ENGINEERING
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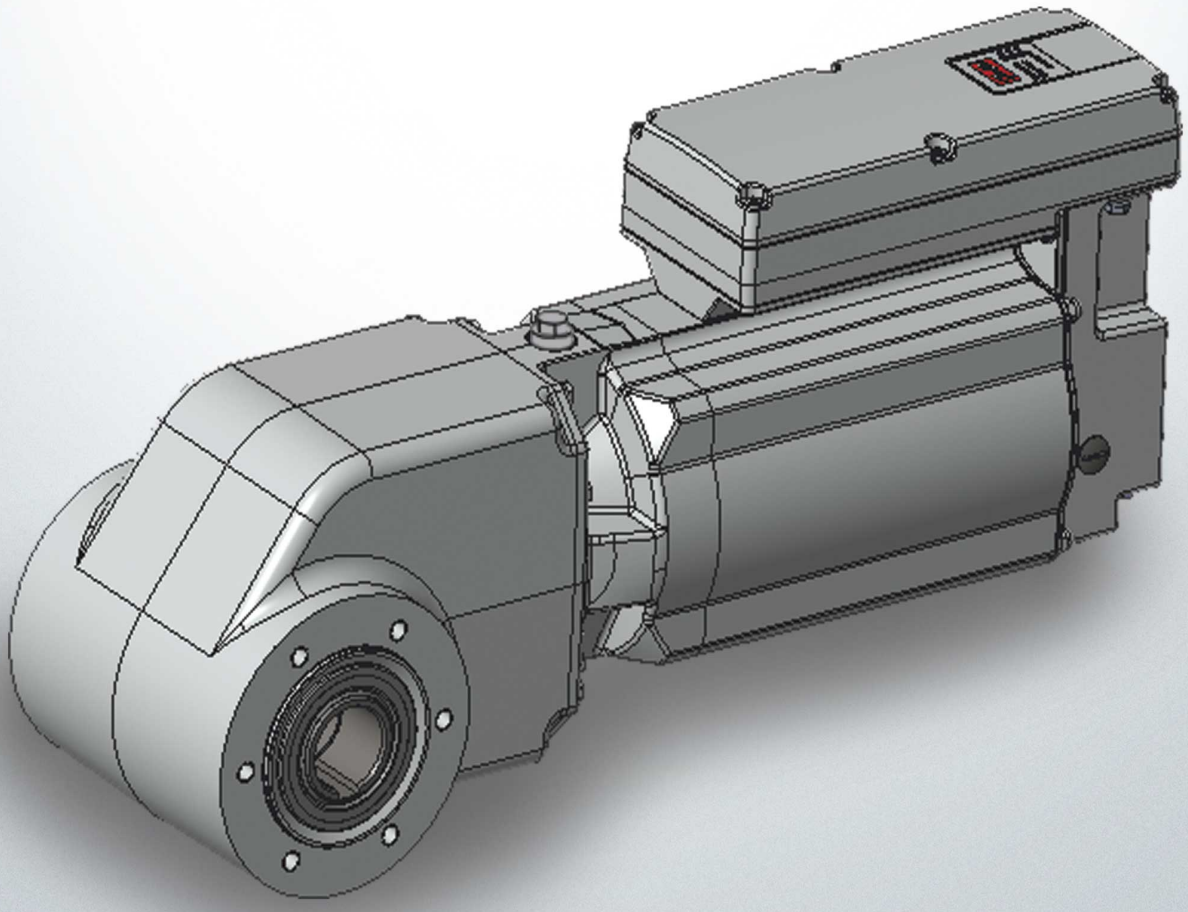
Operating Guide

VLT® Integrated Gear Drive IGD 510 System



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1 Introduction

1.1 Purpose of the Operating Guide

The purpose of this operating guide is to describe the VLT® Integrated Gear Drive IGD 510 system. The operating guide contains information about:

- Safety
- Installation
- Commissioning
- Maintenance and repair
- Specifications
- Options and accessories

This operating guide is intended for use by qualified personnel. Read this operating guide in full in order to use the IGD 510 system safely and professionally. Pay particular attention to the safety instructions and general warnings.

This operating guide is a part of the IGD 510 and also contains important service information. Always keep this operating guide available with the IGD 510 system.

Compliance with the information in this operating guide is a prerequisite for:

- Trouble-free operation.
- Recognition of product liability claims.

Therefore, read this operating guide before working on or with the IGD 510 system.

1.2 Approvals and Certifications

Table 1: 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 60204-1	Safety of machinery - Electrical equipment of machines. Part 1: General requirements.
IEC/EN 62061	Safety of machinery - Functional safety of safety-related electrical, electronic, and programmable electron- ic controlsystems.

Certification	Description
IEC/EN 61326-3-1	Electrical equipment for measurement, control, and laboratory use - EMC requirements. Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications.
2006/42/EC	Machinery Directive
2014/30/EU	EMC Directive
2014/35/EU	Low Voltage Directive
RoHS (2011/65/EU)	Restriction of hazardous substances.
PROFINET RT/IRT®	Ethernet-based fieldbus system.

1.3 Areas of Application

Potential areas of application for the VLT® Integrated Gear Drive IGD 510 system are:

- Conveyors for food and beverage machines
- Conveyors for packaging machines
- Conveyors for pharmaceutical machines
- Applications running with a group of decentral gear drives

1.4 Software Updates

Updates to the firmware, VLT® Servo Toolbox software may be available. When updates are available, they can be downloaded from the danfoss.com website.

The VLT® Servo Toolbox software can be used to install the firmware on the IGD 510, Decentral Access Module (DAM 510), Power Supply Module (PSM 510), and Auxiliary Capacitors Module (SDM 510).

1.5 Terminology

Table 2: Terminology

Term	Description
IGD 510	Integrated Gear Drive
System modules	Includes the Power Supply Module (PSM 510), Decentral Access Module (DAM 510), and the Auxiliary Capacitors Module (ACM 510).
PSM 510	Power Supply Module that generates a 600 V DC power supply.
DAM 510	Decentral Access Module that connects the IGD 510 drives to the system via a hybrid cable.
ACM 510	Auxiliary Capacitors Module
PLC	External device for controlling the IGD 510 system.
Connection box	Box for easy connection to the IGD 510.

2 Safety

2.1 Safety Symbols

The following symbols are used in this guide:

⚠ WARNING ⚠

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

⚠ CAUTION ⚠

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

NOTICE

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

2.2 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 IGD 510 system and its components.
- Only suitably trained and qualified personnel may work on the IGD 510 system and its components or in its vicinity.
- Only use accessories and spare parts approved by Danfoss.
- Comply with the specified ambient conditions.
- The information in this manual about the use of available components is provided solely by way of examples of applications and suggestions.
- The plant engineer or system engineer is personally responsible for checking the suitability of the supplied components and the information provided in this manual for the specific application concerned:
  - For compliance with the safety regulations and standards relevant to the specific application.
  - For implementing the necessary measures, changes, and extensions.
- Commissioning the IGD 510 system or its components is not allowed until it has been ascertained that the machine, system, or plant in which they are installed conforms to the statutory provisions, safety regulations, and standards that apply to the application in the country of use.
- Operation is only allowed in compliance with the national EMC regulations for the application concerned.
- Compliance with the limit values specified by national regulations is the responsibility of the producer of the plant, system, or machine.
- Compliance with the specifications, connection conditions, and installation conditions in this manual is mandatory.
- The safety regulations and safety provisions of the country in which the equipment is used must be observed.
- To protect the user against electrical shock and to protect the IGD 510 system against overload, protective grounding is obligatory and must be performed in accordance with local and national regulations.

2.2.1 Operational Safety

Operational safety

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

2.3 Important Safety Warnings

The following safety instructions and precautions relate to the IGD 510 system. Read the safety instructions carefully before starting to work in any way with the IGD 510 system or its components. Pay particular attention to the safety instructions in the relevant sections of this manual.

⚠ WARNING ⚠

HAZARDOUS SITUATION

If the IGD 510 drive or the bus lines are incorrectly connected, there is a risk of death, serious injury, or damage to the unit.

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

⚠ WARNING ⚠

HIGH VOLTAGE

The IGD 510 system contains components that operate at high voltage when connected to the electrical supply network. There are no indicators on the components that indicate the presence of mains supply. Incorrect installation, commissioning, or maintenance may lead to death or serious injury.

- Installation, start-up, maintenance, and decommissioning must only be performed by qualified personnel.
- Before working on any connectors in the IGD 510 system (disconnecting or connecting the cable to the VLT® Integrated Gear Drive IGD 510), disconnect the PSM 510 from the mains and wait for the discharge time to elapse.

⚠ CAUTION ⚠

DANGER OF BURNS

The surface of the VLT® Integrated Gear Drive IGD 510 and the oil in the IGD 510 can reach high temperatures during operation.

- Do not touch the IGD 510 until it has cooled down.
- Do not carry out an oil change until the oil has cooled down sufficiently.

⚠ WARNING ⚠

LEAKAGE/GROUNDING CURRENT HAZARD

Leakage/grounding currents are >3.5 mA. Improper grounding of the IGD 510 system components may result in death or serious injury.

- For reasons of operator safety, use a certified electrical installer to ground the components of the IGD 510 system correctly in accordance with the applicable local and national electrical standards and directives, and the instructions in this manual.

NOTICE

RCD COMPATIBILITY

The IGD 510 system contains components that can cause a DC current in the protective earthing conductor, which may result in damage to the components of the IGD 510 system and any other devices connected to the system.

- Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, use a type B RCD or RCM device on the supply side of the IGD 510 system components.

⚠ WARNING ⚠

UNINTENDED START

The IGD 510 system contains drives that are connected to the electrical supply network and can start running at any time. This may be caused by a fieldbus command, a reference signal, or clearing a fault condition.

- Take suitable measures to prevent unintended starts and to ensure that unintended movement cannot pose any danger.

⚠ WARNING ⚠

DISCHARGE TIME

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

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

Minimum waiting time (minutes)
15

⚠ DANGER ⚠

- Risque du choc électrique. Une tension dangereuse peut être présentée jusqu'à 15 min après avoir coupé l'alimentation.

⚠ WARNING ⚠

UNINTENDED MOVEMENT

Unintended movement may occur when parameter changes are carried out immediately, 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.

2.4 Qualified Personnel

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

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

2.5 Due Diligence

The operator and/or fabricator must ensure that:

- The IGD 510 system is only used as intended.
- The IGD 510 and system components are only operated in a perfect operational condition.
- The operating guide is always available near the IGD 510 system in complete and readable form.
- The IGD 510 system is only fitted, installed, commissioned, and maintained by adequately qualified and authorized personnel.
- Qualified personnel are regularly instructed on all relevant matters of occupational safety and environmental protection, as well as the contents of the operating guide and in particular the instructions it contains.
- The product markings and identification markings applied to the IGD 510, 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, which are applicable at the place of use, are complied with.
- The users always have all current information relevant to their interests about the IGD 510 system and its use and operation.

2.6 Intended Use

The components of the IGD 510 system are intended to be installed in machines used in industrial environments in accordance with local laws and standards.

NOTICE

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

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

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

2.6.1 Prohibited Application Areas

The IGD 510 system **may not** be used in the following application areas:

- Areas with potentially explosive atmospheres.
- Mobile or portable systems.
- Floating or airborne systems.
- Inhabited facilities.
- Sites where radioactive materials are present.
- Areas with extreme temperature variations or in which the maximum rated temperatures may be exceeded.
- Under water.

2.7 Forseeable Misuse

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

2.8 Service and Support

Contact the local service representative for service and support.

3 System Description

3.1 Overview of the VLT® Integrated Gear Drive IGD 510 System

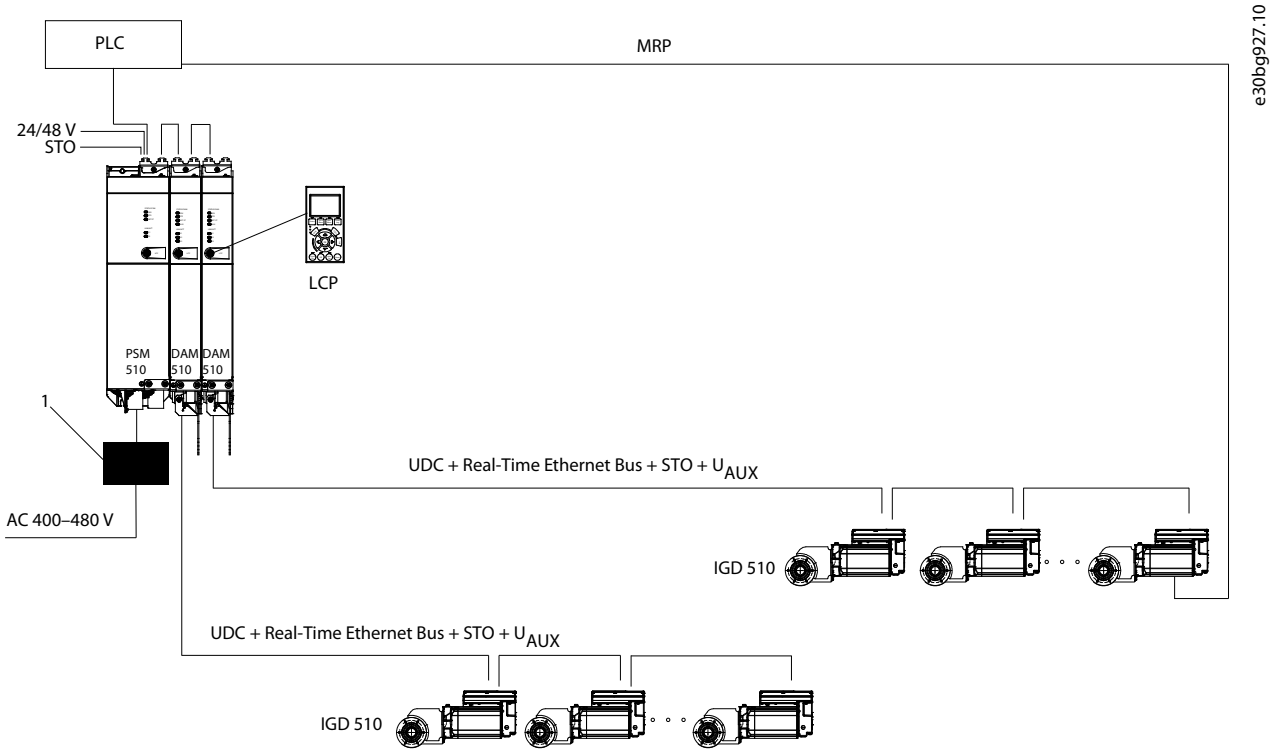


Illustration 1: Overview of the VLT® Integrated Gear Drive IGD 510 System

IGD is the abbreviation of Integrated Gear Drive. The VLT® Integrated Gear Drive IGD 510 system is a high-performance decentral conveyer motion solution. The system supports the Ethernet system PROFINET® RT.

The system comprises:

- Integrated Gear Drive (IGD 510)
- Power Supply Module (PSM 510)
- Decentral Access Module (DAM 510)
- Auxiliary Capacitors Module (ACM 510), optional
- Software
  - Firmware for the Integrated Gear Drive (IGD 510)
  - Firmware for the Power Supply Module (PSM 510)
  - Firmware for the Decentral Access Module (DAM 510)
  - Firmware for the Auxiliary Capacitors Module (ACM 510)
  - VLT® ServoToolbox
  - PLC libraries for Siemens S7 and TIA® portal (contact Danfoss for availability)

The system modules PSM 510, DAM 510, and ACM 510 are mounted to a backplate located in the control cabinet. The DC-link and the control voltage are integrated in the backplate. The 'click and lock' backplate concept offers easy mounting and installation.

The connection box offers easy connection to the IGD 510.

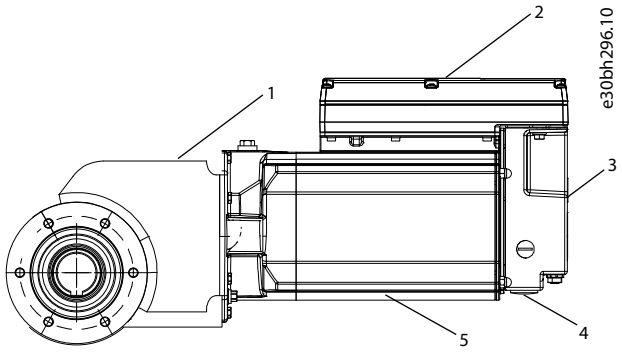
NOTICE

- The IGD 510 and the system modules cannot be used in DC systems from other manufacturers. Drives from other manufacturers cannot be used in the IGD 510 system.
- Contact Danfoss for further information.

3.2 IGD 510 Gear Drive

The IGD 510 is a single-axis, integrated gear drive and is available for mounting in 2 positions: P1 and P3 (see 10.2.3.2 Oil Volume).

The IGD 510 is connected via a connection box to 2 hybrid cables. The connectors inside the box are for Ethernet, STO, AUX, and UDC. In the extended version of the connection box, 2 x M12 and 1 x M8 external accessible connectors are integrated into the connection box. The connection box also has a looping function that enables the system to be implemented in daisy-chain format.



1 Gear	**2** Drive
3 Connection box	**4** Cable output
5 Motor	

Illustration 2: VLT® Integrated Gear Drive IGD 510

3.3 Power Supply Module (PSM 510)

3.3.1 Overview

PSM is the abbreviation for Power Supply Module. It is the power supply to the IGD 510 system. The PSM 510 generates a 600 V DC power supply and guarantees high density output. The PSM 510 can be controlled via Ethernet-based fieldbus.

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

NOTICE

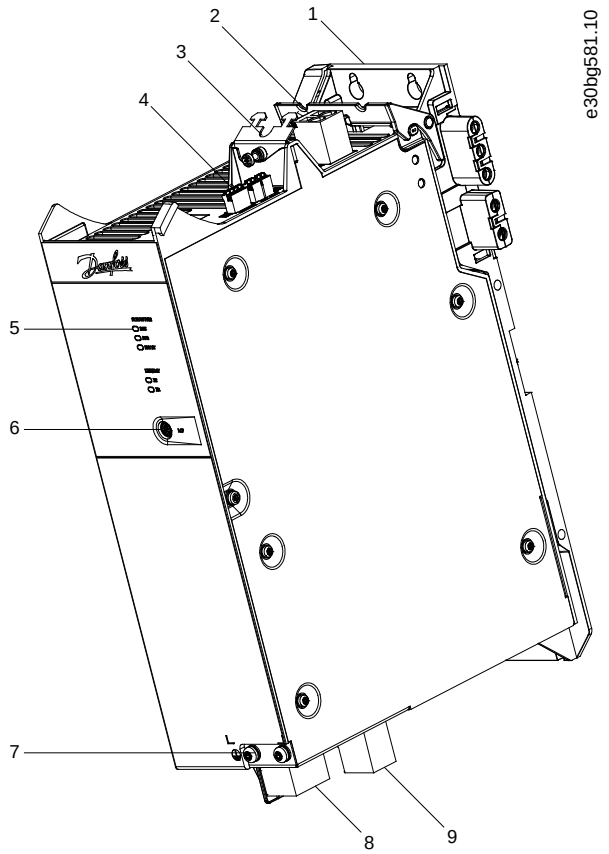
- The system modules are designed for use within a control cabinet. If the STO function is used, the cabinet must be rated at least IP54.
- The PSM 510 has an IP-rating of IP20.
- The PSM 510 may be damaged if exposed to fluids.

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

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

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

The typecode for the PSM 510 is: MSD510PSM510F2P10C0D6E20PLSXXXXXXXXXXXXX.

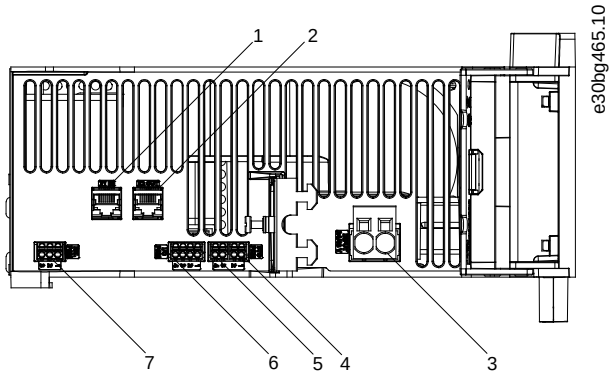


1	Backplate	**2**	24/48 V input connector
3	Cable relief and shielding	**4**	Connectors: I/O, STO, relay, and Ethernet
5	Operating LEDs	**6**	LCP connector
7	PE screw	**8**	AC mains supply connector

9 Internal/external brake resistor connector	

Illustration 3: PSM 510

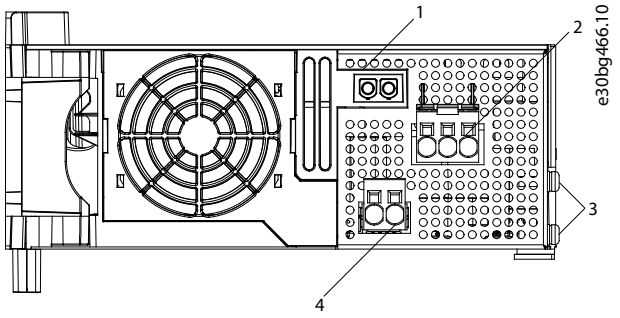
3.3.2 Connectors on the Top of PSM 510



1 Ethernet connector IN	**2** Ethernet connector OUT
3 24/48 V IN connector	**4** STO connector IN
5 STO connector OUT	**6** I/O connector
7 Relay connector	

Illustration 4: Connectors on the Top of PSM 510

3.3.3 Connectors on the Bottom of PSM 510



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

Illustration 5: Connectors on the Bottom of PSM 510

3.4 Decentral Access Module (DAM 510)

3.4.1 Overview

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

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

- Overcurrent protection of the hybrid cable
- Overvoltage protection
- Charging circuit of the DC-link
- External encoder connection
- DC-link buffer for the IGD 510 drives

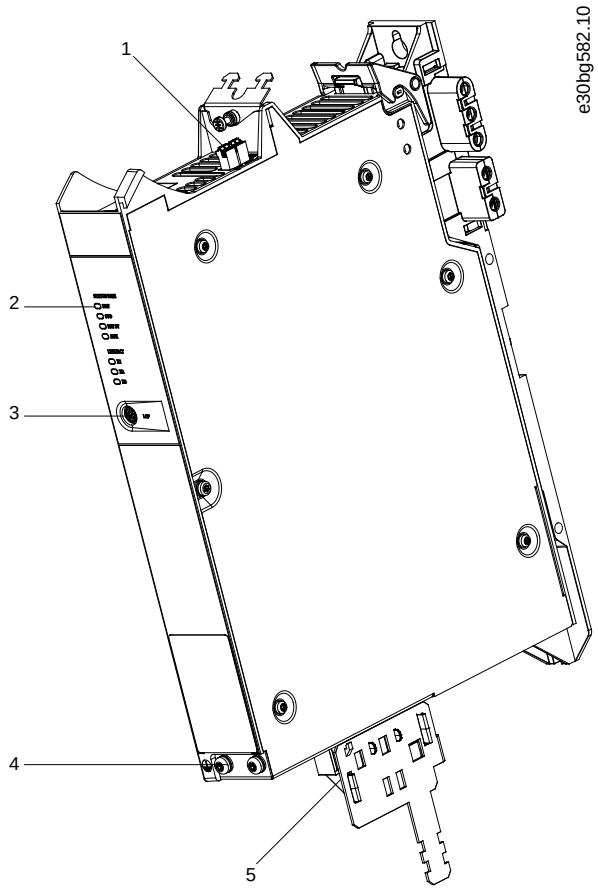
The DAM 510 can be controlled via Ethernet-based fieldbus.

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

NOTICE

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

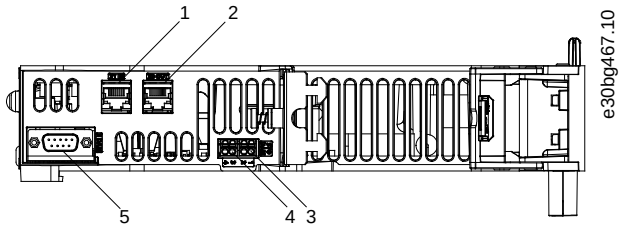
The type code for the DAM 510 is: MSD510DAM510F1C015AD6E20PLSXXXXXXXXXXXXX.



1	Connectors: I/O, STO, relay, and Ethernet	**2**	Operating LEDs
3	LCP connector	**4**	PE screw
5	Connectors: UDC, AUX, STO out, and Ethernet		

Illustration 6: DAM 510

3.4.2 Connectors on the Top of DAM 510

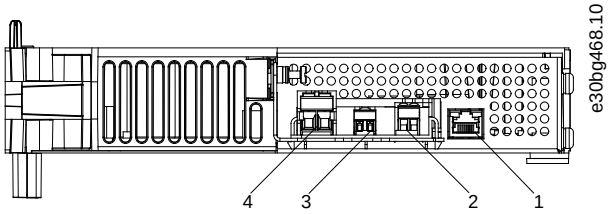


1	Ethernet connector IN	**2**	Ethernet connector OUT
3	STO connector IN	**4**	STO connector OUT

5 External encoder connector	

Illustration 7: Connectors on the Top of DAM 510

3.4.3 Connectors on the Bottom of DAM 510



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

Illustration 8: Connectors on the Bottom of DAM 510

3.5 Auxiliary Capacitors Module (ACM 510)

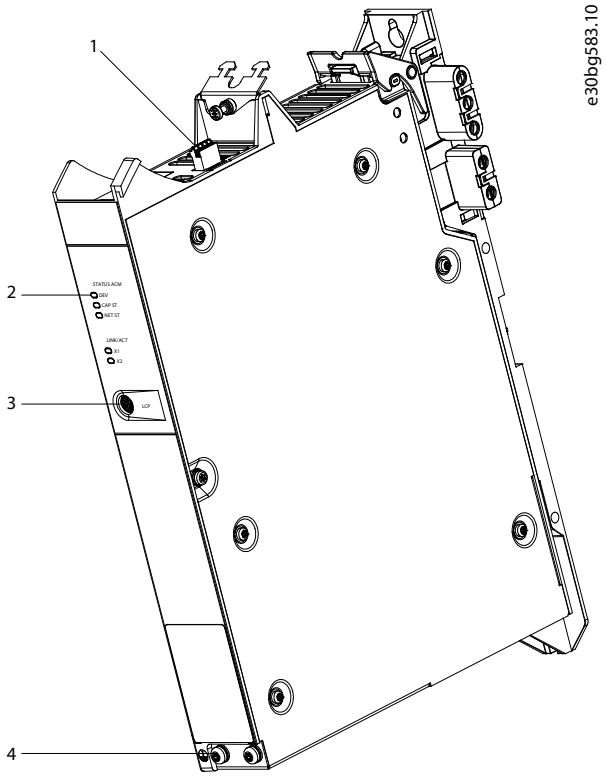
3.5.1 Overview

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

NOTICE

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

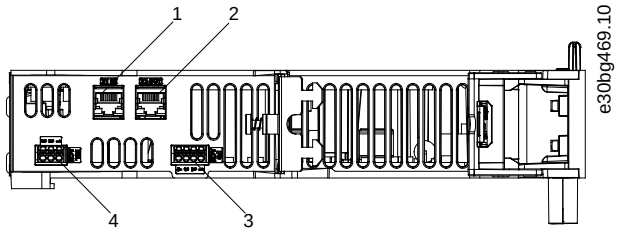
The type code for the ACM 510 is: MSD510ACM510F1E00C8D6E20PLSXXXXXXXXXXXXX.



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

Illustration 9: ACM 510

3.5.2 Connectors on the Top of ACM 510



1 Ethernet connector IN	**2** Ethernet connector OUT
3 I/O connector	**4** Relay connector

Illustration 10: Connectors on the Top of ACM 510

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 can be connected to all modules in the IGD 510 system using an optional cable (M8 to LCP SUB-D extension cable).

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 line on the DAM 510.

The LCP can be mounted on the front of the control cabinet using a mounting set (available as an accessory) and then connected to the modules via M8 to SUB-D cables (available as an accessory). See the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 Design Guide** for accessory order numbers.

NOTICE

- Further information on the LCP functions can be found in the **VLT® Servo Drive System ISD 510, DSD 510, MSD 510 Programming Guide**.

3.7 Software

The software for the IGD 510 system comprises:

- The pre-installed firmware on the PSM 510, DAM 510, ACM 510, and IGD 510 drives.
- VLT® Servo Toolbox: A Danfoss PC-based software tool for commissioning and debugging the devices.

3.8 Cables

3.8.1 Hybrid Cable

Use a hybrid cable that is approved by Danfoss. Contact Danfoss for further information.

The hybrid cable is used to connect the 1st IGD 510 drive of a line to the connection point on the Decentral Access Module (DAM 510).

There are 2 types of hybrid cable:

- Cable with UDC± with gauge of 2.5 mm^2.
- Cable with UDC± with gauge of 4 mm^2.

The connectors for the hybrid cable are mounted on the corresponding terminals on the Decentral Access Module (DAM 510).

3.8.2 Ethernet Cable

Table 3: Ethernet Cable Recommendations

	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 100 m each)
Crosstalk damping	24 dB (at 100 Mhz and 100 m each)
Return loss	10 dB (100 m each)
Surge impedance	100 Ω
Maximum cable length	100 m between switches or network devices

NOTICE

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

3.9 Cable Layout and Routing

The PSM 510, DAM 510, and ACM 510 are connected via the backlink connector (see 11.2.5.1 Backlink Connector).

Connect the real-time Ethernet fieldbus to the PSM 510 using a standard Ethernet cable (not provided).

Use the Ethernet loop hybrid cable to connect from the PSM 510 to the other system modules in daisy-chain format.

3.9.1 Maximum Cable Lengths

Table 4: Maximum Cable Lengths

Cable/specification	Maximum length
Feed-in	40 m
Hybrid cable for connecting the IGD 510 drives in daisy-chain format	25 m
Cable for connecting extra fieldbus devices	Maximum length to next port: 100 m
Maximum cable length per line	100 m

3.9.2 Standard Cabling Concept for 2 Decentral Access Modules (DAM 510)

In this example, a hybrid feed-in cable with quick-release connectors provides the supply voltage from the DAM 510 to the 1st IGD 510 drive.

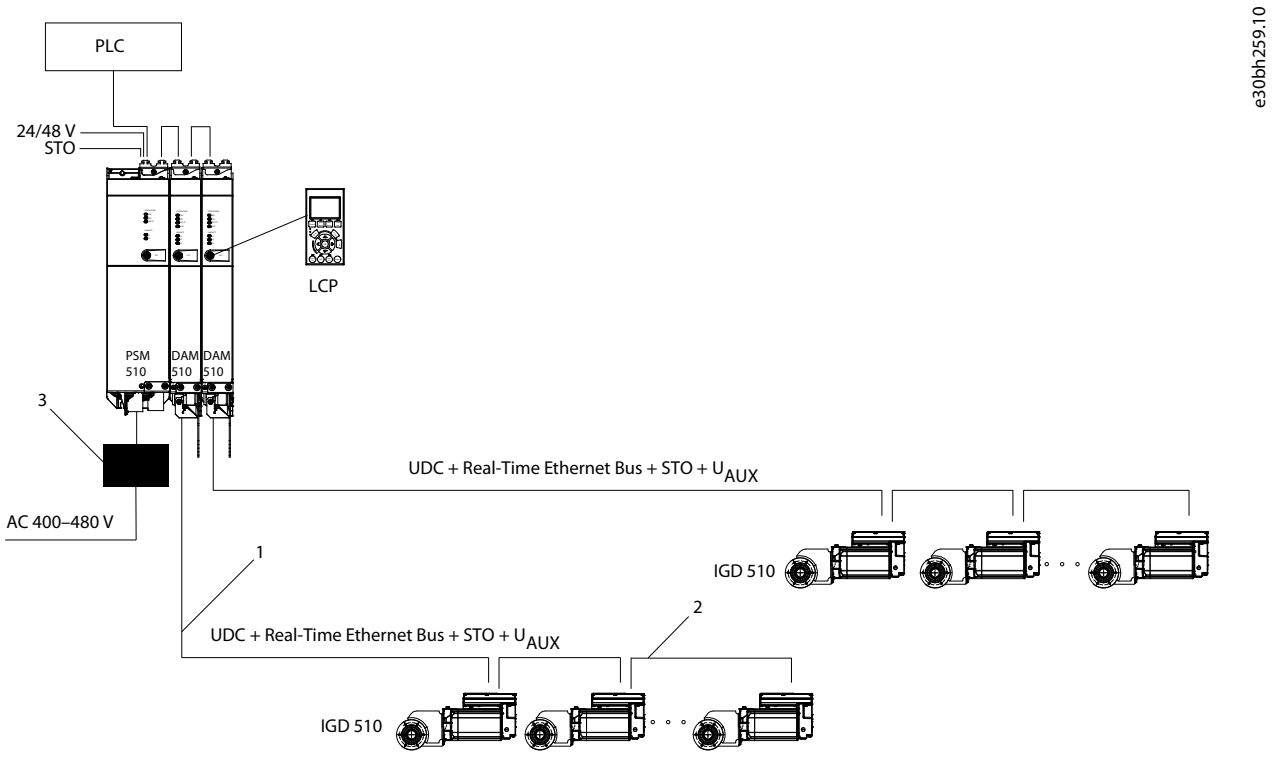


Illustration 11: Standard Cabling Concept for 2 Decentral Access Modules (DAM 510)

4 Mechanical Installation

4.1 Items Supplied

Depending on the application, the items supplied with the VLT® Integrated Gear Drive IGD 510 system are:

- VLT® Integrated Gear Drive IGD 510.
- VLT® Power Supply Module (PSM 510)
- VLT® Decentral Access Module (DAM 510)
- VLT® Auxiliary Capacitors Module (ACM 510), optional
- This operating guide
- Hybrid cables
- Eyebolt
- Plastic cap for eyebolt opening
- Torque arm, optional
- Hollow shaft cover with 3 washers and fixing screws
- Disc and retaining ring

4.2 Transport

Before transporting the VLT® Integrated Gear Drive IGD 510, ensure the eyebolt provided is firmly tightened down to its bearing surface. Only use the eyebolt to transport the IGD 510 and not for lifting attached machines.

Avoid vibration, heavy impacts, and blows during transport.

4.3 Inspection on Receipt

After receiving the delivery, immediately check whether the item supplied matches the shipping documents. Danfoss does not honor claims for faults registered later.

Register a complaint immediately:

- With the carrier, if there is visible transport damage.
- With the responsible Danfoss representative, if there are visible defects or the delivery is incomplete.

Do not carry out commissioning if the VLT® Integrated Gear Drive IGD 510 or the system modules are damaged.

4.4 Safety Measures during Installation

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

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

4.5 Protection Rating

The VLT® Integrated Gear Drive IGD 510 complies with EN 60529 and IEC 34-5/529.

The IGD 510 is suitable for use in aggressive areas and is supplied in protection rating IP67 as standard.

4.6 Protective Coating

NOTICE

DAMAGE TO THE PROTECTIVE COATING

Damage to the paint coating reduces its protective function.

- Handle the VLT® Integrated Gear Drive IGD 510 with care and do not place it on any rough surfaces.

4.7 Mounting Arrangement

⚠ CAUTION ⚠

HIGH TORQUE AND FORCE

Depending on the reduction ratio, the VLT® Integrated Gear Drive IGD 510 develops substantially higher torques and forces than high-speed motors of similar power. The installer is responsible for the mechanical protection depending on the back driving torques.

- Rate the mounts, substructure, and torque restraint for the high forces anticipated during operation. Secure them sufficiently against loosening.

Avoid vibration when installing the IGD 510.

Contact Danfoss for installation locations with abnormal operating conditions (for example high ambient temperatures >40 °C (104 °F)). Ensure that the fresh air intake is not restricted by unsuitable installation or build-up of dirt. If unexpected overheating occurs, refer to 10.2.2 Inspection during Operation.

With certain layouts (for example unventilated machines), temperatures on the surface may exceed the limits of EN ISO 13732-1, but still be within the specified limits for the IGD 510. If the IGD 510 is installed in a place where it is subject to intensive contact, the installer or operator must provide protective shielding.

Take care when fitting the shaft with keyway onto the hollow shaft of the IGD 510, which is finished to ISO H7. Use the tapped end hole intended for this purpose according to DIN 332.

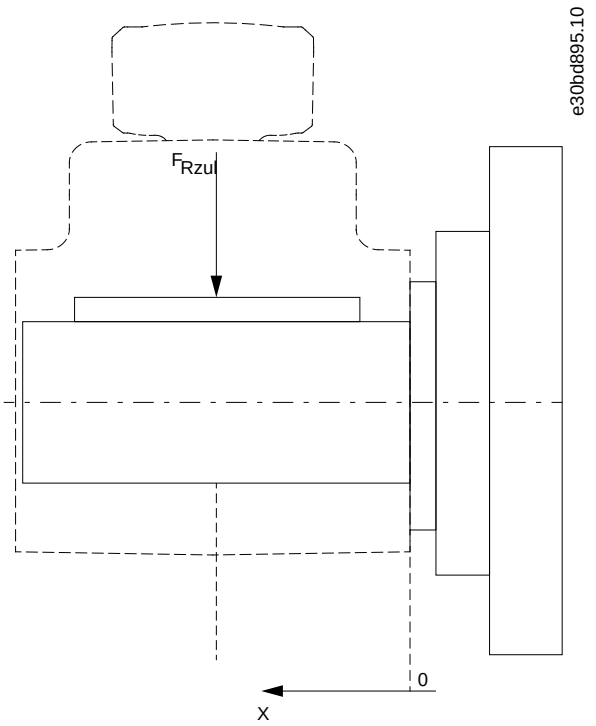


Illustration 12: Maximum Force

Table 5: Maximum Force

Up to n2 [RPM]	F_{RZUL} [N] up to X [mm] (1)				
	25	**50**	**75**	**100**	**125**
50	4319	3763	3335	2994	2716
100	3023	2634	2334	2096	1901
200	1727	1505	1334	1198	1086
360	1404	1223	1084	973	883

[1] *X is the distance from the surface of the hollow shaft to the force location.*

4.8 Dimensions of the Shaft and Disc

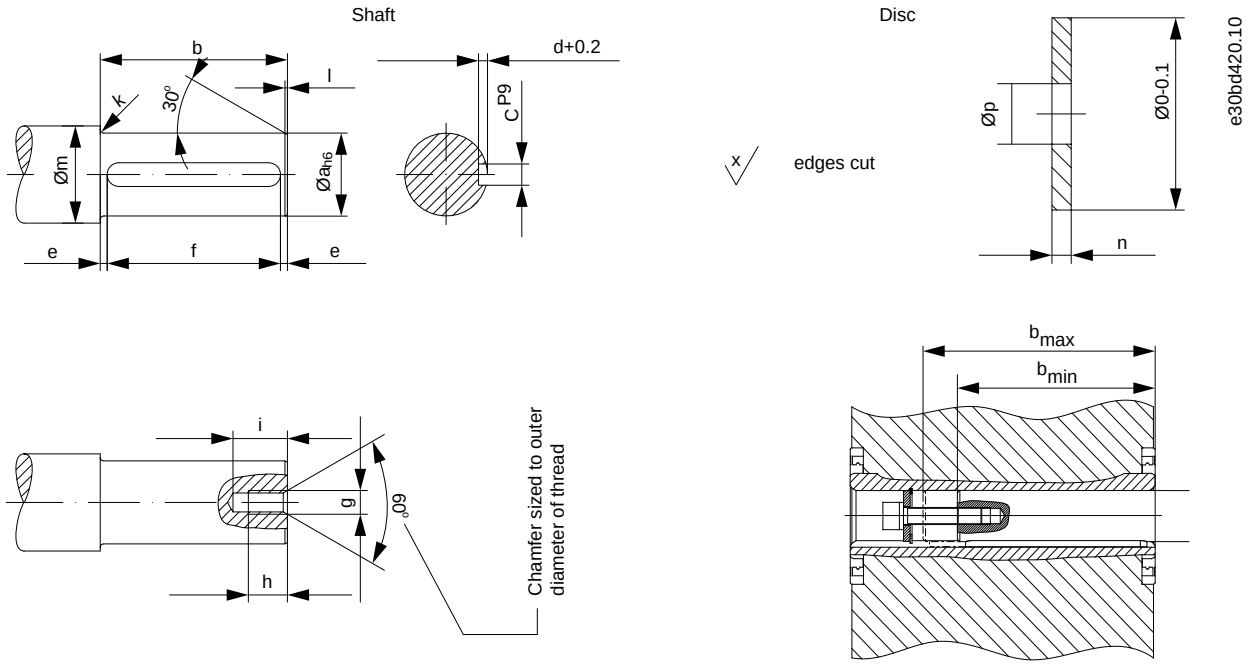


Illustration 13: Axial Fastening

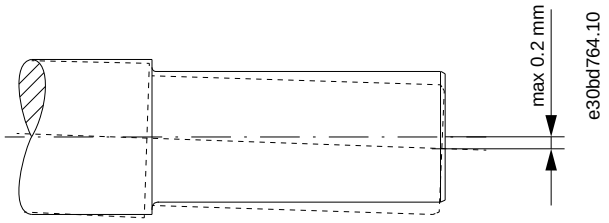


Illustration 14: Maximum Permitted Eccentricity of the Conveyor

Table 6: Dimensions of the Shaft and Disc

Type	Shaft [mm]													Disc [mm]		
	a	b_{min}	b_{max}	c	d	e	f [1]	g	h	i	k	l	m	n	o	p
IGD-30	30	120	140	8	4	5	100	M10	22	30	3	1.5	38	4	29.8	11
IGD-35	35	120	140	10	5	5	100	M12	28	37	3	1.5	43	4	34.8	13
IGD-40	40	120	140	12	5	5	100	M16	36	45	3	2	48	4	39.8	17

[1] *Key length required for b_{min}. Adapt the key length according to the shaft length used (b).*

The dimensions shown could differ from the customer conditions and must potentially be changed by the customer.

4.9 Mounting Procedure

Procedure

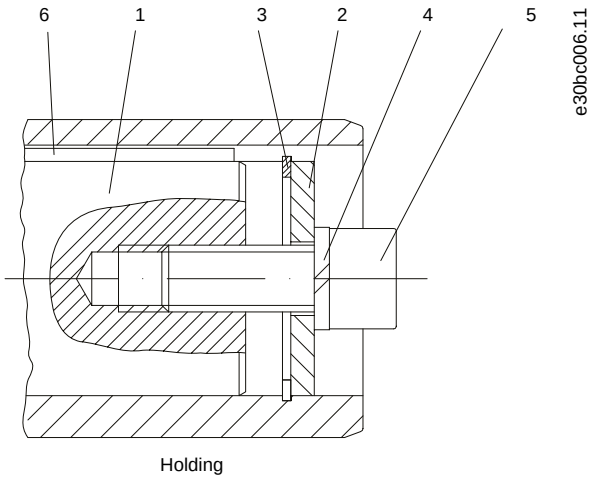
1. Fasten the VLT® Integrated Gear Drive IGD 510 by its flange using the torque arm
2. Attach the IGD 510 on to the driven shaft using the means provided.

NOTICE

- Use grease to mount the VLT® Integrated Gear Drive IGD 510 onto the shaft. For example, CASTROL Obeen Paste NH1, ARAL Noco Fluid, or similar. Always use a stainless steel key with the IGD 510 and the stainless steel hollow shafts option.

4.10 Assembly Kit

4.10.1 Overview



1	Shaft	**2**	Disc
3	Retaining ring	**4**	Lock washer
5	Fixing screw (fillister head)	**6**	Key

Illustration 15: Assembly Kit

4.10.2 Dimensions

Table 7: Dimensions of Assembly Kit Items

Type	Dimensions [mm]			
	Stainless steel retaining ring [3] **DIN 472**	**Lock washer [4]** **DIN 7980**	**Fixing screw [5]** **DIN 912-8.8**	**Key [6]** **DIN 6885** **Width x Height x Length**

Type	Dimensions [mm]			
IGD-30	30 x 1.2	10	M10 x 30	A 8 x 7 x 100 [1]
IGD-35	35 x 1.5	12	M12 x 35	A 10 x 8 x 100 [1]
IGD-40	40 x 1.75	16	M16 x 35	A 12 x 8 x 100 [1]

[1] *Key length for bmin is shown in 4.8 Dimensions of the Shaft and Disc. Adapt the key length according to the shaft length used.*

4.10.3 Mounting Procedure

Procedure

1. Rotate the disc [2] and fit it against the retaining ring [3].
   Both items are supplied.
2. Insert the lock washer [4] and fixing screw [5].
   Both items are not supplied and depend on the length and size of the shaft. See 4.7 Mounting Arrangement for further information.
3. Tighten the fixing screw.

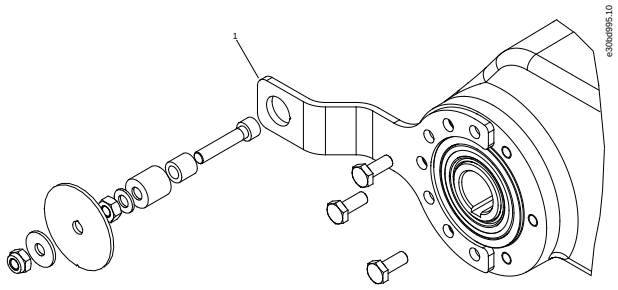
4.11 Torque Restraint

The VLT® Integrated Gear Drive IGD 510 requires a suitable torque restraint to resist the reaction torque. The torque arm with mounting set is available as an option.

Ensure that the torque arm does not create excessive constraining forces, for example due to the driven shaft running untrue. Excessive backlash can result in excessive shock torques in switching or reversing operations.

4.12 Final Assembly

Context:

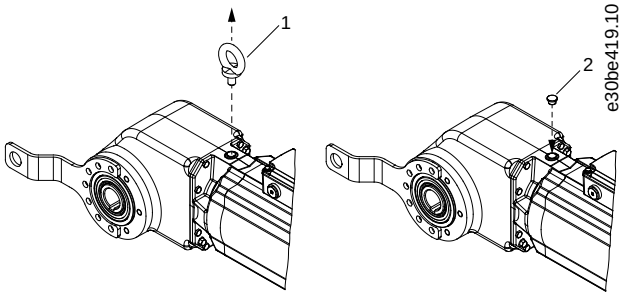


1	Torque arm (optional)

Illustration 16: Final Assembly

Procedure

1. Remove the red plastic screw if installed.
2. Remove the eyebolt [1] and cover the hole with the plastic cap [2]. This ensures the hygienic features of a smooth surface.



1 Eyebolt	**2** Plastic cap

Illustration 17: Exchanging the Eyebolt with the Plastic Cap after Installation

3. Assemble the VLT® Integrated Gear Drive IGD 510 to the shaft using the assembly kit.

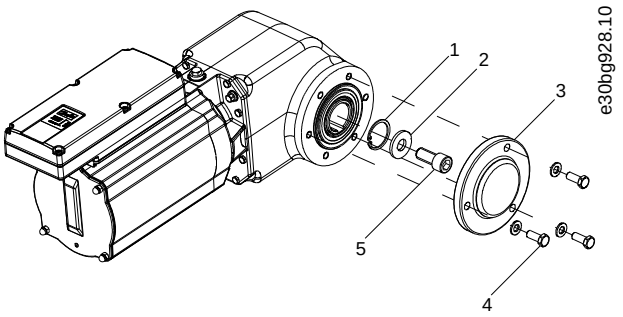


Illustration 18: Assembly of the Mounting Arrangement and the Hollow Shaft Cover

1 Retaining ring	**2** Disc
3 Shaft cover	**4** Shaft cover screws
5 Screw (not included)	

4. Assemble the hollow shaft cover [3] onto the IGD 510 using the 3 shaft cover screws [4].
   A Using a flat spanner, turn the screws 180° clockwise by hand to fasten them. The tightening torque is 4.5 Nm (39.8 in-lb).

4.13 Installation of System Modules

4.13.1 Space Requirements for System Modules

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

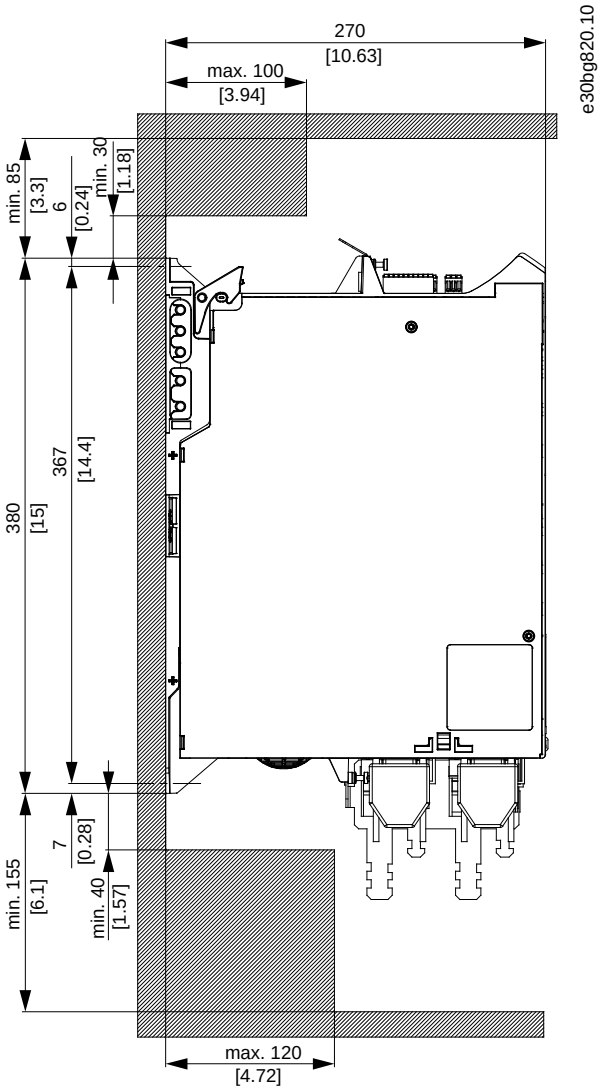


Illustration 19: Minimum Space Required at the Top and Bottom

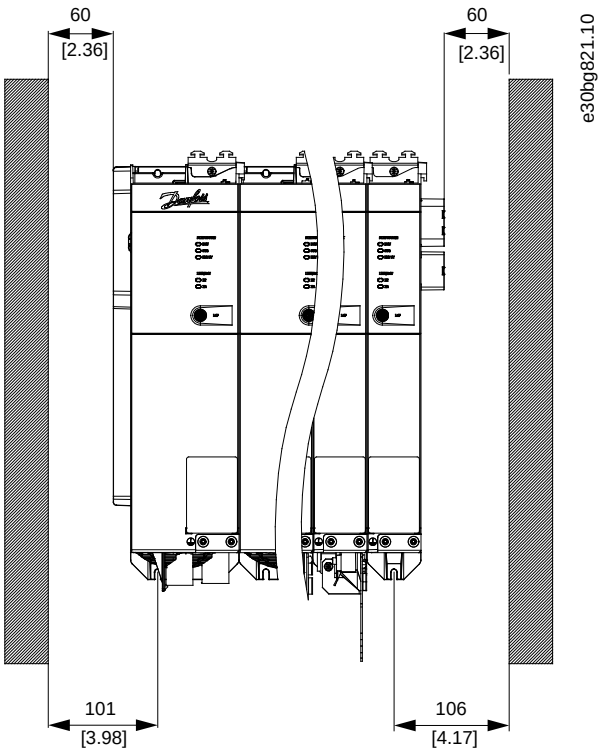


Illustration 20: Minimum Space Required at the Sides

4.13.2 Preparation for Installation of the System Modules

Context:

Make the following preparations to ensure that the system modules 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.
4. Ground the modules.

4.13.2.1 Drilling Templates

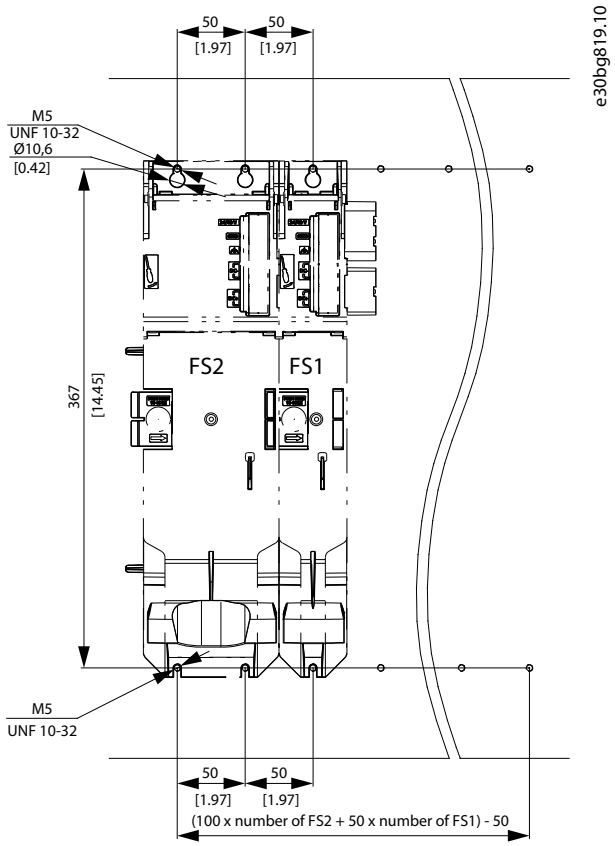


Illustration 21: Drilling templates for 50 mm and 100 mm System Modules

4.13.3 Installation Procedure

4.13.3.1 Installation Aids and Tools Required

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

4.13.3.2 Fitting Instructions for System Modules

Context:

NOTICE

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

Procedure

1. Drill the holes for mounting the backplate as per the drilling template (see 4.13.2.1 Drilling Templates).
2. Connect the backplates via the click and lock method.

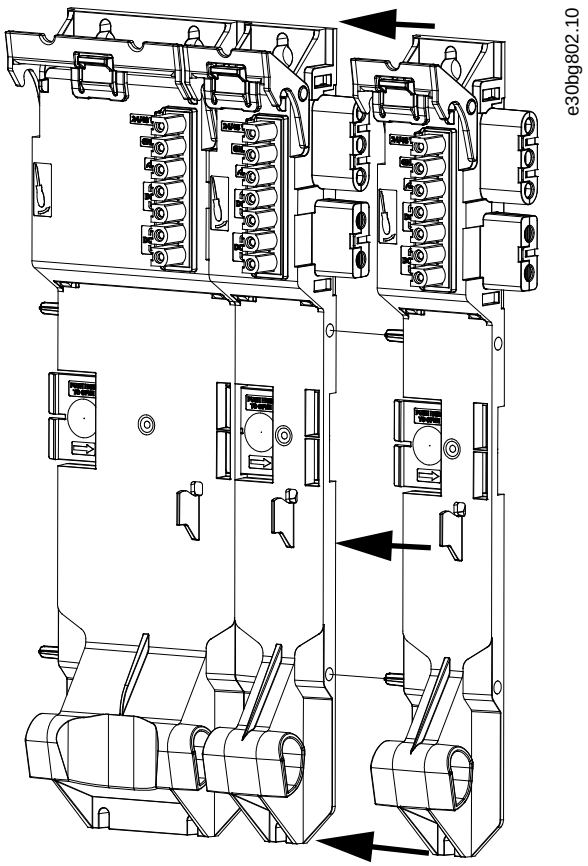


Illustration 22: Connecting the Backplates

3. Mount the backplates to the mounting plate in the control cabinet using M5 screws. The tightening torque is 3 Nm.

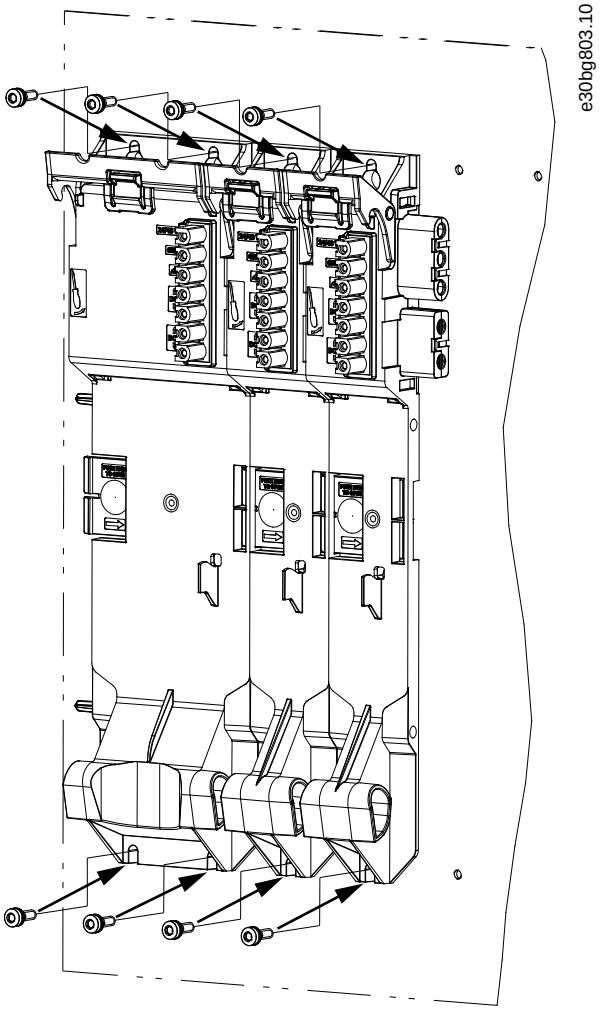


Illustration 23: Mounting the Backplates in the Control Cabinet

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.

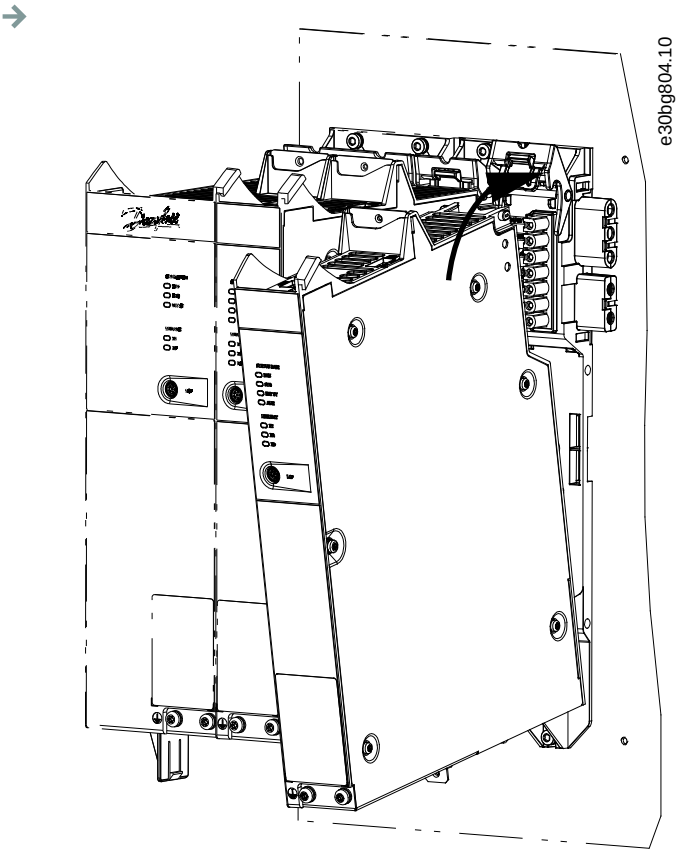


Illustration 24: Pressing the Module onto the Backlink Connector

6. To secure the module, pull down the holding clamp ([1] in illustration 25) at the top of the backplate.

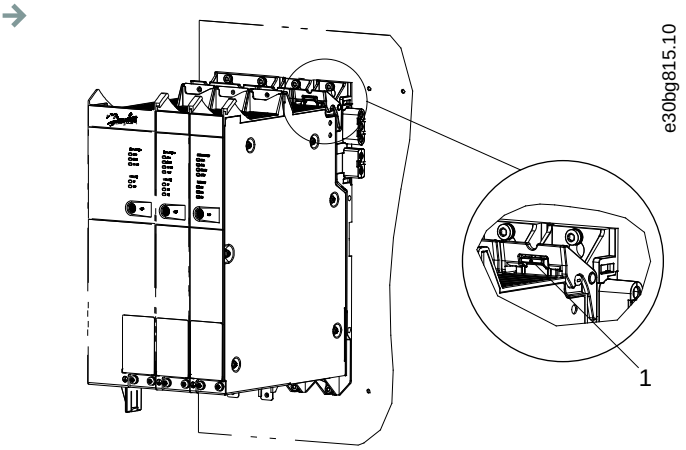


Illustration 25: Pulling Down the Holding Clamp at the Top of the Backplate

7. Repeat steps 4, 5, and 6 for the remaining modules, ensuring that the lip at the left side of the 2nd module is inside the guiding groove at the right side of the 1st module (([1] in illustration 26).

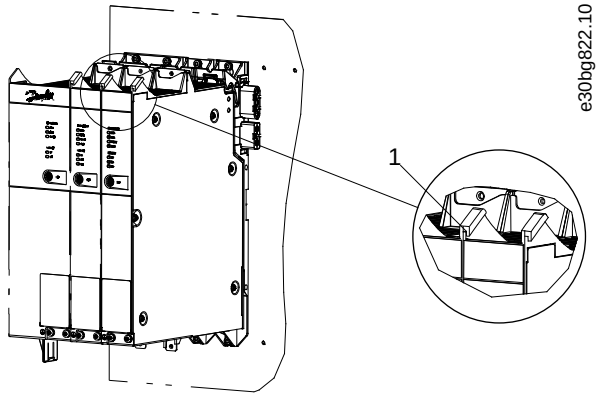


Illustration 26: Guiding Groove

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 manual.

⚠ WARNING ⚠

LEAKAGE/GROUNDING CURRENT HAZARD

Leakage/grounding currents are >3.5 mA. Improper grounding of the IGD 510 drives and the system modules may result in death or serious injury.

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

⚠ WARNING ⚠

HIGH VOLTAGE

The IGD 510 system contains components that operate at high voltage when connected to the electrical supply network. There are no indicators on the components that indicate the presence of mains supply. Incorrect installation, commissioning, or maintenance may lead to death or serious injury.

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

⚠ WARNING ⚠

HIGH VOLTAGE

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

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

5.2 Electrical Environmental Conditions

Compliance with the following electrical environmental conditions is necessary to enable safe and effective operation of the VLT® Integrated Gear Drive IGD 510 system:

- Only for use in TN-S, TN-C, TN-CS, TT (not corner grounded) supply earthing system
- Prospective short-circuit current: 5 kA.
- Protective class I.
- Grounded 3-phase mains network, 400–480 V AC.
- 3-phase frequency 44–66 Hz.
- 3-phase lines and PE line.
- External supply for auxiliary voltage, 24–48 V DC (PELV).
- AC choke with the following characteristics:
  - I_{rms}: minimum 60 A
  - U_{rms}: 500 V
  - Inductance: 0.47 mH ±10%
- Observe the national statutory provisions.
- The leakage current is >3.5 mA. Therefore, use a type B residual current device (RCD).

NOTICE

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

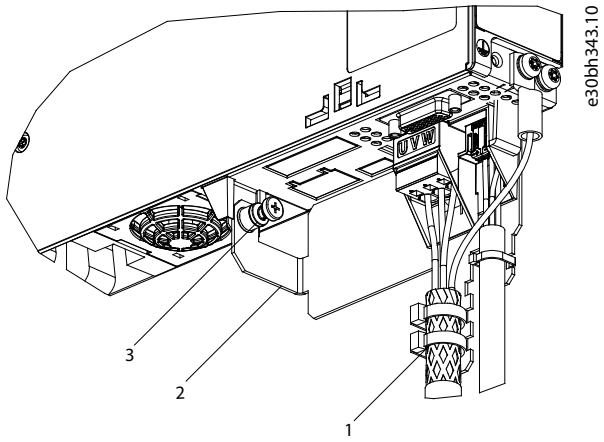
5.3 Grounding

5.3.1 Grounding for Electrical Safety

- For the IGD 510, ensure a minimum ground wire cross-section of at least 10 mm^2 or 2 separate ground wires both complying with the dimensioning rules. See EN/IEC 61800-5-1 for further information.
- Use a dedicated ground wire for input power and control wiring.
- Do not ground the modules in daisy-chain format.
- Keep the ground wire connections as short as possible.
- Follow the wiring requirements in this manual.
- For the system modules, ensure a minimum ground wire cross-section of at least 16 mm^2 or 2 separate ground wires both complying with the dimensioning rules. See EN/IEC 61800-5-1 for further information.

5.3.2 Grounding for EMC-Compliant Installation

- Establish electrical contact between the cable shield and the system module enclosure by using the EMC metal shielding plate on each module.



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

Illustration 27: Cable Shielding on the Bottom of the System Modules

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

NOTICE

POTENTIAL EQUALIZATION

- There is a risk of electrical interference when the ground potential between the IGD 510 system and the machine is different. Install equalizing cables between them. The recommended cable cross-section is 16 mm^2.

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 between signal and power cables.
- Only cross cables at 90°.

5.4 Mains Supply Requirements

Ensure that the supply has the following properties:

- TN-S, TN-C, TN-CS, TT (not corner earthed) supply earthing system.
- Prospective short circuit current: 5 kA.
- Protective class I.
- Grounded 3-phase mains network, 400–480 V AC ±10%.
- 3-phase lines and PE line.
- 3-phase frequency: 44–66 Hz
- Maximum input current: 55 A

5.4.1 Fuses

NOTICE

- Use fuses on the supply side of the Power Supply Module PSM 510 that comply with CE and UL requirements (see table 8).

Table 8: Fuses

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

5.4.2 Circuit Breakers

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

NOTICE

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

5.5 Auxiliary Supply Requirements

Supply the PSM 510 with a power supply unit with an output of 24/48 V DC ±10% (PELV) and maximum 50 A (the actual current depends on the modules used). The output required depends on the system topology. The output ripple of the power supply unit must be <250 mV_{pp}. Only use supply units that conform to the PELV specification.

NOTICE

- 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.

NOTICE

- The secondary circuit must be supplied from an external isolated source.

The 24/48 V DC external supply for auxiliary voltage must be dedicated to the IGD 510 system, meaning that the supply is used exclusively for powering the PSM 510. The maximum cable length between the supply and the PSM 510 is 3 m.

5.5.1 Fuses

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

Table 9: Fuses

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

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

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

5.6 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

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

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

The auxiliary supply can be used for the STO function if the following condition is met:

- Maximum cable length: 3 m

NOTICE

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

5.7 Connecting the Power Supply Module PSM 510 and Decentral Access Module DAM 510

5.7.1 AC Line Choke

It is mandatory to use a 3-phase AC line choke.

Table 10: Line Choke Characteristics for 1 PSM 510

Model	Minimum I_{rms} [A]	U_{rms} [V]	Inductance [mH]
PSM 510 (10 kW)	22	500	1.47 ±10%
PSM 510 (20 kW)	40	500	0.74 ±10%
PSM 510 (30 kW)	60	500	0.47 ±10%

Table 11: Line Choke Characteristics for 2 PSM 510 installed in parallel

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

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

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

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

5.7.1.1 Connecting 1 PSM 510 to the AC Choke

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

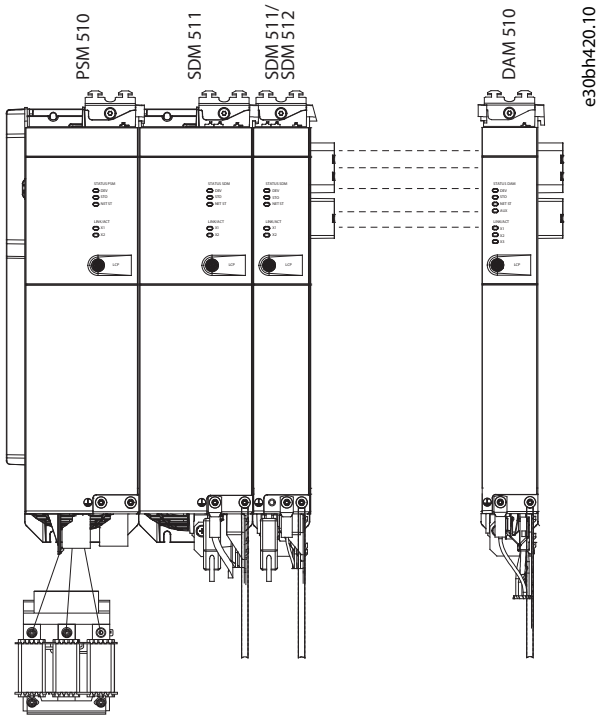


Illustration 28: Connecting 1 PSM 510 to the AC Choke

5.7.1.2 Connecting 2 PSM 510 Modules to the AC Choke

Connect the PSM 510 modules to the same AC choke as shown in illustration 29.

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

The AC choke wiring length to each PSM 510 must be <0.5 m.

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

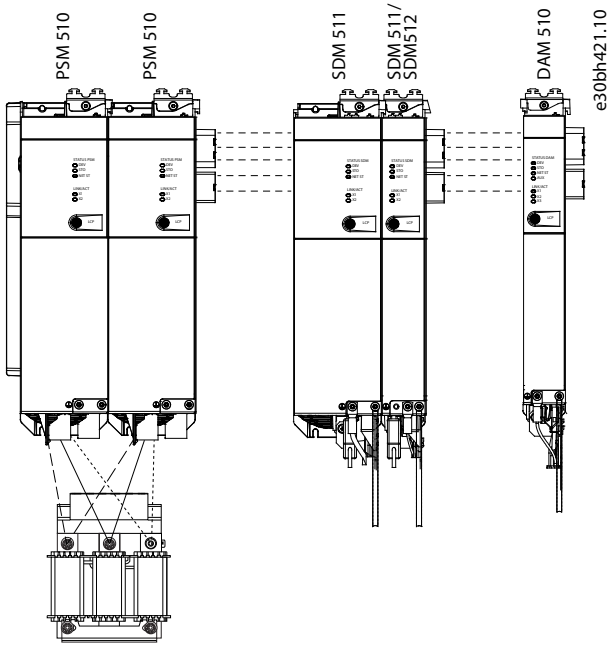


Illustration 29: Connecting 2 PSM 510 Modules to the AC Choke

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

Connect the PSM 510 modules to the same AC choke regardless of the load position (for example, before or after the system splitting) as shown in illustration 30.

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

The AC choke wiring length to each PSM 510 must be <0.5 m.

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

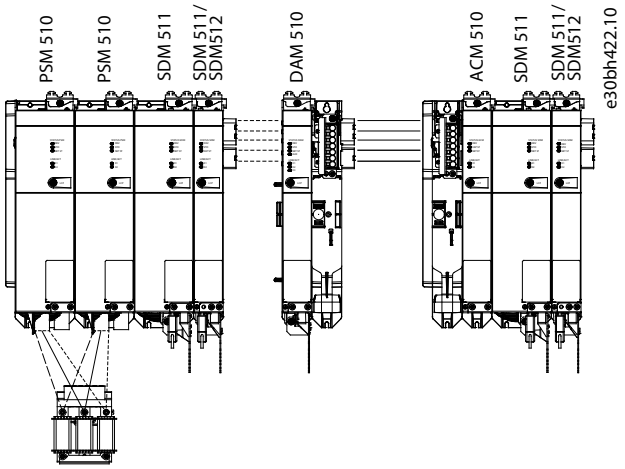


Illustration 30: Connecting 2 PSM 510 Modules to the AC Choke with System Splitting

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

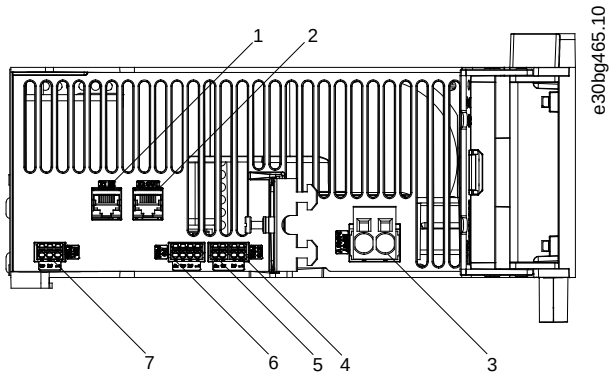
If 2 AC chokes are used (1 per PSM 510) where 1 PSM 510 module is mounted before and 1 after the splitting, the loads must be balanced equally. The derating of both PSM 510 modules is equal to the AC choke's tolerance. For example, tolerance 10% + 10% means –20% derating.

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

5.7.2 Step 1: Connecting the Cables on the Power Supply Module PSM 510

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

Context:



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

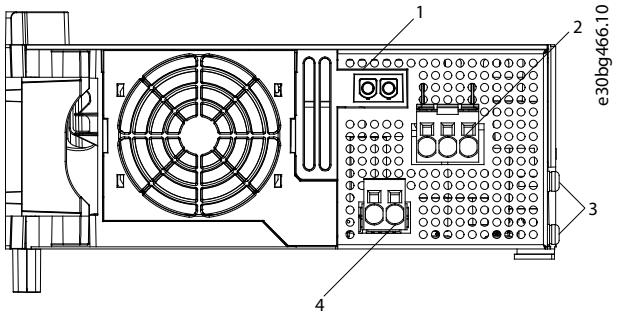
Illustration 31: Connectors on the Top of PSM 510

Procedure

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

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

Context:



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

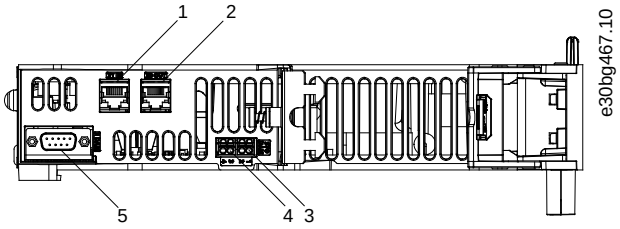
Illustration 32: Connectors on the Bottom of PSM 510

Procedure

1. Insert the wires into the AC mains supply connector.
2. Insert the AC mains supply connector [2].
3. If an external brake resistor is required, disconnect the wiring from the existing internal brake resistor and connect the wires from the external brake resistor.
4. Insert the brake resistor connector [4].
5. Connect the PSM 510 to the PE screw on the front side [3] using a PE wire. The tightening torque is 3 Nm.

5.7.3 Step 2: Connecting the Cables on the Top of the Decentral Access Module DAM 510

Context:



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

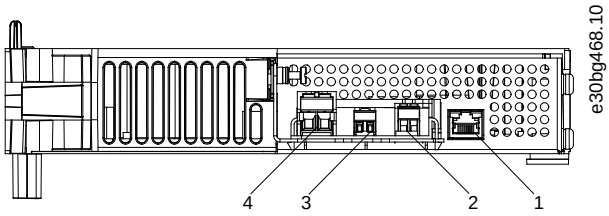
Illustration 33: Connectors on the Top of DAM 510

Procedure

1. Connect the Ethernet cable from the output of the previous module to the input connector [1].
2. Insert the wires into the 24 V IN (STO input) connector, see 11.2.5.9.2 STO Connector on DAM 510.
3. Insert the 24 V IN (STO connector IN) connector [3] into the DAM 510.
4. If required, connect the external encoder connector [5].

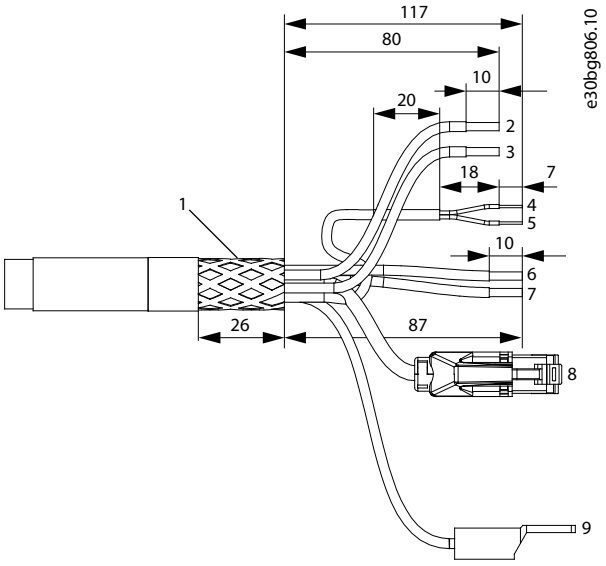
5.7.4 Step 3: Connecting the Hybrid Cable

Context:



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

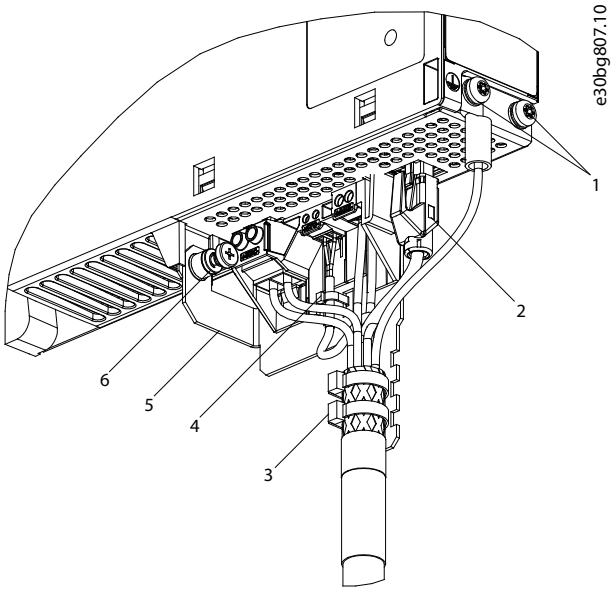
Illustration 34: Connectors on the Bottom of DAM 510



1	Shielded area	**2**	AUX+ (red, 2.5 mm^2)
3	AUX– (blue, 2.5 mm^2)	**4**	STO+ (pink, 0.5 mm^2)
5	STO– (gray, 0.5 mm^2)	**6**	UDC+ (black, 2.5 mm^2/4 mm^2)
7	UDC– (gray, 2.5 mm^2/4 mm^2)	**8**	Bus connection (green, RJ45 connector)

9 PE (yellow/green, 2.5 mm^2/4 mm^2, fork lug)	

Illustration 35: Hybrid Cable



1 Hybrid cable PE screws	**2** Bus connector
3 Cable tie for hybrid cable	**4** Cable tie for STO cable
5 EMC plate	**6** EMC plate screw

Illustration 36: Connecting the Hybrid Cable

Procedure

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

5.8 Preparing the Hybrid Cable

Table 12: Preparing the Hybrid Cable

Step	Cable/wire	Preparation	Insulation removal length [mm]	Shield length [mm]
1	Hybrid cable	Remove the isolation sleeve from the cable and prepare the main screen.	130	20
2	UDC and AUX	Cut the UDC and AUX wires.	100	–
3	STO and Ethernet	Cut the STO and Ethernet cable.	110	–
4	STO	Remove the isolation envelope and prepare the screen.	110	20
5	STO	Remove the wire insulation.	8	–
6	–	Connect the main screen and the STO screen and wrap copper tape around the screen.	–	–
7	Ethernet	Remove the envelope isolation from the Ethernet cable and prepare the Ethernet screen.	35	9
8	Ethernet	Remove the wire insulation.	8	–
9	Ethernet	Mount the copper foil on the Ethernet screen ensuring that all wires are underneath the copper foil.	–	–
10	External PE	Remove the wire isolation and assemble the cable shoe on the PE wire.	10	–
11	UDC	Remove the wire insulation.	10	–
12	AUX	Remove the wire insulation.	10	–

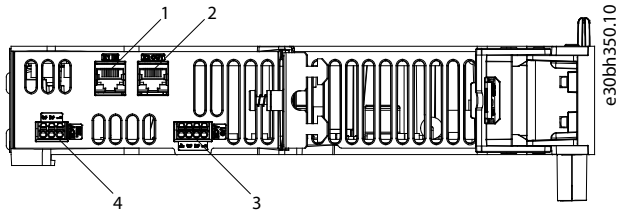
5.9 Connecting the IGD 510

Procedure

1. Prepare the hybrid cable as detailed in 5.8 Preparing the Hybrid Cable.
2. Remove the connection box cover by removing the 6 screws. Take care not to damage the paint.
3. Remove the ground wire on the power control board from the PE screw on the housing of the connection box.
4. Remove the power circuit board using a torx screwdriver.
5. Insert the 2 hybrid cables into the connection box.
6. On the input cable, install the Ethernet, and STO wires (gray and pink) and fix them in place using the cable clamps.
7. On the output cable, install the Ethernet, and STO wires (gray and pink) and fix them in place using the cable clamps.
8. Replace the power circuit board and fix it in place using the torx screw.
9. Connect the ground wire to the PE screw on the housing of the connection box.
10. Mount the UDC and AUX wires for both the input and output cables.
11. If used, mount the external PE wire and connect it to the PE screw on the housing of the connection box.
12. Replace the connection box cover.
13. Mount the connection box to the IGD 510 and secure it loosely using the bottom torx screw between the 2 hybrid cables.
14. Fasten the 2 torx screws at the top of the connection box. The tightening torque is 7 Nm ±10%.
15. Tighten the bottom torx screw between the 2 hybrid cables. The tightening torque is 4.5 Nm ±10%.

5.10 Connecting the Auxiliary Capacitors Module ACM 510

Context:



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

Illustration 37: Connectors on the Top of ACM 510

Procedure

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

6 Commissioning

6.1 Warnings for Commissioning

⚠ WARNING ⚠

UNINTENDED START

The IGD 510 system contains drives and the PSM 510 and DAM 510 that are connected to the electrical supply network and can start running at any time. This may be caused by a fieldbus command, a reference signal, or clearing a fault condition. The IGD 510 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

Context:

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

Procedure

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

6.3 Measures before Commissioning the IGD 510

If the VLT® Integrated Gear Drive IGD 510 has been stored, take the measure detailed in this section.

Gear unit component

- **Oil**
  Change the oil in the IGD 510 if the storage period exceeds 5 years, or the temperatures were harsh throughout a shorter storage period.
- **Shaft seals**
  Lubricate the hollow shaft seal with grease if the storage period exceeds 2 years. When changing the oil, check the function of the shaft seals between the motor and gear unit, and on the output shaft. Replace the shaft seals if any change in shape, color, hardness, or any sealing defect is detected.

6.4 Commissioning Procedure for IGD 510

Procedure

1. Remove the protective films.
2. Disconnect the mechanical connection to the driven machine as far as possible and examine the direction of rotation in the no-load state.
3. Remove the feather keys or secure them in such a way that they cannot be ejected.
4. Ensure that the current draw in the loaded condition does not exceed the rated current indicated on the nameplate for any length of time (see 11.1.3 Speed/Torque Values).
5. After first commissioning, observe the IGD 510 for at least 1 hour to detect any unusual heat or noise.

6.5 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.

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.

6.6 System Module Power-Up Time

The maximum power-up time for the system modules 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 statusword.

NOTICE

- Do not operate any of the system modules until they are all powered up correctly.

6.7 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 statusword.

NOTICE

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

Table 13: DC-Link (UDC) Charging Time for PSM 510, DAM 510, and ACM 510

Specification	Unit	PSM 510	DAM 510	ACM 510
UDC charging time	s	2.0	2.0	3.5

6.8 Switching on the IGD 510 System

Complete the cabling of the PSM 510 and DAM 510 before applying power to the drives. This cabling provides the supply voltage and the communication signals for the IGD 510 system. This is a fundamental requirement for the operation of the IGD 510 drives.

The IGD 510 system can be switched on in 3 ways:

- If the Power Supply Module (PSM 510) and the Decentral Access Module (DAM 510) are supplied with mains, STO, and U_{AUX}, communication to the PSM 510 and DAM 510 internal controllers is established and U_{AUX} is automatically passed on to the connected drives.
- If the PSM 510 and DAM 510 are only powered by U_{AUX}, then the PSM 510, DAM 510, and IGD 510 control units are communicating.
- If the PSM 510 and DAM 510 are only supplied with mains power, then only the PSM 510 and DAM 510 control units are communicating and power is not passed on to the connected IGD 510 drives.

6.8.1 Procedure for Switching on the IGD 510 System

Procedure

1. Switch on U_{AUX} power to enable communication to the PSM 510, DAM 510, and IGD 510 drives to be established.
2. Switch on the mains.
3. Set the PSM 510 and DAM 510 to state *Normal operation*.
   → Now the PSM 510, DAM 510, and IGD 510 drives are ready for operation.

6.9 VLT® Servo Toolbox Software

6.9.1 Overview

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

The VLT® Servo Toolbox contains several sub-tools, which provide various functionalities.

Table 14: Important Sub-tools

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

Sub-tool	Description
ACM control	For operating the Auxiliary Capacitors Module (ACM 510) for testing purposes.

6.9.2 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 7, Windows 8.1, Windows 10.
- .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.

6.9.3 Installing the VLT® Servo Toolbox Software

Context:

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

Procedure

1. Check that your system meets the system requirements specified in 6.9.2 System Requirements.
2. Download the VLT® Servo Toolbox installation file from the Danfoss website.
3. Right-click on the .exe file and select *Run as administrator*.
4. Follow the on-screen instructions to complete the installation process.

6.9.4 VLT® Servo Toolbox Communication

6.9.4.1 Overview

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

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

6.9.4.2 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.

6.9.4.3 Indirect Communication

6.9.4.3.1 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.

6.9.4.3.2 Enabling Indirect Communication

Context:

Carry out the following steps to enable indirect communication.

NOTICE

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

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

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

Procedure

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

6.9.4.3.3 Additional Settings for Indirect Communication with PROFINET®

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 node being searched for can be specified.

To reach further nodes, the dialog *Accessible nodes* enables IP addresses and subnets to be added to the PG/PC interface. The new IP addresses and subnets are then added to the Ethernet interface of the PG/PC.

6.9.4.4 Direct Communication

6.9.4.4.1 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.

⚠ WARNING ⚠

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

6.9.4.4.2 Disabling Unused Protocols on the Network Interface on the PC

Procedure

1. Open the *Network and Sharing Center*.
2. On the left, click on *Change adapter settings*.
3. Right-click on the network interface used for fieldbus communication and select *Properties*.
4. Uncheck all checkboxes except the one for *Internet Protocol Version 4 (TCP/IPv4)*.
5. Disable the *IPv4 Checksum offload* on the network interfaces as described in 6.9.4.3.1 Network Settings for Indirect Communication.

6.9.5 VLT® Servo Toolbox Commissioning

6.9.5.1 Step 1: Opening the Main Window

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

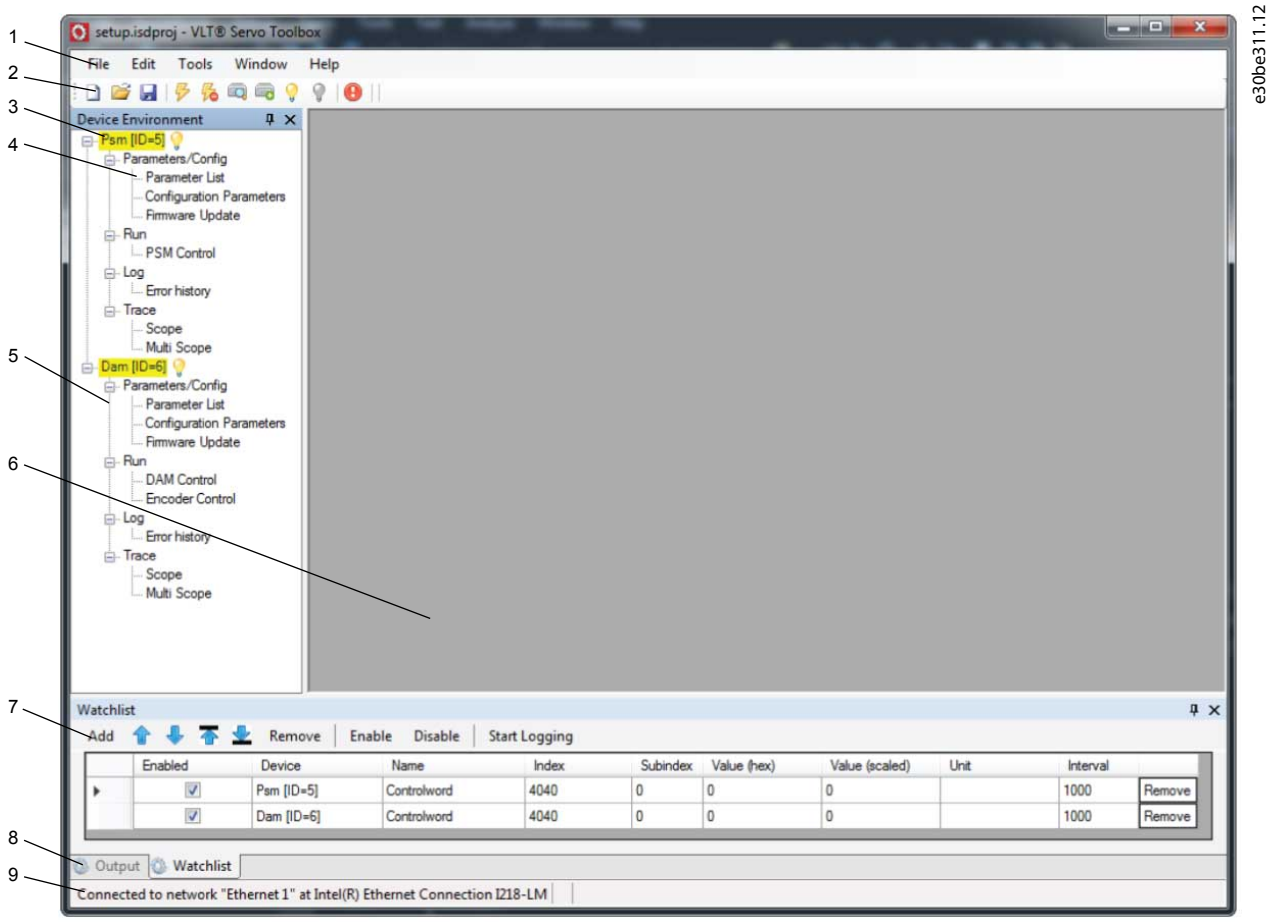


Illustration 38: Main Window

Table 15: 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 sub-tools, 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.

Legend number	Name	Description
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, which the VLT® Servo Toolbox is currently 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	Available sub-tools	A sub-tool is opened by double-clicking the left mouse button on its name in the *Device Environment*, or by selecting the entry and pressing the *Enter* key on the keyboard.
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 sub-tools for each added device.
6	Workspace	This is the space for hosting the sub-tools and its size depends on the *Main Window* size. The sub-tools 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.

6.9.5.2 Step 2: Connecting to Network

Context:

Pre-configure the appropriate communication settings to connect to a network (see 6.9.4.1 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*.

6.9.5.3 Step 3: Scanning for Devices

Procedure

1. After verifying that the VLT® Servo Toolbox is connected to the selected network, click on the *Scan for Devices* icon in the toolbar to trigger the device scan procedure.
2. When the scan is complete, a list of available devices is shown in the *Select Devices* window. Select which devices to add 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).

6.9.6 Motion Library

6.9.6.1 Overview

NOTICE

- Contact Danfoss for the availability of motion libraries for the VLT® Integrated Gear Drive IGD 510 system.

6.9.6.2 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 IGD 510 system.

The following PLCopen® characteristics apply to all function blocks:

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

7 Operation

7.1 Operating Status Indicators

The operating status of the IGD 510 system modules is indicated via the LEDs on each module.

7.1.1 Operating LEDs on the IGD 510

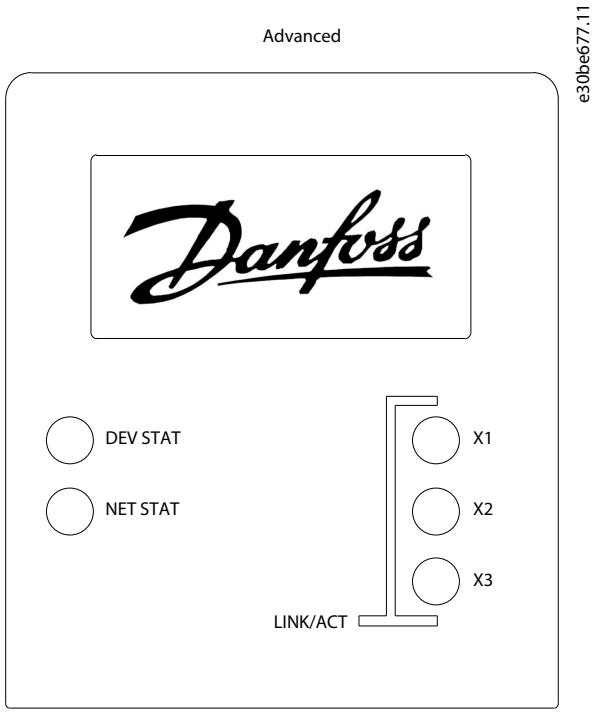


Illustration 39: Operating LEDs on the IGD 510

Table 16: Operating LEDs on the IGD 510

LED	Color	Flash status	Description
DEV STAT	Green	On	IGD 510 is in state *Operation*.
		Flashing	Auxiliary voltage is applied.
	Red	On	IGD 510 has a fault.
		Flashing	DC-link voltage is not applied.
NET STAT	Green	On	Connected.
	Orange	On	Online.
	Red	Flashing	Initialization.
		On	Initialization failed or other error.

LED	Color	Flash status	Description
Link/ACT X1	Green	–	Link/activity status of *Hybrid In* (X1).
		On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
Link/ACT X2	Green	–	Link/activity status of *Hybrid Out* (X2).
		On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.
Link/ACT X3	Green	–	Link/activity status of the Ethernet port (X3).
		On	Ethernet link established.
		Flashing	Ethernet link established and active.
		Off	No link.

7.1.2 Operating LEDs on the PSM 510

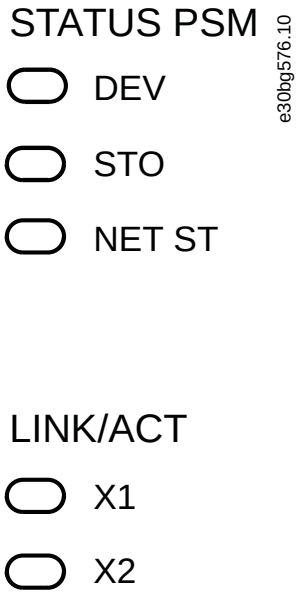


Illustration 40: Operating LEDs on PSM 510

Table 17: Operating LEDs on PSM 510

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.
STO	Green	On	24 V for STO is present.
		Off	24 V for STO is not present.
NET ST	Green	On	Connected.
	Orange	On	Online.
	Red	Flashing	Initialization.
		On	Initialization failed or other error.
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.

7.1.3 Operating LEDs on the DAM 510

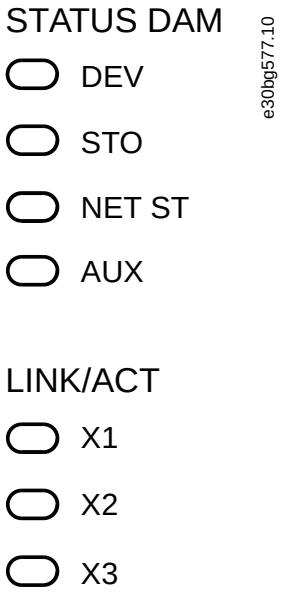


Illustration 41: Operating LEDs on DAM 510

Table 18: Operating LEDs on DAM 510

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	DC-link is not applied at the input.
STO	Green	On	24 V for STO is present.
		Off	24 V for STO is not present.
NET ST	Green	On	Connected.
	Orange	On	Online.
	Red	Flashing	Initialization.
		On	Initialization failed or other error.
AUX	Green	On	Auxiliary voltage is applied to the output connector.
(State of the auxiliary voltage)		Off	Auxiliary voltage is not applied to the output connector.
	Red	On	Auxiliary voltage undervoltage detected in the hardware.
LINK/ACT X1	Green	On	Ethernet link established.
(Link/activity of *In*)		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X2	Green	On	Ethernet link established.
(Link/activity status of *Hybrid Out*)		Flashing	Ethernet link established and active.
		Off	No link.
LINK/ACT X3	Green	On	Ethernet link established.
(Link/activity status of *Out*)		Flashing	Ethernet link established and active.
		Off	No link.

7.1.4 Operating LEDs on the ACM 510

Illustration 42: Operating LEDs on ACM 510

Table 19: Operating LEDs on ACM 510

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	DC-link is not applied at the input.
CAP ST	Green	On	Capacitors fully charged.
		Flashing	Capacitors charging/discharging.
		Off	Capacitors discharged.
NET ST	Green	On	Connected.
	Orange	On	Online.
	Red	Flashing	Initialization.
		On	Initialization failed or other error.
LINK/ACT X1 (Link/activity 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.

8 Functional Safety Concept

8.1 Functional Description

The VLT® Integrated Gear Drive IGD 510 system integrates the safety function Safe Torque Off (STO). The safety function is available in daisy-chain format, which is possible between all system modules except for ACM 510 (cables are not included). The hybrid cable passes the STO signal from the DAM 510 to all IGD 510 drives in the chain. Once STO is activated, no torque is generated on the IGD 510 drives. Reset of the safety function and diagnostics can be carried out via the PLC.

NOTICE

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

8.2 Safety Precautions

⚠ WARNING ⚠

UNCONTROLLED MOVEMENT

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

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

⚠ WARNING ⚠

RISK OF ELECTRICAL SHOCK

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

- Only perform work on electrical parts of the system or the IGD 510 drives after isolating the mains voltage supply and waiting for the discharge time to elapse.

⚠ WARNING ⚠

RISK OF RESIDUAL ROTATION

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

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

NOTICE

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

NOTICE

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

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 timing and distance for coast to stop (Stop Category 0 or STO). See EN 60204-1 for further information.
- All signals connected to the STO must be supplied by a PELV supply.

8.3 Qualified Personnel for Working with Functional Safety

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

Furthermore, they must:

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

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

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

8.4 Applied Standards and Compliance

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

The integrated STO function complies with the following standards:

- IEC 60204-1: 2016 Stop Category 0 – uncontrolled stop
- EN 60204-1: 2018 Stop Category 0 – uncontrolled stop
- IEC/EN 61508: 2010 SIL 2
- IEC 61800-5-2: 2016 SIL 2
- EN 61800-5-2: 2017 SIL 2
- IEC 62061: 2005 and A1: 2012 and A2: 2015
- EN 62061: 2005 and Cor.:2010 and A1: 2013 and A2: 2015
- IEC/EN 62061: 2015 SIL CL2
- EN ISO 13849-1: 2015 Category 3, PL d
- EN ISO 13849-2: 2014

8.5 Abbreviations and Conventions

Table 20: 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 EN IEC 62061	Safety Integrity Level
STO	EN IEC 61800-5-2	Safe Torque Off

8.6 Installation

Safety relays that have a plus and minus switching output signal can be directly connected to the IGD 510 system to activate STO.

The example in illustration 43 shows the basic connection to be made for the STO function. A suitable safety device to switch it off is not supplied by Danfoss. The STO is activated by opening STO+ and STO–.

Table 21: Activation of STO Function

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

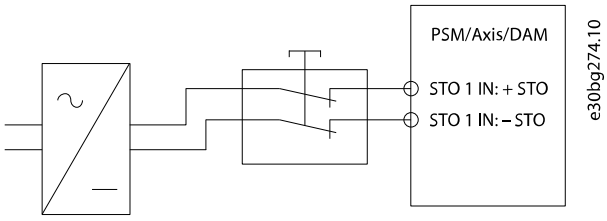


Illustration 43: Safety Relay with Plus and Minus Switching Output

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

8.6.1 Protective Measures

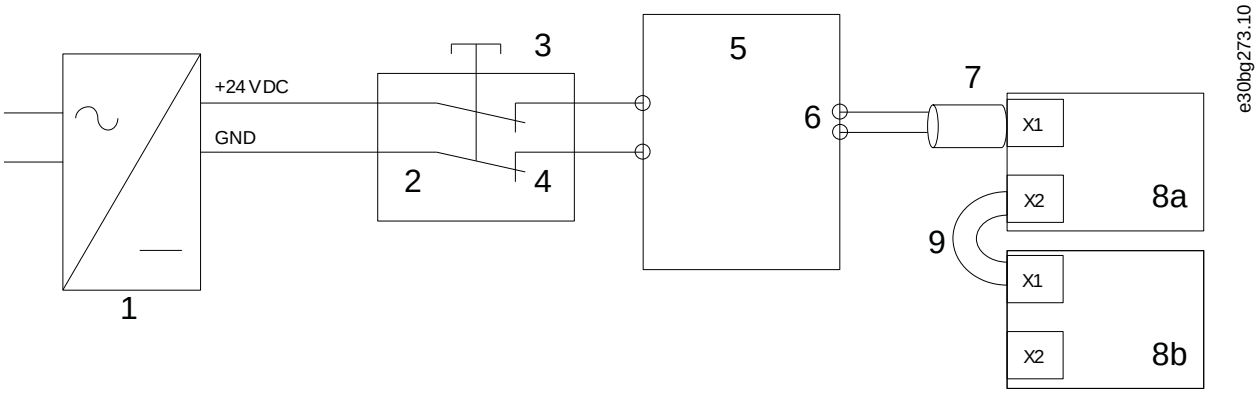
- Install the system modules in an IP54 cabinet as per IEC 60529 or in an equivalent environment. A higher IP protection may be necessary for certain applications.
- If external influences can affect the motor axis, for example suspended loads, use additional measures, such as a safety holding brake,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

8.7 Application Example

An example of an application that can be put in Safe Torque Off mode by a safety circuit is shown in illustration 44.

The safety circuits can be remote from each other and are not supplied from the IGD 510 system.

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



1 24 V DC supply	**2** Safety device
3 Emergency stop button	**4** Safety device contacts
5 Decentral Access Module (DAM)	**6/7** Hybrid cable to the 1st IGD 510 drive on the line
8a/8b IGD 510 drive	**9** Hybrid cable for connecting the IGD 510 drives in daisy-chain format.

Illustration 44: Application Example: Safe Torque Off Function

8.8 Commissioning Test

NOTICE

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

The commissioning test can be implemented using bit-wise readout of the status.

8.8.1 Commissioning Test using PROFINET® Devices

Table 22: Commissioning Test using PROFINET® Devices

	Test steps	Reason for the test step	Expected result
1	Run the application (all the 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 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 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 LEDs on the devices.

	Test steps	Reason for the test step	Expected result
6	Run the application (all the 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 IGD 510.
8	Try to run the application (enable 1 or more 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 IGD 510.
10	Try to run the application (enable 1 or more drives).	Check whether reset is required.	Application does not run.
11	Send a reset signal via the PLC.	–	STO error 0x11E is cleared in all IGD 510.
12	Try to run the application (all drives are enabled).	–	Application runs as expected.

8.9 Operation of the STO Function

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

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

If STO is activated when the drive is disabled, and no attempt is made to enable the drive while STO is active, it is not necessary to reset the STO function after reapplying supply to the STO terminals.

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

8.9.1 Error Codes

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

Table 23: Error Codes

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

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

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

8.9.2 Fault Reset

To reset faults, change bit 7 of the controlword from 0 to 1.

8.10 Functional Safety Characteristic Data

Table 24: Functional Safety Characteristic Data

Data	PSM 510	DAM 510	IGD 510
General information			
Response time (from switching on the input until torque generation is disabled)	<100 ms		
Lifetime	20 years		
Data for EN/ISO 13849-1			
Performance level (PL)	–	–	d
Category	–	–	3
Mean time to dangerous failure ($MTTF_D$)	–	–	>5000 years
Diagnostic coverage (DC)	–	–	60%
Data for EN/ISO 61508 and EN/IEC 62061			
Safety integrity level (SIL)	–		2
Probability of failure per hour (PFH)	0/h		$<4 \times 10^{-9}$/h
Safe failure fraction (SFF)	100%		>95%
Hardware fault tolerance (HFT)	0		
Subsystem classification	Type A		
Maximum interval between tests of the STO safety function (see 8.11 Maintenance, Security, and User Accessibility)	1 year		

8.11 Maintenance, Security, and User Accessibility

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

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

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

User accessibility: Restrict access to the IGD 510 drives and system modules if access to them could result in safety risks.

9 Diagnostics

9.1 Faults

If faults occur during the operation of the IGD 510 system, check:

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

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

NOTICE

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

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

- Type number
- Error code
- Firmware version
- System setup (for example, number of IGD 510, system modules, and lines).

9.2 Troubleshooting for the IGD 510 System

9.2.1 LCP Display is Dark/Not Functioning

This fault applies to the IGD 510 drives, PSM 510, and DAM 510.

Possible Causes

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

Troubleshooting

Table 25: Fault, LCP Display is Dark/Not Functioning

Possible cause	Possible solution
Missing input power.	Check the input power source.
Missing or open fuses or circuit breaker tripped.	Check the fuses and circuit breaker.
No power to the LCP.	• 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.

Possible cause	Possible solution
Display is defective.	Replace the faulty LCP or connection cable.

9.2.2 Open Power Fuses or Circuit Breaker Trip

This fault applies to the PSM 510.

Possible Causes

- Phase-to-phase short.

Troubleshooting

- Check the cabling
- Check for loose connections.

9.2.3 DC-Link Voltage Too High

Possible Causes

- Brake resistor not connected.
- Brake resistor too high resistance.
- Brake resistor functionality not activated.
- Several drives are decelerating with insufficient ramp time.

Troubleshooting

Table 26: Fault, DC-Link Voltage Too High

Possible cause	Possible solution	Applies to:
Brake resistor not connected.	Check the brake resistor cabling.	PSM 510
Brake resistor too high resistance.	Check if the lowest resistance value has been entered.	PSM 510
Brake resistor functionality not activated.	Activate the brake function.	PSM 510
Several drives are decelerating with insufficient ramp time.	• Avoid simultaneous deceleration of several drives. • Change the deceleration speed.	DAM 510, PSM 510, IGD 510

9.2.4 DC-Link Voltage Too Low

This fault applies to all system modules.

Possible Cause

- Incorrect mains input supply.

Troubleshooting

- Check that the supply voltage matches the allowed specification.

9.2.5 DC-Link Overcurrent

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

Possible Causes

- The sum of the IGD 510 drive current exceeds the maximum rating of the DAM 510.
- The sum of the system modules' current exceeds the maximum rating of the PSM 510.

Troubleshooting

- Check the IGD 510 drive current consumption.
- Avoid simultaneous acceleration of all IGD 510 drives.

9.2.6 UAUX Overcurrent

This fault applies to the DAM 510.

Possible Causes

- The IGD 510 drives are consuming more power on the U_{AUX} line than allowed.

Troubleshooting

- Avoid simultaneous lifting of the drive brakes.

9.2.7 UAUX Overvoltage

This fault applies to the DAM 510.

Possible Causes

- Incorrect U_{AUX} supply.

Troubleshooting

- Check that the supply matches the auxiliary supply requirements.

9.2.8 UAUX Undervoltage

This fault applies to the PSM 510 and DAM 510.

Possible Causes

- Incorrect U_{AUX} supply.

Troubleshooting

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

9.2.9 Mains Phase Loss

This fault applies to the PSM 510.

Possible Causes

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

Troubleshooting

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

9.2.10 Grounding Fault

This fault applies to the PSM 510 and DAM 510.

Possible Causes

- Grounding fault.

Troubleshooting

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

9.2.11 Brake Resistor Error

This fault applies to the PSM 510.

Possible Causes

- Faulty brake resistor.

Troubleshooting

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

9.2.12 Brake Chopper Error

This fault applies to the PSM 510.

Possible Causes

- Faulty brake chopper.

Troubleshooting

- Check the setting in parameter *2-15 Brake Check*.

9.2.13 Internal Fan Error

This fault applies to PSM 510.

Possible Causes

- Fan is not mounted.
- Fan is blocked.

Troubleshooting

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

9.3 Error Codes

9.3.1 No error (0x0000 / 0x0)

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

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

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

9.3.2 Generic err (0x1000 / 0x100)

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

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

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

9.3.3 Overcurr out (0x2310 / 0x101)

This error is valid for IGD 510.

Table 29: Overcurr out (0x2310 / 0x101)

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

9.3.4 High current overload (0x2311 / 0x15F)

This error is valid for DAM 510 and IGD 510.

Table 30: High current overload (0x2311 / 0x15F)

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

9.3.5 IIT current overload (0x2312 / 0x160)

This error is valid for DAM 510 and IGD 510.

Table 31: IIT current overload (0x2312 / 0x160)

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

9.3.6 High power overload (0x2313 / 0x161)

This error is valid for PSM 510.

Table 32: High power overload (0x2313 / 0x161)

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

9.3.7 PT power overload (0x2314 / 0x162)

This error is valid for PSM 510.

Table 33: PT power overload (0x2314 / 0x162)

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

9.3.8 Short circuit (0x2320 / 0x163)

This error is valid for PSM 510 and DAM 510.

Table 34: Short circuit (0x2320 / 0x163)

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

9.3.9 Earth leakage (0x2330 / 0x151)

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

Table 35: Earth leakage (0x2330 / 0x151)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2330	0x151	Earth leakage	Warning, error	Current leaking to earth.	earth leakage

9.3.10 AUX overcurrent (0x2391 / 0x125)

This error is valid for DAM 510.

Table 36: 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

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

This error is valid for DAM 510.

Table 37: 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

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

This error is valid for PSM 510 and DAM 510.

Table 38: 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

9.3.13 AUX fuse failure (0x2395 / 0x129)

This error is valid for DAM 510.

Table 39: AUX fuse failure (0x2395 / 0x129)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2395	0x129	AUX fuse failure	Error	Fuse failure. Current or voltage is above the limit on the AUX line.	AUX fuse fail

9.3.14 DC overcurrent trip (0x2396 / 0x15C)

This error is valid for DAM 510 and IGD 510.

Table 40: DC overcurrent trip (0x2396 / 0x15C)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x2396	0x15C	DC Overcurrent trip	Error	DC overcurrent trip.	overcurr trip

9.3.15 Output power trip (0x2397 / 0x12B)

This error is valid for PSM 510.

Table 41: Output power trip (0x2397 / 0x12B)

Code	PROFINET® code	Name	Severity (warning/error/ trip lock)	Description	LCP name
0x2397	0x12B	Output power trip	Error	The peak output power of the device is exceeded.	Out pow

9.3.16 IIT overload motor (0x239B / 0x102)

This error is valid for IGD 510.

Table 42: Short circuit (0x239B / 0x102)

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

9.3.17 Mains phase loss (0x3130 / 0x12F)

This error is valid for PSM 510.

Table 43: 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

9.3.18 DC link overvoltage (0x3210 / 0x103)

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

Table 44: 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

9.3.19 DC link undervoltage (0x3220 / 0x104)

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

Table 45: 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

9.3.20 UDC charging error (0x3230 / 0x152)

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

Table 46: UDC charging error (0x3230 / 0x152)

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

9.3.21 DC Link Voltage unbalanced (0x3280 / 0x153)

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

Table 47: DC Link Voltage unbalanced (0x3280 / 0x153)

Code	PROFINET™ code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x3280	0x153	DC Link voltage unbalanced	Trip lock	DC-link voltage unbalanced.	DC link unbal

9.3.22 UAUX high voltage (0x3291 / 0x132)

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

Table 48: 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

9.3.23 UAUX overvoltage (0x3292 / 0x133)

This error is valid for DAM 510.

Table 49: 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

9.3.24 UAUX low voltage (0x3293 / 0x134)

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

Table 50: 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

9.3.25 UAUX undervoltage (0x3294 / 0x135)

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

Table 51: UAUX undervoltage (0x3294 / 0x135)

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

9.3.26 UDC high voltage (0x3295 / 0x136)

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

Table 52: UDC high voltage (0x3295 / 0x136)

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

9.3.27 UDC low voltage (0x3296 / 0x137)

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

Table 53: UDC low voltage (0x3296 / 0x137)

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

9.3.28 UAUX charging error (0x3297 / 0x154)

This error is valid for DAM 510.

Table 54: 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

9.3.29 UDC shutdown error (0x3298 / 0x165)

This error is valid for DAM 510.

Table 55: UDC shutdown error (0x3298 / 0x165)

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

9.3.30 UAUX shutdown error (0x3299 / 0x155)

This error is valid for DAM 510.

Table 56: UAUX shutdown error (0x3299 / 0x155)

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

9.3.31 UAUX undervoltage hardware (0x329A / 0x156)

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

Table 57: 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

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

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

Table 58: Automated fault reset failure (0x329B / 0x168)

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

9.3.33 Device overtemperature (0x4210 / 0x157)

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

Table 59: 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. PSM: Thyristor rectifier module. DAM: Maximum temperature of both high side and low side IGBTs.	overtemp device

9.3.34 Too low temperature (0x4220 / 0x138)

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

Table 60: Too low temperature (0x4220 / 0x138)

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

9.3.35 Overtemperature: Power module (0x4290 / 0x105)

This error is valid for IGD 510.

Table 61: Overtemperature: Power module (0x4290 / 0x105)

Code	PROFINET® code	Name	Severity (warning/error/ trip lock)	Description	LCP name
0x4290	0x105	Overtemperature: Power module	Error	Overtemperature on power module.	overtemp PM

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

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

Table 62: Overtemperature: Control card (0x4291 / 0x106)

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

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

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

Table 63: 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

9.3.38 Inrush overtemperature: DC link (0x4293 / 013C)

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

Table 64: 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.	inrush UDC

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

This error is valid for DAM 510.

Table 65: 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 transitions into state *Normal operation* have occurred within a short time period, which potentially overheat the AUX line switching circuit.	inrush UAUX

9.3.40 Overtemperature: Motor (0x4310 / 0x108)

This error is valid for IGD 510.

Table 66: 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

9.3.41 UAUX undervoltage (0x5112 / 0x109)

This error is valid for IGD 510.

Table 67: Short circuit (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

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

This error is valid for PSM 510.

Table 68: 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

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

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

Table 69: 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	Missing parameter in internal device configuration.	config err

9.3.44 Parameter error (0x6320 / 0x10B)

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

Table 70: Param err (0x6320 / 0x10B)

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

9.3.45 Conf par ver (0x6382 / 0x15D)

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

Table 71: 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.	conf par ver

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

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

Table 72: 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: the parameter set is not valid for this device.	conf par lim

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

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

Table 73: Power EEprom configuration error (0x6384 / 0x166)

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.	conf par EEPROM

9.3.48 Brake chopper failure (0x7111 / 0x141)

This error is valid for PSM 510.

Table 74: 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

9.3.49 Brake chopper overcurrent (0x7112 / 0x167)

This error is valid for PSM 510.

Table 75: 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

9.3.50 Brake resistor maximum power limit (0x7181 / 0x142)

This error is valid for PSM 510.

Table 76: Brake resistor maximum power limit (0x7181 / 0x142)

Code	PROFINET® code	Name	Severity (warning/error/ trip lock)	Description	LCP name
0x7181	0x142	Brake resistor maximum power limit	Warning, error	The brake resistor maximum power limit is exceeded.	brake pwr lim

9.3.51 Brake resistor user power limit (0x7182 / 0x143)

This error is valid for PSM 510.

Table 77: Brake resistor user power limit (0x7182 / 0x143)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x7182	0x143	Brake resistor user power limit	Warning, error	The brake resistor power limit is exceeded. The power transmitted to the brake resistor is calculated as an average value over the last 300 s of run time. -The calculation is based on the DC-link voltage and the brake resistor value set in parameter *2-16* (Brake resistor power 300 s). The error is reported when the value is exceeded within 300 s.	brake usr pwr lim

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

This error is valid for PSM 510.

Table 78: 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 brake resistor mains voltage is too high.	brake volt high

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

This error is valid for DAM 510.

Table 79: 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

9.3.54 Excess Torque (0x8311 / 0x16A)

This error is valid for IGD 510.

Table 80: Excess torque (0x8311 / 0x16A)

Code	PROFINET® code	Name	Severity (warning/error/trip lock)	Description	LCP name
0x8311	0x16A	Excess torque	Error	The allowed torque limit has been exceeded for too long.	excess torque

9.3.55 Mechanical brake failure (0xFF01 / 0x112)

This error is valid for IGD 510.

Table 81: 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

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

This error is valid for IGD 510.

Table 82: 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

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

This error is valid for IGD 510.

Table 83: 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

9.3.58 Communication interrupted (0xFF10 / 0x14F)

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

Table 84: 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

9.3.59 Fan feedback inconsistent (0xFF21 / 0x145)

This error is valid for PSM 510.

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

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

9.3.60 Fan lifetime critical (0xFF22 / 0x15A)

This error is valid for PSM 510.

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

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

9.3.61 Timing violation 1 (0xFF60 / 0x115)

This error is valid for IGD 510.

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

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

9.3.62 Timing violation 2 (0xFF61 / 0x116)

This error is valid for IGD 510.

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

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

9.3.63 Timing violation 3 (0xFF62 / 0x117)

This error is valid for IGD 510.

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

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

9.3.64 Timing violation 4 (0xFF63 / 0x118)

This error is valid for IGD 510.

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

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

9.3.65 Timing violation 5 (0xFF64 / 0x119)

This error is valid for IGD 510.

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

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

9.3.66 Timing violation 6 (0xFF65 / 0x11A)

This error is valid for IGD 510.

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

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

9.3.67 Timing violation 7 (0xFF66 / 0x168)

This error is valid for IGD 510.

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

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

9.3.68 Timing violation 8 (0xFF67 / 0x16B)

This error is valid for IGD 510.

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

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

9.3.69 Timing violation 9 (0xFF68 / 0x16C)

This error is valid for IGD 510.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

This error is valid for PSM 510 and DAM 510.

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

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

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

This error is valid for IGD 510.

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

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

9.3.75 STO mismatch (0xFF81 / 0x11F)

This error is valid for IGD 510.

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

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

9.3.76 P_STO error (0xFF85 / 0x120)

This error is valid for IGD 510.

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

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

10 Maintenance, Decommissioning, and Repair

10.1 Warnings

⚠ WARNING ⚠

HIGH VOLTAGE

Potentially lethal voltage is present on the connectors, which can lead to death or serious injury.

- Before working on the power connectors (disconnecting or connecting the cable to the VLT® Integrated Gear Drive IGD 510), disconnect the supply to the Power Supply Module PSM 510 and wait for the discharge time to elapse.
- Installation, start-up, maintenance, and decommissioning must only be performed by qualified personnel.

⚠ WARNING ⚠

DISCHARGE TIME

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

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

Minimum waiting time (minutes)
15

⚠ CAUTION ⚠

DANGER OF BURNS

Depending on the operating point, the surface of the VLT® Integrated Gear Drive IGD 510 and the oil in the IGD 510 can reach high temperatures.

- Do not touch the IGD 510 until it has cooled down.
- Do not carry out an oil change until the oil has cooled sufficiently.

10.2 Maintenance of the IGD 510 Drive

10.2.1 Overview of Maintenance Tasks

To prevent breakdown, danger, and damage, examine the VLT® Integrated Gear Drive IGD 510 at regular intervals depending on the operating conditions. Replace worn or damaged parts using original spare parts or standard parts.

Contact the local service representative for service and support: http://vlt-drives.danfoss.com/Support/Service/.

The IGD 510 has a low rate of maintenance. The maintenance tasks listed in table 103 can be performed by the customer. No other tasks are required.

Table 103: Overview of Maintenance Tasks

Component	Maintenance task	Maintenance interval	Instruction
VLT® Integrated Gear Drive IGD 510	Check for abnormal noise and vibration.	Every 6 months.	Contact Danfoss Service.
Protective coating	Check for damage.	Every 6 months.	Repair damage using the Danfoss paint repair set.
Hollow shaft seal (stainless steel shaft)	Check the condition and check for leakage.	Every 6 months.	If damaged, replace with a Viton seal.
Hollow shaft seal (mild steel shaft)	Check the condition and check for leakage.	Every 6 months.	If damaged, replace with an NBR seal.
Oil	Change the oil.	Standard oil: After 25000 hours run. Food grade oil: After 35000 hours run.	See 10.2.3 Changing the Oil.
	Check for oil leakage on gear and motor housing.	Every 12 months.	Replace the IGD 510.

10.2.2 Inspection during Operation

Changes in relation to normal operation, such as higher temperatures, vibrations, or noises, indicate that the function is impaired. To avoid faults that could lead, directly or indirectly, to injury to persons or damage to property, inform the maintenance staff responsible. If in any doubt, switch off the VLT® Integrated Gear Drive IGD 510 immediately.

Carry out regular inspections during operation. Check the VLT® Integrated Gear Drive IGD 510 at regular intervals for anything unusual.

Pay particular attention to:

- Unusual noises.
- Overheated surfaces (temperatures up to 80 °C (176 °F) can occur in normal operation).
- Uneven running.
- Strong vibrations.
- Loose fastenings.
- Condition of electrical wiring and cables.
- Poor heat dispersion.

Overheated surfaces can be caused by incorrect gearbox selection or incorrect parameter set-up in the frequency converter. If irregularities or problems occur, contact Danfoss Service.

10.2.3 Changing the Oil

The VLT® Integrated Gear Drive IGD 510is supplied with oil ready for operation.

The oil change period in part load is up to 35000 hours run. The oil change interval is based on normal operating conditions and an oil temperature of approximately 70 °C (158 °F). The oil change interval must be reduced at higher temperatures (halve the interval for each 10 K increase in the oil temperature).

The IGD 510 has drain and filling plugs that make it possible to change the oil without disassembly.

When changing the oil, inspect and, if necessary, replace the seals.

Flush the IGD 510 if the oil grade or oil type is changed. See 10.2.3.3 Procedure.

10.2.3.1 Oil Grade

The filled oil type is specified on the nameplate. Danfoss uses food grade oils that comply with NSF H1.

Do not mix different oil types as this may impair the characteristics of the oil.

Contact Danfoss for further information on oil types.

10.2.3.2 Oil Volume

The recommended oil quantity for the particular mounting position is indicated on the motor nameplate. When filling, ensure that the upper gear unit components are also lubricated.

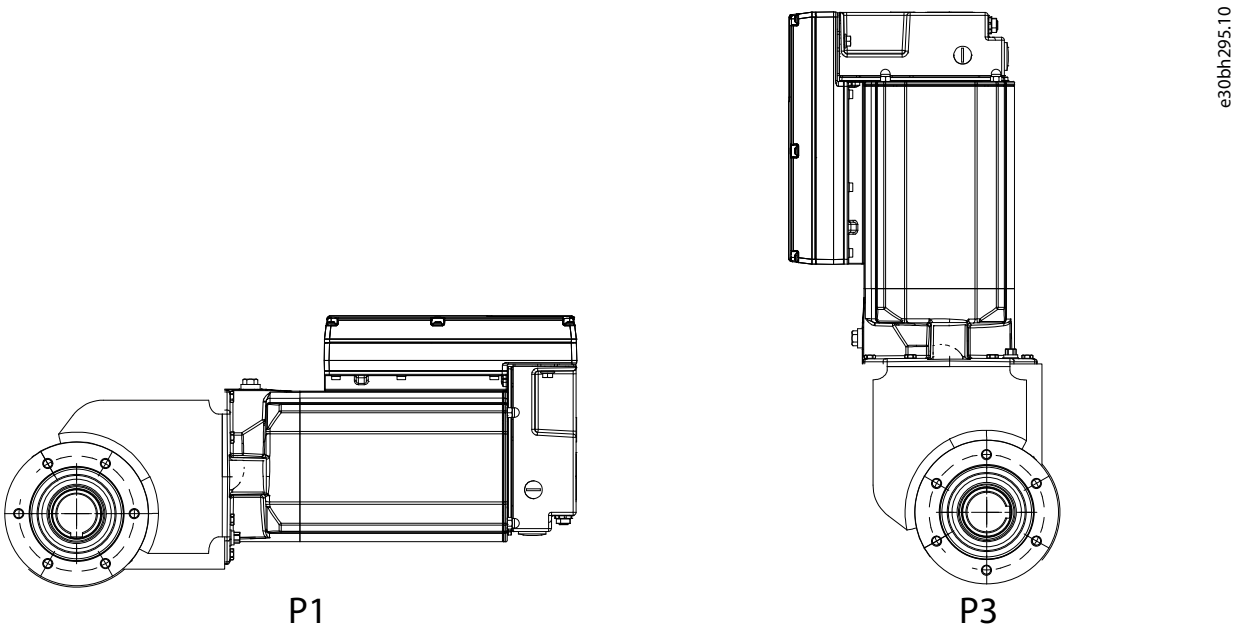


Illustration 45: Mounting Positions

Table 104: Oil Volume in Litres

	Mounting position	
	P1	P3
Oil volume for IGD 510 [l (fl oz)]	2.2 (74.4)	3.1 (105)

10.2.3.3 Procedure

Context:

⚠ CAUTION ⚠

DANGER OF BURNS

The surface of the VLT® Integrated Gear Drive IGD 510 and the oil in the IGD 510 can reach high temperatures during operation.

- Do not touch the IGD 510 until it has cooled down.
- Do not carry out an oil change until the oil has cooled down sufficiently.

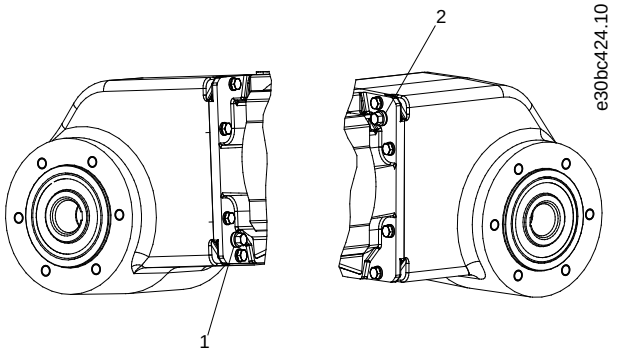


Illustration 46: Oil Screws 1 and 2

Draining the oil

1. Once the IGD 510 and the oil have cooled down, remove the IGD 510 from the system.
2. Bring the IGD 510 into a vertical position and remove oil screws [1] and [2].
3. Turn the IGD 510 into a horizontal position and drain the oil through screw hole [1] into a suitable container.
4. Turn the IGD 510 back into a vertical position.

Filling the oil

NOTICE

- **The required oil quantities can be found on the nameplate and in 10.2.3.2 Oil Volume.**

1. Fill the IGD 510 with the appropriate amount of oil through screw hole [1].
2. Remove all traces of oil from the surface of the IGD 510 using a soft cloth.
3. Reinsert and tighten oil screws [1] and [2].

10.3 Maintenance of the System Modules

10.3.1 Maintenance Tasks

The IGD 510 system components are largely maintenance free.

The maintenance tasks must be performed by qualified personnel. No other tasks are required.

Table 105: Overview of Maintenance Tasks

Component	Maintenance task	Maintenance interval	Instruction
IGD 510 system components	Carry out a visual inspection.	Every 6 months	Check for any abnormalities on the surface of the component.
	Check the fan.	Every 12 months	Check that the fan can turn and remove any dust or dirt.
Functional safety	Perform a system power cycle and check the STO function.	Every 12 months	Activate STO and check the status with the PLC.

10.4 Spare Parts

Spare parts can be ordered via the Danfoss VLT Shop: vltshop.danfoss.com.

10.5 Decommissioning

⚠ WARNING ⚠

HIGH VOLTAGE

Potentially lethal voltage is present on the connectors, which can lead to death or serious injury.

- Before working on the power connectors (disconnecting or connecting the cable to the VLT® Integrated Gear Drive IGD 510), disconnect the supply to the Power Supply Module PSM 510 and wait for the discharge time to elapse.
- Installation, start-up, maintenance, and decommissioning must only be performed by qualified personnel.

⚠ CAUTION ⚠

DANGER OF BURNS

Depending on the operating point, the surface of the VLT® Integrated Gear Drive IGD 510 and the oil in the IGD 510 can reach high temperatures.

- Do not touch the IGD 510 until it has cooled down.
- Do not carry out an oil change until the oil has cooled sufficiently.

10.5.1 Dismounting the IGD 510

Procedure

1. Disconnect the supply to the Power Supply Module PSM 510 and wait for the discharge time to elapse.
2. Remove the torx screw located between the 2 hybrid cables at the bottom of the connection box.
3. Remove the 2 torx screws at the top of the connection box.
4. Dismount the IGD 510 from the shaft.

10.5.2 Dismounting the System Modules

See 10.7.1 Dismounting the System Modules for instructions on how to dismount the system modules.

10.6 Repair

Contact the local Danfoss sales company for repair options.

10.7 System Module Replacement

10.7.1 Dismounting the System Modules

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

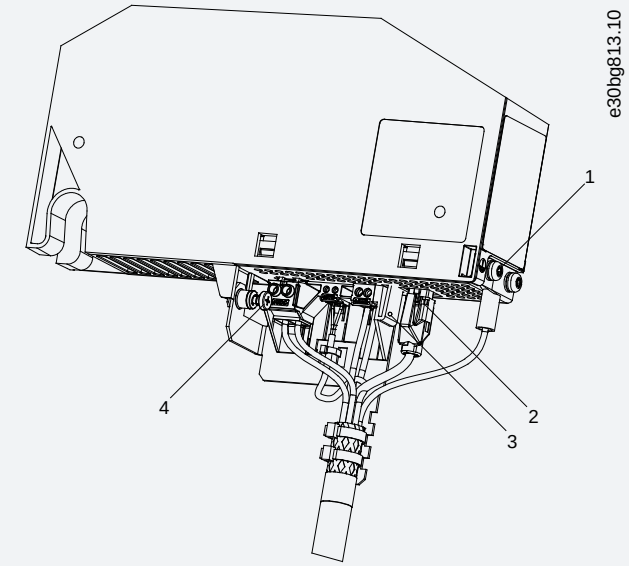


Illustration 47: Disconnecting the EMC Plate

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

Unscrew the screw [4] on the EMC plate.

Press the clip [3] to release the EMC plate.

Unscrew the PE screw [1].

3. Disconnect the EMC plate on the top of the system modules:

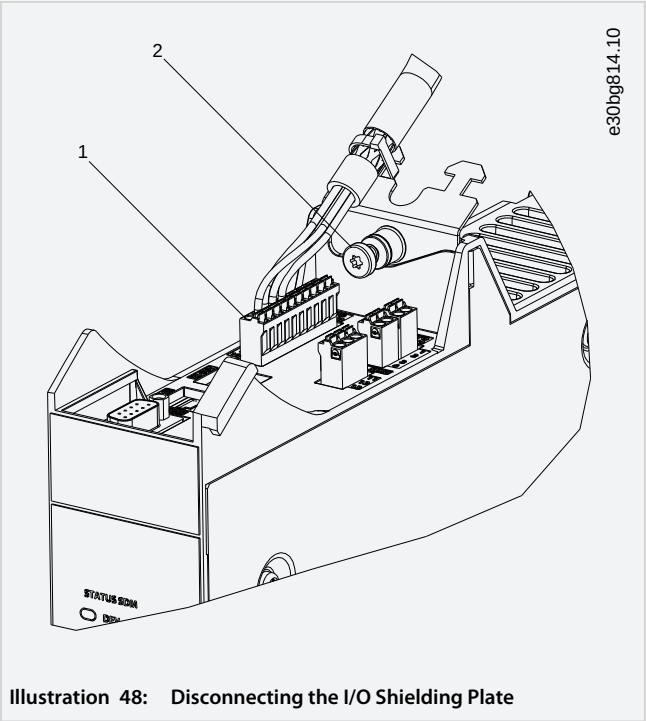


Illustration 48: Disconnecting the I/O Shielding Plate

Unplug the top connectors [1].

Unscrew the screw on the I/O shielding plate [2].

Pull the I/O shielding plate upwards to remove it.

4. Release the securing clamp at the top of the module.

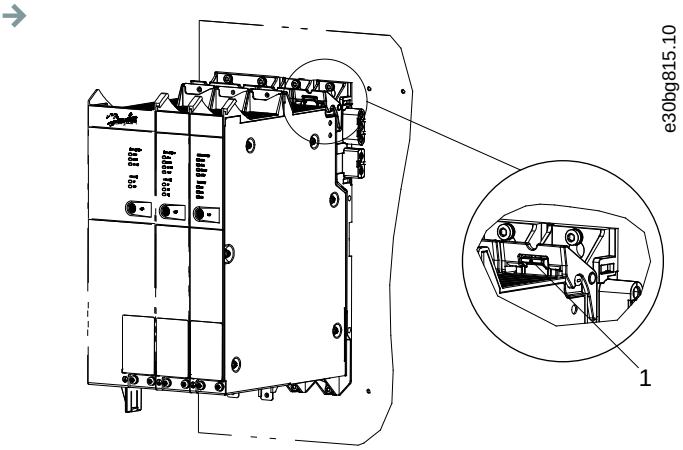


Illustration 49: Releasing the Securing Clamp

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

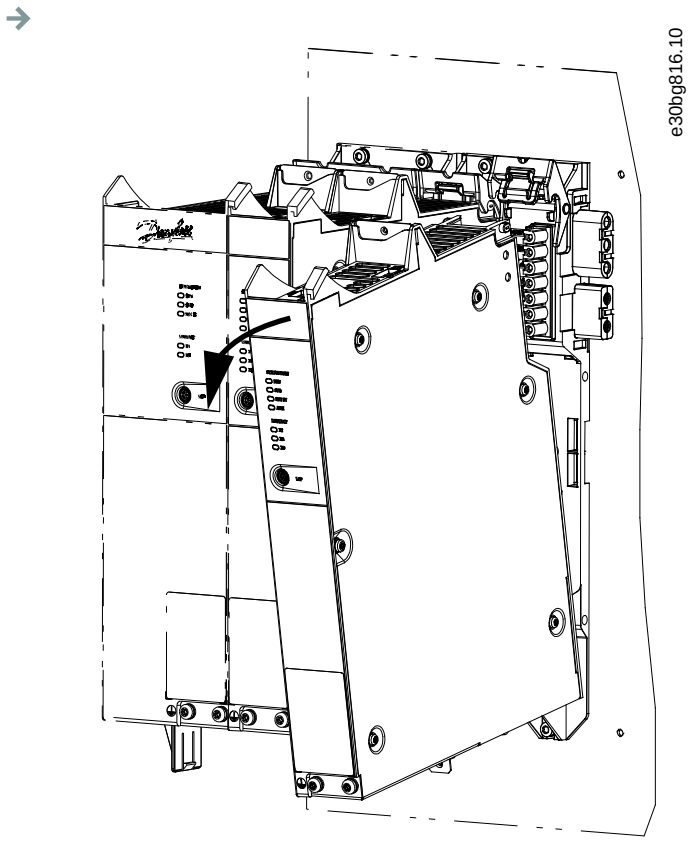


Illustration 50: Removing the Module

10.7.2 Fitting and Commissioning the System Modules

1. Check if preparation is required (see 4.13.2 Preparation for Installation of the System Modules).
2. Fit the system modules (see 4.13.3.2 Fitting Instructions for System Modules).
3. Connect the electrical cables (see chapter **Electrical Installation**).
4. Switch the system on (see 6.8 Switching on the IGD 510 System).
5. Configure the system module's parameters according to the fieldbus used (see 6.5 PROFINET® ID Assignment).
6. Conduct a test run.

10.8 Fuse Replacement in Decentral Access Module (DAM 510)

Context:

If a single fuse blows, replace all the fuses with fuses from the same batch (fuse CAT No. 5012006.25, SIBA).

Procedure

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

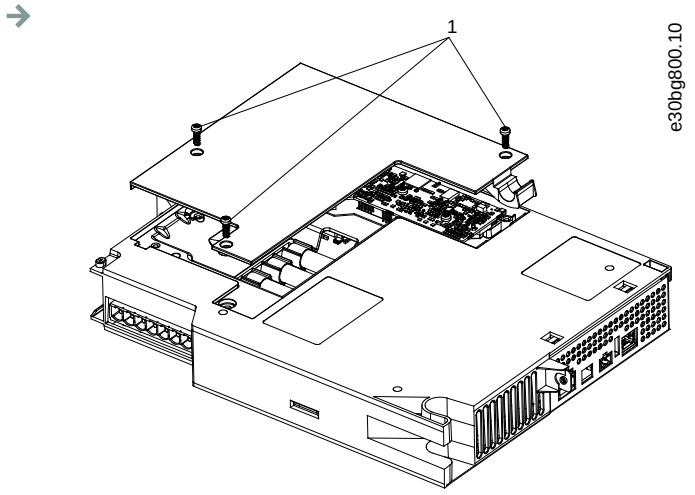


Illustration 51: Opening the Cover on DAM 510

2. Use a screwdriver to remove the fuses and replace them with identical type fuses (see 5.4.1 Fuses).

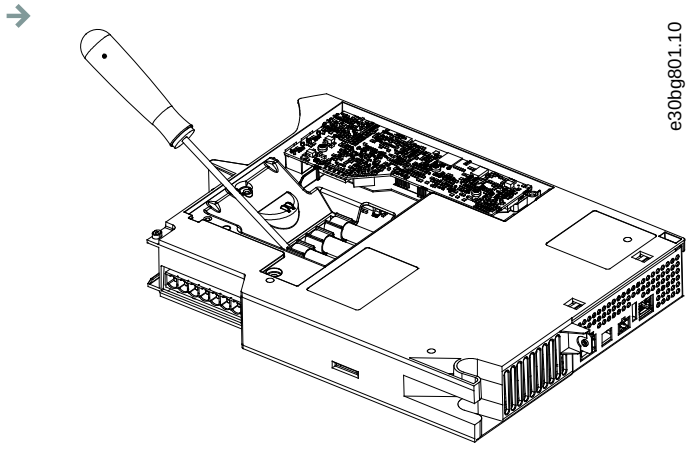


Illustration 52: Removing the Fuse

3. Replace the cover and tighten the screws [1].

10.9 Fan Replacement

Context:

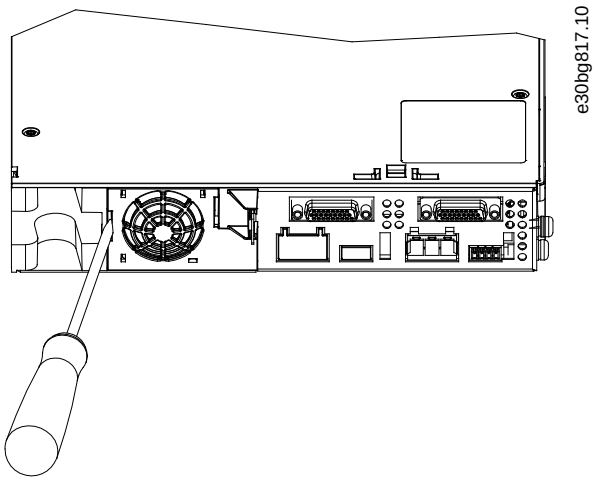


Illustration 53: Fan Replacement on 50 mm Modules

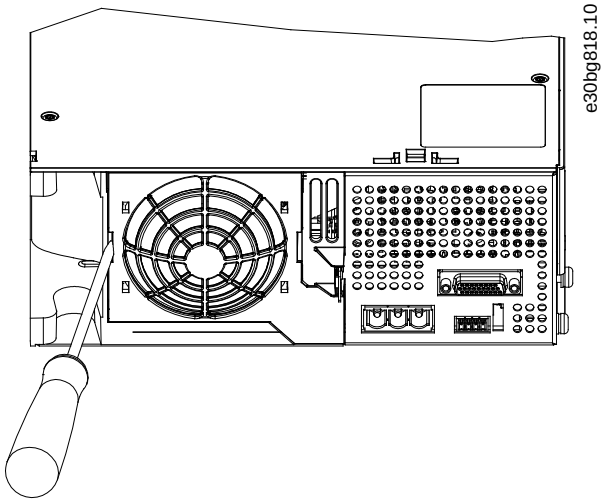


Illustration 54: Fan Replacement on 100 mm Modules

Procedure

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

10.10 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.

10.11 Recycling

Take metals and plastics to recycling stations.

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

10.12 Disposal

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

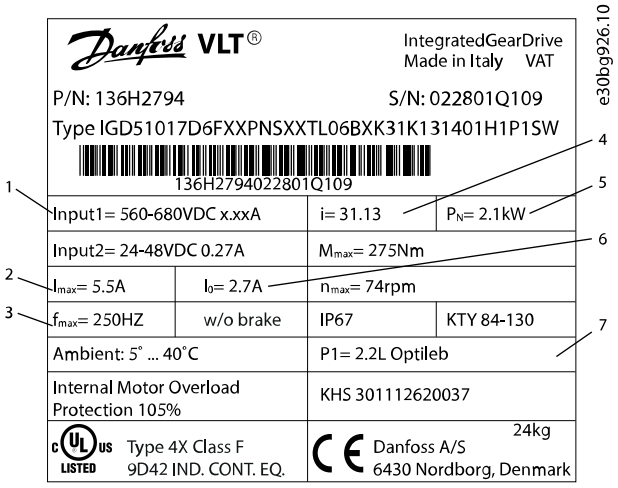
Dispose of the IGD 510 and system modules as hazardous waste, electrical waste, recyclable waste, and so on, in accordance with applicable local regulations.

11 Specifications

11.1 Specifications for the IGD 510

11.1.1 Nameplate on the IGD 510

The nameplate on the VLT® Integrated Gear Drive IGD 510 is corrosion-proof.



1	DC voltage	**2**	Maximum output current
3	Nominal motor frequency	**4**	Gear ratio
5	Motor size	**6**	Nominal motor current
7	Installation position		

Illustration 55: Example Nameplate

11.1.2 Type Code for the IGD 510

NOTICE

- The Drive Configurator shows the valid configuration of IGD 510 variants. Only valid combinations are shown. Therefore, not all variants detailed in the type code are visible.

Pos.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Fixed	I	G	D	5	1	0	1	7	D	6									T	L	0	6			K						1				H	1				W
Variant											F	X	X	P	N	S	X	X					B	X		0	5	K	9	2		3	0	1			P	1	A	
																S	C	0					B	1		1	4	K	1	3		3	5	2			P	3	S	
																										3	1	K	1	3		4	0							
																																I	1							
																																I	2							
																																I	3							

e30bg787.10

Illustration 56: Type Code

Table 106: Legend to Type Code

[01–03]	**Product group**		**[20–22]**	**Motor size**		**[32–33] continued**	**Output shaft size**
IGD	VLT® IntegratedGearDrive		L06	Maximum 2.2 kW (V210)		I1	1 ¼ inch
[04–06]	**Product variant**		**[23–24]**	**Mechanical brake**		I2	1 7/16 inch
510	IGD® 510		BX	Without brake		I3	1 1/2 inch
[07]	**Hardware configuration**		B1	24 V DC, 10 Nm		**[34]**	**Output shaft material**
1	Advanced with connection box		**[25]**	**Gear type**		1	Mild steel with MBR gasket
[08]	**Drive enclosure**		K	Bevel gear		2	Stainless steel with Viton gasket
7	IP67		**[26–30]**	**Gear ratio**		**[35–36]**	**Oil**
[09–10]	**DC voltage**		05K92	5.92		H1	Food grade
D6	600 V DC-link voltage		14K13	14.13		**[37–38]**	**Installation position**
[11–13]	**Drive feedback**		31K13	31.13		P1	Horizontal A, drive up
FXX	Without feedback		**[31]**	**Output shaft design**		P3	Vertical, motor up
[14–15]	**Bus system**		1	Hollow shaft		**[39]**	**Surface coating**
PN	PROFINET®		**[32–33]**	**Output shaft size**		A	Aseptic
[16–18]	**Firmware**		30	30 mm		S	Standard
SXX	Standard		35	35 mm		**[40]**	**Surface coating color**
SC0	Customized		40	40 mm		W	Standard white RAL 9010
[19]	**Safety**						
T	Safe Torque Off (STO)						

11.1.3 Speed/Torque Values

Table 107: Speed/Torque Values at 25 °C Ambient Temperature

i	n_{max}	I_{max}	I_N	M_{HST}		M_n		M_{max}	
5.92	507 RPM	9.0 A	5.5 A	120 Nm (at n 0-400 RPM)	100 Nm at n_{max}	75 Nm (at n 0-255 RPM)	40 Nm at n_{max}	75 Nm (at n 0-255 RPM)	40 Nm at n_{max}
14.13	212 RPM	9.0 A	5.5 A	280 Nm (at n 0-150 RPM)	250 Nm at n_{max}	180 Nm (at n 0-120 RPM)	131 Nm at n_{max}	180 Nm (at n 0-120 RPM)	131 Nm at n_{max}
31.13	96 RPM	7.2 A	5.5 A	520 Nm (at n 0-50 RPM)	400 Nm at n_{max}	320 Nm (at n 0-45 RPM)	255 Nm at n_{max}	380 Nm (at n 0-45 RPM)	255 Nm at n_{max}

11.1.4 General Specifications and Environmental Conditions for the IGD 510 Drive

Table 108: General Specifications and Environmental Conditions

Installation altitude	No limitation up to 1000 m. Maximum 2000 m with derating. 9% derating up to 2000 m with normal supply voltage, 3-phase AC 400 V.
Minimum backlash of gearbox unit	±0.07°

11.1.5 Dimensions

11.1.5.1 VLT® Integrated Gear Drive IGD 510

The length of the IGD 510 is the same with or without the connection box fitted and with or without the brake fitted.

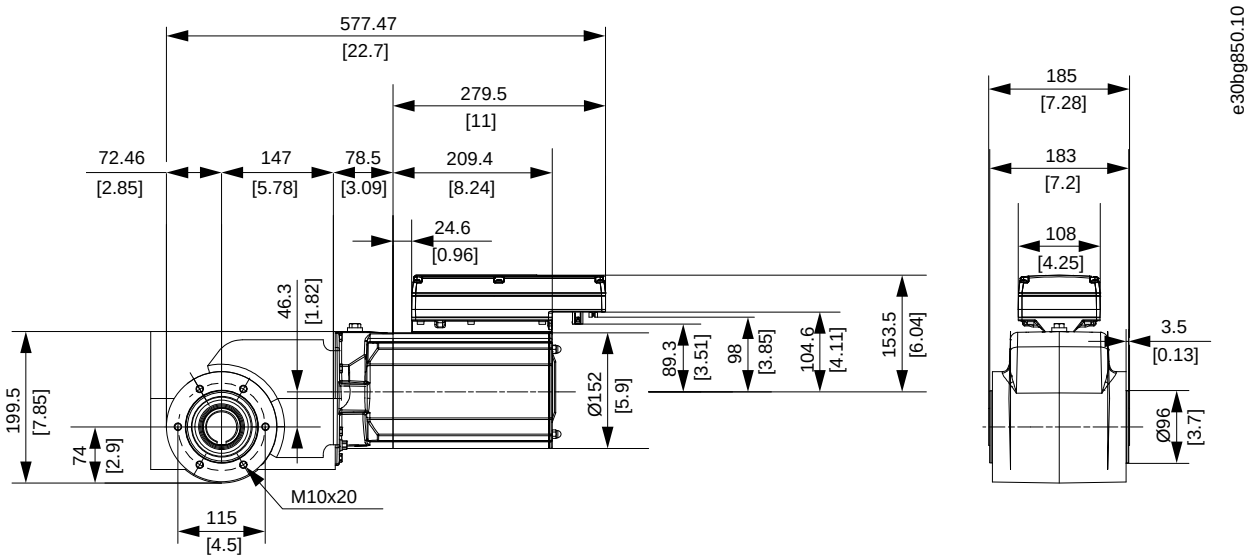


Illustration 57: VLT® IntegratedGearDrive IGD 510

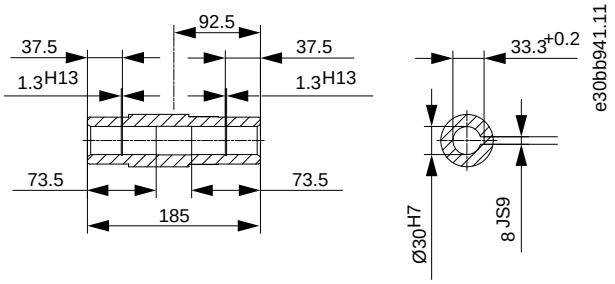


Illustration 58: 30 mm Steel/Stainless Steel Shaft

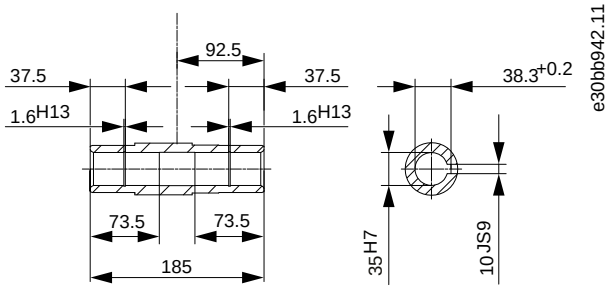


Illustration 59: 35 mm Steel/Stainless Steel Shaft

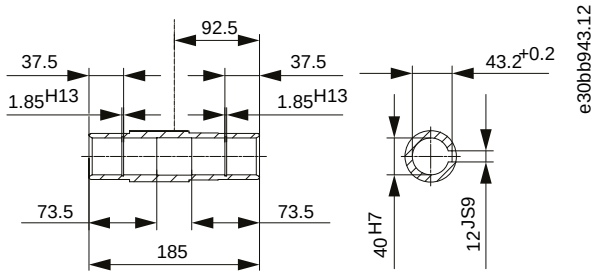


Illustration 60: 40 mm Steel/Stainless Steel Shaft

11.1.5.2 VLT® Integrated Gear Drive IGD 510 with Torque Arm in Front Position

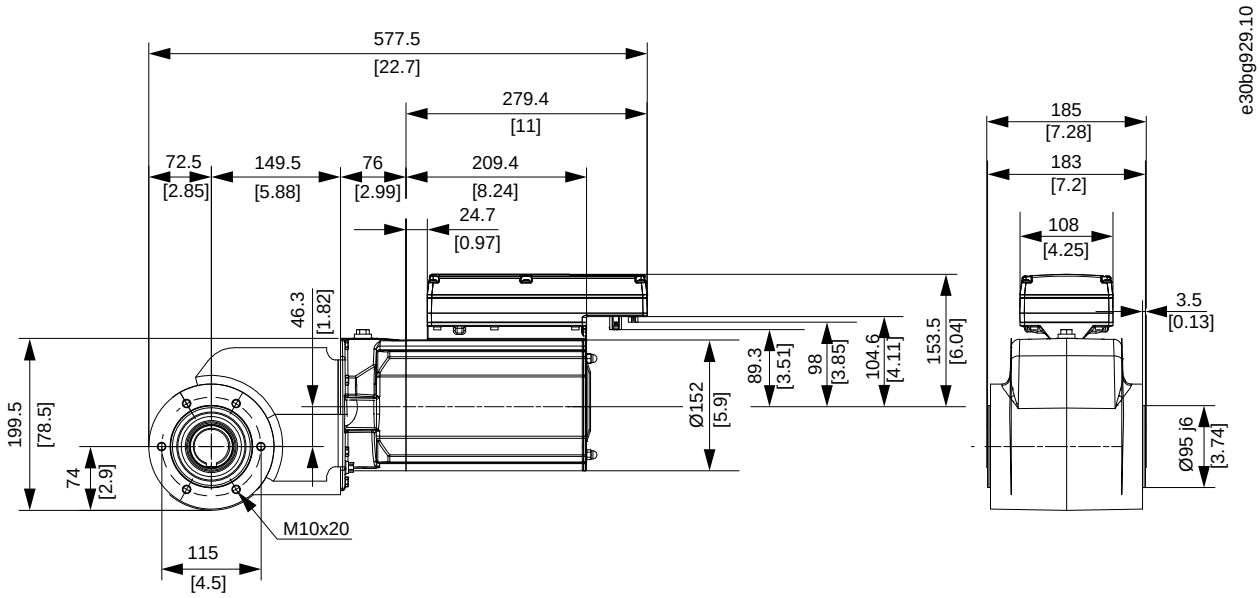


Illustration 61: Torque Arm in Front Position

11.1.5.3 Connection Box for IGD 510

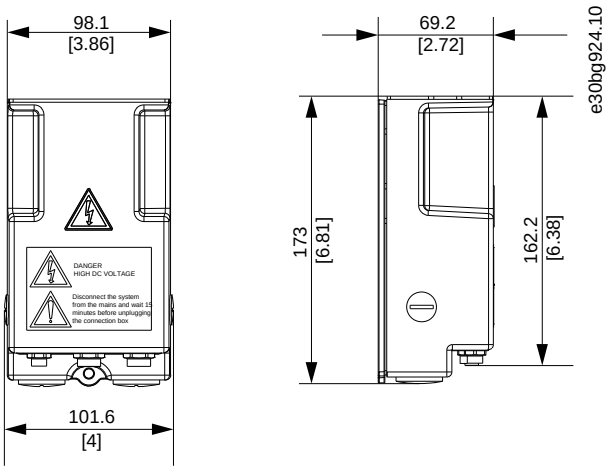
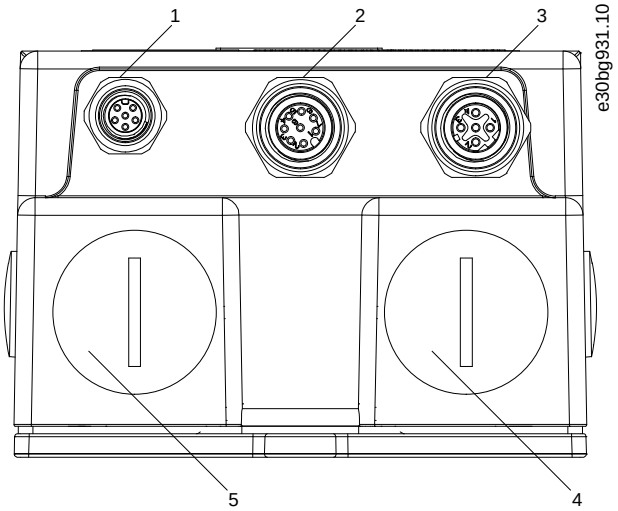


Illustration 62: Connection Box

11.1.6 Connectors

11.1.6.1 Connectors on the IGD 510 Connection Box

The connectors are located on the bottom of the connection box.



1 M8 LCP connector	**2** M12 Sensor connector
3 M12 Ethernet connector	**4** Gland for hybrid cable in
5 Gland for hybrid cable out	

Illustration 63: Connectors on the IGD 510 Connection Box

11.1.7 Options

11.1.7.1 Torque Arm Set

Part number: 178H5006

The torque arm set consists of:

- Torque arm
- Mounting set

11.1.7.1.1 Torque Arm

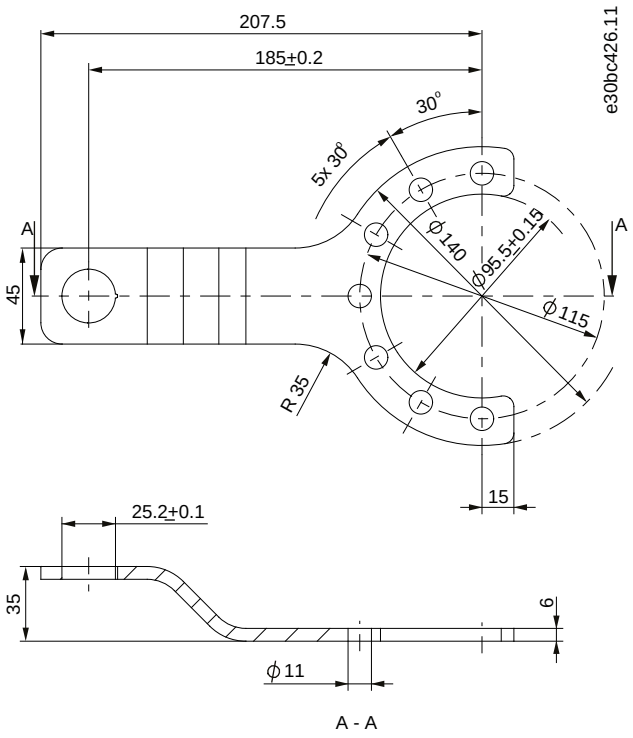


Illustration 64: Torque Arm

11.1.7.1.2 Mounting Set

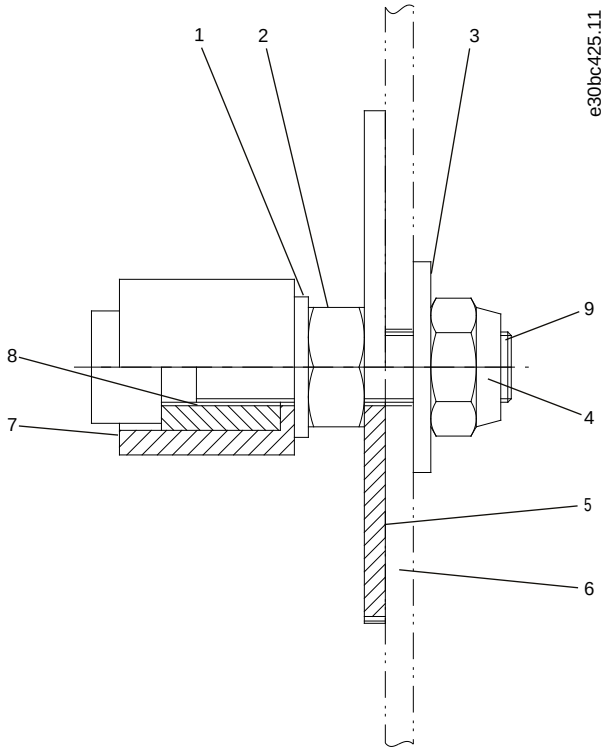


Illustration 65: Mounting Set

Table 109: Mounting Set

Position	Description	Specification
1	Disc	DIN 125-A10 5
2	Nut	DIN 934 M10
3	Disc	DIN 9021 10, 5 x 30 x 25
4	Nut	DIN 985 M10
5	Disc	Ø73 x 3 stainless steel
6	Customer frame	–
7	Barrel	POM-C white
8	Bushing	Stainless steel
9	Screw	Stainless steel

NOTICE

- The set also contains 3 x DIN 933, M10 x 25, 8.8, stainless steel screws. The tightening torque is 49 Nm (433.7 inlb).

NOTICE

- Only use the original Danfoss or comparable mounting set to mount the VLT® Integrated Gear Drive IGD 510 to the conveyor. The mounting equipment used must ensure the same degree of flexibility as the original Danfoss mounting set. The torque arm cannot be screwed directly onto the conveyor frame.

11.1.7.2 Mechanical Brake

11.1.7.2.1 Overview

The VLT® Integrated Gear Drive IGD 510 is available with a 24 V DC brake option. This mechanical brake option is intended for emergency stop and park brake duty.

Spring-loaded brakes are safety brakes that continue to work in the event of power failure or usual wear. Since other components could also fail, take suitable safety precautions to avoid any injury to persons or damage to objects caused by operation without a brake.

⚠ WARNING ⚠

SEVERE OR FATAL INJURIES

The IGD 510 is designed exclusively for horizontal conveyor applications with or without a slope. Using the IGD 510 in vertical lifting and hoisting applications can cause danger of fatal injury if the hoist falls.

- Do not use the brake in safety relevant vertical lifting and hoisting applications.

11.1.7.2.2 Technical Data

Table 110: Technical Data: Mechanical Brake Option

	Unit	Value
Voltage	V_{DC}	24V
P_{el}	W	15.6
Resistance at 20°	Ω	32 ±5%
Current	A	0.65
Maximum brake torque	Nm (in-lb)	10

11.1.7.2.3 Dimensions

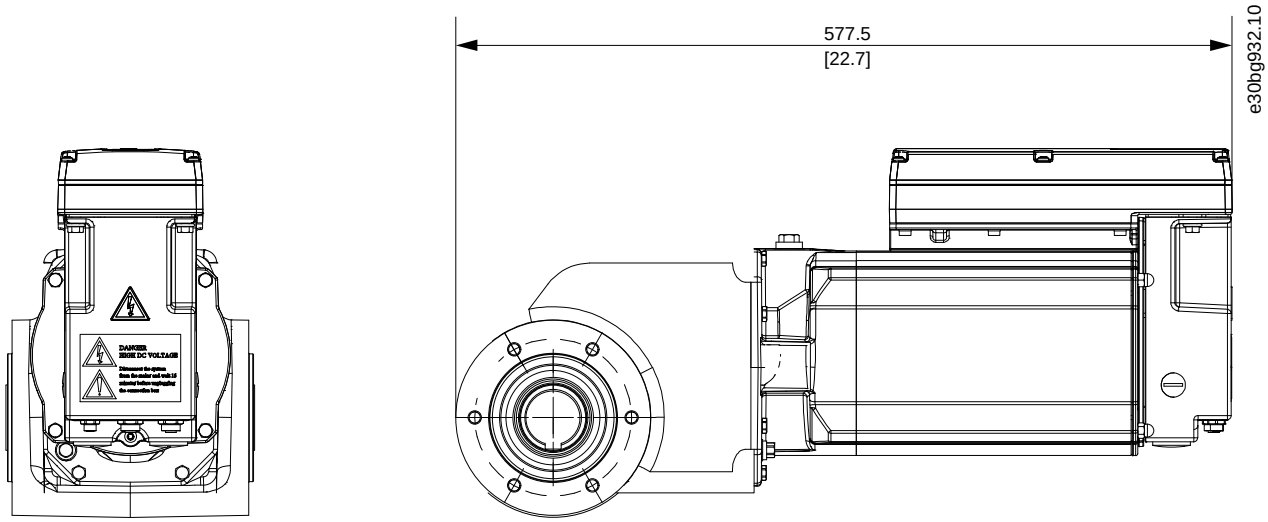


Illustration 66: VLT IntegratedGearDrive IGD 510 with Mechanical Brake Option

11.1.8 Storage

If the VLT® Integrated Gear Drive IGD 510 is to be stored, ensure a dry, dust free, and well-ventilated environment.

If the temperature in the storage space exceeds the normal range of –20 °C (–4 °F) to 40 °C (+104 °F) for an extended period, or varies frequently, employ the measures before start-up specified in 6.3 Measures before Commissioning the IGD 510, even after short storage times.

Damage sustained during storage:

- The life of the oils and seals is reduced with longer storage times.
- There is a risk of fracture at low temperatures (under approximately –20 °C (–4 °F).

If the IGD 510 is being stored for an extended time before start-up, increased protection against damage by corrosion or humidity can be achieved by observing the following information. The actual load depends strongly on local conditions, therefore the time period stated is only a guiding value. This period does not include any extension of the warranty. If disassembly is necessary before start-up, contact Danfoss Service. The instructions contained in this operating guide must be observed.

11.1.8.1 Measures during Storage

Turn the VLT® Integrated Gear Drive IGD 510 180° every 12 months so that the oil in the gear unit covers the bearings and gearwheels that were previously positioned on top. Also, turn the output shaft manually to churn the rolling-contact bearing grease and distribute it evenly. For IGD 510 drives with mechanical brake, apply power to the IGD 510 to enable the shaft to be turned.

11.1.8.2 Measures after Storage

Repair any damage to the exterior paint layer.

Ensure the VLT® Integrated Gear Drive IGD 510 contains the correct amount of oil and confirm the correct mounting position, see 10.2.3 Changing the Oil.

11.2 Specifications for the System Modules

11.2.1 Nameplates

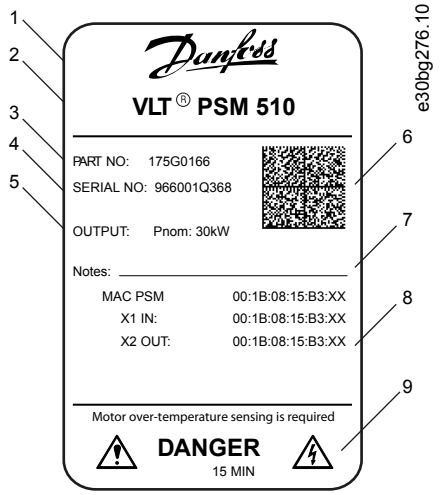
Check the nameplate and compare it with the order data. Use the part number for reference. The part number uniquely identifies the module type.

Ensure that the nameplate is clearly legible.

11.2.1.1 Example Nameplate on the Front of the System Modules

Ensure that the nameplate is clearly legible.

The following data is shown on the nameplate on the front of the IGD 510 system modules:



1	Danfoss logo	**2**	System module name
3	Part number	**4**	Serial number
5	Output	**6**	Data matrix
7	Notes	**8**	MAC addresses
9	Warning symbols		

Illustration 67: Example Nameplate on the Front of the System Modules

11.2.1.2 Example Nameplate on the Side of the System Modules

The following data is shown on the nameplate on the side of the system modules:

1	Typecode	**2**	Supply voltage
3	Output voltage	**4**	Maximum power
5	Ambient temperature range	**6**	Protection rating
7	U_{AUX} supply	**8**	Rated power
9	Standstill torque		

Illustration 68: Example Nameplate on the Side of the System Modules for PSM 510

11.2.2 Power Supply Module (PSM 510)

11.2.2.1 Dimensions of PSM 510

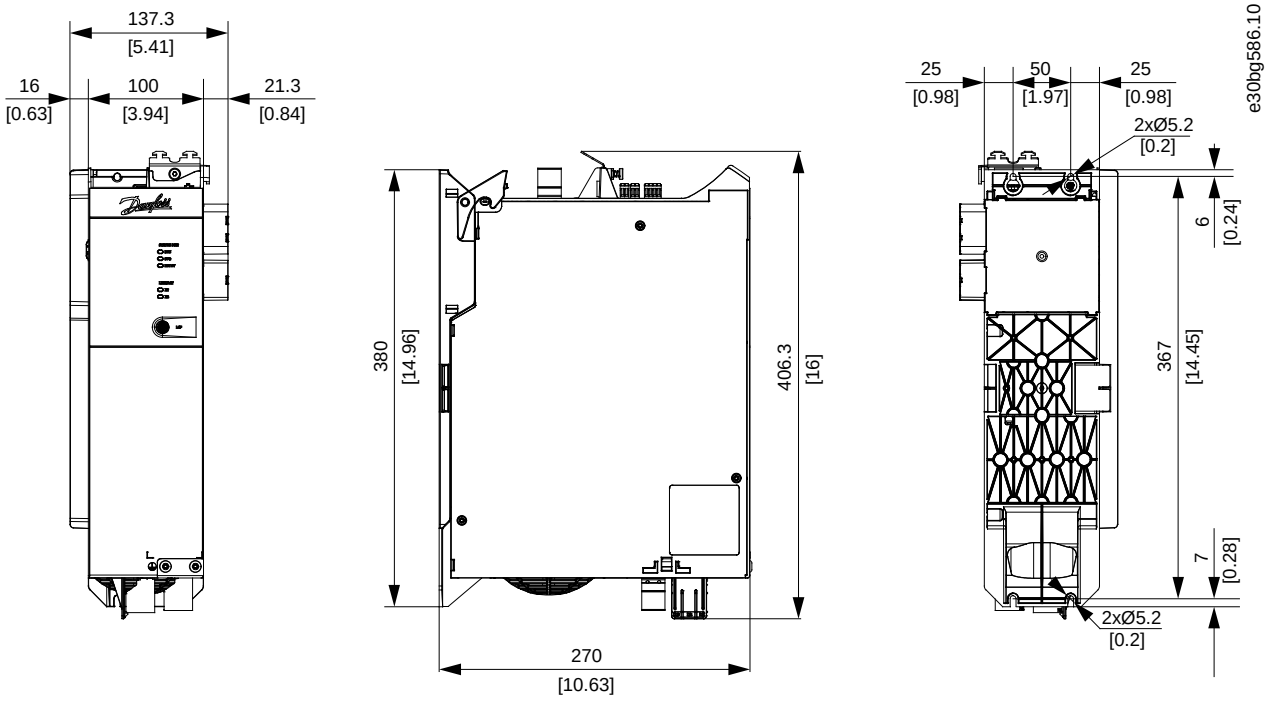


Illustration 69: Dimensions of PSM 510

11.2.2.2 Characteristic Data for PSM 510

Table 111: Characteristic Data for Power Supply Module (PSM 510)

Definition	Unit	Power size 1	Power size 2	Power size 3
Input				
Mains input voltage	V AC	400–480 ±10%, 3-phase (see 5.2 Electrical Environmental Conditions)		
Input current @ U_{MIN}	A	20	34	50
Output				
DC-link voltage	V DC	565–680 ±10%		
DC-link capacitance	µF	1800		
Rated current I_N	A	20	40	60
Rated power P_N	kW	10	20	30
Peak power P_{max} t <3.0 s)	kW	20	40	60
U_{AUX} current consumption at 24 V DC	A DC	2.0		
U_{AUX} current consumption at 48 V DC	A DC	1.0		

Definition	Unit	Power size 1	Power size 2	Power size 3
Internal Brake resistor [1]				
Peak power P_{max}	kW	8		
Rated power P_N	W	150		
Minimum resistance	Ω	15		
External Brake resistor				
Peak power P_{max}	kW	60		
Rated power P_N	W	7.5		
Minimum resistance	Ω	10		
General				
Line filter in accordance with EN 61800-3	–	Category C3		
Cooling	–	Integrated fan		
Mounting	–	Wall-mounted on backplate using backlink connector		
Weight	kg	6		
Dimensions (W x H x D)	mm	137.3 x 406.3 x 270		

[1] *An external brake resistor can be connected.*

11.2.3 Decentral Access Module (DAM 510)

11.2.3.1 Dimensions of DAM 510

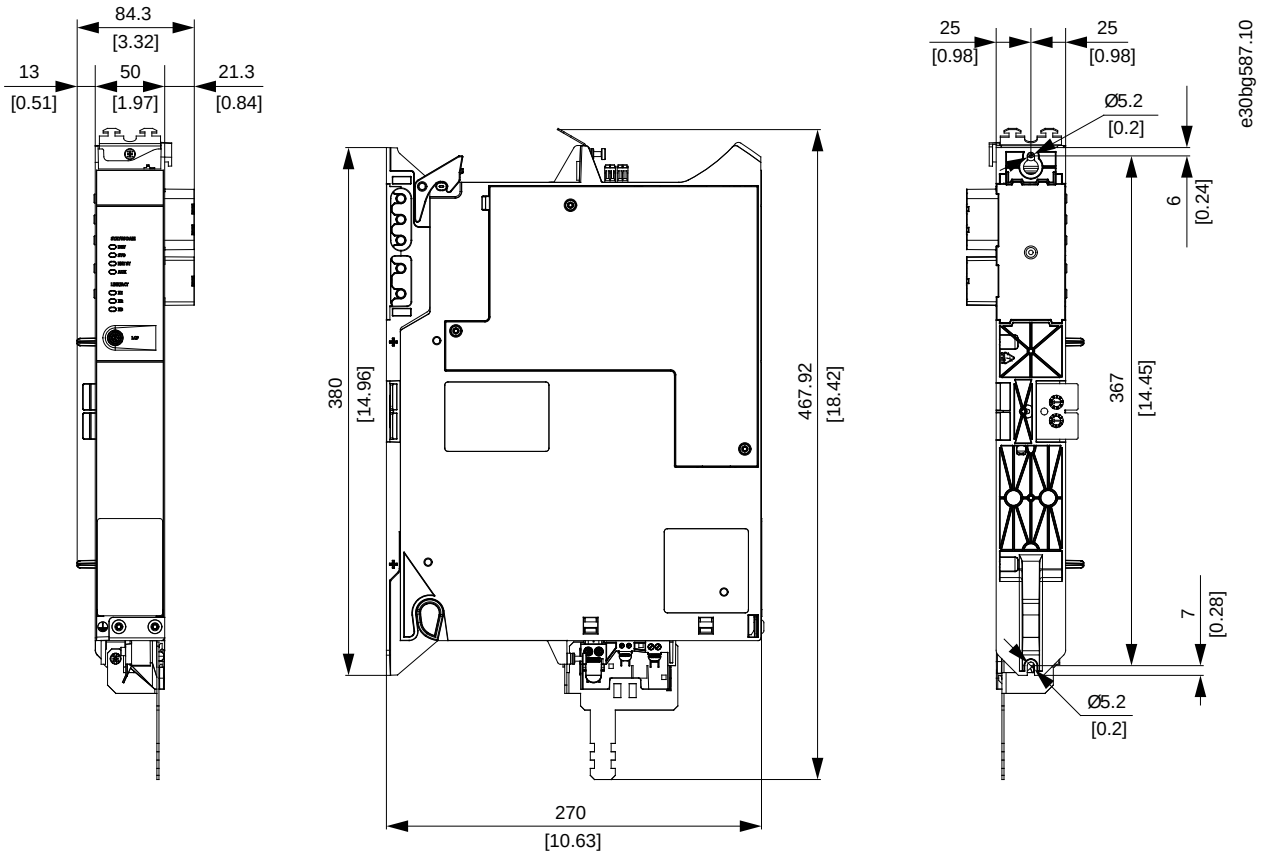


Illustration 70: Dimensions of DAM 510

11.2.3.2 Characteristic Data for DAM 510

Table 112: Characteristic Data for Decentral Access Module (DAM 510)

Definition	Unit	Power size 1	Power size 2
DC-link	V DC	565–680 ±10%	
DC-link capacitance	µF	660	
Output current DC-link	A DC	15	25
Peak current DC-link (rms value) t <1.0 s	A DC	30 for <1 s	48 for <1 s
Output current U_{AUX}	A DC	15	
U_{AUX} current consumption at 24 V DC	A DC	0.5	
U_{AUX} current consumption at 48 V DC	A DC	0.3	
Protective measures	–	Overload, short-circuit, and ground fault protection	

Definition	Unit	Power size 1	Power size 2
Cooling	–	Natural convection	
Mounting	–	Wall-mounting on backplate using backlink connector	
Weight	kg	3.05	
Dimensions (W x H x D)	mm	84.3 x 467.9 x 270	

11.2.3.3 Hybrid Cable Protection

The AUX 24/48 V has 3 levels of protection:

- Software (seconds timing range): The control boards opens the 24/48 V AUX if an overload is present (>15 A).
- Hardware (microseconds timing range): Opens automatically if a short circuit of >36 A is present.
- Hardware: A 20 A non-replaceable SMD (surface-mounted device) fuse in case the first 2 fuses fail.

11.2.4 Auxiliary Capacitors Module (ACM 510)

11.2.4.1 Dimensions

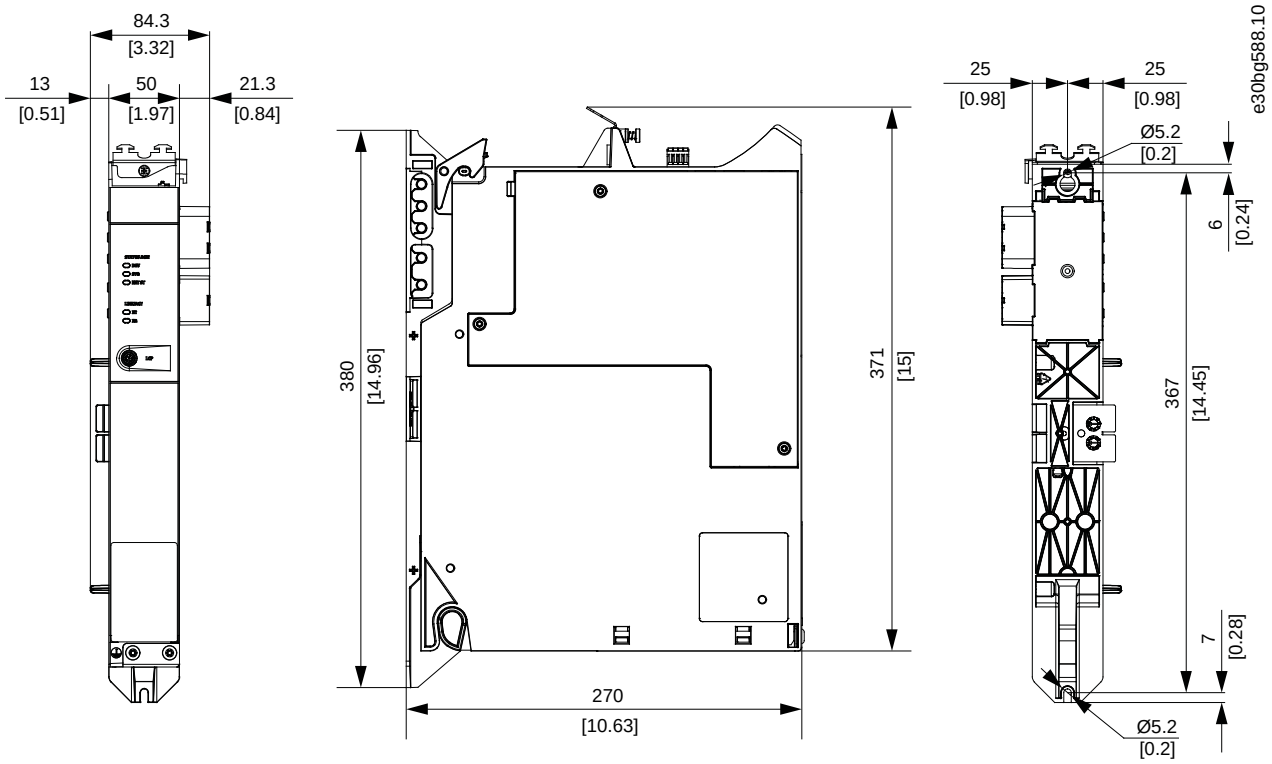


Illustration 71: Dimensions of ACM 510

11.2.4.2 Characteristic Data for ACM 510

Table 113: Auxiliary Capacitors Module (ACM 510) Characteristic Data

Definition	Unit	Value
DC-link	V DC	565–678 ±10%
DC-link capacitance	µF	2750
U_{AUX} current consumption at 24 V DC	A DC	0.5
U_{AUX} current consumption at 48 V DC	A DC	0.3
Cooling	–	Natural convection
Mounting	–	Wall-mounting on backplate using backlink connector
Weight	kg	3.54
Dimensions (W x H x D)	mm	84 x 371 x 270

11.2.5 Connectors on the System Modules

11.2.5.1 Backlink Connector

The backlink connector is located at the top of the backside of all the IGD 510 system modules.

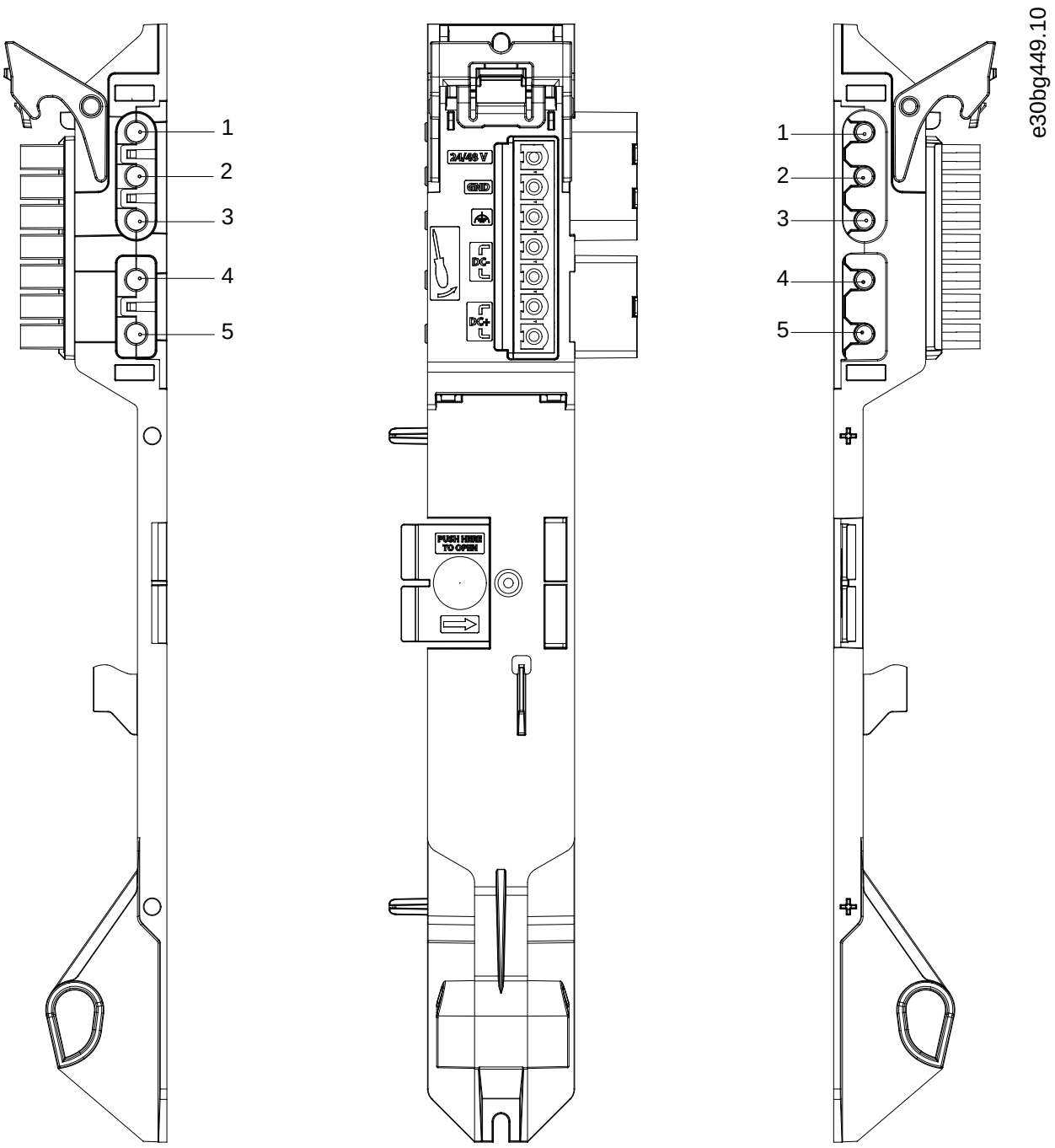


Illustration 72: Pin Assignment of Backlink Connector (U_{AUX})

Table 114: Pin Assignment of Backlink Connector (U_{AUX})

Pin	Description
1	24/48 V
2	GND

Pin	Description
3	FE: Functional earth
4	DC–
5	DC+

11.2.5.2 Brake Connectors

Brake connectors are located on the Power Supply Module (PSM 510).

NOTICE

- The maximum length of the brake cable is 10 m (shielded).

11.2.5.2.1 Brake Resistor Connector on PSM 510

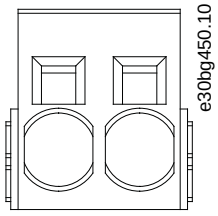


Illustration 73: Brake Connector on PSM 510

Table 115: Pin Assignment of Brake Connector on PSM 510

Pins (left to right)	Description	Notes	Ratings
1	DC+/R+	Used for connecting a brake resistor.	Nominal voltage: 565–778 V DC
2	R–		Maximum brake current: 80 A Maximum cross-section: 16 mm^2

11.2.5.3 Ethernet Connectors

Ethernet connectors are located on all the system modules.

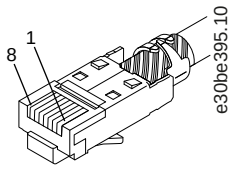


Illustration 74: Ethernet Connector

NOTICE

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

11.2.5.3.1 Ethernet Connectors on PSM 510 and ACM 510

Table 116: Ethernet Connectors on PSM 510 and ACM 510

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

11.2.5.3.2 Ethernet Connectors on DAM 510

Table 117: Ethernet Connectors on DAM 510

Connector name	Description	Pins	Ratings
X1 IN	Ethernet IN	Pins (left to right):	According to standard 100BASE-T.
X2 OUT	Ethernet OUT2 (connection to hybrid cable)	1: TX+	
X3 OUT	Ethernet OUT1	2: TX–	
		3: RX+	
		4: –	
		5: –	
		6: RX–	
		7: –	
		8: –	

11.2.5.4 I/O Connectors

11.2.5.4.1 I/O Connector on PSM 510/ACM 510

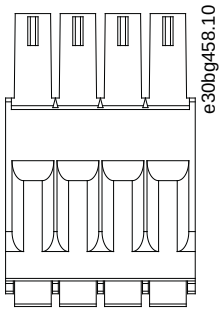


Illustration 75: I/O Connector on PSM 510/ACM 510

Table 118: Pin Assignment of I/O Connector on PSM 510/ACM 510

Pins (left to right)	Description	Notes	Rating/parameter
1	DIG_OUT+	Digital output	Maximum voltage between terminals: 24 V DC or AC
2	DIG_OUT–		Maximum current: 1 A Maximum output switching frequency: 50 Hz

Pins (left to right)	Description	Notes	Rating/parameter
3	DIN1+	Digital input	Input voltage: 0–48 V DC
4	DIN1–		Maximum input signal frequency: 50 Hz Maximum input current at 48 V: 11 mA Maximum input resistance: 4.8 KΩ

NOTICE

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

11.2.5.5 UAUX Connector

The U_{AUX} connector is located on the Power Supply Module (PSM 510).

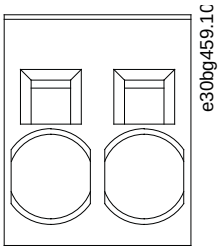


Illustration 76: U_{AUX} Connector

Table 119: Pin Assignment of U_{AUX} Connector

Pins (left to right)	De-scrip-tion	Notes	Rating/parameter
1	24 V AUX	Used for 24–48 V DC input to the Power Supply Module (PSM 510).	Nominal input voltage: 24 V/48 V DC ±10%
2	GND		Nominal current: Depends on the number of IGD 510 drives in the application. Maximum current: 50 A Maximum cross-section: 16 mm^2 Maximum cable length: 3 m Conductor cross-section range 0.75–16 mm^2, solid or flexible (AWG 18–AWG 4")

NOTICE

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

11.2.5.5.1 24/48 V Cable Cross Sections for PSM 510

Table 120: 24/48 V Cable Cross Sections for PSM 510

Minimum cable cross section for CE (minimum 70 °C, Cu)	16 mm^2
Minimum cable cross section for UL (minimum 60 °C, Cu)	4 AWG

11.2.5.6 LCP Connector (M8, 6-pole)

The LCP connector is located on the front of all the system modules. It used to connect the LCP directly via a cable.

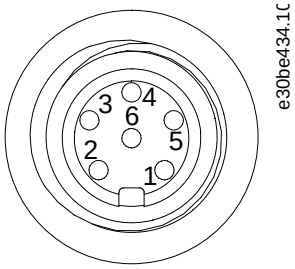


Illustration 77: LCP Connector (M8, 6 pole)

Table 121: Pin Assignment of LCP Connector

Pin	Description	Notes	Rating/parameter
1	Not connected	–	–
2	/LCP RST	Reset	Active at ≦0.5 V
3	LCP RS485	Positive RS485 signal	Speed:
4	/LCP RS485	Negative RS485 signal	38.4 kBd The levels fulfill the RS485 specification.
5	GND	GND	–
6	VCC	5 V supply for LCP	5 V ±10% at 120 mA maximum load

NOTICE

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

11.2.5.7 AC Mains Connector

The AC mains connector is located on the Power Supply Module (PSM 510).

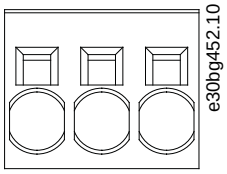


Illustration 78: AC Mains Connector

Table 122: Pin Assignment of AC Mains Connector

Pins (left to right)	Description	Notes	Rating/parameter
1	L3	Used to connect L1/L2/L3	Nominal voltage: 400–480 V AC ±10%
2	L2		Nominal power: 30 kW
3	L1		Maximum cross-section: 16 mm^2 (4 AWG) Conductor cross-section range 0.75–16 mm^2, solid or flexible (AWG 18–AWG 4")

11.2.5.7.1 Mains Cable Cross Sections for PSM 510

Table 123: Mains Cable Cross Sections for PSM 510

	PSM 510 (10 kW)	PSM 510 (20 kW)	PSM 510 (30 kW)
Minimum cable cross section for CE	4 mm^2 (minimum 70 °C, Cu)	16 mm^2 (minimum 70 °C, Cu)	16 mm^2 (minimum 90 °C, Cu)
Minimum cable cross section for UL	10 AWG (minimum 60 °C, Cu)	6 AWG (minimum 60 °C, Cu)	4 AWG (minimum 75 °C, Cu)

11.2.5.8 Relay Connector

The relay connector is used for a user-defined reaction and is located on the Power Supply Module (PSM 510).

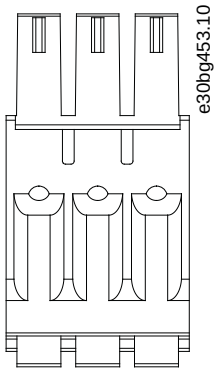


Illustration 79: Relay Connector

Table 124: Pin Assignment of Relay Connectors

Name	Pins (left to right)	Description	Notes	Rating/parameter
Relay	1	COM	Common	Nominal current: 2 A
	2	NO	Normally open, 24 V DC	Maximum cross-section: 1.5 mm^2
	3	NC	Normally closed, 24 V DC	

NOTICE

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

11.2.5.9 STO Connectors

11.2.5.9.1 STO Connectors on PSM 510

There is 1 input and 1 output STO connector on the Power Supply Module (PSM 510).

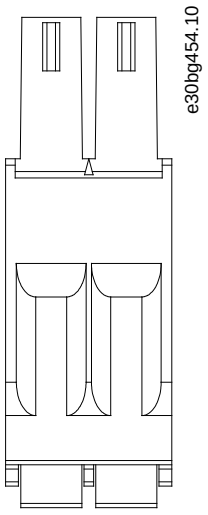


Illustration 80: STO Connectors on PSM 510

Table 125: Pin Assignment of STO Connectors on PSM 510

Connector name	Pins (left to right)	Description	Notes	Rating/parameter
STO IN	1	STO+	Used for STO input voltage.	Nominal voltage: 24 V DC±10%
	2	STO–		Nominal current: Depends on the number of IGD 510 drives in the application.
STO OUT	1	STO+	Used for STO output voltage to the input of the other system modules.	
	2	STO–		Maximum current: 1 A Maximum cross-section: 1.5 mm^2

11.2.5.9.2 STO Connector on DAM 510

There are 1 input and 2 output STO connectors on the Decentral Access Module (DAM 510). One of the outputs is for the hybrid cable.

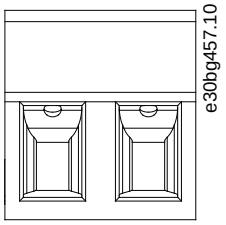


Illustration 81: STO Connector on DAM 510

Table 126: Pin Assignment of STO Connector on DAM 510

Connector name	Pins	Description	Notes	Rating/parameter
STO OUT	1	STO+	Used for the STO output from the DAM to the hybrid cable.	Nominal voltage: 24 V DC ±10%
	2	STO–		Nominal current: Depends on the number of IGD 510 drives in the application. Maximum current: 1 A Maximum cross-section: 1.5 mm^2

11.2.5.10 UDC Connector

The UDC connector is located on the Decentral Access Module (DAM 510).

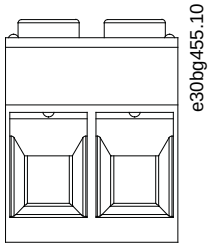


Illustration 82: UDC Connector

Table 127: Pin Assignment of UDC Connector

Pins (left to right)	Description	Notes	Rating/parameter
1	UDC+	Used to connect the DC-link voltage from the Decentral access Module (DAM 510) to the hybrid cable for the IGD line.	Nominal voltage: 565–778 V DC
2	UDC–		Nominal current: Depends on the number of IGD 510 drives in the application. Maximum current: 25 A Maximum cross-section: 2.5 mm^2 Plug terminal tightening torque: 0.5–0.8 Nm

11.2.5.11 AUX Connector

The AUX connector is located on the Decentral Access Module (DAM 510).

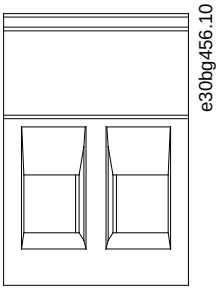


Illustration 83: AUX Connector

Table 128: Pin Assignment of AUX Connector

Pins (left to right)	Description	Notes	Rating/parameter
1	AUX+ (24/48 V)	Used to connect the AUX output from the Decentral access Module (DAM 510) to the hybrid cable for the line of IGD 510 drives.	Nominal voltage: 24/48 V DC ±10% Nominal current: Depends on the number of IGD 510 drives in the application. Maximum current: 15 A Maximum cross-section: 2.5 mm^2
2	AUX– (GND)		

NOTICE

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

11.2.6 General Specifications and Environmental Conditions for the System Modules

Table 129: General Specifications and Environmental Conditions for the System Modules

Specification	Value
Protection rating	IP20 **⚠ WARNING ⚠** **RISK OF ELECTRICAL SHOCK** The IP20 rating of the system 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.

Specification	Value
Vibration test	Random vibration: 1.14 g (2h/axis according to EN 60068-2-64)
	Sinusoidal vibration: 0.7 g (2h/axis according to EN 60068-2-6)
Maximum relative humidity	Storage/transport: 5–95% (non-condensing)
	Stationary use: 5–93% (non-condensing)
Ambient temperature range	Operating: 5–40 °C nominal, up to 55 °C with derating
	Transport: –25 °C to +55 °C
	Storage: –25 °C to +55 °C
Installation elevation	Nominal 1000 m above sea level Maximum 2000 m above sea level with derating
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

11.2.7 Storage

Store the IGD 510 and the system modules in a dry, dust-free location with low vibration ($v_{eff} \leqq 0.2$ mm/s).

Do not store the packaged system components on top of each other.

The storage location must be free from corrosive gases.

Avoid sudden temperature changes.

Long-term Storage

To recondition the electrolytic capacitors, drives and system components not in service must be connected to a supply source once per year to allow the capacitors to charge and discharge. Otherwise the capacitors could suffer permanent damage.

12 Appendix

12.1 Abbreviations

Table 130: Abbreviations

Abbreviation	Explanation
AC	Alternating current
DC	Direct current
EMC	Electromagnetic capability
FC	Frequency converter
IP	Ingress protection
PE	Protective earth
PELV	Protective extra low voltage
PM motor	Permanent magnet motor
RPM	Revolutions per minute

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Glossary

A

Ambient temperature — The temperature in the immediate vicinity of the system or component.

Axial force — The force in newton-meters acting on the rotor axis in the axial direction.

C

CE — European test and certification mark.

CleanConnect® — EHEDG certified connection from Danfoss with a stainless steel connector.

CSA — Canadian test and certification mark.

E

EHEDG — European Hygienic Engineering and Design Group.

ExtensionBox — Optional part for IGD 510 that increases the output torque.

F

f_{max} — Maximum frequency specified.

G

Gear ratio — The speed ratio of the input pinion and the output shaft of the IGD 510.

H

Hygienic — Variant of the IGD 510 for hygienic critical areas.

I

Installation elevation — Installation elevation above normal sea level, typically associated with a de-rating factor.

I_N — Nominal current specified for the IGD 510.

I_{MAX} — Maximum allowed current for the IGD 510.

IP — International protection codes.

M

Mechanical brake — Option for the IGD 510.

MRP — Media Redundancy Protocol for PROFINET®.

M_{HST} — Maximum allowed high starting torque within 3 s and 10 cycles/h for the IGD 510.

M_{MAX} — Maximum allowed torque in part-load operation for the IGD 510.

M_n — Specified nominal torque for the IGD 510.

Motor shaft — Rotating shaft on the A side of the motor, typically without a key groove.

Mounting set — Extra components to fix the torque arm to the conveyor frame and included in the torque arm set.

N

n_{MAX} Maximum allowed speed at final shaft.

P

PG/PC interface Used to define the communication protocol that will be used to connect to a device, for example, Ethernet TCP/IP.

R

Radial force The force in newton-meters acting at 90° to the longitudinal direction of the rotor axis.

T

t_{amb} Maximum ambient temperature specified.

Terminal box Connection cage for the IGD 510.

Torque arm set Accessory for the IGD 510 that includes a torque arm and a mounting-set.

U

UL Underwriters Laboratories.

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