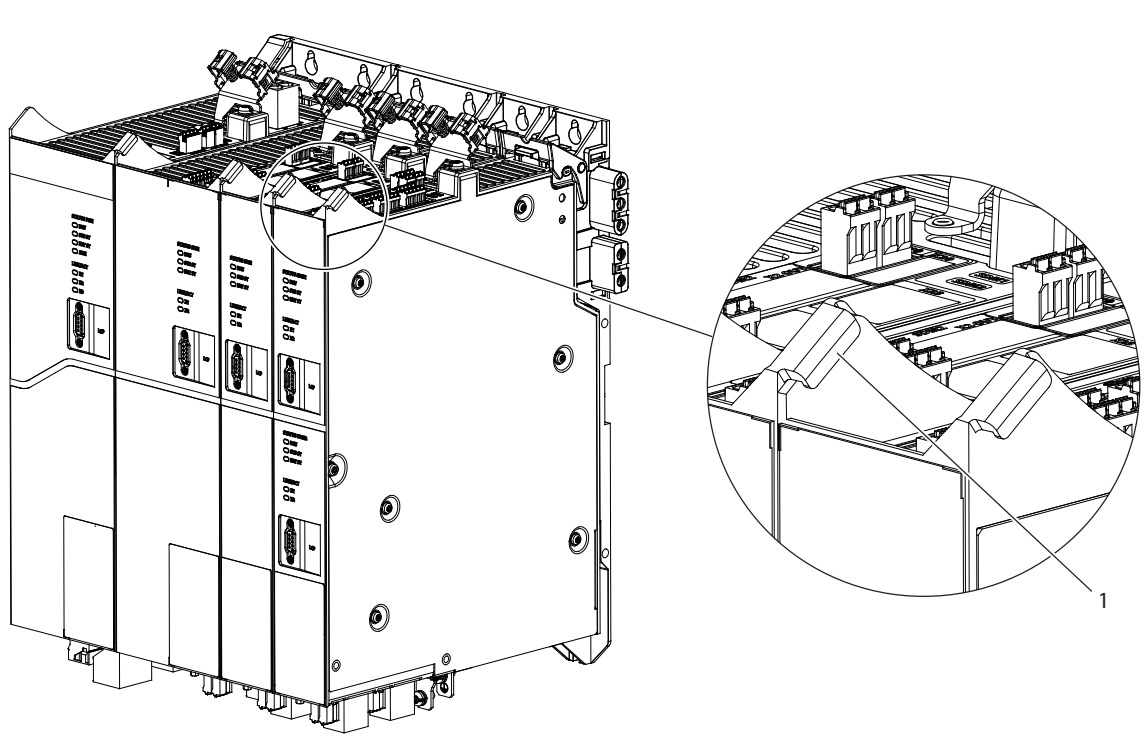


Figure 28: Guiding Groove

1	Guiding groove

5 Electrical Installation

5.1 Warnings for Electrical Installation

During electrical installation, observe the relevant local and national regulations in addition to the information in this guide.

⚠ WARNING

HIGH VOLTAGE

The 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 520 from the mains and wait for the discharge time to elapse.
- Do not open under load. No isolating device is in place to interrupt load current.

⚠ WARNING

TOUCH CURRENT HAZARD

The touch current is the electric current passing through a person when touching conductive accessible parts of an electrical device. This is > 3.5 mA. Improper grounding of the system components may result in death or serious injury.

- For reasons of personal 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 guide.
- The minimum size of the PE conductor shall comply with the local safety regulations for high touch current.

NOTICE

PE conductor and grounding connection must comply with the requirements specified in chapter 5.4 Grounding.

If the PE conductor is damaged, disconnected, or leakage current exceeds 5% of rated input current, accessible parts may become hazardous. Use a 16 mm^2 PE conductor and properly ground the supplementary enclosure.

NOTICE

- Use a motor with reinforced insulation between the thermistor and the motor windings (tested with 4300 V DC and 8000 V_{peak} impulse).
- Use a motor with reinforced insulation between the brake and the motor windings (tested with 4300 V DC and 8000 V_{peak} impulse).

NOTICE

CABLE INSULATION REQUIREMENTS

Use cables with the following insulation:

- Minimum 0.4 mm for power cables.
- Minimum 0.2 mm for signal cables.

5.2 Electrical Environmental Conditions

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 device (RCD) is used for protection against electric shock, only an RCD of Type B is allowed on the supply side of this product. All upstream RCD, up to the supply transformer, shall be of Type B.
- Recommended RCD sensitivity is 300 mA. For complex systems with more than 10 drives, it is recommended to consider RCD with lower sensitivity (>300 mA, for example, 500 mA).

NOTICE

- Mount all modules in a control cabinet.

5.3 DVC Classification

NOTICE

- The DVC As and DVC C classification of the circuits is according to EN 61800-5-1.
- The DVC As circuit is not for use in salt water-wet locations.

Table 20: Connector Classification

Connector description	Classification
11.5.2 Backlink Connector **(DC+, DC-)**	**DVC**
11.5.2 Backlink Connector (FE)	FE
11.5.2 Backlink Connector (24/48V, GND)	DVC As
11.5.3.2 Brake Resistor Connector on PSM 520	**DVC C**
11.5.3.3 Brake, Motor Temperature Sensor and HIPERFACE® DSL or EnDat 3® Connector on SDM 521/SDM 522	DVC As
11.5.4.2 Ethernet Connectors on PSM 520 and DAM Option	DVC As
11.5.4.3 Ethernet Connectors on SDM 521/SDM 522	DVC As
11.5.5.1 I/O Connector on PSM 520	DVC As
11.5.5.2 I/O Connector on SDM 521/SDM 522	DVC As
11.5.6.1 UAUX Connector on PSM 520	DVC As
11.5.7 LCP Connector	DVC As
11.5.8.1 AC Mains Connector on PSM 520	**DVC C**
11.5.9.1 Overview of Motor Connector	**DVC C**

Table 20: Connector Classification - (continued)

Connector description	Classification
11.5.10.2 Relay Connector on PSM 520	**DVC C**
11.5.11.1 STO Connectors on PSM 520	DVC As
11.5.11.2 STO Connector on the Bottom of PSM 520 with DAM Option	DVC As
11.5.11.3 STO Connectors on SDM 521 and SDM 522	DVC As
11.5.12 UDC Connector	**DVC C**
11.5.13 AUX Connector	DVC As
11.5.14 Motor Feedback Connectors	DVC As
11.5.15.1 Expansion Module Connector on EXM 520 **(DC+, DC-)**	**DVC C**
11.5.15.1 Expansion Module Connector on EXM 520 (PE)	FE
11.5.15.1 Expansion Module Connector on EXM 520 (24/48V, GND)	DVC As

5.4 Grounding

5.4.1 Grounding for Electrical Safety

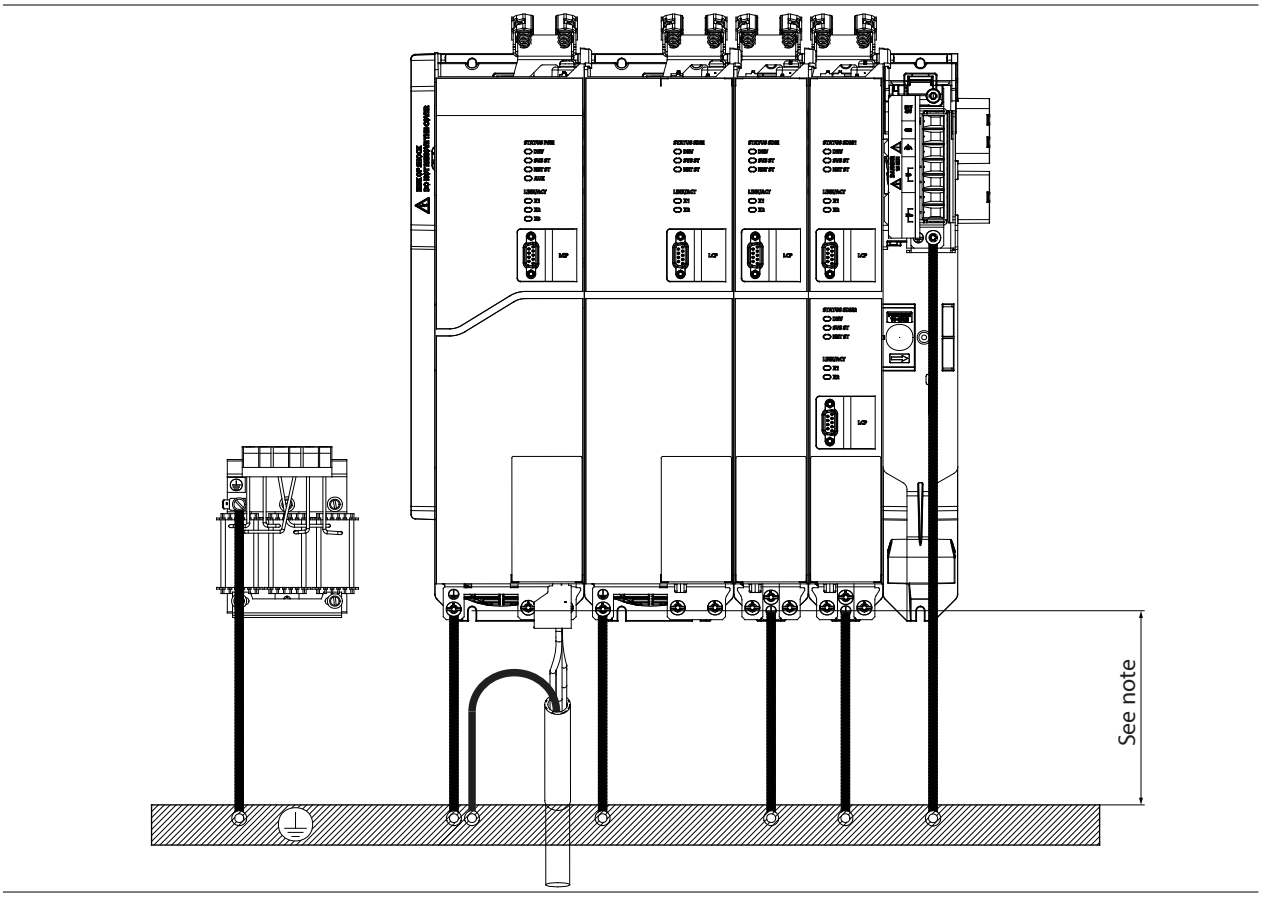


Figure 29: Grounding for Electrical Safety

NOTICE

- Spacing must consider cables diameter and direction of run.

Do not ground the system modules in daisy-chain format. Use the grounding method shown in Figure 29.

- To comply with CE requirements, ensure a minimum ground wire cross-section of at least 16 mm^2 (minimum 70 °C (158 °F), Cu). To comply with UL requirements, ensure a minimum ground wire cross-section of 6 AWG (minimum 60 °C (140 °F), Cu).
  - If a PSM 520 module with 10 kW is used, the cable cross-section can be reduced to 10 mm^2 (minimum 70 °C (158 °F), Cu) to comply with CE requirements, and 8 AWG (minimum 60 °C (140 °F), Cu) to comply with UL requirements.
- Keep the ground wire connections as short as possible.
- Follow the wiring requirements in this operating guide.

NOTICE

- If 2 separate backlinks are used (connected via 1 or 2 pairs of EXM 520 modules), the 2 grounding bars must also be connected together with a 16 mm^2 (6 AWG) cable cross-section.

- If a feed-in cable is used:
  - Connect the yellow/green PE wire of the feed in cable as shown in 5.9.3.2 Connecting the Cables on the Bottom of the Power Supply Module PSM 520.

5.4.2 Grounding for EMC-Compliant Installation

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

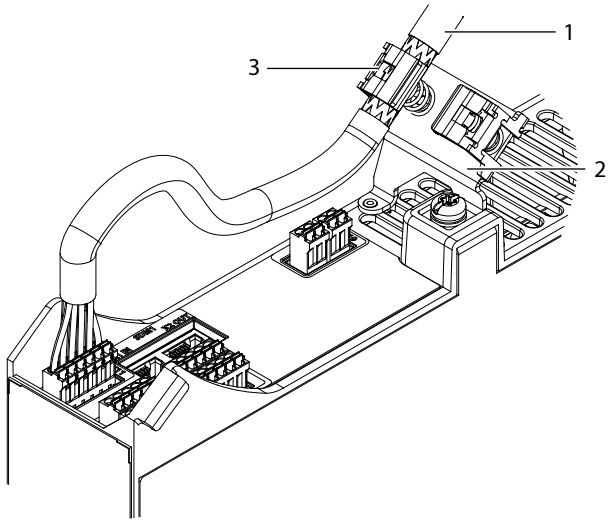


Figure 30: Cable Shielding on the Top of the System Modules

1	Cable	2	Cable relief and shielding
3	Spring-loaded shield clamp		

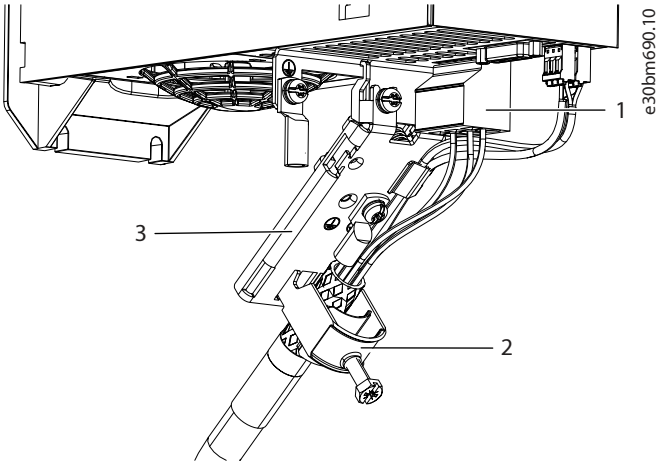


Figure 31: Cable Shielding on the Bottom of the System Modules

1	Connector	2	Cable clamp
3	Cable relief and shielding		

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

NOTICE

- If 2 separate backlinks are used (connected via 1 or 2 pairs of EXM 520 modules), the 2 grounding bars must be also connected together with a 16 mm^2 (6 AWG) cable cross-section.
- For cable cross-sections, see 11.5.15.2 Cable Cross-sections for EXM 520.

NOTICE

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 mm^2 (6 AWG).

NOTICE

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 (7.87 in) between signal and power cables.
- Only cross cables at 90°.

5.5 Mains Supply

5.5.1 Mains Supply Requirements

Ensure that the supply has the following properties:

- TN-S, TN-C, TN-CS, TT (not corner-grounded) supply grounding system
- Minimum required prospective short circuit current (Icp, mr): 5 kA

- Conditional short circuit current (Icc): 5 kA
- Protective class I
- Grounded 3-phase mains network, 208–480 V AC ±10%
- 3-phase lines and PE line
- 3-phase frequency: 44–66 Hz
- Maximum input current for 1 PSM 520 at 30 kW: 55 A_AVG
- AC choke (see 5.9.1 AC Line Choke)

5.5.2 Fuses

NOTICE

- Use fuses on the supply side of the Power Supply Module (PSM 520) that comply with CE and UL requirements (see Table 21).
- When 2 PSM 520 modules are used, each module must have its own dedicated set of fuses.

Table 21: Fuses

Model and power rating	CE compliance (IEC 60364) maximum fuse type	UL compliance (NEC 2014) maximum fuse type
PSM 520 (10 kW)	gG 25 A	30 A (class T or J only)
PSM 520 (20 kW)	gG 50 A	50 A (class T or J only)
PSM 520 (30 kW)	gG 63 A	80 A (class T or J only)

5.5.3 Circuit Breakers

Use a type B or type C circuit breaker with a capacity of 1.5 times the rated current of PSM 520 to fulfill CE requirements.

NOTICE

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

5.6 Auxiliary Supply

5.6.1 Auxiliary Supply Requirements

Supply the Power Supply Module (PSM 520) with a power supply unit with an output of 24/48 V DC ±10%. The output ripple of the power supply unit must be <250 mV_{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.
- Ensure that the secondary circuit is supplied from an external isolated source.

The auxiliary power supply unit must be dedicated to the system components, meaning that the supply is used exclusively for powering the PSM 520. The maximum allowed cable length between the supply unit and the PSM 520 is 3 m (9.8 ft).

NOTICE

- For cable lengths <10 m (32.8 ft), use 24 V auxiliary voltage. For cable lengths ≥10 m (32.8 ft), use 48 V auxiliary voltage.
- If a mechanical brake is connected, always supply the servo system with 48 V auxiliary voltage.

5.6.2 Fuses

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

Table 22: Fuses

CE compliance (IEC 60364) maximum fuse type	UL compliance (NEC 2014) maximum fuse type
50 A[1]	63 A[2]

1) *If the maximum current is lower, a fuse with a 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 a 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 ±10%
- Maximum current: 1 A

The maximum current is the maximum allowed current throughout the system. The typical current depends on the system topology and dimensioning.

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.

⚠ WARNING

RISK OF SAFETY FUNCTION IMPAIRMENT

A common supply for auxiliary and safety supply can be used, but multiple connection points between the 2 circuits may short-circuit emergency stop switches, impair the safety function, and result in death or serious injury.

- If a common supply for auxiliary and safety supply is used, ensure that there is only 1 connection point between the 2 circuits to avoid any safety risk.

The maximum cable length between the 24 V supply unit and the servo system is 3 m (9.8 ft).

The safety supply can be looped from PSM 520 to the other system components. The cable for this is not provided.

NOTICE

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

5.8 UL Requirements

NOTICE

- 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 (140 °F). Use Class 1 wire only. For PSM 520 rated 30 kW and EXM 520, use a minimum heat resistance of 75 °C (167 °F).
- Control circuit overcurrent protection is required.

5.9 Connecting the Power Supply Module PSM 520

5.9.1 AC Line Choke

The AC line choke is optional for power sizes of 10 kW and 20 kW. This depends on the electrical grid stiffness, which is expressed as Prospective Short-Circuit Current (PSCC), as indicated in Table 23. For the 30 kW model, the use of an AC line choke is mandatory, regardless of the electrical grid characteristics.

Table 23: AC Line Choke Requirements for PSM520 Modules Based on PSCC

PSM modules	PSCC < 5 kA	PSCC > 5 kA	PSCC > 10 kA
30kW/60A	AC Choke mandatory	AC Choke mandatory	AC Choke mandatory
20kW/40A	AC Choke optional	AC Choke mandatory	AC Choke mandatory
10kW/20A	AC Choke optional	AC Choke optional	AC Choke mandatory

Table 23 outlines the limits and requirements for the PSM 520. It does not consider any regional or national normative requirements related to the reduction of Total Harmonic Distortion (THD). Danfoss recommends the optional AC choke as it significantly reduces THD, minimizes peak inrush currents, lowers system losses, and extends product lifetime.

For more information regarding 3-phase AC line choke, see:

- 5.9.2.1 Connecting 1 PSM 520 Module to the AC Choke
- 5.9.2.2 Connecting 2 PSM 520 Modules to the AC Choke

Table 24: Line Choke Characteristics for 1 PSM 520

Model	Minimum I_{rms} [A]	U_{rms} [V]	Inductance [mH]
PSM 520 (10 kW)	20	500	Minimum: 0.47 Maximum: 1.47
PSM 520 (20 kW)	40	500	Minimum: 0.47 Maximum: 1.47
PSM 520 (30 kW)	60	500	0.47 ±10%

If 2 PSM 520 modules are installed in parallel, use an AC choke as specified in Table 25. See 5.9.2.2 Connecting 2 PSM 520 Modules to the AC Choke for further information.

Table 25: Line Choke Characteristics for 2 PSM 520 Installed in Parallel

Model	Minimum I_{rms} [A]	U_{rms} [V]	Inductance [mH]
PSM 520 (2 x 30 kW)	125	500	0.24 ±10%

Danfoss recommends mounting the AC line choke close to the PSM 520.

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 520, the maximum cable distance is 5 m (16.4 ft).

5.9.2 Connecting the Power Supply Module PSM 520 to the AC Choke

5.9.2.1 Connecting 1 PSM 520 Module to the AC Choke

Connect the PSM 520 to the electric grid with the correct AC choke for the power size of the PSM 520.

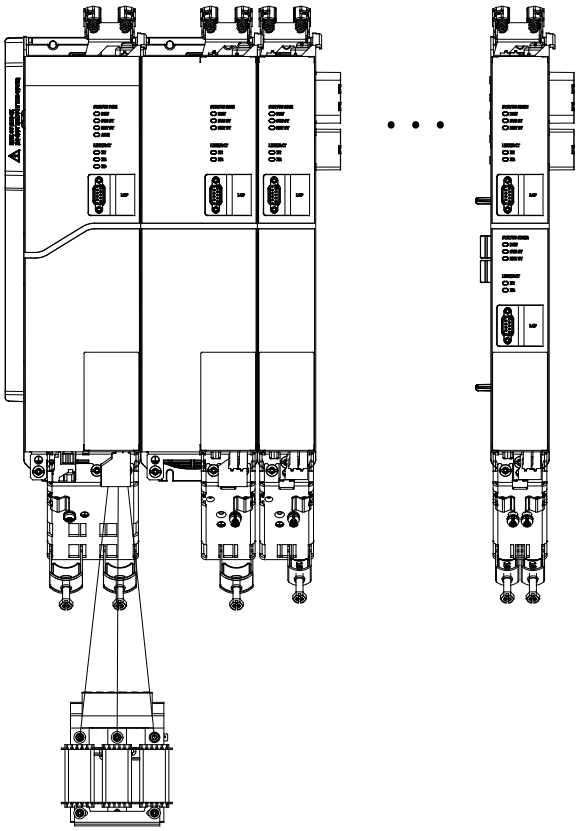


Figure 32: Connecting 1 PSM 520 to the AC Choke

5.9.2.2 Connecting 2 PSM 520 Modules to the AC Choke

Connect the PSM 520 modules to the same AC choke as shown in Figure 33.

Ensure that the choke used is the correct size based on the combined power of the PSM 520 modules.

When 2 PSM 520 modules are used, the wiring between the AC line choke and each PSM 520 must be the same length, within a tolerance of 0.5 m (1.6 ft).

Connect each PSM 520 to the AC choke directly. Parallel wiring is not allowed.

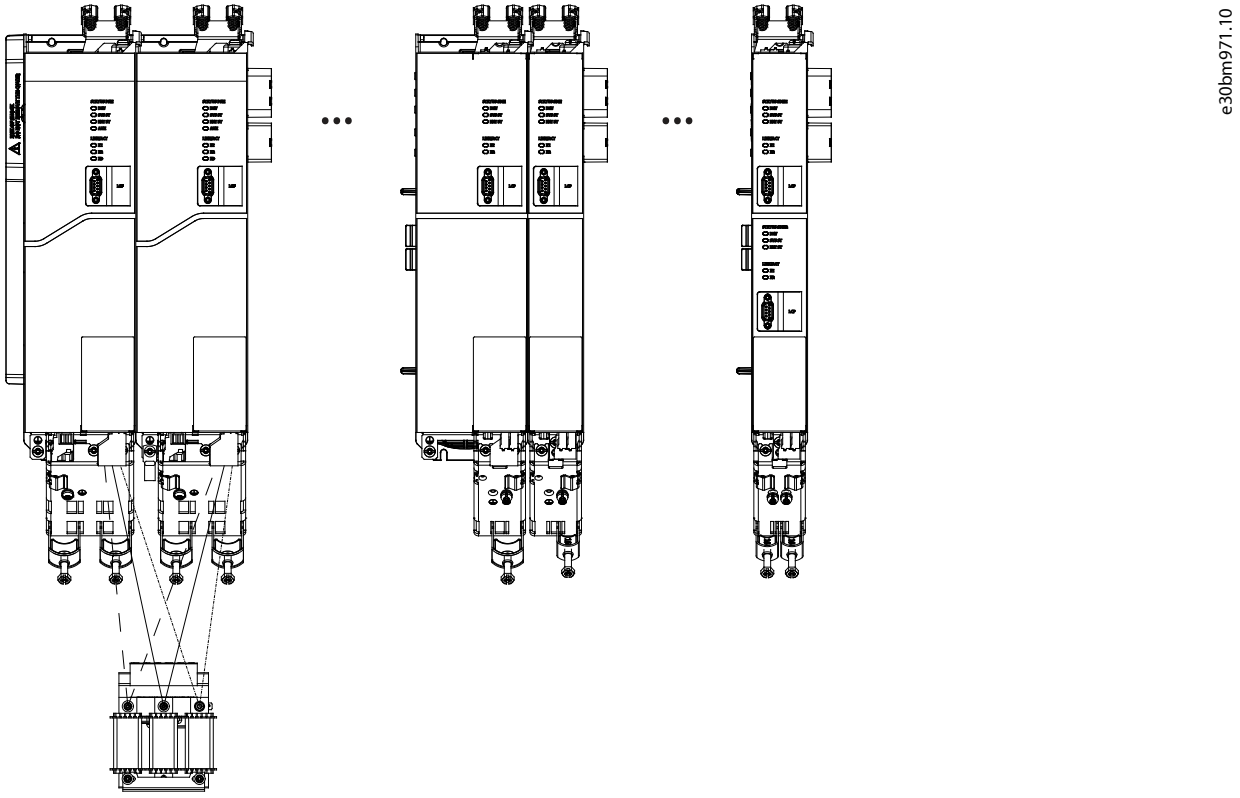


Figure 33: Connecting 2 PSM 520 Modules to the AC Choke

5.9.2.3 Connecting 2 PSM 520 Modules to the AC Choke with System Splitting

Connect the PSM 520 modules to the same AC choke regardless of the load position (for example, before or after the system splitting) as shown in Figure 34.

Ensure the choke used is the correct size based on the combined power of the PSM 520 modules.

When 2 PSM 520 modules are used, the wiring between the AC line choke and each PSM 520 must be the same length, within a tolerance of 0.5 m (1.6 ft).

Connect each PSM 520 to the AC choke directly. Parallel wiring is not allowed.

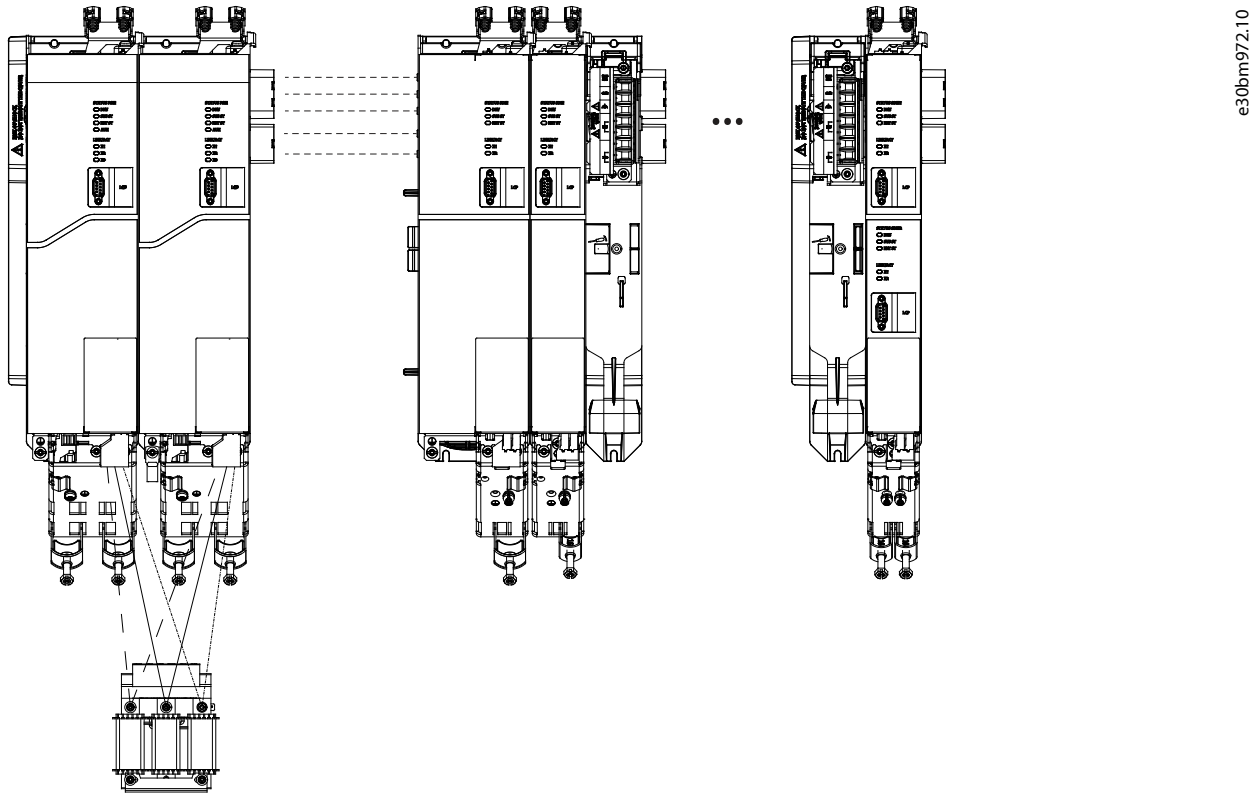


Figure 34: Connecting 2 PSM 520 Modules to the AC Choke with System Splitting

- If 2 AC chokes are used (1 per PSM 520), and both PSM 520 modules are mounted at the same side of the system splitting:
  - The setup is allowed with derating equal to the AC chokes tolerance referred to 60 kW. For example, 10% derating is 54 kW.
- If 2 AC chokes are used (1 per PSM 520) where 1 PSM 520 module is mounted before the splitting and 1 after the splitting:
  - Balance the loads equally otherwise, the derating of both PSM 520 modules is equal to the AC chokes tolerance. For example, tolerance 10% + 10% means is 20% derating.
- If 2 AC chokes are used (1 per PSM 520), and 1 PSM 520 module is mounted before the splitting and 1 after the splitting. Half of the loads are set before the system splitting and half are set after the system splitting:
  - The setup is allowed with derating equal to the tolerance of the AC choke referred to 60 kW. For example, 10% derating is 54 kW.

NOTICE

- See 11.5.15.1 Expansion Module Connector on EXM 520 for further information of the EXM 520 module and wiring.

5.9.3 Connecting the Cables on the Power Supply Module PSM 520

5.9.3.1 Connecting the Cables on the Top of the Power Supply Module PSM 520

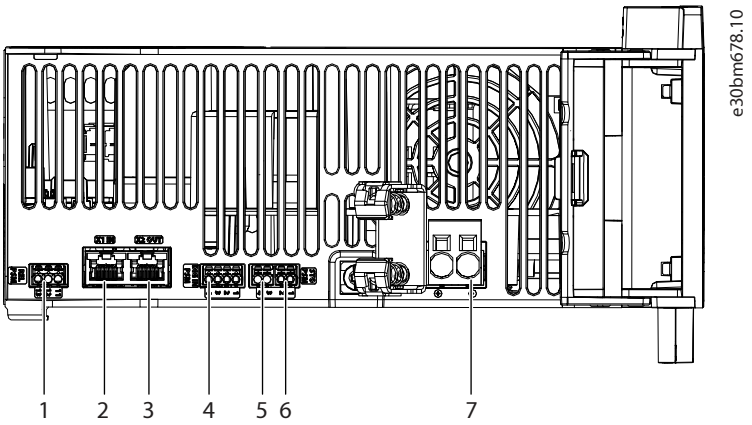


Figure 35: Connectors on the Top of PSM 520

1	Relay connector	2	Ethernet connector IN
3	Ethernet connector OUT	4	Digital input
5	STO connector OUT	6	STO connector IN
7	24/48 V IN connector		

Procedure

1. Plug the 24/48 V input connector (INPUT 24/48 V) [7].
2. Plug the STO connector IN (STO PSM) [6].
3. Plug the STO connector OUT (STO PSM) [5].
4. Plug the DIG IN connector (DIG IN PSM) [4].

   Only if digital input is required.

5. Plug the relay connector (REL PSM) [1].

   Only if a relay is required.

6. Connect the Ethernet cable from the Ethernet output connector (X2 OUT) [3] of the previous module to the Ethernet input connector (X1 IN) [2].

5.9.3.2 Connecting the Cables on the Bottom of the Power Supply Module PSM 520

Figure 36 is an overview of the PSM 520 connectors that each supports distinct operational functions.

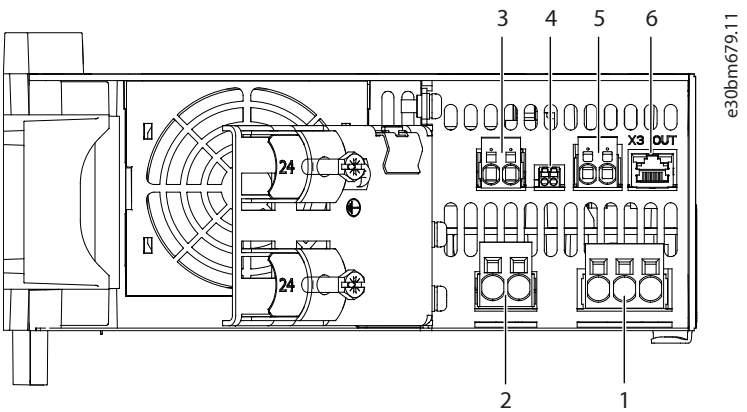


Figure 36: Connectors on the Bottom of PSM 520

1	AC mains supply connector	2	External brake resistor connector
3	UDC connector	4	STO connector
5	AUX connector	6	Ethernet connector

Dimensions in Figure 37 and Figure 38 are in mm [in].

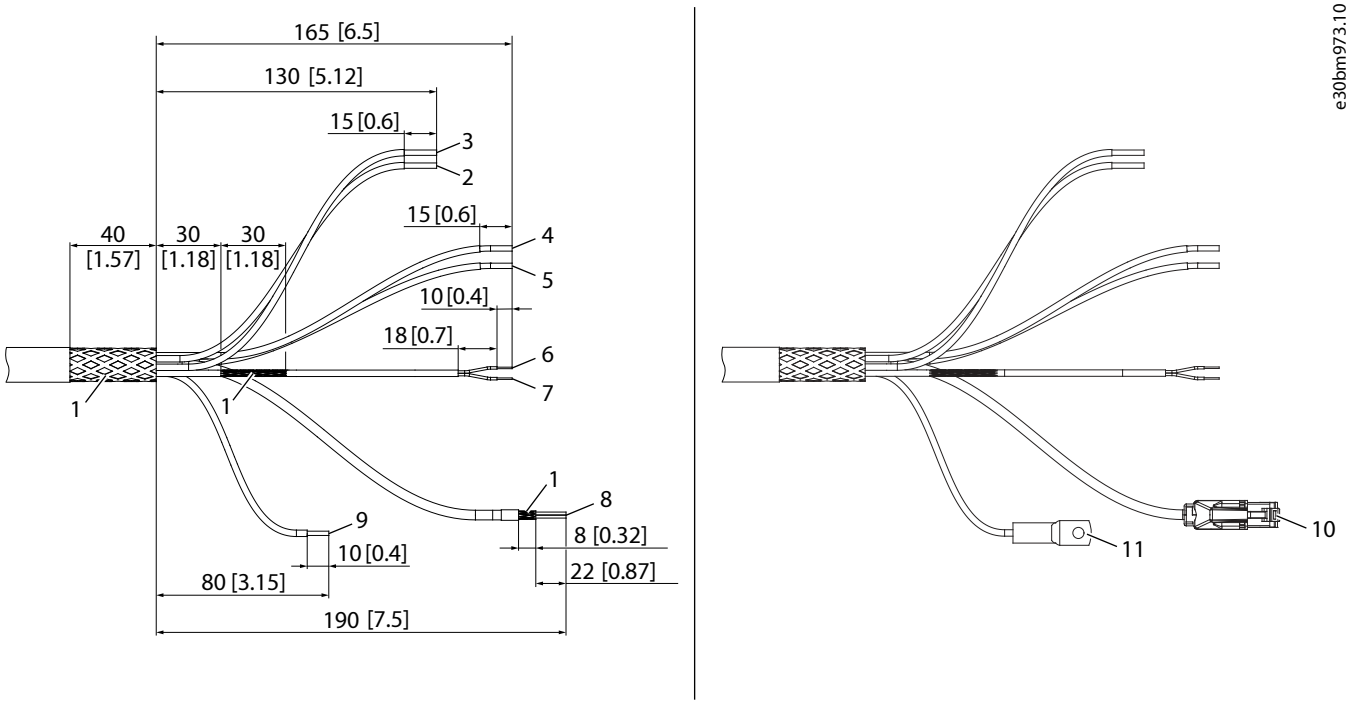


Figure 37: DAM Option Feed-in Cable

1	Shielded area	2	Black/UDC+ (Ferrules with plastic sleeve 2.5 mm^2)
3	Grey/UDC- (Ferrules with plastic sleeve 2.5 mm^2)	4	Red/AUX+ (Ferrules with plastic sleeve 2.5 mm^2)
5	Blue/AUX- (Ferrules with plastic sleeve 2.5 mm^2)	6	Wire pink/STO+ (Ferrules with plastic sleeve 0.5 mm^2)
7	Wire grey/STO- (Ferrules with plastic sleeve 0.5 mm^2)	8	Green
9	Yellow/green PE	10	Bus connector RJ45
11	Ring terminal M5		

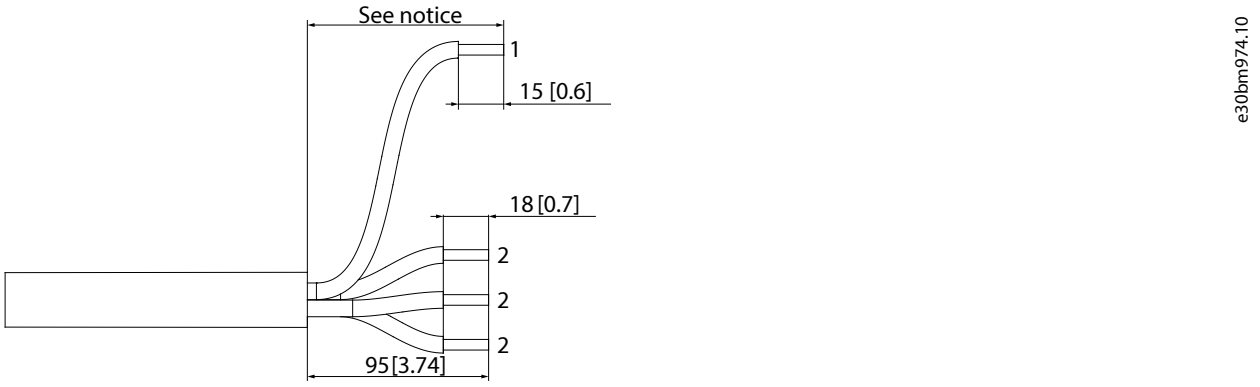


Figure 38: PSM AC Main Cable

1	Yellow/green PE	2	Phase

NOTICE

- Cable length based on the distance of the PE bar.

Procedure

The following procedure refers to Figure 39 and Figure 40.

1. Connect the PSM 520 to PE, connecting the PSM AC PE cable to the PE screw (T25) [4].

   Torque 3.0 Nm (26.6 in-lb).

2. Insert the phase wires into the AC main supply connector and the brake wires (if available) into the brake resistor connector.
3. Insert the wires into the UDC, STO, and AUX connectors.

   Only with DAM option.

4. Secure the AC mains cable [5] with the right cable clamp [6].
5. Secure and shield the DAM option feed-in cable [7] with the left cable clamp [6].

   Ensure that the shielded area on the cable is positioned exactly under the cable clamp.

6. Fasten the EMC plate [1] on the PSM 520 module with 2 screws [1A].

   Torque 3.0 Nm (26.6 in-lb)

7. Plug the brake resistor and AC main supply connector.

   Start from back.

8. Plug the UDC, STO, and AUX connectors.

   Start from back.

9. Plug the RJ45 bus connector.
10. Shield the STO cable by activating the spring loaded slider [8].

    Ensure that the shielded area is positioned exactly under the spring-loaded slider.

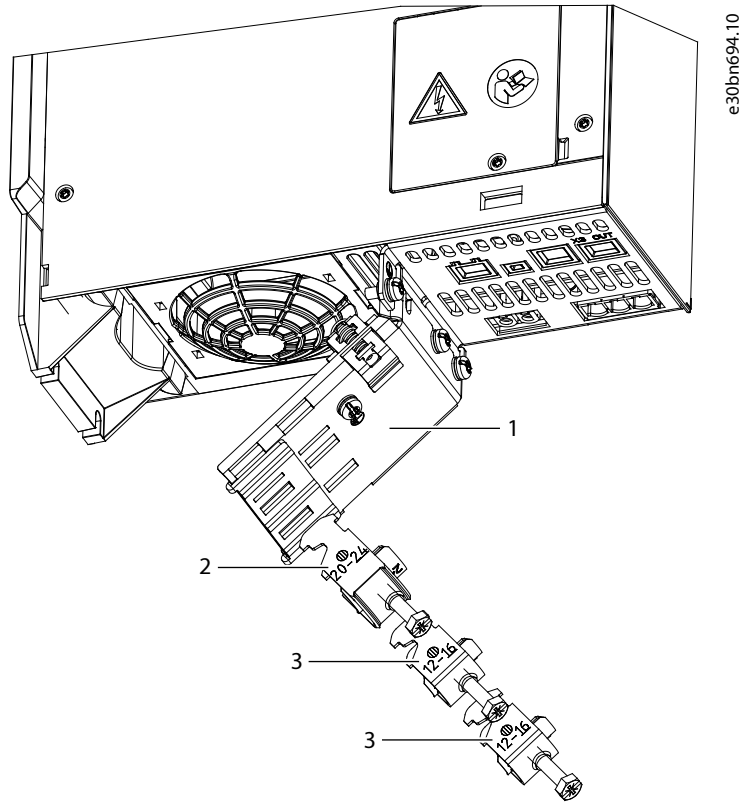


Figure 39: Assembly of EMC Plate and Cable Clamps on the PSM 520 Module

1	EMC plate	1A	Screws for EMC plate
2	Cable clamp 20–24 mm	3	Cable clamp 12–16 mm

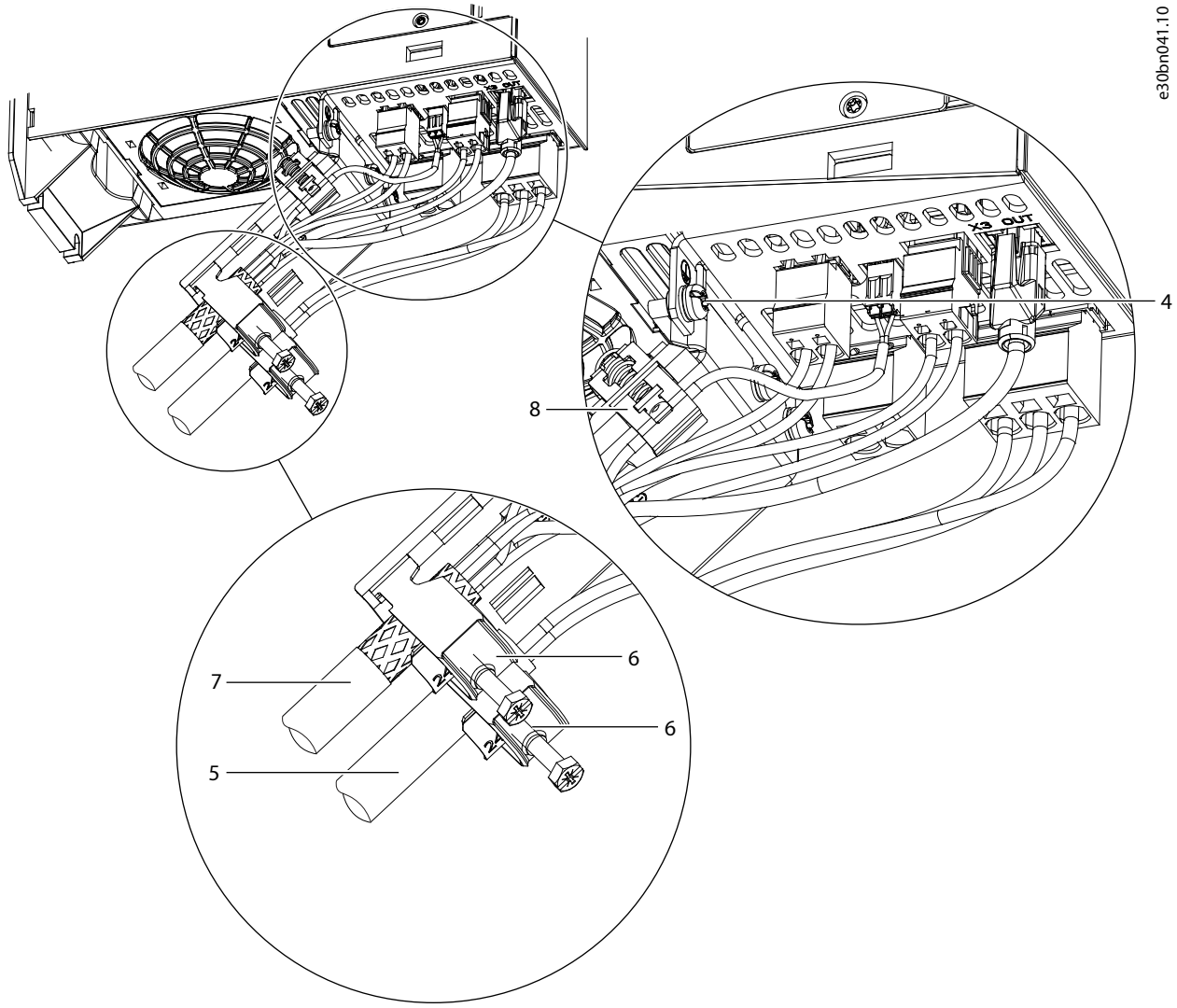


Figure 40: PSM/DAM Cable Connection

4	Screw for PE cable (T20)	5	PSM AC main cable
6	Cable clamp	7	DAM option feed-in cable
8	EMC shield bracket with compression spring		

5.9.4 Connecting the Brake Resistor on the Power Supply Module PSM 520

5.9.4.1 Connection of External Brake Resistor on 1 PSM 520 Module

The PSM 520 module can be connected to an external brake resistor. In this case, the proper selection must be applied in the drive configuration, to inhibit the use of the internal brake resistor on the PSM 520 module.

Paralleling or series of brake resistors is not allowed.

5.9.4.2 Connection of Brake Resistor on 2 PSM 520 Modules in Parallel

When using 2 PSM 520 modules, each PSM 520 module is connected to its own internal brake resistor (factory setting).

Alternative allowed configurations for 2 PSM 520 modules:

- 1 PSM 520 module is connected to the internal brake resistor and the other PSM 520 module is connected to an external brake resistor.
- Both PSM 520 modules are connected to an external brake resistor. In this case, the internal brake resistor on each PSM 520 module must be deactivated in the drive configuration.

Paralleling or series of brake resistors is not allowed.

5.10 Connecting the Servo Drive Module SDM 521/SDM 522

5.10.1 Connecting the Cables on the Top of the Servo Drive Modules SDM 521/SDM 522

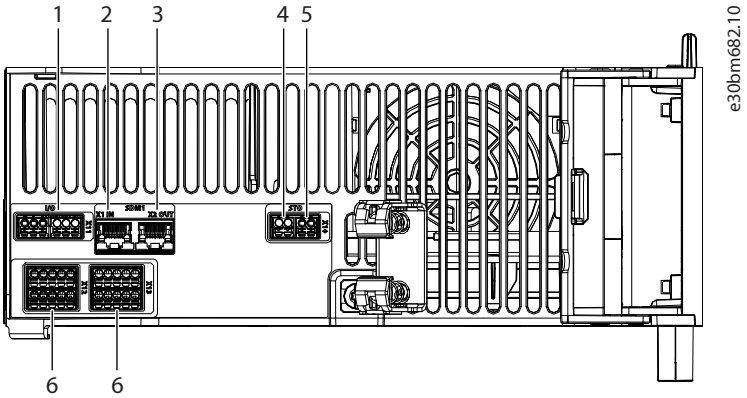


Figure 41: Connectors on the Top of SDM 521/SDM 522 (Example)

1	I/O connector	2	Ethernet connector IN
3	Ethernet connector OUT	4	STO connector OUT
5	STO connector IN	6	Safe I/O connector

The following procedure refers to Figure 41.

Procedure

1. Connect the STO output [4] of the previous module into the STO input (STO IN) connector [5].
2. Plug the I/O connectors [1].

   Only if I/Os are required.
3. Plug the safe I/O connector [6].

   Only if safe I/Os are required.
4. Connect the Ethernet cable from the Ethernet output connector (X2 OUT) [3] of the previous module to the Ethernet input connector (X1 IN) [2].

5.10.2 Connecting the Cables on the Bottom of the Servo Drive Modules SDM 521/SDM 522

Figure 42 is an overview of the SDM 521/SDM 522 connectors that each supports distinct operational functions.

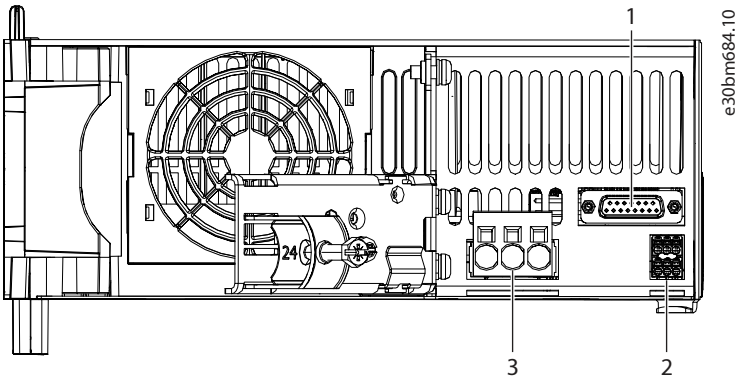


Figure 42: Connectors in the Bottom of SDM 521

1	Motor feedback connector	2	Motor brake and thermistor connector
3	Motor connector		

Dimensions in Figure 43 are in mm [in].

Dimensions A-B-C, see Table 26.

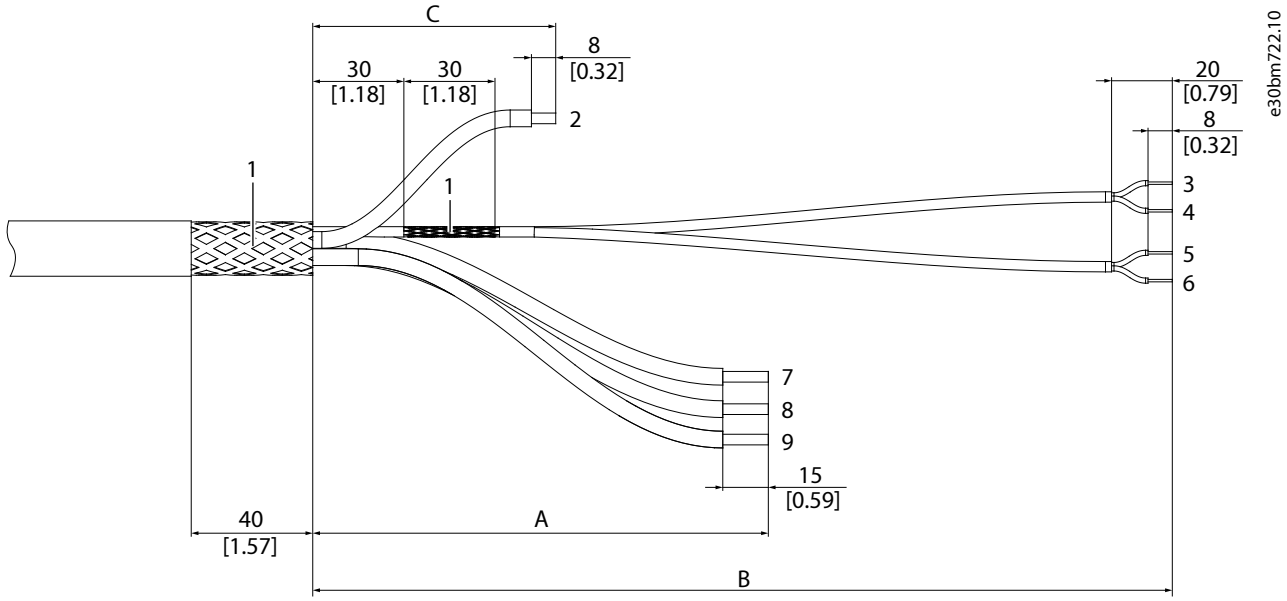


Figure 43: Motor Cable for 50/100 mm (2.0/3.9 in) Wide Servo Drive Modules

1	Shield area	2	PE (Ring terminal M5)
3	Brake +	4	Brake -
5	Temp +	6	Temp -
7	U	8	V
9	W		

Table 26: Cable Length A-B-C

SDM module		A (Phase cable) [mm (in)]	B (Temperature/brake cable) [mm (in)]	C (PE cable) [mm (in)]
SDM 521 (FS2)		150 (5.91)	190 (7.48)	80 (3.15)
SDM 521 (FS1)		150 (5.91)	190 (7.48)	70 (2.76)
SDM 522 (FS1)	Axis 1	180 (7.09)	200 (7.87)	50 (1.97)
	Axis 2	130 (5.12)	160 (6.30)	50 (1.97)

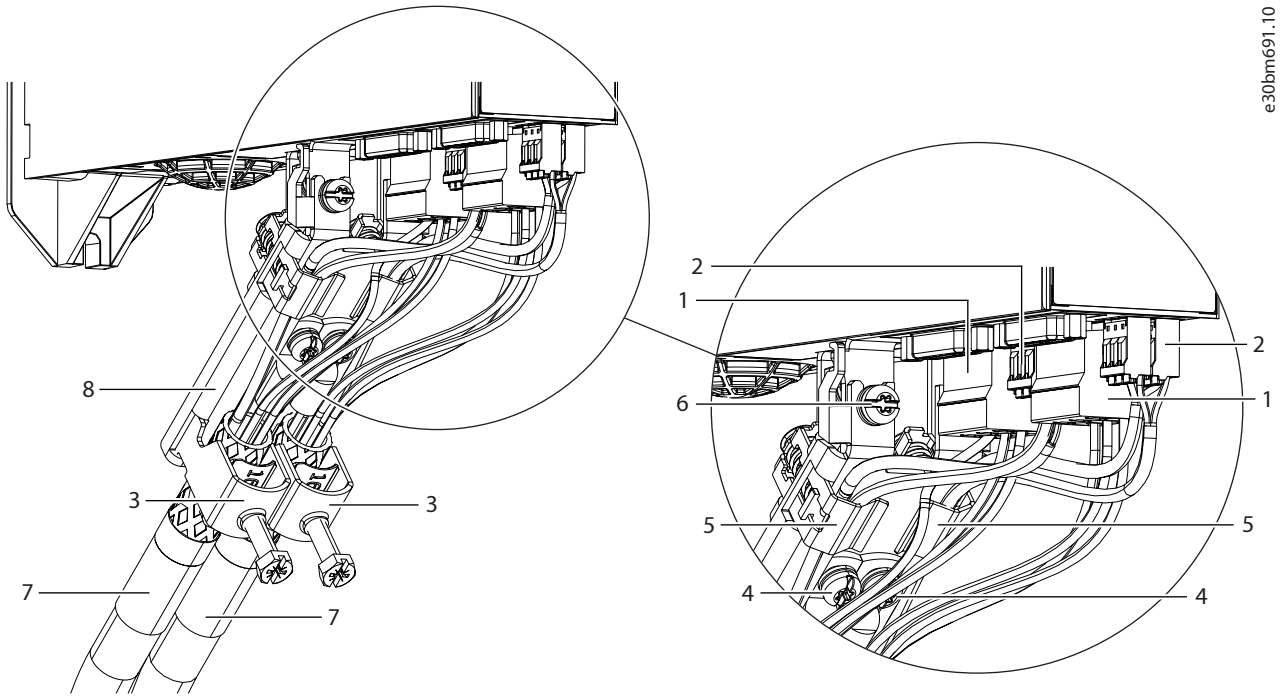


Figure 44: Connecting the Motor Cable on 50 mm (2.0 in) Wide Servo Drive Modules

1	Motor connector	2	Brake/thermistor connector
3	Cable clamp	4	Screw (T20) for PE cable
5	Shield with spring-loaded slider	6	Screw (T20) for EMC plate
7	Motor cable	8	EMC plate

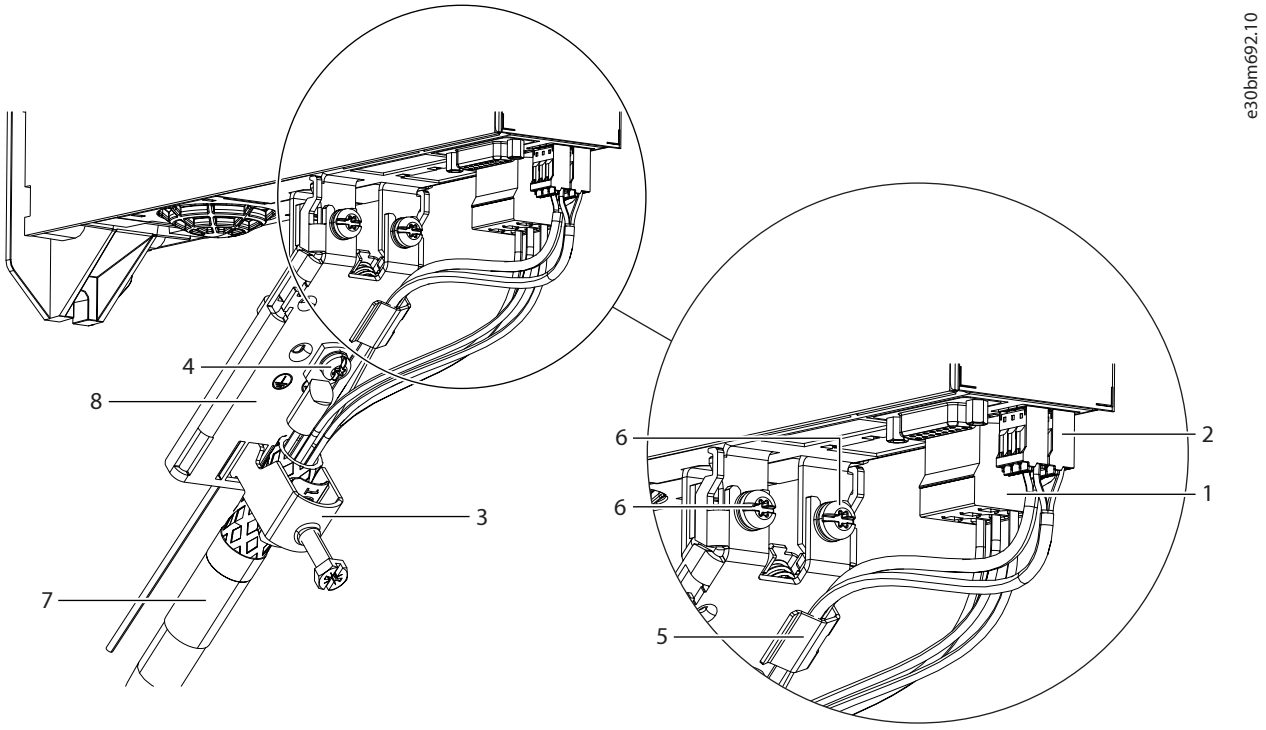


Figure 45: Connecting the Motor Cable on 100 mm (3.9 in) Wide Servo Drive Modules

1	Motor connector	2	Brake/thermistor connector
3	Cable clamp	4	Screw (T20) for PE cable
5	Shield with spring-loaded slider	6	Screw (T20) for EMC plate
7	Motor cable	8	EMC plate

The following procedure refers to Figure 44 and Figure 45.

Procedure

1. Connect the SDM 521/SDM 522 to PE using the PE screw (T25).

   Torque 3.0 Nm (26.6 in-lb)

2. Insert the wire into the motor connector [1]
3. Insert the wire into the brake/thermistor connector [2].
4. Secure and shield the motor cable [7] with the cable clamp [3].
5. Fasten the motor PE cable with screw (T20) [4].

   Torque 3.0 Nm (26.6 in-lb)

6. Shield the brake/ thermistor cable by activating the spring loaded slider [5].

   Ensure that the shielded area is positioned exactly under the spring-loaded slider.

7. Fasten the EMC plate [8] with 2 screws (T20) [6]

   Torque 3.0 Nm (26.6 in-lb)

8. Plug the motor and brake/thermistor connectors.

5.11 Connecting the Expansion Module EXM 520

Dimensions in Figure 46 are in mm [in].

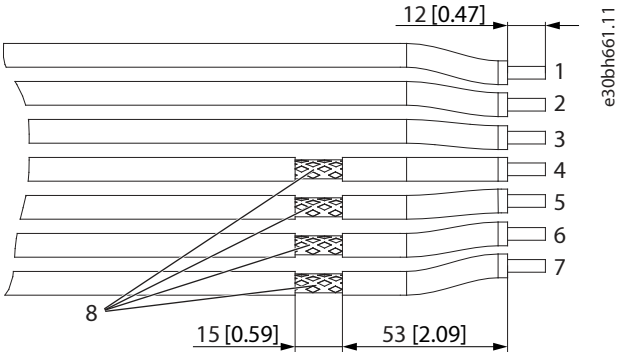


Figure 46: Expansion Module Cable

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

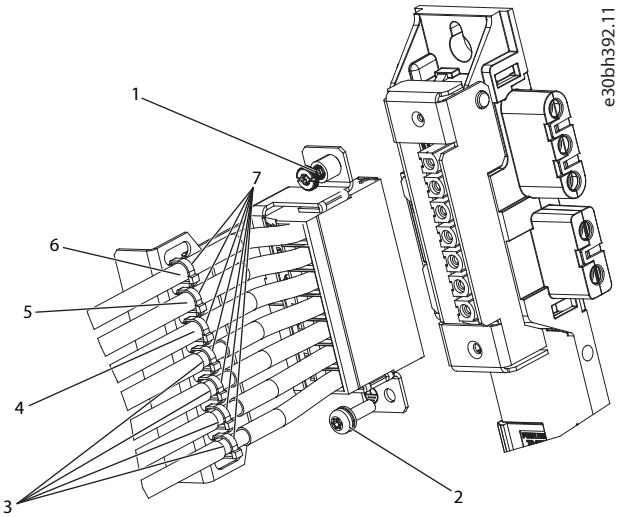


Figure 47: Connecting the Expansion Module EXM 520

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

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].

Torque 3 Nm.

6. Connect the EXM 520 to PE using the PE screw [2] and a PE wire.

   Torque 3 Nm.

6 Commissioning

6.1 Warnings for Commissioning

⚠ WARNING

UNINTENDED START

The servo system is 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.

6.2 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 8.9 Commissioning Test).

6.3 SDM 521/SDM 522 Configuration Parameter and Drive Commissioning

6.3.1 Configuration Parameter Subtool

The *Configuration Parameter* subtool is the VLT ® Servo Toolbox subtool for configuring:

- Motor data
- Application data
- Control data
- Input/output configurations
- External encoder

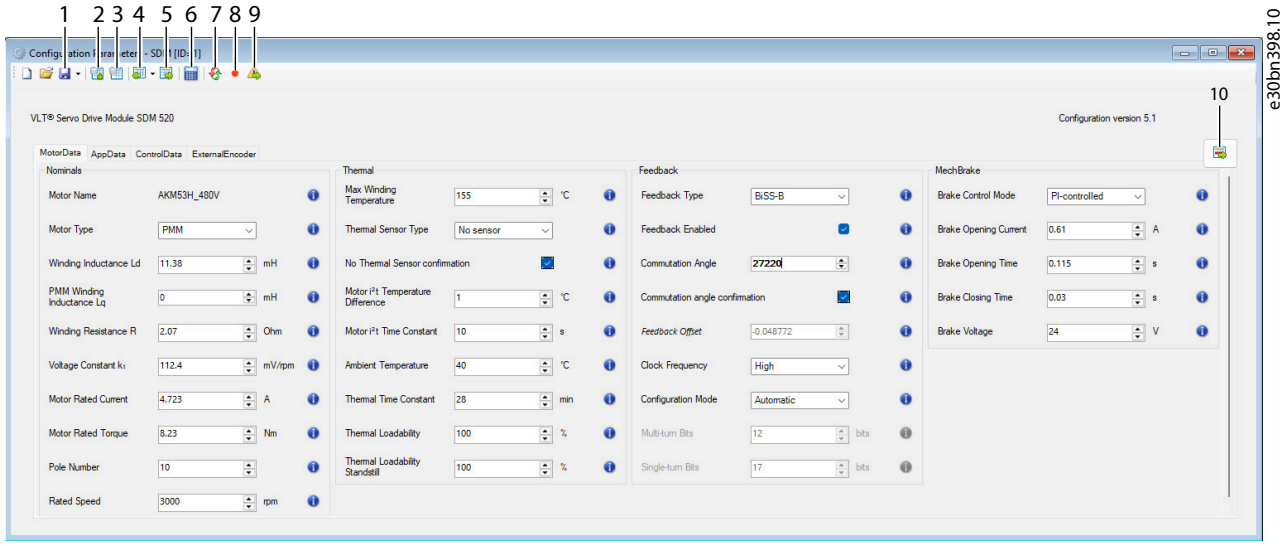


Figure 48: Configuration Parameter Subtool

1	Save/Save as	2	Save to motor database
3	Open motor database	4	Read configuration from device
5	Write configuration to the device	6	Calculate PID values
7	Set default values	8	Permanently store device configuration
9	Reset device configuration	10	Write the parameter group to the device

The configuration parameters are part of the object dictionary of the device. At power-up they assume default values, unless the parameters are permanently stored.

NOTICE

- Refer to the subtool for a detailed description of each parameter.

The following procedure refer to Figure 48.

1. Select *Read configuration from device* button [4] to read the current values of the configurable parameters from the device.
2. Select the *Save/Save as* button [1] to save the file locally.
3. Select *Write configuration to device* button [5] to write the modified parameter values to the device. The new values are lost if the values not are permanently stored with the *Permanently store device configuration* button [8].
4. Select the *Save to motor database* button [2] to save the current motor configuration as customized "user defined" motor in the local catalog of motors.
5. Select the *Open motor database* button [3] to open and browse the local catalog of motors. Find and select the specific motor and import the corresponding parameters.
6. Select the *PID values* button [6] to compute the values of control gains for the given value of inertia.
7. Select the *Set default values* button [7] to reset the user interface values to the default values.
8. Select the *Permanently store device configuration* button [8] to save the storable parameter at device side. When completed the device must keep the parameter values after a power cycle.
9. Select the *Reset device configuration* button [9] to reset the parameters at device side to the factory setting.
10. Select the *Write the parameter group to device* button [10] to write the modified parameter values of the shown group to the device.

6.3.2 Drive Commissioning Subtool

The *Drive Commissioning* subtool is the VLT® Servo Toolbox subtool for carrying out commissioning tasks, such as:

- Automatic motor adaption
- Motor feedback adjustment
- Resolver amplitude calibration
- Inertia measurement
- Control loop tuning

Figure 49 and Figure 50 is an example from the *Drive Commissioning* subtool.

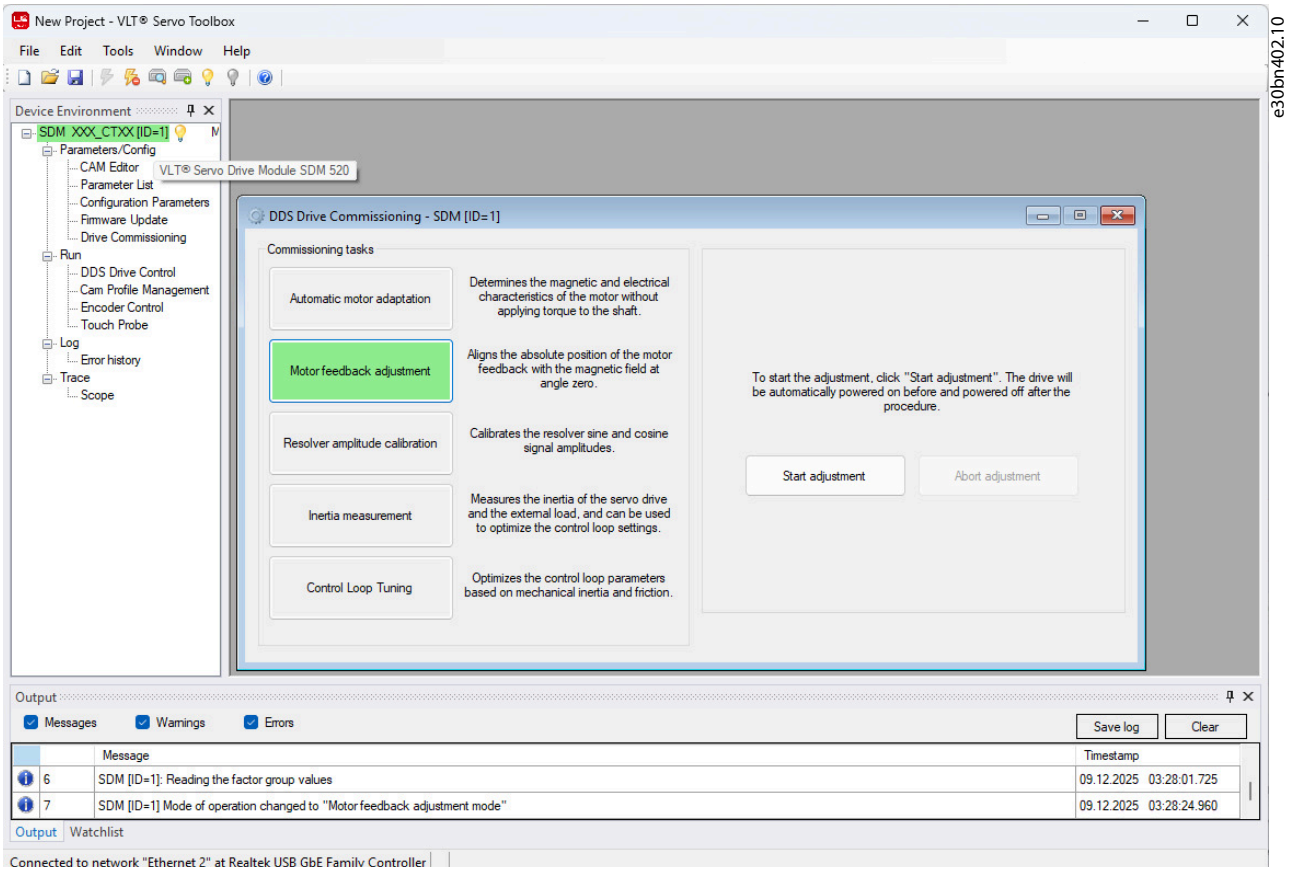
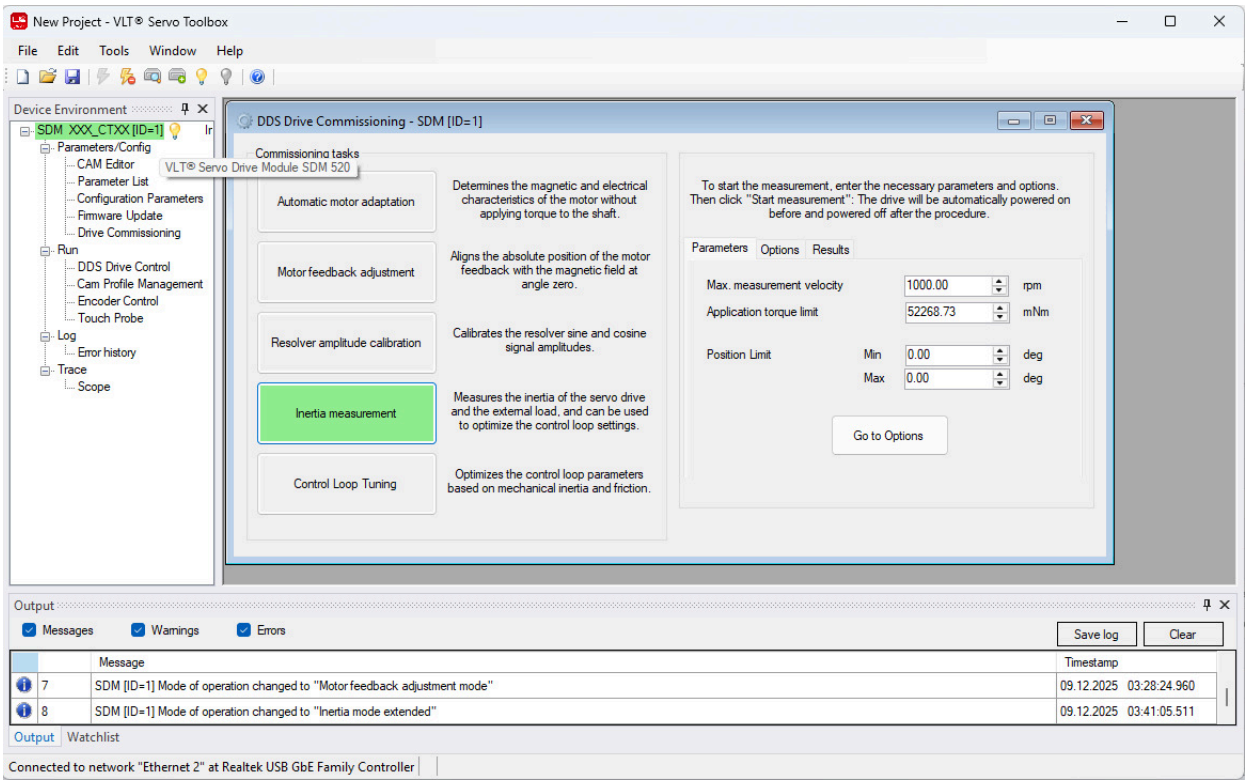


Figure 49: Motor Feedback Adjustment (Example)



e30bn403.10

Figure 50: Inertia Measurement (Example)

6.4 EtherCAT® ID Assignment

EtherCAT® needs no special ID assignment (IP address). Special ID assignment is only required when using indirect communication via the VLT® Servo Toolbox software.

6.5 Ethernet POWERLINK® ID Assignment

6.5.1 Overview

Ethernet POWERLINK® master communication must not be active when using the VLT® Servo Toolbox to assign IDs to the devices. ID assignment via the VLT® Servo Toolbox is only possible when acyclic Ethernet POWERLINK® communication is used. If Ethernet POWERLINK® cyclic communication is already started, perform a power cycle to stop it.

Detach the PLC and carry out a power cycle before setting IDs. Alternatively, in the POWERLINK® interface, restart the PLC in service mode while parameter ***Basic Ethernet*** in service mode is set to *Basic Ethernet enabled*.

6.5.2 Single Device ID Assignment

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 520, DSD 520, MSD 520 (VLT® FlexMotion™) Programming Guide* for further information).

Setting an ID to a device can also be done via the LCP.

6.5.3 Setting Node ID for Single Device

6.5.3.1 Setting the Node ID Directly on a Servo Drive or on the System Modules

All IP-related parameters are in parameter group ***12-0* IP Settings***. According to the Ethernet POWERLINK® standard, the IP address is fixed to 192.168.100.xxx. The last number is the value in parameter ***12-60 Node ID***. For parameter ***12-02 Subnet Mask***, the IP address is fixed to 255.255.255.0 and cannot be changed.

Procedure

1. Attach the LCP to the servo drive or system module for which the node ID should be changed.
2. Press [*Hand On*] for >1 s to make the LCP the controlling interface.
3. Press [*Main Menu*], scroll down to parameter group ***12-** Ethernet***, and press [*OK*].
4. Scroll down to parameter group ***12-6* Ethernet POWERLINK*** and press [*OK*].
5. Change the PSM 520 node ID to the desired value (1–239).
6. Press [*OK*] to confirm the selection and wait for the ID assignment procedure to complete.
7. Carry out a power cycle to ensure that all ID changes are in effect and operational on the fieldbus.

6.5.3.2 Setting the Node ID for a Single Servo Drive via the Power Supply Module (PSM) using the LCP

It is also possible to change the node ID of a servo drive when the LCP is connected to the PSM 520. This functionality is contained in parameter group ***54-1* Manual***.

Procedure

1. Attach the LCP to the PSM 520 that is connected to the servo drives and system modules for which the node ID should be changed.
2. Press [*Hand On*] for >1 s to make the LCP the controlling interface for the PSM 520.
3. Press Main Menu, scroll down to parameter group ***12-** Ethernet***, and press [*OK*].
4. Scroll down to parameter group ***12-6* Ethernet POWERLINK*** and press [*OK*].
5. Change the PSM 520 node ID to the desired value (1–239) by pressing *[OK]*.
6. Return to the [*Main Menu*] and select parameter group ***54-** ID Assignment***.
7. Select parameter group ***54-1* Manual***.
8. PSM 520 only: In parameter ***54-01 Epl id assignment line***, select either Ethernet port X1 or X2. The PSM 520 assigns IDs to the selected device via the selected port and the fieldbus network.
9. Select parameter ***54-12 Epl ID assignment start id***, and select a valid value (1–239). The value is assigned to the device at the specified position index. The PSM 520 connected to the LCP is at position 0 and the 1st reachable device on the selected port is position index 1, and so forth.
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

6.5.4 Multiple Device ID Assignment

When assigning IDs to several devices (for example, when setting up a new network), use the VLT® Servo Toolbox subtool *DAM ID assignment*. For further information, see the programming guide *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 FlexMotion™*.

6.5.5 Setting Node ID for Multiple Devices

6.5.5.1 Setting the Node IDs of all Servo Drives and System Modules on a Power Supply Module (PSM 520) Line

The automatic PSM 520 ID assignment is used for automatically setting the node IDs on all servo drives and system modules for a specified PSM 520 line (with or without DAM option). This functionality is contained in parameter group ***54-0* Automatic***.

Procedure

1. Attach the LCP to the PSM 520 that is connected to the servo drives and system modules for which the node ID should be changed.
2. Press [*Hand On*] for >1 s to make the LCP the controlling interface for the PSM 520.
3. Press Main Menu, scroll down to parameter group ***12-** Ethernet***, and press [*OK*].
4. Scroll down to parameter group ***12-6* Ethernet POWERLINK*** and press [*OK*].
5. Change the PSM 520 node ID to the desired value (1–239) by pressing [*OK*].
6. Return to the [*Main Menu*] and select parameter group ***54-** ID Assignment***.
7. Select parameter group ***54-0* Automatic***.
8. PSM 520 only: In parameter ***54-01 Epl id assignment line***, select either Ethernet port X1 or X2. The PSM 520 assigns IDs to the selected device via the selected port and the fieldbus network.
9. Select parameter ***54-02 Epl ID assignment start id*** then select a valid value (1–239). The value is assigned to the device at the specified position index. The PSM 520 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 ***54-03 Automatic 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 ***54-04 Epl ID assignment state***
    b. Parameter ***54-05 Epl ID assignment error code***
    c. Parameter ***54-06 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

6.6 PROFINET® ID Assignment

Each PROFINET® device needs a device name and an IP address. The IP address and the device name are assigned by the I/O controller, when the connection to the I/O device is established.

The IP address assignment is also required when using indirect communication via the VLT® Servo Toolbox software. For further information, see the programming guide *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 FlexMotion™*.

The IP address and the device name can also be assigned using PRONETA®, a free tool that supports in the analysis and configuration of PROFINET® networks.

6.7 Power-up Time

The maximum power-up time for the system components is 15 s. This means the time from supplying the system with auxiliary voltage to the module being initialized completely.

The power-up time stated is an indicative time. The exact status of the module can be seen via the status word.

NOTICE

- Do not operate any of the system modules until they are all powered up correctly.
- If 2 PSM 520 modules are mounted in parallel, power up both PSM 520 modules simultaneously (within a maximum delay of 1 s).

6.8 System Module Charging Time

The charging time of the system is determined by the longest charging time of each individual system module.

The exact status of each module can be seen via the status word.

NOTICE

- Do not operate any of the system modules until they are charged up completely and are in state *Operation enabled*.

Table 27: DC link (UDC) Charging Time for PSM 520

Specification	Unit	PSM 520
UDC charging time	s	2.0

Table 28: DC Link (UDC) Charging Time for SDM 521

Specification	Unit	SDM 521 2.5 A	SDM 521 5 A	SDM 521 10 A	SDM 521 20 A
UDC charging time	s	2.0			

Table 29: DC Link (UDC) Charging Time for SDM 522

Specification	Unit	SDM 522 2 x 2.5 A	SDM 522 2 x 5 A	SDM 522 2 x 10 A	SDM 522 2 x 20 A
UDC charging time	s	2.0			

6.9 System Power-up Requirements

6.9.1 Switching on the MSD 520 System

Complete the cabling of the MSD 520 system before applying power to the Servo Drive Modules (SDM 521/SDM 522). This cabling provides the supply voltage and the communication signals for the system. This is a basic requirement for the operation of the servo drives.

The MSD 520 system is switched on by supplying the Power Supply Module (PSM 520) with U_{AUX}. This supply is then automatically passed on to all connected system modules and only the control units of the connected modules are running. The system is ready for operation when mains and STO are supplied.

6.9.2 Procedure for Switching on the MSD 520 System

Procedure

1. Switch on U_{AUX} power to enable communication to the PSM 520, and SDM modules to be established.
2. Switch on the mains.
3. Set the PSM 520 to state *Operation enabled*.

The system modules are now ready for operation.

6.10 Libraries

The libraries provided for the MSD 520 system can be used in:

- TwinCAT® V2 and V3
- SIMOTION SCOUT® V5.2:
  - C240 from V4.4
  - D410-2 from V4.4
  - D425-2 from V4.4
  - D435-2 from V4.4
  - D445-2 from V4.4
  - D455-2 from V4.4
  - P320 from V4.4
- Automation Studio™ environment (version 3.0.90 and 4.x, supported platform SG4) to easily integrate the functionality without the need for special motion run-time on the controller.
- Totally Integrated Automation® (TIA Portal® from V15)

The provided function blocks conform to the PLCopen® standard. Knowledge of the underlying fieldbus communication and/or the CANopen® CiA DS 402 profile is not necessary.

The library contains:

- Function blocks for controlling and monitoring the system components.
- Function blocks for all available motion commands of the servo drives.
- Function blocks for controlling and monitoring the power supply module PSM 520.

- Function blocks and structures for creating *Basic CAM* profiles.
- Function blocks and structures for creating *Labeling CAM* profiles.

6.11 Programming with Automation Studio™

6.11.1 Requirements for Programming with Automation Studio™

The following files are required to integrate the system components into an Automation Studio™ project:

- Package of libraries for the system components: Danfoss_VLT_ServoMotion_V_x_y_z.zip
- XDD file (XML Device Description) for the ISD 520 servo drive: 0x0200008D_VLT_ISD_520_XXX_CTXX.xdd
- XDD file (XML Device Description) for the ISD 520 servo drive with Standard IO Option board: 0x0200008D_VLT_ISD_520_XXX_CTIO.xdd
- XDD file (XML Device Description) for the DSD 520 servo drive: 0x0200008D_VLT_DSD_520_XXX_CTXX.xdd
- XDD file (XML Device Description) for the DSD 520 servo drive with Standard IO Option board: 0x0200008D_VLT_ISD_520_XXX_CTIO.xdd
- XDD file (XML Device Description) for the SDM 521/SDM 522 servo drive module: 0x0200008D_VLT_SDM_520_XXX_CTXX.xdd
- XDD file (XML Device Description) for the Power Supply Module (PSM 520): 0x0200008D_VLT_PSM_520_AKXX.xdd
- XDD file (XML Device Description) for the Power Supply Module (PSM 520) with DAM option board: 0x0200008D_VLT_PSM_520_AKDX.xdd

6.11.2 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.

Creating a project:

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*].

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

1. In the *Logical View*, open the menu entry [*File*] and [*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 *Open*.
4. Assign the libraries to the CPU in the next window.
5. Click *Finish*. Now the libraries are integrated into the Automation Studio™ project.

Table 30: Servo Motion Libraries

Library	Description
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. • When integrating the DDS_Drive package, some standard libraries are integrated automatically, unless they are already part of the project.
DDS_PSM	• Contains POUs defined by Danfoss (name starting with DD_) and provides the functionality for the Power Supply Module (PSM 520). • The names of the POUs that target the PSM 520 all end with _PSM.
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.

NOTICE

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

6.11.4 Constants within the DDS_Drive Library

The constants are defined inside the DDS_Drive library (see Table 31).

Table 31: List of Constants

Constant	Description
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 POUs. • The reason is given in an output *ErrorInfo.ErrorID* that is available in all POUs.
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 POUs.

Table 31: List of Constants - (continued)

Constant	Description
PSM_ErrorCodes	• Constants for error codes of the Power Supply Module (PSM 520). • 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 520). • Intended to be used with the function block *DD_Trace_PSM*.

6.11.5 Instantiating AXIS_REF_DDS in Automation Studio™

1. Create 1 instance of function block *AXIS_REF_DDS* (located in folder *DDS_Drive*) for every SDM 521/SDM 522 drive module and 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.
   a. Open the *Logical View*.
   b. Initialize each instance with its node number and the slot name it is connected to (for example, IF3).
   c. Initialize each instance of a drive with its *DriveType*.

6.11.6 Instantiating PSM_REF in Automation Studio™

1. Create 1 instance of function block *PSM_REF* (located in folder *DDS_PSM*) for every Power Supply Module (PSM 520) that has to be controlled or monitored.
2. To create a link to the physical PSM 520, link each instance of *PSM_REF* to 1 physical PSM 520. This makes it the logical representation of 1 physical PSM 520.
   a. Open the *Logical View*.
   b. Initialize each instance with its node number and the slot name it is connected to (for example, IF3).

6.11.7 Importing a Servo Drive into Automation Studio™

NOTICE

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

6.11.7.1 Project Version

6.11.7.1.1 Version V4.x

1. Select the menu entry [*Tools*] → [*Import Fieldbus Device...*].
2. Select the XDD file (for example, 0x0200008D_VLT_ISD_520_XXX_CTIO.xdd) from its location on the hard drive. The device is then known to Automation Studio™.
3. Now add the SDM 521/SDM 522 drive module or servo drive to the Ethernet POWERLINK® interface of the controller in the *Physical View*:
   a. Select the menu entry [*Open*] → [*System Designer*] to show the *System Designer*.
   b. 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.
   c. Drag the selected module to the desired position to connect it to the selected hardware module, network interface, or slot.
   d. To change the node number, right-click on the device and select [*Node Number*] → [*Change Node Number*].

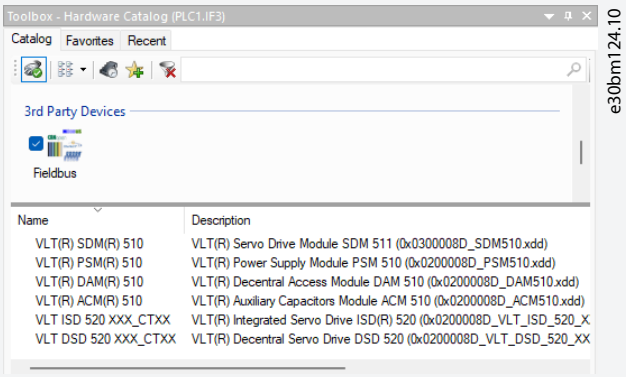


Figure 51: Adding a Servo Drive to the Project

6.11.8 Importing PSM 520 into Automation Studio™

NOTICE

- For each physical PSM 520 line (with or without DAM option), add 1 entry to the Physical View of Automation Studio™.

6.11.8.1 Project Version

6.11.8.1.1 Version V4.x

Procedure

1. Select the menu entry [*Tools*] → [*Import Fieldbus Device...*].
2. Select the XDD file for the PSM 520 from its location on the hard drive. The device is then known to Automation Studio™.
   - Power Supply Module (PSM 520): 0x0200008D_PSM.xdd
3. Now add the PSM 520 to the Ethernet POWERLINK® interface of the controller in the *Physical View*:
   a. Select the menu entry [*Open*] → [*System Designer*] to show the *System Designer*.
   b. To add a hardware module to the *Physical View* or *System Designer*, select the PSM 520 in the group *POWERLINK* in the *Hardware Catalog toolbox*.
   c. Drag the selected module to the desired position to connect it to the selected hardware module, network interface, or slot.
   d. 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

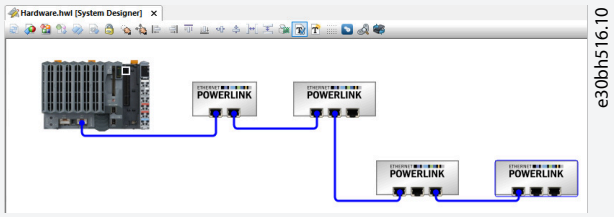


Figure 52: 1 PSM 520, and 2 ISD 520 Servo Drives Added to the Ethernet POWERLINK® Interface in V4.x

6.11.9 I/O Configuration and I/O Mapping

Procedure

1. Parameterize the I/O configuration of the SDM 521/SDM 522 drive modules or servo drives so that the library has access to all necessary objects.
   a. Right-click the entry of the SDM 521/SDM 522 drive module or servo drive and select *Configuration* in V4.x.
   b. 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 (PSM 520), so that the library has access to all necessary objects.
   a. Right-click the entry of the PSM 520 and select *Configuration*.
   b. 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*.

NOTICE

- These settings configure the cyclic communication with the device. These parameters are required for the library to work.
- It is possible to use copy and paste to apply the same I/O configuration to multiple devices of the same type.

3. Set *Module supervised* to *off* for the servo drives and the PSM 520. The parameter is found in the I/O configuration of the device.

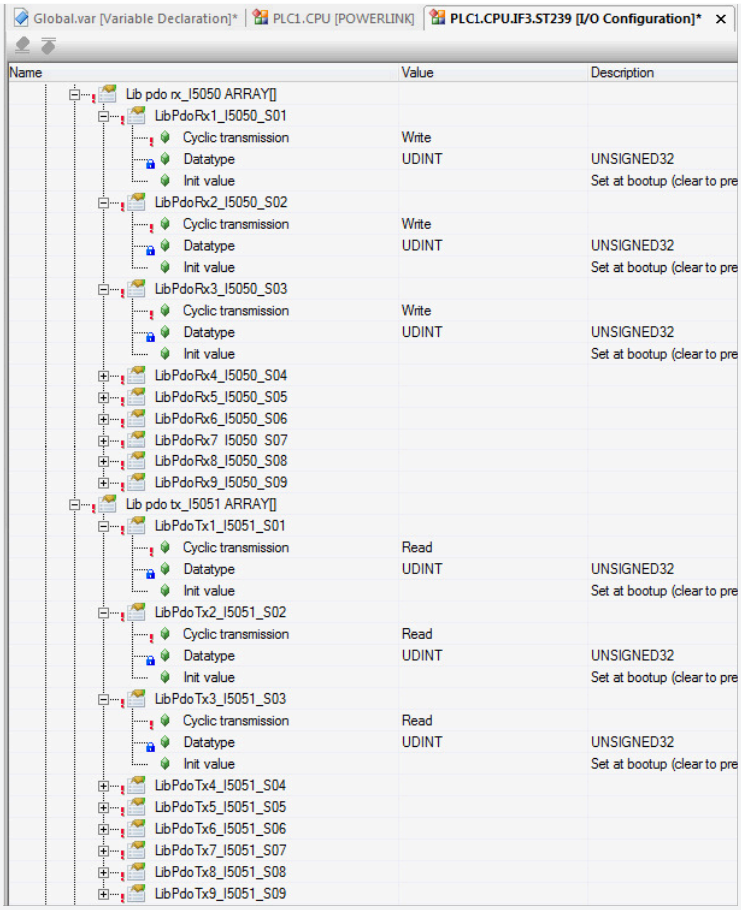


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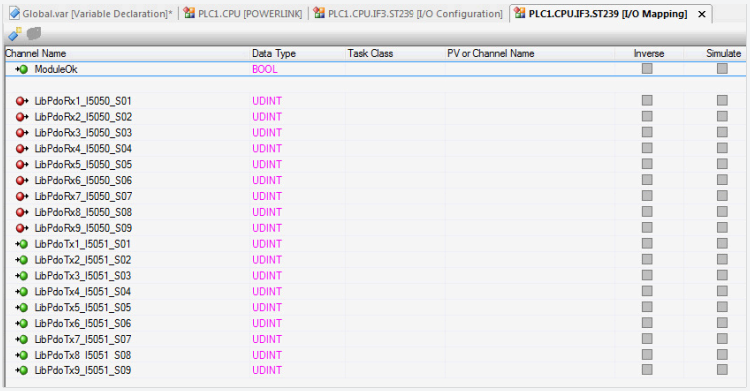
Figure 53: I/O Configuration of an ISD 520 Device



e30bg342.10

Figure 54: I/O Mapping after Successful Configuration

4. Map the inputs and outputs of the instance of the *AXIS_REF_DDS* function block and the physical data points of the ISD 520/ DSD 520 servo drive (here *myAxis* is an instance of *AXIS_REF_DDS*):

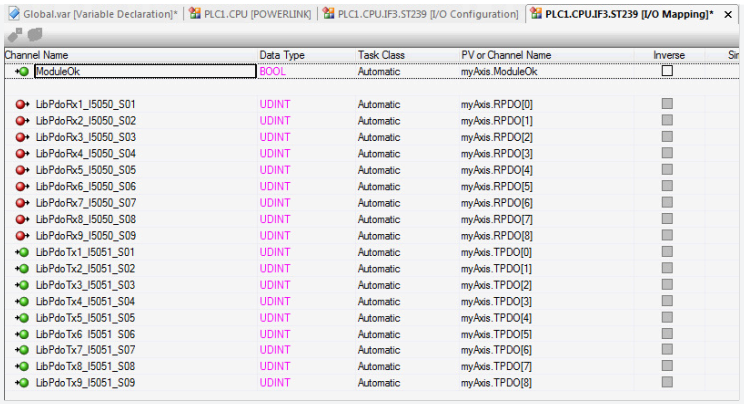


Figure 55: I/O Mapping of an ISD 520 Servo Drive

5. Map the inputs and outputs of the instance of the *PSM_REF*, function blocks, and the physical data points of the PSM 520 accordingly.

6.11.10 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.

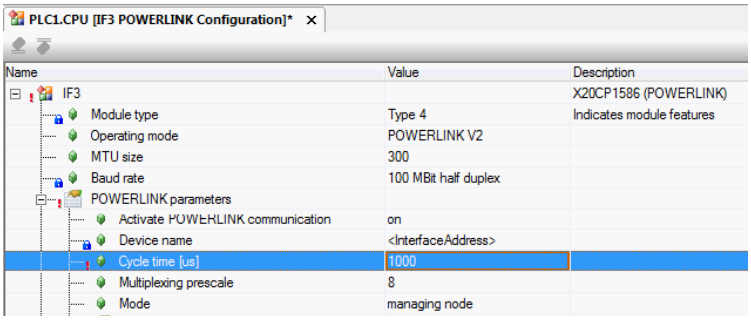


Figure 56: Ethernet POWERLINK® Configuration Window to Parameterize Ethernet POWERLINK® Cycle Time

Procedure

1. Right-click [*CPU*] → [*Configuration*] → [*Timing*] in the *Physical View*.
2. Ensure that the PLC cycle time is the same as the Ethernet POWERLINK® cycle time.

6.11.11 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*].

6.12 Programming with TwinCAT®

6.12.1 Requirements for Programming with TwinCAT®

To integrate a system component into a TwinCAT® project, the following files are required:

- Library for the system components: Danfoss_VLT_ServoMotion_V_x_y_z.compiled-library
- Common ESI file (EtherCAT® Slave Information) Danfoss_Drives.xml with a separate linked file for each configuration:
  - VLT® Integrated Servo Drive ISD 520
  - VLT® Integrated Servo Drive ISD 520 with VLT® FlexSafety™ option
  - VLT® Integrated Servo Drive ISD 520 with VLT® FlexSafety™ option and Safe I/O option board
  - VLT® Integrated Servo Drive ISD 520 with VLT® FlexSafety™ option and Standard I/O option board
  - VLT® Integrated Servo Drive ISD 520 with Standard I/O option board
  - VLT® Decentral Servo Drive DSD 520
  - VLT® Decentral Servo Drive DSD 520 with VLT® FlexSafety™ option
  - VLT® Decentral Servo Drive DSD 520 with VLT® FlexSafety™ option and Safe I/O option board
  - VLT® Decentral Servo Drive DSD 520 with VLT® FlexSafety™ option and Standard I/O option board
  - VLT® Decentral Servo Drive DSD 520 with Standard I/O option board
  - VLT® Power Supply Module PSM 520
  - VLT® Power Supply Module PSM 520 with Decentral Access Module Option

6.12.2 Creating a TwinCAT® Project

Information on how to install TwinCAT® can be found in detail in Beckhoff Information System (beckhoff.com).

Open the information system and select [*TwinCAT 3*] → [*Installation*].

Information on how to create a project in TwinCAT® can be found by opening the information system and selecting [*TwinCAT 3*] → [*TE1000 XAE*] → [*PLC*].

6.12.3 Including the TwinCAT® Library into a TwinCAT® Project

Before a library can be used in a project, it has to be first installed on the system via the *Library Repository*:

1. Right-click the *References* in the PLC project tree and select *Library Repository*.
2. Click *Install* and select the *Danfoss_VLT_ServoMotion_V_x_y_z* library file (according to the location on the hard drive). Now the library can be integrated into the TwinCAT project.
3. Close the *Library Repository* dialog by clicking the *Close* button.
4. Right-click the *References* in the PLC project tree and select *Add Library*.
5. Use the search field in the upper area of the *Add Library* dialog to filter available library references by name and select the *Danfoss_VLT_ServoMotion* library.
6. Click *OK* to complete the procedure and integrate the library reference into the TwinCAT® PLC project.

Library references are also shown in the *Library Manager*, which offers a good overview of the installed PLC libraries. It can be used to integrate and manage libraries in a project, similar to the preceding procedure.

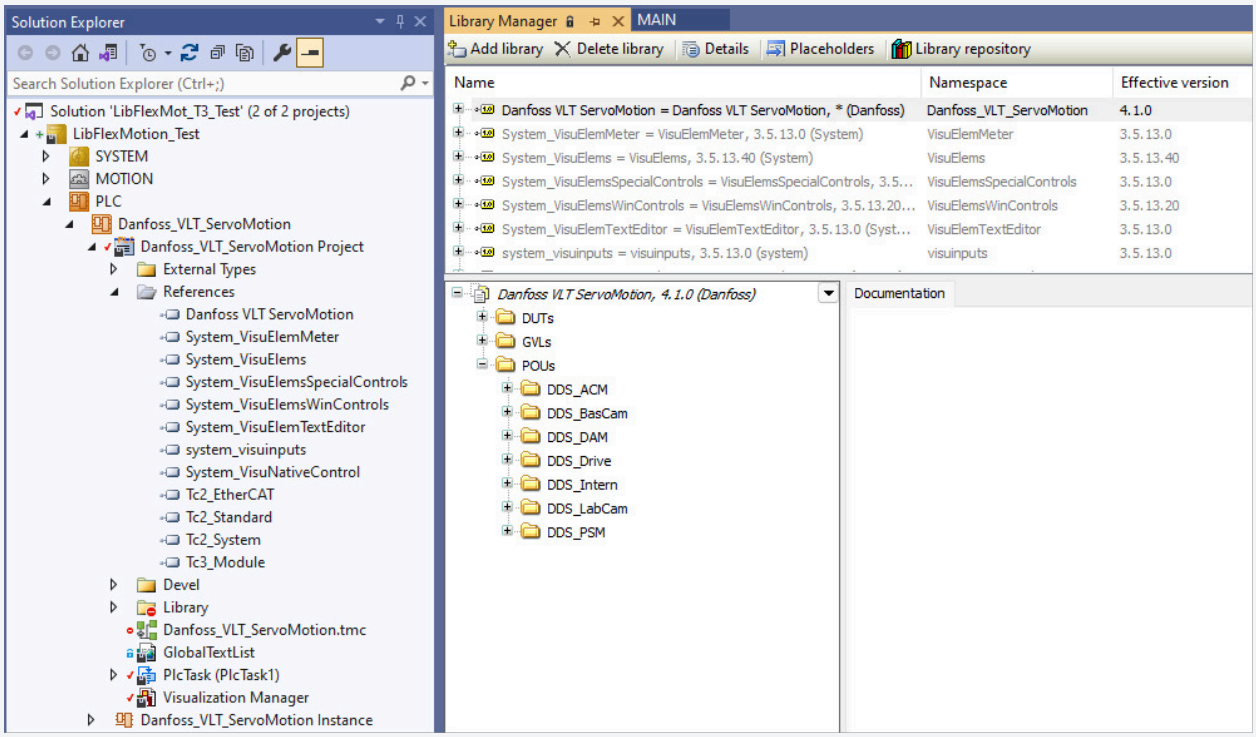


Figure 57: Library Manager after Including the ServoMotion Library

Inside the library, the POUs are organized into folders:

- 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 drives all end with _DDS.
- DDS_PSM
  - Contains POUs defined by Danfoss (name starting with DD_) and provides the functionality for the Power Supply Module (PSM 520).
  - The names of the POUs that target the PSM 520 all end with _PSM.
- 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 VLT® Integrated Servo Drive library, some standard libraries are integrated automatically, unless they are already part of the project.

NOTICE

- Do not remove these libraries, otherwise the DDS libraries will malfunction.

6.12.4 Constants within the DDS_Drive Library

The constants are defined inside the DDS_Drive library (see Table 32).

Table 32: List of Constants

Constant	Description
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 POUs. • The reason is given in an output *ErrorInfo.ErrorID* that is available in all POUs.
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 POUs.
PSM_ErrorCodes	• Constants for error codes of the Power Supply Module (PSM 520). • 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 520). • Intended to be used with the function block *DD_Trace_PSM*.

6.12.5 Instantiating AXIS_REF_DDS in TwinCAT®

Procedure:

1. Create 1 instance of function block *AXIS_REF_DDS* (located in folder *DDS_Drive*) for the SDM 521/SDM 522 drive module or servo drive that must be controlled or monitored.
2. Repeat step 1 for additional SDM 521/SDM 522 drive modules or servo drives.

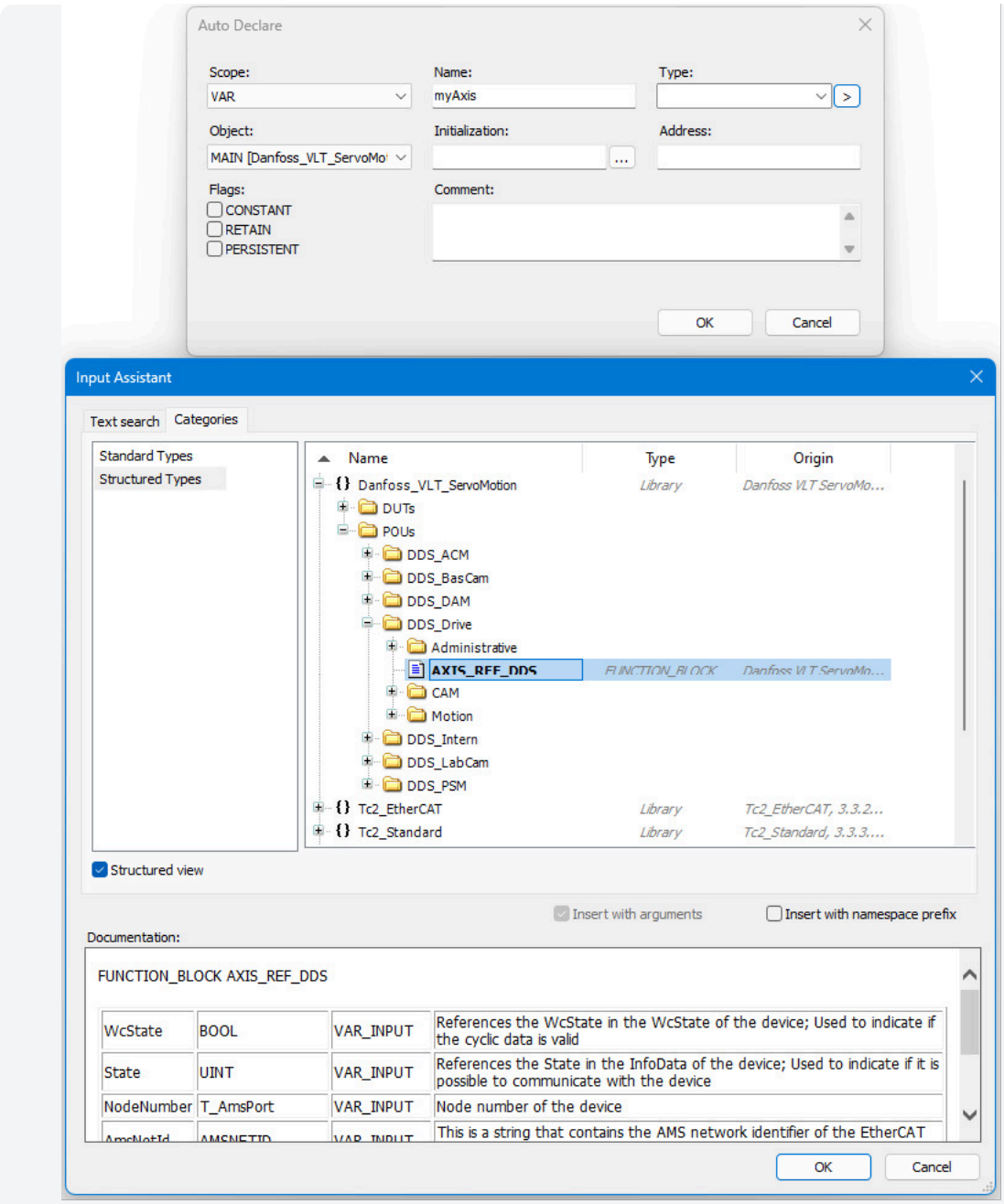


Figure 58: Instantiation of AXIS_REF_DDS

6.12.6 Instantiating PSM_REF in TwinCAT®

Procedure:

1. Create 1 instance of function block *PSM_REF* (located in folder *DDS_PSM*) for each Power Supply Module that has to be controlled or monitored.
2. Repeat step 1 for each additional PSM 520.

6.12.7 Adding a PLC Project to TwinCAT® System Manager

A PLC project contains the objects required to create a controller program:

- Pure programming blocks, for example, programs, function blocks, functions, GVLs.

- Objects that are also required to run the program on a PLC, for example, referenced tasks, library managers, and visualizations.

A standard PLC project can be created as follows:

1. Select the command [*New*] → [*Project*] in the menu *File*.
2. Select the template [*TwinCAT Projects*] → [*TwinCAT XAE Project*], then enter a name (for example, *TwinCAT project*) and a storage location in the file system.
3. Click *OK* to confirm.
4. A new solution opens in the Solution Explorer with an empty PLC project.
5. Mark the *PLC* object in the project tree and select the command [*Add New Item*] in the menu *Projector* in the context menu. The dialog *Add New Item <TwinCAT project name>* opens.
6. Select the [*Standard PLC Project*] in the category *Plc Templates* and enter a name (for example, *PLC project*).
7. Quit the dialog with *Add*. The following structure is created in the view *Solution Explorer*.

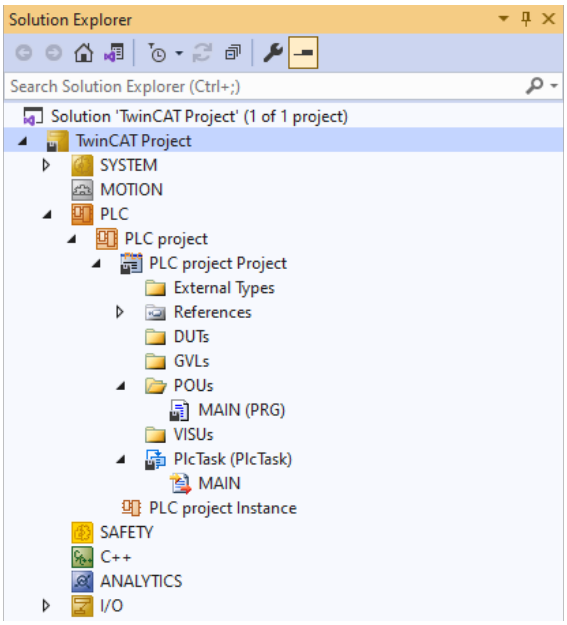


Figure 59: Structure of a Standard PLC Project

With the selected template the following basic objects appear automatically under the node *PLC Project*:

- A PLC project (*PLC project Project*) and a project instance (*PLC project Instance*).
- The PLC project contains:
  - A library manager (*References*).
  - The standard program block *MAIN* and a task reference (*PlcTask*). The task referenced there (PlcTask) defines the execution of the program block *MAIN*.
  - In addition, the structure folders *External Types*, *DUTs*, *GVLs*, *POUs*, and *VISUs* appear automatically.

The library manager already contains the standard libraries with basic blocks such as counters, timers, and string functions that can then be used for programming.

Filling *MAIN* with error-free code enables it to be loaded to the controller and run without the need for further programming objects.

6.12.8 Importing Devices to TwinCAT®

The TwinCAT® System Manager and the TwinCAT® EtherCAT Master require the device description files of all EtherCAT® devices for configuration in online and offline mode.

The device descriptions are contained in the so-called ESI files (EtherCAT Slave Information) in XML format. They must be made available to TwinCAT® before a device can be imported into the project. Only then can new I/O modules be imported into the TwinCAT® project.

The whole procedure can be summarized as follows.

1. Copy the *Danfoss_Drives.xml* ESI file into TwinCAT® installation directory *C:\TwinCAT\3.1\Config\Io\EtherCAT* on the hard drive*.
2. Right-click [*I/O*] → [*Devices*] and select [*Add New Item*].
3. In the following window, select [*EtherCAT*] → [*EtherCAT Master*] and click *OK*.

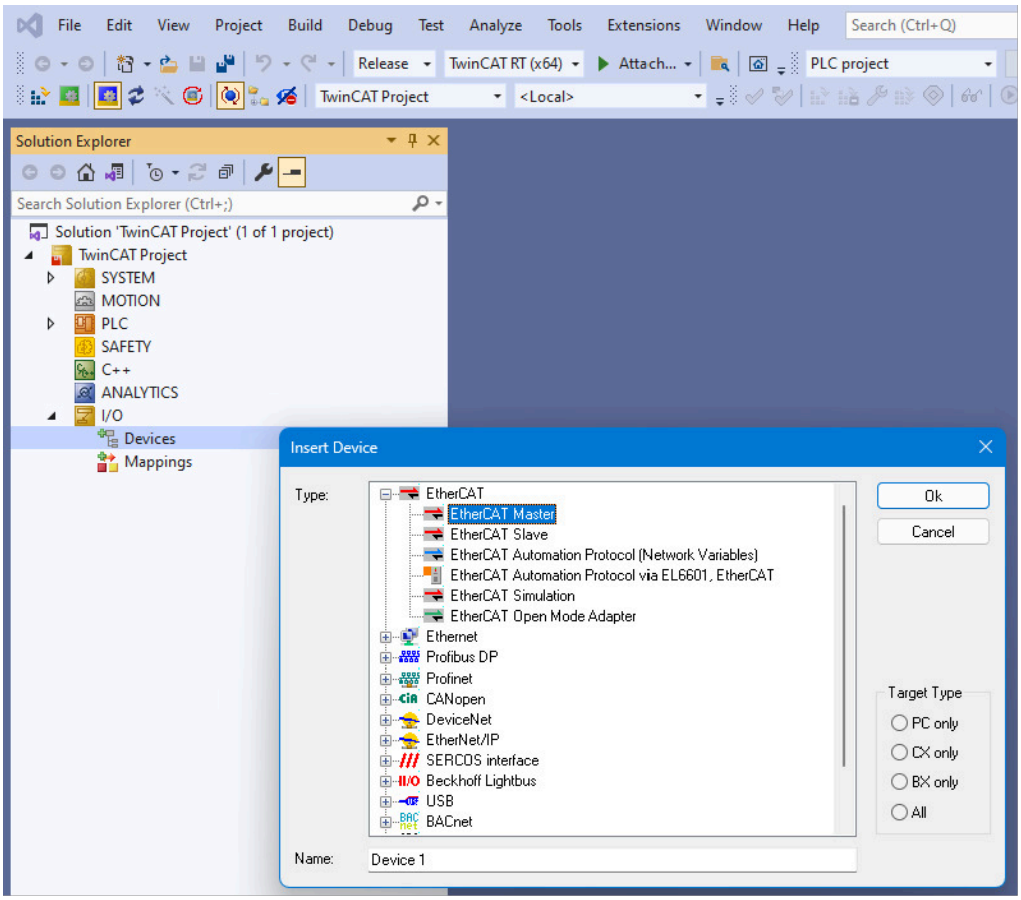


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Figure 60: Add an EtherCAT® Master to the Project

4. A new entry *Device 1* is now available in the tree view of the I/O configuration, with its own input and output modules (boxes) added below the devices node. Before it can be used, the correct network adapter should be selected in the *Device Found At* window.
5. Right-click the configured I/O device *Device1 (EtherCAT)* to open the context menu for adding 1 of the supported I/O modules. Select menu item [*Add New Item*] to open the *Insert EtherCAT Device* window and select from the available modules.
6. To add a VLT® Power Supply Module, select [*Danfoss GmbH*] → [*VLT® FlexMotion*] → [][*VLT® Power Supply Module PSM 520*] and click *OK* to confirm I/O device selection and close the window.
7. Answer the question if the servo drive is used as an NC axis with *Cancel*. If the servo drive is to be used as an NC axis, see 6.12.13.1 Configuration as a TwinCAT® NC Axis.

This is the result after appending a new PLC Project and adding some Danfoss devices:

- 1 x Power Supply Module 520 with DAM option
- 2 x VLT® Integrated Servo Drive ISD® 520

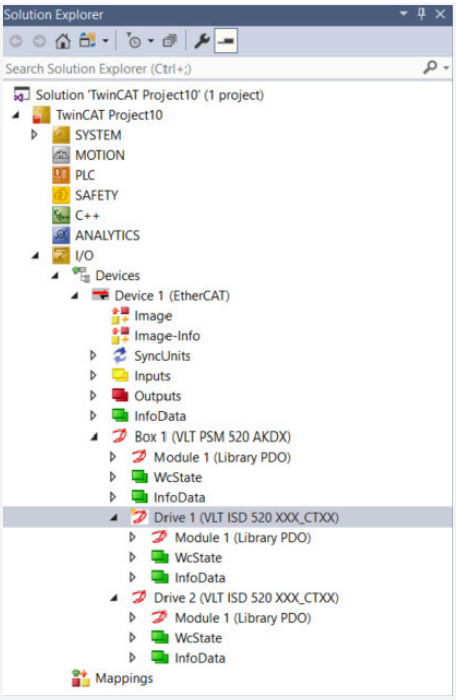

Figure 61: VLT® Power Supply Module PSM 520 with Decentral Access Module Option

8. In the *Add EtherCAT® Device* window, select [*Danfoss Drives A/S*] → [*VLT® FlexMotion*] → [*VLT® Integrated Servo Drive ISD 520*] and click *OK* to confirm I/O device selection and close the window.

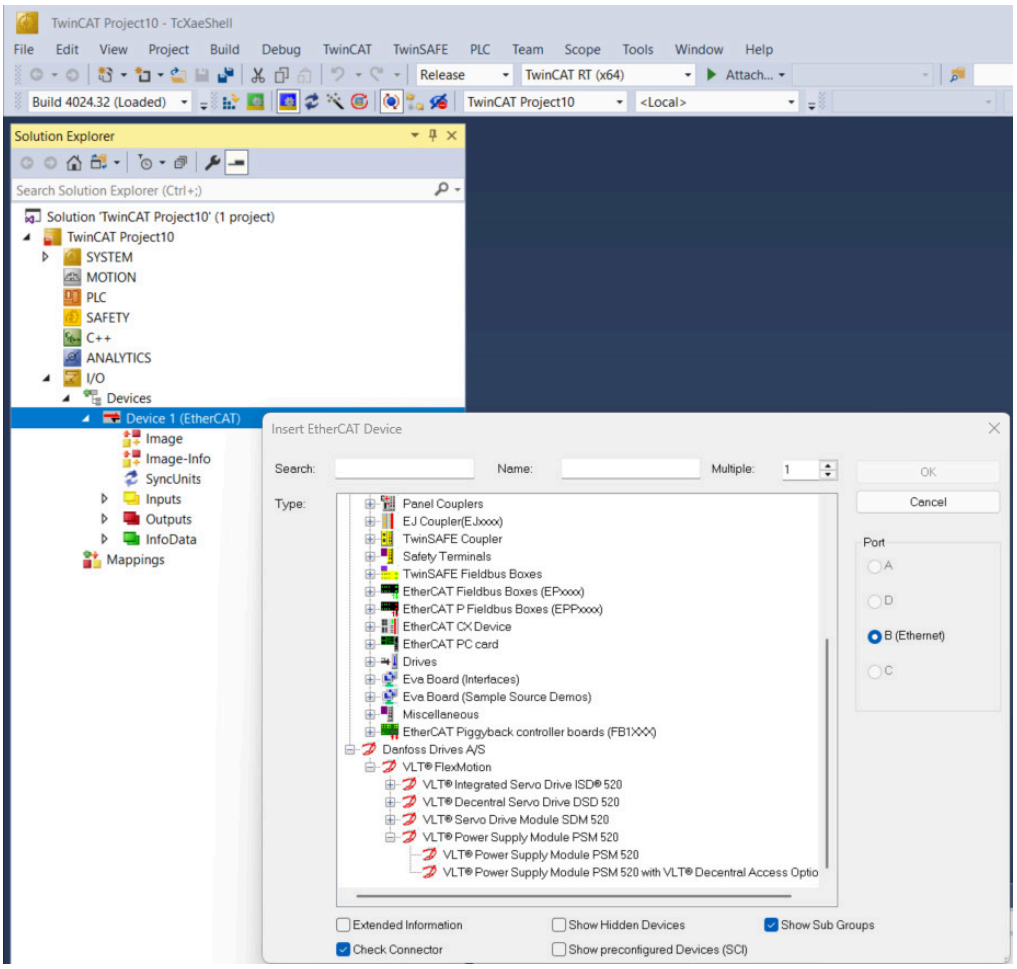

Figure 62: Insert EtherCAT®Device

Perform this step once per project because the TwinCAT® System Manager automatically searches for ESI files at this location on the hard drive during start-up.

6.12.9 I/O Configuration and I/O Mapping

For each EtherCAT device, the TwinCAT® System Manager indicates at which *Previous Port* it is connected, that is, the name of the connected port (B to D) of the previous slave. This assignment is required to map an EtherCAT® network in TwinCAT® "offline" configuration.

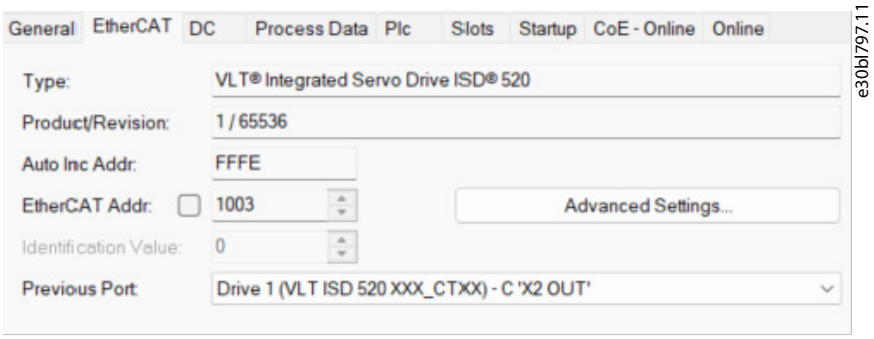

Figure 63: Setting the Previous Port of an EtherCAT®Device

When connecting >1 SDM 521/SDM 522 drive module or servo drive, ensure that port B of the previous servo drive is connected to port C of the next servo drive. Port assignment is also required for VLT® Decentral Access Modules.

If the hardware setup is already present, the *Scan* command of the TwinCAT® System Manager can be used to automatically add the connected devices to the configuration in the correct order.

It is also important that the SDM 521/SDM 522 drive module or servo drive configuration is optimized so that the process data output (PDO) mapping matches the requirements of the library.

1. Click the VLT® ISD 520 drive entry to show the general and terminal-specific dialogs.
2. Select the *Slots* tab on the right side of the window.
3. Make sure that *Library PDO* is selected as the PDO mapping module in the *Slot* box. If not, replace the current module (for example, *CSP PDO configuration*) with *Library PDO* using the available buttons.

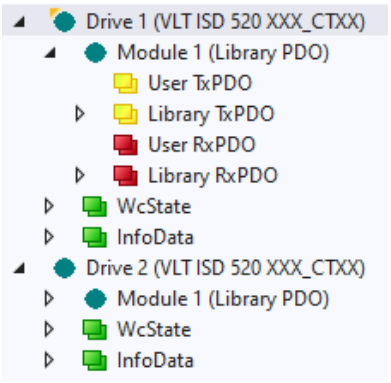

Figure 64: ISD 520 Servo Drive with Correct I/O Configuration

6.12.10 Attaching the Input and Output Variables to the Physical Data Points

Use the TwinCAT® System Manager to attach the input and output variables of the PLC program to the physical inputs and outputs of the device. This ensures that the library has access to all necessary objects.

NOTICE

- Repeat steps 2–22 for Box 1 (VLT® Power Supply Module) and the instance *myPSM*.

1. In the tree view of the I/O configuration, select *Library TxPDO* via menu [*I/O*] → [*Devices*] → [*Device 1 (EtherCAT)*] → [][*Box 1 (VLT® PSM 520 with DAM option)*] → [*Drive 1 (VLT ISD 520 XXX_CTXX)*] → [*Module 1 (Library PDO)*] → [*Library TxPDO*].
2. Select entries from *Lib pdo tx 1* to *Lib pdo tx 9* that form the transmit PDO (TxPDO).
3. Right-click and select *Change Multi Link*.
4. In the *Attach Variable 36.0 Byte(s) (Input)* window, select the variable referencing the servo drive [*MAIN.*] → [*myAxis1.*] → [*TPDO*]. Ensure that the *Matching Size* option is selected in the *Attach Variable* window.

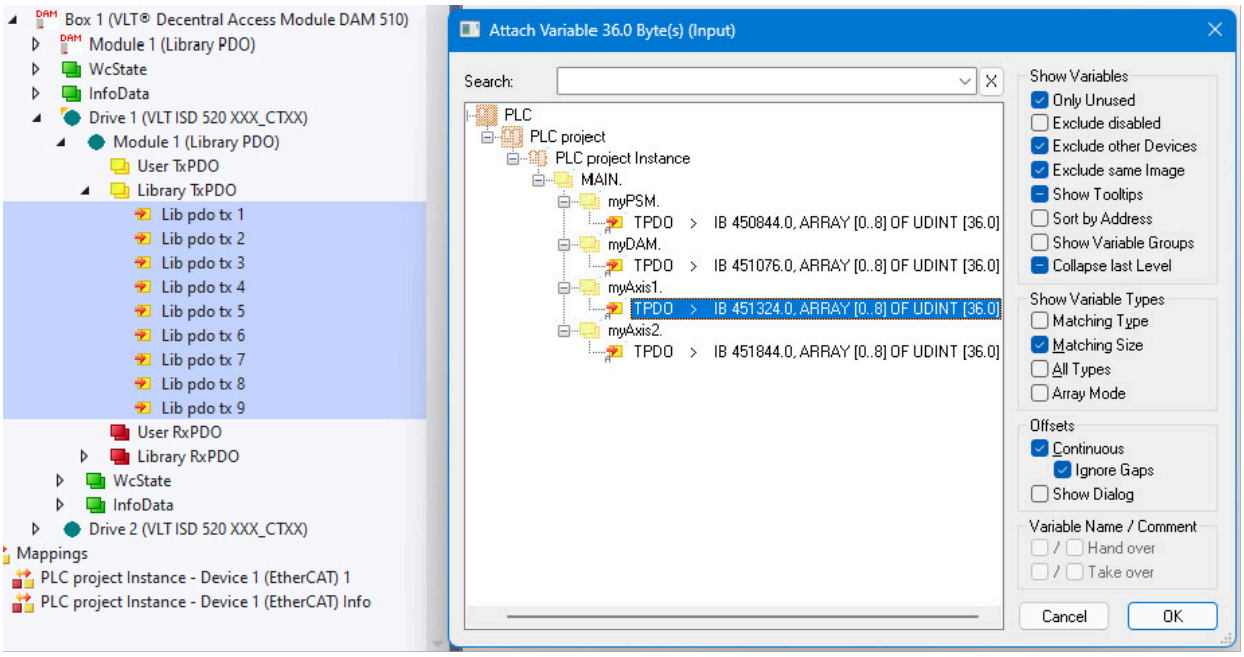

Figure 65: Attaching Inputs and Outputs to the Physical Data Points

5. Click *OK*.
6. In the tree view of the I/O configuration, select *Library RxPDO* via menu [*I/O*] → [*Devices*] → [*Device 1 (EtherCAT)*] → [][*Box 1 (VLT® PSM 520 with DAM option)*] → [*Drive 1 (VLT ISD 520 XXX_CTXX)*] → [*Module 1 (Library PDO)*] → [*Library RxPDO*].
7. Select all entries from *Lib pdo rx 1* to *Lib pdo rx 9* that form the receive PDO (RxPDO).
8. Right-click and select *Change Multi Link*.
9. In the *Attach Variable 36.0 Byte(s) (Output)* window, select the variable referencing the servo drive *MAIN.* → *myAxis1.* → *RPDO.* Ensure that the *Matching Size* option is selected in the *Attach Variable* window.
10. Click *OK*.
11. Right-click on the *WcState* item [*I/O*] → [*Devices*] → [*Device 1 (EtherCAT)*] → [][*Box 1 (VLT® PSM 520 with DAM option)*] → [*Drive 1 (VLT ISD 520 XXX_CTXX)*] → [*WcState*] → [*WcState*] and select *Change Link*.
12. In the *Attach Variable State (Input)* window, select [*MAIN.*] → [*myAxis1.*] → [*WcState*].
13. Click *OK*.
14. Right-click on the *State* item [*I/O*] → [*Devices*] → [*Device 1 (EtherCAT)*] → [][*Box 1 (VLT® PSM 520 with DAM option)*] → [*Drive 1 (VLT ISD 520 XXX_CTXX)*] → [*InfoData*] → [*State*] and select *Change Link*.
15. In the *Attach Variable State (Input)* window, select [*MAIN.*] → [*myAxis1.*] → [*State*].
16. Click *OK*.
17. Right-click on the *netId* item [*I/O*] → [*Devices*] → [*Device 1 (EtherCAT)*] → [][*Box 1 (VLT® PSM 520 with DAM option)*] → [*Drive 1 (VLT ISD 520 XXX_CTXX)*] → [*InfoData*] → [*AdsAddr*] → [*netId*] and select *Change Link*.
18. In the *Attach Variable netId (Input)* window, select [*MAIN.*] → [*myAxis1.*] → [*AmsNetId*].
19. Click *OK*.
20. Right-click on the *port* item [*I/O*] → [*Devices*] → [*Device 1 (EtherCAT)*] → [][*Box 1 (VLT® PSM 520 with DAM option)*] → [*Drive 1 (VLT ISD 520 XXX_CTXX)*] → [*InfoData*] → [*AdsAddr*] → [*port*] and select *Change Link*.
21. In the *Attach Variable port (Input)* window, select [*MAIN.*] → [*myAxis1.*] → [*NodeNumber*].
22. Click *OK*.

6.12.11 Transferring the Mappings back to the PLC Program

To transfer the mappings back to the PLC program, select *Activate Configuration...* in menu item *Actions*.

After a rebuild in TwinCAT® PLC Control, the TwinCAT® configuration is according to Figure 66 (here *myAxis* and *mySecondAxis* are instances of *AXIS_REF_DDS*, *myPSM* is an instance of *PSM_REF*). The concrete addresses can be different.

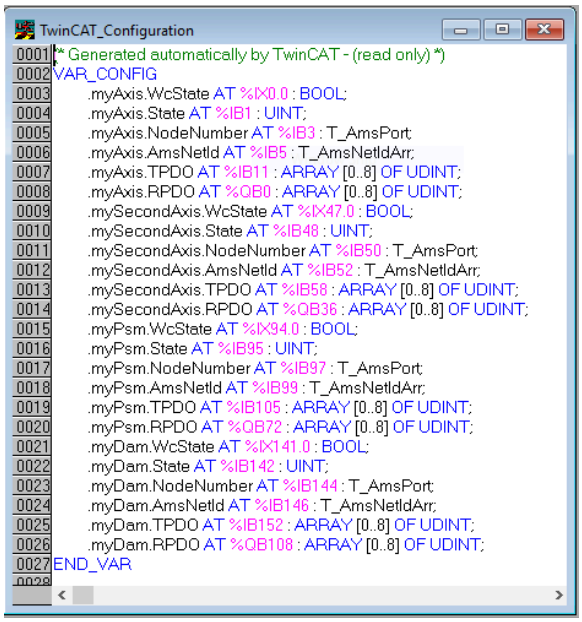

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Figure 66: TwinCAT® Configuration: I/O Mapping of 2 Servo Drives, 1 PSM 520

NOTICE

- Connect the PSM 520, and SDM 521/SDM 522 to 1 SYNC unit and the ISD 520/DSD 520 servo drives to another. This protects against interruptions in communication to the PSM 520 if the U_{AUX} supply to the decentral servo drives is switched off due to an error.

6.12.12 Setting the PLC Cycle Time in TwinCAT® PLC Control

The minimum cycle time is 400 µs. The MSD 520 devices can run EtherCAT® cycle times in multiples of 400 µs or 500 µs. The devices are automatically parameterized by the PLC on start-up, depending on the EtherCAT® configuration of the physical interface. To access the system base time, select [*SYSTEM-Configuration*] → [*Real-Time Settings*] in the TwinCAT® System Manager. Multiples of this base time can then be used as EtherCAT® cycle times.

NOTICE

- Set the task cycle time of the PLC program to be the same as the EtherCAT® cycle time. Otherwise data may be lost and performance reduced.

Procedure

1. Double-click *Task configuration* in the *Resources* tab.
2. Ensure that the PLC cycle time is the same as the EtherCAT® cycle time.

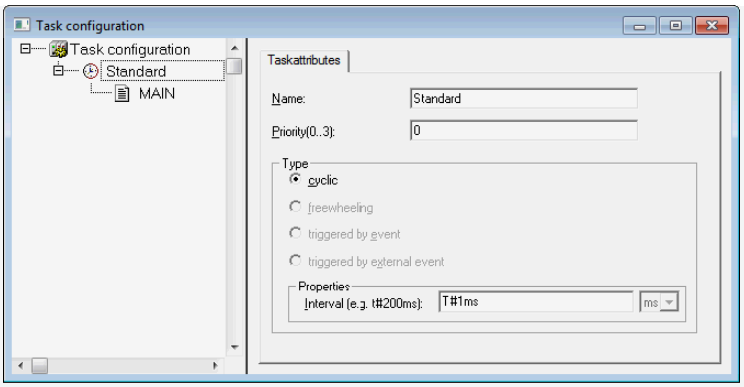

Figure 67: Task Configuration to Parameterize the PLC Cycle Time

NOTICE

- After changing the task cycle time in *TwinCAT® PLC Control*, carry out a *ReScan* of the PLC configuration inside the *TwinCAT® System Manager* to update the settings. Afterwards, activate the configuration in the PLC.

6.12.13 TwinCAT® NC Axis

6.12.13.1 Configuration as a TwinCAT® NC Axis

The servo drives can be used with the built-in NC functionality of TwinCAT®.

Everything that is related to the PSM 520 line (with or without DAM option) must be done as described in 6.12.2 Creating a TwinCAT® Project.

1. In addition to the *Danfoss_VLT_ServoMotion_V_x_y_z.lib* file, include the *Tc2_MC2* library.
2. Create 1 instance of *AXIS_REF* (instead of *AXIS_REF_DDS*) for each ISD 520/DSD 520 servo drive that is used as an NC axis.
3. Append the PLC project into the TwinCAT® System Manager, import the devices, and add them to TwinCAT®. In the last step, answer the question if the servo drive is used as an NC axis with *Yes*, then an NC task is created automatically.

6.12.13.2 I/O Configuration for Servo Drives used as NC Axes

In the TwinCAT® System Manager, select a different I/O Configuration for the servo drives used as NC axes.

1. Depending on the mode of operation to be used, select either the slot *CSP PDO* or *CSV PDO* (see 6.12.9 I/O Configuration and I/O Mapping for process data output (PDO) mapping details). Per default, *CSV PDO* is mapped and pre-selected.
2. Map the following variables if the VLT® Integrated Servo Drive servo drive is required to work with CSP PDO:
   a. In the *Settings* tab of the NC Axis, select [*MOTION*] → [*NC-Task 1 SAF*] → [*Axes*] → [*Axis 1*]. Click on the *Link To I/O* button and select the servo drive under I/O to be linked with the NC axis.
   b. Click on the *Link To PLC* button and select the PLC instance of the axis to be linked with the NC axis.
3. In the same tab, select the preferred *Unit* for the position of the axis.
4. Depending on the selected unit, adjust the Scaling Factor for the axis encoder via menu [*MOTION*] → [*NC-Task 1 SAF*] → [*Axes*] → [*Axis 1*] → [*Enc*] in the *Parameter* tab.

   When the unit *Degrees* is selected, the scaling factor is $360°/2^{20} = 0.00034332275390625$.
5. Set the *Reference Velocity* in the *Parameter* tab via menu [*MOTION*] → [*NC-Task 1 SAF*] → [*Axes*] → [*Axis 1*].
6. Set the *Output Scaling Factor* (Velocity) to 125.
7. Test the functionality and the configuration in the *Online* tab of the axis.

6.12.14 Loading the Program Code and Starting the PLC

Information on how to transfer the PLC project to the controller can be found in the Back-end Information System.

Open the information system and go to [*TwinCAT 3*] → [*TE1000 XAE*] → [*PLC*] → [*Transfer PLC project to the PLC*].

6.13 Programming Guidelines for Automation Studio™ and TwinCAT®

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 520 to control the DC-link voltage on the output. 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.

6.14 Programming with SIMOTION SCOUT®

6.14.1 Requirements for Programming with SIMOTION SCOUT®

The following files are required to integrate the system components into a SIMOTION SCOUT® project. In the filename, *2.xx* shows the version number and *yyyymmdd* shows the date.

Table 33: Required Files

System module	File required
Whole servo system	Package of libraries for MSD 520 the servo system: Danfoss_VLT_ServoMotion_V_x_y_z.zip
	Online Help file(.chm): Programming with SIMOTION SCOUT®
Servo Drive Module SDM 521/SDM 522	GSDML file (General station description): GSDML-V2.xx-Danfoss-DDS-yyyymmdd.xml
Integrated Servo Drive ISD 520	GSDML file (General station description): GSDML-V2.xx-Danfoss-DDS-yyyymmdd.xml
Decentral Servo Drive DSD 520	GSDML file (General station description): GSDML-V2.xx-Danfoss-DDS-yyyymmdd.xml
Power Supply Module PSM 520	GSDML file (General station description): GSDML-V2.xx-Danfoss-PSM-yyyymmdd.xml

6.14.2 Connecting to the PLC with SIMOTION SCOUT®

Information on how to connect to the PLC can be found in detail in the SIMOTION SCOUT® Help.

Open *SIMOTION SCOUT* and go to [*Help → Help Topics → Getting Started with SIMOTION SCOUT → Download the project to the target system → Connect to selected target devices → Go online*].

6.14.3 Creating a SIMOTION SCOUT® Project

Information on how to install SIMOTION SCOUT® refer to the *SIMOTION SCOUT® Configuration Manual*.

NOTICE

- SIMATIC STEP 7 V5.5 or higher with HF11 must be installed to create a project.

Information on how to create a project in SIMOTION SCOUT® can be found in detail in the SIMOTION SCOUT® online help.

Open SIMOTION SCOUT® and go to [*Help*] → [*Help Topics*] → [*Getting started with SIMOTION SCOUT*] → [*Create SIMOTION device and configure PG/PC communication connection*].

6.14.4 Including the Servo Motion Libraries into a SIMOTION SCOUT® Project

The folder *LIBRARIES* in the *Project* tab contains these libraries:

- 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 servo drive.
  - It is possible to combine POUs defined by PLCopen® with POUs defined by Danfoss.
  - The names of the POUs that target the SDM 521/SDM 522 drive modules and servo drives all end with _DDS.
- DDS_PSM
  - Contains POUs defined by Danfoss (name starting with DD_) and provides the functionality for the Power Supply Module (PSM 520).
  - The names of the POUs that target the PSM 520 all end with _PSM.
- 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.

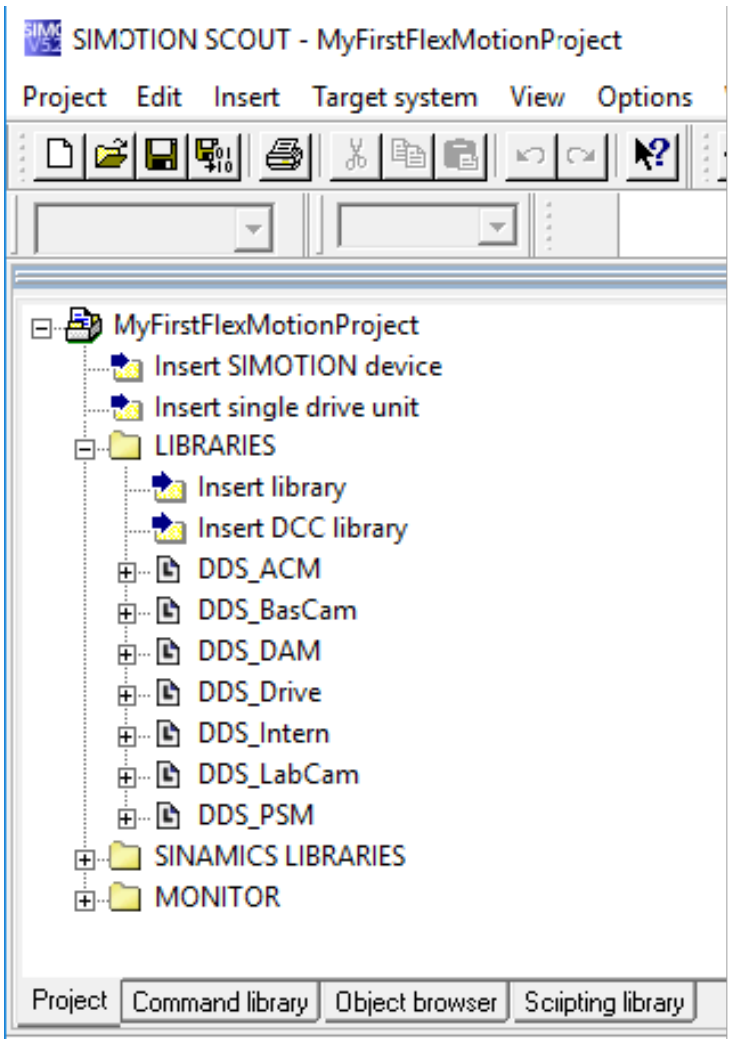

Figure 68: Project Tree after Including Danfoss Servo Motion Libraries

NOTICE

- Do not remove or rename these libraries.

Procedure

1. Extract the files from the *Danfoss_VLT_ServoMotion_V_x_y_z.zip* file (according to the location on the hard drive).

   The *DDS_Xxxx.xml* file and *XML_DDS_Xxxx* folder must be located together in the same folder to import the library.

2. In the *Project* tab, right-click on *LIBRARIES* and select [*Export/import*] → [*Import folders/objects*].

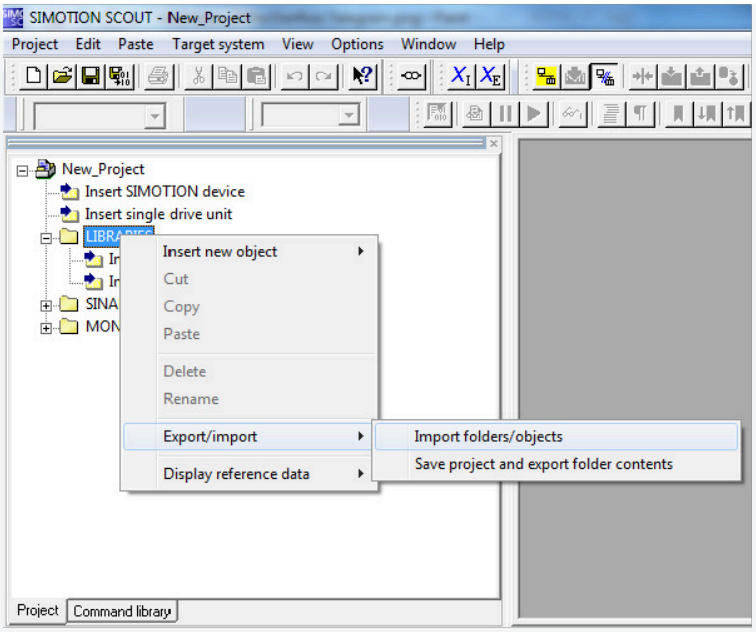

Figure 69: Import Library

3. Select file *DDS_Intern.xml* according to the location on the hard drive.
4. Click *OK*.

   Now the library is integrated into the SIMOTION SCOUT® project.

5. Repeat steps 2–4 for *DDS_BasCam.xml*, *DDS_Drive.xml*, *DDS_LabCam.xml*, *DDS_PSM.xml*, *DDS_DAM.xml*.

6.14.5 Importing Devices into SIMOTION SCOUT®

NOTICE

- For each physical servo drive, PSM 520, add 1 entry to the PROFINET® Ethernet network in the *HW Config* tool.

Procedure

1. Open the *HW Config* tool.
2. Select [*Options* → *Install GSD File...*].
3. To add an SDM 521/SDM 522 drive module or servo drive, select the xml file (according to the location on the hard drive) and click *Install*. In the filename, *2.xx* shows the version number and *yyyymmdd* shows the date.
   - GSDML-V2.xx-Danfoss-DDS-yyyymmdd.xml
4. Repeat steps 2 and 3 for:
   - Power Supply Module (PSM 520): *GSDML-V2.xx-Danfoss-PSM-yyyymmdd.xml*
5. Drag the device *Danfoss Drive Servo IRT* to an existing PROFINET® Ethernet network.

   Find the servo drive device named *Danfoss Drive Servo IRT* by expanding the *PROFINET IO* entry in the hardware catalog on the right side of the screen and select [*Additional Field Devices*] → [*Drives*] → [*VLT® FlexMotion*]. If the device is not visible, update the hardware catalog by selecting [*Options*] → [*Update catalog*].

6. Expand *Drive Object 1* and folder *Profile* in the hardware catalog on the right side of the screen and drag the *Danfoss Telegram* to the free slot of *Drive Object 1* at the bottom of the screen.

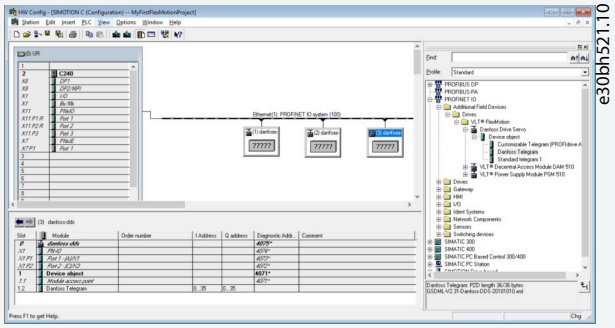

Figure 70: Dragging the Danfoss Telegram to a Free Slot

7. To set the communication parameters, double-click the icon depicting the servo drive in the main window showing the Ethernet network.
8. In the *General* tab, enter a name in field *Device name*.
9. In the *General* tab, click *Ethernet...* button to set the IP address of the servo drive, and click *OK*.
10. Repeat steps 6–9 for:
    - Power Supply Module (PSM 520): *VLT PSM IRT*

6.14.6 Assigning IP Configuration and Device Name

NOTICE

- If more than 1 servo drive is used in the same PROFINET® network, each servo drive must have a different name and IP address.
- The IP address assignment is also required when using indirect communication via the VLT® Toolbox software. See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Programming Guide* for further information.

Procedure

1. Open menu [*PLC → Ethernet → Edit Ethernet Node*].
2. In the next window, click *Browse*.

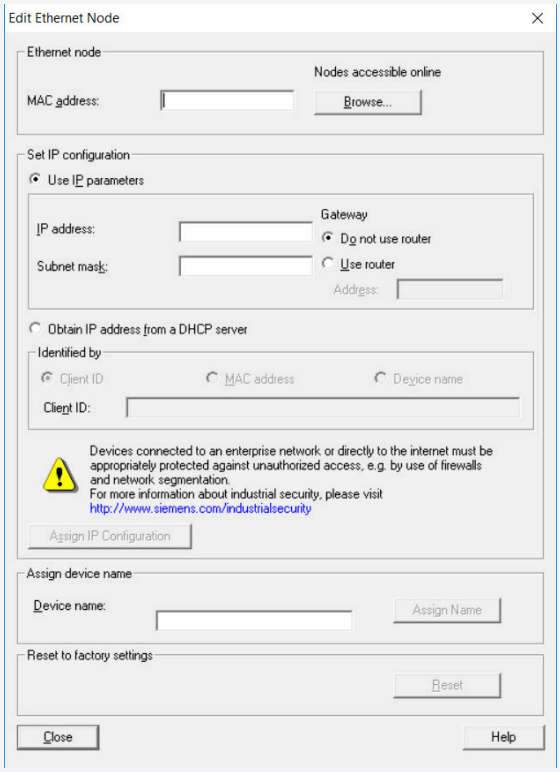

Figure 71: Edit Ethernet Node

All accessible Ethernet nodes are shown in this window.

The ISD 520 servo drives are listed under device type *VLT® ISD 520*.

The DSD 520 servo drives are listed under device type *VLT® DSD 520*.

The SDM 521/SDM 522 servo drive modules are listed under device type *VLT® SDM 520*.

3. Select the desired servo drive and click *OK*.

Use the *Flash* button to identify the specific servo drive.

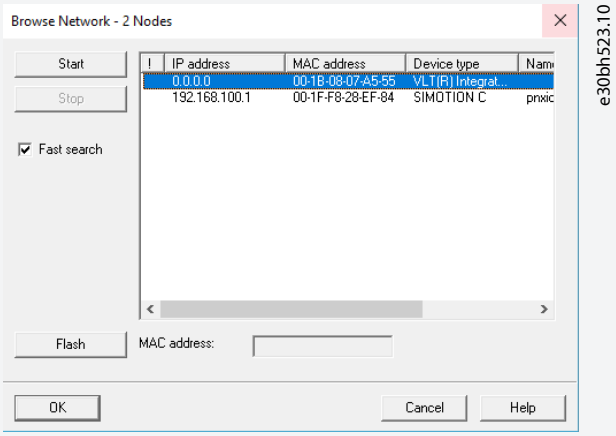

Figure 72: Selecting the Servo Drive

4. In the *Edit Ethernet Node* window, select the option *Use IP parameters*.
5. Enter the *IP address* and *Subnet mask* and click *Assign IP configuration*.

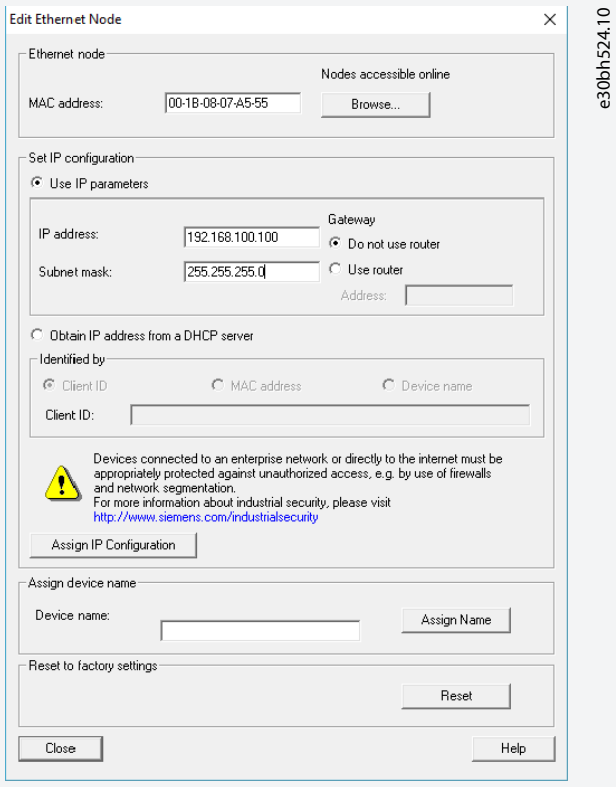

Figure 73: Entering the IP Address and Assigning the IP Configuration

6. Enter the device name that was previously selected and click *Assign Name* click *Close*.

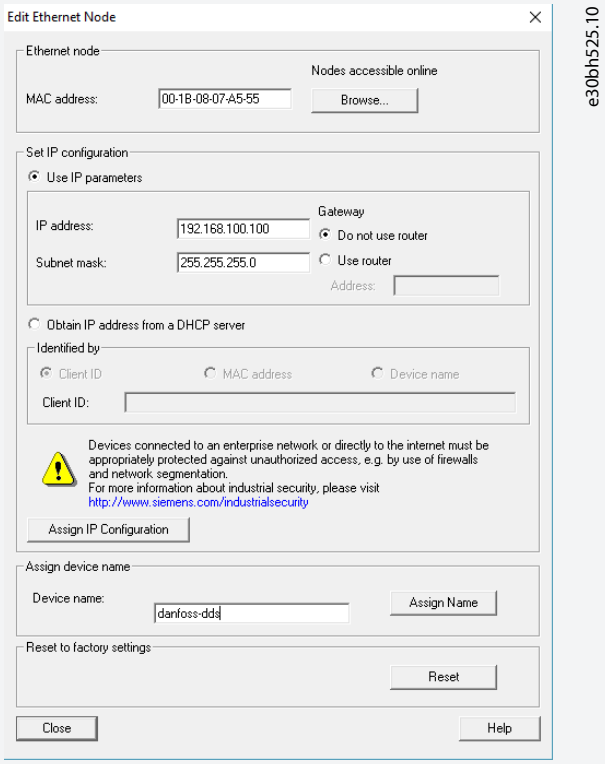

Figure 74: Assigning the Device Name

6.14.7 Creating a Sync Domain

A sync domain is a group of PROFINET® devices synchronized to a common cycle clock. One device has the role of the sync master (clock generator). All other devices are sync slaves.

NOTICE

- All devices that exchange data via Isochronous Real-Time (IRT) must belong to the same sync domain.

Procedure

1. Open the *HW Config* tool.
2. Select the station with the PROFINET® devices to be involved in IRT communication.
3. Select the PROFINET® I/O interface in the section *Station/IO system*.
4. Select the menu [*Edit → PROFINET IO → Domain management*].

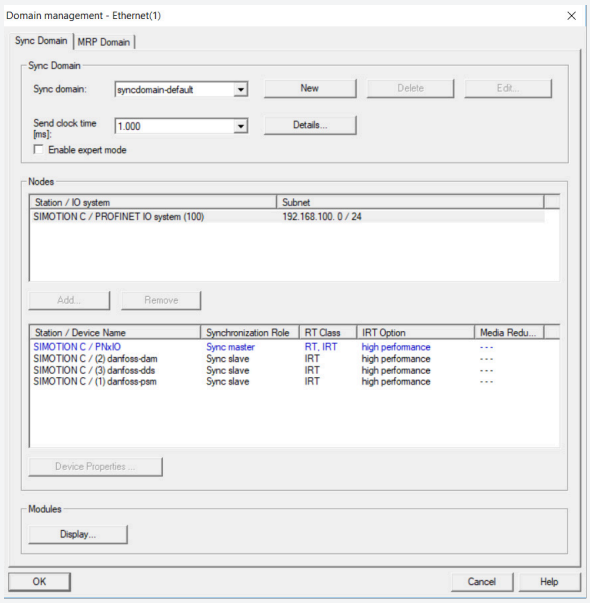

Figure 75: Domain Management

5. In the *Sync Domain* tab, select the station in the upper field of the *Nodes* section.
6. In the lower field of the *Nodes* section, double-click the device that must be configured as the sync master.
7. When the *Device properties* window opens, select *Sync master* as *Synchronization role* and click *OK*.

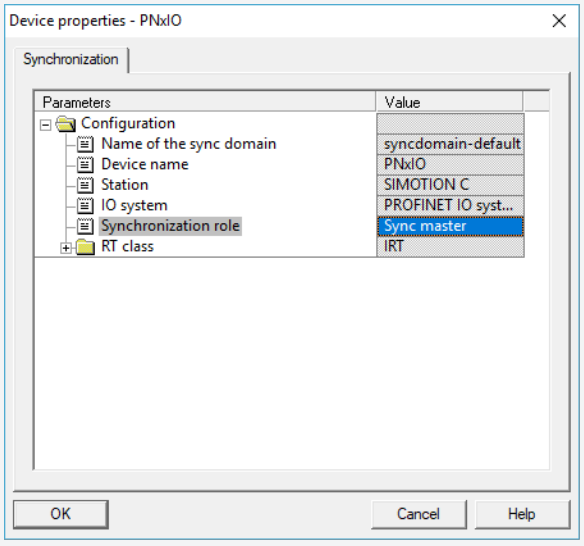

Figure 76: Device Properties: Sync Master

8. In the *Domain management* window, select all devices to be configured as sync slaves in the *Nodes* section

   Keep the *CTRL* button depressed to select >1 device.

9. Click *Device Properties* button.
10. In the *Device Properties* window, select *Sync slave* as *Synchronization role* and click *OK*.

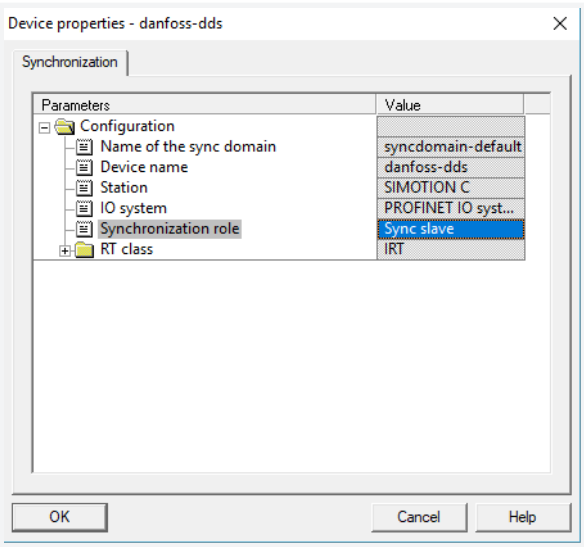

Figure 77: Device Properties: Sync Slave

11. In the *Domain management* window, click *OK*.
12. Select the station with the PROFINET® devices.
13. Select the menu [*Edit → Object Properties*].
14. In the next window, open the *Isochronous Tasks* tab, select the isochronous mode for I/O data change, and click *OK*.

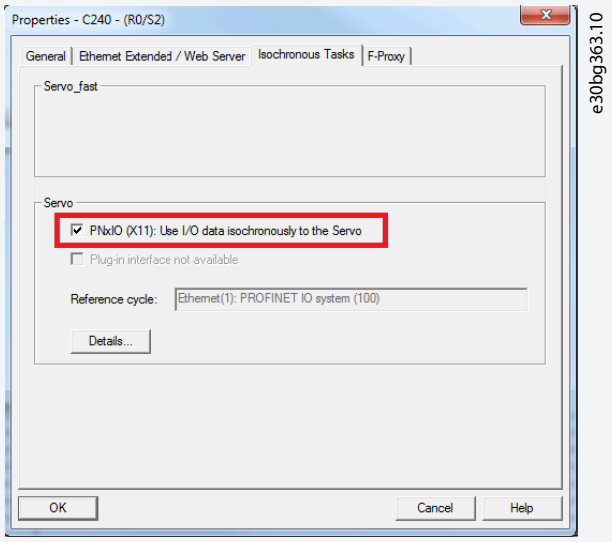

Figure 78: Use I/O Data Isochronously to the Servo

15. Click *VLT® ISD 520 IRT* device.
16. Double-click the *PN-IRT-Inteface* in the *Module*.
17. In the next window, open the *IO Cycle* tab and set field *Assign IO device in isochronous mode* to *Servo*.

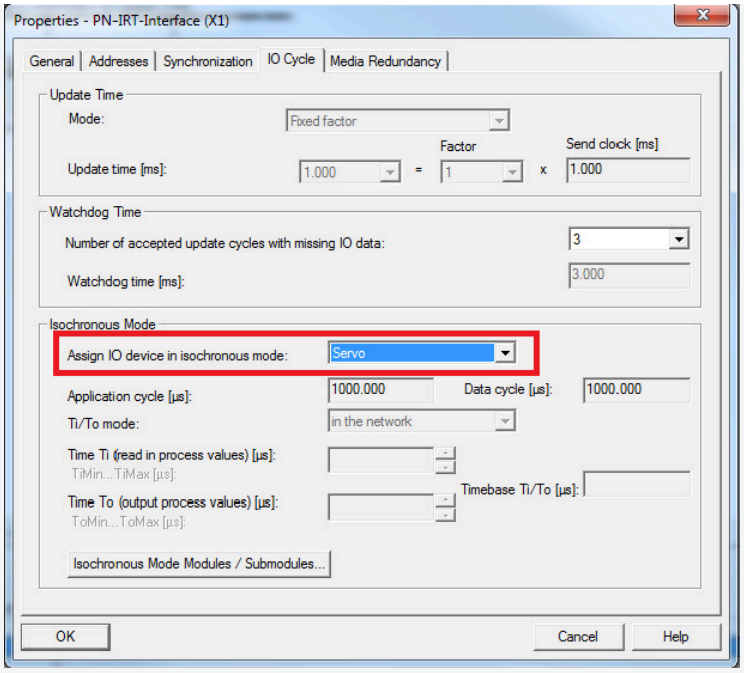

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Figure 79: Assign I/O Device in Isochronous Mode

6.14.8 Configuring a Topology

The topology must be configured and parameterized.

Procedure

1. Open the *HW Config* tool.
2. Select the path for the PROFINET® I/O system or PROFINET®module, for example a Danfoss MSD 520 series.
3. Select the menu [*Edit → PROFINET IO → Topology*].
4. In the next window, select the *Graphic view* tab.

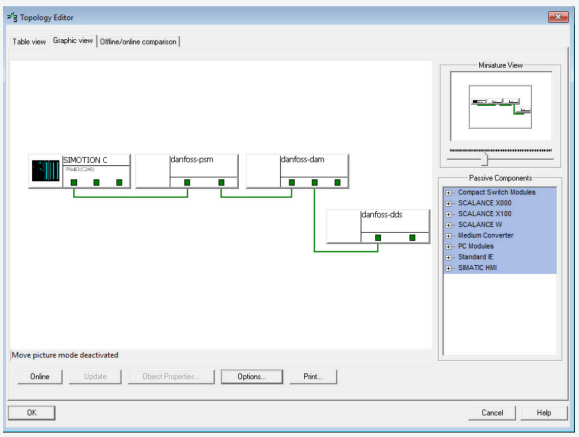

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Figure 80: Graphic View Tab in Topology Editor

5. Connect the PROFINET® device with the station. Establish connections between ports by holding down the left mouse button and drawing a line between the 2 ports.
6. Once all connections are made, click *OK*.

6.14.9 Defining Send Clock and Update Time

6.14.9.1 Configuring the Send Clock Time

Procedure

1. Open the *HW Config* tool.
2. Select the station with the PROFINET® devices to be involved in IRT communication, for example PNxIO.
3. Select the menu [*Edit → PROFINET IO → Domain management*].
4. In the next window, open the *Sync Domain* tab and in the *Send clock time [ms]* field, select an appropriate time for the process, for example, 1.000 ms, and click *OK*.

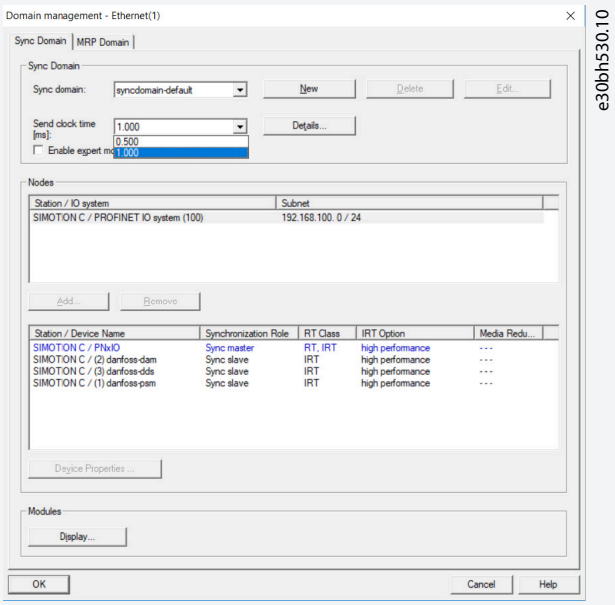

Figure 81: Configuring a Send Clock for PROFINET® IRT

6.14.9.2 Configuring the Update Time

NOTICE

- The system cycle clocks of the PLC program must be the same as the PROFINET® send clock, otherwise data can be lost and performance reduced.

Procedure

1. Open the *HW Config* tool.
2. Select the path for the PROFINET® I/O system.
3. Select the menu [*Edit → Object properties*].
4. In the next window, open the *Update Time* tab, highlight the I/O device, and click *Edit* button.
5. In the next window *Edit Update Time/Mode*, select the *Update Time* and click *OK*.

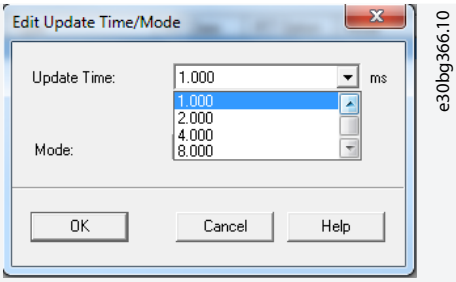

Figure 82: Set Update Time

6.14.10 Accessing Inputs and Outputs

SIMOTION SCOUT® provides access to the device inputs and outputs of the SIMOTION device through the process image of cyclic tasks using I/O variables.

Procedure

1. Open the *Project* tab and double-click *ADDRESS LIST* element in the device subtree.

   For example *C240 [C240 PN]*.

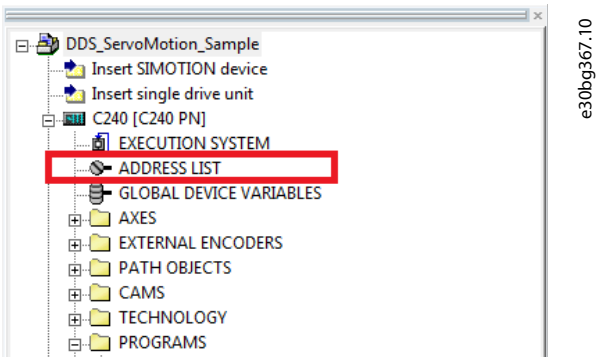

Figure 83: Address List in the Project Navigator

2. In the next window Figure 84 , create 1 variable for incoming and outgoing PPO data for each device.

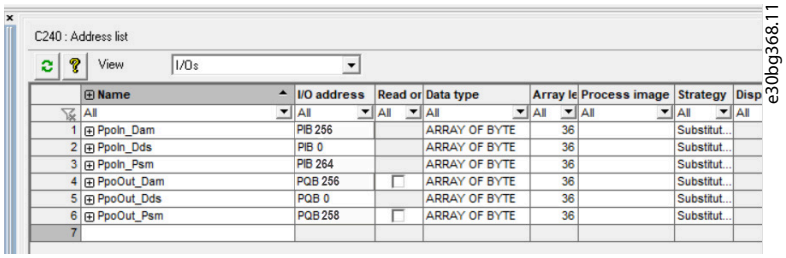

Figure 84: Address List Detailed View

3. Set the following properties for each variable:
   - *Name* (of the I/O variable)
   - *I/O address*
   - *Data type*: ARRAY OF BYTE
   - *Array length*: 36
   - *Process image*: IPOsynchronousTask

NOTICE

- The I/O address must fit the configuration of the device in the *HW Config* tool.
- I/O variables can only be created in offline mode.

6.14.11 Programming using the Danfoss VLT® Servo Motion Library

Before using data types, functions, or function blocks from libraries, the following construct must be used in the interface section:

USELIB DDS_BasCam, DDS_Drive, DDS_LabCam, DDS_PSM;

More information on how to use data types, functions, and function blocks from libraries can be found in detail in the online help for SIMOTION SCOUT®.

Open the SIMOTION SCOUT® and go to [*Help → Help Topics → Programming → Integration of ST in SIMOTION → Using libraries → Using data types, functions and function blocks from libraries*].

NOTICE

- Do not use the POUs, Constants, and User-Defined Data Types (UDT) that start with *iDD_* in an application.

6.14.12 Instantiating AXIS_REF_DDS in SIMOTION SCOUT®

Create 1 instance of *AXIS_REF_DDS* (located in folder *DDS_Drive*) for every servo drive that has to be controlled or monitored. Each instance of *AXIS_REF_DDS* is the logical representation of 1 physical servo drive.

NOTICE

- The instance of the *AXIS_REF_DDS* structure must be created as a global variable (variable in the interface section of a unit declared with *VAR_GLOBAL*).

In the *AXIS_REF_DDS* structure, only assign the variable *InputLogAddress* once at the beginning of the application program for each axis. This is to specify the input logical base address of the I/O module from the HW Config. For this initialization, use the system function *_getLogicalAddressOfIoVariable()*. Only assign the variable *InputLogAddress* once in the 1st PLC cycle for initialization.

In the *AXIS_REF_DDS* structure, assign the variable *Quality* at the beginning of the application program for each axis in every cycle. Use the system function *_quality.<I/Ovariable>*, whereby *<I/Ovariable>* is the variable containing the cyclic data that was assigned in the *ADDRESS LIST*. Carry out this assignment in every PLC cycle.

Call the function *DD_UpdateProcessInput_DDS* at the beginning of the application program for each device in every cycle. Call the function *DD_UpdateProcessOutput_DDS* at the end of the application program for each device in every cycle.

NOTICE

- Only create instructions and other program parts between the calls of *DD_UpdateProcessInput* and *DD_UpdateProcessOutput*.

6.14.13 Instantiating PSM_REF in SIMOTION SCOUT®

Create 1 instance of *PSM_REF* (located in folder *DDS_PSM*) for every Power Supply Module (PSM 520) that has to be controlled or monitored. Each instance of *PSM_REF* is the logical representation of 1 physical PSM.

NOTICE

- The instance of the *PSM_REF* structure must be created as a global variable (variable in the interface section of a unit declared with *VAR_GLOBAL*).

In the *PSM_REF* structure, assign the variable *Quality* at the beginning of the application program for each Power Supply Module in every cycle. Use the system function *_quality.<I/Ovariable>*, whereby *<I/Ovariable>* is the variable containing the cyclic data that was assigned in the *ADDRESS LIST*. Carry out this assignment in every PLC cycle.

Call the function *DD_UpdateProcessInput_PSM* at the beginning of the application program for each device in every cycle. Call the function *DD_UpdateProcessOutput_PSM* at the end of the application program for each device in every cycle.

NOTICE

- Only create instructions and other program parts between the calls of *DD_UpdateProcessInput* and *DD_UpdateProcessOutput*.

6.14.14 Global Compiler Settings

Activate the global compiler settings *Permit language extensions*.

Procedure

1. Open the menu [*Options* → *Settings*].
2. In the next window, select the *Compiler* tab.
3. Activate the checkbox *Permit language extensions* and click *OK*.

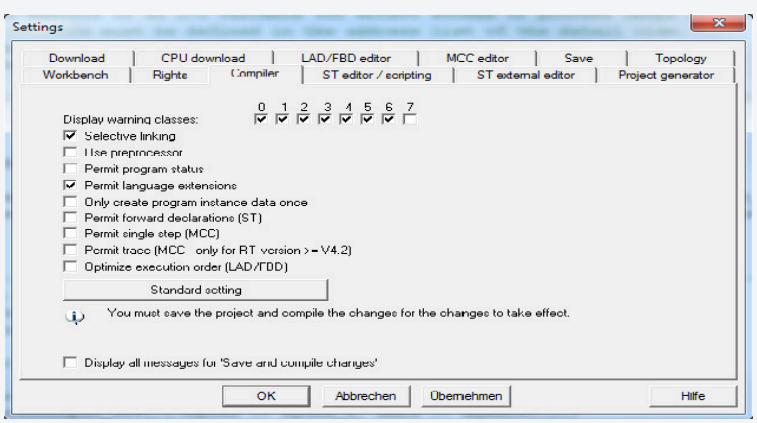

Figure 85: Global Compiler Settings

6.14.15 Assigning Tasks

To guarantee synchronous operation, the application must use a *Synchronous Task* and a *Peripheral Fault Task* to evaluate the alarms.

Procedure

1. Open the *Project* tab.
2. Double-click *EXECUTION SYSTEM* in the device subtree.

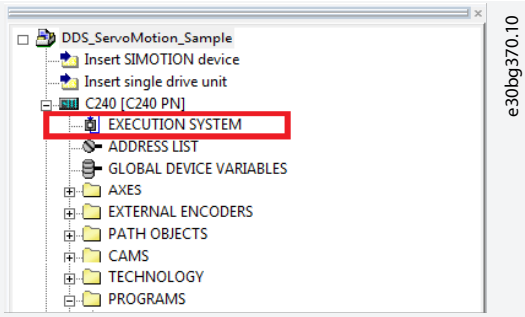

Figure 86: Execution System in the Project Navigator

3. In the next window, expand entry *Execution levels* and select *OperationLevels* and *SynchronousTask* in the tree structure.
4. In the *SynchronousTask* window, activate checkbox *Use task in execution system*.
5. Click the new entry *IPOsynchronousTask* in the tree structure.
6. In the *Program assignment* area at the left side of the *Synchronous Task* window, assign the program by selecting it and click [>>] button. The program is moved to the *Programs used* section on the right side.

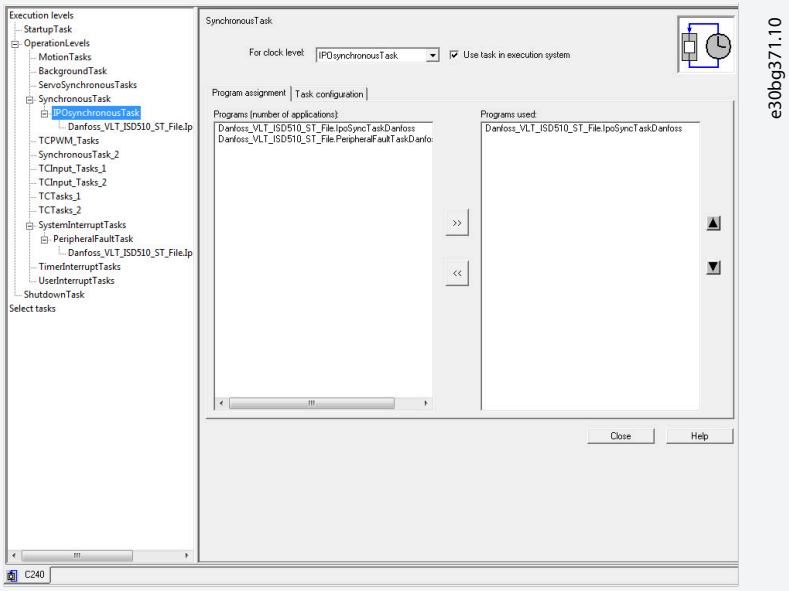

Figure 87: IPOsynchronousTask in Execution System

7. In the *Task configuration* tab, set the *Number of level overflows in the IPO cycle clock* to [*1*] and the *IPOsynchronousTask / IPO cycle clock* to [*50%*].

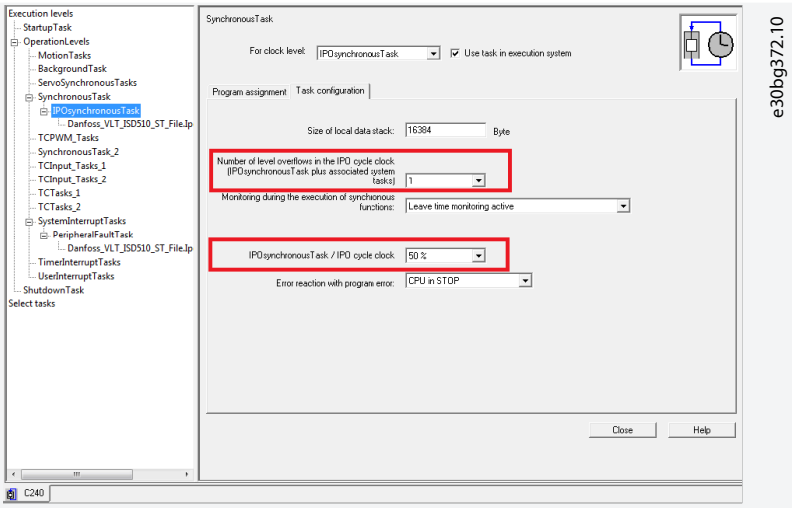

Figure 88: IPOsynchronousTasks Configuration

8. Expand entry *SystemInterruptTasks* in the tree structure and select the new entry *PeripheralFaultTask*.
9. In the *PeripheralFaultTask* window, activate checkbox *Use task in execution system*.
10. In the *Program assignment* area at the left side of the *PeripheralFaultTask* window, assign the program by selecting it and click [>>] button. The program is moved to the *Programs used* section on the right side.
11. To save and compile the settings, click *Close*.

6.15 Programming Guidelines for SIMOTION SCOUT®

Recommendations for implementation:

- Only assign the variable *InputLogAddress* in the *AXIS_REF_DDS* structure once for each axis at the beginning of the program. Use the system function *_getLogicalAddressOfIoVariable* to get this address from the I/O variable of the address list. Use the input address of the module as the I/O variable. Only assign this variable in the 1st PLC cycle for initialization.
- Initialize parameters that usually do not change only once at the beginning of the program.
- Only assign the variable *Quality* in the *AXIS_REF_DDS* structure once for each axis at the beginning of the program. Use the system function *_quality.var-name*. Carry out this check for every PLC cycle.
- Call up the function blocks *DD_UpdateProcessInput_DDS* and *DD_UpdateProcessOutput_DDS* for every axis to update the process image partition of inputs and outputs. Call up these function blocks in every PLC cycle.
- Only create instructions and other program parts between calling up function blocks *DD_UpdateProcessInput_DDS* and *DD_UpdateProcessOutput_DDS*.
- Call up function blocks that provide status or error information with *Enable input* at the beginning of the program.
- Use 1 instance of 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 function block *DD_Power_PSM* for every PSM 520 to control the DC-link voltage on the output lines. 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 UDTs, POUs, enumerations, or constants starting with the prefix *iDD_*.
- Do not change the reference to the axis on a function block while it is busy.

6.16 VLT® Servo Toolbox Software

6.16.1 Overview

The VLT® Servo Toolbox is a standalone PC software designed by Danfoss. It is used for parameterization and diagnostics of the system components. 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 34: Important Subtools

Subtool	Description
Scope	For visualization of the tracing functionality of the servo drives, the Power Supply Module (PSM 520).
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 520), for testing purposes.
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 feedback adjustment, and inertia measurement.
Safety subtool	For setting up safety parameters, for the servo drives with VLT®FlexSafety™ option.

For a detailed description of the VLT® Servo Toolbox functionality and the full parameter lists. See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Programming Guide*.

6.16.2 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, 20 MB hard disk space
- Recommended hardware requirements: Minimum 1 GB RAM, Intel Core i5/i7 or compatible

6.16.3 Installing the VLT® Servo Toolbox Software

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

Procedure

1. Check that the system meets the system requirements specified in 6.16.2 System Requirements.
2. Download the VLT® Servo Toolbox installation file from the Danfoss website (http://drives.danfoss.com).
3. Right-click the .exe file and select ***Run as administrator***.
4. Follow the on-screen instructions to complete the installation process.

6.16.4 VLT® Servo Toolbox Communication

6.16.4.1 Overview

This section 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.

6.16.4.2 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.

NOTICE

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

6.16.4.3 Indirect Communication

6.16.4.3.1 Overview

Communication between MSD 520 devices and the VLT® Servo Toolbox through a PLC is called indirect communication.

Ethernet-based fieldbus communication (marked **A** in Figure 89) takes place between the PLC and the MSD 520 devices.

However, there is non-fieldbus communication between the PLC and the VLT® Servo Toolbox host system (marked **B** in Figure 89).

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 520, DSD 520, MSD 520 (VLT® FlexMotion™) Programming Guide*.

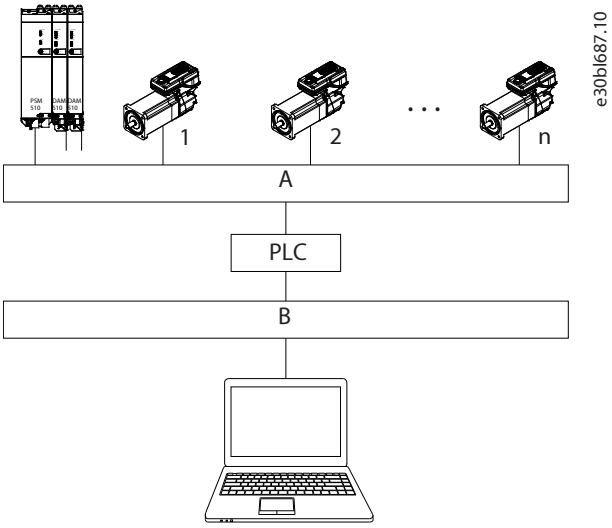

Figure 89: Logical View of Indirect Ethernet-based Fieldbus Communication (Communication via PLC)

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.

6.16.4.3.2 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.

6.16.4.3.3 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:

1. Open the *Network and Sharing Center*.
2. Select *Change adapter settings*.
3. Right-click the network interface used for fieldbus communication and select *Properties*.
4. If the TCP/IPv6 is available for the network interface, disable it.

6.16.4.3.4 Additional Settings for Indirect Communication with EtherCAT®

Set the IP address of the EtherCAT® Master:

Procedure

1. Open the TwinCAT® System Manager.
2. Select [*I/O-Configuration*] → [*I/O Devices*] → [*Device1 (EtherCAT®)*] and check the IP-address in the *Adapter* tab. The IP address of the PLCs network adapter may not be a link-local address (so not in the range of 169.254.0.1 to 169.254.255.254).
3. If necessary, change the IP address inside the IPv4 Protocol properties according to the given operating system. This can be done on the controller locally or via *Remote Desktop*.

6.16.4.3.5 Activating the IP Routing in the EtherCAT® Master

The procedure described here may vary depending on the type of PLC and operating system installed.

Procedure

1. Open the *TwinCAT® System Manager*.
2. Click on *Advanced Settings...* via menu [*I/O-Configuration*] → [*I/O Devices*] → [*Device1 (EtherCAT)*] in the *EtherCAT* tab.
3. Select *EoE Support* in the *Advanced Settings* window.
4. Enable *Connect to TCP/IP Stack* in the *Windows Network* section.

5. Enable *IP Enable Router* in the *Windows IP Routing* section.
6. Reboot the PLC for the changes to take effect.

6.16.4.3.6 Setting the IP Address of the EtherCAT® Slave

The procedure for setting the IP Address of the EtherCAT® slave is valid for:

- ISD 520/DSD 520 servo drives
- Power Supply Module (PSM 520)
- Servo Drive Module SDM 521/SDM 522

NOTICE

- The last number of the IP address is the ID that is used in the VLT® Servo Toolbox to identify the device.

Procedure

1. Open the TwinCAT® System Manager.
2. Click *Advanced Settings...* under [*I/O-Configuration*] → [*I/O Devices*] → [*Device1 (EtherCAT)*] → [[]*Box 1 (VLT® Power Supply Module)* → *Drive 2 (VLT® Integrated Servo Drive ISD 520)*] in the *EtherCAT®* tab.
3. Select [*Mailbox*] → [*EoE*] in the *Advanced Settings* window.
4. Enable *Virtual Ethernet Port* and enter a valid IP-address.
5. Each slave in the configuration requires an IP-address. This address is reassigned with every transition from *INIT* to *Pre-Operational* state of the slave state machine. The IP communication of the slaves is deactivated per default.

6.16.4.3.7 Additional Settings for Indirect Communication with PROFINET®

Overview

Each PROFINET® device needs a device name and an IP address. The IP address and the device name are assigned by the I/O controller, when the connection to the I/O device is established.

For the automatic detection of accessible nodes via a PG/PC interface with TCP/IP, connect the nodes to the same physical Ethernet subnet as the PG/PC. If a node is located in a different physical Ethernet subnet, the IP address of the sought node can be specified.

To reach further nodes, accessible nodes provide the capability of adding IP addresses and subnets to the PG/PC interface. The new IP addresses and subnets are then added to the Ethernet interface of the PG/PC.

NOTICE

- If >1 Danfoss servo drive is used in the same PROFINET® network, each servo drive must have a different name and IP address.
- The last number of the IP address is the ID that is used in the VLT® Servo Toolbox software to identify the device.

NOTICE

- IP addresses and subnets can also be added using PRONETA®.

Adding IP Addresses and Subnets

Procedure

1. Open SIMOTION SCOUT®.
2. Select the menu [*Project*] → [*Accessible nodes*].
3. If accessible nodes are found in another subnet, the *Add IP addresses/subnet masks* window is shown, listing those nodes.

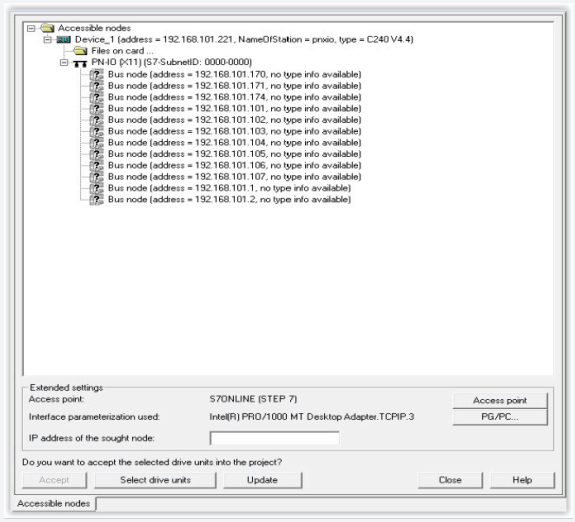

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Figure 90: Accessible Nodes

4. To accept the addresses, click *Yes*.
5. The IP address/subnet mask is now added.

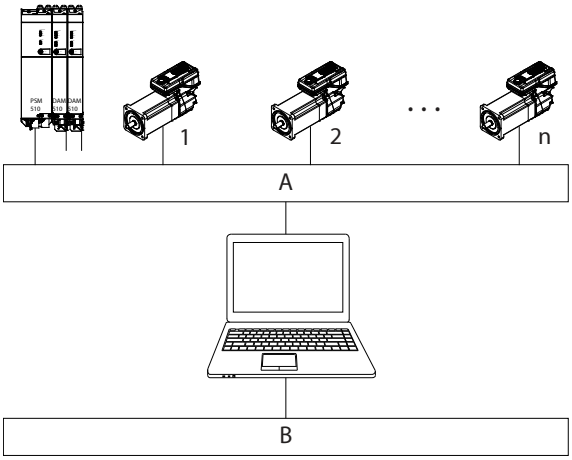
NOTICE

- When the *Accessible nodes* tab is closed, the addresses are retained. The newly added addresses are only discarded when SIMOTION SCOUT® is closed.

6.16.4.4 Direct Communication

6.16.4.4.1 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.



e30bl688.10

Figure 91: Logical View of Direct Ethernet-based Fieldbus Communication

A	Ethernet-based fieldbus communication	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.

6.16.4.4.2 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.

6.16.4.4.3 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 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 6.16.4.3.3 Enabling Indirect Communication.

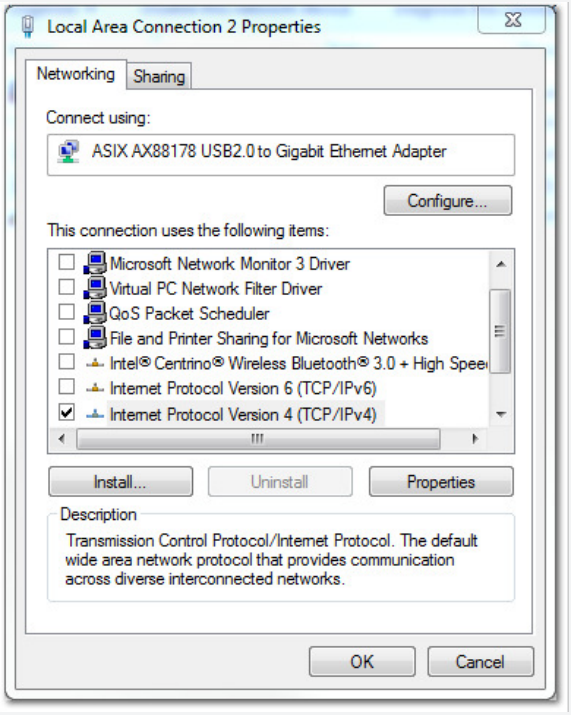


Figure 92: Disabling Unused Protocols on the Network Interface

6.16.4.4.4 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 the network interface used for fieldbus communication and select *Properties*.
4. Click *Internet Protocol Version 4 (TCP/IPv4)* (the checkbox must be checked) and then click *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.

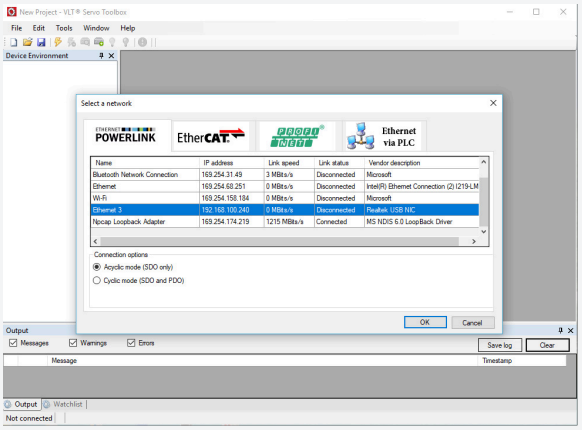


Figure 93: Internet Protocol Version 4 (TCP/IPv4) Properties

6.16.4.4.5 Network Settings for Direct Communication with EtherCAT®

Disable all network protocols except TCP/IPv4 on the network interface used for direct EtherCAT® 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.

6.16.5 VLT® Servo Toolbox Commissioning

6.16.5.1 Step 1: Opening the Main Window

The *Main Window* is the basis for all VLT® Servo Toolbox functionalities. It consists of the following components:

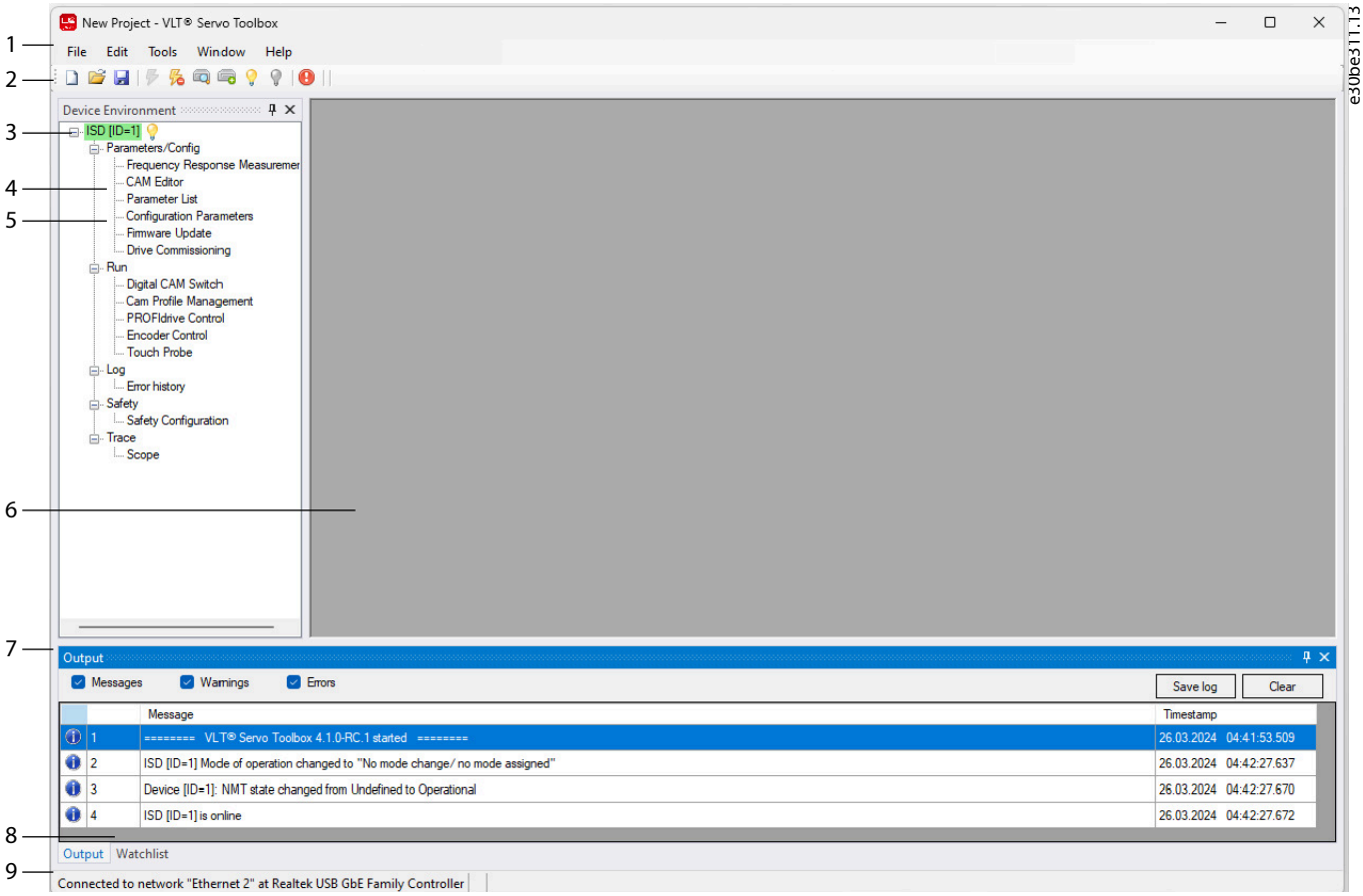


Figure 94: Main Window

Table 35: Main Window Description

Legend number	Name	Description
1	Menu bar	Contains the general functionalities for saving and loading projects, managing connections, showing and changing settings, managing open subtools, and showing help contents.
2	Tool bar	Contains shortcuts for saving and loading projects, connecting to and disconnecting from networks, automatic searching for online devices, and manually adding devices.
3	Online status and state information	Online devices are indicated by a glowing light bulb next to the device ID. • An online device is a logical device for which a physical device exists that the VLT® Servo Toolbox is connected to. • The color indicates the state of the device and is device-specific.
	Offline status and state information	Offline devices are indicated by a gray light bulb next to the device ID. • An offline device is a logical device without a corresponding physical device. An offline device can represent a saved device configuration or state, for example for offline analysis or troubleshooting. It also contains pre-configured parameter values to be written to a physical device.
4	Subtools	A subtool is opened by double-clicking its name in the *Device Environment*, or by selecting the entry and pressing the *Enter* key on the keyboard.

Table 35: Main Window Description - (continued)

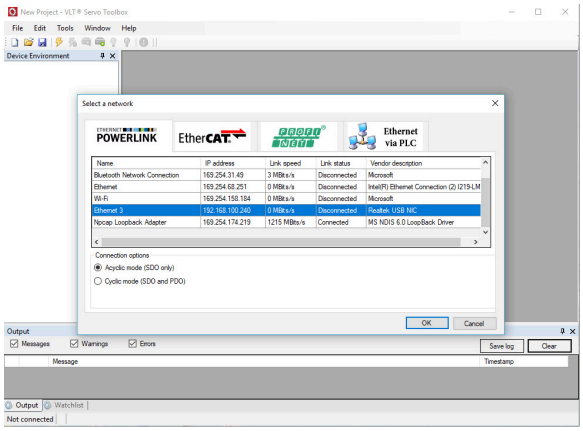
Legend number	Name	Description
5	Device environment	The *Device Environment* section of the *Main Window* lists all logical devices managed by the VLT® Servo Toolbox, visualizes their states, and serves as the user interface for accessing the device functionalities. The *Device Environment* window lists all available subtools for each added device. See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT®FlexMotion™) Programming Guide* for further information on the subtools.
6	Workspace	This is the space for hosting the subtools and its size depends on the *Main Window* size. The subtools can be maximized, minimized, horizontally or vertically aligned, or cascaded.
7	Watchlist window	Evaluates the parameter values of 1 or more devices by cyclically reading them from the devices. Allows parameter values to be logged and saved to a text file. It is also possible to modify/write values in the watchlist.
8	Output window	Shows operating information, warnings, and errors. Depending on the user settings, shows messages of up to 3 different logging levels (high, medium, and low). Used for showing advanced error and warning information.
9	Status strip	Shows the communication state of the VLT® Servo Toolbox. If connected to a network, it shows the used hardware interface (for example, network adapter) and the network name.

6.16.5.2 Step 2: Connecting to Network

Pre-configure the appropriate communication settings to connect to a network (see 6.16.4.1 Overview).

Procedure

1. In the *Main Window* toolbar, click on the *Connect to bus* icon to open the *Connect to Network* window.
2. Select the fieldbus type and the network interface to connect to.
3. Click on *OK* to connect.
4. Verify that the connection is successful by checking the status strip at the bottom of the *Main Window*.



e30bh531.10

Figure 95: Connect to Network Window (Ethernet POWERLINK®)

6.16.5.3 Step 3: Scanning for Devices

Procedure

1. After verifying that the VLT®Servo Toolbox is connected to the selected network, click the *Scan for Devices* icon in the toolbar to trigger the device scan procedure.

NOTICE

- If connected to an Ethernet POWERLINK® network in cyclic mode, select the scan range (minimum and maximum IDs) in the next window to reduce the time needed for scanning. In all other cases, the complete ID range is scanned.

2. When the scan is complete, a list of available devices is shown in the *Select Devices* window. Select the devices to be added to the *Device Environment* and click on *OK*.
3. All selected devices appear in the *Device Environment* window and automatically go online (indicated by a glowing light bulb next to each device name).

6.17 Motion Library

6.17.1 Simple Programming Template

TwinCAT®

A basic sample PLC application for starting up the servo system with 1 Power Supply Module (PSM 520), and 2 axes is provided. The project *DDS_ServoMotion_SampleProject* can be downloaded from the Danfoss website (http://drives.danfoss.com).

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.

PROFINET®

The project *DDS_ServoMotion_SampleProject* is a basic sample PLC (C240PN) application for starting up the servo system with 1 Power Supply Module (PSM 520), and 2 axes.

6.17.2 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 (behavior of the outputs)
- General calling conventions

NOTICE

- See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT®FlexMotion™) Programming Guide* for further information on the available function blocks and their behavior.

7 Operation

7.1 Operating Modes

7.1.1 Supported Operating Modes

The servo drive implements 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 there are also ISD-specific modes of operation.

All supported modes of operation are available for:

- EtherCAT®
- Ethernet POWERLINK®
- PROFINET®

The various modes of operation are described in detail in the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Programming Guide*.

Table 36: Operating Modes

Mode	Description
Inertia measurement mode	This mode measures the inertia of an axis. It is used to measure the inertia of the servo drive and the external load, and to optimize the control loop settings. The friction effects are eliminated automatically.
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 is done by a CAM profile that contains slave positions corresponding to master positions. CAMs can be designed graphically with the Servo Toolbox software, or can be parameterized via the PLC. An external encoder, virtual axis, or the position of another axis can provide the guide value. The different CAM profile types are described in the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Programming Guide*.
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. An external encoder, virtual axis, or the position of another axis can provide the guide value.
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.

7.1.2 Motion Functions

Table 37: 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 after a rising or falling edge at the configured digital input.

7.2 Status Indicators

7.2.1 Operating Status Indicators

The operating status of the system modules is indicated via the indicator lights (LEDs) on each module.

NOTICE

- Status indicators are not reliable for safety functions. Only use them for general diagnostics during commissioning and troubleshooting.

7.2.2 Operating Indicator Lights (LEDs) on PSM 520

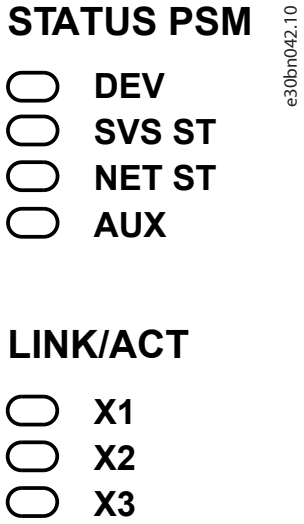


Figure 96: Operating Indicator Lights (LEDs) on PSM 520

Table 38: Operating Indicator Lights (LEDs) on PSM 520

LED	Color	Flash status	Description
DEV	Green	On	Device is in state *Operation enabled*.
		Flashing	Device is in state *Standby* or *Power-up*.
	Red	On	Device is in state *Fault* or *Fault reaction active*.
		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 the corresponding fieldbus standard).[1]
AUX (distinguish between with and without DAM option)	Green	On	Auxiliary voltage is present on the output connector (on backlink). For PSM with DAM option: Auxiliary voltage is present on DAM output.
		Off	Auxiliary voltage is not present on the output connector (on backlink). For PSM with DAM option: Auxiliary voltage is not present on DAM output.
	Red	On	Auxiliary voltage is out of limits due to an HW error (UAUX supply fault (HW) on DAM option board).
LINK/ACT X1 (Link/activity status of *In*)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X2 (Link/activity status of *Out*)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X3 (Link/activity status of *Out*)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.

1) POWERLINK® and EtherCAT®: Refer to the corresponding fieldbus standard. For PROFINET®: Green = communication with master established; Orange = device is online and can be reached via the network; Blinking red = communication initialization is completed; Solid red = communication error.

7.2.3 Operating Indicator Lights (LEDs) on SDM 521 and SDM 522

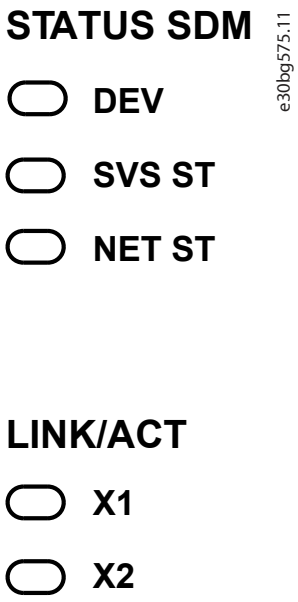


Figure 97: Operating Indicator Lights (LEDs) on SDM 521 and SDM 522

Table 39: Operating Indicator Lights (LEDs) on SDM 521 and SDM 522

LED	Color	Flash status	Description
DEV	Green	On	Device is in state *Operation enabled*.
		Flashing	Auxiliary voltage is applied.
	Red	On	Device is in state *Fault* or *Fault reaction active*.
		Flashing	DC link 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 *In*)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X2 (Link/activity status of *Out*)	Green	On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.

1) POWERLINK® and EtherCAT®: Refer to the corresponding fieldbus standard. For PROFINET®: Green = communication with master established; Orange = device is online and can be reached via the network; Blinking red = communication initialization is completed; Solid red = communication error.

8 Functional 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 components (cables are not included). The hybrid cable passes the STO signal from the Power Supply Module (PSM 520) with integrated DAM option to all ISD 520/DSD 520 servo drives in the chain. Once STO is activated (safe state), no torque is generated on the ISD 520 servo drives, or on any motors connected to DSD 520 or SDM 521/SDM 522. 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.

NOTICE

- SDM 521/SDM 522 and ISD 520/DSD 520 can also be ordered with the VLT® FlexSafety™ option, implementing advanced functional safety. See the *Advanced Functional Safety for VLT® FlexMotion™ Operating Guide* for the available safety functions and related safety capability.
- For VLT® FlexSafety™, the HMI of the device requires a password to inhibit unauthorized access.

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 to prevent uncontrolled and hazardous movement, for example, mechanical brakes.

⚠ WARNING

RISK OF ELECTRIC 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 components, 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°/(number of poles).

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

⚠ WARNING

INDICATOR LIGHT (LED) STATUS RELIABILITY

Status indicator lights (LEDs) are not reliable for safety functions.

- Only use status indicator lights 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 8.9 Commissioning Test).
- For advanced functional safety, perform a commissioning test to validate the safety functions and their safety properties for the whole system. See the *Advanced Functional Safety for VLT® FlexMotion™ Operating Guide*.

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.

NOTICE

- 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 the timing and distance for the 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 guide.
- 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: 2023, PL d, Cat. 3
- EN ISO 13849-2: 2012, PL d, Cat. 3

The SDM 521/SDM 522 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 40: 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 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	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.

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 Figure 98 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-.

A suitable safety device to switch it off is not supplied by Danfoss. The STO is activated by opening STO+ and STO–.

Table 41: Activation of STO Function

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

⚠ CAUTION

STO VOLTAGE/TIME LIMITS

Failure to comply with the voltage limits specified for the STO input or with the specified transition time, could lead to permanent damage to the drive, due to the direct control over the power stage.

- Ensure that no voltage outside the following limits is provided to the STO input.

  STO active: within -3 V to 3 V

  STO not active: 24 V ± 10%

- Ensure that the transition from STO deactivated to STO activated (and conversely) is executed within 1 ms in either direction.

NOTICE

- 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.

Signals with test pulses must not have test pulses of >2 ms. Longer pulses may lead to reduced availability of the servo system.

8.7 Protective Measures

NOTICE

- Install the system modules in a cabinet that is rated at least IP54 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.

8.8 Application Example

An example of an application that can be put in safe torque off (STO) mode by a safety circuit is shown in Figure 98.

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

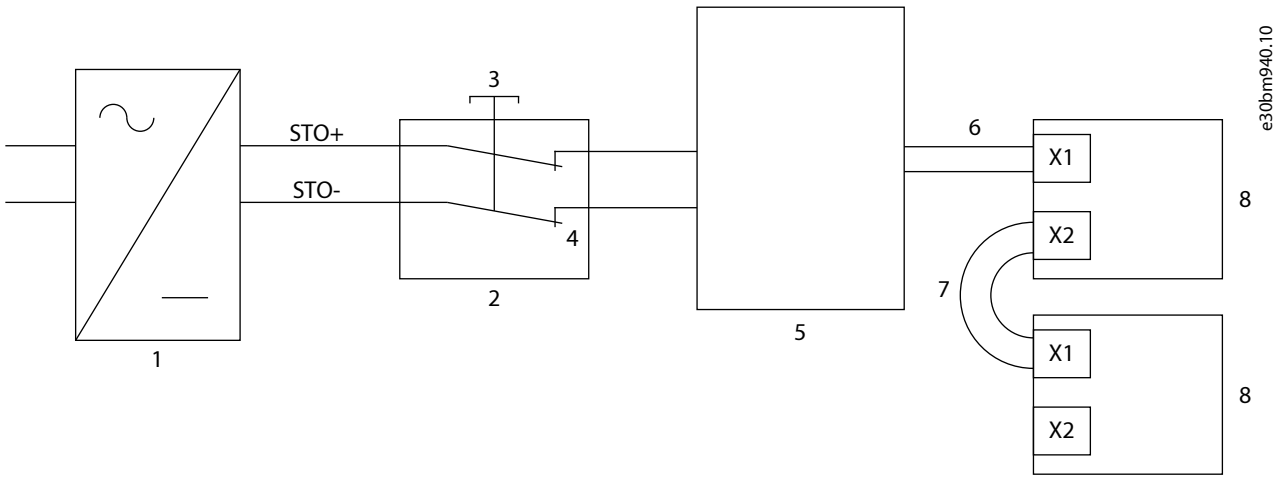


Figure 98: Application Example: Safe Torque Off Function

1	24 V DC supply	2	Safety device
3	Emergency stop button	4	Safety device contacts
5	PSM 520 with integrated DAM option	6	Feed-in cable
7	Loop cable	8	Servo drive

8.9 Commissioning Test

NOTICE

- Perform a commissioning test according to standard EN/ISO 13849-1 for the whole servo system. Perform the test 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 or the TwinCAT® Library.
- Bit-wise readout of the status.

8.9.1 Commissioning Test Methods

8.9.1.1 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
- TwinCAT® Library
  - MC_ReadStatus
  - MC_ReadAxisError
  - MC_Reset

Table 42: Commissioning Test using Libraries

	Test steps	Reason for the test step	Expected result for Danfoss library	Expected result for TwinCAT® library
1	Run the application (all the servo drives are enabled).	Check that the application can run.	Application runs as expected.	Application runs as expected.
2	Stop the application.	–	All servo drives are at speed 0 RPM.	All servo drives are at speed 0 RPM.
3	Disable all the servo drives.	–	All servo drives are disabled.	All servo drives are disabled.
4	Enable STO.	Check that STO can be activated without error.	*MC_ReadAxisInfo_DDS* output *SafeTorqueOff* = True for all servo drives on the corresponding line.	–
5	Disable STO.	Check that STO can be deactivated without error. No reset is required.	*MC_ReadAxisInfo_DDS* output *SafeTorqueOff* = False for all servo drives on the corresponding line.	–
6	Run the application (all the servo drives are enabled).	–	Application runs as expected.	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. *MC_ReadAxisInfo_DDS* output *SafeTorqueOff* = True and *MC_ReadStatus_DDS* output *ErrorStop* = True and *MC_ReadAxisError_DDS* output *AxisErrorID* = 0xFF80 on all enabled servo drives.	Motors are torque free. Motors coast and stop after some time. For enabled motors: *MC_ReadAxisInfo_DDS* output *SafeTorqueOff* = True and *MC_ReadStatus* output *ErrorStop* = True and *MC_ReadAxisError* output *AxisErrorID* = 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.	Application does not run.
9	Disable STO.	Check that the STO start is still inhibited by the error signal.	*MC_ReadAxisInfo_DDS* output *SafeTorqueOff* = False and *MC_ReadStatus_DDS* output *ErrorStop* = True	*MC_ReadStatus output ErrorStop* = True
10	Try to run the application (enable 1 or more servo drives).	Check whether reset is required.	Application does not run.	Application does not run.

Table 42: Commissioning Test using Libraries - (continued)

	Test steps	Reason for the test step	Expected result for Danfoss library	Expected result for TwinCAT® library
11	Send a reset signal via *MC_Reset(_DDS)*.	–	*MC_ReadAxisInfo_DDS* output *SafeTorqueOff* = False and *MC_ReadStatus_DDS* output *ErrorStop* = False	*MC_ReadStatus output ErrorStop* = False
12	Try to run the application (all servo drives are enabled).	–	Application runs as expected.	Application runs as expected.

8.9.1.2 Commissioning Test using PROFINET® Devices

Table 43: Commissioning Test using PROFINET® Devices

	Test steps	Reason for the test step	Expected result
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.	No errors are present. The successful STO activation can be checked on the indicator lights (LEDs) on the devices.
5	Disable STO.	Check that STO can be deactivated without error. No reset is required.	No errors are present. The STO status can be checked on the indicator lights (LEDs) on the devices.
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. Error 0x11E is shown in object 0x603F on all 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.	Error 0x11E is shown in object 0x603F on all servo drives.
10	Try to run the application (enable 1 or more servo drives).	Check whether a reset is required.	Application does not run.
11	Send a reset signal via the PLC.	–	STO error 0x11E is cleared in all servo drives.
12	Try to run the application (all servo drives are enabled).	–	Application runs as expected.

8.10 STO Function

8.10.1 Operation of the STO Function

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

The servo drive modules (SDM 521/SDM 522) provide 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 520, DSD 520, MSD 520 (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 the servo drive is enabled and STO is activated, 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 reapply the supply voltage to the STO terminals, before enabling the drive.

8.10.2 Error Codes

If bit 3 of the status word 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 44: 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	The 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), the PLC can automatically provide this reset information. All servo drives on the same line show 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.

8.10.3 Fault Reset

To reset faults, change bit 7 of the control word from *0* to *1*. See the *VLT®Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Programming Guide* for further information.

8.11 Functional Safety Characteristic Data

Table 45: Functional Safety Characteristic Data

Data	PSM 520	SDM 521	SDM 522
General information			
Response time [1]	<100 ms		
Lifetime	20 years		
Data for EN/ISO 13849-1			
Performance level (PL)	–	d	d
Category	–	3	3
Mean time to dangerous failure ($MTTF_D$)	–	>100 years	>100 years[2]
Diagnostic coverage (DC)	–	Low	Low
Data for EN/ISO 61508			
Safety integrity level (SIL)	–	2	2
Probability of failure per hour (PFH)	0 /h	$<4 \times 10^{-9}$/h	$<4 \times 10^{-9}$/h
Subsystem classification	Type A		
Diagnostic test interval	1 year		

1) From switching on the input, until torque generation is disabled.

2) For each axis.

NOTICE

- The PSM 520 does not contribute to the dangerous failure rate of the 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.

8.12 Diagnostic Test

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

1. Check that the motor shaft is not blocked by the application and can run freely.
2. Start the motor.
3. Activate STO by removing the STO input voltage, see 8.6 Installation.
4. Verify that the motor stops running.
5. Verify that the STO error is logged. See the toolbox history for details.

9 Diagnostics

9.1 Faults

If faults occur during operation, check:

- The indicator lights (LEDs) on the servo drives, servo drive modules SDM 521/SDM 522 for general problems relating to communication or device status.
- The indicator lights (LEDs) on the PSM 520 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 and type of system components).
- System status when the fault occurred.
- Ambient conditions.

9.2 Troubleshooting

9.2.1 Troubleshooting for the Servo Drive Modules SDM 521/SDM 522

9.2.1.1 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.

9.2.1.2 Drive Hums and Draws High Current

Possible cause

- Drive defective.

Troubleshooting

- Contact Danfoss.

9.2.1.3 Drive Stops Suddenly and Restart is not Possible

Possible cause

- No drive communication.
- Drive in error mode.

Troubleshooting

- Check the fieldbus connection and the indicator lights (LEDs) on the drive.

9.2.1.4 Motor Rotating in Wrong Direction

Possible cause

- Mirror mode activated.

Troubleshooting

- Check the parameter settings.

9.2.1.5 Motor not Generating Expected Torque

Possible cause

- Drive defective.
- Parameter error.

Troubleshooting

- Check the parameter settings.
- Contact Danfoss.

9.2.1.6 Drive Screaming

Possible cause

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

Troubleshooting

- Check the parameter settings.
- Contact Danfoss.

9.2.1.7 Uneven Running

Possible cause

- Defective bearing.

Troubleshooting

- Check the shaft.

9.2.1.8 Vibration

Possible cause

- Defective bearing.
- Incorrect control loop parameters.

Troubleshooting

- Check the shaft.

- Check the parameter settings.

9.2.1.9 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.

9.2.1.10 Drive Speed Drops Sharply under Load

Possible cause

- Drive is running at current limit.
- Drive is running with incorrect parameters.
- Speed control loop bandwidth is too low.

Troubleshooting

- Check the application.
- Check the parameter settings.
- Modify the speed control loop parameters.

9.2.1.11 Brake not Releasing

Possible cause

- Defective brake control.
- Incorrect mechanical brake parameters.

Troubleshooting

- Check the parameter settings.
- Contact Danfoss.

9.2.1.12 Holding Brake not Holding the Servo Drive

Possible cause

- Mechanical brake defective.
- Shaft load exceeds the holding torque of the brake.

Troubleshooting

- Contact Danfoss.

9.2.1.13 Delayed Brake Engagement

Possible cause

- Software error.

Troubleshooting

- Contact Danfoss.

9.2.1.14 Noises when Power-Off Brake is Engaged

Possible cause

- Mechanical brake damaged.

Troubleshooting

- Contact Danfoss.

9.2.1.15 Indicator Lights (LEDs) not Lighting Up

Possible cause

- No power supply.

Troubleshooting

- Check the power supply.

9.2.1.16 Drive Protection Trips Immediately

Possible cause

- Short circuit.
- Incorrect control loop parameters.

Troubleshooting

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

9.2.2 Troubleshooting for the Servo System

9.2.2.1 LCP Display is Dark/Not Functioning

This fault applies to the ISD 520/DSD 520 servo drives, PSM 520.

Possible causes and troubleshooting

Table 46: Possible Causes and Troubleshooting

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.	• 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.

9.2.2.2 Open Power Fuses or Circuit Breaker Trip

This fault applies to the PSM 520.

Possible causes

- Phase-to-phase short.
- Short on backlink.
- Short on SDM 521/SDM 522 output.

- Short on hybrid cable.
- Short on EXM 520 connector or cable.

Troubleshooting

- Check the cabling.
- Check for loose connections.

9.2.2.3 DC-link Voltage Too High (Error 0x3210/0x103)

This fault applies to PSM 520.

Table 47: Possible Causes and Troubleshooting

Possible cause	Possible solution	Applies to:
Brake resistor not connected.	Check the brake resistor cabling.	PSM 520.
Brake resistor too high resistance.	Check if the lowest resistance value has been entered.	PSM 520.
Brake resistor functionality not activated.	Activate the brake function.	PSM 520.
Several servo drives are decelerating with insufficient ramp time.	Avoid simultaneous deceleration of several servo drives. Change the deceleration speed.	PSM 520, ISD 520/DSD 520 servo drives, SDM 521/SDM 522 servo drive modules.
Mains voltage out of range.	Check the mains voltage and wiring.	–

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

This fault applies to the PSM 520.

Possible cause

- Incorrect mains input supply.

Troubleshooting

- Check that the supply voltage matches the allowed specification.

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

This fault applies to the PSM 520.

Possible causes

- The sum of the system modules' current exceeds the maximum rating of the PSM 520.
- Short on backlink.

Troubleshooting

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

9.2.2.6 AUX Overcurrent (Error 0x2391/0x125)

This fault applies to the PSM 520.

Possible causes

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

Troubleshooting

- Check the number of attached servo drives with the shell diagrams in the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Design Guide*.
- Avoid simultaneous lifting of the servo drive brakes.

9.2.2.7 AUX Overcurrent on DAM Option (Error 0x2392/0x17D)

This fault applies to the PSM 520.

Possible causes

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

Troubleshooting

- Check the number of attached servo drives with the shell diagrams. Refer to the *VLT® Servo Drive System ISD 520, DSD 520 Design Guide*.
- Avoid simultaneous lifting of the servo drive brakes.

9.2.2.8 AUX Overvoltage (Error 0x3292/0x133)

This fault applies to the PSM 520.

Possible causes

- Incorrect U_{AUX} supply.

Troubleshooting

- Check that the supply matches the auxiliary supply requirements.

9.2.2.9 AUX Undervoltage (Error 0x3290/0x17C)

This fault applies to the PSM 520.

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.

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

This fault applies to the PSM 520.

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.

9.2.2.11 Mechanical Brake Failure (Error 0xFF01/0x112)

This fault applies to all servo drives.

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.

9.2.2.12 Brake Chopper Overcurrent (Error 0x7112/0x167)

This fault applies to the PSM 520.

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.

9.2.2.13 Grounding Fault (Error 0x2330/0x151)

This fault applies to all system components.

Possible causes

- Grounding fault.
- When 2 PSM 520 modules are mounted in parallel and the maximum delay time for power-up is exceeded (see 6.7 Power-up Time).

Troubleshooting

- Check for proper grounding and loose connections.
- Check the hybrid cables for short circuits or leakage currents.
- Check the EXM 520 connection and cable.

9.2.3 Error Codes

9.2.3.1 No error (0x0000 / 0x0)

This error code is valid for PSM 520, and SDM 521/SDM 522.

Table 48: No Error (0x0000 / 0x0)

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

9.2.3.2 Generic application error (0x1000 / 0x100)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 49: 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

9.2.3.3 Overcurrent Trip (0x2310 / 0x101)

This error is valid for SDM 521/SDM 522.

Table 50: Overcurr Out (0x2310 / 0x101)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x2310	0x101	Overcurrent trip	Error	Overcurrent trip on output.	overcurr trip

9.2.3.4 High cont. current overload (0x2311 / 0x15F)

This error is valid for PSM 520 and SDM 521/SDM 522.

Table 51: High Cont. Current Overload (0x2311 / 0x15F)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x2311	0x15F	High cont. current overload	Error	High continuous current overload error.	high curr ovld

9.2.3.5 Continuous current overload (0x2312 / 0x160)

This error is valid for PSM 520 and SDM 521/SDM 522.

Table 52: Continuous Current Overload (0x2312 / 0x160)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x2312	0x160	Continuous current overload	Error	Continuous current overload error.	cont curr ovld

9.2.3.6 Fuses and hybrid cable overload (0x2316 / 0x161)

This error is valid for PSM 520.

Table 53: Fuses and Hybrid Cable Overload

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x2316	0x161	Fuse and hybrid cable overload	Warning	Overload on fuses and hybrid cable, related to DAM option board.	fuses hybrid cable ovld

9.2.3.7 Overcurrent short circuit (0x2320 / 0x163)

This error is valid for PSM 520.

Table 54: 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 short

9.2.3.8 Ground fault (0x2330 / 0x151)

This error is valid for all system components.

Table 55: 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

9.2.3.9 Motor Overload Fault (0x2350 / 0x179)

This error is valid for SDM 521/SDM 522.

Table 56: Motor Overload Fault (0x2350 / 0x179)

Code	PROFINET®code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x2350	0x179	Motor Overload Fault	Error	Motor Overload Fault (I2T thermal state).	Motor Overload Fault

9.2.3.10 Motor Overload Warning (0x2351 / 0x17A)

This error is valid for SDM 521/SDM 522.

Table 57: Motor Overload Warning (0x2351 / 0x17A)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x2351	0x17A	Motor Overload Warning	Warning	Motor Overload Warning (I2T thermal state).	Motor Overload Warning

9.2.3.11 AUX overcurrent (0x2391 / 0x125)

This error is valid for PSM 520.

Table 58: 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

9.2.3.12 AUX overcurrent on DAM (0x2392/0x17D)

This error is valid for PSM 520.

Table 59: AUX Overcurr (0x2392 / 0x17D)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x2392	0x17D	AUX overcurrent DAM	Error	Current on the AUX line has reached the overcurrent limit.	AUX overcurr DAM

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

This error is valid for PSM 520.

Table 60: 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

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

This error is valid for PSM 520.

Table 61: 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

9.2.3.15 AUX supply failure (0x2395 / 0x129)

This error is valid for PSM 520.

Table 62: 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

9.2.3.16 Current overload trip (0x2396 / 0x15C)

This error is valid for PSM 520 and SDM 521/SDM 522.

Table 63: 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

9.2.3.17 Thermal overload motor (0x239B / 0x102)

This error is valid for SDM 521/SDM 522

Table 64: Thermal Overload Motor (0x239B / 0x102)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x239B	0x102	Thermal overload motor	Warning, error	Thermal overload motor error.	therm ovld motor

9.2.3.18 DC short circuit (0x239C/0x16F)

This error is valid for SDM 521/522

Table 65: DC Short Circuit (0x239C/0x0x16F)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x239C	0x16F	Short circuit on DC-link	Error	Short circuit on DC-link	DC short

9.2.3.19 Overcurrent motor (0x239D/0x170)

This error is valid for SDM 521/522

Table 66: Overcurrent Motor (0x239D/0x170)

Code	PROFINET®code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x239D	0x170	Overcurrent motor	Error	Motor overcurrent fault with respect to the threshold value defined by object 0x2395.	overcurr motor

9.2.3.20 Mains phase loss (0x3130 / 0x12F)

This error is valid for PSM 520.

Table 67: 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

9.2.3.21 Mains voltage outside limits (0x3131/0x17F)

This error is valid for PSM 520.

Table 68: Mains Voltage Outside Limits (0x3131/0x17F)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x3131	0x17F	Mains voltage outside limits	Error	Mains voltage outside limits. This fault is triggered if the mains voltage deviates too much from the configured value in object 0x203E.	Mains out limit

9.2.3.22 DC link overvoltage (0x3210 / 0x103)

This error is valid for PSM 520.

Table 69: 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

9.2.3.23 DC link undervoltage (0x3220 / 0x104)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 70: 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 *Operation enabled* state.	UDC undervolt

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 71: 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	The maximum time limit to charge the DC link has been exceeded.	UDC charging

9.2.3.25 DC Link unbalanced (0x3280 / 0x153)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 72: 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

9.2.3.26 UAUX undervoltage DAM Option (0x3290 / 0x17C)

This error is valid for PSM 520 with DAM option.

Table 73: UAUX Undervoltage DAM Option (0x3290 / 0x17C)

Code	PROFINET®code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x3290	0x17C	U_{AUX}undervoltage	Error	U_{AUX} below undervoltage limit.	UAUX undervolt DAM

9.2.3.27 UAUX high voltage (0x3291 / 0x132)

This error is valid for PSM 520.

Table 74: 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

9.2.3.28 UAUX overvoltage (0x3292 / 0x133)

This error is valid for PSM 520.

Table 75: 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

9.2.3.29 UAUX low voltage (0x3293 / 0x134)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 76: 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

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

This error is valid for PSM 520.

Table 77: 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

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

This error is valid for PSM 520.

Table 78: DC Link 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

9.2.3.32 UAUX charging error (0x3297 / 0x154)

This error is valid for PSM 520 with DAM option.

Table 79: 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

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

This error is valid for PSM 520.

Table 80: 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

9.2.3.34 UAUX undervoltage hardware (0x329A / 0x156)

This error is valid for PSM 520.

Table 81: 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

9.2.3.35 Device overtemperature (0x4210 / 0x157)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 82: Device Overtemperature (0x4210 / 0x157)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x4210	0x157	Device overtemperature	Warning, error	Triggered when the maximum temperature of the main device component is exceeded.	overtemp device

9.2.3.36 Device under temperature (0x4220 / 0x138)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 83: 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

9.2.3.37 Overtemperature: Power module (0x4290 / 0x131)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 84: Overtemperature: Power Module (0x4290 / 0x105)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x4290	0x131	Overtemperature: Power module	Error	Overtemperature on power module.	overtemp PM

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 85: Overtemperature: Control Card (0x4291 / 0x106)

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

9.2.3.39 Under temperature: Control card (0x4289 / 0x130)

This error is valid for PSM 520 and SDM 521/SDM 522.

Table 86: Under Temperature: Control Card (0x4289 / 0x130)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x4289	0x130	Under temperature: control card	Error	Under temperature on control card.	undertemp CC

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 87: 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

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

This error is valid for PSM 520.

Table 88: 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 *Operation enabled* in a short time period.	UDC inrush

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

This error is valid for PSM 520.

Table 89: 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 inrush

9.2.3.43 Overtemperature: Motor (0x4310 / 0x108)

This error is valid for SDM 521/SDM 522

Table 90: 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

9.2.3.44 UAUX undervoltage (0x5112 / 0x109)

This error is valid for SDM 521/SDM 522.

Table 91: UAUX Undervoltage (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

9.2.3.45 FlyBack overvoltage (0x5113 / 0x139)

This error is valid for SDM 521/SDM 522.

Table 92: FlyBack Overvoltage (0x5113 / 0x139)

Code	PROFINET®code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x5113	0x139	FlyBack Overvoltage	Trip lock	FLYBACK voltage is higher than the high-voltage limit	FLYBACK overvolt

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

This error is valid for PSM 520 and SDM 521/SDM 522.

Table 93: 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

9.2.3.47 Failure on output phase U (0x5411 / 0x123)

This error is valid for SDM 521/SDM 522.

Table 94: Failure on Output Phase U (0x5411 / 0x123)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x5411	0x123	Failure on output phase U	Trip lock	Current offset on output phase U outside limit.	output phase U

9.2.3.48 Failure on output phase V (0x5412 / 0x124)

This error is valid for SDM 521/SDM 522.

Table 95: Failure on Output Phase V (0x5412 / 0x124)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x5412	0x124	Failure on output phase V	Trip lock	Current offset on output phase V outside limit.	output phase V

9.2.3.49 Failure on output phase W (0x5413 / 0x125)

This error is valid for SDM 521/SDM 522.

Table 96: Failure on Output Phase W (0x5413 / 0x125)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x5413	0x125	Failure on output phase W	Trip lock	Current offset on output phase W outside limit.	output phase W

9.2.3.50 Fuse broken (0x5450 / 0x17E)

This error is valid for PSM 520.

Table 97: Fuse Broken (0x5450 / 0x17E)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x5450	0x17E	Fuse broken	Error	A broken DC-link fuse has been detected on the DAM option board.	Fuse broken

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 98: 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.	eeprom err

9.2.3.52 Parameter error (0x6320 / 0x10B)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 99: Parameter Error (0x6320 / 0x10B)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x6320	0x10B	Invalid Parameter Configuration	Trip lock	Invalid configuration. A restore of the configuration is required then power cycle or reset the device.	invalid conf

9.2.3.53 Parameter Configuration: Previous configuration restored (0x6321 / 0x171)

This error is valid for PSM 520, and SDM 521/SDM 522

Table 100: Parameter Configuration: Previous Configuration Restored (0x6321 / 0x171)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x6321	0x171	Parameter Configuration: Previous configuration restored	Error	The previous stored configuration has been reloaded because something went wrong with the latest configuration.	prev config restored

9.2.3.54 Parameter configuration: Power cycle needed (0x6322 / 0x172)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 101: Parameter Configuration: Power Cycle Needed (0x6322 / 0x172)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x6322	0x172	Parameter Configuration: Power cycle needed	Warning, error	Power cycle or reset is needed to apply the new configuration.	power cycle

9.2.3.55 Parameter Configuration: Wrong thermal sensor configuration (0x6323 / 0x173)

This error is valid for SDM 521/SDM 522.

Table 102: Parameter Configuration: Wrong Thermal Sensor Configuration (0x6323 / 0x173)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0x6323	0x173	Parameter Configuration: Wrong thermal sensor configuration	Error	Wrong configuration of parameters 0x2350 and 0x2361. At least 1 of them must be set to *no sensor*.	wrong thermal sens

9.2.3.56 Conf par ver (0x6382 / 0x15D)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 103: 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

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

This error is valid for PSM 520.

Table 104: 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

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 105: 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 EEPROM

9.2.3.59 Brake chopper failure (0x7111 / 0x141)

This error is valid for PSM 520.

Table 106: 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

9.2.3.60 Brake chopper overcurrent (0x7112 / 0x167)

This error is valid for PSM 520.

Table 107: 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

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

This error is valid for PSM 520.

Table 108: 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

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

This error is valid for PSM 520.

Table 109: 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 *external brake chopper power monitoring* this warning or fault appears when the configured nominal external brake chopper power is reached.	ext brake ch ovl

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

This error is valid for PSM 520.

Table 110: 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 *brake chopper start level*.	brake ch high volt

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

This error is valid for SDM 521/SDM 522.

Table 111: 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

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

This error is valid for SDM 521/SDM 522.

Table 112: 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

9.2.3.66 Following error (0x8611 / 0x10E)

This error is valid for SDM 521/SDM 522.

Table 113: 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

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

This error is valid for SDM 521/SDM 522.

Table 114: 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

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

This error is valid for SDM 521/SDM 522.

Table 115: 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

9.2.3.69 Homing error distance (0x8695 / 0x111)

This error is valid for SDM 521/SDM 522.

Table 116: 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

9.2.3.70 Mechanical brake failure (0xFF01 / 0x112)

This error is valid for SDM 521/SDM 522.

Table 117: Mechanical Brake Failure (0xFF01 / 0x112)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF01	0x112	Mechanical brake failure	Trip lock	No brake or wire failure.	brake mech fail

9.2.3.71 Short circuit in mechanical brake control (0xFF02 / 0x113)

This error is valid for SDM 521/SDM 522.

Table 118: Short Circuit in Mechanical Brake Control (0xFF02 / 0x113)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF02	0x113	Short circuit in mechanical brake control	Trip lock	Short circuit in brake control.	brake mech short

9.2.3.72 External interface power failure (0xFF0A / 0x114)

This error is valid for SDM 521/SDM 522.

Table 119: External Interface Power Failure (0xFF0A / 0x114)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF0A	0x114	External interface power failure	Error	External interface power supply failure.	ext IF pwr fail

9.2.3.73 Position limit exceeded (0xFF03 / 0x12D)

This error is valid for SDM 521/SDM 522.

Table 120: Position Limit Exceeded (0xFF03 / 0x12D)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF03	0x12D	Position limit exceeded	Error	SW position limit or HW limit switch has been reached or exceeded.	pos lim exceeded

9.2.3.74 Initial angle detection has failed (0xFF04 / 0x109)

This error is valid for SDM 521/SDM 522.

Table 121: Initial Angle Detection has Failed (0xFF04 / 0x109)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF04	0x109	Initial angle detection has failed	Error	The initial Angle detection procedure has failed, check the alarm subcode.	Inital Angle detect. fail

9.2.3.75 Communication interrupted (0xFF10 / 0x14F)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 122: Communication Interrupted (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

9.2.3.76 Fan feedback inconsistent (0xFF21 / 0x145)

This error is valid for PSM 520 and SDM 521/SDM 522.

Table 123: 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

9.2.3.77 Fan lifetime critical (0xFF22 / 0x15A)

This error is valid for PSM 520 and SDM 521/SDM 522.

Table 124: 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

9.2.3.78 Timing violation 1 (0xFF60 / 0x115)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 125: 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

9.2.3.79 Timing violation 2 (0xFF61 / 0x116)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 126: 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

9.2.3.80 Timing violation 3 (0xFF62 / 0x117)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 127: 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

9.2.3.81 Timing violation 4 (0xFF63 / 0x118)

This error is valid for SDM 521/SDM 522.

Table 128: 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

9.2.3.82 Timing violation 5 (0xFF64 / 0x119)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 129: 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

9.2.3.83 Timing violation 6 (0xFF65 / 0x11A)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 130: 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

9.2.3.84 Timing violation 7 (0xFF66 / 0x168)

This error is valid for SDM 521/SDM 522.

Table 131: 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

9.2.3.85 Timing violation 8 (0xFF67 / 0x16B)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 132: 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

9.2.3.86 Timing violation 9 (0xFF68 / 0x16C)

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 133: 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

9.2.3.87 CAM timing violation (0xFF69 / 0x16D)

This error is valid for SDM 521/SDM 522.

Table 134: CAM Timing Violation (0xFF69 / 0x16D)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF69	0x16D	CAM timing violation	Trip lock	Contact Danfoss.	CAM timing

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 135: 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

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 136: 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 powercycle

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 137: 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 upd invalid

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

This error is valid for PSM 520, and SDM 521/SDM 522.

Table 138: 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

9.2.3.92 PWM switching frequency invalid (0xFF74 / 0x15E)

This error is valid for SDM 521/SDM 522.

Table 139: PWM Switching Frequency Invalid (0xFF74 / 0x15E)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF74	0x15E	PWM switching frequency invalid	Warning	Selected PWM switching frequency via object 0x2396 is not valid with respect to the actual fieldbus cycle. The closest switching frequency is adopted. Check object 0x201D.03 for actual value.	PWM freq invalid

9.2.3.93 Interpolation time invalid (0xFF75 / 0x161)

This error is valid for SDM 521/SDM 522.

Table 140: Interpolation Time Invalid (0xFF75 / 0x161)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF75	0x161	Interpolation time invalid	Error	The interpolation time set via object 0x60C2 is not an integer multiple of the actual fieldbus cycle. Check object 0x201D.02 for the actual value.	Interp time invalid

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

This error is valid for SDM 521/SDM 522.

Table 141: 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 the drive while STO active.	STO active

9.2.3.95 STO mismatch (0xFF81 / 0x11F)

This error is valid for SDM 521/SDM 522.

Table 142: 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

9.2.3.96 P_STO error (0xFF85 / 0x120)

This error is valid for SDM 521/SDM 522.

Table 143: 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

9.2.3.97 Guide value reversed (0xFF90 / 0x121)

This error is valid for SDM 521/SDM 522.

Table 144: 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

9.2.3.98 Guide value implausible (0xFF91 / 0x122)

This error is valid for SDM 521/SDM 522.

Table 145: 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

9.2.3.99 UDU Guide Value out of range (0xFF92 / 0x126)

This error is valid for SDM 521/SDM 522.

Table 146: UDU Guide Value Out of Range (0xFF92 / 0x126)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF92	0x126	UDU Guide Value out of range	Error	UDU Position Guide Value is outside the allowable range $[G_{min}, G_{max}]$.	UDU GV out of range

9.2.3.100 UDU Guide Value Offset out of range (0xFF93 / 0x12A)

This error is valid for SDM 521/SDM 522.

Table 147: UDU Guide Value Offset Out of Range (0xFF93 / 0x12A)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF93	0x12A	UDU Guide Value Offset out of range	Error	UDU Position Guide Value offset is outside the allowable range [G_{min}, G_{max}].	UDU GV offset out of range

9.2.3.101 UDU Min Blending distance out of range (0xFF94 / 0x12C)

This error is valid for SDM 521/SDM 522.

Table 148: UDU Min Blending Distance Out of Range (0xFF94 / 0x12C)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF94	0x12C	UDU Min Blending distance out of range	Error	UDU Min Blending distance is outside the allowable range [G_{min}, G_{max}].	UDU Min Blending distance out of range

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

This error is valid for SDM 521/SDM 522.

Table 149: 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	PROFINET® sign of life error.	PNIO SOL error
				Sign of life error.	SOL error

9.2.3.103 Safe Drive Internal Failure (0xFF96 / 0x150)

This error is valid for SDM 521/SDM 522.

Table 150: Safe Drive Internal Failure (0xFF96 / 0x150)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF96	0x150	Safe Drive Internal Failure	Trip lock	Safe drive internal failure	Safe drv fail

9.2.3.104 SIM Internal Failure (0xFF97 / 0x16E)

This error is valid for SDM 521/SDM 522.

Table 151: Safe Drive Internal Failure (0xFF97 / 0x16E)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF97	0x16E	SIM Internal Failure	Trip lock	SIM internal failure	SIM fail

9.2.3.105 SIM Internal Failure Resettable (0xFF98 / 0x174)

This error is valid for SDM 521/SDM 522.

Table 152: Safe Internal Failure Resettable (0xFF98 / 0x174)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF98	0x174	SIM Internal Failure Resettable	Error	SIM internal failure resettable.	SIM fail res

9.2.3.106 Safe Position Procedure Failed (0xFF99 / 0x175)

This error is valid for SDM 521/SDM 522.

Table 153: Safe Position Procedure Failed (0xFF99 / 0x175)

Code	PROFINET® code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF99	0x175	Safe Position Procedure Failed	Warning, error	Procedure for the safe position referencing failed.	Safe Proc Fail

9.2.3.107 Production firmware running (0xFF9A / 0x17B)

This error is valid for SDM 521/SDM 522.

Table 154: Production Firmware Running (0xFF9A / 0x17B)

Code	PROFINET®code	Name	Severity (warning/ error/trip lock)	Description	LCP name
0xFF9A	0x17B	Production firmware running	Warning, error	This FW is only for Production Tester- NOT USE IN FIELD	Prod FW

10 Maintenance, Decommissioning, and Disposal

10.1 Warnings

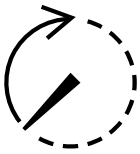
⚠ WARNING

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 520) 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 520). 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 electric shock, fully disconnect the Power Supply Module (PSM 520) 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 Maintenance Tasks

The maintenance tasks for the MSD 520 system are detailed in Table 155. Qualified personnel must perform the maintenance tasks. No other tasks are required.

Table 155: 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.
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.
Screw terminals	Check the terminal screws.	Every 12 months	Tighten the screws with the recommended tightening torque.

10.3 Inspection During Operation

10.3.1 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.

10.4 Repair

Do not attempt to repair the products. Return defective products to Danfoss. Contact the local Danfoss sales company for information about returns.

10.5 System Component Replacement

10.5.1 Dismounting the System Modules

1. Disconnect the mains and all auxiliary supplies from the PSM 520 and wait for the discharge time to elapse.
2. Unplug the motor feedback connectors (only on SDM 521/SDM 522).
3. Disconnect the EMC plate on the bottom of the system modules. Do not dismount the connectors from the EMC plate.
   a. Unplug the connectors.
   b. Unfasten the screw [1] for the EMC plate.
   c. Release the EMC plate.
   d. Unfasten the PE screw [2].

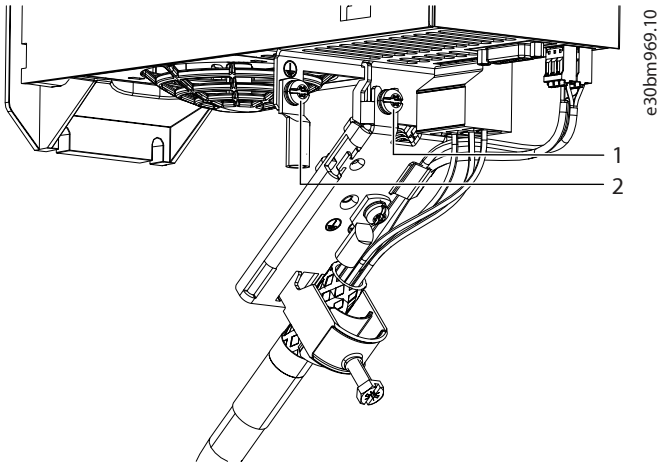


Figure 99: Disconnecting the EMC Plate

1	Screw for EMC plate	2	PE Screw

4. Disconnect the I/O shielding plate on the top of the system modules:
   a. Unplug the top connectors [1].
   b. Release the cable from the shielding clamp [2].

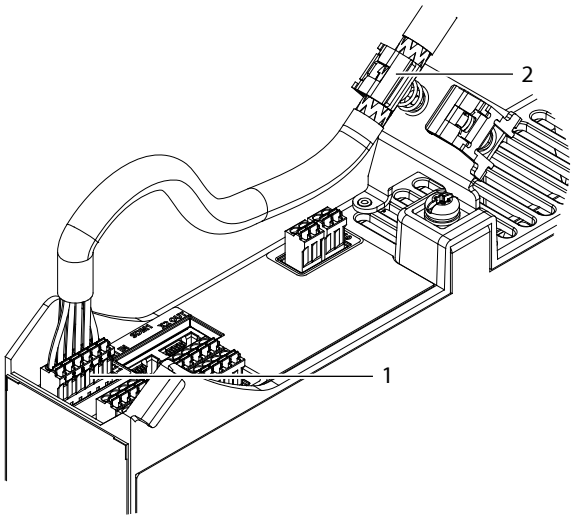


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Figure 100: Disconnecting the I/O Shielding Plate

1	Connector	2	Spring released shielding clamp

5. To release the module, pull up the holding clamp at the top of the backplate.

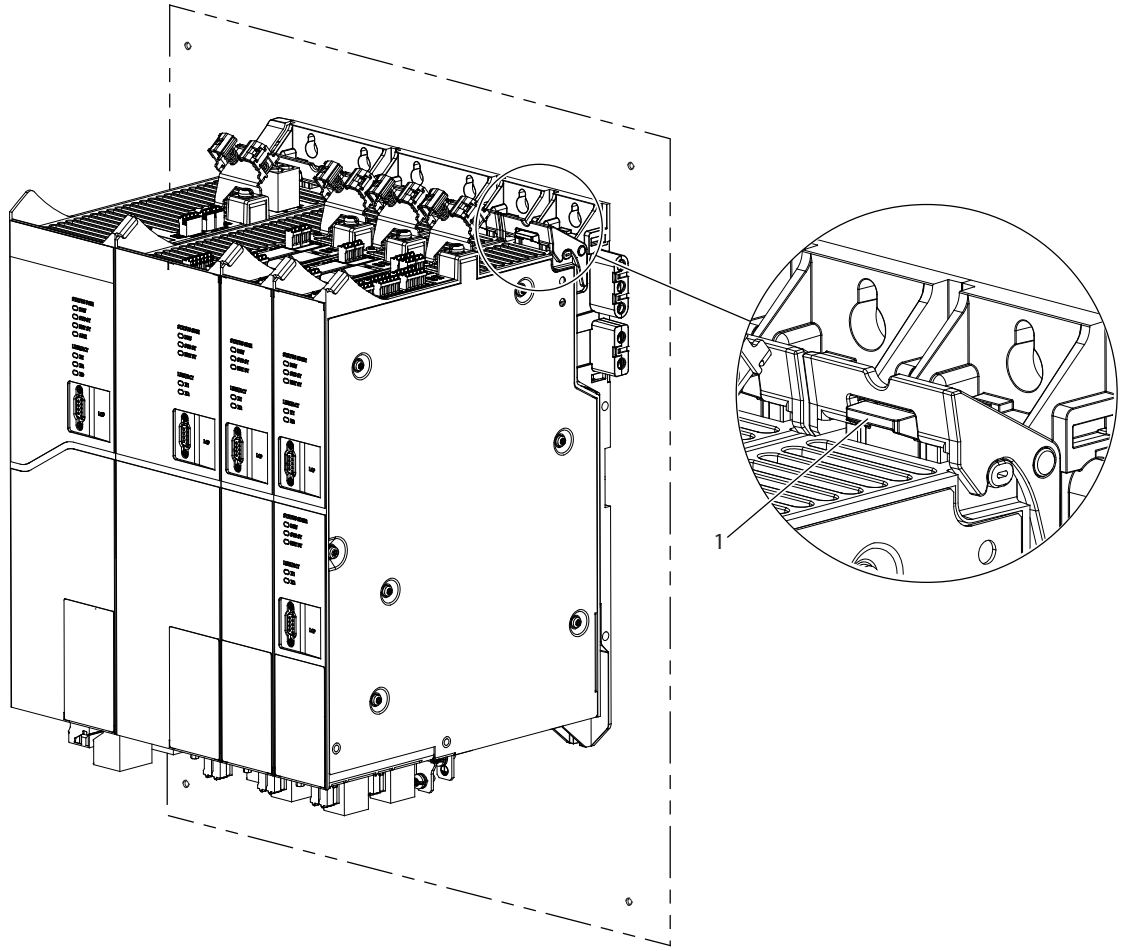

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Figure 101: Releasing the Module

1	Holding clamp

6. Tilt the module forward and slide it out of the guiding groove.

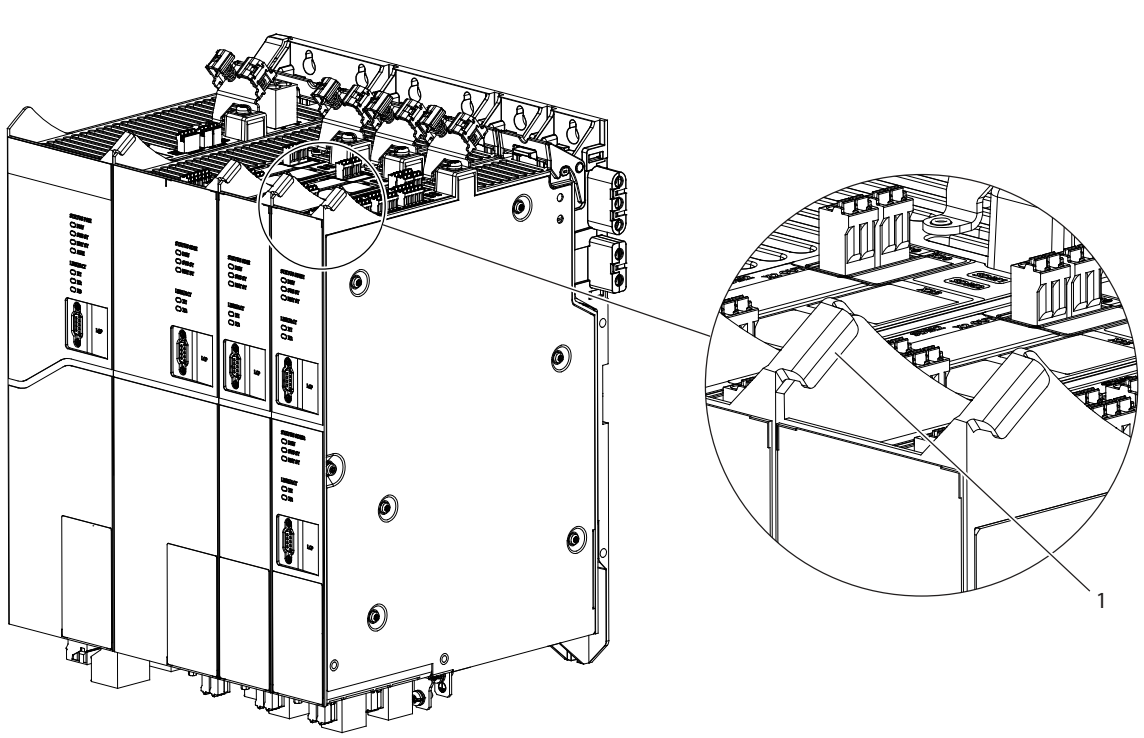

Figure 102: Guiding Groove

1	Guiding groove

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

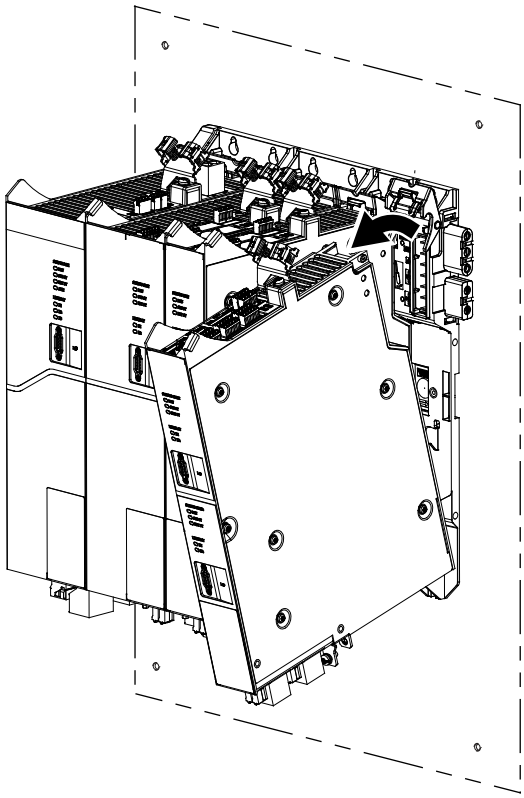

Figure 103: Removing the Module

10.5.2 Fitting and Commissioning the System Modules

1. Check if preparation is required, see 4.6.1 Preparation for Installation of System Modules.
2. Fit the system modules, see 4.7.3 Fitting Instructions for System Modules.
3. Connect the electrical cables, see chapter *Electrical Installation*.
4. Switch on the system, see 6.9.2 Procedure for Switching on the MSD 520 System.
5. Configure the system modules parameters according to the fieldbus used, see chapter *Commissioning* EtherCAT® ID Assignment, Ethernet POWERLINK® Assignment, and PROFINET® ID Assignment.
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 520 from its power source .

Mains network and all auxiliary supplies.

2. Wait for the necessary discharge time to elapse.
3. Disconnect any cables connected to the X3, X4, or X5 ports on the ISD 520/DSD 520 servo drive for easier access to the feed-in cable.
4. Disconnect the PE wire from the PE screw on the PSM 520 with DAM option.
5. Disconnect the Ethernet connector.
6. Open the cable clamp holding the STO cable.
7. Open the cable clamp holding the feed-in cable on the PSM 520 with DAM option.
8. Loosen the feed-in cable connectors on the PSM 520 with DAM option.
9. Disconnect the feed-in cable from the PSM 520 with DAM option.
10. Loosen the threaded ring of the connector on the servo drive.
11. 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. See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Design Guide* for code numbers.

10.6.2.3 Connecting the Feed-in Cable

Procedure:

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 PSM 520 with DAM option.
5. Secure the feed-in cable with a cable clamp.
6. Secure the STO cable with a cable clamp.
7. Connect the Ethernet connector to the PSM 520 with DAM option.
8. Connect the PE wire to the PE screw on the PSM 520 with DAM option.
9. Reconnect any cables that were connected to the X3, X4, or X5 ports.

10.6.3 Loop Cable Replacement

10.6.3.1 Disconnecting the Loop Cable

Procedure:

1. Disconnect the Power Supply Module (PSM 520) from its power source.

   Mains network and all auxiliary supplies.

2. Wait for the necessary discharge time to elapse.
3. Disconnect any cables connected to the X3, X4, or X5 ports on both ISD 520/DSD 520 servo drives for easier access to the loop cable.
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. See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Design Guide* for code numbers.

10.6.3.3 Connecting the Loop Cable

Procedure:

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 X3, X4, or X5 ports on both servo drives.

10.7 Fuse Replacement in PSM 520 with DAM Option

If a single fuse blows, replace all the fuses with fuses from the same batch.

Table 156: Fuse CAT Number DC Link

DC link	Rated current (A)	Code number	Supplier
+AKD1	12.8 A	50 215 26. 16	SIBA®
+AKD2	20 A	50 120 06. 25	
+AKD3	28 A	50 120 06. 32	

Table 157: Fuse CAT Number AUX

AUX	Rated current	Code number	Supplier
+AKD1 +AKD2	15 A	0314020.MXP	LITTELFUSE®
+AKD3	25 A	0314030.MXP	

Procedure:

1. Remove the screw and remove the cover from the side of the DAM option.

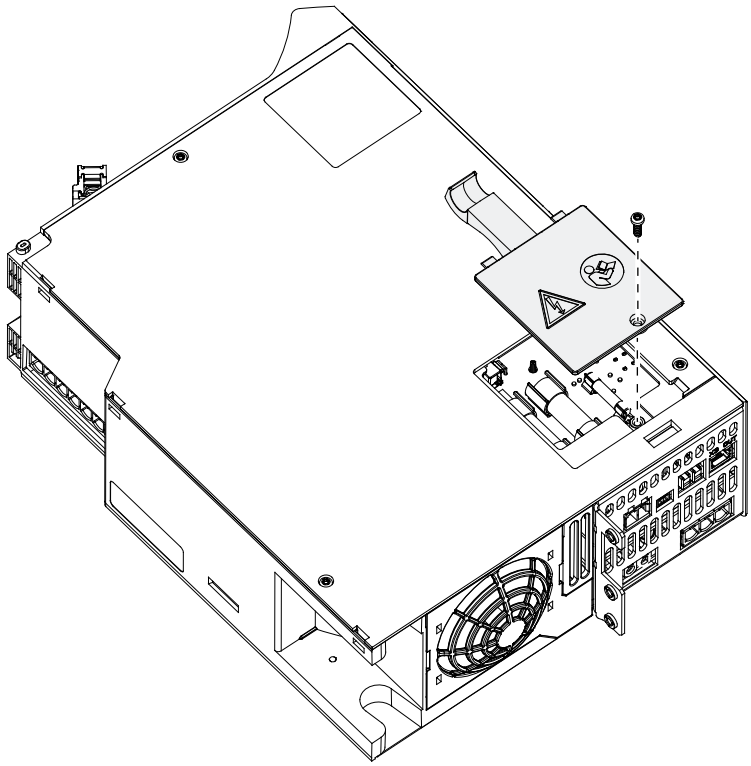

Figure 104: Opening the Cover on DAM Option

2. Use the built-in tool in the cover to remove the fuses from the DAM option. Place the built-in tool under the fuse and gently rotate the cover clockwise until the fuse is released.

   Replace the fuses with the same number of identical type fuses.

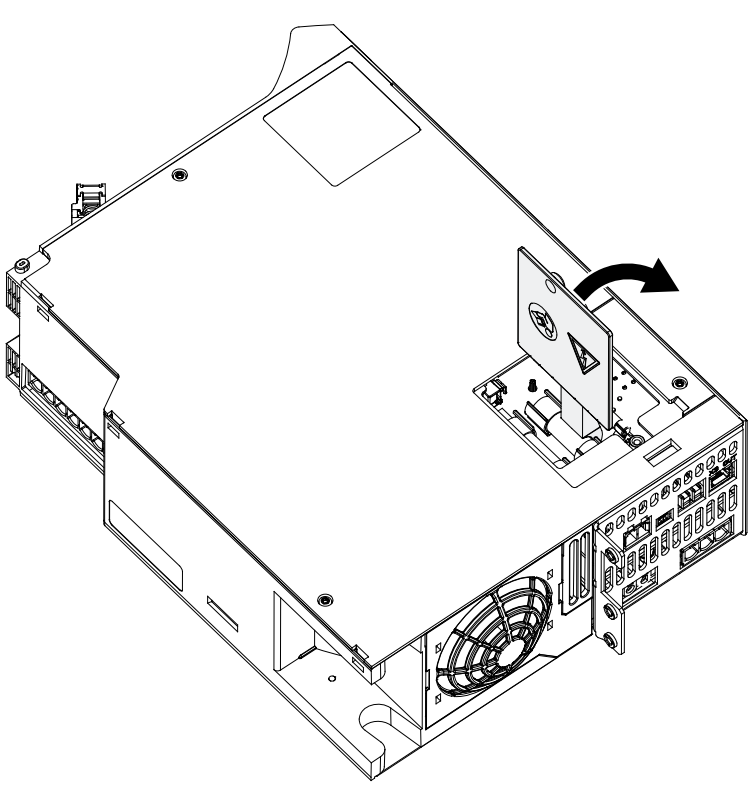

Figure 105: Removing the Fuse

3. Reinstall the cover with 1 screw, and tighten the screw (see Figure 104).

   Torque 2.0 Nm (17.7 in-lb).

10.8 Fan Replacement

NOTICE

- See the *VLT® Servo Drive System ISD 520, DSD 520, MSD 520 (VLT® FlexMotion™) Design Guide* for further information on fan types.

Procedure:

1. Use a screwdriver as a lever to release the fan holder.

   Depending on the size of the module, refer to Figure 106 or Figure 107.

2. Remove the fan.
3. Replace the fan with an identical type fan.

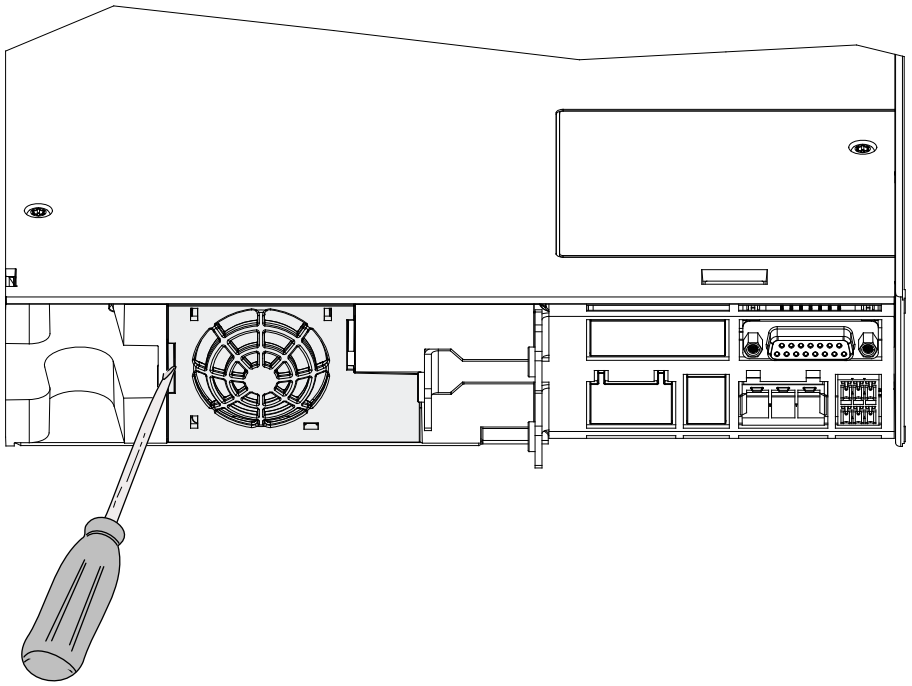

Figure 106: Fan Replacement on 50 mm (2.0 in) Modules

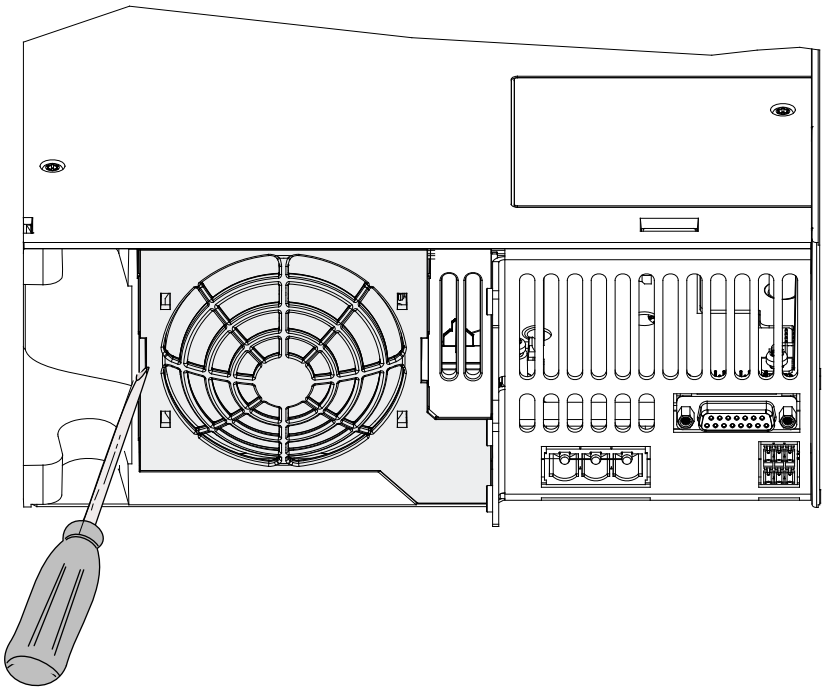

Figure 107: Fan Replacement on 100 mm (3.9 in) Modules

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 system components 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 system components as hazardous waste, electrical waste, recyclable waste, and so on, in accordance with applicable local regulations.

11 Specifications

11.1 Product Labels for MSD 520 System Module

Check the product label and compare it with the order data. Use the part number for reference. The part number uniquely identifies the module type.

Ensure that the product label is clearly legible.

Identify system modules by the original Danfoss product label located on the front of each module.

Example of product label on the front of the system modules

The following data is shown on the product label on the front of the system modules:

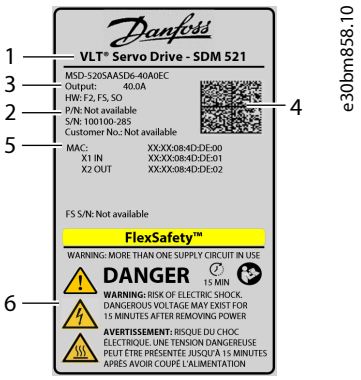

Figure 108: Product Label on the Front of the System Modules (Example)

1	MSD 520 module name	2	(P/N) Part number/(S/N) Serial number
3	Output	4	Data matrix
5	MAC addresses	6	Warning symbols

Example of product label on the side of the system modules

The following data is shown on the product label on the side of the system modules:

Figure 109: Product Label on the Side of the System Modules (Example)

1	Type code	2	Supply voltage
3	U_{AUX} supply	4	Output voltage
5	Maximum power	6	Ambient temperature range
7	Protection rating		

11.2 Power Supply Module (PSM 520)

11.2.1 Dimensions of PSM 520

All dimensions are in mm [in].

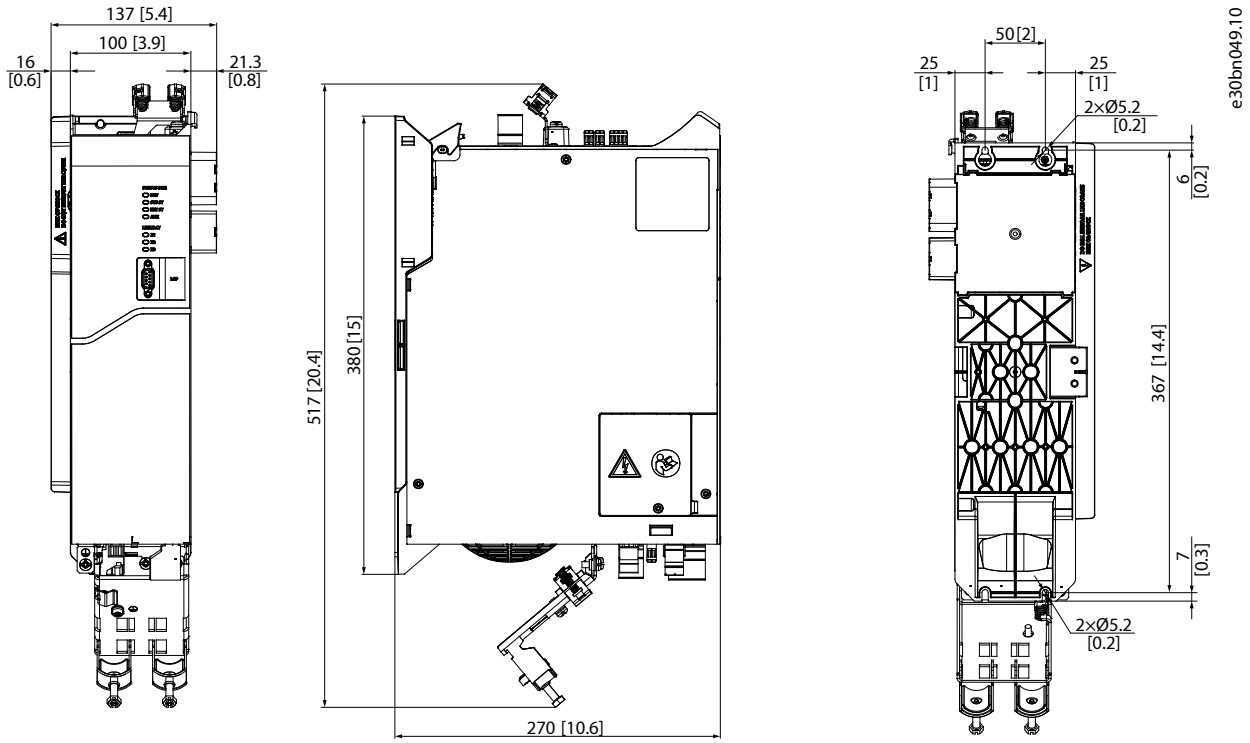

Figure 110: Dimensions of PSM 520

11.2.2 Characteristic Data for PSM 520

Table 158: Characteristic Data for Power Supply Module (PSM 520)/DAM Option

Definition	Unit	Power size 1	Power size 2	Power size 3
Input				
Mains input voltage	V AC	208–480 ±10%, 3-phase		
Input current	A	16	32	48
Input power[1]	kVA	5 (230 V AC)	10 (230 V AC)	15 (230 V AC)
		10 (400 V AC)	20 (400 V AC)	30 (400 V AC)
U_{AUX} input voltage	V DC	24/48±10%		
U_{AUX} current consumption at 24 V DC[2]	A DC	2.0		
U_{AUX} current consumption at 48 V DC[2]	A DC	1.0		
Output				
DC-link voltage	V DC	290–680 ±10%		
DC-link capacitance	µF	1500		
Output rated current I_N	A	20	40	60

Table 158: Characteristic Data for Power Supply Module (PSM 520)/DAM Option - (continued)

Definition	Unit	Power size 1	Power size 2	Power size 3
Output rated power P_N	kW	5 (230 V AC)	10 (230 V AC)	15 (230 V AC)
		10 (400 V AC)	20 (400 V AC)	30 (400 V AC)
Output peak current I_{max} (t < 3.0 s)	A	40	80	120
Output peak power P_{max}(t < 3.0 s)	kW	10 (230 V AC)	20 (230 V AC)	30 (230 V AC)
		20 (400 V AC)	40 (400 V AC)	60 (400 V AC)
Derating @T_{amb} 55 °C (Max output current to nominal value)	%	60		
Protective measures	–	Overload Short-circuit Ground fault protection NOTE: Ground fault protection active only for DC+ side		
Internal brake resistor[3]				
Peak power P_{max} (t < 0.35 s)	kW	8.0		
Average rated power P_N	W	110.0		
Nominal resistance	Ω	20		
External brake resistor				
Peak power P_{max} (t < 50 s)	kW	33		
Average rated power P_N	kW	33		
Minimum resistance	Ω	20		
DAM option/Input				
U_{AUX} input voltage	A DC	U_{AUX} PSM		
U_{AUX} current consumption at 24 V DC	A DC	0.2		
U_{AUX} current consumption at 48 V DC	A DC	0.1		
DAM option/Output				
Output voltage	V DC	V_{OUT} PSM		
Output current DC-link	Arms	12.8	20	28
Peak current DC-link (rms value) t < 1.0 s	A_{rms}	25	40	56
Output current U_{AUX}	A DC	15	15	25
DC-link output cable cross-section	[mm^2(AWG)]	2.5 (14)	4.0 (12)	6.0 (10)
Protective measures	–	Overload Short-circuit Ground fault protection		
General				
Line filter[4]	–	Category C3		
Cooling	–	Integrated fan		

Table 158: Characteristic Data for Power Supply Module (PSM 520)/DAM Option - (continued)

Definition	Unit	Power size 1	Power size 2	Power size 3
Mounting	–	Wall-mounted on backplate using backlink connector		
Weight	[kg (lb)]	5.8 (12.8)		
Dimensions (W x H x D)	[mm (in)]	137.3 x 475 x 270 (5.41 x 18.70 x10.63)		

1) The PSM 520 overload protection is based on the DC-link average output rated-current IN. The input and output power depends on the effective mains input voltage.

2) Module consumption, under the following condition: Running, no load on I/Os, fan full speed.

3) An external brake resistor can be connected.

4) In accordance with EN 61800-3.

Recommendation of PSM 520 with DAM option output cable

The output cable for the PSM 520 with DAM option supplies DC link and AUX voltage, STO, and fieldbus communication. The output cable is available in the hybrid cable type for the 2.5 mm^2 (AWG 14) and 4.0 mm^2 (AWG 12) size.

Standard cables can be used as an alternative. In such a case, ensure that the following conditions are met:

- The selected cables must comply with the minimum ampacity requirements stated in Table 158, with additional 25% margin for the DC link.
  - For example, a 12.8 A rated current needs a 16 A rated cable.
- The selected cable must also ensure the minimum required ampacity at the temperature rating of the cable.
  - Usually 80 °C (176 °F) for CE.
  - Usually 75 °C (167 °F) for UL.
- The selected fuse must always ensure the cable protection to load condition. See 10.7 Fuse Replacement in PSM 520 with DAM Option for further information of the fuse replacement.
- The STO cable must be a shielded cable to comply with functional safety requirements. See Table 182 for further information of the electrical ratings of the STO cable.
- The fieldbus cable must comply with the requirements specified in Table 18.

11.3 Servo Drive Module (SDM 521/SDM 522)

11.3.1 Dimensions of SDM 521/SDM 522

All dimensions are in mm [in].

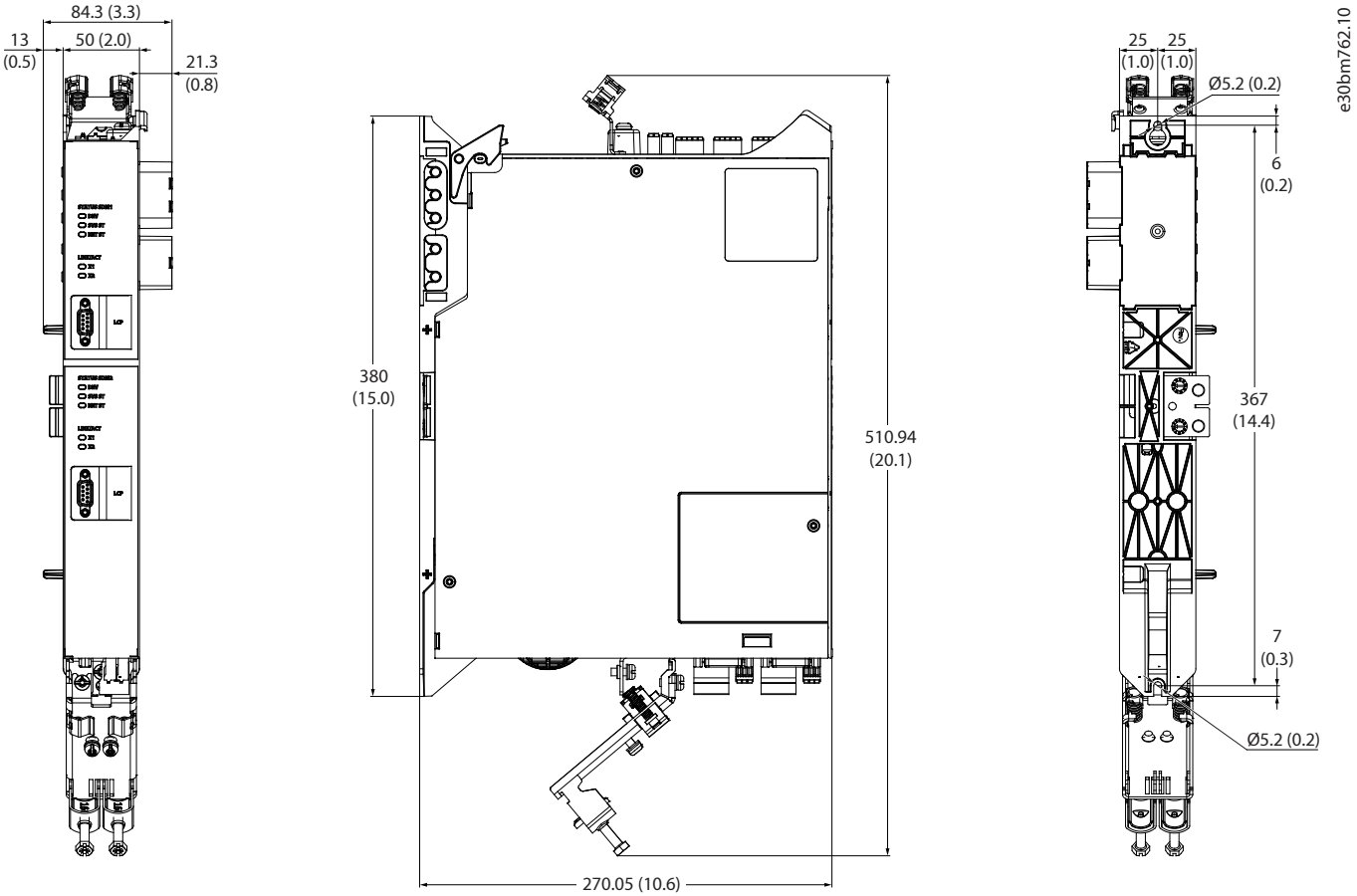

Figure 111: Dimensions of SDM 521/SDM 522, Enclosure Size 1 (FS1)

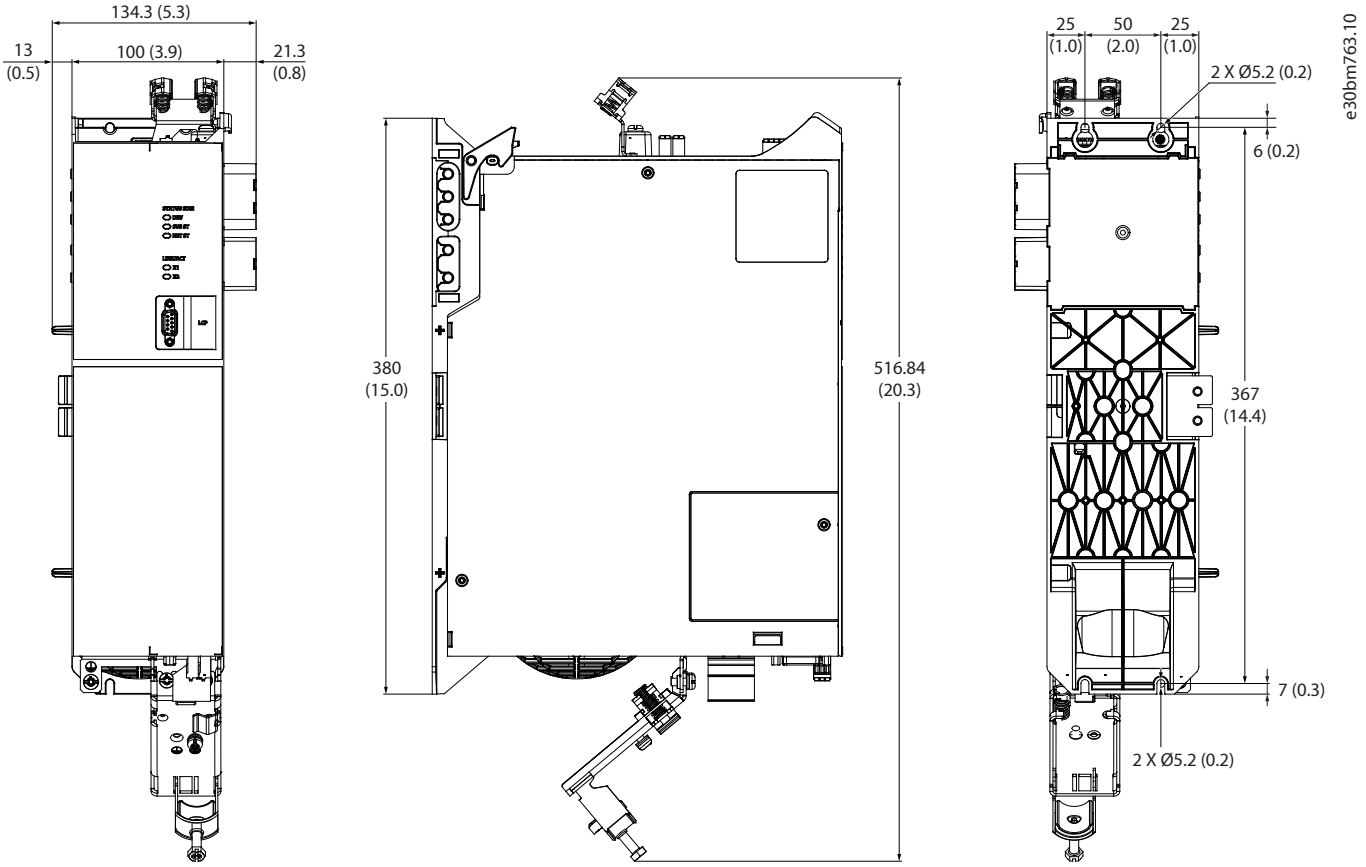

Figure 112: Dimensions of SDM 521 Enclosure Size 2 (FS2)

11.3.2 Characteristic Data for SDM 521

Table 159: Characteristics Data for SDM 521

Specifications	Unit	Enclosure size 1 (FS1), 2.5 A	Enclosure size 1 (FS1), 5 A	Enclosure size 1 (FS1), 10 A	Enclosure size 1 (FS1), 20 A	Enclosure size 2 (FS1), 40 A
Input						
DC-link	V DC	290–680 ±10%				
DC-link capacitance	µF	330				1000
U_{AUX} input voltage	V DC	24/48±10%				
U_{AUX} current consumption (at 24 V DC)(1)	A DC	1.5	1.5	1.5	1.5	2.5
U_{AUX} current consumption (at 48 V DC)(1)	A DC	0.75	0.75	0.75	0.75	1.25
Output						
Output number of phases	–	3				
Output voltage phase-to-phase	V AC	V_{DC}/sqrt(2)				
Output rated current I_N	A_{rms}	2.5	5	10	20	40
Output rated power P_N	kW	1.6	3.2	6.4	12.7	25.5
Output peak current	A_{rms}	7.5	15	30	45	90

Table 159: Characteristics Data for SDM 521 - (continued)

Specifications	Unit	Enclosure size 1 (FS1), 2.5 A	Enclosure size 1 (FS1), 5 A	Enclosure size 1 (FS1), 10 A	Enclosure size 1 (FS1), 20 A	Enclosure size 2 (FS1), 40 A
Nominal switching frequency	kHz	5				
Possible switching frequency	kHz	4/8/10				
Derating of nominal and peak current for switching frequency	%	f_{SW}=4 kHz – 100% (no derating)				
		f_{SW}=5 kHz – 100% (no derating)				
		f_{SW}=8 kHz – 75%				
		f_{SW}=10 kHz – 65%				
Derating @T_{amb} 55 °C (For any switching frequency)	%	60				
Protective measures	–	Overload Short-circuit Ground fault protection				
Maximum output frequency	Hz	590				
Functional safety	–	STO (standard) VLT® FlexSafety™ (optional)				
General						
Cooling	–	Integrated fan				
Mounting	–	Wall-mounted on backplate using backlink connector				
Number of motor connectors	–	1				
Weight	[kg (lb)]	3.9 (8.6)				5.5 (12.1)
Dimensions (W x H x D)	[mm (in)]	84.3 x 476 x 270 (3.32 x 18.74 x 10.63)				134.3 x 476 x 270 (5.29 x 18.74 x 10.63)

1) Module consumption, under the following condition: Running, no brake current, no load on I/Os, fan full speed, HDSL active.

11.3.3 Characteristic Data for SDM 522

Table 160: Characteristic Data for SDM 522

Specifications	Unit	Enclosure size 1 (FS1), 2 x 2.5 A	Enclosure size 1 (FS1), 2 x 5 A	Enclosure size 1 (FS1), 2 x 10 A
Input				
DC-link	V DC	290–680 ±10%		
DC-link capacitance	µF	330		
U_{AUX}	V DC	24/48±10%		
U_{AUX} current consumption (at 24 V DC)[1]	A DC	2.0	2.0	2.0
U_{AUX} current consumption (at 48 V DC)[1]	A DC	1.0	1.0	1.0
Output				
Output number of phases	–	3		
Output voltage	V AC	U_{DC}/sqrt(2)		
Output rated current I_N	A_{rms}	2 x 2.5	2 x 5	2 x 10

Table 160: Characteristic Data for SDM 522 - (continued)

Specifications	Unit	Enclosure size 1 (FS1), 2 x 2.5 A	Enclosure size 1 (FS1), 2 x 5 A	Enclosure size 1 (FS1), 2 x 10 A
Output rated power P_N	kW	2 x 1.6	2 x 3.2	2 x 6.4
Output peak current	A_{rms}	2 x 7.5	2 x 15	2 x 30
Nominal switching frequency	kHz	5		
Possible switching frequency	kHz	4/8/10		
Derating of nominal and peak current for switching frequency	%	f_{SW}=4 kHz – 100% (no derating)		
		f_{SW}=5 kHz – 100% (no derating)		
		f_{SW}=8 kHz – 75%		
		f_{SW}=10 kHz – 65%		
Derating @T_{amb} 55 °C (For any switching frequency)	%	60		
Protective measures	–	Overload Short-circuit Ground fault protection		
Maximum output frequency	Hz	590		
Functional safety	–	STO (standard) VLT® FlexSafety™ (optional)		
General				
Cooling	–	Integrated fan		
Mounting	–	Wall-mounted on backplate using backlink connector		
Number of motor connectors	–	1		
Weight	[kg (lb)]	4.0 (8.8)		
Dimensions (W x H x D)	[mm (in)]	84.3 x 476 x 270 (3.32 x 18.74 x 10.63)		

1) Module consumption, under the following condition: Running, no brake current, no load on I/Os, fan full speed, HDSL active.

11.3.4 Motor Overload Protection

NOTICE

- Internal motor overload protection operates at 120% of the motor full load current.
- Instruct SDM 521/SDM 522 with nominal motor current (full load current according to the motor technical label) to use the protection properly.

NOTICE

Ensure that the following parameters are set as follows, otherwise the trip time may not be respected.

- Motor overload enable = 1
- Motor overload default value = 70

SDM 521/SDM 522 incorporates internal overload protection in the following multiples of current setting:

Table 161: Multiples of Current Setting

Multiple of current setting	Maximum trip time
7.2	20 seconds
1.5	8 minutes
1.2	2 hours

11.3.5 Motor Overtemperature Protection

The internal motor overload protection implemented in SDM 521/SDM 522 has thermal memory retention and speed sensitivity.

NOTICE

- Internal motor overtemperature protection is incorporated. Ensure that the parameters defined in 11.3.4 Motor Overload Protection are set as specified.
- Motor overtemperature sensing is also available. The SDM 521/SDM 522 has an input for motor temperature sensor.

11.4 Expansion Module (EXM 520)

11.4.1 Dimensions of EXM 520

All dimensions are in mm [in].

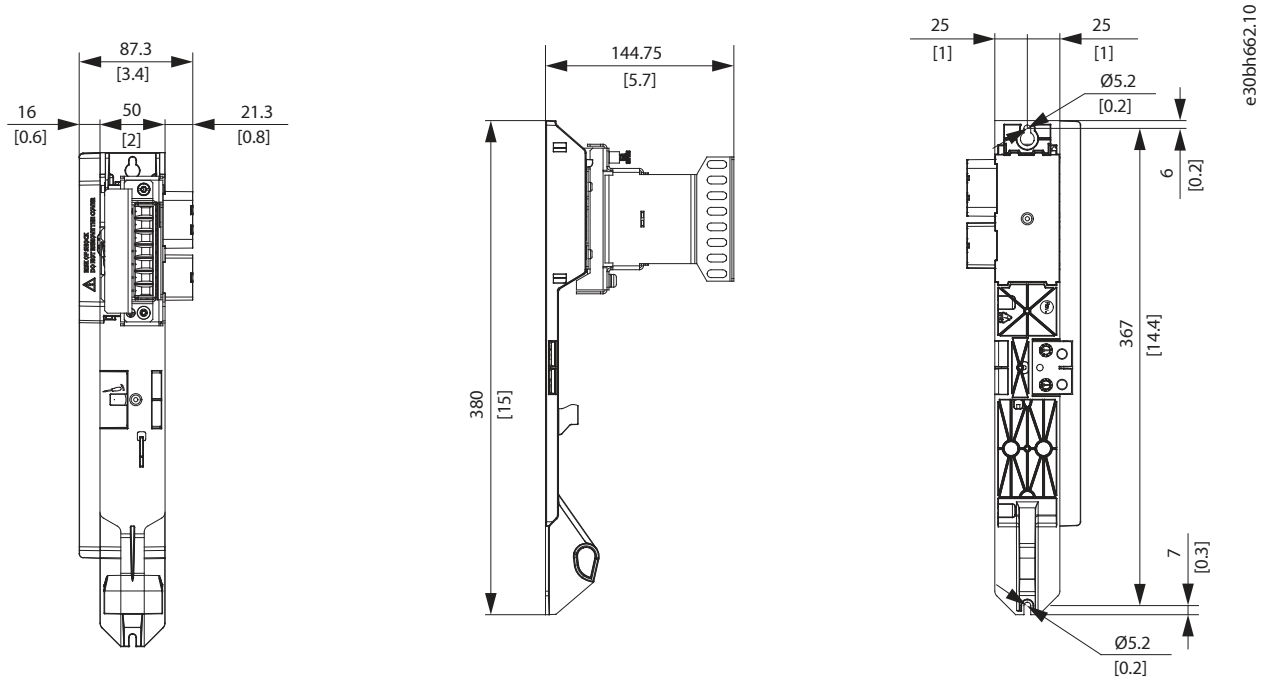

Figure 113: Dimensions of EXM 520

11.4.2 Characteristic Data for EXM 520

Table 162: Characteristic Data for Expansion Module (EXM 520)

Definition	Unit	Value
DC link	V DC	290–680 ±10%
Maximum current	A DC	62

Table 162: Characteristic Data for Expansion Module (EXM 520) - (continued)

Definition	Unit	Value
Mounting	–	Wall-mounted on backplate using backlink connector
Weight	[kg (lb)]	0.6 (1.3)
Dimensions (W x H x D)	[mm (in)]	87 x 380 x 145 (3.43 x 14.96 x 5.71)

11.5 Connectors on the System Modules

11.5.1 Connector Requirements

NOTICE

All connectors in the following chapter are intended for a single conductor (solid or stranded).

11.5.2 Backlink Connector

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

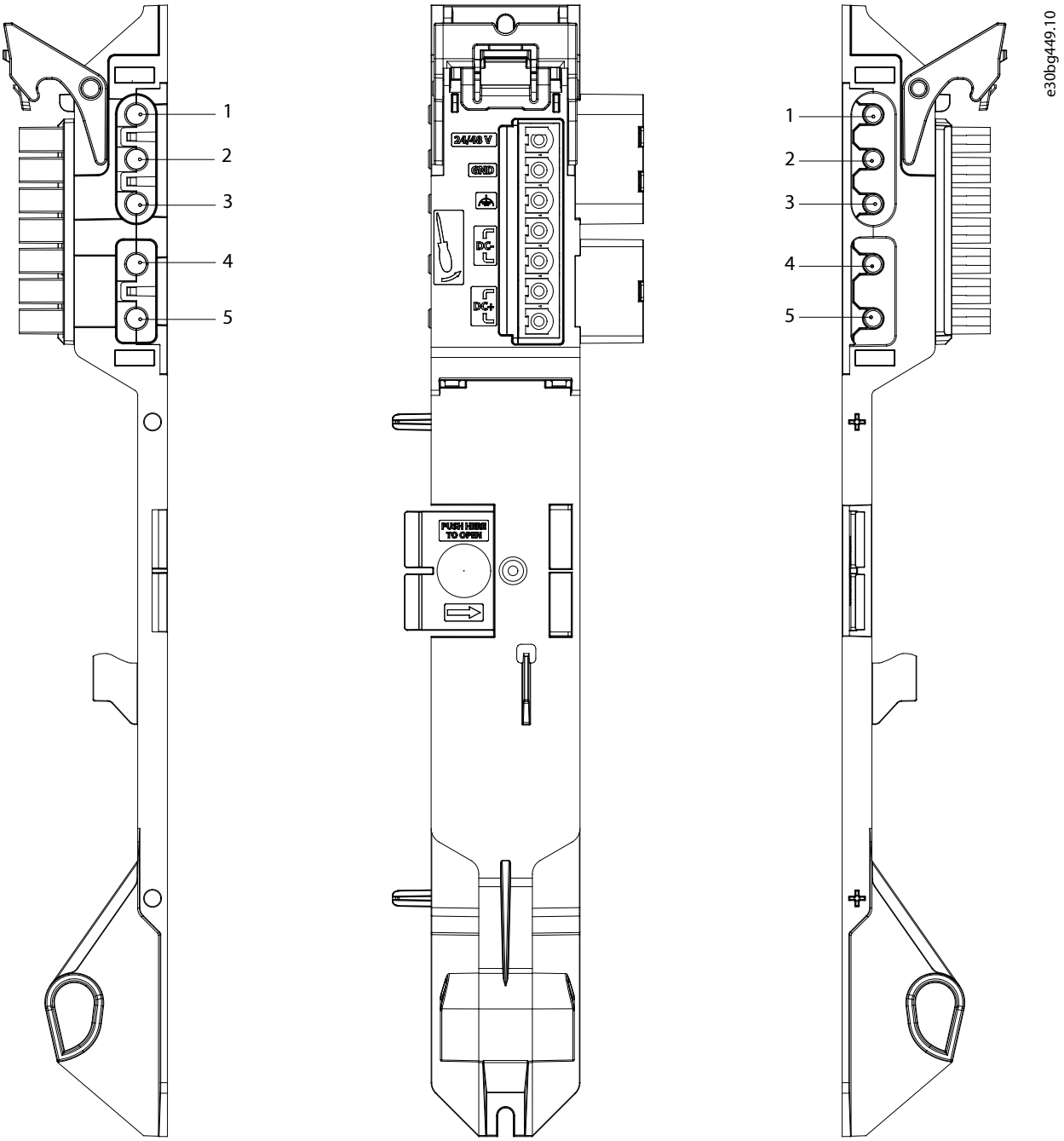

Figure 114: Pin Assignment of Backlink Connector

Table 163: Pin Assignment of Backlink Connector

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

11.5.3 Brake Connectors

11.5.3.1 Overview of Brake Connectors

Brake connectors are located on the Power Supply Module (PSM 520) and the Servo Drive Modules (SDM 521/SDM 522).

11.5.3.2 Brake Resistor Connector on PSM 520

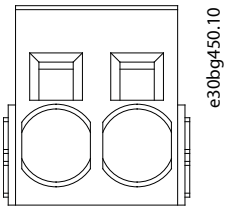

Figure 115: Brake Connector on PSM 520

Table 164: Pin Assignment of Brake Connector on PSM 520

Pins (Left to right)	Description	Notes	Ratings
1	DC+/R+	Used for connecting a brake resistor.	Nominal voltage: 290–680 V DC Maximum voltage: 290–820 V DC Maximum brake current: 41 A Conductor cross-section range: 0.75–16 mm2 (AWG 18–AWG 4)
2	R–		

NOTICE

- The maximum length of the brake cable is 30 m (98.4 ft) (shielded).

11.5.3.3 Brake, Motor Temperature Sensor and HIPERFACE® DSL or EnDat 3® Connector on SDM 521/SDM 522

The brake connector on SDM 521/SDM 522 is used for 3 main functions:

- Mechanical brake
- Temperature sensor (If present)
- Motor feedback: HIPERFACE® DSL or EnDat 3® (If used)

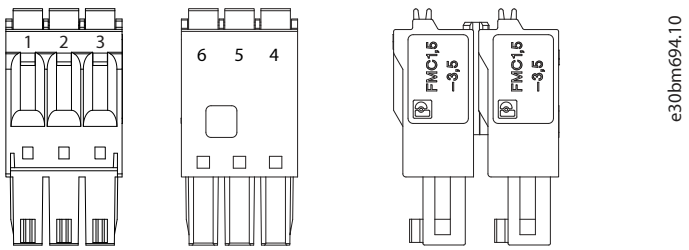

Figure 116: Brake Connector on SDM 521/SDM 522

Table 165: Brake Connector on SDM 521/SDM 522

Connector name	Description	Pins	Ratings/notes
Mechanical brake, motor temperature sensor, and motor feedback systems, as HIPERFACE® DSL or EnDat 3®.	Used to connect the motors mechanical brake, thermistor, and HIPERFACE® DSL (if present).	See Table 166.	Nominal voltage: 24 V Maximum (peak) voltage: 48 V ±10% Maximum brake current: 2.5 A Conductor cross-section range: 0.2–1.5 mm^2(AWG 24–AWG 16)

Table 166: Pin Assignment of Mechanical Brake and Motor Temperature Sensor Connector on SDM 521/SDM 522

Pins	Description	Notes	Rating/parameter
1	HIPERFACE_DSL+ or P_SD+ for EnDat 3	Used to connect the motors HIPERFACE ® DSL or EnDat 3 ® feedback (if present).	–
4	HIPERFACE_DSL- or P_SD- for EnDat 3		
2	BRAKE+	Used to connect the motors mechanical brake (if present).	Nominal voltage: 24 V Maximum (peak) voltage: 48 V ±10% Maximum brake current: 2.5 A Conductor cross-section range: 0.2–1.5 mm^2 (AWG 24–AWG 16)
5	BRAKE-		
3	TEMP+	Used to connect the motors temperature sensor (if present).	KTY83–110 KTY84-130 PT1000 PTC
6	TEMP-		

NOTICE

- The motor temperature measurement can either be connected to the motor feedback connector (see 11.5.14 Motor Feedback Connectors) or the brake and motor temperature sensor connector on the servo drive module SDM 521/SDM 522. The connectors cannot be connected in parallel.

NOTICE

- The signals on this connector are referred to GND and must therefore fulfill reinforced insulation requirements against the motor phases. The internal insulation must withstand 4240 V DC and an 8000 V_{peak} impulse.

NOTICE

- Only PELV potential can be connected to the temperature sensor input.

NOTICE

- The maximum length of the brake cable is 80 m (262.5 ft)(shielded).

11.5.4 Ethernet Connectors

11.5.4.1 Overview of Ethernet Connectors

There are Ethernet connectors on all the system modules.

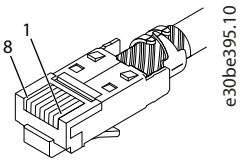

Figure 117: Ethernet Connector

NOTICE

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

11.5.4.2 Ethernet Connectors on PSM 520 and DAM Option

Table 167: Ethernet Connectors on PSM 520 and DAM Option

Connector name	Description	Pins	Ratings
X1 IN	Ethernet IN	1: TX+ 2: TX- 3: RX+ 4: – 5: – 6: RX- 7:– 8:–	According to standard 100BASE-T.
X2 OUT	Ethernet OUT1		
X3 OUT	Ethernet OUT2[1]		

1) Connection to hybrid cable, available only if DAM option is mounted.

11.5.4.3 Ethernet Connectors on SDM 521/SDM 522

Table 168: Ethernet Connectors

Connector name	Description	Pins	Ratings
SDM1 X1 IN	Ethernet IN1	1: TX+ 2: TX– 3: RX+ 4: – 5: – 6: RX– 7: – 8: –	According to standard 100BASE-T.
SDM1 X2 OUT	Ethernet OUT1		
SDM2 X1 IN [1]	Ethernet IN2		
SDM2 X2 OUT [1]	Ethernet OUT2		

1) Only on SDM 522.

11.5.5 I/O Connectors

11.5.5.1 I/O Connector on PSM 520

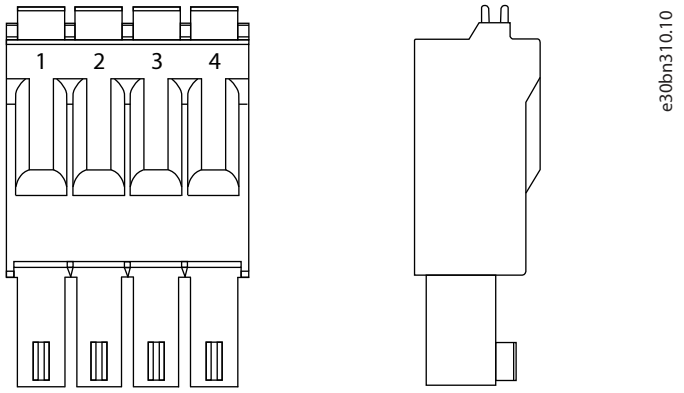

Figure 118: I/O Connector on PSM 520 (I/O PSM)

Table 169: Pin Assignment of I/O Connector on PSM 520

Pins	Description	Notes	Rating/parameter
1	DIN 1-	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	DIN 1+	Digital input	
3	–	–	–
4	–	–	–

The conductor cross-section range is 0.2–1.5 mm^2 (AWG 24–AWG 16).

NOTICE

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

11.5.5.2 I/O Connector on SDM 521/SDM 522

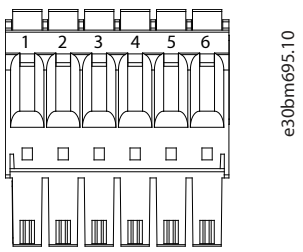

Figure 119: I/O Connector on SDM 521/SDM 522

Table 170: Pin Assignment of I/O Connector on SDM 521/SDM 522

Pins	Description	Notes	Rating/parameter
1	DigIn1	Digital input	Nominal voltage: 0–24 V. High (logic 1) voltage: 10–30 V DC. Low (logic 0) voltage: <5 V DC. Maximum switching frequency: 100 Hz.
2	GND	Ground	–
3	DigIn2	Digital input	Nominal voltage: 0–24 V. High (logic 1) voltage: 10–30 V DC. Low (logic 0) voltage: <5 V DC. Maximum switching frequency: 100 Hz.
4	DigOut1	Switched 24 V as digital output or supply (24 V/50 mA)	Nominal voltage: 24 V ±15%. Maximum current: 50 mA. Maximum switching frequency: 100 Hz.
5	GND	Ground	–
6	DigOut2	Switched 24 V as digital output or supply (24 V/50 mA)	Nominal voltage: 24 V ±15%. Maximum current: 50 mA. Maximum switching frequency: 100 Hz.

The conductor cross-section range is 0.2–1.5 mm^2 (AWG 24–AWG 16).

NOTICE

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

11.5.6 UAUX Connector

11.5.6.1 UAUX Connector on PSM 520

The U_{AUX} connector is on the Power Supply Module (PSM 520).

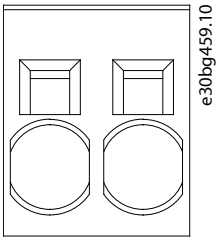

Figure 120: U_{AUX} Connector

Table 171: 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 520).	Nominal input voltage: 24 V/48 V DC ±10% Maximum current: 50 A Maximum cross-section: 16 mm^2 Maximum cable length: 3 m (9.8 ft) Conductor cross-section range 0.75–16 mm^2, solid or flexible (AWG 18–AWG 4)
2	GND		

⚠ 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.

NOTICE

- Only PELV potential can be connected to the U_{AUX} input.

11.5.6.2 UAUX Cable Cross-sections for PSM 520

Table 172: UAUX Cable Cross-sections for PSM 520

Description	Value
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

11.5.7 LCP Connector

There is an LCP connector on the front of all the system modules. It is used to connect the LCP directly via a cable. The LCP connector is a DSUB (9 pole), located on the front of the modules.

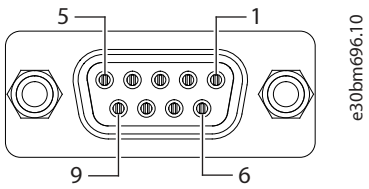

Figure 121: LCP Connector

Position numbers in Figure 121 refer to pin numbers in Table 173.

Table 173: Pin Assignment of LCP Connector

Pins	Description	Notes	Rating/parameter
1	–	–	–
2	–	–	–

Table 173: Pin Assignment of LCP Connector - (continued)

Pins	Description	Notes	Rating/parameter
3	LCP RS-485	Positive RS-485 signal [1]	–
4	–	–	–
5	GND	Ground	–
6	VCC	5 V supply for LCP	5 V±10% at 120 mA maximum load
7	–	–	–
8	/LCP RS-485	Negative RS-485 signal [1]	–
9	/LCP RESET	Reset	Active at < 0.5 V

1) Speed: 38.4 kBd. The levels fulfill the RS-485 specification.

NOTICE

- Only PELV potential can be connected to the LCP input.

11.5.8 AC Mains Connector

11.5.8.1 AC Mains Connector on PSM 520

The AC mains connector is on the bottom of the Power Supply Module (PSM 520).

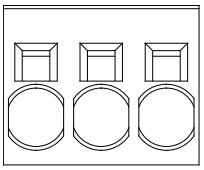

Figure 122: AC Mains Connector

Table 174: Pin Assignment of AC Mains Connector

Pins (Right to left)	Description	Notes	Rating/parameter
3	L3	Used to connect L1/L2/L3	Nominal voltage: 208–480 V AC ±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		
1	L1		

11.5.8.2 AC Mains Cable Cross-sections for PSM 520

Table 175: AC Mains Cable Cross-sections for PSM 520

	PSM 520 (10 kW)	PSM 520 (20 kW)	PSM 520 (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)

11.5.9 Motor Connector

11.5.9.1 Overview of Motor Connector

The motor connectors are located on the bottom of the Servo Drive Modules (SDM521 and SDM522).

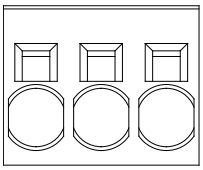

Figure 123: Motor Connector

Table 176: Pin Assignment of Motor Connector

Pins (Left to right)	Description	Notes	Rating/parameter
1	U	SDM 521 has 1 motor connector. SDM 522 has 2 motor connectors.	Nominal voltage: 208–480 V AC ±10% Nominal power: Depends on the servo drive size. Conductor cross-section range: • SDM 521 2.5–20 A_{rms}: Conductor cross-section range 0.2–6 mm^2, flexible (AWG 24–AWG 8) • SDM 521 40 A_{rms}: Conductor cross-section range 0.75–16 mm^2, solid or flexible (AWG 18–AWG 4) • SDM 522 2.5–10 A_{rms}: Conductor cross-section range 0.2–6 mm^2, flexible (AWG 24–AWG 8)
2	V		
3	W		

11.5.9.2 Motor Cable Cross-sections for SDM 521

Table 177: Motor Cable Cross-sections for SDM 521

	SDM 521 (2.5 A_{rms})	SDM 521 (5 A_{rms})	SDM 521 (10 A_{rms})	SDM 521 (20 A_{rms})	SDM 521 (40 A_{rms})
Minimum cable cross-section for CE	1.5 mm^2 (minimum 70 °C, Cu)			4 mm^2 (minimum 70 °C, Cu)	10 mm^2 (minimum 70 °C, Cu)
Minimum cable cross-section for UL	14 AWG (minimum 60 °C, Cu)			10 AWG (minimum 60 °C, Cu)	6 AWG (minimum 60 °C, Cu)

11.5.9.3 Motor Cable Cross-sections for SDM 522

Table 178: Motor Cable Cross-sections for SDM 522

	SDM 522 (2.5 A_{rms})	SDM 522 (5 A_{rms})	SDM 522 (10 A_{rms})
Minimum cable cross-section for CE	1.5 mm^2 (minimum 70 °C, Cu)		
Minimum cable cross-section for UL	14 AWG (minimum 60 °C, Cu)		

11.5.10 Relay Connector

11.5.10.1 Overview of Relay Connector

The relay connector is used for a user-defined reaction and is located on the Power Supply Module PSM 520: 1 relay connector.

NOTICE

- Only PELV potential can be connected to the relay outputs.
- The relay connector has no strain relief, if required fix the cable by other means.

11.5.10.2 Relay Connector on PSM 520

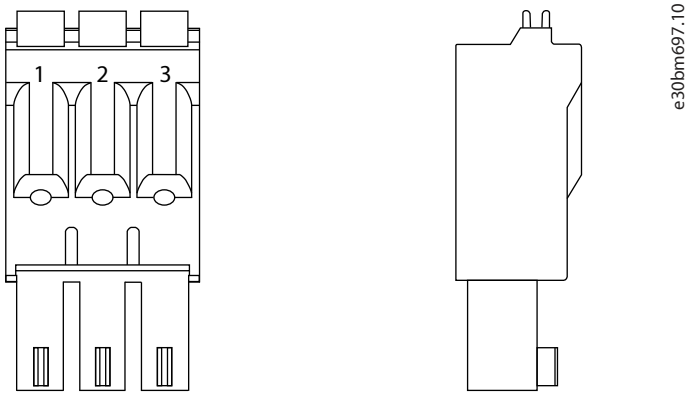

Figure 124: Relay Connector on PSM 520

Table 179: Pin Assignment of Relay Connector on PSM 520 (REL PSM)

Pins	Description	Notes	Rating/parameter
1	NC	Normally closed, 24 V DC	Nominal current: 2 A Conductor cross-section range: 0.2–1.5 mm^2 (AWG 24–AWG 16)
2	NO	Normally open, 24 V DC	
3	COM	Common	

11.5.11 STO Connectors

11.5.11.1 STO Connectors on PSM 520

There is 1 input and 1 output STO connector on the Power Supply Module (PSM 520).

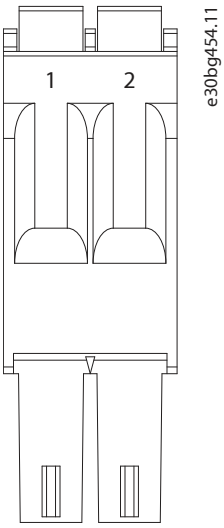

Figure 125: STO Output Connector on PSM 520

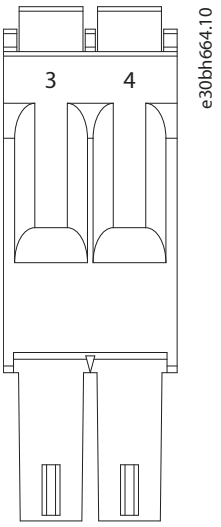

Figure 126: STO Input Connector on PSM 520

Table 180: Pin Assignment of STO Connectors on PSM 520

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 ±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+		

11.5.11.2 STO Connector on the Bottom of PSM 520 with DAM Option

There is 1 output STO connector on the bottom of the Decentral Access Module (DAM option). The output is for the hybrid cable.

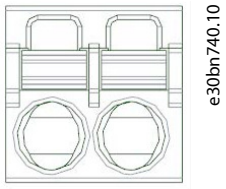

Figure 127: STO Connector DAM Output

Table 181: Pin Assignment of STO Connector on the Bottom of DAM Option

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 ±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–		

11.5.11.3 STO Connectors on SDM 521 and SDM 522

The STO connectors are on the Servo Drive Modules as follows:

- SDM 521: 1 input and 1 output STO connector
- SDM 522: 2 input and 2 output STO connectors

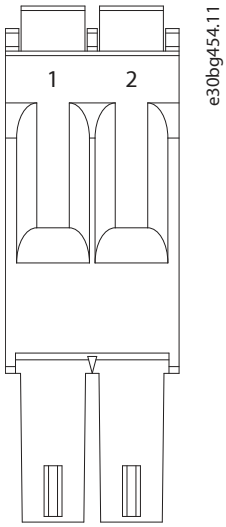

Figure 128: STO Connectors on SDM 521/SDM 522

Table 182: Pin Assignment of STO Connectors on SDM 521/SDM 522

Connector name	Pins	Description	Notes	Rating/parameter
SDM521: • STO SDM SDM522: • STO SDM1 • STO SDM2	1	STO–	Used for STO output voltage 1/2 to the input of the PSM 520, or SDM 521/2.	Nominal voltage: 24 V DC ±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 1/2.	
	4	STO+		

NOTICE

- Only PELV potential can be connected to the STO inputs.

11.5.12 UDC Connector

The UDC connector is on the bottom of the PSM 520 with DAM option.

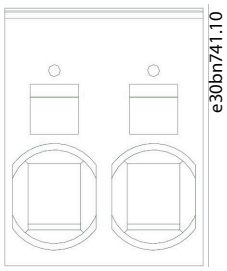

Figure 129: UDC Connector

Table 183: Pin Assignment of UDC Connector

Pins (Left to right)	Description	Notes	Rating/parameter
1	UDC+	Used to connect the DC-link voltage from the PSM 520 with DAM option to the hybrid cable for the ISD line.	Nominal voltage: 290–800 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–		

11.5.13 AUX Connector

The AUX connector is on the bottom of the PSM 520 with DAM option.

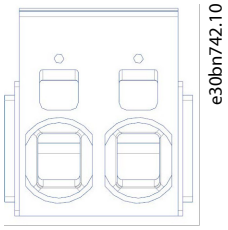

Figure 130: AUX Connector

Table 184: 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 PSM 520 with DAM option to the hybrid cable for the line of drives.	Nominal voltage: 24/48 V DC ±10% Nominal current: Depends on the number of servo drives in the application. Maximum current: 25 A Conductor cross-section range: 0.2–4 mm^2(AWG 24–AWG 12) Plug terminal tightening torque: 0.5–0.6 Nm (4.43–5.31 in-lb)
2	AUX– (GND)		

NOTICE

- Only PELV potential can be connected to the AUX output.

11.5.14 Motor Feedback Connectors

The motor feedback connectors allow the connection of an encoder or resolver to the Servo Drive Modules SDM 521/SDM 522.

SDM 521 has 1 motor feedback connector (E SDM1).

SDM 522 has 2 motor feedback connectors (E SDM1 and E SDM2).

The motor feedback connectors fulfill the following specifications:

- BISS B
- BISS C
- SSI
- Resolver
- EnDat 2.1
- EnDat 2.2
- For HIPERFACE DSL® and EnDat 3®, refer to the connector in 11.5.3.3 Brake, Motor Temperature Sensor and HIPERFACE® DSL or EnDat 3® Connector on SDM 521/SDM 522 .

Use a shielded feedback cable that fulfills the requirements for the used feedback type. The maximum cable length is 80 m (262.5 ft).

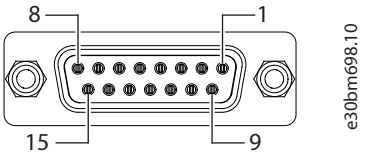

Figure 131: Motor Feedback Connector on SDM 521/SDM 522

Position numbers in Figure 131 refer to pin numbers in Table 185.

Table 185: Pin Assignment of Motor Feedback Connectors E SDM1 and E SDM2

Pins	Description	Resolver	BISS B, BISS C, SSI	HIPERFACE®	EnDat 2.1 and 2.2	Rating/parameter
1	SUPPLY+[1]	–	X	X	X	+5/11 V (depending on feedback type), maximum 250 mA.
2	SUPPLY_SENSE+[2]	–	X	X	X	Positive supply sense line.
3	TEMP+	X	X	X	X	Motor temperature sensor input.
4	RESSY	X	–	–	[3]	Resolver positive exciter output.
5	RESCOS+	X	–	X	[3]	Resolver positive cosine input.
6	RESSIN+	X	–	X	[3]	Resolver positive sine input.
7	ENC_CLK-	–	X	–	X	Encoder negative clock signal.
8	ENC_RXTX-	–	X	X	X	Encoder negative data signal.
9	GND	–	X	X	X	Ground.
10	TEMP-	X	X	X	X	Motor temperature sensor input.
11	RESSY-	X	–	–	[3]	Resolver negative exciter output.
12	RESCOS-	X	–	X	[3]	Resolver negative cosine input.
13	RESSIN-	X	–	X	[3]	Resolver negative sine input.
14	ENC_CLK+	–	X	–	X	Encoder positive clock signal.
15	ENC_RXTX+	–	X	X	X	Encoder positive data signal.

1) The supply switches automatically between 5 V and 11 V depending on which feedback type is selected.

2) To activate the internal power supply compensation, connect only the positive sense lines (SUPPLY_SENSE+, pin 2) on the motor side to the supply (SUPPLY+, pin 1). This automatically adapts the supply voltage, depending on the cable length, and compensates the voltage drop over the feedback cable.

3) The SINE and COSINE signals are optional for EnDat.

NOTICE

- The motor temperature measurement can either be connected to the motor feedback connector or the brake and motor temperature sensor connector on the servo drive module SDM 521/SDM 522 (see 11.5.3.3 Brake, Motor Temperature Sensor and HIPERFACE® DSL or EnDat 3® Connector on SDM 521/SDM 522). The connectors cannot be connected in parallel.
- The motor temperature measurement can either be connected to the motor feedback connector or the brake and motor temperature sensor connector on the servo drive module SDM 521/SDM 522. The connectors cannot be connected in parallel.

NOTICE

- Only PELV potential can be connected to the motor feedback connector.

11.5.15 Expansion Module Connector

11.5.15.1 Expansion Module Connector on EXM 520

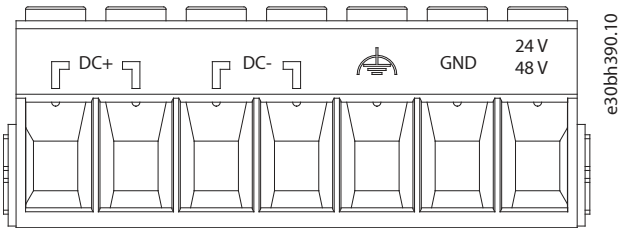

Figure 132: Expansion Module Connector

Table 186: 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 520 EMC plate.	Nominal voltage: 290–680 V DC Maximum voltage: 290–800 V DC Nominal current: Depends on the number of servo drives in the application. Maximum current: 62 A(1) 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)
2			
3	DC–		
4			
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 520 modules, 2 pairs of EXM 520 modules can be used to achieve a maximum current rating of 124 A.

11.5.15.2 Cable Cross-sections for EXM 520

Table 187: Minimum Cable Cross-sections for EXM 520 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.

11.6 General Specifications and Environmental Conditions for MSD 520 System

Table 188: General Specifications and Environmental Conditions for MSD 520 System

Specification	Value
Protection rating	IP20 according to IEC/EN 60529 (except connectors, which are IP00). **⚠ WARNING** RISK OF ELECTRICAL SHOCK The IP20 rating of system modules is not fulfilled if the system is operated with a module that is not connected to the backplate. This may result in death or serious injury. • Do not touch the backplate when a module is removed from the backplate.
Vibration test	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 (Surrounding air temperature)	Operating: 5–40 °C (41–104 °F) nominal, up to 55 °C (131 °F) with derating (see Figure 133)
	Transport: (-25 °C...+55 °C) (-13 °F...+131 °F)
	Storage: (-25 °C...+55 °C) (-13 °F...+131 °F)
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 allowed.
EMC standard for emission and immunity	EN 61800-3
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 61800-5-1	III

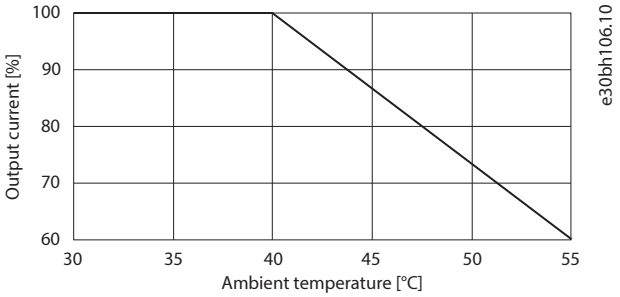

Figure 133: Derating

11.7 Storage

Store the system components in a dry, dust-free location with low vibration (v_{eff} ≤0.2 mm/s).

The storage location must be free from corrosive gases.

Avoid sudden temperature changes.

Long-term storage

To recondition the electrolytic capacitors, system components that are not in service must be connected to a supply source once per year. This allows the capacitors to charge and discharge, and prevents them from suffering permanent damage.

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